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T-Matrix Approach to Spectral and Transport Properties of the QGP

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Understanding the microscopic properties of the hot and dense QCD matter produced at RHIC and the LHC is a critical task for heavy-ion physics. Toward this end, we have developed a non-perturbative microscopic approach to study the bulk, transport and spectral properties of the quark-gluon plasma (QGP) [1-2], treating light, heavy and static partons in a unified framework. Starting from a relativistic effective Hamiltonian with a universal color force, we employ a many-body T-matrix approach, solved self-consistently and constrained by lattice QCD (lQCD) data for the equation of state (EoS), heavy-quark (HQ) free energy and quarkonium correlator ratios. The predictive power resides in the emerging spectral functions and transport properties. In particular, we find a strongly coupled solution where the low-momentum low-temperature parton spectral functions dissolve due to collision widths in excess of 0.5 GeV and give a way to dynamically formed hadronic resonance/bound states which take over in the EoS. The calculations of the HQ diffusion coefficients and the shear viscosity to entropy density ratio yield values (and ratios) near the conjectured lower quantum bounds, corroborating the liquid-like structure of the QGP near Tc. An extension of the approach to finite baryon density and its implications for QCD phase structure will be discussed using benchmarks from various lQCD susceptibilities.
[1]SYF Liu, R Rapp, arXiv:1612.09138
[2]SYF Liu, R Rapp, arXiv:1711.03282

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