

# Measurements of the Neutron Longitudinal Spin Asymmetry $A_1$ and Structure Function $g_1$ 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. 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 4.73 and 5.89 GeV from a longitudinally and transversely polarized  $^3\text{He}$  target in the deep inelastic scattering region, allowing for the extraction of the neutron asymmetry  $A_1^n$  and the longitudinal spin structure function  $g_1^n$ . We will discuss our analysis of the data and present results for  $A_1$  and  $g_1$  on both  $^3\text{He}$  and the neutron in the kinematic range of Bjorken variable  $0.2 < x < 0.65$  and virtual photon four-momentum transfer squared  $2 < Q^2 < 5 \text{ GeV}^2$ . Our measurements of  $A_1$  and  $g_1$  are compared to the world data and a new value of the second moment of  $g_1$ , namely  $a_2$ , is evaluated and compared to a lattice QCD calculation. The quantity  $a_2$  is needed to extract the twist-4 matrix element known as  $f_2$ .