

# Jefferson Lab Proposal Cover Sheet (Generic)

Experimental Hall: \_\_\_\_\_  
Days Requested for Approval: \_\_\_\_\_

Submission Date: 5/94  
Other: PAC 8

- New Proposal Title:  
 Update Experiment Number: 93-026  
 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:

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Receipt Date: 5/94 PR 94-033  
By: \_\_\_\_\_

## Measurement of $G_{en}$

Donal Day, Spokesperson for PR93-026

A precise measurement of the neutron electric form factor will be one of the most significant contributions from the early physics program at CEBAF. Precision data out to large momentum transfer on a quantity of longstanding interest will provide a critical testing ground for models based on QCD. CEBAF experiment PR93-026 has been approved and has received a rating of A from PAC 5. In this communication we will set forth the current state of our preparations along with the suggestion of the earliest possible running date.

Our experiment exploits the asymmetry in the elastic scattering of polarized electrons from polarized nucleons which is proportional to the product of  $G_{en} \times G_{mn}$ . Longitudinally polarized electrons are scattered from a dynamically polarized deuteron target oriented such that the polarization axis is perpendicular to the momentum transfer. The electron is detected in the Hall C HMS in coincidence with the struck neutron in a plastic scintillator wall.

### Target

The polarized target has been built by the collaboration and has completed it's inaugural use at SLAC in E143. In that experiment the deuteron target polarization exceeded 40% with a beam current greater than 80 nA. Even with consideration for the decay of the polarization with accumulated charge the figure of merit equals or is slightly greater than that we have used in the preparation of our proposal for CEBAF. At this moment the target is at SLAC (where several operational enhancements are being made). It should be emphasized that our experience at SLAC was invaluable and we do not anticipate any problems operating this target in the CEBAF environment.

### Neutron Detector

The neutron detector for this experiment will be a segmented plastic wall consisting of three layers of 10 cm thick bars assembled such that it will present an area 3.2 meters vertically by 1.6 meters horizontally. Charged particle veto paddles will cover the entire detector. All the plastic bars and

paddles will have tubes at both ends. A subset of the neutron detector has already been used in a LEGS experiment at Brookhaven. It consists of 32 bars and 16 paddles along with the associated HV and electronics. An additional 16 bars have been assembled and tested. On order are the remaining 32 bars and their tubes, which will be mated and tested this summer. By the end of the year the entire detector will be moved to CEBAF for background studies in Hall C. Over the next 12 months will acquire the remaining electronics and HV channels to complete the detector; the necessary funds are at hand.

### Chicane

The effect of the 5T field of the polarized target on the electron beam will be compensated by a chicane which is part of the initial beam line optics in Hall C. It will be completed by the end of this calendar year.

### Polarimeter

A novel type of polarimeter for the measurement of the electron polarization has been developed, and tested. This polarimeter is based on the *out of plane* polarization of electrons in a pure iron foil placed in a 4T field, and the continuous measurement of the foil polarization exploiting the Kerr effect. This type of polarimeter will allow to measure the beam polarization much more accurately than possible up to now.

The crucial part of the polarimeter — the optical set up — has been tested in Basel, and is presently being shipped to UVA, where the superconducting split coil magnet is installed in the scattering chamber. The elements of the vacuum system are under construction at CEBAF, the slit box is under construction in Basel. The simple set of detectors needed for the coincident detection of scattered and recoil electrons will be built at UVA. The electronics is at hand.

### Collaboration Commitment

Our collaboration has made a significant and extended commitment to CEBAF and to the successful operation of this experiment to measure the electric form factor of the neutron. We have successfully constructed a new high power polarized target of robust performance. We are building the electron

polarimeter in Hall C which will exploit a new technique to allow the smallest systematic errors on such measurements heretofore. We are building a neutron detector 3.2 by 1.6 meters in area and will provide all the associated electronics. The beam line chicane and charge instrumentation has been implemented by collaborators at CEBAF. Our planning has been extensive, and the collaboration has made a large effort in both manpower and funds.

The collaboration has realized all the elements needed for the successful running of the  $G_{en}$  experiment, and the devices needed for the polarization measurement are calibrated to an accuracy better than needed. We will be ready at the earliest possible time consistent with the availability of polarized beam at CEBAF.