Perturbative QCD and multiple scattering in nuclear matter

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Traditional factorization theorems in perturbative QCD describe only one single scattering of partons in high energy collisions of hadrons or nuclei. This is not sufficient if the mean free path of a parton in the final state is smaller than the size of the nuclear matter. We worked on generalizing a QCD factorization framework previously set up by J. Qiu and G. Sterman to accommodate multiple scattering. We developed an approach that allows the identification of all gauge invariant matrix elements contributing to inclusive deep inelastic scattering off very large nuclei, and which at the same time permits a systematic treatment of radiative corrections to both the hard perturbative process and the non-perturbative matrix elements. This comprehensive factorization scheme can also be applied to semi-inclusive deep-inelastic scattering and proton-nucleus collisions with large nuclei. It has the promise to serve as a reliable basis for jet quenching calculations in heavy ion collisions, in particular for computations of hadron-hadron and photon-hadron correlations which are sensitive to both radiative and rescattering contributions.