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Understanding Jet Modifications at the LHC

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Jets are collimated QCD multi-particle states that are abundantly produced in heavy-ion collisions at the LHC. Their description in the vacuum is governed by hardest scale of the problem, typically the jet virtuality. In the presence of a background color field, e.g. such as expected in a quark-gluon plasma, one also has to consider a hard scale arising from the medium interactions. It was recently shown that due to the collinear nature of QCD splittings, high-energy jets are typically quite collimated and are not resolved by the medium, i.e. they are only seen as a total charge and lose energy coherently. Assuming this scenario holds for all jets, we show how a factorization of small-angle jet evolution and large-angle medium-induced emissions can be realized and calculate three key observables: the jet RAA, modification of the intra-jet structure and the amount of out-of-cone radiation. Medium-induced radiation is accounted for using the established factorization of multiple branchings leading to the probabilistic rate equation - which we presently improve upon by introducing finite-size effects and a proper regularization prescription in the infrared. This mechanism is particularly important for the transport of energy away from the jet axis up to large angles. For the intra-jet structure, on the other hand, we find the striking importance of so-called "antiangular ordered radiation," resulting from the slight decoherence of the jet during the passage through the medium.

Keywords

jet physics, jet quenching

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