Spin structure functions of the proton and the neutron at low to moderate Q^2

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Abstract

Double spin asymmetries for the proton and the deuteron have been measured in the EG1b experiment using the CLAS detector at Jefferson Lab. Longitudinally polarized electrons at energies 1.6, 2.5, 4.2 and 5.7 GeV were scattered from longitudinally polarized NH_3 and ND_3 targets. The double spin asymmetry $A_{\|}$ for the proton and the deuteron has been extracted from these data as a function of W and Q^2 with an unprecedented precision. The virtual photon asymmetry A_1 and the spin structure function g_1 were calculated from these measurements by using the parametrization to the world data for the virtual photon asymmetry A_2 and the unpolarized structure functions F_1 and R. The large kinematic coverage of the experiment (0.05 GeV^2 $<$ Q^2 $<$ 5.0 GeV^2 and 1.08 GeV $< W <$ 3.0 GeV) helps us to better understand the spin structure of the nucleon, especially in the transition region between hadronic and quark-gluon degrees of freedom. The results on A_1, g_1 and the first moment Γ_1^1, as well as the higher moments using the entire data set for the deuteron and proton will be presented in this talk. The measured moments will be compared to the theoretical and phenomenological calculations. The data will be used to better understand the polarized parton distributions, quark-hadron duality and help to test the pQCD predictions for the quark polarization at large x as well as more precise calculations of higher-twist matrix elements in the framework of the Operator Product Expansion. In addition, parameterizations of the world data on the asymmetries and the spin structure functions are studied to create and refine the models on these quantities that can be used in various applications. Finally, the neutron spin structure functions are extracted from the combined proton and deuteron data using a new unfolding technique. This is the first representation of the neutron data in the resonance region.