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Jet quenching parameter in an expanding QCD plasma

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We study the phenomenon of transverse momentum broadening for a high-p_T parton propagating through a weakly-coupled quark-gluon plasma undergoing boost-invariant longitudinal expansion. We propose a boost-invariant description for this phenomenon, in which the broadening refers to the angular variables η (the pseudo-rapidity) and ϕ (the azimuthal angle) — the same variables as generally used to describe particle distributions in the experiments. The jet quenching parameter $\hat{q}$, which is the only property of the medium to enter this description, depends upon the proper time alone: it decreases with time due the dilution of the medium via expansion.

We furthermore consider radiative corrections to $\hat{q}$. As in the case of a static medium, we find potentially large corrections enhanced by a double logarithm. But unlike for the static medium, these corrections are now local in time: they depend upon the local (proper) time characterizing the expansion, and not upon the overall path length. We identify and resum such corrections to all orders into a renormalized jet quenching parameter. The main effect of this resummation is to slow down the decrease of $\hat{q}$ with increasing time. We argue that the same (renormalized) value for $\hat{q}$ should also enter the calculation of medium-induced radiation in the expanding medium.

Summary

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