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Abstract

Next-to-eikonal corrections in the Color Glass Condensate

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The high energy limit of Quantum Chromodynamics (QCD), in particular the Color Glass Condensate (CGC) effective theory is the framework used throughout this thesis. In CGC one of the most commonly used approximations is the eikonal approximation. This approximation amounts to taking into account only the contributions that are leading in energy, while systematically disregarding the energy suppressed corrections. The eikonal approximation is based on three assumptions. The first one takes the target as an infinitely thin 'shockwave', the second one is taking into consideration only the leading component of the background field, and, the third assumption is to disregard the dynamics of the target. The eikonal approximation is a very reliable one, specially in the high energy limits such as the energies reached at the Large Hadron Collider (LHC). However, when considering other experiments such as Relativistic Heavy Ion Collider (RHIC) or the future Electron Ion Collider (EIC), the scattering energies are lower compared to LHC.

The main goal of this work is, therefore, to provide the basis needed to compute the corrections to the eikonal approximation. These corrections are suppressed in energy with respect to the eikonal limit. This is the main motivation for the computation of such corrections, since the results obtained at this level of accuracy are expected to provide better precision for the phenomenology at the RHIC and EIC experiments. In order to obtain these corrections we relax the aforementioned eikonal assumptions.

After laying the basis of CGC and computing the Wilson line at the eikonal accuracy, the quark propagator at next-to-eikonal (NEik) accuracy in the gluon background field is computed. With the use of this propagator we compute different observables. The first observable computed is the forward quark-nucleus scattering at NEik accuracy, relaxing two out of the three assumptions in the eikonal approximation while the dynamics of the target is still neglected.

Finally, we relax the third assumption and take into account the dynamics of the target, thus obtaining the quark propagator at the full NEik accuracy in the gluon background field. With this propagator we compute two more observables, the DIS dijet production and the photon + jet production at NEik accuracy.