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Photons associated with jets in p-p and A-A collisions

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Jet modification is now understood to be a multistage effect: a parton produced in a high virtuality initial state, radiates a multitude of partons, giving way to a variety of lower virtuality stages. In the lower virtuality stage, higher energy partons are weakly coupled with the medium and continue to scatter and radiate whereas lower energy partons are strongly coupled with the medium and will eventually thermalize. Hadrons produced in the fragmentation from these partons are clustered within jets. Modeling of these multistage effects involves several parameters: The coupling in the medium, the scales where the shower transitions from one stage to the next, and the parameters of hadronization.

We consider a set of these parameters which have been tuned to successfully describe a variety of jet based data, such as the nuclear modification factors of leading hadrons and jets, the intra-jet fragmentation function and the jet shape, and subject this model to a parameter free validation by calculating the photon production from these in-medium jets. Quarks inside jets can radiate photons along with gluons. Photons are also produced in the hard scattering, via the quark-gluon Compton scattering process. In this work, we study the correlation of photons with jets in p-p and A-A collisions. Photon radiation from the hard scattering, from both the large and small virtuality phases, along with radiation from a PYTHIA based hadronization model are included in this analysis. We focus on the photon jet transverse momentum and angular balance. The calculations of photon production from each stage are calculated in close analogy to gluon radiation, with the exact same approximations, i.e., no new parameters are introduced or tuned either in the p-p or A-A collisions. The level of agreement with experimental data provides an independent verification of the multi-stage theory of jet modification.

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