0T Collision tracks in track-based alignment and LA calibration

(recent results)

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Introduction

- There is a 2012C dataset that contains collision data recorded with no magnetic field;
- Datasets: /ZeroBias[1-4]/Run2012C-TkAlMinBias-v2/ALCARECO
- Run numbers: 201431-201476 : ~60 pb^{-1} : ~200 M tracks
- That large amount of 0T tracks can significantly separate module alignment from LA calibration, improve absolute values and systematic uncertainties of LA corrections.
- Multiple test alignments have been run in order to find optimal selection criteria of good tracks from 0T Collision data.
-

Alignment setup: mp1284

Based on mp1193 baseline alignment presented by Jörg on Tracker Alignment Week:

- Full scale alignment starting from CRAFT12;
- 2012 A+B data used in alignment (original from mp1193):

  MinimumBias, SingleMu, peak Cosmics (interfill + CRAFT12), DoubleMu

Differences from mp1193:

- + 2012 C+D data: SingleMu, MinBias, DoubleMu
- + CRUZET 0T Cosmics, 2012C 0T Collision
- No Kinks&Bows alignment due to technical problems;
- Alignables: Large Structures, PixelModules: 111111
  TIB,TOB,TID,TEC Modules: 101111

Calibration setup: mp1268

- BPIX granularity:

  24 parameters: 3 layers x 8 rings

- FPIX granularity:

  2 parameters: left side, right side;

- Time granularity:

  49 IOVs : ~100 pb^{-1} per IOV

- Plus 1 alignment parameter per TIB, TOB;

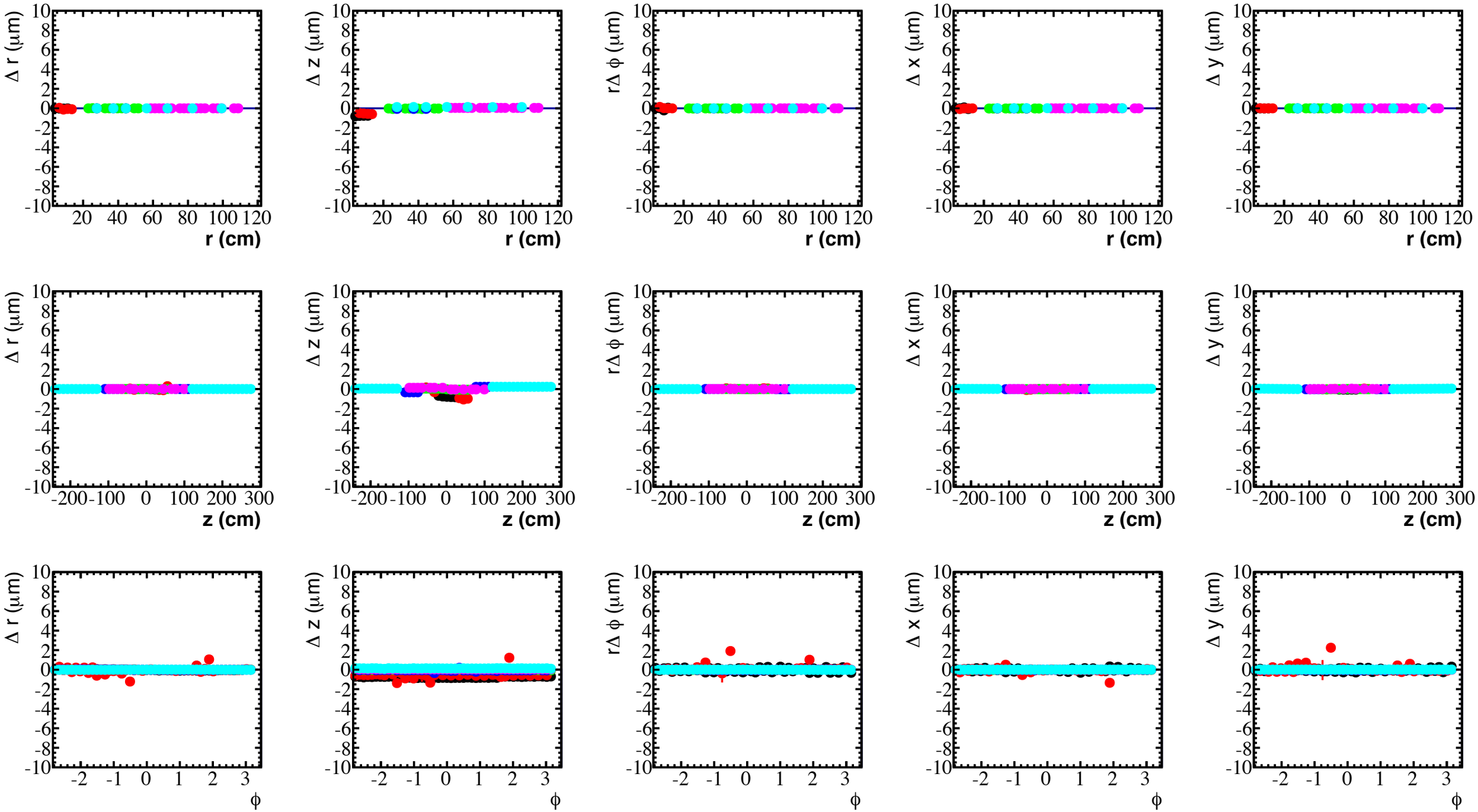
- Total number of used tracks: ~ 55 M
- Number of used 0T Collision tracks: ~ 5.3 M ($\geq$10 hits)

Effect of momentum estimate

P(GeV)	Rejects	NChi2 (0T trk)	N 0T tracks
5	1.6%	1.38	5.33 M
3	0.36%	0.9	5.33 M
2	0.32%	0.58	5.33 M
1	0.31%	0.27	5.33 M
0.5	0.31%	0.13	5.33 M
0.3	-	-	5.33 M
0.1	-	-	47.3 K
No 0T	0.34%	0.9	-

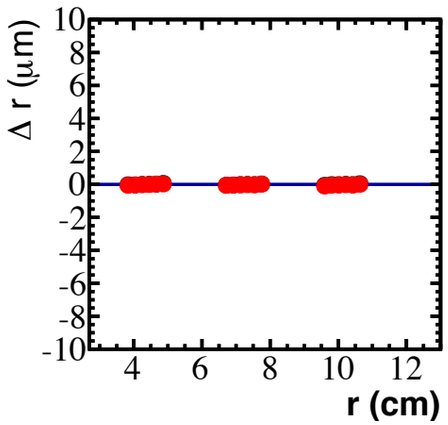
3 GeV momentum estimate was chosen as optimal for validation since it is closest to the result from alignment without 0T collision tracks.

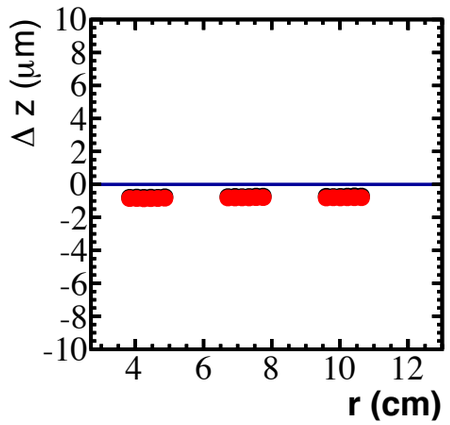
Geometry comparison: DetUnits

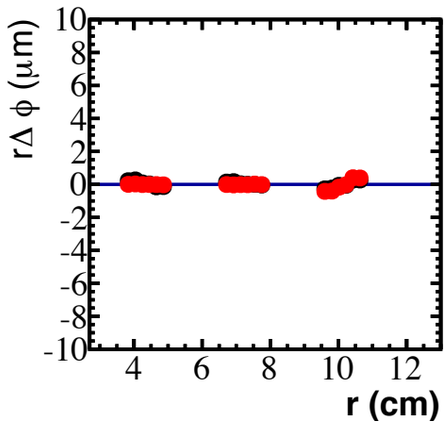


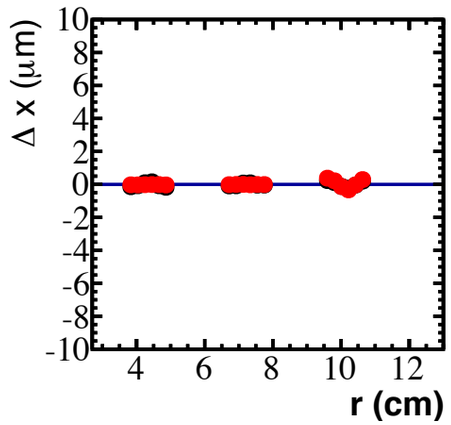
Small difference in Pixel Endcaps between two geometries: aligned with and without 0T Collision tracks.

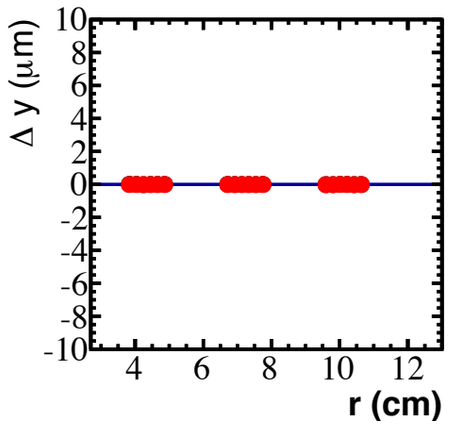
Geometry comparison: BPIX

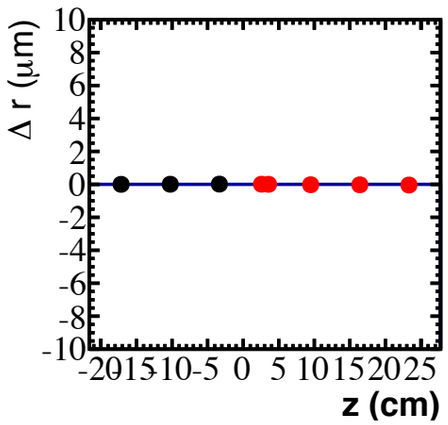


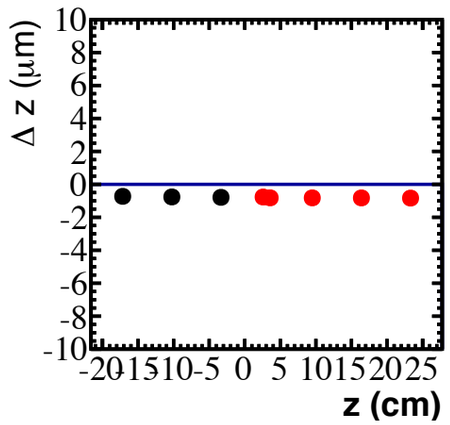


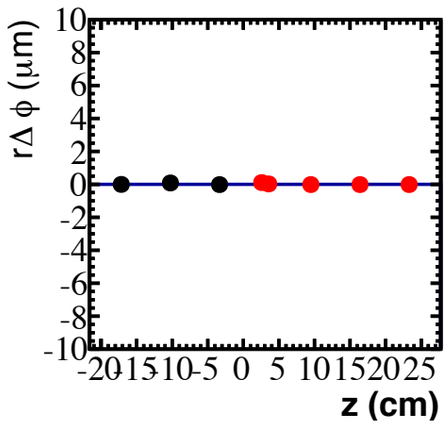


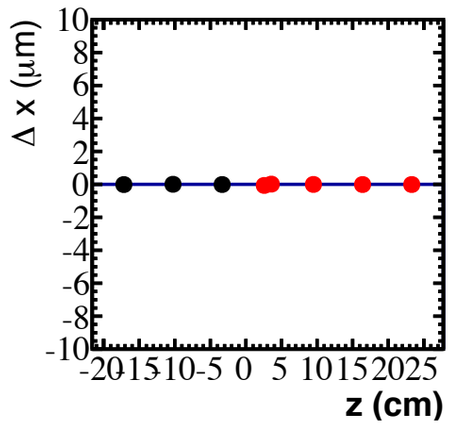


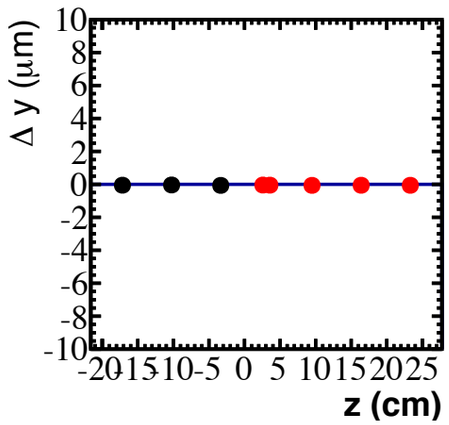


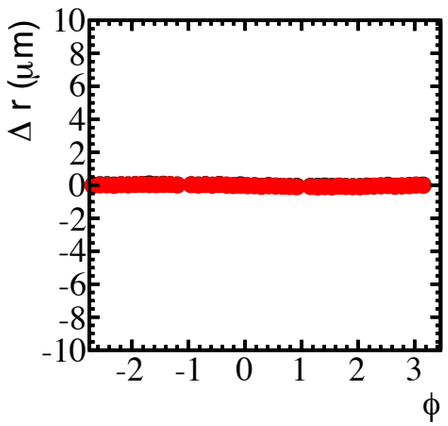


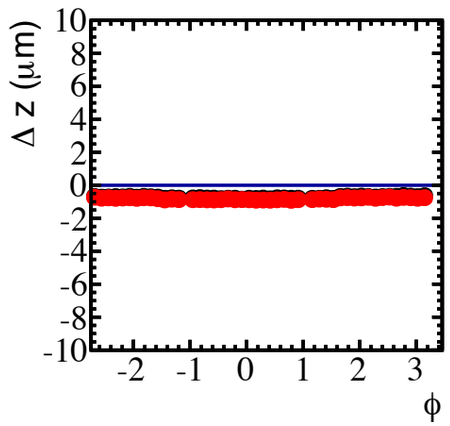


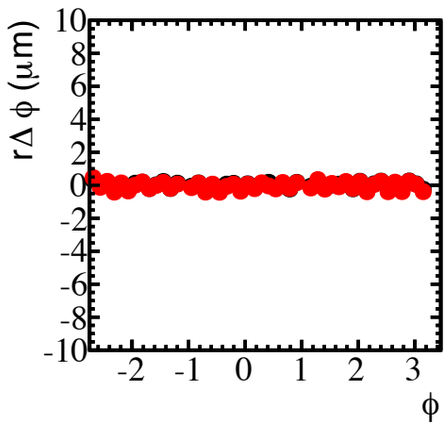


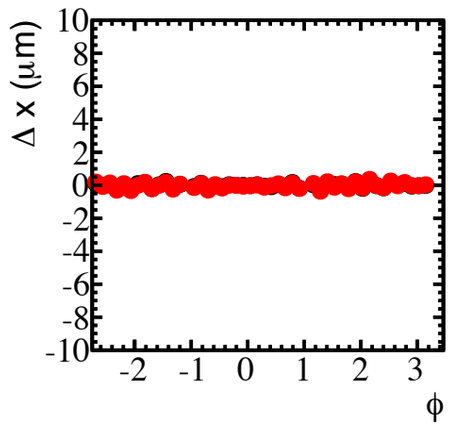


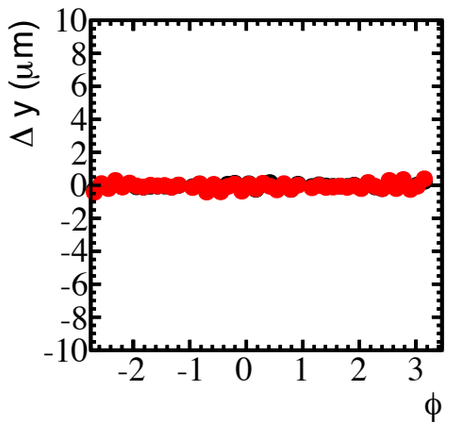




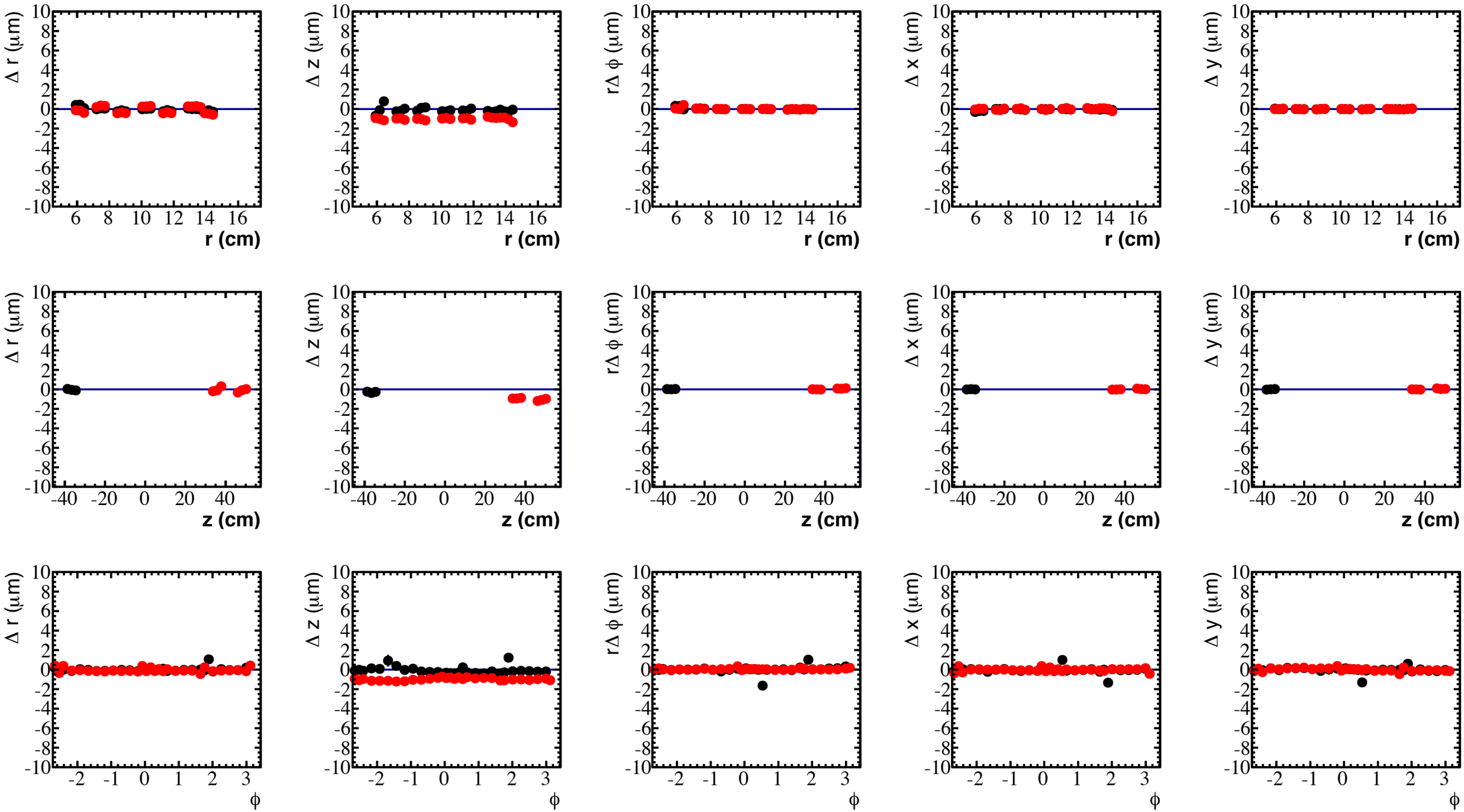








Geometry comparison: FPIX



3.8T validation setup

Dataset: `/SingleMu/Run2012C-TkAlMuonIsolated-v2/ALCARECO`

Run range: 201196 - 201610 (~2.2 M events, ~ 2.4 M tracks)

Run range selected because it fits in a single IOV of LA calibration, that contains all processed 0T Collision data.

Global tag: FT_R_53_V6C::All

TrackerIdealGeometryErrors210_mc

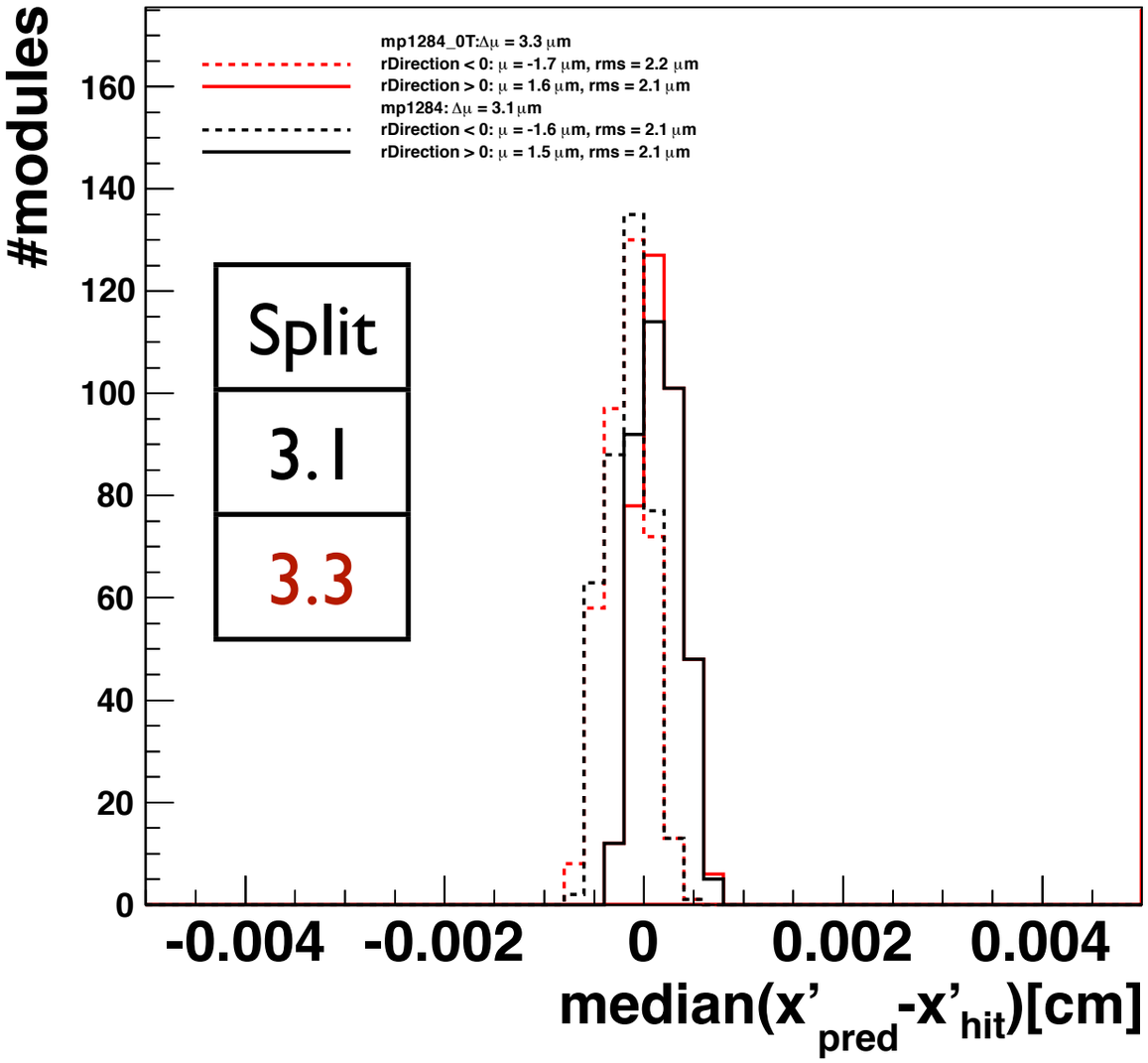
Kinks & bows: mp1098/TrackerSurfaceDeformations_v1_offline_split.db, Deformations_1

PixelLA:

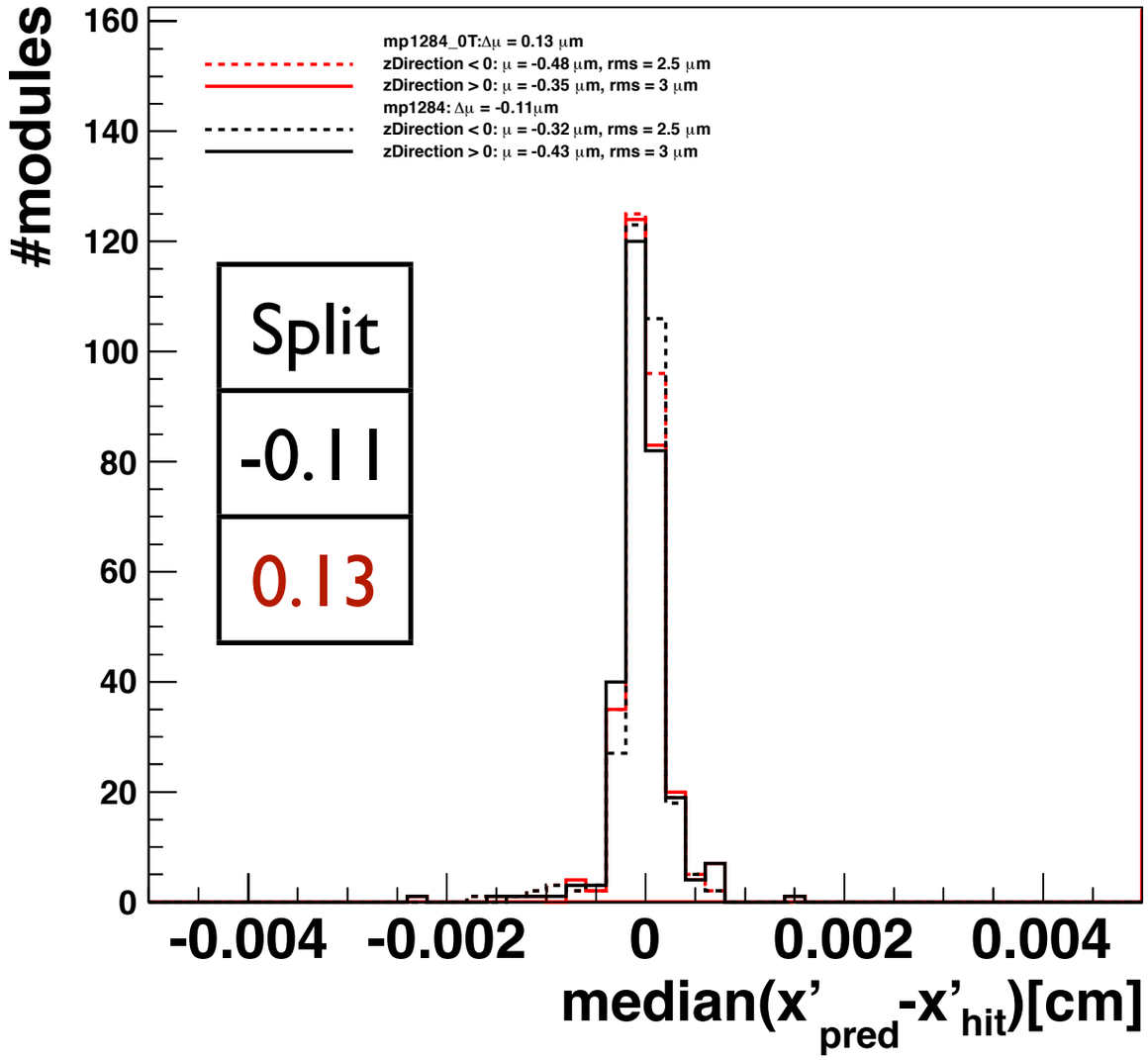
- with 0T Collision tracks
- without 0T Collision tracks

3.8T validation setup

Distribution of the median of the residuals in TPB

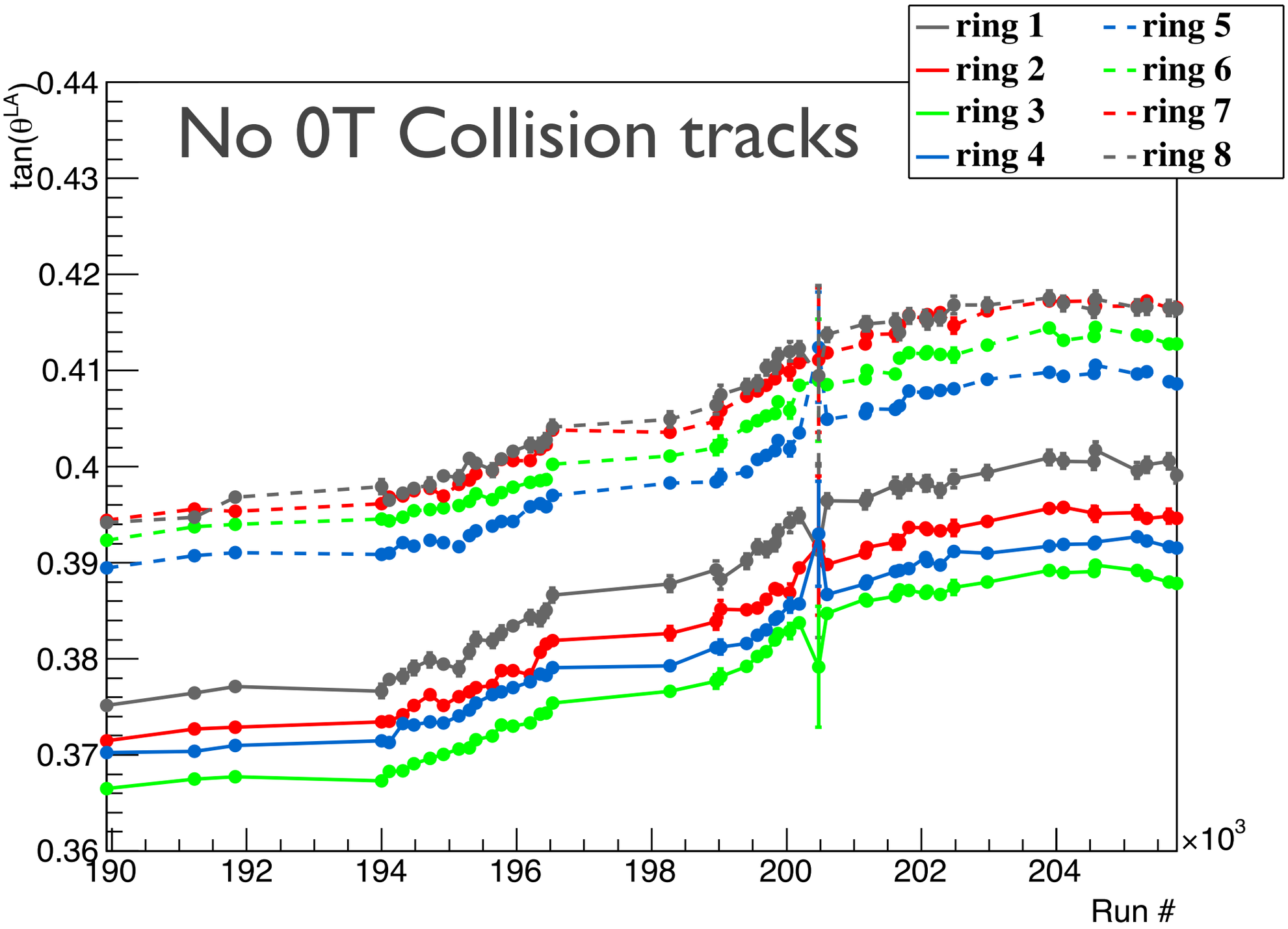


Distribution of the median of the residuals in TPE



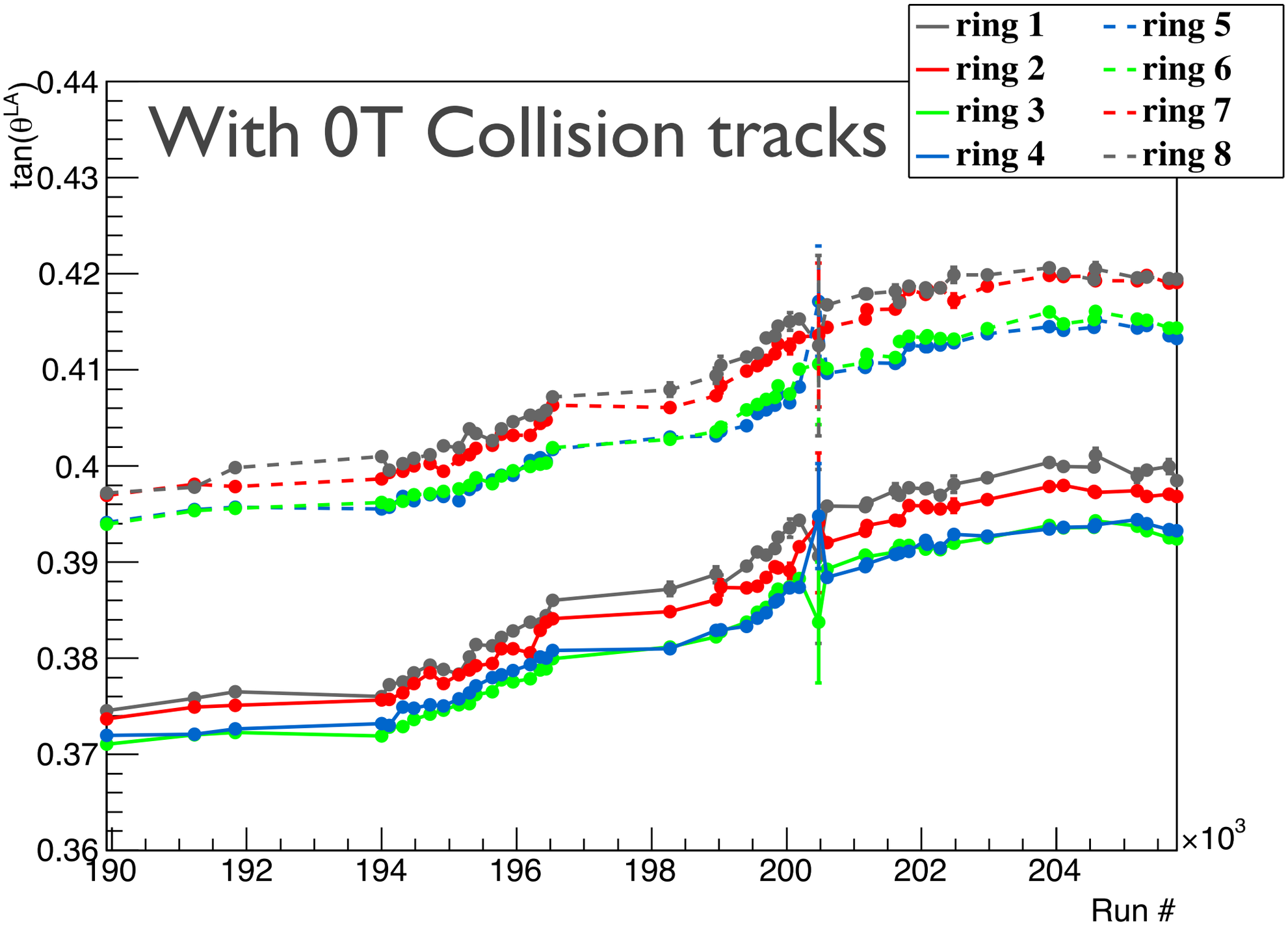
2x narrower DMR from track-based calibration

LA time dependence: BPIX



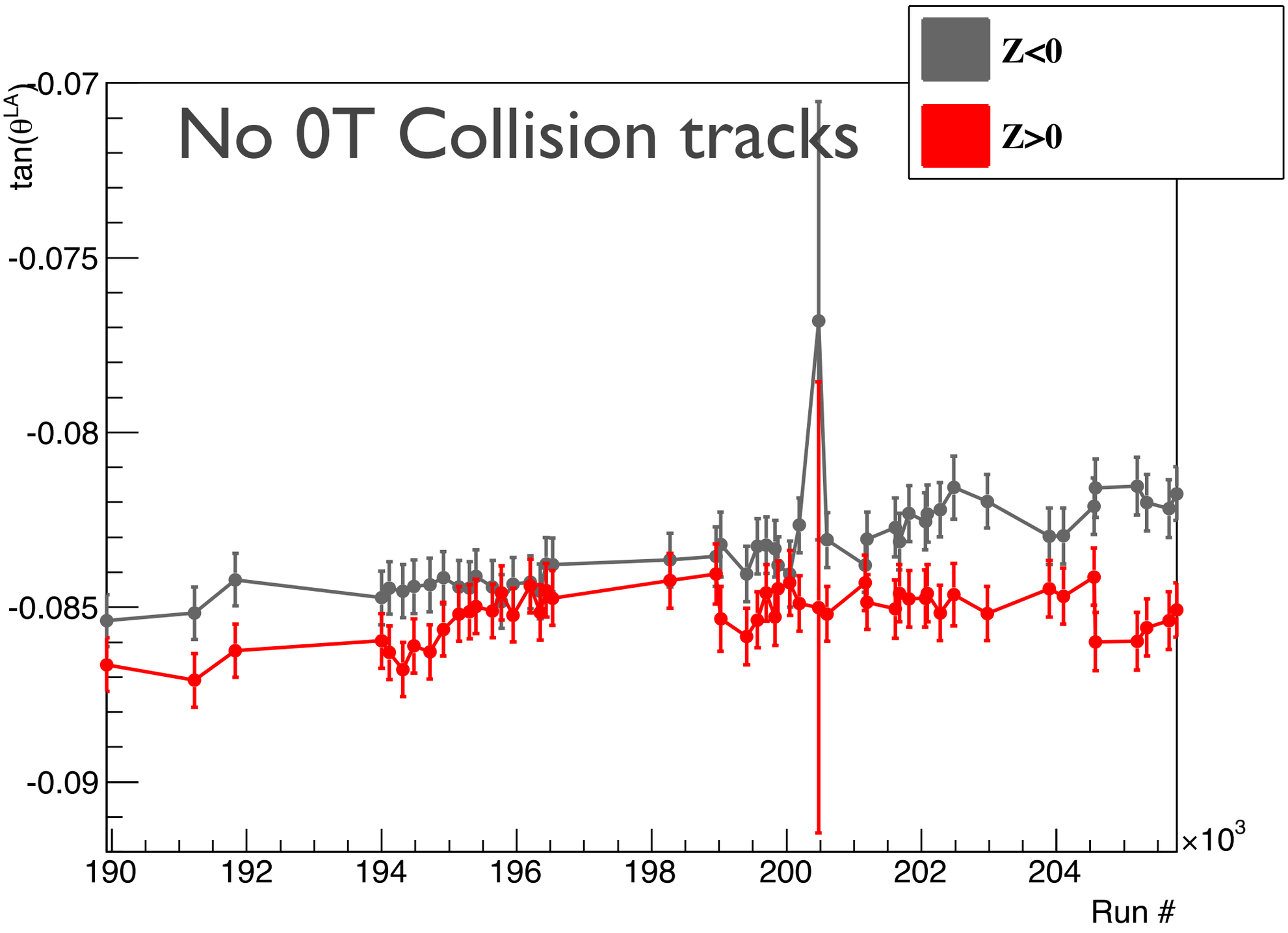
Familiar time dependence in BPIX.

LA time dependence: BPIX

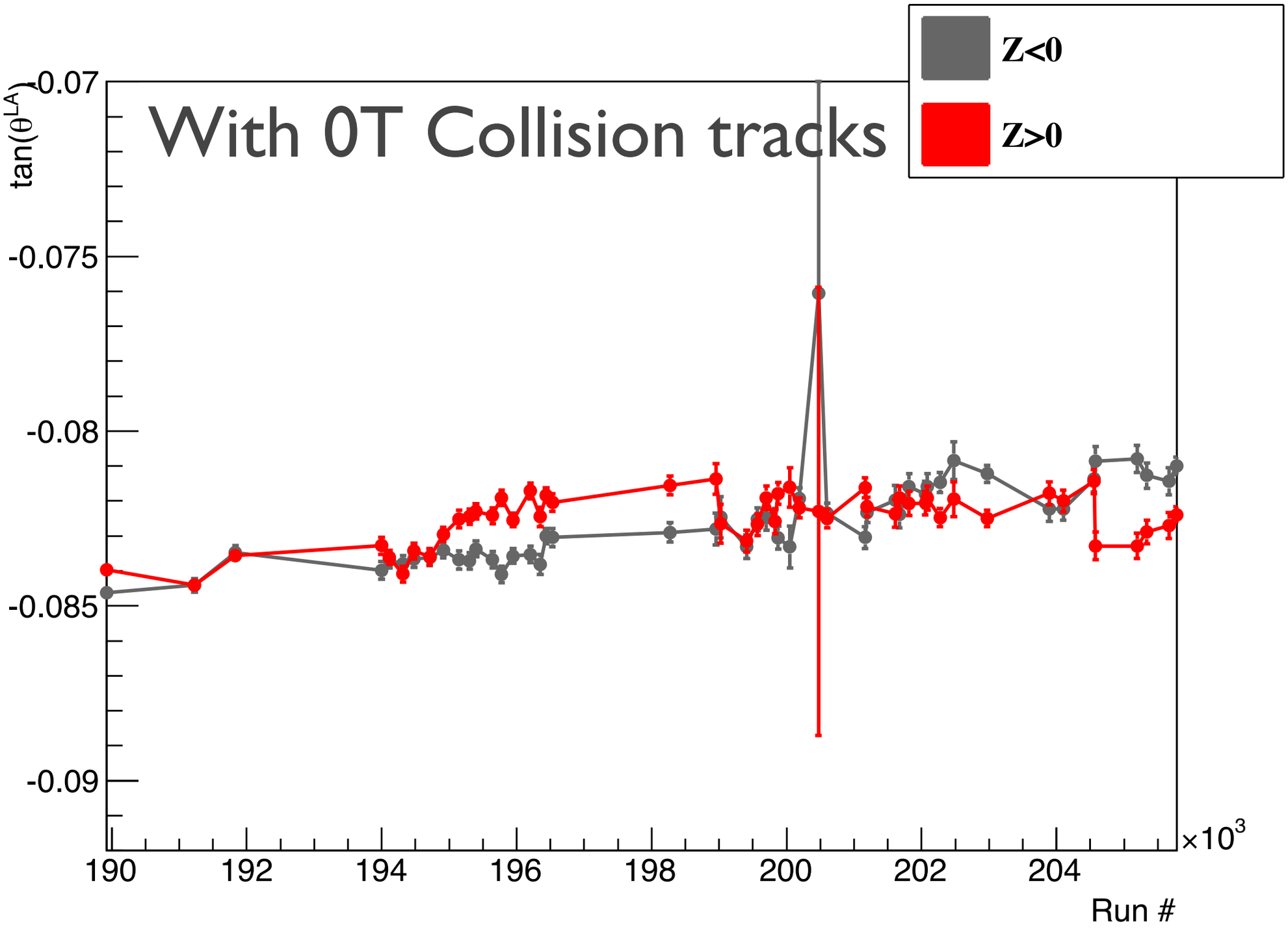


Time dependence hasn't changed but absolute values of mobility became closer between different rings.

LA time dependence: BPIX



LA time dependence: BPIX



As in BPIX, absolute values became closer.

Summary

- Alignment has been run using 5.3M 0T collision tracks in addition to default set of data previously used for calibration.
- Using multiple momentum estimations value of 3 GeV seems to be close to optimal providing the same NormChi2 as tracks from other data.
- No effect from 0T Collision tracks is seen from split DMR plots.
- Absolute mobility values are close one to another among different substructures of BPIX and FPIX, when using 0T Collision tracks, while time dependence remains the same.

Next steps

- New alignment with increased statistics of 0T Collision tracks (up to 90M) and added alignment IOVs for 2012C+D periods is currently running.

- Check the effect of increased statistics with split DMR plots from validation using 0T Cosmics.

- Try using dR isolation when selecting good tracks to eliminate fake low momentum tracks.

- Try to reject low momentum tracks at mille step.