Jefferson Lab
Proposal Cover Sheet (Generic)

Experimental Hall: A
Days Requested for Approval: _____

Submission Date: 5/94
Other: PAC 8

❒ **New Proposal Title:**
☒ **Update Experiment Number:** 89-028
❒ **Letter-of-Intent Title:**
(Choose one)

Proposal Physics Goals
Indicate any experiments that have physics goals similar to those in your proposal.

Approved, Conditionally Approved, and/or Deferred Experiment(s) or proposals:

Contact Person

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Receipt Date: 5/94 PR 94-028
By: _____

May 24, 1994

UPDATE OF CEBAF EXPERIMENT 89-028

Polarization Transfer Measurements in the $d(\vec{e},e\vec{p})n$ Reaction

The Hall A Collaboration

J.M. Finn, P.E. Ulmer, spokesmen

Experiment 89-028 will measure the polarization of recoil protons in the $d(\vec{e},e\vec{p})n$ reaction as a function of Q^2 and recoil momentum. At high recoil momentum this reaction provides a fundamental measure of the short-range character of the two-body current. Deuterium is also an effective neutron target and this experiment will test the validity of the quasifree approximation used in extracting neutron form factors from the complementary $d(\vec{e},e\vec{n})p$ reaction.

The measurement will use the Hall A spectrometer pair including a focal plane polarimeter. The experiment requires a cryogenic liquid deuterium target and a liquid hydrogen target for cross-calibration. Due to the relaxed tolerances of polarization measurements compared to cross section measurements, this experiment can run early in the commissioning phase of Hall A. By exploiting their dierent helicity and second-scattering azimuthal angle dependence, all three components of polarization will be simultaneously extracted. In addition, by making measurements on either side of $\vec{q}$ we will separate ve of the polarization response functions as well as a combination of three additional polarization response functions.

Experiment 89-028 was approved by PAC4 for 8 of the requested 30 days. The PAC recommended the experiment be optimized to minimize the theoretical uncertainties in extracting $G_{E\ n}$ from the complementary reaction. Since then we have reduced the fractional error in the extracted value of g (= G_E/G_M) to 5%. This uncertainty is smaller than that anticipated from the complementary neutron experiment. We have also determined an optimal set of kinematics. The gure of merit of the polarimeter has a maximum at 500 MeV proton kinetic energy which we have chosen for our central Q^2 point. This also corresponds to a favorable precession angle of 124 allowing the extraction of all three polarization components. Working around this maximum we have selected two additional Q^2 points corresponding to proton energies of 250 and 750 MeV (giving three uniformly spaced Q^2 values of 0.47, 0.94 and 1.41 GeV^2 /c^2). Furthermore, by reducing the beam energy and increasing the electron scattering angle we can reduce the fractional error in the polarizations for a given Q^2. This has the benecial eect of reducing both the singles and coincidence rates (thereby reducing our maximum data rate requirement). We have chosen a xed beam energy of 1.6 GeV and electron scattering angles of 26.9, 42.8 and 61.1 degrees. For the central Q^2 point we can also examine recoil momenta up to 200 MeV/c

within the allotted beam time. Within the full 30 day request, we can extend the Q^2 range of the measurements to 3.2 GeV^2/c^2 and the recoil momentum range to 300 MeV/c. Since the sensitivity to two-body currents grows with recoil momentum it is essential to measure up to the highest feasible recoil momenta.

A lower energy version of this experiment is now underway at MIT-Bates utilizing a polarimeter built by members of this collaboration; the experience gained from the Bates experiment will be valuable for executing the CEBAF experiment. The polarimeter for CEBAF is being built by groups from William & Mary and Rutgers and will be available as part of the initial complement of equipment.