Bias Correction for GEM / Angle Effect Studies / Radial Distortions Analysis

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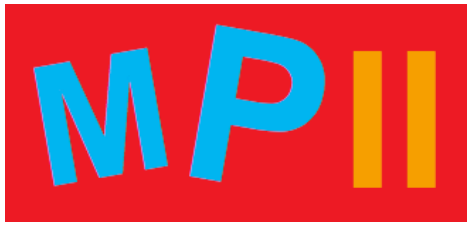
Analysis meeting
22.07.2014



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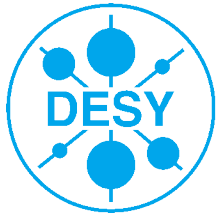


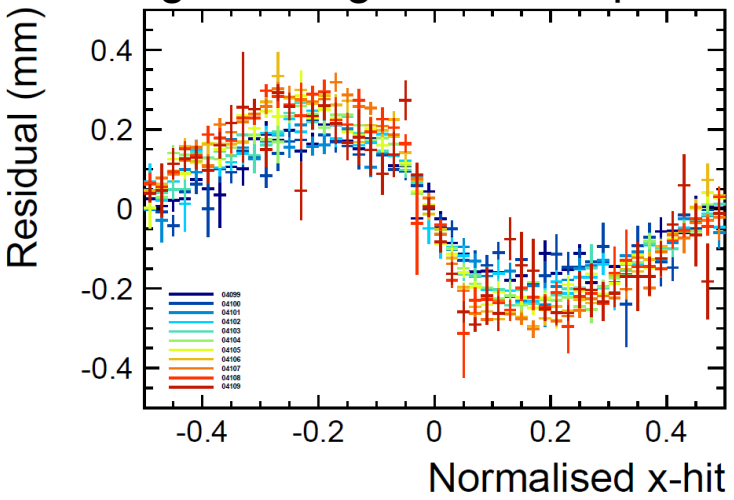
Bias Correction

Bias Correction Studies: Micromegas

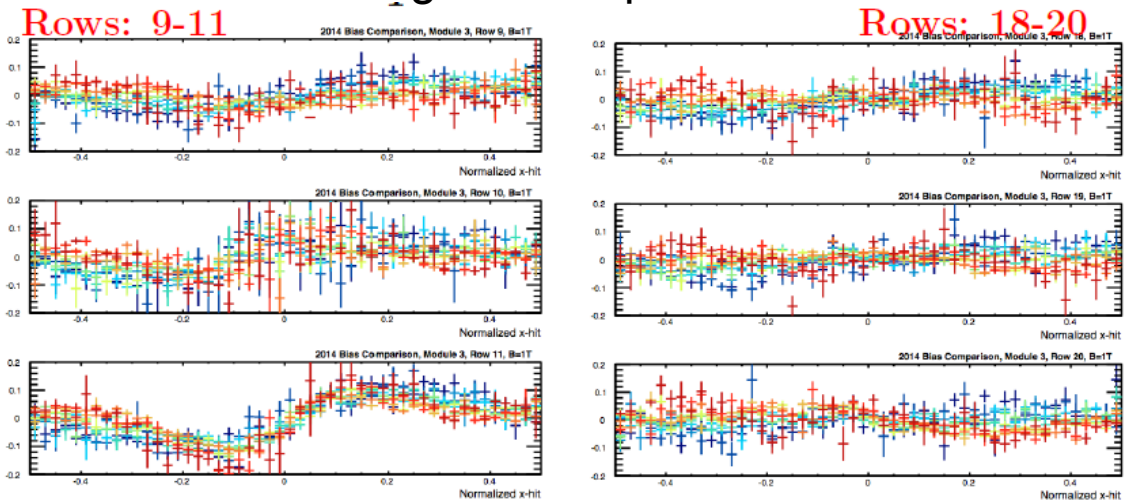
- Micromegas:
  - Large oscillation visible if weighted mean is used as a position estimator
  - Oscillation greatly reduced if PRF is used
  - Remnant oscillation from imperfections of the resistive coating ?!

$$x_{hit} = \frac{x - x_{pad}}{d + \Delta}, \; [-0.5, 0.5]$$

Micromegas: Weighted mean position

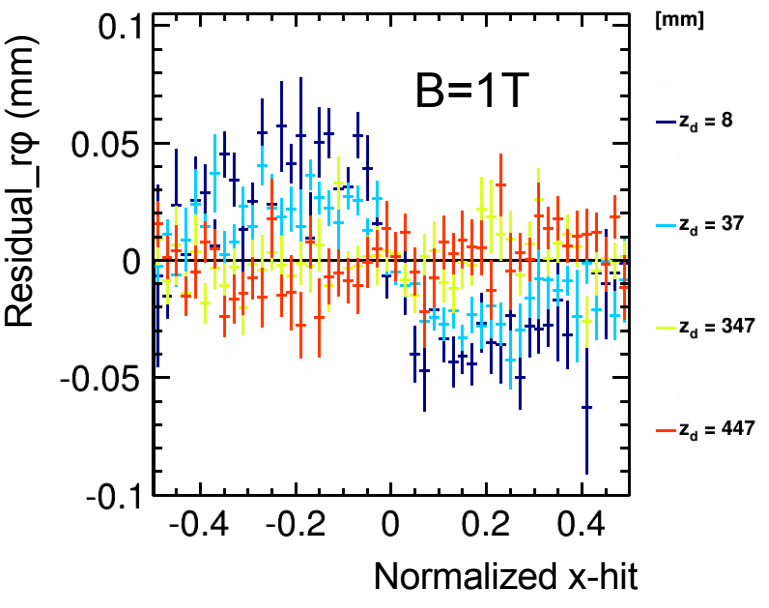


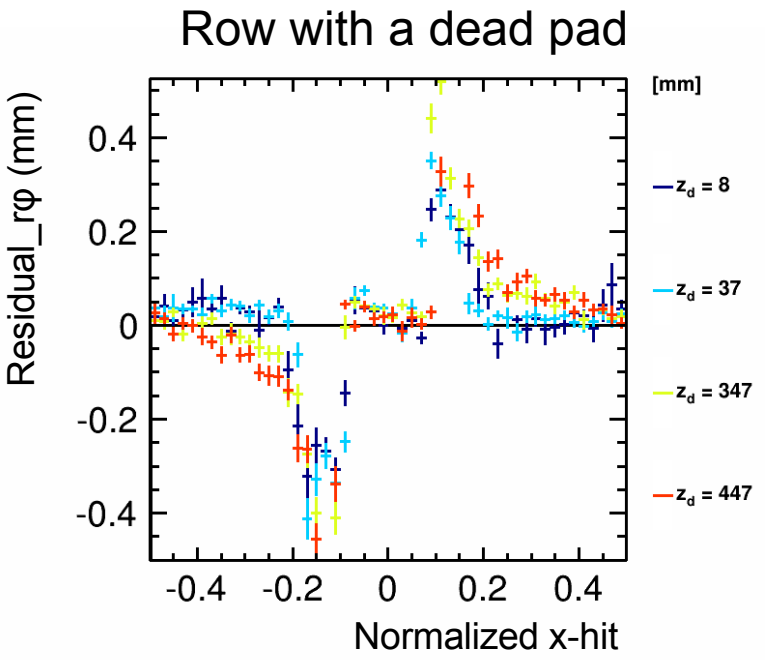
Micromegas: PRF position



Bias Correction Studies: DESY GEM

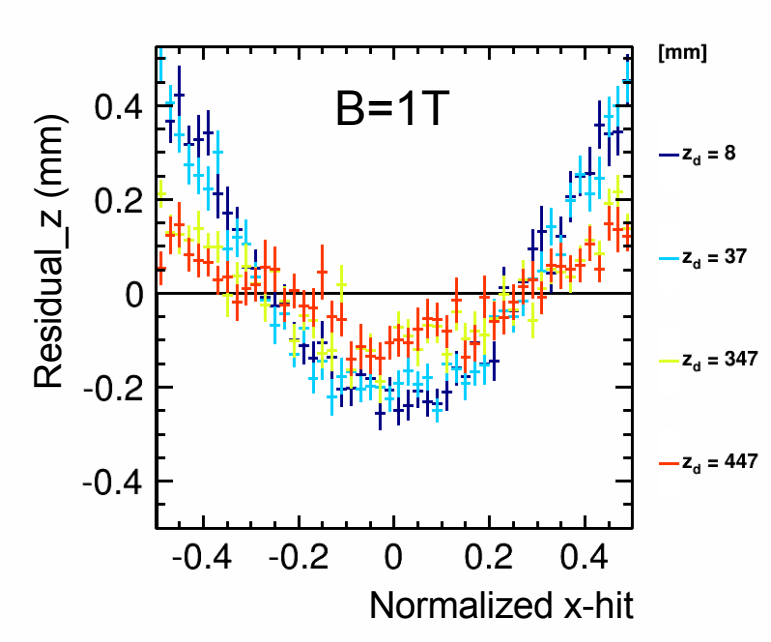
- Check this for DESY GEM beam data
  - Oscillation of ~ 50 µm visible (weighted mean as a position estimator)
  - Gets smaller with longer drift distance / larger charge spread (not visible for B=0T data)
  - similar/same as pad response correction?
  - To do: Implement treatment of dead pad apart from tagging

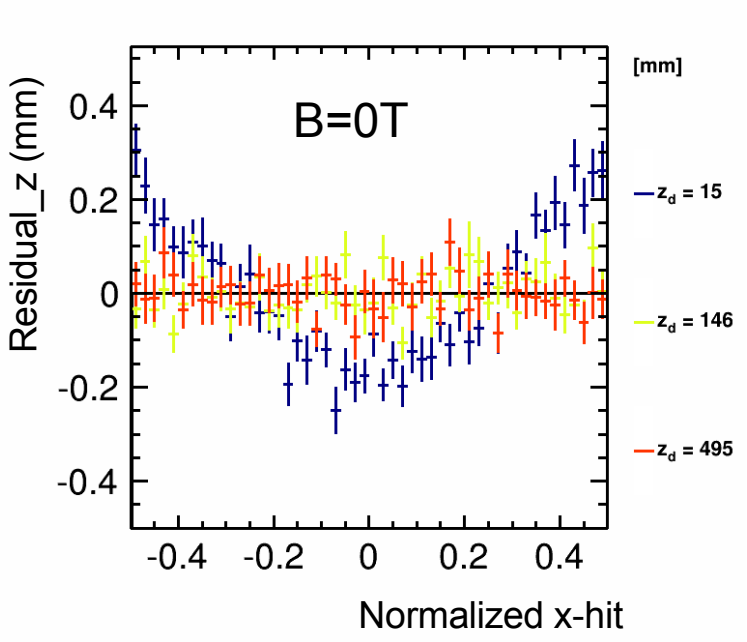




Bias Correction Studies: DESY GEM

- Check z effect as well
  - Parabola shape structure
  - Dependence on the drift distance
  - Charge dependent effect?
  - To do: check different time calculation methods?

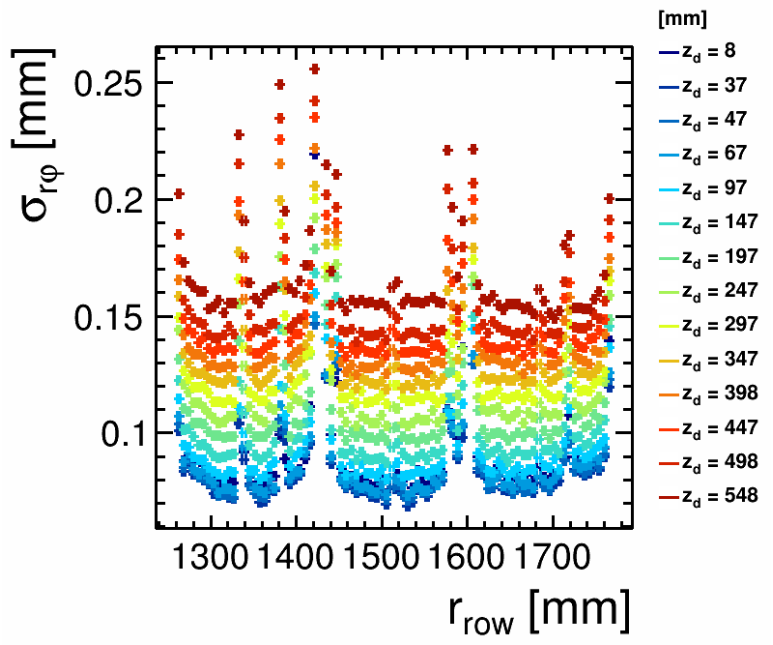


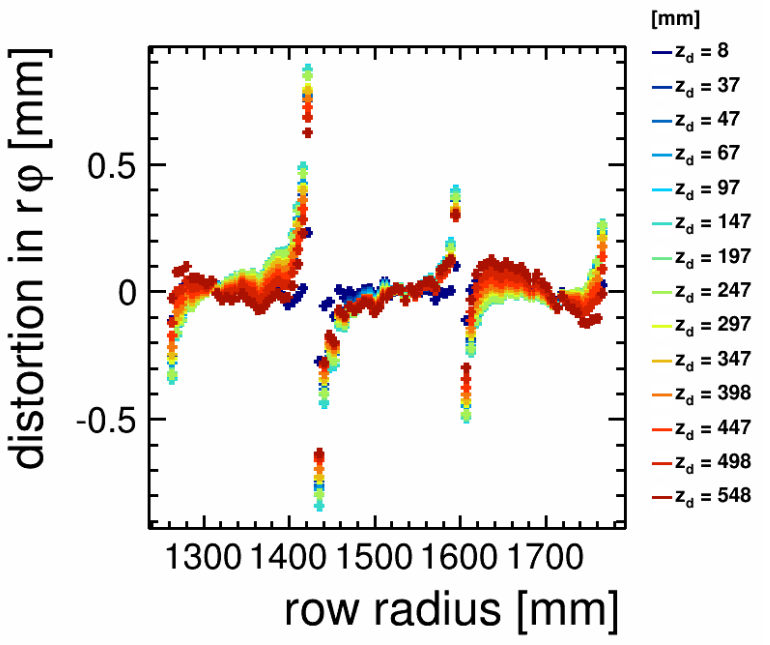


Angle Effect Studies

Local Hit φ Angle

- Observation: Resolution of the outer rows is worse
  - Distortion do not only shift but widen the residual distribution?
  - Due to the shift, a local phi angle of the hit worsens the hit position reconstruction?

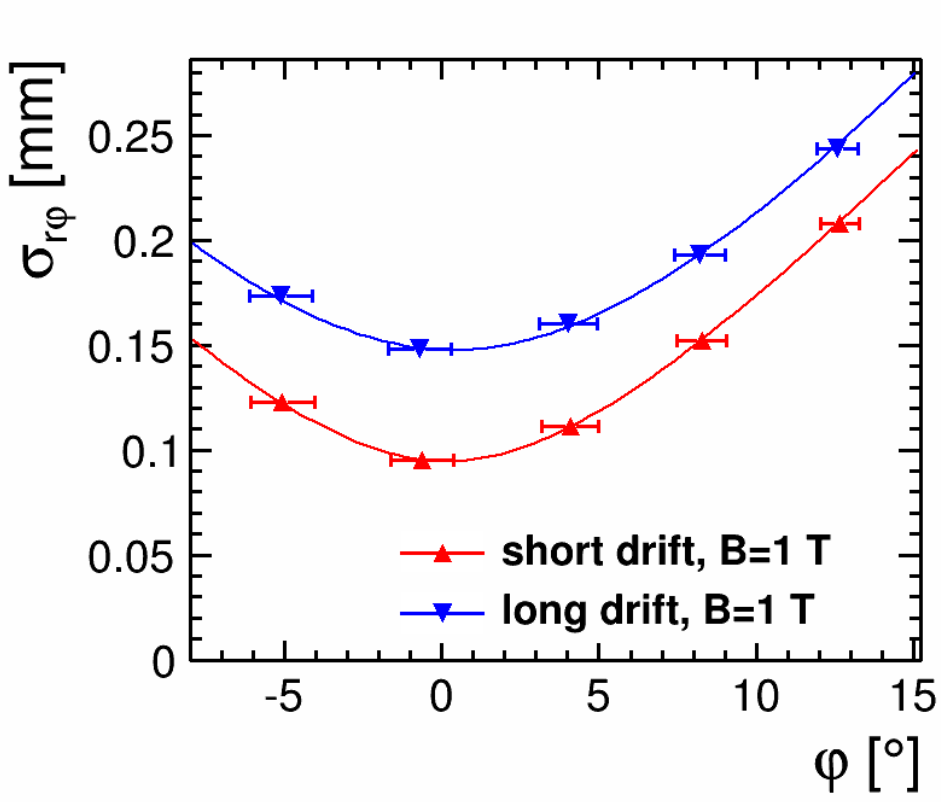




φ Dependent Point Resolution

- Hit reconstruction is dependent on the angle of the track relative to the pad

$$\sigma_{r\varphi} = \sqrt{\sigma_{0,r\varphi}^2 + \frac{L^2}{12 \cdot N_{eff}} \cdot \tan^2(\varphi - \varphi_0)}$$

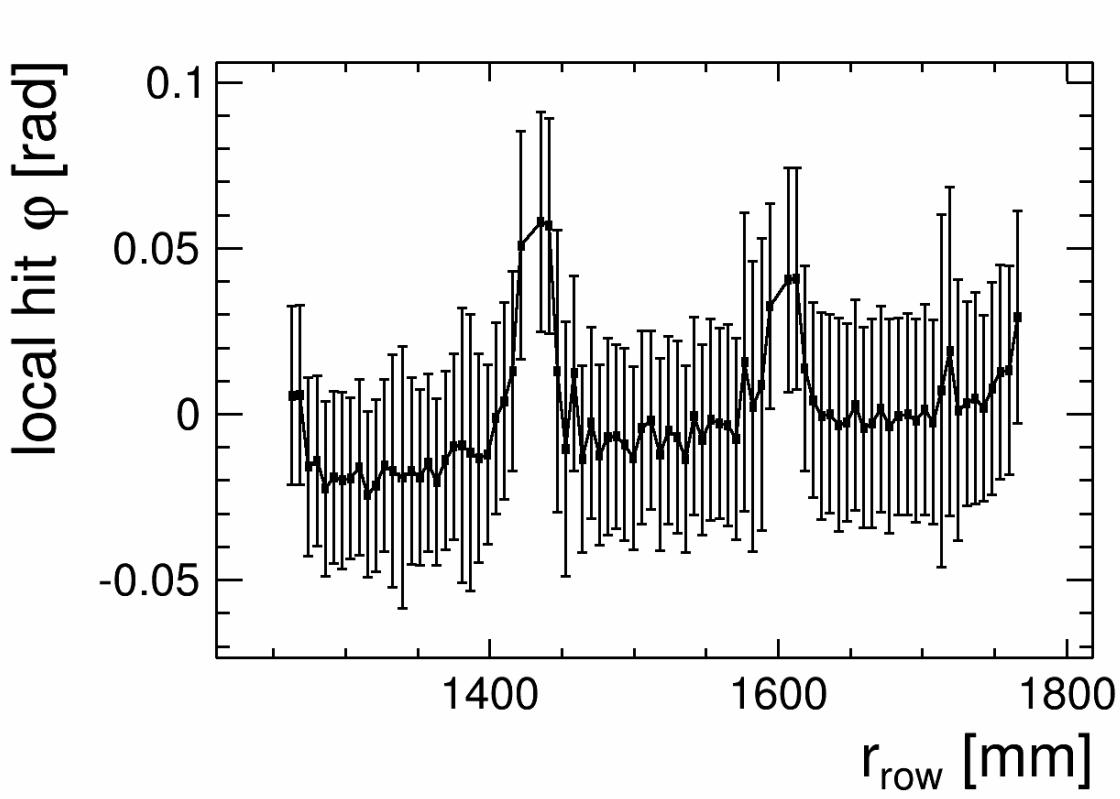


Local Hit Angle

- How to determine the local hit angle
  - Relative to the reconstructed track does not work as the the track does not describe the S-shaped distortions (we need the real physical position of the electrons reaching the amplification structure)
  - Triplet method, distortion ~ 2-3 rows, 3 rows might bias the results too much
  - 2 Hit method
- 2 Hit Method
  - Take the hit under study and the previous hit and do a track fit
  - Relative angle between this fit and the pad orientation
  - Check module boundaries (don't use hit from other modules)
  - For the first row, take the next instead of the previous hit

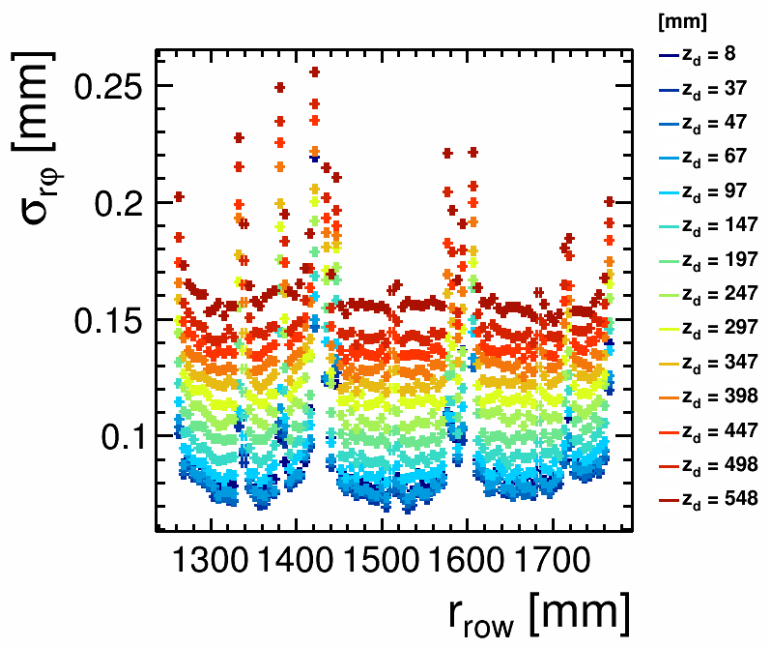
Local Hit Angle

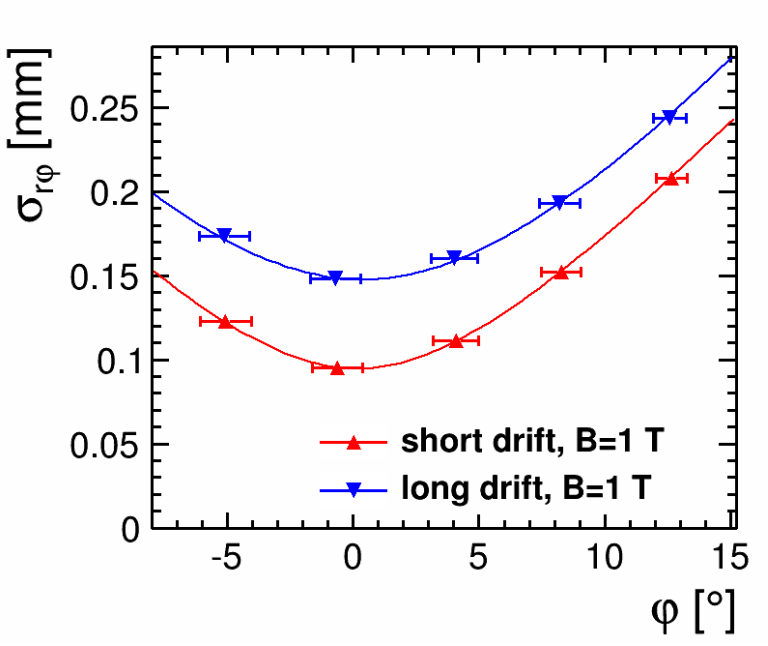
- Peak differences are ~3.5 degree



Resolution Deterioration

- Can the local hit angle explain the deterioration of the resolution?
  - Not completely
- Mixture from local hit angle and field distortions most reasonable





Radial Distortions Analysis

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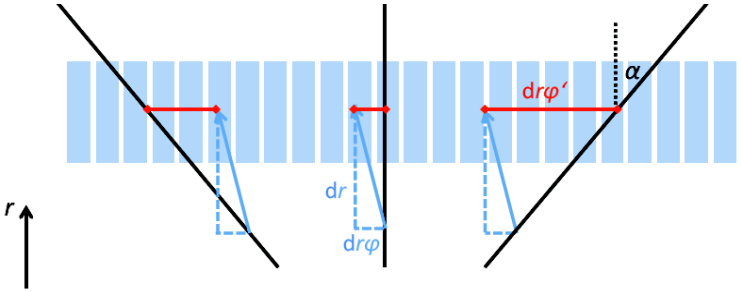
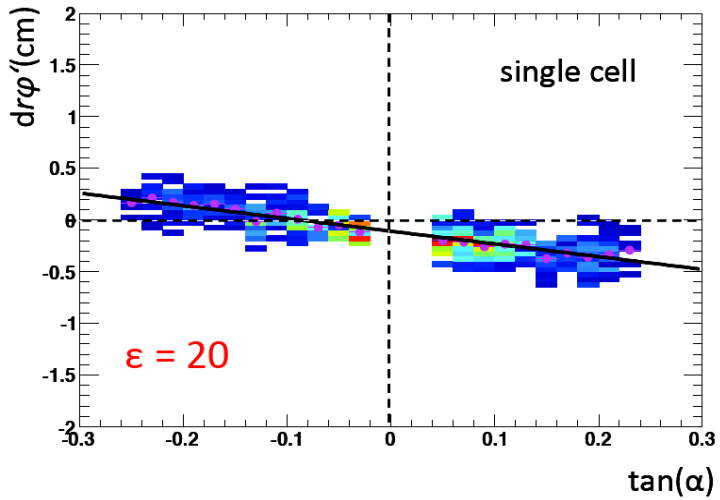
DESY

fast simulation





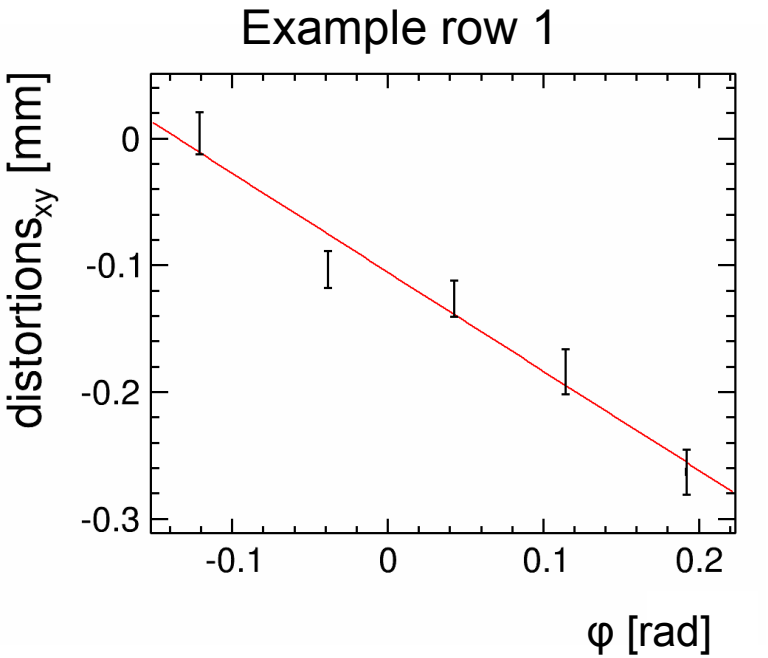
- assume static space-charge configuration within Δt_{calib} = 5 ms → 250 minimum bias events
- analyze residuals of TPC clusters with respect to ITS-TRD reference
- map residual distortions in 72,000 volume elements of size 16cm(*r*) x π/72(φ) x 10cm(*z*)
- 2D – analysis to disentangle *dr-drφ* correlations:

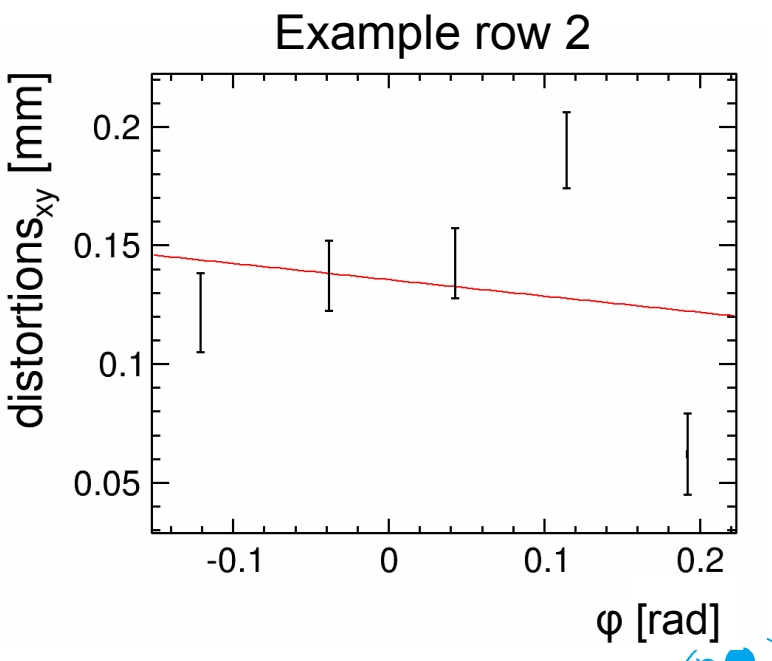
$$\mathrm{d}r\varphi' = \mathrm{d}r\varphi + \mathrm{d}r \cdot \tan\alpha$$

→ extract d*r* and d*rφ*

Straight Line Fit

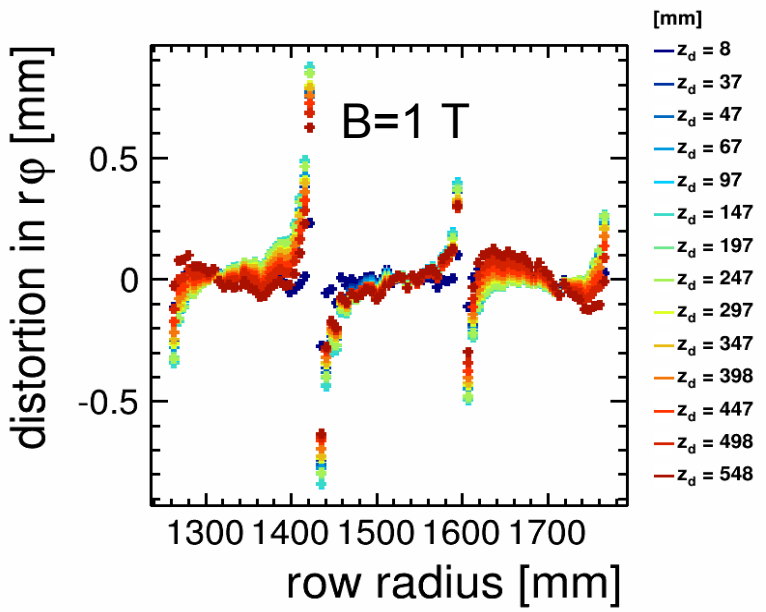
- Need to use phi scans!
- 5 point with and without magnetic field
- In contrast to the previous analysis the relative angle between the hit and the reconstructed track is used

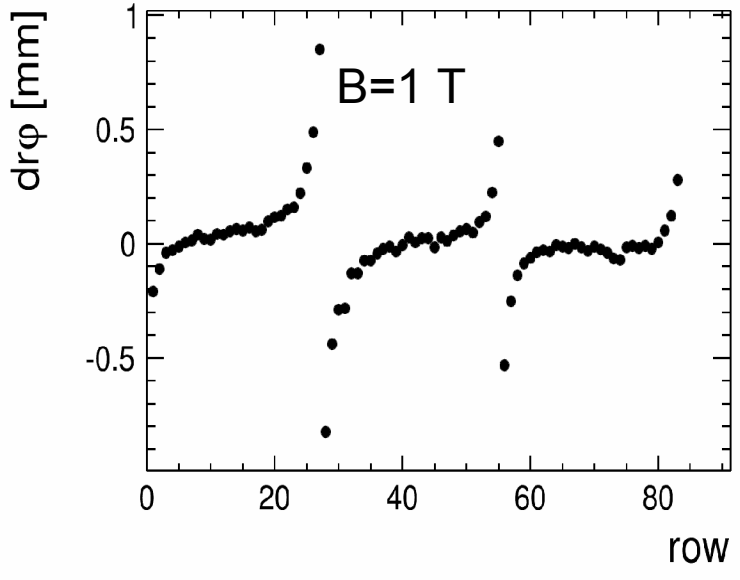




rφ Direction

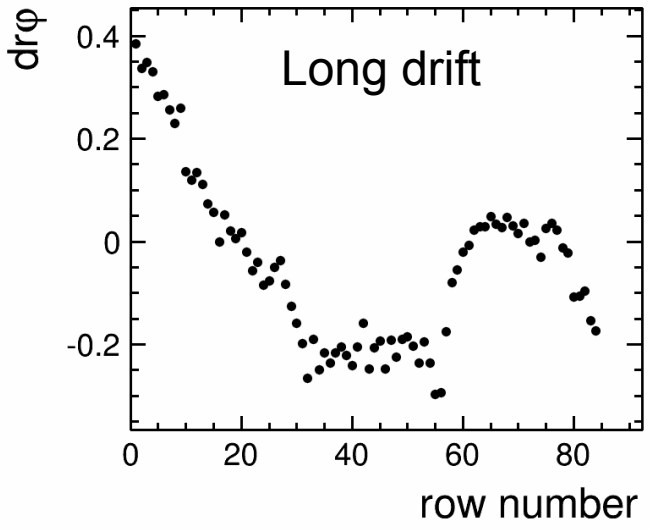
- The straight line fit is not always perfect
- Check reliability of the results
- Compare corrected rφ distortions with old rφ' distortions at φ = 0°
- Same structure as well as similar value -> good agreement

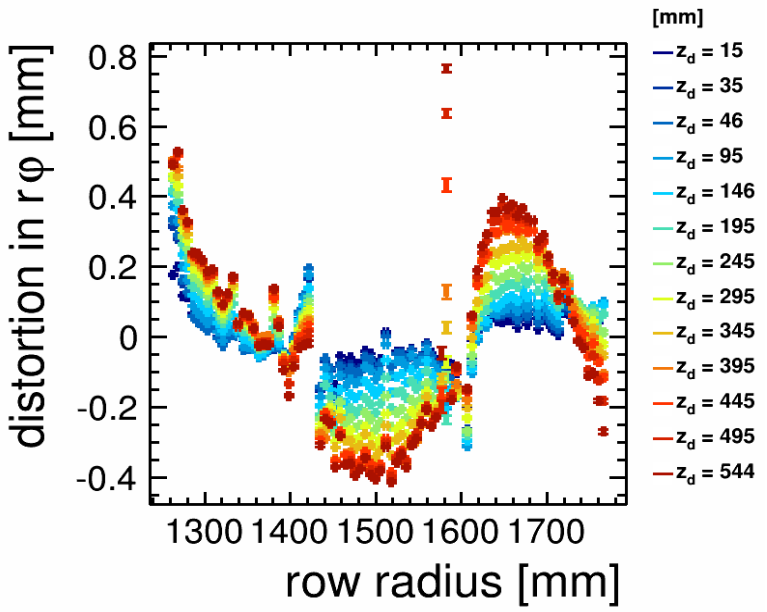


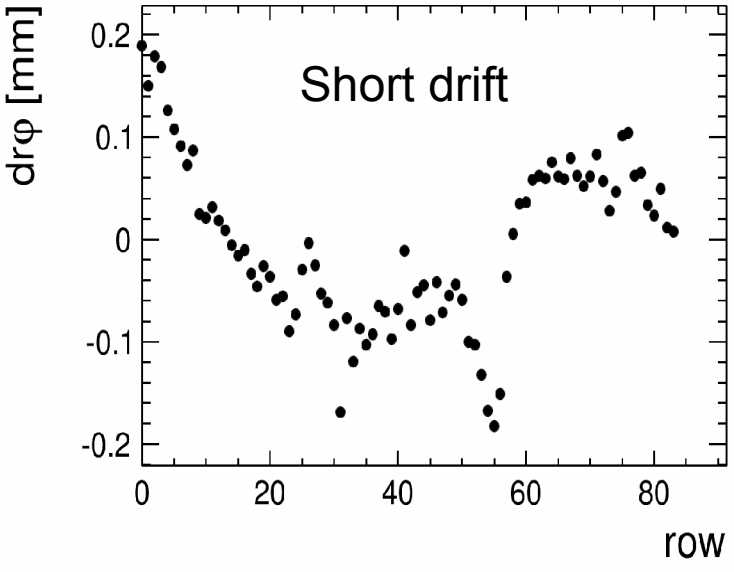


rφ Direction

- Good agreement at B=0T, too
- Z dependence is also still visible

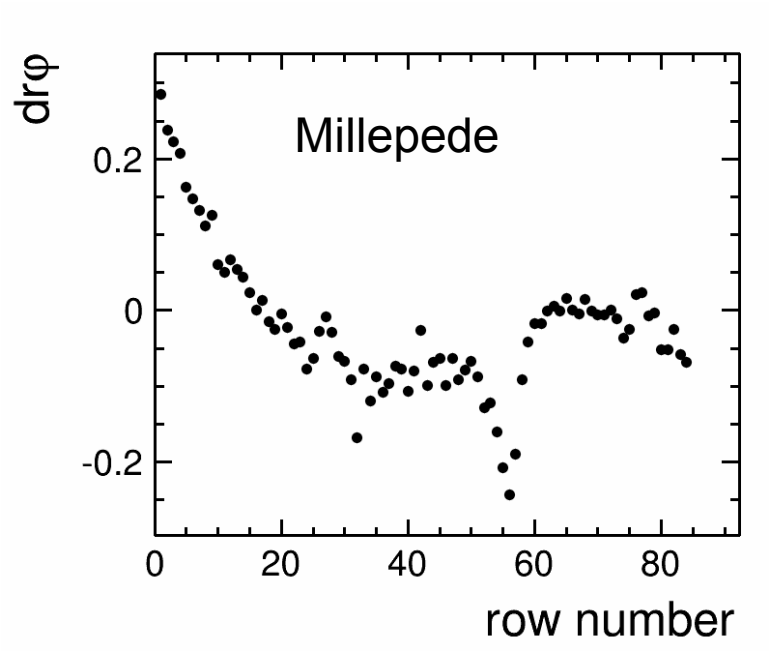


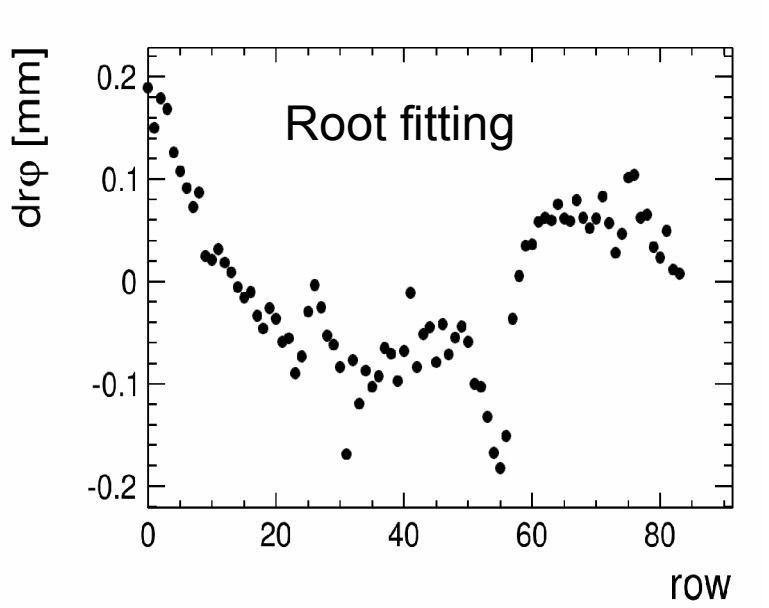




r Direction

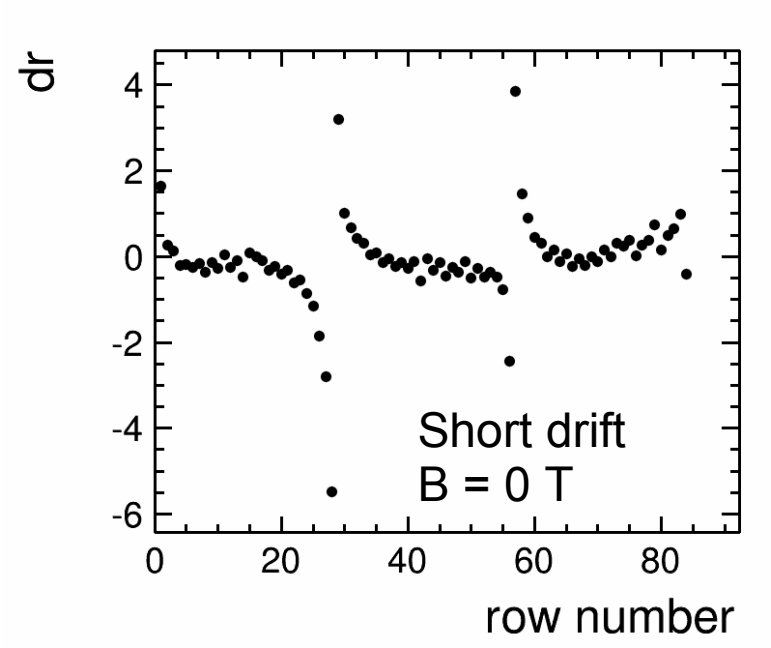
- Changed the calculation Method
  - Use Millepede
  - Minimal biased results
  - Technically easier to perform (less scripts, easier handling of the phi values)
- Good agreement

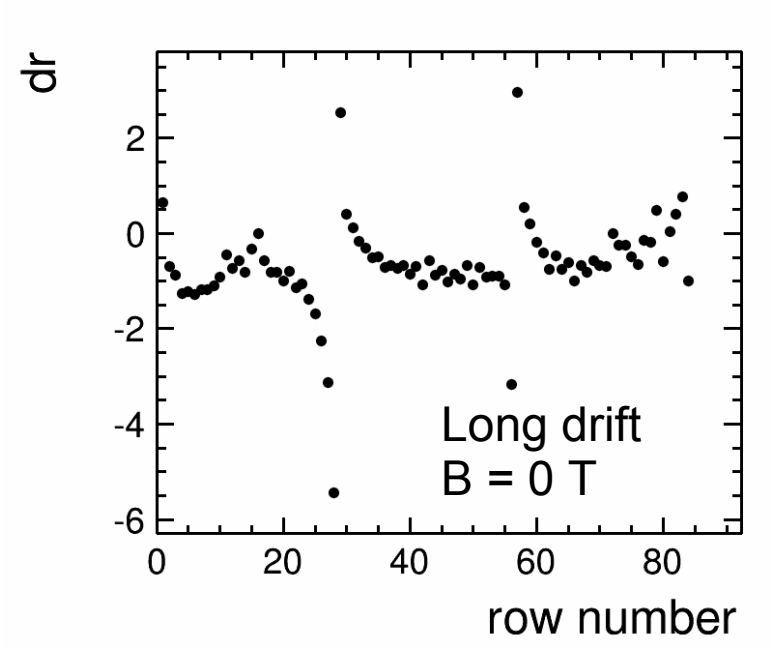




dr Analysis

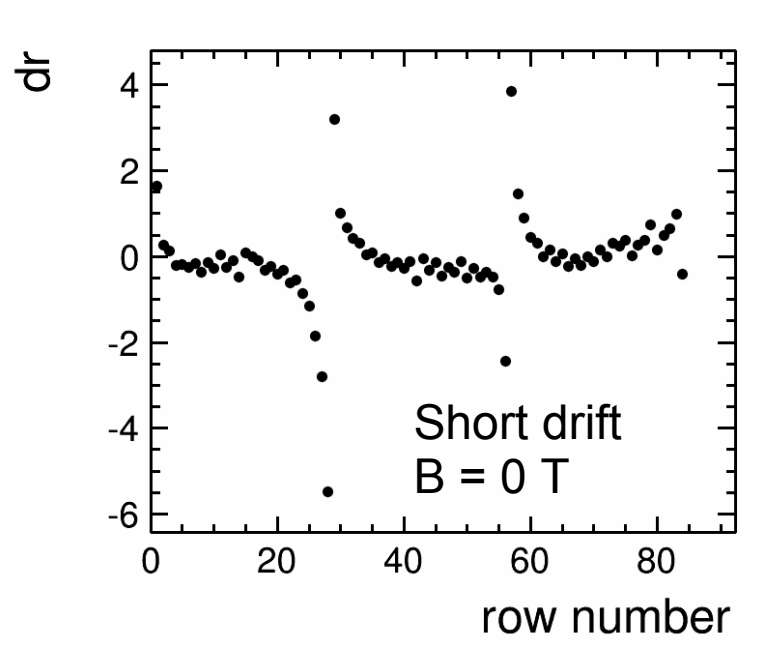
- Expect S-shape as the electrons are sucked into the gaps
- Z dependence visible at the outermost measuring points
  - Inhomogeneity of the drift field?

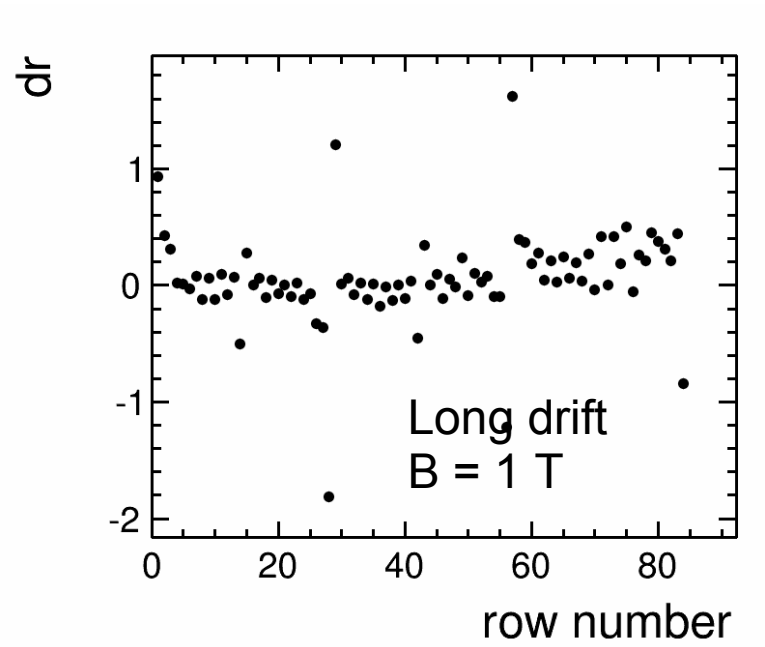




dr Analysis

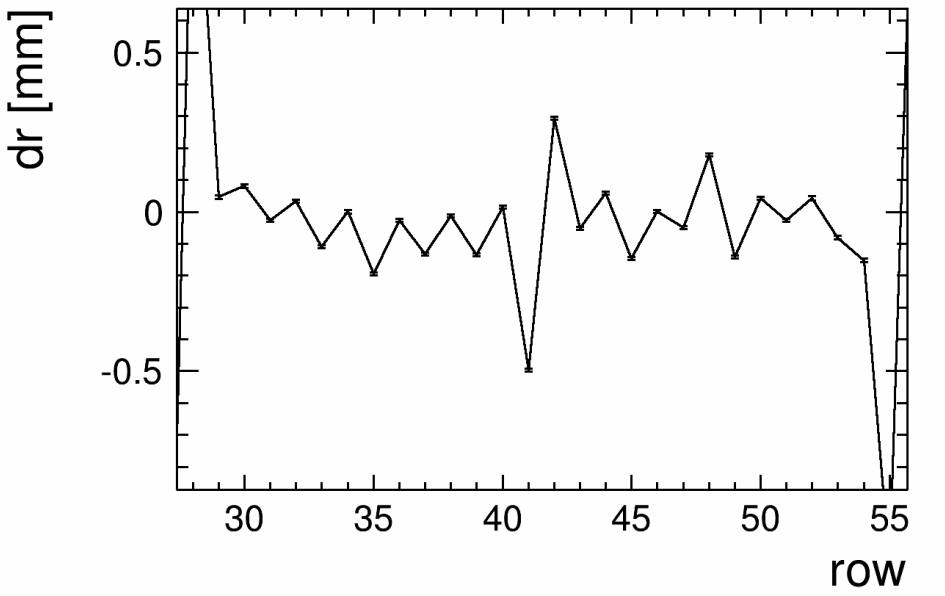
- B = 1T data shows nearly no z dependence (see backup)
- r-distortions are reduced for B = 1T because the electrons follow the magnetic field
- The horizontal bar of the ceramic grid is visible in the data





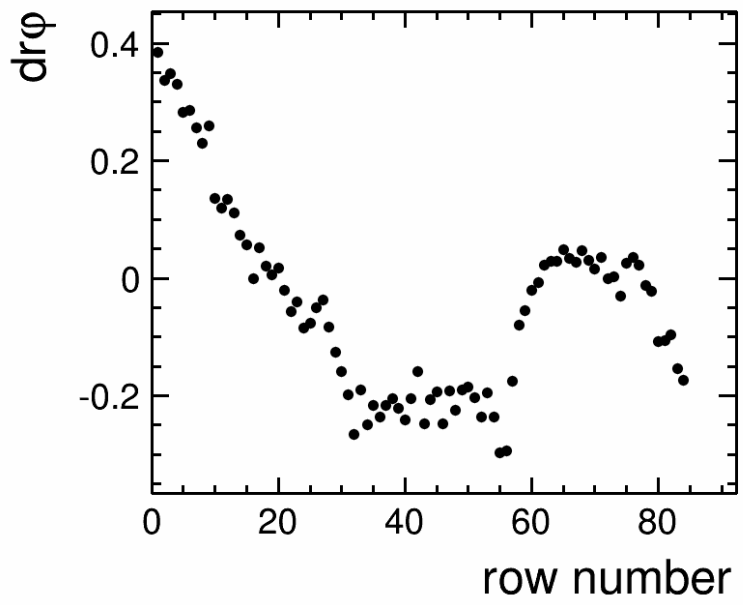
Open Issue

- We observe a zigzag pattern in the distortions in r
  - Does the staggering of pads have an effect on the r value?
  - Would be great to check this on AsianGEM and Micromegas data as well (Wasn't there also something in the AsianGEM data? In rφ?)

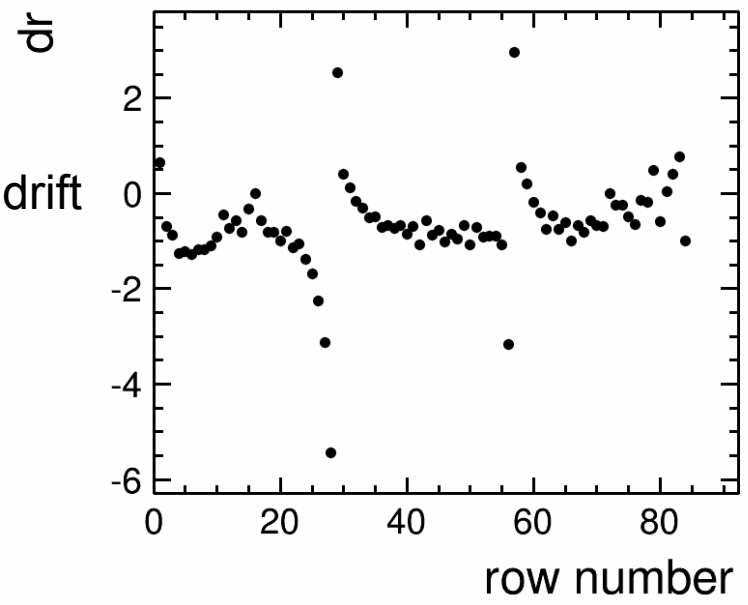


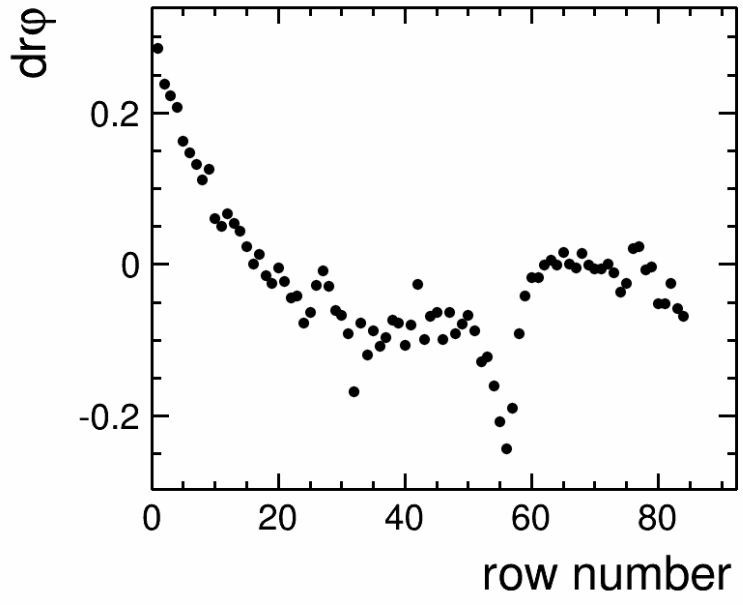
Backup

Using Millepede B = 0 T

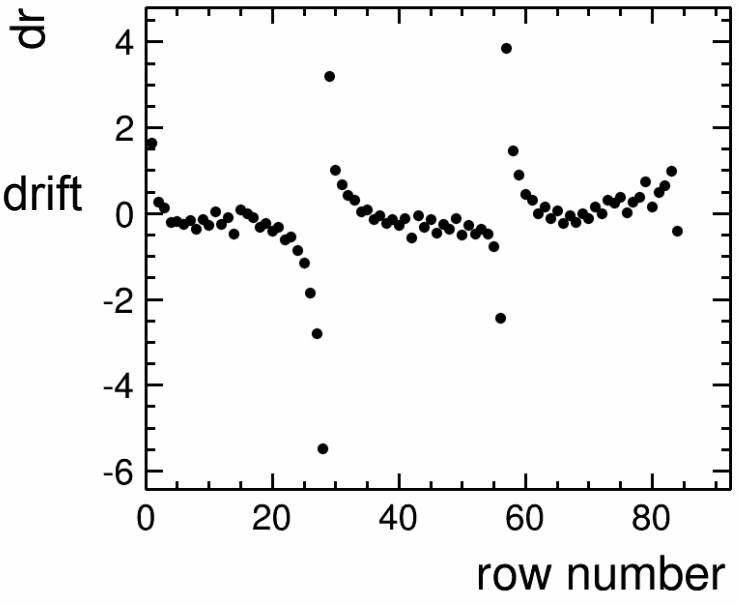


Long drift

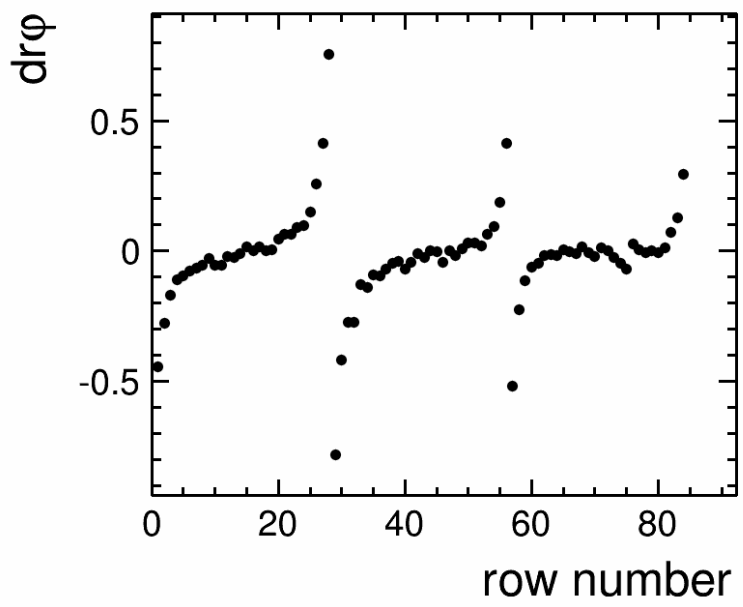




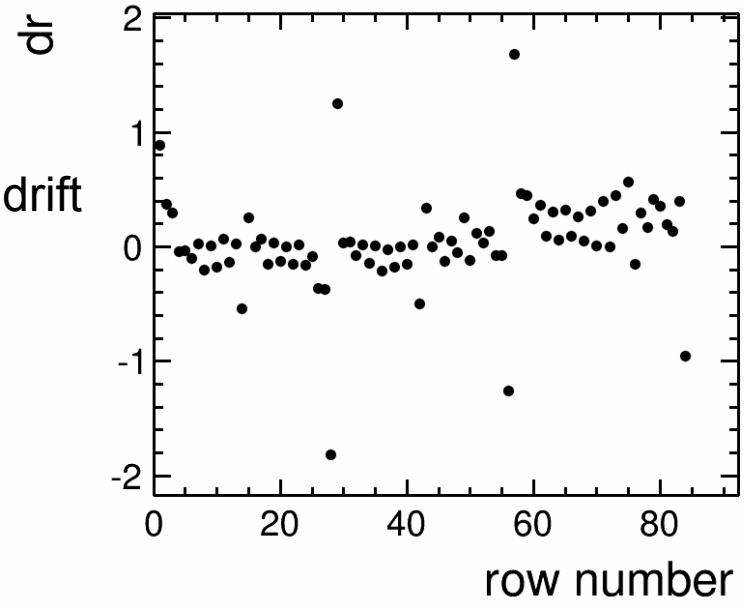
Short drift

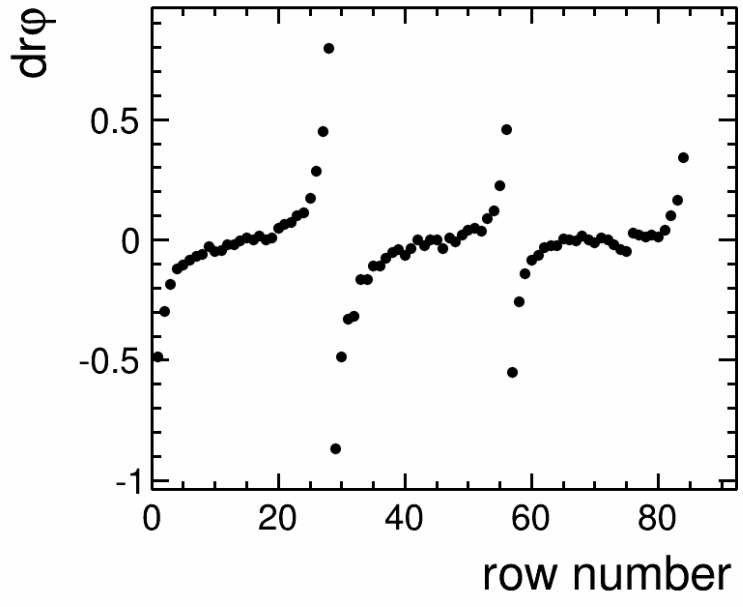


Using Millepede B = 1 T



Long drift





Short drift