First Look at Pixel Endcap Cosmic Data (Part II)

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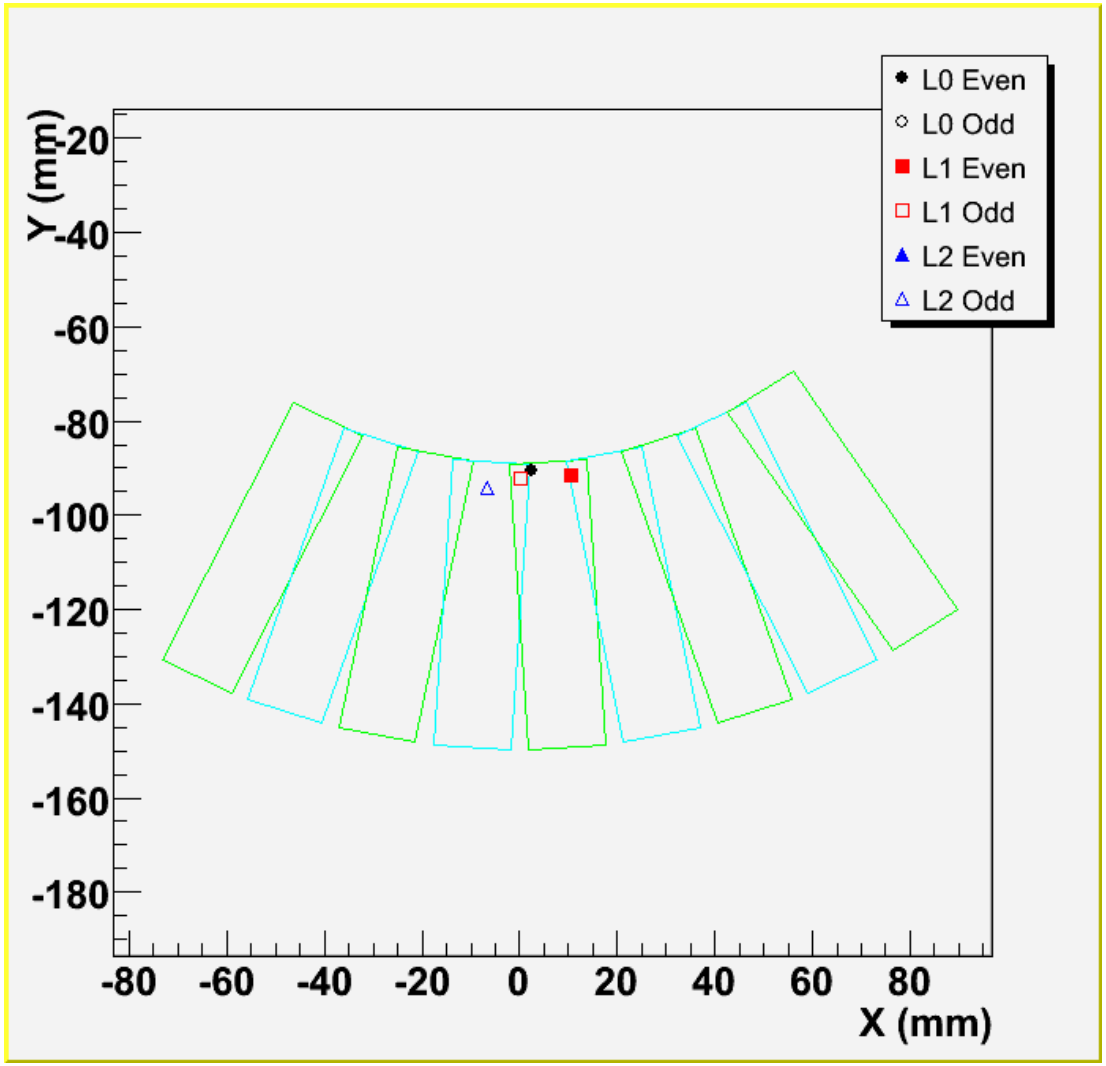
Data Sample and Analysis Steps

- 40K events from run 1125 processed by Ariel with original version of reconstruction -> root tree ntuple.
- Approximate pixel<->cluster association to define cluster time, sum TOT.
- Identified hot pixels at rate >10^{-3} in 13 out of time BeamCrossing (BCID) ticks. Any cluster with hit pixels contributing >20% of sum TOT are discarded.
- Good clusters are selected to require sumTOT>=12 and with BCID = 4-6.
- Events with all 3 layers having good clusters are skimmed off for detailed geometry study.
- Back traced from data all the transformations used for (row,column)<->Local coordinate<->Global coordinate and made geometry utility to allow easy tes of modifications of all the geometry mapping transformations.

Geometry ϕ Flip Problem (I)

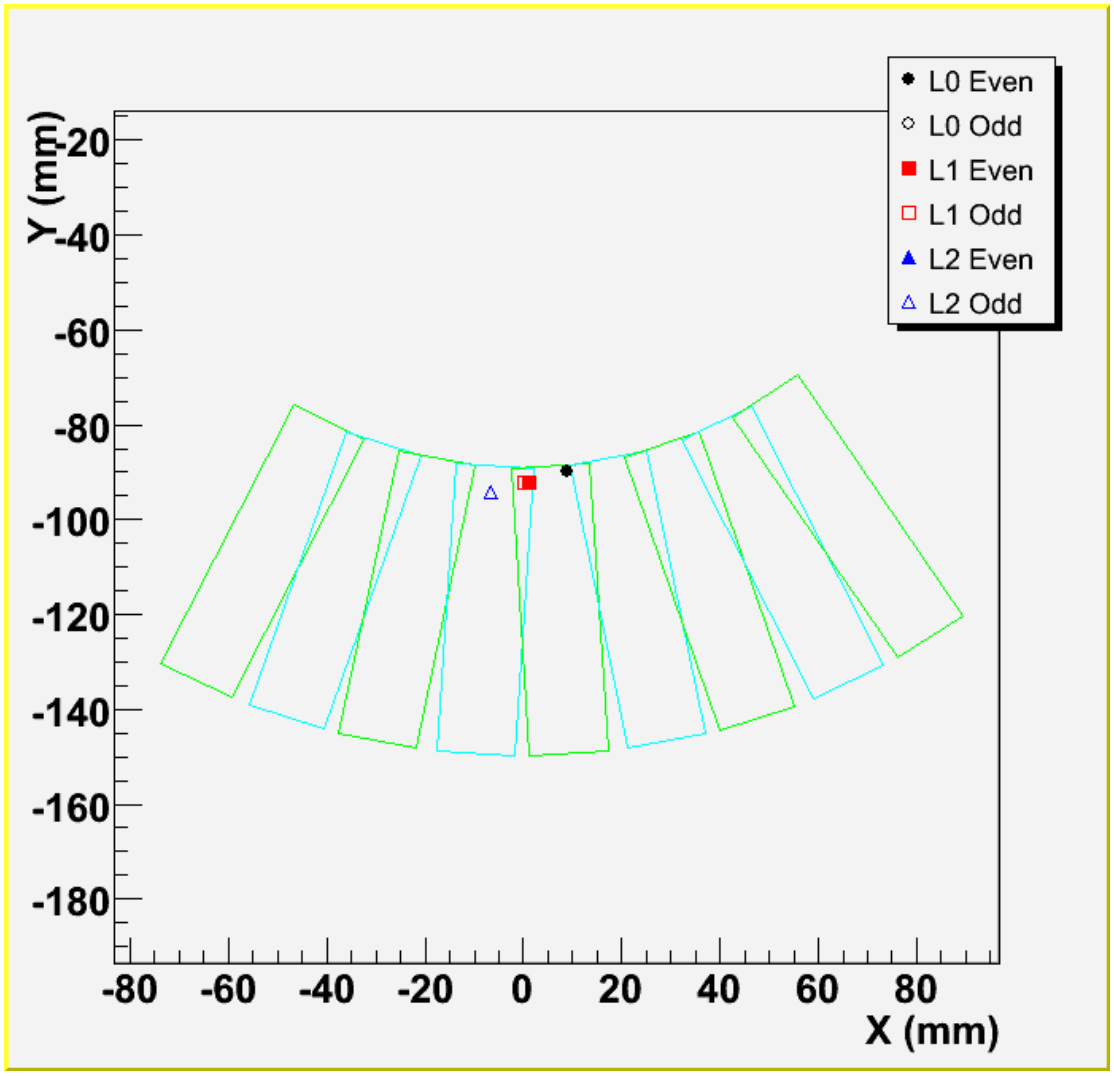


Initial tracking rate very low and residuals were grossly off at ~1cm level.

Very suspiciously like the problem we faced once before at SLD VXD3…

Examining just one event confirmed it: Hits from overlapping region (in this event the two red squares) are supposed to be on top of each other.

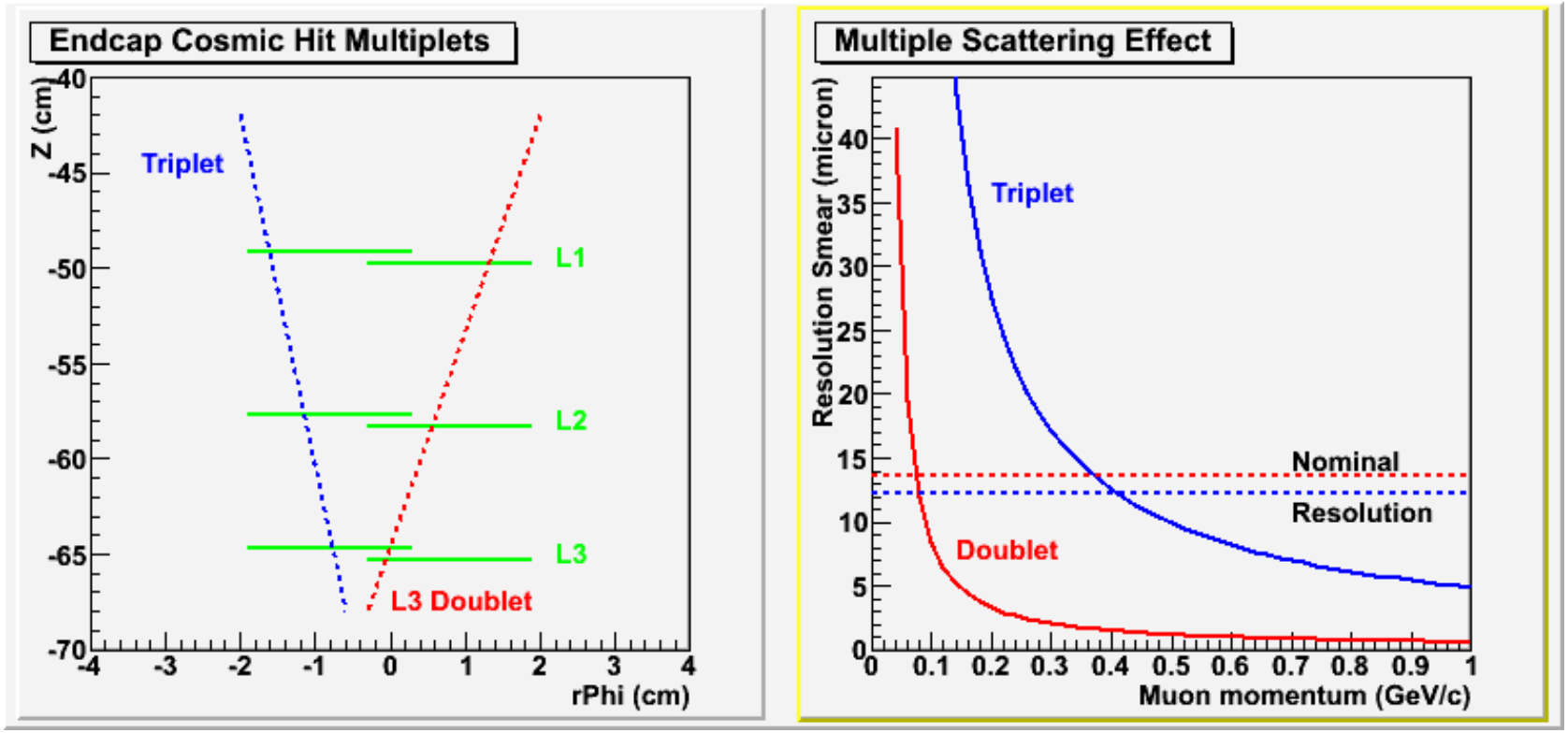
Geometry ϕ Flip Problem (II)



The solution was to flip the ϕ axis of the even (front) modules,

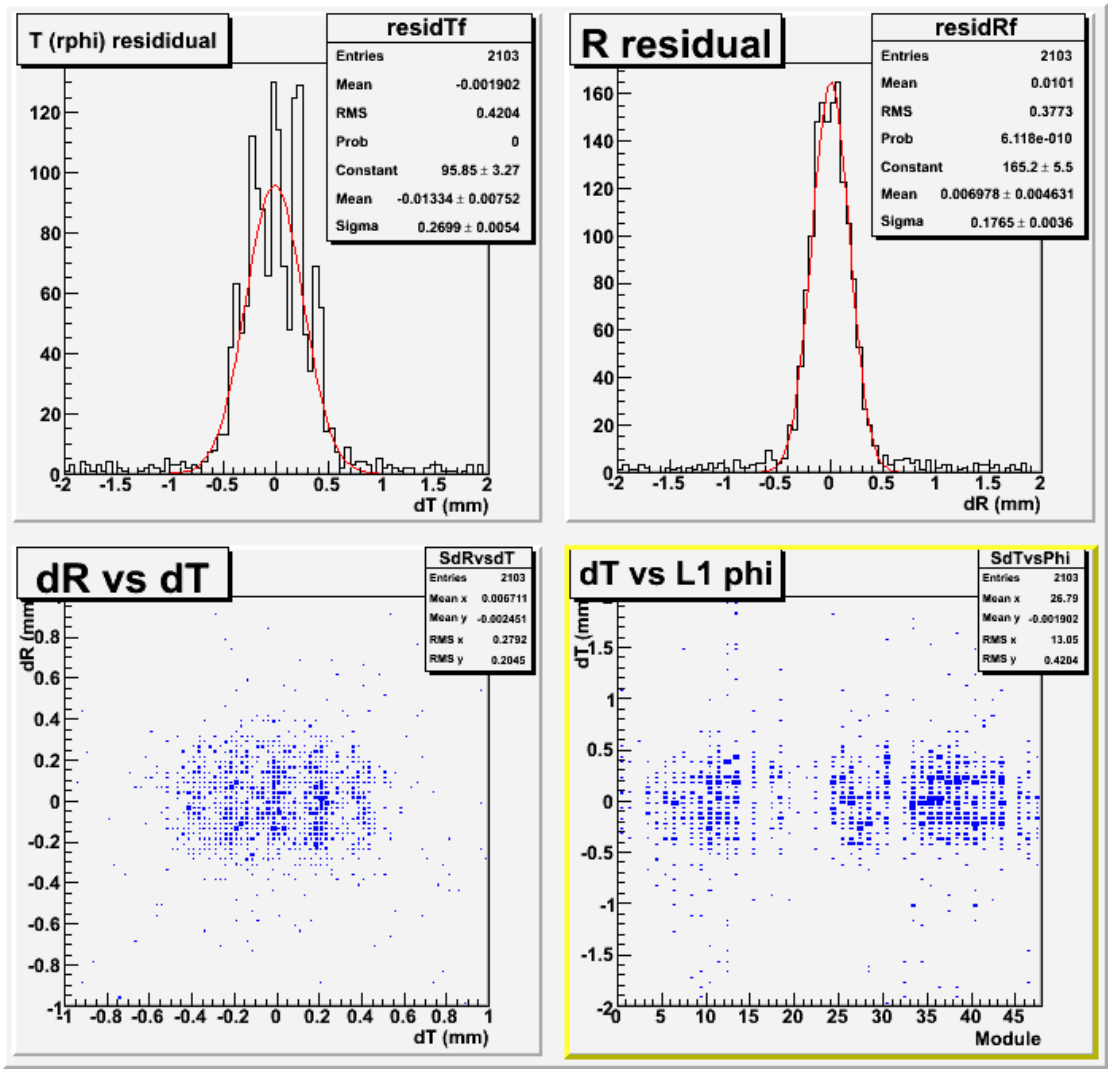
but there was a curious 4 pixel offset in the code which looked a bit strange…

Looking into resolution



Pin a straight line on hits from inner most and outer most hits (L1,L3 in the picture but really L0,L2) and extrapolate line to middle layer to look for residual.
Triplet residual is sqrt(3/2)*single hit resolution. Doublet sqrt(2)*single hit.

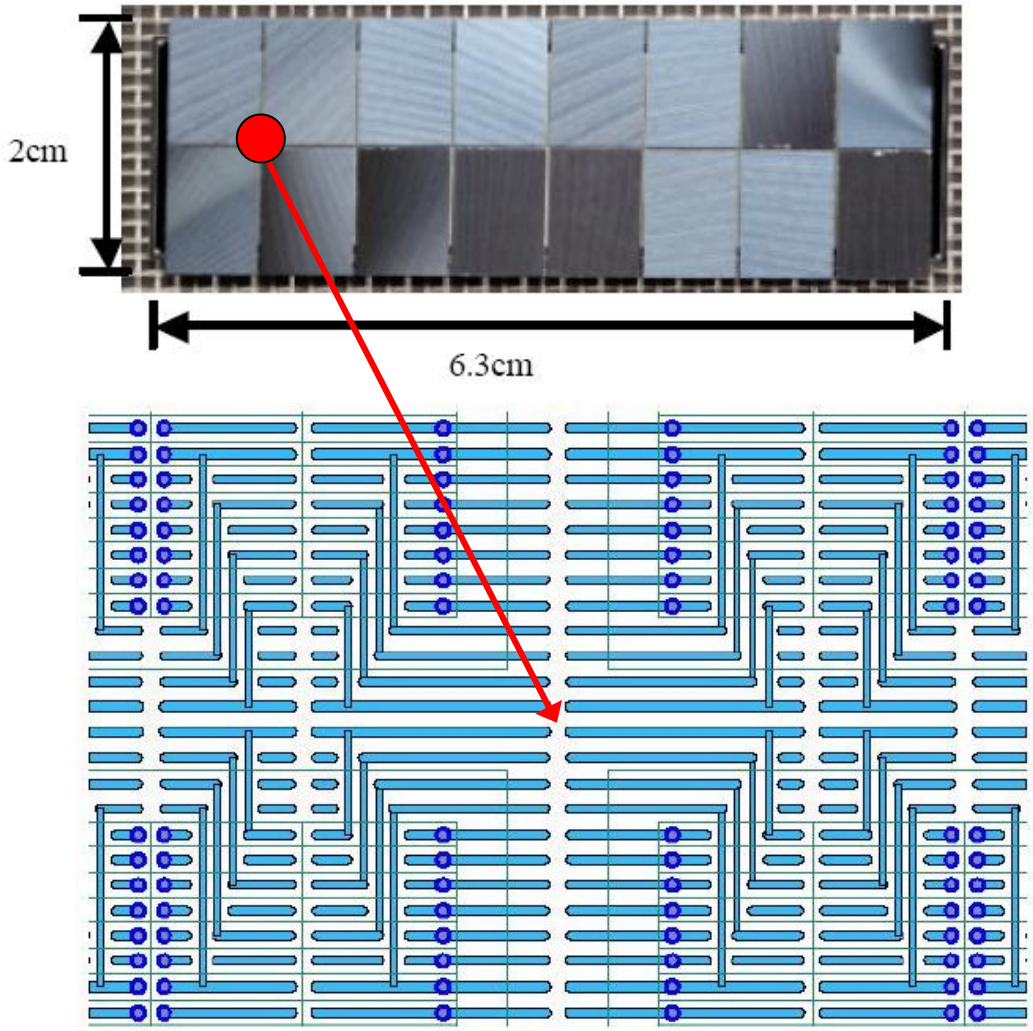
Hit residuals after ϕ flip correction

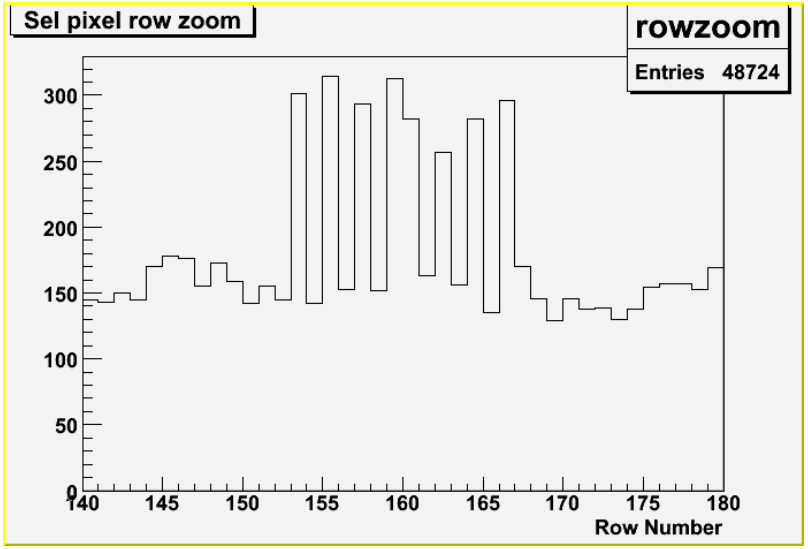


Getting much better and radial resolution of ~180μm already approaching intrinsic resolution, with just the ideal geometry !

Rϕ view still has systematic effects at ~270μm level and here we are supposed to reach ~10μm eventually after alignment.

Ganged Pixels





Readout channels 0-319

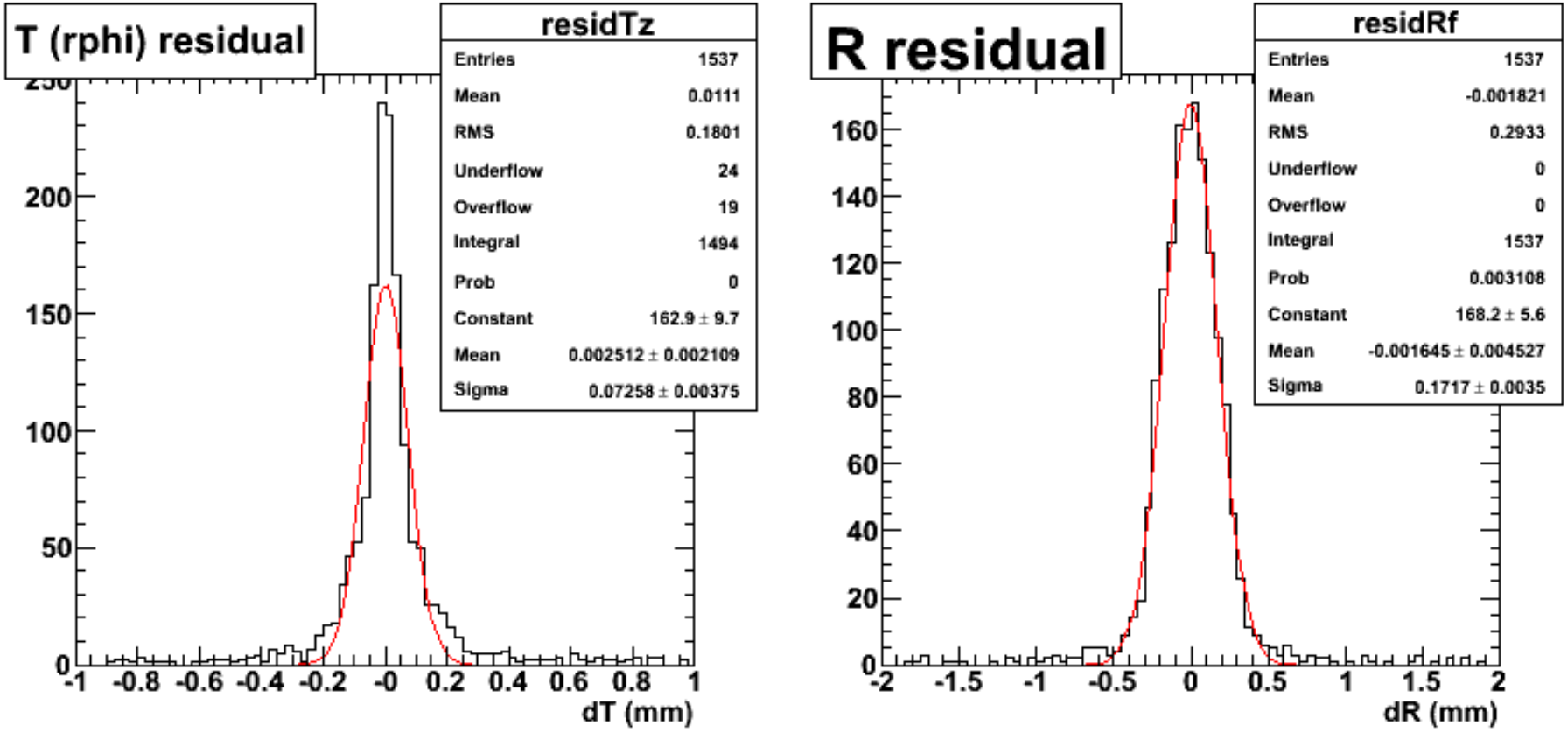
Physical pixels:

0-159, 160-167, 166-327

(ganged pixels)

The recon code was treating readout channels as physical pixels…

Triplet resolution after ganged pixel fix



rϕ residuals down to ~73μm (or better in the core) (still ideal geometry !) and the remaining may be really alignment issues

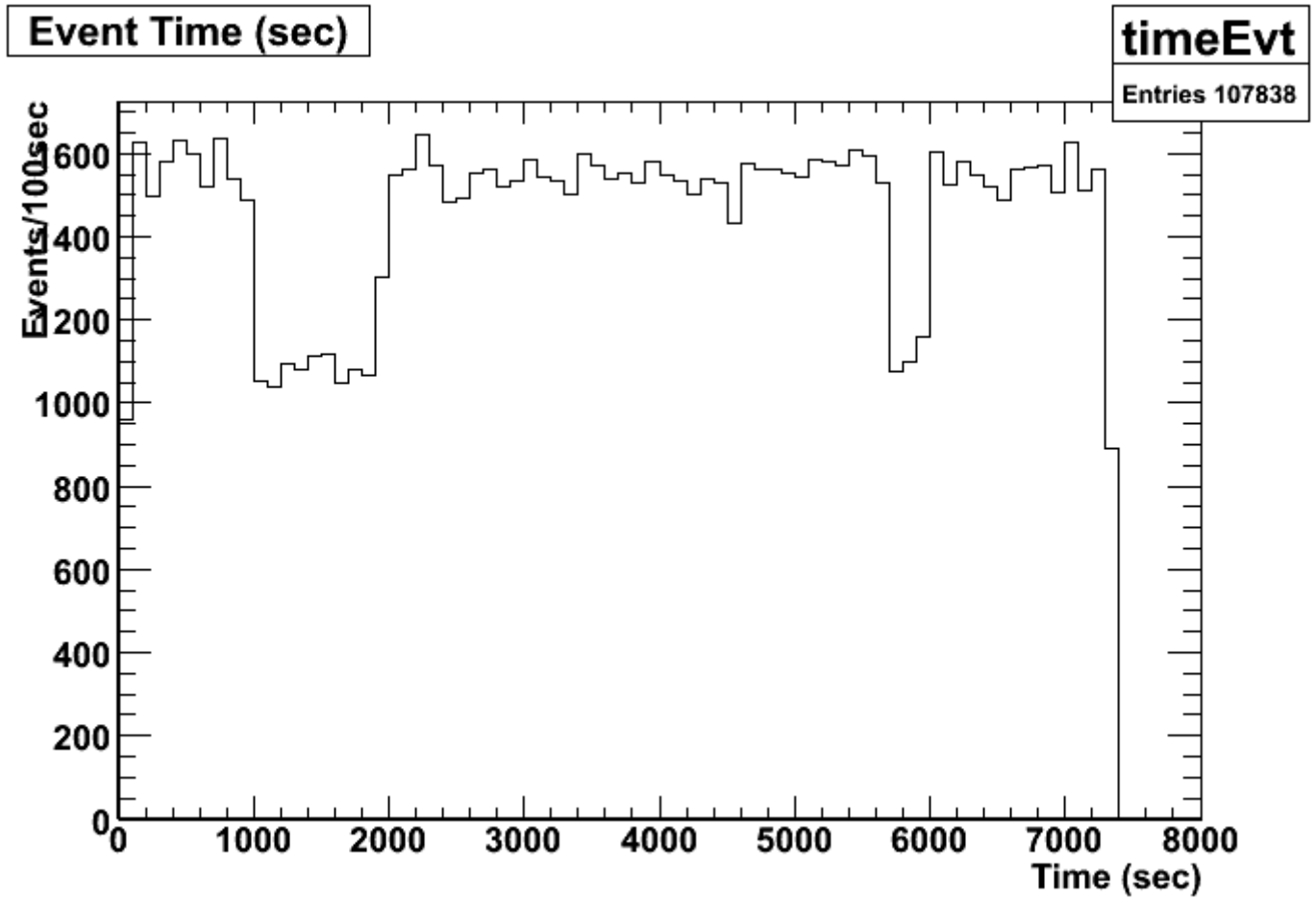
Expected cosmic rates

PDG sea level total (hard:soft=130:50)	180Hz/m^2
SLAC visitor center demo scintillators	140 Hz/m^2
BaBar Drift chamber cosmics	50-75Hz/m^2

BaBar has ~1m of iron on top and 50-75 is between B field on/off. There are quite a bit of uncertainty on the overall rate expectation at ~50% level.

Folding into the scintillator geometry and detector geometry we expect 9.4 Hz scintillator trigger rate (assume 100% scintillator efficiency), and 1.1Hz of rate with 3 pixel layers hit.

Cosmic data taking rate



~15 Hz trigger rate is close to expectation if allowing some noise triggers.

"Tracking" rate

All triggered events	40000
Events with good hits in >=1 layer	10938
Events with good hits in >=2 layer	5149
Events with good hits in >=3 layer	1465
3 layers line up to `track' within 2mm	590

The 'tracking' rate is ~0.22Hz. We still need to look into scintillator trigger efficiency, inactive modules etc to get a more realistic expection for the rate…