Comments on Run-Group Proposal:
"Measurement of Deep Exclusive π^- Production using a Transversely Polarized ^{3}He Target and the SoLID Spectrometer"

Measurements of Deep Virtual Exclusive Scattering (DVES) on transversely polarized targets are absolutely essential to the global GPD effort.
This proposal includes a number of key features that would likely make it successful with high impact:

- The nominal final state is only charged particles: "n"(e,e'π^-p), embedded in ^{3}He(e,e π^-p)X. This provides a good signature for exclusivity.
- The projected precision is at least an order of magnitude better than the previous HERMES measurements
- There is good acceptance in proton recoil momentum

In the following are reasons why the committee did not vote to endorse this proposal to JLab PAC-44.

- PAC proposals are archival documents. This proposal potentially merits status as a flagship experiment justifying funding for the SoLID project. As such, the proposed measurement requires a document that more clearly addresses both the goals of the experiment and the potential limitations.
- Regarding goals, the collaboration should attempt to quantify the projected precision of the measured spin-dependent cross section. Although the Asymmetry may have a smaller error bar, the spin-dependent cross section difference has a simpler interpretation. Measuring the spin-dependent cross section is also consistent with the opening sentence of Appendix A (although that sentence makes no mention of spin-dependent terms, and therefore is a little out of context).
- The extraction of the term $\left[\sigma_{TT}^{y}+2\epsilon\,\sigma_{L}^{y}\right]$ in Eq'n 8 from the other sinβ and cosβ terms requires good knowledge of the β-acceptance in each *t*-bin. This should be shown, in addition to the acceptance plots of Fig. 12.
- The committee was confused by the written and oral presentation of Fig's 15 and 16, establishing the exclusivity. (There was also a minor typo in the proposal and the presentation slides in that the blue curve in Fig 15 is labeled "w/o resolution")
    - These figures and curves are labeled (e,e' π^-)p, but in fact the proton ***is*** detected. There was continued confusion whether "Missing momentum" meant the presumed final state proton momentum, based on the (e,e' π^-) kinematics on an assumed at-rest neutron, or the reconstructed initial momentum of the neutron, based on (e,e' π^-p) kinematics.
    - The committee is convinced that the SIDIS background is likely not a major problem. However, an alternate approach (rather than SIDIS fragmentation functions) could be used. The primary channel under study is ^{3}He*(e,e' π^-p) pp*, with the two undetected protons spectators. The continuum background that

can leak under the quasi-exclusive peak can be of the form $e+n \rightarrow e' + \pi^- + \Delta^+$ with the Δ^+ decaying to $p\,\pi^0$

  - The effects of Fermi-smearing, detector resolution, ionization energy loss and bremsstrahlung need to be clarified. Although they seem to all be included in Figs 15 and 16, it was not clear which curves included which effects.
- There are a number of important theory issues raised by this proposal. These probably cannot be fully resolved before re-submission, but it will be important to have a clear dialog with relevant theories (and experimentalists) in place.
  - This proposal focuses on the $\left[\sigma_L^y\right]$ term, which is predicted to dominate at sufficiently high Q^2. This term is also dominant at low-t, due to pion-pole dominance. However, recent $p(e,e'\pi^0)p$ data from CLAS and Hall A demonstrate that σ_T is large, and we cannot count on simple $1/Q^6$ and $1/Q^8$ behavior for σ_L and σ_T, respectively. Both Goloskokov and Kroll, and Liutti and Goldstein have published estimates of σ_T, based on transversity GPDs and a twist-3 helicity-flip pion distribution amplitude. One or the other of these theory groups should be engaged in a discussion of both the $\left[\sigma_L^y\right]$ and $\left[\sigma_{TT}^y\right]$ terms.
  - There is extensive new data and theoretical progress regarding *NN* final state interactions (FSI) in *(e,e'N)* reactions on light nuclei. The upcoming Hall A *(e,e'p)* measurements on ^{3}He and ^{3}H may be particularly instructive. The QCD factorization theorem implies color transparency for the final state π^- in this proposal. Thus the FSI are identical with ^{3}He(e,e'p), just with a more exotic scattering amplitude. In general, FSI effects are small except for a large peak at $\theta_N \approx 70°$. It is not practical to obtain full FSI calculations before resubmission, but again, a dialog should be started both with the groups doing FSI calculations, and the groups doing Deep Virtual calculations on light nuclei. Empirically, it will be useful to determine if the FSI 'peak' lies within the $^3\mathrm{He}(e,e'\pi^- p)NN$ acceptance of this proposal.
  - Fermi-momentum is not just a kinematic effect. It also affects the DVES amplitude. The ^{3}He momentum distribution $\rho(p)$ is plotted in Fig.10 (Appendix A). The weighted distribution $p^2\rho(p)$ peaks at $p_n \approx 60$ *MeV/c*. This means that the effective x_B is smeared by $\approx p_n/M \approx 6\%$. The significance of this effect should be discussed. Also, if the proton momentum resolution is good enough, it will be possible to correct for this effect, event-by-event.

The following are some more minor points, typos, to be corrected in an updated proposal.

- The definition of the azimuthal angles in Fig 3 is inconsistent between the drawing and the caption. The drawing has ϕ_π, the caption refers to ϕ_S and ϕ.
- Eq'n 7 makes no reference to proton terms in numerator or denominator, or to the TT term in numerator.
- In the discussion of "precocious" scaling on page 8, there is no clear statement of how scaling can be tested.
- The description of the CLEO magnet in section 2.2 is possibly in error. The inner diameter of the CLEO coils is close to 3 m, not 1 m.

- Table 2, under ‘polar angle coverage’ makes mention of a proton recoil detector covering the range 24°—50°. No further mention of this supplemental detector is made, but no clarification is given that this hypothetical detector is not included in the projected acceptance.
- The z-axis labels (color scale) are truncated in Fig. 11.
- Fig 16 caption refers to Top(bottom) panels but there is only left-right. The phrase “The broadening effect of the missing mass due to the Fermi motion and the energy loss is indicated by the magenta curve” is confusing. It is the blue curve that includes Fermi-motion effects.
- Table 5 (systematic errors) needs a little more discussion/justification.

In summary, the committee feels that the physics is exciting, and looks forward to an updated proposal.