**Proposal Number:** LOI 12-21-002 and LOI 12-21-004 **Hall:** A

**Title:** Measurement of the Tensor Observable Azz using SoLID and Measurement of the

Deuteron Tensor Structure Function *b1* with SoLID

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**Beam time request:**

Days requested for approval: 14 days production + 4.9 days overhead

Time needed including energy changes: Yes

Tune up included in beam time request: No

**Beam characteristics:**

Energy: 6.6 and 8.8 GeV

Current: 100 nA

Polarization: No

**Targets:**

Nuclei: ND3 (3 cm)

Rastering: Yes

Polarized: Yes

**Spectrometers:**

HRS-L No

HRS-R No

Other SoLID

**Special requirements/requests:**

-Installation of the UVa/JLab Polarized ND3 target.

**General Comments:**

1. The two LOIs, LOI12-21-002 and LOI12-21-004, propose to use the same 14 PAC days split evenly between 6.6 and 8.8 GeV beam energies. The first LOI requests 4.9 days of overhead for polarization changes, pass changes, target annealing, calibrations, etc., and the second LOI requests 3 days for similar overhead requirements. As the equipment and beam time requests are the same it seems reasonable to combine the two LOIs into one proposal in the future. Presumably, there is significant, if not complete, overlap between the two overhead requests, and this should be detailed explicitly in any future proposal.
2. These LOIs propose to use the SoLID detector to study the deuteron tensor structure function *b1* and the tensor asymmetry *AZZ* using using DIS and quasi-elastic electron scattering respectively.
   1. Past *b1* measurements made by HERMES found unexpectedly large values of *b1* compared to model predictions consistent with a small or zero *b1.* However, these measurements were all consistent with zero to about the two sigma level providing motivation for a more accurate measurement. A precise determination of *b1* that is inconsistent with conventional models, i.e. large, would require more exotic models as an explanation.
   2. Quasi-elastic *AZZ* data will be useful for comparing light cone calculations with nucleon-nucleon calculations. A determination of *AZZ* would also improve our understanding of the high momentum components of the deuteron wavefunction and tensor effects like the dominant *pn* correlations in nuclei.

**Technical Comments:**

1. These LOIs are very similar to the conditionally approved C12-15-005 and PR12-13-011 proposals in Hall C. Does the collaboration intend to withdraw either of these proposals if the current LOIs become approved proposals? What are the benefits of running both sets of experiments?
2. This experiment proposes to use the JLab/UVa dynamically polarized solid ND3 target and assumes a tensor polarization of 25% (56% vector polarization).
3. The condition that 30% tensor polarization be demonstrated under experimental conditions was applied to the two Hall C proposals. In the updated C12-15-005 proposal RF hole-burning was said to have achieved 30% tensor polarization in deuterated butanol and was being applied to ND3 with results expected in the coming months. Has any further progress towards 30% tensor polarization in ND3 been demonstrated?
4. The target group indicates Level 3 effort: Installation or modification of a technically challenging, existing target system.
5. The target group further notes:
   1. “A tensor polarization of 25% is assumed, which is the value that one obtains when the vector polarization is 56%. However, I do not believe 56% vector polarization has been demonstrated in ND3 or 6LiD using a 1K/5T target system under normal experimental conditions. A more realistic value for the vector polarization is probably 40%. This corresponds to a tensor polarization of 12%.”
   2. “The LOI also mentions that the tensor polarization can be enhanced using partial saturation of the deuteron’s NMR line. This technique has been demonstrated with considerable success in the UVa target lab, but it obviates the ability to determine the polarization via the standard NMR techniques described in Section 2.3.1. Instead, a more sophisticated lineshape analysis, also developed at UVa, must be utilized. While on strong theoretical grounds, the absolute accuracy of this analysis has not been established.” Although it should be noted the update C12-15-005 proposal states, “Progress has been made in determining and increasing Pzz from line shape analysis, which includes a publication in Eur.J.Phys. A. that is currently under review.” Explicit details of this progress would help to address this concern.
   3. “The caption of Fig. 8 is in error (LOI12-21-002). The plot on the right-hand side shows a *negative* polarization of about -30% (low-frequency peak > high-frequency peak). It also shows that the larger NMR peak was destroyed by RF saturation. Doing so increases the population of the m=0 spin state, which actually *decreases* the tensor polarization.”
   4. “Note that the target will acquire radiation damage during the unpolarized as well as polarized runs and will reduce the lifetime of the target samples. The most efficient data-taking sequence to reduce the overhead for annealing is probably Polarized : Unpolarized : Anneal : Polarized, etc.”
6. In the tables describing the rate estimates rates are given in `physics rate' and `total rate'. It is unclear which of these rates is the trigger rate. An explanation of what each of these rates represents should be included in a full proposal.
7. As noted by the authors, a full simulation of the SoLID detector should be performed for rate estimates before a full proposal is submitted.
8. The authors acknowledge the importance of time dependent drifts on systematic quantities like luminosity and detector efficiency due to taking polarized and unpolarized measurements at different times. If these drifts are not well controlled and understood they could dwarf small asymmetries. This is addressed more explicitly in LOI12-21-004 section 2.1.2 where fluctuation rates from past experiments are used for estimates (HRS detector drift rates are referenced, but of course the SoLID detector will have different characteristics). The discussion of time dependent systematic errors and mitigation plans for each type of uncertainty in section 3.4.2 of the C12-15-005 proposal would be useful to add to a full proposal (and be adapted to the SoLID detector when necessary). Do the authors anticipate any changes required to monitoring systems to minimize these time dependent systematic uncertainties?
9. Will the BCM calibrations listed in the overhead tables be invasive to the other halls?
10. Is the tungsten calorimeter required for 1% charge uncertainty? If it is required, it should be addressed in the full proposal since it would need to be installed and may require DAQ upgrades. Another option instead of the tungsten calorimeter would be to use a Faraday cup like the one in Hall C.
11. The authors should investigate the possibility of using an physics channel, like Moller or DIS, to monitor the luminosity with SoLID.