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Overview of HERMES results on longitudinal spin asymmetries

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The HERMES experiment has collected a wealth of data using the 27.6 GeV polarized HERA lepton beam and various polarized and unpolarized gaseous targets. This allows for a series of unique measurements of observables sensitive to the multidimensional (spin) structure of the nucleon, in particular semi-inclusive deep-inelastic scattering (SIDIS) measurements, for which the HERMES dual-radiator ring-imaging Cherenkov counter provided final-hadron identification between 2 GeV to 15 GeV for pions, kaons, and (anti)protons.

In this contribution, longitudinal single- and double-spin asymmetries in SIDIS will be presented. The azimuthally uniform double-spin asymmetries using longitudinally polarised nucleons constrain the flavour dependence of the quark-spin contribution to the nucleon spin. For a first time, such asymmetries are explored differential in three dimensions in Bjorken- x and the in the hadron kinematics z and $P_{h\perp}$ (which respectively represent the energy fraction and transverse momentum of the final-state hadron) simultaneously. This approach increases the quark-flavour sensitivity and allows to probe the transverse-momentum dependence of the helicity distribution. The measurement of hadron charge-difference asymmetries allows, under certain simplifying assumptions, the direct extraction of valence-quark polarisations. The azimuthal modulation of this double-spin as well as of the single-(beam)spin asymmetry probe novel quark-gluon-quark correlations through twist-3 distribution and fragmentation functions. Also here asymmetries are explored in several dimensions. Furthermore, in case of the beam-spin asymmetry, results for electro-produced protons and antiprotons have become available. The beam-spin asymmetries for pions are compared to similar measurements for pions at CLAS and unidentified hadrons at COMPASS.

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