Beitrag ID: **253** Typ: **Talk**

Computing jet transport coefficients on the lattice

Dienstag, 28. März 2023 14:00 (20 Minuten)

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_τ=4, 6, 8 and 10) for a range of temperatures, ranging from 200MeV < T < 1GeV. 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. C87 034905 (2013).

Experiment/Theory

Theory/Phenomenology

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Sitzung Einordnung: Parallel: Jets and their modification in QCD Matter

Track Klassifizierung: Jets and their modification in QCD matter