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Computing jet transport coefficients on the lattice

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The leading jet transport coefficients \hat{q} or \hat{e}_2 encode transverse or longitudinal momentum broadening of a hard parton traversing a hot medium. Computing their normalization and temperature dependence from first principles is key to appreciating the observed suppression of high-transverse momentum probes at RHIC or LHC collision energies. We present a first continuum extrapolated result of \hat{q} computed on pure SU(3) lattices with non-trivial temperature dependence different from the weak-coupling expectation.

We discuss the formalism published in Refs [1,2] and its challenges and status in view of obtaining \hat{e}_2 or of unquenching the calculation. We consider a hard quark subject to a single scattering on the plasma. The transport coefficients are factorized in terms of matrix elements given as integrals of non-local gauge-covariant gluon field-strength field-strength correlators. After the analytic continuation to the deep-Euclidean region, the hard scale permits to recast these as a series of local, gauge-invariant operators. The renormalized leading twist term in this expansion is closely related to static quantities, and is computed on pure SU(3) lattices ($n_\tau=4, 6, 8$ and 10) for a range of temperatures, ranging from $200\text{MeV} < T < 1\text{GeV}$. Our estimate for the unquenched result in $2 + 1$ -flavor QCD has very similar features.

[1] A. Kumar et al., Phys. Rev. D 106, 034505 (2022).

[2] A. Majumder, Phys. Rev. C 87 034905 (2013).

Experiment/Theory

Theory/Phenomenology

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