Semi-Inclusive Hadron Electroproduction

The semi-inclusive electroproduction of hadrons is an important tool for studying the nucleon structure in the perturbative Quantum Chromodynamics (pQCD) framework at medium energies. Indeed, the detection of a hadron produced by the struck quark or by nucleon spectator fragments provides an information about the orbital momentum of the quark in the initial state (see Fig. 1). Meanwhile, the undetected hadronic system allows to apply the optical theorem, reducing the energy necessary for convergence towards basic pQCD processes.

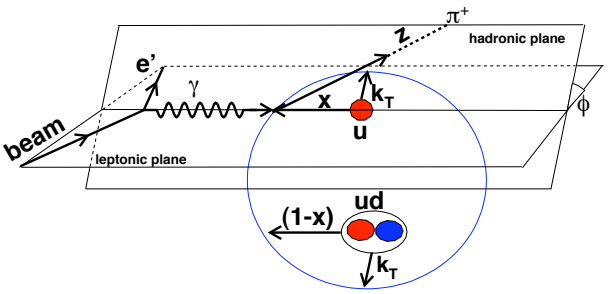

Figure 1: Schematic diagram of the semi-inclusive π^+ electroproduction on the proton (large blue circle). u and d indicate valence quarks inside the proton. x and k_T are the initial longitudinal and transverse momenta of the struck quark. z is the momentum of the measured π^+. ϕ is the angle between leptonic and hadronic planes, azimuthal around the virtual photon direction.

CLAS has measured the semi-inclusive electroproduction of π^+ on the proton at the beam energy of 6 GeV. Our measurements of ϕ-independent term of the cross section were found to be in fairly good agreement with pQCD calculations (see Fig. 2). This encourages further studies of the semi-inclusive reactions at Jefferson Lab. Moreover, the conventional current fragmentation term (due to π^+ production by the struck quark, as in Fig. 1) can account for almost all of the observed cross section, even at small π^+ momentum (low z). We have observed that the two ϕ-dependent terms of the cross section are small. Within our precision the $\cos 2\phi$ term is compatible with zero, providing no information about the distribution of transversely polarized quarks in the proton (Boer-Mulders distribution). While, the measured $\cos\phi$ term is much smaller in magnitude than the predictions due to the intrinsic quark transverse motion (Cahn effect) and asymmetric fragmentation of the struck quark (Berger effect).

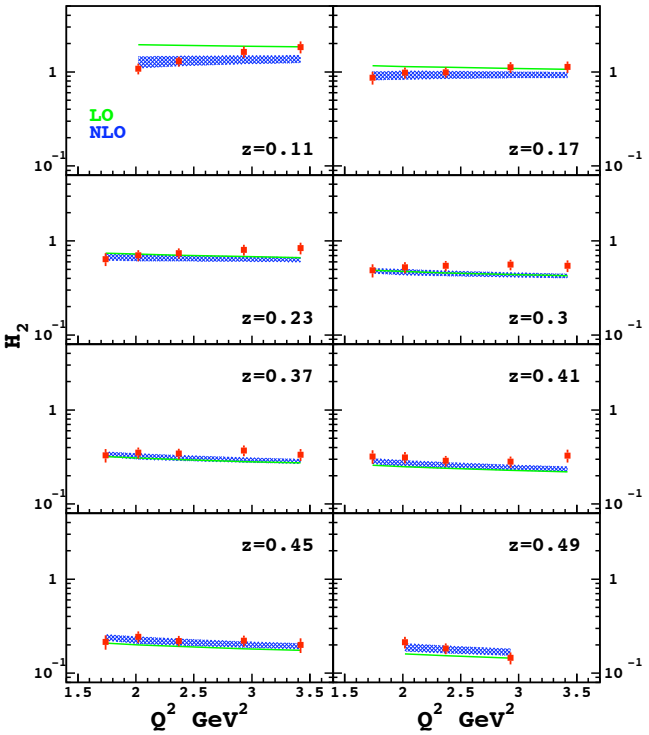

Figure 2: The Q^2-evolution of H_2 structure function at $x = 0.3$. The data are shown by red squares with statistical and systematic uncertainties combined in quadrature. The green lines show LO pQCD calculations; NLO calculations are shown by the blue shaded area, for which the width indicates theoretical uncertainties.