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Can jet quenching constrain the evolution history of parton showers?

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In the soft and collinear limit, the choice of evolution scale in a parton shower algorithm is ambiguous and several options have been implemented in existing Monte Carlo event generators for proton-proton collisions. However, the resulting space-time evolution could result in subtle differences depending on the particular choice. In this work we quantify measurable consequences of the choice of the evolution variable and show how the implications of such a choice propagates into jet quenching observables.
We have developed a parton shower algorithm for a general evolution variable, that includes the virtuality, angle, transverse momentum and formation time. We study the interplay between the shower history for different evolution variables and the phase space affected by parton energy loss. In particular, we implement effects of jet quenching in the dense and dilute medium limits, and highlight the role of color coherence effects [1,2]. We compare the results of the different evolutions to existing Monte Carlo shower implementations on the parton level by analyzing primary and secondary Lund planes. Finally, we study the sensitivity of quenched jets to the choice of evolution variable by confronting our results for certain key observables, such as the inclusive jet spectrum, the (groomed) momentum sharing fraction or the jet mass, against theoretical expectations and experimental data.

[1] D. Pablos and K. Tywoniuk, JHEP 1611, 174 (2016).
[2] Y. Mehtar-Tani and K. Tywoniuk, Phys. Rev. D98, 051501 (2018).

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