## Abstract

We propose to measure the parity-violating electroweak asymmetry $A_{PV}$ in the deep-inelastic scattering of polarized electrons (PVDIS) to high precision in order to search for physics beyond the Standard Model in lepton-quark neutral current interactions. Presently, the atomic parity-violation measurement in $^{133}$Cs provides important limits on such new physics, and the Qweak experiment at Jefferson Laboratory will provide an additional constraint. Our proposed PVDIS experiment will provide constraints of similar precision to these measurements, but will be unique in that it is sensitive to axial-hadronic currents. Such currents are only accessible in DIS; their interpretability in analogous measurements in elastic scattering is limited due to unconstrained and theoretically intractable radiative corrections. One measure of our sensitivity is that we will measure $\sin^2\theta_W$ with a precision of $\pm 0.0006$.

In order to perform such a precise test, possible novel hadronic physics issues must be addressed. One is the violation of charge symmetry (CSV) at the quark level. Another is the contributions from interesting higher-twist operators. Since we will measure an asymmetry, some higher-twist contributions will cancel, but those particular higher-twist terms involving quark-quark correlations might remain at a significant level. Establishing whether or not these two effects are substantial is extremely interesting in itself.

We plan to use several different targets. Deuterium is ideally suited for the Standard Model test. With a hydrogen target, we can measure the $d/u$ ratio in the proton. Finally, with a heavy nucleus like $^{208}$Pb, we can provide a new window on the EMC effect.

In order to untangle the above physics, we plan to measure $A_{PV}$ with a precision of about 0.5% over the range $0.3 < x < 0.7$ and with a dynamic range of $Q^2$ of about a factor of two. To reach the region where $x > 0.55$ with $W > 2$ GeV, scattering angles on the order of 30° with an 11 GeV beam are required. To obtain sufficient statistics, very high luminosity combined with a large azimuthal acceptance, about $1/3$ of $2\pi$, is required. Presently, no machine or apparatus exists which meets this requirement.

In this proposal, we present a design of a new spectrometer, called SoLID, which is based on a large solenoidal magnet. Fast-counting of particles through tracking, Cherenkov, and calorimeter detectors will provide sufficient resolution and particle identification for precision measurements at high rates in well-defined kinematics. Combined with upgraded polarimetry at the level of 0.5%, the resolution and luminosity of SoLID will provide the precision necessary for this broad program of electroweak studies.