TOWARDS TRANSVERSE MOMENTUM DEPENDENCE IN DISTRIBUTIONS AND FRAGMENTATION

Rolf Ent[1]
[1]Jefferson Lab

Semi-inclusive deep inelastic scattering (SIDIS) is an important tool for understanding the structure of nucleons and nuclei. Hadron multiplicities, and spin asymmetries in polarized SIDIS, are directly related to transverse momentum dependent parton distributions (TMDs) and fragmentation functions. The usual collinear parton distribution functions depend on the fraction of hadron momentum carried by the parton, x, and the space-time resolution scale, Q^2. The TMDs depend also on the intrinsic transverse momentum of the parton, k_T and, in principle, provide a three-dimensional partonic picture of the nucleon in momentum space. Fragmentation functions parameterize the hadron production following the electron-quark scattering processes (or electron-positron collisions). Massive and colorless hadrons emerge from this process only by a near-massless quark binding with one additional antiquark (or two quarks), to be picked up either from the QCD vacuum or from the remnant beam (target) fragments. The final hadron accumulates a momentum transverse to the beam direction by a convolution of the transverse momentum of the struck quark and the transverse momentum of the additional antiquark. This turns the understanding of fragmentation into a correlated 3D problem. To make headway here calls for a multi-pronged approach with multi-dimensional data, for all combinations of beam and target polarization, and different hadrons, and the incorporation of spin effects in the fragmentation process. The Jefferson Lab 12-GeV program combining both precision and large acceptance experiments will be presented. The possible reciprocity between the transverse-momentum inducing effects of the distributions and fragmentation will also be discussed.