Measurement of the (e,e'p) Cross Section on Tensor Polarized Deuterium

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A recent theoretical study of the two nucleon density distribution in Deuterium [1] and heavier nuclei has shown that the two nucleon distributions in the T = 0 isospin and S = 1 spin state have a strong dependence on the spin projection M_d. If the two nucleons are in a relative $M_d = 0$ state, the surface of constant density has the shape of a toroid while if the two nucleons are found in the $M_d = \pm 1$ state the surface of constant density has a dumbbell shape. The two nucleon density is at a maximum in the $M_d = 0$ state for a torus with a diameter of approximately 1 fm and has a value of 0.34 fm^{-3} which corresponds to twice nuclear matter density. The shape of the torus is produced by the combined action of the tensor force and the repulsive core which is responsible for the hole.

We plan to study this structure in the Deuteron since for this nucleus the most precise calculations are available. Information on the size of these structures can be obtained from the measurement of the t_{20} and the magnetic Deuteron form factor. It is however impossible to discriminate between conventional descriptions of the nucleus and QCD based models which predict similar structures [2].

The goal of this experiment is to measure the d(e,e'p)n cross sections for the $M_d = 0$ and $M_d = \pm 1$ states at missing momenta ranging from 200 MeV/c to 400 MeV/c at a momentum transfer of 500 MeV/c. We will use the polarized NH_3 target of UVA which has been used previously in the G_E^n Experiment[3]. The incident electron beam will be bent vertically such that the scattered electrons and the coincident protons can be detected in the HMS and SOS spectrometers respectively without having to move the SOS out of plane.

References

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