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First-principles derivation of the jet energy-momentum deposition source term in the QGP and its implications for shockwave formation at RHIC and at the LHC

I present a new derivation for the distribution of energy and momentum transmitted from a fast parton to a medium of thermalized quarks and gluons, or the source term. A thermal field theory approach enables the direct evaluation of the source term from the divergence of the QCD energy momentum tensor. This approach is more general than previously used Boltzmann transport techniques and allows for the coupling of realistic external quark and gluon currents to the Lagrangian of soft QCD matter. Specifically, I consider for the first time the medium response to back-to-back jets and jets + medium-induced gluon bremsstrahlung. The calculation includes the effects of quantum interference between the interactions of the multiple fast partons with the medium, and demonstrates that the energy absorbed by the medium is enhanced in a non-trivial way due to the presence and formation time of medium induced radiation. The numerical results suggest that the use of such realistic external currents has important implications for the shockwave formation in relativistic heavy ion collisions at RHIC and the LHC and soft-to-intermediate transverse momentum particle correlation phenomenology.

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