Tracking Efficiency Studies for 5- and 8-Layer Microstrip Trackers

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The Idea

- Originally, the point of this study was to explore the differences (if any) between a 5 and an 8 layer central tracking barrel.
- For now we have just been exploring the range of efficient tracking with the new track reconstruction algorithm (N. Sinev)

The Code

- JAS/LCD tracking studies using an updated and modified version of TrackEfficiencyDriver by W. Walkowiak (Snowmass '01).
- VXDBasedReco by N. Sinev used as the tracking code.
  - Reconstructs vertex hits and extrapolates out through the central tracker.
  - Previous studies have shown 99% efficiency with this tracking code.

The Detectors: 5 layers vs. 8

- 5 layer simply the SDJan03 detector.
- 8 layer modeled on the SDJan03, but with 8 layers distributed in the same volume.
- Only the central region is considered in either case.

The Events

- $e^+ e^- \rightarrow$ qqbar (uds only)
- 10,000 events for each detector.
- No beam- or bremsstrahlung.
- 80% electron polarization
- ILC500 configuration

Event Selection

- We focus on events and MC particles that should always be caught by the detector: 2 jet events located in the central region.
  - MC truth jets filtered by thrust axis direction: $|\cos \theta_{thrust}| < 0.5$
  - MC truth thrust magnitude: > 0.94 required.

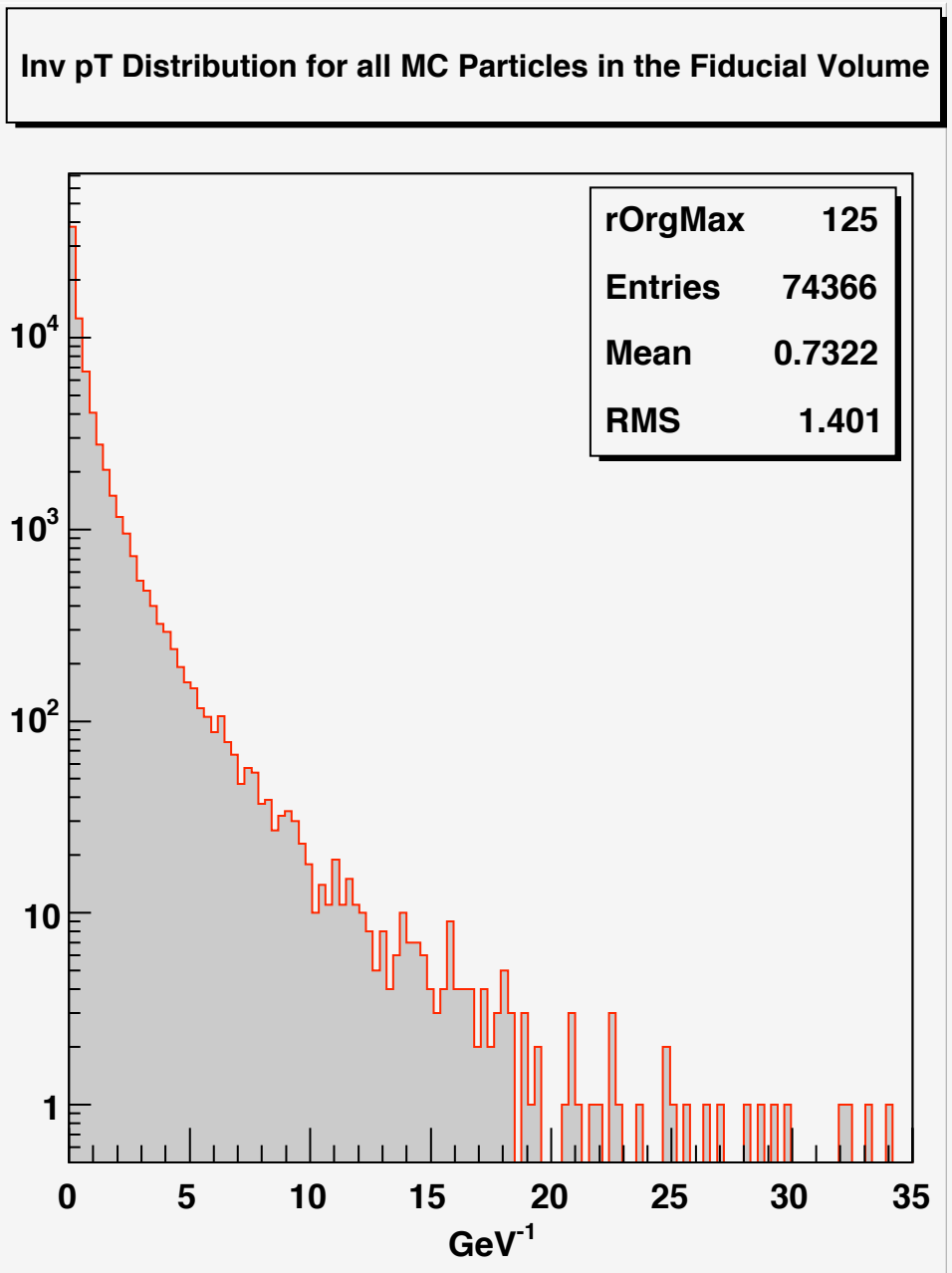
MC Particle Selection

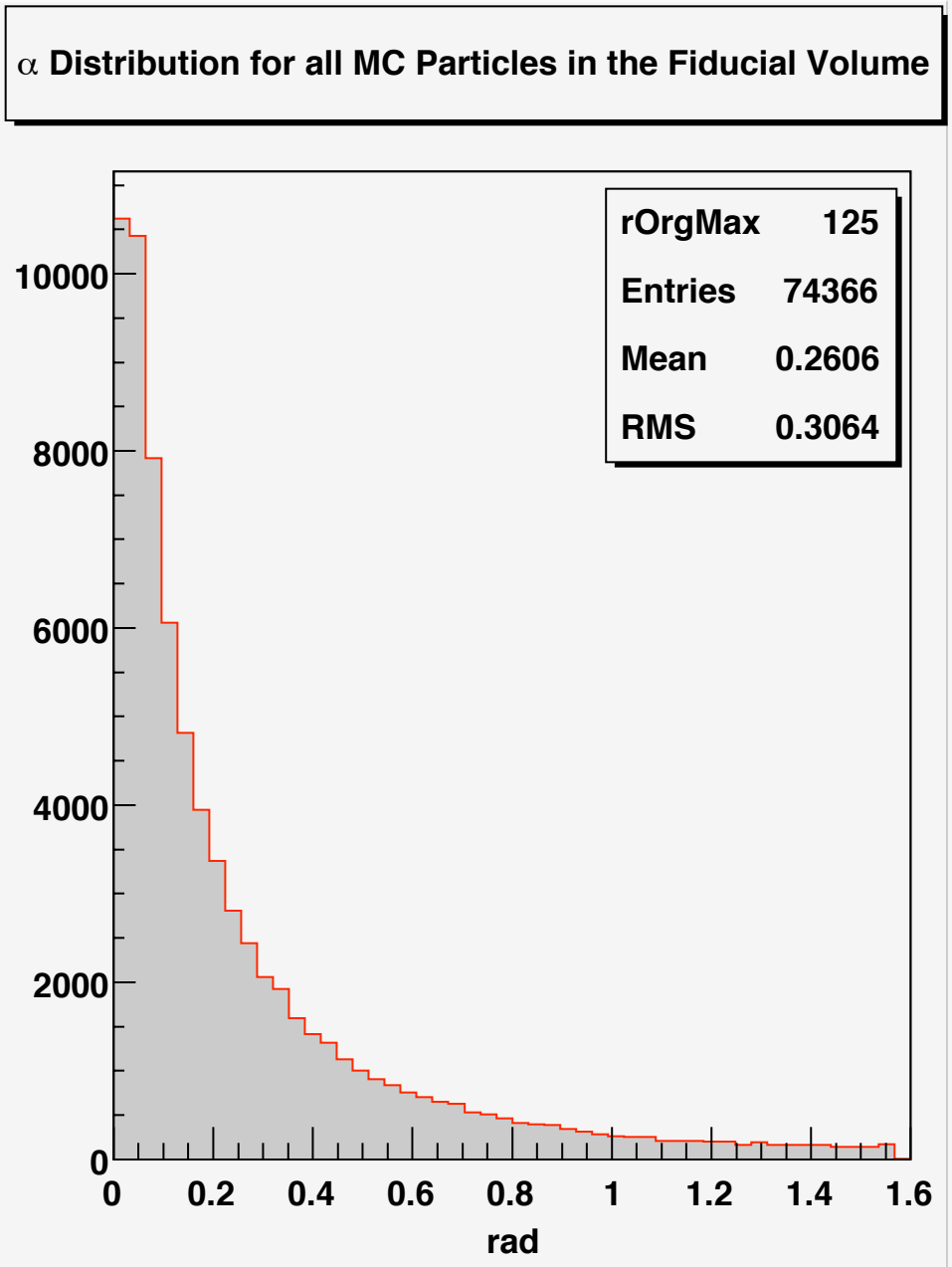
Based on MC truth information

- Radial origin min = 0 cm, max = 1 cm
- Z-origin min = 0 cm, max = 167 cm
- Radial endpoint min = 3.6 cm, max = ∞
- Central region only: $|\cos\theta| < 0.5$
- Transverse momentum: $pT \geq 5$ GeV

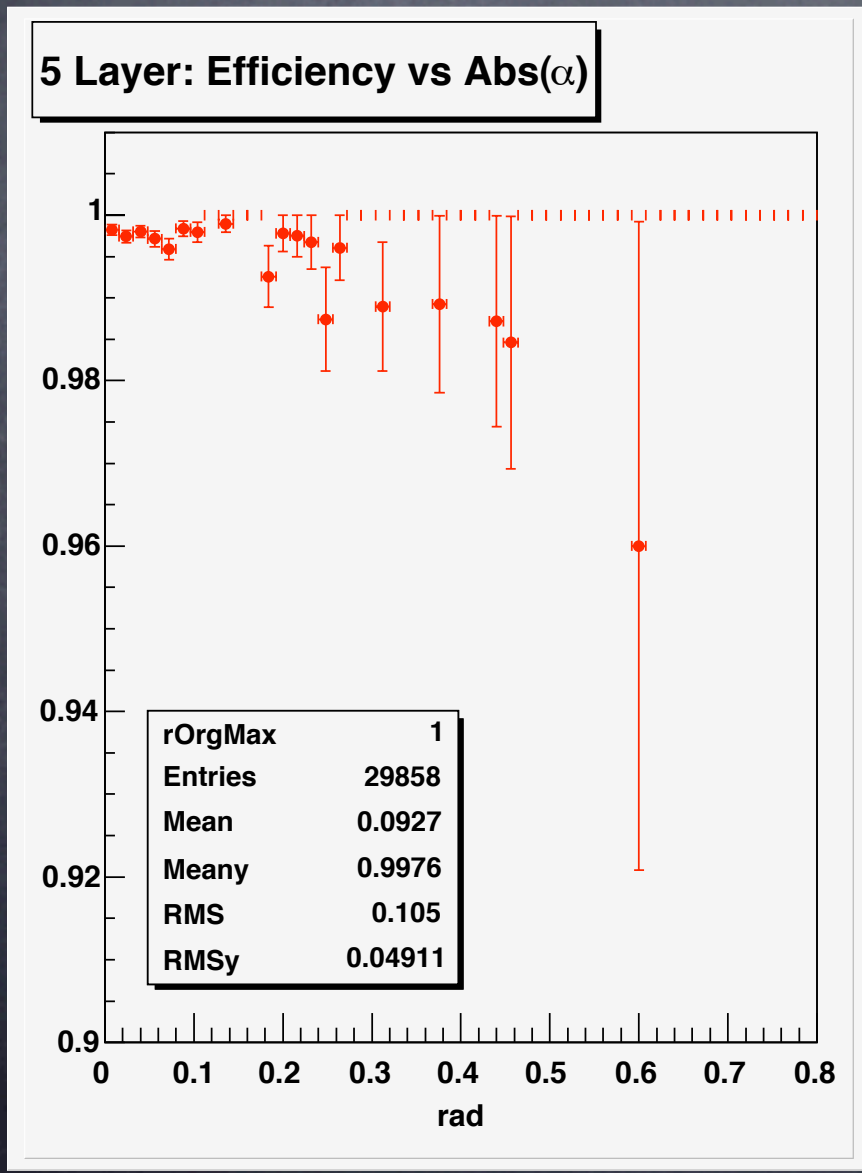
On to the results!

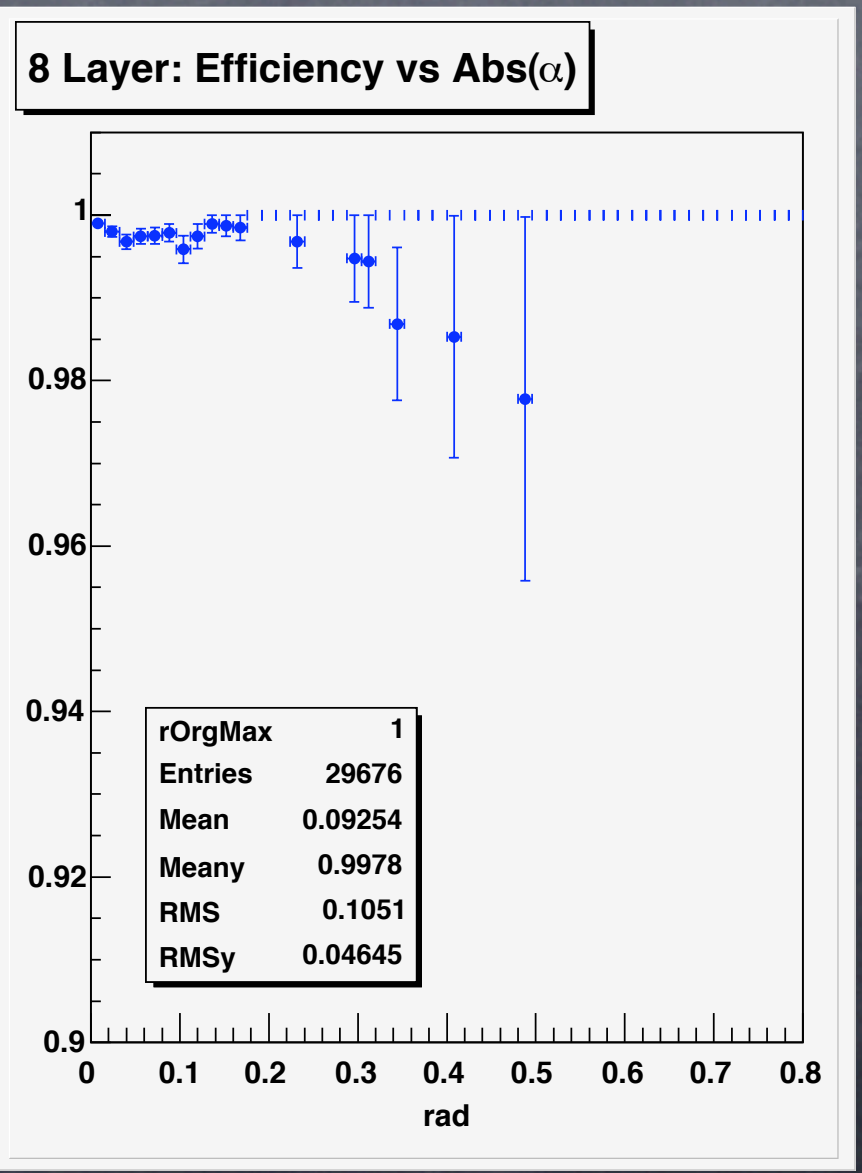
The Distributions





How do we do near the Jet Core?

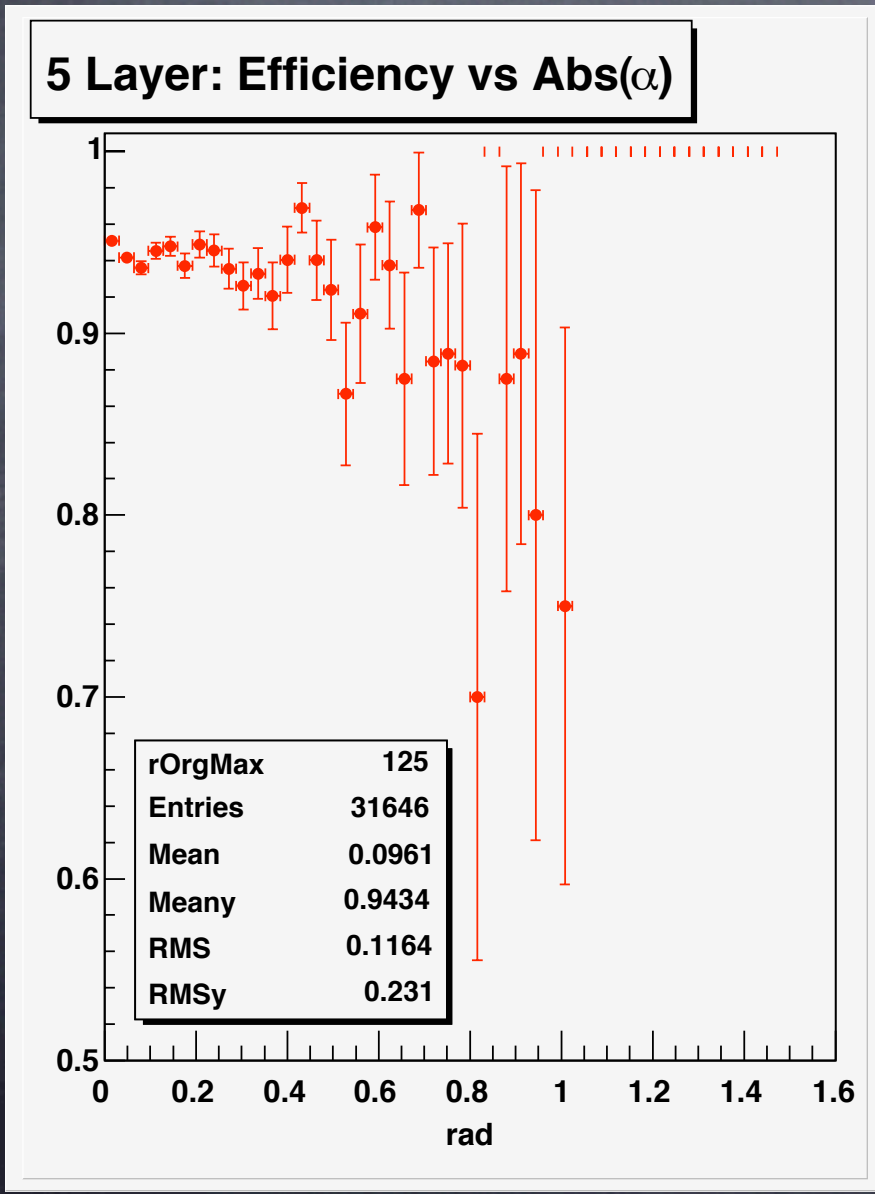


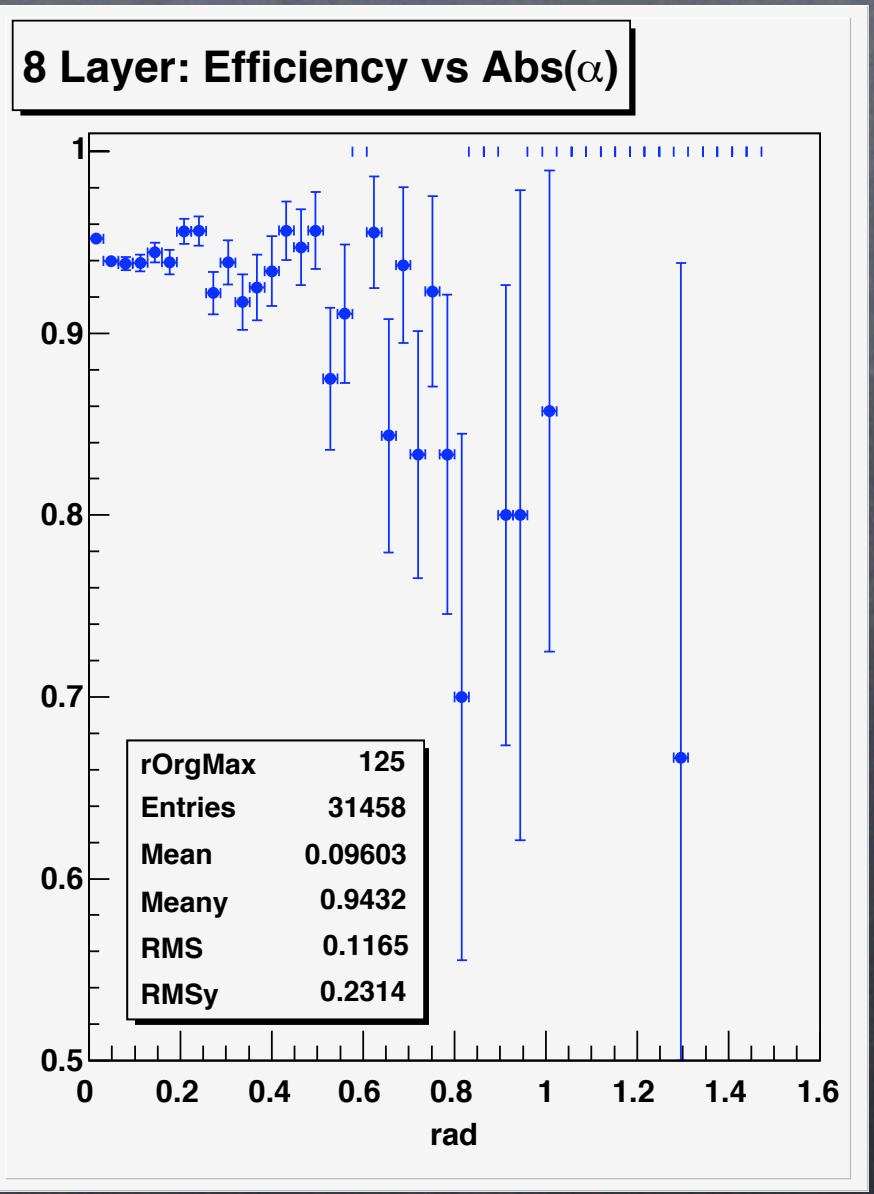


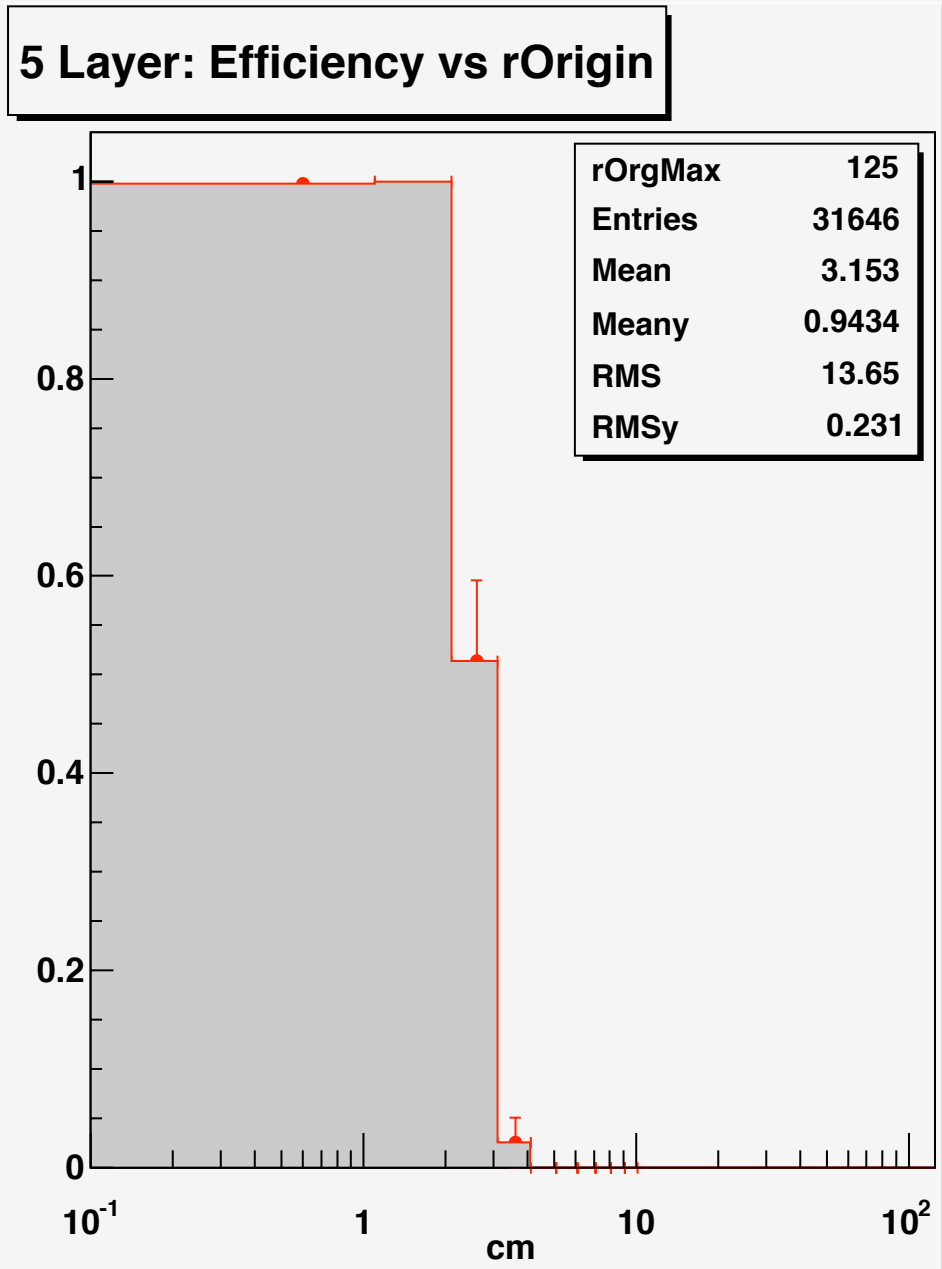
Relaxing some cuts

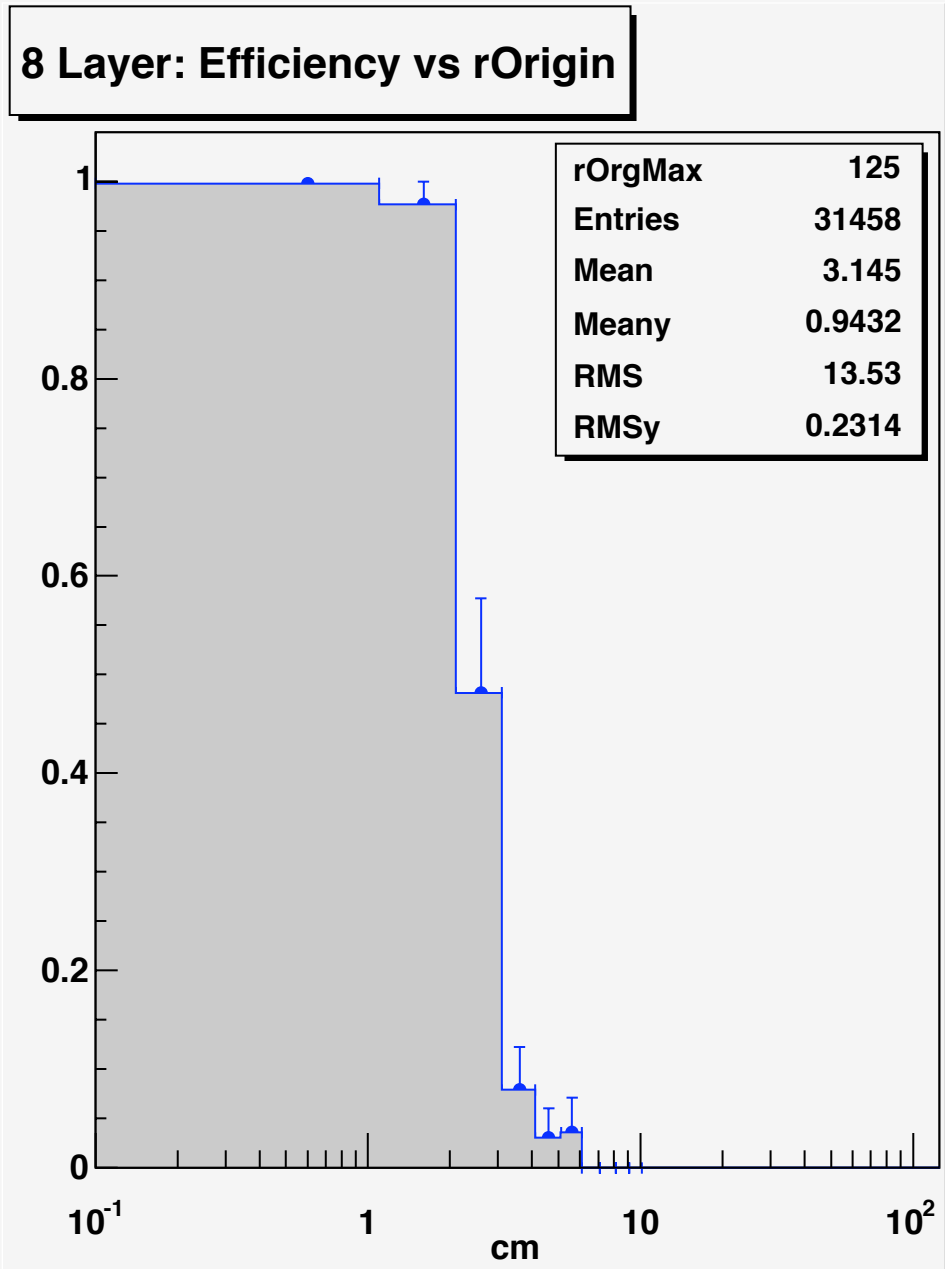
- We now ask how well the model tracker performs under less stringent conditions:
  - pT min = 5 GeV with rOrgMax = 125 cm (edge of outer layer)
  - pT min = 0 GeV with rOrgMax = 1 cm

How do we do at large radial origin?

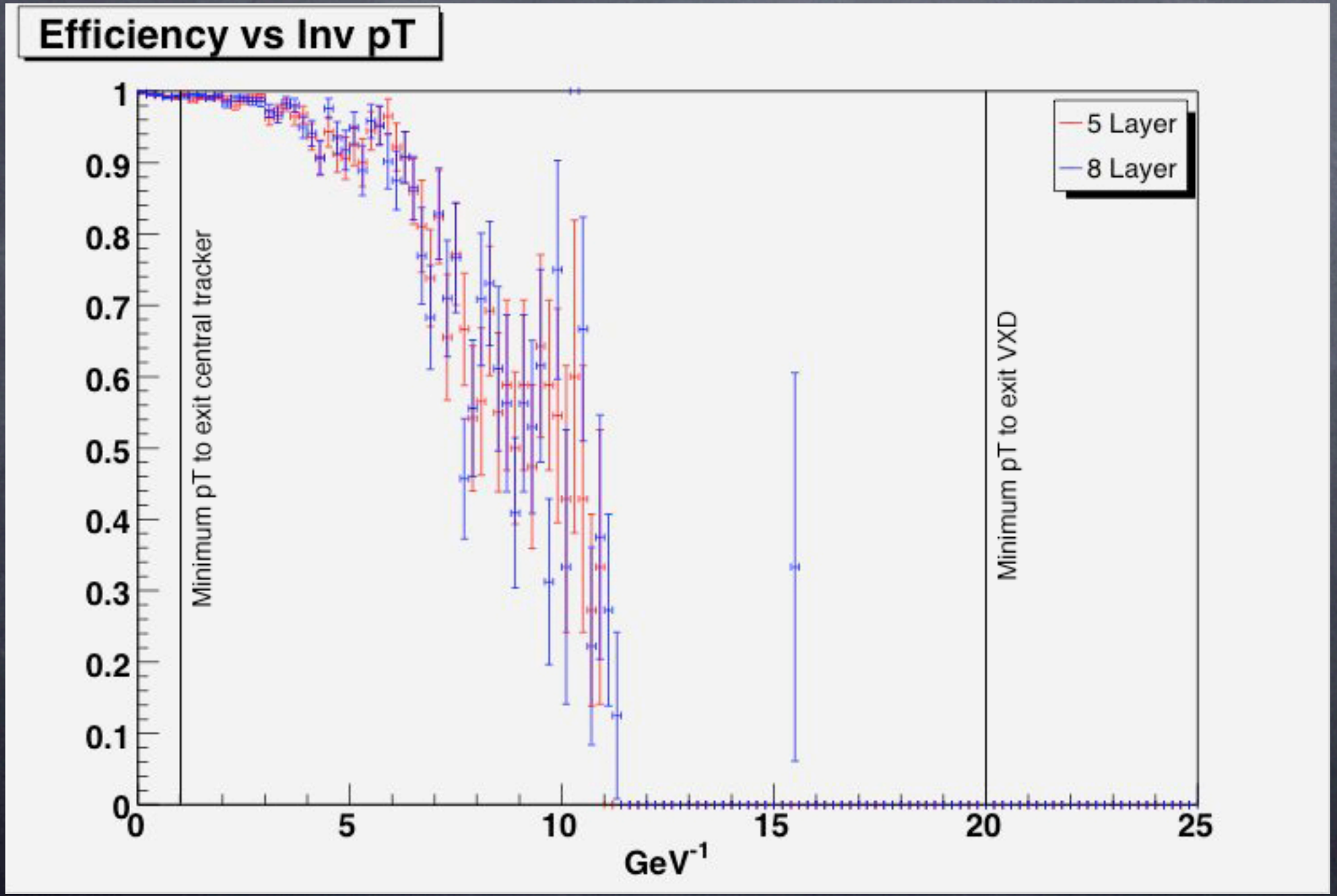




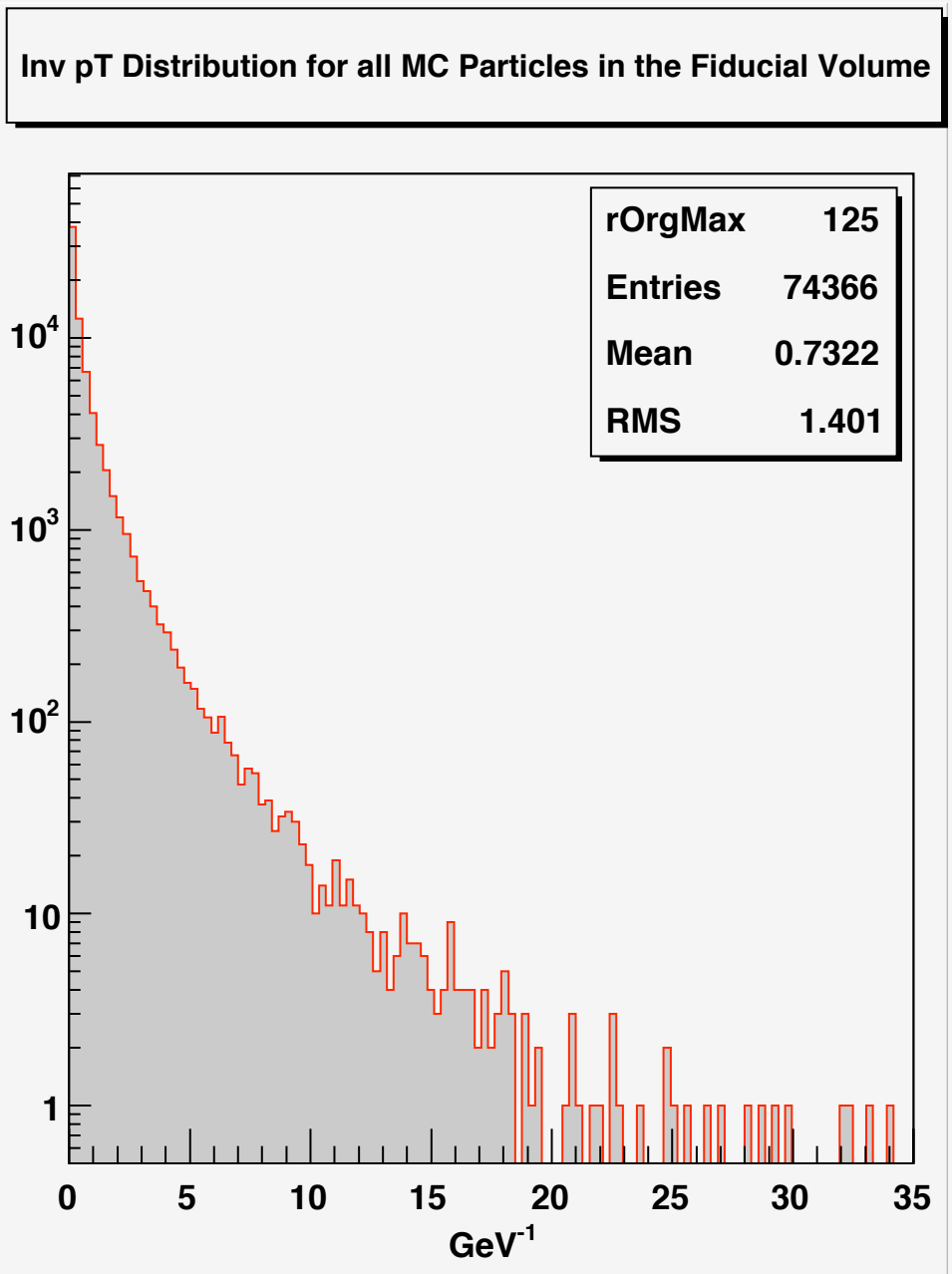

5 Layer: Efficiency vs rOrigin
rOrgMax 125
Entries 31646
Mean 3.153
Meany 0.9434
RMS 13.65
RMSy 0.231
1
0.8
0.6
0.4
0.2
0
10^{-1}
1
10
10^{2}
cm

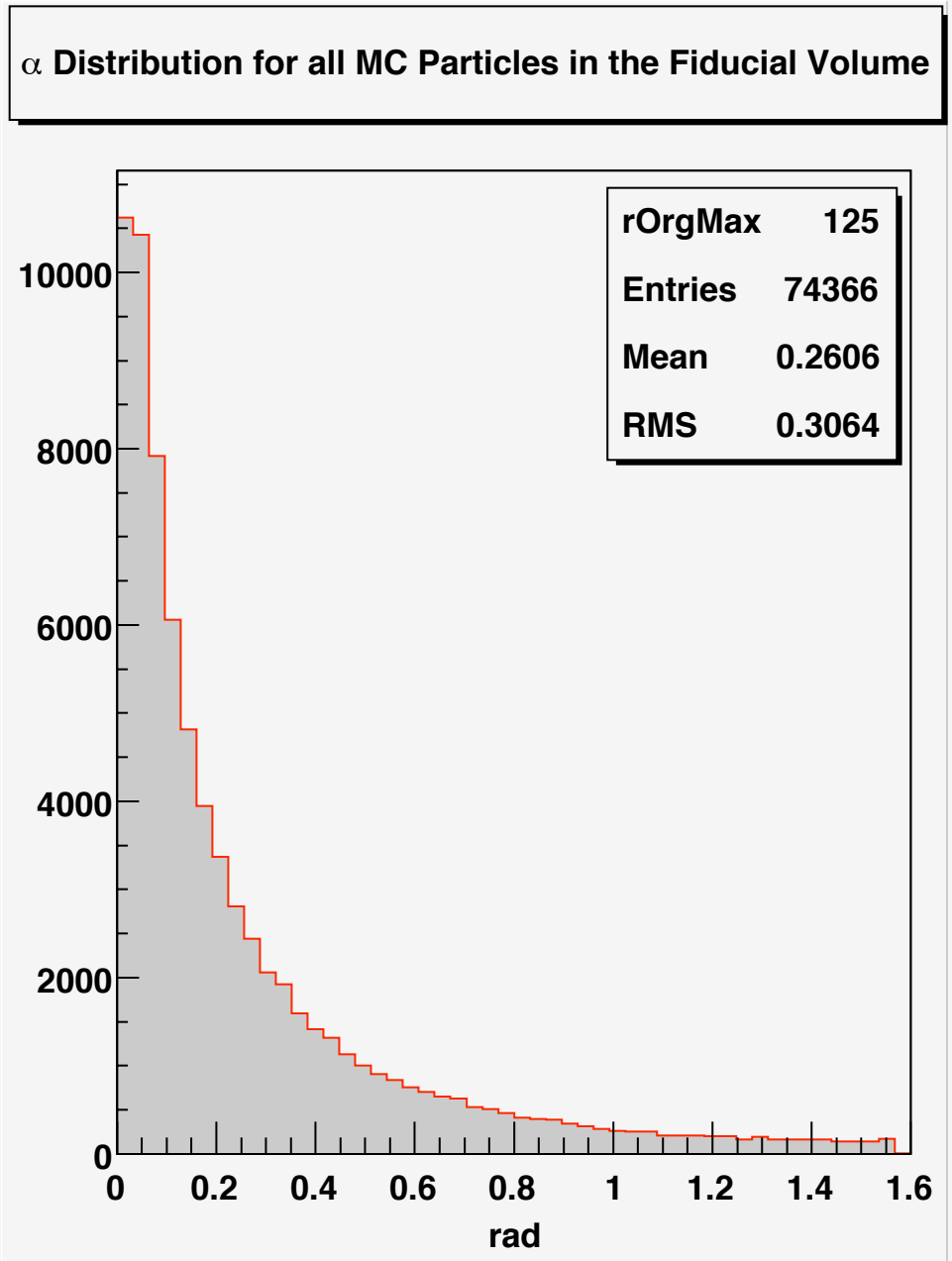

8 Layer: Efficiency vs rOrigin
rOrgMax 125
Entries 31458
Mean 3.145
Meany 0.9432
RMS 13.53
RMSy 0.2314
1
0.8
0.6
0.4
0.2
0
10^{-1}
1
10
10^{2}
cm

How do we do at low pT?



The Distributions (again)





Conclusions

- So in retrospect, it seems a bit obvious that VXDBasedReco will give very similar results for the 5 and the 8 since it requires a seed track from the vertex layers.
- High efficiency maintained in jet cores.
- Efficiency seems to fall off rapidly with decreasing pT...

- VXDBasedReco might really shine in tandem with a second tracking routine working in the central tracker and extrapolating inward. (Should UCSC take this on?)

- Without such a tracker (or further changes to Nick's code), we'll not see differences between the 5 & 8 layer central tracker geometries.