

MM Z resolution determination

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Outline

- Pulse shapes
- Fit to the pulse shape
- Z-residuals in MM
- Z-resolution results

MM pulses shapes

100 ns shaping time.

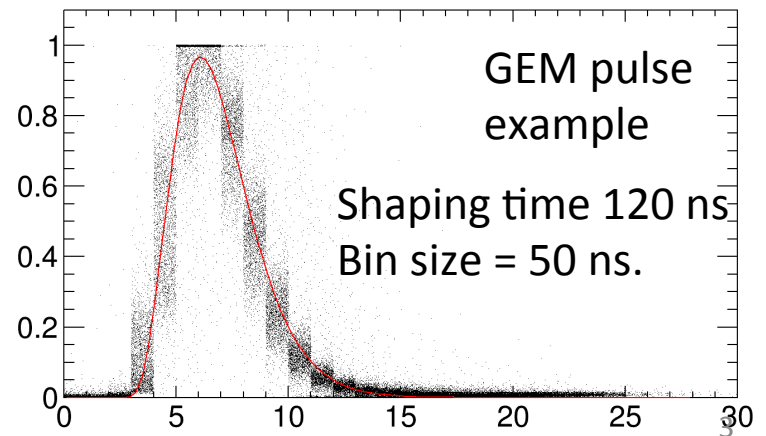
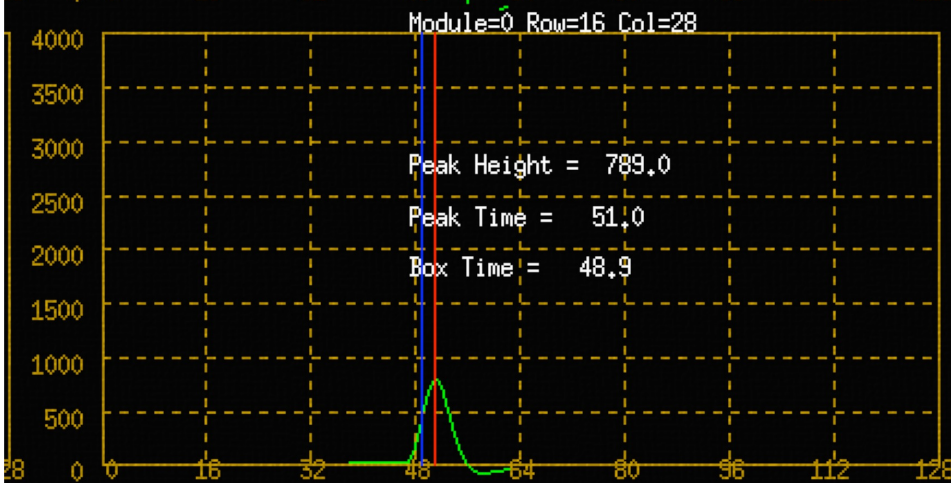
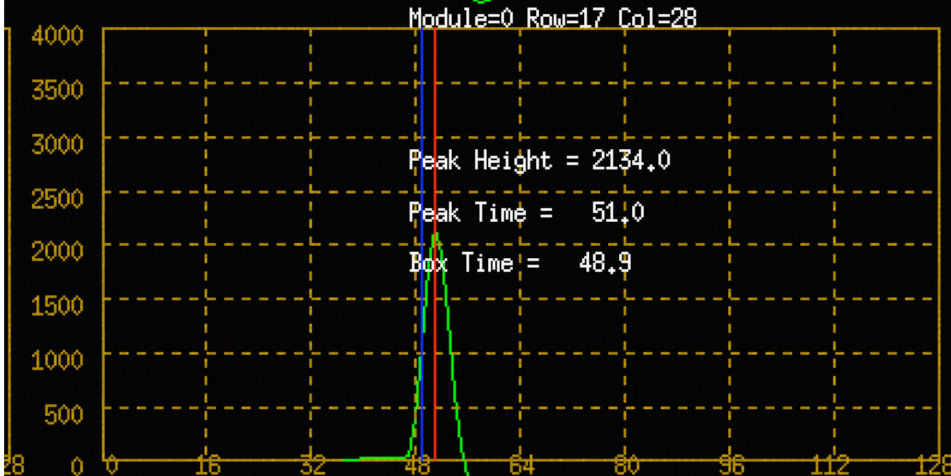
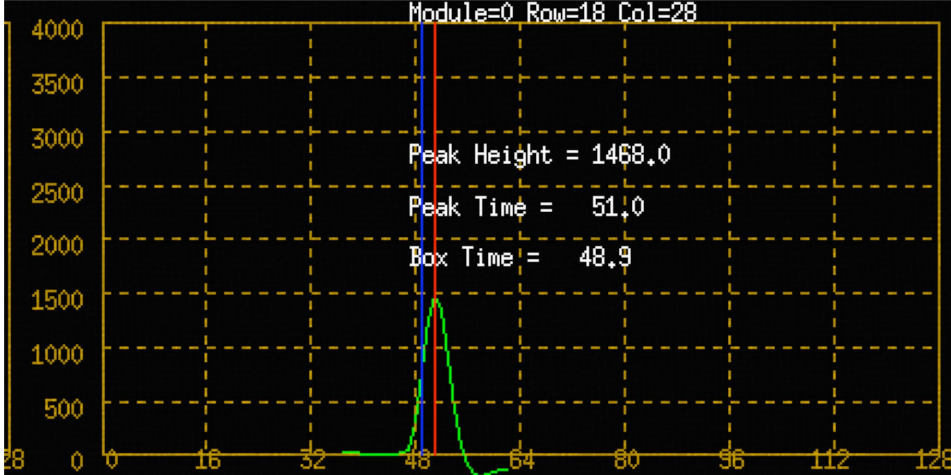
Drift distance = 10 cm.

This is typical pulse shape in **BD**, Run 5119 (Rows 16-18). Max Bin = 51, .

Only central pads, used in time estimation, are shown.

There are at least 5-6 time bins on the rising edge. (AFTER Bin size = 40 ns).

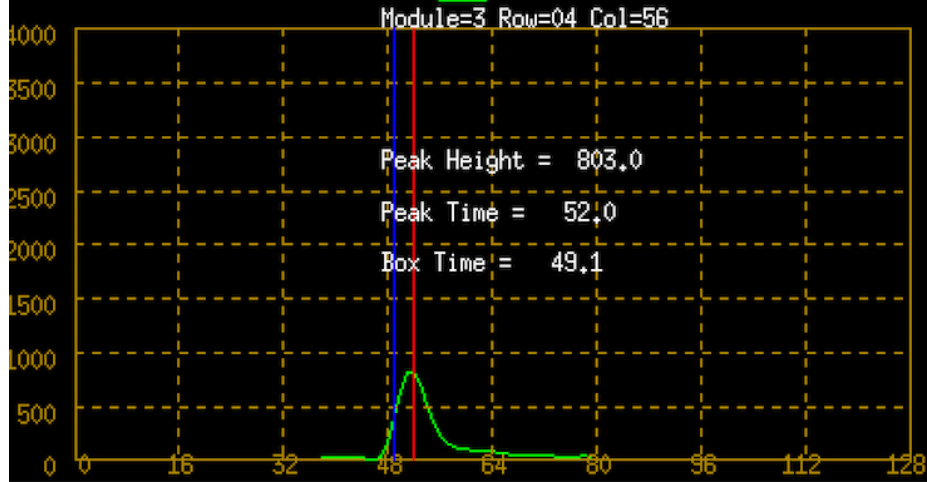
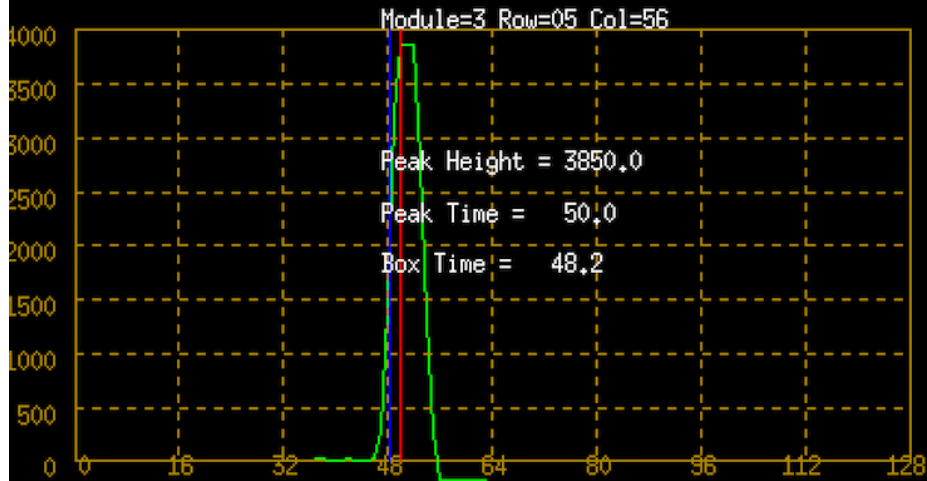
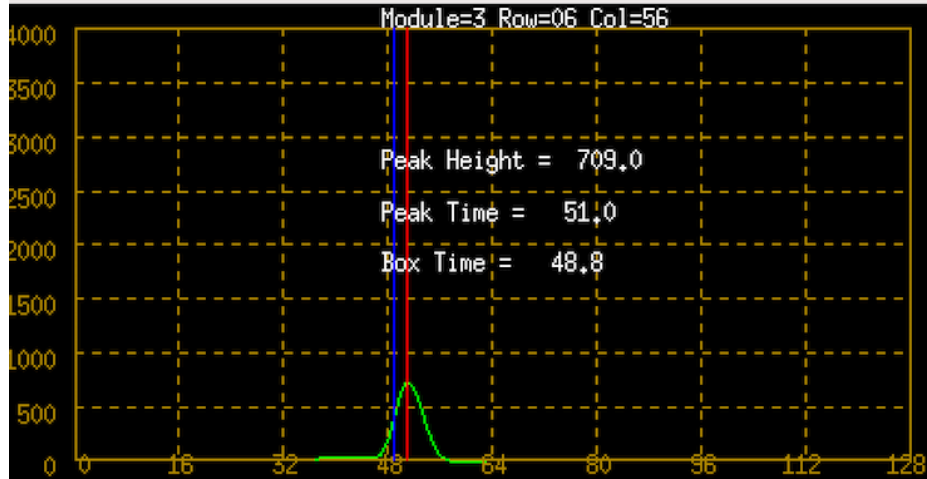
But, for better time estimation, the fit, if any, should start from the baseline.



MM Pulse in CLK

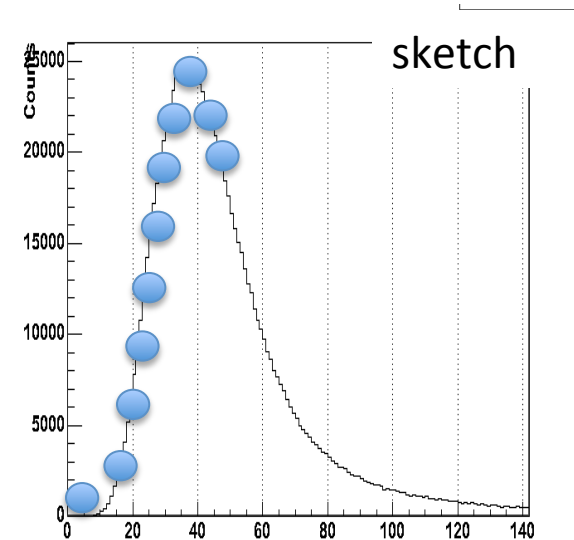
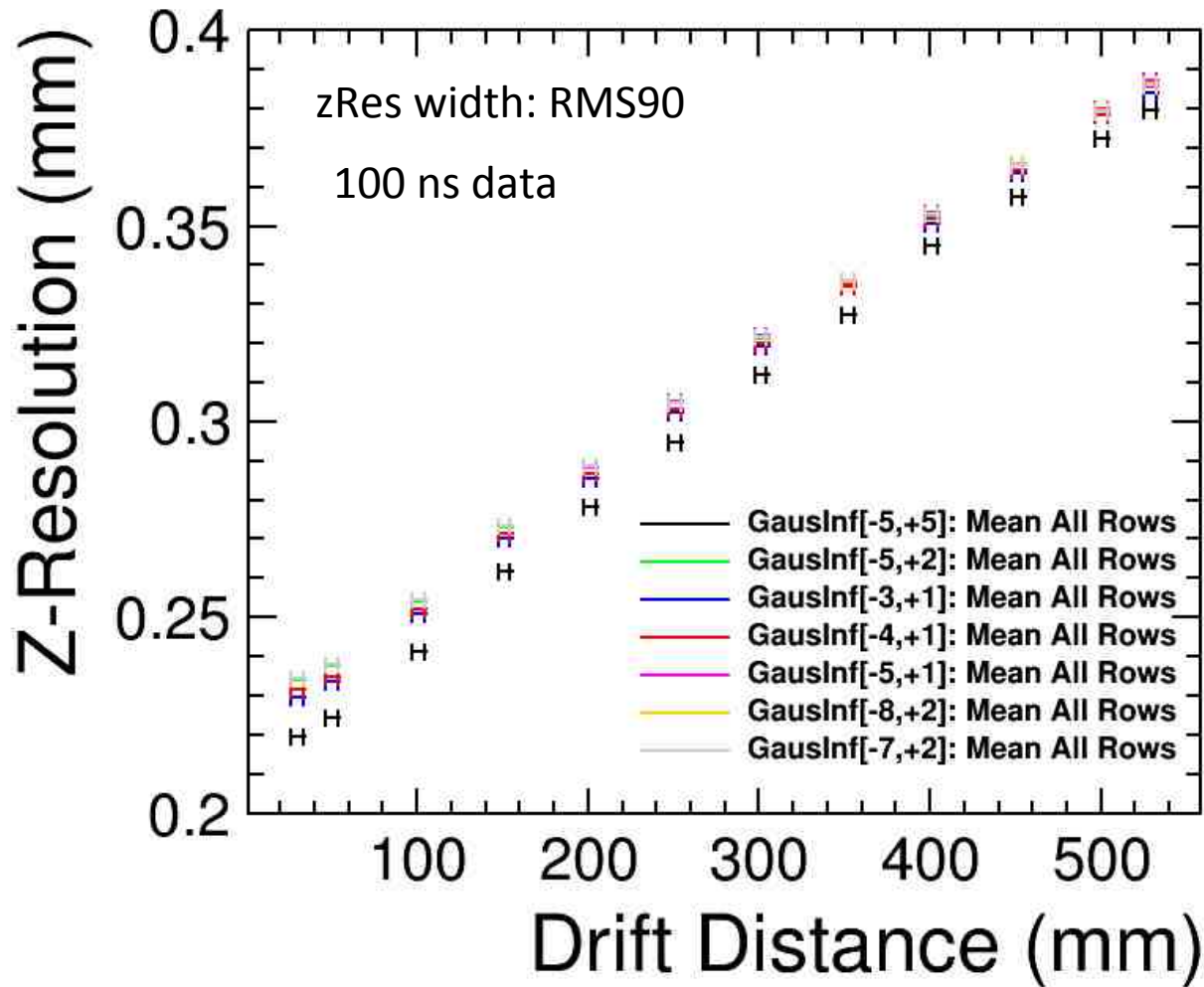
The same track as in the previous page.

Max bin has more height due to less charge dispersion in Capton modules.
(in comparison to BD).



Gaussian Fit range choices

2015 Z-Resolution, B=1T

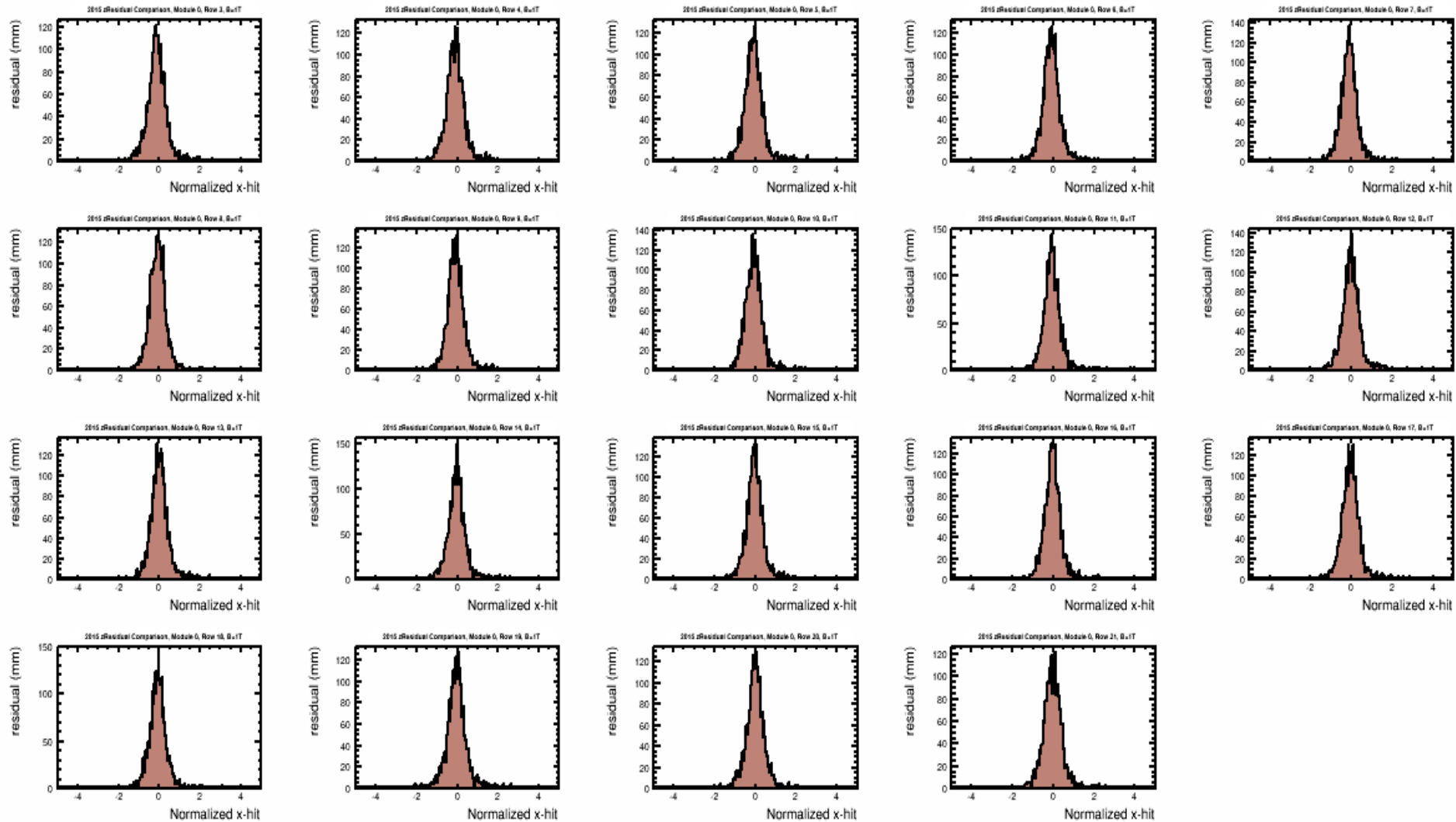


Valuable time information is available only from the rising edge and few bins after the maximum. Note, there at least 2 points firmly on the baseline.

There is not much difference between a number of choices, that's a good sign of credibility of the method. [-7,2] or [-8,2] – are suitable/better options.

Z-Residuals Row by Row, MM, Inflexion

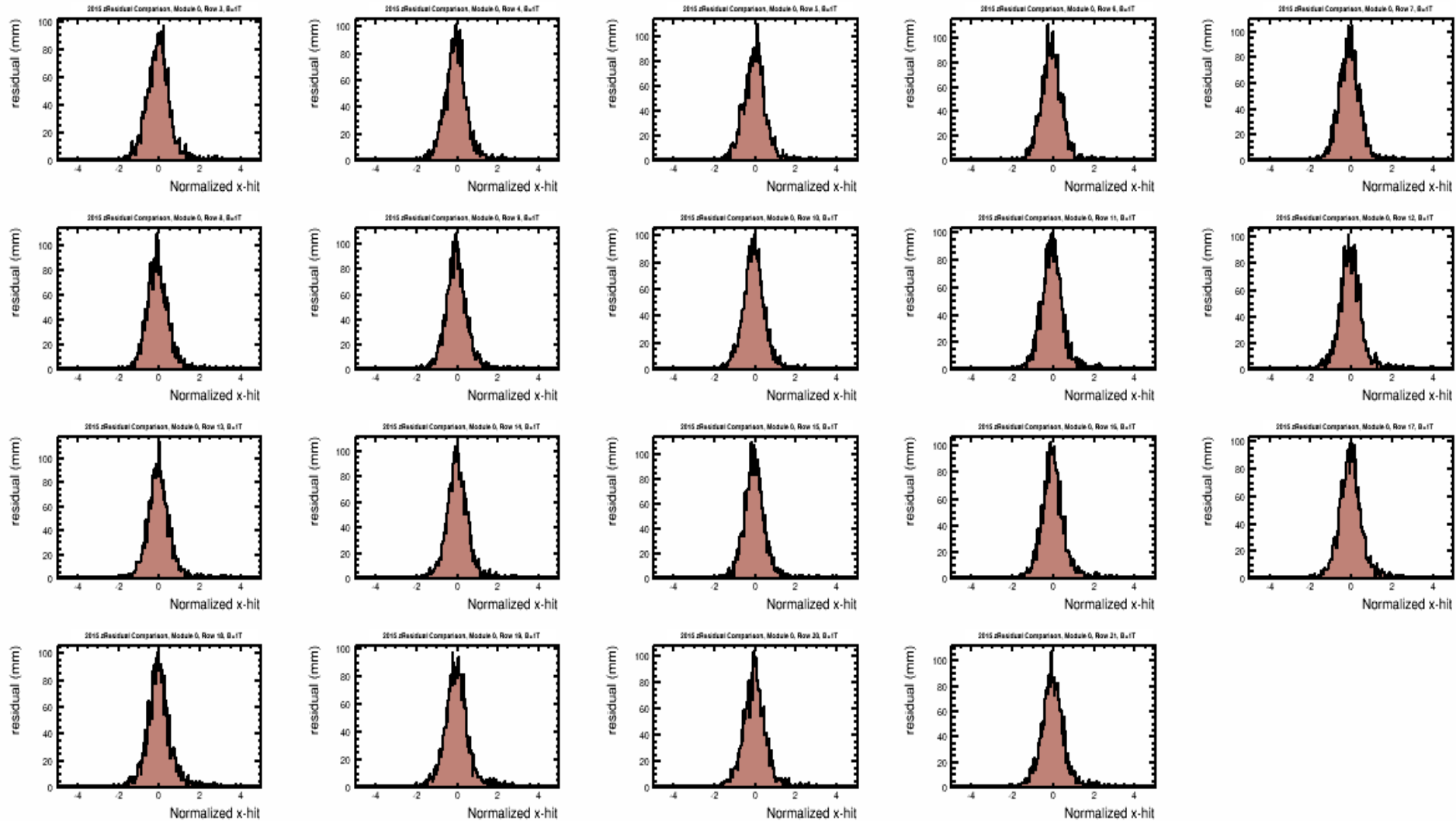
2015 **BD** module, **short** drift, after Distortion corrections



MM Z-residuals **before** corrections are in the **backup** section also with GEM z-residuals.

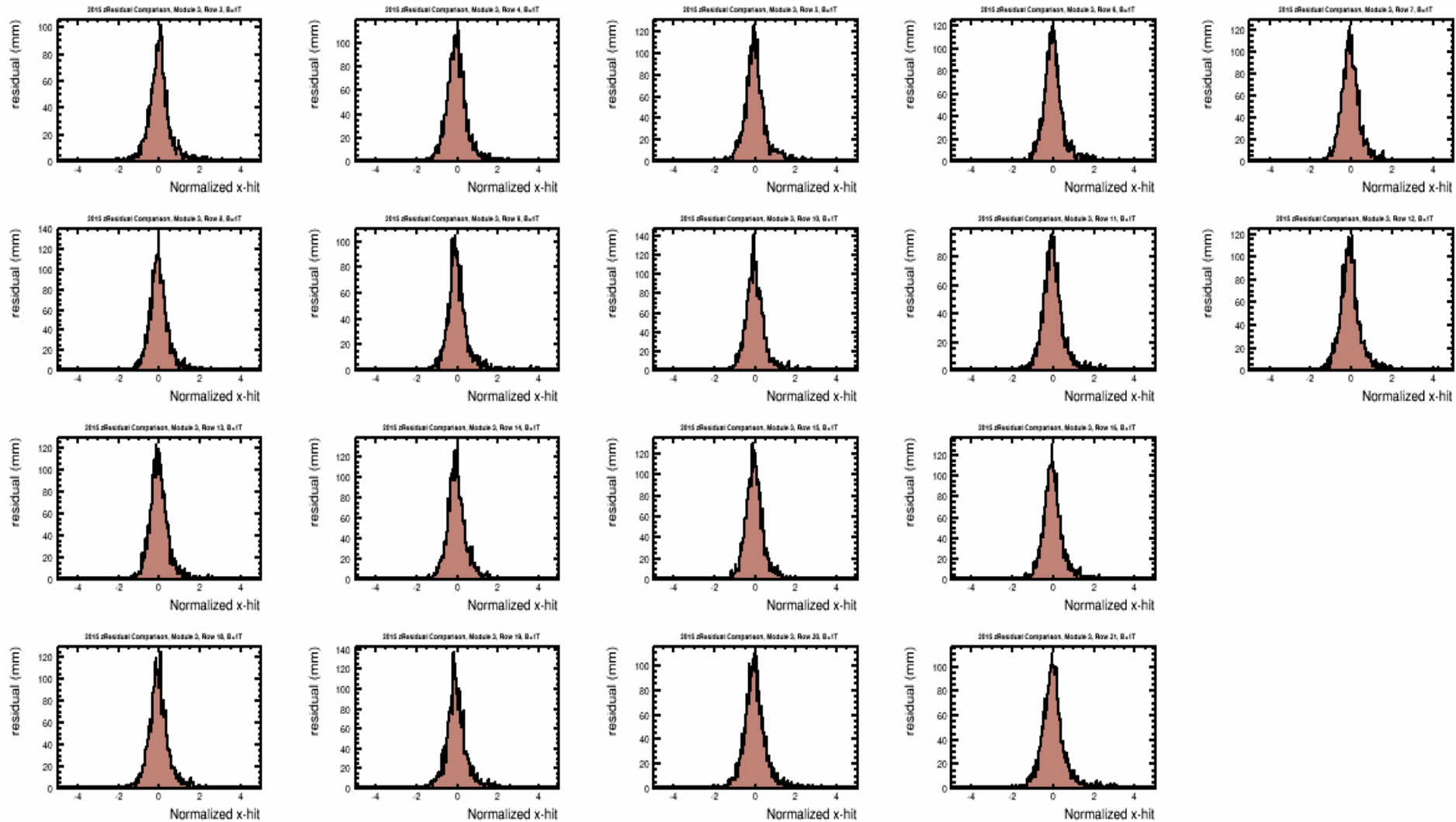
Z-Residuals Row by Row, MM, Inflexion

2015 **BD** module, **long** drift, after distortion corrections



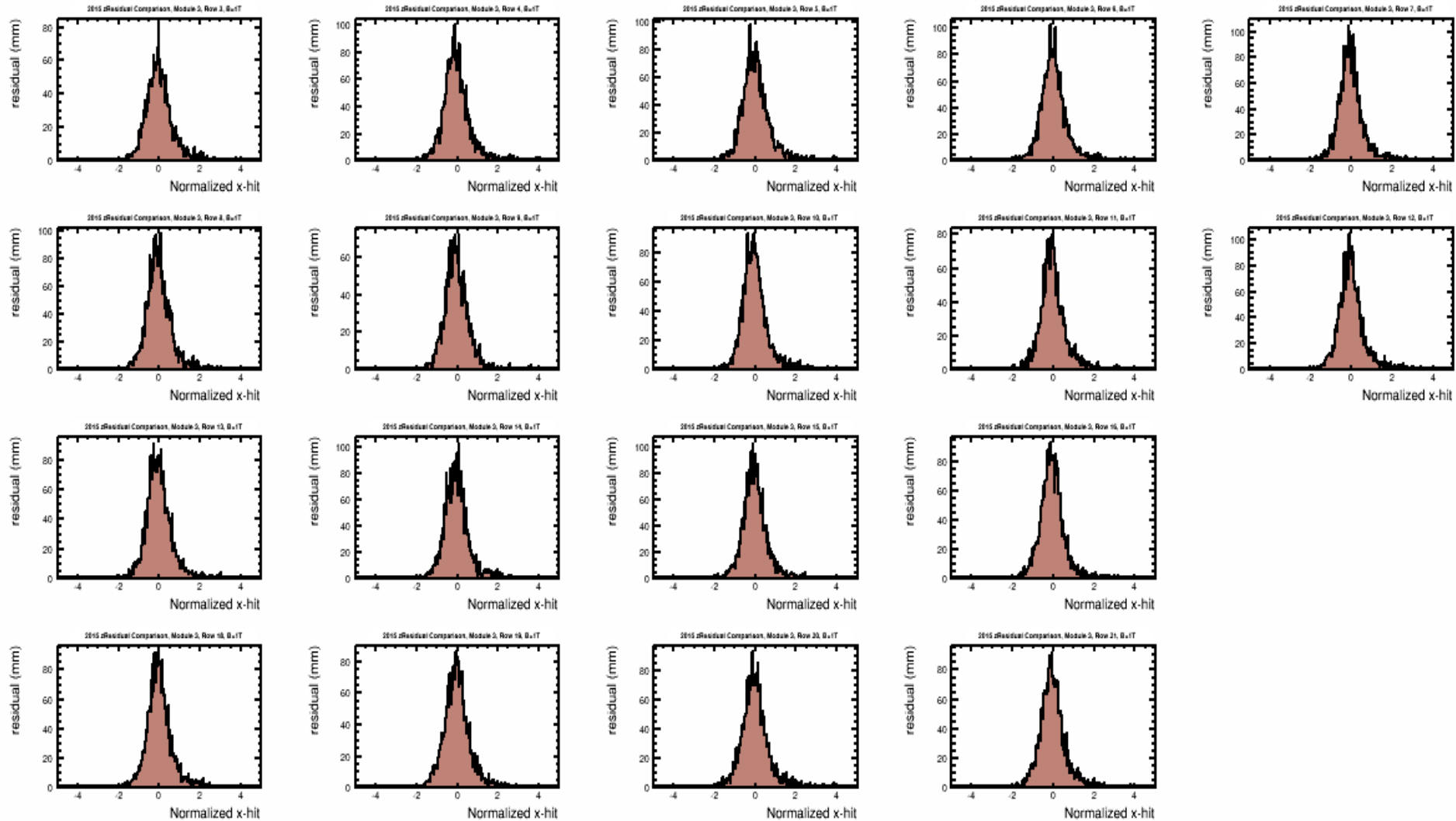
Z-Residuals Row by Row, MM, Inflexion

2015 CLK module, short drift, after distortion corrections



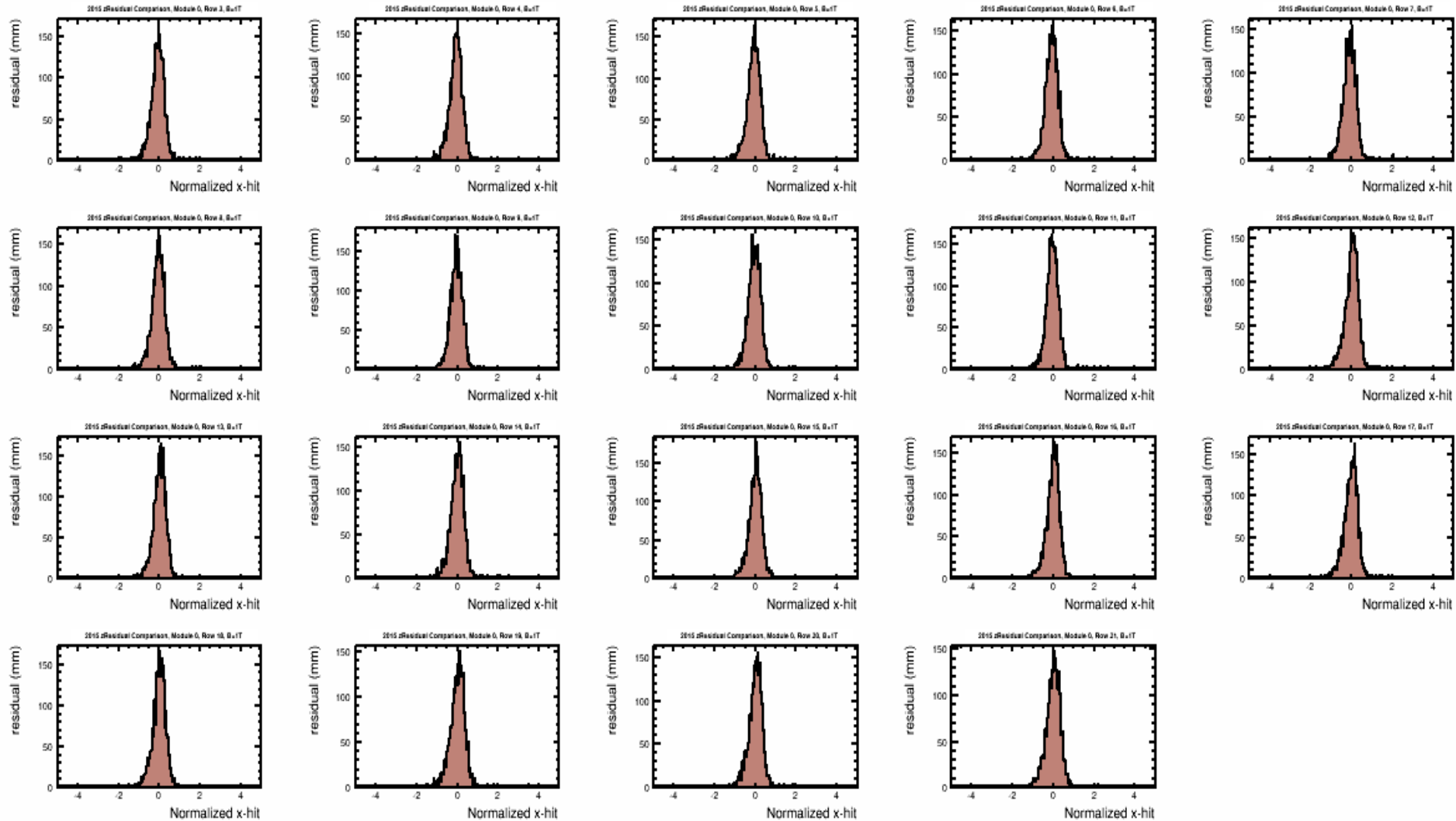
Z-Residuals Row by Row, MM, Inflexion

2015 CLK module, long drift, after distortion corrections



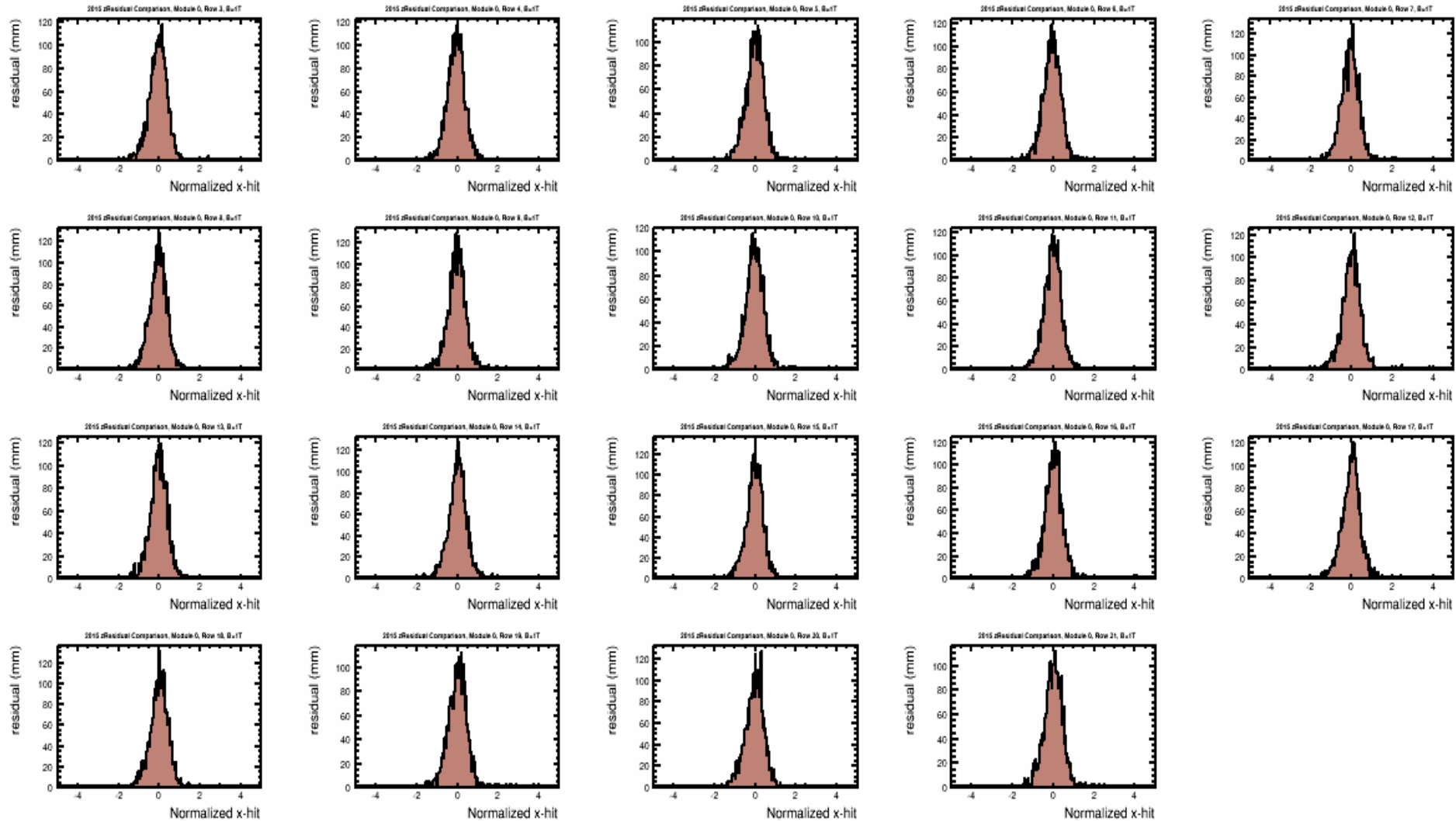
Z-Residuals Row by Row, MM, Gaus. Inflexion

2015 **BD** module, **short** drift, after Distortion corrections.



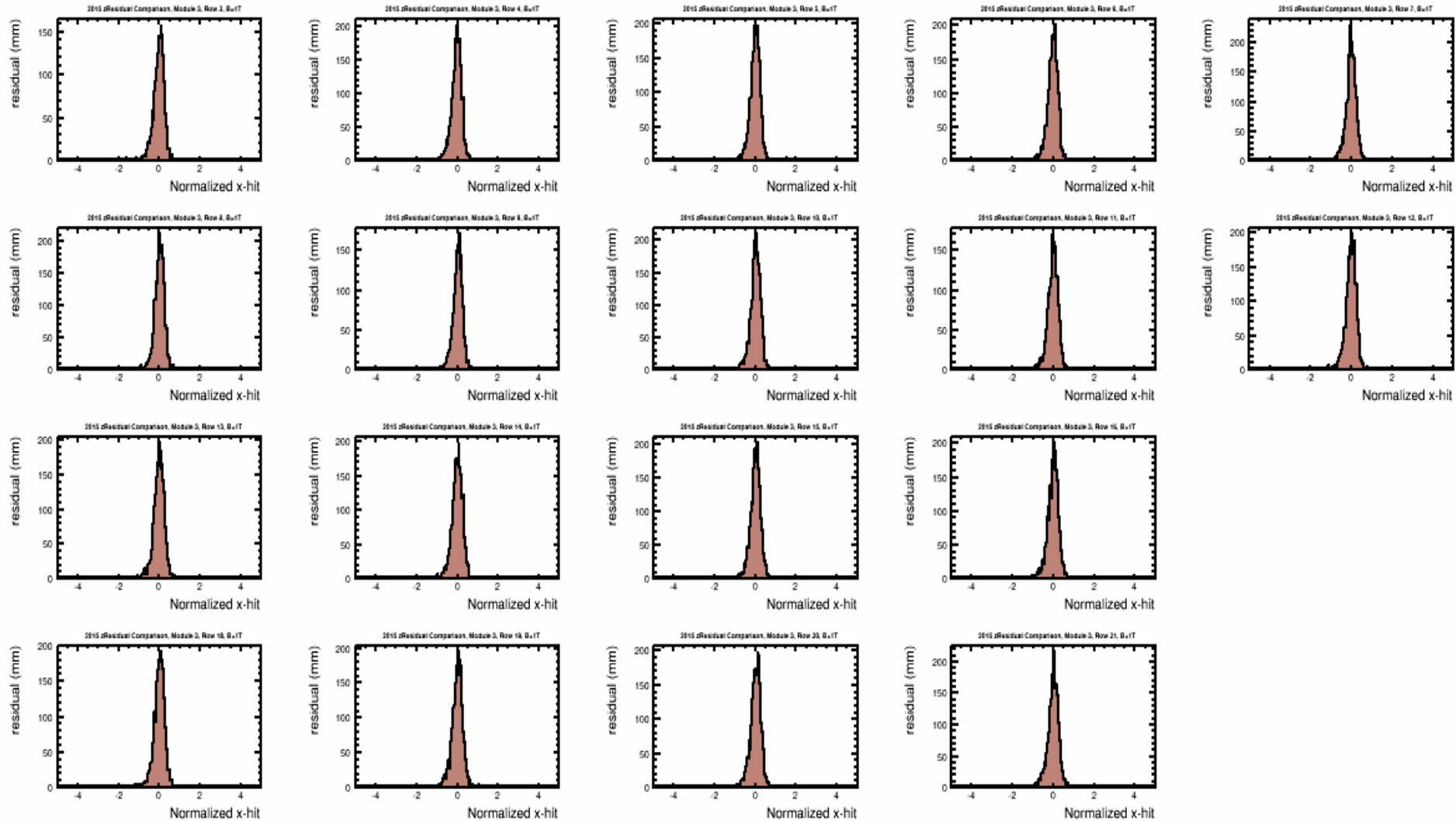
Z-Residuals Row by Row, MM, Gaus. Inflexion

2015 **BD** module, **long** drift, after Distortion corrections.



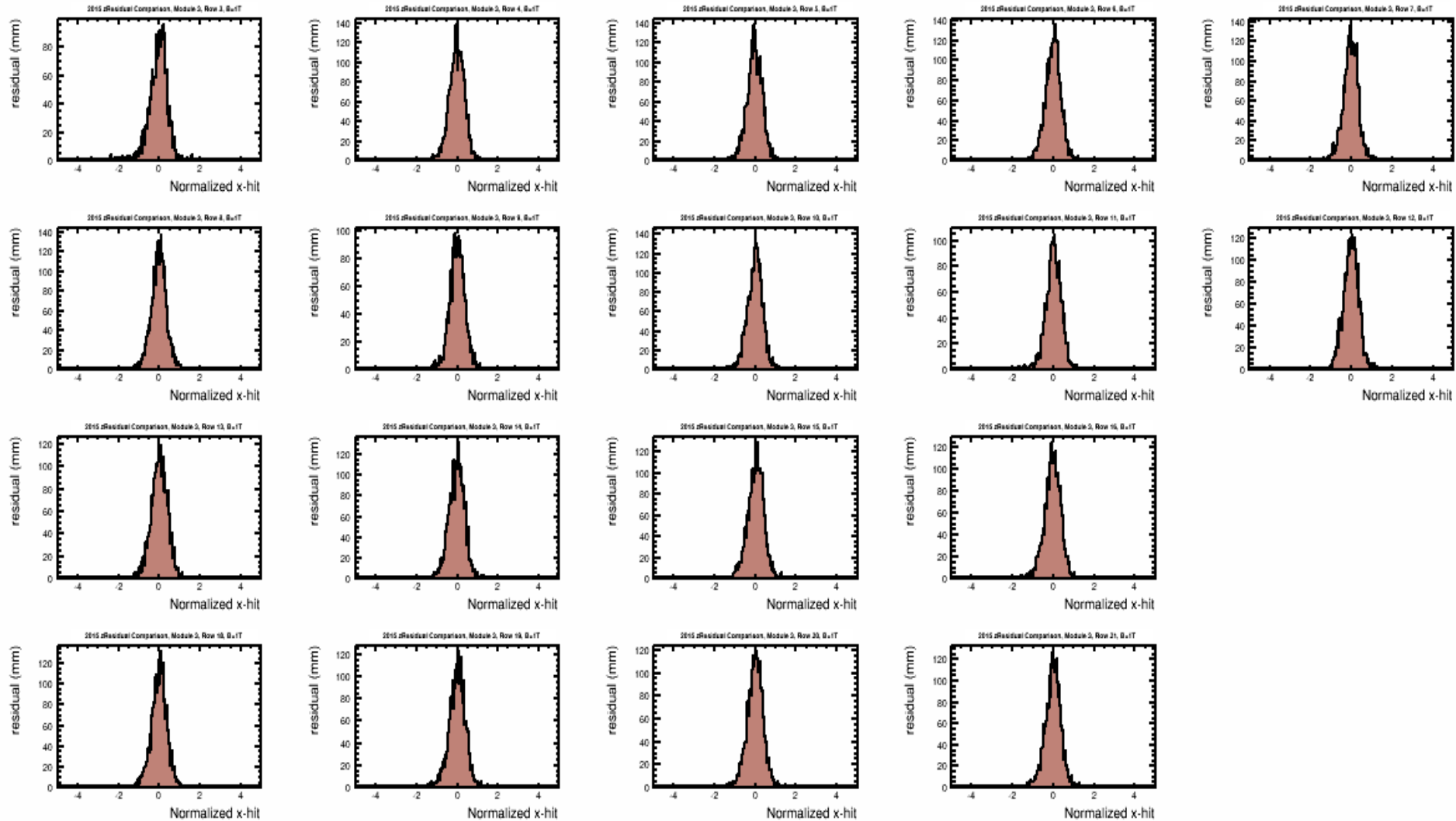
Z-Residuals Row by Row, MM, Gaus. Inflexion

2015 CLK module, short drift, after Distortion corrections.



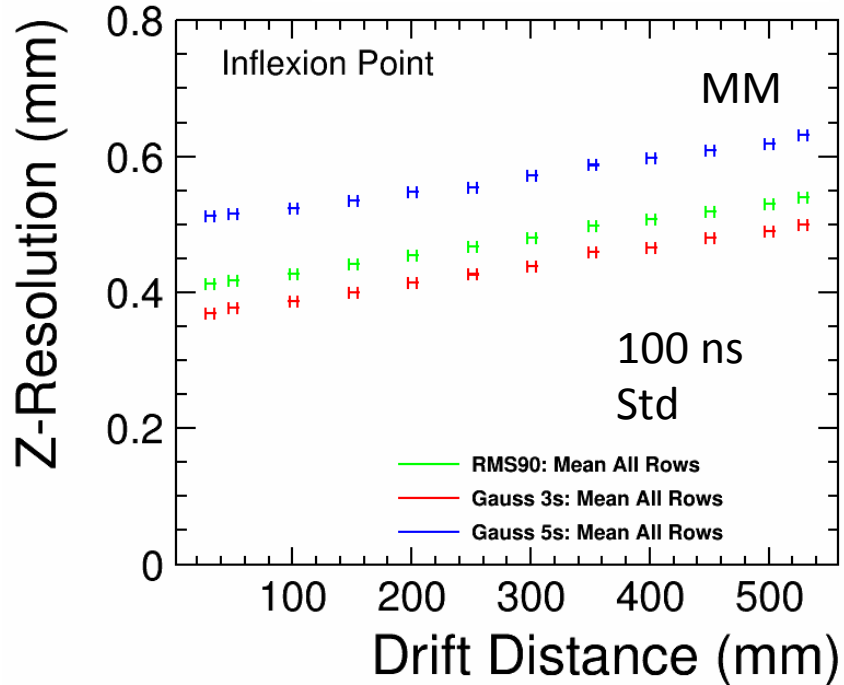
Z-Residuals Row by Row, MM, Gaus. Inflexion

2015 CLK module, long drift, after Distortion corrections.

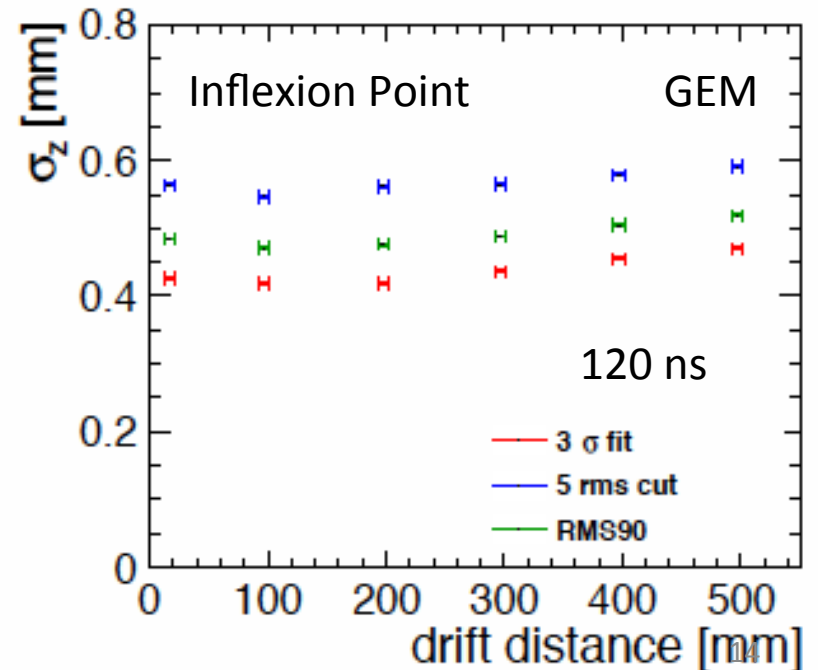


Numerical Inflexion Method

2015 Z-Resolution, B=1T

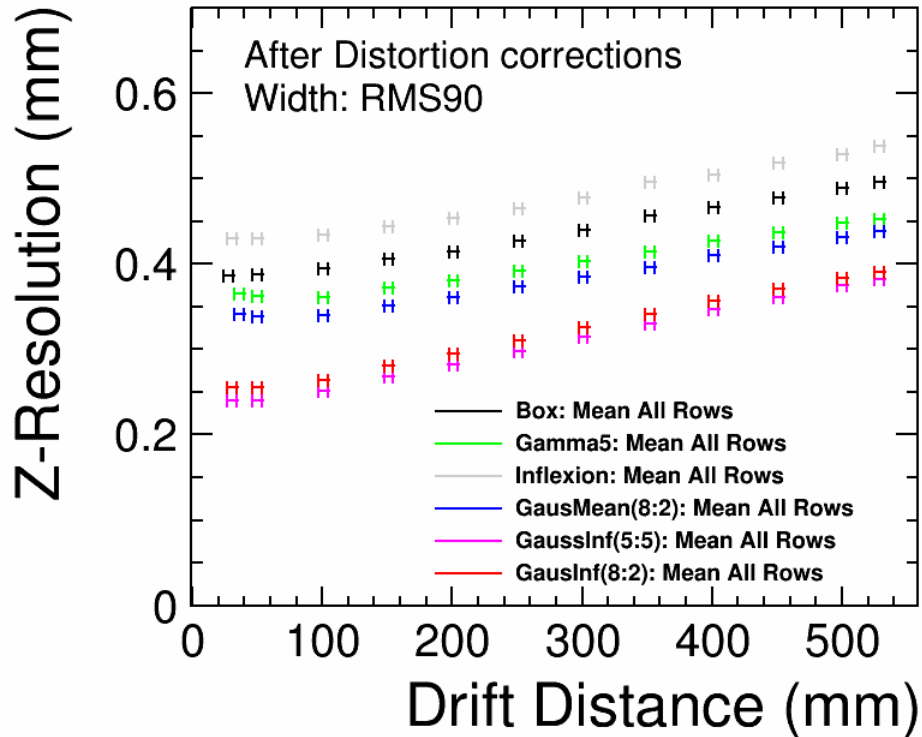


Smaller difference between RMS90 and 3sigma Gaussian in MM case.

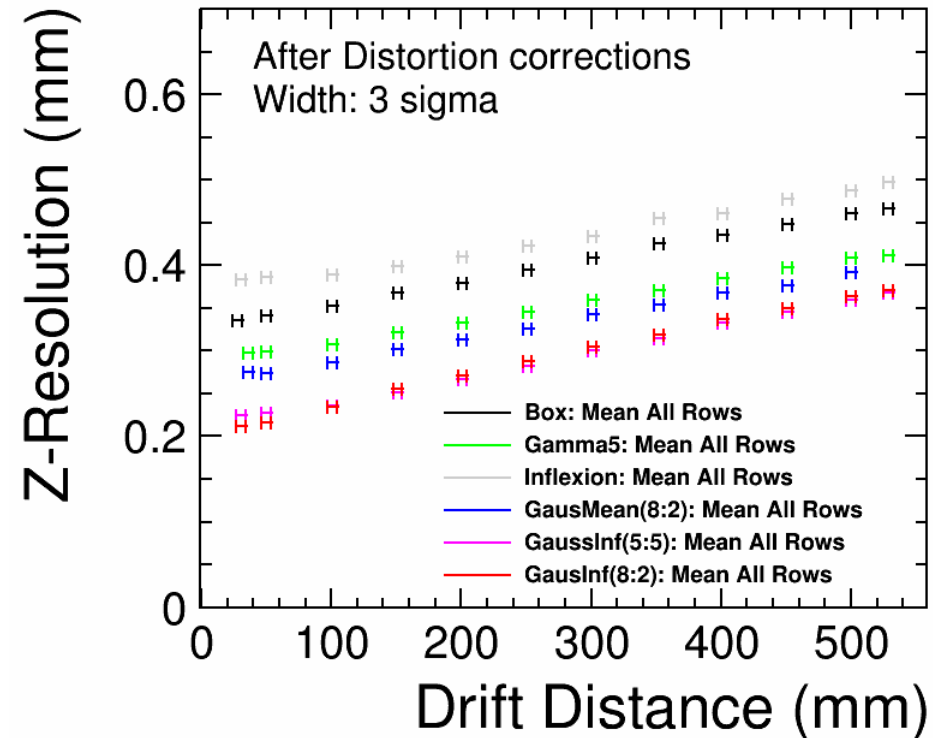


MM Z resolution comparison

2015 Z-Resolution, B=1T



2015 Z-Resolution, B=1T



3 sigma width estimation provides better Z-resolution results in MM.
Note that for MM case, z-residuals can be reliably fitted with Gaussian.
Gaussian Inflexion point seems to be also best for Z-resolution determination.

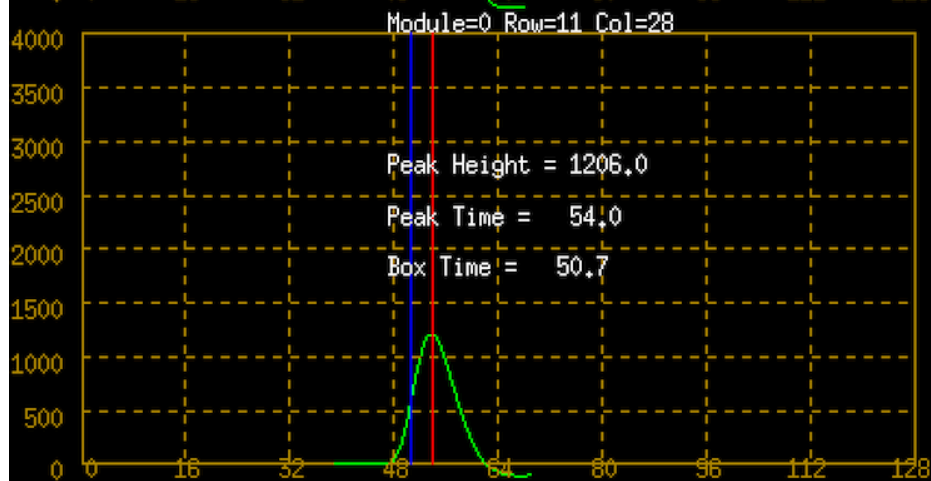
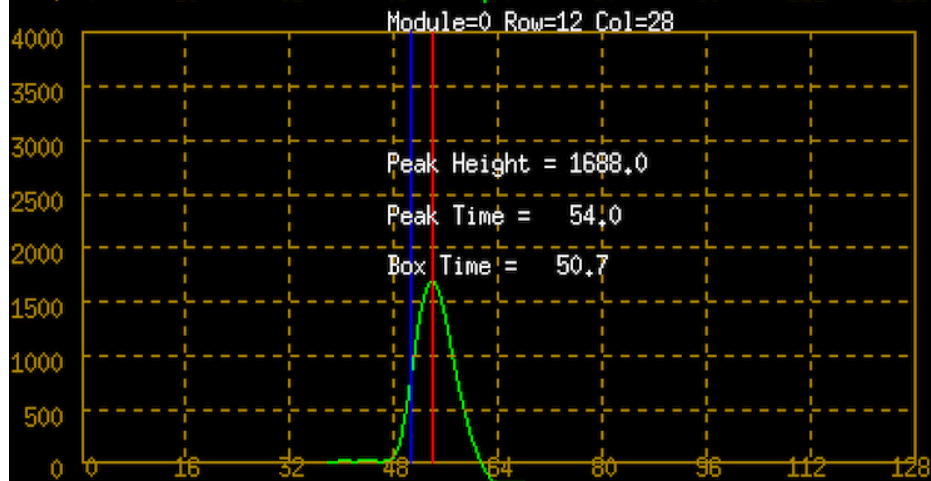
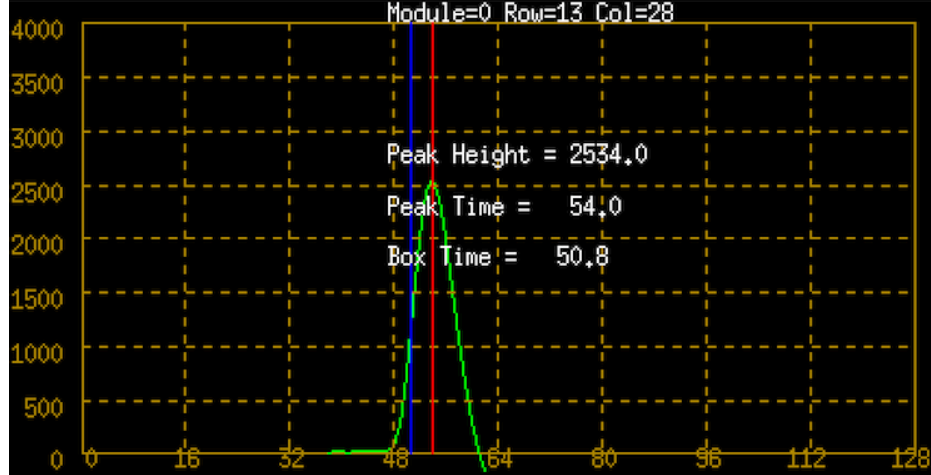
Summary

- MM Z-resolution determination is based on the pulse shape fitted with Gaussian within $[-8:+2]$ bins range around the max bin.
- Z-residuals width estimation is best with 3-sigma Gaussian fit. RMS90 method is not very different from 3-sigma for MM case.
- Best Z-resolution performance is achieved with Gaussian Inflection point time estimation method.

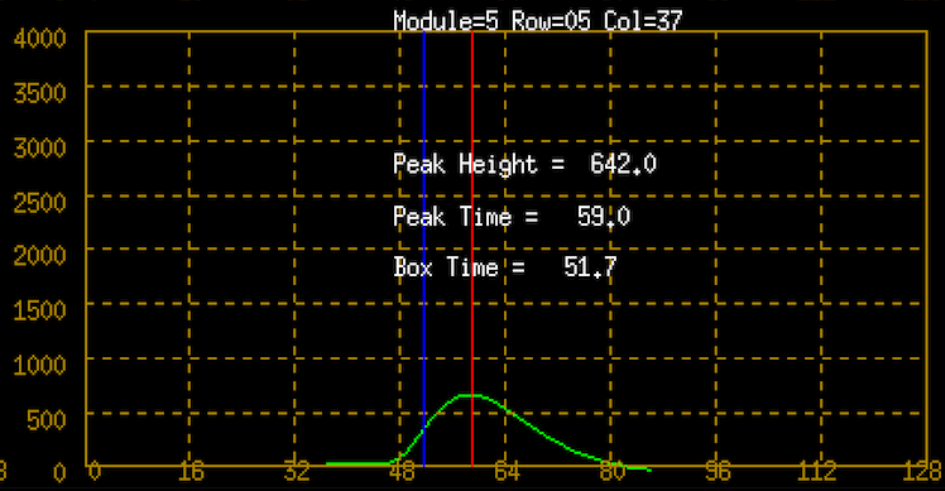
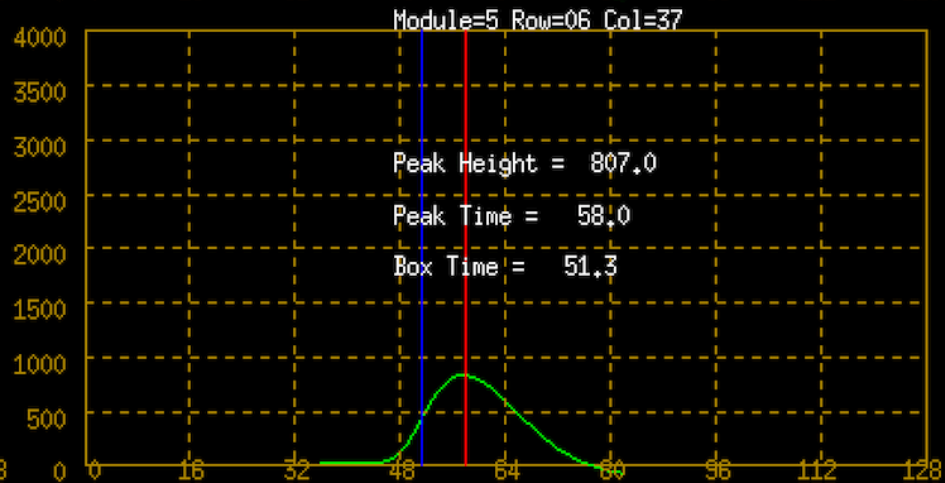
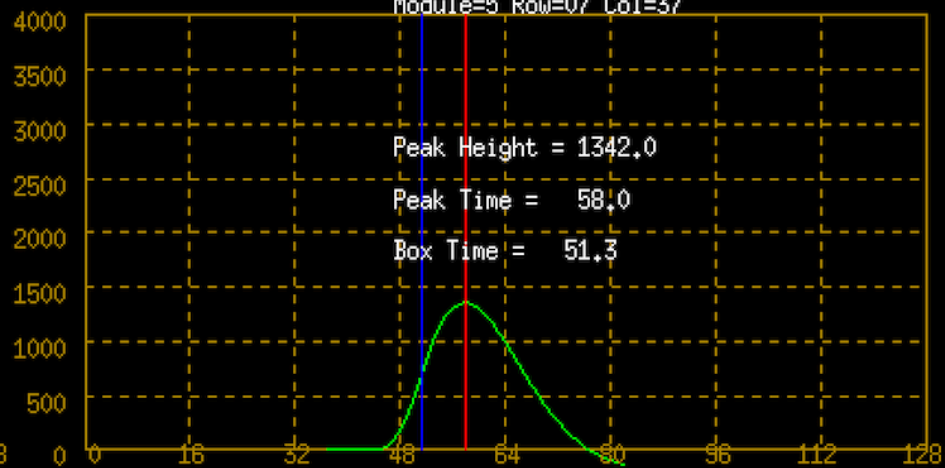
BACK UP

BD Pulse 200 ns

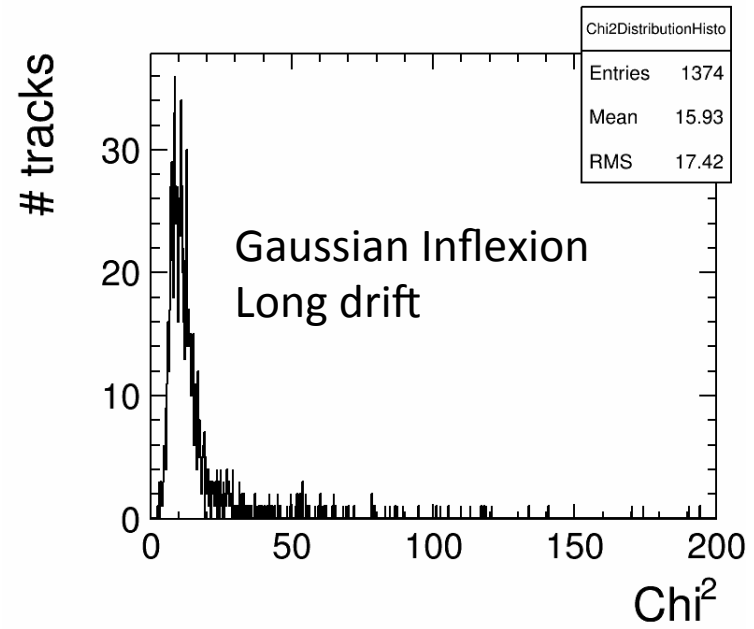
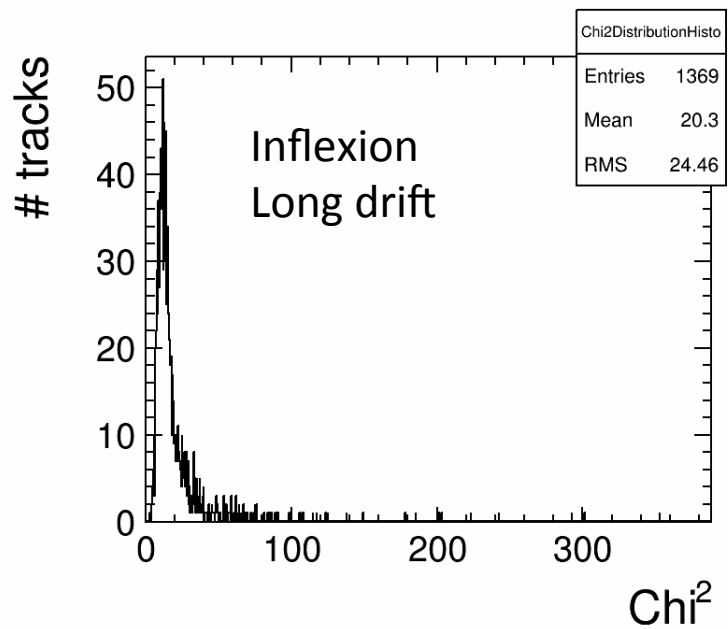
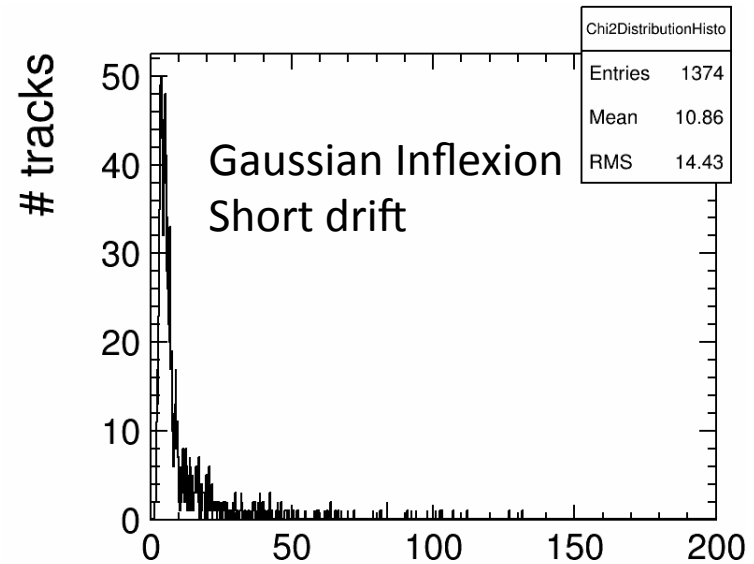
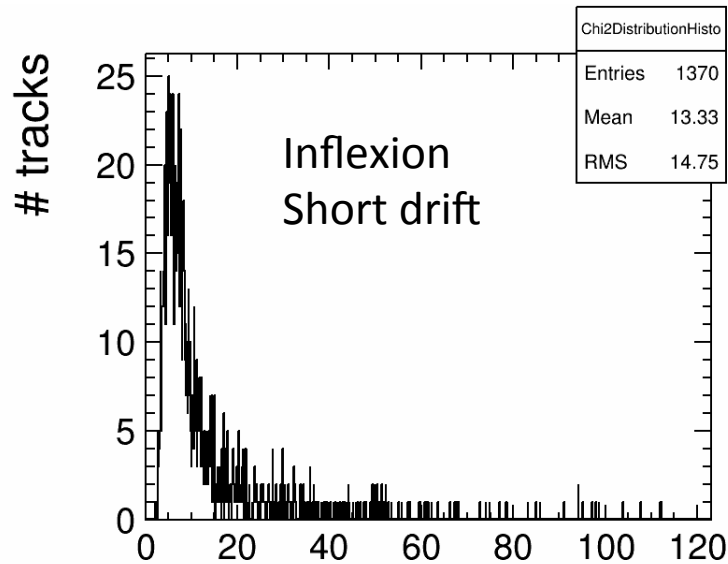
The pulse shape from 200 ns data is much broader



2011 500 ns pulses



Track Fit χ^2



Track χ^2 is better for Gaussian Inflexion method and less failures.

2013 KEK meeting recommendations

On both rphi- and Z- resolution:

“Extracting the width from distributions: Gaussian fit in r with wide range, then a refit within 3 sigma, also keep previous method of rms after iterative 5 rms cut. For distributions with tails and asymmetries observed for example in z we will use the RMS90 with a factor to get back to . A comparison with **the fit method** should be carried out.”

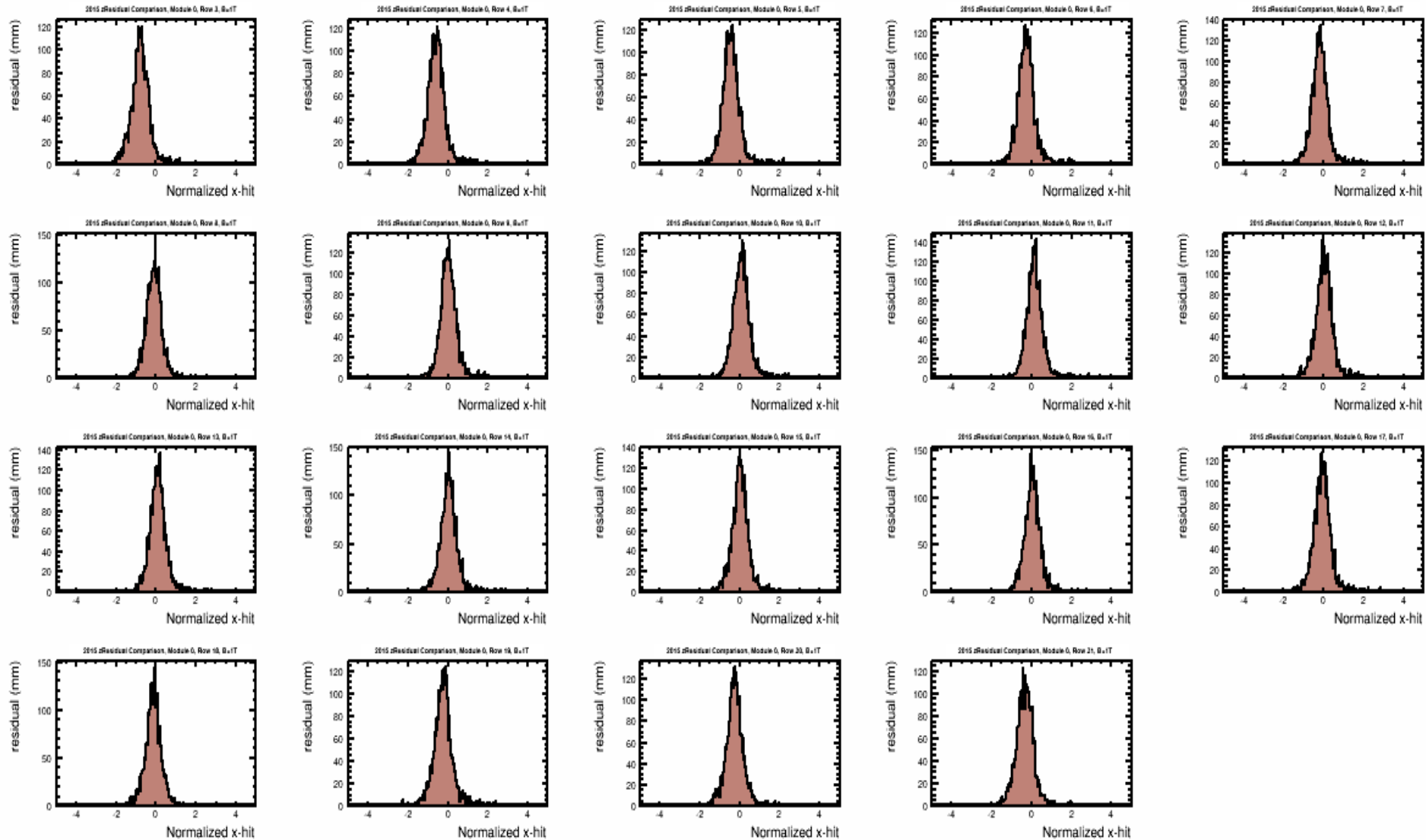
On Z- resolution determination:

"We agreed to use the default **inflexion point** method which seems to give the best results for the z resolution so far. The charge of the pulse has an effect on the calculated time. This time walk effect could be corrected. But it needs further study to determine its dependencies and systematics. A second effect is the time dependence on the position of the pulse within the hit. A correction is only possible at hit level as the information of neighboring pads is needed."

Forwarded from Felix Mueller.
Highlighting is mine.

GEM z-residuals for comparison with MM z-residuals

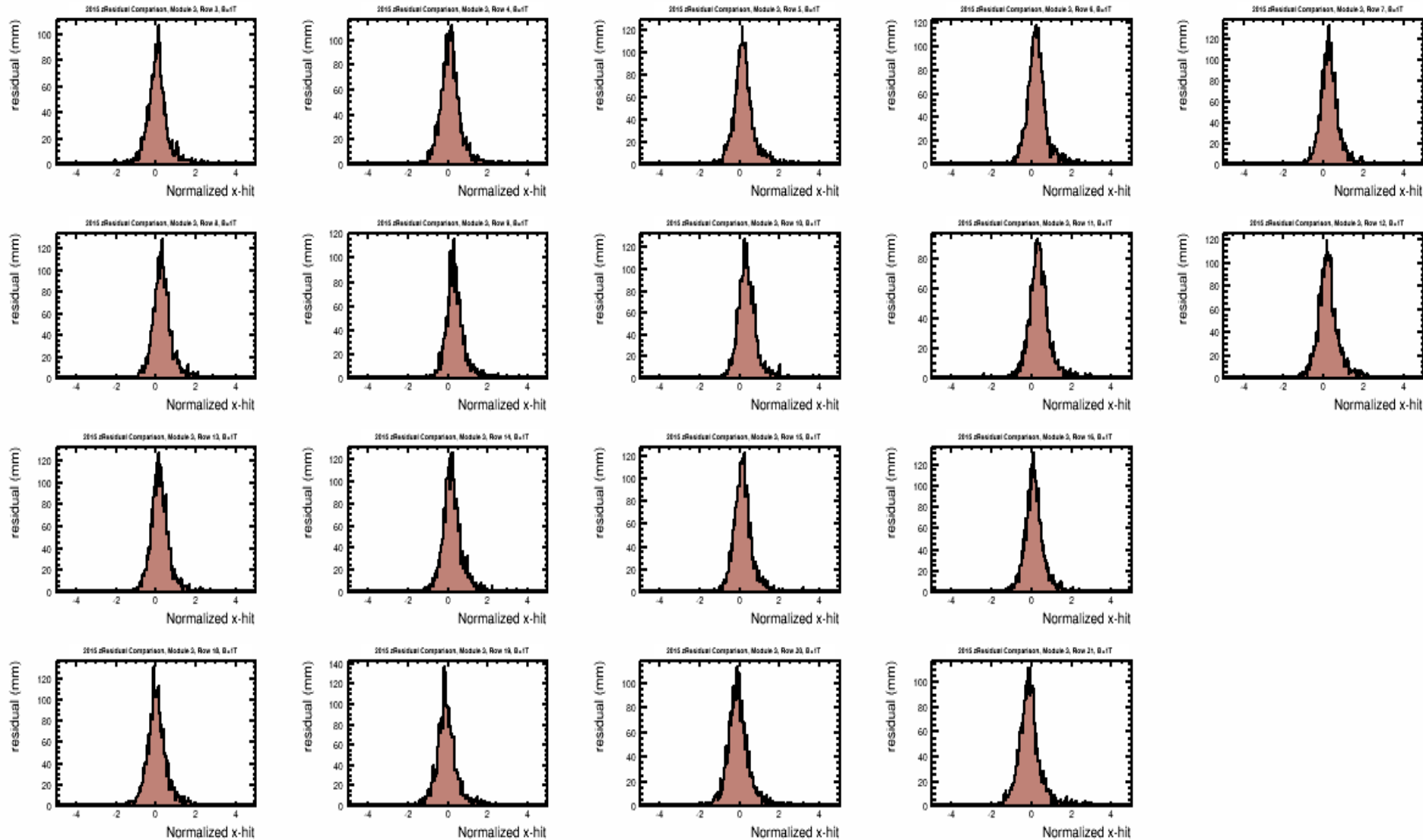
zResiduals Row by Row, MM, 10cm, Inflexion



BD module

BEFORE
Corrections

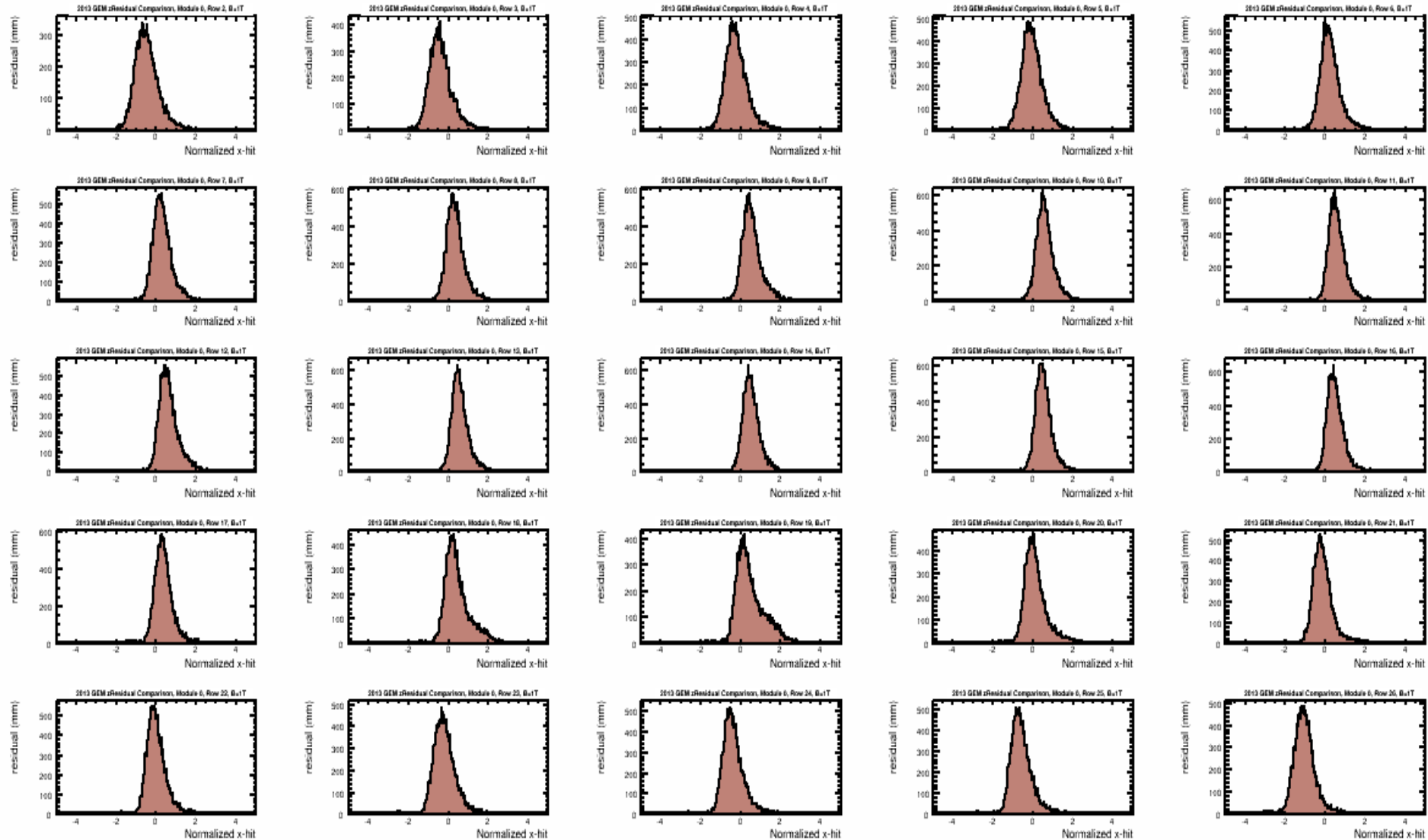
zResiduals Row by Row, MM, 10cm, Inflexion



CLK module

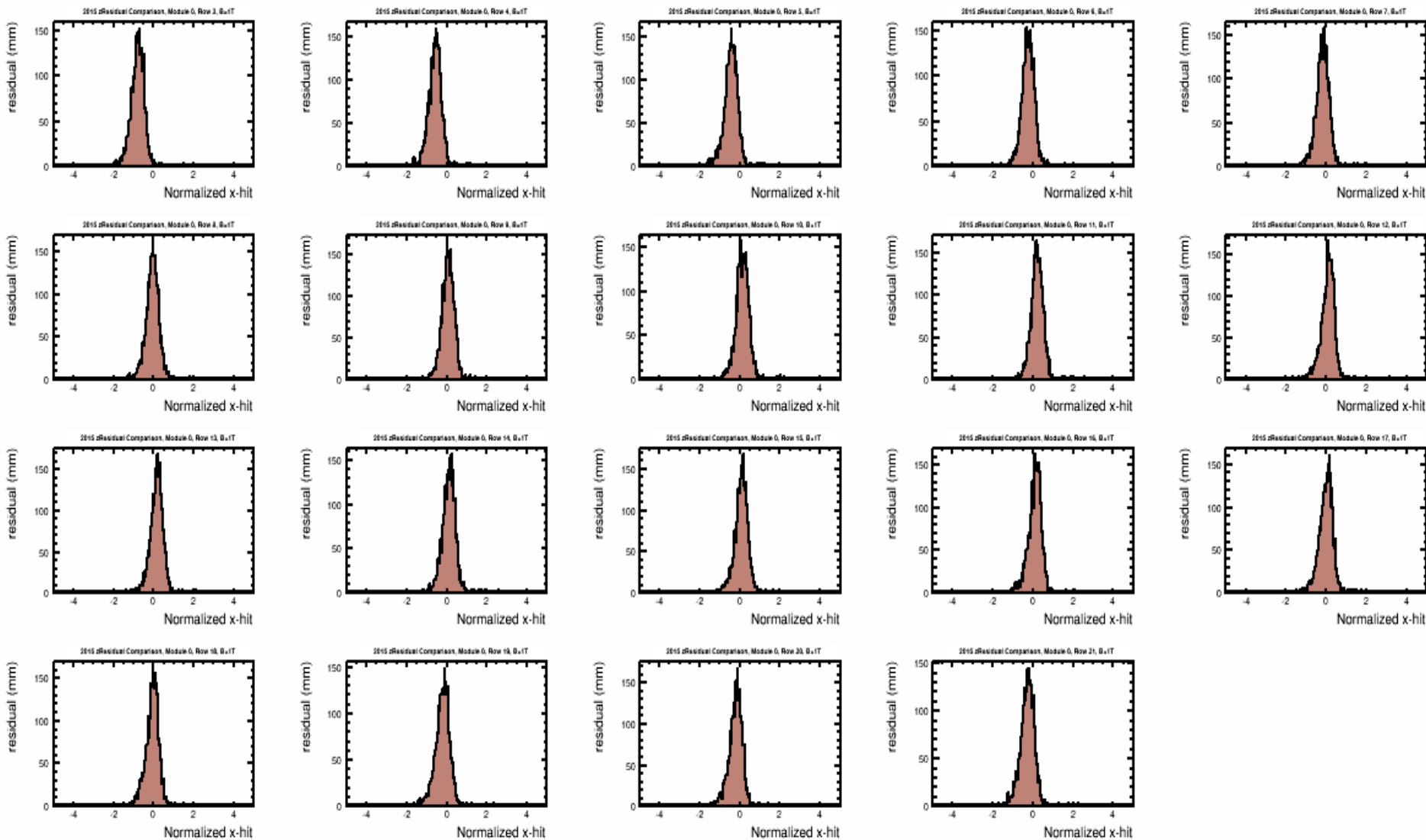
BEFORE
Corrections

zResiduals Row by Row, GEM, 10cm, Inflexion



BEFORE
Corrections

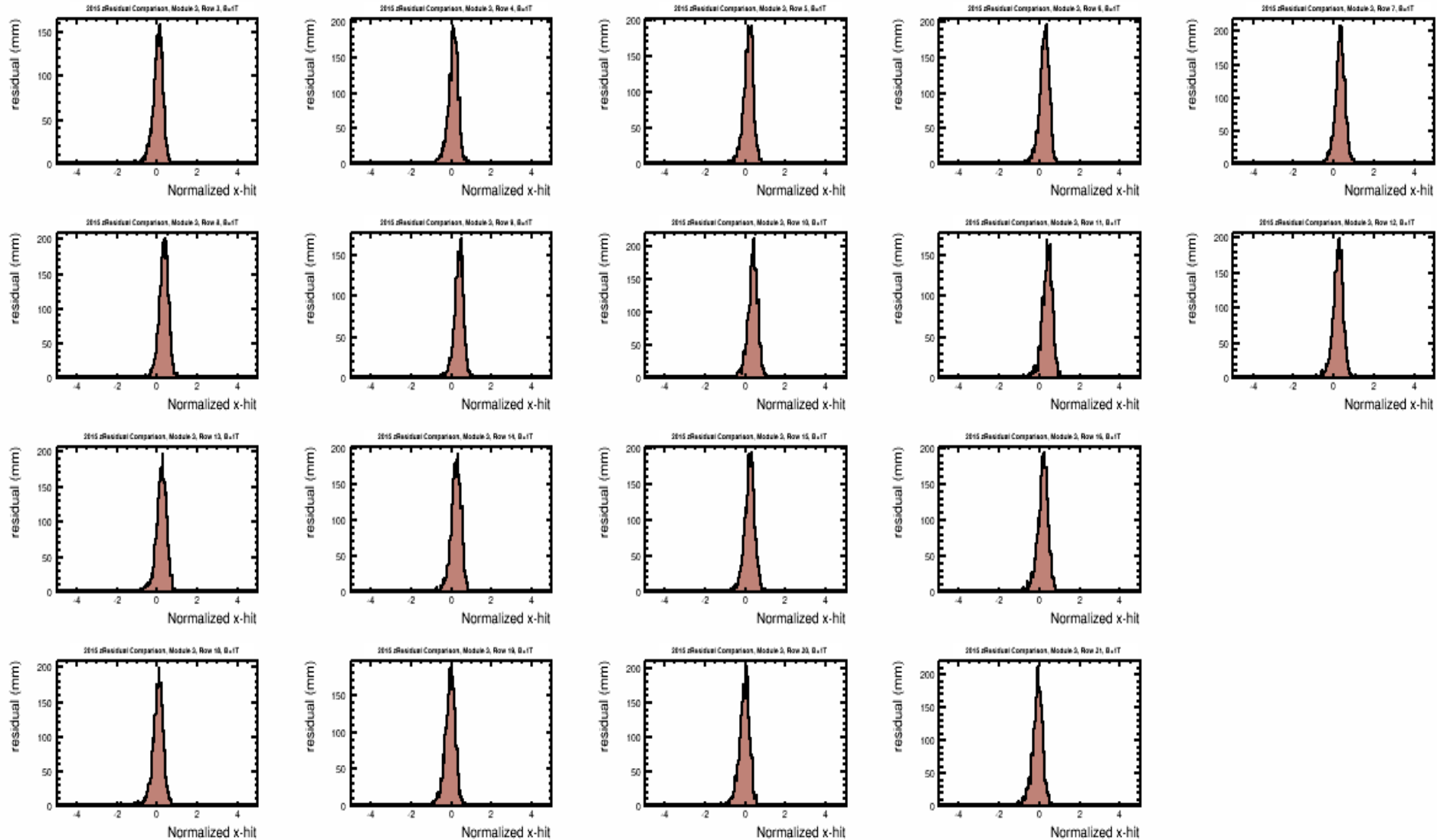
zResiduals Row by Row, MM, 10cm, Gauss. Inf



BD module

BEFORE
Corrections

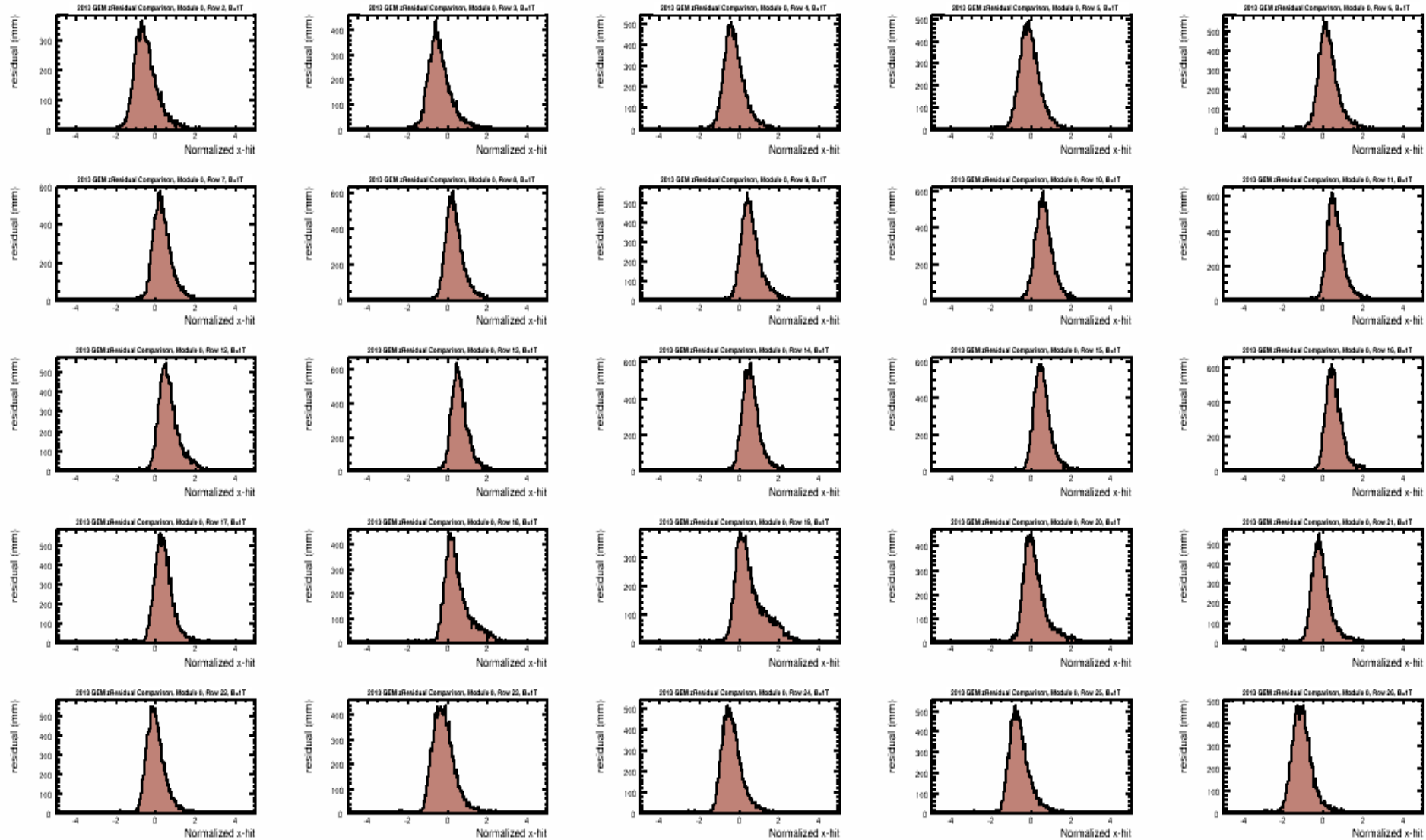
zResiduals Row by Row, MM, 10cm, Gauss. Inf



CLK module

BEFORE
Corrections

zResiduals Row by Row, GEM, 10cm, Gauss. Inf



Note, GEMs Gaussian Inflexion Z-res are pretty close to Inflexion Point!

BEFORE
Corrections