

1 - 6 Transverse Momentum Structure of Proton within the Basis Light-front Quantization Framework*

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We obtain the leading-twist valence quark transverse-momentum-dependent parton distribution functions (TMD PDFs) of quarks in the proton within the basis light-front quantization (BLFQ) framework. Our results are consistent with lattice QCD calculations and the previous BLFQ calculations of the collinear distributions. We also obtain consistency with the Soffer-type bounds. Within our approach, we find that six T -even TMDs in the leading twist are all independent of each other, and previously found model-dependent relations do not hold. This is a promising sign that our results are representative of future, more extensive treatments of QCD (Fig. 1). Furthermore, we obtain a non-trivial x -dependence of the $\langle(p^\perp)^2\rangle$

$$\langle(p^\perp)^2\rangle_f^q(x) = \frac{\int d^2p^\perp (p^\perp)^2 f_{\text{BLFQ}}^q(x, (p^\perp)^2)}{\int d^2p^\perp f_{\text{BLFQ}}^q(x, (p^\perp)^2)}. \quad (1)$$

and some consistency with the Gaussian ansatz but only in the small $(p^\perp)^2$ region. Those features suggest our results may be a useful alternative in future experimental extractions.

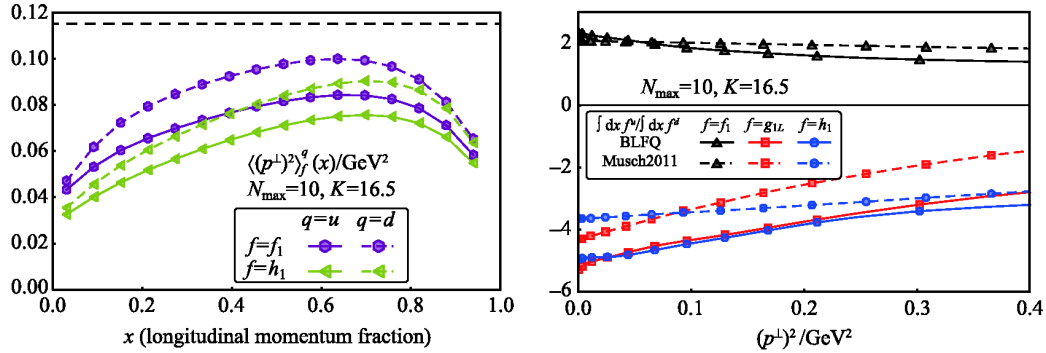


Fig. 1 (color online) The left panel is the x and flavor dependence of $\langle(p^\perp)^2\rangle_f^q(x)$ of the BLFQ results for f_1 and h_1 . Lines with different markers (colors) represent $\langle(p^\perp)^2\rangle_f^q(x)$ obtained from different TMDs as indicated in the legends. Solid lines represent calculations of u quark and dashed lines d quark. The right panel is comparisons of $\int dx f^u / \int dx f^d$ for f_1 , g_{1L} and h_1 from the BLFQ framework and the central values from the lattice QCD simulations obtained by parameterizing \tilde{A}_2 , \tilde{A}_6 and \tilde{A}_{9m} ^[1]. Lines with different markers (colors) represent flavor-ratios of different distributions as indicated in the legend. Solid lines represent the BLFQ results and dashed lines represent lattice QCD results.

Reference

- [1] B. U. Musch, P. Hagler, J. W. Negele, et al., Phys. Rev. D, 83(2012)094510.

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