Instrumentation for Colliding Beam Physics

Monday 24 February 2014 - Saturday 01 March 2014

Book of Abstracts

Contents

First years of running for the LHCb calorimeter system 1

Particle flow calorimetry for Linear Collider 1

Development of direct readout scintillator tile for HCAL at ILC 1

Performance of the ATLAS Tile Hadronic Calorimeter at LHC in Run 1 and planned upgrades 2

Large area avalanche photodiodes with high quantum efficiency and extended UV response 2

Space-charge effects in liquid argon ionization chambers 3

Development of the polystyrene scintillator technology and particle detectors on their basis 3

Upgrade of the Belle II Electromagnetic Calorimeter 3

The LXe calorimeter and the pixelated timing counter in the MEG II experiment . . . 3

Performance of the BGO endcap calorimeter of the CMD-3 detector 4

CMS ECAL performance and upgrade 4

Performance of the Atlas Liquid Argon Calorimeter after three years of LHC operation and plans for a future upgrade 5

Developing of Scintillation crystals for Calorimetry and Astroparticle Physics 5

The combined liquid xenon - crystal CsI calorimeter of CMD-3 detector 6

Beam Condition Monitors and a Luminometer Based on Diamond Sensors 6

CMS Alignment and Calibration 6

Detector Challenges at CLIC 7

Measurement of the integrated luminosity and the luminosity spectrum at the linear collider 7

Beam energy determination in collider experiments using backscattering of laser light 7

A luminosity detector for the PANDA experiment at FAIR 8

The Multi-Purpose Detector for JINR heavy-ion collider 8

Photon collider Higgs factories . . . 8

The Mu2e Experiment at Fermilab . . . 8

Detectors for Muon-to-Electron Conversion at the COMET Experiment . . . 9

Polarisation and beam energy measurement at linear e+e- colllider . . . 9

The superconducting magnet of the Multipurpose Detector . . . 10

Detector Systems at the International Linear Collider . . . 10

TAIGA - Tunka Advanced Instrument for cosmic ray physics and Gamma Astronomy - present status and perspectives . . . 10

Two-phase detectors . . . 11

The Search for Dark Matter . . . 11

The coordinate-tracking setup based on the drift chambers for ultrahigh-energy cosmic ray investigations . . . 11

Gravitational wave detectors . . . 12

Constraining Dark Energy with modern telescopes . . . 12

Measurement of Ultra-High Energy Cosmic Rays: Present and Future . . . 12

LHCb experience on Triple-GEM detectors and upgrade perspective . . . 12

Upgrade of the CMS Muon System with Triple-GEM detectors . . . 13

MPGD-based counters of single photons developed for COMPASS RICH-1 . . . 13

RD51 Collaboration and MPGD Developments: Five Years Experience and Future Plans 14

MPGD production situation at CERN . . . 14

Construction, commissioning and first data-taking of the Cylindrical-GEM KLOE-2 Inner Tracker . . . 15

Micromegas detectors for the ATLAS Muon System upgrade . . . 15

Review of simulations for gas detectors . . . 15

Development of high resolution tracking detectors with Gas Electron Multipliers . . . 16

Study of focusing aerogels with electron beam . . . 16

Threshold aerogel Cherenkov counters of the KEDR detector . . . 16

MCP PMT in colliding beam experiments . . . 17

Status of the CMS Muon Chambers . . . 17

Development and Construction of the Belle II TOP Detector . . . 17

Long term experience and performance of COMPASS RICH-1 . . . 18

ARICH for Belle II 18

Recent progress in particle identification methods 18

Upgrade of the CMD-3 TOF system 19

Status of BESIII 19

New developments in solid state photomultipliers 19

The Time-of-Flight system for MPD 19

Distributed data analysis system for CMD-3 detector 20

The gamma-quantum registration system of SVD setup 20

Results on radiation hardness of avalanche photodiodes up to neutron fluences of 2.5×10^{14} n/cm^2 20

Testbench of shaper-digitizer modules for Belle II calorimeter 21

New Drift Chamber for the KEDR Detector 21

Particle identification system based on dense aerogel for SND detector at VEPP-2000 collider 21

Extracted e- and gamma beams in BINP SB RAS 22

The charge measurements system at PHIL, LAL 22

Processing of the Liquid Xenon Calorimeter's signals for timing measurements 22

Track-based alignment of the CMS Muon System 23

Test results of the aerogel Cherenkov counters with n=1.05 using electrons and muons at p<500 MeV/c 23

Liquid xenon calorimeter of the CMD-3 detector 23

2-dimensional GEM detector with FEE based on the nXYTER 24

Simulation of the ATLAS Tile Hadronic Calorimeter at LHC and validation studies . . 24

Luminosity measurement with CMD-3 detector at the VEPP-2000 e+e- collider . . . 24

The array for the detection of the neutron component of extensive air showers 25

The project of laser polarimeter for beam energy measurement of VEPP-4M collider by resonance depolarization method 25

Calibration of energies at photon colliders 25

A conception of the photon collider beam dump 25

The CMD-3 TOMA DAQ infrastructure 26

The development of high resolution coordinate detectors for the DEUTRON facility . 26

SND data acquisition system upgrade 26

Compton backscattering for the calibration of KEDR Tagging System 27

The energy calibration system of the KEDR tagger 27

Muon System of SND Detector 27

Proposal for the upgrade of the tracking and trigger system of the CMD-3 detector . 28

New electronics with high time and energy resolution for SND detector calorimeter . . 28

Muon System of the KEDR Detector 28

ATLAS TDAQ application gateway upgrade during LS1 29

European Strategy for Particle Physics 29

Satus of BEPCII 29

Fermilab accelerator complex and experimental program status and plans 29

Collider experiments in Budker Institute 30

Fundamental Science at J-PARC 30

ILC project 30

Challenges in Instrumentation at the PANDA Experiment 30

Status of the Frascati Laboratory 30

Status of Belle II and SuperKEKB 31

A Time Projection Chamber for the International Linear Collider 31

Past & Future of the Silicon-On-Insulator Pixel Detector 31

DEPFET at Belle II 31

Upgrade of the LHCb Vertex Locator 32

DEPFET as a measurement device: simulation and data reconstruction 32

CMS Phase-1 Upgrades and Plans, with focus on Pixel Upgrade 33

Time-Projection-Chamber for MPD NICA Project 33

High Voltage Monolithic Active Pixel Sensors for the PANDA Luminosity Detector . . 33

The Ultra Lightweight Support Structure and Gaseous Helium Cooling for the Mu3e Silicon Pixel Tracker 34

The MEG upgrade Drift Chamber 34

Performance and Radiation Damage Effects in the LHCb Vertex Locator 34

Track chambers based on precision drift tubes housed inside a 30 mm mylar pipe . . . 35

CLIC Vertex-Detector R&D 35

The Upgrade of the ALICE TPC 35

Small angle detectors for study the diffractive processes with CMS 36

Upgrade of trigger and DAQ for CsI at BelleII 36

A specialized processor for track reconstruction at the LHC crossing rate 36

ATLAS Minimum Bias Trigger Scintillator upgrade for LHC RunII 37

The Detector Control of the PANDA Experiment 37

Performance of the LHCb trigger and its upgrade 37

The Belle II Pixel Detector DAQ 38

CMD-3 detector DAQ upgrade 38

Time resolution measurements of scintillation counters prototypes for a new trigger Charged Hodoscope (CHOD) 38

The upgrade of the CMS trigger system 39

Conference Summary and Perspectives 39

Calorimeters / 131

First years of running for the LHCb calorimeter system

FILIPPOV, Sergey[1]

[1] *Institute for Nuclear Research*

Corresponding Author(s): serguei.filippov@cern.ch

The LHCb experiment is dedicated to precision measurements of CP violation and rare decays of B hadrons at the Large Hadron Collider (LHC) at CERN (Geneva) [1, 2]. LHCb is a single-arm spectrometer with a forward angular coverage from approximately 10 mrad to 300 mrad. It comprises a calorimeter system composed of four subdetectors [3], selecting transverse energy hadron, electron and photon candidates for the first trigger level (L0), which makes a decision 4 s after the interaction. It provides the identification of electrons, photons and hadrons as well as the measurement of their energies and positions. The set of constraints resulting from these functionalities defines the general structure and the main characteristics of the calorimeter system and its associated electronics. A classical structure of an electromagnetic calorimeter (ECAL) followed by a hadron calorimeter (HCAL) has been adopted. In addition the system includes in front of them the Scintillating Pad Detector (SPD) and Pre-Shower (PS), which are two planes of scintillating pads separated by a 2.5 radiation length lead sheet, aimed at tagging the electric charge and the electromagnetic nature of the calorimeter clusters for the first level of trigger. ECAL, PS and SPD account for about 6000 channels each with three degrees of granularity, concentric around the beam pipe, namely, the inner, the middle and the outer parts. HCAL is made of about 1500 channels and is divided into two parts only. All four detectors are arranged in pseudo-projective geometry and follow the general principle of reading the light from scintillator tiles with wave-length shifting fibers, and transporting the light towards photomultipliers, all following the 25 ns readout. The calorimeter has been pre-calibrated before its installation in the pit, and the calibration techniques have been tested with the data taken in 2010. During operation, hadronic, leptonic and photon triggers of particular interest for hadronic B decays and radiative decays were provided by the calorimeter system. The design and construction characteristics of the LHCb calorimeter will be recalled. Strategies for monitoring and calibration during data taking will be detailed in all aspects. Scintillating fibres, plastics and photomultipliers suffer from ageing due to radiation damage or high currents. Different methods which are used to calibrate the detectors and to recover the initial performances will be presented. The performances achieved will be illustrated in selected channels of interest for B physics. References: [1] LHCb Collaboration, The LHCb Detector at the LHC, JINST 3 S08005 (2008), and references therein. [2] LHCb collaboration, A large Hadron Collider Beauty experiment, Technical Proposal, CERN/LHCC 1998-004. [3] LHCb Collaboration, LHCb calorimeters Technical Design Report, Technical Design Report, CERN/LHCC 2000-036.

Calorimeters / 128

Particle flow calorimetry for Linear Collider

SEFKOW, Felix[1]

[1] *Deutsches Elektronen Synchrotron*

Corresponding Author(s): felix.sefkow@desy.de

The development and optimisation of calorimeters for particle methods at future colliders will be discussed. The talk will present the status of experimental validation with emphasis on recent results from test beam data analysis. Examples from current studies on scalable engineering solutions and system integration are shown.

Calorimeters / 57

Development of direct readout scintillator tile for HCAL at ILC

MIRONOV, Dmitry[1]

[1] *Institute for Theoretical and Experimental Physics*

Corresponding Author(s): okdimok@gmail.com

The ILC hadron calorimeter is supposed to consist from nearly 10 000 000 tiles 30x30x3 mm. The configuration of tile readout without WLS-fiber is studied and is being optimized in terms of response uniformity. With a SiPM positioned in the center of tile and hole milled in front of a SiPM uniformity of 8% has been achieved. This enables sandwich technology in detector plane construction.

Calorimeters / 112

Performance of the ATLAS Tile Hadronic Calorimeter at LHC in Run 1 and planned upgrades

SOLOVYANOV, Oleg[1]

[1] *Institute for High Energy Physics*

Corresponding Author(s): oleg.solovyanov@ihep.ru

The Tile Calorimeter (TileCal) is the central section of the ATLAS hadronic calorimeter at the Large Hadron Collider, a key detector for the measurements of hadrons, jets tau leptons and missing transverse energy. Scintillation light produced in the tiles is transmitted by wavelength shifting fibers to photomultiplier tubes (PMTs). The resulting electronic signals from approximately 10000 PMTs are measured and digitized before being transferred to off-detector data-acquisition systems. After an initial setting of the absolute energy scale in test beams with particles of well-defined momentum, the calibrated scale was transferred to the rest of the detector via the response to radioactive sources. The calibrated scale was validated in situ with muons and single hadrons and the timing performance with muons and jets as detailed in this contribution. The data quality procedures used during the LHC data-taking and the evolution of the detector status are exposed. The energy and the time reconstruction performance of the digitized signals is presented and the noise behavior and its improvement with the detector consolidation in maintenance periods are shown. A set of calibration systems allow the monitoring and the equalization of the calorimeter channels response via signal sources that act at every stage of the signal path, from scintillation light to digitized signal. These partially overlapping systems are described in detail, their individual performance is exposed as well as comparative results on the response evolution of the calorimeter with time during the full LHC data-taking period. The procedure of setting the absolute energy scale for channels/cells is described and the challenge of preserving it at the % level during 3 years of LHC collision data is described. Its main upgrade will occur for the High Luminosity LHC phase (phase 2) where the peak luminosity will increase 5-fold compared to the design luminosity (10^{34} cm^{-2}s^{-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 will probably happen around 2022. The TileCal upgrade aims at replacing the majority of the on- and off-detector electronics so that all calorimeter signals are directly 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. Which one to use will be decided after extensive test beam studies. 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.

Calorimeters / 38

Large area avalanche photodiodes with high quantum efficiency and extended UV response

HITLIN, David[1]

[1] *California Institute of Technology*

Corresponding Author(s): hitlin@caltech.edu

Scintillators with fast decay time, such as the barium fluoride fast component (220 nm) or liquid xenon (165 nm) pose a difficult problem for photodetectors. This motivates the development

by a Caltech/JPL/RMD collaboration of large area (˜10×10 mm) avalanche photodiodes using superlattice doping. These devices have high quantum efficiency and extended UV response and excellent timing properties. They also incorporate an interference filter to discriminate against the slow decay time component of barium fluoride.

Calorimeters / 68

Space-charge effects in liquid argon ionization chambers

RUTHERFOORD, John[1]

[1] *University of Arizona*

Corresponding Author(s): rutherfo@physics.arizona.edu

We have uniformly irradiated liquid argon ionization chambers with betas from high-activity Strontium-90 sources. The radiation environment is similar to that in the liquid argon calorimeters which are part of the ATLAS detector installed at CERN's Large Hadron Collider (LHC). We measured the resulting ionization current over a wide range of applied potential for two different source activities and for three different chamber gaps. These studies provide operating experience at exceptionally high ionization rates. In particular they indicate a stability at the 0.1% level for these calorimeters over years of operation at the full LHC luminosity when operated in the normal mode at an electric field of 1.0 kV/mm. We can operate these chambers in the normal mode or in the space-charge limited regime and thereby determine the transition point between the two. This transition point is parameterized by a positive argon ion mobility of $_{+} = 0.08 \pm 0.02$ mm^2/Vs at 88.0 ± 0.5 K and 1.02 ± 0.02 bar. In the space-charge limited regime the ionization currents are severely degraded and show signs of instability. At the highest electric fields in our study the ionization current is still slowly rising with increasing electric field, that is, the currents don't appear to be approaching an asymptotic value.

Calorimeters / 69

Development of the polystyrene scintillator technology and particle detectors on their basis

RYKALIN, Vladimir[1]

[1] *Institutef for high Energy Physics (Protvino)*

Corresponding Author(s): vladimir.rykalin@ihep.ru

The new designed at IHEP technologies of polystyrene scintillators manufacturing - molding of polystyrene granules under pressure, melting of granules in forms with mirrors walls, production of scintillating granules and detectors on their basis are considered.

Calorimeters / 99

Upgrade of the Belle II Electromagnetic Calorimeter

MIYABAYASHI, Kenkichi[1]

[1] *Nara Women University*

Corresponding Author(s): miyabaya@cc.nara-wu.ac.jp

The construction of the SuperKEKB electron-positron collider and upgrade of the Belle II spectrometer are going on at KEK aiming at high precision measurements in bottom, charm and tau flavor sectors. We describe a replacement of the electronics for the CsI(Tl) crystal calorimeter with PIN-PD readout to match the luminosity increase up to 800/(nb·sec) at maximum. A plan to replace CsI(Tl) crystals with pure CsI in the endcaps is also mentioned.

Calorimeters / 98

The LXe calorimeter and the pixelated timing counter in the MEG II experiment

IWAMOTO, Toshiyuki[1]

[1] *The University of Tokyo*

Corresponding Author(s): iwamoto@icepp.s.u-tokyo.ac.jp

The purpose of the MEG experiment is to look for a lepton flavor violating →e decay with an unprecedented sensitivity, and we set an upper limit of the branching ratio for this decay, 5.7×10^{-13} at 90% C.L. in 2013 which is twenty times more stringent limit than the previous experiment, MEGA. Since the sensitivity improvement of the MEG experiment was limited by the accidental background, we have considered the major detector upgrade. A proposal was submitted to PSI committee, and was approved by PSI in 2013, which aims for a sensitivity enhancement of one order of magnitude compared to the final MEG result. Here I will mainly introduce you two components of the MEG detector, a gamma-ray calorimeter with 900 l liquid xenon (LXe), and a pixelated timing counter. The LXe detector will be improved by increasing the granularity at the incident face, by replacing the current PMTs with a larger number of smaller photosensors (MPPC) and optimizing the photosensor layout also on the lateral faces. A new highly segmented, fast timing counter array will replace the old system to allow improved timing resolution capabilities.

Calorimeters / 19

Performance of the BGO endcap calorimeter of the CMD-3 detector

AKHMETSHIN, Ravel[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): akhmetshin@inp.nsk.su

The BGO endcap calorimeter was successfully operated in the CMD-2 detector at the VEPP-2M collider. It consists of 680 BGO crystals each with a size of $25\times25\times150$ mm^3, arranged in two identical endcaps, with a total crystal weight of 450 kg. The light readout used vacuum phototriodes. The endcap calorimeter has now been upgraded to work in the CMD-3 detector at new collider VEPP-2000. The major part of the endcap calorimeter, the BGO crystals, remains the same. The main upgrade is the use of silicon PIN photodiodes and new electronics. Main reason to change photosensitive device is the strong non-uniform magnetic field in the endcap calorimeter volume and redused available space. The Hamamatsu PIN photodiode S3590-08 was chosen as the optimal solution, as they are insensitive to magnetic fields and are both compact and stable. An order of magnitude larger capacitance of silicon photodiodes requires design and produce new custom electronics. The upgrade is expected to bring an overall improvement of parameters. The endcap calorimeter has been installed in the detector and participates in data taking which started at 2010. The preliminary energy resolution is measured in the energy range 160-1000 MeV. It is better compare to the CMD-2 detector.

Calorimeters / 42

CMS ECAL performance and upgrade

KARNEYEU, Anton[1]

[1] *Institute for Nuclear Research of the Russian Academy of Sciences*

Corresponding Author(s): anton.karneyeu@cern.ch

The CMS ECAL is a hermetic, fine grained and homogeneous calorimeter containing 75848 lead-tungstate ($PbWO_4$) crystals, located inside the CMS superconducting solenoidal magnet. The scintillation light is detected by avalanche photodiodes (APDs) in the barrel section and by vacuum phototriodes (VPTs) in the two endcap sections. A silicon/lead pre-shower detector is installed in front of the endcaps. Presented is ECAL performance and upgrade plans.

Calorimeters / 77

Performance of the Atlas Liquid Argon Calorimeter after three years of LHC operation and plans for a future upgrade

STRIZENEC, Pavol[1]

[1] *Institute of Experimental Physics SAS*

Corresponding Author(s): strizene@saske.sk

The ATLAS experiment is designed to study the protonproton collisions produced at the Large Hadron Collider (LHC) at CERN. Liquid argon sampling calorimeters are used for all electromagnetic calorimetry covering the pseudorapidity region up to 3.2, as well as for hadronic calorimetry in the range 1.4-4.9. The electromagnetic calorimeters use lead as passive material and are characterized by an accordion geometry that allows a fast and uniform azimuthal response. Copper and tungsten were chosen as passive material for the hadronic calorimetry; whereas a parallel plate geometry was adopted at large polar angles, an innovative one based on cylindrical electrodes with thin argon gaps was designed for the coverage at low angles, where the particles flow is higher. All detectors are housed in three cryostats kept at 88.5 K. After installation in 2004-2006, the calorimeters were extensively commissioned over the three years period prior to first collisions in 2009, using cosmic rays and single LHC beams. Since then, around 27 fb^{-1} of data have been collected at a unprecedented center of mass energies between 7 TeV and 8 TeV. During all these stages, the calorimeter and its electronics have been operating with performances very close to the specification ones. After 2019, the instantaneous luminosity will reach $2\text{-}3\times10^{34}$ $cm^{-2}s^{-1}$, well above the luminosity for which the calorimeter was designed. In order to preserve its triggering capabilities, the detector will be upgraded with a new fully digital trigger system with a refined granularity. In 2023, the instantaneous luminosity will ultimately reach $5\text{-}7\times10^{34}$ $cm^{-2}s^{-1}$, requiring a complete replacement of the readout electronics. Moreover, with an increased particle flux, several phenomena (liquid argon boiling, space charge effects...) will affect the performance of the forward calorimeter (FCal). A replacement with a new FCal with smaller LAr gaps or a new calorimeter module are considered. The performance of these new calorimeters is being studied in highest intensity particle beams. The talk will cover all aspects of the first three years of operation. The excellent performance achieved will be especially detailed in the context of the discovery of the Higgs boson announced in July 2012. The future plans to preserve this performance until the end of the LHC program will be also presented.

Calorimeters / 74

Developing of Scintillation crystals for Calorimetry and Astroparticle Physics

SHLEGEL, Vladimir[1]

[1] *Nikolaev Institute of Inorganic Chemistry*

Corresponding Author(s): shlegel@niic.nsc.ru

Development of detector materials takes place both due to the search of new scintillation crystal, and by improvement of growing technology for already known crystals. Basically scintillation crystals are grown by traditional techniques under high temperature gradient conditions. In most cases, the temperature gradients nearly growth interface are in the range 40-200 K/cm. In such conditions thermoelastic stress and melt superheating are inevitable. In some cases, especially when it is necessary to grow large size crystals or crystals with strong anisotropy of the thermal properties and low mechanical strength, high thermal gradients lead to the destruction of crystals and that is a major obstacle to growth of high quality crystals. The melt superheating leads to volatility of charge components, disruption of stoichiometry and inhomogeneity functional properties of crystal. In the report the results of growth of top quality scintillation crystals at low temperature gradient (LTG) conditions is presented. In LTG CZ technique temperature gradients are reduced by two orders of magnitude in comparison with the conventional crystal growth techniques. The results of growing BGO crystals large size (up to 60 kg) with high radiation hardness are presented. The advantages of use LTG CZ technique for growth of isotopically enriched crystals used for rare events searches are most essential. The crystal growth for these applications generally is associated the use of very expensive raw materials (high radio purity, isotopically- enriched composition,etc.) which is available in a very limited quantity. In addition

for these projects requirements to crystal quality are very high. Another essential requirement is a need to obtain the maximum possible weight of a crystal from initial charge. The ossibility of the LTG technique are demonstrated on example of successful growth of isotopically enriched crystals $106CdWO_4$ and $116CdWO_4$ with duty factor about 85% are presented. Growth of large sized $ZnMoO_4$ crystals including development of precursor's synthesis starting from Mo metal and recycling of residuals for producing isotopically enriched $Zn100MoO_4$ crystals for LUMINEU project are also reported.

Calorimeters / 71

The combined liquid xenon - crystal CsI calorimeter of CMD-3 detector

SHEBALIN, Vasiliy[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): vasiliy.shebalin@gmail.com

Since 2010 the CMD-3 detector has been collecting data at the e^+e^- collider VEPP-2000 in the Budker Institute of Nuclear Physics. CMD-3 is a general purpose detector designed to study e^+e^- annihilation into hadrons in the wide energy range, E(c.m.s) = 0.3÷2 GeV. During 3 years of operation detector collected integral luminosity of about 60 nb^{-1}. The barrel electromagnetic calorimeter of the detector consists of two subsystems: closest to the beam pipe is the Liquid Xenon calorimeter (LXe) and the outer one is based on CsI scintillation crystals (CsI). LXe calorimeter contains 400 liters of LXe, covers a solid angle 0.8×4 and has a thickness equals to 5.4 X_0. Finely segmented strip structure of the calorimeter electrodes provides the possibility to analyze energy deposition profile through the shower direction, reconstruct tracks of charged particles and measure total energy deposition. The CsI calorimeter consists of 8 octants, located around the LXe calorimeter, and contains 1152 counters. Each counter is based on CsI(Tl) or CsI(Na) crystal of 6×6×15 cm^3 size that corresponds to 8.1 X_0 in the direction transverse to the beam. The total thickness of the barrel calorimeter is equal to 13.5 X_0. The main advantage of the combined barrel calorimeter is that the LXe calorimeter allows to measure the coordinates of gamma conversion point with spatial resolution of about 1.5 mm, and additional 8 X_0 of crystal CsI provides the total energy resolution of combined calorimeter of about 4.5% /1GeV. The design of the calorimeter and its current performance are presented. The energy calibration procedures using cosmic rays for LXe and CsI and using elastic e^+e^- scattering process for the LXe calorimeter are presented in this work. The accuracy of calibration constants for LXe and CsI calorimeters are about 2% and 3% correspondingly. Also the gamma energy reconstruction is described in the work and the results of ^{0} reconstruction giving the ^{0} width of about 8% are presented.

Colliders and Detector Integration / 25

Beam Condition Monitors and a Luminometer Based on Diamond Sensors

LANGE, Wolfgang[1]

[1] *DESY Zeuthen*

Corresponding Author(s): wolfgang.lange@desy.de

Detectors with diamond sensors are used in the CMS experiment and along the LHC ring to monitor beam conditions. The fast system BCM1F in CMS using single crystal diamond sensors allows bunch by bunch measurements with nanosecond time resolution. Operating right from the very first beams in CMS it was extended to deliver the online luminosity of the experiment. Similar detectors were also installed at critical positions of the LHC. The talk will review the performance and give an outlook to the upgrade in the current shutdown.

Colliders and Detector Integration / 126

CMS Alignment and Calibration

PAKHOTIN, Yuriy[1]

[1] *Texas A and M University*

Corresponding Author(s): pakhotin@tamu.edu

Determination of alignment and calibration constants plays one of the central role in the operation of the CMS experiment. Prompt and accurate alignment and calibration of the CMS components are crucial to achieve optimal performance of the detector and to allow the CMS physics program to reach its goals. Sophisticated algorithms and workflows are developed and routinely employed to align and calibrate various systems of the CMS detector. Also dedicated express streams of promptly reconstructed data events with reduced content have been deployed to achieve fast access to data samples after collection and their efficient processing in alignment and calibration workflows. We discuss details of the alignment and calibration procedures for all CMS components, results of the several years of CMS operation and achieved performance of the CMS detector for physics analyses. We also present plans for upgrade and future development.

Colliders and Detector Integration / 54

Detector Challenges at CLIC

LUKIC, Strahinja[1]

[1] *Vinca Institute of Nuclear Sciences*

Corresponding Author(s): slukic@vinca.rs

The presentation reports on ongoing studies for general purpose detectors at a future TeV-scale e^+e^- Compact LInear Collider (CLIC). The CLIC physics goals impose stringent requirements on the detector. Improvements on state-of-the-art track and jet energy resolutions are needed. At the same time, the beam-induced backgrounds introduce challenging conditions for the event reconstruction. Under these circumstances, satisfying the physics goals is achieved by designing the detectors with high granularity particle flow in mind. In the presentation, several sub-detector systems are highlighted and it is shown how the detector requirements can be achieved.

Colliders and Detector Integration / 53

Measurement of the integrated luminosity and the luminosity spectrum at the linear collider

LUKIC, Strahinja[1]

[1] *Vinca Institute of Nuclear Sciences*

Corresponding Author(s): slukic@vinca.rs

The high charge density and high energy at future linear colliders will present challenges to the luminosity measurement that have not been there in the past. The intense electromagnetic interaction between the electron bunches influences the luminosity measurement at the level of several percent. Precise correction of the beam-beam effects, based on experimentally measurable quantities, is described here. In addition, a comprehensive list of systematic effects in luminosity measurement is given, with their individual contributions to the final uncertainty of the luminosity figure.

Colliders and Detector Integration / 114

Beam energy determination in collider experiments using backscattering of laser light

ACHASOV, Mikhail[1]

[1] *G.I.Budker Institute of Nuclear Physics SB RAS*

Corresponding Author(s): achasov@inp.nsk.su

The review of using of compton backscattering method for electron beam energy determination is given.

Colliders and Detector Integration / 39

A luminosity detector for the PANDA experiment at FAIR

JASINSKI, Prometeusz[1]

[1] *Helmholtz Institute Mainz*

Corresponding Author(s): jasinski@kph.uni-mainz.de

The PANDA experiment at FAIR (Darmstadt) is a fixed target experiment in a high energy storage ring. Antiprotons with a momentum of 1.5 GeV/c up to 15 GeV/c collide with an atomic beam perpendicular to the interaction point (IP). The spectrometer consists of a solenoid magnet around the IP followed by a dipole magnet. The spectrometer stages are both equipped with various planes of detectors for charged and neutral channels. To determine the luminosity with a precision of better than 3%, PANDA will implement a tracking device to reconstruct elastically scattered antiprotons near the non interacting antiproton beam. Four planes equipped with retractable HV-MAPS placed inside vacuum around the beam pipe. In this overview talk we will discuss topics such as cooling of CVD-diamonds used as heat conductors for the active pixel sensors, production of aluminum support frames with stainless steep pipes melted inside, the construction of a differentialy pumped vacuum system, the corresponding feed throughs at the vacuum box and the status of the sensors themselves. All topics are completed by existing prototype results.

Colliders and Detector Integration / 64

The Multi-Purpose Detector for JINR heavy-ion collider

RAZIN, Stepan[1]

[1] *Joint Institute for Nuclear Research*

Corresponding Author(s): razin@jinr.ru

The Multi-Purpose Detector (MPD) is designed as 4 spectrometer to study heavy-ion collisions at the Nuclotron-based heavy Ion Collider fAcility at JINR. At the designed luminosity the event rate in the MPD is ~7kHz and charge particle multiplicity ~1000. A superconducting 5m diameter solenoid is equiped with a inner tracking system based on silicon microstrip detector, large volume time-projection chamber, time-of-flight system based on RPC, electromagnetic calorimeter, endcap tracker and a series of fast trigger detectors.

Colliders and Detector Integration / 91

Photon collider Higgs factories

TELNOV, Valery[1]

[1] *Budker INP*

Corresponding Author(s): telnov@inp.nsk.su

Abstract is not provided.

Colliders and Detector Integration / 90

The Mu2e Experiment at Fermilab

TASSIELLI, Giovanni Francesco[1] ; HITLIN, David[2]

[1] *Fermi National Accelerator Laboratory*

[2] *California Institute of Technology*

Corresponding Author(s): hitlin@caltech.edu

We present the status of Mu2e experiment for the search of coherent, neutrino-less conversion of muons into electrons in the field of a nucleus to a few parts in 10^{-17}, a sensitivity improvement of a factor of 10^4 over existing limits. The Mu2e experiment will be hosted by Fermilab at a new muon campus. It will use a complex of solenoids to collect and transport the muons, produced when the 8 GeV pulsed proton beam hits the tungsten production target. The last solenoid in the complex will allow for the measurement of the momentum of the electrons produced by the muons trapped into the muon stopping targets. To this goal, Mu2e will adopt a challenging detector system. We present a detailed description and the expected performance. The central part of the detector is a low-mass straw tube tracker immersed in a 1 Tesla uniform magnetic field and placed in vacuum (10^{-4} torr) to efficiently identify 105 MeV/c electrons, with a resolution of the order of 100 KeV/c, and to reject a large amount of background hits (average hit rate of ~15 kHz/cm^2) within a high radiation environment (peak hit rate of ~3 MHz/cm^2). A BaF_2 crystal calorimeter, downstream of the tracker, will provide particle ID, to further reduce backgrounds, energy and time measurements. The large detector area will be extensively covered by multi-layer scintillation counters to reject, at the level of 10^{-4}, cosmic rays that could mimic signal tracks.

Colliders and Detector Integration / 94

Detectors for Muon-to-Electron Conversion at the COMET Experiment

UCHIDA, Yoshi[1]

[1] *Imperial College London*

Corresponding Author(s): yoshi.uchida@imperial.ac.uk

COMET is a muon-to-electron conversion experiment at the J-PARC laboratory, the first of two phases of which is scheduled to start running in 2016. Its final single-event sensitivity to this rare muon decay process is expected to be 2.6×10^{-17}. This experiment places very specific requirements on its particle detectors, which arise from the high background rates and the need to find single electrons in the kinetic energy region of 100 MeV. We describe the challenges posed by this experiment and the solutions that are being developed for the two phases.

Colliders and Detector Integration / 97

Polarisation and beam energy measurement at linear e+e- colllider

VORMWALD, Benedikt[1]

[1] *DESY*

Corresponding Author(s): benedikt.vormwald@desy.de

The International Linear Collider (ILC) is a future e^+e^- collider at the energy frontier. Its physics goals are clearly focused on precision measurements at the electroweak scale and beyond. Beam polarisation and beam energy are two important parameters, which need to be measured and monitored to unprecedented possible precision. In this talk we will present the concepts of polarisation and energy measurement according to the baseline design of the Technical Design Report of the ILC. Two Compton polarimeters per beam line will determine the beam polarisation. The anticipated precision of this measurement of $\Delta P/P = 2.5 \times 10^{-3}$ puts highest demands on detector alignment and linearity. We will comment on recent detector developments as well as detector calibration, which allows for meeting this challenging design goal. The beam energy will be measured before and after the interaction point to a targeted precision of $\Delta E/E = O(10^{-4})$. We will discuss both planned independent concepts in this talk: A noninvasive energy spectrometer based on beam position monitors is planned to be operated before the interaction region. Behind the interaction region, a synchrotron radiation imaging detector will allow not only for measuring the beam energy, but also gives access to the beam energy spread of the beam after collision.

Colliders and Detector Integration / 45

The superconducting magnet of the Multipurpose Detector

KOSHURNIKOV, Evgeny[1]

[1] *Joint Institute for Nuclear Research*

Corresponding Author(s): evgeny.koshurnikov@magnet.spb.su

The multipurpose detector (MPD) is a 4 spectrometer to be used for studying charged hadrons, electrons, and photons generated in heavy ion collisions at energies provided by the NICA collider of the Joint Institute for Nuclear Research (Dubna). A constituent part of the MPD is a solenoid magnet with a superconducting NbTi coil and a steel flux return yoke. The magnet weighs eight hundred tons and is intended for providing a highly homogeneous magnetic field of 0.5 T in an aperture 4596 mm in diameter to ensure the transverse momentum resolution within the range of 0.1-3 GeV/c at NICA. Structurally, the MPD magnet yoke is a cylindrical barrel-like structure, which consists of 24 beams that return the magnetic flux of the coil, two support rings, two poles, and two support cradles that carry the total weight of the detector. The stainless cryostat with the superconducting coil is rigidly fixed inside the yoke barrel. The adopted structural arrangement of the yoke guarantees high rigidity of the whole magnet and will ensure the required field homogeneity (integral of the radial magnetic induction component) in the TPC region after subsequent withdrawals of the poles and multiple movements of the magnet to the assembly site for updating or repair. The coil is a one-layer solenoid made of a superconducting NbTi cable in the aluminum matrix. The conductor is wound onto inside the aluminium support cylinder. The cooling method chosen for the MPD magnet is based on the forced two-phase helium flow using a helium refrigerator. The coil conductor is cooled indirectly via the thermal contact with the aluminum cylinder and heat removal through the cylinder to the aluminum tube with circulated liquid helium.

Colliders and Detector Integration / 76

Detector Systems at the International Linear Collider

SIMON, Frank[1]

[1] *Max-Planck-Institute for Physics*

Corresponding Author(s): fsimon@mpp.mpg.de

The International Linear Collider is a planned energy frontier electron-positron collider which will cover the energy range from 250 GeV to 1 TeV in several stages. This machine will precisely study the Higgs and Top sectors, perform electroweak precision measurements and will explore New Physics both directly and indirectly. This ambitious program requires highly performant detector systems. Two detector concepts are being developed for this future collider: The International Large Detector ILD and the Silicon Detector SiD. Both are optimized for precise event reconstruction based on particle flow in a hermetic detector, with high precision main trackers, highly granular imaging electromagnetic and hadronic calorimeters and high-resolution low-mass vertex detectors. The two detector concepts adopted different technology choices to achieve the physics goals, with SiD based on an all-silicon tracker in a compact detector with a 5T magnetic field, and ILD based on a large TPC favoring a highly redundant pattern recognition over single-point resolution in a more moderate 3.5 T to 4 T field. This presentation will motivate the designs of both detectors based on the main physics objectives of ILC, will give an overview over the different detector subsystems and will show selected results from performance studies based on realistic detector simulations.

Detectors for Astrophysics and Neutrino Physics / 23

TAIGA - Tunka Advanced Instrument for cosmic ray physics and Gamma Astronomy - present status and perspectives

BUDNEV, Nikolay[1]

[1] *Irkutsk State University*

Corresponding Author(s): nbudnev@api.isu.ru

The TAIGA - Tunka Advanced Instrument for cosmic ray physics and Gamma Astronomy with hybrid detector system for gamma-ray astronomy from 10 TeV to several PeV, and cosmic rays studies from 100 TeV to 1 EeV is presented. It will search for "Pevatrons" (ultra-high energy gamma-ray sources), and measure cosmic ray composition and spectrum in the transition range from a supposed Galactic to extragalactic origin of cosmic rays. The TAIGA is include wide-angle optical stations (0.6 sr) placed at distances of 150-200m which will cover an area of 1 km^2 - 100 km^2 (Tunka-HiSCORE installation), 16 Imaging Atmospheric Cherenkov Telescopes (IACT) with 3 m diameter reflectors, a net of surface and underground scintillation stations and Cherenkov array Tunka-133 which have been in operation since 2009 year.

Detectors for Astrophysics and Neutrino Physics / 124

Two-phase detectors

BUZULUTSKOV, Alexei[1] ; SOKOLOV, Andrey[2]

[1] *Budker Institute of Nuclear Physics*

[2] *BINP*

Corresponding Author(s): A.V.Sokolov@inp.nsk.su

Abstract is not provided.

Detectors for Astrophysics and Neutrino Physics / 115

The Search for Dark Matter

SCHUMANN, Marc[1]

[1] *Albert Einstein Center for Fundamental Physics*

Corresponding Author(s): marc.schumann@lhep.unibe.ch

The indirect evidence for dark matter in the Universe is one of the strongest indications for the existence of new physics. A promising candidate for the dark matter particle is the weakly interacting massive particle (WIMP) which appears naturally in many models beyond the standard model. Many experiments aim at detecting interactions of WIMPs with baryonic matter in ultra-sensitive low-background detectors. In this talk, I will review the current status of direct dark matter detection, focusing on the latest results and in particular on the different detector techniques employed for the search. In order to reach the required sensitivities, the next generation of detectors requires target masses at the ton-scale and beyond, which has a strong impact on the choice of instrumentation for future experiments.

Detectors for Astrophysics and Neutrino Physics / 87

The coordinate-tracking setup based on the drift chambers for ultrahigh-energy cosmic ray investigations

ZADEBA, Egor[1]

[1] *National Research Nuclear University MEPhI*

Corresponding Author(s): eazadeba@mephi.ru

The project of the coordinate-tracking setup based on the drift chambers, designed for a joint operation with Cherenkov water detector NEVOD is presented. The use of large drift chambers (4000x508x112 mm^3), developed in IHEP for experiments at the neutrino channel of U-70 accelerator, will allow to create a unique large-scale detector of 270 m^2 area for registration of multi-particle events at large zenith angles generated by ultrahigh-energy cosmic ray particles. The results of the study of characteristics of drift chambers in the flux of cosmic ray muons including their operation with other systems of the experimental complex NEVOD are described. Basing on results of simulation of detection of near-horizontal muons by drift chambers and

Cherenkov water detector, a block-diagram and main elements of the trigger and DAQ systems for new experimental setup were developed. The project of deployment of the drift chambers around the water Cherenkov detector is presented.

Detectors for Astrophysics and Neutrino Physics / 103

Gravitational wave detectors

KLIMENKO, Sergey[1]

[1] *University of Florida*

Corresponding Author(s): klimenko@phys.ufl.edu

Since Einstein's prediction of gravitational waves in 1916, their detection has been one of the most challenging problems in physics. With the inception and the following advances of the gravitational wave interferometers operating at exceptionally low noise levels, the first direct observation of gravitational waves may become a reality in the next few years. In my talk I describe the existing and the future gravitational wave experiments, both terrestrial and in space. I'll discuss the detection techniques, detector networks and data analysis methods used in the emerging field of gravitational wave astronomy.

Detectors for Astrophysics and Neutrino Physics / 100

Constraining Dark Energy with modern telescopes

NOMEROTSKI, Andrei[1]

[1] *Brookhaven National Laboratory*

Corresponding Author(s): anomerotski@bnl.gov

Investigation of Dark Energy remains one of the most compelling tasks for modern cosmology. It can be studied with several probes which are accessible through precise and deep surveys of the Universe. In the talk I will review the current and next generation of experiments to probe Dark Energy with emphasis on fully depleted CCD sensors with extended infrared sensitivity. I will also briefly review future spectroscopic experiments and new detector ideas relevant to studies of Dark Energy.

Detectors for Astrophysics and Neutrino Physics / 106

Measurement of Ultra-High Energy Cosmic Rays: Present and Future

FUKUSHIMA, Masaki[1]

[1] *Institute for Cosmic Ray Research, The University of Tokyo*

Corresponding Author(s): fukushim@icrr.u-tokyo.ac.jp

Ultra-High Energy Cosmic Rays (UHECRs) with energy reaching 10^{20} eV have been measured by large-scale hybrid detectors employing an array of ground particle detectors and air fluorescence telescopes. Recent findings from Telescope Array (TA) in Utah, USA and Pierre Auger Observatory (PAO) in Malargue, Argentina include a sudden flux decrease above ~10^{19}[U+2027]^{7} eV possibly caused by the predicted Greisen-Zatsepin-Kuzmin (GZK) interaction of UHECR with CMBs, measurements of primary nuclear compositions, proton or heavier nuclei, and hints of anisotropy and association with Active Galactic Nuclei (AGN) in the cosmic ray arrival directions. The detectors of TA and PAO will be introduced with plans of near future extensions. Further RDs and technical challenges including the MHz/GHz radio detection from the air shower and space observation of air fluorescence (JEM-EUSO, TUS and KLYPVE) will be reviewed.

MPGD / 132

LHCb experience on Triple-GEM detectors and upgrade perspective

Author(s): CARDINI, Alessandro[1]
Co-author(s): BENCIVENNI, Giovanni [2] ; DE SIMONE, Patrizi [2]

[1] *INFN Sezione di Cagliari*

[2] *INFN Frascati, Italy*

Corresponding Author(s): alessandro.cardini@cern.ch

The LHCb muon system consists of more than a thousand gas detectors, mostly MWPC, located in five different stations. The muon detector is used to define the muon trigger and to identify muons at the reconstruction stage. The first station of the muon detector, located in front of the calorimetric system, is made of 274 chambers. The 12 most irradiated chambers, the ones closer to the beam pipe, are double triple-GEM detectors with pad readout. These detectors have an active area of 200x240 mm2 and are routinely operated at rates closer to 500 kHz/cm2. With the gas mixture used (Ar/CO2/CF4 45/15/40) these detectors have the requested efficiency (>96% in a 25 ns time window for the logical OR of the two sensitive gaps) when operated at gains of about 4300. In this presentation we will report on the performance of these 24 triple-GEM detectors after more than 2 years of operation in the harsh LHCb conditions. We will also discuss some problems occurred during data taking, in particular the failure of a few GEM foils following repeated discharge phenomena and the solutions implemented to reduce the occurrence of such problems. Thanks to their excellent performances, we are considering the possibility of using triple-GEM technology also for the muon system upgrade. The LHCb upgrade, that will be installed and commissioned during LHC long shutdown 2 (LS2) starting in 2018, will allow the sub-detectors' readout at 40 MHz while running at an instantaneous luminosity of $2x10^{33}$, ten times larger than LHCb design luminosity. Upgraded detectors will have to be able to operate in these difficult operating conditions. While station M1 will be removed because the extremely large occupancies will make it useless for triggering purposes, station M2 will experience particle rates similar to the ones currently seen today in M1. For this reason we believe that triple-GEM detector technology will be perfectly adequate for detectors located in the innermost region of M2. An R&D for these new detectors has been started.

MPGD / 27

Upgrade of the CMS Muon System with Triple-GEM detectors

DILDICK, Sven[1]

[1] *Universiteit Gent*

Corresponding Author(s): sven.dildick@ugent.be

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&D has been going on since 2009 and it has lead to the development of several GEM prototypes and associated detector electronics. These GEM prototypes have been subjected to extensive tests in the laboratory and in test beams at the CERN Super Proton Synchrotron (SPS). This contribution will review the status of the CMS upgrade project with GEMs and its impact on the CMS performance.

MPGD / 52

MPGD-based counters of single photons developed for COMPASS RICH-1

LEVORATO, Stefano[1]

[1] *Istituto Nazionale di Fisica Nucleare*

Corresponding Author(s): stefano.levorato@ts.infn.it

In fundamental research, gas detectors of single photons are a must in the field of Cherenkov imaging techniques (RICH counters) for particle identification in large momentum ranges and with wide coverage of the phase space domain. These counters, already extensively used, are foreseen in the setups of future experiments in a large variety of fields in nuclear and particle physics. The quest of novel gaseous photon detector is dictated by the fact that the present gaseous photon detectors have unique characteristics concerning operation in magnetic field, low material budget and cost, but they suffers of severe limitations in effective efficiency, rates, life time and stability, discouraging their use in high precision and high rate experiments. We are developing large size THick GEM (THGEM)-based detectors of single photons. The R&D program includes the complete characterization of the THGEM electron multipliers, the study of the aspects related to the detection of single photons and the engineering towards large size detector prototype. Our most recent achievements include: dedicated studies concerning the ion back-flow to the photo-cathode; relevant progress in the engineering aspects, in particular related to the production of large-size THGEMs, where the strict correlation between the local gain-value and the local thickness-value has been demonstrated and a 300 cm $\times$ 300 mm^2 active area detector has been successfully operated at the CERN PS T10 test beam; the introduction of a new hybrid detector architecture offering promising indication, which is formed by a THGEM layer which acts as CsI support and pre-amplification device followed by a MICROMEGAS multiplication stage. The general status of the R&D program and the recent progress are reported.

MPGD / 105

RD51 Collaboration and MPGD Developments: Five Years Experience and Future Plans

OLIVERI, Eraldo[1]

[1] *CERN*

Corresponding Author(s): eraldo.oliveri@cern.ch

Driven by the availability of modern photolithographic techniques, the Micro Pattern Gas Detectors (MPGD) have been introduced in the last years of the 20th century by pioneer activities: Gas Electron Multipliers (GEM) and Micromegas, later followed by thick-GEM, resistive GEM (RETGEM) and novel micro-pattern devices. Nowadays, a flourishing of R&D activities dedicated to MPGDs and of diversified applications is ongoing, largely favored by the technological collaboration RD51, whose aims are to facilitate the development of these advanced gas-avalanche detector technologies and associated electronic-readout systems, for applications in basic and applied research. The areas of activities within RD51 include MPGD technology and new structures, device characterization, software and simulations, electronics, MPGD production, common test facilities, and applications of MPGD. By this coverage of all aspects of MPGD, RD51 aims to bring together leading experts in the field for the development of new technology and colleagues using this technology for a wide array of applications. The talk will review the collaboration activities and the MPGDs-related developments achieved within the RD51 framework. Future RD51 projects and plans will be summarized.

MPGD / 63

MPGD production situation at CERN

DE OLIVEIRA, Rui[1]

[1] *CERN*

Corresponding Author(s): rui.de.oliveira@cern.ch

CERN PCB workshop is involved since more than a decade in the production of MPGD devices. The main part of the presentation will be an overview of the present situation of large size MPGD production at CERN and also in industry. At the end of the talk some preliminary ideas for single board gas detector production and motivation will be presented as well as special new devices (multi-layer conical THGEM) for IBF control.

MPGD / 96

Construction, commissioning and first data-taking of the Cylindrical-GEM KLOE-2 Inner Tracker

DOMENICI, Danilo[1]

[1] *INFN - Laboratori Nazionai di Frascati*

Corresponding Author(s): danilo.domenici@lnf.infn.it

The KLOE-2 experiment aims to continue the successful program of KLOE, that collected 2.5 fb^{-1} of integrated luminosity between 2001 and 2006 at DANE, the -factory at the Frascati National Laboratory of INFN, fulfilling a vast set of precision kaon and hadron physics measurements. One of the major upgrades of the apparatus is the extension of the tracking system with the insertion of a central Inner Tracker (IT) inside the Drift Chamber. The IT is realized as four concentric cylindrical triple-GEM detectors, directly fixed onto the DAFNE beam pipe, at a distance from the interacion point going from 130 mm to 205 mm. The conception, design and realization of the cylindrical-GEM have been taken on in Frascati since 2007, with the goal of minimizing dead-spaces, support frames and material budget. The final result is a very light detector with an overall thickness corresponding to only 2% of a radiation length. Moreover the detector exploits the outstanding rate capability typical of the micro-pattern gas detectors, useful to cope with the unavoidable background of a high-luminosity e^+e^- collider. The tracker provides space points with resolutions of 200 m in r and 500 m in z. The two coordinates are obtained by an XV strips patterned readout coupled to the GASTONE front-end, the 64 channels ASIC with digital output developed for the KLOE-2 experiment. In this talk we will give a comprehensive review of the construction procedures, the integration with the collider and the commissioning. Very preliminary measurements with cosmic muons and beam interactions will be shown as well. Extremely challenging problems have to be faced during these phases, lasted two years, that demanded for likewise advanced solutions.

MPGD / 88

Micromegas detectors for the ATLAS Muon System upgrade

ZIBELL, Andre[1]

[1] *Julius-Maximilians-Universitaet Wuerzburg*

Corresponding Author(s): andre.zibell@physik.uni-wuerzburg.de

We will present the status and the plans of the micromegas detector project for the upgrade of the ATLAS muon system in the next long LHC shutdown in 2018. The project consists of the construction of 1200 m^2 of micromegas detectors, with single detector elements of 2-3 m^2 area each, and their instrumentation with readout electronics based on a novel chip developed for this purpose. The detector comprises 2M readout channels and delivers track segments for triggering and high precision off-line track reconstruction. The detector elements will be assembled with high precision into 128 four-layer modules, two of which each form a measurement station. We will present the detector concept and our ideas and steps towards the construction of the modules which will take place in several production sites. In addition we will report on the realization of a first pre-series four-layer module to be installed in ATLAS in 2014.

MPGD / 119

Review of simulations for gas detectors

VEENHOF, Rob[1]

[1] *RD51 and Uludag university*

Corresponding Author(s): rob.veenhof@cern.ch

Gas-based tracking devices are currently undergoing a revival: with the advent of MPGDs (such as Micromegas, GEM, InGrid ...) spatial resolutions of 50m and better have become

commonplace. MGPDs are in addition light, well suited to cover large areas with, and affordable. Traditionally, gas-based detectors are simulated by integrating field gradients and transport tables. This technique is not suitable for MPGDs because the mean free path between collisions, a few m, is not much smaller than the smallest structural elements nor much smaller than the spatial resolution of the best MPGDs. A more appropriate method consists in tracking electrons from molecule to molecule and applying the various processes (elastic and inelastic collisions, excitation, ionisation, attachment). Magboltz contains an elaborate library of cross section terms - simulations routinely involve well over a hundred terms. Even if the technique is computing time intensive, it has eanwhile been shown to yield accurate results. The method can be used to simulate space charge and charge accumulations on the surfaces of dielectrics. This is even more time intensive, but first results for GEMs show that the main features from the experimental data are reproduced.

MPGD / 72

Development of high resolution tracking detectors with Gas Electron Multipliers

SHEKHTMAN, Lev[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): l.i.shekhtman@inp.nsk.su

Cascaded Gas Electron Multipliers (GEM) allow to construct detectors for charge particles tracking with high spatial resolution and rate capability. Such detectors can withstand high background fluxes up to 10^5 particles/mm^2/s and determine track coordinates with precision of 50-70 micron. These remarkable features of GEM govern the use of this technology in a number of experiments at the Budker Institute of Nuclear Physics. In this presentation the current status and progress in the performance studies and the development of the detectors for the tagging system of the KEDR experiment at the VEPP-4M collider and for the DEUTERON facility at the VEPP-3 storage ring will be covered. The new proposals for the upgrade of tracking and trigger system of the CMD-3 detector, the tracking detectors for the extracted beam from the VEPP-4M storage ring and the tracking detectors for the polarimeter at the VEPP-4M with the use of GEM technology will be discussed.

PID / 120

Study of focusing aerogels with electron beam

KONONOV, Sergey[1]

[1] *Budker Institute of Nuclear Physics SB RAS*

Corresponding Author(s): s.a.kononov@inp.nsk.su

Recent results from the beam test of the FARICH detector prototypes at the BINP electron beam line are reported. We studied several samples of focusing aerogel using multichannel SiPM photodetectors with a high position resolution. One of photodetectors was based on novel digital SiPM technology - Digital Photon Counter produced by Philips. Particle track was measured by gaseous strip detectors based on GEMs that have 70 m resolution. That allowed us to precisely measure the radius distribution of Cherenkov photons from aerogel and compare with a prediction based on aerogel refractive index profile obtained by a digital radiography. In 2012, the first aerogel blocks with a continuous density gradient along thickness were produced. This technology can dramatically reduce the contribution from the radiator thickness to the resolution of the measured Cherenkov angle in the FARICH detector. A special automatic setup was used to control reagents ratio during the synthesis process. The first few samples were tested using a digital radiography and the electron beam.

PID / 121

Threshold aerogel Cherenkov counters of the KEDR detector

BARNYAKOV, Alexander[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): m.yu.barnyakov@inp.nsk.su

Particle identification system based on aerogel threshold Cherenkov counters ASHIPH (Aerogel SHifter PHotomultiplier) was installed in the KEDR detector in 2013. The system consists of 160 counters arranged in two layers and contains 1000 liters of aerogel with refractive index 1.05 and 160 MCP PMTs with multialkali photocathode. The efficiency of relativistic particles registration was measured. Long term stability of ASHIPH counters was studied. The main factors of efficiency degradation are presented.

PID / 122

MCP PMT in colliding beam experiments

BARNYAKOV, Mikhail[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): m.yu.barnyakov@inp.nsk.su

Photomultiplier tubes based on microchannel plates (MCP PMT) provide effective detection of single photons in high magnetic field with excellent time and space resolution. This makes MCP PMT very attractive photosensor for PID detectors in experiments at colliders. Main characteristics of MCP PMT and their limitations are discussed. Current and possible future applications of MCP PMT in colliding beam experiments are described.

PID / 58

Status of the CMS Muon Chambers

MITSELMAKHER, Guenakh[1]

[1] *University of Florida*

Corresponding Author(s): mitselmakher@phys.ufl.edu

Status of the Muon detectors of the CMS experiment at LHC is presented.

PID / 80

Development and Construction of the Belle II TOP Detector

SUZUKI, Kazuhito[1]

[1] *Graduate School of Science, Nagoya University*

Corresponding Author(s): kazuhito@hepl.phys.nagoya-u.ac.jp

A Time-of-Propagation (TOP) detector is a ring-imaging Cherenkov detector that images a Cherenkov ring using propagation times and detected x- and y-positions of Cherenkov photons. It has been developed for particle identification in the barrel region of the Belle II spectrometer, which will probe new physics beyond the Standard Model with a luminosity of $8x10^{35}/cm^2/s$. The TOP detector is intended to achieve good /K separation in the momentum range up to around 3 GeV/c under the high-luminosity environment. The detector construction has been started and the remaining development is being finalized toward the installation into the spectrometer in early 2015. A single detector module mainly consists of a synthetic silica plate, as the Cherenkov radiator, and an array of micro-channel plate (MCP) photomultiplier tubes (PMTs) with readout electronics. Optical components for the first detector module are being delivered one after another. The delivered components are in process of optical inspections and assembly preparation. Mass production of the MCP-PMTs is on going smoothly. The performance details are being inspected under the operational magnetic field of 1.5 T. Although the lifetime of an MCP-PMT has been an issue concerning the high-luminosity environment, atomic layer deposition on MCPs has improved the lifetime significantly. Development of the readout electronics is being finalized. Their high-speed waveform sampling ASICs and circuit board stacks are in preproduction. Preproduction for the mechanical structure of a detector module is about to start. It is crucial to establish the optical and electrical contacts between the optics, MCP-PMTs and readout electronics. A beam test on a detector module prototype has been carried out using a 2 GeV/c e^+ beam at the LEPS beam line of SPring-8 in June 2013. The prototype consists of the optics and MCP-PMTs that have nearly final and final specifications, respectively. The test results have demonstrated the detector principle reasonably.

PID / 81

Long term experience and performance of COMPASS RICH-1

TESSAROTTO, Fulvio[1]

[1] *INFN - Trieste*

Corresponding Author(s): fulvio.tessarotto@ts.infn.it

The RICH-1 Detector of the COMPASS Experiment at CERN SPS provides high quality hadron identification in the particle momentum range from 3 to 60 GeV/c, covering a wide angular acceptance and operating at high rates. It is in operation since 2002 and its performance increased thanks to progressive optimization and to a major upgrade of its photon detection system, implemented in 2006; a new upgrade is foreseen for 2016, using MPGD-based photon detectors. The main characteristics of COMPASS RICH-1 and the most critical problems encountered and presently faced are discussed together with the adopted solutions to guarantee radiator gas purity, mirror alignment control, stable photon detector response, heat removal and readout electronics optimization. The PID performance is presented and the observed evolution of the effective quantum efficiency of CsI photocathodes in gas photon detectors is discussed. The motivation and the plan for the future upgrade are briefly mentioned.

PID / 86

ARICH for Belle II

YUSA, Yosuke[1]

[1] *Niigata University*

Corresponding Author(s): yusa@hep.sc.niigata-u.ac.jp

We will present overview of Aerogel Ring Imaging Cherenkov counter (ARICH) which is developed as a particle identification detector in next generation B-factory experiment, the Belle II. We show results of the studies for detector components such as aerogel radiator and newly developed photon sensor.

PID / 104

Recent progress in particle identification methods

KORPAR, Samo[1]

[1] *University of Maribor, FKKT*

Corresponding Author(s): samo.korpar@ijs.si

In the talk recent progress in particle identification methods will be reviewed. The survey of present experience with Cherenkov detectors used for particle identification in various particle physics experiments will be presented and planed upgrades of existing devices will be discussed. We will also review particle identification by state-of-the-art detectors based on time-of-flight, dE/dx and transition radiation measurements.

PID / 32

Upgrade of the CMD-3 TOF system

FEDOTOVICH, Gennadiy[1]

[1] *Budker Institute of nuclear physics*

Corresponding Author(s): fedotovich@inp.nsk.su

A new time-of-flight system based on strip scintillator counters for the CMD-3 detector is presented. This system designed to detect the annihilation products of the antineutrons near threshold production and will be inserted to narrow gap (7 mm) between LXe and CsI calorimeters. A time resolution about 0.8 ns achieved that is enough to separate this type of the events from other relativistic particles.

PID / 37

Status of BESIII

HENG, Yuekun[1]

[1] *Institute of High Energy Physics, Chinese Academy of Sciences*

Corresponding Author(s): hengyk@ihep.ac.cn

The status and prospects for BESIII (BEijing Spectrometer III) is presented. It has been running stably since 2009 on the BEPCII (Beijing Electron Positron Collider II) machine. Upgrade plans for its sub-detectors have been proposed and the upgrade is undergoing. The major upgrade comes from the drift chamber and the time of flight counter. The other sub-detectors show good status and no upgrade are needed. Given the current status and upgrade plan of the BESIII detectors, it's foreseen that the BESIII is able to work for 8˜10 years from now.

PID / 61

New developments in solid state photomultipliers

MUSIENKO, Yury[1]

[1] *Institute for Nuclear Research (RAS)*

Corresponding Author(s): iouri.musienko@cern.ch

Solid state photon detectors have been extensively developed during recent years and promise to be an alternative to photomultiplier tubes. During the last decade, a variety of new solid state photomultipliers (SSPMs) appeared on the market and interest in these devices increased regarding their application in high energy physics experiments and positron emission tomography. This presentation reviews the latest developments in SSPMs (SiPMs, APDs, HAPDs etc.) discusses the SSPM properties and problems and gives a speculative outlook on their future evolution.

PID / 67

The Time-of-Flight system for MPD

RUMIANTCEV, Mikhail[1]

[1] *Joint Institute for Nuclear Research*

Corresponding Author(s): mikhail.rumyantse@yandex.ru

The TOF system of MPD is the main detector for particles identification. For an efficient separation of pions from kaons in the momentum range 0-2.5 GeV/c and protons from kaons in the range 0[U+2011]4.5 GeV/c it should have time resolution better than 100 ps. The TOF system is based on mRPC detectors. It consists of a barrel with radius of 1.5 m and two End caps. The barrel and caps cover the region || < 1.4 and 1.5 < || < 2 correspondingly. During the test of full size mRPC prototype with active area of 600 x 300 mm^2 and strip readout a time resolution of about 65 ps and efficiency of ˜99% were obtained. The start signal for TOF system in the MPD setup will be provid by two stations of Cherenkov quartz counters (FFD - Fast Forward Detector). The key idea is registration of high-energy photons from neutral pions decays, by their conversion to electrons inside a lead plate. The electrons leave the lead plate and pass through a quartz radiator, generating the Cherenkov light with excellent time characteristics. The Cherenkov light registration by multianode microchannels photomultiplier tube (MCP-PMT). The FFD consists of two sub-detectors FFDL and FFDR, arranged as arrays of modules and situated near the beam pipe at a distance of 75 cm to the left and to the right from the interaction region. Each sub-detector array has a hole for the beam pipe and a pseudorapidity acceptance of 2.3 < || < 3.1. Four prototypes of the FFD modules were test on the Nuclotron beam also and it have time resolution les then 35 ps.

Posters / 133

Distributed data analysis system for CMD-3 detector

GAYAZOV, Stavro[1]

[1] *Budker Institute of Nuclear Physics, Siberian Branch of Russian Academy of Science,*

Corresponding Author(s): s.e.gayazov@gmail.com

The architecture and the implementation of the distributed data analysis system for CMD-3 detector is presented. The system effectively uses available heterogeneous resources for data storing and processing. Two type of the resources are used: local computing cluster, dedicated to CMD-3 data storage and processing, and dynamically allocated resources of supercomputers at BINP, SSCC and NUSC. A uniform data processing cloud, a CMD-3 Cloud, with transparent user access and HTCondor as the batch system is organized over available set of different resources. Dedicated level of software, Large File Catalog (LFC), is used for data storage and access. The local cluster nodes are used as the main repository for detector data. Additional storage at BINP supercomputer is used for data caching and as temporal working space. LFC provides universal interface for data access, using XROOTD or SSH as transport protocol. If neccessary, the management level of the CMD-3 Cloud system dynamically allocates resources at supercomputers with the help of virtualization technology. The system is fully implemented and operational.

Posters / 137

The gamma-quantum registration system of SVD setup

GOLOVNYA, Sergey[1]

[1] *Institute for High Energy Physics*

Corresponding Author(s): sergey.golovnya@ihep.ru

The gamma quantum registration system is the part of the SVD setup at the U-70 accelerator (IHEP) exposures in experiments: SERP E-184 (An experiment for studying mechanisms of charmed particle production and decays in pA-interactions at 70 GeV/c) and SERP E-190 (Production of particles in pp-interactions in high multiplicity events at 50 GeV/c). The system consists of two detectors - the hodoscope detector of 1532 (48x32) cherenkov full absorption counters with a lead glass absorber (DEGA) and the soft photons calorimeter of 49 (77) counters with BGO (SPC) crystals. The following systems are described: the high-voltage power system, the DEGA platform positioning control system for detector calibration in an electron beam, the DEGA LED monitoring system. The description of the soft photons calorimeter is provided. This subsystem is focused to detecting the gamma quantum in energy range of tens MeV. The test results of SPC obtained during the accelerator run of 2013 year are presented, the energy spectrum of photons are given.

Posters / 136

Results on radiation hardness of avalanche photodiodes up to neutron fluences of 2.5×10^{14} n/cm^2

MUSIENKO, Yury[1]

[1] *Institute for Nuclear Research (RAS)*

Corresponding Author(s): iouri.musienko@cern.ch

Results on the radiation hardness of avalanche photodiodes to fast neutrons are presented. APDs from Hamamatsu were irradiated with reactor neutrons up to 1 MeV equivalent fluence of 2.5×10^{14} n/cm^2. The effects of this radiation on many parameters such as gain, intrinsic dark current, quantum efficiency, noise and capacitance for these devices are shown and discussed.

Posters / 135

Testbench of shaper-digitizer modules for Belle II calorimeter

MATVIENKO, Dmitry[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): d.v.matvienko@inp.nsk.su

The design and construction work of the Belle II detector sub-systems, including electromagnetic calorimeter, is ongoing. The modification of the calorimeter includes the development of new electronics based on specially developed shaper-digitizer-signal-processing (Shaper DSP) modules. Shaper DSP module performs signal shaping, digitization, wave form analysis and provides fast sum signal for trigger. The calorimeter includes 576 Shaper DSP modules. Recently mass-production stage has been started and now the complete performance test for all modules is necessary. To test a workability of modules and measure their parameters, specialized testbench has been developed. The testbench allows one to study the signal shape, fast output, deviations from linearity, noise level and DSP logic. All test results are recorded to the database and some of them have graphical representation.

Posters / 139

New Drift Chamber for the KEDR Detector

BASOK, Ivan[1]

[1] *BINP*

Corresponding Author(s): ivan.basok@gmail.com

For further implementation of physical research program at the KEDR detector and for accompanying equipment upgrade the new drift chamber is currently being developed. This main tracking and momentum-measuring system represents gas multilayer wire chamber operating in proportional mode. Design features and modifications versus existing chamber are described. Using prototype the spatial resolution in various gas mixtures is being studied. Preliminary results of spatial resolution measurements are presented. For KEDR DC Group: Basok I.Yu, Blinov V.E., Bykov A.V., Kharlamova T.A., Prisekin V.G.,Rodyakin V.A., Savinov G.A., Todyshev K.Yu.

Posters / 21

Particle identification system based on dense aerogel for SND detector at VEPP-2000 collider

BELOBORODOV, Konstantin[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): k.i.beloborodov@inp.nsk.su

For experiments with SND detector at the e^+e^- - collider VEPP-2000 a new particle identification system based on dense aerogel put into operation. The system is intended for the separation of and K mesons up to particle energy of 1 GeV. Cherenkov radiator has refractive index n = 1.13. Structurally, the system has the form of a barrel, divided into 9 sections in the axial angle. Light collection is implemented through green wave length shifter on the flat PMT with micro channel plate. MIP particle creates a signal 6-10 photoelectrons. The system was calibrated with the e, , and K particles produced in e^+e^- -collisions. In this paper preliminary result on the cross-section of the process $e^+e^- \rightarrow K^+K^-$ are presented.

Posters / 22

Extracted e- and gamma beams in BINP SB RAS

BOBROVNIKOV, Victor[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): v.s.bobrovnikov@inp.nsk.su

The purpose of the project is to create a setting for the generation of the extracted beams of electrons and gamma-rays on the basis of e^+e^- collider VEPP-4M. It is planned to have a beam of electrons with energies derived from 0.1 GeV to 3.0 GeV to measure the momentum of an electron to an accuracy of better than 1% , the range of energy generated by a tagged gamma rays would be between 0.05 GeV to 1.5 GeV with an accuracy of 0.5% of energy. This project will develop new types of particle detectors for scientific and applied research. The results obtained in the process of new knowledge and experience will be used to provide the experimental basis of modern facilities for high-energy physics in Russia and abroad.

Posters / 28

The charge measurements system at PHIL, LAL

ELKAMCHI, Noureddine[1]

[1] *Laboratoire de l Accelerateur Lineaire*

Corresponding Author(s): elkamchi@lal.in2p3.fr

PHIL is an electron beam accelerator at LAL (Laboratoire de l Accelerateur Lineaire). It produce low energy (E<5 MeV) and high current (1nC/bunch) electrons bunch at a repetition frequency of 5Hz. The charge measurements are performed by two Integrated Current Transformers (ICT) and two Faraday's cup. Signals from the charge measurement system were displayed on an oscilloscope, and used to calculate the charge and dark current manually using the oscilloscope features. This operation is long, not accurate and cannot be integrated in the control command system. To overcome this problems, a new approach was adopted, based on two systems: 1) An electronic system to integrate the signal from the charge measurement systems (20ns large pulse), and outputs a large duration signal (around 400μs) whose amplitude is proportional to the beam charge. 2) A microcontroller that aquire the integrated signal with a repition rate of 5Hz, make the analog-digital conversion, and calculate the statistical values of the signal. Output signal can be sent to the control command system for displaying and to automate other process, especially the charge-RF phase measurements. This system is accurate, with a resolution of around 1pC, and can be easily integrated in the control command system.

Posters / 29

Processing of the Liquid Xenon Calorimeter's signals for timing measurements

EPSHTEYN, Leonid[1]

[1] *Budker Insitute of Nuclear Physics*

Corresponding Author(s): angel-of-world@yandex.ru

One of the goals of the Cryogenic Magnetic Detector at Budker Institute of Nuclear Physics SB RAS (Novosibirsk, Russia) is a study of nucleons production in electron-positron collisions

near threshold. The neutron-antineutron pair production events can be detected only by the calorimeters. In the barrel calorimeter the antineutron annihilation typically occurs by 5 ns or later after beams crossing. For identification of such events it is necessary to measure the time of flight of particles to the LXe-calorimeter with accuracy of about 3 ns. The LXe-calorimeter consists of 14 layers of ionization chambers with anode and cathode readout. The duration of charge collection to the anodes is about 4.5 mks, while the required accuracy of measuring of the signal arrival time is less than 1/1000 of that. Besides, the signal shapes differ substantially from event to event, so the signal arrival time is measured in two stages. At the first stage, the signal arrival time is determined with an accuracy of 1-2 discretization periods, and initial values of parameters for subsequent fitting procedure are calculated. At the second stage, the signal arrival time is determined with the required accuracy by means of fitting of the signal waveform with a template waveform. To implement that, a special electronics has been developed which performs waveform digitization and On - Line measurement of signals' arrival times and amplitudes.

Posters / 127

Track-based alignment of the CMS Muon System

PAKHOTIN, Yuriy[1]

[1] *Texas A and M University*

Corresponding Author(s): pakhotin@tamu.edu

The muon system of the CMS experiment provides fast muon trigger decisions, muon identifications, and muon trajectory measurements. The CMS muon system consists of drift tube chambers in central part and cathode strip chambers in forward parts complimented by trigger system consisting of resistive plate chambers distributed in both regions. The performance of the muon system depends on a precise knowledge of the positions and orientations of all its elements within the CMS detector. We present track-based alignment technique which uses muon tracks reconstructed in pp collision data at the LHC to align the muon system elements with respect to the inner silicon tracker. Iterative algorithm for the track-based alignment has been designed and implemented in the CMS software framework. We discuss details of the algorithm, results of the several years of CMS operation, methods utilized to evaluate the systematic uncertainties of the alignment parameters, achieved precision of the algorithm and improved muon momentum resolution. We also present plans for upgrade and future development.

Posters / 55

Test results of the aerogel Cherenkov counters with n=1.05 using electrons and muons at p<500 MeV/c

MARTIN, Karina[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): martin@inp.nsk.su

Test results of the threshold aerogel Cherenkov counters system with n=1.05 intended for particle separation are presented. The system is constructed for SND detector which is taking data at VEPP-2000 e^+e^- collider. The measurements have been done using particles from $e^+e^- \to e^+e^-$ and $e^+e^- \to {}^{+-}$ reactions. The average signal from electrons is 3.5 photoelectrons.

Posters / 56

Liquid xenon calorimeter of the CMD-3 detector

MIKHAILOV, Kirill[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): kmikhail@inp.nsk.su

During 2010 year the CMD-3 detector has started to collect experimental data produced at e^+e^- collider VEPP-2000 at Budker Institute of Nuclear Physics. CMD-3 is a general purpose detector designed to study of e^+e^- annihilation in to hadrons in the wide energy range, $\sqrt{s} = 0.3 \div 2$ GeV. The barrel electromagnetic calorimeter of the detector consists of two subsystems: closest to the beam pipe liquid xenon calorimeter and outer calorimeter based on CsI scintillation crystals. The liquid xenon calorimeter contains 400 liters of LXe, covers solid angle ˜0.8÷4 and has a thickness equal to $5.4X_0$. The electrodes structure of calorimeter provides possibility to measure deposited energy, reconstruct tracks of charged particles and analyze the deposited energy distribution in the calorimeter volume. The design of LXe calorimeter and its current performance are presented in report.

Posters / 89

2-dimensional GEM detector with FEE based on the nXYTER

ZRYUEV, Vladislav[1]

[1] *Joint Institute for Nuclear Research*

Corresponding Author(s): vlad@jinr.ru

The fast GEM detector with 2-dimensional orthogonal strip readout has been developed and constructed. The multichannel front end electronics based on the 128 channel n-XYTER chip has been used. The investigations with this detector are focused on applications with high rate X-ray sources (6-20 keV). The measurement results of gas gain, spatial resolution and energy resolution are presented.

Posters / 113

Simulation of the ATLAS Tile Hadronic Calorimeter at LHC and validation studies

KARPOV, Sergey[1]

[1] *Joint Institute for Nuclear Research (JINR)*

Corresponding Author(s): karpovsn@jinr.ru

The Tile Calorimeter (TileCal) is the central section of the ATLAS hadronic calorimeter at the Large Hadron Collider. Scintillation light produced in the tiles is transmitted by wavelength shifting fibers to photomultiplier tubes (PMTs). The resulting electronic signals from approximately 10000 PMTs are measured and digitized before being transferred to off-detector data-acquisition systems. This contribution describes the detailed simulation of this large scale calorimeter from the implementation of the geometrical elements down to the realistic description of the electronics readout pulses, the special noise treatment and the signal reconstruction. The improved description of the optical signal propagation is highlighted and the validation with the real particle data is presented.

Posters / 31

Luminosity measurement with CMD-3 detector at the VEPP-2000 e+e- collider

FEDOTOVICH, Gennadiy[1]

[1] *Budker Institute of nuclear physics*

Corresponding Author(s): fedotovich@inp.nsk.su

Preliminary results of the luminosity measurement in a broad energy range are presented. The analysis is based on the integrated luminosity ˜60 pb^{-1}. For the energy range smaller 320 MeV the luminosity was determined using two processes: $e^+e^- \to e^+e^-$, $^{+-}$. As for higher energies up to 2 GeV the luminosity determination was based on study processes $e^+e^- \to e^+e^-$, . The applying two well known QED processes provided cross-check possibility, that in turn, allowed more correctly estimate the systematics errors. Currently the systematics for luminosity is estimated as 0.5% ÷ 1% for different energy region.

Posters / 35

The array for the detection of the neutron component of extensive air showers

GROMUSHKIN, Dmitry[1]

[1] *National Research Nuclear University MEPhI*

Corresponding Author(s): dmgromushkin@mephi.ru

The idea of the array consists in registration of delayed thermal neutrons generated by hadronic component of extensive air showers (EAS). The array includes 32 en-detectors deployed over the area of 450 m^2. En-detectors are able to detect two main EAS components: electromagnetic one in the case of a group passage of charged particles (e), and hadron component through thermal neutrons (n). Detectors are based on specialized inorganic scintillator, which represents a granulated alloy of powder-based ZnS (Ag) doped with LiF, being enriched up to 90% by 6Li isotope. The array is triggered by the electromagnetic component of EAS, and provides information about the delayed neutrons accompanying the EAS within 20 ms after the trigger. During 1.5 years of operation more than 10^5 events were registered. The analysis of obtained information on hadronic and electromagnetic components of the EAS has been performed. Examples of EAS registration and results on temporal and lateral distributions of detected thermal neutrons are given.

Posters / 62

The project of laser polarimeter for beam energy measurement of VEPP-4M collider by resonance depolarization method

NIKOLAEV, Ivan[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): i.b.nikolaev@inp.nsk.su

To high precision measurement of -meson masses on VEPP-4M - KEDR accelerator complex the beam energy calibration is needed. The project of laser polarimeter for beam energy measurement by resonance depolarization method is discussed. The polarization measurement is based on up-down asymmetry of Compton backscatterring of circular polarized photons on vertical polarized electrons. Scattered photons are registered by two-coordinate GEM detector. Expected effect is about 1% with ten sigma confidence level.

Posters / 93

Calibration of energies at photon colliders

TELNOV, Valery[1]

[1] *Budker INP*

Corresponding Author(s): telnov@inp.nsk.su

Abstract is not provided.

Posters / 92

A conception of the photon collider beam dump

TELNOV, Valery[1] ; SHEKHTMAN, Lev[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): telnov@inp.nsk.su

Abstract is not provided.

Posters / 48

The CMD-3 TOMA DAQ infrastructure

KOZYREV, Aleksey[1]

[1] *Institute of Nuclear Physics*

Corresponding Author(s): akozyrev@inp.nsk.su

The CMD-3 detector for VEPP-2000 e^+e^- collider is under upgrade now in Novosibirsk in Budker Institute of Nuclear Physics. The CMD-3 is equipped with a DAQ which is a time oriented measurement and acquire (TOMA) system specially developed for the precise experiments. The CMD-3 TOMA DAQ capacity is to process some about 10k channels with mean Trigger rate up to 5 kHz thus producing about 2.8 Gbps data rate. The main feature of CMD-3 TOMA DAQ is high grade of unification, which allows low count of module types. It is the way to decrease the cost of ownership and production time of the system. Unification is based on flat model design approach and multiple synchronization modes which provided by CMD-3 TOMA DAQ. The special attention is devoted to synchronization of data transmission, and electronics efficiency on-line checks. The environment of signaling of synchronization and the data, named C-Link has been for this purpose specially developed. The accepting decisions by working out have allowed to reach high degree of unification of electronics that has allowed to reduce the nomenclature of units. This paper describes the features of hardware part of TOMA DAQ system.

Posters / 49

The development of high resolution coordinate detectors for the DEUTRON facility

KUDRYAVTSEV, Vasily[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): v.n.kudryavtsev@inp.nsk.su

The DEUTERON internal target facility at the VEPP-3 storage ring at BINP is intended for the experiments on interaction of electrons and positrons with proton and deuteron. The experiment requires high resolution tracking detectors which can provide the energy and angles of scattered electron. The prototype detector with a sensitive area of 160x40 mm^2 was built and proved to be operational. It consists of three cascades of gaseous electron multiplier (GEM), the readout structure and detector electronics. Readout structure has 640 channels which reside evenly on two layers skewed by 30 degrees. Electronics of the detector includes APC128 ASICs, Altera Cyclone III FPGA, 100 MBit ethernet. In the APC128 ASIC each channel has a separate analog pipeline consisting of 32 cells which are cyclically switched by a global clock synchronized to the bunch crossing rate (˜4 MHz). At the trigger input channels of APC128 are electronically disconnected from the readout structure, and the stored charges of the pipeline capacitors are serially transferred through analog multiplexer into 14bit ADC. Finally FPGA sends UDP packets with digitized measurements to PC over ethernet. For the needs of DEUTRON experiment the expected resolution of less than 100 m and thickness ˜0.15% of radiation length are considered to be quite satisfactory. At the conference the latest results will be presented, including tests with radioactive sources and at the extracted beam installation at the VEPP-4M collider.

Posters / 46

SND data acquisition system upgrade

KOROL, Aleksandr[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): a.a.korol@inp.nsk.su

The data acquisition (DAQ) system of the SND detector successfully operated during four data-taking seasons (2010-2013) at the e^+e^- collider VEPP-2000. Currently the collider is shut down for planned reconstruction, which is expected to increase the VEPP-2000 luminosity and data flow from the SND detector electronics by up to 10 times . Since current DAQ system implementation (electronics and computer part) does not have enough reserve for selection of events in the new environment without compromising quality, there arose the need for the system upgrade. Here we report on the major SND data acquisition system upgrade which includes developing new electronics for digitization and data transfer, complete redesign of the data network, increasing of the DAQ computer farm processing capacity and making the event building process concurrent. These measures will allow us to collect data flow from the most congested detector subsystems in parallel in contrast to the current situation.

Posters / 41

Compton backscattering for the calibration of KEDR Tagging System

KAMINSKIY, Vyacheslav[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): v.v.kaminskiy@inp.nsk.su

KEDR detector has the tagging system (TS) to study the gamma-gamma processes. To determine the two-photon invariant mass, the energies of the scattered at small angles electrons and positrons are measured by the magnetic spectrometer embedded into the lattice of the VEPP-4M collider. The energy resolution (scattered electron/positron energy resolution divided by the beam energy) of this spectrometer varies from 0.6% to 0.03% depending on the electron/positron energy. The Compton backscattering of laser radiation on the electron/positron beam is used for the accurate energy scale and resolution calibration of the tagging system. The report covers the design, recent results and current status of the KEDR TS calibration system.

Posters / 140

The energy calibration system of the KEDR tagger

ZHILICH, Victor[1]

[1] *BINP*

Corresponding Author(s): v.n.zhilich@inp.nsk.su

The KEDR Tagging System is designed to enhance the detector ability to study the two-photon processes $e^+e^- \rightarrow e^+e^-X$. The collider magnetic elements (dipoles and lenses) form a magnetic spectrometer for the scattered electrons and positrons. Its energies are measured with 8 coordinate blocks which are placed beside of the vacuum chamber. In the double–tag mode an invariant mass of the system X can be measured with resolution 3-15 MeV for Winv=300÷3000 MeV depending on the mass and the beam energy. The changes of the beam energy cause the small changes in the magnetic structure and the beam orbit. This cause systematic shifts of the e± energy which is measured with the coordinate blocks. These different shifts leads to degradation of the Winv resolution. The complex calibration system was constructed to allow the calibration for all tagger blocks with the necessary accuracy.

Posters / 75

Muon System of SND Detector

SHTOL, Dmitry[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): shtol@inp.nsk.su

The muon system composed of proportional tubes and plastic scintillation counters is described. This system is constructed for the SND detector collecting data at VEPP-2000 e^+e^- collider. The results of the muons and pions detection efficiency measurements are presented. These measurements have been porformed using $e^+e^- \rightarrow {}^{+-}$ and $e+e^- \rightarrow {}^{+-}$ processes. Efficiency for muons is 94% for the energies 0.6-1.0 GeV and becomes much lower in energy range 0.45-0.55 GeV. Efficiency for pions is preliminary estimated and varies from 5% at 0.5 GeV to 30% at 1 GeV.

Posters / 73

Proposal for the upgrade of the tracking and trigger system of the CMD-3 detector

SHEKHTMAN, Lev[1] ; GENNADIY, Fedotovich[2]

[1] *Budker Institute of Nuclear Physics*

[2] *Budker Institute of nuclear physics*

Corresponding Author(s): l.i.shekhtman@inp.nsk.su

Large cylindrical triple-GEM detector (CGEM) is proposed to upgrade the CMD-3 tracker subsystem. CGEM is considered both for precise measurement of z-coordinate of tracks in drift chamber (DC) and for generating signals for the first level trigger. This chamber will have better spatial resolution, trigger segmentation and rate capability with respect to the previous Z-chamber which is used in CMD-3 today. A new end-cup discs with GEM-based detectors are considered too. This tracker will improve significantly the detection efficiency for multi-hadron events, will help to study processes with ISR and measure the cross section with double tagged electrons when two virtual photons radiated by initial electrons produced C-even states (^{0},).

Posters / 79

New electronics with high time and energy resolution for SND detector calorimeter

SURIN, Ilya[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): i.k.surin@inp.nsk.su

It is planned to improve the NaI(Tl) SND electromagnetic calorimeter (EMC) with the new measuring channel. It's necessary for providing reliable detection of low-speed anti-neutrons, which are produced in $e^+e^- \rightarrow$ n anti-n reaction near threshold. The proposed channel, providing about 1 ns time resolution at 100 MeV energy deposition in EMC, is described.

Posters / 78

Muon System of the KEDR Detector

SUKHAREV, Andrey[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): suharev@inp.nsk.su

Muon system of the KEDR detector is based on single-wire gas chambers operating in self-quenching streamer mode. Its main purposes are muon/hadron separation and cosmic veto. The system's history, status and future prospects as well as the experience gained are shown in the poster.

Posters / 47

ATLAS TDAQ application gateway upgrade during LS1

KOROL, Aleksandr[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): a.a.korol@inp.nsk.su

The ATLAS Gateway service is implemented with a set of dedicated computer nodes to provide a fine-grained access control between CERN General Public Network (GPN) and ATLAS Technical Control Network (ATCN). ATCN connects the ATLAS online farm used for ATLAS Operations and data taking, including the ATLAS TDAQ (Trigger and Data Aquisition) and DCS (Detector Control System) nodes. In particular, it provides restricted access to the web services (proxy), general login sessions (via SSH and RDP protocols), NAT and mail relay from ATCN. At the Operating System level the implementation is based on virtualization technologies. Here we report on the Gateway upgrade during Long Shutdown 1 (LS1) period: it includes the transition to the last production release of the CERN Linux distribution (SLC6), the migration to the centralized configuration management system (based on Puppet) and the redesign of the internal system architecture.

Status reports from HEP centres / 138

European Strategy for Particle Physics

Corresponding Author(s): manfred.krammer@oeaw.ac.at

Status reports from HEP centres / 24

Satus of BEPCII

CAO, Jianshe[1]

[1] *institute of high energy physics, Chinese academy of sciences*

Corresponding Author(s): caojs@ihep.ac.cn

As a comprehensive and larger fundamental research unit in China, BEPCII is characterized with "one machine, two purposes". It means BEPCII will deliver beams not only for high energy physics, but also for synchrotron radiation users. Usually, BEPCII runs for high energy physics for 6 months, 3 months for SR users dedicatedly, and one and half months for machine study, in every year. In my talk, the machine status and beam instrumentation of BEPCII will be presented. It includes the beam commissioning & machine research, the main progress and main problems of BEPCII, beam instrumentation system, summary and outlook.

Status reports from HEP centres / 26

Fermilab accelerator complex and experimental program status and plans

DENISOV, Dmitri[1]

[1] *Fermilab*

Corresponding Author(s): denisovd@fnal.gov

With successful completion of the Tevatron program Fermilab is developing powerful proton and neutrino beams for a wide spectrum of particle physics experiments. Intense beams of muons are also designed for high precision g-2 and muon to electron conversion experiments. Planned at Fermilab experiments require wide range of unique particle detectors from multi-kilotons neutrino detectors to very low backgrounds rare decay experiments. In addition to the above topics, the talk will cover long term Fermilab's accelerator complex developments and related particle detectors including muon collider and 100 TeV proton-proton collider.

Status reports from HEP centres / 125

Collider experiments in Budker Institute

Corresponding Author(s): tikhonov@inp.nsk.su

Abstract is not provided.

Status reports from HEP centres / 118

Fundamental Science at J-PARC

SAITO, Naohito[1]

[1] *KEK / J-PARC*

Corresponding Author(s): naohito.saito@kek.jp

Abstract is not provided.

Status reports from HEP centres / 85

ILC project

YAMAMOTO, Hitoshi[1]

[1] *Tohoku University*

Corresponding Author(s): yhitoshi@epx.phys.tohoku.ac.jp

We overview the physics opportunities provided by the ILC project, and briefly summarize the current status and future prospects.

Status reports from HEP centres / 34

Challenges in Instrumentation at the PANDA Experiment

FRITSCH, Miriam[1]

[1] *Helmholtz-Institut Mainz*

Corresponding Author(s): miriam@slac.stanford.edu

The PANDA Experiment located at the Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany will be the main experiment at FAIR addressing the field of hadron physics. The detector subsystems are in the phase of finishing their technical designs and are about to commence the detector construction. The ambitious physics goals of PANDA lead to challenges in the detector design in terms of reduced mass, high resolution and high rate capability as well as physics selectivity. In the presentation selected highlights will show how these challenges are met by low mass tracking systems, charged particle identification detectors, calorimetry and data acquisition.

Status reports from HEP centres / 95

Status of the Frascati Laboratory

BRANCHINI, Paolo[1]

[1] *Sezione INFN RomaTre*

Corresponding Author(s): paolo.branchini@roma3.infn.it

The KLOE-2 program and its status will be illustrated in this talk. In particular I'll focus the attention on the status of the new detector and the DAFNE machine.

Status reports from HEP centres / 116

Status of Belle II and SuperKEKB

ADACHI, Ichiro[1]

[1] *KEK*

Corresponding Author(s): ichiro.adachi@kek.jp

The SuperKEKB project, to increase 40 times higher luminosity ever achieved in KEKB, was approved in 2010. Since then, we have been conducting the detector and the accelerator upgrade programs. For the SuperKEKB accelerator, new tunnels for a damping ring are being built and other accelerator components are now in full production stage. For the Belle II detector, various detector elements are in the middle of the construction phase. For instance, CDC wire stringing has been just completed and new scintillator-based counters for KL and muon cather were installed into the Belle II barrel structure last November. We will further gear up our construction speed. In my talk, recent progress from the Belle II detector as well as the SuperKEKB accelerator construction will be presented.

Tracking / 130

A Time Projection Chamber for the International Linear Collider

COLAS, Paul[1]

[1] *CEA/Irfu Saclay*

Corresponding Author(s): paulcolas@cea.fr

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 vertex detector 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 Micro-Pattern Gas Detector (MPGD) modules. Recently, the LP has been completely equipped with resistive anode Micromegas (MM) and 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 (spatial resolution, field distortions, estimates of the effect of ion backflow on the track) and the effort towards electronic integration and cooling by 2-phase CO_2 will be presented. Future plans of the LCTPC R&D with MM and GEM will be shown, within the 'fast track' hypothesis of a global effort to timely build the ILC in Japan. Readiness of the various components and open issues will be discussed.

Tracking / 20

Past & Future of the Silicon-On-Insulator Pixel Detector

ARAI, Yasuo[1]

[1] *High Energy Accelerator Research Organization (KEK)*

Corresponding Author(s): yasuo.arai@kek.jp

We have been developing a monolithic pixel detector process using a Silicon-on-Insulator (SOI) technology. The SOI wafer is composed of a thick, high-resistivity substrate for the sensing part and a thin Si layer for CMOS circuits. In the 1990's, a few group tried to develop the SOI detector, but all the project was stopped without success. We have developed many new techniques to solve the difficult issues in the SOI detector. Now we have many projects to use the SOI process not only in high-energy physics but also in the fields of X-ray, material science, medical, etc. Past development and recent progress of the SOI technology are presented.

Tracking / 59

DEPFET at Belle II

MUELLER, Felix[1]

[1] *Max-Planck-Institute for Physics*

Corresponding Author(s): fmu@mpp.mpg.de

The innermost detector of the Belle II experiment makes use of the DEPFET technology to provide the accurate position measurements that are needed for the reconstruction of B-meson decay vertices. This technology combines signal detection and amplification in a single silicon pixel structure, so that the position measurement of traversing particles can be achieved with an overall material budget of 0.075% radiation length, corresponding to 75 m^2 in order to minimize the impact of multiple scattering for low transverse momentum tracking. Moreover, the DEPEFT detector has an excellent signal-to-noise ratio, low power consumption and offers a non-destructive readout. The instantaneous luminosity of $8x10^{35}$ $cm^{-2}s^{-1}$ expected at SuperKEKB increases the event rate and causes a large background. The close proximity of the pixel detector to the beampipe (only 1.4 cm from the interaction point) poses many challenges to the detector technology, in particular to radiation hardness and electronics. The vertex pixel detector consists of two DEPFET layers (radii at 14 mm and 22 mm). These are 20 ladders in total corresponding to 8 Mega Pixels (pixel sizes: 50x55 m^2 and 50x75 m^2). The four-fold readout in rolling shutter mode results in a total readout time of about 20 s for an entire frame. The concept of the sensor and the surrounding readout electronics will be presented in detail with focus on the Belle II experiment. 17 institutes from Europe and Asia work together in the DEPFET collaboration to meet these challenges.

Tracking / 51

Upgrade of the LHCb Vertex Locator

LEFLAT, Alexander[1]

[1] *Lomonosov Moscow State University Skobeltsyn Institute of Nuclear Physics (SINP MSU)*

Corresponding Author(s): aleflat@cern.ch

The upgrade of the LHCb experiment, planned for 2018, will transform the entire readout to a trigger-less system operating at 40 MHz. All data reduction algorithms will be executed in a high-level software farm, with access to all event information. This will enable the detector to run at luminosities of $1\text{-}2\times10^{33}$ $cm^{-2}s^{-1}$ and probe physics beyond the Standard Model in the heavy sector with unprecedented precision. The upgraded VELO must be low mass, radiation hard and vacuum compatible. It must be capable of fast pattern recognition and track reconstruction and will be required to drive data to the outside world at speeds of up to 3 Tbit/s. This challenge is being met with a new VELO design based on hybrid pixel detectors positioned to within 5 mm of the LHC colliding beams. The sensors have 55 x 55 m square pixels and the VELOPix ASIC which is being developed for the readout is based on the Timepix/Medipix family of chips. The hottest ASIC will have to cope with pixel hit rates of up to 900 MHz. The material budget will be optimised with the use of evaporative CO_2 coolant circulating in microchannels within a thin silicon substrate. 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. LHCb is also focussing effort on the construction of a lightweight foil to separate the primary and secondary LHC vacua, the development of high speed cables, and the metallisation and radiation qualification of the module. 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.

Tracking / 50

DEPFET as a measurement device: simulation and data reconstruction

KVASNICKA, Peter[1]

[1] *Charles University in Prague*

Corresponding Author(s): peter.kvasnicka@mff.cuni.cz

This talk looks at DEPFET as a physicist's tool and shows properties of the DEPFET based on simulation and analysis of data from an extensive DEPFET testbeam programme. An overview of DEPFET digitization and hit reconstruction as implemented in Belle II will be used as a basis for estimating the performance of the Belle pixel vertex detector.

Tracking / 117

CMS Phase-1 Upgrades and Plans, with focus on Pixel Upgrade

DOMINGUEZ, Aaron[1]

[1] *University of Nebraska – Lincoln*

Corresponding Author(s): aarond@unl.edu

After a highly successful Run 1 of the LHC, CMS is planning the first phase of upgrades to maintain and extend our detector's performance as the LHC continues to increase the instantaneous luminosity of the accelerator. In order to keep the same, or improve, our experiment's performance in runs with 50 or more pile-up events per crossing, we are planning to replace the pixel tracker with a new low mass, four layer, three forward/backward disk, detector. In addition, we will be upgrading the electronics and photodetectors for the HCAL, while increasing the granularity of the detector to improve jet triggering and reconstruction in these high pile-up events. Finally, upgrades to the trigger electronics will allow us to efficiently deal with these higher rates coming from the increases in the accelerator's performance.

Tracking / 82

Time-Projection-Chamber for MPD NICA Project

VERESCHAGIN, Stepan[1]

[1] *Joint Institute for Nuclear Research*

Corresponding Author(s): vereschagin@jinr.ru

The Time-Projection Chamber (TPC) is the main device for tracking and identification of charged particles in the MPD experiment at NICA collider. The TPC is cylinder in shape with a volume close to 18 m^3, length 3 m, diameter 2.8 m. Solenoidal magnetic field is 0.5 T. The report presents the design consideration of this detector for it operation at the central Au-Au collisions at energy up to 11 Gev/c and event rate of 5 kHz. Status of the TPC construction and features of main parts (field cage, read-out chambers, front end electronics, gas and cooling systems, laser-calibration) as well as testing software are described.

Tracking / 83

High Voltage Monolithic Active Pixel Sensors for the PANDA Luminosity Detector

WEBER, Tobias[1]

[1] *Helmholtz Institut Mainz*

Corresponding Author(s): webert@kph.uni-mainz.de

The PANDA-Experiment will be part of the new FAIR accelerator center at Darmstadt, Germany. It is a fixed target experiment using a antiproton beam with very high resolution for precision measurements. For a variety of measurements like energy-scans the precise determination of the luminosity is needed. The luminosity detector will determine the luminosity by measuring the angular distribution of elastically scattered antiprotons very close to the beam axis (3-8 mrad). To reconstruct antiproton tracks four layers of thinned silicon sensors with smart pixel readout on chip (HV-MAP) will be used. Those sensors are currently under development by the Mu3e-collaboration. In the talk the concept of the luminosity measurement is shortly introduced before a summary of the status of HV-MAP prototypes and readout electronics is given.

Tracking / 84

The Ultra Lightweight Support Structure and Gaseous Helium Cooling for the Mu3e Silicon Pixel Tracker

WIEDNER, Dirk[1]

[1] *Physikalisches Institut der Universitaet Heidelberg*

Corresponding Author(s): dwiedner@cern.ch

The Mu3e experiment searches for charged lepton flavor violation in the rare decay →eee. In order to reach a sensitivity of better than 10^{-16}, more than 10^9 muon decays per second have to be observed over a running time of one year. Precise determination of particle momentum, vertex position and time are necessary for background suppression. These requirements can be met by combining an ultra-lightweight tracker based on High-Voltage Monolithic Active Pixel Sensors (HVMAPS) with a timing system which consists of a scintillating fiber detector and a tile hodoscope. As the momentum of particles from muon decay is below 53 MeV/c, the silicon pixel tracker resolution is dominated by multiple Coulomb scattering. This leads to extreme requirements for the material budget of the tracking detector of below 0.1% of a radiation length per layer. Even though the target power consumption of the HVMAPS detector is as low as 150 mW/cm^2, the detector cooling must be very efficient and at the same time avoid adding material inside the active tracking volume. In this presentation the ultra-lightweight support structure and the gaseous helium cooling system for the thin silicon pixel tracker will be discussed.

Tracking / 101

The MEG upgrade Drift Chamber

GRANCAGNOLO, Francesco[1]

[1] *Istituto Nazionale di Fisica Nucleare*

Corresponding Author(s): franco.grancagnolo@le.infn.it

We present the design and the construction details of the drift chamber planned for the upgrade of the MEG detector at PSI, to be in operation during the second half of 2015.

Tracking / 107

Performance and Radiation Damage Effects in the LHCb Vertex Locator

HEAD, Tim[1]

[1] *CERN*

Corresponding Author(s): thead@cern.ch

LHCb is a dedicated experiment to study New Physics in the decays of heavy hadrons at the Large Hadron Collider (LHC) at CERN. Heavy hadrons are identified through their flight distance in the Vertex Locator (VELO), and hence the detector is critical for both the trigger and offline physics analyses. The VELO is the retractable silicon-strip detector surrounding the LHCb interaction point. It is located only 7 mm from the LHC beam during normal LHC operation, once moved into its closed position for each LHC fill when stable beams are obtained. During insertion the detector is centred around the LHC beam by the online reconstruction of the primary vertex position. Both VELO halves comprise 21 silicon micro-strip modules each. A module is made of two n+-on-n 300 mum thick half-disc sensors with R-measuring and Phi-measuring micro-strip geometry, mounted on a carbon fibre support paddle. The minimum pitch is approximately 40 mum. The detector is also equipped with the only n-on-p sensors operating at the LHC. The

detectors are operated in vacuum and a bi-phase CO2 cooling system is used. The signals read out with analogue front-end chips are subsequently processed by a set of algorithms in FPGA processing boards. The VELO has been performing very successfully during the first run of the LHC in 2010-12. Possible effects of radiation damage have been monitored and studied in detail throughout this period. Indeed the VELO module sensors receive a large and non-uniform radiation dose having inner and outer radii of only 7 and 42 mm, respectively. A maximum dose of 1.2 x 1014 1 MeV neutron equivalent /cm2 was received in the innermost region of the sensors for the combined 2010-12 run I (3.4 fb-1 of delivered data). Being operated in an extreme and highly non-uniform radiation environment, type-inversion of the inner part of the n-on-n sensors has already been measured. The radiation damage in the detector is monitored and studied in three ways: (1) dependence of sensor currents on voltage and temperature; (2) measurement of the effective depletion voltage of the sensors from the charge collection efficiency and from studying the noise versus voltage behaviour; and (3) cluster finding efficiency. Results will be presented in all three areas with the most recent results from the full run I.

Tracking / 30

Track chambers based on precision drift tubes housed inside a 30 mm mylar pipe

FAKHRUTDINOV, Rinat[1]

[1] *Institute for High Energy Physics*

Corresponding Author(s): rinat.fakhrutdinov@ihep.ru

The paper presents a technical design and some technical characteristics of the multilayer track chambers consisting of the precision drift tubes housed inside a 30 mm mylar pipe. The pipes are manufactured (welded by ultrasonic) from 125 mkm mylar film powdered with aluminium from both sides. 26 chambers with dimensions up to 2.5 x 2.5 sq.m incorporating totally 4400 drift tubes have been launched for the experiments at 70 GeV Serpukhof accelerator.

Tracking / 65

CLIC Vertex-Detector R&D

REDFORD, Sophie[1]

[1] *CERN*

Corresponding Author(s): sophie.redford@cern.ch

The CLIC vertex detector must have excellent spatial resolution, full geometrical coverage extending to low polar angles, extremely low mass, low occupancy facilitated by time-tagging, and sufficient heat removal from sensors and readout. These considerations, together with the physics needs and beam structure of CLIC, push the technological requirements to the limits and imply a very different vertex detector than the ones currently in use elsewhere. A detector concept based on hybrid planar pixel-detector technology is under development for the CLIC vertex detector. 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 talk, the CLIC vertex-detector requirements are reviewed and the current status of R&D on sensors, readout and detector integration is presented.

Tracking / 43

The Upgrade of the ALICE TPC

KETZER, Bernhard[1]

[1] *Univ. Bonn*

Corresponding Author(s): bernhard.ketzer@cern.ch

A large Time Projection Chamber (TPC) is the main tracking device in the barrel region of the ALICE detector at the CERN Large Hadron Collider. It provides state-of-the-art charged-particle tracking and identification for ultra-high multiplicity particle collisions. In order to make full use of the increase in luminosity after the second long shutdown of the LHC, it is foreseen to operate the detector in an ungated mode with continuous readout, thus increasing the event rate by two orders of magnitude. To this end, the present multiwire proportional chambers will be replaced by a system of Gas Electron Multiplier (GEM) foils. Together with advanced techniques for online space-charge corrections, the upgrade will enable the detector to perform to specifications under the conditions foreseen for the LHC Pb-Pb program in RUN 3. The talk will discuss the extensive R&D program which has been started to reach this ambitious goal and motivate the design choices which have been adopted.

Tracking / 70

Small angle detectors for study the diffractive processes with CMS

SAMOYLENKO, Vladimir[1]

[1] *Insitute for High Energy Physics*

Corresponding Author(s): vladimir.samoylenko@ihep.ru

The aim of the Proton Precision Spectrometer (PPS) Project is to add precision forward-proton tracking (~10 m, ~1 rad) and timing (with resolution < ~10 ps) at 240 m on both sides of CMS, with installation foreseen by 2014, for p + p → p + X + p physics at normal high-luminosity low-beta pp running. These will be new CMS sub-detectors, fully integrated and operative in standard data taking conditions. We present the approach and results for tracking and timing detectors in PPS.

Trigger, electronics and DAQ / 123

Upgrade of trigger and DAQ for CsI at BelleII

ZHULANOV, Vladimir[1]

[1] *Budker Institute of Nuclear Physics*

Corresponding Author(s): zhulanov@inp.nsk.su

The upgrade of the Belle detector (BelleII) is going on now. This upgrade is needed to operate on high luminosity of the KEKB storage ring after its upgrade (SuperKEKB) and concludes redesign of the most subdetectors, front-end electronics, Trigger and DAQ systems. In this report we present the modified trigger subsystem of the CsI calorimeter and its integration with Global Decision Logic of the BelleII detector. We also mention the data processing in the CsI calorimeter front-end electronics and its integration with BelleII DAQ system.

Trigger, electronics and DAQ / 129

A specialized processor for track reconstruction at the LHC crossing rate

PUNZI, Giovanni[1]

[1] *University of Pisa and INFN*

Corresponding Author(s): giovanni.punzi@pi.infn.it

We present the results of an R&D study of a specialized processor capable of precisely reconstructing events with hundreds of charged-particle tracks in pixel 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 by studies of the processing of visual images by the brain as it happens in nature. We find that high-quality tracking in large detectors is possible with sub-s latencies when this algorithm is implemented in modern, high-speed, high-bandwidth FPGA devices.

Trigger, electronics and DAQ / 109

ATLAS Minimum Bias Trigger Scintillator upgrade for LHC RunII

SIDOTI, Antonio[1]

[1] *Istituto Nazione Fisica Nucleare Sezione Roma La Sapienza*

Corresponding Author(s): antonio.sidoti@roma1.infn.it

The Minimum Bias Trigger Scintillators (MBTS) delivered the primary triggers for selecting events from real LHC collisions with the smallest bias for the low luminosity LHC RunI fills from 2009-2013 (proton-proton, lead-lead and lead-proton collisions). MBTS also will provide key ingredients for the first RunII physics measurements at the new LHC proton-proton collisions energies (charge multiplicity, proton-proton cross section, rapidity gap measurements, etc). After more than 25 fb^{-1} of proton-proton collisions delivered during RunI of LHC, MBTS detectors have been substantially upgraded for the RunII of LHC (starting in 2015). The upgrade strategy will be presented showing the scintillator replacement, the modified read out scheme, the optical measurements on RunI scintillators assessing the degradation due to the dose received and how the new simulation is being implemented to take into accounts all the modifications foreseen for RunII.

Trigger, electronics and DAQ / 33

The Detector Control of the PANDA Experiment

FELDBAUER, Florian[1]

[1] *Helmholtz-Institut Mainz*

Corresponding Author(s): florian@ep1.rub.de

The PANDA experiment will be build at the antiproton storage ring HESR, a part of the new accelerator facility FAIR in Darmstadt, Germany. PANDA aims amongst others for high precision measurements in hadron spectroscopy and search for exotic matter. To guarantee the high resolution of the different components a detector control system (DCS) monitoring temperatures, humidity, pressure, and controlling chillers and power supplies is needed. The DCS of PANDA is build using the open-source software package EPICS (Experimental Physics and Industrial Control System) with a PANDA specific version of Control-System Studio. The concepts and plans for the PANDA DCS and new developments will be presented.

Trigger, electronics and DAQ / 36

Performance of the LHCb trigger and its upgrade

HEAD, Tim[1]

[1] *CERN*

Corresponding Author(s): thead@cern.ch

The trigger of the LHCb experiment consists of two stages : an initial hardware trigger, and a high-level trigger implemented in a farm of CPUs. It reduces the event rate from an input of 15 MHz to around 5 kHz. To maximize efficiencies and minimize biases, the trigger is designed around inclusive selection algorithms, culminating in a novel boosted decision tree which enables the efficient selection of beauty hadron decays based on a robust partial reconstruction of their decay products. The performance of the LHCb trigger during Run 1 of the LHC is presented. In order to improve performance, the LHCb upgrade aims to significantly increase the rate at which the detector will be read out, and hence shift more of the workload onto the high-level

trigger. It is demonstrated that the current high-level trigger architecture will be able to meet this challenge, and the expected efficiencies in several key channels are discussed in context of the LHCb upgrade.

Trigger, electronics and DAQ / 60

The Belle II Pixel Detector DAQ

MUENCHOW, David[1]

[1] *Univerity Giessen, II. Physical Institute*

Corresponding Author(s): david.muenchow@exp2.physik.uni-giessen.de

At the future Belle II experiment the inner DEPFET (DEPleted Field Effect Transistor) pixel detector will consist of ~8 million channels. Because of its small distance to the interaction region and the high luminosity in Belle II, for a trigger rate of ~30 kHz with an estimated occupancy of ~3% a data rate of ~22 GB/s is expected. Due to the high data rate a reduction factor higher than 30 is needed to achieve the specifications of the event builder. The main hardware to reduce the data rate is an ATCA based Compute Node (CN) developed in cooperation between IHEP Beijing and University Giessen. Each node has as main component a Xilinx Virtex-5 FX70T and uses the xTCA standard. The CN is equipped with 2x2 GB RAM , GBit Ethernet and 4x6.25 Gb/s optical links. An additional carrier board is able to hold up to four CN and supplies high bandwidth connections between the four CNs and to the ATCA backplane. To fulfill the required data reduction on the CNs Regions of Interest (ROI) are used. This regions are calculated in two independent systems by projecting tracks back to the pixel detector. One is the High Level Trigger (HLT) which uses the data from the outer detectors. The other is the Data Concentrator (DatCon) which calculates based on Silicon Vertex Detector (SVD) data only to get low momentum tracks. With this information only data inside this ROIs will be forwarded to the event builder while data outside of this regions will be discarded. The ROI selection and the buffer managment for the data stored in RAM is implemented in VHDL, as well as a merging system to combine the ROI data from HLT and DatCon. First results of the test beam time in january 2014 at DESY with a prototype detector and full DAQ chain will be presented.

Trigger, electronics and DAQ / 66

CMD-3 detector DAQ upgrade

RUBAN, Alexander[1]

[1] *BINP SB RAS*

Corresponding Author(s): ruban@inp.nsk.su

The BINP VEPP2000 e^+e^- collider is under upgrade now. The new particle injection system will increase the collider's luminosity in order of magnitude. This article is devoted to how the CMD-3 detector DAQ works and how it to be upgraded to accept a higher luminosity. Now the CMD-3 detector DAQ named TOMA is already at physical data taking for few years. It operates with 12.5 MHz bunch crossing rate producing up to 700 Mbps data stream at input of 3-rd level trigger. DAQ hardware is based on distributed serial link backplane. The main feature of TOMA DAQ is the flat model both of architecture and of synchronization. It allows stable data taking operation still new digitizing boards are added and new features are activated. The mainstream upgrade plan is to preserve flat model while expand using of standard inexpensive networking hardware to increase TOMA DAQ throughout output performance up to 10 Gbps of physical data. The next step is to design the DAQ built-in computer cluster based on inexpensive small form factor PC motherboards. Due to high parallelism of process it will allows affective on-line data rate compressing to preserve server power requirements.

Trigger, electronics and DAQ / 44

Time resolution measurements of scintillation counters prototypes for a new trigger Charged Hodoscope (CHOD)

KHOLODENKO, Sergey[1]

[1] *Institute for High Energy Physics*

Corresponding Author(s): sergey.kholodenko@ihep.ru

New CHOD would be a part of L0 trigger at NA62 experiment and should provide a veto signal on multiplicity and photonuclear interaction at RICH mirrors from one hand and be a time setting counter together with RICH for single track events from another. Measurements were done on cosmic muons using MWPC as a tracking system and SiPM's as photodetectors.

Trigger, electronics and DAQ / 40

The upgrade of the CMS trigger system

JEITLER, Manfred[1]

[1] *Institute of High Energy Physics of the Austrian Academy of Sciences*

Corresponding Author(s): manfred.jeitler@cern.ch

The LHC accelerator at CERN in Geneva is being upgraded to increase its energy and luminosity, which requires that the CMS detector and its trigger system are also upgraded to make full use of higher collision rates. The trigger upgrade will proceed in several stages. At present the hardware-based Level-1 trigger is being upgraded to improve the resolution and thus allow for efficient data taking at higher collision rates while keeping the present Level-1 trigger rate of 100 kHz. The new system will be running in parallel to the existing Level-1 trigger for commissioning in 2015, when LHC starts running again, and will take over the full trigger functionality in 2016. A fundamental change in the trigger is planned for the time when the CMS silicon tracker is replaced in 2022. While at present the tracker does not send data to the Level-1 trigger and is only read out when a positive Level-1 trigger decision is received, the new tracker will be integrated into the Level-1 trigger. For that second upgrade stage, a significant increase of the Level-1 trigger rate by a factor of up to ten is planned. The talk will give an overview over both stages of the trigger upgrade. Also, a comparison of the trigger requirements and approaches of CMS and the other LHC experiments will be given.

102

Conference Summary and Perspectives

TITOV, Maxim[1]

[1] *CEA Saclay*

Corresponding Author(s): maxim.titov@cea.fr