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A unified picture of medium-induced emissions

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We revisit the picture of jets propagating in the quark-gluon plasma. In addition to vacuum radiation, related to the high initial virtuality, jet particles scatter on the medium constituents resulting in induced emissions. Analytical approaches to resumming these interactions have traditionally dealt separately with multiple, soft, or rare, hard scatterings. A full resummation has so far only been available using numerical methods. We recently achieved analytical control in the full phase space [1]. To this aim, we extended existing resummation schemes to the Bethe-Heitler regime, to cover emissions from early to late times, and from hard splittings to emissions below the thermal scale. Based on the separation of scales, a new space-time picture emerges: at early times, jets start building from both, vacuum and rare, hard scattering-induced emissions. At a later stage, determined by a resolution criterion, these emissions initiate a turbulent cascade that rapidly degrades energy down to, and including the Bethe-Heitler regime. We quantify the impact of such an improved picture, compared to the current factorization that includes only soft scatterings, by analytical and numerical methods for different jet observables. We introduce the concept of accuracy for quenched observables for the first time and show how it improves jet quenching from small to large systems and serves upgrades for Monte Carlo generators.

[1] J. H. Isaksen, A. Takacs and K. Tywoniuk, arXiv:2206.02811.

Experiment/Theory

Theory/Phenomenology

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