



Contribution ID: 831

Type: Poster

Resummation in the presence of energy loss: jet observables and substructure

Wednesday 6 April 2022 19:14 (4 minutes)

Experimental data on a wide range of jet observables measured in heavy-ion collisions provide strong constraints on the underlying medium dynamics and are addressed by state-of-the-art Monte Carlo models. However, so far there has been little theoretical guidance on the systematics of medium modifications on such diverse quantities as the inclusive jet spectrum, the intra-jet fragmentation functions and (groomed) substructure observables. We put forward a versatile and systematically improvable resummation framework for calculating jet observables that accounts for radiative and elastic energy loss [1,2,3]. This relies only on the separation of jet scales and medium scales that lead to the factorization of hard, early vacuum emissions and soft, medium-induced branchings [1,4]. As three concrete examples, we discuss the a) inclusive jet spectrum for different radii [2], b) the distribution of microjets/hadrons inside large jets, and c) the jet mass in heavy-ion collisions. Tuning the medium parameters to the nuclear modification factor of inclusive jets simultaneously provides a baseline modification of the fragmentation function as well as the shift and distortion of the jet mass peak. This program grants, on one hand, a powerful framework to consistently study modifications of jets across a wide range of observables (with a grip on their resilience to non-perturbative effects) and, on the other hand, furnishes access to the value of the coupling between individual jet color charges with the underlying medium.

[1] Y. Mehtar-Tani and K. Tywoniuk, “Sudakov suppression of jets in QCD media,” *Phys.Rev.D* 98 (2018) 051501 [arXiv:1707.07361 [hep-ph]].

[2] Y. Mehtar-Tani, D. Pablos and K. Tywoniuk, “Cone size dependence of jet suppression in heavy-ion collisions,” (accepted for publication in *Phys.Rev.Lett.*) [arXiv:2101.01742 [hep-ph]].

[3] Y. Mehtar-Tani and K. Tywoniuk, in preparation

[4] P. Caucal, E. Iancu, A. H. Mueller and G. Soyez, “Vacuum-like jet fragmentation in a dense QCD medium,” *Phys.Rev.Lett.* 120 (2018) 232001 [arXiv:1801.09703 [hep-ph]].

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Session Classification: Poster Session 2 T04_2

Track Classification: Jets, high-pT hadrons, and medium response