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Quarkonium emissions as probes of the hadronic structure at small-x

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Quarkonium emissions in forward as well as in central directions of rapidity are widely recognized as excellent channels to access the nucleon structure in the high-energy/small-x regime. Here, several phenomenological analyses have been proposed so far, this allowing us to probe kinematic ranges in the intersection corners of different approaches. At large transverse momenta, a high-energy factorization (HEF) formula is established within the Balitsky-Fadin-Kuraev-Lipatov (BKFL) formalism, where the so-called unintegrated gluon distribution (UGD) drives the gluon evolution at small-x. Recent analyses on the diffractive electroproduction of ρ mesons have corroborated the underlying assumption that the small-size dipole scattering mechanism is at work, thus validating the use of the HEF formalism. Nonetheless, a significant sensitivity of polarized cross sections to intermediate values of the meson transverse momenta, where, in the case of inclusive emissions, a description at the hand of the transverse-momentum dependent (TMD) factorization starts to be most appropriate framework, has been observed. Similar studies on emissions of quarkonium states, whose theoretical description at small-x mainly relies on quark dipoles of larger size, would certainly help us to shed light on the interplay between HEF and TMD formalisms. Moreover, when the TMD approach is considered, quarkonium-production reactions probe the gluon TMD densities. More in particular, they represent a golden channel for the extraction of those gluon densities which are sensitive to the Weizsacker-Williams (WW) gauge link.
In this overview talk I propose to address all the considered points, showing how phenomenological analyses doable at new-generation colliding machines, as the EIC, the HL-LHC and NICA-SPD, can accelerate progress in our understanding of the hadronic structure at small-x via quarkonium production. Ultimately, they trace the path toward the development of a unified formalism, where both the TMD and the BFKL evolution mechanisms are consistently integrated in the definition of small-x gluon TMD distributions.

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