

Analysis Progress

for the d_2^n analysis meeting

Diana Parno

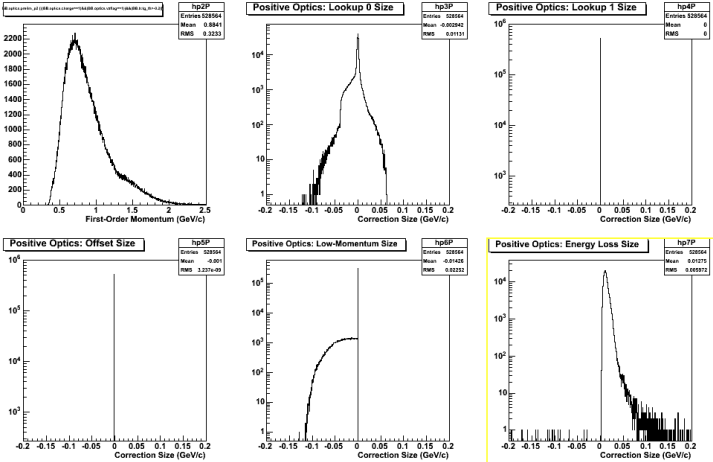
Carnegie Mellon University

November 11, 2010

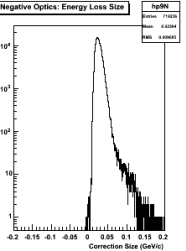
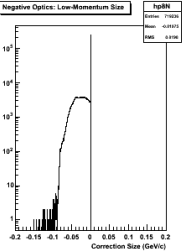
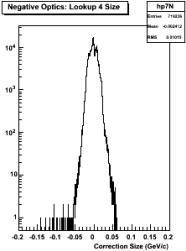
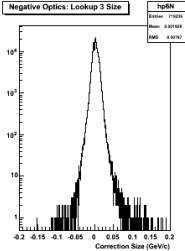
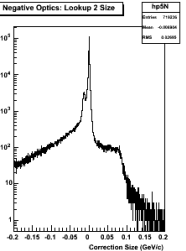
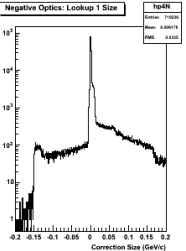
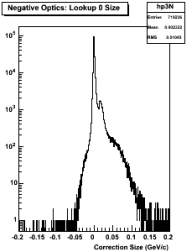
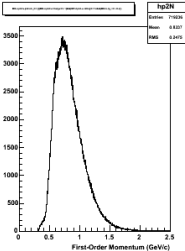
- 1 BigBite Optics
 - Stages of Momentum Reconstruction
 - Final Form of Optics Calibration
- 2 BigBite Cerenkov: Multi-Hit TDCs
- 3 BigBite Kinematics Coverage
 - $E_e = 5.89$ GeV
 - $E_e = 4.73$ GeV
- 4 Preliminary Asymmetries
- 5 Summary
- 6 What's Next?

Momentum Corrections and Acceptance (i)

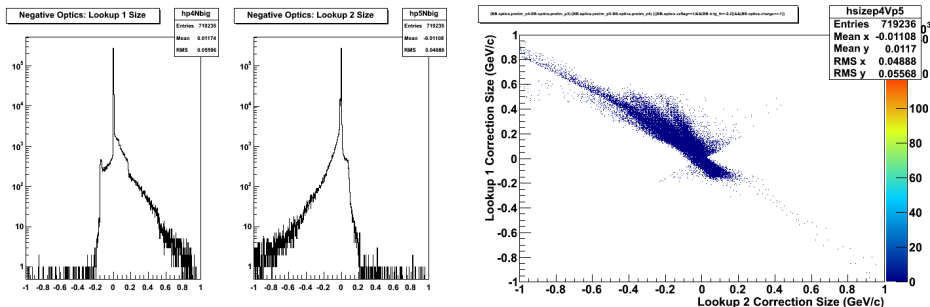
- Acceptance cuts remove most of the large momentum corrections
- What's left? Consider positive optics first:



Momentum Corrections and Acceptance (ii)



Momentum Corrections and Acceptance (iii)



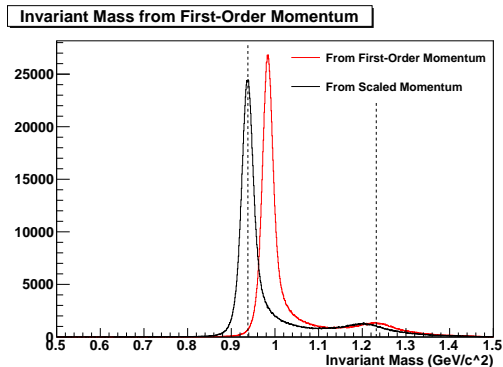
- The two largest lookup-table corrections largely correct each other...

Optics Strategy

- Our decision last time:
 - ▶ Go back to the first-order momentum reconstruction and see what we can do
 - ▶ Trust the vertex corrections (which, after all, yield continuous results)
- Our tools: proton and $\Delta(1232)$ peaks in ^2H elastic scattering

Optics: Scaling

- Xin's first-order optics code in red
 - ▶ Includes some corrections in vertical position at bend plane
 - ▶ $\Delta(1232)$ in right place, but proton mass is 50 MeV too high
- Scale factor of 1.041 brings proton peak to 938 MeV



Optics: Low-Momentum Correction (i)

- Xin introduced the low-momentum correction to move the Δ peak:

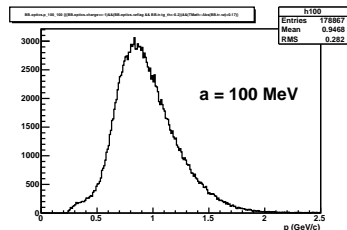
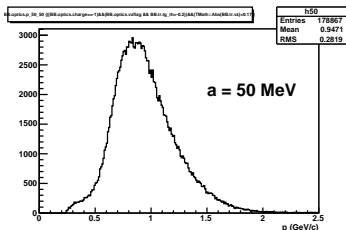
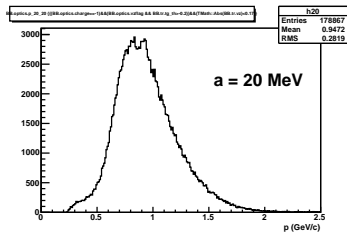
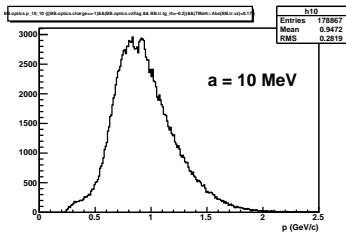
$$p^{(2)} = \begin{cases} p^{(1)} & \text{for } p^{(1)} > 0.9 \\ p^{(1)} + 0.148 (p^{(1)} - 0.9) & \text{for } p^{(1)} \leq 0.9 \end{cases} \quad (1)$$

- We added a transitional smoothing function over a characteristic distance a to make the momentum continuous in the first derivative:

$$p^{(2)} = \begin{cases} p^{(1)} & \text{for } p^{(1)} > 0.9 + a \\ p^{(1)} - 3.7 (p^{(1)} - (0.9 + a))^2 & \text{for } 0.9 - a \leq p^{(1)} \leq 0.9 + a \\ p^{(1)} + 0.148 (p^{(1)} - 0.9) & \text{for } p^{(1)} < 0.9 - a \end{cases} \quad (2)$$

Optics: Low-Momentum Correction (ii): Size of a

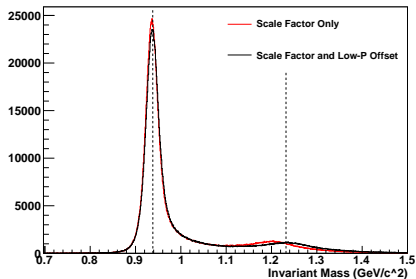
- The size of a affects the performance of the smoothing function
- $a = 50$ MeV seems a good balance between
 - 1 Maintaining continuity at production energies
 - 2 Not shifting the proton peak at calibration energies



Optics: Low-Momentum Correction (iii)

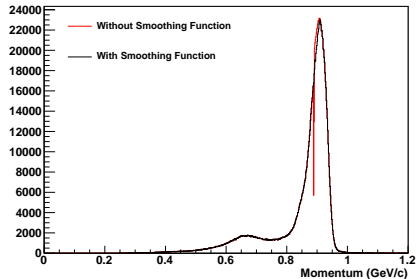
W peaks are correct to within 1 MeV

Invariant Mass: Corrections to First-Order Momentum

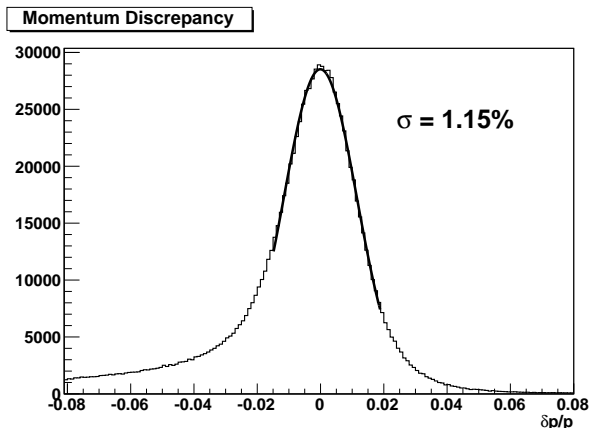


Momentum distribution is continuous

Momentum Distribution



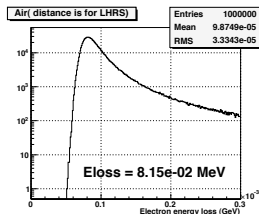
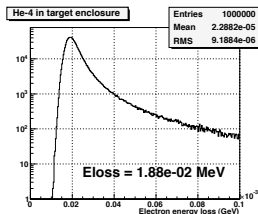
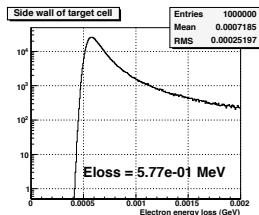
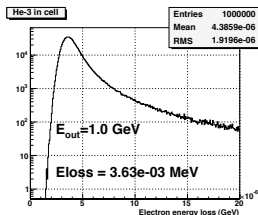
Optics: Momentum Resolution



- We can extract the momentum resolution from the plot of $(p - p_{elas})/p$
- Our resolution is about 1.15%
- Compare to resolution of Xin's full reconstruction on our data: 1.30%

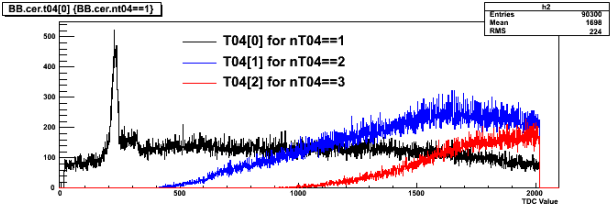
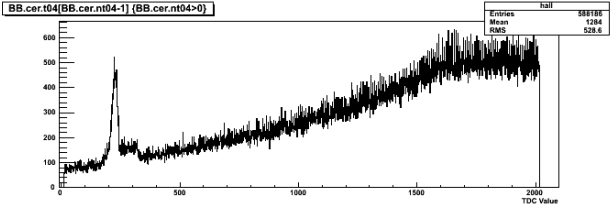
What About Energy Loss?

- Mean energy loss is up to $\sim 10\%$, but *most likely* energy loss is more like $\sim 0.1\%$
- Incorporating most likely energy loss leads to momentum change of 1 – 5 MeV/c and no appreciable change in momentum resolution

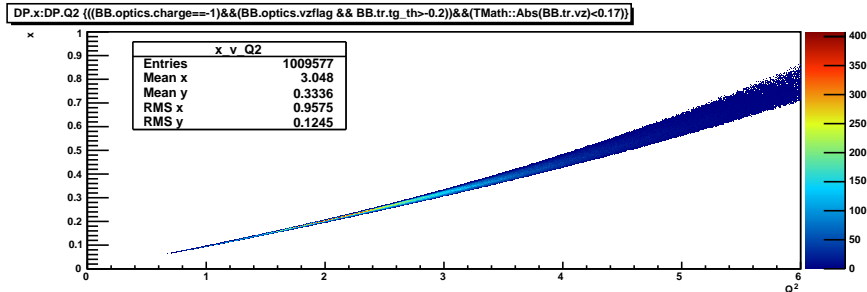
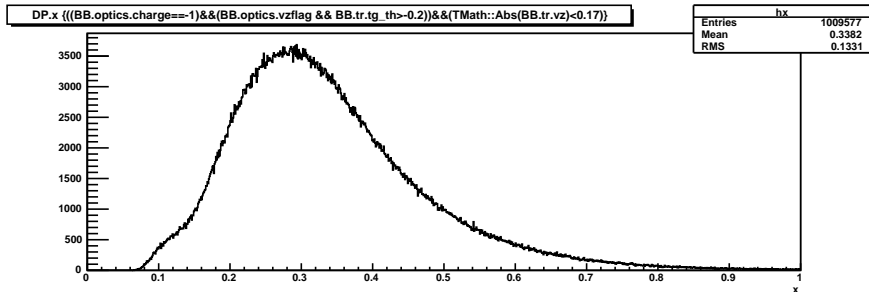


Multi-Hit TDCs

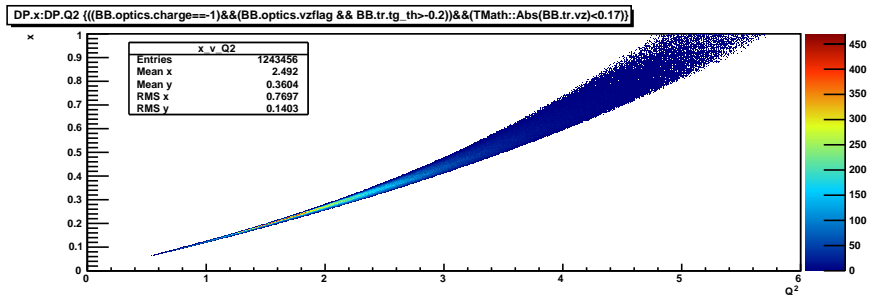
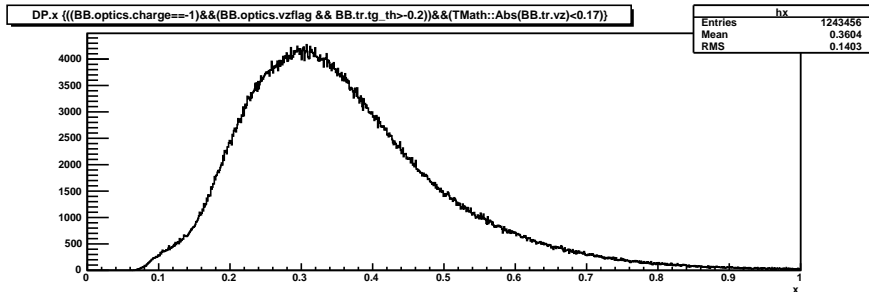
- It looks as though only the first hit in each multi-hit TDC is within the trigger timing window
- This should allow us to simplify our code ...



Kinematics Coverage at $E_e = 5.89$ GeV



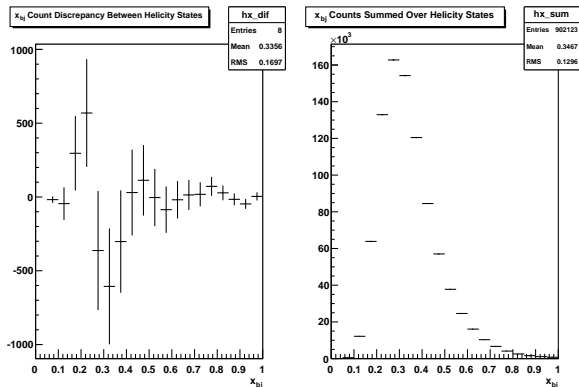
Kinematics Coverage at $E_e = 4.73$ GeV



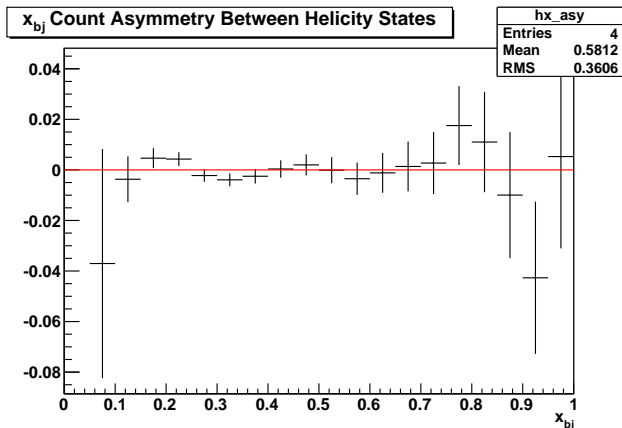
Counts and Helicity State

- I've started working on code to count good electron tracks binned by x and by beam helicity
- Even in a small number of runs (4), we can see nonzero effects

$$A = \frac{N^+ - N^-}{N^+ + N^-} \quad (3)$$

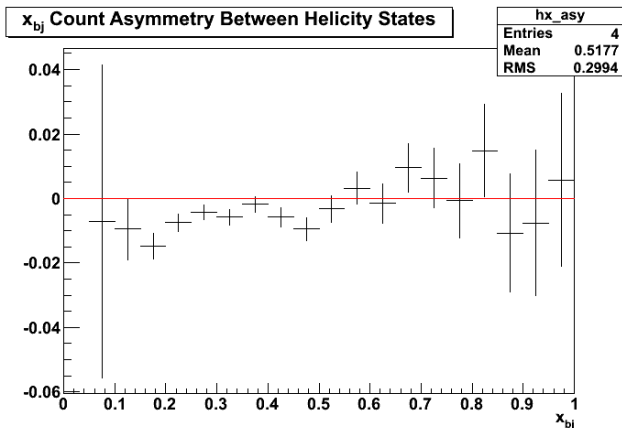


Very Preliminary Asymmetries at 5.89 GeV



- Cuts are very preliminary: charge, BB acceptance, T2 events, shower position agreement, vertex position
- Only four runs went into this plot

Very Preliminary Asymmetries at 4.73 GeV



- Same cuts/statistics as 5.89 GeV plot
- Sign change is due to IHWP (IN during 5-pass runs above, OUT during 4-pass runs here)

Summary

- BigBite Optics
 - ▶ Look-up table corrections are small and/or cancel in our acceptance
 - ▶ First-order reconstruction works with small adjustments: $\sim 1.2\%$ resolution
 - ▶ Energy loss not as important as we'd thought
 - ▶ Studying size of smoothing region
 - ▶ Fix axes for BB.tr.tg_th, BB.tr.tg_ph?
- Gas Cerenkov
 - ▶ We can simplify code, lighten ROOT files by keeping only first TDC hit
- Asymmetries
 - ▶ Code in place to compute asymmetries binned in x
 - ▶ Numbers will be improved by better statistics, better cuts

What's Next?

- I hope to have a draft of the status report by this weekend
 - ▶ Please keep sending figures and updates!
- Final touches on momentum reconstruction
- Start replays of BB production runs with momentum, shower calibrations done
- Skimming and data quality code
- Slightly less preliminary asymmetries with better cuts, statistics

I'm entertaining hopes of graduating in January.