7-module Micromegas TPC test, results with a new resistive material

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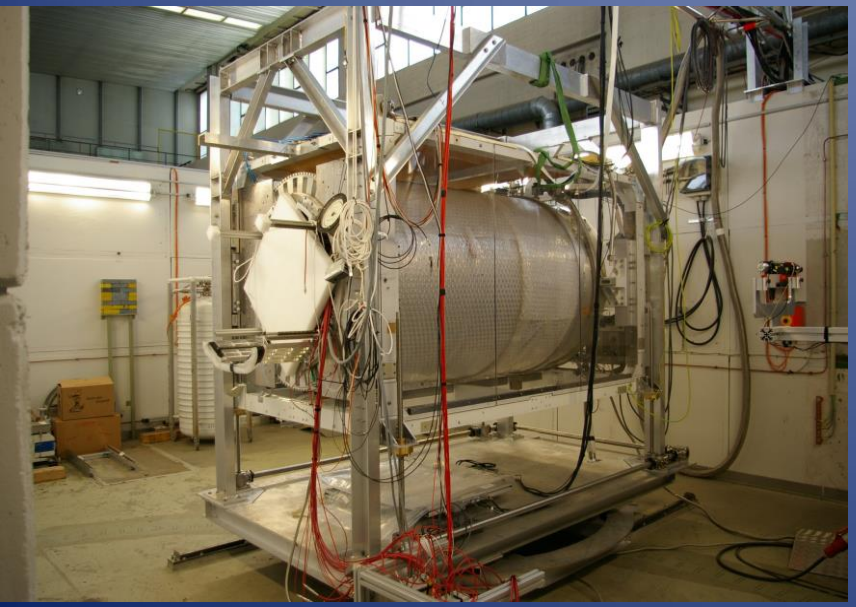
15th RD51 collaboration meeting, CERN,
20th March 2015

Preview

- LP-TPC in brief
- Resistive foil Micromegas
- Results
- 2 Phase CO2 cooling results

Large Prototype TPC at DESY

with 5 GeV electron beam
And 1 Tesla magnetic field



Proposed ILD

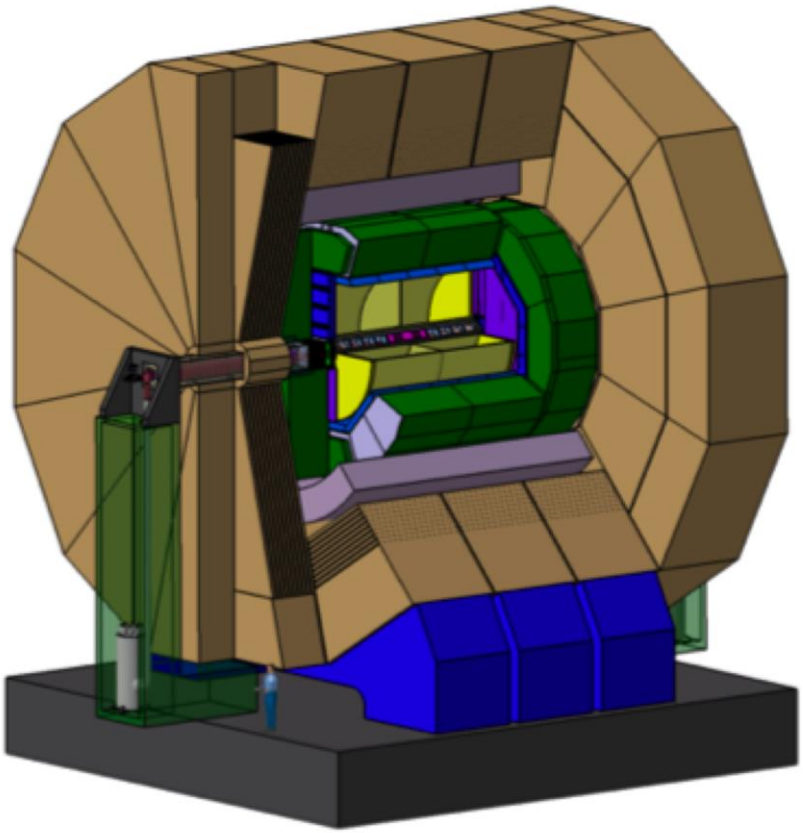
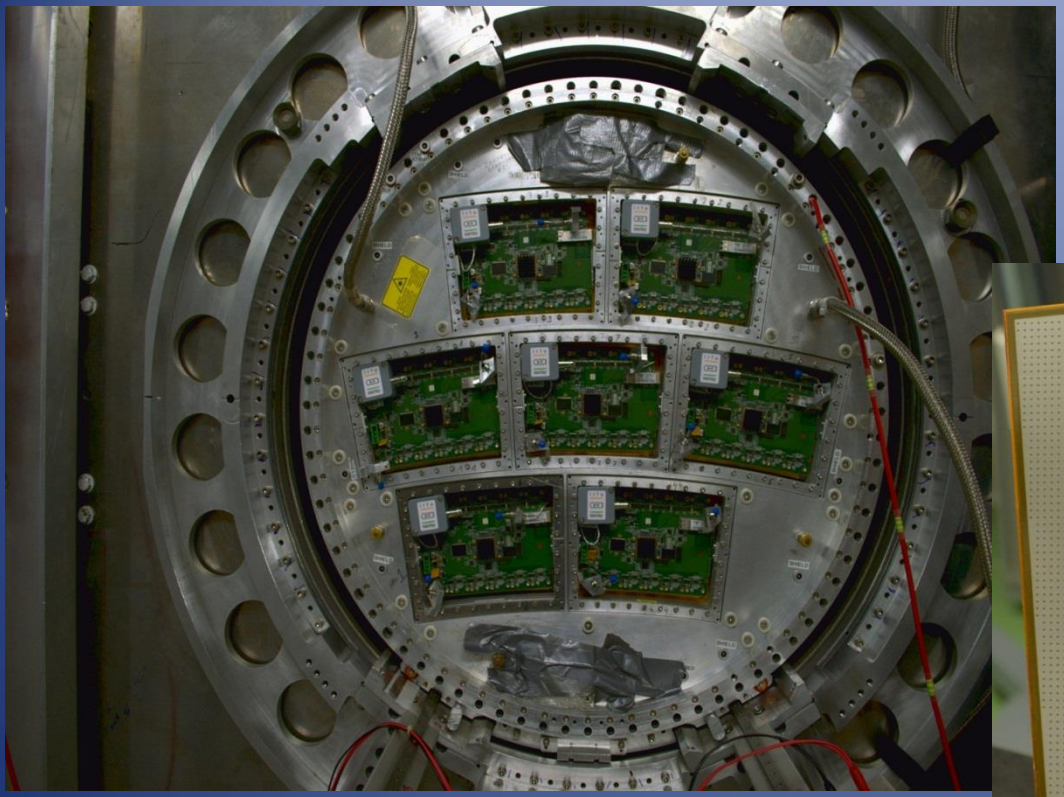
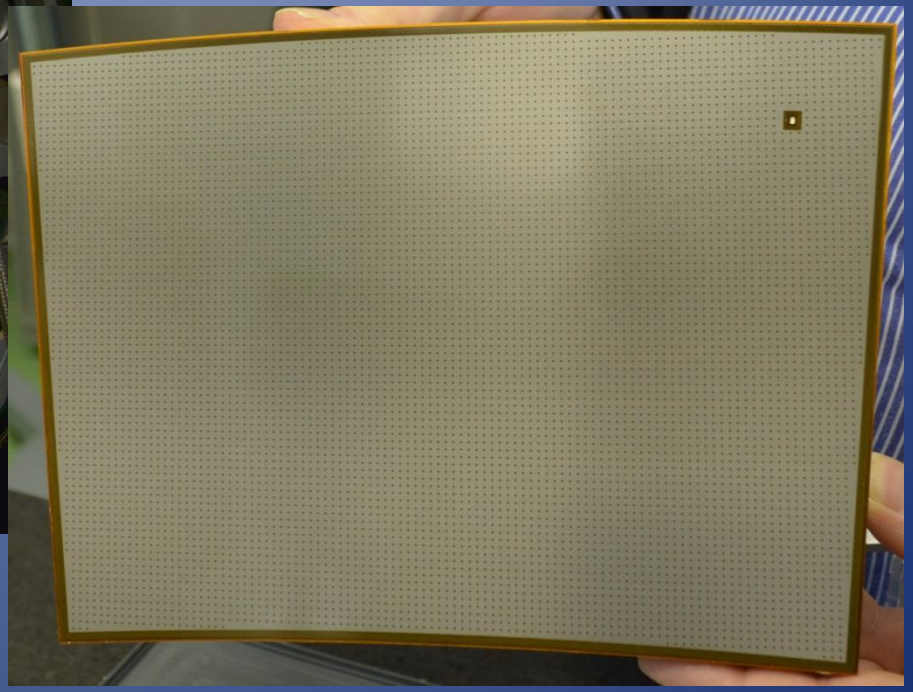


Figure 2: A schematic view of the International Large Detector concept (the TPC is the yellow cylinder inside the blue electromagnetic calorimeter).

End plate of LP TPC



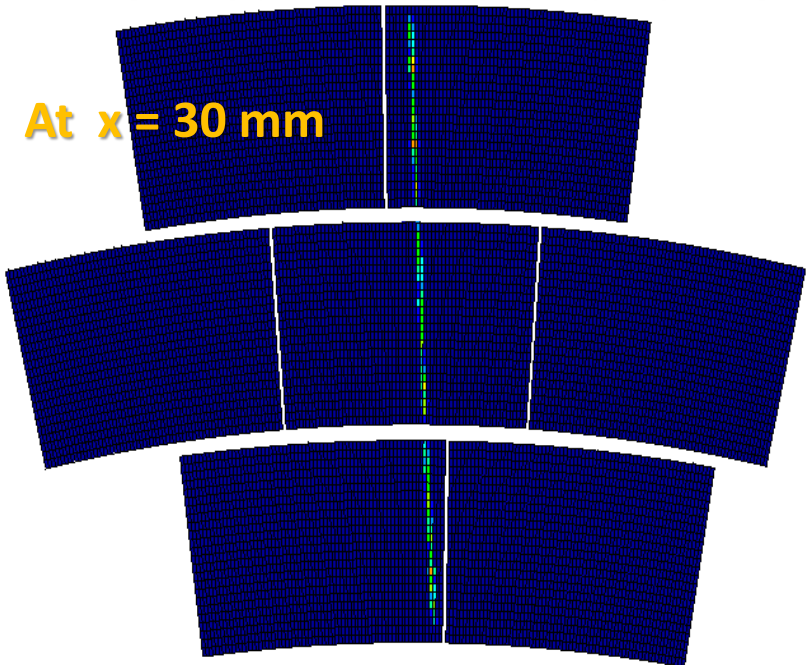
Micromegas module



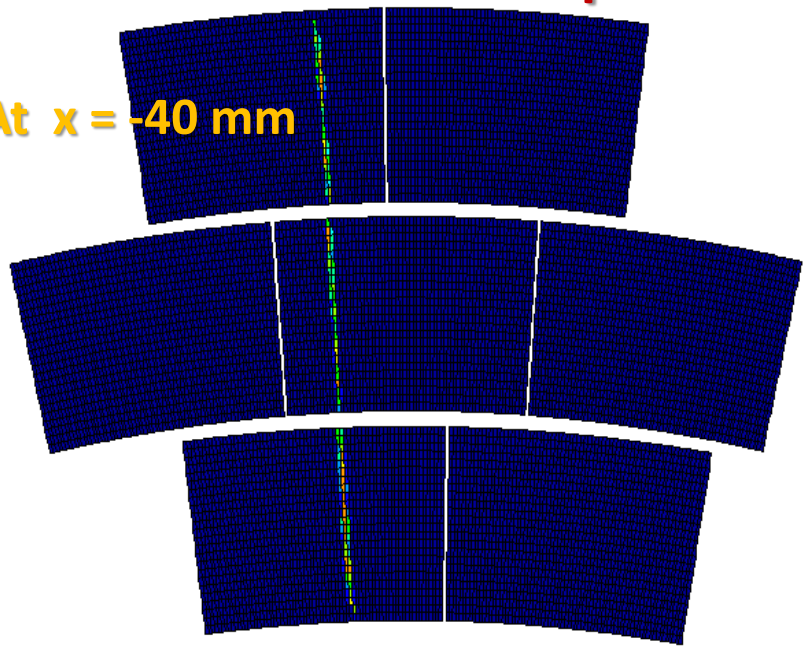
- **Module size: 22 cm × 17 cm**
- **24 rows × 72 columns**
- **Readout: 1726 Pads**
- **Pad size: ~3 mm × 7 mm**

The first 2 weeks of this month we took data at different positions

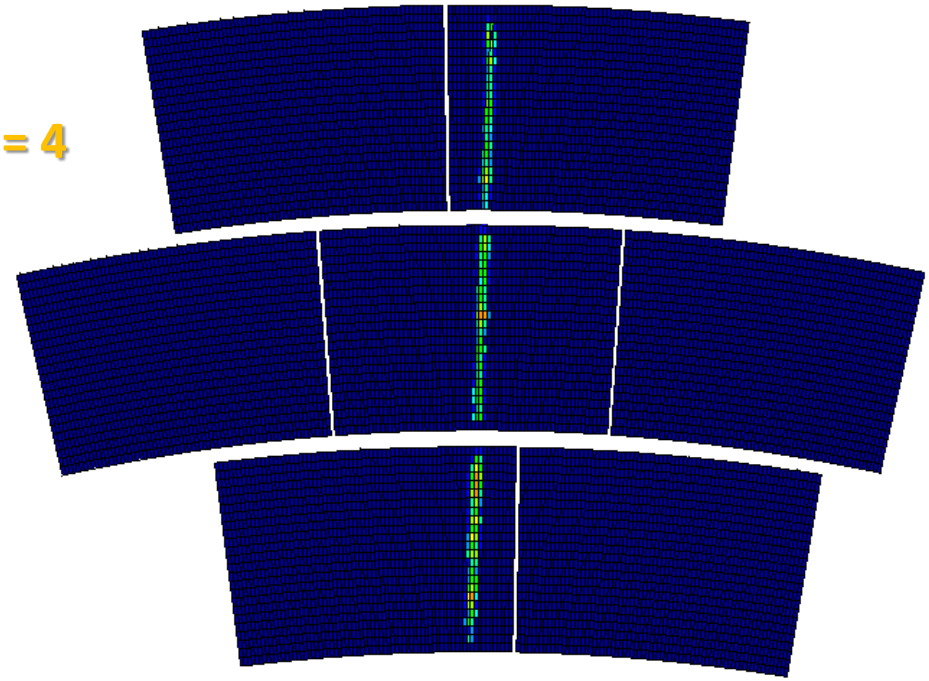
At x = 30 mm



At x = -40 mm



At phi = 4



For bulk Micromegas, resolution $\sigma = w/\sqrt{12}$

We are using resistive foil Micromegas where charge is dispersed

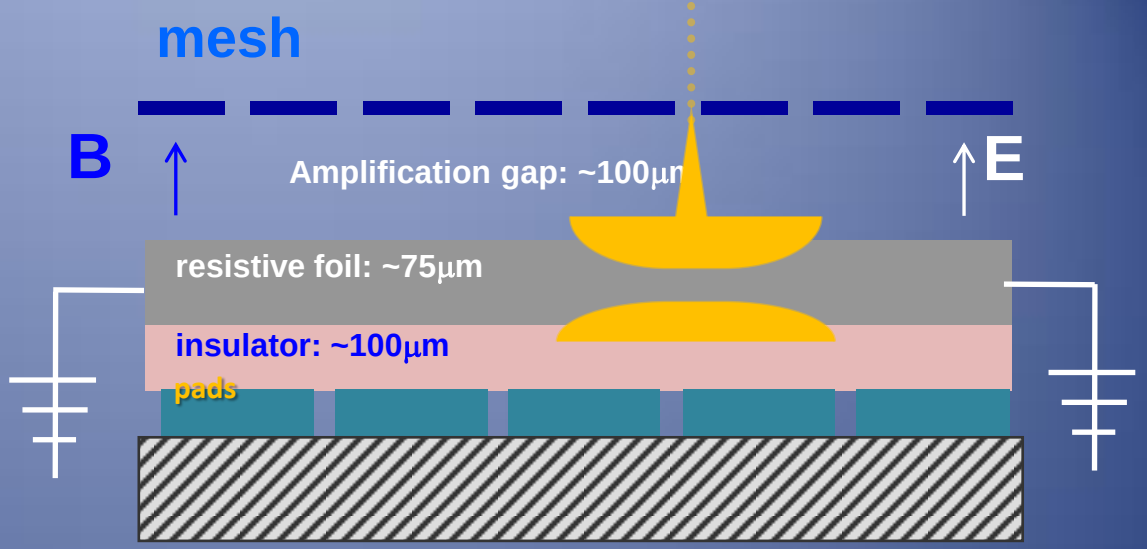
Equation for surface charge density function on the 2D continuous RC network:

$$\frac{\partial \rho}{\partial t} = \frac{1}{RC}\left(\frac{\partial^2 \rho}{\partial r^2} + \frac{1}{r}\frac{\partial \rho}{\partial r}\right)$$

$$\Longrightarrow \rho(r,t) = \frac{RC}{2t} exp\left(\frac{-r^2 RC}{4t}\right)$$

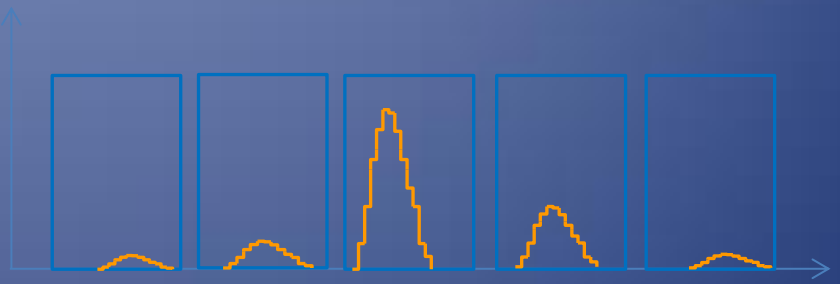
$\rho(r,t)$: the surface charge density
R: the surface resistivity of the resistive layer
C: the capacitance per unit area.

$$\sigma = \sqrt{(2t/RC)}$$



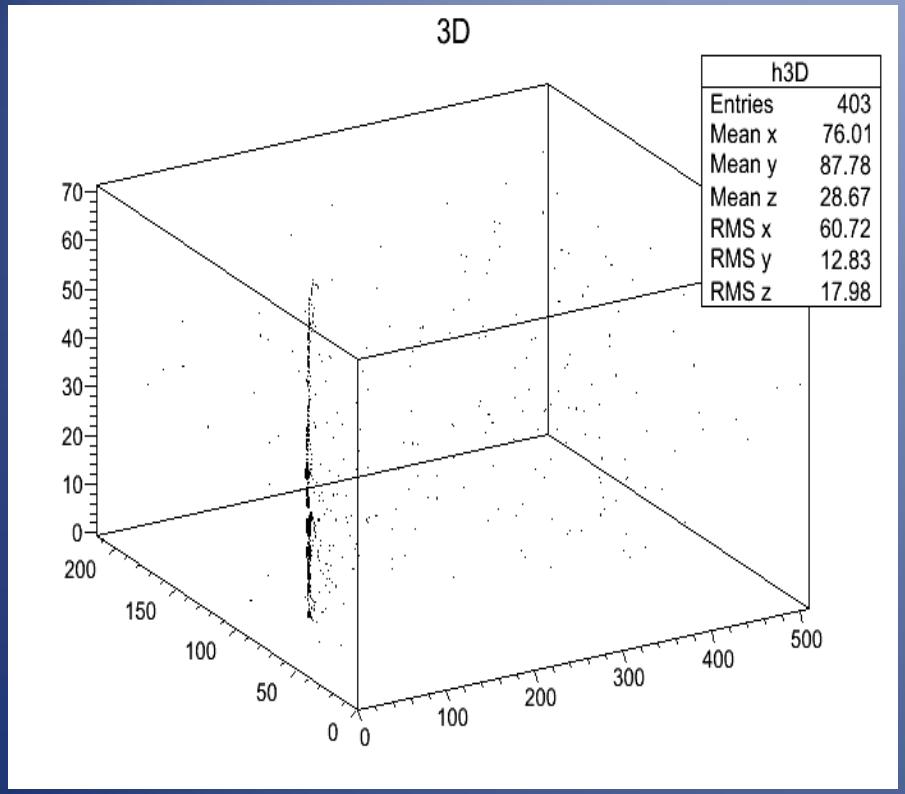
When values of R, C, t are applied,
It gives,

Charge dispersion ≅ 2 mm



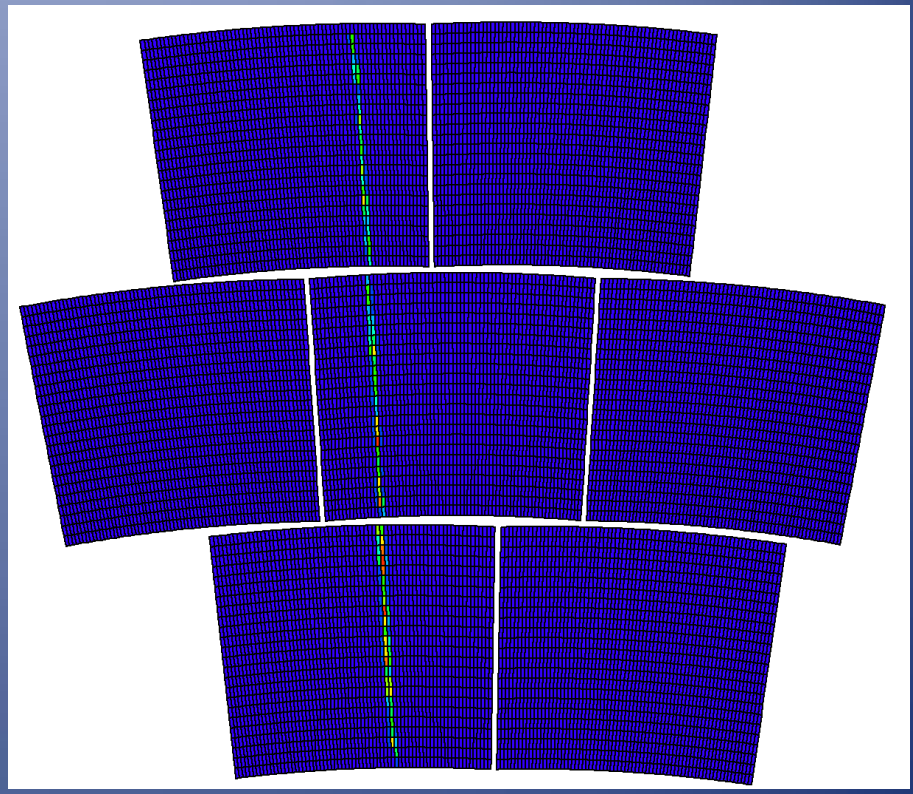
A new kind of resistive foil called Diamond Like Carbon is provided by Ochi and two new Micromegas modules called 'Black Diamond' is prepared at Rui's workshop.

Track in 3-D space



5-GeV electron beam

Track on 7-module Micromegas

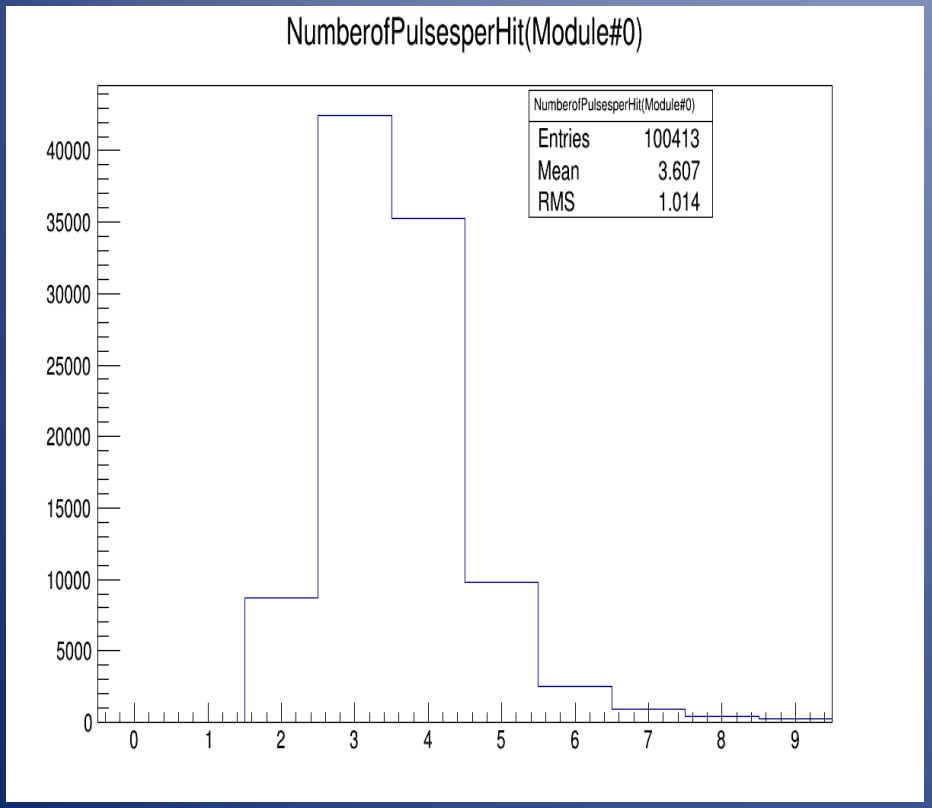


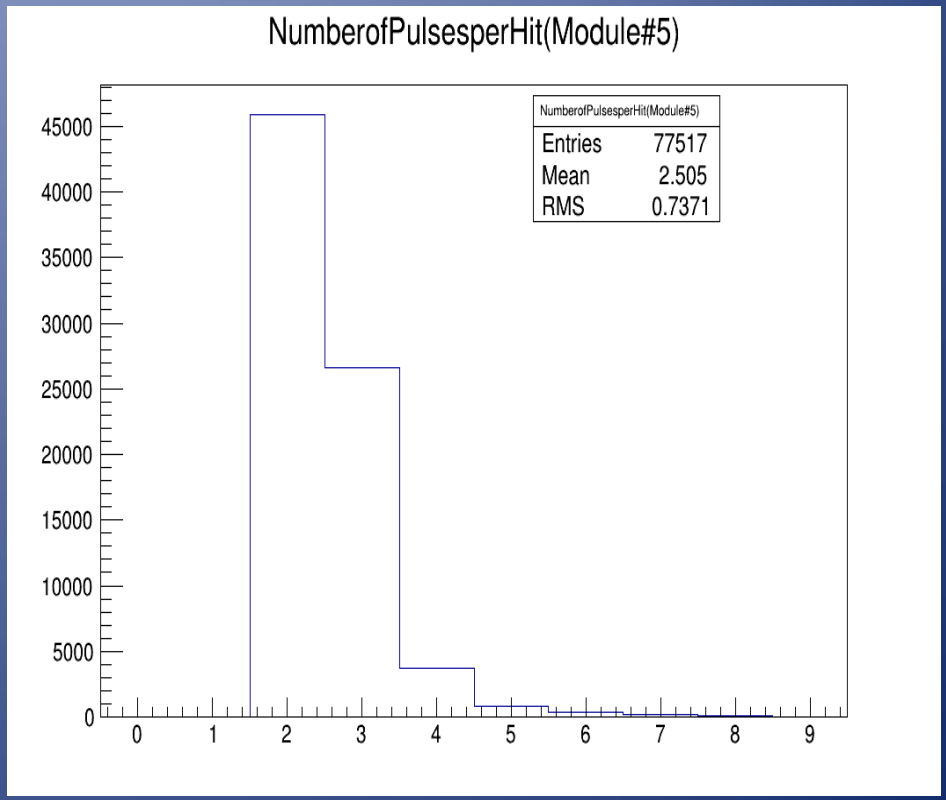
5-GeV electron beam

Number of Pulses per Hit

Comparison of Black Diamond and the old modules

RUN-05125, Drift field=140 v/cm, peaking time=100 nano second, B=1 T





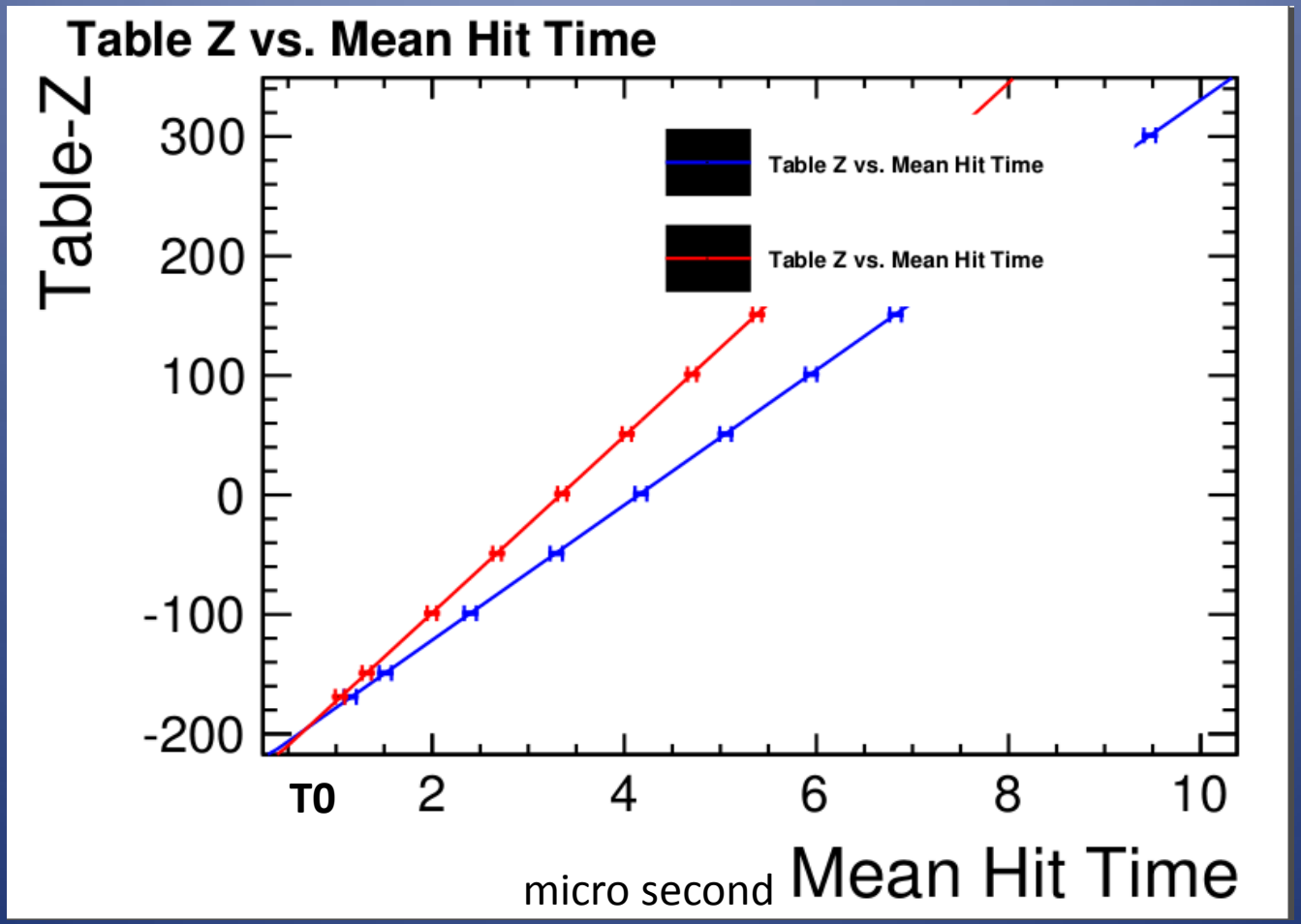
Average pulse per hit =3.607

Diamond like carbon

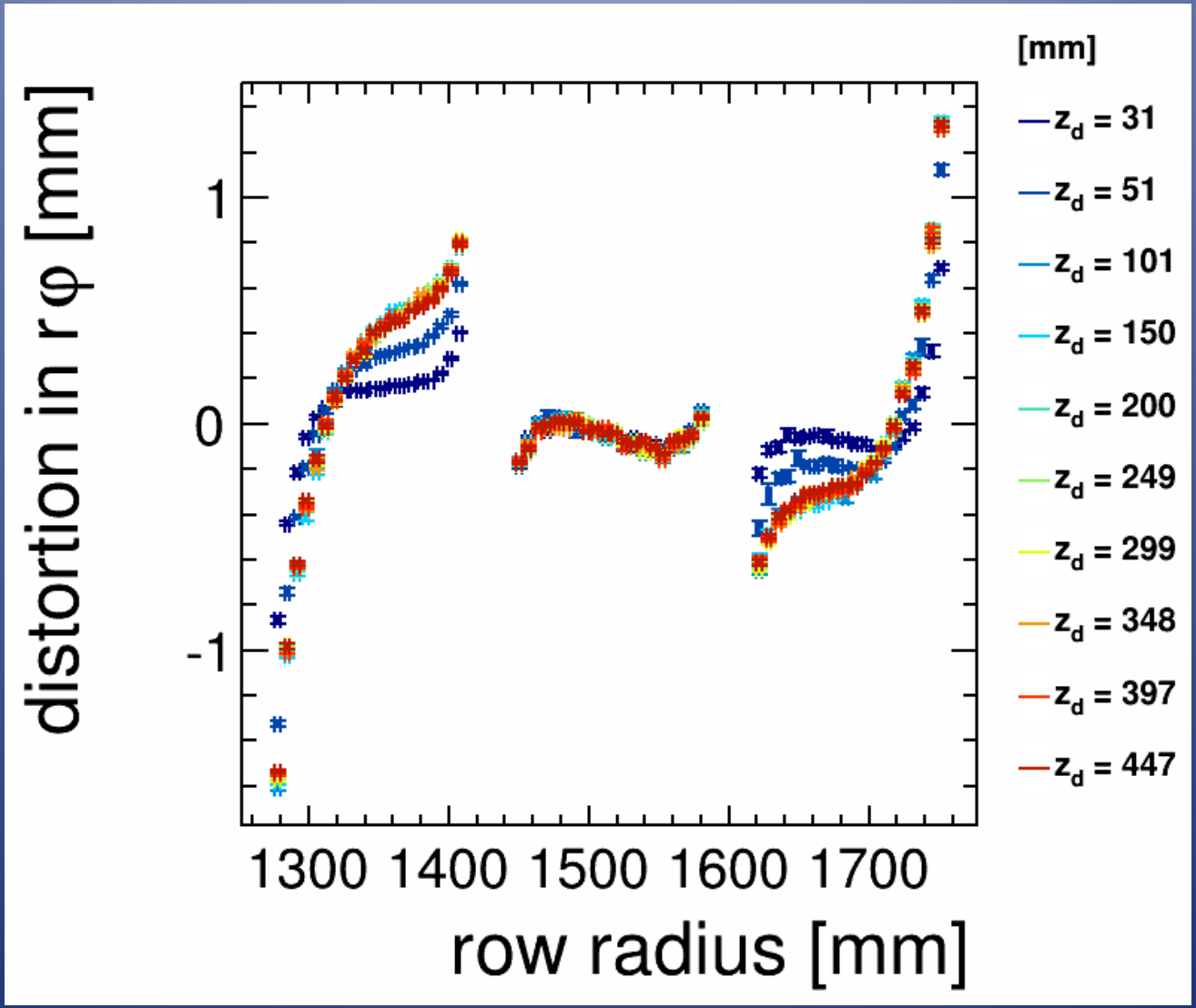
Average pulse per hit = 2.505

Carbon loaded Kapton

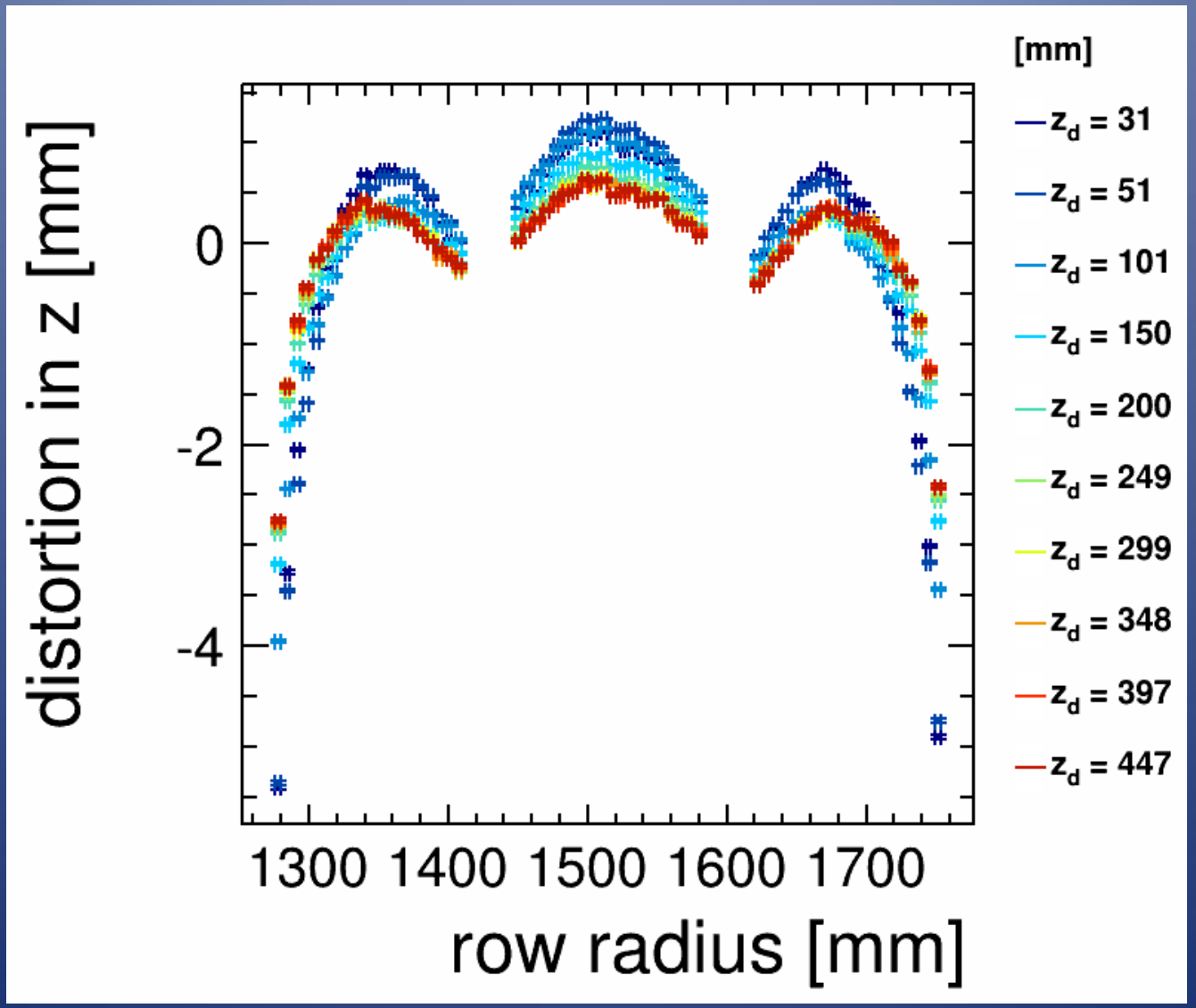
Measurement of drift velocity and T0



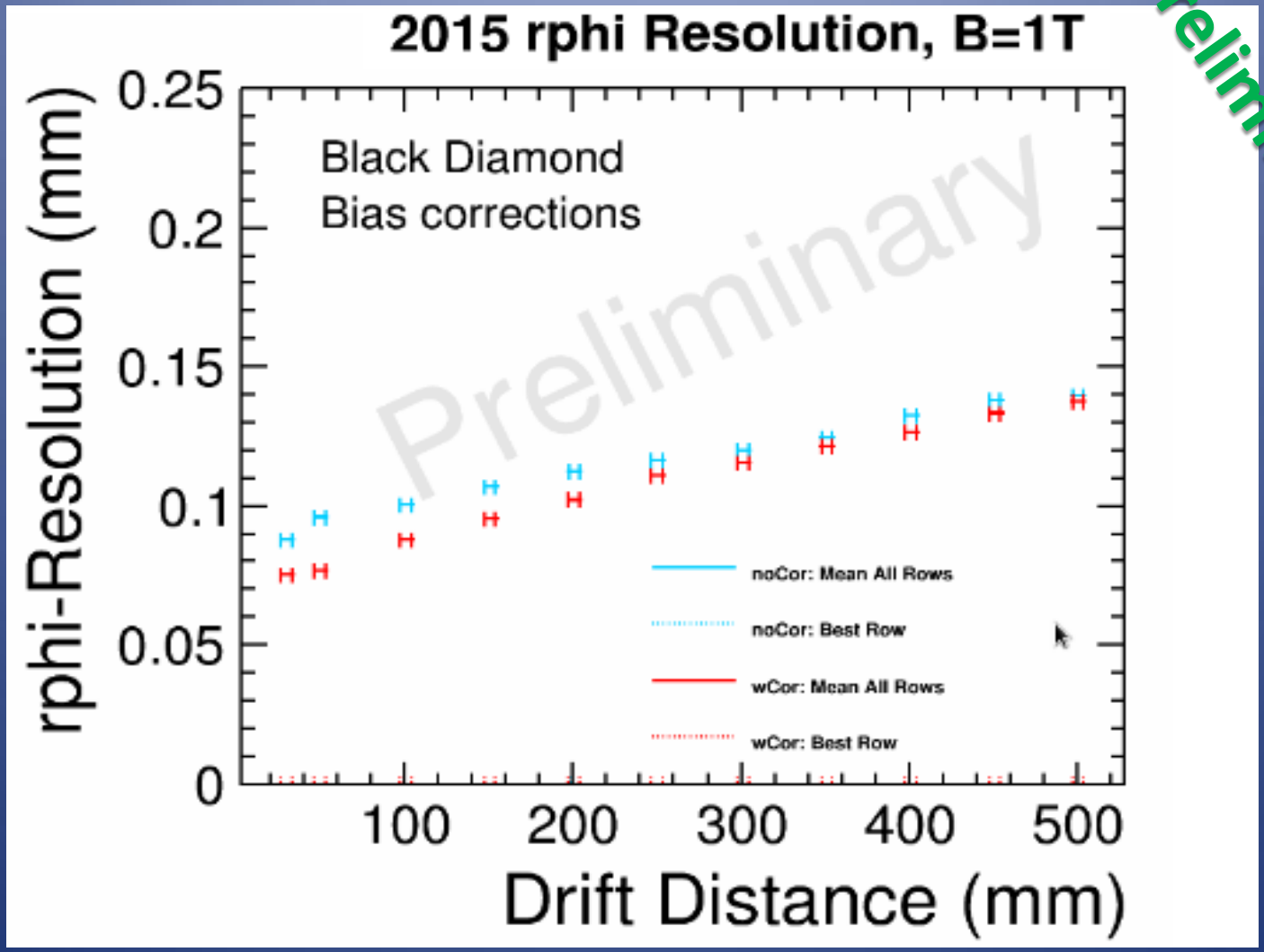
Distortion in r_phi
low field, B=1T, peaking time 100 ns, phi=0



Distortion in Z
low field, B=1T, peaking time 100 ns, phi=0



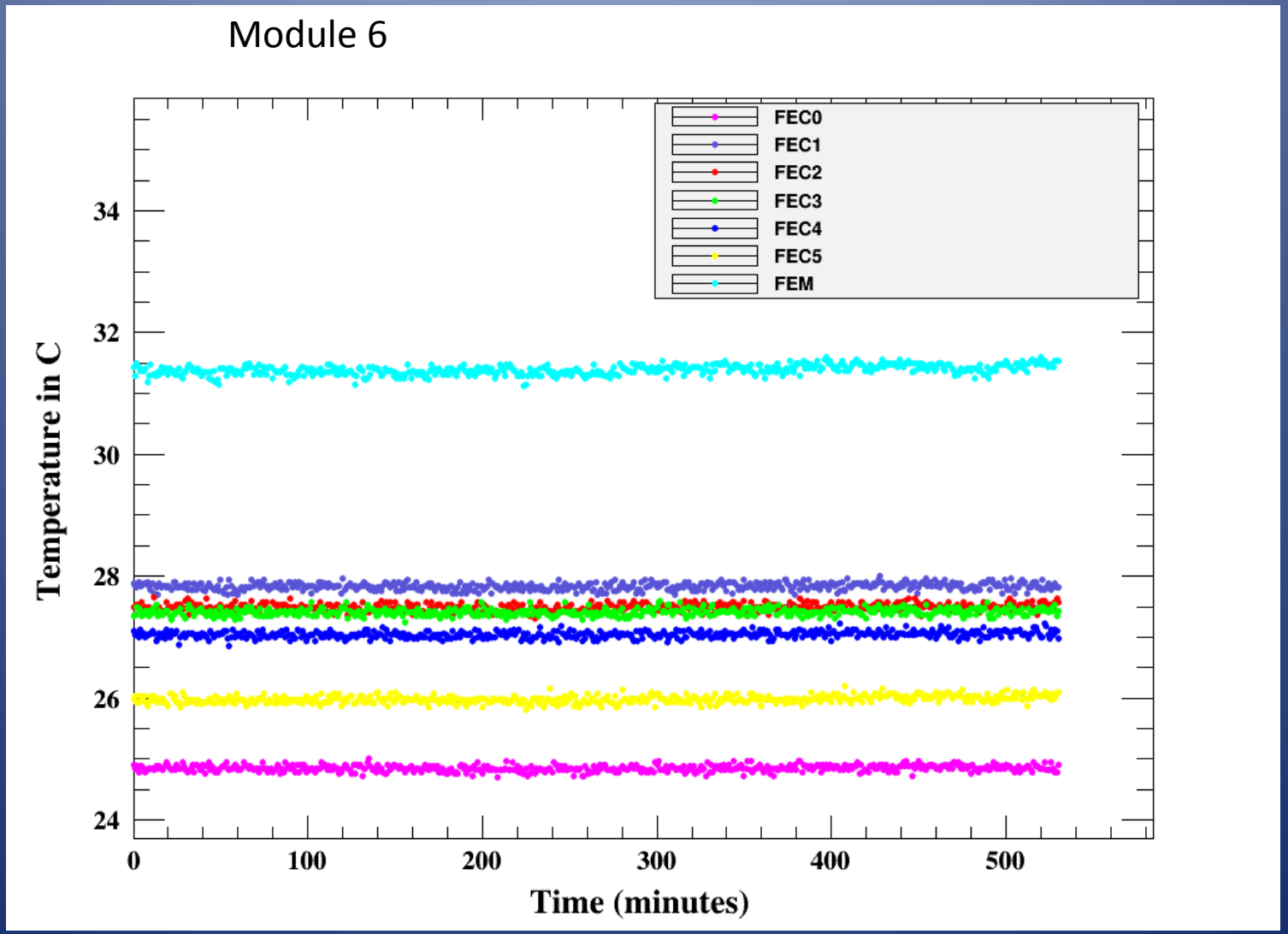
Resolution vs drift distance



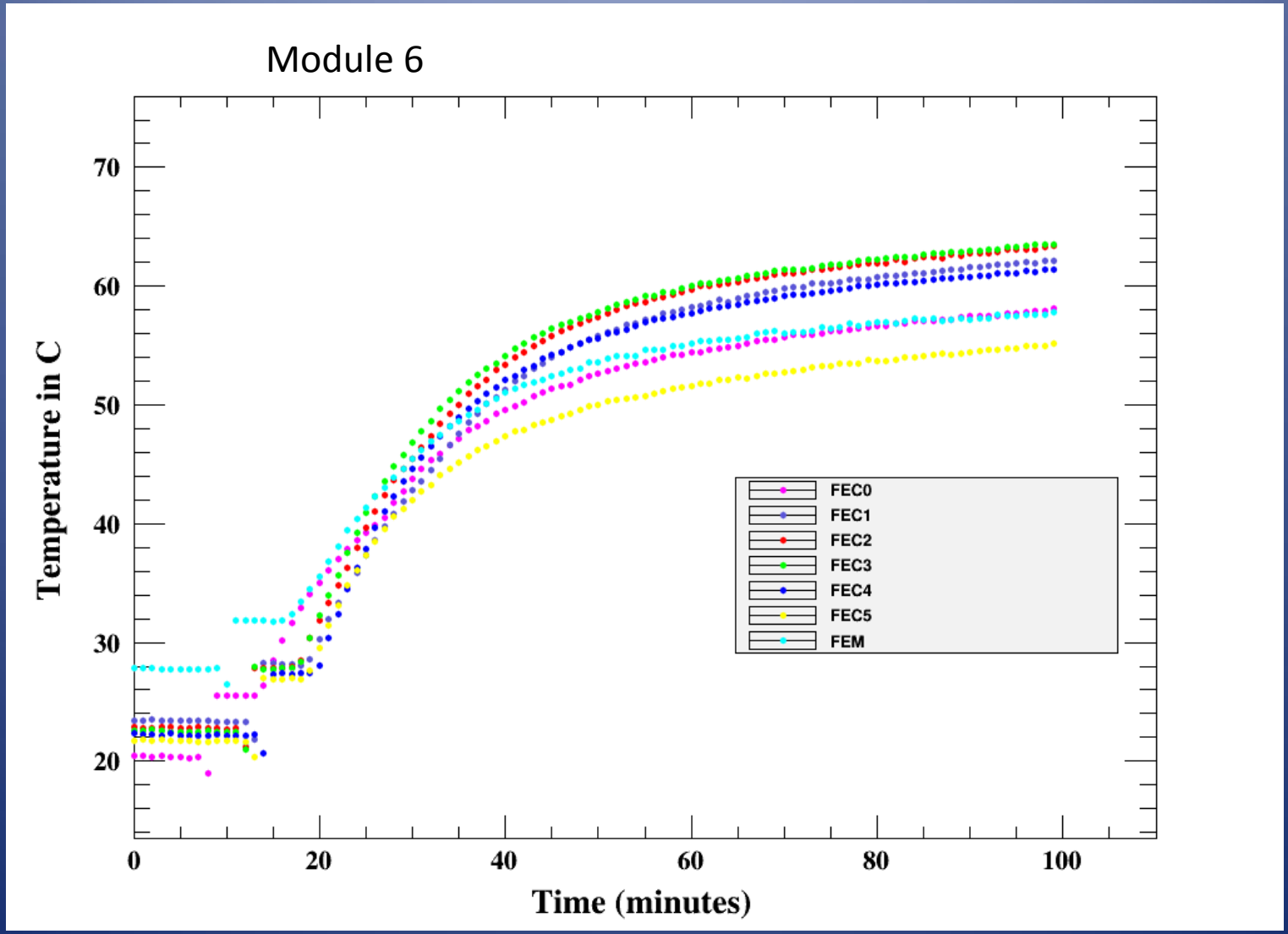
Preliminary

Track fitting is done by 'RowTripletBasedTrackFinder'

Temperature of all the FECs and the FEM of Module 6

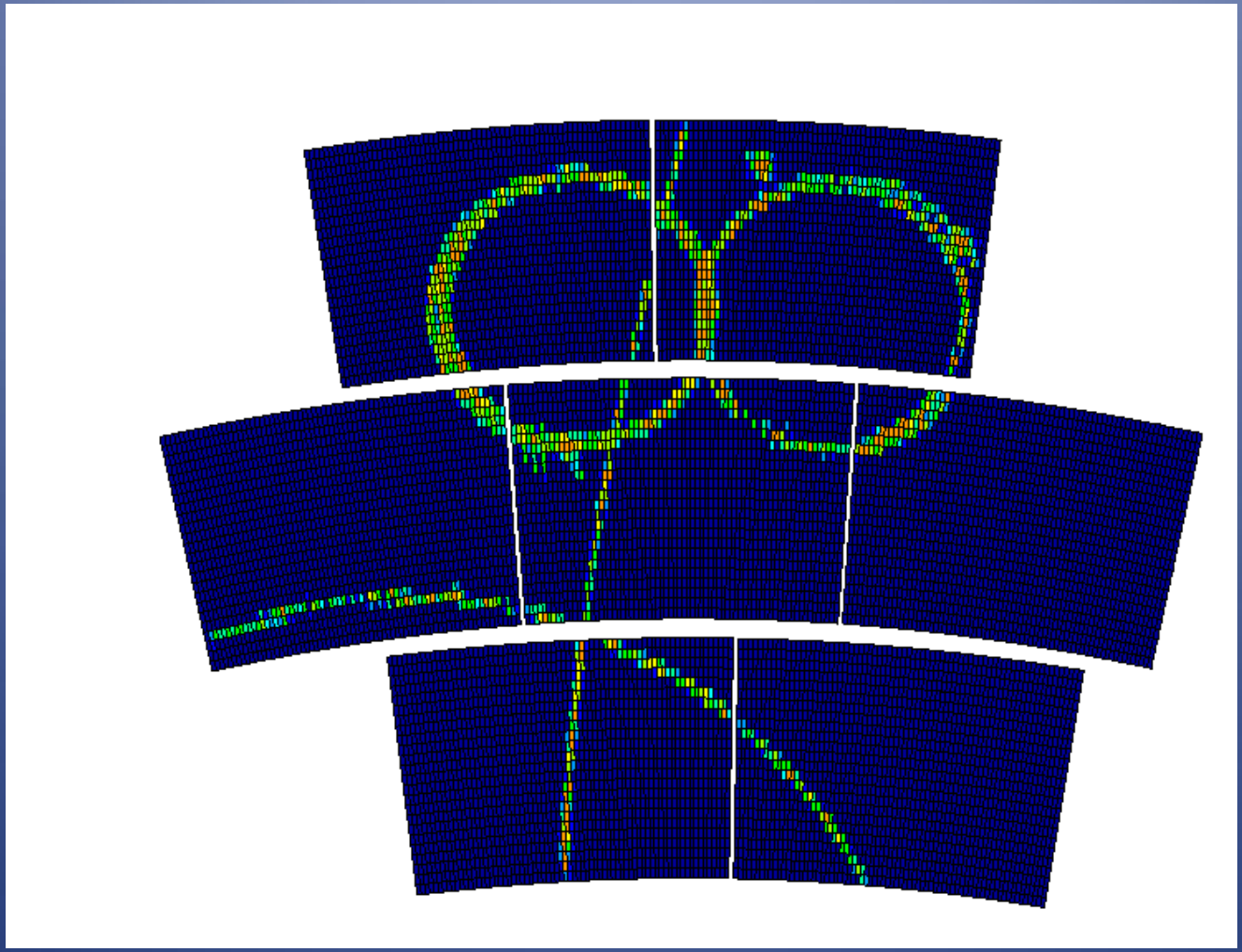


Rise of temperature when the cooling is stopped



Summary

- All the 7 Micromegas modules are well used to take data in different configurations.
- In 1 Tesla field, the space resolution of Micromegas modules is below 100 micron. *Work in progress for more results*.
- Two Micromegas modules with resistive layer of Diamond Like Carbon (DLC) have been tested and the result is satisfactory.
- 2 Phase CO2 cooling is used uninterruptedly for more than 80 hrs. Temperature of individual Front End Cards (FECs) is stable within 0.5 degree C during the experiment.
- For better performance, the modules will be updated in near future.



THANK YOU