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Many-body T-matrix Approach to Strongly Coupled Quark Gluon Plasma

Current experimental findings at RHIC and LHC imply that a strongly coupled quark gluon plasma (QGP) is created in heavy-ion collisions. This calls for a non-perturbative investigation to understand relations between various observables and the underlying physical mechanisms. Considering the difficulties in first principle approaches, we have developed a tractable non-perturbative many-body T-matrix model to investigate the strongly coupled features of the QGP. Through our recent developments [1,2], we can self-consistently solve the thermodynamics of our model including resummed non-perturbative t-channel contributions [3], where two-body resonance and scattering states are treated on equal footing. Inputs of the model are constrained by matching thermal Euclidian-time quantities with lattice QCD, such as static quark free energy, equation of states (EoS), and various susceptibilities. With these constrained inputs, the model can directly calculate various real-time amplitudes and spectral functions that closely relate to observables without involving analytic continuations. More concretely, matching to heavy-quark (HQ) free energy data, we extract a strongly coupled potential [1]. Using this potential as input, we find broad light-parton spectral functions by comparing to the EoS [2]. With these constraints, we obtain large HQ relaxation rates with nontrivial temperature and momentum dependences. Results from implementing these into a HQ transport model will be compared to low-momentum heavy-flavor observables from experiments [4]. We also discuss the calculation of the EoS at finite chemical potential and the comparison to susceptibilities at the finite temperature.

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Preferred Track

QCD at High Temperature

Collaboration

Not applicable

Primary author: LIU, Shuai (Texas A&M University)

Co-author: RAPP, Ralf (Texas A&M University)

Presenter: LIU, Shuai (Texas A&M University)

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