# MEASUREMENT OF THE LONGITUDINAL DEUTERON SPIN-STRUCTURE FUNCTION IN DEEP-INELASTIC SCATTERING

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# ABSTRACT

MEASUREMENT OF THE LONGITUDINAL DEUTERON SPIN-STRUCTURE FUNCTION IN DEEP-INELASTIC SCATTERING

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Experiment E143 at SLAC performed deep-inelastic scattering measurements with polarized electrons incident on polarized protons and deuterons. The data for the beam energy of 29 GeV cover the kinematical range of $x_{\mathrm{Bj}} > 0.03$ and $1 < Q^2 < 12\,\mathrm{GeV}^2$. From these data, the spin-dependent structure functions $g_1$ were determined. This dissertation describes the experiment and its analysis and discusses the results. The measured integral of $g_1^d$ over $x$ from $x = 0$ to $x = 1$ is $\Gamma_1^d = 0.046 \pm 0.003\,(\mathrm{stat}) \pm 0.004\,(\mathrm{syst})$ at $Q^2 = 3\,\mathrm{GeV}^2$ and disagrees by more than three standard deviations with the prediction of the Ellis-Jaffe sum rule. The data suggest that the quark contribution to the nucleon helicity is $0.35 \pm 0.05$. From the proton data of the same experiment, the integral over the proton spin-structure function $g_1^p$ was determined to be $\Gamma_1^p = 0.127 \pm 0.003\,(\mathrm{stat}) \pm 0.008\,(\mathrm{syst})$. By combining the deuteron data with the proton data, the integral $\Gamma_1^n$ was extracted as $-0.027 \pm 0.008\,(\mathrm{stat}) \pm 0.010\,(\mathrm{syst})$. The integral $\Gamma_1^p - \Gamma_1^n$ is $0.154 \pm 0.010\,(\mathrm{stat})$ $\pm 0.016\,(\mathrm{syst})$ according to the E143 analysis. This result agrees with the important Bjorken sum rule of $0.171 \pm 0.009$ at $Q^2 = 3\,\mathrm{GeV}^2$ within less than one standard deviation. Furthermore, results of a separate analysis involving GLAP evolution equations are shown. Data were also collected for beam energies of 16.2 and 9.7 GeV. Results for $g_1$ at these energies are presented.

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