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Bayesian Inference of QGP Properties and 3D Dynamics in Heavy-Ion Collisions in the RHIC Beam Energy Scan Program

Tuesday, 5 September 2023 15:30 (20 minutes)

This talk will present the Bayesian inference approach for quantitatively characterizing the 3D dynamics of heavy-ion collisions and the Quark-Gluon Plasma (QGP) properties in the RHIC Beam Energy Scan (BES) program. To model the dynamics of the collisions from 7.7 to 200 GeV, we employ a (3+1)D dynamical initialization model coupled with the relativistic viscous hydrodynamics + hadronic cascade hybrid framework [1]. To account for shear and bulk viscous effects at RHIC BES energies, we derive the out-of-equilibrium corrections to particle distributions with multiple conserved charge currents using Grad's moment and Chapman-Enskog methods. A fast model emulator is then trained in a 22-dimensional parameter space to accurately predict identified particle yields, average transverse momenta, and charged hadron anisotropic flow coefficients. By carrying out a joint Bayesian analysis of the RHIC BES phase I measurements for Au+Au collisions at 7.7, 19.6, and 200 GeV, we set robust constraints on initial-state baryon stopping and the μ_B and T dependence of the QGP shear and bulk viscosity. Our results show that the Bayesian inference approach with our full (3+1)D hybrid framework effectively extracts the QGP properties and the 3D dynamics of the collision events from the RHIC BES measurements and provides quantitative insights into the QCD matter in a baryon-rich environment.

[1] C. Shen and B. Schenke, "Longitudinal dynamics and particle production in relativistic nuclear collisions," Phys. Rev. C105, no.6, 064905 (2022)

Category

Theory

Collaboration (if applicable)

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