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Transversity PDFs and GPDs from lattice QCD

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Generalized parton distributions (GPDs) are important quantities that characterize the 3-D structure of hadrons, and complement the information extracted from TMDs. They provide information about the partons'momentum distribution and also on their distribution in position space. Most of the information from lattice QCD is on the Mellin moments of GPDs, namely form factors and their generalizations. Recent developments in calculations of matrix elements of boosted hadrons coupled with non-local operators opened a new direction for extracting the x dependence of GPDs.

Traditionally, lattice QCD computations of GPDs have been carried out in a frame, where the transferred momentum is symmetrically distributed between the incoming and outgoing hadrons. However, such frames are inconvenient for lattice QCD calculations since each value of the momentum transfer requires a separate calculation, increasing the computational cost. Here, we present results extracted through a new Lorentz invariant parametrization that leads to more effective calculations of GPDs applicable for any frame, with freedom in the transferred momentum distribution. We demonstrate the efficacy of the formalism through numerical calculations using one ensemble of $_f = 2+1+1$ twisted mass fermions with a clover improvement. The value of the light-quark masses lead to a pion mass of about 260 MeV. Concentrating on the proton and zero skewness, we extract the invariant amplitudes from matrix element calculations in both the symmetric and asymmetric frame, and obtain results for the twist-2 light-cone GPDs for unpolarized quarks, 𝐻 and 𝐸, as well as polarized quarks, $\widetilde{H}$.

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