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Large-Momentum Effective Theory vs. Short-Distance Operator Expansion: Contrast and Complementarity

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Many present lattice QCD approaches to calculate the parton distribution functions (PDFs) rely on a factorization formula or effective theory expansion of certain Euclidean matrix elements in boosted hadron states. In the quasi- and pseudo-PDF methods, the matching coefficient in the factorization or expansion formula includes large logarithms near the threshold, which arise from the subtle interplay of collinear and soft divergences of an underlying 3D momentum distribution. We use the standard prescription to resum such logarithms in the Mellin-moment space at next-to-leading logarithmic accuracy, which also accounts for the DGLAP evolution, and we show that it can suppress the PDF at large x. Unlike the deep inelastic scattering and Drell-Yan cross sections, the resummation formula is away from the Landau pole. We then apply our formulation to reanalyze the published lattice results for the pion valence PDF, and find that within the current data sensitivity, the effect of threshold resummation is marginal for the accessible moments and the PDF at large x.

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