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Transverse momentum distribution of charmonium production in lepton-hadron scattering at the EIC

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Heavy quarkonium production of high transverse momentum (p_T) in hadronic collisions can be studied in the QCD factorization formalism in both leading and the first subleading power in $1/p_T$ expansion with heavy quarkonium fragmentation functions (FFs) [1]. The scale evolution of quarkonium FFs enables us to resum logarithmically enhanced corrections $\alpha_s \ln(p_T^2/m^2)$ with heavy quark mass m, which is an essential piece to explore the nonperturbative process of bound quarkonium formation. Boundary conditions of the evolution equations of the FFs at $p_T \sim 2m$ are given by combining perturbatively calculable coefficients in NRQCD and long-distance-matrix elements (LDMEs) for different intermediate states of a produced heavy quark pair. LDMEs correspond to relative weights of individual terms after expanding the input FFs in quark velocity v, and should be determined by data fitting.

We demonstrated in Ref.[1] that the QCD contribution to the production at the first subleading power is critically important for describing the full range of p_T-distributions of J/ψ production at the hadron colliders, in particular, for the region of $p_T \geq calO(2m)$, while the leading power contribution describes the main feature of data for $p_T \gg calO(2m)$. In this talk, we will present our predictions for transverse momentum distribution of J/ψ production in lepton-hadron scatterings at the EIC in terms of a hybrid factorization approach to take into account both collision-induced QCD and QED radiative corrections on equal footing [2]. At the EIC energy, we will demonstrate that the first subleading power contribution is very important for matching our calculations with the resummation of the logarithms to the fixed-order NRQCD calculations at $p_T \sim calO(2m)$. We will discuss the complementarity between inclusive high-p_T J/ψ production without measuring the scattered electron and the production of J/ψ in semi-inclusive deep inelastic scattering (SIDIS) with the scattered electron measured. We will also discuss the transition from the collinear factorization regime to the phase-space where TMD factorization is necessary.

[1] K. Lee, J.W.Qiu, G. Sterman and K.Watanabe,
"Subleading power corrections to heavy quarkonium production in QCD factorization approach," [arXiv:2211.12648 [hep-ph]].

[2] T. Liu, W. Melnitchouk, J.W. Qiu and N. Sato,
"A new approach to semi-inclusive deep-inelastic scattering with QED and QCD factorization," JHEP 11, 157 (2021) [arXiv:2108.13371 [hep-ph]].

Submitted on behalf of a Collaboration?

No

Participate in poster competition?

No

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