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Poster Session / 1

The $\pi^0/\eta/\eta'$ light-by-light contribution to the muon $g-2$ in Chiral Perturbation Theory with Resonances

Dr. ROIG, Pablo ¹; Prof. LOPEZ CASTRO, Gabriel ²; GUEVARA, Adolfo ²

¹ *Instituto de Física, UNAM*

² *CINVESTAV*

Corresponding Author: patricia.mage@cern.ch

The pion transition form factor, computed within Chiral Perturbation Theory with Resonances, is confronted to data. Good agreement is found including only the lightest multiplet of vector and pseudoscalar resonances. Short-distance constraints obtained by matching the Vector-Vector-Pseudoscalar resonance Green function to its QCD counterpart are satisfied with high accuracy. We evaluate the corresponding pion-exchange contribution to the hadronic light-by-light muon $g-2$ obtaining $(6.66 \pm 0.21) \cdot 10^{-10}$.

Using the double-angle mixing scheme for the η and η' mesons, we employ the previous information to predict the corresponding transition form factors, that follow measurements well. Therefore, we also predict their contributions to the muon anomaly, which results in $(10.47 \pm 0.54) \cdot 10^{-10}$ for the sum of the $\pi^0/\eta/\eta'$ exchanges. This result is in accord with the reference determinations in the literature but reduces the error by roughly one third.

Besides this, we improve upon previous similar studies by:

- i) including the whole complete set of consistent high-energy constraints.
- ii) making a more robust error determination which includes, in particular, the effect of the uncertainty on the pion transition form factor value at the origin.
- iii) updating the data used to include the most recent Belle measurements of the pion transition form factor.

We also propose to measure the cross-section and di-muon invariant mass distribution of the $e^+e^- \rightarrow \mu^+\mu^- P$ ($P=\pi^0/\eta/\eta'$) processes to improve the knowledge on these transition form factors.

The understanding of the current discrepancy (slightly above three sigmas for a decade) between the standard theory value and the measurement of the muon $g-2$ is one of the most striking anomalies in particle physics, specially in view of the lack of new Physics signals in direct searches at the LHC.

Poster Session / 11

PERSPECTIVE STUDIES OF CHARMONIUM AND EXOTICS ABOVE $D\bar{D}$ THRESHOLD IN ANTIPROTON-PROTON ANNIHILATIONDr. BARABANOV, Mikhail¹; Prof. VODOPYANOV, Alexander¹¹ Joint Institute for Nuclear Research**Corresponding Author:** barabanov@jinr.ru

The study of strong interactions and hadron matter in the process of antiproton-proton annihilation seems to be a challenge nowadays. The research of charmonium $c\bar{c}$, charmed hybrid $c\bar{c}g$ and tetraquark $(cq(cq')\bar{q})\bar{q}$, q and q' ($q = u, d, s$) spectra and their main characteristics (mass, width, branching ratio) in experiments using high quality antiproton beam with momentum up to 15 GeV/c, is promising to understand the dynamics of quark interactions at small distances. Charmonium and exotics spectroscopy is a good testing tool for the theories of strong interactions: QCD in perturbative and non-perturbative regimes, LQCD, QCD inspired potential models and phenomenological models.

Nowadays the scalar $^1P_{1}$, $^1D_{2}$ and vector $^3P_{J}$, $^3D_{J}$ charmonium states and higher lying scalar $^1S_{0}$ and vector $^3S_{1}$ charmonium states are poorly investigated. The domain above $D\bar{D}$ threshold is badly studied. According to the contemporary quark models namely in this domain, the existence of charmed hybrids with exotic ($J^{PC} = 0^{--}, 0^{+-}, 1^{-+}, 2^{+-}, 3^{+-}$) and non-exotic ($J^{PC} = 0^{++}, 1^{++}, 2^{++}, 1^{+-}, 1^{-+}, 2^{--}, 2^{++}, 3^{+-}$) quantum numbers and tetraquarks is expected [1 - 4]. A prediction that distinguishes tetraquark states containing a $c\bar{c}$ pair from conventional charmonia is possible existence of multiplets which include members with non-zero charge $cu(c\bar{d})\bar{u}$, strangeness $cd(cs)\bar{u}$, or both $cu(cs)\bar{u}$. The detailed analysis of the spectrum of charmonium, charmed hybrids and tetraquarks with hidden charm and strangeness was carried out, and attempts to interpret a great quantity of experimental data above the $D\bar{D}$ threshold were considered. New higher lying states of charmonium, charmed hybrids and tetraquarks are expected to exist in the mass region above the $D\bar{D}$ threshold. But much more data on different decay modes are needed for deeper analysis. These data can be derived directly from the experiments with high quality antiproton beam.

A special attention is given to the new XYZ states with hidden charm discovered recently [3 - 6]. Their interpretation is far from being obvious nowadays [2 - 4]. The experimental data from different collaborations like BES, Belle, BaBar, LHCb, CLEO, CDF were carefully studied. Some of these states can be interpreted as charmonium [7, 8] and tetraquarks [9, 10] in the framework of the combined approach proposed earlier [11, 12]. It has been shown that charge/neutral tetraquarks must have neutral/charge partners with mass values which differ by few tens of MeV. This treatment coincides with hypothesis proposed by Maiani and Polosa [13, 14]. It seems to be a promising approach and needs to be carefully verified in experiments using high quality antiproton beam with momentum ranging up to 15 GeV/c.

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Poster Session / 12

Detecting the long-distance structure of the X(3872)

Dr. NIEVES, Juan M ¹; Mr. HIDALGO, Carlos ²; Dr. PAVÓN VALDERRAMA, Manuel ³; Dr. OZPINECI, Altug ⁴; Dr. GUO, Feng-Kun ⁵

¹ *IFIC, CSIC-UV*

² *Becario*

³ *Institut de Physique Nucleaire*

⁴ *Middle East Technical University - Department of Physics*

⁵ *Helmholtz-Institut für Strahlen- und Kernphysik and Bethe Center for Theoretical Physics*

Corresponding Author: carloshd@ific.uv.es

We study the X(3872) to $D\bar{D}\pi^0$ decay within a molecular $D\bar{D}^*$ picture for the X(3872) state. This mode is more sensitive to the long-distance structure of the X(3872) resonance than its $J/\psi\pi\pi$ and $J/\psi 3\pi$ decays, which are mainly controlled by the details of the X(3872) wave function at short distances. We show that the $D\bar{D}$ final state interaction can be important, and that a precise measurement of this partial decay width can provide valuable information on the interaction strength between $D^{(*)}\bar{D}^{(*)}$ charm mesons.

Poster Session / 13

Multilepton and multiphoton signatures of supersymmetry at the LHC

PETERSSON, Christoffer ¹

¹ *ULB, Brussels*

Corresponding Author: christoffer.petersson@ulb.ac.be

Motivated by the absence of any clear signal of physics beyond the Standard Model (SM) at the LHC after Run 1, I will discuss one slight (but tantalizing) hint of new physics and one non-minimal extension of the SM. In the first part of the talk I will do the exercise of explaining a small excess of multilepton events recently observed by the CMS collaboration by means of a simplified model of gauge mediated supersymmetry breaking (GMSB). In the second part of the talk I will discuss how the standard phenomenology of GMSB can be significantly modified by the non-minimal assumption that supersymmetry is broken in more than one hidden sector. Multiple hidden sectors give rise to light neutral fermions called pseudo-goldstini and due to the extra decay steps they give rise to, where soft photons are emitted, these models give rise to multiphoton plus missing energy signatures. I will compare against existing LHC searches and propose new searches designed to probe these models.

Poster Session / 15

Pseudorapidity spectra of secondary particles emitted in the relativistic nucleus-nucleus collisions

Mrs. KHALILOVA, Shahla¹; Mr. SULEYMANOV, Mais²; Mr. BELASHEV, B.Z²; Mr. VOKAL, Stanislav²; Mr. VODOPIANOV, A.S.²; Mrs. VRLAKOVA, J.²; Mr. ABDINOV, Ovsat²; Mr. AJAZ, Muhammad²; Mr. ZAMAN, Ali²; Mr. KHAN, Kamal²

¹ *PhD student*

² *Dr*

Corresponding Author: shahlaganbarova@gmail.com

We discuss new results connected with more detail structure of the pseudorapidity spectra of charged relativistic particles with $\beta > 0.7$ produced in Si (at energy 4 A GeV and 14 A GeV), Au (at energy 11.6 A GeV) and Pb+Em (at energy 158 A GeV) reactions. The relativistic nucleus beams were obtained from AGS and SPS machines. The pseudorapidity spectra were analyzed using Maximum Entropy Methods. The number of fast target protons: g-particles are used to fix the centrality of collisions. Using the method we found some selected pseudorapidity values – nontrivial structure, the number of which depends on energy; increases from 2 to 4 with energy.

Neutrino Physics / 16

Effective Spectral Function for Quasielastic Scattering on Nuclei

Prof. BODEK, Arie¹; Dr. CHRISTY, Eric²; Mr. COOPERSMITH, Brian¹

¹ *University of Rochester*

² *Hampton U.*

Corresponding Author: bodek@pas.rochester.edu

Spectral functions that are used in modeling of quasi elastic scattering in neutrino event generators such as GENIE, NEUT, NUANCE and NUWRO, and GiBUU include Fermi gas, local Fermi gas, Bodek-Ritche Fermi gas with high momentum tail, and the Benhar Fantoni two dimensional spectral function. We find that the $\frac{d\sigma}{d\nu}$ predictions for these models are in disagreement with the prediction of ψ 's superscaling function which is good extracted from fits to quasielastic electron scattering data on nuclear targets. It is known that spectral functions do not fully describe quasielastic scattering because they only model the initial state. Final state interactions distort the shape of the quasi elastic peak, reduce the cross section at the peak and increase the cross section at the tail of the distribution for large energy transfer to final state nucleons. We show that the kinematic distributions predicted by the ψ 's superscaling formalism can be well described by the predictions using a modified "effective spectral function". }

Detector RD and Performance / 17**DEPFET pixel detectors for future electron-positron experiments**Dr. LACASTA, Carlos ¹¹ *IFIC-Valencia***Corresponding Author:** carlos.lacasta@ific.uv.es

The DEPFET Collaboration develops highly granular, ultra-thin pixel detectors for outstanding vertex reconstruction at future collider experiments. A DEPFET sensor, by the integration of a field effect transistor on a fully depleted silicon bulk, provides simultaneously position sensitive detector capabilities and in-pixel amplification. The characterization of the latest DEPFET prototypes has proven that a comfortable signal to noise ratio and excellent single point resolution can be achieved for a sensor thickness of 50 micrometers. The close to final auxiliary ASICs have been produced and found to operate a DEPFET pixel detector of the latest generation with the required read-out speed. A complete detector concept is being developed for the Belle II experiment at the new Japanese super flavor factory. DEPFET is not only the technology of choice for the Belle II vertex detector, but also a solid candidate for the ILC. Therefore, in this paper, the status of DEPFET R project is reviewed in the light of the requirements of the vertex detector at a future electron-positron collider.

Heavy Ions / 21**Remarks on the U(1) axial symmetry and the chiral transition in QCD at finite temperature**Dr. MEGGIOLARO, Enrico ¹¹ *University of Pisa (ITALY)***Corresponding Author:** enrico.meggiolaro@df.unipi.it

We discuss the role of the U(1) axial symmetry for the scalar and pseudoscalar meson mass spectrum of QCD at finite temperature, above the chiral transition at T_c , using a chiral effective Lagrangian model, which, in addition to the usual chiral condensate, also includes a (possible) genuine U(1)_A-breaking condensate that (possibly) survives across the chiral transition. The motivations for considering this Lagrangian (and a critical comparison with other effective Lagrangian models existing in the literature) are presented. A detailed comparison between the case $N_f=3$ (or $N_f>3$) and the (remarkably different) case $N_f=2$ is performed. The results obtained in the case $N_f=2$ are also critically compared with the available lattice results.

Education and Outreach / 22

Sciences ACO, a Museum of Light and Matter

Dr. ARNAUD, Nicolas ¹; Mrs. BESSON, Martine ²; Mrs. GACOIN, Marie-Pauline ³; Mr. HAISSINSKI, Jacques ⁴; Mr. JOLIVOT, Roland ⁵; Mr. JULLIAN, Serge ⁶; Mr. KHALILI, Guyve ⁷; Mr. ORTEGA, Jean-Michel ⁸; Mr. RISKALLA, Robert ⁵; Mr. ROUDEAU, patrick ⁹; Mr. SOMMER, Michel ⁵; Mr. SOTTY, Christophe ¹⁰; Mr. BORIE, Henri ⁵; Mr. SZKLARZ, Gerszon ¹¹; Mr. JEANJEAN, Jack ⁵; Mr. BRUNET, Paul ⁵; Mr. CHAPPELLIER, Maurice ¹²; Mr. DAMANY, André ⁵; Mrs. DARTYGE, Elisabeth ⁵; Mr. DELERUE, Nicolas ⁴; Mr. DHEZ, Pierre ⁵; Mr. DUCROS, Yves ⁵

¹ LAL (CNRS/IN2P3 and Université Paris Sud)

² Laboratoire de l'Accélérateur Linéaire (CNRS/IN2P3 et Université Paris Sud)

³ FCS Campus Paris Saclay

⁴ LAL (CNRS/IN2P3 et Université Paris Sud)

⁵ Association Sciences ACO

⁶ LAL (CNRS/IN2P3 Université Paris Sud)

⁷ Laboratoire Aime Cotton (CNRS et Université Paris Sud)

⁸ Laboratoire de Chimie Physique (CNRS et Université Paris Sud)

⁹ Laboratoire de l'Accélérateur Linéaire (LAL)

¹⁰ University of Leuven

¹¹ LAL (CNRS/IN2P3 et Université Paris-Sud)

¹² CSNSM (CNRS/IN2P3 et Université Paris Sud)

Corresponding Author: narnaud@lal.in2p3.fr

Sciences ACO is a non-profit association based in Orsay (France). It manages a “Museum of Light and Matter” visited by more than 1,000 people each year. In this unique place, scientists and cultural mediators preserve, exhibit and explain pieces of the history of science & technology, to pass on the knowledge of this heritage to the audience.

The museum is located at the centre of the “LAL-LURE accelerator complex”, which was awarded the “Historic Site” label by the European Physical Society last September. The main piece of Sciences ACO is indeed the “Anneau de Collisions d’Orsay” (ACO), a lepton storage ring whose operation started in 1965 and ended in 1988. ACO was first used as an electron-positron collider. It led to important discoveries in accelerator physics and to many pioneering measurements of vector meson properties. In 1973, ACO became the first storage ring in Europe available to synchrotron light users. Ten years later, a free-electron laser was successfully operated at ACO – the second in the world, it was the first one in the visible bandwidth and the first at a storage ring. Rather than being decommissioned and disassembled like almost all accelerators in the world once they are turned off, ACO was carefully preserved by the very people who worked on it. The machine was later recognized as a French “historic monument” and the association, still very active, is now bringing three generations of scientists together.

Sciences ACO visitors – among them there are many high school students and teachers – come to learn about the progress of science and the evolution of the technologies over more than four decades. As an example, a new room was recently opened in the museum to display the control room of the former LAL linear accelerator. This record of the seventies allows our guides not only to explain how this machine was operated and what its performances were, but also to shed light on the extraordinary advances of electronics and computing. Therefore, Sciences ACO is more than just a historical museum: it is a driving force for the development of outreach and pedagogical activities on the Paris Sud University campus and in the neighboring towns. Moreover, real demonstration apparatuses – like the “Electrons’ ronde”, probably the world’s smallest interactive electron storage ring model – are being designed by engineering experts from the association, while virtual visits are being developed to enrich the visitors experience.

All of this has been obtained by a small group of dedicated individuals, within the limited financial resources of the association. The history, the present activity and the prospects of Sciences ACO will be presented in the talk proposed in the “Education and Outreach” ICHEP 2014 parallel session.

Astroparticle Physics and Cosmology / 23

Axion helioscopes update: the status of CAST & IAXODr. DAFNI, Theopisti ¹¹ *Universidad de Zaragoza***Corresponding Author:** tdafni@unizar.es

After almost 25 years since their suggestion as a good solution to the strong CP-problem, axions remain one of the viable candidates for the Dark Matter, although still eluding detection. Most of the methods for their detection are based on their coupling to photons, one of the most promising ones being the helioscope technique.

We will report on the current status of the CERN Axion Solar Telescope and the future International Axion Observatory (IAXO). Recent results from the second part of CAST phase II, where the magnet bores were filled with ^3He gas at variable pressure achieving sensitivities on the axion mass up to $1.2 \text{ eV}/c^2$, will be presented. Currently CAST is expecting to improve sensitivity to solar axions with rest mass below $0.02 \text{ eV}/c^2$ after the upgrade of the X-ray detectors and with the implementation of a second X-ray optic. On the other hand IAXO, a fourth generation axion helioscope, aims at improving CAST's performance in terms of axion-photon coupling by 1-1.5 orders of magnitude. The details of its projected toroidal magnet, x-ray optics and x-ray detectors will be given.

Strong Interactions and Hadron Physics / 24

Prompt photon associated with jet photoproduction at HERA in the parton Reggeization approachMr. NEFEDOV, Maxim ¹; Prof. SALEEV, Vladimir ¹; Prof. KNIEHL, Berndt ²¹ *Samara State University*² *II. Institut für Theoretische Physik, Universität Hamburg,***Corresponding Author:** nefedovma@gmail.com

We study the photoproduction of isolated prompt photons associated with jets in the framework of the parton Reggeization approach. The data on pseudorapidity and transverse momentum distributions of the photon and jet, obtained by H1 and ZEUS Collaborations at DESY HERA, are described with the good accuracy, as well, as the data on azimuthal decorrelation variables. The main improvements of the present calculation, with respect to the previous studies in the k_T -factorization framework, are the usage of Reggeized quarks formalism, to provide exactly gauge-invariant amplitudes with off-shell initial state quarks, and the first exact treatment of the $\gamma R \rightarrow \gamma g$ box contribution with off-shell initial state gluons.

Detector RD and Performance / 25

Totally Active Scintillator Calorimeter for the Muon Ionization Cooling ExperimentMr. ASFANDIYAROV, Ruslan ¹¹ *University of Geneva***Corresponding Author:** ruslan.asfandiyarov@gmail.com

The Electron-Muon Ranger (EMR) is a totally active scintillator detector installed in the muon beam of the Muon Ionization Cooling Experiment (MICE) - the R project for the future neutrino factory. It is aimed at measuring properties of low energy beam composed of muons, electrons and pions performing the identification particle by particle. The EMR is made of 48 intersecting layers. Each layer consists of 59 triangular scintillator bars. The granularity of the detector (2880 readout channels) makes it possible to identify tracks and measure particle ranges and shower shapes. The read-out is based on FPGA custom made electronics and commercially available modules. It was built at University of Geneva and installed at the Rutherford Appleton Laboratory in Oxford in September 2013. Tests with low energy beam (100 - 400MeV/c) revealed an exceptional performance of the detector.

BEH Physics / 26

Bounds on Neutral and Charged Higgs from the LHCMr. ILISIE, Victor ¹; PICH, Antonio ¹; CELIS, Alejandro ²¹ *IFIC*² *IFIC-Universitat de Valencia***Corresponding Author:** ilisiev@ific.uv.es

After the recent discovery of a boson with mass around 125 GeV with Standard Model-like properties, the possibility of an enlarged scalar sector arises as a natural question. The discovery of an extra scalar would be the ultimate proof of this scenario. Keeping the generic Yukawa structure of the Aligned Two-Higgs Doublet Model framework, we study the implications of the LHC data on the allowed scalar spectrum.

Poster Session / 27

B to ρ , K^* transition form factors in AdS/QCD model.Dr. AHMADY, Mohammad ¹; Dr. SANDAPEN, Ruben ²; Ms. CAMPBELL, Robyn ¹; Mr. LORD, Sebastien ²¹ *Mount Allison University*² *Universite de Moncton***Corresponding Author:** mahmady@mta.ca

We use the light front wave functions obtained from the AdS/QCD model for light mesons to calculate the transition form factors for B to ρ , K^* decays. We analyze the semileptonic B $\rightarrow \rho$ $l \nu$ and radiative B $\rightarrow K^* \mu^+ \mu^-$ decays and point out the distinctive features of the AdS/QCD model.

Lattice QCD / 28**Observables in Higgsed Theories**Dr. MAAS, Axel¹¹ *University of Jena***Corresponding Author:** axelmaas@web.de

The Higgs sector of the standard model, the Higgs and the W/Z bosons, is a quite peculiar theory. Because of the Higgs effect, for some regions of the quantum phase diagram of the theory the observable particles, i.e. gauge-invariant bound states, have the same mass as the elementary particles. This is what makes perturbation theory in the electroweak sector possible. Under which conditions this holds true is not only important for understanding the Higgs sector itself, but may have severe implications for observable states in generic higgsed theories. Herein, the underlying mechanisms are studied with the standard-model Yang-Mills-Higgs sector as an example, using lattice gauge theory. It is shown under which conditions a perturbative description can be expected to give an accurate representation of the observable states. Especially, it is found that only in a rather narrow range of Higgs masses this appears possible, and it is briefly digressed on the connection to the experimental results. In addition, some remarks will be given on the situation in more general theories, which are relevant to the construction of extensions of the standard model.

Astroparticle Physics and Cosmology / 29**Low-Mass Dark Matter Searches with Sub-keV Germanium Detectors**Dr. SOMA, ARUN KUMAR¹¹ *ACADEMIA SINICA***Corresponding Author:** arunkumarsoma@gmail.com

Germanium detectors with sub-keV sensitivities can probe low-mass WIMP Dark Matter. This experimental approach is pursued at the Kuo-Sheng Neutrino Laboratory (KSNL) in Taiwan and at the China Jinping Underground Laboratory (CJPL) in China via the TEXONO and CDEX programs, respectively. The highlights of R efforts on point-contact germanium detectors and in particular the differentiation of surface and bulk events by pulse shape analysis [1] will be described. The latest results on WIMP-nucleon scattering cross-sections [2] will be presented. Some of the allowed parameter space implied by other experiments are probed and excluded. Future prospects will be discussed.

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Flavour Physics / 30

Dilepton invariant mass spectrum and the decay rate in $B^{\pm} \rightarrow \pi^{\pm} \mu^+ \mu^-$

Prof. ALI, Ahmed ¹¹ DESY**Corresponding Author:** ahmed.ali@desy.de

We present a precise calculation of the dilepton invariant-mass spectrum and the decay rate for $B^{\pm} \rightarrow \pi^{\pm} \ell^+ \ell^-$ ($\ell^{\pm} = e^{\pm}, \mu^{\pm}$) in the Standard Model (SM) based on the effective Hamiltonian approach for the $b \rightarrow d \ell^+ \ell^-$ transitions. With the Wilson coefficients already known in the next-to-next-to-leading logarithmic (NNLL) accuracy, the remaining theoretical uncertainty in the short-distance contribution resides in the form factors $f_+(q^2)$, $f_0(q^2)$ and $f_T(q^2)$. Of these, $f_+(q^2)$ is well measured in the charged-current semileptonic decays $B \rightarrow \pi \ell^+ \ell^-$ and we use the B-factory data to parametrize it. The corresponding form factors for the $B \rightarrow K$ transitions have been calculated in the Lattice-QCD approach for large- q^2 and extrapolated to the entire q^2 -region using the so-called z -expansion. Using an $SU(3)_F$ -breaking Ansatz, we calculate the $B \rightarrow \pi$ tensor form factor, which is consistent with the recently reported lattice $B \rightarrow \pi$ analysis obtained at large q^2 . The prediction for the total branching fraction $B(B^{\pm} \rightarrow \pi^{\pm} \mu^+ \mu^-) = (1.88 + 0.32 - 0.21) \times 10^{-8}$ is in good agreement with the experimental value obtained by the LHCb collaboration. In the low q^2 -region, the Heavy-Quark Symmetry (HQS) relates the three form factors with each other. Accounting for the leading-order symmetry-breaking effects, and using data from the charged-current process $B \rightarrow \pi \ell^+ \ell^-$ to determine $f_+(q^2)$, we calculate the dilepton invariant-mass distribution in the low q^2 -region in the $B^{\pm} \rightarrow \pi^{\pm} \ell^+ \ell^-$ decay. This provides a model-independent and precise calculation of the partial branching ratio for this decay.

Strong Interactions and Hadron Physics / 31

Hadroproduction of $\Upsilon(nS)$ above the $B\bar{B}$ threshold and implications for $Y_b(10890)$

Prof. ALI, Ahmed ¹¹ DESY**Corresponding Author:** ahmed.ali@desy.de

Based on the non-relativistic QCD factorization scheme, we study the hadroproduction of the bottomonium states $Y(5S)$ and $Y(6S)$. We argue to search for them in the final states $Y(1S,2S,3S)\pi^+\pi^-$, which are found to have anomalously large production rates at $Y(5S)$. The enhanced rates for the dipionic transitions in the $Y(5S)$ -energy region could, besides $Y(5S)$, be ascribed to $Y_b(10890)$, a state reported by the Belle collaboration, which may be interpreted as a tetraquark. The LHC/Tevatron measurements are capable of making a case in favor of or against the existence of $Y_b(10890)$, as demonstrated here. Dalitz analysis of the $Y(1S,2S,3S)\pi^+\pi^-$ states from the $Y(5S)/Y_b(10890)$ decays also impacts directly on the interpretation of the charged bottomonium-like states, $Z_b(10600)$ and $Z_b(10650)$, discovered by Belle in these puzzling decays.

Poster Session / 34

Natural quark mass structure in a $U(1)'$ gauge extensionDr. OCHOA, Fredy¹; Dr. MARTINEZ, Roberto¹¹ *Universidad Nacional de Colombia***Corresponding Author:** faochoap@unal.edu.co

In the standard model, the fermion masses are provided by Yukawa interactions consistent with the gauge symmetry and with the inclusion of only one scalar doublet. However, the mass spectrum of the quarks exhibit very different mass values, which require unnatural large tuning of the Yukawa parameters without any apparent fundamental reason. In this work we propose a new nonuniversal $U(1)'$ extension of the standard model with the addition of three quark singlets, two scalar singlets and one scalar doublet. By introducing additional global symmetries and mixing couplings between ordinary quarks and the new quark singlets, we obtain predictable mass relations of quarks with few free parameters. The model exhibit a natural scenario where a large hierarchical mass spectrum can be obtained by providing Yukawa couplings with a soft breaking of the global symmetry.

Astroparticle Physics and Cosmology / 35

Strong thermal leptogenesis and the N_2 -dominated scenarioMr. RE FIORENTIN, Michele¹; Ms. KING, Sophie¹; Dr. DI BARI, Pasquale¹¹ *University of Southampton***Corresponding Author:** mrf1g12@soton.ac.uk

I will briefly review the main aims and concepts of leptogenesis, analysing different possible realisations. Particular attention will be devoted to the so-called N_2 -dominated scenario, both in its unflavoured and flavoured versions. Its main features will be pointed out, as well as the impact of possible relevant corrections. I will then consider the conditions required by strong thermal leptogenesis, where the final asymmetry is fully independent of the initial conditions. Barring strong cancellations in the seesaw formula and in the flavoured decay parameters, I will show that strong thermal leptogenesis favours a lightest neutrino mass $m_1 \sim 10$ -meV for normal ordering and $m_1 \sim 3$ -meV for inverted ordering. Finally, I will comment on the power of absolute neutrino mass scale experiments to either support or severely corner strong thermal leptogenesis.

This work is mainly based on JCAP 1403 (2014) 050

Strong Interactions and Hadron Physics / 37

Precise α_s determination from the low- z parton-to-hadron fragmentation functions

Dr. D'ENTERRIA, David ¹; PEREZ-RAMOS, Redamy ²

¹ *CERN*

² *Jyvaskyla Univ.*

Corresponding Author: dde@cern.ch

We present a new precise method to extract the QCD coupling constant α_s from the energy evolution of the moments of the parton-to-hadron fragmentation functions measured in $e+e-$ annihilation and DIS $e-p$ collisions. The evolution of the moments (multiplicity, peak, width, skewness) of the low momentum charged-hadron distribution in jets is computed at NMLLA+NLO accuracy and compared to the experimental data. Values of Λ_{QCD} , and corresponding two-loop coupling constant at the Z resonance, are obtained in excellent numerical agreement with the current world average obtained using other methods at NLO accuracy. A detailed study of the (small) systematic uncertainties associated with this procedure will be also presented.

[1] R. Perez-Ramos and D. d'Enterria, "Energy evolution of the moments of the hadron distribution in QCD jets including NNLL resummation and NLO running-coupling corrections"; arXiv:1310.8534.

[2] D. d'Enterria and R. Perez-Ramos, "Determination of the strong coupling α_s from the energy evolution of the distributions of low momentum hadrons in QCD jets", in preparation.

Poster Session / 38

The educational project « Passeport pour les deux infinis »

Dr. ARNAUD, Nicolas ¹; Dr. DESCOTES-GENON, Sébastien ²; Mrs. KERHOAS-CAVATA, Sophie ³; Mr. PAUL, Jacques ³; Mr. ROBERT-ESIL, Jean-Luc ⁴; Mrs. ROYOLE-DEGIEUX, Perrine ⁵

¹ LAL (CNRS/IN2P3 and Université Paris Sud)

² LPT Orsay (CNRS/Univ. Paris-Sud 11)

³ CEA/IRFU

⁴ APC (CNRS/IN2P3 and Université Paris Diderot)

⁵ CNRS/IN2P3

Corresponding Author: narnaud@lal.in2p3.fr

“Passeport pour les deux infinis” (« Passport for the two infinities », in short Pass2i) is a French educational project aiming at promoting the physics of the “infinitely small” (particle physics) and of the “infinitely big” (cosmology & astrophysics) to high-school teachers and students. These two fields of basic science are indeed more and more tightly connected, with common topics and tools, often tackled by research teams gathered in the same laboratories.

The Pass2i cornerstone is a revertible book where each side explores one of the two infinities, presenting first the main theoretical concepts of the field and then the current experiments exploring it. It was edited by a steering committee of six editors-in-chief with contributions from more than 50 experts coming from the French scientific community. The first edition was released in 2010 and a second one last September – including the latest physics results (Higgs boson & CMB) and taking into account the feedback received from its readers. Both editions have been published by the well-known French scientific editor Dunod and are available in bookshops (several thousand copies sold over the years, including at CERN)

But the originality of the project lies in its specific targeting of high-school teachers, in order to provide them with teaching material and ideas involving the physics of the two infinities. Indeed, thanks to our funding agencies, 4,500 copies of the two editions (in total) have been bought by the Pass2i association and are given to physics teachers who register on our website <http://www.passeport2i.fr>.

Indeed, Pass2i wants to be a bridge between science and education. Training sessions are organized for teachers, during which they are encouraged to create educational contents for their courses based on the content of the Passport. The resulting pedagogical sheets are gathered in our website, accessible to all interested teachers. The association keeps in contact with the registered teachers via a quarterly e-letter, in which information about outreach & pedagogical opportunities (within Pass2i and outside of it) are provided. Its members are present as well to conferences for teachers.

As the book has been well-received by French teachers and the general audience, we have the project to translate and adapt it to English. Discussions are ongoing with the French editor and other potential partners.

All these activities will be presented in the talk proposed in the “Education and Outreach” ICHEP 2014 parallel session.

Poster Session / 40

Universality of identified hadron production in pp-collisionsMr. BYLINKIN, Alexander ¹; Prof. ROSTOVSTEV, Andrey ¹¹ IITEP**Corresponding Author:** alexander.bylinkin@gmail.com

The shapes of invariant differential cross-sections for identified π^{+-}, K^{+-}, p and $pbar$ production as function of transverse momentum measured in \sqrt{s} collisions by the PHENIX, ALICE and CMS experiments (from 62.4 to 7000 GeV c.m.s. energy) are analyzed in terms of recently introduced approach. Simultaneous fit of these data to the sum of exponential and power-law terms show significant difference in the exponential term (Boltzmann-like) contributions. This effect qualitatively explains the observed shape of the experimental K/π and p/π yield ratios measured as function of transverse momentum of produced hadrons. A picture with two types of mechanisms for hadron production is given. Universality of the second mechanism (pQCD power-law) for π^{+-}, K^{+-}, p and $pbar$ production is shown: the parameters of the power law term take practically the same values which depend on the global conditions like a collision energy rather than a type of produced hadron.

Poster Session / 41

Searching for Doubly-Charged Vector Bileptons at LHCProf. NEPOMUCENO, Andre ¹; Dr. MEIROSE, Bernhard ²¹ Universidade Federal Fluminense² Federal University of Rio de Janeiro**Corresponding Author:** asevedo@gmail.com

In this work one investigates the LHC potential for discovering doubly-charged vector bileptons considering the measurable process $p, p \rightarrow \mu^{+}, \mu^{+}, \mu^{-}, \mu^{-}, X$. We perform the study assuming different bilepton masses and different exotics quark masses. The process cross-section is calculated at leading-order using the CALCHEP package. Combining this calculation with the latest ATLAS results at 7 TeV, we derive, for the first time, bounds on bilepton mass using LHC data. The results exclude bileptons with masses in the range 200 GeV to 500 GeV, depending on the exotics quarks masses. A detector simulation is also performed using the DELPHES package assuming a LHC center-of-mass energy of 13 TeV. The results of the simulation are used to obtain minimal integrated luminosities needed for discovering and for setting limits on bilepton masses at 13 TeV.

Poster Session / 42

Anomalous Higgs couplings in $e-e \rightarrow ZHH$.Mr. KUMAR, Satendra ¹; Dr. POULOSE, Poulouse ¹; Dr. GARG, Sumit Kumar ²¹ Department of Physics, Indian Institute of Technology Guwahati, Guwahati 781 039, India² Department of Physics and IPAP, Yonsei University, Seoul 120-749, Korea**Corresponding Author:** satendra@iitg.ernet.in

One of the main processes to study the Higgs self-coupling, HHH is $e+e- \rightarrow ZHH$. There had been studies on how precisely this coupling can be determined at ILC through this process. This process is also dictated by the couplings of the Higgs boson with the gauge boson, especially ZZH coupling. Presence of anomalous ZZH, $Z\gamma H$, and ZZHH couplings, may change the process on HHH coupling. Here, we investigate the effect of anomalous couplings on this process, considering a model independent effective Lagrangian approach. It is noticed that the quartic couplings have very small effect, while the effect of ZZH coupling be considerable.

BEH Physics / 43

Effective Lagrangian approach to the EWSB sectorMr. GONZALEZ-FRAILE, Juan¹¹ *Universitat de Barcelona***Corresponding Author:** fraile@ecm.ub.edu

In a model independent framework, the effects of new physics can be parametrized in terms of an effective Lagrangian at the electroweak scale. If the $SU(2)_L \times U(1)_Y$ gauge symmetry is linearly realized, these effects appear at lowest order as dimension--six operators, containing all the SM fields and the light scalar doublet. With a proper choice of the operator basis we perform a global fit to all the existing updated available data related to the EWSB sector: triple gauge boson vertex (TGV) measurements, electroweak precision tests and Higgs searches. In this framework modifications of the couplings of the Higgs field to the electroweak gauge bosons are related to anomalous TGVs. We show that the analysis of the latest Higgs boson data at the LHC and Tevatron gives rise to strong bounds on TGVs that are complementary to those from direct TGV analysis. We then present the tight constraints on TGVs obtained by combining all the available data on direct TGV studies and on Higgs production analysis. Interestingly, we show that this correlated pattern of deviations from Standard Model predictions and couplings can be different for theories of new physics based on a non-linear realization of the $SU(2)_L \times U(1)_Y$ symmetry. Furthermore, anomalous signals expected at first order in the non-linear realization may appear only at higher orders of the linear one, and viceversa. We analyze in detail the impact of both type of discriminating signals on LHC physics. They could lead to hints on the nature of the observed boson.

Lattice QCD / 44

CHARMONIA DECAY CONSTANTS FROM LATTICE QCD AND QCD SUM RULESBECIREVIC, Damir¹; DUPLANCIC, Goran²; KLAJN, Bruno²; SANFILIPPO, Francesco³; MELIC, Blazenka²¹ *Laboratoire de Physique Théorique (Bât. 210) 1 Université Paris Sud, F-91405 Orsay-Cedex, France*² *Rudjer Boškovic Institute, Theoretical Physics Division P.O.Box 180, HR-10002 Zagreb, Croatia*³ *School of Physics and Astronomy, University of Southampton, Highfield, Southampton, SO171 BJ, UK***Corresponding Author:** blazenka.melic@gmail.com

We compute the decay constants of the lowest $c\bar{c}$ -states with quantum numbers $J(PC)=0(-+)$ [η_c], $1(-)$ [J/ψ], and $1(+)$ [h_c] by using lattice QCD and QCD sum rules. We consider the coupling of J/ψ to both the vector and tensor currents. Lattice QCD results are obtained from the unquenched ($N_f=2$) simulations using twisted mass QCD at four lattice spacings, allowing us to take the continuum limit. On the QCD sum rule side we use the moment sum rules.

The results are then used to discuss the rate of $\eta_c \rightarrow \gamma\gamma$ decay, and to comment on the factorization in $B \rightarrow X K$ decays, with X being either η_c or J/ψ .

Poster Session / 45

Pion-like dark matter

MELIC, Blazenka ¹; BHATTACHARYA, Subhaditya ²; WUDKA, Jose ²

¹ *Rudjer Boskovic Institute, Zagreb*

² *Department of Physics Astronomy, University of California Riverside Riverside CA 92521-0413, USA*

Corresponding Author: blazenka.melic@gmail.com

We study the scenario where dark matter corresponds to a set of pseudo-Goldstone bosons, that we call dark pions, generated by the spontaneous breaking of a symmetry in the dark sector, and show that one can accommodate studied experimental and theoretical constraints in wide regions of parameter space.

Education and Outreach / 46

Phantom of the Universe: A State-of-the-Art Planetarium Show on Dark Matter

Dr. BARNETT, Michael ¹; DE, Kaushik ²; SCHWIENHORST, Reinhard ³; PEQUENAO, Joao ⁴; SMOOT, George ⁵; STRELECKI, Carey Ann ⁶

¹ *Lawrence Berkeley National Lab*

² *University of Texas Arlington*

³ *Michigan State University*

⁴ *CERN*

⁵ *Univ. of California, Berkeley*

⁶ *LBNL*

Corresponding Author: rmbarnett@lbl.gov

Phantom of the Universe is a planetarium show premiering late summer 2014 that will showcase an exciting exploration of dark matter, from the Big Bang to the Large Hadron Collider. The show will reveal the first hints of its existence through the eyes of Fritz Zwicky. Viewers will marvel at the astral choreography witnessed by Vera Rubin in the Andromeda galaxy. They will plummet deep underground to see the most sensitive dark matter detector on Earth. From there, they will end the journey at the Large Hadron Collider, speeding alongside particles before they collide in visually stunning explosions of light and sound, and learning how scientists around the world are collaborating to track down the constituent of dark matter. The show will be offered to planetariums worldwide free of charge. It will feature music composed by Mickey Hart (Apocalypse Now, The Twilight Zone, The Grateful Dead) and narration by Academy-Award winning actress Tilda Swinton, and showcase the creativity and directing prowess of Joao Pequeno and the writing and producing talents of award-winning filmmaker, Carey Ann Strelecki.

Lepton Flavour Violation / 47**Disentangling new physics contributions in lepton flavour violating tau decays**PASSEMAR, Emilie ¹; CELIS, Alejandro ²; CIRIGLIANO, Vincenzo ³¹ *TTP Bern*² *IFIC-Universitat de Valencia*³ *Los Alamos National Laboratory***Corresponding Author:** alejandro.celis@ific.uv.es

Within an effective field theory framework, I will discuss the possibility to discriminate between different operators that contribute to lepton flavour violating tau decays. Correlations among decay rates in different channels as well as differential distributions in many-body decays are considered. Recent developments in the determination of the hadronic form factors for tau \rightarrow mu pi pi decays are incorporated in the analysis.

Formal Theory Developments / 48**On the smallness of the cosmological constant in SUGRA models with Planck scale SUSY breaking and degenerate vacua**Prof. NIELSEN, Holger ¹; Prof. THOMAS, Anthony ²; Dr. NEVZOROV, Roman ²; Prof. FROGGATT, Colin ³¹ *Niels Bohr Institute*² *University of Adelaide*³ *University of Glasgow***Corresponding Author:** roman.nevzorov@adelaide.edu.au

In $\mathcal{N}=1$ supergravity (SUGRA) supersymmetric (SUSY) and non-supersymmetric Minkowski vacua originating in the hidden sector can be degenerate. This allows for consistent implementation of the multiple point principle (MPP) assumption. We present no-scale inspired SUGRA model where the MPP assumption is realised at the tree-level without extra fine-tuning. In the supersymmetric phase in flat Minkowski space SUSY may be broken dynamically inducing tiny vacuum energy density which can be assigned, by virtue of MPP, to all other phases including the one in which we live. We argue that the measured value of the cosmological constant, as well as the small values of quartic Higgs self-coupling and the corresponding beta function at the Planck scale, which can be obtained by extrapolating the Standard Model (SM) couplings to high energies, can originate from supergravity (SUGRA) models with degenerate vacua. This scenario is realised if there are at least three exactly degenerate vacua. In the first vacuum, associated with the physical one, local supersymmetry (SUSY) is broken near the Planck scale while the breakdown of the $SU(2)_W \times U(1)_Y$ symmetry takes place at the electroweak (EW) scale. In the second vacuum local SUSY breaking is induced by gaugino condensation at a scale which is just slightly lower than Λ_{QCD} in the physical vacuum. Finally, in the third vacuum local SUSY and EW symmetry are broken near the Planck scale.

BEH Physics / 49

Nonstandard Higgs decays in the E6 inspired SUSY modelsDr. NEVZOROV, Roman ¹; Prof. PAKVASA, Sandip ²¹ *University of Adelaide*² *University of Hawaii***Corresponding Author:** roman.nevzorov@adelaide.edu.au

We study the decays of the SM-like Higgs state within the E_6 inspired supersymmetric (SUSY) model based on the SM gauge group together with an extra $U(1)_N$ gauge symmetry under which right-handed neutrinos have zero charge. To ensure anomaly cancellation and gauge coupling unification the low energy matter content of this SUSY model involves three 27 representations of E_6 and a pair of $SU(2)$ doublets from additional 27 and $\overline{27}$. In addition, we impose a \tilde{Z}^H_2 symmetry to forbid tree-level flavor-changing transitions and the most dangerous baryon and lepton number violating operators. This model contain at least two states which are absolutely stable and can contribute to the dark matter density. One of them is the lightest SUSY particle (LSP) which is expected to be lighter than 1 eV forming hot dark matter in the Universe. The presence of another stable neutral state which is the lightest ordinary neutralino can account for all or some of the observed cold dark matter density. In this SUSY model the next-to-lightest SUSY particle (NLSP) also tend to be light. We argue that the NLSP with GeV scale mass can result in the substantial branching ratio of the nonstandard decays of the SM-like Higgs boson into NLSPs.

BEH Physics / 51

Softening Higgs Naturalness: an Effective Field Theory AnalysisDr. BAR-SHALOM, Shaouly ¹; Dr. SONI, Amarjit ²; Prof. WUDKA, Jose ³¹ *Technion, Haifa, Israel*² *Brookhaven National Laboratory (BNL), NY, USA*³ *University of California at Riverside (UCR), CA, USA***Corresponding Author:** shaouly@gmail.com

We use an effective field theory (EFT) prescription to accommodate naturalness in the Standard Model (SM) Higgs sector. We study the 1-loop corrections to the Higgs mass which are generated by the (complete) set of relevant effective operators of dimension $n > 4$, assuming that the SM's degrees of freedom and gauge symmetries are valid up to some new physics scale Λ . We find that there are only three classes of higher dimensional effective operators which can balance the SM's 1-loop corrections to the Higgs mass, and that these operators can be generated in the underlying heavy theory through tree-level exchanges of a heavy singlet or triplet scalar, a heavy isosinglet, doublet or isotriplet fermion and a heavy isosinglet or isotriplet vector-boson. Using the EFT naturalness as a guide, we demonstrate how naturalness can be restored within simple toy models containing these heavy degrees of freedom. In particular, we show that the SM Higgs sector can be kept natural up to an arbitrary large scale if certain relations hold between the masses and couplings of the heavy and SM fields; the amount of fine-tuning required depends on the amount of fine-tuning one is willing to tolerate in the Higgs mass corrections.

Formal Theory Developments / 52

Calculating repetitively.III:Prof. KAMATH, Gopinath ¹¹ *Indian Institute of Technology Madras***Corresponding Author:** kamath@iitm.ac.in

This talk has two highlights: a. The utility of the Dirac δ – function as an aid to repetitive integration in multiple integrals, and b. An extension to 3 + 1 dimensional stationary curved space of a recent effort by the author in 2 + 1 dimensional stationary curved space to determine the zeta function for the Lagrangian density for a real massive scalar field using the Schwinger operator expansion; this is a reworking to advantage by the author of the Antonsen – Bormann idea that was originally proposed by these latter authors for the computation of the heat kernel in curved space. The repetitive nature of the calculation in 2 + 1 dimensional curved space at all higher orders (≥ 3) in the gravitational constant G suggested the use of the Dirac delta-function and one of its integral representations – in that it is convenient to obtain answers, so its utility is also checked in the 3 + 1 dimensional case.

BEH Physics / 54

EW Chiral Lagrangian with a Light Higgs and the $\gamma\gamma \rightarrow W^+W^-$ and $\gamma\gamma \rightarrow ZL$ scattering at One Loop

Prof. DOBADO, Antonio ¹; HERRERO, Maria Jose ²; Mr. DELGADO LÓPEZ, Rafael ³; Dr. SANZ-CILLERO, Juan Jose ⁴¹ *Departamento de Física Teórica. Universidad Complutense*² *UAM-IFT*³ *Dep. Física Teórica I, Universidad Complutense de Madrid (UCM)*⁴ *Universidad Autonoma de Madrid - IFT***Corresponding Author:** cillero@ifae.es

In this work we study the $\gamma\gamma \rightarrow W^+W^-$ and $\gamma\gamma \rightarrow ZL$ scattering processes within the effective chiral Lagrangian approach, including a light Higgs-like scalar as a dynamical field together with the would-be-Goldstone bosons w^\pm and z associated to the electroweak symmetry breaking. This approach is inspired by the possibility that the Higgs-like boson be a composite particle behaving as another Goldstone boson, and assumes the existence of a mass gap between m_h , m_W , m_Z and the potential new emergent resonances, setting an intermediate energy region (above $m_{h,W,Z}$ and below the resonance masses) where the use of these effective chiral Lagrangians are the most appropriate tools to compute the relevant observables. We analyse in detail the proper chiral counting rules for the present case of photon-photon scattering and provide the one-loop $\gamma\gamma \rightarrow W^+W^-$ and $\gamma\gamma \rightarrow ZL$

scattering amplitudes within this Effective Chiral Lagrangian approach, including a discussion on the involved renormalization procedure. We also propose here a joint analysis of our results for the two-photon scattering amplitudes together with other photonic processes and electroweak precision observables for a future comparison with data. This could help to disentangle the nature of the light Higgs-like particle.

Neutrino Physics / 56

Electromagnetic interactions of neutrinos: a window to new physics

Prof. STUDENIKIN, Alexander ¹; Prof. GIUNTI, Carlo ²¹ *Moscow State University and JINR-Dubna*² *University and INFN of Turin***Corresponding Author:** a-studenik@yandex.ru

A wide review on neutrino electromagnetic properties and interactions is presented, both theoretical and experimental aspects of the problem are discussed. It is shown that these studies open a window to new physics. The talk is based on the recent wide review on the subject available on web since March 25, 2014:

C.Giunti, A.Studenikin, “Electromagnetic interactions of neutrinos: a window to new physics”, arXiv: 1403.6344 March 25, 2014, 72 pages and more than 350 references.

Poster Session / 57

New bounds on neutrino electric millicharge from limits on neutrino magnetic momentProf. STUDENIKIN, Alexander ¹¹ *Moscow State University and JINR-Dubna***Corresponding Author:** a-studenik@yandex.ru

A possibility for a neutrino to be an electrically millicharged particle is one of the presently discussed manifestation of physics beyond the Standard Model. Using the new limit on the neutrino anomalous magnetic moment recently obtained by the GEMMA experiment on measurements of the cross section for the reactor antineutrino scattering on free electrons, we get a new direct upper bound on the neutrino millicharge $q_{\nu} < 1.5 \times 10^{-12} e_0$. This is a factor of 2 more stringent than the reactor neutrino scattering constraint obtained the TEXONO reactor experiment data and included by the Particle Data Group Collaboration to the Review of Particle Physics 2012. We predict that with data from the ongoing new phase of the GEMMA experiment the upper bound on the neutrino millicharge will be reduced to $q_{\nu} < 3.7 \times 10^{-13} e_0$ within two years. We also predict that with the next phase of the considered experiment the upper bound on the millicharge will be reduced by an order of magnitude over the present bound and reach the level $q_{\nu} < 1.8 \times 10^{-13} e_0$ within approximately four years. Accordingly, a new bound on the millicharge that will be obtained within a few years with next release of the GEMMA experiment data will be a factor of 10 more stringent than one from the present GEMMA data.

Poster Session / 58

Millicharged neutrino with anomalous magnetic moment in rotating magnetized matterProf. STUDENIKIN, Alexandert ¹; Dr. TOKAREV, Ilya ²¹ *Moscow State University and JINR-Dubna*² *Moscow State University***Corresponding Author:** a-studenik@yandex.ru

New exact solutions of the modified Dirac equation describing a neutrino with nontrivial electromagnetic properties in extreme background conditions are obtained. Within the quasi-classical treatment the effective Lorentz force that describes the neutrino propagation in the magnetized rotating matter is introduced. We predict the effect of the spatial separation of different types of relativistic neutrinos and antineutrinos (different in flavors and energies) by the magnetized rotating matter of a star. Low energy neutrinos can be even trapped inside the star. We also predict two new phenomena: a new type of the neutrino electromagnetic radiation (termed "Light of (milli)Charged Neutrino", $LC\nu$) and a new mechanism of the star angular velocity shift due to neutrinos escaping the star (termed "Neutrino Star Turning" mechanism, $\nu S T$). The possible impact of the $\nu S T$ mechanism on a supernova explosion yields a new astrophysical limit on the neutrino millicharge $q_{\nu} < 1.3 \times 10^{-19} e_0$. This limit is stronger than many other constraints known in literature. In addition, the $\nu S T$ mechanism can be also used to explain the origin of pulsar "anti-glitches" and ordinary glitches as well.

Poster Session / 59

New mechanism of electromagnetic radiation emitted by an electron in dense relativistic neutrino fluxes

Prof. STUDENIKIN, Alexander ¹

¹ *Moscow State University and JINR-Dubna*

Corresponding Author: a-studenik@yandex.ru

We propose and investigated a new mechanism of electromagnetic radiation that can be emitted by electrons when they are dipped in dense fluxes of relativistic neutrinos. These studies are based on the obtained exact solution for the electron wave function in presence of relativistic neutrino background. The energy spectrum, rate and power of this radiation are calculated and applications to different astrophysical settings, including supernovae, are considered.

1. A.Studenikin, “Method of wave equations exact solutions in studies of neutrinos and electrons interaction in dense matter”, *J. Phys. A: Math. Theor.* 41 (2008) 164047.
2. I. Balantsev, A. Studenikin, I. Tokarev , “New solutions to the Dirac equation for particles in a magnetic field and a medium”, *Phys.Part.Nucl.* 43 (2012) 727.
3. I.Balantsev, Yu.Popov, A.Studenikin, “On the problem of relativistic particles motion in strong magnetic field and dense matter”, *J.Phys. A44* (2011) 255301.
4. A.Grigoriev, A.Lokhov, A.Studenikin, A.Ternov, “The effect of plasmon mass on spin light of neutrino in dense matter”, *Phys.Lett. B718* (2012) 512, arXiv: 1207.6396 v2, 16 March 2014.

Poster Session / 60

Theory of neutrino-atom collisions: the history, present status and BSM physics

Dr. KOUZAKOV, Konstantin ¹; Prof. STUDENIKIN, Alexander ²

¹ *Skobeltsin Nuclear Physics Institute, Moscow State University*

² *Moscow State University and JINR-Dubna*

Corresponding Author: a-studenik@yandex.ru

We give an overview of the current theoretical studies on neutrino-atom scattering processes. We focus on the ionization channel of these processes which is studied in experiments searching for neutrino magnetic moments. Recent developments in the theory of atomic ionization by impact of reactor antineutrinos are discussed. It is shown that the stepping approximation is well applicable for the data analysis practically down to the ionization threshold. We show that studies of neutrino-atom collisions provide a powerful tool in testing neutrino electromagnetic properties that opens a window to BSM physics.

Neutrino Physics / 61

Status of the CUORE and results from the CUORE-0 neutrinoless double beta decay experimentsDr. SISTI, Monica ¹¹ *Università degli Studi di Milano-Bicocca and INFN Milano-Bicocca***Corresponding Author:** monica.sisti@mib.infn.it

CUORE is a 741 kg array of TeO₂ bolometers for the search of neutrinoless double beta decay of Te-130. The detector is being constructed at the Laboratori Nazionali del Gran Sasso, Italy, where it will start taking data in 2015. If the target background of 0.01 counts/(keV kg y) will be reached, in five years of data taking CUORE will have an half life sensitivity of about 10^{26} y. CUORE-0 is a smaller experiment constructed to test and demonstrate the performances expected for CUORE. The detector is a single tower of 52 CUORE-like bolometers that started taking data in spring 2013. The status and perspectives of CUORE will be discussed, and the first CUORE-0 data will be presented.

Beyond the Standard Model / 62

Searching for hidden sectors in multiparticle production at the LHCProf. SANCHIS-LOZANO, Miguel-Angel ¹; Prof. SARKISYIAN-GRINBAUM, Edward ²¹ *IFIC - University of Valencia*² *CERN***Corresponding Author:** miguel.angel.sanchis@ific.uv.es

Most signatures of new physics in colliders have been studied on the transverse plane with respect to the beam direction. In this work we consider the impact of a hidden sector (e.g. hidden valley models) beyond the SM on inclusive longitudinal (pseudo)rapidity correlations and factorial moments of multiplicity distributions in pp inelastic collisions, with special emphasis in the forthcoming LHC results.

Top-quark and ElectroWeak Physics / 64

New Results and Combination of the Top-Quark Mass at CDFDr. VELEV, George ¹¹ *Fermilab***Corresponding Author:** velev@fnal.gov

We present the final combination of the top-quark mass, M_t , performed by the CDF experiment at the Tevatron collider. The combination includes three recently published and two preliminary results from the CDF Run II data collected at 1.96 TeV center of mass collision energy. The analyses use the full Run II samples of 8.7- 9.3 fb⁻¹ of data. The latter measurements are combined with the CDF Run I published results (1998-2001). The combination includes measurements in the $t\bar{t} \rightarrow \text{lepton}+\text{jets}$, $t\bar{t} \rightarrow \text{dilepton}$, $t\bar{t} \rightarrow \text{all jets}$ and $t\bar{t} \rightarrow \text{Emiss}+\text{jets}$ final states. The resulting combined measurement of the top-quark mass is $M_t = 173.16 \pm 0.57$ (stat) ± 0.74 (syst) GeV/c², with a total uncertainty of 0.93 GeV/c².

Strong Interactions and Hadron Physics / 66

Hadron Spectroscopy at BESIII

Prof. YUAN, Changzheng¹

¹ IHEP, Beijing

Corresponding Author: yuancz@ihep.ac.cn

Based on the world's largest samples of J/ψ , $\psi(3686)$ decays, as well as the data taken around the peak of $Y(4260)$ resonance collected at the BESIII detector, the progresses on the hadron spectroscopy are presented, including the PWA of J/ψ radiative decays, η and η' physics, and observations of charmonium-like Z_c states.

Flavour Physics / 69

D leptonic decay and semi-leptonic decays from BESIII

Prof. YUAN, Changzheng¹

¹ IHEP, Beijing

Corresponding Author: yuancz@ihep.ac.cn

Based on 2.92/fb of data accumulated at $\psi(3770)$, BESIII measured the branching ratio of $(D^+ \rightarrow \mu^+ \nu)$ is about $(3.71 \pm 0.19 \pm 0.06) \times 10^{-4}$, and determine the weak decay constant $f_D = (203.2 \pm 5.3 \pm 1.8) \text{ MeV}$. these are the most precise results.

Based on the $\psi(3770) \rightarrow D\bar{D}$ data accumulated at the BESIII experiment, we present studies of $D^0 \rightarrow K^- e^+ \nu$ and $D^0 \rightarrow \pi^0 e^+ \nu$ decays which include preliminary results of $B(D^0 \rightarrow K^- e^+ \nu)$, $B(D^0 \rightarrow \pi^0 e^+ \nu)$, as well as the partial decay rates of these decays in q^2 bins. The measured partial decay rates, in return, allow us to determine different parameterizations of the form factors.

Flavour Physics / 70

Charm Mixing and D Dalitz analysis at BESIII

Prof. YUAN, Changzheng¹

¹ IHEP, Beijing

Corresponding Author: yuancz@ihep.ac.cn

We measured the asymmetry A_{CP} of branching ratios of $D^0 \rightarrow K\pi^+$ in the CP-odd and CP-even eigenstates to be $(12.7 \pm 1.3 \pm 0.7)\%$ based on 2.92fb⁻¹ of data accumulated at $\psi(3770)$ at BESIII/BEPCII. The A_{CP} can be used to extract the strong phase difference $\delta_{K\pi}$ between the double Cabbibo-suppressed process $D^0 \rightarrow K\pi^+$ and the Cabbibo-favored process $D^0 \rightarrow K\pi^+$. Using the world-average values of external parameters, we obtain $\cos(\delta_{K\pi}) = 1.02 \pm 0.11 \pm 0.06 \pm 0.01$. Here, the first and second uncertainties are statistical and systematic, while the third uncertainty arises from the external parameters. This is the most precise measurement of $\delta_{K\pi}$ to date.

We perform an analysis of the $D^+ \rightarrow K_S \pi^+ \pi^0$ Dalitz plot analysis use a data set of 2.92 fb⁻¹ e^+e^- collisions at $\psi(3770)$ mass accumulated by the BESIII Experiment. The Dalitz plot is found to be well-represented by a combination of six quasi-two-body decay channels ($K_S \rho$, $K_S \rho(1450)$, $K^{*0} \bar{\pi}^+$, $K^{*0}(1430) \bar{\pi}^+$, $K(1680) \bar{\pi}^+$ and $\kappa^0 \bar{\pi}^+$) plus a small non-resonant component. Using the fractions from this analysis, partial branching ratios are updated with higher precision than previous measurements.

Flavour Physics / 71

Branching fractions and CP violation in charmless 3-body decays of B mesons

Prof. CHENG, Hai-Yang¹; Prof. CHUA, Chun-Khiang²

¹ *Academia Sinica*

² *Chung Yuan Christian University*

Corresponding Author: phcheng@phys.sinica.edu.tw

Branching fractions and CP-violating asymmetries of charmless three-body decays of $B_{u,d}$ and B_s mesons are studied using a simple model based on the factorization approach. We consider both resonant and nonresonant contributions. Dominant nonresonant contributions to tree-dominated three-body decays can be evaluated using heavy meson chiral perturbation theory valid in the soft meson limit. For penguin-dominated decays, nonresonant signals come mainly from the penguin amplitude governed by the matrix elements of scalar densities. Inclusive and regional CP asymmetries are predicted and confronted with the LHCb data. For B_s decays, several model-independent U-spin symmetry relations for CP violation are derived.

Beyond the Standard Model / 72

Precision predictions for direct gaugino and slepton production at the LHC

Prof. KLASSEN, Michael¹

¹ *Institute for Theoretical Physics, University of Münster*

Corresponding Author: michael.klassen@uni-muenster.de

The search for electroweak superpartners has recently moved to the centre of interest at the LHC. We provide the currently most precise theoretical predictions for these particles at NLO+NLL, use them to assess the precision of parton shower simulations, and reanalyse public experimental results assuming more general decompositions of gauginos and sleptons.

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Precision predictions for supersymmetric dark matter

Prof. KLASSEN, Michael¹

¹ *Institute for Theoretical Physics, University of Münster*

Corresponding Author: michael.klassen@uni-muenster.de

The dark matter relic density has been measured by PLANCK and its predecessors with an accuracy of about 2%. We present theoretical calculations with DM@NLO in NLO SUSY QCD and beyond, which allow to reach this precision for gaugino and squark (co-)annihilations, and use them to scan the phenomenological MSSM for viable regions, applying also low-energy, electroweak and hadron collider constraints.

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Physics of the Brout-Englert-Higgs boson in CMS

Dr. DAVID, André ¹

¹ CERN

Corresponding Author: andre.david@cern.ch

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Physics of the Brout-Englert-Higgs boson in ATLAS

Corresponding Author: kado@lal.in2p3.fr

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Physics of the Brout-Englert-Higgs boson: theory

Prof. GROJEAN, Christophe ¹

¹ ICREA/IFAE (Spain)

Corresponding Author: christophe.grojean@cern.ch

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Results on Physics Beyond the Standard Model from ATLAS and CMS

Dr. WUERTHWEIN, Frank ¹

¹ UC San Diego (United States)

Corresponding Author: frank.wuerthwein@cern.ch

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Physics Beyond the Standard Model: theory

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Electroweak Physics: highlights of experimental results at low energy

Corresponding Author: carlini@jlab.org

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Electroweak Physics: highlights of experimental results from hadron colliders

Dr. BERRYHILL, Jeffrey¹

¹ *Fermilab (United States)*

Corresponding Author: jeffrey.berryhill@cern.ch

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Understanding electroweak physics in the Standard Model and beyond

FREITAS, Ayres¹

¹ *University of Pittsburgh*

Corresponding Author: afreitas@pitt.edu

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Top quark physics at LHC

Dr. CARLI, Tancredi¹

¹ *CERN*

Corresponding Author: tancredi.carli@cern.ch

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Top-quark physics --- Theory status

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Highlights of Tevatron results

Prof. BERNARDI, Gregorio¹

¹ *LPNHE-Paris 6/CNRS-IN2P3 (France)*

Corresponding Author: gregorio@fnal.gov

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Rare decays in quark flavour physics

Dr. ALBRECHT, Johannes¹

¹ *TU Dortmund (Germany)*

Corresponding Author: johannes.albrecht@tu-dortmund.de

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CP-Violation and B-Physics: experimental results and future prospects

Prof. BROWDER, Thomas E ¹

¹ *University of Hawaii (United States)*

Corresponding Author: teb@phys.hawaii.edu

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Looking for physics beyond the SM via the Flavour Window

Prof. ISIDORI, Gino ¹

¹ *University of Zurich (Switzerland)*

Corresponding Author: gino.isidori@lnf.infn.it

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Highlights of Heavy Ions experimental results

Corresponding Author: j.wessels@uni-muenster.de

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Heavy Ions Physics: theory

Prof. GALE, Charles ¹

¹ *McGill University (Canada)*

Corresponding Author: gale@physics.mcgill.ca

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Probing the strong interactions: highlights of experimental results

Corresponding Author: chiara.roda@cern.ch

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QCD and hadron physics: theory

Corresponding Author: paolo.nason@mib.infn.it

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Hadron Spectroscopy

Dr. PENG, Haiping ¹

¹ *USTC*

Corresponding Author: penghp@ustc.edu.cn

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Progress in Lattice QCD: a new landscape

Corresponding Author: axk@illinois.edu

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Neutrino experiments: highlights of accelerator and reactor results

ZITO, Marco ¹

¹ *IRFU-Saclay*

Corresponding Author: marco.zito@cea.fr

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Neutrino properties: Highlights of non-oscillation results

Prof. LINDNER, Manfred ¹

¹ *MPI Heidelberg, (Germany)*

Corresponding Author: lindner@mpi-hd.mpg.de

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Neutrino Phenomenology: Highlights of oscillation results and future prospects

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Direct Dark Matter searches

Dr. ARAUJO, Henrique ¹

¹ *Imperial College London (United Kingdom)*

Corresponding Author: h.araujo@imperial.ac.uk

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Space based cosmic ray experiments: highlights of recent results

Dr. BERDUGO, Javier¹

¹ *CIEMAT*

Corresponding Author: javier.berdugo@ciemat.es

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Ground based cosmic ray experiments: highlights of recent results

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Gamma ray experiments: highlights of recent results

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Upgrade of the ALICE Time Projection Chamber for High-Rate Experiments

Dr. GASIK, Piotr¹

¹ *TU München*

Corresponding Author: p.gasik@tum.de

ALICE at the CERN LHC is planning a major upgrade of the central barrel detectors to cope with an increase of the LHC luminosity in Pb-Pb after 2018. The goal is to record Pb-Pb interactions at a rate of 50 kHz after Long Shutdown 2 (LS2), which is a factor of about 100 more than the current data acquisition rate. For the Time Projection Chamber (TPC) this implies replacement of the existing MWPC-based readout chambers by continuously operated Gas Electron Multiplier (GEM) to overcome the rate limitations imposed by the present gated readout scheme.

An extensive R program has been launched to reach the challenging goals of the upcoming upgrade of the detector and online calibration and data reduction system. As a first step of this program, a prototype of an ALICE Inner Read-Out Chamber (IROC) was equipped with large-size GEM foils as amplification stage to demonstrate the feasibility of this solution.

In this presentation the most recent results will be discussed concerning ion backflow suppression, gain stability, energy and dE/dx resolution, stability against discharges. The status of the upgrade of the online calibration and data reduction system, which includes advanced techniques for online corrections of space-charge distortions, as well as the development of a new readout electronics will be also reported.

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Poster prizes. Elsevier young scientist awards

Dr. PRESANI, Eleonora ¹

¹ *Elsevier*

Corresponding Author: e.presani@elsevier.com

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IUPAP young scientist prize winner on theoretical high energy physics

Corresponding Author: claude.duhr@durham.ac.uk

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IUPAP young scientist prize winner on experimental high energy physics

Corresponding Author: kerstin.tackmann@desy.de

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Very High Energy Neutrinos

Corresponding Author: alexander.kappes@icecube.wisc.edu

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Formal Theory developments

Corresponding Author: jose.barbon@uam.es

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Education, Communication and Outreach

Corresponding Author: hans.peter.beck@cern.ch

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Computing in High Energy Physics

Dr. MOUNT, Richard ¹

¹ *SLAC National Accelerator Laboratory (United States)*

Corresponding Author: rmount@slac.stanford.edu

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Detector R in Particle Physics

Corresponding Author: allport@liverpool.ac.uk

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Energy-frontier colliders - the road ahead

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Theoretical highlights of ICHEP 2014. Outlook

Corresponding Author: antonio.pich@ific.uv.es

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Experimental highlights of ICHEP 2014

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Farewell

Corresponding Author: juan.fuster@ific.uv.es

Heavy Ions / 120**QCD analysis and effective temperature of direct photons in lead-lead collisions at the LHC**Prof. KLASSEN, Michael ¹¹ *Institute for Theoretical Physics, University of Münster***Corresponding Author:** michael.klasen@uni-muenster.de

We present a rigorous theoretical analysis of the ALICE measurement of low- p_T direct-photon production in central lead-lead collisions at the LHC with a centre-of-mass energy of $\sqrt{s_{NN}}=2.76$ TeV. Using NLO QCD, we compute the relative contributions to prompt-photon production from different initial and final states and the theoretical uncertainties coming from independent variations of the renormalisation and factorisation scales, the nuclear parton densities and the fragmentation functions. Based on different fits to the unsubtracted and prompt-photon subtracted ALICE data, we consistently find $T = 304 \pm 58$ MeV and 309 ± 64 MeV for the effective temperature of the quark-gluon plasma (or hot medium) at $p_T \in [0.8; 2.2]$ GeV and $p_T \in [1.5; 3.5]$ GeV as well as a power-law (p_T^{-4}) behavior for $p_T > 4$ GeV as predicted by QCD hard scattering.

Poster Session / 121**Implications of the Higgs discovery on minimal dark matter**Prof. KLASSEN, Michael ¹¹ *Institute for Theoretical Physics, University of Münster***Corresponding Author:** michael.klasen@uni-muenster.de

Dark matter (DM) constitutes the only clear evidence for physics beyond the Standard Model (SM). Minimal extensions of the SM with additional scalars or fermions allow to explain the observed DM relic density in an economic way. We analyse several of these possibilities like the inert Higgs and radiative seesaw models in the light of the recent Higgs discovery and study prospects for the direct and indirect detection of DM in these models.

Neutrino Physics / 122**Intense Neutrino Super Beam Experiment for Leptonic CP Violation Discovery based on the European Spallation Source Linac**Dr. DRACOS, Marcos ¹; Prof. EKELOF, Tord ²¹ *IPHC/IN2P3 Strasbourg*² *Uppsala University***Corresponding Author:** marcos.dracos@in2p3.fr

The European Spallation Source (ESS) linac with 5 MW proton power has the potential to become the proton driver of - in addition to the world's most intense pulsed spallation neutron source - the world's most intense neutrino beam. The physics performance of that neutrino Super Beam in conjunction with a megaton Water Cherenkov neutrino detector installed 1000 m down in a mine at a distance of about 500 km from ESS will be described. In particular, the superior potential of such a neutrino experiment placed at the 2nd oscillation maximum to discover the lepton CP violation in order to explain the matter-antimatter asymmetry in Universe and also the neutrino mass hierarchy will be presented. In addition, the choice of such detector will extent the physics program to proton-decay, atmospheric neutrinos and astrophysics searches. The ESS proton linac, the target station optimization and the physics potential will be described.

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The Characterization of the Gamma-Ray Signal from the Central Milky Way: A Compelling Case for Annihilating Dark MatterDr. LINDEN, Tim ¹¹ *University of Chicago***Corresponding Author:** trlinden@uchicago.edu

In scenarios where dark matter particles can annihilate to produce standard model, the galactic center of the Milky Way is expected to provide the highest flux from dark matter in the sky. Recently, we have worked on gamma-ray observations from the Fermi-LAT telescope, and have detected a significant extended excess, which is spherically symmetric around the position of the galactic center, and does not trace any known astrophysical emission profile. In this talk, I will summarize the current status of these observations and discuss dark matter and astrophysical interpretations of the data. I will show results which strongly constrain the properties and the possible interpretations of the observed excess. Finally, I will posit upcoming tests which will strongly suggest, or rule out, a dark matter interpretation.

Poster Session / 124

Generation of cosmic magnetic fields in electroweak plasma with neutrino-antineutrino asymmetryDr. DVORNIKOV, Maxim ¹¹ *Institute of Physics, University of Sao Paulo***Corresponding Author:** maxim.dvornikov@gmail.com

We study the generation of strong magnetic fields in magnetars and in the early universe. For this purpose we calculate the antisymmetric contribution to the photon polarization tensor in medium consisting of electron-positron plasma and a gas of neutrinos and antineutrinos, interacting within the Standard Model. Such a contribution exactly takes into account the temperature and the chemical potential of plasma as well as the photon dispersion law in this background matter. Using this result we derive the Faraday equation for the magnetic field evolution which accounts for the parity violating interaction between electrons and neutrinos. On the basis of the Faraday equation we predict the instability of a seed magnetic field and its growth provided a nonzero asymmetry between neutrinos and antineutrinos is present. We apply our result to the magnetic field amplification, driven by the electron neutrinos asymmetry, during the first second of a supernova explosion. It is suggested that this mechanism can explain strong magnetic fields of magnetars. Then we study the cosmological magnetic field evolution driven by the neutrino asymmetry density. Within this approach we find a lower bound on the neutrino asymmetries consistent with the well-known Big Bang nucleosynthesis bound in a hot universe plasma.

M. Dvornikov and V. B. Semikoz, to be published in JCAP (2014); arXiv:1311.5267 [hep-ph].

Poster Session / 125

Induced magnetic moment in the magnetic catalysis of chiral symmetry breakingProf. FERRER, Efrain J. ¹¹ *The University of Texas at El Paso***Corresponding Author:** ejferrer@utep.edu

The chiral symmetry breaking in an NJL-type effective model of quarks in the presence of a magnetic field is investigated. We show that new interaction tensor channels open up via Fierz identities due to the explicit breaking of the rotational symmetry by the magnetic field. We demonstrate that the magnetic catalysis of chiral symmetry breaking leads to the generation of two independent condensates, the conventional chiral condensate and a spin-one condensate. While the chiral condensate generates, as usual, a dynamical fermion mass, the new condensate enters as a dynamical anomalous magnetic moment in the dispersion of the quasiparticles. Since the pair, formed by a quark and an antiquark with opposite spins, possesses a resultant magnetic moment, an external magnetic field can align it giving rise to a net magnetic moment for the ground state. Our results show that the magnetically catalyzed ground state in QCD is actually richer than previously thought. The two condensates contribute to the effective mass of the LLL quasiparticles in such a way that the critical temperature for chiral symmetry restoration becomes enhanced.

Heavy Ions / 126

The onset of the ridge structure in AA, pA and pp collisions.Prof. PAJARES VALES, Carlos ¹; Mr. MOSCOSO RIAL, Alexis ¹; Ms. ANDRÉS CASAS, Carlota ¹¹ *Universidade de Santiago de Compostela***Corresponding Author:** alexis.mrial@gmail.com

It is shown that the anomalous sharp increasing of the strength of the near-side ridge structures observed in Au-Au collisions at $\sqrt{s} = 62$ GeV and $\sqrt{s} = 200$ GeV and the onset of the ridge structure in pPb and in pp collisions can be naturally explained in the framework of string percolation. In all the cases the near-side strength reflects the collision area covered by the strings stretched between the colliding objects and therefore it is related to the shape of their profile functions. The dependence of the pseudorapidity and azimuthal widths on multiplicity and energy is qualitatively explained.

Accelerator Physics and Future Colliders / 127

FCC study: parameters and optics for hadron and lepton collidersDr. TOMAS GARCIA, Rogelio ¹; Dr. BENEDIKT, Michael ¹; SCHULTE, daniel ²; TODESCO, ezio ²; BOTTURA, Luca ¹; HOLZER, bernhard ¹; ZIMMERMANN, frank ¹; JENSEN, Erk ¹; MEDINA, Luis ¹; MARTIN, roman ²; HAERER, Bastian ¹; WENNINGER, Jorg ¹¹ *CERN*² *cern***Corresponding Author:** rogelio.tomas@cern.ch

A new international study has just been launched to design a hadron collider with a centre-of-mass energy of the order of 100 TeV in a new 80-100 km tunnel as a long-term goal. The design study includes a 90-350 GeV lepton collider, seen as a potential intermediate step, and an ep option. This paper reports on the overall parameters and preliminary optics designs with special emphasis on the Interaction Regions and the constraints arising for having to host both the lepton and the hadron colliders. Preliminary hardware specifications, as magnetic field, gradient, lengths and aperture are also presented.

Flavour Physics / 128

A new way to search for right-handed currents in semileptonic $B \rightarrow \rho \ell \bar{\nu}$ decay

Mr. TURCZYK, Sascha¹; Mr. BERNLOCHNER, Florian²; Mr. LIGETI, Zoltan³

¹ *University of Mainz*

² *Humboldt University Berlin*

³ *Lawrence Berkeley National Laboratory*

Corresponding Author: turczyk@uni-mainz.de

There exist a long standing tension among determinations of the CKM matrix element $|V_{ub}|$ from various (semi)leptonic B decay channels with varying significance of up to $\sim 3\sigma$. An interesting possibility to ease this tension is to allow for a right-handed contribution to the standard model left-handed weak current mediating the $b \rightarrow u$ quark decay. The current bounds on such a contribution are fairly weak. We propose a new way to search for such a right-handed current in semileptonic B meson decay to ρ mesons. We describe a new variable that we propose, and discuss the theoretical uncertainties. Especially we investigate the uncertainties and their correlations among all contributing form factors with the assumed z -expansion for its shape, valid over the whole q^2 range. Then we study the achievable sensitivity both from the available Babar and Belle data sets, as well as from an anticipated 50 fb^{-1} at Belle-II.

Education and Outreach / 129

‘Cascade’ Outreach Competitions for schools – an efficient way to introduce Particle Physics to many students

Prof. WATKINS, Peter¹; Mrs. LONG, Lynne¹

¹ *University of Birmingham*

Corresponding Author: pmw@hep.ph.bham.ac.uk

The Particle Physics group at the University of Birmingham has tried many different formats for Outreach competitions over recent years. We have found that a ‘Cascade’ competition is a very efficient way to introduce Particle Physics concepts and experiments to a wide range of students. Small groups of students research, prepare and deliver a short presentation to other students.

We will describe variations on the format of this type of competition and include some examples from our winning entries. All the material that we have used for these competitions is freely available on the web which we hope will make it easier for more groups to try similar competitions in the future.

The name Cascade emphasises that the competition aims to introduce and inform many students about Particle Physics. However relatively limited time is required from researchers and teachers to enable this. The students research the material themselves and give their presentations, which often include novel demonstrations well matched to the target age group, to younger students or students of their own age. The participants also gain valuable experience in teamwork from the challenge of producing and delivering a clear and interesting talk by all members of the team, as well as improving their own understanding of the subject during the process.

Education and Outreach / 130

LHCb Masterclass measurement of the D0 lifetimeDr. GLIGOROV, Vladimir ¹¹ *CERN***Corresponding Author:** vladimir.gligorov@cern.ch

The LHCb experiment is a general purpose spectrometer in the forward region optimized for precision studies of beauty and charm hadron properties. The volumes of data produced by the LHC make it possible to perform such precision measurements with only a fraction of the total LHCb dataset, making it an ideal playground for developing new types of masterclass exercises. We present here LHCb's first foray into the masterclass programme, in which students are taught how to make a 1% precision measurement of the D0 meson lifetime. The students learn to separate D0 mesons from the background in LHCb's vertex detector and build up a signal mass peak, before learning about how to use background sidebands to extract the signal properties in other variables of interest. They then perform a fit to measure the D0 lifetime, and discover that the result is biased by charm produced in the decays of B hadrons, which has an artificially long lifetime compared to charm produced directly in the proton-proton collision. Finally, the students learn how to separate these two kinds of charm based on the D0 mesons distance of closest approach to the primary interaction and obtain a precise measurement in agreement with the world average. We present the software framework developed for this exercise, give a demonstration of the exercise, and discuss plans for the future.

Poster Session / 131

The Higgs-radion scenario: a new candidate for the 126 GeV stateMr. GELLER, Michael ¹; Dr. BAR-SHALOM, Shaouly ¹; Dr. SONI, Amarjit ²¹ *Technion, Israel*² *Brookhaven National Laboratory***Corresponding Author:** mic.geller@gmail.com

We investigate a Randall-Sundrum model with an SU(2) doublet propagating in the bulk. Upon calculating its gravitational effect we find that a stabilized radius can be generated without the use of an additional scalar, as needed for example in the Goldberger-Wise (GW) mechanism, and with no additional fine-tuning other than the inescapable one due to the cosmological constant; similar tuning is also present in the GW mechanism. The lowest scalar excitation in this scenario, the counterpart of the radion of the GW mechanism, has both radion-like and Higgs-like couplings to the SM fields. It, thus, plays a dual role and we, therefore, denote it as the "Higgs-radion" (hr). As opposed to the GW radion case, our Higgs-radion is found to be compatible with the 126 GeV scalar recently discovered at the LHC, at the level of 1σ , with a resulting 95% CL bound on the KK-gluon mass of: $4.48 \text{ TeV} < M_{KK} < 5.44 \text{ TeV}$.

Poster Session / 132

Particle Physics Education in Hungary

Prof. HORVATH, Dezso ¹; Mrs. EVA, Olah ²; Dr. SZILLASI, Zoltan ³

¹ *Wigner Research Centre for Physics, Budapest*

² *Mechatronika High School and Eotvos U., Budapest*

³ *MTA Atomki, Debrecen*

Corresponding Author: horvath.dezso@wigner.mta.hu

In recent years various educational activities have been pursued in Hungary with the aim to raise the interest of high school students in natural sciences, and especially in physics. Our poster will present some of the key projects of broader interest for the scientific community:

Hungarian Teachers Programme: In 2006 we organized the first National Teachers Programme at CERN which since then expanded to many countries. Every year about forty Hungarian physics teachers participate in a one-week activity at CERN. These weeks are preceded by a meeting in Budapest where the participants get acquainted and we offer them some general information. They spend 5 days at CERN, lectures in the mornings, visiting experiments and solving exercises in the afternoons and evenings. We have a follow-up meeting at the end of the year, where we analyze the evaluation sheets of the various activities of the visit. That post-meeting is attended by all the teachers, most of the lecturers, the representatives of CERN and of the sponsors, including those of the Hungarian CERN Committee and of the Hungarian Physical Society. This programme is quite popular and heavily oversubscribed. Several involved teachers have organized student visits to CERN.

Masterclasses: They are organized at 3 institutions in Hungary: at Wigner RCP, Budapest, at University of Debrecen and at Óbuda University, Székesfehérvár. The Budapest masterclass is so popular that since many years we have to organize an additional one after the official IPPOG masterclass: we have the same lectures and same analysis job (at present CMS events) for the students, but instead of the joint video session we make virtual visits to Hungarian groups at CERN.

Virtual Visits to CERN: In these visits, developed on the request of Hungarian teachers, the schools' workstations have a 3-way audio-visual connection to the control room of an experiment and to a mobile unit. First the convenor in the control room introduces the experiment, then the mobile unit shows various places of the experiment, some of which are even off-limits for visitors.

Detector Laboratory: Two groups of high-school students have regular weekly work at the Detector Physics Laboratory of Wigner RCP. They listen to lectures on particle physics and do real research work building test detectors and electronics, testing them with cosmic rays and radioactive sources.

Open Days: Atomki and Wigner RCP organizes Open Days, the last ones were devoted to particle physics. Wigner RCP's last one coincided with CERN's Open Day and this year it will be devoted to CERN's 60th anniversary.

Boson Bus: Wigner RCP is preparing a moving exhibition of solid-state and particle physics. It will visit high schools all over Hungary and together with popular lectures hopefully raise the interest of the students in physics. The solid state physics part, called nano bus has been used already, the particle physics part will be a boson bus.

Education and Outreach / 133

“Café Científico”, “Wake up with Science”, really fun and interesting outreach activities

Mrs. VILAR CORTABITARTE, Rocío¹; Mrs. MARÍN FARRONA, ANA MARÍA²

¹ *Instituto de Física de Cantabria (IFCA)*

² *INSTITUTO DE FÍSICA DE CANTABRIA (IFCA)*

Corresponding Author: ammarin@ifca.unican.es

“Café Científico” is a series of relaxed discussions about different topics of interest related to research done at the UC that tries to connect research and society. This outreach activity allows people to ask/discuss/comment with the researcher while engaging with cutting-edge researchers from University of Cantabria. To avoid the formalism that the university space offers it is done in an alternative theatre of the city, Café de las Artes every last Friday of the month during the academic year. Since its beginning the public has progressively increased and now there is a group of fans.

At the same time, we take on the same activity for children up to 16 years old: “Wake up with Science”. This activity is done at the university, to bring the kids to our environment. We introduce a subject for short time and then, let them ask any question that they have in mind about the subject. Previously, we send material to the teachers so they are prepared to have more knowledge about what they are about to hear.

With this contribution we want to present a successful outreach activity, with two versions, adapted for participants age.

Education and Outreach / 134

How can we turn a science exhibition into a really successful outreach activity?

Mrs. ANA MARÍA, MARÍN¹; Dr. VILAR CORTABITARTE, ROCÍO¹

¹ *INSTITUTO DE FÍSICA DE CANTABRIA*

Corresponding Author: ammarin@ifca.unican.es

In April 2013, a CERN exhibition was shown in Santander: “The largest scientific instrument ever built”. Around the exhibition, were proposed several activities done by the researchers that work on the subjects: guided tours for children, younger and adults, workshops, film projections... In this form, the exhibition was visited by more than two thousand people, a complete success keeping in mind that Santander is a small city and its population is not used to take part in outreach activity. This contribution shows the way to take advantage of punctual science exhibitions and transform them into full outreach activities; touching more topics than just the exhibition itself and getting the interest, even in many the enthusiasm, for science. This first approach was repeated in a second exhibition about ESO with an enlarged response from the public that already had expectations.

Strong Interactions and Hadron Physics / 135**Inclusive deep-inelastic scattering at HERA**SCHMITT, Stefan ¹; DAUM, Karin ¹¹ DESY**Corresponding Author:** stefan.schmitt@desy.de

Recent results on deep-inelastic scattering at HERA are presented. The H1 and ZEUS experiments each have determined new measurements of the proton longitudinal structure function FL, making use of the HERA data recorded at reduced centre-of-mass energies. The results are in agreement with each other and with predictions derived from QCD fits. The region of high x is explored in a dedicated measurement by the ZEUS collaboration. All HERA inclusive data published up to now by H1 and ZEUS are combined, taking into account the experimental correlations between measurements. As a result, a combined dataset is obtained. It includes measurements of neutral current and charged current cross sections recorded at different centre-of-mass energies, spanning up to six orders of magnitude both in momentum transfer Q^2 and in Bjorken-x. The dataset is superior in precision compared to the previous HERA data combination which included a smaller fraction of the total integrated luminosity collected at HERA. Point-to-point uncorrelated uncertainties better than 1% are observed in certain kinematic regions.

Poster Session / 136**NICA: the critical end point**Dr. KOZLOV, Gennady ¹¹ JINR**Corresponding Author:** kozlov@jinr.ru

The critical phenomena are studied in the frame of an effective theory of strong interactions at high temperatures. The critical end point (CEP) is a distinct singular feature existence of which is dictated by the appropriate dynamics. The physical approach of the effective CEP is studied via the influence fluctuations of two-body Bose-Einstein correlations for observed particles to which the critical end mode couples. The results can be included in the program of NICA to search the hadronic matter produced at extreme conditions.

Poster Session / 137

Measurement of Feynman-x Spectra of Photons and Neutrons in the Very Forward Direction in Deep-Inelastic Scattering at HERASCHMITT, Stefan ¹; DAUM, Karin ¹¹ DESY**Corresponding Author:** stefan.schmitt@desy.de

Measurements of normalised cross sections for the production of photons and neutrons at very small angles with respect to the proton beam direction in deep-inelastic ep scattering at HERA are presented as a function of the Feynman variable x_F and of the centre-of-mass energy of the virtual photon-proton system W . The data are taken with the H1 detector in the years 2006 and 2007 and correspond to an integrated luminosity of 131 pb^{-1} . The measurement is restricted to photons and neutrons in the pseudorapidity range $\eta > 7.9$ and covers the range of negative four momentum transfer squared at the positron vertex $6 < Q^2 < 100 \text{ GeV}^2$, of inelasticity $0.05 < y < 0.6$ and of $70 < W < 245 \text{ GeV}$. To test the Feynman scaling hypothesis the W dependence of the x_F dependent cross sections is investigated. Predictions of deep-inelastic scattering models and of models for hadronic interactions of high energy cosmic rays are compared to the measured cross sections.

Strong Interactions and Hadron Physics / 138

Inclusive diffraction and tests of QCD factorisation at HERASCHMITT, Stefan ¹; DAUM, Karin ¹¹ DESY**Corresponding Author:** stefan.schmitt@desy.de

Results from diffractive deep-inelastic scattering with a leading proton detected in forward spectrometers are presented. Data from the two experiments H1 and ZEUS, using the FPS and LPS spectrometers, respectively, are combined in a common phase space. New four-differential measurements using the VFPS installed at the H1 experiment are also presented. A QCD factorisation theorem is tested by comparing diffractive jet production data to QCD predictions based on fits to inclusive diffractive cross section data. H1 measured dijet production with a leading proton detected in the VFPS, both in deep-inelastic scattering and in photoproduction. The DIS measurements are complemented by measurements of dijet production with an associated rapidity gap.

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Exclusive diffraction at HERA

SCHMITT, Stefan ¹; DAUM, Karin ¹

¹ DESY

Corresponding Author: stefan.schmitt@desy.de

The exclusive reaction $\gamma p \rightarrow \psi(2S) p$ has been studied in both deep inelastic electroproduction and in photoproduction with the ZEUS detector in ep collisions at HERA using an integrated luminosity of 350 pb⁻¹. The $\psi(2S)$ mesons were identified via their decay chain: $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ with $J/\psi \rightarrow \mu^+ \mu^-$. The ratio of the production cross sections $R = \sigma(\psi(2S)) / \sigma(J/\psi)$ was measured as a function of the kinematic variables, in particular the photon-proton centre-of-mass energy, W , and compared to predictions of perturbative QCD. The exclusive production of dijets in diffractive deep inelastic lepton-proton scattering has also been measured. Jets have been reconstructed in the photon-Pomeron ($\gamma^* \text{-IP}$) centre-of-mass system frame using the exclusive k_T algorithm. The cross section for the exclusive production of dijets is given as a function of the angle between the plane defined by exchanged photon and dijet system and the plane defined by the incoming and scattered lepton momenta in the $\gamma^* \text{-IP}$ rest frame. It is compared to theoretical predictions of models based on boson-gluon fusion and two-gluon exchange processes. The first measurement of exclusive photoproduction of ρ mesons associated with leading neutrons with the H1 detector at HERA is also presented. The data correspond to an integrated luminosity of 1.12 pb⁻¹. The ρ meson is identified by its decay pions reconstructed in the central tracking chamber, while the leading neutron carrying a large fraction of the incoming proton momentum, $x_L > 0.3$, is detected in the Forward Neutron Calorimeter. The cross section of the reaction $\gamma p \rightarrow \rho + n + Y$, where Y is a small mass system escaping undetected in the proton direction, is measured as a function of the neutron energy, the invariant mass of the $\pi^+ \pi^-$ system and p_T^2 of the ρ meson. The data are interpreted in terms of two dominant contributions: diffractive proton dissociation channel and elastic production via virtual pion exchange.

Strong Interactions and Hadron Physics / 144

Jet production and QCD measurements at HERA

SCHMITT, Stefan ¹; DAUM, Karin ¹

¹ DESY

Corresponding Author: stefan.schmitt@desy.de

The production of inclusive jets as well as of dijet and trijet topologies is investigated at HERA. Both the H1 and the ZEUS experiment have determined the corresponding cross sections with improved experimental precision, compared to previous measurements. For both experiments, a hadronic energy scale uncertainty as small as 1% is reached. The value of the strong coupling constant $\alpha_s(M_Z)$ is extracted and its running is probed. Using topologies involving high track multiplicities and an associated jets, the H1 data are used to search for the production and decay of QCD instantons.

BEH Physics / 145

Dilaton vs Higgs: Nearly Conformal Physics

Dr. KOZLOV, Gennady ¹

¹ *JINR*

Corresponding Author: kozlov@jinr.ru

We consider the model containing a dilaton vs Higgs boson in the nearly conformal sector (NCS). The potential of a dilaton in NCS is linearly rising with distances. The light scalar dilaton would be one of the best candidates to explain the LHC data in recent discovery of a Higgs-like resonance around 125 GeV.

Strong Interactions and Hadron Physics / 146

Nucleon PDF separation with the collider and fixed-target data.

Dr. ALEKHIN, Sergey ¹; Dr. BLUEMLEIN, Johannes ²; Mr. MOCH, Sven-Olaf ³; PETTI, Roberto ⁴; Dr. LIPKA, Katerina ²; Dr. PLACAKYTE, Ringaile ²; Dr. LOHWASSER, Kristin ²

¹ *Institute for High Energy Physics (Protvino, Russia)*

² *DESY*

³ *Univ. Hamburg*

⁴ *University of South Carolina*

Corresponding Author: sergey.alekhin@ihep.ru

We consider impact of the recent data obtained by the LHC, Tevatron, and fixed-target experiments on the quark distributions in nucleon with a particular focus on disentangling different quark species. Improved determination of the poorly known strange sea distribution and the sea isospin asymmetry is obtained. The standard candle benchmarks for the Drell-Yan process at the LHC energies are updated.

Computing and Data Handling / 147**The ATLAS EventIndex: Full chain deployment and first operation**

Dr. BARBERIS, Dario ¹; Dr. CRANSHAW, Jack ²; Dr. SALT, JOSE ³; Mr. SANCHEZ MARTINEZ, Fco. Javier ³; Dr. YUAN, Ruijun ⁴; Dr. TÖBBICKE, Rainer ⁵; Mr. FAVARETO, Andrea ⁶; FERNANDEZ, Alvaro ³; Dr. GALLAS, Elizabeth ⁷; Dr. GONZALEZ DE LA HOZ, Santiago ³; Dr. HRIVNÁČ, Julius ⁴; Dr. MALON, David ²; Dr. NOWAK, Marcin ⁸; Dr. PROKOSHIN, Fedor ⁹

¹ *Università di Genova INFN*

² *Argonne National Laboratory, Argonne, IL, United States*

³ *IFIC*

⁴ *LAL, Université Paris-Sud and CNRS/IN2P3, Orsay, France*

⁵ *CERN*

⁶ *Università di Genova and INFN, Genova, Italy*

⁷ *Oxford University, Oxford, United Kingdom*

⁸ *Brookhaven National Laboratory, Upton, NY, United States*

⁹ *Universidad Técnica Federico Santa María, Valparaíso, Chile*

Corresponding Author: santiago.gonzalez@ific.uv.es

The Event Index project consists in the development and deployment of a complete catalogue of events for experiments with large amounts of data, such as the ATLAS experiment at the LHC accelerator at CERN. Data to be stored in the EventIndex are produced by all production jobs that run at CERN or the GRID; for every permanent output file a snippet of information, containing the file unique identifier and for each event the relevant attributes is sent to the central catalogue. The estimated insertion rate during LHC Run2 is about 80 Hz of file records containing ~15 kHz of event records. This contribution describes the system design, the initial performance tests of the full data collection and cataloguing chain, and the project evolution towards the full deployment and operation by the end of 2014.

Neutrino Physics / 148**Status of the NEXT experiment**

GOMEZ CADENAS, Juan Jose ¹

¹ *IFIC*

Corresponding Author: sorel@fnal.gov

Neutrinos may be Majorana particles. If so, neutrinoless double beta decay processes could be observed by the next-generation $0\nu\beta\beta$ experiments. I will briefly discuss one of the most promising ideas in the field, the use of a High Pressure Gas Xenon TPC (HPGXe) with electroluminescence gain and optical readout. A 100 kg incarnation of such a device will start operations at the Canfranc Underground Lab in Spain in 2015. The technology can be extrapolated to 1 ton, and thus lead the exploration of the inverse hierarchy in Majorana landscape.

Astroparticle Physics and Cosmology / 149

Flavour Covariant Formalism for Resonant Leptogenesis

Dr. DEV, P. S. Bhupal¹

¹ *University of Manchester*

Corresponding Author: bhupaldev@gmail.com

Flavour effects play an important role in the statistical evolution of particle number densities. We present a fully flavour-covariant formulation of transport phenomena. As an application, we consider the heavy-neutrino and lepton flavour effects in Resonant Leptogenesis scenario, for which our formalism provides a complete and unified description.

Poster Session / 150

Latest results of NEXT-DEMO, the prototype of the NEXT-100 double beta decay experiment

SERRA DIAZ CANO, LUIS¹; Mr. LORCA GALINDO, DAVID¹

¹ *IFIC*

Corresponding Author: luis.serra@ific.uv.es

In this poster we present the latest results of NEXT-DEMO, a 1:4.5 scale prototype of the NEXT100 detector, a high-pressure xenon gas TPC that will search for the neutrinoless double beta decay of Xe-136.

X-ray energy depositions produced by the de-excitation of Xenon atoms after the interaction of gamma rays from radioactive sources have been used to characterize the response of the detector obtaining the spatial calibration needed for close-to-optimal energy resolution. Our result, 5.5% FWHM at 30 keV, extrapolates to 0.6% FWHM at the Q value of Xe-136.

Additionally, alpha decays from Radon have been used to measure several detection properties and parameters of xenon gas such as electron-ion recombination, electron drift velocity, diffusion and primary scintillation light yield. Alpha spectroscopy is also used to quantify the activity of Radon inside the detector, a potential source of background for most double beta decay experiments.

Neutrino Physics / 151

The NESSiE way for sterile neutrinosDr. STANCO, Luca ¹¹ *INFN - Padova***Corresponding Author:** stanco@pd.infn.it

Neutrino physics is nowadays receiving more and more attention as a possible source of information for the long-standing problem of new physics beyond the Standard Model. The recent measurement of the third mixing angle θ_{13} in the standard mixing oscillation scenario encourages us to pursue the still missing results on leptonic CP violation and absolute neutrino masses. However, several puzzling measurements exist, which deserve an exhaustive evaluation.

The NESSiE Collaboration has been setup to undertake a definitive experiment to clarify the muon disappearance measurements at small L/E, which will be able to put severe constraints to any model with more than the three-standard neutrinos, or even to robustly measure the presence of a new kind of neutrino oscillation for the first time.

To this aim the use of the current FNAL-Booster neutrino beam has been carefully evaluated. The need for at least two sites, Near and Far, carried on an extensive study on their positions, together with the performances of two OPERA-like spectrometers. This proposal is constrained by availability of existing hardware and a time-schedule compatible with the CERN project for a new more performant neutrino beam, which will nicely extend the physics results achievable at the Booster.

The experiment to be possibly setup at Booster will allow to clarify the current ν_μ disappearance tension with ν_e appearance and disappearance at the eV mass scale. Instead, the new CERN beam will allow a further span in the parameter space together with a refined control of systematics and, more relevant, the measurement of the antineutrino sector, by upgrading the spectrometer with detectors currently under R study.

BEH Physics / 152

Status of the Type-II 2HDMDr. WIEBUSCH, Martin ¹¹ *IPPP Durham***Corresponding Author:** martin.wiebusch@durham.ac.uk

The precise determination of the Higgs boson couplings (and their comparison with the SM predictions) will be one of the major goals of future collider experiments. To estimate the possible size of signals for physics beyond the SM, such as models with an extended Higgs sector, global analyses of all currently available data are necessary. In this talk I report on the results of our global

fits of flavour, electroweak precision and LHC Higgs data in the context of the the type-II two Higgs doublet model (2HDM). Within the 2HDM, I discuss the allowed regions of parameter space and the possible deviations of the Higgs couplings to SM fermions and vector bosons from their SM values. I will also comment on the possible enhancements of triple Higgs couplings in the type-II 2HDM and the implications for heavy Higgs searches and (light) Higgs pair production at the LHC.

Neutrino Physics / 154

Solar neutrinos in Super-KamiokandeDr. SEKIYA, Hiroyuki¹¹ ICRR, University of Tokyo**Corresponding Author:** sekiya@icrr.u-tokyo.ac.jp

Recently the concern with the effect of matter on the neutrino oscillation has been growing, because the possibility of mass hierarchy determination by next generation experiments through the matter effect has been recognized.

We report an indication that the elastic scattering rate of solar B8 neutrinos with electrons in the Super-Kamiokande detector is larger when the neutrinos pass through Earth during nighttime. This is the first direct indication that neutrino oscillation probabilities are modified by the presence of matter.

We determine the day-night asymmetry, defined as the difference of the average day rate and average night rate divided by the average of those two rates, to be $[-3.2 \pm 1.1(\text{stat}) \pm 0.5(\text{syst})]\%$, which deviates from zero by 2.7σ . Since the elastic scattering process is mostly sensitive to electron-flavored solar neutrinos, a nonzero day-night asymmetry implies that the flavor oscillations of solar neutrinos are affected by the presence of matter within the neutrinos' flight path. Super-Kamiokande's day-night asymmetry is consistent with neutrino oscillations for $4 \times 10^{-5} \text{ eV}^2 \leq \Delta m^2_{21} \leq 7 \times 10^{-5} \text{ eV}^2$ and large mixing values of θ_{12} , at the 68% C.L. We also report the measured recoil electron spectrum whose shape should reflect the transition between vacuum dominated oscillations (lower energy solar neutrinos) and matter dominated oscillations (higher energy solar neutrinos).

Poster Session / 155

The Higgs mechanism for undergraduate studentsProf. ORGANTINI, Giovanni¹¹ "Sapienza" Università di Roma**Corresponding Author:** giovanni.organtini@uniroma1.it

The Higgs mechanism that gives the mass to particles as a result of the interaction between a massless particle and a scalar field is reformulated in terms of purely classical mechanics, using a simple formalism suitable for undergraduate students. The need for such a field is justified with arguments following a review of the concept of energy and special relativity.

While most of the popularisations of the Higgs mechanism relies on analogies with friction, the proposed explanation appears to be at the same time formally coherent and simple enough to be proposed to undergraduate students, the prerequisites being just the knowledge of the energy density of electric and magnetic fields.

Poster Session / 157

Backgrounds and sensitivity of the NEXT double beta decay experiment.

NEBOT-GUINOT, Miquel ¹; Mr. MUÑOZ VIDAL, Javier ²; MARTIN-ALBO SIMON, Justo ³; Dr. FERRARIO, Paola ¹; GOMEZ CADENAS, juan jose ¹

¹ *IFIC*

² *IFIC*

³ *IFIC-Valencia*

Corresponding Author: miquel.nebot@ific.uv.es

NEXT (Neutrino Experiment with a Xenon TPC) is a neutrinoless double-beta ($bb0\nu$) decay experiment that will operate at the Canfranc Underground Laboratory (LSC). It is an electroluminescent high-pressure gaseous xenon Time Projection Chamber based on separated-function capabilities for calorimetry and tracking. Energy resolution and background suppression are the two key features of any neutrinoless double beta decay experiment. NEXT has both good energy resolution ($<1\%$ FWHM) and an extra handle for background identification provided by track reconstruction.

This poster describes the background model of NEXT which will be validated during the first phase of the experiment using the NEW detector. Detailed detector simulation and evaluation of the detector radiopurity by material screening have been done. This leads to the determination of the sensitivity to a measurement of the two neutrino ($bb2\nu$) mode in NEW and to a $bb0\nu$ search in NEXT100. With this work we predict a background rate of 5×10^{-4} counts/(keV kg yr), and a sensitivity to the Majorana neutrino mass down to 100 meV after a 5-years run of NEXT100.

Lepton Flavour Violation / 158

Precision tests of the Standard Model with kaon decays at CERN

Dr. LAZZERONI, Cristina ¹

¹ *University of Birmingham*

Corresponding Author: cristina.lazzeroni@cern.ch

Recent results and prospects for precision tests of the Standard Model in kaon decay in flight experiments at CERN are presented. A measurement of the ratio of leptonic decay rates of the charged kaon at a 0.4% precision constrains the parameter space of new physics models with extended Higgs sector, a fourth generation of quarks and leptons or sterile neutrinos.

Searches for heavy neutrino mass states and the dark photon in the ~ 100 MeV/ c^2 mass range based on samples collected in 2003-2007 are in progress and prospects will be discussed. The NA62 experiment starting in 2014 will search for a range of lepton number and lepton flavour violating decays of the charged kaon and the neutral pion at improved sensitivities down to $\sim 10^{-12}$, which will probe new physics scenarios involving heavy Majorana neutrinos or R-parity violating SUSY.

Flavour Physics / 159

Prospects for $K^+ \rightarrow \pi^+ \nu \nu$ observation at CERN in NA62

Dr. LAZZERONI, Cristina ¹

¹ *University of Birmingham*

Corresponding Author: cristina.lazzeroni@cern.ch

The rare decays $K^+ \rightarrow \pi^+ \nu \nu$ are excellent processes to make tests of new physics at the highest scale complementary to LHC thanks to their theoretically cleanliness.

The NA62 experiment at CERN SPS aims to collect of the order of 100 events in two years of data taking, keeping the background at the level of 10%.

Part of the experimental apparatus has been commissioned during a technical run in 2012. The physics prospects and the status of the experiment will be reviewed in view of the first physics run scheduled for 2014.

Poster Session / 160

ChiPT tests at NA48 and NA62 experiments at CERN

Dr. LAZZERONI, Cristina ¹

¹ *University of Birmingham*

Corresponding Author: cristina.lazzeroni@cern.ch

New final results from an analysis of about 400 $K^{+-} \rightarrow \pi^{+-} \gamma \gamma$ rare decay candidates collected by the NA48/2 and NA62 experiments at CERN during low intensity runs with minimum bias trigger configurations are presented. The results include a model-independent decay rate measurement and fits to Chiral Perturbation Theory (ChPT) description. The data support the ChPT prediction for a cusp in the di-photon invariant mass spectrum at the two pion threshold.

Poster Session / 161

Detailed study of the Ke_4 decay mode properties

Dr. LAZZERONI, Cristina ¹

¹ *University of Birmingham*

Corresponding Author: cristina.lazzeroni@cern.ch

The NA48/2 Collaboration at CERN has accumulated unprecedented statistics of rare kaon decays in the Ke_4 modes $Ke_4^{+-} \rightarrow \pi^+ \pi^- e \nu$ and $Ke_4(00) \rightarrow \pi^0 \pi^0 e \nu$ with ~one percent background contamination. The detailed study of form factors is sensitive to small isospin symmetry breaking effects. This brings new inputs to low energy QCD description and crucial tests of predictions from Chiral Perturbation Theory and lattice QCD calculations.

Top-quark and ElectroWeak Physics / 163**Measurement of differential cross sections in top pair production in pp collisions with CMS**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Differential top quark pair production cross sections are measured in proton-proton collisions at the LHC at centre-of-mass energies of 7 and 8 TeV, using data collected by the CMS experiment in the years 2011 and 2012. The differential cross sections are measured as functions of various kinematic observables, including the transverse momentum and rapidity of the (anti)top quark and the top-antitop system and the jets and leptons of the event final state. Multiplicity and kinematic distributions of the jets produced in addition to the top pair are investigated. First measurements of the associate production of top quark pairs with vector bosons and with additional b-quarks in the final state are also presented.

Top-quark and ElectroWeak Physics / 170**Measurement of top quark properties in single top production at CMS**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Single top topologies are exploited for studies of top quark properties. This includes the first measurement of single top polarization in the t-channel production mode in pp collisions, which directly confirms the V-A nature of the tWb production vertex. W-helicity fractions are measured in the phase space sampled by a selection optimized for t-channel single top production, orthogonal to the ttbar final states used in traditional measurements of these properties. Anomalous couplings of the top quark are searched in t-channel single top production with a NN-based analysis.

Detector RD and Performance / 172**Role of the CMS electromagnetic calorimeter in the measurement of the Higgs boson properties and search for new physics**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

The precise determination of the mass, the width and the couplings of the particle discovered in 2012 around 125 GeV is of capital importance to clarify the nature of such a particle, in particular to establish precisely if it is a Standard Higgs boson. In several new physics scenarios, in fact, a Higgs boson may behave differently with respect to the Standard one, or may not be unique, i.e. there can be more than one Higgs boson. In order to achieve the precision needed to discriminate between different models, the energy resolution, the scale uncertainty and the position resolution for electrons and photons are required to be as good as possible. The CMS scintillating lead-tungstate electromagnetic calorimeter (ECAL) was built as a precise tool with an exceptional energy resolution and a very good position resolution that improved over the years with the knowledge of the detector. Moreover, thanks to the fact that most of the lead-tungstate scintillation light is emitted in about 20 ns, ECAL can be used to determine the time of flight of photons, hence giving precious information about the vertex position. In this talk we are going to show the current performance of the CMS ECAL and its evolution over time, with a special emphasis on the impact on the measurement of the properties of the Higgs boson and on searches for new physics.

Detector RD and Performance / 173**Design options for the upgrade of the CMS electromagnetic calorimeter**MEYER, Arnd ¹; Dr. PARAMATTI, Riccardo ²¹ *RWTH Aachen University*² *INFN - Rome***Corresponding Author:** meyera@cern.ch

The CMS scintillating lead-tungstate calorimeter was designed to operate for at least ten years at the LHC, assuming an instantaneous luminosity of $2 \times 10^{34} \text{ cm}^{-2}/\text{s}$. According to our measurements, the detector has performed according to design specifications and will survive with excellent performance through the lifetime of the LHC. However, plans for an upgrade of the LHC (the High Luminosity LHC, HL-LHC, project) aim at accumulating a much higher integrated luminosity, up to 3000/fb in ten years. This will expose the detector to a total irradiation of about six times higher with respect to the design specifications.

An intense campaign of activities is then started to define the improvements needed to survive such an increase in irradiation levels. The activities carried out include both irradiation studies, simulations, design, realisation and test of prototypes of new detectors that may substitute at least part of the current one if needed, especially at large pseudorapidity.

We will show the current options under study and the results obtained so far on the subjects outlined above.

Detector RD and Performance / 174**Phase I Upgrade of the CMS Hadron Calorimeter**MEYER, Arnd ¹; COOPER, Seth ²¹ *RWTH Aachen University*² *University of Alabama***Corresponding Author:** meyera@cern.ch

In preparation for Run 2 (2015) and Run 3 of the LHC (2019), the CMS hadron calorimeter has begun a series of ambitious upgrades. These include new photodetectors in addition to improved front-end and back-end readout electronics. In the hadron forward calorimeter, the existing photomultiplier tubes are being replaced with thinner window, multi-anode readout models, while in the central region, the hybrid photodiodes will be replaced with silicon photomultipliers. The front-end electronics will include high precision timing readout, and the backend electronics will handle the increased data bandwidth. The barrel and endcap longitudinal segmentation will also be increased. This report will describe the motivation for the upgrade, its major components, and its current status.

Detector RD and Performance / 175**CMS Trigger Improvements towards Run II**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The trigger systems of the LHC detectors play a crucial role in determining the physics capabilities of the experiments. A reduction of several orders of magnitude of the event rate is needed to reach values compatible with detector readout, offline storage and analysis capability. The CMS experiment has been designed with a two-level trigger system: the Level-1 Trigger (L1T), implemented on custom-designed electronics, and the High Level Trigger (HLT), a streamlined version of the CMS offline reconstruction software running on a computer farm. Both systems need to provide an efficient and fast selection of events, to keep the average write-out rate below 450Hz. For Run II, the doubling of both the center of mass energy to 13 TeV and the collision rate to 40 MHz, will imply increased cross sections and out-of-time pile-up. We will present the improvements brought to both L1T and HLT strategies to meet those new challenges.

Education and Outreach / 176**Preparations for the public release of high-level CMS data**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The CMS Collaboration is preparing for a public release up to a half of the reconstructed collision data collected in 2010, in accordance with its commitment to open access and data preservation. Efforts are at present focused on the usability of the data in education. The data will be accompanied by example applications tailored for different levels -- including ready-to-use web-based applications for histogramming or visualising individual collision events -- and a virtual machine image of the CMS software environment that is compatible with these data. The VM image will contain instructions for using the data with the online applications as well as examples of simple analyses. The novelty of this initiative is two-fold: In terms of open science, it lies in releasing the data in a format that is good for analysis; from an outreach perspective, it is to provide the possibility for people outside CMS to build educational applications using our public data. CMS will rely on services for data preservation and open access being prototyped at CERN with the input from CMS and the other LHC experiments.

Poster Session / 177**b-Jet Identification in CMS**MEYER, Amd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

A large fraction of the CMS physics program relies on the identification of jets containing the decay of a B hadron (b jets). The b jets can be discriminated from jets produced by the hadronization of light quarks based on characteristic properties of B hadrons, such as the long lifetime or the presence of soft leptons produced during their decay.

An overview of the large variety of b-tagging algorithms and the measurement of their performance with data collected in 2011 and 2012 are presented in this talk. A special focus lies on new methods of b-tagging in jet substructure.

As the excluded mass regions for new physics beyond the Standard Model continue to increase, searches often focus on boosted final states characterized by particles with large transverse momenta. In the boosted regime the resulting decay products for hadronic decays of heavy particles tend to be collimated and can fall within a single jet, known as fat-jet. In this case, selections based on multiple jets cannot be applied and jet substructure is necessary to identify (tag) the particle initiating the jet. Substructure methods can be significantly improved by the identification of jets originating from bottom quarks (b-jets). This talk presents recent developments from the CMS collaboration in commissioning b-tagging algorithms in boosted topologies, both on fat-jets and on their subsets. A particular challenge is the measurement of the b-tagging performance in these topologies.

Detector RD and Performance / 178**CMS muon system towards LHC Run 2 and beyond**MEYER, Amd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The CMS muon system has played a key role for many physics results obtained from the LHC Run 1 data. The LHC will increase the beam energy as well as progressively increase the peak instantaneous luminosity in Run 2 and in the following years. Significant consolidation and upgrade activities are ongoing, in order to improve the CMS muon detectors and trigger performance and robustness. With LHC and then HL-LHC running beyond 2030, the large accumulated radiation dose, the high pileup environment, and the ageing of several detector and electronics components become challenges that can only be met with further development and upgrade work. We will introduce the CMS muon system and present the consolidation work in preparation for LHC Run 2. We will then describe the main constraints and the solutions proposed for the upgrade of the muon detector system towards HL-LHC.

Poster Session / 179**Tracking at High Level Trigger in CMS**MEYER, Amd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The trigger systems of the LHC detectors play a crucial role in determining the physics capabilities of the experiments. A reduction of several orders of magnitude of the event rate is needed to reach values compatible with detector readout, offline storage and analysis capability. The CMS experiment has been designed with a two-level trigger system: the Level-1 Trigger (L1T), implemented on custom-designed electronics, and the High Level Trigger (HLT), a streamlined version of the CMS offline reconstruction software running on a computer farm. A software trigger system requires a trade-off between the complexity of the algorithms, the sustainable output rate, and the selection efficiency. With the computing power available during the 2012 data taking the maximum reconstruction time at HLT was about 200 ms per event, at the nominal L1T rate of 100 kHz. Track reconstruction algorithms are widely used in the HLT, for the reconstruction of the physics objects as well as in the identification of b-jets and lepton isolation. Reconstructed tracks are also used to distinguish the primary vertex, which identifies the hard interaction process, from the pileup ones. This task is particularly important in the LHC environment given the large number of interactions per bunch crossing: on average 25 in 2012, and expected to be around 40 in Run II. We will present the performance of HLT tracking algorithms, discussing its impact on CMS physics programme, as well as new developments done towards the next data taking in 2015.

Poster Session / 180**Track reconstruction in CMS high luminosity environment**MEYER, Amd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The CMS tracker is the largest silicon detector ever built, covering 200 square meters and providing an average of 14 high-precision measurements per track. Tracking is essential for the reconstruction of objects like jets, muons, electrons and tau leptons starting from the raw data from the silicon pixel and strip detectors. Track reconstruction is widely used also at trigger level as it improves objects tagging and resolution.

The CMS tracking code is organized in several levels, known as 'iterative steps', each optimized to reconstruct a class of particle trajectories, as the ones of particles originating from the primary vertex or displaced tracks from particles resulting from secondary vertices. Each iterative step consists of seeding, pattern recognition and fitting by a kalman filter, and a final filtering and cleaning. Each subsequent step works on hits not yet associated to a reconstructed particle trajectory.

The CMS tracking code is continuously evolving to make the reconstruction computing load compatible with the increasing instantaneous luminosity of LHC, resulting in a large number of primary vertices and tracks per bunch crossing. This is achieved by optimizing the iterative steps and by using new software techniques.

Tracking algorithms used in CMS are described; physics and computing performances are discussed with respect to Run 1 and Run 2 physics program and within CMS future upgrades.

Poster Session / 181**Muon reconstruction and identification in CMS Run I and towards Run II**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The performance of muon reconstruction and identification in CMS has been studied on data collected in pp collisions at $\sqrt{s} = 7$ TeV and 8 TeV at the LHC. We present measurements of muon reconstruction and trigger efficiencies, fake rates, and momentum scale and resolution, and discuss methods developed to differentiate prompt isolated muons from decays of heavy particles (W/Z/H boson or top quarks) from non-isolated or non-prompt muons and other background sources. During the current shutdown period the muon detector is undergoing significant upgrades. Improvements to the trigger and reconstruction algorithms are under development to cope with the higher luminosity and pileup expected for the LHC Run II.

Astroparticle Physics and Cosmology / 182**The high energy cosmic ray particle spectra measurements with the PAMELA calorimeter**Dr. KARELIN, Alexander ¹; Mr. KOLDOBSKIY, Sergey ²¹ *MEPhI*² *NRNU MEPhI***Corresponding Author:** karelin@hotmail.ru

The PAMELA apparatus is in orbit from 2006 for today. The magnetic spectrometer, being the main part of the equipment, has a finite size and as a consequence the upper limit of energy measurements with it does not exceed 1 TeV. Therefore, to extend the available energy range towards higher energies the calorimeter data should be used. With the method based on the calorimeter data the energy spectra of electrons, protons and helium at high energies have been obtained for the period 2006-2013.

Top-quark and ElectroWeak Physics / 183**Electroweak production and hadronic activity in events with a Z and forward/backward jets with CMS**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The measurement of the electroweak production cross section of a Z-boson with two jets in proton-proton collisions by the CMS experiment is presented. The cross section is measured in dielectron and dimuon final states and the measurement, combining different methods and channels is in agreement with the theory prediction. The hadronic activity in events with Z-boson production in association with jets is also studied, in particular in the rapidity interval between the associated forward/backward jets.

Poster Session / 184

Search for s-channel single top-quark production in pp collisions with the CMS experiment at the LHCMEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

A search for single top-quark production in the s channel in proton-proton collisions at a centre-of-mass energy of $\sqrt{s} = 8$ TeV by the CMS detector at the LHC is presented. Leptonic decay modes of the top quark with an electron or muon in the final state are considered. The signal is extracted by performing a maximum-likelihood fit to the distribution of a multivariate discriminant defined using Boosted Decision Trees to separate the expected signal contribution from the background processes. Data collected in 2012, corresponding to an integrated luminosity of 19.3/fb, leads to an upper limit on the cross section times branching ratio of 11.5 pb at 95% confidence level.

Poster Session / 185

A study of bottom baryons with extended local hidden gauge approachMr. XIAO, chw¹; Prof. LIANG, Wei-Hong²; Prof. OSET, Eulogio³¹ IFIC² Department of Physics, Guangxi Normal University, Guilin, 541004, P. R. China³ IFIC, University of Valencia**Corresponding Author:** xiaochw@ific.uv.es

In present work we investigate the interaction of $\bar{B} N$, $\bar{B} \Delta$, $\bar{B}^* N$ and $\bar{B}^* \Delta$ states, together with their coupled channels. We consider the heavy quark spin symmetry for pion exchange and reproduces the results of the Weinberg Tomozawa term, coming from light vector exchanges in the extended local hidden gauge approach. With this dynamics we search states dynamically generated from the interaction and find two states with small width, which we associate to the $\Lambda_b(5912)$ and $\Lambda_b(5920)$ states. The states couple mostly to $\bar{B}^* N$, which are degenerate with the Weinberg Tomozawa interaction. The difference of masses between these two states, with $J=1/2, 3/2$ respectively, is due to pion exchange connecting these states to intermediate $\bar{B} N$ states. In addition to these two Λ_b states, we find three more states with $I=0$, one of them nearly degenerate in two states of $J=1/2, 3/2$. Furthermore we also find eight more states in $I=1$, two of them degenerate in $J=1/2, 3/2$, and other two degenerate in $J=1/2, 3/2, 5/2$.

Strong Interactions and Hadron Physics / 187**Heavy flavour production at ATLAS and CMS**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Studies of heavy flavour production are very important to improve our understanding of QCD and hadron formation, given that the heavy quark masses allow the application of theoretical tools less sensitive to nonperturbative effects.

This talk presents ATLAS and CMS heavy flavour results obtained in pp collisions, at 7 and 8 TeV, placing emphasis on the most recent measurements. In particular, we will present a series of systematic measurements in quarkonium production physics, including double-differential cross sections and polarizations, for five S-wave quarkonia: J/psi, psi(2S), Y(1S), Y(2S), and Y(3S). Some of these measurements extend well above $p_T \sim 50$ GeV, probing regions of very high $p_T/mass$, where the theory calculations are the most reliable. Recent results on P-wave quarkonia will also be shown, as well as measurements in the field of B-hadron and exotic quarkonium spectroscopy.

Poster Session / 188**Identification of hadronic tau decays in CMS**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The algorithm used for reconstruction and identification of hadronic tau decays by the CMS experiment at the LHC is presented. The tau reconstruction in CMS takes advantage of the particle-flow algorithm which allows to reconstruct individual hadronic decay modes. The performance of the algorithm in terms of tau ID efficiency, rate of jet \rightarrow tau, $e \rightarrow$ tau and $\mu \rightarrow$ tau fakes and in terms of tau energy reconstruction is measured in \sqrt{s} collision data recorded in 2012 at a center-of-mass energy of $\sqrt{s} \sim 8$ TeV, corresponding to an integrated luminosity of 19.7 fb^{-1} .

Poster Session / 189**Nuclei as Near-BPS Skyrmions**Prof. MARLEAU, Luc¹¹ *Université Laval***Corresponding Author:** lmarleau@phy.ulaval.ca

The Skyrme Model is low-energy QCD effective field theory from which baryons (and nuclei) emerge as topological solitons. Despite it provides a rather successful description of the nucleons, it overestimates the binding energies in nuclei by at least an order of magnitude. On the other hand Skyrme-like models that nearly saturate the Bogomol'nyi bound seem to provide to a better picture of nuclei since their mass is roughly proportional to the baryon number. We review the properties of such a models, so-called near-BPS Skyrme Models, which consist of terms up to order six in derivatives of the pion fields with the usual nonlinear sigma and Skyrme terms assumed to be relatively small. We compare the axial and rational map ansatz as solutions and identify the requirements to obtain the observed constant baryon density configurations. Fitting the four model parameters, we find a remarkable agreement for the binding energy per nucleon B/A with respect to experimental data thereby supporting the idea that nuclei could be near-BPS Skyrmions.

Neutrino Physics / 190

Borexino: recent solar and terrestrial neutrino resultsBOREXINO, Collaboration ¹¹ LNGS**Corresponding Author:** gioacchino.ranucci@mi.infn.it

The first phase of the Borexino experiment, currently running at the Laboratori del Gran Sasso in Italy, has been completed in 2010, and after a successful purification campaign which have further brought down the background levels, a second data taking phase is now in progress, started in October 2011.

In this talk the, after recalling the main features of the detector, the final results of Phase I will be summarized, as well as the first outcomes of Phase II, namely: a new measurement of the geoneutrino flux, the detection of the imprinting of the annual modulation in the solar neutrino signal, the full understanding of the cosmogenic backgrounds and very recent limits on heavy sterile neutrino mixing in 8B decay. Moreover, the full perspectives for solar neutrinos with the whole amount of data planned to be taken in Phase II will be given, emphasizing the unique possibility of Borexino to cover at the end of its program the entire solar neutrino spectrum, including the two important and challenging still missing pieces represented by pp and CNO neutrinos.

Neutrino Physics / 191

SOX : Short Distance Neutrino Oscillations with BorexinoBOREXINO, Collaboration ¹¹ LNGS**Corresponding Author:** gioacchino.ranucci@mi.infn.it

The Borexino detector has convincingly shown its outstanding performances in the in the low energy, sub-MeV regime through its unprecedented accomplishments in the solar and geo neutrinos detection. These performances make it the ideal tool to accomplish a state-of-the-art experiment able to test unambiguously the long-standing issue of the existence of a sterile neutrino, as suggested by the several anomalous results accumulated over the past two decades, i.e. the outputs of the LSND and Miniboone experiments, the results of the source calibration of the two Gallium solar neutrino experiments, and the recently hinted reactor anomaly.

The SOX project will exploit two sources, based on Chromium and Cerium, respectively, which deployed under the experiment, in a location foreseen on purpose at the time of the construction of the detector, will emit two intense beams of neutrinos (Cr) and anti-neutrinos (Ce). Interacting in the active volume of the liquid scintillator, each beam would create an unmistakable spatial wave pattern in case of oscillation of the ν -e (or anti ν -e) into the sterile state: such a pattern would be the smoking gun proving the existence of the new sterile member of the neutrino family. Otherwise, its absence will allow setting very stringent limit on its existence.

The talk will outline the project and discuss in detail the sensitivity of both Cerium and Chromium measurements.

Detector RD and Performance / 193**Diamond particle detectors systems in high energy physics**TRISCHUK, William ¹; KAGAN, Harris ²¹ *University of Toronto*² *Ohio State University***Corresponding Author:** william@physics.utoronto.ca

With the first three years of the LHC running complete, ATLAS and CMS are planning to upgrade their innermost tracking layers with more radiation hard technologies. Chemical Vapor Deposition (CVD) diamond is one such technology. CVD diamond has been used extensively in beam condition monitors as the innermost detectors in the highest radiation areas of BaBar, Belle, CDF and all LHC experiments. This talk will describe the lessons learned in constructing the ATLAS Beam Conditions Monitor (BCM), Diamond Beam Monitor (DBM) and the CMS Pixel Luminosity Telescope (PLT) all of which are based on CVD diamond with the goal of elucidating the issues that should be addressed for future diamond based detector systems. The talk will also present the first beam test results of prototype diamond devices with 3D detector geometry that should further enhance the radiation tolerance of this material.

Poster Session / 194**Recent results of diamond radiation tolerance**TRISCHUK, William ¹; Prof. KAGAN, Harris ²¹ *University of Toronto*² *Ohio State University***Corresponding Author:** william@physics.utoronto.ca

Progress in experimental particle physics in the coming decade depends crucially upon the ability to carry out experiments at high energies and high luminosities. These two conditions imply that future experiments will take place in very high radiation areas. In order to perform these complex and perhaps expensive experiments new radiation hard technologies will have to be developed. Chemical Vapor Deposition (CVD) diamond has been developed as a radiation tolerant material for use very close to the interaction region where detectors must operate in extreme radiation conditions. During the past few years many CVD diamond devices have been manufactured and tested. As a detector for high radiation environments CVD diamond benefits substantially from its radiation hardness, very low leakage current, low dielectric constant, fast signal collection and ability to operate at room temperature. As a result CVD diamond has now been used extensively in beam condition monitors at every experiment in the LHC. In addition, CVD diamond is now being considered as a sensor material for particle tracking detectors closest to the interaction region where the most extreme radiation conditions exist. We will present the present state-of-the-art of polycrystalline CVD diamond and single crystal CVD diamond and the latest results on the radiation tolerance of these materials for a range of protons, pions and neutrons obtained from strip detectors constructed with these materials.

Poster Session / 195

Signature of an h_1 state in the $J/\psi \rightarrow \eta h_1 \rightarrow \eta K^0 \bar{K}^0$ decayProf. OSET, Eulogio¹; Dr. XIE, Ju Jun²; Dr. ALBALADEJO, Miguel³¹ *IFIC, University of Valencia*² *Lanzou Laboratory, China*³ *Orsay, Paris***Corresponding Author:** oset@ific.uv.es

The BES data on the $J/\psi \rightarrow \eta K^0 \bar{K}^0$ reaction show a clear enhancement in the $K^0 \bar{K}^0$ mass distribution close to the threshold of this channel. Such an enhancement is usually a signature of a $L=0$ resonance around threshold, which in this case would correspond to an h_1 state with quantum numbers $I^G(J^{PC})=0^-(1^{+-})$. A state around 1800 MeV results from the interaction of the $K^* \bar{K}^*$ using the local hidden gauge approach. We show that the peak observed in $J/\psi \rightarrow \eta K^0 \bar{K}^0$ naturally comes from the creation of this h_1 state with mass and width around 1830 MeV and 110 MeV , respectively. A second analysis, model independent, corroborates the first result, confirming the relationship of the enhancement in the invariant mass spectrum with the h_1 resonance.

Top-quark and ElectroWeak Physics / 197

Search for Top Quark Flavor-Changing Neutral Currents at CMSMEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

We present searches for the top quark flavor-changing neutral current (FCNC) interactions by the CMS experiment. The FCNC searches have been performed in the vertices of tqZ , tqg , tqH and tqA in decay and production processes. The results are based on the data collected from proton proton collisions at the LHC at a centre-of-mass energies of 7 and 8 TeV.

Poster Session / 198

Measurement of the Inclusive Top-Quark Pair + Photon Production Cross SectionMEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The production cross section of top-quark pairs associated with a photon ($t\bar{t} + \gamma$) is determined in the $\mu\text{on} + \text{jets}$ decay channel using 19.7 fb^{-1} of data taken at $\sqrt{s} = 8 \text{ TeV}$ with the CMS detector. The relative fraction of $t\bar{t} + \gamma$ events normalized to inclusive $t\bar{t}$ production is measured. Using an inclusive CMS cross section measurement, the $t\bar{t} + \gamma$ cross section is determined and found to agree with the Standard Model expectation.

Poster Session / 199

Search for anomalous single top quark production in association with a photon in pp collisions at $\sqrt{s}=8$ TeV.MEYER, Arnd ¹; Dr. MOHAMMADI NAJAFABADI, Mojtaba ²¹ RWTH Aachen University² IPM**Corresponding Author:** meyera@cern.ch

A search for single top quark production through flavor-changing neutral current in the anomalous tq γ vertex is performed in proton-proton collisions at the center-of-mass energy of 8 TeV. The analysis is based on a dataset corresponding to an integrated luminosity of 19.1 fb⁻¹ collected with the CMS detector. The search is performed on events with one isolated muon and jets in the final state. No evidence for a signal is observed. Upper limits at 95% confidence level on the strengths of the anomalous couplings for vertices involving a top, a photon, and another up-like quark are set.

Top-quark and ElectroWeak Physics / 200

Measurement of VZ production cross sections in VZ to Vbb $\bar{\bar{b}}$ decay channels in pp collisions at 8 TeV from CMSMEYER, Arnd ¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

We present a measurement of the WZ and ZZ production cross sections in proton-proton collisions at 8 TeV in final states where one Z boson decays to b-tagged jets, while the other gauge boson, either W or Z, is detected through its leptonic decay. The results are based on data corresponding to an integrated luminosity of 18.9 /fb collected with the CMS detector at the Large Hadron Collider.

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Measurement of the muon charge asymmetry in inclusive W production at $\sqrt{s}=7$ TeV at CMS and an improved determination of light parton distribution functionsMEYER, Arnd ¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Measurements of the muon charge asymmetry in inclusive pp to WX production at $\sqrt{s}=7$ TeV are presented. The data sample corresponds to an integrated luminosity of 4.7 inverse femtobarns recorded with the CMS detector at the LHC. With a sample of more than twenty million W to mu nu events, the statistical precision is greatly improved in comparison to previous measurements. These new results provide additional constraints on the parton distribution functions of the proton in the range of the Bjorken scaling variable x from 10E-3 to 10E-1. These measurements and the recent CMS measurement of associated W + charm production are used together with the cross sections for inclusive deep inelastic ep scattering at HERA in a next-to-leading-order QCD analysis. The determination of the valence quark distributions is improved, and the strange-quark distribution is probed directly through the leading-order process g + s to W + c in proton-proton collisions at the LHC.

Strong Interactions and Hadron Physics / 202**Jet production and α_s measurements at CMS**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

We present CMS results related to jet production cross sections, which pose a central test to perturbative QCD predictions. Results include recent jet, dijet, multijet differential cross section and hadronic event shape measurements performed with 2011 data taken at center-of-mass energy of 7 TeV and 2012 data taken at 8 TeV. Recent α_s extraction results are presented. We also present searches for BFKL effects in the azimuthal correlations of forward-backward and forward-central jets at 7 TeV, and studies of the transition from the perturbative to the non-perturbative regime using minijets at 8 TeV.

Strong Interactions and Hadron Physics / 203**PDF constraints from CMS measurements**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

We present recent CMS results related to constraining parton distribution functions. Results are based in recent jet measurements performed with 2011 data taken at center-of-mass energy of 7 TeV and 2012 data taken at 8 TeV and on associated W+charm production, which probes the strange quark in the proton at leading order. Recent CMS measurements of associated W+charm production and W muon charge asymmetry at 7 TeV are used together with HERA DIS data in a QCD analysis at next-to-leading order. The HERAFitter framework is used. The strange-quark fraction is determined as a function of the scaling variable x . Results are compared to measurements of ATLAS and NOMAD experiments.

Strong Interactions and Hadron Physics / 208**Measurement of photon and diphoton production processes at CMS**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

We present differential cross-section measurements of inclusive photon production, photon+jet production, and diphoton production in pp collisions based on data recorded by the CMS detector at the LHC. The associated production of a photon and one or more jets in pp collisions provides a direct probe into the hard QCD interaction, is sensitive to gluon densities in the proton, and is a major source of background to standard model searches. The measured distributions are corrected for efficiency and unfolded for detector effects are compared with event generators and theoretical predictions.

Strong Interactions and Hadron Physics / 209**Production of vector bosons and jets at CMS**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The production cross section of highly boosted vector bosons ($V = W, Z$) recoiling against jets is studied, with CMS data, differentially as function of the transverse momentum and angular correlations of the final state particles. The mechanism of production of heavy-flavoured mesons, containing b or c quarks, in association with vector bosons, W or Z , in the Standard Model is only partially understood. The study of events with one or two well-identified and isolated leptons accompanied by b -jets or b -mesons is therefore crucial to refine the theoretical calculations in perturbative QCD, as well as validate associated Monte Carlo techniques. A measurement of the WZ and ZZ production cross sections in proton-proton collisions at 8 TeV in final states where one Z boson decays to b -tagged jets, while the other gauge boson, either W or Z , is detected through its leptonic decay is also presented.

Poster Session / 211**Study of Topological Distributions of Inclusive Three- and Four-jet Events at the LHC**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

A study of inclusive topological distributions of three- and four-jet events has been conducted by the CMS Collaboration at the LHC with a data sample corresponding to an integrated luminosity of 5.05 fb^{-1} at a centre of mass energy of 7 TeV. Kinematic and angular distributions in inclusive multijet final states serve as a natural probe of quantum chromodynamics and can reveal its inner dynamics. Comparisons are carried out with the data and predictions of leading order calculations and parton shower generators. The compared data results are corrected for detector effects and can be directly compared with other models or next-to-leading order theoretical predictions.

Poster Session / 212**Hadronic event shapes in pp collisions at 7 TeV**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Event shape variables exhibit sensitivity to the structure of QCD radiation in hadron collisions. Five infrared- and collinear-safe event shape variables, each sensitive to the different features of multi-jet production, are measured using hadronic jet data collected with the CMS detector from pp collisions at $\sqrt{s} = 7 \text{ TeV}$, corresponding to a total integrated luminosity of 5 fb^{-1} . The measurements are compared to predictions of various QCD-inspired event generators of multi-jet production.

Poster Session / 213

Differential Z + jet cross section measurements at 8 TeVMEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

In this poster, differential Z + jet cross section measurements with respect to the number of jets and various jet kinematic variables are presented where the Z bosons are reconstructed from opposite sign electron and muon pairs. The analysis is based on data of proton proton collisions with the centre of mass energy of 8 TeV collected in 2012 by the CMS experiment at LHC corresponding to 19.8 fb^{-1} of integrated luminosity. Obtained results are compared with different Monte-Carlo generators and are shown to be consistent with the Standard Model predictions.

Poster Session / 214

Z+jets/photon+jets cross section ratio at 8 TeVMEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

The Poster presents the photon part of the Z/g cross section ratio, as well as the ratio itself. The Z/g cross section ratio is not only a precise measurements that probes the strenght of the perturbative corrections, and the pdf composition, but also a test to validate with CMS-collected data a commonly used method to estimate backgrounds raising from Z to invisibles decays in BSM searches. The photon part of the analysis includes also the photon pT-differential cross section ratio between N+1/N jets (N=1,2). The analyzed dataset corresponds to the full 2012 LHC run luminosity at 8 TeV collected by the CMS detector (19.7 fb^{-1}), and results are compared to theoretical predictions.

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Differential Z+ jets cross section measurements at 8 TeV in multijet final statesMEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

We present a measurement of the differential vector boson transverse momentum cross-section of Z plus jets in proton-proton collisions. The data are collected with the CMS detector at $\sqrt{s}=8 \text{ TeV}$, corresponding to an integrated luminosity of 19 fb^{-1} . It is shown that the precise measurement allows for stringent test of (high multiplicity) NLO perturbative QCD calculations from BlackHat and other multi purpose Monte Carlo generators in several phasespace selection. In addition we confront theoretical predictions with data for differential Z cross-section ratios between jet multiplicities and differential cross-section of ratios between the transverse Z momentum and hadronic quantities like Z_{pt}/HT .

Detector RD and Performance / 216**Status and plan for the upgrade of CMS Pixel Detector**LU, Rong-Shyang ¹¹ *National Taiwan University***Corresponding Author:** meyera@cern.ch

The silicon pixel detector is the innermost component of the CMS tracking system and plays a crucial role in the all-silicon CMS tracker.

While the current pixel tracker is designed for and performing well at an instantaneous luminosity of up to $1 \cdot 10^{34} \text{cm}^{-2} \text{s}^{-1}$, it can no longer be operated efficiently at significantly higher values. Based on the strong performance of the LHC accelerator, it is anticipated that peak luminosities of two times the design luminosity are likely to be reached before 2018 and perhaps significantly exceeded in the running period until 2022, referred to as Phase I.

Therefore an upgrade is planned for the year-end technical stop in 2016: With a new pixel readout chip (ROC), an additional fourth layer, two additional endcap disks, and a significantly reduced material budget the upgraded pixel detector will be able to sustain the efficiency of the pixel tracker at the increased requirements imposed by high luminosities and pile-up. The main new features of the upgraded pixel detector would be ultra-light mechanical design, digital readout chip with higher rate capability and new cooling system. These and other design improvements, along with results of Monte Carlo simulation studies for the expected performance of the new pixel detector will be discussed and compared to that of the current CMS detector.

Poster Session / 217**Movements monitoring of the CMS Tracker detector during the cooling procedure with the Laser Alignment System**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The Laser Alignment System (LAS) of the CMS Tracker detector monitors the position variation of its components every five minutes. A precision of 1 micrometer for the x and y translations, and 1.1 microradians rotation around z-axis was achieved. For rotations around x- and y-axis the achieved precision is 3.7 and 2.6 microradians, respectively.

During the cooling down test performed in November 2013, the Tracker internal structure was monitored and movements of thermal nature were observed. Using the tracks-based alignment algorithm, Millepede, the LAS-derived alignment parameter variations were cross-checked with cosmic rays.

The results obtained from both alignment strategies, LAS and tracks based, are presented. The consistency of the alignment parameters variations is discussed.

Detector RD and Performance / 218**Phase 2 Upgrade of the CMS Tracker**MEYER, Arnd¹; Dr. MERSI, Stefano²¹ RWTH Aachen University² CERN**Corresponding Author:** meyera@cern.ch

The LHC machine is planning an upgrade program which will smoothly bring the luminosity up to or above $5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ sometimes after 2020, to possibly reach an integrated luminosity of 3000 fb^{-1} at the end of that decade. In this ultimate scenario, called Phase2, when LHC will reach the High Luminosity (HL-LHC) phase, CMS will need a completely new Tracker detector, in order to fully exploit the high-demanding operating conditions and the delivered luminosity. The new Tracker should have also trigger capabilities. To achieve such goals, R activities are ongoing to explore options and develop solutions that would allow including tracking information at Level-1. The design choices for the CMS pixel and outer tracker upgrades are discussed along with some highlights of the R activities.

Flavour Physics / 219**Study of $B \rightarrow K^{(*)} \mu^+ \mu^-$ decays at CMS experiment**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Measurements of rare B meson decay properties provide an alternative approach to direct searches for physics beyond the Standard Model. These decays, which proceed through flavor-changing neutral currents, can have interferences from new physics through loop diagrams. In particular, the angular distribution of the decay $B \rightarrow K^{(*)} \mu^+ \mu^-$ can be measured as a function of the square of the dimuon invariant mass, an excellent probe to possible new physics scenarios. This talk presents the forward-backward asymmetries of the muons, the K^* longitudinal polarization fractions and the differential branching fractions, measured with data recorded by the CMS experiment.

Flavour Physics / 220**Observation of B_s to $\mu^+ \mu^-$ decay and search for B_d to $\mu^+ \mu^-$ at CMS**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Rare beauty meson decays $B_{s,d}$ to $\mu^+ \mu^-$ are searched in pp collisions at LHC using a data sample collected by the CMS experiment. These decays are highly suppressed in the standard model. They can only proceed through the flavor-changing neutral currents, which are forbidden at tree-level diagrams. These decays are an excellent probe of new physics: any difference between the measured branching fraction and the standard model prediction could provide a smoking gun signal of new physics. In this talk the observation of B_s to $\mu^+ \mu^-$ decay as well as the search for B_d to $\mu^+ \mu^-$ will be presented.

Flavour Physics / 221**Measurement of the CP-violating phase ϕ_s in the $B_s \rightarrow J/\psi \phi$ decays at CMS**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

In this talk we present a measurement of the time-dependent CP-violating phase ϕ_s in the decays of $B_s \rightarrow J/\psi \phi$. The phase ϕ_s is the key parameter for the CP-violation of the B_s and anti- B_s system. An angular and proper decay time analysis is applied to the $B_s \rightarrow J/\psi \phi$ events. Using a data sample collected by the CMS experiment, the B_s signal candidates are reconstructed and are used to extract the phase ϕ_s . The theoretical prediction of the ϕ_s angle is particularly robust, thus any deviation from the prediction can be a smoking gun signal of new physics. A similar decay, $B_s \rightarrow J/\psi f_0$ can also provide the information on the same mixing phase. This talk might also include the study of lifetime in $B_s \rightarrow J/\psi f_0$ decays, if approved in time.

Strong Interactions and Hadron Physics / 223**Minimum Bias, MPI and DPS, and Diffractive and Exclusive measurements at CMS and TOTEM**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

We present recent results on Minimum Bias, MPI and DPS, and Diffractive and Exclusive studies using data collected during Run 1 of the LHC. The measurements include data collected in p-p collisions at $\sqrt{s} = 2.76, 7, \text{ and } 8 \text{ TeV}$ by the CMS and TOTEM collaborations. Double parton scattering is investigated in several final states including vector bosons and jets, and the effective cross section results are compared to other experiments and to MPI models tuned to recent underlying event measurements at CMS. Inclusive diffractive cross sections are discussed and compared to models, while searches and measurements of central exclusive processes are presented. The results from the first combined measurement by the CMS+TOTEM collaborations of the pseudorapidity distribution of charged particles at 8 TeV are also discussed, and are compared to models and to lower energy measurements.

Poster Session / 224**Low-pT and forward jet measurements at CMS**MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

We present recent measurements of inclusive jet cross sections at low-pT and forward rapidity. The data is collected with the CMS detector using p-p collisions at 8 TeV, exploiting special low-pileup runs of the LHC. The results are compared to theoretical predictions, and to CMS measurements at high-pT and central rapidity.

Poster Session / 226

Probing the Anomalous FCNC Interactions in a Top-Higgs Final State and Charge Ratio Approach

Ms. KHATIBI, Sara¹; Dr. MOHAMMADI NAJAFABADI, Mojtaba¹

¹ *IPM*

Corresponding Author: sara.khatibi@cern.ch

We study the anomalous production of a single top quark in association with a Higgs boson at the LHC originating from flavor changing neutral current (FCNC) interactions in tqg and tqH vertices. We derive the discovery potentials and 68% C.L. upper limits considering leptonic decay of the top quark and the Higgs boson decay into a $b\bar{b}$ pair with 10 fb^{-1} integrated luminosity of data in proton-proton collisions at the center-of-mass energy of 14 TeV. We propose a charge ratio for the lepton in top quark decay in terms of lepton p_T and η as a strong tool to observe the signal. In particular, we show that the charge ratio increases significantly at large p_T of the charged lepton. While the main background from $t\bar{t}$ is nearly charge symmetric and W +jets background has much smaller charge ratio with respect to the signal. We show that this feature can also be used in the probe of anomalous single top production with a Z -boson or a photon which are under the attention of the experimental collaborations.

Detector RD and Performance / 227

Large-size triple GEM detectors for the CMS forward muon upgrade

MEYER, Arnd¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

The CMS collaboration considers upgrading the muon forward region which is particularly affected by the high-luminosity conditions at the LHC. The proposal involves Gas Electron Multiplier (GEM) chambers, which are able to handle the extreme particle rates expected in this region along with a high spatial resolution. This allows to combine tracking and triggering capabilities, which will improve the CMS muon High Level Trigger, the muon identification and the track reconstruction. Intense R has led to the development of several GEM prototypes and associated detector electronics which were operated in several test beams. Strip cluster parameters, detection efficiency, and spatial resolution for charged particles are studied with position and high voltage scans and at different inclination angles. A first GEM station is foreseen to be already installed in LHC phase-1 to operate jointly together with the existing CSC detectors in the forward region. The resulting improved p_T assignment and lower trigger fake rate will reduce the needed bandwidth and therefore allow to lower the trigger threshold resulting in an increased sensitivity in channels triggering on soft muons, such as $H \rightarrow \tau\tau$ with subsequent $\tau \rightarrow \mu$ decays. Further GEM detectors are proposed for LHC phase-2 to significantly increase the forward muon acceptance.

Poster Session / 228**Luminosity determination at CMS**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

During the first three years of data taking at the LHC, considerable advances in understanding and controlling systematic effects in luminosity determination were made both by the experiments and by the accelerator. The precision achieved with the CMS experiment is 2.6% for the pp data taking in 2012 at 8 TeV. This is an unprecedented precision at a hadron collider, comparable in size with the systematic uncertainty with which the inclusive W and Z cross sections are measured with CMS. The absolute luminosity calibration is obtained from dedicated Van der Meer scans performed by the LHC. Several detectors and algorithms, among them the Hadron Forward calorimeters and the pixel cluster counting algorithm are used in CMS as luminometers. In this talk, the performance of the CMS luminometers, their stability and consistency will be described. The Van der Meer methodology for absolute luminosity calibration will be discussed. An alternative method of luminosity calibration that does not require dedicated LHC runs is the analysis of standard candle processes. Z production is one such processes. The production rate of Z bosons, measured in the dimuon decay, is used. The performance will be compared to the other available methods. Luminosity results will be given for proton-proton running at 2.76 TeV and at 8 TeV, as well as for proton-lead-ion running. Upgrades to the luminosity system for the LHC run starting in 2015 include the addition of two new luminometers. One is the Fast Beam Conditions Monitor, a diamond sensor system, the other the Pixel Luminosity Telescope. The expected benefits for luminosity monitoring and calibration from these upgrades will also be covered.

Poster Session / 229**Physics motivation of the CMS Muon System Upgrade with Triple-GEM detectors**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The CMS collaboration considers upgrading the muon forward region with Gas Electron Multiplier (GEM) chambers, which are able to handle the extreme particle rates expected in this region along with a high spatial resolution. This allows to combine tracking and triggering capabilities, resulting in a lower trigger threshold along with improved muon identification and the track reconstruction. In the last year the GEM project took a major leap forward by integrating triple-GEM chambers in the official CMS software, allowing physics studies to be carried out. Several benchmark analyses have been studied for the impact of such detector upgrade on the physics performance. The contribution will review the status of the CMS upgrade project with the usage of GEM detector, discussing the trigger, the muon reconstruction performance and the impact on the physics analyses.

Poster Session / 230

Deuteron spectrum measurements under radiation belt with PAMELA instrumentMr. KOLDOBSKIY, Sergey ¹; Dr. KARELIN, Alexander ²; Prof. VORONOV, Sergey ¹¹ NRNU MEPhI² MEPhI**Corresponding Author:** koldobsky.sergey@gmail.com

In this work the results of data analysis of the deuterons and protons albedo radiation obtained in the PAMELA experiment are presented. PAMELA is an international cosmophysical experiment carried out on board of the satellite Resurs DK-1. The high precision detectors allows to registrate and identify cosmic ray particles in a wide energy range. The deuteron-proton ratio in the energy range 90 - 360 MeV/nucleon has been measured.

Beyond the Standard Model / 233

Unitarity and causality constraints in composite Higgs modelsDr. MESCIA, Federico ¹¹ ECM, Universitat de Barcelona**Corresponding Author:** mescia@lnf.infn.it

We study the scattering of longitudinally polarized W bosons in extensions of the Standard Model where anomalous Higgs couplings to gauge sector and higher order $O(p^4)$ operators are considered. These new couplings with respect to the Standard Model should be thought as the low energy remnants of some new dynamics involving the electroweak symmetry breaking sector. By imposing unitarity and causality constraints on the WW scattering amplitudes we find relevant restrictions on the possible values of the new couplings and the presence of new resonances above 300 GeV. We investigate the properties of these new resonances and their experimental detectability. Custodial symmetry is assumed to be exact throughout and the calculation avoids using the Equivalence Theorem as much as possible.

Astroparticle Physics and Cosmology / 234

Anisotropies of ultra-high energy cosmic rays diffusing from extragalactic sourcesDr. MOLLERACH, Silvia ¹; Dr. HARARI, Diego ²; Dr. ROULET, Esteban ²¹ CONICET, Centro Atomico Bariloche² CONICET**Corresponding Author:** mollerach@cab.cnea.gov.ar

The large angular scale distribution of UHECRs is expected to become an important tool to infer CR properties in the near future, as a considerable statistics is being gathered by the Pierre Auger and TA observatories. Here we obtain the dipolar anisotropy of cosmic rays diffusing from nearby extragalactic sources. We discuss both the energy regime of spatial diffusion and the quasi-rectilinear one leading to just angular diffusion at higher energies. We obtain analytic results for the anisotropies from a single source which are validated using numerical simulations. For a scenario with a few sources in the local supercluster (with the closest source at a typical distance of few to tens of Mpc), we discuss the possible transition between the case in which the anisotropies are dominated by a few sources at energies below few EeV towards the regime in which many sources contribute at higher energies. The effect of a non-isotropic source distribution is also discussed, showing that it can significantly affect the observed dipole.

Lepton Flavour Violation / 235**The Mu2e Experiment at Fermilab**CORCORAN, Marjorie¹¹ *Rice University***Corresponding Author:** corcoran@rice.edu

Mu2e will search for coherent, neutrino-less conversion of muons into electrons in the field of a nucleus with a sensitivity improvement of a factor of 10,000 over existing limits. Such a lepton flavor-violating reaction probes new physics at a scale inaccessible with direct searches at either present or planned high energy colliders. The experiment both complements and extends the current search for muon decay to electron+gamma at MEG and searches for new physics at the LHC. We will present the physics motivation for Mu2e, as well as the design of the muon beamline and the detector.

BEH Physics / 237**Polarized top and Charged Higgs boson**Prof. ZHU, Shou-hua¹¹ *IITP, Peking University***Corresponding Author:** shzhu@pku.edu.cn

The charged Higgs boson is quite common in many new physics models. In this study we examine the potential of observing a heavy charged Higgs boson in its decay mode of top-quark and bottom-quark in the Type-II Two-Higgs-Doublet-Model. In this model, the chirality structure of the coupling of charged Higgs boson to the top- and bottom-quark is very sensitive to the value of $\tan\beta$. As the polarization of the top-quark can be measured experimentally from the top-quark decay products, one could make use of the top-quark polarization to determine the value of $\tan\beta$. We perform a detailed analysis of measuring top-quark polarization in the production channels $g\bar{b}\to tH^-$ and $g\bar{b}\to \bar{t}H^+$. We calculate the helicity amplitudes of the charged Higgs boson production and decay. Our calculation shows that the top-quark from the charged Higgs boson decay provides a good probe for measuring $\tan\beta$, especially for the intermediate $\tan\beta$ region. On the contrary, the top-quark produced in association with the charged Higgs boson cannot be used to measure $\tan\beta$ because its polarization is highly contaminated by the t-channel kinematics.

Computing and Data Handling / 238**CMS Data preparation for Run II**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The LHC Run II will confront us with new challenges, mainly due to the higher number of interactions per bunch crossing (pileup) and the reduced time distance between bunches. Moreover, the higher energy shifts the interest to complex physics objects such as boosted topologies for jet studies.

In order to be ready for the beginning of the run, in view of an early discovery, the CMS Collaboration is currently evolving the infrastructure established during Run I to monitor the data quality, to validate the progresses on detector simulation, event reconstruction, physics object definition, and to handle large scale Monte Carlo samples' production. Beside guaranteeing the readiness for Run II, this infrastructure serves as the basis to test detector upgrade proposals for the High-Luminosity LHC, for which an even higher pileup is expected.

This contribution will cover the development and operational aspects of data preparation at CMS for the Run II operations, reporting on how the experience gained in the operations for the Run I is serving the planning of the physics program for Run II.

Computing and Data Handling / 239**CMS Alignment and Calibration workflows: lesson learned and future plans**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

We review the online and offline workflows designed to align and calibrate the CMS detector. Starting from the gained experience during the first LHC run, we discuss the expected developments for Run II. In particular, we describe the envisioned different stages, from the alignment using cosmic rays data to the detector alignment and calibration using the first proton-proton collisions data ($O(100 \text{ pb}^{-1})$) and a larger dataset ($O(1 \text{ fb}^{-1})$) to reach the target precision. The automatization of the workflow and the integration in the online and offline activity (dedicated triggers and datasets, data skims, workflows to compute the calibration and alignment constants) are discussed.

Computing and Data Handling / 240**Dataset definition for CMS operations and physics analyses**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Recorded data at the CMS experiment are funnelled into streams, integrated in the HLT menu, and further organised in a hierarchical structure of primary datasets, secondary datasets, and dedicated skims. Datasets are defined according to the final-state particles reconstructed by the high level trigger, the data format and the use case (physics analysis, alignment and calibration, performance studies). During the first LHC run, new workflows have been added to this canonical scheme, to exploit at best the flexibility of the CMS trigger and data acquisition systems. The concept of data parking and data scouting have been introduced to extend the physics reach of CMS, offering the opportunity of defining physics triggers with extremely loose selections (e.g. dijet resonance trigger collecting data at a 1 kHz). In this presentation, we review the evolution of the dataset definition during the first run, and we discuss the plans for the second LHC run.

Poster Session / 241**Muons in the CMS High Level Trigger System**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The trigger systems of LHC detectors play a fundamental role in defining the physics capabilities of the experiments. A reduction of several orders of magnitude in the rate of collected events, with respect to the proton-proton bunch crossing rate generated by the LHC, is mandatory to cope with the limits imposed by the readout and storage systems limits. An accurate and efficient online selection mechanism is thus required to fulfill the task keeping maximal the acceptance to physics signals. The CMS experiment operates using a two-level trigger system. Firstly a Level-1 Trigger (L1T) system, implemented using custom-designed electronics, is designed to reduce the event rate to a limit compatible to the CMS Data Acquisition (DAQ) capabilities. A High Level Trigger System (HLT) follows, aimed at further reducing the rate of collected events finally stored for analysis purposes. The latter consists of a streamlined version of the CMS offline reconstruction software and operates on a computer farm. It runs algorithms optimized to make a trade-off between computational complexity, rate reduction and high selection efficiency. With the computing power available in 2012 the maximum reconstruction time at HLT was about 200 ms per event, at the nominal L1T rate of 100 kHz. An efficient selection of muons at HLT, as well as an accurate measurement of their properties, such as transverse momentum and isolation, is fundamental for the CMS physics programme. The performance of the muon HLT for single and double muon triggers achieved in Run I will be presented. Results from new developments, aimed at improving the performance of the algorithms for the harsher scenarios of collisions per event (pile-up) and luminosity expected for Run II will also be discussed.

Poster Session / 242

Performance of MET reconstruction and pileup mitigation techniques in CMSMEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Advanced missing transverse momentum reconstruction algorithms have been developed by CMS to mitigate the effect of pileup. The performance of different missing transverse momentum reconstruction algorithms is compared in pp collision data recorded at a center-of-mass energy of $\sqrt{s} = 8\text{ TeV}$, corresponding to an integrated luminosity of 19.6 fb^{-1} . Further algorithms have been developed to identify and remove events with anomalous missing transverse momentum caused by detector effects and to estimate the missing transverse momentum resolution on an event-by-event basis. The performance of these algorithms is presented.

Education and Outreach / 243

Collider - bringing the Large Hadron Collider to London, and beyondDr. CLIFF, Harry ¹; Ms. BOYLE, Alison ²; Prof. GIBSON, Valerie ³¹ *University of Cambridge Science Museum, London*² *Science Museum, London*³ *University of Cambridge***Corresponding Author:** cliff@hep.phy.cam.ac.uk

On 12th November 2013 the Science Museum in London launched Collider, a major temporary exhibition about the Large Hadron Collider at CERN. The launch event was attended by Peter Higgs, Stephen Hawking, Rolf Heuer and the UK Chancellor of the Exchequer and attracted significant media attention and critical praise in the UK and internationally. By the time the exhibition completes its London run it will have attracted over 50,000 paying visitors and from May 2014 begins an international tour to museums in Europe, Asia and Australia. Developed with the support of CERN and targeted at a general audience, the exhibition uses techniques from theatre, video art and exhibition design to create the atmosphere of a visit to CERN, with the aim of engaging the public with the science, engineering and day-to-day reality of work at the LHC. Visitors are led through a series of theatrical reconstruction of spaces at CERN, including the main auditorium on the day the Higgs boson discovery was announced, the LHC tunnel and even the 1970s offices where much of the data analysis takes place. Authentic artefacts including superconducting magnets, components of the four main LHC experiments and a champagne bottle drunk by Peter Higgs are set in context, telling physics, engineering and human stories. The exhibition also brings the community of CERN to life, through a dramatic re-imagining of events leading to the discovery of the Higgs boson and authentic video and audio recordings of engineers and physicists working on the LHC. We will present an account of the development of the exhibition, the new approaches used to engage the public with particle physics and the results of the audience research that has been conducted during the London run.

Poster Session / 244**ALIBAVA EASY: A SILICON MICROSTRIP READOUT SYSTEM FOR EDUCATIONAL PURPOSES**

Mr. BERNABEU, Pepe ¹; Dr. CASSE, G. ²; GARCIA, Carmen ¹; Mr. GREENALL, A. ³; Dr. LACASTA, Carlos ⁴; Prof. LOZANO, Manuel ⁵; Dr. MARTI GARCIA, Salvador ⁶; Dr. PELLEGRINI, G. ⁷; Mr. RODRIGUEZ, J. ⁸; Dr. ULLAN, Miguel ⁹

¹ IFIC

² U. Of Liverpool

³ U. of Liverpool

⁴ IFIC-Valencia

⁵ IMB-CNM (CSIC)

⁶ IFIC-Valencia (UV-CSIC)

⁷ IMB-CNM, Barcelona

⁸ ALIBAVA Systems

⁹ CNM-Barcelona

Corresponding Author: salvador.marti@ific.uv.es

Semiconductor devices are widely used as radiation sensors in many physics applications. They are of uttermost importance in the High Energy Physics experiments as tracking devices and extensively used in Nuclear Physics for spectroscopy. Moreover, silicon sensors have an increasing number of applications in imaging Medical Physics where their low cost, miniaturization, packaging and integration of electronics represent a clear advantage.

Because of the social impact of this kind of sensors, it becomes necessary that physicists and engineers are educated not only on the first principles of the semiconductor sensors operation, but also in their handling and in the operation of the associated instrumentation. Undergraduate and postgraduate students of the field will boost their professional capabilities if they master this technology.

ALIBAVA SYSTEMS® has designed a compact system that renders the training of students at the university teaching laboratories straightforward and efficient. The system is a perfect tool to learn about the signal formation in semiconductor sensors as well as data processing. It can also be used to test the physics laws that govern the interaction of radiation with matter or as modern alternative to test other physics principles.

ALIBAVA EASY ® is suitable for its handling by undergraduate and postgraduate students (following university lectures on radiation detection instrumentation). The system contains a micro-strip sensor, which is readout by the front-end electronics (based on a low noise ASIC with 128 input channels). The properties and operation of micro-strip sensors and signal formation in those devices can be studied stimulating the sensors with a laser or a radioactive source.

Detector RD and Performance / 245**CMS Detector Performance**

MEYER, Arnd ¹; Dr. GOY LOPEZ, Silvia ²

¹ RWTH Aachen University

² CIEMAT

Corresponding Author: meyera@cern.ch

The performance of CMS detector during LHC Run 1 will be presented. Planned improvements for Run 2 will also be discussed.

Poster Session / 246

Electron and photon performance with the CMS detector at $\sqrt{s} = 8$ TeV

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

The performance of the electron and photon reconstruction and selection with the CMS detector at $\sqrt{s} = 8$ TeV will be presented. After a short description of the reconstruction algorithms, the selection criteria will be presented and their performance assessed using decays of the Z, J/Psi and Y particles. The data to Monte Carlo simulation scale factors are found close to unity for a large range of transverse momentum. The electron and photon energy scales and resolutions will be also presented.

Neutrino Physics / 247

Latest results of NEMO-3 experiment and present status of SuperNEMO

Dr. GOMEZ MALUENDA, Hector ¹

¹ Laboratoire de l'Accélérateur Linéaire (LAL)

Corresponding Author: gomez@lal.in2p3.fr

The NEMO-3 experiment looked for neutrinoless double beta decay processes from 2003 to 2011 at the Modane Underground Laboratory. Seven isotopes were studied by the simultaneous recording of the energy and track of the event, standing out 100-Mo and 82-Se since they were the most massive ones. No evidence for neutrinoless double beta decay has been observed, leading to set limits on the effective neutrino mass that are among the best to date, specially for the mentioned isotopes.

In addition to the results regarding the effective neutrino mass, NEMO-3 results have shown the physics potential of the “tracking + calorimetry” technique for the neutrinoless double beta decay search, specially in terms of background rejection capabilities in the energy region of interest. For this reason, the SuperNEMO experiment has been conceived using this technique as one of the so-called new generation experiments. SuperNEMO is at present under construction after a R phase (started in 2007) which concluded that all the requirements are achievable. First phase is the construction of a first module that has been started in 2012 and will finish during 2015, when the data taking is expected to start.

A summary of the latest NEMO-3 results, as well as the present status of the SuperNEMO progress (which includes, for example, the development of outstanding detectors for materials radiopurity and radon concentration measurements), will be presented, together with collaboration prospects about the installation, commissioning and operation of the experiment.

Poster Session / 248

The CMS Level-1 Tau algorithm for the LHC Run IIMEYER, Arnd ¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

The CMS experiment implements a sophisticated two-level online selection system that achieves a rejection factor of nearly 10^5 . The first level (L1) is based on coarse information coming from the calorimeters and the muon detectors while the High Level Trigger combines fine-grain information from all sub-detectors. During Run II, the centre of mass energy of the LHC collisions will be increased up to 13/14 TeV and progressively reach an instantaneous luminosity of $2 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$. To guarantee a successful and ambitious physics program under this intense environment, the CMS Trigger and Data acquisition system must be consolidated. In particular the L1 calorimeter Trigger hardware and architecture will be upgraded, benefiting from the recent microTCA technology allowing sophisticated algorithms to be deployed, better exploiting the calorimeter granularity and opening the possibility of making correlations between different parts of the detector. Given the enhanced granularity provided by the new system, an optimized tau algorithm has been developed. This algorithm is implementing an innovative dynamic clustering technique which is also used to identify electron and photons at the trigger level. The selection of a hadronically decaying taus, giving multiple decay channels, represents a real challenge for an electronics trigger system. In addition, to satisfy both physics performance, and hardware constraints, the level-1 tau algorithm requires specific adaptation of the electron/photon algorithm. The performance of this tau trigger will be demonstrated, both in terms of efficiency and rate reduction. The different handles to control the rate in different pile-up scenarios will be described. Finally, the plans for the commissioning with the first Run II data will be presented and the expected impact on the physics potential assessed.

BEH Physics / 249

Enhancing the $t\bar{t}$ (bar)Higgs signal through top-quark spin polarization effects at the LHCProf. GABRIELLI, Emidio ¹¹ University of Trieste and NICPB Tallinn**Corresponding Author:** emidio.gabrielli@cern.ch

We compare the impact of top-quark spin polarization effects in Higgs (H) boson production in association with top-quark pairs and in corresponding backgrounds at the LHC. Because of the spin-zero nature of the Higgs boson, one expects, in the chiral limit for the top quarks, a substantial complementarity in $t\bar{t}$ (bar) spin correlations for a Higgs decaying into fermions/gauge-bosons and $t\bar{t}$ (bar) spin correlations for the corresponding irreducible $t\bar{t}$ (bar) $f\bar{f}$ (bar)/VV backgrounds. Although top mass effects in $t\bar{t}$ (bar)H production are in general dominant, and seriously spoil the chiral-limit expectations, one can find observables that capture the $t\bar{t}$ (bar) angular spin correlations and can help in separating the signal from irreducible backgrounds. In particular, we show that, for both $H \rightarrow b\bar{b}$ (bar) and $H \rightarrow \gamma\gamma$, taking into account $t\bar{t}$ (bar) spin correlations in $t\bar{t}$ (bar)H production and irreducible backgrounds could appreciably improve the LHC sensitivity to the $t\bar{t}$ (bar)H channel.

Flavour Physics / 250

Higher order corrections to inclusive semileptonic B decays

Prof. NANDI, Soumitra ¹; ALBERTI, Andrea ²; GAMBINO, Paolo ²

¹ *IIT Guwahati*

² *University of Turin*

Corresponding Author: gambino@to.infn.it

We review the status of the calculation of higher order corrections to inclusive semileptonic B decays, with emphasis on recent developments concerning the perturbative corrections to power suppressed effects and their impact on the determination of V_{cb} .

Flavour Physics / 251

The inclusive determination of V_{cb}

Dr. HEALEY, Kristopher ¹; GAMBINO, Paolo ¹

¹ *University of Turin*

Corresponding Author: gambino@to.infn.it

We perform a new fit to the moments of various kinematic distributions of inclusive semileptonic B decays, including recently computed higher order effects, and extract V_{cb} and the parameters of the heavy quark expansion.

Detector RD and Performance / 252

CMS upgrade perspectives

MEYER, Arnd ¹; PASTRONE, Nadia ²

¹ *RWTH Aachen University*

² *INFN*

Corresponding Author: meyera@cern.ch

After the discovery of the Higgs boson, the Large Hadron Collider will resume operations in 2015 at 13 TeV aiming to collect over 300 fb^{-1} by 2023, with design luminosity up to $2 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. The success of the following major machine upgrade, HL-LHC, planned to achieve considerably higher annual integrated luminosity to achieve 3000 fb^{-1} depends crucially on maintaining and improving the performance of the future CMS detector, under much more difficult operational conditions. An overview of the plans for CMS upgrades for HL-LHC will be presented.

Poster Session / 255

Development of liquid scintillator containing zirconium complex for neutrinoless double beta decay experimentProf. MORIYAMA, Shigetaka¹; Prof. OGAWA, Izumi²; Prof. FUKUDA, Yoshiyuki³¹ *Kamioka Observatory, ICRR, University of Tokyo*² *Faculty of Engineering, Fukui University*³ *Miyagi University of Education***Corresponding Author:** fukuda@staff.miyakyo-u.ac.jp

An organic liquid scintillator containing zirconium complex was studied for neutrinoless double beta decay (ZICOS) experiment. A ^{96}Zr nuclei has a large Q-value (3.35MeV), and no experiment is planned to use as a target. In order to realize ton scale target isotope with good energy resolution (4%@2.5MeV), we have used zirconium beta-diketon complex which has huge solubility (over 10w.t.%) to the Anisole. However, the absorption wavelength of diketon ligand overlaps with the luminescence from Anisole. Therefore, the light yield of liquid scintillator decreased in proportion to the concentration of beta-diketon complex. In order to avoid this problem, we synthesized beta-keto ester complex introducing -OC₃H₇ or -OC₂H₅ substituent groups in the beta-diketon complex. These complexes have shorter absorption wavelength (245nm) than the emission wavelength of Anisole (275nm). The scintillation light yield recovered about double, however, did not reach at the expected value, because the residual absorption around the 275nm still exists. We have found that those were caused by the impurities of beta-keto ester complex and it will be solved by the purifying the complex. We obtained that the light yield was about 40% with respect to the original cocktail, and the energy resolution was 13%@1MeV even though 8.5% of PMT photo coverage for 10 w.t.% concentration, which corresponds to 4.1%@2.5MeV assuming 40% photo coverage for ZICOS detector. We have also found that a diethyl malonate ligand shifted the absorption peak to around 210nm, and the complex should have no quenching for the Anisole based liquid scintillator. Here we will report the present status of ZICOS project.

BEH Physics / 257

Measurements of Higgs boson production and properties in the ZZ decay channel with both Z's decaying into electrons or muons using the CMS detectorMEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

A search for the Higgs boson has been carried out in the Higgs to ZZ to four leptons decay mode with the CMS detector at the LHC collider, where leptons are electrons or muons. The analysis is based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. The analysis strategy and measurements of the mass, coupling, and spin-parity are reported.

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Measurements of Higgs boson production and properties in the WW decay channel with both W's decaying into electrons or muons plus neutrino using the CMS detector

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

A search for the Higgs boson has been carried out in the Higgs to WW decay mode with the CMS detector at the LHC collider, where each W decays into an electron or photon and a neutrino. The analysis is based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. The analysis strategy and measurements of the mass, coupling, and spin-parity are reported.

BEH Physics / 260

Search for the Higgs boson in the bb decay channel using the CMS detector

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

A search for the Higgs boson has been carried out in the Higgs to bb channel with the CMS detector at the LHC collider. The production modes used are the associated VH production, the VBF production and the production in association with top quarks. The analyses are based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. The strategy and results of the searches are reported.

BEH Physics / 261

Combined results of the 126 GeV Higgs boson couplings using all decay channels measured by the CMS detector

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

The combination of the coupling results of all Higgs boson decay channels measured at CMS is presented. The analysis is based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV corresponding to integrated luminosities of 5/fb and 20/fb respectively. Various fits looking for deviations of the couplings from the Standard Model predictions are carried out and the results are summarized.

BEH Physics / 262

Precise measurement of the Higgs boson mass with the CMS detector

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Using the high mass resolution channels $H \rightarrow \gamma\gamma$ and $H \rightarrow ZZ \rightarrow 4$ leptons, where the leptons are electrons or muons, a precise measurement of the Higgs boson mass is obtained. The analysis is based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. The results together with strategy of the measurement and the methods to control the main systematic errors on the energy and momentum scale are discussed in detail.

BEH Physics / 263

Studies of the Higgs boson spin and parity using the $\gamma\gamma$, ZZ , and WW decay channels with the CMS detector

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Studies of the Higgs boson spin and parity are presented using data samples corresponding to the $\gamma\gamma$, ZZ , and WW decay channels. The analyses are based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of approximately 5/fb and 20/fb, respectively. The data are compared to the expectations for a Standard Model Higgs boson, and for several alternative models.

BEH Physics / 266

Searches for MSSM and NMSSM Higgs bosons with the CMS detector

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Several searches for Higgs bosons have been carried out with the CMS detector at LHC. The analyses are based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. Some of them can be interpreted in the framework of the MSSM and NMSSM Supersymmetric models. Given that no evidence of Higgs bosons, in addition to the discovered SM-like 126 GeV Higgs boson, has been found, exclusion limits have been derived.

BEH Physics / 267

Searches for invisible decay modes of the Higgs boson with the CMS detector

MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

A search for Higgs boson invisible decay modes has been carried out in events where the Higgs boson is produced in association with a Z boson as well as through Vector Boson Fusion. In the associated production search, electron, muon and b-quark pair decay modes of the Z-boson are considered. The analyses are based on pp collision data collected with the CMS detector at the LHC collider at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. No evidence of a signal has been found and upper limits on the invisible branching ratio are obtained and interpreted in a Higgs portal model of dark matter interactions.

BEH Physics / 268

Searches for a high-mass Higgs boson in the ZZ and WW decay channels with the CMS detector

MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Searches for a high-mass Higgs boson decaying into WW and ZZ channels has been carried out using data collected at centre-of-mass energies of 7 and 8 TeV at the LHC collider, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. Many different final states have been considered and upper limits on the Higgs boson production cross section have been derived. The results are interpreted in a BSM model containing an additional electroweak singlet.

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Searches for production of two Higgs bosons using the CMS detector

MEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Searches for events containing two Higgs bosons are presented using several decay channels of the h(126) boson. The analyses use pp collision data recorded at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. Extended Higgs sector scenarios predict the resonant decay of new particles into a pair of h(126) bosons. These resonant di-Higgs processes are searched in different final states and the results are described.

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Constraints on the Higgs boson width from off-shell production and decay to ZZ with the CMS detector

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

Constraints on the total Higgs boson width, Γ_H , are presented using off-shell production and decay in the ZZ channel. The analysis is based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV by the CMS experiment at the LHC, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. The analyses are carried out in the ZZ to 4-lepton and to 2-lepton-2-neutrino channels, and constraints on the Higgs boson width are obtained.

Strong Interactions and Hadron Physics / 275

Recent results on $e^+e^- \rightarrow$ hadrons cross sections from SND and CMD-3 detectors at VEPP-2000 collider

Dr. DIMOVA, Tatyana ¹

¹ BINP/NSU Novosibirsk Russia

Corresponding Author: baiert@inp.nsk.su

The recent results on $e^+e^- \rightarrow$ hadrons cross section obtained with the SND and CMD3 detectors at the VEPP-2000 collider in the energy range up to 2 GeV are presented. The following processes were studied: $e^+e^- \rightarrow \pi^+\pi^-$, K^+K^- , $\pi^+\pi^-\pi^0$, $\pi^+\pi^-\pi^0\pi^0$, $\eta \pi^+\pi^-$, $\omega \eta$, $\eta \gamma$, etc. The results on measured cross sections are important from the point of view of their contribution to the total hadron cross section, the muon $g-2$ and the parameters of excited vector mesons. The nucleon anti-nucleon production at the threshold was also studied.

Detector RD and Performance / 276**Sensitivity of the DANSS detector to short range neutrino oscillations**Prof. DANILOV, Mikhail ¹¹ *ITEP, Representing the DANSS Collaboration (ITEP-JINR)***Corresponding Author:** danilov@itep.ru

DANSS is a highly segmented 1m³ plastic scintillator detector. It's 2500 scintillator strips have a Gd loaded reflective cover. Light is collected with 3 wave length shifting fibers per strip and read out with 50 PMTs and 2500 SiPMs. Light collection uniformity across and along the strip as well as the photoelectron yield are adequate to the physics goals of the experiment. Continuous calibration of all strips will minimize the systematic uncertainties in the detector response at different distances from the reactor. Together with the a very high antineutrino counting rate of ~10 thousand per day and a very low background level of less than ~1% this will lead to a high sensitivity of the detector to short range neutrino oscillations. The DANSS will be installed under the industrial 3GW reactor of the Kalinin Nuclear Power Plant at distances varying from 9.7m to 12.2m from the reactor core. Tests of the detector prototype demonstrated that in spite of a small size (20x20x100 cm³), it is quite sensitive to reactor antineutrinos, detecting about 70 Inverse Beta Decay events per day with the signal-to-background ratio of about unity. The prototype tests have demonstrated feasibility to reach the design performance of the DANSS detector. The DANSS experiment will have a high sensitivity to reactor antineutrino oscillations to sterile neutrinos, suggested recently to explain a so-called "reactor anomaly". It will start data taking early in 2015.

Detector RD and Performance / 277**Towards a Level-1 tracking trigger for the ATLAS experiment**Prof. DE SANTO, Antonella ¹; Dr. STELZER, Joerg ²¹ *Univ. of Sussex (UK)*² *CERN***Corresponding Author:** francesca.pastore@cern.ch

Plans for a physics-driven upgrade of the LHC foresee staged increases of the accelerator's average instantaneous luminosity, of up to a factor of five compared to the original design.

In order to cope with the sustained luminosity increase, and the resulting higher detector occupancy and particle interaction rates, the ATLAS experiment is planning phased upgrades of the trigger system and of the DAQ infrastructure. In the new conditions, maintaining an adequate signal acceptance for electro-weak processes will pose unprecedented challenges, as the default solution to cope with the higher rates would be to increase thresholds on the transverse momenta of physics objects (leptons, jets, etc). Therefore the possibility to apply fast processing at the first trigger level in order to use tracking information as early as possible in the trigger selection represents a most appealing opportunity, which can preserve the ATLAS trigger's selectivity without reducing its flexibility.

Studies to explore the feasibility of the new trigger component are ongoing and are developing in two directions: the definition of a fast readout for high-granularity silicon detectors, and the development of fast pattern-recognition algorithms to be applied immediately after the front-end readout of relevant sub-detectors. The status of ongoing tests and preliminary results for the system under development are discussed.

Poster Session / 278

The ATLAS FTK system: how to improve the physics potential with a tracking trigger

Dr. RODA, Chiara¹; Dr. STELZER, Joerg²

¹ *INFN-Pisa (Italy)*

² *CERN*

Corresponding Author: francesca.pastore@cern.ch

After a very successful data taking run, the ATLAS experiment is being upgraded to cope with the higher luminosity and higher center of mass energy that the Large Hadron Collider will provide in the next years. The Fast Tracker (FTK) trigger system, part of the ATLAS trigger upgrade program, is a highly parallel hardware device designed to operate at the level-1 trigger output rate. FTK is a dedicated processor based on a mixture of advanced technologies. Modern, powerful Field Programmable Gate Arrays (FPGAs) form an important part of the system architecture, and the large level of computing power required for pattern recognition is provided by incorporating standard- cell ASICs named Associative Memories (AM).

FTK provides global track reconstruction in the full inner silicon detector, with resolution comparable to the offline algorithms, in approximately 100 microseconds, allowing a fast and precise detection of the primary and secondary vertex information. The track and vertex information is then used by the high-level trigger algorithms, allowing highly improved trigger performance for the most difficult signatures, such as b-jets.

We present the architecture of the FTK system and discuss the expected physics performance in the harsh environment at high pile-up and high luminosities expected for LHC run II.

Poster Session / 279

Real-time flavor tagging selection in ATLAS

Dr. SCHIAVI, Carlo¹; Dr. STELZER, Joerg²

¹ *Universita' di Genova (Italy)*

² *CERN*

Corresponding Author: francesca.pastore@cern.ch

In high-energy physics experiments on hadron colliders, online selection is crucial to reject most uninteresting collisions. In particular, the ATLAS experiment includes b-jet selections in its trigger strategy, in order to select final states with heavy-flavor content and enlarge its physics potentials.

Dedicated selections are developed to quickly identify fully hadronic final states containing b-jets, while rejecting light QCD jets, and maintain affordable trigger rates without raising jet energy thresholds. ATLAS successfully operated b-jet trigger selections during both 2011 and 2012 data-taking campaigns and hard work is on-going now to improve the performance of tagging algorithms for coming Run2 in 2015.

An overview of the ATLAS b-jet trigger strategy and its performance on real data is presented in this contribution, along with future prospects. Data-driven techniques to extract the online b-tagging performance, a key ingredient for all analyses relying on such triggers, are also discussed and results presented.

Computing and Data Handling / 280**ATLAS Jet Trigger Performance during Run1 and preparation for Run2**Dr. MORAIS SILVA GONCALO, Ricardo Jose ¹; Dr. STELZER, Joerg ²¹ *LIP Laboratorio de Instrumentacao e Fisica Experimental de Particulas (PT)*² *CERN***Corresponding Author:** francesca.pastore@cern.ch

During the 2011 data-taking run, the Large Hadron Collider (LHC) collided proton beams at the energy of 7 TeV in the centre-of-mass, as well as heavy ions at the centre of mass energy of 2.76 TeV. The ATLAS Trigger is designed to reduce the rate of events from the nominal maximum bunch-crossing rate of 20 MHz to approximately 400 Hz, which will then be written on disk offline. The online selection of events containing jets is done using a dedicated jet trigger. The rate from jet events is very high, with a steeply falling spectrum in the distribution of the transverse energy. The jet trigger has been designed to keep an approximately constant jet rate of 0.5 Hz in various transverse momentum intervals and accounts for around 10% of the total trigger rate.

During the 2011 data taking the jet trigger at Level 1 was fully efficient for jets with transverse energies above 25 GeV, while full efficiency was reached for energies above 60 GeV for jets identified up to the third trigger level (the Event Filter). The transverse energy resolution of jets reconstructed in the latter region of the spectrum is better than 4%. In this poster, the overall performances of the jet trigger during the 2011 data taking will be summarised, together with important updates used during the 2012 run. In addition, the expected performance of the jet trigger in the LHC Run-II, to start in 2015, will be described.

Detector RD and Performance / 281**The ATLAS Trigger System: Past, Present and Future**Dr. STELZER, Joerg ¹; Dr. PASTORE, Francesca ²¹ *CERN*² *Royal Holloway University of London (UK)***Corresponding Author:** stelzer@cern.ch

The ATLAS trigger has been used very successfully for the online event selection during the first run of the LHC between 2009-2013 at a centre-of-mass energy between 900 GeV and 8 TeV. The trigger system consists of a hardware Level-1 (L1) and a software based high-level trigger (HLT) that reduces the event rate from the design bunch-crossing rate of 40 MHz to an average recording rate of a few hundred Hz.

We will briefly review the performance of the ATLAS trigger system during the past data-taking period and point out the challenges for the trigger system during the next LHC run in early 2015 with a smaller bunch spacing, almost twice the centre-of-mass energy and higher peak luminosity. We will show the ongoing improvements and upgrades to the existing system that will ensure an even better performing trigger system despite the harsher machine conditions. This includes changes to the L1 calorimeter trigger, the introduction of a new L1 topological trigger module, improvements in the L1 muon system and the merging of the previously two-level HLT system into a single event filter farm. In addition, we will give an overview of the algorithmic improvements in the various HLT algorithms used to identify leptons, hadrons and global event quantities like missing transverse energy.

Accelerator Physics and Future Colliders / 282**Neutron-Anti-Neutron Oscillations**BROOIJMANS, Gustaaf¹; Dr. THEROINE, Camille²¹ *Columbia University*² *European Spallation Source***Corresponding Author:** gusbroom@nevis.columbia.edu

Neutral particle oscillations have proven to be extremely valuable probes of fundamental physics. Kaon oscillations provided us with our first insight into CP-violation, fast Bs oscillations provided the first indication that the top quark is extremely heavy, B oscillations form the most fertile ground for the continued study of CP-violation, and neutrino oscillations suggest the existence of a new, important energy scale well below the GUT scale. Neutrons oscillating into antineutrons could offer a unique probe of baryon number violation. The construction of the European Spallation Source in Lund, with first beam expected in 2019, together with modern neutron optical techniques, offers an opportunity to conduct an experiment with at least three orders of magnitude improvement in sensitivity to the neutron oscillation probability. The physics case for such an experiment will be discussed, together with the main experimental challenges and possible solutions.

Computing and Data Handling / 283**The ATLAS Data Acquisition: from Run I to Run II**Dr. STELZER, Joerg¹; Dr. PASTORE, Francesca²¹ *CERN*² *Royal Holloway University of London (UK)***Corresponding Author:** stelzer@cern.ch

The experience gained during the first period of very successful data taking of the ATLAS experiment (Run I) has inspired a number of ideas for improvement of the Data Acquisition (DAQ) system that are being put in place during the so-called Long Shutdown 1 of the Large Hadron Collider (LHC), in 2013/14. We have updated the data-flow architecture, rewritten an important fraction of the software and replaced hardware, profiting from state of the art technologies.

This paper summarizes the main changes that have been applied to the ATLAS DAQ system and highlights the expected performance and functional improvements that will be available for the LHC Run II. Particular emphasis will be put on explaining the reasons for our architectural and technical choices, as well as on the simulation and testing approach used to validate this system.

Poster Session / 284

ATLAS Electron and Photon Trigger Performance in Run 1 and Developments towards Run 2

Dr. STELZER, Joerg¹; Dr. PASTORE, Francesca²

¹ CERN

² Royal Holloway University of London (UK)

Corresponding Author: stelzer@cern.ch

Electron and photon triggers are essential for signal selection in a wide variety of ATLAS physics analyses to study Standard Model processes and to search for new phenomena. Final states including leptons and photons had, for example, an important role in the discovery and measurement of the Higgs particle. Dedicated triggers are also used for the collection of $J/\psi \rightarrow e^+ e^-$, $W \rightarrow e\nu$ and QCD background samples for calibration, efficiency and fake rate measurements. The ATLAS trigger system is divided in a hardware-based (Level 1) and two software stages (Level 2 and Event-Filter). During the LHC Run1 proton-proton data-taking period, the increasing luminosity and the more challenging pile-up conditions demanded the optimization of the trigger selections at each level to control rates and keep efficiencies high. The evolution and performance of the ATLAS electron and photon triggers in Run1 will be discussed, updates and plans for the operation during Run 2 starting in 2015 will be presented.

Poster Session / 285

The ATLAS Tau Trigger Performance during LHC Run1 and Prospects for Run2

Dr. STELZER, Joerg¹; Dr. PASTORE, Francesca²

¹ CERN

² Royal Holloway University of London (UK)

Corresponding Author: stelzer@cern.ch

Triggering on hadronic tau decays at ATLAS is essential for a wide variety of analyses of interesting physics processes at ATLAS. Among those are the measurement of the Higgs boson in the di-tau final state and multiple searches for physics beyond the Standard Model. The ATLAS tau trigger combines information from the tracking detectors and calorimeters to identify the signature of hadronically decaying tau leptons.

In 2015 the trigger strategies will become more important than ever for physics analyses. Under the demanding high luminosity scenario of the LHC Run 2, with instantaneous luminosities up to $2 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$, one of the major challenges will be to sustain high efficiencies and background rejection in events with up to 50 overlapping interactions. In this environment single-tau triggers suffer from severe rate limitations, despite the sophisticated algorithms that are used in the tau identification. Hence, new algorithms with improved resolution, multi-variate selection techniques, and new topological trigger criteria at hardware level are being developed. Novel high-speed tracking methods will be deployed to deal with the much larger event rate.

Measurements of the tau trigger performance during Run1 will be presented. An overview of the developments for an efficient tau trigger in Run 2 will be given.

Poster Session / 286**Simulated Measurements of the Ds Semileptonic Decay Form Factor with the PANDA Detector**Ms. CAO, Lu ¹; Prof. RITMAN, James ¹¹ *Forschungszentrum Juelich***Corresponding Author:** l.cao@fz-juelich.de

The PANDA experiment is one of the major projects at the Facility for Antiproton and Ion Research (FAIR) and will study a wide range of physics topics with beams of antiprotons incident on fixed proton or complex nuclei targets. One of the interesting issues is the Ds semileptonic decay, which is governed by both the weak and strong forces. Here the strong interaction effects can be parameterized by the transition form factor. Techniques such as lattice QCD offer increasingly precise calculations, but as the uncertainties shrink, experimental validation of the results becomes increasingly important. The achievable performance of the full PANDA detector for these types of reactions has not yet been studied in detail; however, this is expected to work very well based upon the design performance and experience with similar detector systems.

This poster summarizes the simulation and reconstruction of the Ds decay chain. In the reconstruction procedure, we focus on modeling properly the decay process and evaluating the expected precision of these measurements with the full PANDA detector. The required models in this decay chain are corroborated via Dalitz plot analysis. The present version of EvtGen in PandaRoot has been enhanced by a new model describing the Ds→KKπ decay. The reconstruction efficiency and resolutions have been studied for the proposed decay chain. With the help of theoretical predictions of the cross section, the event reconstruction rate is estimated.

Beyond the Standard Model / 289**Inclusive SUSY searches at CMS**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

In this talk, the latest results from CMS on inclusive searches for squark and gluino production at the LHC are reviewed. A variety of complementary final state signatures and methods are presented using 20/fb of data from the 8 TeV LHC run.

Poster Session / 290**SUSY searches with the razor variables at CMS**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

We discuss the latest SUSY search results using the razor kinematic variables at CMS. The stop, sbottom and gluino limits are presented in various benchmark simplified models and implications for natural SUSY are discussed.

Beyond the Standard Model / 291

3rd generation squark searches at CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

In this talk, the latest results from CMS on searches for stop and sbottom squarks are presented. Searches for direct 3rd generation squark production in a variety of decay channels are reviewed. The results are based on 20/fb of data collected during the 8 TeV LHC run.

Poster Session / 292

Searches for supersymmetry at CMS in final states with photons

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

In this talk, the latest results from CMS on searches for supersymmetry in final states with photons are presented using 20/fb of data from the 8 TeV LHC run. A variety of complementary final state signatures and methods are used to probe gluino, squark and Electroweak SUSY production.

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Searches for Electroweak SUSY production at CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

In this talk, the latest results from CMS on searches for supersymmetry produced through electroweak production channels are presented using 20/fb of data from the 8 TeV LHC run. A variety of complementary final state signatures and methods are used to probe gaugino and slepton production.

Poster Session / 294

Search for Supersymmetry with Higgs bosons in the final state

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Searches for standard model like Higgs bosons produced in cascade decays of SUSY particles are presented. This includes both strong as well as weak production, and higgs decays to final states with quarks, leptons and photons.

Poster Session / 296

Interpretations of CMS SUSY Search Results using Combinations across multiple final states

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

In this talk we discuss in detail how combinations of searches across multiple final states allow for detailed assessment of search sensitivity as a function of a wide range of branching fractions for sbottom, stop, gluino, chargino and neutralino decays to standard model particles plus a neutral LSP.

Poster Session / 299

Search for Beyond the Standard Model Physics in final states with 2,3, or 4 or more leptons

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

Multilepton final states provide for a variety of opportunities to search for beyond the standard model physics with low backgrounds. We summarize searches with 2,3,4, and more leptons, with and without MET, b-tags, or large amount of hadronic energy.

BEH Physics / 301

Higgs boson production constraints on anomalous fermion couplings

Prof. VALENCIA, German ¹

¹ Iowa State University

Corresponding Author: valencia@iastate.edu

Physics beyond the standard model (SM) can be parameterized with an effective Lagrangian that respects the symmetries of the standard model and contains many operators of dimension six. We consider the subset of these operators that is responsible for flavor diagonal anomalous color magnetic (CMDM) and electric (CEDM) dipole couplings between quarks and gluons. Invariance of these operators under the SM implies that they contribute to Higgs boson production at the LHC and we study the corresponding constraints that can be placed on them. In a similar manner we study the constraints that can be placed on lepton anomalous magnetic moments, electric dipole moments and weak dipole moments at the LHC.

Beyond the Standard Model / 303

Search for Long-lived particles at CMS

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

The most recent searches for long-lived particles at CMS is presented. Searches for displaced jets, displaced leptons, displaced tops, heavy stable charged particles, and stopped particles are among those discussed. A variety of models are constrained by these searches, ranging from hidden valleys to split supersymmetry.

Beyond the Standard Model / 304

Search for Dark Matter at CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

The search for Dark Matter at CMS is presented. Monojet, monophoton, and monolepton final states are all considered, as well as dark matter particles that are produced in association with top quarks. The interpretation of these results as a WIMP are discussed.

Poster Session / 306

Search for heavy resonances decaying to bosons at CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

The search for heavy resonances at CMS involving bosons are presented. These final states include diphoton, VV, VH, and HH resonances.

Beyond the Standard Model / 308

The LHC confronts the pMSSM

Mr. CAHILL-ROWLEY, Matthew ¹; Dr. RIZZO, Thomas ²; Prof. HEWETT, JoAnne ²; Dr. ISMAIL, Ahmed ³

¹ *SLAC National Accelerator Laboratory*

² *SLAC*

³ *Argonne National Laboratory*

Corresponding Author: mrowley@slac.stanford.edu

We explore the impact of current (7+8 TeV) and future (14 TeV) LHC searches on the range of viable sparticle spectra within the 19/20 – dimensional pMSSM. Considering both neutralino and gravitino LSPs, we compare our results with simplified model exclusion limits and describe important cases where the pMSSM results differ significantly from the simplified model descriptions. We also consider models that are poorly constrained by LHC data because of unusual decay topologies and/or displaced decays, and discuss ways to improve the LHC sensitivity in these scenarios. Finally, motivated by naturalness, we examine the sensitivity of current searches to models with light stops and to a specialized set of models with fine-tuning better than 1%. We show that a surprising variety of searches are sensitive to light stops, and that the 14 TeV LHC will be a very powerful probe of natural pMSSM models.

Astroparticle Physics and Cosmology / 310**First Results from the HAWC Gamma-Ray Observatory**

Dr. SALESA GREUS, Francisco ¹; COLLABORATION, The HAWC ²

¹ *Pennsylvania State University*

² *The HAWC Observatory*

Corresponding Author: sagreus@psu.edu

The High Altitude Water Cherenkov (HAWC) Observatory is a TeV gamma-ray detector located at an altitude of 4100 meters on the northern slope of the Sierra Negra volcano in the state of Puebla, Mexico. The detector will consist of 300 water Cherenkov detectors spread on a 22000 square meter area, and is expected to be fully operational by fall this year. Thanks to its large field-of-view, good angular resolution and >90% duty cycle, HAWC will allow us to study the Galactic sources at high energies (100 GeV - 100TeV), diffuse gamma-ray emission, and transient emissions from Active Galactic Nuclei and Gamma-Ray Bursts.

The detector started its continuous operation in August 2013 with a fraction of the array, and its size has been increasing since then. In this talk, I will present the first results of the experiment with almost one year of data.

Beyond the Standard Model / 311**Perturbative analysis of the electron electric dipole moment and CP violation in two-Higgs-doublet models**

Ms. IPEK, Seyda ¹

¹ *University of Washington*

Corresponding Author: ipek@uw.edu

I consider a general two-Higgs-doublet model with CP violation. I give a perturbative expansion for the mass eigenstates in terms of the small CP-violating phase. I use these analytical expressions to show that $O(0.01)$ CP violation is allowed by the experimental bounds on the electron electric dipole moment in some regions of the parameter space. These regions also include parameters that are expected to give a strongly first-order electroweak phase transition required for electroweak baryogenesis. I also comment on how to incorporate the CP violation into the searches for a strongly first-order electroweak phase transition which could explain the matter/antimatter asymmetry in the Universe.

Top-quark and ElectroWeak Physics / 312**P-odd and T-odd asymmetries in W-jet production and top-quark decay processes**

Dr. YOKOYA, Hiroshi ¹

¹ *University of Toyama*

Corresponding Author: hyokoya@sci.u-toyama.ac.jp

It is known that the parity-odd (P-odd) observables without spin measurements are naive-T-odd at the same time, and the naive-T-odd distributions arise from the absorptive part of the scattering amplitudes.

We study the P-odd and naive-T-odd asymmetries at the one-loop level in W+jet production and top-quark radiative decay processes, and their observabilities at collider experiments such as the LHC and the ILC, by using the loop-level event generator and realistic simulation tools.

We find that the expected accuracies in these experiments are enough to observe these asymmetries.

By comparing with the theoretical calculation, our understandings of the perturbative calculation on the absorptive part of the scattering amplitude can be studied.

Education and Outreach / 313

Cosmic-ray detectors for high-schools in France

Dr. ARNAUD, Nicolas ¹; Mrs. BERAT, Corinne ²; MARSOLLIER, Arnaud ³; PELHATE, Jean-Christophe ⁴; PIEZEL, Morgan ⁵; TRISTRAM, Gérard ⁶; BUSTO, José ⁷; CHARDIN, Gabriel ³; DUMORA, Denis ⁸; KAJFASZ, Eric ⁷; LETESSIER-SELVON, Antoine ⁶; LOTT, Benoit ⁸

¹ LAL (CNRS/IN2P3 and Université Paris Sud)

² LPSC, Université Grenoble-Alpes, CNRS/IN2P3, France

³ CNRS/IN2P3, 3 rue Michel-Ange, 75016 Paris, France

⁴ pLycée Jean-Pierre Vernant de Sèvres, 92310 Sèvres, France

⁵ Lycée Camille Claudel, 10000 Troyes, France

⁶ LPNHE, UPMC, Université Paris Diderot, CNRS/IN2P3, France

⁷ CPPM, Aix-Marseille Université, CNRS/IN2P3, Marseille, France

⁸ CENBG, UMR 5797, CNRS/IN2P3 Univ. Bordeaux, 33170 Gradignan, France

Corresponding Author: narnaud@lal.in2p3.fr

Teaching particle physics at high-school level is always challenging, one issue being that there is no easy window onto the world of the “infinitely small”. Cosmic rays are therefore an invaluable tool to allow the students to sense the elementary particles and to understand the problems raised by their detection.

In France, a collaboration started several years ago between the “Institut National de Physique Nucléaire et de Physique des Particules” (IN2P3) of the CNRS and “Sciences à l’Ecole”, a project from the French Education Ministry which is promoting science in high schools and higher education. Large cosmic ray detectors called “Cosmodétecteurs” are built in the Marseille IN2P3 laboratory (CPPM) and loaned to high school teachers selected by Sciences à l’Ecole. These teachers are trained prior to receiving the detector – a one week-long seminar at CERN, part of the High School Teacher program, plus a technical course in Marseille to learn how to use the apparatus. These teachers then exchange information through a dedicated internet forum and present the educational activities they develop with their Cosmodétecteur. There are currently 17 such detectors in France and 15 more will be released in 2014.

These cosmic-ray detectors consist in three mobile plastic scintillators, each coupled to a photomultiplier. The scintillators can be arranged in different geometries in order to perform several complementary experiments (flux and angular distribution of the cosmic rays, Auger-like and Rossi shower experiment, etc.). In addition, one larger block of scintillator allows the measurement of the muon lifetime. These devices are operated over long periods in order to fully exploit their potential. Therefore, they usually remain several months in the same location, under the responsibility of reference teachers educating their colleagues about using them. The Cosmodétecteur is routinely used by these teachers as a part of their pedagogical projects. As an example, in the framework of the “Olympiades de Physique 2010”, a project based on a Cosmodétecteur has been awarded.

IN2P3 is developing a different cosmic-ray detector, called COSMIX, which fits in a small case, is lighter and does not require any setting nor calibration – simply an USB power plug. This new detector, designed at the Gradignan IN2P3 laboratory (CENBG), uses spare scintillator bars from the Fermi satellite and custom electronics. It includes a GPS, a pressure-meter and a data acquisition system allowing data to be stored onto a SD memory card. Many applications are possible for this detector, of which about 15 copies will be produced this year: short introduction to cosmic rays in classrooms, demonstrations at the end of a public lecture or during an exhibit, etc. A collaborative website will allow participating teachers to publish their data while describing how they were acquired – one example: teachers from everywhere in France will be able to study the cosmic ray rates at the different floors of the Eiffel tower, hence reproducing Wulf’s experiment from 1909.

The well-recognized Cosmodétecteur, combined with the IN2P3 physical and technical knowledge and the Sciences à l’Ecole educational expertise, will allow more and more high-school students and teachers to discover particle physics through cosmic rays. The new IN2P3 COSMIX detector is a different tool which offers new opportunities to provide an introduction to cosmic rays to audiences which do not have access to a Cosmodétecteur. All the related activities will be presented in the talk proposed in the “Education and Outreach” ICHEP 2014 parallel session.

Poster Session / 314

P-odd effects in heavy ion collisions at NICA

Prof. SORIN, Alexander ¹; Prof. TERYAEV, Oleg ²

¹ *Joint Institute for Nuclear Research, Dubna*

² *Joint Institute for Nuclear research, Dubna*

Corresponding Author: sorin@theor.jinr.ru

Experimental manifestation of P-odd effects related to the vorticity and hydrodynamic helicity in non-central heavy ion collisions at MPD@NICA and BM@N detectors is discussed. For the NICA and FAIR energy range characterised by the large baryonic charge of the forming medium the effect should manifest itself in the specific neutron asymmetries. The polarization of strange particles probing the vorticity and helicity is also discussed.

Astroparticle Physics and Cosmology / 315

The status of KIMS-NaI experiment

Prof. LEE, Hyun Su ¹

¹ *Ewha Womans University*

Corresponding Author: hyunsulee@ewha.ac.kr

Although an observation of the dark matter is highly interesting in physics community, an observation of the WIMP, strong candidates of dark matter particles, claimed by DAMA/LIBRA experiment has not yet been clearly proved. Many advanced compelling experiments have observed null signals claiming rejections of the DAMA/LIBRA observation, but still some model dependent interpretations are alive. To prove the DAMA/LIBRA observation without any model dependent argument, it is very important to perform an experiment using same detector for same annual modulation signature.

Newly established KIMS-NaI experiment uses NaI(Tl) crystals as a scintillator to search WIMP in the Yangyang underground laboratory. We have planned growing of low background NaI(Tl) crystals about 200kg for the annual modulation searches in the same way of DAMA/LIBRA. The status including crystal growing, background characterization, and its reduction as well as the future prospect of KIMS-NaI experiment will be presented.

Accelerator Physics and Future Colliders / 316

An Introduction to CEPC/SppC Accelerator Design Status

Prof. GAO, Jie ¹

¹ *Institute of High Energy Physics*

Corresponding Author: gaoj@ihep.ac.cn

In this paper the status of CEPC/SppC will be reviewed covering project goals, accelerator design study status, time line, key design drivers, and accelerator physics challenges, et cetera.

BEH Physics / 317

Higgs Phenomenology of the Supersymmetric Grand Unification with the Hosotani Mechanism

KAKIZAKI, Mitsuru¹¹ *University of Toyama***Corresponding Author:** kakizaki@sci.u-toyama.ac.jp

The supersymmetric SU(5) grand unified theory whose gauge symmetry is broken by virtue of the Hosotani mechanism naturally realizes the huge mass splitting between the colored Higgs triplet and the electroweak Higgs doublet superfields, and predicts the existence of adjoint chiral multiplets with masses of the order of the supersymmetry breaking scale as a byproduct. The low-energy Higgs sector is extended to contain an SU(2)_L triplet chiral superfield with hypercharge zero and a neutral singlet as well as the ordinary electroweak Higgs doublets. We investigate the effects from the new triplet and singlet chiral multiplets on the predictions of the couplings of the standard model-like Higgs boson and the masses of the additional Higgs bosons. We show that our model can be differentiated from others through precision measurements of the couplings and masses of the Higgs sector particles. Our model serves as a good example of grand unification testable at colliders such as the luminosity up-graded Large Hadron Collider and future electron-positron colliders.

Poster Session / 318

Differential cross section of the Higgs boson measured in the diphoton decay channel with the CMS detector using 8TeV data

MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

This poster presents differential cross section measurements of the Higgs boson, performed in the diphoton decay channel. The dataset corresponds to 19.7 fb⁻¹ data of pp collisions at $\sqrt{s} = 8$ TeV, produced by the LHC and collected by the CMS detector in the year 2012. With its high signal selection efficiency, the diphoton decay channel is very well suited to probe the underlying kinematic properties of the signal production and decay. Several observables are studied, like p_T of diphoton system, rapidity of diphoton system etc. Results are compared to theoretical predictions.

Poster Session / 319

Search for $H \rightarrow b\bar{b}$ in association with single top quarks as a test of Higgs boson couplings

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

The production of a Higgs boson in association with a single top quark is one of a few channels which are sensitive for not yet excluded anomalous couplings of the Higgs boson to fermions. Multivariate analysis tools are used for the reconstruction and classification of signal events, where the Higgs boson decays into bottom quarks and the single top quark decays leptonically. In this talk the most recent results using the full dataset recorded by the CMS detector at 8 TeV are presented.

Poster Session / 320

Search for $H \rightarrow Z\gamma$ and $\gamma\gamma$ in CMS

MEYER, Arnd ¹

¹ RWTH Aachen University

Corresponding Author: meyera@cern.ch

The most recent CMS results on the search for the Standard Model Higgs boson in $Z\gamma$ and $\gamma\gamma$ channel, using the dataset recorded at the LHC from pp collisions at centre of mass energies of 7 and 8 TeV, will be presented. New physics models that predict a large enhancement of these branching ratios can be excluded.

Astroparticle Physics and Cosmology / 321

The Dark Energy Survey

Dr. SANCHEZ, Eusebio ¹

¹ CIEMAT

Corresponding Author: eusebio.sanchez@ciemat.es

The Dark Energy Survey (DES) is a next generation sky survey aimed directly at understanding the dark energy, by measuring the 14-billion-year history of cosmic expansion and the growth of structure in the universe with high precision.

During fall 2012 the DES collaboration installed and commissioned DECam, a 570 mega-pixel optical and near-infrared camera with a large 3 sq. deg. field of view, set at the prime focus of the 4-meter Blanco telescope in CTIO, Chile, and took the first set of science images for Science Verification. The first observing season then went from August 2013 to February 2014. Observing during five seasons, DECam will map an entire octant of the southern sky to unprecedented depth, measuring the position on the sky, redshift and shape of almost 300 million galaxies, together with thousands of galaxy clusters and supernovae. With this data set, DES will study the properties of dark energy using four main probes: galaxy clustering on large scales, weak gravitational lensing, galaxy-cluster abundance, and supernova distances. In this talk we present the current status of the project, and the plans and goals for the coming years.

Strong Interactions and Hadron Physics / 322

Last results of DIRAC experiment on study hadronic hydrogen-like atoms at PS CERN.

Dr. LEONID, Afanasyev ¹

¹ Joint Institute for Nuclear Research (JINR)

Corresponding Author: leonid.afanasyev@jinr.ru

Results on study the hydrogen-like atoms consisting of charged pions and Kaons are presented. The first measurement of $K+\pi^-$ and $K-\pi^+$ atoms lifetime was fulfilled basing on identification of 178 ± 49 $K\pi$ pairs from the atom breakup. The measured lifetime is $\tau = 2.5 \times (-1.8)^{+3.0}$ fs. This value is dictated by properties of the strong πK -interaction at low energy, namely S-wave πK scattering length. The first experimental value of the isospin-odd combination of S-wave πK scattering length was obtained $|a_0^-| = 1/3 |a_{(1/2)} - a_{(3/2)}| = (0.11 \pm (-0.04)^{+0.09}) M_\pi^{-1}$.

A dedicated experiment with $\pi+\pi^-$ atoms allows further study of these already observed atoms. The preliminary results on observation of the long-lived (metastable) states of $\pi+\pi^-$ atoms are presented. The observation of long-lived states opens the possibility to measure the energy difference between ns and np states – the Lamb shift.

Astroparticle Physics and Cosmology / 323

Latest results from the Pierre Auger ObservatoryProf. MIGUEL, Mostafa¹¹ Penn State University**Corresponding Author:** miguel@psu.edu

The Pierre Auger Observatory is the largest cosmic ray detector ever built. It was designed to detect the highest energy particles in the Universe, and it has been taking data since 2004. Our published results range from the measurement of the flux suppression at the highest energies to limits on ultra high energy neutrinos, from limits on the flux of EeV neutrons from the galaxy to the measurement of the proton-proton cross section at 57 TeV center-of-mass energy. In this talk I will present the most recent results obtained with the Pierre Auger Observatory, and the physics motivation, potential for discoveries, and current status of the upgrades to the Observatory.

Lattice QCD / 324

Effective Field Theory For QCD-like Theory at TeV scaleDr. LU, Jie¹; BIJNENS, Johan²¹ IFIC, University of Valencia² Lund University**Corresponding Author:** lu.jie@ific.uv.es

We study the Effective Field Theory of three QCD-like theories: which can be classified by having quarks in a complex, real or pseudo-real representation of gauge group. We wrote their effective field theories in a very similar way so that the calculations can be done using techniques from chiral perturbation theory.

We calculated the vacuum-expectation-value, the mass and the decay constant of pseudo-Goldstone Bosons up to next-to-next-to leading order (NNLO) in the first paper.

The various channels of general meson-meson scattering of the three cases were systematically studied and calculated up to NNLO in the second paper.

In the third paper, we calculated the vector, axial-vector, scalar, pseudo-scalar two-point functions and pseudo-scalar decay constant up NNLO order.

We also obtained the analytic S parameter for those different QCD-like theories at the TeV scale. Our results can be used for chiral extrapolation in lattice calculation on strong dynamical theory.

It might be also useful for research on the theory about finite baryon density.

Poster Session / 325

Resonance search for quark excitation in the gamma + jet final state at CMSMEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

This poster presents a search for excited quarks (q^*) decaying into a $\gamma + \text{jet}$ final state at $\sqrt{s} = 8$ TeV with the CMS experiment, using the dataset corresponding to an integrated luminosity of 19.7 fb^{-1} collected during 2012 data taking at the LHC. Photons and jets with high transverse momentum are selected to search for a resonance peak in the $\gamma + \text{jet}$ invariant mass distribution. The 95% confidence level upper limits on cross section times branching ratio are evaluated as a function of excited quark mass (M_{q^*}). We exclude at 95% CL excited quarks with $0.7 < M_{q^*} < 3.5$ TeV for standard model couplings, and present exclusions of excited quark mass as a function of coupling strength.

Flavour Physics / 327

High statistics measurement of the $K^+ \rightarrow \pi^0 e^+ \nu$ (Ke3) decay form-factorsProf. OBRAZTSOV, Vladimir ¹¹ *Institute for High Energy Physics, Protvino, Russian Federation***Corresponding Author:** vladimir.obraztsov@ihep.ru

The decay $K^+ \rightarrow \pi^0 e^+ \nu$ (Ke3) is studied using in-flight decays detected with the "OKA" setup, working in the RF-separated secondary K^+ beam of the U-70 synchrotron. About 10M events are available for the analysis. Preliminary results for the parameters of the $f_+(t)$ form-factor are presented. For the linear fit: $\lambda_+ = (2.984 \pm 0.04) \times 10^{-2}$; for the quadratic fit: $\lambda'_+ = (2.499 \pm 0.13) \times 10^{-2}$ $\lambda''_+ = (0.193 \pm 0.048) \times 10^{-2}$

For the Pole parametrization we get: $M_V = 0.889 \pm 0.005$ (GeV)For the Dispersive parametrisation: $\Lambda_+ = (2.462 \pm 0.032) \times 10^{-2}$

In the context of searches for exotic tensor and scalar terms we get:

$$F_T/f_+(0) = (1.20 \pm 1.6) \times 10^{-2}$$

$$F_S/f_+(0) = (0.154 \pm 0.5) \times 10^{-2}$$

Strong Interactions and Hadron Physics / 330

HERAPDF fits of the proton parton densitiesSCHMITT, Stefan ¹; WING, Matthew ²¹ *DESY*² *UCL***Corresponding Author:** stefan.schmitt@desy.de

New combined H1 and ZEUS data on neutral and charged current inclusive cross sections at HERA from all running periods 1994-2007, are used as the sole input to NLO and NNLO QCD analyses to determine new sets of parton distributions, HERAPDF2.0, with small experimental uncertainties and an estimate of model and parametrisation uncertainties. Charm and jet production data are also included in the fit to improve, in particular, the determination of the gluon density and the strong coupling, α_s . A HERAPDF fit, evolved in leading order (LO) in α_s using the DGLAP evolution equations, is also presented. The LO PDF is particularly useful for Monte Carlo event generators based on LO matrix elements plus parton showers.

Strong Interactions and Hadron Physics / 331**Charm final states at HERA**SCHMITT, Stefan ¹; WING, Matthew ²¹ DESY² UCL**Corresponding Author:** stefan.schmitt@desy.de

Recent measurements of final states including charm hadrons observed at the HERA collider are presented. The H1 and ZEUS collaborations combined their D* differential cross section measurements and reach precisions as good as 5-10%, whereas the theory uncertainties are much larger. Using the ZEUS experiment, D* production was measured at different centre-of-mass energies. The production of D1 and D*2 mesons were also measured. Charm fragmentation fractions were obtained for various charm hadrons and are found to be compatible with data collected at e+e- colliders. Finally, the production of inelastic J/psi mesons in the hadronic final state is investigated.

Strong Interactions and Hadron Physics / 332**Charm and beauty structure functions and heavy quark masses at HERA**SCHMITT, Stefan ¹; WING, Matthew ²¹ DESY² UCL**Corresponding Author:** stefan.schmitt@desy.de

The copious production of charm quarks at HERA has yielded a detailed understanding of QCD dynamics, the only measure of the charm contribution to the proton structure, as well as a measurement of the charm mass. Although with smaller samples, measurements of beauty production also place constraints on the structure of the proton and allow a measurement of the beauty quark mass. Several measurements of heavy quark production in deep inelastic scattering, using different decay modes, are presented, both new individual measurements from the H1 and ZEUS collaborations, as well as combined data. These provide a powerful vindication of the form of the gluon density in the proton derived from scaling violations of inclusive deep inelastic scattering data. QCD fits to the data lead to measurements of the charm and beauty masses and also provide precise predictions for e.g. W and Z production at the LHC.

Detector RD and Performance / 335

Strategies for using GAPDs as tracker detectors in future linear collidersDr. VILELLA, Eva¹; Dr. ALONSO, Oscar¹; Dr. VILÀ, Anna¹; Dr. DIÉGUEZ, Angel¹¹ *University of Barcelona***Corresponding Author:** evilella@el.ub.edu

After the recent discovery of the Higgs boson, refined measurements need to be done to unravel the properties of the new particle with high precision. These measurements will be performed in great part at future linear colliders, namely the International Linear Collider (ILC) and the Compact Linear Collider (CLIC). Nevertheless, the physics goals at the mentioned facilities impose such extreme requirements on detector systems that exceed those met by any previous technology. Amongst others, Geiger-mode Avalanche PhotoDiode (GAPD) detectors are being developed to track high energy particles at the next generation of particle colliders.

GAPDs offer outstanding qualities to meet the severe specifications of ILC and CLIC, such as an extraordinary high sensitivity, virtually infinite gain and ultra-fast response time, apart from compatibility with standard CMOS processes. In particular, GAPD detectors enable the direct conversion of a single particle event onto a CMOS digital pulse within the sub-nanosecond time scale. As a result, GAPDs can be read out after each single bunch crossing, a unique feature that none of its competitors can offer at the moment. In spite of all these advantages, GAPD detectors suffer from two main problems, specifically the inherently generated noise pulses and the low fill-factor. The noise pulses worsen the detector occupancy, while the low fill-factor reduces the detection efficiency.

In this work, solutions to the two problems commented that are compliant with the severe specifications of the future linear colliders have been thoroughly investigated. In particular, we will present the design and characterization, including the results of a beam-test campaign, of a prototype GAPD pixel detector in a standard CMOS process. The prototype is operated in the time-gated mode to fit the occupancy requirement. In addition, the design of a GAPD pixel detector in a 3D process to overcome the fill-factor limitation will also be discussed in detail. The 3D GAPD detector shows the maximum fill-factor ever reported with this sensor technology.

BEH Physics / 337

Higgs boson physics and LHC phenomenology in an inverted-hierarchy flavor symmetry modelDr. BERGER, Edmond¹¹ *Argonne National Laboratory, USA***Corresponding Author:** berger@anl.gov

\begin{abstract}

The LHC phenomenology of a low-scale gauged flavor symmetry model with inverted hierarchy is studied. A new scalar (a flavon) emerges with mass in the TeV range along with a new heavy fermion associated with the standard model top quark. After verifying the constraints from electroweak precision observables, we investigate the influence of the model on Higgs boson physics notably its production cross section and decay branching fractions. Limits on the flavon mass from heavy Higgs boson searches at the LHC at 7 and 8 TeV are presented. The branching fractions of the flavon are computed as a function of the flavon mass and the Higgs-flavon mixing angle. We also explore possible discovery of the flavon at 14 TeV, particularly the $\gamma \rightarrow Z^0 Z^0$ decay channel in the $2\ell 2\ell'$ final state, and standard model

Higgs boson pair production $\gamma \rightarrow hh$ in the $b\bar{b}\gamma\gamma$ final state. We conclude that the flavon mass range up to 500 GeV could probed down to quite small values of the Higgs-flavon mixing angle with 300 fb^{-1} of integrated luminosity at 14 TeV.

\end{abstract}

Astroparticle Physics and Cosmology / 339

Results of the LUX Dark Matter ExperimentCARMONA, Carmen ¹¹ *UC Santa Barbara***Corresponding Author:** carmona@physics.ucsb.edu

LUX (Large Underground Xenon) is a dark matter direct detection experiment deployed at the 4850' level of the Sanford Underground Research Facility (SURF) in Lead, SD, operating a 370 kg dual-phase xenon TPC. We have recently published the results of the first WIMP search run, presenting the analysis of 85.3 live-days with a fiducial volume of 118 kg, taken during the period of April to August 2013. The experiment exhibited a sensitivity to spin-independent WIMP-nucleon elastic scattering with a minimum upper limit on the cross section of $7.6 \times 10^{-46} \text{ cm}^2$ at a WIMP mass of $33 \text{ GeV}/c^2$, becoming the world's leading WIMP search result, in conflict with several previous claimed hints of discovery. In this talk I will provide an overview of the experiment, focusing in the recent science results, and an update on the next steps in the LUX program.

BEH Physics / 340

Measuring the Trilinear Higgs Coupling at the LHCProf. KAO, Chung ¹¹ *University of Oklahoma***Corresponding Author:** kao@physics.ou.edu

The results from the LHC indicate that the couplings of the Higgs boson to other particles are consistent with the Standard Model. However the final and ultimate test as to whether this particle is the standard Higgs boson will be the coupling of the Higgs boson to itself. We study the Higgs pair production from gluon fusion at the LHC and try to determine how accurately the trilinear Higgs coupling can be determined theoretically.

Let us introduce a general trilinear Higgs coupling as $\kappa \times \lambda_{\text{HHH}}(\text{SM})$. For the Standard Model, $\kappa = 1$.

We found that at the LHC with a center of mass of energy [\sqrt{s}] of 14 TeV, the measurement of cross section of 40 fb with negligible experimental error would only restrict κ to be between 0.86 and 1.12. For $\sqrt{s} = 100 \text{ TeV}$, the value of κ will be limited to be between 0.89 and 1.10 that is slightly better than the lower energy.

Flavour Physics / 341

Flavor Changing Heavy Higgs Interactions at the LHCProf. KAO, Chung ¹; Dr. ALTUNKAYNAK, Baris ¹; Prof. HOU, Wei-Shu ²; Dr. KOHDA, Masaya ²¹ *University of Oklahoma*² *National Taiwan University***Corresponding Author:** kao@physics.ou.edu

We adopt a general two Higgs doublet model to study flavor changing neutral Higgs interactions at the LHC. We focus on the production of a heavy Higgs boson (H) decaying into a top quark and a charm quark with the final state of $b c \ell \bar{\nu}$.

In the decoupling limit with a SM-like Higgs scalar (h), the production ($gg \rightarrow H$) and decay ($H \rightarrow tc$) of H can be sustained by $\sin(\beta - \alpha)$ that is close to one. Promising results have been found for the LHC with a collider energy of 13 TeV or 14 TeV.

Astroparticle Physics and Cosmology / 344**Status of the early construction phase of the BAIKAL-GVD**Dr. SHAYBONOV, Bair¹¹ *JINR***Corresponding Author:** bairsh@yandex.ru

The second-stage neutrino telescope BAIKAL-GVD in Lake Baikal will be a research infrastructure aimed mainly at studying astrophysical neutrino fluxes by recording the Cherenkov radiation of the secondary muons and showers generated in neutrino interactions. The design for the BAIKAL-GVD neutrino telescope is an array of photomultiplier tubes each enclosed in a transparent pressure sphere to comprise an optical module (OM). The OMs are arranged on vertical load-carrying cables to form strings. The final configuration of telescope will consist of 27 clusters of strings – functionally independent subarrays, which are connected to shore by individual electro-optical cables. Muon effective area rises from 0.3 km² at 1 TeV to about 1.8 km² asymptotically and shower effective volumes are about 0.4–2.4 km³ above 10 TeV. During the R phase of the GVD project in 2008–2010 years the basic elements of GVD – new optical modules, FADC readout units, underwater communications and trigger systems – have been developed, produced and tested in situ by long-term operating prototype strings in Lake Baikal. The prototyping/early construction phase of the BAIKAL-GVD project which aims at deployment and operation of the first Demonstration Cluster has been started in April 2011 with the deployment of a three string engineering array which comprises all basic elements and systems of the GVD in Lake Baikal and was connected to shore by electro-optical cable. Demonstration Cluster will comprise eight 345 m long strings of optical modules – seven peripheral strings are uniformly arranged at a 60 m distance around a central one. Each string comprises 24 OMs spaced by 15 m at depths of 950–1300 m below the surface. OMs on each string are combined in two sections – detection units of telescope. Also the Demonstration Cluster will comprise an acoustic positioning system and an instrumentation string with equipment for array calibration and monitoring of environment parameters. An important step on realization of the GVD project was made in 2013 by the deployment of the first stage of Demonstration Cluster which contains 72 OMs arranged on three 345 m long full-scale strings, as well as equipment of an acoustic positioning system and instrumentation string with an array calibration and environment monitoring equipment. This configuration has been upgraded to 5 string array in 2014. Deployment of the Demonstration Cluster will be completed in 2015.

The review of the design and status of the demonstration cluster construction will be presented.

Neutrino Physics / 345

Neutrinos from STOREd Muons, nuSTORM

Prof. LIU, Ao ¹; Dr. ADEY, David ²; Dr. LAGRANGE, Jean-Baptiste ³; Prof. BROSS, Alan ²

¹ *University of Indiana*

² *Fermilab*

³ *Imperial College, London*

Corresponding Author: bross@fnal.gov

Neutrino beams produced from the decay of muons in a racetrack-like decay ring (the so called Neutrino Factory) provide a powerful way to

study neutrino oscillation physics and in addition provide unique beams for neutrino interaction studies. The Neutrinos from STOREd Muons (nuSTORM) facility is a neutrino factory-like facility designed for short baseline neutrino oscillation and neutrino interaction studies. However, due to the particular nature of nuSTORM, it can also provide an intense, very pure, muon neutrino beam from pion decay which is possibly suitable for long-baseline neutrino oscillation searches as well. This so-called "Neo-conventional" muon neutrino beam from nuSTORM makes nuSTORM a hybrid neutrino factory.

In this talk, I will describe the facility and give a detailed description of the neutrino beam fluxes that are available at the facility and the precision to which these fluxes can be determined. I will present sensitivity plots that indicated how well the facility can

perform for short-baseline oscillation searches and show its potential for a neutrino interaction physics program. Finally, I will comment on the performance potential of the "Neo-conventional" muon neutrino beam available at the nuSTORM facility.

Lepton Flavour Violation / 349

The Zee Babu model revisited in the light of new data

HERRERO, Juan ¹

¹ *Universidad de Valencia-IFIC, CSIC*

Corresponding Author: juan.a.herrero@uv.es

We update previous analyses of the Zee-Babu model in the light of new neutrino and LFV data, and the LHC results. We also analyse the possibility of accommodating the deviations in Higgs the diphoton channel hinted by the LHC experiments, and the stability of the scalar

potential. We find that neutrino oscillation data and low energy constraints are still compatible with masses of the extra charged scalars accessible to LHC. Moreover, if any of them is discovered,

the model can be falsified by combining the information on the singly and doubly charged scalar decay modes with neutrino data. Conversely, if the neutrino spectrum is found to be inverted and the CP phase is quite different from π , the masses of the charged scalars will be well outside the LHC reach.

Computing and Data Handling / 350**Data processing and storage in the Daya Bay Reactor Antineutrino Experiment**Dr. HE, Miao ¹¹ *Institute of High Energy Physics, Beijing***Corresponding Author:** hem@ihep.ac.cn

The Daya Bay Reactor Antineutrino Experiment reported the first observation of the non-zero neutrino mixing angle θ_{13} using the first 55 days of data. It has also provided the most precise measurement of θ_{13} with the extended data to 217 days. Daya Bay will keep running for another 3 years or so. There is about 100TB raw data produced per year, as well as several copies of reconstruction data with similar data volume for each copy. The raw data is transferred to Daya Bay onsite and two offsite clusters: IHEP in Beijing and LBNL in California, with a short latency. There is quasi-real-time data processing at both onsite and offsite clusters, for the purpose of data quality monitoring, detector calibration and preliminary data analyses. The physics data production took place a couple of times per year according to the physics analysis plan. This talk will introduce the data transfer and storage, data processing and monitoring, and the automation of the calibration.

Lattice QCD / 351**Progress of lattice calculation of light-by-light contribution to muon $g-2$** Dr. SHINTANI, Eigo ¹¹ *Mainz Univ.***Corresponding Author:** shintani@kph.uni-mainz.de

I would like to present current progress of lattice calculation of muon $g-2$ for light-by-light contribution. We focus on the lattice calculation of non-perturbative contribution to neutral pion to two-photon decay transition form factor in light-by-light diagram. In this talk I will also compare with the direct computation in QED+QCD lattice simulation.

Poster Session / 352**Classification of lepton mixing patterns from flavour symmetries**FONSECA, Renato ¹; Prof. GRIMUS, Walter ²¹ *IFIC - Valencia*² *University of Vienna***Corresponding Author:** renato.fonseca@ific.uv.es

Flavour symmetries have been used to constrain both quark and lepton mixing parameters. In particular, they can be used to completely fix the mixing angles. For the lepton sector, assuming that neutrinos are Majorana particles, we have derived the complete list of mixing patterns achievable in this way, as well as the symmetry groups associated to each case. Partial computer scans done in the past have hinted that such list is limited, and this does indeed turn out to be the case. In addition, most mixing patterns are already 3-sigma excluded by neutrino oscillation data.

Neutrino Physics / 354

Updated three-neutrino oscillation parameters from global fits

Dr. TÓRTOLA, Mariam¹

¹ *IFIC, Valencia*

Corresponding Author: mariam@ific.uv.es

In this work we present an updated global fit to neutrino oscillation data within the three-flavour framework. The most recent data from solar and atmospheric neutrino experiments are included in our analysis together with the latest results from the long-baseline accelerator experiments T2K and MINOS and the recent measurements of reactor neutrino disappearance reported by Double Chooz, Daya Bay and RENO.

Poster Session / 355

The physics programme of next MICE Step IV

Prof. VITTORIO, Palladino¹

¹ *Univ INFN Napoli, Italy*

Corresponding Author: vittorio.palladino@na.infn.it

The International Muon Ionisation Cooling Experiment is progressing towards full demonstration of the feasibility of this cooling technology decisive for neutrino physics and muon colliders. Its next step IV should provide the first precise measurements of emittances and first evidence of cooling. Spectrometer solenoids, muon trackers and absorber-FC (focus coil) modules are being assembled to make this possible in 2015. The physics programme of ionization cooling Step IV measurements will be described in detail, with Li-H and a few other promising absorber materials of different shapes. It relies on progress of the hardware being detailed in a separate poster. The longer term final step V and step VI complete demonstration measurements being simultaneously prepared (re accelerating RFCC modules, RF cavities inside their own focusing CC ("coupling" coils) will also be outlined.

Accelerator Physics and Future Colliders / 356

The status of the construction of MICE Step IV

Prof. LONG, Kenneth ¹

¹ *Imperial College London*

Corresponding Author: vittorio.palladino@na.infn.it

Muon beams of low emittance provide the basis for the intense, well-characterised neutrino beams necessary to elucidate the physics of flavour at the Neutrino Factory and to provide lepton-anti-lepton collisions at the Muon Collider at energies of up to several TeV. The International Muon Ionization Cooling Experiment (MICE) will demonstrate ionization cooling; the technique by which it is proposed to reduce the phase-space volume occupied by the muon beam at such facilities.

Ionization cooling requires that a muon beam passes through a material (the absorber) in which it loses energy.

In an ionization-cooling channel, the energy lost in the absorber is replaced in a short linac.

The combined effect of energy loss and re-acceleration is to reduce the transverse emittance of the beam (transverse cooling).

MICE is being constructed in a series of Steps.

At Step-IV, MICE will be able to study the properties of liquid hydrogen and lithium hydride that affect cooling.

A solenoidal spectrometer will measure emittance upstream and downstream of the absorber vessel.

The muon beam will be focused at the absorber by a focusing coil.

The construction of Step-IV at the Rutherford Appleton Laboratory is well advanced and is scheduled to be complete early in 2015.

The status of the construction project will be described together with the performance of the principal components.

The demonstration of ionization cooling will be performed at Step-V which requires an additional absorber/focus-coil module and a short linac (the RF/coupling-coil module).

The status of preparation of the Step-V components will be briefly described.

Formal Theory Developments / 357

Vacuum instability in holography

Prof. HASHIMOTO, Koji ¹

¹ *Osaka university / RIKEN*

Corresponding Author: koji@phys.sci.osaka-u.ac.jp

We analyze vacuum instability of strongly coupled gauge theories in a constant electric field using AdS/CFT correspondence. The model is the $N = 2$ 1-flavor supersymmetric large N_c QCD in the strong 't Hooft coupling limit. We calculate the Euler-Heisenberg effective Lagrangian $L(E)$, which encodes the nonlinear response and the quantum decay rate of the vacuum in a background electric field E , from the complex D-brane action in AdS/CFT. We find that the decay rate given by $\text{Im}L(E)$ becomes nonzero above a critical electric field set by the confining force between quarks. A large E expansion of $\text{Im}L(E)$ is found to coincide with that of the Schwinger effects in QED, replacing its electron mass by the confining force.

Strong Interactions and Hadron Physics / 358

NLO QCD corrections to triple collinear splitting functions

DE FLORIAN, Daniel de Florian ¹; Dr. RODRIGO, German ²; Mr. SBORLINI, Germán ³

¹ *Universidad de Buenos Aires*

² *IFIC Valencia*

³ *IFIC and Universidad de Buenos Aires*

Corresponding Author: gfsborlini@df.uba.ar

We present splitting functions in the triple collinear limit at next-to-leading order in the strong coupling. We performed the computation in the context of massless QCD+QED, and consider first collinear processes which include at least one photon. The IR divergent structure of the multi-partonic splitting functions agrees with the Catani's formula. Consistency checks based on symmetry arguments have been implemented and results for different configurations have been cross-checked. Studying photon-started processes, we obtained very compact results which led us to conclude that it is not possible to generalize crossing-like identities involving the parent parton.

Poster Session / 359

The Higgs mass coincidence problem: why is the higgs mass $m_H^2 = m_Z m_{top}$?

Dr. EMILIO, torrente-lujan ¹

¹ *universidad de murcia*

Corresponding Author: etl@um.es

On the light of the recent LHC boson discovery, we present a phenomenological evaluation of the ratio $\rho_t = m_Z m_t / m_H^2$, from the LHC combined m_H value, we get (1 σ)

$$\rho_t^{(exp)} = 0.9956 \pm 0.0081.$$

This value is close to one with a precision of the order

1%. Similarly we evaluate the ratio $\rho_{Wt} = (m_W + m_t) / (2 m_H)$. From the up-to-date mass values we get

$$\rho_{Wt}^{(exp)} = 1.0066 \pm 0.0035; (1\sigma).$$

The Higgs mass is numerically close (at the 1% level) to the $m_H \sim (m_W + m_t) / 2$.

From these relations we can write any two mass ratios as a function of, exclusively, the Weinberg angle (with a precision of the order of 1% or better):

$$\begin{array}{l} \frac{m_i}{m_j} \simeq f_{ij}(\theta_W), \quad \text{quad } i, j = W, Z, H, t. \end{array}$$

For example:

$$\begin{array}{l} m_H / m_Z \simeq 1 + \sqrt{2} s_{\theta_W}^2, \\ m_H / m_t c_{\theta_W} \simeq 1 - \sqrt{2} s_{\theta_W}^2. \end{array}$$

In the limit $\cos \theta_W \rightarrow 1$ all the masses would become equal $m_Z = m_W = m_t = m_H$.

It is tempting to think that such a value, it is not a mere coincidence but, on naturalness grounds, a signal of some more deeper symmetry. In a model independent way, ρ_t can be viewed as the ratio of the highest massive representatives of the spin $(0, 1/2, 1)$ SM and, to a very good precision the LHC evidence tell us that $m_{s=1} m_{s=1/2} / m_{s=0}^2 \simeq 1$. Somehow the "lowest" scalar particle mass is the geometric mean of the highest spin 1, 1/2 masses.

We review the theoretical situation of this ratio in the SM and beyond. In the SM these relations are rather stable under RGE pointing out to some underlying UV symmetry. In the SM such a ratio hints for a non-casual relation of the type

$$\lambda \simeq \kappa \left(g^2 + \{g'\}^2 \right)$$

with $\kappa \simeq 1 + o(g/g_t)$.

Moreover the existence of relations

$$m_i / m_j \simeq f_{ij}(\theta_W)$$

could be interpreted as a hint for a role of the $SU(2)_c$ custodial symmetry,

together with other unknown mechanism. Without a symmetry at hand to explain then in the SM, it arises a Higgs mass coincidence problem, why the ratios ρ_t, ρ_{Wt} are so close to one, can we find a mechanism that naturally gives

$$m_H^2 = m_Z m_t, \quad 2m_H = m_W + m_t?$$

Formal Theory Developments / 360

N=2 SUGRA BPS Multi-center solutions, quadratic prepotentials and Freudenthal transformations

Dr. EMILIO, torrente-lujan ¹; Dr. FERNANDEZ-MELGAREJO, jose juan ²

¹ *universidad de murcia*

² *harvard university*

Corresponding Author: etl@um.es

We present a detailed description of $N=2$ stationary BPS multicenter black hole solutions for quadratic prepotentials with an arbitrary number of centers and scalar fields making a systematic use of the algebraic properties of the matrix of second derivatives of the prepotential, \mathcal{S} , which in this case is a scalar-independent matrix. In particular we obtain bounds on the physical parameters of the multicenter solution such as horizon areas and ADM mass. We discuss the possibility and convenience of setting up a basis of the symplectic vector space built from charge eigenvectors of the σ , the set of vectors $\{q_a\}$ with P_{σ} σ -eigenspace projectors.

The anti-involution matrix \mathcal{S} can be understood as a Freudenthal duality $\tilde{x} = \sigma x$. We show that this duality can be generalized to "Freudenthal transformations"
 $x \rightarrow \lambda \exp(\theta \sigma) x = a x + b \tilde{x}$
 under which the horizon area, ADM mass and intercenter distances scale up leaving constant the scalars at the fixed points. In the special case $\lambda=1$, " σ -rotations", the transformations leave invariant the solution. The standard Freudenthal duality can be written as $\tilde{x} = \exp\left(\frac{\pi}{2} \sigma\right) x$. We argue that these generalized transformations leave invariant not only the quadratic prepotential theories but also the general stringy extremal quartic form Δ_4 , $\Delta_4(x) = \Delta_4(\cos\theta x + \sin\theta \tilde{x})$ and therefore its entropy at lowest order.

Detector RD and Performance / 361**The LHCb VELO Upgrade**Dr. EKLUND, Lars¹¹ *University of Glasgow***Corresponding Author:** lars.eklund@cern.ch

The upgrade of the LHCb experiment, planned for 2018, will transform the experiment to a trigger-less system reading out the full detector at 40 MHz event rate. All data reduction algorithms will be executed in a high-level software farm with access to the complete event information. This will enable the detector to run at luminosities of $2 \times 10^{33} / \text{cm}^2/\text{s}$ and probe physics beyond the Standard Model in the heavy flavour sector with unprecedented precision.

The Vertex Locator (VELO) surrounding the interaction region is used to reconstruct primary and secondary vertices and measure the flight distance of long-lived particles. The upgraded VELO must be capable of fast pattern recognition and track reconstruction while maintaining the exceptional resolution of the current detector. This is realised through a hybrid pixel detector using silicon sensors with $55 \times 55 \text{ um}^2$ pitch, read out by the VeloPix ASIC which is being developed based on the TimePix/MediPix family. The hottest region will have pixel hit rates of 900 Mhits/s yielding a total data rate more than 3 Tbit/s for the upgraded VELO.

The detector modules are located in a separate vacuum, separated from the beam vacuum by a thin custom made foil. The foil will be manufactured through milling and possibly thinned further by chemical etching. The detector halves are retracted when the beams are injected and closed at stable beams, positioning the first sensitive pixel at 5.1 mm from the beams. The high data rates require development of low-mass, high-speed, flexible electrical serial links bringing the data out of the vacuum where electrical-to-optical conversion is performed.

The material budget will be minimised by the use of evaporative CO₂ coolant circulating in microchannels within 400 um thick silicon substrates. Microchannel cooling brings many advantages: very efficient heat transfer with almost no temperature gradients across the module, no CTE mismatch with silicon components, and low material contribution. This is a breakthrough technology being developed for LHCb.

The 40 MHz readout will also bring significant conceptual changes to the way in which the upgrade trigger is operated. Work is in progress to incorporate momentum and impact parameter information into the trigger at the earliest possible stage, using the fast pattern recognition capabilities of the upgraded detector. The current status of the VELO upgrade will be described together with a presentation of recent test results.

Poster Session / 362

Development of NEW, towards the first physics results of NEXT

Mr. MONRABAL CAPILLA, Francesc ¹; Mr. ALVAREZ, Vicente ¹; Dr. LIUBARSKY, Igor ¹; Mr. MARI, Antonio ²; MARTIN-ALBO SIMON, Justo ³; Mr. MARTINEZ, Alberto ¹; Mr. QUEROL, Marc ¹; Mr. RODRIGUEZ, Javier ¹; Dr. SOFKA, Clement ⁴; Dr. TOLEDO ALARCÓN, José Francisco ⁵; Mrs. CARCEL, Sara ¹; Dr. ESTEVE, Raul ²; GOMEZ CADENAS, Juan Jose ¹; Mr. LAING, Andrew ⁶

¹ IFIC

² UPV

³ IFIC-Valencia

⁴ TAMU

⁵ Universidad Politécnica de Valencia

⁶ University of Glasgow

Corresponding Author: franmon4@ific.uv.es

The NEXT $\beta\beta_{0\nu}$ experiment will use a high-pressure gas electroluminescent TPC to search for the decay of ^{136}Xe . The development, construction and installation of NEXT-WHITE (NEW), the first radio-pure version of NEXT, will take place this year at Laboratorio Subterráneo de Canfranc. NEW will run initially using 10 kg of natural xenon during which time NEXT technology will be validated and the topological reconstruction algorithms refined. Moreover, the background model will be benchmarked using data. A second run will use enriched xenon and will make a first measurement of the two neutrino channel ($\beta\beta_{2\nu}$).

This poster will present the various technical aspects of the detector detailing the radio-pure solutions for the low noise, high resolution measurement of both energy and position.

Poster Session / 363

Heavy quark impact factor in kT-factorisation

Dr. DEAK, Michal ¹; Dr. RODRIGO, German ²; Dr. CHACHAMIS, Grigorios ³

¹ IFIC/CSIC

² IFIC Valencia

³ IFIC/CSIC, Valencia

Corresponding Author: michal.deak@ific.uv.es

We present the calculation of the finite part of the heavy quark impact factor at next-to-leading logarithmic accuracy in a form suitable for phenomenological studies at the LHC within the kT-factorization scheme.

Astroparticle Physics and Cosmology / 364

Recent results from DAMA/LIBRA-phase1 and perspectivesDr. CERULLI, Riccardo ¹¹ *INFN-LNGS***Corresponding Author:** riccardo.cerulli@lngs.infn.it

The DAMA/LIBRA set-up (about 250 kg highly radiopure NaI(Tl)) is running at the Gran Sasso National Laboratory of the I.N.F.N..

This experiment is mainly dedicated to the investigation of Dark Matter (DM) particles in the galactic halo by exploiting the model independent DM annual modulation signature. In its first phase DAMA/LIBRA has collected data over 7 annual cycles corresponding to an exposure of 1.04 ton \times yr (DAMA/LIBRA--phase1).

The DAMA/LIBRA--phase1 and the former DAMA/NaI data (cumulative exposure 1.33 ton \times yr, corresponding to 14 annual cycles)

give evidence at 9.3 σ C.L. for the presence of DM particles in the galactic halo on the basis of the exploited model independent signature by using highly radio-pure NaI(Tl) target. No systematic or side reaction able to mimic the exploited DM signature has been found or suggested by anyone over more than a decade. After a relevant upgrading occurred at end 2010, DAMA/LIBRA-phase2 is in data taking in the new configuration equipped with new high quantum efficiency PMTs. The aim of the upgrade has been to lower the software energy threshold to 1 keV in order to improve the knowledge on corollary aspects regarding the signal. Here results, implications and experimental perspectives of the presently running DAMA/LIBRA--phase2 will be discussed.

Neutrino Physics / 365

Searching for Sterile Neutrinos and CP Violation: The IsoDAR and Daedalus ExperimentsProf. SHAEVITZ, Michael ¹¹ *Columbia University***Corresponding Author:** shaevitz@nevis.columbia.edu

The IsoDAR experiment uses a novel isotope decay-at-rest (DAR) source of electron antineutrinos using protons from a 60 MeV cyclotron. Paired with a large neutrino detector (such as KamLAND or WATCHMAN), the experiment can observe hundreds of thousands of inverse beta-decay events and do a decisive test of the current hints for sterile neutrino. Daedalus is a phased program leading to a high-sensitivity search for CP violation. The experiment uses a set of high-intensity 800 MeV cyclotrons to produce pion DAR neutrino sources at several locations (1.5km, 8km, and 20km) going to a single ultra-large, underground detector with free protons such as Hyper-K or LENA. The Daedalus experiment will provide a high-statistics antineutrino data set with no matter effects that can be combined with long-baseline data sets to provide enhanced sensitivity to CP violation and matter effects.

Education and Outreach / 366**Data Portfolio: Instructional materials provide particle physics data in high school classrooms**Ms. BARDEEN, Marge¹¹ *Fermilab***Corresponding Author:** mbardeen@fnal.gov

We discuss Data Portfolio (DP), a new suite of activities that provide experimental particle physics data to high school students and a professional development program for their teachers. DP is a website resource with a broad range of instructional materials that allows teachers to select activities of the correct level and scope for their students. Activities range from introductory to survey, investigation and exploration. DP incorporates existing elements such as masterclasses and e-Labs along with new ways of introducing students to physics concepts that underlie the data measurements and investigations. Evaluators have determined that these elements are in line with the latest standards and effective instructional models. To be successful, teachers need to be confident to use the materials, comfortable to step back so students can guide their own learning, and clever to convince administrators that they are meeting school and district requirements. Professional development workshops accompany the DP where participants experience some of these activities as their students would and plan how to use them in their classes. The first weeklong DP workshop is this July at Fermilab. We have also held outreach workshops in conjunction with ILC workshops around the world. DP is a product of QuarkNet, a long-term professional development program embedded in the U.S. particle physics research community and funded by the National Science Foundation and the U.S. Department of Energy and supported by universities and labs across the country.

Poster Session / 368**Calibration of the CMS Pixel Detector at the Large Hadron Collider**MEYER, Arnd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

The Compact Muon Solenoid (CMS) is one of two general-purpose detectors that reconstruct the products of high energy particle interactions at the Large Hadron Collider at CERN. The silicon pixel detector is the innermost component of the CMS tracking system. It determines the trajectories of charged particles originating from the interaction region in three points with high resolution enabling precise momentum and impact parameter measurements in the tracker. The pixel detector is exposed to intense ionizing radiation generated by particle collisions in the LHC. This irradiation could result in temporary or permanent malfunctions of the read-out chips. We developed procedures in order to correct for these effects. In this poster we present the types of malfunctions and the offline calibration procedures. We will also show both their effects on the performance of the detector and on the quality of track reconstruction.

Neutrino Physics / 369**Neff in low-scale seesaw models versus the lightest neutrino mass**Prof. HERNANDEZ, Pilar Hernandez Gamazo¹¹ *Universidad de Valencia***Corresponding Author:** marija.kekic@ific.uv.es

We evaluate the contribution to effective number of relativistic degrees of freedom of extra sterile states at their decoupling temperatures in Type I seesaw models with two and three extra sterile states as a function of the seesaw and the light neutrino mass.

Accelerator Physics and Future Colliders / 371

Accelerator on a Chip: Recent Progress

Prof. BYER, Robert L. ¹

¹ *Stanford University*

Corresponding Author: rlbyer@stanford.edu

Laser acceleration in dielectric structures offers a new approach to the next generation of accelerators. The recently demonstrated gradient of 300MeV/m is a first step toward an accelerator system with all essential elements designed to be fabricated on a chip using modern lithographic methods. Progress on beam position and the future possibilities of X-ray generation with a dielectric undulator will be discussed.

Neutrino Physics / 372

The KTY formalism and nonadiabatic contributions to the neutrino oscillation probability

YASUDA, Osamu ¹

¹ *Tokyo Metropolitan University*

Corresponding Author: yasuda@phys.se.tmu.ac.jp

It is shown that it is possible to obtain the analytical expression for the effective mixing angle in matter using the formalism which was developed by Kimura, Takamura and Yokomakura for the neutrino oscillation probability in matter with constant density. If we assume that the imaginary part of the integral of the difference of the energy eigenvalues of the two levels at each level-crossing is given by the ratio γ of the difference of the energy eigenvalues of the two levels to the derivative of the effective mixing angle at the level-crossing, then the nonadiabatic contribution to the oscillation probability can be expressed analytically by this formalism. We give one example in which the energy eigenvalues cannot be expressed as roots of a quadratic equation and we show that our assumption is correct in the approximation of the small mixing angle. (arXiv:1402.5569)

BEH Physics / 373

High Precision Prediction for the lightest CP-even MSSM Higgs-Boson Mass

Dr. HEINEMEYER, Sven ¹

¹ *IFCA (CSIC)*

Corresponding Author: sven.heinemeyer@cern.ch

We report on the currently highest precision calculation of the lightest Higgs boson mass, M_h , in the MSSM. We combine the Feynman-diagrammatic method (which gives the highest precision for low and medium mass SUSY mass scales) with an RGE resummation (which gives large contributions at high SUSY mass scales). The results are publicly available in the code FeynHiggs. We discuss the phenomenological implications of the new high-precision mass calculation.

Beyond the Standard Model / 374**SUSY Decays to Higgs bosons and their implications**Dr. HEINEMEYER, Sven¹¹ *IFCA (CSIC)***Corresponding Author:** sven.heinemeyer@cern.ch

We calculate with new precision the decays of SUSY particles to Higgs bosons. Using this new calculation we analyze the impact of these decays on current SUSY searches at the LHC as well as the prospects for measurements at a future e^+e^- collider.

Strong Interactions and Hadron Physics / 376**The loop-tree duality method at NLO and beyond**Dr. RODRIGO, German¹; Dr. CHACHAMIS, Grigorios²; Mr. BUCHTA, Sebastian¹; IOANNIS, Malamos¹¹ *IFIC Valencia*² *Paul Scherrer Institut***Corresponding Author:** german.rodrigo@ific.uv.es

The duality theorem provides a relationship between loop integrals and phase space integrals, such that virtual and real corrections in perturbative higher order calculations can be recast into a form which is suitable for a simultaneous simulation. We summarize recent developments of the loop-tree duality method at one-loop and higher orders.

Flavour Physics / 377**Towards a quantitative understanding of the $D \rightarrow \pi e \nu$ and $B \rightarrow \pi e \nu$ semileptonic decays**Prof. BECIREVIC, Damir¹; Prof. LE - YAOUANC, Alain¹; Dr. OYANGUREN, Arantza²; Prof. ROUDEAU, Patrick³; Dr. SANFILIPPO, Francesco⁴¹ *LPT Orsay*² *IFIC- Valencia*³ *LAL Orsay*⁴ *University of Southampton***Corresponding Author:** arantza.oyanguren@ific.uv.es

The charm semileptonic decay $D \rightarrow \pi e \nu$ has been measured by several experiments. Conversely to other semileptonic decays, this channel presents the interest that contributions from the two first poles can be predicted. We have computed accurately in LQCD the ratio of decay constants f_{D^*}/f_D making the evaluation of the D^* -pole contribution quite accurate. Measurements of the above charm semileptonic decay have been analyzed using a model with 3 poles, the last one being effective. It is found that data agree with the superconvergence condition according to which the sum of the residues at the various poles amounts to zero. This analysis is extended to $B \rightarrow \pi e \nu$ decays for which we compute the ratio f_{B^*}/f_B . We find that both decays verify the superconvergence condition which also assures validity of the heavy quark scaling law in the large recoil limit. We then verify that the value of V_{ub} we extract from a comparison with the experimental data is consistent with those previously found from the exclusive semileptonic decays.

Beyond the Standard Model / 378**Electroweak strongly coupled models with a light Higgs**Dr. ROSELL, Ignasi ¹; Dr. SANZ-CILLERO, Juan Jose ²; Prof. PICH, Antonio ³¹ *Universidad CEU Cardenal Herrera IFIC*² *Universidad Autónoma de Madrid - IFT*³ *Universitat de València - IFIC***Corresponding Author:** rosell@uch.ceu.es

We study strongly coupled models of electroweak symmetry breaking with a light Higgs boson. We use a resonance effective Lagrangian with bosonic massive resonances together with the Standard Model degrees of freedom, including a light Higgs. We consider constraints from the phenomenology and from the assumed high-energy behavior of the underlying theory. This resonance effective theory can be used to estimate the low-energy constants (LECs) of the Electroweak Effective Theory in terms of resonance parameters and to make predictions of low-energy observables like, for instance, the oblique parameters.

Strong Interactions and Hadron Physics / 379**Alpha_s determination from the C-parameter distribution**Dr. MATEU, Vicent ¹; Dr. HOANG, Andre ²; Prof. STEWART, Iain ³; Mr. KOLODRUBETZ, Daniel ³¹ *IFIC*² *MPI Munich*³ *MIT***Corresponding Author:** mateu@mit.edu

For the e^+e^- C-parameter we use soft-collinear effective theory to derive a factorization theorem, and then compute the cross section at N³LL + O(α_s^3). Differences with Thrust are highlighted. Our result holds for C in the peak, tail, and far tail regions, and we treat hadronization effects using a universal nonperturbative soft function defined in field theory. We analyze all available C-parameter tail data and obtain a global fit for $\alpha_s(m_Z)$ and one nonperturbative parameter Ω_1^C with χ^2/dof close to 1. These C-parameter results for $\alpha_s(m_Z)$ and Ω_1 are in excellent agreement with earlier results from thrust. Furthermore, for the first time we include hadron mass effects in the analysis of thrust and C-parameter experimental data.

Poster Session / 380**Secondary hadron distributions in two component model**Prof. RYSKIN, Mikhail ¹; Mr. BYLINKIN, Alexander ²¹ *The Petersburg Nuclear Physics Institute, Saint-Petersburg, Russia*² *IITP***Corresponding Author:** alexander.bylinkin@gmail.com

Inclusive charged hadron cross sections, $d\sigma/d\eta$, and the mean transverse momenta, $\langle p_T \rangle$, are considered within the two component model, which combines the power-like and the exponential terms in p_T . The observed dependences of the spectra shape on energy and the event multiplicity qualitatively agree with that expected from the Regge theory with the perturbative QCD pomeron. Finally, the dependences observed are used to make predictions on the mean transverse momenta, $\langle p_T \rangle$, as function of multiplicity at LHC-energies, which are tested on available experimental data. Predictions for further LHC-measurements at 14 TeV are also presented.

Heavy Ions / 381

Pion production in p+p and Be+Be interactions at the CERN SPS energies

Mr. ADUSZKIEWICZ, Antoni ¹

¹ *University of Warsaw*

Corresponding Author: antoni.aduszkiewicz@fuw.edu.pl

Evidence for the onset of deconfinement in central Pb+Pb collisions was reported by NA49 in fixed target measurements at beam momentum 30A GeV/c. This observation motivated the NA61/SHINE program started in 2009 at CERN SPS, which, in particular, aims to study properties of the onset of deconfinement by measurements of hadron production in proton-proton, proton-nucleus and nucleus-nucleus collisions.

This contribution presents spectra of charged pions produced in p+p interactions and ⁷Be+⁹Be collisions at 20A–158A GeV/c beam momentum. The NA61/SHINE results will be compared with the corresponding NA49 data from central Pb+Pb collisions at the same beam momenta per nucleon.

Top-quark and ElectroWeak Physics / 385

Elastic Z0 production at HERA

WING, Matthew ¹

¹ *UCL*

Corresponding Author: m.wing@ucl.ac.uk

A search for events $ep \rightarrow ep Z0$ has been performed in ep collisions at HERA using the ZEUS detector. The search is based on the entire HERA-I and HERA-II data set, amounting to 0.49 fb⁻¹ of integrated luminosity. The Z0 was searched in the di-jet decay mode with elastic condition defined by $\eta_{\text{max}} < 3$, where η_{max} is defined as the pseudorapidity of the energy deposit in the calorimeter closest to the proton beam direction. A di-jet mass peak is observed at the Z0 mass and the number of signal events is extracted from a fit to the mass spectrum. The elastic Z0 production cross section is determined and compared to the SM prediction.

Strong Interactions and Hadron Physics / 387

Hadronic final states at HERADr. BUSSEY, Peter ¹¹ *Glasgow University***Corresponding Author:** m.wing@ucl.ac.uk

The photoproduction of isolated photons, both inclusive and together with a jet, has been measured with the ZEUS detector at HERA using an integrated luminosity of 374 pb⁻¹. A variety of kinematic variables that are sensitive to different aspects of the event dynamics are studied. Cross sections are given in terms of the collinearity of the photon and the jet, the fraction of the proton energy involved in the interaction, and the pseudorapidity difference between the photon and the jet. These and other variables are also studied for different ranges of $x_{\text{gamma}}^{\{\text{meas}\}}$, the fraction of the photon energy involved in the interaction, in order to enhance the direct and resolved photon components of the process. Differential cross sections are also presented for inclusive isolated-photon production as functions of the transverse energy and pseudorapidity of the photon. Higher-order theoretical calculations are compared to the results. Measurements of normalised cross sections for the production of photons and neutrons at very small angles with respect to the proton beam direction in deep inelastic scattering are presented as a function of the Feynman variable x_F and of the centre-of-mass energy of the virtual photon-proton system, W . The data are taken with the H1 detector and correspond to an integrated luminosity of 131 pb⁻¹. The measurement is restricted to photons and neutrons in the pseudorapidity range $\eta > 7.9$. To test the Feynman scaling hypothesis the W dependence of the x_F dependent cross sections is investigated. Predictions of deep inelastic scattering models and of models for hadronic interactions of high energy cosmic rays are compared to the measured cross sections.

Poster Session / 392

Measurement of the cross-section ratio $\sigma_{\psi(2S)}/\sigma_{J/\psi}$ in deep inelastic exclusive ep scattering at HERAWING, Matthew ¹¹ *UCL***Corresponding Author:** m.wing@ucl.ac.uk

The exclusive deep inelastic electroproduction of $\psi(2S) \rightarrow \mu^+ \mu^-$, $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ and $J/\psi \rightarrow \mu^+ \mu^-$ have been studied with the ZEUS detector at HERA using an integrated luminosity of 354 pb⁻¹. The analysis was carried out in the kinematic range $5 < Q^2 < 70$ GeV², $30 < W < 210$ GeV and $|t| < 1$ GeV², where Q^2 is the photon virtuality, W the photon-proton centre-of-mass energy and t the squared four-momentum transfer at the proton vertex. The cross-section ratio $\sigma_{\psi(2S)}/\sigma_{J/\psi}$ has been measured as a function of Q^2 , W and t .

Astroparticle Physics and Cosmology / 396

Overview of MAGIC resultsDr. RICO, Javier ¹¹ IFAE**Corresponding Author:** jrigo@ifae.es

MAGIC is a system of two 17 m diameter Cherenkov telescopes, located at the Observatorio del Roque de los Muchachos, in the Canary island of La Palma (Spain). MAGIC performs astronomical observations of gamma-ray sources in the energy range between 50 GeV and 10 TeV, and is currently the most sensitive instrument below 100 GeV. The first MAGIC telescope has been operating since 2004, and in 2009 the system was completed with the second one. During 2011 and 2012 the electronics for the readout system were fully upgraded, and the camera of the first telescope replaced. After that, no major hardware interventions are foreseen in the next years, and the experiment has undertaken a final period of steady astronomical observations.

MAGIC studies particle acceleration in the most violent cosmic environments, such as active galactic nuclei, gamma-ray bursts, pulsars, supernova remnants or binary systems. In addition, it addresses some fundamental questions of Physics, such as the origin of Galactic cosmic rays and the nature of dark matter. Moreover, by observing the gamma-ray emission from sources at cosmological distances, we measure the intensity and evolution of the extragalactic background radiation, and perform tests of Lorentz Invariance.

In this talk I present the status and latest results of the MAGIC gamma-ray telescopes, with a special emphasis on topics of fundamental physics, astroparticle physics and cosmology.

Poster Session / 397

Inelastic J/Psi double differential cross sectionsWING, Matthew ¹¹ UCL**Corresponding Author:** m.wing@ucl.ac.uk

The double differential inelastic J/psi photoproduction cross section as function of the squared transverse momentum of the J/psi in bins of the inelasticity z has been measured in ep collisions with the ZEUS detector at HERA. An integrated luminosity of 468 pb⁻¹ was used corresponding to the full data sample collected by the ZEUS experiment. The events were required to have $0.1 < z < 0.9$, $p_t > 1$ GeV and $60 < W < 240$ GeV, where p_t is the transverse momentum of the J/psi and W is the photon-proton centre-of-mass energy. The J/psi mesons were identified through their decay into muon pairs. The double differential cross section measurements are compared to the most recent theoretical predictions.

Astroparticle Physics and Cosmology / 400

Baryogenesis from dark matter annihilationDr. RACKER, Jean ¹; Dr. RIUS, Nuria ²¹ IFIC² IFIC, Valencia University-CSIC**Corresponding Author:** juandiego.racker@gmail.com

We will start with a brief overview of ways to explain the similarity between the energy content of baryons and dark matter in the Universe. Then we will focus on scenarios of baryogenesis from dark matter annihilation, outlining the main ingredients. Finally we will present a variation of these mechanisms that brings a connection between the baryon asymmetry, dark matter, and neutrino masses.

Accelerator Physics and Future Colliders / 401

Design of the Electron Ion Collider - eRHIC

Dr. TRBOJEVIC, DEJAN¹; Prof. LITVINENKO, VLADIMIR¹; Dr. PTITSYN, Vadim²; Dr. BEN-ZVI, Ilan¹; Dr. ROSER, THOMAS¹

¹ Brookhaven National Laboratory

² Brookhaven National Laboratory

Corresponding Author: dejan@bnl.gov

We present a design of polarized electron - proton/He3+ and ion collider eRHIC in the present tunnel of the existing Relativistic Heavy Ion Collider (RHIC). Polarized electrons are accelerated up to the maximum energy of 21 GeV with a 1.334 GeV Energy Recovery Linac - ERL using two Non-Scaling Fixed Field Alternating Gradient (NS-FFAG) arcs. 70% polarized protons have an energy range 25-250 GeV, while the light ions (d, Si, Cu) and heavy ions (Au, U) have an energy range 10- 100 GeV/u, while the polarized He-3 ions 17-167 GeV/u. The ions (protons, He3+, ions) will be with a reduced emittance obtained by coherent electron cooling. Electron and ion beams collide with an angle of ~10 mrad, with a beta-squeeze of 5 cm luminosities above 10^{34} can be reached by using the crab cavities.

Flavour Physics / 402

Time-dependent CP violation measurements in B^0 decays from the Belle experiment

Prof. KWON, Youngjoon¹

¹ Yonsei University

Corresponding Author: yjkwon63@yonsei.ac.kr

We present the results of the time-dependent measurements of CP-violating parameters in B^0 decays to the final states ωK_S^0 and $\eta' K^0$. The results are obtained using the full statistics collected by the Belle experiment on $e^+ e^-$ asymmetric-energy collider KEKB, which corresponds to 772 million $B\bar{B}$ events.

Flavour Physics / 403

 $B^0 \rightarrow D K$ Dalitz plot analyses for ϕ_3 at Belle

Prof. KWON, Youngjoon¹

¹ Yonsei University

Corresponding Author: yjkwon63@yonsei.ac.kr

Dalitz plot analyses of $D \rightarrow K_S^0 h$ ($D = D^0$ or \bar{D}^0 , $h = K$ or π) decays following $B^0 \rightarrow D^{(*)} K^{(*)}$ decay provide sensitive measurements of CP-violating angle ϕ_3 . We present the first measurement of the CP-violating angle ϕ_3 using a model-dependent Dalitz plot analysis of $B^0 \rightarrow D K$, $D \rightarrow K_S^0 K^{\pm} \pi^{\mp}$ decays, and unique model-independent Dalitz plot analysis of $B^0 \rightarrow D K^{*}(892)^0$ decays followed by $D \rightarrow K_S^0 \pi^+ \pi^-$ and $K^{*}(892)^0 \rightarrow K^+ \pi^-$. These measurements use a full data set of 711 fb^{-1} collected at the $\Upsilon(4S)$ resonance by the Belle detector at the KEKB collider.

Flavour Physics / 404

D^0 and \bar{D}^0 mixing and CP violation results from Belle

Prof. KWON, Youngjoon ¹

¹ Yonsei University

Corresponding Author: yjkwon63@yonsei.ac.kr

We search for CP violation in D^0 and \bar{D}^0 decays to the $\pi^0 \pi^0$ final state and measure D^0 - \bar{D}^0 mixing in the decays of $D^0 \rightarrow K^+ \pi^-$ and $K_S^0 \pi^+ \pi^-$. The asymmetry obtained in the rate of D^0 and \bar{D}^0 decays to the $\pi^0 \pi^0$ final state, $[-0.03 \pm 0.64(\text{stat}) \pm 0.10(\text{syst})]\%$, is consistent with no CP violation. The mixing parameters are measured to be $x^2 = (0.09 \pm 0.22) \times 10^{-3}$ and $y' = (4.6 \pm 3.4) \times 10^{-3}$ for $D^0 \rightarrow K^+ \pi^-$, and $x = (0.56 \pm 0.19^{+0.03}_{-0.09})^{+0.06}_{-0.09}\%$ and $y = (0.30 \pm 0.15^{+0.04}_{-0.05})^{+0.03}_{-0.06}\%$ for $D^0 \rightarrow K_S^0 \pi^+ \pi^-$. In $D^0 \rightarrow K^+ \pi^-$, the ratio of doubly Cabibbo-suppressed to Cabibbo-favored decay rates $R_D = (3.53 \pm 0.13) \times 10^{-3}$, which excludes the no-mixing hypothesis at the 5.1 standard deviation level. In $D^0 \rightarrow K_S^0 \pi^+ \pi^-$, with CP-violation allowed, the parameters $|q/p| = 0.90^{+0.16}_{-0.15}{}^{+0.05}_{-0.04}{}^{+0.06}_{-0.05}$ and $\arg(q/p) = (-6 \pm 11)^\circ$ are found to be consistent with conservation of CP-symmetry in mixing.

Flavour Physics / 405

Semileptonic and leptonic B and B_s decays at Belle

Prof. KWON, Youngjoon ¹

¹ Yonsei University

Corresponding Author: yjkwon63@yonsei.ac.kr

Semileptonic B meson decays, $B \rightarrow X \ell \nu$, are currently the preferred modes for determining the Cabibbo-Kobayashi-Maskawa (CKM) matrix elements $|V_{cb}|$ and $|V_{ub}|$, two fundamental parameters of the Standard Model. At the same time they can also be used to test and refine the theoretical tools used for describing B mesons and their decays. Purely leptonic B meson decays, $B \rightarrow \ell \ell \nu$, are helicity-suppressed in the SM, and while more challenging for the extraction of the CKM matrix elements, they are excellent probes of models beyond the SM. The decay $B \rightarrow \mu \nu$ is at the edge of the sensitivity of current experiments, while $B \rightarrow e \nu$ will remain inaccessible to the next generation of experiments in the SM. Based on the large data sample accumulated by the Belle experiment at the KEKB asymmetric energy e^+e^- collider at KEK, Japan, we present new results on semileptonic and leptonic $B_{(s)}$ meson decays.

Flavour Physics / 406

Measurements of charmless B decays at Belle

Prof. KWON, Youngjoon ¹

¹ *Yonsei University*

Corresponding Author: yjkwon63@yonsei.ac.kr

We report measurements of the branching fraction (BF) and CP asymmetry (A_{CP}) for three rare charmless decays $B^0 \rightarrow \pi^0 \pi^0$, $B^0 \rightarrow \eta K^{*}(892)^0$ and $B^+ \rightarrow \bar{K}^{*}(892)^0 K^{*}(892)^+$. Previous measurements of the BF($B^0 \rightarrow \pi^0 \pi^0$) are significantly larger than theoretical expectations. The measured BF and A_{CP} in this mode are vital for the determination of the CP-violation parameter ϕ_2 based on isospin relations in $B \rightarrow \pi \pi$ decays. The mode $B^0 \rightarrow \eta K^{*}(892)^0$ is sensitive to a potentially large flavor-singlet contribution. Previous studies provided evidence for its existence at the 4σ level. The decay $B^+ \rightarrow \bar{K}^{*}(892)^0 K^{*}(892)^+$ proceeds via the $b \rightarrow d$ loop diagram and is sensitive to potential new physics contributions. All three measurements employ the full $\Upsilon(4S)$ data set of 711 fb^{-1} available at Belle and will be our final results for these modes. Further increases in sensitivity will be provided by the upcoming Belle II experiment.

Flavour Physics / 407

Measurement of the branching fraction of $B \rightarrow X_s \gamma$ and A_{CP} in $B \rightarrow X_{s+d} \gamma$ from Belle

Prof. KWON, Youngjoon ¹

¹ *Yonsei University*

Corresponding Author: yjkwon63@yonsei.ac.kr

The radiative B decays proceed through a loop diagram and are sensitive to New Physics. We perform measurements of the branching fraction of $B \rightarrow X_s \gamma$, where X_s is the hadronic state with strangeness. Using a semi-inclusive method in which X_s is reconstructed with 38 exclusive modes, the inclusive branching fraction in $M_{X_s} < 2.8$ GeV is measured. We also report the measurement using the recoil tag method. The Standard Model predicts null CP asymmetry (A_{CP}) of $B \rightarrow X_{s+d} \gamma$, where X_{s+d} is the hadronic state with strange or down quark. We present a measurement of A_{CP} with lepton tag. The analyses are based on the full data set of Belle containing 772 million $B \bar{B}$ pairs.

Poster Session / 408

Tree-level new physics searches in B decays to τ leptons at Belle

Prof. KWON, Youngjoon ¹

¹ *Yonsei University*

Corresponding Author: yjkwon63@yonsei.ac.kr

Semileptonic and leptonic B meson decays involving a heavy τ lepton are sensitive to new physics scenarios with an extended Higgs sector, such as the type II two Higgs doublet model. Branching ratios for the decays $B \rightarrow D^{*} \tau \nu$ and $B \rightarrow D \tau \nu$ in excess of the Standard Model expectation reported by both the Belle and BaBar experiments have thus generated broad interest. In this talk we report on updated results of semileptonic and leptonic B meson decays involving a τ lepton, based on the large data sample accumulated by the Belle experiment at the KEKB asymmetric energy $e^+ e^-$ collider at KEK, Japan.

Poster Session / 409

Search for new physics with electroweak penguin decays of B and B_s mesons from Belle

Prof. KWON, Youngjoon¹¹ Yonsei University**Corresponding Author:** yjkwon63@yonsei.ac.kr

We present the measurements of electroweak penguin decays of B and B_s mesons, which are sensitive to New Physics. We have measured the forward-backward asymmetry in $B \rightarrow X_s \ell^+ \ell^-$ using a semi-inclusive reconstruction technique. We also report the differential branching fraction, isospin asymmetry, K^* -polarization, and forward-backward asymmetry of the exclusive $B \rightarrow K^{(*)} \ell^+ \ell^-$ process. Some New Physics scenarios predict an enhancement of the branching fraction of $B_{(s)} \rightarrow \gamma \gamma$ processes. We present the result of the search for these processes. We also present the study of $B \rightarrow K_{1(1270/1400)} \gamma$, which can be used to measure the photon polarization of $B \rightarrow s \gamma$ process. Finally, we present the result of time-dependent CP violation in the $B \rightarrow \eta K_S^0 \gamma$ decays. The emitted photons in $B \rightarrow s \gamma$ decays are predominantly left-handed in the Standard Model (SM), leading to a very little CP asymmetry. Therefore it is sensitive to new physics beyond SM from right-handed current. The analyses are based on the full data set of Belle

Poster Session / 410

Studies of the Dark Sector at Belle

Prof. KWON, Youngjoon¹¹ Yonsei University**Corresponding Author:** yjkwon63@yonsei.ac.kr

Many extensions of the Standard Model (SM) introduce an additional U(1) interaction, which is mediated by a U(1) boson, often by a Higgs mechanism adding a dark Higgs (or dark Higgses) to the models. This gauge boson, also known as the dark photon, typically has very weak coupling to SM particles and of low mass (MeV to GeV). The ideal tools to discover such particles are therefore not high-energy collider experiments, but lower-energy high-luminosity collider experiments or dedicated fixed target experiments. The dark photon and dark Higgs were searched for, using the entire data set collected by Belle (977 fb^{-1}) in the Higgs-strahlung channels: $e^+ e^- \rightarrow A' h$, with $h \rightarrow A' A'$ and $A' \rightarrow \ell^+ \ell^-$ (with $\ell = e$ or μ) or $A' \rightarrow \pi^+ \pi^-$ and for mass ranges, respectively of $0.15 < m_{A'} < 3.5 \text{ GeV}/c^2$ and $0.5 < m_{h'} < 10.5 \text{ GeV}/c^2$. The Belle results for the prompt case analysis will be presented.

Strong Interactions and Hadron Physics / 412

Quarkonium (-like) states at BELLE

Prof. KWON, Youngjoon ¹

¹ *Yonsei University*

Corresponding Author: yjkwon63@yonsei.ac.kr

Studies of quarkonium and quarkonium-like states have led to several surprises in understanding the strong interaction phenomena. Most notably, exotic resonances that cannot be accommodated with the conventional quarkonium pictures including $X(3872)$, $Z_c(4430)^\pm$, $Z_b(10610)^\pm$ and $Z_b(10650)^\pm$ have been discovered by Belle. In this presentation, we report recent results from Belle on quarkonium and quarkonium-like states at Belle, in B-meson decays, $\Upsilon(nS)$ decays and in ISR processes.

For charmonium(-like) states in B decays, we present new decay modes of $X(3872)$ and $X(3823)$, a new charged state $Z_c(4210)^\pm \rightarrow J/\psi \pi^\pm$, and searches for neutral and charged isospin partners of $D_{s0}(2317)^\pm$. In the ISR processes, we present a search for Z_{cs} , a partner state of $Z_c(3900)$, in $e^+ e^- \rightarrow K^+ K^- J/\psi$, improved measurements of $Y(4360)$ and $Y(4660)$ parameters, and search for new resonances in $e^+ e^- \rightarrow \gamma \chi_{cJ}$.

For bottomonium(-like) states, we present final results of the 6-dimensional amplitude analysis of the $\Upsilon(5S) \rightarrow \Upsilon(1S,2S,3S) \pi^+ \pi^-$ decays which determines the spin-parities of $Z_b(10610)$ and $Z_b(10650)$; energy scan of $\sigma[e^+ e^- \rightarrow \{\text{hadrons}\}]$ and $\sigma[e^+ e^- \rightarrow \Upsilon(1S,2S,3S) \pi^+ \pi^-]$ in the region of the $\Upsilon(5S)$ and $\Upsilon(6S)$ resonances; observation of $\Upsilon(4S) \rightarrow h_b(1P) \eta$ transitions using the $h_b(1P) \rightarrow \eta_b(1S) \gamma$ decays; and the first observation of several new hadronic and radiative transitions, that shed light on the nature of highly excited states. We also present double charmonium production in exclusive bottomonium decays with an evidence for $\Upsilon(1S) \rightarrow J/\psi \chi_{c1}$.

Poster Session / 415

Collins fragmentation in kaon production at Belle

Prof. KWON, Youngjoon ¹

¹ *Yonsei University*

Corresponding Author: yjkwon63@yonsei.ac.kr

Fragmentation functions (FFs) describe the formation of final state particles from a partonic initial state and are directly related to the QCD phenomenon of confinement. Precise knowledge of these functions is a key ingredient in accessing quantities such as the nucleon spin structure in semi-inclusive deep inelastic scattering (SIDIS) and proton-proton collisions. Using Belle data, we study the Collins fragmentation mechanism in kaon production. Such mechanism entails a correlation between the transverse polarization of the fragmenting quark and the outgoing direction of the produced hadron. Knowledge of the Collins FF is a necessary input in the study and extraction of the transversity distribution function from SIDIS and pp reaction.

Top-quark and ElectroWeak Physics / 419

Measurements of electroweak properties of τ lepton at the Belle experiment

Prof. KWON, Youngjoon ¹

¹ *Yonsei University*

Corresponding Author: yjkwon63@yonsei.ac.kr

We present preliminary result of the measurement of Michel parameters in leptonic τ decays and search for the Electric Dipole Moment of the τ lepton using the world-largest τ data sample collected by the Belle detector at the KEKB collider. Michel parameters are extracted from $\tau^{\pm} \rightarrow \ell^{\pm} \nu \nu$, $\tau^{\pm} \rightarrow \pi^{\pm} \pi^0 \nu$ and $\tau^{\pm} \rightarrow \pi^{\pm} \pi^0 \nu$, $\tau^{\pm} \rightarrow \pi^{\pm} \pi^0 \nu$ events in Belle's full τ data sample, where $\tau^{\pm} \rightarrow \pi^{\pm} \pi^0 \nu$ is used as a spin analyzer since τ spin information is necessary to evaluate Michel parameters. The Electric Dipole Moment of the τ lepton is one of the fundamental parameters and useful to discuss the new physics as a signal of it through CP violating loop effect. We have analyzed $\tau^+ \tau^- \rightarrow e^+ e^- \tau^+ \tau^-$ vertex effect from the $e^+ e^- \rightarrow \tau^+ \tau^-$ reaction in Belle's full τ data sample which is about 30 times larger than that used at the previous measurement.

Beyond the Standard Model / 420

Search for Nucleon Decay in Super-Kamiokande

Dr. MIURA, Makoto ¹

¹ *Kamioka observatory, ICRR*

Corresponding Author: miuram@icrr.u-tokyo.ac.jp

Nucleon decay search is one of key for opening a door to Grand Unified Theories (GUTs). A favored proton decay mode by GUTs based on SU(5) symmetry is $p \rightarrow e^+ \pi^0$. On the other hand, SUSY moderated GUTs prefer $p \rightarrow \nu K^+$. The Super-Kamiokande, a large water cherenkov detector, has been running more than 10 years and it is suitable for the nucleon decay search. In this talk, the latest results of nucleon decay searches in Super-Kamiokande will be presented.

Accelerator Physics and Future Colliders / 421

Status of the NICA Project at JINR

Prof. KEKELIDZE, Vladimir ¹; Prof. KOVALENKO, Alexander ¹; Prof. LEDNICKY, Richard ²; Prof. MATVEEV, Viktor ¹; Prof. MESHKOV, Igor ²; Prof. SORIN, Alexander ³; Prof. TRUBNIKOV, Grigory ²

¹ *Joint Institute for Nuclear Research, Dubna*

² *Joint Institute for Nuclear research, Dubna*

³ *Joint Institute for Nuclear Research*

Corresponding Author: kekelidze@jinr.ru

The NICA (Nuclotron-based Ion Collider fAcility) project is now under active realization stage at the Joint Institute for Nuclear Research (JINR, Dubna). The main goal of the project is an experimental study of hot and dense strongly interacting matter in heavy ion (up to Au) collisions at centre-of-mass energies up to 11 GeV per nucleon. Two modes of operation is foreseen, collider mode and extracted beams, with two detectors: MPD and BM@N. In the collider mode expected average luminosity is $10E27 \text{ cm}^{-2} \text{ s}^{-1}$ for Au(79+). The fixed target experiment BM@N at the JINR superconducting synchrotron Nuclotron is in preparation stage. Extracted beams of various nuclei species with maximum momenta 13 GeV/c (for protons) will be available. The NICA project also foresees a study of spin physics with extracted and colliding beams of polarized deuterons and protons at the energies up to 26 GeV (for protons). The proposed program allows to search for possible signs of the phase transitions and critical phenomena as well as to shed light on the problem of nucleon spin structure.

Top-quark and ElectroWeak Physics / 422

Top-quark pair production at hadron colliders: differential cross section and phenomenological applications with DiffTop

Dr. GUZZI, Marco ¹; Prof. MOCH, Sven-Olaf ²; Dr. LIPKA, Katerina ¹

¹ *DESY Hamburg*

² *University of Hamburg, DESY Hamburg, DESY Zeuthen*

Corresponding Author: marco.guzzi@desy.de

We study heavy-flavor production at hadron colliders and present phenomenological results for the differential top-quark pair production cross section calculated in perturbative QCD at approximate next-to-next-to-leading order (NNLO) $\mathcal{O}(\alpha_s^4)$.

Methods of threshold resummation in QCD are utilized for this calculation which is implemented in the computer code `\textsc{DiffTop}`. Transverse momentum and rapidity distributions of final-state top quarks are computed at the LHC center-of-mass energies and compared to recent measurements of the CMS and ATLAS collaborations, which are found to be in very good agreement.

Poster Session / 423

A new jet reconstruction algorithm for e+e- collidersDr. VOS, marcel¹; Mr. GARCIA, Nacho²; Mr. BORONAT AREVALO, Marçà³¹ *IFIC Valencia*² *PhD student*³ *PHD student***Corresponding Author:** marcel.vos@ific.uv.es

Full-simulation studies of jet reconstruction at future e+e- colliders at the energy frontier have shown that the overlaid energy deposits due to the gamma gamma -> hadrons background can have an important impact on the performance. We present a new sequential recombination algorithm for e+e- colliders and compare its performance to the most commonly used jet reconstruction algorithms. The Valencia algorithm is found to be significantly more robust in the presence of background.

Detector RD and Performance / 424

Potential and challenges of the physics measurements with very forward detectors at linear collidersProf. BOZOVIC JELISAVCIC, Ivanka¹¹ *Vinca Institute of Nuclear Sciences***Corresponding Author:** slukic@vinca.rs

The very forward region of the detector at a future linear collider will be instrumented with two sampling calorimeters - BeamCal and LumiCal - for fast beam parameter estimates, precise luminosity measurements, as well as for the improvement of the hermeticity of the detector at small angles. These very forward calorimeters are designed to sustain high radiation doses and deliver precise and valuable data for the machine- and physics-related measurements. In this talk the challenges of the luminosity measurement, as well as of the low-angle particle identification will be discussed, and some of the possible solutions will be presented.

Poster Session / 425

Primary and secondary production of heavy quarks in final state jetsDr. MATEU, Vicent¹; Dr. HOANG, Andre¹; Dr. BUTENSCHOEN, Mathias²; Mr. PIETRULEWICZ, Piotr¹; Mr. DEHNADI, Bahman¹¹ *University of Vienna*² *University of Viena***Corresponding Author:** mateu@mit.edu

We present results for the production of primary heavy quarks in final state jets, as well as secondary radiation of heavy quark pairs related to gluon splitting. We focus in the thrust and C-parameter distributions for e+e- collisions. The results are given in the dijet limit where the hard interaction scale and the scales related to collinear and soft radiation are widely separated. In this limit one can use Soft-Collinear Effective Theory with the inclusion of mass modes in order to factorize the cross section and perform resummation of large Sudakov logs at N3LL order. When the invariant mass of the massive jet is close to the heavy quark mass we match onto a boosted Heavy Quark Effective Theory to sum up a new class of large logs along with the treatment of finite width effects. Our results are relevant for determining the bottom mass, and more importantly for the measurement of the top mass at a future linear collider.

Accelerator Physics and Future Colliders / 426**Future Accelerators at the Particle Physics Frontier**Prof. CHATTOPADHYAY, Swapan ¹¹ *Cockcroft Institute***Corresponding Author:** swapan@cockcroft.ac.uk

A general overview of concepts, designs, technologies and future possibilities will be presented for energy and intensity frontier accelerators and colliders for particle physics in the next 50 to 100 years, offering a scientific, technical and fiscal risk-benefit analysis and strategies to move forward. The talk will discuss the near-, mid-, and long-term future options including various linear and circular colliders for lepton, hadron and lepton-hadron collisions (including the Future Circular Colliders (FCC) at CERN and its global equivalents elsewhere) and high intensity neutrino beams as well as an analysis of advanced acceleration schemes involving lasers, plasmas, crystals, etc. The important factors of energy consumption, efficiencies, capital and operating costs including a “green” agenda will be presented. Finally, alternative schemes to reach the high energy frontier relevant to “dark matter” and “dark energy” via non-accelerator laboratory-scale set-ups using cavities, atoms, lasers and plasmas will be explored.

Detector RD and Performance / 427**ATLAS Upgrades for the next Decades**Dr. GREGOR, Ingrid-Maria ¹¹ *DESY***Corresponding Author:** ingrid.gregor@desy.de

After the successful LHC operation at the center-of-mass energies of 7 and 8 TeV in 2010 - 2012, plans are actively advancing for a series of upgrades of the accelerator, culminating roughly ten years from now in the high luminosity LHC (HL-LHC) project, delivering of the order of five times the LHC nominal instantaneous luminosity along with luminosity leveling. The final goal is to extend the dataset from about few hundred fb⁻¹ expected for LHC running to 3000 fb⁻¹ by around 2035 for ATLAS and CMS. In parallel the experiments need to be kept lockstep with the accelerator to accommodate running beyond the nominal luminosity this decade.

Current planning in ATLAS envisions significant upgrades to the detector during the consolidation of the LHC to reach full LHC energy and further upgrades. The challenge of coping with the HL-LHC instantaneous and integrated luminosity, along with the associated radiation levels, requires further major changes to the ATLAS detector. The designs are developing rapidly for a new all-silicon tracker, significant upgrades of the calorimeter and muon systems, as well as improved triggers and data acquisition. This report summarizes various improvements to the ATLAS detector required to cope with the anticipated evolution of the LHC luminosity during this decade and the next.

Accelerator Physics and Future Colliders / 428

AWAKE : A proton-driven plasma wakefield acceleration experiment at CERNWING, Matthew¹; BRACCO, Chiara²; Dr. GSCHWENDTNER, Edda²¹ UCL² CERN**Corresponding Author:** m.wing@ucl.ac.uk

The AWAKE Collaboration has been formed in order to demonstrate proton-driven plasma wakefield acceleration for the first time. This technology could lead to future colliders of high energy but of a much reduced length compared to proposed linear accelerators. The CERN SPS proton beam in the CNGS facility will be injected into a 10 m plasma cell where the long proton bunches will be modulated into significantly shorter micro-bunches. These micro-bunches will then initiate a strong wakefield in the plasma with peak fields above 1 GV/m that will be harnessed to accelerate a bunch of electrons from about 20 MeV to the GeV scale within a few meters. The experimental program is based on detailed numerical simulations of beam and plasma interactions. The main accelerator components, the experimental area and infrastructure required as well as the plasma cell and the diagnostic equipment are discussed in detail. First protons to the experiment are expected at the end of 2016 and this will be followed by an initial 3-4 year experimental program. The experiment will inform future larger-scale tests of proton-driven plasma wakefield acceleration and applications to high energy colliders.

Heavy Ions / 429

LHCb results in proton-nucleus collisions at the LHCLEROY, Olivier¹¹ CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France**Corresponding Author:** olivier.leroy@in2p3.fr

The production of J/ψ and Y -mesons decaying into dimuon final state is studied at the LHCb experiment, with rapidity $1.5 < y < 4.0$ or $-5.0 < y < -2.5$ and transverse momentum $p_T < 15$ GeV/c, in proton-lead collisions at a proton-nucleon centre-of-mass energy of 5 TeV. The analysis is based on a data sample corresponding to an integrated luminosity of 1.6/nb. The forward-backward production ratio and the nuclear modification factor are determined for J/ψ and $Y(1S)$. Indication of forward backward production asymmetry is observed. There is also an indication of J/ψ and $Y(1S)$ production suppression with respect to proton-proton collisions in forward region and anti-shadowing effect in backward region. Results on vector boson production are also presented.

Flavour Physics / 430

Measurement of the CKM angle γ with $B_s \rightarrow D_s K$ decaysLEROY, Olivier¹¹ CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France**Corresponding Author:** olivier.leroy@in2p3.fr

The angle γ is the least constrained parameter in the CKM unitarity triangle. Its determination in decays induced by tree-level $b \rightarrow c$ transitions is largely unaffected by potential new physics contributions. This allows for a consistency check of the unitarity triangle, but also of comparisons with γ determinations from modes with loop-diagrams. We present here a new precise determination of γ using a time-dependent flavour-tagged analysis of $B_s \rightarrow D_s K$ decays.

Flavour Physics / 431

Dalitz analyses with $B \rightarrow Dh$ decays

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Decays of b-hadrons to states including open charm provide a rich laboratory to constrain the unitarity matrix and search for new physics. We present recent measurements in this sector, including observations of new decay modes, CP violation and effective lifetime measurements.

Flavour Physics / 432

Electroweak penguins at LHCb

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Electroweak penguin b-hadron and c-hadron decays are very sensitive to physics beyond the Standard Model. Recent LHCb measurements have shown indications of large unexpected asymmetries in $B \rightarrow K^* \mu \mu$ and the first observation of the photon polarisation in $b \rightarrow s \gamma$ decays. We report the most recent LHCb results in this sector.

Flavour Physics / 433

Semileptonic decays at LHCb

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

LHCb has recorded large samples of semileptonic decays of c- and b-flavoured hadrons. We review the latest results in semileptonic decays of B, Bs and Λ_b decays. Recent results on CP violation and determination of CKM matrix elements are shown.

Flavour Physics / 434

Measurements of CP violation and mixing in two body charm decays

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

LHCb has collected the world's largest sample of charmed hadrons. This sample is used to search for direct and indirect CP violation in charm, and to measure D^0 mixing parameters. New updated measurements from several decay modes are presented, with complementary time-dependent and time-integrated analyses. We report on recent measurements of CP asymmetries in $D \rightarrow KK$ and $D \rightarrow \pi\pi$ decays using the full LHCb dataset.

Flavour Physics / 435

Measurements of CP violation in multibody charm decays

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Charmed hadrons are a unique probe of CP violation with up-type quarks. Yet, CP violation in the charm sector is very suppressed by tiny CKM phases in the Standard Model. Any non-zero measurement would thus be a sign of New Physics. We report on recent measurements of CP asymmetries in multibody charmed meson and baryon decays. The CP asymmetries are studied in regions of the Dalitz space.

Flavour Physics / 436

Measurement of the phase of Bs mixing with $B_s \rightarrow \phi\phi$

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

The Bs meson provides an ideal laboratory for measurements of CP violation and searches for CPV beyond the Standard Model. We present recent LHCb results on measurements of the Bs mixing phase using the penguin mediated decay $B_s \rightarrow \phi\phi$, which is very sensitive to physics beyond the Standard Model.

Flavour Physics / 437

Dalitz plot analysis of charmless b-hadron decays

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Charmless b-hadron decays are suppressed in the Standard Model by tiny CKM matrix elements which brings the tree amplitudes to levels comparable with loop amplitudes, and potentially New Physics amplitudes. CP violation measurements using Dalitz plot analyses in multi-body decays allow to disentangle these various contributions. We report about the most recent measurements from LHCb, including observations of new decay modes.

Flavour Physics / 438

Measurement of the phase of Bs mixing with $B_s \rightarrow J/\psi hh$ decays

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

The Bs meson provides an ideal laboratory for measurements of CP violation and searches for CPV beyond the Standard Model. We present recent LHCb results on measurements of the Bs mixing phase using $B_s \rightarrow J/\psi KK$ and $J/\psi \pi\pi$ decays.

Flavour Physics / 439

Study of b-hadron to J/ψ hh decays

LEROY, Olivier ¹

¹ CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France

Corresponding Author: olivier.leroy@in2p3.fr

b-hadron decays to J/ψ and light mesons and/or baryons allow to perform studies in the J/ψ hh "Dalitz" decay plane. We determine the resonant structure and CP components of $B \rightarrow J/\psi KK$ and $\pi\pi$, which serve as input to CP violation studies. We also report the observation of new decay modes of the B_c meson and the Λ_b baryon.

Flavour Physics / 440

b-flavour tagging in pp collisions

LEROY, Olivier ¹

¹ CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France

Corresponding Author: olivier.leroy@in2p3.fr

An essential ingredient of all time-dependent CP violation studies of B mesons is the ability to tag the initial flavour of the B meson. The harsh environment of 7 and 8 TeV pp collisions makes this a particularly difficult enterprise. We report progresses in the flavour tagging of B_0 and B_s mesons.

Poster Session / 442

Event reconstruction in NEXT using the ML-EM algorithm

Mr. MONRABAL CAPILLA, Francesc ¹; GOMEZ CADENAS, juan jose ¹; Mr. CERVERA, ANSELMO ¹; Mr. LERCHE, Christoph ²; Mr. SIMÓN ESTÉVEZ, Ander ¹; Dr. FERRARIO, Paola ¹; Dr. IZMAYLOV, Alexander ³

¹ IFIC

² Philips

³ IFIC CSIC

Corresponding Author: ander.simon@ific.uv.es

The NEXT collaboration aims to find the neutrinoless double beta decay in Xe^{136} . The rareness of this decay demands an exceptional background rejection. This can be obtained with an excellent energy resolution, which has been already demonstrated in the NEXT prototypes. In addition to this, the $2\beta_0\nu$ decay in gas produces a characteristic topological signal which could be an extremely useful extra handle to avoid background events.

The need for a satisfactory topology reconstruction has led the NEXT Collaboration to implement the Maximum Likelihood Expectation Maximization method (ML-EM) in the data processing scheme. ML-EM is a generic iterative algorithm for many kinds of inverse problems. Although this method is well known in medical imaging and has been used widely in Positron Emission Tomography, it has never been applied to a time projection chamber. First results and studies of the performance of the method will be presented in this poster.

Neutrino Physics / 443**Current status and perspectives of the LUCIFER experiment**Dr. ORIO, Filippo ¹¹ *INFN - Sezione di Roma***Corresponding Author:** filippo.orio@roma1.infn.it

The quest for Neutrinoless Double Beta Decay ($0\nu\text{DBD}$) represents one of the most promising ways to investigate the neutrino mass nature, Dirac or Majorana. A convincing detection claim demands for detectors with excellent energy resolution and almost zero background in the energy region of interest.

These features can be obtained with the approach of the LUCIFER project, funded by an European grant, which is based on the double read-out of the heat and scintillation light produced by ZnSe scintillating bolometers. The resulting identification and rejection of the α interactions, as well as the large Q-value of the emitter, will guarantee a background lower than 10^{-3} counts/keV/kg/y in the energy region of the $0\nu\text{DBD}$ of ^{82}Se , an order of magnitude lower with respect to the present generation experiments.

Despite the small mass of ~ 17 -kg, LUCIFER will reach a 90% CL sensitivity of 0.6×10^{26} y on the half-life of the decay.

We describe the current status of the project, including results of the recent R&D activity.

Beyond the Standard Model / 444**The 125 GeV Higgs boson as the lightest Higgs in a general MSSM model with explicit CP-violation.**Mrs. LÓPEZ IBÁÑEZ, María Luisa ¹; Dr. VIVES GARCÍA, Óscar ¹¹ *Universidad de Valencia***Corresponding Author:** m.luisa.lopez-ibanez@uv.es

We analyze the LHC experimental results in a general MSSM setup including CP violation where the resonance found at ≈ 125 GeV corresponds to the lightest Higgs. In this framework, we rule out the possibility of having a Higgs mass spectrum aside from that corresponding to the decoupling limit. LHC constraints in Higgs decay to $\tau\text{-}\tau$, together with that of $\gamma\text{-}\gamma$, are enough to reach this conclusion. Moreover, the excess in the diphoton channel found at CMS, corresponding to a second resonance at $m_H = 136$ GeV, proves to be complicated to accommodate in any minimal SUSY extension.

Neutrino Physics / 445

Scintillating bolometers based on ZnMoO₄ and Zn¹⁰⁰MoO₄ crystals to search for 0ν2β decay of ¹⁰⁰Mo (LUMINEU project): first tests at the Modane Underground Laboratory

Dr. PODA, Denys ¹¹ *Centre de Sciences Nucléaires et de Sciences de la Matière (CSNSM)***Corresponding Author:** denys.poda@csnsm.in2p3.fr

Neutrinoless double beta (0ν2β) decay is a powerful tool to investigate neutrino properties, weak interaction, and effects beyond the Standard Model of particle physics. The main aim of the LUMINEU project (Luminescent Underground Molybdenum Investigation for NEUtrino mass and nature) is to realize a pilot experiment to search for 0ν2β decay of ¹⁰⁰Mo with the help of zinc molybdate (ZnMoO₄) crystals operated as scintillating bolometers and to demonstrate prospects of this technique for a next large scale 0ν2β experiment to probe the inverted neutrino mass hierarchy. First results of measurements with a 313 g ZnMoO₄ crystal installed in the low-background EDELWEISS set-up at the Modane Underground Laboratory (LSM, France) show high energy resolution (FWHM = 9 keV at 2615 keV) and excellent rejection efficiency from alpha particles in the region of interest (above 2.6 MeV) by using the light and the heat signals. The radiopurity of the ZnMoO₄ sample, derived from the 851 h data of the low background test, satisfies the LUMINEU goals: trace internal contamination is related with ²¹⁰Po at the level of 0.62(3) mBq/kg, ²²⁶Ra (0.026(5) mBq/kg), and ²²⁸Th (0.010(3) mBq/kg), while only limits on the activity of other naturally occurring alpha radionuclides (from U/Th families, ¹⁴⁷Sm and ¹⁹⁰Pt) were set in the range of 0.003–0.014 mBq/kg.

In December 2013 improved ZnMoO₄ cylindrical crystals, with size D50 x 40 mm and mass 334 and 336 g, have been produced by recrystallization using the low-thermal-gradient Czochralski technique from molybdenum purified by double recrystallization from aqueous solutions. Moreover, a zinc molybdate crystal from enriched ¹⁰⁰Mo (Zn¹⁰⁰MoO₄) was successfully grown for the first time. Two samples cut from the Zn¹⁰⁰MoO₄ boule (with mass 59 and 63 g) were tested as scintillating bolometers at the Centre de Sciences Nucléaires et de Sciences de la Matière (Orsay) with satisfactory results, and then installed in the EDELWEISS set-up at the LSM. First results of the low background measurements with the new LUMINEU detectors, as well as prospects of scintillating bolometers array based on 48 Zn¹⁰⁰MoO₄ crystals (which contain ~ 10 kg of enriched ¹⁰⁰Mo) and located in the EDELWEISS set-up will be presented.

Astroparticle Physics and Cosmology / 446

DEAP-3600 Dark Matter Search at SNOLAB

Dr. KUZNIAK, Marcin ¹¹ *Queen's University***Corresponding Author:** kuzniak@owl.phy.queensu.ca

The DEAP-3600 experiment is located 2 km underground at SNOLAB, in Sudbury, Ontario. It is a single-phase detector, which searches for dark matter particle interactions with 1 tonne fiducial mass of liquid argon target.

A first generation prototype detector (DEAP-1) with a 7-kg liquid argon target mass demonstrated a high level of pulse-shape discrimination (PSD) for reducing beta/gamma backgrounds and helped to develop low radioactivity techniques to mitigate surface related alpha backgrounds.

Construction of the large detector containing a total mass of 3600 kg of liquid argon is nearly complete. The target sensitivity to spin-independent scattering of Weakly Interacting Massive Particles (WIMPs) on nucleons of 10⁻⁴⁶ cm² will allow one order of magnitude improvement in sensitivity over current searches at 100 GeV WIMP mass. DEAP-3600 commissioning starts summer 2014. This talk will present an overview and status of the project.

Beyond the Standard Model / 448**SUSY fits with full LHC Run I data**

Dr. BUCHMUELLER, Oliver ¹; Mr. DE VRIES, Kees Jan ¹; Prof. OLIVE, Keith ²; Dr. CAVANAUGH, Richard ³; Mr. CITRON, Matthew ¹; Prof. DE ROECK, Albert ⁴; Dr. DOLAN, Matthew ⁵; Dr. FLAECHEER, Henning ⁶; Dr. ISIDORI, Gino ⁷; Dr. MALIK, Sarah ¹; Dr. MARROUCHE, Jad ⁸; Dr. MARTÍNEZ SANTOS, Diego ⁹; Dr. RONGA, Frédéric ¹⁰; Dr. WEIGLEIN, Georg ¹¹; Prof. ELLIS, John ¹²; Dr. HEINEMEYER, Sven ¹³

¹ *Imperial College London*

² *University of Minnesota*

³ *Fermi National Accelerator Laboratory*

⁴ *Antwerp University*

⁵ *SLAC National Accelerator Laboratory*

⁶ *University of Bristol*

⁷ *Laboratori Nazionali di Frascati*

⁸ *CERN*

⁹ *NIKHEF*

¹⁰ *ETH Zürich*

¹¹ *DESY*

¹² *King's College London*

¹³ *Instituto de Física de Cantabria IFCA-CSIC*

Corresponding Author: kees.de-vries10@imperial.ac.uk

We present the latest results from the MasterCode collaboration on supersymmetric models, in particular on the CMSSM, the NUHM1, the NUHM2 and the pMSSM. We combine the data from LHC Run I with astro-physical observables, flavor and electroweak precision observables. We determine the best fit regions of these models and analyze the discovery potential at LHC Run II.

Beyond the Standard Model / 450**Kinematic reconstruction of vector-like tops from fully hadronic events**

Prof. ENDO, Motoi ¹; Prof. HAMAGUCHI, Koichi ¹; Mr. ISHIKAWA, Kazuya ¹; Mr. STOLL, Martin ¹

¹ *The University of Tokyo*

Corresponding Author: stoll@hep-th.phys.s.u-tokyo.ac.jp

Vector-like top partners are introduced in various BSM models. After mixing with third generation quarks, decays to $t\bar{t}$, tZ and bW are possible. Recent searches at the LHC give $M > 700\text{--}800$ GeV. We propose an algorithm to kinematically reconstruct vector-like tops from fully hadronic final states at the LHC Run II. Larger signal yield is expected because the branching ratio top-to-hadrons is large. Jet unclustering / substructure methods prove useful in efficiently rejecting the overwhelming backgrounds. We tag and reconstruct boosted tops and higgses from the heavy decay. Different values of the heavy particle's mass are investigated at moderate integrated luminosity, and smaller branching ratios are discussed. A good signal-to-background ratio is found and it is shown that kinematic reconstruction of the top partner and a mass measurement are possible. We conclude that our study can usefully complement existing searches in (semi)leptonic final states. Paper in preparation.

Poster Session / 452

Searches for lepton flavour violation at LHCb

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

The observation of neutrino oscillations has re-opened the case for searches of lepton-flavour violating decays. We report on recent results on searches for short or long-lived Majorana heavy neutrinos in $B\mu\pi$ and $\tau\rightarrow\mu\mu$ decays.

Poster Session / 453

Searches for long-lived heavy particles at LHCb

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Its forward acceptance and good resolution allow LHCb to perform competitive searches for heavy particles beyond the Standard Model. We report a search for the stau particle with the LHCb detector and give our prospects for searches of Hidden Valley particles.

Top-quark and ElectroWeak Physics / 454

Electroweak physics at LHCb

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

The LHCb forward acceptance covers a range of rapidities not accessible by the other LHC experiments, allowing for complementary measurements. We report recent measurements of electroweak boson production, either inclusive, or in association with a jet or a D meson.

Strong Interactions and Hadron Physics / 455

Soft QCD measurements at LHCb

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: olivier.leroy@in2p3.fr

Its forward acceptance puts the LHCb in a unique position at the LHC to measure soft QCD phenomena at large rapidities and low transverse momenta. Recent results on charged particle multiplicity production, energy flow, and inclusive cross-sections are presented.

Strong Interactions and Hadron Physics / 457**Heavy flavour spectroscopy and production in the forward acceptance at the LHC**LEROY, Olivier¹¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France***Corresponding Author:** olivier.leroy@in2p3.fr

The latest years have seen a resurrection of interest in searches for predicted and exotic states motivated by tantalising observations by Belle and CDF. Using the data collected at pp collisions at 7 and 8 TeV by the LHCb experiment. We present a study of the properties of the $Z(4430)^+$ resonance, with a first unambiguous determination of its quantum numbers. We also report on observations of excited states of the B, Bs and Λ_b hadrons and measurements of their masses and decay widths. Its forward acceptance puts the LHCb in a unique position at the LHC to measure QCD phenomena at large rapidities and low transverse momenta, where theoretical models often fail to describe the data accurately. We present studies of the production and polarisation of the J/ψ , $\psi(2S)$ and χ_c charmonium states as well as those of Υ and χ_b bottomonia.

Poster Session / 460**Search for $\nu_\mu \rightarrow \nu_e$ oscillations with the OPERA experiment in the CNGS beam**Dr. TENTI, Matteo¹¹ *INFN - BO***Corresponding Author:** matteo.tenti@bo.infn.it

The OPERA hybrid detector, designed to prove neutrino oscillations in the $\nu_\mu \rightarrow \nu_\tau$ channel, was exposed to the CNGS ν_μ beam at a distance of 730 km from the neutrino source. Profiting of the tracking capabilities of its Emulsion Cloud Chamber system, OPERA can perform also a search for $\nu_\mu \rightarrow \nu_e$ oscillations. Current results are compatible with the non-oscillation hypothesis in the three-flavour mixing model. The same data allow to constrain the non-standard oscillation parameters θ_{new} and $\Delta m_{2\text{new}}^2$ indicated by the LSND and MiniBooNE experiments.

Neutrino Physics / 461

Neutrinos and Nuclear Astrophysics at LUNA

Dr. GUSTAVINO, Carlo ¹¹ *INFN-Roma***Corresponding Author:** carlo.gustavino@roma1.infn.it

The LUNA experiment plays an important role in understanding open issue of neutrino physics. As an example, two key reactions of the solar p-p chain ${}^3\text{He}({}^3\text{He},2p){}^4\text{He}$ and ${}^3\text{He}({}^4\text{He},\gamma){}^7\text{Be}$ have been studied at low energy with LUNA, providing an accurate experimental input to the Standard Solar Model and consequently to the study of the neutrino mixing parameters. The LUNA collaboration will study the reaction ${}^2\text{H}(p,\gamma){}^3\text{He}$ at Big Bang Nucleosynthesis (BBN) energies. This reaction is presently the main source of the 2\% uncertainty of the calculated primordial abundance of deuterium in BBN calculations [1]. As it is well known, the abundance of deuterium depends on the number of neutrino families (or any other relativistic species existing in the early Universe, "dark radiation"). Therefore, the comparison of computed and observed deuterium abundances allows to severely constrain the number of neutrino species and/or the lepton degeneracy in the neutrino sector. The paucity of data at BBN energy of the ${}^2\text{H}(p,\gamma){}^3\text{He}$ reaction is presently the main limitation to exploit the deuterium abundance as a probe of neutrino physics and to improve the BBN estimation of the baryon density. As a matter of fact, the deuterium abundance derived from damped Lyman α (DLA) system observations has presently an error of only 1.5\% [1]. The aim of the the new measurement is therefore to substantially improve the 9\% error of present ${}^2\text{H}(p,\gamma){}^3\text{He}$ data at BBN energies [2]. Starting from the present uncertainty of the relevant parameters (i.e. baryon density, observed abundance of deuterium and BBN nuclear cross sections), it will be shown that a renewed study of the ${}^2\text{H}(p,\gamma){}^3\text{He}$ process is essential to constrain the number of neutrino families and to probe the existence of dark radiation in the early Universe, by using the BBN theory and the cosmic microwave background (CMB) data.

[1] R.J. Cooke and M. Pettini: arXiv:1308.3240v1 [astro-ph.CO] 14 Aug 2013.

[2] L. Ma et al., Phys. Rev. C 55, 588 (1997).

Strong Interactions and Hadron Physics - Board 1 / 462

NLO + Parton Showers merging: current status and future perspectives

Dr. RE, Emanuele ¹¹ *University of Oxford***Corresponding Author:** emanuele.re@physics.ox.ac.uk

I will summarize the current status of Monte Carlo tools used for LHC phenomenology and highlight the most recent developments in the field, with a particular focus on the progress made towards a consistent inclusion of higher-order perturbative terms in the simulations.

Beyond the Standard Model / 463**Hunting light SUSY: combined impact of LHC searches**Dr. ROLBIECKI, Krzysztof¹; Dr. KIM, Jong Soo¹; Dr. TATTERSALL, Jamie²; Dr. SAKURAI, Kazuki³¹ *IFT Madrid*² *Uni Heidelberg*³ *King's College London***Corresponding Author:** krzysztof.rolbiecki@desy.de

We discuss a possible explanation of a slight excess in the WW cross section measurement performed by ATLAS and CMS. While still consistent with the Standard Model within 1-2 sigma, the excess could be also a first hint of physics beyond the Standard Model. We argue that this effect could be attributed to the production supersymmetric particles, eg. stops or charginos. The stops of mass ~200 GeV has the right cross section and under some assumptions can significantly contribute to the final state of two leptons and missing energy. Using CheckMATE and ATOM, the automated packages for comparing BSM models with experimental data, we scan this region of parameter space to find particle masses preferred by Standard Model measurements (WW and WZ production) and SUSY searches. We propose kinematic observables that could distinguish supersymmetric signal from the Standard Model contribution, as well as differentiate between various supersymmetric processes.

Poster Session / 464**A Desktop Neutrino Detector: The MiniTimeCube**JOCHER, Glenn¹; Prof. LEARNED, John¹; MACCHIARULO, Luca¹; LEE, Viacheslav¹; NEGRASHOV, Sergey¹; SAKAI, Michinari¹; VARNER, Gary¹; ROSEN, Marc¹; MATSUNO, Sigenobu¹; CARPENTER, Andrew¹; DUVALL, Mark¹; SMITH, Stefanie¹; DORRILL, Ryan¹; MCDONOUGH, William²; ANDREW, Matt¹; DYE, Stephen³; Mr. USMAN, Shawn⁴¹ *University of Hawaii*² *University of Maryland*³ *Hawaii Pacific University*⁴ *Johns Hopkins University***Corresponding Author:** glenn.jocher@gmail.com

The miniTimeCube (mTC) is the world's smallest neutrino detector. The two liter plastic scintillator target is viewed by 24 Photonis 64 anode PMTs (1536 pixels in total), has a single pulse resolution of <100ps with waveform recording up to 12 microseconds. Analysis of data from the UH manufactured PMT mounted digitization electronics will provide critical event discrimination. Tests at NIST, Gaithersburg, MD are underway. The detector's special characteristics include studies of neutron scatters via elastic scattering and electron anti-neutrino detection via inverse beta decay. Applications range from reactor monitoring to sterile neutrino searches. We will report the latest results and prospects for further development.

Poster Session / 465

Measurement of the B_c Production Cross Section at $\sqrt{s}=1.96$ TeVLEWIS, Jonathan ¹¹ *Fermilab***Corresponding Author:** jdl@fnal.gov

CDF has performed a measurement of the B_c production cross section times branching fraction for $B_c \rightarrow J/\psi \mu^+ \nu$ relative to the B^+ production cross section times branching fraction for $B^+ \rightarrow J/\psi K^+$. The measurement is based on the complete CDF Run II data set consisting of an integrated luminosity of 8.7 fb^{-1} . A sample of 1370 events is selected in which a J/ψ decay to two muons is matched with a third muon. Background contributions of 630 ± 14 events from misidentified J/ψ , misidentified muons, other B_c decay modes, and decay products of other b-hadrons are estimated using data and PYTHIA Monte Carlo samples. The ratio of the production cross section times branching fraction of $B_c \rightarrow J/\psi \mu^+ \nu$ relative to $B^+ \rightarrow J/\psi K^+$ for $p_T > 6 \text{ GeV}/c$ and $|\eta| < 0.6$ is $0.211 \pm 0.012(\text{stat})^{+0.021}_{-0.020}(\text{sys})$

Poster Session / 466

Search for Magnetic Monopoles at CDFLEWIS, Jonathan ¹¹ *Fermilab***Corresponding Author:** jdl@fnal.gov

We report the results of a direct search for Dirac magnetic monopoles using the CDF Run II detector at Fermilab. Monopoles within this model are produced via a mechanism similar to Drell-Yan pair production, are highly ionizing, and experience magnetic forces parallel to the magnetic field. We employ a dedicated trigger, which requires large light pulses in the scintillators of the time-of-flight system, and which remains highly efficient to monopoles while consuming a negligible fraction of the available simulation is used, and a specialized offline event reconstruction examines the central drift chamber for tracks consistent with highly ionizing particles that do not curve in the plane perpendicular to the magnetic field. Limits are presented for magnetic monopoles with masses between 100 and 800 GeV.

Neutrino Physics / 468

The KATRIN Neutrino Mass ExperimentDr. OBLATH, Noah ¹¹ *Massachusetts Institute of Technology***Corresponding Author:** nsoblath@mit.edu

The Karlsruhe Tritium Neutrino (KATRIN) Experiment aims to measure the neutrino mass using tritium beta decays. KATRIN will carefully determine the shape of the tritium beta-decay spectrum near the endpoint. After collecting three years of data, KATRIN will be able to discover a neutrino mass as small as 350 meV (5σ), or place an upper limit at 200 meV ($90\% \text{ CL}$). The experiment is currently under construction and commissioning at the Karlsruhe Institute of Technology. The main components of the experiment include a windowless, gaseous tritium source, differential and cryogenic pumping to remove the tritium gas, two spectrometers, and a silicon PIN diode detector. The tritium source and pumping sections are currently under construction. KATRIN's spectrometers act as precision high-pass energy filters, using the technique of magnetic adiabatic collimation with an electrostatic retarding potential to precisely remove low-energy electrons. The main spectrometer and the silicon detector are undergoing extensive testing to allow us to fully understand the electron transmission properties. This talk will present the current status of KATRIN construction and commissioning activities.

Poster Session / 469

The Straw-tube Tracker for the Mu2e Experiment at FermilabCORCORAN, Marjorie ¹¹ *Rice University***Corresponding Author:** corcoran@rice.edu

The Mu2e experiment will search for neutrinoless conversion of muons into electrons in the field of an aluminum nucleus. The signature of this process is an electron with energy nearly equal to the muon mass. Precise and robust measurement of the outgoing electron momentum is an essential element to the experiment. We describe the

design of a low mass tracking system to meet this requirement. The tracker must operate in a vacuum and a 1 Tesla magnetic field. We have chosen to use about 20,000 thinwalled Mylar straws held under tension to avoid the need for supports within the active volume. In addition to measuring distance from the wire by drift time, subnanosecond

measurement of signal propagation time will be used to measure position along the wire. Charge will be measured using ADCs to provide particle identification capability. To minimize the number of vacuum penetrations, digitization will be performed on the detector. Readout will use a triggerless, streaming architecture with data transmitted on optical fiber.

Astroparticle Physics and Cosmology / 471

The Dark Matter Self-Interaction and Its Impact on the Critical Mass for Dark Matter Evaporations Inside the SunProf. LIN, Guey-Lin ¹; Mr. LIN, Yen-Hsun ¹; Dr. CHEN, Chian-Shu ²; Dr. LEE, Fei-Fan ¹¹ *IoP, Nat'l Chiao Tung University, Hsinchu, Taiwan*² *Physics Division, National Center for Theoretical Sciences, Hsinchu, Taiwan***Corresponding Author:** chris.py99g@g2.nctu.edu.tw

It has been shown that the self-interaction between dark matter (DM) particles can increase the DM number density inside the Sun. The increasing rate of DM number density by this effect is proportional to the existing DM number density inside the Sun. We demonstrate that this effect can counteract DM evaporations in the regime of small DM mass. Consequently, the critical mass for DM evaporations (typically $3 \sim 4$ GeV without the self-interaction) can be lowered down by DM self-interactions. Hence the DM annihilation rate for m_{χ} around few GeVs may be enhanced by self-interactions. This leads to the enhancement of neutrino flux from such annihilations. We discuss the prospect of observing such enhanced neutrino flux in IceCube-PINGU using the annihilation channels $\chi\chi \rightarrow \tau^+\tau^-$, $\nu\bar{\nu}$ as examples. The PINGU sensitivities to DM self-interaction cross section $\sigma_{\chi\chi}$ are estimated for track and cascade events.

Poster Session / 473

The AMoRE: Search for Neutrinoless Double Beta Decay in ^{100}Mo Dr. PARK, HyangKyu¹¹ *Center for Underground Physics, Institute of Basic Science***Corresponding Author:** hkpark@ibs.re.kr

The AMoRE (Advanced Mo-based Rare process Experiment) collaboration is going to use calcium molybdate (CaMoO_4) crystal scintillators enriched in ^{100}Mo and depleted in ^{48}Ca to search for neutrinoless double-beta decay (DBD) of ^{100}Mo using a technique of cryogenic scintillating bolometers at the underground laboratory in Korea. The collaboration is going to utilize metallic magnetic calorimeters (MMC) as temperature sensors both in heat and light channels of CaMoO_4 detectors operated at milli-Kelvin temperature. Application of relatively fast MMC sensors provides excellent energy resolution, powerful discrimination of internal alpha particles, effective pulse-shape discrimination of randomly coinciding events of two neutrino double beta decay of ^{100}Mo . In its first phase, the AMoRE-10 will use about 10 kg of CaMoO_4 crystals. As a next step, the AMoRE-200 is going to build about 200 kg detector to reach a half-life sensitivity on the level of 1026 years with an aim to explore inverted hierarchy region of the effective Majorana neutrino mass 0.02 - 0.05 eV. Recent progress on the calcium molybdate detectors developments at room and milli-Kelvin temperatures as well as background study based on Monte Carlo simulations will be presented.

BEH Physics / 474

Vacuum stability, Higgs and top masses, and new physicsProf. BRANCHINA, Vincenzo¹¹ *University of Catania***Corresponding Author:** branchina@ct.infn.it

One of the scenarios considered in these days explores the possibility for the SM to be valid up to the Planck scale. The phase diagram for the stability of the EW vacuum is then derived assuming that new physics interactions at this scale have no impact on it. In particular, for the central values of M_H and M_t , the EW vacuum is metastable, and its lifetime is obtained ignoring new physics. I show that, although new physics interactions appear in terms of higher dimensional operators (and we could naively expect their contribution to be suppressed), due to the non-perturbative nature of the tunnelling, they can have great impact on the EW vacuum lifetime. As a result, the SM phase diagram, far from being universal, strongly depends on new physics. This has a far reaching consequences, as specific BSM candidates can be tested against this stability analysis. Finally, contrary to some claims, higher precision measurements of M_t and M_H cannot provide any definite response on the stability of the EW vacuum. The latter strongly depends on new physics.

Astroparticle Physics and Cosmology / 475

Status of GADZOOKS!: Neutron Tagging in Super-KamiokandeMr. FERNÁNDEZ, Pablo ¹¹ UAM**Corresponding Author:** pablo.fernandezm@uam.es

The GADZOOKS! project pursues the upgrade of the Super-Kamiokande (SK) detector as a way to efficiently detect thermal neutrons. Inverse beta decay reactions, as well as charged current quasi-elastic (CCQE) scattering of low energy anti-neutrinos (up to a few hundreds of MeV) in SK, produce one positron and one neutron in the final state. Being able to observe the final state neutron in coincidence with the prompt positron would mean that SK could identify these reactions as genuine with very high confidence.

GADZOOKS! will open to Super-Kamiokande - and water Cherenkov detectors in general - a wealth of physics currently inaccessible due to background limitations. The most important is observing for the first time the diffuse supernova neutrino background: Super-Kamiokande enriched with gadolinium will discover it after few years of running.

In GADZOOKS! we will dissolve a Gadolinium (Gd) salt in the water of SK at a loading of 0.2% by mass. The Gd has an enormous absorption cross section for thermal neutrons, emitting in the process an ~8 MeV gamma cascade measurable by SK. Thus, by a double coincidence in space and time of the signals recorded by SK from the positron and the ~8 MeV gamma cascade from the Gd-capture of the neutron, low energy anti-neutrinos interacting in the detector will be identified with a large efficiency, > 80%.

The main R program towards GADZOOKS! is EGADS: a 200 ton fully instrumented tank built in a new cavern in the Kamioka mine. EGADS incorporates all the necessary subsystems to make GADZOOKS! a reality, namely pretreatment, selective filtration, monitoring of different parameters (water transparency, Gd concentration...) and Gd recovery. In this contribution we will describe EGADS, we will present its current status and discuss the main results and conclusions arrived at so far. In addition, we will analyze other issues specific to the running of GADZOOKS!, like radiopurity, CCQE reconstruction, and its impact to other SK measurements.

Poster Session / 476

The CANDLES experiment for the study of Ca-48 double beta decay

Dr. IIDA, Takashi ¹

¹ *Osaka University*

Corresponding Author: tiida@rcnp.osaka-u.ac.jp

Neutrino less double beta decay is the only practical way to prove the Majorana nature of the neutrino. CANDLES is a ⁴⁸Ca double beta decay experiment with CaF₂ scintillator. The CANDLES III (U.G.) detector is currently running with 300kg CaF₂ crystals in the Kamioka underground observatory, Japan. New light collection system was installed in 2012, and accordingly photo-coverage has been enlarged by about 80%. We are currently analyzing the data taken until 2013 to clarify the origin of the backgrounds. Here we will present the performance of the latest CANDLES III (U.G.) system and the background reduction technique developed using waveform analysis. We also mention about future prospects of our project including a further improvement by installing a detector cooling system in 2014 in order to increase light emission from CaF₂ crystals.

Accelerator Physics and Future Colliders / 477

J-PARC Accelerator Status

Prof. NAITO, Fujio ¹

¹ *KEK*

Corresponding Author: fujio.naito@kek.jp

Japan Proton Accelerator Research Complex (J-PARC) has stated the beam extraction to the neutrino experiment (T2K) and the hadron experiments since 2009. However J-PARC had two big troubles during last three years: 1st one was induced by the Great East Japan Earthquake happened in March 2011 and the second one was caused by the radioactive material leak from hadron experimental hall in May 2013. Fortunately the damage to the accelerators from both troubles has been fixed and J-PARC has resumed the beam delivery to users. The achieved beam power for T2K is 240kW which is one third of design value of 750kW. In this report, the status of the high power operation is described. Furthermore it is also described for the issues to be fixed in order to achieve the design beam intensity.

Neutrino Physics / 478

Initial probe of δ_{CP} by T2K with muon neutrino disappearance and electron neutrino appearance

SCHOLBERG, Kate ¹

¹ *Duke University*

Corresponding Author: schol@phy.duke.edu

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Neutrino Physics / 479

Precision measurement of muon neutrino disappearance by T2K

SCHOLBERG, Kate ¹

¹ *Duke University*

Corresponding Author: schol@phy.duke.edu

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Neutrino Physics / 481

JUNO: A Next Generation Reactor Antineutrino Experiment

Dr. ZHAN, Liang ¹

¹ *Institute of High Energy Physics*

Corresponding Author: zhanl@ihep.ac.cn

After the discovery of the large neutrino mixing angle θ_{13} , the next generation neutrino experiments focus on the measurement of the neutrino mass hierarchy and the leptonic CP violating phase. JUNO, a next generation reactor antineutrino experiment, was proposed to determine the neutrino mass hierarchy independent of the CP phase. We studied the sensitivity and found the mass hierarchy can be determined with a 3σ significance after 6 years of running using a 20 kt detector with an energy resolution of $3\%/\sqrt{E}$ at a 45-60 km baseline. This is a multi-purpose experiment, which can also measure the neutrino mixing parameters $\sin^2\theta_{12}$, Δm_{32}^2 and Δm_{21}^2 with a precision better than 1%. In addition, supernova neutrinos, geo-neutrinos, sterile neutrinos as well as solar and atmospheric neutrinos can be studied with this experiment. JUNO was approved in 2013 and the R progress will be reported.

Poster Session / 483

Joint ν_μ disappearance and ν_e appearance analysis at the T2K experiment using a frequentist approach

SCHOLBERG, Kate ¹; Mrs. ESCUDERO, Lorena ²

¹ *Duke University*

² *IFIC*

Corresponding Author: schol@phy.duke.edu

Please see attached file

Poster Session / 484

Studies of muon neutrino event distributions in water at the T2K ND280 detectorMr. SCANTAMBURLO, Enrico ¹¹ *University of Geneva***Corresponding Author:** schol@phy.duke.edu

The T2K collaboration presents studies of muon neutrino event distributions on water, at neutrino energies of the order of 1 GeV, using an improved vertex algorithm at the near detector ND280. This sample can be used to measure neutrino interaction on water and to constrain the expected neutrino energy spectrum at Super-Kamiokande. This sample requires vertices in the FGD2, a detector composed of interleaved water and scintillator bars. Water interactions are selected by using a Kalman Filter to reconstruct the vertices of multiple-track charged-current events. Few measurements of the water cross section have been made, and such measurements have the potential to reduce interaction model systematics in neutrino oscillation analyses.

Poster Session / 485

Transverse momentum distributions of baryons at LHC-energies.Dr. PISKUNOVA, Olga ¹; Mr. BYLINKIN, Alexander ²¹ *The Lebedev Physical Institute of the Russian Academy of Sciences (LPI RAS)*² *ITEP***Corresponding Author:** alexander.bylinkin@gmail.com

Transverse momentum spectra of protons and anti-protons from RHIC and LHC experiments (PHENIX, ALICE, CMS) are considered. The data are fitted with the universal formula that includes the energy dependent slope as the main parameter. The estimated slopes are changing with energy. The dependence of average transverse momenta $\langle p_T \rangle$ on \sqrt{s} shows the behavior $\langle p_T \rangle \sim s^{0.05}$, which is similar to the growing that was observed previously at the study for Λ -baryons. Available data on Λ_c production from LHCb at $\sqrt{s} = 7$ TeV were also considered. The estimated average $\langle p_T \rangle$ is bigger than this value for protons proportionally to masses. The predictions on the characteristics of baryon production at higher energies (including cosmic rays) are discussed.

Astroparticle Physics and Cosmology / 486

Direct Dark Matter Search with XMASSDr. KOBAYASHI, Kazuyoshi ¹¹ *ICRR, University of Tokyo***Corresponding Author:** kenkou@icrr.u-tokyo.ac.jp

XMASS program is a multi-purpose low-background experiment with large volume of liquid Xe scintillator at Kamioka in Japan.

In the current stage, we focus on the the direct detection of dark matter in the form of WIMPs (Weakly Interacting Massive Particles) with 835 kg liquid Xe.

Though we started commissining on 2010, we found unexpected background on PMT sealing material. To overcome the background, we conducted refurbishment from 2012 to 2013 and restarted data taking in Autumn of 2013.

We present the latest result on data after the refurbishment.

We will also present the status of extensive studies for a future XMASS project.

Heavy Ions / 487

Jets and high-pT probes of the QGP measured by the ALICE experimentMr. CONESA BALBASTRE, Gustavo ¹¹ LPSC-CNRS**Corresponding Author:** gustavo.conesa.balbastre@cern.ch

Hard-scattered partons are produced early in heavy-ion collisions, prior to the formation of the strongly interacting nuclear medium, the quark-gluon plasma (QGP). These partons lose energy as they traverse the medium and eventually fragment into jets, which exhibit a modification when compared to jets produced in pp collisions. Large transverse momentum (pT) particles, which are proxies for jets, and inclusive jets are suppressed in heavy-ion collisions at both RHIC and the LHC. Di-hadron correlation measurements have shown that the parton fragmentation is modified by the medium. At LHC energies the parton production cross-section is much larger than at RHIC, allowing jets to be reconstructed over a much wider kinematic range. Such measurements provide the possibility for a differential investigation of the parton energy loss.

The ALICE experiment at LHC, with its powerful tracking and particle identification capabilities and calorimetric systems, performs measurements of high-pT particles, jets (composed of charged or charged plus neutral particles) as well as their correlations. The calorimeters are used as trigger detectors and extend the measurable pT range for such probes.

In this talk, a summary of the recent results of the ALICE experiment on the measurement of high-pT particles, jets and high-pT di-hadron/hadron-jet correlations in pp, p-Pb and Pb-Pb collisions at the LHC between years 2010 and 2013 will be shown. Pb-Pb and p-Pb measurements will be compared to the pp baseline measurements to determine the effect of the QGP (Pb-Pb) or the initial cold nuclear matter (p-Pb).

Accelerator Physics and Future Colliders / 489

The LHeC as a Higgs facilityDr. ARMESTO, Néstor ¹¹ Universidade de Santiago de Compostela**Corresponding Author:** nestor.armesto@usc.es

The Large Hadron Electron Collider (LHeC) is a proposed facility for electron-proton/nucleus scattering at CERN, which will collide electrons and positrons from a new 60 GeV accelerator with the LHC beams. After the release of a detailed technical design report in 2012, the configuration of a linac with racetrack shape has been chosen for its default design. Further work to adapt the electron and high luminosity optics and beam parameters, allows to achieve performance levels around 10^{34} cm⁻²s⁻¹ required for precision Higgs physics. In parallel, work has focused on the design of an LHeC Test Facility at CERN, on the validation and preparation of the Energy Recovery Linac operation mode for the LHeC and on the development of the required Superconducting RF technologies. The talk presents an overview on the design, recent activities and an outlook for further developments.

Accelerator Physics and Future Colliders / 490

FCC study: ep/eA collisions in the 'he' modeDr. ARMESTO, Néstor ¹; Dr. TOMAS GARCIA, Rogelio ²¹ *Universidade de Santiago de Compostela*² *CERN***Corresponding Author:** nestor.armesto@usc.es

The Future Circular Collider (FCC) is a proposed facility at CERN to provide 50 TeV protons and 19.7 TeV/nucleon Pb nuclei, and up to 175 GeV electrons and positrons, in a new 80-100 km tunnel. Recently CERN has launched a study which includes the three principal modes of operation: hadron-hadron, electron-electron and hadron-electron (he) collisions. For the 'he' mode, two options exist for combining the new, FCC hadron accelerator with an electron beam: a) from the LHeC ERL installation or b) from the new electron storage ring of the FCC. The talk presents a first view on the resulting accelerator parameters, the detector concept and the physics case.

Poster Session / 491

Low-mass right-handed gauge bosons from minimal grand unified theoriesProf. PARIDA, Minaketan ¹; Mr. SAHOO, Biswonath ¹¹ *Centre of Excellence in Theoretical and Mathematical Sciences, SOA University, Bhubaneswar 751030***Corresponding Author:** parida.minaketan@gmail.com

Prediction of low-mass W_R and Z_R gauge bosons in popular grand unified theories has been the subject of considerable attention over the last three decades. In this work we discuss two different ways towards achieving this objective with minimal symmetry breaking chains of $SO(10)$ or E_6 grand unified theories in concordance with light neutrino masses. Model predictions for observable lepton flavour violations and new contributions to neutrino-less double beta decay are pointed out.

Poster Session / 492

A new detector for high-energy DISDr. ARMESTO, Néstor ¹¹ *Universidade de Santiago de Compostela***Corresponding Author:** nestor.armesto@usc.es

The Large Hadron Electron Collider (LHeC) is a proposed facility that will exploit the LHC beams for electron-proton/nucleus scattering, using a new 60 GeV electron accelerator. Here we present the detector concept for the measurement of precision deep inelastic scattering phenomena, with the reconstruction of Higgs decay final states with maximum acceptance as benchmark. We also discuss the chosen technologies and the steps towards

simulating the LHeC detector response. Besides, we consider the possibilities for measurements of forward (p,n) and backward (e, γ) particle production as required for diffractive and precision DIS physics. Finally, in view of the proposal of the FCC at CERN, we include some preliminary considerations as to how a DIS detector could be built when exposed to a 50 TeV proton beam colliding off a $SO(100)$ GeV electron beam.

Poster Session / 493

Prospects for Higgs physics in high-energy ep scatteringDr. ARMESTO, Néstor ¹¹ *Universidade de Santiago de Compostela***Corresponding Author:** nestor.armesto@usc.es

The LHeC is a proposed facility at CERN that will provide ep collisions with centre-of-mass energies above 1 TeV and a high luminosity of 10^{31} cm⁻²s⁻¹. This facility will provide a unique opportunity to study the $WW \rightarrow H$ and $ZZ \rightarrow H$ production modes. Several decay channels - such as $H \rightarrow b \bar{b}$, $H \rightarrow c \bar{c}$ and $H \rightarrow \tau^+ \tau^-$ - that are difficult to study precisely at the LHC because of the more involved experimental and theoretical conditions, will be accessible. Besides, the higher centre-of-mass energies of the FCC-he will allow the study of the $H \rightarrow t \bar{t}$ and $H \rightarrow HH$ channels that have too small cross sections at the LHeC. Here we present an overview on the progress in studies of the opportunities for Higgs physics in ep, including couplings, CP properties and different distributions.

Heavy Ions / 495

Heavy-ion physics with high-energy eA scatteringDr. ARMESTO, Néstor ¹¹ *Universidade de Santiago de Compostela***Corresponding Author:** nestor.armesto@usc.es

The Large Hadron Electron Collider (LHeC) at CERN is a proposed facility for electron-nucleus scattering which will collide electrons of about 60 GeV energy beam, with the LHC heavy ion beams. The kinematic coverage extends beyond previous deep inelastic lepton-ion experiments by nearly four orders of magnitude towards lower x_{Bj} and higher Q^2 . This contribution reviews the possibilities for eA studies at the LHeC plus its relation with the LHC PbPb and pPb programs. After an introduction on the open problems in pA and eA collisions and their expected impact on the heavy-ion program, we show inclusive observables and new results on the resulting constraints on nuclear parton densities. We then analyse the possibilities for inclusive and exclusive diffraction and the opportunities that they offer to reveal the non-linear dynamics which should tame the low- x growth of parton densities. Finally, we discuss semi-inclusive measurements that will clarify the mechanism of hadronisation and QCD radiation inside the nuclear medium.

Top-quark and ElectroWeak Physics / 496

New method for precise determination of top quark mass at LHCMs. KAWABATA, Sayaka ¹; Prof. SHIMIZU, Yasuhiro ¹; Prof. SUMINO, Yukinari ¹; Dr. YOKOYA, Hiroshi ²¹ *Tohoku University*² *Toyama University***Corresponding Author:** skawabata@tuhep.phys.tohoku.ac.jp

We propose a new method to measure the top quark mass at the LHC. This method requires only lepton energy distribution and is basically independent of the production process of the top quarks. With this method, the \overline{MS} mass of the top quark can be determined. We perform a simulation analysis of the top quark mass reconstruction with $t\bar{t}$ pair production and lepton+jets decay channel at the leading order. Estimated uncertainties in the top mass reconstruction are about 1.5 GeV with an integrated luminosity of 100 fb^{-1} at $\sqrt{s}=14 \text{ TeV}$. The uncertainties are expected to be improved by including higher-order corrections.

Poster Session / 497

Measurement of the detection systematic uncertainty in the Double Chooz experiment

Mr. CRESPO ANADÓN, José Ignacio¹; COLLIN, Antoine²; HASER, Julia³; YANG, Guang⁴

¹ CIEMAT

² CEA Saclay

³ Max Planck Institut für Kernphysik, Heidelberg

⁴ Argonne National Lab / Illinois Institute of Technology

Corresponding Author: joseignacio.crespo@ciemat.es

Double Chooz is a 2-detector reactor antineutrino oscillation experiment designed to make a precision measurement of the neutrino mixing angle θ_{13} . The electron antineutrinos from the Chooz (France) nuclear power plant are detected through the inverse beta decay process $\bar{\nu}_e + p \rightarrow e^+ + n$ in a gadolinium-loaded liquid scintillator target. In the 1-detector run, started in April 2011, Double Chooz relies on a Monte Carlo simulation to predict the antineutrino flux and measure the oscillation-induced deficit in the Far Detector (located at ~ 1050 m from the reactors). Therefore, the accuracy of the simulation in reproducing the antineutrino generation and detection is essential.

In this poster, the new methods developed for measuring the dominant components of the detection systematic uncertainty using several neutron sources, as well as the Monte Carlo simulations to study the neutron transport boundary effects on the target are described. Benefiting from a revised signal selection criteria and increased statistics, the 0.5% precision level achieved on the detection systematic uncertainty represents a factor 2 improvement with respect to the previous result and leads to a more precise θ_{13} measurement. In addition, in the 2-detector run starting this summer with the operation of the Near Detector (at ~ 400 m from the reactors), the subsequent cancellation of correlated uncertainties is expected to grant the experiment an even better detection systematic uncertainty and a high precision θ_{13} result.

Neutrino Physics / 499

India-Based Neutrino Observatory (INO) Project

Prof. MONDAL, Naba K¹

¹ Tata Institute of Fundamental Research

Corresponding Author: nkm@tifr.res.in

India-based Neutrino Observatory (INO) is a proposed underground facility in the southern part of India. The project envisage the construction of an underground laboratory with a large cavern of dimensions 132m X 26m X 20m to house a 50 kton magnetized iron tracking calorimeter detector (ICAL) to study atmospheric neutrinos. In addition, two smaller caverns will also be constructed to host other experiments. There will be at least 1.2 km rock overburden in all directions.

INO-ICAL detector will have a modular structure of total lateral size 48m X 16m and will consist of a stack of 150 horizontal layers of 5.6 cm thick magnetized iron plates interleaved with 4 cm gaps to house the active detector layers. The active detector elements are resistive plate chambers (RPCs), made up of a pair of 3mm thick glass plates of area 2m X 2m, separated by 2mm spacers.

The main physics goals of INO-ICAL detector are:

- (i) Accurate determination of the atmospheric parameters.
- (ii) Determination of neutrino mass hierarchy.
- (iii) Resolve the octant ambiguity.
- (iv) Non-standard interactions, CPT violation, long range forces, ultra high energy muon fluxes.

The present status of the project and the progress made so far will be discussed.

Computing and Data Handling / 500

Computing at Belle II

Dr. HARA, TAKANORI¹

¹ KEK

Corresponding Author: takanori.hara@kek.jp

The existence of large matter-antimatter asymmetry (CP violation) in the b-quark system as predicted in the Kobayashi-Maskawa theory was established by the B-Factory experiments, Belle and BaBar. However, this cannot explain the magnitude of the matter-antimatter asymmetry of the universe we live in today. This indicates undiscovered new physics exists. The Belle II experiment, the next generation of the B-Factory, is expected to reveal the new physics by accumulating 50 times more data ($\sim 50\text{ab}^{-1}$) than Belle by 2022.

The Belle II computing system has to handle an amount of beam data eventually corresponding to several tens of PetaByte per year under an operation of the SuperKEKB accelerator with a designed instantaneous luminosity. Under this situation, it cannot be expected that one site, KEK, will be able to provide all computing resources for the whole Belle II collaboration including the resources not only for the raw data processing but also for the MC production and physics analysis done by users. In order to solve this problem, Belle II employed the distributed computing system based on DIRAC, which provides us the interoperability of heterogeneous computing systems such as grids with different middleware, clouds and the local computing clusters.

Since the last year, we performed the MC mass production campaign to confirm the feasibility and find out the possible bottleneck of our computing system. In parallel, we also started the data transfer challenge through the transpacific and transatlantic networks.

This presentation describes the highlights of the Belle II computing and the current status. We will also present the experience of the latest MC production campaign in 2014.

Poster Session / 501

New results and future capabilities of the Double Chooz reactor antineutrino experiment

Dr. NOVELLA, Pau¹; Mrs. CARR, Rachel²; Dr. LUCHT, Sebastian³

¹ APC/CNRS

² Columbia University

³ RWTH Aachen

Corresponding Author: pau.novella@in2p3.fr

We present a new measurement of the neutrino oscillation parameter $\sin^2\theta_{13}$ derived from two years of data taken with the Double Chooz far detector. This result, drawn from twice the data used in our previous Gadolinium-based analysis, is the most precise Double Chooz measurement to date. Along with increased statistics, the analysis features an improved energy scale, reduced backgrounds, and a unique background constraint from reactor-off data. Additionally, we report the precision we expect to achieve when the Double Chooz near detector begins taking data within the next year

Neutrino Physics / 502

Commissioning and Early Performance of the NOvA Detectors

Prof. MUSSER, Jim ¹

¹ *Indiana university*

Corresponding Author: jmusser@indiana.edu

NOvA, the NuMI Off-Axis ν electron Neutrino Appearance experiment is designed to carry out studies of $\nu_{\mu} \rightarrow \nu_e$ oscillation, characterized by the mixing angle θ_{13} . A complementary pair of detectors have been constructed roughly

14 mrad off the beam axis to optimize the purity of the electron neutrino signal at the far detector against neutral current backgrounds. The far detector is located 810 km from Fermilab, in Ash River, Minnesota. Both the 14 kton far detector and the near detector feature essentially fully active segmented liquid scintillator tracking volumes that provide fine grained event reconstruction. The first neutrinos to the Ash River site arrived in August 2014 while final construction and commissioning of the far detector was still underway. Final installation and initial commissioning of the near detector, located in the NuMI hall, took place in May 2014. Here, we describe the commissioning and early performance of the NOvA detectors, and preparations for first physics analyses.

Lattice QCD / 503

Neutral meson mixing on the lattice

Dr. CARRASCO VELA, Nuria ¹

¹ *INFN-Rome3*

Corresponding Author: carrasco@fis.uniroma3.it

Accurate measurements of K, D and B meson mixing amplitudes provide stringent constraints in the Unitary Triangle analysis, as well as useful bounds on New Physics scales. Lattice QCD provides a non perturbative tool to compute the hadronic matrix elements entering in the effective weak Hamiltonian, with errors at a few percent level and systematic uncertainties under control. In this talk, I will review the recent lattice results for these hadronic matrix elements.

Astroparticle Physics and Cosmology / 504

Dark Matter Indirect Detection phenomenology: a status assessment

Mr. CIRELLI, Marco ¹

¹ *IPhT CNRS/CEA Saclay*

Corresponding Author: marco.cirelli@cea.fr

I present a phenomenological, data-centered and data-driven assessment of the status of indirect searches for particle Dark Matter, and of the main implications for DM model building. Tantalizing hints and stringent constraints seem to continuously chase each other, as a number of well performing experiments keep delivering their data. This year may be the one in which we finally see the resolution of these dark puzzles, or it may not.

Detector RD and Performance / 505**Highly granular digital electromagnetic Calorimeter with MAPS**Dr. ROCCO, Elena ¹¹ *Nikhef***Corresponding Author:** erocco@nikhef.nl

A highly granular digital electromagnetic calorimeter has been built using MAPS/MIMOSA23 with 30 micron pixel size to prove the feasibility of the proposed Forward electromagnetic Calorimeter (FoCal) as a possible upgrade of the ALICE apparatus.

The physics motivations of such a project are presented together with the calorimeter performance in several test beam campaigns. We show the energy resolution, longitudinal and lateral profile and compare the experimental values with the simulations in the energy range from 2 to 200 GeV.

Lattice QCD / 506**Inclusion of isospin breaking effects in lattice simulations**Dr. PORTELLI, Antonin ¹¹ *University of Southampton***Corresponding Author:** a.portelli@soton.ac.uk

Isospin symmetry is explicitly broken in the Standard Model by the non-zero differences of mass and electric charge between the up and down quarks. Both of these corrections are expected to have a comparable size of the order of one percent relatively to hadronic energies. Although these contributions are small, they play a crucial role in hadronic and nuclear physics. We explain how to properly define QCD and QED on a finite and discrete space-time so that isospin corrections to hadronic observables can be computed ab-initio. We then consider the different approaches to compute lattice correlation functions of QCD and QED observables. Finally we summarise the actual lattice computations which include isospin breaking effects.

Poster Session / 507**Solution of the NLO BFKL Equation and $\gamma^*\gamma^*$ cross-section at NLO**GIOVANNI ANTONIO, Chirilli ¹¹ *The Ohio State University***Corresponding Author:** chirilli.1@osu.edu

I will present the solution of the next-to-leading order (NLO) BFKL equation obtained constructing the eigenfunctions of the NLO kernel using an expansion around the LO BFKL (conformal) eigenfunctions. This method can be used to construct the solution of the BFKL equation with the kernel calculated to an arbitrary order in the coupling constant. Then, using the solution of the NLO BFKL equation and the NLO pomeron impact factor calculated using the high-energy Operator Product Expansion (OPE) in composite Wilson lines operators, I will construct the analytic NLO cross section of the $\gamma^*\gamma^*$ scattering process at high-energy.

Strong Interactions and Hadron Physics / 509**Diphoton isolation studies**Dr. CIERI, Leandro ¹¹ *La Sapienza, Università di Roma***Corresponding Author:** cieri@roma1.infn.it

Diphoton production is the main background in searches and studies (performed at the LHC) for a low mass Higgs boson, decaying in a pair of photons. And for this reason, it is desirable to count with the best theoretical tool to describe this background. In this talk we will present a detailed study on the photon isolation prescriptions, together with a "tight isolation accord" in order to compare experimental data and theoretical calculations obtained at the highest possible perturbative order. Finally we'll show a comparison between theory and the LHC and Tevatron data, and we'll discuss why the NNLO is necessary in order to understand the phenomenology of this process.

Poster Session / 510**Search for new physics using events with two same-sign isolated leptons in the final state**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Although same sign dileptons final states are very rare in the SM context, they appear naturally in many different new physics scenarios such as SUSY where two same-sign dileptons can be produced in the decay chain of supersymmetric particles.

Different scenarios can be presented: Same-sign dileptons accompanied by b-quarks can arise from SUSY processes where 3rd generation quark superpartners are lighter than other squarks, resulting in an abundance of top and bottom quarks produced in the cascade decays. In general, same-sign dileptons can be particularly sensitive to SUSY models with compressed spectra where the mass of the LSP is very close to the mass of the produced supersymmetric particle, either if it is produced via strong production (squarks or gluinos) when it is accompanied with high hadronic activity or if it is produced via ewk production (charginos or neutralinos) when almost no hadronic activity is present. In all cases the SUSY decay chain ends with the LSP, that escapes undetected and therefore contribute strongly to the MET of the event.

We therefore search for SUSY using same sign dilepton events with/out hadronic activity and large missing ET, using the full 2012 integrated luminosity and we interpret our results in the context of various SUSY models.

Top-quark and ElectroWeak Physics / 511

Electroweak corrections to Z+2jets production at the LHC

Dr. HOFER, Lars ¹; Prof. DENNER, Ansgar ²; Dr. SCHARF, Andreas ³; Dr. UCCIRATI, Sandro ⁴

¹ *IFAE Barcelona*

² *Uni Wuerzburg*

³ *Uni-Wuerzburg*

⁴ *Universita di Torino*

Corresponding Author: lhofer@ifae.es

We present results for the electroweak corrections to the hadronic production of a charged lepton pair in association with two jets and give detailed predictions for the LHC operating at 13 TeV. While corrections to the total cross section are small, we find significant non-uniform distortions in high-energy tails due to electroweak Sudakov logarithms.

Neutrino Physics / 512

LBNE in the Precision Era of Neutrino Oscillation: Status and Schedule

Prof. PAOLONE, Vittorio ¹

¹ *University of Pittsburgh*

Corresponding Author: paolonepitt@gmail.com

LBNE (Long-Baseline Neutrino Experiment) is an accelerator-based neutrino oscillation experiment. LBNE will produce a muon-neutrino beam using protons from Fermilab's Main Injector and will detect electron-neutrino appearance and muon-neutrino disappearance using a Liquid Argon TPC located at a distance of 1300 km at Sanford Underground Research Facility in South Dakota. The primary physics motivation of LBNE is to determine the neutrino mass hierarchy, to determine the octant of the neutrino mixing angle θ_{23} , to search for CP violation in neutrino oscillation, and ultimately, to precisely measure the size of any CP-violating effect that is discovered. The status of LBNE and the physics potential of the LBNE research program will be described including the underground physics, in particular atmospheric neutrinos, proton decay, and supernova neutrinos, which are also primary physics goals of LBNE.

Detector RD and Performance / 513

Development of Massive Liquid Argon TPCs for LBNE

Prof. PAOLONE, Vittorio ¹

¹ *University of Pittsburgh*

Corresponding Author: paolonepitt@gmail.com

The LBNE experiment will employ liquid argon TPCs for the far detector, representing a major scale-up from the ICARUS and MicroBooNE designs. This talk will describe the progress and plans for the development of the TPC itself, the photon detection system, electronics and the cryogenic systems. Staging plans and strategies for scaling up the design towards the planned 34 kt fiducial mass (50 kt total mass) will be presented. Progress on the development of simulations and reconstruction algorithms will also be presented.

Accelerator Physics and Future Colliders / 515

Beamline for the LBNE Project

Prof. PAOLONE, Vittorio ¹

¹ *University of Pittsburgh*

Corresponding Author: paolonepitt@gmail.com

The LBNE beamline complex is designed to provide a neutrino beam of sufficient intensity and energy to meet the goals of the LBNE experiment with respect to long-baseline neutrino oscillation physics. Presented in this talk will be the issues related to the baseline design from the physics, beam power (>1 MW), lifetime, and radiological requirements. Potential future upgrades to the beamline to improve the neutrino flux spectrum and for higher beam power (>2 MW) will also be presented

Neutrino Physics / 516

Underground Physics with LBNE

Prof. PAOLONE, Vittorio ¹

¹ *University of Pittsburgh*

Corresponding Author: paolonepitt@gmail.com

The Long-Baseline Neutrino Experiment plans a 34-kton (fiducial mass) liquid argon time projection chamber to be sited at 4850 ft depth at the Sanford Underground Research Facility in South Dakota. The significant overburden at this site gives LBNE significant physics reach for several non-beam physics topics. These include neutrino oscillation studies with atmospheric neutrinos, for which the LAr TPC enables precision reconstruction, baryon number violation searches, for which detection of kaon modes has particularly high efficiency, and detection of neutrino bursts from core-collapse supernovae, for which the electron-neutrino flavor sensitivity will be unprecedented. This talk will discuss the unique underground physics capabilities of LBNE.

Detector RD and Performance / 519

Performance of highly granular calorimeters in test beams

Dr. SIMON, Frank ¹

¹ *Max-Planck-Institute for Physics*

Corresponding Author: fsimon@mpp.mpg.de

The CALICE collaboration has developed highly granular calorimeter prototypes to evaluate technologies for experiments at a future lepton collider optimized for particle flow event reconstruction. These technologies include electromagnetic calorimeters with tungsten absorbers and silicon or scintillator active elements, and hadronic calorimeters with steel and tungsten absorbers with scintillator and gaseous detector active elements, the former with analog and the latter with purely digital and with semidigital readout. We will discuss the design and the calibration of the different prototypes. Results on the performance, in particular the energy reconstruction and energy resolution, will be presented. The high granularity of the calorimeters enables reconstruction techniques such as software compensation to improve the energy resolution, which have already been successfully applied to some of the detector prototypes.

Detector RD and Performance / 520**Comparison of test beam data from imaging calorimeters with GEANT4 simulations**Dr. SIMON, Frank¹¹ *Max-Planck-Institute for Physics***Corresponding Author:** fsimon@mpp.mpg.de

The highly granular calorimeter prototypes of the CALICE collaboration have provided large data samples with precise three-dimensional information on hadronic showers with steel and tungsten absorbers and silicon, scintillator and gas detector readout. From these data sets, detailed measurements of the spatial structure, including longitudinal and lateral shower profiles and of the shower substructure are extracted. Dedicated experiments with scintillator and RPC active elements extend these measurements to include information on the time structure of hadronic showers. These results are confronted with GEANT4 simulations with different hadronic physics models, and present new challenges to the simulation codes and provide the possibility to validate and improve the simulation of hadronic interactions in high-energy physics detectors.

Detector RD and Performance / 521**Study of a Large Prototype TPC for the ILC using Micro-Pattern Gas Detectors**Dr. MUENNICH, Astrid¹¹ *DESY***Corresponding Author:** astrid.muennich@desy.de

In the last decade, R of detectors for the future International Linear Collider (ILC) has been performed by the community. The International Large Detector (ILD) is one detector concept at the ILC where calorimetry and tracking systems are combined. The tracking system consists of a Si vertex detector, forward tracking disks and a large volume Time Projection Chamber (TPC).

Within the framework of the LCTPC collaboration, a Large Prototype (LP) TPC has been built as a demonstrator. Its endplate is able to contain up to seven identical modules of Micro-Pattern Gas Detectors (MPGD). Recently, the LP has been equipped with resistive anode Micromegas (MM) or Gas Electron Multiplier (GEM) modules. Both the MM and GEM technologies have been studied with a 5 GeV electron beam in a 1 Tesla magnet.

After introducing the LP, the current status, recent results (drift velocity, field distortions, ion gate and spatial resolution measurements) as well as future plans of the LCTPC R with MM and GEM will be presented.

Detector RD and Performance / 522**Time of Flight detectors with SiPMT array readout**Dr. BONESINI, Maurizio ¹; BERTONI, Roberto ¹; Dr. DEBARI, Antonio ²; Dr. ROSSELLA, Massimo ³; NARDO', Roberto ²¹ *Sezione INFN Milano Bicocca*² *Sezione INFN Pavia and Dipartimento di Fisica Universita' di Pavia*³ *Sezione INFN Pavia***Corresponding Author:** maurizio.bonesini@mib.infn.it

Scintillator based time-of-flight detectors (TOF) may attain good timing performances (eg the MICE TOF detectors and the MEG timing counter with 50 ps time intrinsic resolution), but may have problems for operation inside external magnetic fields. Even fringe fields of a few hundred Gauss may be a problem and complicate magnetic shieldings need to be devised. This is due to the conventional readout with fast photomultipliers. Alternative readout solutions may be based on large-area SiPMT arrays. These devices are insensitive to magnetic fields up to several Teslas, but may have problems due to their intrinsic noise and gain variation with temperature. Systematic tests have been done to study this option both in laboratory with a home-made laser system tuned to simulate the response to cosmic rays and in testbeam with electrons. Available SiPMT arrays from SenSL (ArraySM-4-3035-CER and ArraySB-4-30035-CER, blue extended), Advansid(ASD-SiPM3S-4x4A) and Hamamatsu (S11828-3344 and S12642 with the new TSV technology) have been studied. Results are promising and competitive with conventional solutions with fast PMT readout (Hamamatsu R4998 photomultipliers, as an example). Results on obtained timing resolutions and rate effect dependence will be reported, together with future prospects.

Accelerator Physics and Future Colliders / 523**Fast beam-collision feedbacks for luminosity optimisation at next-generation lepton colliders**Prof. BURROWS, Philip ¹¹ *Oxford University***Corresponding Author:** p.burrows@physics.ox.ac.uk

Future lepton colliders such as the International Linear Collider (ILC), and the Compact Linear Collider (CLIC) require nanometer-sized beams at the interaction point (IP). We report on the design, prototyping and testing of beam-based feedback systems for steering the beams into collision at the IP so as to maximise the luminosity performance of the colliders. Both all-analogue and digital feedback prototypes have been built and tested for CLIC and ILC, respectively. The latency of such systems needs to be very low so as to match the bunch spacing and bunch-train length. We report on the achievement of systems with 130ns and 23ns latency that meet the beam position resolution and beam kick requirements of both ILC and CLIC, respectively; the prototypes were tested with ILC- and CLIC-like beams at the Accelerator Test Facility at KEK. We have simulated the measured performance and demonstrated the potential of the feedbacks to compensate for ground-motion disruption and recover almost all of the design luminosity.

Astroparticle Physics and Cosmology / 525**Recent Highlights from VERITAS**Prof. MUKHERJEE, Reshmi ¹¹ *Barnard College, Columbia University***Corresponding Author:** muk@astro.columbia.edu

VERITAS is a ground-based gamma-ray observatory consisting of an array of four atmospheric Cherenkov telescopes located in southern Arizona, USA. VERITAS carries out an extensive observation program of the gamma-ray sky at energies above 0.1 TeV. Observations of Galactic and extragalactic sources in the TeV band are sensitive probes of the highly energetic processes occurring in these objects. Observations by VERITAS of the Galactic center and nearby dwarf spheroidal galaxies provide constraints on particle dark matter with masses above a few hundred GeV. VERITAS observations also provide constraints on fundamental physics and cosmology, such as probing the history of galaxy formation and studying Lorentz-invariance violation. The majority of the sources detected by VERITAS are active galactic nuclei (AGN), with gamma-ray emission originating in their relativistic jets. TeV observations of AGN help us constrain models of particle acceleration and energy dissipation in relativistic jets, and the size and location of the gamma-ray emission region. Galactic sources at TeV energies include supernova remnants, pulsar wind nebulae, and binary systems, and TeV emission is a key diagnostic of the highly energetic particles in these objects. VERITAS observations provide important clues on the origin of cosmic rays and on particle acceleration in supernova blast shocks, and relativistic pulsar wind-termination shocks. In this talk I will present some highlights of particle-astrophysics measurements made with VERITAS.

Neutrino Physics / 526**Quasi-elastic scattering, RPA, 2p2h and neutrino energy reconstruction**Dr. NIEVES, Juan M ¹¹ *IFIC, CSIC-UV***Corresponding Author:** jmnieves@ific.uv.es

We discuss some nuclear effects, RPA correlations and 2p2h (multinucleon) mechanisms, on charged-current neutrino-nucleus reactions that do not produce a pion in the final state. We study a wide range of neutrino energies, from few hundreds of MeV up to 10 GeV. We also examine the influence of 2p2h mechanisms on the neutrino energy reconstruction.

Heavy Ions / 528**Hessian PDF reweighting meets the Bayesian methods**Dr. ZURITA, Maria ¹; Dr. PAUKKUNEN, Hannu ²¹ *University of Santiago de Compostela*² *University of Jyväskylä***Corresponding Author:** pia.zurita@usc.es

We discuss the Hessian PDF reweighting - a technique intended to estimate the effects that new measurements have on a set of PDFs. The method stems straightforwardly from considering new data in a usual χ^2 fit and it naturally incorporates also non-zero values for the tolerance, $\Delta\chi^2 > 1$. In comparison to the contemporary Bayesian reweighting techniques, there is no need to generate large ensembles of PDF Monte-Carlo replicas, and the observables need to be evaluated only with the central and the error sets of the original PDFs. In spite of the apparently rather different methodologies, we show that the Hessian and the Bayesian techniques are actually one and the same, but only if the $\Delta\chi^2$ criterion is properly included to the Bayesian likelihood function that is a simple exponential. We illustrate the situation by considering a simplified example and the case of inclusive jets at the LHC.

We also apply the method to proton-lead and heavy ion (lead-lead) collisions to explore their constraining power on nuclear parton distributions.

Neutrino Physics / 529**Neutrino oscillation study with atmospheric neutrinos in Super-Kamiokande**SHIOZAWA, Masato ¹¹ *Kamioka Observatory, ICRR, University of Tokyo***Corresponding Author:** masato@suketto.icrr.u-tokyo.ac.jp

Atmospheric neutrinos have been playing important roles in understanding neutrino properties. In Super-Kamiokande, we have been performing precise measurement of the 2-3 mixing angle and mass squared difference predominantly by muon neutrino disappearance. In addition to that, muon to tau neutrino oscillation channel was established by confirming tau neutrino appearance in the atmospheric neutrinos. We also have good opportunity to study the mass hierarchy and leptonic CP violation by investigating possible electron (and muon) neutrino flux changes. Super-K analysis is being improved especially to enhance the discrimination power of the mass hierarchy by statistical neutrino-antineutrino separation and by combining with reactor and LBL results. We can also test various exotic scenarios such as oscillations between active and sterile neutrinos, and possible Lorentz invariance violation. Latest results of atmospheric neutrino studies in Super-Kamiokande will be reported in this talk.

Beyond the Standard Model / 530**Searches for dark matter with the ATLAS detector**ATLAS, Collaboration ¹¹ *CERN***Corresponding Author:** lroos@lpnhe.in2p3.fr

Different approaches to finding evidence for dark matter at the LHC are presented. These include searches for events with large missing transverse momentum and a single jet, photon or W/Z boson.

Different interpretations of the results are presented, including effective field theories and explicit mediator models.

Results from $\sqrt{s} = 8$ TeV data taking are presented.

Beyond the Standard Model / 531

Searches for extra dimensions with the ATLAS and CMS detectors

ATLAS SPEAKER, on behalf of ATLAS and CMS ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Models with extra spatial dimensions have been proposed to explain the large apparent hierarchy between the Electroweak and Planck scales. Such models predict a host of different new phenomena. For example, classical and quantum black holes with spectacular signatures have been searched for with the full 8 TeV dataset. Extra spatial dimensions can also manifest themselves in a number of non-resonant phenomena. Latest results are reported.

Beyond the Standard Model / 533

Searches for new Physics in events with multiple leptons with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Events containing several leptons are useful probes of new phenomena due to the low background from Standard Model processes. We look for anomalous production of prompt like-sign leptons or events with three or more leptons, as well as search for excited leptons, heavy leptons and heavy neutrinos. Searches for lepton-flavor violation are also presented. The searches use data recorded in 2012 at $\sqrt{s}=8$ TeV centre-of-mass energy by the ATLAS experiment at the LHC.

Beyond the Standard Model / 534

Searches for vector-like quarks, $t\bar{t}$ and $t\bar{b}$ resonances with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Various extensions of the Standard Model predict the existence of new types of quarks. We report on several search channels such as vector-like quarks decaying to a Higgs boson and a top quark or to a W boson and a b quark. The talk presents results from searches for new resonances decaying to a top-antitop pair and a top-antibottom pair, including the use of boosted top quark reconstruction techniques. These searches use the data sample recorded in 2012 at $\sqrt{s}=8$ TeV centre-of-mass energy by the ATLAS experiment at the LHC.

Beyond the Standard Model / 535

Inclusive searches for squarks and gluinos with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Despite the absence of experimental evidence, weak scale supersymmetry remains one of the best motivated and studied Standard Model extensions. This talk summarises recent ATLAS results on inclusive searches for supersymmetric squarks and gluinos, Results are presented for searches in final state events containing jets, missing transverse momentum, light leptons, taus or photons.

Beyond the Standard Model / 537

Searches for direct pair production of third generation squarks with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Naturalness arguments for weak-scale supersymmetry favour supersymmetric partners of the third generation quarks with masses not too far from those of their Standard Model counterparts. Top or bottom squarks with masses less than a few hundred GeV can also give rise to direct pair production rates at the LHC that can be observed in the data sample recorded by the ATLAS detector. The talk presents recent ATLAS results from searches for direct stop and sbottom pair production.

Beyond the Standard Model / 538

Searches for electroweak production of supersymmetric charginos, neutralinos and sleptons with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Many supersymmetry models feature charginos, neutralinos and also sleptons with masses less than a few hundred GeV. These can give rise to direct pair production rates at the LHC that can be observed in the data sample recorded by the ATLAS detector. The talk presents results from searches for charginos, neutralinos and slepton production in final state events characterized by the presence of leptons, missing transverse momentum and possibly jets.

Accelerator Physics and Future Colliders / 541

Gauging the impact of IP beam-beam fields on the physics program of future linear collidersDr. HARTIN, Anthony ¹¹ DESY**Corresponding Author:** anthony.hartin@desy.de

Interaction point (IP) beam parameters at future linear colliders have been chosen in order to limit the impact of non-linear effects from strong electromagnetic fields at the IP. However the field strength experienced by incoming particles is still a significant percentage of the field strength that polarises the vacuum. These vacuum changes can be taken into account at Lagrangian level via the Furry picture. Until now, Furry picture calculations have been limited to first order processes, namely the beamstrahlung and coherent pair production. However there is a need, especially for precision physics requirements, to extend the analysis to higher order processes. I survey the theoretical efforts underway to apply this strong field analysis to collider processes in general, including new particle wavefunctions in overlapping bunch fields, recalculations of physics cross-sections, a new strong field event generator and proposed strong-field experimental tests in the extraction line of a future linear collider.

Education and Outreach / 542

How the “HYPATIA” analysis tool is used as a hands-on experience to introduce HEP to high schoolsProf. CHRISTINE, Kourkouvelis ¹; Mr. VOURAKIS, Stylianos ²¹ University of Athens and IASA² IASA**Corresponding Author:** christine.kourkouvelis@cern.ch

The “HYPATIA” (HYbrid Pupil’s Analysis Tool for Interactions in ATLAS) is a tool which has been created by the authors of this abstract and has been evolving over a number of years. Apart from the IPPOG’s International Masterclass downloadable HYPATIA version, there is an online version which now exists in the form of a webapp. All data from the ATLAS experiment at the Large Hadron Collider of CERN necessary for performing different educational analysis paths, exist online. Such examples of interactive analyses vary from the calculation of the magnetic field of one of the ATLAS magnets, to detecting “pseudo” Higgs events and will be given in the presentation. These applications have been used in recent years in a large number of schools in the form of a half a day mini local (or even remote) masterclass. These activities have been supported by various EC outreach programs which give emphasis to promoting science education in schools through new methods based on the inquiry based techniques: questions, search and answers. This way we have been able to introduce cutting edge research in particle physics to High Schools bridging the gap between research and school hands-on experience.

Poster Session / 543

Inert Higgs Doublet Dark Matter in Type-II SeesawDr. NOMURA, Takaaki¹; Prof. CHEN, Chuan-Hung¹¹ *National Cheng-Kung University***Corresponding Author:** nomura@mail.ncku.edu.tw

Weakly interacting massive particle (WIMP) as a dark matter (DM) candidate is further inspired by recent AMS-02 data, which confirm the excess of positron fraction observed earlier by PAMELA and Fermi-LAT experiments. Additionally, the excess of positron+electron flux is still significant in the measurement of Fermi-LAT. For solving the problem of massive neutrinos and observed excess of cosmic-ray by DM annihilation, we study the model with an inert Higgs doublet (IHD) in the framework of type-II seesaw mechanism by imposing a Z_2 symmetry on the IHD, where the lightest particle of IHD is the DM candidate while the neutrino masses origin from the Higgs triplet in type-II seesaw model. We calculate the cosmic-ray production in our model by using three kinds of neutrino mass spectra, classified as normal ordering, inverted ordering and quasi-degeneracy. We find that if leptonic triplet decays are dominant, the observed excess of positron/electron flux could be explained well in normal ordered neutrino mass spectrum, when the constraints of DM relic density and cosmic-ray antiproton spectrum are taken into account. Moreover, excess of cosmic-ray neutrinos is implied in our model. We find that our results on $\langle \sigma v \rangle$ are satisfied with and close to the upper limit of IceCube analysis. More data from cosmic-ray neutrinos could test our model.

Beyond the Standard Model / 544

Prospects for Beyond Standard Model Physics at CLICDr. ROLOFF, Philipp¹¹ *CERN***Corresponding Author:** ibozovic@vinca.rs

The Compact Linear Collider (CLIC) is an attractive option for a future multi-TeV linear electron-positron collider. A staged construction in several centre-of-mass energy steps from a few hundred GeV up to 3 TeV is foreseen. At high energies, CLIC provides sensitivity to a wide range of phenomena beyond the Standard Model through direct observation of new particles and precision measurements. An overview of these opportunities is given in this presentation. CLIC is in particular well suited for the measurement of weakly interacting states due to the clean experimental conditions and low backgrounds compared to hadron colliders. Most studies are based on full detector simulations using Geant4 and considering pileup from $\gamma\gamma$ to hadrons interactions. The production of supersymmetric particles like sleptons and gauginos was studied in detail in several different models. The scenarios discussed in this presentation include an extended Higgs sector, Z' physics and other models.

Computing and Data Handling / 545**The Software Library of the Belle II Experiment**Prof. KIM, Doris Yangsoo ¹¹ *Soongsil University***Corresponding Author:** dorisykim@ssu.ac.kr

The rich physics of heavy quark decays provides creative and precise ways to look into nature. Experimentally, B factories have been producing quite prominent discoveries and new insights: The CP violation in B meson decays, charm neutral meson oscillations, discovery of new particles such as X(3872), and various other significant physics results. Based on these successes, a next generation B factory and the detector counterpart, SuperKEKB and Belle II, are being built in Japan, as the upgrades of KEKB and Belle, respectively. The new factory will start its physics run in the year 2016. This is an ambitious project. The luminosity of the $e^+ e^-$ collider will be upgraded by the factor of 40, which will create a 50 times larger data set compared to the Belle sample. Both the background and the triggered event rates will be increased by a factor of at least 10. The Belle II software system is designed to accommodate these challenges and to run on grid, cloud, and local resources around the world. Various external software packages are employed to enhance the user interface. The software system, BASF2, is structured as a framework built with dynamic module loading and the ability of parallel processing. The system is written in C++ with Python steering scripts, compatible with common linux operating systems. A full detector simulation library is created based on Geant4. The parallel processing utility is based on a fork-based method, where full events are distributed to the spawned processes. In this talk, we will explain the design of the Belle II software structure with the emphasis on the parallel processing.

BEH Physics / 546**Higgs Physics at CLIC**Dr. SICKING, Eva ¹¹ *CERN***Corresponding Author:** ibozovic@vinca.rs

The Compact Linear Collider (CLIC) is an attractive option for a future multi-TeV linear electron-positron collider, offering the potential for a rich precision physics programme, combined with sensitivity to a wide range of new phenomena. The physics reach of CLIC has been studied in the context of three distinct centre-of-mass energy stages, 350 GeV, 1.4 TeV and 3.0 TeV. This staged scenario provides the ideal environment for precise studies of the properties of the ~ 125 GeV Higgs boson. Operation at 350 GeV allows the couplings and width of the Higgs boson to be determined in a model-independent manner through the study of the Higgs-strahlung and WW-fusion processes. Operation at higher centre-of-mass energies provides high statistics for even more precise measurements and the potential to study the top Yukawa coupling and even the Higgs boson self-coupling. In this talk we explore the potential of the CLIC Higgs physics programme, based on full simulation studies of a wide range of final states. The evolution of the physics sensitivity with centre-of-mass energy is presented in terms of model-independent coupling fits and the constrained kappa fits employed at the LHC.

Poster Session / 548**Vertex detector R for CLIC**Dr. DANNHEIM, Dominik ¹¹ CERN**Corresponding Author:** ibozovic@vinca.rs

A future CLIC vertex detector must satisfy the precision physics needs and be compatible with the challenging beam structure at CLIC. As a result the pixel detector is required to have excellent spatial resolution, precise time-tagging, full geometrical coverage, extremely low mass, low occupancy and sufficient heat removal from sensors and readout. A vertex detector concept based on two hybrid pixel-detector options (with silicon sensors or with a HV-CMOS sensor pre-stage) forms the basis of an active integrated R effort that pushes technology to its limits. It comprises fast, low-power and small-pitch readout ASICs implemented in 65 nm CMOS technology (CLICpix) coupled to ultra-thin sensors via low-mass interconnects. The power dissipation of the readout chips is reduced by means of power pulsing, allowing for a cooling system based on forced gas flow. In this presentation the CLIC vertex-detector requirements are reviewed and the current status of R on sensors, readout and detector integration, including results of recent beam tests are presented.

Top-quark and ElectroWeak Physics / 551**Measurements of the 7 and 8 TeV cross sections for $Z \rightarrow 4l$ in pp collisions with the ATLAS detector**ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

A measurement of the cross section for 4 lepton production near the Z resonance is presented for $\sqrt{s} = 7$ and 8 TeV proton-proton collisions recorded with the ATLAS experiment. The measurement is interpreted as a determination of the branching fraction for the Z boson decaying into 4 leptons and is found consistent with the expectation from the Standard Model. This result provides an important benchmark for the $H \rightarrow 4l$ process.

Top-quark and ElectroWeak Physics / 552**Simultaneous measurements of $t\bar{t}$, WW and $Z \rightarrow \tau+\tau$ productions with the ATLAS detector**ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

A global test of these Standard Model predictions is presented through the study of the common final state made up of a pair of an oppositely charged electron and muon in proton-proton collisions at $\sqrt{s} = 7$ TeV recorded by the ATLAS detector at the LHC. The simultaneous measurement of the cross-sections of the pair production of top quarks, tau-leptons via Drell-Yan, and WW bosons is performed. The simultaneous extraction of the cross-sections is performed in a two-dimensional phase space spanned by missing transverse momentum and jet multiplicity. This analysis allows for a broader test of the Standard Model than that given by dedicated cross-section measurements providing the underlying correlations in the predicted and measured cross-sections due to common proton parton distribution functions parameters. This measurement can help to improve predictions of interaction cross-sections in hadron collisions.

Top-quark and ElectroWeak Physics / 553**Measurement of the electroweak production cross section of vector bosons associated with dijets with the ATLAS detector**ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Measurement of production of vector bosons associated with two forward jets is reported based on 20 fb⁻¹ of data at $\sqrt{s} = 8$ TeV recorded by the ATLAS experiment. The measurement is performed in various fiducial volumes, sensitive to QCD and Electroweak production mechanisms. The electroweak component for single Z boson production is extracted by a fit to the dijet invariant mass distribution in a fiducial region chosen to enhance the electroweak contribution over the dominant background in which the jets are produced via the strong interaction. The measured electroweak cross section is in good agreement with the Standard Model expectations.

Top-quark and ElectroWeak Physics / 554**Measurement of the electroweak production cross section of same-sign WW bosons associated with dijets with the ATLAS detector**ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The measurement of production of same-sign WW bosons associated with two forward jets is reported based on 20 fb⁻¹ of data at $\sqrt{s} = 8$ TeV recorded by the ATLAS experiment. The measurements are performed in fiducial volumes, sensitive to QCD and Electroweak production mechanisms. The electroweak component of same-sign WW production is extracted in a fiducial region with large rapidity difference between two jets with high dijet invariant mass, chosen to enhance the electroweak contribution over the dominant background in which the jets are produced via the strong interaction. The measured electroweak cross section is in good agreement with the Standard Model expectations.

Top-quark and ElectroWeak Physics / 555**Measurement of WW production with the ATLAS detector**ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The measurement of the WW diboson production cross section in proton-proton interactions is reported from the ATLAS experiment. The analysis requires heavy bosons to decay leptonically, using ee, emu and mumu final states associated with large missing energy. The data are used to test the electroweak sector of the Standard Model and search for evidence for new phenomena. The cross section results are first obtained in phase space regions defined by the decay kinematics and then extrapolated to the full phase space. Differential and total cross sections for WW production are compared to NLO predictions of the Standard Model and used to place constraints on anomalous triple-gauge-boson couplings.

Top-quark and ElectroWeak Physics / 556**Measurement of multi-boson production and anomalous gauge boson couplings with the ATLAS detector**ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

ATLAS measurements of multi-boson production processes involving combinations of W, Z and isolated photons are summarized. Measurements using 7 TeV and at 8 TeV p-p collision data are presented. The measurements are performed using leptonic decay modes, including the invisible decay $Z \rightarrow \nu\nu$, as well as semileptonic channels. Differential and total cross sections are presented and are used to place constraints on anomalous triple-gauge boson couplings. An overview of these results is given. The productions of multi-bosons in association with two forward jets at LHC are sensitive to quartic couplings between gauge bosons. We present the latest results of cross section measurements of multi-bosons and limits on anomalous quartic couplings (aQGC) using 8 TeV proton-proton collision data at ATLAS. The aQGC expected sensitivity of tri-bosons and vector boson scattering measurements for future high-luminosity LHC runs is discussed as well.

Top-quark and ElectroWeak Physics / 557**Top quark pair production cross section using the ATLAS detector at the LHC**ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Measurements of the inclusive top quark pair production cross sections in proton-proton collisions with the ATLAS detector at the Large Hadron Collider are presented. The measurements are performed requiring one or two electrons or muons in the final state. Various experimental techniques are compared. The most accurate result requires opposite sign electrons and muons achieves a precision of a few percent and is in good agreement to a recent NNLO+NNLL QCD calculation. In addition, a differential measurement of the top transverse momentum and kinematic properties of the top pair system are presented.

This measurement requires one electron or muon in the final state and probes our understanding of top pair production in the TeV regime and is compared to recent Monte Carlo generators implementing LO and NLO matrix elements matched with parton showers and fixed order NLO QCD calculations. The data show sensitivity to parton density functions.

Top-quark and ElectroWeak Physics / 558**Study of additional radiation in top pair events using the ATLAS detector at the LHC**ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The large centre-of-mass energy available at the proton-proton collider LHC allows for the copious production of top quark pairs in association with other final state particles at high transverse momentum. The ATLAS experiment has measured several final state observables that are sensitive to additional parton radiation in top anti-top quark final states. Examples are the multiplicity of jets for various transverse momentum thresholds or the probability to emit jets above a given threshold in a fixed rapidity region. These measurements are compared to modern Monte Carlo generators based on NLO QCD matrix element or LO multi-leg matrix elements. The data are able to constrain the uncertainty on the modelling of the top pair production mechanism. We also discuss top production in association with photons and Z bosons. In addition, the production of top quark pairs in association with heavy quarks (beauty and charm) is presented.

Top-quark and ElectroWeak Physics / 559**Single Top quark production cross section using the ATLAS detector at the LHC**ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Measurements of single top-quark production cross section in proton proton collisions at 7 and 8 TeV are presented. In the leading order process, a W boson is exchanged in the t-channel. For this process for the first time a fiducial cross section measured within the detector acceptance is presented and the modelling uncertainty when extrapolating to the total inclusive cross section is assessed with a large number of different Monte Carlo generators. The result is in good agreement with the most up-to-date theory predictions. Furthermore, the single top-quark and anti-top total production cross sections, their ratio, as well as a measurement of the inclusive production cross section is presented. Differential cross sections are measured as a function of the transverse momentum and the absolute value of the rapidity of top and anti-top quarks. In addition, a measurement of the production cross section of a single top quark in association with a W boson is presented. The s-channel production is explored and limits on exotic production in single top quark processes are discussed. This includes the search for flavor changing neutral currents and the search for additional W bosons (W').

Flavour Physics / 562

Study of rare and suppressed processes in B meson decays with the ATLAS experimentATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The large amount of Heavy Flavor data collected by the ATLAS experiment is potentially sensitive to New Physics, which could be evident in processes that are naturally suppressed in the Standard Model. The most recent results on the search for the rare decay $B_s(B_0) \rightarrow \mu^+\mu^-$ are presented, as well as results of the angular analysis of the semileptonic rare decay $B_d \rightarrow K^{*0} \mu^+\mu^- \rightarrow K^+\pi^-\mu^+\mu^-$, extracting the distribution parameter AFB and FL (the accuracy obtained from data collected in 2011 is comparable to the best previous measurement in the region $q^2(\mu^+\mu^-) \rightarrow 16 \text{ GeV}^2$).

Flavour Physics / 563

Decay properties of b-hadrons with the ATLAS experimentATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The ATLAS detector at the LHC is collecting - among others - a large statistics of B_s and Λ_b decays, allowing to study their production and decay properties. ATLAS has studied the different amplitudes contributing to the decay $B_s \rightarrow J/\psi \phi (\mu^+\mu^-K^+K^-)$ with a combined analysis of decay time and angular correlations and using initial flavour tagging. The CP-violating phase ϕ_s is measured, as well as the width difference between the B_s eigenstates $\Delta\Gamma_s$ and the average width Γ_s . ATLAS collects also large samples of Λ_b decays and measures the parity violating asymmetry parameter α_b in $\Lambda_b \rightarrow \Lambda J/\psi$. The measurement - obtained from the measurement of angular correlations in the Λ_b final state - is compared to predictions based on perturbative QCD and heavy quarks effective theory.

Strong Interactions and Hadron Physics / 564

Hadronically decaying massive particles, jet substructure, and measurement of the transverse momentum of the Z boson at LHATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The identification and study of jets originated from the hadronic decays of massive particles, like vector bosons or top quark provide a direct test of QCD calculations of gluon and quark radiation and validate novel techniques of jet shapes and jet substructure for reducing the sensitivity to soft QCD and to multiple proton-proton collisions. The measurement of the cross-section of high transverse momentum $Z \rightarrow b\bar{b}$ production in proton-proton collisions at $\sqrt{s}=8$ TeV at LHC is presented and compared to next-to-leading order predictions. In addition, a measurement of jet shapes in $t\text{-}\bar{t}$ final states using data recorded at LHC is presented. Samples of events with top-quark pairs are selected and the differential and integrated shapes of the b-quark jets resulting from the top-quark decays are compared with those of the light-quark jets from the hadronic W-boson decays $W \rightarrow q\bar{q}'$ in the semileptonic channel.

The measurement of the transverse momentum of the Z boson performed at LHC is reported for $\sqrt{s} = 7$ TeV. The measurement is sensitive to soft resummation effects for small momentum transfers and to multiple hard jet emissions for large momentum transfers, probing QCD in a unique way. The data are used to tune next-to-leading order plus parton shower Monte Carlo simulations.

Strong Interactions and Hadron Physics / 565

Measurements of light and heavy-flavour jet production in association with a W or Z boson with the ATLAS detectorATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Productions of light and heavy-flavour jets in association with a W or a Z boson in proton-proton collisions are important processes to study QCD in multi-scale environments and the proton parton content. The cross section, differential in several kinematics variables, have been measured with the ATLAS detector in 7 TeV proton-proton collisions and compared to high-order QCD calculations and Monte Carlo simulations. The results demonstrate the need for the inclusion of high-multiplicity matrix elements in the calculations of high jet multiplicities, even in cases where a parton shower simulation is present and confirm QCD jet production scaling properties. The ratio of $(Z+\text{jets})/(W+\text{jets})$ provides a precise test of QCD due to the large cancellations of theoretical and experimental uncertainties.

Measurement of $W+c$ production cross section has a unique sensitivity to the strange-quark density, which is poorly known at low x . W or Z boson production in association with b-quark jets, on the other hand, probes the b-quark density in the proton and the b-quark production by high-order QCD processes. The experimental results are compared to leading-order and next-to-leading-order QCD calculations and various parton density predictions.

Strong Interactions and Hadron Physics / 568**Measurements of jet production properties in pp collisions with the ATLAS detector**ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Several aspects of the jet production in pp collisions have been measured by the ATLAS collaboration. The measurements of the production cross sections of inclusive, di- and tri-jet events probe the dynamics of QCD and can constrain the parton proton structure. The cross sections are measured using jets clustered with the anti-kT algorithm with different distance parameters and compared to expectations based on next-to-leading order QCD calculations, corrected for non-perturbative effects, as well as to next-to-leading order Monte Carlo simulations. Ratios of inclusive cross sections measured at different centre-of-mass energies allow for reduced experimental and/or theoretical uncertainties. Double-differential dijet and trijet cross sections have been measured in proton-proton collisions at 7 TeV as a function of di- and tri-jet masses and the jet rapidity separation. An NLO QCD analysis of the data indicates constraining power for parton distribution functions of the proton. Measurements of multi-jet systems with or without a veto on additional jets, probe QCD radiation effects. The measurement of the dijet azimuthal decorrelations is sensitive to the strong coupling constant. Measurement of splitting scales in the kt clustering algorithm using jets from W+jet events provide a way to investigate jet clustering at different resolution scales. These measurements constitute precision tests of QCD in a new energy regime.

Poster Session / 571**SM-like Higgs decay into two muons at 1.4 TeV CLIC**Prof. BOZOVIC JELISAVCIC, Ivanka¹¹ Vinca Institute of Nuclear Sciences**Corresponding Author:** ibozovic@vinca.rs

The branching fraction measurement of the SM-like Higgs boson decay into two muons at 1.4 TeV CLIC will be presented. The study is performed in the fully simulated ILD detector concept for CLIC, taking into consideration all the relevant physics and beam-induced backgrounds, as well as instrumentation of the very forward region to tag high-energy electrons. In this analysis we show that BR times the Higgs production cross section can be measured with the 38% statistical accuracy in four years of the CLIC operation at 1.4 TeV center of mass energy. This study complements the Higgs physics program foreseen at various CLIC energy stages.

Strong Interactions and Hadron Physics / 573

Photon, diphoton and photon+jet production measured with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Isolated prompt photons provide a direct probe of short-distance physics, complementary to that provided by measurements of jets or vector-bosons. The data are sensitive to the gluon density of the proton. The inclusive prompt photon cross sections have been measured over a wide range of transverse momenta; the diphoton cross section has also been measured as a function of diphoton mass, total transverse momentum and azimuthal separation. The cross section for photons produced in association with jets is also measured as a function of various

kinematic variables describing the photon+jet system. The results are compared to the predictions of next-to-leading-order QCD.

Strong Interactions and Hadron Physics / 574

Impact of ATLAS data on parton density functions

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Various measurements provided by the ATLAS collaboration have significant impact on parton density functions. Inclusive production of W and Z bosons have been analysed using an NNLO QCD fit and found to constraint the strange-quark density at medium and low Bjorken-x. The inclusive jet production at different centre-of-mass energies, dijet and trijet production measured by ATLAS are used in an NLO QCD fit and show impact for the gluon and quark densities. Off-resonance Drell Yan production may be used to constrain anti-quark density at high x. The measurements have higher impact when they are used in a common fit, taking into account correlations of the systematic uncertainties and will help to constrain parton density function uncertainties.

Strong Interactions and Hadron Physics / 575**Soft QCD, Minimum bias and UE measurements at ATLAS**ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Particle distributions sensitive to the underlying event in proton-proton collisions have been measured with the ATLAS detector at the LHC at 7 TeV centre-of-mass energy. Various and complementary measurements are presented, e.g. charged particle multiplicity, charged and inclusive sum transverse momentum densities and mean charged-particle transverse momentum in the regions of each event, azimuthally transverse to the hardest jet or Z boson directions. When compared to the predictions of different Monte Carlo models, the data show sensitivity to modelling of the underlying event. An explicit study of double-parton scattering using W+dijet events is presented, along with a measure of the effective cross section. In addition the high-energy pp collisions at the LHC provide unique opportunity to study particle flow and event shapes of the hadronic final state particles. Evolution of the event shape variables, such as the transverse thrust, thrust minor and transverse sphericity have been studied for minimum bias events as a function of momentum scale.

Bose-Einstein correlations provide a unique opportunity for detailed understanding of the space-time geometry of the hadronization region, for determining the size and shape of the source from which particles are emitted and for interpreting of quark confinement effects. Bose-Einstein correlation lead to an enhancement of the production of identical bosons close in phase space. The ATLAS collaboration has performed a measurement of Bose-Einstein correlations of the pairs of charged particles with transverse momentum greater than 100 MeV in p-p collisions at 900 GeV and 7 TeV. Bose-Einstein correlation parameters are investigated up to very high charged-particle multiplicities. The dependence of the BEC parameters on the average transverse momentum per pair and per particle is also investigated.

Strong Interactions and Hadron Physics / 576**Measurement of the total cross section of pp collisions at $\sqrt{s}=7$ TeV from elastic scattering with the ATLAS detector**ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The ATLAS measurement of the total p-p cross section at the LHC at $\sqrt{s}=7$ TeV is presented. In a special LHC run with high betastar beam optics corresponding to an integrated luminosity of 80 inverse microbarn the elastic scattering process is measured in the range of the momentum transverse t from $-t=0.0025$ GeV² to $-t=0.38$ GeV² with the ALFA detector of ATLAS. From the extrapolation of the differential elastic cross section to $t=0$ GeV² using the optical theorem the total cross section $\sigma_{pp \rightarrow X}$ is extracted with the luminosity-dependent method. In addition the nuclear slope of the elastic t -spectrum, the total elastic and inelastic cross sections are determined.

BEH Physics / 583

Radiative corrections to Higgs coupling constants in two Higgs doublet models

Ms. KIKUCHI, Mariko¹; KANEMURA, Shinya¹¹ *University of Toyama***Corresponding Author:** kikuchi@jodo.sci.u-toyama.ac.jp

We calculate one-loop corrected Yukawa coupling constants hff for the standard model (SM) like Higgs boson h in two Higgs doublet models with the softly-broken Z_2 symmetry. Under the Z_2 symmetry, four types of models with different Yukawa interactions appear. We find that one-loop contributions from extra Higgs bosons change maximally about several % from tree level hff couplings under the constraints from perturbative unitarity and vacuum stability. We find that the pattern of deviations in each type of Yukawa couplings from the SM predictions does not change from tree level predictions with only mixing effects even with maximal radiative corrections. Moreover, when the gauge couplings hVV ($V = W, Z$) are found to be slightly (with a percent level) differ from the SM predictions, the hff couplings also deviate but more largely. Therefore, in such a case, in addition to determining the type of Yukawa couplings, there is a possibility to obtain more information on the extra Higgs bosons by fingerprinting the theory predictions with future precision data for the hff and hVV couplings at the LHC and the ILC.

This talk is based on the paper:

"Radiative corrections to the Yukawa coupling constants in two Higgs doublet models",
S. Kanemura, M. Kikuchi and K. Yagyu. Phys. Lett. B731 (2014) 27. [arXiv: 1401.0515]

BEH Physics / 584

Measurement of the Higgs boson mass with the ATLAS detector

ATLAS, Collaboration¹¹ *CERN***Corresponding Author:** lroos@lpnhe.in2p3.fr

The latest results on the measurement of the Higgs boson mass in the diphoton and ZZ decay channels with the ATLAS detector is presented, using approximately 25 fb⁻¹ of pp collision data collected at 7 TeV and 8 TeV in 2011 and 2012.

BEH Physics / 586

Measurement of cross sections and couplings of the Higgs boson in the ZZ decay channel using the ATLAS detector

ATLAS, Collaboration¹¹ *CERN***Corresponding Author:** lroos@lpnhe.in2p3.fr

A review of the latest results on the measurement of the cross sections and couplings of the Higgs boson in the ZZ decay channel with the ATLAS detector is presented, using approximately 25 fb⁻¹ of pp collision data collected at 7 TeV and 8 TeV in 2011 and 2012.

BEH Physics / 587

Measurement of cross sections and couplings of the Higgs boson in the WW decay channel using the ATLAS detector

ATLAS, Collaboration¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

A review of the latest results on the measurement of the cross sections and couplings of the Higgs boson in the WW decay channel with the ATLAS detector is presented, using approximately 25 fb⁻¹ of pp collision data collected at 7 TeV and 8 TeV in 2011 and 2012.

BEH Physics / 589

Search for the Higgs boson in VH(bb) channel using the ATLAS detector

ATLAS, Collaboration¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Since the discovery of a Higgs boson by the ATLAS and CMS experiments at the LHC, the emphasis has shifted towards measurements of its properties and the search for less sensitive channels in order to determine whether the new particle is the Standard Model (SM) Higgs boson. Of particular importance is the direct observation of the coupling of the Higgs boson to b-quarks. In this talk a review of ATLAS results in the search for the Higgs boson in the VH production mode with the Higgs decaying to a b-quark pair decay will be given.

BEH Physics / 591

Combination of the Higgs Boson Main Properties Measurements using the ATLAS Detector

ATLAS, Collaboration¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

The combined measurements of the properties of the Higgs boson using the ATLAS detector and up to 25 fb⁻¹ of 7 TeV and 8 TeV pp collision data collected in 2011 and 2012, are discussed.

BEH Physics / 592

Search for a High mass Higgs using the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Since the discovery of a Higgs boson by the ATLAS and CMS experiments at the LHC, the emphasis has shifted towards determining whether the new particle is the Standard Model (SM) Higgs boson. The search for additional Higgs boson states addresses this question. In particular the search for high mass states decaying to diboson final states could shed light on the structure of the electroweak symmetry breaking sector. In this presentation the latest ATLAS results on these searches will be discussed.

BEH Physics / 594

Individual and Combined Measurements of the Spin and Parity Properties of the Higgs boson using the ATLAS Detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

This contribution will review individual and combined measurements of the spin and parity properties in the diphoton, ZZ (with subsequent decays to four leptons) and WW (with subsequent decays to $l\nu l\nu$) channels of the Higgs boson in individual channels using the ATLAS detector and up to 25 fb⁻¹ of 7 TeV and 8 TeV pp collision data collected in 2011 and 2012.

BEH Physics / 596

ATLAS Higgs physics prospects at the high luminosity LHC

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Run-I at the LHC has been very successful and included the discovery of a new particle with mass of about 125 GeV compatible within uncertainties with the Higgs boson predicted by Standard Model. In this talk, the Higgs physics prospects at the high-luminosity LHC are presented, assuming an energy $\sqrt{s} = 14$ TeV and a data sample of 3 ab⁻¹. In particular, the ultimate precision attainable on the couplings measurements of the 125 GeV particle with elementary fermions and bosons is discussed, as well as perspectives on the searches for partners associated to this new object, predicted by several extensions of the standard theory.

BEH Physics / 600

Constraints on new phenomena through Higgs coupling measurements with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

The discovery of the Higgs boson opens many perspectives to explore physics beyond the Standard Model. This talk describes constraints of new physics in a number of models using the combined measurements of the coupling strength of the 125 GeV Higgs particle using the entire ATLAS run-I data. The various models presented include an additional real electroweak singlet, two Higgs doublet models, a simplified Minimal Supersymmetric Standard Model, and a Higgs portal to dark matter.

BEH Physics / 601

Search of Higgs to invisible decays with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Searches for decays of the Higgs boson into non detectable invisible particles are presented. Data taken by the ATLAS detector at center of mass energies of 7 and 8 TeV are analysed and in the absence of evidence of such decays, upper limits on the branching ratio to invisible decays are set.

Top-quark and ElectroWeak Physics / 606

NLO QCD corrections to VVjj production at the LHC

Dr. CAMPANARIO, Francisco ¹; Prof. ZEPPENFELD, Dieter ²; Dr. LE DUC, Nihn ²; Mr. KERNER, Matthias ²

¹ IFIC, UV-CSIC

² KIT

Corresponding Author: francisco.campanario@ific.uv.es

These processes are important backgrounds to the measurement of the quartic gauge couplings of the Standard Model, to the Higgs signal via vector boson fusion, and to the search for signals of new physics beyond the Standard Model.

We present the first calculation of the next-to-leading order QCD corrections to the QCD-induced ZZ production in association with two jets at hadron colliders.

As expected, the next-to-leading order corrections reduce significantly the scale uncertainty and show a non-trivial phase space dependence in kinematic distributions.

Our code will be publicly available as part of the parton level Monte Carlo program VBFNLO

Poster Session / 607

The ATLAS Higgs Boson Machine Learning Challenge

Mrs. ADAM-BOURDARIOS, Claire ¹

¹ *on Behalf of the ATLAS Collaboration*

Corresponding Author: claire.bourdarios@cern.ch

High Energy Physics began utilising Machine Learning technique such as Multivariate Analysis, Neural Nets and Boosted Decision Trees since the 90's, but the connections between the HEP scientific community and the computer science community are poor and can be improved.

In HEP there are exciting and difficult problems such as the extraction of the Higgs boson signal, while computer scientists are eager to develop advanced algorithms. The goal of the HiggsML project is to bring the two fields together by means of a "challenge", where participants from all over the world and any scientific background can compete to obtain the best signal over background ratio on a set of simulated data.

The challenge was organized by the ATLAS collaboration, the LAL and INRIA-Saclay in partnership with CERN and Google. It will run between May 2014 and September 2014 to encourage participation of students and professors.

The organization, the startup and prospects of the challenge, which is half way between outreach and physics analysis, will be described.

Heavy Ions / 608

Recent Results on Soft Probes of the Quark-Gluon Plasma from the ATLAS Experiment at the LHC

ATLAS, Collaboration ¹

¹ *CERN*

Corresponding Author: lroos@lpnhe.in2p3.fr

Measurements of low-pT (< 5 GeV) particle production have provided valuable insight on the production and evolution of the quark-gluon plasma in Pb+Pb collisions at the LHC. In particular, measurements of elliptic and higher order collective flow imprinted on the azimuthal angle distributions of low-pT particles directly probe the strongly-coupled dynamics of the quark-gluon plasma and test hydrodynamic model descriptions of its evolution. The large acceptance of detectors like ATLAS has made it possible to measure flow event-by-event and to determine the correlations between different harmonics. Recent measurements of low-pT particle production and multi-particle correlations in proton-lead collisions have shown features similar to the collective flow observed in Pb+Pb collisions. Results will be presented from a variety of single and multi-particle measurements in Pb+Pb and proton-Pb collisions that probe the collective dynamics of the quark-gluon plasma and possibly provide evidence for collectivity in even small systems.

Heavy Ions / 609

Measurement of Hard Probes of the Quark-Gluon Plasma with the ATLAS Experiment at the LHCATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Jets provide a powerful tool for probing the dynamics of the quark-gluon plasma created in Pb+Pb collisions at the LHC. The modification of high-pT parton showers as they propagate in the quark-gluon plasma, often referred to as "jet quenching", provides insight on the short-distance dynamics of the plasma. Jet quenching has been observed in a variety of single jet, dijet, and photon-jet measurements at the LHC as well as in measurements of modified charged-particle fragmentation functions. These results will be presented along with a survey of results of control measurements using electroweak final states in Pb+Pb collisions and jet production in proton-lead collisions.

BEH Physics / 610

Higgs boson CP-properties in Higgs plus three jet production via gluon fusion at the LHCDr. CAMPANARIO, Francisco ¹; Dr. KUBOCZ, Michael ²¹ IFIC, UV-CSIC² RWTH Aachen**Corresponding Author:** francisco.campanario@ific.uv.es

In high energy hadronic collisions, a general CP-violating Higgs boson Φ with accompanying jets can be efficiently produced via gluon fusion, which is mediated by heavy quark loops.

We study the dominant sub-channel $gg \rightarrow \Phi ggg$ of the gluon fusion production process with triple real emission corrections at order α_s^5 .

We go beyond the heavy top limit approximation and include the full mass dependence of the top- and bottom-quark contributions.

Furthermore, we show within a toy-model scenario that bottom-quark loop contributions in combination with large values of $\tan\beta$ can modify visibly the differential distributions sensitive to Φ -measurements of the Higgs boson particle.

Detector RD and Performance / 611

ATLAS jet and missing ET reconstruction, calibration, and performance

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

ATLAS has achieved a very high precision on jet and missing transverse energy performance by the use of advanced calorimeter-based topological clustering and local cluster calibration, event-by-event pile-up subtraction methods, and in situ techniques to correct for the residual jet energy response difference between data and simulation. Tracking information is being combined with calorimeter to further improve the jet and missing ET performance. ATLAS has also commissioned several new powerful tools for for the analysis and interpretation of hadronic final states at the LHC such as jet substructure, jet mass, quark-gluon discrimination, and jet tagging tools for the identification of boosted heavy particles. An overview of the reconstruction, calibration and performance of jets, missing ET, and jet substructure and tagging at ATLAS is presented.

Detector RD and Performance / 612

Performance of the reconstruction, calibration and identification of electrons and photons with the ATLAS detector, and their impact on the ATLAS physics results

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

The performance of the reconstruction, calibration and identification electrons and photons with the ATLAS detector at the LHC is a key component to realize the ATLAS full physics potential, both in the searches for new physics and in precision measurements. For instance, they all played a critical role in the discovery of a Higgs boson, announced by the ATLAS Collaboration in 2012, and in the measurement of its properties.

We present a description of the algorithms used for the reconstruction and identification of electron and photons with the ATLAS detector, as well as results from the measurements of their efficiencies in pp collisions. The electron and photon energy calibration procedure is discussed, as well as its impact on the precise measurement of the Higgs boson mass.

Poster Session / 613

Advanced alignment of the ATLAS tracking system

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

ATLAS is a multipurpose experiment at the LHC proton-proton collider. In order to reconstruct trajectories of charged particles, ATLAS is equipped with a tracking system built using different technologies, silicon planar sensors (pixel and micro-strip) and gaseous drift-tubes, all embedded in a 2T solenoidal magnetic field. For the LHC Run II, the system is being upgraded with the installation of a new pixel layer, the Insertable B-layer (IBL).

ATLAS physics goals require high resolution, unbiased measurement of all charged particle kinematic parameters in order to assure accurate invariant mass reconstruction and interaction and decay vertex finding. These critically depend on the systematic effects related to the alignment of the tracking system.

In order to eliminate malicious systematic deformations, various advanced tools and techniques have been put in place. These include information from known mass resonances, energy of electrons and positrons measured by the electromagnetic calorimeters, beam-spot and primary vertex constrains, etc. Alignment algorithms are complemented by the extended online and offline monitoring scheme.

Despite being stable under normal running conditions, ATLAS tracking system responses to sudden environmental changes (temperature, magnetic field) by small collective deformations. These have to be identified and corrected in order to assure uniform, highest quality tracking performance throughout the whole data taking. Such a time-aware alignment scheme was put in place for 2012 running.

An outline of the track based alignment approach and its implementation within the ATLAS software will be presented. Special attention will be paid to integration of the IBL to the alignment framework, techniques allowing to identify and eliminate tracking systematics as well as strategies to deal with time-dependent alignment. Performance from LHC proton-proton collision Run I and prospects for LHC Run II will be discussed.

Detector RD and Performance / 614

ATLAS Inner Tracking detectors: Run 1 performance and developments for Run 2ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The measurement of charge particle trajectories with the inner tracking detectors at the ATLAS experiment is a key input for higher-level object reconstructions, ranging from leptons to the identification of heavy-flavor jets. In addition the information provided by the inner tracking systems has been proven to be very powerful for disentangling the effects of several interactions occurring in the same bunch crossing (pile-up).

In this contribution, we will review the performance during the Run 1 data-taking and preparation for the next run in 2015.

In particular, we will show how the knowledge of the passive material inside the inner tracking acceptance has been further studied to reduce the systematic errors on the tracking efficiency, with benefits for physics measurements.

In addition, the developments in disentangling close-by tracks which naturally occur in the decay of very high- p_T objects (e.g. taus, of close to the core of jets) will be presented.

The ongoing upgrade of the ATLAS detector includes an extra silicon layer (IBL) in the inner tracking system; the preparation for the integration of the new hardware and its expected performance will be reviewed as well.

Finally, it will be presented a brief report on recent developments of the tracking software aiming for speed and disk-space optimizations.

Detector RD and Performance / 615

Identification and energy calibration of hadronically decaying tau leptons with the ATLAS experiment.ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The trigger and offline reconstruction, identification and energy calibration algorithms employed for hadronic decays of tau leptons for the data collected in 2012 with the ATLAS detector at the LHC operating at a center-of-mass energy of 8TeV are described. The performance of these algorithms is measured in most cases with Z decays to tau leptons.

An uncertainty on the offline reconstructed tau energy scale of about 2-4%

is achieved using two independent methods. The offline tau identification efficiency is measured with a precision

of (2-3)% for hadronically decaying tau leptons with one associated track, and of (4-5)%

for the case of three associated tracks, inclusive in η and for a visible transverse momentum greater than 20 GeV. Stability of the performance and through the data taking

period is observed with respect to the number of concurrent proton-proton interactions.

Poster Session / 616

Performance of the muon identification and reconstruction with the ATLAS detector.

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

This talk presents the muon reconstruction algorithms used in ATLAS during the LHC run-1 and their performances in terms of efficiency, muon momentum scale and resolution. These performances have been measured using large calibration samples of J/ψ , Υ and Z decays, which allow to control the systematic uncertainties on efficiency and on momentum scale at the per-mille level. Corrections to be applied to simulation have been derived from the performances measurements and used in physics analyses. The impact of these correction on physics measurements, and the associated uncertainties, is also presented.

Poster Session / 617

Search procedure for short-lived particles and charm physics with the OPERA experiment

Dr. DEL AMO SÁNCHEZ, Pablo ¹; COLLABORATION, OPERA ²

¹ LAPP - IN2P3 - CNRS / Université de Savoie

² CNGS-01

Corresponding Author: pablo.delamosanchez@lapp.in2p3.fr

The OPERA experiment was designed to provide evidence of $\nu_\mu \rightarrow \nu_\tau$ neutrino oscillations in appearance mode through the detection of the tau lepton produced in ν_τ Charged Current interactions. The OPERA detector was exposed to the CNGS muon neutrino beam from CERN to Gran Sasso, 730 km away from the source, and collected data from 2008 to 2012.

We report on the search procedure for short-lived particles and on its validation on the charmed sample. Charmed hadrons, produced in about 4% of the neutrino interactions in OPERA, are an important background to the $\nu_\mu \rightarrow \nu_\tau$ channel and an ideal control sample, as their decay exhibits topological and kinematical features strongly resembling those of the tau decay.

Poster Session / 618

Combined measurement of the couplings of the Higgs boson in the $H \rightarrow WW \rightarrow l\nu l\nu$ channel with the ATLAS detector at the LHC

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

We present the combined study of the Higgs boson in the $H \rightarrow WW \rightarrow l\nu l\nu$ channel the full 25 fb⁻¹ of data collected at 7 and 8 TeV center of mass energy collected by the ATLAS experiment at the LHC. In particular, the extractions of the signal yields from the combination of the major production modes and their associated signal strengths will be presented. The interpretation of these with respect to the Standard Model predictions will also be shown.

Poster Session / 619

Search for Higgs-like diphoton resonances in the 65-600 GeV mass range with the ATLAS detector at a centre of mass energy of 8 TeV.ATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The search for a narrow resonance decaying into two photons in the mass range [65-600] GeV in pp collisions with the ATLAS detector at the Large Hadron Collider is presented. The results are given as a model independent limit on the fiducial production cross-section times branching fraction of $X \rightarrow \gamma\gamma$.

Poster Session / 622

Search for anomalous production of same-sign dilepton at $\sqrt{s} = 8$ TeV with the ATLAS detectorATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

An inclusive search for non-Standard Model production of two prompt, isolated leptons with the same electric charge and an application to a doubly charged Higgs boson search are presented. The search is performed in a data sample corresponding to 20.3 fb⁻¹ of integrated luminosity collected in 2012 at $\sqrt{s} = 8$ TeV by the ATLAS detector at the LHC.

Same-sign lepton pairs (ee , $e\mu$, and $\mu\mu$) are selected in an inclusive way, with minimal requirements placed on the non-leptonic activity in the event. No significant deviations from Standard Model expectations are observed. Limits on the contribution of new physics to a fiducial region corresponding to the event selection as well as the production cross section of doubly charged Higgs bosons are extracted.

Poster Session / 623

Search for non-resonant new phenomena in dilepton final states with the ATLAS detectorATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

A search, performed using the ATLAS experimental data, is conducted for non-resonant new phenomena in the dilepton final state, which could originate from contact interactions and large extra spatial dimensions. The full LHC 2012 proton-proton dataset is used comprising 20 fb⁻¹ at $\sqrt{s} = 8$ TeV, recorded by the ATLAS detector under nominal conditions. For the first time in ATLAS, the forward-backward asymmetry was used as a

search variable where relevant, in addition to invariant mass, to increase the search sensitivity to the new physics models under investigation.

Poster Session / 624

Searching for Dark Matter in the Monojet Channel with the ATLAS Detector

ATLAS, Collaboration ¹

¹ *CERN*

Corresponding Author: lroos@lpnhe.in2p3.fr

Searches for monojet plus missing transverse momentum signatures are sensitive to new phenomena involving invisible particles, such as the pair-production of dark matter, one particularly well motivated possibility. We report on the most recent search for monojet signatures with the ATLAS detector. The effective field theory models typically used for monojet dark matter interpretations have validity limitations. These are addressed both through applying additional constraints, and through a first look at the use of simplified models of dark matter pair-production. Preliminary studies into the impact of future datasets and experimental conditions on monojet dark matter searches provide an idea of what to expect in the coming years.

Flavour Physics / 626

$B_{[s,d]}^0 \rightarrow \ell^+ \ell^-$ Decays in the Aligned Two-Higgs-Doublet Model

Dr. LU, Jie ¹; PICH, Antonio ²; Prof. LI, Xin-Qiang ³

¹ *IFIC, University of Valencia*

² *IFIC*

³ *Central China Normal University*

Corresponding Author: lu.jie@ific.uv.es

The rare decays $B_{[s,d]}^0 \rightarrow \ell^+ \ell^-$ are analyzed within the general framework of the aligned two-Higgs doublet model. We present a complete one-loop calculation of the relevant short-distance Wilson coefficients, giving a detailed technical summary of our results and comparing them with previous calculations performed in particular limits or approximations. We investigate the impact of various model parameters on the branching ratios and study the phenomenological constraints imposed by present data.

Computing and Data Handling / 627

PanDA: A New Paradigm for Distributed Computing in HEP Through the Lens of ATLAS and other ExperimentsDE, Kaushik¹; KLIMENTOV, Alexei²; MAENO, Tadashi²; NILSSON, Paul¹; WENAUS, Torre²¹ *Univ. of Texas at Arlington*² *Brookhaven National Laboratory***Corresponding Author:** kaushik@uta.edu

Experiments at the Large Hadron Collider (LHC) face unprecedented computing challenges. Heterogeneous resources are distributed worldwide, thousands of physicists analyzing the data need remote access to hundreds of computing sites, the volume of processed data is beyond the exabyte scale, and data processing requires more than a billion hours of computing usage per year. The PanDA (Production and Distributed Analysis) system was developed to meet the scale and complexity of LHC distributed computing for the ATLAS experiment. In the process, the old batch job paradigm of computing in HEP was discarded in favor of a far more flexible and scalable model. The success of PanDA in ATLAS is leading to widespread adoption and testing by other experiments. PanDA is the first exascale workload management system in HEP, already operating at a million computing jobs per day, and processing over an exabyte of data in 2013. We will describe the design and implementation of PanDA, present data on the performance of PanDA at the LHC, and discuss plans for future evolution of the system to meet new challenges of scale, heterogeneity and increasing user base.

Poster Session / 628

Chargino/Neutralino production with Higgs in the decay chain using proton-proton collisions at $\sqrt{s} = 8$ TeV with ATLAS detectorATLAS, Collaboration¹¹ *CERN***Corresponding Author:** lroos@lpnhe.in2p3.fr

Searches for direct production of chargino (χ_{11}) and neutralino (χ_{12}) leading to final states characterized by the presence of a Higgs boson are reported. Events containing missing transverse momentum and one or more leptons are selected, and various channels sensitive to different Higgs decays are considered. The analyses use 20.3 fb⁻¹ of proton-proton collision data at $\sqrt{s} = 8$ TeV recorded in 2012 with the ATLAS detector at the Large Hadron Collider. Observations are consistent with the Standard Model expectations and limits are set in R-parity conserving phenomenological Minimal Supersymmetric Standard Models and in simplified supersymmetric models.

Poster Session / 629

Search for strongly produced supersymmetric particles in decays with leptons at $\sqrt{s} = 8$ TeV.ATLAS, Collaboration¹¹ *CERN***Corresponding Author:** lroos@lpnhe.in2p3.fr

This poster presents the results of a search for squarks and gluinos in final state events containing jets, missing transverse momentum and at least one isolated lepton (electron or muon), using 20.3 fb⁻¹ of proton-proton collision data at $\sqrt{s} = 8$ TeV recorded by the ATLAS experiment at the LHC in 2012. Exclusions limits are placed in supersymmetric simplified models and specific SUSY breaking models such as mSUGRA/CMSSM.

Poster Session / 630

Searches for direct stop production in the two lepton channel with the ATLAS experimentATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Supersymmetric theories offer one of the most promising solutions to the Standard Model problems, addressing in particular the naturalness problem of the theory. Within this scenario the search of the top quark supersymmetric partner, called stop, plays a key role. The ATLAS Experiment has developed a dedicated strategy to search for this particle. The results obtained searching for stop pair production in two-lepton (electron and muon) final states using 20/fb of 8 TeV pp collisions data taken in 2012 are presented.

Neutrino Physics / 631

The SNO+ Experiment for Neutrinoless Double Beta DecayDr. LOZZA, Valentina¹¹ TU Dresden**Corresponding Author:** steven.biller@physics.ox.ac.uk

The SNO+ experiment will employ 780 tonnes of liquid scintillator to explore a variety of fundamental physics. Chief amongst these will be a sensitive search for neutrinoless double beta decay, to be achieved by loading 130Te into the scintillator using a new technique. A combination of purification, passive shielding and background tagging is expected to leave 8B solar neutrinos and 2nbb decays as the dominant backgrounds in the region of interest, allowing us to achieve a sensitivity near the top of the inverted neutrino mass hierarchy with an initial 0.3% loading. Recent progress suggests that loadings of several percent or more are achievable and could permit a reach approaching the bottom of the inverted hierarchy in the near future. With the initial water fill underway, the status and prospects for the project will be reviewed.

Poster Session / 632

A general search for new phenomena with the ATLAS detector in pp collisions at $\sqrt{s}=8$ TeVATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

This poster presents a model-independent general search for new phenomena in proton-proton collisions at a centre-of-mass energy of 8 TeV with the ATLAS detector at the LHC. The data set corresponds to a total integrated luminosity of 20.3/fb. Event topologies involving isolated electrons, photons and muons, as well as jets, including those identified as originating from b-quarks and missing transverse momentum are investigated. The events are sub-divided according to their final states into exclusive event classes. For the 697 classes with a Standard Model expectation greater than 0.1 events, a search algorithm tests the compatibility of data against the Monte Carlo simulated background in three kinematic variables sensitive to new physics effects. Although this search approach is less sensitive than optimized searches for specific models, it provides a more comprehensive investigation for new physics signals.

Poster Session / 633

Search for electroweak supersymmetric particle production in final states with two leptons and missing transverse momentum with the ATLAS detector

ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Many supersymmetry models feature charginos, neutralinos and also sleptons with masses less than a few hundred GeV. These can give rise to direct pair production rates at the LHC that can be observed in the data sample recorded by the ATLAS detector. The talk presents results from searches for charginos, neutralinos and slepton production in final state events characterized by the presence of two leptons, missing transverse momentum and possibly jets using 20.3fb⁻¹ of proton-proton collision data at $\sqrt{s}=8$ TeV recorded with ATLAS in 2012.

Poster Session / 634

Search for super-symmetric compressed scenarios in monojet-like final states using 20.3 fb⁻¹ of pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector at the LHC

ATLAS, Collaboration ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

This poster presents searches for supersymmetry in compressed scenarios using 20.3 fb⁻¹ of proton-proton collision data at $\sqrt{s} = 8$ TeV recorded by the ATLAS experiment at the LHC. The analysis has been optimized for the stop decaying into a charm quark plus a neutralino SUSY signal. Different signal regions have been defined with different thresholds in $E_{T\text{miss}}$ and P_t of the leading jet, with at most three jets. Limits are set on the visible cross-section. Interpretations for the stop pair production (stop decaying to charm plus neutralino and four body decay) and sbottom pair production (sbottom decaying to bottom plus neutralino) are studied. Results are presented in terms of exclusion limits in the stop-neutralino and sbottom-neutralino mass planes.

Poster Session / 635

Search for direct top squark pair production in final states with one isolated lepton, jets and missing transverse momentum in $\sqrt{s} = 8$ TeV pp collisions with the ATLAS detector

ATLAS, Collaboration ¹¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Motivated by natural SUSY, a search for supersymmetric top squark pair production in final states with one isolated lepton, jets and missing transverse momentum in $\sqrt{s} = 8$ TeV pp collisions using 20.3 fb⁻¹ of data from the ATLAS experiment, is presented. The analysis targets five different decay scenarios for the supersymmetric top squark (stop) : (1) stop decays into a top quark and the lightest neutralino, (2) stop decays into a bottom quark and the lightest chargino, (3) a 3-body decay of the stop, (4) a 4-body decay of the stop, (5) asymmetric decays where each stop can decay either via (1) or (2). As the data are in agreement with predictions from the Standard Model, the measurements are translated into 95% C.L. upper limits on the stop and LSP masses in various Supersymmetric scenarios. The sensitivity to a limited number of pMSSM models, in which the stop can decay into heavy neutralinos and charginos, is also presented.

Poster Session / 636

Search for squarks and gluinos with the ATLAS detector in final states with jets and missing transverse momentum using 20.3 fb⁻¹ of $\sqrt{s} = 8$ TeV proton-proton collision data

ATLAS, Collaboration ¹¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Weak scale supersymmetry is one of the best motivated and studied Standard Model extensions. It predicts the existence of new heavy coloured particles called squarks and gluinos which are the supersymmetric partners of the quarks and gluons respectively. The poster summarises latest results on inclusive searches for supersymmetric squarks and gluinos in events containing jets and missing transverse momentum without leptons. The searches use the full data sample recorded in 2012 at $\sqrt{s}=8$ -TeV centre-of-mass energy by the ATLAS experiment at the LHC.

Poster Session / 637

The SNO+ Project

Dr. SEGUI, Laura ¹¹ Oxford University

Corresponding Author: steven.biller@physics.ox.ac.uk

The SNO+ project will make use of the basic SNO detector infrastructure to create a large liquid scintillator experiment to explore a variety of fundamental physics, with a strong focus on neutrinoless double beta decay using ¹³⁰Te. Substantial modifications to the original SNO detector are being affected in order to achieve this. The initial water fill is currently underway, with the transition to liquid scintillator scheduled for next year. Details of the detector preparation, commissioning and design goals will be presented.

Poster Session / 638

Measurement of the Wt production cross section in dilepton events on ATLASATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Single top quark production accounts for $\sim 1/3$ of the overall top quark production cross-section at the LHC, opening a great opportunity to probe electroweak couplings. One important production mode in the Standard Model is the creation of a single top quark in association with a W boson, which had eluded discovery until summer 2013. The close similarity of its final state to that of top quark pair production, which has a ~ 10 times larger production cross-section, makes the measurement a challenging endeavour. Hence multivariate techniques are used to identify the Wt signal. The results of the latest Wt cross-section measurement with the ATLAS detector, based on 20 fb⁻¹ of pp collision data at $\sqrt{s}=8$ TeV, will be presented.

Poster Session / 639

ATLAS $t\bar{t}$ resonance searchesATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

An overview is given of the ATLAS searches for new massive states decaying to top quark pairs. The combination of classical, resolved selection and reconstruction of the top quark pair with an algorithm designed specifically for boosted top quarks yields good acceptance for a broad range of resonance masses. A new result is presented from an analysis of 20/fb of proton-proton collisions collected during the 2012 run of the LHC, at a center-of-mass energy of 8 TeV. Limits are set on the production cross-section times branching of several resonance models.

Beyond the Standard Model / 640

Interplay between the Higgs and the inert dark matterSWIEZEWSKA, Bogumila¹; Prof. KRAWCZYK, Maria¹; Dr. SOKOLOWSKA, Dorota¹; Mr. SWACZYNA, Pawel¹¹ University of Warsaw**Corresponding Author:** bogumila.swiezewska@fuw.edu.pl

An interplay between the LHC results on the Higgs boson: measurement of the total width, invisible decays branching ratios and especially the signal strength in the decay of the Higgs boson to two photons, and the properties of the Higgs-portal dark matter (DM) in the Inert Doublet Model is analysed. The results are combined with the PLANCK constraints on the DM relic density, and strong constraints on the DM scenarios are derived. A comparison with the XENON and LUX results is presented.

Poster Session / 642

First measurement of associated vector boson plus prompt charmonium production at the ATLAS experimentATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

We present evidence of associated vector boson+prompt J/psi production and measure its production rate. This is a key observable to further the understanding of quarkonium production mechanisms. We estimate the relative contributions to the signal from single and double parton scattering and discuss possible implications of this novel final state for study of multiple parton interactions. Single parton scattering cross-sections are compared to cutting-edge theoretical calculations in the colour singlet and colour octet formalisms.

Poster Session / 643

Measurements of the production of P-wave charmonium states through radiative decays at the ATLAS experimentATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

Understanding of the production of P-wave charmonium states is a significant bottleneck in the understanding of charmonium production as a whole. Current theoretical calculations are limited in their ability to model the production and decay of these states. We present new measurements of the double-differential production cross-sections of the three χ_{cJ} spin states separately, extending upon previous measurements in precision, kinematic reach, and number of measurements. The relative production cross-sections of the various χ_c states through prompt and non-prompt production modes are explored as a function of transverse momentum, as well as the fraction of the total J/psi production which occurs via χ_c feed-down. Results are compared with latest theoretical predictions from a variety of theoretical approaches. A competitive measurement of the branching fraction of $B^\pm \rightarrow \chi_{c1} + K^\pm$ is also presented.

Poster Session / 647

Double-charmonium production at the ATLAS experimentATLAS, Collaboration¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

We present cross-section measurement of double-J/psi production at ATLAS. The analysis separates the prompt-prompt, prompt-non-prompt and non-prompt di-J/psi production. A contribution from double parton scattering is estimated. The results are compared with the latest theoretical calculations in the colour singlet and colour octet formalisms.

Poster Session / 648

b-jet identification algorithms and performance in the ATLAS experiment

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

The identification of b-quarks jets (b-tagging) is a crucial ingredient in many physics analyses carried out in the ATLAS experiment at the LHC. In this poster, we present the status of b-tagging algorithms and their performance calibration. In particular, new tagging algorithms with improved c-jet rejection and extending to high jet pt are discussed, as well as recent improvements and extensions of the performance calibration methods.

Poster Session / 649

Measurement of missing transverse momentum with the ATLAS detector at the LHC Run-I and beyond

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

During the LHC Run-I data taking period, ATLAS has developed and refined several approaches for measuring missing transverse momentum $\{MET\}$ in proton-proton collisions. Standard calorimeter-based $\{MET\}$ reconstruction techniques have been improved to obtain high precision measurement, while new track-based $\{MET\}$ methods provide an independent, and complementary measurement from charged particle momenta reconstructed with the inner detectors. While both procedures are individually useful, preliminary studies have shown that combining information from both techniques leads to an improved understanding of $\{MET\}$. This combined calorimeter and tracking $\{MET\}$ measurement has also proven to be very effective in the high-pileup conditions in Run-I as it reduces the dependence of the $\{MET\}$ on pileup activity.

The LHC Run-II could be even more challenging as higher luminosity will be delivered. The worsening of pileup conditions require a better precision in order to measure the $\{MET\}$ which originates from the hard interaction. Monte Carlo simulations using Run-II conditions have shown that the ATLAS $\{MET\}$ measurement maintain good performance in such extreme environment, with continuous development for further improvement.

Poster Session / 650

Determination of the Jet Energy Scale and the Jet Energy Resolution in the 20fb-1 of data collected by the ATLAS detector in 2012

ATLAS, Collaboration¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Precision measurements of jets produced in pp collisions at the LHC are of key importance to analyses measuring Standard Model processes or searching for new physics. To account for signal losses in the detector, the energy of calorimeter jets needs to be calibrated. In ATLAS, jets are calibrated in multiple steps using techniques driven by both Monte Carlo simulations and data. The jet energy scale (JES) is evaluated and corrected after pile-up removal using QCD dijet Monte Carlo simulation. Further Monte Carlo based corrections take advantage of the dependence of the JES on tracker and calorimeter observables. The final correction and the total JES uncertainty are determined using in-situ techniques which compare the jet energy to the energy of a calibrated reference object. The jet energy resolution (JER) is evaluated in Monte Carlo simulation by comparing the reconstructed jet energy to the energy of jets constructed from stable simulated particles. The JER and its total uncertainty are also measured in data using in-situ techniques similar to those used to determine the jet energy scale. A summary of the techniques used by ATLAS to assess the jet energy scale and jet energy resolution are presented here.

Poster Session / 651

Performance of Jet Substructure Techniques and Boosted Object Identification in ATLAS

ATLAS, Collaboration¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

ATLAS has implemented and commissioned many new jet substructure techniques to aid in the identification and interpretation of hadronic final states originating from Lorentz-boosted heavy particles produced at the LHC.

These techniques include quantum jets, jet charge, jet shapes, quark/gluon, boosted boson and top quark tagging, along with grooming methods such as pruning, trimming, and filtering. These techniques have been validated using the large 2012 ATLAS dataset. Presented here is a summary of the state of the art jet substructure and tagging techniques developed in ATLAS, their performance and recent results.

Poster Session / 652

Performance of the Shower deconstruction algorithm for top tagging in ATLAS

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

This poster describes the performance of the shower deconstruction algorithm, a jet tagging algorithm, using proton-proton collisions at a centre of mass energy of $\sqrt{s} = 8$ TeV. Data recorded with the ATLAS detector corresponding to an integrated luminosity of 14.2 fb⁻¹ are considered. Using small-radius jets to probe the substructure of a large-radius jet, shower deconstruction assigns a probability based on an approximate parton shower model, that the jet originated from a massive particle. In this poster, the shower deconstruction algorithm is investigated to identify jets produced from boosted, hadronically decaying top quarks. The performance is evaluated using events enriched in top-quark pairs in the lepton plus jets final state and a sample of dijet events. The distribution of the shower deconstruction observable, the likelihood ratio χ_{SD} , is compared between data and simulation and the expected performance of shower deconstruction is compared to that of other tagging algorithms.

Poster Session / 653

Electron and photon reconstruction and identification with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

An excellent performance of the reconstruction, calibration and identification of electrons and photons with the ATLAS detector at the LHC is a key component to realize the ATLAS full physics potential, both in searches for new physics and in precision measurements. For instance, all these played a critical role in the discovery of a Higgs boson, announced by the ATLAS Collaboration in 2012, and in the measurement of its properties.

This poster will highlight the reconstruction and identification of electrons and photons, and present the data-driven measurement of the efficiencies.

Strong Interactions and Hadron Physics / 654**Next-to-leading order QCD corrections to five jet production at the LHC**

Dr. BIEDERMANN, Benedikt¹; Dr. BADGER, Simon²; Dr. YUNDIN, Valery³; Prof. UWER, Peter⁴

¹ *Universität Würzburg*

² *CERN*

³ *MPI Munich*

⁴ *Humboldt-Universität zu Berlin*

Corresponding Author: benedikt.biedermann@physik.uni-wuerzburg.de

We present theoretical predictions for five jet production in proton-proton collisions at next-to-leading order accuracy in QCD. Inclusive as well as differential observables are studied for collision energies of 7 and 8 TeV. In general the next-to-leading order corrections stabilize the theoretical predictions with respect to scale variations. In case of the inclusive jet cross sections, we compare with experimental data where possible and find reasonable agreement. We observe that the four-to-three and five-to-four jet ratios show better perturbative convergence than the known three-to-two ratio and are promising candidates for future α_s measurements. Furthermore, we present a detailed analysis of uncertainties related to parton distribution functions. For the computation of the full colour virtual seven-point matrix elements, we use a generalised d-dimensional unitarity framework implemented in the publicly available library NJet.

Poster Session / 655**Muon momentum efficiency, scale and resolution in pp collisions at $\sqrt{s}=8\text{TeV}$**

ATLAS, Collaboration¹

¹ *CERN*

Corresponding Author: lroos@lpnhe.in2p3.fr

The ATLAS experiment identifies and reconstructs muons with two high-precision tracking systems, the Inner Detector and the Muon Spectrometer, which provide independent measurements of the muon momentum. This poster summarizes the performance of the combined muon reconstruction in terms of reconstruction efficiency, momentum scale and resolution. Data-driven techniques are used to derive corrections to be applied to simulation in order to reproduce the reconstruction efficiency, momentum scale and resolution as observed in experimental data, and to assess systematic uncertainties on these quantities. Analyzed dataset corresponds to an integrated luminosity of 20.4 fb⁻¹ from 8 TeV pp collisions recorded in 2012.

Education and Outreach / 656**Sharing ATLAS data and research with young students**Mrs. PEDERSEN, Maiken¹; Prof. OULD-SAADA, Farid¹¹ *University of Oslo***Corresponding Author:** farid.ould-saada@fys.uio.no

Sharing ATLAS data and research with young students

Maiken Pedersen, Farid Ould-Saada, on behalf of the ATLAS Collaboration and IPPOG International Masterclasses

In recent years the International Masterclasses (IMC) featured the use of real experimental data as produced by the LHC and collected by the detectors. We present ATLAS-based educational material using these data allowing high-school students to learn about properties of known particles and search for new phenomena. The ambition to bring to the “classrooms” important LHC discoveries is realised using the recent discovery of the Higgs boson. About 10% of the ATLAS discovery data are made available for students to search for the Higgs boson: 2fb^{-1} at 8 TeV for the Z-path, and 1fb^{-1} at 7 TeV for the Wpath, in the 2014 version of IMC. The Higgs study samples constitute one third of the total sample including Z, W and other low mass resonances.

The goal of the Zpath measurement is to rely on the invariant mass concept to identify and measure properties of known particles, such as the Z boson, inferred from the decay products, pairs of leptons. When a heavy gauge boson Z' with mass 1 TeV is mixed with the real data, the simulated signal shows up in the di-lepton mass distribution, to the surprise of students, who realize that they have mastered a discovery tool. They go on and apply the same technique to di-photons and pairs of di-leptons to search for the Higgs boson. To help the buildup and display of the invariant mass distributions, we developed OPlOT, a scalable, php-based web-plotting tool for submission and automatic combination of all measurements performed. This allows for prompt access of results for further discussion within institutes and during videoconferences. The W-Path deals, with the structure of the proton, by comparing the numbers of W^+ and W^- , and search for the Higgs into a pair of W bosons, by measuring the angle between the leptons stemming from the W bosons. Event-display files are read using Hypathia (Zpath) or Minerva (Wpath).

The educational material is tuned and expanded to follow LHC “heartbeats”. In the future we hope to bring new discoveries to the public. Among new features being implemented in the Zpath, a signal of graviton resonances in di-lepton, di-photon mass distributions, and the exploiting of missing transverse energy to study di-lepton invariant mass endpoints of supersymmetric particles. Finally, a script is available for more advanced university students to loop through all events.

Neutrino Physics / 657**Latest results from KamLAND-Zen second phase**Dr. GANDO, Yoshihito¹¹ *Research Center for Neutrino Science, Tohoku Univ.***Corresponding Author:** gando@awa.tohoku.ac.jp

KamLAND-Zen is an experiment for neutrinoless double beta decay search with xenon 136 based on large liquid scintillator detector KamLAND.

The first phase of the experiment was operated from Oct. 12, 2011 to June 14, 2012 and we set lower limit for the neutrino-less double beta decay half-life, $T_{1/2}(0\nu) > 1.9 \cdot 10^{25}$ yr. The combined result of KamLAND-Zen and EXO data give $T_{1/2}(0\nu) > 3.4 \cdot 10^{25}$ yr.

At the first phase, we found problematic background, 110mAg. Then we purified liquid scintillator and xenon gas by distillation to remove the background. The purification campaign was started just after the first phase and ended at Dec. 2013.

We present the progress of background rejection, current status and latest results from KamLAND-Zen second phase.

Poster Session / 659

Reactor antineutrino detection in the Double-Chooz experiment: Techniques for background reduction

Mr. LÓPEZ, José Mariano ¹; Mr. WURM, Michael ²; Ms. CONOVER, Emily ³; Mr. PRONOST, Guillaume ⁴; Ms. SHARANKOVA, Ralitsa ⁵; Mr. HOURLIER, Adrien ⁴; Mr. KITAZAWA, Makoto ⁶; Mr. RONCIN, Romain ⁴; Ms. CARR, Rachel ⁷; Mr. STOKES, Lee Fedor ²

¹ CIEMAT

² Universität Tübingen

³ University of Chicago

⁴ APC-Paris

⁵ Tokio Institute of Technology

⁶ Niigata University

⁷ Columbia University

Corresponding Author: josemario.lopez@ciemat.es

The purpose of Double-Chooz reactor neutrino experiment is a precision measurement of the mixing angle θ_{13} . A crucial item of this analysis is the thorough investigation of the different backgrounds found in the detector: neutrino coincidence signals are imitated by accidental coincidences of single events and by correlated events induced by cosmic muons, including stopped muons, fast neutrons and the spallation isotopes Li-9/He-8.

This contribution presents the current state of investigations for these background sources in the Double-Chooz far detector. Several techniques designed for the identification of the corresponding events are present in it. In addition, the impact of the backgrounds on the result of the oscillation analysis is reduced by the efficient veto techniques developed. As a consequence of these efforts, the current uncertainty on the background rate has been reduced by about a factor 2 compared to earlier publications. The detailed understanding of the background sources will be crucial for a future near+far detector oscillation analysis in which the correlated background will remain as the main source of systematic uncertainty.

Astroparticle Physics and Cosmology / 660

The XENON Dark Matter Project: from XENON100 to XENON1T

Dr. ALFONSI, Matteo ¹

¹ Nikhef

Corresponding Author: malfonsi@nikhef.nl

The XENON Collaboration aims at Dark Matter direct detection searching for interactions in a liquid xenon target. The XENON100 detector, a dual phase xenon Time Projection Chamber employing 161 kg of liquid xenon, started the first science run at the Laboratori Nazionali del Gran Sasso in Italy in 2009. It provided as scientific output limits on the spin-independent and spin-dependent interaction cross sections of Weakly Interacting Massive Particles (WIMPs), and the couplings of solar axions and galactic axion-like particles. We present the most recent results and we report the plan for the 2014 data taking. This run mainly focuses on additional calibration for the low energy response of the detector and the validation of new calibration techniques in view of the successor experiment, XENON1T. The new detector, currently under construction and starting data taking in 2015, will employ a liquid xenon target larger than 1 ton, reaching a sensitivity to spin-independent WIMP-nucleon cross section of the order of 10^{-47} cm^2 .

Poster Session / 661**Observation of ortho-Positronium formation in Double Chooz**Dr. PERASSO, Stefano ¹; Mr. MINOTTI, Alessandro ²¹ APC² IPHC - Université de Strasbourg**Corresponding Author:** alessandro.minotti@iphc.cnrs.fr

The Double Chooz experiment measures the neutrino mixing angle θ_{13} by detecting the reactor electron anti- ν via inverse beta decay. The positron-neutron delayed coincidence yields a sizeable background suppression; a further contribution might come from the development of techniques for an efficient identification of positrons. Pulse shape discrimination, a well-established technique for background rejection in liquid scintillator detectors, fails in separating them from electrons, as they give rise to identical light pulses. However, in some cases the positron decay is delayed by the formation of a positron-electron metastable bound state, called ortho-positronium (o-Ps), which introduces a delay between the light signal from the positron energy deposition in the scintillator and the one from the annihilation gammas. The consequent deformation in the positron-induced light pulse can be exploited to identify positrons with the pulse shape discrimination, as already successfully done statistically in Borexino.

In Double Chooz, we observed the o-Ps formation using the data sets resulting from neutron capture on Gd. We performed the first o-Ps formation tagging on an event-by-event basis and we could also measure the o-Ps formation probability and its lifetime, finding $(42 \pm 13)\%$ and (3.68 ± 0.23) ns respectively. These values are in good agreement with independent measurements obtained with a dedicated setup.

Detector RD and Performance / 662**Upgrade of the CMS instrumentation for luminosity and machine induced background measurements**MEYER, Arnd ¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

To cope with the higher luminosity, higher energy and shorter bunch spacing of 25 ns at the LHC after 2014, an upgrade program is performed for the detectors to measure the luminosity and machine induced background. A new detector is the pixel luminosity telescope consisting of 8 telescopes, equipped with silicon pixel sensors, on both ends of the interactions point (IP). The Beam Conditions Monitoring system, using diamond sensors, is upgraded to 24 sensors, 12 on each end of the IP. In addition, dedicated fast ASICs in 130 nm technology and dead-time free backend electronics using FPGAs for fast signal processing are being developed and built. Also, the part of the forward HCAL used for the luminosity measurement is instrumented with new readout electronics, in uTCA standards. The machine induced background measurement will be supported by a new system of direction sensitive quartz Cherenkov counters, with excellent timing resolution. A data acquisition architecture is developed that is common for all subsystems and allows for synchronization across different hardware. The design of the new system will be presented, and a report will be given on the performance of each system measured in several test-beam campaigns and prototype operation in the last LHC run.

Top-quark and ElectroWeak Physics / 663**Combined Top Quark Physics Results from ATLAS and CMS**MEYER, Amd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Combinations of several measurements of top quark physics from ATLAS and CMS are presented and compared with the expectations from theory. This includes measurements of top quark pair and single top production cross sections as well as properties. The world average combination of the top quark mass will also be presented. The treatment of experimental and modelling systematic uncertainties in the combinations and their correlations between experiments will be discussed in detail.

Poster Session / 664**The nEXO double beta decay experiment**POCAR, andrea¹¹ *umass amherst***Corresponding Author:** pocar@umass.edu

The nEXO Collaboration is designing a very large detector for neutrino-less double beta decay of Xe-136. The nEXO detector is rooted in the the currently-running EXO-200 program, which has reached a sensitivity for the half life of the decay of 1.9×10^{25} years with an exposure of 99.8 kg-yr. The baseline nEXO design uses 5 tonnes of liquid xenon, enriched in the mass 136 isotope, in a time projection chamber with scintillation readout. The detector is designed to reach a half-life sensitivity of $>5 \times 10^{27}$ years and cover the inverted neutrino mass hierarchy with 5 years of data. We present the nEXO detector design, the current R, and the physics case for the experiment.

Astroparticle Physics and Cosmology / 665**Dark Matter Searches with ANTARES Neutrino Telescope**ARDID, Miguel¹¹ *Universitat Politècnica de València***Corresponding Author:** miquelardid@gmail.com

The ANTARES Collaboration is operating the largest water Cherenkov neutrino telescope in the Northern hemisphere, installed in the Mediterranean Sea. One of the objectives of ANTARES is the search for neutrinos produced in self-annihilation of Dark Matter particles. The results on the search for Dark Matter annihilations in the Sun with the data recorded between 2007 and 2012 are presented. The obtained competitive limits on the WIMP-proton cross-section are compared to the ones of other indirect and direct detection experiments as well as to predictions of SUSY models. The possibility of testing secluded dark matter models with this search is also addressed. Results of ANTARES on Dark Matter searches towards the Galactic Centre are also presented, leading to competitive limits on the annihilation cross-sections for high mass WIMPs. Finally, the work on indirect searches towards dwarf galaxies and the centre of the Earth will also be presented.

Detector RD and Performance / 666**The STAR Heavy Flavor Tracker (HFT)**Mr. CONTIN, Giacomo ¹¹ *Lawrence Berkeley National Laboratory - LBNL***Corresponding Author:** gcontin@lbl.gov

The heavy quark hadrons are suggested as a clean probe for studying the early dynamic evolution of the dense and hot medium created in high-energy nuclear collisions.

The Heavy Flavor Tracker (HFT) of the STAR experiment, designed to improve the vertex resolution and extend the measurement capabilities in the heavy flavor domain, was installed for the 2014 heavy ion run of RHIC.

It is composed of three different silicon detectors arranged in four concentric cylinders close to the STAR interaction point. The two innermost layers are based on CMOS monolithic active pixels (MAPS), featured for the first time in a collider experiment, and the two outer layers are based on pads and strips.

The two innermost HFT layers are placed at a radius of 2.7 and 8 cm from the beam line and accommodate 400 ultra-thin (50 um) high resolution MAPS sensors arranged in 10-sensor ladders to cover a total silicon area of 0.16 m². Each sensor includes a pixel array of 928 rows and 960 columns with a 20.7 μm pixel pitch, providing a sensitive area of ~ 3.8 cm². The sensor features 185.6 μs readout time and 170 mW/cm² power dissipation.

The detector is air-cooled, allowing a global material budget of 0.50% radiation length per layer. A novel mechanical approach to detector insertion enables effective installation and integration of the pixel layers within an 8 hour shift during the on-going STAR Run.

After a detailed description of the design specifications and the technology implementation, the detector status and operations during the current 200 GeV Au+Au run will be presented in this talk, with a particular focus on calibration and general system operations aimed at stabilizing the running conditions.

A preliminary estimation of the detector performance meeting the design requirements will be reported.

Lattice QCD / 667**Precision lattice heavy flavour results from Nf=2+1+1 simulations**

Dr. DIMOPOULOS, Petros ¹; Mr. BUSSONE, Andrea ²; Prof. ROSSI, Giancarlo ³; Dr. PICCA, Eleonora ⁴; Prof. SIMULA, Silvano ⁵; Dr. TARANTINO, Cecilia ⁴; Dr. CARRASCO, Nuria ⁴; Dr. FREZZOTTI, Roberto ³; Prof. LUBICZ, Vittorio ⁴; Mr. NAZZARO, Francesco ³; Dr. LAMI, Paolo ⁴; Dr. RIGGIO, Lorenzo ⁴

¹ *Centro Fermi - Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi" - Dipartimento di Fisica, Univ. di Roma "Tor Vergata"*

² *Physics Department - Univ. of Rome "Tor Vergata"*

³ *Univ. of Rome "Tor Vergata"*

⁴ *Univ. of Rome Tre*

⁵ *INFN Sezione di Roma Tre*

Corresponding Author: dimopoulos@roma2.infn.it

We present precision lattice calculations for the decay constants of the D and B sector as well as determinations of the charm and b quark mass values. Heavy flavour lattice computations are indispensable for SM accuracy tests and may serve as discovery tools for new physics. We use Nf=2+1+1 dynamical quark gauge configurations generated by European Twisted Mass Collaboration. We use data at three values of the lattice spacing with pion masses as low as 210 MeV. Strange and charm quark masses are close to their physical values.

Poster Session / 668

Hadron Production Measurements with the T2K Replica Target in the NA61/SHINE Experiment for the T2K Neutrino Flux PredictionMr. HAESLER, Alexis ¹¹ *University of Geneva***Corresponding Author:** alexis.haesler@unige.ch

We present latest results of the measurements of hadron production with the T2K replica target in the NA61/SHINE experiment at CERN SPS. They aim to further improve the precision on the T2K neutrino flux prediction.

The current method applied in the T2K experiment to reduce uncertainties on the flux predictions is based on re-weighting of hadron cross sections in the interaction vertices. As an input, this method uses data for 31-GeV/c protons on thin carbon target (4% interaction length) measured by NA61/SHINE. This allows to constrain $\sim 60\%$ of the neutrino flux, the other 40% being due to re-interactions within the target material and in surrounding support structure, thus model dependent. Direct measurements of the hadrons exiting from the surface of the T2K replica target (1.9 interaction length) should allow to constrain up to 90% of the flux. These measurements are the ultimate goal in order to achieve precise neutrino flux predictions. Comparisons of the flux predictions tuned with thin target data and the T2K replica target data will provide information on the re-interactions of particles in the target.

Three different data-sets were recorded.

The pilot data-set taken in 2007 demonstrated the capabilities of the spectrometer with the T2K replica target and was analyzed to establish analysis techniques, while 2009 and 2010 runs have been used in order to record much higher statistics.

The latest 2009 results on pion spectra are presented and experimental data are compared to model predictions.

Poster Session / 669

R with very forward detectors at linear collidersFCAL, Collaboration ¹; Ms. MILUTINOVIC-DUMBELOVIC, Gordana ²¹ *FCAL Collaboration*² *Vinca Institute of Nuclear Sciences Belgrade Serbia***Corresponding Author:** slukic@vinca.rs

The very forward region of the detector at a future linear collider will be instrumented with two sampling calorimeters - BeamCal and LumiCal - for fast beam parameter estimates, precise luminosity measurements, as well as for the improvement of the hermeticity of the detector at small angles. These very forward calorimeters are designed to sustain high radiation doses and deliver precise and valuable data for the machine- and physics-related measurements. In this talk the R on sensor radiation hardness, electronics, as well as the precise positioning of the detector will be presented. In addition, test-beam results with prototype sensor units and mechanical structure will be reviewed.

Accelerator Physics and Future Colliders / 670

Muon Accelerators for High Energy Physics Applications: nuSTORM, NuMAX & Beyond...Dr. PALMER, Mark ¹¹ *Fermilab***Corresponding Author:** mapalmer@fnal.gov

Muon accelerators offer unique potential for high energy physics applications.

They can provide clean, well-characterized and intense neutrino beams for short- and long baseline oscillation studies – thus providing unmatched measurement precision for key parameters such as the CP-violating phase as well as unique sensitivity to probe for new physics. Two Neutrino Factory concepts, nuSTORM and NuMAX, have recently been developed which can provide this unique physics reach at short- and long-baseline, respectively. This talk describes in detail the specifications and capabilities of these machines. In the further future, the implementation of these machines could also provide the foundation for deploying lepton collider capabilities in the multi-TeV regime.

Formal Theory Developments / 672

A unified approach to nuclei: The BPS Skyrme ModelProf. ADAM, Christoph ¹; Mr. NAYA, Carlos ¹; Prof. SANCHEZ-GUILLEN, Joaquin ¹; Prof. WERESZCZYNSKI, Andrzej ²¹ *Universidade de Santiago de Compostela and Instituto Galego de Física de Altas Enerxías (IGFAE)*² *Institute of Physics, Jagiellonian University***Corresponding Author:** carlos.naya87@gmail.com

In this talk, we will present a concrete model of a low energy effective field theory of QCD, the well-known Skyrme Model. Specifically, we will work with the BPS submodel [1] in order to describe the binding energies of nuclei. This BPS Skyrme model is characterized by having a saturated bound for the energy proportional to the baryon number of the nuclei. After presenting this classical result, we will proceed with a semi-classical quantization of the coordinates of spin and isospin. Then, with the further inclusion of the Coulomb interaction as well as a small explicit breaking of the isospin symmetry, we finally calculate the binding energies of nuclei, where an excellent agreement has been found for the nuclei with high baryon number [2], [3].

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Astroparticle Physics and Cosmology / 673

AMS-02 measurement of cosmic ray positrons and electronsDr. WENG, Zhili¹; Mr. VAGELLI, Valerio²¹ *Massachusetts Institute of Technology*² *Karlsruhe Institute for Technology***Corresponding Author:** zweng@cern.ch

Origin of high energy positrons in cosmic rays remains highly uncertain. In addition to being produced in the interactions of cosmic ray nuclei with interstellar media they may be produced in nearby pulsars, in the annihilation of Dark Matter particles or in a yet unknown process. The nature of the production mechanisms are expected to influence the abundance of cosmic-ray positrons and electrons.

The Alpha Magnetic Spectrometer (AMS-02) is a general purpose high-energy particle physics detector operational on the International Space Station since May 2011 to conduct fundamental physics research in space. During its unique long duration mission (about 20 years), AMS-02 will collect large amount of data of unparalleled significance to study positron flux and electron flux separately, as well as their time-dependence and directional-dependence behavior.

In this contribution, data sample collected during the first 30 months of operations will be used. We will review the analysis technique used for measuring positron flux and electron flux, as well as positron fraction extending to energies beyond the published results. Anisotropy of individual fluxes will be also discussed.

Poster Session / 674

Lepton mixing under the lepton charge nonconservation, neutrino masses and oscillations and the "forbidden" decay $\mu^- \rightarrow e^- + \gamma$ Dr. LYUBOSHITZ, Valery¹; Dr. LYUBOSHITZ, Vladimir¹¹ *Joint Institute for Nuclear Research (Dubna)***Corresponding Author:** valery.lyuboshitz@jinr.ru

The lepton-charge (L_e, L_μ, L_τ) nonconserving

interaction leads to the mixing of the electron, muon and tau neutrinos, which manifests itself in spatial oscillations of a neutrino beam, and also to the mixing of the electron, negative muon and tau lepton, which, in particular, may be the cause of the "forbidden" radiative decay of the negative muon into the electron and γ quantum.

Under the assumption that the nondiagonal elements of the mass matrices for neutrinos and ordinary leptons, connected with the lepton charge nonconservation, are the same, and by performing the joint analysis of the experimental data on neutrino oscillations and experimental restriction for the probability of the decay $\mu^- \rightarrow e^- + \gamma$ per unit time, the following estimate for the lower bound of neutrino mass has been obtained: $m_\nu > 1.5 \text{ eV}/c^2$.

Strong Interactions and Hadron Physics / 675

Latest LHCf physics results

Prof. ADRIANI, Oscar ¹

¹ *University of Florence and INFN Firenze*

Corresponding Author: adriani@fi.infn.it

The LHCf experiment is composed by two separate detectors, located at +/- 140 m from the ATLAS interaction region of the LHC accelerator.

The main goal of the experiment is the measurement of the neutral particles production in the very high pseudo-rapidity region ($\eta > 8.4$) both in proton-proton and proton-ion collisions. These measurements are extremely useful to calibrate the hadronic interaction models currently used for the study of the development of very high energy cosmic ray's induced showers in the atmosphere.

This talk will describe the latest LHCf physics results both for p-p and p-Pb collisions. In particular, the neutron inclusive spectra in p-p collisions and the neutral pion transverse momentum spectra in p-Pb collisions for different pseudo rapidity regions will be presented.

Poster Session / 676

Hydrodynamic extension of the two component model for hadroproduction.

Ms. CHERNYAVSKAYA, Nadezda ¹; Mr. BYLINKIN, Alexander ²; Prof. ROSTOVTSEV, Andrey ²

¹ *Institute for Theoretical and Experimental Physics, ITEP, Moscow Russia*

² *ITEP*

Corresponding Author: alexander.bylinkin@gmail.com

The hydrodynamic extension of the two component model for hadroproduction using recent theoretical calculations is suggested to describe the spectra of charged particles produced in heavy-ion collisions in the full range of transverse momenta, p_T . Data from heavy-ion collisions measured at RHIC and LHC are analyzed using the introduced approach and are combined in terms of energy density. The Boltzmann-like statistical distribution taking into account the 'collective flow' effects stands for the radiation of the thermalized particles, while the power-like term describes charged hadron production in pQCD. The observed regularities give understanding of the peculiar shape of the nuclear modification factor, R_{AA} , as function of transverse momentum, p_T , and may be explained by the formation of QGP during the collision. Finally, the extracted dependences are used to make predictions for further LHC measurements at $\sqrt{s} = 5.5$ TeV/N.

Astroparticle Physics and Cosmology / 677

CDMSlite: a New Way to Search for Low-Mass WIMPS with Cryogenic DetectorsMr. RICCI, Yohan ¹¹ *Queen's University***Corresponding Author:** yohanricci@owl.phy.queensu.ca

Dark Matter (DM) is thought to make up $\sim 84.5\%$ of the matter content of the universe. It is a key ingredient of the standard model of cosmology (Λ CDM) and could provide a window to new theories beyond the standard model of particle physics. There has been much recent interest in low-mass ($O(5 \text{ GeV})$) Weakly Interacting Massive Particles, as predicted by certain supersymmetric models and other theories, and motivated by various hints from direct detection experiments. The Super Cryogenic Dark Matter Search (SuperCDMS) experiment is currently operating 15 upgraded germanium detectors at the Soudan Underground Laboratory in Minnesota, USA. These detectors were used to set competitive constraints in the search for low-mass WIMPs.

I will present the results and prospects of a very low-threshold operational mode called CDMSlite (CDMS low ionization threshold experiment). For this innovative experiment, we operated a single detector with a higher voltage than usual. This allows for voltage assisted calorimetric amplification, resulting in the lowest ionization threshold obtained with a germanium dark-matter detector. The 170 eVee threshold allowed the exploration of new WIMP parameter space below 6 GeV. A longer run in this mode started in February 2014 and will continue for several months.

Flavour Physics / 678

Probing CP violation in $B_0 \rightarrow K_0^* \pi^+ \pi^-$ decaysGERSHON, Tim ¹; Dr. LATHAM, Thomas ²; Mr. SILVA COUTINHO, Rafael ²¹ *University of Warwick and CERN*² *University of Warwick***Corresponding Author:** t.latham@warwick.ac.uk

The three-body charmless hadronic decay $B_0 \rightarrow K_0^* \pi^+ \pi^-$ provides a number of novel possibilities to search for CP violation effects and test the Standard Model of particle physics. These include model-dependent and model-independent comparisons of the Dalitz plot distributions of the decay-time-integrated $K_0^* \pi^+ \pi^-$ and $K_0^* \pi^+ \pi^0$ final states, decay-time-dependent (but without initial state flavour tagging) fits to the Dalitz plot distributions, as well as full decay-time-dependent and flavour tagged fits. The relative sensitivities of these different approaches are investigated.

BEH Physics / 679

Measurement of Higgs Boson Couplings at the International Linear Collider

Dr. SIMON, Frank¹

¹ *Max-Planck-Institute for Physics*

Corresponding Author: fsimon@mpp.mpg.de

One of the key topics in the physics program of the ILC is the precision measurement of the couplings of the Higgs boson. At linear colliders, Higgs bosons are produced singly in association with Z bosons and by W boson fusion. In both processes, the backgrounds to Higgs production are relatively small, and all major Higgs boson decay modes can be observed. The Zh process gives tagged Higgs bosons, allowing measurement of absolute branching ratios and the observation of invisible and other exotic decays. The W fusion process gives high rates for precision measurement and allows the model-independent determination of the Higgs boson width and the individual Higgs couplings. This contribution will report the current status of this program, with results from full-simulation studies of Higgs processes in the detectors proposed for the ILC.

Poster Session / 680

Measurement of the Higgs Boson Coupling to the Top Quark and the Higgs Boson Self-Coupling at ILC

Dr. SIMON, Frank¹

¹ *Max-Planck-Institute for Physics*

Corresponding Author: fsimon@mpp.mpg.de

At center of mass energies of 500 GeV and above, e^+e^- collisions lead to processes in which the Higgs boson is radiated from top quarks and antiquarks and events in which two Higgs bosons are produced. The first of these processes leads to a precision measurement of the Higgs boson coupling to top quarks, the second to a measurement of the Higgs boson self-coupling. The rates of these processes are small, but linear colliders offer many tools to extract the signal processes from background, including highly efficient flavor tagging, the full reconstruction of top-antitop systems, precise control of (3-dimensional) missing energy, control of initial beam polarization, and measurement of final-state polarization. This contribution will report the current status of this program, with results from full-simulation studies of these processes in the detectors proposed for the ILC.

Poster Session / 681

On the coherent inelastic binary and multiparticle processes in ultrarelativistic hadron--nucleus, photon--nucleus and nucleus--nucleus collisions

Dr. LYUBOSHITZ, Valery¹; Dr. LYUBOSHITZ, Vladimir²

¹ *Joint Institute for Nuclear Research (Dubna)*

² *Joint Institute for Nuclear Research (Dubna)*

Corresponding Author: valery.lyuboshitz@jinr.ru

The coherent inelastic processes of the type $a \rightarrow b$, which may take place in the interaction of hadrons and γ quanta with nuclei at very high energies (the nucleus remains the same), are theoretically investigated. For taking into account the influence of matter inside the nucleus, the optical model, based on the conception of the refraction index, is used. Analytical formulas for the effective cross section $\sigma_{\text{coh}}(a \rightarrow b)$ are obtained, taking into account that at ultrarelativistic energies the main contribution into $\sigma_{\text{coh}}(a \rightarrow b)$ is provided by very small transferred momenta in the vicinity of the minimal longitudinal momentum transferred to the nucleus. It is shown that the cross section $\sigma_{\text{coh}}(a \rightarrow b)$ may be expressed through the "forward" amplitudes of inelastic scattering $f_{\{a + N \rightarrow b + N\}}(0)$ and elastic scattering $f_{\{a + N \rightarrow a + N\}}(0)$, $f_{\{b + N \rightarrow b + N\}}(0)$ on a separate nucleon, and it depends on the ratios L_a/R and L_b/R , where L_a and L_b are the respective mean free paths in the nucleus matter for the particles a and b , and R is the nuclear radius. The above formalism is generalized also for the case of coherent inelastic multiparticle processes on a nucleus of the type $a \rightarrow \{b_1, b_2, b_3 \dots b_i\}$, and for the case of coherent processes at collisions of two ultrarelativistic nuclei.

Beyond the Standard Model / 682

Discovering Supersymmetry and Dark Matter at the International Linear Collider

Dr. SIMON, Frank¹

¹ *Max-Planck-Institute for Physics*

Corresponding Author: fsimon@mpp.mpg.de

Although the LHC experiments have put strong limits on coloured supersymmetric states, it is still possible that electroweakly interacting supersymmetric particles have masses in the range 100-200 GeV. Even outside of supersymmetry, candidates for the particle of dark matter may have masses in this range unconstrained by LHC data. In $e+e-$ annihilation, the low backgrounds, precise knowledge of the initial-state beams, and sensitivity to small energy depositions provides discovery potential complementary to the LHC, for instance in cases with small mass differences. This contribution will report the current status of studies for the prospects of measurements of WIMPs, Higgsinos and other light electroweak states at the International Linear Collider, with results based on simulation of the detectors proposed for the ILC.

Poster Session / 683

Precision measurement of SUSY at the ILC

Dr. SIMON, Frank¹

¹ *Max-Planck-Institute for Physics*

Corresponding Author: fsimon@mpp.mpg.de

While the current 7/8 TeV results from the LHC exclude highly constrained SUSY models with a light sparticle spectrum, less constrained models are still viable. Certain such models promise both discovery of coloured sparticles during the 14 TeV run of the LHC, and a rich spectrum of non-coloured states, accessible at the ILC. LHC might or might not give a hint to the existence of these electro-weak states, but only at the ILC can measurements with sufficient precision be done to elucidate the details of the model. This contribution reports on studies of such models at the ILC based on simulation of the current detector proposals. It also discusses how the combined observations from LHC and ILC can be used to determine MSSM parameters in models with large numbers of free parameters.

Poster Session / 686

Search for pair production of heavy vector-like partners of the top quark (T), with $T \rightarrow tH$ ($\rightarrow \gamma\gamma$)

MEYER, Arnd¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

The recent discovery of a Higgs boson at the LHC sets strong constraints on a simple, sequential third generation of quarks. Still, the presence of new physics is necessary to stabilize the mass of the Higgs boson, if one wants to avoid an unnaturally high level of fine tuning of the theory. In supersymmetry, bosonic top quark partners would cancel the loops that induce this large instability. Similarly, fermionic top quark partner quarks can also serve this purpose. We present a search for a new T particle, which is a vector-like partner of the top quark, focusing on the T quark pair production. We use data collected with the CMS experiment during the year 2012, in proton-proton collisions at the LHC at a centre-of-mass energy of 8 TeV. Older searches for heavy vector-like-quarks focused separately either on the $T \rightarrow bW$ or $T \rightarrow tZ$ final states. The precise knowledge of the Higgs boson mass now allows to target the $T \rightarrow tH$ decay as well. Here we focus exclusively on events with at least one top partner undergoing the $T \rightarrow tH$ decay chain; in order to ensure a Higgs boson is actually present in the final state, we exploit the Higgs to diphoton final state.

Astroparticle Physics and Cosmology / 688

Constraints on dark matter and future observational strategies with gamma-ray space experimentsDr. MORSELLI, Aldo ¹¹ *INFN Roma Tor Vergata***Corresponding Author:** aldo.morselli@roma2.infn.it

Detection of gamma rays and cosmic rays from the annihilation or decay of dark matter particles is a promising method for identifying dark matter, understanding its intrinsic properties, and mapping its distribution in the universe. I will review recent results from the Fermi Gamma-ray Space Telescope and other space-based experiments, and highlight the constraints these currently place on particle dark matter models. I will also discuss the prospects for indirect searches to robustly identify or exclude a dark matter signal using upcoming data and the comparison with LHC searches

Poster Session / 689

Readout electronics for the Silicon micro-strip detector of the ILD conceptDr. ALONSO, Oscar ¹; Dr. VILELLA FIGUERAS, Eva ¹; Dr. DIEGUEZ, Angel ²¹ *Universitat de Barcelona*² *University of Barcelona***Corresponding Author:** oalonso@el.ub.edu

Si-strips are the baseline for the forward tracker detector (FTD) of the International Linear Detector (ILD). The main element of the front-end (FE) electronics is a multi-channel System-on-Chip (SoC) for self-triggered detection and processing of low level charge signals. The architecture used in this chip is very similar to the typical structure of a silicon strip readout system presented in previous works (ABCD3T, APV25, Beetle chip, KPjX or SiTRK).

For the FE there are special considerations to be taken, given that the FE resides inside the detector. It must be designed to meet two conflicting requirements: low power and low noise. Low power FE electronics is a necessity to avoid cooling systems in the detector. If the FE is not designed with the necessary low power dissipation, the generated heat will become unmanageable. To achieve these goals the appropriate choice of which semiconductor technology to use must be done. Deep and ultra-deep submicron CMOS has been the technology of choice for low power applications in the last decade, at least in the digital field of electronics. These technologies also assure the necessary radiation hardness, which is not critical in ILC. Moreover, all modules are designed with power-off capabilities to adapt the operation to the ILC structure and pulsed power mode of operation. This mode together with the low power of each module will satisfy the power constraints for this chip below 700uW/channel in continuous (not pulsed) operation. A reduction of a factor 50-200 can be expected with pulsed operation.

To reduce the noise a pre-amplifier and a shaping amplifier are added at the beginning of each channel.

In this talk we discuss the work done in the readout electronics, starting from the modelling of one channel in Verilog-AMS, noise estimations and finishing with the design of the analog circuits designed in 65nm CMOS technology from TSMC.

Beyond the Standard Model / 690**The Fermilab Muon $g-2$ Experiment**Prof. VENANZONI, Graziano ¹¹ *Laboratori Nazionali di Frascati dell' INFN***Corresponding Author:** lawrence.gibbons@cornell.edu

The anomalous magnetic dipole moment of the muon can be both measured and computed to very high precision, making it a powerful probe to test the standard model and search for new physics such as SUSY. The previous measurement by the Brookhaven E821 experiment found a 3.6 standard deviation discrepancy from the predicted value. The new $g-2$ experiment at Fermilab will improve the precision by a factor of four through a factor of twenty increase in statistics and a reduced systematic uncertainty with an upgraded apparatus. The experiment will also carry out an improved measurement of the muon electric dipole moment. Construction at Fermilab is well underway.

Poster Session / 691**Determination of the hierarchy and of the octant of θ_{23} with PINGU**Dr. MARRONE, Antonio ¹¹ *University of Bari and INFN Bari***Corresponding Author:** antonio.marrone@ba.infn.it

This study is being performed in collaboration with E. Lisi (INFN, Bari, Italy) and F. Capozzi (U. of Bari, Italy). The low-energy IceCube extension experiment, PINGU, will allow to probe the neutrino mass hierarchy and the θ_{23} octant. We perform a prospective analysis of PINGU data in a three neutrino oscillation framework, by varying all relevant neutrino oscillation parameters and taking into account the main sources of systematic errors. We also introduce a continuous parameter α , which interpolates between normal hierarchy ($\alpha=+1$) and inverted hierarchy ($\alpha=-1$). We show that with 5 years of data taking, both the hierarchy and the θ_{23} octant can be discriminated at about 3σ .

Strong Interactions and Hadron Physics / 692**Matching NLO with parton shower in Monte Carlo scheme**Dr. SAPETA, Sebastian ¹¹ *CERN***Corresponding Author:** sebastian.sapeta@cern.ch

I will discuss a new method of including NLO QCD corrections to the hard process in the LO Monte Carlo (MC) shower. The method is based on the recently proposed MC factorization scheme, which dramatically simplifies the NLO coefficient functions. The NLO corrections are introduced by a simple reweighing of the events produced by the LO shower, with a single, positive MC weight. I will show a practical implementation of the method for the case of electro-weak boson production in the hadron-hadron collision and compare it with the well established approaches to NLO+PS matching. I will advocate the theoretical and practical advantages of the new method. I will also briefly discuss the perspectives of using it to include NLO corrections in the ladder part.

Poster Session / 693

On the pair correlations of neutral K, D, B and B_s mesons with close momenta produced in inclusive multiparticle processes

Dr. LYUBOSHITZ, Valery¹; Dr. LYUBOSHITZ, Vladimir²

¹ Joint Institute for Nuclear Research (Dubna)

² Joint Institute for Nuclear Research (Dubna)

Corresponding Author: valery.lyuboshitz@jinr.ru

The phenomenological structure of inclusive cross-sections of the production of two neutral K mesons in hadron-hadron, hadron-nucleus and nucleus-nucleus collisions is theoretically

investigated taking into account the strangeness conservation in strong and electromagnetic interactions. Relations describing the dependence

of the correlations of two short-lived and two long-lived neutral kaons

$K^0_S K^0_S$, $K^0_L K^0_L$ and the correlations of "mixed" pairs

$K^0_S K^0_L$ at small relative momenta upon the space-time parameters

of the generation region of K^0 and \bar{K}^0 mesons

have been obtained. These relations involve the contributions

of Bose-statistics and S -wave strong final-state interaction of two

K^0 (\bar{K}^0)-mesons as well as of a K^0 -meson with

a \bar{K}^0 -meson, and also the contribution of transitions

$K^+ + K^- \rightarrow K^0 \bar{K}^0$, and they depend upon the

relative fractions of generated pairs

$K^0 K^0$, $\bar{K}^0 \bar{K}^0$ and $K^0 \bar{K}^0$.

It is shown that under the strangeness

conservation the correlation functions of

the pairs $K^0_S K^0_S$ and $K^0_L K^0_L$, produced in the same

inclusive process, coincide, and the difference between the

correlation functions of the pairs $K^0_S K^0_S$ and $K^0_S K^0_L$

is conditioned exclusively by the production of the pairs of non-identical

neutral kaons $K^0 \bar{K}^0$.

Analogous correlations for the pairs

of neutral heavy mesons D^0 , B^0 and B_s^0 , generated in

multiple inclusive processes with the charm (beauty) conservation, are also theoretically analyzed,

and differences from the case of neutral K mesons are discussed .

Poster Session / 694

The importance of jet shapes for tagging purposes

Mr. CALVENTE, Sergio¹; Mr. LLORENTE, Javier¹; Prof. BARREIRO, Fernando¹

¹ Universidad Autonoma de Madrid

Corresponding Author: fernando.barreiro@uam.es

Recent measurements by the ATLAS Collaboration of b- and light jet shapes in $t\bar{t}$ final states at the LHC, show clear evidence that b-jets are wider. There is also evidence that b-jets in $t\bar{t}$ final states are narrower than those produced inclusively. This can be interpreted as due to the two different colour structures considered. We apply multivariate techniques on MC generated data to illustrate possible applications of these observations to i) measurement of $|V_{ts}|$ and ii) separation of $H \rightarrow b\bar{b}$ in association with a Z from the background process $Z + b\bar{b}$.

The lessons to be learned is that jet shape measurements show more potential in the former case than in the latter.

Strong Interactions and Hadron Physics / 695**Overview of the COMPASS results on the nucleon spin**Dr. FRANCO, Celso¹¹ *LIP***Corresponding Author:** celso@lip.pt

The COMPASS experiment at CERN is one of the leading experiments studying the spin structure of the nucleon. These studies are being carried on since 2002, by measuring hadrons produced in deep inelastic scattering (DIS) of polarised muons off different polarised targets (NH₃ for polarised protons and 6LiD for polarised deuterons). One of the main goals is to determine how the total longitudinal spin projection of the nucleon, 1/2, is distributed among its constituents, quarks and gluons. We review here the recent results on the quark and gluon helicities obtained by COMPASS, using a longitudinally polarised target. However, the understanding of the nucleon spin structure based only on parton helicities is not in any way complete. Therefore, COMPASS also studies the transverse momentum dependent parton distributions (TMDs) with a transversely polarised target. Concerning the TMDs, the latest results on the Collins and Sivers asymmetries will be shown. The former is sensitive to the transverse spin structure of the nucleon, while the latter reflects the correlations between the quarks transverse momentum and the nucleon spin. This overview will conclude with a summary of the approved plans of COMPASS for the near future: the study of TMDs with a pioneering polarised Drell-Yan experiment, and the measurement of generalised parton distributions (GPDs).

Poster Session / 696**Design and Test of a Trigger Data Serializer ASIC Chip for the ATLAS Muon Detector Phase-I Upgrade**ZHU, Junjie¹¹ *University of Michigan***Corresponding Author:** junjie@umich.edu

To maximize the physics reach for the high energy and high luminosity LHC, the ATLAS collaboration plans to build and install a new small wheel (nSW) detector with eight layers of MicroMegas (MM) detector and eight layers of small-strip Thin Gap Chambers (sTGC) to improve the Level-1 muon triggering as well as the offline muon precision tracking. For the sTGC trigger path, both pad and strip detector signals will be first amplified, shaped, discriminated and digitized. A trigger data serializer (TDS) ASIC chip is then needed to prepare trigger data for many input channels with the additional task of serializing data to the circuitry on the rim of the nSW detector. The large number of input channels (128 differential input channels), short time available to prepare and transmit trigger data (<100 ns), high speed output data rate (5 Gbps), harsh radiation environment (about 300 kRad), and low power consumption (<1 W), impose great challenges for the design of this ASIC chip using the IBM 130 nm CMOS process. We will present our design and test results of the TDS ASIC chip.

Poster Session / 697

Transverse energy-energy correlations at LHC energiesProf. ALL, Ahmed ¹; Prof. BARREIRO, Fernando ²; Mr. LLORENTE, Javier ²; Dr. WANG, Wei ³¹ DESY² Universidad Autonoma de Madrid³ Universitaet Bonn**Corresponding Author:** fernando.barreiro@uam.es

We compute the transverse energy-energy correlations (TEEC) and its asymmetry (AEEC) in NLO for p-p collisions at three c.m. energies i.e. 7, 8 and 13 TeV. We show that the TEEC and AEEC distributions exhibit very small sensitivity to the QCD factorization and renormalization scales as well as to the proton structure function choice. We further discuss the dependence on p_{T_min} , the minimum transverse momentum required in the selection of the final state jets, underlying event effects and the choice of jet radius.

Poster Session / 698

Electron swarm behaviour and system aspects of a 1kg (10bar) Xenon-TMA TPC for Rare Event SearchesDr. DAFNI, Theopisti ¹¹ Universidad de Zaragoza**Corresponding Author:** tdafni@unizar.es

Xenon-trimethylamine (TMA) mixtures are particularly interesting in the framework of rare event searches with gaseous Time Projection Chambers (TPC): first because gain measurements indicate that they form a Penning mixture, anticipating a 'supra-intrinsic' energy resolution stemming from the initial ionization and, second, because TMA is known to strongly fluoresce around 300nm, a convenient wavelength for standard photomultipliers (for Xe-TMA the primary scintillation yield is yet unknown, though). In addition, we establish experimentally that, for ~% concentrations nearing the optimum charge Penning-transfer (as estimated from gain measurements), the track blurriness introduced by the transport of the electrons from the decay region to the measuring plane is reduced in about 1 order of magnitude when using such a mixture, as compared with Xenon at the same pressure.

In order to address the main topological characteristics of such a mixture (as derived from its electron swarm transport coefficients), we report the behaviour of a 70-liter Xe-TMA TPC, developed within the framework of the NEXT experiment. The TPC is equipped with novel highly pixelated and low radioactivity microbulk-Micromegas detectors and is being used for pressures ranging from 1-10bar. We include a 3-D characterization at 1, 3 and 10bar both for point-like electron tracks and extended ones from gamma-ray interactions (511keV), of interest in the most appealing next generation Xenon-based experiments.

Poster Session / 699**Results of the material screening program of the NEXT experiment**Dr. CEBRIAN, Susana ¹; Dr. DAFNI, Theopisti ¹¹ *Universidad de Zaragoza***Corresponding Author:** tdafni@unizar.es

The “Neutrino Experiment with a Xenon TPC” (NEXT) is intended to investigate the neutrinoless double beta decay using a high-pressure xenon gas TPC filled with Xe enriched in ¹³⁶Xe and therefore demands extremely low background levels. An extensive screening and material selection process is underway for several years to help in the design of the set-up and in the construction of the experiment background model. Determination of the material activity levels is based on gamma-ray spectroscopy using ultra-low background germanium detectors of the Radiopurity Service of the Laboratorio Subterráneo de Canfranc (Spain) and also on Glow Discharge Mass Spectrometry. Materials analyzed include: lead and copper to be used in the shielding; ³¹⁶Ti stainless steel for the pressure vessel; different plastics for electroluminescence and high voltage components; capacitors, resistors, adhesives and materials for printed circuit boards to be used in the tracking readout plane; and photomultipliers, bases and related components for the energy readout plane. The latest results obtained will be shown, discussing their implications for the NEXT experiment.

Accelerator Physics and Future Colliders / 700**Crab cavities for colliders - past, present and future**Dr. VERDÚ-ANDRÉS, Silvia ¹; Prof. BELOMESTNYKH, Sergey ²; Prof. BEN-ZVI, Ilan ²; Dr. CALAGA, Rama ³; Dr. WU, Qiong ⁴; Dr. XIAO, Biping ⁵¹ *Brookhaven National Laboratory (BNL)*² *BNL, Upton, Long Island, New York, USA; Stony Brook University, Stony Brook, USA*³ *CERN, Geneva, Switzerland*⁴ *BNL, Upton, Long Island, New York, USA*⁵ *BNL, Upton, Long Island, New York, USA***Corresponding Author:** sverdu@bnl.gov

The numerous parasitic encounters in the LHC are mitigated by introducing a crossing angle between beams. Crab cavities would allow restoring head-on collisions at the interactions point, thus increasing the geometric luminosity. Crab cavities would also offer a mechanism for luminosity leveling.

KEKB was the first facility to implement the crab crossing technique in 2007, for the interaction of electron and positron beams. The High Luminosity Large Hadron Collider (HL-LHC) project envisages the use of crab cavities for increasing and leveling the luminosity of proton-proton collisions in LHC. And crab cavities have been proposed and studied for future colliders like CLIC, ILC and eRHIC.

We will review in this paper the past, present and future of crab cavities for particle colliders.

Beyond the Standard Model / 701

How alive is constrained SUSY really?

Dr. BECHTLE, Philip ¹; Prof. DESCH, Klaus ¹; Dr. WIENEMANN, Peter ¹; Prof. DREINER, Herbert K. ²; Dr. HAMER, Matthias ³; Prof. KRÄMER, Michael ⁴; Dr. O'LEARY, Ben ⁵; Prof. POROD, Werner ⁵; Mr. SARRAZIN, Björn ¹; Mr. STEFANIAK, Tim ²; Mr. UHLENBROCK, Mathias ¹

¹ *Physikalisches Institut, Bonn University, Germany*

² *Physikalisches Institut and Bethe Center for Theoretical Physics, Bonn University, Germany*

³ *Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil*

⁴ *Institute for Theoretical Particle Physics and Cosmology, RWTH Aachen, Germany*

⁵ *Institut für Theoretische Physik und Astrophysik, University of Würzburg, Germany*

Corresponding Author: sarrazin@physik.uni-bonn.de

Constrained SUSY models like the CMSSM might look less attractive nowadays because of fine tuning arguments. They also might look less probable in terms of Bayesian statistics. The question how well the model under study describes the data, however, is answered by frequentist p-values. Thus, for the first time, we calculate p-values for the CMSSM by performing dedicated toy experiments. We combine constraints from low-energy and astrophysical observables, Higgs mass and rate measurements as well as the non-observation of new physics in searches for supersymmetry at the LHC. Using the framework Fittino, we perform global fits of the CMSSM to the toy data. In this way we also derive estimates of the allowed ranges of parameters and observables in this model. Results using the well-established profile likelihood technique are shown in comparison.

Accelerator Physics and Future Colliders / 702

Development of the fast kicker for the muon g-2 experiment

Dr. KIM, SeungCheon ¹

¹ *Cornell University*

Corresponding Author: lawrence.gibbons@cornell.edu

We are developing the fast muon kicker for the muon g-2 experiment at Fermilab. The kicker is a pulsed magnet that provides the transverse kick to the muon particles required to direct them onto the stable (magic radius) orbit of the storage ring. To provide the right kick and maximize the storage efficiency of muons, the magnetic pulse generated from the kicker should have, approximately, 250 Gauss peak value and 120 ns full width. Based on the experiences from the earlier g-2 experiment at BNL, we have redesigned the system using a triaxial blumlein pulse forming network and the prototype model has been built and tested. The details of the current status of kicker development will be presented at the conference.

Accelerator Physics and Future Colliders / 703

High Power Targets for Accelerator Based Research FacilitiesMr. RIEMER, Bernard¹¹ *Oak Ridge National Laboratory***Corresponding Author:** riemberw@ornl.gov

Target designs used in accelerator facilities that serve to produce useful particles for physics or materials research are being pushed to accept increasing levels of beam power to enable new regimes of study. The field of high power targets spans a range of applications, including neutron sources, neutrino factories, radioactive ion beams sources, isotope production and materials irradiation test facilities. They operate with continuous or pulsed beams. "High power" broadly refers to high volume power density or volume energy density per pulse, or simply high time-averaged power. In addition to achieving efficient production of the desired particles, common challenges to the engineers in the high power target community include meeting facility requirements for duty cycle and target lifetime, removal of deposited beam heating, management of thermal stress and thermal shock effects, dealing with radiation damage effects on target thermo-physical properties, and satisfying safety and waste regulations. These demands have led to some novel target designs and concepts such as liquid metals, rotating solids, flowing metal powder or granular targets. A review of high-powered targets – operating and in development – will be presented. The High Power Targetry Workshop takes place at Fermilab this May with participants from the full spectrum of applications; highlights from that workshop will also be covered.

Poster Session / 704

ORCA: a feasibility study of measuring the neutrino mass hierarchy with an underwater Cherenkov detectorMr. HOFESTÄDT, Jannik¹¹ *ECAP***Corresponding Author:** jannik.hofestaedt@physik.uni-erlangen.de

Since the measurement of the neutrino mixing parameter θ_{13} , the determination of the neutrino mass hierarchy has become a central goal of upcoming neutrino physics experiments. A promising pathway to this measurement are atmospheric neutrino experiments probing neutrino oscillation in matter.

We present the status of a dedicated feasibility study 'Oscillation Research with Cosmics in the Abyss' (ORCA) to evaluate the potential of a megaton scale underwater Cherenkov detector to determine the mass hierarchy. The detector will be a dense array of optical modules using technology developed for KM3NeT, the future multi-km³ water Cherenkov neutrino telescope in the Mediterranean Sea. The final size and layout of the detector will depend on the outcome of the ongoing optimisation study and on available funding. The baseline performance in terms of energy and angular accuracy, flavor identification, and background rejection will be discussed for a reference detector of 50 lines (about 1.8 Mton). Preliminary projections for the ORCA sensitivity to the neutrino mass hierarchy will be presented. The exciting possibility to use the ORCA detector in conjunction with a neutrino beam will also be discussed briefly.

Poster Session / 706

Constraints on the T2K neutrino flux prediction from hadron production measurements at NA61/SHINE

Mr. SGALABERNA, Davide¹

¹ *ETH Zurich*

Corresponding Author: davide.sgalaberna@cern.ch

One of the main issues in modern accelerator neutrino experiments is a relatively poor knowledge of the initial neutrino flux, due in particular to a large uncertainty on the production of hadrons that decay into neutrinos.

T2K is a long baseline neutrino experiment that aims to precisely measure the parameters of the PMNS matrix and to look for the first indication of CP violation in the lepton sector. A better knowledge of the neutrino flux is also needed for neutrino cross section measurements.

In order to achieve the required total systematic uncertainty on the neutrino flux as low as 5%, high precision hadron production measurements, performed by the dedicated auxiliary NA61/SHINE experiment at the CERN SPS, are fundamental.

Interactions of incoming 31 GeV/c protons on Carbon are measured with a thin target, 4% of the nuclear interaction length.

Recent results on multiplicities of charged hadrons (π^{\pm} , K^{\pm} and protons) will be presented as well as the total p+C production cross section. Moreover, new measurements on production of neutral strange particles (K^0_S and Λ) will be shown. These are crucial for the reduction of the systematic uncertainties on charged pion spectra. Production of neutral kaons is also important for an accurate calculation of the intrinsic ν_e component in the T2K neutrino beam.

The hadron production measurements based on the high statistics thin target data are then needed to tune and constrain the T2K neutrino flux. The used re-weighting procedure is presented as well.

This method will be very important also for the future neutrino long-baseline experiments for which is required

a precision of the 2% on the flux knowledge for the discovery of CP violation in the lepton sector.

Lattice QCD / 707

Lattice QCD studies of the leading order hadronic contribution to the muon $g-2$

HERDOIZA, Gregorio¹; FRANCIS, Anthony²; GÜLPERS, Vera²; HORCH, Hanno²; JÄGER, Benjamin³; MEYER, Harvey²; WITTIG, Hartmut²

¹ *KPH Mainz IFT Madrid*

² *KPH Mainz*

³ *Swansea University*

Corresponding Author: herdoiza@kph.uni-mainz.de

The anomalous magnetic moment of the muon, $g-2$, is one of the most promising observables to identify the signs of physics beyond the Standard Model. QCD contributions are currently responsible for the largest fraction of the overall theoretical uncertainty in the determination of the muon $g-2$, and in the running of the QED coupling constant. Studies of the vacuum polarisation function and of the Adler function, currently being carried out by the Mainz lattice group, will be presented. The various systematic effects present in the lattice QCD determinations of the muon $g-2$ and of the running of the QED coupling will be discussed.

Strong Interactions and Hadron Physics / 708

Study of baryon productions at Belle and BABAR

ANULLI, fabio¹

¹ *INFN Rome*

Corresponding Author: fabio.anulli@roma1.infn.it

Production of baryons in B decays, in $\Upsilon(nS)$ decays and in $e^+e^- \rightarrow q\bar{q}$ continuum processes can play a key role to improve our understanding of strong interaction and hadron dynamics. Moreover, inclusive anti-deuteron production rate from hadronization process can shed light in searching for dark matter annihilation in cosmic ray anti-deuterons. In this presentation, we report on recent results on baryon production and decays from the e^+e^- B-factory experiments, Belle and BABAR. In particular, we present new results in charmed and charmless baryonic decays of B mesons, inclusive anti-deuteron and hyperon productions in $\Upsilon(nS)$, χ_{bJ} and continuum processes, new spectroscopic results - mass, width, absolute branching fraction - in charmed baryon states, and double baryon production in bottomonium annihilations. We also present new results on $\eta_c \rightarrow \bar{p} \Lambda K^+ + (c.c.)$.

Computing and Data Handling / 709

ATLAS Computing challenges before the next LHC run

Prof. OULD-SAADA, Farid ¹

¹ *University of Oslo*

Corresponding Author: farid.ould-saada@fys.uio.no

ATLAS Computing challenges before the next LHC run

On behalf of the ATLAS Collaboration

ATLAS software and computing is in a period of intensive evolution. The current long shutdown presents an opportunity to assimilate lessons from the very successful Run 1 (2009-2013) and to prepare for the substantially increased computing requirements for Run 2 (from spring 2015). Run 2 will bring a near doubling of the energy and the data rate, high event pile-up levels, and higher event complexity from detector upgrades, meaning the number and complexity of events to be analyzed will increase dramatically. At the same time operational loads must be reduced through greater automation, a wider array of opportunistic resources must be supported, costly storage must be used with greater efficiency, a sophisticated new analysis model must be integrated, and concurrency features of new processors must be exploited. This presentation will survey the distributed computing aspects of the upgrade program and the plans for 2014 to exercise the new capabilities in a large scale Data Challenge.

Computing and Data Handling / 710

Rucio, the next-generation Data Management system in ATLAS

Prof. OULD-SAADA, Farid ¹

¹ *University of Oslo*

Corresponding Author: farid.ould-saada@fys.uio.no

Rucio, the next-generation Data Management system in ATLAS

On behalf of the ATLAS Collaboration

Rucio is the next-generation of Distributed Data Management (DDM) system benefiting from recent advances in cloud and "Big Data" computing to address HEP experiments scaling requirements. Rucio is an evolution of the ATLAS DDM system Don Quijote 2 (DQ2), which has demonstrated very large scale data management capabilities with more than 160 petabytes spread worldwide across 130 sites, and accesses from 1,000 active users. However, DQ2 is reaching its limits in terms of scalability, requiring a large number of support staff to operate and being hard to extend with new technologies. Rucio addresses these issues by relying on new technologies to ensure system scalability, cover new user requirements and employ new automation framework to reduce operational overheads.

In this talk, we will present the history of the DDM project and the experience of data management operation in ATLAS computing. Thus, We will show the key concepts of Rucio, including its data organization. The Rucio design, and the technology it employs, will be then described, specifically looking at its architecture and the various software components it uses. We will show also the performance of the system and will conclude by giving a status of the project and its future evolution.

Flavour Physics / 711

Study of CP violation effects in the charmless hadronic decay $B \rightarrow K_s \pi^+ \pi^0$

ANULLI, fabio ¹

¹ *INFN Rome*

Corresponding Author: fabio.anulli@roma1.infn.it

We report a Dalitz plot analysis of the charmless hadronic decays of charged B mesons to the final state $K_s \pi^+ \pi^0$ using the full BABAR dataset of 471 million $B\bar{B}$ events collected at the $\Upsilon(4S)$ resonance. We observe an excess of signal events and measure the branching fractions and CP asymmetries, for the different resonant decay modes and inclusively.

Strong Interactions and Hadron Physics / 712

Quarkonium (-like) states at BABAR

ANULLI, fabio ¹

¹ *INFN Rome*

Corresponding Author: fabio.anulli@roma1.infn.it

The B factories provide a unique playground for studying the properties of conventional and exotic quarkonium states which are produced through various mechanism.

We report on a variety of recent results obtained using the full data set collected with the BABAR detector at the PEP-II e^+e^- collider.

In particular, we present measurements of the prompt production of J/ψ or $\psi(2S)$ in association with a second charmonium state at a center-of-mass energy of 10.58 GeV, searches for exotic neutral and charged charmonium-like states, studies of charmonium production in two-photon fusion and initial state radiation processes, as well as studies of radiative transitions between bottomonium states.

Poster Session / 713

Phenomenology and formal studies on small-x physics by using Monte Carlo techniques

Dr. CHACHAMIS, Grigorios ¹

¹ *IFIC (CSIC-UV)*

Corresponding Author: grigorios.chachamis@ific.uv.es

We will review our recent studies on a number of BFKL related projects in QCD and $N = 4$ SYM by using advanced Monte Carlo techniques.

We will discuss the new setup of our code as a Monte Carlo tool that produces theoretical predictions ready to be directly compared against experimental data in order to perform a number of important phenomenological studies at the LHC

Detector RD and Performance / 714

Status of the ATLAS calorimeters: their performance during three years of LHC operation and plans for future upgradesProf. KRIEGER, Peter ¹¹ *University of Toronto***Corresponding Author:** krieg@physics.utoronto.ca

The ATLAS experiment is designed to study the proton-proton collisions produced at the Large Hadron Collider (LHC) at CERN. Its calorimeter system measures the energy and direction of final state particles over the pseudorapidity range $|\eta| < 4.9$. Accurate identification and measurement of the characteristics of electromagnetic objects (electrons/photons) are performed by liquid argon (LAr)-lead sampling calorimeters in the region $|\eta| < 3.2$, using an innovative accordion geometry that provides a fast, uniform response without azimuthal gaps. This system played a critical role in the ATLAS analyses contributing to the Higgs boson discovery announced in 2012. The hadronic calorimeters measure the properties of hadrons, jets, and tau leptons, and also contribute to the measurement of the missing transverse energy and the identification of muons. A scintillator-steel sampling calorimeter (TileCal) is employed in the region $|\eta| < 1.7$, while the region $1.5 < |\eta| < 3.2$ is covered with a copper-LAr sampling calorimeter. The calorimetric coverage is extended to $|\eta| < 4.9$ by an integrated forward calorimeter (FCal) based on LAr with copper and tungsten absorbers and employing a novel electrode design.

In the first three years of LHC running, approximately 27 fb^{-1} of data have been collected at centre-of-mass energies of 7 and 8 TeV. Results on the calorimeter operation and performance over this period will be presented, including the calibration, stability, absolute energy scale, uniformity, and time resolution. These results demonstrate that the calorimeters are performing well within the design requirements and providing reliable input to physics analyses.

Although LHC data-taking is expected to continue for a number of years, plans are already underway for operation at an instantaneous luminosity about 5 times the original design value of $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. The calorimeter upgrade for this High Luminosity LHC (HL-LHC) involves two phases. In the first, upgrades to the LAr calorimeter electronics will provide more granular information to the trigger in order to reduce the effects of the high pile-up. The second phase will be devoted to the complete replacement of the front- and back-end electronics of both the TileCal and LAr calorimeters. In the case of the LAr calorimeter, additional complications may arise as a result of the increased instantaneous and integrated luminosities at the HL-LHC. These problems will be discussed along with a number of proposed solutions.

Poster Session / 715

Dalitz plot analysis of $\eta_c \rightarrow K^+ K^- \eta$ and $\eta_c \rightarrow K^+ K^- \pi^0$ in two-photon interactionsANULLI, fabio ¹¹ *INFN Rome***Corresponding Author:** fabio.anulli@roma1.infn.it

We study the processes $\gamma\gamma \rightarrow K^+ K^- \eta$ and $\gamma\gamma \rightarrow K^+ K^- \pi^0$ using a data sample of 519 fb^{-1} recorded with the BABAR detector operating at the SLAC PEP-II asymmetric-energy e+e- collider at center-of-mass energies at and near the Upsilon(nS) ($n = 2,3,4$) resonances.

We observe $\eta_c \rightarrow K^+ K^- \eta$ and $\eta_c \rightarrow K^+ K^- \pi^0$ decays, measure their relative branching fraction, and perform a Dalitz plot analysis for each decay. We observe the $K^*(1430) \rightarrow K \eta$ decay and measure its branching fraction relative to the $K \pi$ decay mode.

The $\eta_c \rightarrow K^+ K^- \eta$ and $K^*(1430) \rightarrow K \eta$ results correspond to the first observations of these channels. The data also show evidence for $\eta_c(2S) \rightarrow K^+ K^- \pi^0$ and first evidence for $\eta_c(2S) \rightarrow K^+ K^- \eta$.

Astroparticle Physics and Cosmology / 717

Direct Dark Matter Searches: Status and Implications

Prof. GONDOLO, Paolo ¹

¹ *University of Utah*

Corresponding Author: paolo.gondolo@utah.edu

Direct dark matter searches look for the scattering of dark matter particles from the galactic halo off nuclei in laboratory detectors. A host of apparently contradictory experimental results have been accumulated over the past few years: unexplained events in excess of the expected background, annual modulations with the predicted characteristics of a dark matter signal, upper limits stronger than the possible detections. In this overview, I will present a theorist's perspective on the present-day situation, indicating current trends on the experimental and theoretical scenes.

Computing and Data Handling / 719

The LHCb trigger system: performance and outlook

Dr. ALBRECHT, Johannes ¹; Dr. GLIGOROV, Vladimir ²; Prof. RAVEN, Gerhard ³

¹ *TU Dortmund*

² *CERN*

³ *NIKHEF VU Amsterdam*

Corresponding Author: johannes.albrecht@tu-dortmund.de

The LHCb experiment is a spectrometer dedicated to the study of heavy flavour at the LHC. The current LHCb trigger system consists of a hardware level, which reduces the LHC inelastic collision rate of 13MHz to 1 MHz, at which the entire detector is read out. In a second level, implemented in a farm of 20k parallel-processing CPUs, the event rate is reduced to about 5 kHz. We review the performance of the LHCb trigger system, focusing on the High Level Trigger, during Run I of the LHC.

The High Level Trigger showcased a number of pioneering concepts, for example : the deployment of an inclusive multivariate B-hadron tagger as the main physics trigger of the experiment, buffering of events to local disks in order to leverage the otherwise idle resources when the LHC does not produce collisions, and simulation-free event-by-event trigger efficiency corrections.

The LHCb experiment plans a major upgrade of the detector and DAQ system in the LHC shutdown of 2018. In this upgrade, a purely software based trigger system is being developed, which will have to process the full 30 MHz of inelastic collisions delivered by the LHC. We demonstrate that the planned architecture will be able to meet this challenge, particularly in the context of running stability and long term reproducibility of the trigger decisions.

This talk will cover the design and performance of the LHCb trigger system in Run I as well as the planned improvements in the upgrade of the LHCb experiment.

Strong Interactions and Hadron Physics / 720**Production of light mesons at BABAR**ANULLI, fabio ¹¹ *INFN Rome***Corresponding Author:** fabio.anulli@roma1.infn.it

The clean environment of e^+e^- annihilation at the center-of-mass energy of about 10 GeV allows precise studies of several aspects of hadron production both in exclusive and inclusive processes.

Precise measurement of exclusive $e^+e^- \rightarrow$ hadrons cross sections are needed to improve the theory prediction of the muon anomalous magnetic moment, and for shedding light on the current ~ 3.5 sigma difference between the predicted and the experimental values. BABAR has an intensive program of studying hadronic cross sections in low-energy e^+e^- collisions, which are accessible with data taken near the $\Upsilon(4S)$ via initial-state radiation, and it has previously published results on a number of processes with two to six hadrons in the final state. Here, we report the results of cross section measurements in the energy region between the production threshold and about 4.5 GeV for the $\pi^+\pi^-\pi^0$, the K^+K^- and $K_S K_L$ final states, and the first measurements for several other final states with two neutral kaons, obtained by BABAR.

Fragmentation functions, which describe the formation of final state particles from a partonic initial state and are directly related to the QCD phenomenon of confinement, can be effectively studied at a B factory via inclusive $e^+e^- \rightarrow$ hadrons processes. Precise knowledge of these functions is a key ingredient in accessing quantities such as the nucleon spin structure in semi-inclusive deep inelastic scattering and proton-proton collisions. Such mechanism entails a correlation between the transverse polarization of the fragmenting quark and the outgoing direction of the produced hadron. We report on measurements, performed by the Belle and BABAR collaborations, of the azimuthal asymmetries induced by the Collins effect in inclusive production of hadron pairs, in the $e^+ e^- \rightarrow h_1 h_2 X$ annihilation process, where h_1 and h_2 are pions or kaons produced in opposite hemispheres.

Flavour Physics / 721**FlavorKit: flavor physics beyond the standard model**Dr. VICENTE, Avelino ¹¹ *Université de Liège***Corresponding Author:** avelino.vicente@ulg.ac.be

We present a new kit for the study of flavor observables beyond the standard model. In contrast to previous flavor codes, FlavorKit is not restricted to a single model, but can be used to obtain predictions for flavor observables in a wide range of models (SUSY and non-SUSY).

FlavorKit can be used in two different ways. The basic usage of FlavorKit allows for the computation of a large number of lepton and quark flavor observables, using generic analytical expressions for the Wilson coefficients of the relevant operators. The setup is based on the public codes SARAH and SPheno, and thus allows for the analytical and numerical computation of the observables in the model defined by the user. If necessary, the user can also go beyond the basic usage and define his own operators and/or observables. For this purpose, a Mathematica package called PreSARAH has been developed. This tool uses FeynArts and FormCalc to compute generic expressions for the required Wilson coefficients at the tree- and 1-loop levels. Similarly, the user can easily implement new observables. With all these tools properly combined, the user can obtain analytical and numerical results for the observables of his interest in the model of his choice.

Accelerator Physics and Future Colliders / 724

The High Luminosity LHC Project Status and Perspectives

Prof. ROSSI, Lucio ¹

¹ *CERN*

Corresponding Author: lucio.rossi@cern.ch

The High Luminosity LHC project is now entering in the final stage of design. Aimed at improving the LHC reach in integrated luminosity for 300 to 3000 fb⁻¹, the project relies on a few novelties: 1) use of a special optics, the achromatic telescopic squeeze to enhance beam matching and chromaticity correction beyond the present LHC possibility; use of advanced magnet technology based on Nb3Sn to double the inner triplet quadrupole aperture; use of RF crab cavities to rotate the beam at the collision points. Progress on these and other advanced technologies, being developed for managing the doubling of the beam current, will be reported; the last developments on the issue of pile up and pile up density will be reported, too. Finally an overview of the schedule and of project implementation will be discussed.

Poster Session / 725

Soudan Underground Lab Education and Outreach

Dr. GRAN, Richard ¹

¹ *University of Minnesota Duluth*

Corresponding Author: rgran@d.umn.edu

There has been an education and public outreach program at the Soudan Underground Lab in Minnesota for twenty-five years, for a long time funded piecewise from multiple sources, and for seven years funded by dedicated grants from the U.S. National Science Foundation. The current program hosts an annual open house and a summer program where three undergraduate interns and two or three high school teachers lead public tours, coordinated with the historical tours organized by the Soudan Underground Mine State Park, and now also includes activities at the NOvA far detector site. In addition, the participants work to improve outreach and web materials and/or take part in research on one of the experiments (MINOS neutrino oscillation experiment and CDMS dark matter experiment) as part of their summer experience. Through natural associations, the program includes direct engagement with community groups as well as with other outreach efforts such as the MINERvA experiment's high school activity project using real neutrino data through an event display with a web interface, and regional college and high school science clubs who schedule special tours. Discussion of the successful aspects and outcomes for the different stakeholders as well as ongoing challenges will be presented.

Poster Session / 726

Measurement of the proton and kaon time-like electromagnetic form factors at high energy with the BABAR detector

ANULLI, fabio¹¹ *INFN Rome***Corresponding Author:** fabio.anulli@roma1.infn.it

We have used ISR technique to measure the proton magnetic form factor in the energy region from 3.0 to 6.5 GeV and charged kaon form factor in the range from 2.6 to 7.5 GeV. The proton data clearly indicate that the difference between values of time- and space-like magnetic form factors decreases with increase of energy. The kaon form factor decreases with energy faster than $1/E^2$ approaching the asymptotic pQCD predictions. We have also measured the branching fractions for the J/ψ and ψ decays into p anti- p and $K+K^-$ pairs. We have used our data on kaon form factor together with data from other experiments to perform model-independent determination of the relative phases between single-photon and tree-gluon amplitudes in $\psi \rightarrow k$ anti- K decays. The values of the branching fractions measured in the reaction $e^+e^- \rightarrow K+K^-$ are shifted relative to their actual values due to interference of resonant and non-resonant amplitudes. We have determined the absolute values of the shifts to be 5% for J/ψ and 15% for $\psi(2S)$. The study has been performed using about 470 fb⁻¹ data collected with the BABAR detector at the PEP-II e^+e^- collider at center-of-mass energy about 10.6 GeV.

Poster Session / 728

Latest news on the Unitarity Triangle fits within the Standard Model

Dr. BONA, Marcella¹¹ *Queen Mary University of London***Corresponding Author:** m.bona@qmul.ac.uk

The vast amount of flavour physics results delivered in the last decade by the B factories and the Tevatron have been continuously improving our knowledge on all the B sectors allowing for precision test of the Standard Model (SM). More results are now flowing from the LHC experiments, in particular LHCb, now delivering unprecedented insight and new evidences of rare decays. The CKM picture can be now tested with great precision and from the global analysis the most precise SM expectations can be obtained. We present here the latest results from the UTfit collaboration for the SM global fit.

Flavour Physics / 729

Probing the New Physics scale with the Unitarity Triangle fit

Dr. BONA, Marcella ¹

¹ *Queen Mary University of London*

Corresponding Author: m.bona@qmul.ac.uk

The Unitarity Triangle (UT) analyses within and beyond the SM are powerful tools to summarise the state of the art and explore the possibilities for future new physics (NP) searches. We present the update of the Unitarity Triangle analysis in a scenario beyond the Standard Model. Combining all available experimental and theoretical information on DF=2 processes and using a model-independent parametrisation, we extract the allowed NP contributions in the kaon, D, Bd, and Bs sectors. Then in various NP scenarios, we extract the NP lower scale as function of the NP coupling with the SM.

Poster Session / 730

Latest averages on mixing in the D system by the UFit Collaboration

Dr. BONA, Marcella ¹

¹ *Queen Mary University of London*

Corresponding Author: m.bona@qmul.ac.uk

We update the analysis of D meson mixing including the latest experimental results as of January 2014. We derive constraints on the parameters M_{12} , Γ_{12} and Φ_{12} that describe D meson mixing using all available data, allowing for CP violation. We also provide posterior distributions for observable parameters appearing in D physics.

Flavour Physics / 731

Measurement of the $D \rightarrow \pi^- e^+ \nu$ partial branching fraction, form factor and implications for V_{ub} .

ANULLI, fabio ¹

¹ *INFN Rome*

Corresponding Author: fabio.anulli@roma1.infn.it

Precision measurements of the $D \rightarrow \pi e^+ \nu$ form factor could shed new light on the persistent difference between inclusive and exclusive measurements of V_{ub} . We report the measurement of the partial branching fraction of $D \rightarrow \pi e^+ \nu$ in bins of the four-momentum transfer squared of the D to pi system using 347.2 /fb of integrated luminosity of the BaBar data. The $D \rightarrow \pi$ form factor is extracted with fits to the unfolded partial branching fraction using pole or generalized expansions and the value at zero recoil is determined. These form factors are compared to the current world average, the available lattice predictions, and interpreted with the expectation of a single dominant pole term. The measured form factor is then combined with previous BaBar $B \rightarrow \pi l \nu$ information to determine a value of V_{ub} .

Heavy Ions / 732**Soft probes of the QGP measured by ALICE**Mr. CHOJNACKI, Marek ¹¹ *University of Copenhagen, Niels Bohr Institute***Corresponding Author:** marek.chojnacki@cern.ch

The combination of multiple particle identification systems along with the excellent tracking capabilities makes ALICE a unique tool to study QCD matter at high-temperature and density. The measurements of light flavor hadron production and multi-particle correlations over a broad transverse momentum (p_{T}) range from 100 MeV/c up to 20 GeV/c, are the main soft probes of the quark-gluon plasma (QGP), system created in ultrarelativistic heavy-ion collisions.

In this talk an overview of the ALICE results on light flavor hadron production, azimuthal flow, long-range angular correlations and femtoscopy measurements in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV will be presented. The results will be compared to hydrodynamic calculations. In addition, particle production will be also compared to results from statistical models. In order to show the evolution of the soft probes with the size of the collision system the results from the pp and p-Pb collisions will also be presented.

Neutrino Physics / 733**Neutrinoless double beta decay with EXO-200**Prof. DOLINSKI, Michelle ¹¹ *Drexel University***Corresponding Author:** dolinski@drexel.edu

See attached PDF for proper formatting.

EXO-200 is one of the most sensitive searches for neutrinoless double beta decay in the world. The experiment uses 175 kg of enriched liquid xenon in an ultralow background time projection chamber installed at the Waste Isolation Pilot Plant, a salt mine with a 1600 m water equivalent overburden. This detector has demonstrated excellent energy resolution and background rejection capabilities. Using the first two years of data, EXO-200 has set a limit of 1.1×10^{25} yr at 90% C.L. on the neutrinoless double beta decay half-life of Xe-136.

Flavour Physics / 734**Exclusive semileptonic B decays to high-mass charm hadrons**ANULLI, fabio ¹¹ *INFN Rome***Corresponding Author:** fabio.anulli@roma1.infn.it

The experimental knowledge of semileptonic B decays to a D or D* meson with one or more pions is limited. These limitations are relevant to two experimental puzzles: the tension between the values of V_{cb} determined from inclusive and exclusive semileptonic decays, and the gap between the sum of the exclusive semileptonic B decays to charm and the inclusive $b \rightarrow c l \nu$ rate. The full BABAR data set is used to improve the precision on decays involving $D^{(*)} \pi l \nu$ and to search for decays of the type $D^{(*)} \pi \pi l \nu$. Fully-reconstructed hadronic B decays are used to tag events and provide good resolution on the discriminant variable $U = E_{\mathrm{miss}} - P_{\mathrm{miss}}$. A simultaneous fit to charged and neutral B decays to $D(n\pi)$ and $D^{*}(n\pi)$ decays is used to extract relative branching fractions. In addition to studying these high mass charm final states, the data are used to determine a precise measurement of the ratio of branching fractions for $B \rightarrow D l \nu / B \rightarrow D^{*} l \nu$.

Heavy Ions / 735

Inhomogeneous Phases in QCD

DE LA INCERA, Vivian¹

¹ *University of Texas at El Paso*

Corresponding Author: vincera@utep.edu

An important part of the current research efforts in QCD is focused on finding the phases of nuclear matter that occur at finite densities and temperatures. While the zero density, finite temperature region can be addressed with the help of lattice QCD, and the zero temperature, very high-density region can be explored with weak-coupling QCD, for the strong-interaction region of intermediate densities and temperatures one can only rely on effective models and nonperturbative methods. In recent years, compiling arguments and several model calculations indicate that this region may be described by inhomogeneous phases, that is, phases where (some) spatial symmetries are broken. I will present an overview of the most recent results on the topic of inhomogeneous phases of QCD and will discuss their implications for the existence and location of the QCD critical point, the symmetries of the different phases, and the order of the transition lines separating them.

Flavour Physics / 737

Study of $B \rightarrow K \pi \pi \gamma$ decays

ANULLI, fabio¹

¹ *INFN Rome*

Corresponding Author: fabio.anulli@roma1.infn.it

In $b \rightarrow s$ gamma transitions, the standard model predicts that B^0 ($\text{anti}B^0$) decays are related predominantly to the presence of right (left) handed photons in the final state. Therefore, the mixing-induced CP asymmetry in $B \rightarrow f_{CP}$ decays, where f_{CP} is a CP eigenstate, is expected to be small. This prediction may be altered by new-physics (NP) processes in which opposite helicity photons are involved. Independently, decays to $K \pi \pi \gamma$ can display an interesting hadronic structure: they have contributions from several kaonic resonances decaying to $K\pi\pi$. The decays of these resonances themselves exhibits a resonant structure, with contributions from $K^*\pi$, $K\rho$ and a $(K\pi)$ S-wave. In the present analysis, we extract information about the $K\pi\pi$ resonant structure by means of an amplitude analysis of the $K\pi\pi$ and $K\pi$ invariant mass distributions in $B^+ \rightarrow K^+\pi^-\pi^+\gamma$ decays. The results are used, assuming isospin symmetry, to extract the mixing-induced CP parameters of the process $B^0 \rightarrow K^0S \rho^0 \gamma$ from the time-independent analysis of $B^0 \rightarrow K^0S \pi^+ \pi^- \gamma$.

Poster Session / 738

FlexibleSUSY - a META spectrum generator for supersymmetric modelsVOIGT, Alexander ¹; PARK, Jae-hyeon ²; ATHRON, Peter ³; STÖCKINGER, Dominik ¹¹ *TU Dresden*² *University of Valencia*³ *University of Adelaide***Corresponding Author:** jhyeon@gmail.com

FlexibleSUSY is a software package that takes as input a description of supersymmetric models, the MSSM and beyond, and generates a set of spectrum generator library and executables, with the aid of SARAH. The design goals are modularity, speed, and readability of the code. The high/low-scale boundary conditions are independent C++ objects that are plugged into the RGE solver together with the model objects. This clean separation also makes it easy to build a "tower" configuration with multiple effective theories stacked together such as the MSSM + right handed neutrinos on top of the MSSM. The current status and simple use examples are explained as well as future plans, from straightforward to challenging.

Poster Session / 740

The artificial retina processor for track reconstruction at the LHC crossing rate

Dr. MORELLO, Michael Joseph ¹; Dr. ABBA, Andrea ²; NINCI, Daniele ³; PETRUZZO, Marco ⁴; PIUCCI, Alessio ³; Prof. PUNZI, Giovanni ³; Dr. RISTORI, Luciano ⁵; Dr. SPINELLA, Franco ⁶; Dr. STRACKA, Simone ¹; Dr. TONELLI, Diego ⁷; Dr. WALSH, John ⁶; Dr. BEDESCHI, Franco ⁶; Dr. CAPONIO, Francesco ⁸; Dr. CITTERIO, Mauro ⁴; CUSIMANO, A. ⁹; Prof. GERACI, Angelo ⁹; LIONETTO, Federica ⁶; MARINO, Pietro ¹; Dr. NERI, Nicola ⁸

¹ *Scuola Normale Superiore and INFN Pisa*² *Università degli Studi and INFN Milano*³ *Università di Pisa and INFN Pisa*⁴ *Università di Milano and INFN Milano*⁵ *Fermilab and INFN Pisa*⁶ *INFN Pisa*⁷ *CERN*⁸ *INFN Milano*⁹ *Politecnico di Milano and INFN Milano***Corresponding Author:** michael.morello@pi.infn.it

We present the results of an R study for a specialized processor capable of precisely reconstructing events with hundreds of charged-particle tracks in pixel and silicon strip detectors at 40 MHz, thus suitable for processing LHC events at the full crossing

frequency. For this purpose we design and test a massively parallel pattern-recognition algorithm, inspired to the current understanding of the mechanisms adopted by the primary visual cortex of mammals in the early stages of visual-information processing.

The detailed geometry and charged-particle's activity of a large tracking detector are simulated and used to assess the performance of the artificial retina algorithm. We find that high-quality tracking in large detectors is possible with sub-microsecond latencies when the algorithm is implemented in modern, high-speed, high-bandwidth FPGA devices.

Poster Session / 741**Search for dark photon at BABAR**ANULLI, fabio ¹¹ *INFN Rome***Corresponding Author:** fabio.anulli@roma1.infn.it

A new class of dark matter theories introducing a dark sector charged under a new force has recently been proposed.

The corresponding gauge boson, the so-called dark photon (A'), has MeV–GeV mass and couples to the Standard Model through its kinetic mixing with the photon.

We present a search for a dark photon in $e^+e^- \rightarrow \gamma A'$, $A' \rightarrow e^+e^-$, $\mu^+\mu^-$ at BABAR. We do not observe a significant signal and we set 90% confidence level upper limits on the Standard Model-dark sector mixing strength at the level of $10^{-4} - 10^{-3}$ in the mass range 0.02 – 10.2 GeV.

BEH Physics / 744**Search for low-mass CP odd Higgs boson**ANULLI, fabio ¹¹ *INFN Rome***Corresponding Author:** fabio.anulli@roma1.infn.it

Searches for low mass CP-odd Higgs boson (A_0) predicted in non-minimal supersymmetric extensions of the Standard Model, have been performed at BABAR studying the radiative decays of the $Y(nS)$ resonances, with $n=1,2,3$. Stringent limits on the production of a light Higgs boson have been set from a variety of decay channels, as A_0 to lepton pairs, gluon gluon and $q\bar{q}$.

Poster Session / 745**Measurements of tau hadronic spectra**ANULLI, fabio ¹¹ *INFN Rome***Corresponding Author:** fabio.anulli@roma1.infn.it

We present a set of final results on invariant mass spectra of tau lepton decays into three hadrons and a neutrino. The results are based on the analysis of about 315 million tau lepton pairs, corresponding to an integrated luminosity of 342 fb^{-1} , collected with the BABAR detector at the PEP-II asymmetric energy e^+e^- storage rings.

Accelerator Physics and Future Colliders / 749

Status of SuperKEKB constructionKANAZAWA, Ken-ichi¹¹ *High Energy Accelerator Research Organization***Corresponding Author:** ken-ichi.kanazawa@kek.jp

SuperKEKB is a major upgrade of the asymmetric B-factory collider, KEKB, to provide a 40 times higher luminosity than that achieved at KEKB. The design of SuperKEKB adopted the nano-beam scheme for the collision of two beams which was originally proposed for Italian Super B Factory. This scheme uses a nano-scale beam size (the vertical size is 50 nm and horizontal size is ~ 0.01 mm) and a large crossing angle at the interaction point. The nano-scale beam size is realized with a low emittance optics and very small beta function at the collision point. For the low emittance design, a substantial part of the positron ring (LER) was reconstructed. All dipole magnets of LER were replaced with longer ones. The beam pipes of LER were renewed to mitigate the electron cloud problem. Around the interaction point, about 300 m region of both rings was completely redesigned for the new collision scheme.

In various aspects, the nano-beam scheme SuperKEKB is a challenging accelerator. The final focusing superconducting magnets are unprecedentedly compact. The tolerances for the hardware to realize a nano-scale beam size and to keep the collision are very tight. And optics design is still looking for a wider dynamic aperture.

The present status of these challenging upgrades and a commissioning strategy will be reported.

Astroparticle Physics and Cosmology / 750

Dark energy, QCD axion, BICEP2, and trans-Planckian decay constantProf. KIM, Jihn E.¹¹ *Kyung Hee University***Corresponding Author:** jihnekim@gmail.com

To interpret DE as the potential energy of the approximate U(1) dark energy global symmetry, one must find color-anomaly free U(1). This necessarily invites to consider U(1)_{de} symmetry together with U(1)_{PQ} symmetry such that one gluon-anomaly free combination is constructed. This gives a hilltop potential of height GUT scale energy density. Since the recent BICEP2 result forbid the hilltop inflation, the chaoton is introduced to fit to the BICEP2 data at bull's eye. The DE symmetry, the PQ symmetry, and the Lyth bound are described from a unified view from string derived discrete symmetries.

Lepton Flavour Violation / 751**Search for lepton-flavour violating muon decay in MEG**MEG COLLABORATION, -¹¹ _**Corresponding Author:** wataru@icepp.s.u-tokyo.ac.jp

The MEG experiment in search for the lepton-flavour violating muon decay $\mu \rightarrow e \gamma$ completed its data-taking in August 2013.

The new data in 2013 are now being analysed together with the data taken in 2012 with improved analysis algorithms, which will eventually double the total data statistics.

The latest result from the search analysis will be presented.

The status and prospect of the MEG upgrade (MEG II) with an ultimate sensitivity ten times higher than the present MEG will also be described.

Lepton Flavour Violation / 752**The COMET experiment: A search for muon-to-electron conversion at J-PARC**Dr. NISHIGUCHI, Hajime¹¹ KEK**Corresponding Author:** hajime.nishiguchi@kek.jp

The COMET Experiment at J-PARC aims to search for the lepton-flavour violating process of muon to electron conversion in a muonic atom, $\mu^{-}N \rightarrow e^{-}N$, with a branching-ratio sensitivity of 6×10^{-17} , in order to explore the parameter region predicted by most well-motivated theoretical models beyond the Standard Model. The need for this sensitivity places several stringent requirements on both the muon beam and the detector system. In order to realize the experiment effectively, a staged approach to deployment is endorsed by J-PARC Program Advisory Committee and KEK, and the "COMET Phase-I" experiment will commence engineering runs in 2016. The current R & D and construction status and prospects of the experiment are presented in addition to the experimental overview.

Neutrino Physics / 753**Measurement of Reactor Antineutrino Flux and Spectrum at Daya Bay**Dr. ZHONG, Weili¹¹ Institute of High Energy Physics**Corresponding Author:** zhongwl@ihep.ac.cn

Electron antineutrinos from six 2.9 GW_{th} reactors are detected with six detectors deployed in two near and one far underground experimental halls at Daya Bay. Using 217 days of data, more than 300,000 antineutrino candidates were detected in the three halls. In this talk, a measurement of absolute reactor antineutrino flux and spectrum will be described, including comparisons of the measurement to predictions based on different flux models. Methods of extracting a generic reactor antineutrino spectrum from the measured absolute antineutrino spectrum will be presented, which could be used in place of current flux models.

Astroparticle Physics and Cosmology / 754

Radio Arrays for Detecting Ultra-high Energy Cosmic Neutrinos

BECHTOL, Keith ¹

¹ *KICP / University of Chicago*

Corresponding Author: bechtol@kip.uchicago.edu

Ultra-high energy (UHE, $>10^{18}$ eV) cosmic neutrinos are anticipated to reveal the most distant, most obscured, and highest energy particle accelerators in the Universe. An almost guaranteed flux of UHE neutrinos is predicted from the interactions of UHE cosmic rays with the cosmic microwave background, and additional contributions may arise from prompt emission at individual sources. The spectrum of UHE neutrinos is a sensitive discriminator of the cosmological evolution of UHE sources, as well as the composition of UHE cosmic rays. At the same time, UHE neutrinos will enable several tests of fundamental physics, including constraints on the neutrino-nucleon interaction cross section at center-of-momentum energies ~ 100 TeV, and searches for Lorentz invariance violation.

Theoretical predictions and subsequent laboratory measurements of coherent radio emission from showers initiated by neutrino interactions in dielectric media (e.g., ice, sand, salt, lunar regolith) have motivated diverse experimental approaches involving "detectors" comprised of up to millions of cubic kilometers of natural materials. I will review experimental progress in the search for UHE cosmic neutrinos with an emphasis on experiments using polar ice as the detection medium (e.g., ANITA, EVA, ARA, ARIANNA, and GNO) and the complementarity of these radio arrays with IceCube.

Astroparticle Physics and Cosmology / 755

Halo-Independent analysis of direct dark matter detection data for any WIMP interaction

Prof. GELMINI, Graciela ¹

¹ *University of California, Los Angeles (UCLA)*

Corresponding Author: gelmini@physics.ucla.edu

The halo independent comparison of direct dark matter detection data eliminates the need to make any assumption on the uncertain local dark matter distribution and is complementary to the usual data comparison which required assuming a dark halo model for our galaxy. The method, initially proposed for WIMPs with spin-independent contact interactions, has been generalized to any other interaction and applied to recent data on "Light WIMPs".

Poster Session / 756

Constraining Majorana CP phase in precision era of cosmology and double beta decay experiment

Dr. QUIROGA, Alexander¹¹ Pontificia Universidade Católica do Rio de Janeiro**Corresponding Author:** alarquis@fis.puc-rio.br

We show that precision measurement of (1) sum of neutrino masses by cosmological observation and (2) lifetime of neutrinoless double beta decay in ton-scale experiments, with supplementary use of (3) effective mass measured in single beta decay experiment, would allow us to obtain information on the Majorana phase of neutrinos. To quantify the sensitivity to the phase we use, in addition to the conventional allowed region plots, the CP exclusion fraction, a fraction of the CP phase parameter space that can be excluded for a given set of assumed input parameters, a global measure for CP violation. We illustrate the sensitivity under varying assumptions, from modest to optimistic ones, on experimental errors and theoretical uncertainty of nuclear matrix elements. We find that in the latter case one of the two Majorana phases (denoted as α_{21}) can be constrained rather strongly by excluding ~ 10 -50% of the phase space at 3 sigma CL for the lowest neutrino mass of 0.1 eV. The characteristic features of the sensitivity to α_{21} , such as dependences on the other phase α_{31} and on the true values of α_{21} , are addressed. We also raise the question of whether the uncertainties of nuclear matrix elements could be constrained by consistency of such measurement.

Poster Session / 758

Measurement of (Anti-)(Hyper-)Nuclei and Search for Exotic Objects at the LHC with ALICE

Dr. SHARMA, Natasha¹¹ Institute of Physics (IN)**Corresponding Author:** natasha.sharma@cern.ch

The extremely high center-of-mass collision energies at the Large Hadron Collider (LHC) are expected to produce significant yields of light (hyper-)nuclei in proton-proton, proton-lead, and especially in lead-lead collisions. In addition, these collisions give one the possibility to search and study light exotic states.

The use of the Time Projection Chamber and the Time-Of-Flight detector provides excellent particle identification of these (anti-)nuclei in a broad momentum range. The detailed study of these (anti-)nuclei provides important information about the particle production mechanism in these ultra-relativistic collisions.

Transverse-momentum spectra and production yields of light composite objects such as (anti-)nuclei and the (anti-)(hyper)triton will be shown. To understand their production mechanism, the (anti-)(hyper-)nuclei results will be compared to the predictions from thermal and coalescence models. In addition, we will present results of searches for weakly-decaying light exotic states, such as the Lambda-Lambda (H-dibaryon) and the Lambda-neutron bound states.

Computing and Data Handling / 760**Development of new data acquisition system for COMPASS experiment**

Mr. JARY, Vladimir ¹; Mr. BODLAK, Martin ¹; Mr. NOVY, Josef ¹; Dr. VIRIUS, Miroslav ¹; Mr. KONOROV, Igor ²; Mr. FROLOV, Vladimir ³; LEVIT, Dmytro ²; Mr. HUBER, Stefan ²

¹ *Czech Technical University in Prague*

² *Technische Universitat Munchen*

³ *European Organization for Nuclear Research*

Corresponding Author: vladimir.jary@cern.ch

This paper presents development and recent status of the new data acquisition system of the COMPASS experiment at CERN with up to 50 kHz trigger rate and 36 kB average event size during 10 second period with beam followed by approximately 40 second period without beam. In the original DAQ, the event building is performed by software deployed on switched computer network, moreover the data readout is based on deprecated PCI technology; the new system replaces the event building network with a custom FPGA-based hardware. The custom cards are introduced and advantages of the FPGA technology for DAQ related tasks are discussed.

In this paper, we focus on the software part that is mainly responsible for control and monitoring. The most of the system can run as slow control; only readout process has realtime requirements. The design of the software is built on state machines that are implemented using the Qt framework; communication between remote nodes that form the software architecture is based on the DIM library and IPBus technology. Furthermore, PHP and JS languages are used to maintain system configuration; the MySQL database was selected as storage for both configuration of the system and system messages. The system has been design with maximum throughput of 1500 MB/s and large buffering ability used to spread load on readout computers over longer period of time. Great emphasis is put on data latency, data consistency, and even timing checks which are done at each stage of event assembly. System collects results of these checks which together with special data format allows the software to localize origin of problems in data transmission process. A prototype version of the system has already been developed and tested – the new system fulfills all given requirements. It is expected that the full-scale version of the system will be finalized in June 2014 and deployed on September provided that tests with cosmic run succeed.

Poster Session / 761**Muon Induced Background for JUNO**

Mr. LI, XIAONAN ¹

¹ *IHEP*

Corresponding Author: lixn@ihep.ac.cn

Jiangmen Underground Neutrino Observatory (JUNO), with 53 km baseline, 700 meter overburden, will aim at measurement of neutrino mass hierarchy as well as many other physical goals. Based on the geological survey, muon flux in the underground hall was estimated to be about 0.003 Hz/m². Muon induced background was discussed. In addition, the underground facility was described in the detail.

Neutrino Physics / 762**The LAGUNA/LBNO neutrino observatory in Europe**DUCHESNEAU, Dominique ¹¹ *LAPP, CNRS/IN2P3***Corresponding Author:** duchesneau@lapp.in2p3.fr

The LAGUNA and LAGUNA-LBNO consortia have performed two detailed design studies from 2008 to 2014 to define the optimal combination of baseline and detector technology for the next generation neutrino observatory. Starting from seven sites and three detector technologies we have prioritized our options and selected the Pyhäsalmi mine in Finland, 2300 km from CERN at 1400 m depth, using a liquid Argon double phase TPC as detector. The combination of the very long baseline and a detector deep underground allows a full neutrino astrophysics program, the test of BSM physics by measuring proton decay and long baseline neutrino physics. We will demonstrate the capability of LBNO to discover the mass hierarchy at the >5 sigma level within 4 years running using a 20 kt DLAr detector and an upgraded classical neutrino beam based on 400 GeV protons from the CERN SPS achieving 750 kW beam power. Knowing the mass hierarchy allows the determination of the CP violating phase δ_{cp} . This measurement uses the full figure of the oscillatory behaviour, the L/E dependence of the oscillation probability, predicted by the three neutrino-mixing paradigm. The very long baseline allows disentangling and demonstrating the matter effect from CP violating effects.

Poster Session / 763**Measurement of Cosmic-ray Muon-induced Spallation Neutrons in the Aberdeen Tunnel Underground Laboratory**Dr. NGAI, Ho Yin ¹¹ *The University of Hong Kong***Corresponding Author:** jimngai@hku.hk

Muon-induced neutrons are one of the major backgrounds to various underground experiments, such as dark matter searches, low-energy neutrino oscillation experiments and neutrino-less double beta-decay experiments. Previous experiments on the underground production rate of muon-induced neutrons were mostly carried out either at shallow sites or at very deep sites. The Aberdeen Tunnel experiment aims to measure the neutron production rate at a moderate depth of 611 meters water equivalent. Our apparatus comprises of six layers of plastic-scintillator hodoscopes for tracking the incident cosmic-ray muons, and 760 L of gadolinium-doped liquid-scintillator for both neutron production and detection targets. In this poster, we describe the design and the performance of the apparatus. The latest result on the measurement of neutron production rate is also presented.

Top-quark and ElectroWeak Physics / 764**Update of the electroweak precision fit and model-independent constraints on new physics**

Dr. MISHIMA, Satoshi ¹; Prof. CIUCHINI, Marco ²; Prof. FRANCO, Enrico ³; Prof. SILVESTRINI, Luca ³

¹ *University of Rome "La Sapienza"*

² *INFN Rome 3*

³ *INFN Rome*

Corresponding Author: satoshi.mishima@roma1.infn.it

We present the updated global fits of the Standard Model and beyond to the electroweak precision data, taking into account the Higgs mass measurements at the LHC and recent progress in theoretical calculations. We use the up-to-date theoretical expressions for the partial widths of the Z boson which include the full two-loop fermionic electroweak contributions. From the global fits, we derive model-independent constraints on new physics by introducing the oblique parameters, the epsilon ones, the modified Zbb couplings, and the dimension-six effective Lagrangian.

Detector RD and Performance / 765**The New Small Wheel Upgrade Project of the ATLAS Experiment.**

Dr. IENGO, Paolo ¹

¹ *CERN*

Corresponding Author: paolo.iengo@cern.ch

The instantaneous luminosity of the Large Hadron Collider at CERN will be increased up to a factor of five with respect to the design value by undergoing an extensive upgrade program over the coming decade.

Several sub-systems of the ATLAS detector will also be upgraded in order to cope with the higher particle rate and to further improve the excellent performance provided during the first run period.

The largest upgrade project for the ATLAS Muon System is the replacement of the present first station in the high-rapidity regions with the so-called New Small Wheels (NSWs), to be installed during the LHC long shutdown in 2018/19.

The NSWs consist of eight layers each of Micromegas and small-strip Thin Gap Chambers (sTGC), both providing trigger and tracking capabilities, for a total active surface of more than 2500 m². It represents the first system with such a large size based on Micro Pattern (Micromegas) and wire detectors (sTGC).

We will describe the technological novelties and the expected performance of the NSW system, including the detector design, prototypes construction and test results, the trigger and readout electronics based on a new front-end ASIC (VMM) and the first deployment of a readout architecture based on commercial components.

The status of the project and the plan for the completion will also be discussed.

BEH Physics / 768

Global Bayesian analysis of the Higgs couplings

Dr. MISHIMA, Satoshi ¹; Prof. CIUCHINI, Marco ²; Prof. FRANCO, Enrico ³; Prof. SILVESTRINI, Luca ³; Dr. PIERINI, Maurizio ⁴; Prof. REINA, Laura ⁵; Dr. GHOSH, Diptimoy ⁶; Dr. DE BLAS MATEO, Jorge ⁶

¹ *University of Rome "La Sapienza"*

² *INFN Rome 3*

³ *INFN Rome*

⁴ *CERN*

⁵ *Florida State University*

⁶ *INFN Rome (Italy)*

Corresponding Author: satoshi.mishima@roma1.infn.it

We perform a global Bayesian fit of the Higgs couplings to the latest experimental data, combining the LHC Higgs data with electroweak precision measurements. We consider an effective Lagrangian for a light Higgs boson, and analyze constraints on the modified Higgs couplings to the SM vector bosons and to the SM fermions. We discuss implications of the fit results for new physics models.

Education and Outreach / 769

Netzwerk Teilchenwelt: A German programme on Particle Physics Education and Outreach

Dr. BILOW, Uta ¹; Prof. KOBEL, Michael ¹

¹ *TU Dresden*

Corresponding Author: uta.bilow@physik.tu-dresden.de

Netzwerk Teilchenwelt is a German network of HEP scientists, high school students, and teachers in direct contact with CERN. It aims at sharing the excitement of particle and astroparticle physics research. Scientists from 24 research institutes work with students and teachers to bring cutting edge research to the classroom. Programmes in particle physics and astroparticle physics are offered on four levels, ranging from one-day activities like a masterclass at school up to workshops at CERN and research projects at universities and institutes. Local projects happen throughout the year, every second school day Netzwerk Teilchenwelt organizes a masterclass somewhere in Germany. Netzwerk Teilchenwelt also focuses on the development of context material that can be used in classrooms.

Astroparticle Physics and Cosmology / 770

Low-threshold WIMP search at SuperCDMSDr. LOPEZ ASAMAR, Elias ¹¹ *Universidad Autonoma de Madrid***Corresponding Author:** elias.lopez@uam.es

Gravitational effects observed at different astronomical scales indicate that ~85% of the matter content of the Universe consist of dark matter (DM) whose particle nature remains unknown. Hints from direct and indirect measurements, together with some theoretical scenarios, motivate the interest in low-mass ($< 30 \text{ GeV}/c^2$) weakly-interacting massive particles (WIMPs) as DM candidates.

The Super Cryogenic Dark Matter Search (SuperCDMS) experiment has been operating 15 germanium detectors at the Soudan Underground Laboratory in Minnesota (USA) since March 2012 with improved background rejection capabilities with respect to CDMS II. A low-threshold analysis of the SuperCDMS data has been performed using events from the seven detectors with the lowest trigger thresholds, allowing to explore WIMP masses below $30 \text{ GeV}/c^2$. This is the first analysis using the full background rejection capabilities of SuperCDMS. In particular both ionization and phonon signals are used for defining a fiducial volume excluding events near any of the surfaces of the detectors. In addition, the background discrimination includes multivariate techniques optimized for several WIMP masses. The results are competitive with other low-threshold WIMP searches, and probe new parameter space for WIMP-nucleon scattering for WIMP masses between 4 and $6 \text{ GeV}/c^2$.

Poster Session / 771

Recent results from the search for the critical point of strongly interacting matter at the CERN SPSDr. STEFANEK, Grzegorz ¹¹ *Jan Kochanowski University in Kielce***Corresponding Author:** grzegorz.stefanek@ujk.edu.pl

The exploration of the phase diagram of strongly interacting matter particularly the search for a critical endpoint, is one of the most challenging tasks in present heavy ion physics. The existence of the critical point is expected to result in large event-by-event fluctuations of many observables of produced particles, provided the freeze-out occurs close to its location in the phase diagram.

The NA49 experiment studied event-by-event fluctuations of multiplicity, transverse momentum, azimuthal angle and charge of particles in the final state as well as intermittency in low-mass dipion and in proton production.

In this talk new NA61/Shine results on event-by-event fluctuations of hadron multiplicities, the average transverse momentum and chemical composition of the final state in p+p interactions at the CERN SPS will be shown. The results will be compared with the fluctuations measured in nucleus-nucleus collisions collected by NA49 and predictions from string hadronic models. In particular, the results and advantages of new strongly intensive measures of fluctuations will be discussed.

Further on a first look by NA61/Shine at fluctuations in Be+Be interactions will be presented. Finally the status and plans of data taking in the NA61/Shine ion program will be summarized.

Lepton Flavour Violation / 773**Radiatively-induced LFV Higgs decays from massive ISS neutrinos**Dr. ARGANDA, Ernesto ¹; Prof. HERRERO, Maria Jose ²; Mr. MARCANO, Xabier ³; Dr. WEILAND, Cédric ³¹ *Departamento de Física Teórica, Universidad de Zaragoza*² *UAM-IFT*³ *IFT-UAM***Corresponding Author:** ernesto.arganda@unizar.es

In the inverse seesaw, the smallness of the neutrino masses is related to the smallness of a lepton number violating mass term whilst the seesaw scale is naturally close to the TeV. This allows for large effects in lepton flavor and universality violating observables as was previously demonstrated. With the ongoing and planned measurements of the Higgs boson properties at the LHC, we found timely to investigate the possibility of having large lepton flavor violating branching ratios in Higgs decays within the context of SUSY and non-SUSY extensions of the SM. In this presentation, we will discuss our results on the lepton flavor violating Higgs decay rates, comparing the SUSY and non-SUSY contributions induced radiatively by massive ISS neutrinos.

Astroparticle Physics and Cosmology / 774**Status and physics goals of KM3NeT**Dr. PIATTELLI, Paolo ¹¹ *INFN***Corresponding Author:** piattelli@lns.infn.it

The KM3NeT Collaboration has started the first phase of construction of a next generation high-energy neutrino telescope in the Mediterranean Sea. With several cubic kilometres instrumented with thousands optical sensors, KM3NeT will be, when completed, the largest and most sensitive high-energy neutrino detector. Thanks to its location in the Northern hemisphere and to its large instrumented volume KM3NeT will be the optimal instrument to search for neutrinos from the Southern sky and in particular from the Galactic plane, thus making it complementary to IceCube.

The full KM3NeT detector will be a distributed, networked infrastructure comprising several detector blocks with an array of optical sensors. Each block will contain about one hundred detection units, i.e. vertical structures with a height of about 700 m hosting the optical sensors. In Italy, off the coast of Capo Passero, and in France, off the coast of Toulon, the construction of the KM3NeT-It and KM3NeT-Fr infrastructures respectively is in progress.

The status of construction of the KM3NeT detector will be presented as well as its capability to discover neutrino sources.

Accelerator Physics and Future Colliders / 775

High Precision Energy Calibration by Resonant Depolarization at VEPP-4M Collider

Dr. NIKITIN, Sergei ¹

¹ *Budker Institute of Nuclear Physics*

Corresponding Author: nikitins@inp.nsk.su

At the VEPP-4M collider the record accuracy of 10^{-6} of an absolute beam energy calibration was achieved with the resonant depolarization technique in the energy range including the J/ψ , $\psi(2S)$, $\psi(3770)$ resonances as well as the tau-lepton production threshold. This report discusses the equipments, methods and results.

Accelerator Physics and Future Colliders / 776

The CLIC project, status and prospects

Prof. STAPNES, Steinar ¹

¹ *CERN*

Corresponding Author: steinar.stapnes@cern.ch

The Compact Linear Collider (CLIC) project explores the possibility of constructing a future multi-TeV linear electron-positron collider for high energy frontier physics post LHC. The CLIC-concept is based on high gradient normal-conducting accelerating structures. The RF power for the acceleration of the colliding beams is produced by a two beam acceleration scheme, where power is extracted from a high current drive beam that runs parallel with the main linac. The key ongoing studies cover accelerator parameter optimisation, technical studies and component development, alignment and stability including a number of system performance studies in test-facilities around the world. The CLIC physics potential and main detector issues, as well as possible implementation stages are being studied in parallel.

A summary of the progress and status of the corresponding studies will be given, as well as an outline of the preparation and work towards developing a CLIC implementation plan by 2018.

Neutrino Physics / 779

Constraining new physics scenarios in neutrino oscillations

Dr. MELONI, Davide ¹

¹ *Dipartimento Matematica e Fisica, Universita' di RomaTre*

Corresponding Author: meloni@fis.uniroma3.it

We consider the disappearance data of the Daya Bay experiment to constrain the parameter space of models where sterile neutrinos can propagate in a large compactified extra dimension (LED) and models where non-standard interactions affect the neutrino production and detection (NSI). I will show that compactification radius R in LED scenarios can be constrained at the level of $0.57\mu\text{m}$ for normal ordering and of $0.19\mu\text{m}$ for inverted ordering, at 2σ confidence level. For the NSI model, reactor data put a strong upper bound on the parameter ϵ_{ee} at the level of $\sim 10^{-3}$, whereas the main effect of $\epsilon_{e\mu}$ and $\epsilon_{e\tau}$ is a worsening of the determination of θ_{13} .

Poster Session / 780

The (e+ + e-) flux measurement up to the TeV with the AMS-02 experimentMr. VAGELLI, Valerio ¹¹ Karlsruhe Institute of Technology**Corresponding Author:** valerio.vagelli@cern.ch

The AMS-02 detector is a large acceptance cosmic ray detector operating on the International Space Station since May 2011.

About 40 billion events have been collected by the instrument in the first 30 months of data taking.

Among them, 10.5 million of electrons and positrons have been selected to measure the combined electron plus positron energy spectrum at energies up to the TeV.

In this contribution we will present the latest result on the combined electron plus positron energy spectrum evaluation, we will review the employed analysis techniques and we will discuss the implications of this measurement in the investigation of sources for high energy CR electrons and positrons.

Poster Session / 781

Precision measurement of neutrino oscillation parameters at INO-ICAL DetectorMs. KAUR, DALJEET ¹; Mr. MD., Naimuddin ¹; Mr. KUMAR, Sanjeev ¹¹ University of Delhi**Corresponding Author:** daljeet.kaur97@gmail.com

To study the properties of elusive atmospheric neutrinos, the India-based Neutrino Observatory (INO) has been planned to be set up at Theni (Tamil Nadu), South India. INO will host a 50 ktons magnetized Iron CALorimeter (ICAL) detector for the determination of neutrino mass and mixing parameters which is one of the important issues for the leptonic sector in today's particle physics. The detector will have three modules, each of size 16 m x 16 m x 14.5 m and consists of stack of 151 horizontal layers of 5.6 cm thick iron slab interleaved within 4 cm gap for the active detector element. Resistive Plate Chambers (RPCs) of dimension 2 m x 2 m, which have good time resolution (~1ns) and spatial resolution (~3 cm), will be used as active part of the detector.

We will report about the precision measurement analysis for the atmospheric neutrino oscillation parameters with the muon neutrino events, generated through Monte Carlo NUANCE event generator. The analysis has been performed using neutrino energy and muon direction as the observables. ICAL detector will be able to detect muon tracks and hadron showers produced by neutrino events. We have used the realistic resolutions and efficiencies obtained by the INO collaboration from a GEANT4-based simulation to reconstruct neutrino energy and muon direction. We will present the ICAL sensitivity for atmospheric neutrino mixing parameters ($\sin^2(\theta_{23})$) and ($|\Delta m^2_{23}|$) on the basis of marginalised χ^2 analyses using neutrino energy and muon zenith angle binning scheme for the 10 years of running INO-ICAL detector.

Flavour Physics / 782**Effect of mixing and CP violation in D decays in the extraction of the angle γ of the CKM unitarity triangle with $B \rightarrow D^{(*)}K^{(*)}$ decays.**RAMA, Matteo¹¹ *Istituto Nazionale di Fisica Nucleare - Frascati***Corresponding Author:** matteo.rama@lnf.infn.it

The datasets that the LHCb and Belle II experiments are expected to collect in the coming years will allow a sub-degree precision measurement of the angle γ of the CKM unitarity triangle using $B \rightarrow D^{(*)}K^{(*)}$ decays. To reach this goal a number of effects that have been neglected so far will require careful evaluation. We discuss these corrections with particular emphasis on the impact of D-Dbar mixing and CPV in charm decays.

Neutrino Physics / 783**The latest oscillation results from the Daya Bay reactor neutrino experiment**Prof. CAO, Jun¹¹ *Institute of High Energy Physics***Corresponding Author:** caoj@mail.ihep.ac.cn

The Daya Bay reactor neutrino experiment (Daya Bay) is one of the three current-generation short-baseline reactor neutrino experiments designed to measure the lastly known neutrino mixing angle θ_{13} . Its unique design of eight identical 20t liquid scintillator (LS) antineutrino detectors (AD) at the three near and far experimental sites does not only make it the most sensitive θ_{13} experiment but also provides the flexibility of re-arranging ADs. Daya Bay was able to discover the non-zero θ_{13} value using the first completed six ADs at an earlier stage of the experiment by adapting a 2-1-3 detector arrangement scheme. By establishing a precise energy model of the ADs, Daya Bay has further improved the precision of $\sin^2 2\theta_{13}$ to $\sim 10\%$ and measured the atmospheric mass-squared splitting Δm_{21}^2 using electron-flavor reactor antineutrinos for the first time. The Δm_{21}^2 measurement of Daya Bay is consistent with the one using muon-flavor (anti)neutrinos. The Daya Bay experiment has completed, installed and commissioned all eight ADs since Fall 2012 and has collected the largest reactor antineutrino dataset. The unpaired dataset has enabled the study of physics topics like oscillation analysis using neutron captured on hydrogen events, sterile neutrino search and other standard or exotic physics. Looking into the future, Daya Bay is expected to measure $\sin^2 2\theta_{13}$ to $\sim 3\%$ precision and Δm_{21}^2 to a precision better than the current one by MINOS. The discovery and the precision measurement of non-zero θ_{13} have enabled other physics opportunities in neutrino physics. This talk will report the latest oscillation results and the current status with emphases on precision oscillation analysis and future prospect.

Astroparticle Physics and Cosmology / 786**Measurement of the TeV atmospheric muon charge ratio with the full OPERA data set**Dr. MAURI, Nicoletta ¹¹ *Università di Bologna and INFN***Corresponding Author:** nicoletta.mauri@bo.infn.it

The OPERA detector, designed to search for muon- to tau-neutrino oscillations in direct appearance mode, is located in the underground Gran Sasso laboratory, a privileged location to study TeV-scale cosmic rays. Given the large rock depth and the detector's wide acceptance, the apparatus was used to measure the atmospheric muon charge ratio in the TeV energy region. The muon charge ratio, defined as the number of positive over negative charged muons, provides an understanding of the mechanism of multiparticle production in the atmosphere in kinematic regions not accessible to accelerators, as well as information on the primary cosmic ray composition.

We present the results obtained with the full statistics collected by OPERA from 2008 to 2012. The combination of two data sets with opposite magnet polarities allows minimizing systematic uncertainties and reaching an accurate determination of the muon charge ratio. Relevant parameters on the composition of primary cosmic rays and the associated kaon production in the forward fragmentation region are obtained.

Beyond the Standard Model / 787**Triplet extended MSSM: naturality vs LHC data & perturbativity constraints**Dr. DI CHIARA, Stefano ¹; Prof. HUITU, Katri ¹; Dr. BANDYOPADHYAY, Priyotosh ¹; Ms. SABANCI, Asli ¹¹ *University of Helsinki***Corresponding Author:** stefano.dichiara@helsinki.fi

In this talk, I will briefly review the triplet extended MSSM, and then show that for a sizable portion of viable parameter space, associated with a large but still perturbative triplet coupling, the model features conspicuously smaller fine-tuning than in the case of MSSM-like couplings. I will then present the results of a fit to Higgs physics data as well as to low energy observables like the B to X_{γ} decay, which demonstrate that the couplings allowed by direct search constraints generally lie well within the experimentally viable regions. Finally, I will show that the goodness of fit of the given experimental data by the triplet extended MSSM is comparable with that of the SM.

Poster Session / 788

2D position sensitive microstrip sensors with resistive charge division along the strip

Ms. ESTEBAN, Currás Rivera¹; Dr. FERNANDEZ, Marcos¹; Dr. HIDALGO, Salvador²; Dr. JARAMILLO, Richard¹; Prof. LOZANO, Manuel²; Ms. MUÑOZ SÁNCHEZ, Francisca J.¹; Dr. PELLEGRINI, Giulio²; Dr. QUIRION, David³; Dr. VILA ALVAREZ, Ivan¹

¹ *Instituto de Física de Cantabria (CSIC-UC)*

² *IMB-CNM (CSIC)*

³ *IMB-CNM, CSIC*

Corresponding Author: ecurras@ifca.unican.es

Position sensitivity in semiconductor detectors of ionizing radiation is usually achieved by the segmentation of the sensing diode junction in many small sensing elements read out separately as in the case of conventional microstrips and pixel detectors. Alternatively, position sensitivity can be obtained by splitting the ionization signal collected by one single electrode amongst more than one readout channel with the ratio of the collected charges depending on the position where the signal was primary generated. Following this later approach, we implemented the resistive charge division method in a conventional microstrip detector to obtain position sensitivity along the strip. We manufactured a proof-of-concept demonstrator where the conventional aluminum electrodes were replaced by slightly resistive electrodes made of strongly doped poly-crystalline silicon and being readout at both strip ends. Here, we partially summarize the laser, radioactive source and test beam characterization of this first proof-of-concept demonstrator. Among other applications, we study the feasibility of this technology on the implementation of very long microstrip sensors for the future linear collider detectors.

Neutrino Physics / 789

Latest results on $\nu_{\mu} \rightarrow \nu_{\tau}$ oscillations from the OPERA experiment

Dr. KOMATSU, Masahiro¹

¹ *Nagoya University, JAPAN*

Corresponding Author: komatsu@flab.phys.nagoya-u.ac.jp

The OPERA experiment is designed to prove neutrino oscillations in the ν_{μ} to ν_{τ} channel through the direct observation of the tau lepton in tau neutrino charged current interactions. The experiment has accumulated data for five years, from 2008 to 2012, with the CERN Neutrinos to Gran Sasso (CNGS), an almost pure ν_{μ} beam.

In the last two years, a very large amount of the data accumulated in the nuclear emulsions has been analyzed. The latest results on oscillations with the increased statistics, which include a fourth tau neutrino candidate event, will be presented. Given the extremely low expected background, this result corresponds to the observation of the oscillation process with a four sigma level significance.

Lattice QCD / 790

The strange and charm quark contributions to the anomalous magnetic moment of the muon from lattice QCD

Dr. KOPONEN, Jonna¹¹ *University of Glasgow***Corresponding Author:** jonna.koponen@glasgow.ac.uk

We describe a new technique (presented in arXiv:1403.1778) to determine the contribution to the anomalous magnetic moment of the muon coming from the hadronic vacuum polarization using lattice QCD. Our method uses Padé approximants to reconstruct the Adler function from its derivatives at $q^2=0$. These are obtained simply and accurately from time-moments of the vector current-current correlator at zero spatial momentum. We test the method using strange quark correlators calculated on MILC Collaboration's $n_f = 2+1+1$ HISQ ensembles at multiple values of the lattice spacing, multiple volumes and multiple light sea quark masses (including physical pion mass configurations). We find the (connected) contribution to the anomalous moment from the strange quark vacuum polarization to be $a^s_\mu = 53.41(59) \times 10^{-10}$, and from charm to be $a^c_\mu = 14.42(39) \times 10^{-10}$ - 1% accuracy is achieved for the strange quark contribution. The extension of our method to the light quark contribution and to that from the quark-line disconnected diagram is straightforward.

Accelerator Physics and Future Colliders / 791

Progress towards A Fixed-Target Experiment at the LHC: AFTER@LHC

Dr. RAKOTOZAFINDRABE, Andry ¹; Dr. ANSELMINO, M. ²; Dr. ULRICH, R. ³; Dr. YANG, Z. ⁴; Dr. ARNALDI, R. ²; Dr. BRODSKY, S.J. ⁵; Dr. CHAMBERT, V. ⁶; Dr. DIDELEZ, J.P. ⁶; Dr. GENOLINI, B. ⁶; Dr. GONZALEZ FERREIRO, Elena ⁷; Dr. FLEURET, F. ⁸; Prof. GAO, Y. ⁴; Dr. HADJIDAKIS, C. ⁶; Dr. LANSBERG, Jean-Philippe ⁹; Dr. LORCÉ, C. ¹⁰; Mr. MIKKELSEN, R. ¹¹; Dr. ROSIER, P. ⁶; Dr. SCHIENBEIN, Ingo ¹²; Dr. SCOMPARIN, E. ²; Dr. UGGERHØJ, U.I. ¹¹

¹ CEA Saclay, IRFU, France

² Dip. di Fisica and INFN Sez. Torino, Via P. Giuria 1, I-10125, Torino, Italy

³ Karlsruhe Institute of Technology, Germany

⁴ Center for High Energy Physics, Tsinghua University, Beijing 100084, China

⁵ SLAC National Accelerator Lab., Theoretical Physics, Stanford University, Menlo Park, CA 94025, USA

⁶ IPNO, Université Paris-Sud, CNRS/IN2P3, F-91406, Orsay, France

⁷ Universidade de Santiago de Compostela

⁸ Laboratoire Leprince Ringuet, École Polytechnique, CNRS/IN2P3, 91128 Palaiseau, France

⁹ IPN Orsay - Paris-Sud U - CNRS/IN2P3

¹⁰ IPNO, Université Paris-Sud, CNRS/IN2P3, F-91406, Orsay, France; and IFPA, AGO Department, Université de Liège, Sart-Tilman, 4000 Liège, Belgium

¹¹ Department of Physics and Astronomy, University of Aarhus, Denmark

¹² LPSC

Corresponding Author: arakotoz@cern.ch

If used in the fixed-target mode, the multi-TeV LHC beams will allow the most energetic fixed-target experiments ever performed, including studies of high precision pp, pd and pA collisions at $\sqrt{s_{NN}} \sim 115$ GeV as well as Pb-p and PbA collisions at $\sqrt{s_{NN}} \sim 72$ GeV. In particular, AFTER@LHC -- for A Fixed-Target Experiment -- can greatly complement [1] existing collider experiments, in particular that of Brookhaven's Relativistic Heavy Ion Collider (RHIC) and the proposed electron-ion colliders (EIC).

We thus discuss the conception of a multi-purpose fixed-target experiment with the proton or lead-ion LHC beams extracted by a bent crystal. This mature extraction technique, which is being studied as a smart collimator solution for the LHC [2], offers an ideal way to obtain a clean and very collimated high-energy beam, without altering the performance of the LHC [2-4].

We have shown that the instantaneous luminosity achievable with AFTER using typical targets would surpass that of RHIC by more than 3 orders of magnitude. This provides a quarkonium, prompt photon and heavy-flavour observatory [1, 5] in pp and pA collisions where, by instrumenting the target-rapidity region, gluon and heavy-quark distributions of the proton, the neutron and the nuclei can be accessed at large x and even at x larger than unity in the nuclear case. In addition, the fixed-target mode has the advantage to allow for spin measurements with a polarized target [6] and for access over the full backward rapidity domain up to x_F close to (-1) [7]. The nuclear target-species versatility provides a unique opportunity to study the nuclear matter versus the hot and dense matter formed in heavy-ion collisions. Modern detection technology will allow for the study of quarkonium excited states, in particular χ_c and χ_b resonances as well as exotic states such as the Z^c pentaquark and double-charmed baryons thanks to the boost of the fixed-target mode [8].

In this talk, we will also show the results of the first fast simulations based on a LHCb-like detector used in the fixed-target mode at LHC. We will also discuss the connection with existing and future data from the LHCb SMOG runs, which can be considered as a low-density internal gas target.

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Detector RD and Performance / 792

The Pixel Detector of the ATLAS experiment for the Run2 at the Large Hadron Collider

TRONCON, Clara ¹

¹ *INFN*

Corresponding Author: clara.troncon@cern.ch

The Pixel Detector of the ATLAS experiment has shown excellent performance during the whole Run-1 of LHC. Taking advantage of the long shutdown, the detector was extracted from the experiment and brought to surface, to equip it with new service quarter panels, to repair modules and to ease installation of the Insertable B-Layer (IBL).

IBL is a fourth layer of pixel detectors, and will be installed in May 2014 between the existing Pixel Detector and a new smaller radius beam-pipe at a radius of 3.3 cm.

To cope with the high radiation and pixel occupancy due to the proximity to the interaction point, a new read-out chip and two different silicon sensor technologies (planar and 3D) have been developed.

Furthermore, the physics performance will be improved through the reduction of pixel size while, targeting for a low material budget, a new mechanical support using

lightweight staves and a CO₂ based cooling system have been adopted.

IBL construction is now completed.

An overview of the IBL project as well as the experience in its construction will be presented, focusing on adopted technologies, module and staves production, qualification of assembly procedure, integration of staves around the beam pipe and commissioning of the detector.

Heavy Ions / 793**Nuclear Matter effects on Quarkonia and Heavy-Quarks**

Dr. RAKOTOZAFINDRABE, Andry ¹; Dr. CONESA DEL VALLE, Zaida ²; Dr. LANSBERG, Jean-Philippe ³; Dr. GONZALEZ FERREIRO, Elena ⁴; Dr. FLEURET, Frédéric ⁵

¹ CEA Saclay, IRFU, France

² IPNO, Université Paris-Sud, CNRS/IN2P3, F-91406, Orsay, France

³ IPN Orsay - Paris-Sud U - CNRS/IN2P3

⁴ Universidade de Santiago de Compostela

⁵ Laboratoire Leprince Ringuet, École Polytechnique, CNRS/IN2P3, 91128 Palaiseau, France

Corresponding Author: arakotoz@cern.ch

The last pPb run at 5 TeV which took place at CERN LHC provides measurements of the Nuclear Matter (NM) effects at an unprecedented energy, especially for the heavy quark and quarkonium sectors. The comparison of the experimental results to the phenomenological inputs is therefore essential, both to put stringent constraints on their main features and to envision the next most discriminating measurements.

We study the NM effects on J/psi [1], Upsilon [2] and open beauty [3] production. We consider an exact 2 to 2 kinematics (as expected from LO pQCD) for the bulk of the heavy-quark and quarkonium [4] production process. We show that the evaluation of the J/psi nuclear modification factor R_{pPb} suffers from large factorisation scale uncertainties, on top of the already large uncertainties due to the current knowledge of the nuclear modifications (shadowing, EMC effects, ...) of the parton distribution. Such scale uncertainties are reduced for the Upsilon case, owing to the larger mass and hence the larger scale of the production process. Also, we advocate that the nuclear absorption of the pre-resonant b-bbar pair should be negligible at LHC energies.

We finally emphasize the complementarity between the studies of open heavy flavour and quarkonium production in pA collisions. Indeed, there is no debate that the heavy quark propagates as a colored object in the nuclear matter. On the contrary, for the quarkonia, there is neither a consensus on the impact of the possible break-up of the heavy quark pair in the matter nor on whether the pair propagates in a color singlet or octet state and is thus subject to a fractional energy loss, recently revived in the literature [5].

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Astroparticle Physics and Cosmology / 794

Physics with the Cherenkov Telescope Array

Prof. GREENSHAW, Tim ¹

¹ *Liverpool University*

Corresponding Author: green@liv.ac.uk

The Cherenkov Telescope Array (CTA) is the next generation observatory for ground-based gamma-ray astronomy. Current instruments (HESS, MAGIC and VERITAS) have made huge progress in the observation of cosmic sources of photons in the ~ 50 GeV to ~ 50 TeV energy range using Imaging Atmospheric Cherenkov Telescopes (IACTs). CTA will extend the range of these observations at both low and high energies, will improve their sensitivity by a factor of about 10 and will increase the precision of photon energy and direction measurements. This talk presents briefly the designs of the 23 m, 12 m and 4 m diameter IACTs that CTA will use to achieve this performance, before discussing the impact the array will have on studies of Fundamental and Astroparticle Physics. Topics covered include: searches for Dark Matter (DM) and axion-like particles (ALPs); studies of possible violation of Lorentz invariance; and studies of the sources and acceleration mechanisms of high energy cosmic rays.

Poster Session / 796

ATLAS Virtual Visits : Bringing the World into the ATLAS Control Room

Dr. GOLDFARB, Steven ¹

¹ *University of Michigan*

Corresponding Author: steven.goldfarb@cern.ch

ATLAS Virtual Visits is a project initiated in 2011 for the Education & Outreach program of the ATLAS Experiment at CERN. Its goal is to promote public appreciation of the LHC physics program and HEP, in general, through direct dialogue between ATLAS physicists and remote audiences.

A Virtual Visit is an IP-based videoconference, coupled with a public webcast and video recording, between physicists at the ATLAS Experiment at CERN, and remote locations around the world that typically include high school or university classrooms, Masterclasses, science fairs, or other special events, usually hosted by collaboration members.

Over the past two years, more than 10,000 people, from all of the world's continents, have actively participated in ATLAS Virtual Visits, with many more enjoying the experience from the publicly available webcasts and recordings. We present an overview of our experience and discuss potential development for the future.

Lepton Flavour Violation / 798**Search for Muon to Electron Conversion in Nuclear Field at J-PARC MLF**Dr. NAKATSUGAWA, Yohei ¹¹ *High Energy Accelerator Research Organization (KEK)***Corresponding Author:** nakatsu@post.kek.jp

A new experiment to search for muon to electron conversion in nuclear field, DeeMe, is proposed at J-PARC Materials and Life Science Experimental Facility (MLF). This experiment will be carried out at a brand-new beamline (H-Line) which will be constructed at J-PARC MLF Muon Science Establishment (MUSE).

Muonic atoms formed in a muon production target will be utilized. The signal electrons from muon to electron conversion will be captured and transported to a spectrometer by the beamline. The single event sensitivity which will be achieved by DeeMe experiment is estimated to be 2×10^{-14} with a silicon carbide (SiC) muon production target and 1 year data acquisition, while the current upper limit is of the order of 10^{-13} .

The preparation of the experiment is in progress. The simulation studies for beamline optics, background estimation and spectrometer calibration were performed. Some performance tests of the prototype of tracking device (MWPC) have been done and further R is ongoing. The SiC muon production target is under development. The current graphite target of MLF MUSE will be replaced with a SiC target in order to improve physics sensitivity of the experiment and the preparation for the replacement is also ongoing.

DeeMe already has Stage-2 approval from PAC under KEK-IMSS (Institute of Materials Structure Science), and the experiment will start data taking in 2015.

Education and Outreach / 799**Hangout With CERN: A direct conversation with the public**Dr. GOLDFARB, Steven ¹; Mrs. KAHLE, Kate ²; Mr. RAO, Achintya ³¹ *University of Michigan*² *CERN DG Communication*³ *CMS Experiment, CERN***Corresponding Author:** steven.goldfarb@cern.ch

On 4 July 2012, particle physics became a celebrity. Around 1,000,000,000 people (yes, 1 billion) saw rebroadcasts of two technical presentations announcing the discovery of a new boson. The occasion was a joint seminar of the CMS and ATLAS collaborations, and the target audience were particle physicists. Yet the world ate it up like a sporting event.

Roughly two days later, in a parallel session of ICHEP in Melbourne, Australia, a group of physicists decided to explain the significance of this discovery to the public. They used a tool called “Hangout”, part of the relatively new Google+ social media platform, to converse directly with the public via a webcast videoconference. The demand to join this Hangout overloaded the server several times. In the end, a compromise involving Q via comments was set up, and the conversation was underway.

We present a new project born shortly after this experience called Hangout with CERN, and discuss its success in creating an effective conversational channel between the public and particle physicists. We review earlier efforts by both CMS and ATLAS contributing to this development, and then describe the current programme, involving nearly all aspects of CERN, and some topics that go well beyond that. We conclude by discussing the potential of the programme both to improve our accountability to the public and to train our community for public communication.

Flavour Physics / 800**Status of the $KL \rightarrow \pi^0 \nu \nu$ Experiment at J-PARC**Dr. NOMURA, Tadashi ¹¹ KEK**Corresponding Author:** nomurat@post.kek.jp

J-PARC-E14/KOTO experiment aims at observation of the rare decay $KL \rightarrow \pi^0 \nu \nu$ using a neutral kaon beam in the Hadron experimental hall at J-PARC. This mode occurs through a flavor-changing neutral current and violates CP symmetry. The branching ratio is calculated in the Standard Model (SM) to be 2.4×10^{-11} . Since the theoretical uncertainty is small ($\sim 2\%$), this can be a good probe to explore new physics beyond the SM.

KOTO completed the first stage of the detector construction in 2012, performed commissioning runs in early 2013, and finally started the first physics run in May 2013. We took data for about 100 hours with the 24kW beam power, which roughly corresponds to 1/5 of the originally expected amount to reach the Grossman-Nir limit sensitivity of 1.5×10^{-9} . We are now analyzing the data, expecting to update the current experimental upper limit of 2.6×10^{-8} .

In this contribution, the status of the KOTO experiment, including data analysis and prospects, will be reported.

Poster Session / 801**Kaon semileptonic decay vector form factor with Twisted Mass fermions at $N_f = 2+1+1$** Mr. LAMI, Paolo ¹¹ *Università degli Studi Roma Tre***Corresponding Author:** lamipaolo@gmail.com

We present a lattice QCD determination of the vector and scalar form factors of the kaon semileptonic decay, which are relevant for the extraction of the CKM matrix element $|V_{us}|$ from experimental data. Our results are based on the gauge configurations produced by the European Twisted Mass Collaboration with $N_f = 2+1+1$ dynamical fermions, which account for the sea quark effects of the up, down, strange and charm quarks. We simulated at three different values of the lattice spacing and with pion masses as small as 210 MeV.

Poster Session / 802**Parity violation and new physics in superconductors**Prof. HONG, Deog-Ki ¹¹ *Pusan National University***Corresponding Author:** dkhong@pusan.ac.kr

We propose a new method, using the Andreev reflection at superconductors, to measure parity violation induced by the standard electroweak theory, which in turn constrain the possible parity-violating effect of new physics. The weak neutral currents induce parity-violating, marginal effective operators, though quite tiny, in superconductors. We estimate their effects on superconducting gaps and propose a method to measure the parity-violation from the spin polarization effect when electrons or holes get Andreev-reflected at the interface between normal metal and a superconductor. Such polarization effects are comparable to the atomic parity violation and thus naturally will give a stringent bound on certain models of new physics.

Formal Theory Developments / 804**Lifshitz hyperscaling violating holography**Dr. PAPADIMITRIOU, Ioannis ¹; Dr. CHEMISSANY, Wissam ²¹ *Instituto de Fisica Teorica UAM/CSIC*² *Stanford University***Corresponding Author:** ioannis.papadimitriou@csic.es

Holographic techniques have been instrumental in understanding certain aspects of strongly correlated systems, both in high energy and condensed matter physics. One of the most interesting applications of holography in the condensed matter setting is the study of quantum critical points exhibiting Lifshitz or hyperscaling violating Lifshitz symmetry. Although various aspects of the holographic dictionary for Lifshitz quantum critical points have been studied in special cases, the general structure for arbitrary critical exponent z has not been fully understood, while very little is known for the hyperscaling violating case.

We develop a general method for systematically constructing the holographic dictionary for both Lifshitz and hyperscaling violating Lifshitz critical points with arbitrary Lorentz violating and hyperscaling violating parameters, for a large class of bulk actions admitting such backgrounds. This allows us to determine quite generically various physical properties of the dual quantum critical points, such as the spectrum of operators, the Ward identities, and the Lifshitz conformal anomaly.

BEH Physics / 805**Determination of the Higgs CP mixing angle in the tau decay channels**Dr. BERGE, Stefan ¹; Prof. DR. BERNREUTHER, Werner ¹; Mr. KIRCHNER, Sebastian ¹¹ *RWTH Aachen***Corresponding Author:** berge@physik.rwth-aachen.de

We investigate the measurement of the CP mixing angle of the 126 GeV neutral spin-0 Higgs boson in its tau decay channels. The tau decay channel of the Higgs boson has the particular advantage that possible CP-violating contributions alter the Higgs-tau-tau coupling already at the leading order. Within our proposed method the di-lepton, lepton-hadron as well as the hadron-hadron channel of the tau decay can be included in the measurement.

We discuss the prospect of the precision on the CP mixing angle measured at the LHC and compare with the expected sensitivity at the LC. We furthermore derive the distributions of the major background - the contribution due to virtual Z and photon exchange.

Beyond the Standard Model / 806**CheckMATE: Confronting your Favourite New Physics Model with LHC Data**

Dr. KIM, Jong Soo ¹; Prof. DREES, Manuel ²; Prof. DREINER, Herbert ²; Dr. TATTERSALL, Jamie ³; Mr. SCHMEIER, Daniel ²

¹ *IFT Madrid*

² *University of Bonn*

³ *University of Heidelberg*

Corresponding Author: jongsoo.kim@tu-dortmund.de

In the first three years of running, the LHC has delivered a wealth of new data that is now being analysed. With over 20 fb⁻¹ of integrated luminosity, both ATLAS and CMS have performed many searches for new physics that theorists are eager to test their model against. However, tuning the detector simulations, understanding the particular analysis details and interpreting the results can be a tedious task. CheckMATE (Check Models At Terascale Energies) is a program package which accepts simulated event files in many formats for any model. The program then determines whether the model is excluded or not at 95% C.L. by comparing to many recent experimental analyses. Furthermore the program can calculate confidence limits and provide detailed information about signal regions of interest. It is simple to use and the program structure allows for easy extensions to upcoming LHC results in the future.

Astroparticle Physics and Cosmology / 807**Acoustic Detection of Neutrinos: Review and Future Potential**

Dr. LAHMANN, Robert ¹

¹ *Erlangen Centre for Astroparticle Physics (ECAP)*

Corresponding Author: robert.lahmann@physik.uni-erlangen.de

The acoustic neutrino detection technique is a promising approach for future large-scale detectors with the aim of measuring the small expected flux of cosmogenic neutrinos at energies exceeding 100 PeV. The technique is based on the thermo-acoustic model, which implies that the energy deposition by a particle cascade - resulting from a neutrino interaction in a medium with suitable thermal and acoustic properties - leads to a local heating and a subsequent characteristic pressure pulse that propagates in the surrounding medium. The main advantage of using sound for the detection of neutrino interactions, as opposed to Cherenkov light, lies in the much longer attenuation length of the former type of radiation - several kilometers for sound compared to several ten meters for light in the respective frequency ranges of interest in sea water.

As detection media for future detectors, water, ice, salt domes and permafrost have been discussed, but it is the first two which have been investigated most thoroughly by using existing arrays of acoustic receivers - mainly military arrays in various bodies of water - or by implementing dedicated acoustic arrays in Cherenkov neutrino telescopes. Such arrays have been installed in IceCube at the South Pole, in the Lake Baikal experiment in Siberia and in ANTARES and the former Nemo experiment in the Mediterranean Sea. The future KM3NeT neutrino telescope to be installed in the Mediterranean Sea will be equipped with acoustic sensors for position calibration that are suited to also serve acoustic detection purposes.

Ongoing experiments in water and ice have established the feasibility of the acoustic neutrino detection technique and allowed for the investigation of prevailing background conditions. Methods to improve the signal detection efficiency and to reduce the rate of mis-identified neutrinos have been devised and potential future large-scale detector designs are investigated using detailed simulations in combination with the wealth of collected experimental data.

In this presentation, a brief review of acoustic particle detection, considering both theoretical and experimental aspects, will be given. The current status and plans for the future will be discussed.

Astroparticle Physics and Cosmology / 808

Nuclear Form Factors for Direct Dark Matter Detection

Dr. ALVAREZ RUSO, Luis ¹; Dr. ORRIGO, Sonja ²; Dr. PEÑA GARAY, Carlos ¹¹ *IFIC*² *IFIC Valencia***Corresponding Author:** sonja.orrigo@ific.uv.es

The goal of several ongoing and future direct detection experiments is to discover the dark matter present in our galactic halo in the form of Weakly Interacting Massive Particles (WIMPs). These experiments attempt to isolate from various backgrounds the signal of nuclear recoils from the elastic scattering of WIMPs with the target nuclei inside the detector. The expected signal (for a given flux) depends on the WIMP mass, the WIMP-nucleon cross section and the nuclear form factor. The nuclear form factor critically determines the spectrum of the recoil nuclei. Therefore its precise determination and error estimation is crucial to establish the bounds on the WIMP-nucleon cross section from running experiments and to plan future ones. While the distribution of protons in nuclei, which determines the corresponding form factor, can be extracted precisely and, to a large extent, model independently, our present knowledge of neutron distributions is far more uncertain. The latter are particularly important in scenarios where the cross sections on protons and neutrons are different [1].

We have performed a systematic global determination of nuclear form factors for nuclei ranging from ^9Be to ^{209}Bi using the available experimental information. We provide realistic (conservative) uncertainties for the parameters, estimating the systematic errors, and exploring possible correlations. In direct dark matter searches and related studies, it has been customary to describe the nuclear form factors using the Helm ansatz, which leads to an analytic expression for the form factor. On the other hand, the charge density distributions have been extracted from muon spectroscopy [2] using two-parameter Fermi (2PF) distributions. The widespread strategy to deal with this dichotomy [3] is to convert the 2PF parameters of Ref. [2] into Helm ones adopting an ad-hoc value for the nuclear thickness. We have improved this approach by fitting directly the measured nuclear radii and diffuseness [2,4]. Systematic errors related to the finite nucleon size, differences between electromagnetic and scalar form factors and the approximated compact expression adopted for the nuclear thickness are investigated. For the neutron distributions, we have used the experimental determination of the difference between neutron and proton radii using antiprotonic atoms [5]. The systematic errors have the same sources as in the proton case plus the one from the two extreme “halo” and “skin” distributions of neutrons in nuclei. The larger errors in neutron distributions should get smaller in the future thanks to parity-violating electron scattering experiments such as PREX, CREX and QWEAK.

[1] J. L. Feng, *Ann. Rev. Astron. Astrrophys.* 48 (2010) 495.[2] G. Fricke et al., *At. Data Nucl. Data Tables* 60 (1995) 177.[3] J. D. Lewin and P.F. Smith, *Astrop. Phys.* 6 (1996) 87.[4] H. de Vries et al., *At. Data Nucl. Data Tables* 36 (1987) 495.[5] A. Trzcinska et al., *Phys. Rev. Lett.* 87 (2001) 082501.

Poster Session / 809

On the performances of YaPT (Yet another High Energy Physics Tool)

Prof. JIPA, Alexandru¹; Dr. CIORANU, Silviu²; Dr. ESANU, Tiberiu¹; Dr. COVLEA, Vania¹; Dr. GROSSU, Ion¹; Dr. FELEA, Daniel³; Prof. LAZANU, Ionel¹; Prof. BESLIU, Calin¹; Dr. BIRZU, Adrian²; Dr. POTLOG, Mihai³; Dr. RISTEA, Catalin³; Dr. RISTEA, Oana¹; Dr. CALIN, Marius¹

¹ *University of Bucharest*

² *Faculty of Physics, University of Bucharest*

³ *Institute of Space Science, Bucharest-Măgurele*

Corresponding Author: oana@brahms.fizica.unibuc.ro

A simulation using a specific code implies many steps, some of its difficult to be accomplished by any user. Therefore, the utilization of the Monte Carlo codes associated with distributed calculus systems, places where the codes can be configured and optimized, is a better way due to the specific features. Taking into account the scientific tasks in different international collaborations in the High Energy Physics field, as well as the educational programs for Master and PhD degrees, at the Computing Laboratory of the Research Center „Nuclear matter in extreme conditions” from the Atomic and Nuclear Physics Chair, Faculty of Physics, University of Bucharest, the YaPT system – Yet another High Energy Physics Tool was created [1-3]. The main vulnerabilities of web applications have been taken into account. Specific procedures and the integration of different security mechanisms have been included for solving these aspects.

Using few simulation codes frequently used in High Energy Physics fields – UrQMD and AMPT, mainly – we compared 12 functionalities (possibility for simulation type control, multiple simulations in the same time, download of the simulation results, analysis of the results, search of the results after the input simulation parameters, notification for the simulation end etc.) of 5 such systems (JetWeb, HepWeb, IguanaCMS, PPCW and YaPT) existing at different laboratories. The YaPT system has all these functionalities, permitting easy understanding and utilization. The other systems have between 1 and 5 functionalities from our list. We tested these functionalities during practical classes at Mater and PhD study programs, too, with good results. Therefore, we can affirm that the YaPT system offers good opportunities, both for research and education.

Poster Session / 812

125 GeV Higgs decays into $\gamma\gamma$, γZ and rare top quark decay in generic 2HDM

Ms. SEMLALI, SOUAD¹; Mr. ARHRIB, Abdesslam²; Mr. BENBRIK, Rachid³; Mr. CHEN, Chuan-Hung⁴; Mrs. GOMEZ-BOCK, Melina⁵

¹ *LPHEA,FSSM, Cadi Ayyad University*

² *FST,B.P 416 Tangier, Morocco*

³ *Faculté polydisciplinaire de Safi, Morocco*

⁴ *National Cheng-kung University, Taiwan*

⁵ *Instituto de Fisica, Benmrita Universidad Autonoma de Puebla Apartado Postal 7-48 Puebla, Pue, Mexico*

Corresponding Author: s.seemlali@gmail.com

Models of electroweak symmetry breaking with extended Higgs sectors are theoretically well motivated.

In this study, we investigate the phenomenology of the new Yukawa couplings in generic two-Higgs-doublet models. We find that a heavy charged Higgs together with $\alpha, \tan\beta \sim O(1)$, type-II and III could enhance the two-photon production cross section; however, with large $\tan\beta$ scenario, only type-III could match the LHC data. Additionally, we study the implications of LHC data on the production cross sections for the channel $h \rightarrow Z\gamma$ and branching ratio for $t \rightarrow c h$ decay.

Astroparticle Physics and Cosmology / 813

Atmospheric neutrinos at high energy

GAISSER, Thomas¹

¹ *University of Delaware*

Corresponding Author: gaisser@udel.edu

Neutrinos produced by cosmic-ray interactions in the Earth's atmosphere are a background in the search for neutrinos of astrophysical origin. In addition, they provide a beam that can be used for calibration and to study neutrino properties, such as oscillations. Several issues that arise in evaluating the atmospheric neutrino spectrum up to the PeV range will be addressed in this paper:

What is the level of production of prompt neutrinos from decay of charmed hadrons?

What is the effect of the steepening of the primary cosmic-ray spectrum at the knee and the energy dependence of the production of the parent mesons that decay to neutrinos?

To what extent is it possible to distinguish atmospheric neutrinos from astrophysical neutrinos, for example, by using a muon produced in the same cosmic-ray event as a veto?

Top-quark and ElectroWeak Physics / 814

Measurement of the Charged Triple Gauge Boson Couplings at the ILC

ROSCA, Aura¹

¹ *DESY*

Corresponding Author: aura.rosca@desy.de

After the discovery of the Higgs boson it became even more important to perform precision measurements and to search for deviations from the Standard Model predictions in the electroweak sector. A study of the measurement of trilinear gauge couplings is presented looking at the semi-leptonic W-pair production in e+e- annihilation at the ILC at centre-of-mass energies of 500 GeV and 1 TeV with polarized beams. It is based on a realistic full simulation of this process in the ILD detector at the ILC. We employed a maximum likelihood analysis of a three-dimensional differential cross section based on the W and W decay product angular distributions. A high sensitivity can be reached at the ILC that will allow to probe effects of new physics at the loop level.

Poster Session / 815**Upgrade of the ATLAS Tile Calorimeter electronics**MORENO MARTI, Pablo ¹¹ *Instituto de Física Corpuscular (IFIC), Centro Mixto Universidad de Valencia - CSIC***Corresponding Author:** boh@physto.se

The Tile Calorimeter (TileCal) is the hadronic calorimeter covering the central region of the ATLAS experiment at LHC. The TileCal readout consists of about 10000 channels. The bulk of its upgrade will occur for the High Luminosity LHC phase (phase 2) where the peak luminosity will increase 5x compared to the design luminosity (10^{34} cm⁻²s⁻¹) but with maintained energy (i.e. 7+7 TeV). An additional increase of the average luminosity with a factor of 2 can be achieved by luminosity leveling. This upgrade is expected to happen around 2023. The TileCal upgrade aims at replacing the majority of the on- and off-detector electronics to the extent that all calorimeter signals will be digitized and sent to the off-detector electronics in the counting room. To achieve the required reliability, redundancy has been introduced at different levels. Three different options are presently being investigated for the front-end electronic upgrade. Extensive test beam studies will determine which option will be selected. 10 Gbps optical links are used to read out all digitized data to the counting room while 5 Gbps down-links are used for synchronization, configuration and detector control. For the off-detector electronics a pre-processor (ROD) is being developed, which takes care of the initial trigger processing while temporarily storing the main data flow in pipeline and de-randomizer memories. Field Programmable Gate Arrays are extensively used for the logic functions off- and on-detector. One demonstrator prototype module with the new calorimeter module electronics, but still compatible with the present system, is planned to be inserted in ATLAS this year.

Neutrino Physics / 817**PINGU and the Neutrino Mass Hierarchy**Dr. CLARK, Kenneth ¹¹ *University of Toronto***Corresponding Author:** kclark@physics.utoronto.ca

The Precision IceCube Next Generation Upgrade (PINGU) is a proposed IceCube in-fill array designed to measure the neutrino mass hierarchy using atmospheric neutrino interactions in the ice at the South Pole. PINGU will have a neutrino energy threshold of a few GeV with a multi-megaton effective volume. We present PINGU's expected sensitivity to the hierarchy with an optimized geometry and with consideration of a full complement of systematic uncertainties. We also briefly present PINGU sensitivity to other topics in neutrino oscillations, as well as to low-mass dark matter.

BEH Physics / 818

Anomalous Higgs couplings in angular asymmetries of $H \rightarrow Z\ell\ell$ and $e^+e^- \rightarrow HZ$

Dr. BOITO, Diogo¹; Prof. BENEKE, Martin¹; Dr. WANG, Yu-Ming¹¹ Technische Universitaet Muenchen --- TUM**Corresponding Author:** boito@ifae.es

In this work we study in detail the phenomenological impact of anomalous Higgs couplings in angular asymmetries of the crossing symmetric processes $H \rightarrow Z\ell\ell$ and $e^+e^- \rightarrow HZ$. Beyond Standard Model (BSM) physics is parametrized in terms of the $SU(3) \times SU(2) \times U(1)$ dimension six effective Lagrangian. In the light of present bounds on $d=6$ interactions we study how angular asymmetries can reveal non-standard CP even and CP odd couplings. We provide simplified approximate expressions to all observables of interest making transparent their dependence on anomalous couplings. We show that some of the asymmetries may reveal BSM effects that would be hidden in other observables. In particular, CP even and CP odd $d=6$ $HZ\gamma$ couplings as well as $HZ\ell\ell$ contact interactions can generate asymmetries at the percent level, while having small or no effect on the di-lepton invariant mass spectrum of $H \rightarrow Z\ell\ell$. Finally, the higher di-lepton invariant masses probed in $e^+e^- \rightarrow HZ$ lead to interesting differences in the asymmetries with respect to those of $H \rightarrow Z\ell\ell$.

Strong Interactions and Hadron Physics / 819

α_s from tau decays: higher orders and perturbative behaviour

Prof. BENEKE, Martin¹; Dr. BOITO, Diogo¹; Prof. JAMIN, Matthias²¹ Technische Universitaet Muenchen --- TUM² ICREA & IFAE**Corresponding Author:** boito@ifae.es

I present a discussion of recent developments in the QCD description of hadronic tau decays with emphasis in the perturbative contribution. The perturbative series is the main ingredient in the extraction of the strong coupling (α_s) from these decays. The ambiguity due to the different prescriptions regarding the renormalization group improvement of the series is studied under different assumptions for the large-order corrections. Our results show that some of the hadronic spectral function moments employed in α_s determinations have poor perturbative behaviour and should be avoided. Exploiting this information we develop the optimal theoretical framework for precise α_s extractions from the 2014 update of the ALEPH data. Some preliminary results of our 2014 analysis will be discussed.

Beyond the Standard Model / 820**EWSB and CDM from strongly interacting hidden sector**KO, Pyungwon ¹¹ *KIAS***Corresponding Author:** pko@kias.re.kr

We present a scale invariant extension of the standard model with new QCD-like strong interaction in the hidden sector. A scale Λ_H is dynamically generated in the hidden sector by dimensional transmutation, and chiral symmetry breaking occurs in the hidden sector. This scale is transmitted to the SM sector by a real singlet scalar messenger S , and can trigger electroweak symmetry breaking (EWSB). Thus all the mass scales in this model arises from the hidden sector scale Λ_H which has quantum mechanical origin. Furthermore the lightest hadrons in the hidden sector is stable by the flavor conservation of the hidden sector strong interaction, could be the cold dark matter (CDM). We study collider phenomenology, and relic density and direct detection rates of the CDM of this model.

Poster Session / 821**e/p separation and analysis techniques used in the AMS-02 (e+ +e-) flux measurement**Ms. GRAZIANI, maura ¹¹ *INFN***Corresponding Author:** maura.graziani@cern.ch

AMS-02 is a large acceptance cosmic ray detector which has been installed in the International Space Station ISS in May 2011, where it is collecting cosmic rays up to TeV energies.

A primary cosmic ray research topic is the search for Dark Matter indirect signatures in the lepton fluxes. AMS-02 is providing cosmic lepton data with an unprecedented precision.

Such a physics goal has been achieved thanks to the large hadron/lepton separation power obtained combining the independent measurements from the TRD, ECAL and Tracker detectors.

In this contribution we will detail the analysis techniques used to distinguish leptons from the hadronic background and show the in-flight performances of these detectors relevant for the electron/positron measurements.

Poster Session / 822**Invisible Higgs decay width vs. DM direct decetion in Higgs portal DM models**KO, Pyungwon ¹¹ *KIAS***Corresponding Author:** pko@kias.re.kr

The correlation between the invisible Higgs decay width vs. DM direct decetion in Higgs portal DM models is usually presented in the effective field theory approach. This is fine for singlet scalar DM, but not in the singlet fermion or vector DM with Higgs portal. In this talk, I recapitulate the UV completions of the singlet fermion DM and vector DM with Higgs portal, and show that there are hidden parameters, the additional singlet scalar mass and its mixing angle with the SM Higgs boson. I show the correct form of the upper bounds on DM direct detection cross sections derived from the invisible Higgs decay width.

BEH Physics / 823

Implications of LHC data on 125 GeV Higgs-like boson for the Standard Model and its various extensions

KO, Pyungwon¹¹ KIAS**Corresponding Author:** pko@kias.re.kr

Recent data on 125 GeV Higgs-like boson at the LHC starts to constrain the electroweak symmetry breaking sector of the SM and its various extensions. If one imposes the local gauge symmetry of the Standard Model (SM) ($SU(3)_c \times SU(2)_L \times U(1)_Y$) to the SM and any possible new physics scenarios, the SM Higgs properties will be modified by intrinsically two different ways: by new physics either coupling directly to the SM Higgs boson h , or affecting indirectly the SM Higgs properties through the mixing of h with a SM singlet scalar s . The models of two Higgs doublet, extra sequential and mirror fermions belong to the first category, whereas the models with a hidden sector dark matter, extra vector-like fermions and new charged vector bosons, which can enhance the diphoton rate of the SM Higgs-like resonance, belong to the second category. We perform a global fit to data in terms of the effective Lagrangian description of two interaction eigenstates of scalar bosons, a SM Higgs and a singlet scalar, and their mixing. This framework is more suitable to study singlet-extended scenarios discussed above compared to other approaches based on the Lagrangian of mass eigenstates. With fairly model-independent assumptions, the effective Lagrangian contains at most four free parameters still encompassing the majority of models in the literature. Interestingly, the SM gives the best fit if all data from ATLAS and CMS are used, whereas various singlet extensions can fit better to individual ATLAS or CMS data. Without further assumptions, an upper bound on the total width (or, non-standard branching ratio) is generically obtained. Furthermore, global fit based on our parameterization can be used to probe interactions of the singlet scalar if the singlet resides below 2mW.

Astroparticle Physics and Cosmology / 824

ν AMDM: A Model for Sterile Neutrino and Dark Matter Reconciles Cosmological and Neutrino Oscillation Data after BICEP2

KO, Pyungwon¹¹ KIAS**Corresponding Author:** pko@kias.re.kr

We propose a ultraviolet complete theory for cold dark matter(CDM) and sterile neutrino that can accommodate both cosmological data and neutrino oscillation experiments at 1σ level. A new $U(1)_X$ dark gauge symmetry is introduced, and is assumed to be broken at $\sim \mathcal{O}(\text{MeV})$ scale. Such a light mediator for DM's self-scattering and scattering-off sterile neutrinos can resolve three controversies for cold DM on small cosmological scales, cusp vs. core, too-big-to-fail and missing satellites problems. We can also accommodate $\sim \text{eV}$ scale sterile neutrinos as the hot dark matter(HDM) and can fit some neutrino anomalies from neutrino oscillation experiments within 1σ . Finally the right amount of HDM can make a sizable contribution to dark radiation, and also helps to reconcile the tension between the data on the tensor-to-scalar ratio reported by Planck and BICEP2 Collaborations.

BEH Physics / 827**Studies of the Higgs boson properties at D0**D0 COLLABORATION, et al.¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present the combination of searches for the Standard Model Higgs boson at a center-of-mass energy of $\sqrt{s}=1.96$ TeV, using the full Run 2 dataset collected with the D0 detector at the Fermilab Tevatron collider. The major contributing processes include associated production ($WH \rightarrow lvbb$, $ZH \rightarrow \nu\nu bb$, $ZH \rightarrow llbb$, and $WH \rightarrow WWW^*$) and gluon fusion ($gg \rightarrow H \rightarrow WW^*$). We also present tests of different spin and parity hypotheses for a particle H of mass 125 GeV produced in association with a vector boson and decaying into a pair of b quarks.

Education and Outreach / 828**The QuarkNet CMS masterclass: bringing the LHC to students**Dr. MCCAULEY, Thomas¹¹ *University of Notre Dame***Corresponding Author:** thomas.mccauley@cern.ch

QuarkNet is an educational program which brings high school teachers and their students into the particle physics research community. The program supports research experiences and professional development workshops and provides inquiry-oriented investigations, some using real experimental data.

The CMS experiment at the LHC has released several thousand proton-proton collision events for use in education and outreach. QuarkNet, in collaboration with CMS, has developed a physics masterclass and e-Lab based on this data.

A masterclass is a day-long educational workshop where high school students travel to nearby universities and research laboratories. There they learn from LHC physicists about the basics of particle physics and detectors. They then perform a simple measurement using LHC data, and share their results with other students around the world via videoconference. The U.S. Masterclass includes three activities that QuarkNet teachers use to prepare students for the trip to the university or lab. Data show that this preparation enhances the student experience.

Since 2011 thousands of students from over 25 countries have participated in the CMS masterclass as organised by QuarkNet and IPPOG, the International Particle Physics Outreach Group. We describe here the masterclass exercise: the physics, the online event display and database preparation behind it, the measurement the students undertake, their results and experiences, and future plans for the exercise.

Top-quark and ElectroWeak Physics / 829**Measurement of the single top quark production cross section with the D0 detector**D0 COLLABORATION, et al. ¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present measurements of the cross sections for the two main production modes of single top quarks in pp(\bar{p}) collisions at a center-of-mass energy of 1.96 TeV in the Run II data collected with the D0 detector at the Fermilab Tevatron Collider. For this measurement the full D0 data set corresponding to an integrated luminosity of 9.7 fb⁻¹ is used. We present the evidence of the s-channel production with a significance of 3.7 standard deviations. We also present an updated measurement of the production cross section of t- and s+t-channels. Using these measurements we set a lower limit on the CKM matrix element $|V_{tb}| > 0.92$ at 95% C.L., assuming $m(\text{top}) = 172.5$ GeV. We also report the first observation of single top quark production in the s-channel through the combination of the CDF and D0 measurements with a significance of 6.3 standard deviations.

Top-quark and ElectroWeak Physics / 832**Measurement of the top quark mass with the D0 detector**D0 COLLABORATION, et al. ¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We report a measurement of the mass of the heaviest known standard model particle, the top quark, performed by the D0 experiment at the Fermilab Tevatron Collider. We present the most precise D0 measurement employing the matrix element technique in the lepton+jet channel. For this measurement the full D0 data set corresponding to an integrated luminosity of 9.7 fb⁻¹ is used. We also discuss top quark mass measurements in the dilepton and alljets channels and an updated D0 top quark mass combination.

Poster Session / 835**MOSCAB: Direct Dark Matter Search Using the Geyser Technique**ARDID, Miguel ¹; Dr. BOU CABO, Manuel ²; Mr. FELIS, Ivan ²; MARTÍNEZ-MORA, Juan A. ¹¹ *Universitat Politècnica de València*² *UPV***Corresponding Author:** miquelardid@gmail.com

The MOSCAB experiment (Materia OSCura A Bolle) uses the Geyser technique for dark matter search. The results of the first 0.5 kg mass prototype detector using superheated C3F8 liquid were very encouraging, achieving a 5 keV nuclear recoil threshold with high insensitivity to gamma radiation. Additionally, the technique seems to be easily scalable to higher masses for both in terms of complexity and costs, resulting in a very competitive technique for direct dark matter search, especially for the spin dependent case. Here, we report in the construction and commissioning of the big detector of 40 kg at the Milano-Bicocca University. The detector, the calibration tests and the evaluation of the background will be presented. Once demonstrated the functionality of the detector, it will be operated at the Gran Sasso National Laboratory in 2015.

Education and Outreach / 837**CERN@school: bringing CERN into the classroom**Dr. WHYNTIE, Tom ¹; Dr. PARKER, Becky ²¹ *Queen Mary, University of London*² *Simon Langton Grammar School for Boys***Corresponding Author:** t.whyntie@qmul.ac.uk

CERN@school [1] brings technology from CERN [2] into the classroom to aid with the teaching of particle physics. It also aims to inspire the next generation of physicists and engineers by giving participants the opportunity to be part of a national collaboration of students, teachers and academics, analysing data obtained from detectors based on the ground and in space to make new, curiosity-driven discoveries at school. CERN@school is based around the Timepix hybrid silicon pixel detector [3] developed by the Medipix Collaboration [4], which features a 300 μm thick silicon sensor bump-bonded to a Timepix readout ASIC. This defines a 256 \times 256 grid of pixels with pitch 55 μm , the data from which can be used to visualise ionizing radiation in a very accessible way.

Broadly speaking, CERN@school consists of a web portal that allows access to data collected by the Langton Ultimate Cosmic ray Intensity Detector (LUCID) experiment [5] in space and the student-operated Timepix detectors on the ground; a number of Timepix detector kits for ground-based experiments, to be made available to schools for both teaching and research purposes; and educational resources for teachers to use with LUCID data and detector kits in the classroom.

By providing access to cutting-edge research equipment, raw data from ground and space-based experiments, CERN@school hopes to provide the foundation for a programme that meets the many of the aims and objectives of CERN and the project's supporting academic and industrial partners. The work presented here will provide an update on the current status of the programme as supported by the UK's Science and Technology Facilities Council (STFC) and Royal Commission for the Exhibition of 1851. This includes recent results from work with the UK's GridPP Collaboration [6] on using grid resources with schools to run GEANT4 [7] simulations of CERN@school experiments and integration with ArcGIS mapping software [8] to combine Timepix data with geographical information. Plans for expansion to other CERN member states will also be discussed.

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[8] <https://www.arcgis.com>**Top-quark and ElectroWeak Physics / 838****Measurement of the W boson mass with the D0 detector**D0 COLLABORATION, et al. ¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present a measurement of the W boson mass using D0 Run II data. We select $e + \nu$ events consistent with a W decay and extract the W boson mass from the distributions of the electron transverse momentum, the neutrino transverse momentum, and the system transverse mass.

Poster Session / 839**Status of the Development of Reconstruction Software for MicroBooNE**Dr. KETCHUM, Wesley¹¹ *Los Alamos National Laboratory***Corresponding Author:** wketchum@lanl.gov

MicroBooNE is a liquid argon time projection chamber (LArTPC) that will detect neutrinos from Fermilab's Booster Neutrino Beamline. From the large sample of neutrino interactions that will be collected, MicroBooNE will perform short-baseline neutrino oscillation searches, will resolve the source of the MiniBooNE "low-energy excess," and will measure cross sections and properties of ~1 GeV neutrino interactions in liquid argon. Using LArTPC detection technology, MicroBooNE aims to see neutrino interactions in "high-definition," with excellent interaction vertex resolution and particle identification, critical for achieving its physics goals. Due to the expected large number of neutrino interactions, and the even larger cosmic-ray backgrounds intrinsic to its surface location, it is essential that fully-automated software be capable of reconstructing MicroBooNE events. I will discuss the challenges of developing a fully-automated LArTPC reconstruction software package, and present the status of MicroBooNE's reconstruction software.

Strong Interactions and Hadron Physics / 840**Jet physics: algorithms and jet substructure techniques**CACCIARI, Matteo¹¹ *LPTHE Paris***Corresponding Author:** cacciari@lpthe.jussieu.fr

Jets are ubiquitous in LHC physics. We will review the advances in algorithms and techniques that have taken place in the past few years, with an emphasis on the role of jet substructure in the analyses of heavy boosted particles.

Poster Session / 841**Search for dark matter in events with a Z boson and large missing transverse momentum with the ATLAS detector**ATLAS, Collaboration¹¹ *CERN***Corresponding Author:** lroos@lpnhe.in2p3.fr

A search is presented for production of dark matter particles recoiling against a leptonically decaying Z boson in 20.3 fb⁻¹ of pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector at the Large Hadron Collider. Events with large missing transverse momentum and two oppositely-charged electrons or muons consistent with the decay of a Z boson are analyzed. No excess above the Standard Model prediction is observed. Limits are set on the mass scale of the contact interaction as a function of the dark matter particle mass using an effective field theory description of the interaction of dark matter with quarks or with Z bosons. In addition, we introduce a simplified model of dark matter, in which the mediating particle is accessible at the LHC, to address the possible problem of EFT validity. The interaction is mediated by a coloured scalar particle exchanged in the t-channel, and we set limits on the coupling strength and mediator mass.

Astroparticle Physics and Cosmology / 842

Dark Matter in scalar extensions of the Standard ModelDr. SOKOLOWSKA, Dorota ¹¹ *University of Warsaw***Corresponding Author:** dsok@fuw.edu.pl

Multi-scalar extensions of the Standard Model can accommodate a viable Dark Matter candidate and modifications of the Higgs decay rates, particularly into two photons. One of the simplest choices for the extended scalar sector is the Inert Doublet Model, i.e. the Standard Model with an additional inert scalar doublet. LHC measurements of the decay of the SM-like Higgs boson into two photons and PLANCK/WMAP results provide very strong constraints for the IDM. We discuss also further extensions of the scalar sector by additional singlets or doublets, which may modify the viable DM mass regions and allow for new phenomena not present in the IDM.

Astroparticle Physics and Cosmology / 843

Constraints on the dark matter interaction sector via extra radiation contributionsDr. LINEROS, Roberto ¹¹ *IFIC***Corresponding Author:** rlineros@ific.uv.es

Despite the observational evidences in favor of Dark Matter its nature is still a mystery. Theoretical realizations assume that dark matter is stable and is the lightest state within the dark sector (e.g. WIMPs). The dark sector can also contains even lighter states like dark bosons and fermions. However, those can be completely disconnected from the visible sector except by interaction with the dark matter. We focus our attention on these very-light dark particles and their contribution to the radiation budget of the Universe as dark radiation. We provide constraints on how large the dark matter sector can be depending on the dark matter freeze-out temperature and on the number of dark particles.

Beyond the Standard Model / 844

Discarding a 125 GeV heavy Higgs in an MSSM model with explicit CP-violationMr. BOSCH SERRANO, Cristian ¹; Prof. BARENBOIM, Gabriela ²¹ *University of Valencia*² *University of Valencia and IFIC***Corresponding Author:** cristian.bosch@uv.es

We prove that the present experimental constraints are already enough to rule out the possibility of the ≈ 125 GeV Higgs found at LHC being the second lightest Higgs in a general MSSM context, even with explicit CP violation in the Higgs potential. Contrary to previous studies, we are able to eliminate this possibility analytically with a relatively small number of observables. We show that the present LHC constraints on the diphoton signal strength, tau-tau production through Higgs and indirect flavor bounds are enough to preclude the possibility of H₂ being the observed Higgs with $m_H \sim 125$ GeV within an MSSM context, without leaving room for finely tuned cancellations.

BEH Physics / 845**Higgs Physics at the FCC-ee**BLONDEL, Alain ¹¹ UNIGE**Corresponding Author:** alain.blondel@cern.ch

Now that the masses of the Higgs and Top quark are known, circular electron positron colliders, able to measure the properties of these particles with high accuracy, are receiving considerable attention. As part of the Future Circular Collider study at CERN, the Future e+e- Circular Collider, FCC-ee, (formerly called TLEP) is a new generation collider, fitting in a 80 to 100km tunnel, and able to deliver high luminosity in up to four interaction points from at least the Z peak to above the top pair threshold.

At the ZH production optimum, around 240 GeV, the luminosity of $6 \cdot 10^{34} / \text{cm}^2/\text{s}$ in four IPs yields more than 2 Million Higgs decays in 5 years through the e+e- \rightarrow ZH process. This sample opens the possibility of sub-per-cent precision measurement of the Higgs boson couplings to light fermions and to gauge-bosons, and of the Higgs boson width. These precision measurements are sensitive to multi-TeV new physics interacting with the scalar sector. The ZH production mechanism also gives access to the invisible or exotic branching ratios down to the per mil level, and with a more limited precision to the triple Higgs coupling. The luminosity expected at the top pair production threshold ($\sqrt{s} \sim 340\text{-}350$ GeV) further improves some of these figures by a factor of two, and is sensitive to the Higgs boson coupling to the top quark.

Lepton Flavour Violation / 846**Flavour violating lepton decays in supersymmetric low-scale seesaws**Dr. WEILAND, Cedric ¹; Dr. VICENTE, Avelino ²; Prof. ABADA, Asmaa ³; Mr. KRAUSS, Manuel ⁴; Prof. POROD, Werner ⁴; Dr. STAUB, Florian ⁵¹ Universidad Autonoma de Madrid² Université de Liège³ Université Paris Sud 11⁴ Universität Würzburg⁵ Universität Bonn**Corresponding Author:** cedric.weiland@uam.es

In previous works (JHEP03(2012)100, JHEP09(2012)015), we have highlighted that the Higgs and Z-mediated penguin diagrams contributing to lepton flavour violating (LFV) observables like $\tau \rightarrow 3\mu$ are strongly enhanced in the supersymmetric inverse seesaw model. It has recently been pointed out that an error in the literature for the Z-penguins form factors would lead to a non-physical non-decoupling behaviour (1312.5318). This work is devoted to the study of LFV lepton decays and $\mu \rightarrow e$ conversion in the supersymmetric inverse seesaw, taking all contributions into account with the corrected form factors. We explicitly distinguish various regimes depending on the dominant contribution and give predictions for various observables, some of them already within reach of the current experiments.

Top-quark and ElectroWeak Physics / 847**Precision Electroweak measurements at FCC-ee**BLONDEL, Alain ¹¹ UNIGE**Corresponding Author:** alain.blondel@cern.ch

As part of the Future Circular Collider study at CERN, the Future e+e- Circular Collider, FCC-ee, (formerly called TLEP) is a new generation collider, able to fit in a 80 to 100km tunnel, and able to deliver high luminosity in up to four interaction points from at least the Z peak to above the top pair threshold.

The luminosity at the Z pole and W pair threshold are over 2.5 and 1.2 10³⁵/cm²/s in each of four Interaction points, respectively allowing to contemplate statistics of over 10¹² Z decays and 10⁸ W pairs. Because of the large ring radius, transverse polarization for energy calibration should be available up to and including the W pair threshold, allowing to reach statistical (resp systematic) uncertainties of 10keV (resp 100 keV) on the Z mass and width, and 0.3 MeV (resp 0.5 MeV) on the W mass.

At 350 GeV centre-of-mass energy the FCC-ee can deliver a luminosity is 1.8 10³⁴/cm²/s in up to four IPs with a nearly gaussian energy spread of ~0.2%, allowing a detailed scan of the top threshold and production of over a million top quark pairs. A precise measurement of the top quark mass with an experimental error of the order of 10 MeV is feasible, as well as an investigation of rare decays and other top quark properties.

These and many other precision measurements available in the high statistics and clean environment will be discussed.

Beyond the Standard Model / 848**Search for rare phenomena at FCC-ee**BLONDEL, Alain ¹¹ UNIGE**Corresponding Author:** alain.blondel@cern.ch

As part of the Future Circular Collider study at CERN, the Future e+e- Circular Collider, FCC-ee, (formerly called TLEP) is a new generation collider, able to fit in a 80 to 100km tunnel, and able to deliver high luminosity in up to four interaction points from at least the Z peak to above the top pair threshold. Statistics of 10¹² Z, 10⁸ W pairs, 2 10⁶ ZH events, and 10⁶ top pairs can be contemplated. The search for rare phenomena will be discussed, including in particular: flavor changing neutral currents, violations of universality, invisible and exotic Higgs and Z decays, and the possibility to discover the existence of heavy sterile neutrinos.

Neutrino Physics / 849

The GERDA Experiment for the Search of Neutrinoless Double Beta DecayMr. BENATO, Giovanni¹¹ *University of Zurich***Corresponding Author:** gbenato@physik.uzh.ch

The search for neutrinoless double beta decay ($0\nu\beta\beta$) is playing since two decades a major role in astroparticle physics.

The discovery of this process would demonstrate the violation of lepton number conservation and the presence of a Majorana term in the neutrino mass.

The GERmanium Detector Array (*{sc{gerda}}*) experiment, located at the Gran Sasso underground laboratory in Italy,

is one of the leading experiments for the search of $0\nu\beta\beta$ decay in ^{76}Ge .

The first data taking (Phase I) took place between November 2011 and June 2013.

With a $\approx 21\text{~kg} \cdot \text{yr}$ exposure and a background index (BI) at $\{\text{Q}_{\beta\beta}\}$ -of $1.1 \cdot 10^{-2} \text{~cts}/(\text{kg} \cdot \text{yr} \cdot \text{keV})$ after pulse shape discrimination, *{sc{gerda}}*-Phase I set a limit on the $0\nu\beta\beta$ decay half life of $T_{1/2}^{0\nu} > 10^{25}\text{~yr}$ ($90\% \text{~mathrm{C.L.}}$).

The setup is now being upgraded for the Phase II of the experiment. A final sensitivity on $0\nu\beta\beta$ decay half life

up to $2 \cdot 10^{26}\text{~yr}$ can be obtained with an exposure of $100\text{~kg} \cdot \text{yr}$ and a BI of $10^{-3} \text{~cts}/(\text{kg} \cdot \text{yr} \cdot \text{keV})$.

The main strategies for reaching this are the use of the newly developed Broad Energy Germanium detectors (BEGe),

with enhanced energy resolution and pulse shape discrimination capabilities,

and the installation of an active veto in the liquid argon surrounding the germanium crystals for the recognition of external background events.

In this talk, a review of the *{sc{gerda}}*-Phase I results will be given, followed by a report on the ongoing operations for the preparation of Phase II.

Neutrino Physics / 851

Heavy neutrino hunting in Higgs- and Z decays at high luminosity Higgs and Z factory.BLONDEL, Alain¹¹ *UNIGE***Corresponding Author:** alain.blondel@cern.ch

With the discovery of the Higgs $H(126)$ boson at the LHC, the Standard Model of particle physics is still lacking an understanding of the generation and nature of neutrino masses. Dirac mass term? Majorana mass term? The favorite theoretical scenario is that both mass terms are present, leading to the existence of heavy partners of the light neutrinos, presumably more massive and nearly sterile. For suitable choices of parameters the heavy neutrinos can serve as good candidates for dark matter, and generate the baryon asymmetry of the universe. These heavy neutrinos can be searched for at high energy lepton colliders of very high luminosity, such as the Future $e+e-$ Circular Collider, FCC-ee, presently studied within Future Circular Collider study at CERN as a possible first step. A first look at sensitivities both from neutrino counting and from search for heavy neutrino decay will be presented.

Heavy Ions / 852**Exclusive two-photon production of W-pairs in heavy-ion and proton-proton collisions**Prof. NYSTRAND, Joakim¹; Mr. DJUVSLAND, Oystein¹¹ *University of Bergen***Corresponding Author:** joakim.nystrand@ift.uib.no

The strong electromagnetic fields surrounding the protons and heavy nuclei accelerated at the CERN Large Hadron Collider may be used to study two-photon and photon-proton/nucleus interactions at unprecedented energies. A process of particular interest is two-photon production of pairs of W bosons. This process is sensitive to the coupling between photons and W bosons, and may therefore be used to probe in particular any anomalous quartic WW $\gamma\gamma$ coupling. The experimental feasibility of studying this process has recently been shown by the CMS experiment.

In this presentation, we calculate the expected standard model cross section for this process. The strong absorption is treated in a realistic way to properly exclude interaction where the projectiles interact hadronically. In addition, the polarization of the W and how it affects the angular distribution of its decay products is investigated. These two effects have to our knowledge not been considered in previous calculations. They are found to be essential for the calculation of the production cross section and for the expected yield within an experimentally accessible phase space region.

Poster Session / 853**Overview of FCC-ee physics**BLONDEL, Alain¹¹ *UNIGE***Corresponding Author:** alain.blondel@cern.ch

As part of the Future Circular Collider study at CERN, the Future e+e- Circular Collider, FCC-ee, (formerly called TLEP) is a new generation collider, able to fit in a 80 to 100km tunnel, and able to deliver high luminosity in up to four interaction points from at least the Z peak to above the top pair threshold. The luminosity at the Z pole, W pair and top threshold are over 2.5, 1.2 10^{35} and 1.8 10^{34} /cm²/s in each of four interaction points, respectively allowing to contemplate statistics of over 10^{12} Z decays 10^8 W pairs and 10^6 top quark pairs. This leads to several independent ways of extracting the strong coupling constant α_S with a precision of the order of 0.0001, with different theoretical and experimental assumptions and model dependencies.

Neutrino Physics / 855

The need for an early anti neutrino run for NOvA

Prof. UMASANKAR, Sankagiri ¹; Dr. PRAKASH, Suprabh ²; Mr. RAHAMAN, Ushak ¹

¹ *Indian Institute of Technology Bombay*

² *Harish-Chandra Research Institute*

Corresponding Author: uma@phy.iitb.ac.in

The moderately large value of θ_{13} , measured recently by reactor experiments, is very welcome news for the future neutrino experiments. In particular, the NOvA experiment, with 3 years of neutrino run followed by an equal anti-neutrino run, will be able to determine the mass hierarchy if one of the following two favourable combinations is true:

normal hierarchy with the CP phase in the lower half plane or inverted hierarchy with the CP phase in the upper half plane.

In this report, we study the hierarchy reach of the first 3 years of NOvA data.

Since $\sin^2(2\theta_{23})$ is measured to be non-maximal, θ_{23} can be either in the lower or higher octant.

Pure neutrino data is affected by θ_{13} -hierarchy and octant-hierarchy degeneracies, which limit the hierarchy sensitivity of such data. A combination of neutrino and anti-neutrino data is not subject to these degeneracies and hence has much better hierarchy discrimination capability.

We find that, with a 3 year neutrino run, hierarchy determination is possible for only two of the four octant-hierarchy combinations. Equal 1.5 year runs in neutrino and anti-neutrino modes give good hierarchy sensitivity for all the four combinations.

Heavy Ions / 856**Ultra-peripheral heavy-ion collisions with ALICE and CMS**Dr. TAPIA TAKAKI, Daniel ¹¹ *The University of Kansas***Corresponding Author:** daniel.tapia.takaki@cern.ch

Protons and ions accelerated by the LHC carry an electromagnetic field, which acts as a source of photons. The beam energy at the LHC makes it the most energetic photon source ever built. The interaction of such high-energy photons with nuclei (or protons) can be studied in ultra-peripheral heavy-ion collisions, where the impact parameter is larger than the sum of the nuclear radii and hadronic interactions are therefore strongly suppressed.

Both the ALICE and CMS collaborations have studied photonuclear production of vector mesons in ultra-peripheral Pb-Pb and p-Pb collisions. The process effectively corresponds to an interaction between a photon, generated from the electromagnetic field of one of the nuclei with the other (target) nucleus. The ALICE Collaboration has already published results on exclusive photoproduction of J/ψ mesons at mid and forward rapidities in Pb-Pb collisions. The cross section for this process is particularly sensitive to the nuclear gluon distribution.

In this talk, the latest results from ALICE and CMS on exclusive production of light and heavy vector mesons in ultra-peripheral Pb-Pb collisions will be presented, as well as the measurement of exclusive heavy vector meson photoproduction off protons in ultra-peripheral p-Pb collisions at $\sqrt{s_{\text{NN}}} = 5.02$ TeV. Exclusive photoproduction of quarkonia is a powerful tool to search for parton saturation effects. Although gluon saturation is expected to occur at some scale to limit the growth of the Parton Distribution Function (PDF) at low Bjorken- x values, no compelling evidence for this effect has been found so far. ALICE results provide direct tests of the power law dependence on the J/ψ photoproduction cross section over a wide range of γp energies. CMS results on quarkonia photoproduction in p-Pb will also be presented. The prospects for future analyses on ultra-peripheral collisions at the highest LHC energy will also be discussed.

Lattice QCD / 857

Fits and Related Systematics for the Hadronic Vacuum Polarization on the LatticePERIS, Santiago ¹; AUBIN, Christopher ²; BLUM, Tom ³; GOLTERMAN, Maarten ⁴; MALTMAN, Kim ⁵¹ *U. Autonoma de Barcelona, Spain*² *Fordham Univ., USA*³ *Univ. of Connecticut, USA*⁴ *San Francisco State Univ., USA*⁵ *York Univ., Canada***Corresponding Author:** peris@ifae.es

(See Attached file.)

In order to test the systematic error coming from the extrapolation at low Q^2 carried out in present lattice determinations of the hadronic vacuum polarization contribution to the muon anomalous magnetic moment, we employ a physically motivated model for the isospin-one non-strange vacuum polarization function $\Pi(Q^2)$ [1]. The model is based on the OPAL experimental vector-channel spectral function for energies below the τ mass and a successful parametrization, including perturbation theory and a model for quark-hadron duality violations, for higher energies. Using the same covariance matrix and Q^2 values as in a recent lattice simulation, we then generate fake data for $\Pi(Q^2)$. The fake data is then used to extrapolate to low Q^2 and evaluate the hadronic vacuum polarization contribution to the muon anomalous magnetic moment, after which the result is compared to the exact model value. From this comparison we unravel a systematic error much larger than the few-percent total error sometimes claimed for such extractions in the literature. We find that errors deduced from fits using a Vector Meson Dominance ansatz are misleading, typically turning out to be much smaller than the actual discrepancy between the fit and exact model results. The use of a sequence of multipoint Pade approximants appears to provide a safer fitting strategy [2]. Alternatively, the use of one-point Pades based on the coefficients of the Taylor expansion of $\Pi(Q^2)$ at $Q^2=0$ could also prove effective, as recently emphasized in Ref. [3], but only if these coefficients are accurately known, not only for the s,c quarks but also for u and d .

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Poster Session / 858

Measurement of CP and CPT violation parameters in heavy-flavor decays at the D0 experiment

D0 COLLABORATION, et al.¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present two recent measurements of direct CP-violation parameters in charm meson decay, using 10.4 fb⁻¹ of proton-antiproton collisions collected by the D0 detector during Run II at the Fermilab Tevatron Collider. We extract the asymmetry in decay widths for the positively and negatively charged cases of $D_s \rightarrow \phi \pi$ (with $\phi \rightarrow K^+K^-$) and $D \rightarrow K \pi \pi$. In both cases, we determine the raw charge asymmetry by simultaneous fits of the appropriate invariant mass distribution. We then correct for detector asymmetries using data-driven methods, and account for any possible asymmetries from CP-violation in B meson decays using simulation, to determine the underlying direct CP-violation parameters. In both cases, we report world-leading precision on these quantities. In addition, we test for Lorentz invariance by extracting the semileptonic mixing asymmetry in B_s^0 mesons, a_{sl}^s as a function of sidereal time, and fitting the resulting distribution to an oscillatory model. We search for detector-related asymmetries using a periodogram method, and set world-leading limits on relevant CPT-violation parameters.

Flavour Physics / 860

B_s^0 lifetime measurements from the D0 experiment

D0 COLLABORATION, et al.¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present new lifetime measurements of B mesons, using 10.4 fb⁻¹ of proton-antiproton collisions collected by the D0 detector during Run II at the Fermilab Tevatron Collider. We report an update of the B_s^0 lifetime in semi-inclusive flavor-specific decays $B_s^0 \rightarrow \mu \nu D_s X$ (and charge conjugate). We account for the missing energy from the neutrino and other possible undetected decay products using simulation. The same analysis also determines the B^0 lifetime in the corresponding decay mode $B^0 \rightarrow \mu \nu D^- X$ and from these two measurements, we report the most precise extraction of the lifetime ratio $\tau(B_s^0)/\tau(B^0)$, which agrees with lattice QCD predictions. In addition, we analyse the fully-reconstructed CP-odd decay $B_s^0 \rightarrow J/\psi f_0(980)$, and extract the lifetime of this B_s^0 state, which is associated with the heavy mass eigenstate in the absence of CP violation. We perform a multi-dimensional unbinned fit of the mass, lifetime, and lifetime uncertainty, and account for contamination from several peaking backgrounds close to the signal mass range.

Flavour Physics / 861

The impact of power corrections on $B \rightarrow K^* \mu \mu$ observables

Dr. HOFER, Lars ¹; Prof. MATIAS, Joaquim ²; Dr. VIRTO, Javier ³; Dr. DESCOTES-GENON, Sébastien ⁴

¹ *IFAE Barcelona*

² *Universitat Autònoma de Barcelona*

³ *Universitat Autònoma de Barcelona - IFAE*

⁴ *LPT Orsay (CNRS/Univ. Paris-Sud 11)*

Corresponding Author: lhofer@ifae.es

The exclusive decay $B \rightarrow K^* \mu \mu$ has gained a lot of attention because the recent LHCb angular analysis has indicated significant deviations from the Standard Model which could be interpreted as a possible first signal of new physics. The sensitivity of theory predictions to hadronic input parameters can be minimized by choosing an optimized set of observables. On the other hand, non-perturbative $\Lambda_{\text{QCD}}/\text{mb}$ power corrections introduce a source of uncertainty for theory predictions as they cannot be calculated from first principles. In my talk I will present a systematic approach to estimate factorizable power corrections and discuss their impact on angular observables.

Neutrino Physics / 864

Recent results from the ICARUS experiment

Prof. GIBIN, Daniele ¹

¹ *Dipartimento di Fisica ed Astronomia "G. Galilei" e INFN sezione di Padova*

Corresponding Author: daniele.gibin@pd.infn.it

ICARUS is the largest liquid Argon TPC detector ever built (~600 ton LAr mass). It was smoothly operated underground at the LNGS laboratory in Gran Sasso since summer 2010, up to June 2013, collecting data with the CNGS beam and with cosmics. Liquid argon TPCs are really "electronic bubble chambers" providing a completely uniform imaging and calorimetry with unprecedented accuracy on massive volumes.

ICARUS is internationally considered as a milestone towards the realization of next generation of massive detectors (~tens of ktons) for neutrino and rare event physics. It permits as a unique feature the unambiguous identification of ν_e events. In particular the experimental search for a ν_e signal in the LSND anomaly region in the CNGS beam will be here presented with an updated statistics with respect to the published one. The published result strongly limits the window of opened options for the LSND anomaly, reducing the remaining effect to a narrow region centred around $(\Delta m^2, \sin^2(2\theta)) = (0.5 \text{ eV}^2, 0.05)$ where there is an over-all agreement (90% CL) between the present ICARUS limit, the published limits of KARMEN and the published positive signals of LSND and MiniBooNE collaborations. There is tension between our limit and the neutrino lowest energy points of MiniBooNE with $200 < E_{\nu} < 475$ MeV, suggesting an instrumental or otherwise unexplained nature of the low energy signal reported by MiniBooNE. This relevant parameter region will be fully explored by a proposed dual detector experiment to be performed at a short baseline and low neutrino energies which increase the event rate, reduce the overall multiplicity of the events, enlarge the angular range and therefore substantially improve the ν_e selection efficiency.

Poster Session / 865

KM3NeT: R and technical solutions for the next generation underwater neutrino telescope

Dr. CHIARUSI, Tommaso¹

¹ *INFN - Sezione di Bologna*

Corresponding Author: tommaso.chiarusi@bo.infn.it

The KM3NeT Collaboration aims at constructing a multi-km³ neutrino telescope in the Mediterranean Sea, exploiting the Cherenkov emission of relativistic charged particles in water. The detector will consist of a three-dimensional array of large-diameter pressure-resistant digital optical modules (DOMs), each equipped with 31 photomultipliers with 3" photocatode diameter. The DOMs are attached to vertical structures called detection units. Although the standard DOM density is optimized for the measurement of astrophysical neutrinos, the same technology can also be used to construct more densely instrumented detectors, as investigated in the ORCA sub-project targeting a measurement of the neutrino mass hierarchy with atmospheric neutrinos. The KM3NeT project will be implemented in three subsequent phases, increasing the telescope size from about 0.1 km³ (phase 1) to 1 km³ (phase 1.5) and finally to several km³ (phase 2).

Construction in phase 1 will start at two installation sites (40 km offshore Toulon, France at a depth of 2500 m; 80 km offshore Capo Passero in Sicily, at a depth of 3500 m); a third site offshore Pylos, Greece is expected to join in the next phase. The deployment of the first prototype detection unit, composed of only 3 DOMs is planned by May 2014, in the Capo Passero site. In this contribution we present all the key features of the detector, reviewing the DOM performance, the organization of the sea-floor network infrastructure, the strategies for deploying, connecting and calibrating the detection units, the trigger and data acquisition system and the computing model adapted.

Poster Session / 867

Optimization of neutrino fluxes for future long baseline neutrino oscillation experiment

Dr. DI LUISE, Silvestro ¹

¹ *ETH Zurich*

Corresponding Author: silvestro.di.luise@cern.ch

We present an optimization of the neutrino beam which could be produced at CERN and aimed to the newly proposed deep-underground neutrino observatory LAGUNA-LBNO.

The main goals of LAGUNA-LBNO, a next-generation long-baseline neutrino and antineutrino oscillation experiment, are to discover CP-violation in the leptonic sector (CPV) and determine the neutrino mass hierarchy.

In particular LAGUNA-LBNO aims to attain a unique sensitivity to CPV through the exploration of the first and second oscillation maxima.

This implies that the neutrino beam line must be able to provide neutrinos whose energy distribution is fairly uniform from the sub-GeV region up to several GeV's.

The need of a wide-band neutrino beam represents an extremely challenging requirement as focusing through a magnetic horn is, by principle, effective for narrow-band neutrino beam where the ideal energy distribution is peaked around one oscillation maximum.

A novel algorithm has been then developed to search for the optimal configuration of the beam line with respect to a generic figure of merit, for example the discovery potential for the CPV and/or the mass hierarchy.

The procedure relies on an analytical parametrization of the horns shapes and the figure of merit is maximized through a stochastic search within the multidimensional space of the design parameters of the beam line elements: primary beam, target, focusing system (e.g.: horn-reflector layout), decay pipe.

For a given beam line layout the expected neutrino flux energy distribution is obtained by means of a full GEANT4 simulation of the primary proton beam interaction in the target, the secondary hadrons focusing system and the decay pipe.

Specific scenarios for the proton driver and the far detectors have been investigated. For different CERN SPS proton beam energy and baseline sensitivity limits will be presented as a function of the beam exposure and the far detector fiducial mass.

It is worth noting that the proposed method, applied to the LAGUNA-LBNO physics searches, it is conceived to be used for the optimal beamline design determination of any future long baseline neutrino oscillation experiment.

Strong Interactions and Hadron Physics / 869**Searching for extremely rare W decays at the LHC**Dr. MELIA, Tom¹¹ CERN**Corresponding Author:** thomas.melia@cern.ch

A gigantic number of W bosons will be produced by the LHC during its lifetime, opening up the possibility of making the first measurements of some extremely rare decay modes of this particle. The decay $W \rightarrow \pi \gamma$ has been previously searched for at LEP and the Tevatron, and these experiments already placed limits on the branching ratio approaching the standard model prediction, which is in the range $\sim 10^{-6}$ to $\sim 10^{-8}$. I will discuss the theoretical issues and motivation for the observation of this and similar decays of the W boson, and present an estimate of the LHC reach for these measurements.

Lattice QCD / 871**Volume (in-)dependence for SU(N) gauge theories with twisted boundary conditions**Dr. KOREN, Mateusz¹; Prof. GONZALEZ-ARROYO, Antonio²; Prof. GARCIA-PEREZ, Margarita²; Prof. OKAWA, Masanori³¹ Instituto de Física Teórica UAM/CSIC² IFT UAM/CSIC³ Graduate School of Science, Hiroshima University**Corresponding Author:** mateusz.koren@csic.es

We analyze 2+1 dimensional Yang-Mills theory regularized on a lattice. We employ twisted boundary conditions in the spatial directions and show, using both perturbation theory and non-perturbative simulations, that the physical quantities depend only on the combination NL/b and the magnetic flux given by the twist (N is the number of colors, L the length of the spatial torus and b is the inverse 't Hooft coupling). In this talk we extend the previous analyses to the glueball sector. Finally, extension to 3+1 dimensions and theories with fermions is discussed.

Poster Session / 874**Electromagnetic Polarizabilities of Mesons**Dr. ALEKSEJEVS, Aleksandrs¹; Dr. BARKANOVA, Svetlana²¹ Grenfell Campus of Memorial Univeristy² Acadia University**Corresponding Author:** aaleksejevs@grenfell.mun.ca

The Chiral Perturbation Theory (ChPT) has been tremendously successful in describing low-energy hadronic properties in the non-perturbative regime of Quantum Chromodynamics.

The results of ChPT, many of which are currently under active experimental investigation, provide stringent predictions of many fundamental properties of hadrons, including quantities such as electromagnetic polarizabilities. Yet, even for the simplest hadronic system, a pion, we still have a broad spectrum of polarizability measurements (MARK II, VENUS, ALEPH, TPC/2g, CELLO, Belle, Crystal Ball). The meson polarizability can be accessed through Compton scattering, so we can measure it through Primakoff reaction. The talk will provide a detailed analysis of the ChPT predictions of the SU(3) meson electromagnetic polarizabilities and outline their relationship to the Primakoff cross section at the kinematics relevant to the planned JLab experiments.

Strong Interactions and Hadron Physics / 875**Vector Boson + jets production at the Tevatron**D0 COLLABORATION, et al.¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

Studies of associated production of a vector bosons with heavy quarks (b/c) provide important tests of perturbative quantum chromodynamics calculations, important constraints on parton distribution functions, and good understanding of major backgrounds in Higgs studies and searches for new phenomena. We present several measurements of vector boson with heavy quark processes production at the Tevatron experiments, CDF and D0. We present measurements of W+bX and W+cX production and the ratio of Z+bb(bar) to Z+ jets production using Run 2 Tevatron data collected by the D0 detector. The measurements are performed for the integrated acceptance as well differentially as a function of leading jet transverse momenta. We also present first measurements of the cross section of photon plus bottom quark pair production in proton-antiproton collisions at $\sqrt{s}=1.96$ TeV using Tevatron data collected by the D0 experiment as well as the ratio of cross sections for photon plus two b-quark jets to photon plus b-jets production as a function of photon transverse momentum. We present the first measurements of W/Z+c production at low c-quark pT ($p_T < 15$ GeV) by measuring the cross-section ratios of $\sigma(W+D^*)/\sigma(W)$ and $\sigma(Z+D^*)/\sigma(Z)$ in the W/Z leptonic decay channels, for $p_T(D^*) > 3$ GeV with data collected by the CDF detector. We also present a search for Upsilon(1S) production in association with a vector boson using data collected by the CDF detector, providing the best cross-section limits for these processes and also providing a guide to limits on new physics processes producing an Upsilon+W/Z. In all cases, results are compared to current theory calculations as well as predictions from Monte Carlo generators.

Poster Session / 876**Measurement of cross section for direct photon pair production in association with dijet events at the Tevatron**D0 COLLABORATION, et al.¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present the first measurement of the cross section for direct photon pair production in association with dijet events in proton-antiproton collisions at $\sqrt{s}=1.96$ TeV. We also determine the fraction of events with hard double parton (DP) scattering in a single proton-antiproton collision. Aside from the stringent test of the perturbative QCD predictions, diphoton + dijet production provides an important test of various models of multiple parton interactions.

Poster Session / 877

FCC-ee accelerator parameters, performance and limitationsKORATZINOS, Michael ¹¹ *Univ. of Geneva***Corresponding Author:** m.koratzinos@cern.ch

Now that the masses of the Higgs and Top quark are known, circular electron-positron colliders, able to measure the properties of these particles with high accuracy, are receiving considerable attention. As part of the Future Circular Collider study at CERN, the Future e+e- Circular Collider, FCC-ee (formerly called TLEP) is a new generation collider, fitting in a 80 to 100km tunnel, and able to deliver high luminosity in up to four interaction points from the Z peak to above the top pair threshold.

The performance potential of such circular machines, their main limitations and the latest set of parameters of FCC-ee will be presented. Beamstrahlung will get a special mention as its mitigation is an important factor in modern high-luminosity colliders. The potential for polarization will be discussed in some detail, as it is a challenge due to long natural polarization times in such large circumference rings.

Poster Session / 878

Non-diagonal charged lepton mass matrix, the TBM and non-zero θ_{13} .Ms. ROJAS, Alma ¹¹ *IFIC, Universidad de Valencia***Corresponding Author:** alma.drp@gmail.com

After the experimental confirmation of the non-zero value of θ_{13} , the most useful ansatz for the lepton mixing matrix, the tribimaximal (TBM) mixing matrix, requires deviations coming possibly from the charged lepton sector to take into account the non-zero value of this mixing angle.

Then, assuming that the neutrino mixing matrix is diagonalized by the TBM, i.e. $U_{\nu}=U_{\text{TBM}}$, we looked for the charged lepton mass matrix textures which render a $U_{\text{PMNS}}=U_{\ell}^{\dagger}U_{\nu}$ lepton mixing matrix consistent with data, being U_{ℓ} the charged lepton mixing matrix.

We were interested in the textures with the maximum number of zeros, so, we explored the cases of real matrices with three and four zeros and found which of them provide solutions in agreement with data. We present the successful Yukawa textures including the relative sizes of their non-zero entries. Moreover, we found some interesting relations among the entries of these textures in terms of the charged lepton masses.

Accelerator Physics and Future Colliders / 879

Design to Realization of the International Linear Collider: ILCProf. YAMAMOTO, Akira ¹¹ *KEK/CERN***Corresponding Author:** akira.yamamoto@kek.jp

The International Linear Collider (ILC) has been proposed for a next generation, energy frontier, e+e- colliding accelerator. The Technical Design Report (TDR) was published in 2013, and the project is getting into the transition of the "Design to Realization" stage. The report will describe the ILC accelerator design and technology as well as future prospect of the project anticipated to be hosted in Japan and to be realized with a global cooperation project.

Education and Outreach / 880

Questions and answers on extreme energy cosmic rays: A guide to explore the public data set of the Pierre Auger Observatory

Dr. ESPÍRITO SANTO, Catarina ¹; Dr. ANDRINGA, Sofia ¹; Mr. DIOGO, Francisco ¹; Prof. ABREU, Pedro ²

¹ *LIP*

² *LIP and IST*

Corresponding Author: abreu@lip.pt

The Pierre Auger Observatory is the largest extensive air shower detector, covering 3000 km² in Argentina. The observatory makes available, for educational and outreach purposes, 1% of its cosmic ray data set, which after 10 year of running corresponds to more than 30000 cosmic ray events. Several different proposals of education activities have been developed within the collaboration and are available. We will focus on the activity guide we developed with the aim of exploring the rich education and outreach potential of cosmic rays with Portuguese high-school students.

In this guide we use the Auger public data set as a starting point to introduce open questions on the origin, particle type and spectrum of high energy cosmic rays. To address them, the students learn about the air-shower cascade development, data reconstruction and its statistical analysis.

The guide has been used both in the context of student summer internships at research labs and directly in schools, under the supervision of trained teachers and in close collaboration with Auger researchers. It is now available in Portuguese, English and Spanish.

Astroparticle Physics and Cosmology / 881

Astrophysical Neutrinos with the IceCube Detector

KIRYLUK, Joanna ¹; COLLABORATION, The IceCube ²

¹ *Stony Brook University*

² *The IceCube Neutrino Observatory*

Corresponding Author: joanna.kiryluk@stonybrook.edu

The IceCube Neutrino Observatory at the South Pole has powerful capabilities to explore the universe. Two of its primary goals are to observe cosmic neutrinos with TeV energies and above, and to find astrophysical sources of ultra high energy cosmic rays. IceCube is comprised of a cubic kilometer of glacial ice instrumented with 86 vertical strings, each with 60 optical sensors deployed at depths between 1450 and 2450 meters, and a square kilometer array at the surface. The sensors detect Cherenkov radiation from charged particles produced in all flavors of neutrino interactions in the ice. This talk will focus on the latest IceCube results from searches for high energy astrophysical neutrinos, including the first detection of PeV neutrinos, the highest energy neutrinos detected to date. Evidence will be presented that IceCube has observed, for the first time, a diffuse neutrino flux consistent with an astrophysical origin. This will be followed by an outlook and plans to extend the detector capabilities at highest energies.

Neutrino Physics / 882**Supernovae Neutrinos: Oscillation and Phenomenology.**Dr. CHAKRABORTY, Sovan ¹¹ *Max plank for Physics***Corresponding Author:** sovan@mpp.mpg.de

Supernovae (SN) are one of the highest energetic astrophysical events. Almost all the enormous energy (10^{53} ergs) released during such an event is emitted in terms of neutrinos. These neutrinos while free streaming out of the SN will undergo flavor oscillations. Apart from the usual MSW oscillations the SN neutrinos will have nonlinear flavor evolution due to neutrino-neutrino interactions. These oscillations can generate unique signatures under different oscillation scenarios. Thus opening the possibility of rich phenomenology in the earth based neutrino detectors for a future galactic SN burst. Moreover, the absence of such a galactic event in near future will increase the importance of detecting the diffuse background of neutrinos from all past supernovae. Detection of such a relic background of SN neutrinos will push the frontier of astrophysical neutrinos to cosmic distances.

Top-quark and ElectroWeak Physics / 883**New Physics Search with Precision Experiments: Theory Input**Dr. ALEKSEJEVS, Aleksandrs ¹; Dr. BARKANOVA, Svetlana ²; Dr. ZYKUNOV, Vladimir ³¹ *Grenfell Campus of Memorial Univeristy*² *Acadia University*³ *Belarussian State Univeristy of Transport***Corresponding Author:** svetlana.barkanova@acadiau.ca

The best way to search for new physics is by using a diverse set of probes - not just experiments at the energy and the cosmic frontiers, but also the low-energy measurements relying on high precision and high luminosity.

One example of ultra-precision experiments is MOLLER planned at JLab, which will measure the parity-violating electron-electron scattering asymmetry and allow a determination of the weak mixing angle with a factor of five improvement in precision over its predecessor, E-158. At this precision, any inconsistency with the Standard Model should signal new physics. Another promising new physics probe, Belle II experiment at SuperKEKB, will study low-energy electron-positron collisions at high luminosity.

The talk will outline the recent developments of the theoretical and computational approaches to higher-order electroweak effects needed for the accurate interpretation of experimental data, and show how new physics particles enter at the one-loop level. For MOLLER and Belle II, we analyze the effects of Z'-boson and dark photon on the total calculated cross section and asymmetry, and show how these hypothetical interactions carries may influence the future experimental results.

Beyond the Standard Model / 884**Testing SUSY models for the muon $g-2$ anomaly at LHC**Dr. DAS, Siba Prasad ¹; Prof. ROY, D.P. ²; Prof. GUCHAIT, Monoranjan ³¹ *IOP, Bhubaneswar, India*² *Homi Bhabha's Centre for Science Education, TIFR, V. N. Purav Marg, Mumbai-400088, India*³ *TIFR, Mumbai, India***Corresponding Author:** spdas@iopb.res.in

Non-universal gaugino mass models can naturally account for the dark matter relic density via the bulk annihilation process with relatively light Bino LSP and right sleptons in the mass range of ~ 100 GeV, while accommodating the observed Higgs boson mass of ~ 125 GeV with TeV scale squark/gluino masses. A class of these models can also account for the observed muon $g-2$ anomaly via SUSY loops with wino and left sleptons in the mass range of 400 - 600 GeV. These models can be tested at LHC via electroweak production of charged and neutral wino pair, leading to robust trilepton and same sign dilepton signals. We investigate these signals along with the standard model background for both 8 and 13 TeV LHC runs.

Poster Session / 885**A single Higgs-like interacting scalar field and the role of late-time acceleration in BICEP2 data**Dr. VERMA, Murli ¹¹ *University of Lucknow***Corresponding Author:** sunilmmv@yahoo.com

It is proposed that a single Higgs-like tachyonic cosmological scalar field generates the late-time acceleration of the universe due to interaction among its components. It is found that the B-mode polarization can also be obtained from the tensor perturbations arising from the present acceleration. This may contribute to the relatively high value of the tensor-to-scalar ratio $r \sim 0.2$ observed by BICEP2 recently. In our proposal, there appears an extra contribution to this ratio, in addition to that caused by the early inflation. A further proposal is made for the gravitational wave detector at the LHC to detect the tensor perturbations in the spacetime near the compact high energy density spots due to beam collision.

Poster Session / 887**The $S(3)$ Flavour Symmetry: Quarks and Leptons**Dr. GONZALEZ-CANALES, Felix ¹¹ *IFIC-CSIC Universidad de Valencia***Corresponding Author:** felix.gonzalez@ific.uv.es

We discuss the masses and mixings of Quarks and leptons as the realization of an $S(3)$ flavour permutational symmetry. In this model the flavour $S(3)$ symmetry is left unbroken and the concept of flavour is extended to the Higgs sector by introducing in the theory three Higgs fields which are $SU(2)$ doublets. The mass matrices of fermions are reparametrized in terms of their eigenvalues, and explicit analytical expressions for the flavour mixing angles are obtained. If the masses of the three right handed neutrinos are assumed to be different, non-degenerate, then it is possible to get a numerical value for the rector mixing angle, θ_{13} , in very good agreement with the last experimental data, including the results of the experiments Daya Bay and RENO. We also show the branching ratios of some selected flavour changing neutral currents (FCNC) process.

Astroparticle Physics and Cosmology / 888**Recent Results of the ANTARES Neutrino Telescope**

Dr. DE BONIS, Giulia ¹; THE ANTARES COLLABORATION, ANTARES ²

¹ *INFN*

² *ANTARES*

Corresponding Author: giulia.debonis@roma1.infn.it

The discovery of cosmic neutrinos of astrophysical origin by IceCube has started a new chapter in the field of Neutrino Astronomy and has officially initiated the neutrino era in high-energy astrophysics. Noticeably, a small accumulation of events in the region near the Galactic Centre has been observed: a telescope in the Mediterranean Sea constitutes a great opportunity for the physics quest, since it offers a perfect complementarity to IceCube and, in particular, a better visibility of the Galactic Centre.

ANTARES (Astronomy with a Neutrino Telescope and Abyss Environmental RESearch) is the first operational Cherenkov neutrino telescope in the Mediterranean Sea and the largest neutrino detector in the Northern hemisphere, covering an area of about 0.1 km²; located ~40 km offshore Toulon, France, at a depth of 2475m, it has been completed in June 2008 and it is currently taking data. It consists of a tri-dimensional array of 885 photo-multipliers tubes (PMTs), distributed in 12 lines.

ANTARES has recently performed a search for an excess of high energy neutrinos in the direction of the Galactic Centre, close to the accumulation of the IceCube events. The results of this search will be presented, together with other achievements of the experiment, for instance the search for point-like and extended neutrino sources and

the search for neutrino emission from the Fermi bubbles. A key attention is given to the multi-messenger approach, by looking for correlations of neutrinos with GeV/TeV gamma-rays, charged cosmic rays and gravitational waves from astrophysical objects.

Results on the indirect search for dark matter will be presented in a separated contribution.

ANTARES offers a first view of the Neutrino Sky from the Mediterranean and its results makes more compelling the expectations for the next generation experiment, KM3NeT.

Poster Session / 889

Light neutrino mass spectrum with one or two right-handed singlet fermions addedDr. JURCIUKONIS, Darius¹; Dr. GAJDOSIK, Thomas²; Dr. JUODAGALVIS, Andrius¹¹ Vilnius University Institute of Theoretical Physics and Astronomy² Vilnius University, Physics Faculty**Corresponding Author:** darius.jurciukonis@tfai.vu.lt

Neutrino oscillation experiments showed that neutrinos have tiny but non-zero masses. The seesaw mechanism is the most fruitful explanation of the light neutrino masses and mixings, which connects the tiny neutrino masses with heavy right-handed neutrino masses. After spontaneous symmetry breaking of the Standard Model gauge group one obtains a $(n_L+n_R)\times(n_L+n_R)$ Majorana mass matrix M_{ν} for the neutrinos. The mixing between the n_R right-handed singlet fermions and the neutral parts of the n_L lepton doublets gives masses to the neutrinos which are of the size expected from neutrino oscillations.

The diagonalization of the mass matrix gives rise to a split spectrum consisting of heavy and light states of neutrinos given by $U^T M_{\nu} U = \text{diag}(m^{\{\text{light}\}}_{n_L}, m^{\{\text{heavy}\}}_{n_R})$. We analyse two cases of the minimal extension of the Standard Model when one or two right-handed fields are added to the three left-handed fields. A second Higgs doublet is included in our model.

We calculate the one-loop radiative corrections to the mass parameters which produce mass terms for the neutral leptons. In both cases we numerically analyse light neutrino masses as functions of the heavy neutrino masses. Parameters of the model are varied to find light neutrino masses that are compatible with experimental data of solar Δm^2_{sol} and atmospheric Δm^2_{atm} neutrino mass differences for normal and inverted hierarchy. We choose values for the parameters of the tree-level by numerical scans, where we look for the best agreement between computed and experimental neutrino oscillation angles. Different mixing angles between the Higgs fields give different mass spectra of light neutrinos and different distributions of neutral Higgs masses.

Heavy Ions / 891

Soft probes of the QGP: Pb-Pb and p-Pb CMS resultsMEYER, Arnd¹¹ RWTH Aachen University**Corresponding Author:** meyera@cern.ch

Measurements of soft particle production probe the collectivity of the medium created in heavy-ion collisions. This presentation focuses on measurements of two- and multi-particle angular correlations in pPb and PbPb collisions. Particular emphasis is placed on studies of long-range correlations in high multiplicity pPb collisions.

Heavy Ions / 892

Jets and high-pT probes of the QGP in CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Jet studies provide experimental means to explore the details of parton-medium coupling and the energy loss mechanisms in QCD matter. In this talk an overview of recent jet and high-pT measurements from 2.76 TeV PbPb and pp collisions with the CMS detector will be presented. Additionally, the latest CMS jet results from pPb collisions at 5.02 TeV will be discussed in the context of initial state effects in jet measurements.

Heavy Ions / 893

Heavy-quark and quarkonia probes of the QGP in CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Quarkonia are especially relevant for studying the quark-gluon plasma since they are produced at early times of the collision and propagate through the medium, mapping its evolution. This talk presents measurements of quarkonia in pp and PbPb collisions at 2.76 TeV and in pPb collisions at 5.02 TeV.

Heavy Ions / 894

Electroweak probes in Pb-Pb and p-Pb collisions at CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

The electroweak bosons are insensitive to final state effects in heavy-ion collisions and thus make excellent probes of the initial state parton distributions in nuclei. This talk presents measurements of photons and weak bosons, via their leptonic decay channels, in pp and PbPb collisions at 2.76 TeV and in pPb collisions at 5.02 TeV.

Poster Session / 895

Simulations of Minimum Bias Events and the Underlying Event using different PDFs: Tuning resultsDr. FIRDOUS, Nameeqa¹; Prof. RUDOLPH, Gerald¹¹ *University of Innsbruck***Corresponding Author:** nameeqa@gmail.com

Minimum bias and underlying event data from the LHC and Tevatron have been used to tune the PYTHIA 6.4.28. We tune Multiple Parton Interaction (MPI) parameters including three Lambda parameters. It is shown that these tunings describe selected distributions quite well, especially pt distribution at three collision energies, 0.9 TeV, 1.9 TeV and 7 TeV provided that charge particles with $p_T > 500\text{MeV}$ are used. Results are presented using three types

of Parton Density Functions (PDFs) of proton : leading order (LO), modified leading order (LO*) and next-to-leading order (NLO). We found that all three types of PDFs can describe minimum bias and underlying event distributions equally well.

Poster Session / 896

 τ hadronic spectral function moments in a nonpower QCD perturbation theoryDr. ABBAS, Gauhar¹; Prof. ANANTHANARAYAN, B.²; Prof. CAPRINI, Irinel³; Prof. FISCHER, Jan⁴¹ *IFIC, Valencia*² *IISc Bangalore*³ *Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN HH), Bucharest - Magurele, Romania*⁴ *Institute of Physics, Academy of Sciences of the Czech Republic, CZ-182 21 Prague 8, Czech Republic***Corresponding Author:** abbas.gauhar@gmail.com

The moments of the hadronic spectral functions are of interest for the extraction of the strong coupling α_s and other QCD parameters from the hadronic decays of the τ lepton. Motivated by the recent analyses of a large class of moments in the standard fixed-order and contour-improved perturbation theories, we consider the perturbative behavior of these moments in the framework of a QCD nonpower perturbation theory, defined by the technique of series acceleration by conformal mappings, which simultaneously implements renormalization-group summation and has a tame large-order behavior. Two recently proposed models of the Adler function are employed to generate the higher order coefficients of the perturbation series and to predict the exact values of the moments, required for testing the properties of the perturbative expansions. We show that the contour-improved nonpower perturbation theories and the renormalization-group-summed nonpower perturbation theories have very good convergence properties for a large class of moments of the so-called "reference model", including moments that are poorly described by the standard expansions. The results provide additional support for the plausibility of the description of the Adler function in terms of a small number of dominant renormalons.

Poster Session / 897

Investigation of phenomenological approaches implemented in PYTHIA6 to describe multiple parton interactions

Dr. FIRDOUS, Nameeqa¹; Prof. RUDOLPH, Gerald¹

¹ *University of Innsbruck*

Corresponding Author: nameeqa@gmail.com

Soft hadronic interactions are modeled in PYTHIA6 using phenomenological adaptation of QCD to describe non perturbative pp processes. We studied the MPI, lambda treatment, matter distribution and color reconnection models using best fit to minimum bias data published by ATLAS experiment at two center of mass energies 0.9 TeV and 7TeV.

Poster Session / 898

A parameter study of Pythia6 MPI model using LHC data

Dr. FIRDOUS, Nameeqa¹; Prof. RUDOLPH, Gerald²

¹ *University of Innsbruck*

² *University of Innsbruck*

Corresponding Author: nameeqa@gmail.com

A parameter study of PYTHIA6 Multiple Parton Interaction (MPI) using best fit to the data published by ATLAS Collaboration is presented. Altogether thirteen parameters are investigated to find the most sensitive parameters to the selected data. This type of study helps in better understanding of different parameters needed to be used in PYTHIA6 tunes.

Heavy Ions / 899

Electroweak probes in heavy-ion collisions at the LHC with ATLAS

ATLAS, Collaboration¹

¹ *CERN*

Corresponding Author: lroos@lpnhe.in2p3.fr

Measurements of vector boson production in Pb+Pb collisions provide essential control data for studies of jets and jet quenching in the quark gluon plasma. Because the electroweak bosons do not interact strongly in the plasma measurements their production rates can be predicted using standard high-energy event generators. In addition, the vector boson spectra are potentially sensitive to nuclear parton distribution functions. Results will be presented for measurements of photon, Z, and W^{+/-} production in Pb+Pb and proton-Pb collisions. The measurements will be compared to predicted rates from JETPHOX (for photons) and POWHEG (for Z and W).

Poster Session / 900

The VISPA Internet Platform for Students - A Professional Analysis Environment in the Lecture Hall

FISCHER, Robert ¹; GLASER, Christian ¹; MÜLLER, Gero ¹; QUAST, Thorben ¹; RIEGER, Marcel ¹; URBAN, Martin ¹; ASSELDONK, Daniel van ¹; ERDMANN, Martin ¹

¹ *III. Physikalisches Institut A, RWTH Aachen*

Corresponding Author: robert.fischer@cern.ch

The VISPA internet platform enables users to remotely run simple Python scripts or complex analysis chains and view resulting plots or inspect their output data. With a standard web browser as the only user requirement on the client-side, the system becomes suitable for e-learning / blended learning approaches for university physics students.

VISPA was used in two consecutive years each by approx. 100 third year's physics students at RWTH Aachen University for their homework assignments. For example, in one exercise students gained a deeper understanding of Einstein's mass-energy equivalence by analyzing experimental data of electron-positron pairs revealing J/Psi and Z particles in proton-proton collisions with public data from LHC experiments.

Because the students were free to chose their working hours, the access to the platform was spread over the course of a week with only few simultaneous users at a time. The positive feedback from students and the stability of the platform lead to further development of the concept. This year, students will access the platform in parallel while they analyze the data recorded by demonstrated experiments live in the lecture hall.

The platform is based on experience in the development of professional analysis tools. It combines core technologies from previous projects: an object-oriented C++ library, a modular data-driven analysis flow, and visual analysis steering.

We present the platform and discuss its benefits in the context of teaching based on surveys that are conducted each semester.

Reference: <http://iopscience.iop.org/0143-0807/35/3/035018/>

Accelerator Physics and Future Colliders / 901

Prospects of high energy photon colliders

Prof. TELNOV, Valery ¹

¹ *Budker INP and Novosibirsk Univ.*

Corresponding Author: telnov@inp.nsk.su

High energy photon colliders ($\gamma\gamma, \gamma e$) based on Compton scattering of laser photons on high energy electrons are considered for many years as a natural option for e^+e^- linear colliders. Photon colliders can study New Physics at energies and statistics similar to those in e^+e^- collisions—but in different reactions. In some cases, photon colliders provide access to higher masses or allow the study of some phenomena with higher precision. They do not need positron and damping rings are not absolutely needed as well. In addition to photon colliders at ILC and CLIC the discovery of the Higgs boson has triggered several proposals of photon collider Higgs factories based on recirculation linacs in rings (incl. HERA and Tevatron tunnels). In this talk, following a brief discuss of physics motivation, technological aspects and photon colliders based on ILC and CLIC, I give a critical overview of the recently proposed photon-collider Higgs factories.

Poster Session / 903

Searches for new Resonances with Dielectrons, Dimuons or Electron-Muon Pairs at CMSMEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Searches for new massive resonances that decay to dielectrons, dimuons or electron-muon pairs are presented. Resonances in the dielectron and dimuon decay channels arise in many well established theories beyond the standard model, like the sequential standard model or grand unified theories. The search in the electron-muon channel opens the field for theories where the lepton number is not conserved. Such theories include lepton flavour violating Z' models, R-parity violating SUSY or quantum black hole models. The searches use the full dataset collected by the CMS experiment in 2012 from pp collisions at a center-of-mass energy of 8 TeV, and corresponding to about 20 /fb. In absence of a significant deviation from the standard model predictions, 95% confidence level limits are calculated on cross sections or cross section ratios. For several models lower limits on the resonance mass are derived and a sequential standard model Z' _SSM and a superstring-inspired Z' _psi lighter than 2960 GeV and 2600 GeV respectively can be excluded at 95% confidence level.

Neutrino Physics / 904

Core-Collapse Supernova Neutrino DetectionSCHOLBERG, Kate ¹¹ *Duke University***Corresponding Author:** schol@phy.duke.edu

This talk will briefly survey the capabilities of current detectors sensitive to supernova neutrino bursts. It will then cover recent progress in development of supernova neutrino detection techniques as well as prospects for specific future experiments.

Astroparticle Physics and Cosmology / 905

Sommerfeld enhancements and relic abundance of neutralino dark matter in the general MSSMDr. RUIZ-FEMENIA, Pedro ¹; Prof. BENEKE, Martin ²; Mrs. HELLMAN, Charlotte ³¹ *IFIC, Valencia*² *TU Munich RWTH Aachen*³ *TU Munich***Corresponding Author:** pedro.ruiz@ific.uv.es

We discuss the calculation of Sommerfeld enhancements on the neutralino LSP relic abundance calculation for heavy neutralino dark matter including co-annihilations of nearly mass-degenerate neutralino and chargino states. A newly developed EFT framework enables us to consider for the first time all (off)-diagonal potential and annihilation matrices including P- and next-to-next-to-leading order S-wave effects for a generic MSSM parameter space point, and to treat effects from heavy states perturbatively. To investigate the impact of the enhanced cross sections on the predicted neutralino relic abundance we identify interesting regions of parameter space. We discuss the different features of these regions, focusing in particular on heavy wino- and higgsino-like dark matter and models interpolating between the two scenarios.

Poster Session / 906**Flavour constraints on SO(10) extended GMSB models**Dr. JELINSKI, Tomasz ¹¹ *University of Silesia***Corresponding Author:** tomasz.jelinski@us.edu.pl

It is known that superpotential couplings between messenger sector and MSSM matter fields can significantly change phenomenology of the standard GMSB models. Those interactions not only give rise to A-terms and soft masses but also can lead to large FCNC effects. In this talk, we shall discuss examples of SO(10) unification models in which messengers couple to all generations of MSSM matter and confront predictions of such scenarios with low-energy flavour observables. Emerging constraints on messengers couplings will be presented.

Strong Interactions and Hadron Physics - Board 1 / 907**Tevatron Energy Scan: Findings & Surprises**Prof. FIELD, Rick ¹¹ *Florida***Corresponding Author:** boj@fnal.gov

We present results from a recent CDF study of min-bias collisions (MB) and the "underlying event" (UE) using charged particles produced in proton-antiproton collisions at 300 GeV, 900 GeV, and 1.96 TeV. The 300 GeV and 900 GeV data are a result of the "Tevatron Energy Scan" which was performed just before the Tevatron was shut down. The direction of the leading charged particle in each event, P_{Tmax} , is used to define three regions of eta-phi space; "toward", "away", and "transverse". The "transverse" region is further divided into the "transMAX" and "transMIN" contributions. The "transMIN" region is very sensitive to the MPI & BBR components of the UE, while the "transDIF" region ("transMAX" minus "transMIN") is more sensitive to the ISR & FSR. The data are corrected to the particle level and are compared with LHC data at 900 GeV and 7 TeV. This CDF analysis together with LHC UE data provides detailed information about the energy dependence of the various components of the UE which tests the UE models and constrain their parameters, allowing for more precise predictions at 13 TeV and 14 TeV.

Top-quark and ElectroWeak Physics / 909**A measurement of the electro-weak mixing angle and an indirect measurement of the W mass at CDF**Prof. BODEK, Arie ¹; Dr. SAKUMOTO, Willis ¹¹ *University of Rochester***Corresponding Author:** boj@fnal.gov

We report on precision measurements of the electro-weak mixing angle and an indirect measurement of the W mass extracted from the forward-backward asymmetry of both $e+e-$ and $\mu+\mu-$ Drell-Yan events in the Z boson mass region at CDF.

Poster Session / 911

A change of perspective in quarkonium production: all data are equal, but some are more equal than others

Dr. LOURENCO, Carlos¹

¹ *CERN*

Corresponding Author: carlos.lourenco@cern.ch

Quarkonium polarization data, usually considered a difficult challenge for the QCD description of quarkonium production and relegated to an a posteriori test of predictions exclusively driven by cross-section measurements (with puzzling results), provide in reality the most fundamental, direct and model-independent connection to the production mechanisms. Simultaneously fitting charmonium and bottomonium differential cross sections and polarizations, reliably measured at the LHC up to higher transverse momentum (p_T) values than ever before, as a superposition of colour-singlet and colour-octet contributions perturbatively calculated up to next-to-leading order, we see that all the measurements are very well reproduced, except for the lowest p_T cross-section data, where factorization between short-distance and long-distance QCD effects is not expected to be applicable. Besides providing a straightforward solution to the so-called quarkonium polarization puzzle (a 19-year-old problem), our study shows that quarkonium production is completely dominated by the unpolarized $1S0$ octet term, a very interesting and unexpected observation that opens a new and surprisingly simple path towards the understanding of hadron formation in QCD.

Poster Session / 912

The ECHo neutrino mass experiment

Dr. GASTALDO, Loredana ¹; Prof. BLAUM, Klaus ²; Prof. LAHIRI, Susanta ³; Dr. MAITI, Moumita ⁴; Mr. DOERR, Andreas ²; Prof. NOVIKOV, Yuri ⁵; Mr. RANITZSCH, Philipp, C.-O. ⁶; Mr. RICHTER, Sven ⁷; Mr. SCHNEIDER, Fabian ⁷; Dr. SCHOLL, Stephan ⁸; Prof. SIMKOVIC, Fedor ⁹; Dr. STORA, Thierry ¹⁰; Dr. FLEISCHMANN, Andreas ¹¹; Dr. SZUCS, Zoltan ¹²; Dr. TAKACS, Sandor ¹²; Prof. TUERLER, Andreas ¹³; Mr. DORRER, Holger ¹⁴; Mr. WEGNER, Mathias ¹¹; Prof. WENDT, Klaus ⁷; Prof. DUELLMANN, Christoph E. ¹⁵; Dr. EBERHARDT, Klaus ¹⁶; Dr. ELISEEV, Sergey ²; Prof. ENSS, Christian ¹¹; Mr. HASSEL, Clemens ¹¹; Prof. FAESSLER, Amand ¹⁷; Mr. FILIANIN, Pavel ⁵; Prof. JOCHUM, Josef ⁸; Dr. JOHNSTON, Karl ¹⁸; Dr. KEMPF, Sebastian ¹¹; Dr. KOESTER, Ulli ¹⁹; Prof. KRIVORUCHENKO, Mikhail ²⁰; Mr. KRON, Tobias ⁷

¹ *Kirchhoff Institute for Physics, Heidelberg University*

² *Max-Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117, Heidelberg Germany*

³ *Saha Institute of Nuclear Physics, 1/AF Bidhannagar, 700064 Kolkata, India*

⁴ *Department of Physics, Indian Institute of Technology Roorkee, Roorkee-247667, India*

⁵ *Petersburg Nuclear Physics Institute, 188300 Gatchina, Russia*

⁶ *Kirchhoff Institute for Physics, Heidelberg University, INF 227 D-69120 Heidelberg, Germany*

⁷ *Institut fuer Physik, Johannes Gutenberg-Universitaet Mainz, Staudingerweg 7, D - 55128 Mainz*

⁸ *Kepler Center for Astro and Particle Physics, University of Tuebingen, Auf der Morgenstelle 14, 72076 Tuebingen – Germany*

⁹ *Department of Nuclear Physics and Biophysics, Comenius University, Mlynska dolina, pav. F1; SK-84248 Bratislava, Slovakia*

¹⁰ *CERN, Physics Department, 1211 Geneva 23, Switzerland*

¹¹ *Kirchhoff-Institute for Physics, Heidelberg University, INF 227 D-69120 Heidelberg, Germany*

¹² *Institute of Nuclear Research of the Hungarian Academy of Sciences, 4026 Debrecen, Bem ter 18/C, Hungary*

¹³ *Laboratory for environmental and radiochemistry, Paul Scherrer Institut, 5232 Villigen, Switzerland Department for Chemistry and Biochemistry, University of Bern, 3012 Bern, Switzerland*

¹⁴ *Laboratory for environmental and radiochemistry, Paul Scherrer Institut, 5232 Villigen, Switzerland*

¹⁵ *Institute for Nuclear Chemistry, Johannes Gutenberg University, Fritz Strassmann Weg 2, D- 55128, Mainz, Germany, GSI Helmholtzzentrum fuer Schwerionenforschung, Planckstraße 1, 64291, Darmstadt, Germany, Helmholtz Institute Mainz, Johann-Joachim-Becherweg 36, 55128 Mainz, Germany*

¹⁶ *Institute for Nuclear Chemistry, Johannes Gutenberg University, Fritz Strassmann Weg 2, D- 55128, Mainz, Germany, Helmholtz Institute Mainz, Johann-Joachim-Becherweg 36, 55128 Mainz, Germany*

¹⁷ *Institute for Theoretical Physics, University of Tuebingen, Auf der Morgenstelle 14; D-72076 Tuebingen, Germany*

¹⁸ *Technische Physik, Universitaet des Saarlandes, 66041 Saarbruecken; CERN, Physics Department, 1211 Geneva 23, Switzerland*

¹⁹ *Institut Laue-Langevin, Grenoble, France*

²⁰ *Institute for Theoretical and Experimental Physics, B. Chermushkinskaya 25, 117259 Moscow, Russia*

Corresponding Author: loredana.gastaldo@kip.uni-heidelberg.de

The Electron-Capture-¹⁶³Ho experiment, ECHo, aims to investigate the electron neutrino mass in the sub-eV range by means of the analysis of the calorimetrically measured electron capture spectrum of ¹⁶³Ho. Arrays of low temperature metallic magnetic calorimeters having the ¹⁶³Ho source embedded in the absorber will be used for the measurement of the spectrum. A precise description of the expected spectrum will be achieved by theoretical calculations in parallel with dedicated experimental investigations. Independent measurements of the QEC-value will be performed using high precision Penning traps. For the QEC measurements as well as for the calorimetric measurement of the ¹⁶³Ho spectrum, high purity ¹⁶³Ho sources will be produced. Detailed studies of the background and of methods to reduce it will be performed in order to increase the sensitivity of the calorimetric measurement to the effect of a non-zero electron neutrino mass.

A pilot experiment consisting of about 100 detectors grouped in arrays which are read out with the microwave multiplexing technique is under preparation. The activity per pixel will be between 1 and 10 Bq. With one year of measuring time the ECHo experiment will be able to improve the limit on the electron neutrino mass by one order of magnitude.

Poster Session / 913**Measuring the Properties of the Higgs Boson at CMS**MEYER, Amd¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

After the announcement of a 125 GeV particle by the ATLAS and CMS collaborations on July 04, 2012, it became very important to study all the properties of this new particle (Higgs Boson). Measurements of the properties of the Higgs boson with a mass near 125 GeV will be presented. The results are based on data samples corresponding to integrated luminosities of up to 5.1/fb at 7 TeV and up to 19.6/fb at 8 TeV in proton-proton collisions at the LHC. The combined result for the measured mass, the best-fit signal for all the channels and different fits for couplings, using all the studied Higgs boson decay modes, will be described. We will also present the results obtained from the measurement of double ratios i.e. ratio of the branching ratios between different decay modes.

Poster Session / 914**SoLid: Search for Oscillations with Lithium-6 Detector at the SCK•CEN BR2 reactor**Dr. YERMIA, Frederic¹; Dr. VACHERET, Antonin²¹ *SUBATECH CNRS/Université de Nantes/EMN*² *Oxford University***Corresponding Author:** yermia@subatech.in2p3.fr

Sterile neutrinos have been considered as a possible explanation for the recent reactor and Gallium anomalies arising from reanalysis of reactor flux and calibration data of previous neutrino experiments. A way to test this hypothesis is to look for distortions of the anti-neutrino energy caused by oscillation from active to sterile neutrino at close stand-off (~ 6-8m) of a compact reactor core. Due to the low rate of anti-neutrino interactions the main challenge in such measurement is to control the high level of gamma rays and neutron background. The SoLid experiment is a proposal to search for active-to-sterile anti-neutrino oscillation at very short baseline of the SCK•CEN BR2 research reactor in Belgium.

This experiment uses a novel approach to detect anti-neutrino with a highly segmented detector based on Lithium-6. With the combination of high granularity, high neutron-gamma discrimination using ⁶LiF:ZnS(Ag) and precise localization of the Inverse Beta Decay products, a better experimental sensitivity can be achieved compared to other state-of-the-art technology. This compact system requires minimum passive shielding allowing for very close stand off to the reactor. The experimental set up of the SoLid experiment and the BR2 reactor will be presented. The new principle of neutrino detection and the detector design with expected performance will be described. The expected sensitivity to new oscillations of the SoLid detector as well as the first measurements made with the 8 kg prototype detector deployed at the BR2 reactor in 2013-2014 will be reported.

Heavy Ions / 915

Heavy-quark and quarkonia probes of the QGP at the LHC with the ALICE detector

CONESA DEL VALLE, Zaida¹¹ *IPN Orsay (CNRS/IN2P3 - Université Paris-Sud)***Corresponding Author:** zconesa@in2p3.fr

The experimental laboratory to create and study strongly interacting matter under extreme conditions of temperature and energy density are ultra-relativistic heavy-ion collisions. A transition of hadronic matter to a Quark Gluon Plasma (QGP) phase is predicted by lattice Quantum ChromoDynamics for high enough temperatures. Heavy quarks (charm and beauty) and quarkonia are produced in the early stages of the interaction and probe the entire medium evolution. Their production has been measured in heavy-ion collisions at the LHC with the ALICE detector.

Open heavy-flavour production is affected by heavy-quark in-medium energy loss. Heavy-flavour hadron spectra are modified in the most central Pb--Pb collisions at a centre-of-mass energy $\sqrt{s_{NN}}=2.76$ TeV per nucleon--nucleon pair, with respect to those of pp collisions at the same energy. The second harmonic of the azimuthal distribution Fourier decomposition, v_2 , of heavy-flavour hadrons is positive for non-central collisions at intermediate transverse momentum, suggesting that heavy quarks take part in the system collective motion.

A small fraction of heavy quarks ends up forming quarkonia (J/ψ , ψ' , Υ). The inclusive p_T -integrated J/ψ yield is suppressed in the most central Pb--Pb collisions at $\sqrt{s_{NN}}=2.76$ TeV, with respect to that of pp collisions at the same energy. The comparison of these results with the measurements performed at RHIC energies, suggests that mechanisms for both breaking-up or recombining the heavy-quark bound states are at play at the LHC. The measurements of heavy-flavour hadrons in p--Pb collisions at $\sqrt{s_{NN}}=5.02$ TeV demonstrate that the medium modifications observed in Pb-Pb collisions are not dominated by effects due to the presence of cold nuclear matter but have to be attributed to genuine effects due to the formation of a hot and dense QGP phase.

Heavy-flavour hadron measurements with the ALICE detector will be presented. The results in Pb--Pb and p--Pb collisions at $\sqrt{s_{NN}}=2.76$ TeV and 5.02 TeV, respectively, will be discussed.

Detector RD and Performance / 916**High-Rate Capable Floating Strip Micromegas Detector**

Mr. BORTFELDT, Jonathan ¹; BIEBEL, Otmar ¹; RUSCHKE, Alexander ¹; PARODI, Katia ²; ZIBELL, André ³; BENDER, Michael ¹; DANGER, Helge ¹; FLIERL, Bernhard ¹; HERTENBERGER, Ralf ¹; LÖSEL, Philipp ¹; MOLL, Samuel ¹; MÜLLER, Ralph ¹; RINALDI, Ilaria ⁴

¹ *LMU Munich*

² *LMU Munich, Heidelberg University Hospital*

³ *University Würzburg*

⁴ *Heidelberg University Hospital, LMU Munich*

Corresponding Author: jonathan.bortfeldt@physik.uni-muenchen.de

We report on the development of novel discharge insensitive floating strip Micromegas (MICRO-MESH GASEOUS) detectors, fit for use in high-energy muon spectrometers. The suitability of these detectors for particle tracking is shown in high-background environments and at very high particle fluxes up to 60MHz/cm².

Measurement and simulation of the microscopic discharge behavior demonstrate the excellent discharge tolerance. A floating strip Micromegas with an active area of 48cm x 50cm with 1920 copper anode strips exhibits in 120GeV pion beams a spatial resolution of 50µm at detection efficiencies above 95%. Pulse height, spatial resolution and detection efficiency are homogeneous over the detector. Reconstruction of particle track inclination in a single detector plane is discussed, optimum angular resolutions below 5° are observed. Systematic deviations of this µTPC-method are fully understood.

The reconstruction capabilities for minimum ionizing muons are investigated under intense background irradiation of 550kHz 20MeV protons. An influence on the performance is only observed for temporally and spatially coincident muon and background signals.

A 6.4cm x 6.4cm floating strip Micromegas doublet with low material budget is investigated in highly ionizing proton and carbon ion beams at particle rates between 2MHz and 2GHz. Stable operation up to the highest rates is observed, spatial resolution, detection efficiencies, the multi-hit and high-rate capability will be discussed.

BEH Physics / 917**Interference effects of neutral Higgs bosons in the MSSM**

Ms. FUCHS, Elina ¹; Prof. WEIGLEIN, Georg ¹

¹ *DESY*

Corresponding Author: elina.fuchs@desy.de

The interpretation of the Higgs signal within the MSSM requires precise theoretical predictions including mixing and higher-order effects. In case of nearby resonances in the Higgs sector, interference effects may be relevant. However, the interference term is neglected by the standard narrow-width approximation (NWA), which is in other respects a convenient tool for the factorisation of a more complicated process into production and subsequent decay of a particle with a small width compared to its mass.

Hence, a generalisation of the usual NWA is analysed which allows for a consistent treatment of interference effects between nearly mass-degenerate particles. This can be useful for the application to processes for which the factorisation into different sub-processes is essential to enable the computation of higher-order contributions.

Phenomenological consequences of interference effects between neutral MSSM Higgs bosons will be presented for an example process of Higgs boson production and its subsequent decay including one-loop corrections. To validate the generalised NWA, the factorised version will be compared to the calculation of the complete process at the one-loop level. Furthermore, full Higgs propagator mixing will be examined in comparison to the Breit-Wigner approximation.

BEH Physics / 918**Effective Higgs Couplings Extraction in the 4 lepton channel at the LHC: surprises and prospects**Mr. CHEN, Yi ¹; Prof. SPIROPULU, Maria ¹; Dr. VEGA-MORALES, Roberto ²; Dr. LYKKEN, Joe ³¹ *Caltech*² *LPT Orsay*³ *FNAL***Corresponding Author:** smaria@caltech.edu

Kinematic distributions in Higgs decays to four charged leptons, the so called "golden channel", are a powerful probe of the tensor structure of its couplings to neutral electroweak gauge bosons. We discuss a comprehensive analysis framework designed to perform direct extraction of the all possible Higgs couplings. In this framework we study the sensitivity of the four lepton final state, to higher dimensional loop-induced couplings of the Higgs boson to ZZ , $Z\gamma$, and $\gamma\gamma$, allowing for general CP mixtures. We present the results of these studies and the impact on handles for studying CP violation in the Higgs sector.

Neutrino Physics / 919**Hyper-Kamiokande: A next generation neutrino observatory to search for CP violation in the lepton sector**Mr. TANAKA, hirohisa ¹¹ *UBC/IPP***Corresponding Author:** tanaka@phas.ubc.ca

Hyper-Kamiokande (Hyper-K), a proposed one-megaton water cherenkov detector to be built in Japan, is the logical continuation of the highly successful program of neutrino (astro)physics and proton decay using the water Cherenkov technique. Hyper-K will search for CP violation in neutrino oscillations associated with the irreducible phase δ in the lepton mixing matrix using the neutrino beam produced at J-PARC. With an exposure of $7.5 \text{ MW} \times 10^7$ seconds, δ can be measured to better than 19 degrees at all values, and CP violation can be detected with more than 3 sigma significance for 76% of values of δ . In addition to the search for neutrino CP violation, Hyper-K will offer a broad program of neutrino astrophysics, including continued studies of atmospheric neutrinos and the detection of neutrinos produced in supernovae as far as the Andromeda Galaxy. It will also extend the sensitivity to proton decay, an incontrovertible sign of new physics and grand unification, by an order of magnitude.

Astroparticle Physics and Cosmology / 920**First Results from POLARBEAR CMB Polarization Experiment**NISHINO, Haruki ¹¹ *Kavli IPMU***Corresponding Author:** haruki.nishino@ipmu.jp

A large number of Cosmic Microwave Background (CMB) polarization experiments have been searching for the CMB B-mode polarization signatures, which were produced either in degree scales by primordial gravitational waves from the epoch of cosmic inflation or in sub-degree scales by gravitational lensing by cosmological large-scale structure. POLARBEAR is a ground-based experiment designed to measure CMB B-mode polarizations at both angular scales at the Atacama desert in Chile and started observing in the early 2012 at 150 GHz with an array of 1,274 polarization sensitive antenna-couple Transition Edge Sensor bolometers with a beam size of 3.5 arcminutes. In the first season observations, POLARBEAR focused on measuring the polarization signals in the small angular scales and detected gravitational lensing with the CMB polarization data alone for the first time. The first results from the first season observations of POLARBEAR are presented in this talk.

Neutrino Physics / 921**Short-baseline neutrino physics at Fermilab**Dr. SCHMITZ, David ¹¹ *University of Chicago***Corresponding Author:** dwschmitz@uchicago.edu

The existing Booster Neutrino Beam (BNB) and the exceptional reconstruction capabilities of the liquid argon TPC detector technology provide an opportunity to execute a world-leading short-baseline neutrino physics program at Fermilab. The MicroBooNE detector, located 470m from the beamline target, is set to begin operation in 2014. The Liquid Argon Near Detector, LAr1-ND, is a proposed new detector to be located 100m from the target. LAr1-ND will provide a detailed characterization of the intrinsic content of the BNB, allowing for a near-to-far extrapolation between the two detectors and enabling precision searches for neutrino oscillations. We will present the capabilities of this program to resolve existing experimental anomalies within neutrino physics or to observe evidence for eV mass-scale sterile neutrinos through neutrino appearance and disappearance channels. The important role this short-baseline program plays in the continued development of the LArTPC technology for long-baseline neutrino experiments in the future will also be described.

Accelerator Physics and Future Colliders / 922**ATF2 for final focus test beam for future linear colliders**Dr. KURODA, Shigeru ¹¹ *KEK***Corresponding Author:** shigeru.kuroda@kek.jp

International Linear Collider(ILC) adopt local chromaticity correction scheme in the final focus system. ATF2 is a project to test the performance of the ILC final focus system experimentally. A new test beam line was constructed downstream of ATF Damping Ring(DR) in KEK in 2008. Though the energy is as low as 1.3GeV while 250 GeV for the ILC, low emittance beam is available from the DR. The optics is designed by scaling ILC optics, and the goal of the beam size is about 40nm. In this talk, the recent results of the study is reported.

Top-quark and ElectroWeak Physics / 923**Two-Loop Effects in Low-Energy Electroweak Measurements**

Dr. ZYKUNOV, Vladimir ¹; Dr. BARKANOVA, Svetlana ²; Dr. ALEKSEJEVS, Aleksandrs ³

¹ *Belarussian State University of Transport*

² *Acadia University*

³ *Grenfell Campus of Memorial Univeristy*

Corresponding Author: zykunov@cern.ch

The talk will outline the recent results on the two-loop electroweak contributions to the electron-electron scattering cross sections and asymmetries.

Of course, the two-loop corrections are strongly suppressed relative to the one-loop corrections, but they still contribute a few percent to the cross section, and even this small contribution cannot be ignored at for ultraprecision experiments such as MOLLER planned at JLab.

The NNLO calculation techniques we developed for the electron-electron scattering can be adapted for electron-proton processes, electron-positron collisions, and other low-energy experiments involving leptons.

Detector RD and Performance / 924**The ATLAS Forward Proton (AFP) detector**

Dr. RIJSSENBEEK, Michael ¹

¹ *Stonybrook*

Corresponding Author: cristobal.padilla@cern.ch

The ATLAS Forward Proton (AFP) is a project to upgrade the ATLAS experiment with additional 3-D silicon detectors, placed at ± 206 and ± 214 meters on both sides of the ATLAS experiment, allowing measurements of the forward protons scattered diffractively or electromagnetically and with the remarkable capability to tag and measure both protons in exclusive central diffractive/elmg processes. The use of precision timing detectors allows this type of physics to be pursued to high luminosity for the first time.

The AFP project opens up an important new window on LHC physics not available with the existing ATLAS detector. The AFP physics programme will be discussed, including soft diffraction, hard inclusive diffraction, exclusive diffraction and exotics studies in two-photon exchange processes. The experimental challenges in constructing this detector as well as the status of the project will be discussed

Poster Session / 925**Physics Reach of ICAL at INO**

Prof. AGARWALLA, Sanjib Kumar ¹

¹ *Institute of Physics, Bhubaneswar, India*

Corresponding Author: sanjib@iopb.res.in

The upcoming Iron Calorimeter (ICAL) detector at the India-based Neutrino Observatory (INO) cavern aims to explore the Earth's matter effect by observing the energy and zenith angle dependence of the atmospheric neutrinos in the multi-GeV range. Due to its charge identification capability using a magnetic field, the ICAL detector can study neutrino and anti-neutrino events separately. The design of ICAL is primarily optimized to measure muon momentum, however it is also capable of measuring the hadron energy in each event. These features are crucial to identify the neutrino mass hierarchy and to improve the precision on the atmospheric neutrino mixing parameters. I will elaborate on these issues and present the latest physics simulation results of the ICAL experiment.

Poster Session / 926

POLARBEAR-2 - a new CMB polarization receiver for exploring the physics of inflation and neutrino mass

Dr. HASEGAWA, MASAYA ¹¹ KEK

Corresponding Author: masaya.hasegawa@kek.jp

POLARBEAR-2 (PB-2) is a new receiver system that will be deployed on the Simons Array telescope platform in early 2015 alongside the current observing POLARBEAR-1 receiver for Cosmic Microwave Background (CMB) polarization measurements. The science goals of PB-2 are to characterize the B-mode (curl component) signal both at large and small angular scales with unprecedented precision. The polarization data on large angular scale can be used for quantitative studies on inflation, such as the reconstruction of the energy scale of inflation and the consistency relation of scalar and tensor perturbations under the single-field slow-roll condition. The small angular scale data are an excellent tracer of large-scale structure in the universe, and can be used to constrain the sum of the neutrino masses. The projected statistical error is 40 meV with PLANCK temperature data (90meV with PB-2 data alone). In this talk, we describe the scientific objectives, system requirements, and instrument design. The status of receiver development will also be presented.

Poster Session / 927

Development of silicon-tungsten electromagnetic calorimeter for ILD

Dr. BALAGURA, Vladislav ¹; Dr. YOSHIOKA, Tamaki ²¹ LLR² Kyushu University

Corresponding Author: balagura@cern.ch

The best jet energy resolution required for precise physics measurements at ILC is achievable using a Particle Flow Algorithm (PFA) and highly granular calorimeters. As it was shown by CALICE international R collaboration, the silicon-tungsten imaging electromagnetic calorimeter provides the best granularity, stability and jet resolution. After proving the PFA concept with physical prototypes in 2006-2011, an emphasis is now moved to building a technological prototype satisfying challenging physical, mechanical, electronic and thermal requirements. All chosen technologies should be reliable and scalable for a mass production of a future detector. We report on the current status of R, in particular, on beam, cosmic and charge injection tests of the technological prototype and on the tests of ECAL mechanical structure with embedded fiber Bragg grating optical sensors. We also report on our plans to build a realistic almost full-scale prototype detector of 1-1.5 m length and test it together with an existing 600 kg carbon fiber - tungsten mechanical structure in 2015 at CERN beams.

A similar silicon-tungsten technology has been recently proposed for the Phase 2 upgrade of CMS endcap calorimeter, and for the TLEP (CERN) and the CEPC (Beijing) future high energy circular collider projects. The required changes in ILD ECAL technology are also discussed.

Poster Session / 928

The minimal 3+2 neutrino model versus Higgs decaysDr. JONES-PEREZ, Joel¹; Prof. HERNANDEZ, Pilar²; Prof. GAGO, Alberto³; Prof. LOSADA, Marta⁴; Dr. MORENO, Alexander⁴¹ *Universitat de Valencia - IFIC*² *University of Valencia*³ *PUCP*⁴ *UAN***Corresponding Author:** joel.jones@uv.es

The minimal 3+2 neutrino model is a Type-I seesaw model with two Weyl fermions, singlets under the Standard Model. Apart from light neutrino masses and mixings, this model can be fully described by four additional parameters.

In this work, we study the minimal 3+2 neutrino model in scenarios where the singlets have masses at the GeV scale. This can lead to Higgs decays into heavy neutrinos, which would be observable at the LHC.

Neutrino Physics / 929

Minimal SO(10) unification at two loopsDr. MALINSKY, Michal¹¹ *Charles University in Prague***Corresponding Author:** malinsky@ipnp.troja.mff.cuni.cz

I will review the current status of the minimal SO(10) GUT and comment on the new results of a dedicated two-loop analysis and their phenomenological implications, focusing, in particular, on the complementarity of the constraints from the LHC physics and those from the future proton decay searches.

Poster Session / 930

"Physical parameters of the cosmological electroweak crossover"Ms. D'ONOFRIO, Michela¹; Prof. RUMMUKAINEN, Kari¹; Prof. TRANBERG, Anders²¹ *Helsinki University*² *University of Stavanger***Corresponding Author:** michela.donofrio@helsinki.fi

We use large-scale lattice simulations to compute the rate of baryon number violating processes (the sphaleron rate), the Higgs field expectation value, and the critical temperature in the Standard Model across the electroweak phase transition temperature.

While there is no true phase transition between the high-temperature symmetric phase and the low-temperature broken phase, the cross-over is sharply defined at $T_c = (159 \pm 1) \text{ GeV}$. The sphaleron rate in the symmetric phase ($T > T_c$) is $\Gamma/T^4 = (18 \pm 3) \alpha_W^5$, and in the broken phase in the physically interesting temperature range $130 \text{ GeV} < T < T_c$ it can be parametrized as $\log(\Gamma/T^4) = (0.83 \pm 0.01) T / \text{GeV} - (147.7 \pm 1.9)$.

The freeze-out temperature in the early Universe, where the Hubble rate wins over the baryon number violation rate, is $T_* = (131.7 \pm 2.3) \text{ GeV}$. These values, beyond being intrinsic properties of the Standard Model, are relevant for e.g. low-scale leptogenesis scenarios.

Strong Interactions and Hadron Physics / 931**Impact of PDFs at LO, NLO and NNLO with correlated uncertainties between orders using HERAFitter**Dr. RADESCU, Voica¹; Dr. PLACAKYTE, Ringaile¹¹ DESY**Corresponding Author:** voica@mail.desy.de

We present the HERAFitter project which provides a framework for Quantum Chromodynamics (QCD) analyses related to the proton structure in the context of multi-processes and multi-experiments.

Based on the concept of factorisable nature of the cross sections into universal parton distribution functions (PDFs) and process dependent partonic scattering cross sections, HERAFitter allows determination of PDFs from the various hard scattering measurements.

Here we report a set of parton distribution functions determined with the HERAFitter program using HERA data and preserving correlations between uncertainties for the LO, NLO and NNLO sets. The sets are used to study uncertainties for ratios of cross sections at LHC calculated at different order in QCD. A reduction of overall theoretical uncertainty is observed in this case.

Poster Session / 932**COMPASS polarized target for pion-induced Drell-Yan experiment**Dr. FINGER, Michael¹; Prof. FINGER, Miroslav¹; Mr. MATOUSEK, Jan¹; Mr. PESEK, Michael¹¹ Charles University in Prague**Corresponding Author:** miroslav.finger@cern.ch

The Drell-Yan (DY) process is considered to be a powerful tool to study hadron structure. A new generation of polarized DY measurements using unpolarized pion beam and polarized target is under the preparation at COMPASS experiment at CERN. One of the key experimental tasks here is the modification of the unique COMPASS low temperature polarized target for Drell-Yan experiment which is the prerequisite to cope with high heat input from the pion beam. This includes the preparation of the new target holder, high frequency polarizing cavity and nuclear magnetic resonance (NMR) system for measuring of target polarization in Drell-Yan studies. At COMPASS the unpolarized pion beam with momentum of 190 GeV/c and intensity up to 10⁸ pions/s will interact with transversely polarized proton target producing muon pair via Drell-Yan process. The solid NH₃ is polarized by dynamic nuclear polarization (DNP) method. Maximum polarization reached during data taking is expected to be up to 90 %. Two target cells with gap of 20 cm, each 55 cm long and 4 cm in diameter give target cell volume about 690 cm³. The microwave cavity has one central microwave stopper. Non-interacting beam and other particles produced inside the target will be stopped in the hadron absorber after the polarized target. This absorber will worsen somewhat the vertex resolution in comparison with present COMPASS system. Among the first distributions to be studied at COMPASS DY experiments are Sivers, Boer-Mulders and pretzelosity TMDs as well as transversely polarized quark distributions. These measurements will make it possible to test a most important prediction of QCD. The Drell-Yan data taking is expected to start in 2014 - 2015 for period of approximately 180 days. Current status of the polarized target, the required modifications and future plans will be presented.

Astroparticle Physics and Cosmology / 933

On the flavor composition of the high-energy neutrino events in IceCubeDr. PALOMARES-RUIZ, Sergio ¹; Ms. MENA, Olga Mena ²; Dr. VINCENT, Aaron ¹¹ *IFIC*² *IFIC/CSIC-UV***Corresponding Author:** sergio.palomares-ruiz@durham.ac.uk

The IceCube experiment has recently reported the observation of 28 high-energy (> 30 TeV) neutrino events, separated into 21 showers and 7 muon tracks, consistent with an extraterrestrial origin. In this talk we discuss the compatibility of such an observation with possible combinations of neutrino flavors with relative proportion

($\alpha_e:\alpha_\mu:\alpha_\tau$). Although the 7:21 track-to-shower ratio is naively favored for the canonical (1:1:1) at Earth, this is not true once the atmospheric muon and neutrino backgrounds are properly accounted for. We find that, for an astrophysical neutrino E^{-2} energy spectrum, (1:1:1) at Earth from hadronic sources is disfavored at 79% CL. If this proportion does not change, six more years of data would be needed to exclude (1:1:1) at Earth at 3 sigma CL. Indeed, with the recently-released preliminary 3-year data, that flavor composition is excluded at 91% CL. The best-fit is obtained for (1:0:0) at Earth, which cannot be achieved from any flavor ratio at sources with averaged oscillations during propagation. If confirmed, this result would suggest either a misunderstanding of the expected background events, or a misidentification of tracks as showers, or even more compellingly, some exotic physics which deviates from the standard scenario.

Astroparticle Physics and Cosmology / 934

Results from the Telescope Array ExperimentProf. JUI, Charles ¹¹ *University of Utah, Telescope Array***Corresponding Author:** cchjui@gmail.com

The Telescope Array (TA) is the largest ultrahigh energy cosmic ray detector in the northern hemisphere. The experiment consists of three fluorescence stations viewing the air space over a surface array of 503 scintillation counters deployed over 700 square kilometers. TA has been in operation since 2008. The most recent results from TA, including that of composition studies and search for arrival direction anisotropy, will be presented. We will also report on the progress of the new TA low energy extension (TALE).

Strong Interactions and Hadron Physics / 936

GoSam: Automated One-loop Calculations within the Standard Model and BeyondGREINER, Nicolas ¹¹ *Max-Planck Institute for Physics***Corresponding Author:** greiner@mpp.mpg.de

In this talk I will present the recent developments of the GoSam package, an automated tool for one-loop calculations. I will give a short introduction and explain the most recent features and developments. Furthermore, phenomenological applications and results are presented.

Neutrino Physics / 937

Constraints on heavy neutrinos and applications

Prof. VALLE, JWF¹; Dr. TÓRTOLA, Mariam²; Mr. ESCRIBUELA, Francisco³; Prof. MIRANDA, Omar⁴; Mr. VANEGAS, David⁵

¹ IFIC

² IFIC, Valencia

³ AHEP Student, University of Valencia

⁴ CINVESTAV, México D.F.

⁵ AHEP, Valencia

Corresponding Author: franesfe@alumni.uv.es

Several models of neutrino masses predict the existence of neutral heavy leptons. Here, we review current constraints on heavy neutrinos and apply them to inverse and linear seesaw models. We discuss the effect of a fourth heavy neutrino in oscillation experiments

Top-quark and ElectroWeak Physics / 938

Measurement of the differential $W+W-$ production cross section with jets at in ppbar collisions at CDF

Mr. WILLIAM, Parker¹; Prof. MATTHEW, Herndon²

¹ University of Wisconsin Madison

² University of Wisconsin Madison

Corresponding Author: herndon@hep.wisc.edu

We present a measurement of the W boson pair production cross section in ppbar collisions at $\sqrt{s} = 1.96$ TeV. The WW candidates are reconstructed from decays containing two charged leptons and two neutrinos, where the charged leptons are either electrons or muons. The measurement is performed using data collected by the CDF II detector from 9.7 fb⁻¹ of integrated luminosity. The total and differential cross section vs. the number of observed jets and the jet transverse momentum are presented.

Poster Session / 940

An 3-3-1 model with an abelian B-L factor

Dr. RAMIREZ BARRETO, Elmer¹; Dr. DIAS, Alex¹; Dr. TONASSE, Mauro²

¹ Universidade Federal do ABC

² UNESP

Corresponding Author: elmer.barreto@ufabc.edu.br

In this work, we present one construction involving the 3-3-1 model with heavy leptons plus an abelian factor with charge B-L. The major characteristic of this class of models: the relation between the number of families and the chiral anomalies cancellation, is maintained when the anomalies associated with the BL charge are too included. Some implications about the phenomenology of the model in the context of the LHC are discussed.

Poster Session / 941

Heavy Higgs and exotic quarksMr. CAMARGO, Daniel ¹; Dr. DIAS, Alex ²¹ *Ph.D Student*² *Professor***Corresponding Author:** dacamargov@gmail.com

We present the search of the heavy Higgs into a new chiral framework, in which there are new consistent set of chiral fermions some of them with electric exotic charges, as the quarks X and Y with electric charge $5/3$ and $-4/3$, respectively. The heavy Higgs lies into 2HDM context and interact at tree level mainly with the exotic sector due to the Z_{4} symmetry.

Prospects of these Higgs search through different channels are present here.

Detector RD and Performance / 942

Particle Identification with the Belle II iTOP DetectorDr. KIRBY, Brian ¹¹ *University of Hawaii at Manoa***Corresponding Author:** kirbybri@phys.hawaii.edu

The Imaging Time-of-Propagation (iTOP) Cherenkov ring-imaging detector is a particle identification system designed for use in the barrel region of the Belle II spectrometer. The system detects Cherenkov photons produced by charged particles passing through one of 16 quartz bars arranged in a barrel around the inner tracking detectors. An array of 32 pixelated micro-channel plate photomultipliers (MCP-PMTs) instrument each bar to detect internally reflected photons with time resolution better than 50ps. A waveform sampling ASIC-based frontend readout electronics system digitizes and measures photon detection times. Photon time information is combined with tracker data to reconstruct the charged particle's Cherenkov ring image for use in particle identification analysis. The ability to distinguish between kaons and pions with high sensitivity will be crucial in many Belle II physics measurements. This presentation will describe the iTOP detector design and application in physics analyses, and summarize current detector development activities and plans leading up to installation in early 2015.

Poster Session / 943

Hadronic total cross sections, Wilson loop correlators and the QCD spectrumDr. GIORDANO, Matteo ¹; MEGGIOLARO, Enrico ²¹ *Institute for Nuclear Research (ATOMKI), Debrecen*² *University of Pisa (ITALY)***Corresponding Author:** giordano@unizar.es

We show how to obtain rising hadronic total cross sections in QCD, in the framework of the nonperturbative approach to soft high-energy scattering based on Wilson-loop correlators. Total cross sections turn out to be of "Froissart"-type, i.e., the leading energy dependence is of the form $B(\log s)^2$, in agreement with experiments. The observed universality of the prefactor B is obtained naturally in this framework. In this case, B is entirely determined by the stable spectrum of QCD, and predicted to be $B_{th} = 0.22$ mb, in fair agreement with experiments.

Heavy Ions / 944

Heavy Flavor measurements at STAR

STAR, Collaboration ¹

¹ STAR Collaboration

Corresponding Author: evdolga@uic.edu

In ultrarelativistic heavy ion collisions, a phase transition occurs from hadronic matter into a state of deconfined quarks and gluons. Properties of this new state of matter, dubbed as the strongly interacting Quark-Gluon Plasma (sQGP), have been a subject of extensive measurements at the Relativistic Heavy Ion Collider (RHIC) in the past decade. Due to their large masses, charm and bottom quarks are dominantly produced in hard QCD processes early in the collisions and thus provide a unique means of exploring the properties of the sQGP. Open heavy flavor production is sensitive to interactions with the medium, while the production of different quarkonium states probe the thermal properties of the sQGP. Other effects, such as initial state cold nuclear matter effects, production via recombination of quark-antiquark pairs in the sQGP, and dissociation in hadronic phase, could also alter the expected picture. Measurements of the open heavy flavor and quarkonium production in different collision systems and at different energies are therefore crucial for disentangling relative contributions from these effects.

In this talk we report recent STAR heavy flavor results at $\sqrt{s_{NN}}=200$ GeV in p+p and d+Au collisions, $\sqrt{s_{NN}}=200$ GeV, 62.4 and 39 GeV in Au+Au collisions, as well as $\sqrt{s_{NN}}=193$ GeV in U+U collisions. The latter provides the highest energy density at RHIC. Measurements of open heavy flavor hadrons through both hadronic and semi-leptonic channels, and those of J/ψ and Υ states will be presented and compared to theoretical calculations. The future prospect of the heavy flavor program at STAR in light of recent detector upgrades will also be discussed.

Formal Theory Developments / 947

Spontaneous Breaking of Scale Invariance in U(N) Chern-Simons Gauge Theories in Three DimensionsProf. BARDEEN, William ¹¹ *Fermilab***Corresponding Author:** gabriela.barenboim@uv.es

I demonstrate the existence of a massive phase in a conformally invariant U(N) Chern-Simons gauge theory in D=3 with matter fields in the fundamental representation. These models have attracted recent attention as being dual, in the conformal phase, to theories of higher spin gravity on AdS₄. Using the 't Hooft large N expansion, exact solutions are obtained for scalar current correlators in the massive phase where the conformal symmetry is spontaneously broken. A massless dilaton appears as a composite state, and its properties are discussed. Solutions exist for matter fields that are either bosons or fermions.

Astroparticle Physics and Cosmology / 948

Transplanckian masses in inflationProf. BARENBOIM, Gabriela ¹; VIVES, Oscar ²¹ *University of Valencia and IFIC*² *IFIC***Corresponding Author:** gabriela.barenboim@uv.es

We postulate that the need of transplanckian masses that single field inflation seems to need to accommodate experimental data can be due to the fact that we "force" our scalar field to be minimally coupled to gravity. Although it is true that the field itself is a "dummy" variable and one is always free to make a field redefinition to the Einstein frame (where the field is minimally coupled) such a redefinition may not be innocent. It may be hiding for example non minimal couplings to gravity or modified gravity scenarios.

Astroparticle Physics and Cosmology / 949

A first walk on the DarkSideDr. DAVINI, Stefano ¹¹ *University of Houston***Corresponding Author:** davini@ge.infn.it

DarkSide-50 (DS-50) at Gran Sasso underground laboratory, Italy, is a direct dark matter search experiment based on a TPC with liquid argon from underground sources. The DS-50 TPC, with 50 kg of active argon and a projected fiducial mass of >33 kg, is installed inside an active neutron veto based on a boron-loaded organic scintillator. The neutron veto is built inside a water cherenkov muon veto. DS-50 has been taking data since Nov 2013, collecting more than 2e7 events with atmospheric argon. This data represents an exposure to the largest background, beta decays of Ar-39, comparable to the full three-year run planned for DS-50 with underground argon. When analyzed with a threshold that would give a sensitivity in the full run of about 1e-45 cm² at a WIMP mass of 100 GeV/c², there is no Ar-39 background observed. The detector design and performance will be presented as well as results from the atmospheric argon run. Plans for the underground argon run and for a ton-scale detector within the same neutron veto vessel will be presented.

Poster Session / 950

High resolution low background Calorimeter for SuperNEMODr. MARQUET, Christine ¹¹ CENBG/CNRS**Corresponding Author:** marquet@cenbg.in2p3.fr

The SuperNEMO double beta decay project is a modular tracker-calorimeter based experiment that will reach about 1026 years for neutrinoless double beta decay half-life corresponding to 50-100meV in terms of Majorana effective neutrino mass. It will scrutinize a hundred of kilograms of ⁸²Se double beta decay isotope. The first module is under construction and will be installed early 2015 in the LSM (Laboratoire Souterrain de Modane) underground laboratory.

The calorimeter is based on Optical Modules made of large volume plastic scintillators (10L) coupled with large area photomultipliers (Hamamatsu R5912---Mod and R6594). They are assembled in walls that surround the isotope foil and the tracking volume. One of the main goals is to reach an energy resolution (FWHM) as low as 8% for 1 MeV electrons for the most sensitive parts of the calorimeter with a 4π coverage in terms of gamma tagging for background suppression.

The other cornerstone of the success of the calorimeter is to reach the radiopurity requirements for its construction materials and detecting parts.

Poster Session / 951

Measurements of Higgs Boson Couplings and Constraints on New PhysicsROOS, Lydia ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The couplings of the Higgs boson are measured by the ATLAS experiment using the LHC Run I data sample. The data analyzed involve decays of the Higgs boson to pairs of photons, Z bosons, W bosons, tau leptons, or b-quarks. Evidence for Higgs boson decays into fermion pairs is found with 3.7 significance using the combination of the bb and tau-tau channels. The measured values and mass dependence of the couplings agree well with the predictions for the Standard Model Higgs boson. The coupling measurements are used to set limits on a composite Higgs boson, an additional electroweak singlet, two-Higgs-doublet-models, and a simplified Minimal Supersymmetric Standard Model. A search for the $Zh \rightarrow ll + \text{missing transverse energy}$ process is used together with the coupling measurements to constrain a Higgs portal to dark matter.

Poster Session / 952

Property measurements of the Higgs boson in the $\gamma\gamma$ final state with the ATLAS detector at LHCROOS, Lydia ¹¹ CERN**Corresponding Author:** lroos@lpnhe.in2p3.fr

The discovery of a particle consistent with a Higgs Boson is a great success for the LHC Physics Program. Using the full 25 fb Run I dataset, ATLAS has established a clear excess of signal over background in the di-photon channel alone. In this poster, we will present properties measurements of the new particle in the $H \rightarrow \gamma\gamma$ analysis which relies on a new calibration of photon energy and of a new simulation with improved geometry description. Also, the categorization of events was re-optimized to improve the measurement sensitivity.

Lepton Flavour Violation / 953

LFV in SUSY seesaws after θ_{13} , MEG13 and LHC13

JOAQUIM, Filipe ¹

¹ CFTP, IST

Corresponding Author: filipe.joaquim@tecnico.ulisboa.pt

A general overview of the connection between radiative LFV decays, neutrino and LHC data in the context of SUSY seesaws will be given. The impact of the measurement of the reactor neutrino mixing angle and the most recent bounds on rare LFV decays will be discussed.

Beyond the Standard Model / 954

Searches for Dark Forces with KLOE

Dr. BOSSI, Fabio ¹

¹ INFN-LNF

Corresponding Author: fabio.bossi@lnf.infn.it

In some models of physics beyond the Standard Model it is predicted the existence of light neutral vector particles (U bosons) mediator of new gauge interactions under which ordinary matter is uncharged. Motivated by astrophysical considerations, their mass, M_U , is expected to be of order 1 GeV or lighter.

These new particles can be observed as sharp resonances at M_U in the invariant mass distribution of charged lepton or pion pairs in reactions of the type $e^+e^- \rightarrow l(\pi)+l(\pi)^- \gamma$, or in meson Dalitz decays.

KLOE has formerly searched for U boson production using ϕ daitz decay events, setting limits in the mass region $50 < M_U < 520$ MeV. We have now completed our analysis of $e^+e^- \rightarrow \mu^+\mu^- \gamma$, which has allowed us setting the best limits to date in the region between 500 and 1000 MeV.

Preliminary results for the electron-positron final state are also available.

Poster Session / 955

Comparisons of Exact Amplitude--Based Resummation Predictions and LHC DataProf. WARD, Bennie ¹; Dr. MAJHI, S. K. ²; Ms. MUKHOPADHYAY, A. ¹; Prof. YOST, S.A. ³¹ *Baylor University*² *IACS, Kolkata, IN*³ *The Citadel, Charleston, SC, USA***Corresponding Author:** bfl_ward@baylor.edu

We present the current status of the comparisons with the respective data of the predictions of our approach of exact amplitude-based resummation in quantum field theory as applied to precision QCD calculations as needed for LHC physics, using the MC Herwiri1.031. The agreement between the theoretical predictions and the data exhibited continues to be encouraging.

Astroparticle Physics and Cosmology / 956

Resummed Quantum Gravity Prediction for the Cosmological Constant and Constraints on SUSY GUTSProf. WARD, Bennie ¹¹ *Baylor University***Corresponding Author:** bfl_ward@baylor.edu

We use our resummed quantum gravity approach to Einstein's general theory of relativity in the context of the Planck scale cosmology formulation of Bonanno and Reuter to estimate the value of the cosmological constant as $\rho_{\Lambda} = (0.0024 \text{ eV})^4$. We show that the closeness of this estimate to experiment constrains susy GUT models. We also address various consistency checks on the calculation.

Poster Session / 957

CEEX EW Corrections for $f \rightarrow f$ at LHC, Muon Colliders and FCC-ee as Realized in KK MC 4.22Prof. WARD, Bennie ¹; Prof. JADACH, S. ²; Prof. WAS, Z. ²¹ *Baylor University*² *Institute of Nuclear Physics, Krakow, Poland***Corresponding Author:** bfl_ward@baylor.edu

With an eye toward the precision physics of the LHC, FCC-ee and possible high energy muon colliders, we present the extension of the CEEX (coherent exclusive exponentiation) realization of the YFS approach to resummation in our KK MC to include the processes $f \rightarrow f$, $f = \mu, \tau, q, \nu_{\ell}$, $f = e, \mu, \tau, q, \nu_{\ell}$, $q = u, d, s, c, b, t$, $\ell = e, \mu, \tau$ with $f \neq f$. After giving a brief summary of the CEEX theory in comparison to the older EEX (exclusive exponentiation) theory, we illustrate theoretical results relevant to the LHC, FCC-ee, and possible muon collider physics programs.

Flavour Physics / 958**Constraints on a Class of Two-Higgs Doublet Models with tree level FCNC**Dr. NEBOT, Miguel ¹¹ *U. of Valencia - IFIC***Corresponding Author:** miguel.nebot@uv.es

Relevant constraints and selected phenomenological implications of a class of two Higgs doublet models where flavour-changing neutral currents (FCNC) couplings are suppressed by small entries of the mixing matrix are analysed. This property of the considered models is the result of a discrete symmetry of the Lagrangian such that the FCNC are completely fixed, in the quark sector, by the CKM mixing matrix V and the ratio of the vacuum expectation values of the neutral Higgs. Extending it to the leptonic sector introduces FCNC controlled by the PMNS mixing matrix. The analysis involves a significant number of processes which include tree and loop level transitions mediated by a charged and/or neutral Higgses. The new physical scalars, i.e. beyond the standard Higgs boson, can have masses within experimental reach.

Neutrino Physics / 959**Current status of the Double Chooz experiment**HASER, Julia ¹¹ *Max-Planck-Institut fuer Kernphysik***Corresponding Author:** julia.haser@mpi-hd.mpg.de

The Double Chooz reactor antineutrino experiment aims for a precision measurement of the neutrino mixing angle θ_{13} . Located at the Chooz nuclear power plant in France, it observes an energy dependent deficit in the neutrino spectrum, currently with one detector filled with gadolinium-loaded liquid scintillator at a baseline of 1.05 km. The past Double Chooz publications featured different analysis approaches: The θ_{13} result was not only provided via rate-only analysis of the deficit in neutrino flux; a combined rate and spectral shape fit as well as a background model independent analysis based on reactor power variations were performed, giving consistent results. Besides that, Double Chooz has been the first experiment to determine θ_{13} using the neutrino detection channel via neutron captures on hydrogen nuclei. Among the recent reactor-based oscillation experiments with comparable baseline it was the only one to observe scheduled reactor shutdown phases. These enabled to measure the background spectrum solely, allowing to crosscheck the background models used in the oscillation analysis.

At present an improved analysis is in progress with twice as much data statistics collected compared to the last publication. Revised selection criteria and background studies enhance the signal to background ratio while a reduction in the corresponding uncertainties is achieved. Along with an improved energy calibration the overall systematic uncertainty on θ_{13} is decreased preparing for a two detector analysis.

In the near future the second identically constructed detector will commence operation at 400 meters distance to the reactor cores, leading to a cancellation of correlated systematic uncertainties, which allows for a high precision θ_{13} measurement.

Poster Session / 960

Higgs(es) in Triplet extended supersymmetric standard model at the LHC.Dr. BANDYOPADHYAY, Priyotosh ¹; Ms. SABANCI, Asli ²; Prof. HUITU, Katri ²¹ *University of Helsinki and Helsinki Institute of Physics*² *University of Helsinki***Corresponding Author:** bpriyo@gmail.com

We will discuss the recent Higgs discovery results both by CMS and ATLAS at the LHC. In this context we will consider the status of supersymmetric scenarios. In minimal supersymmetric scenarios in order to have a ~ 125 GeV Higgs, one needs large quantum corrections from strong supersymmetric sectors and either large supersymmetric mass scale or large mass splitting between the contributing super-particles is demanded.

We focus on the triplet extension of minimal supersymmetric scenario, where we can see that the electroweak contributions coming from triplet are also important and comparable to the strong contributions. We discuss this in the context of the observed Higgs like particle around 125 GeV and also look into the status of other Higgs bosons in the model. We also calculate in this model the $\text{Br}(B_s \rightarrow X_s \gamma)$ which has contributions coming from

three physical charged Higgs bosons and three charginos. In particular the doublet-triplet mixing plays an important role in constraining the parameter space. In this context we also discuss the phenomenology of light charged Higgs probing $H^{\pm} W^{\pm} Z$ coupling at the LHC.

Heavy Ions / 962

PHENIX Results on Heavy Flavor PhysicsDr. HOLLIS, Richard ¹¹ *University of California, Riverside***Corresponding Author:** rhollis@ucr.edu

The PHENIX experiment at the Relativistic Heavy Ion Collider has measured a suite of observables for open and closed heavy flavor in a variety of collision systems, p+p, d+Au, Cu+Cu, Au+Au, U+U, and at different beam energies. These results indicate substantial modification in the yields of quarkonia, including J/Psi, Psi', and Upsilon states, and a substantial redistribution in momentum space of open heavy flavor quarks. We present the latest results and comparisons to competing theoretical interpretations.

Heavy Ions / 963**PHENIX Results in d+Au Collisions**Dr. CHEN, Chin-Hao ¹¹ *RIKEN BNL Research Center***Corresponding Author:** chchen@bnl.gov

The PHENIX experiment at the Relativistic Heavy Ion Collider has performed a comprehensive set of measurements in d+Au collisions. Observables in d+Au collisions were originally conceived as a control experiment where no quark-gluon plasma is formed and one could isolate so-called cold nuclear matter effects, including nuclear modified parton distributions and parton multiple scattering. However, recent data from the PHENIX experiment in d+Au, in conjunction with new p+Pb results at the Large Hadron Collider, give strong evidence for a very different picture. We present new results that hint at the formation of a small quark-gluon plasma, that though short lived, leaves a fingerprint of evidence on final state observables. These new results will be discussed in the context of competing theoretical interpretations.

965**TEST SALVA: AUTOMATIC E-MAIL NOTIFICATION TEST**Dr. MARTI GARCIA, Salvador ¹; Dr. COSTA, Maria Jose ²; Dr. FUSTER VERDU, Juan Antonio ³¹ *IFIC-Valencia (UV-CSIC)*² *IFIC*³ *IFIC (Instituto de Fisica Corpuscular)***Corresponding Author:** salvador.marti@ific.uv.es

TEST CONTENT TEST CONTENT

BEH Physics / 966**Search for Higgs bosons decaying to photons in the CMS detector**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** jolsen@princeton.edu

A search for Higgs bosons has been carried out in the Higgs to gammagamma decay channel with the CMS detector at the LHC collider. In addition, a search for diphoton resonances at high mass using techniques similar to the SM Higgs boson search is presented. The analyses are based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV corresponding to integrated luminosities of 5/fb and 20/fb, respectively. In the case of the SM Higgs boson search, the analysis strategy and measurements of the mass, coupling, and spin-parity are reported.

BEH Physics / 967

Search for Higgs bosons decaying to leptons with the CMS detector

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: jolsen@princeton.edu

A search for the SM Higgs boson has been carried out in the Higgs to tautau and mumu channels with the CMS detector at the LHC collider. In addition, a search for lepton-flavor-violating decays is reported. The analyses are based on pp collision data collected at centre-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of 5/fb and 20/fb, respectively. For the SM Higgs boson search in the tautau channel, the analysis strategy and resulting evidence for this decay are summarized.

BEH Physics / 968

Search for Higgs bosons produced in association with top quarks in the CMS detector

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: jolsen@princeton.edu

Searches for a Higgs boson produced in association with top quarks, both singly and in pairs, and decaying to gamma gamma, ZZ, WW, tautau, and bbbar final states are presented. The analyses use pp collision data collected at center-of-mass energies of 7 and 8 TeV, corresponding to integrated luminosities of about 5/fb and 20/fb, respectively. No signals are observed for production of a Higgs boson in association with either one or two top quarks, and combined limits on the signal strength are presented.

BEH Physics / 969

Prospects for Higgs physics with an upgraded CMS detector at the high-luminosity LHC

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: jolsen@princeton.edu

Projections for the expected performance of an upgraded CMS detector are presented for various Higgs property measurements planned for the high luminosity running period of the LHC.

Formal Theory Developments / 970**A scenario for critical scalar field collapse in AdS₃**Dr. FABBRI, Alessandro ¹¹ *Centro Fermi / Univ. Bologna / IFIC (CSIC)***Corresponding Author:** afabbri@ific.uv.es

We present a family of exact solutions, depending on two parameters α and b (related to the scalar field strength), to the three-dimensional Einstein-scalar field equations with negative cosmological constant.

For $b = 0$ these solutions reduce to the static BTZ family of vacuum solutions, with mass $M = -\alpha$. For nonvanishing b , the solutions become dynamical and develop a strong spacelike central singularity.

The $\alpha < 0$ solutions are black-hole like, with a global structure topologically similar to that of the BTZ black holes, and a finite effective mass.

We show that the near-singularity behavior of the solutions with $\alpha > 0$ agrees qualitatively with that observed in numerical simulations of subcritical collapse.

We analyze the linear perturbations of the threshold solution, $\alpha = 0$, in the $\Lambda = 0$ approximation, and find that it has only one unstable growing mode, which qualifies it as a candidate critical solution for scalar field collapse.

Neutrino Physics / 971**Statistical issues in neutrino mass ordering sensitivity**Dr. BLENNOW, Mattias ¹¹ *KTH Royal Institute of Technology***Corresponding Author:** sorel@fnal.gov

During the last two years, there has been some confusion in the field on how to assess the sensitivity of future neutrino oscillation experiments to the neutrino mass ordering. A factor of two difference to the common approach has been proposed. We resolve the situation by going back to the basic statistical definitions and apply the results to compare future possibilities of experiments aiming for determination of the mass ordering. We find that the typical median sensitivity measure is very close to that given by the common approach. We also discuss other possible measures of sensitivity and briefly discuss other situations where the method is applicable, such as for the determination of the octant of θ_{23} .

BEH Physics / 972**Search for Charged Higgs Bosons with the ATLAS Detector**ROOS, Lydia ¹¹ *CERN***Corresponding Author:** savard@physics.utoronto.ca

Several non-minimal Higgs scenarios, e.g. Two Higgs Doublet Models (2HDM), predict the existence of charged Higgs bosons. This talk describes searches for charged Higgs bosons produced in top quark decays, in association with a top quark, or decaying to a tau lepton and a neutrino using the Run I data collected by the ATLAS detector at the LHC.

BEH Physics / 973

Higgs Boson Decays to Photons with the ATLAS Detector

ROOS, Lydia ¹

¹ CERN

Corresponding Author: savard@physics.utoronto.ca

A review of the latest results on Higgs boson decays to photons with the ATLAS detector is presented, using approximately 25 fb⁻¹ of pp collision data collected at 7 TeV and 8 TeV in 2011 and 2012.

BEH Physics / 974

Higgs Boson decays to Leptons with the ATLAS detector

ROOS, Lydia ¹

¹ CERN

Corresponding Author: savard@physics.utoronto.ca

A review of the latest results on Higgs boson decays to leptons with the ATLAS detector is presented, using approximately 25 fb⁻¹ of pp collision data collected at 7 TeV and 8 TeV in 2011 and 2012.

BEH Physics / 975

Search for Higgs Bosons produced in association with top quarks with the ATLAS detector

ROOS, Lydia ¹

¹ CERN

Corresponding Author: savard@physics.utoronto.ca

Since the discovery of a Higgs boson by the ATLAS and CMS experiments at the LHC, the emphasis has shifted towards measurements of its properties and the search for less sensitive channels in order to determine whether the new particle is the Standard Model Higgs boson. Of particular importance is the direct observation of the coupling of the Higgs boson to top quarks. In this talk a review of ATLAS results on the search for the

Higgs boson produced in association with top quarks, and on the search for flavour- changing neutral currents in top quark decays $t \rightarrow qH$ ($q = c, u$), will be presented.

BEH Physics / 976

Searches for Pseudo-scalar Higgs Bosons in the context of 2HDM, MSSM, and NMSSM scenarios with the ATLAS Detector

ROOS, Lydia ¹

¹ CERN

Corresponding Author: savard@physics.utoronto.ca

Searches for pseudo-scalar Higgs bosons in the context of 2HDM, MSSM, and NMSSM scenarios with the ATLAS detector are presented.

Future accelerator facilities and open discussion / 977

Overview and scope of the session

Corresponding Author: tatsuya.nakada@cern.ch

60th CERN anniversary / 978

Presentation of the Spanish stamp celebrating CERN 60th anniversary

60th CERN anniversary / 979

CERN: a Large International infrastructure with impact beyond science and technology

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The construction of the Large Hadron Collider

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CERN: the scientific and technological quest

60th CERN anniversary / 982

Future CERN projects and their technological challenges

Corresponding Author: jose.miguel.jimenez@cern.ch

60th CERN anniversary / 983

Spain at CERN

Corresponding Author: manuel.aguilar@ciemat.es

Special Session on Cosmology and Particle Physics / 984

A detection of degree scale B-mode polarization with BICEP2

Special Session on Cosmology and Particle Physics / 985

Cosmological constraints from Planck

Prof. MARTINEZ-GONZALEZ, Enrique ¹

¹ *Instituto de Fisica de Cantabria (Spain)*

Corresponding Author: martinez@ifca.unican.es

Future accelerator facilities and open discussion / 986

Regional strategies and roadmaps. Community vision: Americas

Future accelerator facilities and open discussion / 987

**Round table with regional representatives and laboratory directors
(CERN-S.Bertolucci, Fermilab-N. Lockyer, IHEP-Y. Wang, KEK-A. Suzuki)**

Dr. BERTOLUCCI, Sergio ¹

¹ *CERN*

Corresponding Author: sergio.bertolucci@cern.ch

Opening Ceremony / 988

CERN Director General

Accelerator Physics and Future Colliders / 989

Status and perspectives for PANDA at FAIR

Dr. PRENCIPE, Elisabetta¹

¹ IKP Forschungszentrum Juelich

Corresponding Author: e.prencipe@fz-juelich.de

The Facility for Antiproton and Ion Research (FAIR) is an international accelerator facility which will use antiprotons and ions to perform research in the fields of nuclear, hadron and particle physics, atomic and anti-matter physics, high density plasma physics, and applications in condensed matter physics, biology and the bio-medical sciences. It is situated in Darmstadt (Germany) and it is under construction. It is expected to provide beams to the experiments from 2018.

FAIR will be based upon an expansion of the GSI Helmholtz Centre for Heavy Ion Research. Roughly 3,000 scientists from more than 50 countries are already working on the planning of the experiment and accelerator facilities.

Among all projects which are under construction at FAIR in this moment, the PANDA experiment (Antiproton Annihilation at Darmstadt) will investigate fundamental questions of hadron and nuclear physics, studying the interactions of antiprotons with nucleons and nuclei. The physics program of PANDA is wide and ambitious: the hadron spectroscopy is one of the highlight physics topic, searching for gluonic excitations, charmonium and baryon spectroscopy, and D meson spectroscopy, which is interesting either from the point of view of the Strong and the Weak interactions; nucleon structure will be under investigation, with the study of parton distributions and the time-like form factor of the proton; then hadrons in matter and hypernuclei physics program are in the list of the topics under study as well. PANDA will focus attention on the phenomenon of the confinement of quarks and the generation of the hadron masses.

Gluonic excitations and hadrons composed by strange and charm quarks could be abundantly produced and their features will be accessible with unprecedented accuracy, thereby allowing high precision tests of the strong interaction theory in the intermediate energy regime. PANDA is designed to reach mass resolution 20 times better than attained at the B factories, which is essential to extract the width of very narrow states (such as $D_s J$ mesons) from the excitation function of the cross section of those. An overview of the PANDA experiment and the PANDA physics program will be presented.

PANDA is designed for measurements of reactions induced by high intensity antiproton beams with a momentum between 1.5 GeV/c and 15 GeV/c interacting with hydrogen as well as nuclear targets. Basic subsystems of PANDA including magnets and target, tracking detectors, particle identification system, calorimeters and data acquisition are described.

The technique to measure the width of very narrow states in Charm and Charmonium Physics will be presented in this context, stressing on what is the original contribution of PANDA in this field and how competitive these measurements are in comparison with other experiments.

Top-quark and ElectroWeak Physics / 990

Top mass measurements using the ATLAS detector at the LHC

ATLAS, Collaboration¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Measurements of the top-quark mass with the ATLAS detector in proton-proton collisions are presented. Events where top quark pairs are produced are selected and the top mass distribution is derived from the reconstructed top decay products. The top mass is then measured with the template method. All decay modes of the top quark pairs are used

($l+l$, jets, the dilepton and the fully hadronic decay channel). The systematics uncertainties associated to these measurements are discussed in detail.

Top-quark and ElectroWeak Physics / 993

Single top quark production at CDF

Dr. LEONE, Sandra ¹

¹ *INFN Pisa*

Corresponding Author: sandra.leone@pi.infn.it

We present the most recent CDF measurements of single top quark production cross section. We also present the measurements of single top quark production in s-channel and t-channel separately. The extraction of the CKM matrix element $|V_{tb}|$ from the single top quark cross section is discussed as well.

Flavour Physics / 996

Recent KLOE results on Kaon Physics

Dr. DE LUCIA, Erika ¹

¹ *LNF-INFN*

Corresponding Author: erika.delucia@lnf.infn.it

The KLOE experiment at the DAΦNE ϕ -factory of the INFN Frascati Laboratory collected data corresponding to 2.5 fb^{-1} of integrated luminosity.

Neutral kaon pairs produced in ϕ -meson decays offer a unique possibility to perform tests of fundamental discrete symmetries. The entanglement of the two kaons is exploited to search for possible violation of CPT symmetry and Lorentz invariance in the context of the Standard-Model Extension (SME) framework. A new approach to the analysis of $\phi \rightarrow K_S K_L \rightarrow \pi^+ \pi^-, \pi^+ \pi^0$ events has been adopted allowing us to independently measure all four CPT violating parameters Δa_{μ} appearing for neutral kaons in the SME.

The final KLOE results on Δa_{μ} will be presented.

These are presently the most precise measurements in the quark sector of the SME. We also shortly discuss the perspectives for a new measurement using the KLOE-2 apparatus equipped with a new inner tracker.

The measurement of the absolute BR of the $K^+ \rightarrow 3\pi(\gamma)$ decay completes the KLOE program of precise and fully inclusive kaon dominant BR's measurements. The most recent result, $\text{BR}(K^+ \rightarrow \pi^+ \pi^+ \pi^-) = (5.56 \pm 0.20)\%$ (Chiang et al.), dates back to more than 30 years ago. We use as normalization sample the tags given by $K^+ \rightarrow \mu^+ \nu$ decays.

The track of the tagging kaon is backward extrapolated to the interaction point, then the kinematics of the decay $\phi \rightarrow K^+ K^-$, gives us the possibility to define the path of the signal kaon (direction and momentum). The decay products of the kaons have a very low momentum, less than 200 MeV/c, and curl up in the KLOE magnetic field (0.52 T). To optimize the quality of the track reconstruction we select kaons decaying before the Drift Chamber Inner Wall (inner radius(DC) = 25 cm), so that only their decay products cross the DC (three tracks instead of four). We require at least two reconstructed tracks (pion candidates) and we count the number of $K^+ \rightarrow 3\pi(\gamma)$ decays from the missing mass spectrum. The KLOE result on the $\text{BR}(K^+ \rightarrow \pi^+ \pi^+ \pi^- (\gamma))$ will be presented.

Astroparticle Physics and Cosmology / 997

Review on gravitational wave detectorsDr. SINTES, Alicia ¹¹ *Universitat de les Illes Balears***Corresponding Author:** zornoza@ific.uv.es

The ground-based world-wide network of gravitational-wave laser interferometers has the ambitious goal of the first direct detection of gravitational waves. Their detection will provide a fundamental, new tool to probe the universe, with information on supernovae, colliding black holes and rotating neutron stars. In this talk I will give an overview of the status of the gravitational wave instruments, review the most significant observational results obtained so far and their impact on our understanding of gravitational wave sources. I will also briefly outline the future steps to further increase the reach of the instruments (such as Einstein Telescope) or space observatories which together with the second generation of detectors are expected to lead to the opening of a new observational window on the universe in the coming years.

Flavour Physics / 998

Study of CP-violating charge asymmetries of like-sign dimuons and first measurement of the forward-backward asymmetry in the production of B⁺ mesons in pp(\bar{p}) collisionsD0 COLLABORATION, et al. ¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present a measurement of the inclusive single muon charge asymmetry and the like-sign dimuon charge asymmetry in pp(\bar{p}) collisions using the full data set of 10.4 fb⁻¹ collected with the D0 detector at the Fermilab Tevatron. The measurements differ from the standard model predictions of CP violation in these asymmetries with a significance of 3.6 standard deviations. These results are interpreted in a framework of B meson mixing to measure the relative width difference $\Delta(\Gamma_d)/\Gamma_d$ between the mass eigenstates of the B⁰ meson system, and the semileptonic charge asymmetries $A_{FB}^{B^0}$ and $A_{FB}^{B^0_s}$ mesons.

We also present the first measurement of the forward-backward asymmetry in b-quark production at a hadron collider using the same dataset. The b-quarks are detected in the fully reconstructed decay $B^+ \rightarrow J/\psi K^+$. The frequent reversal of the magnetic fields in the D0 detector allows for the cancellation of many detector effects. Remaining detector asymmetries are corrected using data-driven methods, and the final results are checked using separate B^{+} and B^{-} samples.

Top-quark and ElectroWeak Physics / 999**Top quark pair production and top quark properties at CDF**Dr. MOON, Chang-Seong ¹¹ *CNRS-Paris and INFN-Pisa***Corresponding Author:** csmoon@cern.ch

Result of merging two abstracts:

We present the most recent CDF top quark pairs production cross sections measurements. We also present the test of Standard Model predictions for top quark decaying into b quarks, performed by measuring the ratio R between the top quark branching fraction to b quark and the branching fraction to any type of down quark. The extraction of the CKM matrix element $|V_{tb}|$ from the ratio R is discussed. Finally, the direct measurement of top quark width and the W helicity fractions from top decays are shown.

We present the latest measurements on the forward-backward asymmetry (AFB) in top anti-top quark production in proton-antiproton collisions with center-of-mass energy of 1.96 TeV using CDF II detector at the Tevatron. With the full CDF Run II data set, the measurements are performed in top anti-top decaying to final states that contain one or two charged leptons (electrons or muons). In addition, we combine the results of the leptonic forward-backward asymmetry between the two final states. All the results show deviations from the next-to-leading order (NLO) standard model (SM) calculation.

Top-quark and ElectroWeak Physics / 1000**Measurement of single top quark production in pp collisions at CMS**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Result of abstract merging:

Measurements are presented of t-channel single top quark production in proton-proton collisions at the LHC at centre-of-mass energies of 7 and 8 TeV, using data collected with the CMS experiment during the years 2011 and 2012. The analyses consider decay channels where the W from the top decays into electron-neutrino or muon-neutrino, and makes use of kinematic characteristics of electroweak single top production for the separation of signal from backgrounds using multivariate methods. The results are compared with the most precise standard model theory predictions. Measurements of top/antitop cross section ratio and of various differential single top quark production cross sections are also presented.

Measurements of single top quark production in the tW-channel in pp collisions are presented. In the tW-channel a top quark is produced in association with a W boson. The data were collected in the years 2011 and 2012 at centre-of-mass energies of 7 and 8 TeV. The experimental signature is similar to top pair production, and there is interference at higher orders between the two processes. The measurements are performed using final states in which the associated W boson as well as the one originating from the top quark decay leptonically. Multivariate methods are used to extract the cross section. The result is compared with current standard model theory predictions. Furthermore, a search for s-channel single top production at 8 TeV is presented.

The ratio of single-top t-channel events with a positive or negative lepton final state was measured. This measurement is made at a center-of-mass energy of 8 TeV. The measured ratio of top- to anti-top quark production is compared with predictions from different parton density distribution functions.

Top-quark and ElectroWeak Physics / 1001**Top quark pair production and top quark properties at D0**Prof. VAN KOOTEN, Rick ¹¹ *Indiana University***Corresponding Author:** rvankoot@indiana.edu

Result of merged abstracts:

We present the most recent measurement of the top quark pair cross section with the D0 detector at the Tevatron proton-antiproton collider in the lepton plus jets and dilepton channels using the full D0 Run II data corresponding to an integrated luminosity of 9.7/fb. We use the measured inclusive cross section to extract the top quark mass via the $t\bar{t}$ cross section dependence from the top quark mass. We also present the measurements of differential distributions of top quarks in the lepton plus jets channel using again the full D0 Run II data. The measured spectra, binned in several observables, are corrected to parton level and compared to the spectra obtained from the Monte Carlo simulation and QCD at approximate NNLO.

We present the measurement of the forward-backward asymmetry in top antitop quark pair production in proton antiproton collisions in the lepton plus jets and dilepton final states. Measurements use the full data set collected by D0 in Run II corresponding to an integrated luminosity of 9.7/fb. We present the most recent measurements of the lepton-based asymmetries in both lepton+jets and dilepton final states and their combination. We also present the measurement of the top quark based asymmetry inclusively as well as differentially in $m(t\bar{t})$. These results are corrected for efficiency, acceptance and resolution effects to the parton level. Measurements are compared to theory predictions.

We present results of top quark property studies with the D0 detector in $p\bar{p}$ collisions at a center-of-mass energy of 1.96 TeV at the Tevatron collider. In particular we discuss the measurement of spin correlations using the matrix element technique. The full D0 data set corresponding to an integrated luminosity of 9.7 fb⁻¹ is analyzed. We also discuss the new D0 measurement of the fraction of $t\bar{t}$ events produced via the gg fusion process and an updated measurement of the top quark charge.

Top-quark and ElectroWeak Physics / 1002**Measurement of top quark properties using the ATLAS detector at the LHC**ATLAS, Collaboration ¹¹ *CERN***Corresponding Author:** lroos@lpnhe.in2p3.fr

Result of merged abstracts:

In proton-proton collisions at the LHC, pairs of top and anti-top quarks are expected to be mostly produced through gluon fusion. Making use of the large number of top quark pairs collected in the 7 TeV data, we present measurements of the spin correlation between top and anti-top quarks using several variables and discuss their sensitivity to new physics. In addition, we present measurements of the top quark polarisation predicted in models with CP-conserving and CP-violating processes. A top pair-enriched sample of events with a single lepton (electron or muon), missing transverse momentum and at least four high transverse momentum jets, of which at least one is tagged as coming from a b-quark, is used to measure $t\bar{t}$ production charge asymmetry to $A_c=0.006 \pm 0.010$. Differential A_c measurements as a function of the invariant mass, the rapidity and the transverse momentum of the $t\bar{t}$ -system are also presented. In addition, A_c is measured for a subset of events with large $t\bar{t}$ velocity, where physics beyond the Standard Model could contribute. All measurements are consistent with the Standard Model predictions.

Properties of the top quark are measured in proton-proton collisions data at 7 and 8 TeV. The charge of the top quark of the top quark is found in agreement with the Standard Model prediction. In addition, the polarization of W bosons is measured. Together with other measurements this probe the structure of the Wtb -vertex are measured and constraints on anomalous couplings derived. A search for flavour changing neutral current processes in top quark decays is also presented.

Top-quark and ElectroWeak Physics / 1003**Measurements of top quark properties in top pair production and decay at the LHC using the CMS detector**MEYER, Arnd ¹¹ *RWTH Aachen University***Corresponding Author:** meyera@cern.ch

Result of merged abstracts:

Measurements are presented of the properties of top quarks in pair production from proton-proton collisions at the LHC. The data were collected at pp centre-of-mass energies of 7 and 8 TeV by the CMS experiment during the years 2011 and 2012. The charge asymmetry is measured using the difference of the absolute rapidities of the reconstructed top and anti-top kinematics, as well as from distributions of the top quark decay products. The measurements are performed in the decay channels of the $t\bar{t}$ pair into both one and two leptons in the final state. The results, obtained differentially in several kinematic variables of the $t\bar{t}$ -system, are discussed in the context of the forward-backward asymmetry measurements at Tevatron. The polarization of top quarks is measured from the decay angular distributions. Top quark spin correlations and asymmetries are measured from the angular distributions of the top quark decay products. Measurements of the associate production of top quark pairs with vector bosons (photons, W and Z) are also presented. The results are compared with standard model predictions.

Several measurements of top quark properties in top quark decays are presented using data collected by the CMS experiment during the years 2011 and 2012. The polarization of W bosons in top quark decays is measured. The W-boson helicity fractions and angular asymmetries are extracted and limits on anomalous contributions to the Wtb vertex are determined. The flavor contents in top-quark pair events are measured using the fraction of top quarks decaying into a W-boson and a b-quark relative to all top quark decays, $R = BR(t \rightarrow Wb) / \text{Sum}(BR(t \rightarrow Wq))$, and the result is used to determine the CKM matrix element V_{tb} as well as the width of the top quark resonance. The top-quark charge is measured, using the charge correlations between high-pT muons from W boson decays and soft muons from B-hadron decays in b jets.

Neutrino Physics / 1004**Neutrino mass experiments with Ho**Dr. FERRI, Elena ¹¹ *Università Milano-Bicocca***Corresponding Author:** capelli@mib.infn.it

Neutrino oscillation experiments have proven that neutrinos are massive particles, nevertheless the assessment of their absolute mass scale is still an outstanding challenge in today particle physics and cosmology. The experiments dedicated to effective electron-neutrino mass determination are the ones based on the study of nuclear processes involving neutrino, like single beta decay and electron capture decay. The end-point measurement of ^{163}Ho EC is an appealing alternative respect to the single beta decay because fewer nuclei are needed and it is a self-calibrating measurement. Although the calorimetric measurement of the energy released in the EC decay of ^{163}Ho was proposed in 1982 by A. Rujula and M. Lusignoli, only recent detector technological progresses have allowed to design a sensitive experiment. Nowadays the two experiments dedicated to this delicate measurement are ECHO and HOLMES. This contribution gives an outlook for both experiments underling their technical challenges and perspectives.

Top-quark and ElectroWeak Physics / 1005

Study of the W/Z differential distributions and properties of the W and Z production from CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Result of merged abstracts:

The production of W and Z bosons has been observed in pp collisions at a center-of-mass energy of 7 and 8 TeV using data collected in the CMS experiment. W events were selected containing an isolated, energetic electron or muon. Z events were selected containing a pair of isolated, energetic electrons or muons. We present studies of single and double differential cross sections for W/Z/DY production. The final state radiation properties are discussed.

The production of W and Z bosons has been observed in pp collisions at a center-of-mass energy of 7 and 8 TeV using data collected in the CMS experiment. W events were selected containing an isolated, energetic electron or muon. Z events were selected containing a pair of isolated, energetic electrons or muons. We present measurements of the DY angular coefficients, AFB, properties of hadronic decays.

Top-quark and ElectroWeak Physics / 1006

Double-boson and triple-boson production from CMS and limits on aTGC and QGC

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Result of merged abstracts:

We present studies of WW, WZ and ZZ diboson production in pp collisions based on data recorded by the CMS detector at the LHC. These include precise measurements the production cross section of these processes at center-of-mass energies of 7 and 8TeV . The leptonic decay modes of the W and Z bosons are used. The results are interpreted in terms of constraints on anomalous triple gauge couplings.

We present measurements of triboson production and VV scattering in pp collisions at 8 TeV center-of-mass energy based on data recorded by the CMS detector at the LHC in 2012. The results are interpreted in terms of constraints on anomalous quartic gauge couplings. estigated. In addition we present studies of exclusive and quasi-exclusive $\gamma\gamma \rightarrow W+W-$ production p-p collisions at the LHC using the CMS detector, and new limits on anomalous quartic couplings.

Top-quark and ElectroWeak Physics / 1007**Measurements of the W charge asymmetry, the weak mixing angle and $Z \rightarrow \mu^+ \mu^-$ in $pp(\bar{p})$ collisions with the D0 detector**Prof. VAN KOOTEN, Rick ¹¹ *Indiana University***Corresponding Author:** rvankoot@indiana.edu

Result of merged abstracts:

We present charge asymmetry measurements from W boson decays in both electron and muon channels, with 7.3 fb⁻¹ to 9.7 fb⁻¹ of Run II data collected by the D0 detector at the Fermilab Tevatron Collider. In the electron channel, we present the lepton asymmetry as a function of the electron transverse momentum and pseudo-rapidity out to $|\eta| \leq 3.2$; we also give the W charge asymmetry as a function of W boson rapidity. These asymmetries are compared with next-to-leading order perturbative quantum chromodynamics calculations. In the muon channel, we present the lepton asymmetry for three kinematic ($p_T(\mu)$, MET) bins. These charge asymmetry measurements will allow more accurate determinations of the proton parton distribution functions.

Using all RunII data collected by the D0 detector at the Fermilab Tevatron Collider, we present measurements of the forward-backward charge asymmetry distribution of e^+e^- as a function of dielectron invariant mass around the Z pole and an extraction of the effective weak mixing angle. The measured value of the weak mixing angle is the most precise from light quark interactions, and comparable to the best LEP and SLD results. We also present measurements of the Z/γ^* variable ϕ . The measurement of ϕ probes the same physical effects as the Z/γ^* boson transverse momentum, but is less susceptible to the effects of experimental resolution and efficiency. The ϕ distribution is measured in three invariant mass regions, and compared with higher-order predictions.

Top-quark and ElectroWeak Physics / 1008**Measurement of the top quark mass and couplings at Linear Colliders**Dr. SIMON, Frank ¹¹ *Max-Planck-Institute for Physics***Corresponding Author:** fsimon@mpp.mpg.de

Result of merged abstracts:

The future precision studies of the Standard Model require excellent knowledge of the top quark mass, to an accuracy of 100 MeV or better. This mass can be measured in a way that is free of any ambiguities from soft QCD by locating the threshold position for e^+e^- annihilation to top quarks, or, more precisely, the mass of the unstable $1S$ resonance. The measurement requires a combination of precise QCD calculations, excellent detection efficiency and recognition of top quark events, and excellent control of the initial beam energy and profile. This contribution will report the current status of this program, with results from full-simulation studies of measurements of the top quark threshold in the detectors proposed for ILC and CLIC.

Models in which the Higgs boson is composite or strongly interacting typically predict modifications of the coupling of the top quark to vector bosons and, in particular, to the Z boson. The production of the top quarks at e^+e^- colliders goes through the top quark couplings to the photon and the Z. Thus, precision studies of this pair production process, including its full dependence on electron and top quark polarization, has the potential to extract the form factors for the top quark couplings with high precision and in a model-independent way. This contribution will report the current status of this program, with results from full-simulation studies of top quark pair production in the detectors proposed for ILC and CLIC.

Top-quark and ElectroWeak Physics / 1009

CMS Measurements of the top quark mass, including alternative techniques and differential measurements

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Result of abstract merging:

Measurements of the top quark mass are presented using data collected by the CMS experiment in proton-proton collisions at the LHC at centre-of-mass energies of 7 and 8 TeV. Analyses in several decay channels of top quark pair events are employed to determine the top quark mass. The results are combined and compared to the world average.

Measurements of the top quark mass employing alternative methods are presented using data collected by the CMS experiment in proton-proton collisions at the LHC in the years 2011 and 2012 at centre-of-mass energies of 7 and 8 TeV. The alternative methods include the use of endpoint distributions as well as the study of possible model dependencies of the top mass measurement on the event kinematics. Measurements of the difference between the masses of top and anti-top quarks are also presented. Furthermore, the top quark mass, and also α_s are extracted from the measured top quark pair cross section.

Top-quark and ElectroWeak Physics / 1010

Measurements of the top quark pair production cross section in pp collisions with CMS

MEYER, Arnd ¹

¹ *RWTH Aachen University*

Corresponding Author: meyera@cern.ch

Result of merged abstracts:

Precision measurements are presented of the top-quark pair inclusive production cross section in proton-proton collisions at the LHC at centre-of-mass energies of 7 TeV and 8 TeV. The data are collected with the CMS experiment during the years 2011 and 2012. The analyses include all top quark pair final states with the exception of events with two tau-leptons in the final state. In most analyses b-jet identification is used to increase the purity of the selection. The backgrounds are determined using data-driven techniques. The results are combined with each other and compared with theory predictions.

Full NNLO+NNLL QCD predictions for the cross section of top-quark pair production are used together with different parton distribution functions (PDFs) to extract the strong coupling constant, α_s , from the cross section measured by the CMS experiment in proton-proton collisions at a center-of-mass energy of 7 TeV.

Flavour Physics / 1011

Branching fraction and CP asymmetry measurements in inclusive $B \rightarrow X_s \gamma$ and $B \rightarrow X_s l+l-$ decays

ANULLI, fabio¹

¹ *INFN Rome*

Corresponding Author: fabio.anulli@roma1.infn.it

We use the large dataset collected with the BABAR detector to measure the branching fractions and CP asymmetries of the inclusive decays $B \rightarrow X_s l+ l-$ and $B \rightarrow X_s \gamma$. We adopt a sum-of-exclusive-states method, whereby 20 different final states are selected.

The branching fraction and CP asymmetry for $B \rightarrow X_s l+ l-$ are measured in intervals of q^2 (di-lepton invariant mass) and also in bins of $m(X_s)$, the hadronic mass. Simulation is used to extrapolate to the fully inclusive rate.

We also report the CP asymmetry for $B \rightarrow X_s \gamma$, and the first measurement of the difference between ACP for charged and neutral decay modes, $\Delta A(X_s \gamma)$. Using the value obtained, we provide 68% and 90% confidence intervals on the imaginary part of the ratio of the Wilson coefficients corresponding to the chromo-magnetic dipole and the electromagnetic dipole transitions.

Education and Outreach / 1012

ATLAS Public Outreach - Content, Platforms and Strategy of ATLAS Education & Outreach

Dr. GOLDFARB, Steven¹

¹ *University of Michigan*

Corresponding Author: steven.goldfarb@cern.ch

The ATLAS Education & Outreach program supports a wide variety of projects designed to communicate the goals and accomplishments of the ATLAS Experiment to the general public. Essential to the implementation of these projects are a well structured and current communication plan, an active core group with diverse expertise, and an engaged and imaginative collaboration. We present a small sampling of current projects, describe their goals, messages and target audiences, and then discuss how the Outreach program is supporting these projects. Detailed descriptions of the projects are presented separately in the accompanying poster session.

Poster Session / 1013

ATLAS Public Web Pages

Dr. GOLDFARB, Steven¹

¹ *University of Michigan*

Corresponding Author: steven.goldfarb@cern.ch

The heart and soul of nearly any major communication effort (at least during the post-web era) is its public home page. This is the platform that introduces the audience to the look, feel and purpose of the organization. It is where one learns of goals and accomplishments, news and features, general principles, specific details, and where to find more information about the latest discovery. This is certainly the case for the ATLAS Experiment, which is currently undergoing a complete rebuild of its public web site, including a new design, new organizational structure, and a new supporting infrastructure, based on a content management system. We present a glimpse of the research made over the past year to prepare for the design and implementation of our new public web site, including audience surveys, stakeholder interviews, and the reasoning behind our choices for infrastructure, navigational structure and content.

Neutrino Physics / 1014

Quasi-Elastic Scattering in MINERvA

Corresponding Author: sorel@fnal.gov

MINERvA (Main INjector Experiment for ν -A) has recently measured neutrino and antineutrino quasi-elastic cross-sections on plastic (CH) scintillator. These results will provide insight into neutrino and anti-neutrino cross sections off of nuclear targets which are important for neutrino oscillation experiments and the probing of the nuclear medium. We will focus on these results and how they compare to the predictions of various nuclear models simulated in the GENIE and NuWro generators. In addition we will present results from a similar analysis of charged current quasi-elastic-like interactions where a final state muon and proton have been identified, but where the kinematics of the event are determined by the leading proton rather than the muon.

Neutrino Physics / 1015

Studies of the Nuclear Environment in MINERvA

Corresponding Author: sorel@fnal.gov

MINERvA (Main INjector Experiment for neutrino-A) is a few-GeV neutrino nucleus scattering experiment at Fermilab that probes the nuclear environment in both inclusive charged current interactions off various targets, and by studying in detail the process of pion production on Carbon, which itself is sensitive to the nuclear environment through final state interactions. An analysis of the nuclear dependence of inclusive charged-current neutrino scattering using events in carbon, iron, lead, and scintillator targets of the MINERvA detector will be presented and compared to models. In addition a measurement of the differential cross-sections for muon-neutrino charged current charged pion production in the MINERvA active plastic target will be discussed. Both results are of great interest to high energy and nuclear physics and increasingly important for neutrino oscillation experiments.

Beyond the Standard Model / 1016

Search for heavy resonances with the ATLAS and CMS detector

ATLAS SPEAKER, on behalf of ATLAS and CMS ¹

¹ CERN

Corresponding Author: tobias.golling@cern.ch

Resonances decaying into a pair of particles are an obvious place to look for phenomena beyond the Standard Model. This talk summarizes recent results on searches for resonances in pairs of jets, leptons, lepton and jet, photon and jet, as well as pairs of photons. Various models are considered such the Z' and W' , the Randall-Sundrum warped extra dimensions as excited quarks, quantum black holes, technicolor. Results from $\sqrt{s} = 8$ TeV are presented.

Beyond the Standard Model / 1017

Searches for long-lived particles, lepton-jets, stable and meta-stable particles with the ATLAS detector

ATLAS SPEAKER, on behalf of ATLAS ¹

¹ CERN

Corresponding Author: tobias.golling@cern.ch

Several extensions of the Standard Model like supersymmetric scenarios predict the existence of massive long-lived particles, and some of these postulate the existence of a hidden sector of particles. We report on searches for production of long-lived particles resulting in displaced vertices, abnormal specific energy loss, appearing or disappearing tracks, or collimated lepton-jets. The talk presents results of analyses using data recorded in 2012 at $\sqrt{s}=8$ TeV centre-of-mass energy by the ATLAS experiment at the LHC.

Beyond the Standard Model / 1018

Searches for supersymmetry in resonance production and R-parity violating prompt signatures with the ATLAS and CMS detector

ATLAS SPEAKER, on behalf of ATLAS and CMS ¹

¹ CERN

Corresponding Author: tobias.golling@cern.ch

In R-parity violating supersymmetric scenarios sparticles can be produced individually or in pairs with rates that are detectable at the LHC. This talk presents recent results from searches for resonant production and R-parity violating prompt signatures in multi-lepton and multi-jet final states in the data sample recorded by the ATLAS and CMS detectors.

Beyond the Standard Model / 1019

Prospects for BSM searches at the high-luminosity LHC with the ATLAS detector

ATLAS SPEAKER, on behalf of ATLAS and CMS ¹

¹ CERN

Corresponding Author: tobias.golling@cern.ch

Discovering new physics beyond the Standard Model is a primary goal of research at the LHC. Recent searches by ATLAS and CMS, using data taken at a centre-of-mass energy of 8 TeV, have already probed a considerable fraction of the parameter space for a wide variety of models. The discovery reach is expected to be considerably extended at higher energy. The high-luminosity phase of upgraded LHC will provide datasets with a total integrated luminosity of about 3 ab⁻¹, allowing ATLAS to probe new physics well beyond the reach of the first 0.3 ab⁻¹ of 14 TeV running. In this talk, the prospects of ATLAS searches for new heavy bosons, dark matter candidates, inclusive strong production of squarks and gluinos, direct production of 3rd generation squarks and weak production of electro-weakinos at the 14 TeV LHC are presented. The results make use of parametrisations of the expected performance of the LHC for the first 0.3 ab⁻¹ of 14 TeV running and for the high-luminosity phase.

Beyond the Standard Model / 1021

Searches for vector-like quarks and heavy resonances decaying to 3rd generation quarks with the CMS detector

MEYER, Arnd ¹; MOORTGAT, Filip ²

¹ *RWTH Aachen University*

² *CERN*

Corresponding Author: filip.moortgat@cern.ch

In many models of physics beyond the Standard Model the coupling of new physics to third generation quarks is enhanced. We present a review of searches for heavy particles beyond the standard model decaying to final states with top and bottom quarks. This includes searches for heavy gauge bosons and excited states, as well as vector-like quarks. The searches span a range of final states, from multi-leptonic to entirely hadronic. We use data collected with the CMS experiment during the year 2012, in proton-proton collisions at the LHC at a centre-of-mass energy of 8 TeV.

Beyond the Standard Model / 1022

Search for SUSY with extremely compressed spectra using the ATLAS and CMS detector

MEYER, Arnd ¹; MOORTGAT, Filip ²

¹ *RWTH Aachen University*

² *CERN*

Corresponding Author: filip.moortgat@cern.ch

Searches that target SUSY with extremely compressed spectra are presented using the ATLAS and CMS detectors. This includes monojet signatures, with or without "c-tagging", as well as data taken with specially loose trigger conditions during the 8 TeV LHC run in 2012.

Beyond the Standard Model / 1023

Search for leptoquark signatures with the ATLAS and CMS detectors

MEYER, Arnd ¹; MOORTGAT, Filip ²

¹ *RWTH Aachen University*

² *CERN*

Corresponding Author: filip.moortgat@cern.ch

The most recent results on searches for 1st, 2nd, and 3rd generation leptoquarks with the ATLAS and CMS experiment are presented. Alternative interpretations of the searches for R-parity-violating stop squark decays are also presented.

Beyond the Standard Model / 1024

Search for Beyond the Standard Model Physics in multi-leptonic and photonic final states with the CMS detector

MEYER, Arnd ¹; MOORTGAT, Filip ²

¹ RWTH Aachen University

² CERN

Corresponding Author: filip.moortgat@cern.ch

In this talk, the latest results from CMS on searches for beyond the Standard Model physics in final states with 2, 3, 4 (or more) leptons and with photons are presented using 20/fb of data from the 8 TeV LHC run. A variety of complementary final state signatures and methods are used to probe new physics.

Top-quark and ElectroWeak Physics / 1025

Measurement of the charged and neutral current DY process, forward-backward asymmetry and the determination of the weak mixing angle with the ATLAS detector

ATLAS, Collaboration ¹

¹ CERN

Corresponding Author: lroos@lpnhe.in2p3.fr

Result of merged abstracts:

Charged and neutral current Drell Yan cross sections are sensitive to the parton distribution functions of the proton and electroweak corrections. The measurements of the neutral current DY process in three distinct kinematic regions, i.e. at the Z boson mass peak, below and above, are performed by the ATLAS collaboration using 7 TeV proton-proton collision data. The results are compared to NLO Monte Carlo simulations and to NNLO QCD predictions corrected for NLO EW effects calculated using various parameterizations of the parton distribution functions.

A measurement of the forward-backward asymmetry for the neutral current Drell Yan process is presented. The asymmetry is measured using dielectron and dimuon final states with $\sqrt{s} = 7$ TeV data collected by the ATLAS detector. For the dielectron channel, the measurement includes electrons detected in the forward calorimeter which extends the covered phase space to the region less sensitive to the uncertainties of the parton density functions. The forward-backward asymmetry spectra in all channels are found to be consistent with the corresponding Standard Model predictions. The results are then used to extract a measurement of the effective weak mixing angle. The result is compared with the measurements from LEP, SLD, D0, CDF and CMS.

Beyond the Standard Model / 1026

Search for heavy resonances decaying to bosons with the ATLAS and CMS detectors

MEYER, Arnd ¹; MOORTGAT, Filip ²

¹ RWTH Aachen University

² CERN

Corresponding Author: filip.moortgat@cern.ch

The search for heavy resonances involving bosons in ATLAS and CMS are presented. These final states include diphoton, VV, VH, and HH resonances.

Beyond the Standard Model / 1028

Prospects for BSM searches at the high-luminosity LHC with the CMS detector

MEYER, Arnd ¹; MOORTGAT, Filip ²

¹ *RWTH Aachen University*

² *CERN*

Corresponding Author: filip.moortgat@cern.ch

Aspects of the Supersymmetry & other BSM search programme for the High Luminosity LHC are discussed. These include the expected discovery reach for strongly and weakly interacting Susy particles. We also discuss some example measurements the HL-LHC will allow if evidence of new physics is found during Run 2 or Run 3 of the LHC.

Beyond the Standard Model / 1029

Searches for exotica at Belle

Prof. KWON, Youngjoon ¹

¹ *Yonsei University*

Corresponding Author: filip.moortgat@cern.ch

Searches for exotic phenomena at Belle are presented.

Beyond the Standard Model / 1030

Searches for exotica at Babar

ANULLI, fabio ¹

¹ *INFN Rome*

Corresponding Author: filip.moortgat@cern.ch

Searches for exotic phenomena at Babar are presented.

Beyond the Standard Model / 1031

Searches for exotica at LHCb

LEROY, Olivier ¹

¹ *CPPM, Aix-Marseille Université CNRS/IN2P3, Marseille, France*

Corresponding Author: filip.moortgat@cern.ch

Searches for exotic phenomena at LHCb are presented.

Neutrino Physics / 1032**Analysis of muon and electron neutrino charged current interactions in the T2K near detectors**

Corresponding Author: sorel@fnal.gov

We present the updated measurement of the muon neutrino interaction rates and spectrum at the T2K near detector complex, ND280, located at the JPARC accelerator facility in Tokai, Japan, 280 meters downstream from the target. The measurements are obtained using all the data collected until 2014. The spectrum measured at ND280 off-axis detector constrains the flux and cross section uncertainties in the T2K oscillation analysis. The great reduction of these uncertainties was achieved thanks to the selection method of the charged-current events in the tracker, in which the selected events are divided into three subsamples based on the charged pion multiplicity in the final state, and fitting the muon spectrum separately for each subsample. The subsamples will be also used to determine the inclusive and exclusive cross section for the T2K flux. The prospects for the future measurements will be presented, including running with anti-neutrino mode beam. The on-axis detector (INGRID) at 280 m was used to select charged current events in the 2014 data as well, and results will be presented on the measurement of the cross sections for the inclusive, quasi elastic and coherent pion production.

The main and irreducible background to the observation of ν_e appearance in T2K comes from the presence of a small intrinsic ν_e component in the beam originating from muon and kaon decays. This component is expected to represent 1.2% of the total neutrino flux and it has been measured using the Near Detector (ND280) Tracker. A 65% pure sample of ν_e charged current (CC) interactions is selected by combining the particle identification capabilities of the time projection chambers and of the electromagnetic calorimeters of ND280. The measured ratio between the observed beam ν_e component and the prediction is 1.01 ± 0.10 providing a direct confirmation of the neutrino fluxes and neutrino cross section modeling used for all the T2K neutrino oscillation analyses. Also the differential ν_e CC cross section in electron momentum, angle, and Q^2 is measured, along with the total flux-averaged cross section.

Poster Session / 1033**Recent results from the T2K ND280 Detector**

Corresponding Author: sorel@fnal.gov

The T2K near detector complex, ND280, is located at the JPARC accelerator facility in Tokai, Japan, 280 meters downstream from the target. This poster will summarize recent physics results from ND280.

Detector RD and Performance / 1034**The Mu2e Straw Tube Tracker and Crystal Calorimeter of the Mu2e Experiment**CORCORAN, Marjorie ¹¹ *Rice University***Corresponding Author:** demarteau@anl.gov

The Mu2e experiment will search for neutrinoless conversion of muons into electrons in the field of an aluminum nucleus. The signature of this process is a 105 MeV electron. Precise and robust measurement of the outgoing electron momentum, along with powerful background rejection, are essential elements of the experiment. We describe the unique features of the low-mass straw tube tracker and the crystal calorimeter that meet these stringent requirements. The tracking and calorimeter systems must operate in a vacuum and a 1 Tesla magnetic field. The tracker consists of about 20,000 thin-wall Mylar straws held under tension to avoid the need for supports within the active volume. In addition to measuring distance from the wire by drift time, subnanosecond measurement of signal propagation time is used to measure position along the wire. Charge will be measured using ADCs to provide particle identification capability. The calorimeter confirms the identity of conversion electrons found in the tracker, aids in track reconstruction by providing a seed cluster, and, using timing and E/p information, rejects cosmic ray muons that evade the cosmic ray veto system. The calorimeter consists of two disks, each containing 930 crystals of barium fluoride (BaF₂). The readout of the fast scintillation component of BaF₂ at 220 nm will be done with high efficiency by a large area UV-sensitive APD that incorporates an interference filter to discriminate against the more intense slow scintillation component at 300nm.

Top-quark and ElectroWeak Physics / 1037**Constraining top-Z couplings through tt̄+Z production at the LHC**Dr. RONTSCH, Raoul ¹; Dr. SCHULZE, Markus ²¹ *Fermilab*² *CERN***Corresponding Author:** sheltonj@illinois.edu

The LHC has observed top-pair production in association with electroweak gauge bosons in the 7 TeV dataset, with many more events expected at the higher energy and luminosity run. This allows the EW interactions of the top, previously only constrained indirectly, to be investigated directly. I will present a calculation of tt̄+Z production to NLO in QCD, including decays of the top and Z boson in the narrow-width approximation, and retaining all spin correlations. Using this calculation, I will put constraints on the top-Z coupling from the measured CMS 7 TeV cross-section. Using the opening angle of the leptons arising from the Z decay, I will consider future constraints from the 13 TeV LHC run. In both cases, the lower scale uncertainty and reasonably large k-factor associated with the NLO predictions allows greater sensitivity to the top-Z couplings.

Computing and Data Handling / 1038**CMS Computing Preparations for Run2**FISK, Ian ¹; Dr. GIRONE, Maria ²¹ *FNAL*² *CERN***Corresponding Author:** ifisk@fnal.gov

The CMS Computing system was successfully commissioned and operated in the first run of LHC. Beginning in 2015, CMS will collect, process, simulate and analyze 1kHz of higher complexity, higher energy events. In order to meet this increased computing challenge within the resource budget expected, we have had to evolve the computing model and the techniques used. In this presentation we will discuss the challenges expected in Run2 and the choices made to try to mitigate them. We will outline the improvements in the processing system and the goal to maximize flexibility in how processing resources are used. We will present how the primary reconstruction will be distributed between CERN and the global network of Tier-1 processing centers, and we will show the progress made in allowing resources to be shared across workflows. We will show the development and deployment status of the CMS data federation and how this is expected to reduce the growth of disk resources needed to facilitate analysis, and we will present the progress on a new analysis submission tool for CMS.

Detector RD and Performance / 1039**CLIC detector: performance optimisation for e+e- physics above 1 TeV and status of the corresponding R activities**Dr. LINNSEN, Lucie ¹¹ *CERN***Corresponding Author:** felix.sefkow@desy.de

Detectors at CLIC are optimised for precision e+e- physics at multi-TeV centre-of-mass energies, as well as for the CLIC-specific beam timing conditions and beam-induced background processes. The talk will provide an overview of these requirements, illustrated on the basis of example physics benchmark processes, and show how optimal physics performance can be achieved under these conditions. The resulting requirements set very high demands on sub-detector capabilities. The vertex and tracking detectors require very small cell sizes and hit timing at the 10 ns level, as well as ultra-low mass, facilitated by power pulsing and air cooling. The calorimetry calls for ultra dense solutions with high granularity, large dynamic range and hit timing at the 1 ns level. Detector R following these stringent requirements is progressing well in several areas. A status report on the innovative detector R efforts for CLIC will be included in the presentation.

Detector RD and Performance / 1040**Optimization of a detector for the ILC**BEHNKE, Ties ¹; STANITZKI, Marcel ¹; Prof. WHITE, Andy ²¹ *DESY*² *U. Texas at Arlington***Corresponding Author:** demarteau@anl.gov

The two detector concepts for the International Linear Collider, SiD and ILD, were described in the Detailed Baseline Design documents, which are part of the ILC Technical Design Report. These designs represented a large body of work on detector prototyping and physics studies. Together, these studies established the feasibility of constructing these detectors to address the full range of the ILC physics program.

After the discovery of the Higgs particle at CERN many of the requirements for a detector at the ILC have been sharpened. In addition, as work has continued to carry prototyping work into realistic sections of the future detectors, opportunities for improvement and optimization have naturally arisen both in terms of physics performance and cost. Such opportunities are also enhanced by the further development of advanced technologies. This talk will focus on these opportunities with examples from vertex detectors, the main tracking systems, and the electromagnetic and hadronic calorimeters from both SiD and ILD.

Detector RD and Performance / 1041**Engineering Challenges for detectors at the ILC**BEHNKE, Ties ¹; Prof. WHITE, Andy ²; STANITZKI, Marcel ¹¹ *DESY*² *U. Texas at Arlington***Corresponding Author:** demarteau@anl.gov

Over the last years two proposals for experiments at the ILC have been developed. Extensive R has been carried out around the world to develop the needed technologies. Furthermore a first round of engineering studies was made as part of the ILC TDR to understand the integration of these different sub-systems into coherent and integrated detector concepts. Among the key challenges for the subdetectors are the extreme low mass/ low power requirements or the extreme channel densities needed in particle flow based detectors. Throughout these studies special care was taken to ensure that the engineering models and the simulation models, used in studies of the physics capabilities of the detectors, stay synchronized. In the near future, the models will need to be evolved to take the special requirements of the potential ILC site in Japan into account. In this talk, the state of the integration of the detectors, and the future directions, will be discussed.

Lattice QCD / 1042**Non-perturbative results for large-N gauge theories**Prof. LUCINI, Biagio ¹¹ *University of Swansea***Corresponding Author:** b.lucini@swansea.ac.uk

It has been known for a long time that large-N methods can give invaluable results into non-perturbative phenomena such as confinement. Lattice techniques can be used to compute quantities at large N. In this talk, I will review some recent large-N lattice results and discuss their implications for our understanding of non-perturbative QCD.

Strong Interactions and Hadron Physics / 1043**Double Parton Studies at D0: Measurements of the prompt single J/psi and double J/psi production cross section and studies of photon + 3 jets events and photon +b/c+2 jet events**D0 COLLABORATION, et al. ¹¹ *Fermi National Accelerator Laboratory***Corresponding Author:** rvankoot@indiana.edu

We present measurements of the production cross section of prompt J/psi mesons, as well as the cross section of simultaneous production of two prompt J/psi mesons, in proton-antiproton collisions at $\sqrt{s}=1.96$ TeV using 8.1 fb⁻¹ of Tevatron data collected by the D0 experiment. The latter cross section is separated into contributions due to single parton and double parton (DP) scatterings. Using these measurements, the effective cross section, a parameter characterizing an effective spatial area of parton-parton interaction and tightly related to the parton spatial density inside the nucleon, is also measured.

We have also used a sample of photon + 3 jets as well as photon + b/c + 2 jet events collected by the D0 experiment with an integrated luminosity of 8.7 fb⁻¹ to determine the fraction of events with hard DP scattering in a single proton-antiproton collision. The DP fraction and effective cross section are measured in three different kinematic regions.

Strong Interactions and Hadron Physics / 1044**NNPDF3.0: Next Generation PDFs for LHC Run II**Dr. ROJO, Juan ¹¹ *University of Oxford***Corresponding Author:** forte@mi.infn.it

PDFs have been an essential ingredient for Run I phenomenology, and will be so even more at the upcoming Run II. Many crucial LHC analysis benefit from improved PDFs, from precision Standard Model measurements, like the W mass determination, and Higgs boson characterization to BSM searches. NNPDF3.0 is the new forthcoming PDF release from the NNPDF Collaboration, a major upgrade that accounts for recent progress in experimental constraints, theory calculations and methodological improvements. In this talk I will present in detail the new NNPDF3.0 set, and discuss the improvements in new experimental data such as the HERA-II structure functions, ATLAS and CMS jets, CMS W+charm, ATLAS and CMS Drell-Yan production and top quark production, the improved theory calculations such as approximate NNLO K-factors for jets and electroweak effects for Drell-Yan data, and the brand-new fitting methodology with the C++ rewriting of the code and fitting strategy validated on closure tests. Finally I explore the phenomenological implications of NNPDF3.0 for the LHC Run II

Strong Interactions and Hadron Physics / 1046

QCD at NNLO and beyond

Dr. DUHR, Claude ¹

¹ *Durham University*

Corresponding Author: forte@mi.infn.it

I review the current status of higher-order calculations in perturbative QCD, with special regards to recent developments, and process of interest for physics at the LHC.

Strong Interactions and Hadron Physics / 1047

Resummation and jet vetos

Dr. MONNI, Pier Francesco ¹

¹ *Durham University*

Corresponding Author: forte@mi.infn.it

I review recent developments in resummation in perturbative QCD, with special regards to its application to the computation of observables involving jets and jet vetos.

Strong Interactions and Hadron Physics / 1048

Automated tools for QCD calculations

Dr. BADGER, Simon ¹

¹ *CERN*

Corresponding Author: forte@mi.infn.it

I review recent progress in the development of automated tools for QCD calculations, especially at NLO, and their application to LHC processes.

Plenary Session / 1049

IUPAP-C11 report

Dr. SCHELLMAN, Heidi ¹

¹ *Northwestern University (United States)*

Corresponding Author: schellma@fnal.gov

Plenary Session / 1050

ICFA report

MNICH, Joachim ¹

¹ *DESY*

Corresponding Author: joachim.mnich@desy.de

Poster Session / 1051**Search for an Invisible Decaying Higgs Boson in Dilepton Events at CDF**Ms. PRINCIPATO, Cristiana ¹¹ *Fermilab***Corresponding Author:** denisovd@fnal.gov

A direct search at CDF for an exotic Higgs boson that decays to invisible particles is reported. The simplest $H \rightarrow$ invisible Standard Model (SM) process has a branching ratio of 10^{-3} . However, Higgs boson decays to invisible particles can be significantly enhanced in many BSM models. One of the cleanest signatures in searching for this process is when the Higgs boson is produced in association with a Z boson that decays to a charged dilepton pair. In this analysis we model the ZH signal assuming the SM production cross section and a $H \rightarrow$ invisible branching ratio of 100%. We investigate several Higgs mass hypotheses from 115 to 150 GeV/ c^2 , and place 95% credibility level limits on Higgs boson production in this final state. The results here use the full CDF data set corresponding to 9.7 fb^{-1} of luminosity.

Strong Interactions and Hadron Physics / 1052**Updates of PDFs for the 2nd LHC run**Dr. MOTYLINSKI, Patrick ¹¹ *UCL***Corresponding Author:** forte@mi.infn.it

Abstract: In this talk I will present results on continuing updates in PDFs within the MSTW framework due to both theory improvements and the inclusion of new data sets, including most of the up-to-date LHC data. A new set of PDFs is close to being finalised, with no significant changes expected to the PDFs presented here.

Poster Session / 1053**Measurement of the Higgs boson mass from the $H \rightarrow \gamma\gamma$ and $H \rightarrow ZZ^* \rightarrow 4l$ channels with the ATLAS detector at the LHC**ROOS, Lydia ¹¹ *CERN***Corresponding Author:** savard@physics.utoronto.ca

This poster presents an updated measurement of the Higgs boson mass with the combined fit of two decay channels $H \rightarrow ZZ^* \rightarrow 4l$ and $H \rightarrow \gamma\gamma$. The analyses are based on 4.6 fb^{-1} and 20.7 fb^{-1} of proton-proton collisions at centre of mass energies of 7 TeV and 8 TeV respectively, recorded with the ATLAS detector at the LHC. This result is based on updated energy-scale calibrations for photons, electrons, and muons, as well as other analysis improvements.

Poster Session / 1054

Study about Neutrino Oscillation and Dissipative Effect in LBNE

OLIVEIRA, Roberto ¹; GUZZO, Marcelo ²; DE GOUVEA, Andre ³

¹ *Universidade Estadual de Campinas and Northwestern University*

² *Universidade Estadual de Campinas*

³ *Northwestern University*

Corresponding Author: robertol@ifi.unicamp.br

Astroparticle Physics and Cosmology / 1055

Status of CoGeNT and C-4, and progress towards PICO-250l, a large bubble chamber for dark matter detection

Dr. COLLAR, Juan ¹

¹ *U. Chicago*

Corresponding Author: cortina@ifae.es

We will discuss the status of CoGeNT and C-4, searches for low-mass WIMPs below 10 GeV/c². The performance of the first C-4 detector will be presented and compared to the previous generation of p-type point contact germanium detectors, employed in CoGeNT. First results from a sophisticated energy-time analysis of the 3.4 year CoGeNT dataset will be shown. This analysis considers not only the possibility of a WIMP signal from standard and non-standard galactic haloes, but also signatures from axion-like particles, as well as other scenarios able to account for a low-significance annual modulation.

We will also discuss the ongoing status of PICO-250l, a large bubble chamber containing C3F8 or CF3I, to be installed at SNOLAB. PICO is the merger of the PICASSO and COUPP collaborations. Ongoing related activities at SNOLAB (PICO-2l and COUPP-60) will be presented.

Future accelerator facilities and open discussion / 1056

Regional strategies and roadmaps. Community vision: Asia

Future accelerator facilities and open discussion / 1057

Regional strategies and roadmaps. Community vision: Europe

Corresponding Author: manfred.krammer@oeaw.ac.at

Poster Session / 1058

Study about Neutrino Oscillation and Dissipative Effect in LBNE

OLIVEIRA, Roberto ¹; Prof. DE GOUVEA, Andre de Gouvea ²; GUZZO, Marcelo ³

¹ *Universidade Estadual de Campinas and Northwestern University*

² *Northwestern University*

³ *Universidade Estadual de Campinas*

Corresponding Author: sorel@fnal.gov

In this work we show a complete development for three neutrino oscillation taking into account the matter effect from the open quantum system approach. Open quantum system approach has a rigorous set of the statements and when it is applied on neutrino oscillation, due to dissipative phenomena, the neutrinos exhibit new and peculiar effects, in special, decoherence and relaxation. We use the most effective dissipators and we study which the possible neutrino behavior considering the LBNE experiment. LBNE is an experiment that belongs to next generation of the experiments and it will go to test the actual paradigm of neutrino oscillation. So, the study about which kind of the unusual effects that can happen it is important. In particular, we show how each kind of dissipative effect is linked to each mixing angle and consequently, we can leave evident the new effect in the survival and appearance probabilities. Interesting enough, in the LBNE case we present a new behavior at matter resonance region that can be seen even when the dissipative effect is small compared with energy dependent oscillation parameters.

Accelerator Physics and Future Colliders / 1059

Fermilab Accelerator Complex Proton Improvement Plan II

Dr. PEGGS, Stephen ¹; Dr. TAUCHI, Toshiaki ²

¹ *BNL*

² *High Energy Accelerator Reserach Organization, KEK*

Corresponding Author: toshiaki.tauchi@kek.jp

Fermilab has proposed a plan for upgrading the Fermilab proton accelerator complex using Superconducting Radio Frequency Linac that would deliver in excess of 1 MW proton beam to the neutrino production target at the initiation of the Long Baseline Neutrino Experiment. The plan is structured to deliver, in a cost effective manner, more than 1 MW of beam power to LBNE while creating a flexible platform for longer-term development of the Fermilab complex to multi-MW capabilities in support of a broader research program, as future resources become available.

Poster Session / 1060

Simulation of the MoEDAL experiment

Dr. KING, Matthew ¹; Dr. MITSOU, Vasiliki ²

¹ *IFIC*

² *IFIC Valencia*

Corresponding Author: matthew.king@ific.uv.es

The MoEDAL experiment (Monopole and Exotics Detector at the LHC) is designed to directly search for magnetic monopoles and other highly ionising stable or metastable particles at the LHC. The MoEDAL detector comprises an array of plastic Nuclear Track Detectors deployed around the P8 intersection region of the LHCb detector, combined with trapping volumes for capturing charged highly ionising particles and TimePix pixel devices for monitoring. The passive detector elements do not require a trigger, electronic readout or computerised data acquisition, therefore the software components mainly concern the simulation rather than digitisation or reconstruction. In this talk we present the current status of the MoEDAL simulation software. Specifically we focus on the material description --within the Geant4 framework-- of the detector geometry including its cavern surroundings. We also discuss Geant4 simulation studies on the propagation of monopoles and highly-charged particles through the MoEDAL material.

Closed meeting : Linear Collider Board (LCB) / 1061

Linear Collider Overview

Corresponding Author: lyn.evans@cern.ch

Closed meeting : Linear Collider Board (LCB) / 1062

ILC Status

Closed meeting : Linear Collider Board (LCB) / 1063

CLIC Status

Corresponding Author: steinar.stapnes@cern.ch

Closed meeting : Linear Collider Board (LCB) / 1064

Linear Collider Detector Status

Corresponding Author: akira.yamamoto@kek.jp

Closed meeting : Linear Collider Board (LCB) / 1065

LCB Subcommittee 1 on Governance, etc.

Closed meeting : Linear Collider Board (LCB) / 1066

LCB Subcommittee 2 on an International Agreement for the ILC Project

Closed meeting : Linear Collider Board (LCB) / 1067

Regional Reports (3x10)

Corresponding Author: gaoj@ihep.ac.cn

Closed meeting : Linear Collider Board (LCB) / 1068

Future LCB Meetings

Closed meeting : Linear Collider Board (LCB) / 1069

Any Other Business

Closed meeting : International Committee for Future Accelerators (ICFA) / 1070

FALC Report

Closed meeting : International Committee for Future Accelerators (ICFA) / 1071

ILC Progress in Japan

Closed meeting : International Committee for Future Accelerators (ICFA) / 1072

US HEP Future Planning

Closed meeting : International Committee for Future Accelerators (ICFA) / 1073

Global Planning for HEP, including a 100 TeV Collider

Closed meeting : International Committee for Future Accelerators (ICFA) / 1074

ICFA Seminar

Closed meeting : International Committee for Future Accelerators (ICFA) / 1075

Future ICFA Meetings

Closed meeting : International Committee for Future Accelerators (ICFA) / 1076

Any Other Business

Poster Session / 1077

Searches for invisibly decaying Higgs Boson with ATLAS

ROOS, Lydia ¹

¹ *CERN*

Corresponding Author: savard@physics.utoronto.ca

A theoretically well motivated and interesting decay channel of the Higgs boson involves stable weakly interacting or neutral particles that do not interact with the detector. Searches have been performed in proton-proton collisions at the LHC using the ATLAS Detector for an invisibly decaying Higgs Boson produced in association with a Z Boson, and with an additional jet leading to a jet plus missing transverse energy signature.

Welcome by Academic and Scientific Authorities / 1078

Chair of the Spanish Research Council (CSIC)

Welcome by Academic and Scientific Authorities / 1079

Vicerector of the University of Valencia for Research and Scientific Policy

Welcome by Academic and Scientific Authorities / 1080

Chair of the Spanish Royal Society of Physics

Welcome by Academic and Scientific Authorities / 1081

Spanish Scientific Manager for Particle Physics (MINECO)

Poster Session / 1082

One-loop computations from the Electroweak Chiral Lagrangian with a light HiggsMr. DELGADO LÓPEZ, Rafael ¹¹ *Dep. Física Teórica I, Universidad Complutense de Madrid (UCM)***Corresponding Author:** rdelgadol@ucm.es

Recently, a new boson has been discovered at LHC which, so far, fits the properties of the SM Higgs boson. This would make the SM unitary. However, the SM is not the more general low-energy dynamics for the minimal electroweak symmetry breaking sector with three Goldstone bosons and one light scalar.

By using the more general low energy effective Lagrangian for these four particles and their scattering amplitudes, we study different processes at one-loop precision, identifying the counterterms needed to cancel the divergences. Our aim is using the unitarization methods over a partial wave decomposition of these one-loop computations, both to make phenomenological prediction which can be tested at LHC run II and to discuss the limitations of the one-loop computations. The studied processes are the elastic scattering amplitude for both the longitudinal components of the gauge bosons $V=W, Z$ and the $\varphi\varphi \rightarrow \varphi\varphi$, as well as the inelastic $VV \rightarrow \varphi\varphi$. Furthermore, we have studied the scattering processes $\gamma\gamma \rightarrow W_L^+ W_L^-$ and $\gamma\gamma \rightarrow ZZ$.

Poster Session / 1083

Identification of hadronically decaying tau leptons with the ATLAS experimentROOS, Lydia ¹¹ *CERN***Corresponding Author:** demarteau@anl.gov

The offline identification algorithm employed for hadronic decays of tau leptons for the data collected in 2012 with the ATLAS detector at the LHC operating at a center-of-mass energy of 8 TeV is described. It consists of two Boosted Decision Trees including both tracking and calorimetric information to discriminate hadronically decaying tau leptons from hadronic jets and electrons. The performance of this algorithms is measured in most cases with Z decays to tau leptons.

The offline tau identification efficiency is measured with a precision of (2-3)% for hadronically decaying tau leptons with one associated track, and of (4-5)% for the case of three associated tracks, inclusive in η and for a visible transverse momentum greater than 20 GeV. Stability of the performance and through the data taking period is observed with respect to the number of concurrent proton-proton interactions.

Industrial opportunities in future High Energy Physics projects / 1084

Future new projects and windows of opportunities at CERN**Corresponding Author:** jose.miguel.jimenez@cern.ch

Industrial opportunities in future High Energy Physics projects / 1085

Perspectives in China for future experiments in particle Physics

Corresponding Author: gaoj@ihep.ac.cn

Industrial opportunities in future High Energy Physics projects / 1086

The International Linear Collider in Japan

Corresponding Author: akira.yamamoto@kek.jp

Industrial opportunities in future High Energy Physics projects / 1087

Prospects for future accelerator based experiments in the US

Corresponding Author: peggs@bnl.gov

Industrial opportunities in future High Energy Physics projects / 1088

Accelerator activities in Spain. CONECTA: Spanish Coordination on Accelerator's Science and Technology

Corresponding Author: jm.perez@ciemat.es

Industrial opportunities in future High Energy Physics projects / 1089

Open discussion on industrial opportunities in future projects of particle physics

Poster Session / 1090**ANAIS: Status and prospects**

Dr. MARTÍNEZ, María ¹; AMARÉ, Julio ¹; OLIVÁN, Miguel Ángel ¹; ORTIGOZA, Ysrael ¹; ORTIZ DE SOLÓRZANO, Alfonso ¹; POBES, Carlos ¹; PUIMEDÓN, Jorge ¹; SARSA, María Luisa ¹; VILLAR, Miguel Ángel ¹; VILLAR, Patricia ¹; CEBRIÁN, Susana ¹; CUESTA, Clara ¹; GARCÍA, Eduardo ¹; GINESTRA, Carlos ¹

¹ UZ

Corresponding Author: zornoza@ific.uv.es

ANAIS (Annual modulation with NAI Scintillators) experiment will look for dark matter annual modulation with 250 kg of ultra-pure NaI(Tl) scintillators at the Canfranc Underground Laboratory (LSC), aiming to confirm the DAMA/LIBRA positive signal in a model-independent way. The detector will consist in 20 close-packed single modules, each of them coupled to two high efficiency Hamamatsu photomultipliers. Two 12.5 kg each NaI(Tl) crystals provided by Alfa Spectra are currently taking data at the LSC. The outstanding light collection efficiency obtained with these prototypes (12- 16 phe/keV) allows us to anticipate an energy threshold of the order of 1 keVee. ANAIS crystal radiopurity goals are fulfilled for 40K and 232Th and 236U chains, but a 210Pb contamination out-of-equilibrium has been identified, whose origin has been determined and is being solved. Finally, prospects of the experiment considering several background and threshold scenarios are revised.

Poster Session / 1091**J/psi photoproduction in ultra-peripheral Pb-Pb and p-Pb collisions with the ALICE detector**

Mr. ADAM, Jaroslav ¹

¹ *Czech Technical University in Prague*

Corresponding Author: jaroslav.adam@cern.ch

Ultra-relativistic heavy ions generate strong electromagnetic fields which offer the possibility to study gamma-gamma, gamma-nucleus and gamma-proton processes at the LHC in ultra-peripheral Pb-Pb and p-Pb collisions (UPC). Exclusive photoproduction of J/psi vector mesons is sensitive to the gluon distribution of the interacting target (proton or nucleus). The reactions allow one to study saturation phenomena and nuclear gluon shadowing. Here we report on the ALICE measurement of J/psi coherent and incoherent photoproduction in Pb-Pb UPC at $\sqrt{s_{NN}} = 2.76$ TeV at forward and central rapidity. Furthermore, we present also results on the J/psi photoproduction in p-Pb UPC at $\sqrt{s_{NN}} = 5.02$ TeV in the forward and backward rapidities, where the rapidity is measured in the laboratory frame with respect to the proton beam direction. The J/psi's have been identified through their leptonic decays.

Closed meeting : International Committee for Future Accelerators (ICFA) / 1092**Linear Collider School**

Poster Session / 1093

Measurement of the Z boson production differential cross section as a function of transverse momentum in pp collisions at $\sqrt{s} = 8$ TeV

MEYER, Arnd ¹; Dr. LEE, Sangeun ²; Dr. WICKRAMAGE, Nadeesha ³

¹ *RWTH Aachen University*

² *Kyungpook University, Korea, Republic Of*

³ *Tata Inst. of Fundamental Research (India)*

Corresponding Author: ublumen@gwdg.de

A measurement is presented of the Z boson production differential cross section as a function of Z transverse momentum. The sample of proton-proton collisions collected by the CMS experiment at the LHC at $\sqrt{s} = 8$ TeV corresponds to an integrated luminosity of 18.4 ± 0.5 pb⁻¹. The Z bosons are identified via their decay to dilepton pairs. The measured cross sections are well described by theoretical predictions.

Opening Ceremony / 1094

Valencian Ministry of Education, Culture and Sports