

Pulse Time Estimators and Simulation.

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- Pulse Time Estimators: A Comparison
- Detailed Simulation: High magnetic fields and long ILD like TPC
- Detailed Simulation: Distortions and Momentum Resolution



Different Methods to Obtain a Pulse Time

Functionality provided through `PulseFinder` class:

- 0 Inflexion Point: Time is the inflexion point of the rising slope
- 1 Parabola Fit: Time and/or charge is determined by parabolic fit
- 2 Center of Gravity: Time is the center of gravity of the charge
- 3 First above threshold: Time is the first sample above the start threshold
- 4 At maximum: Time is the first sample at the maximum
- 5 Constant fraction: Time is at the constant fraction of the maximum pulse
- 6 Gamma fit: Time from a Gamma4 function fit to the pulse
- 7 Center of Gravity at maximum: COG for given bin range around maximum

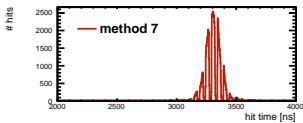
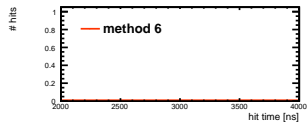
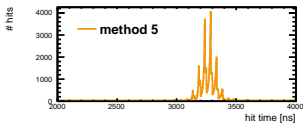
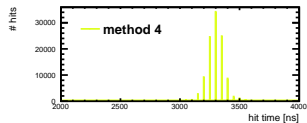
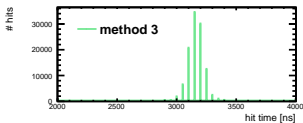
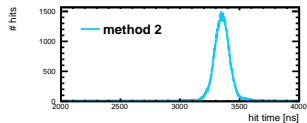
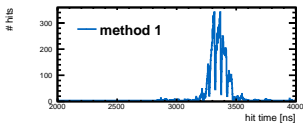
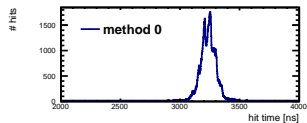


General Observations

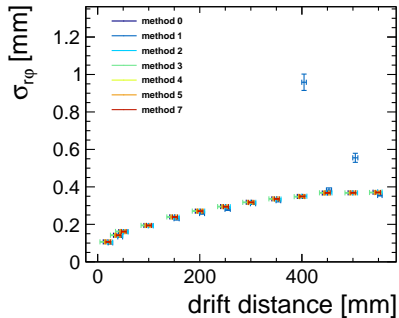
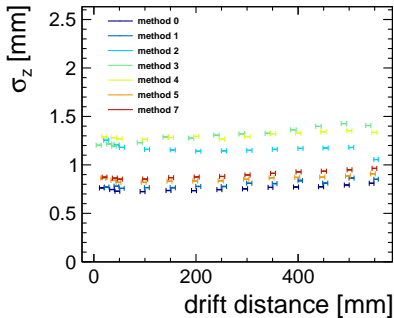
- Method has no influence on rphi resolution and distortion (as expected)
- Method has no influence on z distortion
- Method 6, the gamma4 fit currently gives a too wide spread in times for successful tracking
→ more work needed to understand the problem
- Methods that use binned information (e.g. maximum bin) are worse (as expected)
- Methods that use fits can be unreliable (e.g. how to handle failed fits?)
- Results are the same for 0 and 1 T



Time Distributions



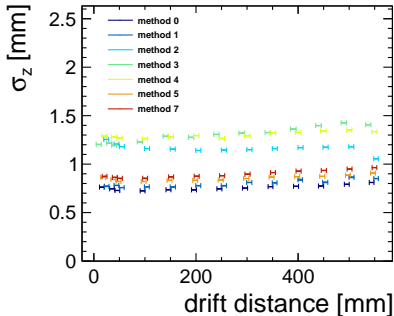
Results on Data



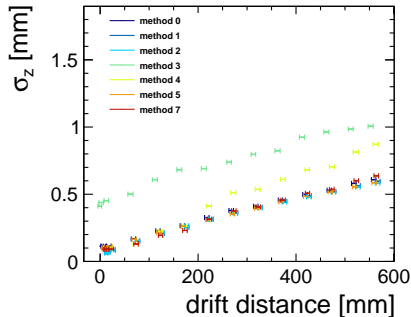
→ inflexion point methods gives the best results

Comparison with Simulation

Data



Simulation

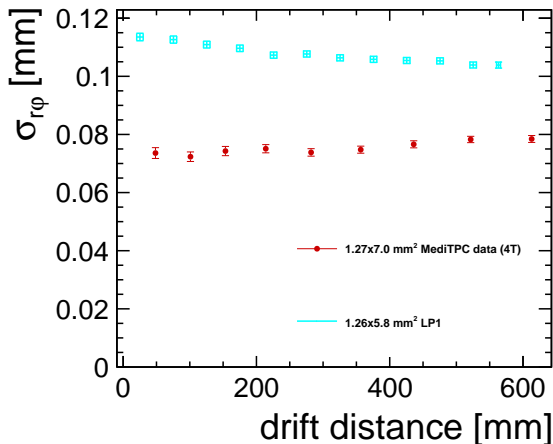


→ inflexion point methods gives the best results



Simulation for High B Field and Long TPC

For T2K at 3.5T the resolution dropped in the simulation.
Not expected from previous measurement.

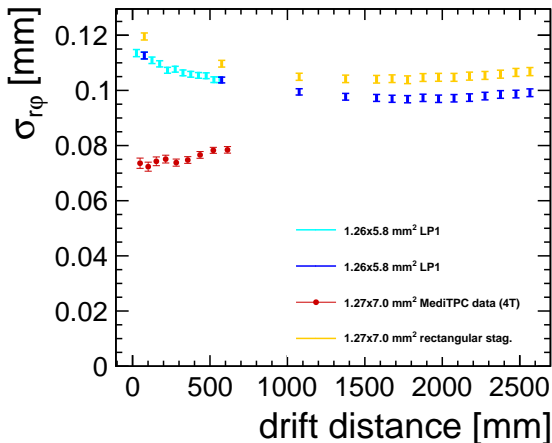


Investigate further whats going on...



Simulation for High B Field (4T) and Long TPC

Extend the TPC length to a full ILD TPC:

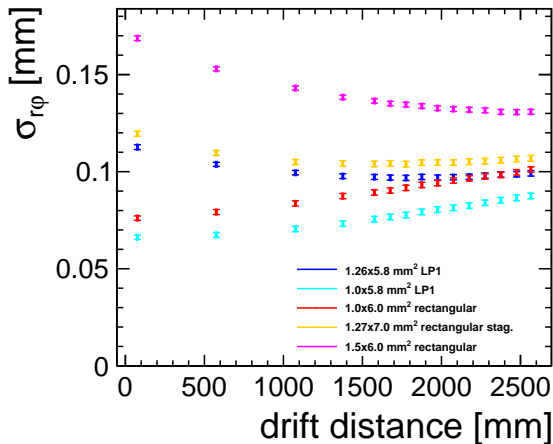


Simulation does not match old MediTPC data.



Simulation for High B Field and Long TPC

Try different pad geometries:

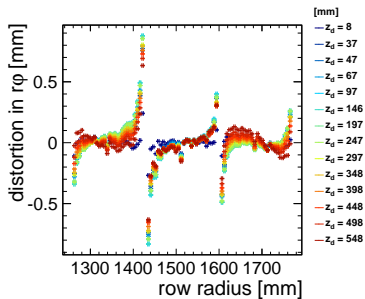


Simulation of 1x6 mm² matches MediTPC data.

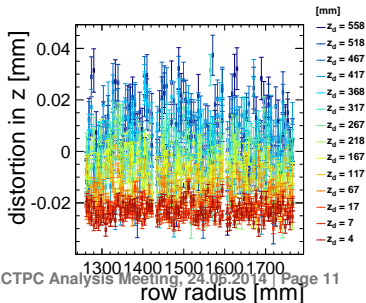
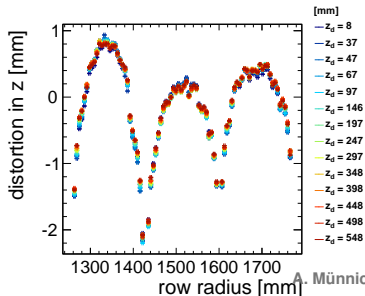
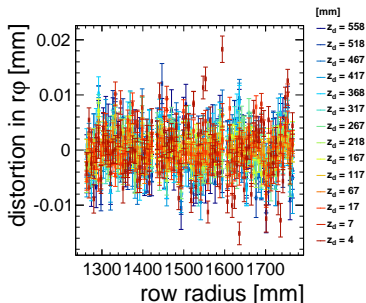


Simulation: Distortions

Data

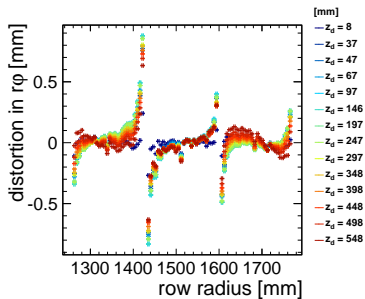


Simulation

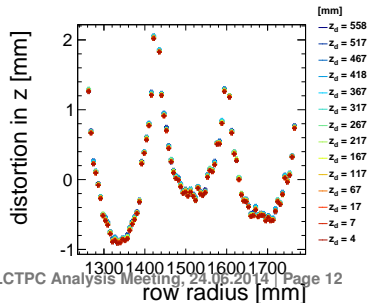
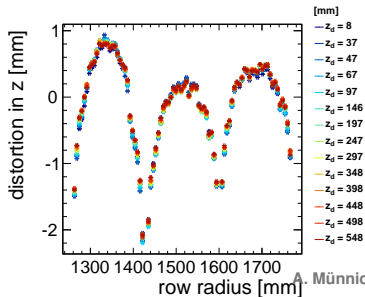
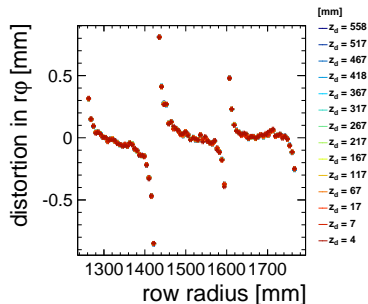


Simulation: Distortions

Data

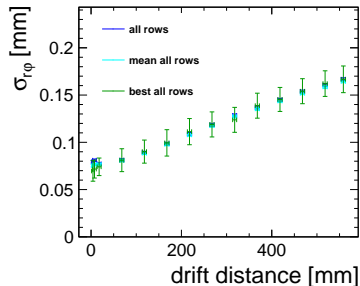


Simulation

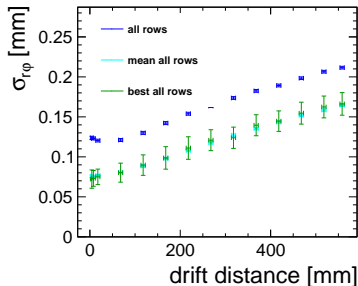


Simulation: Single Point Resolution r_φ

No distortions



With distortions

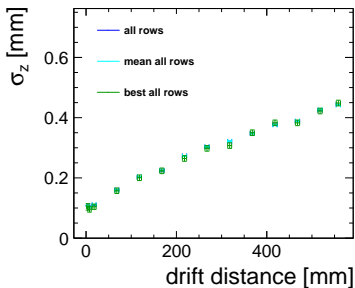


→ mean all rows shows no reaction to distortion, as expected

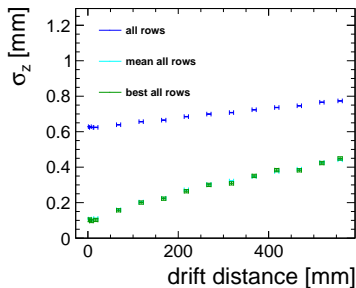


Simulation: Single Point Resolution z

No distortions



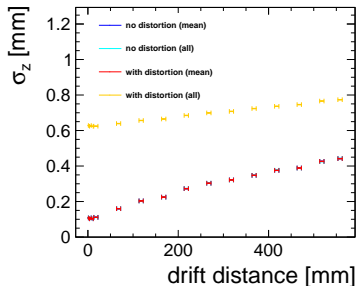
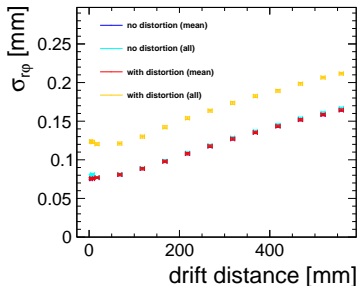
With distortions



→ distortions flatten z resolution
but mean all rows stays the same



Simulation: Single Point Resolution

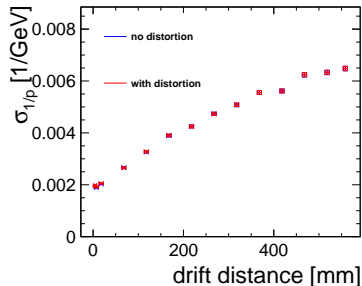


→ Mean of all rows is a good value to evaluate single point resolution with the exclusion of distortion effects as best as possible at the moment.

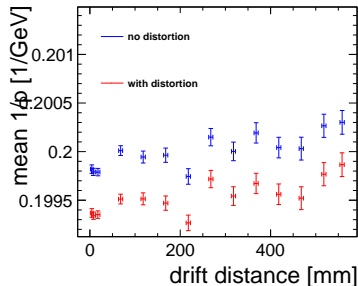


Simulation: Momentum Resolution

width of $1/p$ distribution



mean value (5 GeV beam)

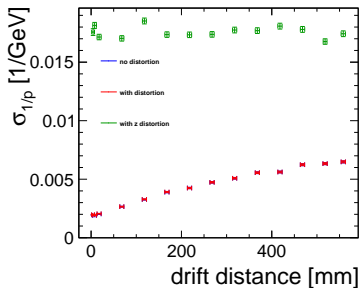


- Small reaction to distortions: Why?
- Distortions are symmetric, and most points are at 0

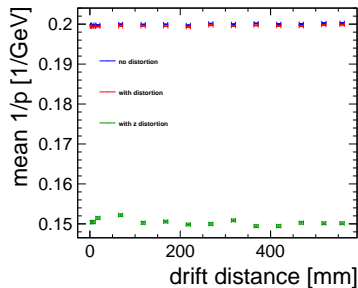


Simulation: Momentum Resolution

Apply z distortions in rphi:
width of 1/p distribution



mean value (5 GeV beam)



Pulse Time Estimators:

- For now we keep the inflexion point method as standard
- More work on gamma4 fit needed
- Easy to test/add new methods into software structure

Simulation:

- More confidence in simulation at high magnetic field
- Goal can be reached with a pad width of 1 mm
- Small increase in pad width from 1 to 1.26 mm has large effect on resolution
- Match between simulation and old data set not great
- Plan: Reconstruct and analyze MediTPC with MarlinTPC to be able to compare (→ summer student project)

