CEBAF EXPERIMENT 91-026

Measurement of the Electric and Magnetic Elastic Structure Functions of the Deuteron at Large Momentum Transfers

G. G. Petratos, Spokesperson

Electron scattering from the deuteron has long been an extremely important means of understanding the properties of the nuclear two-body system. The deuteron electromagnetic form factors in particular, measured in elastic scattering, offer unique opportunities to test models of the short-range nucleon-nucleon interaction, calculations of meson-exchange currents, isobaric configurations, relativistic effects, as well as the possible influence of explicit quark degrees of freedom. This proposal aims to a better understanding of the deuteron structure by exploring the limits of elastic electron deuteron scattering that can be achieved at CEBAF. Its objectives are:

- To measure the electric elastic form factor $A(Q^2)$ to the highest possible momentum transfer, probably over $Q^2 = 6$ $(\mathrm{GeV/c})^2$, and to improve the quality and resolve differences of the existing low Q^2 data.

- To improve significantly the existing SLAC data on the magnetic elastic form factor $B(Q^2)$ around its apparent diffraction minimum and extend them to the highest possible Q^2, with a cross section sensitivity of 2×10^{-42} $\mathrm{cm}^2/\mathrm{sr}$.

The expected precision of the measurements together with recent data on the nucleon form factors will provide severe constraints in the theoretical calculations of the short range structure of the deuteron.

All $A(Q^2)$ measurements and $B(Q^2)$ measurements for $Q^2 < 1.5$ $(\mathrm{GeV/c})^2$ will use the Hall-A spectrometer facilities. The scattered electrons will be detected in the electron High Resolution Spectrometer and the recoiling deuterons in the hadron High Resolution Spectrometer. The $B(Q)^2$ measurements for $Q^2 > 1.5$ $(\mathrm{GeV/c})^2$ will require a 180^o electron spectrometer system made up of surplus magnets. The recoil deuterons will be detected in coincidence in a 0^o spectrometer consisting of a dipole magnet in addition to either the Hall-A hadron High Resolution Spectrometer or the Hall-C High Momentum Spectrometer. The Figure shows projected data using the Hall-A high-power liquid deuterium target and 15(30) days of beam time for the electric (magnetic) form factor measurement. Shown also is a recent

relativistic impulse approximation calculation with meson exchange current effects by Hummel and Tjon.