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

(+ dR isolation study)

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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 improve separation between module alignment and LA calibration, fixing module position and improving absolute values and systematic uncertainties of LA corrections.

- Multiple test alignments and validations have been run in order to find optimal selection criteria of good tracks from 0T Collision data.

Track distribution

Presented are the general track distributions from MillePedeMonitor root files. Compared are tracks from 0T Collision data and Minimum Bias data with selection, exactly as in the alignment:

<u>0T Collision</u>: 57 K

≥10 hits

≥1 PIXEL hits

≥2 2D hits

-50≤d0≤50

-18≤dZ≤18

<u>Minimum Bias</u>: 102 K

≥8 hits

≥1 PIXEL hits

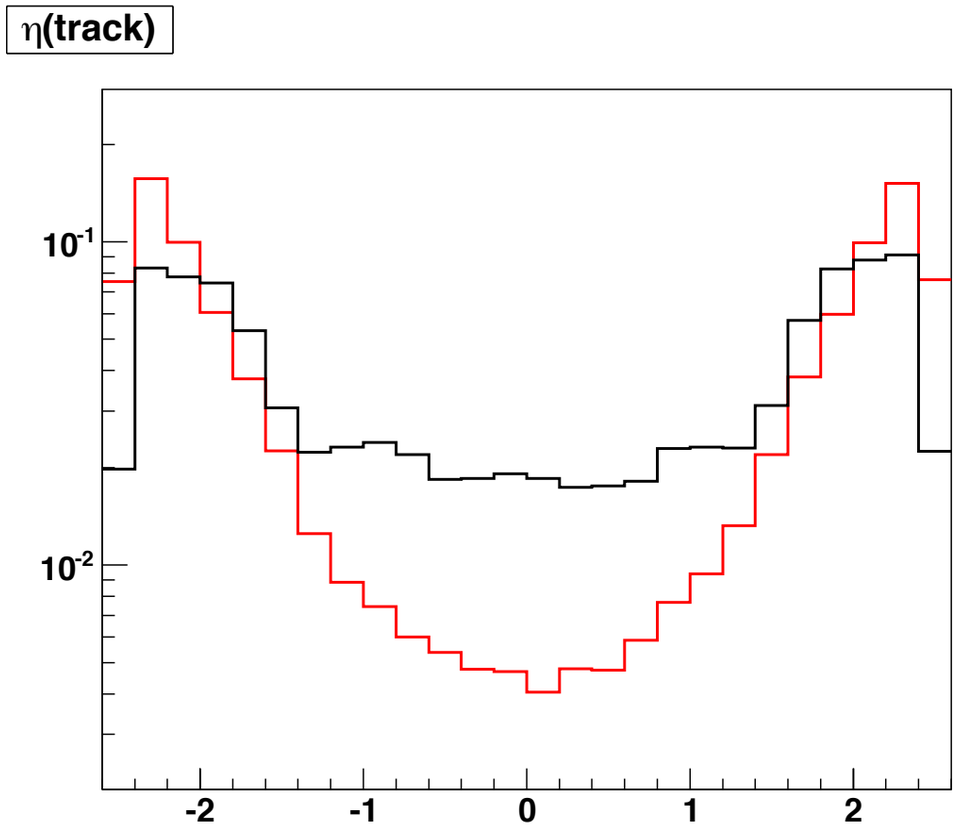
≥2 2D hits

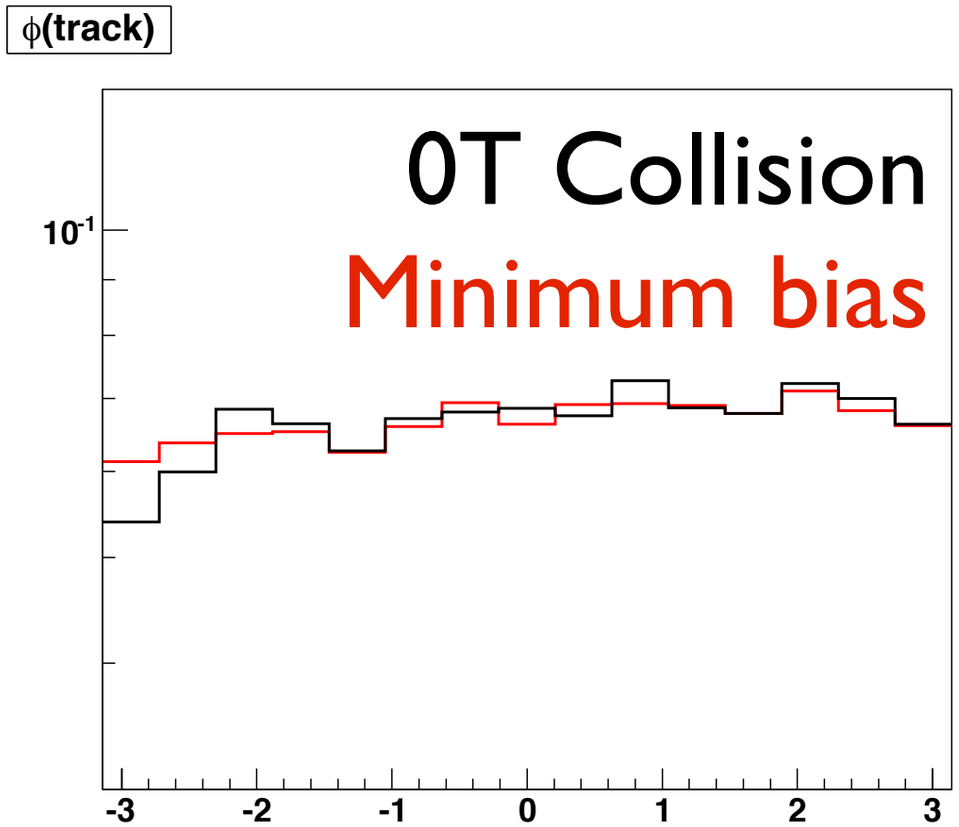
-50≤d0≤50

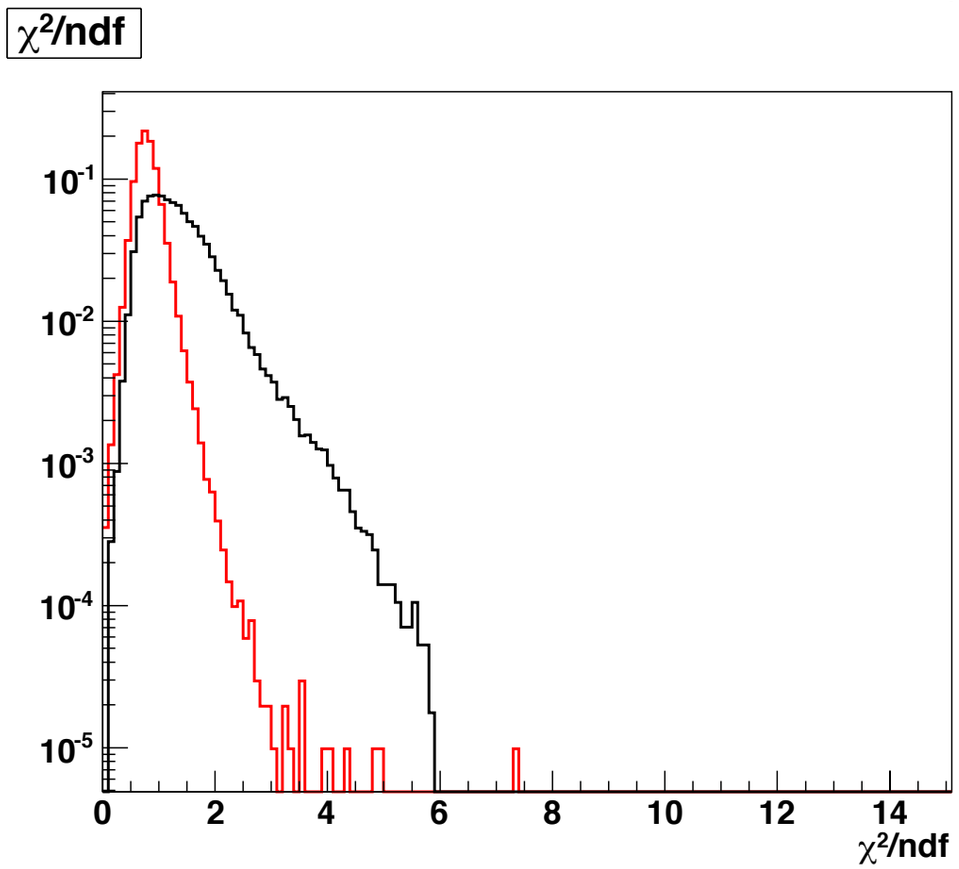
P≥8 GeV

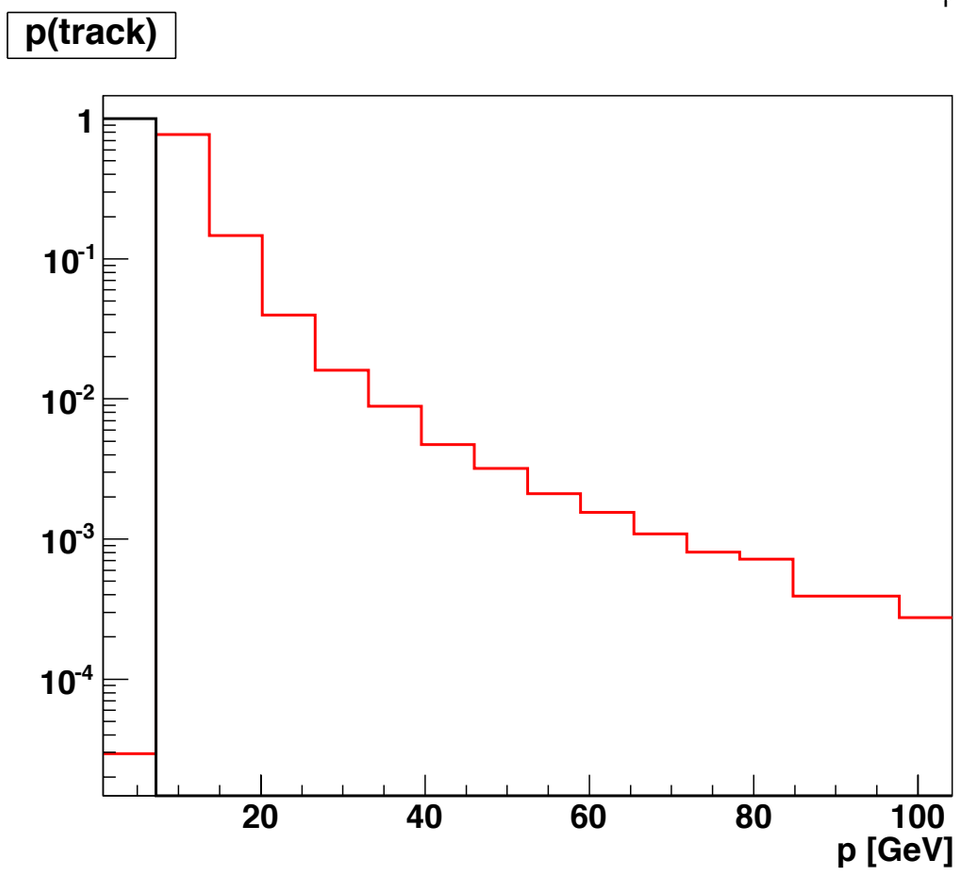
Pt≥1 GeV

Track distributions: Kinematics

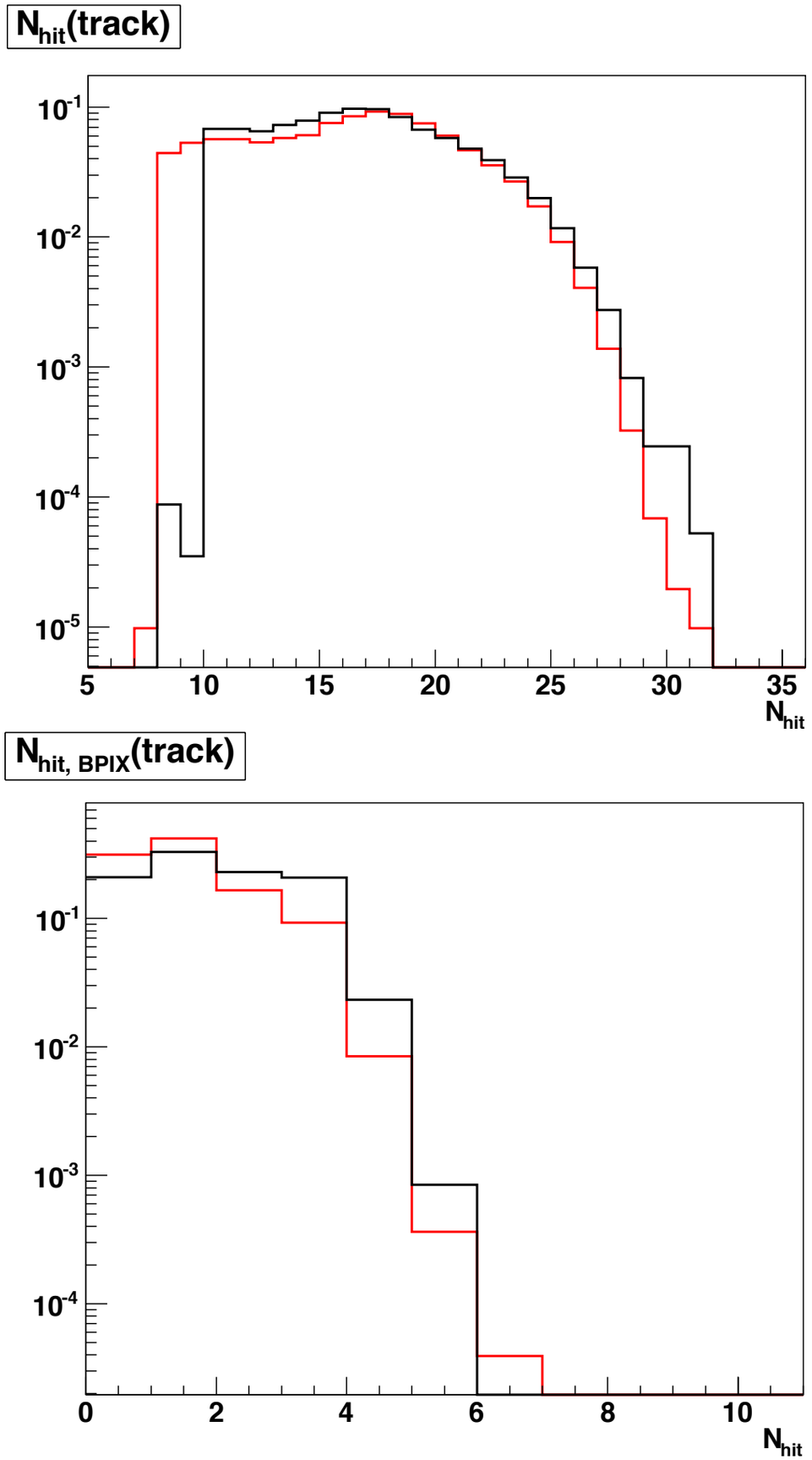


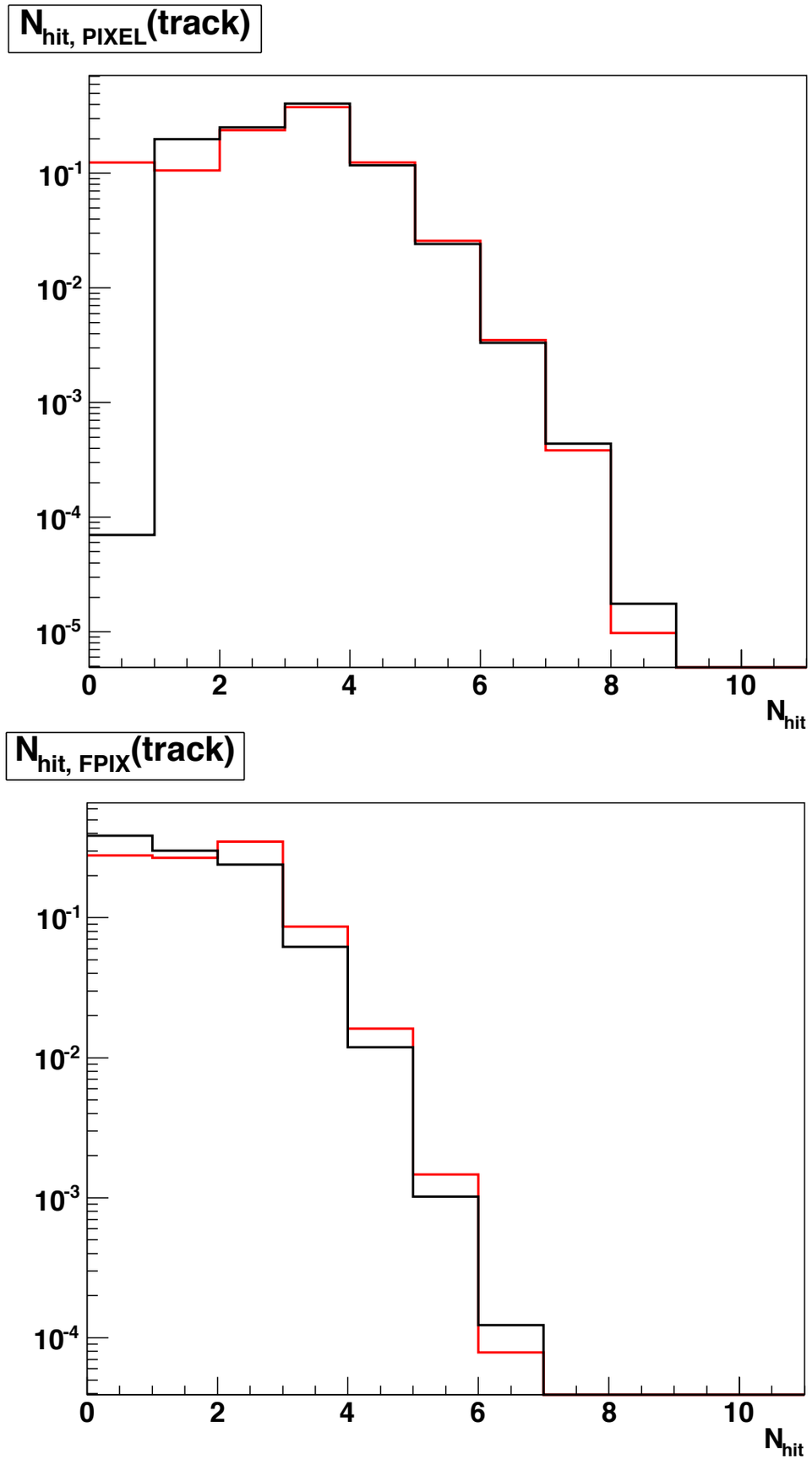




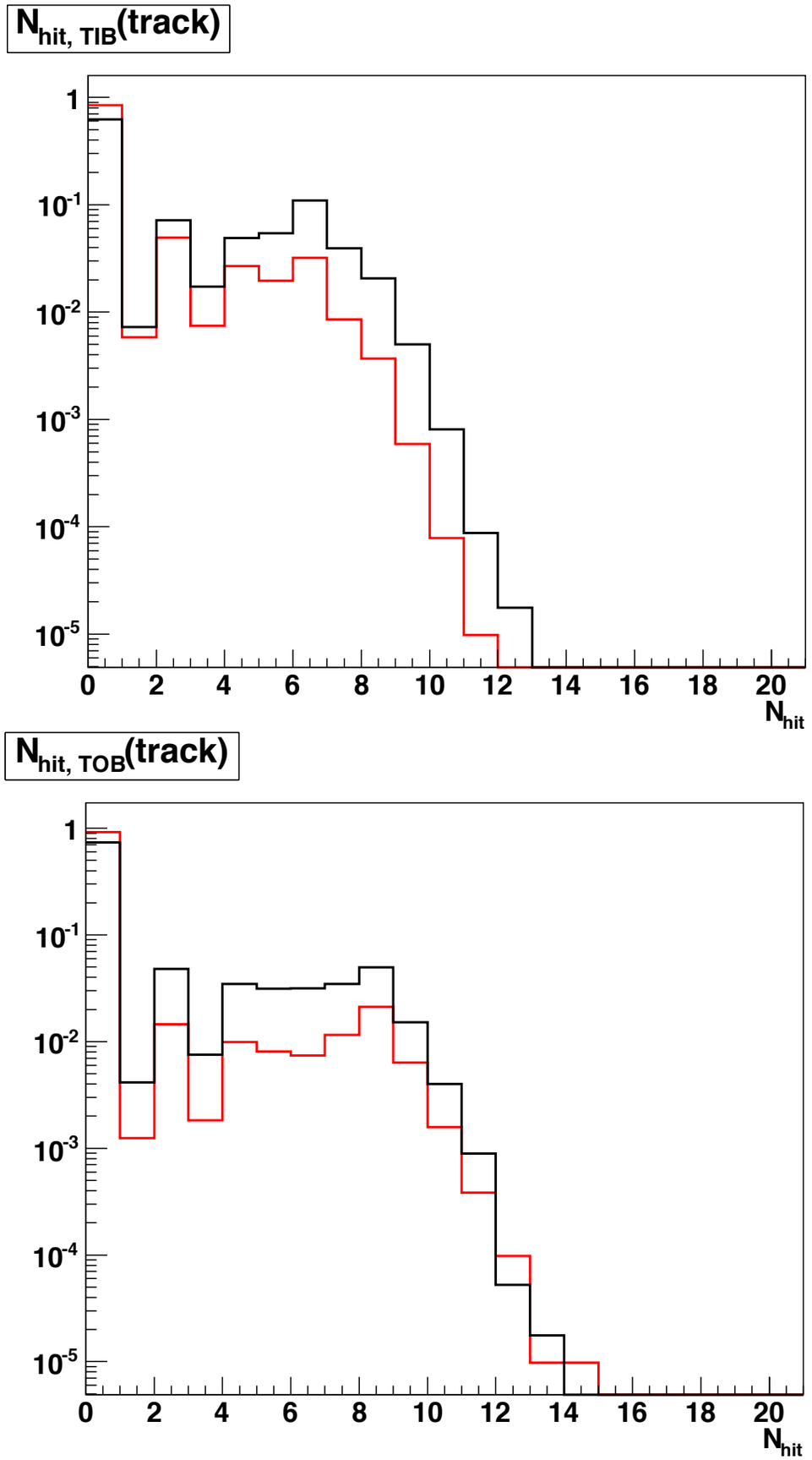


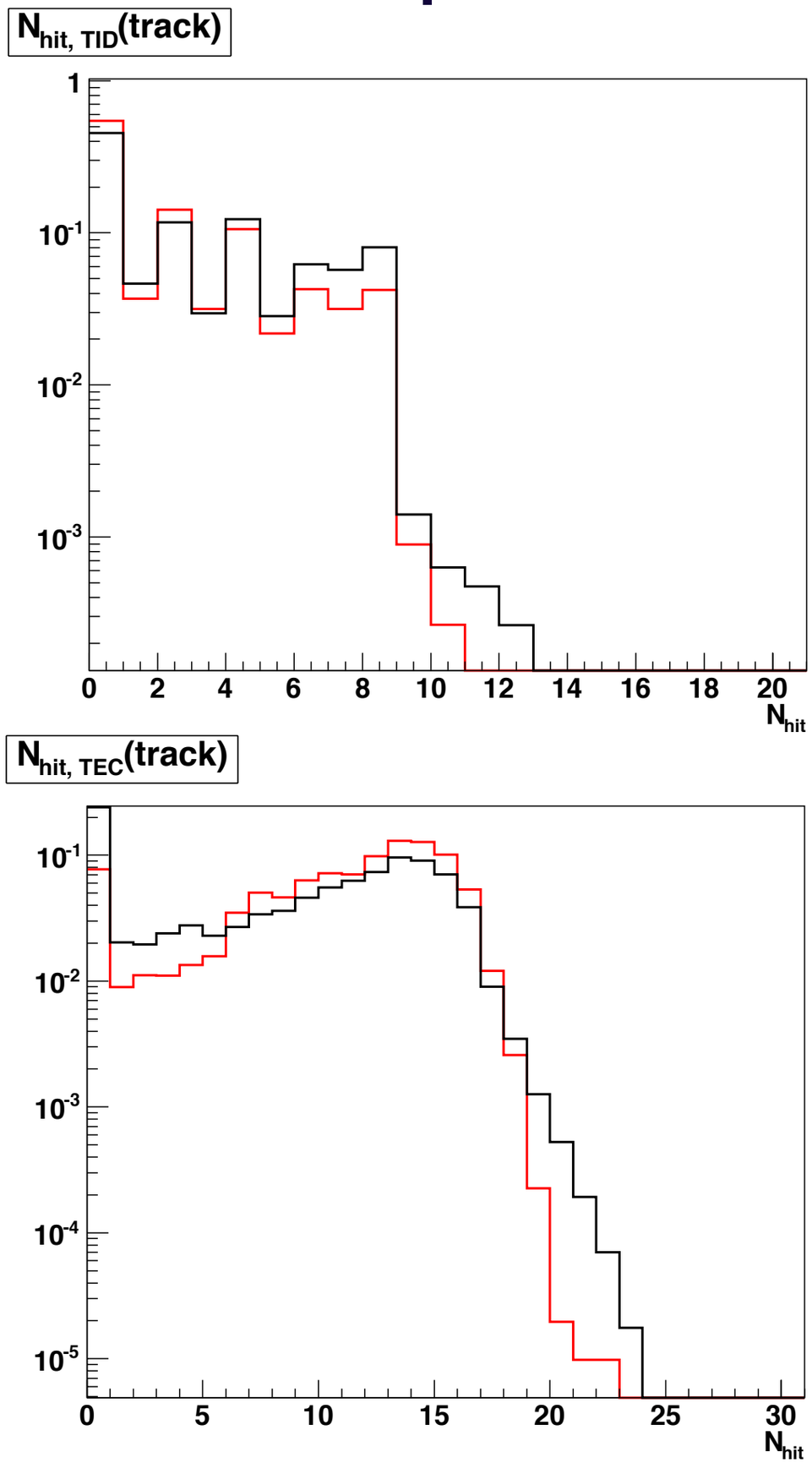
Track distributions: Pixel hits



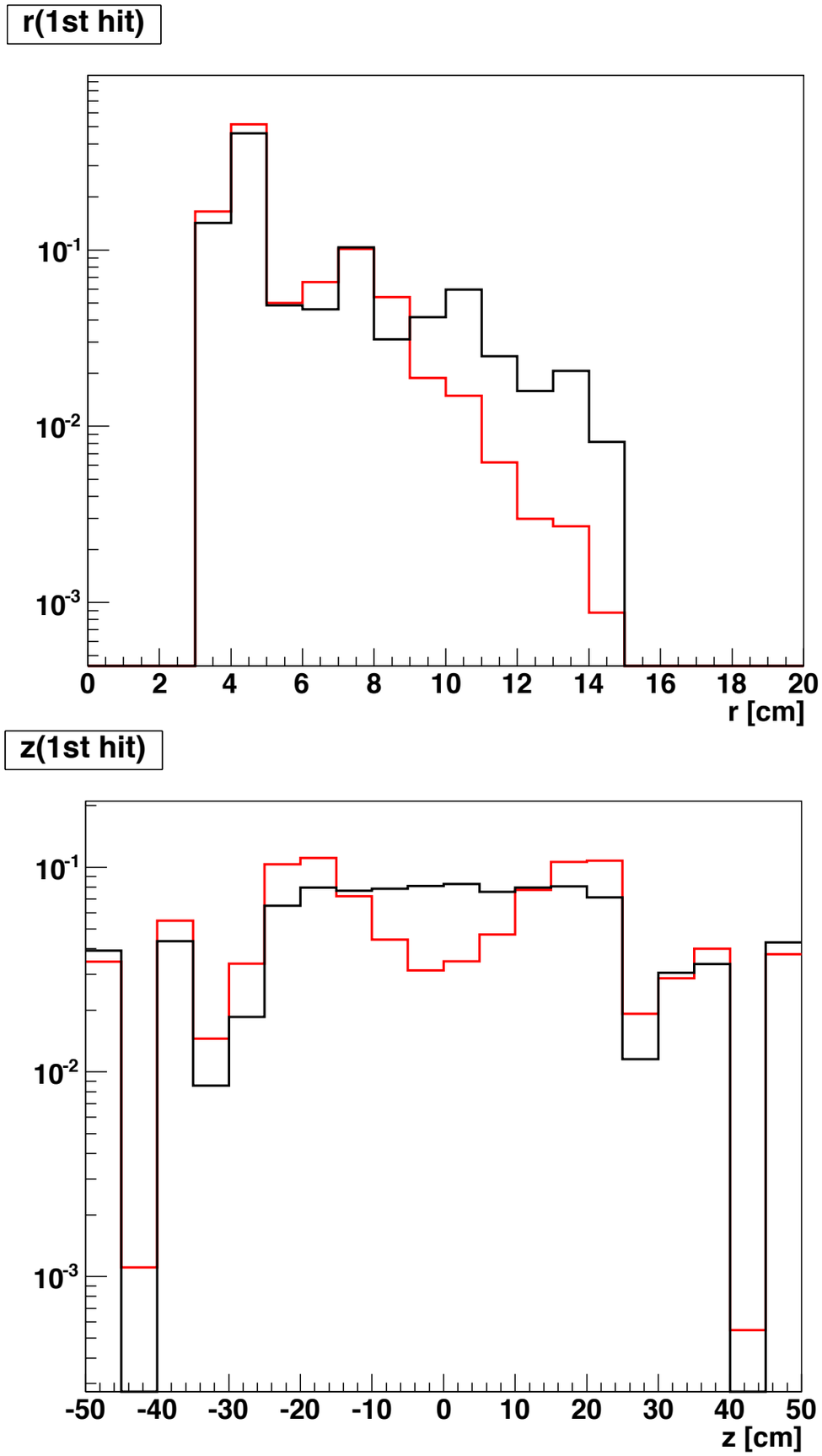


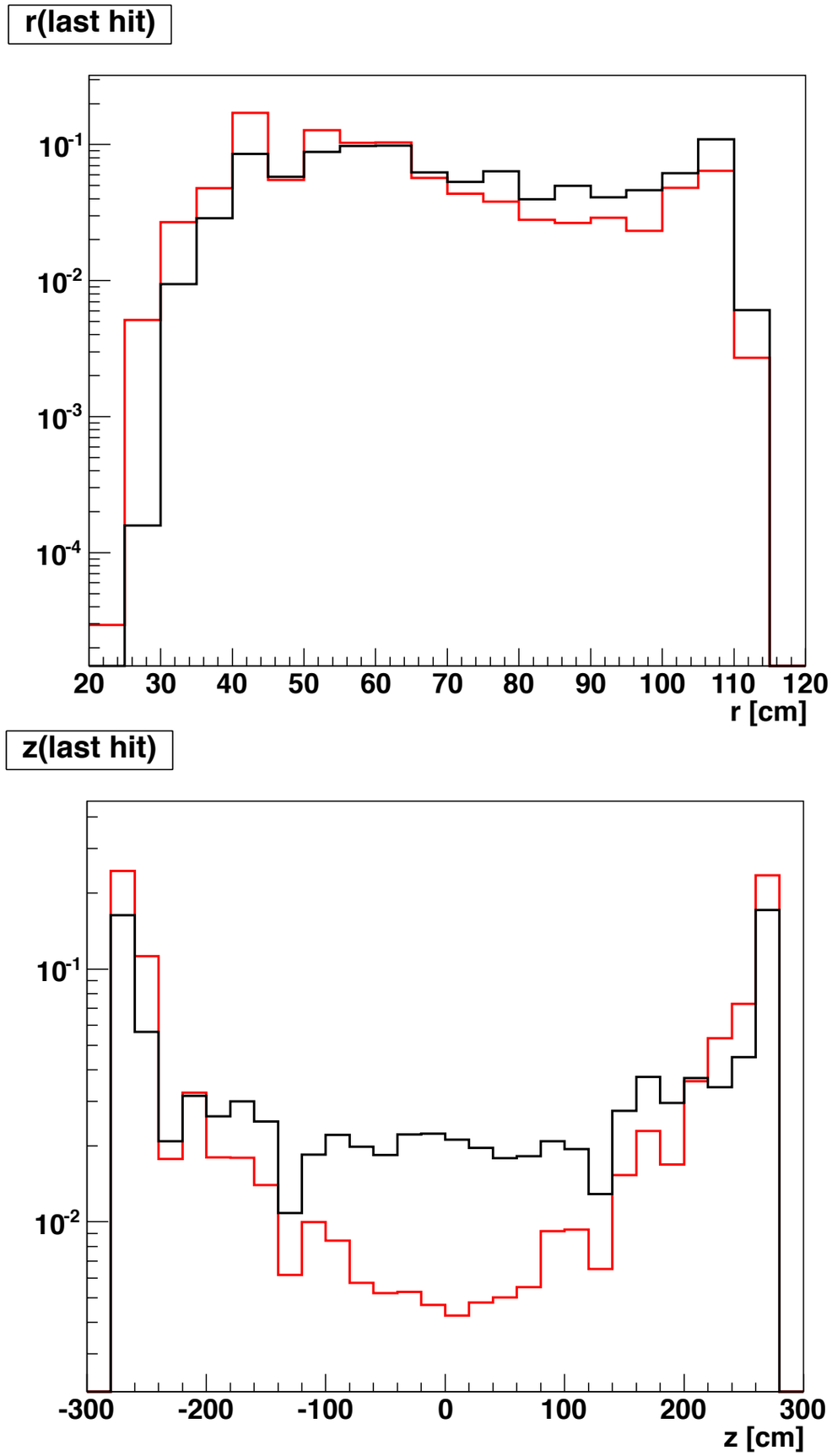
Track distributions: Strip hits





Track distributions: Border hits





dR isolation study

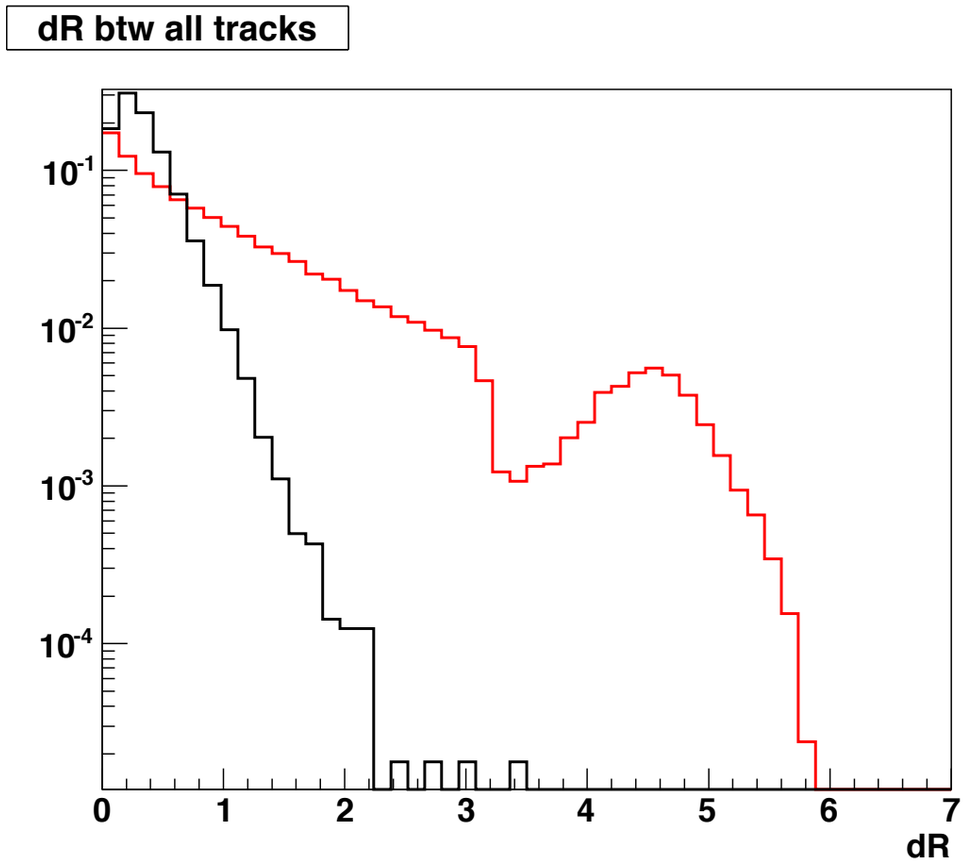
New histograms have been added to the MillePedeMonitor in order to study the isolation of 0T Collision tracks.

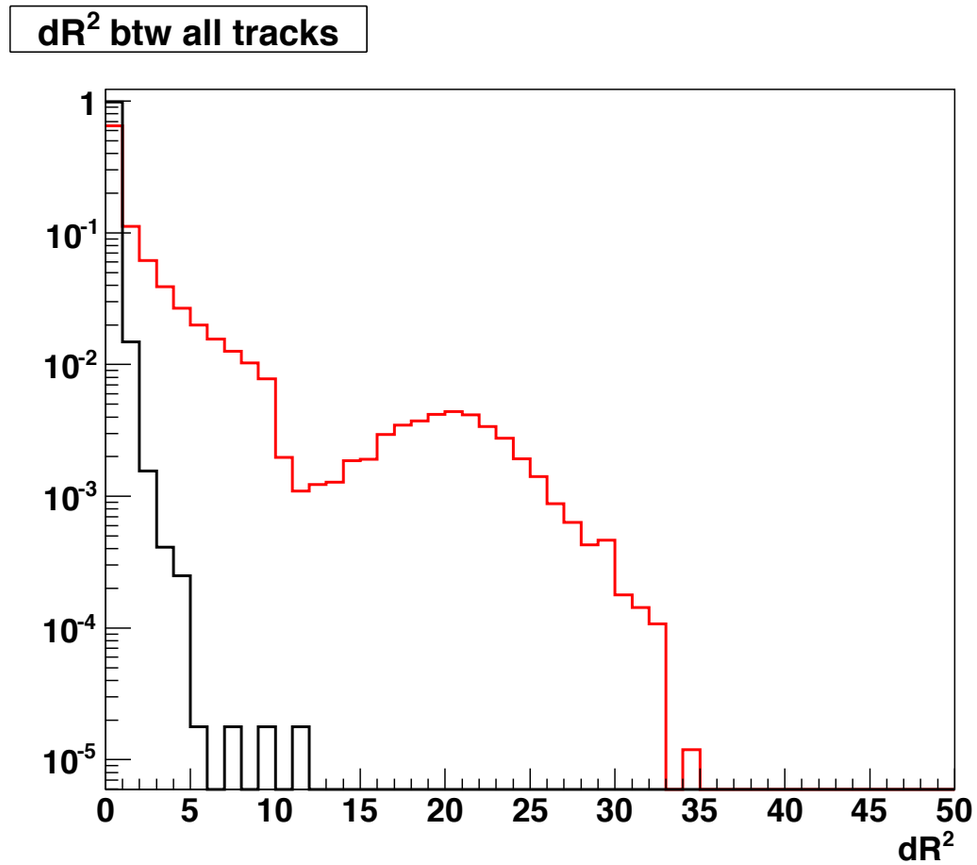
dR of the track represents the dR relative to the closest track in event.

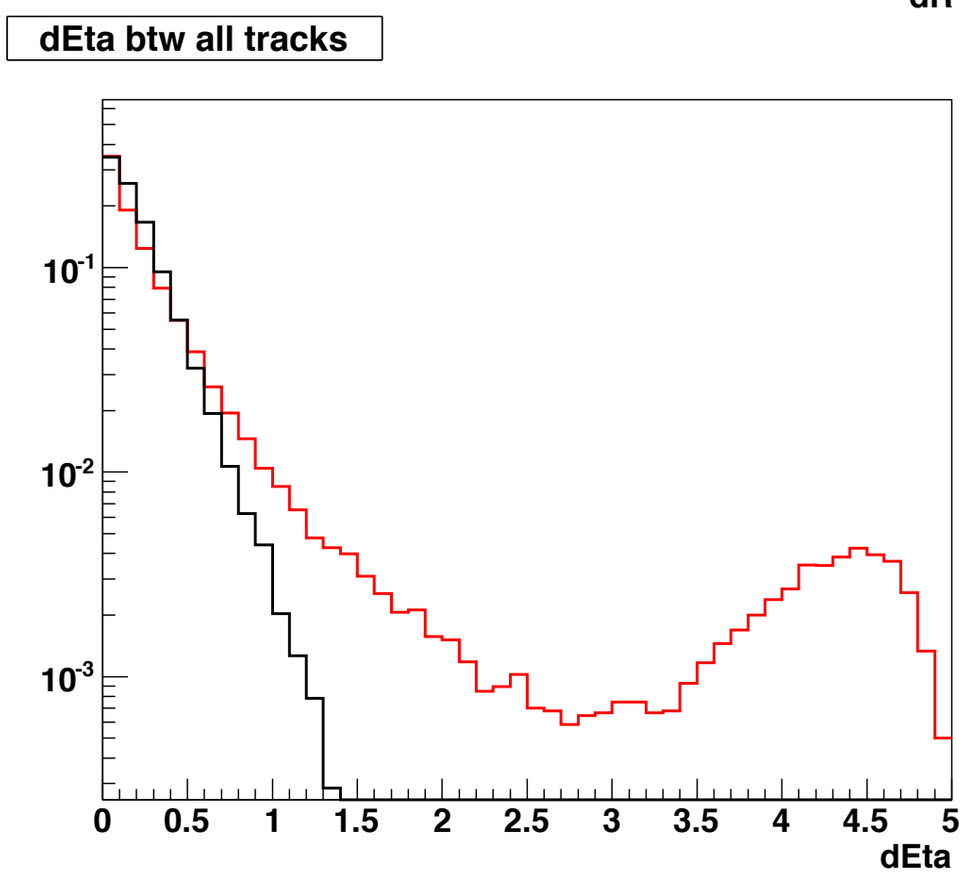
Other variables like dEta, dPhi are also relative to the track, closest by dR.

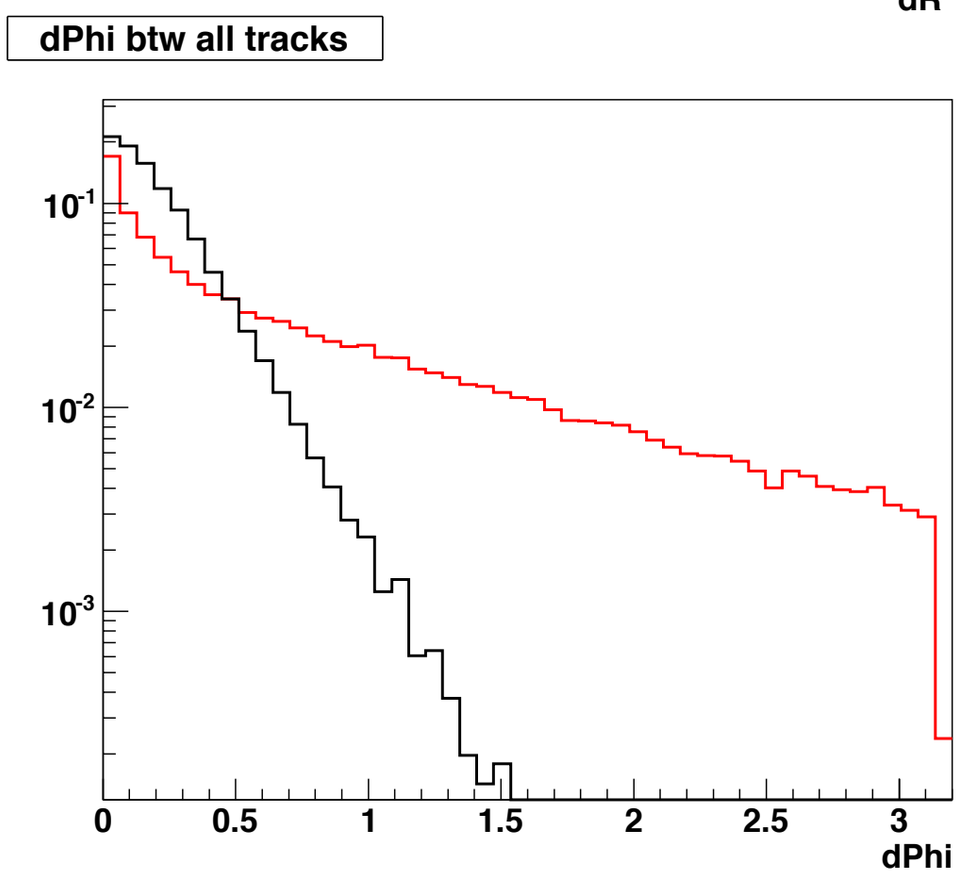
Compared are distribution for 0T Collision tracks and Minimum Bias tracks.

Track isolation









Effect of momentum estimate

P(GeV)	Rejects	NChi2 (0T trk)
5	14.2%	1.38
3	0.53%	0.9
2	0.05%	0.58
1	0.01%	0.27
0.5	0.007%	0.13
No 0T	0.49%	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.

Alignment setup: mp1276

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;
- Alignables: Large Structures, PixelModules: 111111

Calibration setup: mp1276

- BPIX granularity:

  24 parameters: 3 layers x 8 rings

- FPIX granularity:

  2 parameters: left side, right side;

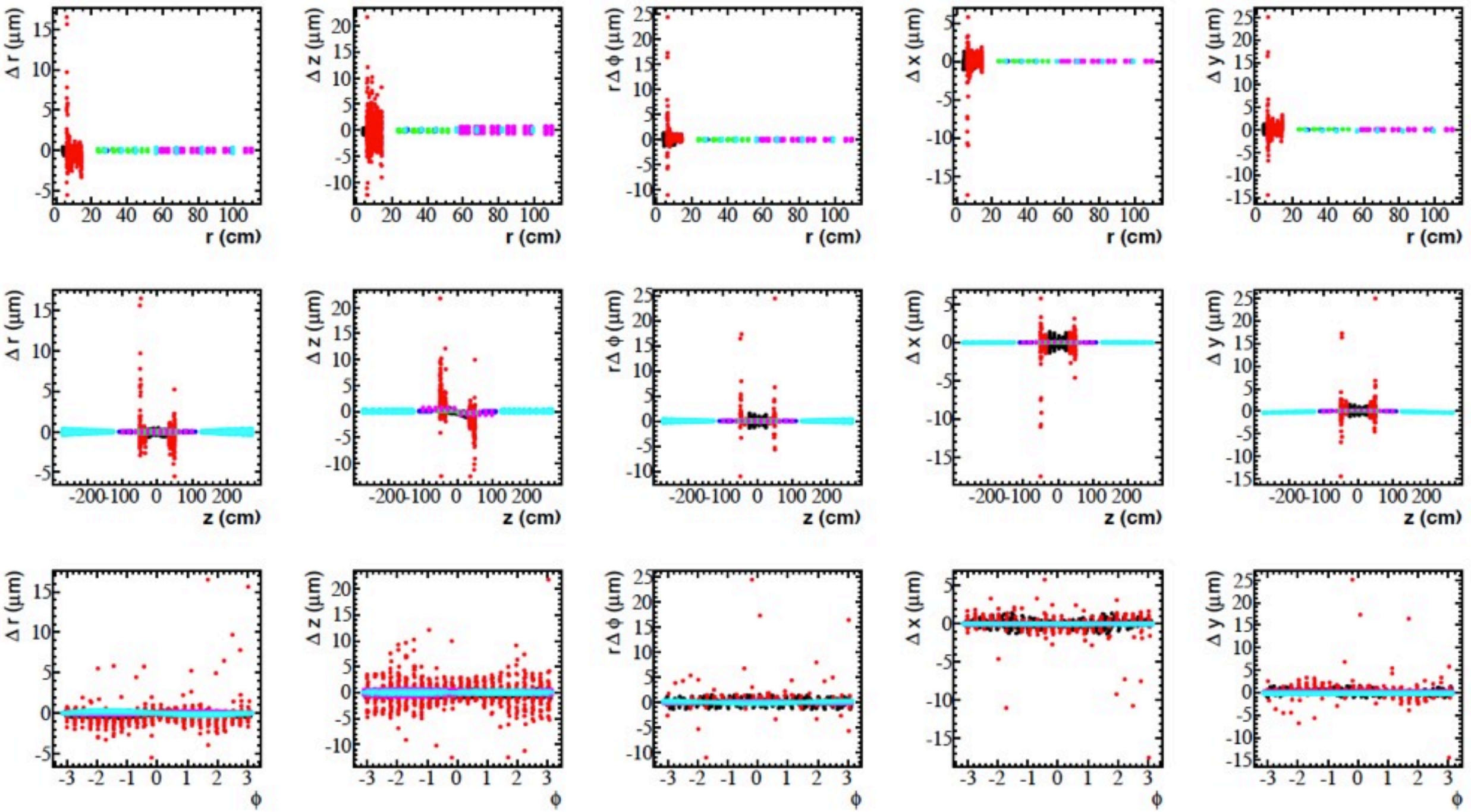
- Time granularity:

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

- Plus 1 alignment parameter per TIB, TOB;

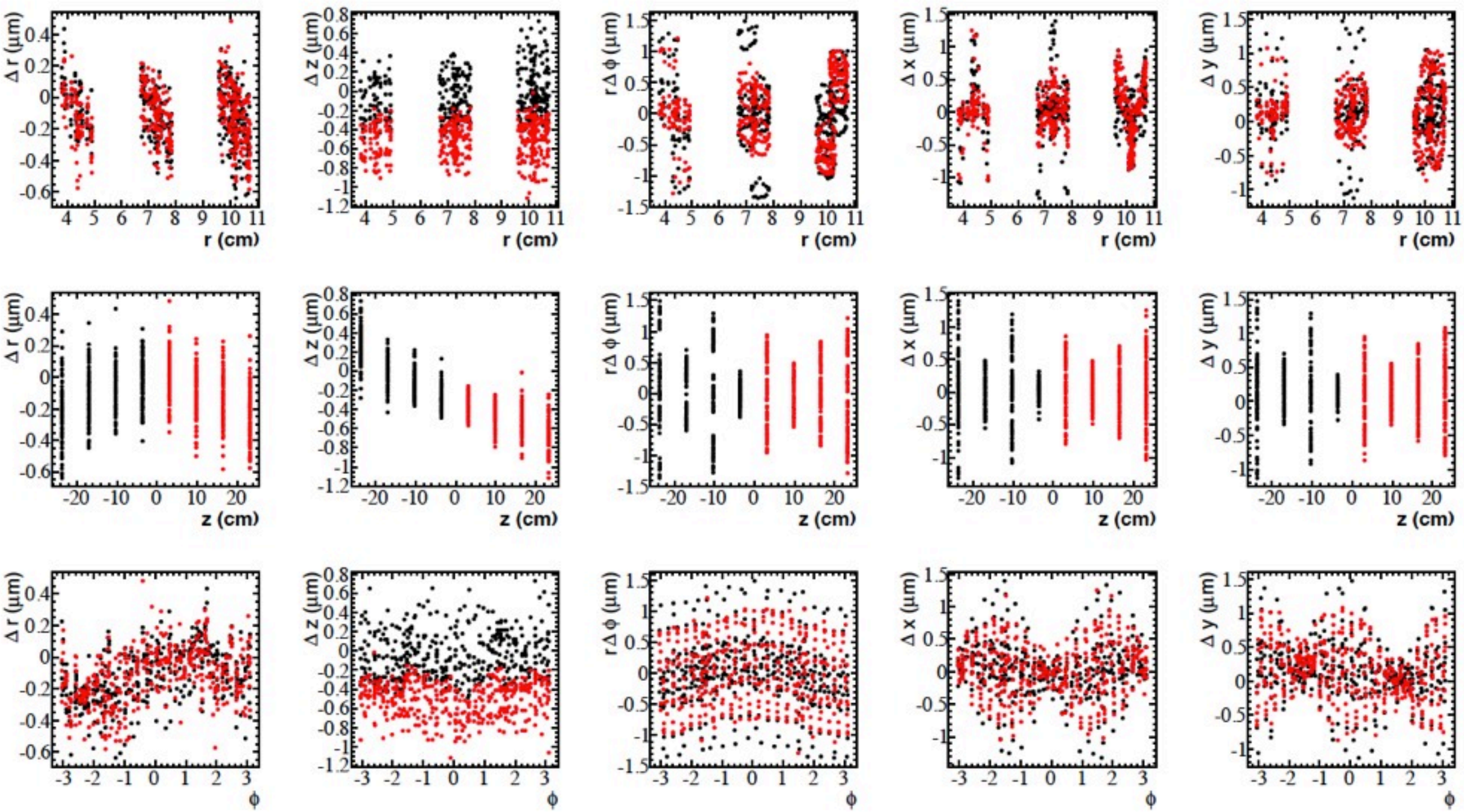
- Number of used tracks (default): 52.4 M
- Number of used 0T Collision tracks: +36.4 M
- Total number including 0T Collision tracks: 88.8 M

Geometry comparison: Tracker

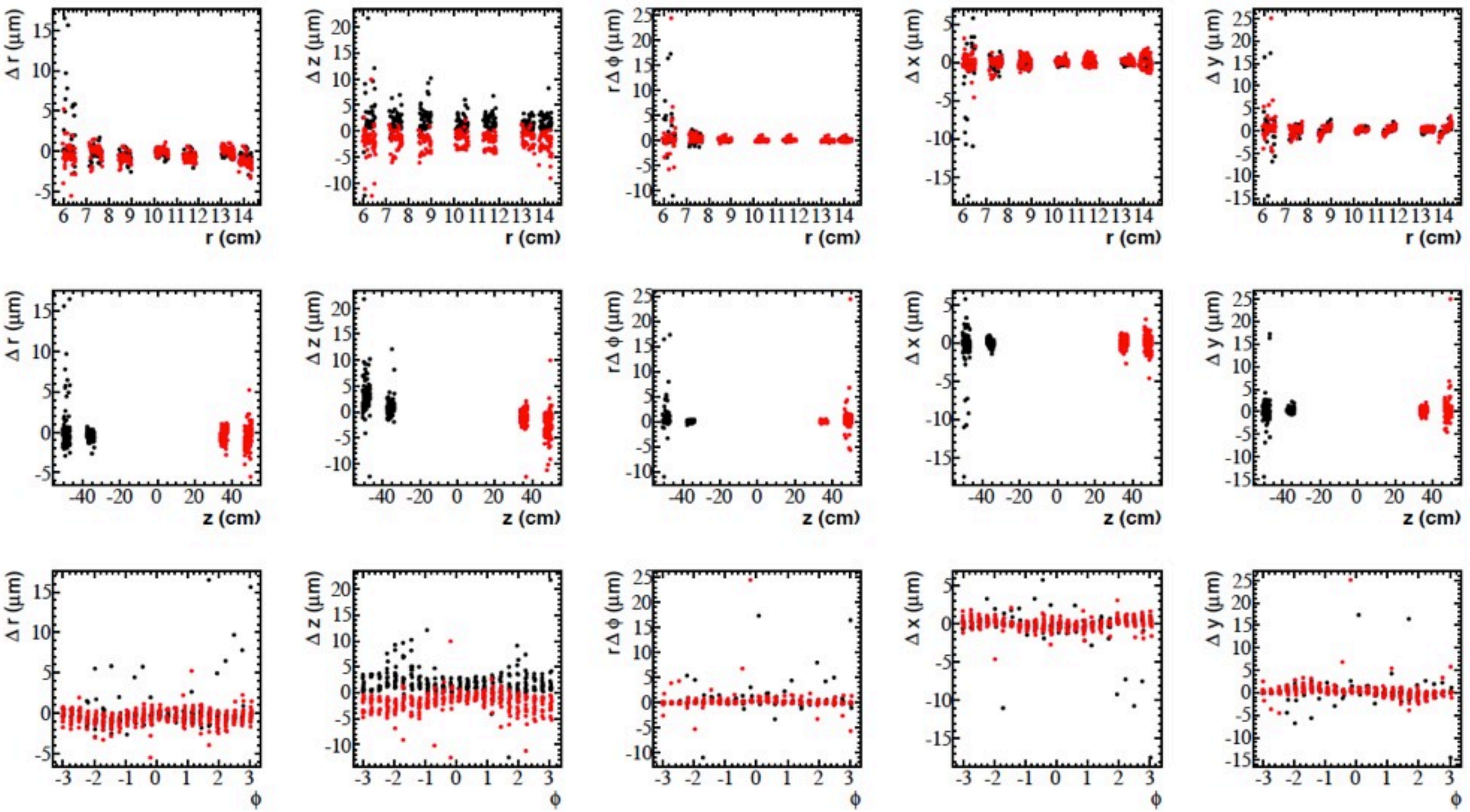


Small difference in Pixel Endcaps between two geometries: aligned with and without 0T Collision tracks.

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)

Global tag: FT_R_53_V6C::All

Errors: TrackerIdealGeometryErrors210_mc

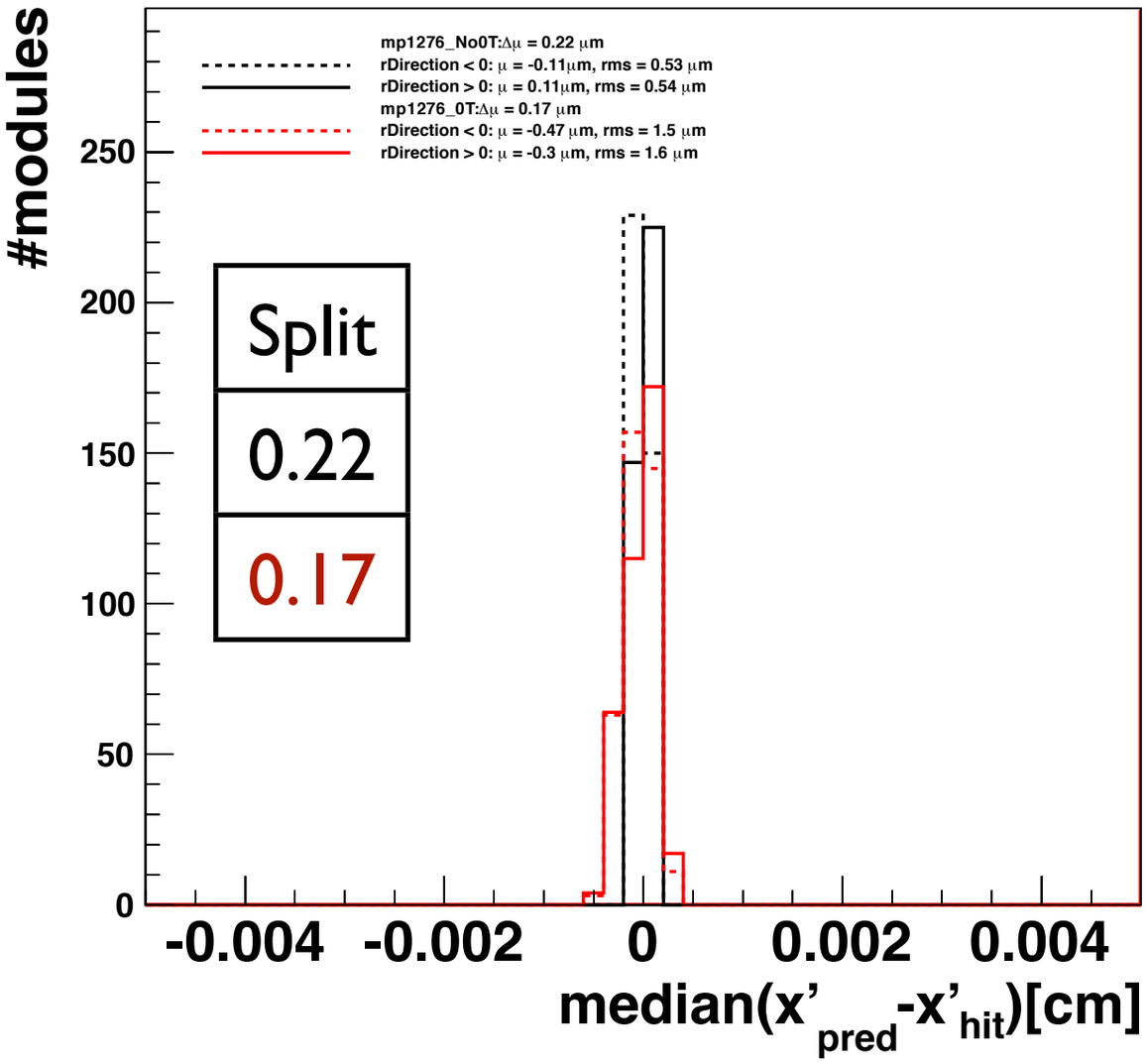
Kinks & bows: from Global Tag

Compared are 2 geometries, aligned:

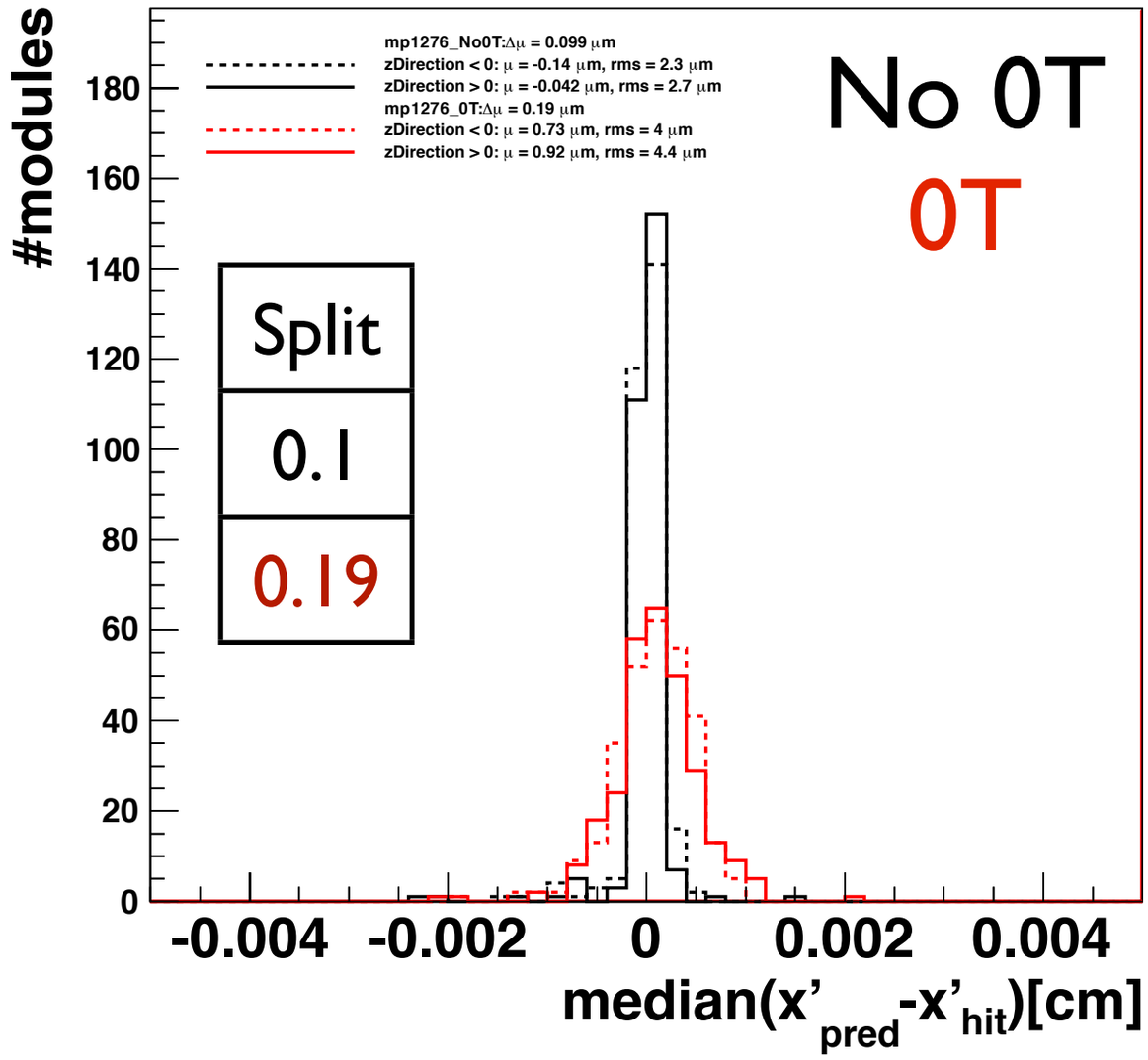
- with 0T Collision tracks
- without 0T Collision tracks

Single Muon validation: 3.8T

Distribution of the median of the residuals in TPB



Distribution of the median of the residuals in TPE



Width of DMR is significantly larger in TPE when aligned with 0T Collision tracks.

0T validation setup

Dataset: `/Cosmics/Commissioning12-TkAlCosmics0T-13Jul2012-v1/ALCARECO`

Statistics: ~700 K events, ~ 358 K tracks

Global tag: FT_R_53_V6C::All

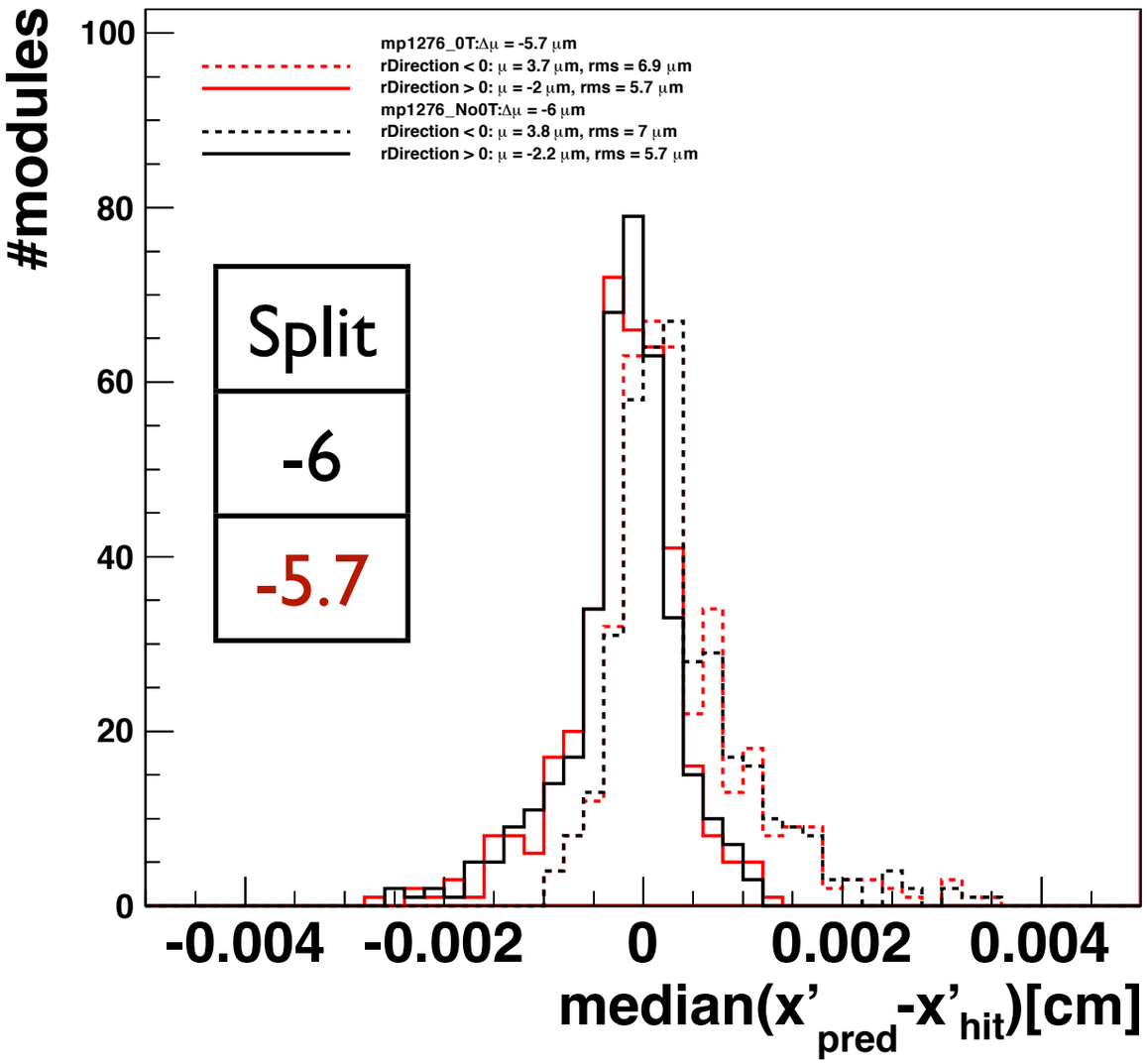
Errors: TrackerIdealGeometryErrors210_mc

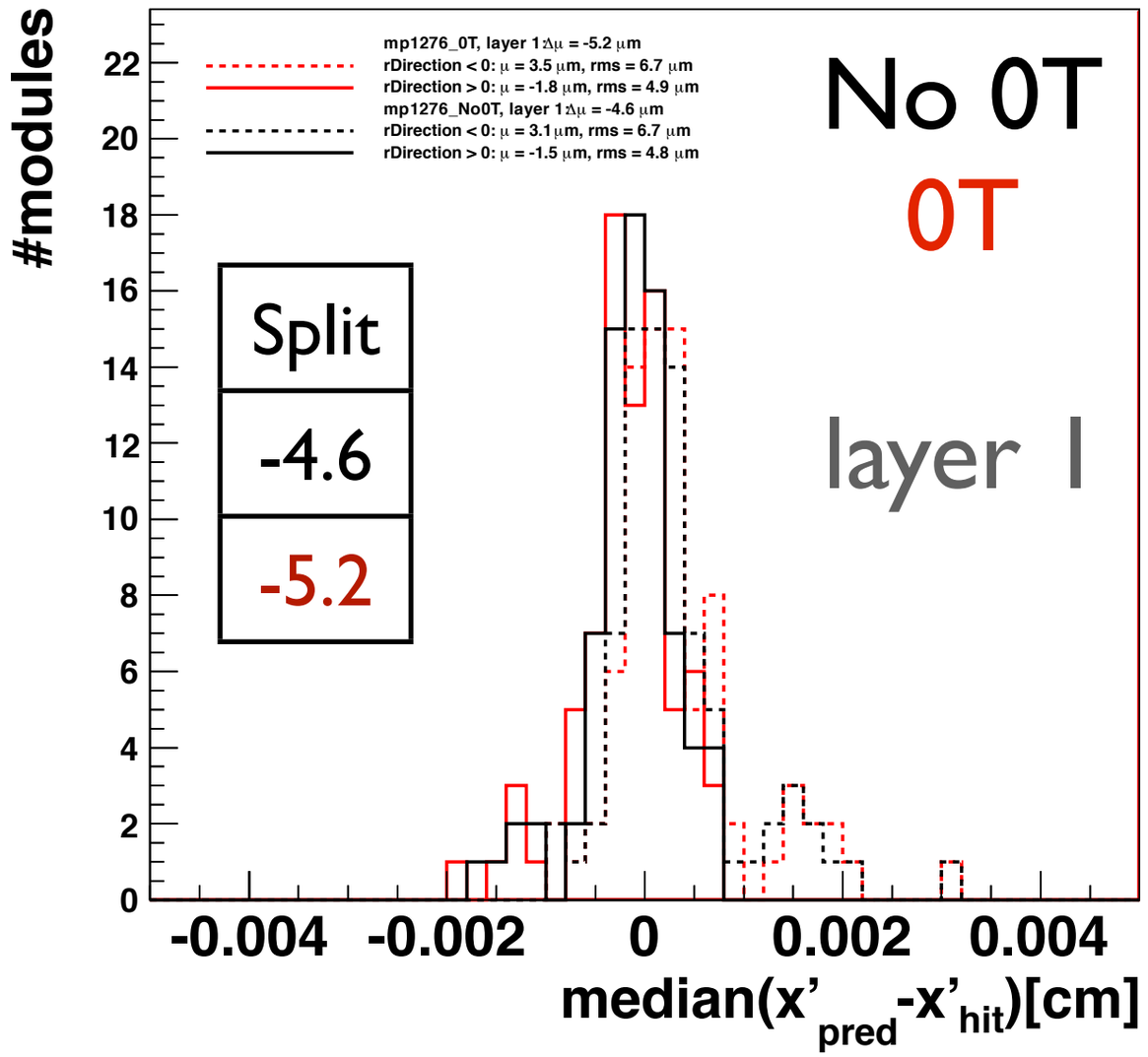
Kinks & bows: from Global Tag

Compared are 2 geometries, aligned:

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

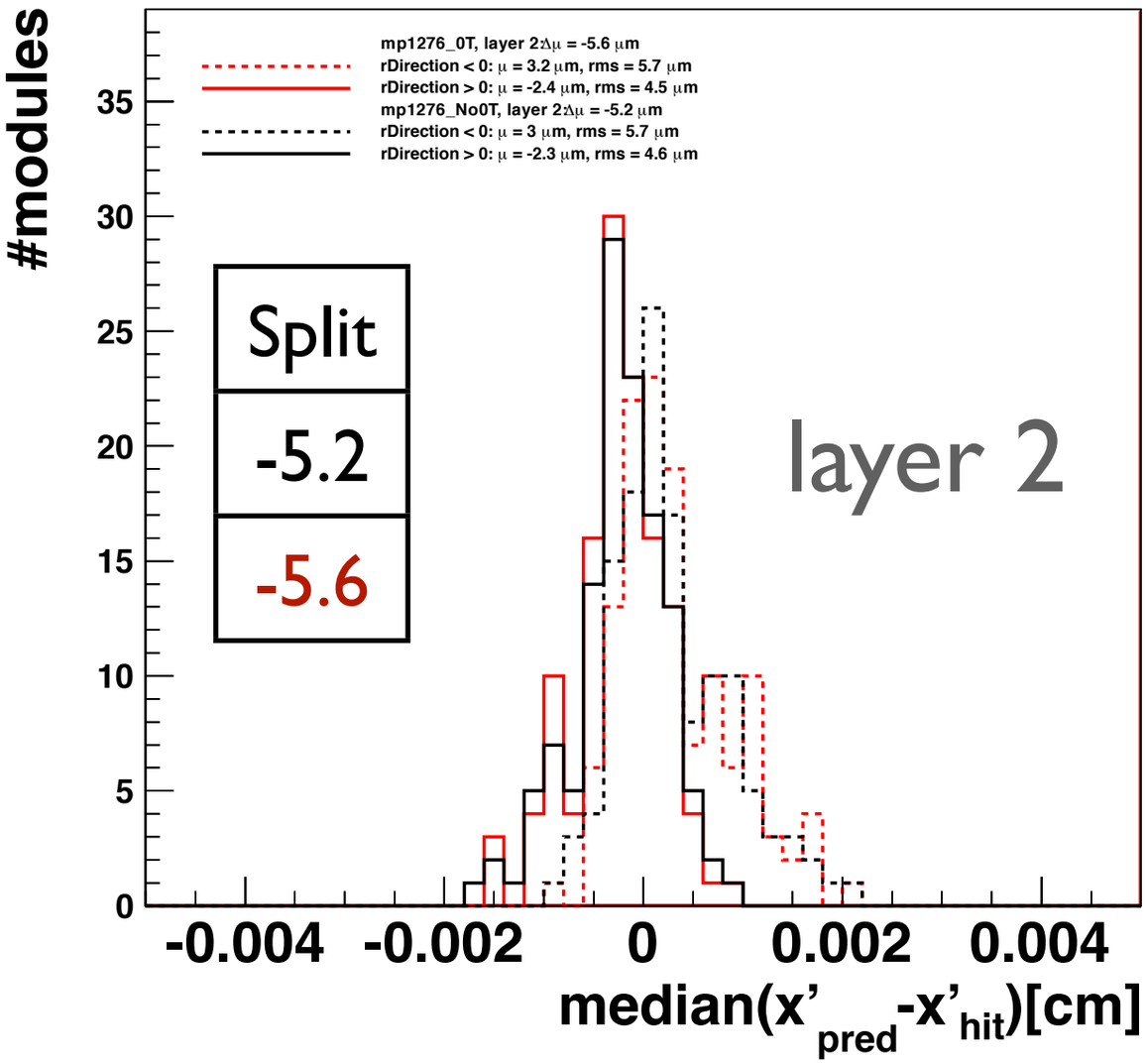
Cosmics validation: 0T

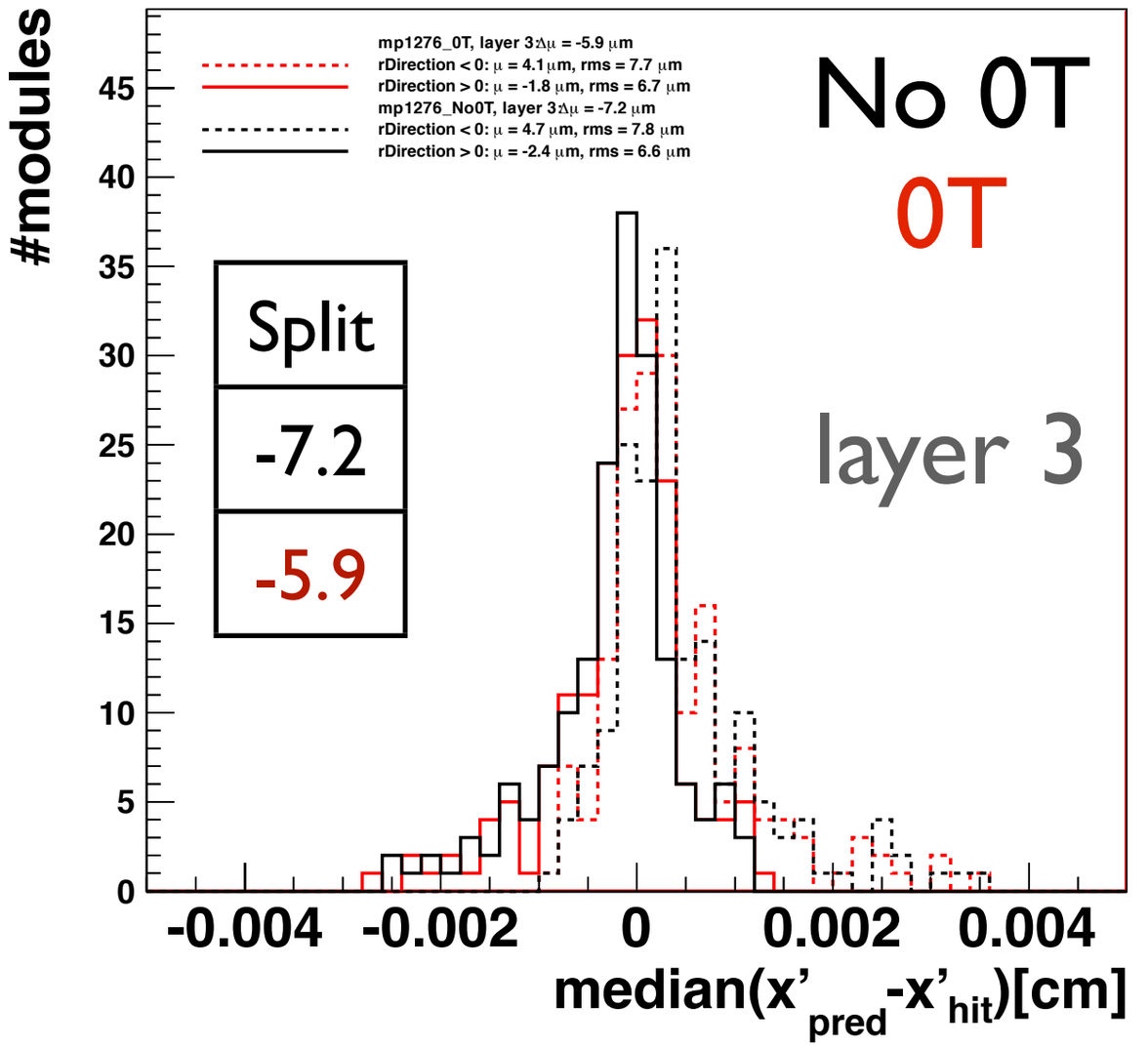




No difference in 0T validation.

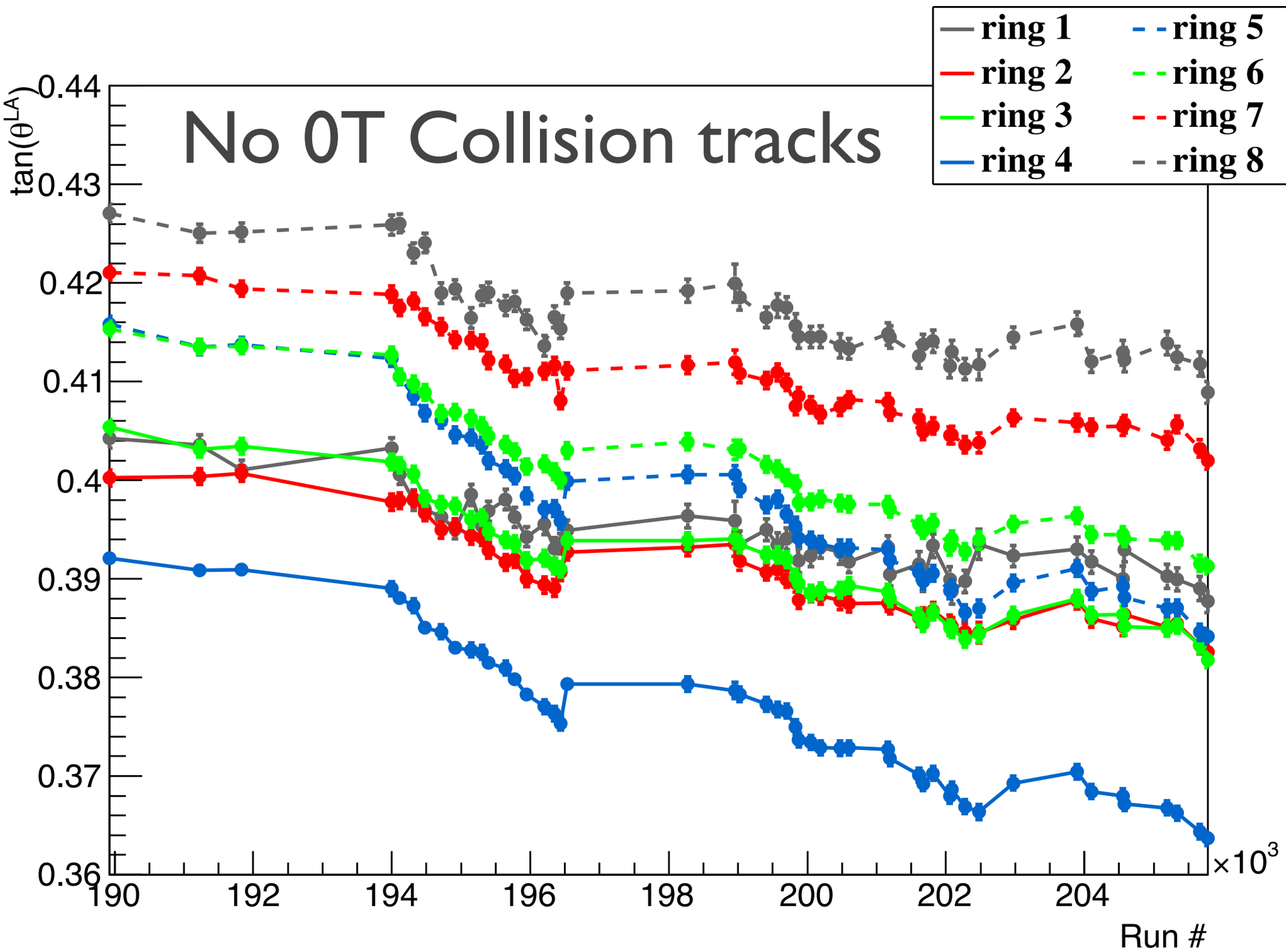
Cosmics validation: 0T





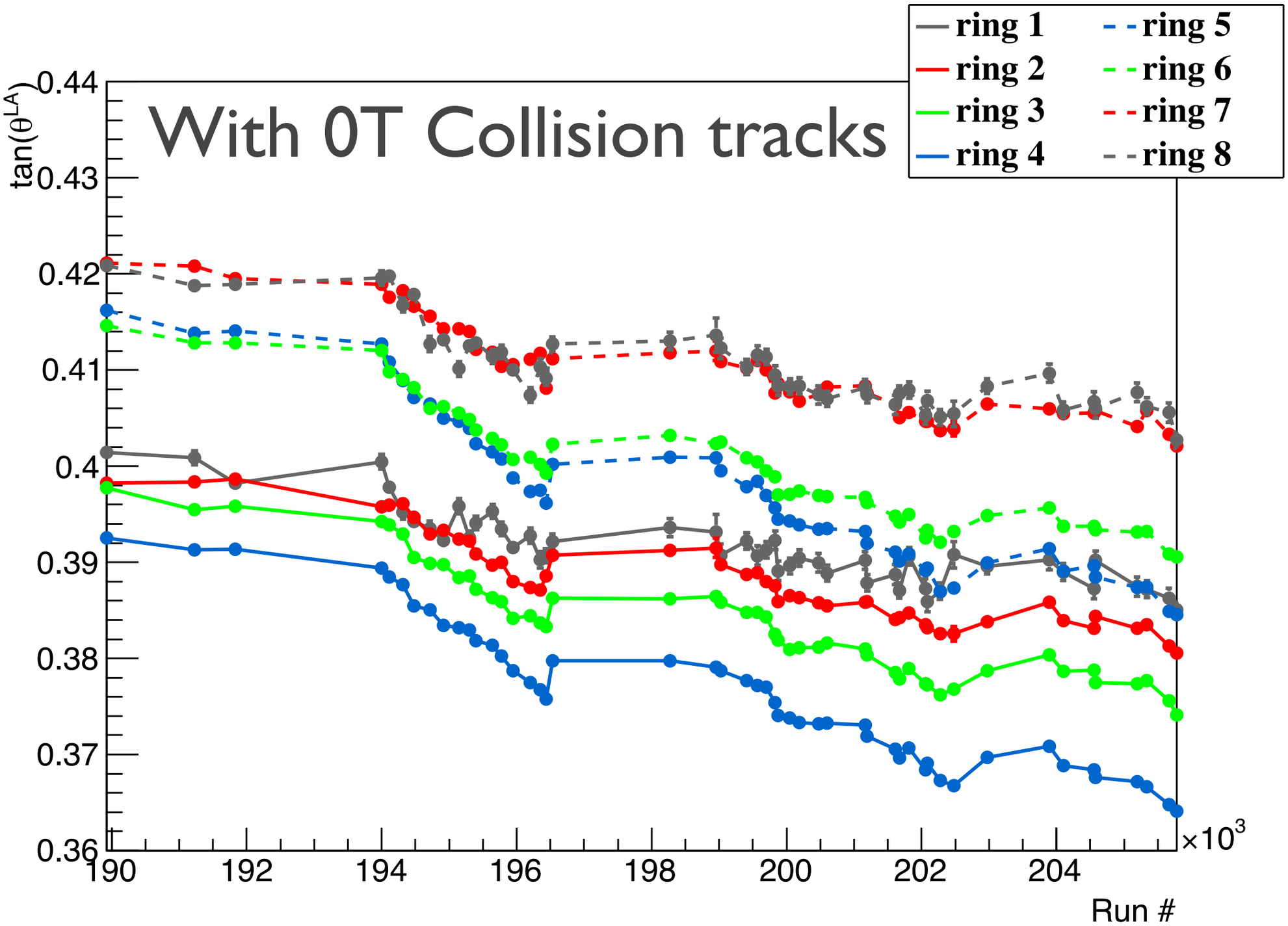
Slight improvement of split in layer 3

LA time dependence: BPIX (layer 1)



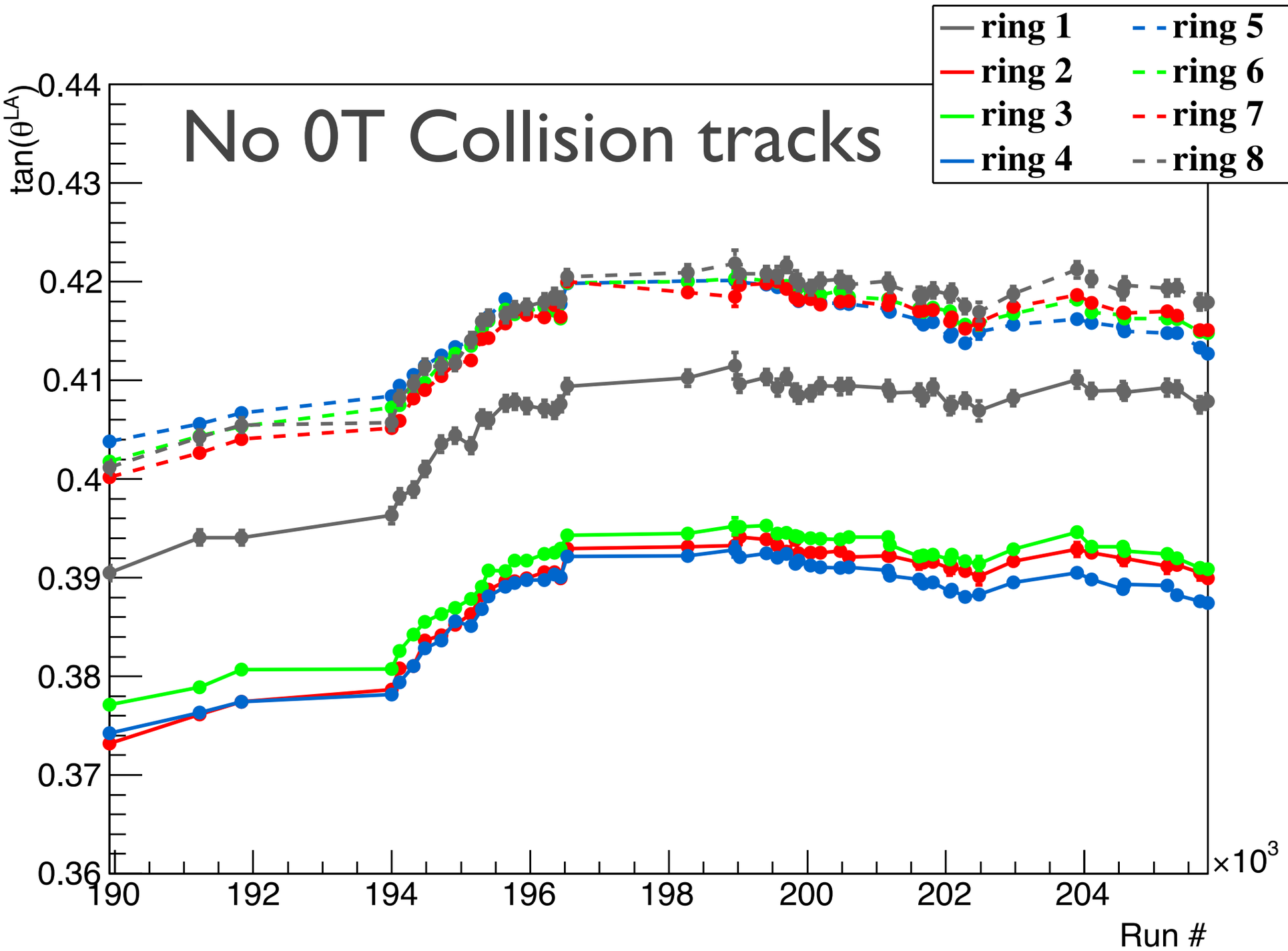
Familiar time dependence in BPIX.

LA time dependence: BPIX (layer 1)

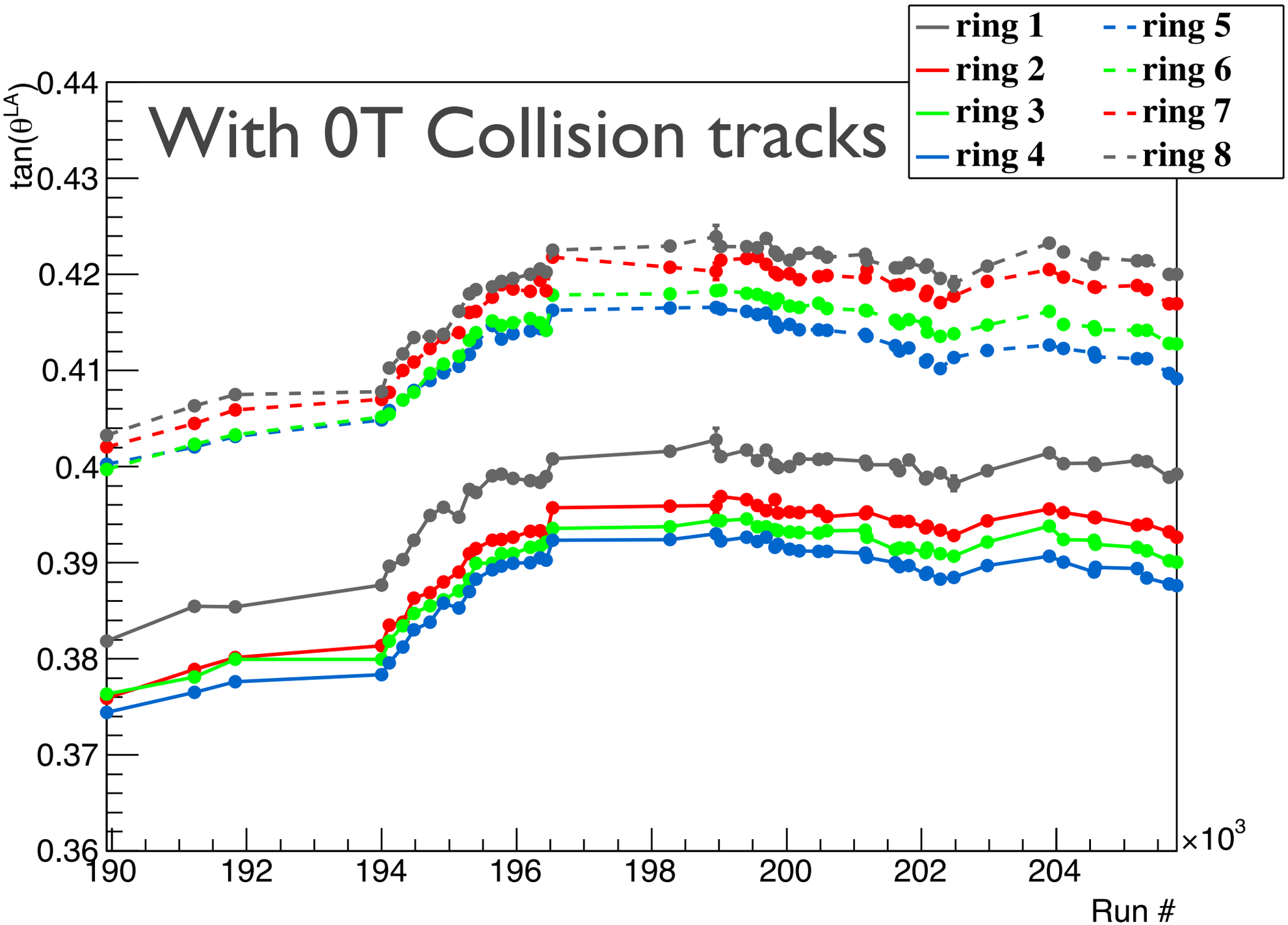


Time dependence hasn't changed but absolute values of mobility became closer between different rings.

LA time dependence: BPIX (layer 2)

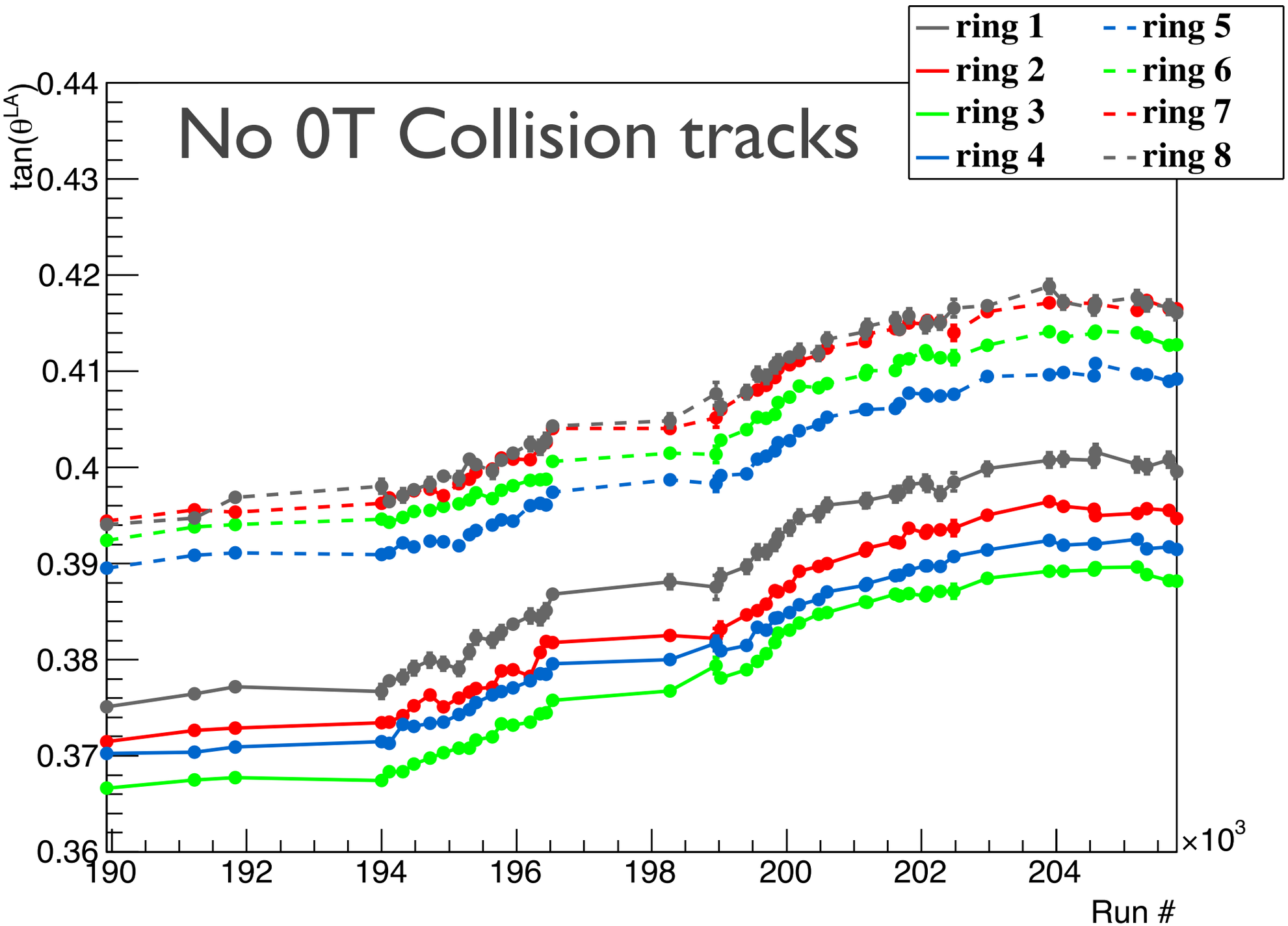


LA time dependence: BPIX (layer 2)

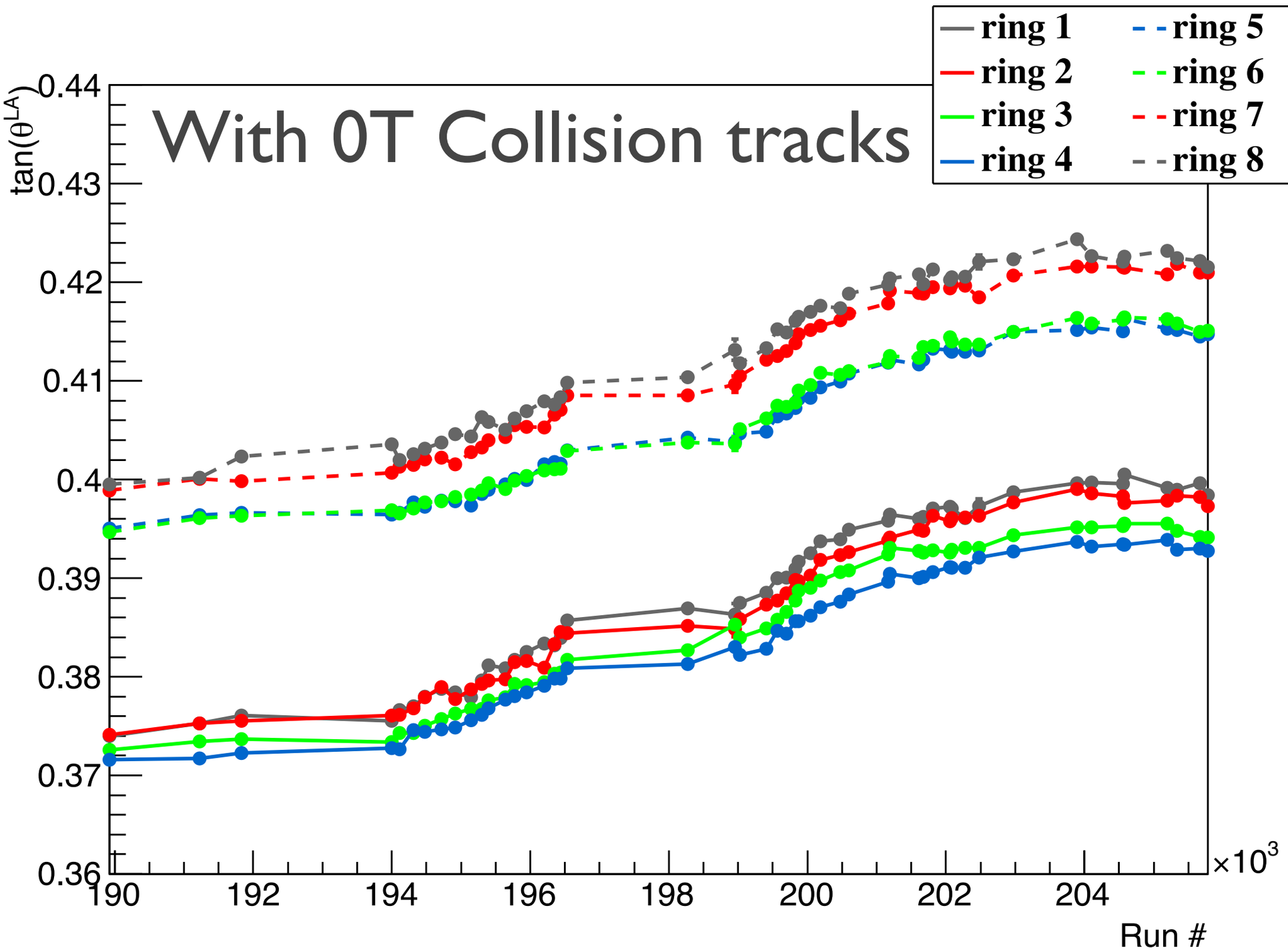


Difference between rings increases, but ring 1 comes closer to others in negative Z half.

LA time dependence: BPIX (layer 3)

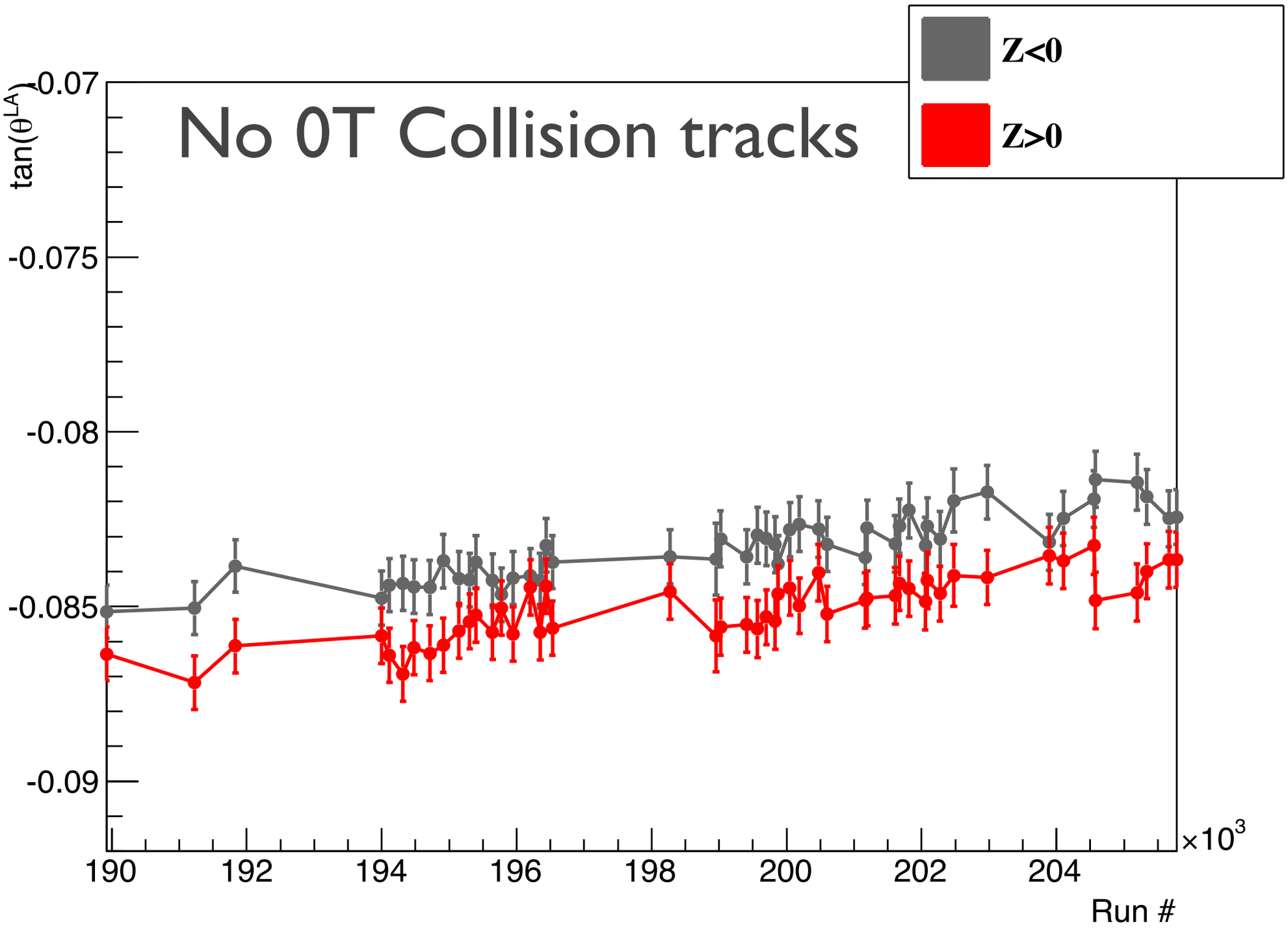


LA time dependence: BPIX (layer 3)

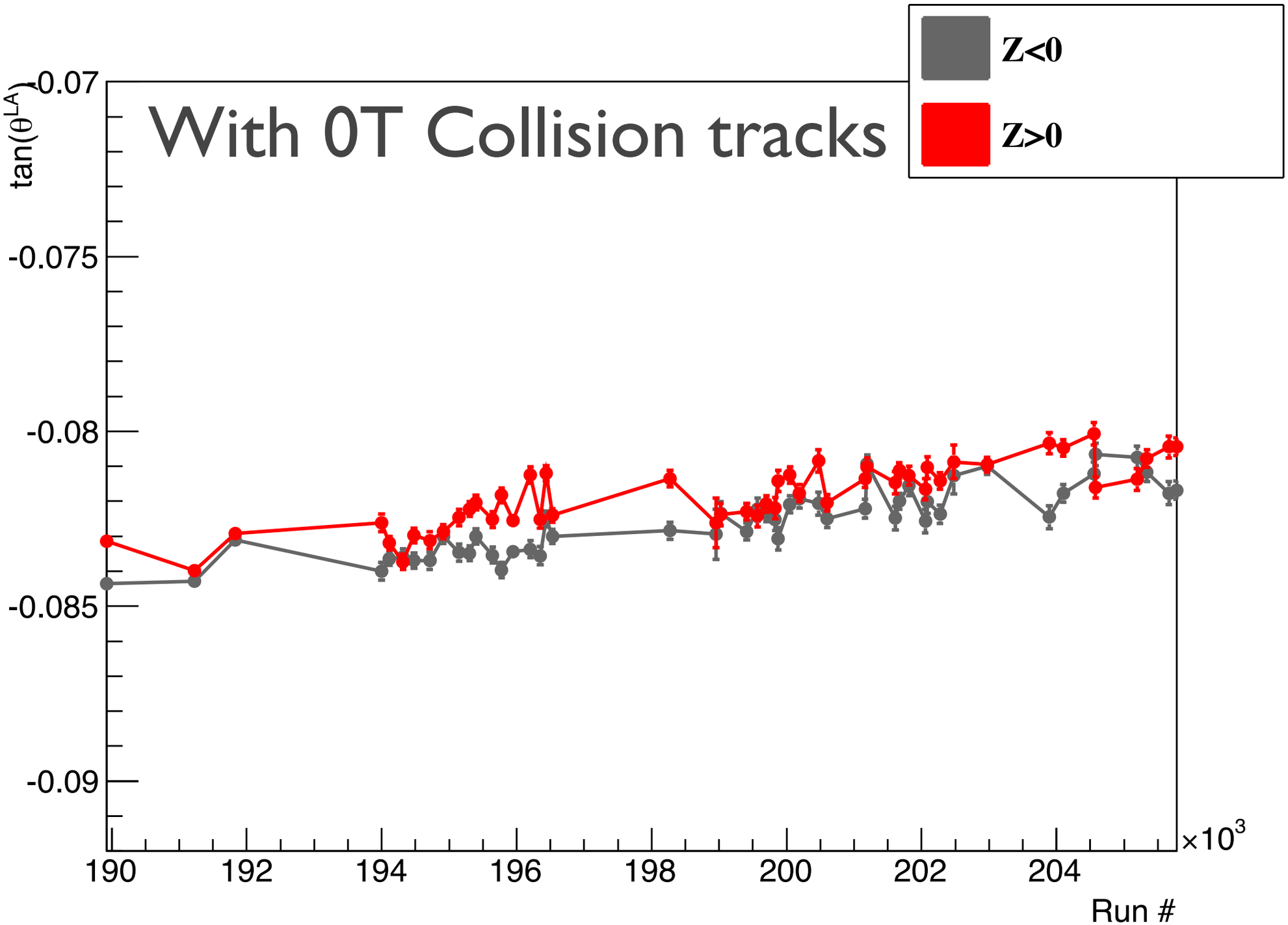


Absolute values become closer.

LA time dependence: FPIX



LA time dependence: FPIX



As in FPIX, absolute values became closer. Uncertainties are reduced.

Summary

- Alignment has been run using 36M of 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.
- Effect from addition of these tracks shows improvement of the split only in layer 3.
- Absolute mobility values become closer one to another in layers 1 and 3 of BPIX and in FPIX.
- Time dependence remains the same.

Next steps

- Apply isolation cut for 0T Collision tracks in alignment.

- Probably fitting these tracks to the primary vertex can be useful to remove fake tracks.