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Measurements of the Spin Structure of the Deuteron

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As a spin-1 object composed of two nucleons, the deuteron exhibits a spin structure that can be probed by elastic and quasielastic electron scattering through single and double polarization observables. Such measurements of spin-dependent electron scattering from deuterium have been carried out recently at the MIT-Bates Linear Accelerator Center with the Bates Large Acceptance Spectrometer Toroid (BLAST). The experiment uses a longitudinally polarized (>65%) electron beam in com- bination with an isotopically pure, highly-polarized (>70%) internal target of vector- and tensor- polarized deuterium. BLAST consists of a toroidal magnetic spectrometer with the two in-plane sectors symmetrically equipped with detectors, which allows for simultaneous measurement of the inclusive and exclusive reaction channels in elastic and quasielastic kinematics. Due to its D-wave content, the deuteron has an elastic quadrupole form factor. Unpolarized elastic scattering only provides a combination of the charge and quadrupole form factor, their separation requires a spin observable such as the tensor analyzing power T20, which is determined with BLAST from the single-spin asymmetry in elastic electron scattering from tensor-polarized deuterium. While the small D-wave component modifies the nucleon momentum distribution only little, the corresponding tensor single-spin and vector double-spin asymmetries AT d and AV ed in exclusive deuteron electrodisintegration are much more sensitive to nucleons in the D-state. In the quasifree limit, AT d vanishes and AV ed is determined by the form factors of the free nucleon. The above sets of polarization observables have been measured with small statistical and system- atic errors and are compared with recent theoretical calculations. PACS numbers: Electronic address: kohlm@mit.edu