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Direct Photons From Jets in Quark Gluon Plasma

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The universe, shortly after the Big Bang, was at temperatures much higher than the confinement scale of Quantum Chromodynamics (QCD) and was filled by a plasma of quarks and gluons (QGP). We can now study the properties of the QGP at major experimental facilities such as the Relativistic Heavy Ion Collider (RHIC, New York, USA) or the Large Hadron Collider (LHC, CERN, Switzerland) by colliding heavy ions together at very high energies and observing the spectra of the resulting particles from the collision. From these spectra, we can then deduce important information about the strongly interacting medium such as its transport coefficients, and also study the phase diagram of QCD.

Direct photons have proven themselves as enticing probes of the medium. These photons do not originate from a hadronic decay and are produced at all stages of the evolution, giving access to information such as shear and bulk viscosities. Moreover, since photons interact exclusively via electromagnetism, they experience no final state interactions in the QCD plasma once created and escape the system unscathed. Thus, they can faithfully carry information about the local conditions at the moment of their creation. However, it is difficult if not impossible to experimentally separate different production mechanisms of direct photons. As such we have to rely on models and aim for solid theoretical calculations to understand photon emission processes involved at all different stages of evolution.

Here we present the first modern calculation of direct photons, probing the early evolution of the medium. We consider the dynamics of QCD jets, and account for realistic hydrodynamic evolution of the medium as well as jet energy loss. These results include the first systematic calculation of jet-medium photons, arising from the interaction of a jet with the thermal medium, which results in the conversion of the jet to a photon. We will compare our results to current experimental observations as well as make predictions for future runs of the LHC.

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