

## Precision Measurement of the Proton and Deuteron Spin Structure Functions $g_2$ and Asymmetries $A_2$

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We have measured the spin structure functions  $g_2^p$  and  $g_2^d$  and the virtual photon asymmetries  $A_2^p$  and  $A_2^d$  over the kinematic range  $0.02 \leq x \leq 0.8$  and  $0.7 \leq Q^2 \leq 2$ - GeV<sup>2</sup> by scattering 29.1 and 32.3 GeV longitudinally polarized electrons from transversely polarized NH<sub>3</sub> and <sup>6</sup>LiD targets. Our measured  $g_2$  approximately follows the twist-2 Wandzura-Wilczek calculation. The twist-3 reduced matrix elements  $d_2^p$  and  $d_2^n$  are less than two standard deviations from zero. The data are inconsistent with the Burkhardt-Cottingham sum rule if there is no pathological behavior as  $x \rightarrow 0$ . The Efremov-Leader-Teryaev integral is consistent with zero within our measured kinematic range. The absolute value of  $A_2$  is significantly smaller than the  $A_2 < \sqrt{R(1+A_1)/2}$  limit.