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Resummation of small-momentum logarithms for lattice calculation of GPDs in the large momentum effective theory

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The generalized parton distributions (GPDs) provide important information for 3D imaging of the proton in the longitudinal momentum fraction x and transverse impact parameter space. Recently, thanks to large-momentum effective theory, they can be directly calculated in lattice QCD from the so-called quasi-GPDs. In the perturbative matching of quasi-GPDs to GPDs, there are logarithms related to three different physical scales, the quark (antiquark) momentum $|x \pm \xi|P_z$ at skewness $\xi = \frac{P_+ - P'_+}{P_+ + P'_+}$, and the momentum of emitted gluon $|x - y|P_z$. When calculating near $x \rightarrow \pm\xi$ or $x \rightarrow \pm 1$, the contribution of higher-order logarithms become important, thus needs to be resummed. We examine under which conditions these logarithms are becoming important in ERL and DGLAP region, and propose an approach to resum these logarithms in the two regions. After resummation, we can improve the estimation of perturbation theory uncertainty, and demonstrate which region of x can be reliably calculated from lattice through the large momentum effective theory.

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