Strip Lorentz angle and Backplane calibration in MP II

- alignment/calibration setup
- mobility evolution

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Tracker Alignment Meeting

DESY, Hamburg

16.07.2013

Introduction

- Last time presented results of alignment + LA calibration in TIB and TOB.
- This time backplane calibration results are presented.
- Effect from BP calibration validated with DMR plots.

Alignment setup: mp1296 (full)

Alignment starting from CRAFT12; GT: FT_R_53_V21

Data used in alignment (no weights applied):

- MinimumBias | A+B+C+D
- SingleMuon | A+B+C+D
- ZtoMuMu | A+B+C+D
- Cosmics interfill | A+B+C+D
- Cosmics CRAFT12 | A
- Cosmics CRUZET | A (10 GeV P estim.)
- Cosmics 0T | C (10 GeV P estim.)
- 0T Collision (mp1276_0T) | C (3 GeV P estim.)

No Kinks&Bows

Number of used tracks: ~60 M

Large structures, Pixel modules: 111111 Strip modules: 101111

Calibration setup: mp1296 (full)

LA calibration setup:

- BPIX:
  24 parameters: 3 layers x 8 rings
- FPIX:
  2 parameters: left side, right side
- Time granularity: 65 IOVs

- TIB:
  24 parameters: (4 layers x 6 rings) x 2 [strip/deco]
- TOB:
  36 parameters (6 layers x 6 rings) x 2 [strip/deco]
- Time granularity: 20 IOVs

Alignment setup: mp1330 (inversion)

mp1296 geometry:

- supposed to have good alignment
- supposed to have good Pixel LA calibration
- used as starting geometry

Pixel LA from mp1296.

Inversion mode to get uncertainties.

Alignables:

- Large structures: 111111
- TIB,TOB modules: 101000
  - Coordinate most sensitive to LA shift (u)
  - Coordinate most sensitive to BP shift (w)

Calibration setup (LA): mp1330 (inversion)

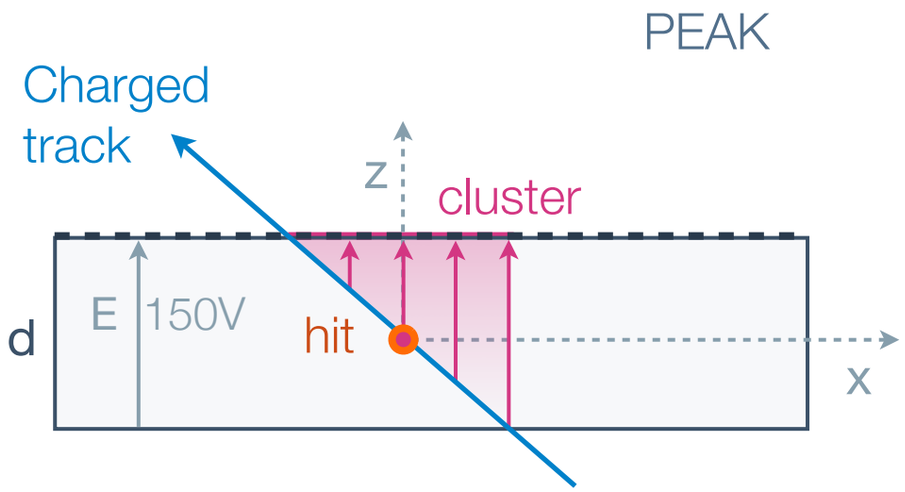
LA calibration setup:

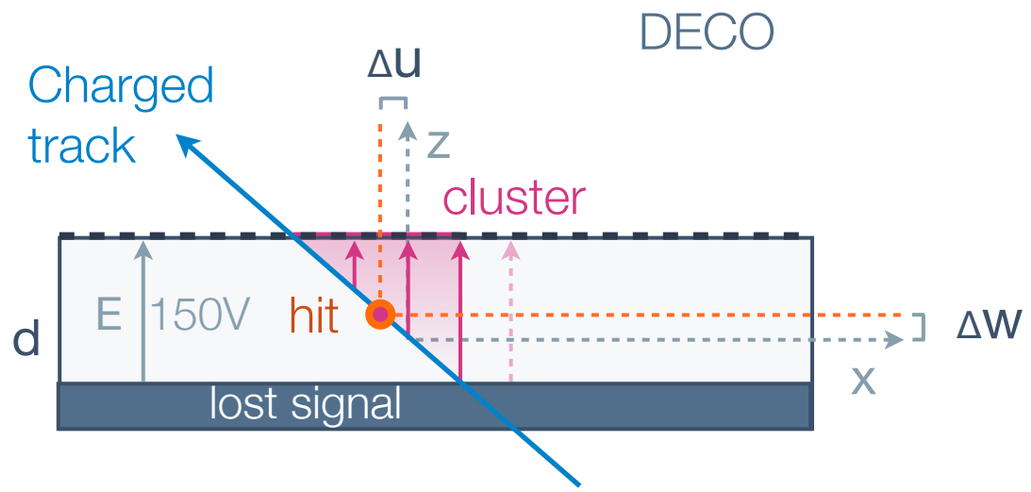
- No LA calibration in Pixel detector

- TIB (deconvolution):
  24 parameters: (4 layers x 6 rings)
- TOB (deconvolution):
  36 parameters (6 layers x 6 rings)
- Time granularity: 21 IOVs

- TIB (peak):
  12 parameters: (4 layers x 3 rings)
- TOB (peak):
  36 parameters (6 layers x 6 rings)
- Time granularity: 6 IOVs

Calibration setup (BP): mp1330 (inversion)





BP calibration setup (Δw):

- TIB:
  24 parameters: (4 layers x 6 rings)
- TOB:
  36 parameters (6 layers x 6 rings)
- Time granularity: 6 IOVs

In total 19660 alignment parameters in pede.

Validation setup

Compared 2 geometries:

mp1296:

LA in BPIX, FPIX, TIB, TOB

mp1330:

starting from mp1296

LA in TIB, TOB (less IOVs for peak LA)

BP in TIB, TOB ⟵ main difference

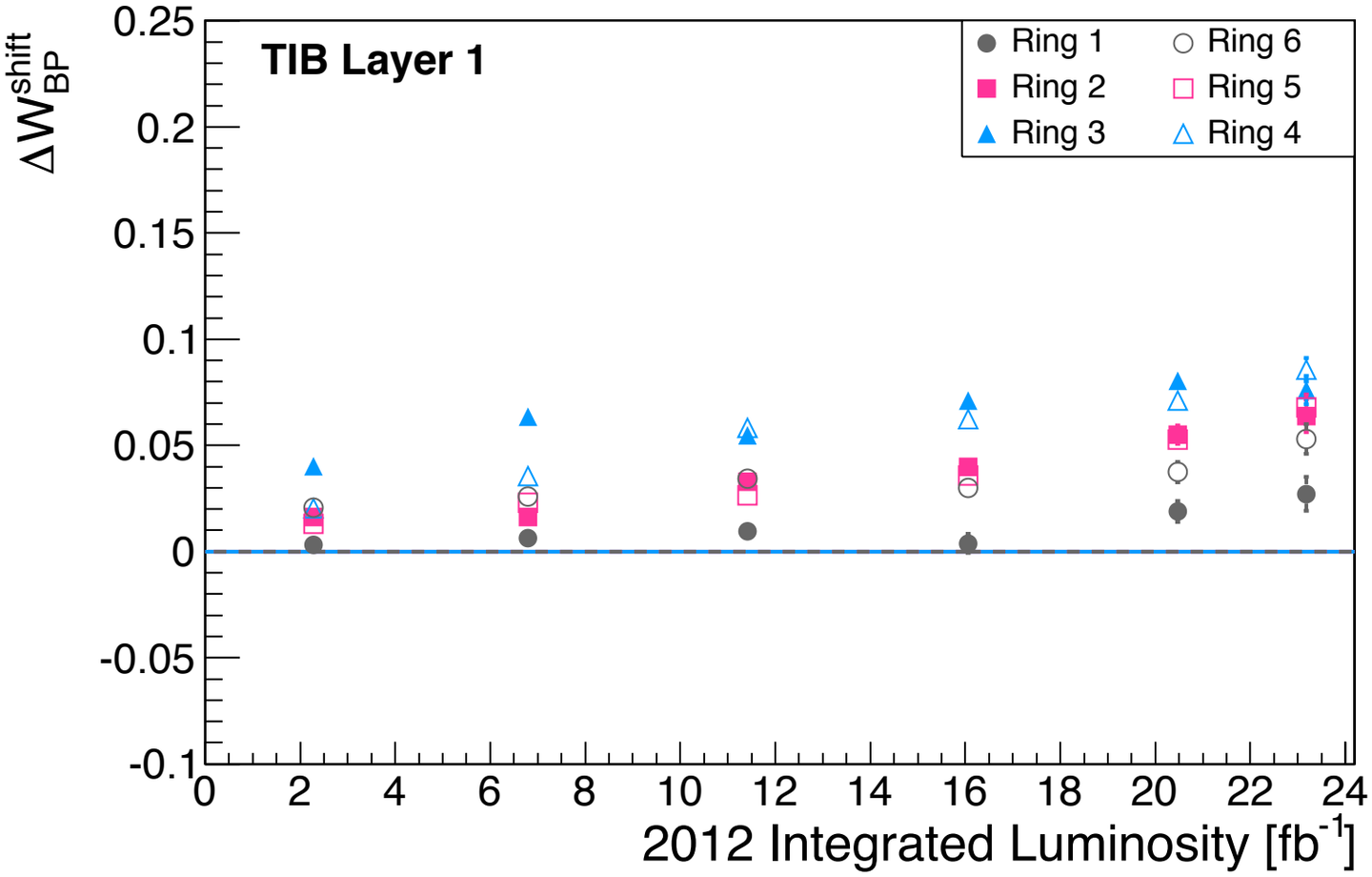
Validation to show effect from BP calibration and better peak LA:

All peak 3.8T Cosmics data (~3.7 million tracks)

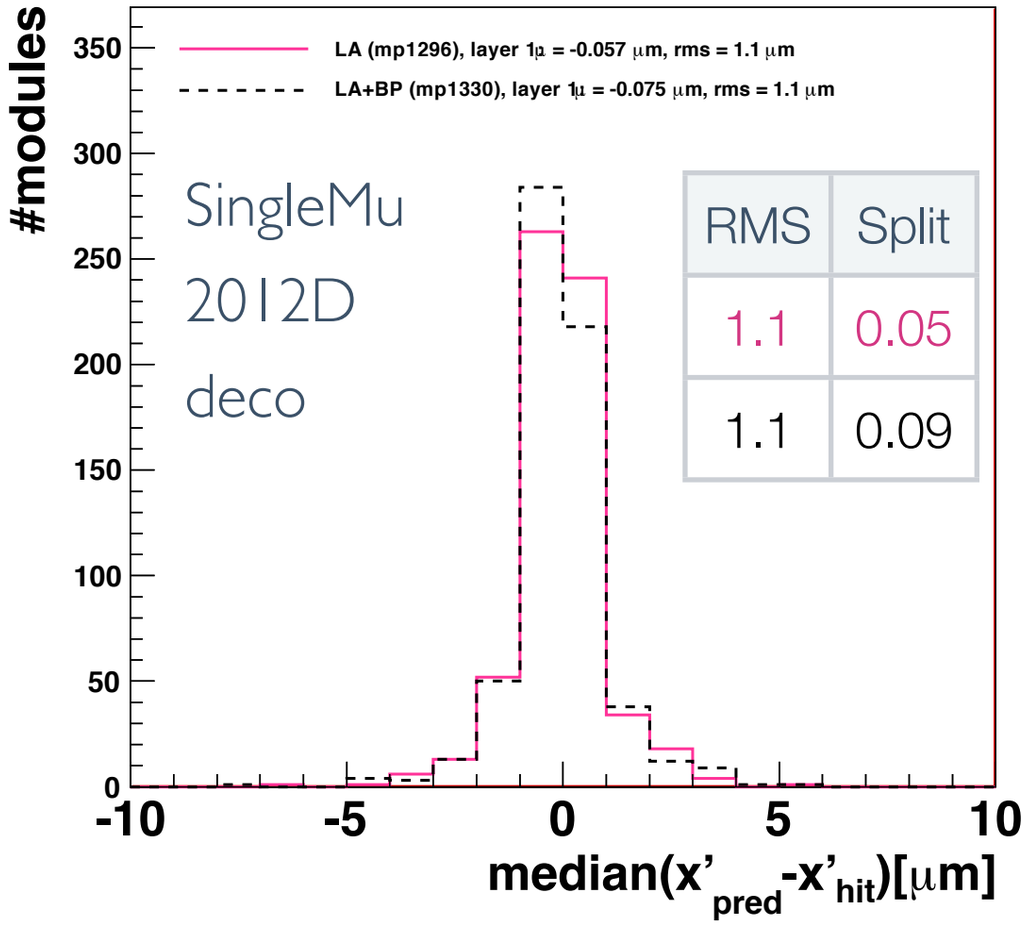
Additional requirement: ≥ 1 hit in TOB && ≥ 1 hit in TEC

↳ smaller track^module angle (higher sensitivity to the BP correction)

BP evolution: TIB (Layer 1) [mp1330]

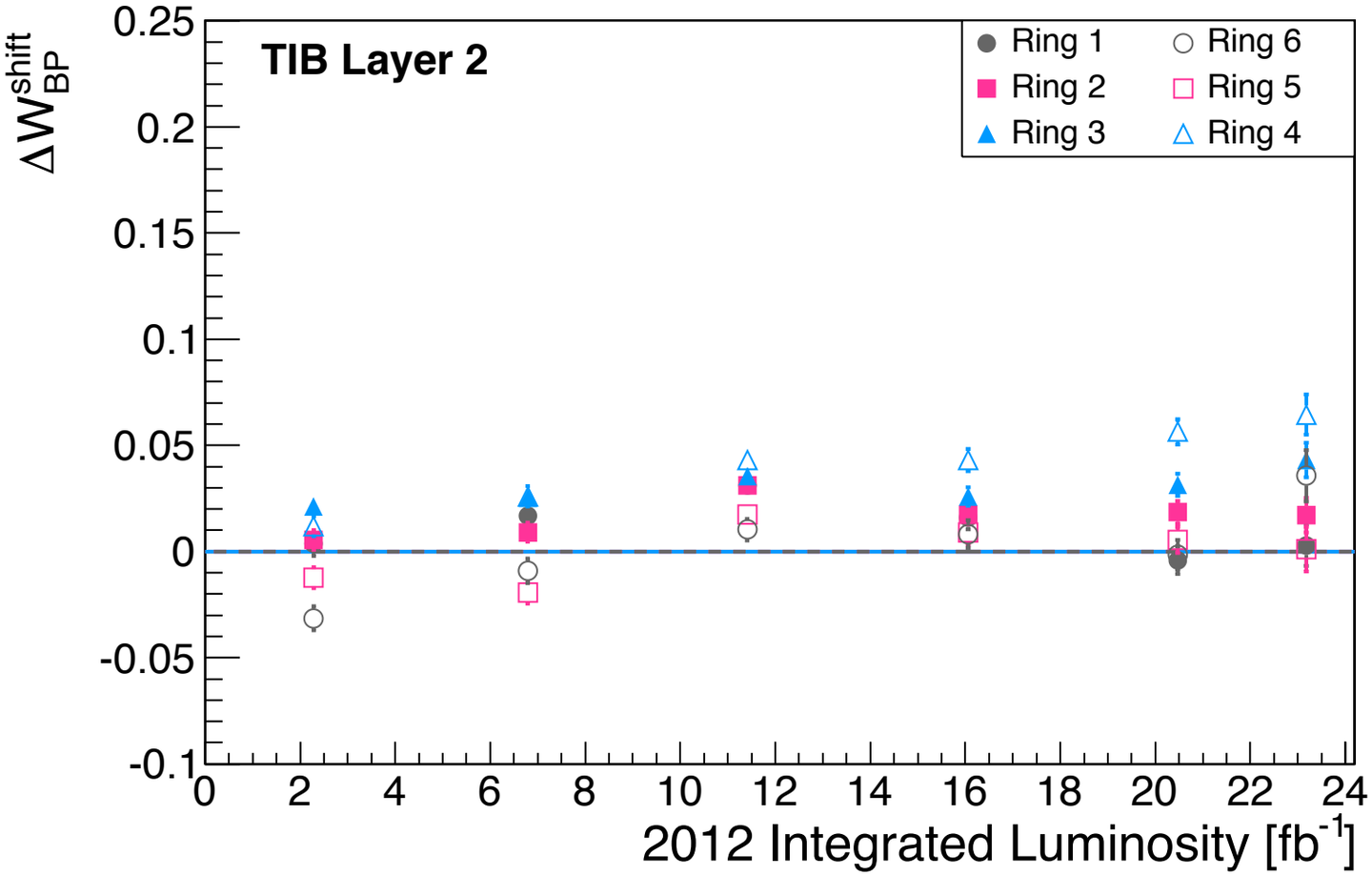


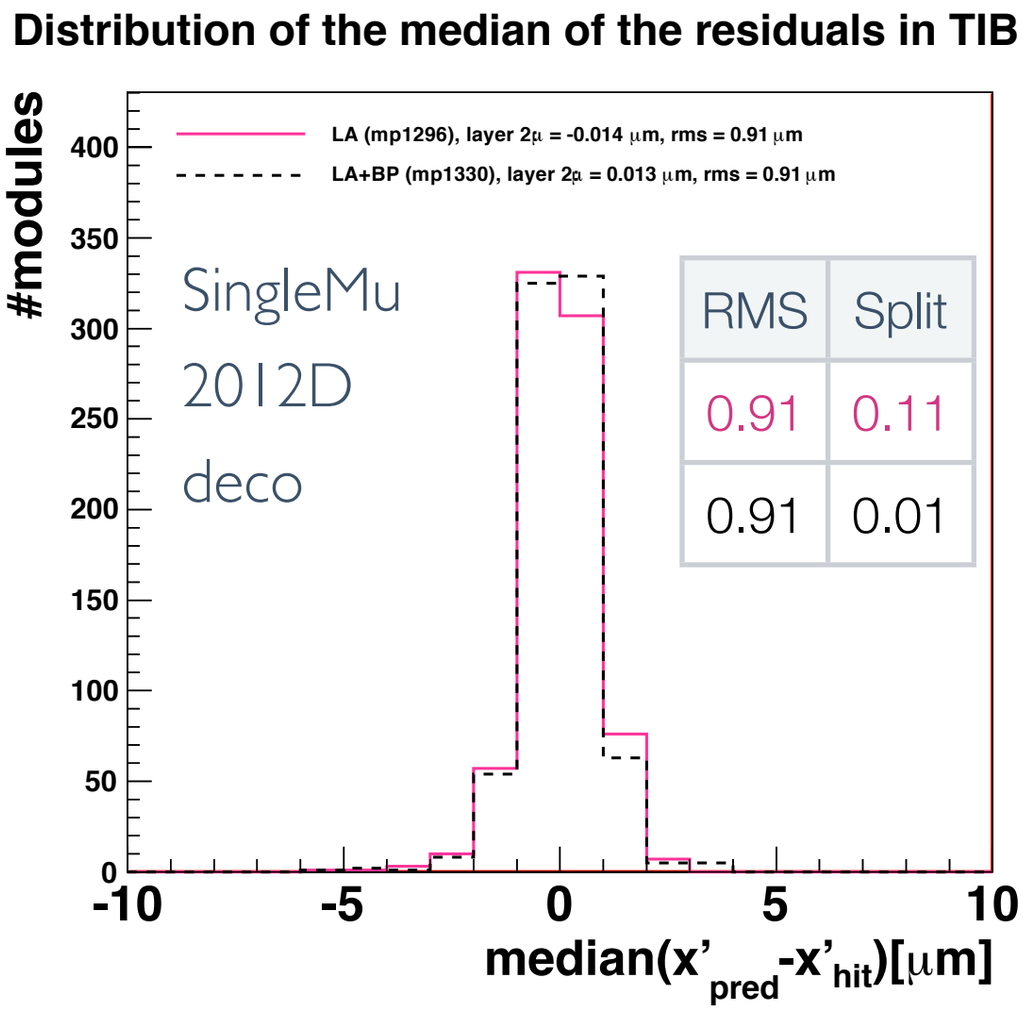
Distribution of the median of the residuals in TIB



- Small increase with time.
- No effect on DMR.

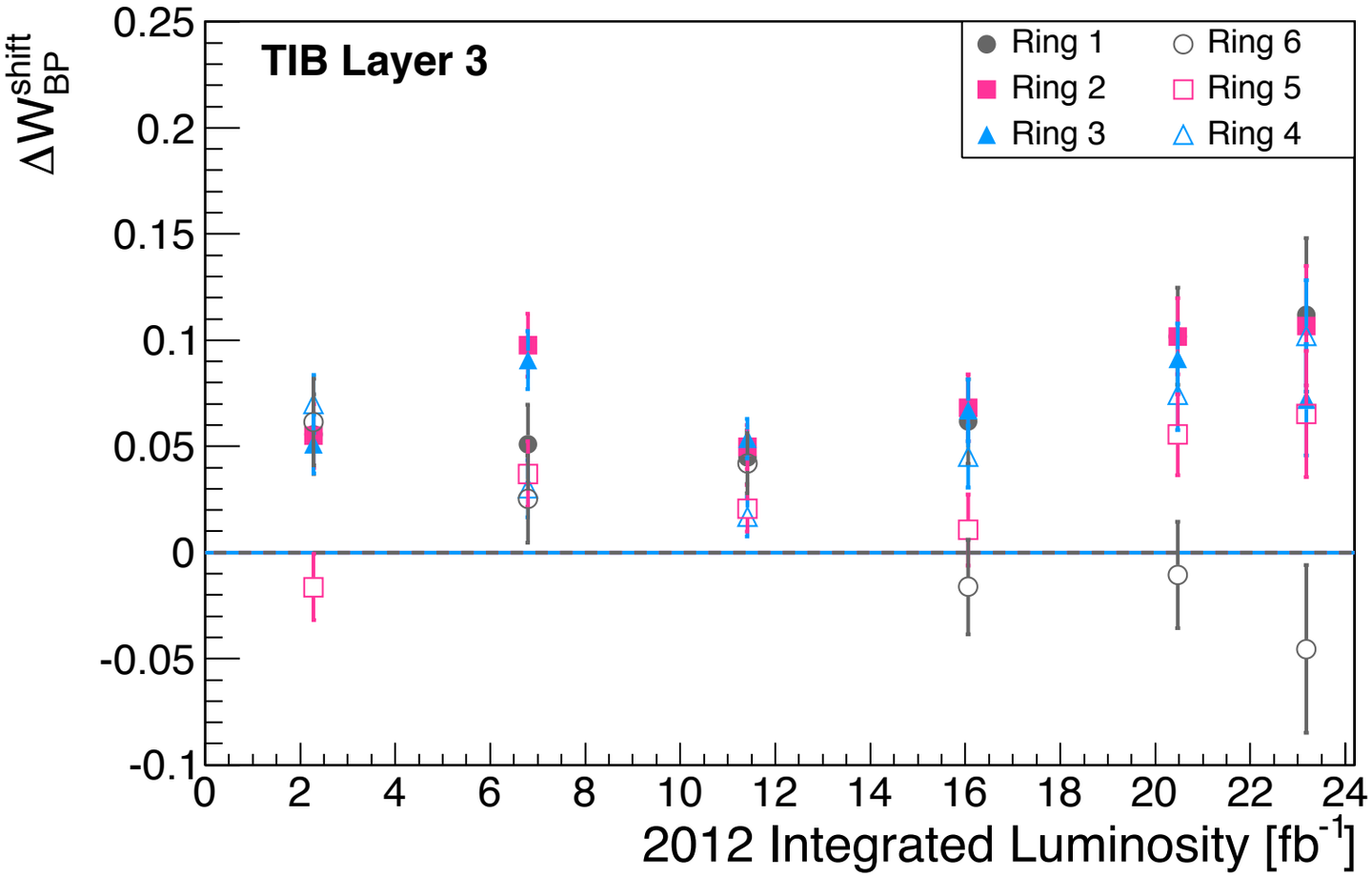
BP evolution: TIB (Layer 2) [mp1330]

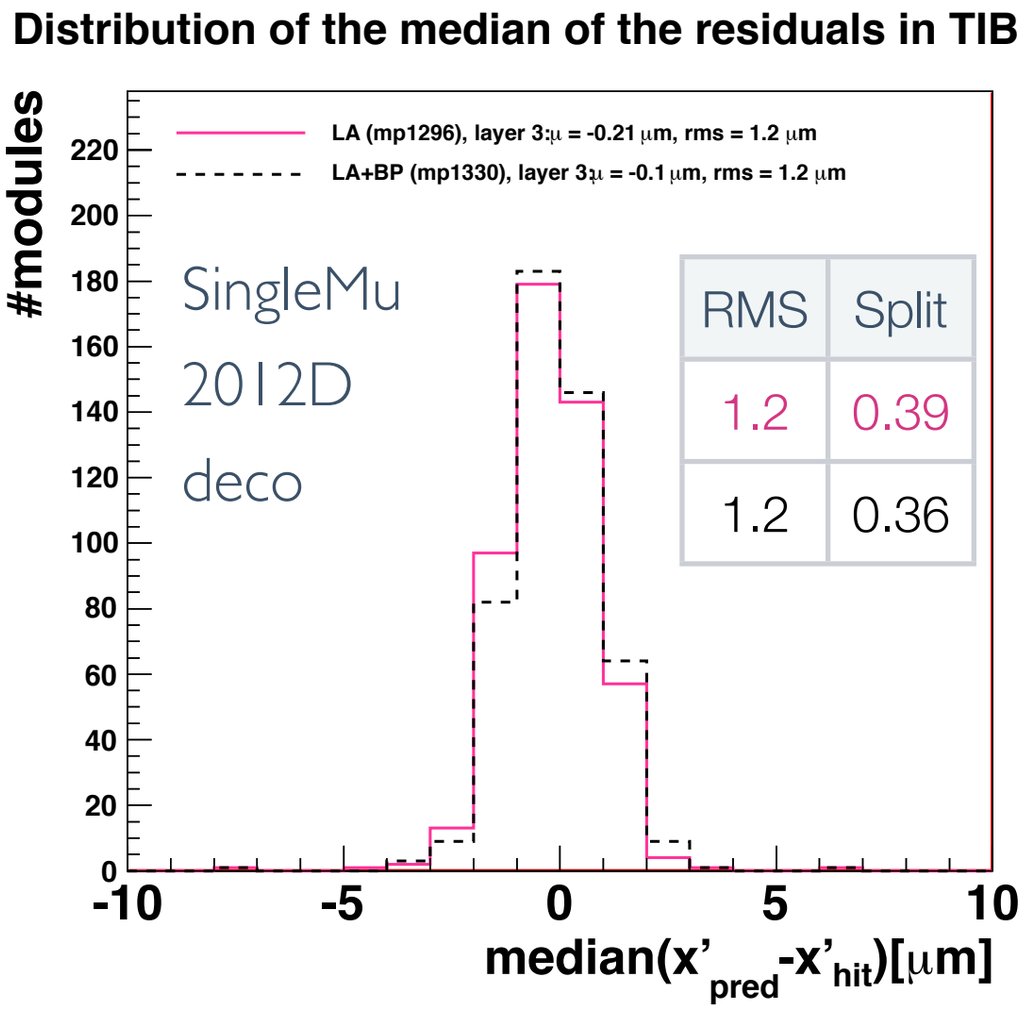




- Small increase with time.
- No effect on DMR.

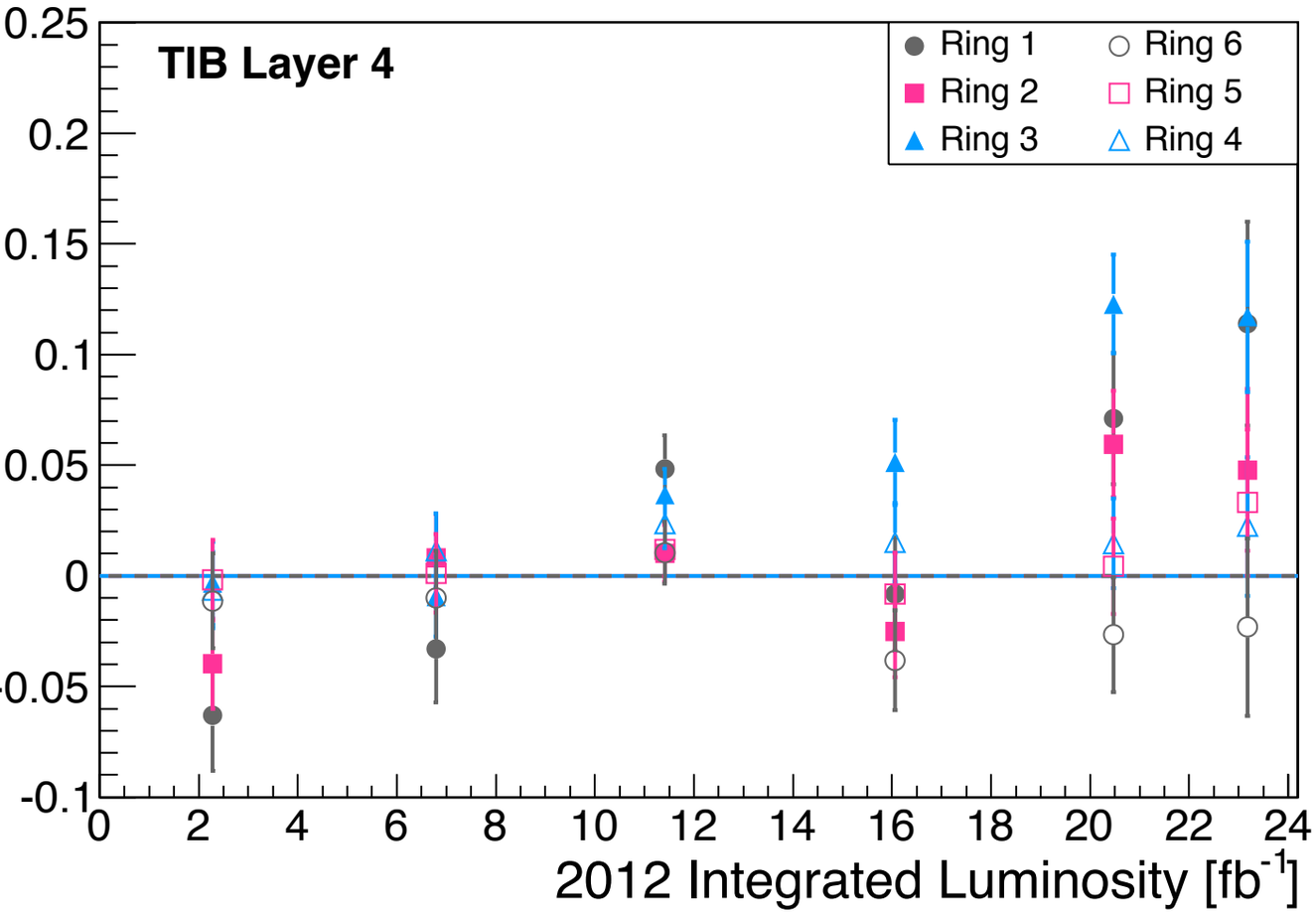
BP evolution: TIB (Layer 3) [mp1330]



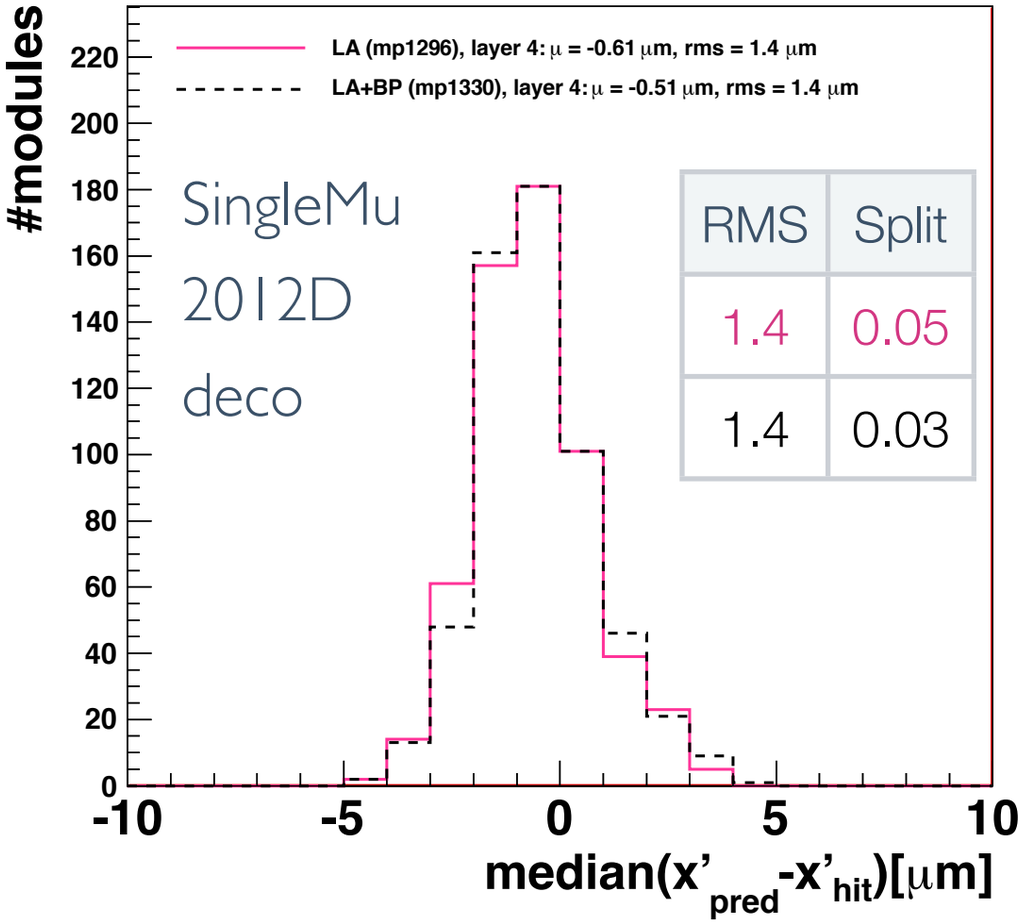


- Larger variations with time.
- Small statistics.
- No effect on DMR.

BP evolution: TIB (Layer 4) [mp1330]

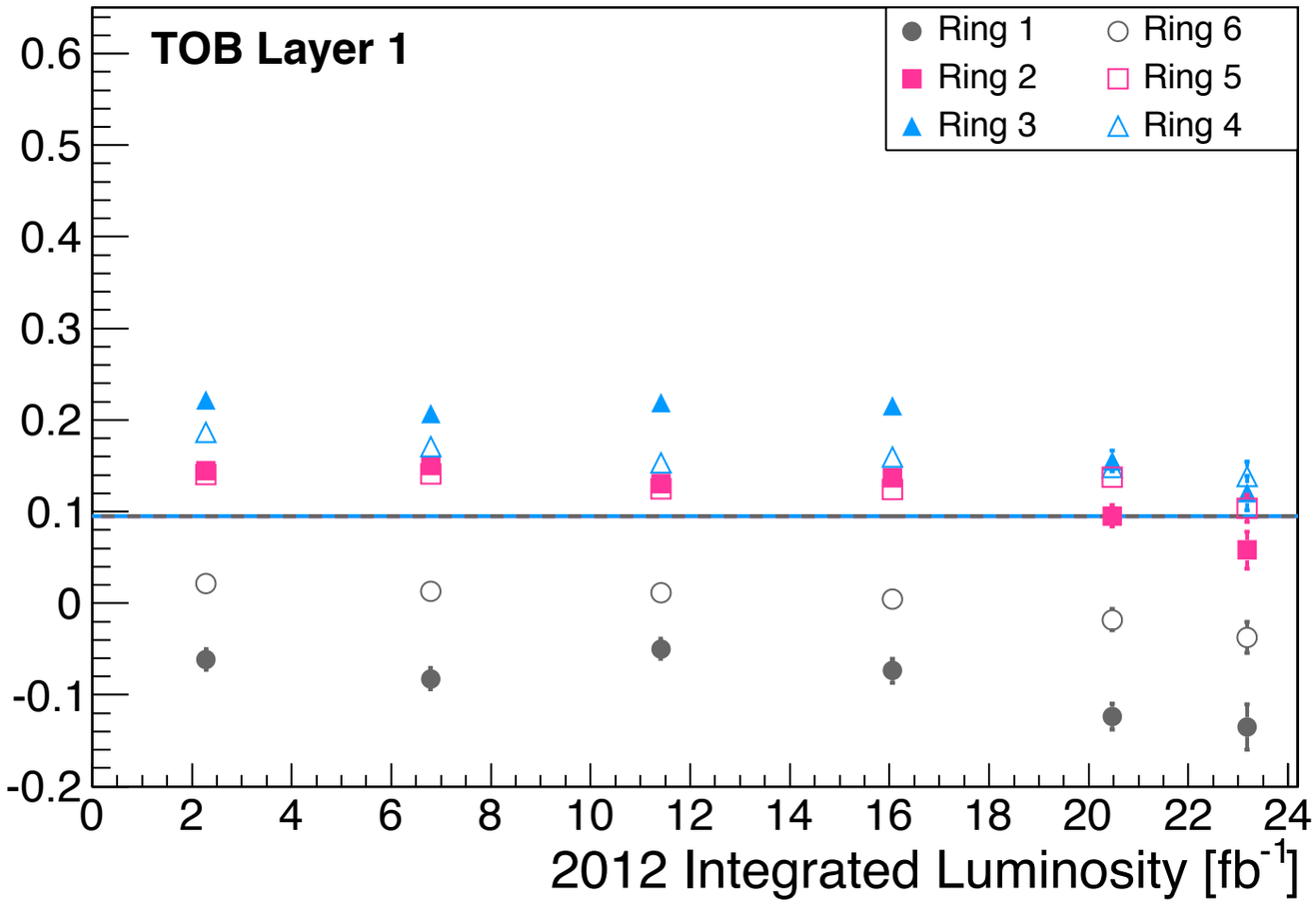


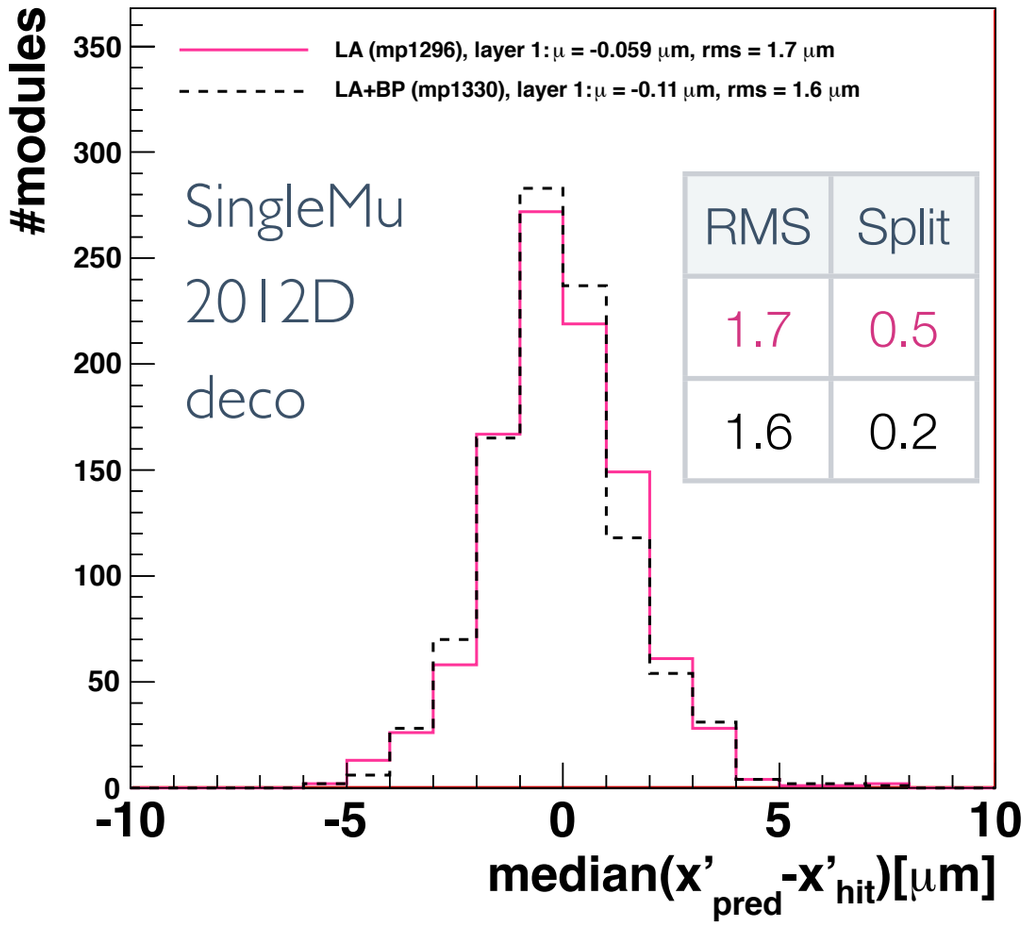
Distribution of the median of the residuals in TIB



- Larger variations with time.
- Small statistics.
- No effect on DMR.

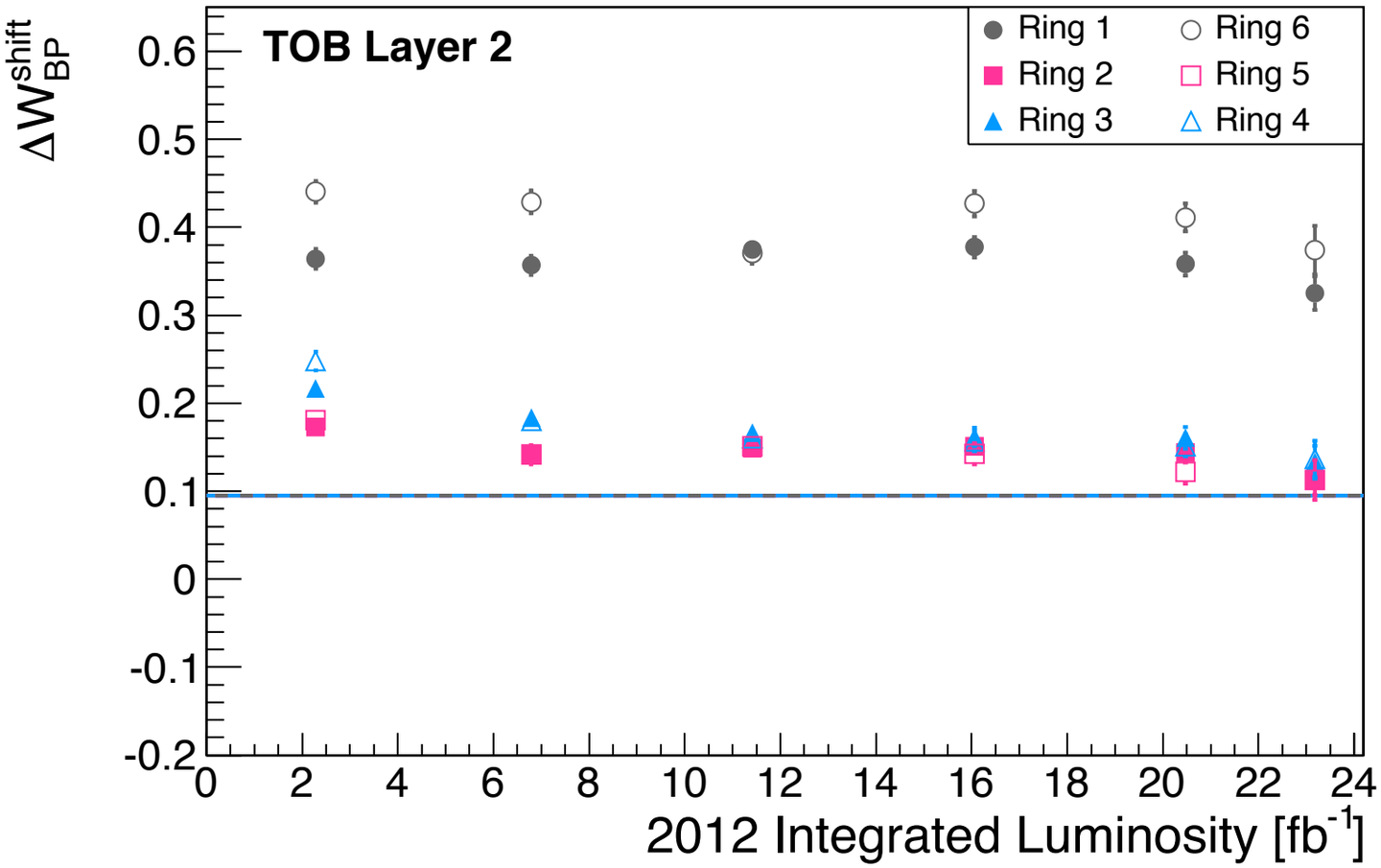
BP evolution: TOB (Layer 1) [mp1330]

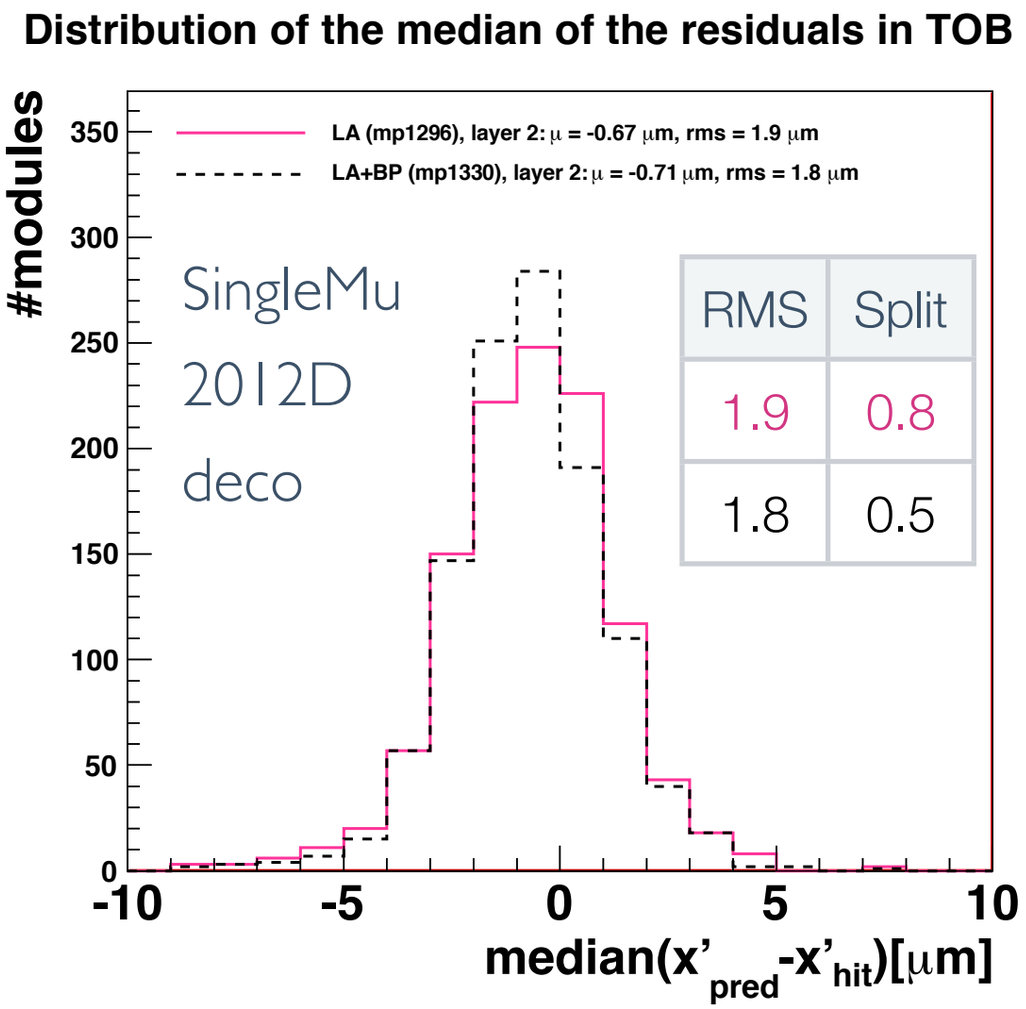




- Small time variation.
- Large offsets.
- Sub-micron improvement with BP calibration.

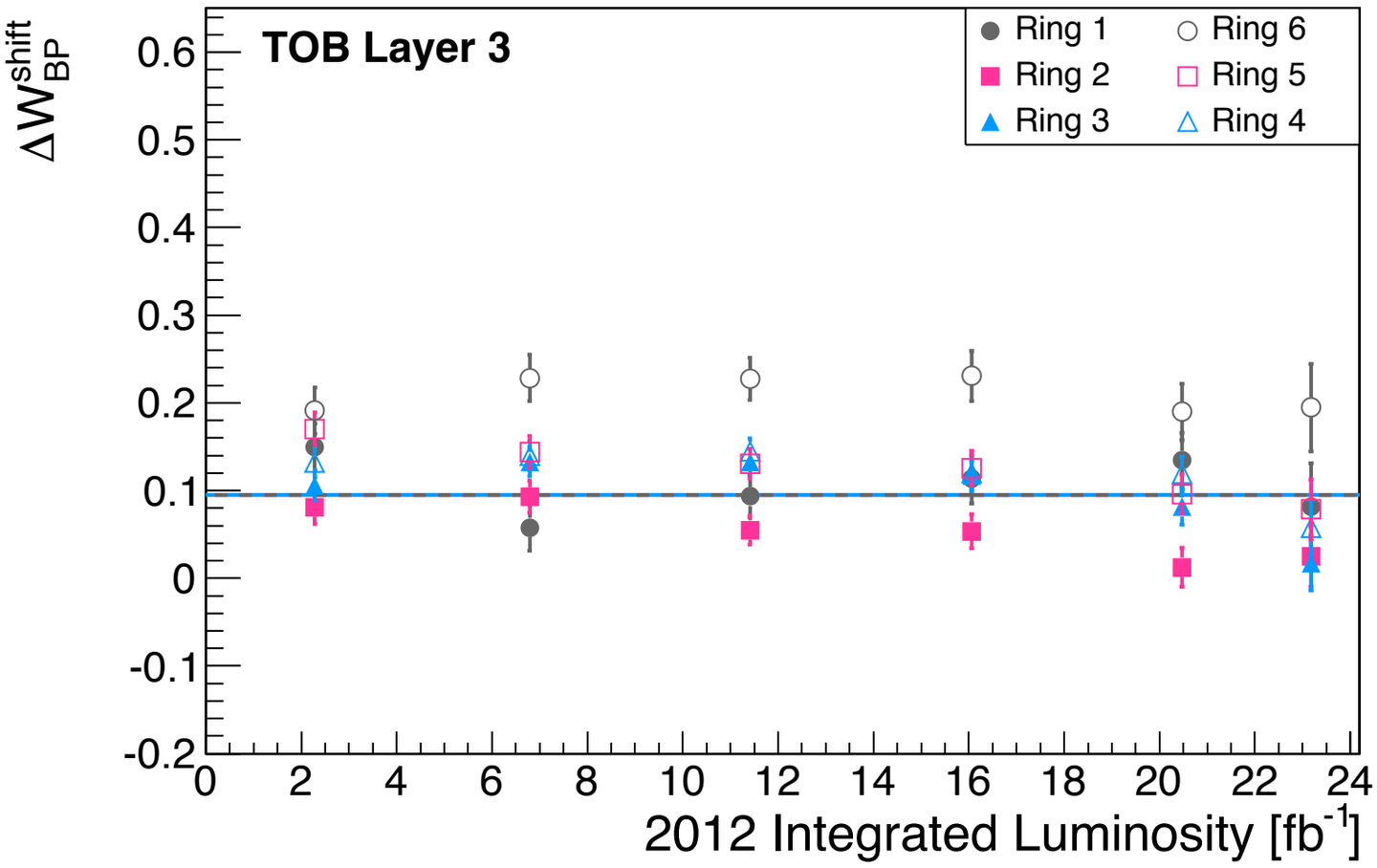
BP evolution: TOB (Layer 2) [mp1330]

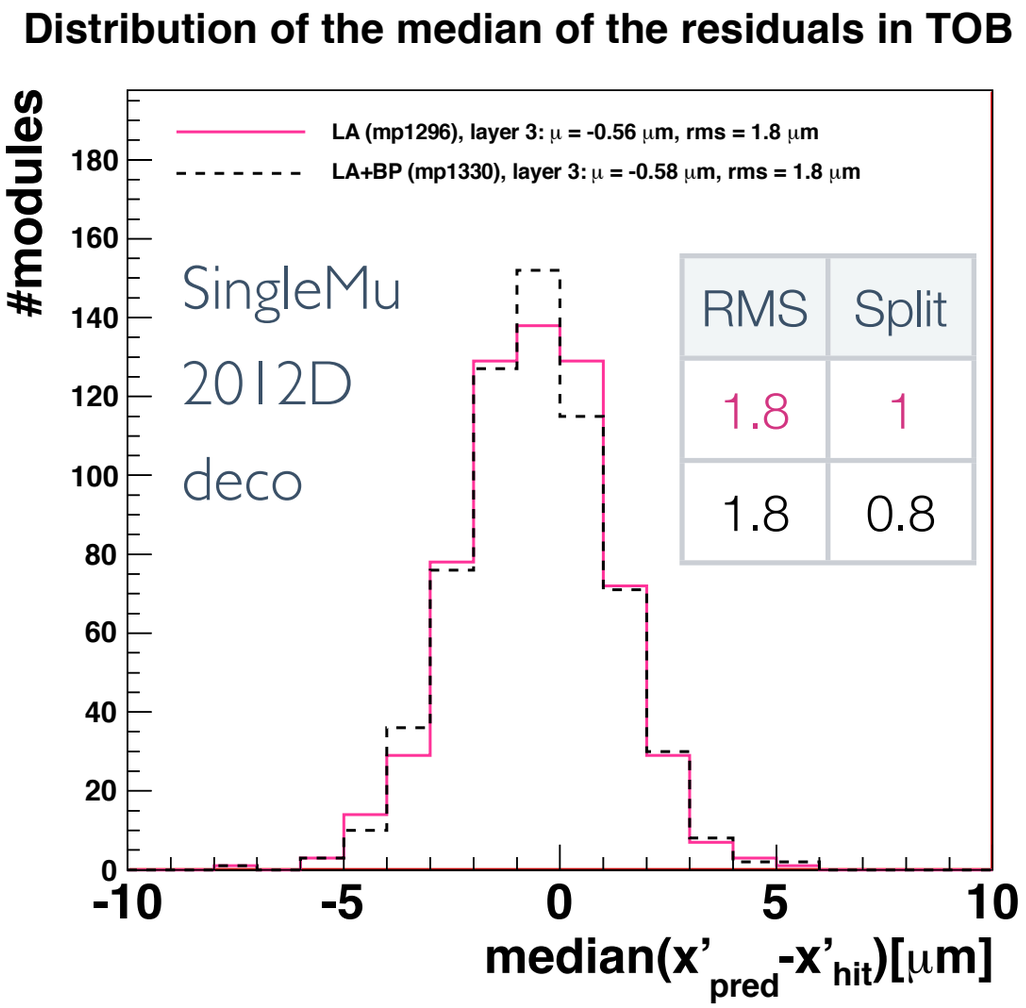




- Large offset in the outermost rings.
- Sub-micron improvement with BP calibration.

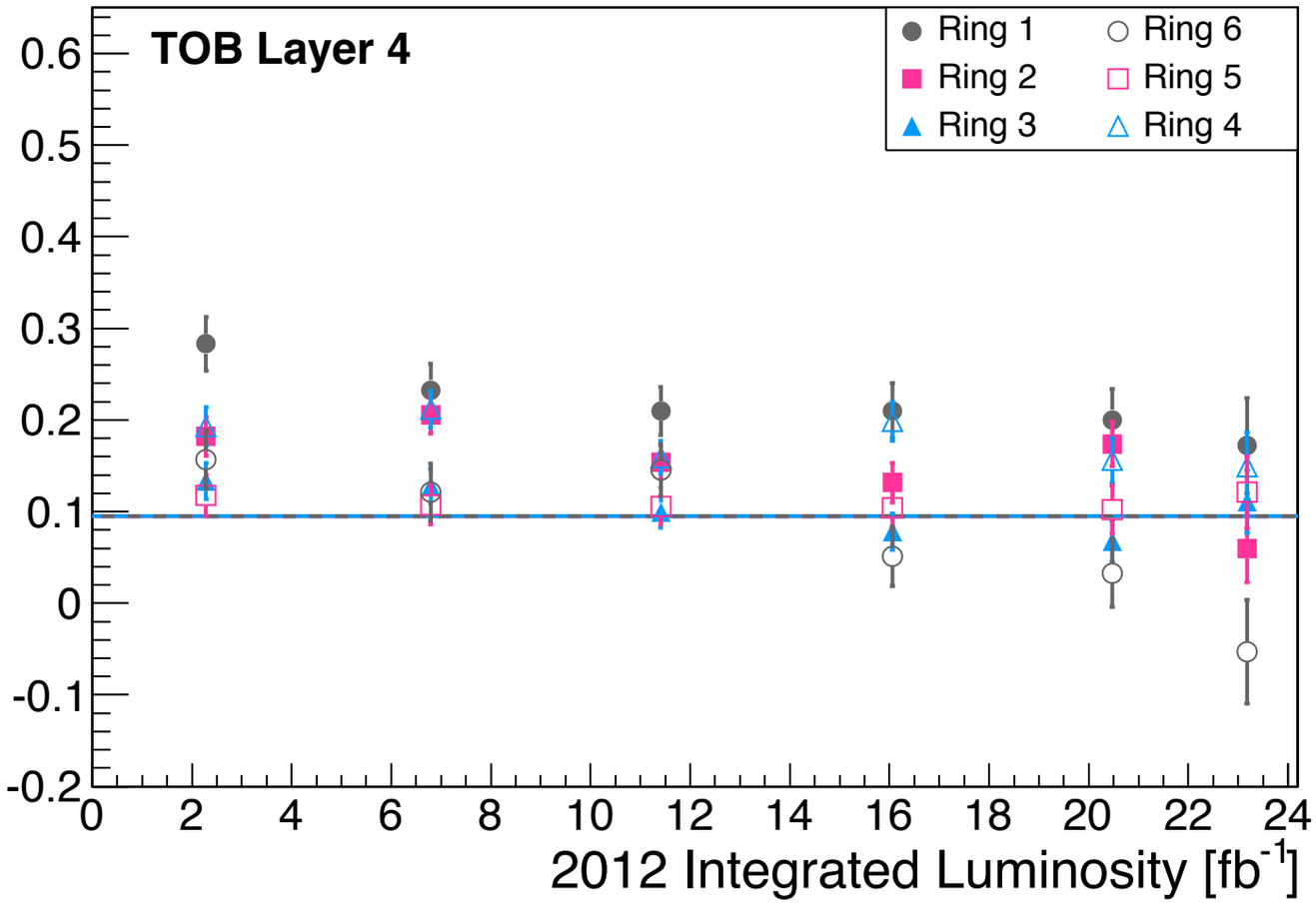
BP evolution: TOB (Layer 3) [mp1330]

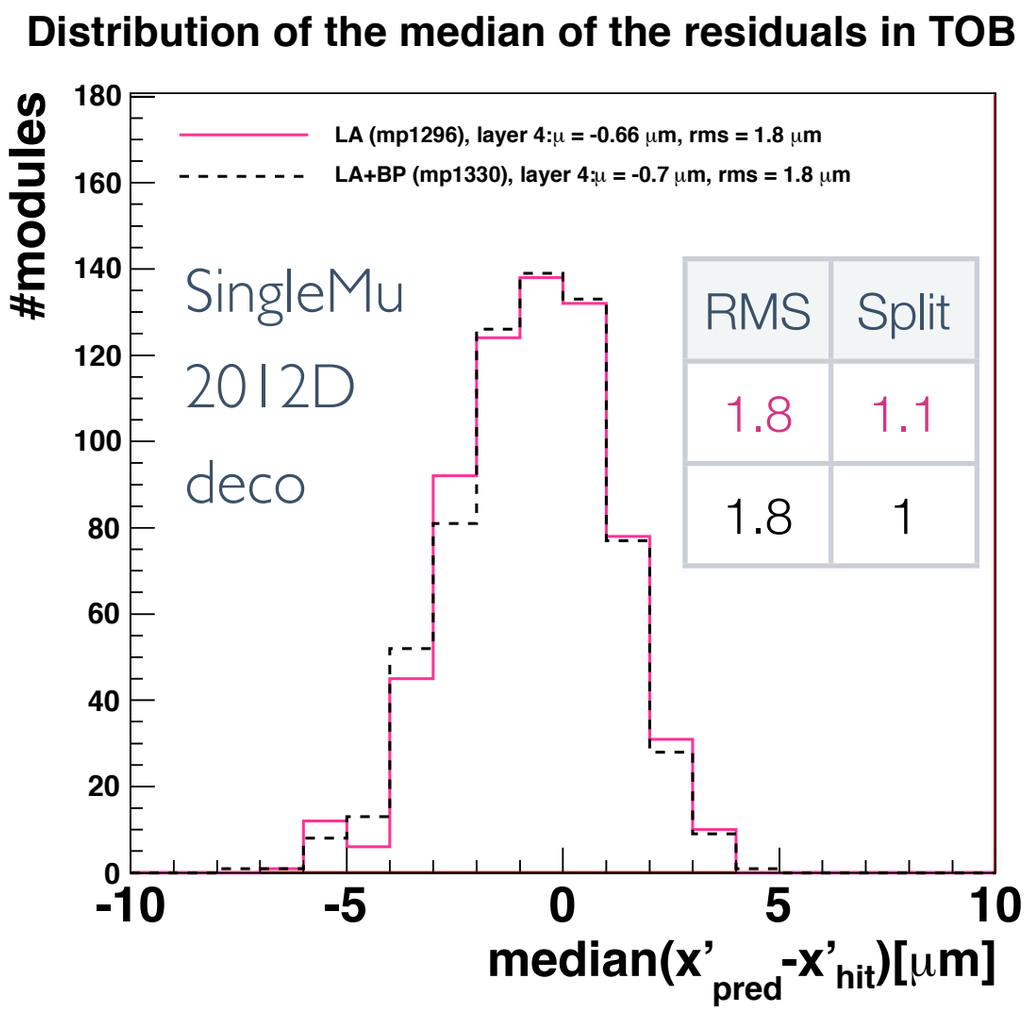




- Input value closer to the calibrated one.
- Smaller offsets.
- Sub-micron improvement with BP calibration.

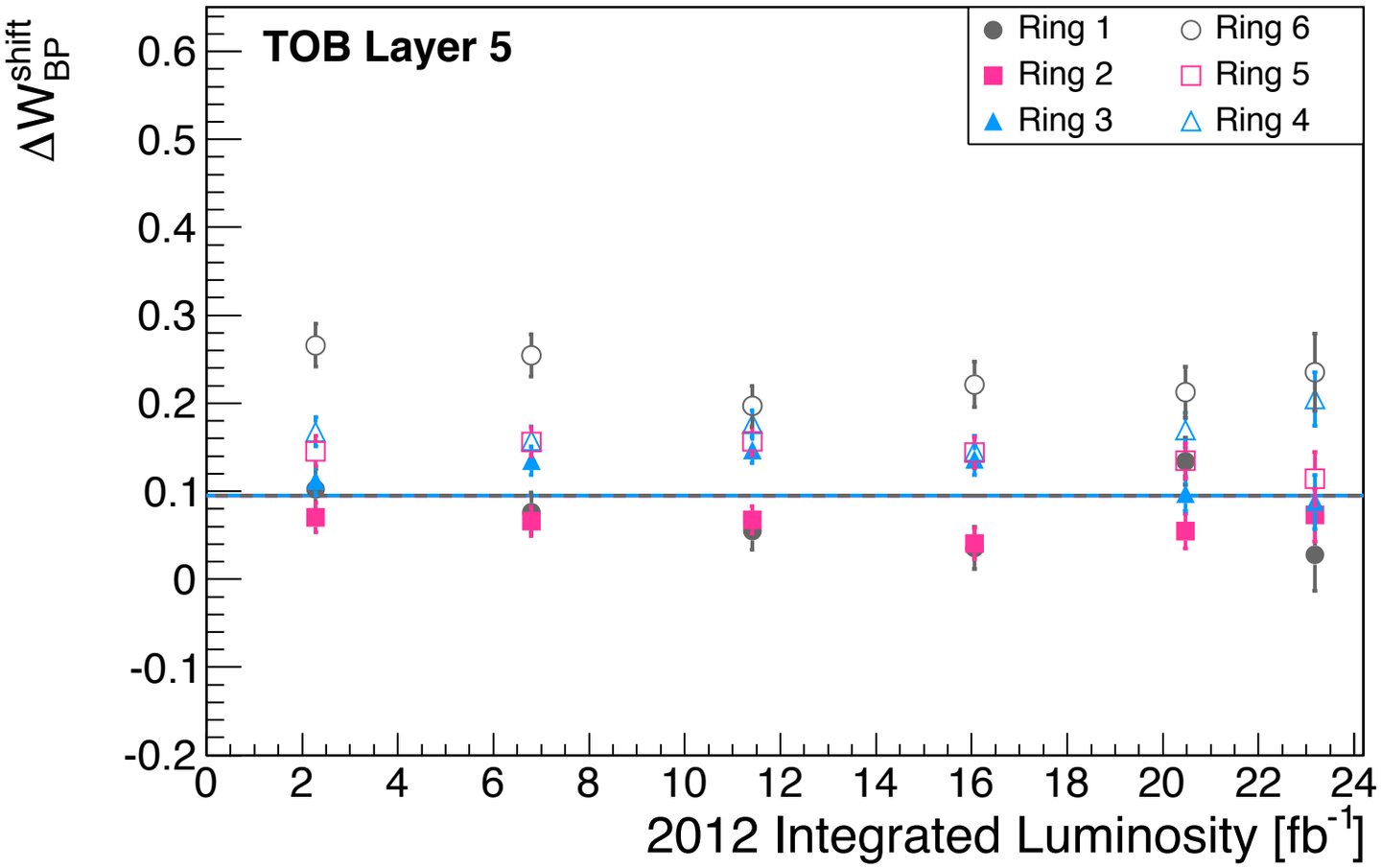
BP evolution: TOB (Layer 4) [mp1330]

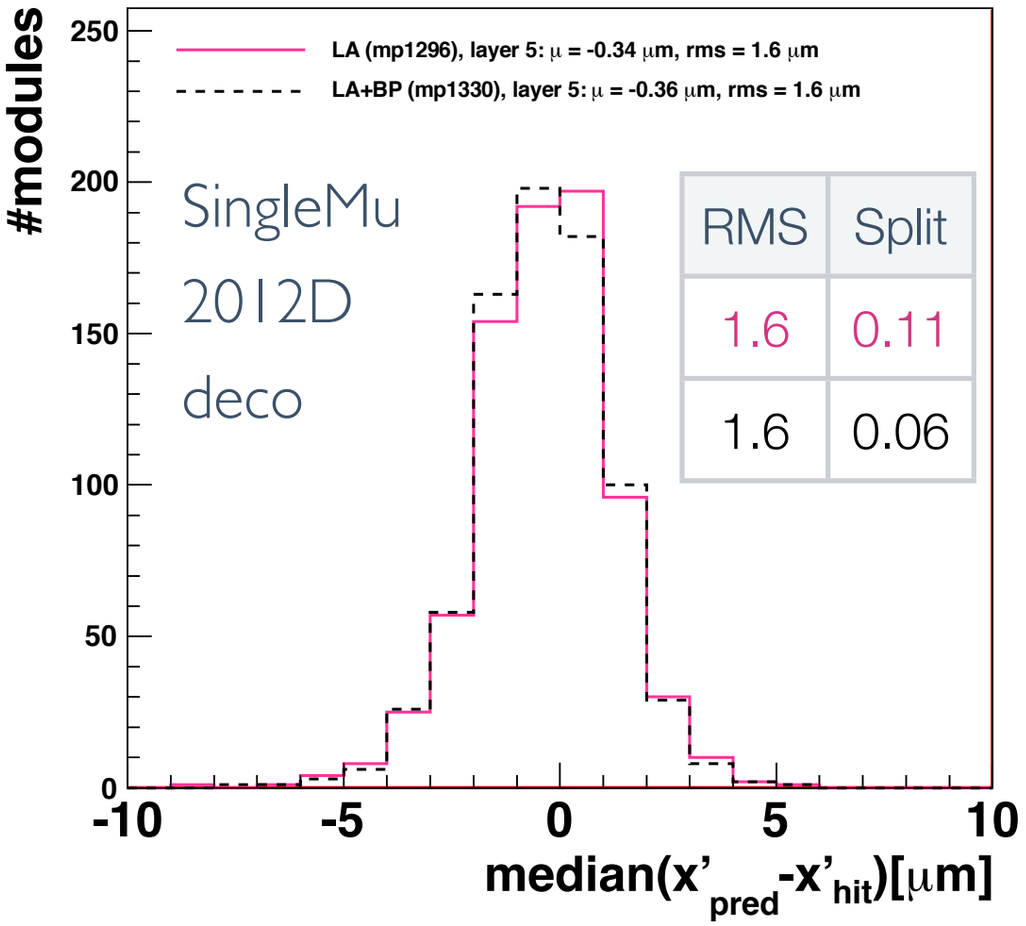




- Smaller variations.
- Smaller effect on DMR.

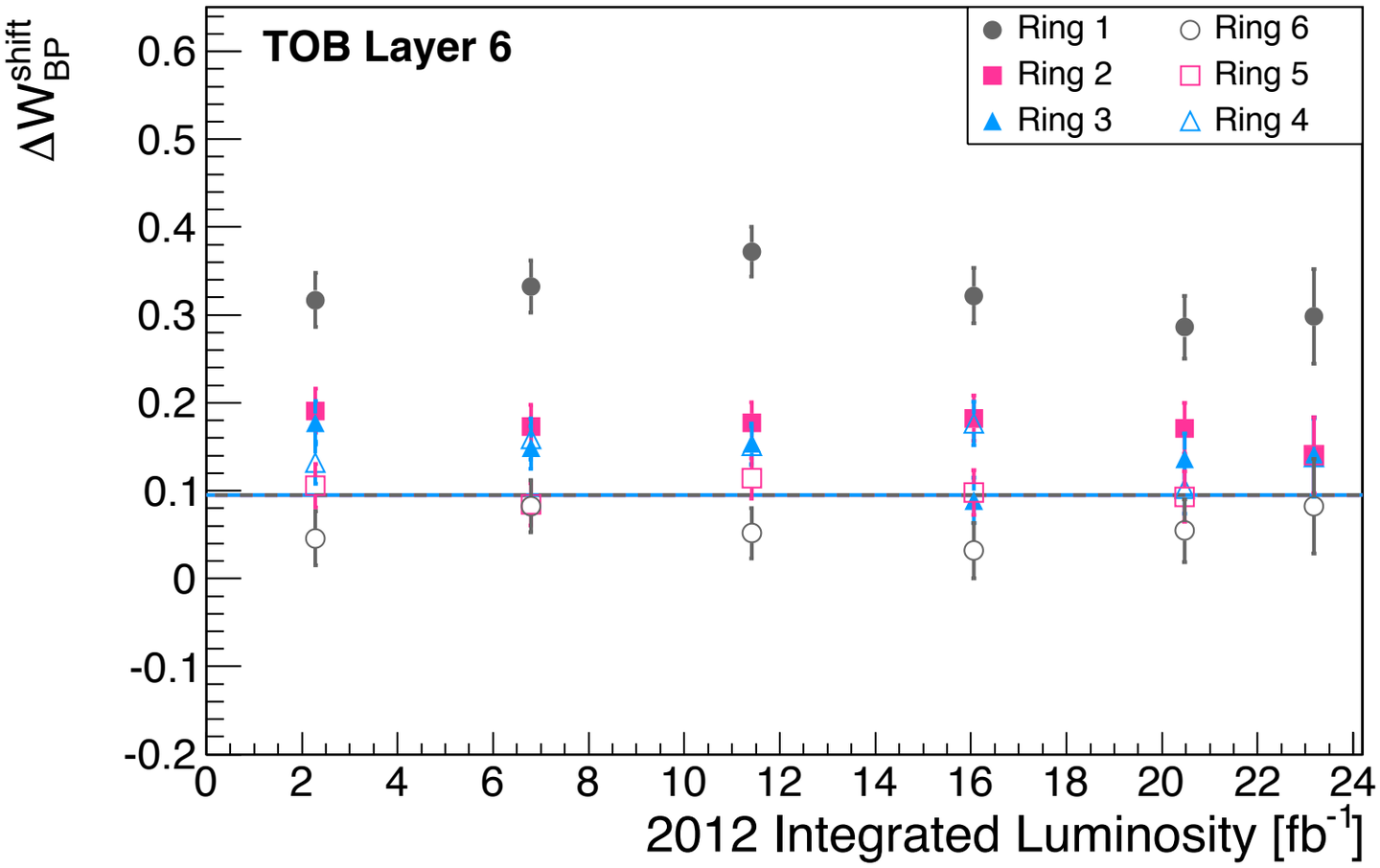
BP evolution: TOB (Layer 5) [mp1330]

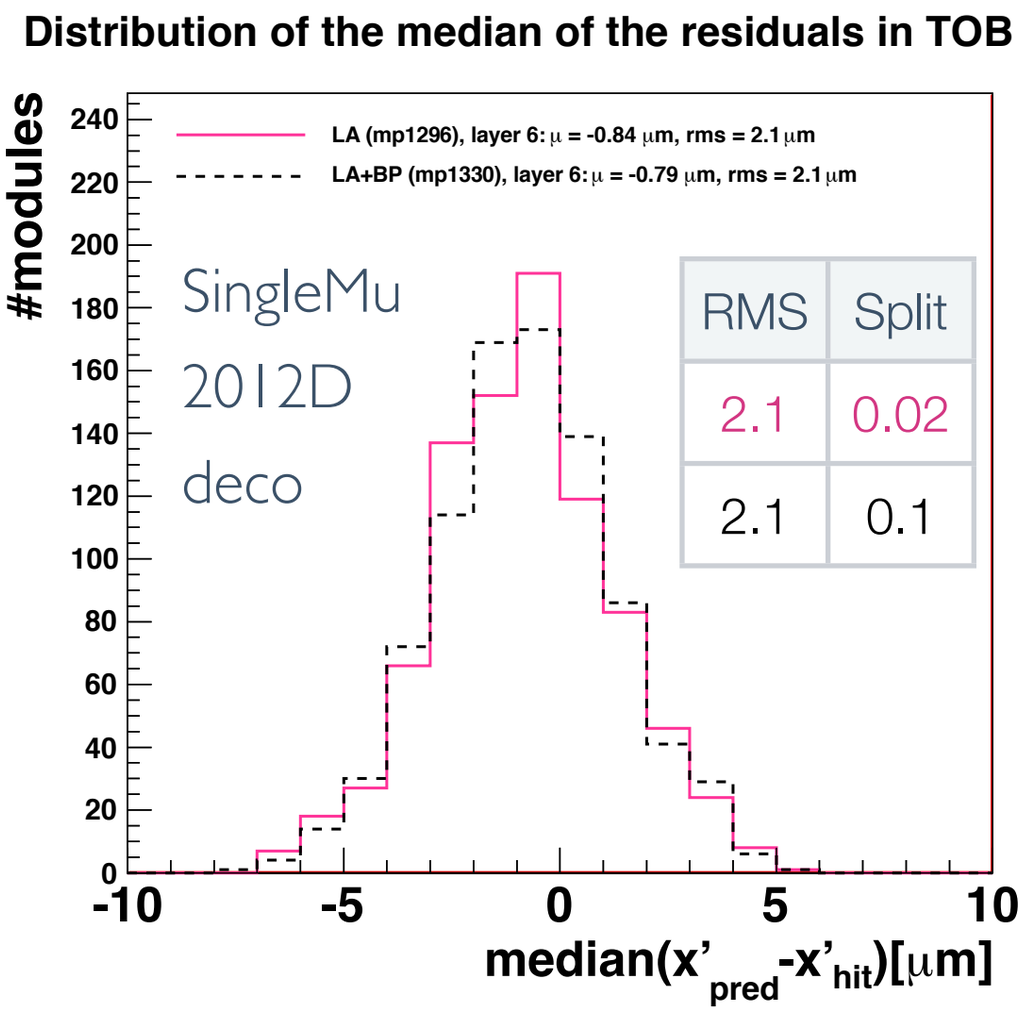




- More constant values.
- No effect on DMR.

BP evolution: TOB (Layer 6) [mp1330]





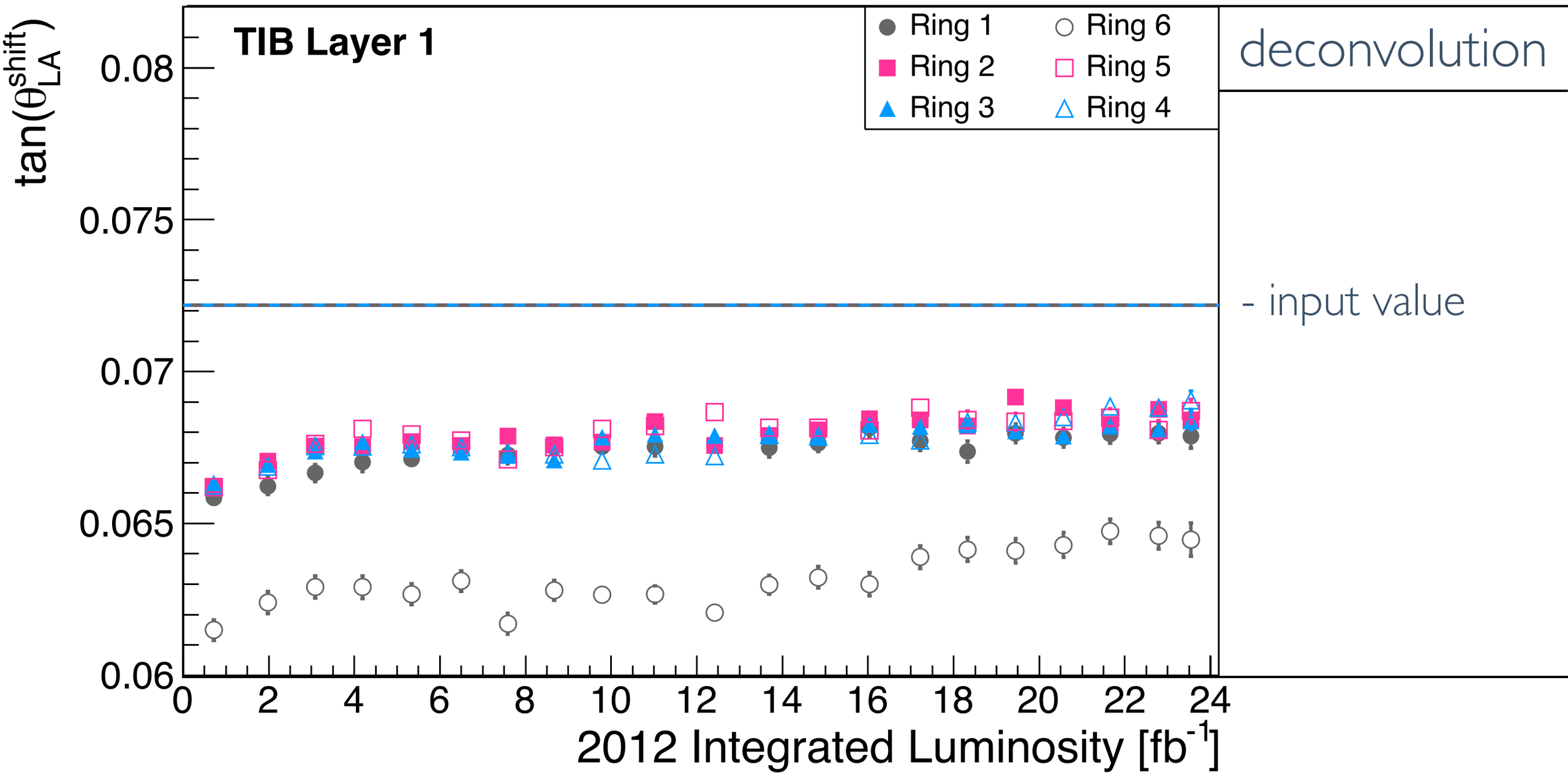
- Offset in ring 1.
- Very small effect.

Conclusions

- New alignment performed with Lorentz angle and backplane calibration in TIB + TOB.
- Effect from BP correction is very small (slightly visible in TOB)
- Spatial granularity can be reduced in most parts of the detector.
- Temperature maps have to be checked to define separate parameters for the hot modules.

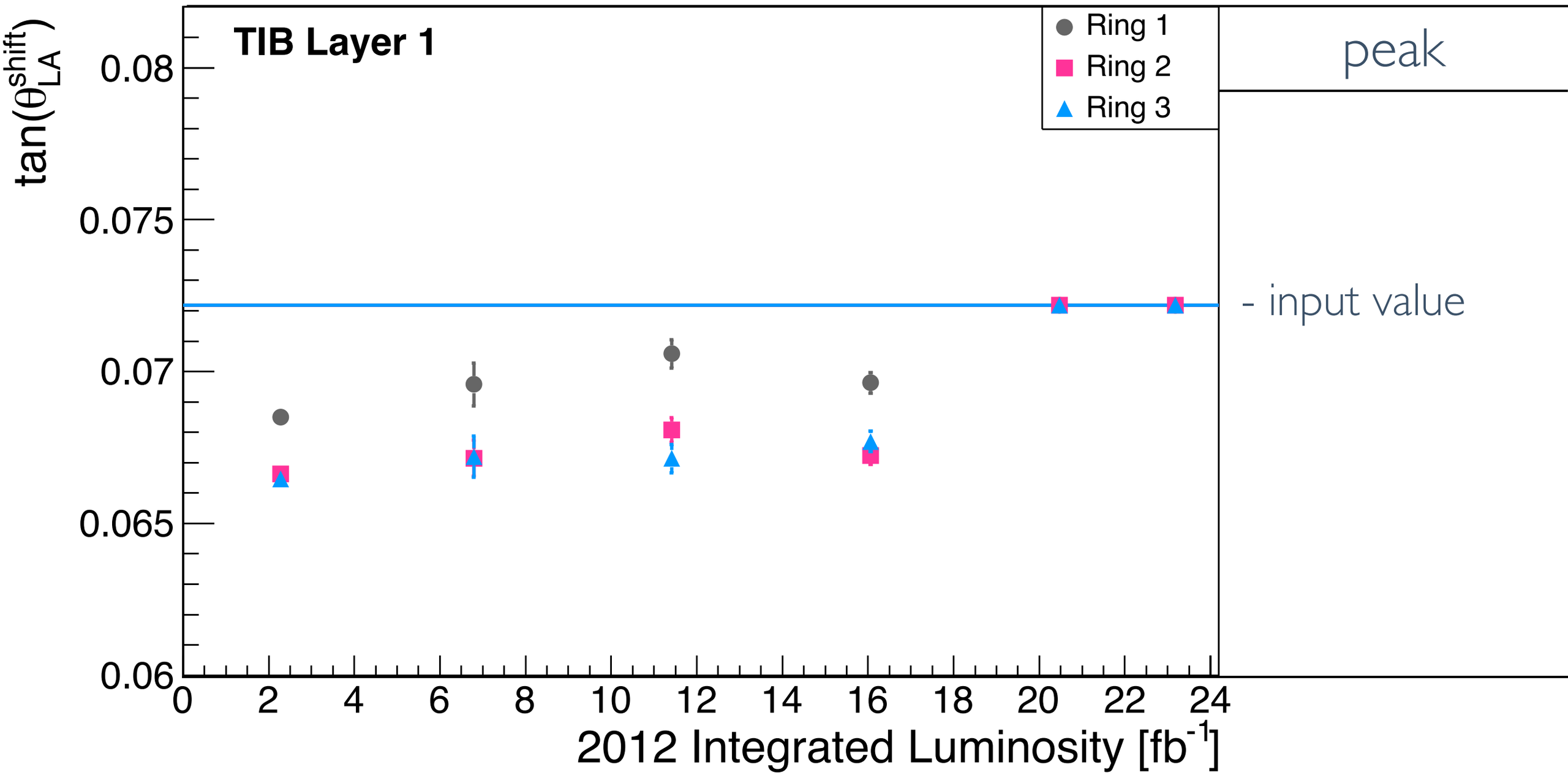
LA time dependence in TIB/TOB

LA evolution: TIB (Layer 1) [mp1330]



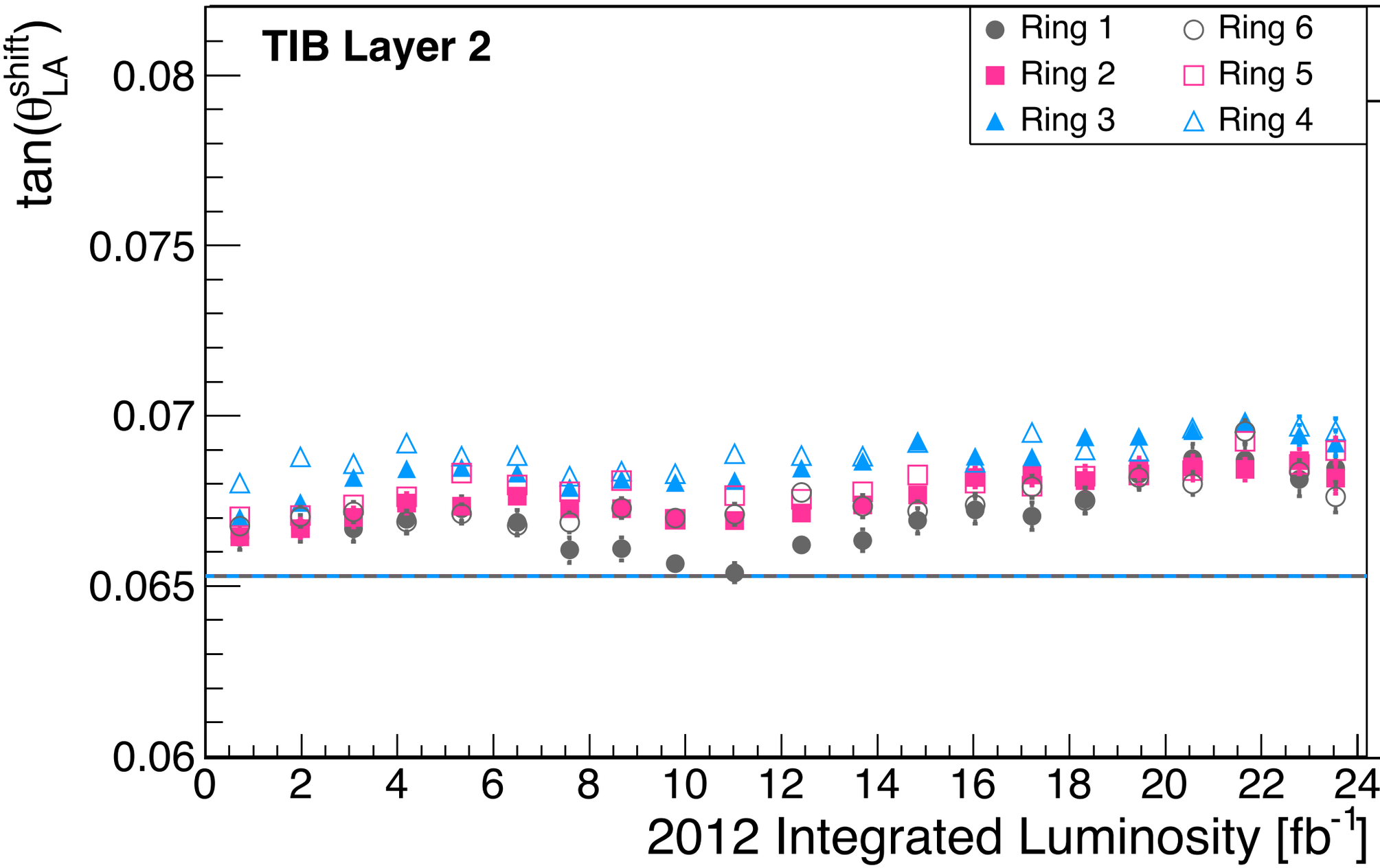
- Rings 1-5 can be merged.
- Offset in ring 6 – higher temperature of the modules? (to be checked with the temperature map)

LA evolution: TIB (Layer 1) [mp1330]



- Peak LA doesn't differ significantly.
- Same time dependence.

LA evolution: TIB (Layer 2) [mp1330]

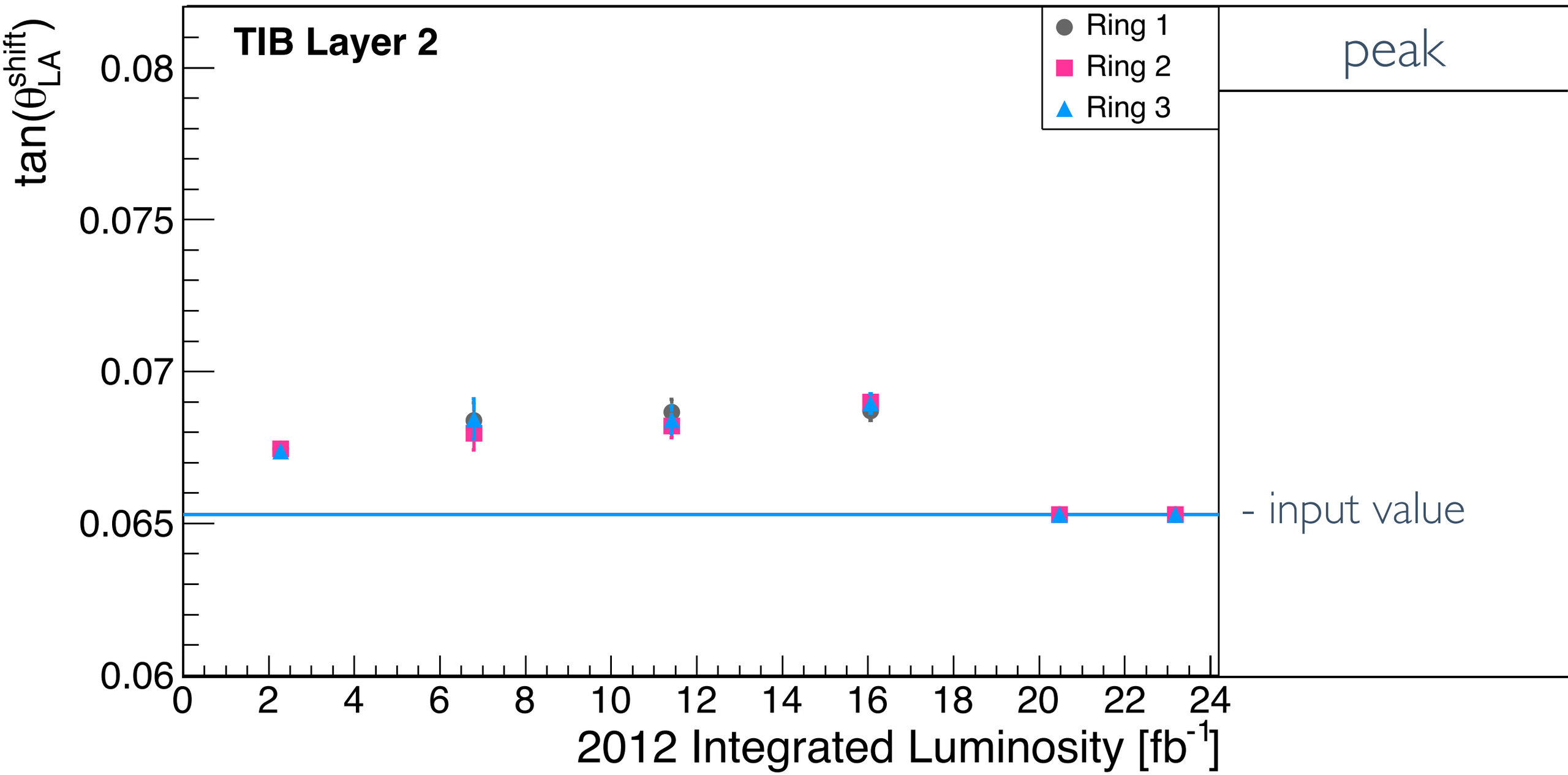


deconvolution

- input value

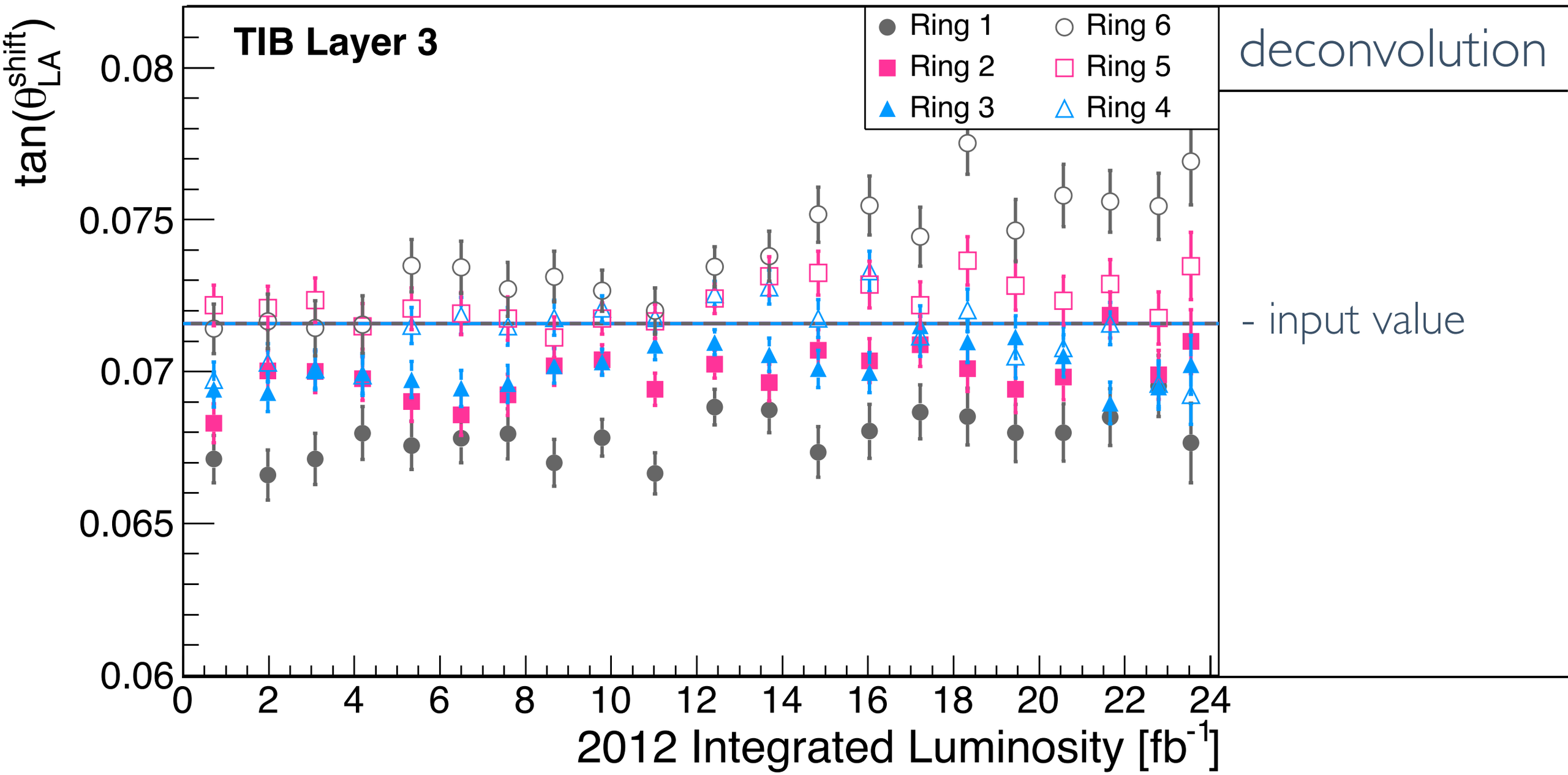
- No significant offsets.
- Rings 2-6 can be merged.

LA evolution: TIB (Layer 2) [mp1330]



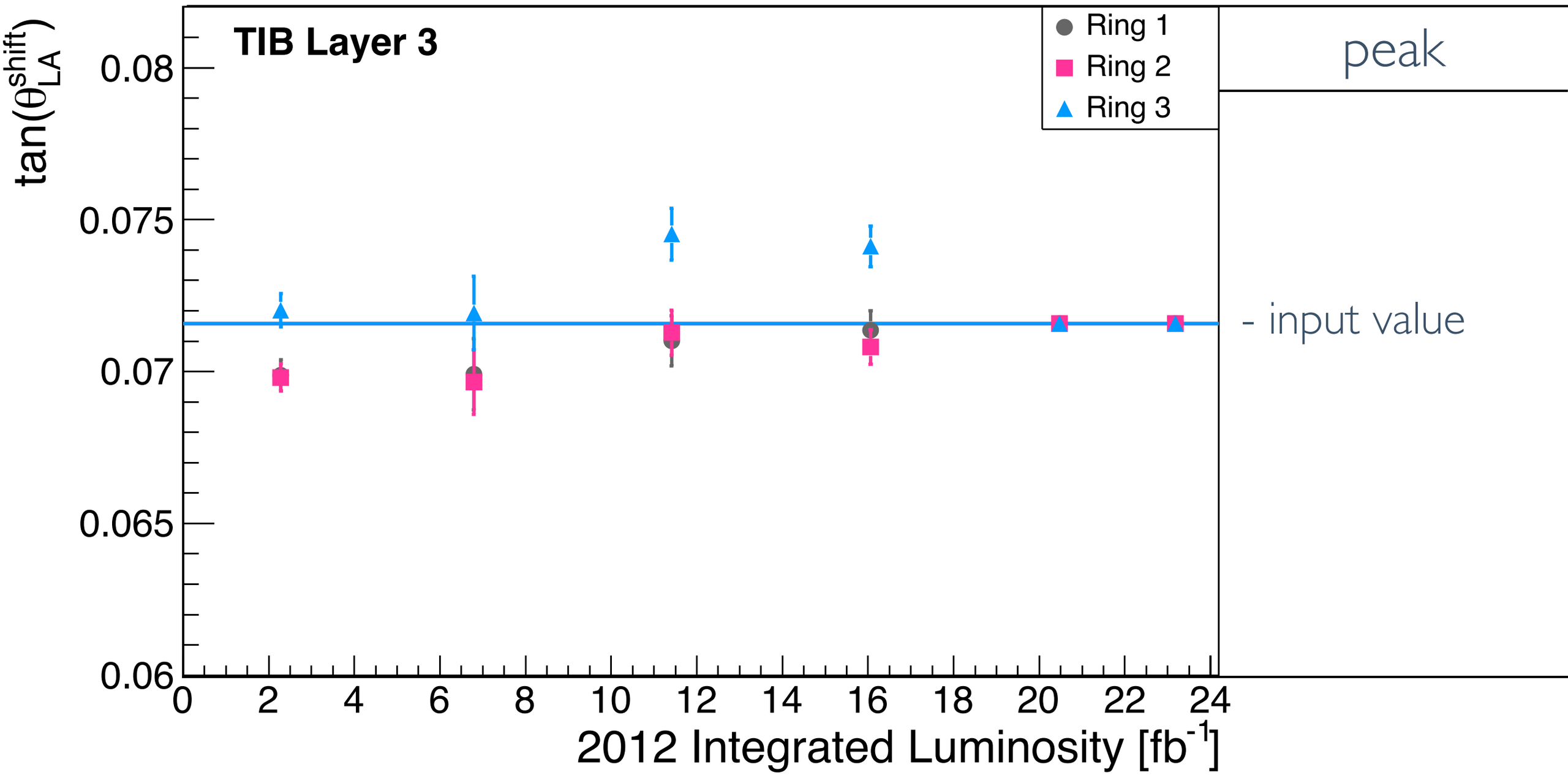
- 1 parameter should is sufficient

LA evolution: TIB (Layer 3) [mp1330]



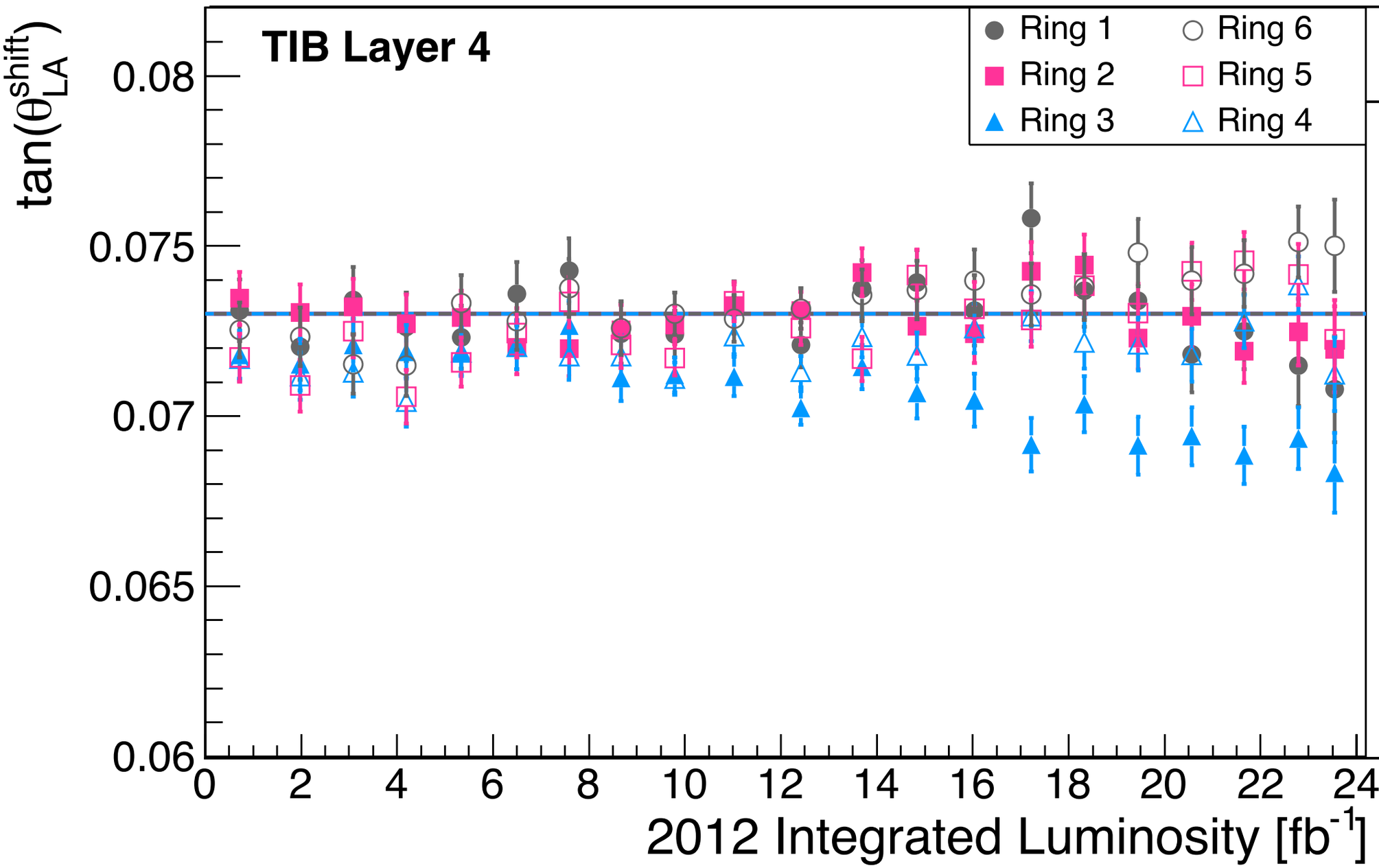
- Low statistics.
- 3 parameters: rings 1,6 + rings 2,3 + rings 4,5

LA evolution: TIB (Layer 3) [mp1330]



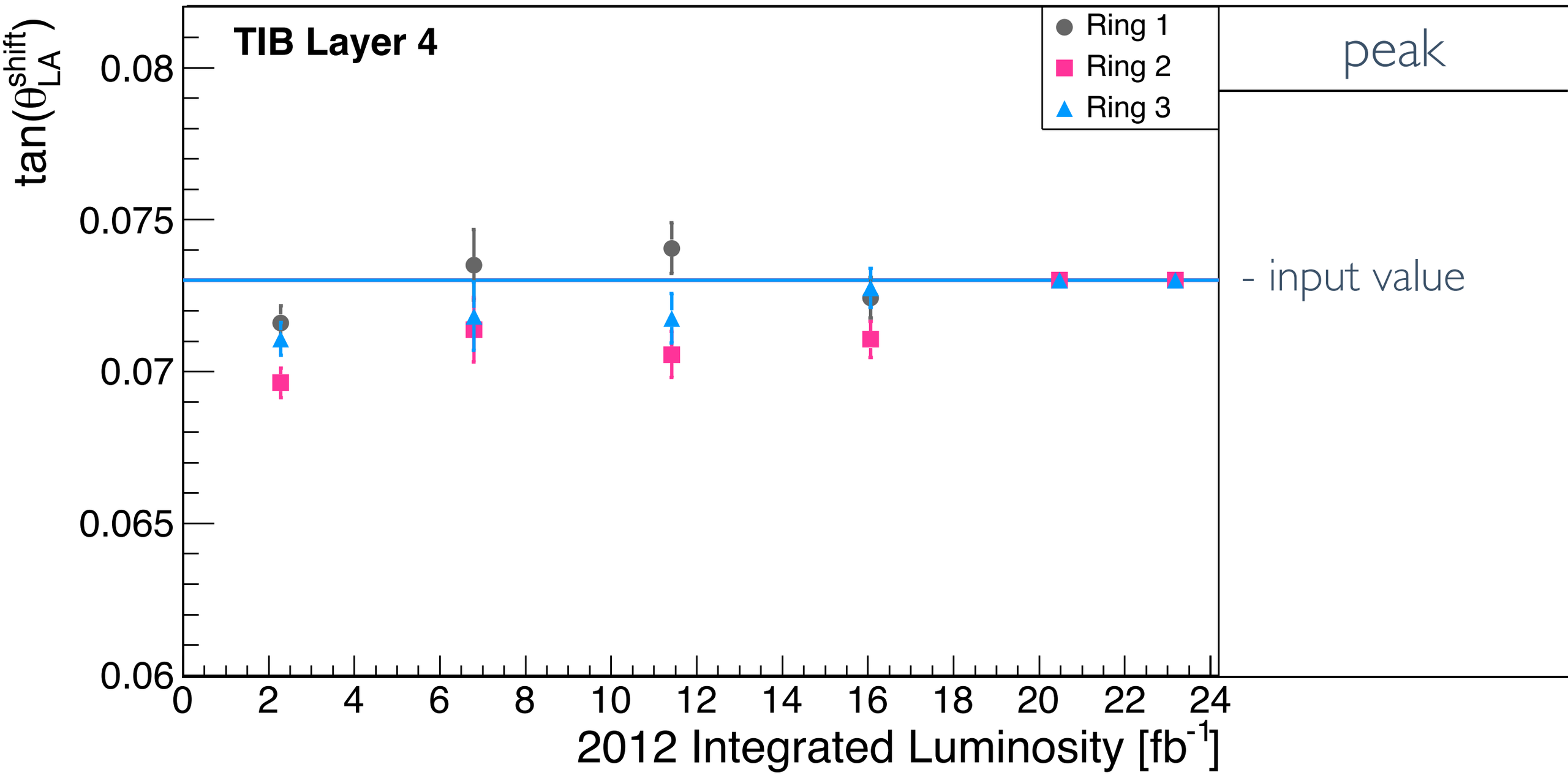
- Rings 1-2 can be merged.

LA evolution: TIB (Layer 4) [mp1330]



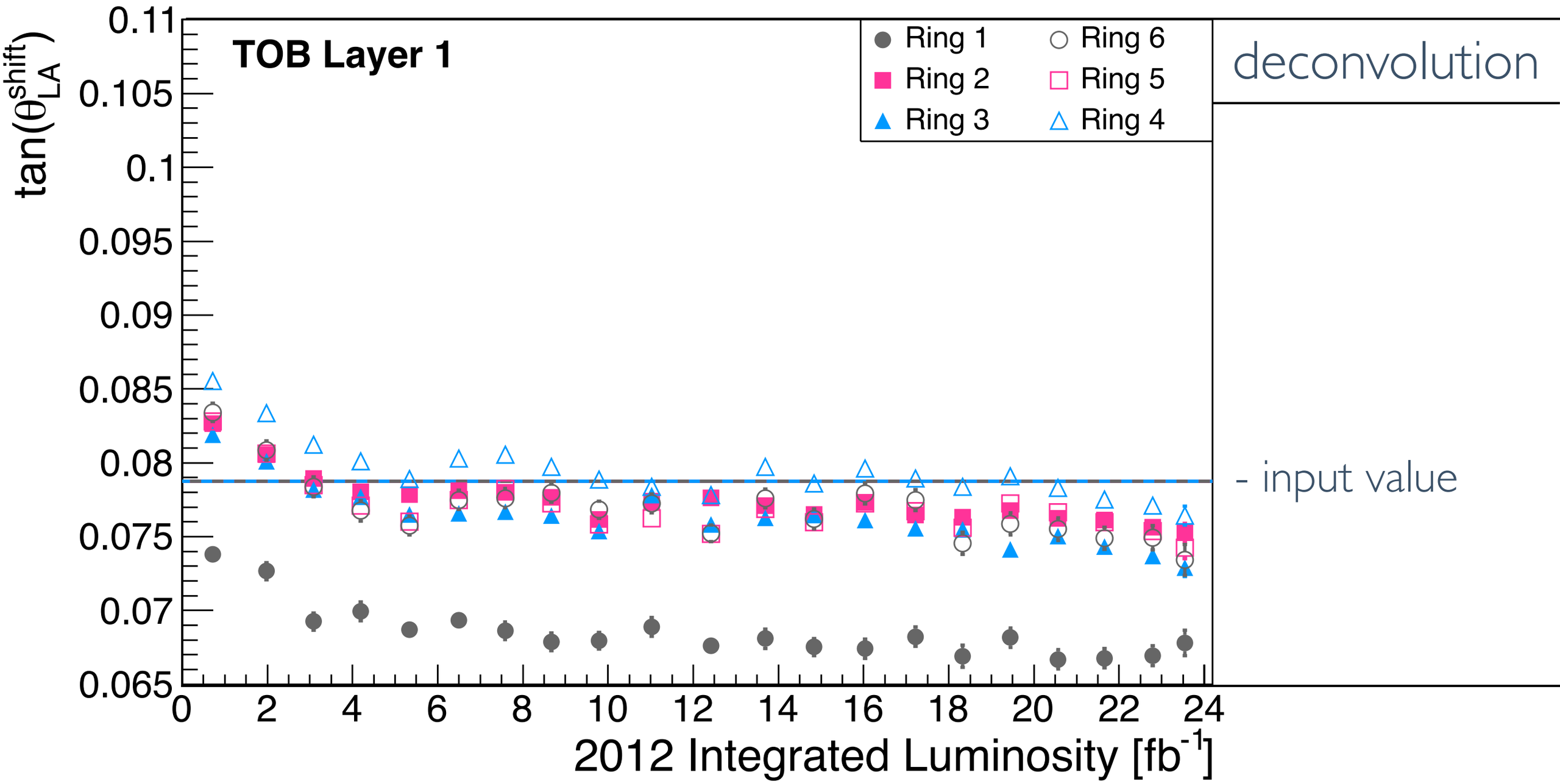
- Low statistics.
- Merge all rings except ring 3.

LA evolution: TIB (Layer 4) [mp1330]



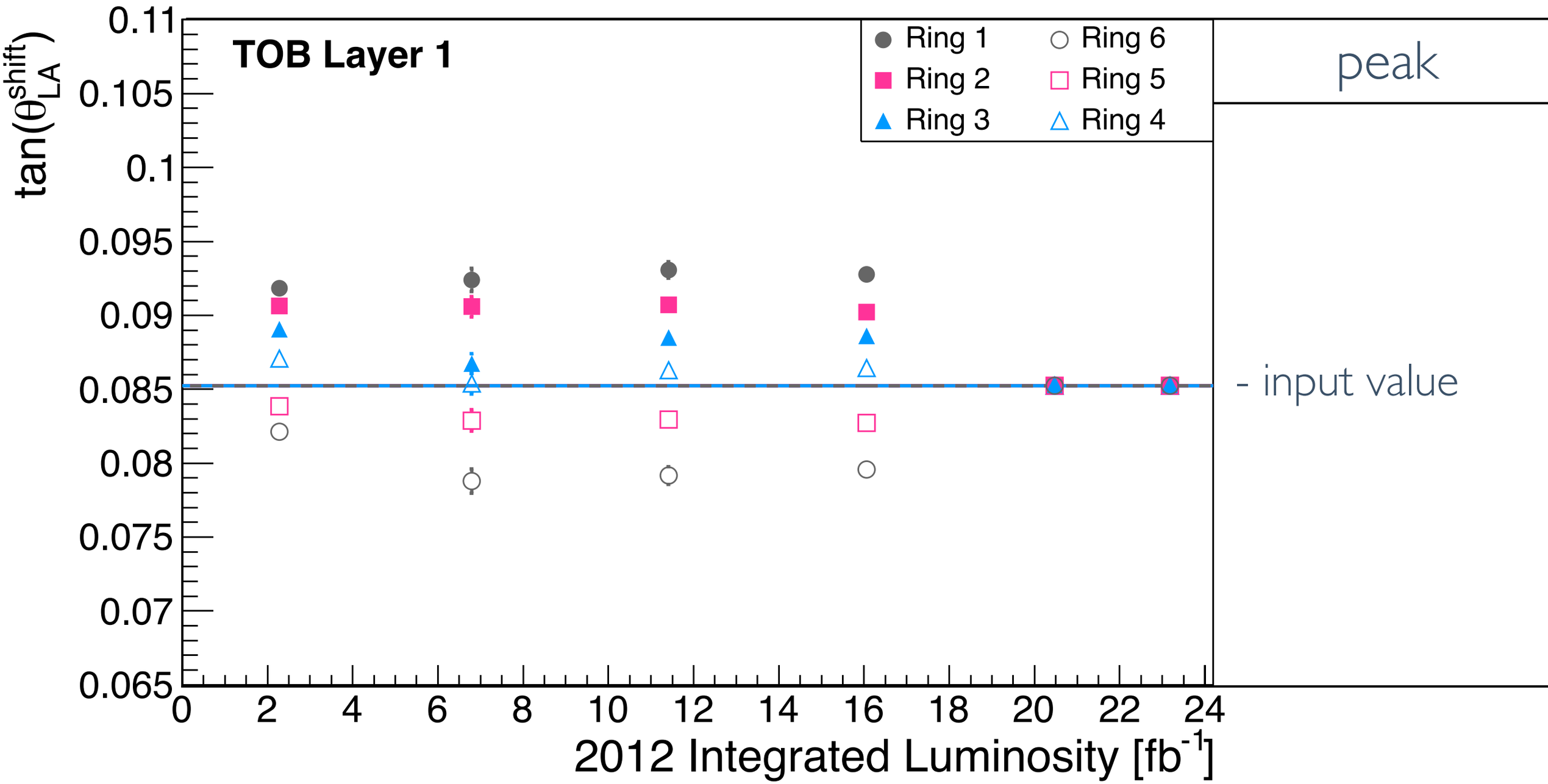
- Lower statistics.
- Rings 2-3 could be merged.

LA evolution: TOB (Layer 1) [mp1330]



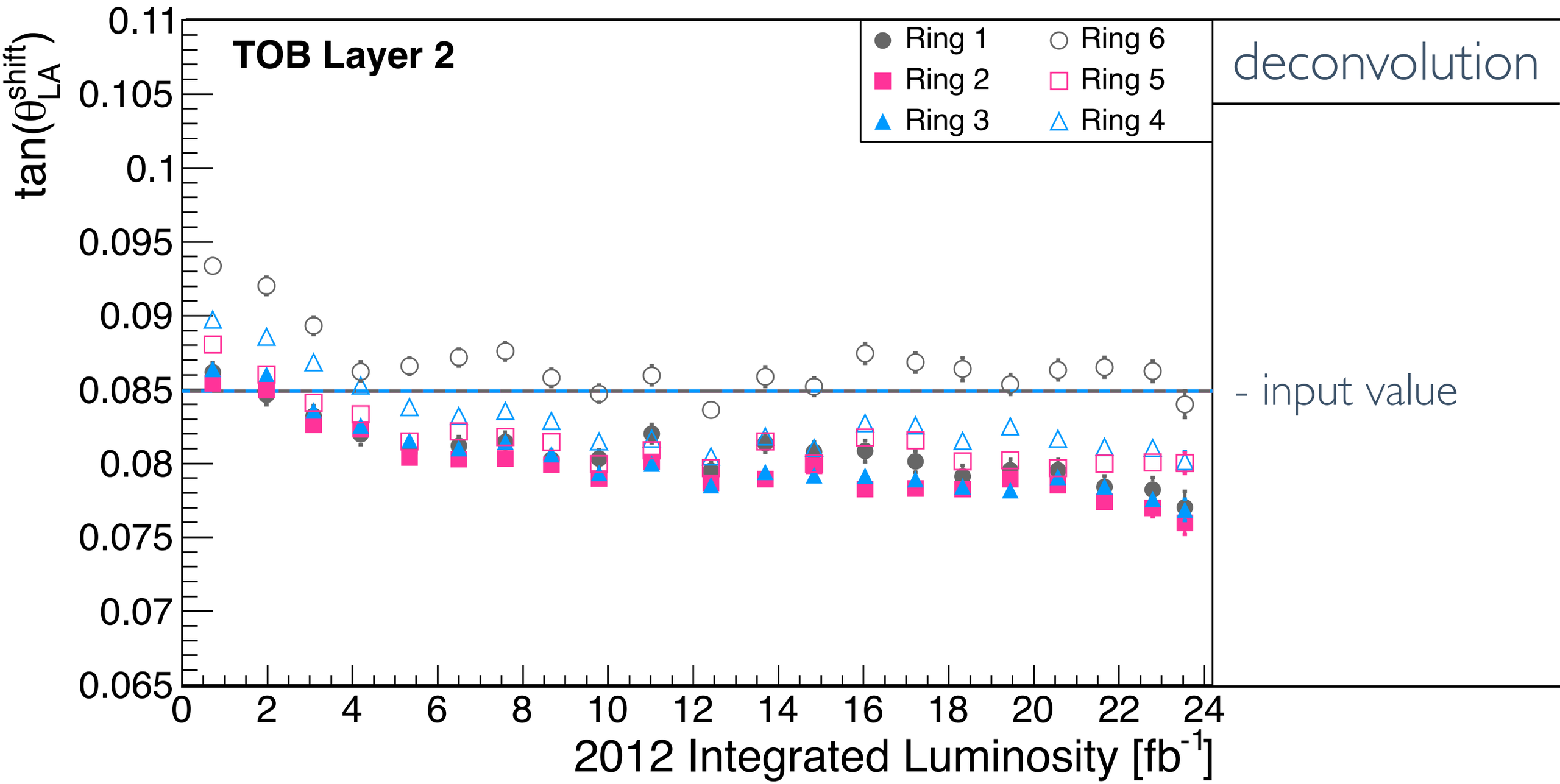
- Rings 2-6 can be merged.
- Offset in ring 1 – temperature effect?

LA evolution: TOB (Layer 1) [mp1330]



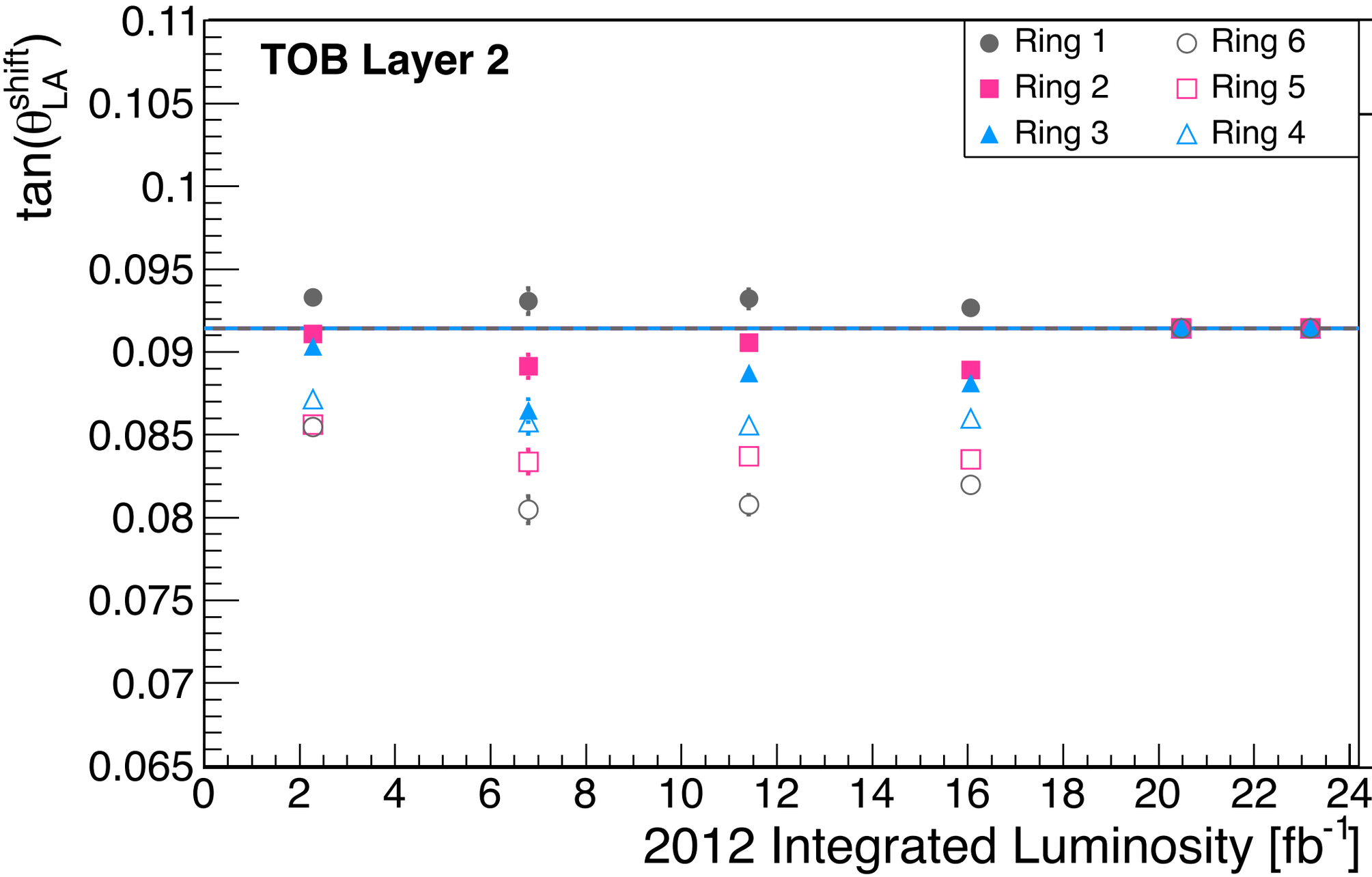
- Noticeable offset in each ring.
- Constant values.

LA evolution: TOB (Layer 2) [mp1330]

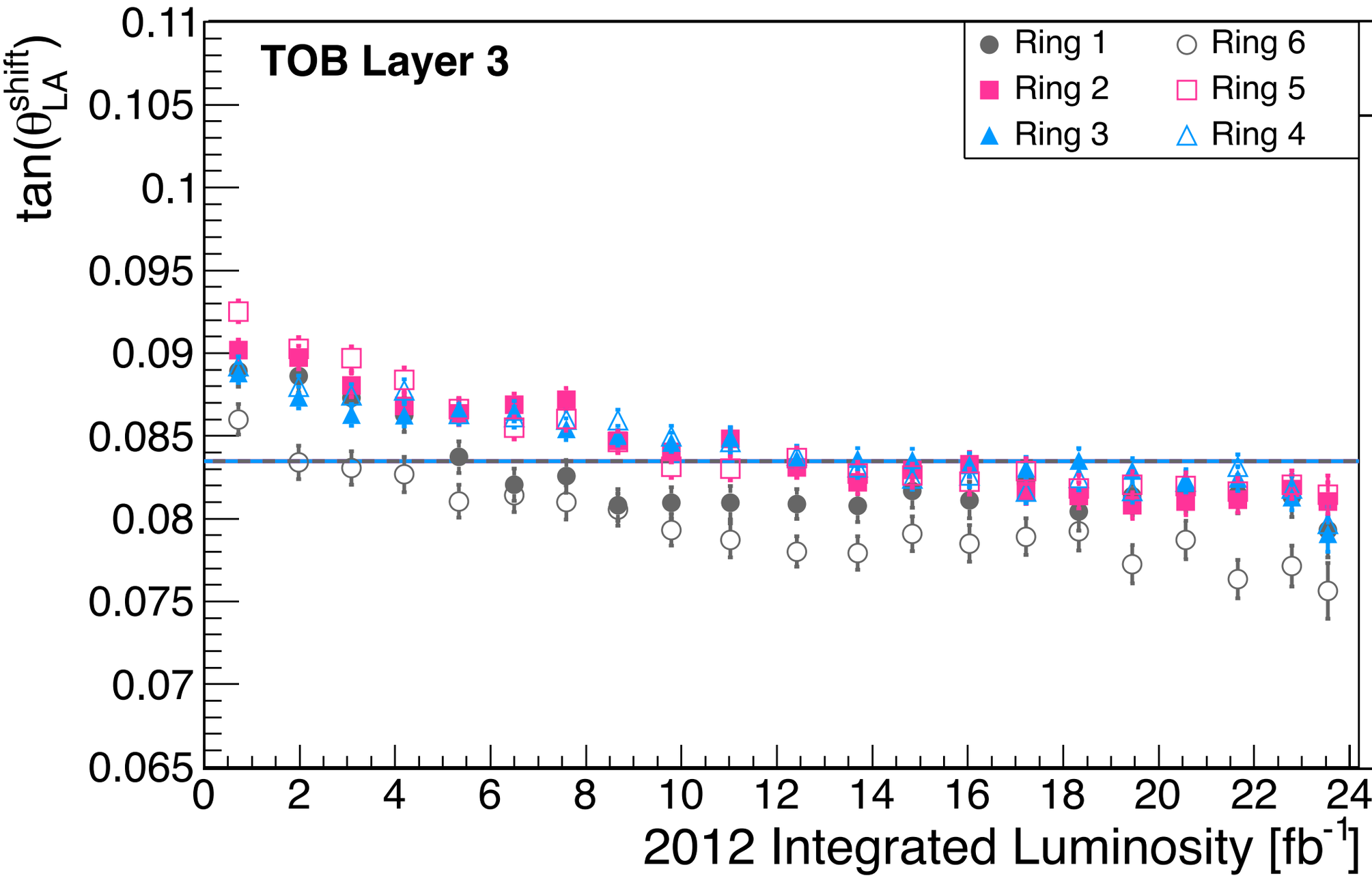


- Offset in ring 6.

LA evolution: TOB (Layer 2) [mp1330]

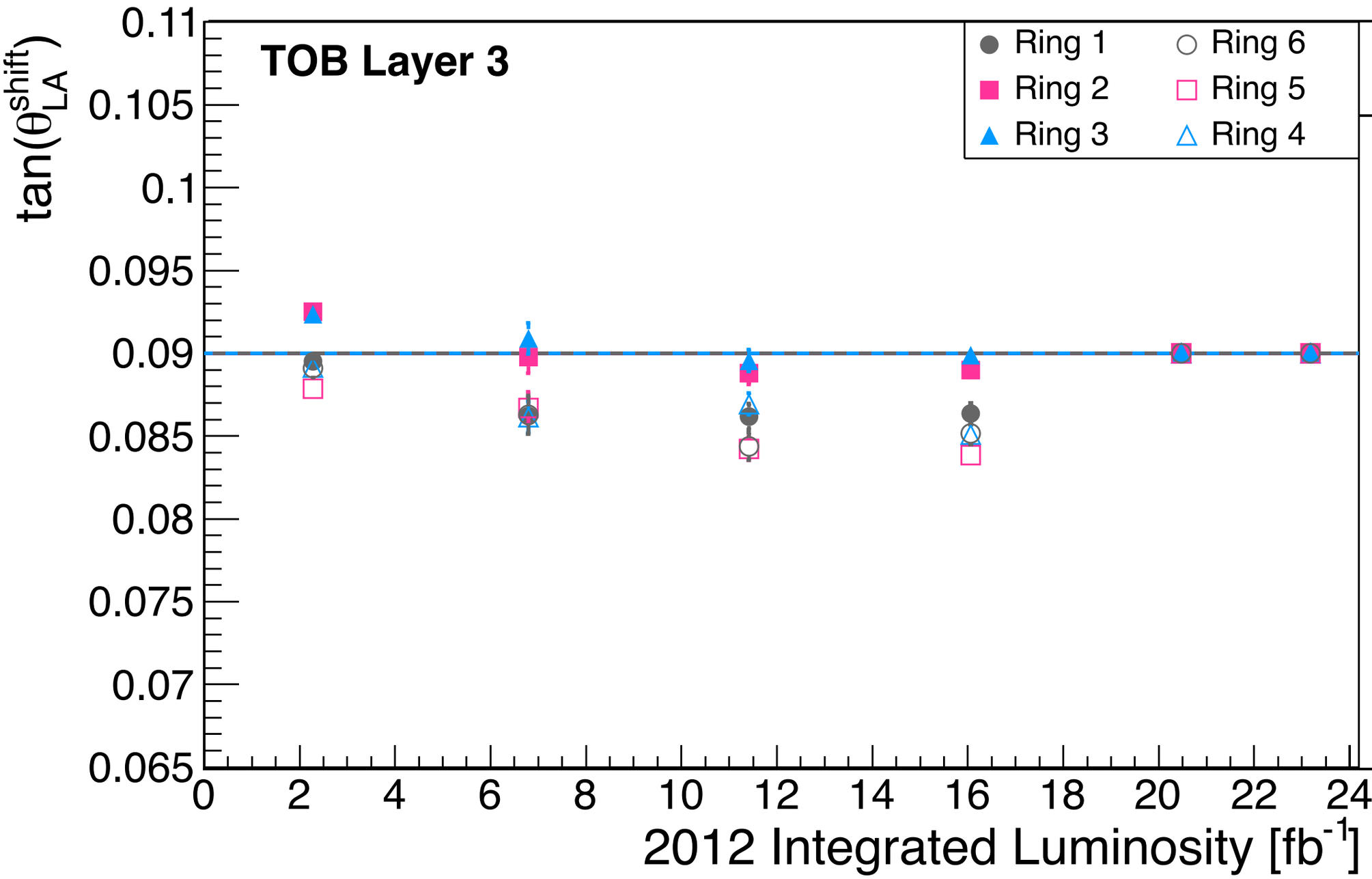


LA evolution: TOB (Layer 3) [mp1330]



- Rings 2-5 can be combined.

LA evolution: TOB (Layer 3) [mp1330]

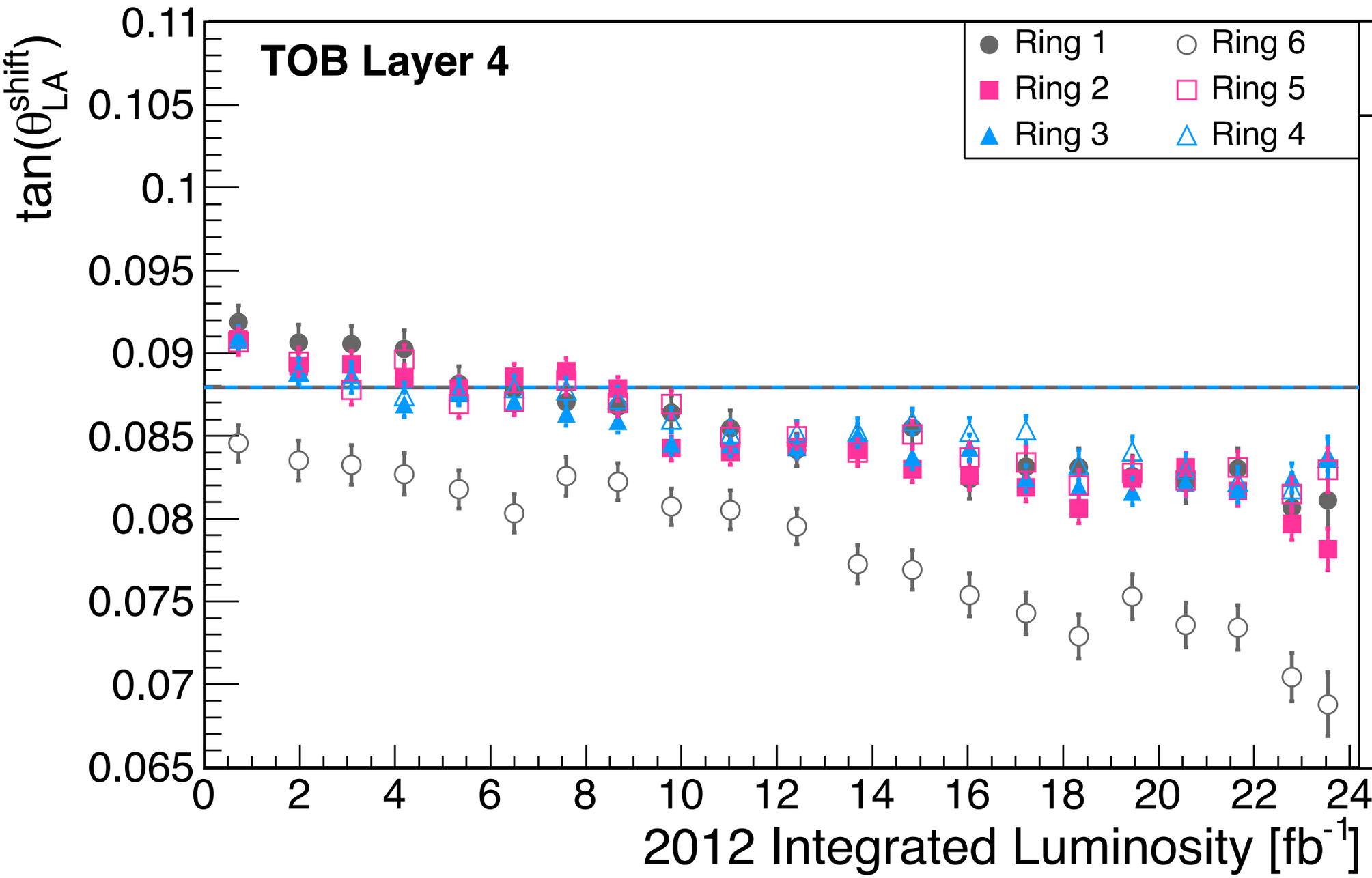


peak

- input value

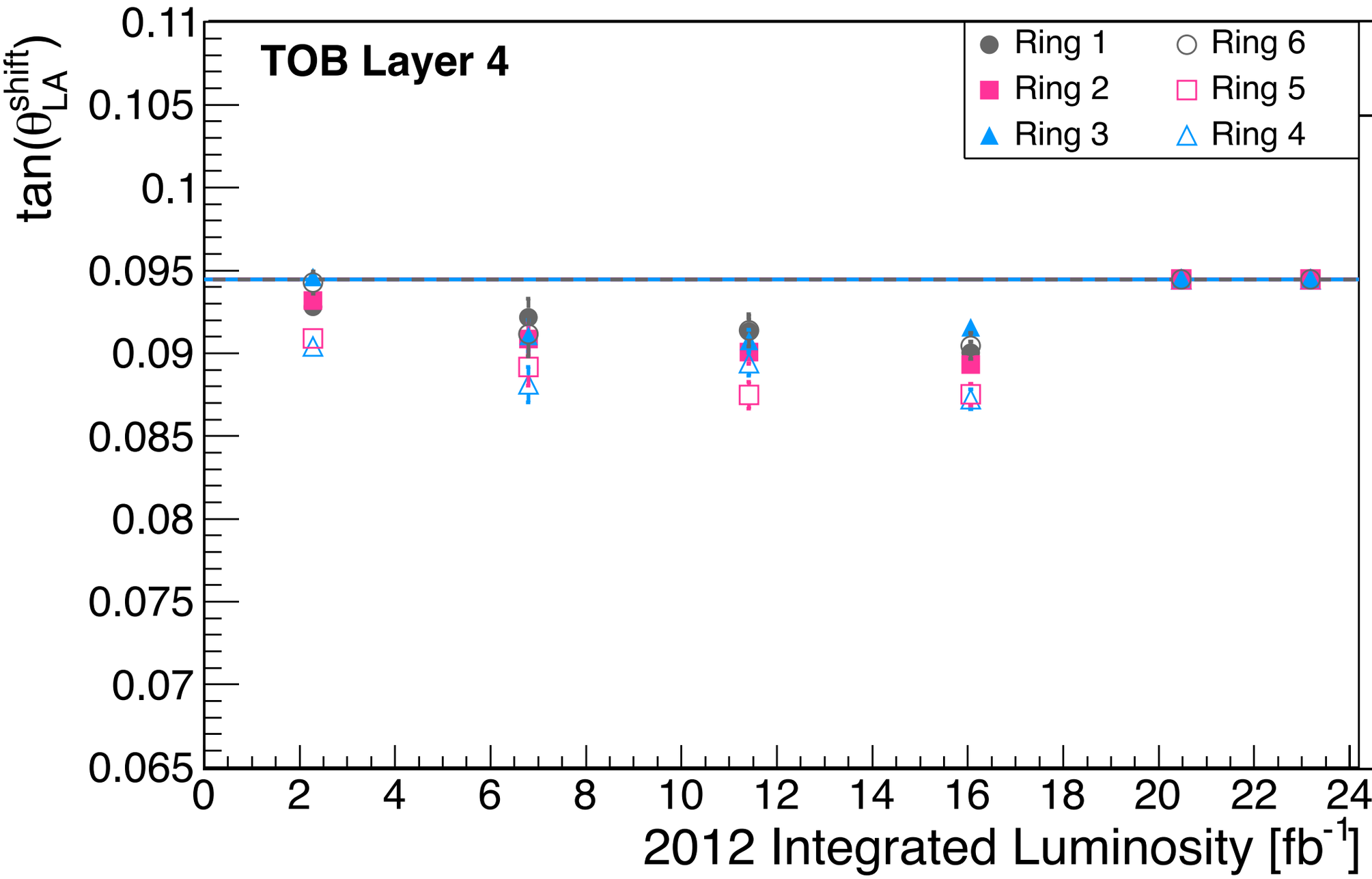
- 2 parameters: rings 1,3 + rings 1,2,4,5,6

LA evolution: TOB (Layer 4) [mp1330]



- Offset in ring 6.
- Rings 1-5 can be combined.

LA evolution: TOB (Layer 4) [mp1330]

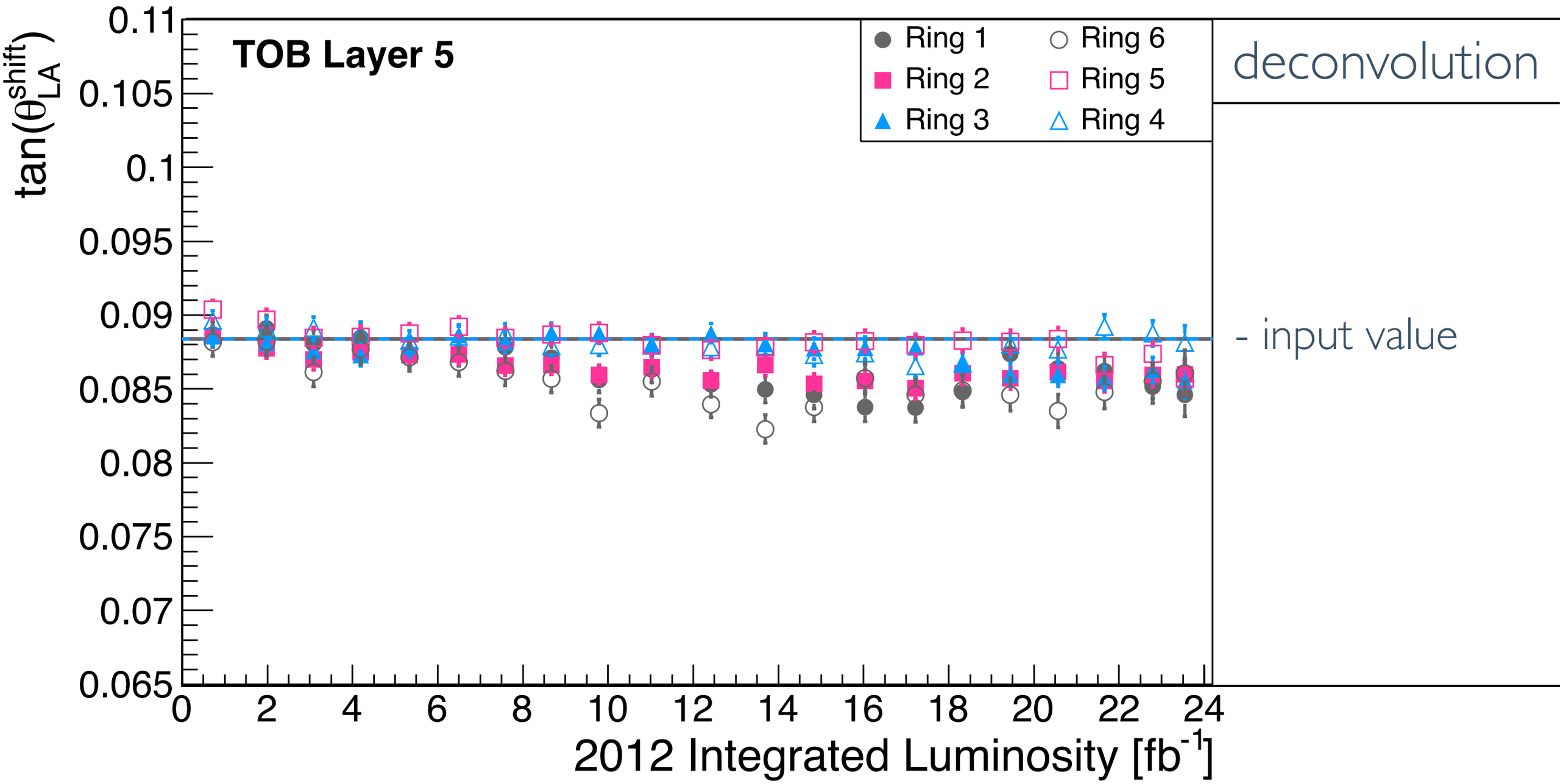


peak

- input value

- 2 parameters: rings 1-3,6 + rings 4-5

LA evolution: TOB (Layer 5) [mp1330]

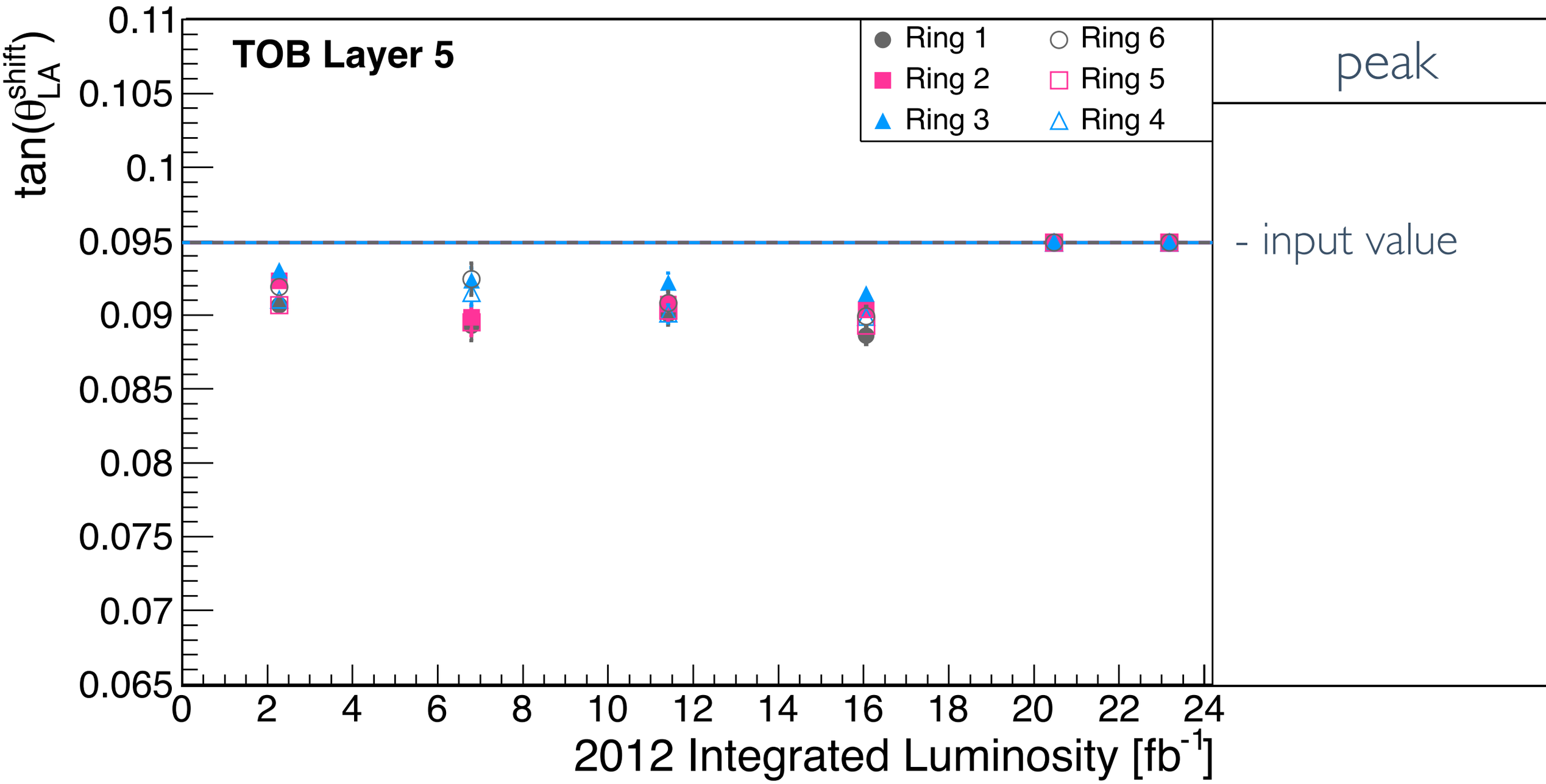


deconvolution

- input value

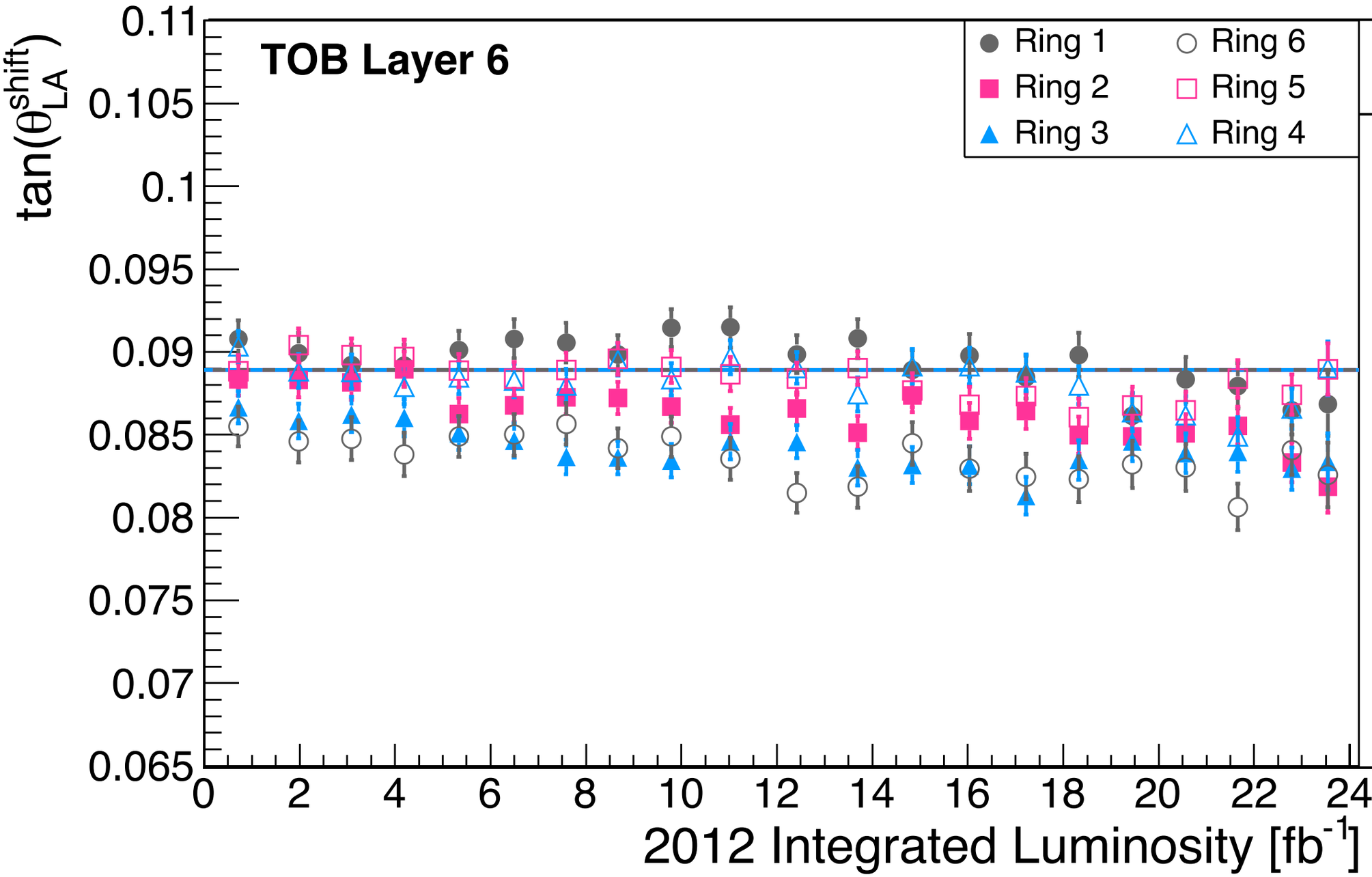
- 1 parameter for the whole layer

LA evolution: TOB (Layer 5) [mp1330]



- 1 parameter for the whole layer

LA evolution: TOB (Layer 6) [mp1330]

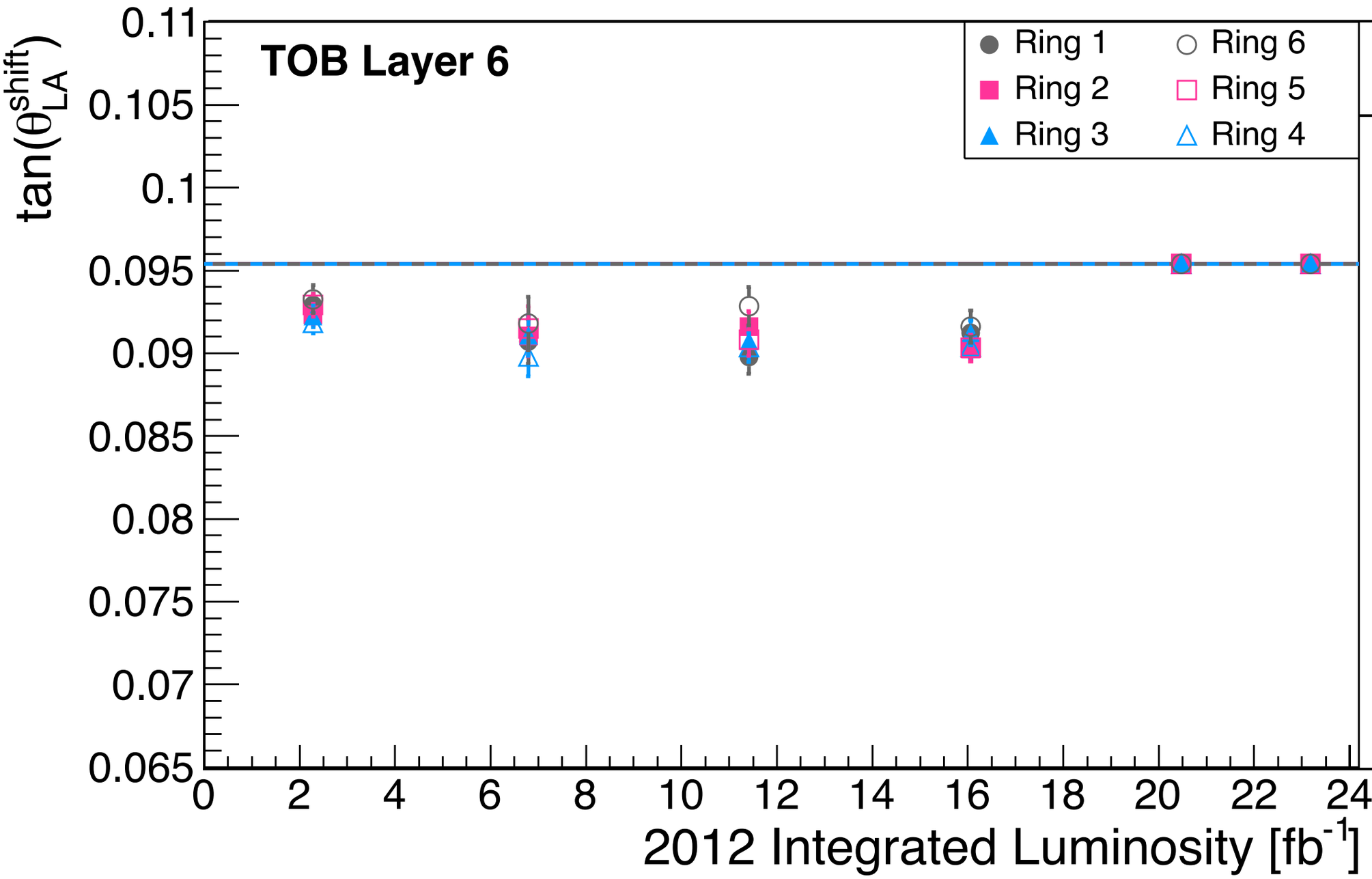


deconvolution

- input value

- 1 parameter for the whole layer

LA evolution: TOB (Layer 6) [mp1330]



- 1 parameter for the whole layer