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Event-by-event determination of thermodynamic quantities at NICA energies

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Currently, studies of the properties of a strongly interacting medium in collisions of hadrons and nuclei are actively being carried out in experiments at accelerator complexes at BNL, CERN, and JINR. The NICA collider (Dubna) and the multipurpose detector MPD are expected to be put into operation soon. One of the primary research directions for these experiments involves scanning the phase diagram of strongly interacting matter, investigating the phase transition between hadronic gas and quark-gluon plasma, and searching for the critical point. For these purposes, various fluctuation and correlation observable quantities are used.
The process of nuclear collisions and the evolution of the quark-gluon medium created in them in the energy range of the NICA collider is quite complex, and the thermodynamic equilibrium achieved is only local. All thermodynamic characteristics of the medium undergo unavoidable event-by-event fluctuations. In this regard, it is quite relevant to develop a method for estimating the temperature and baryon chemical potential in each event.
To extract thermodynamic parameters from the particle yields and spectra, the Thermal-FIST package was applied. The average values of temperature (T) and baryon chemical potential ($_B$) were extracted from the experimental data of NA61/SHINE and STAR experiments, and the fluctuations of these values were established. Then, it was checked to what extent it is possible to extract event-by-event thermodynamic characteristics, and the method resolution was estimated. The results showed the fundamental applicability of this method in a wide range of (T, $_B$).

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Section

Heavy ion collisions at Intermediate and high energies

Primary author: KOVALENKO, Vladimir (Saint Petersburg State University)

Presenter: KOVALENKO, Vladimir (Saint Petersburg State University)

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