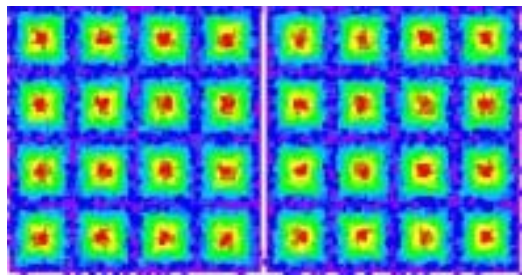
Some Thoughts on a Two-Tower Analysis



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SLAC

Instrument Analysis Workshop 1
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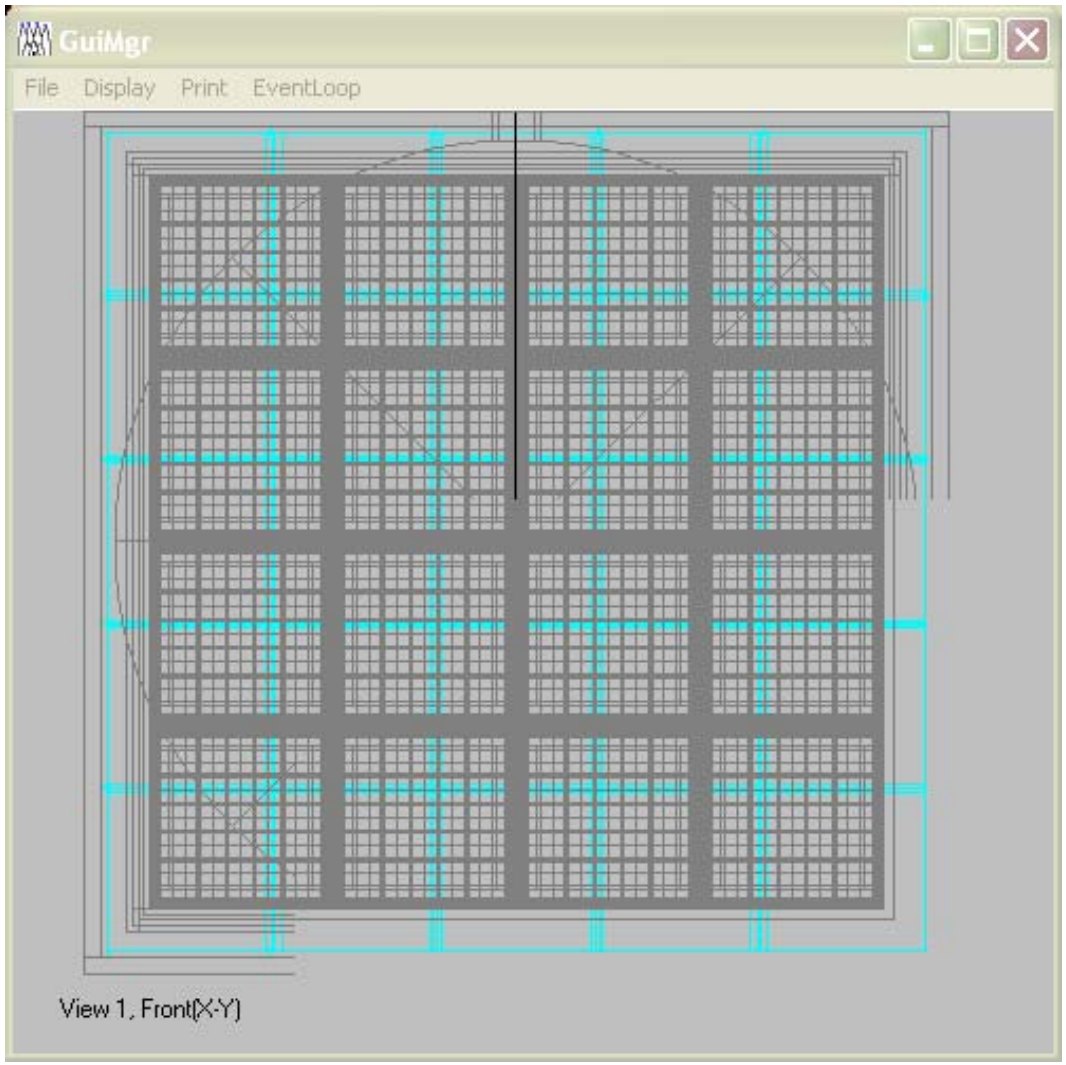
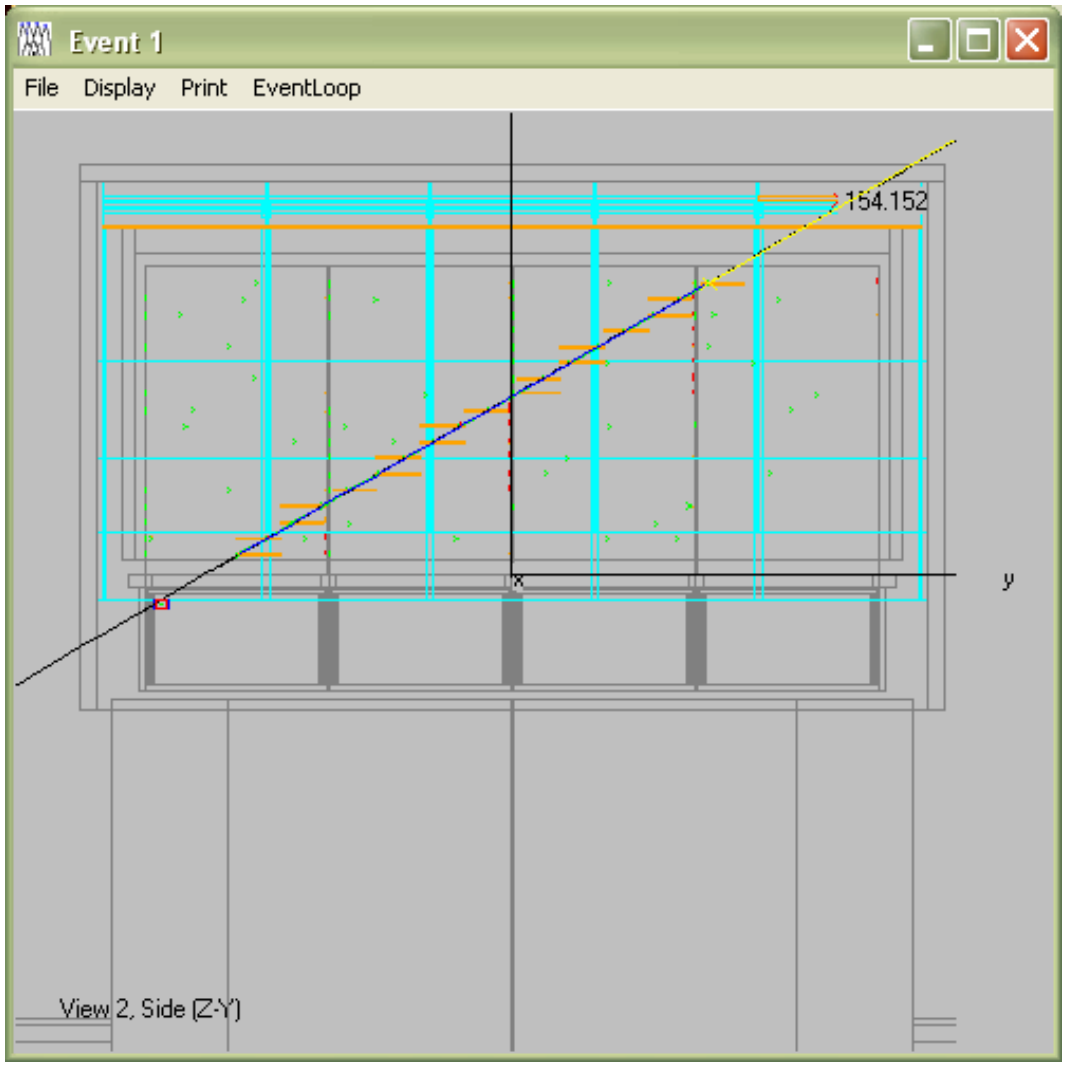
Geometry upgrade

- For most of its life, Gleam has been run only with 4x4 or 1x1 instruments.
- Recently, the Geometry has been upgraded to allow for an arbitrary set of towers in a nxm array, with 4x4 being the interesting case.
  - The original loop over x and y was replaced with an explicit positioning of either a real tower or a skeleton.
  - The skeleton has no internal volumes and is made of vacuum.

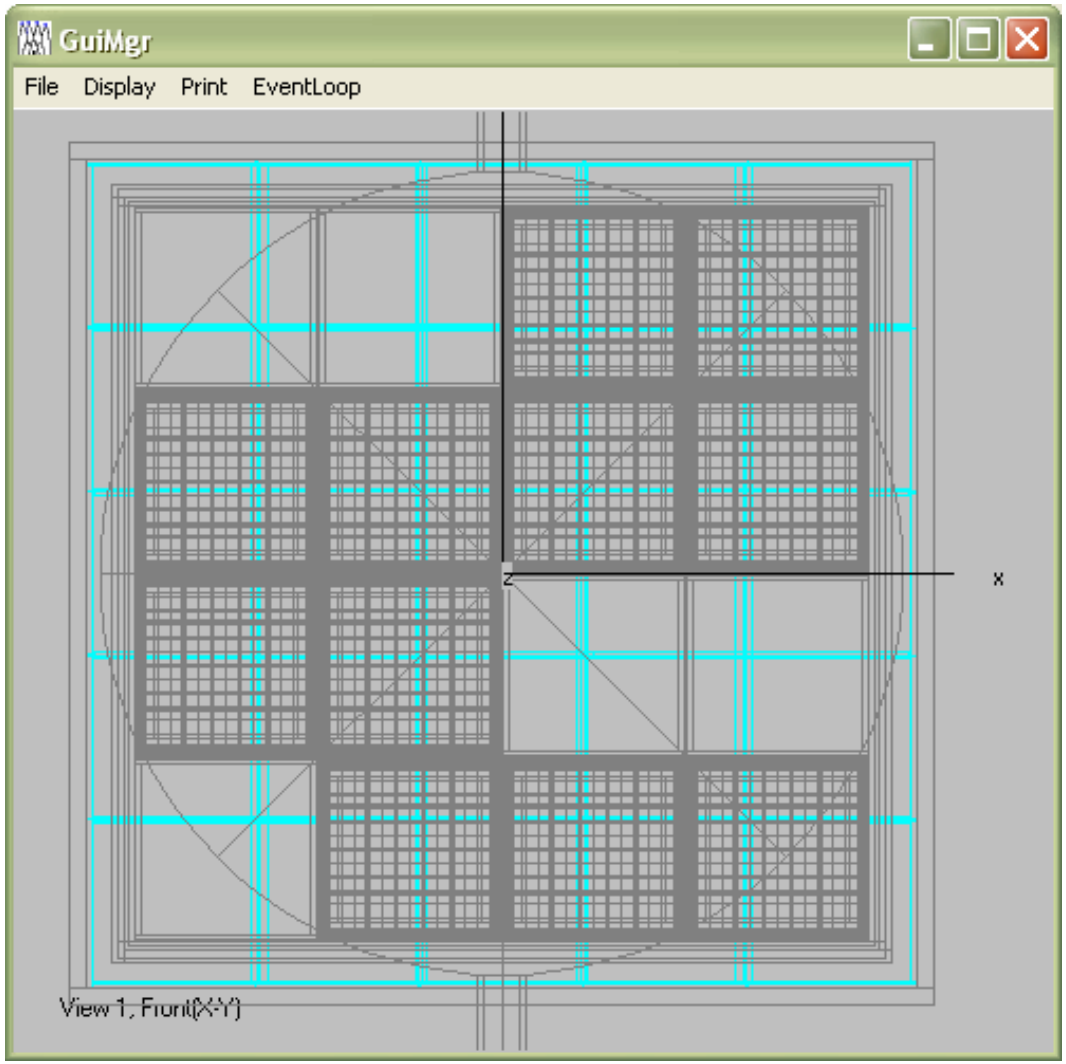
Full LAT geometry (top view)



Test Event

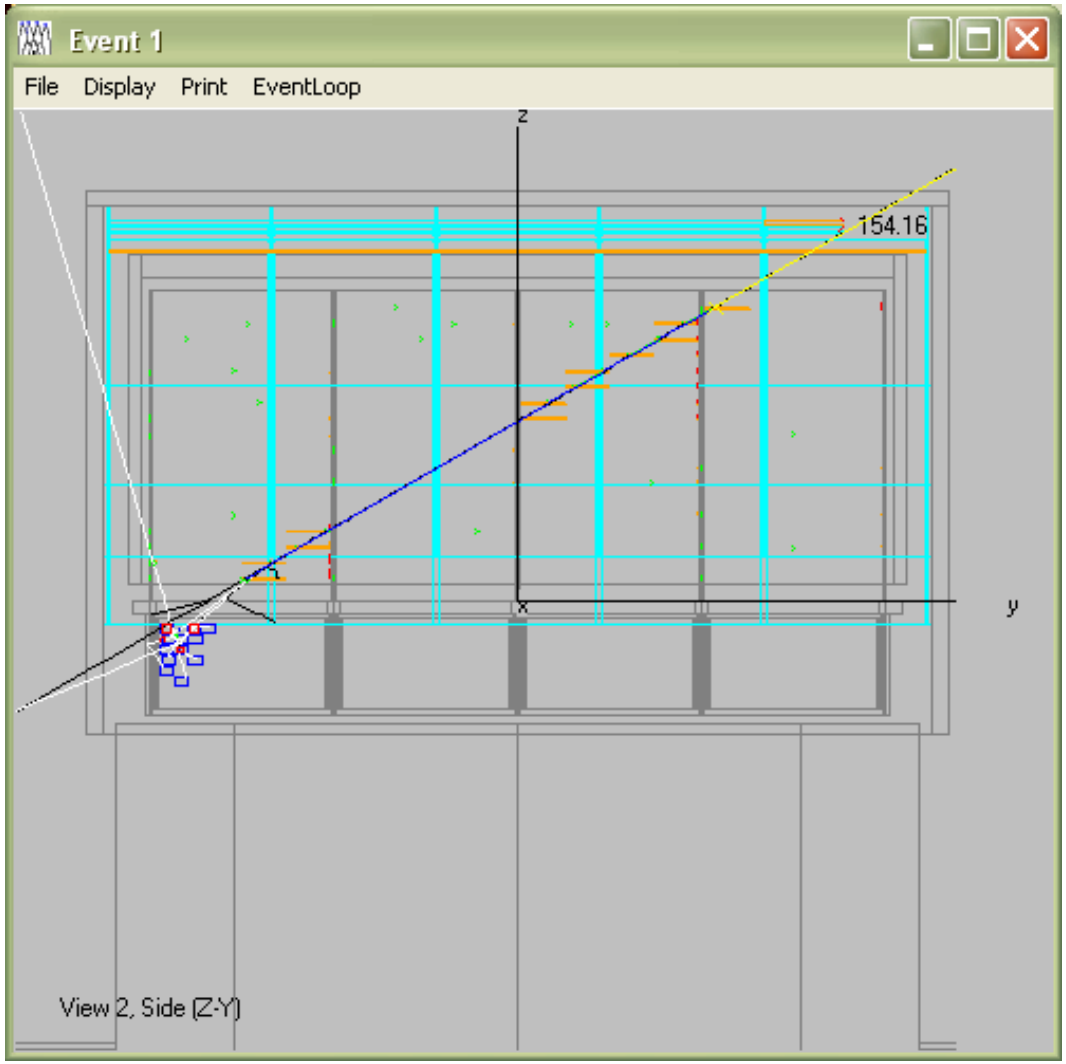


LAT with arbitrary missing towers



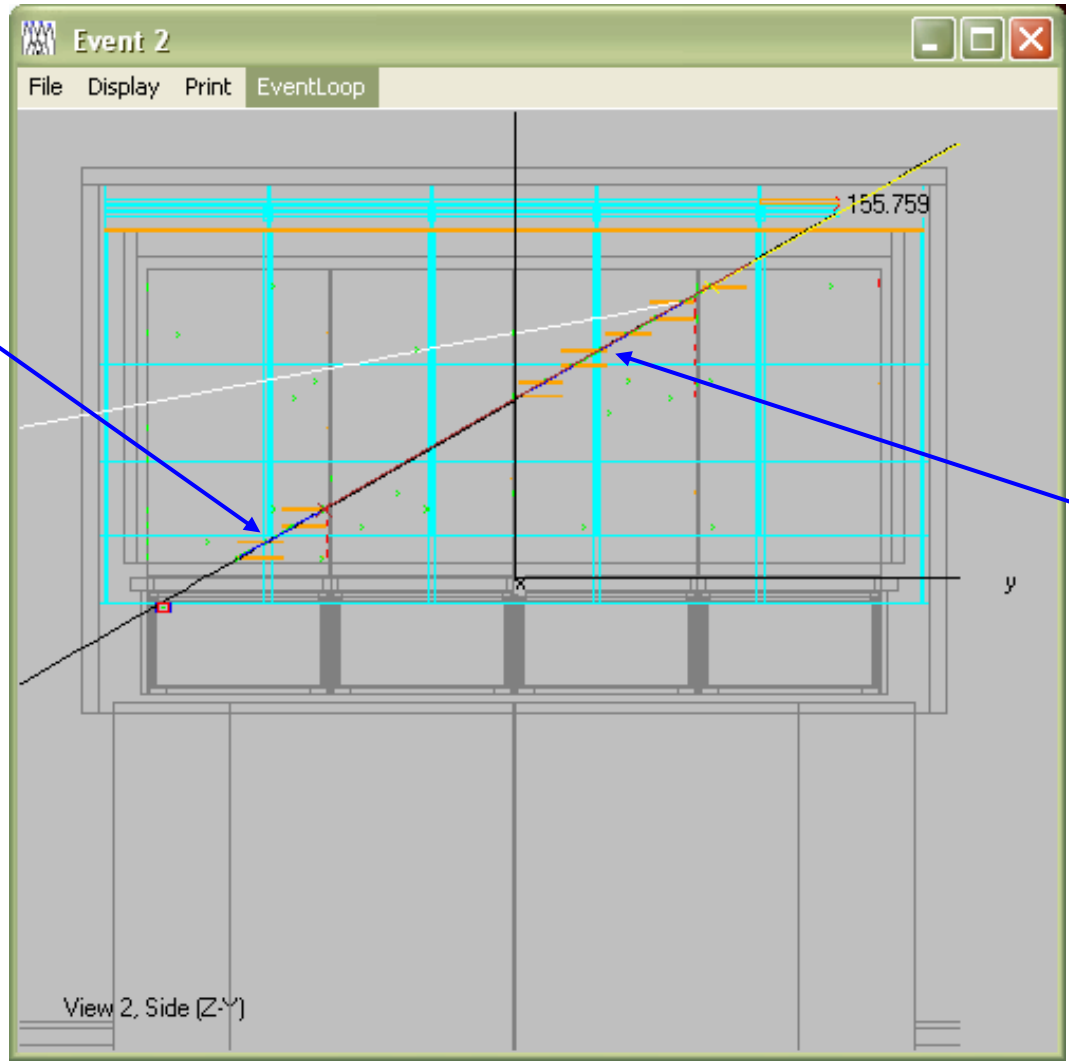
Fixed a few little bugs, and then…

Test event with missing towers



Note: track bridges gap! (propagator)

Next event

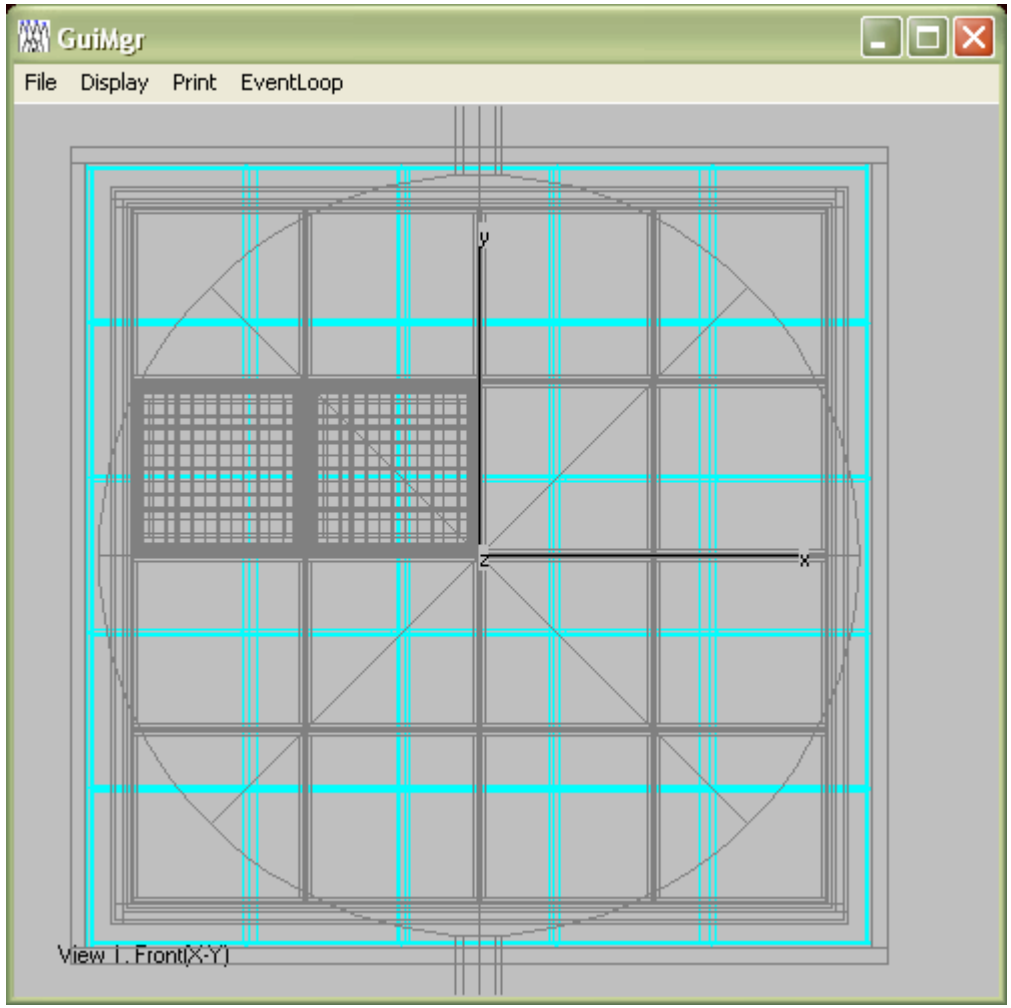


Track 2

Track 1

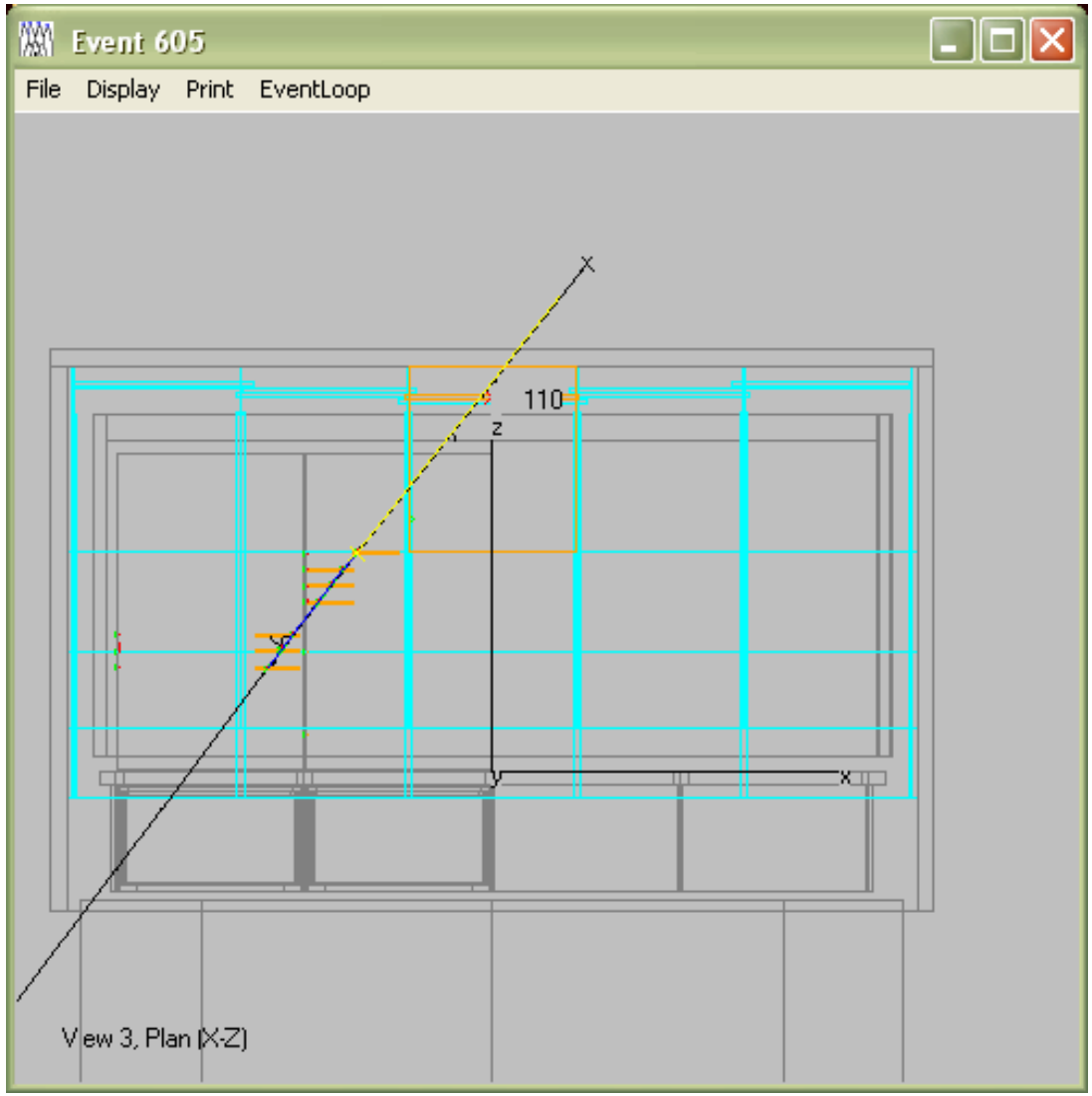
Not so lucky this time…

THE two-tower setup



Fixed a few more bugs, and then…

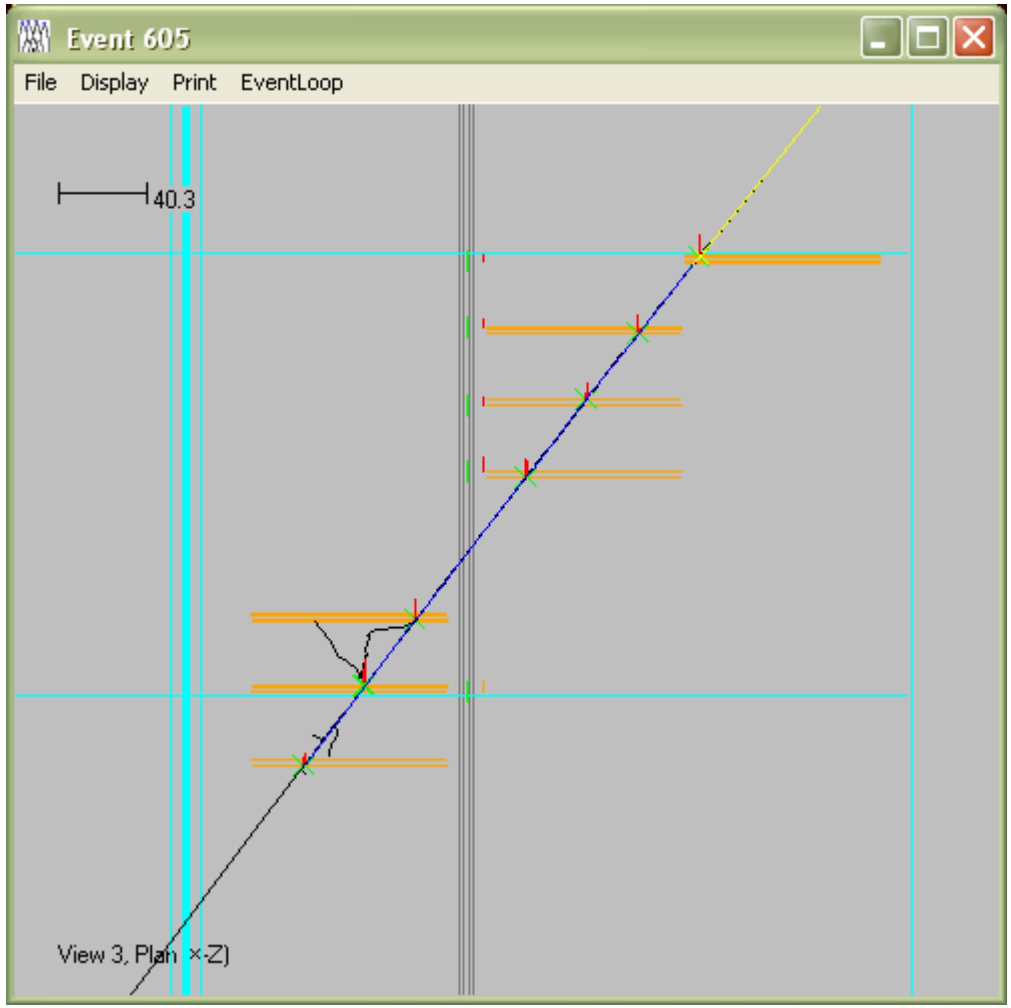
Track crosses two towers



What next?

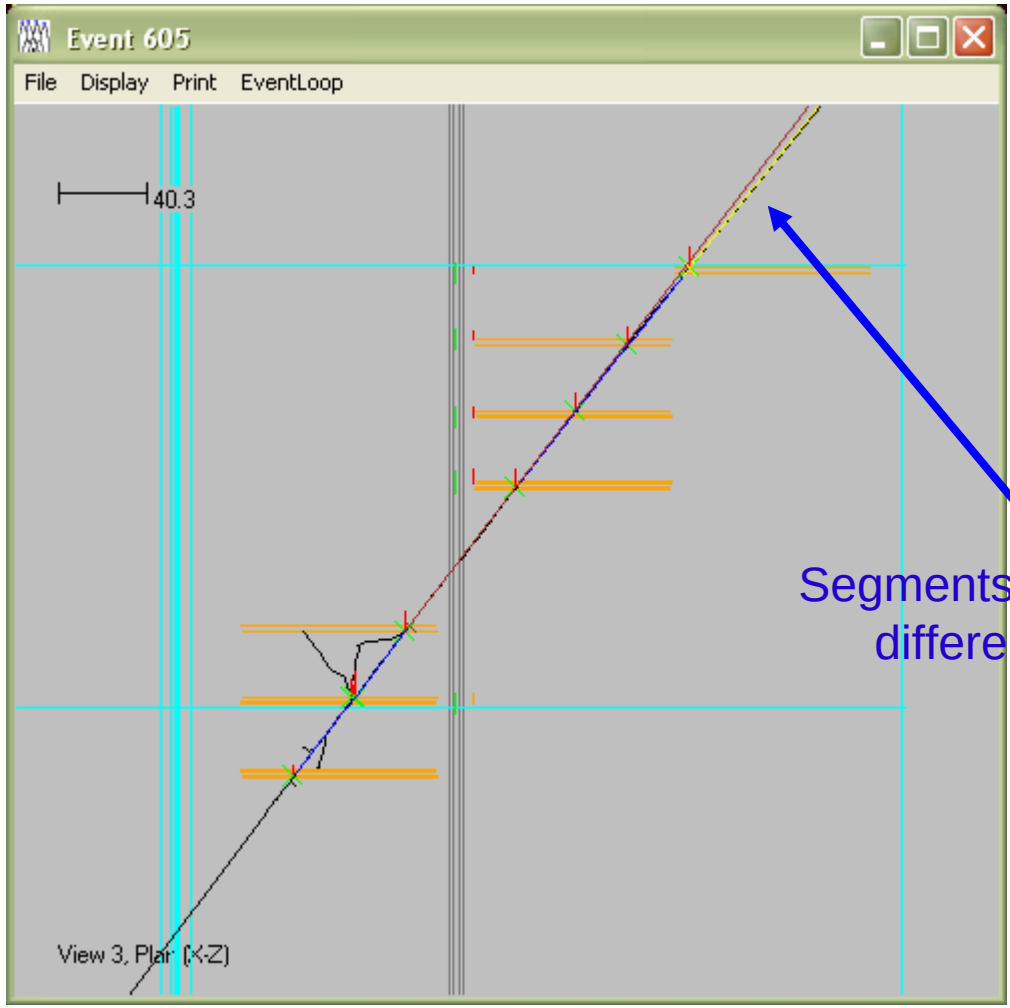
- A standard analysis technique (although Bill had to remind me of it!) is to break up a single track into segments.
- Each segment is a measure of the actual particle
- Comparing the two segments can give us clues about how the tracking is working.

Close-up of previous event



Single track crosses two towers

(Simple!) modification of code



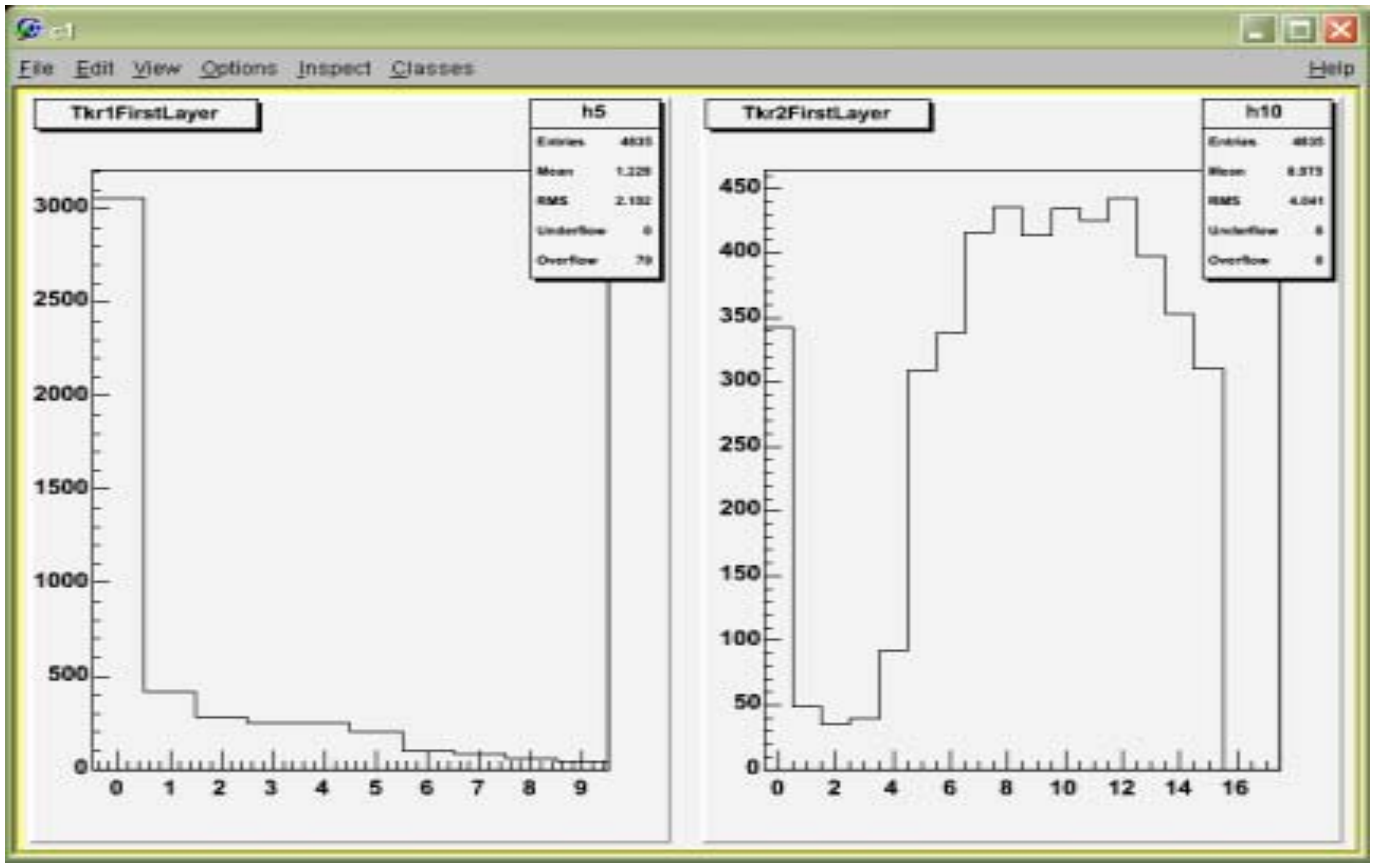
Segments point in slightly different directions

One segment in each tower

First try at comparing the track segments

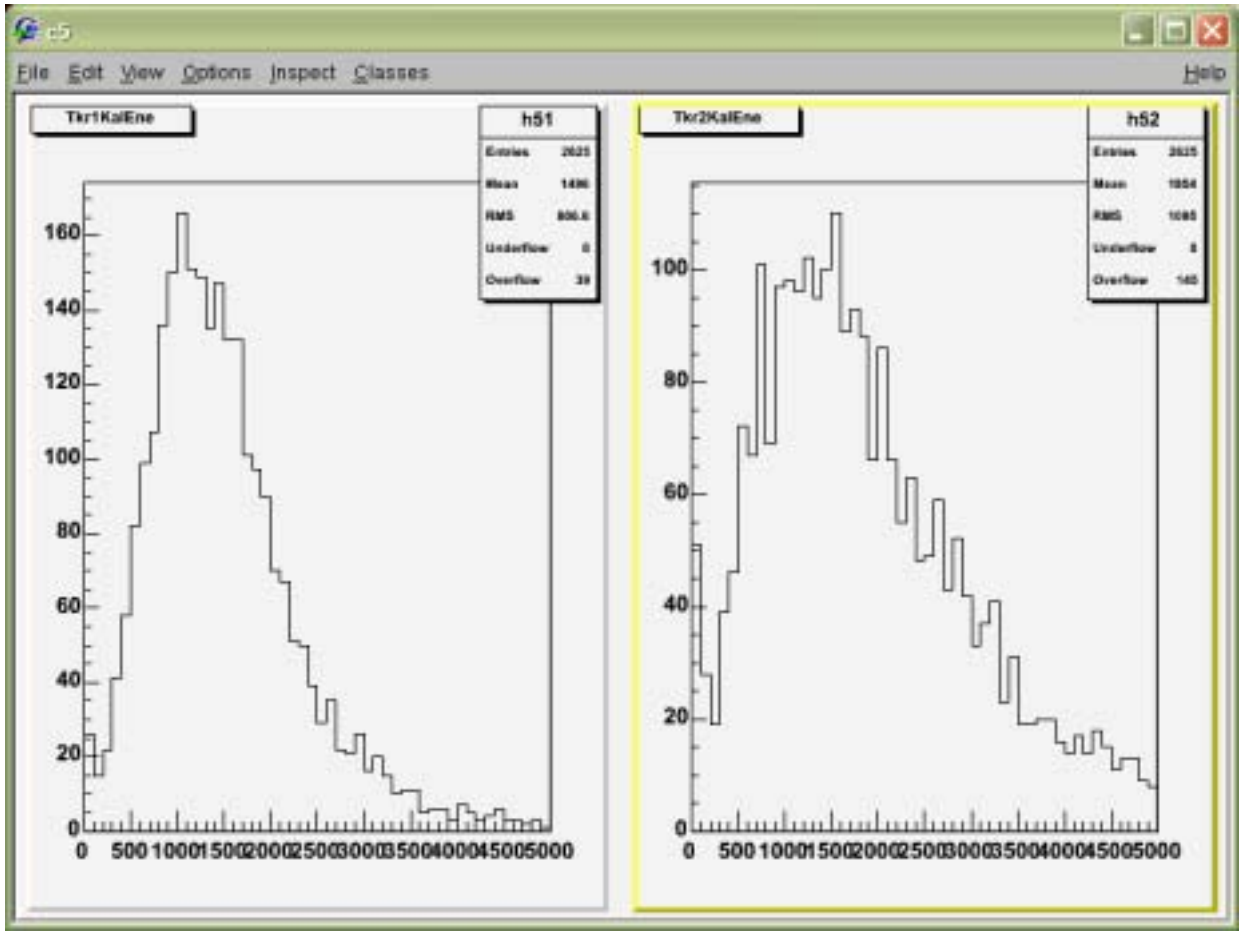
- Pick a surface cosmic ray distribution. There are two available, each with defects. I chose hiro_surface_muons. (This area could use some work!)
- Modify tracking to use only ionization loss, rather than default exp(-radlen). This is not straightforward in the default fitter.
- Raise the minimum energy to 150 MeV. (default is 30 MeV). Remember we don't measure the full energy of the muon, even if it goes through the calorimeter.
- Cheat at bit by using the full LAT to get the trigger efficiency up. We may want to tailor the source for better coverage. Of course, the data will not have this problem!
- Choose events with two and only two "tracks." Ask that the first track start near the top of the tracker, and the 2nd start lower down.

Some plots (from ntuple)



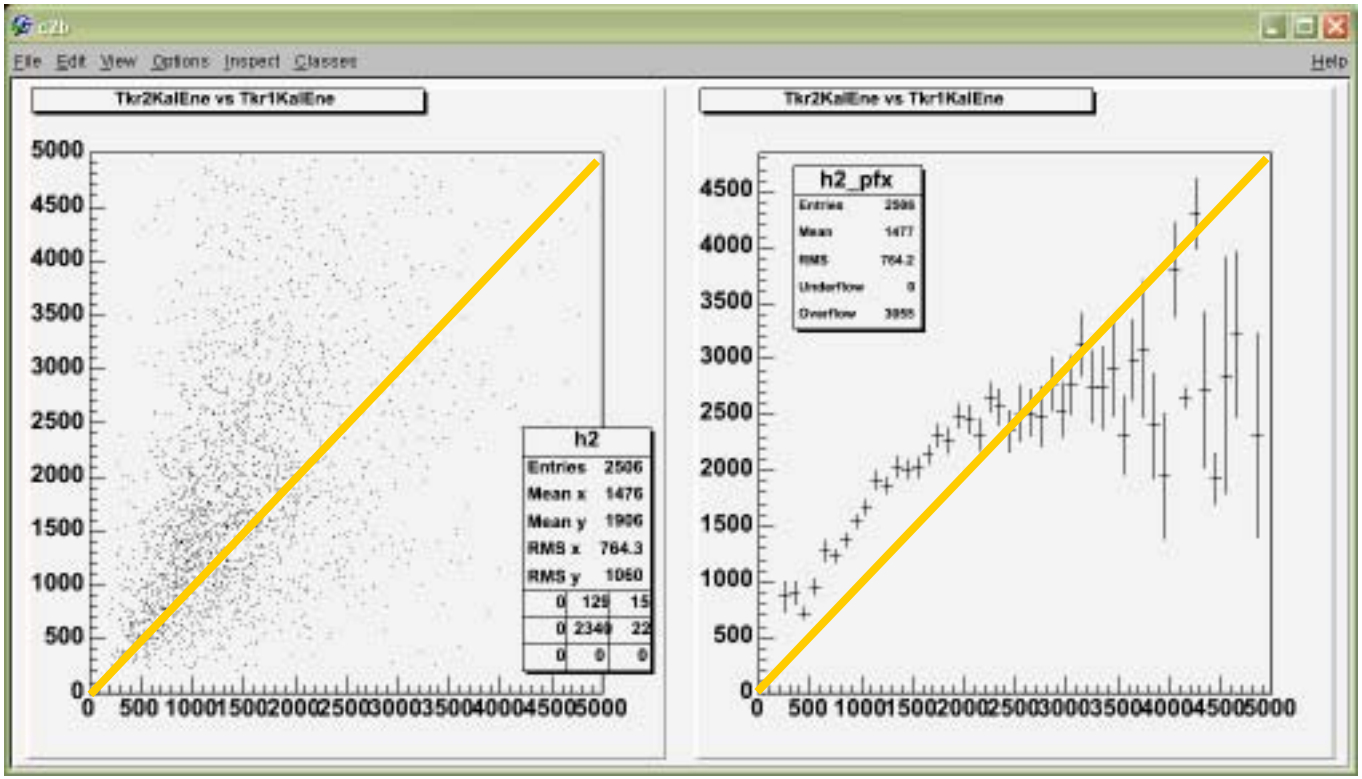
About 2/3 of 1st tracks come in through the top.
Most 2nd tracks start after layer 4.
In 10% of the events 1st and 2nd are interchanged.

Kalman energies of the segments



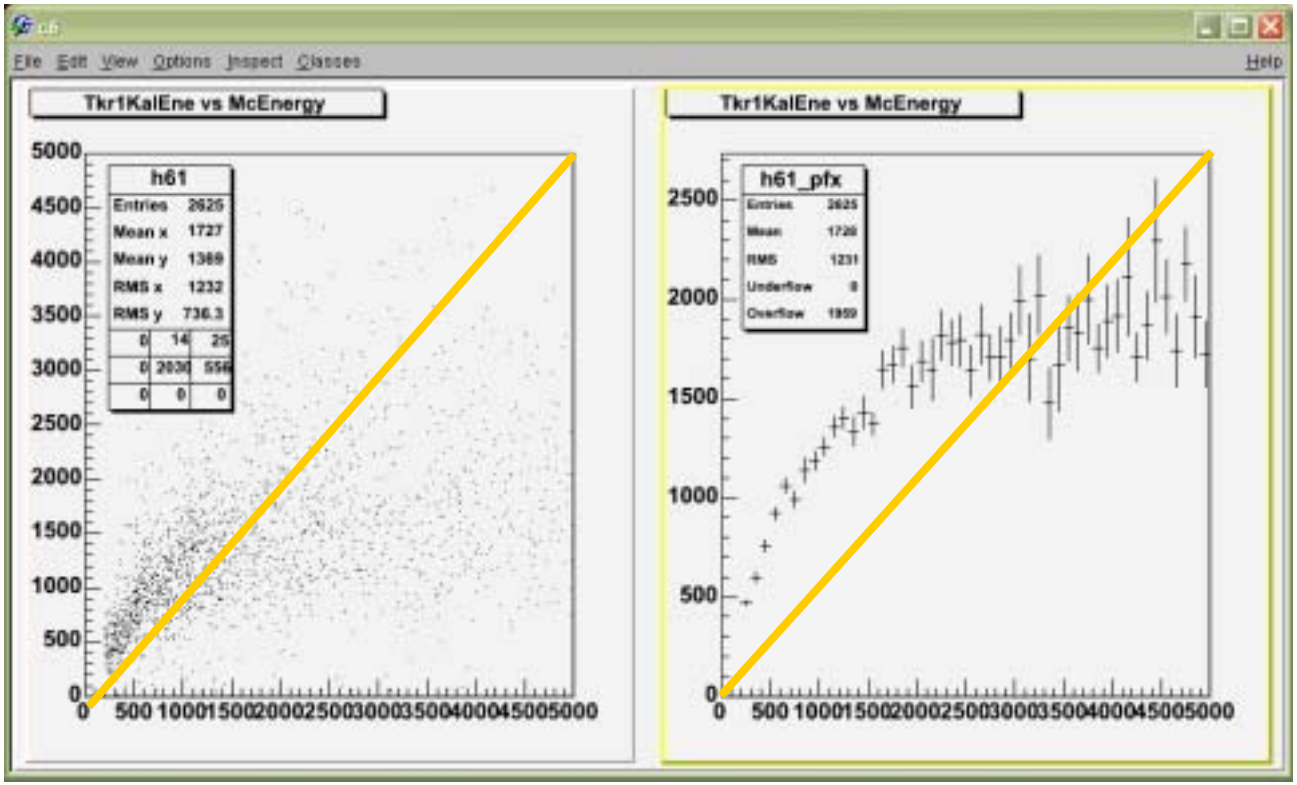
Kalman Energy is inferred from the amount of multiple scattering along a track

Kalman energies of the segments

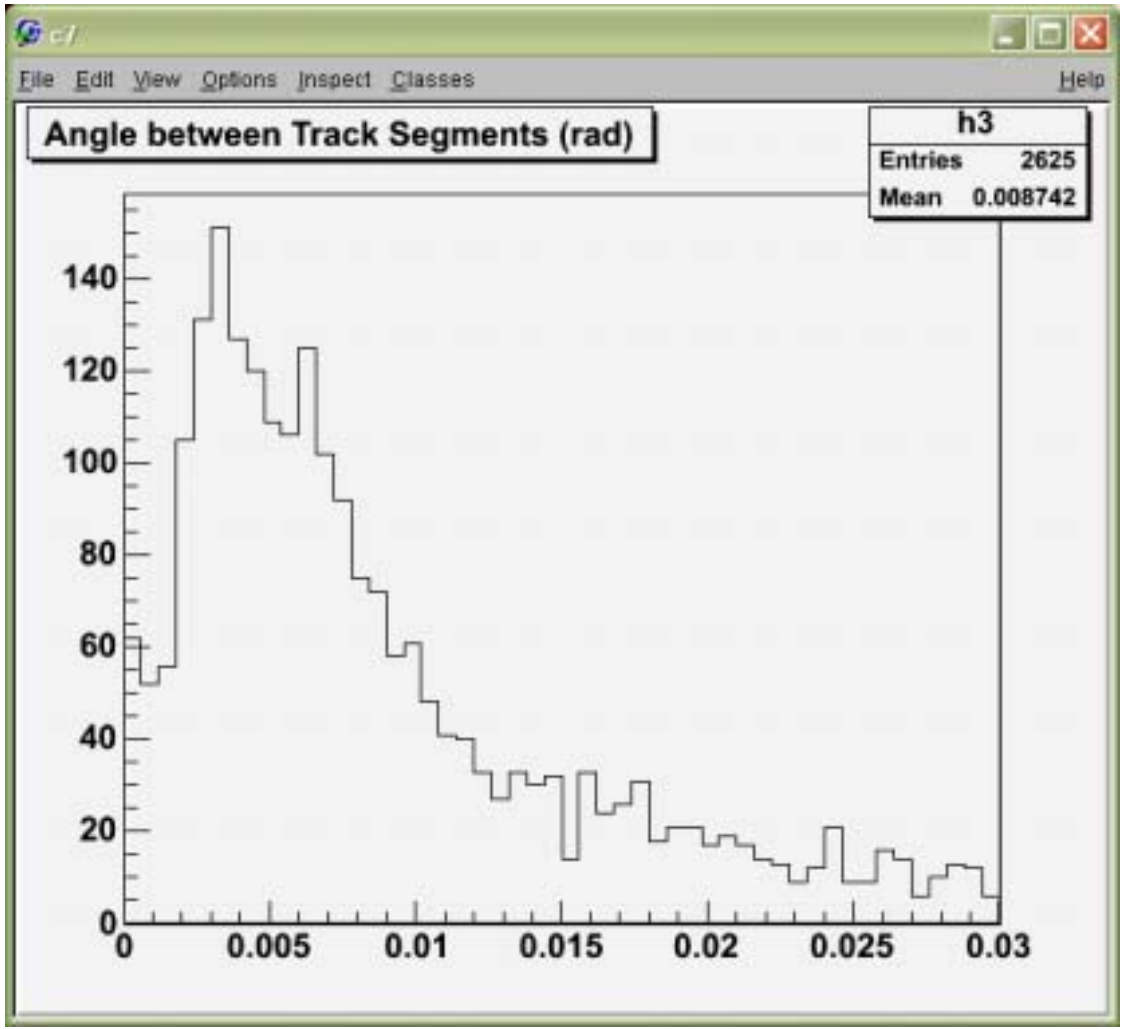


Kalman energies of the segments are correlated, but not in a simple way

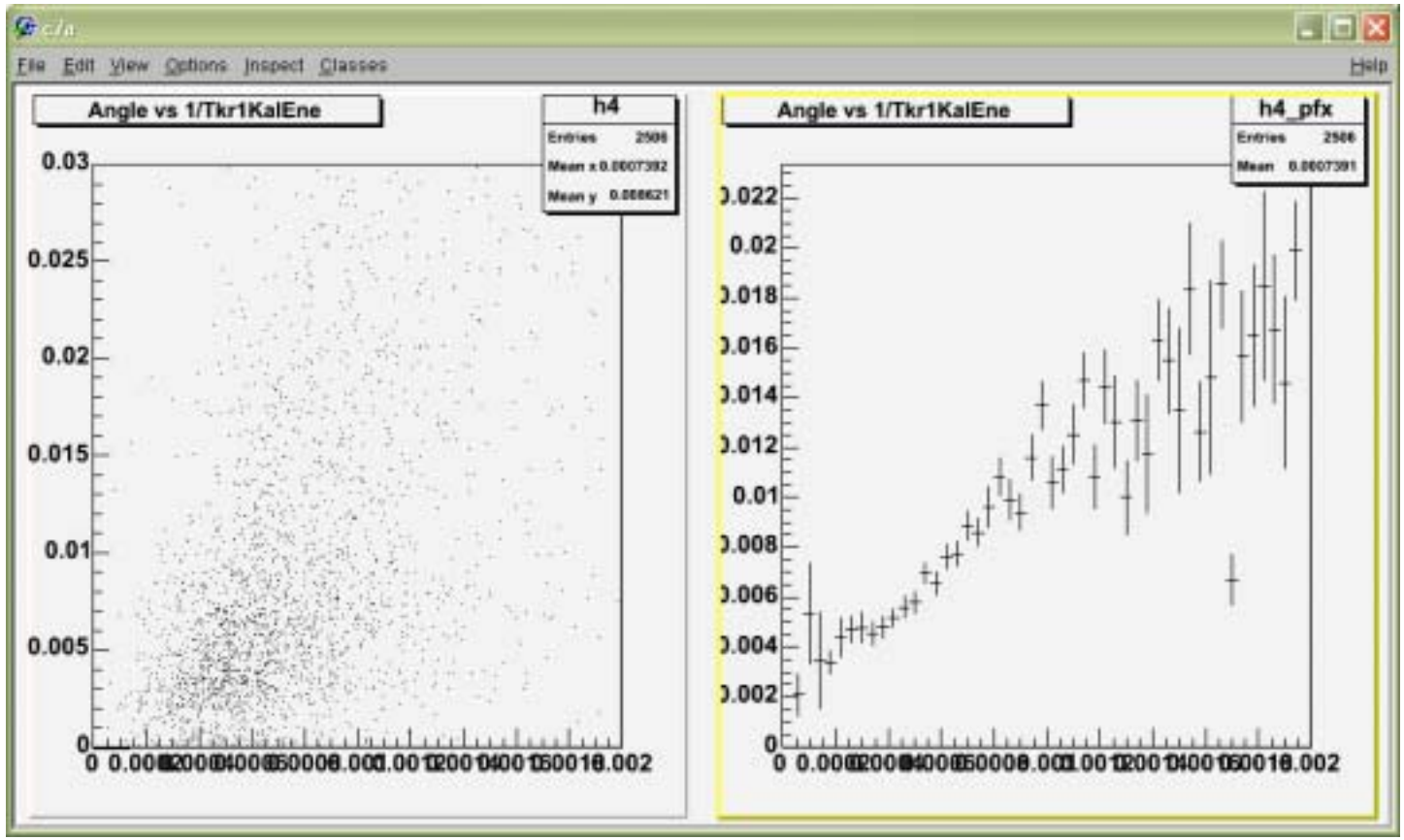
Correlation between KalEne and MC energy



Angle between the segments ("PSF")



Angle vs. 1/Tkr1KalEne



What else?

- Segmented tracks may provide an alternate approach to alignment.
  - The segment parameters and their errors would be measured at the end of the 1st segment and at the beginning of the 2nd.
  - A cut could be made on MIP-like CAL response.
- Tracks can be segmented within a single tower, for example, by restricting the track length, or terminating a track at a given layer.
- Segmented tracks could be used to study reconstruction efficiency using data. For example, if a track enters at the top of the tracker, and produces a MIP in the cal, we would expect 2 segments. The ratio of 1-segment to 2-segment events is a measure of the tracking inefficiency.
- ???