JLab Experiment E00-002

F_2^N at Low Q^2

Spokespersons: I. Niculescu, C. Armstrong

The nucleon structure functions F_2^N, which are fundamental to our understanding of physics at the nucleon scale, are well measured over a broad range in momentum transfer Q^2 and Bjorken x. At large values of Q^2 the structure functions are well understood in terms of logarithmic scaling violations. In this regime, perturbative Quantum Chromodynamics (pQCD) calculations of leading order (LO) and next-to-leading order (NLO) terms, together with target mass corrections, reproduce the data very well.

At low values of Q^2 and moderately low x, however, the theoretical understanding of F_2^N is less clear, and there is a paucity of data. Recent Jefferson Lab work indicates that in this kinematic regime we may be seeing the onset of a drop in F_2^p with decreasing Q^2. This fall-off of the structure function may indicate an insensitivity to the quark component of the nucleon sea at low Q^2.

Experiment E00-002 will measure the inclusive electron-nucleon scattering cross section in both the deep-inelastic and the resonance regions on hydrogen and deuterium. The objective is to map out F_2^N in both the low Q^2, low x ($W^2 > 3.5$ GeV^2) region as well as in the low Q^2, moderate x (resonance) region. These data will fill out our knowledge of the structure functions in this regime, and should aid efforts to develop global descriptions of inclusive electron-nucleon scattering in the low Q^2 region. In addition, the resonance region data will allow studies of Bloom-Gilman (or quark-hadron) duality at low Q^2.

The experiment will use beam energies from 2.2 to 4.4 GeV, and will probe $0.03 \leq Q^2 \leq 1.4$ (GeV/c)^2 for x between 0.008 and 1. The systematic uncertainty for the inclusive cross section is expected to be around 3%, while the statistical uncertainty will be at the 1% level or better for all bins.