

Transverse momentum-dependent parton distributions for longitudinally polarized nucleons from Lattice QCD

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Previous Lattice QCD calculations of nucleon transverse momentum-dependent parton distributions (TMDs) focused on the case of transversely polarized nucleons, and thus did not encompass two leading-twist TMDs associated with longitudinal polarization, namely, the helicity TMD g_1 and the worm-gear TMD h_{1L}^\perp corresponding to transversely polarized quarks in a longitudinally polarized nucleon. Based on a definition of TMDs via hadronic matrix elements of quark bilocal operators containing staple-shaped gauge connections, TMD observables characterizing the aforementioned two TMDs are evaluated, utilizing a RBC/UKQCD domain wall fermion ensemble at the physical pion mass. The results suggest that h_{1L}^\perp is significantly suppressed in magnitude compared to its counterpart, the worm-gear TMD g_{1T} , deviating from the generic prediction of quark models, and thus indicating the influence of strong gluonic dynamical effects.

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