TPC work at DESY Hamburg

reported by Ties Behnke, DESY

Main activities in the group:

Study the behavior of a GEM equipped TPC

- mechanical studies (field cage, ...)
- GEM behavior
- properties in high B-fields

Main people involved:
Markus Ball, Ties Behnke, Markus Hamann, Matthias E. Janssen,
Thorsten Kuhl, Thorsten Lux,
Peter Wienemann
Alexander Kaukher (Rostock)

special thanks to Joern Schaffran (DESY) for technical support

Main Topics

Main activities since the last meeting (Paris):

- experiment in magnet to measure resolution
- start of detailed studies of resolutions (understanding fit systematics, different fitting procedures, etc etc)

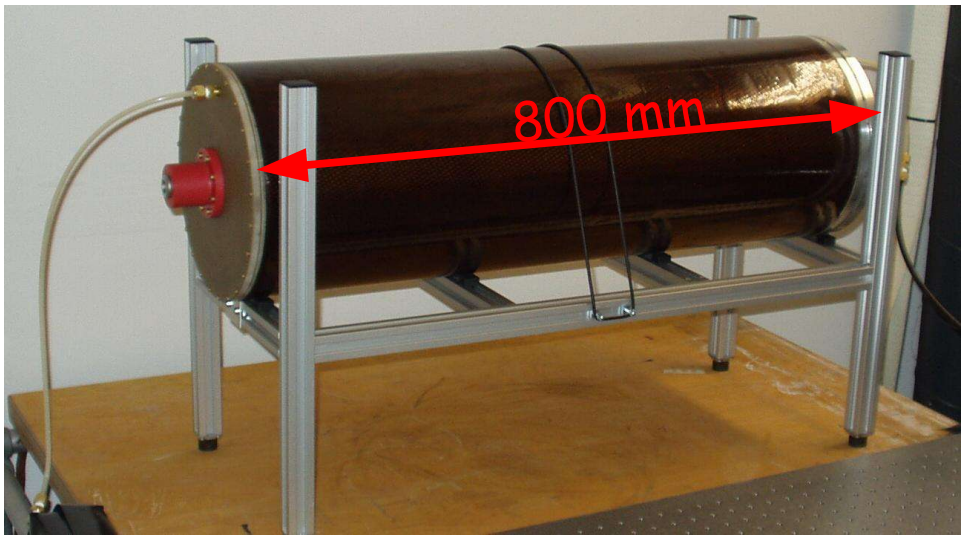
Also being studied (but no results shown here):

- Experiment in 6GeV electron test beam at DESY
  - single track measurements
  - multi particle measurements
- Studies using a UV laser

Facilities

The Chamber:

- 24 x 8 = 192 readout channels
- 2.2 x 6.2 mm^2 readout pads
- Maximal drift length 680 mm
- Gas Ar-CH_4-CO_2 (93-5-2)
- ALEPH based readout electronics

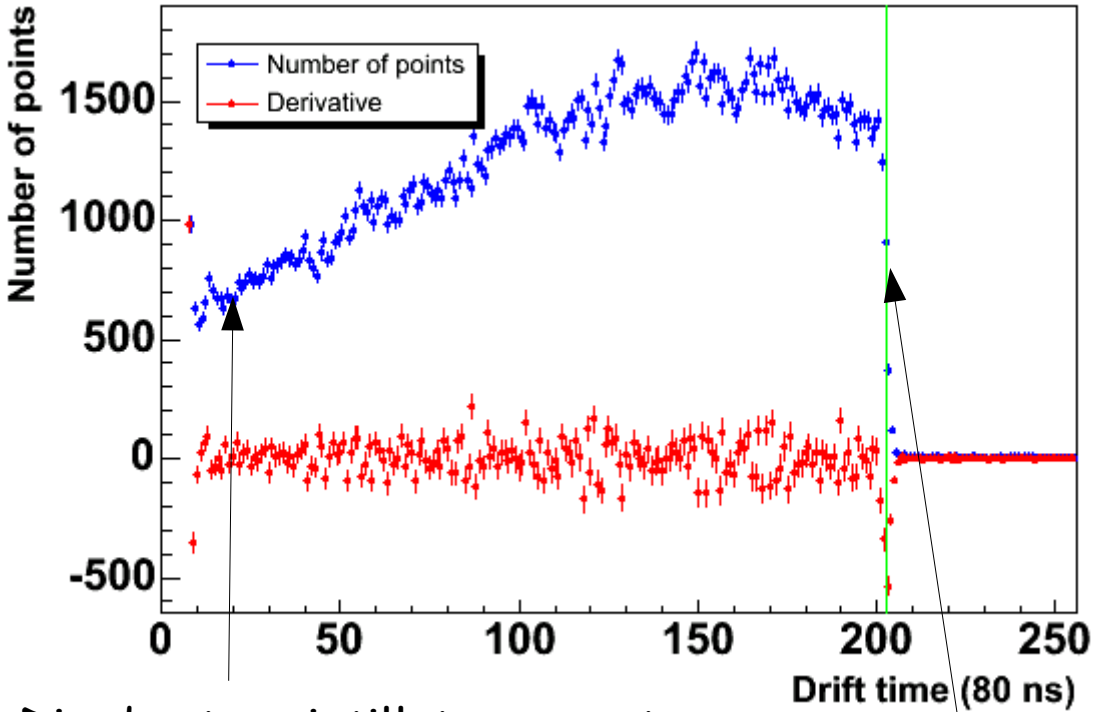


The Magnet:

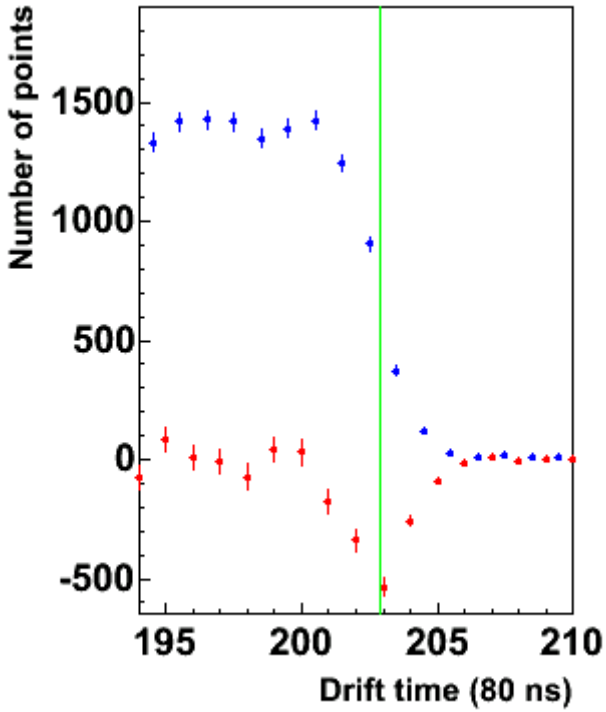
- Superconducting magnet
- 5.3 T maximal field
- 28 cm aperture
- 187 cm cryostat length

Drift velocity measurement

Measure the drift velocity from the known length of the drift region using cosmic muons:



Zoomed view:



Dip due to scintillator acceptance

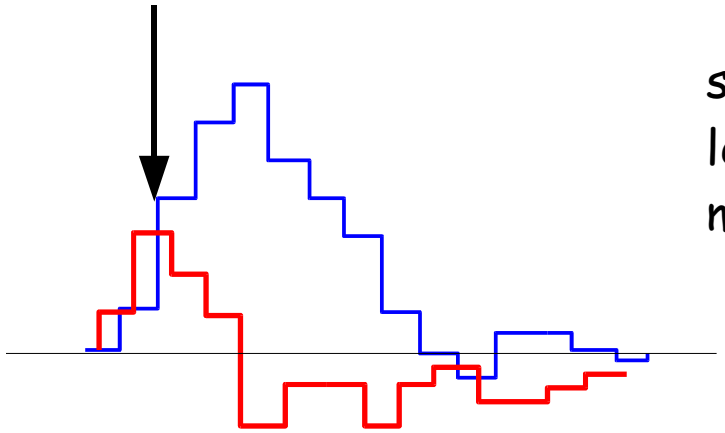
Chamber end = 680 mm

Resulting **drift velocity = 4.190 ± 0.001 (stat) ± 0.023(sys) cm/μm**

In agreement with Magboltz expectation if 700 ppm water is assumed

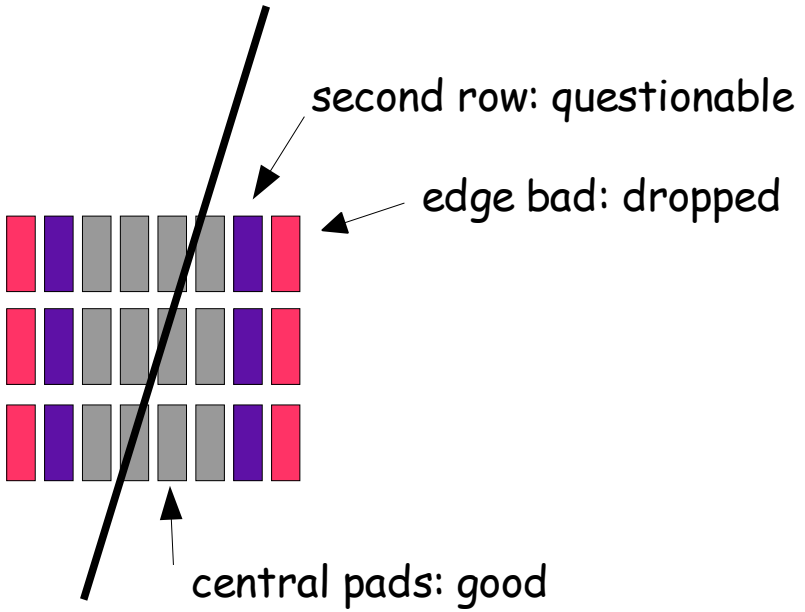
Track Reconstruction

- find drift times per pad using derivative method



seems to give best resolution
least sensitive to long tail
more stable than simple threshold timing

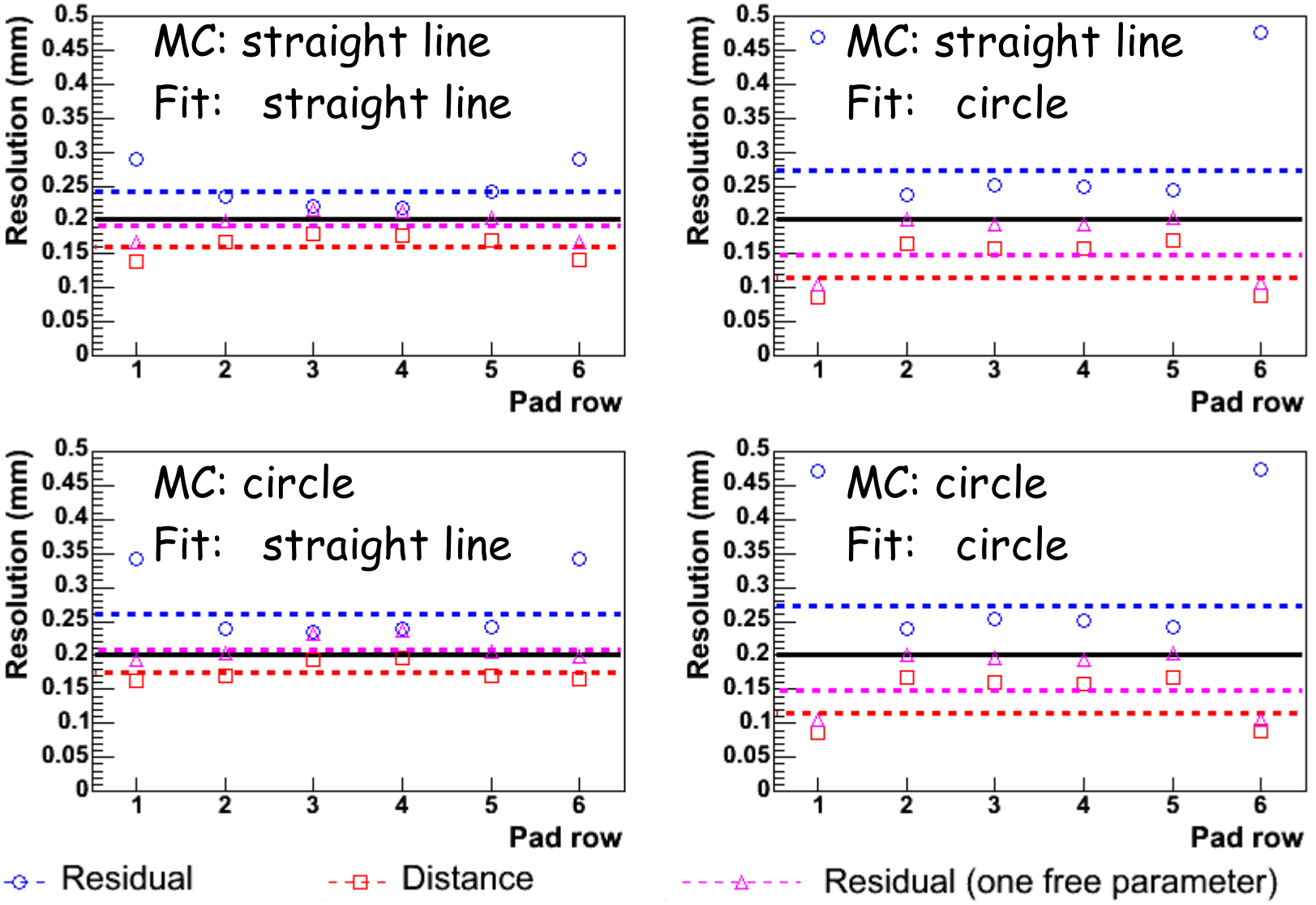
- Form hits by combining close-by hits
- Do track fit using simple χ^2 fit



Track fit systematics: Toy MC

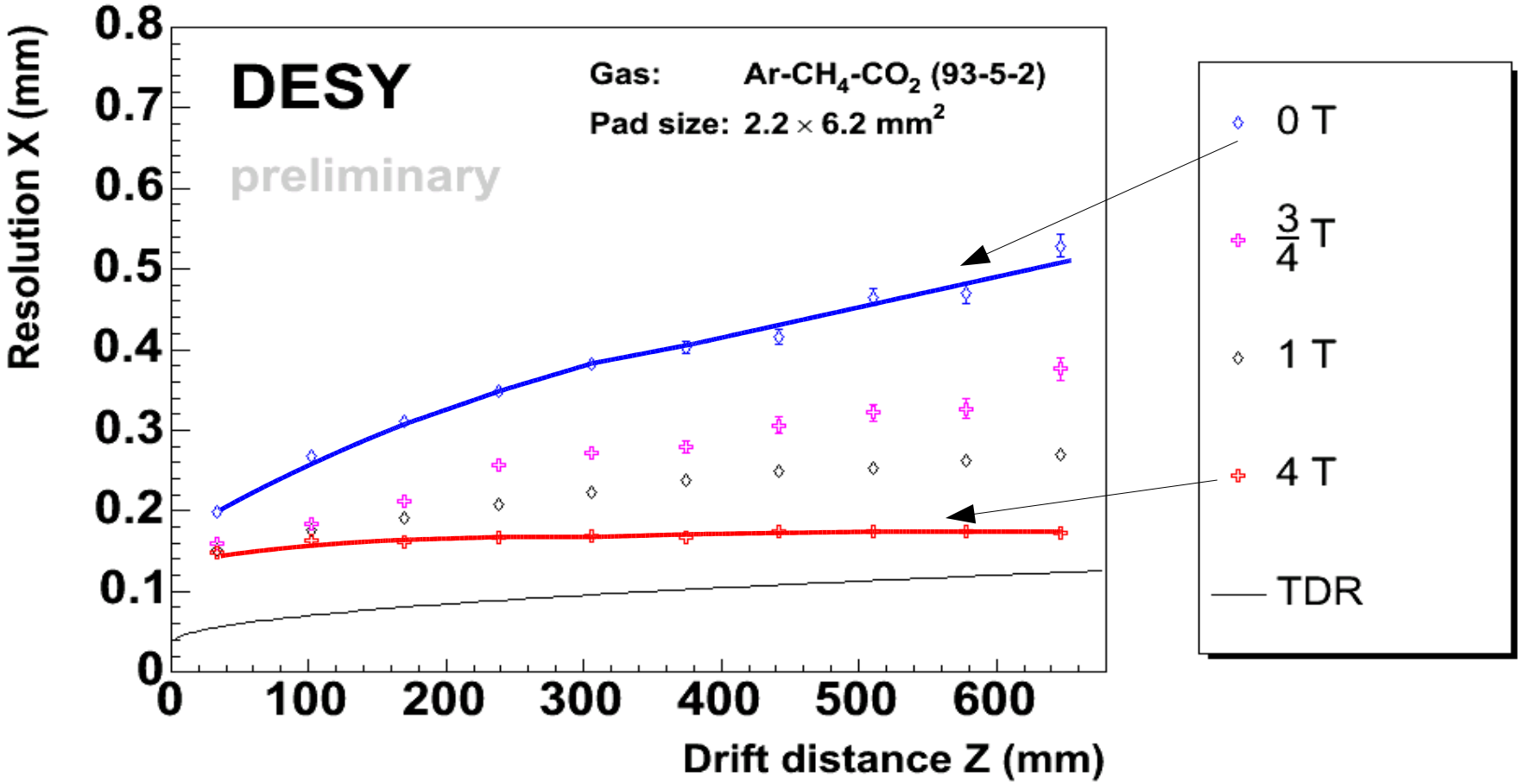
Check of track fitting method with Gaussian smeared toy MC points

Reconstructed residual distribution width for σ_{MC} = 200 μm:



Transverse resolution

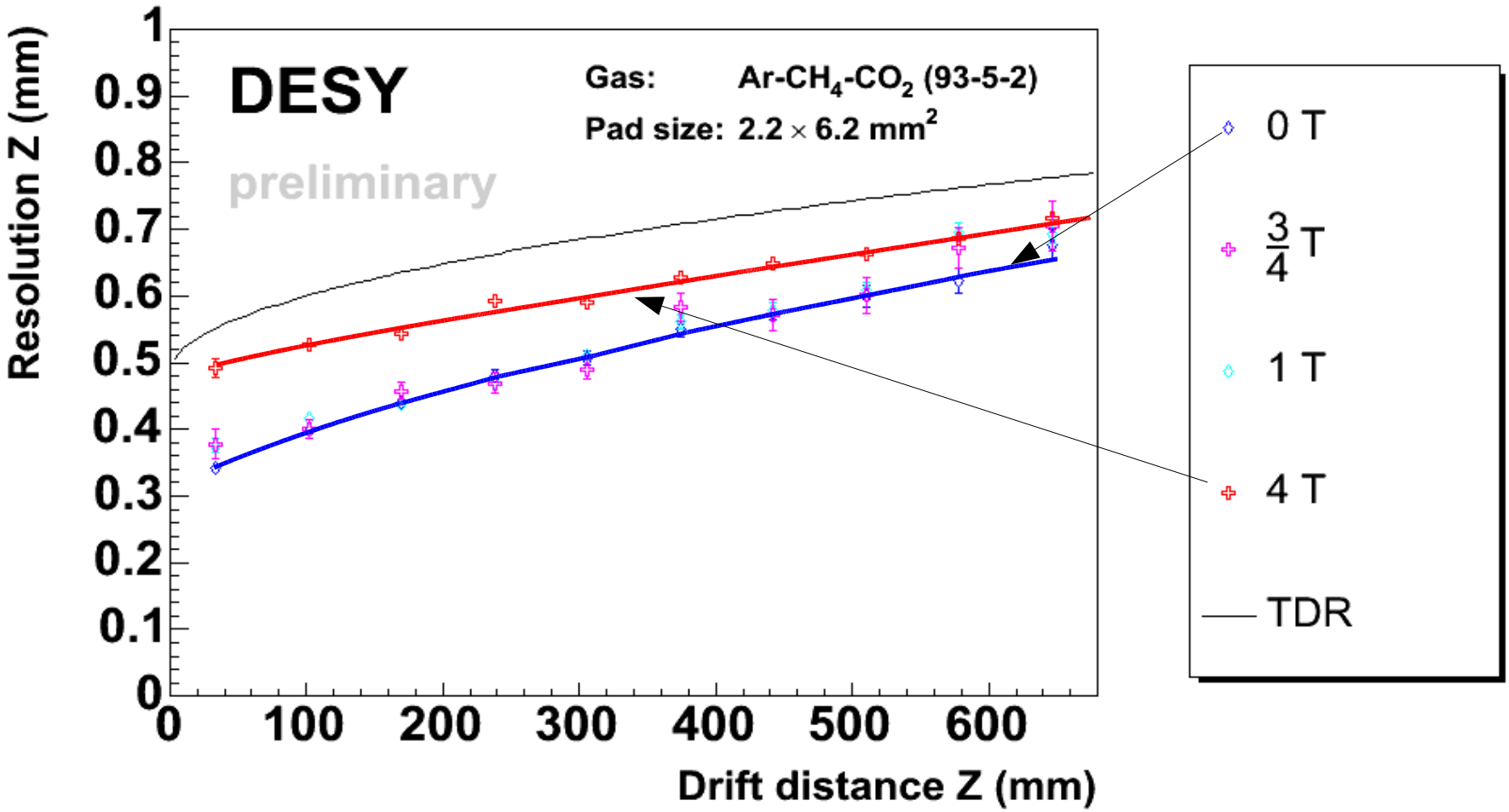
Determined from circle fit using four central pad rows
(reason: see previous slide)



Resolution at 4 T: ≈ 160 μm

Clearly not diffusion limited,
but readout geometry limited at B=4T

Resolution in drift direction



At very low drift distance: pad size too large for efficient charge sharing: reduced resolution

SUMMARY

- Results from high magnetic fields
- Resolutions are worse than expected: Clearly dominated by readout geometry

- Need to optimize the readout geometry (size vs number)
- Need to further develop the algorithms
- Need to study charge spreading

Qualitatively results are in agreement with those shown previously by other groups (Dean, Jochen, etc) for High B-field data