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Exclusive heavy vector meson production at next-to-leading order in deep inelastic scattering

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Exclusive vector meson production is a powerful process to probe the small Bjorken-x structure of protons and nuclei, as such processes are especially sensitive to gluonic structure and also provide access to the spatial distribution of small-x gluons in nuclei. A powerful theoretical framework to study vector meson production at high energy, and to describe the initial condition of heavy-ion collisions, is the Color Glass Condensate (CGC) effective field theory. So far, most calculations in the CGC framework have been done at the leading order. Recent theoretical developments on the NLO heavy vector meson wave function [1] and the NLO virtual photon light-front wave function with massive quarks [2,3] have made it possible to go beyond the leading order, allowing us to include the next-to-leading corrections in α_s and calculate exclusive heavy vector meson production at NLO in the dipole picture for the first time.

In this talk, we will present results from our recent work on longitudinal [4] and transverse [5] NLO vector meson production in the nonrelativistic limit. We demonstrate the cancellation of UV and IR divergences in the NLO calculation, which includes taking into account both the Balitsky-Kovchegov equation describing the rapidity evolution of the dipole amplitude and the renormalization of the leading-order vector meson wave function. The next-to-leading order corrections are found to be sizable; however, their numerical effect on vector meson production is compensated by the dipole amplitude, fitted to HERA inclusive cross section data at NLO [6]. Finally, exclusive J/ψ production is calculated numerically and compared to the existing data. We find that both the NLO corrections and the first relativistic corrections, calculated in Ref. [7], are numerically important and result in a good agreement with the data. We demonstrate that it is possible to simultaneously compute consistently both inclusive and exclusive cross sections at NLO accuracy in the CGC framework.

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