

## PR12-21-006

**Scientific Rating:** N/A

**Recommendation:** Deferred

**Title:** Measurement of the Asymmetry  $A_d^{e^+e^-}$  between  $e^+ - {}^2\text{H}$  and  $e^- - {}^2\text{H}$  Deep Inelastic Scattering Using SoLID and PEPPo at JLab

**Spokespersons:** X. Zheng (contact)

**Motivation:** The proponents seek to measure  $e^+e^-$  asymmetry for the DIS process as a function of  $Q^2$  and  $x$  using the SoLID detector in PVDIS configuration. This quantity will then be converted to a measurement of the combination  $2 C_{3u} - C_{3d}$  of electron-quark couplings, and alternatively of the structure function  $F_3^{\gamma Z}$ . Little is known about these quantities, and the proposed data could reveal a sign of physics Beyond the Standard Model (BSM).

**Measurement and Feasibility:** SoLID is in the approval process; this is an advanced use of that detector. The positron beam at JLab is in the planning stage; this is a very advanced use of that beam.

**Issues:** The PAC is pleased to see such an interesting and far-reaching proposal. The proponents have carefully considered a variety of issues. In particular, their examination of systematic uncertainties is laudable. At the same time, the requirements on the accelerator and theory are both daunting.

The lab is actively investigating the possibilities for a positron beam; a process that will go on for some time. Unfortunately, this proposal expands the existing goals for equality of electron-positron beam energies and the time scale for switching between them. In particular, the lab currently envisages running positron and electron beams in alternate years, whereas the proposers seek changeovers every few weeks.

The accuracy of extracting  $2 C_{3u} - C_{3d}$  from the asymmetry needs to be estimated in a more comprehensive and transparent way. Problems include higher twist contributions, two photon exchange contributions, and QCD NLO corrections among a variety of concerns. The collaboration includes theoretical colleagues, and that is excellent. However, significant work is required from them before such a sophisticated measurement is feasible. At minimum, a realistic assessment of the theoretical uncertainties is needed. Expected backgrounds specific to  $e^+$  beams might be better understood using data from previous experiments with positron beams at other facilities. In addition, some scenarios of BSM model predictions should be checked against the accuracy goals, to gauge the sensitivity of the measurement to BSM physics. The PDG notation of  $g_{AA}^{eq}$  etc. should be used for the weak neutral current couplings, to allow a direct comparison between different experiments, as well as a proper treatment of higher-order corrections.

**Summary:** This proposal will require a tour-de-force effort, and the PAC encourages the group to proceed with development. To allow the community better usage of the results, the proposal

should include estimates of asymmetry and cross section uncertainties. At this time, our concerns about the details of having the proper beam and the optimal theory extraction of the electron-quark couplings leads us to defer the proposal in its present form.