Analysis Progress

for the d_2^n analysis meeting

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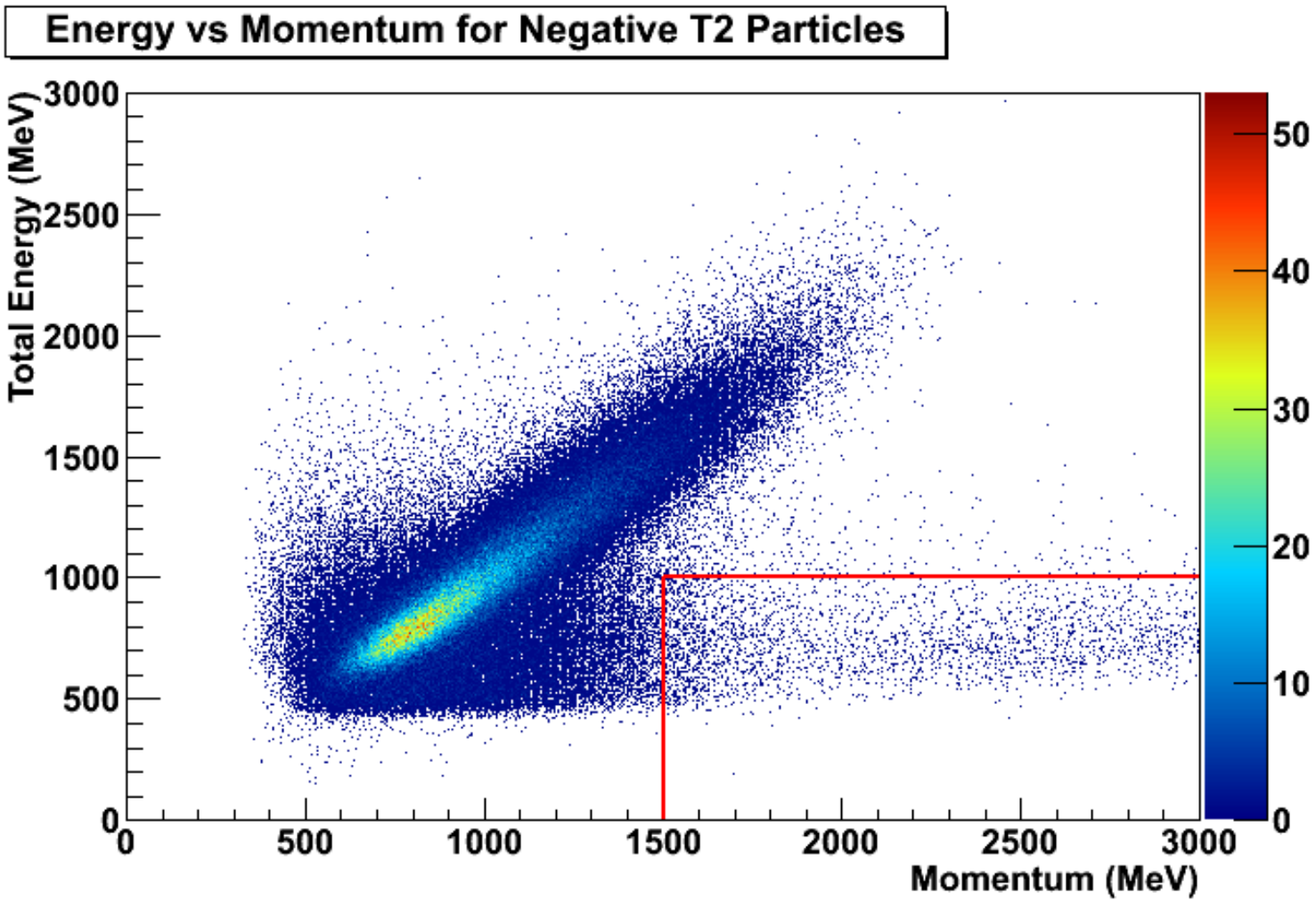
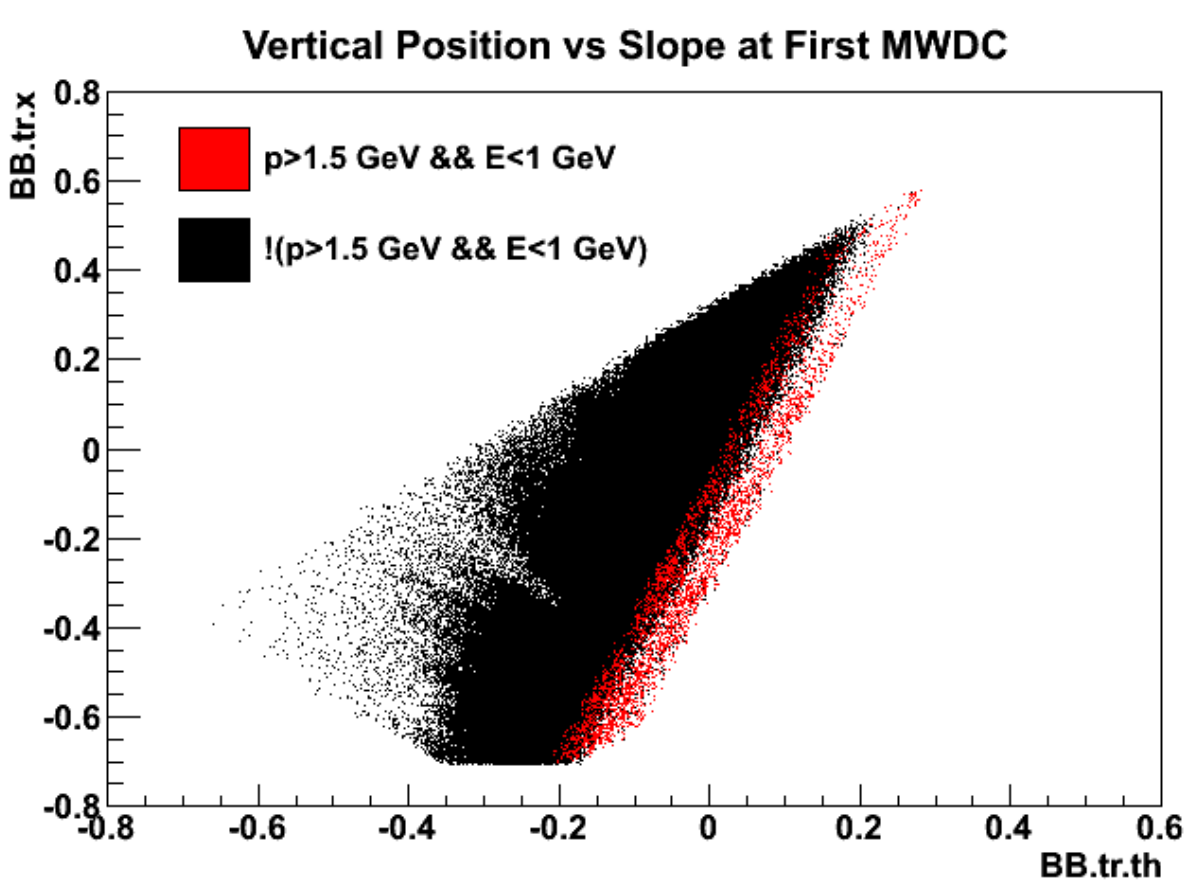
Outliers in E vs p: Definition

- $E < 1$ GeV, $p > 1.5$ GeV/c
- Other cuts: Magnet region, T2 events, alignment of track and shower, vertex z position, momentum in valid range, χ^2/d.o.f.



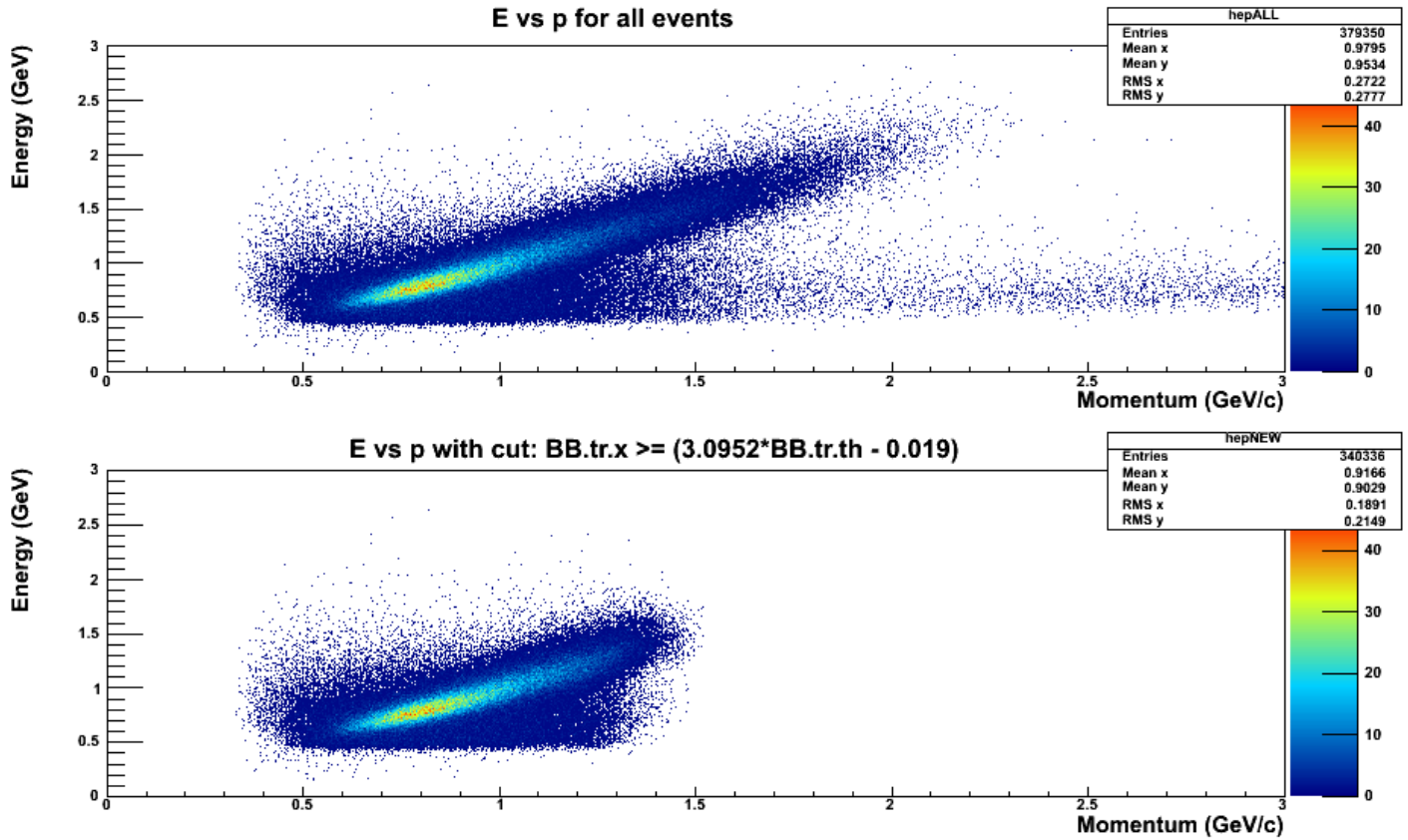
Outliers as Stiff Tracks (i)

- Common outlier characteristics:
  - Uncommonly high momentum
  - Uncommonly low energy
- What if they really are stiff tracks – not bending much in the magnet?



Outliers as Stiff Tracks (ii)

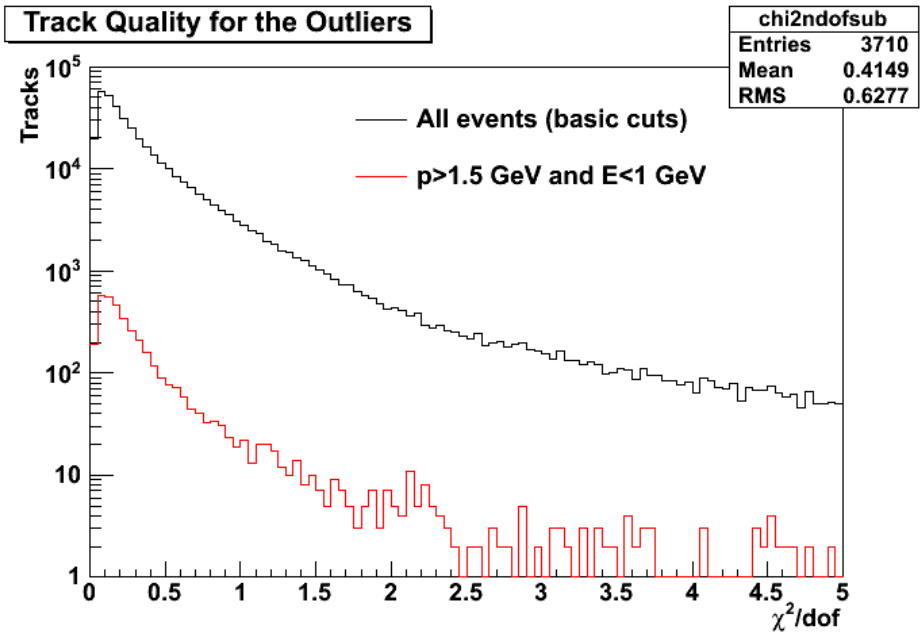
- We can exclude all outliers with a cut on x vs θ:
- Require $x > 3.0952\theta - 0.019$
- This cuts out all the high-p electrons too...



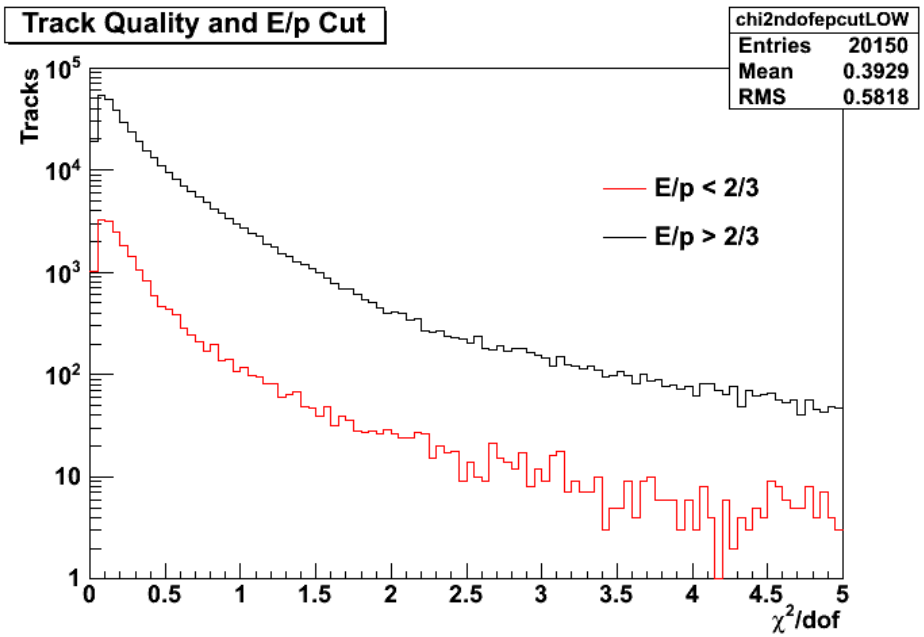
Outlier Behavior (i): Track Quality

- Our outlier and E/p cuts don't clean up χ^2/d.o.f.

Track Quality and E-p Outliers



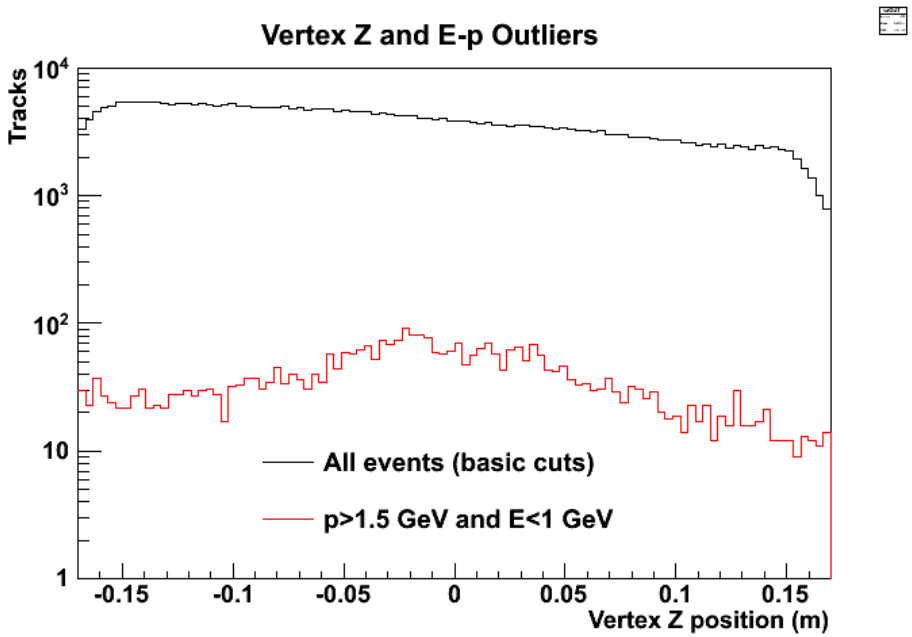
Track Quality and E/p Cut



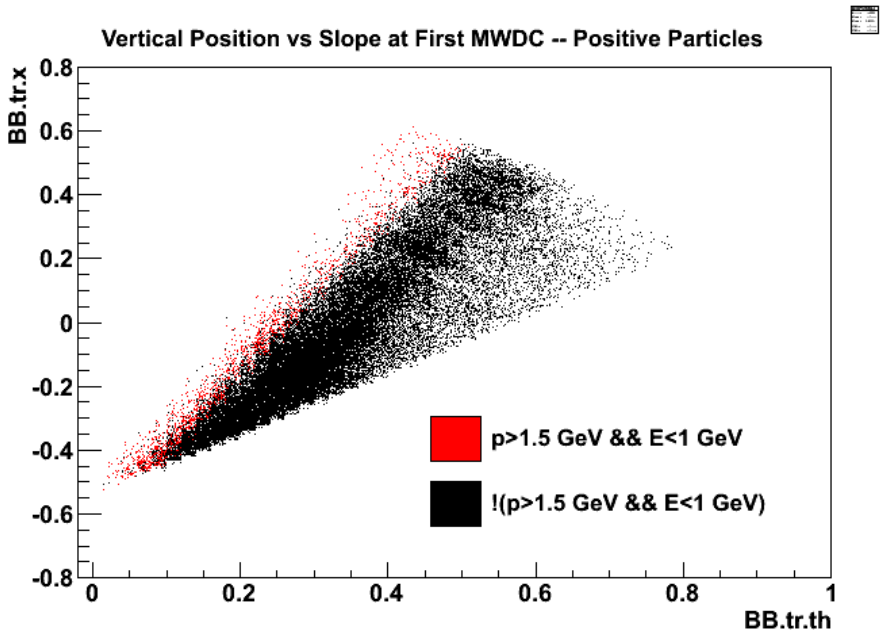
Outlier Behavior (ii): Optics

- Vertex z position is derived from optics package
- Presence of outliers in positive sample argues against optics being at fault

Vertex z and E-p Outliers

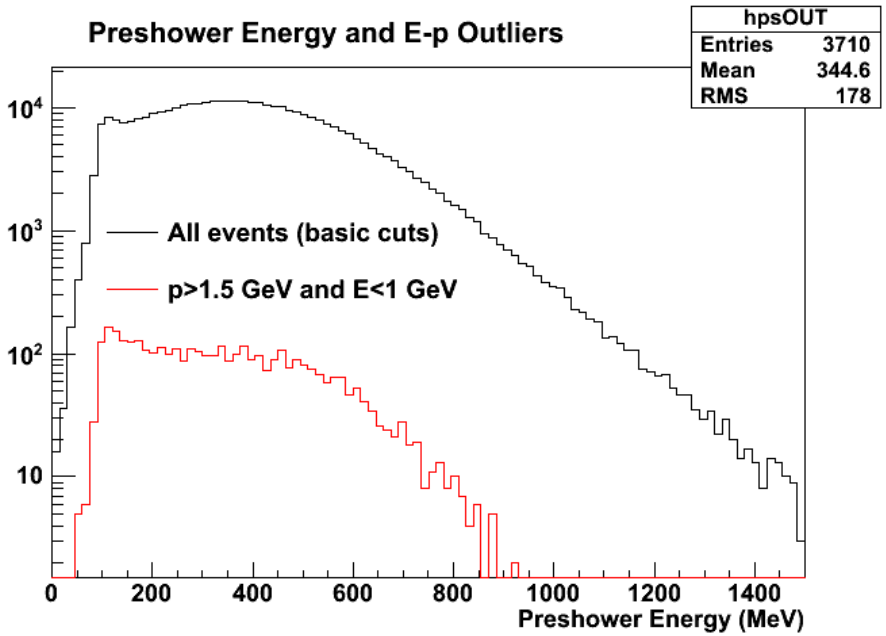


E-p Outliers Among Positively Charged Particles

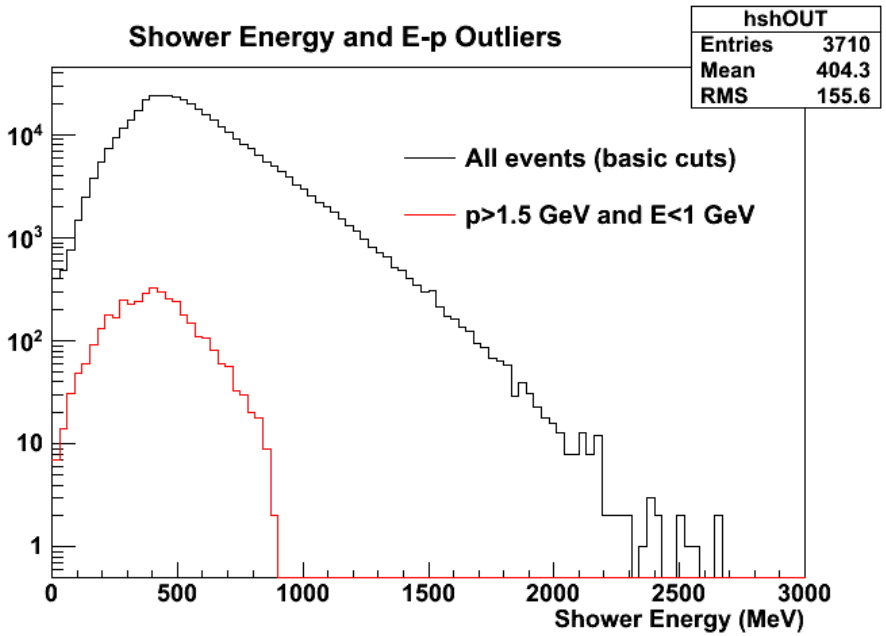


Outlier Behavior (iii): Preshower and Shower

Preshower Energy



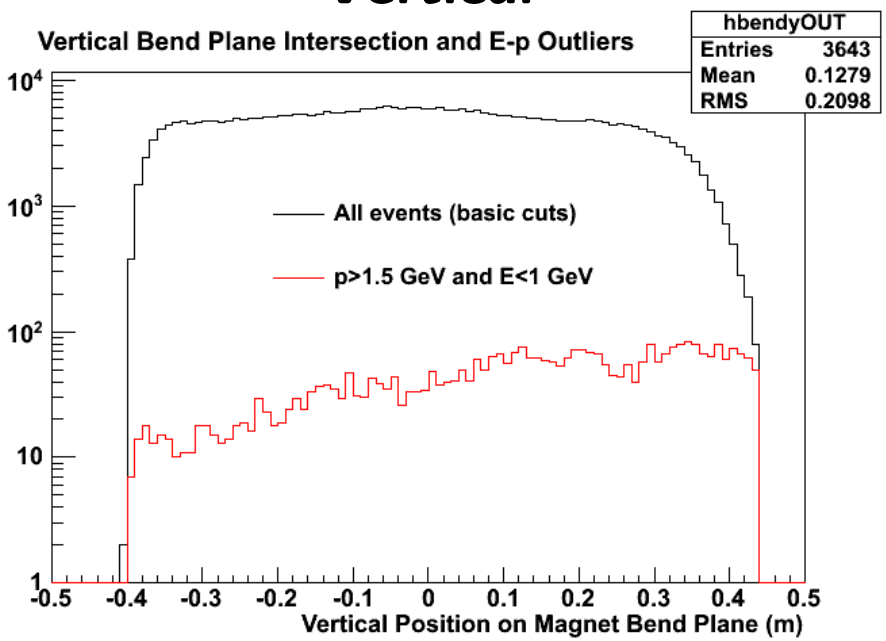
Shower Energy



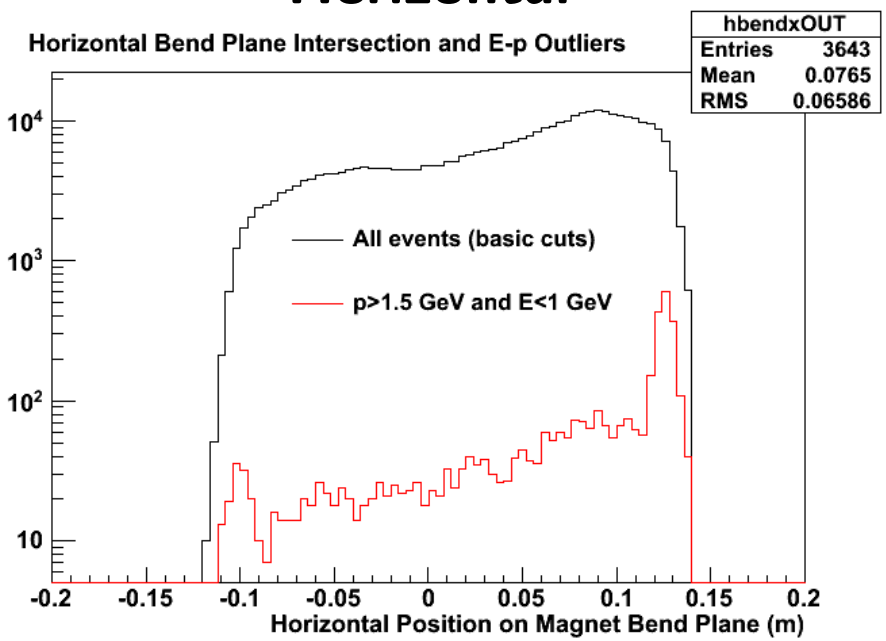
Outlier Behavior (iv): Magnet

- Where do outlier tracks intersect the bend plane?

Vertical

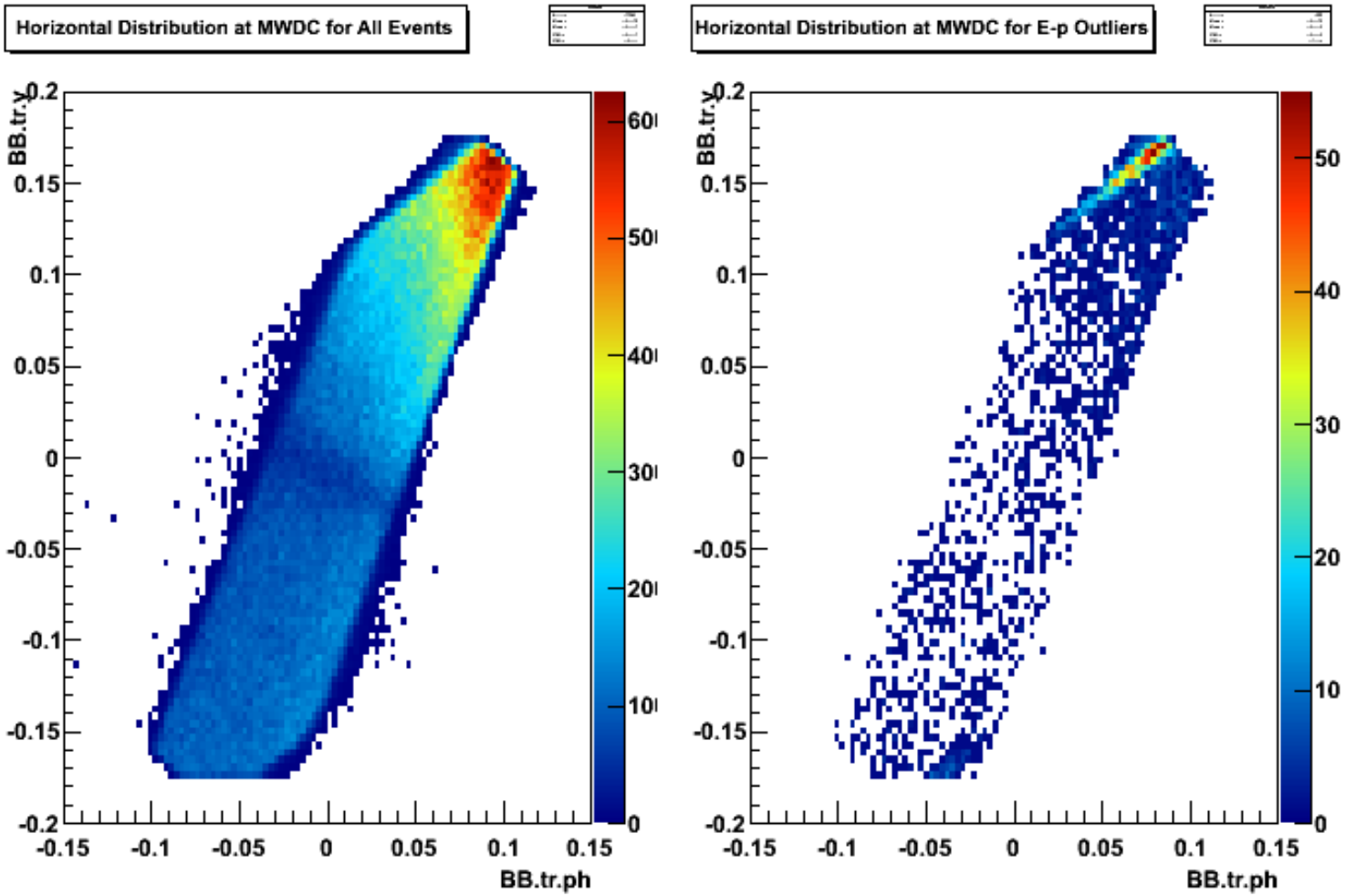


Horizontal



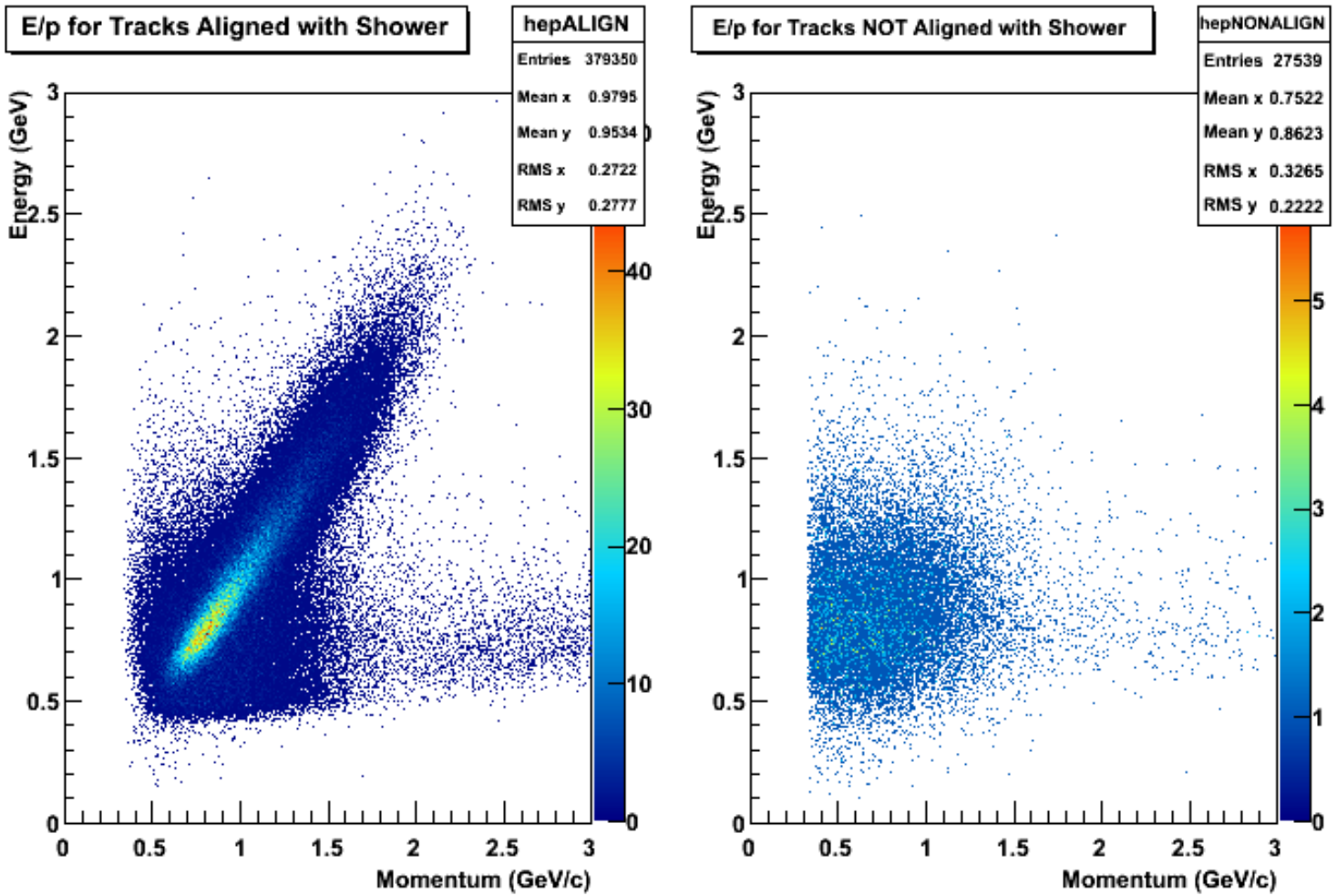
Outlier Behavior (v): Horizontal Trajectory at MWDC

- Bend plane intersection depends on optics
- Do we see anything odd in the horizontal position purely from tracking?

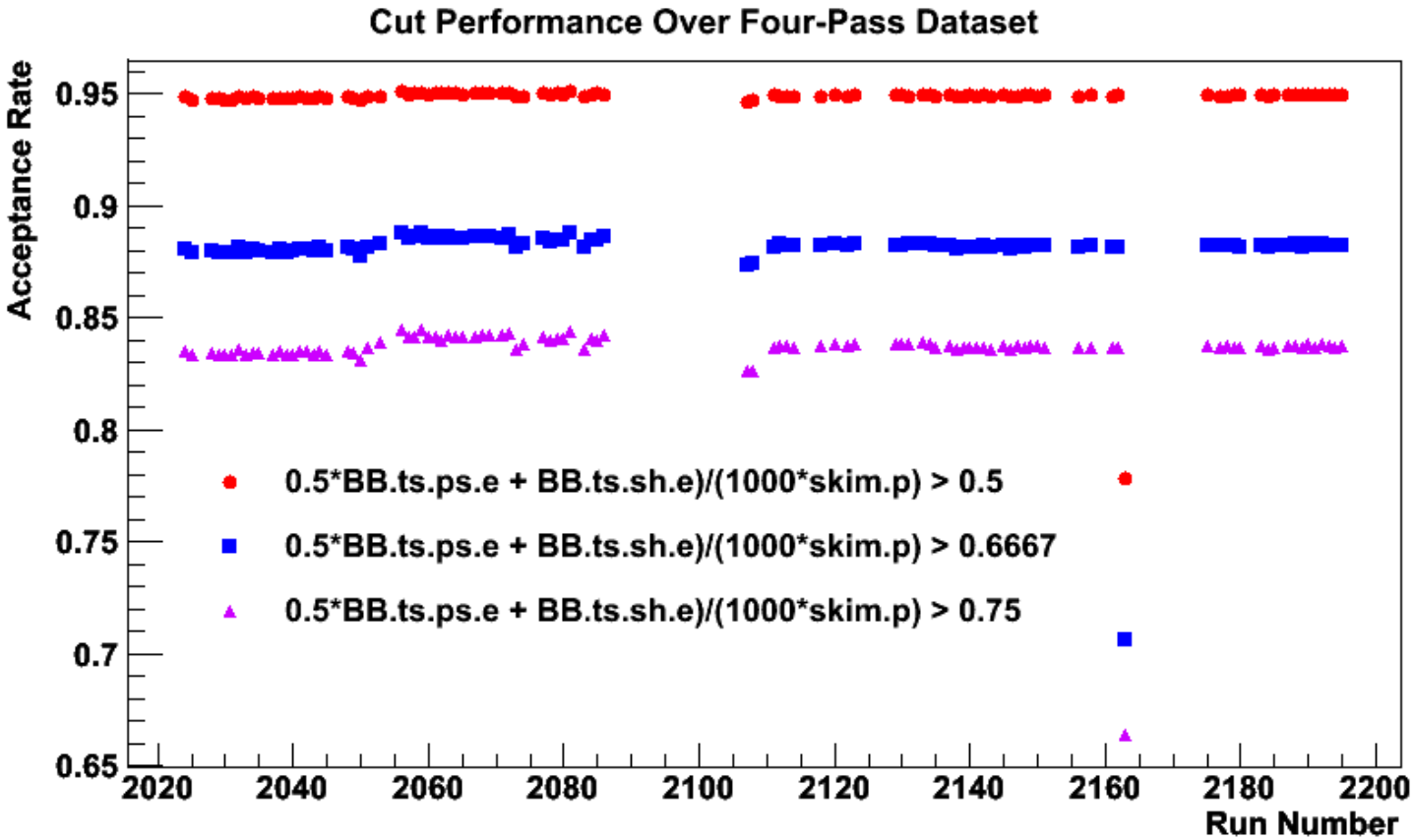


Track-Shower Alignment

- Cut limits discrepancy between projected track position and shower position to 0.15 m
- It cleans up E vs p significantly:



Stability of E/p Cut

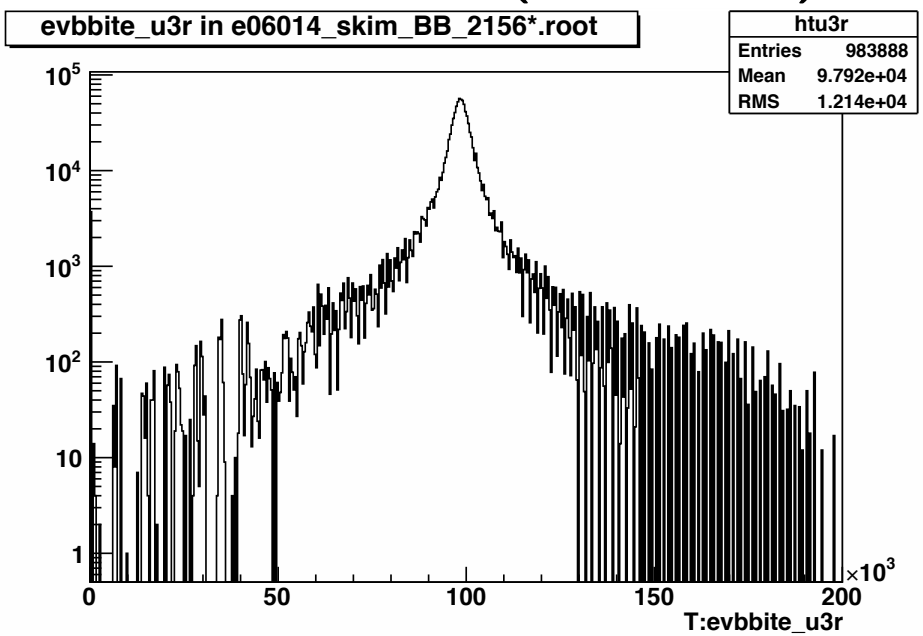


- Cut is generally stable
- Acceptance ticks *up* in the run period where Matt showed the E/p peak shifts *down* by 1%

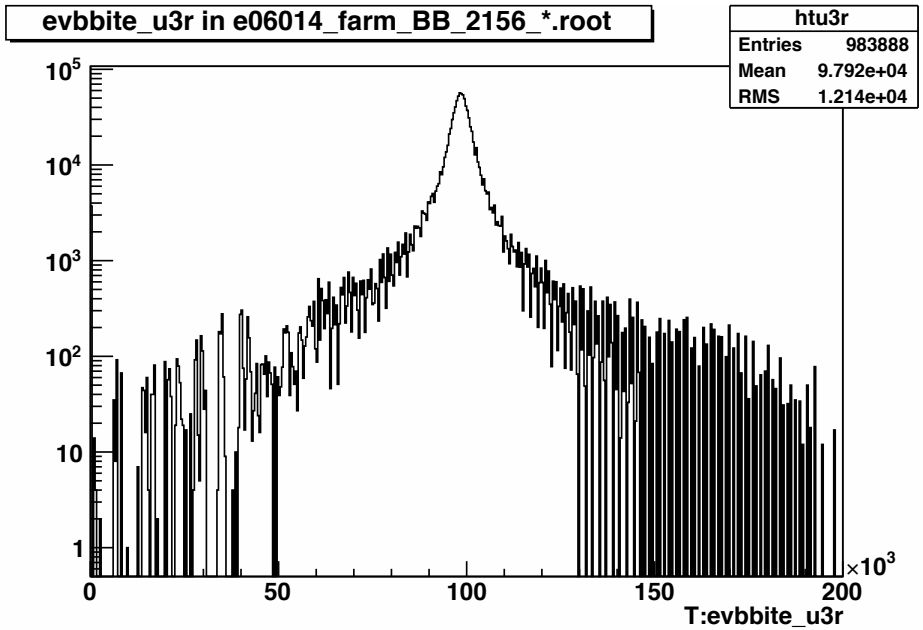
Beam Current: Zero Readouts (i)

- Two weeks ago, Matt noticed that the `evbbite_u3r` variable in the skimmed root files occasionally had a zero value
- This value was obviously not correlated with actual beam trips
- Does this mean there's a problem with the skim process?

Skimmed File (Run 2156)

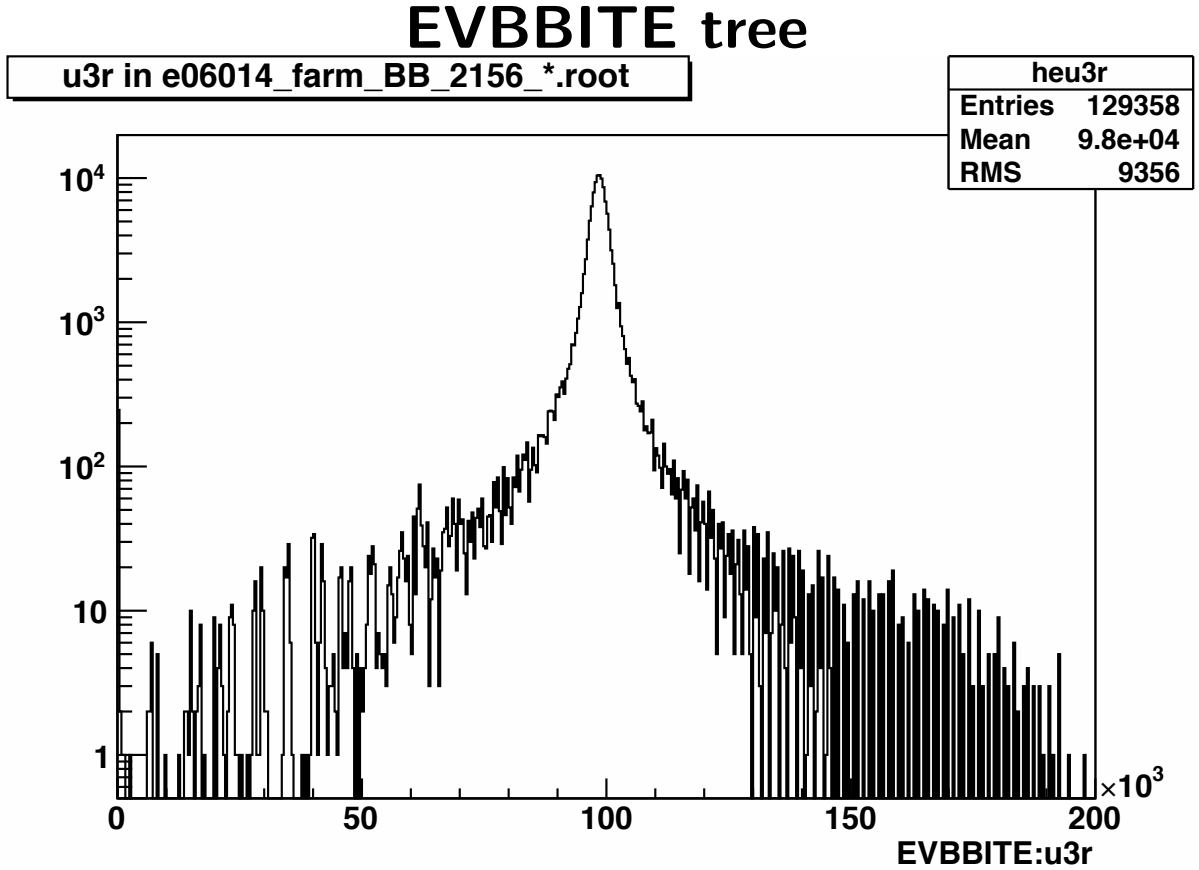


Original Replayed ROOT File (Run 2156)



Beam Current: Zero Readouts (ii)

- 0.38% of entries have zero values in both trees
- Meanwhile, only 0.19% of entries in EVBBITE tree are zero
- These differ by a factor of 1.98



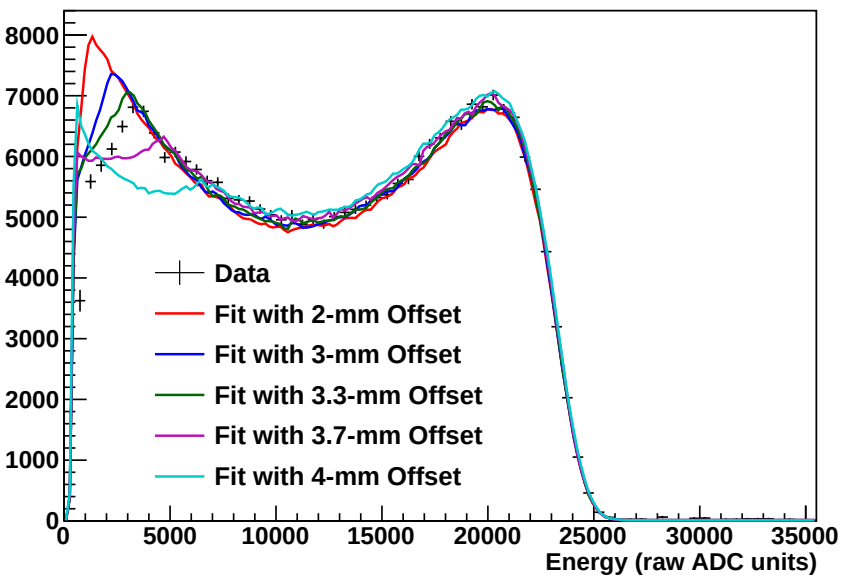
Collimator Misalignment (i)

- Think back several months ...
- Compton relies on detecting back-scattered photons with a single crystal
- We integrate over entire energy spectrum of photons
- But we saw evidence that the 1-cm collimator was misaligned with the photon beam!
- This would cut out some of our lower-energy photons
- **What effect does this have on our analyzing power?**

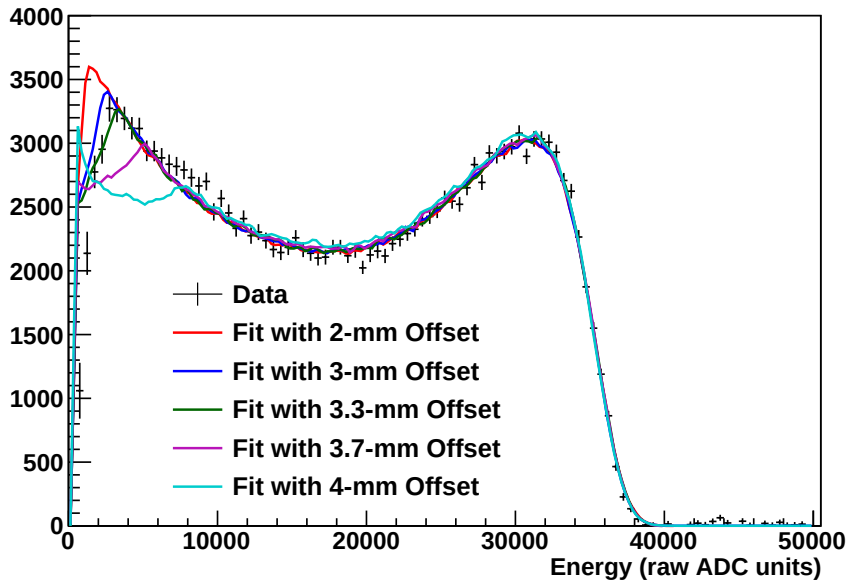
Collimator Misalignment (ii)

- Megan Friend has performed a study of this problem
- First step: Match our data to Monte Carlo fits to quantify misalignment

4.74 GeV



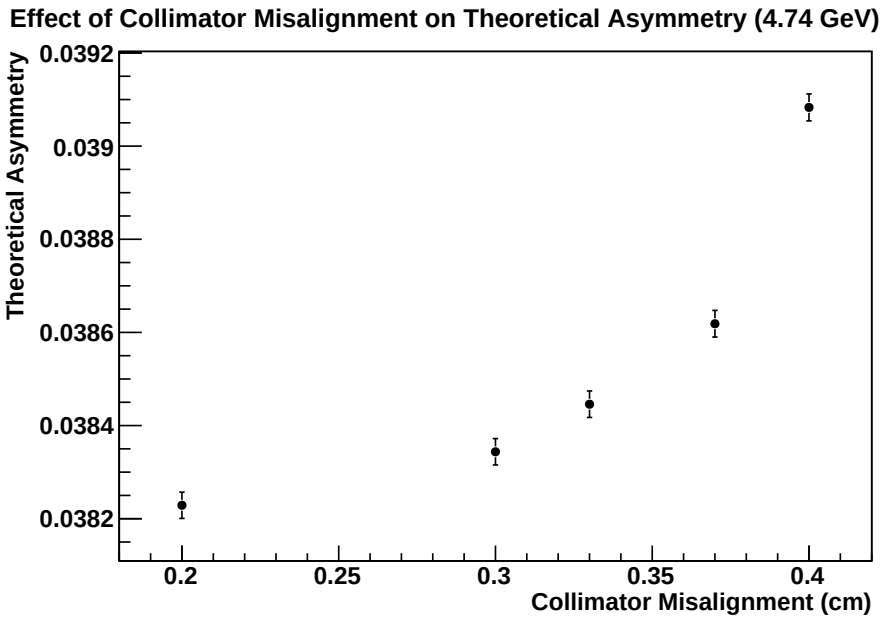
5.90 GeV



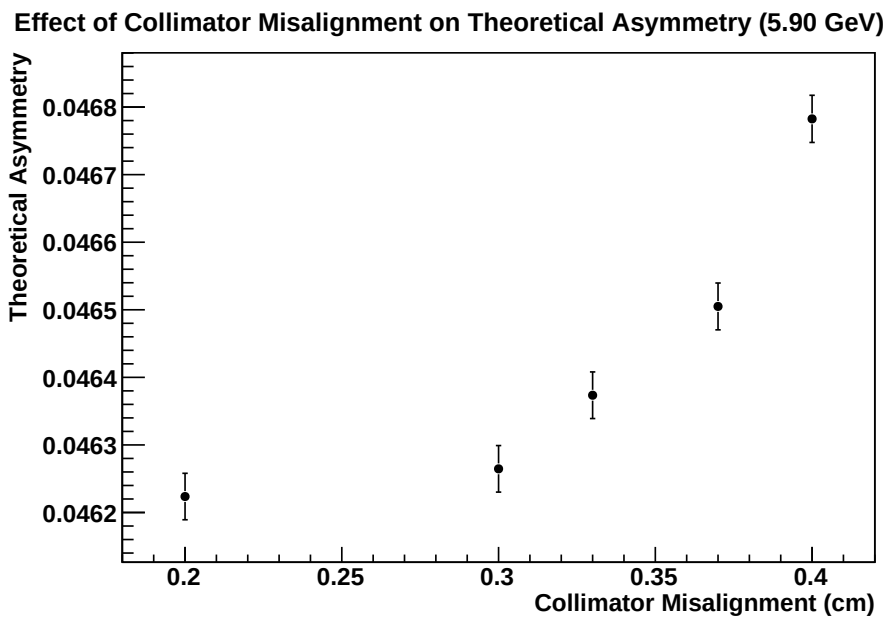
Collimator Misalignment (iii)

- These Monte Carlo fits also allowed Megan to compute the theoretical asymmetry for various misalignments
- The difference in A_I between a 3.3-mm offset and a 3.7-mm offset is quite small
  - 0.45% for 4-pass data
  - 0.28% for 5-pass data

4.74 GeV



5.90 GeV



Summary

- E-p Outliers: We may be seeing scattering from a pole piece, plus a possible mistake in vertex reconstruction
- E/p cut is well behaved
- Current readings of zero were not introduced in skim process
- Compton: Collimator misalignment is not a big effect on our measurements

What's Next?

- Asymmetries
  - Explore PID cuts in BigBite (bring in Cerenkov...)
  - Study consistency of all cuts over time
  - Confirm times of HWP switches
- BigBite Optics
  - Explain width of `BB.tr.tg_ph` distribution in positive optics
- Compton
  - We may have a problem with photon polarization measurements ... will report next week
- Dissertation