Analysis Progress

for the d_2^n analysis meeting

Diana Parno

Carnegie Mellon University

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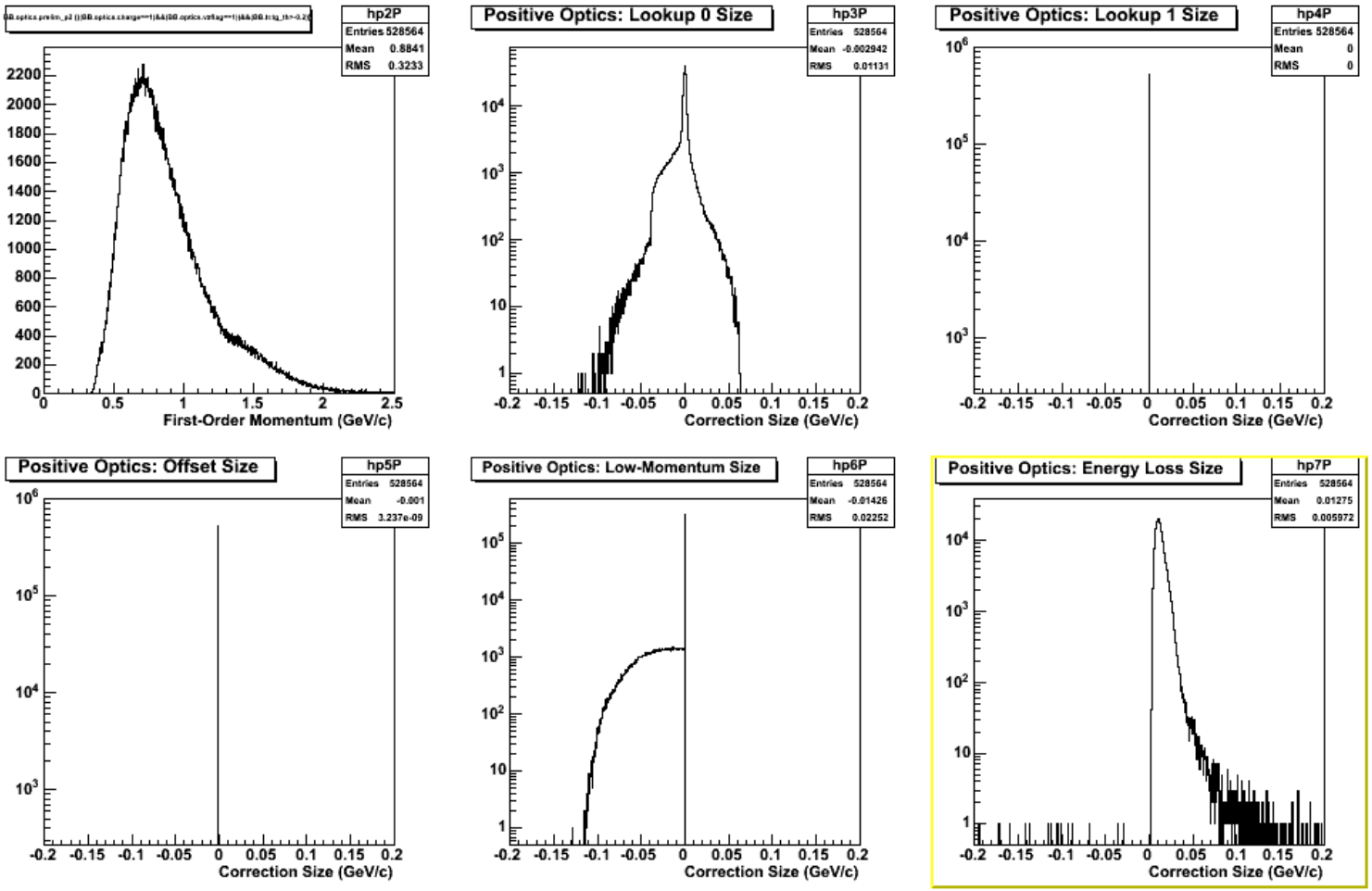
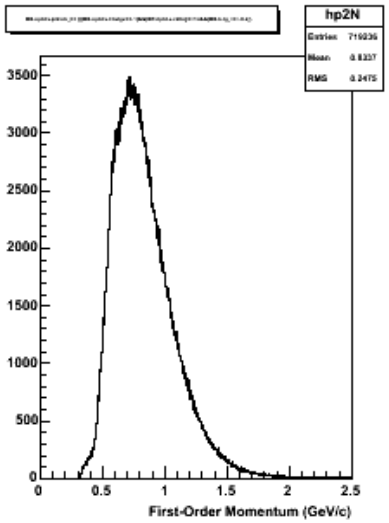
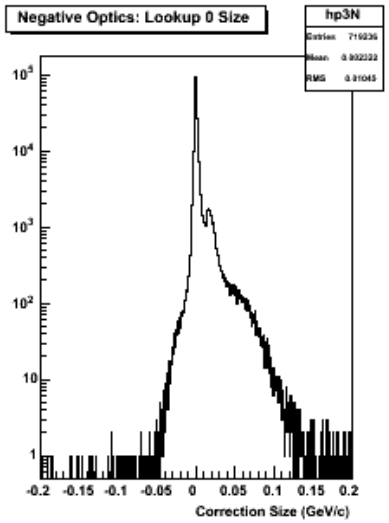
Momentum Corrections and Acceptance (i)

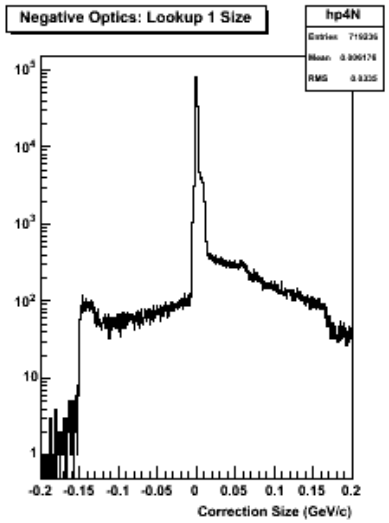
- Acceptance cuts remove most of the large momentum corrections
- What's left? Consider positive optics first:

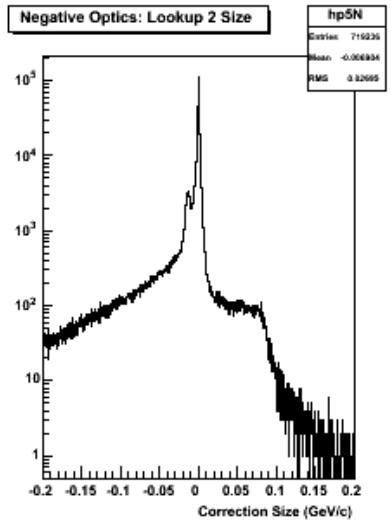


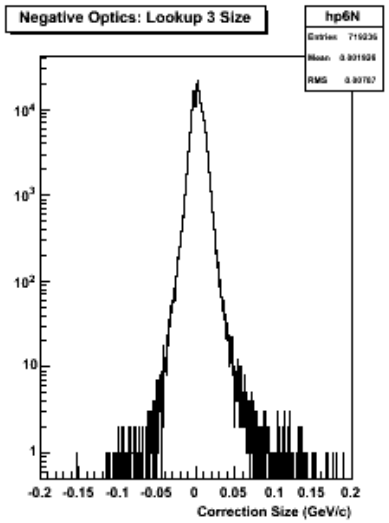
Momentum Corrections and Acceptance (ii)

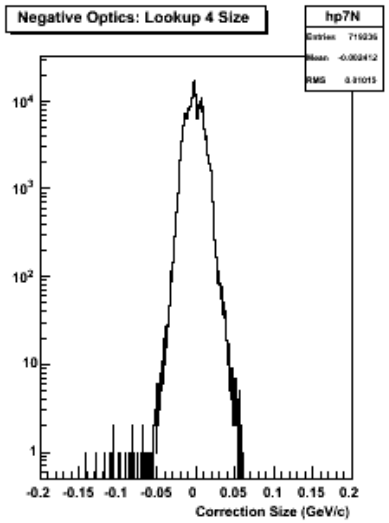


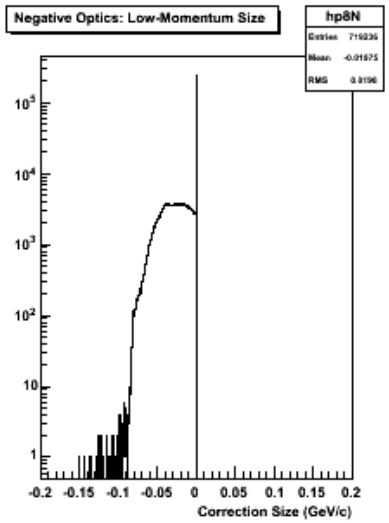


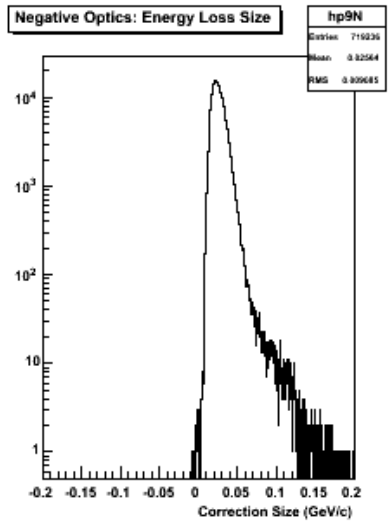




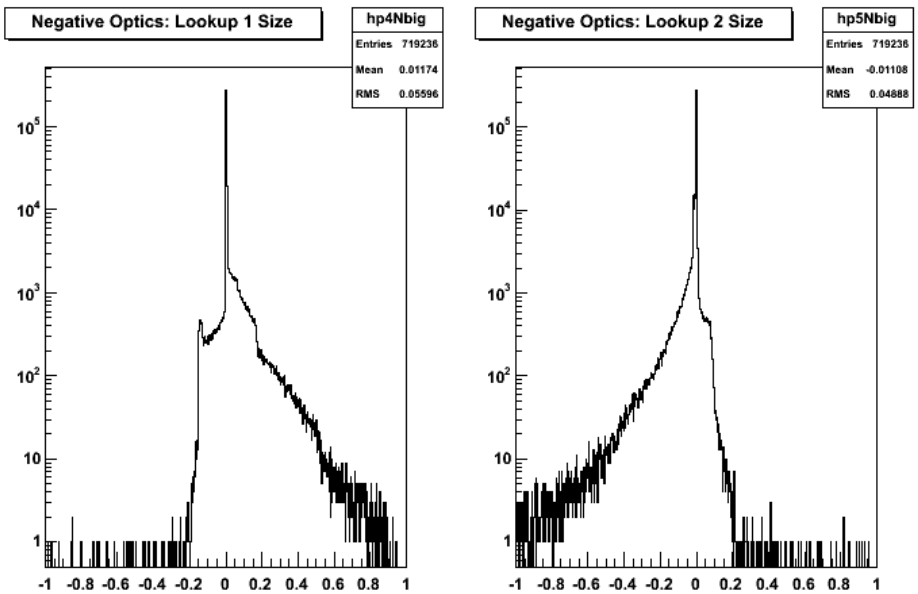


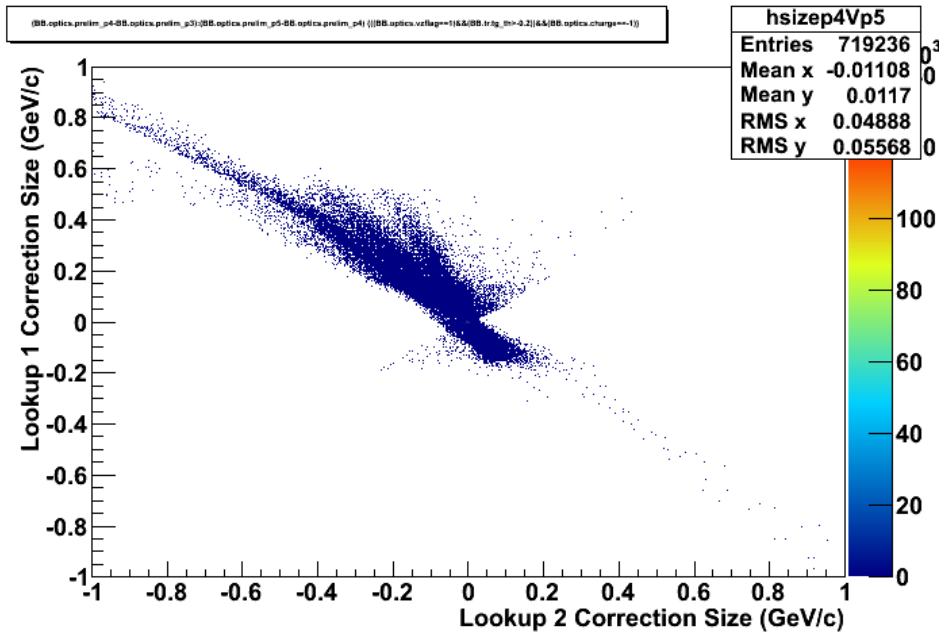






Momentum Corrections and Acceptance (iii)





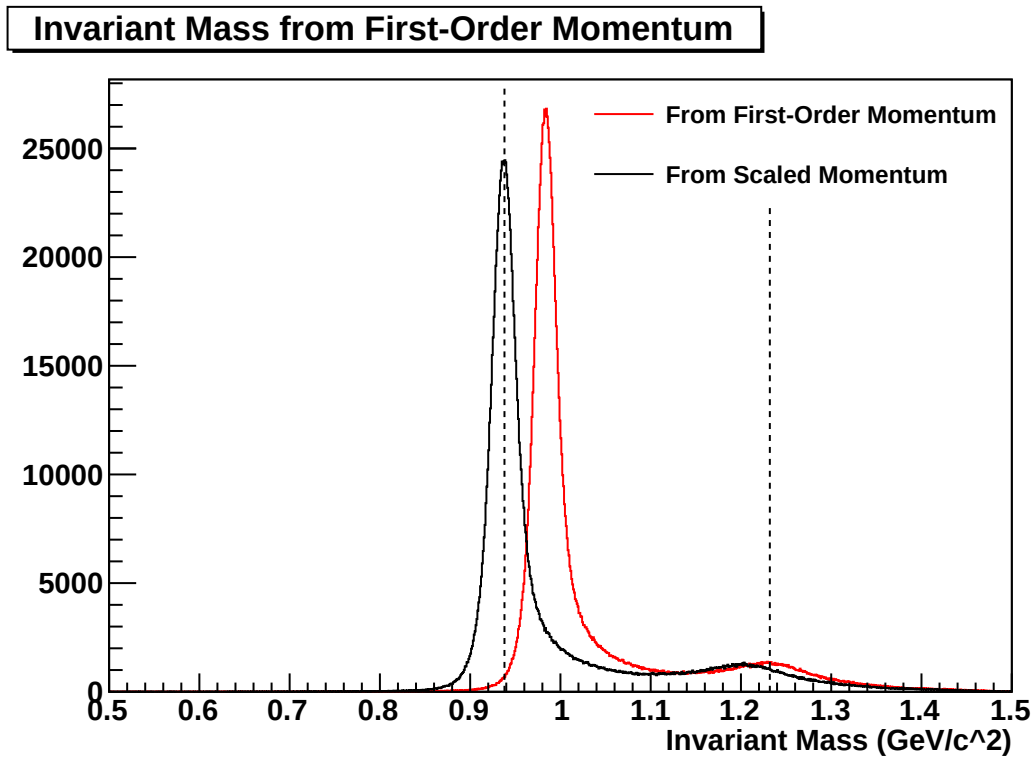
- The two largest lookup-table corrections largely correct each other...

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 ^{2}H 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:

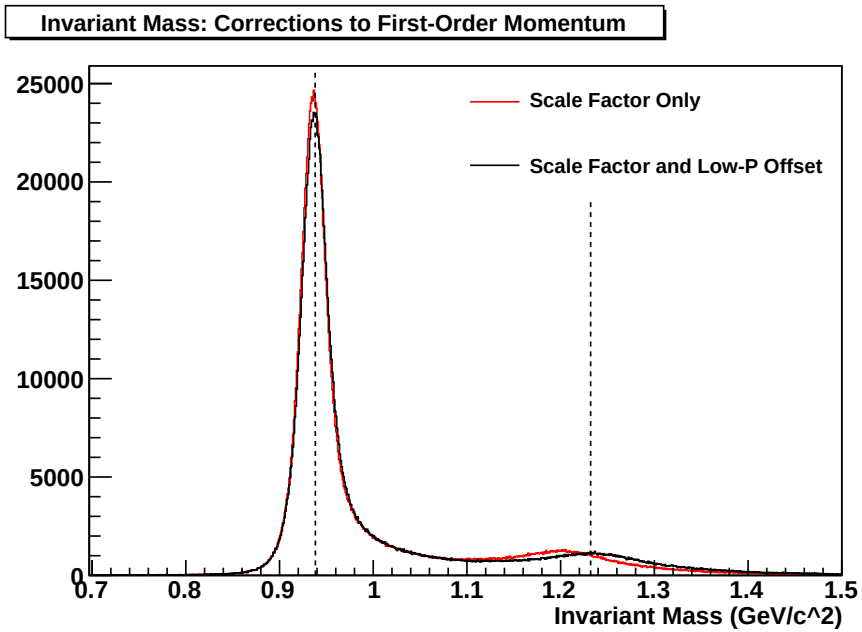
$$p^{(2)} = \begin{cases} p^{(1)} & \text{for } p^{(1)} > 0.9 \\ p^{(1)} + 0.148\left(p^{(1)} - 0.9\right) & \text{for } p^{(1)} \leq 0.9 \end{cases} \tag{1}$$

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

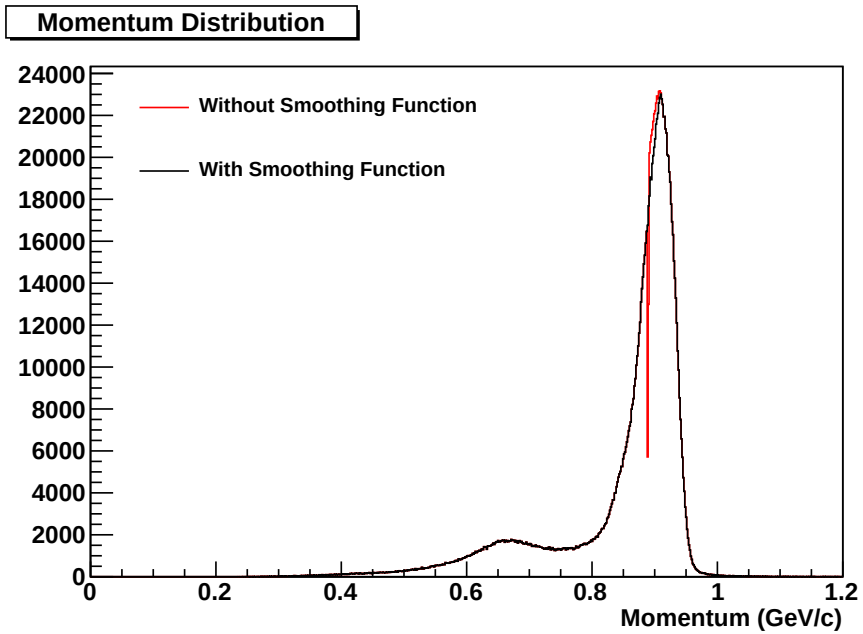
$$p^{(2)} = \begin{cases} p^{(1)} & \text{for } p^{(1)} > 0.91 \\ p^{(1)} - 3.7\left(p^{(1)} - 0.91\right)^2 & \text{for } 0.89 \leq p^{(1)} \leq 0.91 \\ p^{(1)} + 0.148\left(p^{(1)} - 0.9\right) & \text{for } p^{(1)} < 0.9 \end{cases} \tag{2}$$

Optics: Low-Momentum Correction (ii)

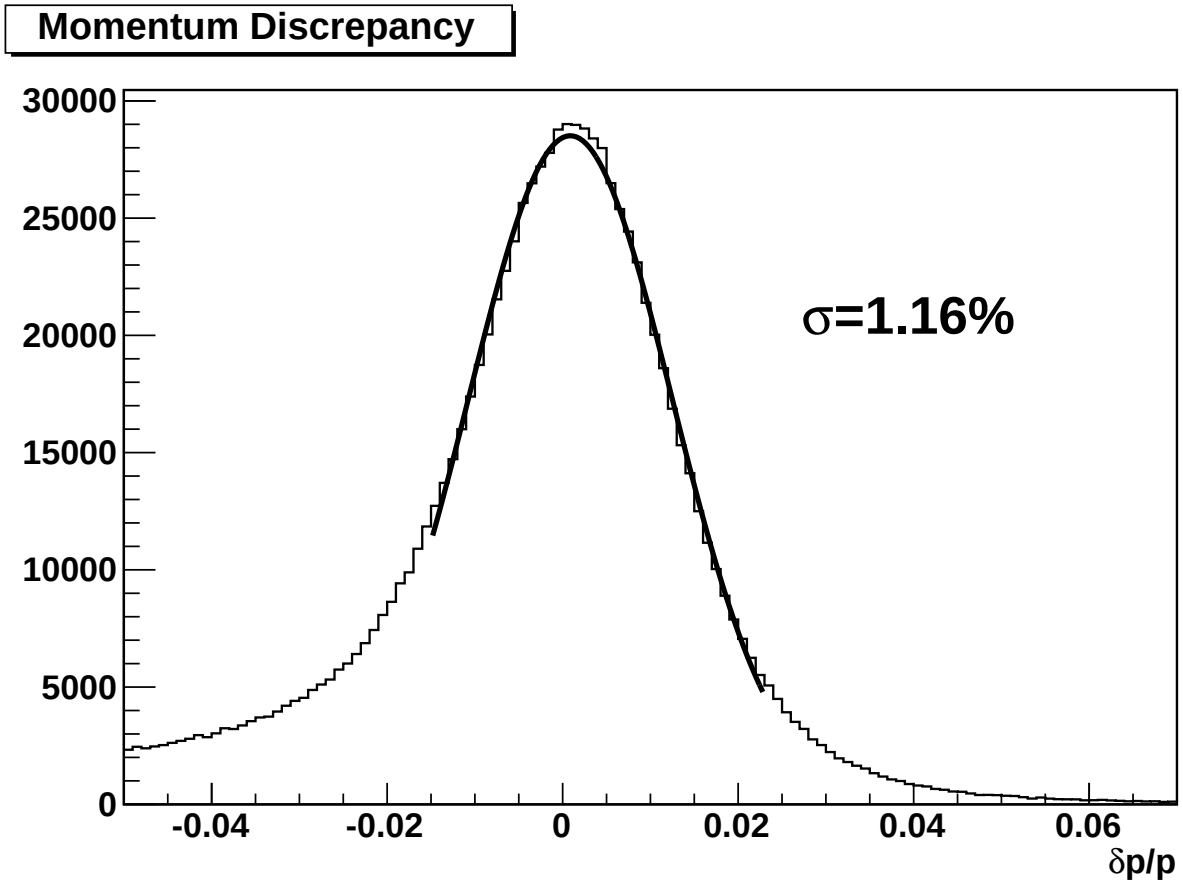
W peaks are correct to within 1 MeV



Momentum distribution is continuous



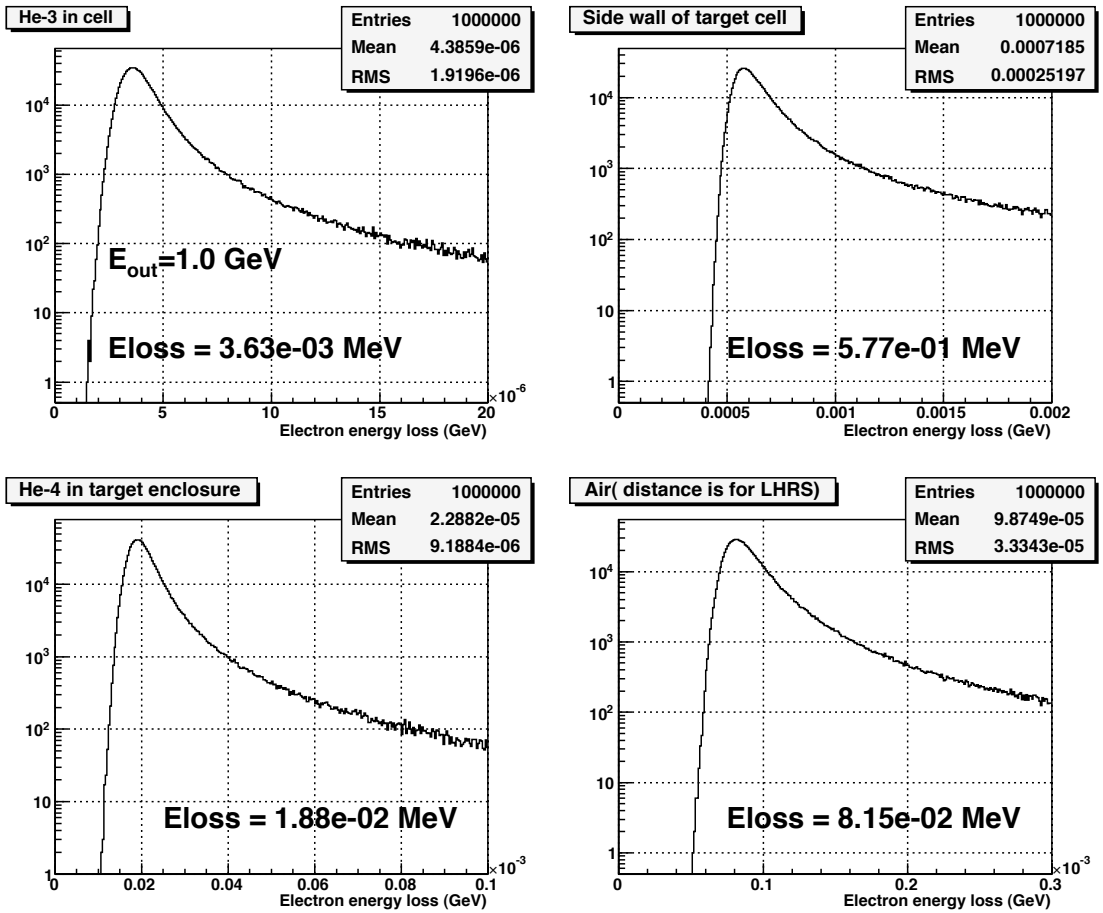
Optics: Momentum Resolution



- We can extract the momentum resolution from the plot of $(p - p_{elas})/p$
- Our resolution is about 1.16%
- Compare to resolution of Xin's full reconstruction on our data: 1.30%

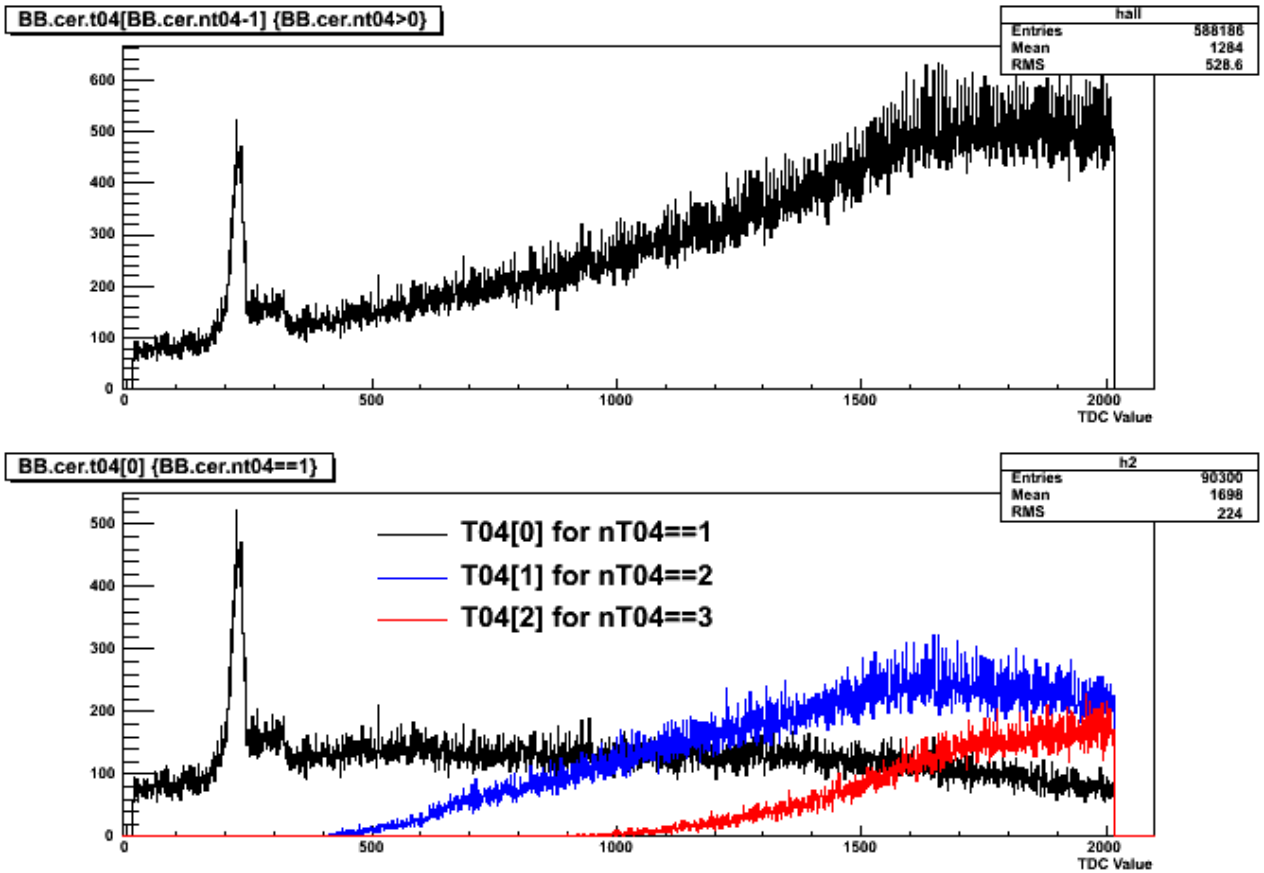
What About Energy Loss?

- *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

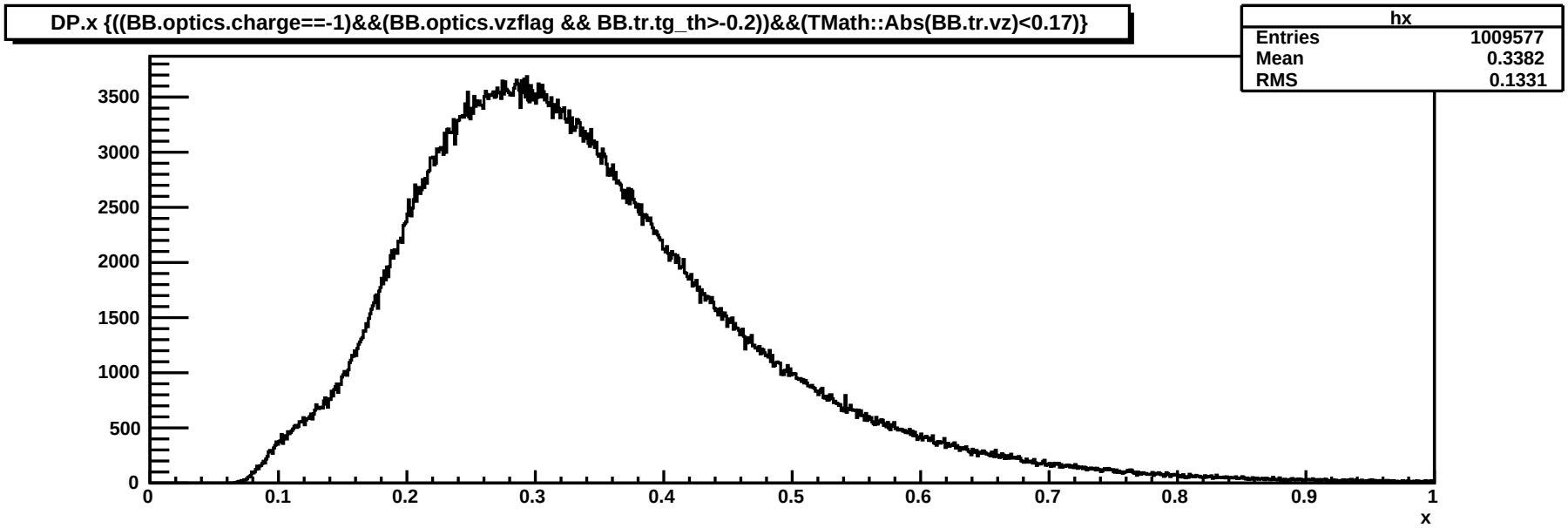


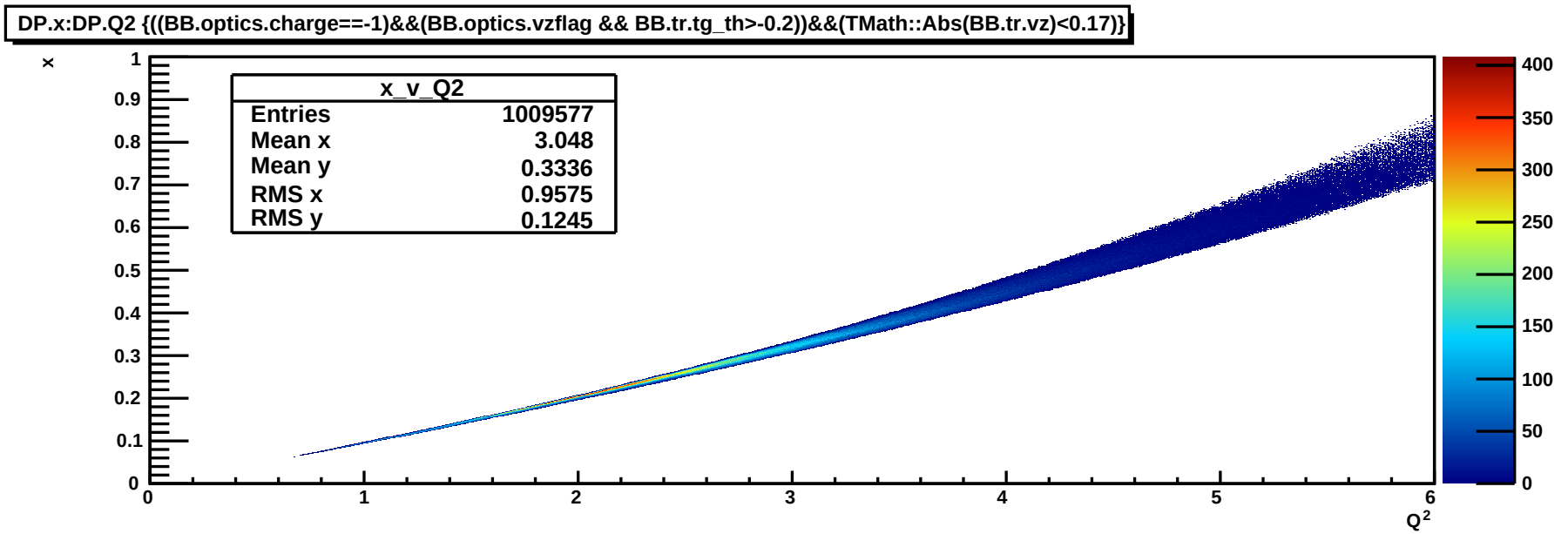
Multi-Hit TDCs

- 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 ...

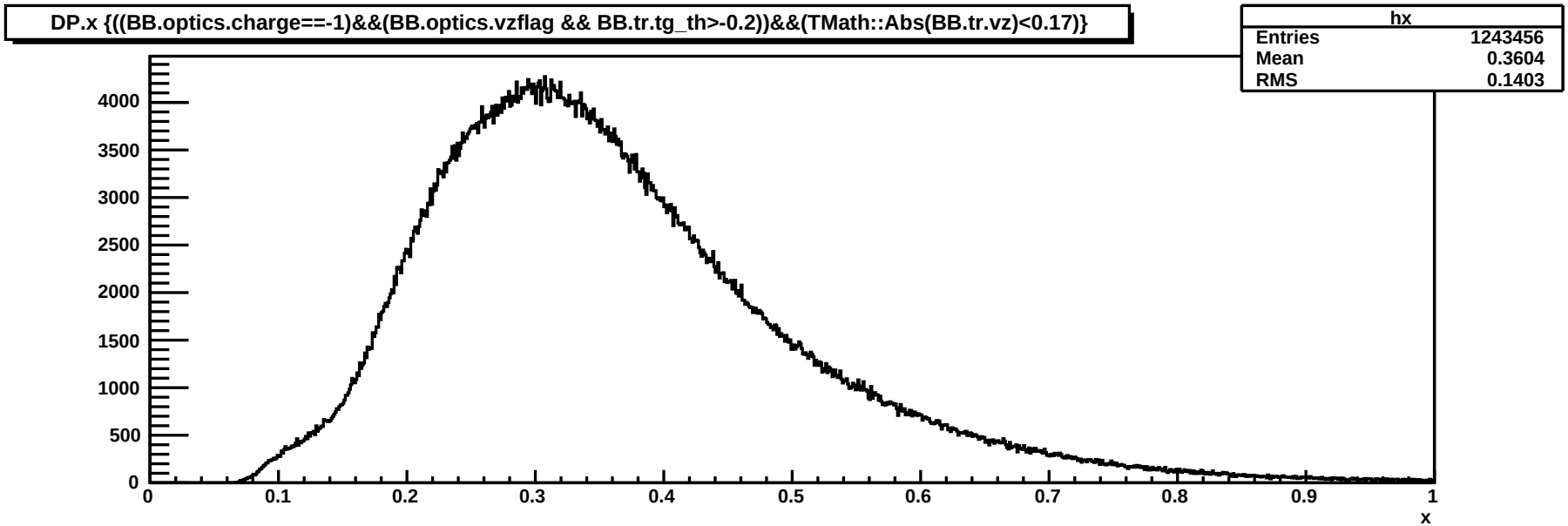


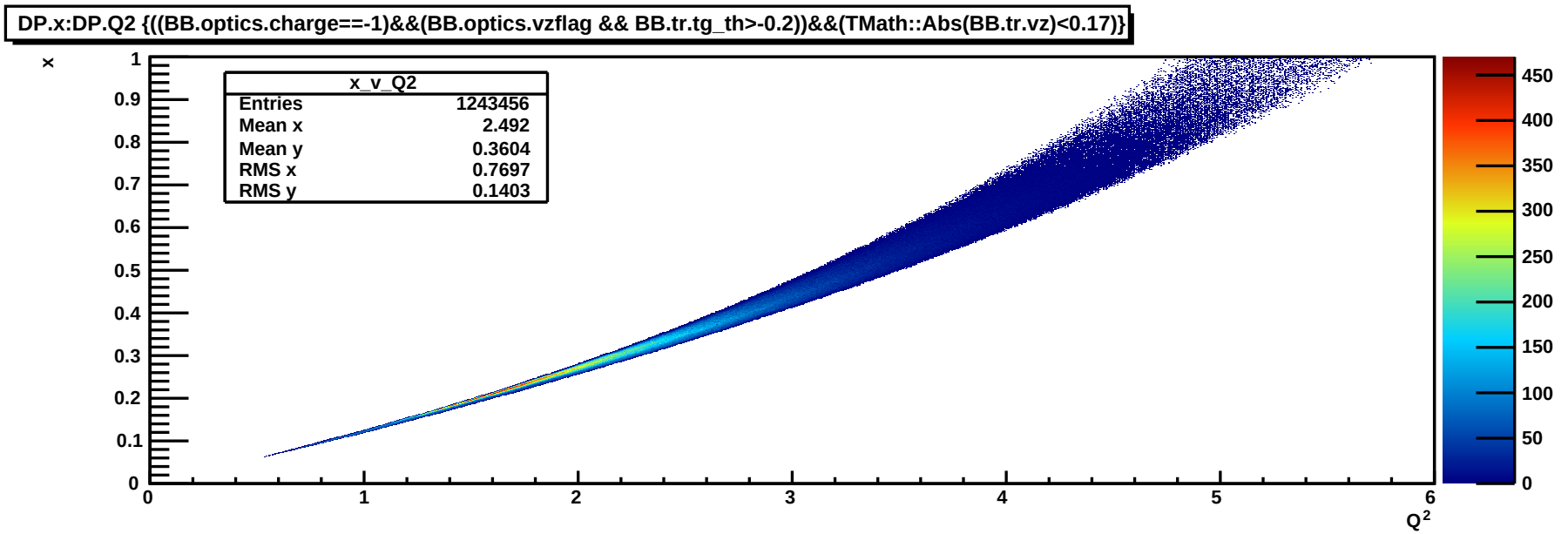
Kinematics Coverage at $E_e = 5.89$ GeV





Kinematics Coverage at $E_e = 4.73$ GeV

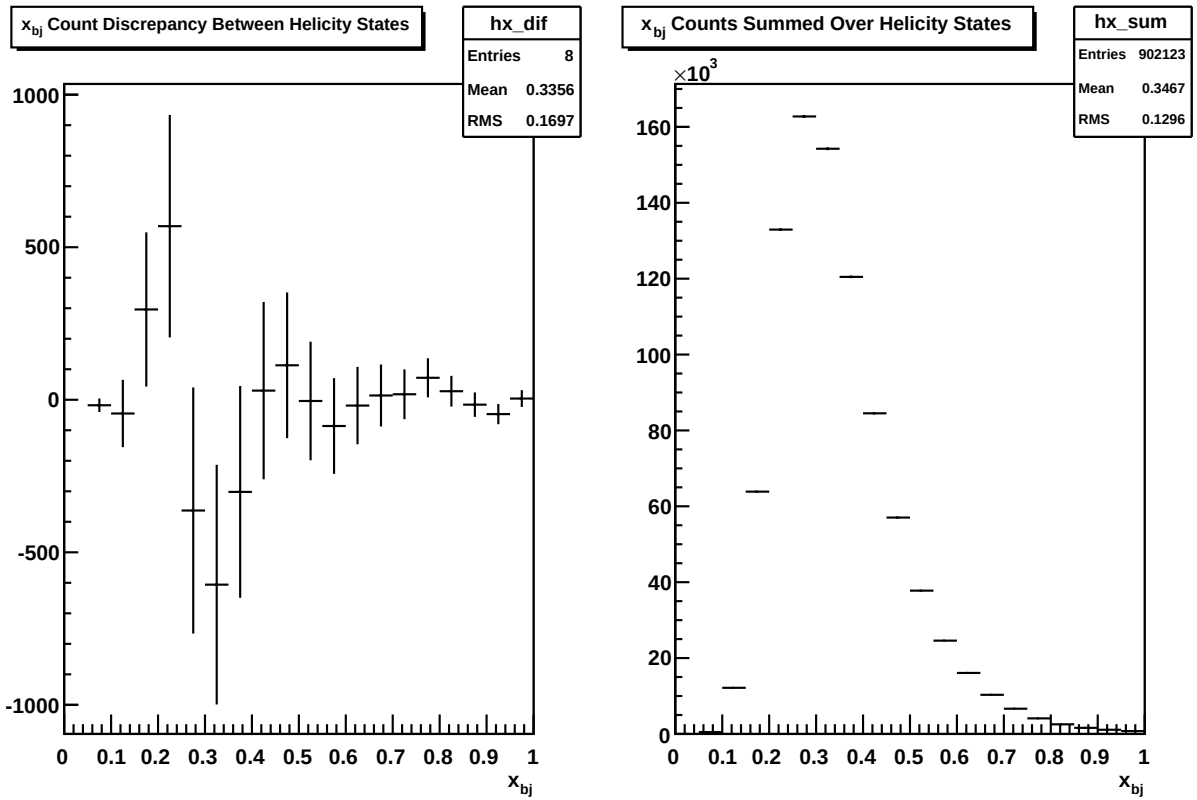




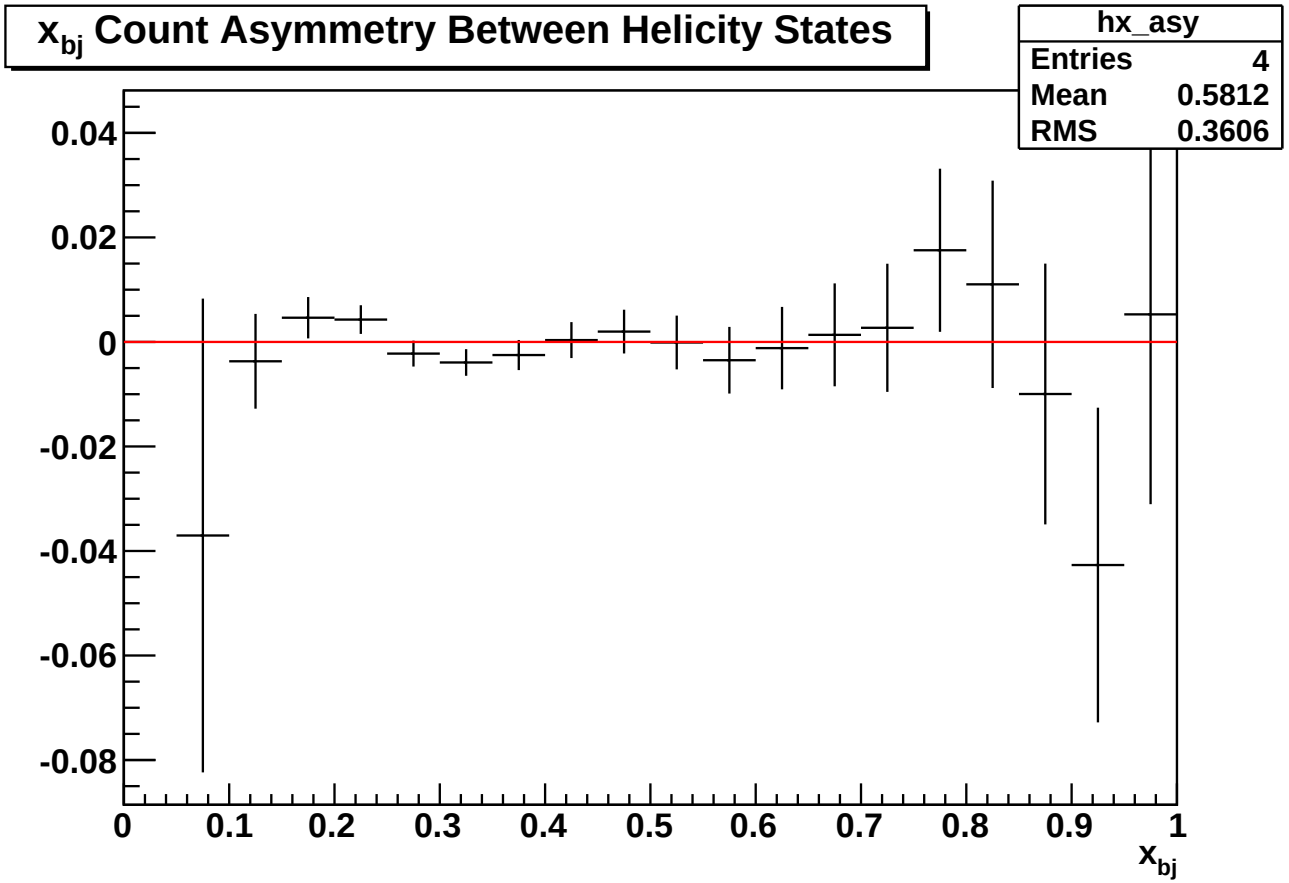
Counts and Helicity State

- 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

$$A = \frac{N^+ - N^-}{N^+ + N^-} \tag{3}$$

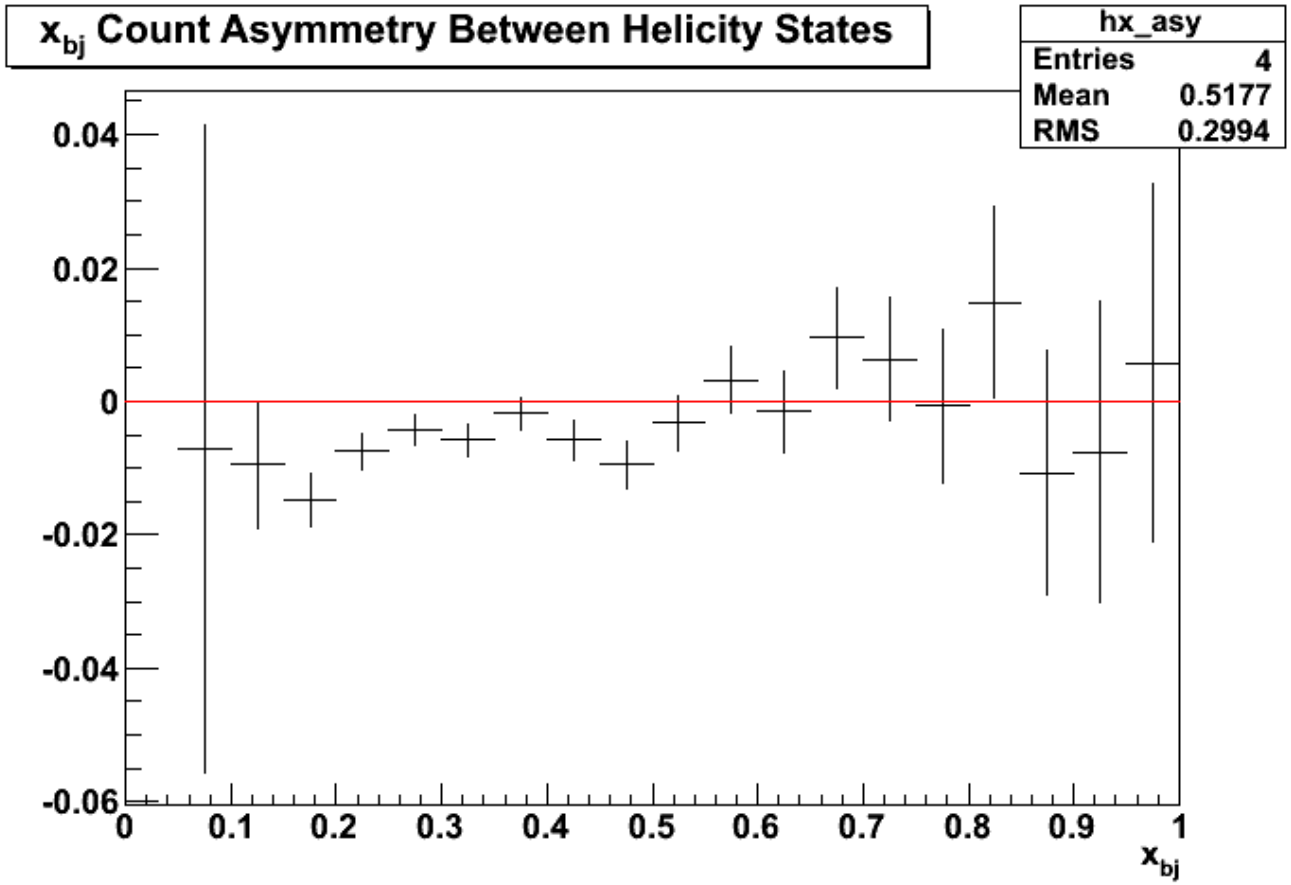


Very Preliminary Asymmetries at 5.89 GeV



- 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.