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Ultraviolet renormalized quasi PDFs

Parton distribution functions (PDFs), $f(x)$, encode important nonperturbative information on the hadron structure as a function of light-cone momentum fraction x which can be extracted from experimental measurements of cross sections. The quasi parton distribution functions (qPDFs) of hadron momentum P_z, $\tilde{f}(\tilde{x}, P_z)$, introduced in the large-momentum effective field theory (LaMET) approach, provide an alternative method to access the same nonperturbative information from lattice QCD calculations. PDFs and qPDFs could be related through an infra-red, collinear and ultraviolet (UV) safe matching coefficient that is calculable perturbatively with the corrections suppressed by the inverse power of P_z. However, there are challenges that must be overcome to uniquely determine such a matching coefficient. Although, PDFs and qPDFs contain the same nonperturbative physics at the leading power in $1/P_z$, the perturbative UV divergences of the qPDFs are different from that of PDFs, and more explicitly, the integration of $\tilde{x}$ of $\tilde{f}(\tilde{x}, P_z)$ or the first $\tilde{x}$-moment of qPDFs could lead to a divergence with a UV origin. To address this issue, we introduce a UV renormalization scheme for qPDFs so that the first moment of qPDFs is finite and the $\tilde{x}$-dependence of the matching coefficient is well defined for all values of $\tilde{x}$.

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