DNP19-2019-000170

Abstract for an Invited Paper
for the DNP19 Meeting of
the American Physical Society

Extracting medium properties from comparisons of collision models to data[1]

STEFFEN BASS, Duke University

A primary goal of heavy-ion physics is the measurement of the fundamental properties of the quark-gluon plasma (QGP), notably its transport coefficients and initial state properties. Since these properties are not directly measurable, one relies on a comparison of experimental data to computational models of the time-evolution of the collision to connect measured observables to the properties of the transient QGP state. These model-to-data comparisons are non-trivial due to the large number of model parameters and the non-factorizing sensitivity of measured observables to multiple parameters. Over the last few years techniques based on Bayesian statistics have been developed that allow for the simultaneous calibration of a large number of model parameters and the precision extraction of QGP properties including their quantified uncertainties. The computational models can take many forms, but need to be governed by parameters that codify the physical properties we wish to extract, for example the temperature and/or momentum dependent transport coefficients. The Bayesian analysis then evaluates the model at a small set of points in the multidimensional parameter space, varying all parameters simultaneously. Gaussian process emulators are used to non-parametrically interpolate the parameter space, providing fast predictions at any point in parameter space with quantitative uncertainty. Finally, the parameter space is systematically explored using a Markov chain Monte Carlo (MCMC) to obtain rigorous constraints on all parameters simultaneously, including all correlations among the parameters. In this talk I will review the basic components of the Bayesian analysis and discuss recent progress in the determination of QGP initial conditions and transport coefficients, including the QGP shear and bulk viscosities and heavy quark transport coefficient.

[1]This work has been supported by DOE grant DE-FG02-05ER41367, NSF grant ACI-1550225 as well as computing resources provided by NERSC and OSG