Progress Report for Analysis of $d(\vec{e}, e'p)n$ for the E5 Run Period

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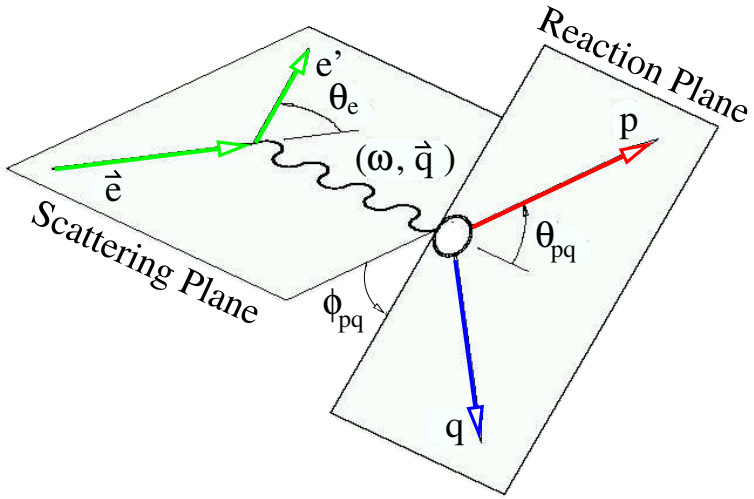
1. Introduction.
2. Impact of electron fiducial cuts.
3. Generating proton fiducial cuts.
4. Effect on fifth structure function asymmetry.

Introduction

- Goal: Measure the imaginary part of the LT interference term of $d(\vec{e}, e'p)n$ to test the hadronic model at low Q^2 ($\approx 1\ (GeV/c)^2$).

- Use the E5 out-of-plane proton production to extract the fifth structure function.



- Cross section:

$$\frac{d^3\sigma}{d\omega d\Omega_e d\Omega_p} = \sigma^{\pm} = \sigma_L + \sigma_T + \sigma_{LT}\cos(\phi_{pq}) + \sigma_{TT}\cos(2\phi_{pq}) + h\sigma'_{LT}\sin(\phi_{pq})$$

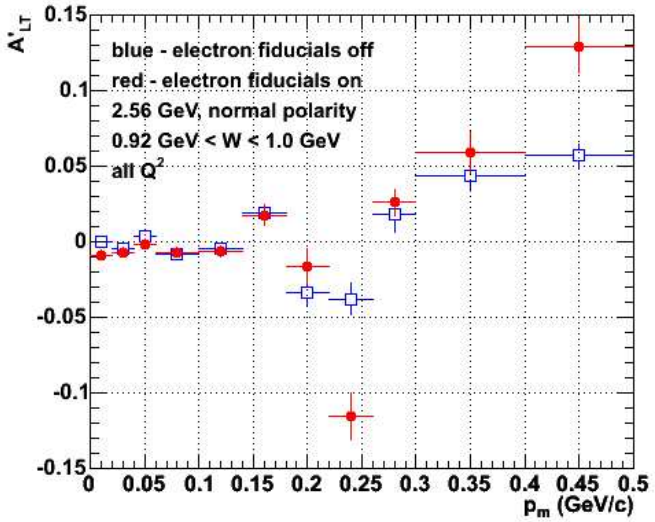
- Helicity Asymmetry

$$A'_{LT} = \frac{\sigma^+_{90} - \sigma^-_{90}}{\sigma^+_{90} + \sigma^-_{90}} \approx \frac{\sigma'_{LT}}{\sigma_L + \sigma_T} = \langle \sin\phi_{pq} \rangle_+ - \langle \sin\phi_{pq} \rangle_-$$

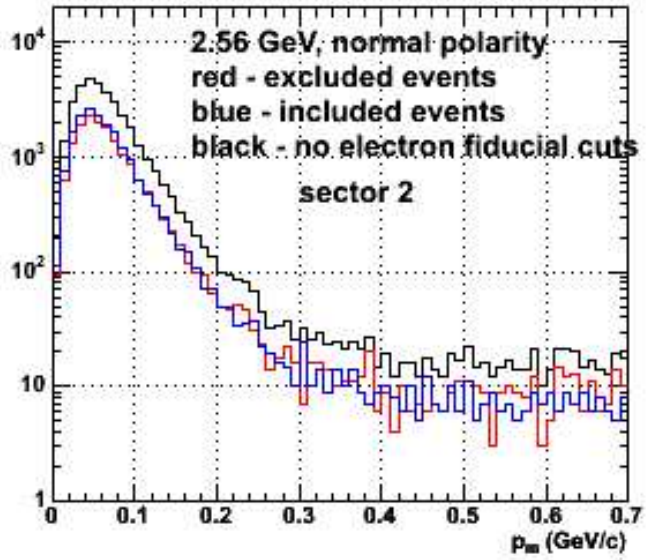
Subscripts - ϕ_{pq}. Superscripts - beam helicity.

Impact of Electron Fiducial Cuts - 1

- The electron fiducial cuts had a significant effect on A'_{LT}, the fifth-structure function asymmetry for $E = 2.6\,GeV$, normal polarity running.

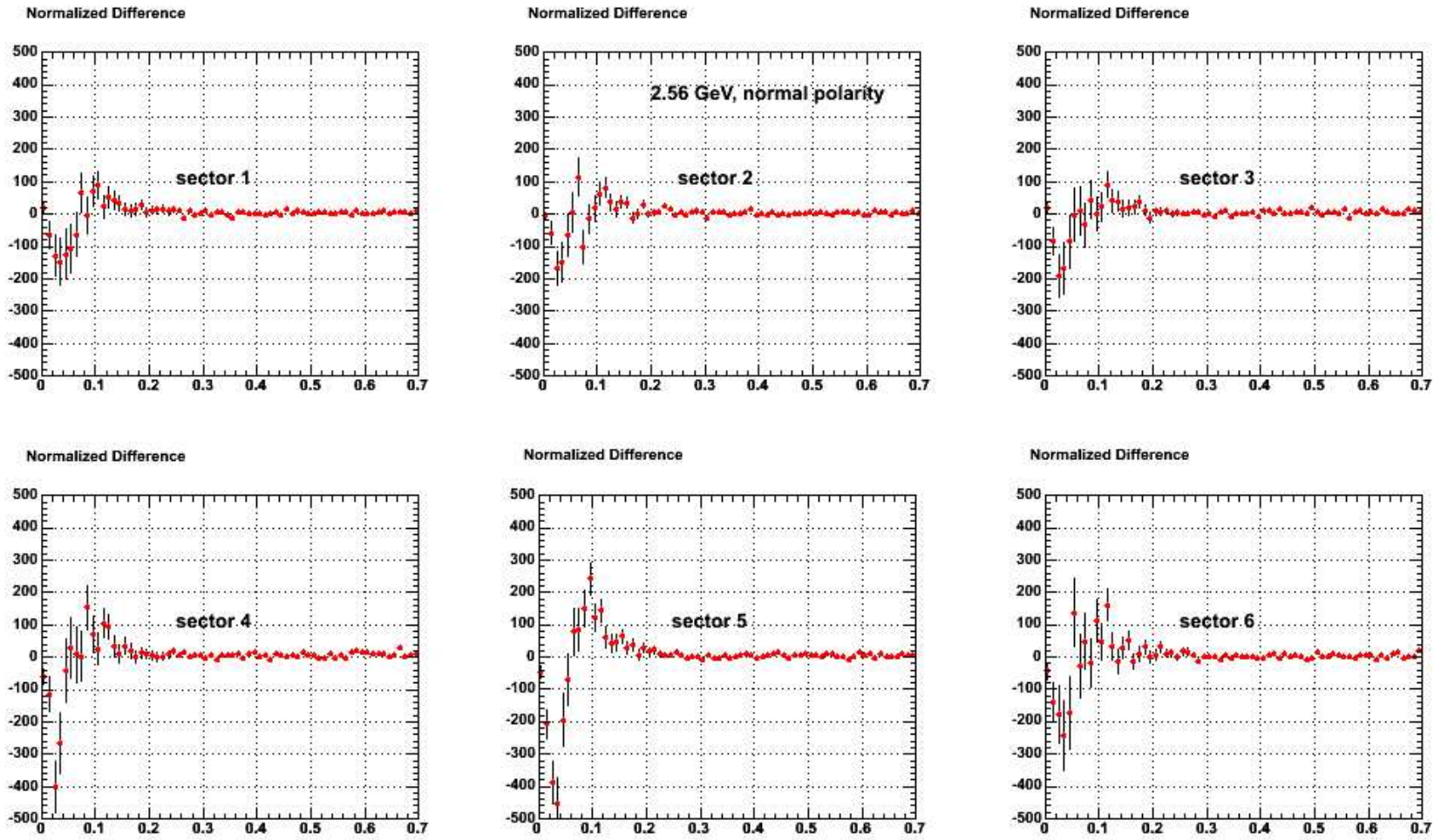


- One possible explanation could be a problem with the reconstruction for tracks near the coils.



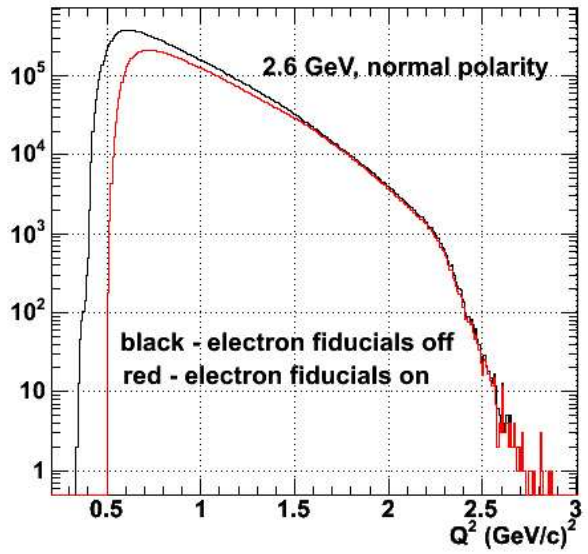
Impact of Electron Fiducial Cuts - 2

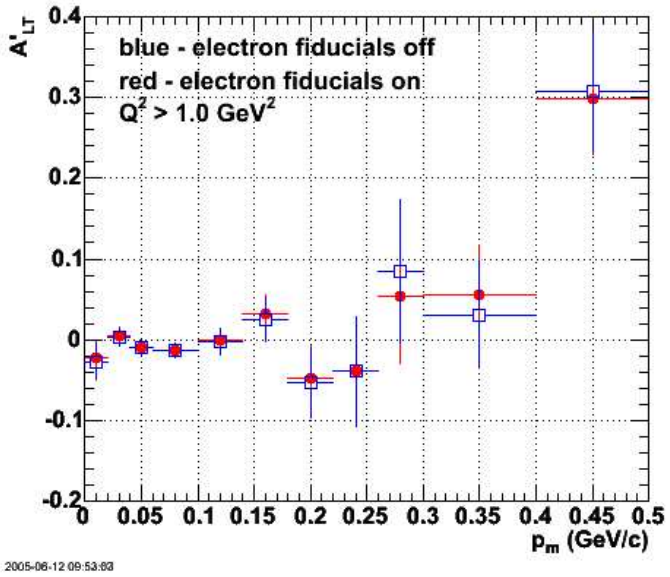
$$N_{diff} = N_{outside} - C \times N_{inside} \quad (C \text{ normalizes the areas})$$



Impact of Electron Fiducial Cuts - 3

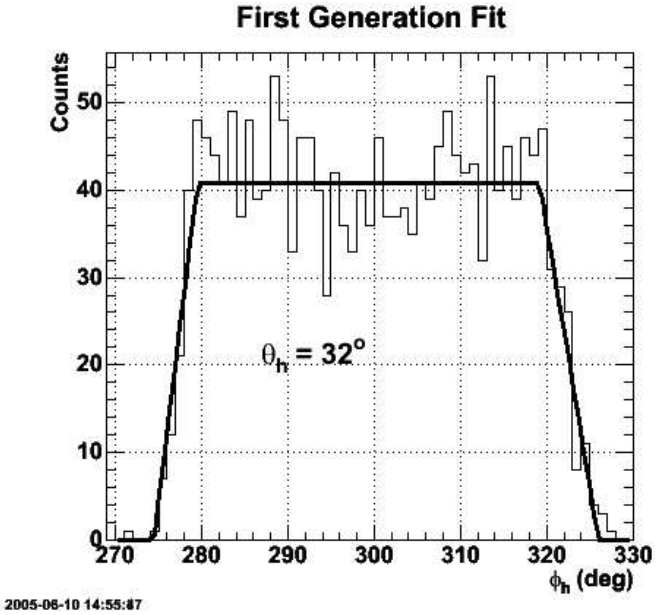
- The effect can be caused by rapid changes in A'_{LT} as a function of Q^2.
- Restrict the Q^2 range so the distribution changes little when the cuts are turned on ($Q^2 > 1.0(GeV/c)^2$).
- This seems to work. The structures in A'_{LT} are sensitive to the underlying Q^2 distribution.



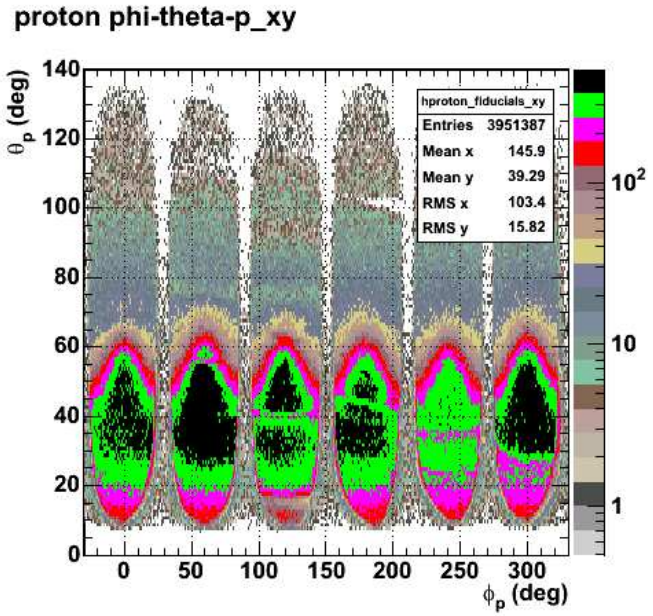


Proton Fiducial Cuts - 1

- Select $e'p$ events from $d(\vec{e}, e'p)n$ and fit the ϕ_p dependence with a trapezoid (generation 1 fits).

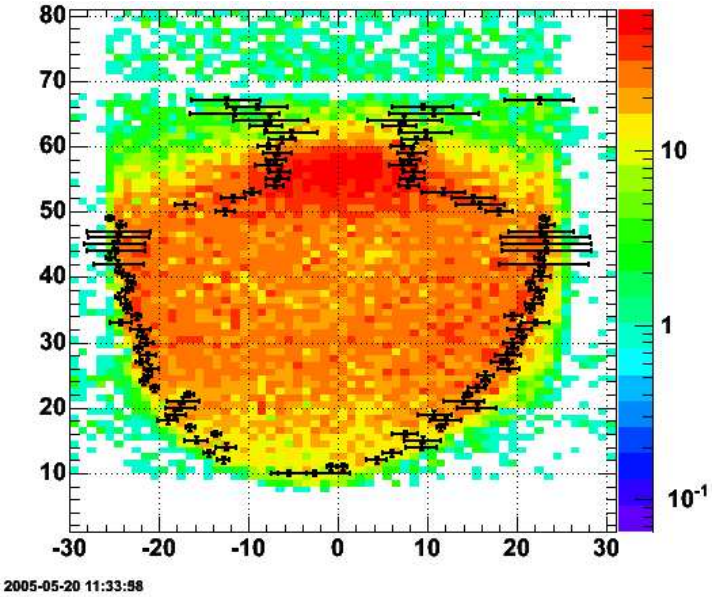


- Unfortunately, the acceptance is not uniform in ϕ_p for $\theta_p \approx 40° - 70°$ due to quasielastic events and the electron acceptance.

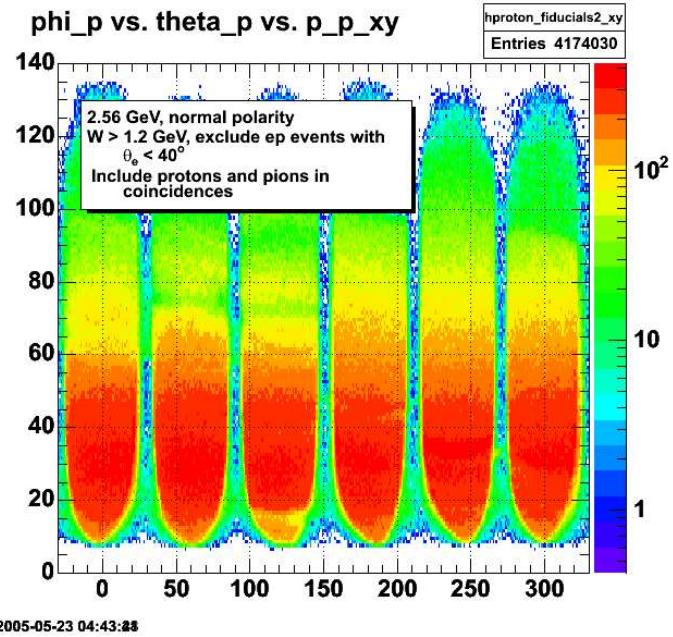


Proton Fiducial Cuts - 2

- Try excluding quasielastic events using W and coplanarity cuts, but the ϕ_p acceptance is still not uniform and there are few events in the region of interest.

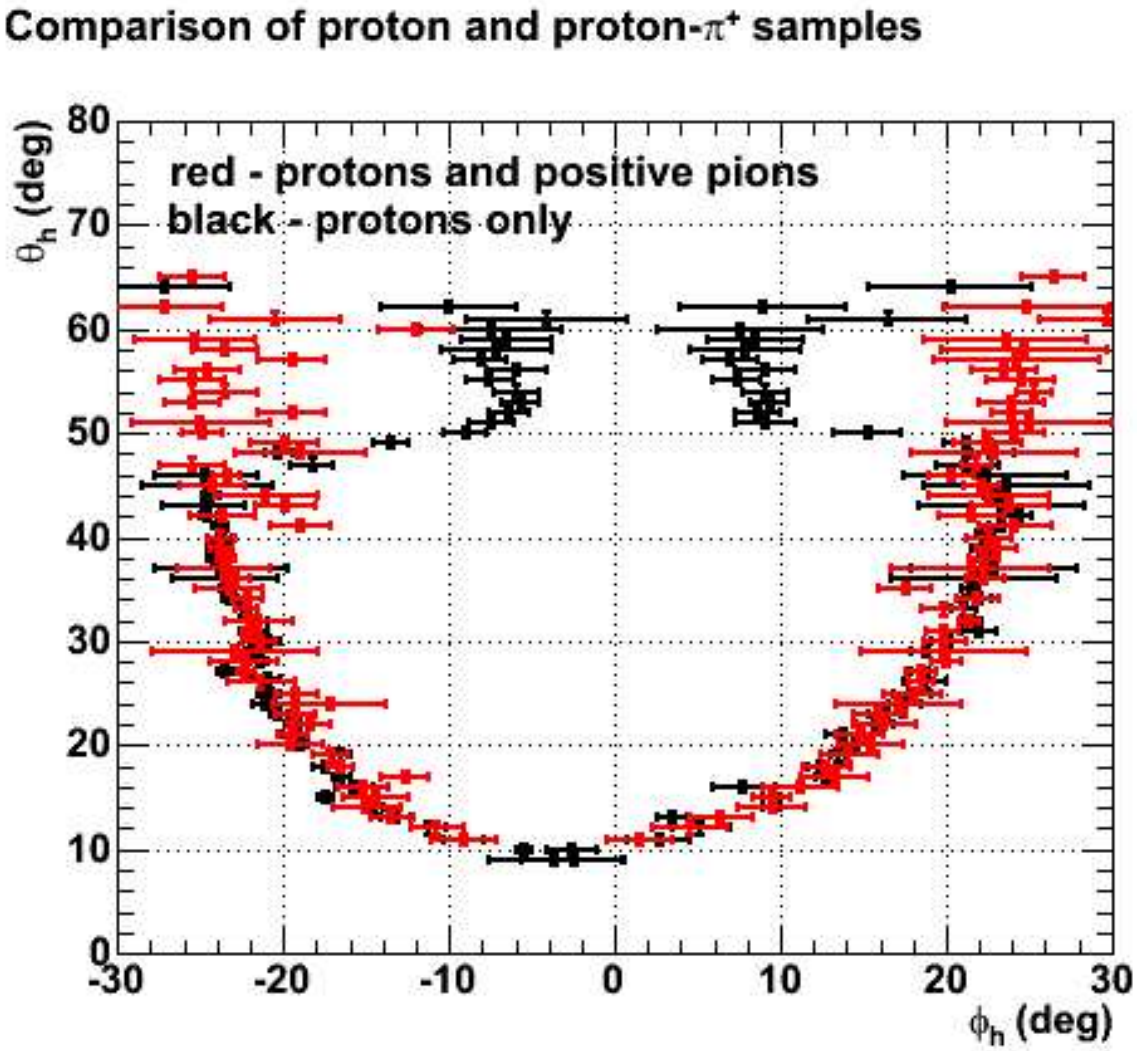


- Exclude events with $W > 1.2\,GeV$, ep coincidences with $\theta_e < 40°$, and include positive pions in the sample. See CLAS-Note 2001-013 (Niyazov and Weinstein).



Proton Fiducial Cuts - 3

- Comparison of proton 'edges' with $p + \pi^+$ edges.



Proton Fiducial Cuts - 4

- Fit the edges with the following (generation 2 fits).

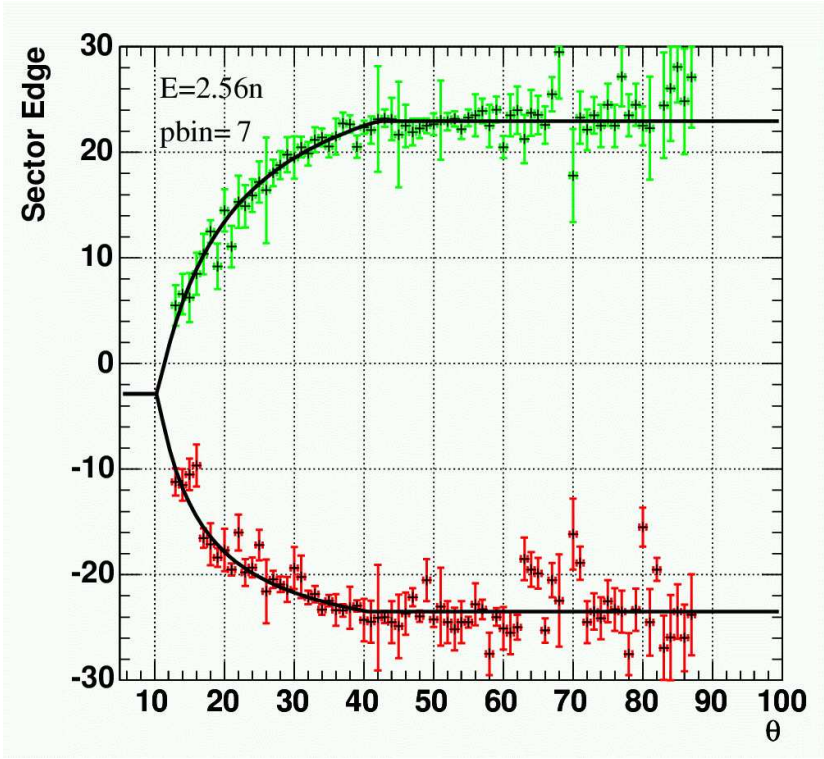
$$\phi_{edge} = \phi_0 \pm b_{l,r}\left(1 - \frac{1}{1+\frac{\theta-\theta_0}{a_{l,r}}}\right) \qquad \theta < \theta_{l,r}$$

$$= constant \qquad \theta \geq \theta_{l,r}$$

θ - hadron scattering angle.

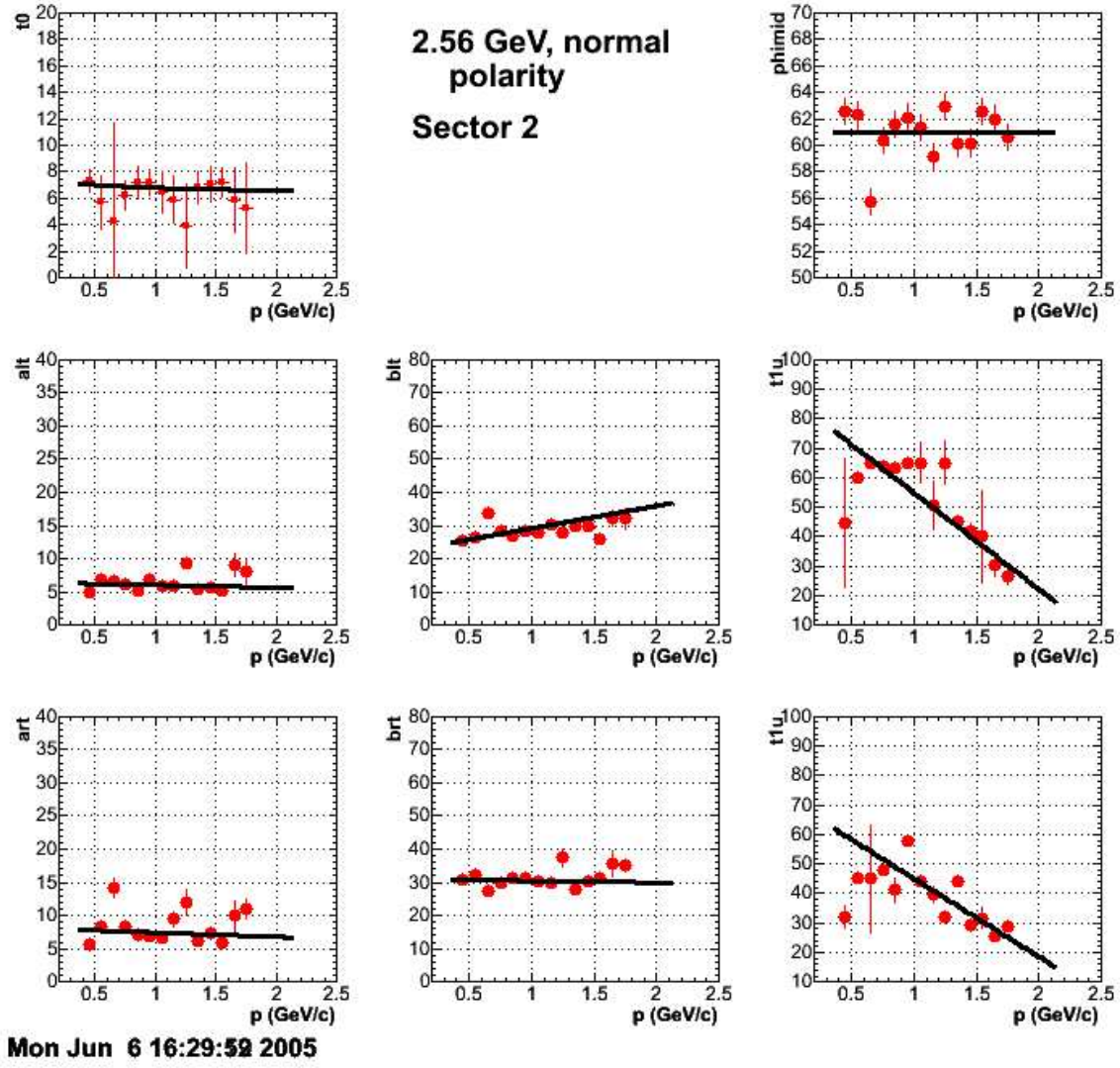
$\phi_0, a_{l,r}, b_{l,r}, \theta_0, \theta_{l,r}$ - fit parameters.

$\pm$ - sign of the second term depends on which side of the sector is being fit (CLAS Note 2001-013).



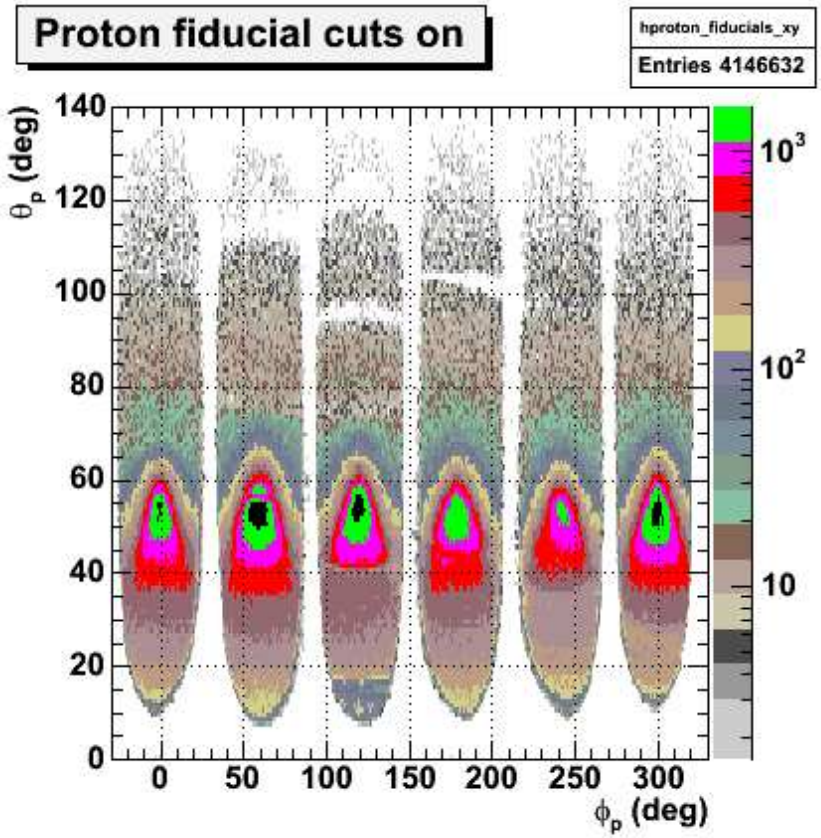
Proton Fiducial Cuts - 5

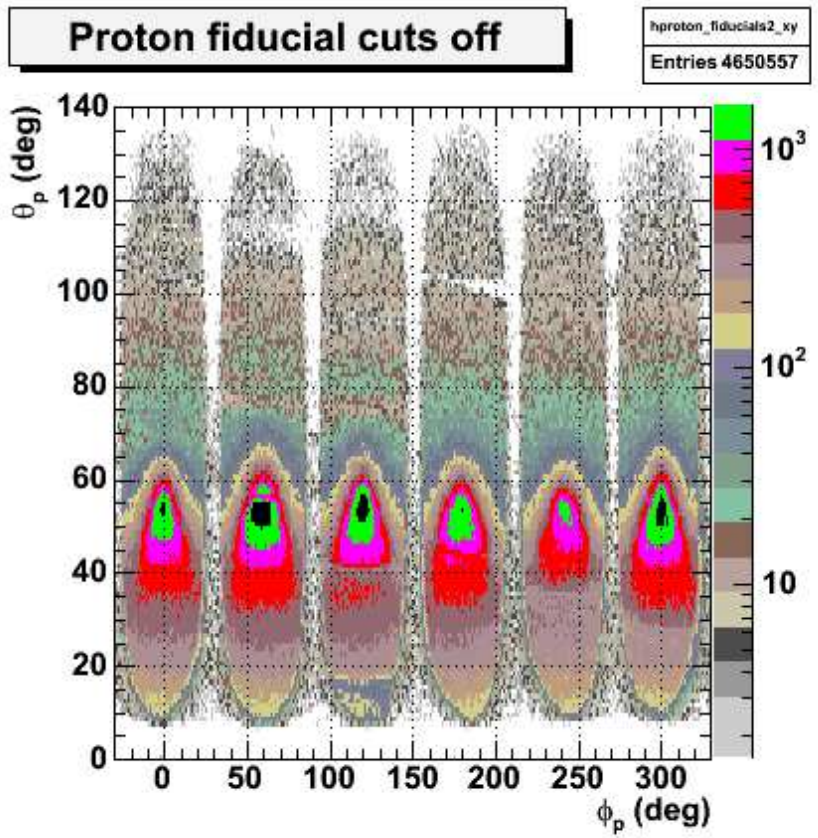
- Fit the momentum dependence of the second generation fit parameters (generation 3 fits).



Impact of Proton Fiducial Cuts - 1

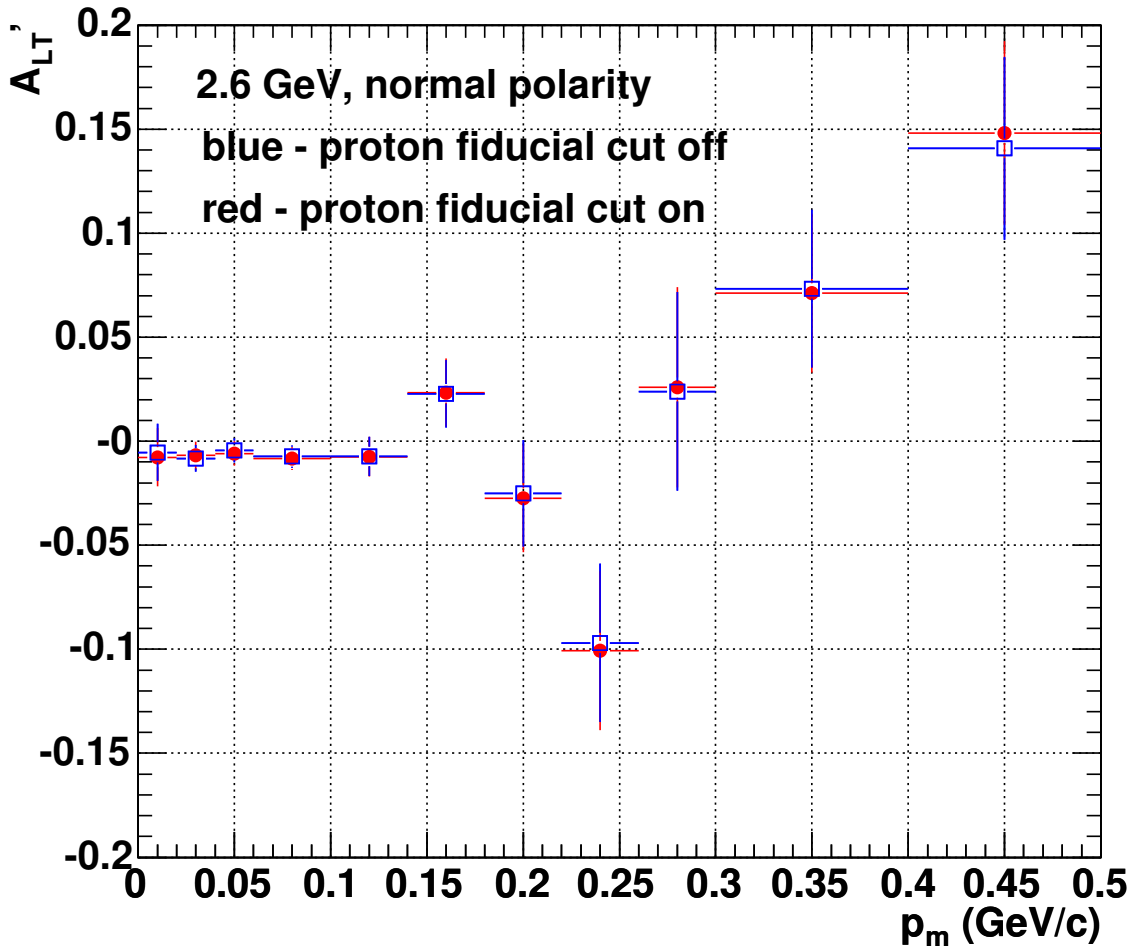
- Cleans up edges of proton acceptance.





Impact of Proton Fiducial Cuts - 2

- Little effect on A'_{LT}.



Conclusions

- Fifth-structure-function asymmetry is sensitive to electron fiducial cuts due to effects on the Q^2 distribution in the event sample. For more details and code see entries 247, 256, 266, and 268 in E5 elog

  `http://clasweb.jlab.org/cgi-bin/ENOTE/enote.pl?nb=e5&action=toc`.

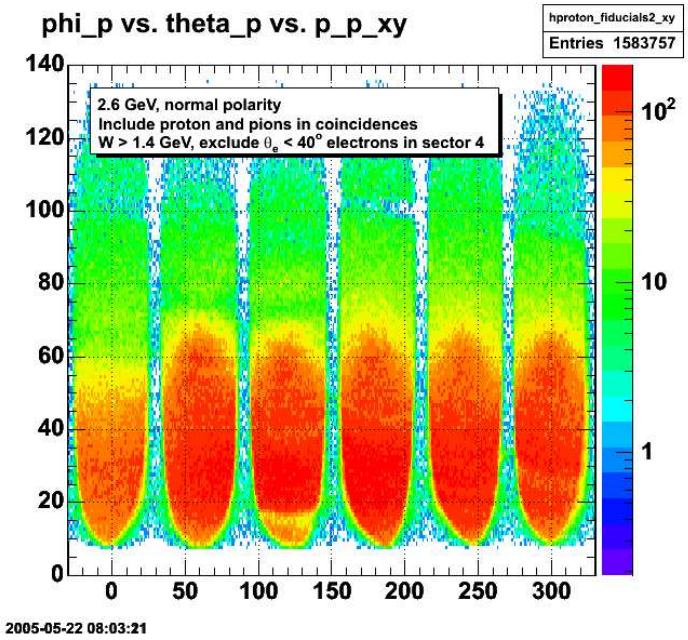
- Fiducial cuts for positive hadrons for the $E = 2.6\,GeV$, normal polarity running conditions were derived from a mixed sample of protons and positive pions. More details and code can be found in the E5 elog in entries 270-273.

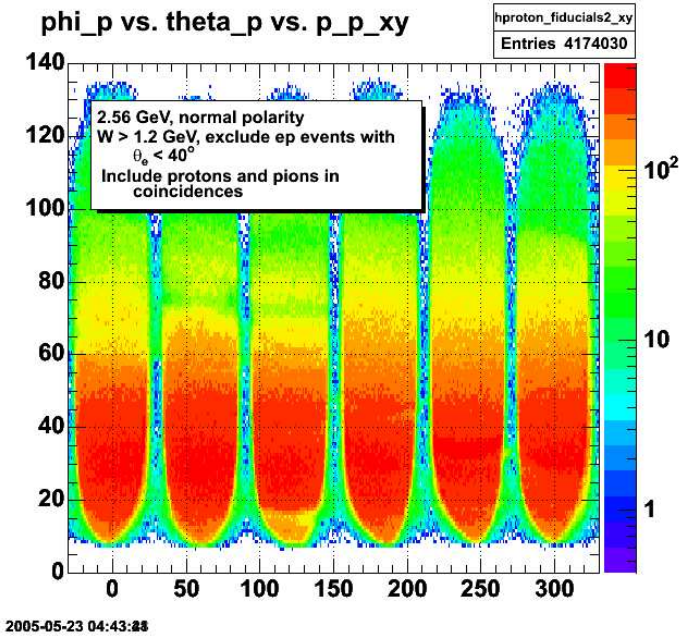
- The positive hadron fiducial cuts have little effect on the fifth-structure-function asymmetry.

- We are now generating electron and proton fiducial cuts and momentum corrections for the $E = 2.6\,GeV$, reversed torus polarity data. The $E = 4.2\,GeV$, normal torus polarity data are next.

Excluding Events with $\theta_e < 40°$

- Proton and positive pion acceptance for $d(\vec{e}, p)n$ in coincidence with an electron.
- The round shape for $\theta_h \approx 60°$ causes the trapezoid fit to fail. The shape is due to the forward-angle electron acceptance.
- In the top panel electrons with $\theta_e < 40°$ are excluded only for sector 4. Note the hadron acceptance in sector 1.





Summary

- For $d(\vec{e}, e'p)n$ at $E = 2.6\,GeV$ and normal torus polarity, the fifth-structure function asymmetry A'_{LT} is sensitive to the electron fiducial cuts reflecting the underlying Q^2 distribution in the data. Other tests show no problems with the event reconstruction for events near the coils.

- We have generated fiducial cuts for the proton for $d(\vec{e}, e'p)n$ using a mixed sample of protons and positive pions. The proton fiducial cuts have little effect on A'_{LT}.