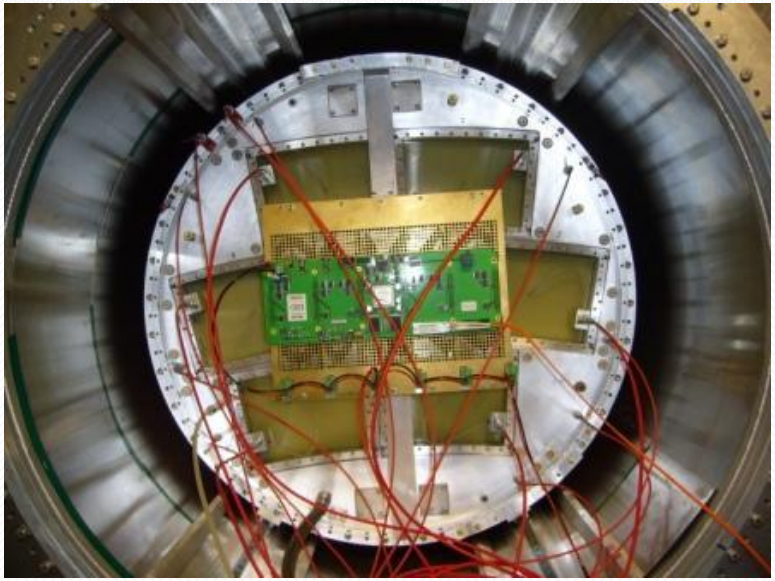
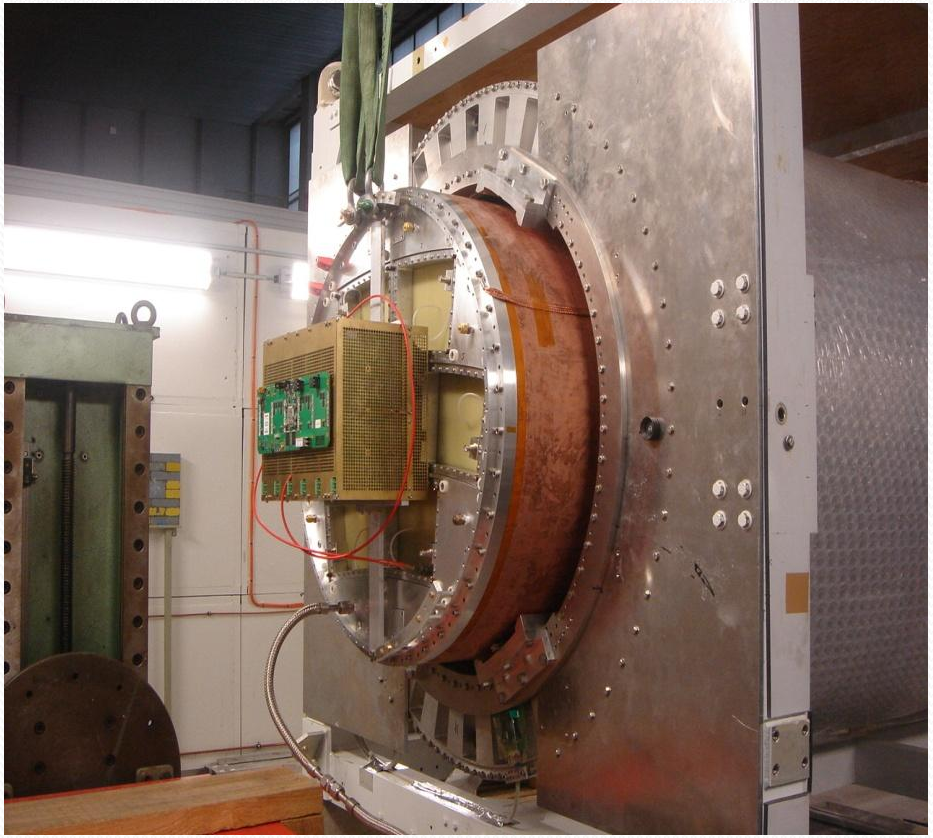
Results with Micromegas modules at LP-TPC

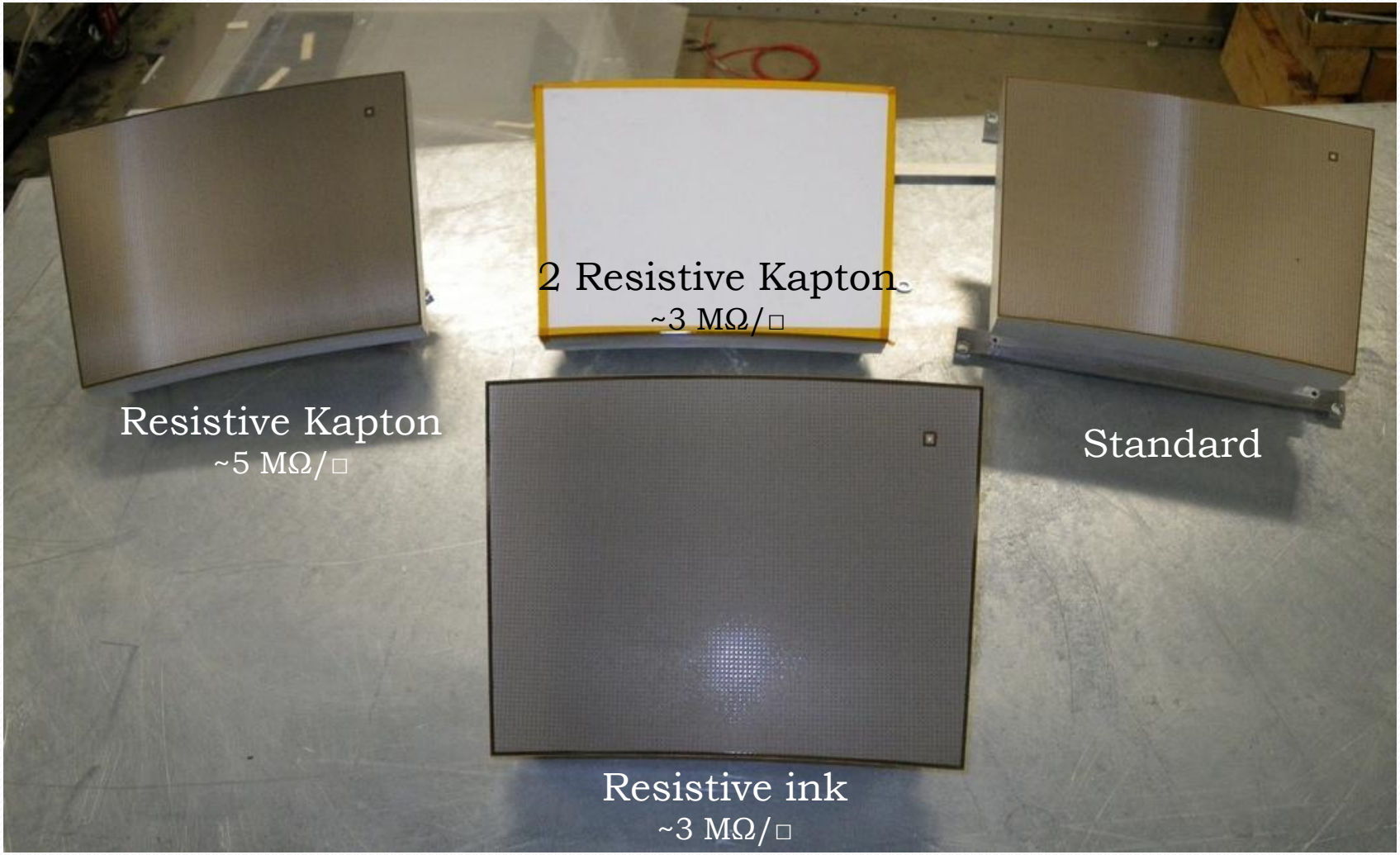
D. Attié, P. Colas, M. Dixit, M. Riallot,
YunHa Shin, S. Turnbull, W. Wang
and **all the LC-TPC collaboration**



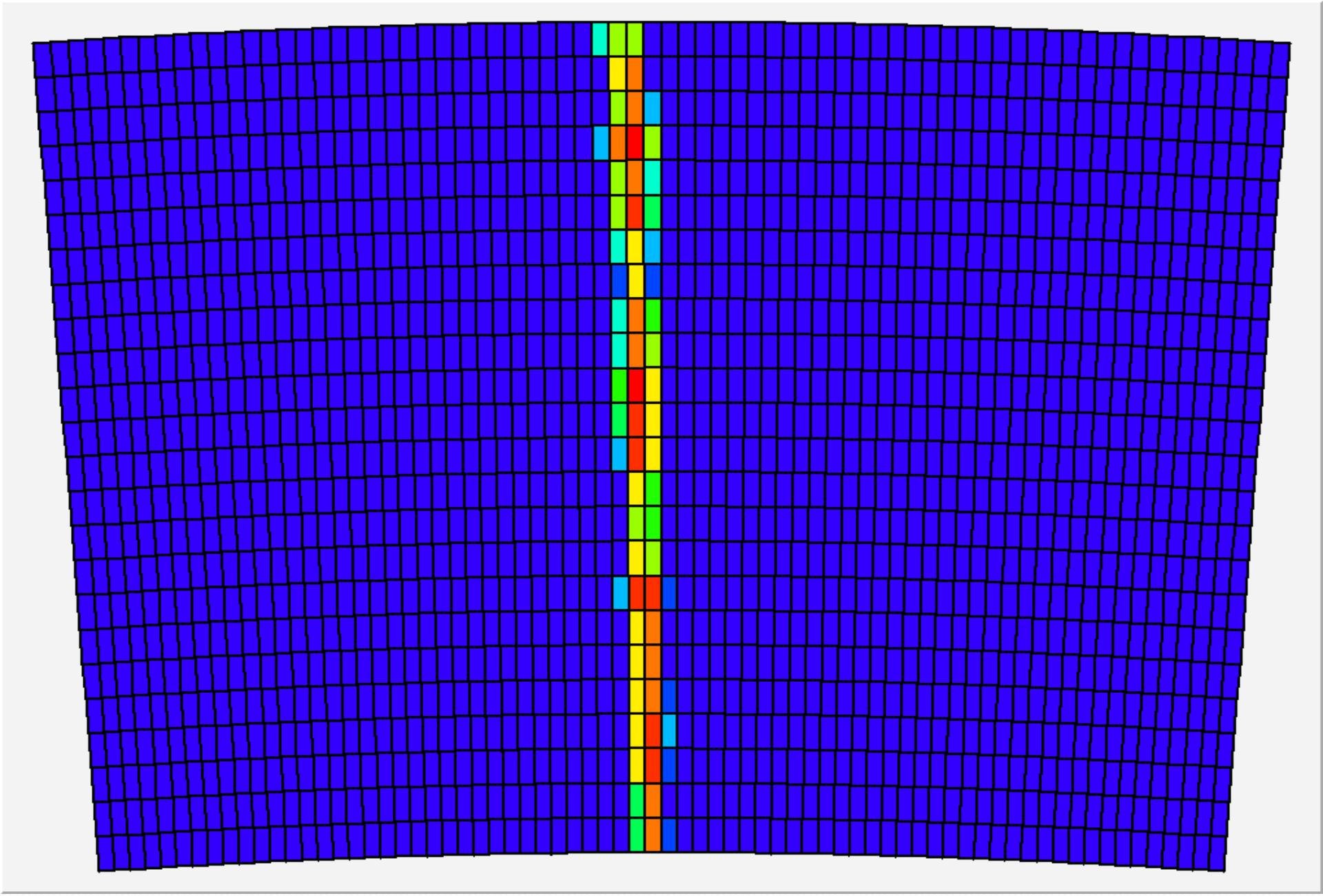


From December 2008 to March 2010 we tested 5 panels. One module was installed in the centre of the Large Prototype each time

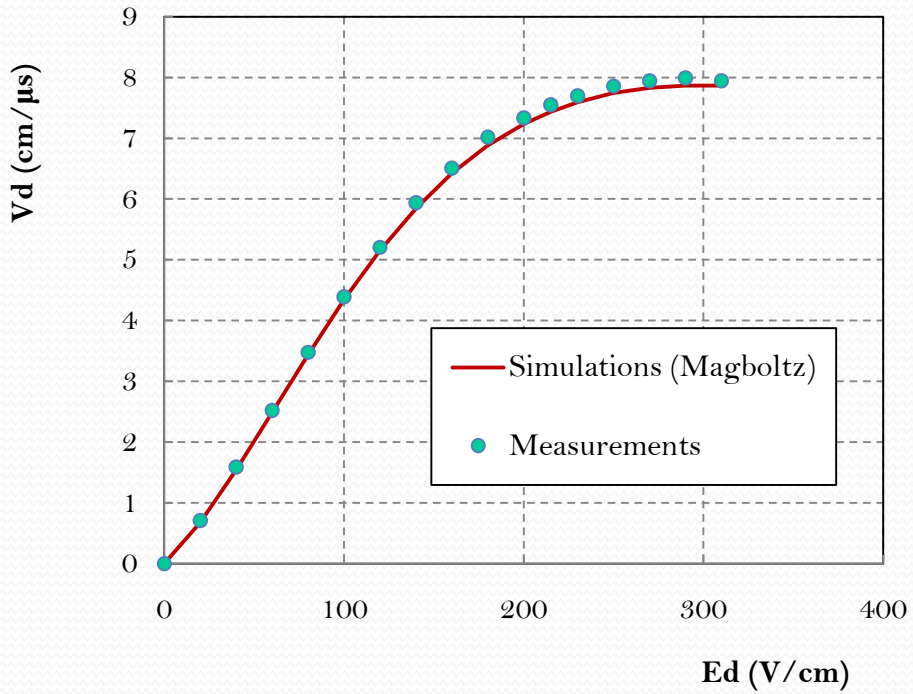
Micromegas Modules for TPC



- **December 2009: tested modules 4 and 5 without magnetic field.**
- **March 2010: tested modules 2 (ink) and 3 (kapton) with 1T magnetic field.**
- **June-July 2010: taken data in a high intensity hadron beam at CERN.**



Data analysis results (B=0T)



Drift Velocity in T2K gas compared to Magboltz simulations for

- **P=1035 hPa**
- **T=19 C**
- **35 ppm H_2o**

(T2K gas: Ar:CF4:iso=95:3:2)

V_{drift} = 7.698 +- 0.040 cm/µs at E=230 V/cm
(Magboltz : 7.583+-0.025(gas comp.))
The difference is 1.5+-0.6 %

B=0 data : Drift velocity measurements

Data analysis results

PRF : Pad Response Function

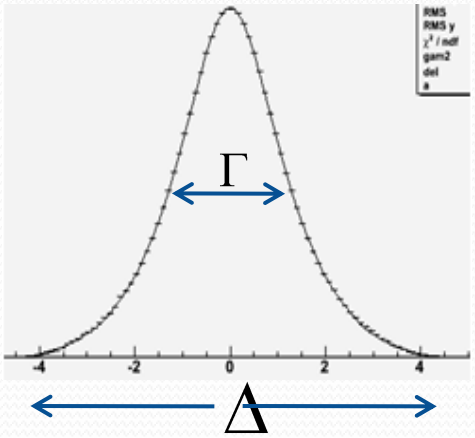
a measure of signal size as a function of track position relative to the centre of the pad

$$PRF[x,\Gamma(z),\Delta,a,b] = \frac{(1+a_2x^2+a_4x^4)}{(1+b_2x^2+b_4x^4)}$$

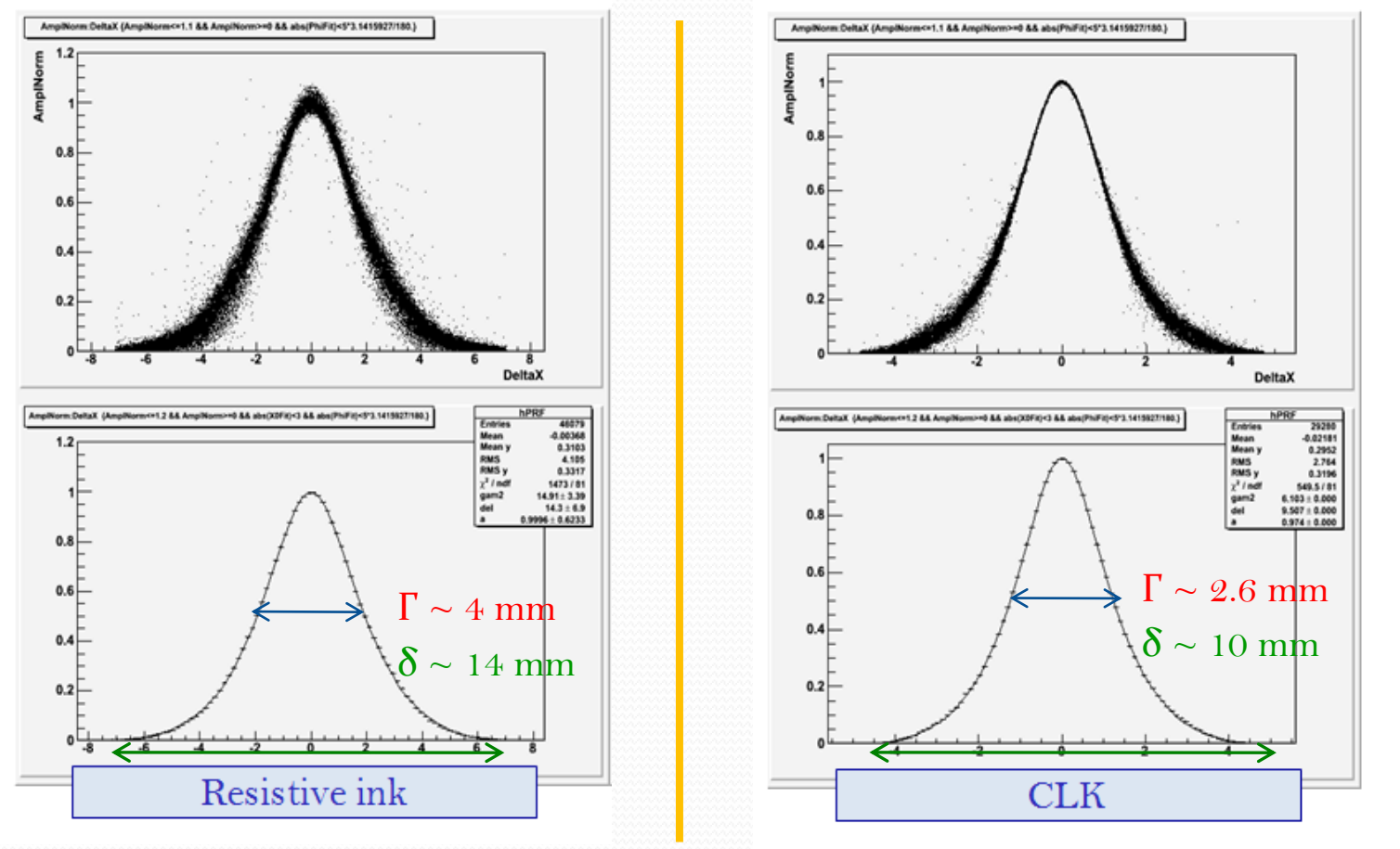
The PRF:

→ is not Gaussian.

→ can be characterized by its FWHM Γ(z) & base Width Δ(z), plus another shape parameter.



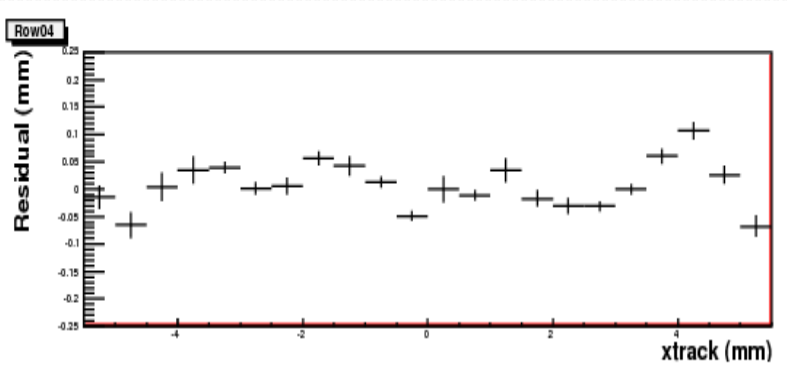
Data analysis results

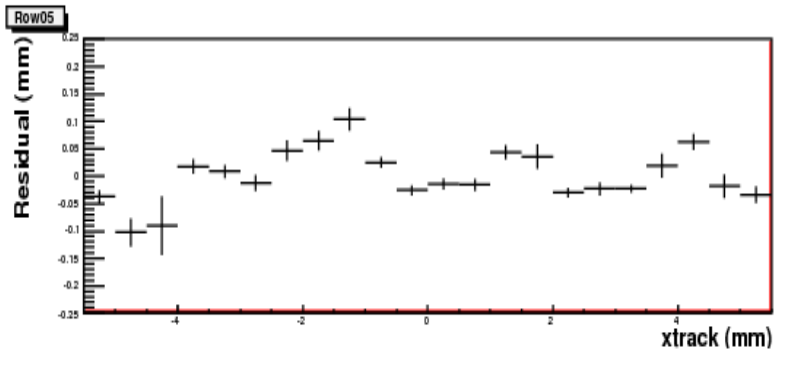


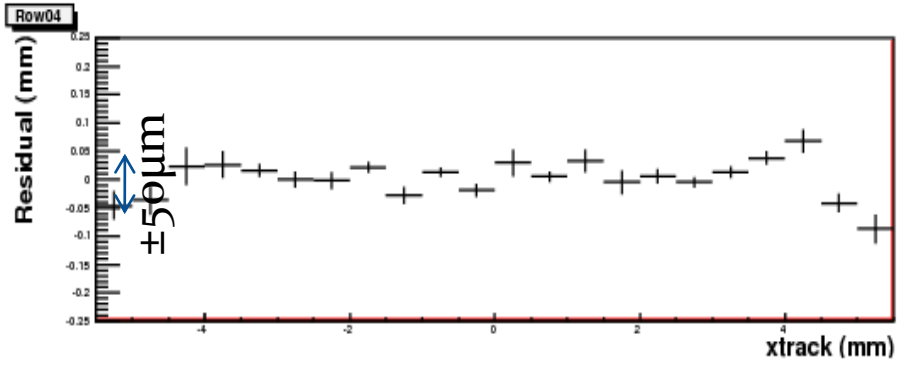
B=1T data : comparison of resistive ink and Carbon-loaded Kapton

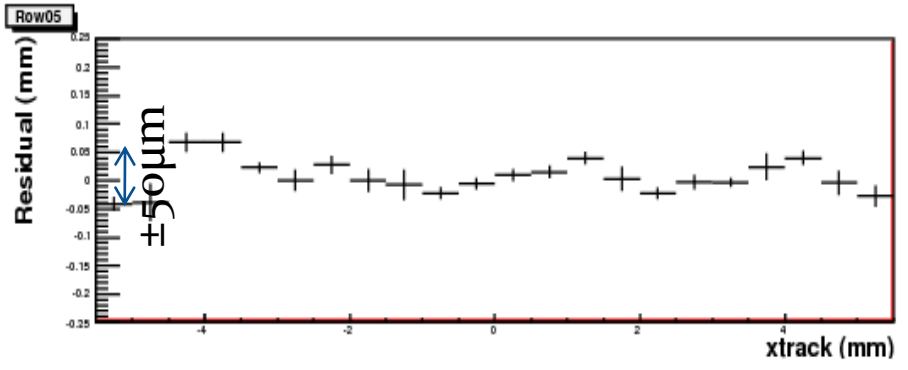
PRF(Pad Response Functions) fits, z ~ 5 cm

Bias







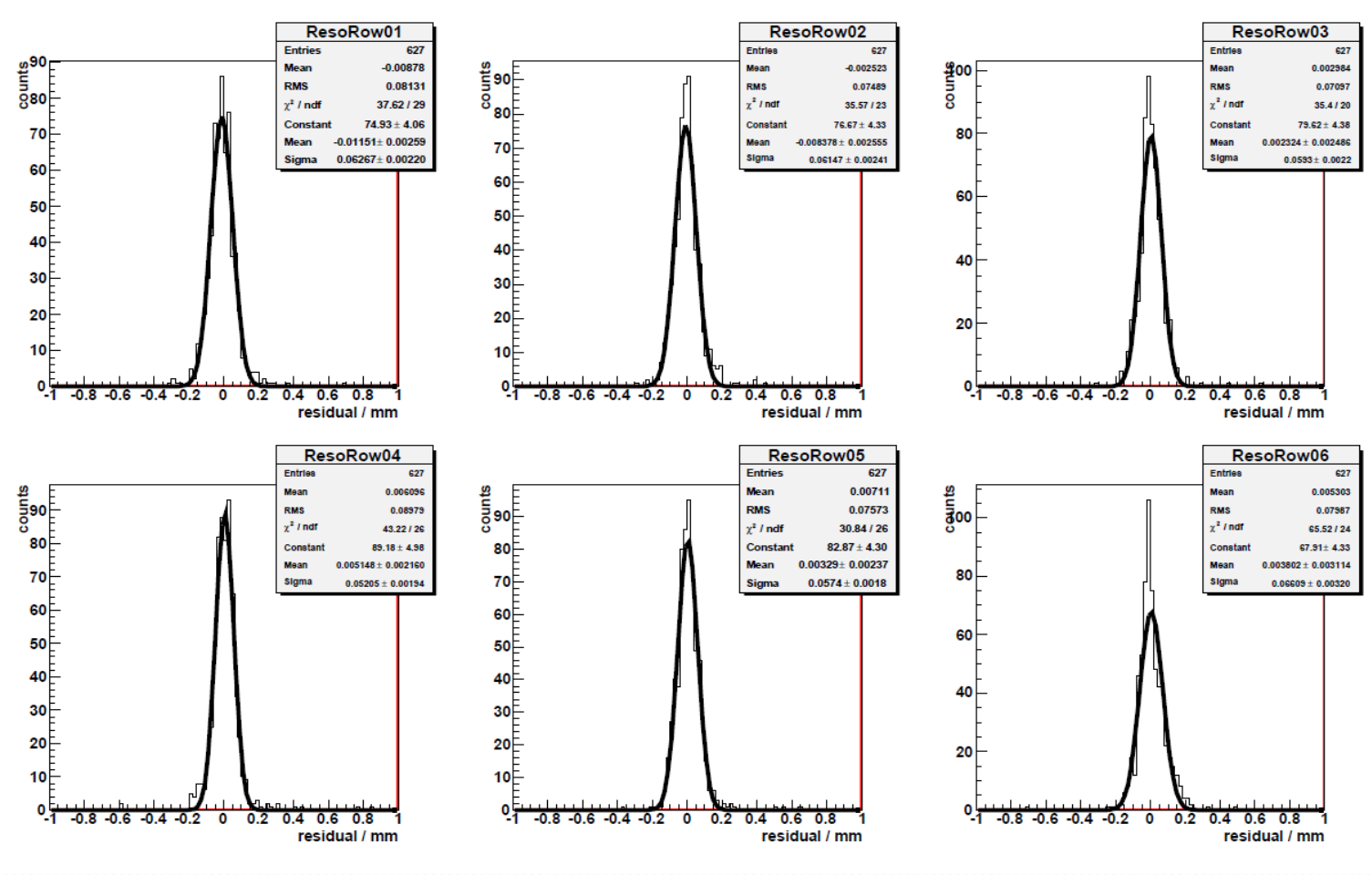


Bias before

Bias after

Bias due to non-uniformity can be easily corrected.

Data analysis results



Position residuals x_{row}-x_{track}

Uniformity

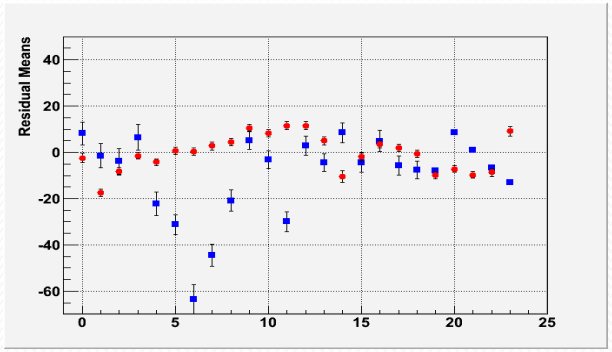
MEAN RESIDUAL vs ROW number

Z-independent distortions

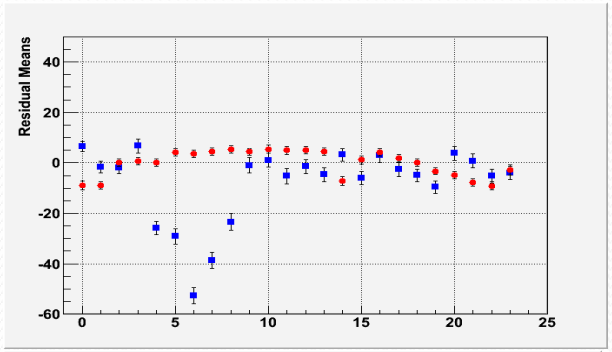
Distortions up to 50 microns for resistive ink (blue points)

Rms 7 microns for CLK film (red points)

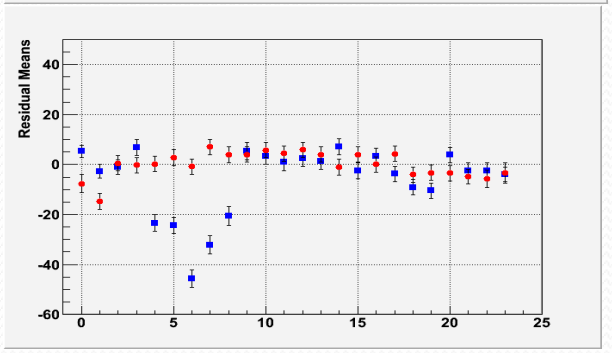
Z=5cm



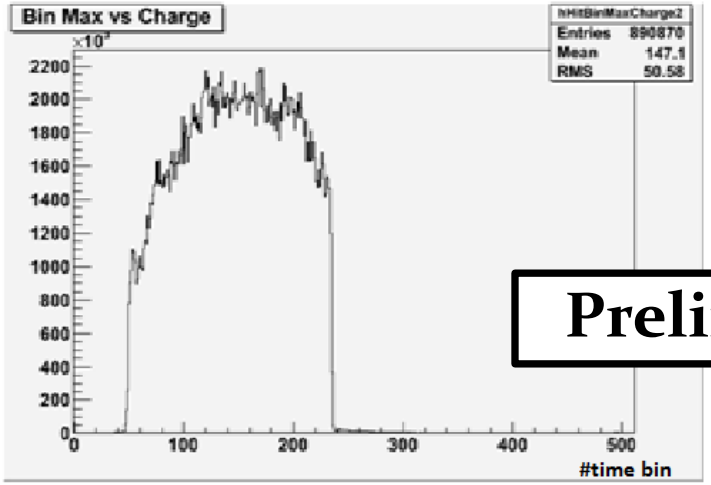
Z=35cm

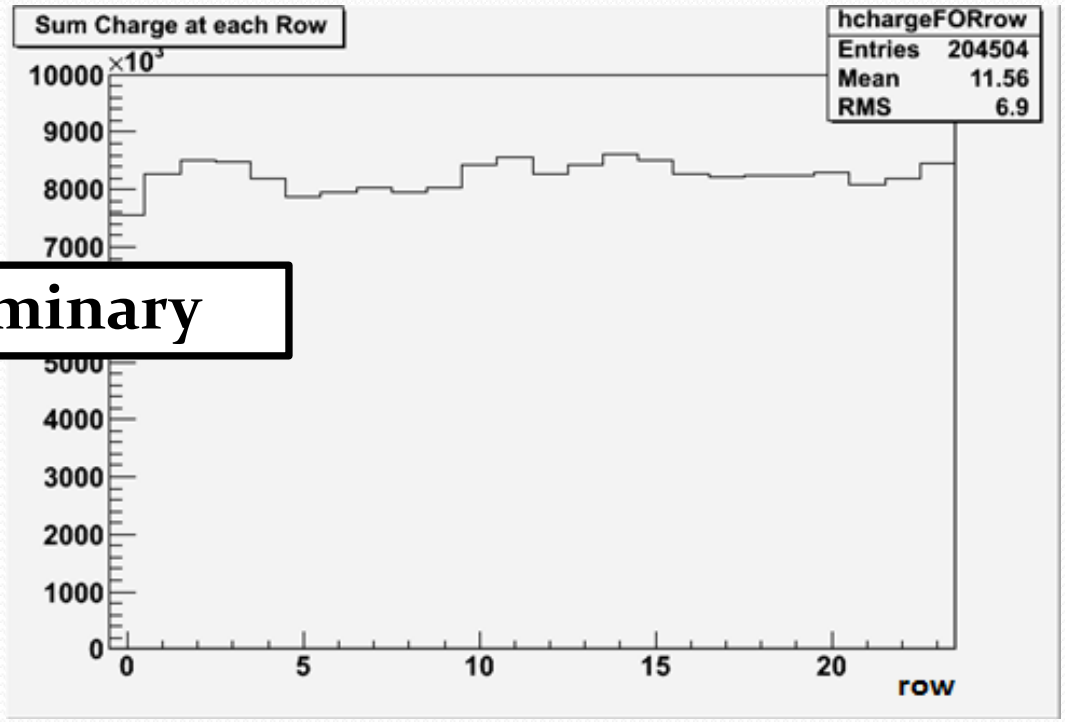


Z=50cm



Uniformity (B = 0T)





Preliminary

Using cosmic-ray

Total charge by row using cosmic-ray events

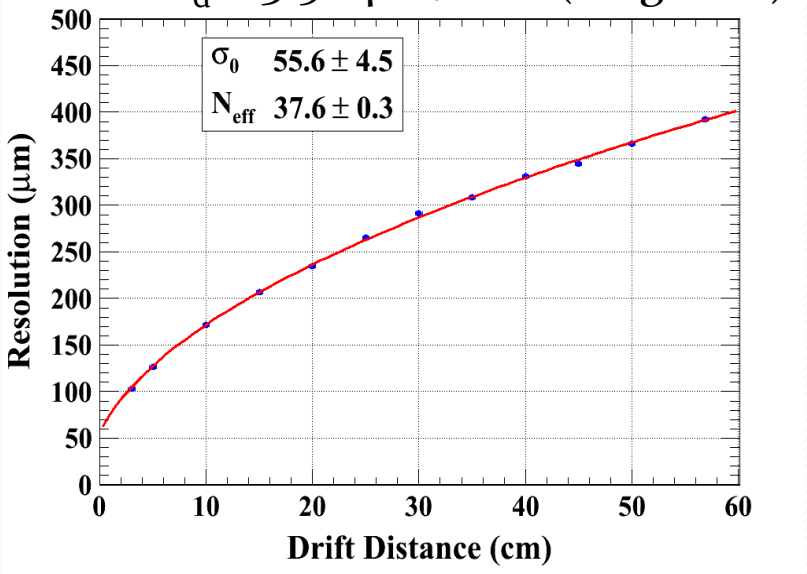
Data analysis results (B = 0T & 1T)
Carbon-loaded kapton resistive foil

$$\sigma = \sqrt{\sigma_0^2 + \frac{C_d^2 \cdot z}{N_{eff}}}$$

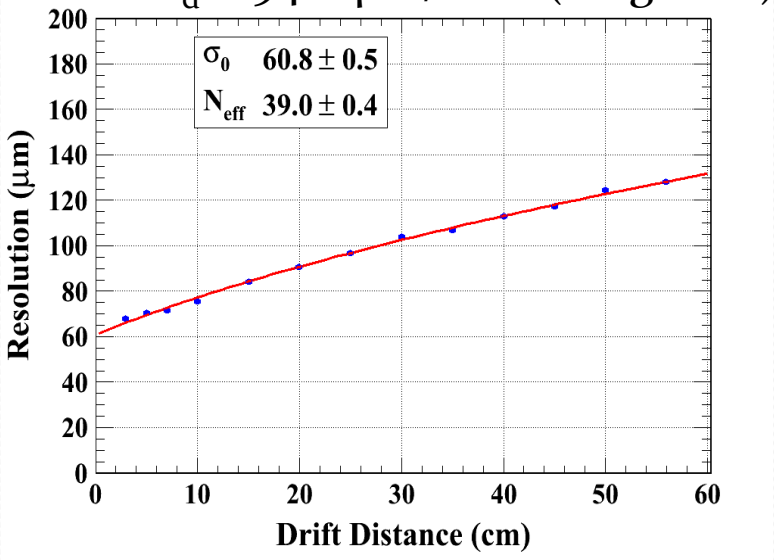
σ_0 : the resolution at Z=0

N_{eff} : the effective number of electrons

B=0 T C_d = 315.1 μm/√cm (Magboltz)



B=1 T C_d = 94.2 μm/√cm (Magboltz)



Module 4 [χ^2 : 10.6 Ndf: 10]

Module 3 [χ^2 : 29.1 Ndf: 11]

N_{eff} measurement with Micromegas

Averaging B=0T data and B=1T data (excluding ink module):

- N_{eff} = 38.0±0.2(stat) ±0.8 (Cd syst)
- σ_o= 59 ± 3 μm

Note that 1/<1/N> = 47.1 from Heed for 5 Gev electrons on 6.84 mm long pads.

This demonstrates that gain fluctuations are not exponential (Neff would be 23) but smaller.

1/<1/N> = 34.9 for 5.4 mm pads (GEM case).

Conclusions

- A lot of experience has been gained in building and operating Micromegas TPC panels
- The uniformity of the detector is excellent, with no distortions nor edge effects, and very small dead areas
- The measured resolution meets LC needs : 60 microns at zero drift distance with 3 mm wide pads
- The effective number of electrons per row is measured to be 38.
- Next step is to equip the whole endplate with full integration of the electronics flat behind the panels

Thank you