Preliminary Measurement of Longitudinal Spin Asymmetry A_1 on ^3He

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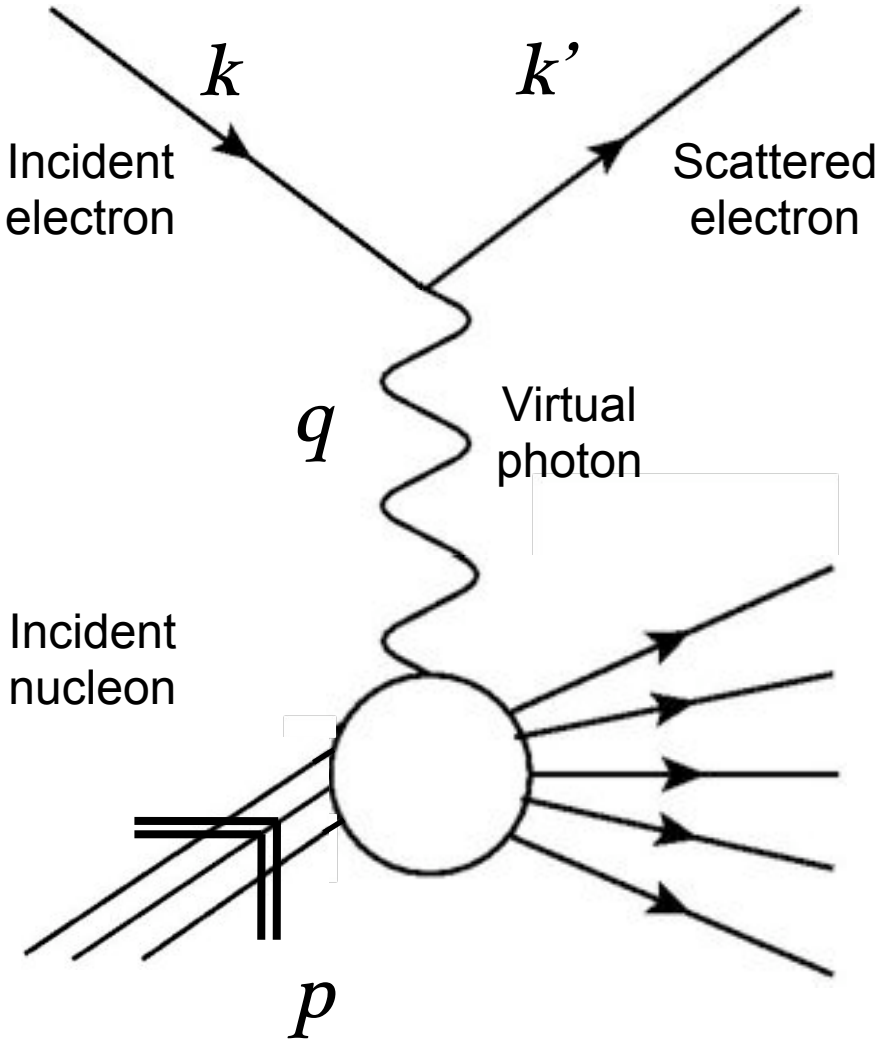
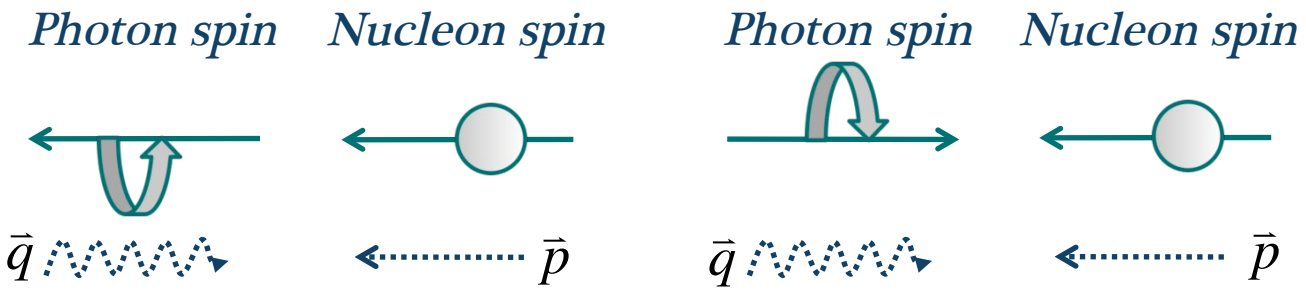
Introduction: Deep Inelastic Scattering



- Start with a polarized electron and a polarized nucleon
- They exchange a virtual photon
- Virtual photon probes single quasi-free quark inside nucleon
- We measure scattered electron

Virtual Photon Asymmetries

- What spin information do we have at the hadron vertex?

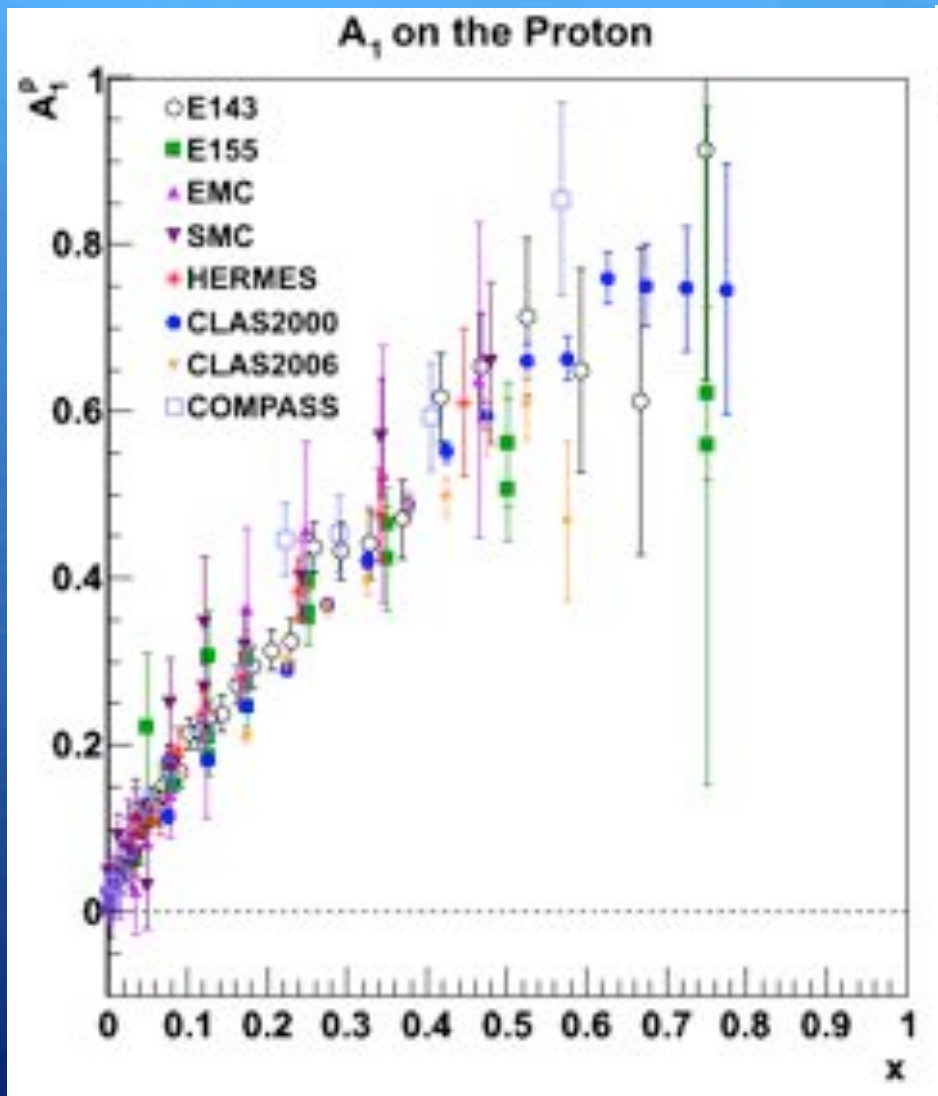


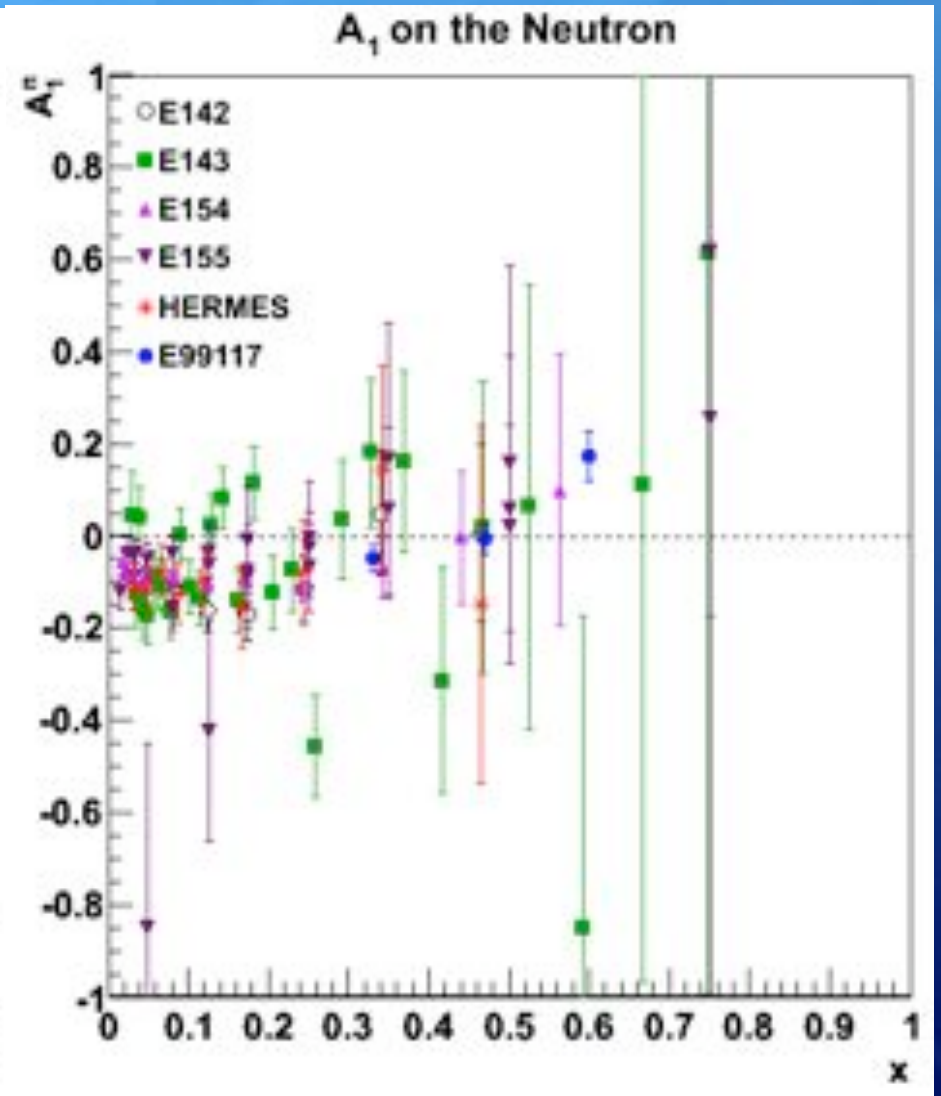
Same helicities: $\sigma_{3/2}$ Opposite helicities: $\sigma_{1/2}$

- We can form an asymmetry based on this relationship

$$A_1\left(x,Q^2\right) \equiv \frac{\sigma_{1/2}-\sigma_{3/2}}{\sigma_{1/2}+\sigma_{3/2}} \approx \frac{g_1\left(x,Q^2\right)}{F_1\left(x,Q^2\right)}$$

Existing DIS Data on Nucleon A_1

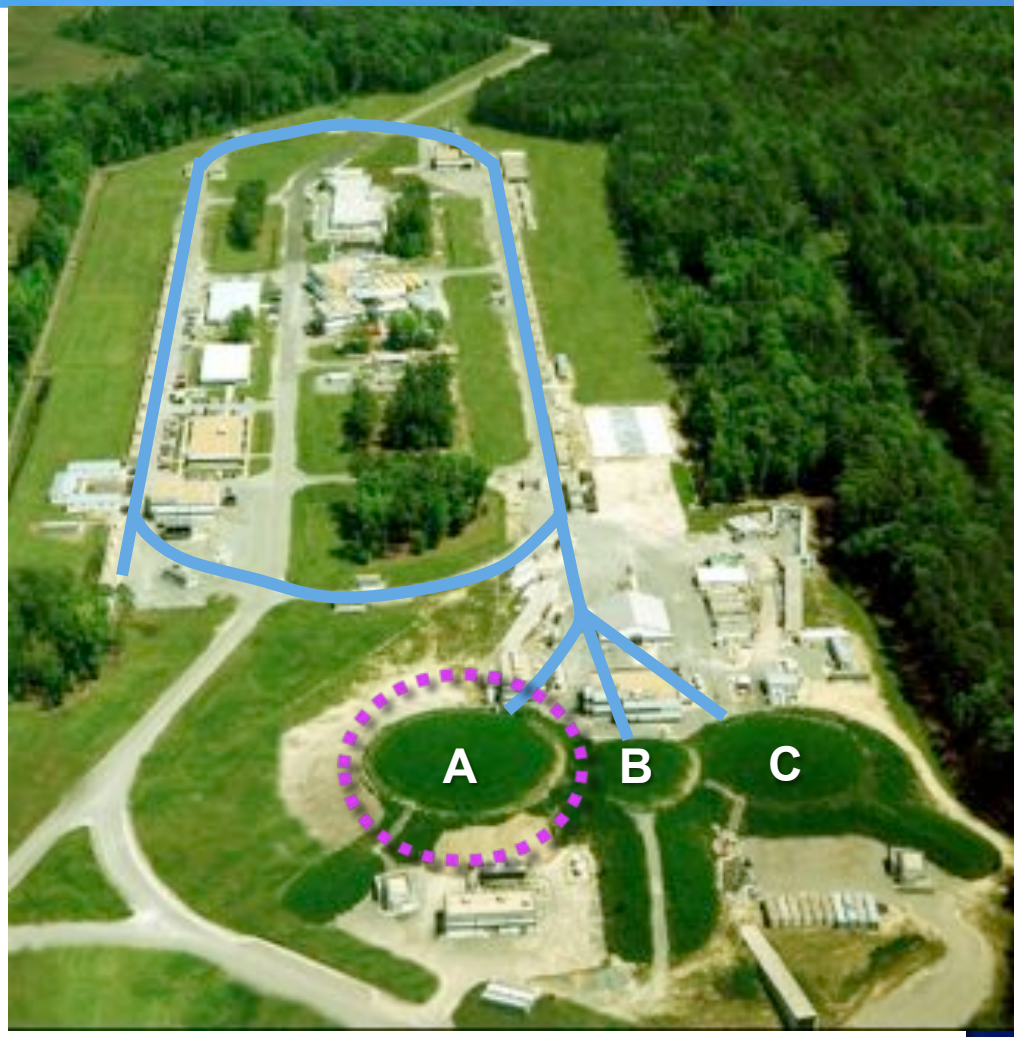




Jefferson Laboratory

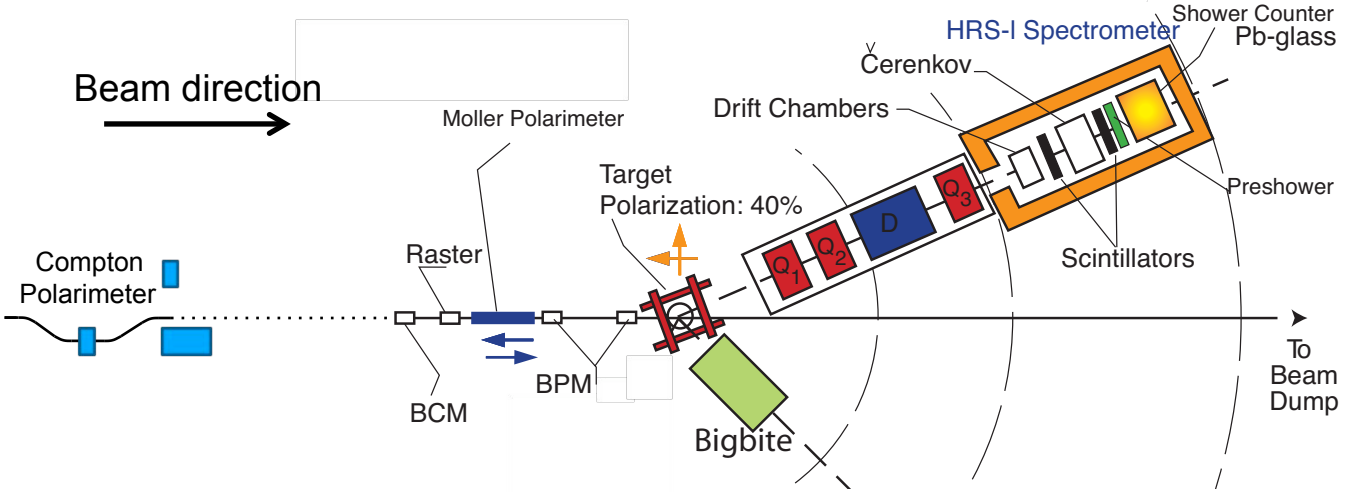
- SRF electron accelerator in Newport News, Virginia
- E06-014 ran in Hall A in 2009
- Use asymmetries in deep inelastic scattering, kinematic variables and world data to form A_1

$$A_1 = \frac{1}{D(1+\eta\xi)} A_{\parallel} - \frac{\eta}{d(1+\eta\xi)} A_{\perp}$$

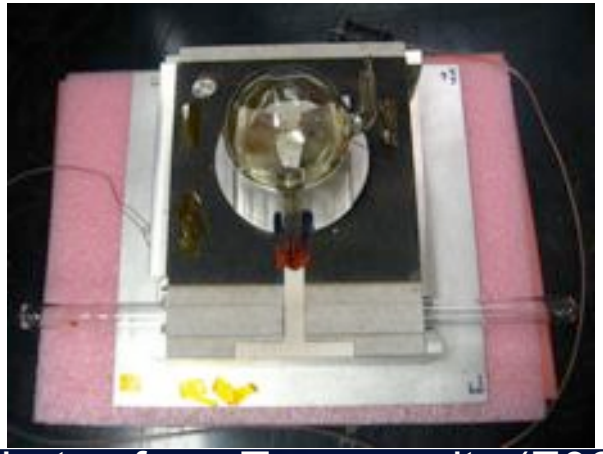


Courtesy of JLab Picture Exchange

E06-014 Setup in Hall A

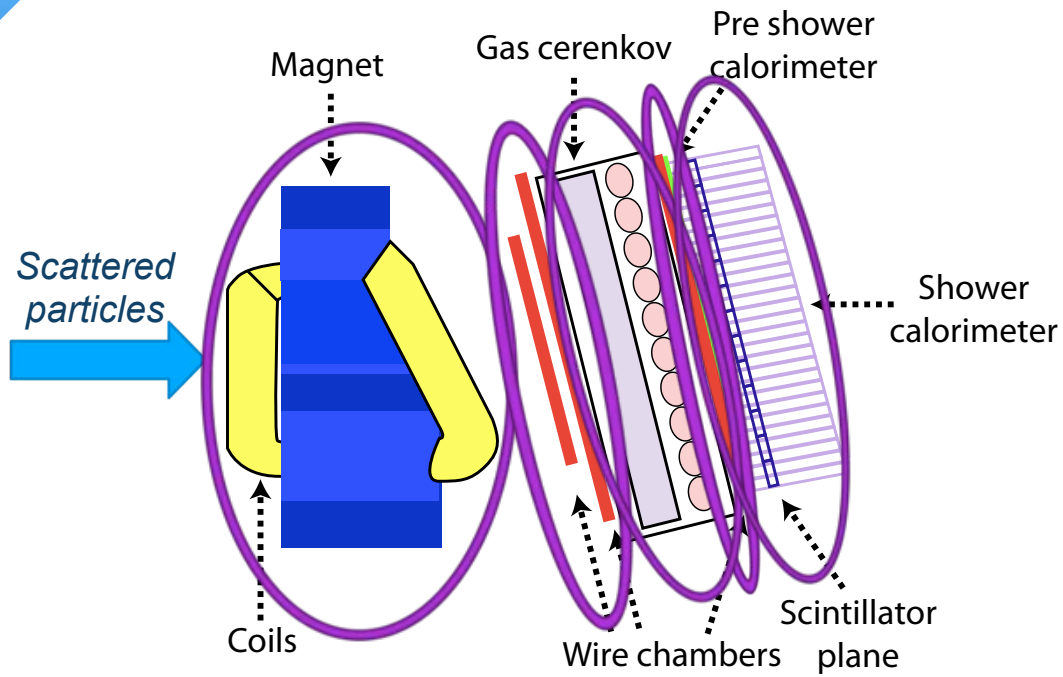


Polarized ^{3}He target



BigBite spectrometer

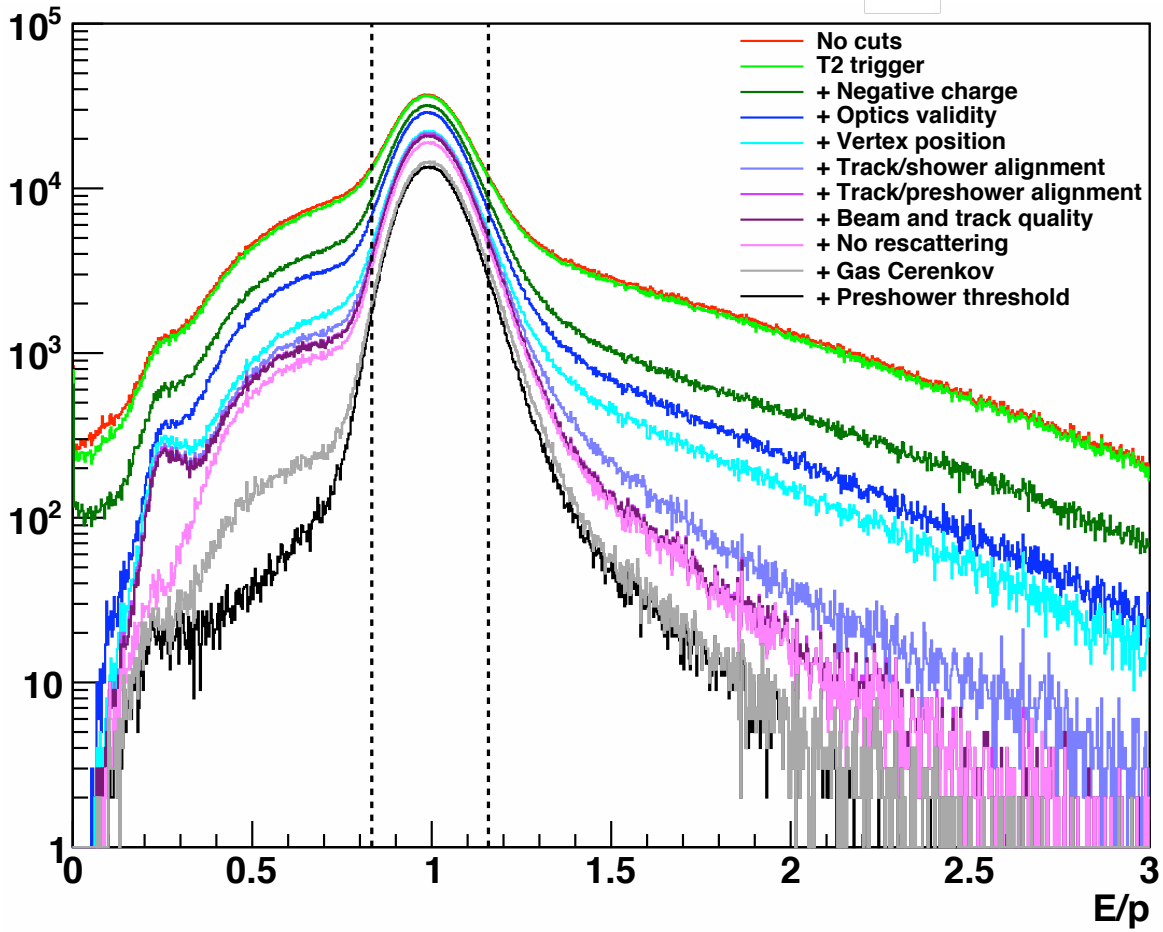
BigBite Spectrometer



Adapted from Xin Qian, PhD thesis, 2010

- Magnet
  - Separates by charge and momentum
- MWDCs
  - Reconstruct trajectory, forward and back
- Gas Čerenkov
  - Removes pions from online trigger
- Calorimeter
  - Measures energy
  - Particle identification

Scattered Electron Sample

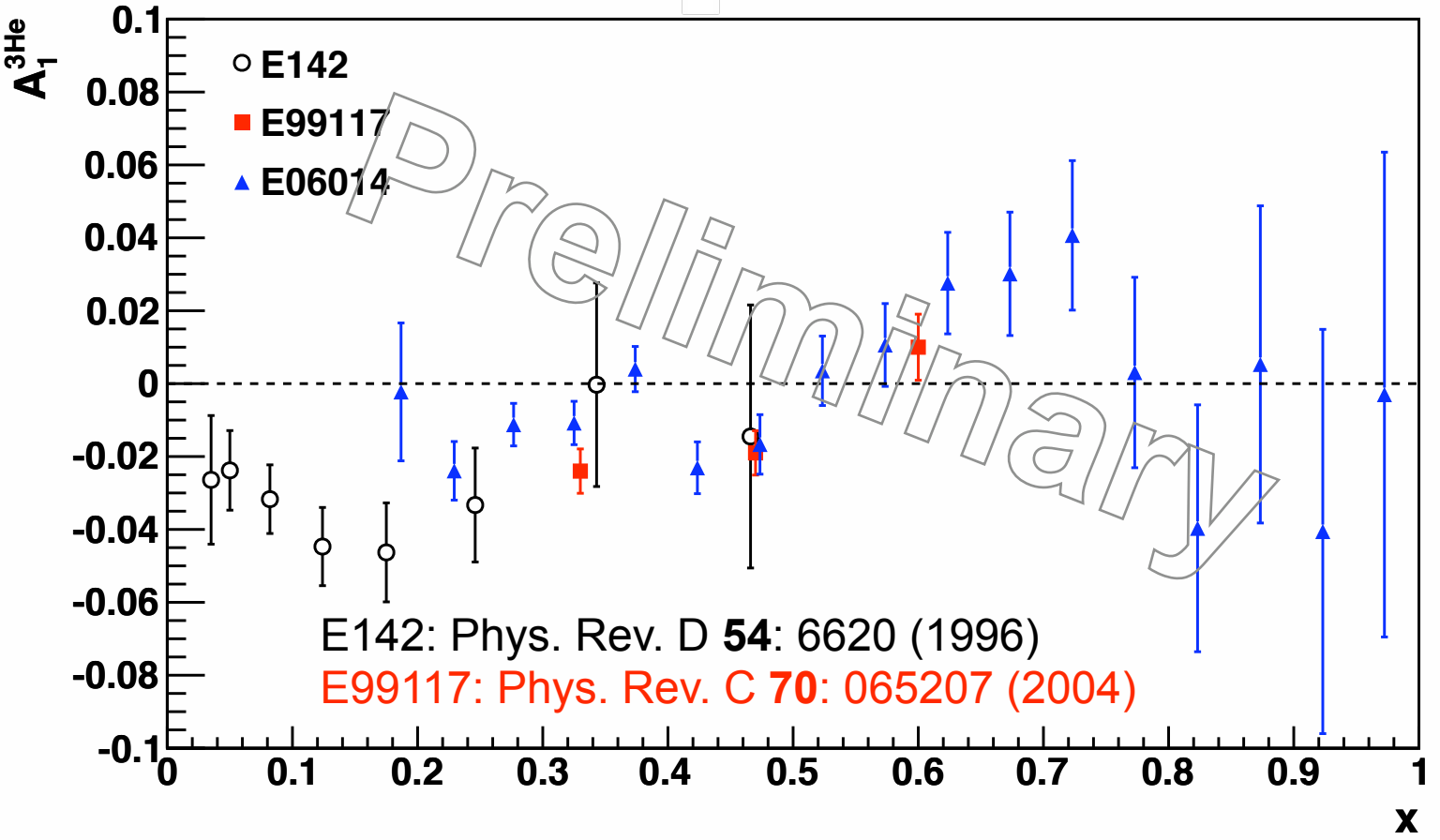


- Negligible pion contamination
- Errors in momentum reconstruction form primary background

$$A = \frac{N^{\downarrow\Uparrow} - N^{\uparrow\Uparrow}}{N^{\downarrow\Uparrow} + N^{\uparrow\Uparrow}} \cdot \frac{1}{P_e P_{^3\mathrm{He}} D_{\mathrm{N}_2}}$$

A_1 on ^{3}He with 4.74-GeV electrons

- Low-*x* bins will be more affected by radiative corrections, pair-production (not yet applied)



Conclusion

- We've measured A_1 on ^{3}He from part of the E06-014 dataset
  - Wide *x* range ($0.15 \leq x \leq 0.55$ DIS, $0.60 \leq x \leq 1.0$ resonance)
  - Support for previous measurements
- Future work
  - Analysis tweaks
  - Radiative corrections, pair-production corrections
  - New dataset: $E_e = 5.9$ GeV
  - Extraction of neutron A_1

Thank you!

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