Comparing resolution plots

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Objectives

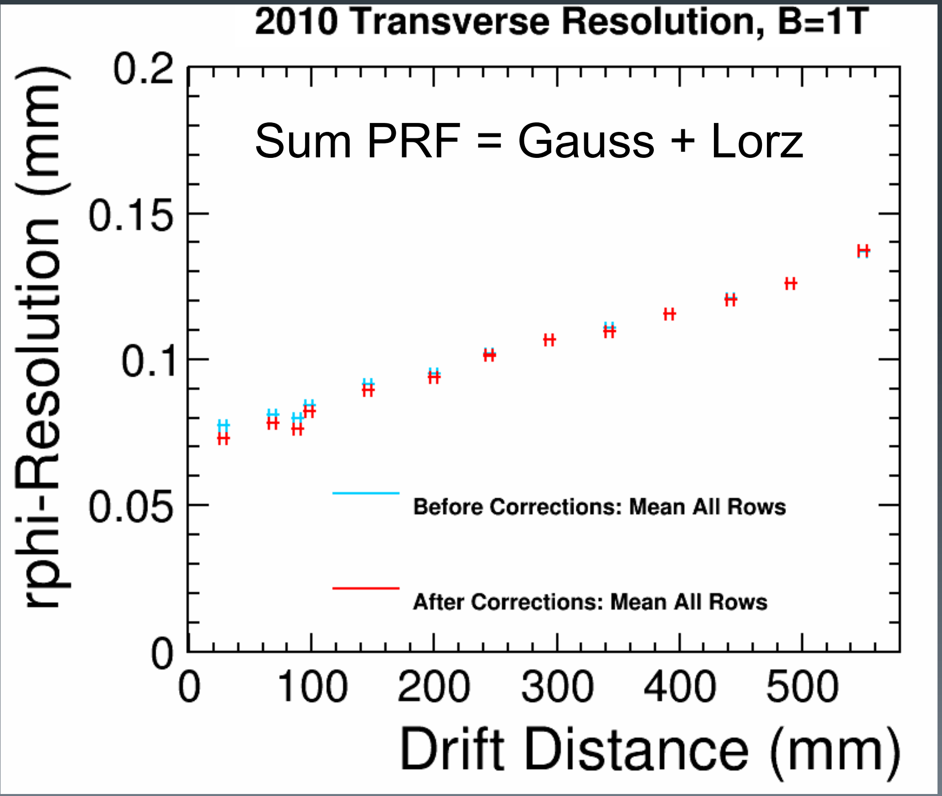
- Transverse and longitudinal resolution parameters are important characteristics of the detector.
- This is a progress report on the work to compare data from different test beam data taking periods using consistently the same analysis code and event selections. The other closely related study is to improve resolution performance after bias and distortion corrections.
- My current analysis uses mostly Sum (Gaussian + Lorentzian function) Form for Pad Response Function (PRF) and Gaussian Inflexion Time Estimation Method.
- All available 2010 - 2014 data have been worked with.

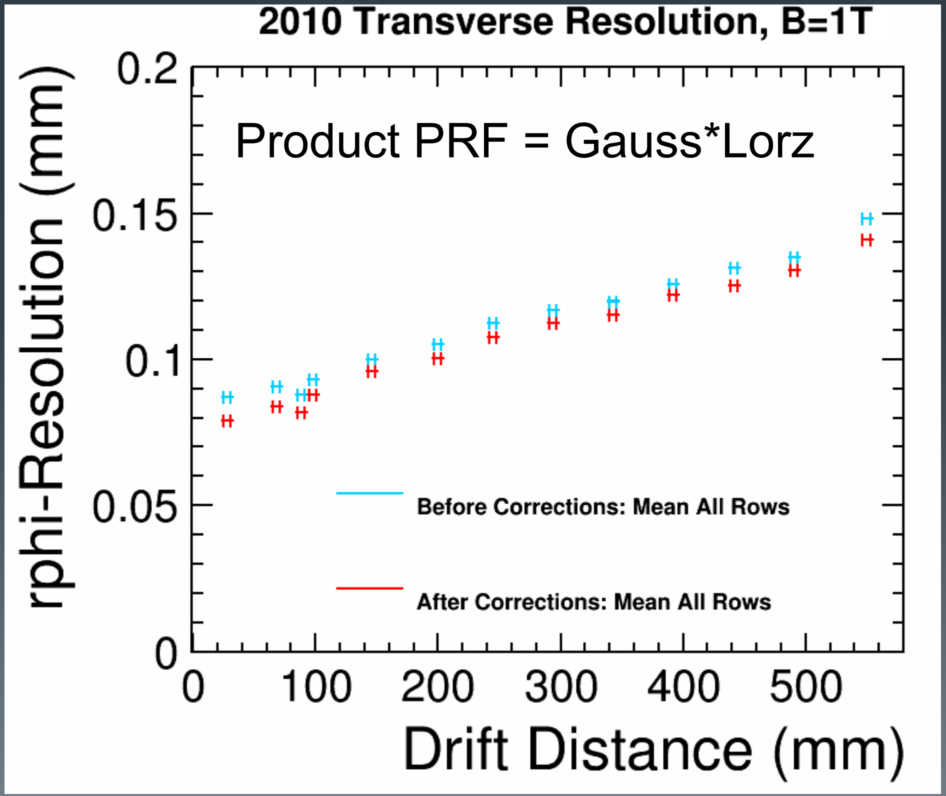
2010 data
(Single module setup)

2010 data, r-phi

Field on Mesh= 380V
Peaking time= 500 ns

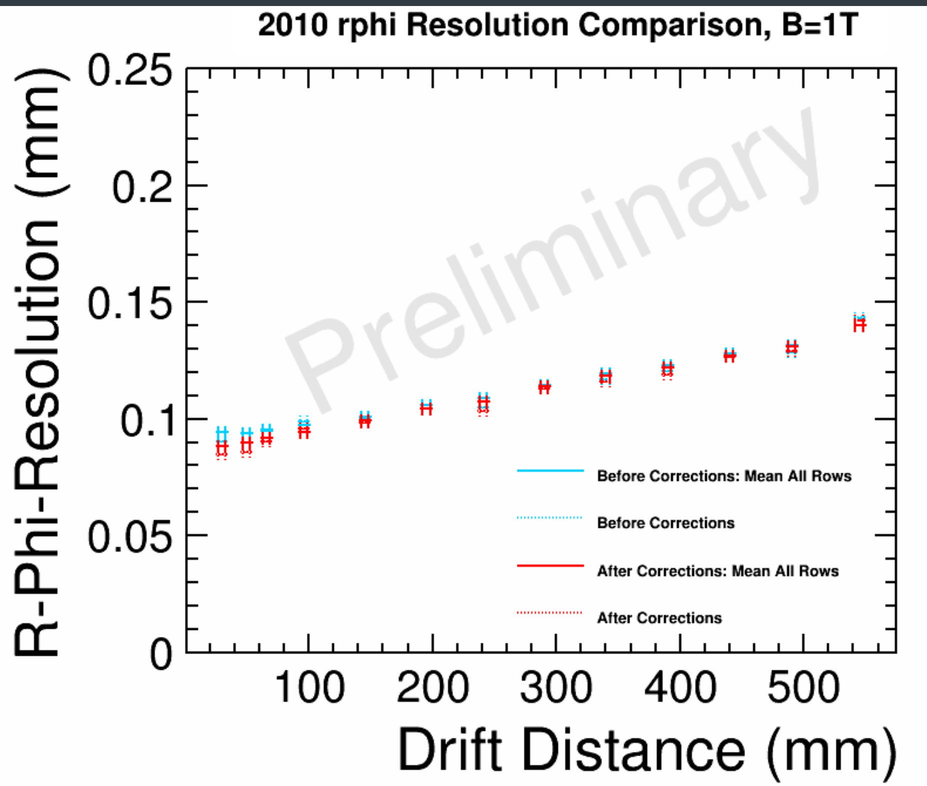
Sum PRF performs slightly better than Product-Form PRF.



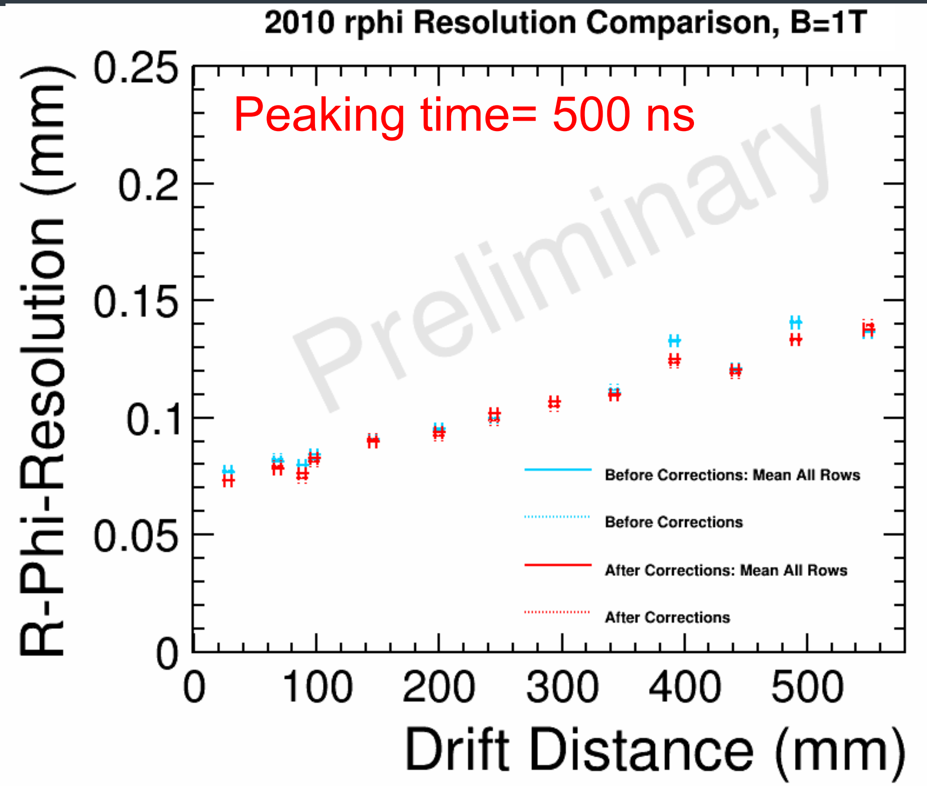


Mesh voltage impact – 2010 data

360V on MESH

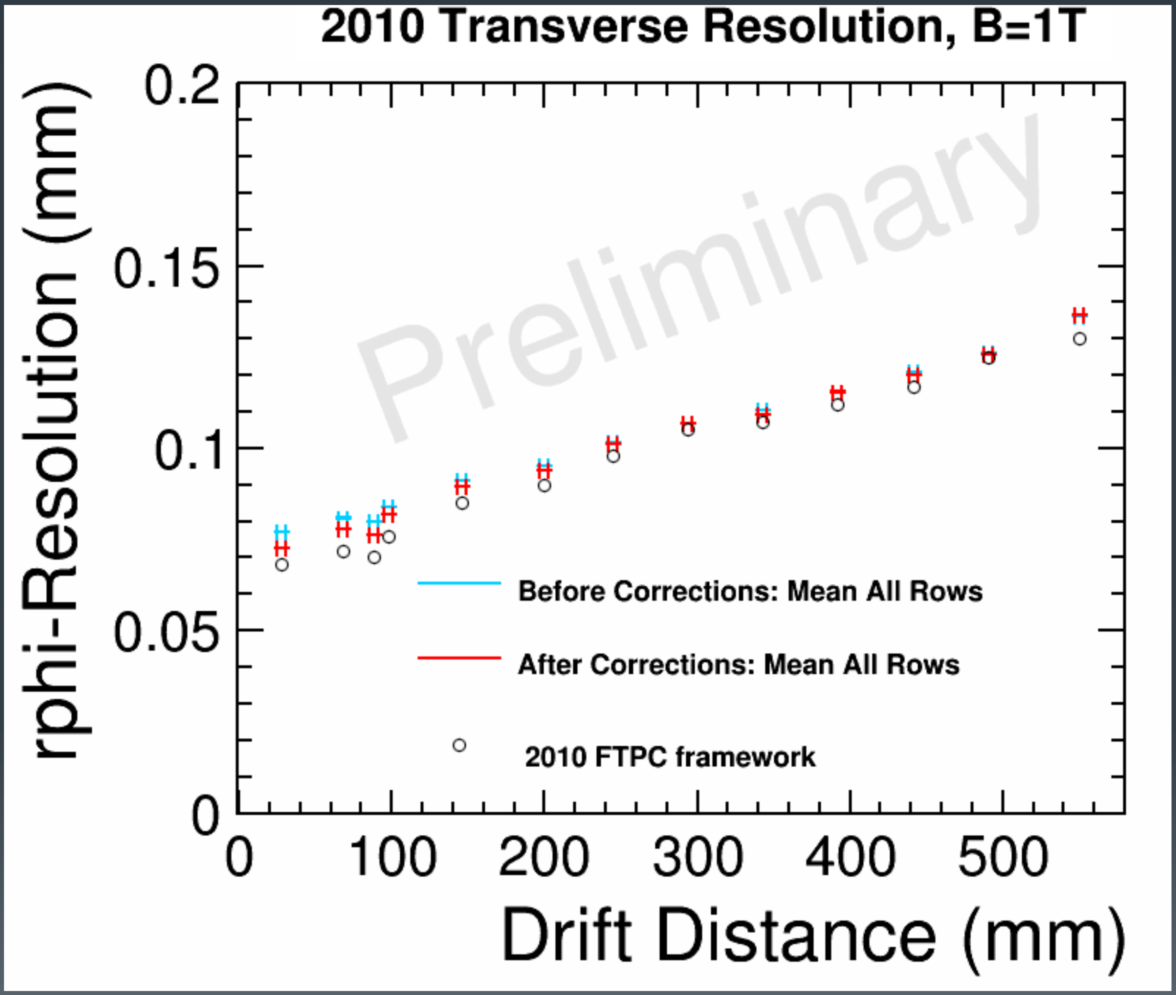


380V on MESH



Resolution slightly improves with larger field on MESH.

Comparison with FTPC results



380V on Mesh
Peaking time= 500 ns
Bias corrected
Sum PRF used.

Open circles – Wenxin resuts with FTPC

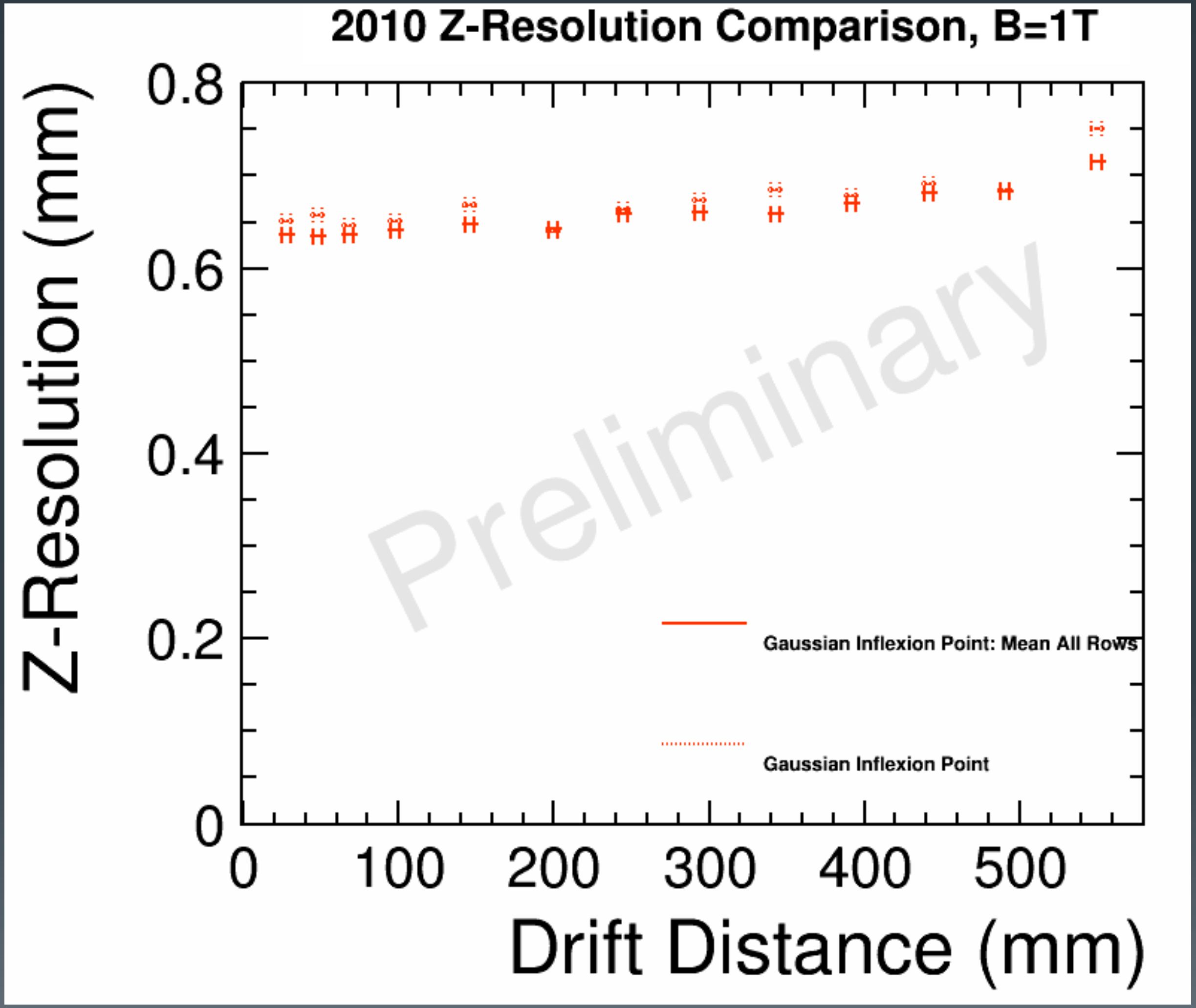
Wenxin used Product PRF

Results obtained with MarlinTPC look pretty much consistent (within less than 10 mkm) to FTPC framework.

Some further fine-tuning of cuts could be possible to Improve the agreement between two frameworks.

Z- Resolution - 2010

380V on Mesh



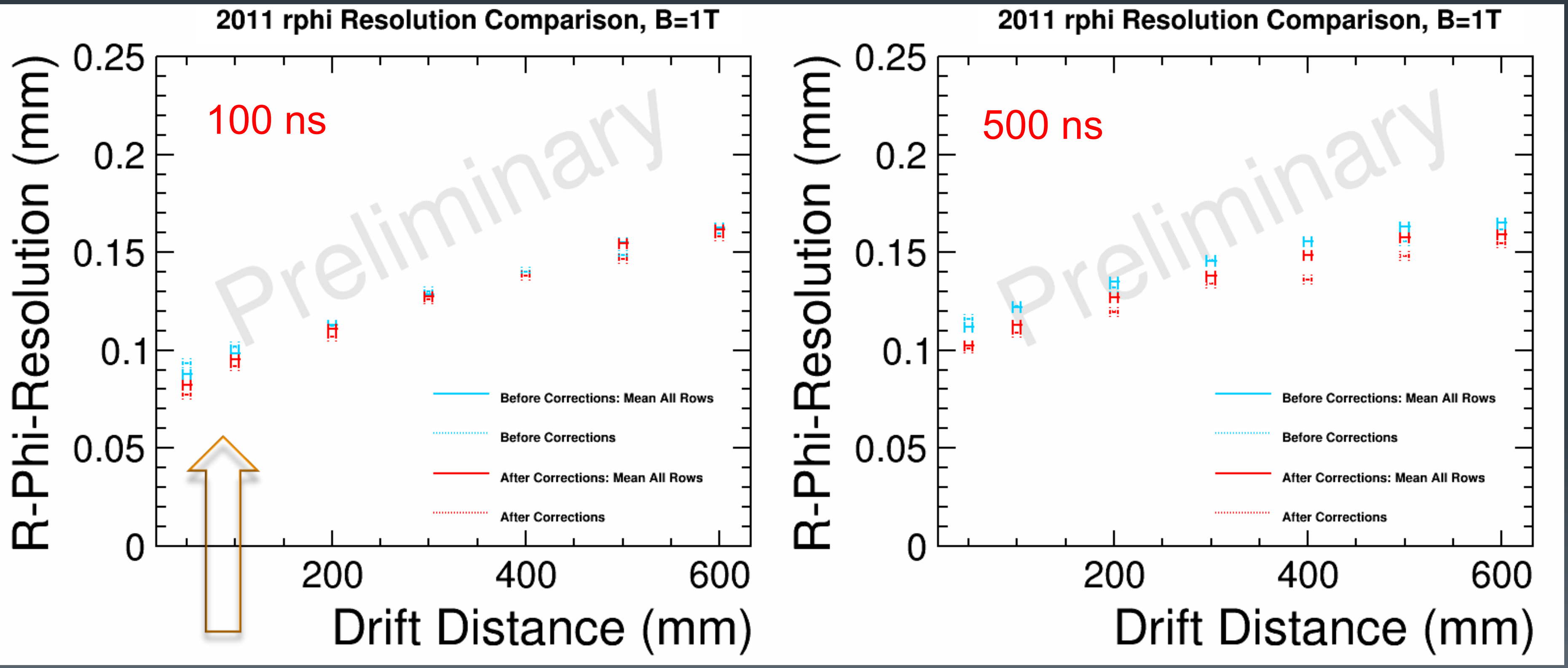
500ns peaking time is not very good for Z-resolution.

Z- Resolution looks much worse than with 100 ns shaping time) – will be shown in this talk.

2011 data
Single Module setup

r-phi resolution in 2011 data

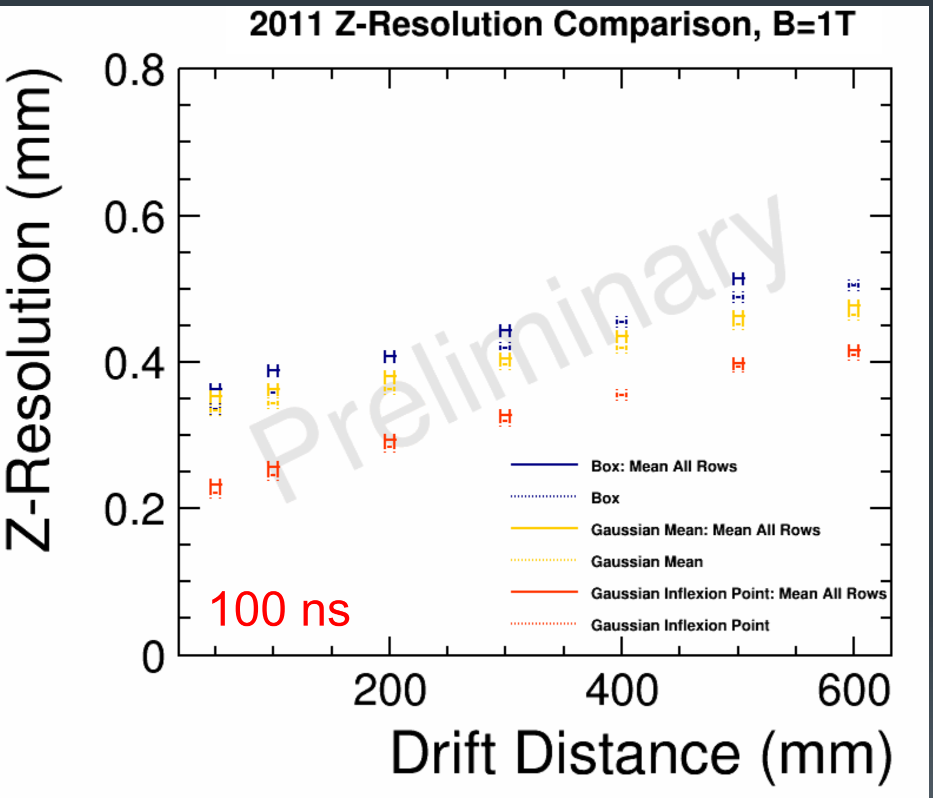
Sum PRF, various peaking time, with bias corrections and without.

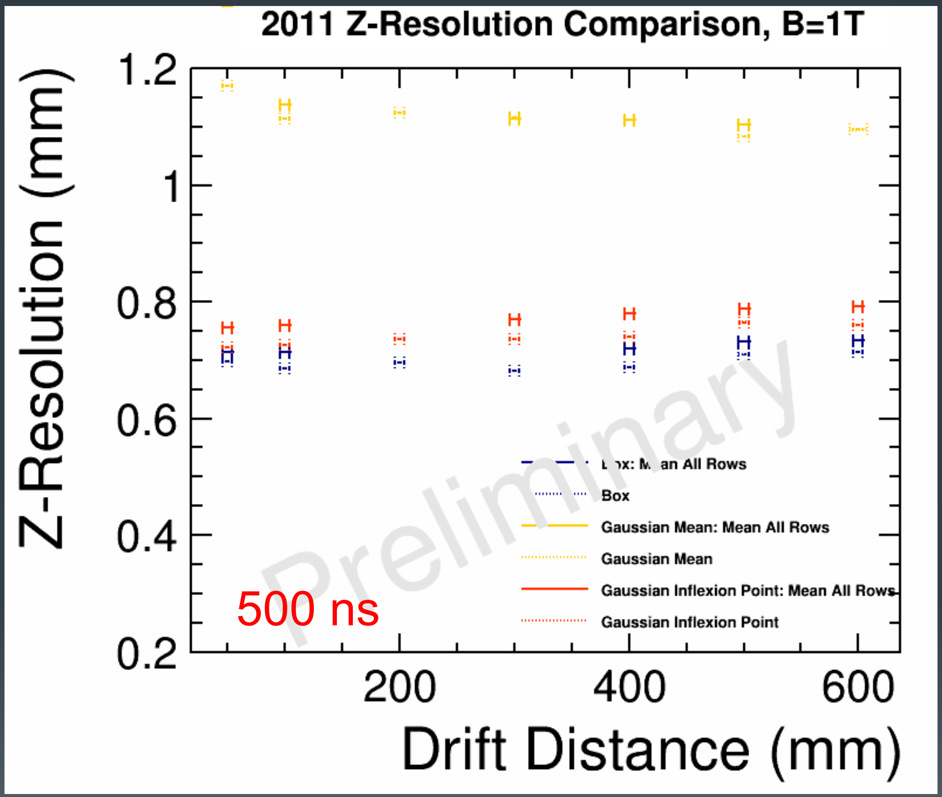


Data obtained with 100 ns perform better (in particular for short drifts) in transverse resolution.

2011 Z resolution

Sum PRF, variable peaking time, time estimator



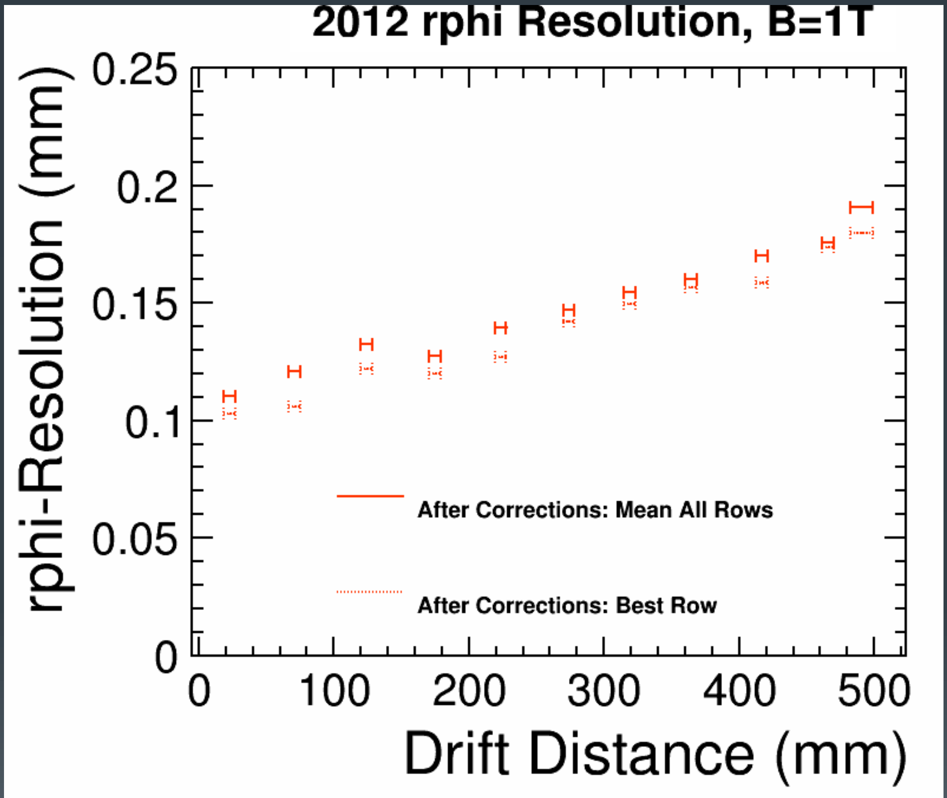


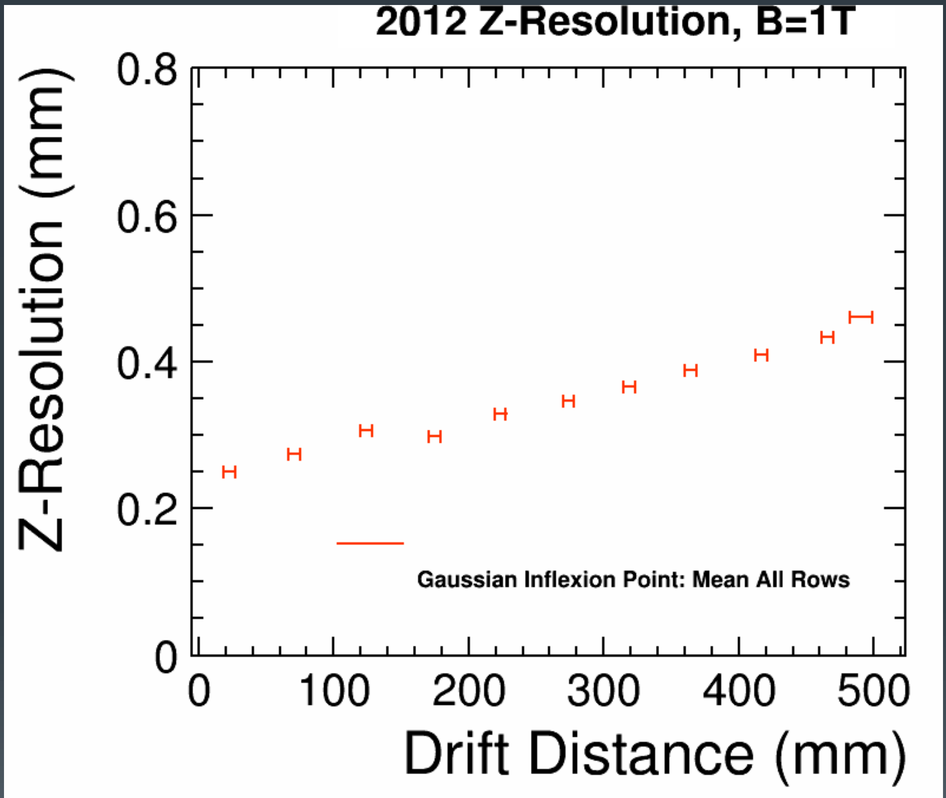
With Gaussian Inflexion estimator, 2011 results (100ns) are comparable on Z resolution with 2014 data!

2012 data
Multi (6) module setup.
Central module data presented here.

2012 one module (#3) data

Peaking time = 100 ns, Field in the volume: 230 V/cm

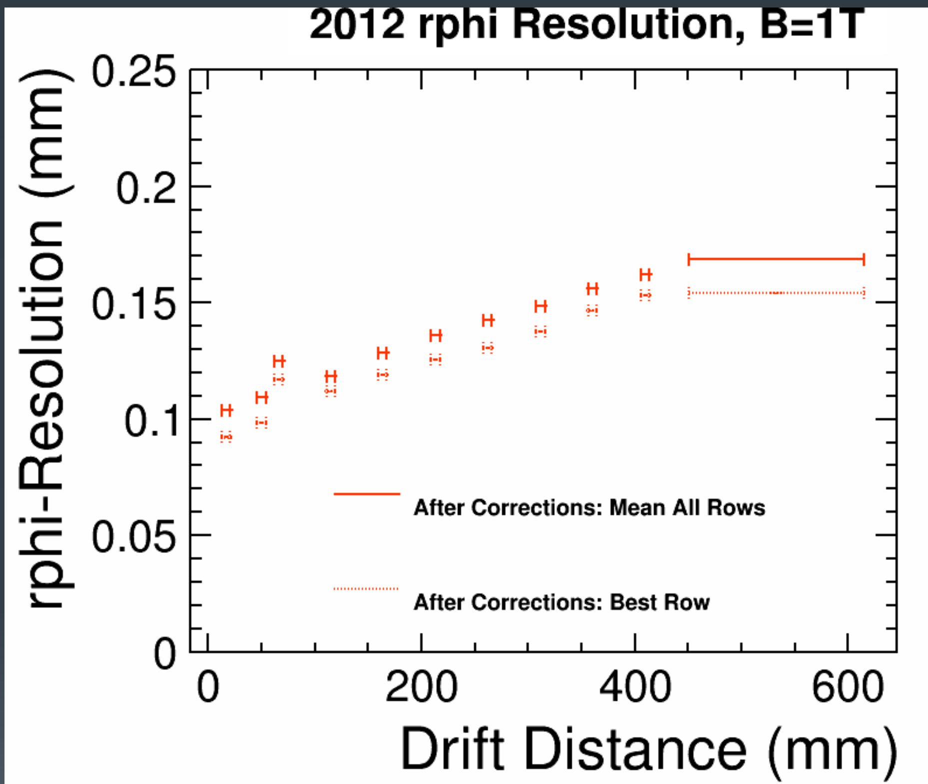


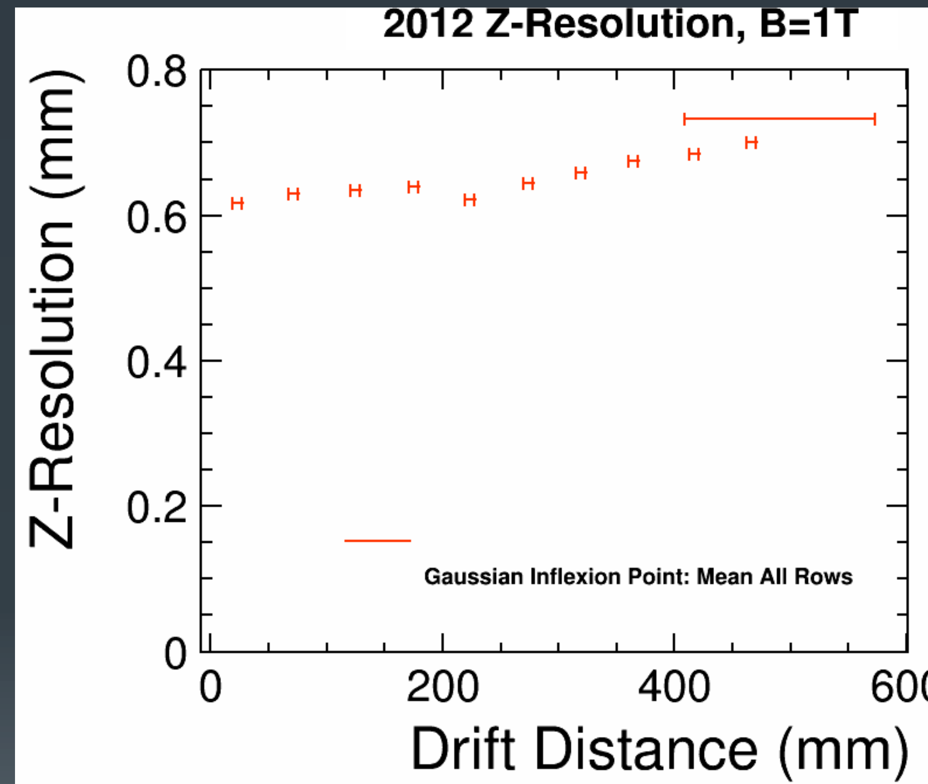


Central module 2012 data (100 ns) is comparable in r-phi resolution with to more recent (100 ns) 2013-2014 data

2012 one module (#3) data

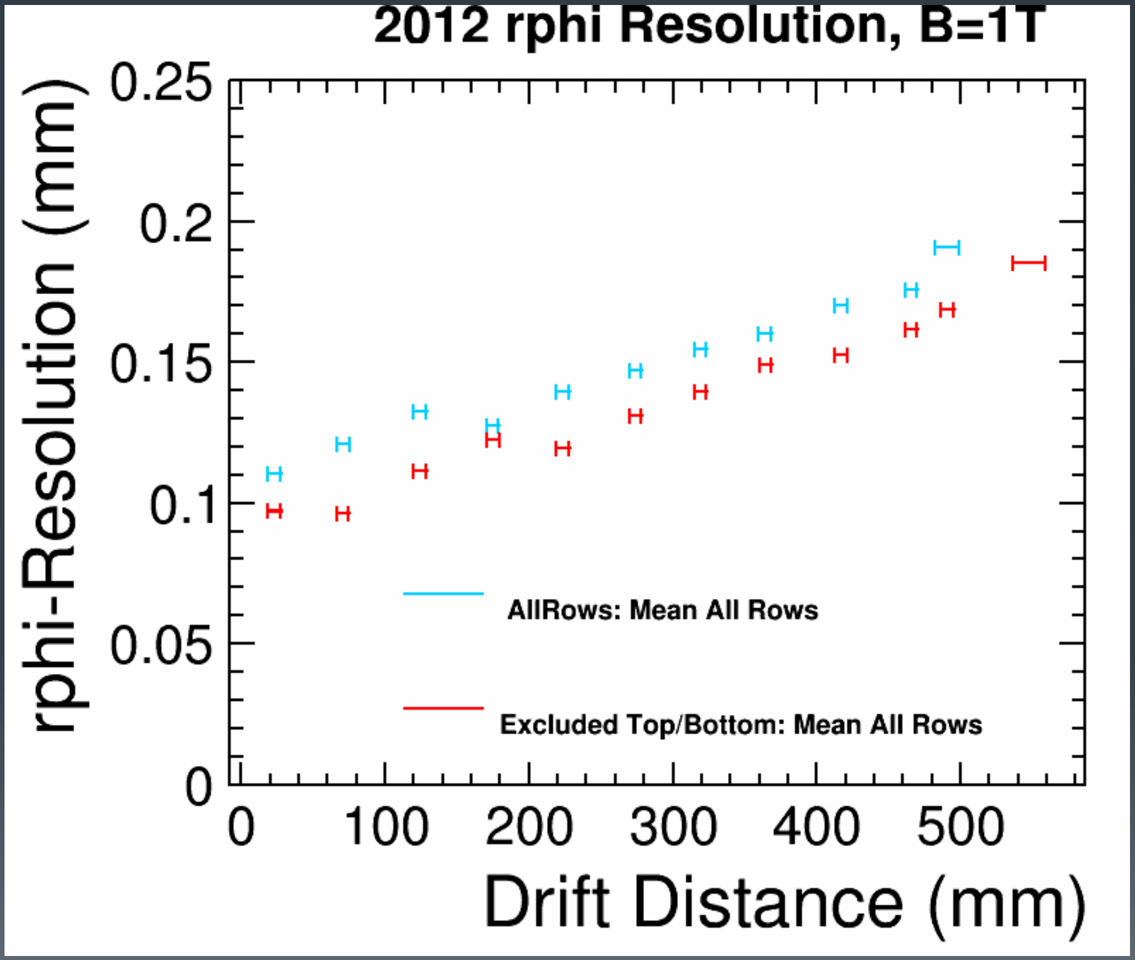
Peaking time = 400 ns, Field in the volume: 230 V/cm





Central module 2012 data (400 ns) is a bit worse than the 2010-2011 r-phi resolution (500 ns). Z resolution (with 400 ns peaking time) is much worse than 100 ns data (on previous slide).

2012 data – excluding rows

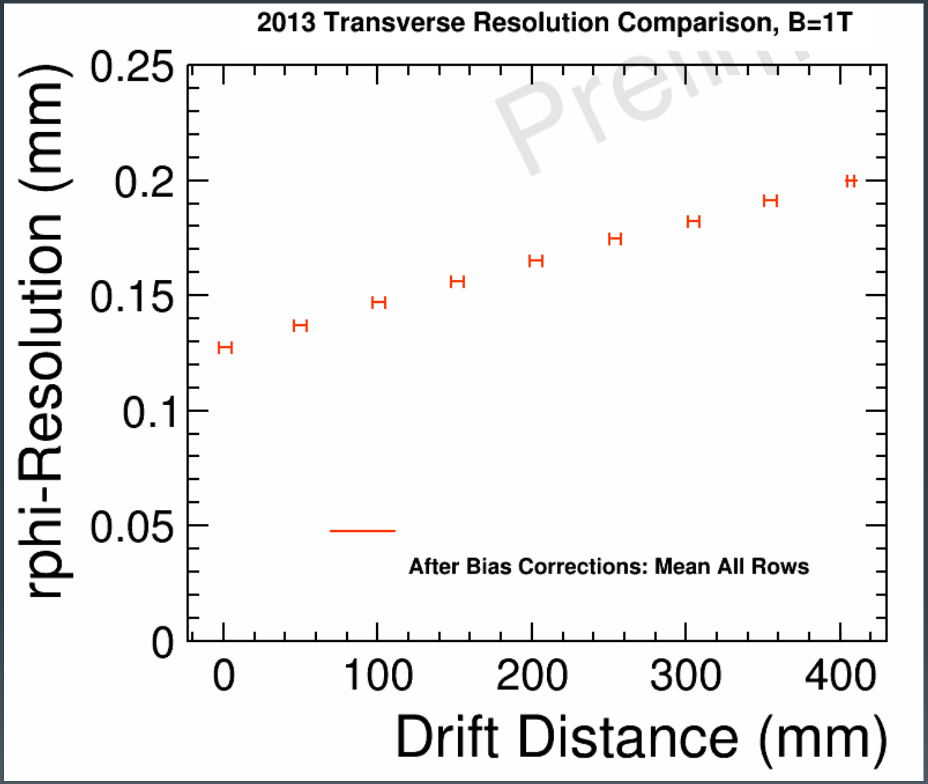


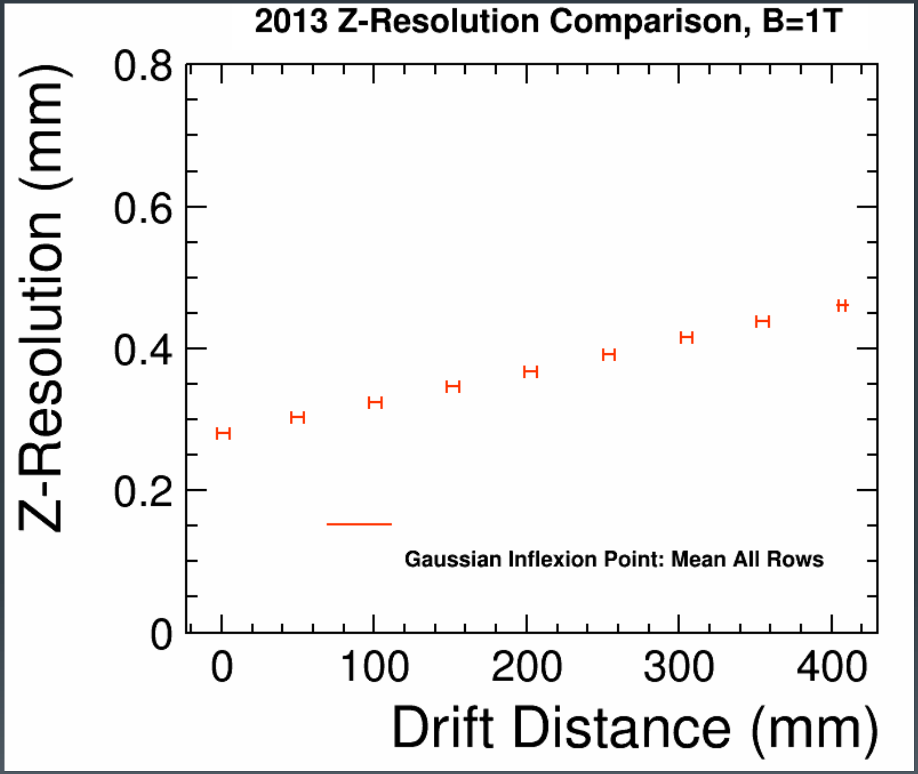
Transverse resolution gets improved by removing 2 rows from top and bottom of the central module.

2013 Data
Multi (7) module setup

2013 resolution plots

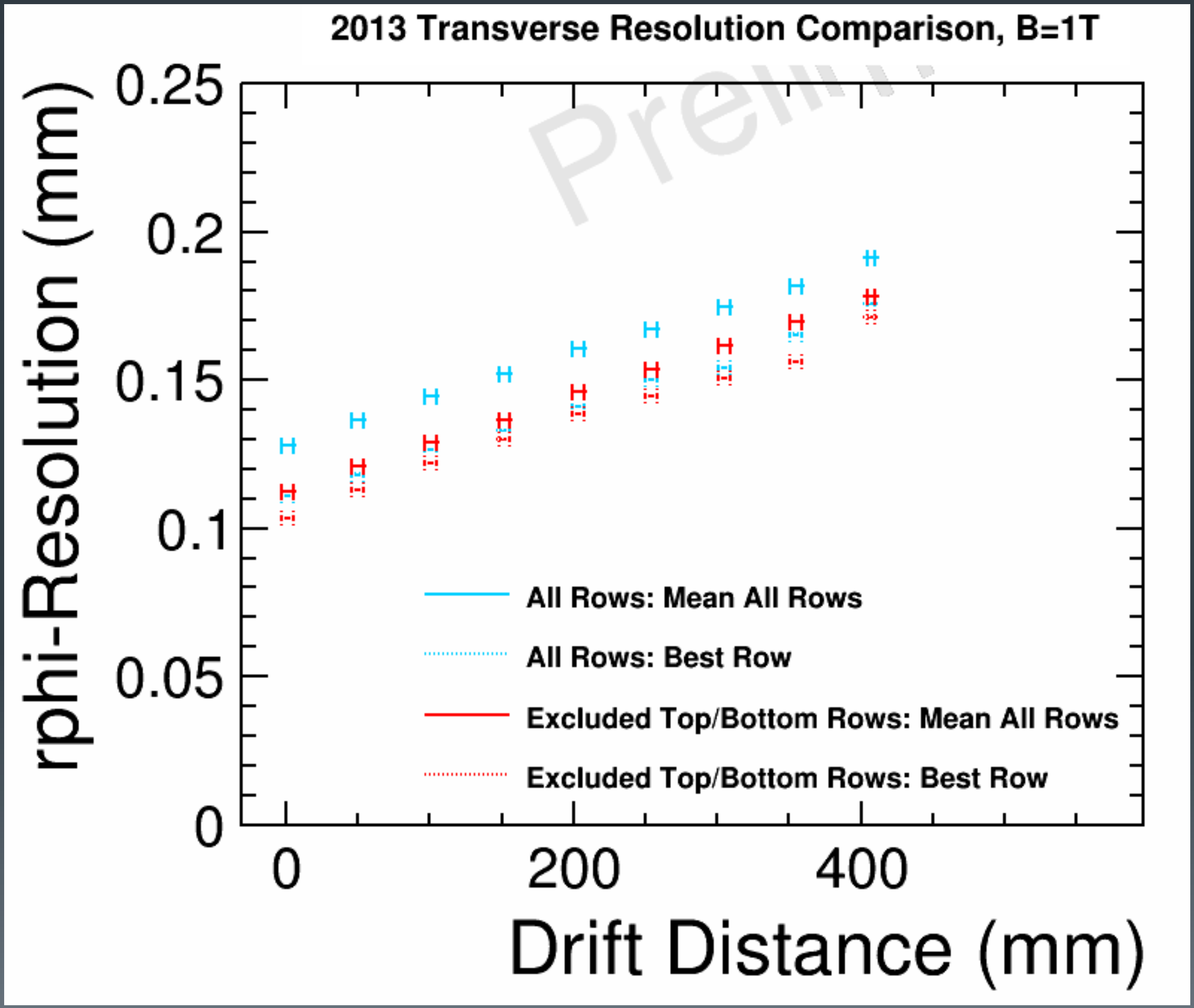
100 ns
380V on Mesh





R-phi resolution is a bit worse than in previous years., presumably due to disconnected pads.

Excluding rows at top/bottom



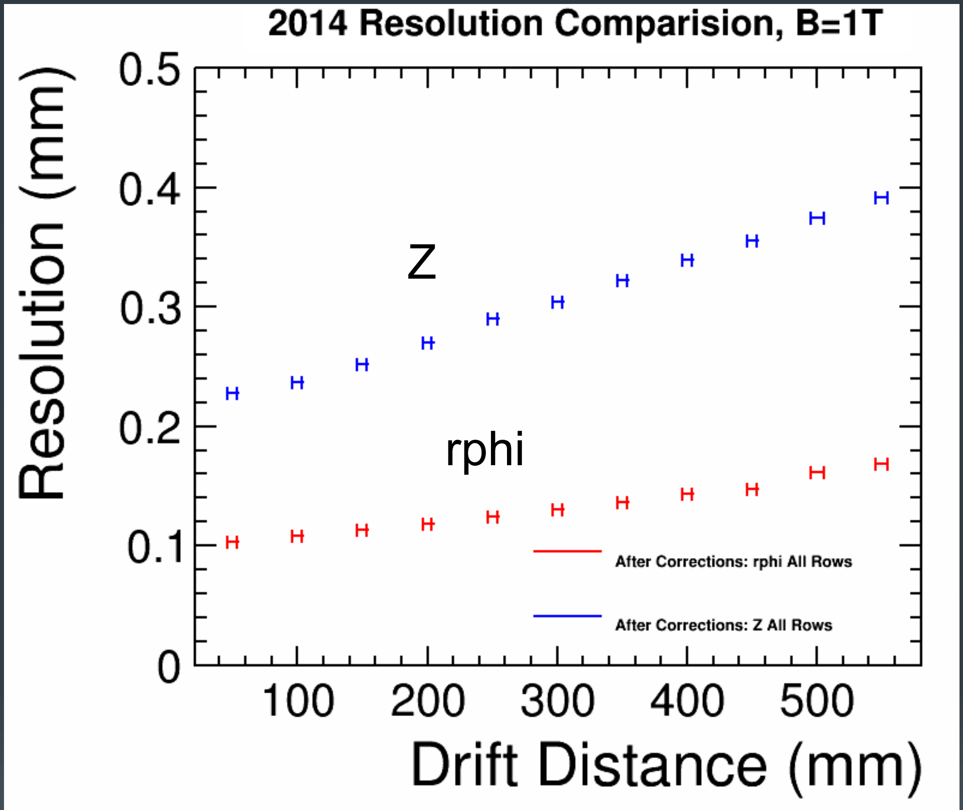
100 ns
380V on Mesh

Excluding 2 rows at each module’s top and bottom does have sizeable (~ 20 mkm) effect on transverse resolution.

2014 Data
Multi (7) module setup

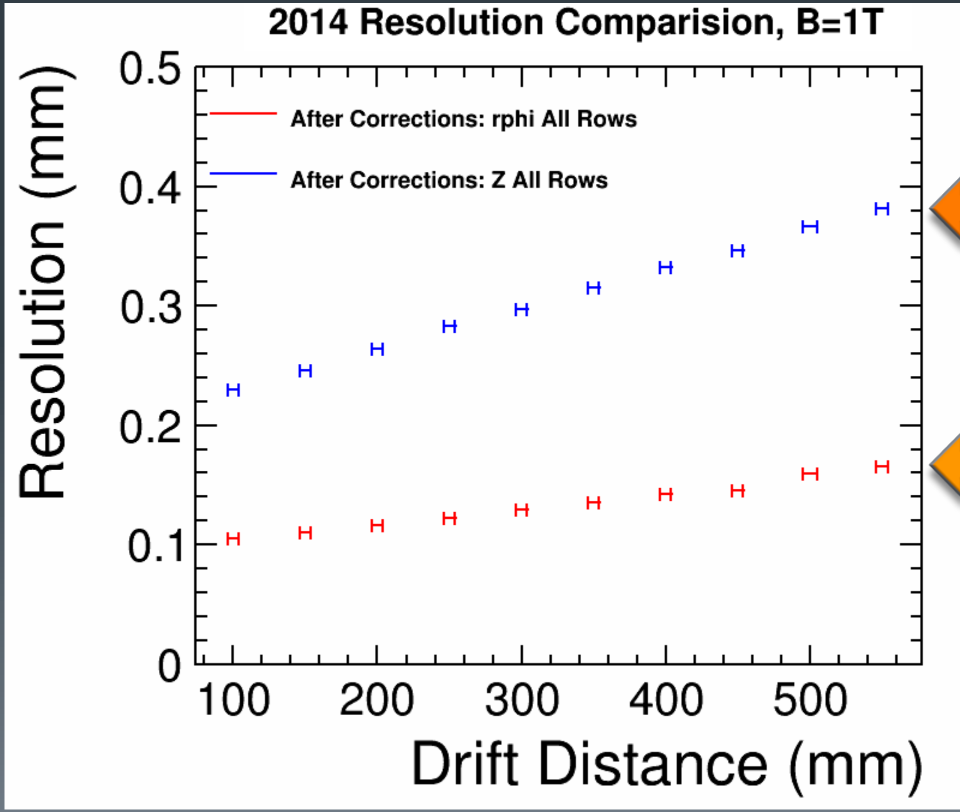
rphi & z- resolution with Sum PRF

Gauss+ Lorz



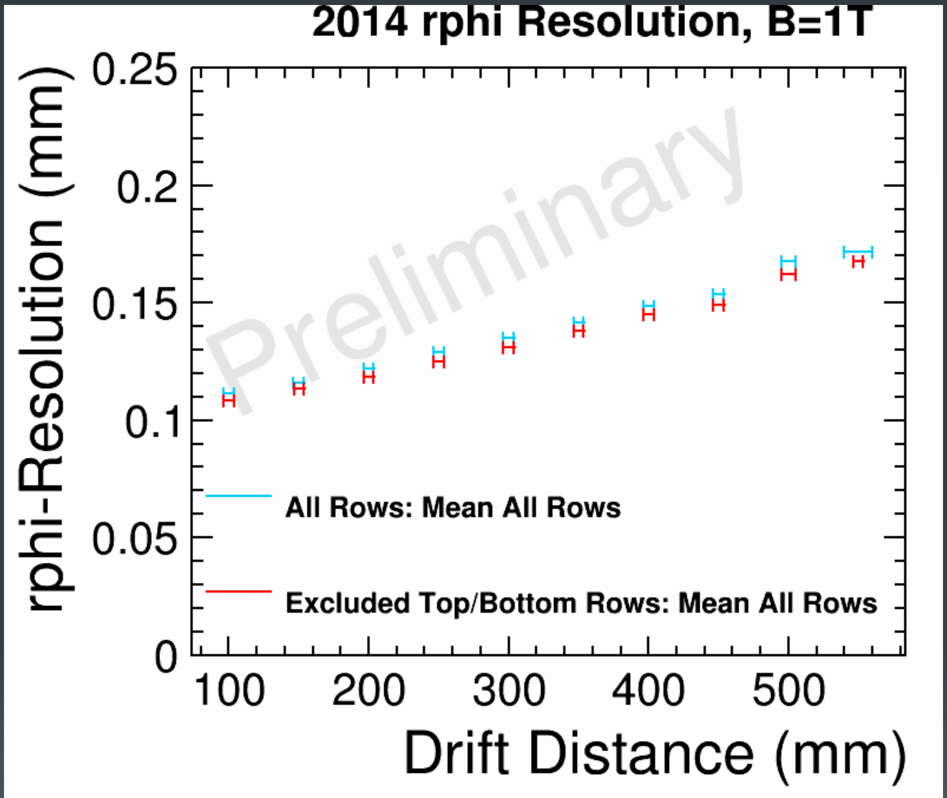
After bias corrections

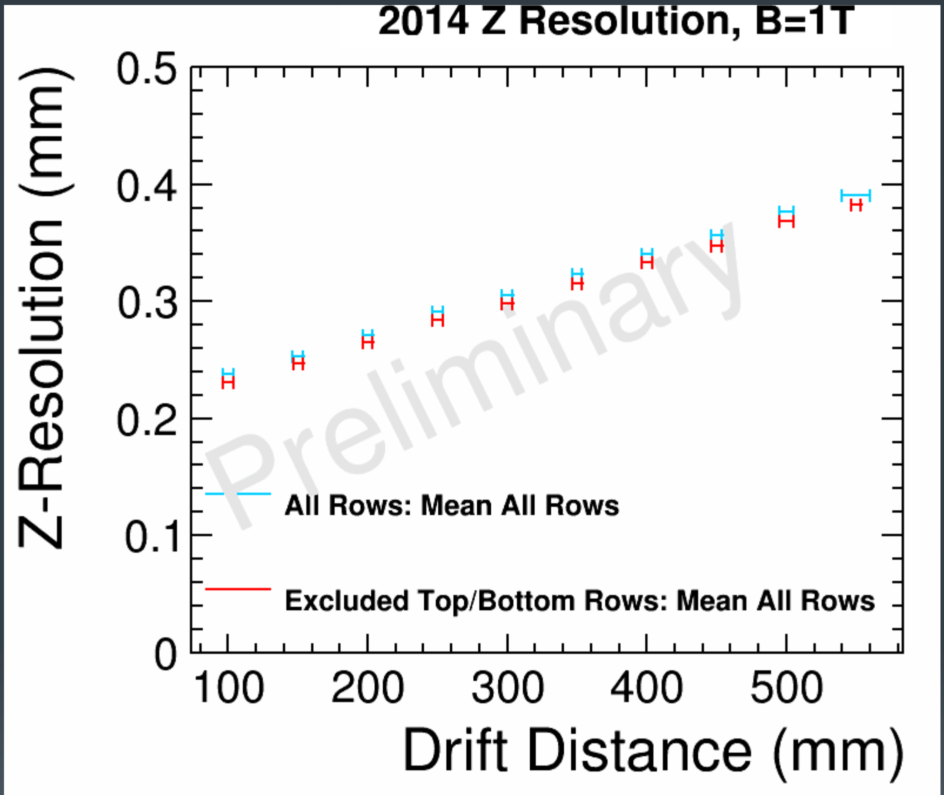
100 ns peaking time
Field: 230 V/cm



Marginal improvements after 1 row excluded from top and bottom
Effect mostly seen on high drift edge.

More with excluded rows

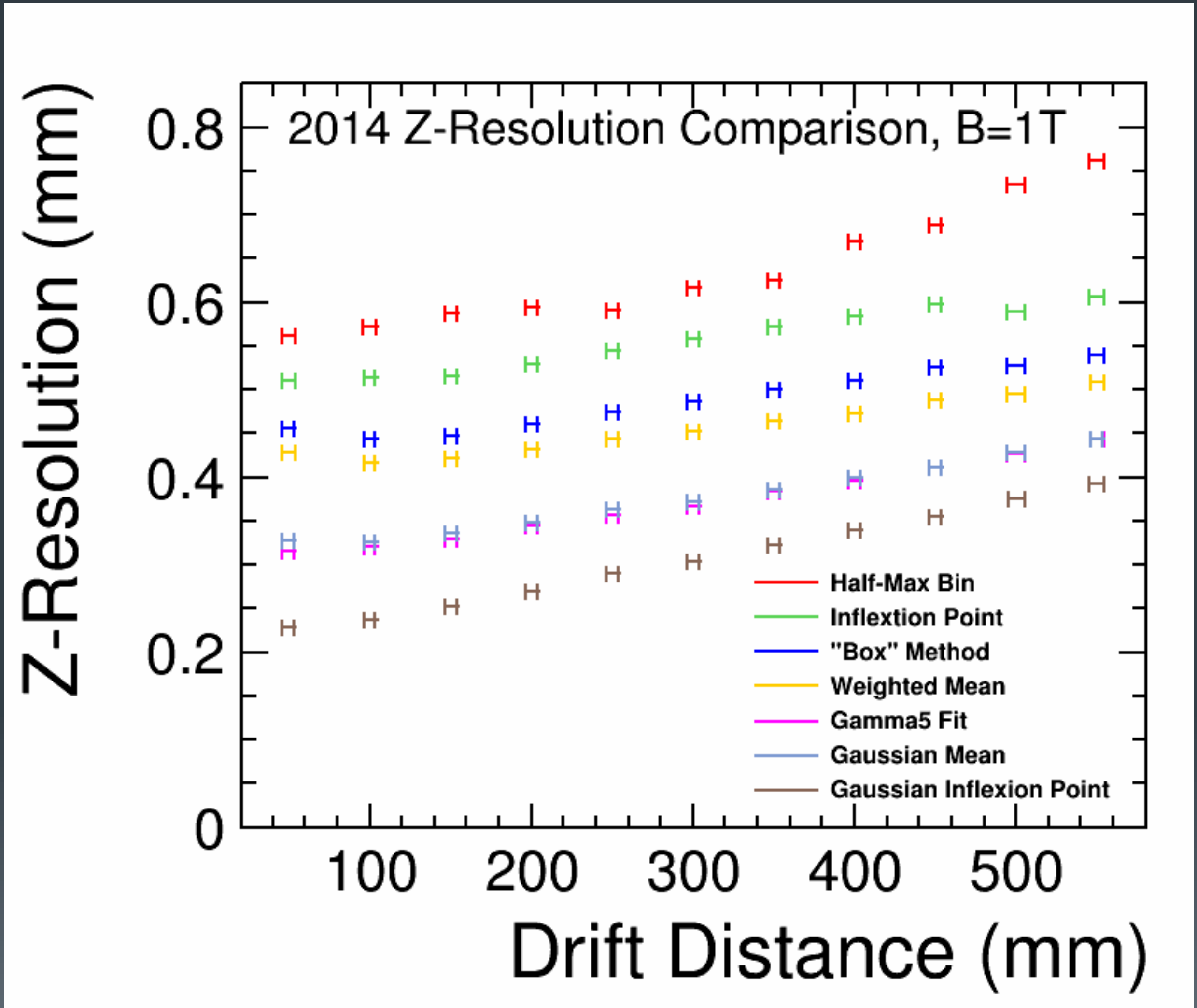




2 rows are excluded from top and bottom of each module.

Both transverse and Z resolution show some improvements.

Time Estimator Scan on Z



Note: Gamma5 (pulse shape method) performs slightly better than Gaussian Mean (at short drift distances). Implies the ~same sort of improvement if using Inflexion point for Pulse shape method wrt Gaussian Inflexion Point (brown points)

Gauss Inflexion Point method shows the best performance at present.

Summary

- The comparison of the resolution performance data made for various data beam data.
- Transverse and Z resolution performance is close or better than the detector requirements.
- However, some newer data (2013/2014) perform slightly worse in transverse resolution. Could be due to many disconnect pads or some other hardware related issues.
- Gaussian Inflection Point Time Estimation method so far demonstrates the best performance results for Z-resolution.
- 100 ns peaking time is proven to be the best for adequate Z resolution performance. Also good enough for r-phi resolution.
- There are many other comparisons made – check some of them in back up section of this talk.

Plans

- Using only good hits (by χ^2) could improve the resolution for 2013/2014 data. (The same argument should work with older data).
- Re-integration method (used in FTPC to add all pulses to the maximum pulse) might be worth to try for 100 ns shaping time to regain good r-phi resolution at large Z.
- Looking forward to 2015 test beam data analysis, e.g.
  - tune threshold to insure 4 or 5 pads per cluster hit [2012-2014 the # of pads per hit has been much less]
  - keep the information on zero suppressed data options for reintegration of 100 ns data

Back Up

2013 data: disconnected pads

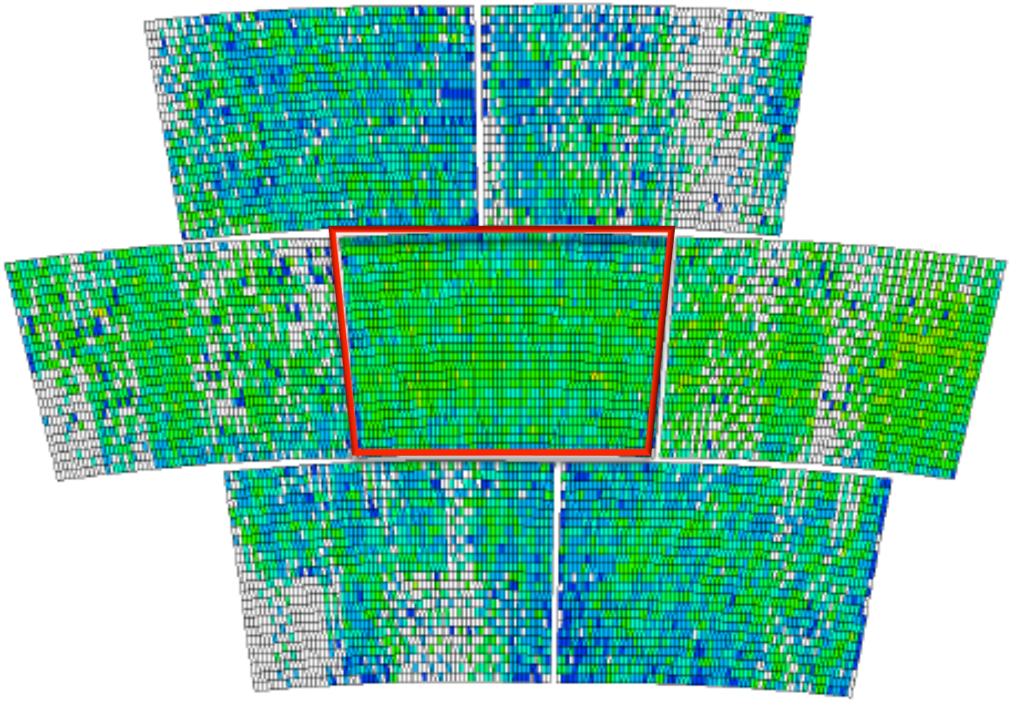
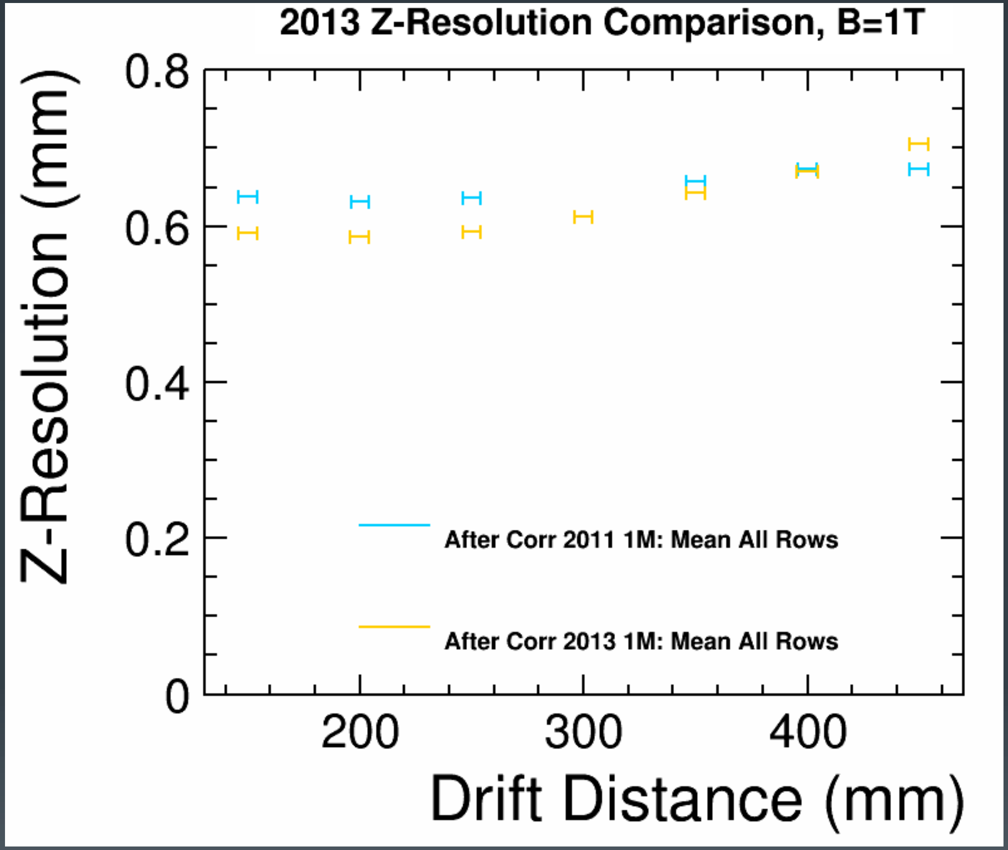


Figure 7-13. The state of missing pads in the last-but-one data taking day. The missing pads are filled with white colour.

One module comparisons (in multi-module setup)

Z resolution: One module comparison (400ns) 2011 vs 2013 data



Central columns & bottom rows selected for 2011 data

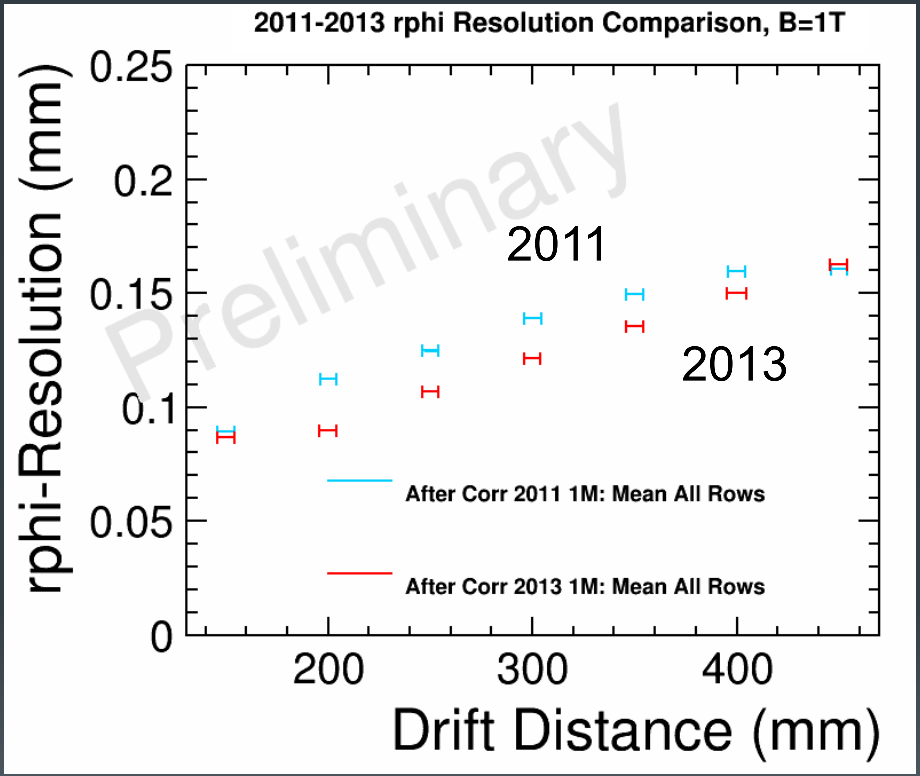
One module (central) for 2013 data

Pads Selection comparable to N.Shiell

One module data (400ns) shows much worse performance than data with 100 ns.
Rows selection for 2011 does not help much – points lay flat across drift distances.

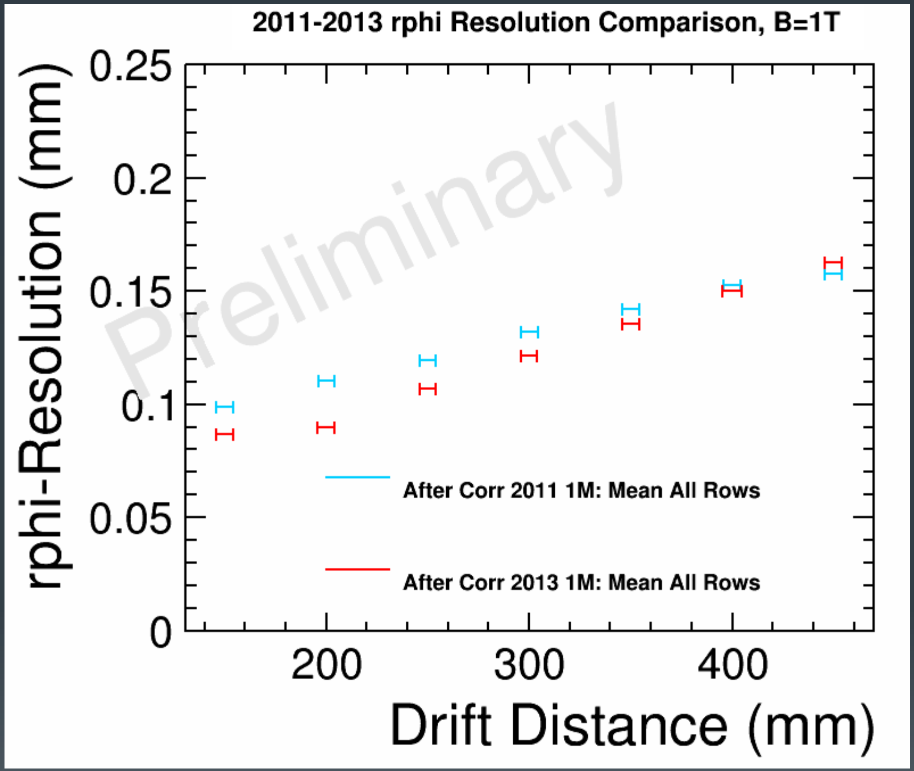
r-phi one module comparison (2011 vs 2013 data - 400 ns)

With all rows



One module (central) for 2013 data

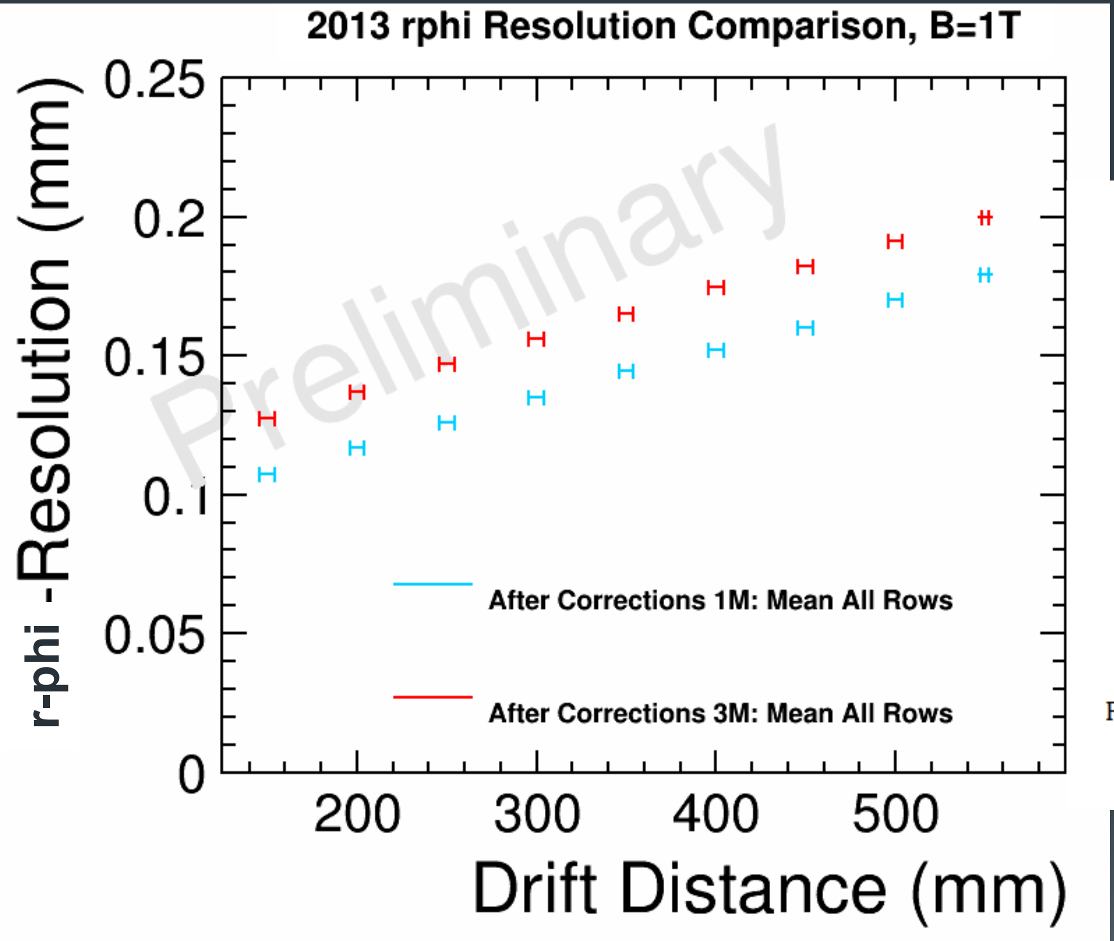
Central columns & bottom rows



Pads selection comparable to N.Shiell

One (central) module data shows better performance in r-phi for 2013 data? Needs to be confirmed.

Vs One Module data



Wenxin

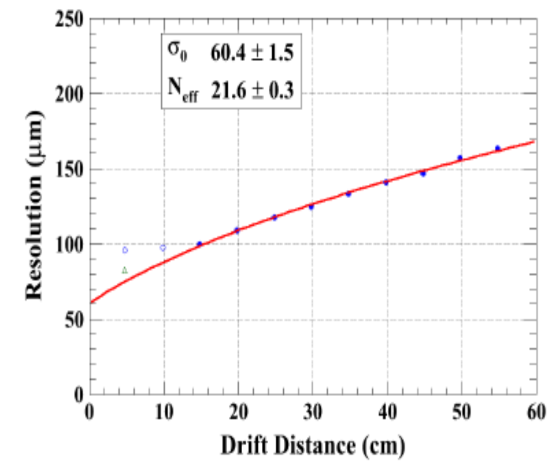
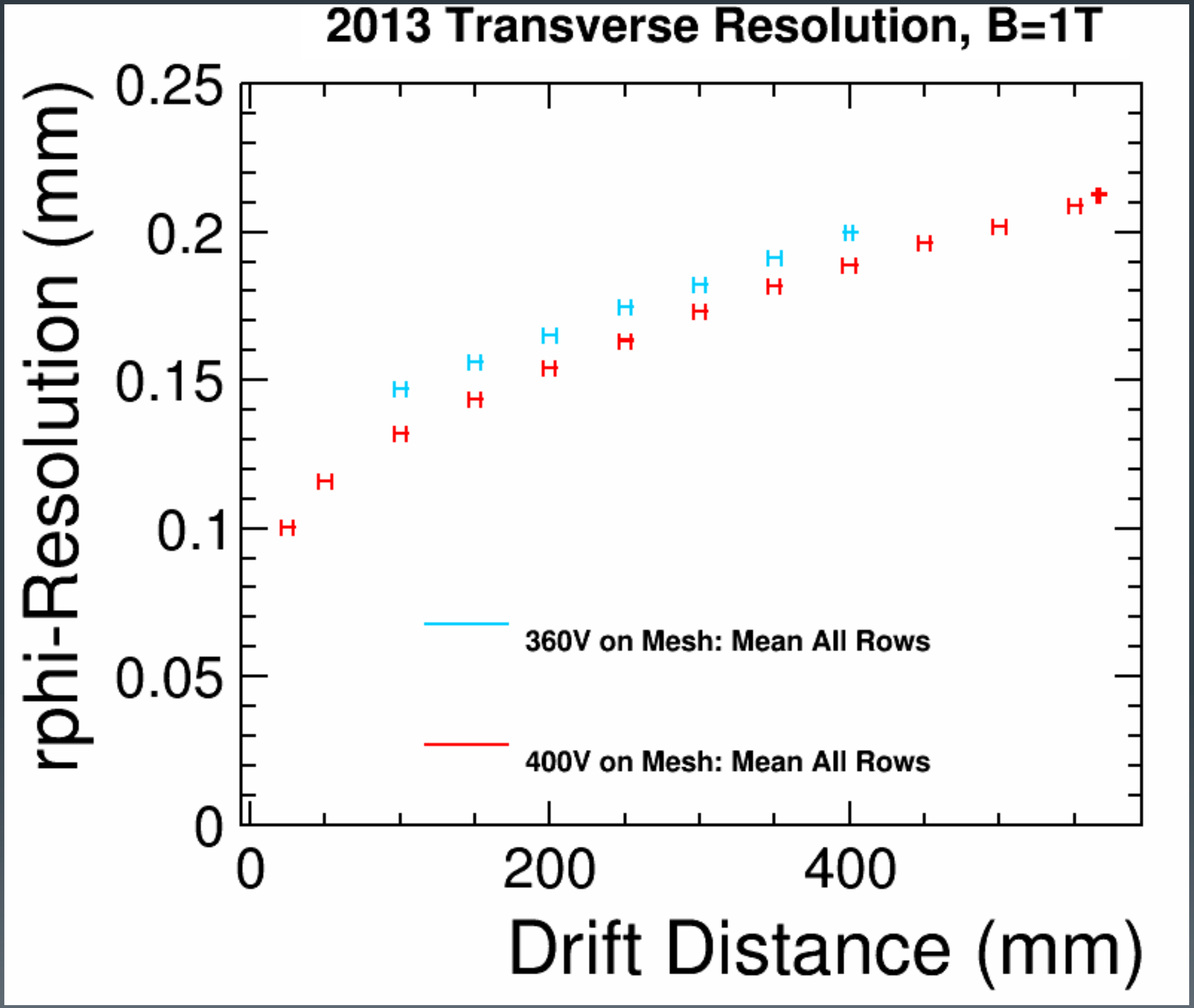


Figure 7-23. Spatial resolution of the central module at B=1 T. Data with seven modules taken in 2013.

One model selection apparently produces better resolution than 3 module together

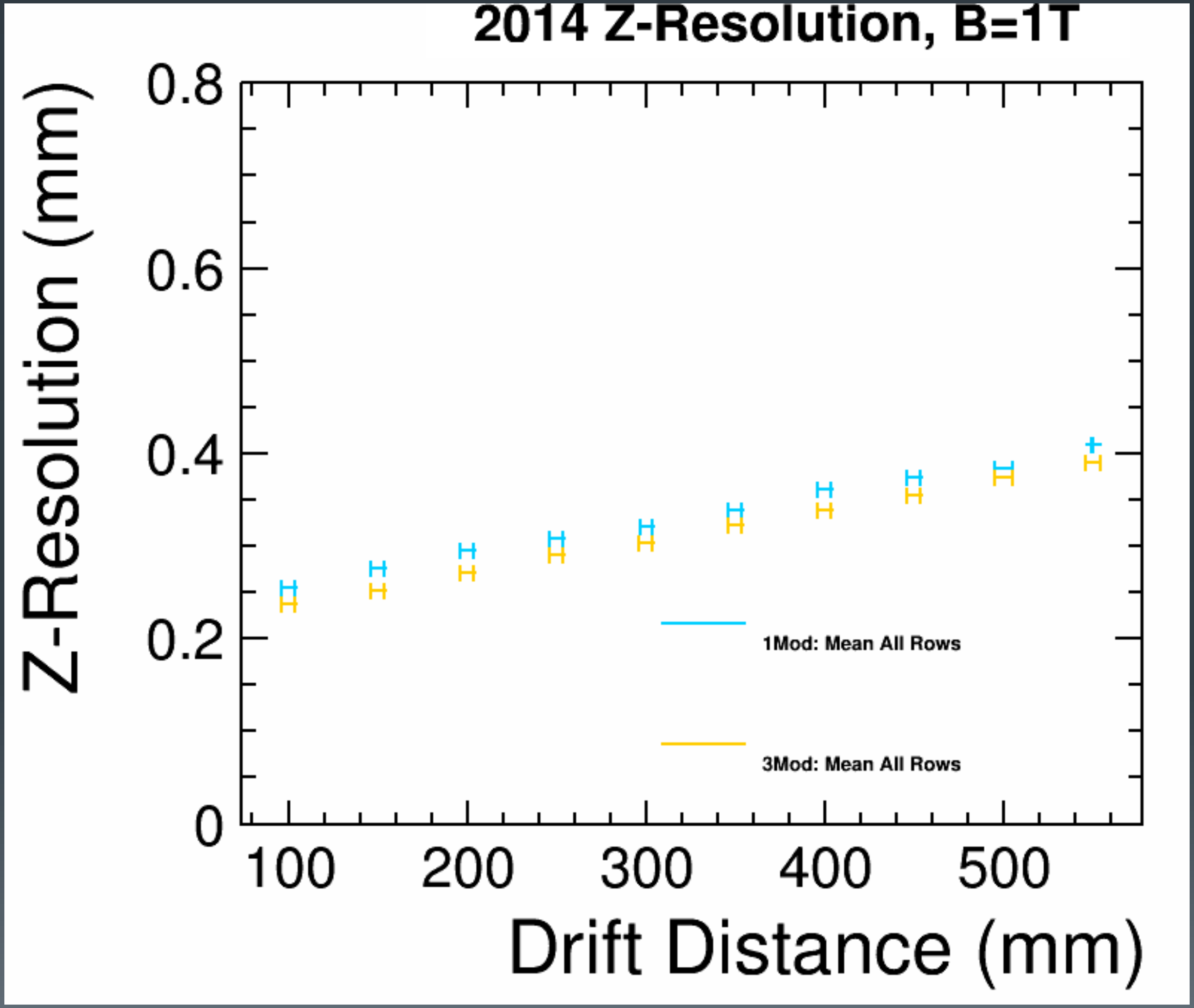
One module (#3) data is better in rphi than 3 module together and pretty close to previous Wenxin analysis of 2013 data made with MarlinTPC code.

Varying voltage on Mesh



400 V on Mesh does slightly improve the resolution performance. however could dangerous due to sparks (close to the limit).

2014 data: 3 module v 1 module Z resolution



Just to check: 3 modules data should be better than the one module (a subset).