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Gluon emission from heavy quarks in dense nuclear medium

Summary

We study the medium-induced gluon emission process experienced by a hard jet parton propagating through the dense nuclear matter in the framework of deep inelastic scattering off a large nucleus. We work beyond the collinear rescattering expansion and the soft gluon emission limit, and derive a closed formula for the medium-induced single gluon emission spectrum from a heavy or light quark jet interacting with the dense nuclear medium via transverse and longitudinal scatterings. \textbf{Without performing the collinear rescattering expansion, the medium-induced gluon emission spectrum is controlled by the full distribution of the differential elastic scattering rates between the propagating partons and the medium constituents}. Then, we use two different models (\textbf{heavy static scattering centers and the effective 1-HTL spectral functions in dynamical medium}) to characterize the traversed nuclear matter.

Firstly, we show that if one utilizes \textbf{heavy static scattering centers} for the traversed nuclear matter and takes the soft gluon emission limit, our result can reduce to the first order in (static) opacity Djordjevic-Gyulassy-Levai-Vitev formula(with zero thermal mass for radiated gluon).[arXiv:1812.11048]

Secondly, we take \textbf{the effective 1-HTL spectral functions for the exchanged gluon field correlation}, and compute the single gluon emission spectrum including both transverse and longitudinal momentum in dynamical medium . By considering some approximations, our result can also reduce to DGLV formula in dynamical QCD medium (with zero thermal mass for radiated gluon).

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