Test Run Analysis Summary

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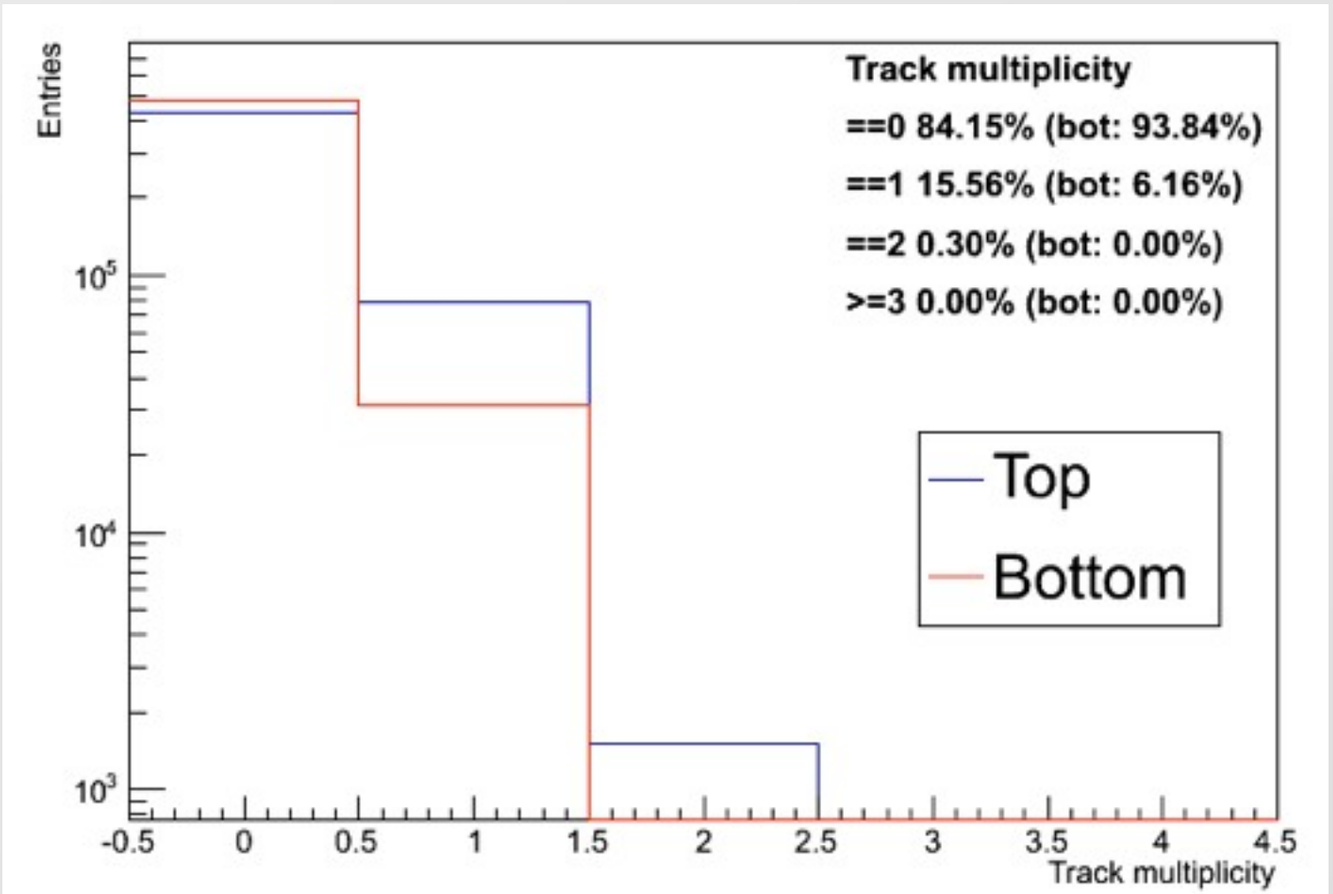
(but mostly Pelle & Takashi & Omar & Sho)
HPS Collaboration Meeting
June 4, 2013

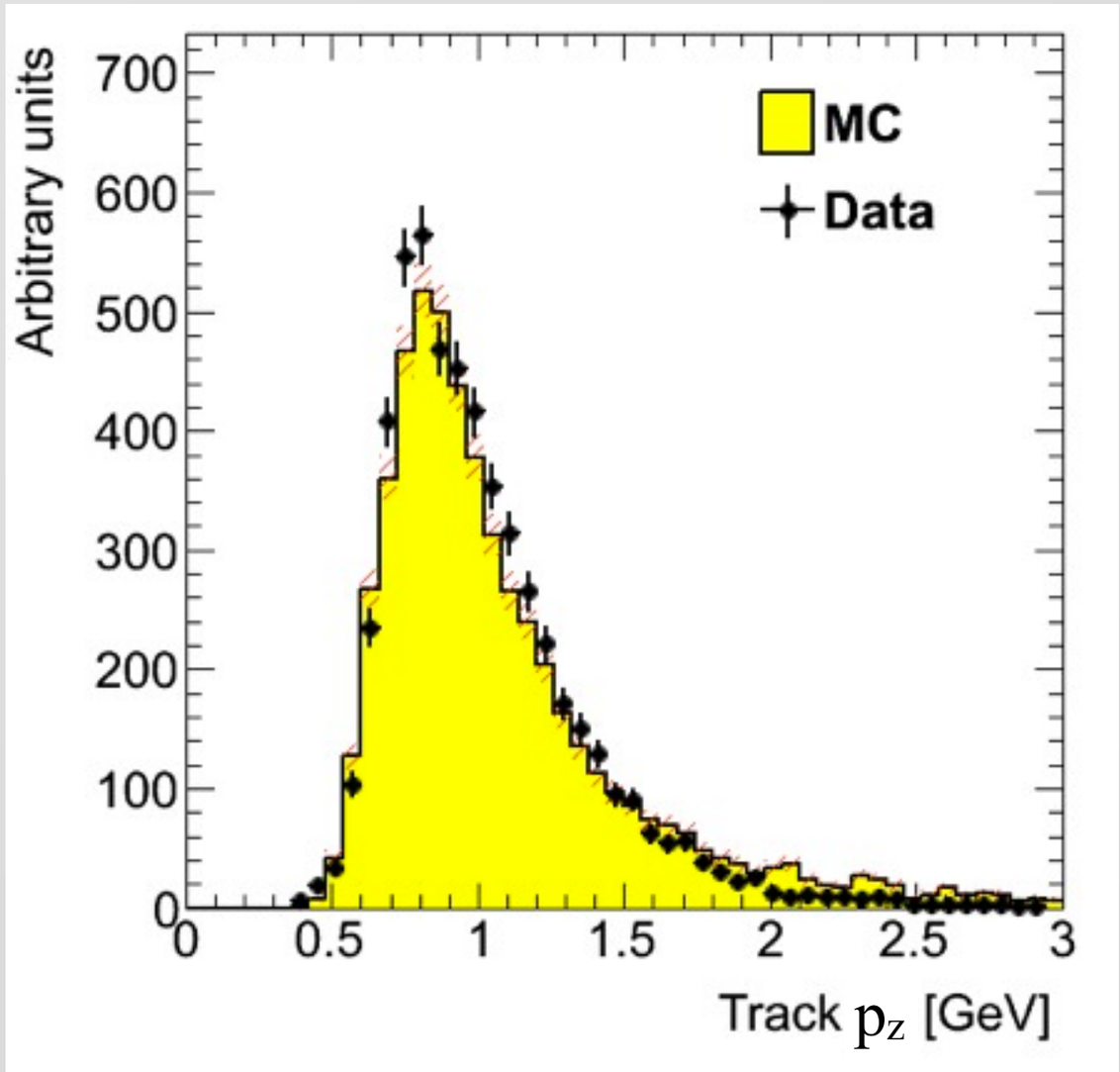
Outline

- Can we find tracks?
  - Yes!
    - How many?
      - a fair amount.
    - The right amount?
      - we'll see.
- How do they look?
  - Ok.
    - Not bad...considering
- Are we done?
  - No.?!
- What about two track events?
  - They are the most interesting...
    - mostly I will talk about this!

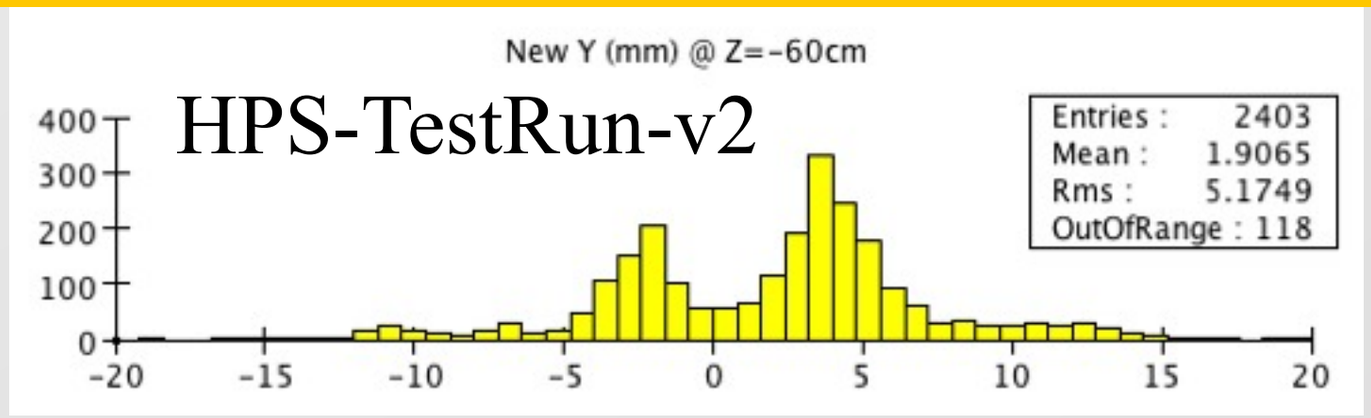
Did we find tracks? Yes.



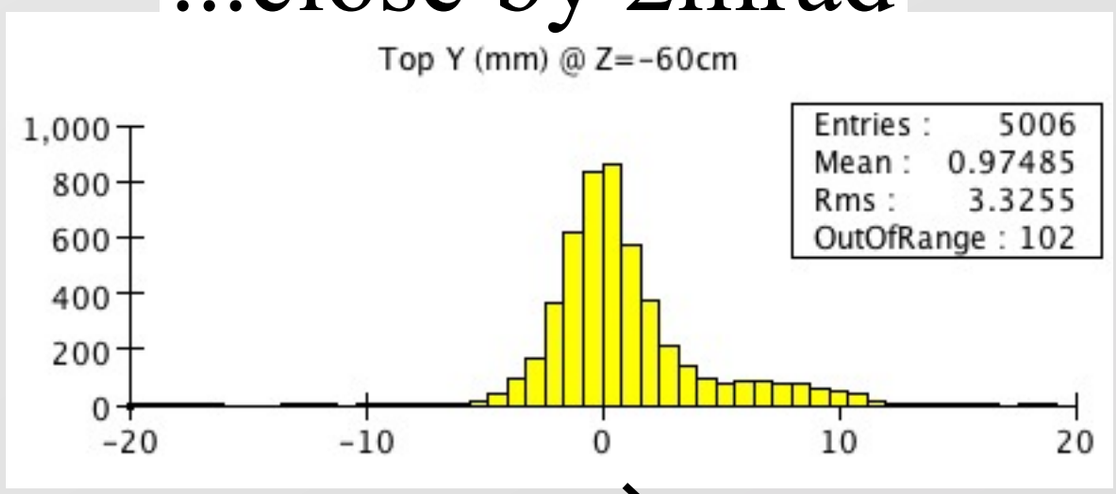
More tracks/trigger in top ...due to wonky sensors in bottom



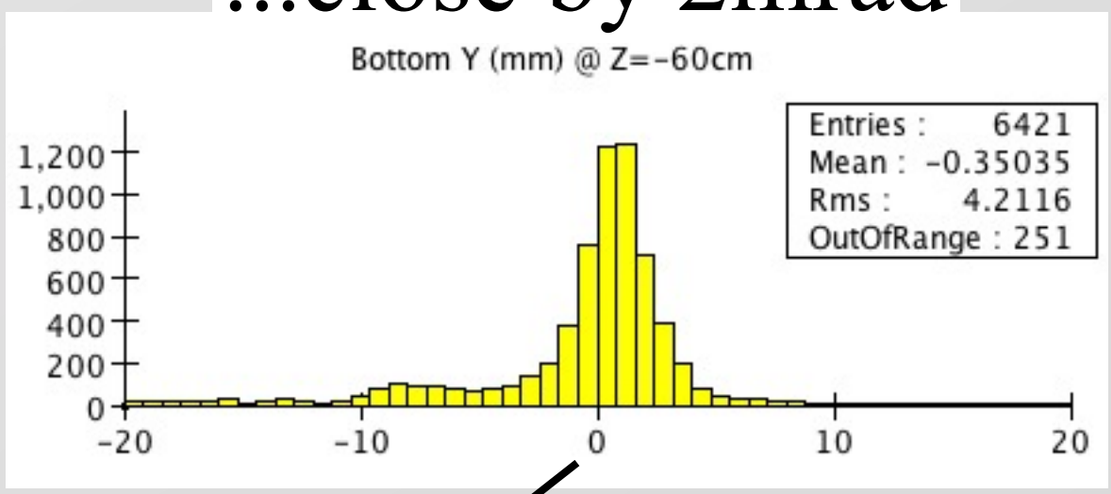
Alignment, such as it is: Non-Bend Plane

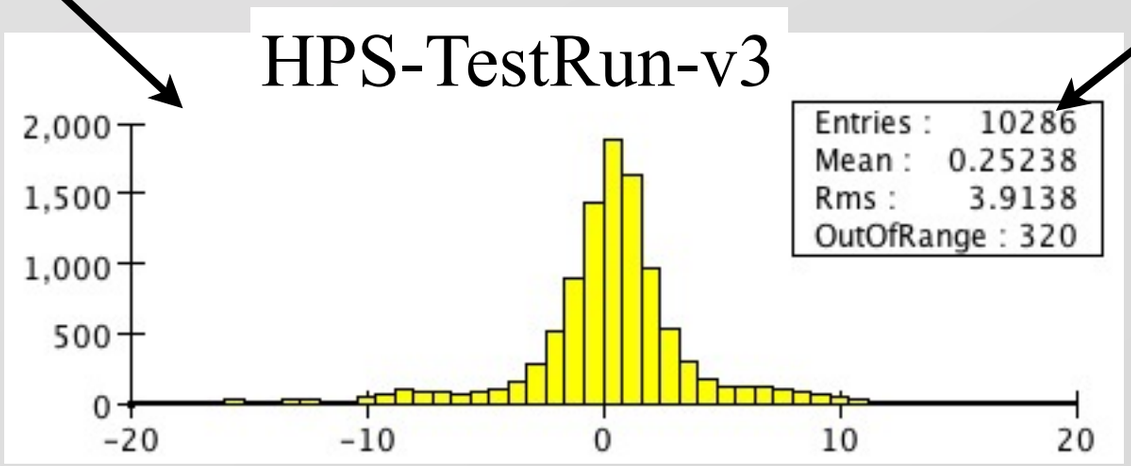


...close by 2mrad

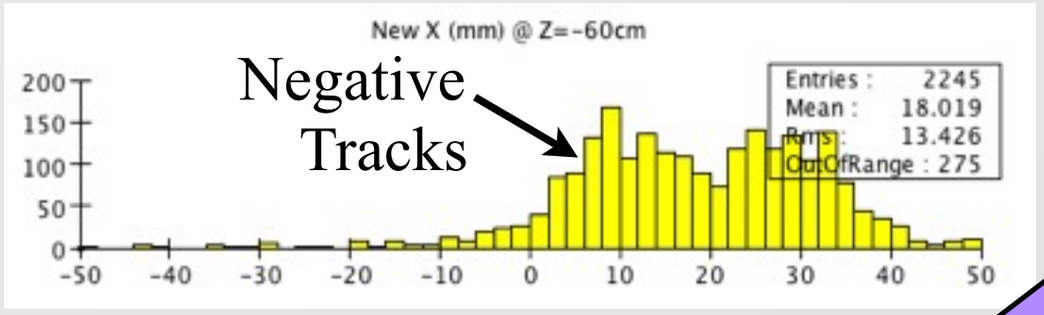


...close by 2mrad



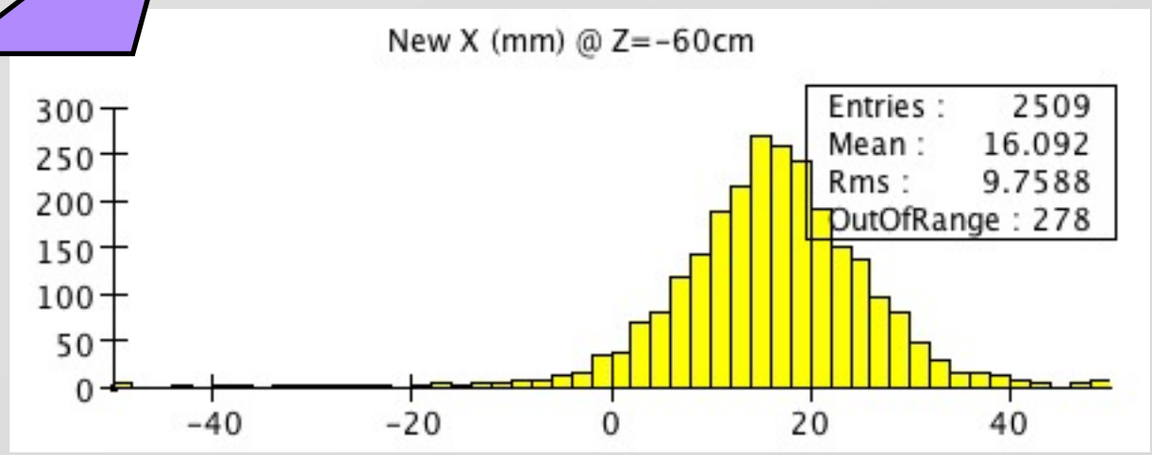


Alignment, such as it is: Bend Plane



Add fringe field

...still ~5mm offset
from where we should be



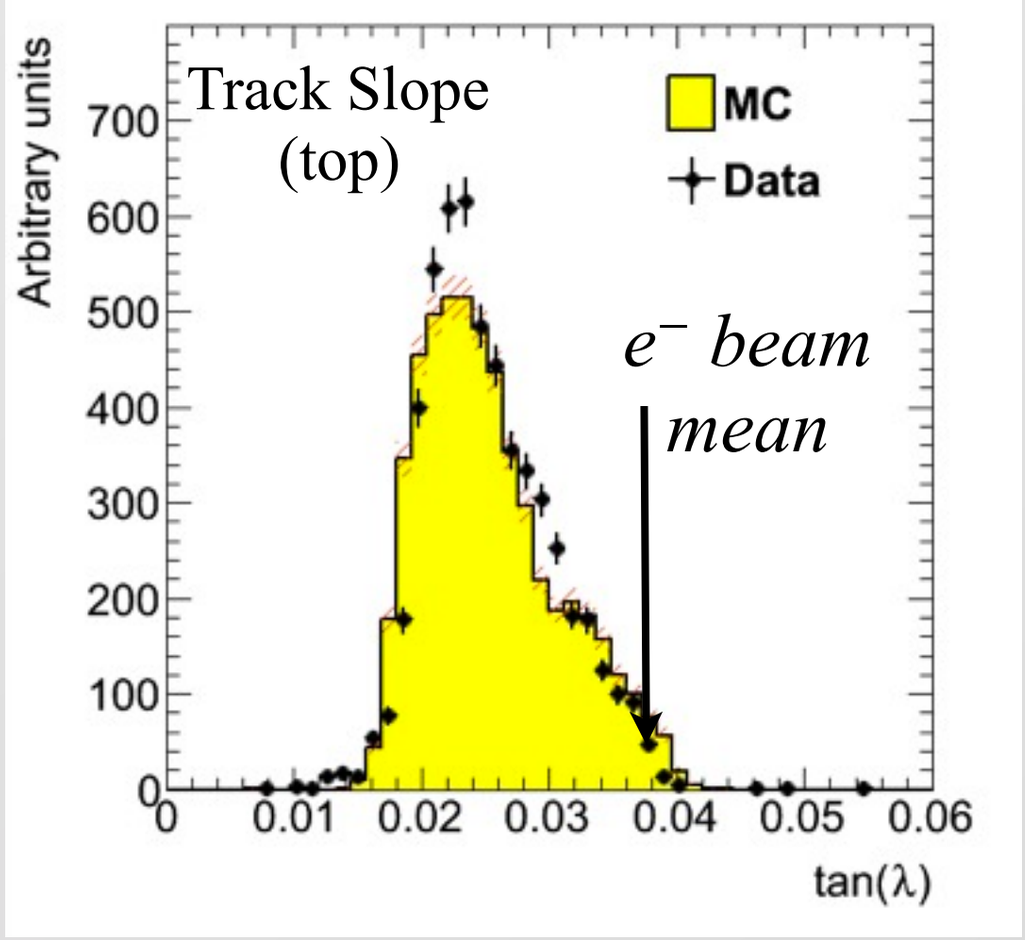
Alignment…for real

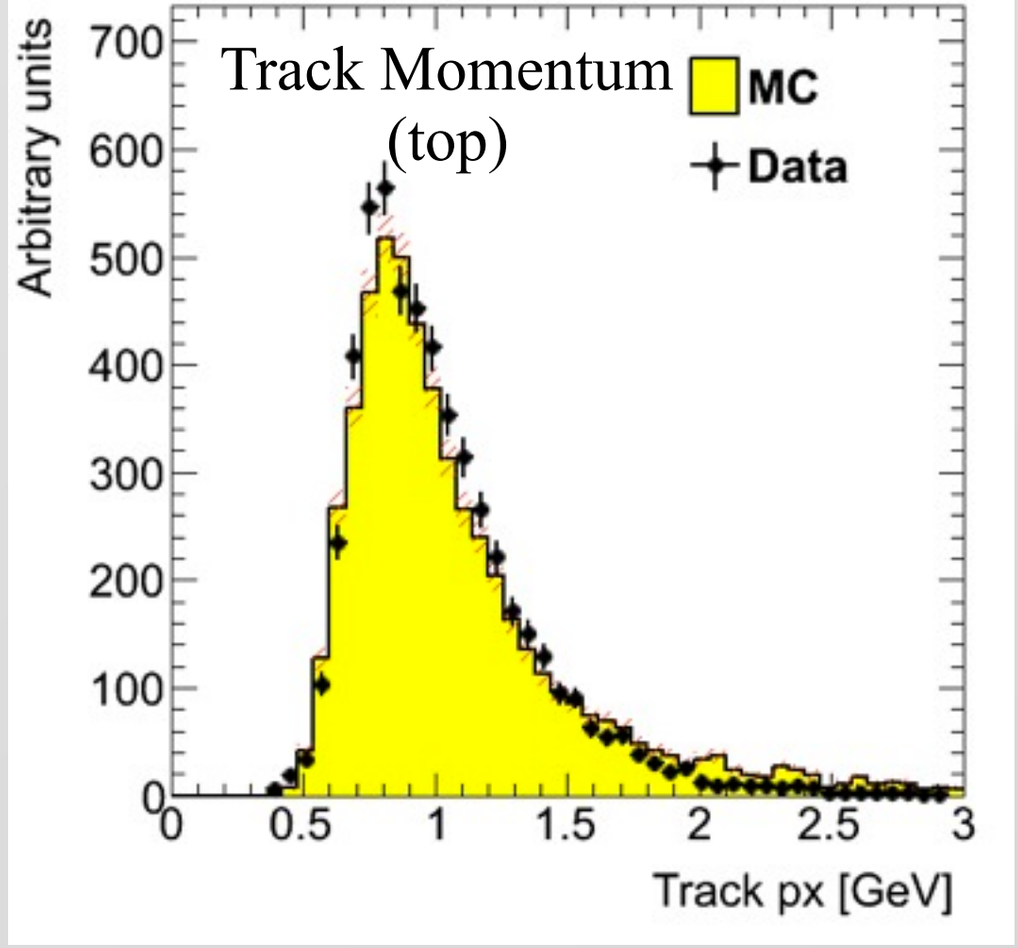
- (as we've been saying forever), we still need to perform track-based alignment to get relative mis-alignment
- Pelle spent significant amount of time with the millepede alignment program...to no avail
  - since he gave up, he found an issue with tracking; track parameters were not updated for final iteration
  - maybe with this fix, millepede with work!?
- We really need to get back to this...not just to align the test-run detector, but to be ready for the full electron beam running
- WE NEED SOMEONE TO TAKE UP THE ALIGNMENT MANTLE!!!!

Single track parameters: data & MC

The MC is generated by running a photon beam through target using EGS to produce secondaries & scatter in target; those then sent to GEANT for detector simulation

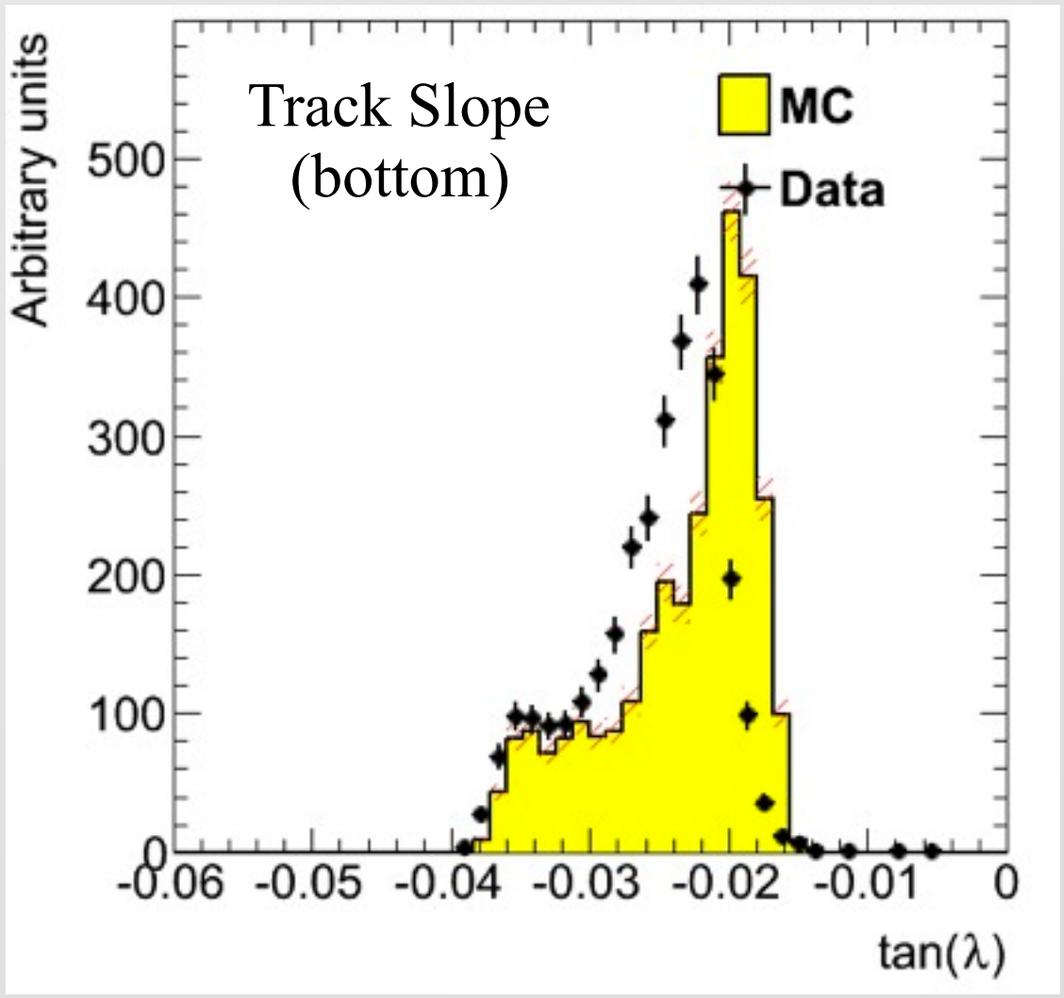
...generally good shape agreement between MC and data, particularly on the top half.

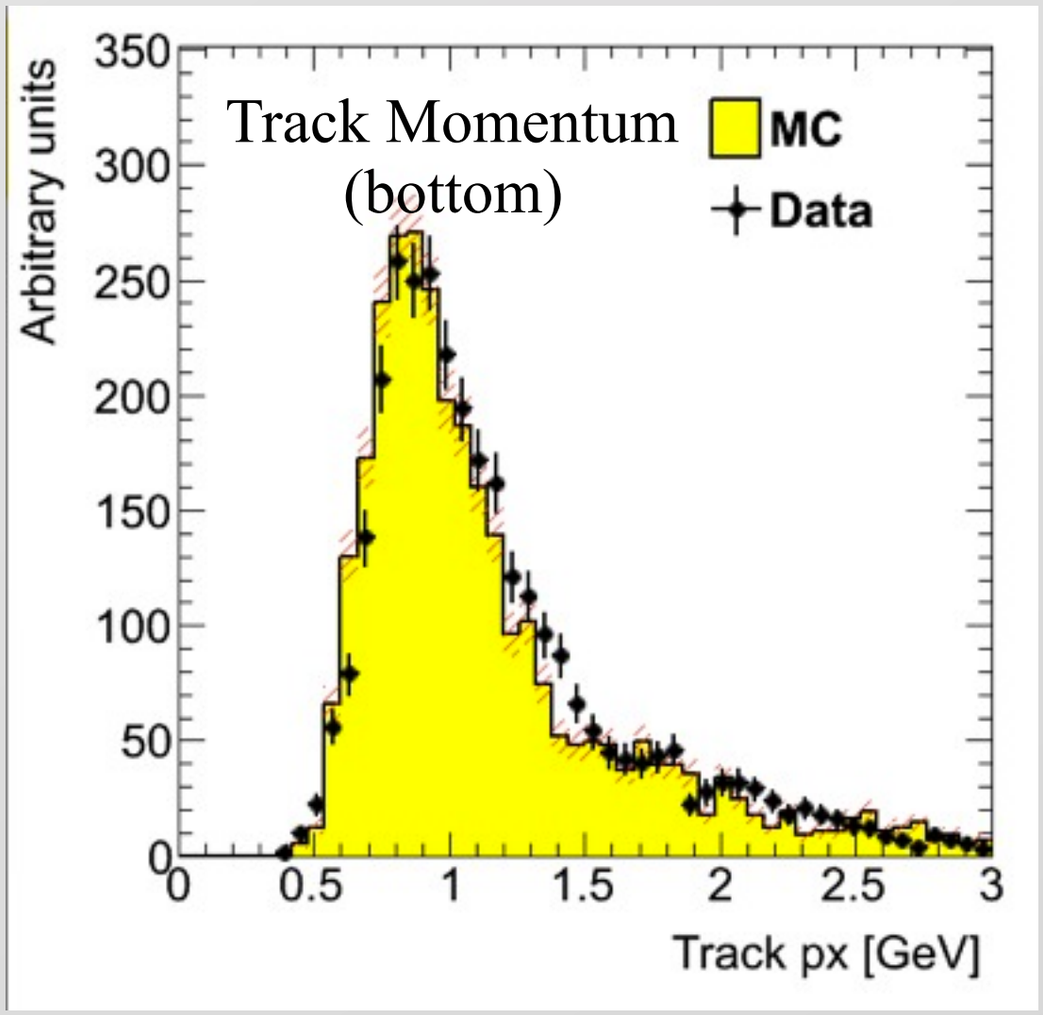




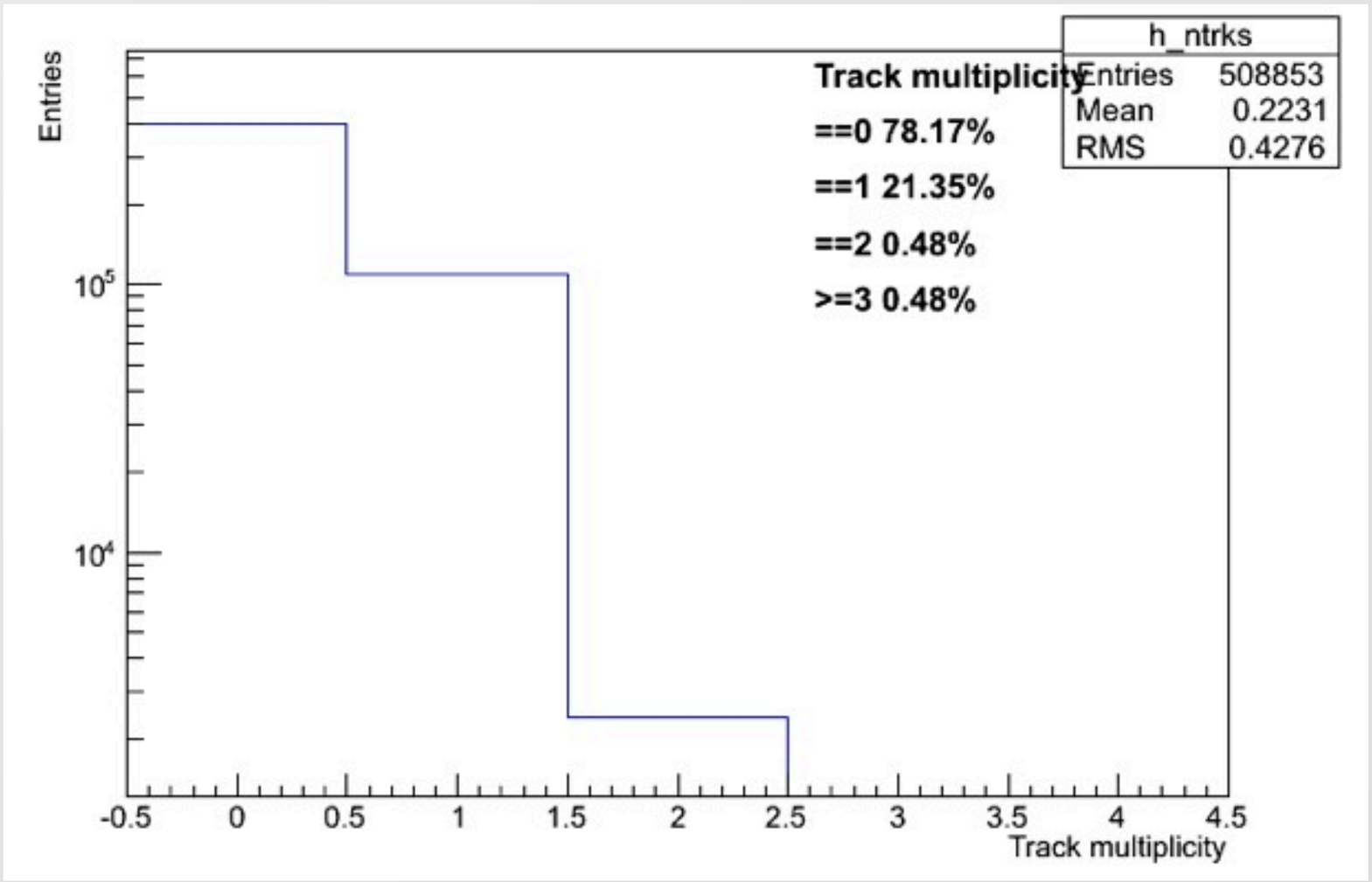
Single track parameters: data & MC

...not quite as good at the bottom...still problem with (global) alignment?





e^+e^- Pair Events

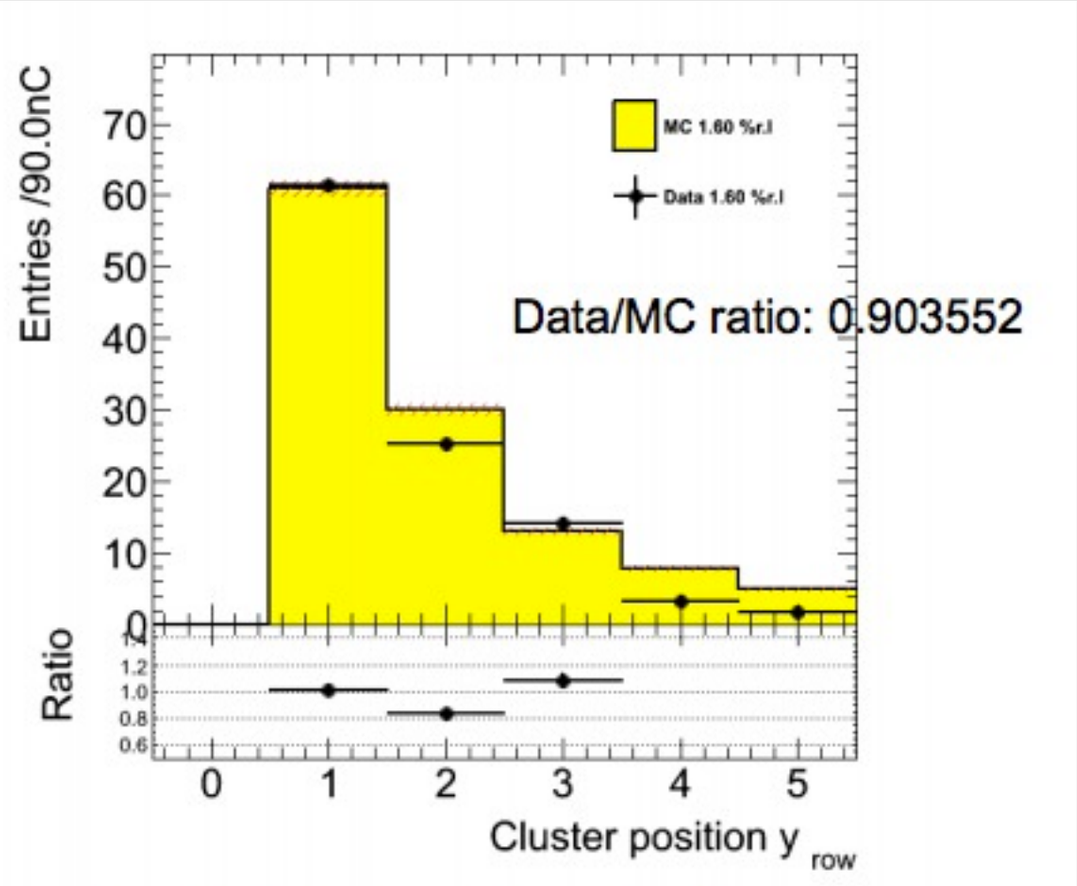


~0.5% of triggers had 2 tracks (1.6% run)

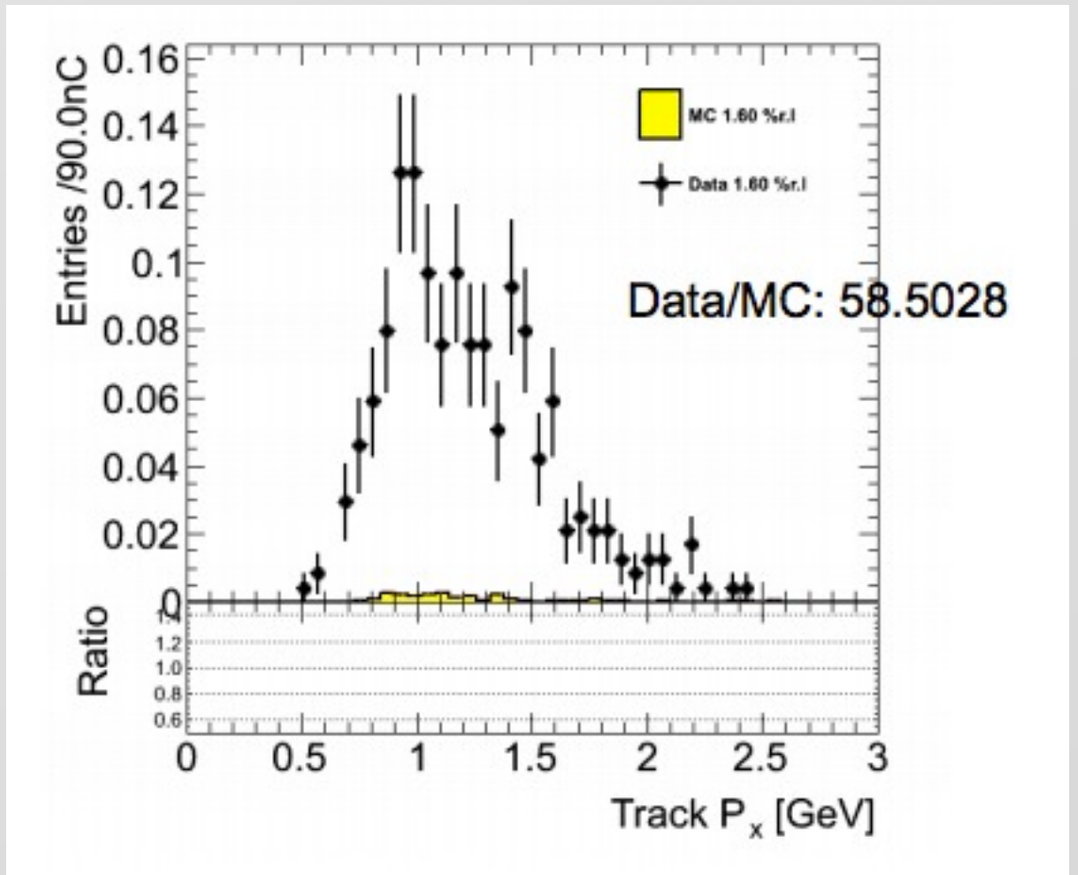
select good pairs == opposite charge; one in top + one in bottom → 1.4 pairs/90nC

Rates…singles ok; pairs screwy?

Prior to April 25….a head scratcher.



Ecal cluster in "good quadrant"
Single track selection(top half)



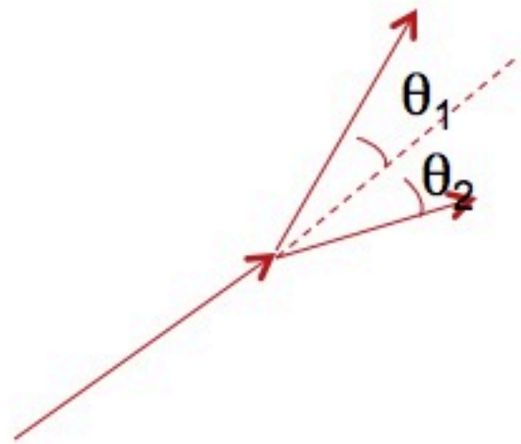
Ecal cluster in "good quadrant"
e+e- track selection

Pair Photoproduction in EGS

From Takashi:

Pair production $d\sigma \sim d\varepsilon_1 d\theta_1 d\theta_2 d\phi$

- $E_\gamma = \varepsilon_1 + \varepsilon_2$
- $\theta_1 \sim \theta_2 \sim m_e/E_\gamma \sim 500\mu$rad at 1 GeV
- $\phi \sim 180°$



Approximations

- $\phi = 180°$
- Energy and polar angle are decoupled.
- θ_1 and θ_2 are decoupled.

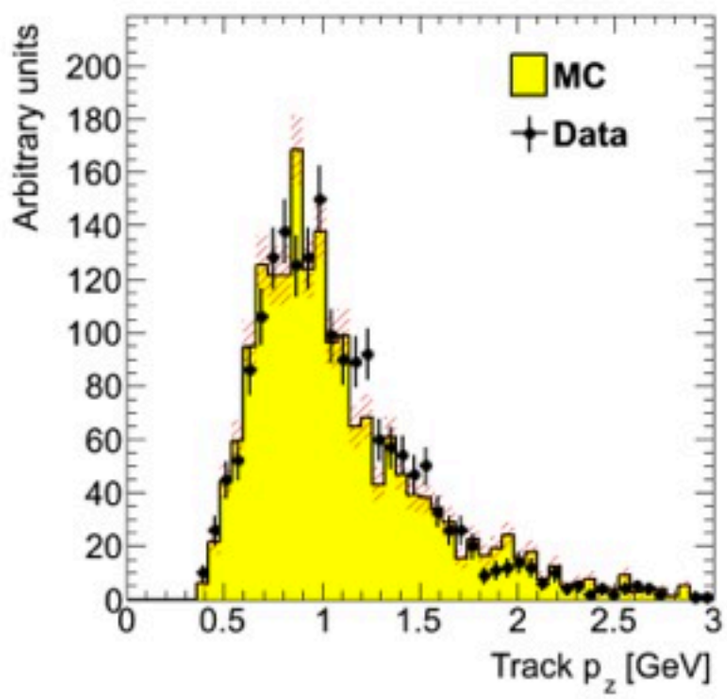
Sampling

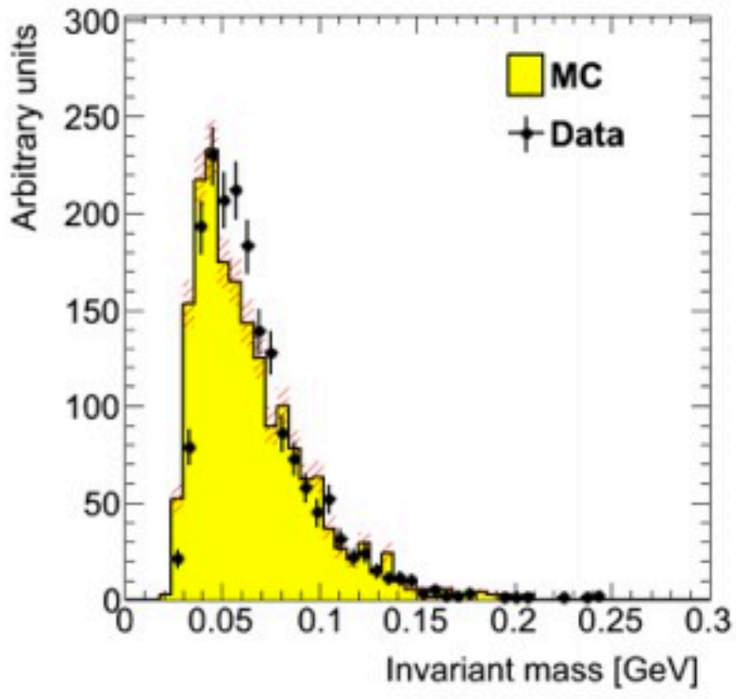
- Sample ε first from $d\sigma = F(\varepsilon)d\varepsilon$
- Sample θ_1 and θ_2 independently from $d\sigma = G(\varepsilon,\theta)d\theta$

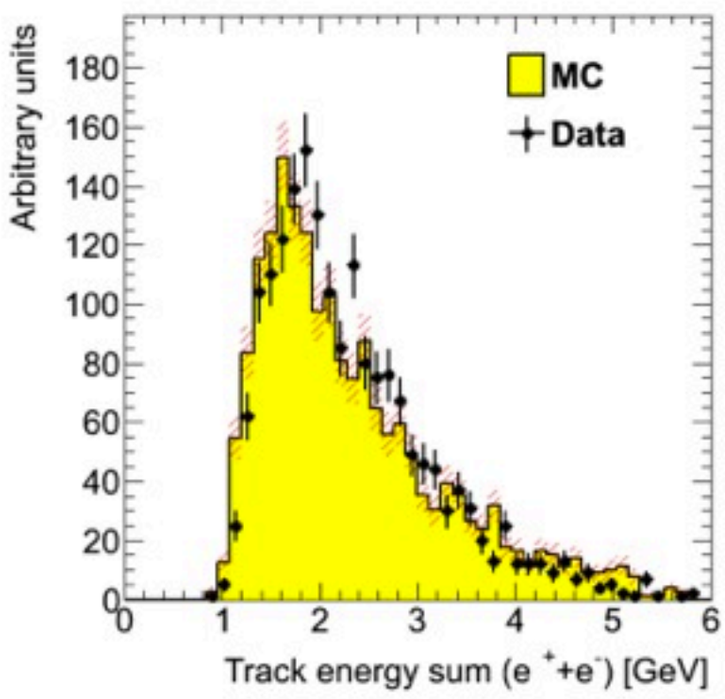
Even if $\theta_1 > 20$ mrad, θ_2 is most likely at $\theta_2 \sim m_e/E_\gamma$.

Some two track kinematics

Shapes show great agreement!







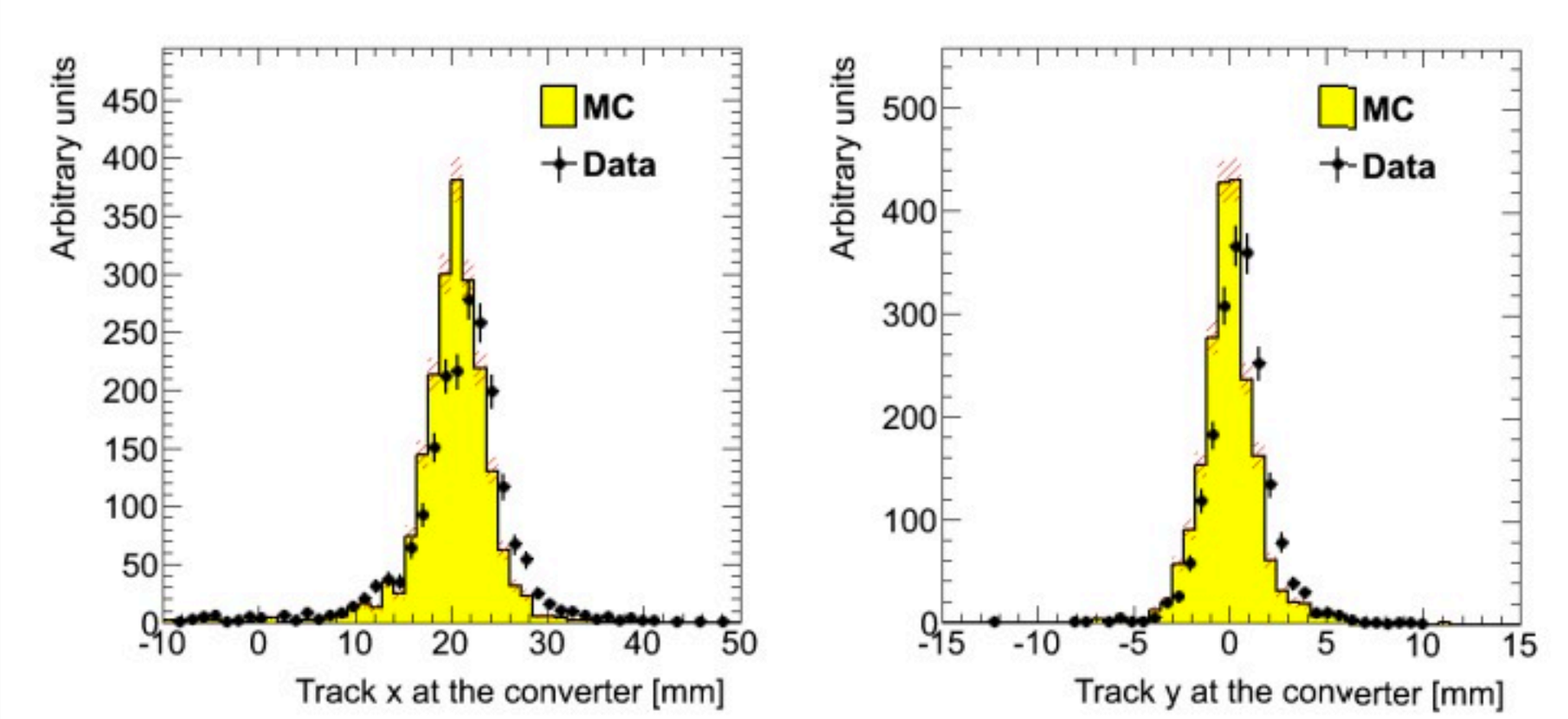
e^+e^- top/bottom events

After EGS fix: ***N(data)/N(MC) ~ 0.6***

that factor of 2....still not understood but much better!

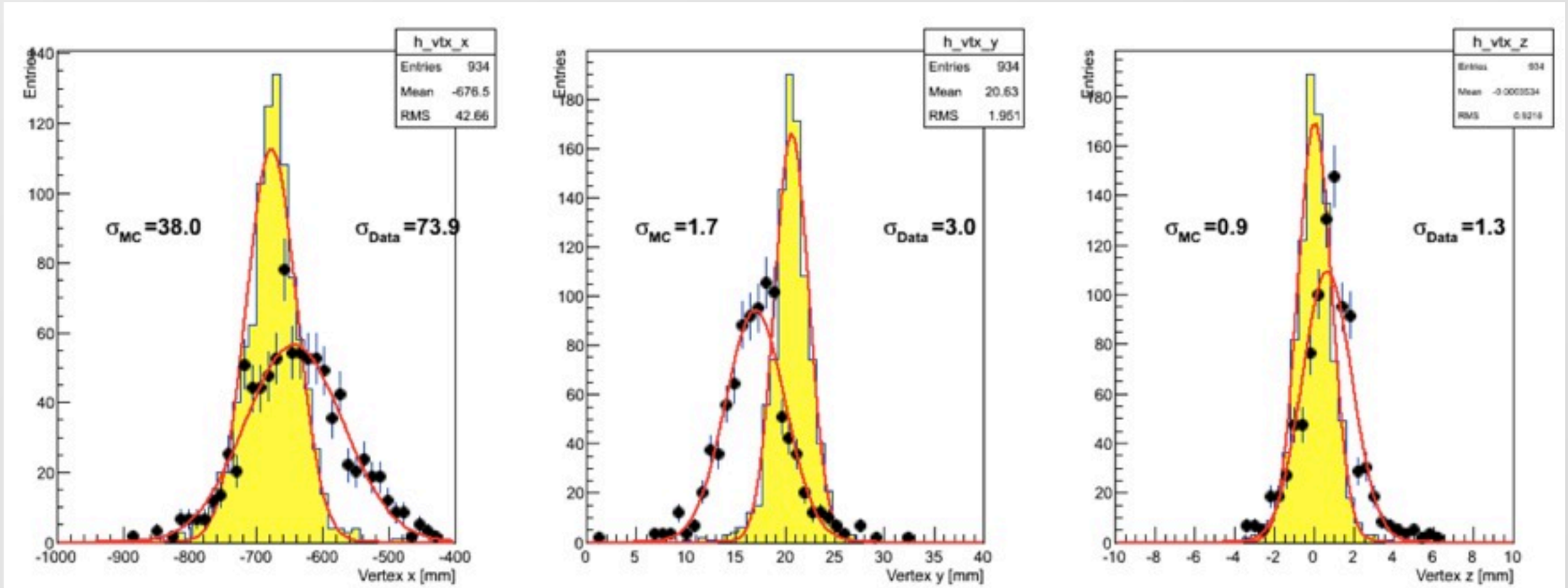
Position resolution @ converter

Single (top) track x & y position at z=−67cm from pair events



...ok MC/data agreement. There is 10-25% difference in the sigmas, likely due to misalignment...

Vertexing from test run



The reconstructed vertex position looks....much worse...

BUT, differences here come from both relative (broaden) AND top/bottom (shifts) mis-alignments...more work to do.

Summary

- A fair bit of analysis has been done on the test run data (particularly by Pelle)
  - found an issue with EGS! Found a bug in lcsim tracking code!
  - There are probably more bugs!
- We are at a point where we have rough agreement between rates and shapes...but the last 10% is always harder than the first 90%...
- Next job (IMO) is to do track-based alignment