Contribution ID: **405** Type: **Oral**

Application of the holographic equations of state for modeling experiments on heavy ion collisions

Friday 4 July 2025 11:40 (20 minutes)

At the beginning of the 21st century, a new phase state of strongly interacting matter was established, known as the quark-gluon plasma (QGP). To study the formation of the QGP in collisions of heavy nuclei, the solution of a system of equations of relativistic hydrodynamics with a specific equation of state (EoS) is typically employed.

Lattice Quantum Chromodynamics (LQCD) is an effective theoretical tool for studying the thermochemical evolution of strongly interacting matter, but it encounters difficulties for non-zero baryonic potentials. In light of this, various holographic models based on the well-known AdS/CFT duality have been proposed to obtain EoS for the QGP using the thermodynamic properties of the corresponding black brane in AdS_5.

In the present work, a calibration method is proposed for the holographic EoS developed by I. Ya. Aref'eva's theoretical group to study QGP properties within the framework of relativistic hydrodynamics. The free parameters of the model are adjusted using the LQCD results for quark masses that approximate the physical values. Machine learning methods were applied to address the regression and optimization issues during the calibration of the relevant parameters. For practical applications in studying heavy-ion collisions, the corresponding holographic EoS was incorporated into the relativistic hydrodynamics packages MUSIC and vHLLE.

To obtain the final hadron spectra, numerical simulations were conducted using the iEBE-MUSIC and SMASH-vHLLE frameworks, which additionally include a set of packages for initial conditions, freeze-out, hadronization, and hadronic afterburner. Consequently, the rapidity and transverse mass distributions of produced hadrons were calculated at the energies of NA49 experiment.

The authors acknowledge Saint-Petersburg State University for a research project 103821868.

Primary authors: ANUFRIEV, Anton (Saint Petersburg State University); KOVALENKO, Vladimir (Saint Petersburg State University)

Presenter: ANUFRIEV, Anton (Saint Petersburg State University)

Session Classification: 4. Relativistic nuclear physics, high-energy and elementary particle physics

Track Classification: Section 4. Relativistic nuclear physics, high-energy and elementary particle physics.