CEBAF EXPERIMENT 94-018

Measurement of the Deuteron Tensor Polarization at Large Momentum Transfers in D(e,e'd) Scattering

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The electromagnetic structure of the deuteron is described by three form factors; the charge monopole (GC), charge quadrupole (GQ), and magnetic dipole (GM). Nonrelativistically, these form factors are related to the spatial distributions of charge, quadrupole deformation and magnetization respectively. Most information on these form factors comes from measurements of the unpolarized cross section in elastic electron-deuteron scattering. Measurements at different scattering angles allow one to separate GM from the other two pieces, but do not provide a sufficient number of degrees of freedom to separate GQ and GC. To identify GC and GQ, one must either measure the asymmetry induced by a tensor polarized deuterium target or measure the tensor polarization of the recoil deuterons (alternatively, one may use vector polarization if the electron beam is polarized).

CEBAF experiment 94-018 will determine the tensor moments of the outgoing deuteron in elastic (e,e'd), at momentum transfers of 3.8-6.8 fm-1. A recent measurement at MIT-Bates provided the first experimental evidence for a zero in GC at about 4.4 fm-1, reflecting the node in the S-state wave function of the NN system. At momentum transfers above the node, various corrections, such as relativistic effects and meson exchange currents (MECs), are expected to be significant. At present, nonrelativistic calculations which include a rpg MEC in order to reproduce the form factor of the three-nucleon system do not reproduce the existing measurements of t20. At even higher momentum transfer it is possible that quark degrees of freedom may be evident. The CEBAF measurements will both determine with better accuracy the behavior of GC around its passage through zero and extend the separate determination of CG and GQ to regions where quark degrees of freedom may begin to play a more significant role. Seven measurements will be made with 47 days of 100 mA beam in Hall C, using the HMS to detect electrons and a specially designed magnetic channel to detect deuterons in coincidence. The deuteron channel will sit at a fixed angle of 60.5. The deuteron tensor polarization will be determined with a new polarimeter, POLDER, which uses as an analyzer the charge-exchange reaction(p,2p)n. This reaction has a large figure of merit for deuterons with kinetic energies between 175 and 500 MeV. POLDER has been constructed by the Institut des Sciences Nucleaires de Grenoble and the Laboratoire National Saturne. It has been calibrated at the Saturne laboratory in France. It is currently being upgraded with the participation of the Service de Physique Nucleaire (Saclay) and will be recalibrated with the polarized deuteron beam of the Saturne Synchrotron in early 1997. The experiment is a collaboration between Grenoble, Saclay/Saturne, Orsay, the University of Basel, the University of Maryland, Indiana University, CEBAF, MIT, Rutgers University, and the Yerevan Physics Institute.