Probing Quark-Gluon Correlations in the Neutron: Precision Measurements of $d_n^2$ and $g_n^2$

BRAD SAWATZKY, Temple University, E06-014 COLLABORATION, E12-06-121 COLLABORATION, JLAB HALL A COLLABORATION — The spin structure function $g_2$ and the higher twist reduced matrix element $d_2$ are fundamentally coupled to the quark-gluon interactions and transverse momentum of the quarks in the nucleon. Unlike most higher-twist processes which can not be separated from associated leading twist terms, $g_2$ contributes to leading order in the longitudinal-polarized lepton scattering on a transversely polarized nucleon. This makes $g_2$ one of the cleanest higher twist observables. Within the OPE, the second moment of a linear combination of $g_1$ and $g_2$ may be connected to the higher twist reduced matrix element $d_2$. This quantity has been well studied in Lattice QCD and other theoretical models. While calculations on the proton are in good agreement with data, calculations on the neutron not only have the opposite sign, but are 3–4 sigma away from the world average. This talk presents two Jefferson Lab measurements focused on $g_2$ and $d_2$ for the neutron. The first, E06-014, completed its run in March 2009 and will reduce the uncertainty on the neutron $d_2$ by a projected factor of four. The second experiment to be described, E12-06-121, is targeted to run shortly after the JLab 12 GeV upgrade is completed (est. 2014–5) and will focus on precision measurements of $g_n^2$ over the region $0.2 < x < 0.95$ and $2.5 < Q^2 < 6 \text{ GeV}^2/c^2$.