MPGD 2019
LA ROCHELLE

A new scheme for Micromegas TPC readout :
the encapsulated resistive anode with reverse grounding

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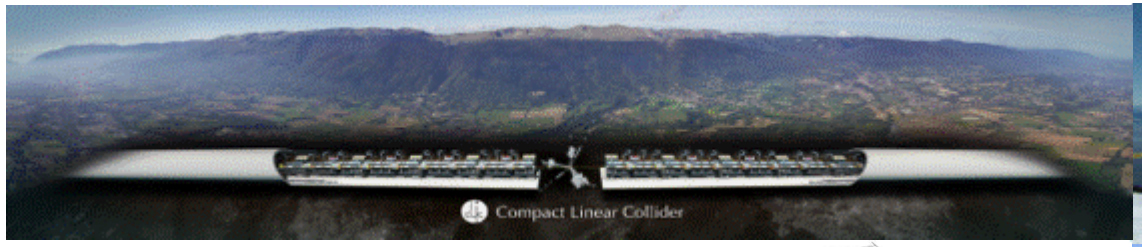
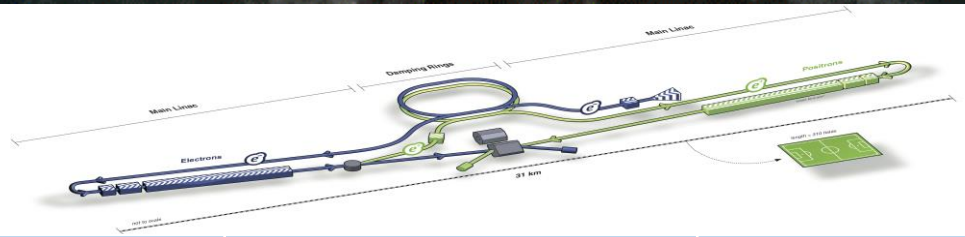
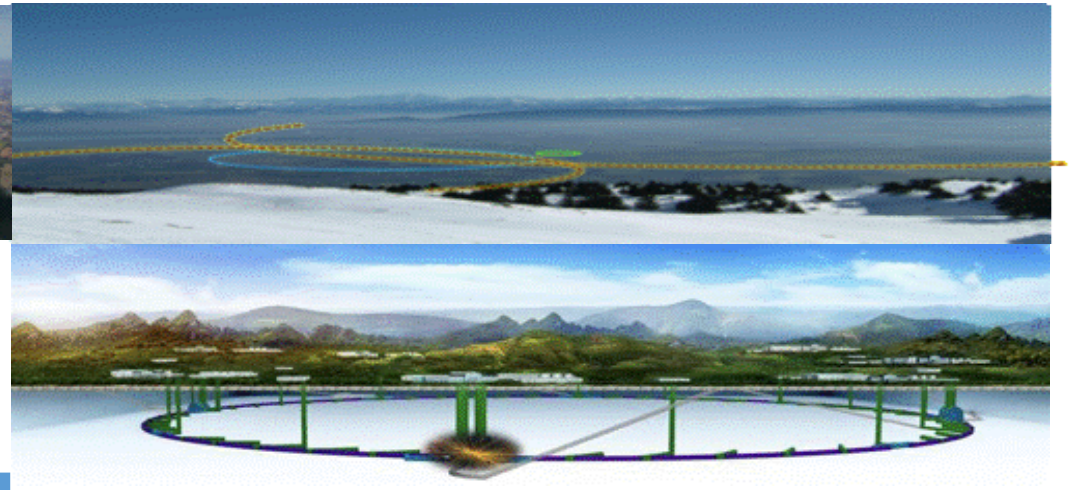
Introduction : tracking at e+e- colliders

The next High Energy collider will be an e+e- for Higgs precision studies







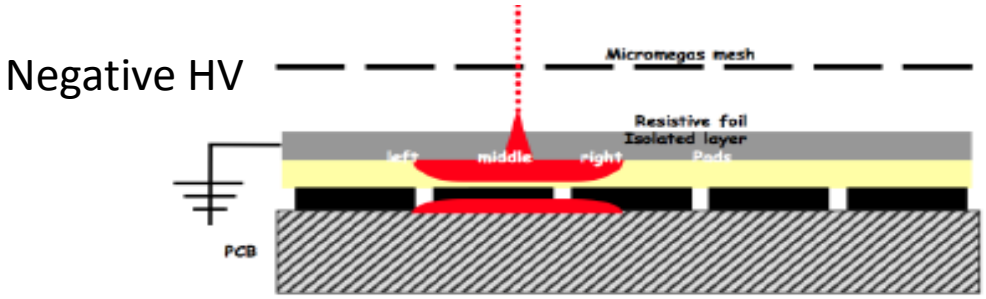
	LINEAR	CIRCULAR
EUROPE	CLIC	FCC-ee
ASIA	ILC	CEPC
	New technology + : polarization possible Upgradable in energy	Standard technology + : high luminosity Limited in energy Large tunnel Perspective : hh

ILC environment is best suited for a TPC as main tracker.

Adaptation would be needed for other machines

Charge spreading by resistive-capacitive anode

Standard scheme



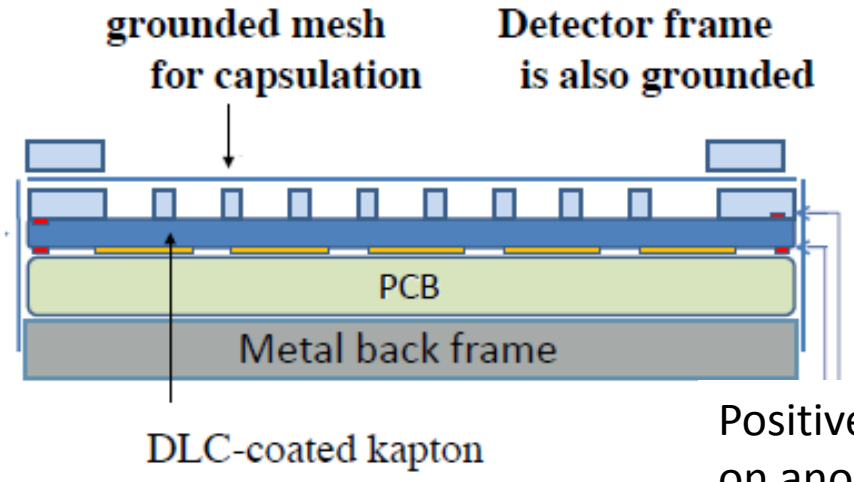
The RC continuous circuit evenly spreads the charge, allowing sharing between neighbouring pads

$$\rho(r,t) = \frac{RC}{2t}\exp[-\frac{-r^2RC}{4t}]$$

R- surface resistivity
C- capacitance/unit area

M. Dixit et al.

New scheme

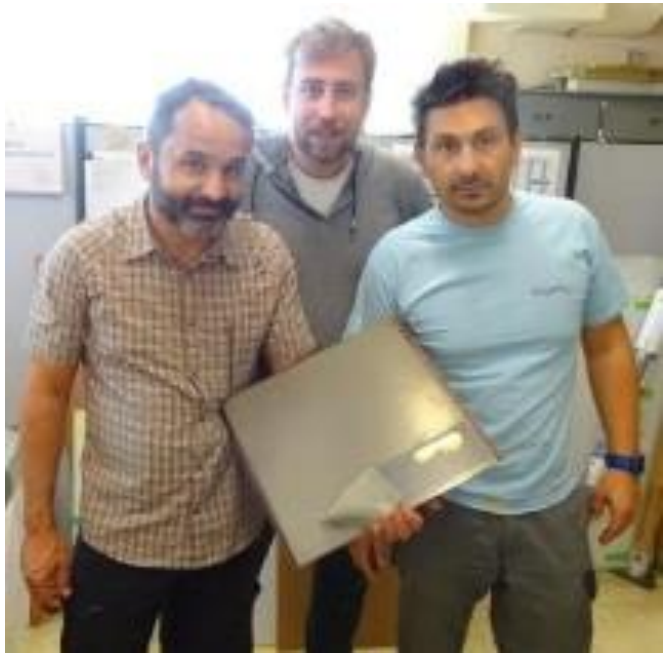


New scheme, to **reduce distortions** at the edges of the modules : mesh
at the same potential as the frame, and resistive anode at the +ve HV.
Also encapsulation **reduces the EMI**.
Another advantage: the amplification field can be tuned independently of the drift field, providing **flexibility**.
The gains can be equalized while keeping the drift field very uniform.

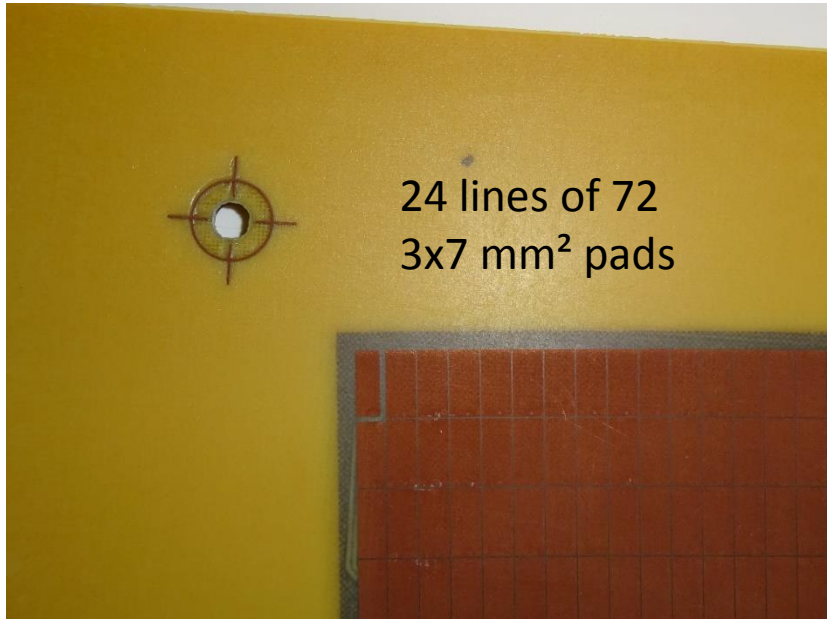
Beam tests

This new scheme was applied in 2018 to

- T2K (D. Attié, previous talk, and A. Delbart, VCI) and to
- ILC-TPC (this talk) : beam tests at DESY, November 2018

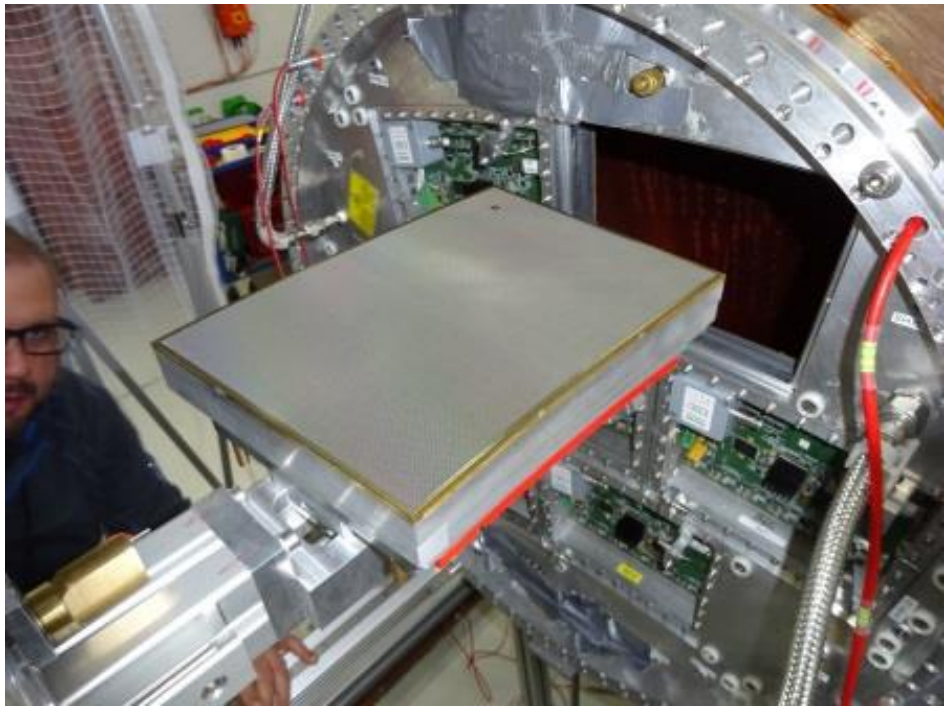


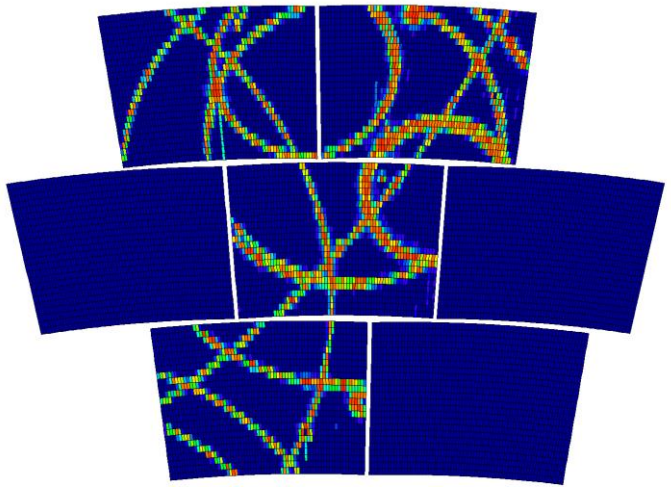
First resistive bulk for T2K/ND280

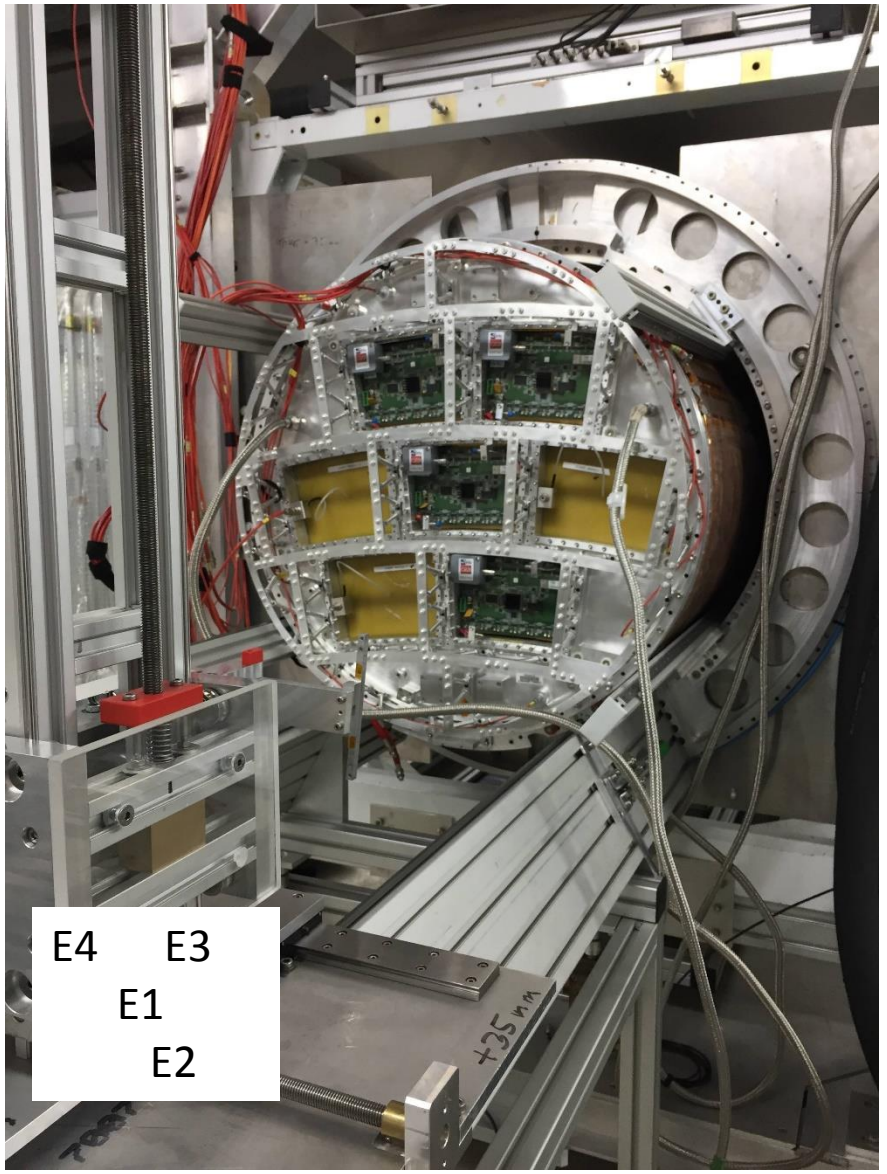


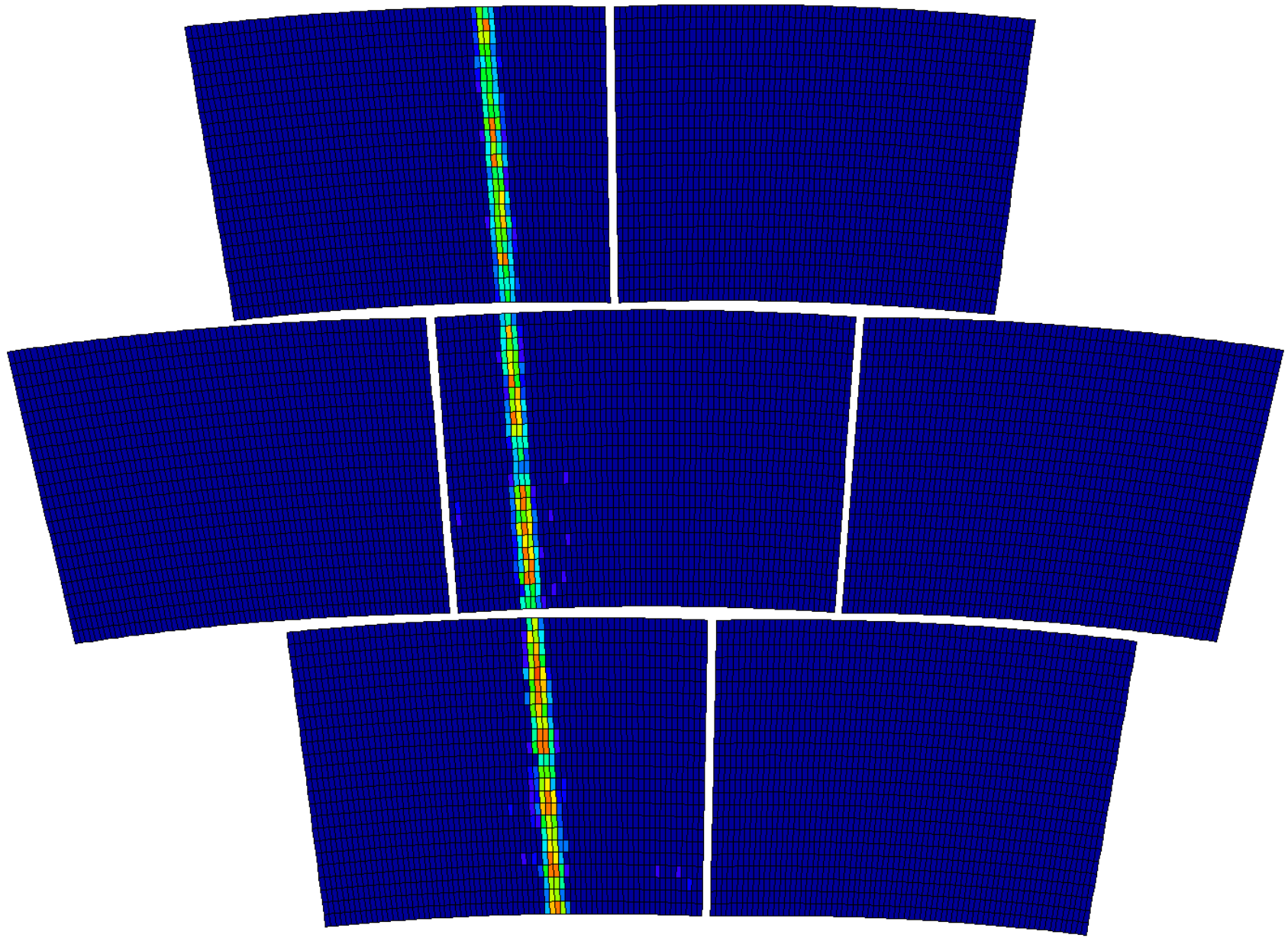
Pad PCB covered with 70 µm insulator + DLC on kapton.

The DLC foils (2.5 Mohm/sq) were not very good (runnings), except one
New modules are numbered E1, E2, E3, E4 in decreasing quality order



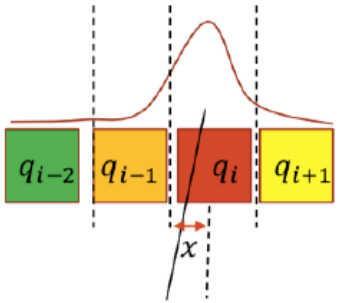



E4 E3
E1
E2



Pad Response function

2D distribution :
Charge fraction vs Xpad-Xtrack

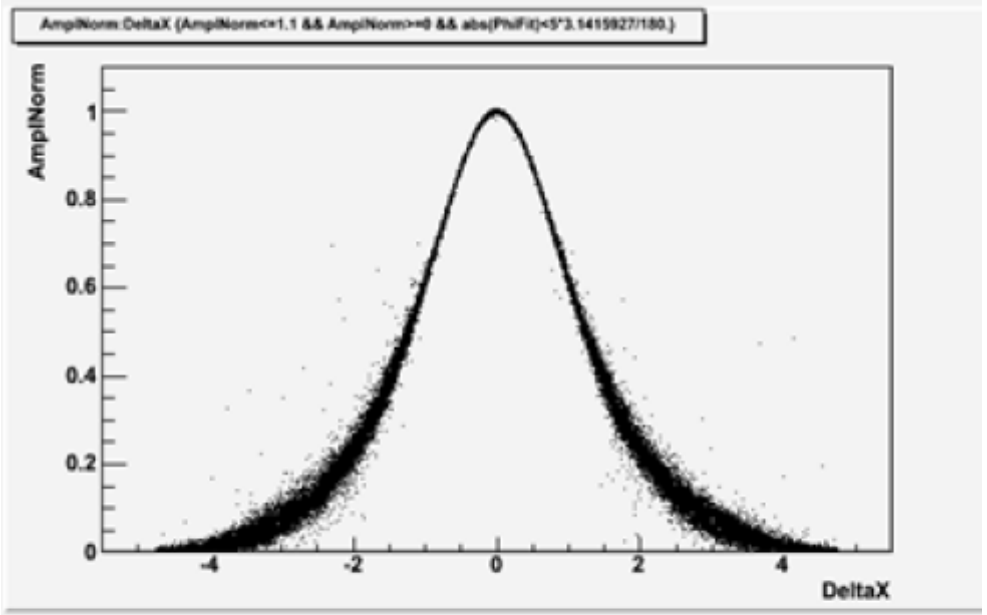


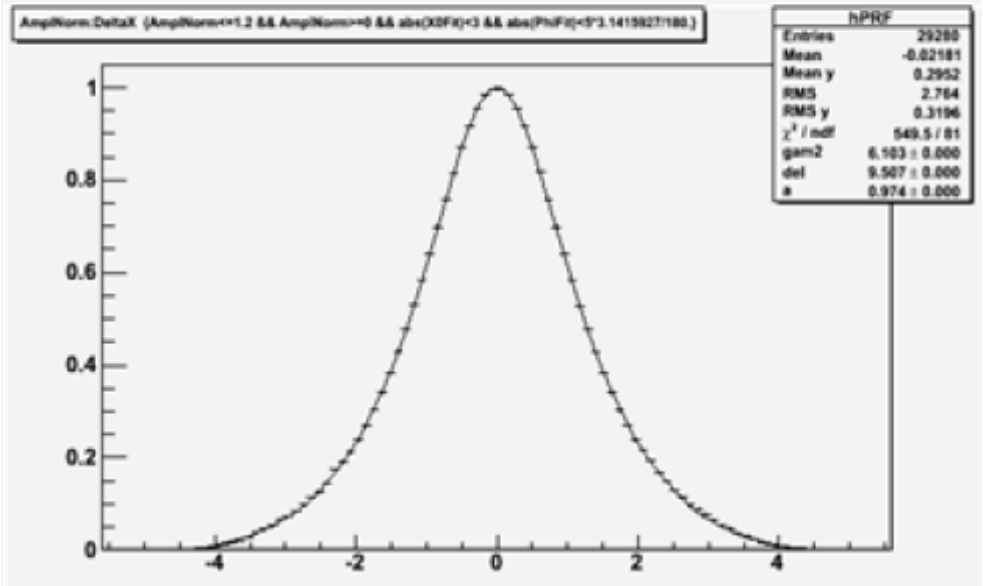
Fit a parameterization to the profile, for i

$$PRF(x, r, w) = \frac{\exp[-4\ln 2(1-r)x^2/w^2]}{1+4rx^2/w^2}$$

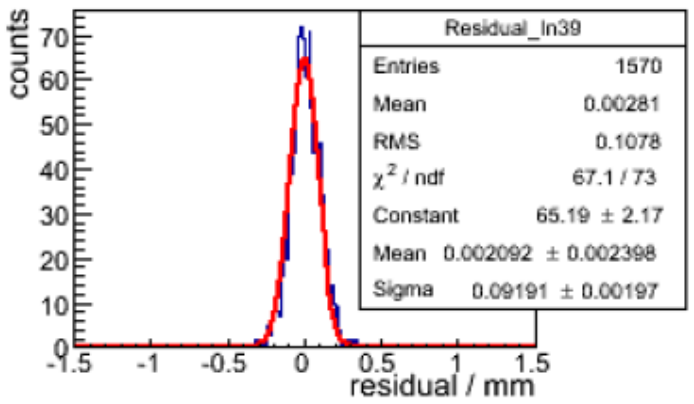
Use the Pad Response Function to obtain the track postion in each padrow from the charge fraction

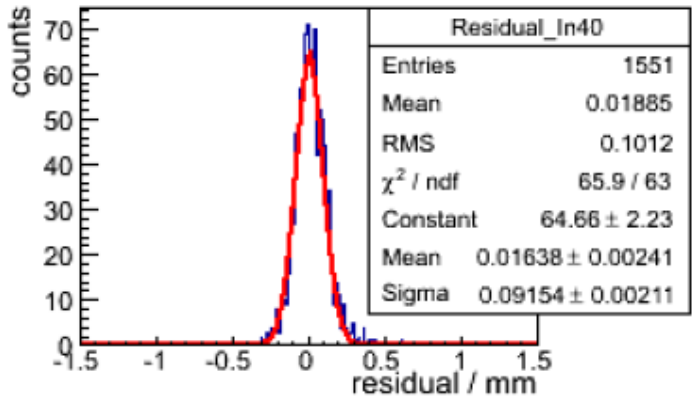
Re-fit the track and iterate

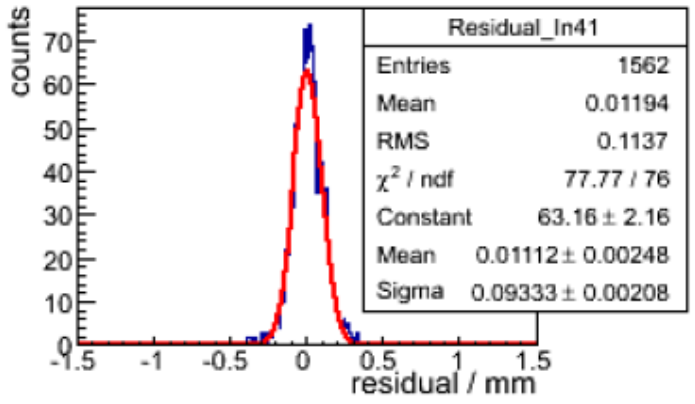


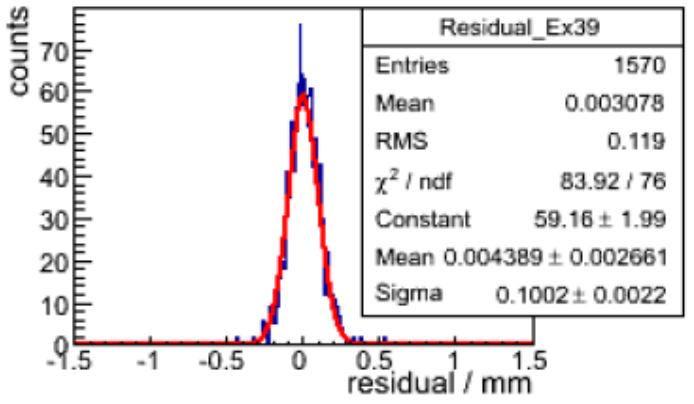


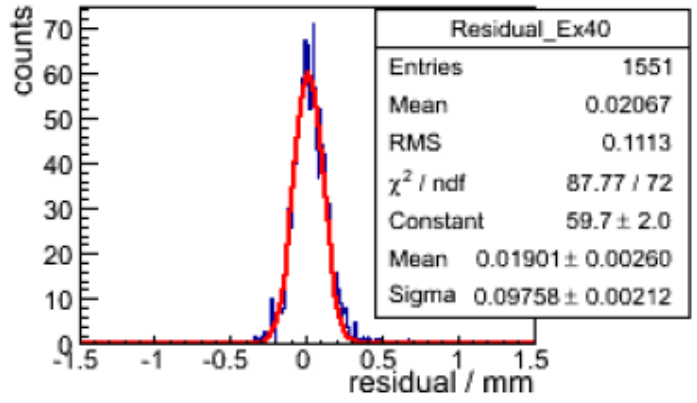
Residuals of the fitted track (after iterations)

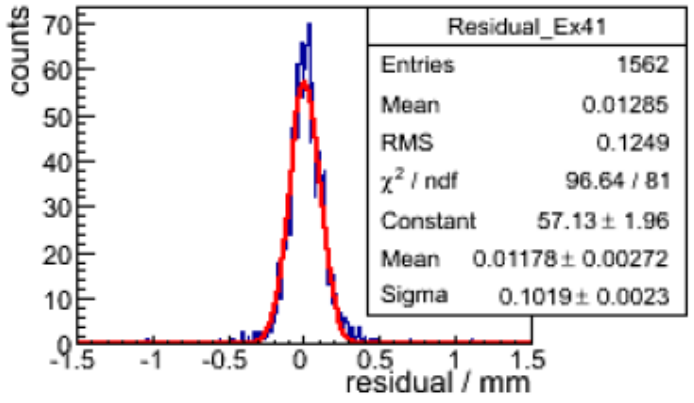










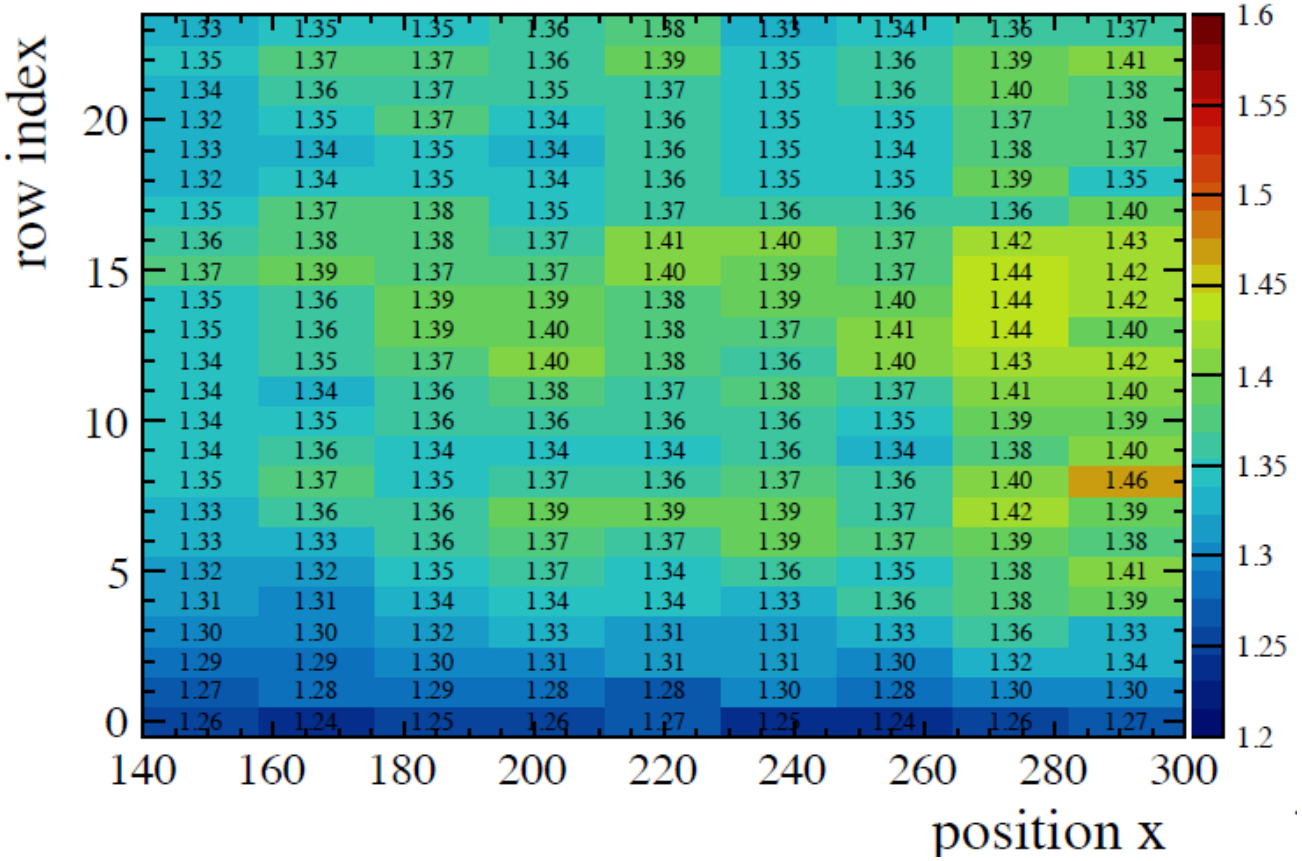


Take the geometrical mean between resolution including and excluding the hit in question to get an unbiased result

Uniformity of the charge spreading

σ = sqrt(2t/RC)

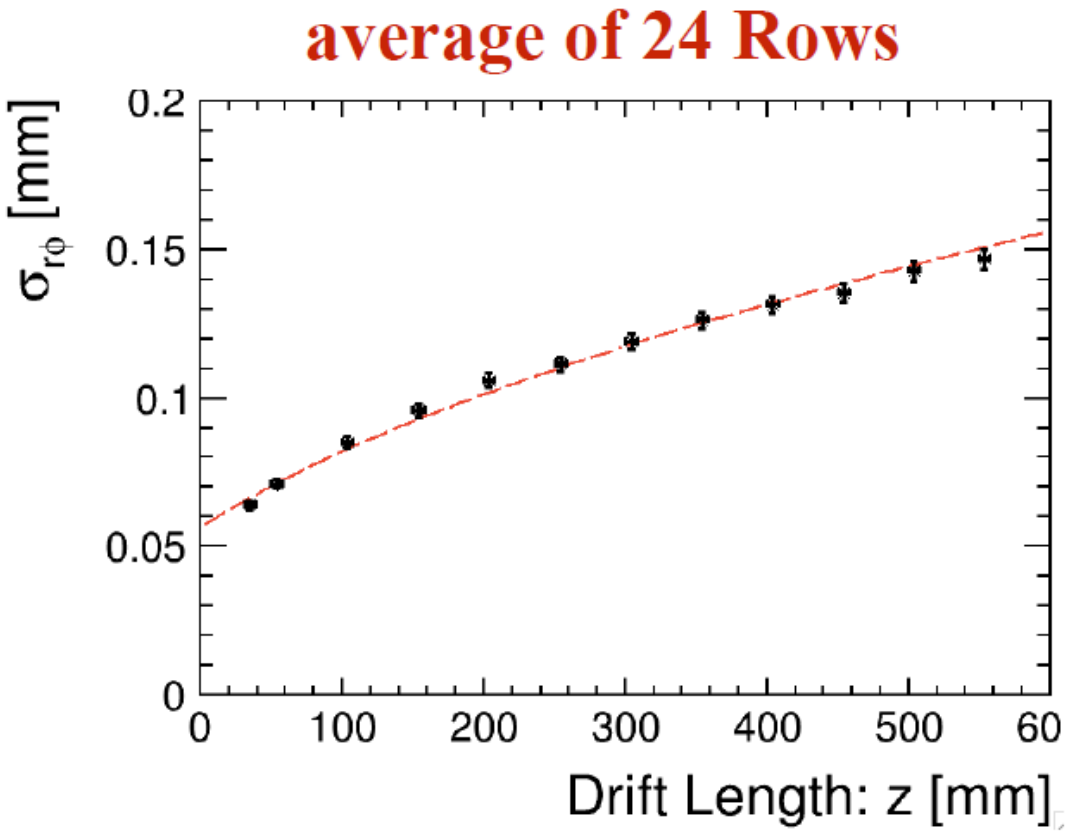
Width parameter of the PRF (mm)



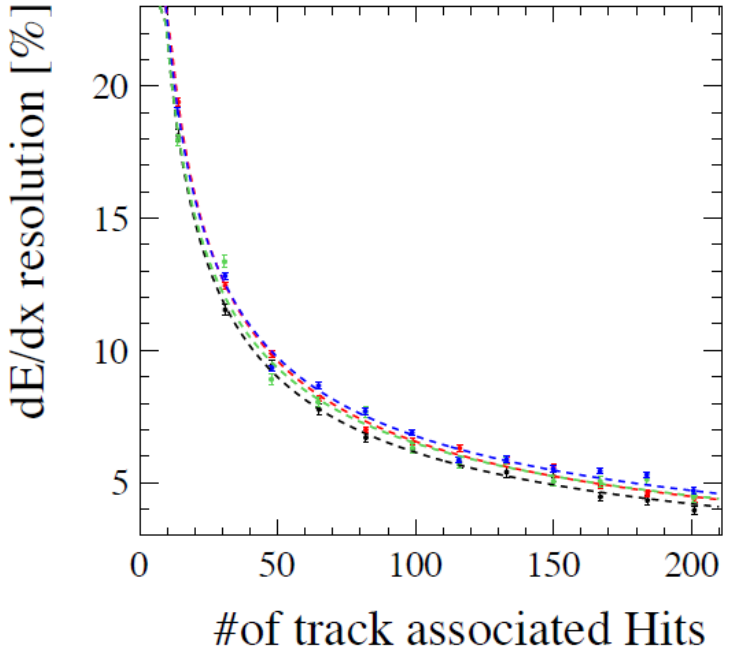
Position resolution

Constant term ⊕ sqrt(z) diffusion contribution

Constant term = 60 µm with 3mm pads!
(1/50th pad witdth)



dE/dx resolution



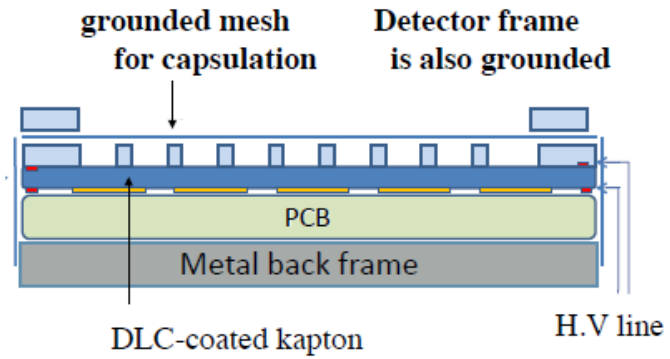
4.8% resolution for nominal track length (192 hits)

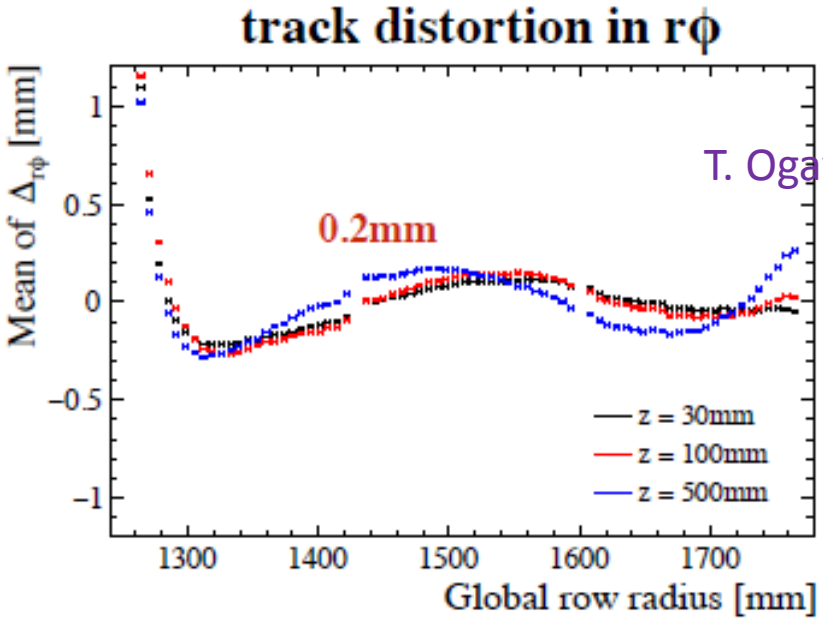
Conclusion : Beam test shows that the high performances are preserved in the new scheme

Mitigation of the distortions at module edges

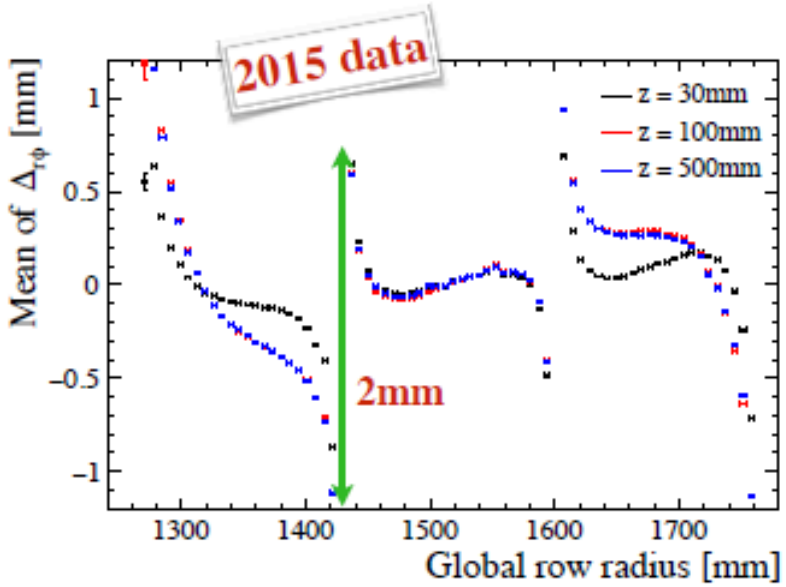
By grounding the mesh and encapsulating the anode at a positive potential, the amplification plane is an almost perfect equipotential, which allows the E-field to be very uniform, even close to the module boundary.

A reduction by an order of magnitude of the ExB distortions is observed.



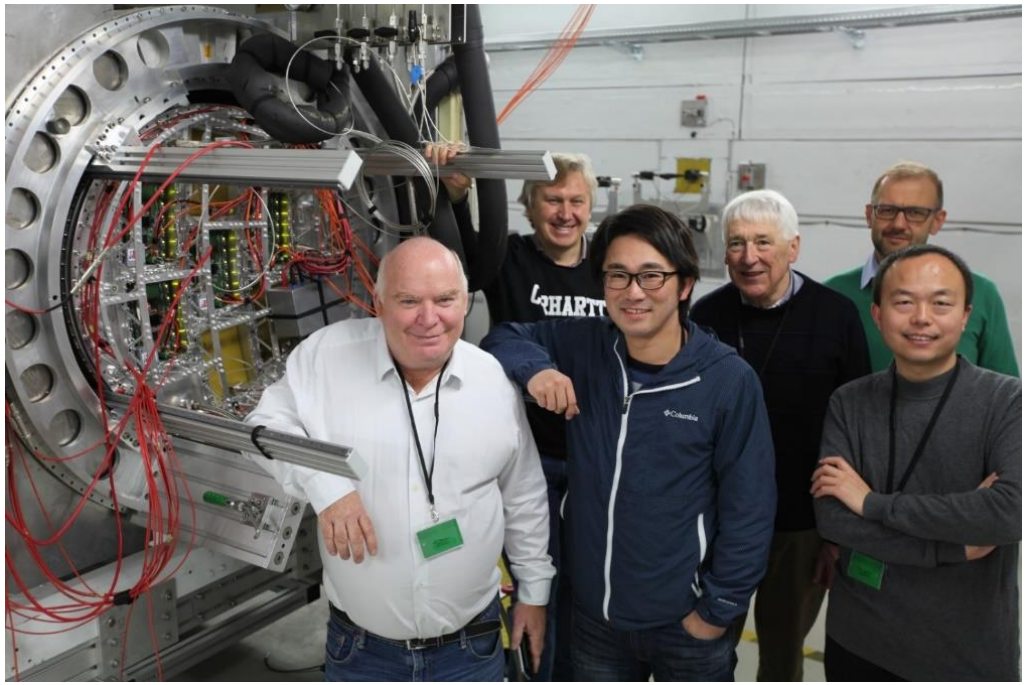


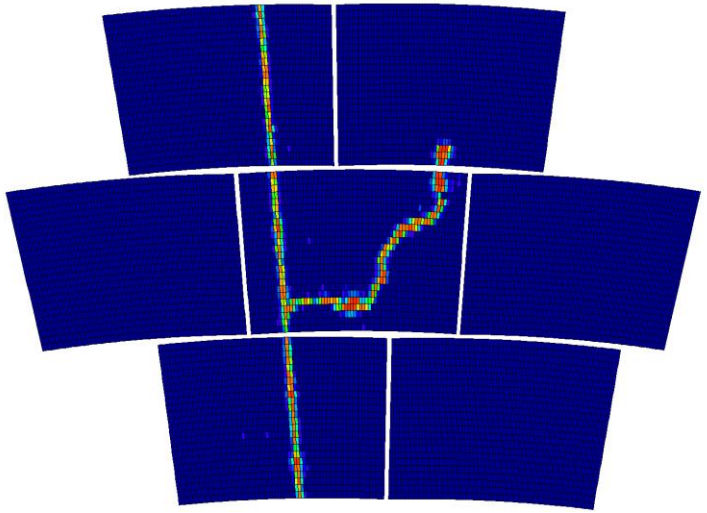
T. Ogawa, S. Ganjour



Conclusion

The new scheme of **encapsulated resistive anode** Micromegas gives very satisfactory results (stable operation, suppressed distortions, increased flexibility)





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