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Interference effects in medium–induced gluon radiation

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The recent results at the LHC on jet quenching in heavy ion collisions call for a fundamental understanding of the evolution of a relatively hard jet propagating through a QCD medium like the quark–gluon plasma. As a first step in that sense, we consider the interference pattern for the medium–induced gluon radiation produced by a color singlet quark–antiquark antenna embedded in a QCD medium with size L. This setup is indeed well suited for studies of coherence phenomena like angular ordering. We focus on the most favorable kinematics for medium–induced gluon radiation in the BDMPS–Z regime, that is transverse momenta $k_\perp \sim \sqrt{\hat{q}L}$, short formation times $\tau_f \ll L$, and relatively large emission angles θ $gtrsim\theta_f \equiv (\hat{q}/\omega)^{1/3}$ ($\hat{q}$ is the medium 'jet quenching' parameter and ω is the gluon energy). We demonstrate that, for a dipole opening angle $\theta_{q\bar{q}}$ larger than θ_f, there is no interference between medium–induced gluon emissions by the quark and the antiquark. That is, the in–medium contribution to the antenna pattern is the incoherent superposition of two individual BDMPS–Z spectra. Physically, this is so since, unlike the direct emissions which can be delocalized anywhere throughout the medium, the interference terms are non–zero only for the very early emissions, such that the size of the $q\bar{q}$ dipole at the time of emission be smaller than the transverse wavelength of the emitted gluon.

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