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Transverse-momentum-dependent (TMD) factorization in reactions with nuclei: from Drell-Yan to hadron production

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We study cold nuclear matter effects on Drell-Yan production at small and moderate p_T in proton/pion-nucleus collisions using a new transverse-momentum dependent (TMD) factorization framework. Both collisional broadening and medium-induced radiative corrections in the initial state are considered in the soft-collinear effective theory with Glauber gluons (SCET$_G$) approach. We demonstrate that in-medium bremsstrahlung exhibits rapidity divergences as $x \to 1$ and collinear divergences at the endpoints $x = 0, 1$ of the emission spectra. We further show that the rapidity divergences lead to Balitsky-Fadin-Kuraev-Lipatov (BFKL) evolution of the collision kernel and can be resummed into the transverse momentum broadening of particle production. In turn, the endpoints divergences of in-medium radiation can be resummed through the collinear evolution of parton densities in nuclear matter. The TMD factorization framework is applied to understand the transverse-momentum spectra of Drell-Yan pair production in pA and πA collisions and provides calculations with improved accuracy for hadron production in cold QCD processes at RHIC and LHC.

Category

Theory

Collaboration (if applicable)

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