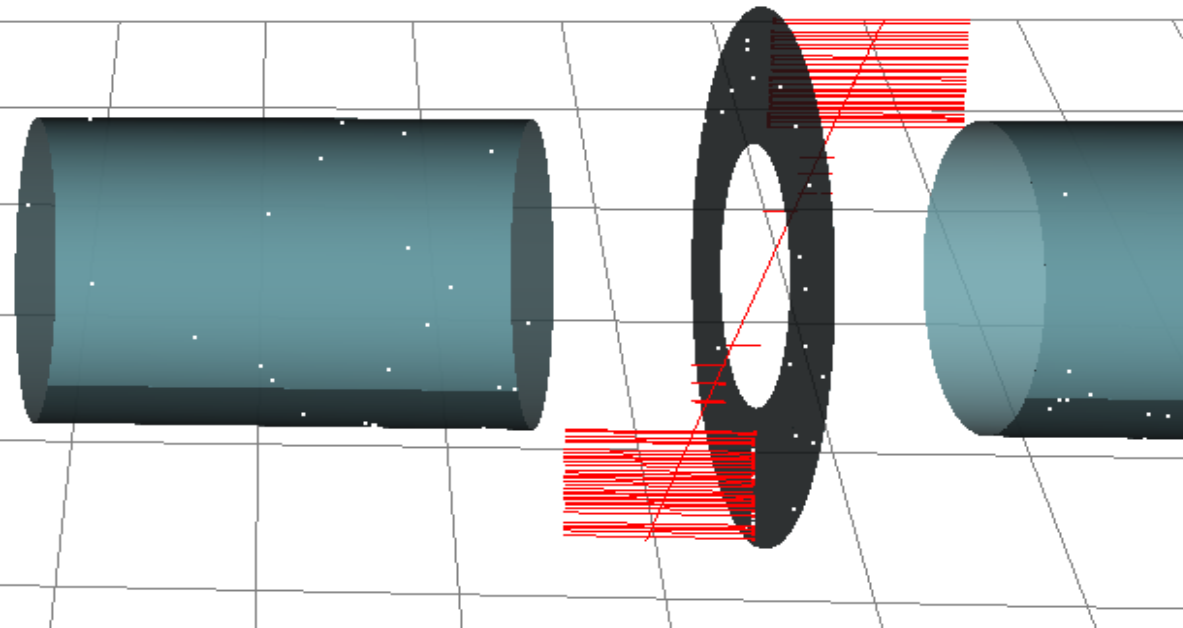


TRT Alignment with Cosmics

John Alison
Andrea Bocci

Outline:

- L1 Results
- Outstanding Issues with L1
- Toward a L2 alignment



L1 TRT Alignment

What was done:

- TRT Barrel Aligned wrt Si in 5 DoF
- TRT Endcaps Aligned in 6 DoF
- Saw convergence, increase in hits / tracks with iteration.
- Monitoring plots validated alignment -> put in database

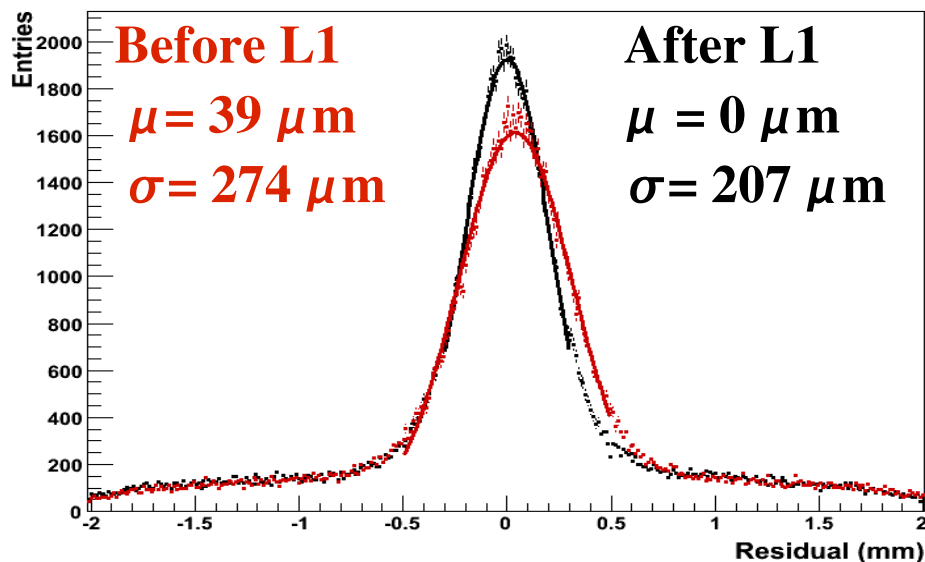
What we learned:

- Independent of B-field
- Independent of run number, number hits/tracks
- Independent of TRT calibration
- Depends on Si internal alignment

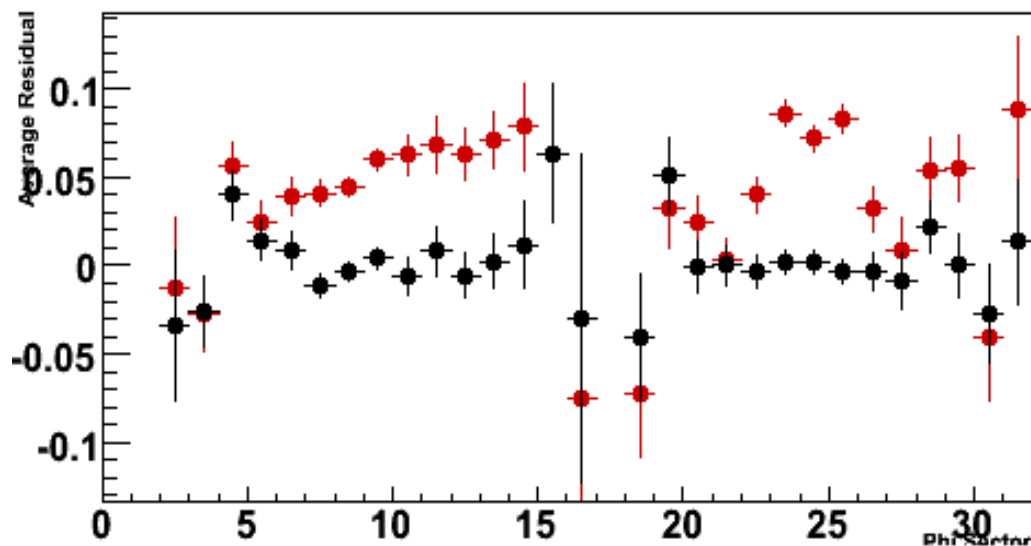


L1 Alignment Results

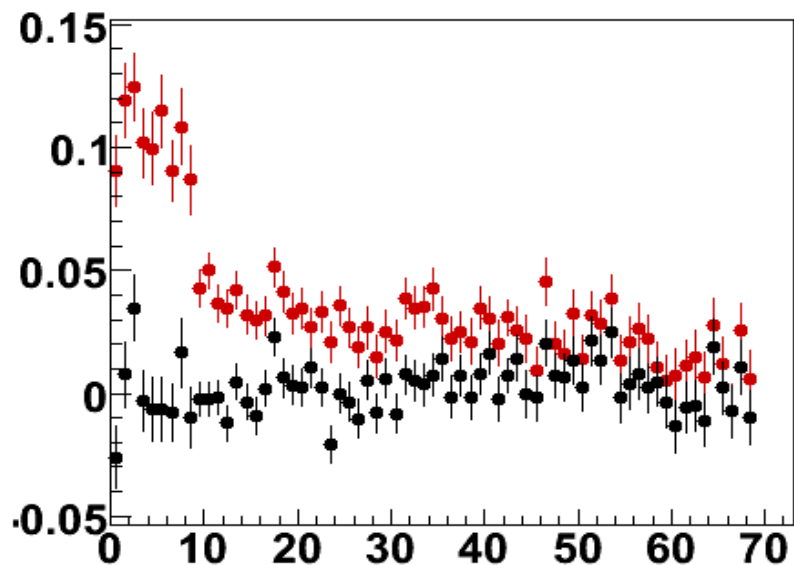
UnBiased Residual for the TRT Barrel



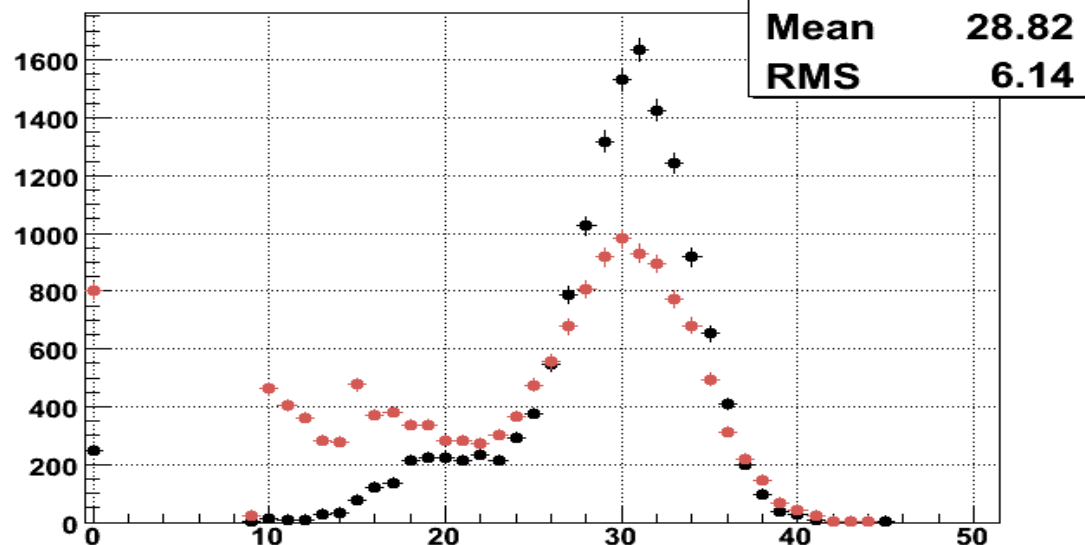
Average Residual vs Phi Sector for TRT Barrel Layer0



Average Residual (Integrated over Phi) Vs Straw Layer



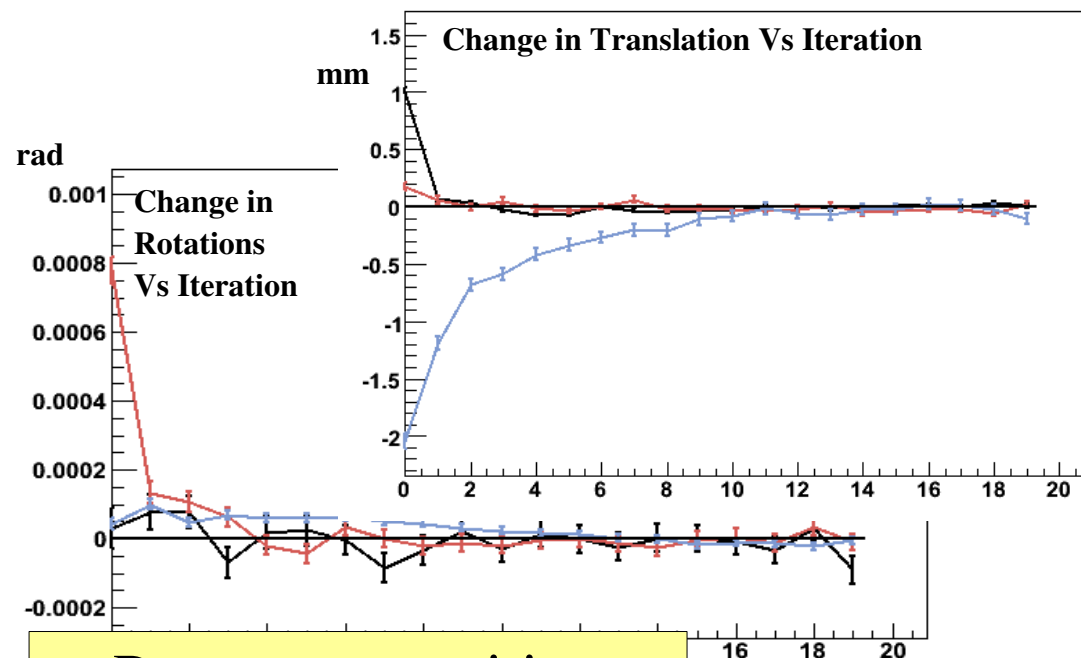
Number of trthits per track (Barrel)



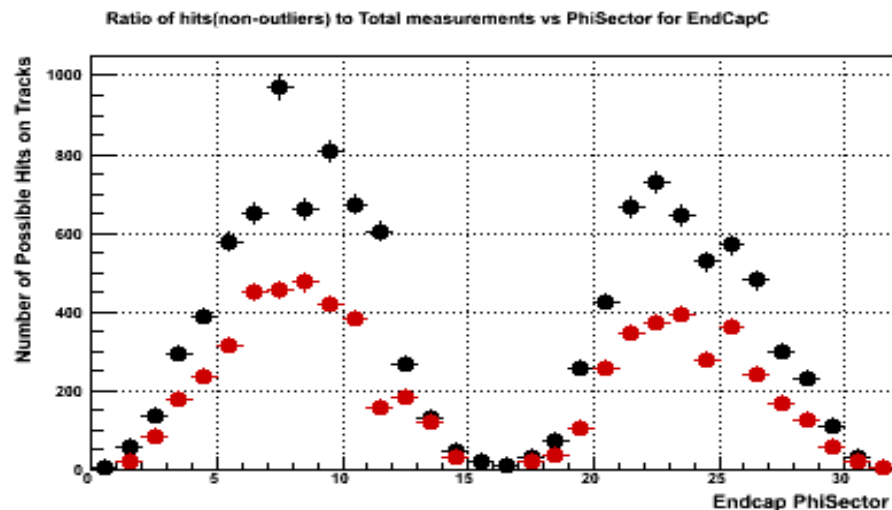
a word about endcaps.



Convergence

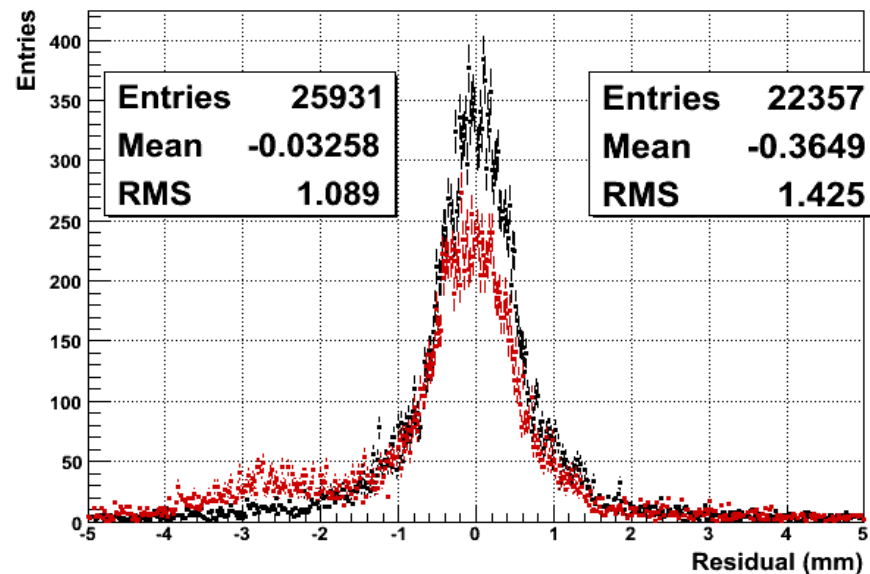


Pattern recognition

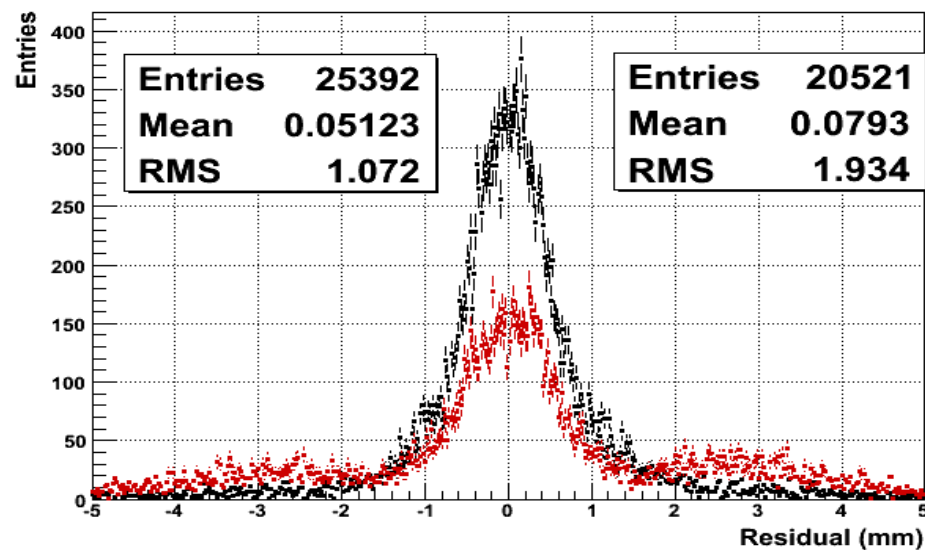


Residual improvement

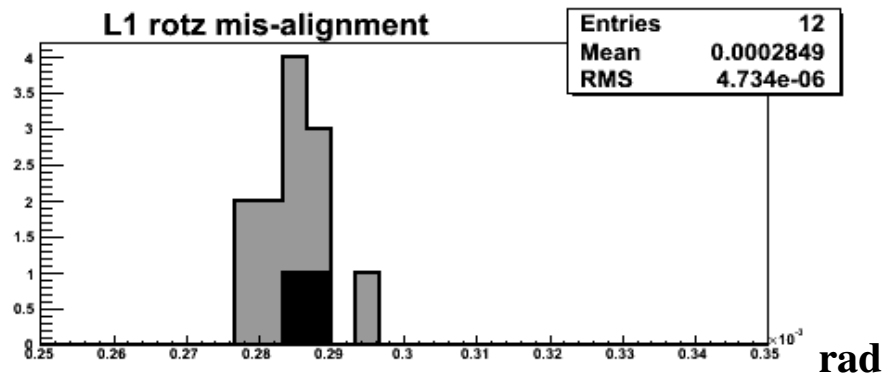
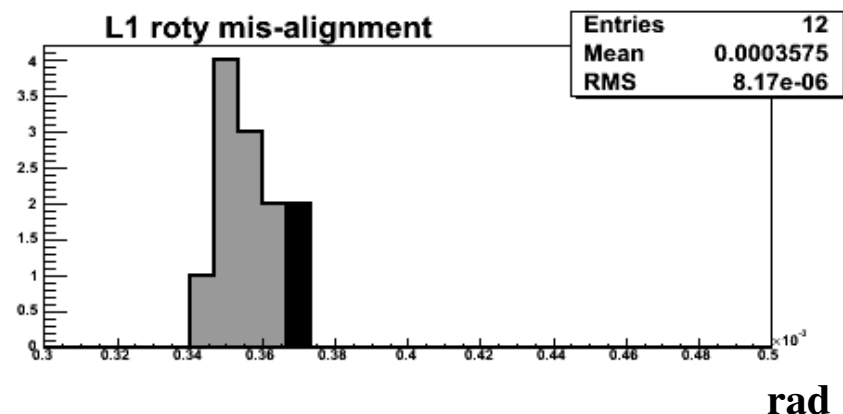
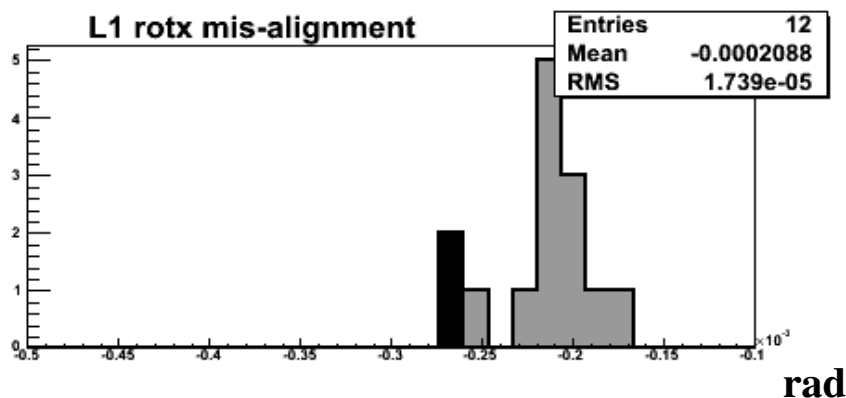
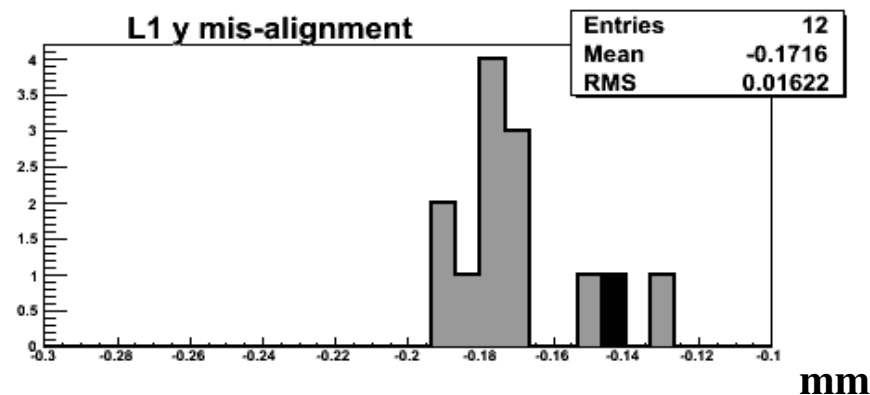
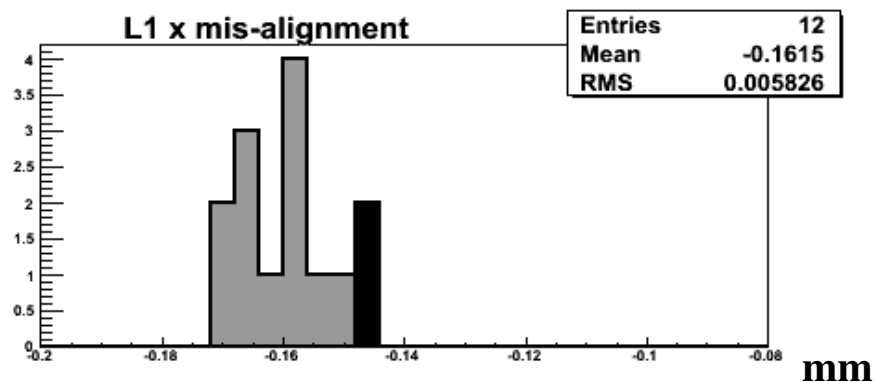
UnBiased Residual for TRT EndCapA



UnBiased Residual for TRT EndCapC



TRT L1 Alignment Results



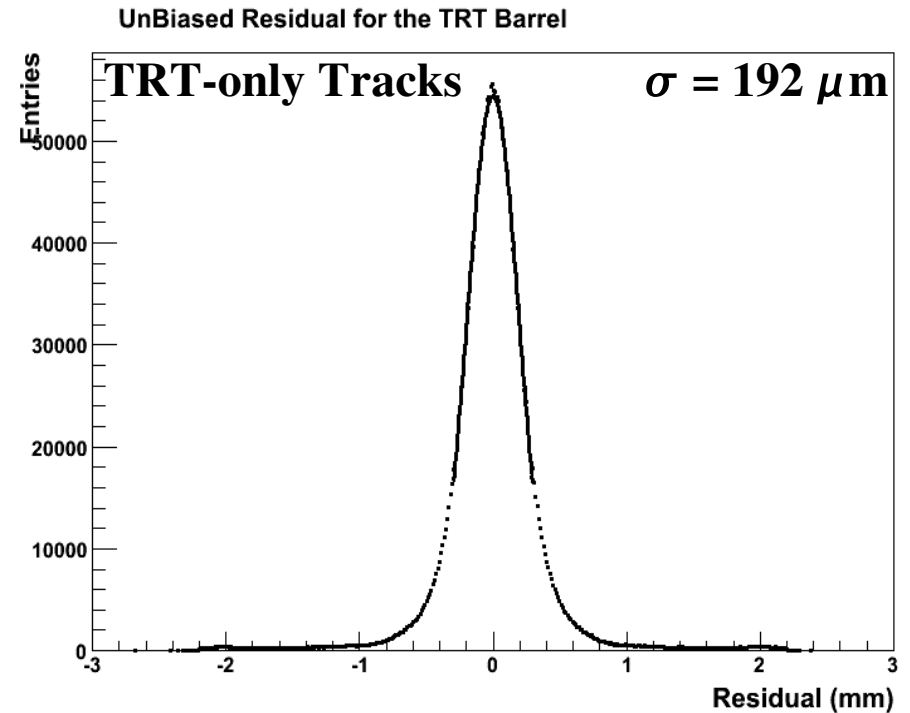
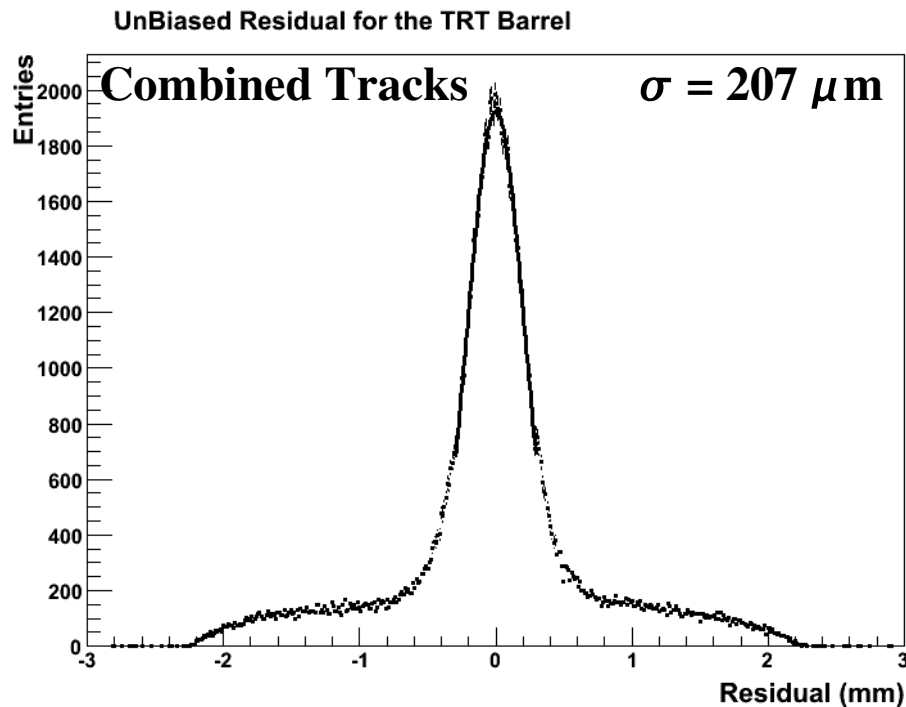
Field On
Field Off



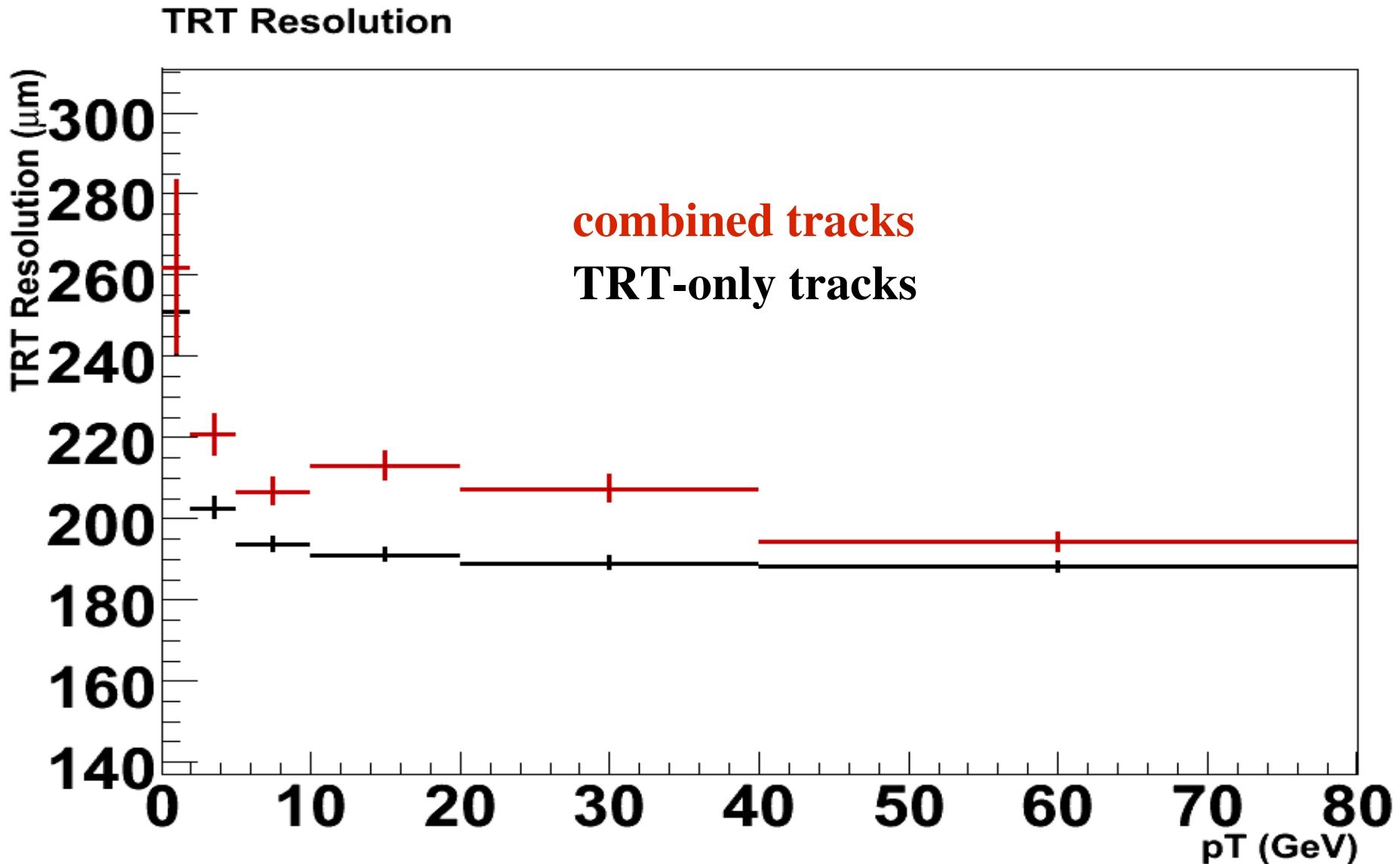
Potential Problems with L1

Combined Track Resolution

- Combined Tracks have worse resolution than TRT-only tracks
- TRT-only tracks : > 45 TRT hits, $D0 < 100\text{mm}$, $pT > 2\text{ GeV}$
- Combined Tracks: above + > 9 SCT hits, > 2 Pixel hits

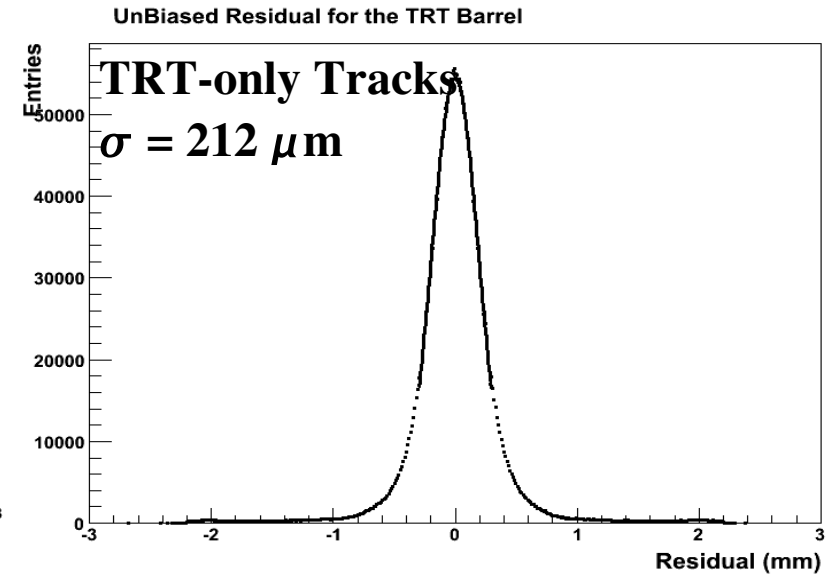
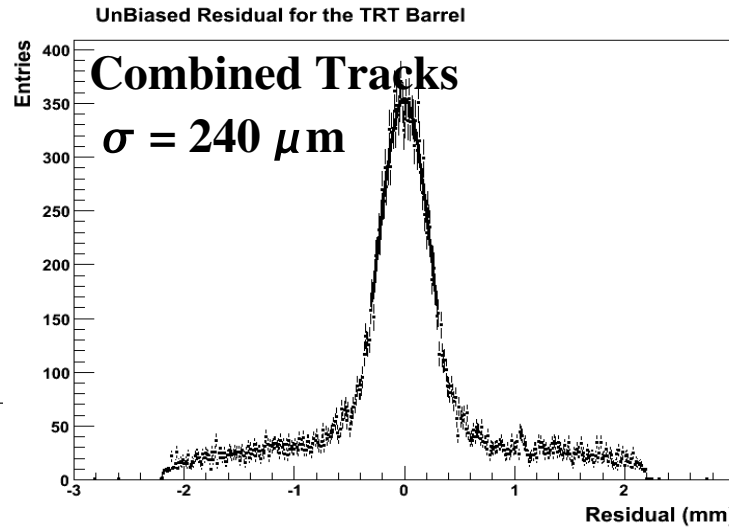
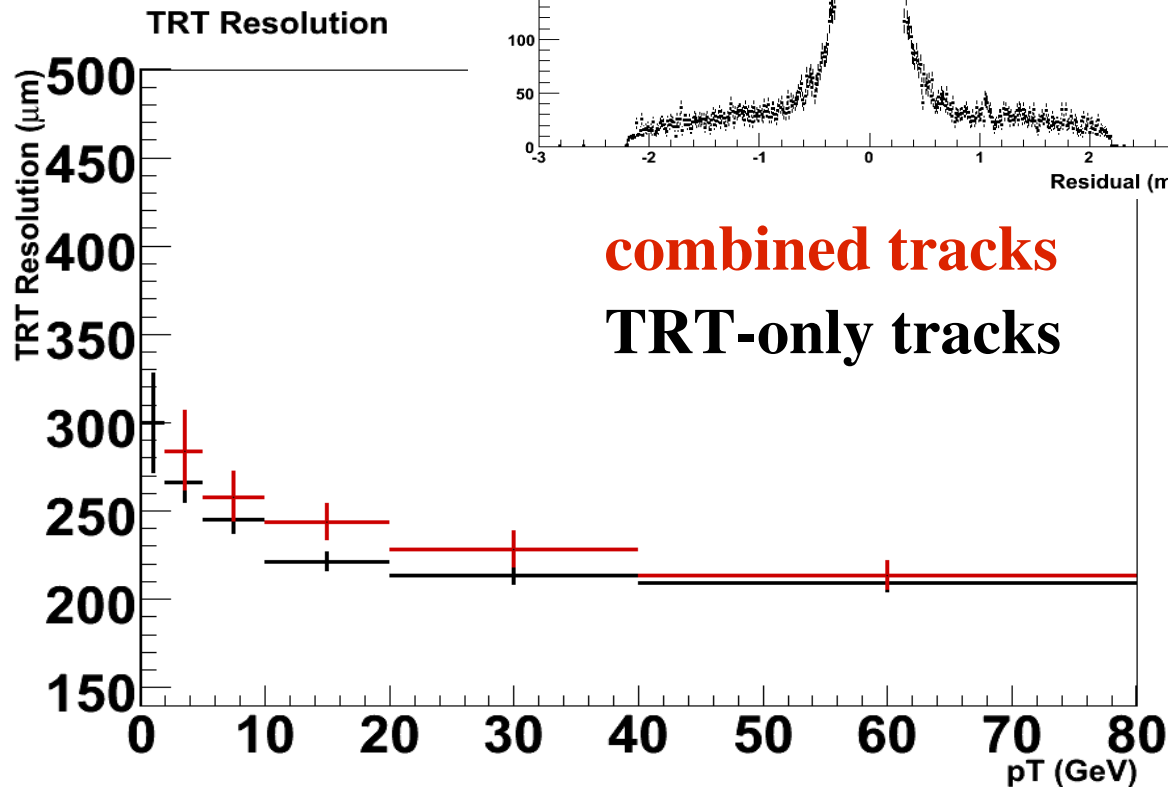


Combined Track Resolution



Combined Track Resolution

In cosmic MC:
(from rel14)

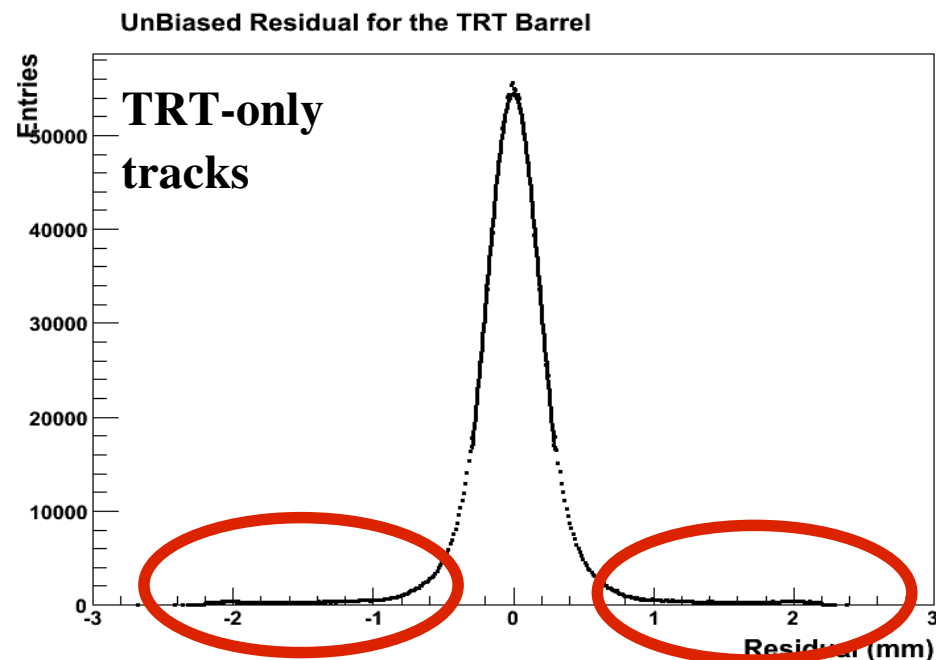
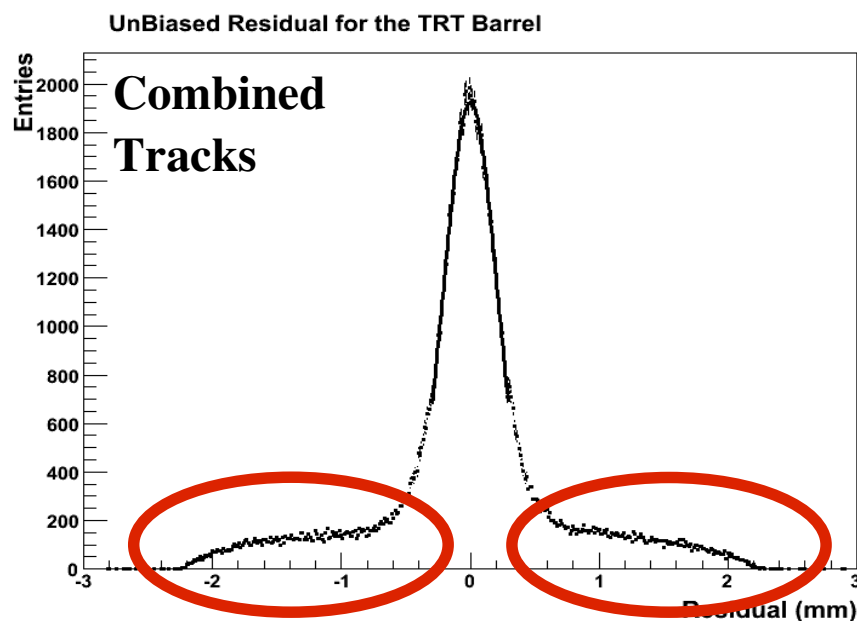


Disclaimer:

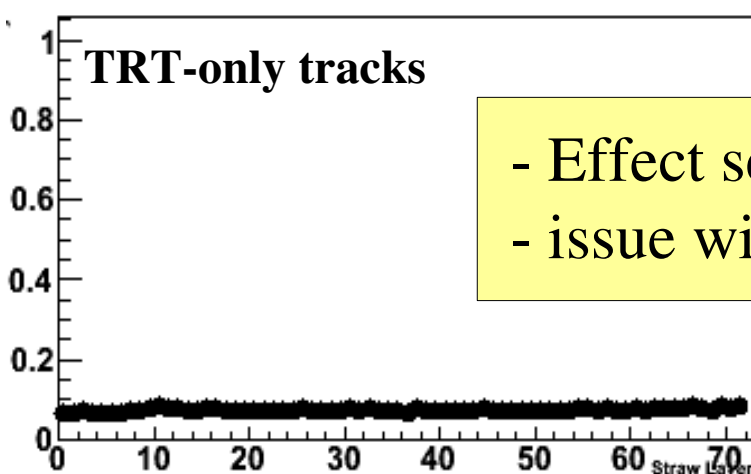
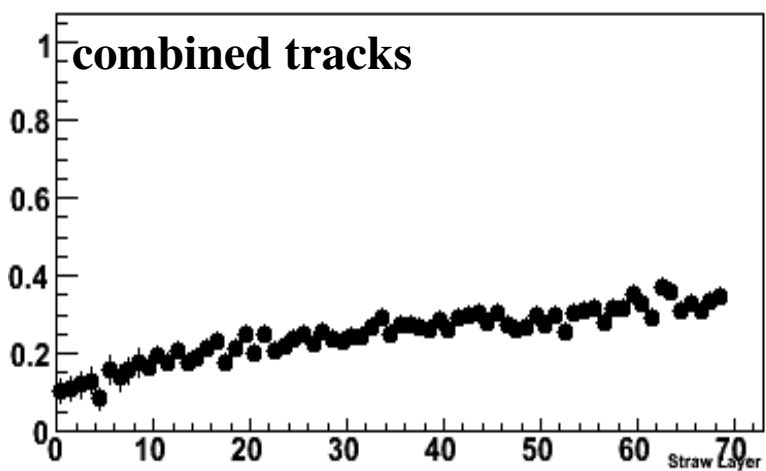
- known problems with cosmic MC (eg: resolution is better in data)
- TRT calibration leading suspect

Resolution difference:
general feature
calibration problem in data?

a related issue

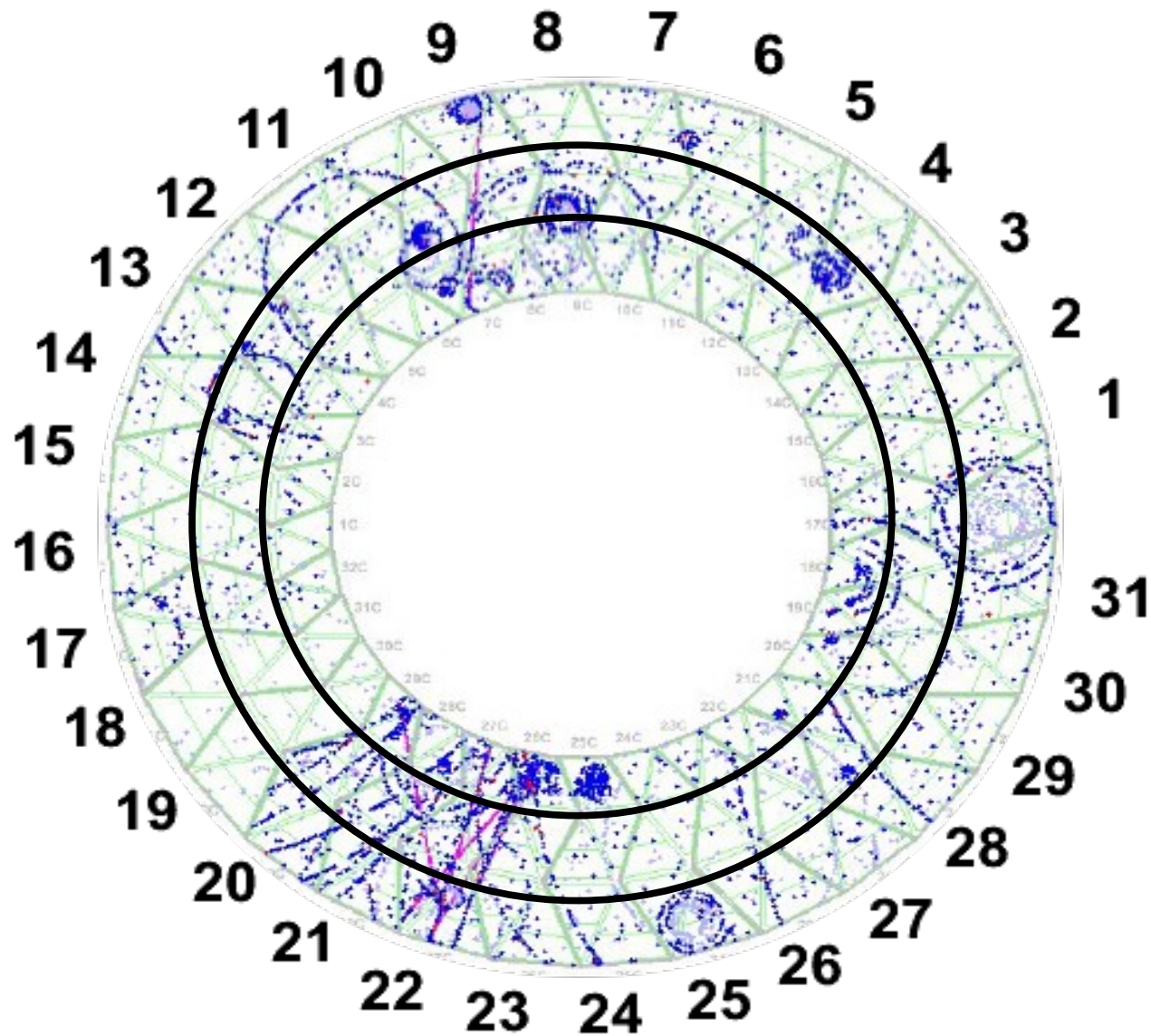


Fraction of “tube hits” Vs radius



- Effect seen in data and MC
- issue with outlier logic ?

TRT L2 Alignment



TRT Phi Residual Structure.

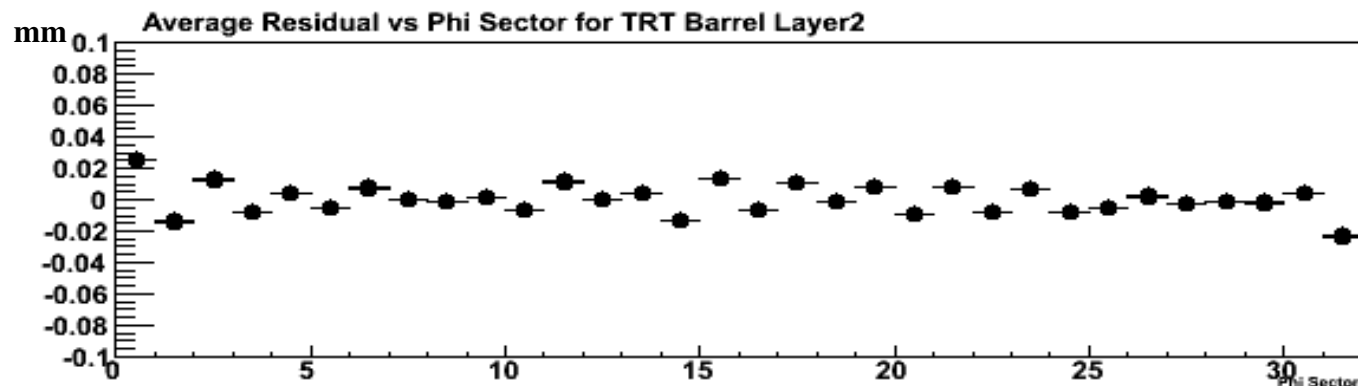
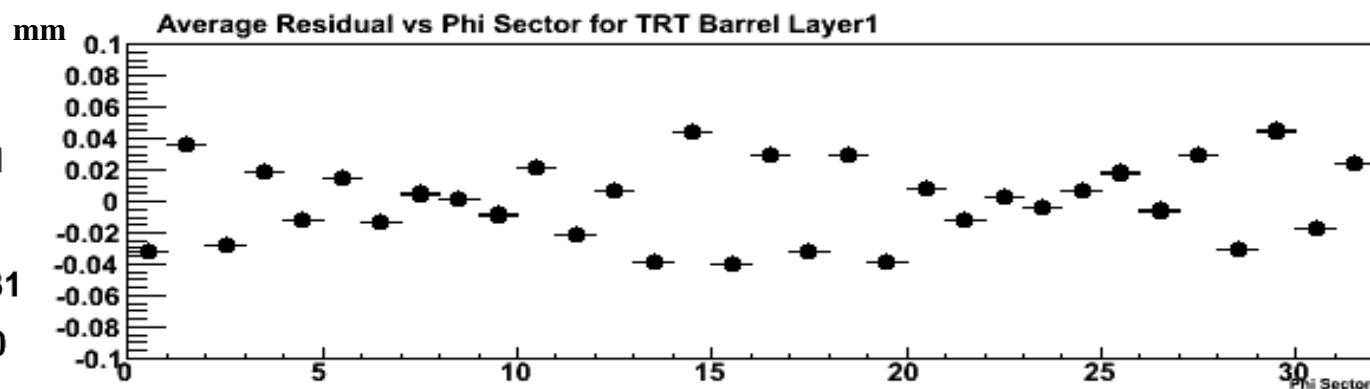
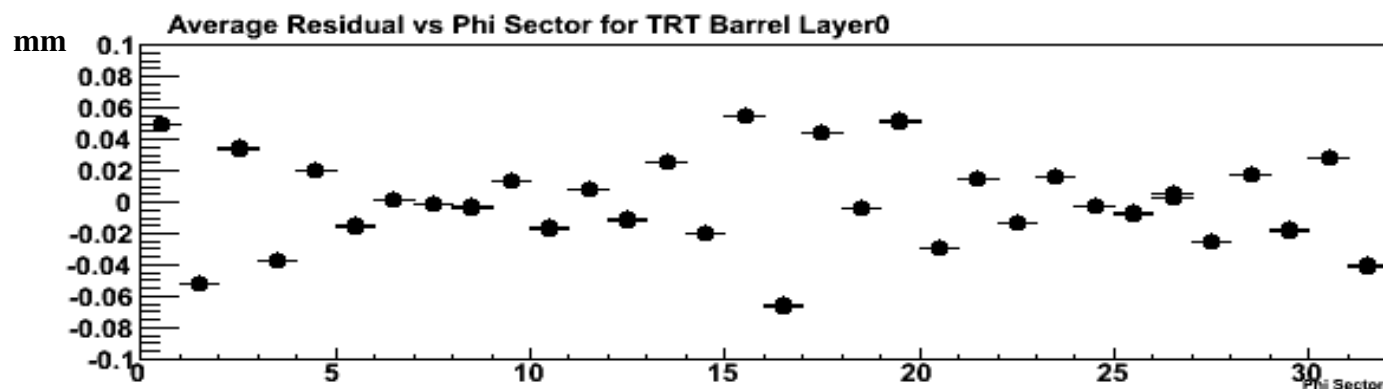
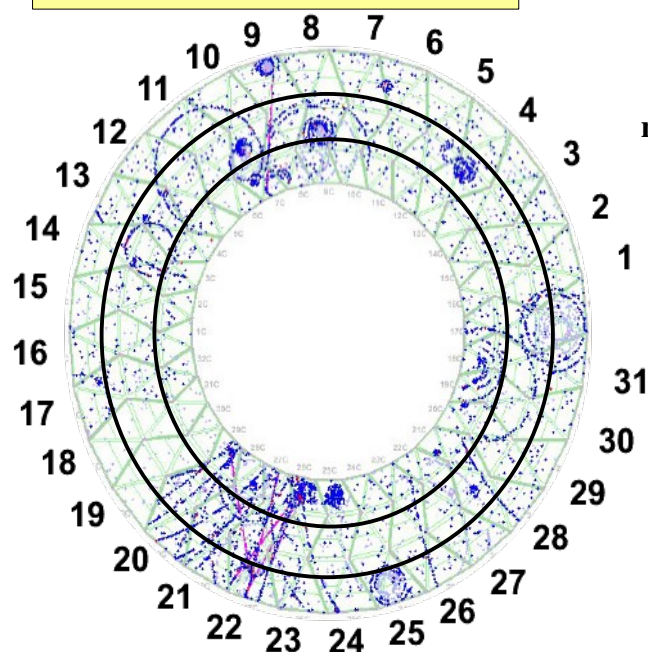
Before L2 Alignment

Track Selection:

TRT-only tracks

> 45 TRT hits

> 2 GeV



Seen with:

B on and off

Xe and Ar

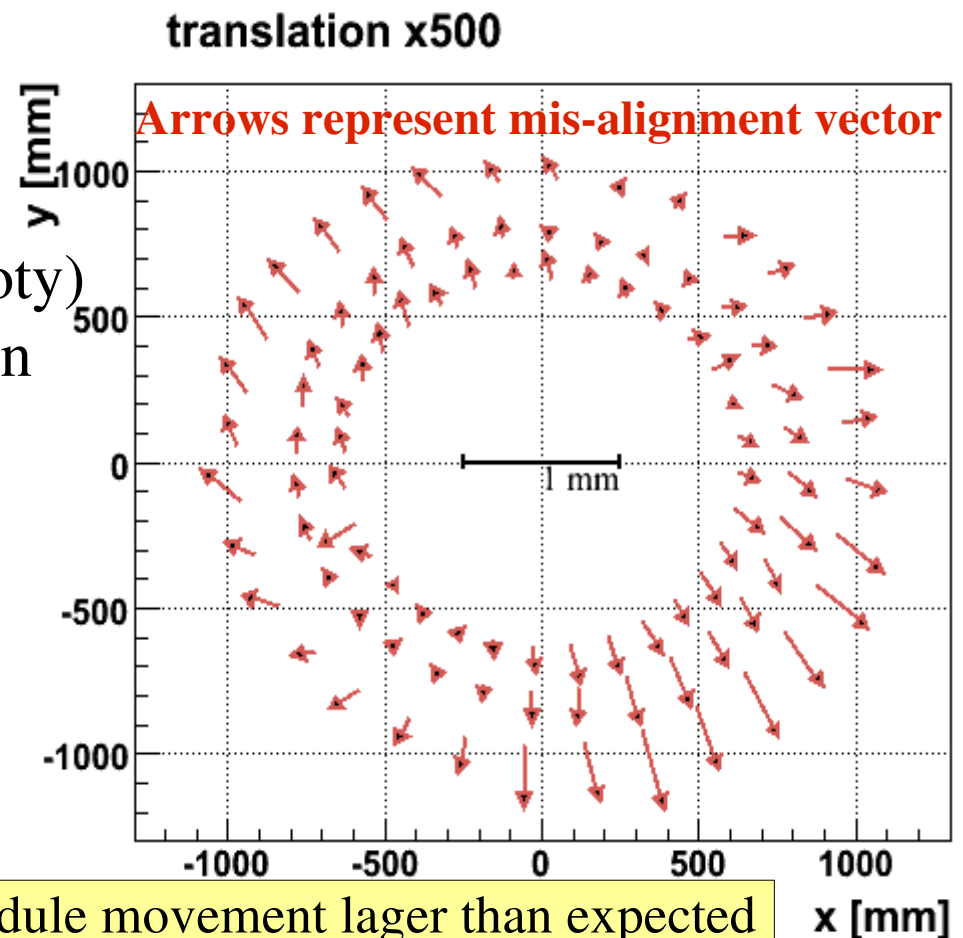
Back to M6

TRT L2 Alignment

- Initial TRT L2 alignment (still preliminary)
- Focused on particular run 91800 (B-field)
- Aligned 96 modules in 5 DoF
(3-rotations/ x and y translations)
- Overall good convergence
(modules on sides problems in rotx, roty)
- Increase in track and hits with iteration
- TRT resolution improvements:
 - TRT-only $210\ \mu\text{m}$ $\longrightarrow$ $190\ \mu\text{m}$
 - Combined $240\ \mu\text{m}$ $\longrightarrow$ $204\ \mu\text{m}$
- In the following:

Before L2

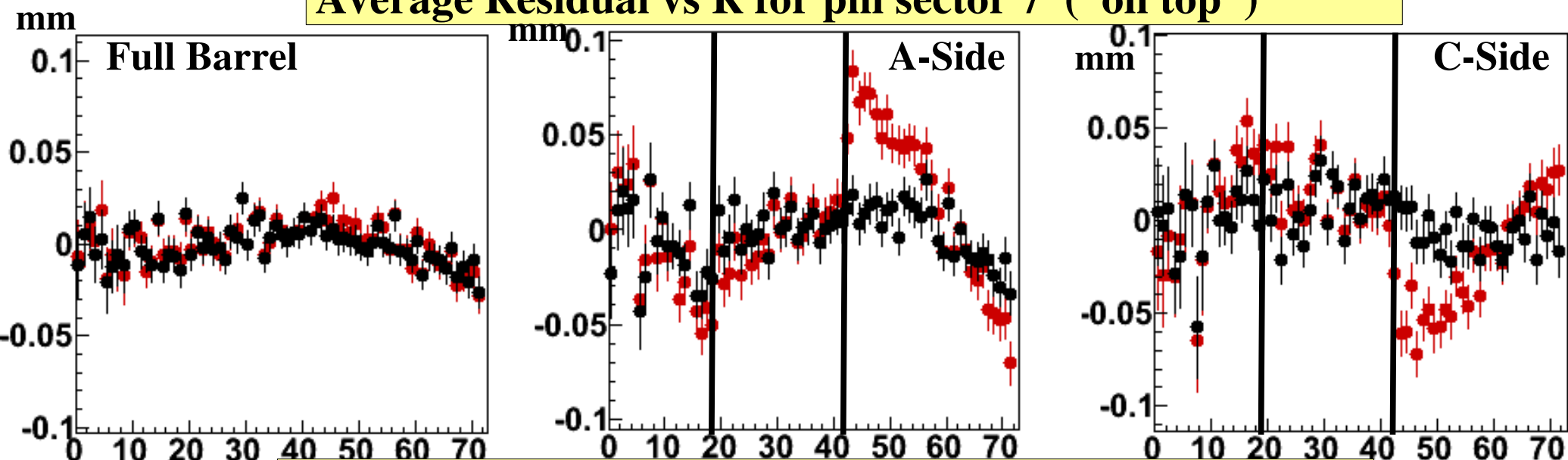
After L2



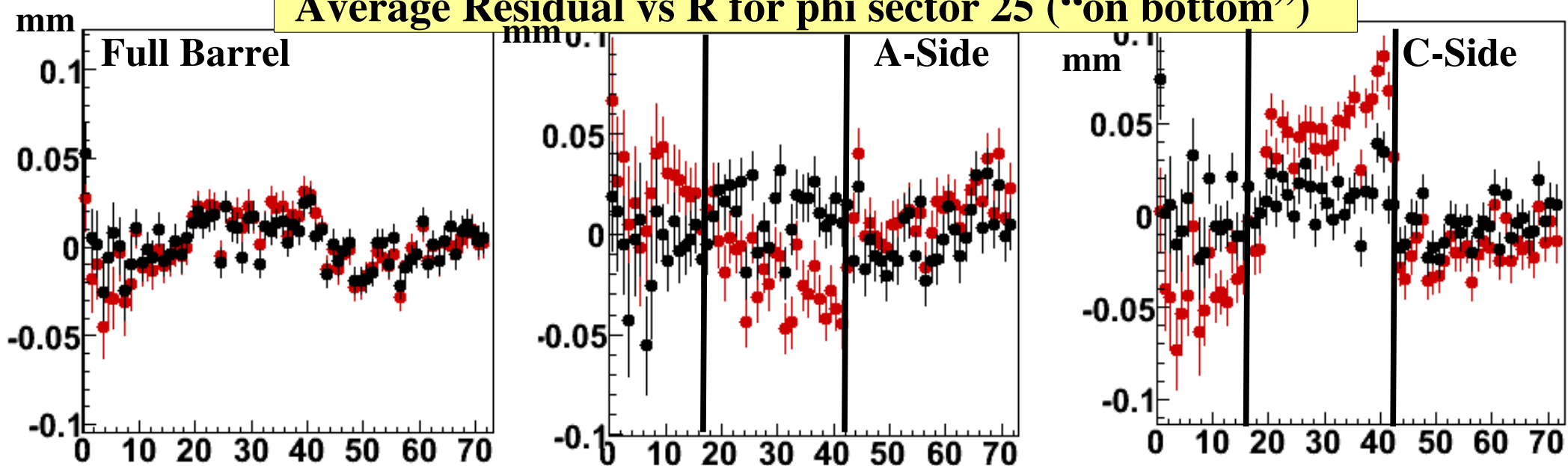
Some module movement larger than expected

TRT L2 Alignment

Average Residual vs R for phi sector 7 (“on top”)



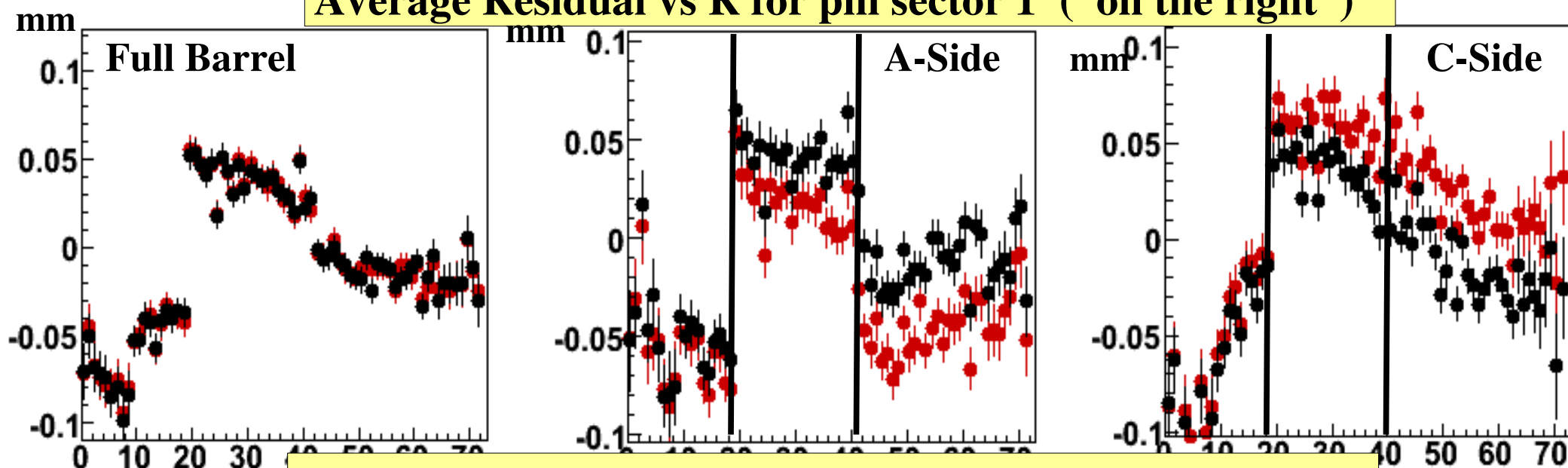
Average Residual vs R for phi sector 25 (“on bottom”)



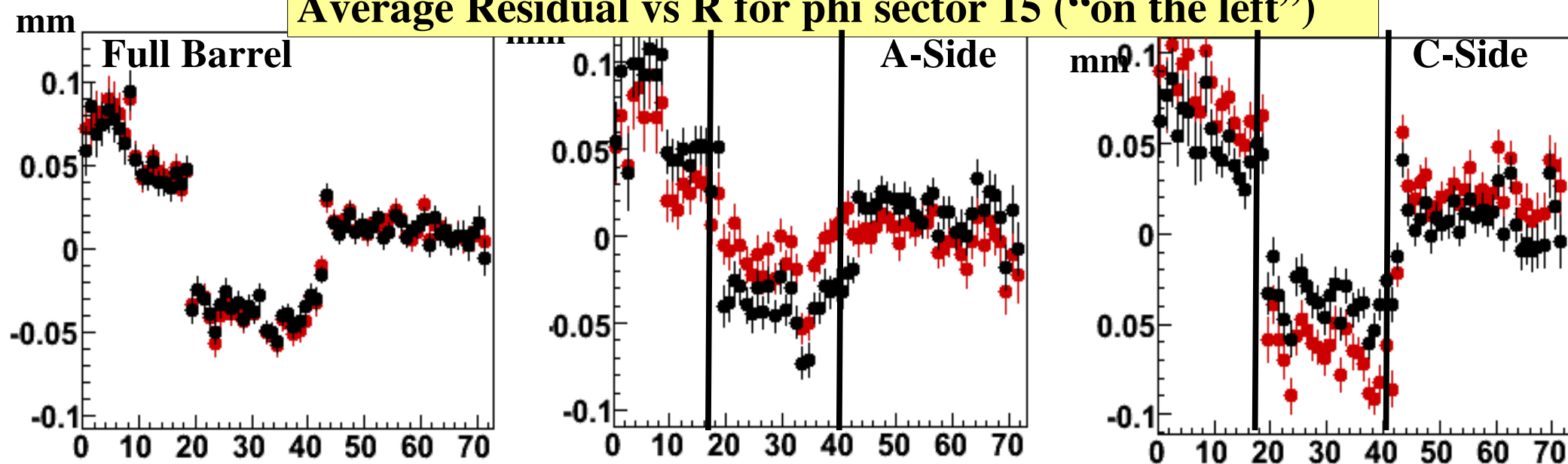
TRT-only tracks

TRT L2 Alignment

Average Residual vs R for phi sector 1 (“on the right”)

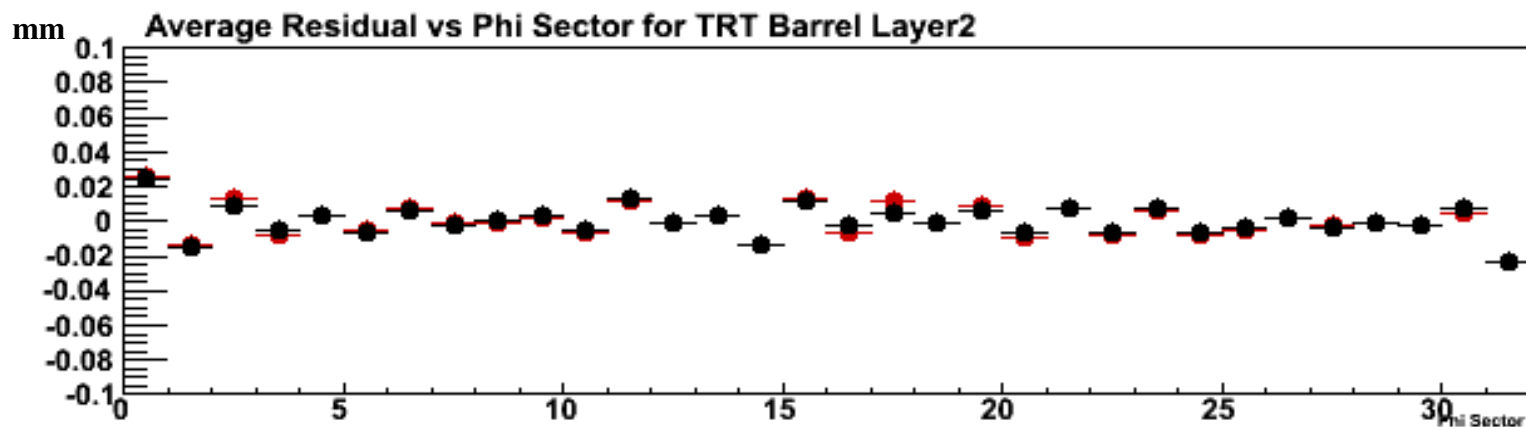
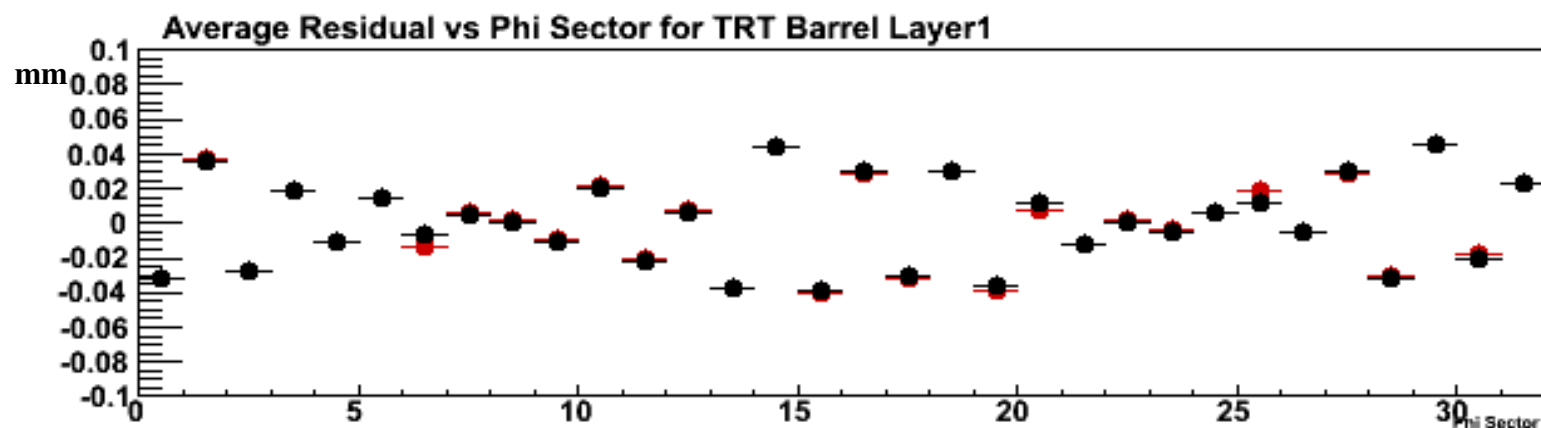
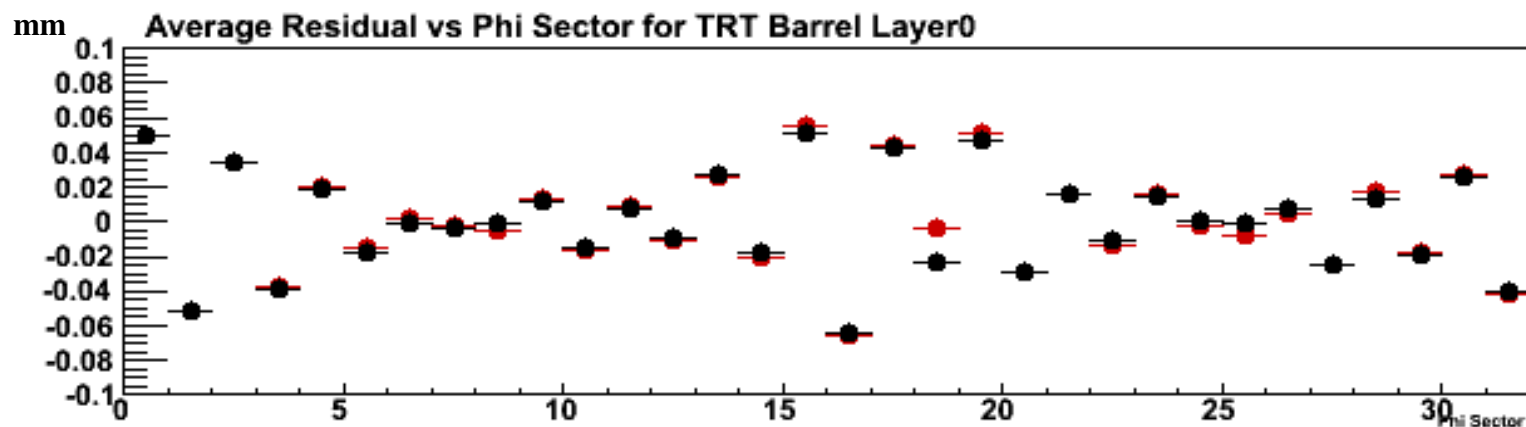


Average Residual vs R for phi sector 15 (“on the left”)

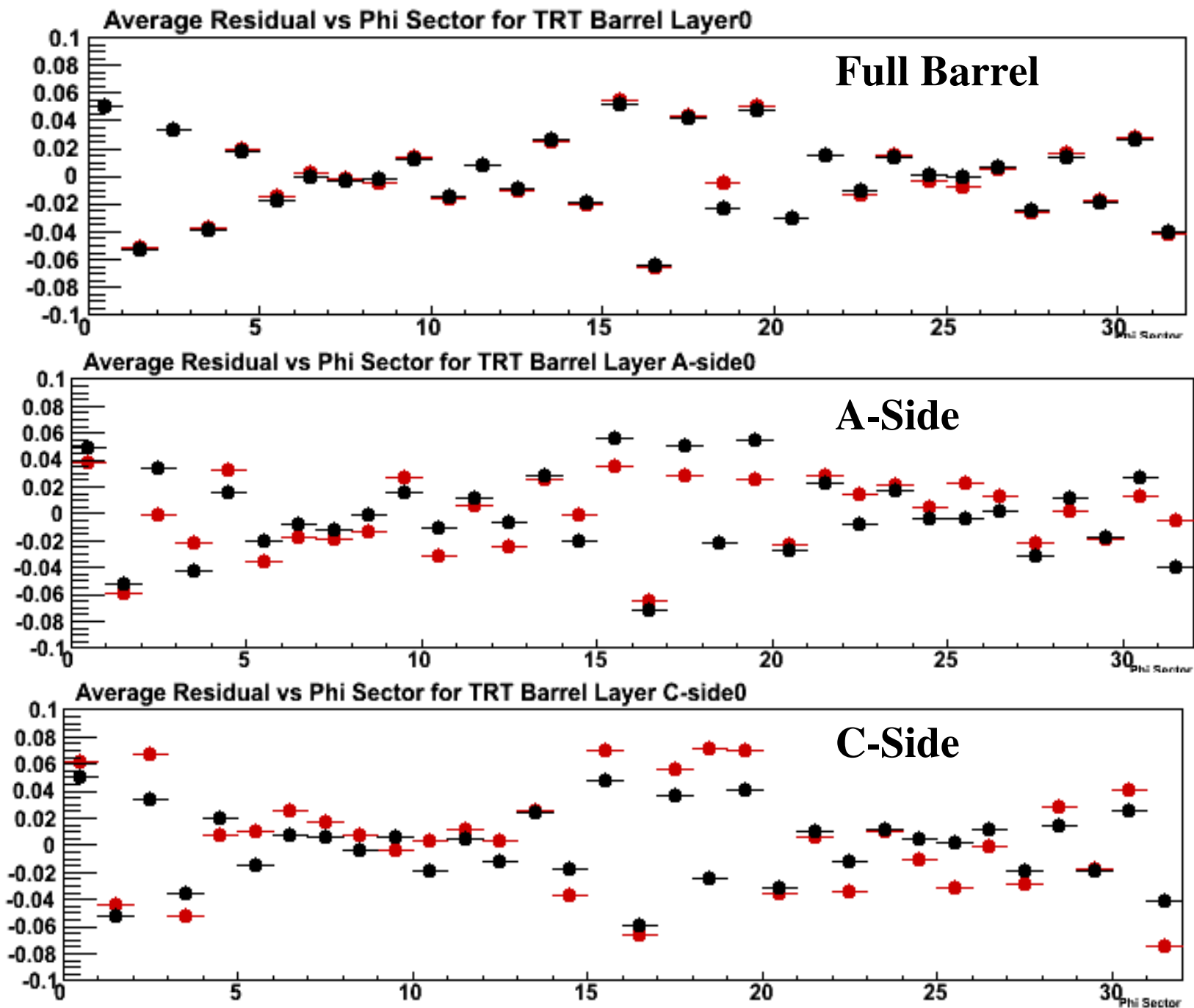


TRT-only tracks

Phi Residual Structure.

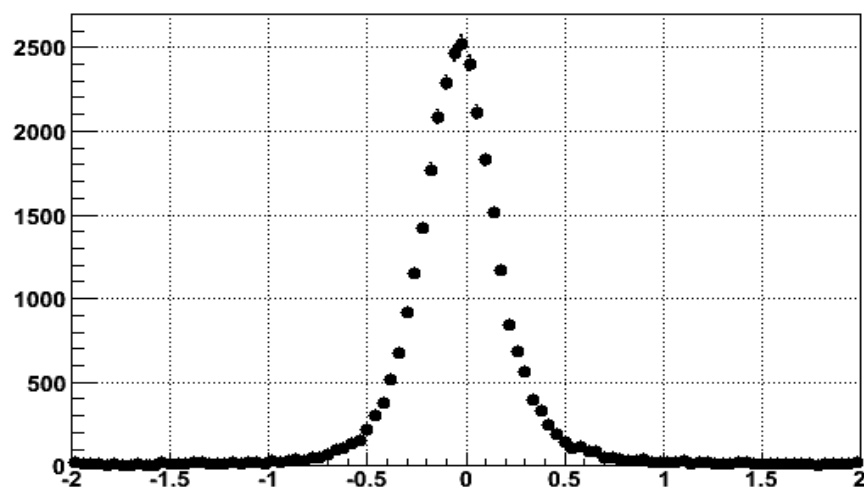
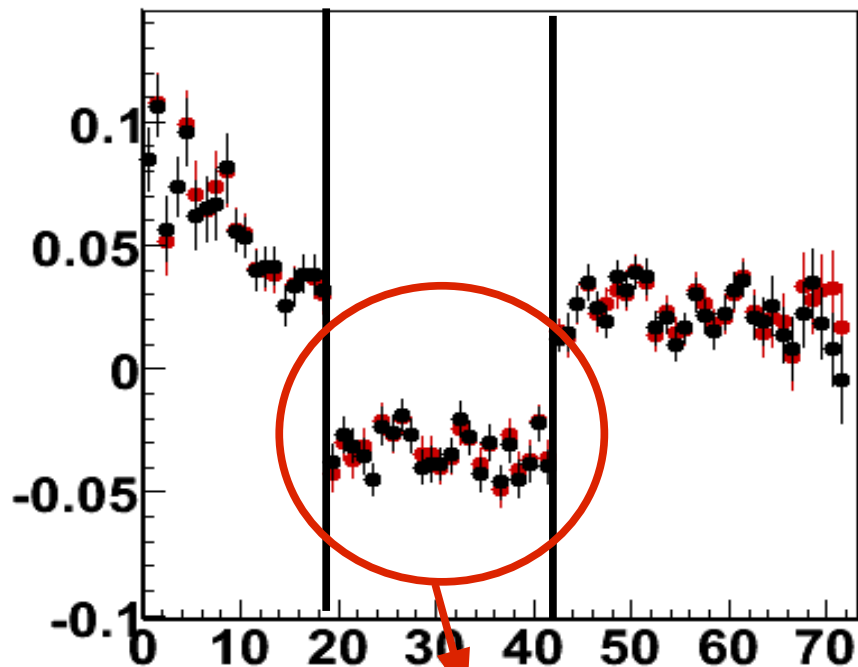


Phi Residual Structure.

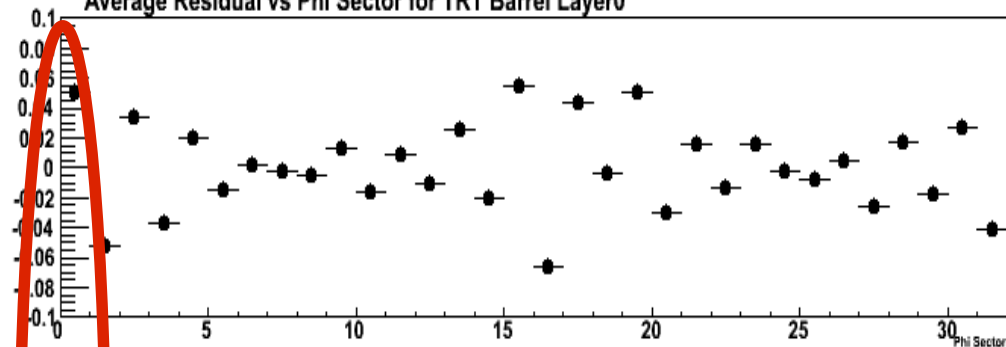


Phi Residual Structure.

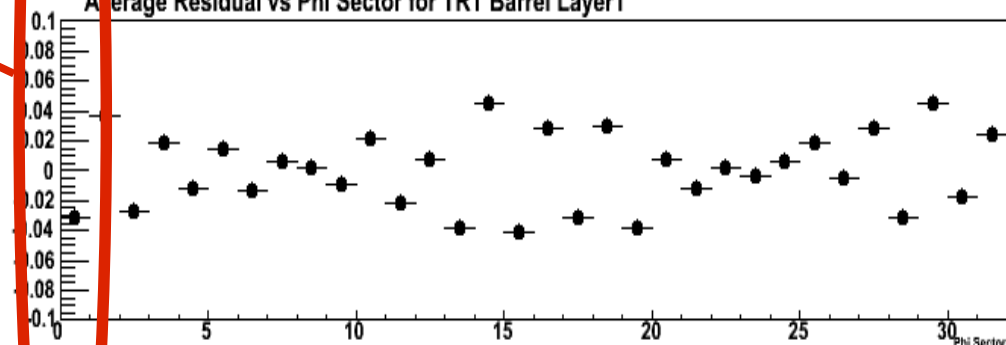
Average Residual vs R for phi sector 0



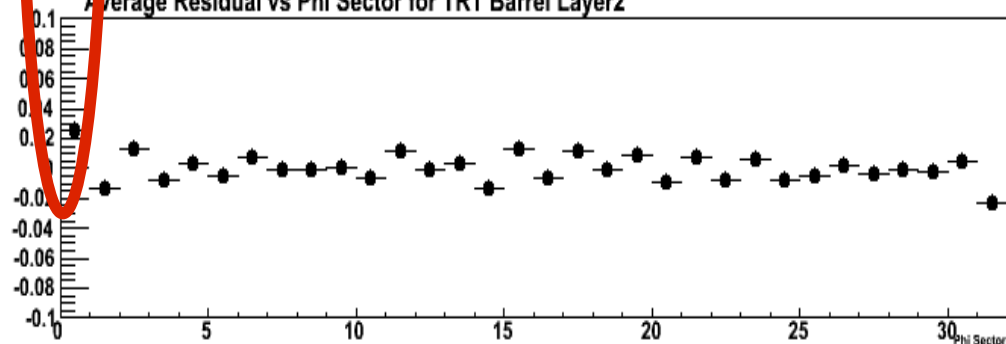
Average Residual vs Phi Sector for TRT Barrel Layer0



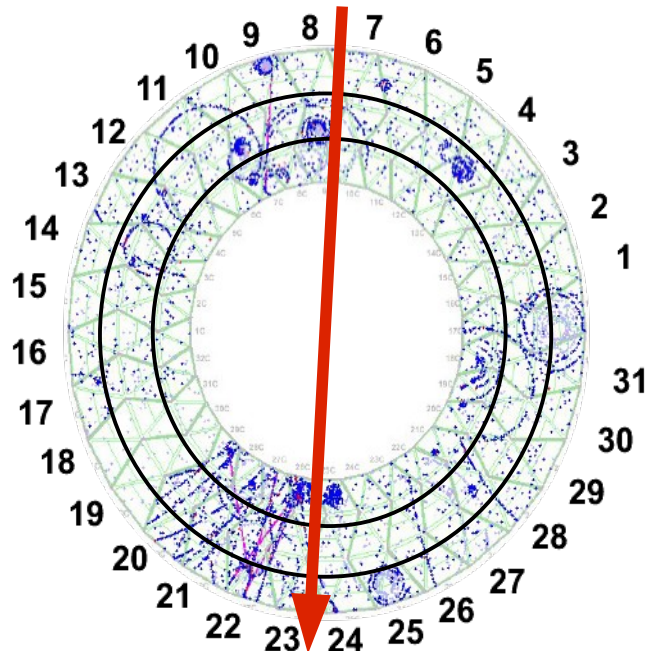
Average Residual vs Phi Sector for TRT Barrel Layer1



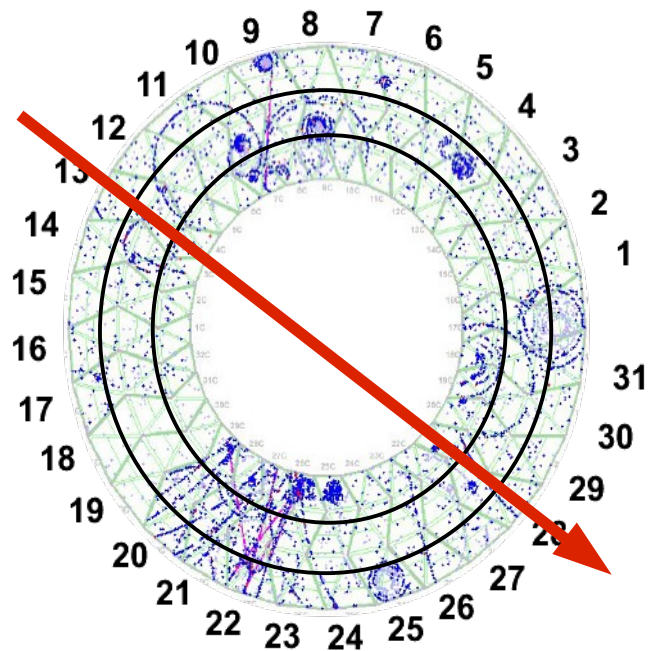
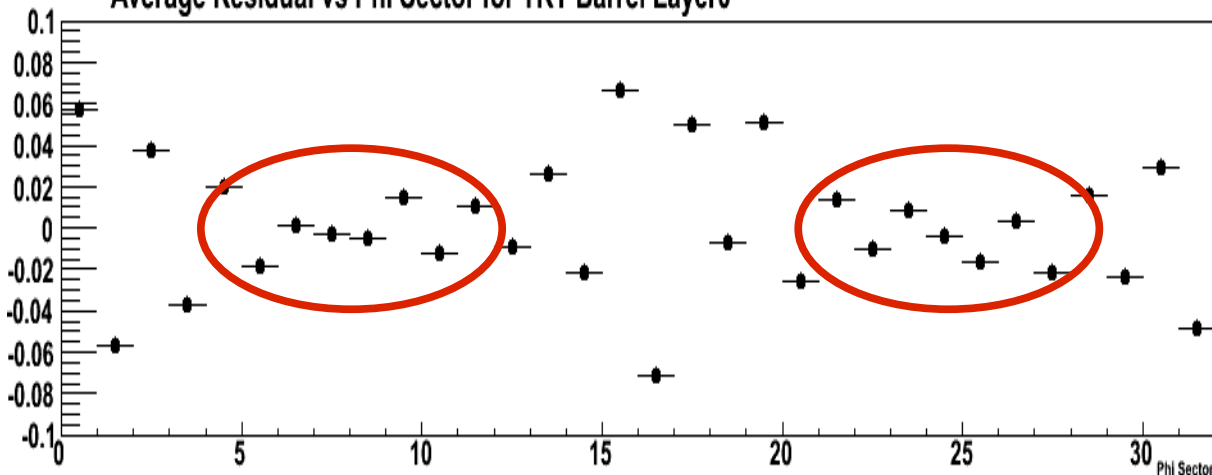
Average Residual vs Phi Sector for TRT Barrel Layer2



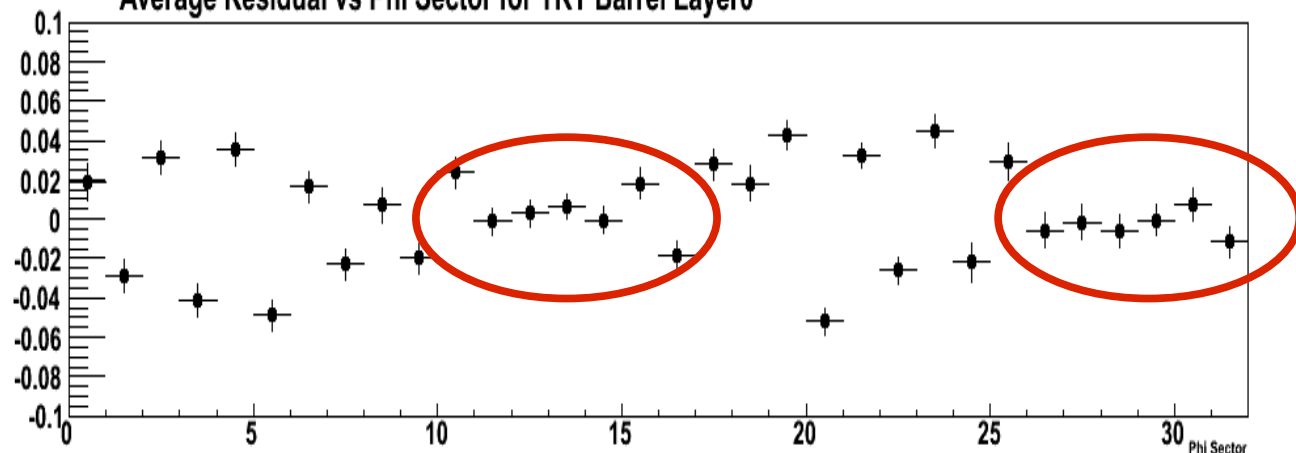
Phi Residual Structure.



Average Residual vs Phi Sector for TRT Barrel Layer0



Average Residual vs Phi Sector for TRT Barrel Layer0



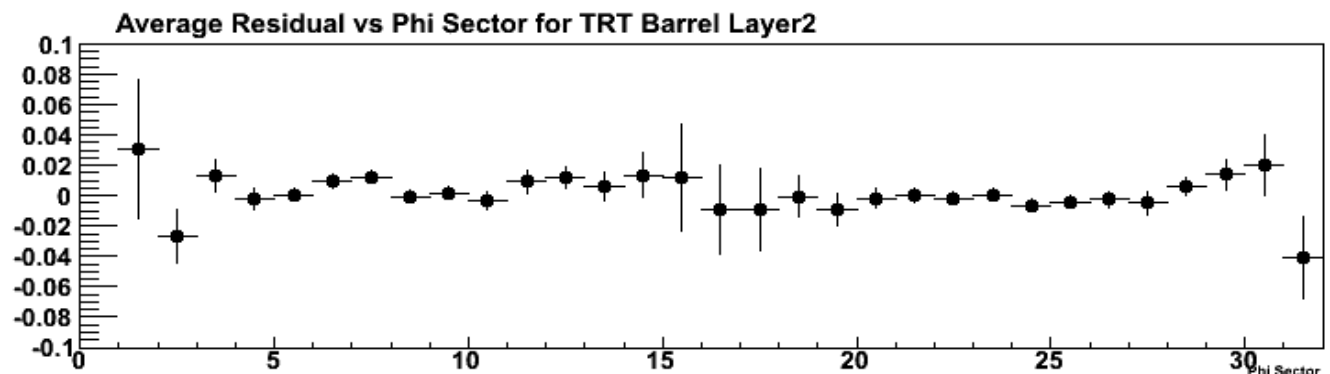
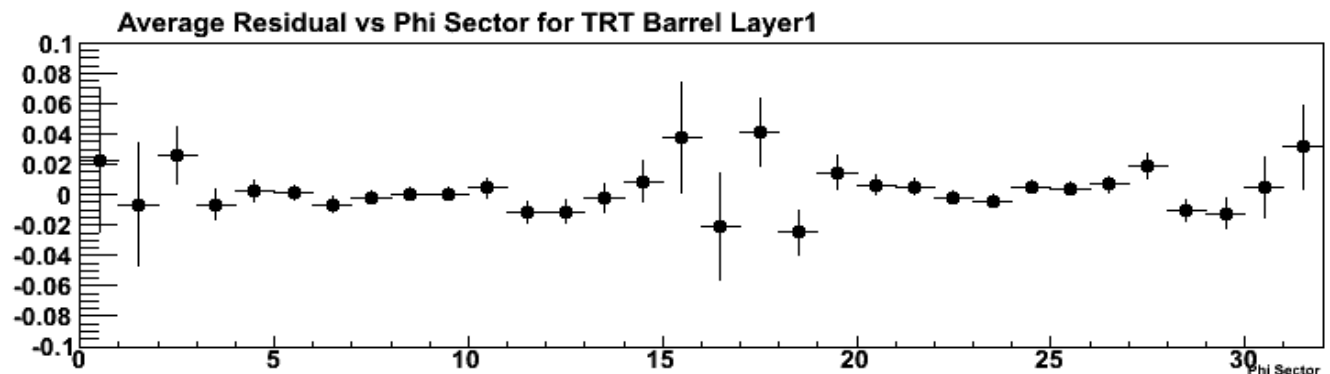
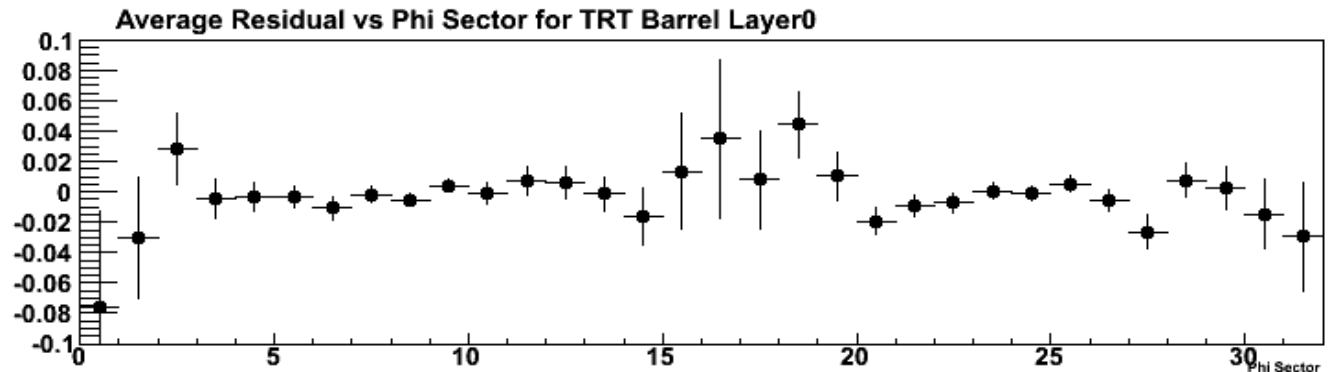
Phi Residual Structure.

- TRT – Only Tracks
- Full Φ_0 acceptance
- impact parameter cut < 100 mm (inside pixel)

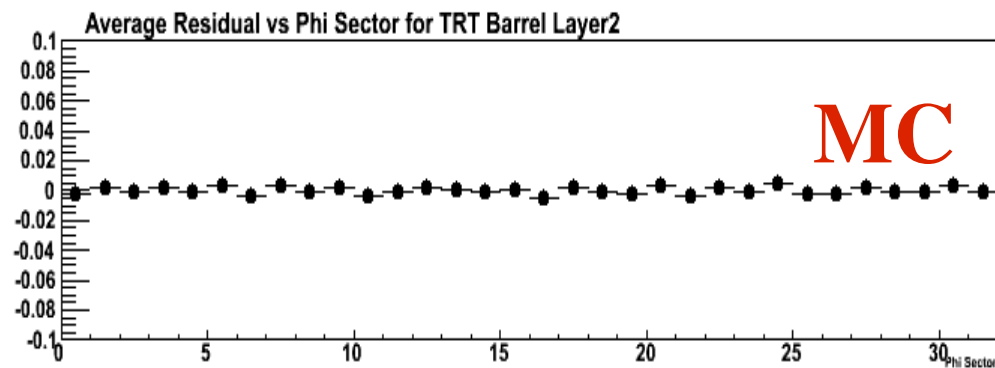
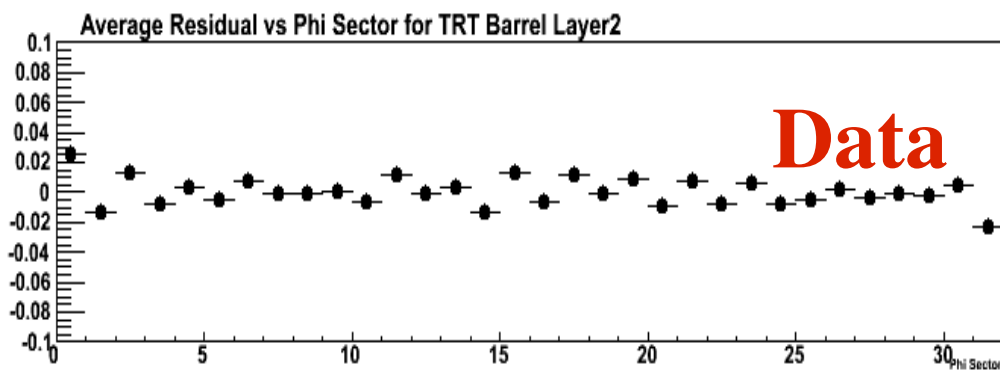
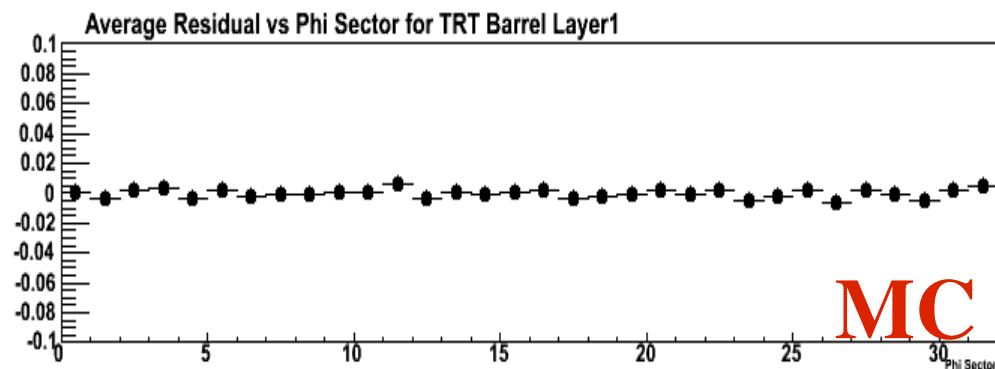
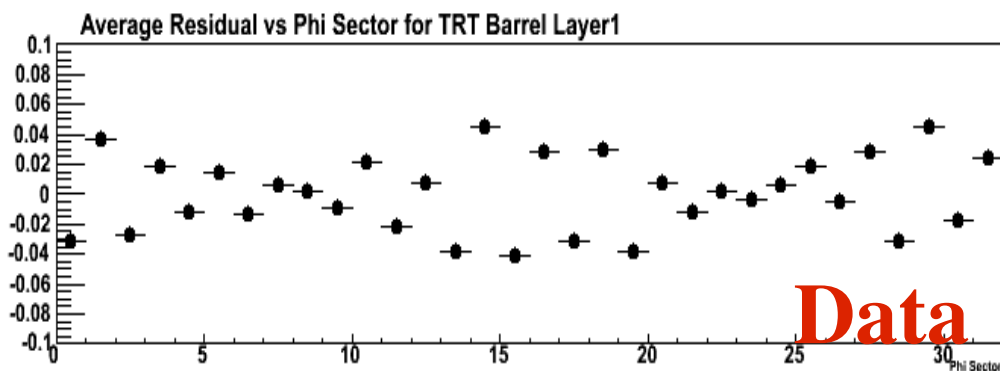
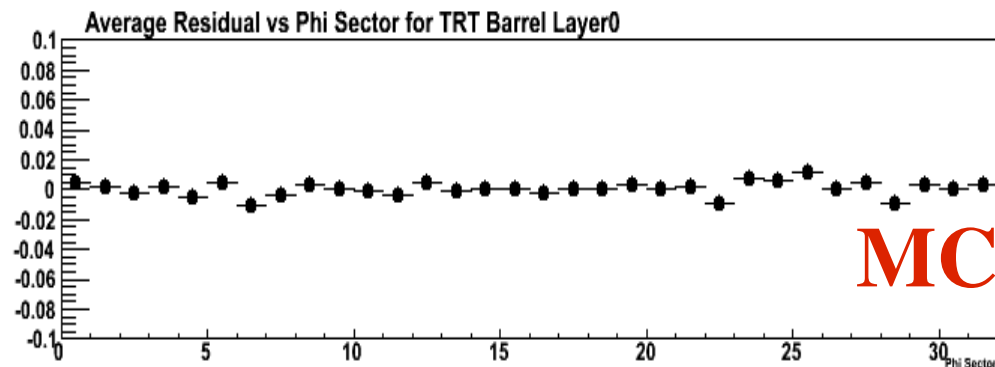
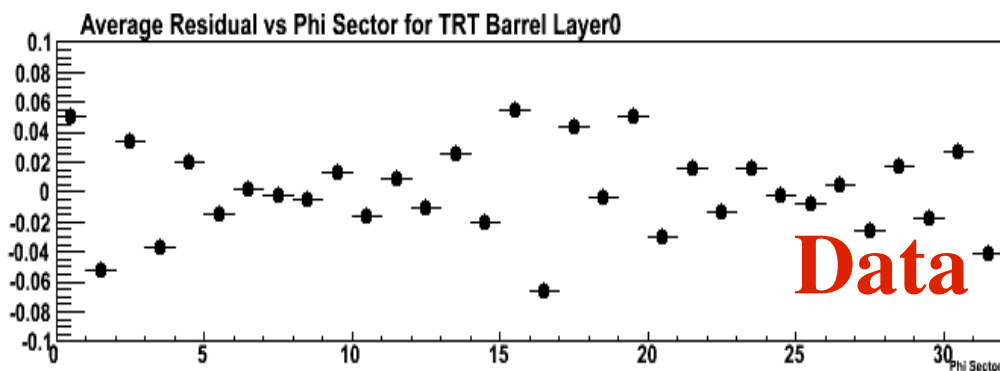
Problem with tracks
away from the
interaction point

Implications:

- Radial misalignment ?
- Problem reconstruction?



Phi Residual Structure.



Hints from SR1

“We have found a pattern in the misalignment of TRT modules suggesting that there is either a small mistake in the geometry description or an actual deformation of the TRT support structure. We have also performed an analysis of module deformations in the TRT. It was shown that such deformations exist and go beyond the simple twist model. At the time of writing only the alignment for a TRT barrel twist is implemented, but the algorithm can easily be extended to other parameterized deformations in the TRT or other subdetectors. (Pixel bow deformations are another important candidate.)”

- TRT Alignment from SR1 cosmics
June 21st 2007



Conclusions

We've got a lot to do

To Do

L1 Alignment

- Worsened combined resolution a result of residual L1 misalignment?
 - modify outlier logic / scale errors
- Large L1 alignments found in the Endcaps need to be studied

L2 Alignment

- TRT resolution should be 135 microns we see 190
- A/C side differences. $f(z)$? Unexpected $\rightarrow$ module distortions ?
- L2 repeated more runs / statistics. Track Selection etc.

Phi Structure (continue to expand monitoring tools)

- real mis-alignment ? (module distortion?)
- geometry problem ?

L3 Alignment

- think about a L3 alignment (Physics reasons?)



Bonus

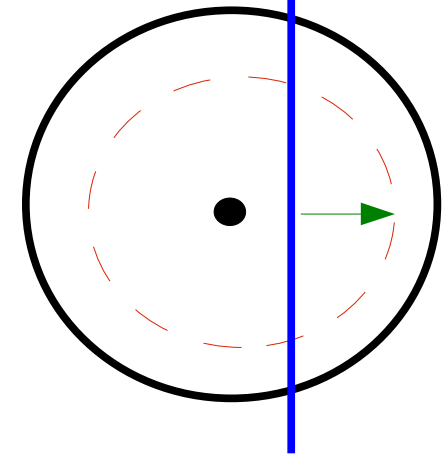
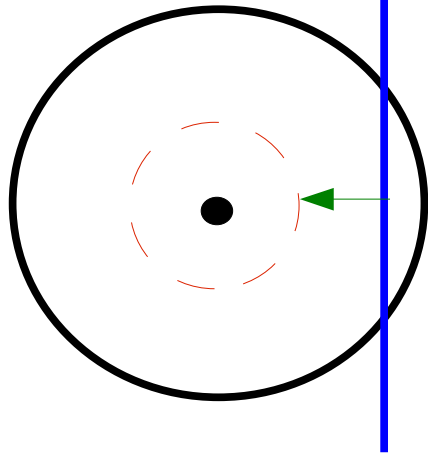


TRT Residual in Alignment Monitoring

$$\text{residualR} = \text{hitR} - \text{perdictedR}$$

*both hitR and perdictedR are signed the same.

4 Cases to Consider



- Straw
- Straw Center

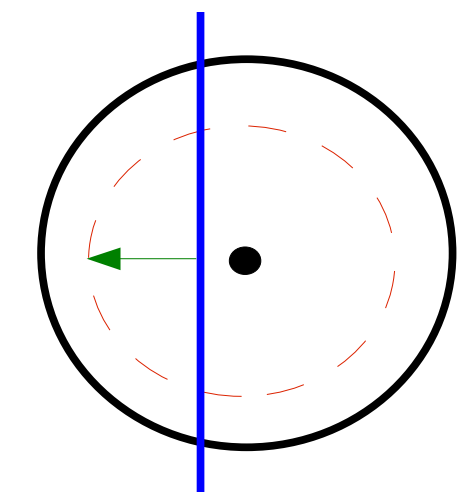
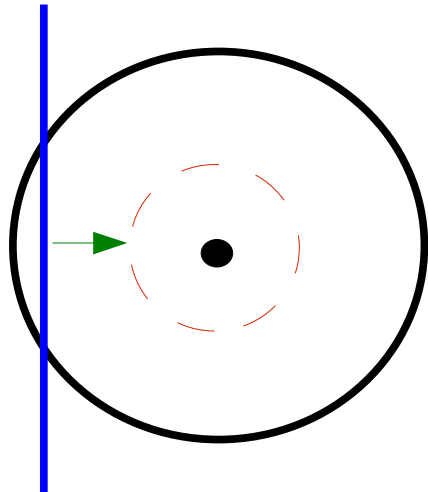
— Measured Drift Circle

— Reconstructed Track

→ Residual (arrow indicates sign)

hitR && perdictedR > 0

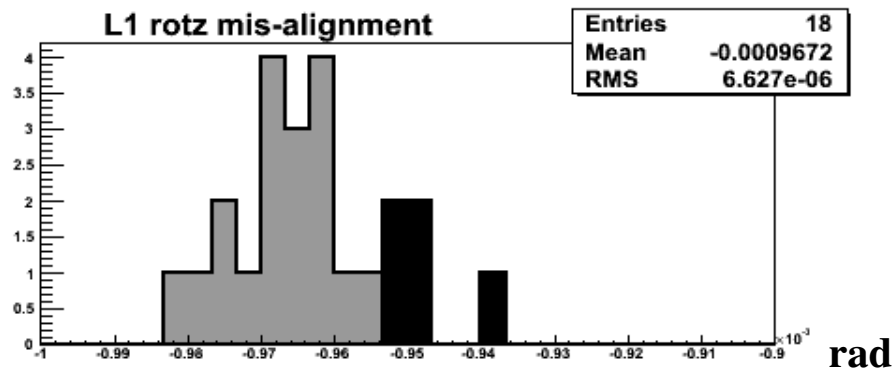
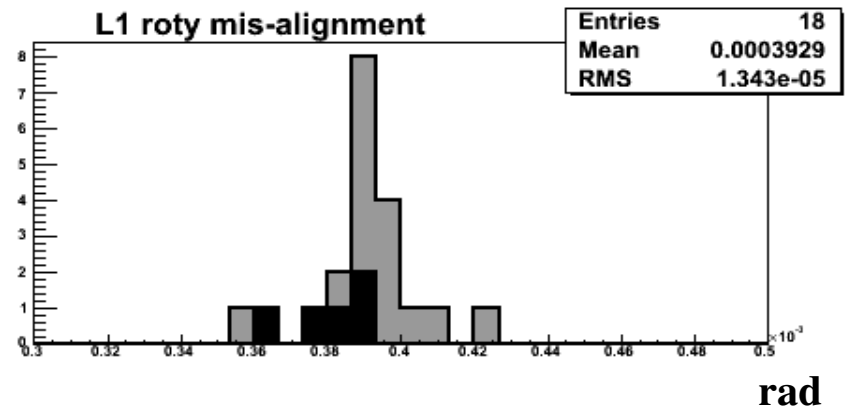
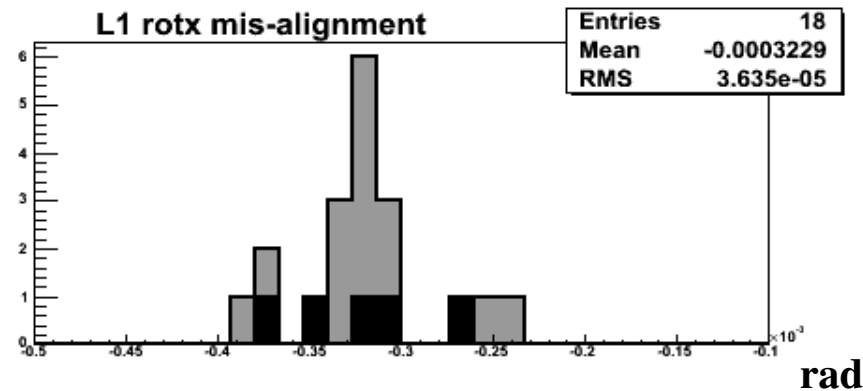
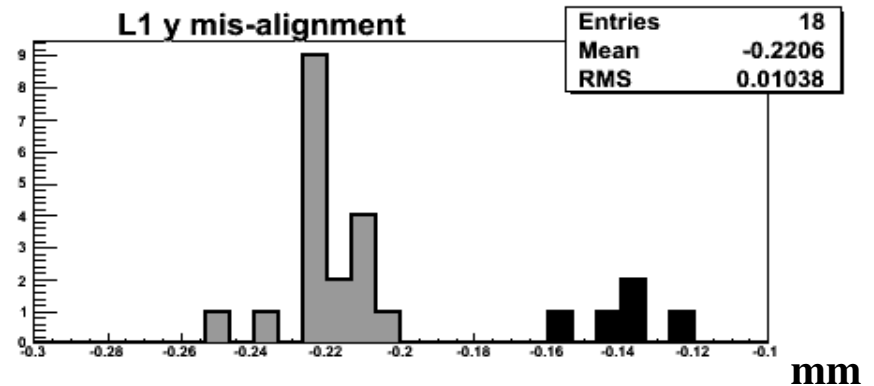
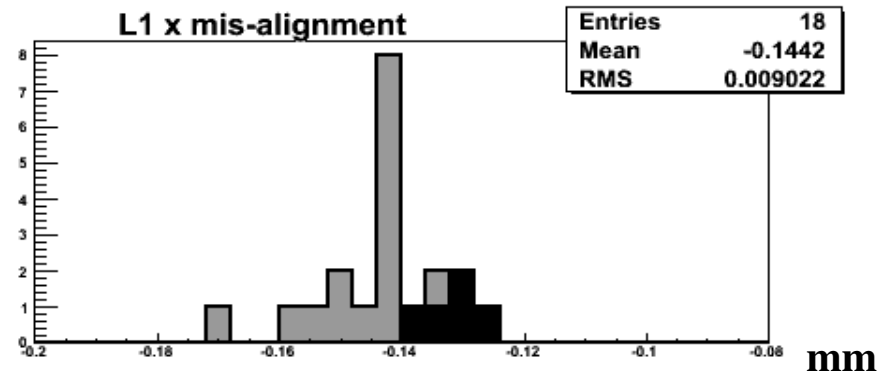
hitR && perdictedR > 0



hitR && perdictedR < 0

hitR && perdictedR < 0

TRT L1 Alignment depends on Si alignment



Field On
Field Off

L2 Rotation around Z

