Individual Letter of Intent Report

Letter of Intent: LOI 03-106

Title: $\vec{e} - {}^2H$ Parity Violating Deep Inelastic Scattering at CEBAF 6 GeV

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This LOI proposes to perform a measurement of the parity violating deep inelastic asymmetry of $\vec{e} - {}^2H$ at $Q^2 = 2$ (GeV/c)^2 with a 6 GeV beam.

The two Hall A HRS spectrometers will be used to detect the electrons scattered from a 15-cm liquid deuterium target. The deuterium target is chosen due to the isospin symmetry that relates u and d quark distributions in the proton and neutron.

A Compton polarimeter upgrade for a 1% precision of the beam polarization and a fast DAQ to handle rates of about 1 MHz will be needed for this measurement. These two specific requirements appear feasible but should be better investigated.

From the asymmetry measurement, the weak mixing angle $\sin^2\vartheta_W$ will be extracted to test the prediction of the Standard Model in a Q^2 domain between the present NuTeV results and the expected ones from SLAC-E158 and JLab-Q_{weak}. The accuracy of the present proposal will not be at the level of the approved JLab-Q_{weak} and not better than the NuTeV result.

In addition, the proponents would like to extract precise information on a combination of the poorly known weak V-A C_{2u} and C_{2d} couplings and on the possible higher twist effects in this Q^2 domain. Since the asymmetry will be dominated by the combination of the A-V C_{1u} and C_{1d} couplings, this extraction will be based on assumptions or on existing results at different Q^2. The implication of this procedure should be better investigated by the Collaboration. Also, the separation of higher-twist effects from deviations beyond the Standard Model should be addressed.

The success of the proposed experiment will depend on the precision of the knowledge of the beam polarization and on a series of corrections like the charge symmetry violation, the electro-magnetic, and electro-weak radiative effects which should be determined with high accuracy.

The PAC recognizes the importance of the proposed measurement but notices that a significant improvement in the test of the Standard Model will not be achieved. In addition, a more convincing case for the extraction of the V-A couplings is required.