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Book of Abstracts

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Lebedev Physical Institute of RAS, Higher School of Economics, and
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All materials are presented in the original form submitted by abstract authors.

Contents

Young Scientist Forum

Studying the CP nature of the Top-Yukawa coupling

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The analysis presented studies the production of a Higgs boson via gluon fusion in association with 2 jets with the aim of setting constraints on the CP properties of the top-Yukawa coupling. According to the SM, the Higgs boson must to be a CP even scalar, however some Beyond Standard Model theories predict the existence of the superposition of CP eigenstates, resulting in a CP mixed state. The distribution of the azimuthal angle between the two jets produced in association with the Higgs boson in the gluon fusion process is directly correlated with its CP properties and is therefore used to investigate the top-Yukawa coupling. Results based on the analysis of the Run-2 dataset collected with the ATLAS experiment at a center-of-mass of 13 TeV will be presented.

Young Scientist Forum

Measurement of the CP violation in Bs->Jpsi+Phi decays in ATLAS at 13 TeV

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A measurement of the $B_s \to J/\psi\phi$ decay parameters using 80.5 fb^{-1} of integrated luminosity collected with the ATLAS detector from 13 TeV pp collisions at the LHC is presented. The measured parameters include the CP-violating phase $_s$.

Young Scientist Forum

Observation of the Lambda_b -> J/psi Lambda phi decay

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The observation of the $\Lambda_b^0 \to J/\psi\Lambda\phi$ decay is reported using proton-proton collision data collected at $\sqrt{s} = 13$ TeV by the CMS experiment at the LHC in 2018, corresponding to an integrated luminosity of 60 fb^{-1}. The ratio of branching fractions $B(\Lambda_b^0 \to J/\psi\Lambda\phi)/B(\Lambda_b^0 \to \psi(2S)\Lambda)$ is measured to be $(8.26 \pm 0.90(stat) \pm 0.68(syst) \pm 0.11(B)) \times 10^{-2}$, where the first uncertainty is statistical, the second is systematic, and the last uncertainty reflects the uncertainties in the world-average branching fractions of ϕ and $\psi(2S)$ decays to the reconstructed final states.

Young Scientist Forum

Numerical study of multiparticle probabilities in the λϕ4 theory

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The talk is aimed at giving insights from the ongoing research into multiparticle scattering in the real scalar field theory. The object of the research is the unbroken $\lambda\phi^4$ theory in the case of weak coupling. The research aims are to obtain semiclassical suppression exponents for the processes few $\to N$, where N is a semiclassically large ($\sim 1/\lambda$) final number of particles, and ``few'' is a few-particle initial state.

Since in the semiclassical limit solutions of the saddle-point equations (which replace classical field equations in semiclassics) become singular for considered boundary value problem (they have a discontinuity in the energy), this singular behaviour can be represented through the term with a delta-like source j in the action. In this approach, properties of the saddle-point solutions are recovered in the limit $j \to 0$. In our research, we start from source-dominated solutions which we can describe analytically and then take the limit $j \to 0$ by solving lattice saddle-point equations with Newton-Raphson method for every new smaller amplitude of the source, step by step.

During the talk, I would like to describe our research and show the first obtained results.

Young Scientist Forum

Study of excited Lambda_b baryons at the CMS experiment

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The study of excited Λ_b^0 baryons is reported, based on a data sample of $140\,\text{fb}^{-1}$ collected with the CMS detector in proton-proton collision at centre-of-mass energy of 13 TeV. Existence of four baryon states $\Lambda_b^*(5912)^0$, $\Lambda_b^*(5920)^0$, $\Lambda_b^*(6146)^0$, and $\Lambda_b^*(6152)^0$ is confirmed and their masses are measured.

Young Scientist Forum

Light scalar dark matter coupled to a trace of energy-momentum tensor

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We consider dark matter represented by the light scalar field whose coupling to the ordinary matter is extremely suppressed. We assume that this interaction can be described as the coupling of the square of the field to the energy-momentum tensor. We study the effect of this interaction on the evolution of dark matter scalar, as well as bounds on the model parameters that come from the variation of fundamental constants at the BBN.

Young Scientist Forum

Partial Wave Analysis of pbarp->phiphi at PANDA

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The $\overline{\text{P}}$ANDA experiment at FAIR in Darmstadt (Germany), which is currently under construction, will provide excellent opportunities to search for exotic states in anitproton-proton annihilations. Various experiments observed tensor resonances in the $\phi\phi$ system in the same mass region where

Lattice QCD calculations predict the tensor glueball. The determined magnitude of the reaction exceeds expectations from a simple application of the OZI rule by two orders of magnitude, which was interpreted as a hint for a possible intermediate glueball state. Therefore, the reaction $\overline{p}p \to \phi\phi$ is considered to offer a gluonrich environment and will be studied at $\overline{\mathrm{P}}$ANDA by performing an energy scan at center of mass energies between about 2.25 GeV and 2.6 GeV. Contributing resonances in the $\phi\phi$ system can then be identified by means of a mass independent partial wave analysis. In this contribution, studies will be presented that have been carried out in order to address the feasibility to identify contributing resonances produced in this formation process, utilizing the partial wave analysis software PAWIAN.

Young Scientist Forum

Light sgoldstinos and Higgs sector in the supersymmetric extension of the Standard Model

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We consider a supersymmetric extension of the Standard Model with a broken supersymmetry. Our model contains the fields of the Minimal Supersymmetric Standard Model and goldstino multiplet, which is present due to the supersymmetric version of the Goldstone theorem. Scalar component of this multiplet is traditionally called sgoldstino. We consider the interval of sgoldstino masses from 260 GeV to 1 TeV.

We investigate the possibility of increase in resonant di-Higgs production cross section at the LHC energies due to processes with sgoldstino. Sgoldstino is an R-even particle and thus it can be produced by the gluon fusion and then decay into the pairs of the Standard Model particles, for instance, the pairs of light neutral Higgs bosons.

We show that there are two typical behaviors of sgoldstino branching ratio: gluon domination and the major decay to pairs of light neutral Higgses, W-bosons and Z-bosons. We estimate the borders of the corresponding regions in the parameter space. For particular values of sgoldstino-Higgs mixing angles we obtain an upper limit for the ratio M_3/F from experimental searches for heavy scalar resonances made by the ATLAS and the CMS collaborations.

Young Scientist Forum

Search for electroweak production of charginos and sleptons decaying into final states with two leptons and missing transverse momentum at Run 2 with the ATLAS detector

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Recent results from a search for the electroweak production of charginos and sleptons decaying into final states with two leptons (electrons and/or muons) are presented on 139 fb^{-1} proton-proton collision data recorded by the ATLAS detector at the Large Hadron Collider at $\sqrt{s} = 13$ TeV. Three different R-parity conserving scenarios, based on simplified models, are considered: the direct production of lightest chargino pairs, followed by their decays into final states with leptons and the lightest neutralino via either W bosons or sleptons/sneutrinos; the direct production of slepton pairs, where each slepton decays into the lightest neutralino and a lepton. No significant deviations from the Standard Model expectations are observed and limits at 95% confidence level are set on the masses of the relevant supersymmetric particles in each of these scenarios.

Poster Session - Board: 1

Electromagnetic Stress-Energy tensor in a dispersive medium

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The main purpose of this work is to obtain the Electromagnetic Stress-Energy Tensor in a medium for a nonlocal theory. In order to get it, we generalise Minkowski electrodynamics to dispersive media. As a consequence of this generalisation, the Lagrangian density becomes non-local due to the non-local dependencies of the magnetic permeability and electric permittivity. This leads a convolution product in the Lagrangian where the field at point `x' depends on the values of the field at any point in spacetime. Then, we derive the field equations and, applying the Noether's theorem, the conserved energy-momentum tensor. Because non-local Lagrangians are seldom found in textbooks, we devote a non-local formalism to outline the derivation of the field equations and Noether's theorem. For that, the procedure is the following: First, the non-local Lagrangian is converted into an infinite order Lagrangian (that depends on derivatives of the field of any order). Then, the equations of motion and Noether's theorem are derived as though it was an order-n Lagrangian. Finally, we extend n to infinite and the outcomes that appear contain formal series that can be summed by the techniques that we have developed. To conclude, we study the obtained Belinfante Stress-Energy Tensor for plane wave solutions for a dispersive medium.

Poster Session - Board: 2

Stimulated Recovery of the Radiation Damage in Lead Tungstate Crystals

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The lead tungstate crystal (PbWO4, PWO) is one of the widely used scintillation materials for electromagnetic calorimeters in high energy physics experiments. The degradation of the optical transmittance in the range of the luminescence spectrum under ionizing radiation leads to losses of the light output resulting in the deterioration of the energy resolution and limiting the life time of the calorimeter. A possible way to restore radiation damage is the in-situ illumination of visible or near infrared light of the whole crystal volume. It allows to recover the transmittance losses due to the depopulation of the color centers. Such kind of stimulated recovery subsystem based on a blue light emitting diode is considered for the electromagnetic calorimeter of the PANDA detector at FAIR (Darmstadt, Germany). Here we report on the stimulated recovery studies of the lead tungstate radiation damage induced by external light from laser diodes at different wavelengths. The level of technological development of laser diodes allows to increase the efficiency of the stimulated recovery.

Poster Session - Board: 3

Loop corrections in Schwarzschild black hole background

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When quantizing theory in curved space-time, one can define vacuum state with respect to different timelike Killing vectors. In case of Schwarzschild space-time one usually considers Boulware, Unruh and Hartle-Hawking vacua, where the latter two use Kruskal null coordinates to define positive-frequency modes. Loop corrections to the occupation numbers and anomalous quantum averages are considered for scalar particles and it is shown that there are no corrections up to second order

in coupling constant for Boulware and Hartle-Hawking vacua, but there are non-zero contributions in case of Unruh vacuum.

Poster Session - Board: 4

Neutron from cosmic muons background simulation in DANSS experiment

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The DANSS experiment aims to search for sterile neutrinos. It is a compact neutrino spectrometer located at the Kalinin Nuclear Power Plant close to the core of the industrial power reactor. The detector records about 3000-4000 events per day after subtracting the background depending on the position. The significant contribution to background events is made by neutrons from the interaction of cosmic muons formed in the materials surrounding the detector volume. In this work preliminary results of neutron signal spectra are presented.

Poster Session - Board: 5

Notes on quantum fields in Static patch of de Sitter space

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We show the explicit mode expansion of tree-level propagators in Static (or Compact) Patch of de Sitter space. We construct propagator for thermal state corresponding to arbitrary temperature T. We show that the propagator that respects the de Sitter isometry corresponds to the thermal state with $T = (2\pi)^{-1}$ in the units of de Sitter curvature. Which confirms the old and well known result, making it a bit more explicit. Propagators with $T \neq (2\pi)^{-1}$ do not respect the isometry. Moreover, we show that propagators with $T \neq (2\pi)^{-1}$ have extra singularities on the boundary of the Static Patch, as opposed to the case of $T = (2\pi)^{-1}$. We discuss physical meaning of these observations. We also discuss loop corrections to the propagators in the Static patch and their physical meaning both for $T = (2\pi)^{-1}$ and $T \neq (2\pi)^{-1}$.

Poster Session - Board: 6

Calibration of SiPM-based Neutron Monitors for CMS Experiment

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Development of a distributed system of the neutron monitors is required to estimate the neutron spectra and monitor the neutron fields in the CMS experimental cavern. The proposed neutron monitor is based on the 6Li-enriched scintillator coupled to SiPM. During LHC Run 2, several monitor samples were successfully commissioned at the CERN laboratory and tested in CMS environment with the set of Bonner spheres. To rescale collected data to the absolute value of the neutron flux the same SiPM-based monitor samples with the set of Bonner spheres were calibrated at the CERN Radiation Protection calibration facility using Am-Be source. Afterwards, monitor readings measured in the CMS radiation field can be deconvoluted to the neutron spectrum by means of the unfolding procedure.

Poster Session - Board: 7

A new QFT description of finite duration processes

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Currently the phenomena of neutrino and neutral kaon oscillations, which take place at finite space-time intervals, are usually described in the framework of approaches that are inconsistent or not convenient for describing such processes. We develop a new QFT approach, adjusting the standard S-matrix formalism for the case. One applies the usual Feynman rules in the coordinate representation to construct the amplitude of the process and then passes to the momentum representation in a way which reflects the experimental setting. Effectively, it leads to the Feynman propagator in the momentum representation being modified, while all the other Feynman rules in this representation are kept intact. Wave packets are not employed, we work in the plane wave approximation, which simplifies the calculations considerably. The novel approach allows one to consistently describe unstable particle displaced decay and particle oscillation processes and to successfully reproduce the well-known results.

Poster Session - Board: 8

Superfield realization of hidden R-symmetry in extended supersymmetric gauge theories and its applications

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An object of the crucial importance in quantum field theory is the effective action. By definition, it is a generating functional for one-particle irreducible Green's functions, which contains complete information about the quantum properties of this model. To find an effective action, it is convenient to use the technique of harmonic superspace.

Superspace[1] is a generalization of Minkowski space and allows explicitly and in a simple form to implement supersymmetry transformations. In theories with extended supersymmetry, the concept of harmonic superspace[2] plays an important role, which allows one to realize the symmetries of the theory off shell. Its important property is the presence of an analytic subspace invariant with respect to supersymmetry.

When studying $4D, \mathcal{N} = 4$, and $5D, \mathcal{N} = 2$ of supersymmetric Yang-Mills theories in harmonic superspace, some of the transformations of supersymmetry and, accordingly, R-symmetry are realized hiddenly[3,4]. The standard approach for obtaining low-energy effective action is as follows[4,5]. First, the leading one-loop quantum corrections for to the effective actions of $4D, \mathcal{N} = 2$ and $5D, \mathcal{N} = 1$ SYM theories are calculated. Then, by calculating the expansion of this contribution with respect to hidden supersymmetry, expression is obtained for the effective action for $4D, \mathcal{N} = 4$, and $5D, \mathcal{N} = 2$ theories, respectively.

In this paper, a different approach is used. The hidden R-symmetry transformations was found. Then, by calculating the expansion of the leading term with respect to R-symmetry, the expression for the effective action was obtained. This procedure was applied for $4D, \mathcal{N} = 4$ and $5D, \mathcal{N} = 2$ SYM theories. The nontrivial result is that the effective action is not only R-symmetric invariant, but can also be obtained from the requirement of the presence of R-symmetry.

It is expected that this approach may be useful in the study of other supersymmetric theories, for example, $6D, \mathcal{N} = (2, 0)$ SYM theory.

This reseerch based on the parer[6].

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Poster Session - Board: 9

Generalized unimodular gravity: cospological applications and renormalizeability

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The recently suggested generalized unimodular gravity theory, which was originally put forward as a model of dark energy, can serve as a model of cosmological inflation driven by the effective perfect fluid—the dark purely gravitational sector of the theory. Its excitations are scalar gravitons that can generate, in the domain free from ghost and gradient instabilities, the red tilted primordial power spectrum of cosmic microwave background (CMB) perturbations matching with observations. The reconstruction of the parametric dependence of the action of the theory in the early inflationary universe is qualitatively sketched from the cosmological data and satisfies the naturalness criterion—the O(1) magnitude of all its parameters. In particular, the only phenomenological exponentially big parameter—the e-folding factor with N~60, leads in this model to a specific expression for tensor-to-scalar ratio r ⊠ 0.004, matching with the existing observational bounds on r and the CMB spectral index. The alternative possibilities of generating the cosmological acceleration and possibility of generalized renormalizeability of the theory are also discussed.

Poster Session - Board: 10

Using of neural network technology for improvement of energy resolution of highly granular hadron calorimeter

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The technology of highly granular calorimeters is one of the innovations that will be implemented in the planned accelerator experiments, for example in the future linear collider. The work is devoted to the study of hadronic showers in the highly granular hadron calorimeter of the ILD detector and the application of machine learning to the improvement of the energy resolution. The artificial neural network was built, the dependencies between the selected input variables were studied. The study was performed using the simulation of single hadrons with energies from 5 to 60 GeV in the ILD detector.

Poster Session - Board: 11

Radiative recoil corrections to the hyperfine splitting of light muonic atoms

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Nuclear radiative recoil corrections of order \alpha(Z*\alpha)^5 to the hyperfine structure of S-states in light muonic atoms are calculated in the framework of quasipotential method in quantum electrodynamics. Separate expressions for the contributions of the muon self-energy, muon vertex operator and the amplitude with spanning photon are obtained. For the radiative photon, we use the Fried-Yennie gauge. Numerical values of these corrections improve the accuracy of previous calculations and should be taken into account when comparing with experimental data.

Poster Session - Board: 13

The status of the large-scale coordinate-tracking detector TREK

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The new large-scale coordinate-tracking detector TREK is being developed at National Research University MEPhI. The aim of the project is the solution of so-called “muon puzzle”: the unpredicted by any theory excess of high multiplicity muon bundles generated by ultra-high energy primary cosmic rays. The joint operation with Cherenkov water detector NEVOD will allow investigation specific energy deposit of quasi-parallel inclined muon bundles generated by high energy cosmic rays in 2000 m3 water volume.

The detector TREK has an area of 250 m2 and it is based on 264 multi-wire drift chambers developed at Institute of High Energy Physics for neutrino experiment at accelerator U-70. The drift chamber has size 4000×508×112 mm3. TREK will consist of 2 planes (vertical and horizontal) with 132 chambers for each. The total area of installation is about 250 m2.

The drift chambers were tested with a joint operation with muon hodoscope URAGAN. Two prototypes of TREK were constructed, their operation demonstrated high efficiency of application of such gaseous detectors for cosmic ray investigations. The experiments on URAGAN has allowed us to investigate drift chamber work in different positions, CTUDC has allowed to test joint work of chambers with NEVOD and prototype of TREK has allowed to test multiparticle event reconstruction taking into account the relative location of chambers as in TREK installation.

Three reconstruction methods of multiparticle events have been developed. The methods have been tested on experimental data of CTUDC and prototype of TREK. A new reconstruction method based on deep learning is being developed. Also a time-digital converter based on FPGA Altera Cyclone V is being developed for TREK installation. The report describes the current status of detector TREK.

Poster Session - Board: 14

Geant4 simulation as part of luminometer development for CMS at HL-LHC

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Luminosity is one of the main characteristics of an accelerator. It determines the number of colliding particle (e.g. protons) interactions in a bunch crossing. The task of luminosity measurements in two-beam experiments is challenging. It becomes harder with the LHC upgrade – High-Luminosity LHC – with even higher energies, luminosity and a complex time structure of the beam. The proposed luminometer is being designed to perform online bunch-by-bunch luminosity measurements with the frequency of 25 ns, the accuracy of 1% and the ability to withstand high radiation. The proposed for this task radiation hard quartz fibers are simulated using Geant4: the physics, geometry and optical parameters are varied to optimize the accuracy of the processes of emission, capturing and transportation of Cherenkov light.

Poster Session - Board: 15

Development of a method for reweighting distributions to search for new physics using effective field theory

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It is conveniently to use a model-independent approach of effective field theory for indirect search of new physics. This approach consists of parametrization of the lagrangian with operators of higher dimensons with some coefficients. If we compare experimental data with Monte Carlo results, it becomes possible to impose an upper limit of the value of coefficients. However, the real value of any coefficient belongs to a continuous spectrum, whereas Monte Carlo modeling can be performed for discrete set of the values of coefficients. In this work the problem of reweighting of kinematic distributions was considered. There was developed a method to get distributions for any value of coefficient using initial distributions, obtained with fixed coefficient value. This method will be employed to get constraints on the values of coefficients.

Poster Session - Board: 16

Quantum decoherence during inflation

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During inflation the universe rapidly expands and the observed classical distribution of inhomogeneities originates from the substantially non-classical state. The problem of transition from quantum to classical behavior is also important outside the cosmological context in connection with the study of mesoscopic systems. And this problem can be viewed in the context of the theory of decoherence induced by environment. In short, this phenomenon lies in the fact that the quantum degrees of freedom of the system are entangled with the degrees of freedom of the environment, which leads to the suppression of interference effects and the classicalisation of the system.
In cosmological context, the transition to classical behavior is studied within the Wheeler-DeWitt approach with small inhomogeneous perturbations considered over quantized homogeneous background. The Wheeler-DeWitt equation is solved in the Born-Oppenheimer approximation. Using this approximation, one can represent the wave function as a product of homogeneous and inhomogeneous parts. Inhomogeneous wave function is associated with QFT approach on a clas-sical curved background and homogeneous part provides probability amplitude for different backgrounds. The decoherence process itself is observed by studying the corresponding density matrix.
In this paper we discuss the decoherence of background degrees of freedom due to the loss of information about modes going beyond the cosmological horizon while mantaining the full information about the short wavelength perturbations. We demonstrate the classicalization process of the quantum state of inhomogeneities of the universe by observing reduced density matrix of the short wavelength fluctuations.

Poster Session - Board: 17

DsTau (NA65): Study of tau neutrino production at the CERN-SPS

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The uncertainty in tau neutrino production in high energy proton interactions has been the largest uncertainty in current and future tau neutrino measurements, preventing a precise test of lepton universality in neutrino scattering. DsTau (NA65) at the CERN-SPS is a recently approved experiment, which aims to study the problematic tau neutrino production. The main source of tau neutrino production is through the decay of Ds mesons, namely $D_s \to \tau\nu_\tau$ and then $\tau \to \nu_\tau X$. There is no data on the differential production cross section of Ds in proton-nucleus interactions, which leads to a large uncertainty of tau neutrino cross section measurements. DsTau addresses this issue and will provide essential inputs for future tau neutrino experiments. A large amount of charmed particles decay events ($\sim 10^5$) is expected to be detected as well, providing a possibility for interesting by-product studies, in particular a search for intrinsic charm in a proton. The experimental method is based on a use of high resolution emulsion detectors for effective registration of events with short lived particle decays. Here I present the motivation of the study, details of the experimental technique and the first results of the analysis of the data collected during test runs.

Poster Session - Board: 18

On quantization in background scalar fields

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We consider (0+1) and (1+1) dimensional Yukawa theory in various scalar field backgrounds, which are solving classical equations of motion. The (0+1)–dimensional theory we solve exactly. In (1+1)–dimensions we consider background fields of the form $\phi_{cl} = Et$ and $\phi_{cl} = Ex$, which are inspired by the constant electric field. Here E is a constant. We study the backreaction problem by various methods, including the dynamics of a coherent state. We also calculate loop corrections to the correlation functions in the theory using the Schwinger–Keldysh diagrammatic technique.

Young Scientist Forum

Decays-in-flight muon polarization measurement to extract the Michel parameter ξ' in τ-decays at the Future Super charm-tau Factory.

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We present a feasibility study of the muon polarization measurement to extract the Michel parameter ξ' in τ-decays. We suggest as a method using the angular distribution of an electron in the rest frame of a decayed in the drift chamber muon, as electron momentum correlates with muon polarization. The Monte Carlo simulation of the Belle detector with parameters of the Future Super charm-tau Factory beams was used to generate signal events. The possible background was studied and methods of its suppression were suggested. The most contribution is expected from the light mesons decays-in-flight and particles scattering. The reconstruction efficiency and statistical uncertainties were estimated.

Young Scientist Forum

Study of Xi_bˆ- signal and its excitations on LHC data

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A study of Ξ_b^- baryon and its excited state Ξ_b^{*0} is reported using proton-proton collisions data sample collected at $\sqrt{s} = 13$ TeV by the CMS experiment at the LHC in 2016-2018, corresponding to an integrated luminosity of $140\ fb^{-1}$. Ξ_b^- is reconstructed in $J/\psi\Xi^-$ channel ($J/\psi \longrightarrow \mu^+\mu^-, \Xi^- \longrightarrow \Lambda\pi^-, \Lambda \longrightarrow p\pi^-$), and its excited state studied through decay to $\Xi_b^-\pi^+$, where pion is taken from primary vertex. More than 1000 signal events of Ξ_b^- and up to 90 of Ξ_b*^0 are obtained, that are planned to be used for further search of new Ξ_b states in $\Xi_b^-\pi^+$ and $\Xi_b^-\pi^+\pi^-$ systems.

Young Scientist Forum

Measurement of charged-particle multiplicities in jets and gluon jet fractions for jet samples selected in dijet channel produced in pp-collisions at √⊠ = 13 TeV with the CMS detector (Run-II)

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The subject of the study is the measurement of the properties of the jets selected by the CMS detector in 2016 at a collision energy of 13 TeV with an integrated luminosity of 36 fbˆ-1. The jets were selected in events with two oppositely directed jets (dijet channel). Three samples of jets were used in the study: from events without additional jets, from events with one or two additional jets, and from events with more than two additional jets. The samples are divided into subsamples of the jets in bins according to the transverse momentum of the jet in the range from 30 to 1000 GeV. The bin size is 30 GeV.
The goal of the study is to measure the average charged-particle multiplicity and the fraction of gluon jets in the samples, depending on the average transverse momentum of the jet.
In the work, the average charged-particle multiplicity was measured for jets with cutting off low-energy tracks (less than 500 MeV). The corrections were made: (1) the contribution of the pile up jets was subtracted, (2) the correction for low-energy tracks and tracks outside the tracker, (3) jet energy correction, (4) the correction for lost and fake tracks.
The second measurement performed in the work is the measurement of the gluon jet fractions in the same samples. The quark-gluon discriminator (QGL) developed for CMS is used for this measurement. The measurement was performed by fitting the QGL distribution of jets in the data by a linear combination of QGL distributions for quark and gluon jets with one parameter — the gluon jet fraction. For fitting, the method of weighted least squares is used. Quark and gluon QGL distributions were obtained using a combination of MadGraph5 + Pythia8 generators. In this study, it was shown that independent measurements of the average charged-particle multiplicities in the jet and the gluon jet fractions are in qualitative agreement with each other for the studied jet samples.

Young Scientist Forum

Title of the talk : General Treatment of Reflection of Spherical Electromagnetic Waves from the Spherical, Uneven Antarctic Surface and its Implications for the Mystery Events detected by ANITA detector.

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The NASA sponsored balloon-borne ANITA detector in Antarctica is designed to detect ultra high energy cosmic rays (UHECR) with energies exceeding 1 EeV (10^{18} eV) by collecting the radio pulse generated through the interaction of the primary particle with Earth's atmosphere. The radio pulse is

detected after reflection from the Antarctic ice surface. For calibration and measurement of surface reflectivity, the balloon-borne HiCal radio-frequency (RF) transmitter is used. Here we are interested in determining the mean value of reflection coefficient over the range of frequencies which are of interest in HiCal observations.
We have developed a general formalism to treat reflection of spherical electromagnetic waves from a spherical surface. Our main objective is interpretation of radio wave signals produced by cosmic ray interactions with Earth's atmosphere which are observed by the Antarctica based ANITA detector after reflection off the ice surface. The incident wave is decomposed into plane waves and each plane wave is reflected off the surface using the standard Fresnel formalism. For each plane wave the reflected wave is assumed to be locally a plane wave. This is a very reasonable assumption and there are no uncontrolled approximations in our treatment of the reflection phenomenon. The surface roughness effects are also included by using a simple model. We apply our formalism to the radiation produced by the balloon-borne HiCal radio-frequency (RF) transmitter. The final results for the reflected power are found to be in good agreement with data for all elevation angles. our framework can also handle the in-ice interaction of neutrino-induced radio signals, applicable to various neutrino detection experiments that employ the Askaryan effect. We also study the properties of reflected radio pulses in order to study their phase relationship with direct pulses. We find that for some roughness models the pulse shape can be some what distorted and may be misidentified as a direct pulse. The effect of various surface roughness models on the pulse shape will also be discussed. In this talk, I will also explain that our proposed roughness model, suitable for actual Antarctic surface topography is able to provide an explanation for the observed mystery events by ANITA.

Young Scientist Forum

Statistical data analysis in the DANSS experiment

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DANSS is a one cubic meter highly segmented solid scintillator detector. It consists of 2500 scintillator strips, covered with gadolinium loaded reflective coating and read out with SiPMs via wavelength shifting fibers. DANSS is placed under a 3 GW industrial reactor at the Kalinin NPP (Russia) on a movable platform. The distance from the reactor core center is varied from 10.7 m to 12.7 m on-line. The inverse beta decay (IBD) process is used to detect antineutrinos. DANSS detects about 4000 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 exclusion area in the sterile neutrino parameter plane is obtained using a ratio of positron energy spectra collected at different distances. We compare the most robust analysis based on a comparison of antineutrino energy spectra shapes at different distances with the analysis that uses information about the counting rates as well. The talk will cover the analysis of systematic uncertainties and the statistical methods used to obtain exclusion areas.

Young Scientist Forum

Studying of processes caused by stopped muons for the energy scale determination in the DANSS experiment

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DANSS is a one cubic meter highly segmented solid scintillator detector. It consists of 2500 scintillator strips, covered with gadolinium loaded reflective coating and read out with SiPMs and PMTs via wavelength shifting fibers. DANSS is placed under a 3 GW industrial reactor at the Kalinin NPP (Russia) on a movable platform. 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 a few percent. Antineutrino energies are determined from the IBD reaction by measuring energies of produced positrons, therefore the energy scale accuracy is a key parameter for the data analysis. We use two processes caused by stopped muons in order to determine the energy scale. Muon and anti-muon decays at rest provide electrons and positrons with energies up to 53 MeV. The second process is a beta decay of borum produced in stopped muon's capture on carbon: $\mu^- + {}^{12}C \rightarrow {}^{12}B + \nu_\mu$. The borum beta decay electron energy spectrum ranges up to 14 MeV. In the talk we describe a method of identification of muons stopped inside the central cube of the detector and present selection criteria for studied reactions. The measured electron and positron energy spectra from the two studied processes are compared with the results of the Monte Carlo simulations in order to determine the corrections to the energy scale and the additional blurring coefficient, required to describe the experimental data.

Young Scientist Forum

Hadronic molecular binding of $Z_b(10610)$ and $Z_b(10650)$

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Starting with the discovery of the $X(3872)$ in 2003, evidence for many exotic states beyond explanations within the quark model have been found in experiments worldwide. Many of those states are close to thresholds of two combined open-flavor states with convenient quantum numbers, such that the data suggests a treatment as a composite system, namely a hadronic molecule. In the talk, research for the case of $Z_b(10610)$ and $Z_b(10650)$ will be examined. Calculations using HQET and χPT that might disclose the molecular nature of a composite $B^{(*)}$-$\bar{B}^{(*)}$ system will be presented. The obtained matrix elements could be used for the computation of a possible molecular binding energy and the shape of the corresponding potential well which hopefully gives insight into the internal mechanism of Z-states.

Young Scientist Forum

Belle II Status and Prospects

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At the end of 2018 the inner subdetectors, SVD (Silicon Vertex Detector) and PXD (Pixel Detector) were installed in Belle II. By the end of 2019 Belle II has collected a total of 10 fb^{-1}. With the early data taken the charged-particles tracking performance of the detector was characterized, reconstruction of known resonances and the capability of identifying displaced vertices decays.
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One of the first benchmarks for B physics was the measurement of the B 0 –B mixing frequency. First results are based on the B mesons semileptonic decay mode. The rediscovery of the “golden mode” $B^0 \rightarrow J/\psi K^0_S$, a CP eigenstate, is shown along other $B \rightarrow [c\bar{c}]X_s$ decay modes.
Prospects for dark sector searches, CPV in Charm physics and other motivations for B physics are discussed.

Young Scientist Forum

Measurement of γ*ωπ0 form factor using SND detector on VEPP-2000

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The cross section $e^+e^- \to \omega\pi^0 \to \pi^+\pi^-2\pi^0$ is measured in 1 - 2 GeV c. m. energy range using statistics collected by SND detector installed on VEPP-2000 collider in experiments MHAD2011 and MHAD2012 with integrated luminosity 35 pb^{-1}. The measured cross section is in the agreement with previous measurements but has better accuracy. $\gamma^*\omega\pi^0$ form factor is calculated from the obtained cross section and approximated using several variants of the vector meson dominance model. It is found that the model is not able to describe the form factor with sufficient accuracy in the studied energy range. The data of NA60 experiment show a noticeably faster growth of the form factor as the c. m. energy approaches the ρ-meson in comparison with model predictions.

Young Scientist Forum

Extension of the N/D-method for Kπ scattering using unitarity, χPT and resonance exchanges (consistent with chiral symmetry) to energies above 1.4 GeV

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The ongoing improvement of data of processes such as $B \to J/\psi$ K π containing Kπ final state interactions, measured by LHCb or COMPASS, require a theoretically sound description consistent with unitarity and analyticity. The understanding of such meson-meson strong interactions is still unclear and controversial in some energy regions. In particular a lot of resonances are very broad or difficult to distinguish from background. Hence a parametrisation using standard Breit-Wigner resonances is inept. In contrast the N/D-method gives the right branch cut structure consistent with unitarity and analyticity relying on χPT and resonance exchanges consistent with chiral symmetry. We want to present our ongoing process of expanding the area of validity for the description of K$\pi \to$ Kπ scattering amplitudes beyond 1.4 GeV using the N/D-method (as done up to 1.4 GeV [1]). The present model is enhanced by taking additionally to the Kη coupled channel the Kη' into account as well as adding higher energetic resonances. Our main focus will be on $I(J^P) = \frac{1}{2}(0^+)$ s-wave amplitudes, where the $\mathrm{K}_0^*(700)$ (prior κ) as well as $\mathrm{K}_0^*(1430)$ and $\mathrm{K}_0^*(1950)$ are present. In the future the framework should be expanded to incorporate higher partial waves as well.

[1] J. A. Oller and E. Oset, ``N/D description of two meson amplitudes and chiral symmetry'' in Phys. Rev. D60, 1999

Young Scientist Forum

Study of the e+e- -> eta gamma process with SND detector on VEPP-2000 e+e- collider

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We report preliminary results for the cross section of the $e^+e^- \to \eta\gamma$ process measured in the center-of-mass energy range below 1.04 GeV. The data used for the analysis were collected by the SND detector at the VEPP-2000 e^+e^- collider in 2013 and 2018 with the integrated luminosity of 82 pb^{-1}. Kinematic reconstruction of events was performed to select the signal process. Integrated luminosity at each energy point was measured using the process $e^+e^- \to \gamma\gamma$.

Young Scientist Forum

Optimization of the Hyper-Kamiokande detector to increase sensitivity to low-energy neutrinos.

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To increase the sensitivity for detection of solar neutrinos and Supernova relic neutrinos by the Cherenkov radiation in the Hyper-Kamiokande detector it is proposed to use light collectors (mirrors) surrounding PMTs. The simulation of the light collectors was done. An increase in the efficiency of neutrino registration for different mirror shapes and sizes was investigated, as well as negative effects associated with the reflection of Cherenkov light.

Young Scientist Forum

Monte Carlo event generators for neutrino-nucleus scattering in the few-GeV region

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Accelerator-based neutrino oscillation experiments rely on the description of neutrino interactions with bound nucleons inside atomic nuclei. Neutrino fluxes used in modern experiments (T2K, NOvA) are peaked in the 0.5–5 GeV energy region where one can identify contributions from multiple interaction channels and various nuclear effects. The neutrino-nucleus cross sections in this region are known with a precision not exceeding 20% and have to be investigated further in pursue to reduce systematic errors in oscillation measurements.
The concept of Monte Carlo neutrino event generators, which provide essential cross section expectations for oscillation experiments, is examplified by NuWro, the generator developed at the University of Wroclaw. I will discuss various implementations of nuclear effects on top of the factorization framework used to describe neutrino-nucleus scattering, focusing specifically on possible generator development using more sophisticated microscopic models.

Young Scientist Forum

SIDIS Kaon Beam Spin Asymmetry Measurements with CLAS12

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In 2018 the CLAS12 detector started data taking with a polarized 10.6 GeV electron beam at Jefferson Laboratory (JLab). One of the quantities which can be extracted from the data is the moment $A_{LU}^{\sin(\phi)}$ corresponding to the polarized electron beam spin asymmetry in semi-inclusive deep inelastic scattering.

$A_{LU}^{\sin(\phi)}$ is a twist-3 quantity that provides information about the quark gluon correlations. It was studied with a 10.6 GeV longitudinally polarized electron beam and an unpolarized liquid hydrogen target.

The talk will present an analysis of meson channels over a large kinematic range with virtualities Q^2 ranging from 1 GeV^2 to 8 GeV^2. The measurement in a large range of z, x_B, p_T and Q^2, including not yet measured kinematic regions, will allow a comparison with different reaction models.