Precision Measurement of g_1 of the Proton and of the Deuteron with 6 GeV Electrons

Measuring the spin structure function g_1 of the nucleon is important to understand the quark and gluon contributions to the nucleon spin.

g_1 is extracted from measurements of the double-spin asymmetry in inclusive polarized electron-nucleon scattering. The sensitivity to the spin content results from the requirement that the quark's spin be anti-parallel to the virtual photon's spin in order for the quark to absorb the virtual photon, as shown in Fig. 1.

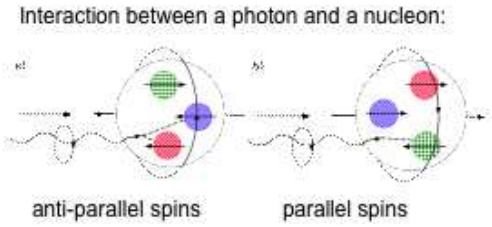

Figure 1: Virtual photon couples to quarks of opposite helicity.

Precision measurements with polarized proton and deuteron targets were made in Hall B of Jefferson Lab. For the usual deep inelastic region kinematics, Q^2 >1 GeV^2 and the final-state invariant mass W >2 GeV, the ratio of polarized to un-polarized structure functions g_1/F_1 is found to be nearly independent of Q^2 at fixed x[1]. Significant resonant structure is apparent at values of W up to 2.3 GeV.

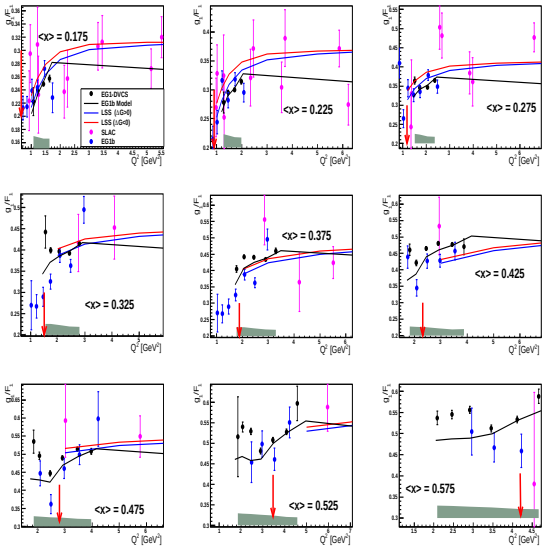

Figure 2: g_1^p vs Q^2 in bins of x

In the framework of perturbative quantum chromodynamics, these results can be used to better constrain the polarization of quarks and gluons in the nucleon, as well as high-twist contributions. A recent PDF analysis *(arXiv:1410.1657)* emphasizes the importance of these very precise data in understanding the strange quark contribution to the nucleon spin.

The data were also used for high precision determination of the Q^2-evolution of the Bjorken Sum for the kinematic range of $0.6 < Q^2 < 4.8$ GeV^2, and the extraction of strong force coupling with an uncertainty a factor of 1.5 smaller than earlier estimates using polarized DIS data *(arXiv:1405.7854)*.

[1]Y. Prok *et al. (CLAS Collaboration)*, Phys. Rev. C **90**, 025212 (2014).