POSTER PRESENTATIONS BY YOUNG SCIENTISTS IN THE FIELD OF PARTICLE PHYSICS RESEARCH

1. **An amplitude analysis of the $\pi^0\pi^0$ system produced in radiative $\psi(2S)$ decays: current results**

Author: **Prokhor Egorov**
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Abstract:
Glueballs are predicted in a wide range of nonperturbative approaches to QCD, but such states have not been reliably identified experimentally. Their existence (or non-existence) is a crucial test for our understanding of QCD. In the analysis of radiative J/ψ decays, with a strong contribution from the JINR BESIII group, strong evidence of the scalar gluon production is obtained. At the same time, no evidence of the tensor gloun production is seen in the available J/ψ decay data, despite the higher expected production rate. This motivates a comprehensive study of radiative ψ' decays where hadrons with larger mass can be produced.
We present the current state of the amplitude analysis of $\psi(2S)$ radiative decays into $\pi^0\pi^0$ system. Approximately 96.000 events of these decays were selected from the BESIII data of $\psi(2S)$ decays gathered during 2021. The background ratio for selected events is estimated to be less than 2%.

2. **The BM@N online QA system**

Author: **Ilnur Gabdrakhmanov**
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Abstract:
The BM@N experiment (Baryonic Matter at Nuclotron) is a fixed target experiment and the first stage of the NICA project (Nuclotron based Ion Collider fAcility). The experimental facility is designed to explore properties of dense quark matter.
The QA code is a part of BmnRoot – a framework developed for BM@N, based on the FairRoot package.
The system is capable of online decoding of the raw data stream from the data acquisition the consequent reconstruction and live web histogramming.
The user is able to monitor any detector subsystem, select specific detector station, plane, time or strip profile histograms in 1/2/3D view.
The QA functions are presented by reference run auto-selecting and consequent overlaying histograms.
The online QA has been tested on several technical and the physical run during the 4th NICA commissioning run.

3. **Double J/ψ production in pion-nucleon scattering at COMPASS**

Author: **Andrey Gridin**
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Abstract:
The problem of intrinsic charm of a hadron has been discussing already for 40 years. However, only in 2022 the NNPDF collaboration obtained the first convincing indications of existence of intrinsic charm in a proton using the LHCb data.
The differential cross section of J/ψ pair production has been measured by the COMPASS experiment, that used a 190 GeV/c pion beam scattering off different nuclear targets. Obtained results allow to study charmonia production mechanisms (single and double parton scattering) and to put an upper limit on J/ψ pair production cross section assuming its production through intrinsic charm mechanism.
The distribution of invariant mass of J/ψ pairs obtained by COMPASS does not exhibit any statistical significant signals from exotic tetraquark states that were recently observed by experiments at LHC.

4. **Detection of the atmospheric neutrinos in the NOvA experiment**

Author: **Aleksandra Ivanova**
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Abstract:
The NOvA experiment, aimed at studying the neutrino oscillations in the muon neutrino beam, uses two segmented liquid scintillation detectors, with masses of 300 tons and 14 kilotons, respectively.
The large size and high segmentation of the NOvA detectors, as well as a flexible system of software triggers and data acquisition, make it possible to solve additional physical problems, in particular, to detect and study the atmospheric neutrino flux in NOvA detectors.
This poster presents the technique for detecting and selecting events from interactions of the atmospheric neutrinos in the far detector of the NOvA experiment.

5. **Gravitational chiral anomaly in a vortical quantum fluid**

Author: **Roman Khakimov**
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Abstract:
We construct a hydrodynamic gradient expansion for the axial current and the stress-energy tensor of massless fermions in a fluid with rotation and acceleration in a curved space-time. We establish a duality between the currents induced by the cosmological constant and the finite acceleration in flat space-time. We also verify the duality between the current in a rotating and accelerated medium, the so-called kinematical vortical effect (KVE), and the gravitational chiral anomaly. Finally, we construct the hydrodynamic expansion for the stress-energy and show brand new derivation of Unruh-Deser temperature, which depends on the acceleration in five-dimensional space-time

6. **Femtoscopy Results in Au+Au collisions at $\sqrt{s_{NN}} = 3$ GeV from STAR**

Author: **Anna Kraeva**
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Abstract:
One of the main tasks of relativistic nuclear physics is the search for signs of formation, quantitative evaluation and description of the properties of quark-gluon matter (QGM). Collisions of heavy ions at colliders present a unique opportunity to study QGM in the laboratory. One of the important parameters characterizing quark-gluon matter is the size, shape, and lifetime of the particle emission source, which can be estimated using the method of correlation femtoscopy.
In this report, will be presented the results of measurements of femtoscopic correlations of proton-proton, proton-deuteron, deuteron-deuteron and identical pions pairs produced in Au+Au collisions at $\sqrt{s_{NN}} =$ 3 GeV recorded by 11 the STAR experiment at RHIC.

7. **Study of the interaction trigger and development of a TOF neutron spectrometer in the BM@N experiment**

Author: **Nikita Lashmanov**
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Abstract:
The report presents the results of studying the characteristics of trigger detectors and the trigger efficiency for nucleus-nucleus interactions in the BM@N experiment. The performed simulation based on the DCM-QGSM + GEANT4 code demonstrated that including the fast interaction information from the beam fragments detector and the hadron calorimeter in the trigger ensures reliable event selection based on centrality for Xe + Sn collisions. One of the main trigger detectors is the multi-channel scintillation Barrel Detector (BD) located around the target. The simulation revealed that relativistic nuclei passing through the target generate a significant background of δ-electrons in the BD detector, which can be minimized by employing lead shielding of a certain thickness. The efficiency of event selection by the trigger during the recent BM@N run with a Xe-124 beam at an energy of 3.9 GeV/nucleon and CsI target is discussed.

The second part of the report is dedicated to the development of a compact time-of-flight neutron spectrometer emitted at large angles in the nucleus-target fragmentation region. Neutron detection was performed using stilbene crystals coupled with an assembly of four SensL SiPMs, allowing measurements to be conducted in a strong magnetic field of 0.9 T. The use of the n/g-pulse shape discrimination method is an important feature of the spectrometer, enabling the discrimination of gamma-ray background and the identification of neutron events. The concept of the spectrometer, construction of neutron detectors, and data processing methodology are discussed. The report will cover the current status of processing neutron data obtained in Xe+CsI collisions.

8. **Atmospheric muons and neutrinos: spectra calculations and comparison with experiment**

Author: **Anna Morozova**
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Abstract:
High-energy neutrinos and muons are generated in weak decays of mesons and baryons resulting from the interaction of cosmic rays with the Earth's atmosphere. Relatively recently, measurements of the spectrum of atmospheric neutrinos at high energies in the IceCube, ANTARES experiments were published: up to ~ 650 TeV (muonic neutrinos), and ~ 20 TeV electron neutrinos, and new data on the spectra of high-energy muons up to energies of ~ 1 PeV. Measurement of the spectra and angular distributions of cosmic ray muons and neutrinos makes it possible to study the spectrum and composition of primary cosmic rays (CR). The energy spectrum and zenith-angular distribution of atmospheric muons and neutrinos are sensitive to the details of pion and kaon production. This paper shows calculations of spectra, characteristics of atmospheric muon and neutrino fluxes in comparison with the IceCube experiment. In addition, the possibility of using the far detector (FD) of the NOvA experiment as a muon parameter is studied based on the reconstruction of the muon energy from the energy losses in the detector to produce e^+e^- - pairs.

9. **Straw signal modeling using GARFIELD++ interface to LTspice**

Author: **Assel Mukhamejanova**
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Abstract:
The aim of this work is to describe method of modeling straw signal using Garfield++ interface to LTspice. Straw Tube Trackers will be use in the SPD experiment. When designing such large scale and complex detector it is of extreme importance to run precise simulations. The physical task of this research is to reliably predict drift time and shape signal, which is important for further modeling of electronics for SPD Straw Trackers.

10. **The Correction System of the NICA Booster Guiding Magnetic Field**

Author: **Mikhail Shandov**
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Abstract:
The NICA accelerator complex consists of two injector chains, a new 25 T*m superconducting (SC) booster synchrotron (Booster), the existing SC synchrotron – Nuclotron, the new SC collider that has two storage rings each of about 503 m in circumference and beam transfer lines. Construction of the Booster was finished in 2020 and the first machine Run with ion beam was successfully carried out in December. So far, three commissioning Runs with various ion beams have been successfully completed. One of the first procedures after beam injection is the closed orbit correction and providing stable circulation. The closed orbit distortion is should not be out of the tolerance range during the accelerating cycle. The influence of the fringe fields and the lattice elements errors (nonlinearities and integral field value errors, misalignment of the elements etc.) and natural chromaticity should be corrected by the correction system. Dynamic aperture (DA)

is one of the key characteristics for any accelerator facilities. The estimation of the lattice elements errors and beam correction system influence at DA are the milestone stages during construction of the facility. The main parameters, arrangements and the field calculations of the corrector magnets, the closed orbit correction algorithms in superconducting synchrotrons, which can be implemented in the Booster, the tuning processes, the study of the beam parameters and optical characteristics of the Booster during Runs are presented. The methods of the DA calculation for the NICA Booster in MAD-X software among other factors including symplectic tracking algorithm PTC (Polymorphic tracking code) are also described.

11. **The PRISM method of the DUNE accelerator neutrino experiment for predicting the «wrong» sign background in the $\bar{\nu}_\mu$ disappearance mode**

Author: **Anna Stepanova**
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Abstract:
The future long-baseline accelerator neutrino experiment DUNE, being built in the USA, aims to measure and refine the values of neutrino oscillation parameters.
It will have near detector parts (TMS/GArTPC, LArTPC) moving perpendicular to
a neutrino beam. This is a fundamentally new approach in comparison with other experiments of this type where detectors are fixed at a particular position. The DUNE-PRISM method, which includes near detector off-axis measurements of neutrino energy spectra, will be used for the far detector data extrapolation. Based on the characteristic dependence of the muon neutrino energy on the pion momentum at different positions, one can predict a neutrino oscillation spectrum to determine the oscillation parameters more precisely. The standard DUNE-PRISM method is used for signal channels in electron neutrino and antineutrino appearance modes and muon neutrino and antineutrino disappearance modes. It is shown that, along with this, it is possible to apply this
method to the «wrong» lepton sign background (WSB) in the muon antineutrino disappearance mode that allows carrying out a Monte-Carlo independent analysis in order to estimate the DUNE sensitivities to the values of neutrino oscillation parameters.

12. **Vortex rings, hydrodynamic helicity, and global polarization of hyperons at the NICA energies within the PHSD model**

Author: **Nikita Tsegelnik**
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Abstract:
The experimentally observed significant polarization of Λ and anti-Λ particles in heavy-ion collisions leads to speculations that rapidly rotating swirls of nuclear matter are created. We use the PHSD transport model to simulate the Au+Au collisions at the NICA energies and perform the fluidization procedure determining density, temperature, and velocity, and then calculating vorticity and hydrodynamic helicity fields. The velocity field looks dominantly as the Hubble-like profiles expanding in transverse and longitudinal directions (approximate cylindrical symmetry). The vorticity field is like a small perturbation on the top of the longitudinal and transverse flows. We see that two vortex (asymmetrical) rings moving in the opposite direction along the z-axis are formed. We also calculate the kinematic vorticity number, which is a reliable measure of rotationality. Finally, we calculate the global polarization of (anti-)hyperons on a dynamic freeze-out surface and compare the results with the experimental data.

13. **Search for Sterile Neutrino in the Daya Bay experiment**

Author: **Vitalii Zavadskyi**
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Abstract:
The search for physics beyond the Standard Model is a one of the popular research field.
Neutrino oscillation is the fact that neutrinos are massive particles. Several anomalies are known that con not been described by three-neutrino framework. We know about accelerator, gallium and reactor anomalies. These anomalies may be described by adding extra generations of neutrino that called sterile. Sterile neutrino interacts only gravitationally.
The reactor experiment Daya Bay precisely measured $\sin^2 2\theta_{13}$ and Δm^2_{32}. No significant signal from sterile neutrino was observed in the experiment during 3158 days of data collection. It allows to search for possible regions of parameters of sterile oscillation $\sin^2 2\theta_{14}$ and Δm^2_{41} with the usage CLs method.
The overview of the experiment and results of the sensitivity analysis of the Daya Bay based on the full data set will be presented.