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Computing jet transport coefficient $\hat{q}$ in lattice QCD

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The jet transport coefficient $\hat{q}$ is the leading coefficient that characterizes the transverse broadening of the hard parton traversing QGP. The transverse kicks received from the medium changes the off-shellness of the hard parton, which leads to enhancement in the gluon emissions. Since the transverse broadening is the dominant mechanism responsible for the suppression of the high-transverse momentum charged-hadrons and jets, understanding the temperature and parton's momenta dependence of $\hat{q}$ are crucial.
In this talk, we present for the first time a lattice QCD calculation of $\hat{q}$ in pure gluonic plasma and $n_f = 3$ QCD plasma. In this formalism[1,2,3], we considered a light-like hard quark undergoing a single scattering with the plasma. $\hat{q}$ is factorized and expressed in terms of matrix elements for transverse broadening and field-strength field-strength correlator. The presence of the hard scale allows one to carry out Taylor expansion of the correlator after the analytic continuation to deep-Euclidean region. The leading twist operator in the operator-product expansion is computed on both quenched and unquenched lattices for a wide range of temperatures, ranging from 200MeV < T < 1GeV. The lattice extracted $\hat{q}$ from our formalism is compared with the existing (non) perturbative calculations and phenomenology-based extractions of $\hat{q}$. The computed $\hat{q}$ shows a temperature dependence similar to the entropy density and shows considerable agreement with phenomenology-based extractions carried out by the JET and JETSCAPE collaboration.

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