Contribution ID: **363** Type: **2a) Jets and high-pT hadrons (TALK)**

Moliere scattering in QGP: finding scatterers within the liquid

Thursday 4 October 2018 10:45 (20 minutes)

By looking for rare (but not exponentially rare) large-angle deflections of a jet or of partons within a jet, experimentalists can find the weakly coupled short-distance quark and gluon quasiparticles (scatterers) within the strongly coupled liquid quark-gluon plasma produced in heavy ion collisions, as was proposed in Ref.˜1. In this previous work, the probability for picking up a given transverse momentum via a Moliere scattering was calculated, but in the limit of infinite parton energy which means zero angle scattering. Here we calculate the Moliere scattering probability for incident partons with finite energy, meaning that we have now calculated the probability for a parton showing up with a nonzero angle with respect to its initial direction due to scattering with the constituents of QGP, using leading order perturbative QCD. We include all relevant channels, including those in which the parton that shows up at a large angle was kicked out of the medium as well as the Rutherford-like channel in which what is seen is the scattered incident parton. These results will serve as valuable inputs to jet Monte Carlo calculations, allowing hard scattering to be added to Monte Carlos that do not include it or allowing these effects to be identified in Monte Carlo calculations in which they are already incorporated. Our results provide key theoretical input toward finding the scatterers within the QGP liquid, which in turn is the necessary first step toward using precise, high statistics, suitably differential measurements of jet modification in heavy ion collisions to discern the microscopic structure of QGP.

Ref. 1: F. D'Eramo, M. Lekaveckas, H. Liu and K. Rajagopal, Momentum Broadening in Weakly Coupled Quark-Gluon Plasma (with a view to finding the quasiparticles within liquid quark-gluon plasma), JHEP 05 (2013) 031, [1211.1922].

Summary

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Session Classification: Parallel 1