Proposal Number: LOI12-16-007 **Hall: A**

Title: First Measurement of the e - $^3\overrightarrow{He}$ Parity Violation Deep Inelastic Scattering Asymmetry using an Upgraded Polarized ^{3}He Target

Contact person: Y. X. Zhao

Beam time request:

Days requested for approval:	180
Tune up included in beam line request:	No

Beam characteristics:

Energy:	11
Current:	60 μA
Polarization:	NA

Targets:

Nuclei:	60 cm ^{3}He
Target Cryo Load:	< 100 watt
Rastering:	Yes
Polarized:	Yes
Radiator	No

Spectrometers:

HRSL	No
HRSR	No
Other	SoLID

Special requirements/requests:

Special addition to the previously considered configuration of SoLID with a new upgrade to the polarized ^{3}He gas target. The required target density is 16 times over the stage 2 upgrade of polarized ^{3}He target for the Gen-II experiment with a larger polarizing cell and the target cell kept in cryogenic conditions on the beam line.

Technical Comments:

1. This letter of intent proposes to measure the parity violating asymmetry between an unpolarized beam and polarized ^{3}He to extract $g_1^{\gamma Z}$ the polarized electroweak interference structure function of the nucleon. The SoLID apparatus configuration is similar to two approved SIDIS experiments E12-10-006 and E12-11-007 and it

is claimed that it would minimize setup and installation if scheduled adjacent to one of them, except for the target installation.

2. The required target for this measurement will be new equipment. The target is billed as a stage 3 upgrade of the polarized ^{3}He gas target with 16 times higher density than the stage 2 upgrade, with a 60 cm glass cell with metal endcaps on the beam line kept at 77 K. While it is not known if ^{3}He can be polarized at over 50 atm, the collaboration acknowledges that the target will require significant R&D and feels confident that it will work. The liquid nitrogen source on site has not been reliable so the collaboration should elaborate more on their use of cryogens.
3. The LOI requires 180 days just for the physics measurement but does not provide contingency for target density reduction with beam on and lost helicity states due to beam trips. There are no estimates of luminosity loss due to the target density reduction when the beam is on. Numerical estimates done with computational fluid dynamics for the tritium gas target, 40 cm closed cryogenic cell, at a beam of only 20 μA are about 15%. The ^{3}He cell is a 60 cm long and the beam is 60 μA so it could have significant luminosity loss due to density reduction, which has not been accounted for in the beam time request.
4. The PV asymmetry will be made by flipping the ^{3}He polarization every minute. A pair of helicities will be made over a 2 minute window. In the beam time request there is no account on how the beam trips will reduce the running efficiency by cutting the number of valid helicity pairs that will go into the PV asymmetry calculation.