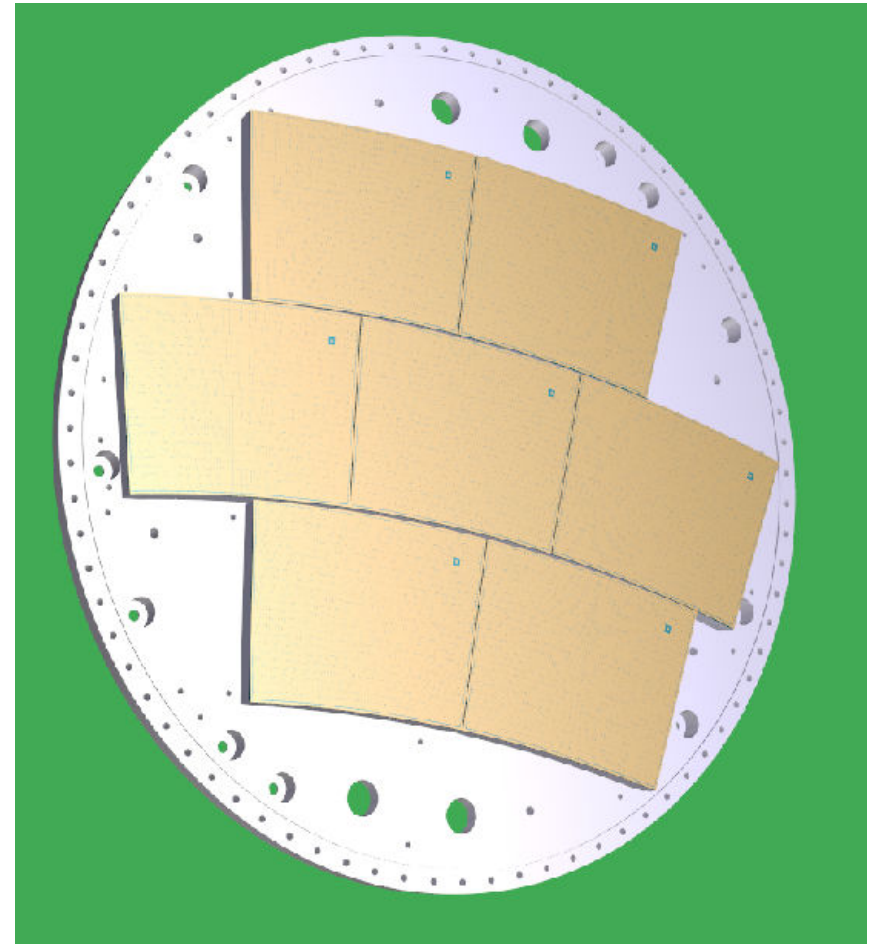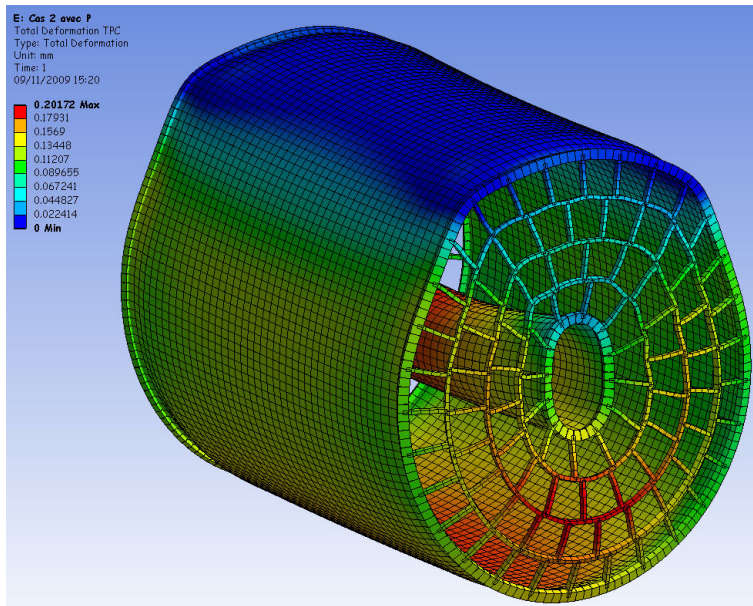# Micromegas TPC

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

Results from beam tests
7-module design
ILD TPC mechanics and integration

First phase of Micromegas testing in the LC-TPC Large Prototype, with 1 module in the centre, read out by T2K electronics:
5 data taking periods from November 2008 to March 2010:
-1 standard Micromegas + 1 with resistive Carbon-Loaded-Polyimide anode (5 MΩ/sq) (nov-dec 2008)
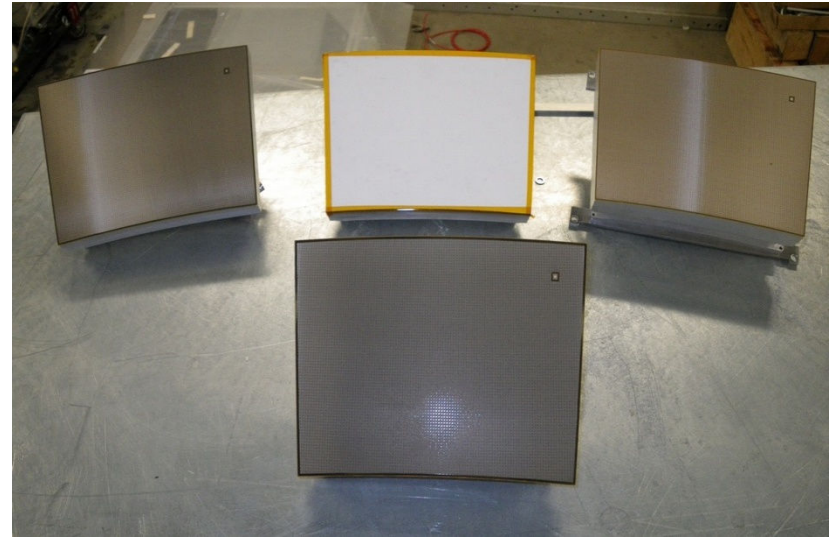-1 resistive ink (2 MΩ/sq) + the same CLP, new electronics (May 2009)
-Laser run (shot on the patterned cathode) (August 2009)
-Run synchronized with Si tracker (November 2009)
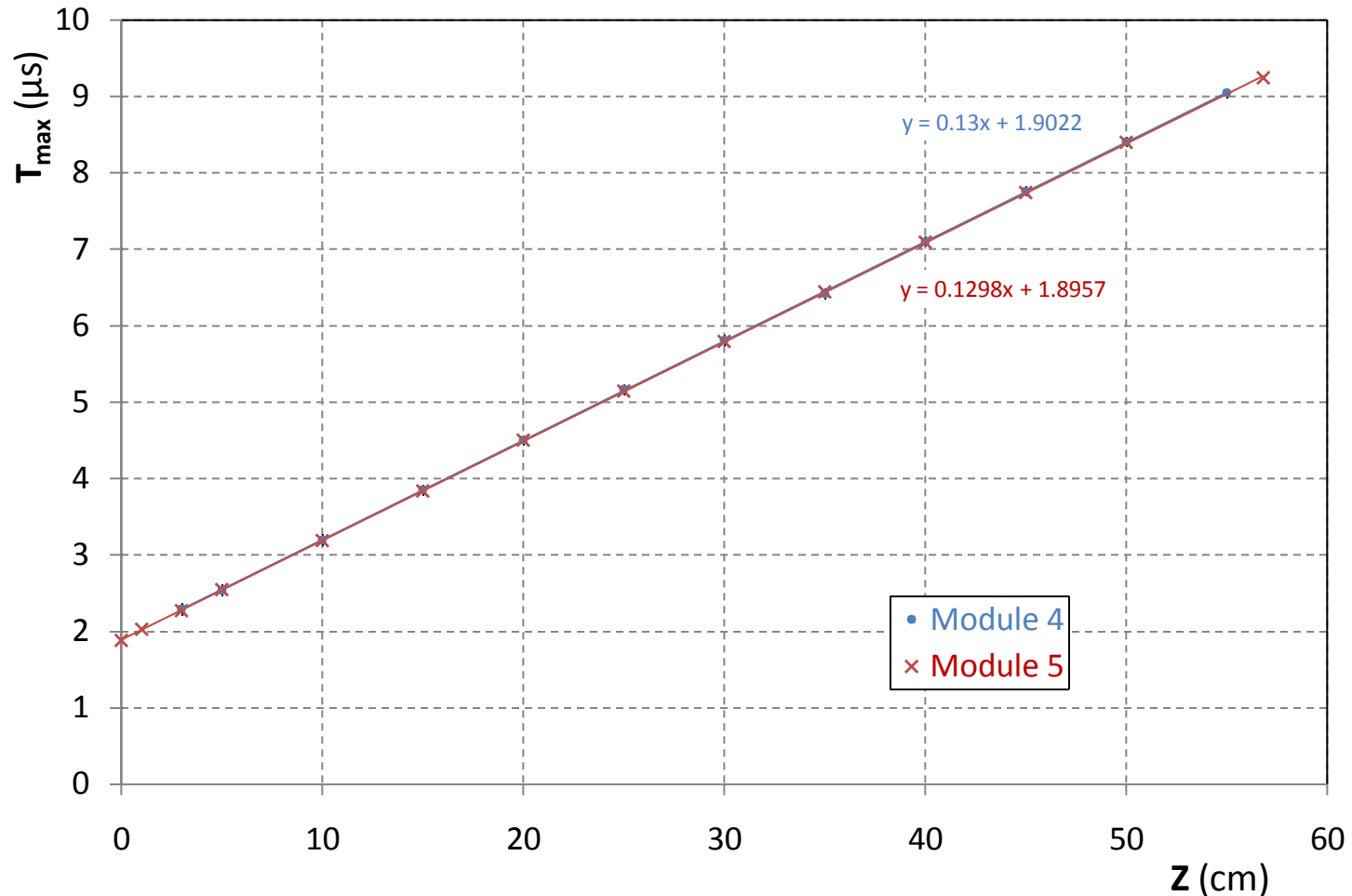-2 modules with 3 MΩ/sq CLP anodes, with different routings, at B=0 (dec 2009)
-2 modules, same as May 2009, but with moving table (March 2010)

Pb with 2 last modules : sparking at vias

B=0 data : Drift velocity measurements
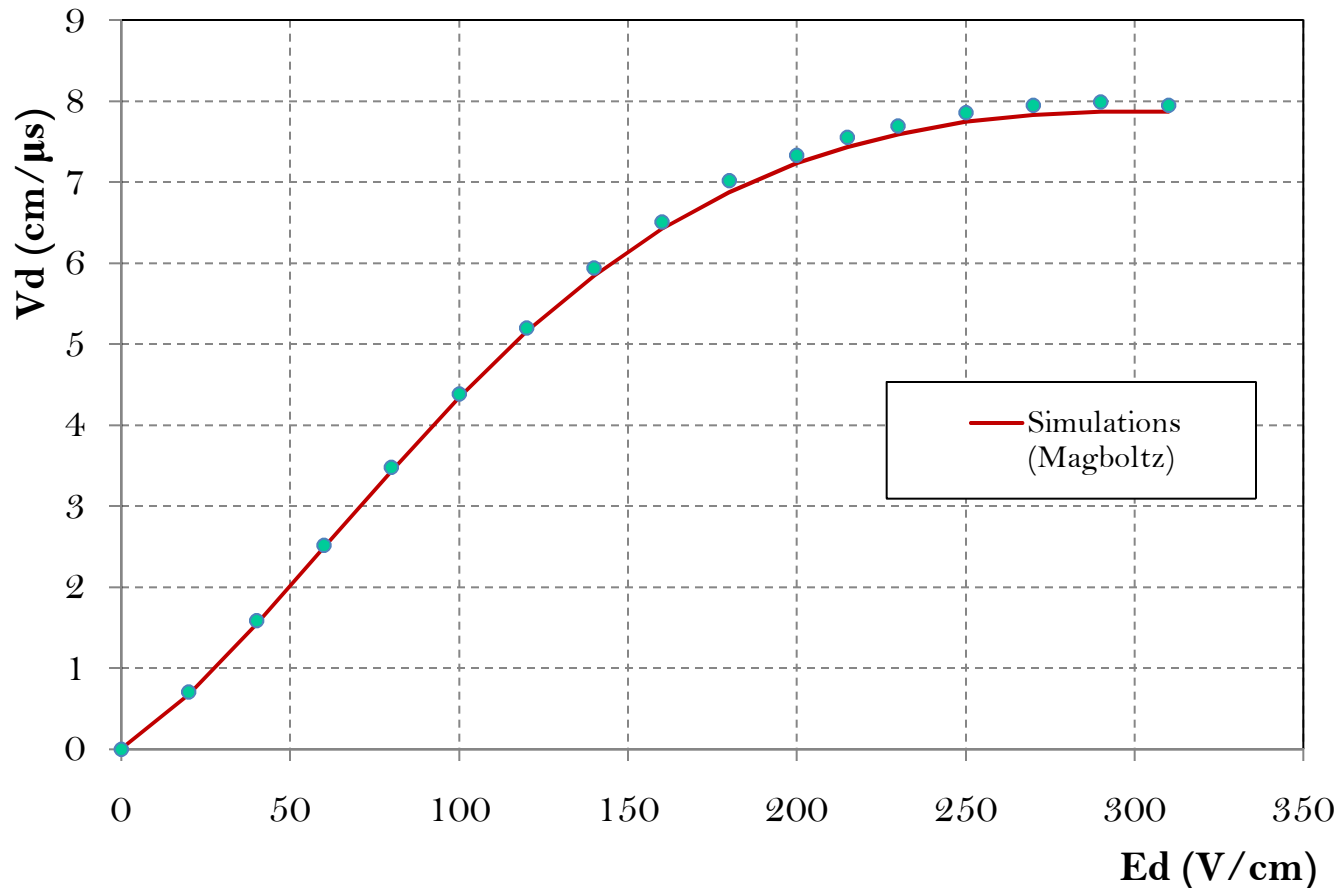
(200 ns shaping)

Chart: T_{max} (μs) vs Z (cm)

y = 0.13x + 1.9022

y = 0.1298x + 1.8957

- Module 4
- × Module 5

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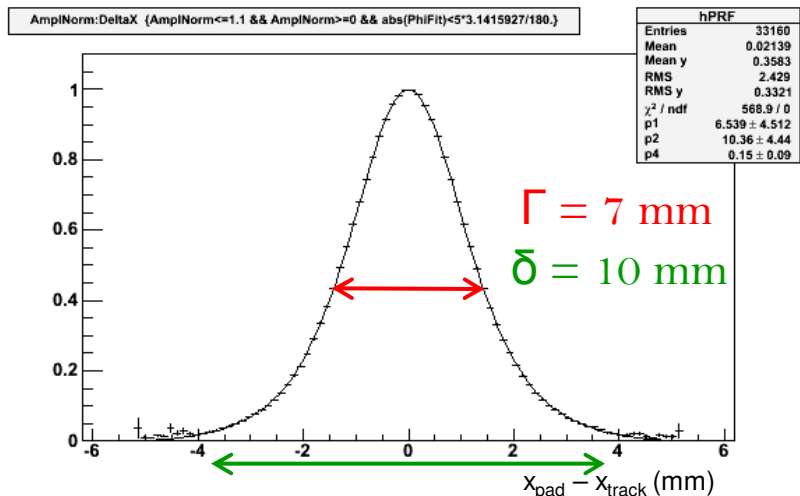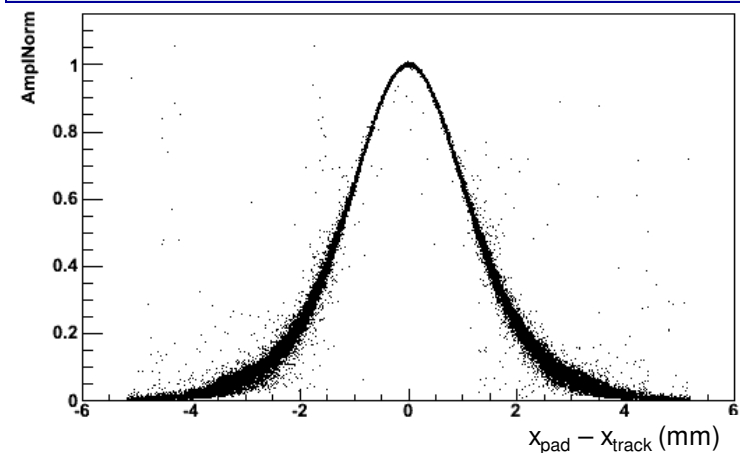The difference is 1.5+-0.6 %

B=0 data : Drift velocity measurements

Drift Velocity in T2K gas and compared to Magboltz simulations for
P=1035 hPa, T=19°C and 35 ppm H_2O

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

Pad Response Functions, z ~ 5 cm
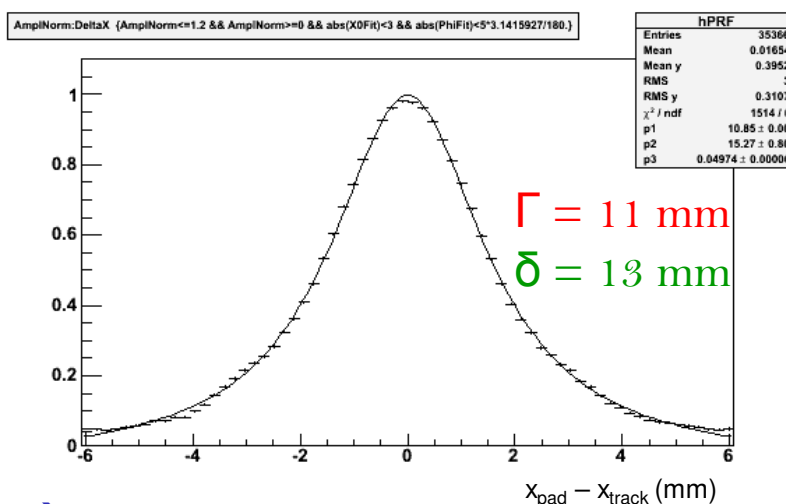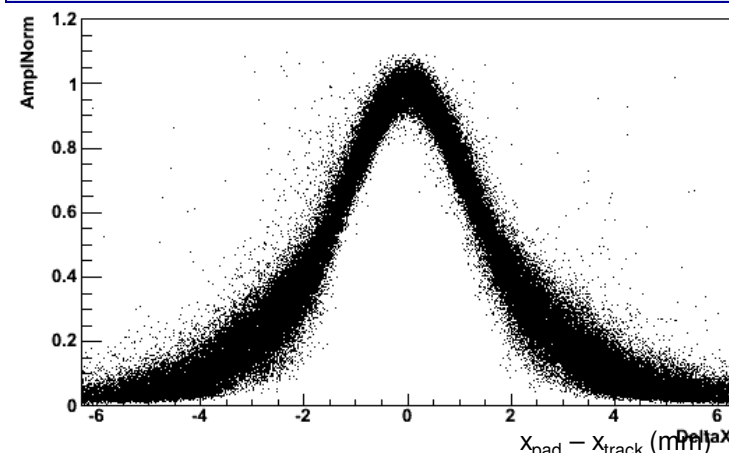
CLP	Resistive ink

$\Gamma = 7$ mm
$\delta = 10$ mm

$\Gamma = 11$ mm
$\delta = 13$ mm

→ $\sigma_{z=5\ cm} = 68$ μm
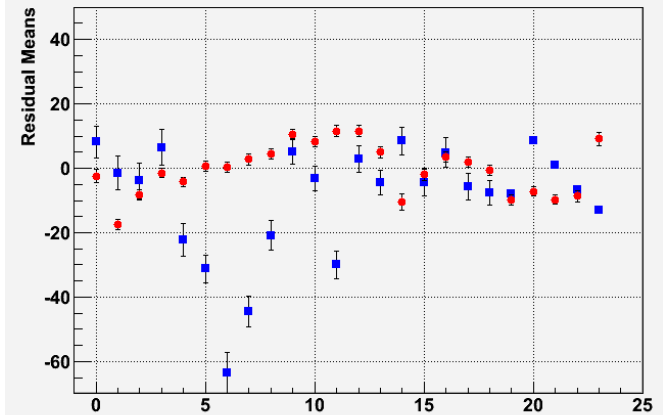
→ $\sigma_{z=5cm} = 130$ μm !
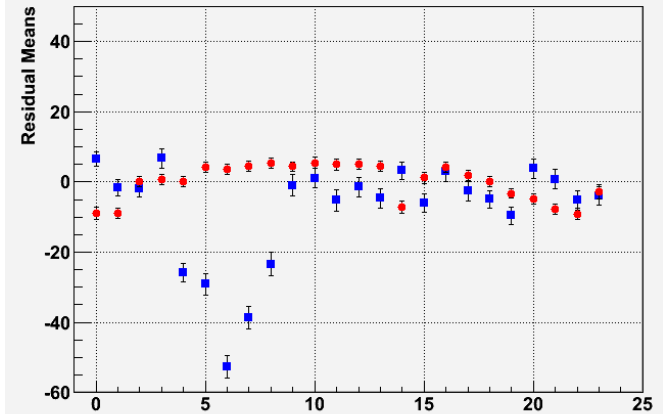
MEAN RESIDUAL vs ROW number

Z-independent distortions

Distortions up to 50 microns for resistive paint

Rms 7 micron for CLP film

Z=5cm

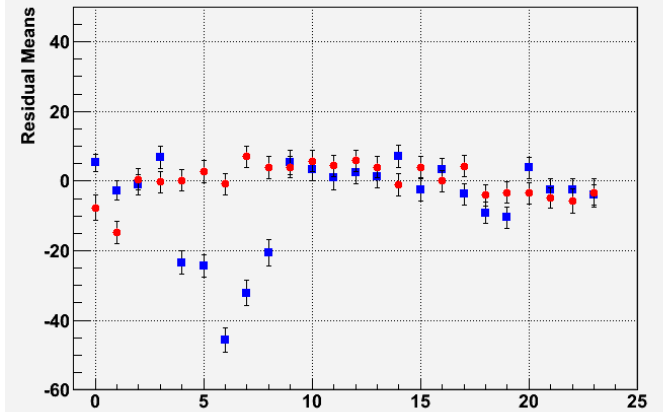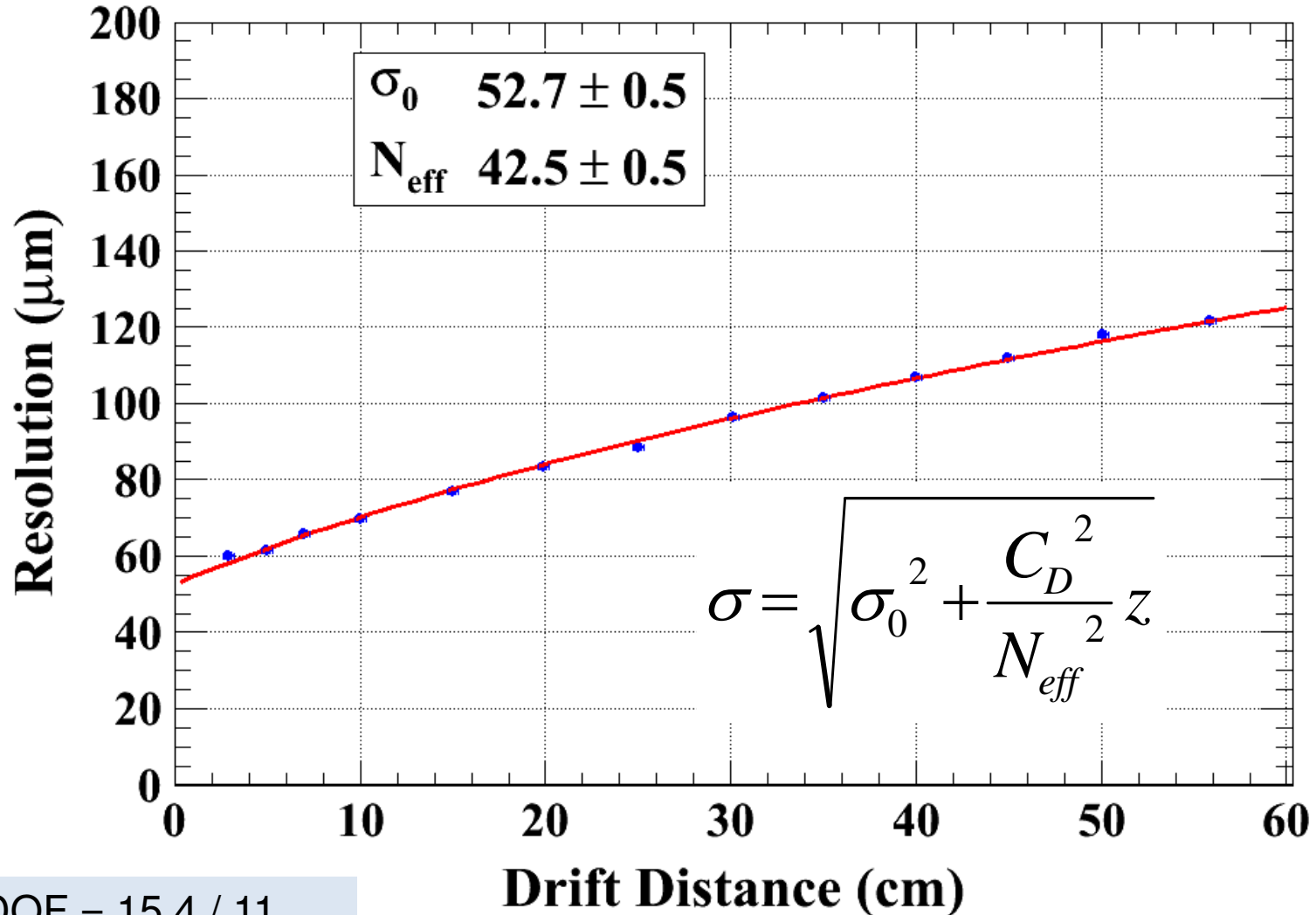Z=35cm

Z=50cm

Resolution vs Drift Distance

CLP module

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

σ_0	52.7 ± 0.5
N_{eff}	42.5 ± 0.5

χ^2 /NDOF = 15.4 / 11

RESULTS

- σ_0 = 53 μm : confirms previous results. 1/57 times the pad size. No hodoscope effect down to 3cm drift.

- N_{eff} = 42.5 ± 0.5 (stat) ± 1.5 (C_D) at P=1035 hPa, with C_D = 95.5±1.6 μm/√cm(B=0.98 T).
  - To be compared to $N_{eff} = \dfrac{1}{<1/N>}\dfrac{<G>^2}{<G^2>}$

- $<1/N>^{-1}$ from Heed (H. Schindler) : 47.1 (in these conditions)

- Thus $<G^2>/<G>^2$ = 1.11 ± 0.04 (θ_{polya} ~8 !)

Discussion

- N_{eff} is close to the maximum value allowed by ionization statistics.

- This implies that the resolution with this resistive anode detector is largely insensitive to gain fluctuations
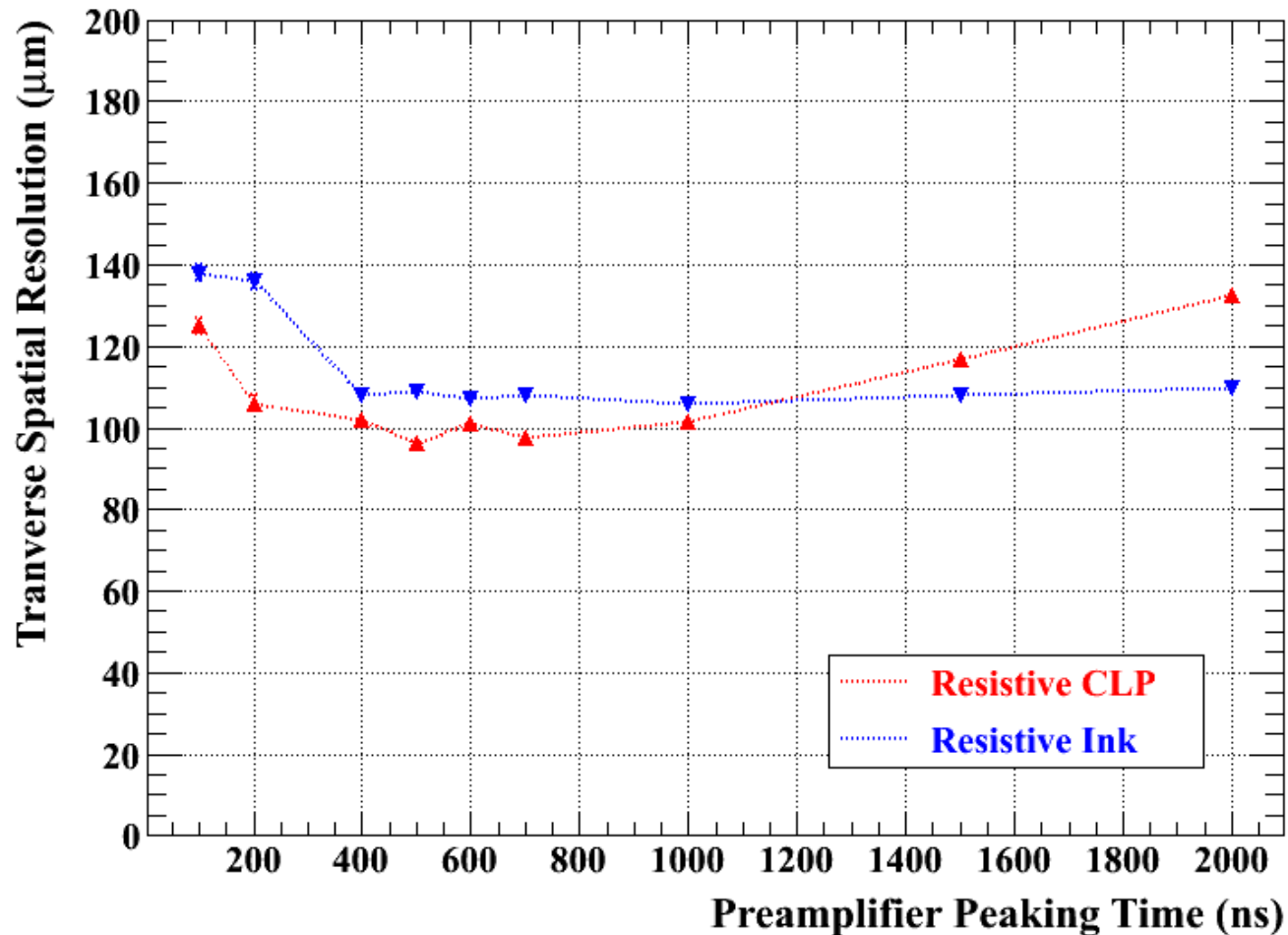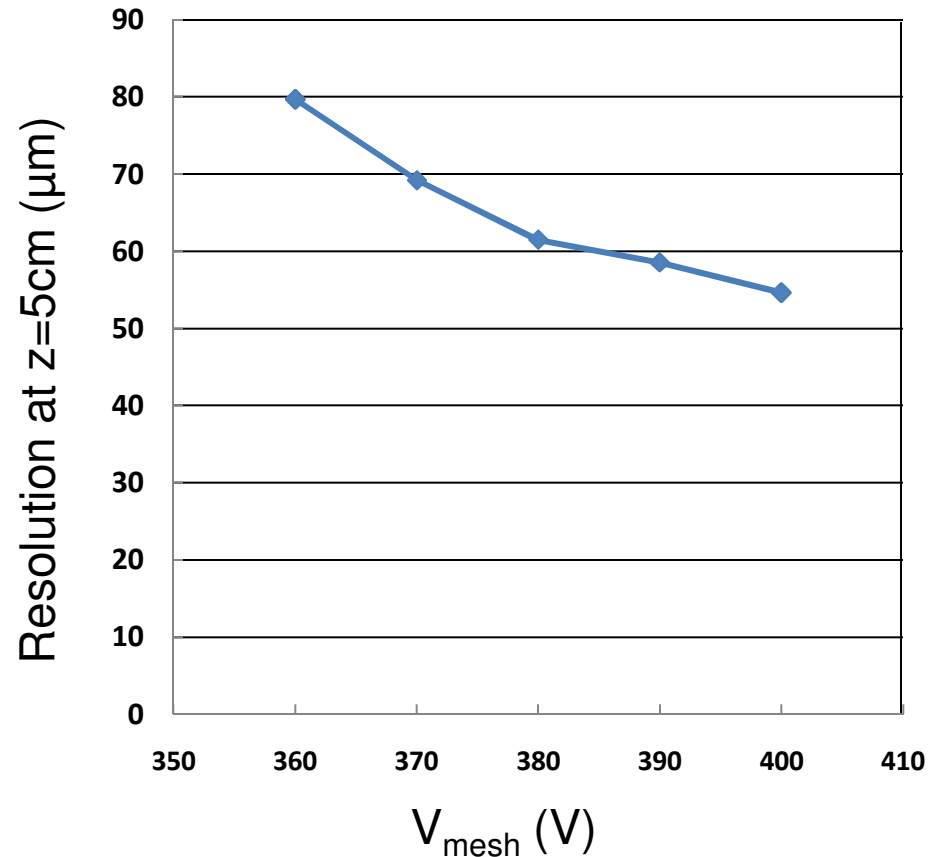
Spreading by diffusion : gain fluctuations matter
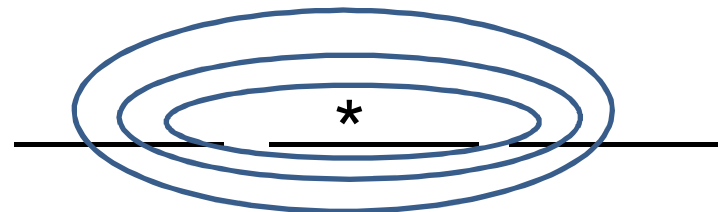
Spreading by RF no effect from gain fluctuations

Dependence of resolution with data taking conditions

Relaxed
fiducial
cuts
Z=5cm

# Dependence of resolution with data taking conditions

The Saclay-Carleton 7-module project

D. Attié, P. Baron, D. Calvet, C. Coquelet, E. Delagnes, M. Dixit, A. Le Coguie, R. Joannes, S. Lhénoret, I. Mandjavidze, M. Riallot, S. Turnbull, Yun-Ha Shin, W. Wang, E. Zonca

Goal : Fully equip 7 modules with more integrated electronics, still based on the T2K AFTER chip.

First prototype in June 2010
Tests at fall 2010

Then production and characterization of 9 modules in 2011 at the CERN clean room
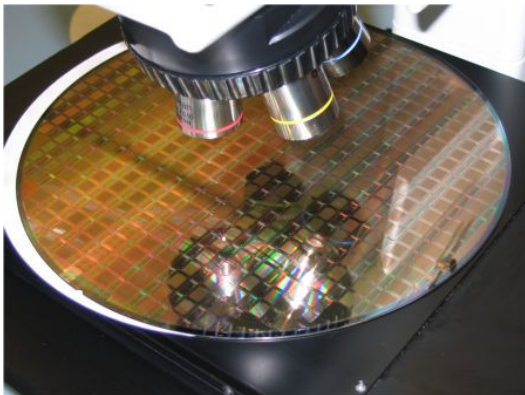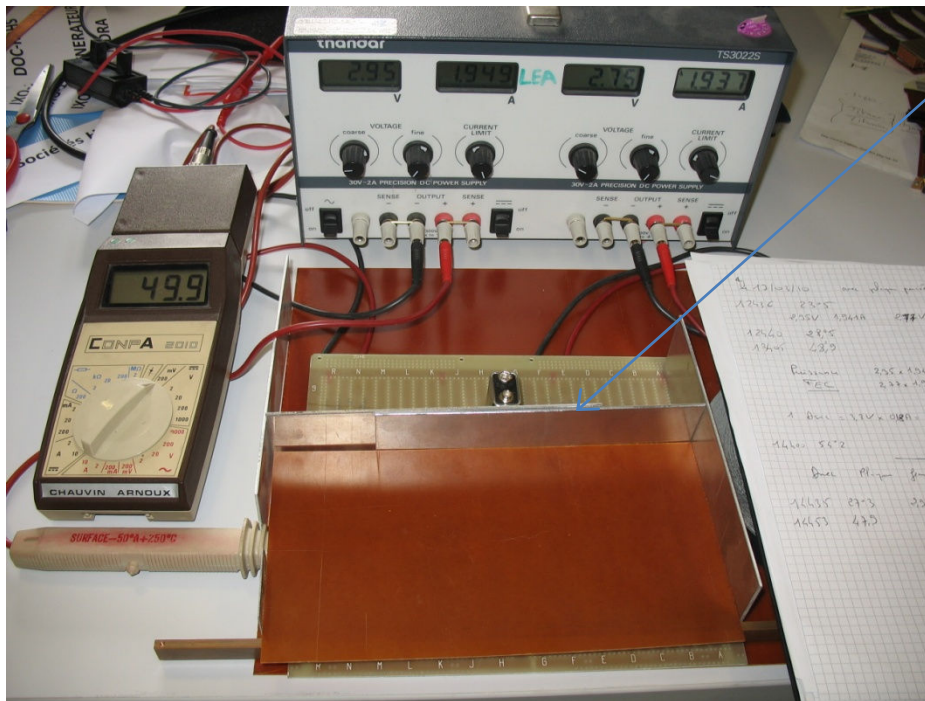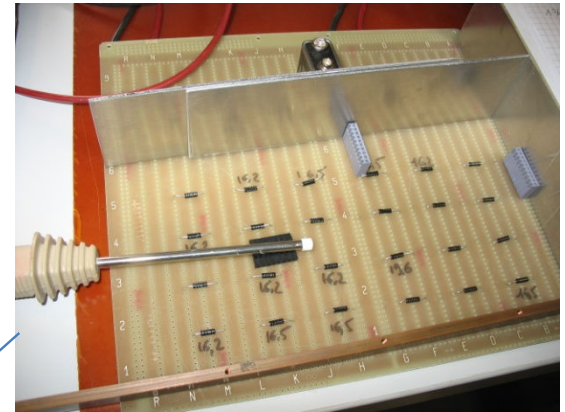
NEW ELECTRONICS – FLAT ON THE BACK OF THE MODULE

-Naked AFTER
chips wire-bounded
on cards
-Flat 300-point
connectors
-New mezzanine
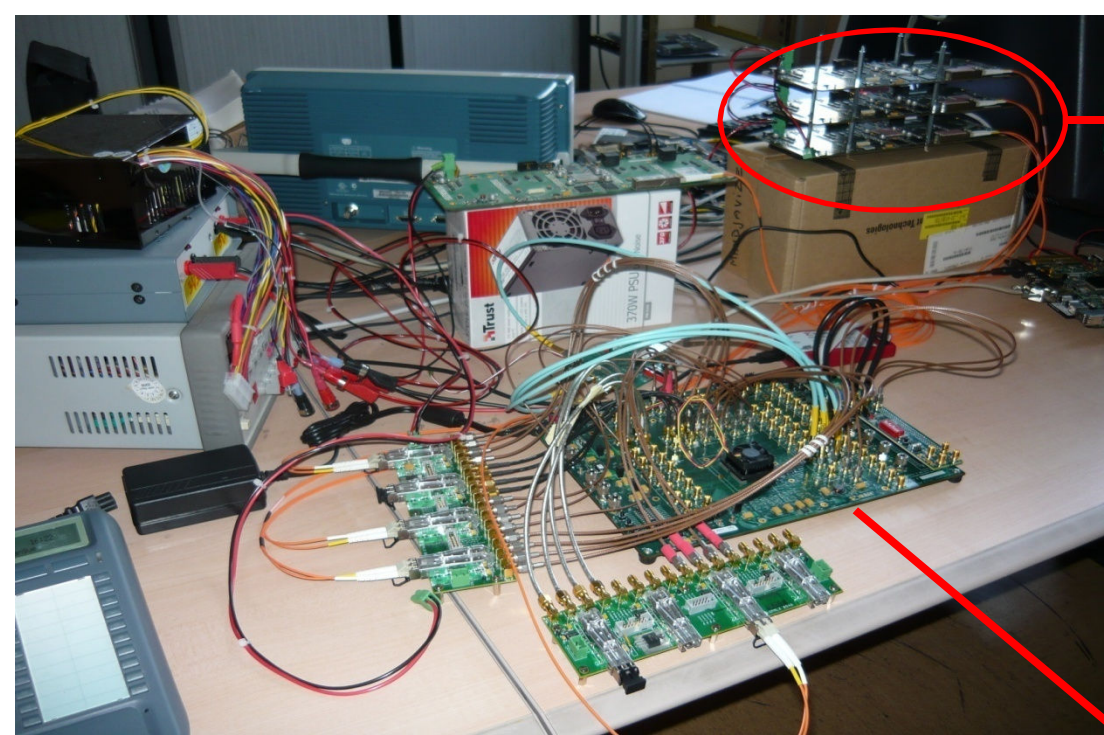bearing ADCs and
regulators
-Air cooling
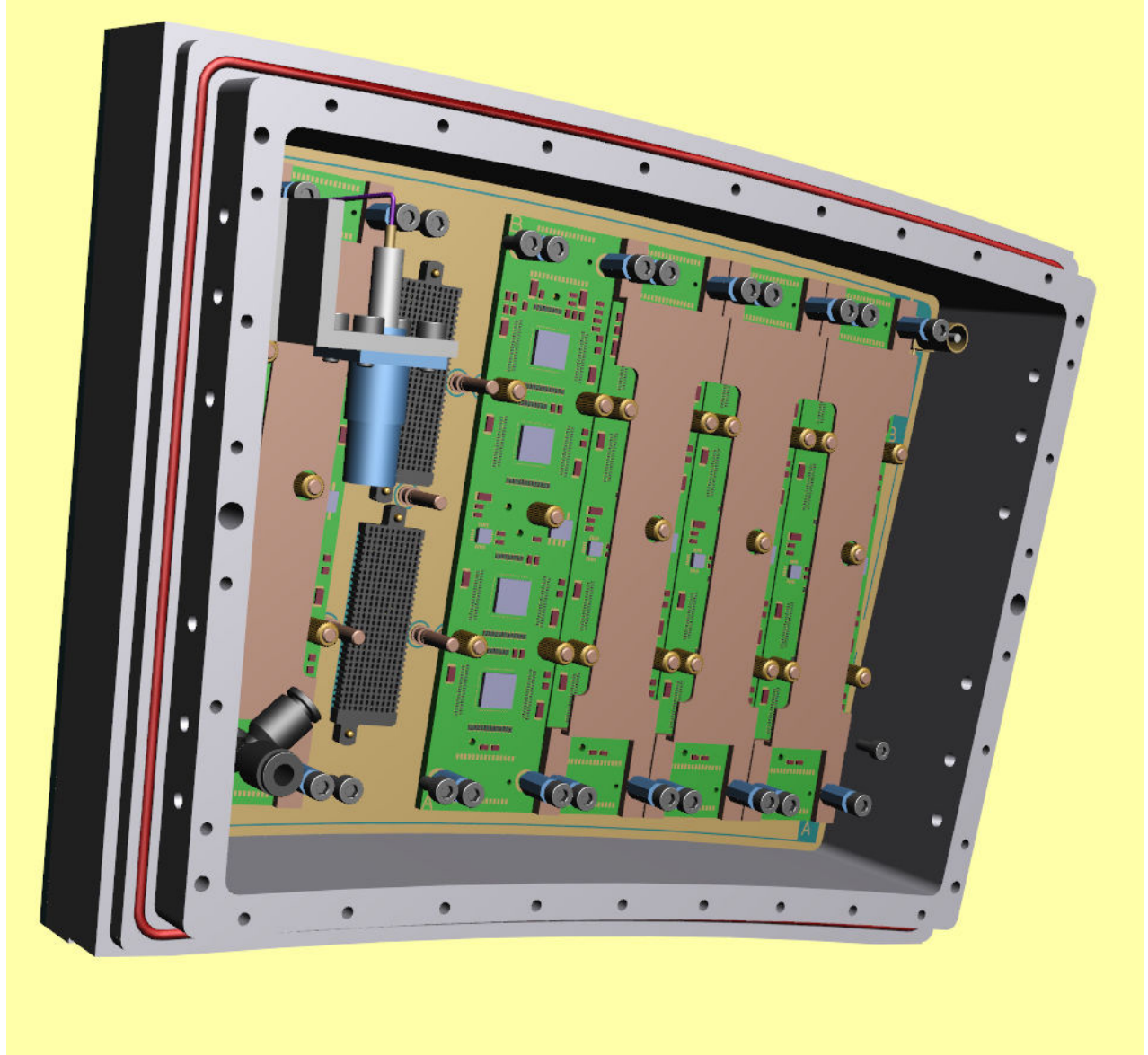
NEED FOR COOLING:

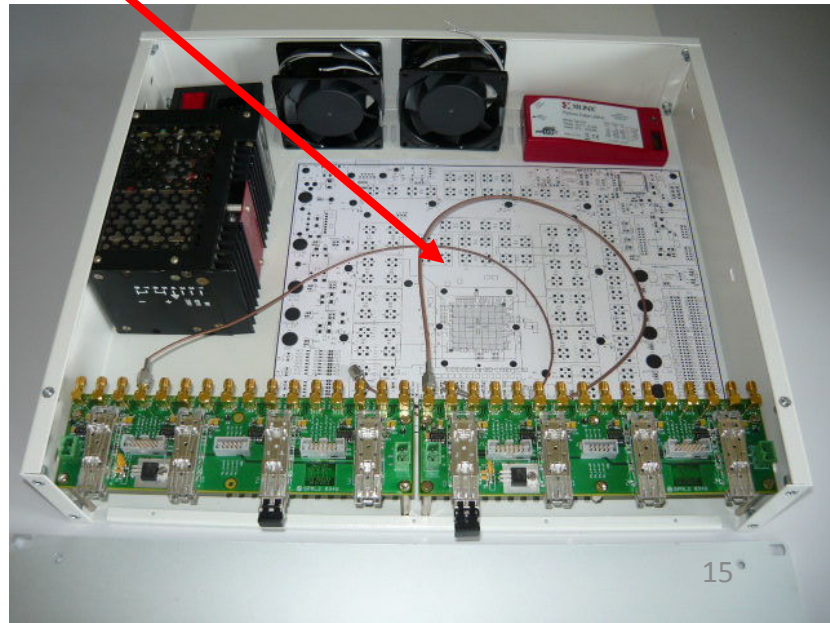Mimic 14 W of power dissipation
(equivalent to 24 chips) with 24 resistors

Temperature raised to 50 °C
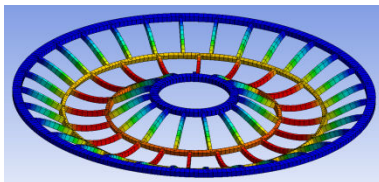
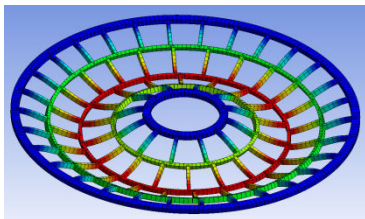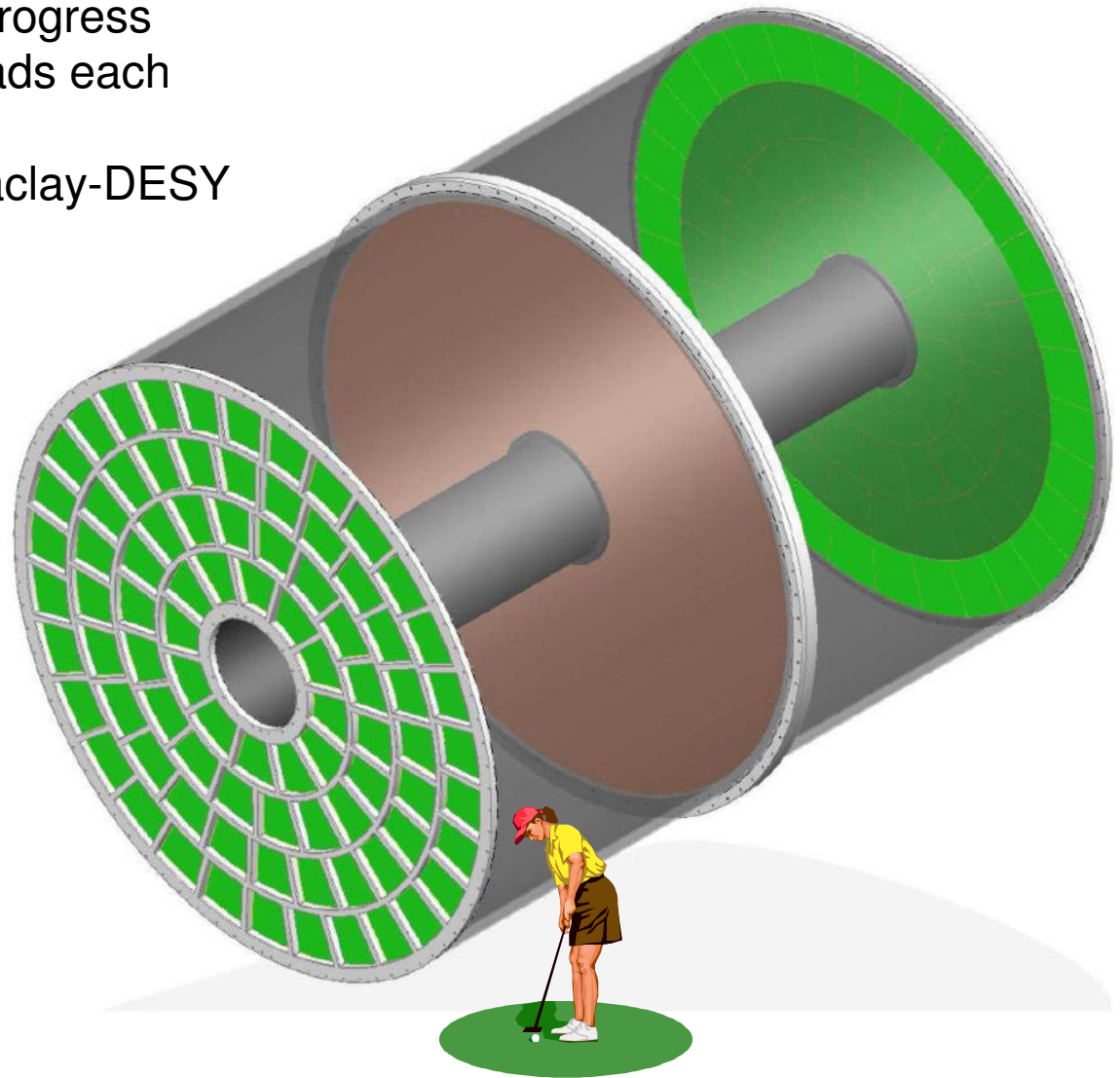FEM

SACLAY-CARLETON BACKEND UNDER TEST

Kit ML523

Micromegas TPC

Design for an ILD TPC in progress
2x80 modules with 8000 pads each

Mechanics under study (Saclay-DESY
within AIDA)

CONCLUSIONS

- Very good results of the single-module tests after 18 months. The concept is globally validated.

- Resolution at z=0 : 50 times smaller than the pad size. Quantitative measurement of N_{eff}.

- Next step well advanced : 7 modules to fully equip the present endplate.