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Transverse Momentum Broadening in Weakly Coupled Quark-Gluon Plasma

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We calculate P(k_perp), the probability distribution for an energetic parton propagating for a distance L through a medium to pick up transverse momentum k_perp, for a medium consisting of weakly coupled quark-gluon plasma. We use full or HTL self-energies in appropriate regimes, resumming each in order to find the leading large-L behavior. We estimate the jet quenching parameter and compare to results in the literature. And, we compare P(k_perp) at weak coupling to the P(k_perp) expected from holographic calculations that presume the quark-gluon plasma to be strongly coupled at all length scales. We find that the weak coupling and strong coupling results need not differ greatly at modest k_perp, but we find that P(k_perp) must be parametrically larger in a weakly coupled plasma than in a strongly coupled plasma at large enough k_perp. By looking for rare large-angle deflections of the jet resulting from a parton produced initially back-to-back with a hard photon, experimentalists can find the weakly coupled quark and gluon short-distance constituents of the strongly coupled liquid quark-gluon plasma, much as Rutherford found the nuclei within atoms or Friedman, Kendall and Taylor found the quark within nucleons.

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