Progress Report on *Out-of-Plane Measurements of the Structure Functions of the Deuteron*

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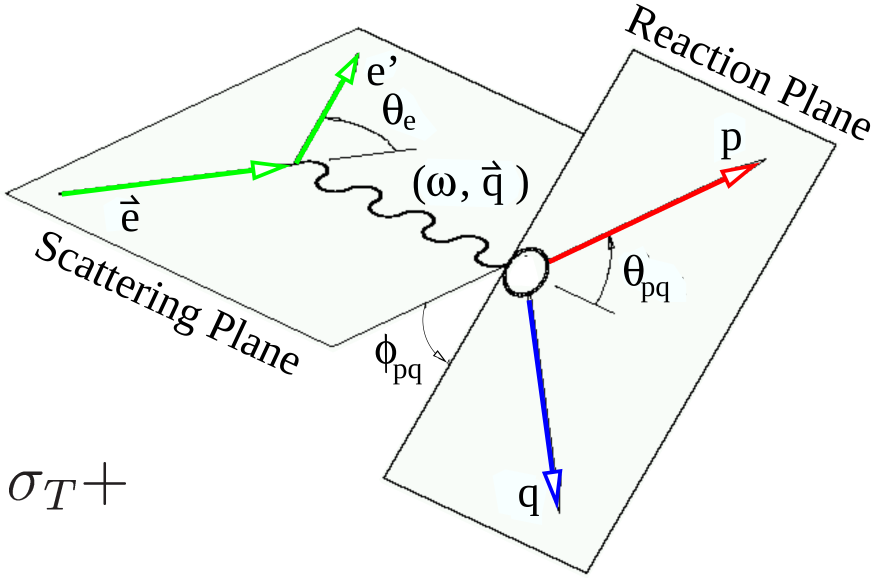
1. Motivation
2. Experimental Details
3. Selecting Quasi-Elastic Events
4. Electron Fiducial Cuts
5. Electron Momentum Corrections

Kinematics and Formalism

- Kinematics for
  $d(\vec{e}, e'p)n$.



- Cross section:

$$\frac{d^3\sigma}{d\omega d\Omega_e d\Omega_p} = \sigma^{\pm} = \sigma_L + \sigma_T +$$

$$\sigma_{LT}\cos(\phi_{pq}) + \sigma_{TT}\cos(2\phi_{pq}) + h\sigma'_{LT}\sin(\phi_{pq})$$

- Asymmetry

$$A'_{LT} = \frac{\sigma^+_{90} - \sigma^-_{90}}{\sigma^+_{90} + \sigma^-_{90}} \approx \frac{\rho' f'_{LT}}{\rho_L f_L + \rho_T f_T} = \langle \sin\phi_{pq} \rangle_+ - \langle \sin\phi_{pq} \rangle_-$$

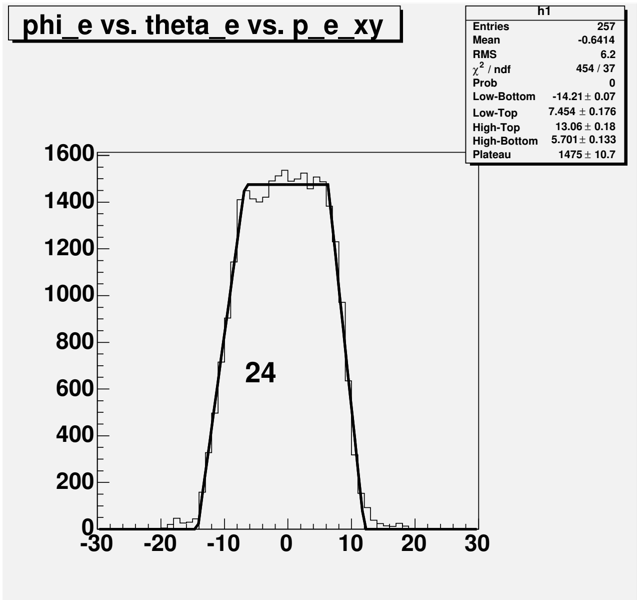
Subscripts - ϕ_{pq}. Superscripts - beam helicity.

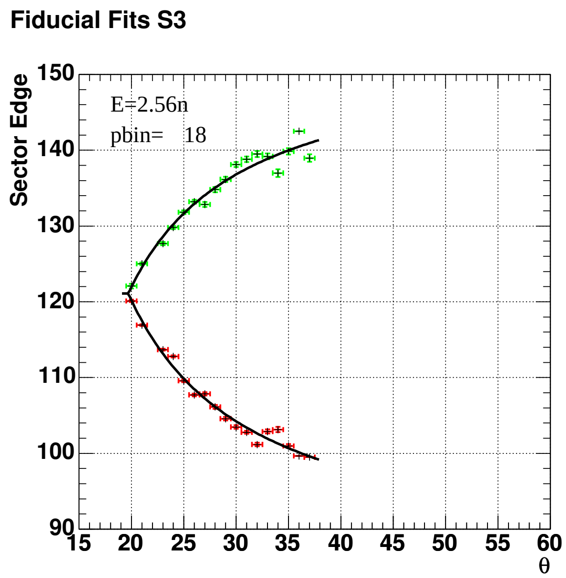
Electron Fiducial Cuts for E5 - 1

1. Use method for D. Protopopescu, *et al* in CLAS-Note 2000-07.
2. Select electrons by electron momentum, θ_e, and sector (ϕ_e range).
3. Fit the results.

For each p_e and θ_e bin and sector (ϕ_e range) fit the ϕ_e dependence with a trapezoid.

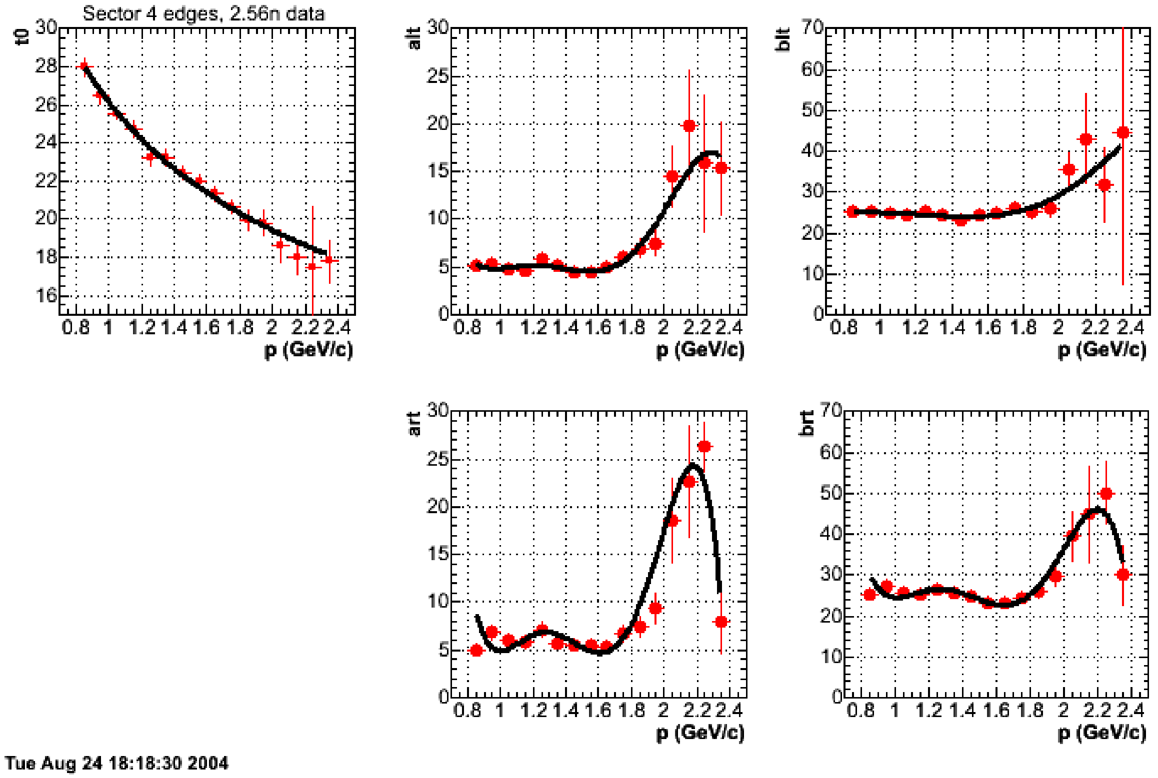
For each p_e bin fit the edges of the trapezoid as a function of θ_e.





Electron Fiducial Cuts for E5 - 2

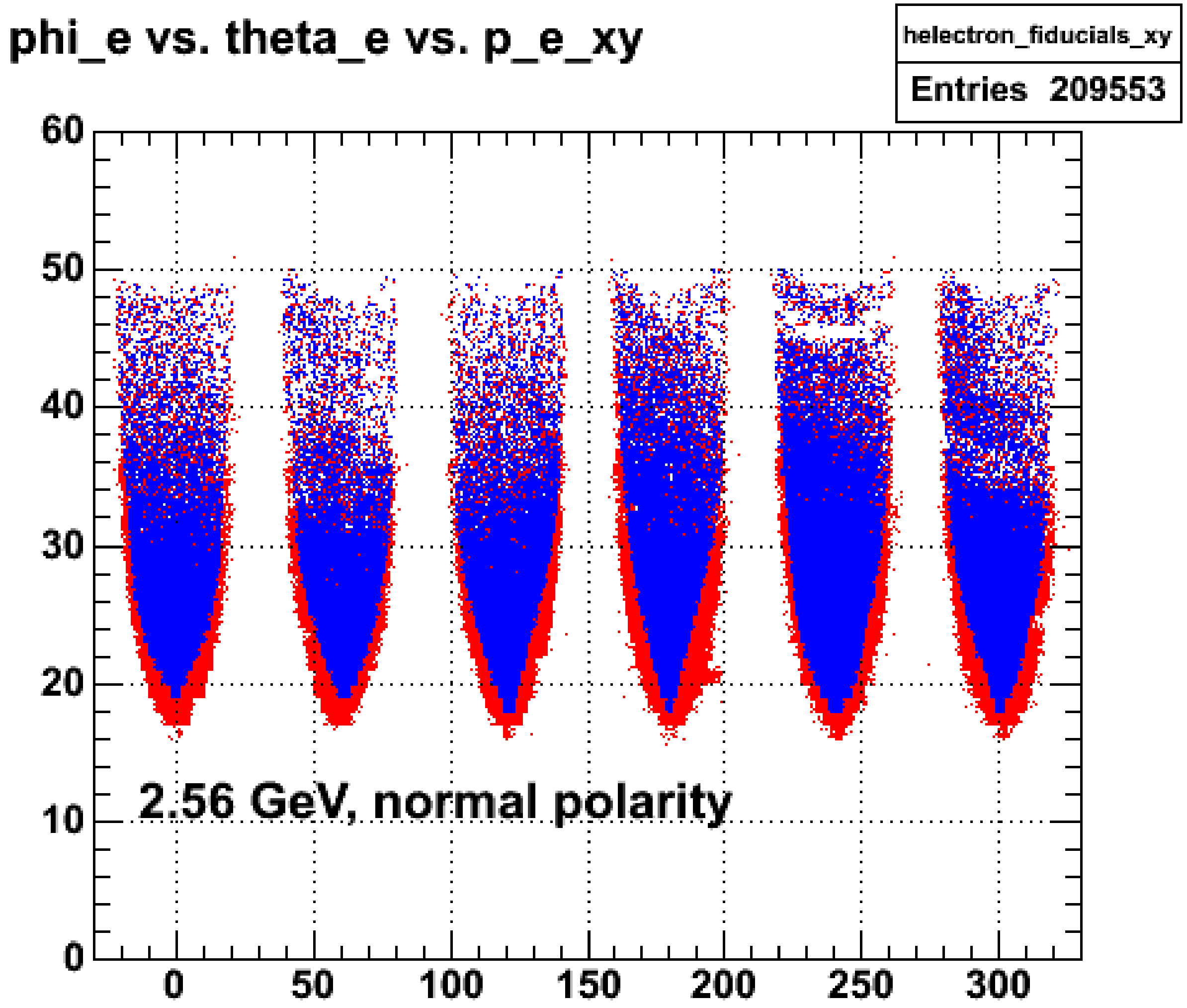
4. Final fits - Fit the momentum dependence p_e of the fit parameters from the previous fit.



5. Use the third generation fits to generate the electron fiducial cuts. This process reduces variations in the fiducial cuts from bin to bin.

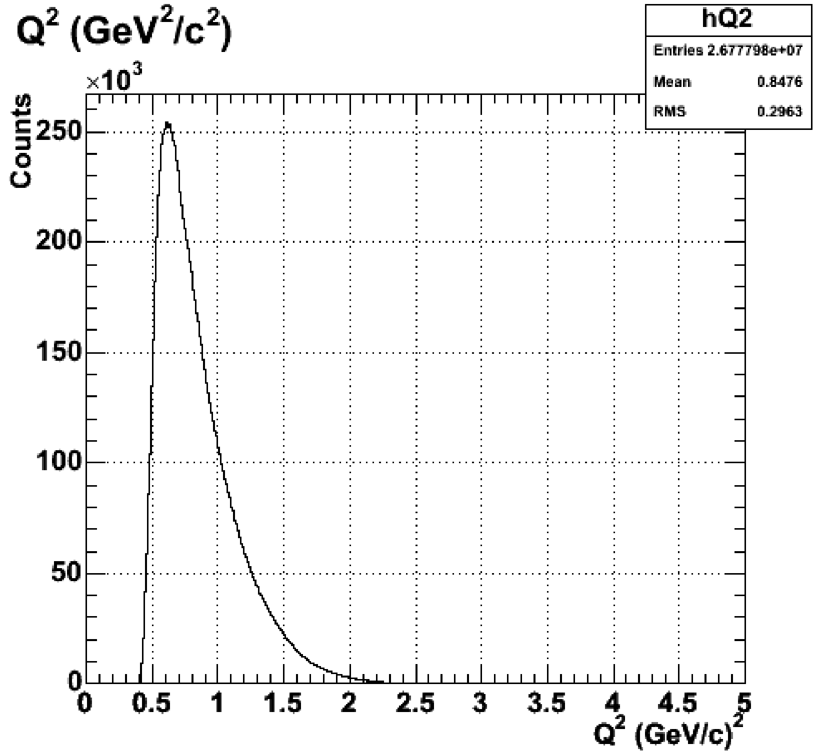
Electron Fiducial Cuts for E5 - 3

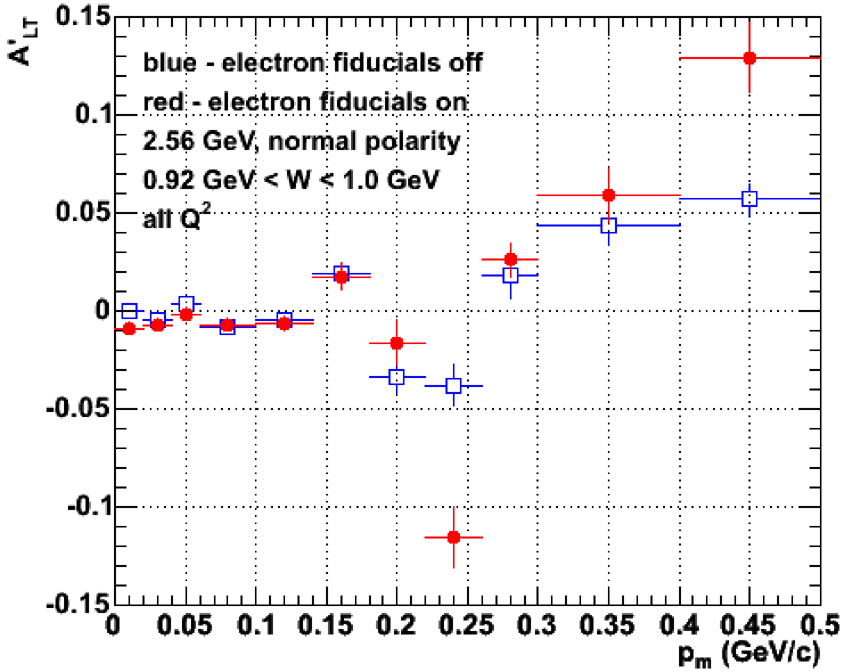
6. Before and after pictures of $\theta_e - \phi_e$ distribution for $E = 2.56\ GeV$, normal polarity, E5 running conditions.



Electron Fiducial Cuts for E5 - 4

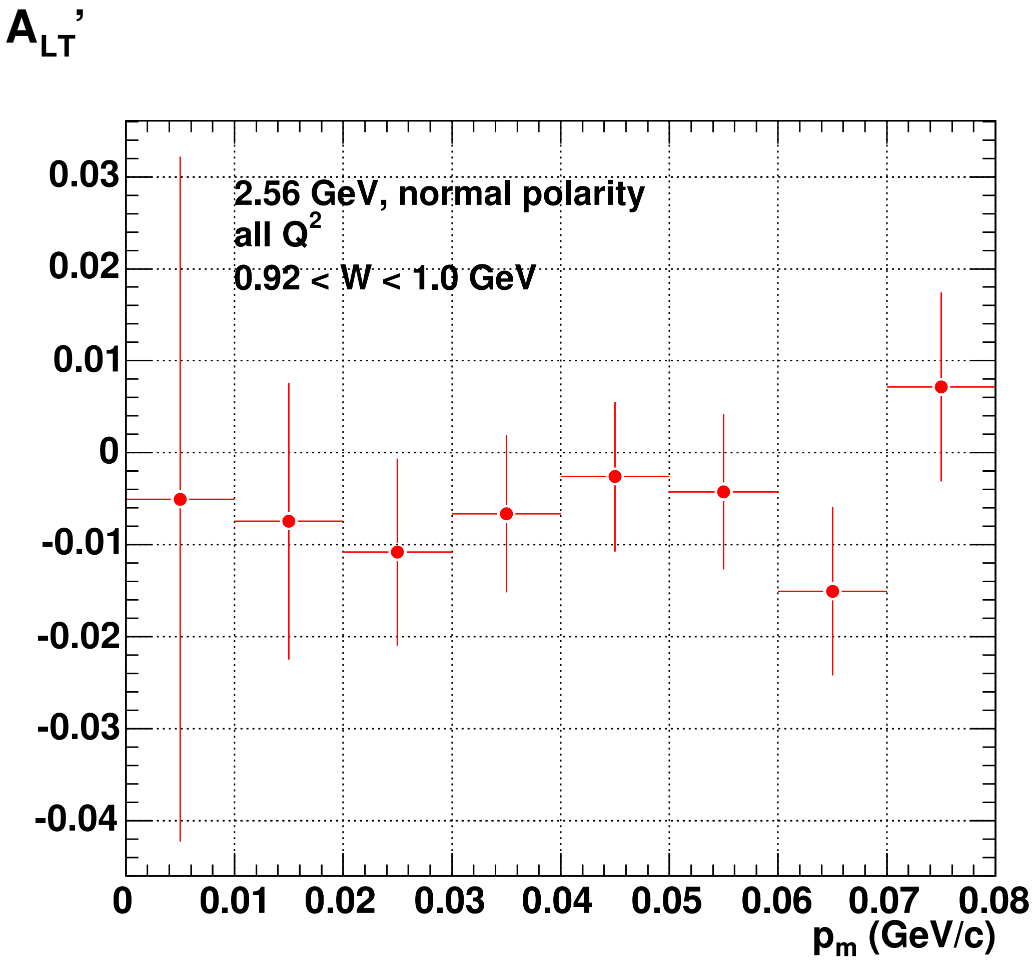
7. Before and after pictures of A'_{LT} for $E = 2.56\ GeV$, normal polarity, E5 running conditions.





Consistency Check at $p_m \approx 0$

We expect the asymmetry A'_{LT} to go to zero when p_m goes to zero.

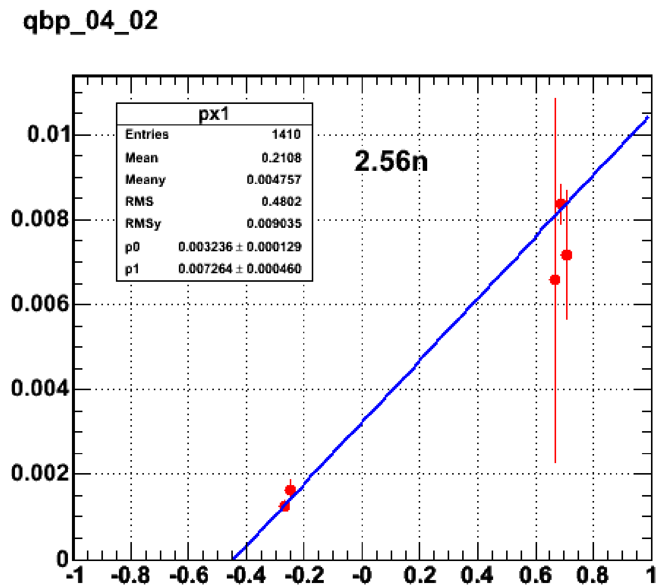


Electron Momentum Corrections - 1

1. Use University of Pittsburgh method (CLAS-Note 2001-18) first.
   (a) Use electron and proton scattering angles to calculate momentum for elastic scattering off the proton target.
   (b) For each θ_e and ϕ_e bin calculate the 'curvature' qB/p and fit it.

$$\left(\frac{qB}{p}\right)_{measured} - \left(\frac{qB}{p}\right)_{calculated} = \alpha + \beta \left(\frac{qB}{p}\right)_{calculated}$$

2. The E5 data were well calibrated so the effect of the momentum corrections is small. This observation is consistent with Jeff Lachniet's analysis.



Electron Momentum Corrections - 2

3. Proton peak position and width in W^2 spectra.

Sector	centroid before (GeV^2)	centroid after (GeV^2)	Width before (GeV^2)	Width after (GeV^2)
1	0.8698	0.8865	0.03371	0.02631
2	0.8389	0.8790	0.04495	0.02230
3	0.8873	0.9033	0.03253	0.02867
4	0.8722	0.8886	0.03032	0.02754
5	0.8743	0.8905	0.03115	0.02464
6	0.8845	0.8946	0.02914	0.02809
Average	0.8712	0.8904	0.03363	0.02626

4. The average centroid is no better for the corrected results than the uncorrected ones (it's small in both cases), but the width is smaller in the corrected case. Consistent with other (JL) analysis.

Electron Momentum Corrections - 3

5. Apply the VB method to correct the electron momentum.
   - Use the electron scattering angle to determine the electron momentum and calculate the invariant mass.
   - Extract a scale factor in bins of θ_e and ϕ_e, using the proton mass.

Sector	centroid before (GeV^2)	centroid after (GeV^2)	Width before (GeV^2)	Width after (GeV^2)
1	0.8682	0.8790	0.03557	0.02789
2	0.8355	0.8767	0.04839	0.02699
3	0.8940	0.8808	0.03346	0.02800
4	0.8711	0.8791	0.03126	0.02781
5	0.8729	0.8793	0.03332	0.02870
6	0.8729	0.8807	0.03006	0.02957
Average	0.8711	0.8793	0.03534	0.02816

Electron Momentum Corrections - 3

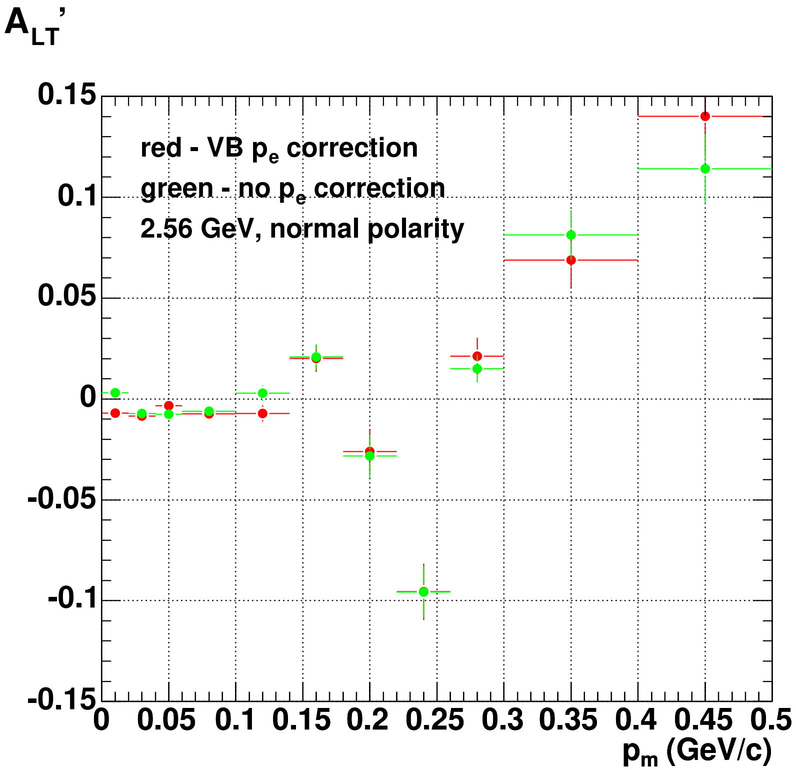
6. Compare the results of the two methods.

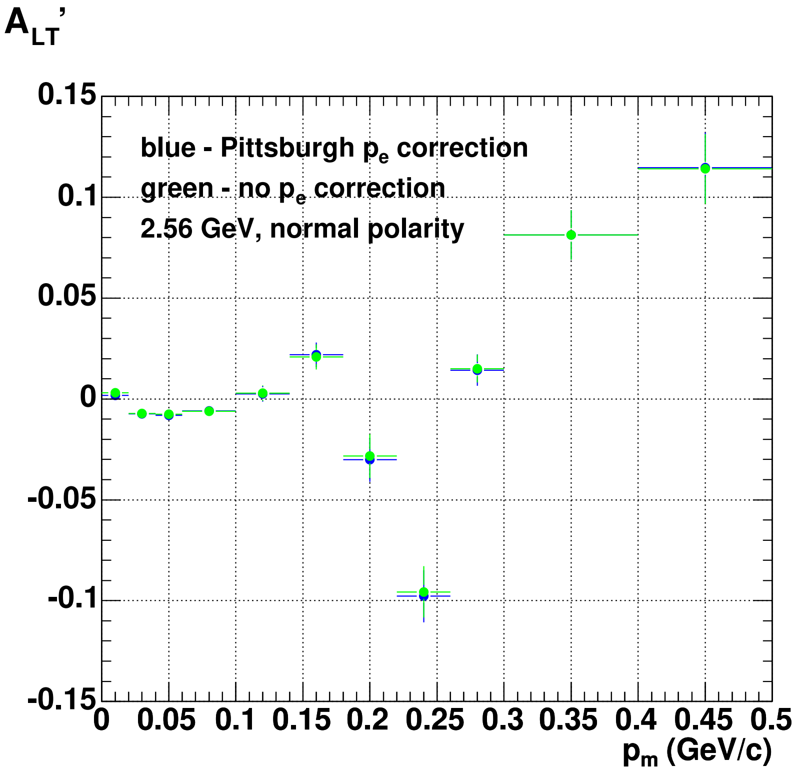
Sector	centroid (GeV^2) Pitt method	centroid (GeV^2) VB method	Width (GeV^2) Pitt method	Width (GeV^2) VB method
1	0.8865	0.8790	0.02631	0.02789
2	0.8790	0.8767	0.02230	0.02699
3	0.9033	0.8808	0.02867	0.02800
4	0.8886	0.8791	0.02754	0.02781
5	0.8906	0.8793	0.02464	0.02870
6	0.8946	0.8807	0.02809	0.02957
Average	0.8904	0.8793	0.02626	0.02816

The VB method does better at reproducing the proton peak position (a difference of $0.0011\ GeV^2$ versus $0.0100\ GeV^2$). Both methods give similar results for the widths.

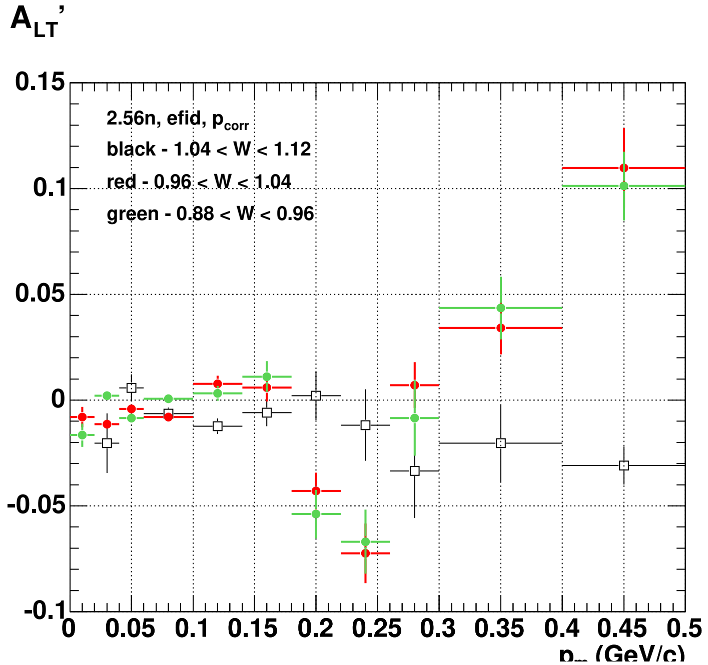
Electron Momentum Corrections - 4

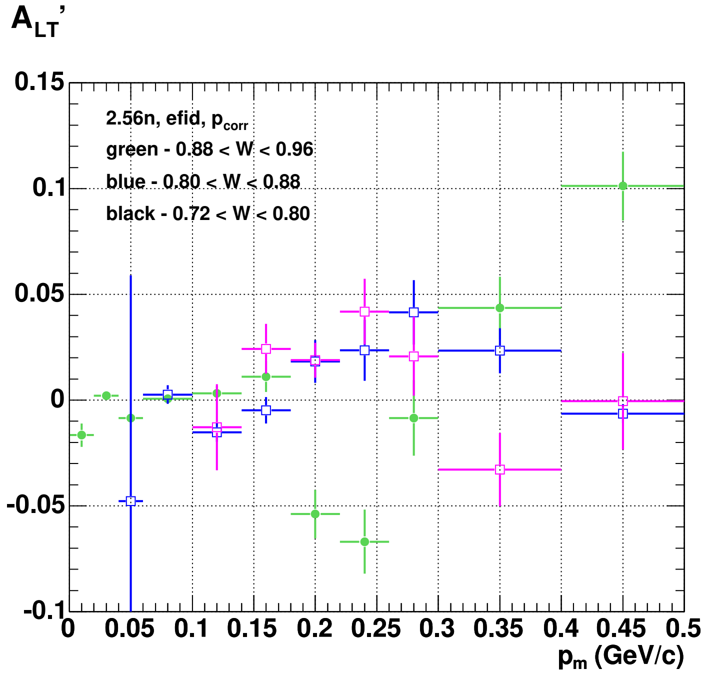
7. Effect of momentum corrections on A'_{LT} is small for most points.

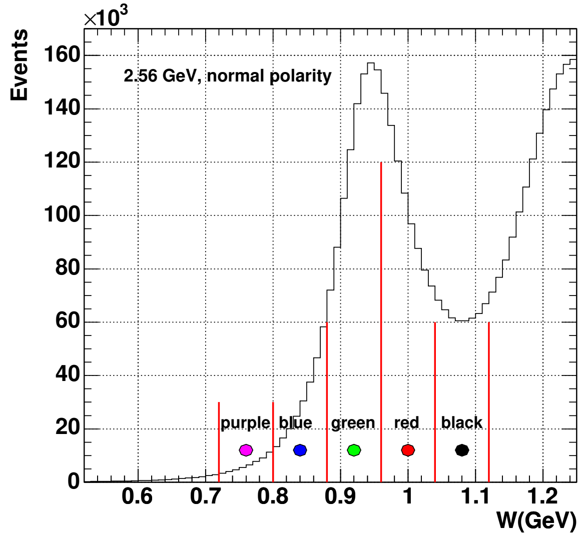




W dependence of A'_{LT} at the Quasi-elastic Peak







Conclusions

1. The Pittsburgh and VB methods for correcting the electron momenta give comparable results and have limited effect on the asymmetry A'_{LT} at most values of p_m.

2. Applying tighter electron fiducial cuts effects A'_{LT} when the magnitude of the asymmetry is large.

3. The structures observed in A'_{LT} are strongly correlated with the proton peak in the W spectrum.