Measurements of polarization observables in elastic and inelastic electron-deuteron scattering at the VEPP-3 storage ring.

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Measurement of the polarization observables in elastic and inelastic electron-deuteron scattering provides important information for the investigation of the details of the nucleon-nucleon interaction, as well as of the non-nucleon degree of freedom. Thus the measurement of tensor analyzing power components in the elastic electron-deuteron scattering gives a possibility to separate the charge monopole and quadrupole form factors of the deuteron. Starting from 80th several laboratories (MIT, Bonn, Novosibirsk, NIKHEF, TJNAF) have been performed such experiments in a different modifications.
Here we describe a new phase of the internal target experiment at VEPP-3 storage ring where the substantial increase of the experiment figure of merit is achieved. For this purpose a new Atomic Beam Source having five strong superconducting sextupoles [1] has been manufactured . The ABS flux of polarized deuterium atoms 6.4×10^{16} at/sec was measured [2]. Also compression of electron beam (by means of the change in the beam optics) has allowed to apply a target cell with small cross section and small wall thickness (0.03 mm). The detection system also was upgraded for this experiment.

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Resent results from CMD-2 detector on e^+e^- annihilation to hadrons

CMD-2 COLLABORATION

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Abstract

Recent results of the study of e^+e^- annihilation into hadrons by the CMD-2 collaboration at VEPP-2M collider are presented for the c.m. energy from 0.61 to 1.39 GeV. CMD-2 is a general purpose detector [1,2] combining a magnetic spectrometer with a good electromagnetic calorimeter based on CsI and BGO crystals. It has been running at the VEPP-2M e^+e^- collider in Novosibirsk since 1992 studying the c.m. energy range from threshold of hadron production to 1.4 GeV. The total integrated luminosity collected up to now is about 25 pb^{-1}. At present new results are obtained on the pion form factor around ρ-meson, ω-meson parameters. Measurements of various decay modes of the ϕ-meson as well as searches for its rare decay modes were performed [3].

The results on the pion form factor presented in this report cover the energy range from 0.61 to 0.96 GeV and are based on the data sample of about 150,000 events. The obtained systematic uncertainty of about 1.4% improves the precision of hadronic vacuum polarisation contribution to muon (g-2) by a factor about 1.5. The fit of the form factor energy dependence provides the information on the ρ-meson parameters and $\rho - \omega$ interference.

Several dedicated runs around the ϕ-meson have been performed with the total integrated luminosity of 15.8 pb^{-1} which corresponds to 2.1×10^7 ϕ-meson decays. One of the main decay mode, $\phi \to K_S K_L$, was used to get the resonance mass and width as well as the branching ratio for this mode with high precision.

Study of $\phi \to \pi^+\pi^-\pi^0$ decay concentrates on the dynamics of three pion production and separation between the $\rho\pi$ mechanism and direct ϕ to 3π transition.

New results were obtained on rare decays of ϕ-meson such as $\phi \to \eta\gamma$, $\phi \to \eta'\gamma$, $\phi \to \eta e^+e^-$, $\phi \to \pi^0 e^+e^-$, $\phi \to \pi\pi\gamma$ and others.

The unique possibility to have tagged kaons and η-mesons in the ϕ-meson decays is used to study some decay modes of $K_{S,L}$, $K^\pm$ and η-mesons.

The multipion production cross section was measured below and above ϕ-meson. The production mechanisms of these processes are also discussed.

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The process $e^+e^- \to K_S K_L$ in the energy range 2E from 1.05 to 1.40 GeV

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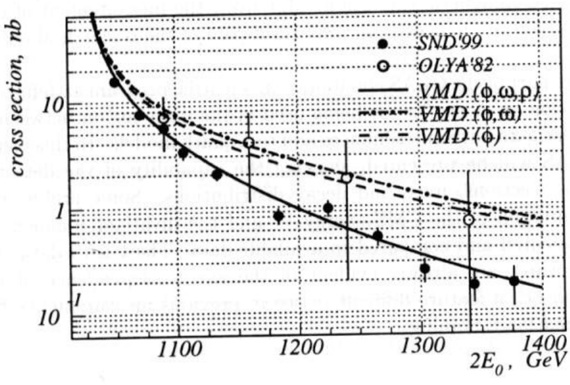
Abstract

The cross section of the process $e^+e^- \to K_S K_L$ is known with a high accuracy only in the energy range close to the ϕ-meson peak. In 1982 the reaction $e^+e^- \to K_S K_L$ was studied with the DM1 detector (Orsay) in the energy range $2E_0 = 1400 \div 2200\ MeV$ [1]. At the same time this process was measured in the energy range $2E_0 = 1060 \div 1400\ MeV$ with OLYA detector (Novosibirsk) [2]. In both experiments the achieved accuracy was not high, so new measurements are desirable. The $e^+e^- \to K_S K_L$ cross section has been measured between 1.05 and 1.40 GeV with the Spherical Nonmagnetic Detector (SND) at VEPP-2M e^+e^- collider in BINP (Novosibirsk). The SND results of $e^+e^- \to K_S K_L$ production cross section show, that in the energy range from 1.05 to 1.40 GeV the cross section agrees with VMD prediction with ρ, ω, and ϕ taken into account.



Cross section of process $e^+e^- \to K_S K_L$

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Measurement of the Muon Magnetic Anomaly

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A new and improved experiment for a precise measurement of the muon magnetic anomaly a_μ was successfully started at the Brookhaven National Laboratory (BNL) and has obtained a first result [1]. The difference between the cyclotron and the spin precession frequencies is measured using 3.09 GeV/c muons stored in a 1.45 T highly homogeneous magnetic field. The positrons from the decay $\mu^+ \rightarrow e^+\nu_e\bar{\nu}_\mu$ constitute our signal and are detected with lead-scintillating fiber calorimeters placed inside of the storage ring. New major components of the experiment compared to conceptually similar earlier projects carried out at CERN include a superferric storage ring magnet, a superconducting dc inflector, electrostatic quadrupoles, lead-scintillating fiber electron calorimeters and a high precision NMR magnetic field measurement and control system. A first measurement from a startup run yields $a_\mu = 1165925(15) \times 10^{-9}$. This value is similar in accuracy and agrees well with previous results for μ^+ at CERN and with standard theory calculations, which are accurate to 0.66 ppm. At present the theory is limited by hadronic vacuum polarization which can be determined from measurements of e^+ - e^- annihilation into hadrons and hadronic τ-decays. Experiments at Novosibirsk (BINP), Beijing (BES), Frascati (DAΦNE) and at Cornell (CLEO) promise a substantial improvement of the knowledge of the hadronic contributions.

A novel magnetic muon kicker has been installed and employed very recently to store and observe the decays of more than 2 orders of magnitude more muons compared to previous experiments. The data acquired is expected to improve significantly our knowledge of a_μ. The goal of the experiment is a precision in a_μ of 0.35 ppm at which contributions to the magnetic anomaly arising from weak interaction can be tested significantly and where a sensitivity to effects from physics beyond the standard model, for example from super symmetry, exists.

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Nuclear Anapole Moment

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The first measurement of the anapole moment of $^{133}_{55}Cs$ has been reported 2 years ago [1]. Nuclear anapole moment is a complementary source of information about parity-violating nuclear forces, therefore, the accuracy of theoretical calculations of the anapole moment is of great importance.
Here we present more accurate calculation of the nuclear structure effects discussed in [2]. First, we discuss the accuracy of the leading approximation. We show, that although it is good enough for the valence nucleon, for other occupied states it can be worse and it should not be used in calculations of the core polarization loops. Another effect important for $^{133}_{55}Cs$ is the pairing. The polarization loops for $^{133}_{55}Cs$ involve the transitions over Fermi-surface with the energy difference about 200 KeV. Their contribution is overestimated when calculated without pairing effects. In addition, the direct contribution of the two-particle weak nucleon-nucleon interaction has been calculated.
Finally, we discuss the accuracy of the local limit of the weak pion-exchange potential. We explicitly compare for a set of nuclei the matrix elements of the local potential and the matrix elements of the original non-local pion-exchange potential. We show that the parameters of the local potential differ from nucleus to nucleus, therefore, the use of non-local potential is preferable.

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New possibilities for nuclear physics experiments with Novosibirsk Race-Track Microtron-Recuperator.

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The race-track microtron-recuperator (RTMR) with a high power free electron laser in its last straight section is under construction for the Siberian Center of Photochemical Researches in Novosibirsk [1]. This machine can be used also for nuclear physics experiments with broad possibilities. The main beam parameters of RTMR are:

electron energy	100 MeV
beam current	100 mA
electron energy dispersion	0.3%
micropulses repetition frequency	45 MHz

The special by-pass for the nuclear physics experiment may be introduced in RTMR where a target with a thickness up to $Xo/10^3$ (here Xo is radiation length unit) without a sizable influence to the beam dynamics can be placed. It gives possibility to get very high luminosity:
$L = 4 \cdot 10^{40}/Z \cdot (Z+1)\ \frac{1}{sec \cdot cm^2}$
A various rare processes (such as Compton, magnetic scattering, electrofission and others) may be investigated.

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