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Characterization of the initial state and QGP medium from a combined Bayesian analysis of RHIC and LHC data

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A primary goal of heavy-ion physics is the measurement of the fundamental properties of the quark-gluon plasma (QGP) and the characterization of the initial state that leads to its formation.
While these properties—such as temperature-dependent transport coefficients—are not directly measurable, they may be quantitatively estimated through computational models of heavy-ion collisions.
The properties of interest are input as model parameters and tuned so that a variety of simulated observables optimally fit corresponding experimental data.

Previous studies [1, 2] have applied Bayesian parameter estimation methods to simultaneously constrain a variety of QGP properties, including the temperature dependence of the specific shear viscosity $(\eta/s)(T)$ and the scaling of initial entropy deposition, and confirmed a finite QGP bulk viscosity $\zeta/s > 0$.
However, this work also demonstrated that more precise estimates of the shear and bulk viscosities could be achieved by including experimental data from multiple beam energies and improving several aspects of the computational model.

In this work, we utilize Bayesian methodology to estimate the parameters of an updated heavy-ion collision model [3] including the parametric initial conditions TRENTO [4], a pre-equilibrium free streaming phase [5], viscous 2+1D hydrodynamics, improved Cooper-Frye particlization, and UrQMD.
We calibrate the model to multiplicity, transverse momentum, and flow data from multiple RHIC and LHC beam energies, report the latest quantitative estimates of the temperature dependence of QGP shear and bulk viscosities as well as initial state properties, and validate model predictions of higher-order observables such as flow correlations.

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Preferred Track

Collective Dynamics

Collaboration

Not applicable

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