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Parton cascades at DLA: the role of the evolution variable

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While experimental studies on jet quenching have achieved a large sophistication, the theoretical description of this phenomenon still misses some important points. One of them is the interplay of vacuum-like emissions, usually formulated in momentum space, with the medium induced ones that demand an interplay with a space-time picture of the medium and thus must be formulated in position space. A unified description of both vacuum and medium-induced emissions is lacking. In this work, we compute the tree-level probability of a double gluon emission in vacuum, and identify the enhanced phase-space regions for each diagram, corresponding to different configurations of the parton cascade. This calculation provides a parametric form for the formation times associated with each diagram, highlighting the equivalence of various ordering variables at double logarithmic accuracy. This equivalence is further explored by building a toy Monte-Carlo parton shower ordered in formation time, virtuality, transverse momentum, and angle. Aiming at a link with jet substructure, we compute the Lund Plane distributions and trajectories for each ordering prescription. We also compute the distributions in number of splittings and final partons, with the goal of clarifying the differences to be expected from the different ordering variables and the vetoes that must be implemented at Monte Carlo level to conserve energy-momentum, which turn out to have a sizable influence on the shower's evolution.

Experiment/Theory

Theory/Phenomenology

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