Precise Measurements of the Inclusive Spin-dependent Quasi-elastic Transverse Asymmetry $A_{T'}$ from $^3\vec{H}e(\vec{e}, e')$ at Low Q^2

Experiment: E95-001 Spokesperson: H. Gao

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Electromagnetic form factors are of fundamental importance for an understanding of the underlying structure of the nucleons. Knowledge of the distribution of the charge and magnetization within the nucleons provides a sensitive test of models based on QCD, as well as a basis for calculations of process involving the electromagnetic interactions with complex nuclei. The neutron electromagnetic form factors are known rather poorly due to the lack of free neutron targets. Because of its unique ground state spin structure of a polarized ^{3}He nucleus, polarized ^{3}He targets have been used widely to study the neutron electromagnetic structure as well as its spin structure. Precise measurement of the neutron magnetic form factor at low Q^2 is very important in terms of the experimental determination of the neutron electric form factor at low Q^2, as well as the determination of the strange form factors of the nucleon from parity violating electron-proton scattering experiments.

Experiment E95-001 was proposed to perform precise measurements of the ^{3}He inclusive quasielastic transverse asymmetry $A_{T'}$ at Q^2 from 0.1 to 0.5 (GeV/c)^2 by scattering longitudinally polarized electrons from a polarized ^{3}He target. The neutron magnetic form factor at low Q^2 will be extracted from the measured asymmetry. Experiment E95-001 will use both Hall A HRS spectrometers for measuring the ^{3}He inclusive spin-dependent quasielastic transverse asymmetry and the ^{3}He elastic asymmetry. A longitudinally polarized electron beam with polarization of 70% or higher at a beam current of 5 to 10μA is required at beam energies of 0.8 and 1.6 GeV. A polarized ^{3}He target based on the spin-exchange optical pumping technique will be employed for this experiment. The product of the beam and target polarizations will be determined to an overall uncertainty of 3% by simultaneously measuring the ^{3}He elastic asymmetry during the experiment. The transverse asymmetry $A_{T'}$ will be measured to an overall uncertainty of 4% at all the proposed Q^2 values and the neutron magnetic form factor will be determined to an accuracy of 2%. This experiment will also constrain models of the ^{3}He quasielastic asymmetry calculations by measuring the quasielastic transverse asymmetry $A_{T'}$ precisely across the quasielastic peak.