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SIDIS measurements at the EIC: probing TMDs with the ePIC detector

Transverse-momentum dependent parton distributions (TMDs) are a key tool to explore the three-dimensional structure of hadrons in momentum space. Recent extractions of unpolarized quark TMDs in the nucleon have reached a theoretical accuracy comparable to that of collinear parton distribution functions, although their uncertainties remain significantly larger due to the limited size of the available data sets. In this work, we investigate the potential impact of future Semi-Inclusive Deep Inelastic Scattering measurements at the Electron–Ion Collider on the reduction of TMD uncertainties. In particular, we discuss the role of the ePIC detector, whose excellent acceptance, kinematic resolution, and particle identification capabilities enable precise reconstruction of SIDIS observables over a broad kinematic range. We highlight the achievable physics goals in the early stages of EIC operation, even with limited luminosity, with emphasis on transverse-momentum dynamics and spin-dependent observables.

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