New Trends in High-Energy Physics

Monday, 24 September 2018 - Sunday, 30 September 2018

Budva, Becici, ”Splendid Hotel”

Book of Abstracts

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The NUCLEON and TUS space experiments status

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The NUCLEON orbital experiment is designed to investigate directly the energy spectra of galactic cosmic ray (CR) nuclei and its charge composition before the "knee": from 100 GeV to 100 TeV and Z = 1-30 respectively. The "knee"energy range of 1014 – 1016 eV is a crucial region for the understanding of the cosmic-ray acceleration and propagation in the interstellar medium. The NUCLEON detector is working since December, 2014 for 5 years of data taken. The NUCLEON detector structure and CR events selection are described. Results of the beam tests at the SPS CERN, flight tests in orbit and preliminary physical results will be presented.
The TUS experiment is aimed to study the energy spectrum and arrival direction of Ultra High Energy Cosmic Rays (UHECR) at E ~100 EeV from the space orbit by measuring the fluorescence yield of the Extensive Atmospheric Shower (EAS) in the atmosphere. It is the first orbital telescope aimed for such measurements. The "Lomonosov" satellite, with the TUS instrument on board, was launched on April 28, 2016. The TUS apparatus structure, methods of UHECR on-line selection and off-line data analysis are described. The preliminary results of data analysis, search and study of candidates for the UHECR event are described.

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Tunka Advanced Instrument for cosmic rays and Gamma Astronomy (TAIGA): status, results and perspectives

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We present the current status of high-energy cosmic-ray physics and gamma-ray astronomy at the Tunka Astrophysical Center. This complex is located in the Tunka Valley, about 50 km from Lake Baikal. At present, three arrays of the complex are operating to study charged CRs: Tunka-133, Tunka-REX and Tunka-Grande. Their measurement of the energy spectrum and mass composition is important in order to understanding the acceleration limit of the Galactic CR sources and the transition from Galactic to extragalactic CR.
Currently, most efforts are focused on the construction of the first stage of the gamma-ray observatory TAIGA. TAIGA (Tunka Advanced Instrument for cosmic ray physics and Gamma Astronomy) is designed to study gamma rays and charged cosmic rays in the energy range 10E13 eV - 10E18 eV. TAIGA prototype will consists of 100 wide angle timing Cherenkov stations (TAIGA-HiSCORE) on the area of 1 km2 and three Imaging Atmospheric Cherenkov Telescopes (IACTs) on the same area. The field of view of the IACT is ~10×10 degrees and it has a Davis-Cotton optical system with 34 mirrors, 0.60m diameter each, a focal length of 4.75m and a camera of 560 PMTs. The first IACT is operating since 2016 in the Tunka site. Production of the second IACT is in progress. The deployment of such array will be finished in 2019. Reconstruction of an EAS energy, direction and core position are based on the TAIGA-HiSCORE data and Monte-Carlo simulation allows to increase a distance between an expensive IACT up to 600m.
The low investments together with high sensitivity for energies ≥ 30-50 TeV make this pioneering technique very attractive for studying the galactic PeVatrons and cosmic rays. In addition to the Cherenkov light detectors we intend to deploy muon detectors over an area of 1km2 with a total area of muon detectors of about 1000 m2 .
The results of the first season of joint operation of the first IACT with 40 stations of TAIGA-HiSCORE are presented. The report also presents the progress of the second IACT production including the procedure and the results of the PMT calibration, the camera and mirror facet fabrication and its optical parameter measurements.

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Control system for experimental setups of MASHA at cyclotron DC280.

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Modernization of control system of the experiment MASHA will be discussed. The controlling system based on CompactRIO, FlexRIO and PXI/PXIe standards will be developed, tested and integrated with new experimental setups at cyclotron DC280. MASHA Experiment is designed to study properties of super heavy elements synthesized in reactions 242,244Pu and other neutron rich actinides + 48Ca. Setup of MASHA is a combination of ISOL (Isotope Separator On-Line)methods and the classical mass spectroscopy. There is a requirement for high reliability and stability of the measurement and control. Therefore, we are gradually building distributed control network consist of up-to-date devices. Controllers based on RIO architecture was applied for control (several actuators) and connecting to whole experiment for study cross sections of reactions 40Ar + 144Sm and 166Er. And there is plan to use RIO standard (consist of microprocessor working on real-time operating system and Field Programmable Gate Array) in new setup of MASHA with gas catcher and beam line from new accelerator DC280.

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Experimental search of nuclear fusion reactions in a ptμ system

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We present the most recent study of nuclear reactions, proton and tritium fusion, catalyzed by negative muons. The experiment was performed at TRITON installation in JINR, in 2016. This phenomenon of light nuclei pt-fusion at low temperatures was so far investigated in the only experiment (PSI, 1993). The yeilds of main reaction channels, gamma rays and conversion muons, were measured for two different tritium concentrations, and the rates didn't match theoretical expectations. To study this problem in detail and to observe other possible channels predicted by the theory, namely, electron-positron and gamma-gamma pairs, we carried out the experiment at the negative muon beam (104 1/s, 100 MeV/c) from the JINR Phasotron with a specially created target of 50 c.c. volume, filled with a liquid hydrogen-tritium H/T mixture (tritium concentration of 1% and 0.1%). The experiment used an effective detection system containing two gamma-detectors which ensured reliable registration and identification of pt-reaction products at different relative dispositions of target and detectors. In three experimental runs with a total duration of 300 hours, besides the channels of pt-fusion with single gamma-quanta and conversion muons, the electron-positron (e+e-) and gamma-gamma (γγ) pairs in output channels were detected, which were not observed earlier, either "in-flight" (beam-target experiments), or within the ptμ- muonic molecules.
In Figures the ptμ molecule disappearance rates for the single gamma-quanta and conversion muons channels are presented. The measured yields of γ- and μ- channels of pt-fusion are in a good agreement with the results of PSI experiment, what makes a major challenge for the nuclear physics theory to explain the results.
The description of TRITON installation and the methods developed for the experimental search of

the pt-fusion within the ptμ molecule are presented. It is notified that further analysis of the experimental data and their interpretation will be performed on the basis of the Monte Carlo simulations to describe the kinetics of processes of muon catalysis in a hydrogen-tritium H/T mixture taking into account the actual geometry of the experiment. As a result of the time and energy experimental spectra analysis, the yields of pt-fusion products (for the first time for e+e- pairs and γγ pairs) will be determined. This outcome will allow extracting the nuclear reaction constants for magnetic dipole M1- and electric monopole-E0 transitions in the A = 4 nucleon system.

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First use of an active polarized Frozen Spin Target in a 4 π detector - Detection of particles under cryogenic conditions below 1 Kelvin

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We have developed a Frozen Spin Target in close collaboration with the polarized target group of the Joint Institute for Nuclear Research (JINR, DLNP) in Dubna. The 3/4Helium dilution refrigerator provides temperatures down to 25 mKelvin. Both longitudinally and transversely polarized protons and deuterons are possible with the help of superconducting holding coils.
The A2 Collaboration at the Mainz Microtron MAMI measures photon absorption cross sections using circularly and linearly polarized 'Bremsstrahlung' photons up to an energy of ~1.5GeV. We use a 4 π detection system with the 'Crystal Ball' as central part.
In this talk the first double polarized experiment with the use of a newly developed active polarized solid target in the year 2016 will be described and new possibilities for the use of this technology in high energy physics experiments will be adressed.

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Kinematically Dependent Renormalization

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We suggest a renewed view on non-renormalizable interactions treated perturba- tively within a kinematically dependent renormalization procedure. It is based on the usual BPHZ R-operation which is equally applicable to any local QFT indepen- dently whether it is renormalizable or not. The key point is that the renormalization constant becomes the function of kinematical variables acting as an operator on the amplitude. The procedure is demonstrated by the example of D=8 supersymmetric gauge theory considered within the spinor helicity formalism.

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Polarization experimets at MAMI and ELSA with Dubna-Mainz frozen spin target

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In recent years, many data show the presence of exotic states at low energies, below 2 GeV. Some authors claim about a signature of a new physics.
The Mainz Microtron MAMI is one of the main world facility for investigations in this energy region due to the presence of the high-intensity linearly and circularly polarized photon beams, recoil polarimeters, 4π calorimeter for detection of the final particles, and the tagged photon system with high energy resolution.
Last years the facility was updated by a frozen spin target designed in Dubna.
This made it possible to significantly expand the set of experimentally measured polarization observables.
Besides, the Dubna-Mainz frozen spin target is used at an electron accelerator, ELSA, in Bonn.
It allows to obtain experimental data at more high beam energy, up to 3.2 GeV.
In this contribution, an overview over recent experiments at MAMI and ELSA with the Dubna-Mainz frozen spin target is given. Observed exotic states are discussed.
The results are compared to different model predictions.

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BM@N experiment at Nuclotron: status and first results

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BM@N (Baryonic Matter at Nuclotron) is the first experiment to be realized at the accelerator complex of NICA-Nuclotron at JINR (Dubna). The aim of the experiment is to study interactions of relativistic heavy ion beams with a kinetic energy from 1 to 4.5 AGeV with fixed targets. The BM@N set-up at the starting phase of the experiment is introduced. First results of the analysis of minimum bias experimental data collected in the technical runs in interactions of the deuteron and carbon beams of 4 AGeV with different targets are presented.

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High-precision numerical estimates of Mellin-Barnes integrals for Mellin moments of the structure functions using a stationary phase contour

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Within the framework of the Mellin transform method we investigate the effective contours that allow to accelerate a numerical computation of Mellin-Barnes (MB) integrals significantly.
We consider the case of a finite asymptotic behavior of the contour of the stationary phase, which start at the saddle point, in the limit Re(z) tends minus infinity.
The MB integrals arising for the nonsinglet structure functions correspond to this case. We propose

a new approximation for the contour of the stationary phase. The asymptotic behavior of the constructed contour coincides with the contour of the stationary phase, when Re(z) tends minus infinity. In order to clarify the reason of the high efficiency of the application of the asymptotic contour, using the stationary phase contour, we consider the exactly solvable example giving behavior close to that which arises in the QCD analysis of DIS data.

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Future e+e- Colliders at the Energy Frontier

Author: Tadeusz Lesiak[1]

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A new giant electron-positron collider, operating at energy frontier, is a natural proposal in order to push particle physics into new regime of precise measurements, in particular in the sectors of electroweak observables and Higgs boson parameters. The four projects of such accelerators: two linear (ILC and CLIC) and two circular (FCC and CEPC) are currently in various stages of development. The next few years will be critical as far the decisions about the construction of such colliders, in particular in view of the update of European HEP strategy and expectations of important decisions from Japan, China and USA.
The talk will discuss the motivation and very attractive physics program for new e+e- colliders, spanning in particular perspectives in Higgs, electroweak and flavour sectors together with expectations of searches for New Physics. The relevant aspects and challenges of the accelerators and detectors together with the proposed schedules of construction and operation will be discussed.

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New cryostat for Bonn electron accelerator “ELSA”.

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Co-authors: Anton Dolzhikov [1]; Nikolay Borisov [1]; Yury Usov [1]

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We describe the design, constructon and last results of the horizontal
Cryostat for the new Bonn frozen spin TARGET developing for the
spin physics experiments with tagged photons from the Bonn electron
accelerator “ELSA”. A frozen spin polarized targets cooled by the
$^3He/^4He$ diluton refrigerators developed at the LP„ INPR from 1976 for
different accelerators⋯is given.

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Search for New Physics with LHCb

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Lepton flavour violation and rare decays are excellent probes in search for physics beyond the SM. Recently hints of lepton universality violation have been observed in b -> c l nu and b -> s l+l- decays. Combining with the tensions observed in angular and branching fraction measurements of

rare semileptonic decays, it could be the first evidence of Physics beyond the SM.
Recent results on rare decays and searches for lepton-flavour violating decays from the LHCb experiment will be presented.

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Radiation hardness of scintillation detectors based on organic plastic scintillators and optical fibers.

Author: Yuri Kharzheev[1]

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Scintillation detectors (SDs) based on organic plastic scintillators and optical fibers are among of the basic detectors at all modern accelerators and in astrophysics and neutrino experiments. In recent years, interest in SDs has increased significantly due to the forthcoming large-scale Updates of LHC, the construction of new accelerators NICA, FAIR, FCC, etc. At the same time, requirements for the stability and reliability of SD operation in the new conditions became stricter and their fullfilment largely depends on the radiation hardness of the scintillators, optical fibers and photodetectors.
The review presents the results of the radiation hardness investigations of various scintillators and optical fibers (scintillating, wave length shifting and clear), and optical glues used to increase the light collection from the scintillators by the fibers.
The influence of various factors (dose, radiation dose rate, scintillator materials, fluors) on light output, light collection and light transmission of the irradiated materials and their recovery is considered. Aging of scintillators can be caused not only by radiation but also by environment effect (temperature, humidity). In the review, to this problem some attention is also given.

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News on physics and detectors at CLIC

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The Compact Linear Collider (CLIC) is a proposed high-luminosity linear electron-positron collider at the energy frontier. To optimize its physics potential, CLIC is foreseen to be built and operated in three stages, with a centre-of-mass energy ranging from a few hundred GeV up to 3 TeV. In the first stage, CLIC will focus on high precision measurements of the Higgs-boson and the top-quark properties, such as an unprecedented precise measurement of the Higgs total decay width and of the top-quark mass. During the subsequent energy stages, the aim of the physics program will revolve around measurements of rare Higgs-boson processes, as well as direct and indirect searches for new physics, and precision measurements of possible new particles. In order to fulfill this rich physics program and to face the challenges imposed by the CLIC beam structure conditions, innovative new technologies as well as an optimized detector design are required. This is pursued by the CLIC collaboration with an ambitious R&D program whose driving force are highly granular calorimeters, an ultra-low mass silicon tracking system and subdetectors with a precise hit-timing resolution. This program goes hand in hand with a full-detector simulation framework which allows to perform detailed optimization studies of critical parameters of the CLIC detector. An overview of the physics analysis results and the detector R&D and optimization will be given in this contribution, with an emphasis on the recent developments.

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Status of Jiangmen Underground Neutrino Observatory

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Jiangmen Underground Neutrino Observatory (JUNO), a next generation underground reactor antineutrino experiment, is proposed to determine the neutrino mass hierarchy and precisely measure neutrino oscillation parameters using a massive liquid scintillator detector underground. The experimental hall, spanning more than 50 meters, is under a granite mountain of over 700 m overburden. The central antineutrino detector, built with 35.4-meter diameter acrylic sphere, contains 20 kilotons of liquid scintillator and ~18,000 20 inch PMTs (and ~25,000 3 inch PMTs). The antineutrino detector is placed in a water pool shielding system which also functions as an active water Cherenkov veto detector. On the top of water pool is a Top Tracker system which further improves the muon track reconstruction. This talk presents the JUNO facility and detector design.

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Status and prospects of charged lepton flavor violation searches with the MEG-II experiment

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The MEG experiment took data at the Paul Scherrer Institute in the years 2009-2013 and published the most stringent limit on the charged lepton flavor violating decay $\mu \to e\gamma$: BR($\mu \to e\gamma$) $< 4.2\times10^{-13}$ @90% C.L.

The MEG detector is currently being upgraded in order to reach a sensitivity of $\sim 5 \times 10^{-14}$, which corresponds to an improvement of one order of magnitude.
The basic idea of MEG-II is to achieve the highest possible sensitivity by making the maximum use (7×10^7 muons/second) of the available muon intensity at PSI with an improved detector, since MEG ran at a reduced intensity (3×10^7 muons/second) in order to keep the background at a manageable level.
The key features of the MEG-II are the increase of the rate capability of all detectors to enable running at the intensity frontier, and to increase the resolutions while maintaining the same detector concept.
A new mass, single volume, high granularity tracker, together with a thinner muon stopping target, will lead to better spatial, angular and energy positron resolution.
A new highly segmented timing counter will improve positron timing capabilities. The detector acceptance for positrons will be increased by more than a factor 2 by diminishing the material between these two detectors. The liquid Xenon calorimeter will have new smaller photosensors (VUV-sensitive SiPM) that will replace current phototubes and will improve in particular photon energy resolution. The status of the MEG-II detector and the current schedule will be presented.

MEG-II, together with the next generation charged lepton flavor violation experiments Mu3e ($\mu^+ \to e^+e^-e^+$) at PSI and Mu2e and COMET ($\mu \to e$ conversion) at Fermilab and JPARK respectively, will reach an unprecedent sensitivity in the next five years. On the same time scale accelerator upgrades are expected that will provide muon beams with intensities of the order of 10^{10} muons/second. At this extremely high beam rates, new detector concepts should be adopted in order to overcome the accidental background. Some future directions will be discussed.

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Overview of nuclear clustering studies in dissociation of relativistic light nuclei

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Events of dissociation of relativistic nuclei in nuclear track emulsion (NTE) allow a holistic investigation of "cold"ensembles of lightest nuclei. So far, with regard to fine structure dissociation of relativistic nuclei, the NTE technique remains the only means providing unique completeness of such observations at the best angular resolution and as well as a sufficient statistical provision. Moreover, full-bodied studies of light nuclear structure require reconstruction of relativistic decays of the unstable 8Be and 9B nuclei. Feasibility of such studies in electronic experiments is not visible at all. The cluster structure of light nuclei and the role of the unstable 8Be and 9B nuclei in them is studied in the BECQUEREL project (http://becquerel.jinr.ru/) on the basis of NTE layers longitudinally exposed at the JINR Nuclotron to relativistic Be, B, C and N nuclei, including radioactive isotopes [1]. Recent advances are highlighted [2,3]. On the practical side series of experiments with newly reproduced samples NTE has confirmed prospects of NTE in low and high energy nuclear studies [5].
Recently it is suggested to search in relativistic 12C dissociation for α-particle triples in the second excited state 0+2 of the 12C nucleus (the Hoyle state). The study of the Hoyle-state (HS) in dissociation is setting new limit of NTE use. Being performed in contrast to relativistic energy of 3α-ensembles and minimum possible energy stored by them such observations would clearly demonstrated HS as a full-fledged and sufficiently long-lived nuclear-molecular object. Probably, not only single but also pair- and even triple-wise combinations of α-particles that are close to 8Be might be observed to reflecting the HS structure in less distorted way. It can be expected that 8Be and HS will become reference points to search for more complex states of dilute nuclear matter in dissociation of heavier relativistic nuclei. The current experiment task is to search for several hundreds of 3α-events in NTE pellicles and measure the angles of α-particles in the relevant ranges with a resolution allowing reconstructing decays of the unstable 8Be nucleus and HS. HS events are observed in dissociation 12C → 3α at 4.5 A GeV/c and 1 A GeV/c 12C nuclei with a contribution preliminary estimated to be of the order of 10%. Thus, the first data on relativistic HS are encouraging.

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Summary:

The status of nuclear structure studies by means dissociation of relativistic light nuclei in nuclear track emulsion is overviewed. In dissociation 12C → 3α at 4.5 and 1 A GeV/c in nuclear track emulsion production of the Hoyle's-state is identified in approximately invariant representation. HS is observed in both cases with a contribution of about 10-15%. This conclusion is grounded on the basis of the most precise angular measurements performed by three research groups in two exposures at two momentum values that are separated in time by two decades. This fact demonstrates the thoroughness of the NTE technique. The first data on the search for HS are encouraging. However, the approach does not allow one to investigate the features of the HS decay. Nevertheless reconstruction of HS on the invariant mass of relativistic α-triples can be applied to study processes with the HS formation as a wholesome relativistic object at large moment transfers.

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Imaging of few-body nuclear systems in nuclear track emulsion

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In spite of the fact that nuclear track emulsion (NTE) was developed more half a century ago, it still remains a universal and cost-efficient detector. The application of NTE is especially well grounded where tracks of nuclear particles cannot be reconstructed using electronic detectors. At the JINR Nuclotron the BECQUEREL experiment [1] is performed a program of irradiation of NTE stacks in the beams of relativistic isotopes of beryllium, boron, carbon and nitrogen, including radioactive ones to study their cluster structure. Charge-topology distributions of final states have an individual character appearing to be some kind of a signature of the isotope under study. The NTE technique allows one to observe the 3D images of few-body ensembles originated in peripheral collisions and explore the fragmentation of the relativistic nuclei down to the most peripheral interactions - nuclear "white"stars [2].
The competitive character of the novel NTE is proved in measurements of slow α particles and heavy ions (summarized in [3]). The possibility of α spectrometry was verified and the atom drift effect is established in measurement of decays of 60 MeV 8He nuclei implanted in NTE [4]. Correlations of α particles in splitting of 12C nuclei by 14.1 MeV neutrons [5] as well as 7Li and 4He nuclei produced in 10B breakup by thermal neutrons in boron-enriched NTE [6] are studied. NTE samples were irradiated with slow Kr and Xe ions [7,8]. Surface irradiations of NTE samples were performed with automatic movement of the 252Cf source [9].
Recently, samples of reproduced NTE were also irradiated with 2.5 and 160 GeV muons (started in [10]). Such irradiation allows one to study few-body fragmentation under the action of an electromagnetic probe [11]. Multiphoton exchange or virtual photon–meson transformations can serve as the fragmentation mechanisms. It was established that the breakup of carbon nuclei into trios of α particles has a nuclear diffraction rather than electromagnetic character. Thus, the connection of high energy and low energy nuclear physics appears.
Classic observations of fundamental importance presented in "The Study of Elementary Particles by the Photographic Method"by C. H. Powell, P. H. Fowler and D. H. Perkins can serve as a model of clarity in our time. Our research is implemented in keeping with this tradition by state-of-art means. The rich collection of videos and images of the nuclear few-body processes gathered at the Web site is presented [1]. In terms of applications they are relevant for the development of advanced systems of automatic search for nuclear interactions, as well as for university education.

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Charged dark matters, cosmic rays and extended standard model

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Three generations of leptons and quarks correspond to the lepton charges (LC) in the present work. Then, the leptons have the electric charges (EC) and lepton charges (LC) [1,2,3,4]. And the rest mass of 1.4 TeV/c^2 is assigned to the Le particle (new heavy lepton) with the EC charge of -2e based on the cosmic-ray electron/positron data of DAMP (Dark Matter Particle Explorer) and the cosmic gamma ray spectrum by CALET 5 year measurements [1]. The 3.5 and 74.9 keV X-ray peaks observed from the cosmic X-ray background spectra support the presence of the Q1 quark (new heavy quark) with the EC of -4e/3 [1]. The quarks have the EC, LC and color charges (CC). Three new particles (bastons) with the electric charges (EC) are proposed as the charged dark matters [1,2]. The decreasing coupling constant of the strong force, neutron lifetime anomaly and the pressure distribution inside the proton are explained by the unobservable proton and hadronization. Also, the weak force, strong force and dark matter force bosons are created from the interactions of the elementary particles with the T fluctuations of the vacuum energy [3].

Because of the graviton evaporations, the very small Coulomb's constant (k(dd)) of 10^-48k and large gravitation constant (G_N(dd)) of 10^6G_N for the charged dark matters at the present time are expected [3,4]. These tentative values of G and k can be used and changed for the explanation purpose. Therefore, F_c(mm) > F_g(dd) > F_g(mm) > F_g(dm) > F_c(dd) > F_c(dm) = 0 for the proton-like particle. In the present work, the B1, B2 and B3 bastons with the condition of k(mm) = k » k(dd) > k(dm) = k(lq) = 0 are explained as the good candidates of the dark matters. Also, the particle creation, dark matters and dark energy could be deeply associated with the changing gravitation constants (G). It is expected that the changing process of the gravitation constant between the matters from G_N(mm) ≈ 10^36G_N to G_N(mm) = G_N happened mostly near the inflation period. Therefore, during most of the universe evolution the gravitation constant could be taken as GN(mm) = GN. And the effective charges and effective rest masses of the particles are defined in terms of the fixed Coulomb's constant (k) and fixed gravitation constant (G_N). Then, the effective charge of the B1 dark matter with EC =-2/3 e is (EC)_eff = -2/3 10^(-24)e [3,4].

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Search for the neutrinoless double beta decay of Xenon-136 and Dark Matter at KamLAND

Author: Alexandre Kozlov[1]

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The talk gives current status of search for new physics at the KamLAND
neutrino detector located at the Kamioka mine in the western Japan. A brief overview of the world's largest neutrinoless double beta decay
experiment using Xenon-136 called KamLAND-Zen 800 will be presented. A
second part of the talk will be dedicated to our experimental efforts to
test the DAMA/LIBRA Dark Matter observation claim using an "identical"
ultra-low backgroound detector made of radio-pure NaI(Tl) crystals.

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The Professional Precision Laser Inclinometer: the noise origins and data processing

Authors: Beniamino Di Girolamo[1]; Julian Budagov[2]; Mikhail Lyablin[2]

Co-authors: Andrey Pluznikov [2]; Dirk Mergelkuhl [1]; Grigori Shirkov [2]; Grigori Trubnikov [2]; Jan-Christophe Gayde [1]; Nikolay Azaryan [2]; Vladimir Glagolev [2]

[1] *CERN*

[2] *JINR*

For the Professional Precision Laser Inclinometer, the noise sources have been analyzed. The efficient methodic for these noises accounting proposed and realized.The PPLI measured intrinsic noise is 6 10-12 rad/Hz1/2 in the Microseismic Peak frequency band of [0.1Hz: 1Hz]. For the day long oservation period the minimal spectral density of the PPLI measured signal was found to be 2,4 10-11rad/Hz1/2.

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The Belle II experiment

Authors: Daniel Cervenkov[1]; Zdenek Dolezal[1]

[1] *Charles University Prague*

The Belle II experiment is a substantial upgrade of Belle detector and will operate at the SuperKEKB energy-asymmetric e^+e^- collider. The accelerator has successfully completed the second phase of commissioning; with the first collisions in April 2018. The design luminosity of 8×10^{35} cm^{-2}s^{-1} and the Belle II experiment aims to record 50 ab^{-1} of data, a factor of 50 more than the Belle experiment. This large data set will be accumulated with low backgrounds and high trigger efficiencies in a clean e^+e environment; it will allow to probe New Physics scales that are well beyond the reach of direct production at the LHC and will complement the searches through indirect effects that are currently ongoing or planned. This talk will review the detector upgrade, present results obtained from the first collision data analysis and overview the prospects for the data taking planned to start early 2019.

Summary:

SuperKEKB energy-asymmetric e^+e^- collider. The accelerator has successfully completed the second phase of commissioning; with the first collisions in April 2018. The design luminosity of 8×10^{35} cm^{-2}s^{-1} and the Belle II experiment aims to record 50 ab^{-1} of data, a factor of 50 more than the Belle experiment. This large data set will be accumulated with low backgrounds and high trigger efficiencies in a clean e^+e environment; it will allow to probe New Physics scales that are well beyond the reach of direct production at the LHC and will complement the searches through indirect effects that are currently ongoing or planned. This talk will review the detector upgrade, present results obtained from the first collision data analysis and overview the prospects for the data taking planned to start early 2019.

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The odderon: myths and realituy

Author: László Jenkovszky[1]

Co-author: István Szanyi [2]

[1] *BITP, Kiev*

[2] *Uzhgorod State University*

High-energy hadron scattering is dominated by the exchange of two Regge exchanging: the pomeron and the odderon. The contribution from secondary reggeons, lying on the f and \rho trajectories at the LHC energies is negligible. While the existence and the properties of the pomeron are firmly established, this is not the case for the odd C-parity counterpart of the pomeron, the odderon, mainly because of its relatively small contribution. We argue that in pp scattering at the LHC energies, the odderon may be important (and "visible") in the dip-bump region, rather than in the ratio \rho(13,0)=01.

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MUSE and the Proton Radius Puzzle

Author: Ievgen Lavrukhin[1]

[1] *The George Washington University*

Until 2010, the accepted value for the proton charge radius was 0.8768 ± 0.0069 fm. This was determined from both electron-proton scattering and electron hydrogen spectroscopy. In 2010 the Proton Radius Puzzle (PRP) began when the CREMA Collaboration determined the proton radius via muonic hydrogen spectroscopy, yielding a value 7σ smaller that the previous result (0.84184 ± 0.00067 fm).
One possible explanation of the PRP is that the discrepancy in the proton radius measured in electronic and muonic hydrogen spectroscopy is due to higher order bound state effects previously not included. Another scenario is that this discrepancy is caused by a fundamental difference in electron and muon coupling to the photon, which leads to the physics beyond the Standard Model. This motivates the extraction of the proton radius from muon-proton scattering data since this is the only missing element of the puzzle.
The Muon Proton Scattering Experiment (MUSE) is designed to address the PRP by simultaneous measurement of proton radius from both electron-proton and muon-proton elastic scattering at a very low momentum transfer. The measurement will be done for both beam charge polarities that allow us direct access to hard Two-Photon Exchange (TPE), which is the largest model dependent correction.
We will give a brief overview of the Proton Radius Puzzle, and present development and current status of MUSE. A brief overview of the experiment will be provided, followed by a discussion of the milestones already achieved.

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COMET experiment : search for muon to electron conversion

Author: Hisataka YOSHIDA[1]

[1] *Osaka University*

The COMET experiment is seeking to measure the neutrinoless, coherent transition of a muon to an electron (μ−e conversion) in the field of an aluminum nucleus. The facility for the experiment is J-PARC Hadron Hall at Tokai village in Japan. The J-PARC Main Ring can provide high intensity 8-GeV proton beam to the Hadron Hall, and the generated pions are captured by the surrounding capture solenoid and will decay to muons in the curved transport solenoid which is connecting to the detector part. With these system, the muon intensity will be the world highest, thus the sensitivity of the experiment could reach to the branching ratio to test the several beyond the standard models which predict the neutrinoless muon to electron conversion process.
In the COMET Phase-I, we will search for the μ-e conversion process with a single event sensitivity of

~10^{−15}, corresponding to the factor 100 improvement from the past search done by the SINDRUM-II experiment at PSI. After the Phase-I, the transport solenoid and detector part will be extended and modified, and the sensitivity will be ~10^{−17}.The COMET Phase-I is now under construction. I will report on the status of Phase-I and prospects for the Phase-II.

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NOvA RECENT RESULTS WITH NEUTRINO+ANTINEUTRINO DATA

Author: Tomas Nosek[1]

[1] *Charles University, Institute of Particle and Nuclear Physics*

NOvA is a long-baseline neutrino oscillation experiment using Fermilab's 700 kW NuMI muon neutrino beam. Two functionally identical scintillator detectors are placed off the beam axis, separated by 810 km oscillation baseline. Both detectors have high active material fractions and are finely segmented allowing for precise identification and analysis of neutrino interactions. By observing both the disappearance of muon (anti)neutrinos and appearance of electron (anti)neutrinos in the beam, NOvA can impose constraints on the yet undetermined parameters of neutrino oscillation phenomenon, such as the neutrino mass ordering, CP violation and the octant of the large mixing angle. NOvA also studies neutral-current neutrino interactions, thus extending its scope beyond the standard three-flavor paradigm. This talk will present the latest NOvA results with the complete neutrino data sample up to date and first antineutrino data collected since February 2017. Future plans and prospects, as well as expected physics reach will be discussed.

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Study of the properties of the Higgs boson

Author: Tomas Davidek[1]

[1] *Charles University, IPNP*

After the discovery of the Higgs boson in summer 2012, the understanding of its properties has been a high priority of the ATLAS and CMS physics programmes. Measurements of the Higgs boson mass, coupling constants and cross-sections are presented, based on the pp collision data acquired at 13 TeV. The analyses in several decay channels will be described and the results of the combination of different decay channels will be shown.

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Baikal GVD experiment: present status and perspectives

Author: Rastislav Dvornicky[1]

[1] *JINR, Dubna*

Baikal-GVD (Gigaton Volume Detector) is a next-generation neutrino telescope designed for the detection of high-energy neutrinos of astrophysical origin. The telescope is located in deep water of the lake Baikal near the shore. The top and bottom part of the detector are placed in the depths of 735 and 1 260 meters, respectively. The neutrinos should interact with matter in the vicinity of the detector by creating charged particles, which should emit Cherenkov light to be recorded by the telescope.

The basic detection unit is the optical module (OM), a water resistant glass sphere containing photomultiplier. A three-dimensional array of 288 OMs placed on 8 vertical strings forms a cluster. The first cluster was installed in 2016 and is data taking since then. The second and the third cluster were commissioned in 2017 and 2018, respectively.
In recent, Baikal-GVD consists of 3 fully operating clusters, which are independently connected to the shore by individual electro-optical cables. In the first phase, Baikal GVD-1, 8 clusters are planned to be installed with the total amount 2 304 of the OMs deployed by 2020-2021.

We present the description of the Baikal-GVD cluster design. The present activity of the Baikal-GVD experiment is reviewed. Particularly selected results obtained in 2015-2017 are discussed.

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Recent results with ALICE experiment

Author: Marek Bombara[1]

[1] *Pavol Jozef Safarik University*

The ALICE experiment is dedicated to study the hot and dense nuclear matter created in heavy ion collisions at the Large Hadron Collider. A crucial part of the ALICE physics programme is to study small colliding systems like proton-proton and proton-lead collisions and compare them with heavy ion collisions in order to disentangle effects coming from individual nucleon-nucleon interactions or from cold nuclear matter. Recent results from the small systems revealed that several effects that were thought to be unique to large collision systems are also observed in small systems, i.e. that there is no strict border between small and large system collisions. Recent results from large collisional systems (Xe-Xe, Pb-Pb) and from small collisional systems (pp, p-Pb) at various energies measured by ALICE will be reported.

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The ATLAS experiment. Status and prospects

Author: Gabriella Gaudio[1]

[1] *INFN-Pavia*

The ATLAS experiment is currently taking data (Run 2) at an energy in the center of mass of 13 TeV. The large statistic integrated in the last 3 years has allowed for both precise measurements in the Standard Model sector, in particular for the Higgs bosons, and searches for new physics. Highlights on achieved results are reported.
The experiment is also preparing for the next two phases of the detector upgrade, in 2019-2020 (phase 1) and 2024-2026 (HL-LHC), in order to cope with growing harsh environment in future data taking periods.

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Neutrinoless double beta decay search with GERDA Phase II

Author: Valerio D'Andrea[1]

[1] *Università dell'Aquila*

The GErmanium Detector Array (GERDA) experiment, located at the Laboratori Nazionali del Gran Sasso, searches for the neutrinoless double beta (0νββ) decay of the isotope Ge-76. High-purity germanium crystals enriched in Ge-76, simultaneously used as source and detector, are directly deployed into ultra-pure, cryogenic liquid argon, acting both as cooling medium and shield against the external radiation.
The second phase of the experiment is taking data since end of 2015 with an additional mass of 20 kg of newly developed BEGe type Germanium detectors, allowing for a superior background rejection by pulse shape discrimination. Moreover, the instrumentation of the cryogenic liquid volume surrounding the germanium detectors, acts as additional active veto and assures a further background suppression.
Initial results from Phase II, with about 10 kg·yr exposure (published in Nature vol. 544, April 6th 2017) indicate that the target background of 10-3 counts/(keV·kg·yr) is achieved, thus making GERDA the first experiment in the field which will be "background free"up to the design exposure of 100 kg·yr. The last data release in June 2018, with a total exposure of 82.4 kg·yr of Ge-76 allowed to further improve the limit on the half-life to 0.9·10^26 yr (90% C.L.).
In this talk we will summarize the basic concept of the GERDA design, the data taking and the physics results obtained in Phase II. A special focus will be given to the background level achieved and to the analysis of the residual background components. We will then show the expected performances for the full 100 kg·yr exposure and the future prospects of the search for the neutrinoless double beta with the Ge-76.

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Tests of 3x3 undoped CsI matrix with an extremely low intensity electron beam

Author: Yuri Davydov[1]

[1] *JINR*

A. Artikov, A. Babayan, V. Baranov, J. Budagov, Yu.I Davydov, V. Glagolev, A. Hakobyan, H. Hakobyan, D.G. Hitlin, S. Miscetti, T. Mkrtchian, A. Simonenko, A. Sirunyan, A. Shalyugin, V. Tereschenko, H. Torosyan, Z. Usubov, H. Zohrabyan

We report measurements of energy resolution of a 3x3
array made of 30x30x200 mm^3 undoped CsI crystals. The
measurements have been performed using the electron beam of the linear
accelerator of the Yerevan Physics Institute (Yerevan, Armenia) in the energy range of 15-35 MeV. The accelerator operated at extremely low beam intensity (10-50 electrons per second). That operation mode have been achieved by decreasing photo cathode temperature and lowering applied high voltage. The measured energy resolution is σ_E/E=6.4% at E=35 MeV. This resolution is dominated by the energy leakage due to the small dimensions of the prototype.

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Probing QCD at high energy

Author: YURI KULCHITSKY[1]

[1] *JINR*

Perturbative QCD calculations at next-to-next-to leading order are available for many processes since several years and can be rigorously tested with a large variety of final states. The latest results from the ATLAS collaboration involving jets, dijets, photons in association with heavy flavors and vector bosons in association with jets, measured at center of mass energies of 8 and 13 TeV are presented. All measured cross-sections are compared to state-of-the art theory predictions.

113

Hadronic and semileptonic decays of B_c meson

Author: Aidos Issadykov[1]

[1] *Jinr*

In the wake of the recent measurements of the decays $B_c \to J/\psi\,\pi(K)$ and $B_c \to J/\psi\,\ell\nu_\ell$ reported by the LHCb Collaboration we calculate the form factors for the $B_c \to J/\psi$ and $B_c \to \eta_c$ transitions in full kinematical region within covariant confined quark model. Then we use the calculated form factors to evaluate the partial decay widths of the above-mentioned semileptonic and nonleptonic decays of the B_c meson. We find that the theoretical predictions on the ratios of $\mathcal{R}_{K^+/\pi^+}$ and $\mathcal{R}_{\pi^+/\mu^+\nu}$ are in good agreement with last LHCb-data. However, the prediction for the $\mathcal{R}_{J/\psi}$ is found to be underestimated.

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Constraints on the Intrinsic Charm Content of the Proton from Recent ATLAS Data

Author: Gennady Lykasov[1]

[1] *JINR*

Constraints on the intrinsic charm probability Wcc¯ = Pcc¯/p in the proton are obtained for the first time from LHC measurements. The ATLAS Collaboration data for the production of prompt photons, accompanied by a charm-quark jet in pp collisions at √s = 8 TeV, are used. The upper limit wcc¯ < 1.93 % is obtained at the 68 % confidence level. This constraint is primarily determined from the theoretical scale and systematical experimental uncertainties. Suggestions for reducing these uncertainties are discussed. The implications of intrinsic heavy quarks in the proton for future studies at the LHC are also discussed.

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Pentaquark states: current status from theory and experiment

Author: Ivan Yeletskikh[1]

[1] *JINR*

Exotic charmonium states Pc-4380 and Pc-4450, consistent with pentaquark hypothesis, have been discovered in 2015 by the LHCb experiment. Discovery inspired numerous theoretical works on the pentaquarks structure and properties as well as further experimental studies. Report summarizes our current knowledge of the physics of these states.

116

New results from the Daya Bay experiment

Author: Maxim Gonchar[1]

[1] *JINR*

The Daya Bay neutrino experiment is the first experiment to make a definitive observation of electron antineutrino disappearance and is the first reactor experiment to measure the neutrino mass splitting Δm^2_{32}. The experiment utilizes eight functionally identical detectors to observe antineutrino flux from three pairs of nuclear reactors with baselines from 0.5 km to 1.5 km. The new dataset of almost 4M antineutrino interactions enables Daya Bay to provide the most precise θ_{13} measurement and the world's second best measurement of Δm^2_{32}. In addition, there are several other significant results, such as a high-statistics determination of the absolute reactor antineutrino flux and spectrum, a search for sterile neutrino mixing, study of wave packet treatment of neutrino oscillations, among others. The most recent results from Daya Bay, alongside the status and prospects of the experiment, are covered in this talk.

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Sterile neutrino searches with the ICARUS detector

Author: Daniele Gibin[1]

Co-author: Filippo Varanini [2]

[1] *Università di Padova and INFN sez. di Padova*

[2] *INFN sez. di Padova*

The 760 ton ICARUS T600 detector performed a successful three-year physics run at the underground LNGS laboratories studying neutrino oscillations with the CNGS neutrino beam from CERN, and searching for atmospheric neutrino interactions. ICARUS performed a sensitive search for LSND like anomalous nu_e appearance in the CNGS beam, which contributed to constrain the allowed parameters to a narrow region around Δm2~eV2, where all the experimental results can be coherently accommodated at 90% C.L. After a significant overhauling at CERN, the T600 detector has now been placed in its experimental hall at Fermilab. It will be soon exposed to the Booster Neutrino Beam to search for sterile neutrino within the SBN program, devoted to definitively clarify the open questions of the presently observed neutrino anomalies.
The proposed contribution will address ICARUS achievements, its status and plans for the new run and the ongoing analyses also finalized to the next physics run at Fermilab.

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Status of the NICA project at JINR.

Author: Andrey Butenko[1]

Co-authors: Anatoly Sidorin [2]; Hamlet Khodzhibagiyan [1]; I. Meshkov [1]; Sergei Kostromin [1]; Viktor Karpinsky [1]; Vladimir Kekelidze [1]; evgeny syresin [1]

[1] *JINR*

[2] *VBLHEP JINR*

The present status of the project of new accelerator complex Nuclotron-based Ion Collider fAcility (NICA), which is under construction at JINR (Dubna), is presented. The main goal of the project is to provide ion beams for experimental studies of hot and dense strongly interacting baryonic matter and spin physics. The collider will provide heavy ion collisions in the energy range of √sNN=4/11 GeV for 197Au79+ nuclei and polarized proton collisions in energy range of √sNN=12/27 GeV. The key issue of the accelerator complex is application of sophisticated beam accumulation schemes and both stochastic and electron cooling methods. The current status of all key elements of the NICA project: HILAC, Booster, Nuclotron and Collider rings should be presented as well.

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Muon System for Spin Physics Detector at NICA

Author: Georgy Golovanov[1]

[1] *JINR*

The SPD project is under preparation at 2nd interaction point of NICA collider. The main purpose of this experiment is the study of the nucleon spin structure with high intensity polarized proton and deuteron beams. Both beams will be effectively polarized. One gives us unique possibilities to investigate the wide range of polarized phenomena. One of the main detectors of the installation is Range System (RS) which provides the identification of muons. The latest results on RS prototype tests are presented.

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Actual status of "DANSS"project

Author: Vyacheslav Belov[1]

[1] *JINR*

DANSS is a one cubic meter highly segmented solid scintillator detector. It consists of 2500 scintillator strips (100x4x1 cm3), covered with gadolinium loaded reflective coating and read out with SiPMs via wave length shifting fibers. Groups of 50 strips are also read out by conventional PMTs. The detector does not contain dangerous liquids and therefore has no safety restrictions on location close to an industrial reactor. It is mounted just under the cauldron of the 3 GW_th reactor WWER-1000 of Kalinin NPP (Russia) on a special lifting platform which varies the distance to the reactor core from 10.7 to 12.7 m within few minutes once per 2-3 days. Due to such location, DANSS is perfectly shielded against cosmic neutrons by 50 m.w.e. of reactor body, cooling pond and other hydrogen-containing elements of the building. The inverse beta decay (IBD) process is used to detect antineutrinos. DANSS detects about 5000 IBD events per day with the background from cosmic muons at the level of few percent. Sterile neutrinos are searched for assuming a 4 neutrino model (3 active and 1 sterile neutrino). The data analysis consists in comparison of the neutrino energy spectra measured at different distances, it does not use any theoretically calculated spectrum and therefore is completely model-independent; systematic errors caused by long-term variation of the reactor fuel and detector efficiency are eliminated as well. In one year of the detector operation we have collected more than 1,000,000 IBD events and could exclude a big part of sterile neutrino parameters region. In particular, the Reactor Antineutrino Anomaly optimum point is excluded with a confidence level higher than 5σ.

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Modern approaches in ultra-low background experiments at the LSM underground laboratory

Author: Evgeny Yakushev[1]

[1] *JINR*

The talk will be devoted to general approaches to search and investigation of rear processes. Real examples that will be considered in the talk are experiments with JINR (Dubna) participation conducting in the LSM deep underground laboratory. Main limitations of the experiments are connected with radioactive backgrounds. Modern nuclear physics methods allow significantly reduce the background level and thus to investigate processes with counting rate below unity per kilograms of matter per year.

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Data Acquisition System for the SCube Detector

Author: Jakub Vlasek[1]

[1] *IEAP CTU Prague*

We present new data acquisition system software being developed at the DLNP JINR. The DAQ software is designed for multi-channel detectors, such as the SCube reactor antineutrino detector. The SCube detector has a similar design as the DANSS detector, but uses improved scintillating plates with higher light yield. It will be also placed underneath a 1 GW nuclear reactor at the Kalinin NPP in Udomlya. The DAQ is designed to operate with the CAEN VME family of digitizers and allows on-line reduction of the data. An emphasis is given to the quality of the data collection.

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Search for Manifestations of New Physics

Author: Merve Sahinsoy[1]

[1] *Heidelberg University*

Understanding the structure of matter has been one of the most astonishing puzzle about the universe and life since ages. Each answer that people discovered has fed the curiosity for knowing the smaller. With this desire, many effort has been made so far. Today, we are witnessing some of the most exciting moments of this search thanks to the Large Hadron Collider (LHC), the world's most powerful accelerator. The quest for new physics beyond the standard model (BSM) is one of the driving topic for LHC Run2 and all the LHC collaborations are pursuing searches for new physics in a vast variety of channels. In this talk, I will summarise the status of these searches at LHC.

126

Precision Measurement of Muonium Hyperfine Structure at J-PARC

Author: Shoichiro Nishimura[1]

Co-authors: Hiroaki Tori [1]; Koichiro Shimomura [2]; Patrick Strasser [2]; Shun Seo [1]; Sohtaro Kanda [3]; Toya Tanaka [1]; Yasuhiro Ueno [1]

[1] *The University of Tokyo*

[2] *KEK IMSS*

[3] *Riken*

Muonium is a hydrogen-like atom consisting of a positive muon and an electron. It is an ideal two-body leptonic system, so it is possible to verify bound-state theory precisely. The muonium ground state hyperfine structure (HFS) can be used to extract fundamental constants: the muon-electron mass ratio and muon-proton magnetic moment ratio. In particular, muon-proton magnetic moment ratio is used to determine the experimental value of muon anomalous magnetic moment g−2, which was reported of having a discrepancy of 3.7 standard deviations between theoretical value and experimental value. Therefore, the precise muonium HFS measurement is important and necessary. The most precise measurement value of muonium HFS interval in a zero magnetic field is 4.463 302 2(14) GHz.
In the previous experiment, the statistical uncertainty was dominant. This problem was inevitable since the continuous muon beam was used. In order to improve the uncertainty of the measured value of the muonium HFS, a new experiment using the high-intensity pulsed muon beam was proposed by the MuSEUM collaboration (MuSEUM is an acronym for "Muonium Spectroscopy Experiment Using Microwave").
In addition, there is another idea to improve the uncertainty by using the new analysis method, which is named the time differential method. In this method, the time dependence of signal is directly fitted and it contains more information than the conventional method, which is called the time integral method.
Furthermore, the muonium HFS frequency is obtained from only one microwave frequency data in the time differential method while it obtained from multiple microwave frequency data in the time integral method. Therefore, the time differential method can improve the uncertainty due to the time and microwave frequency variation of the stored microwave energy. In this presentation, we will report the status of MuSEUM.

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Future e+e- colliders and CR effects study

Author: Nelli Pukhaeva[1]

[1] *JINR*

At future e+e- colliders integral luminosity will amount to several ab-1 to provide the needed statistics for precision physics measurements (both SM and BSM).
New measurements which will be possible with large statistics and high energies accessible at the future e+e- colliders would allow detailed study of the CR phenomenon, specially in the hadronic WW decays, and would be help for other studies: presents of this effects in $t\bar{t}$ and in Higgs decays.

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The front-end electronics of the Mu2e electromagnetic calorimeter

Author: Nikolay Atanov[1]

[1] *JINR*

The main goal of Mu2e experiment at Fermilab is to found a Charged Lepton Flavor Violation (CLFV) in the neutrinoless, coherent conversion of a negative muon into an electron in the Coulomb field of nucleus.The Mu2e electromagnetic calorimeter setup is designed for powerful μ/e particle identification.

The calorimeter will be built from ~1400 CsI scintillation crystals with sizes 3.4x3.4x20cm3. To collect optical signal from crystals, 2 arrays of 6 UV-extended SiPMs with front-end electronics (FEE) are placed at the end of each crystal. The FEE is a multi-layer, double-sided, discrete board directly connected to photosensor. It provides amplification stage and regulation of the SiPMs bias voltage with custom digitally controlled low-dropout regulator (LDO).

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Direct low-mass WIMP searches with HPGe Semiconductor Bolometers

Author: Sergey Rozov[1]

[1] *JINR*

S. Rozov on behalf of the EDELWEISS collaboration

The talk will be devoted to the EDELWEISS program searches for direct evidence of Dark Matter WIMPs from the Milky Way galaxy through their scattering off Ge nuclei within cryogenic Ge crystals.
Due to the extremely low event rates expected the main limitations of the experiment arise from the background radioactivity. Thus the experiment is set at the LSM underground laboratory (France) and using the mountain as a natural shielding of 4850 meters of water equivalent that reduces the muon flux down to about 5 μ/m2/day. In the current phase of the experiment novel 800-grams Fully Inter-Digitized detectors were commissioned and used. EDELWEISS detectors have an excellent background rejection performance, the best in the world, but not competitive with large Ar/Xe detectors in sensitivity to searches of WIMPs with masses above 6 GeV. Thus, the experimental program is moving to EDELWEISS-LT phase, with aims of investigation of "light WIMPs", Axion Like Particles, etc in the energy region inaccessible by Ar/Xe. The region of "light WIMPs" could be thoroughly investigated in the EDELWEISS experiment thanks to advantage of energy resolution below 100 eV reachable with HPGe bolometers via the Neganov-Luke effect of internal amplification of the heat signal. First results obtained during the R&D phase are very promising. With excellent energy resolution achieved first sub-GeV limit with Ge, down to 500 MeV, will be presented.

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First Data of the KATRIN Experiment

Author: Susanne Mertens[1]

[1] *Max Planck Institute for Physics*

The Karlsruhe Tritium Neutrino (KATRIN) experiment is designed to directly measure the absolute neutrino mass scale from the kinematics of tritium beta-decay with an unprecedented sensitivity of 200 meV (90%CL). A nonzero neutrino mass reduces the endpoint energy and distorts the spectrum, especially in the vicinity of this endpoint. Thanks to the high source luminosity and stability KATRIN has the ability to extend its physics program to also search for eV- to keV-scale sterile neutrinos.

This talk will focus on the results of the first tritium measurement campaign that took place in June 2018. As a major result this so-called "First-Tritium" phase demonstrated the integrity of the full electron beamline and the system stability at the required level. Moreover, the presentation will cover the current R&D effort that is targeted at extending the KATRIN setup in the future to enable a high-sensitivity sterile neutrino search.

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Gravitational wave astronomy with Virgo and the GW detectors network

Author: Ciani Giacomo[1]

[1] *University of Padova and INFN Padova*

Thanks to the historical detection of gravitational wave radiation from binary black hole and binary neutron star systems, the Virgo and LIGO observatories have enabled a revolutionary new channel to observe the Universe. The handful of very first, sensational observations have already provided precious new information relevant to astronomy, astrophysics, cosmology and fundamental physics, marking the birth of gravitational-wave astronomy first, and multi-messenger astronomy shortly after.
I will describe the Virgo instrument and its place in the worldwide gravitational-wave detectors network; I will then review the observations made so far and the key scientific outomes stemmed for them. An outlook on what the observation scenario will be in the near and medium term will conclude my talk.

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Study of CEvNS by the COHERENT collaboration

Author: Yuri Efremenko[1]

[1] *Univeristy of Tennessee*

The first observation of Coherent Elastic neutrino Nuclear Scattering (CEvNS) has been observed at a 6.7-sigma confidence level by the COHERENT collaboration using 14.6-kg CsI[Na] scintillator at pulsed neutrino beam from Spallation Neutron Source at Oak Ridge National Laboratory [1]. The CEvNS process predicted by the standard model is a neutral-current weak interaction with cross section is enhanced by N^2, where N is the number of neutrons in the nucleus. This indicates a new way to build compact neutrino detectors and unlocks new channels to test the standard model. In this talk we will review implications of the first result and future plans of collaboration of high statistic studies of CEvNS with next generation of detectors.

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Machine learning methods for cluster identification in pixel detectors

Author: Sergei Kotov[1]

[1] *JINR*

Using machine learning methods, in particular various types of autoencoders, we try to perform identification of clusters, formed by different particles passing through a pixel detector. Particularly we analyze images from GaAsPix detectors installed in the ATLAS cavern.

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The muon g-2 experiment at Fermilab

Author: Rebecca Chislett[1]

[1] *UCL*

The new muon g-2 experiment at Fermilab has just reached the end of the first year of data taking and will continue to run for at least 2 more years. The previous measurement with a precision of 540ppb made at BNL had a discrepancy of 3.6 sigma with the theoretical prediction. The new experiment aims to improve the measurement precision by a factor 4 to 140ppb.

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The Precision Laser Inclinometer, method of data processing and data storage

Author: Ivan Bednyakov[1]

[1] *JINR*

The Precision Laser Inclinometer (PLI) is an instrument for recording micro-seismic ground motion with nano-radian accuracy. The PLI has been proposed by JINR and nowadays is being developed by a JINR-CERN cooperation for the further study of the PLI application to the HL-LHC program and ATLAS experiment and, in general, to multi-TeV colliders.
In this report described the basic aspects of data acquisition from PLI, data processing and data placement. The plans for data integration in CALS(CERN Accelerator Logging Service).

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Incoherent and coherent diffractive production of J/ψ and Υ on heavy nuclei

Author: Wolfgang Schaefer[1]

[1] *Institute of Nuclear Physics PAN*

Recently there has been much interest in the exclusive and semiexclusive
production of vector mesons in nucleus-nucleus collisions at the LHC.
These processes are induced by the strong electromagnetic field of one of the ions.
The relevant subprocesses are the coherent and incoherent diffractive photoproduction mechanisms.
We develop the multiple scattering expansion
fro incoherent photoproduction in the color dipole model and use
new recent fits of the color dipole cross section to precise HERA data on F2 for the numerical predictions.

Summary:

Based on

A.~Łuszczak and W.~Schäfer,
"Incoherent diffractive photoproduction of J/ψ and Υ on heavy nuclei in the color dipole approach,"
Phys.\ Rev.\ C {\bf 97} (2018) no.2, 024903

and ongoing work by us.

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From D meson asymmetries at the LHC to neutrino production at IceCube

Author: Antoni Szczurek[1]

[1] *Institute of Nuclear Physics*

We interpret asymmetries for D^+D^- and $D_s^+D_s^-$,
as observed recently by the LHCb collaborations in terms of subleading
quark/antiquark fragmentation. The related conclusions for lower collision energies as well as for production of high-energy neutrinos in the Earth's atmosphere will be presented.

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Fractal properties of the multiparticle events in heavy ion collisions.

Author: Oleg Rogachevskiy[1]

[1] *JINR*

The methods of the fractal geometry are applied to the particles distribution for the multiparticle events from heavy-ion collisions (HIC). It is shown that such kind of analyses provides a possibility to distinguish between different equation of state in hydrodynamic models of HIC. Implementation of these methods could reveal many other features of the physics for particle production.

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New physics at the EW scale and the production of multiple leptons at the LHC

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A number of features of the Run 1 data impelled us to hypothesize the existence of a heavy boson with a mass around 270 GeV that decays predominantly into Sh, where h is the SM Higgs boson and S is an additional, lighter boson. A number of predictions are made. This includes the anomalous production of opposite sign di-leptons, same sign di-leptons, three and more leptons. These multi-lepton final states appear with and without b-tagged jets. Run 2 data with multi-leptons is compared to these predictions. A large discrepancy between the data and SM MCs is observed cannot be resolved with available tools. These results are interpreted in terms of H—>Sh produced via gluon-gluon fusion and in association with top quarks. The compatibility of the results with the current Higgs boson data is discussed.

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The latest results from the long-baseline neutrino experiment T2K

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T2K is a long-baseline experiment which has been designed to measure neutrino oscillations.
A high intensity beam of muon neutrinos or anti-neutrinos is produced at the J-PARC accelerator complex
and sent towards the near detector station (280 meters away from the neutrino source) and the far detector Super-Kamiokande (295 km).
The change in the measured intensity and composition of the beam is used to provide information on the oscillation parameters.
The T2K experiment has provided one of the world's best measurements of the θ_{23} angle and delivered 2σ confidence intervals for δ_{CP} phase shedding some light on the CP violation/conservation problem in the neutrino sector.
Several useful neutrino cross section measurements have also been performed by the T2K experiment allowing to improve our understanding of the neutrino interactions.

A summary of the recent measurements from the T2K experiment are presented.

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