TRT Alignment

Past, Present, and Future

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Past:

TRT Alignment Ran and Extensively Tested with Cosmic Data.

- **L1:** 5 DoF Barrel, 6 DoF Endcaps
- **L2:** 5 DoF Barrel, 3 DoF Endcaps

Validated/Moved to New integrated Alignment Framework

- Based of TRT Alignment Algorithm
- Will be used to align the entire ID,
- Will be used to do track-based alignment in muon systems

TRT Alignment with collisions

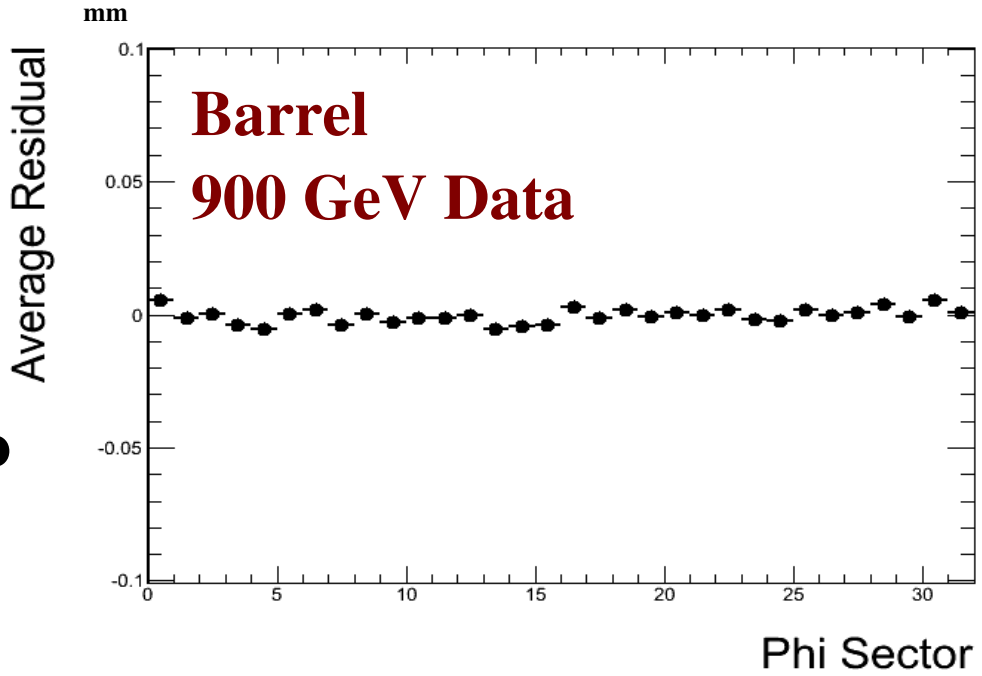
- L1 Cosmic Alignment and L2 Barrel validated on initial 900 GeV data
- New L2 Endcap Alignment produced. (**timescale ~day**)

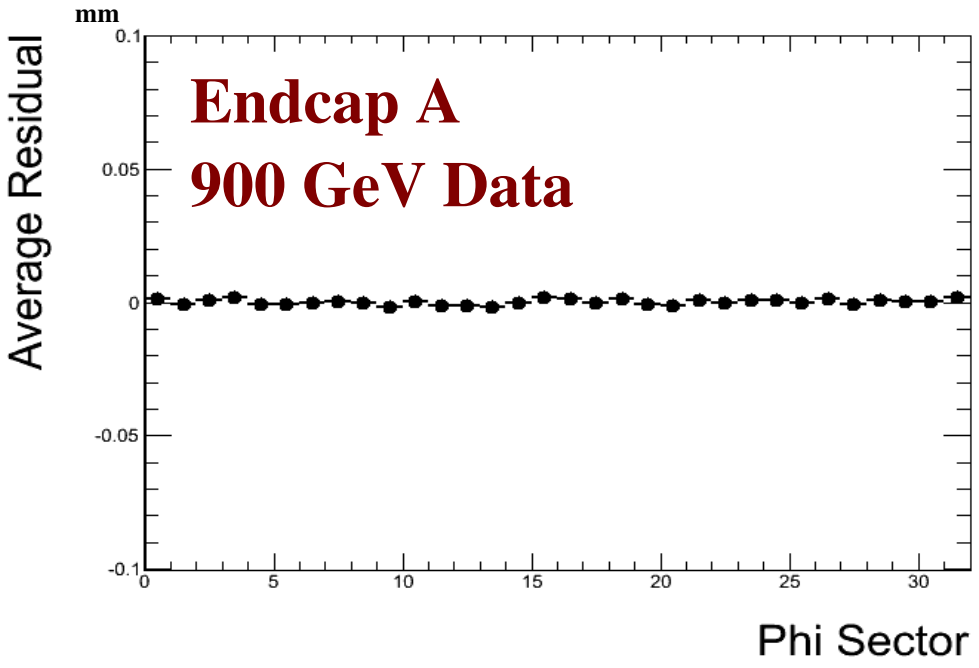
L1 Alignment

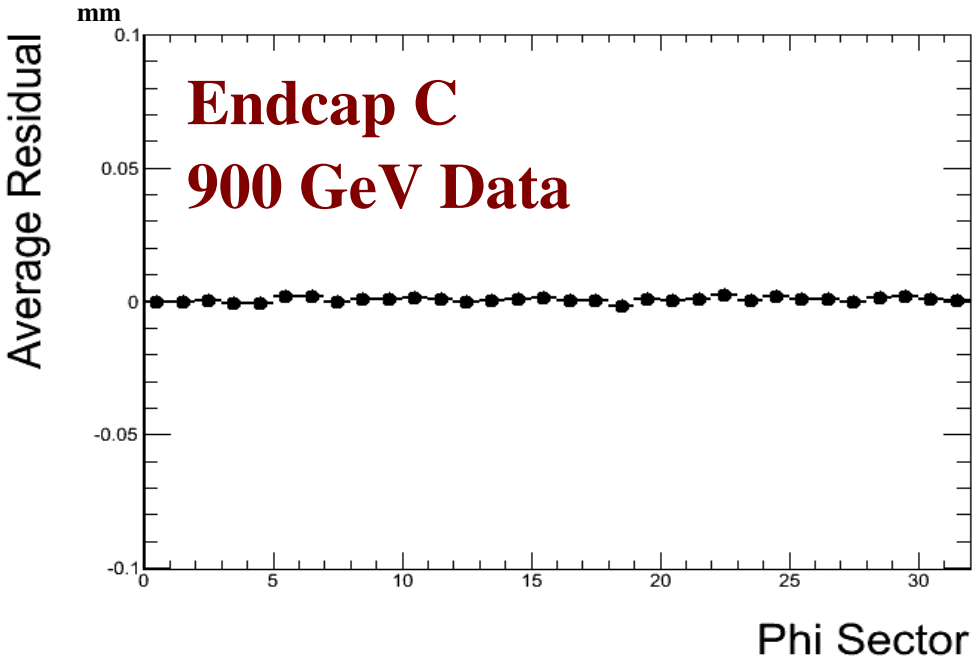
Studied from M6 through 1st Collisons

Firm Indication that L1 Alignment under control.

- **Average Residual Centered on Zero**
- **No coherent structure in Phi**



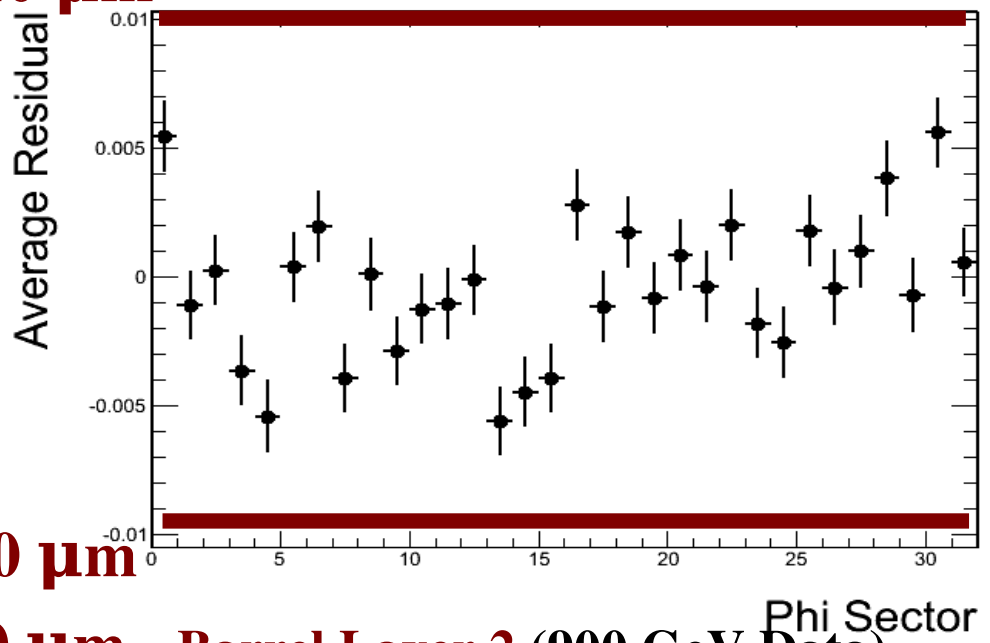




L2 Barrel Alignment

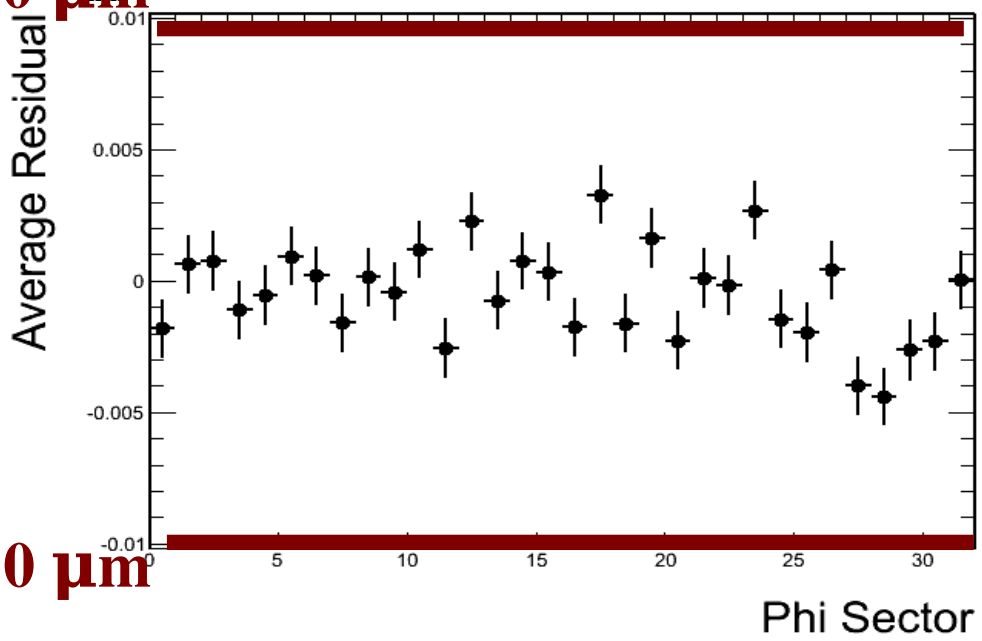
- Barrel Alignment from cosmics
- Validated with **900 GeV Data**
- **Average Residual for each module < 10 µm**

10 µm **Barrel Layer 0 (900 GeV Data)**



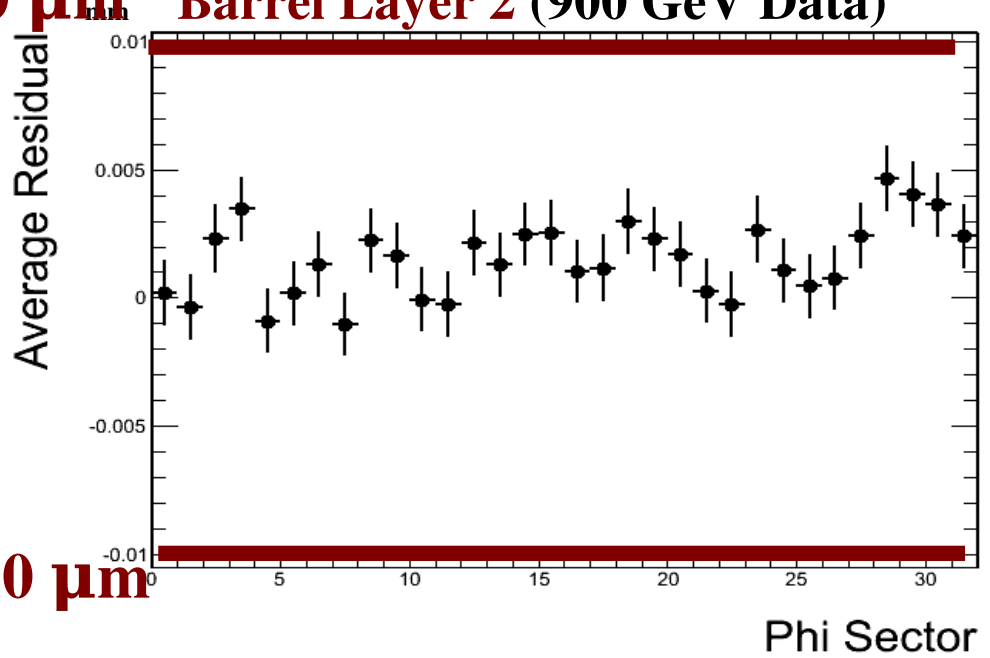
10 µm

10 µm **Barrel Layer 1 (900 GeV Data)**



10 µm

10 µm **Barrel Layer 2 (900 GeV Data)**

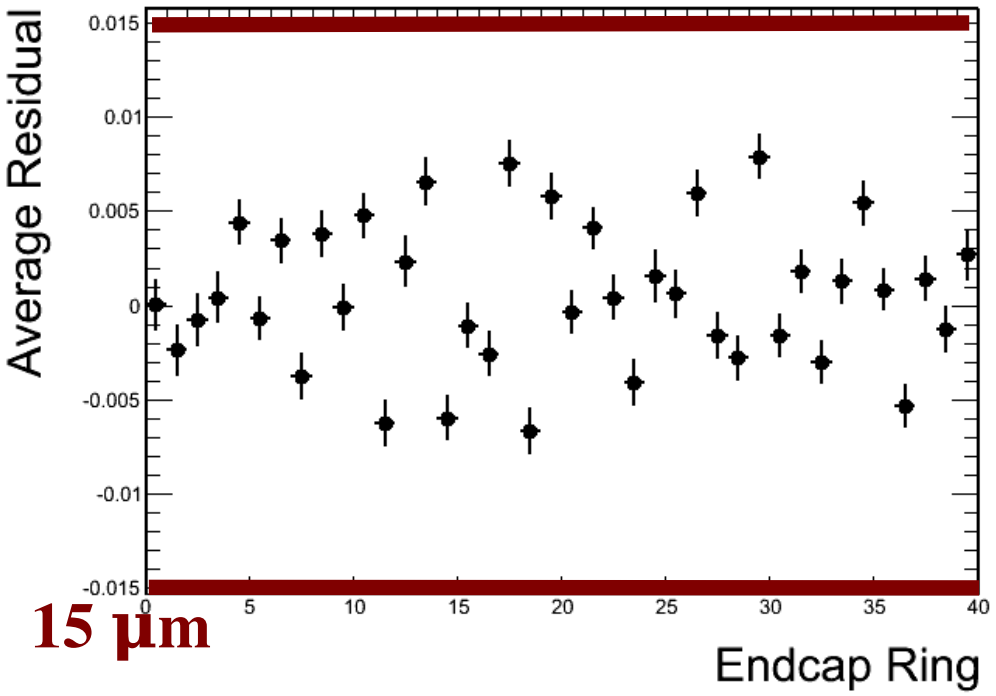


10 µm

L2 Endcap Alignment

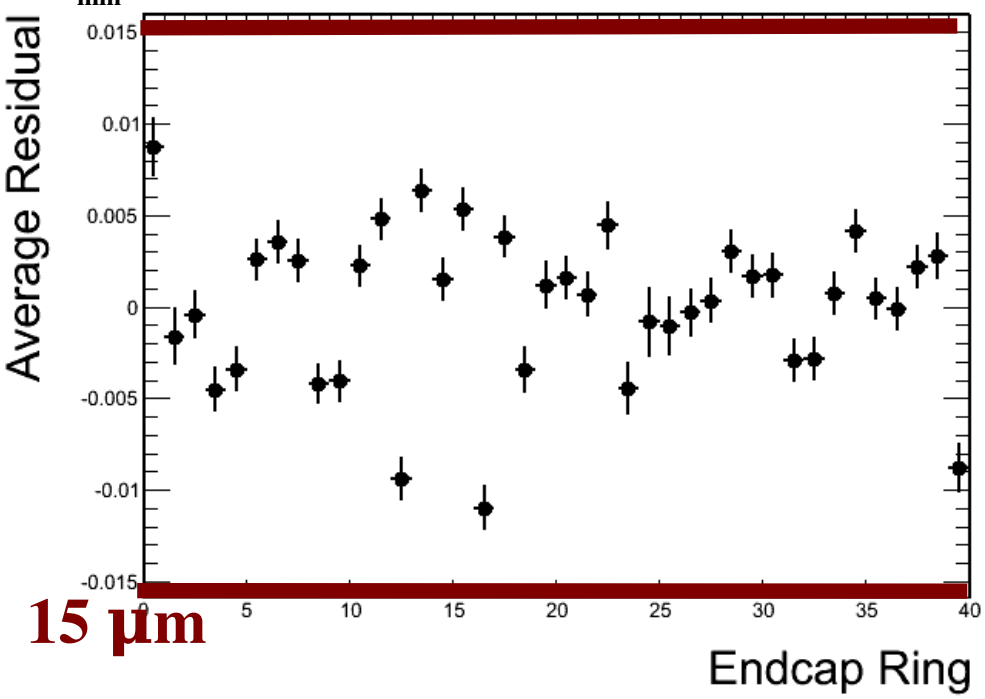
- Initial Endcap Alignment from cosmics
- Repeated with first 900 GeV (run 141749)
- Validated with **900 GeV Data**
- **Average Residual for each ring < 15 µm**

15 µm **Endcap C (900 GeV Data)**



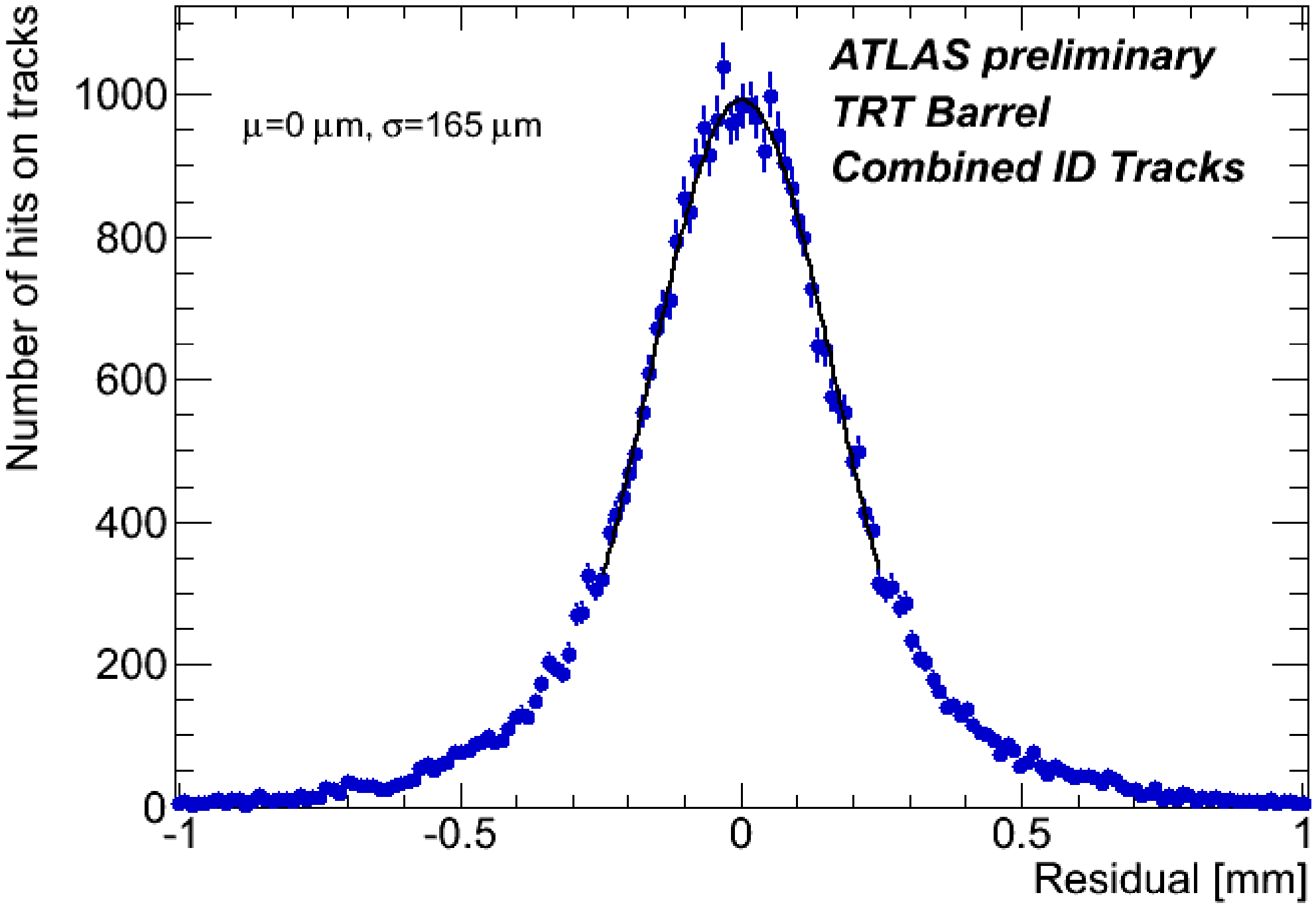
15 µm

15 µm **Endcap A (900 GeV Data)**

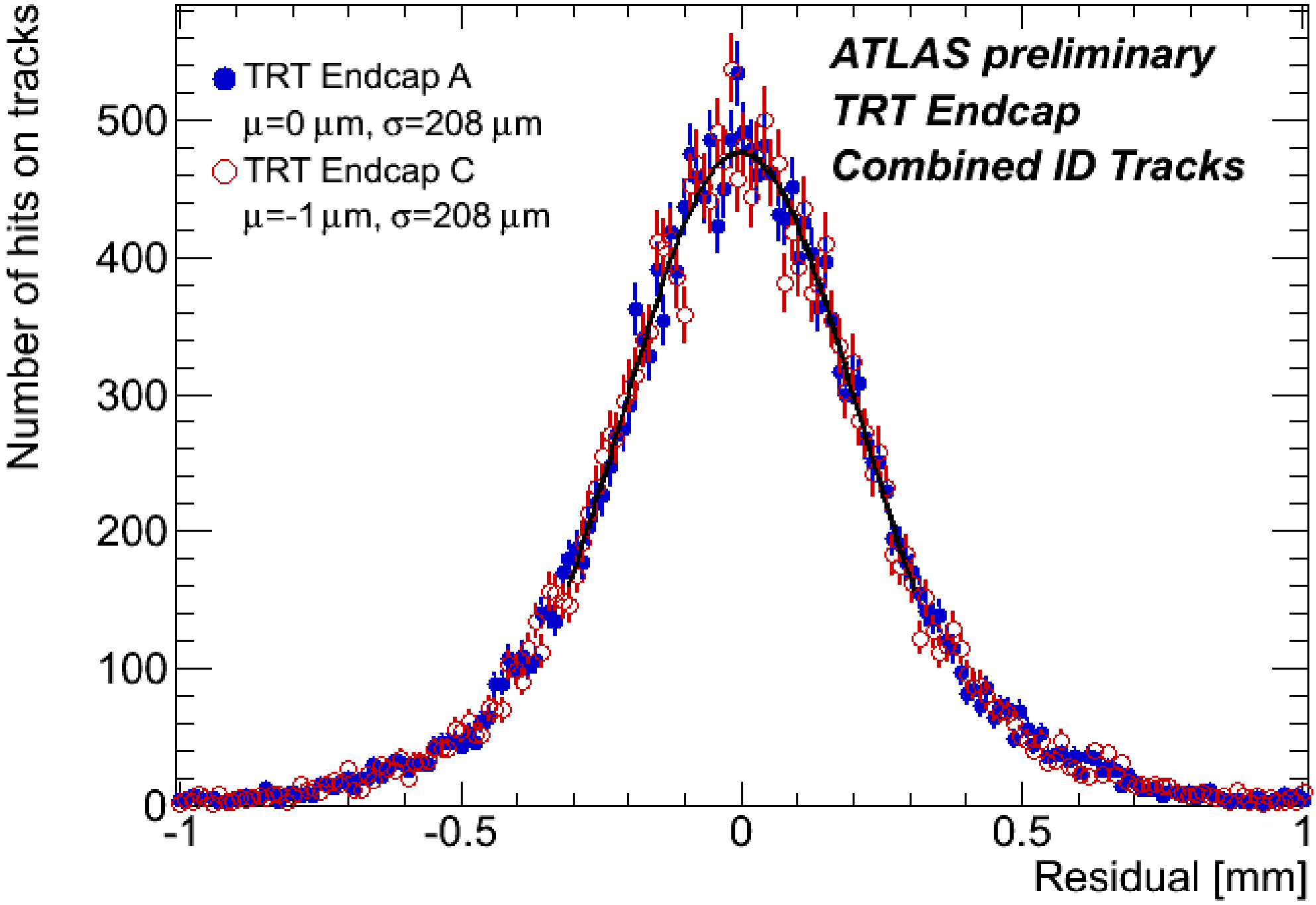


15 µm

Approved Plots w/ 1st Collisions



Approved Plots w/ 1st Collisions



Present:

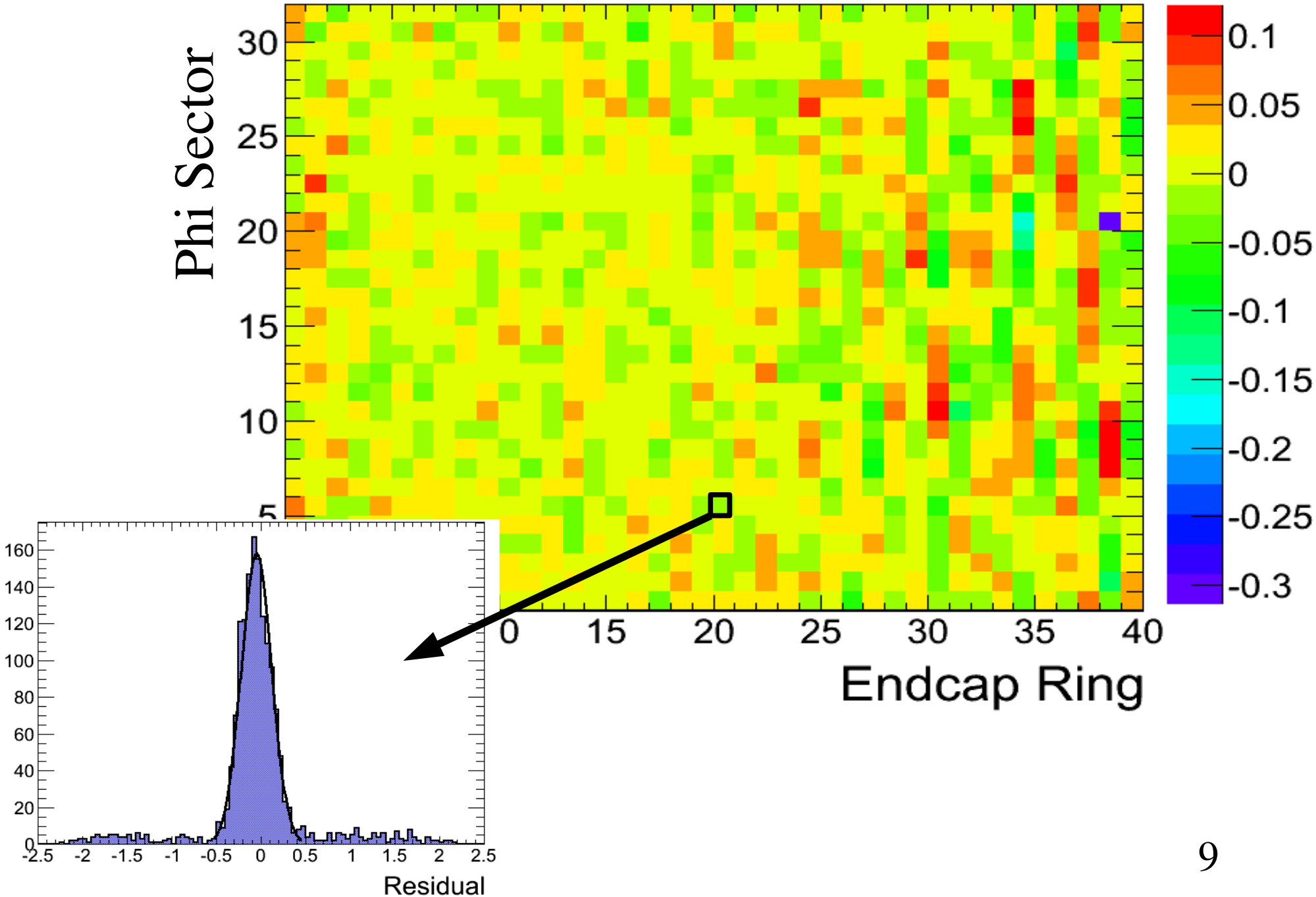
Determining Detector Residual Misalignment

- *Are we done with L2 ?* (looks like answer is yes.)
- **Coherent straw level misalignments, not at module/ring level ?**
- Dont want to do wire-by-wire if we dont have to.
- Other natural DoF that describe detector deformation ?

Tool Development for Wire by Wire alignment:

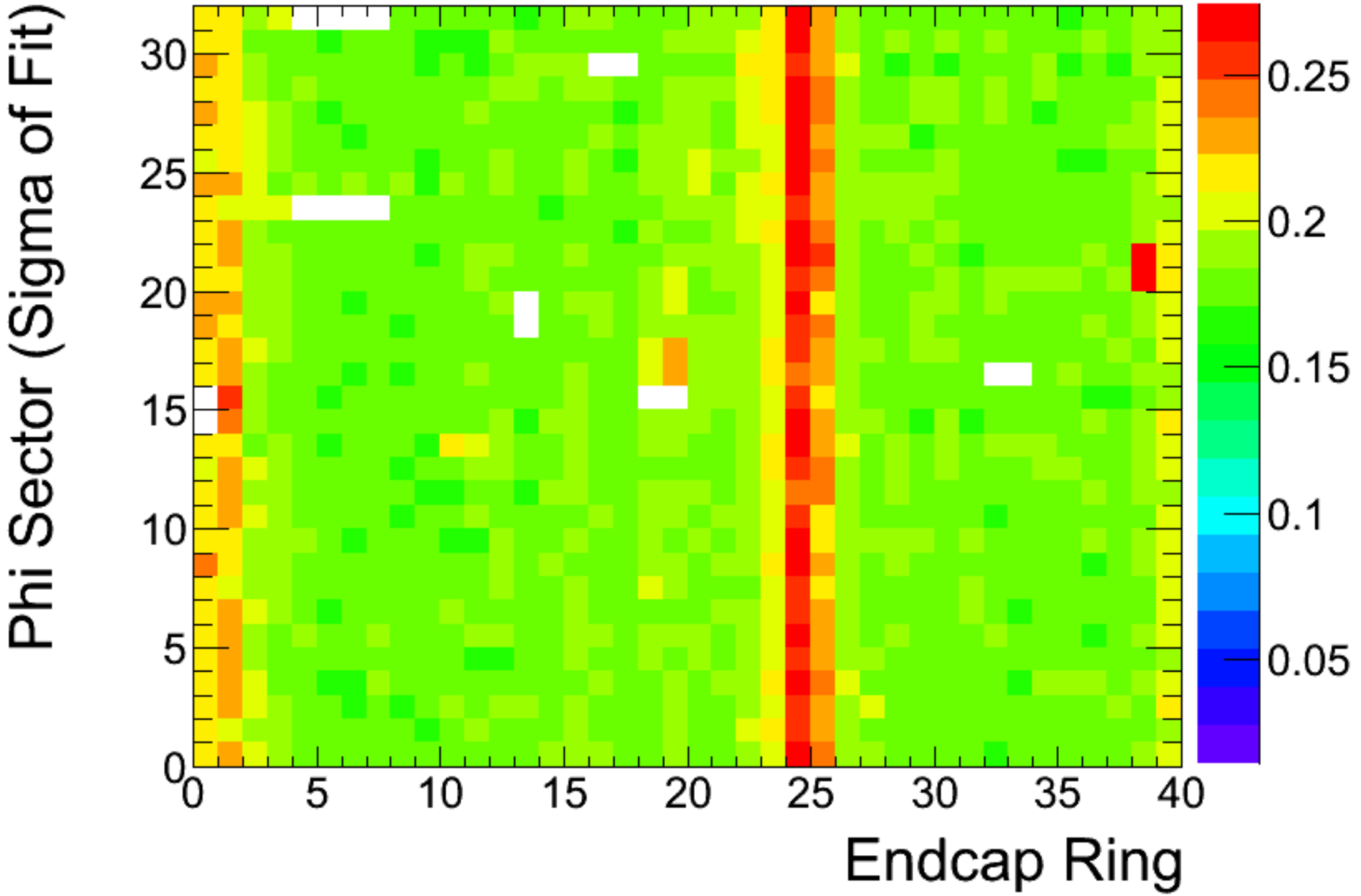
- Infrastructure for Calculating alignment constants
- Db Tools for storing, Accessing constants
- Validation tools, Based on **`TrkValidation`** ntuples
- Visualization tools.

Residual Maps



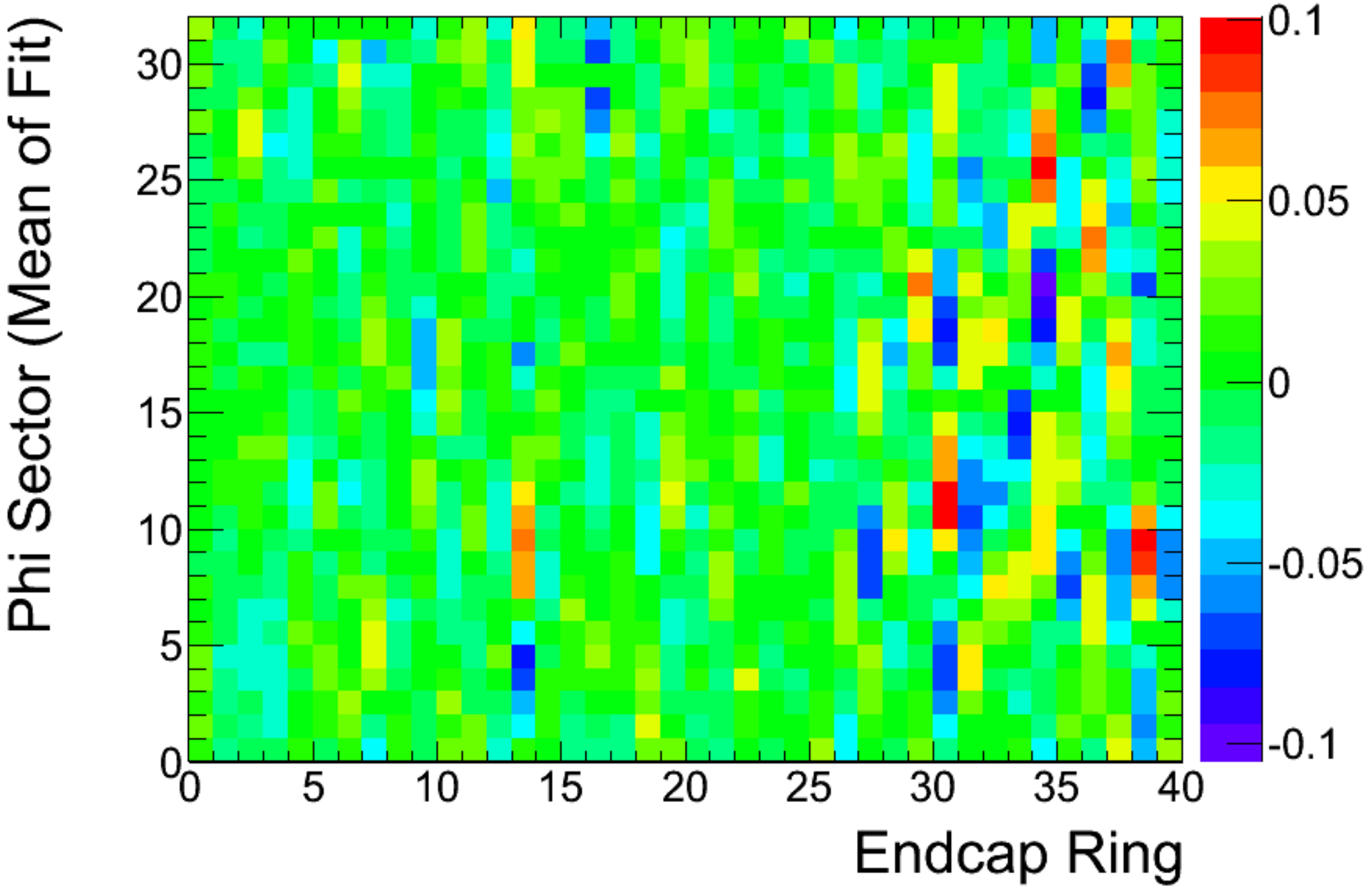
Endcap A

Resolution



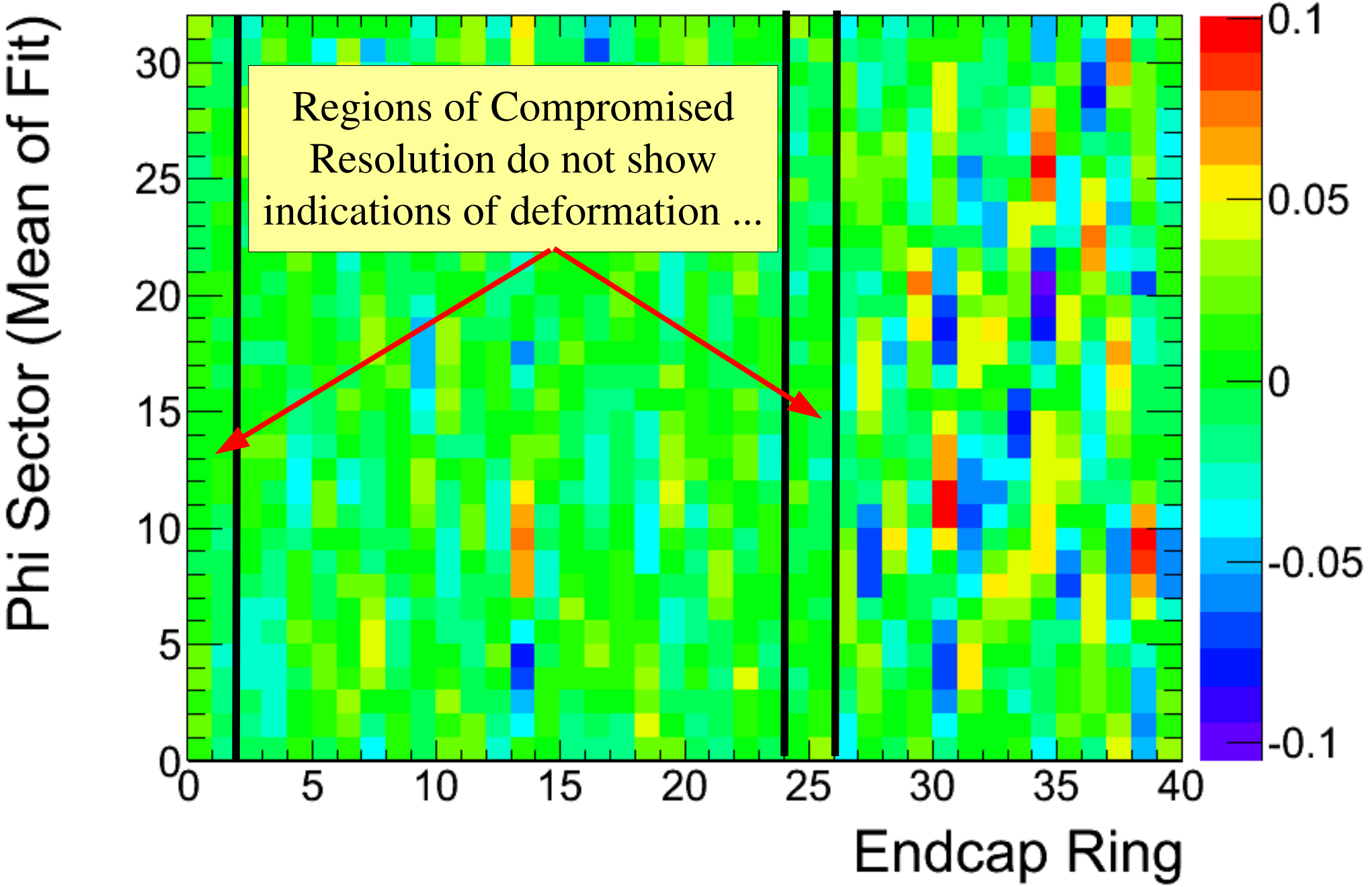
Endcap A

Residual



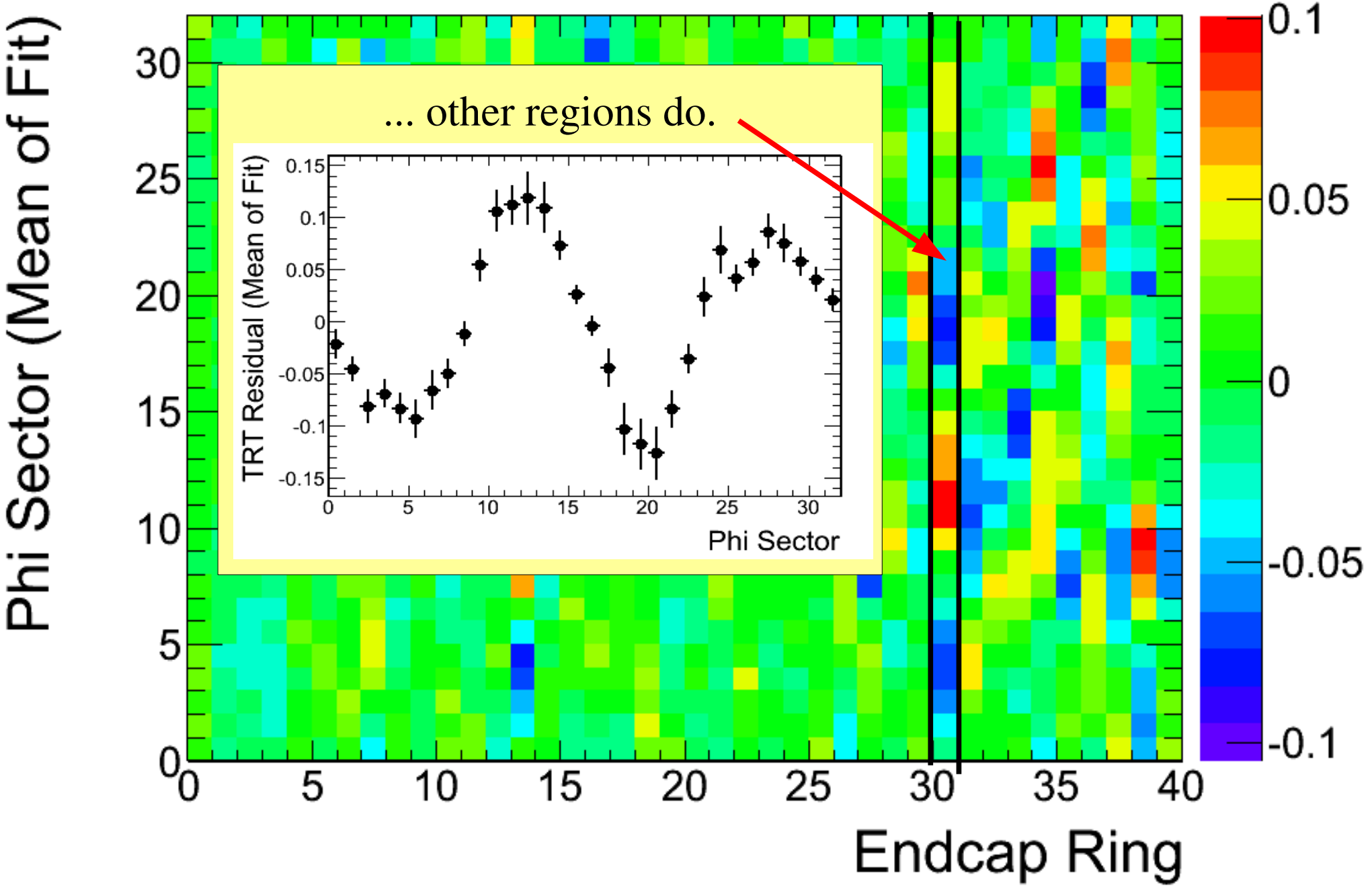
Endcap A

Residual



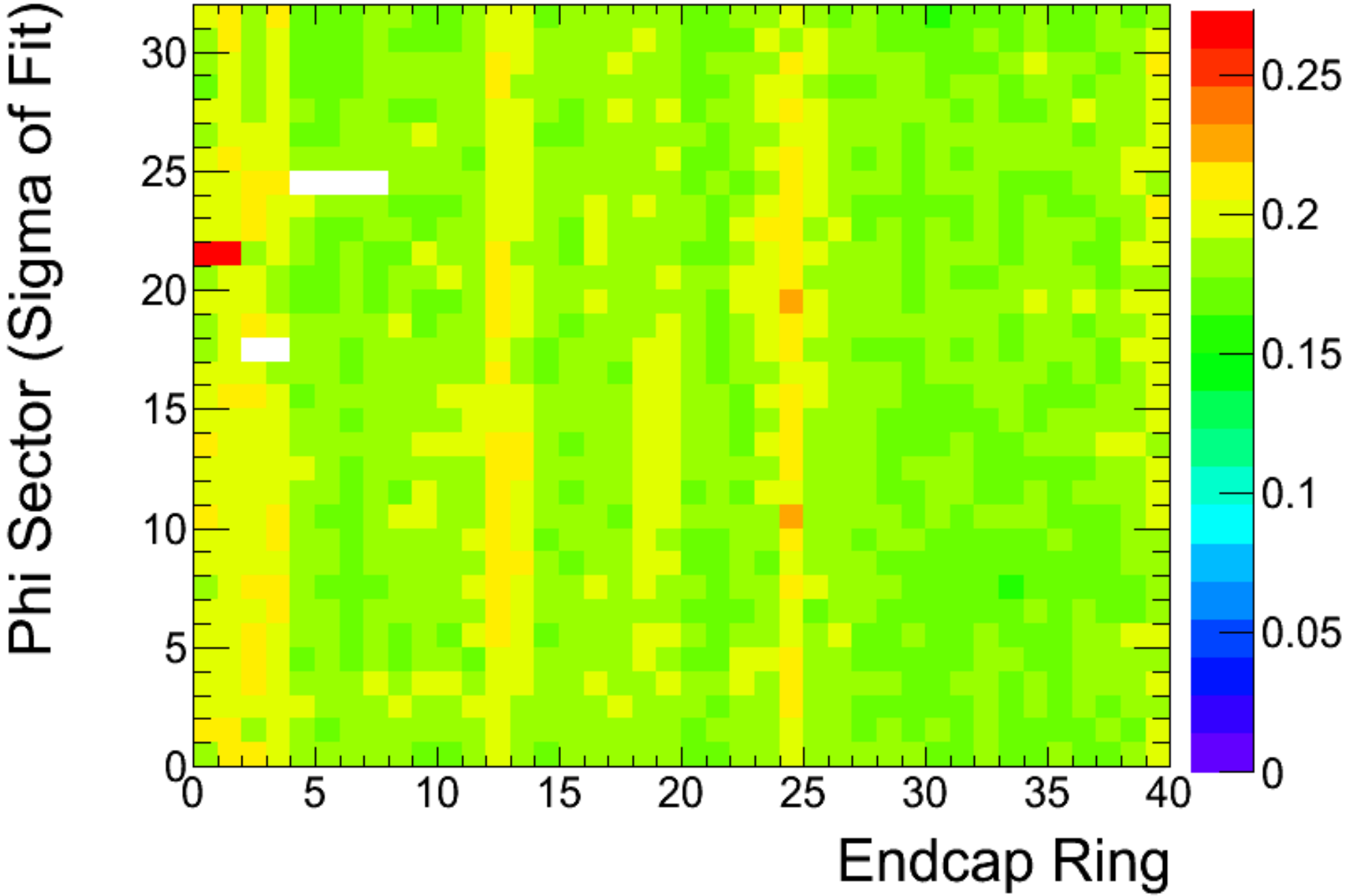
Endcap A

Residual



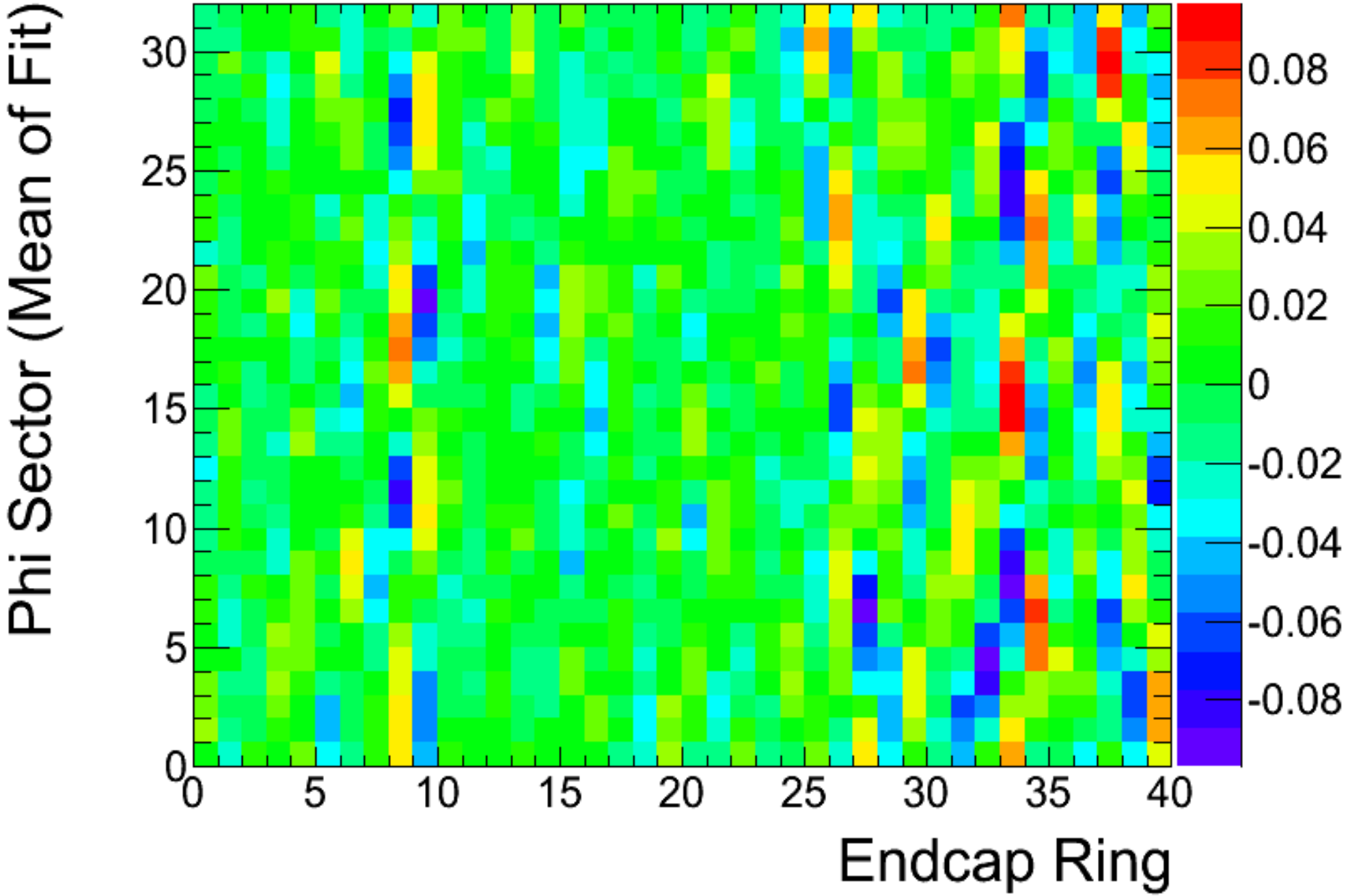
Endcap C

Resolution



Endcap C

Resolution



Reminder:

Endcap Division in Phi Sector is Only logical
Nevertheless, may be convenient to
parameterize misalignment at this level

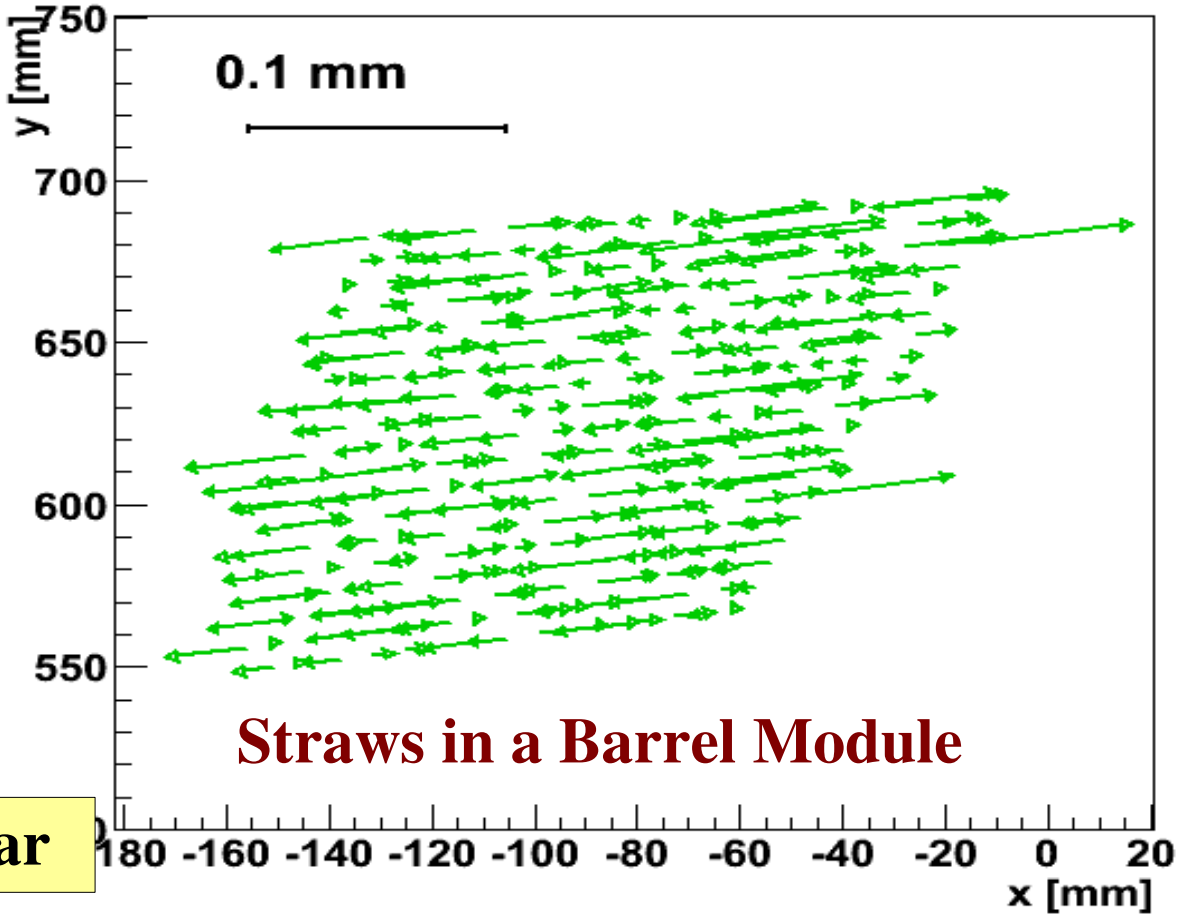
Wire by Wire Alignment

Currently foreseen to:

Position each end of the wire independently, with in the the straw plane.
Effectively, can correct Translations along phi hat, Rotations about r.

Implemented and Validated in Barrel

Endcap still needs tested.

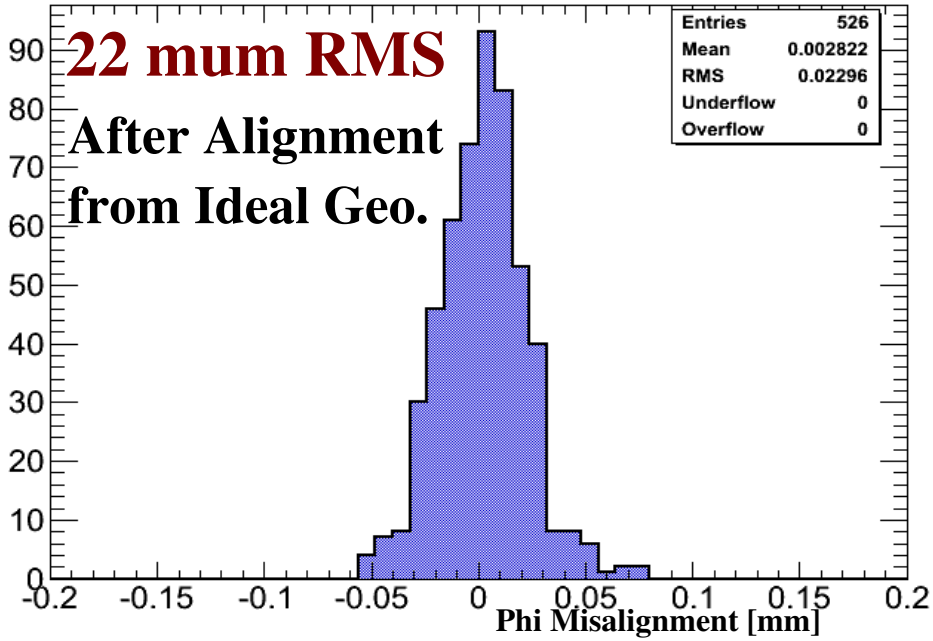


Straws in a Barrel Module

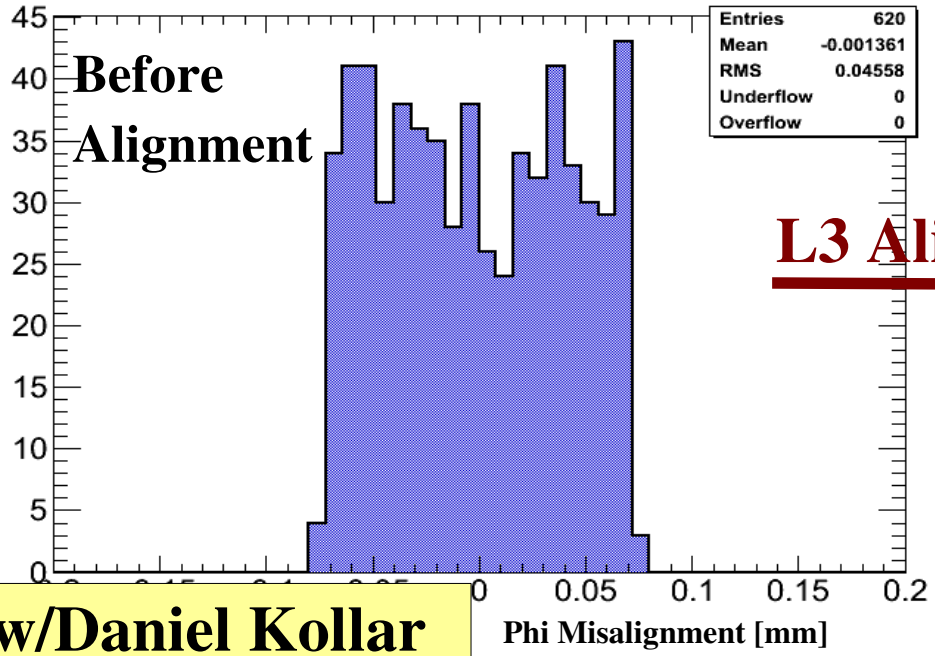
w/Daniel Kollar

Wire by Wire Alignment

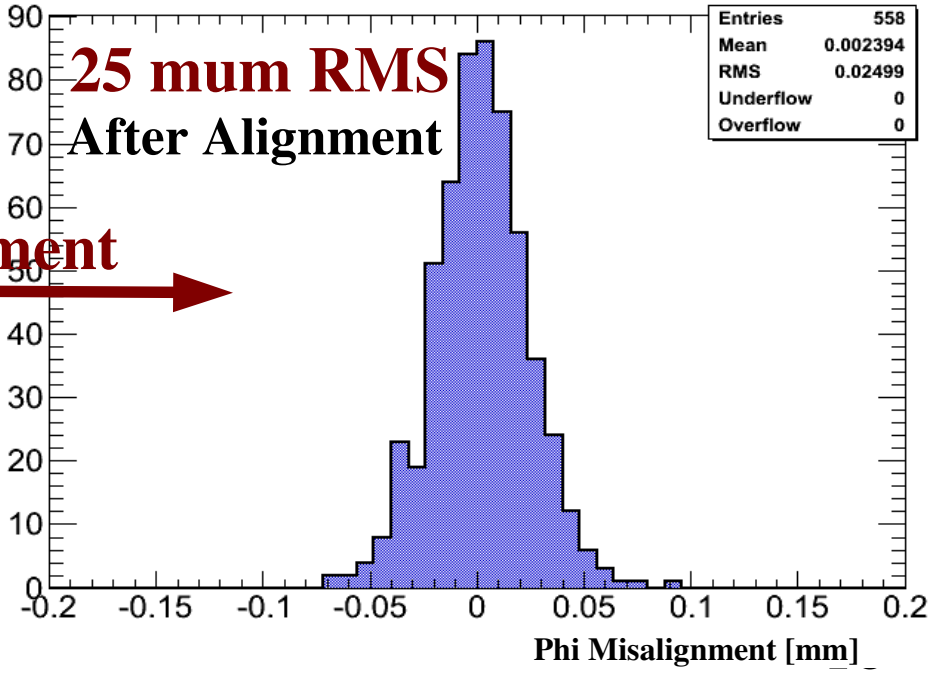
L3 Alignment on one Barrel Module
Run with 10K single muon MC.



Misalignment +/- 75 mum



L3 Alignment



w/Daniel Kollar

Wire by Wire Alignment

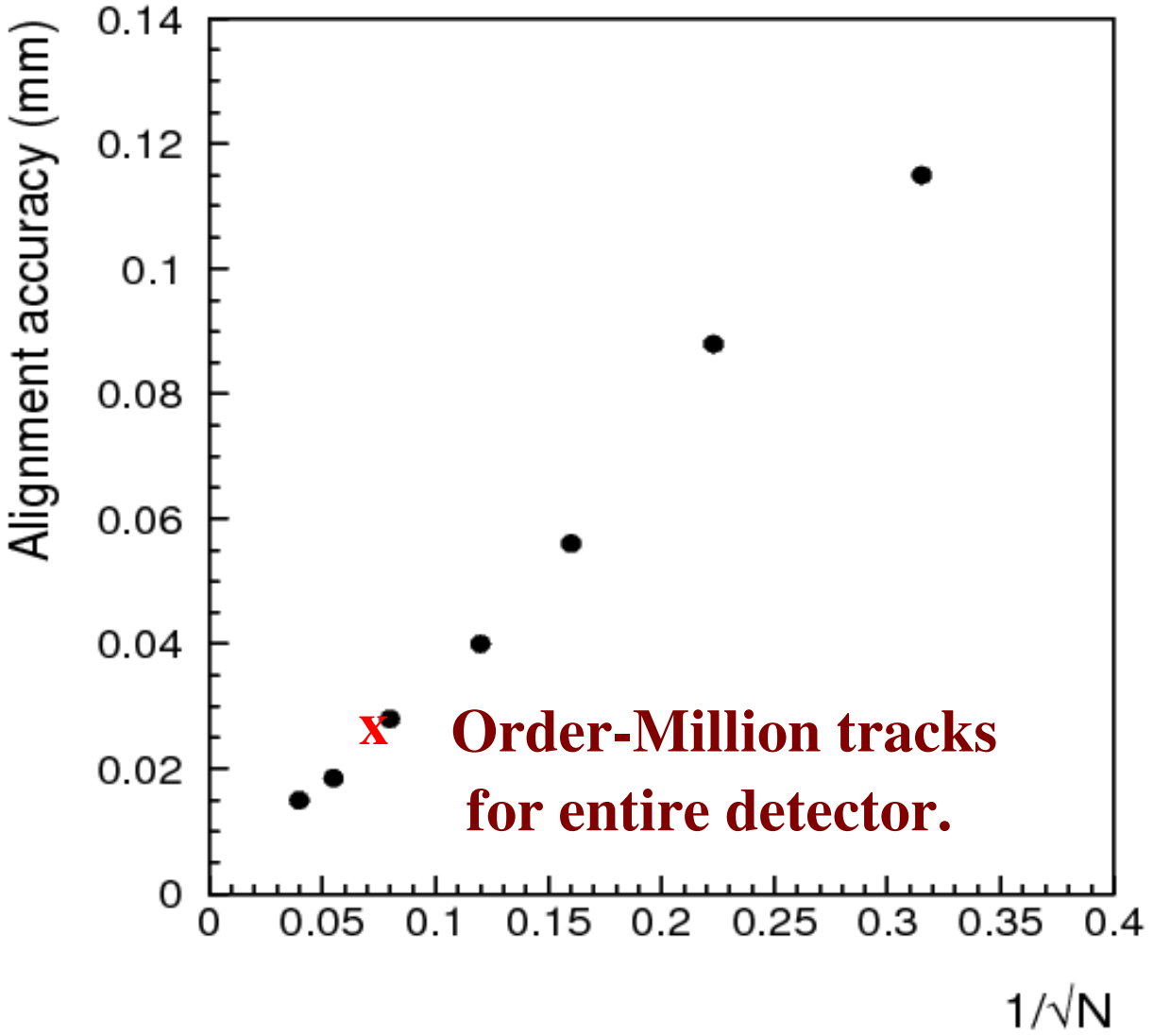


Figure 9-20 Accuracy of the wire alignment as a function of the number of tracks. **- Inner Detector TDR**

Future:

- **Look for / Correct Detector Deformations.**
- L3 Misalignment in a few modules.
- **Alignment End-Game.**
- *How well do we need to align the detector ?*
- Large scale L3 alignment production.

9.1 Requirements

Any misalignment of the elements of the Inner Detector will degrade the resolutions of the overall Inner Detector. Any significant deterioration of the intrinsic detector resolution due to misalignment will degrade both the physics performance and the pattern recognition capability of the Inner Detector. Therefore the requirements for the alignment precision are set by demanding that the overall effect of all misalignments of the Inner Detector should not significantly degrade the resolutions. For this analysis, a 20% degradation has been defined as significant. The resolutions assumed for the detector elements of the Inner Detector[1] are given in Table 9-1

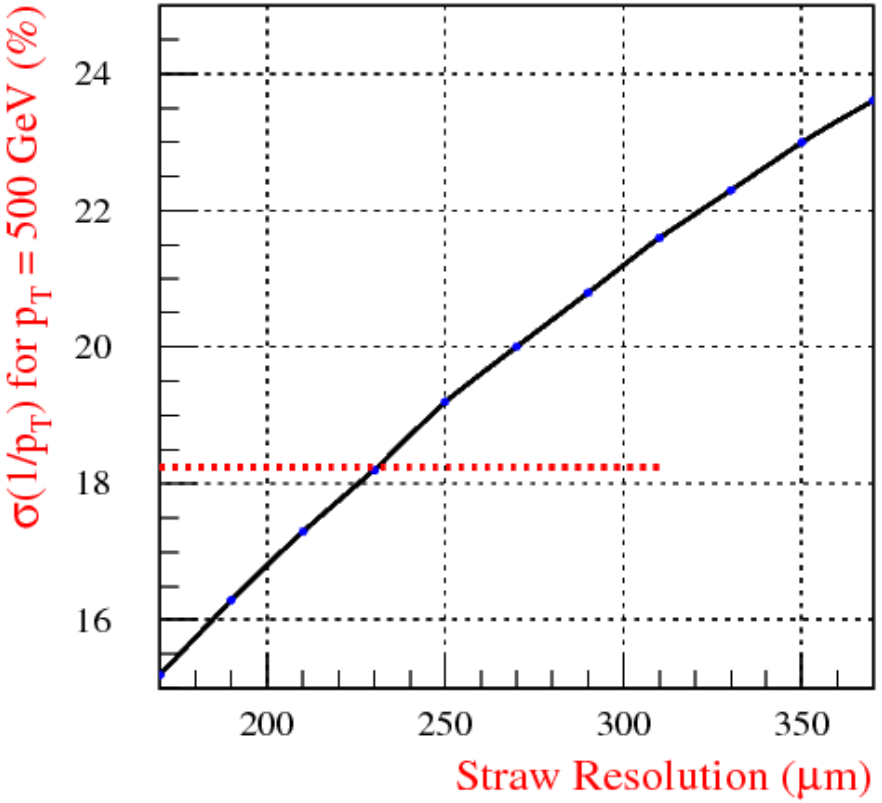


Figure 9-1 Overall Inner Detector p_T resolution as a function of the individual straw resolution. The dotted line corresponds to a 20% degradation.

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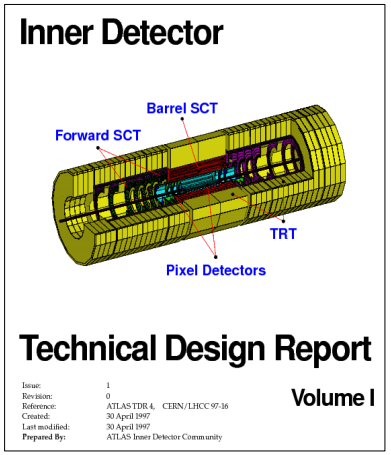


- Simulation with **TRACKERR**
- **Misaligned "Super-Layers"**
- **170 μm resolution assumed**.
- *Is this the correct benchmark ?*
- others ... ?

Combined Test Beam

Information | References | Citations | Discussion | Usage statistics | Fulltext

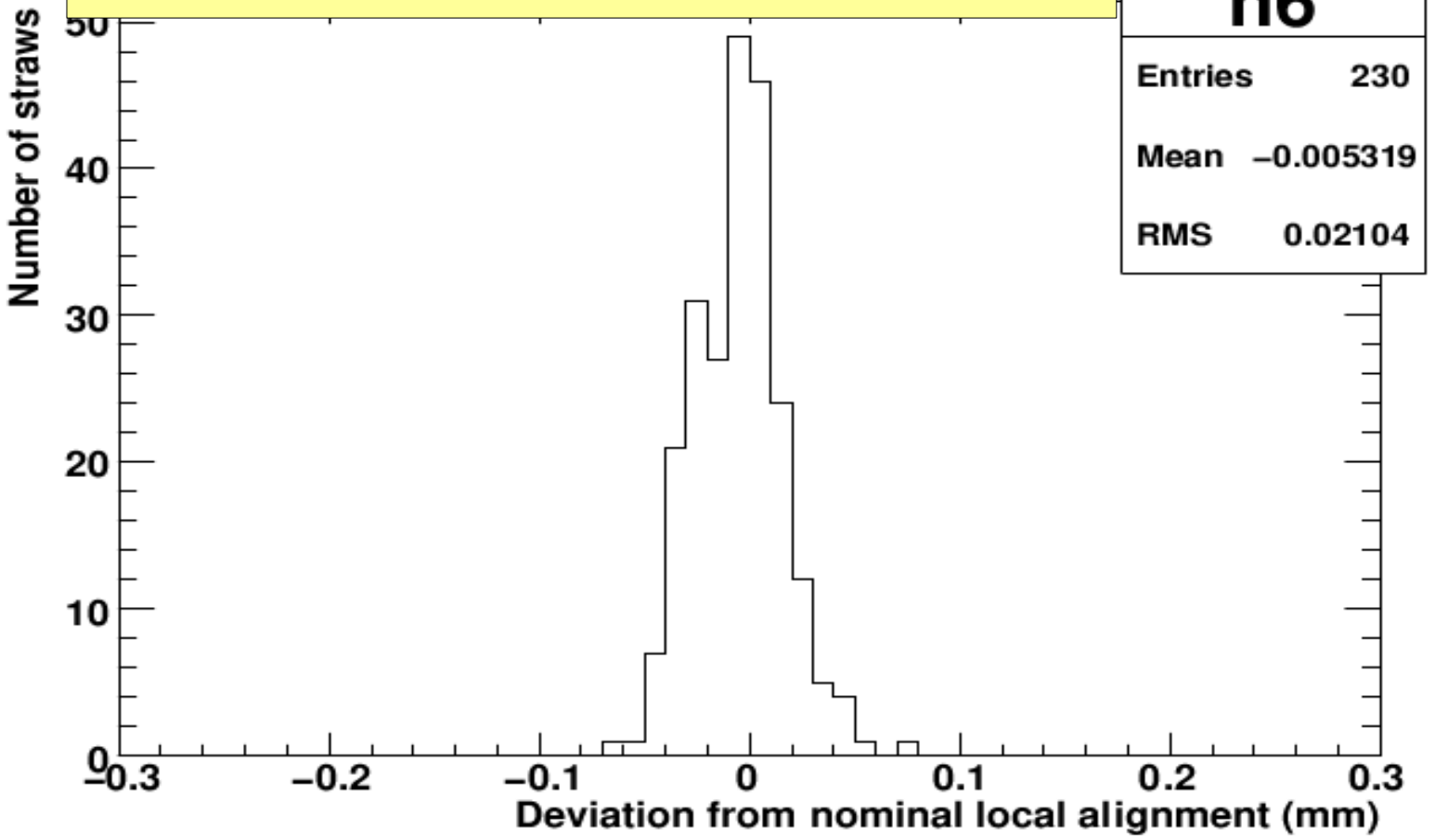
Internal Note

Report number	ATL-COM-INDET-2009-064
Title	**Tracking with the Transition Radiation Tracker in the ATLAS Combined Test Beam**
Author(s)	Hansen, P H (Niels Bohr Institute)
Imprint	28 Sep 2009. - 19 p.
Subject category	Detectors and Experimental Techniques
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	Combined Test Beam
Abstract	

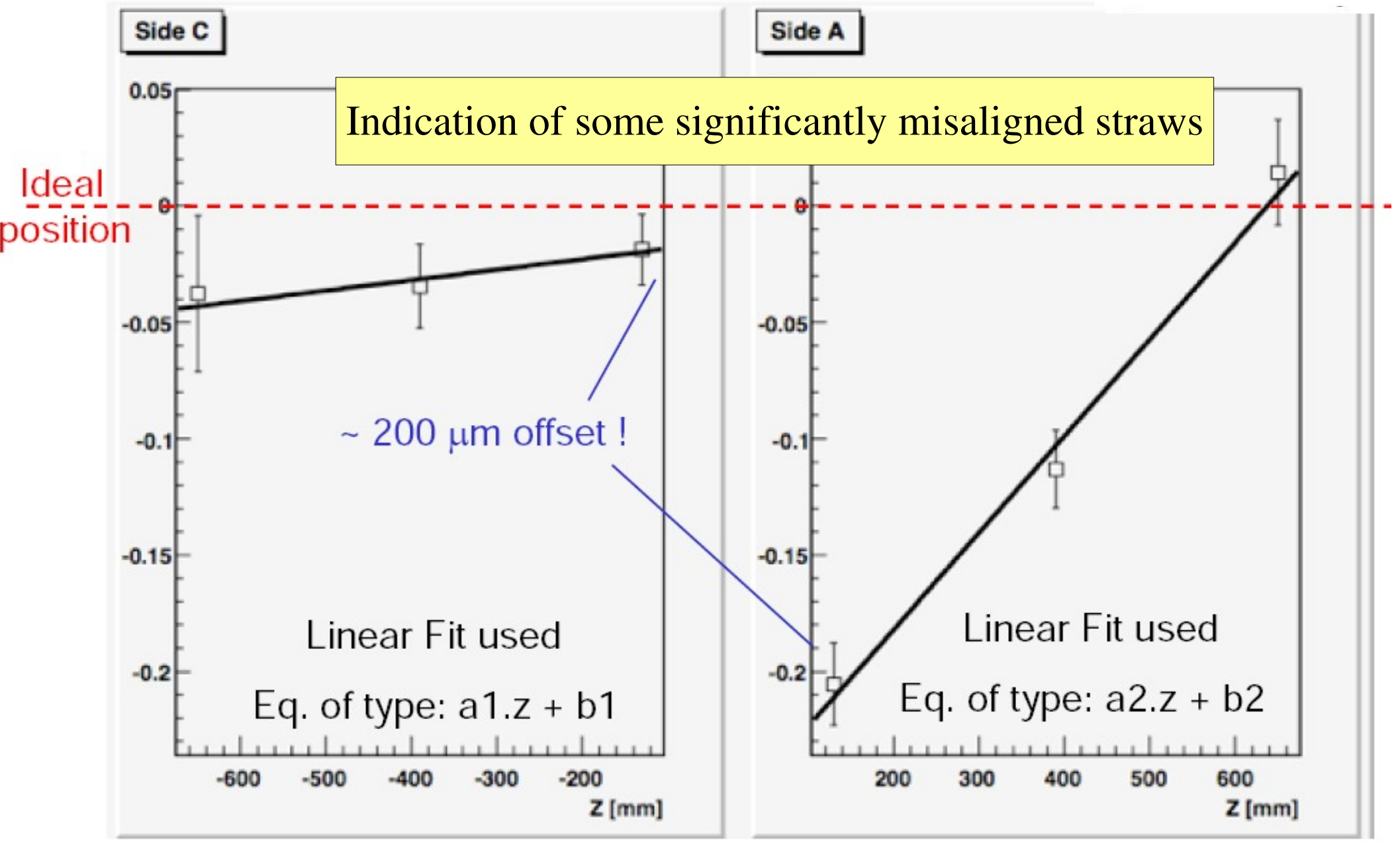
Email contact: phanse

Record created 2009-09

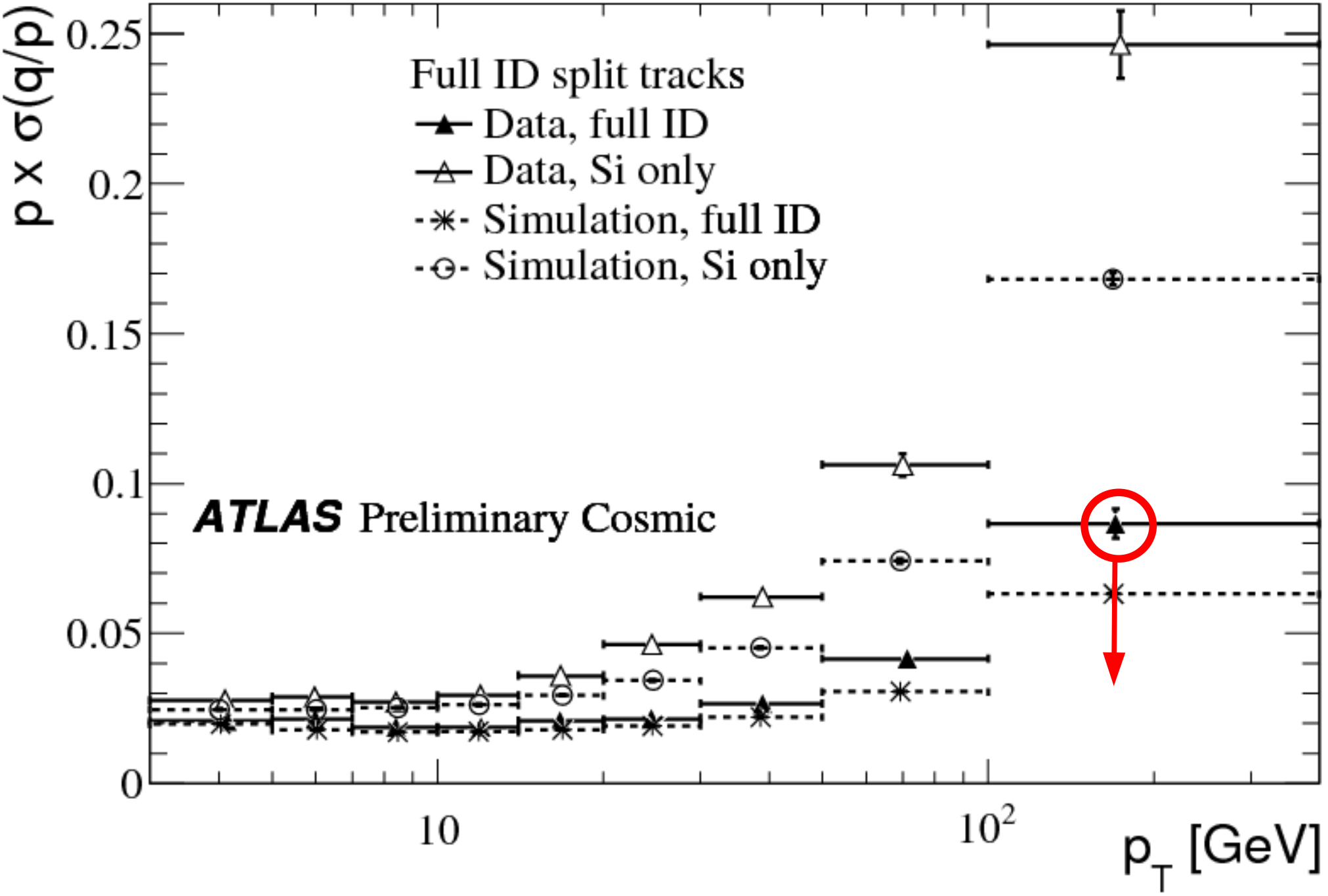
"Straw placement accuracy of 20 mum"



Cosmic Data


Side C
Side A
Indication of some significantly misaligned straws
Ideal position
~ 200 μm offset !
Linear Fit used
Eq. of type: a1.z + b1
Linear Fit used
Eq. of type: a2.z + b2
0.05
0
-0.05
-0.1
-0.15
-0.2
-600
-500
-400
-300
-200
200
300
400
500
600
Z [mm]
Z [mm]

Summary


p x σ(q/p)
0.25
0.2
0.15
0.1
0.05
0
Full ID split tracks
Data, full ID
Data, Si only
Simulation, full ID
Simulation, Si only
ATLAS Preliminary Cosmic
10
10^2
p_T [GeV]

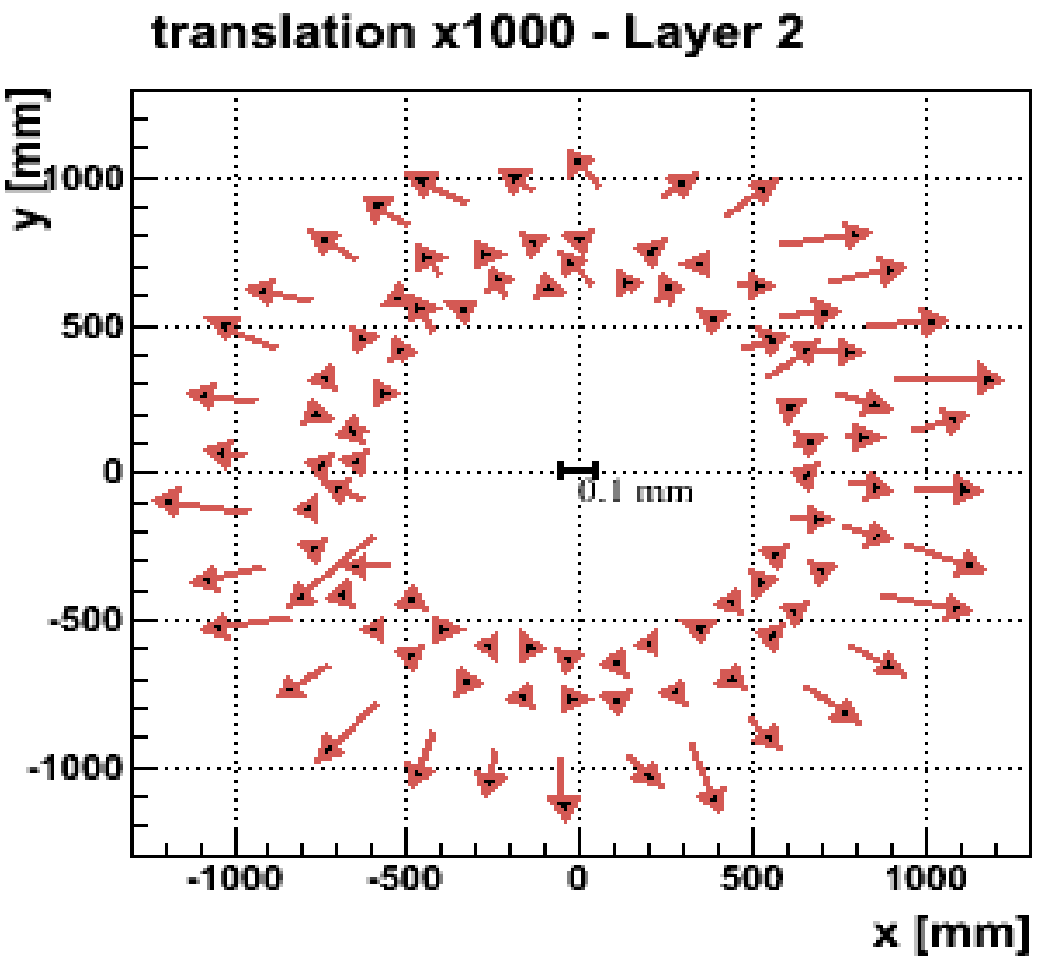
Back Up

L1 Alignment Corrections w/respect to Nominal

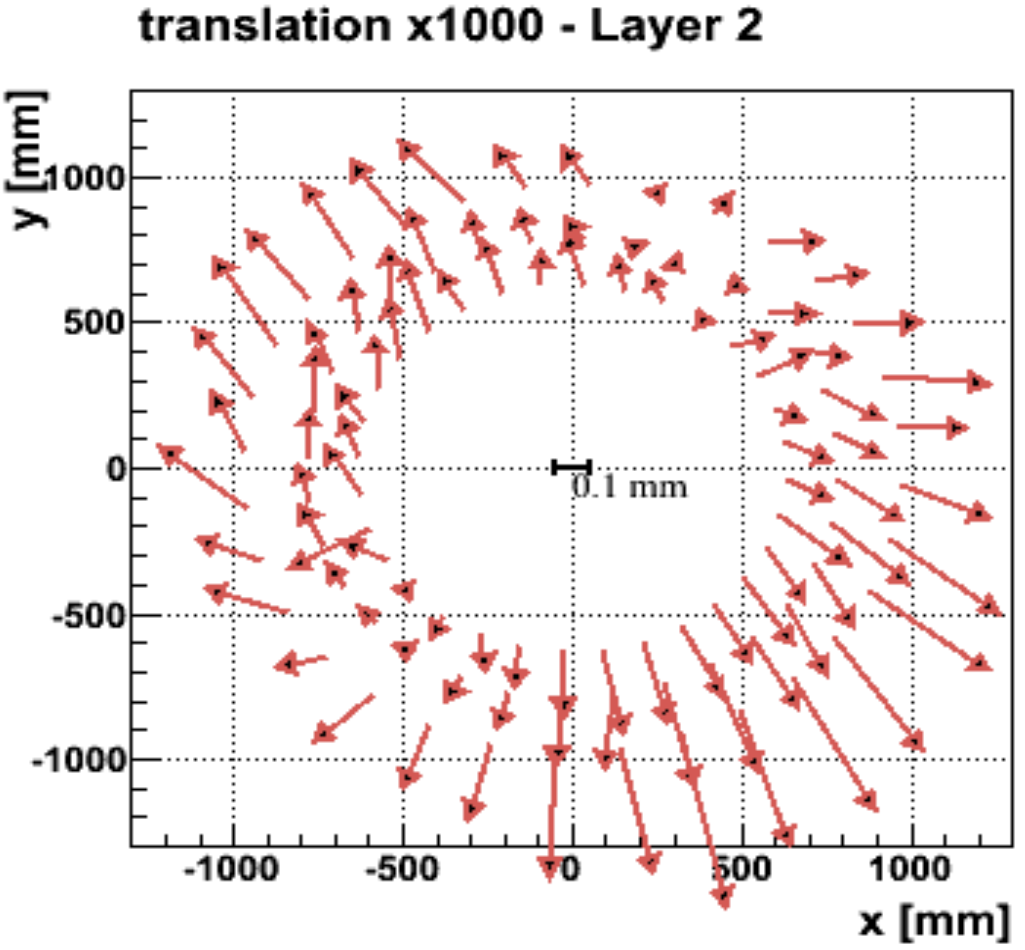
	Endcap C	Barrel	Endap A
Tx[mm]	-1.048	0.239	-1.488
Ty[mm]	1.746	-0.171	0.242
Tz[mm]	2.112	N/A	-3.375
Rotx[mrad]	-0.758	-0.135	0.055
Roty[mrad]	0.038	0.402	0.884
Rotz[mrad]	6.391	-0.040	-6.978

L2 Barrel Corrections

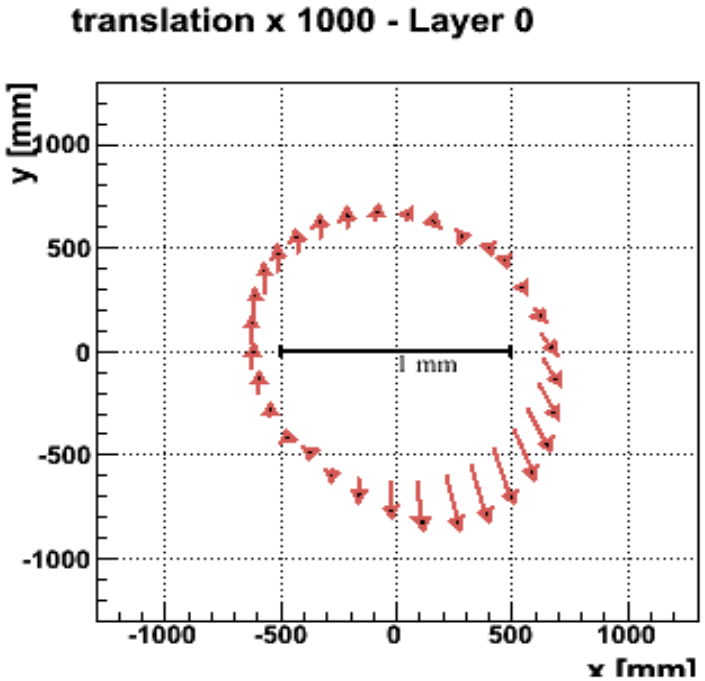
Only TRT information

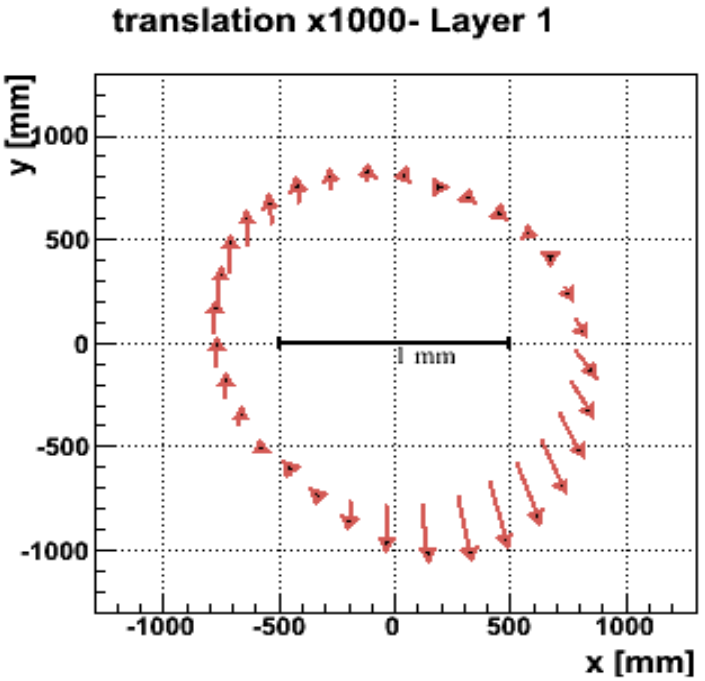


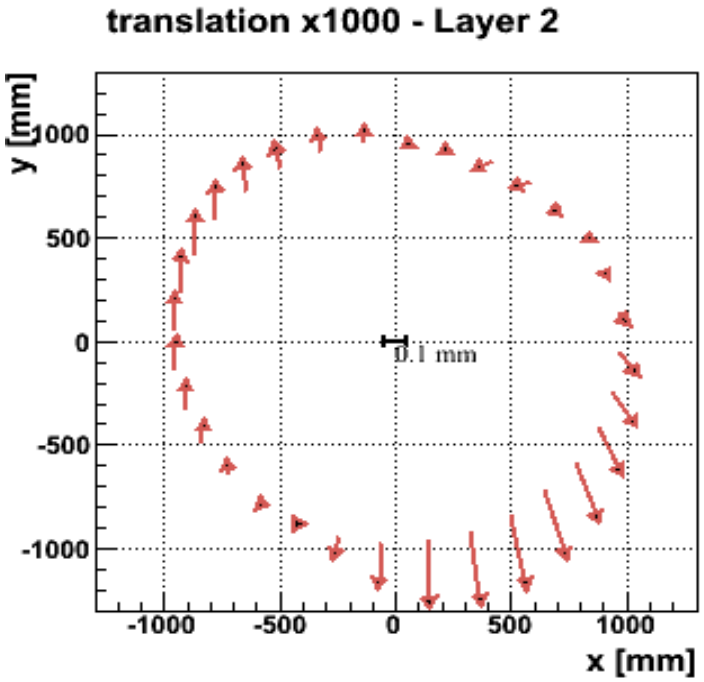
Using Si Information

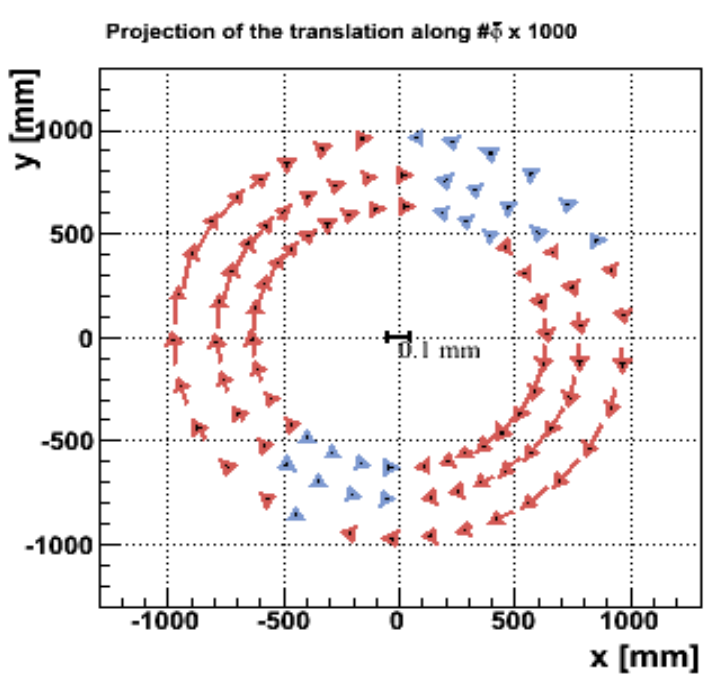


Differences in L2 Barrel Geometries

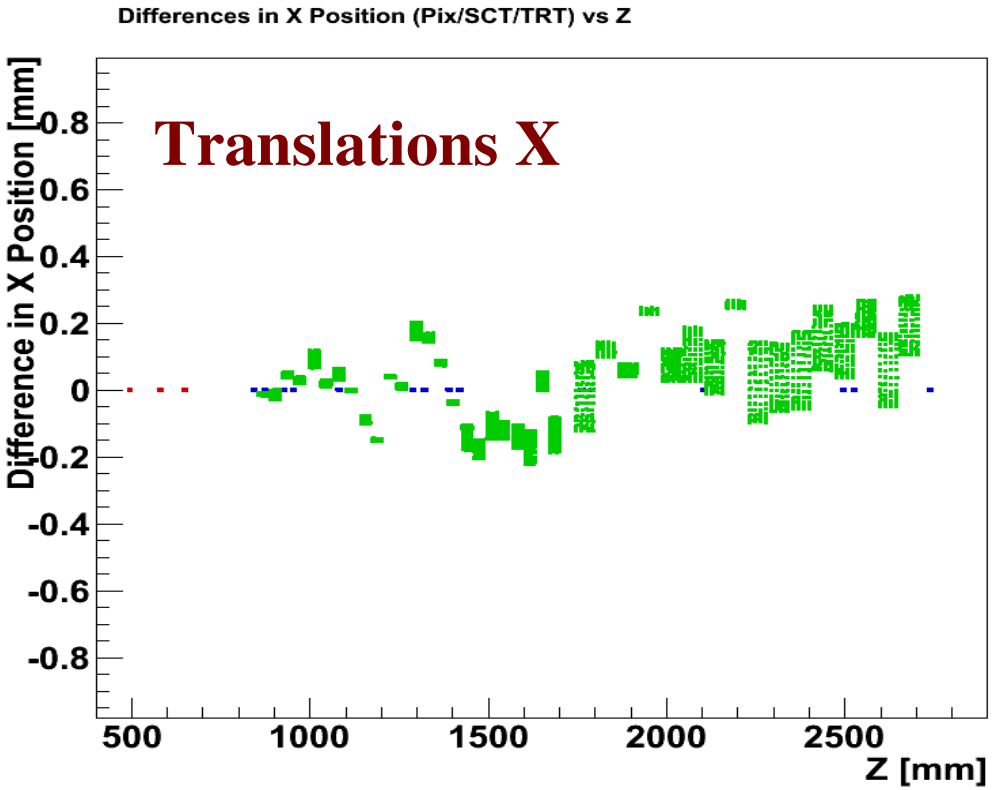


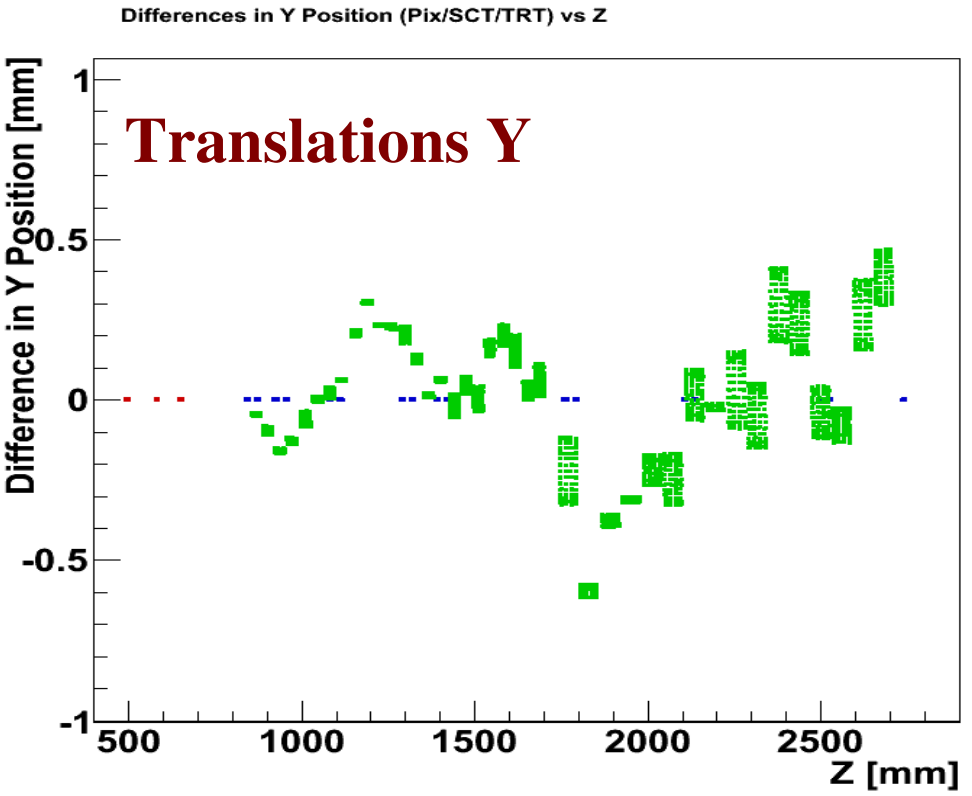




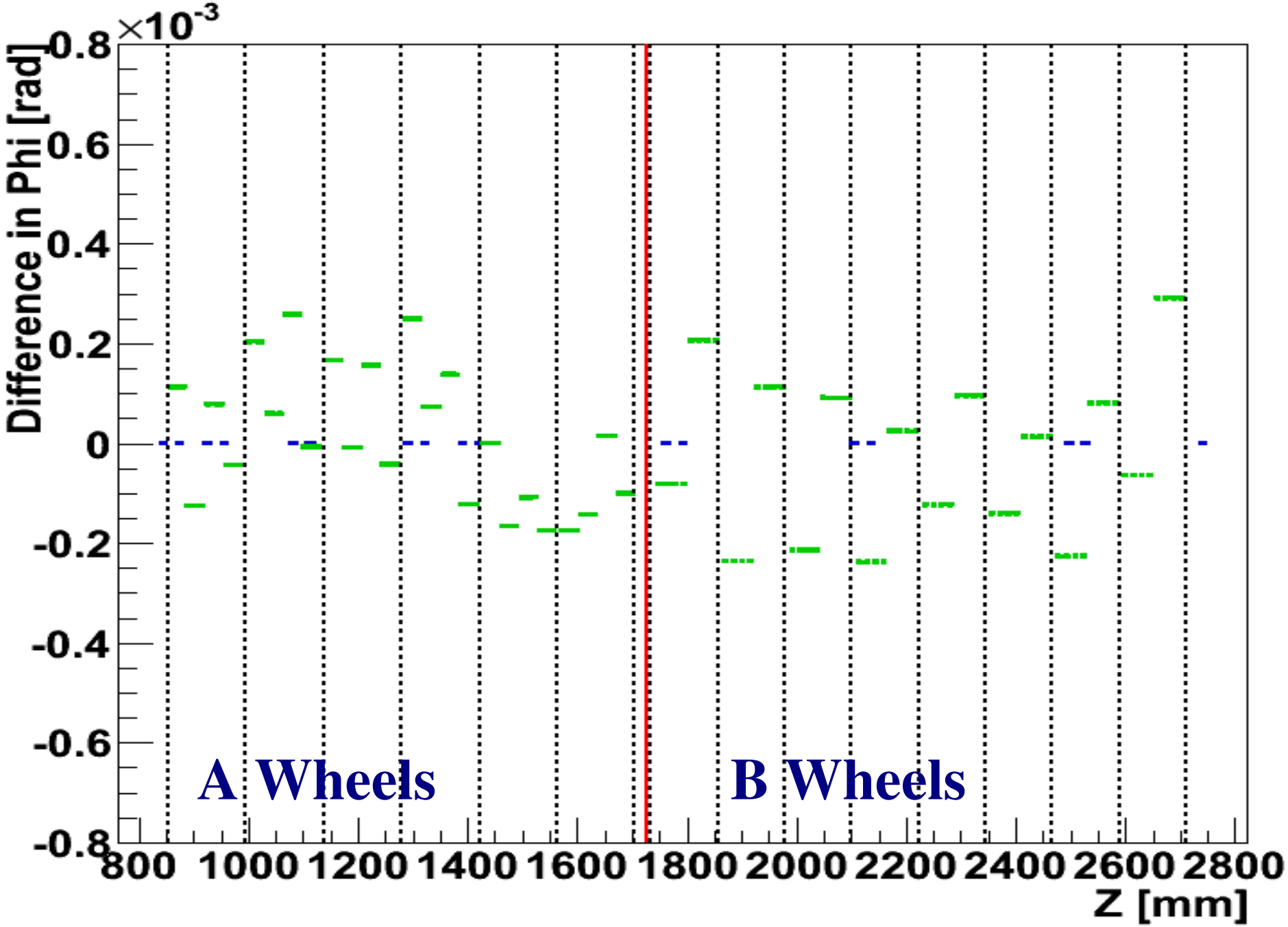


L2 Endcap A Translations

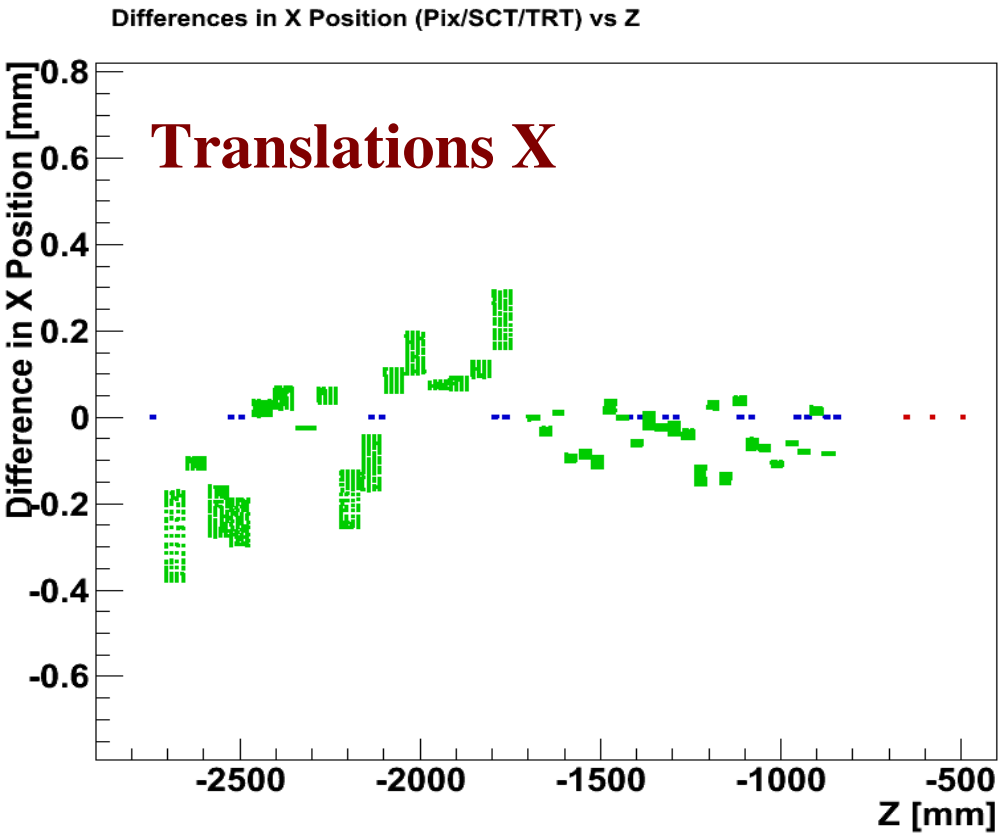


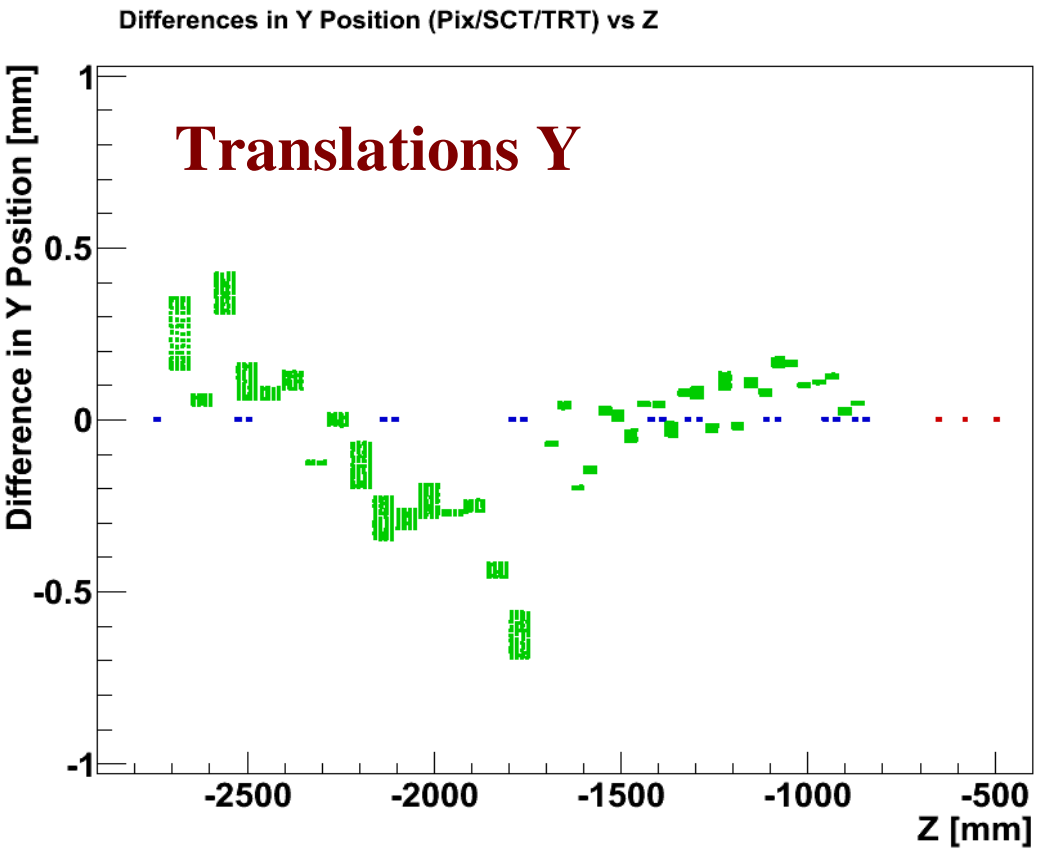


L2 Endcap A Phi Corrections



L2 Endcap C Translations





L2 Endcap C Phi Corrections