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Leading order, next-to-leading order, and non-perturbative parton collision kernels: Effects on the jet substructures

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Jet energy loss is an important signature of the creation of QGP. High-precision energy-loss model is essential to independently verifying the QGP properties learned from soft particles. In this work, we study the phenomenological influence of the higher order collision kernels — the up-to-NLO one evaluated by EQCD and the non-perturbative (NP) one computed in lattice QCD — in the energy loss of hard parton, compared to the LO kernel using AMY.

We first optimize the energy loss modeling in MARTINI. Introducing formation time to the parton shower in the initial hard scattering is found to be essential for a simultaneous description of hadron and jet R_AA. It also improves jet shape at small angle and fragmentation function of leading hadrons. Discrepancy with data is observed at the soft sections of jet substructures, i.e. shape at large angles and the fragmentation function at small momentum fractions, which necessitates introduction of energy loss to high virtuality partons.

We then perform comprehensive parameter scans of MARTINI using LO, NLO, and NP kernels. Hadron and jet R_AA are calculated with AMY rates using the three kernels and the optimized parameter sets for the running coupling. The results exhibit remarkable similarities in their overall values, as well as pT and centrality dependences. Due to the differences in the soft radiation rates, sizable differences in the jet substructure is observed.

Refs: the authors, PRC106.064902; in progress.

Category

Theory

Collaboration

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