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Radiative energy loss reduction in a plasma due to damping

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The strong quenching of jets and the suppression of hadron spectra at high transverse momenta are striking experimental observations made in high energy nuclear collisions. Both have been interpreted as signature for the formation of a deconfined plasma of QCD matter, in which partons suffer a medium-induced energy loss. In theoretical studies devoted to a parton's radiative energy loss, however, the damping of radiation within the plasma has so far widely been neglected.

We investigate the radiative energy loss per unit distance of a relativistic colour charge traversing as probe an infinite absorptive plasma. The Landau-Pomeranchuk-Migdal effect is incorporated as well as modifications due to the polarization of and damping mechanisms in the medium. The latter are phenomenologically described by a complex index of refraction, while the colour charge dynamics is considered in the Abelian approximation. We find a substantial reduction of the medium-induced mechanical work in addition to the well known Ter-Mikaelian effect from the polarization of matter. Moreover, the formation time of radiated quanta is also drastically reduced, both for small frequencies, where damping has a minor additional impact besides the polarization effect, and for larger frequencies. These effects are more pronounced for larger medium damping and/or larger initial energy of the charge.

Therefore, we expect that our study will have a significant impact on the understanding of jet quenching phenomena in ultra-relativistic heavy-ion collisions at RHIC and even more at LHC.

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