Contribution ID: **43** Type: **Contributed Talk**

An In-Medium Potential and Its Applications to Heavy-Quark Diffusion and QCD Equation of State

Tuesday, 28 June 2016 15:00 (20 minutes)

The large suppression and elliptic flow of heavy-flavor spectra in heavy-ion collisions at RHIC and LHC indicate that heavy quarks couple strongly to the quark gluon plasma (QGP). This feature leads us to seek for a tractable non-perturbative model to study the interactions of heavy quarks in the QGP and connect them to observables. Toward this end, we have developed a many-body T-matrix approach that includes the fundamental features of the QCD force constrained by lattice QCD. We first use it to define and extract a heavy-quark (HQ) potential in the QGP from lattice QCD data of the singlet free energy [1]. A major outcome of the approach is a potential with a long-range force as the remnant of the confining interaction. As an initial application we implement the potential to calculate HQ transport coefficients using heavy-light T-matrices. A strong coupling at low momentum and low temperature is found to transition into a weakly coupled regime at high momentum and high temperature. The implementation of these new HQ transport coefficients into Langevin simulations for heavy quarks in heavy-ion collisions unravels a direct connection between the potential and the resulting elliptic flow [2]. Toward a self-consistent coupling of the heavy quarks to an interacting QGP at strong coupling, we develop a generalized T-matrix formalism to compute its equation of state (EoS) through a Luttinger-Ward skeleton expansion. This allows us to include both massive quasiparticle and resonance (bound) states systematically with a self-consistent thermal width. Fits to lattice EoS data yield light-parton spectral functions with large thermal widths [4], supporting the strongly-coupled nature of the QGP from this perspective.

[1] S. Y.F. Liu and R. Rapp, Nucl. Phys. A **941**, 179 (2015).

[2] M. He, S. Y.F. Liu and R. Rapp, in prep.

[3] J. M. Luttinger and J. C. Ward, Phys. Rev. **118**, 1417 (1960),
G. Baym, Phys. Rev. **127**, 1391 (1962).

[4] S. Y.F. Liu and R. Rapp, in prep.

On behalf of collaboration:

None

Primary author: LIU, Shuai (Cyclotron Institute and Department of Physics & Astronomy at Texas A&M University)

Co-authors: HE, Min (Nanjing University of Science & Technology); Prof. RAPP, Ralf (Cyclotron Institute and Department of Physics & Astronomy at Texas A&M University)

Presenter: LIU, Shuai (Cyclotron Institute and Department of Physics & Astronomy at Texas A&M University)

Session Classification: Heavy Quark Production