Proposal Number: PR12-11-009 **Hall: C**

Title: The Neutron Electric Form Factor at Q^2 up to 7 $(GeV/c)^2$ from the Reaction $^2H(e,e'n)^1H$ via Recoil Polarimetry

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Beam time request:

Days requested for approval:	67 (= 60+7)
Tune up included in beam line request:	yes

Beam characteristics:

Energy:	4.4, 6.6, 11.0 GeV
Current:	80 μA
Polarization:	Yes (80%)

Targets:

Nuclei:	^2H(40 cm), ^1H(40 cm), dummy target
Rastering:	yes
Polarized:	No

Spectrometers:

HMS:	No
SHMS:	Yes (but see text below)
Other (BigCal, etc.):	Neutron Polarimeter (NPOL)

Special requirements/requests:

Spin precession dipole and shield house for neutron polarimeter.

Technical Comments:

This is a large installation experiment, utilizing a new, significantly redesigned neutron polarimeter (NPOL). This polarimeter consists of a large dipole magnet used to precess the neutron spins, an array of 218 scintillator bars, and a shielded hut to contain the scintillator array.

The meat of the proposal appears identical to the PAC34 document. The principle changes involve dropping the lowest Q^2 point due to a mechanical interference at the associated kinematics, and a significant redesign of the neutron polarimeter. The remaining kinematics, SHMS spectrometer angles, and SHMS detector parameters are all achievable and lie within expected performance envelopes.

The new neutron polarimeter design seems promising. The redesign does involve a considerably different layout than the prior setup, which was an extension of the E93-038 design. This new arrangement seems better matched to the present experiment, and provides a significant increase in the FOM. The upgraded design looks to be well characterized through MC simulations, with attention paid to background rates, false asymmetry and dilution effects. All seem well in hand, and are thoroughly cross checked against prior data taken in Hall C.

As with the previous proposal, the only significant technical question remains the design details of the spin precession dipole. Section 8 touches on this only briefly, with the comment that the decommissioned BM-111 dipole from Argonne is the new proposed candidate (replacing Charybdis). Unfortunately, full specifications for that magnet appear to have been unavailable prior to submission of this proposal. The required average field of 2T over the 2m dipole length is well into the non-linear saturation region of magnet iron. Reaching such fields would seem to require non-trivial (and costly) power supply and cooling requirements that are not addressed in the proposal. We also have concerns about the plan to taper the dipole gap. While the reduced average gap dimension will reduce the power supply requirements, and the resulting curved field lines (conceptually shown in Fig. 12) may have some physics advantage, the change in mechanical load on the dipole yoke and other structural components needs to be investigated.

As there is no detailed layout diagram, we also have some (minor) concerns about possible interference issues between the NPOL magnet, shielding hut and existing Hall C infrastructure (beamline and SHMS carriage).

The power deposited in the 40cm LH2 and LD2 targets at 80uA is more than 500W and thus may require special arrangements, careful scheduling, or ESR upgrades. While certainly achievable, this is an atypical requirement that may constrain operation in other Halls (ex. Q_{weak}, even with the addition of the new heat-exchanger).

In summary, we agree with the TAC report for the previous iteration of this proposal. This is an experienced collaboration with a proven, low-risk technique. However, the collaboration needs to show that they have a viable technical and cost solution for the dipole on the neutron line which is consistent with their proposed spin precession angles, beam request, and projected error bars.