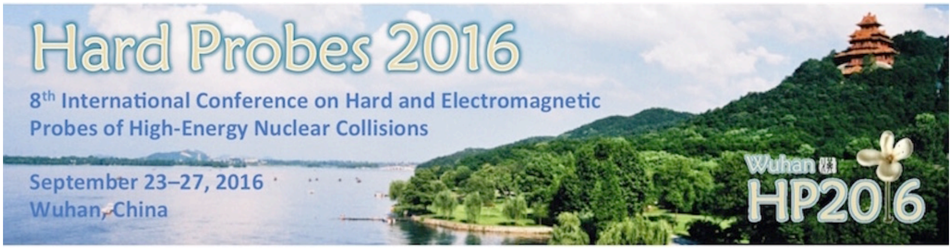

Contribution ID: **29**

Type: **not specified**

Data-driven analysis of the temperature and momentum dependence of the heavy-quark transport coefficient

Saturday, 24 September 2016 15:20 (20 minutes)

Heavy quarks (charm and bottom) serve as valuable probes to study the properties (such as the transport properties) of the strongly-interacting quark-gluon plasma created in ultra-relativistic heavy-ion collisions. However, the simultaneous description the nuclear modification factor R_{AA} and the elliptic flow v_2 of heavy quarks poses a significant challenge for most commonly used transport models, in particular those based on Langevin transport. We purpose a generalized ansatz for the temperature and momentum dependence of the heavy-quark diffusion coefficient and subsequently extract its functional form from a Bayesian model-to-data comparison. Using the results of this analysis, our improved Langevin framework is able to simultaneously reproduce the experimental data of R_{AA} and v_2 , at both RHIC and the LHC energies.

The Bayesian analysis used to extract the information of transport properties of the QGP is set up as follow: a set of input parameters related to the transport coefficient $\hat{q}$ are evaluated via an event-by-event (ebe) heavy flavor dynamic model: heavy quarks propagate through the medium according to an improved Langevin equation, which incorporates both radiative and collisional energy loss in an ebe 2+1 dimensional viscous hydrodyncamical background. The hadronization of heavy quarks is described via a hybrid model of fragmentation and recombination. The calculations are used to train Gaussian process emulators that interpolate the full input parameters space and are capable of predicting the outcome of the dynamical model at any arbitrary point in parameter space. We then calibrate the model parameters on experimental data using Bayes Theorem through Markov chain Monte Carlo (MCMC) sampling. The final result of the analysis are the posterior distributions for all model parameters that contain the high likelihood ranges in which the model describes the data optimally. We find that the transport coefficient $\hat{q}$ has a maximum value around critical temperature, then rapidly decreases with increasing temperature. We also observe a non-trivial momentum dependence of the transport coefficient. With the extracted functional form of $\hat{q}$ (which can be related to the diffusion coeffecient), the R_{AA} and v_2 of heavy quarks in different centralities at 200 GeV Au+Au collisions and 2.56 TeV Pb+Pb collisions are calculated, and observed to be consistent with the experimental data.

Summary

Presentation type

Oral

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Session Classification: Parallel Session III: Heavy Flavor (III)