

Measurements of the Neutron Longitudinal Spin Asymmetry A_1 and Flavor Decomposition in the Valence Quark Region

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Abstract

The current data for the nucleon-virtual photon longitudinal spin asymmetry A_1 on the proton and neutron have shown that the ratio of the polarized-to-unpolarized down-quark parton distribution functions, $\Delta d/d$, tends towards $-1/2$ at large x , in disagreement with the perturbative QCD prediction that $\Delta d/d$ approaches 1 but more in line with constituent quark models. As a part of experiment E06-014 in Hall A of Jefferson Lab, double-spin asymmetries were measured in the scattering of a longitudinally polarized electron beam of energies 4.74 and 5.89 GeV from a longitudinally and transversely polarized ^3He target in the deep inelastic scattering region, allowing for the extraction of the neutron asymmetry A_1^n and the ratios $\Delta d/d$ and $\Delta u/u$. We will discuss our analysis of the data and present results for A_1 and g_1/F_1 on both ^3He and the neutron, and the resulting quark ratios for the up and down quarks in the kinematic range of $0.2 < x < 0.65$ and $2 < Q^2 < 5 \text{ GeV}^2$ for the scattered electrons. Our measurements are compared to the world data and various theoretical models and more recent predictions using the Dyson-Schwinger Equations (DSE) approach. Further plans to measure A_1^n , $\Delta d/d$ and $\Delta u/u$ at larger x with the upgrade of Jefferson Lab will be discussed.