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

1. Investigation of charged particle production energy dependence at MPD.

Author: Aparin A.
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Abstract:
We present an investigation of identified charged particle ($\pi \pm$, K±, p, p-bar) production at midrapidity ($|\eta| < 0.5$) in Au-Au collisions for 4 different energies $\sqrt{SNN}$ = 4, 7, 9, 11 GeV at the MPD detector at NICA. Monte Carlo simulation of the collisions was made with UrQMD MC generator and detector was simulated with GEANT 3. Efficiency of particle identification was calculated for all energies. Midrapidity results for multiplicity density dN/dη, transverse momenta pT for different centralities and particle ratios are presented. Some aspects of model applicability are discussed. Knowledge of particle yields dependence on transverse momentum can help to reveal properties of chemical and freeze-out dynamics as a function of collision energy and centrality.

2. Straw chamber test bench for NA64, CERN and SPD, NICA (MiniSPD).

Author: Burtsev V.
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Abstract:
The success of experimental studies is associated with the need to create detection systems in which many parameters must be taken into accounts, such as the choice and optimization of the geometry of the detectors, their coordinate resolution, and the efficiency of registration of charged particles in a magnetic field. Also, it is necessary to develop methods for testing and debugging detecting modules, verify their radiation resistance, and develop readout electronics. This project is aimed at constructing a system for testing the parameters of the created detector modules using cosmic rays and testing the key characteristics of the detectors before using them in experiments.

3. Data decoding and quality assurance for the BM@N experiment.

Author: Gabdrakhmanov I.
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Abstract:
In order to effectively conduct the experiment, a flexible and powerful data analysis software is needed as well as fast and convenient monitoring tool. The BM@N monitoring system backend as a part of bmnroot is based on the \prog{FairRoot} package while its frontend uses the CERN \prog{jsROOT} [8, 9] library. 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 currently are presented by reference run auto-selecting and consequent overlaying histograms.

4. MCP based detectors, calibration, and first photon measurements of photon radiation.

Author: Grebentsov A.
Laboratory of High Energy Physics, JINR, Dubna, Russia

Abstract:
Detectors based on microchannel plates are used to detect the radiation of free electron lasers operating in short wavelength ranges. We present descriptions of radiation detectors for the FLASH free electron laser (DESY, Hamburg) that operates in vacuum ultraviolet and soft X–ray wavelength ranges (4 – 100 nm) and detectors for the European X–ray free electron laser that are

constructed in Hamburg and is designed to operate in the X–ray wavelength range from 0.05 to 4.3 nm.
At present time the MCP detectors are used for the diagnostic of accelerated ion beams. The MCP detectors for FEL also can be used in NICA complex.

5. The final measurement of the geo-neutrino flux with the Borexino detector and its geophysical implications.

Author: Gromov M.
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Abstract:
The detection of geo-neutrinos provides a powerful tool to investigate the chemical composition of the interior of the Earth. For the moment only two detectors, namely Borexino and KamLAND, have registered the geo-neutrino fluxes with large uncertainties approaching 15-20%. This precision is not sufficient to distinguish between the Earth's models, accurately determine the amount of the radiogenic heat, demonstrate the presence of the geo-neutrino flux from the mantle and check the presence of the hypothetical georeactor at last. The final set of the Borexino data for the geo-neutrino analysis has been selected using well-optimized cuts on increased statistics. As a result the exposure is doubled in comparison with the previous analysis providing (1.29 ± 0.05) ×1032 protons × year. The measured geo-neutrino signal is 47.0+8.4-7.7 (stat) +2.4-1.9 (sys) TNU corresponding to +18.3-17.2% total precision and the full radiogenic heat of 38.2+13.6-12.7 TW. The new results are statistically compatible with different Earth's models though slightly (~2.4σ) disfavoring the geological predictions of the lowest concentration of heat-producing elements in the mantle. The mantle signal of 21.2+9.5-9.0 (stat) +1.1-0.9 (sys) TNU is also derived from the data. The null-hypothesis is excluded at 99.0% C.L. or 2.3σ significance. The new constraint on the hypothetical georeactor power is 2.4 TW at 95% C.L. if located at the Earth's center.

6. Is there any New Physics?

Author: Issadykov A.
Laboratory of Theoretical Physics, JINR, Dubna, Russia
Abstract:
In the wake of the recent measurements of the decays Bc → J/ψπ(K) and Bc → J/ψlνl reported by the LHCb Collaboration we calculate the form factors for the Bc → J/ψ and Bc → ηc 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 Bc meson. We find that the theoretical predictions on the ratios of RK+/π+ and Rπ+/μ+ν are in good agreement with last LHCb-data. However, the prediction for the RJ/ψ is found to be underestimated

7. Hadron production in elementary nucleon-nucleon reactions from low to ultra-relativistic energies.

Author: Kireyeu V.
Laboratory of High Energy Physics, JINR, Dubna, Russia

Abstract:
Two models, PHSD and PYTHIA have been compared with the experimental data on hadron productions from inelastic proton-proton collisions in wide energy range from low to ultra-relativistic energies. We present results on energy dependence of particles multiplicities and bulk spectra comparison.

8. SRC at BM@N: reconstruction of tracks after the target using the MWPC and Silicon detector systems.

Author: Lenivenko V.
Laboratory of High Energy Physics, JINR, Dubna, Russia

Abstract:
Track reconstruction algorithm has been developed for multiwire proportional chambers (MWPCs), as well as in the system of a Silicon Coordinate Detector located before the analyzing magnet of SRC (Short Range Correlations) at BM@N experiment. The combined track after the target and upstream the magnet was reconstructed. The efficiency of track reconstruction was calculated. Connect the reconstructed tracks upstream the magnet with systems of other experiment detectors in progress.
All developed reconstruction algorithms were added to the BmnRoot and tested on the data of the spring 2018 SRC period.

9. Measurement of the di-muon trigger efficiency of the ATLAS experiment in Run-2 pp collisions data.

Author: Lyubushkina T.
Laboratory of Nuclear Problems, JINR, Dubna, Russia

Abstract:
Heavy flavour physics programme of the ATLAS experiment is primarily based on studying pp collision events with di-muon final states selected with dedicated di-muon triggers. Many studies, such as b hadron or heavy quarkonium production cross-section measurements require good understanding of efficiency of those triggers to achieve high measurement precision. In the current study, these efficiencies are measured using a data-driven technique based on tag-and-probe method with $J/\psi\to\mu^+\mu^-$ decay events. Overall strategy, validity tests and preliminary results are shown.

10. Light scalars in NMSSM and $B\to K^{*}ll$ observables.

Author: Mukhaeva A.
Laboratory of Theoretical Physics, JINR, Dubna, Russia

Abstract:
Most of the Beyond-the-SM models predict scalar particles.
Due to this, it is important to study all possible manifestations of the latter in different kind of experiments.
In this talk we consider NMSSM scenarios with light (pseudo) scalars, which have masses ranging from 10 to 100 GeV.
They escape the current experimental bounds since they have large singlet component.
The main goal of the study is to revisit the q^2-dependent angular $B\to K^*ll$ observables, which are sensitive to scalar contributions, and estimate the magnitude of the latter in the considered scenarios. In addition, prospects of experimental study of the effects are discussed.

11. NICA slow control system: booster superconducting magnets thermometry system.

Author: Sedykh G.
Laboratory of High Energy Physics, JINR, Dubna, Russia

Abstract:
NICA is a new accelerator complex being constructed on the JINR aimed to provide collider experiments with heavy ions. It consists of injection complex, booster synchrotron, upgraded Nuclotron and ion collider. The superconducting booster synchrotron is being assembled presently. The report describes a system, developed in JINR, to perform precise temperature measurement of NICA booster superconducting magnets. Thermometry system consists of more

than 240 resistive TVO temperature sensors, National Instruments PXIe controllers and data acquisition modules, Tango-based software and web-based client application.

12. Real-time detection of supernova neutrino signal.

Author: Sheshukov A.
Laboratory of Nuclear Problems, JINR, Dubna, Russia

Abstract:
Core-collapse supernova emits about 99% of its energy in a short burst of neutrinos. This neutrino signal, produced at the early stages of the collapse, can provide valuable information on both neutrino properties and stellar collapse process.
SuperNova Early Warning System (SNEWS), operating since 1998, is designed to combine the online trigger signals of supernova observations from several neutrino experiments around the world and distribute the early supernova alarm among the astronomers and other neutrino experiments.
An upgrade of this system SNEVSv2, being designed since 2019, is expected to improve the sensitivity to galactic supernova, evaluate various features of the progenitor star and collapse process in realtime. Also, this system can contribute to the multimessenger studies of supernova, providing coincidence with gravitational waves, pre-supernova neutrino and optical signals.
As an example of online supernova detection method we present the supernova trigger system developed for the NOvA experiment, and the outlook for the capabilities of SNEWSv2 global network.

13. Off-shell neutrino oscillations in a covariant QFT approach.

Author: Shkirmanov D.
Laboratory of Theoretical Physics, JINR, Dubna, Russia

Abstract:
We study behavior of a generalized neutrino propagator at short but macroscopic distances.
A fully covariant method is applied, which, in particular, leads to an off-shell regime of the neutrino propagation.
It is shown that the neutrino event rate deviates from the classical inverse-square law (ISL) and the relative leading order correction is negative and proportional to the squared distance between the neutrino source and detector. The oscillation pattern remains exactly the same as in he well-known long-distance regime and the decoherence factors are almost similar in form. While these effects are practically unmeasurable for the Standard model neutrinos, the ISL violation could be an experimental signature of the predicted regime. New experiments with artificial radioactive sources are desirable to test the theory.

14. Multilayer neutron detectors development and testing.

Author: Sukhov E.
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Abstract:
One of the main tasks of the SCAN-3 three-arm magnetic spectrometer in the Joint Institute for Nuclear Research (JINR) in Dubna is to detect neutrons from the η-meson decay through πn- and pn-channels [1]. The only way to provide neutron spectrometry is to use the time-of-flight method. Considering the geometry of the SCAN-3 facility, the restrictions are imposed on the accuracy of the neutron flight time measuring in the following way: $\delta t = 2.2$ ns for the πn-channel and $\delta t = 0.4$ ns for the pn-channel in the neutrons kinetic energy field from 100 to 300 MeV. The development, creation and testing of this neutron detector is a sophisticated task for researchers. The most promising for this task seems to create a multilayer hadron detector based on a plastic organic scintillator. The aim is to achieve a better than 50 ps time-of-flight resolution for each projectile.

15. GNA — high performance fitting for neutrino experiments.

Author: Treskov K.
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Abstract:
GNA is a high performance fitter, designed to handle large scale parametric models. Following the data flow paradigm the model in GNA is built as directed acyclic graph. GNA provides a set of "nodes" to implement neutrino oscillation experiments, starting from reactor antineutrino experiments. An overview of GNA capabilities, Daya Bay and JUNO model descriptions are presented.

16. Machine learning-based vertex reconstruction in JUNO experiment.

Author: Treskov K.
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Abstract:
JUNO experiment aims to determine neutrino mass ordering with statistical significance of 3σ and to measure the corresponding oscillation parameters with sub-percent accuracy using a 20-kiloton liquid scintillator detector.
These measurements require 3% energy resolution at 1 MeV and 1% energy scale uncertainty. The position dependence of energy resolution should be taken into account. Hence robust algorithms for vertex reconstruction with an accuracy of few centimeters given the detector size of 35 meters are needed. Such algorithms should also produce the result in few milliseconds in order to deal with expected dataflow.
We present an approach to vertex reconstruction based on machine learning algorithms such as convolutional and residual neural networks. Preliminary results and comparison with classical methods are discussed together with future prospects of machine learning-based methods.

17. Investigation of the radiation hardness of plastic scintillators and reflectors.

Author: Ustinov V.
Laboratory of High Energy Physics, JINR, Dubna, Russia

Abstract:
Modern spectrometers are designed to be operated under intense radiation field conditions. Elementary particle detectors included in these setups degrade under the influence of ionizing radiation. The determination of the radiation resistance of detector materials is the most important task that researches can come across. A wide variety of materials, which are used to develop such detectors (in our case, scintillators) requires numerous measurements.

There were conducted the studies on the radiation hardness of UPS-923A, SCSN-81, SC-301 and SC-307 scintillators based on polystyrene (PS), and BC-408 and EJ-260 scintillators based on polyvinyl toluene (PVT). There were also studied properties of irradiated Tyvek and ESR reflectors.

The obtained results are used to establish a radiation-resistant CMS High-Granularity Calorimeter (HGCAL) at CERN.

18. Search for low-energy neutrinos from astrophysical sources in Borexino.

Author: Vishneva A.
Laboratory of Nuclear Problems, JINR, Dubna, Russia

Abstract:
Borexino is a large volume liquid scintillator neutrino experiment located in the Laboratori Nazionali del Gran Sasso, Italy. In this work, 10 years of Borexino data have been used for search of neutrinos from astrophysical sources in the energy range 1.8-16.8 MeV. An updated model-independent limit on neutrino fluxes from unknown sources is improved by a factor 2.5 with respect to the previous results. Using the same dataset a limit on the diffuse supernova

neutrino flux has been obtained, previously unexplored below 8 MeV. We also performed a search of solar antineutrinos as a test of non-zero neutrino magnetic moment allowing neutrinos to convert into antineutrinos in strong magnetic fields. Finally, a search of neutrinos from solar flares resulted in the strongest neutrino flux limits at the energies below 3 MeV.