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

1. **Multiparticle correlations in pp-collisions at $\sqrt{s}$ = 13 TeV**

Author: Artashes Chinaryan
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Abstract:
This work is devoted to the analysis of multiparticle correlations in events with the Drell-Yan process in proton-proton collisions with the factorial moment method. This method consists in plotting the dependence of factorial moments of multiplicity distribution in the intervals of dynamical variable on the size of these intervals and allows one to exclude statistical effects related to finite particle multiplicity in events, thus exctracting genuine dynamical correlations.
The dataset collected by the CMS detector in 2017 corresponds to an integrated luminosity of 41.55 fb^{-1} at a center-of-mass energy of 13 TeV. Monte-Carlo datasets are used for comparison with experimental data. We present the calculated numerical values of normalized one-dimensional factorial moments of multiplicity distribution in a selected pseudorapidity interval and demonstrate the dependencies of these values on the parameters of theoretical calculations.

2. **Track Reconstruction in SPD Timeslices Using Graph Neural Networks with Contrastive Learning**

Author: Didorenko A.
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Abstract:
The problem of timeslice decomposition in the SPD experiment at the NICA collider consists of two stages: reconstruction of charged particle tracks with noise hit removal, and subsequent event-by-event separation of the reconstructed tracks. High efficiency of track reconstruction at the first stage is crucial, since an SPD timeslice is designed to contain from 10 to 40 overlapping events, making their separation challenging.
We propose a track reconstruction method based on graph neural networks with contrastive learning. A k-nearest-neighbor graph is built in the hit coordinate space, after which a neural network based on EdgeConv layers trained with Contrastive Loss produces an embedding space where hits belonging to the same track are compactly clustered. Final clustering is performed using the DBSCAN algorithm. The data are obtained from the official SPD detector simulation using the SpdRoot software package. The proposed method demonstrates high track reconstruction efficiency and is promising as the primary tracking algorithm for the first stage of timeslice processing in the SPD experiment.

3. **Overlapped signals delimitation for HEP experiments**

Author: Dmitry Fomenok
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Abstract:
The third phase of the Large Hadron Collider's operation continues, characterized by higher luminosity and an increased multiplicity of overlapping signals.
In the cathode-strip chambers of the CMS experiment, when charged particles pass through, electron avalanches are formed, which are registered as clusters (groups of signals from adjacent strips) with charges whose distribution in space can be approximately described by Gauss functions. Often there is an overlap of clusters from closely passing particles, which can lead to significant losses in accuracy in determining their coordinates.
The currently used simple center of gravity algorithm does not provide the required accuracy for overlapped signals (the error is up to 40% of the strip width with the required accuracy of up to 5%).
To solve this problem, a sequential elimination algorithm, wavelet analysis and the use of Kolmogorov-Arnold neural networks are considered. The results of overlapped signals delimitation for all algorithms are presented and discussed.

4. **Dark matter in the two-doublet Higgs model with b-quarks in the final state**

Author: Z. Khabaev
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Abstract:
A search for dark matter particles produced in association with a Higgs boson decaying to a bottom quark-antiquark pair in proton-proton collisions at $\sqrt{s}$= 13 TeV is presented. The data, collected with the CMS detector at the LHC, correspond to an integrated luminosity of 101 fb^{-1}. The analysis is performed in exclusive categories targeting both Lorentz-boosted (merged) and resolved b jet pair topologies, covering a wide range of Higgs boson transverse momentum. A statistical combination is made with a previous search using data collected in 2016 and corresponding to an integrated luminosity of 35.9 fb^{-1}. The observed data agree with the standard model background predictions. Constraints are placed on a type-II two-Higgs-doublet model featuring a heavy pseudoscalar with an additional light pseudoscalar (2HDM+a).
Any drift of the peak immediately signals a variation in the gas quality, enabling fast corrective intervention. This monitor ensures the long-term stable and reliable performance of the straw tracker throughout the experimental runs.

5. **Graph Attention Neural Network for Clustering Particle Tracks by Events in the SPD experiment of the NICA accelerator complex**

Author: Savelii Omelianchuk
Meshcheryakov Laboratory of Information Technologies

Abstract:
A Graph Attention Neural Network (GANN) for particle track clustering by events in time slices obtained at the Spin Physics Detector (SPD) of the Nuclotron-based Ion Collider fAcility (NICA) is presented. A novel approach is applied to time slice processing at high particle multiplicity and pile-up. The model is trained using a hierarchical approach and evaluated on time slices generated by the Monte Carlo technique according to the SPD experiment configuration as close as possible at the moment. The model architecture includes a graph encoder and an edge classifier, both of which use the message-passing principle and iteratively structured approach. The GANN exhibits high performance in track clustering by events for the SPD simulation, achieving 95% accuracy and 90% precision and recall.

6. **Channel Quality System for the JUNO Experiment**

Author: Dmitrii Shpotya
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Abstract:
The Jiangmen Underground Neutrino Observatory (JUNO) is an international neutrino experiment in China designed to study the fundamental properties of neutrinos. The detector contains 20 kilotons of liquid scintillator and more than 40 000 photomultipliers. To ensure high-quality data for physics analyses, continuous monitoring of detector conditions and channel performance is essential.
The Channel Quality system is being developed to monitor the status of detector channels, namely photomultipliers, for every data run. The system is used to identify problematic channels, clarify channel selection criteria, and store information about the channel status throughout the experiment. The report will present the architecture of the system, the database model for Channel Quality and the key functions of the system.

7. **Development of Data Visualization System for the Baikal-GVD Experiment**

Author: Dmitrii Shpotya
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Abstract:
The Baikal-GVD is a large-scale deep-underwater neutrino telescope located in Lake Baikal. It is designed to detect high-energy astrophysical neutrinos and study their sources, making it an important instrument for neutrino astronomy and multi-messenger astrophysics.
To support detector operation and data analysis, a new Data Visualization system for Baikal-GVD is being developed. The system provides a centralized web-based interface for visual inspection of detector data, monitoring information and data quality parameters. The report describes the system architecture, key functionality and a system prototype.