

More about residuals and resolution plots and some more

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What's in here

Since the last week, several avenues are explored:

- Residuals after (bias/distortion) corrections.
- Check for PRF width in 100 ns data.
- Varying threshold to accept pulses in Pulse Finder (mostly noise related issues).
- Varying threshold to accept max. pulse in Hit Finder.
- 3 sigma cut for z0-suppression vs 4.5 cut.
- Kalman Fitter as alternative to Karimaeki Fitter.
- Bias correction by row.

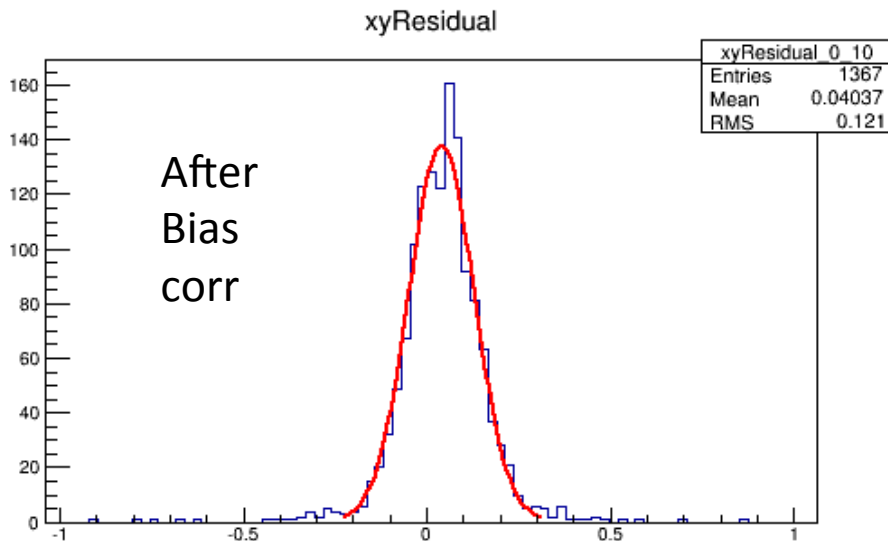
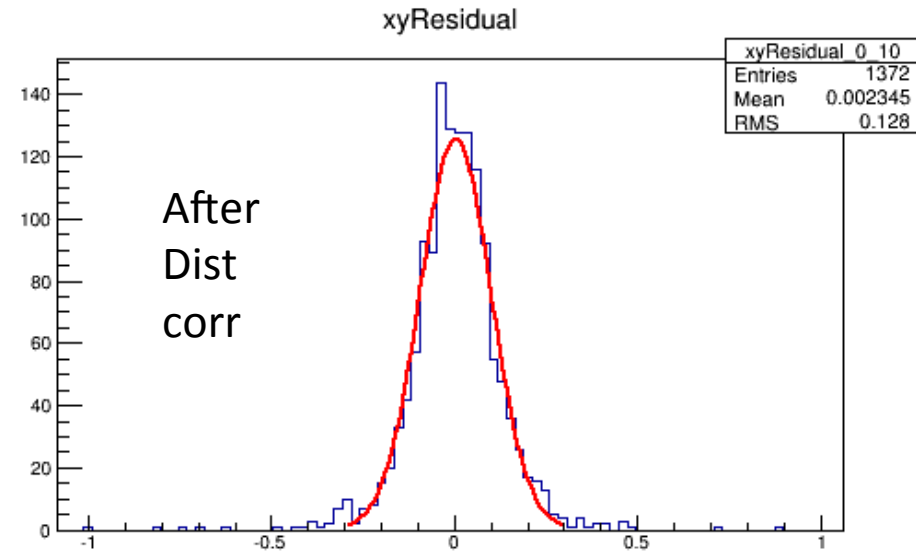
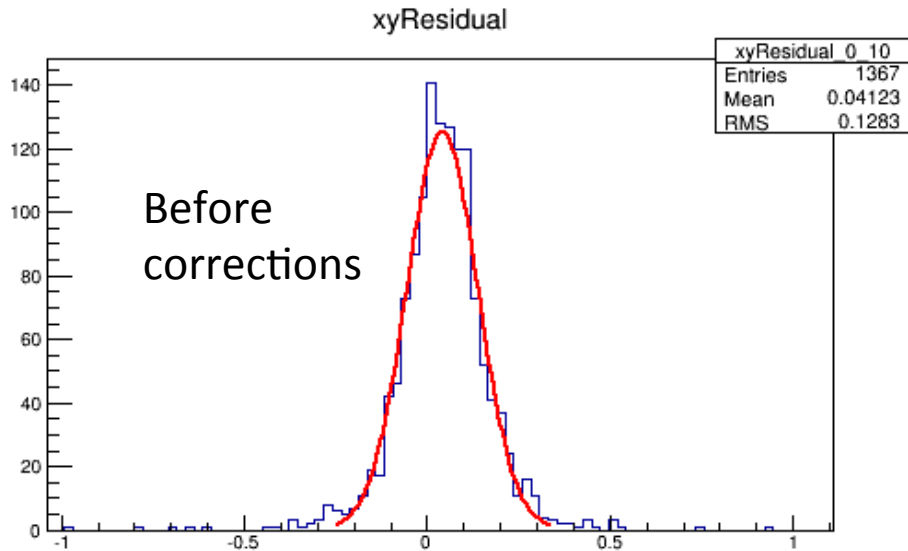
Effect of bias/distortion corrections on residuals.

Corrections recap

- Bias corrections (what is correct below?):
 - Applied across x , within a hit? Yes.
 - Does it alter position of a hit along a row? Yes
 - Is bias correction applied within a pad size? No
- Distortion corrections:
 - Global correction for a full row in a module.
 - Affects the center gravity of a hit.
 - Cannot correct widths/resolution, just a mean value. Corrects a position, not the width!

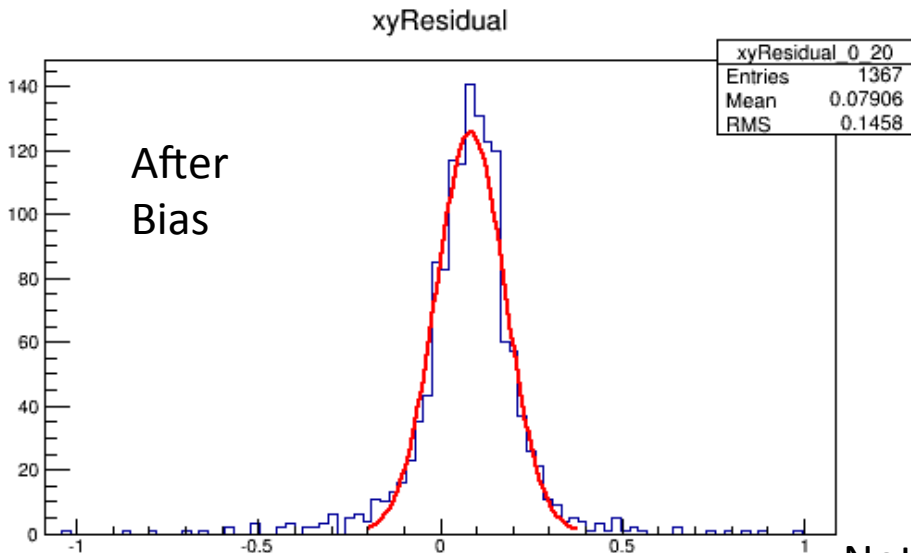
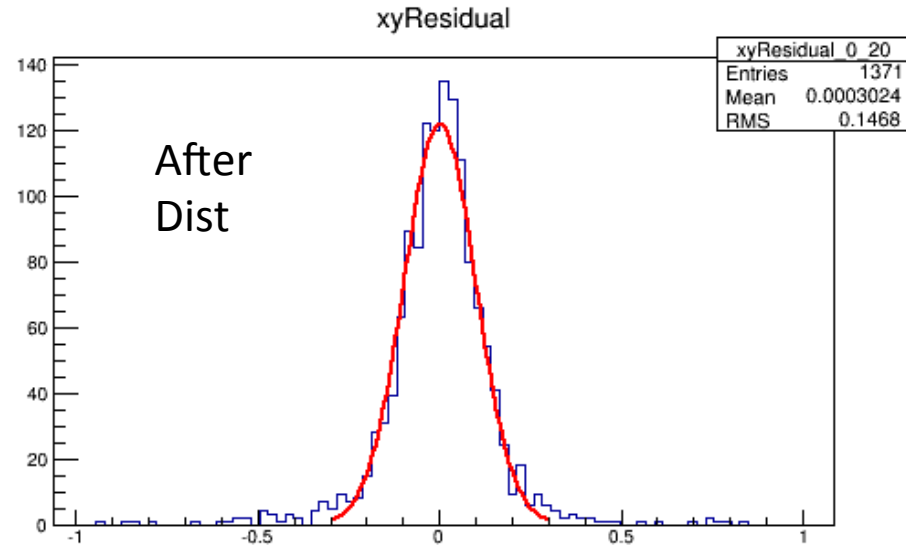
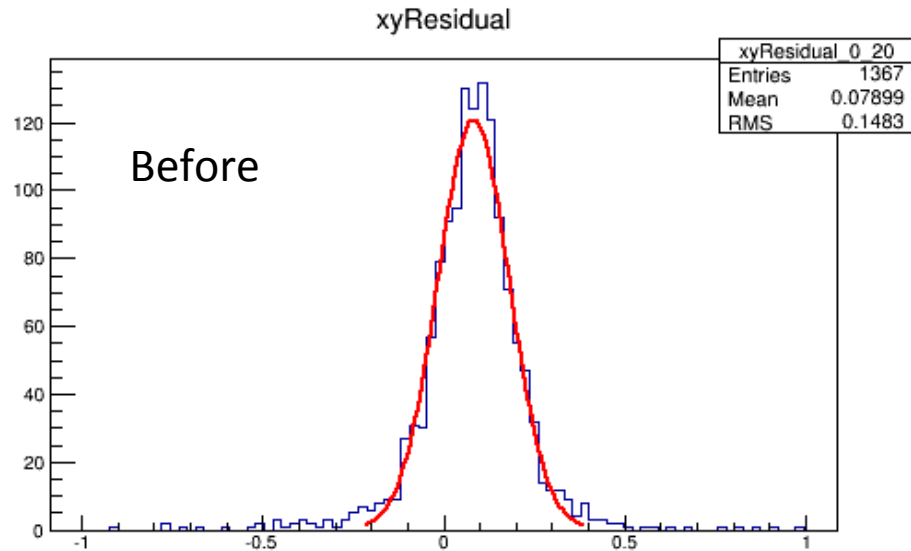
To the issue, does it make sense to apply Distortion corrections first, and THEN bias?
Answer for now: bias and distortion corrections cannot be applied at this stage, since they somewhat overlap with each other. Apply either bias corrections or distortion, not both!

BD module, Row 10 (middle)



Clearly shows that distortion corrections shift the peak to the right position. Bias corr do it just a bit. Width is the best after Bias corr. Position is the best after Dist.cor.

BD module, Row 20 (edge)



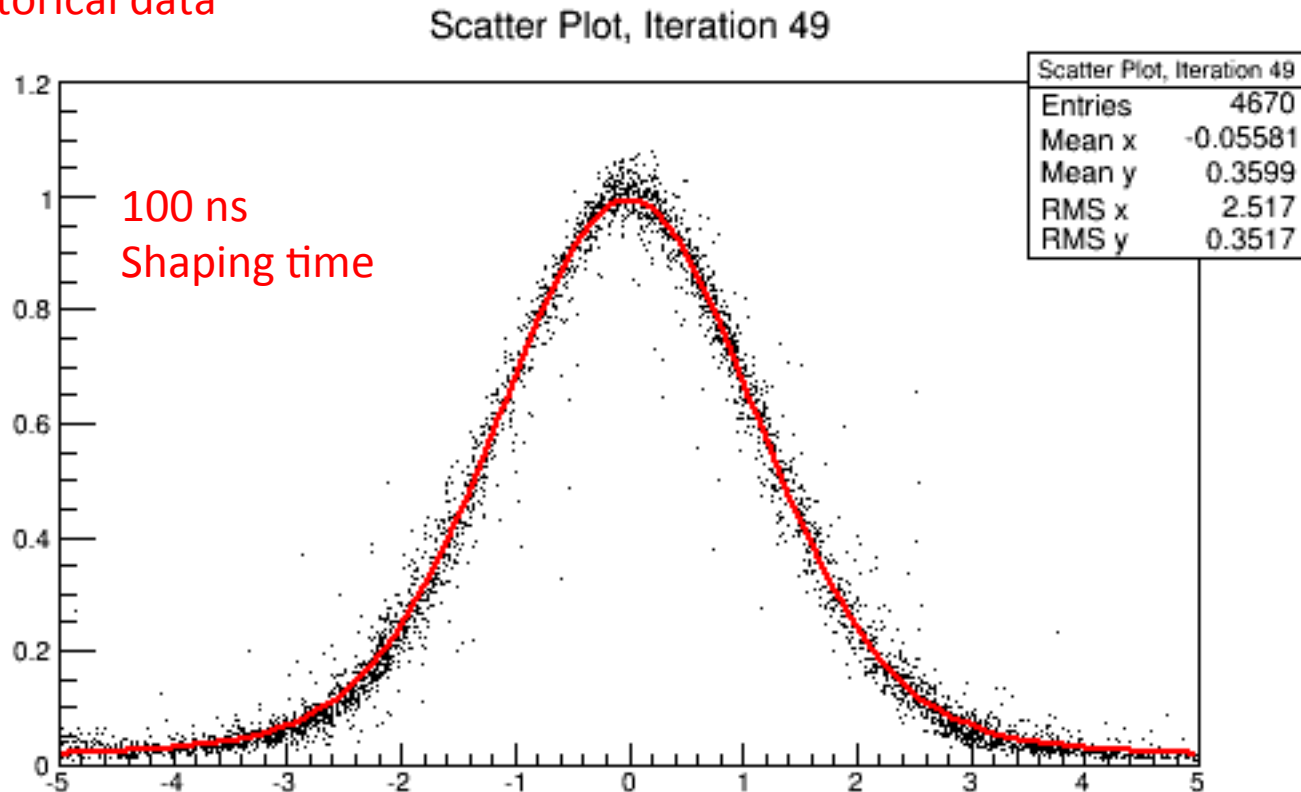
Picture is more dramatic at **the edges**
Distortion correction shift the peak.
Bias corr do it slightly.
NB. Width the best after Bias corr!
That is reflected in the improvement
In the resolution performance results.

Note, peak position fluctuates from row to row.⁶

PRF Width look up
(for the **same** shaping time, drift
distances, analysis cuts etc.)

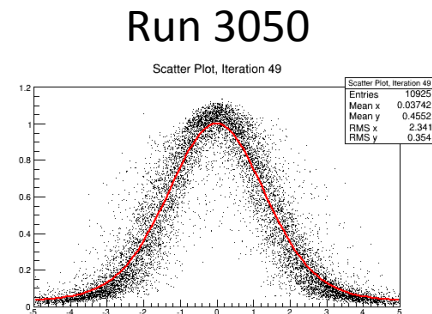
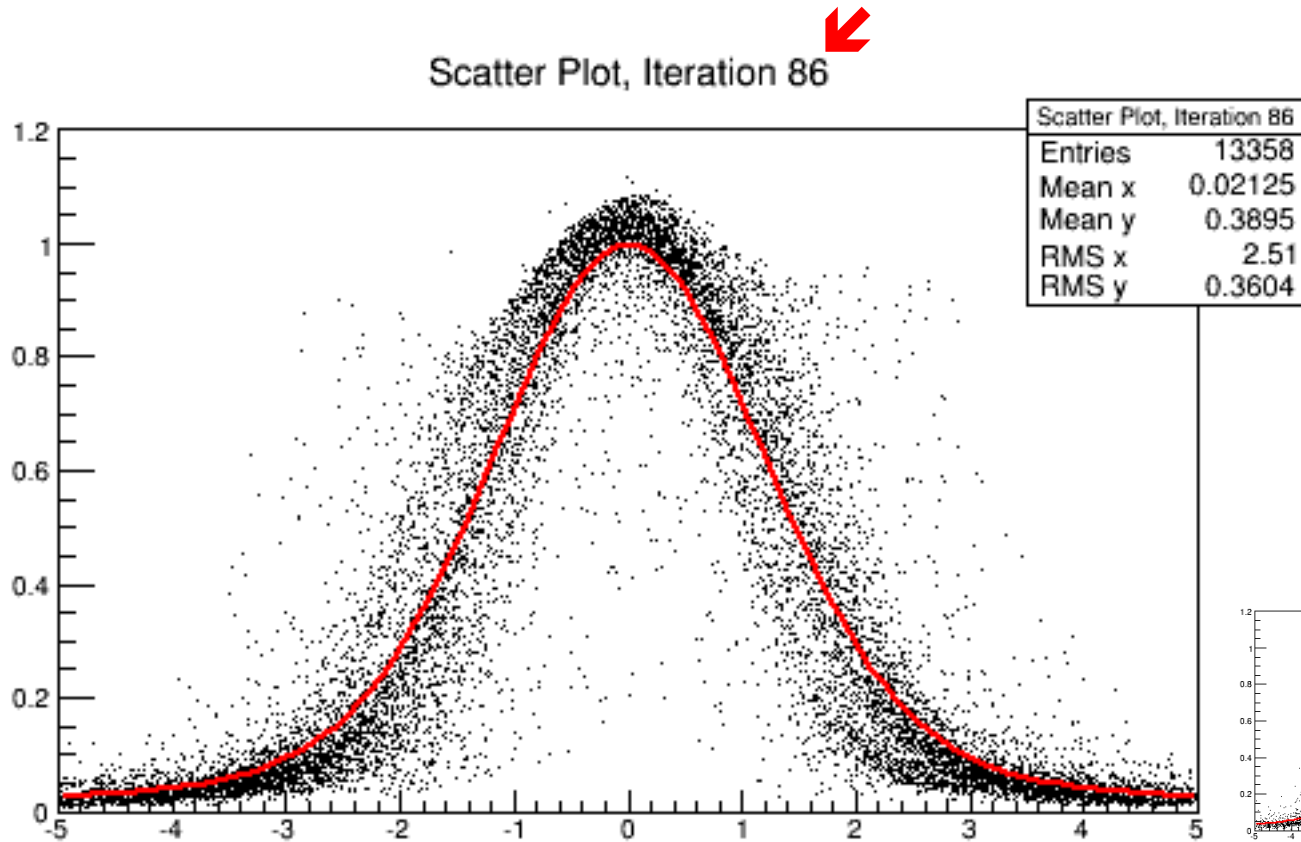
Run 2015, 2011 data, Sum Form

Old historical data



This is an automated MarlinTPC process to get an appropriate PRF width. Title shows how many iterations were needed to converge for this case.

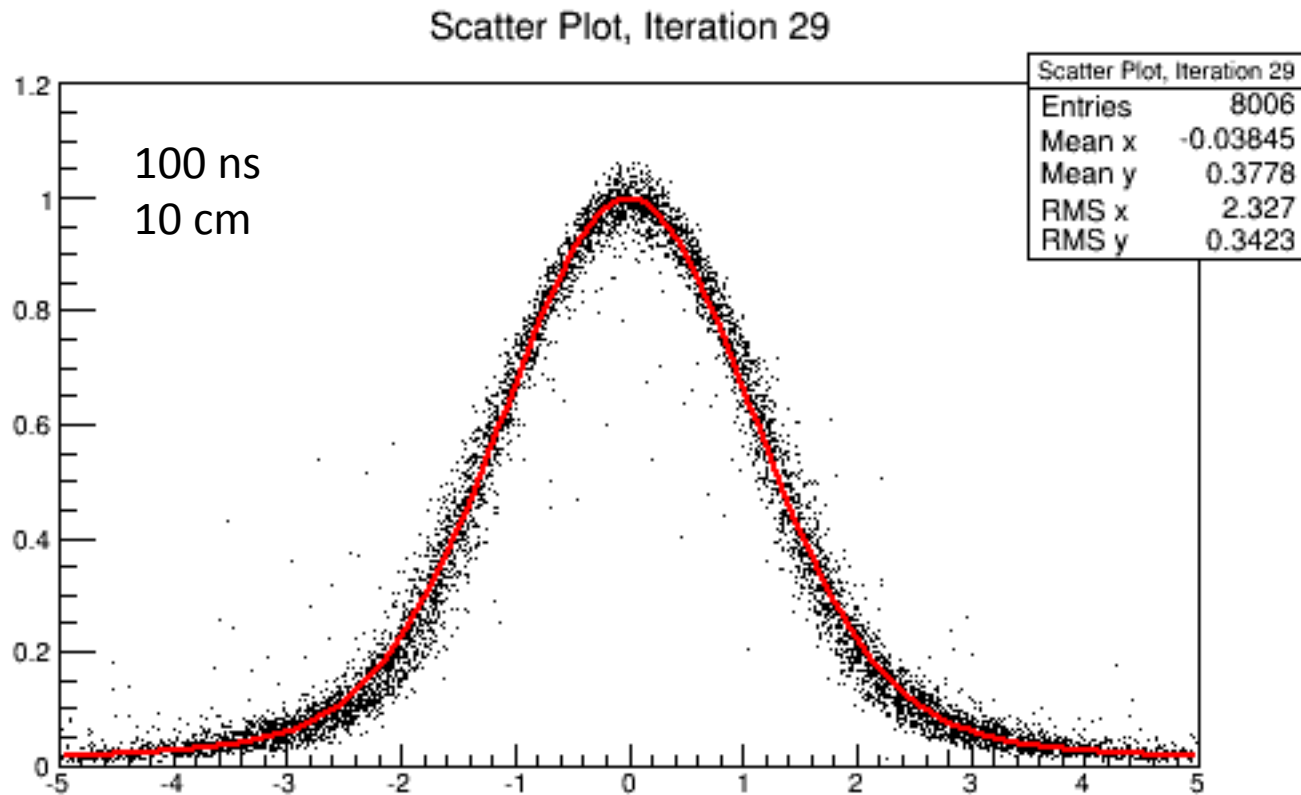
Run 3042, 2013 data, Sum Form



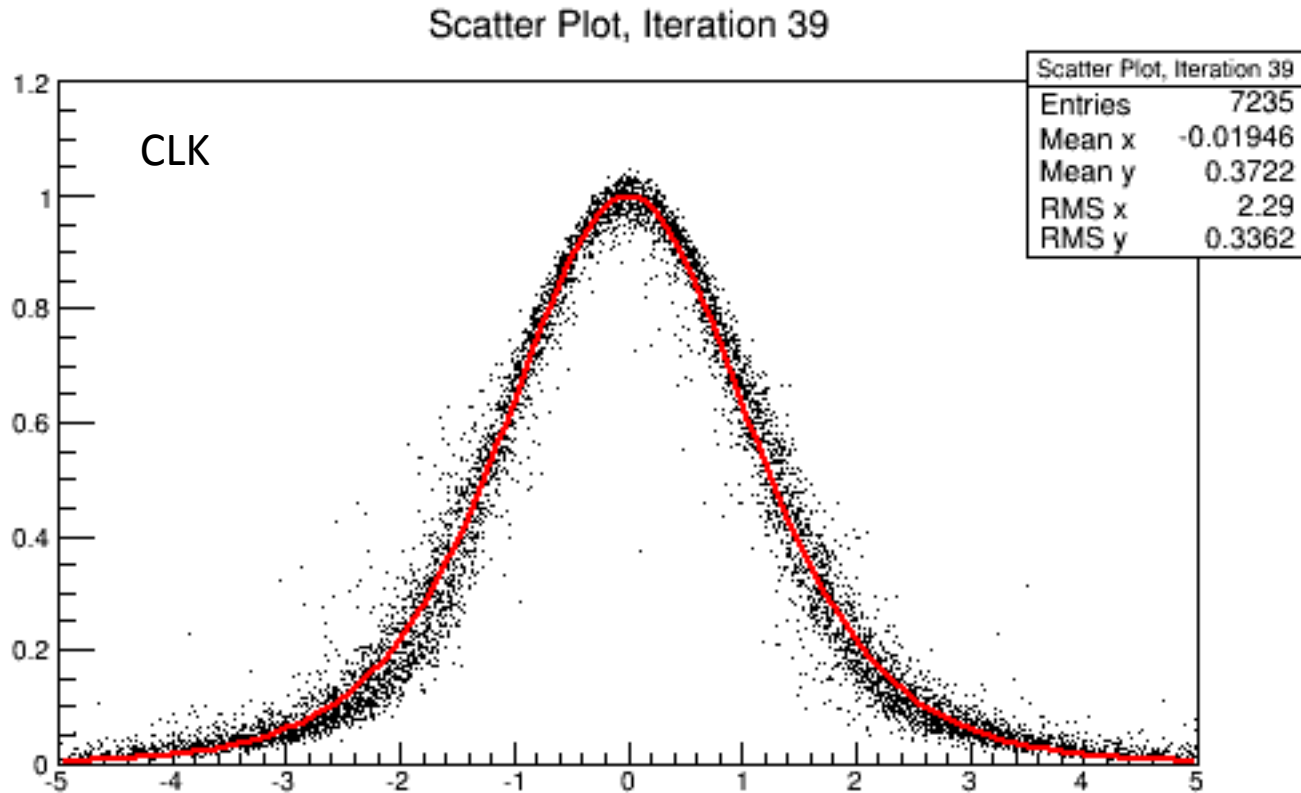
Does not look appealing!

Probably, that's why are unable to get the best resolution results for 2013?

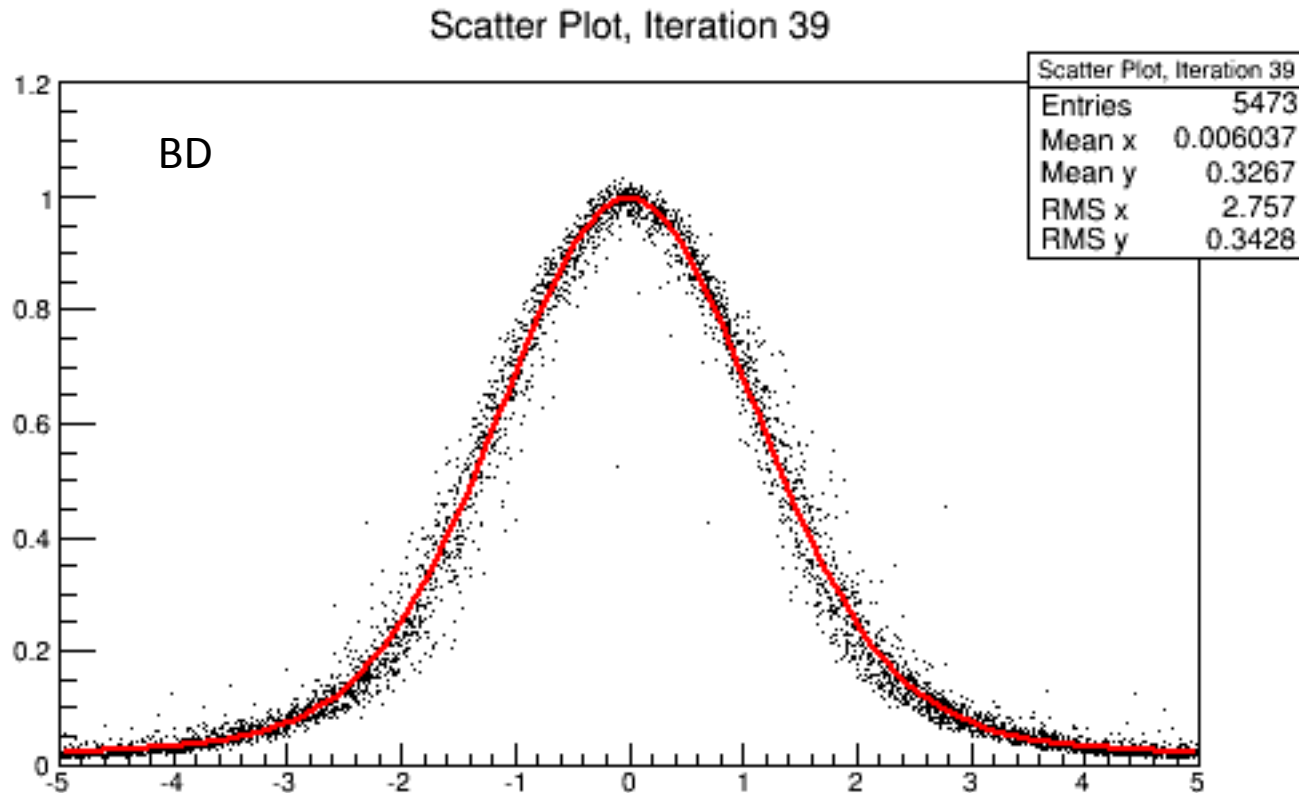
Run 4108, 2014 data, Sum Form



Run5119, 2015 data, Sum Form



Run5119, 2015 data, Sum Form

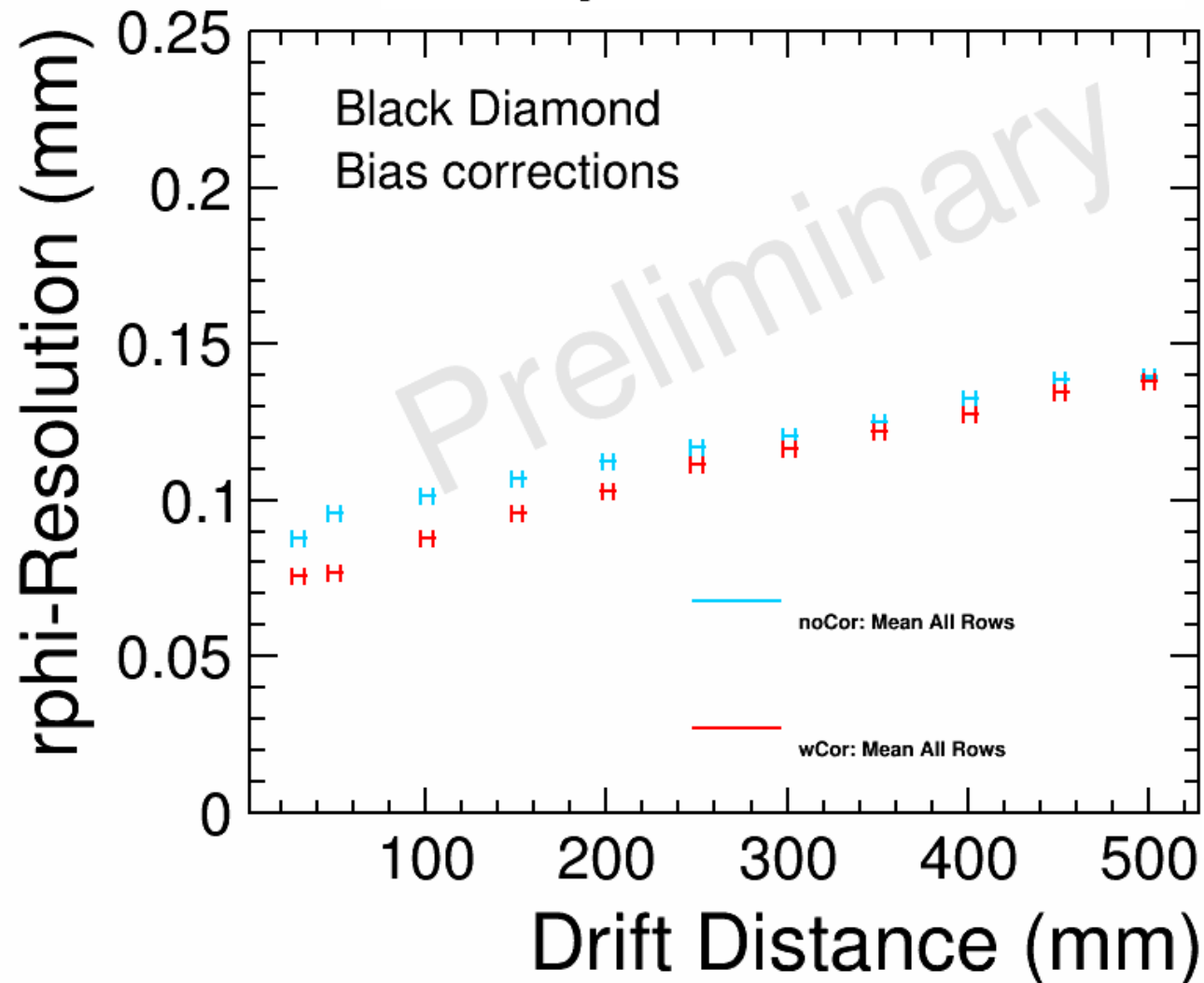


PRF for BD2 appears wider than for CLK, which does make perfect sense. Fit looks OK. Even better than for 2011 data (at the same drift distance).

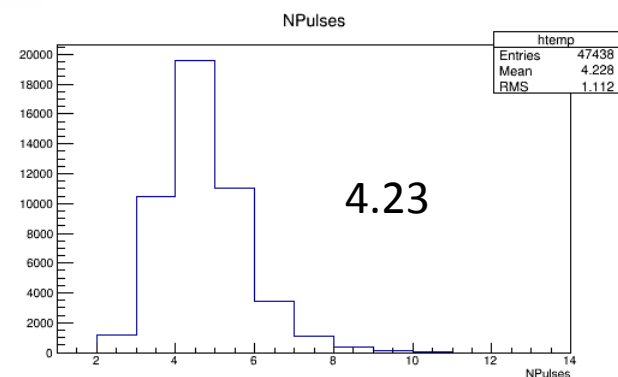
Resolution plots (for BD or CLK) with variable ADC threshold for **all** pulses.

Pulse Threshold: 12 ADC for **all** pulses

2015 rphi Resolution, B=1T

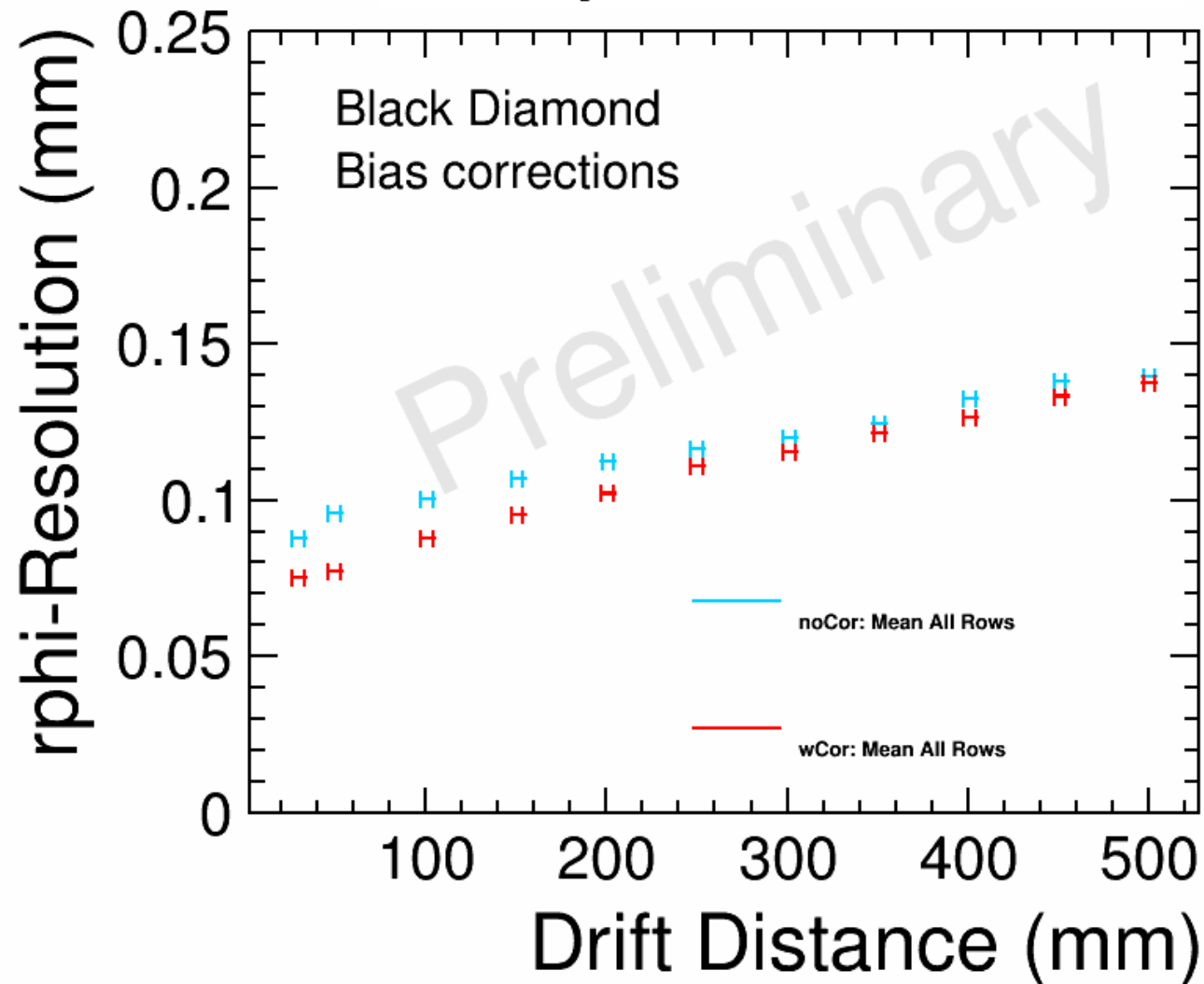


One BD module

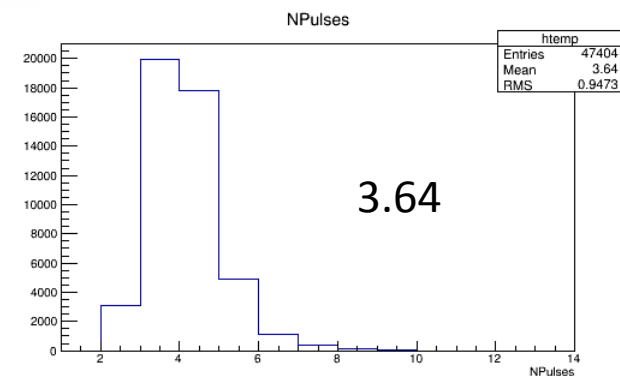


Pulse Threshold 30 ADC (“standard”).

2015 rphi Resolution, B=1T

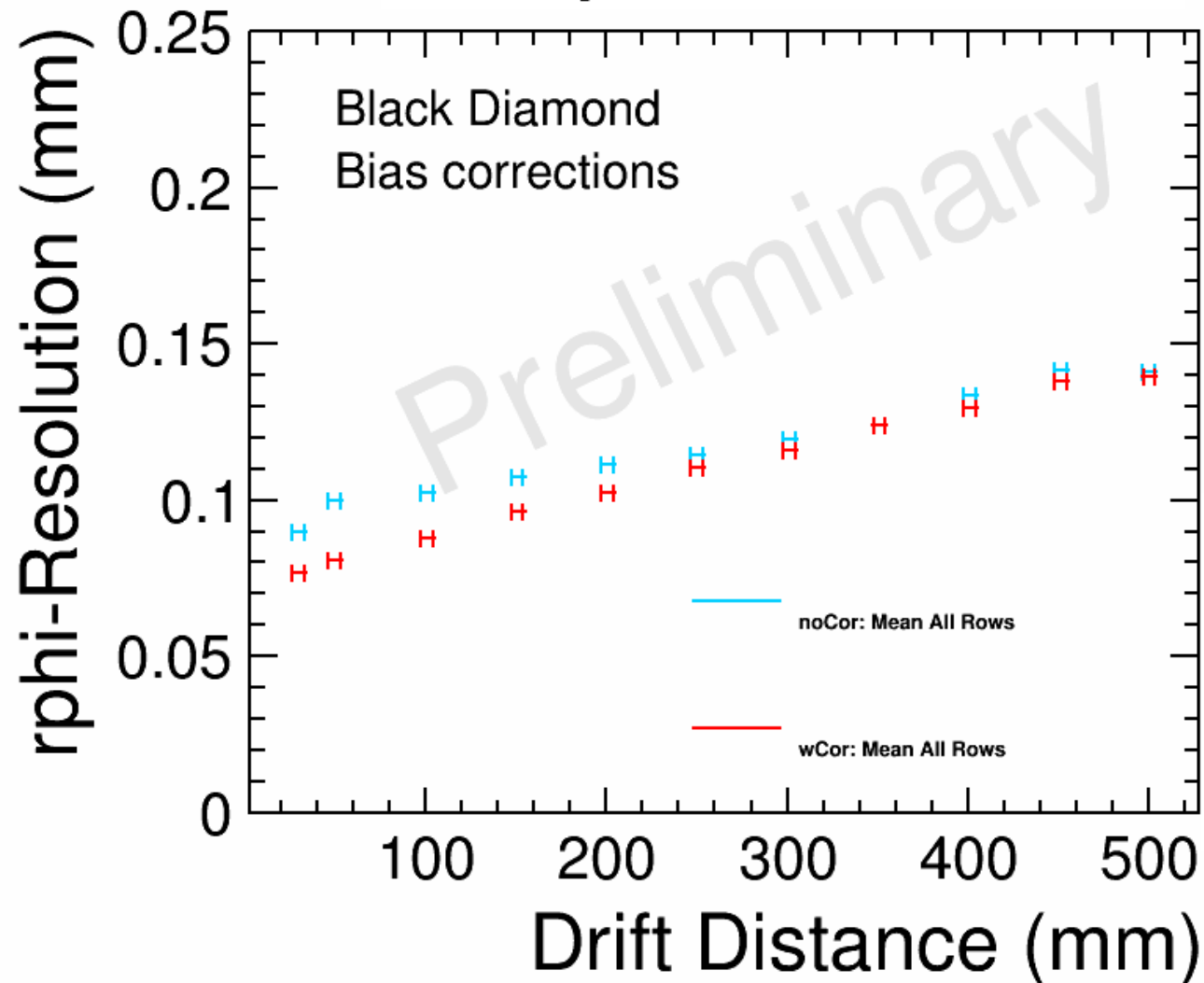


One BD module

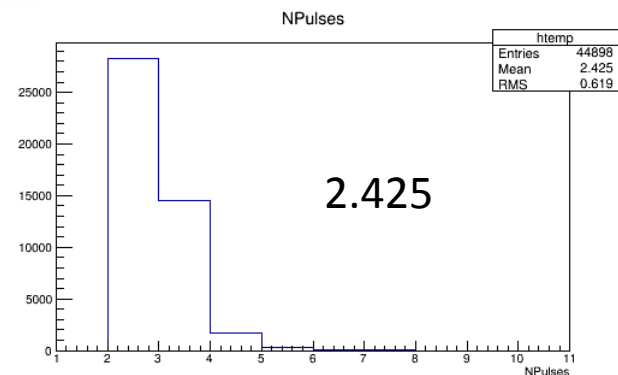


Pulse Threshold: 70 ADC for **all** pulses

2015 rphi Resolution, B=1T



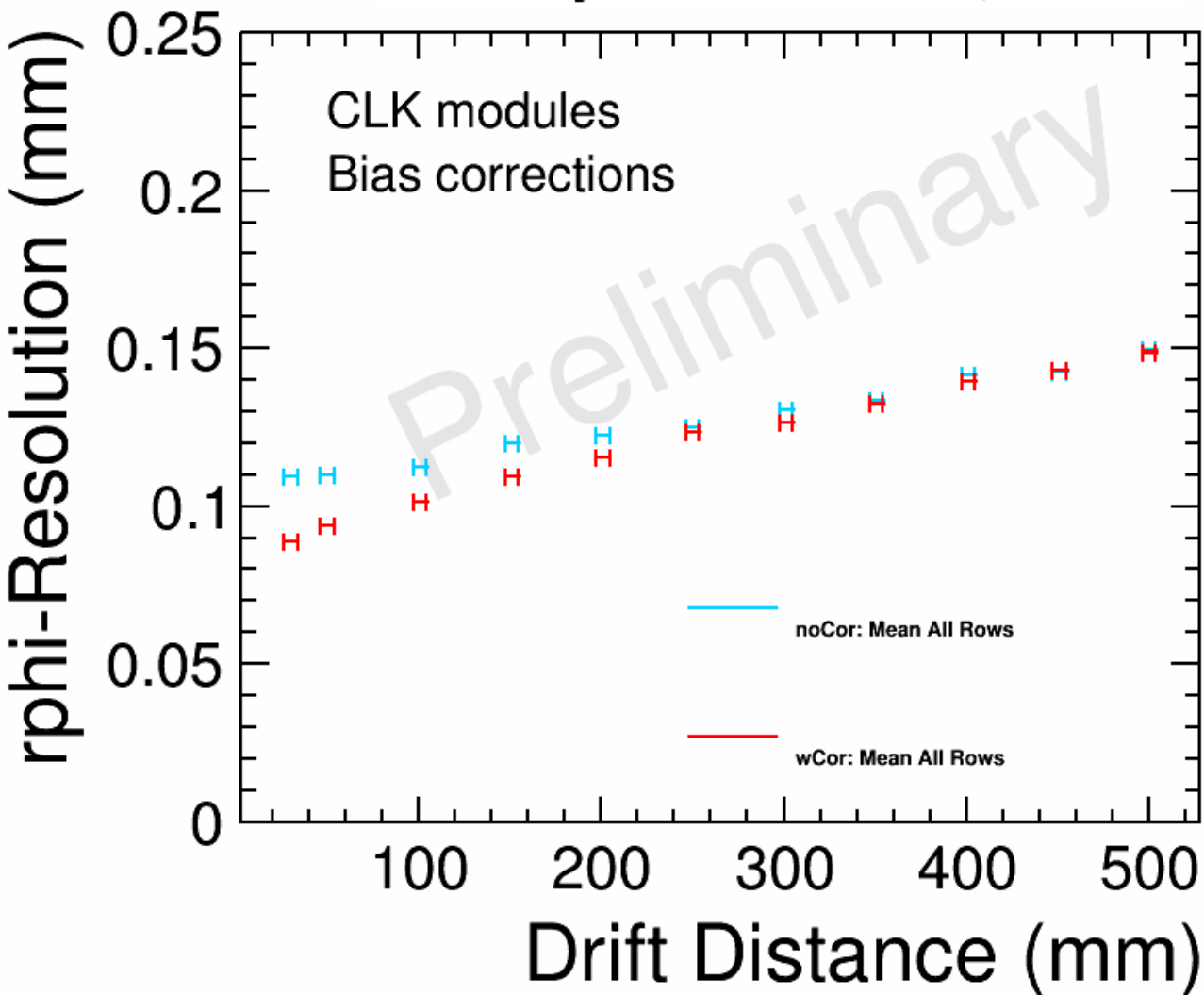
One BD module



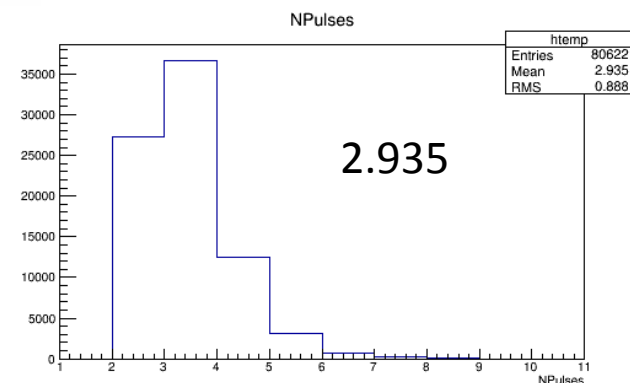
Slight degradation at short drifts

Pulse Threshold: 12 ADC for **all** pulses

2015 rphi Resolution, B=1T

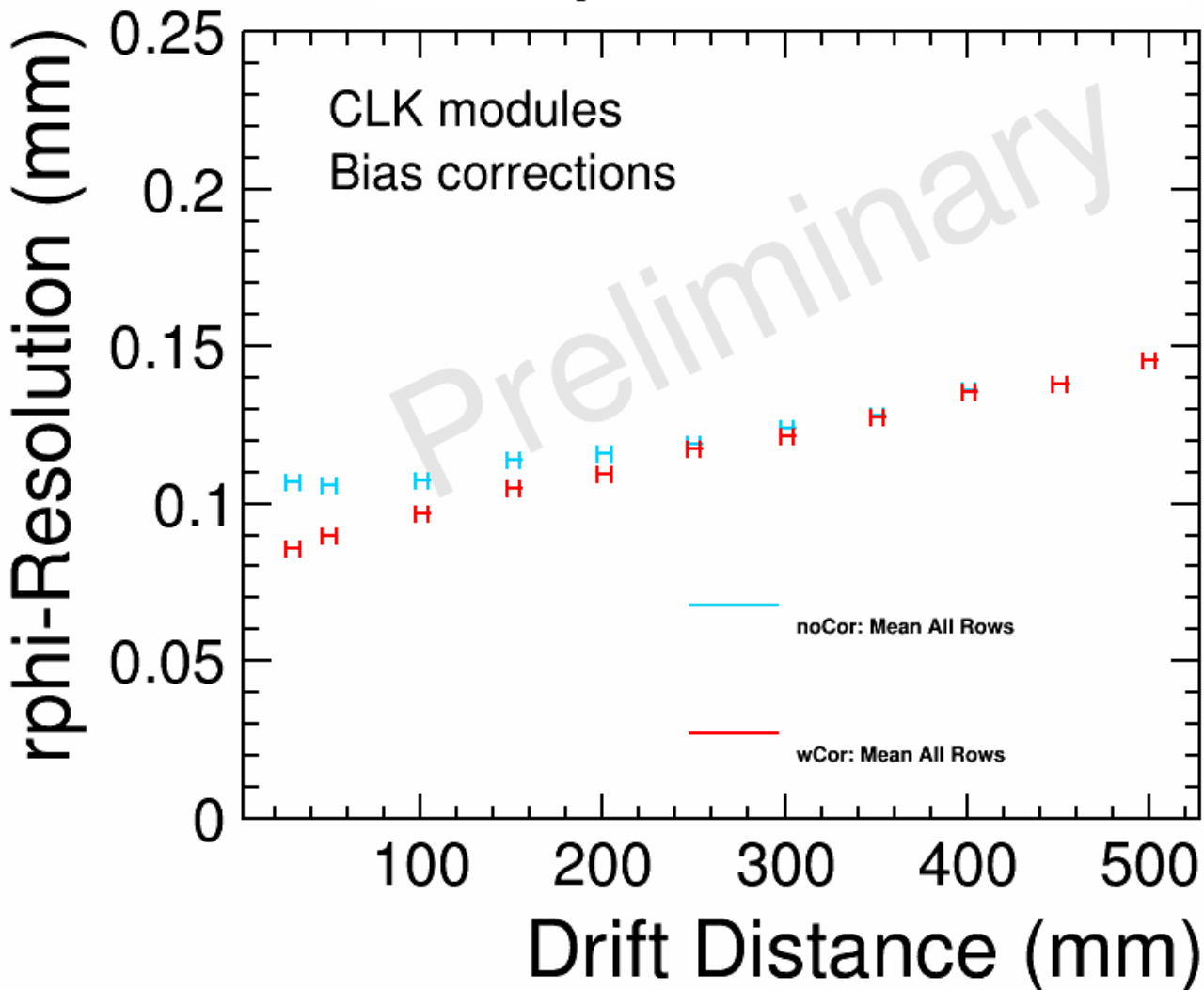


Two CLK modules

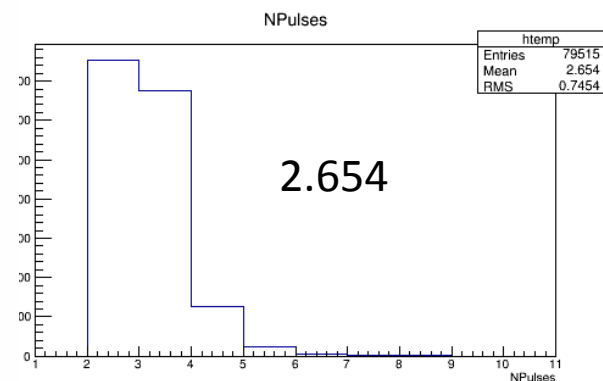


Pulse Threshold 30 ADC (“standard”).

2015 rphi Resolution, B=1T

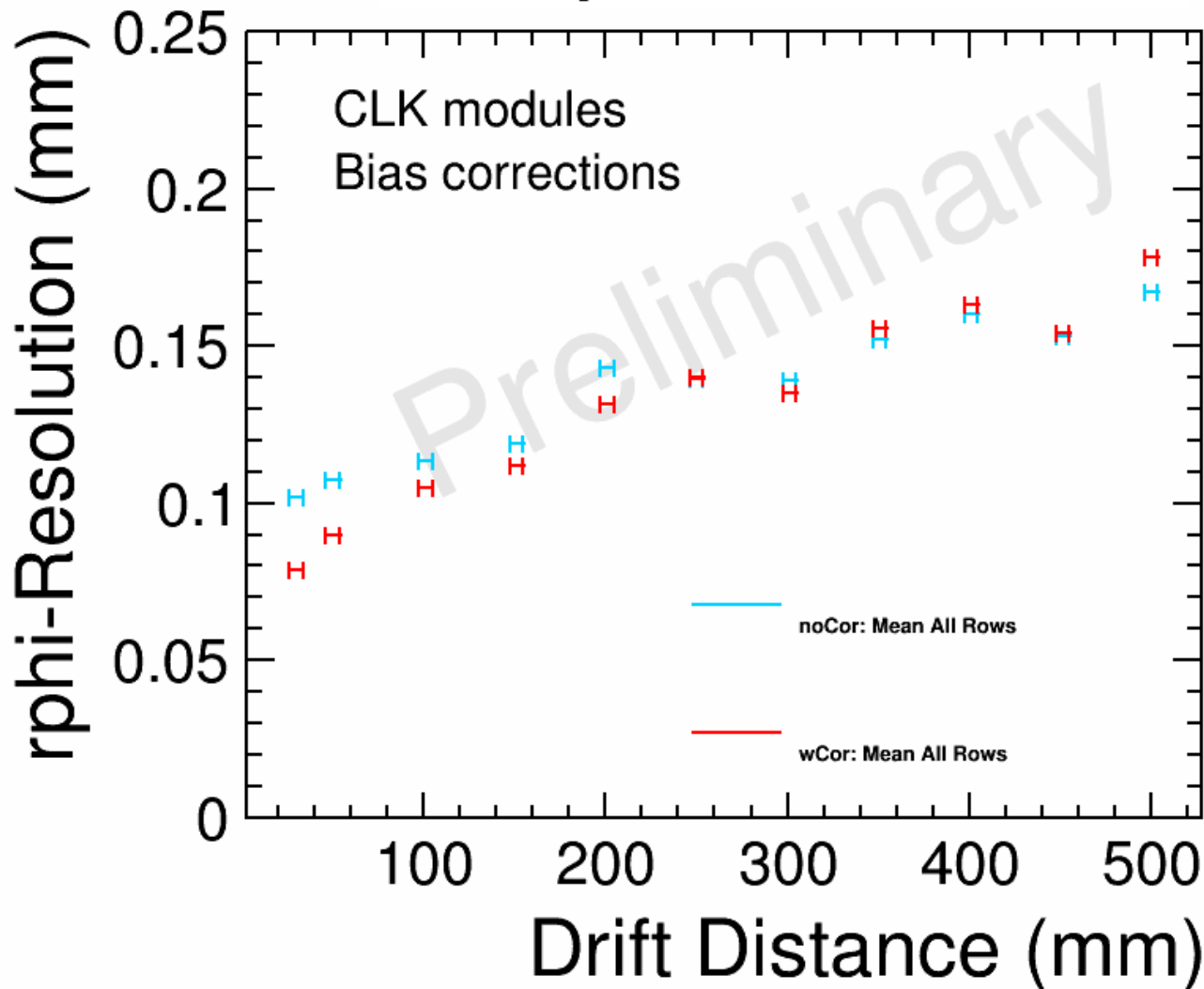


Two CLK modules

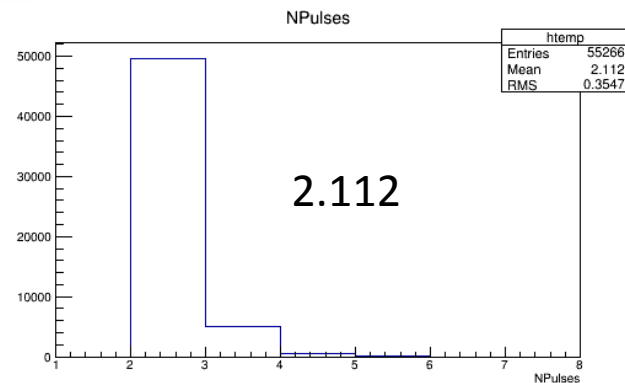


Pulse Threshold: 70 ADC for **all** pulses

2015 rphi Resolution, B=1T



Two CLK modules

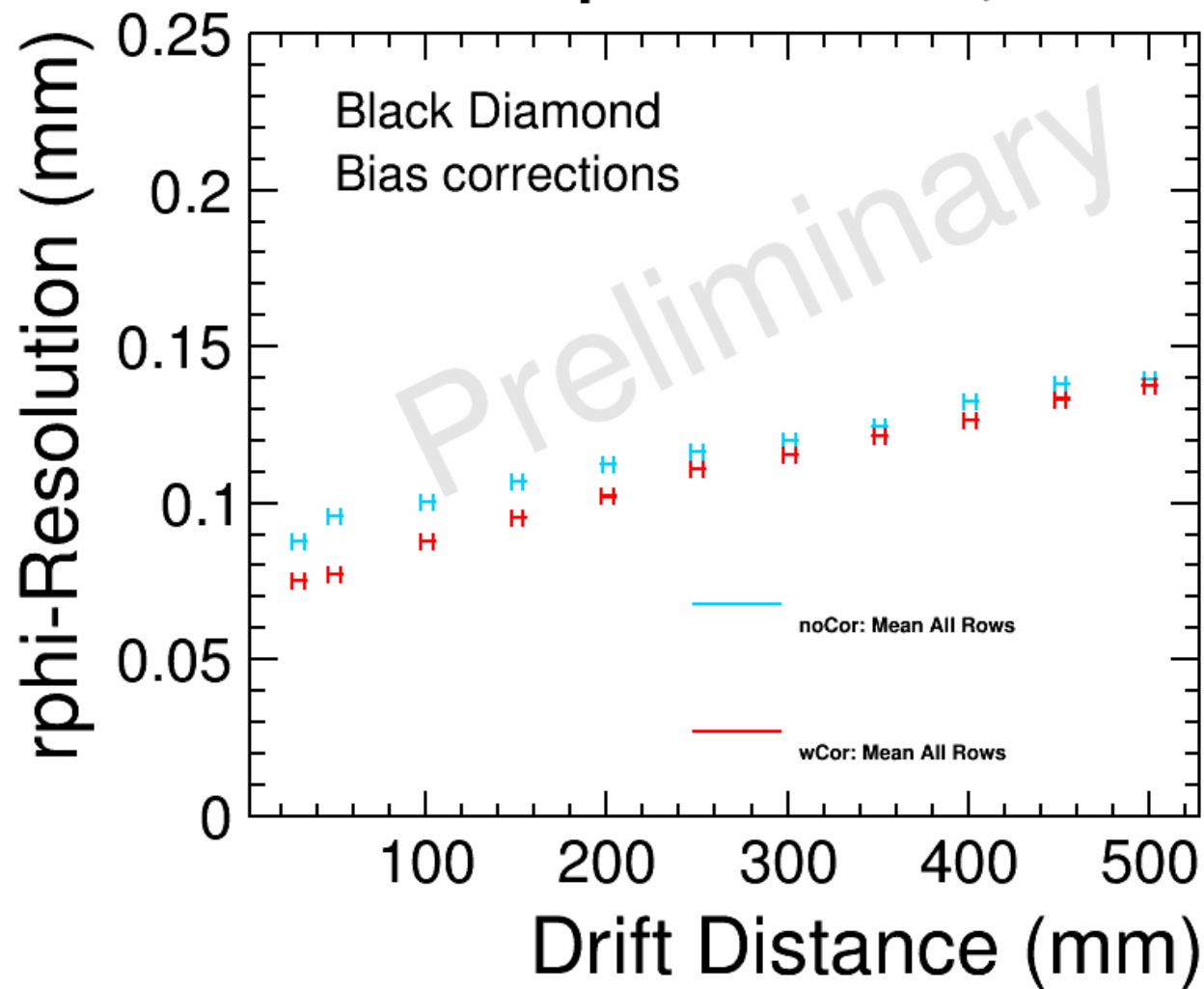


For CLK case, raising the threshold for all pulses, improves resolution at short distances, at degrades at large ones. Not much difference for BD2.

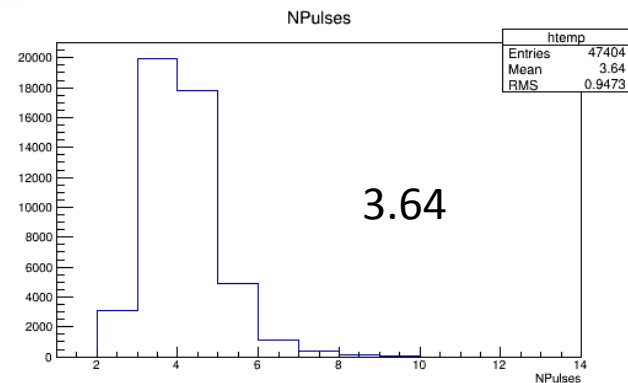
Resolution plots (for BD or CLK) with variable ADC threshold for **Max** Pulse

Hit Threshold 50 ADC (“standard”).

2015 rphi Resolution, B=1T

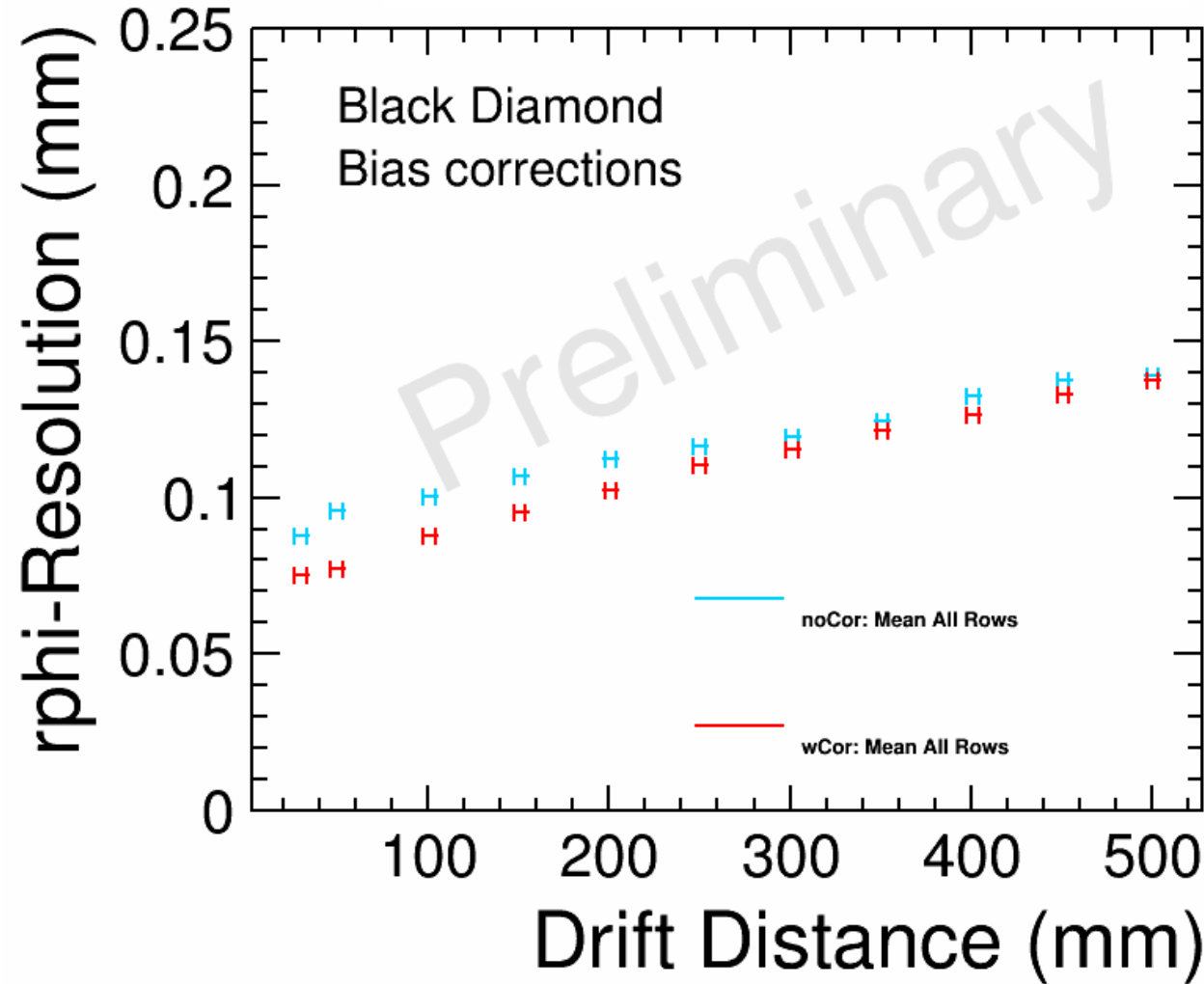


One BD module

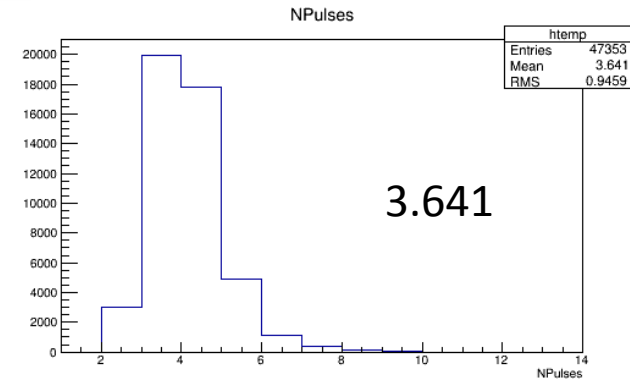


Hit Threshold of 150 ADC

2015 rphi Resolution, B=1T

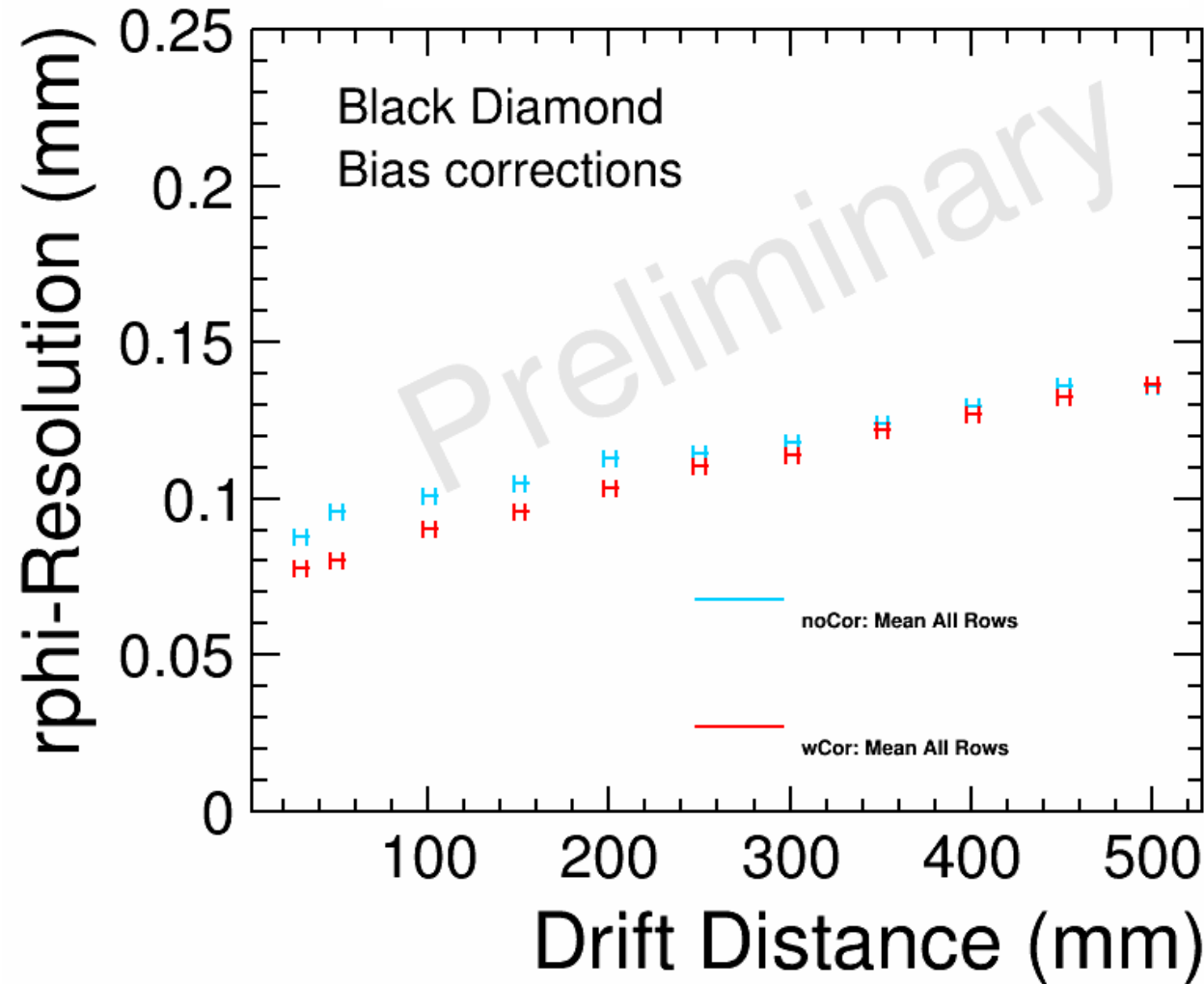


One BD module

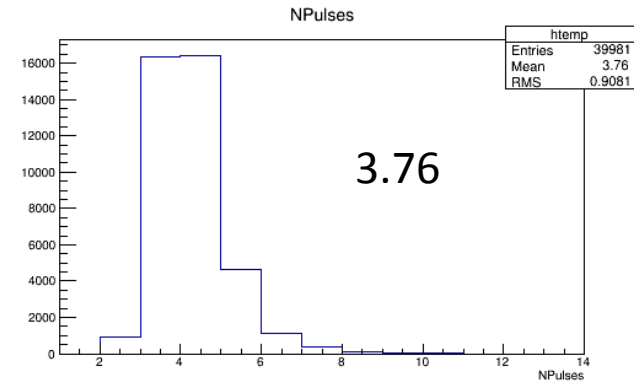


Hit Threshold of 600 ADC

2015 rphi Resolution, B=1T



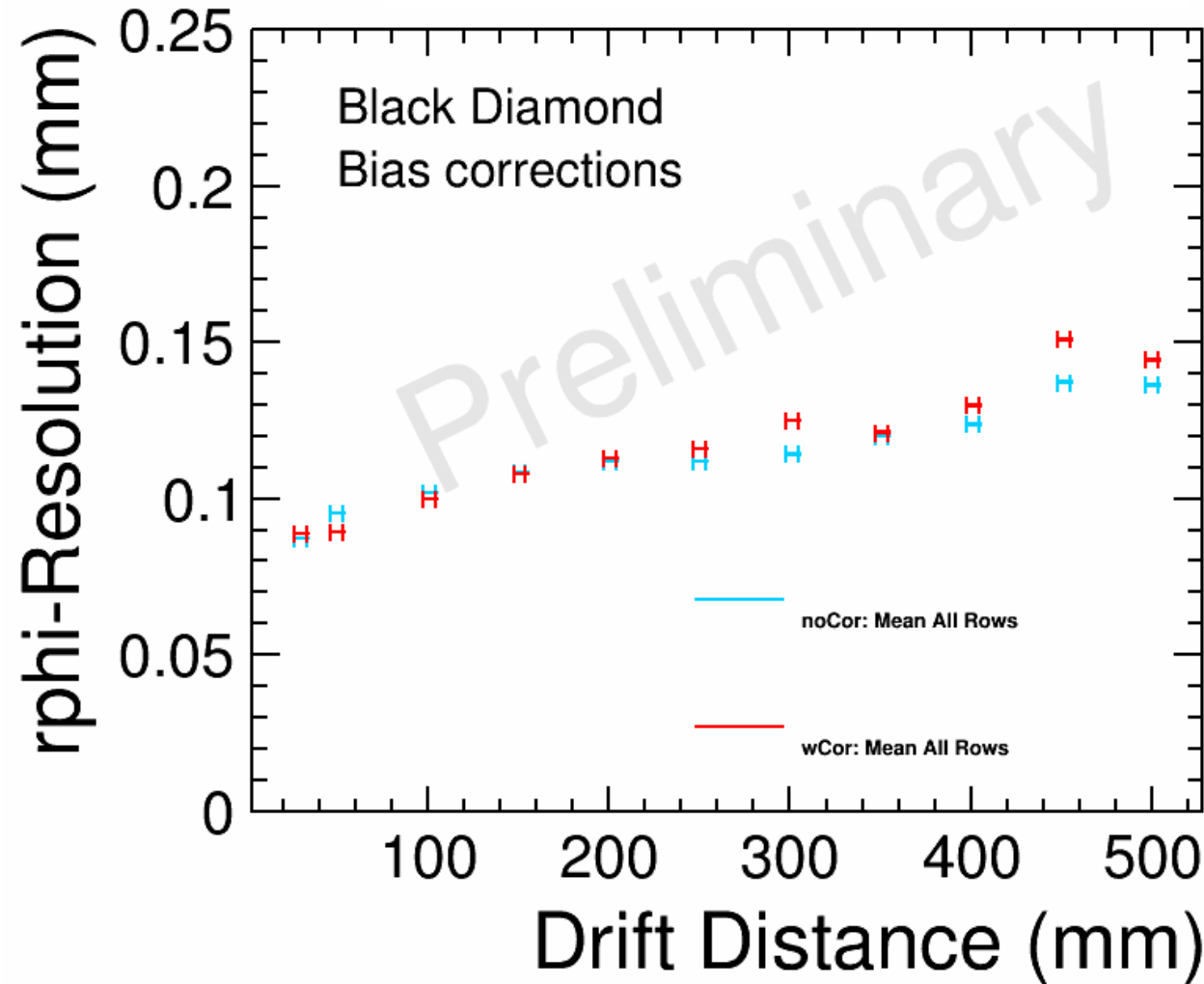
One BD module



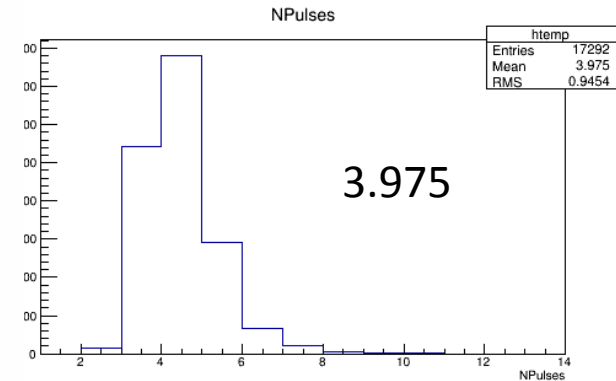
Difference with 150 ADC threshold: worse at low drifts, better at large drifts

Hit Threshold of 1000 ADC

2015 rphi Resolution, B=1T



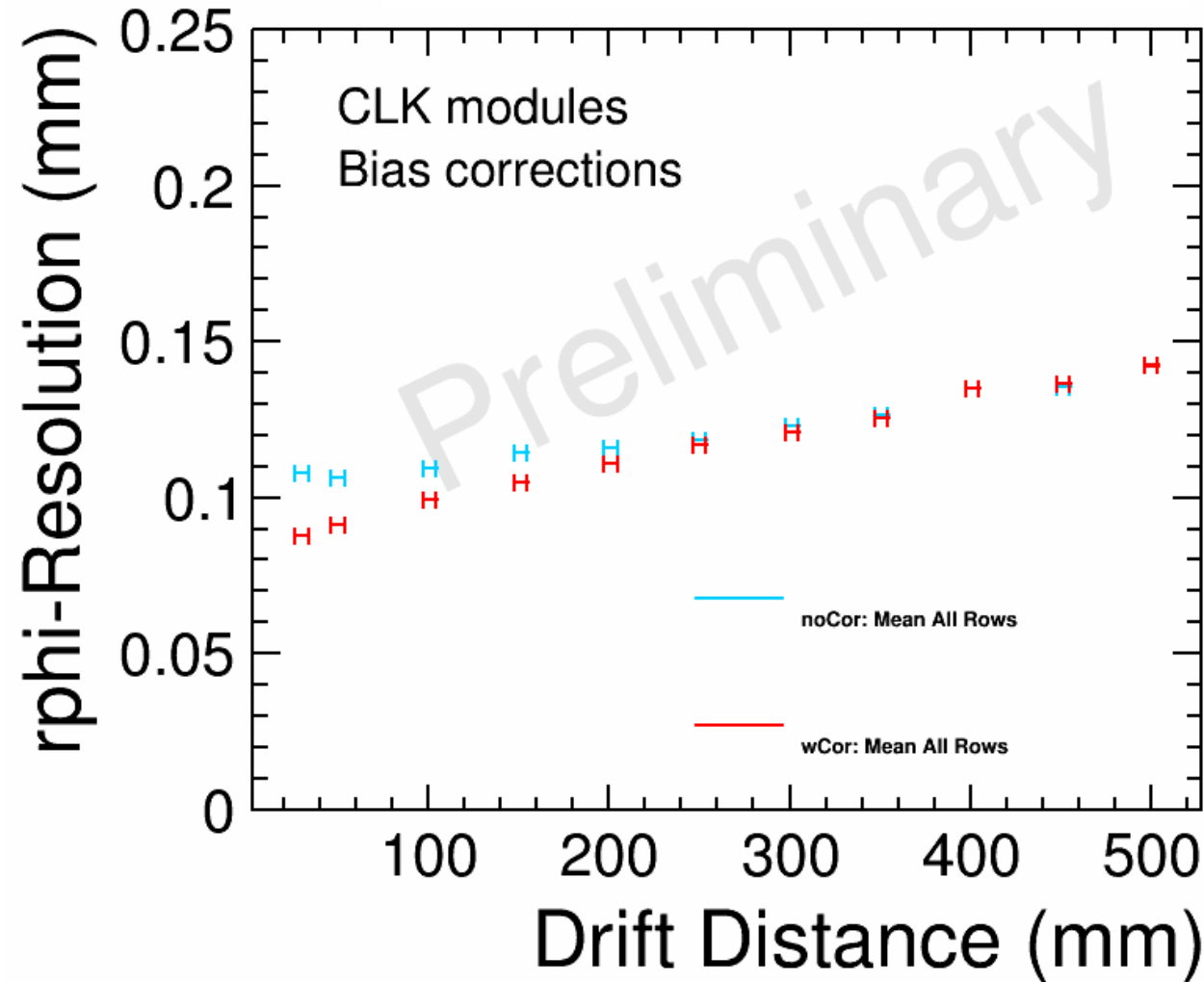
One BD module



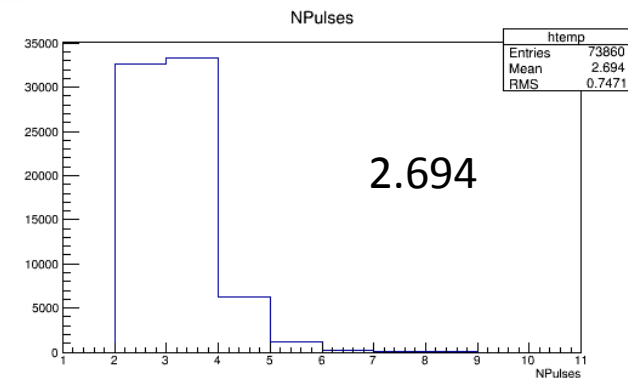
Difference with previous thresholds: better w/o corr.
Bias corr. work opposite way.

Hit Threshold of 50 ADC (“standard”)

2015 rphi Resolution, B=1T



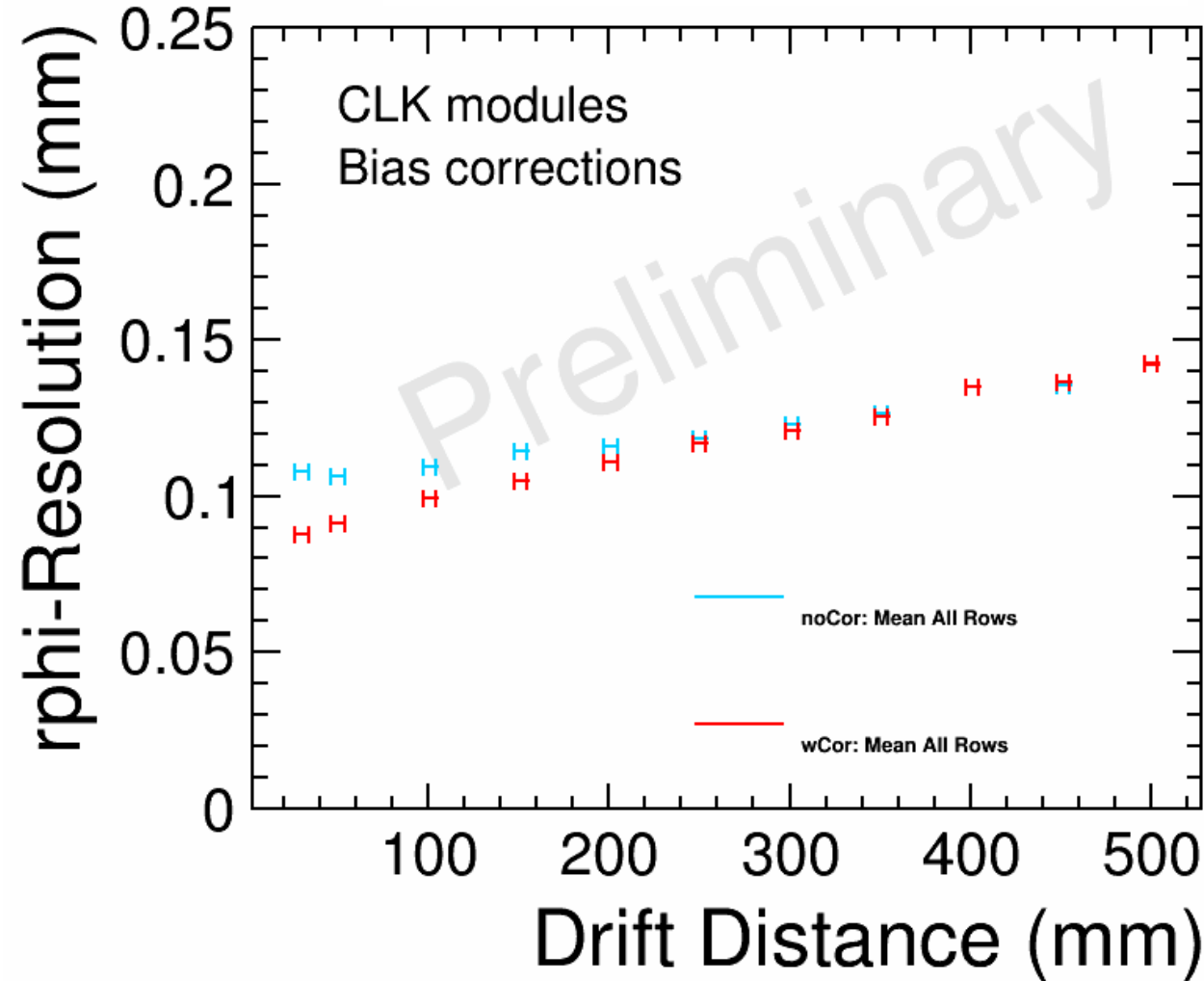
Two CLK modules



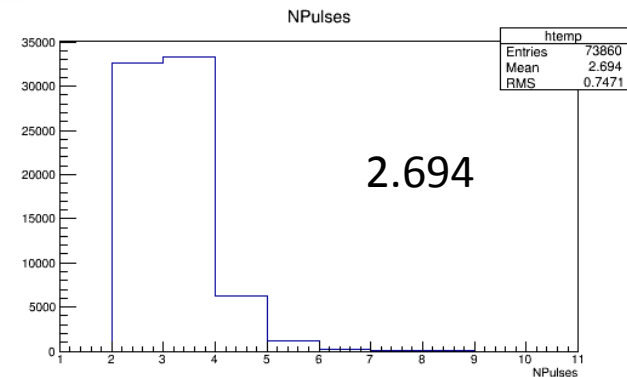
Difference with previous thresholds: worse at both ends.

Hit Threshold of 300 ADC

2015 rphi Resolution, B=1T



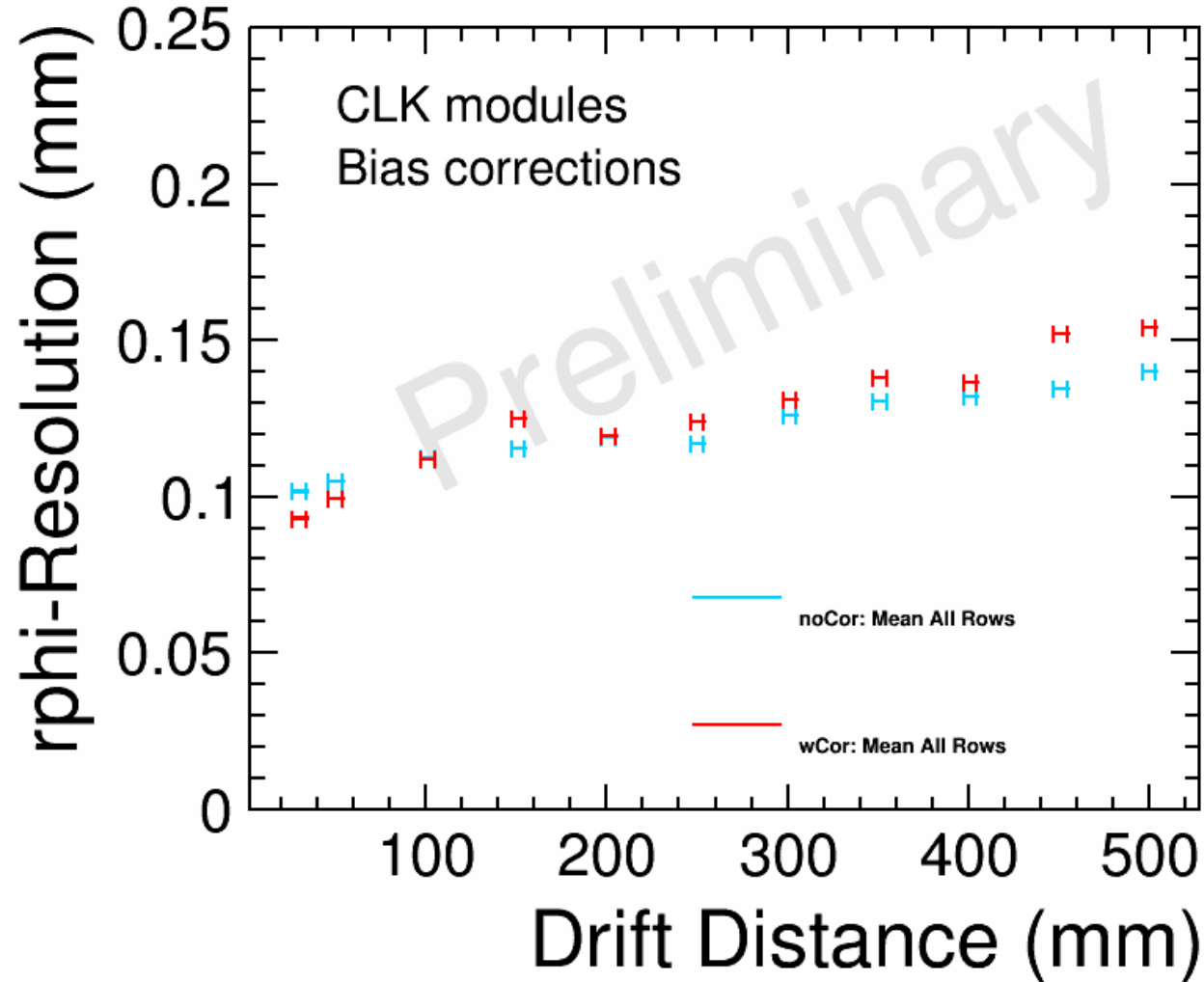
Two CLK modules



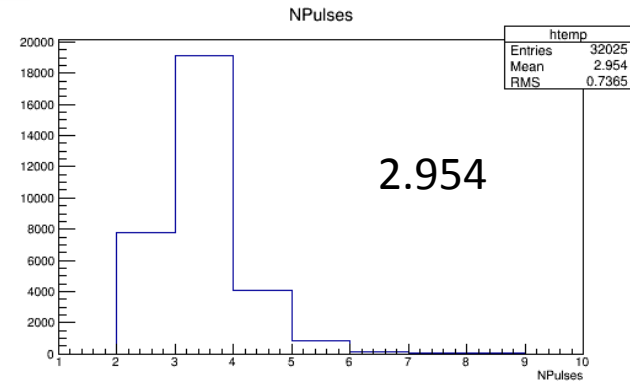
Difference with previous thresholds: worse at both ends.

Hit Threshold of 600 ADC

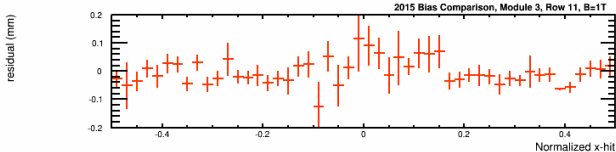
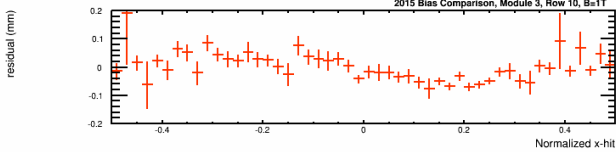
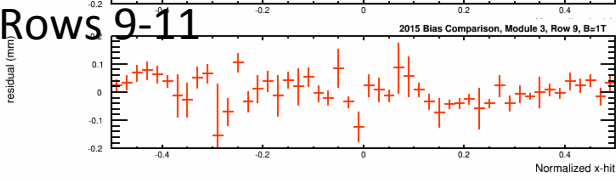
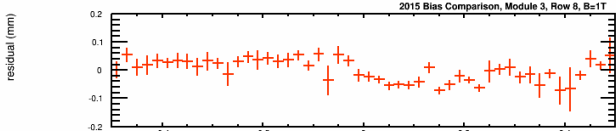
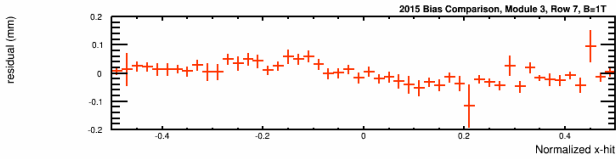
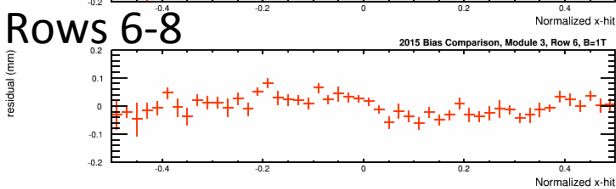
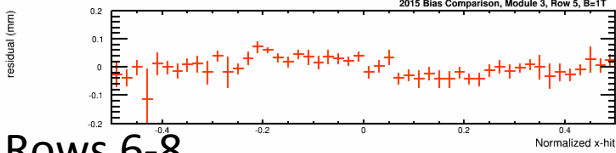
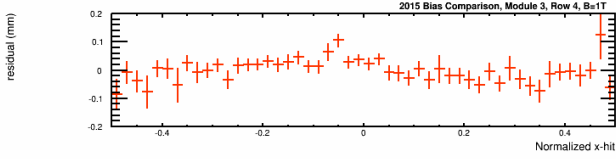
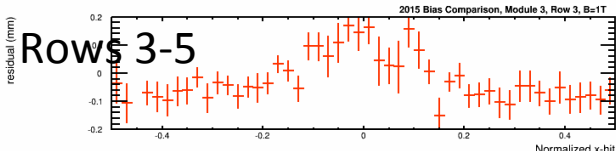
2015 rphi Resolution, B=1T



Two CLK modules



Difference with previous thresholds: blue points (no corr) better.



CLK modules

Hit > 300 ADC



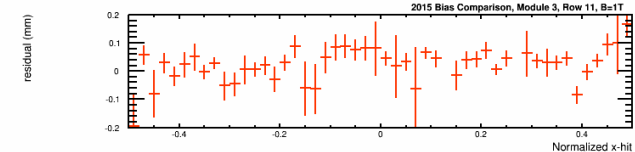
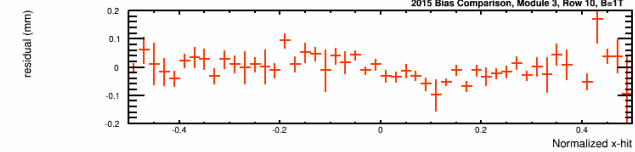
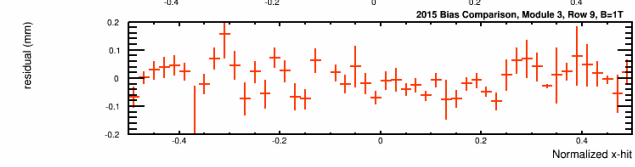
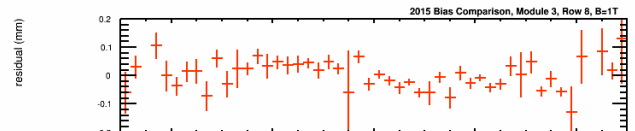
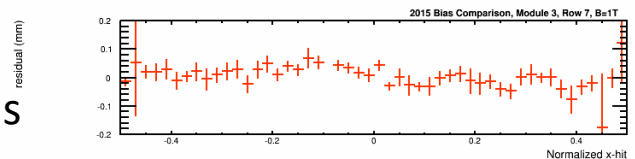
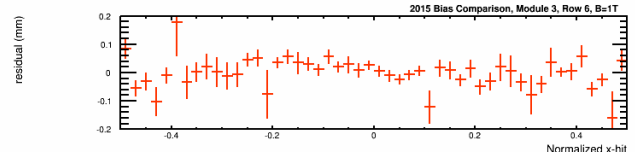
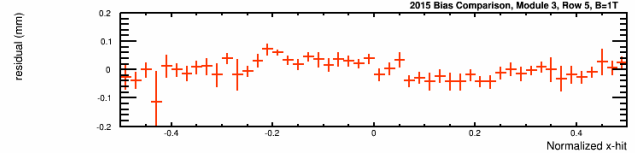
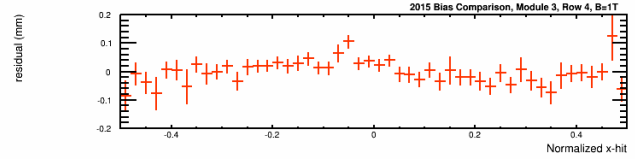
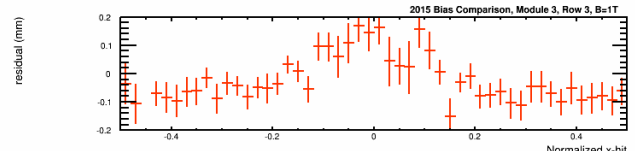
Hit > 600 ADC



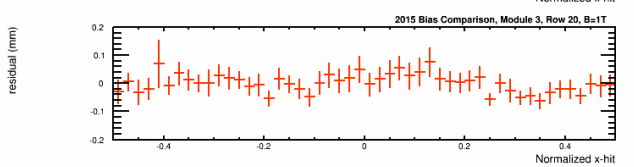
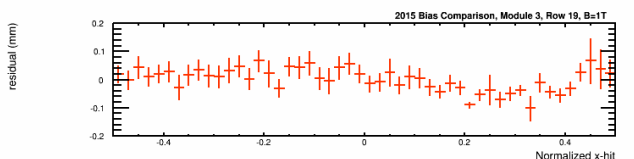
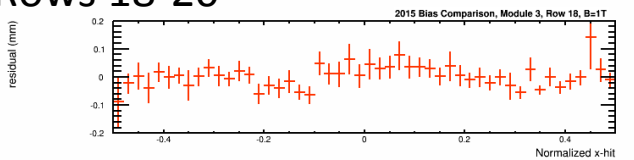
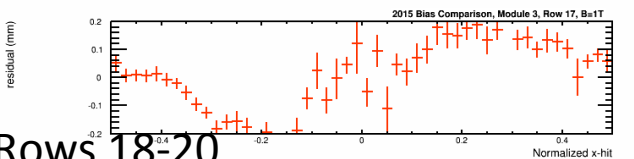
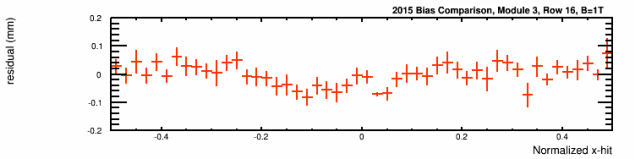
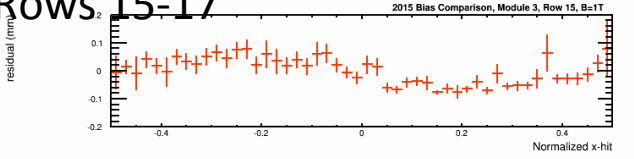
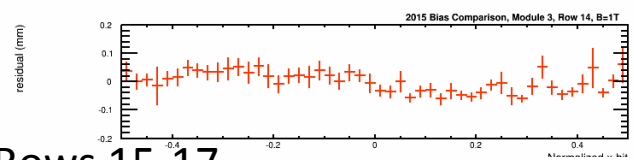
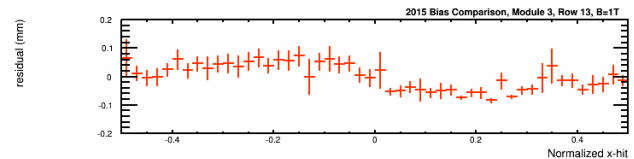
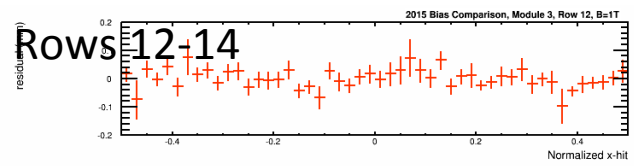
BEFORE corr.

Visual impression:
Statistical fluctuations

Run 5119,
Modules 3 and 5



Bad
row?



CLK modules
Hit > 300 ADC



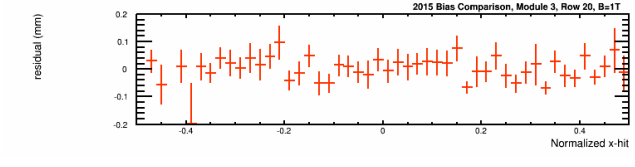
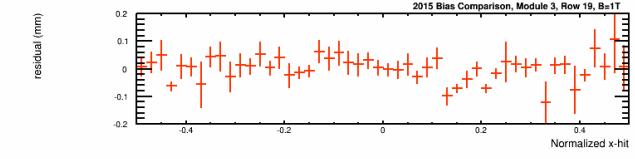
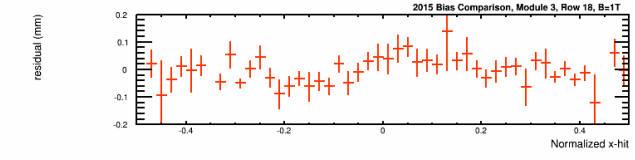
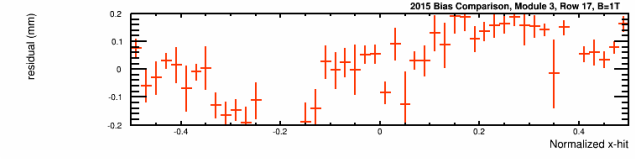
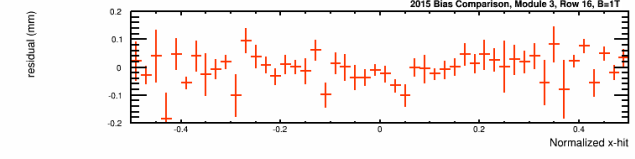
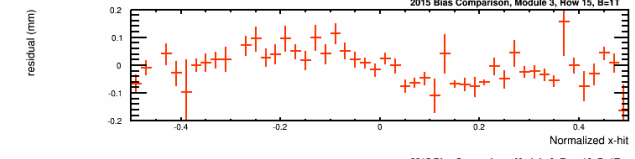
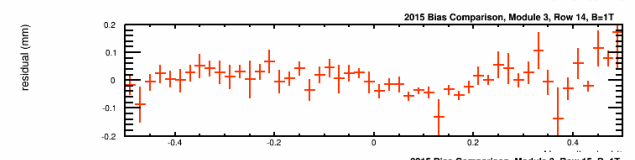
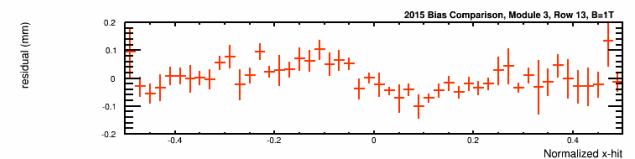
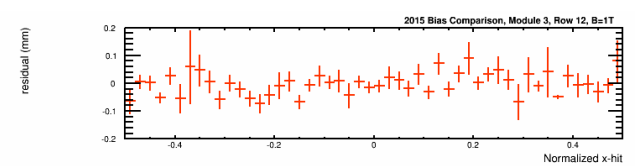
Hit > 600 ADC



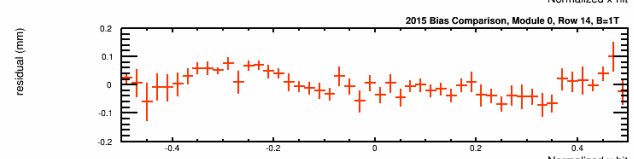
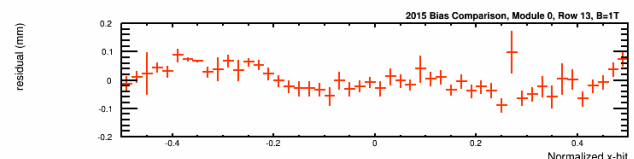
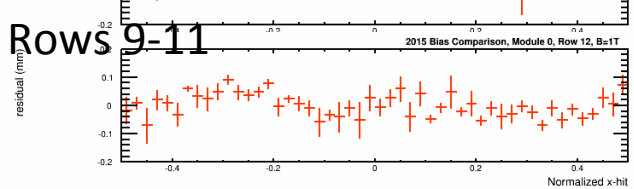
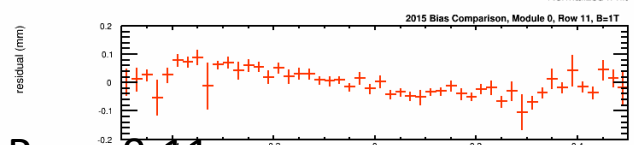
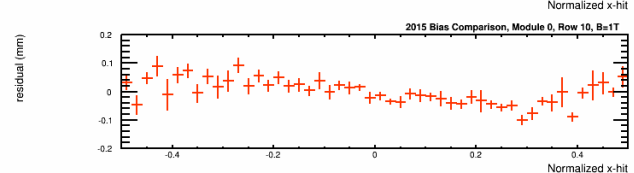
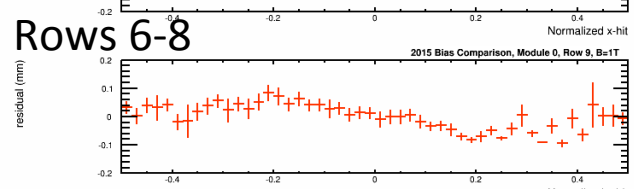
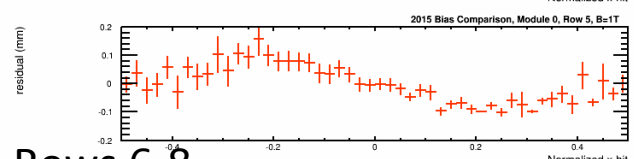
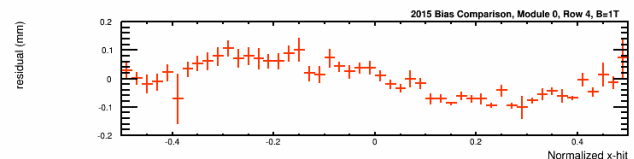
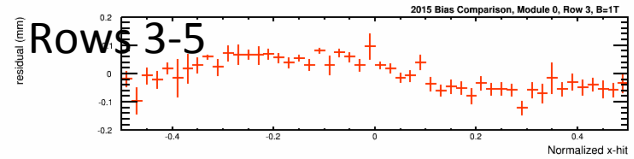
BEFORE corr.

Visual impression:
statistical fluctuations
on the right, the cut
is too harsh.

Run 5119,
Modules 3 and 5



Bad
row?

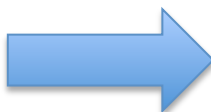


BD module

Hit > 50 ADC

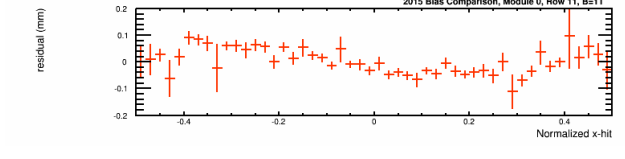
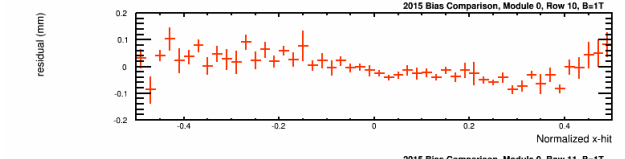
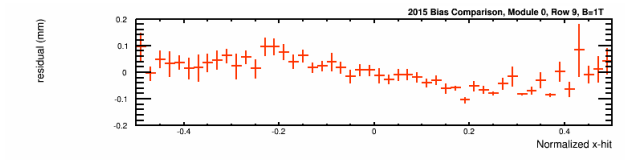
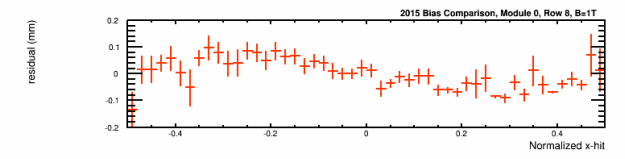
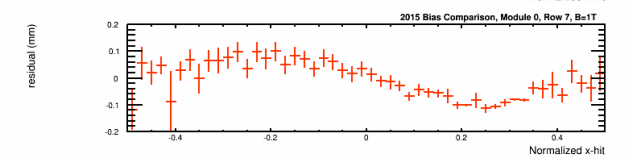
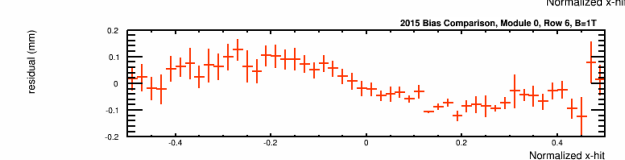
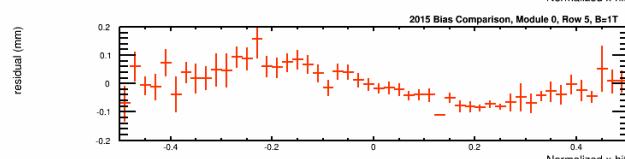
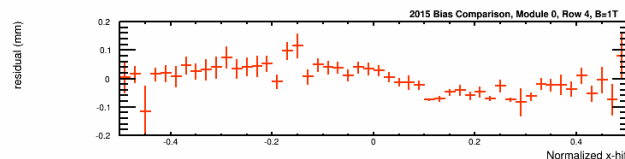
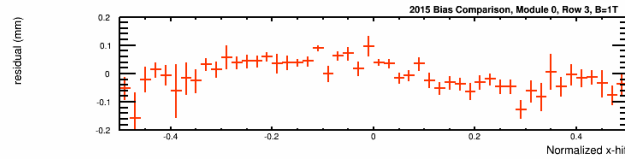


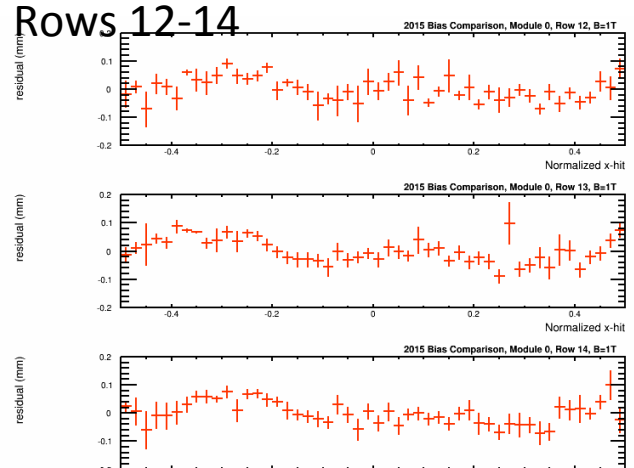
Hit > 600 ADC



BEFORE corr.

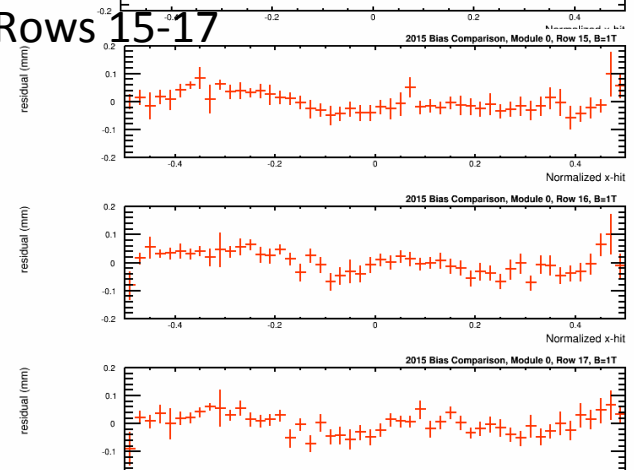
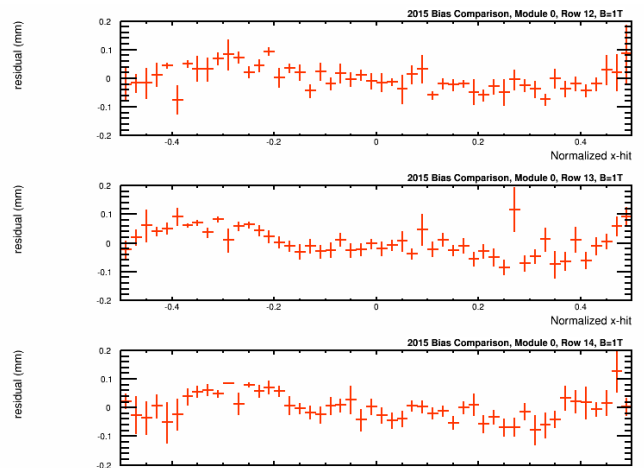
Looks quite stable
over the cut range



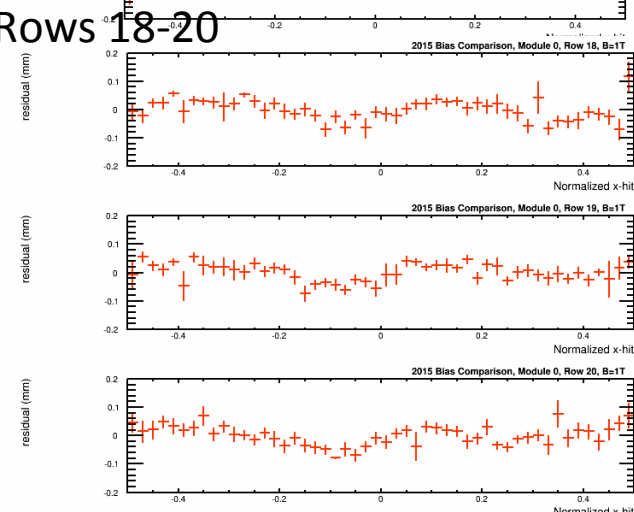
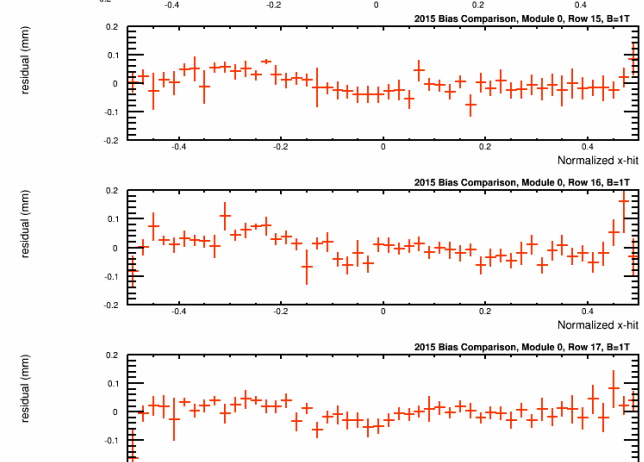


BD module

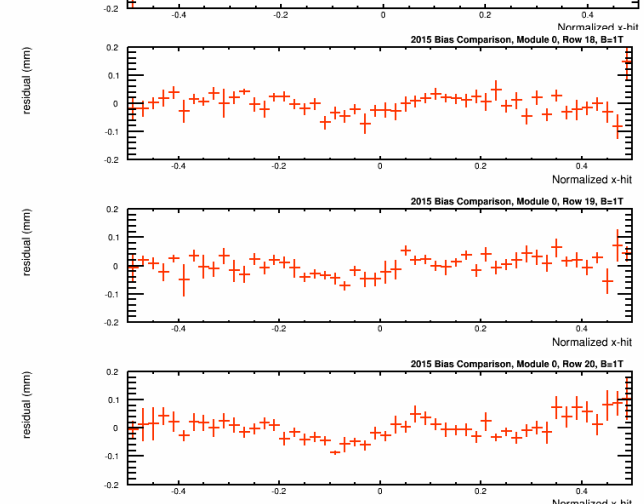
Hit > 50 ADC



Hit > 600 ADC

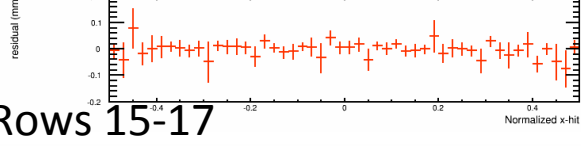
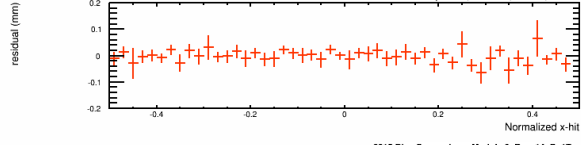
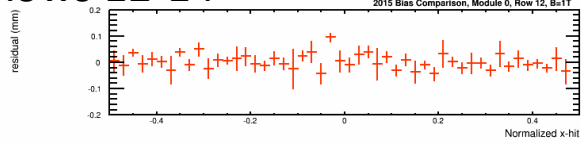


Looks quite stable over the cut range

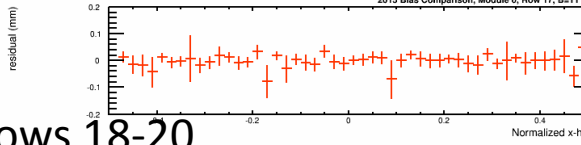
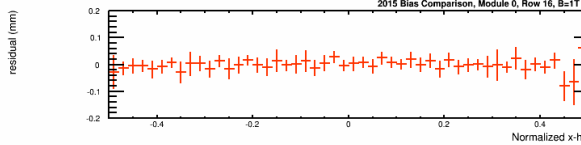
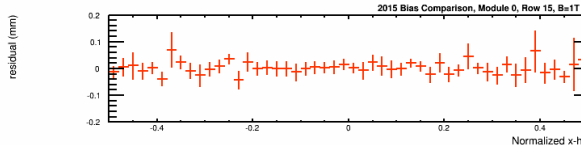


BEFORE corrections

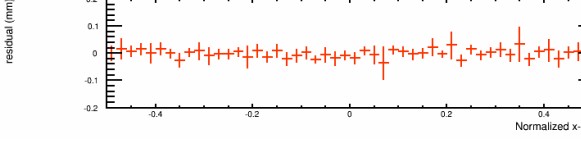
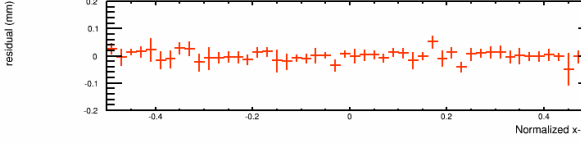
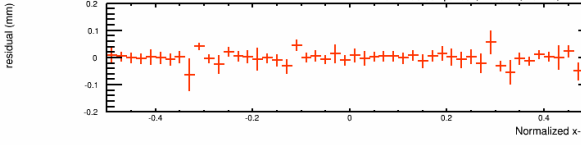
Rows 12-14



Rows 15-17

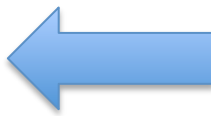


Rows 18-20



BD module

Hit > 50 ADC

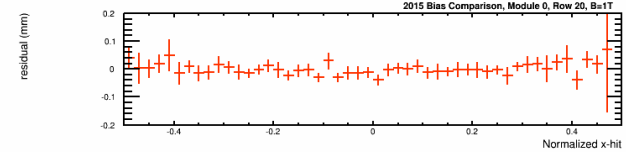
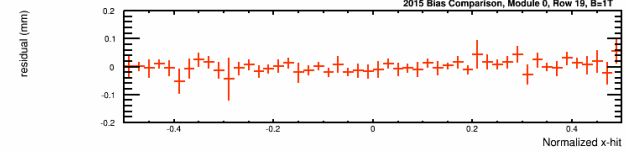
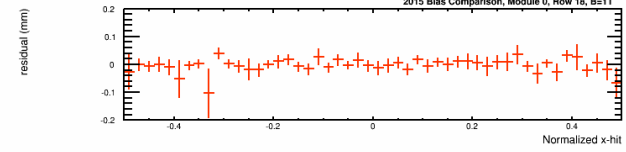
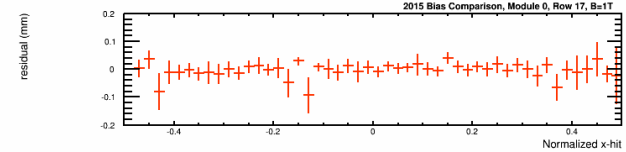
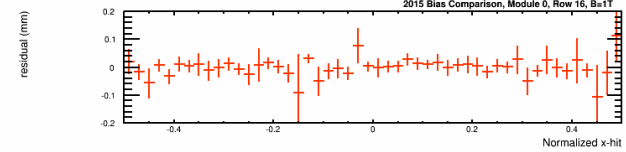
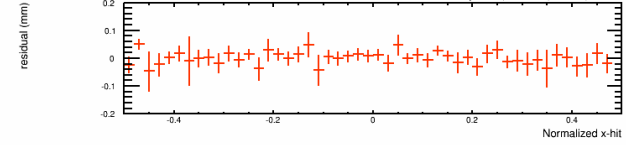
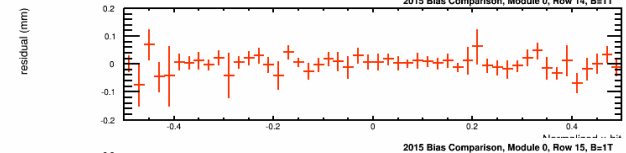
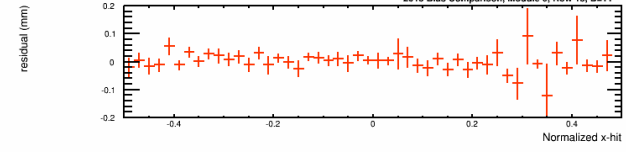
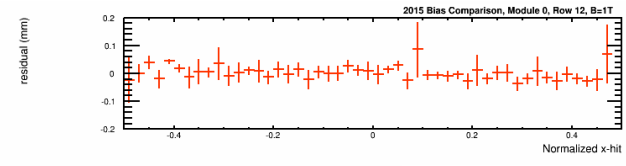


Hit > 600 ADC



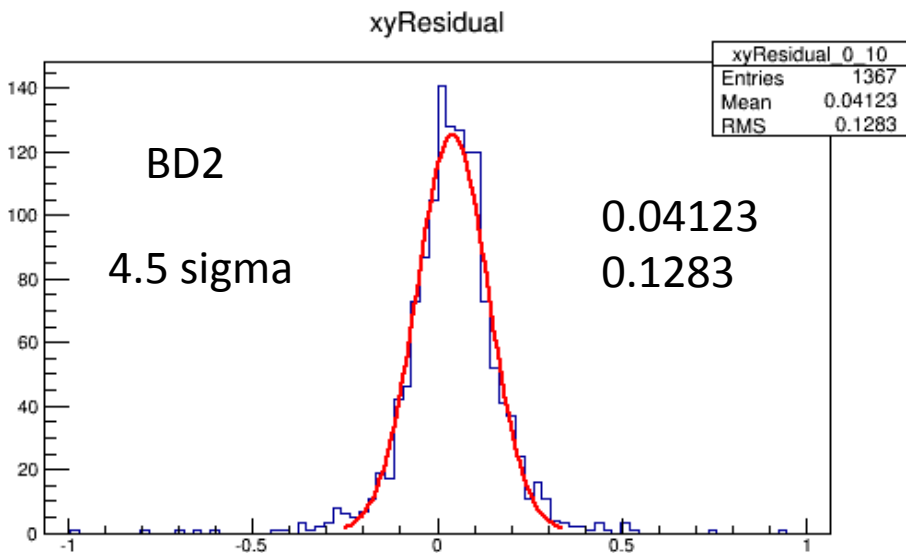
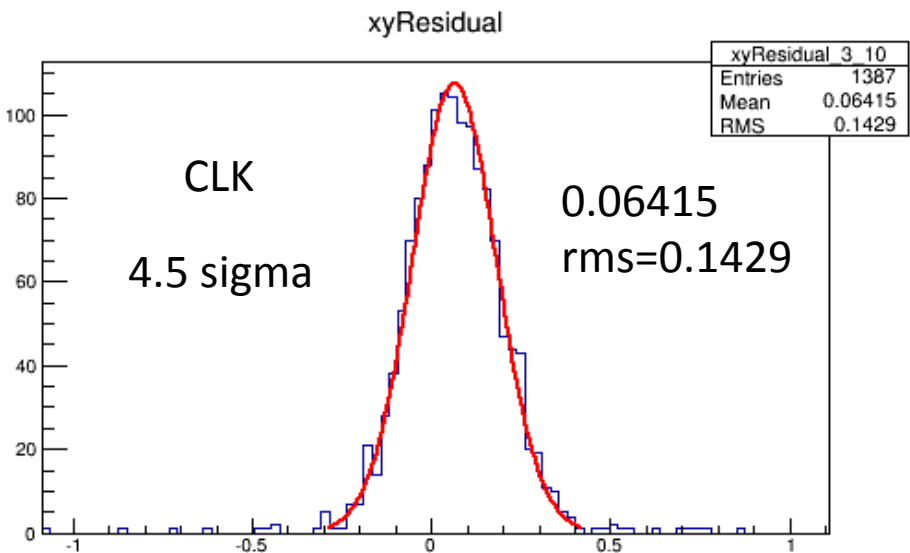
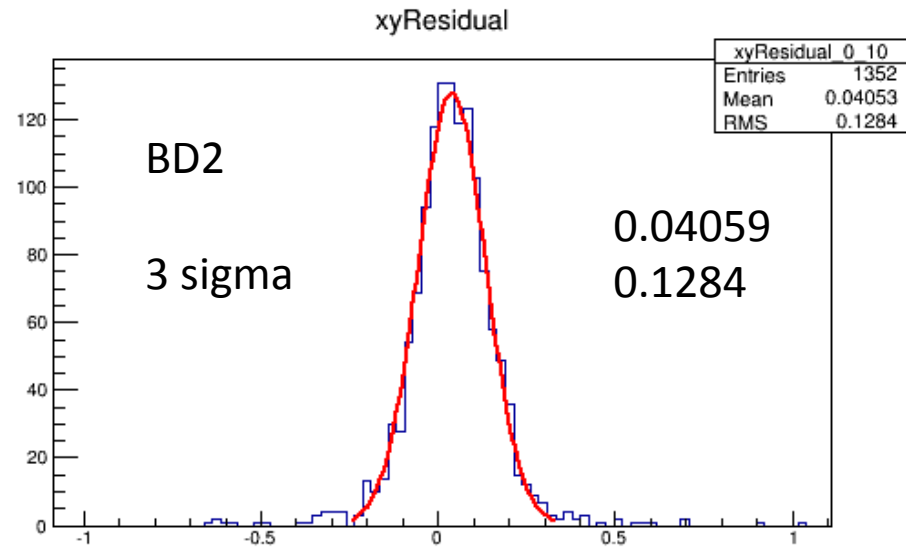
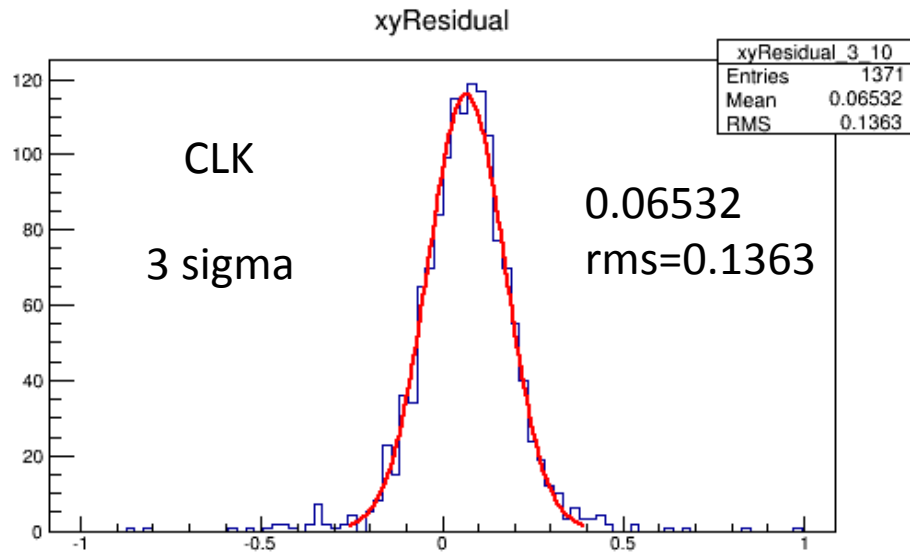
Looks quite stable over the cut range. Wiggles on right Due to statistics

AFTER corrections



3 sigma data – first look

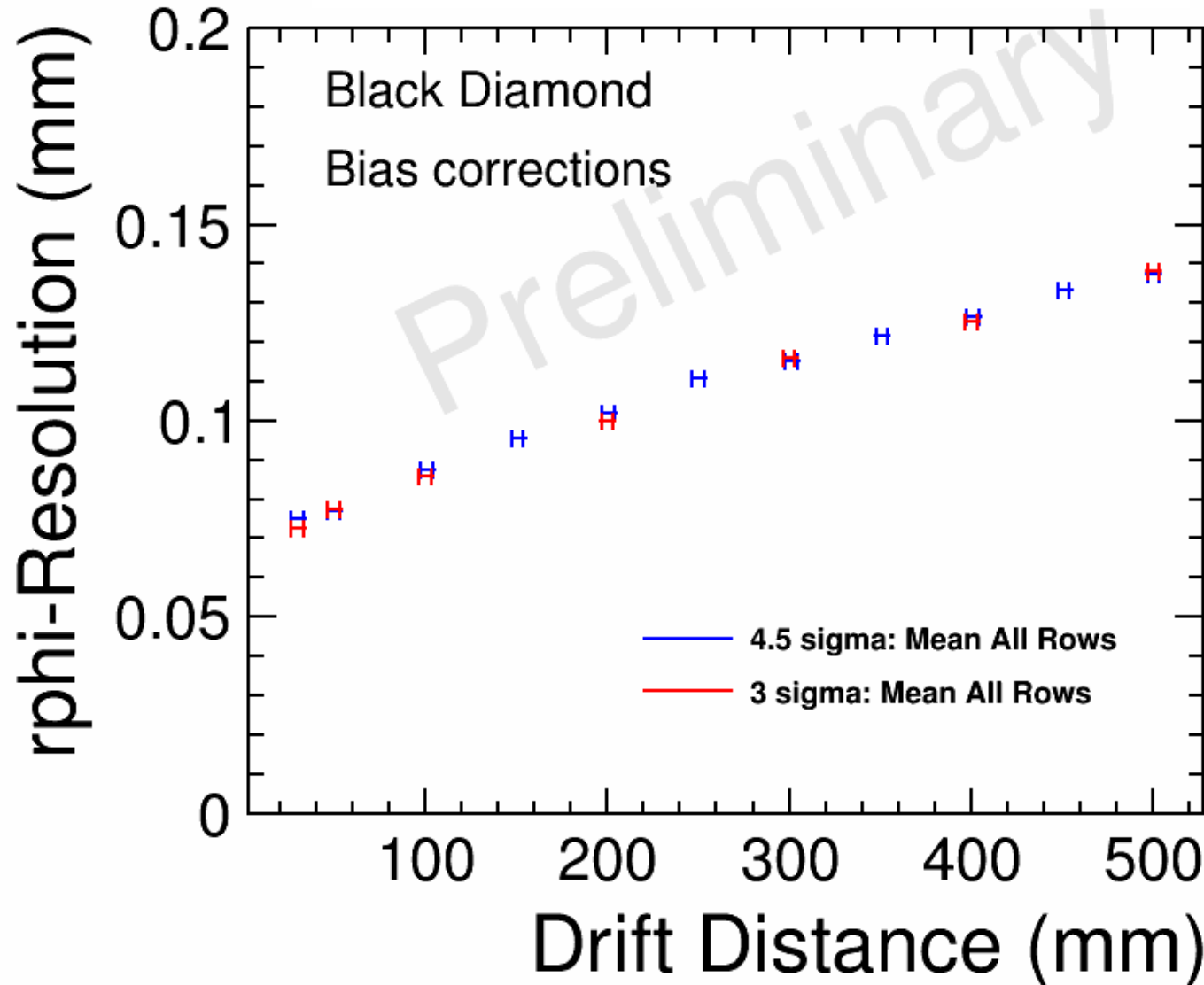
Residuals, Mod3/Mod0, Row 10



I'd say, I like more shape/width with 3 sigma rather than with 4.5 for this selection

Resolution plot, 3 sigma vs 4.5 sigma

2015 rphi Resolution Comparison, B=1T

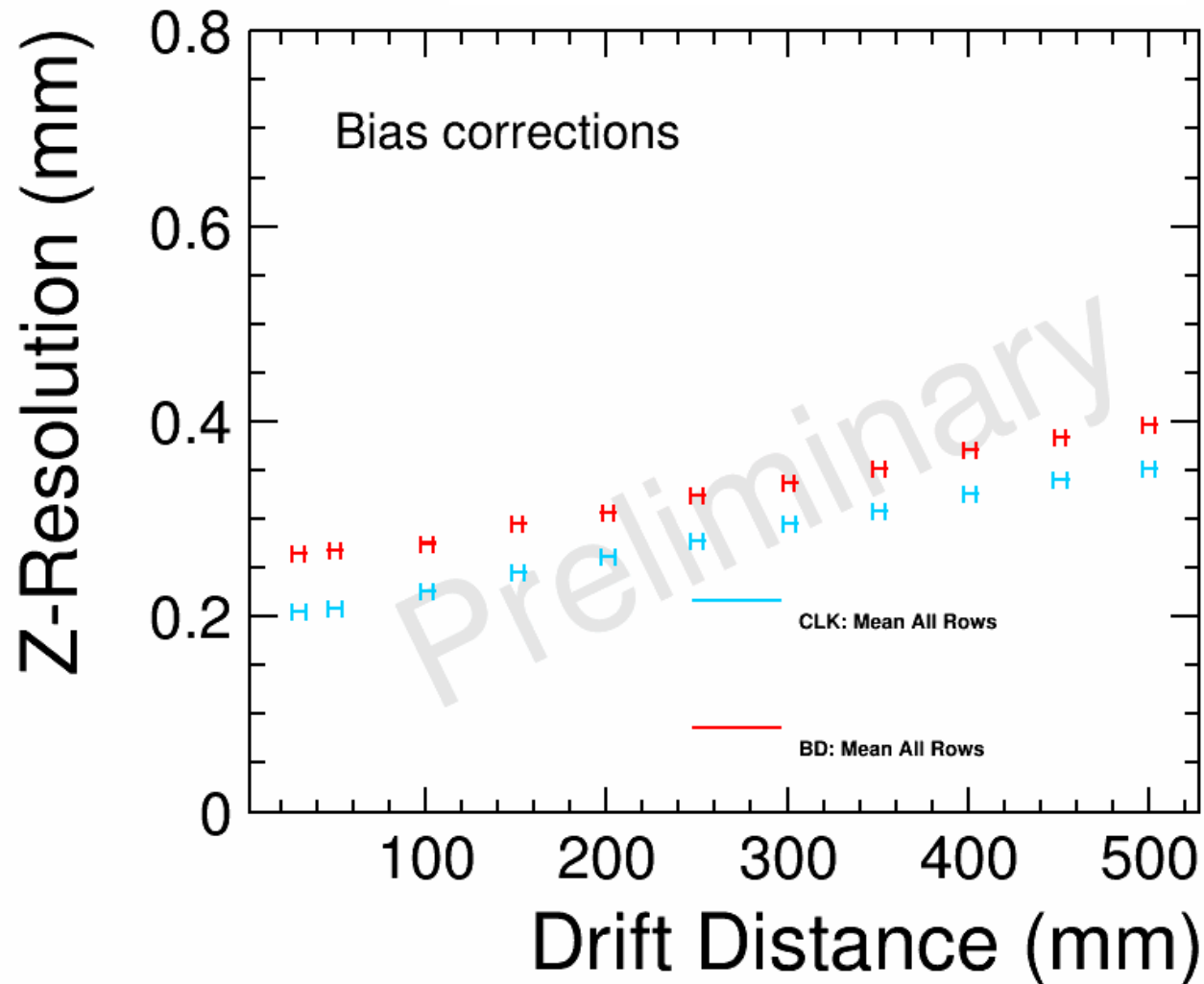


Transverse resolution gets some small improvements wrt Page 13 (4.5 sigma) even before re-integration applied. At long drift distances virtually unchanged.

Z resolution

Z resolution 2015

2015 Z Resolution, B=1T

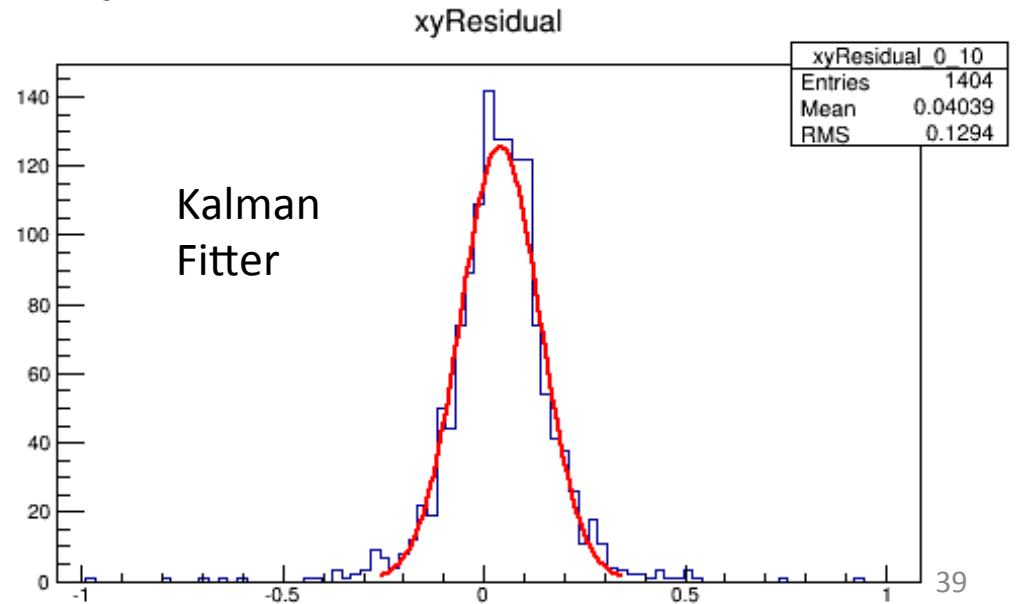
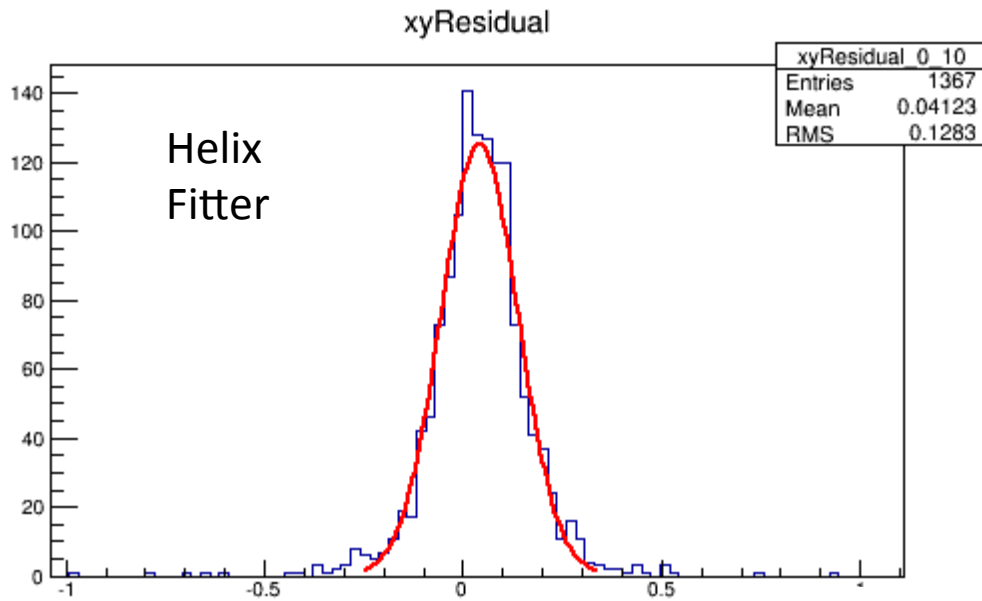


For some reason,
BD2 performs worse
than CLK in Z-resolution?

This is the same data!

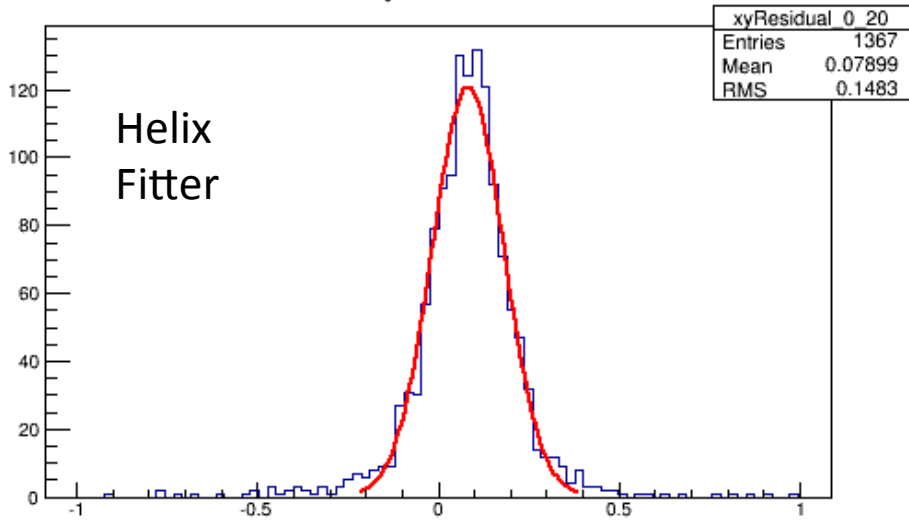
Kalman Fitter

Residuals, BD module, Row 10

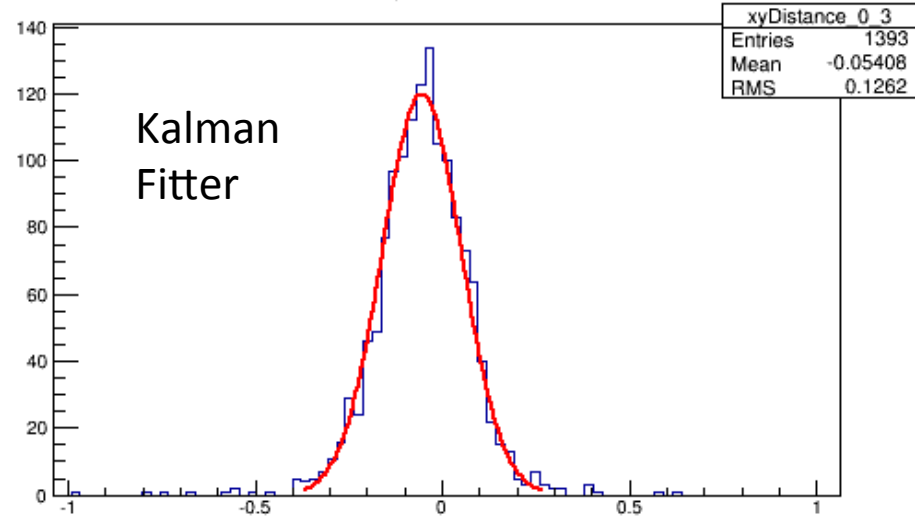


Residuals, row 20 (top) and 3 (bottom)

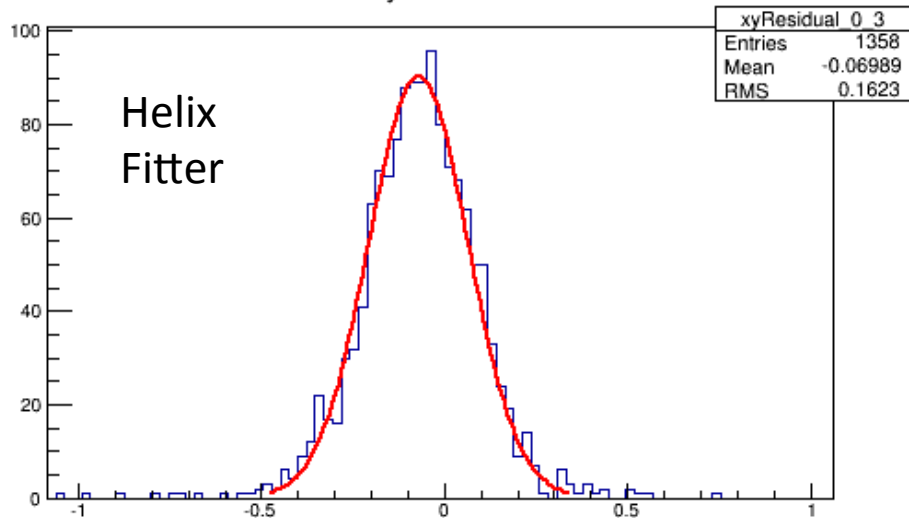
xyResidual



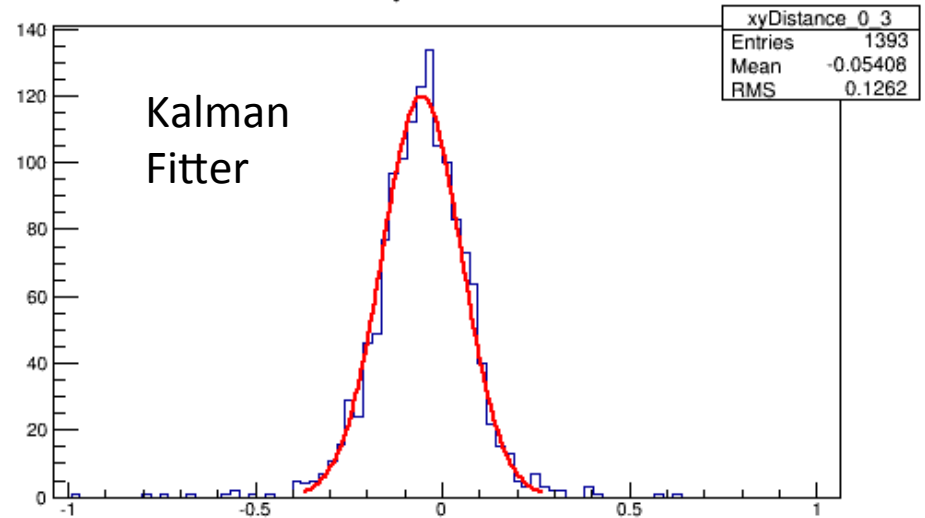
xyDistance



xyResidual



xyDistance



Before any corrections.

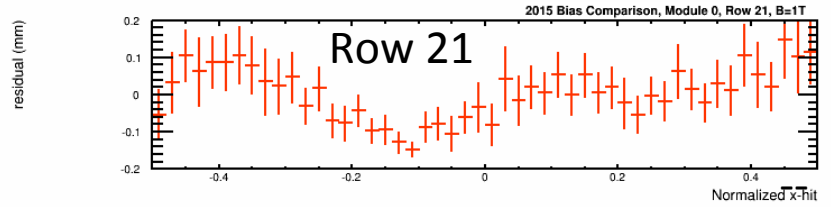
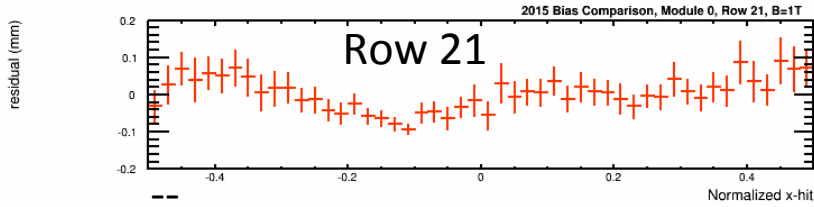
Kalman fitter residuals look more attractive to me.

**Bias corrections after two fitters.
Comparison for each row.**

Black Diamond module, Run 5119

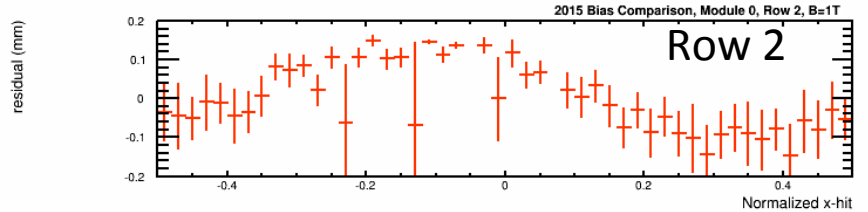
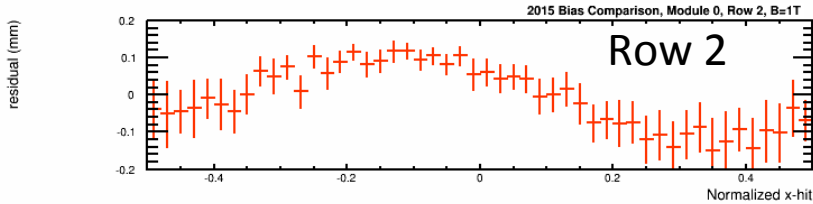
Helix Fitter

Kalman Fitter



Rows in between are on the next 4 pages

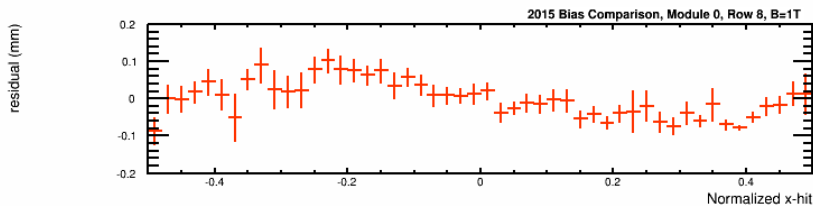
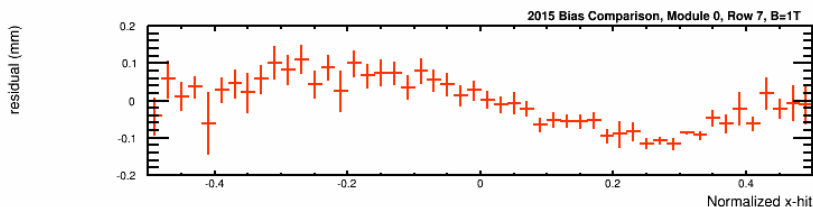
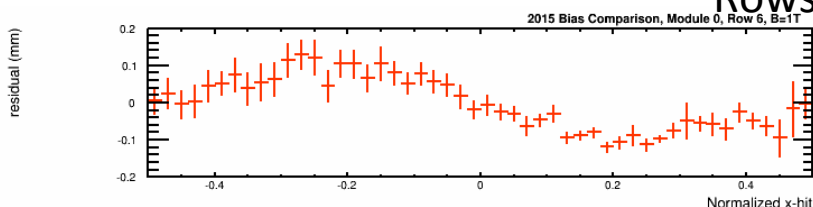
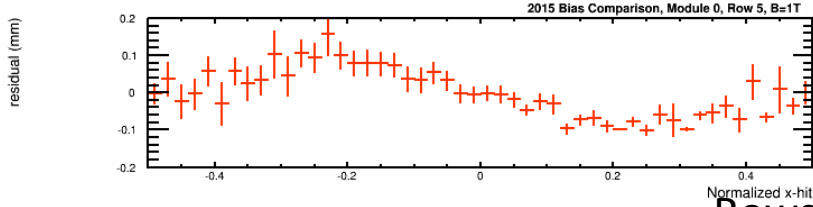
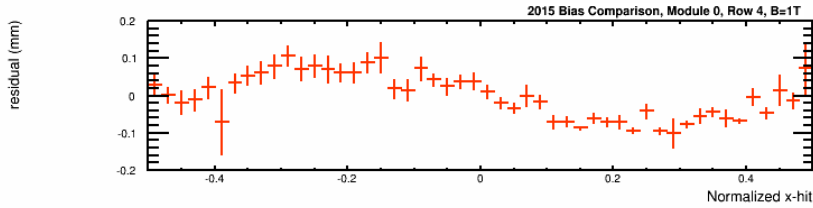
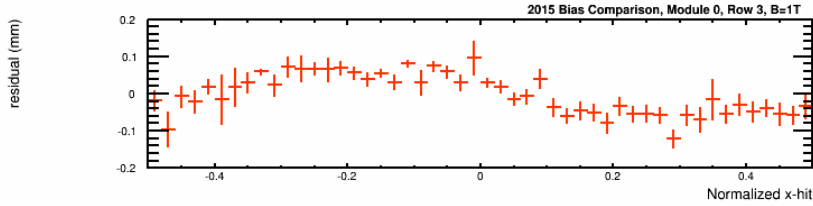
BEFORE any corrections applied!



These rows at the edges. Note that rows 0-1 and 22-23 are typically excluded in the analysis.

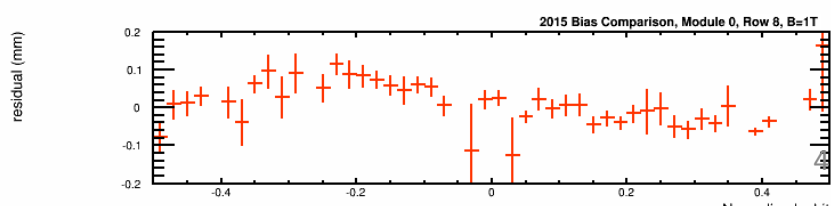
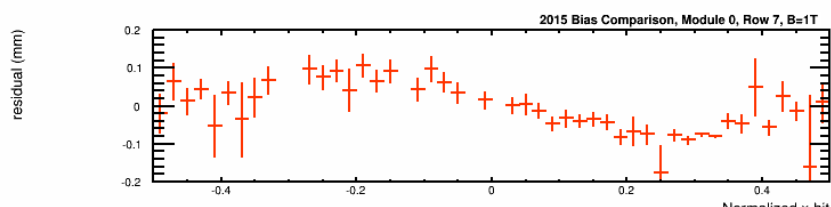
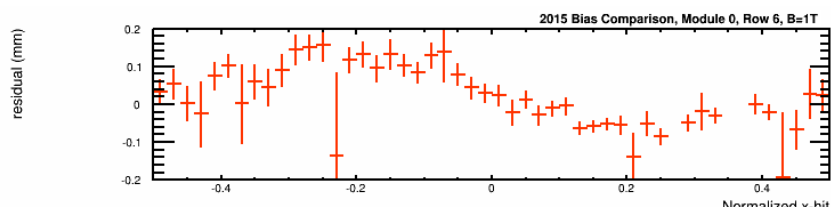
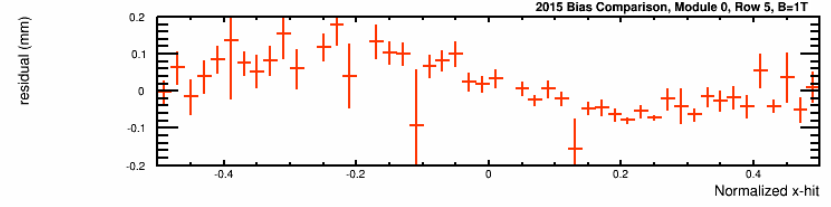
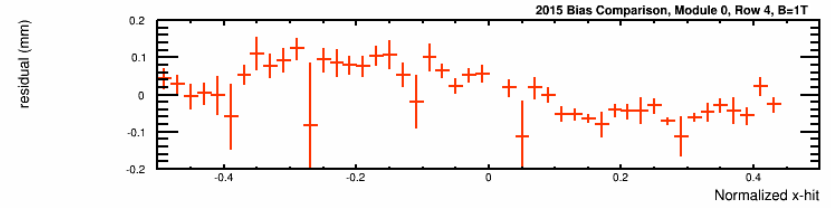
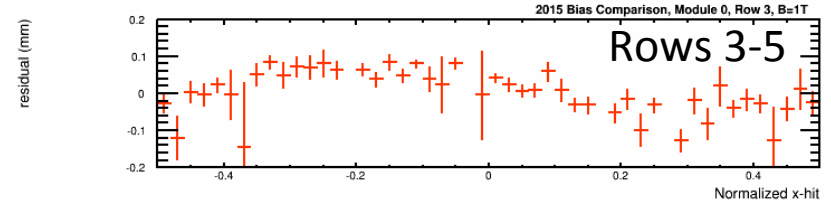
Helix Fitter

Rows 3-5



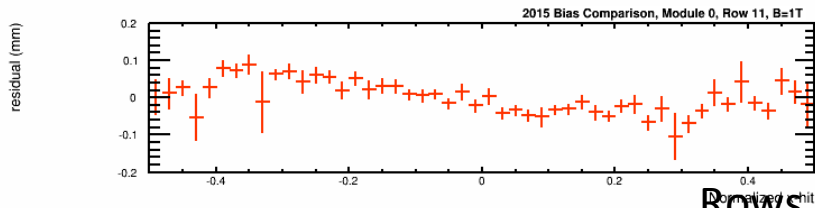
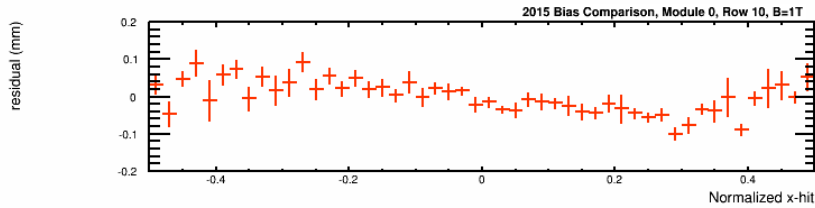
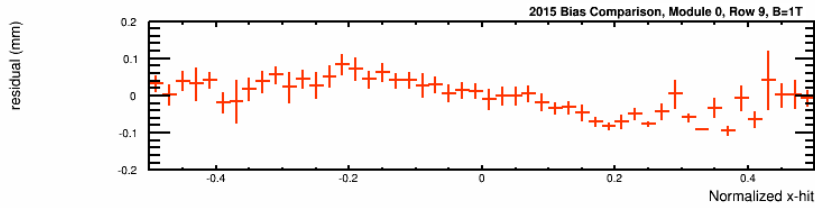
Rows 6-8

Kalman Fitter

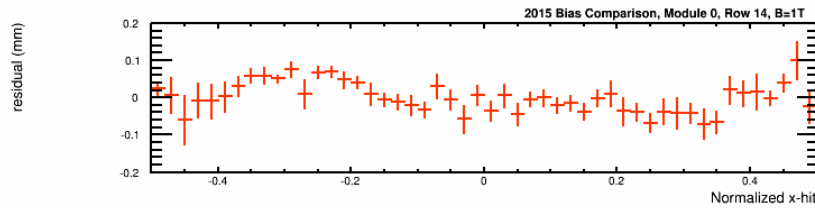
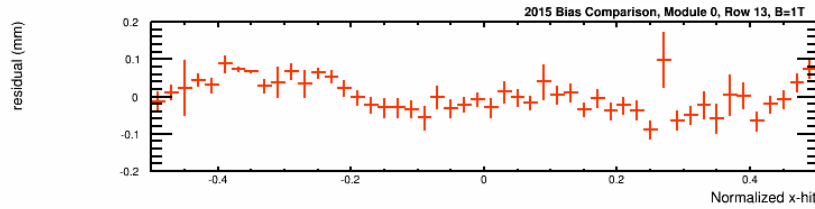
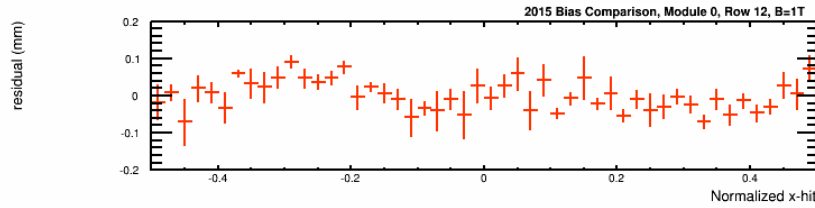


Helix Fitter

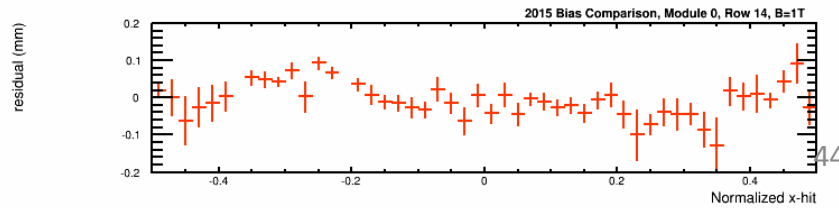
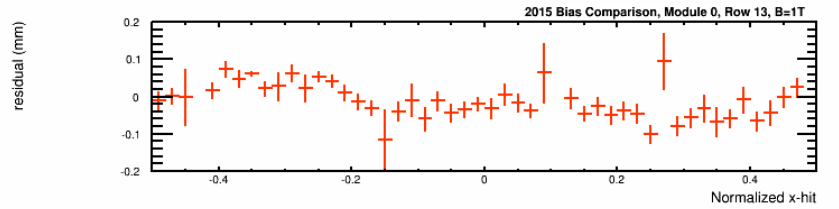
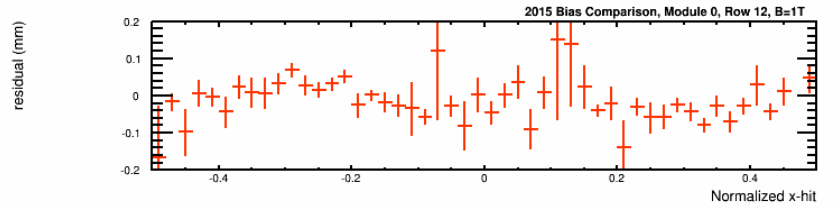
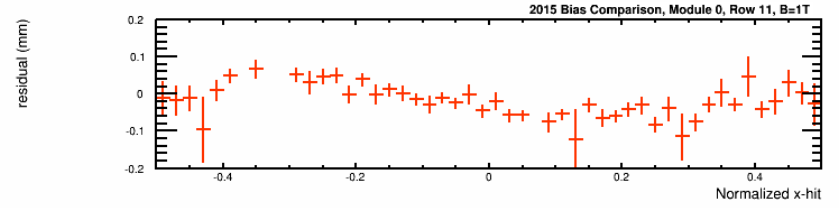
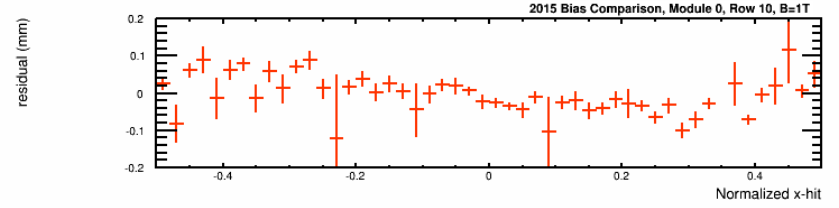
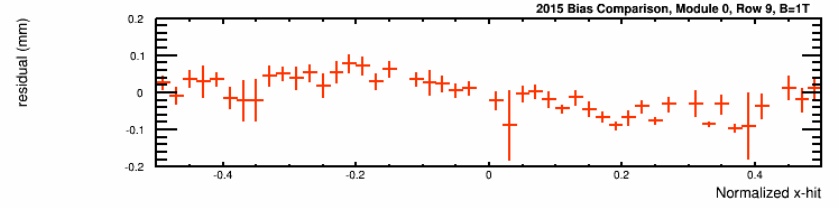
Rows 9-11



Rows 12-14

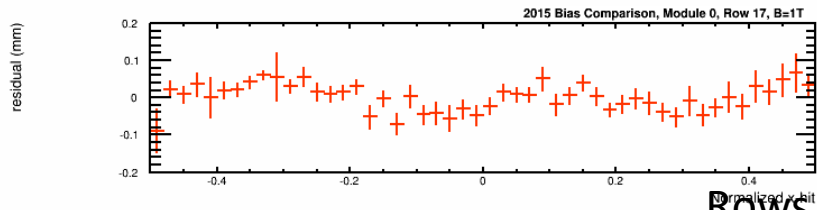
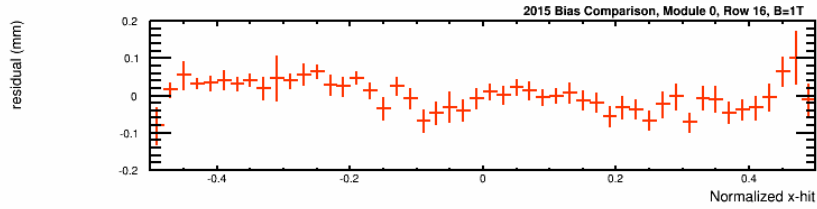
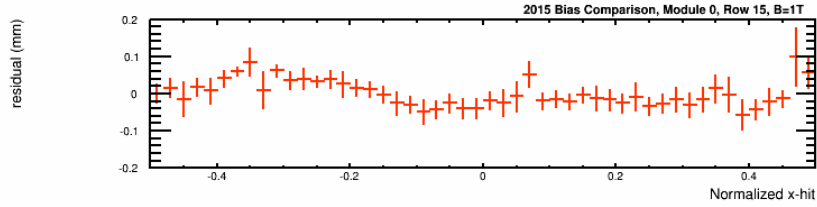


Kalman Fitter

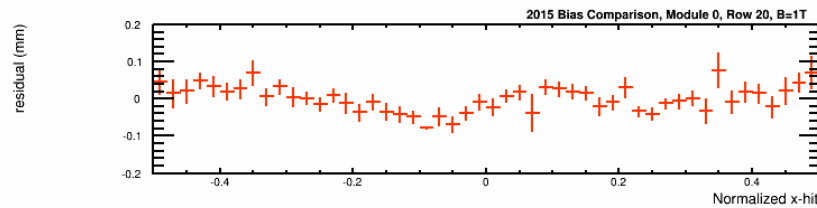
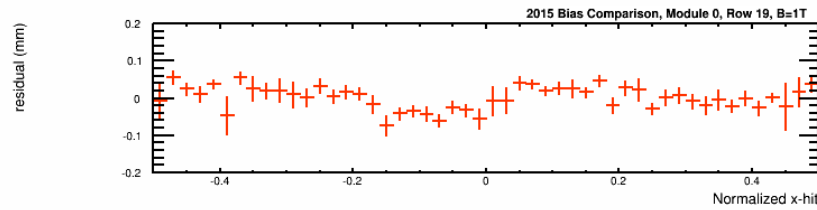
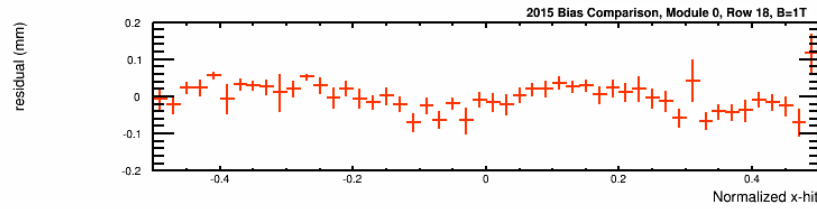


Helix Fitter

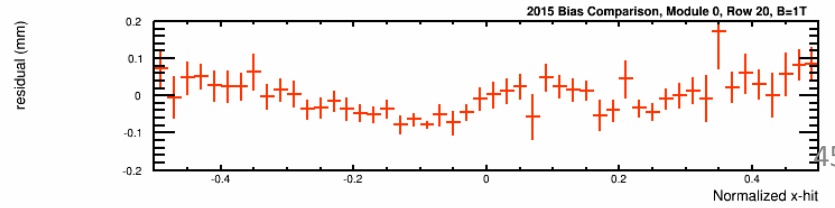
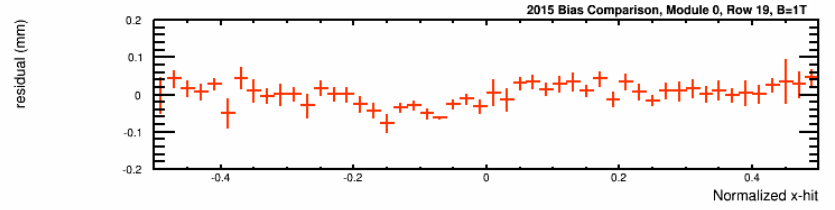
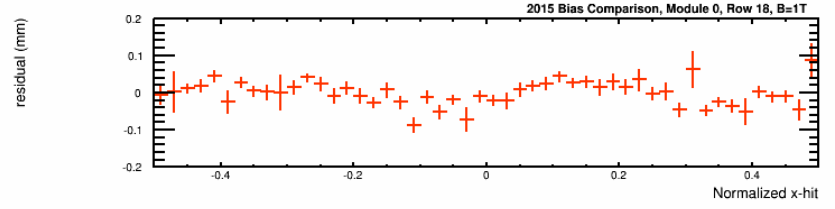
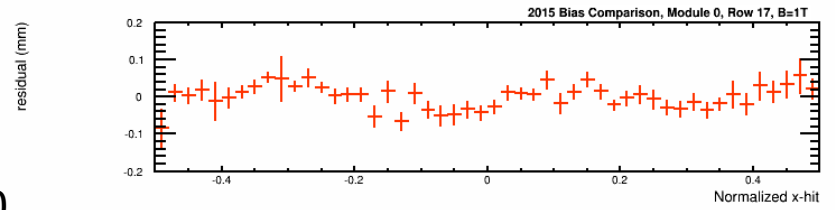
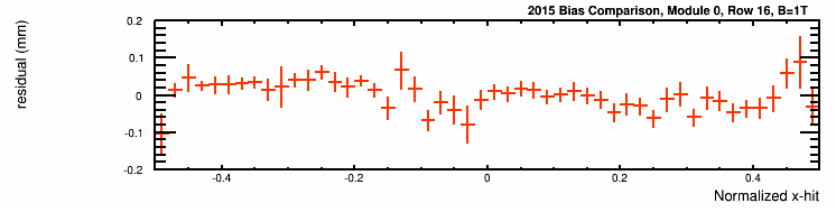
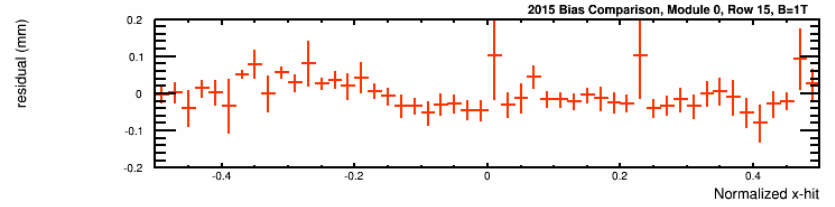
Rows 15-17



Rows 18-20

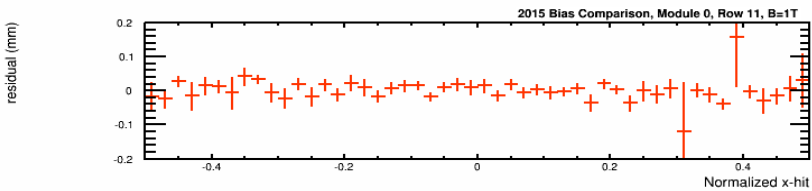
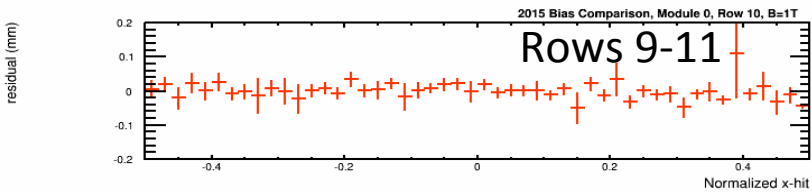
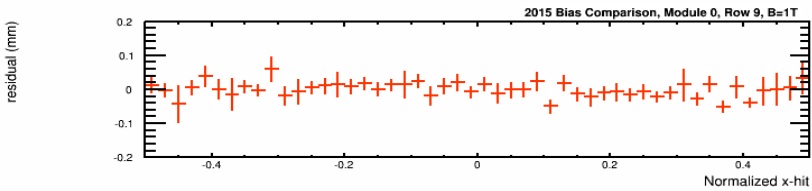
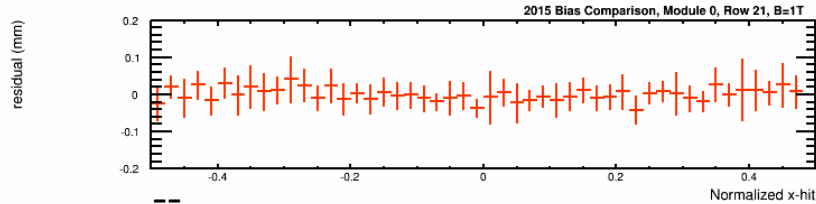


Kalman Fitter

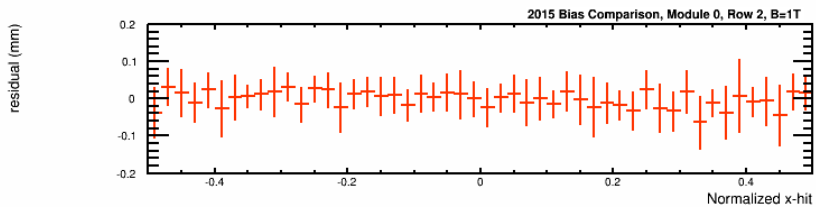


After Bias corrections applied

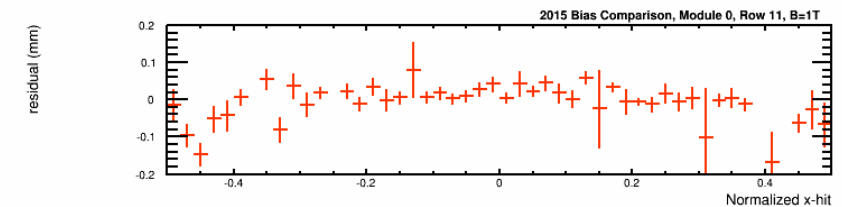
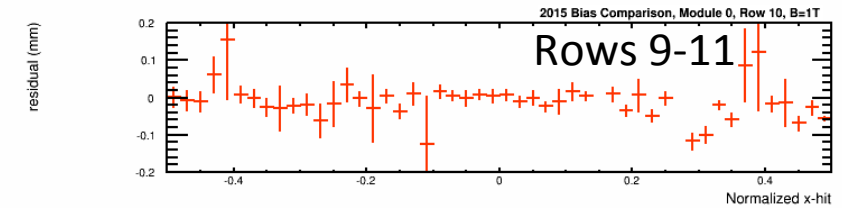
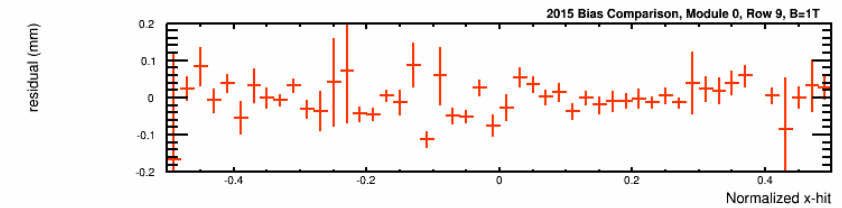
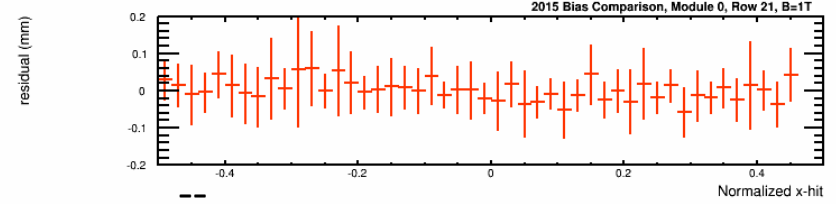
Row 21



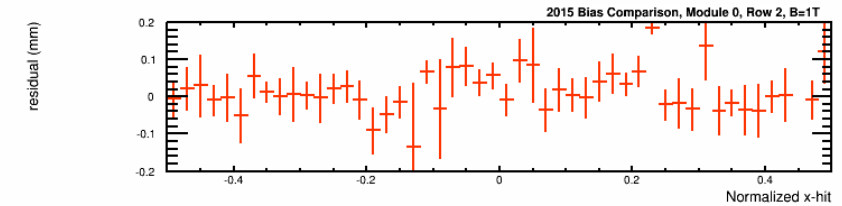
Row 2



Row 21

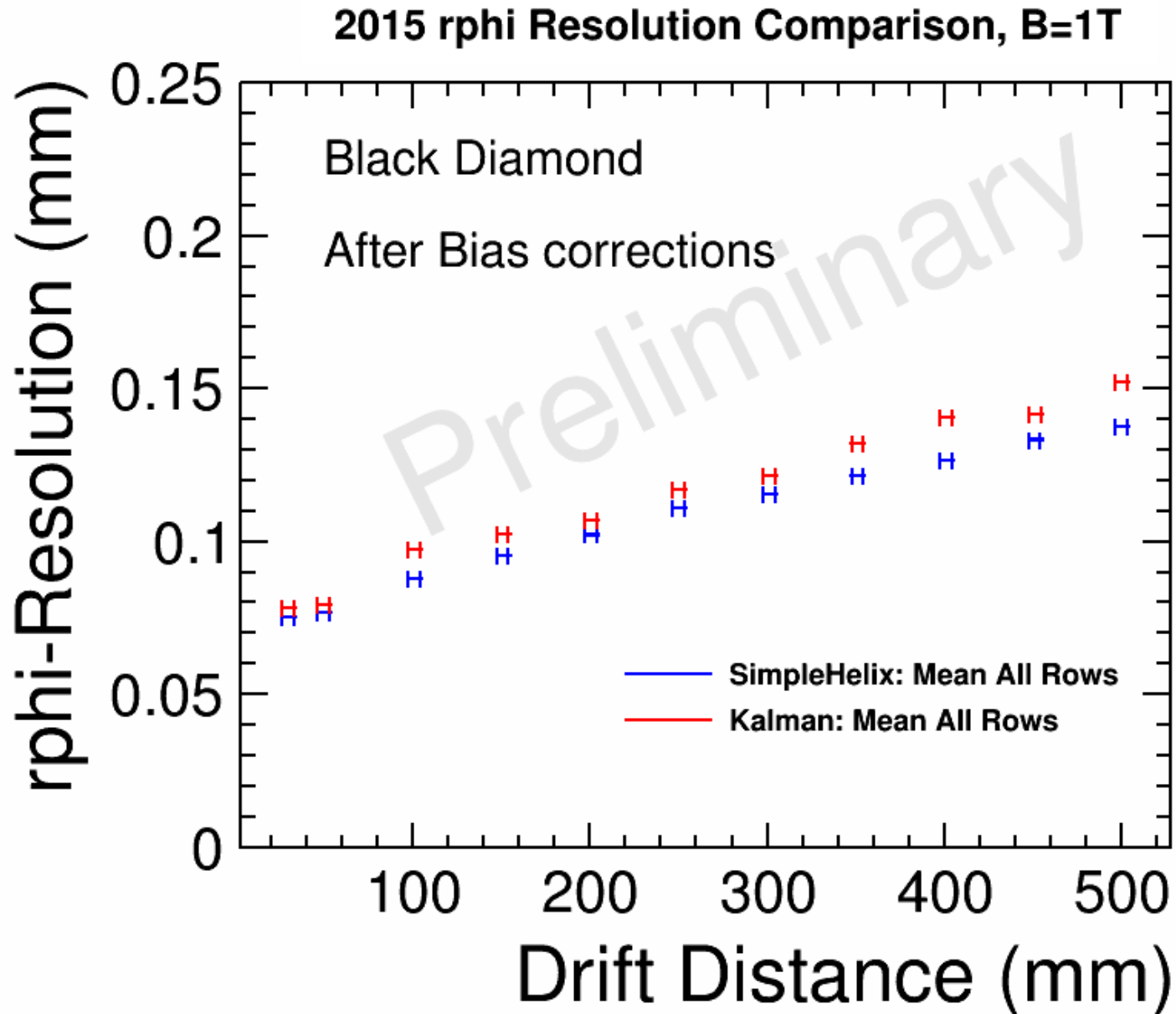


Row 2



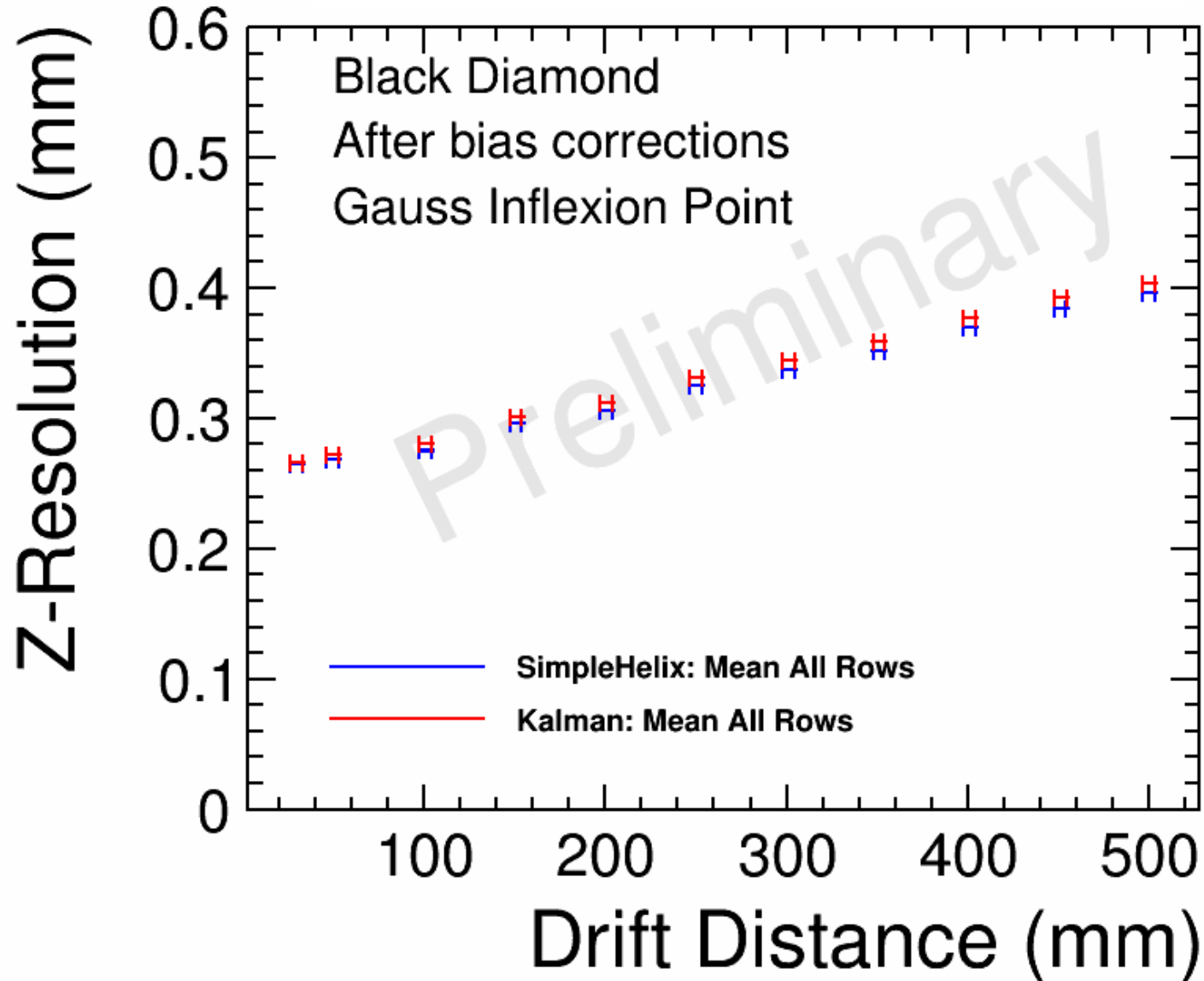
After bias corrections, Helix residuals look like more “contained” than after Kalman fitter.

Transverse Resolution comparison



Z resolution comparison

2015 Z-Resolution Comparison, B=1T



Summary

- Many check have been performed to see whether the recent resolution performance could be significantly degraded.
- In my opinion the obtained results are essentially stable.
- Now I will move to the “summary” plots, in next talk.