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Advancing QCD-based calculations of energy loss

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As a first step towards an understanding the physics of jet modifications in heavy-ion collisions, we analyze the radiation off a QCD antenna propagating through a quark-gluon plasma. The resulting spectrum is characterized in terms of the hardest scale of the problem. We show that this scale is either 1) the inverse size of the antenna as probed by the medium or 2) the maximal momentum transfer from the medium, given by the saturation scale of the QGP. In the former case, called the dipole" regime, the antenna preserves its color correlation during the passage through the QGP and radiates coherently. In the latter situation, called thedecoherence" regime, which applies to the case of a dense medium, the antenna constituents de-cohere rapidly and the resulting spectrum is predominantly the superposition of the independent spectra off the two components. In both cases, however, vacuum coherence is restored for gluons emitted with transverse momenta larger than the hard scale of the associated regime. We explore the typical timescales relevant for emissions in both cases and discuss shortly about the implications for multi-gluon emissions in the QGP, relevant for jet studies in heavy-ion collisions.

References

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