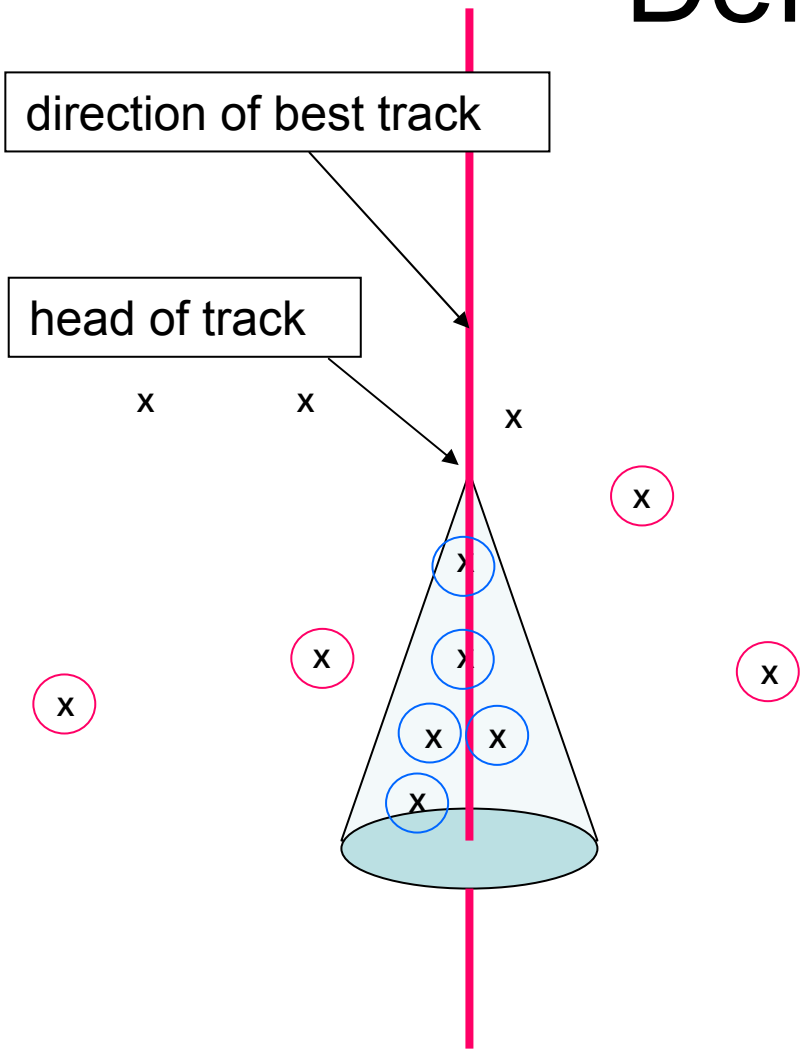
Surplus Hits Ratio, etc.

Leon R.

C&A Meeting

10-31-05 & 11-07-05

Definition



It's the ratio between the number of clusters outside the cone and the number inside

- Starts at the head of the track, and goes to the bottom of the tracker.
- Currently, 1-D distances are used for X and Y separately (so it's actually a square!)
- To reduce noise only clusters in layers with both x and y hits are counted

Details

How does the cone angle vary with angle and energy?

The naïve expectation is that it goes as:

- $1/E_{gamma}$
  and maybe
- $1/\cos\theta_{track}$.

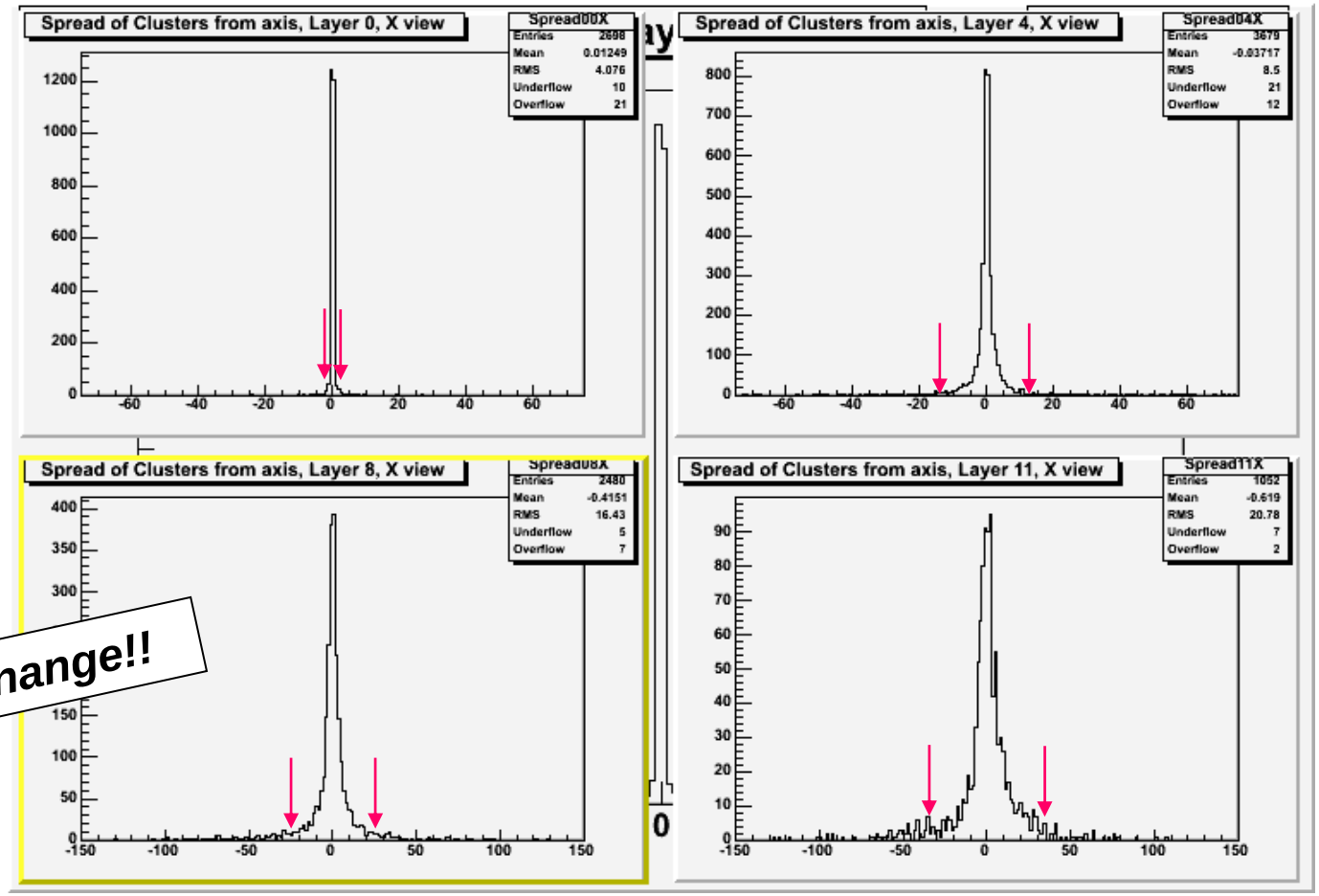
Wrong!

Study with Gleam

Gamma runs:

- Energies: 30, 50, 100, 200 MeV, 1, 3, 10 GeV
- Angles: Theta =0, 30, 45, 55º, Phi = 0º
- Histogram the distance between track projection and clusters in each layer
- Find the 90% lower and upper point
- Compare X and Y

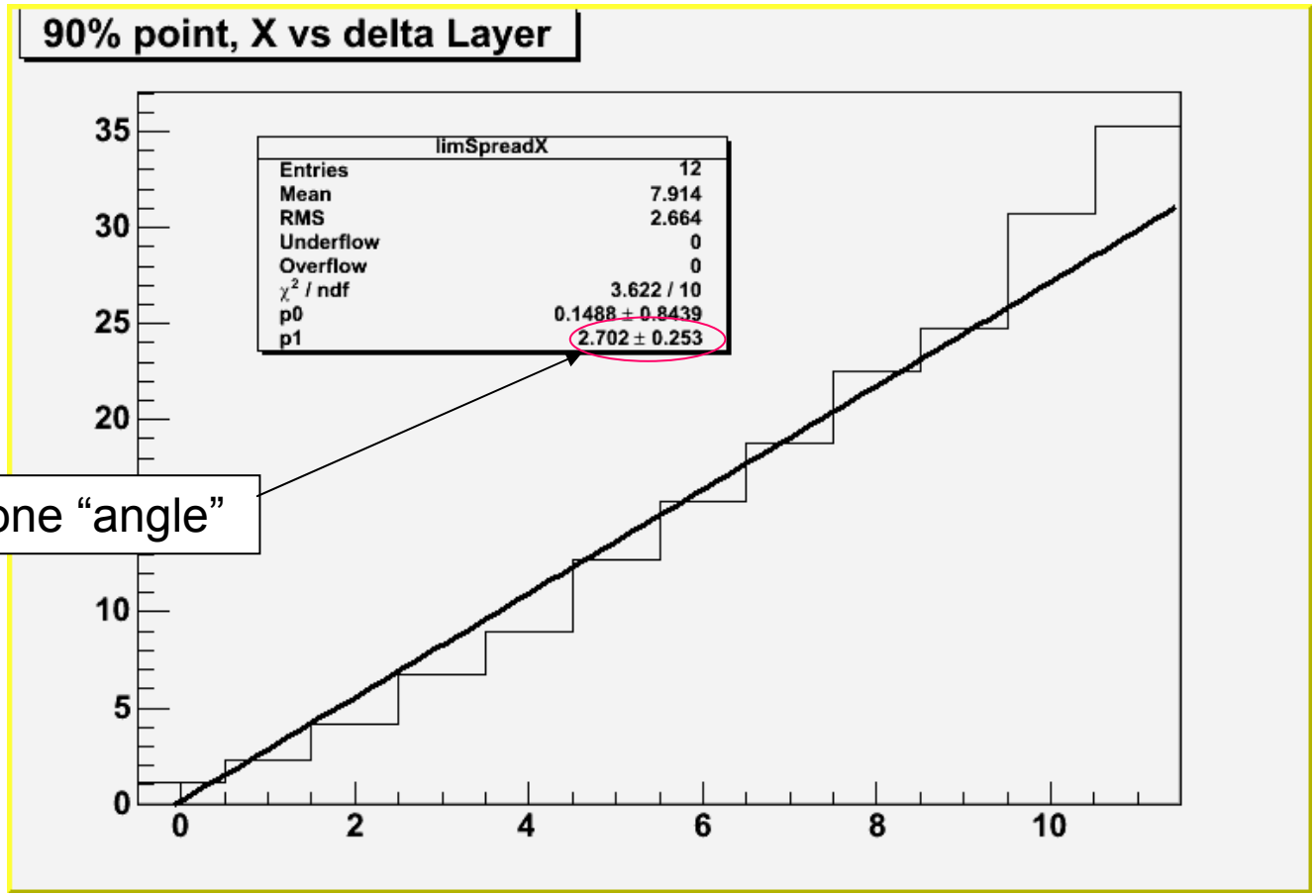
Some Plots for 1GeV 0º



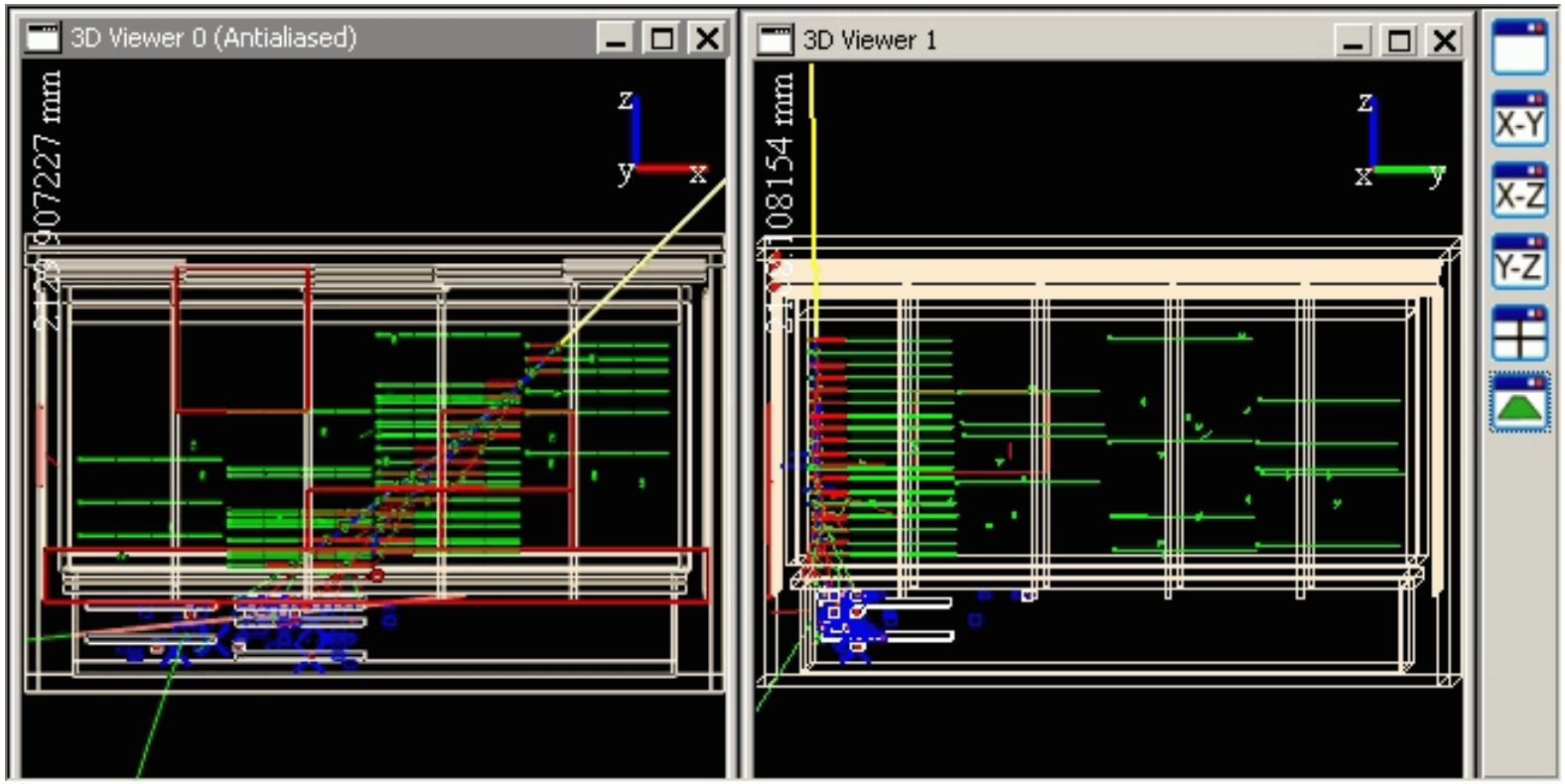
Scale Change!!

"Layer" means length of track in layers
(Only thin layers are used for this plot)
Red arrows mark 90% region

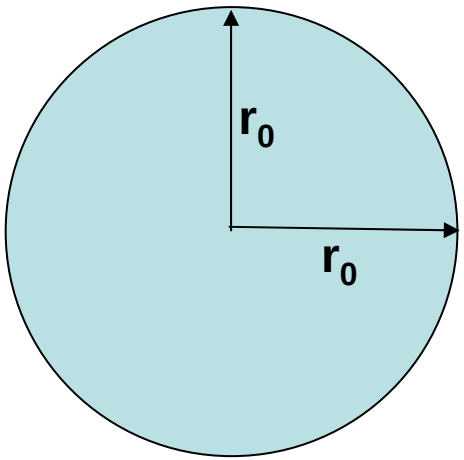
Summary Plot, 1 GeV, 0°



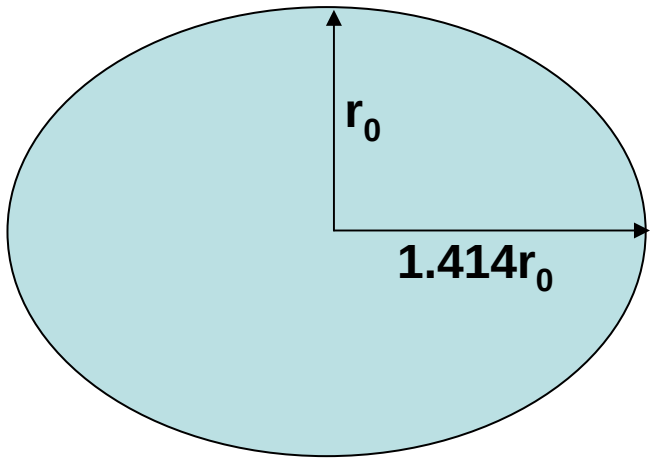
1 GeV, 45º Event



Footprint of Cone on Silicon, Theory



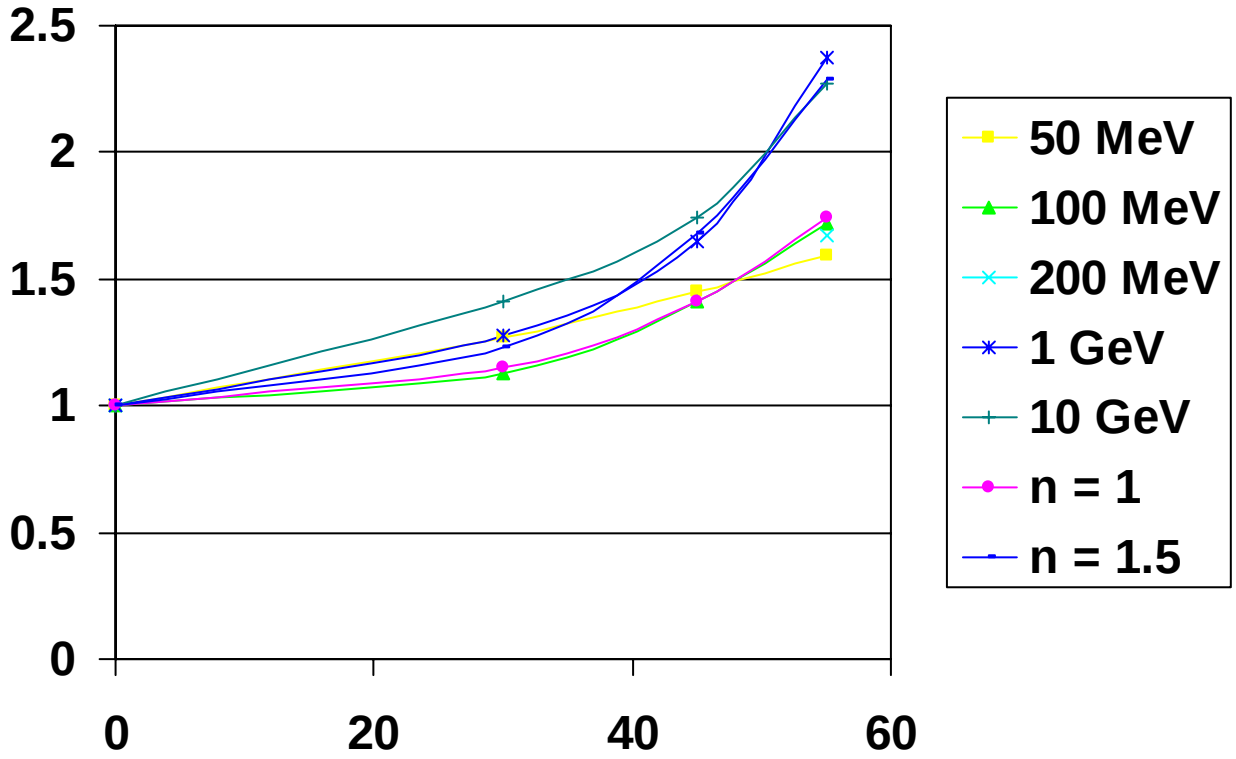
Track at 0º



Track at 45º

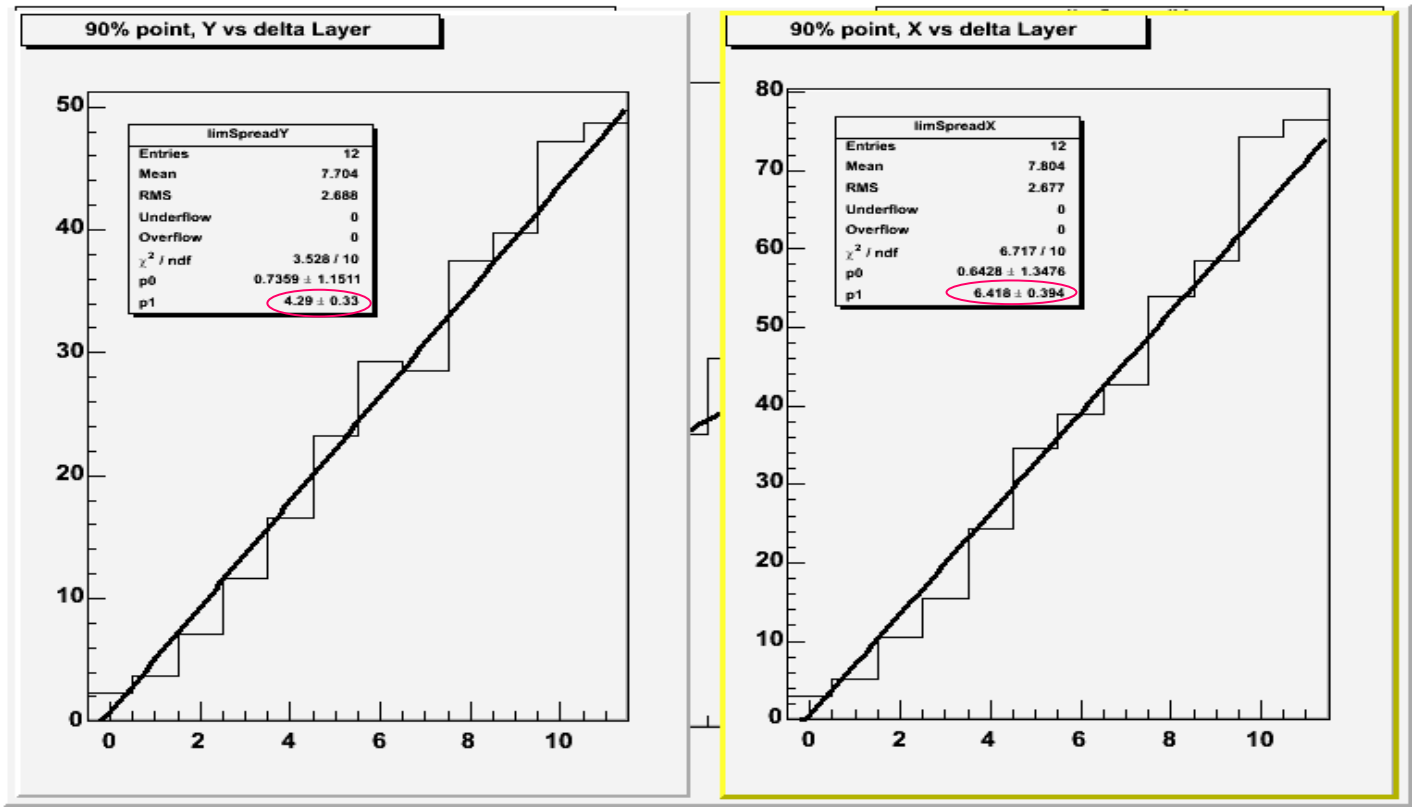
Major axis of ellipse grows as 1/cosθ
Minor axis stays constant

Angular Dependence (Minor Axis)



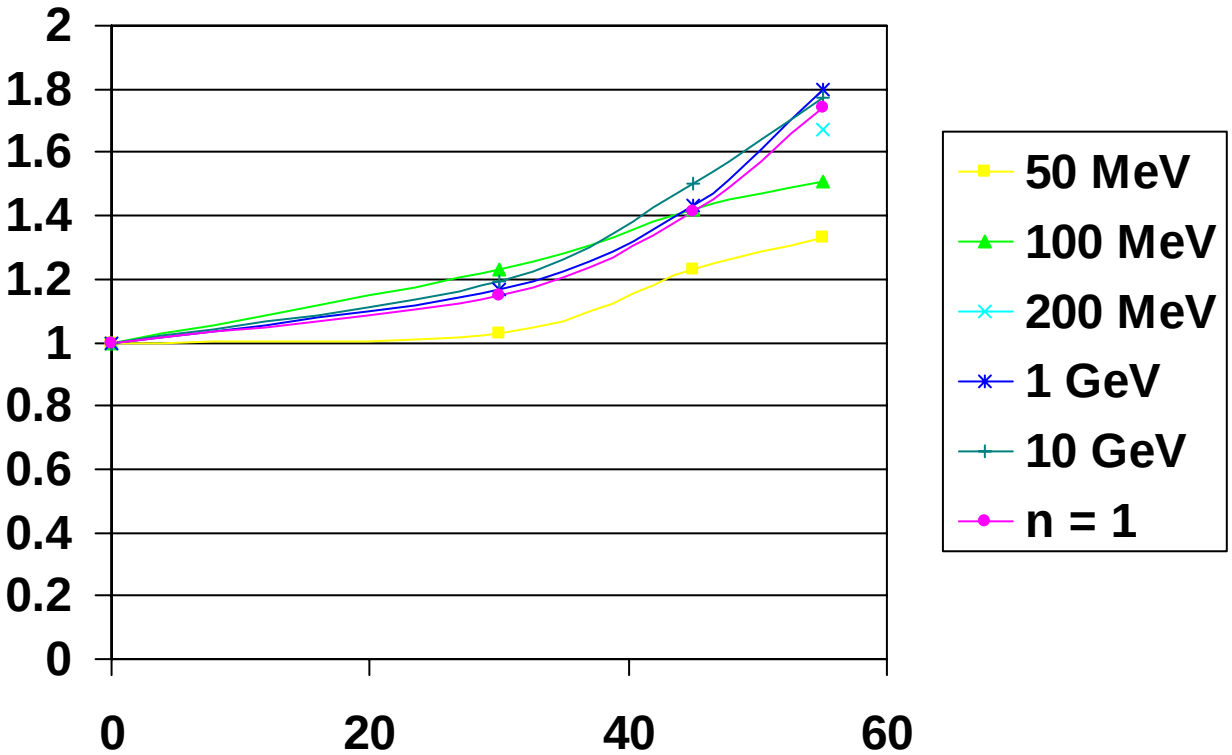
Model shows $(1/\cos\theta)^n$

Footprint of Cone on Silicon, Experiment



By comparing X and Y, we can separate the effects of the footprint. Note that the X projection is wider, as expected.

Footprint Factor



Model shows $(1/\cos\theta)^n$

Angular dependence

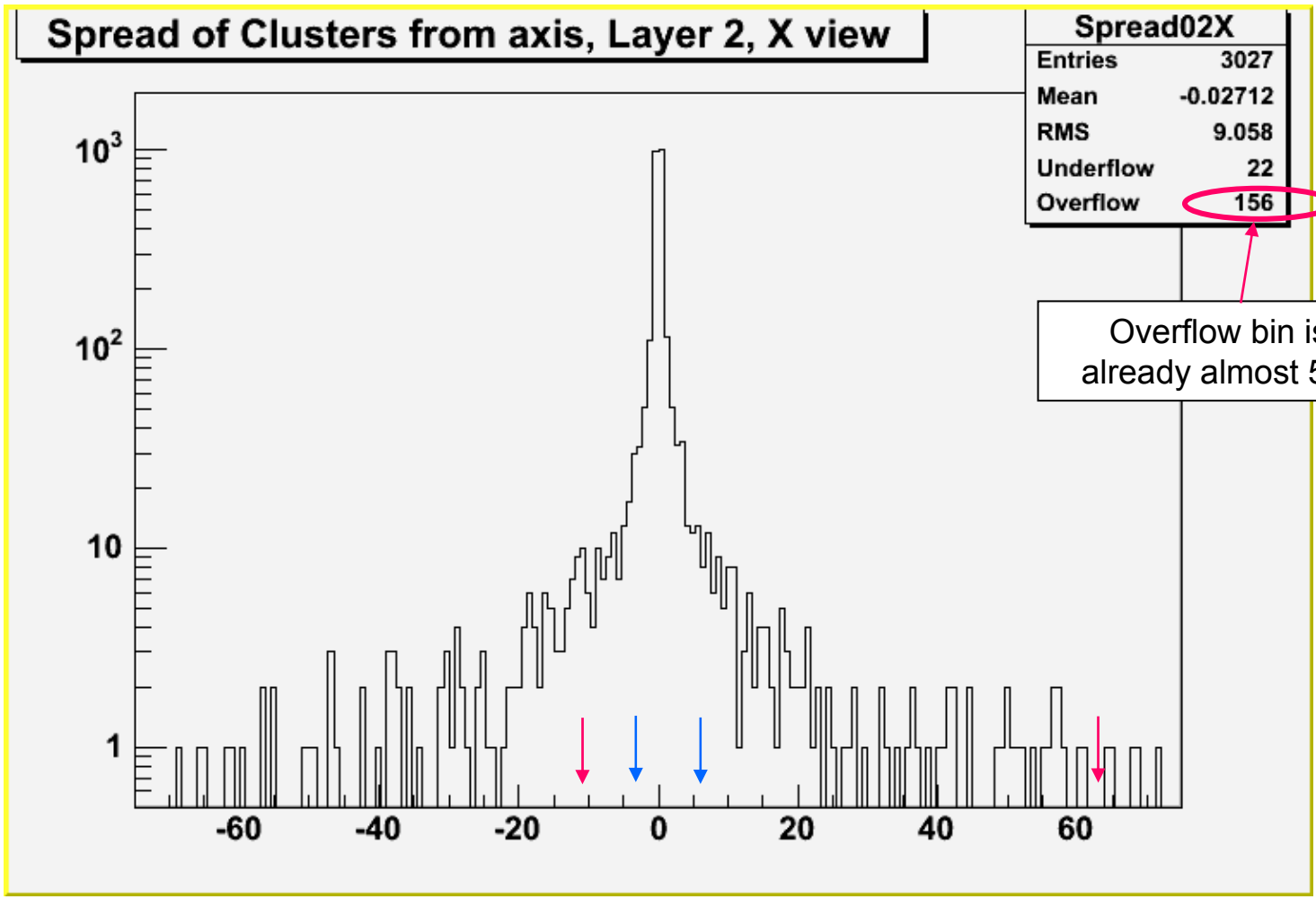
Cone angle goes like $(1/\cos\theta)^{2.5}$

This is “obvious” (now!):

- 1 power from the track length
- ½ power from sqrt(radiation length)
- 1 power from the footprint of the ellipse
  - in general, a different footprint in x and y directions.

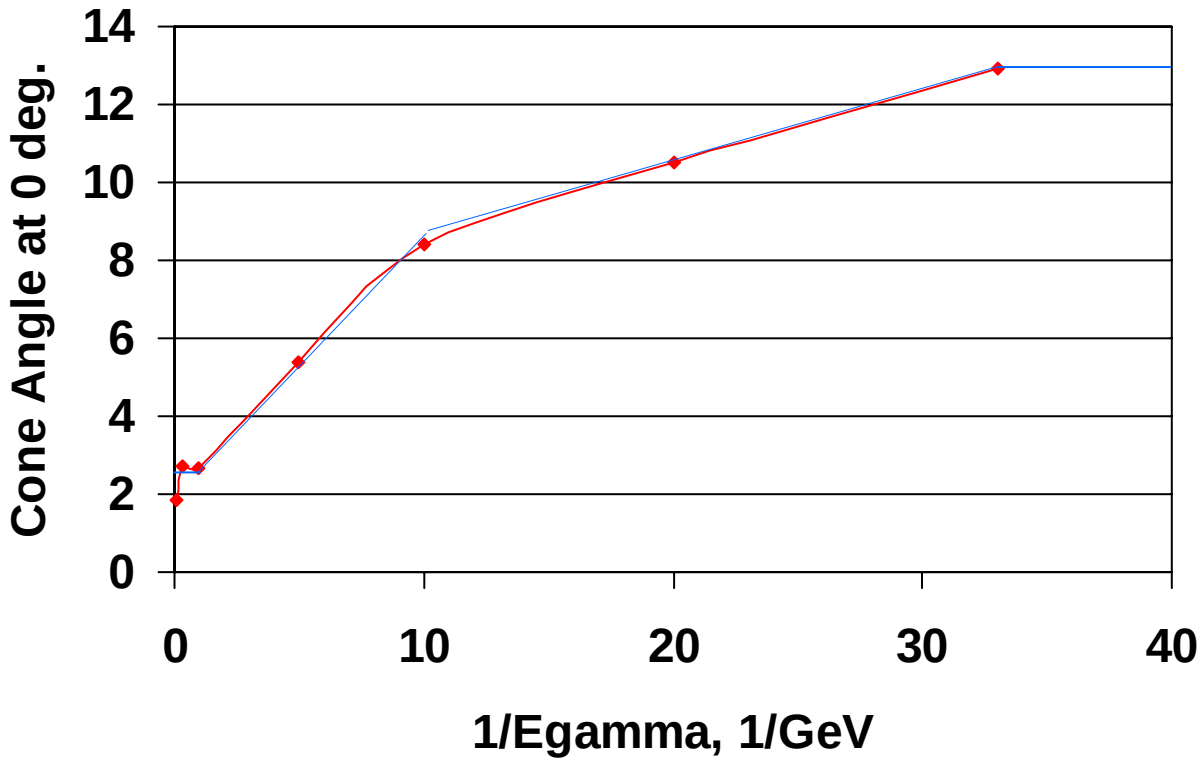
Power softens to ~1.5-2.0 at energies below 200 MeV, but there’s probably no harm in using the same value everywhere, since that will only make the cone a bit larger than it needs to be at these energies.

Effect at Higher Energy, 10 GeV, 45º



At 10 GeV, 90% is too wide (too much tail), so use 80%

Normalization vs Energy



Linear in 1/E at higher energies, but with an offset.
Saturates at low energies.
Blue line is a simple linear model of the data

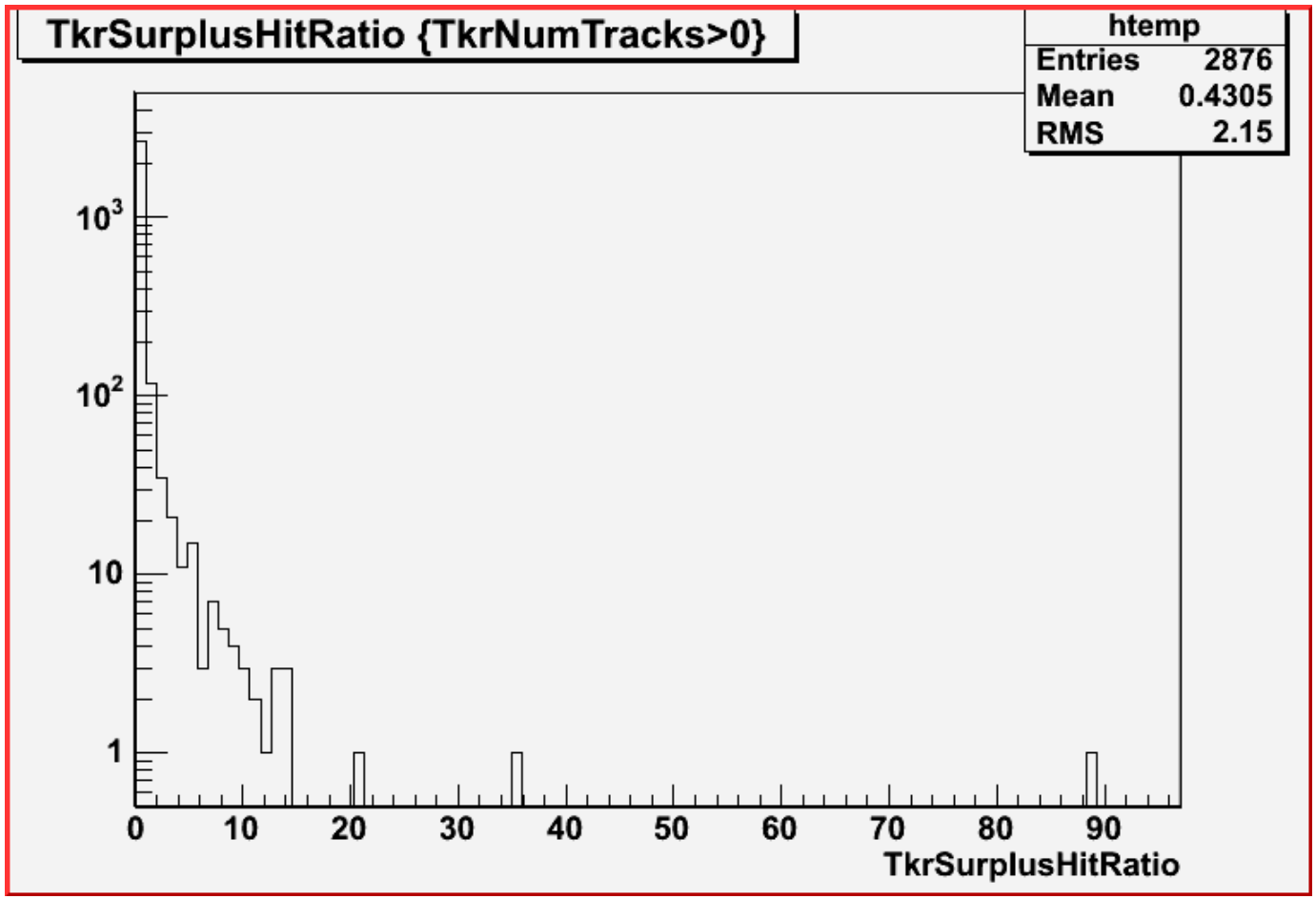
Chapter 2: 11-07-2005

The latest tag of AnaTup has the new variables:

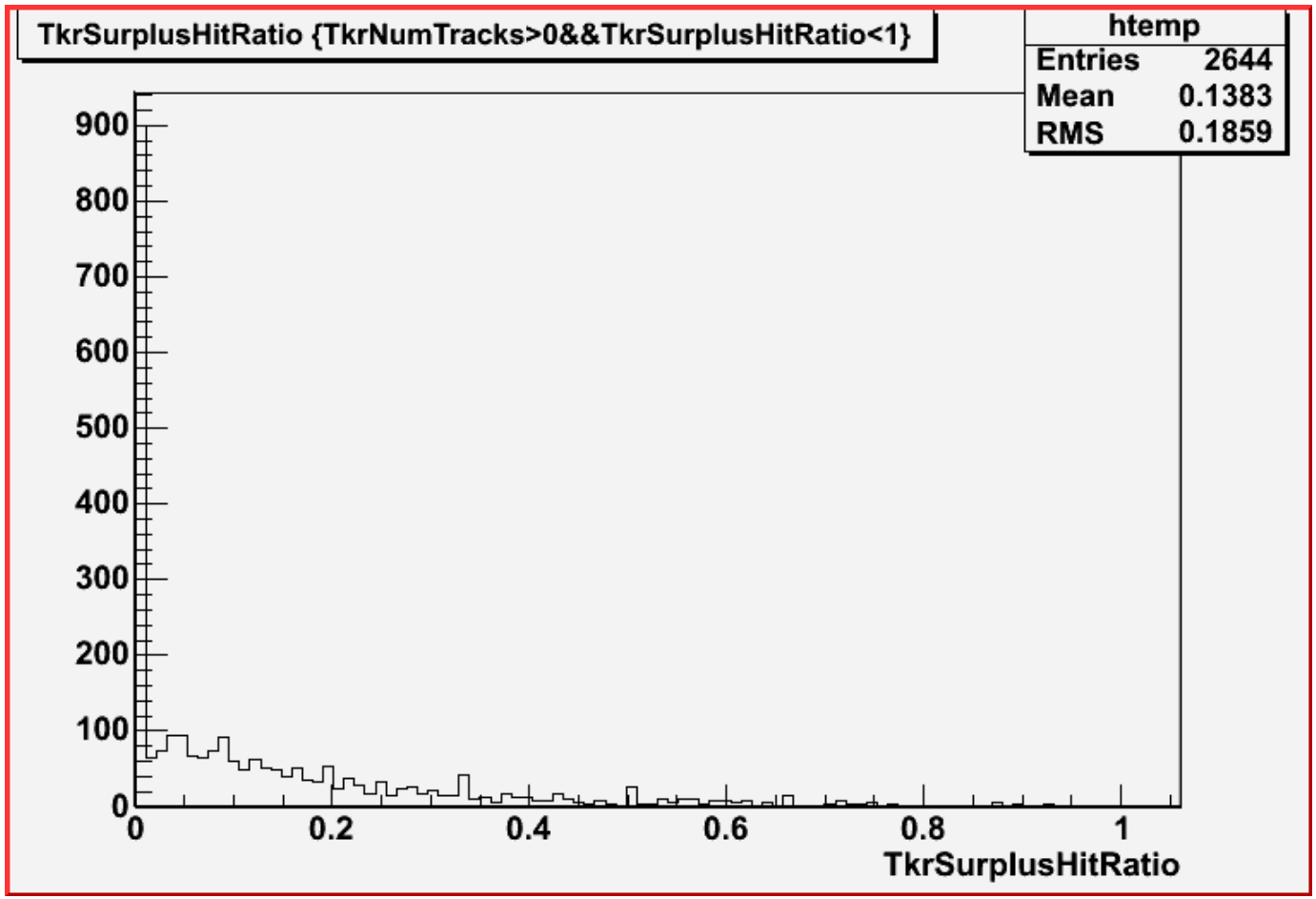
- TkrSurplusHitRatio: Ratio of # clusters outside the “cone” to # inside
- TkrSurplusHCInside: # clusters inside the “cone”
- TkrUpstreamHC: # clusters in a defined volume up to 4 layers above the head of the track
- Tkr1CoreHC: # clusters “close” to the clusters on the first track.

A first look indicates these variables will be useful!

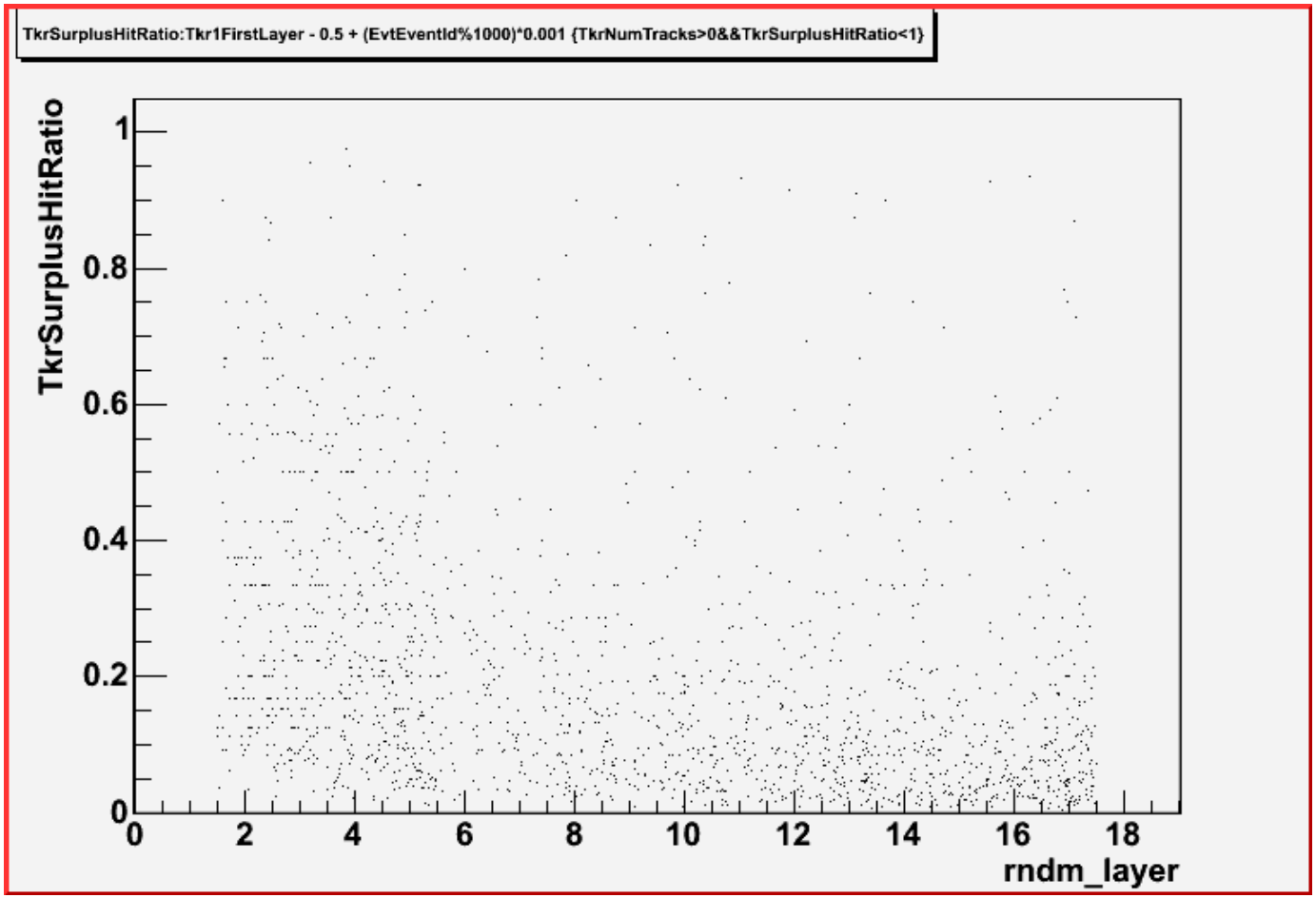
Surplus Hit Ratio, All-gammas



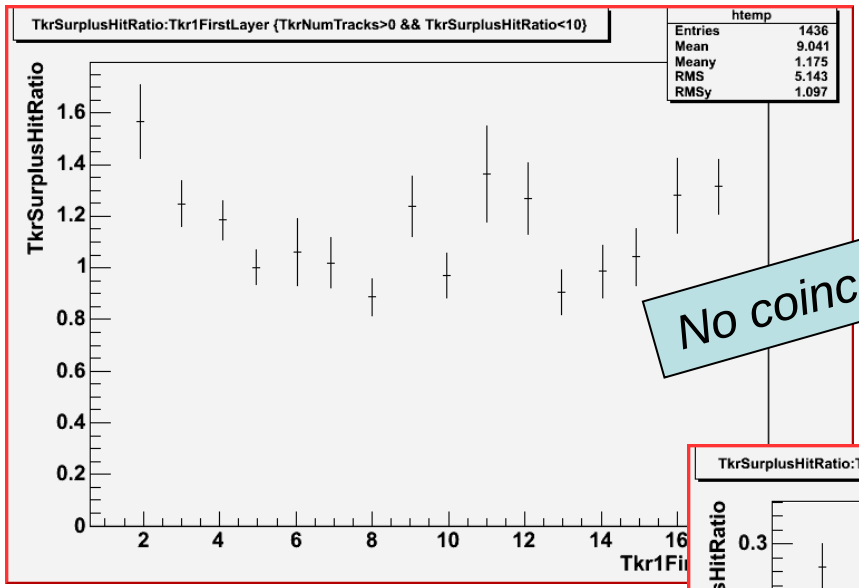
Surplus Hit Ratio, cut

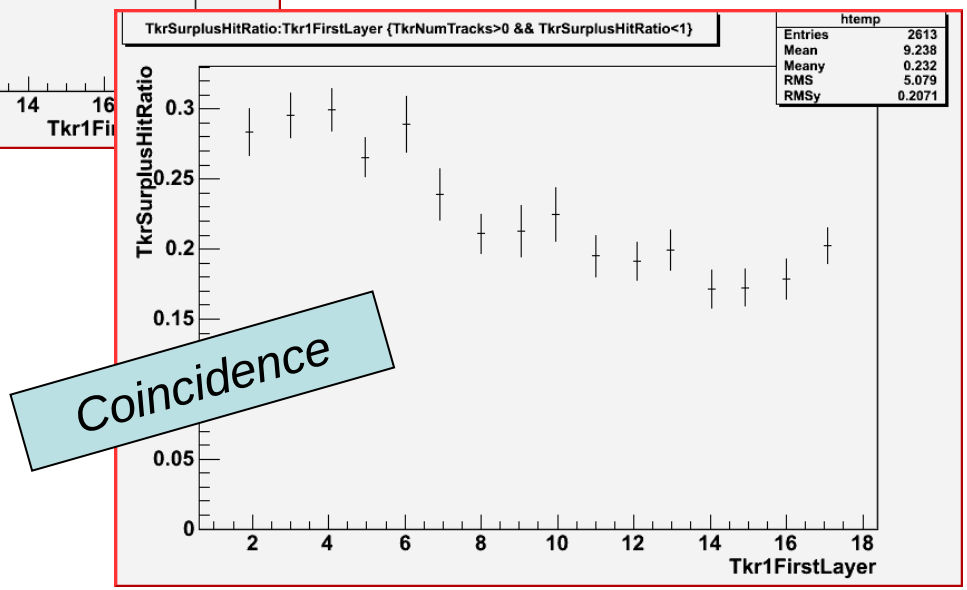


SHR vs First Layer

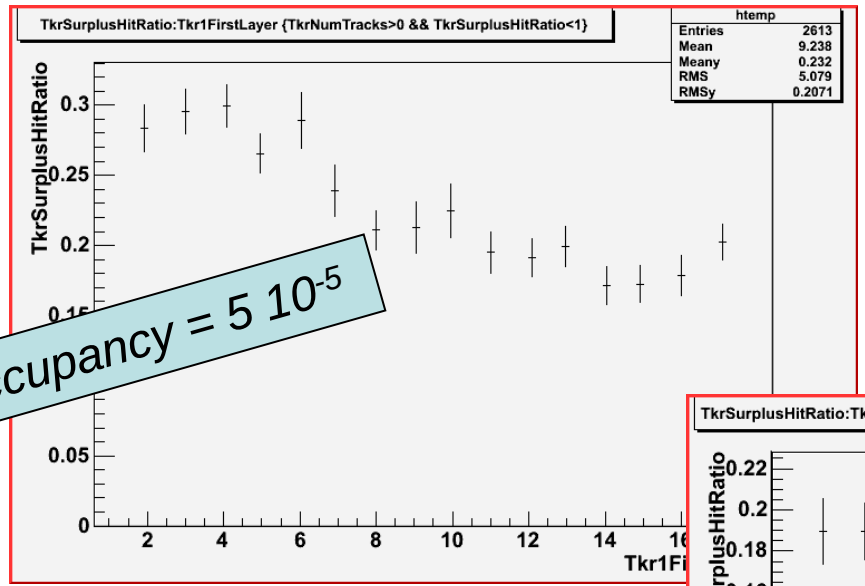


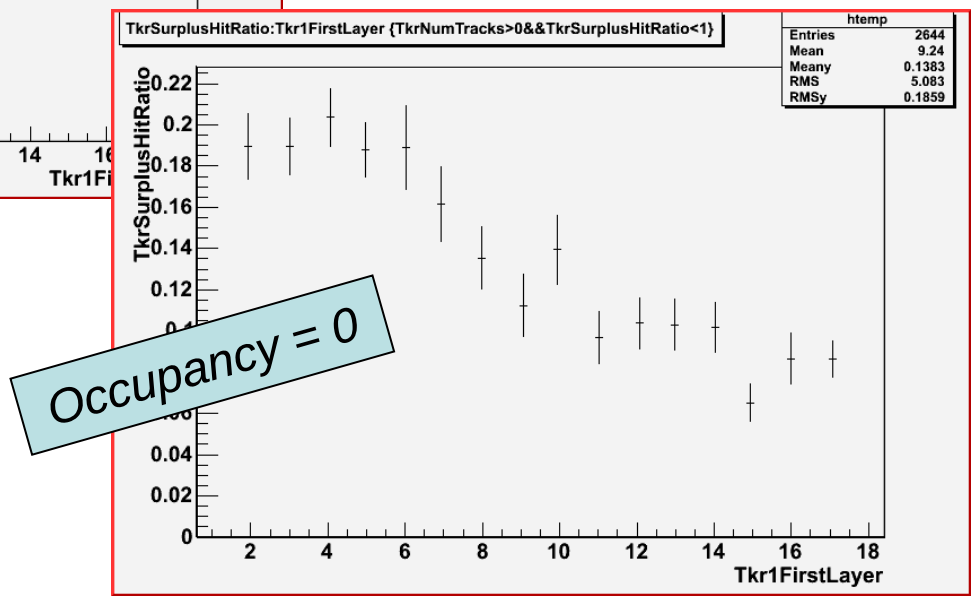
SHR vs First Layer, before and after adding XY coincidence



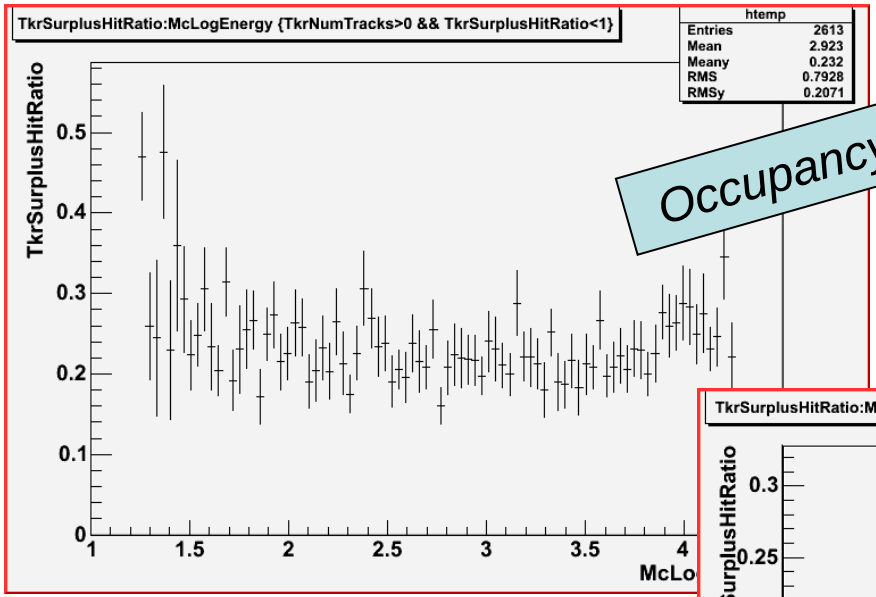


SHR vs 1st Layer, With and Without Noise

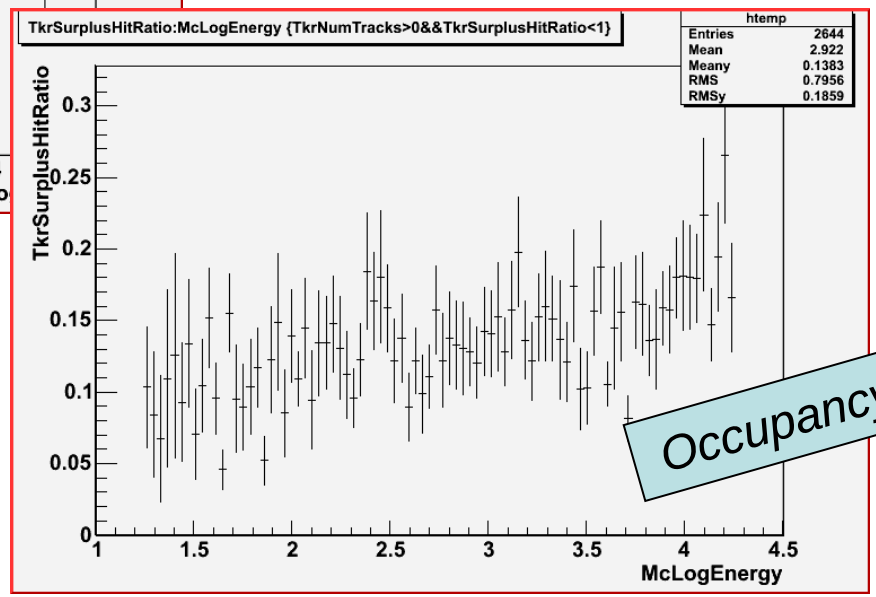




SHR vs LogEnergy, With and Without Noise

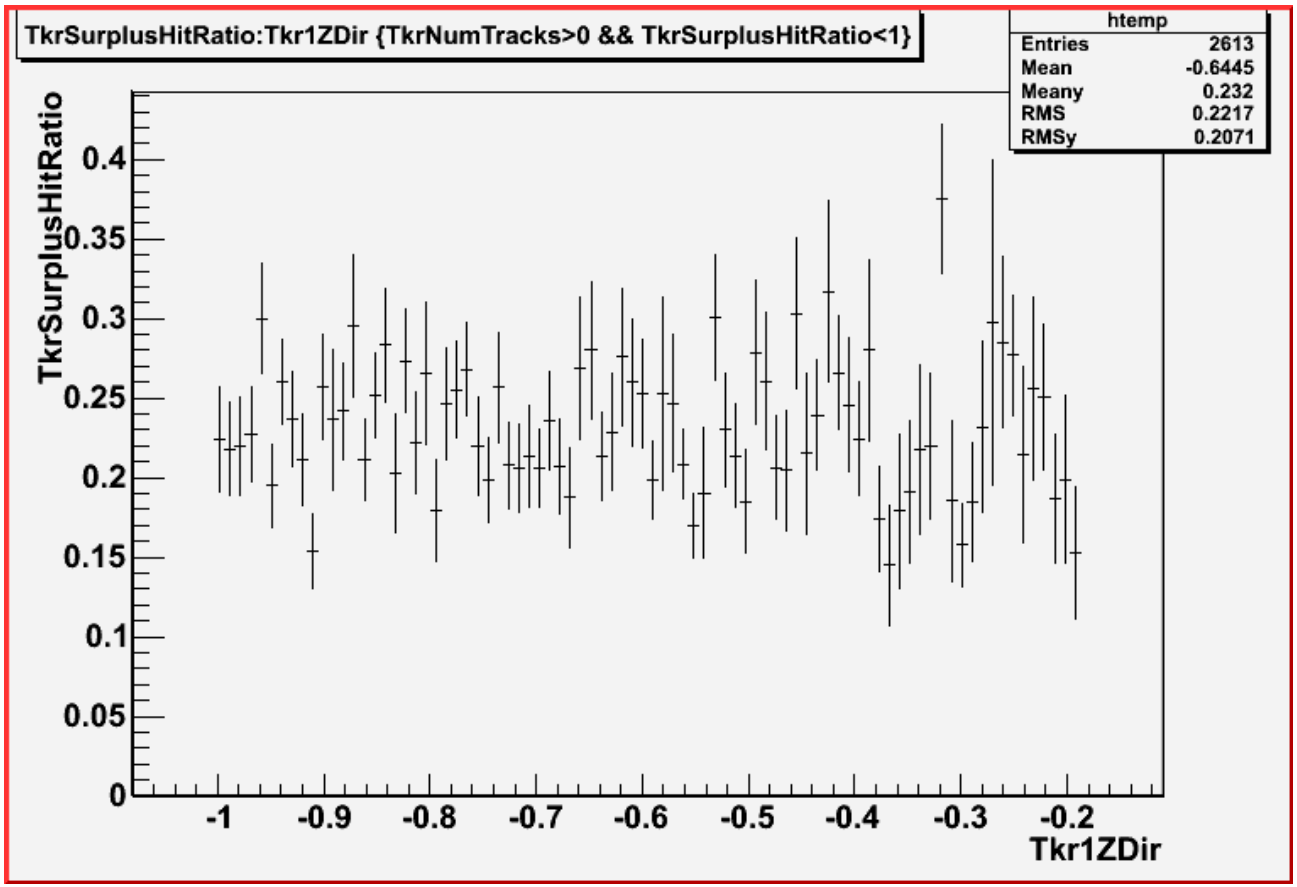


Occupancy = $5\ 10^{-5}$

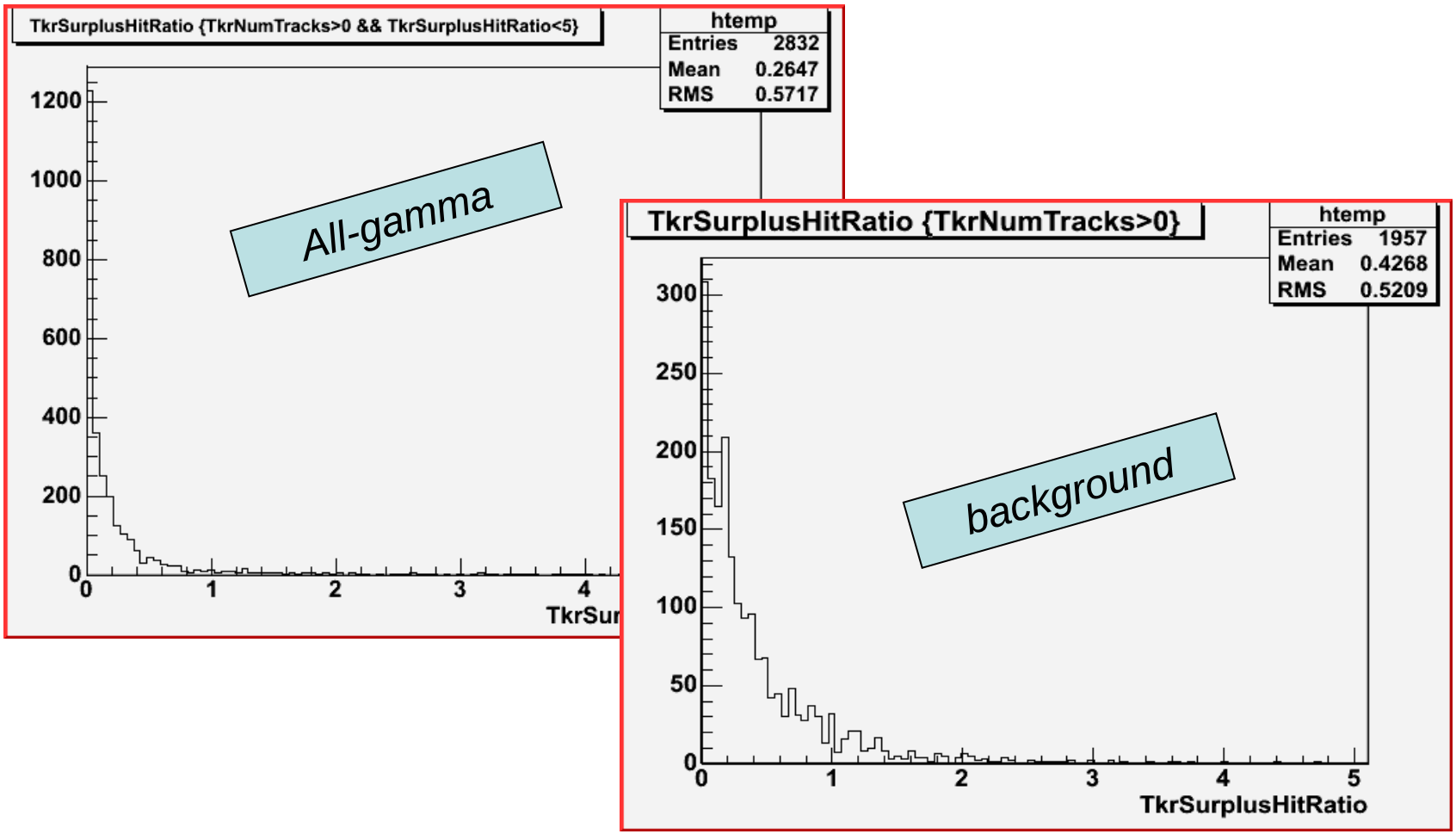


Occupancy = 0

SHR vs cos(θ)

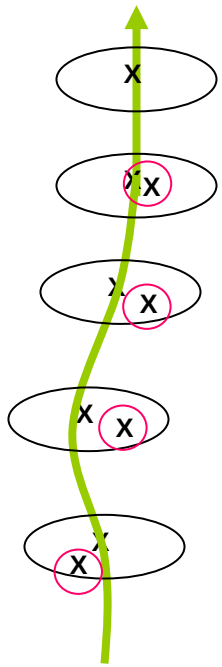

TkrSurplusHitRatio:Tkr1ZDir {TkrNumTracks>0 && TkrSurplusHitRatio<1}
htemp
Entries 2613
Mean -0.6445
Meany 0.232
RMS 0.2217
RMSy 0.2071
TkrSurplusHitRatio
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-1
-0.9
-0.8
-0.7
-0.6
-0.5
-0.4
-0.3
-0.2
Tkr1ZDir

SHR, All-gamma vs. Residual Background

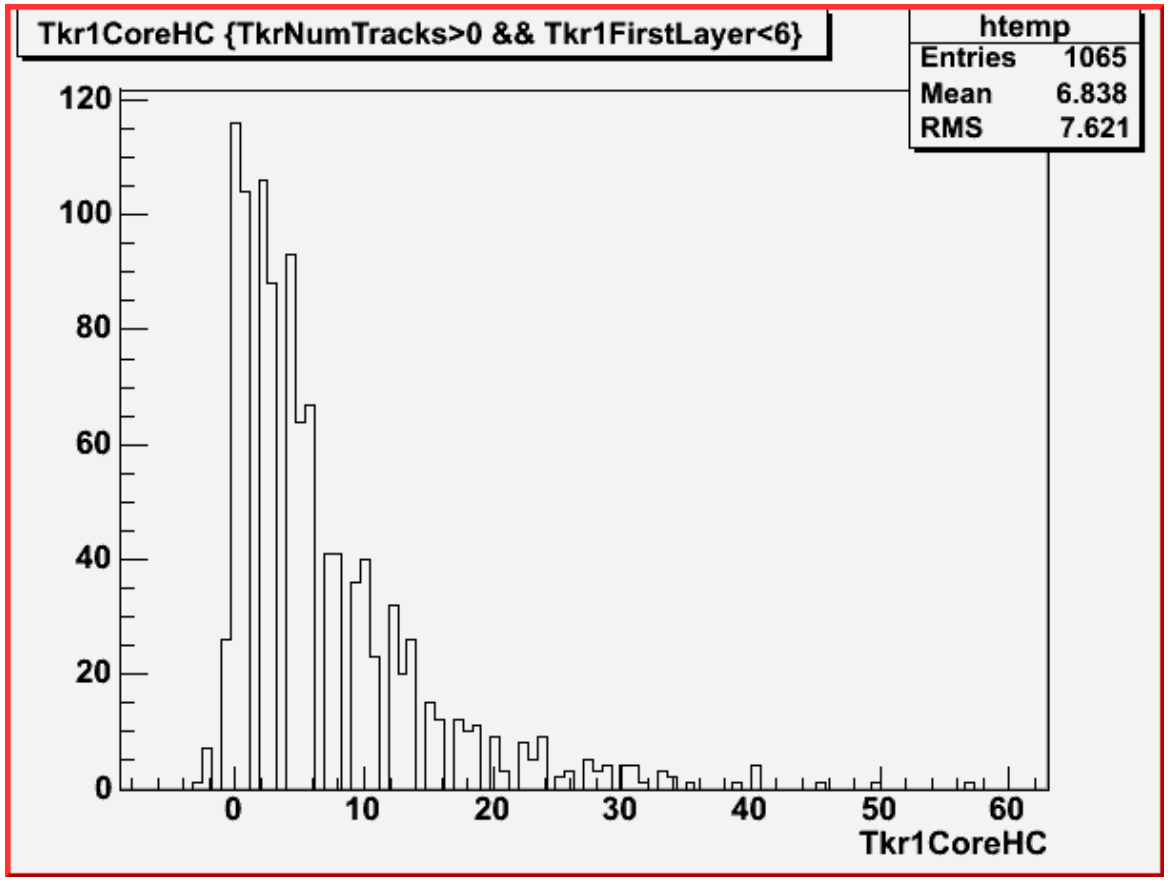


Tkr1CoreHC

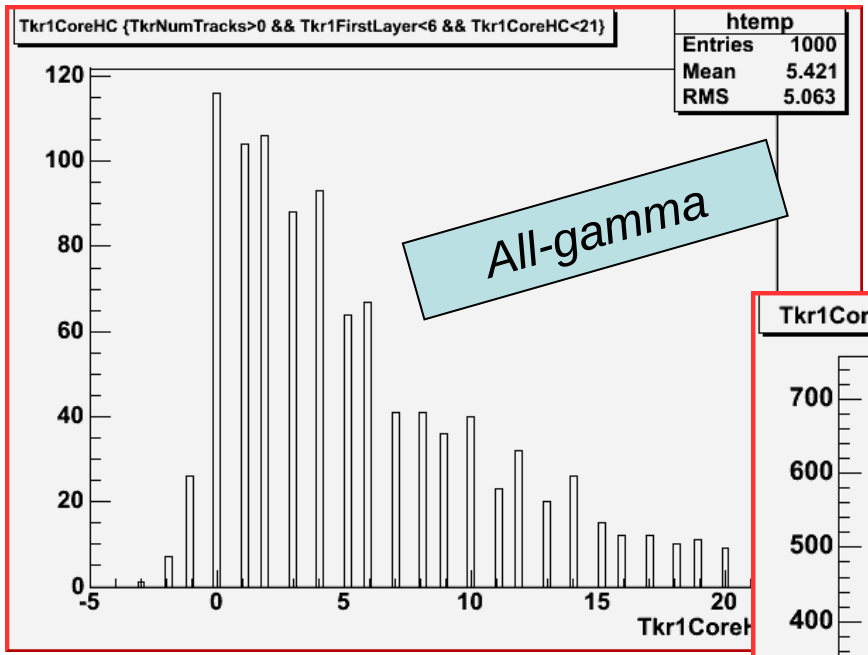
- Counts up the clusters in the immediate vicinity of the clusters on the track. Zero means no other clusters.
- Stopping up-going stubs are relatively clean; down-going gammas tend to have “friends”
- A technical glitch leads to occasional negative numbers.

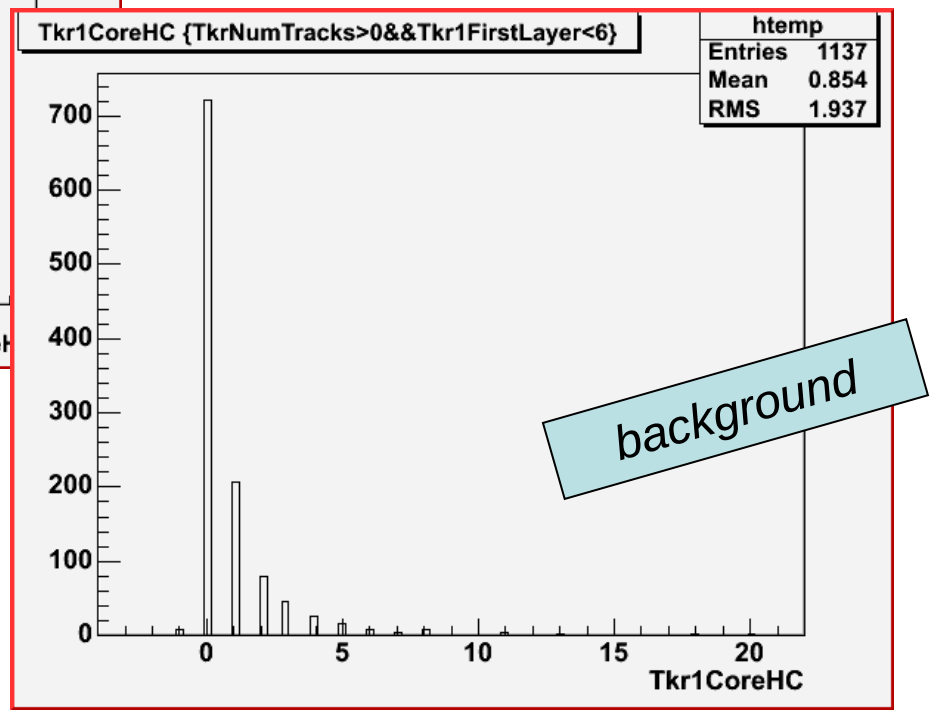


Tkr1CoreHC for All-gammas in first 6 layers



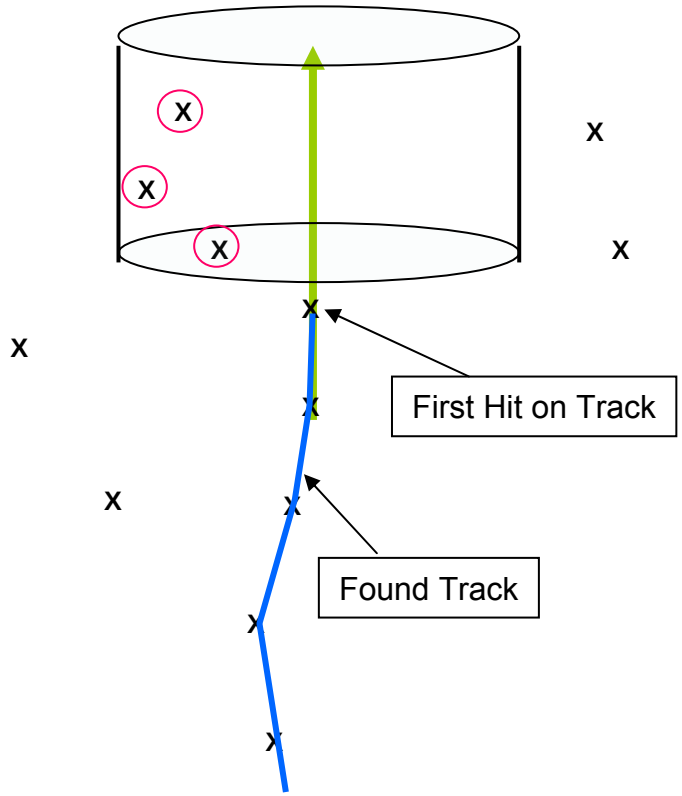
Tkr1CoreHC, All-gammas vs Resid. Bkgd



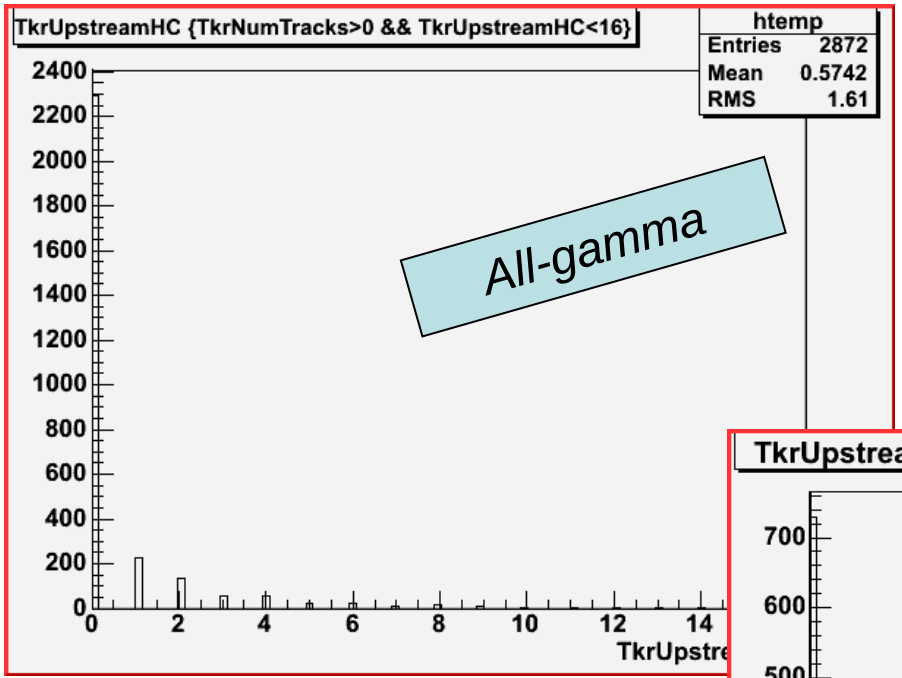


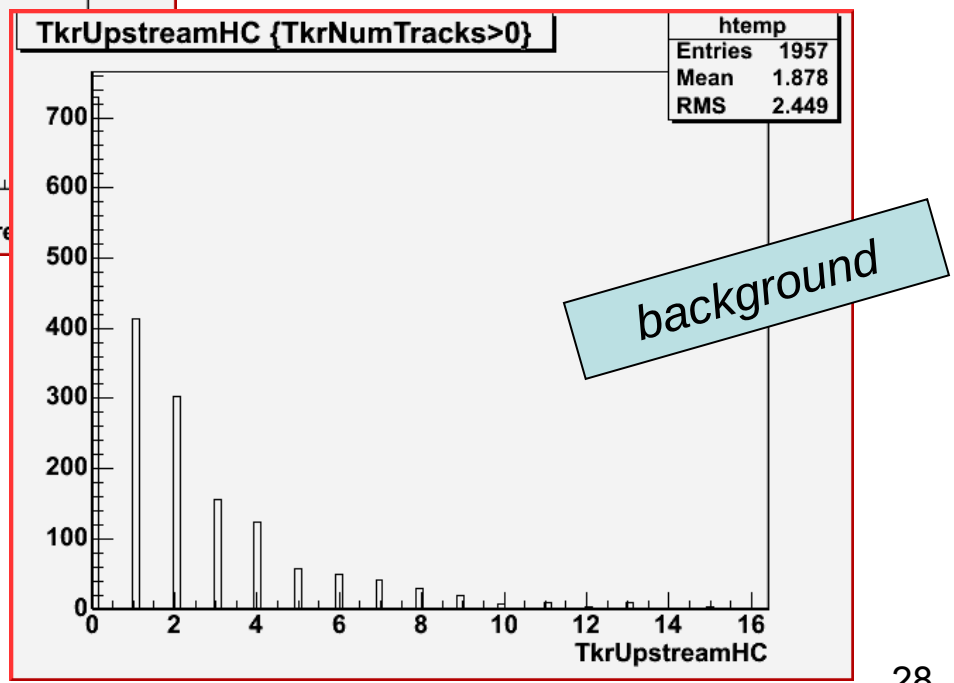
TkrUpstreamHC

- Counts clusters in the vicinity of the upward projection of the first track.
- Counting starts in the first layer above the track, and continues until 4 layers are counted, or the top of the tracker is reached.
- Generally, the space above the track should be relatively free of clusters for real gammas.



TkrUpstreamHC, All-gammas vs Resid. Bkgd

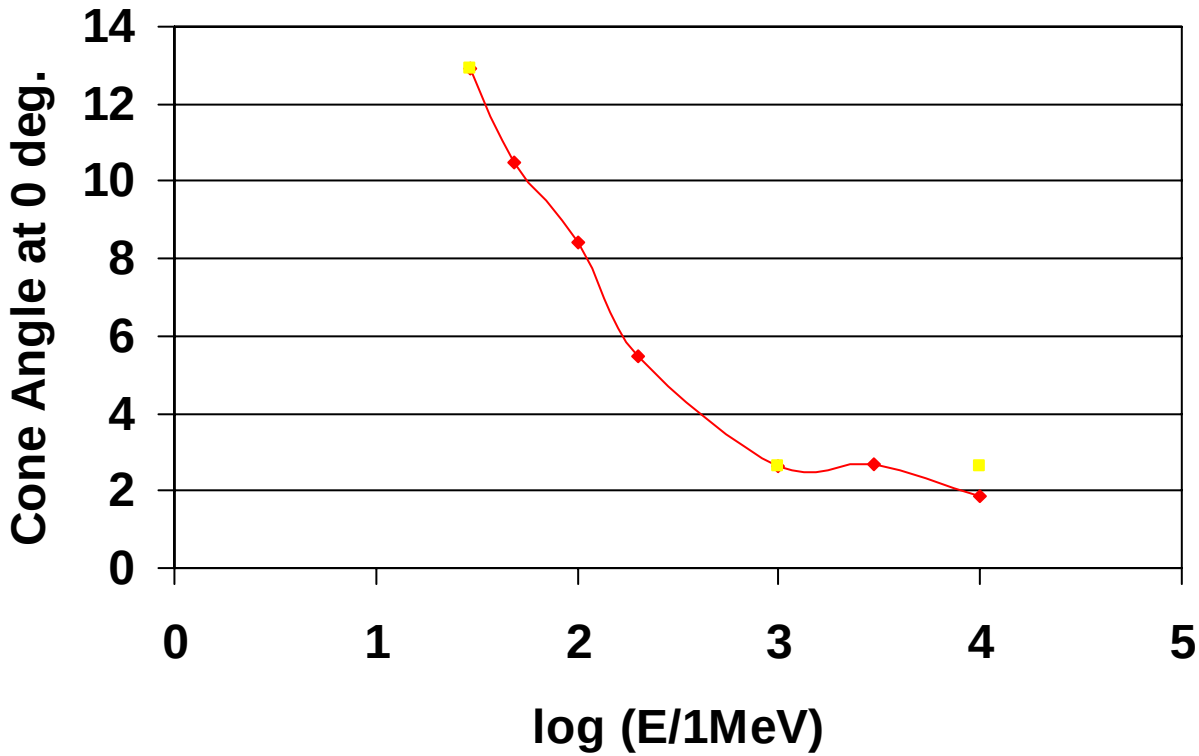




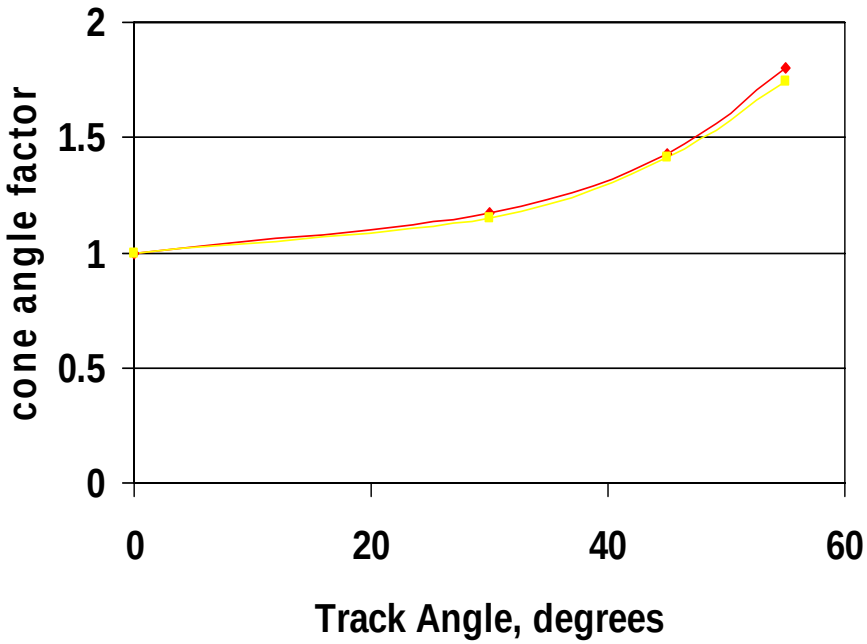
That's All Folks!

(Extras follow…)

Cone Angle vs log(E)

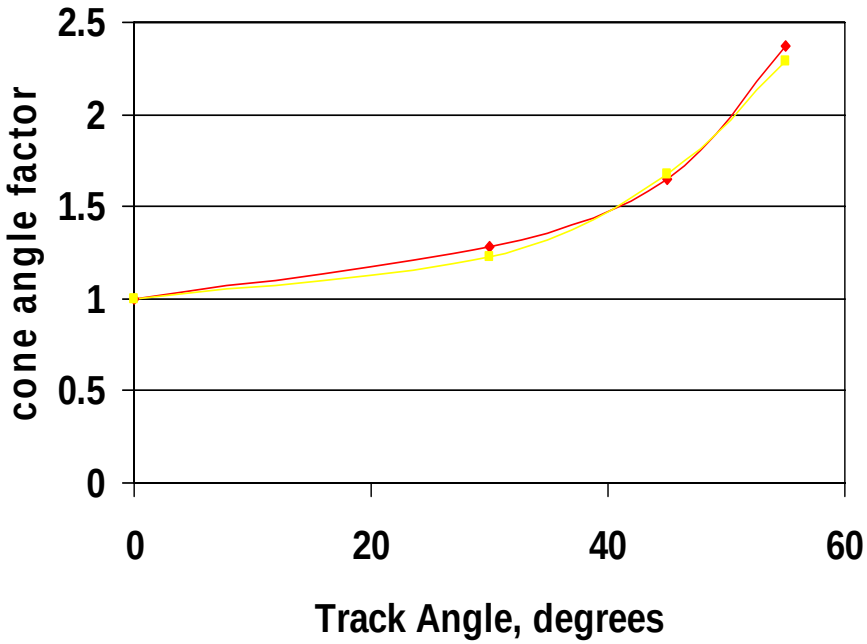


Footprint Factor



red line: data
yellow line: $1/\cos \theta_{track}$

Angular Dependence, 1GeV (minor axis)



red line: data
yellow line: $(1/\cos \theta_{track})^{1.5}$