

Proposal Number:

PR12-21-006

Hall: A

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

Contact person: Xiaochao Zheng

Beam time request:

Days requested for approval:

12

Tune up included in beam time request:

Calibration Yes, Commissioning No

Beam characteristics:

Energy:

6.6, 11 GeV

Current:

3 μA (positrons and electrons)

Polarization:

No

Targets:

Nuclei:

LD_2 , ${}^{12}\text{C}$ (multifoil)

Target Cryo Load:

50W

Rastering:

Yes

Polarized:

No

Spectrometers:

HRS-L

No

HRS-R

No

Other

SoLID (PVDIS configuration)

Special requirements/requests:

1. Positron beam, consistent with the planned PEPPo system
2. Secondary electron beam from PEPPo source will also be used

This experiment will use the SOLID apparatus in the PVDIS configuration (same configuration as E12-10-007).

Until a more developed proposal of the positron injector is agreed upon, proposals have been directed by the Jefferson Lab Positron Working Group to consider as a base line the availability of unpolarized beams up to 3 μA and polarized beams up to 100 nA with >50% polarization.

The requested positron and electron parameters of this proposal are consistent with the parameters of the two conditionally approved experiments of the previous PAC.

Technical Comments:

1. It is not yet known how well the energies of the pair-produced electron and positron beams can be set absolutely, or to one another. The 1E^{-4} requirement on the beam energies being similar may be challenging to achieve, the impact of the beam energies to the success of the experiment should be considered carefully.
2. It will likely take several weeks to switch the accelerator configuration between electron and positron running, possibly resulting the electron and positron runs taking place in different years.
3. This proposal would utilize the 40 cm long cryotarget (liquid deuterium) proposed for the SoLID suite of experiments. This target will be a substantial, multi-year effort which will also be required for the PVDIS experiment.
4. Although polarized beam is not needed, the Compton polarimeter will be used to measure the (nominally low) beam polarization. Operation of the Compton polarimeter for positrons beams should be straightforward.
5. The proposal notes that target boiling effects are primarily driven by the raster size and this will be the same between runs. However, there is some evidence that target boiling effects can also depend on the intrinsic beam size. It might be prudent to plan to monitor the beam size at regular intervals to ensure no time dependence in the target boiling effects.
6. The proposal assumes that the BCM response can be controlled at the 1% level over long periods (i.e. between the positron and electron run periods). Constraining the time dependence of the BCM response at this level will require regular, rather frequent, BCM calibration measurements. In addition, these measurements will likely require use of the Faraday cup in the injector and will be invasive to the other halls.
7. Other possible sources that could change the electron/positron yields in a time dependent way include detector response, acceptance, readout electronics, and beam properties (trajectory and position).
8. The proposal suggests a novel technique to minimize the sensitivity to factors (such as BCM response, beam energy, and detector efficiency) that would impact the relative (global) normalization of the positron and electron data sets. A key assumption is that none of these normalization factors introduce any point-to-point uncertainty (as a function of Q^2) to the asymmetry. The detector efficiency in particular could have acceptance-dependent efficiencies that change with time/run conditions. Even a 0.1% such point-to-point uncertainty have a significant impact on the expected precision.