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Outline

1- Motivation

2- Principle of detection

3- Construction of the detector:

- the detector
- the front-end electronics

4- Results

R3B - TPC in few words

R3B for : Reaction studies with Radioactive Relativistic Beams)

⇒ What is it?

- a multi track Time Projection Chamber detector for protons to beam heavy ions.

⇒ Why ?

- to measure precisely kinematics characteristics of particles with minimum amount of material in the beam.

⇒ Who ? (for instance)

- several teams of CEA Saclay : SPhN, SIS, SEDI
- Cracovie (university and Nuclear Physics institute)
- IN2P3 CNRS CPPM
- Bratislava (Nuclear Physics Institute)

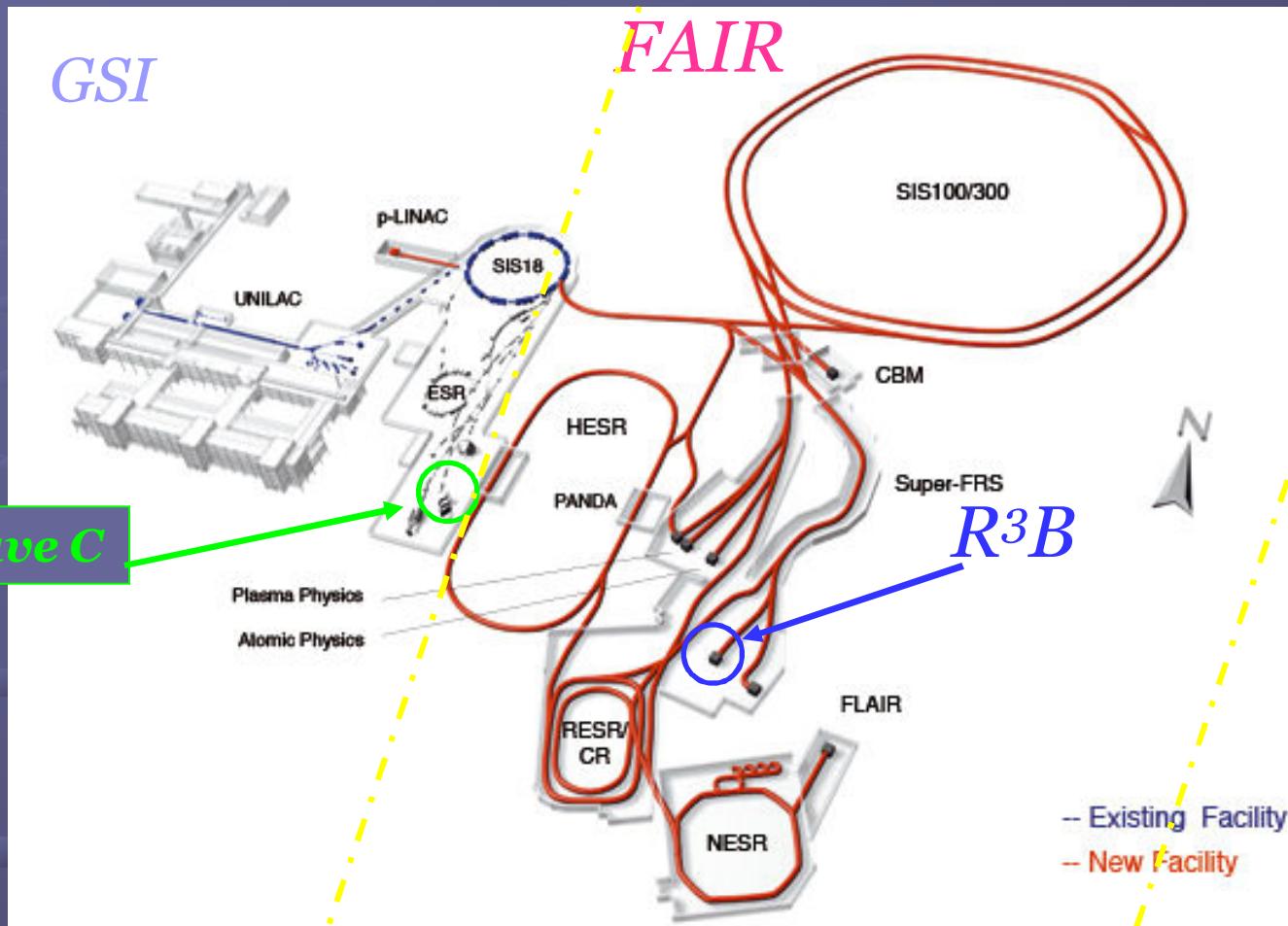
⇒ Where ?

- at GSI, just after GLAD magnet.

⇒ When ?

- end of 2015 ?

R3B hall in the FAIR facility



Still to build

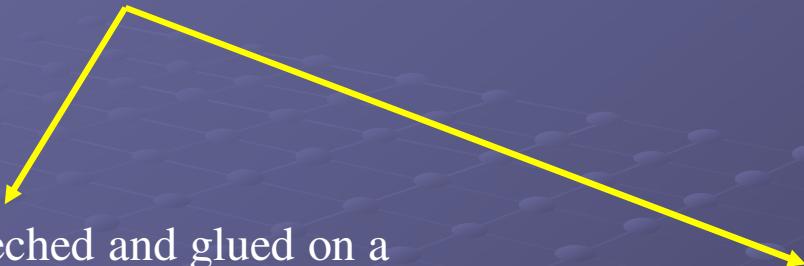
Micromegas : MICROMEsh GASEous

Close-up of a mesh

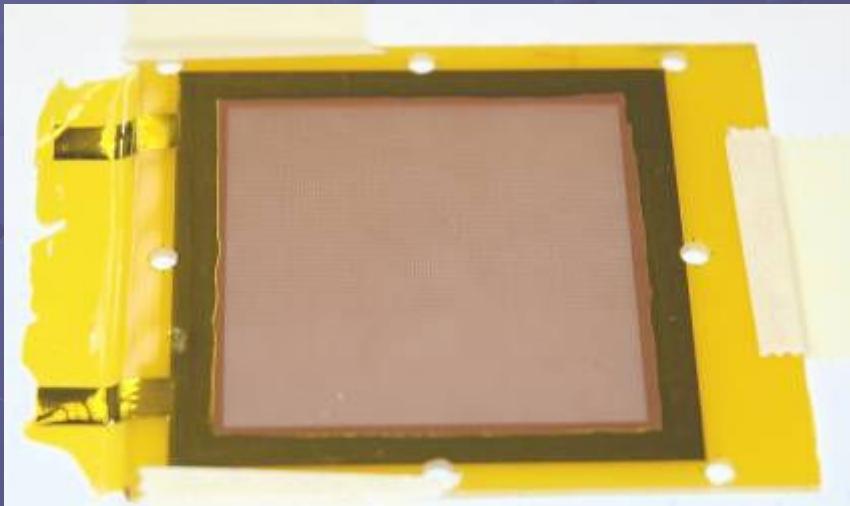
On behalf of Rui de Oliveira at CERN

the Mesh

Two way of making a mesh for a Micromegas design



A Kapton foil stretched and glued on a Frame, and the frame is screwed on the PCB



Improvements are possible (other gap)



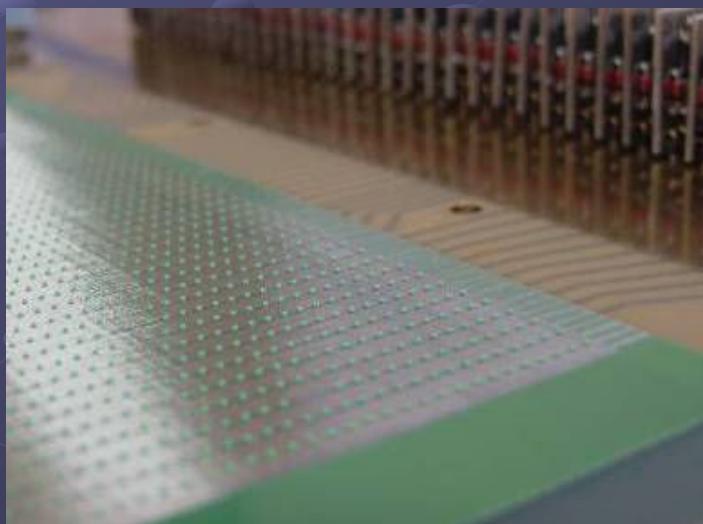
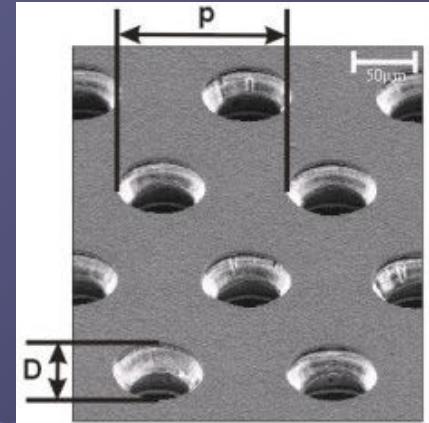
Mounting operation is required



Ready to use solution



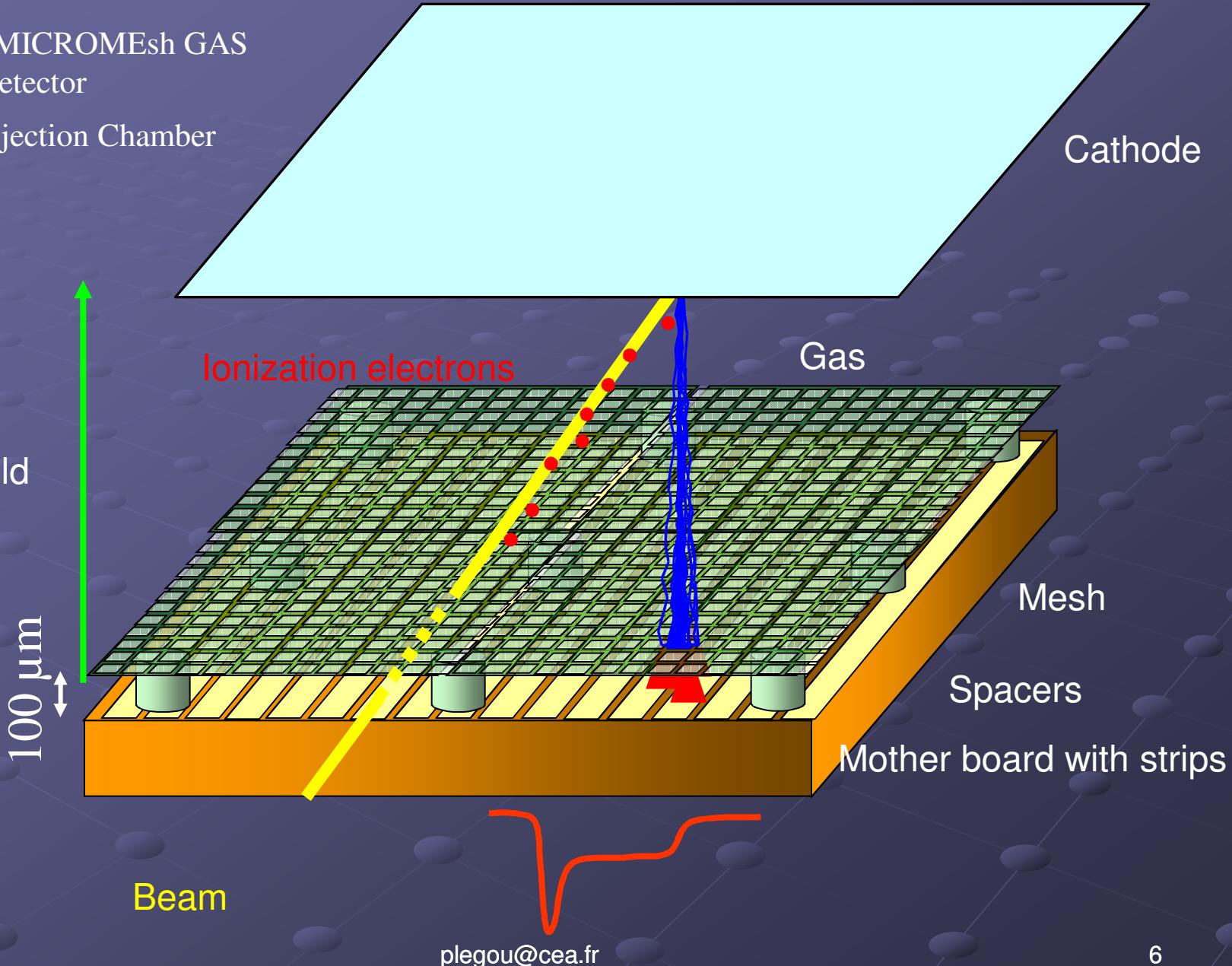
No improvements + difficult to repair



Micromegas used in TPC mode

Micromegas : MICROMEsh GAS
detector

TPC: Time Projection Chamber

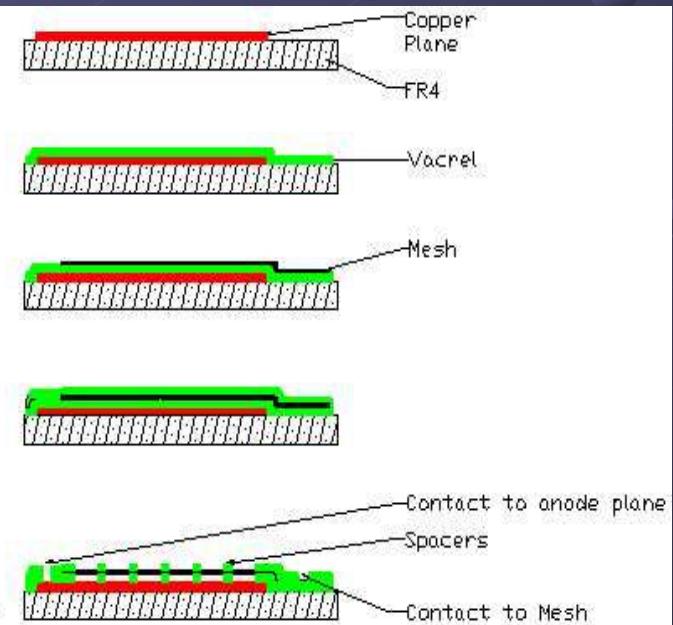
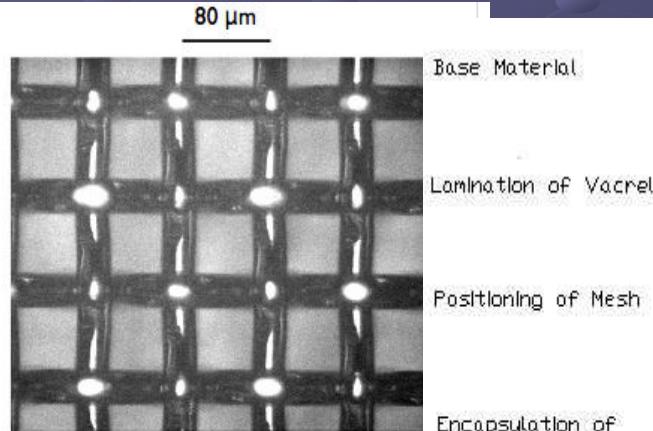
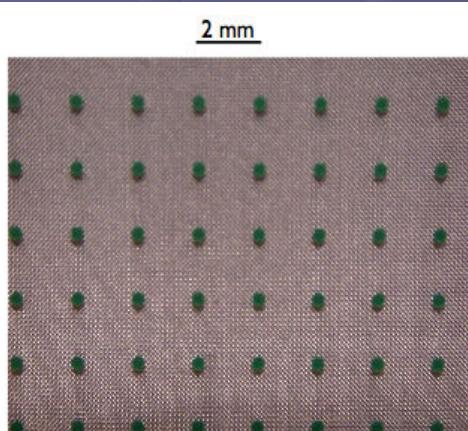


Bulk Micromegas

- Large area and robustness
- Easy implementation
- Low cost
- Industrial process

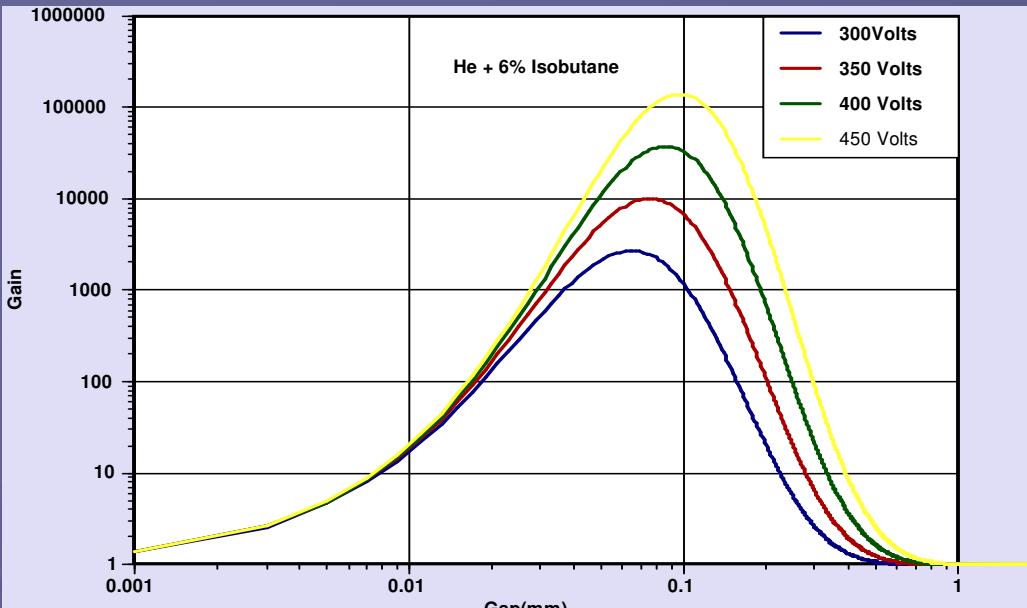
Bulk Micromegas obtained by lamination of a woven grid on an anode with a photo-imageable film

« Bulk » : construction process



Low material detectors

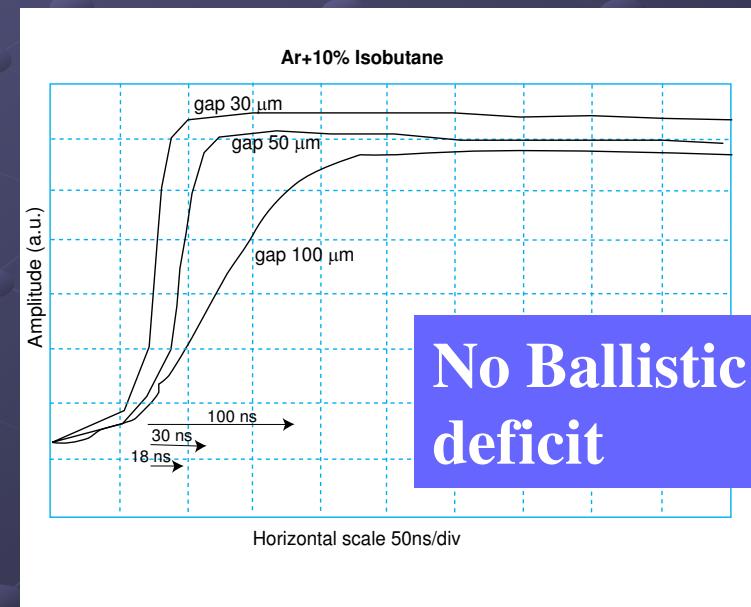
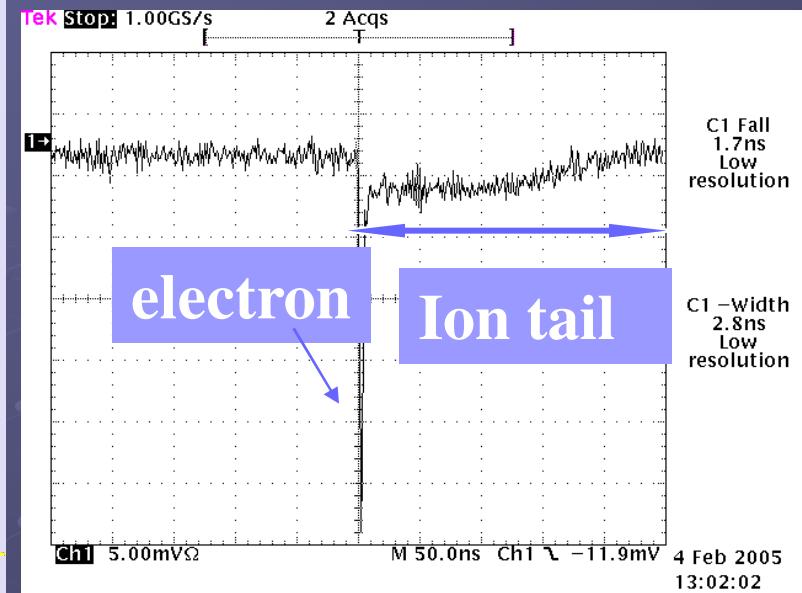
Choice of the amplification gap



Optimum gap : 30 - 100 microns

Small gap → fast signals

12.5 μm Micromegas has been tested for NA48-3
Ion collection time are <5 ns





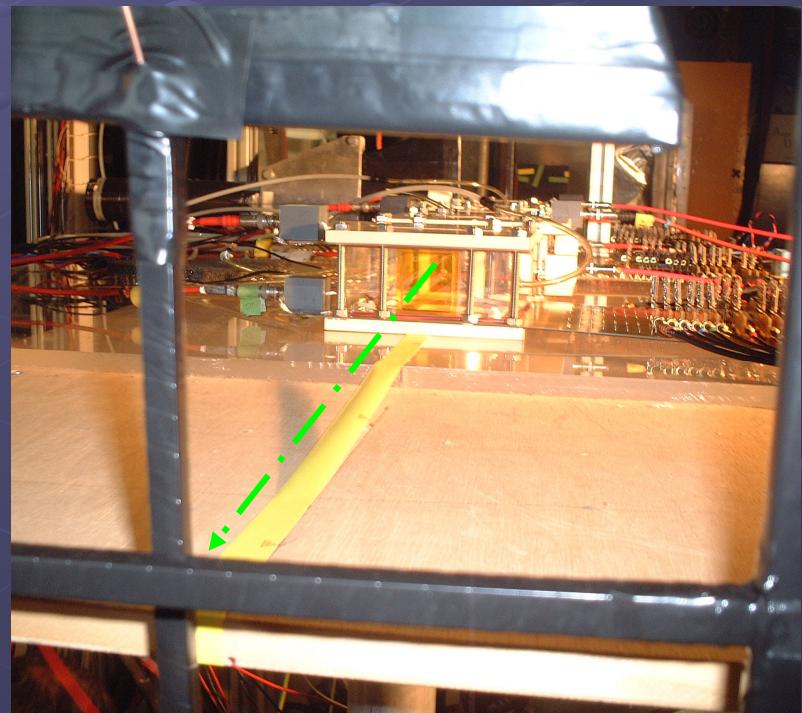
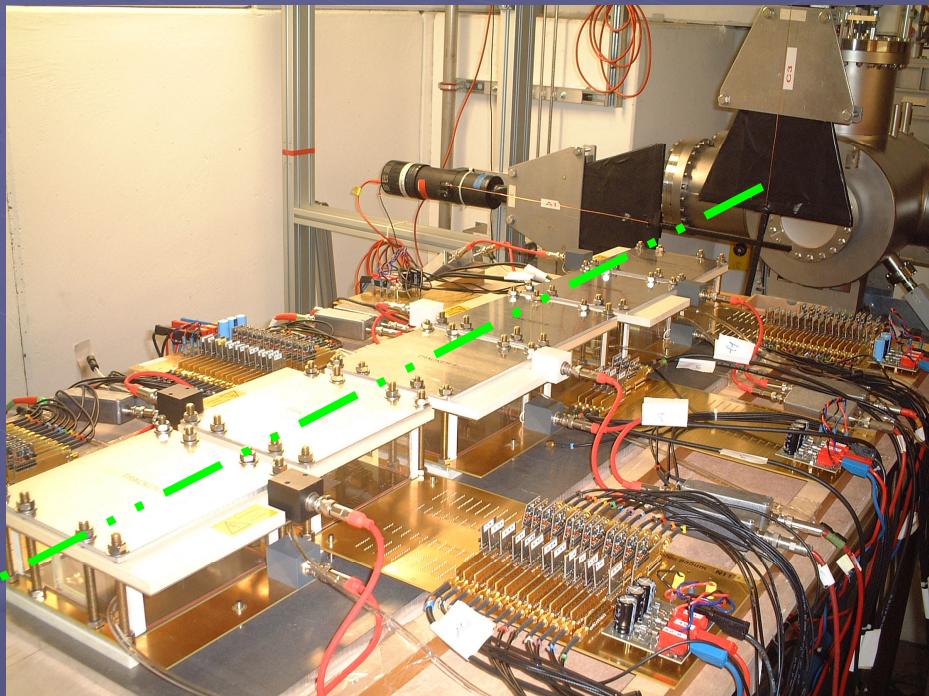
Mesh $10 \times 10 \text{ cm}^2$
100 μm kapton
+5 μm Cu

plegou@cea.fr

R3B - TPC test setup in cave C

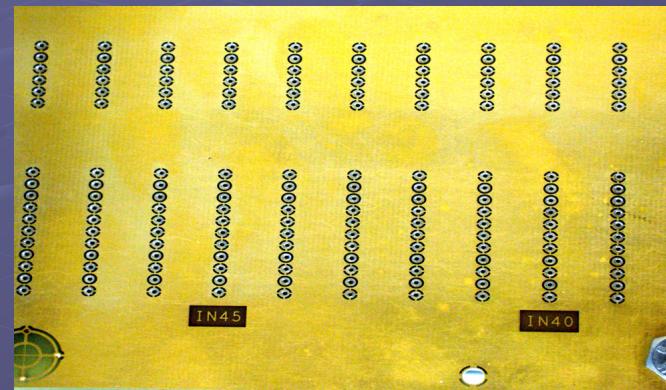
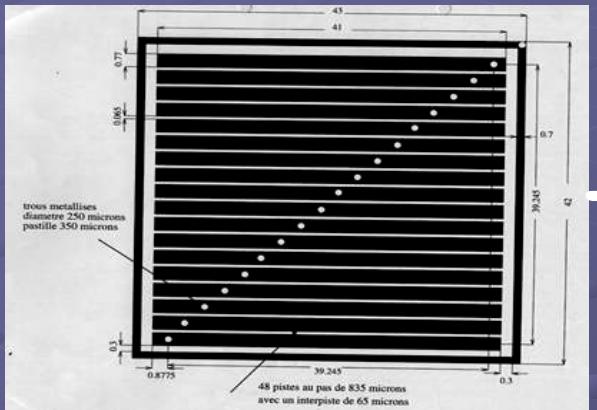
October 2008 & March 2009

Six detectors along the beam between scintillators for the DACQ trigger



Beam direction

a Tracker



+



48 channels

Width of strips : $835 \mu\text{m}$

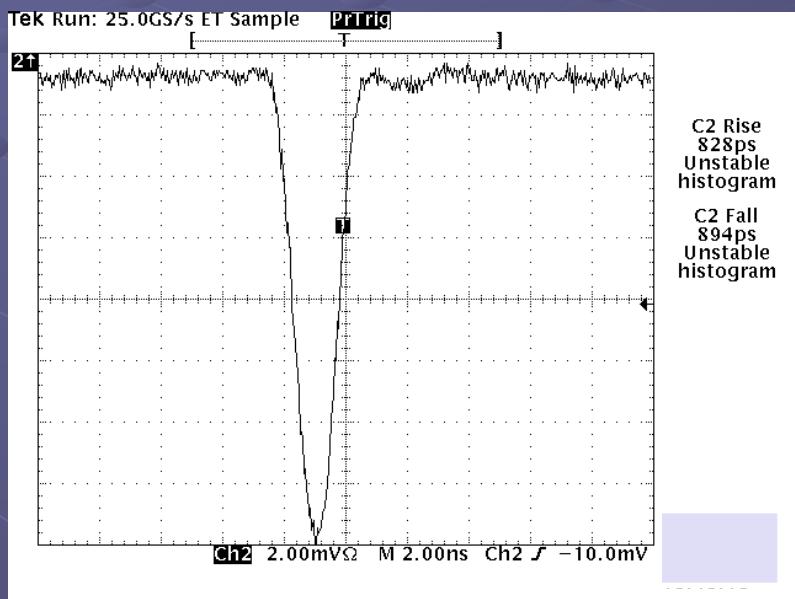
Space between 2 strips : $65 \mu\text{m}$

Mother board

Or 7 channels of 5mm with
150 μm between 2 strips.

Very fast Preamp

Front-end module : FAMMAS (ph.Legou) (Fast Amplifier Module for Micromegas ApplicationS)



In few figures ...

Power supply : + 5V -5V

Consumption \cong 50 mW

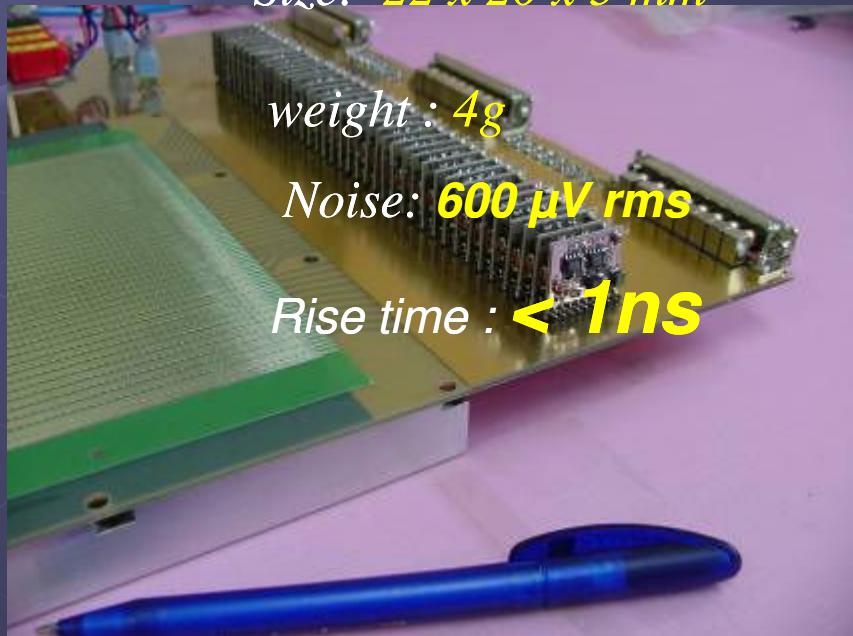
Input: positive or negative

Size: 22 x 20 x 5 mm

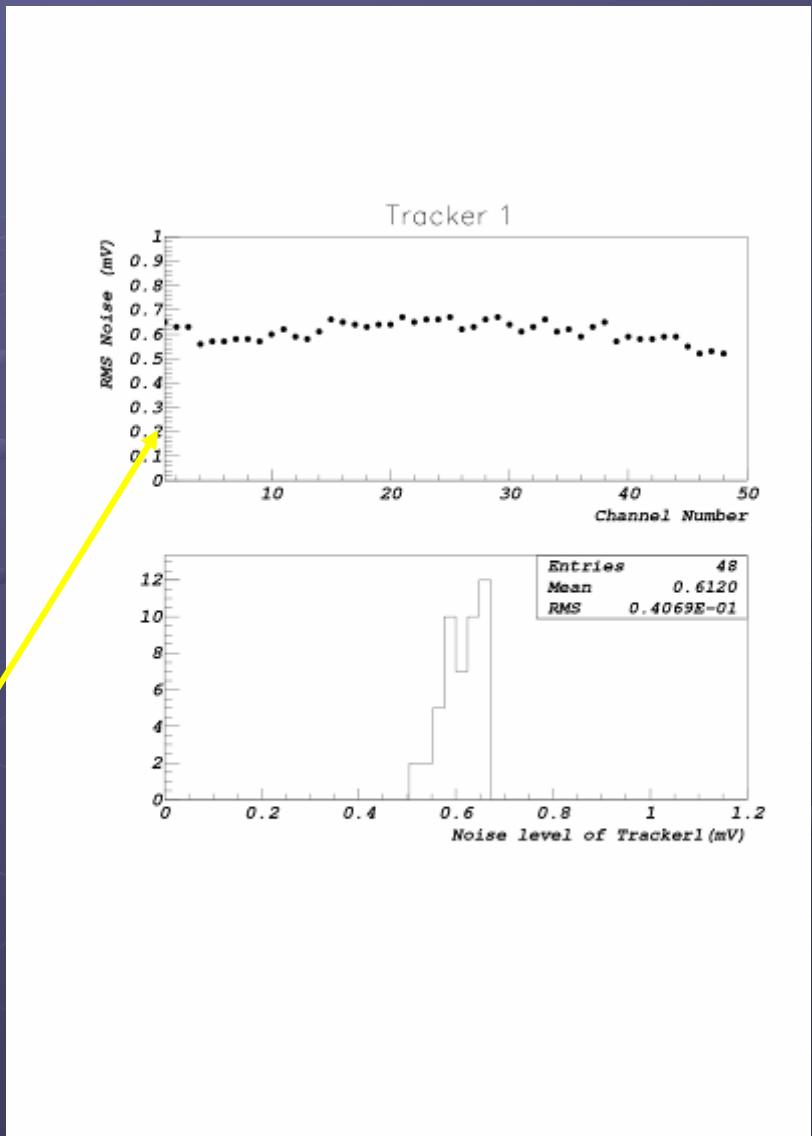
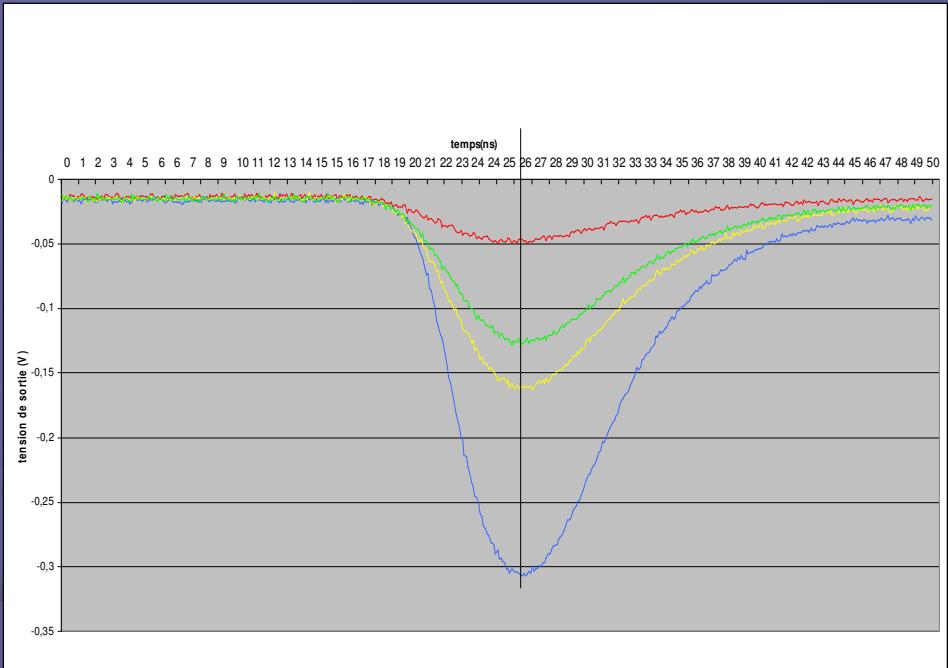
weight : 4g

Noise: 600 μ V rms

Rise time : < 1ns



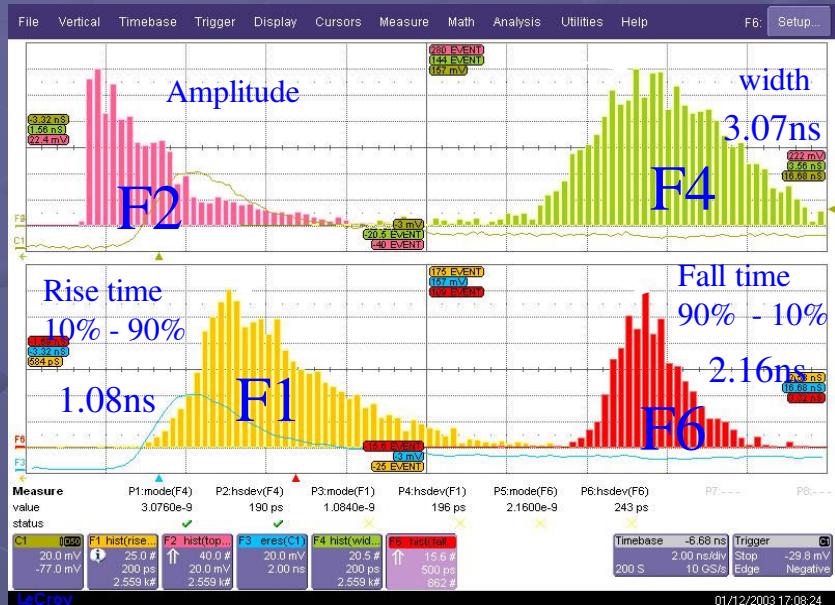
Characterization of the front-end in the lab



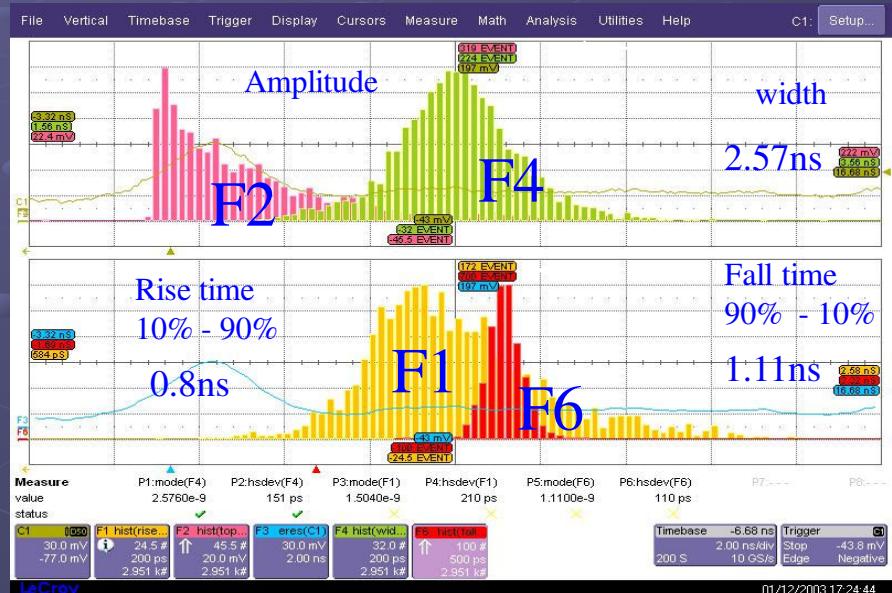
Very good uniformity of the noise
on the 48 channels front-end cards
on each tracker detector

FAMMAS vs commercial Module

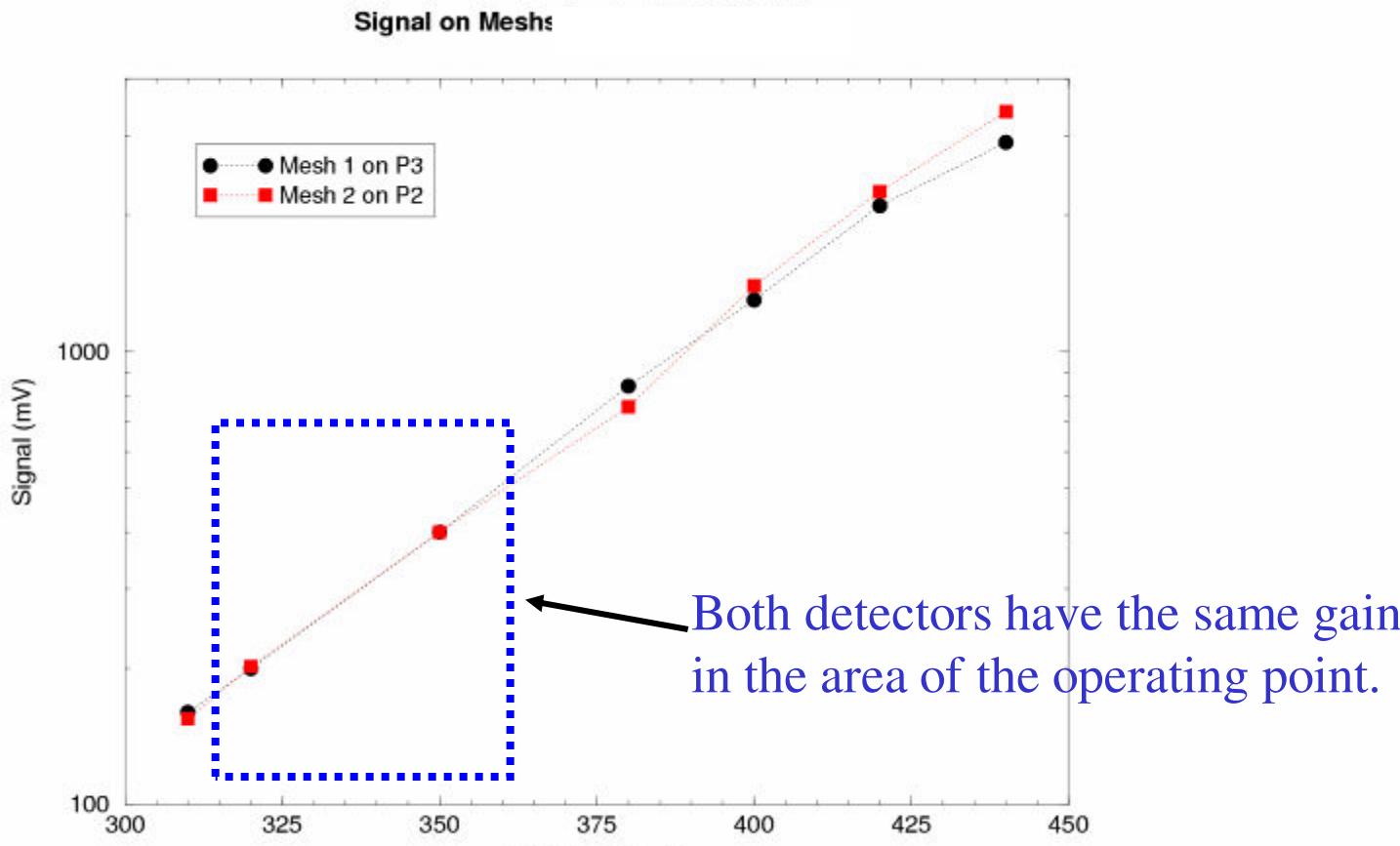
Minicircuits
1GHz ZFL-1000LN



CEA - FAMMAS Front-end module



Characterization of the detector

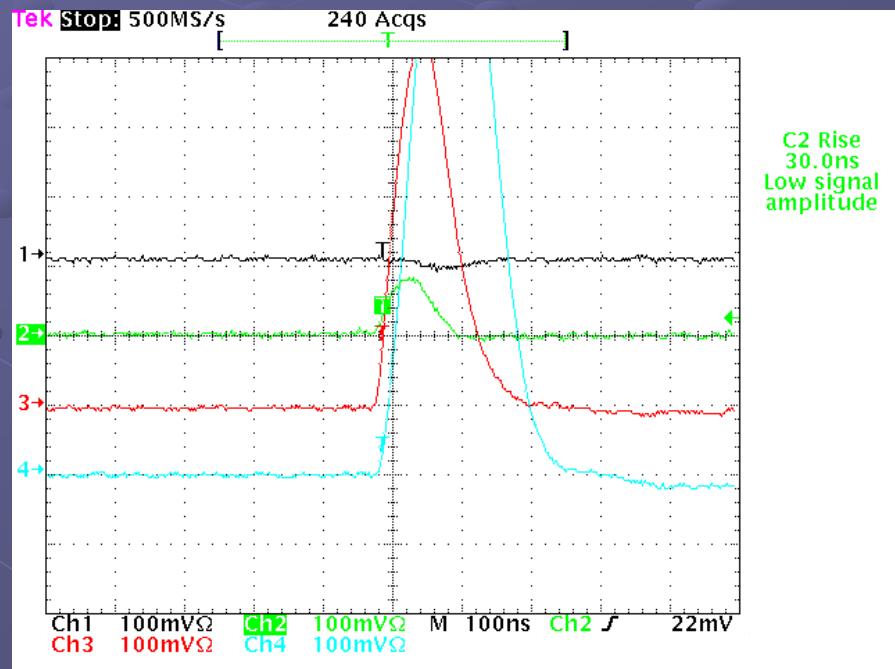


Test on a 100 μm gap detector at CERN

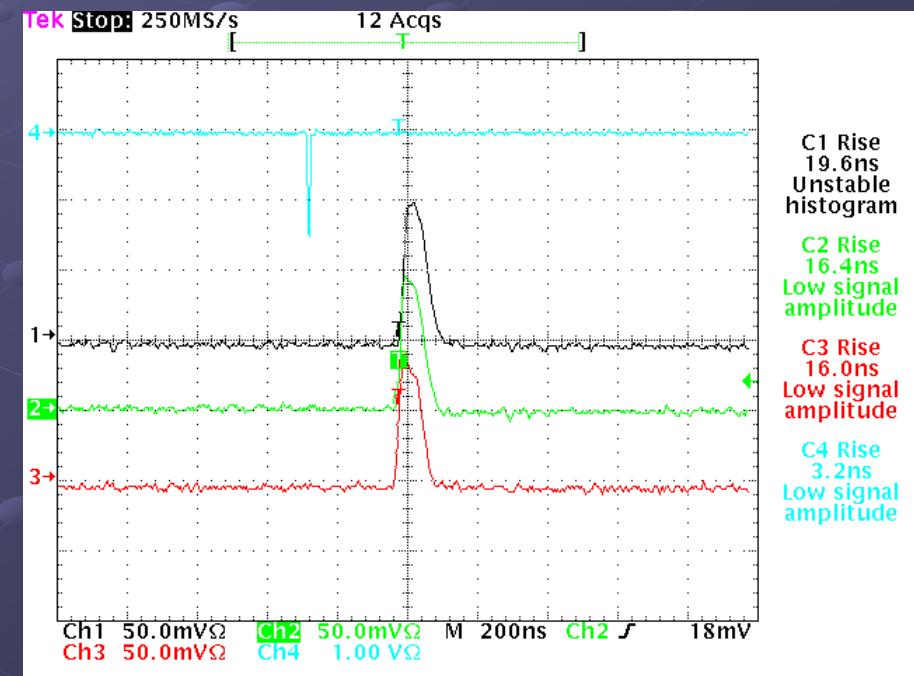
Test conditions :

- visualisation at about 30 meters coaxial cable.
- Gaz : COMPASS.
- Beam.

Mesh Voltage : 350 V



Mesh Voltage : 370 V



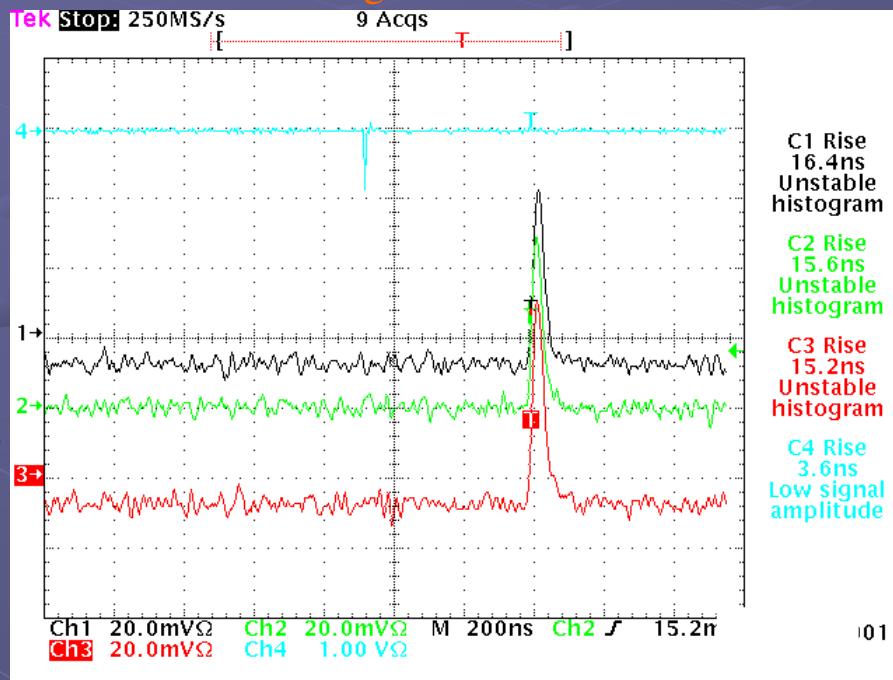
Test on a 100 μm gap detector at CERN

Test conditions :

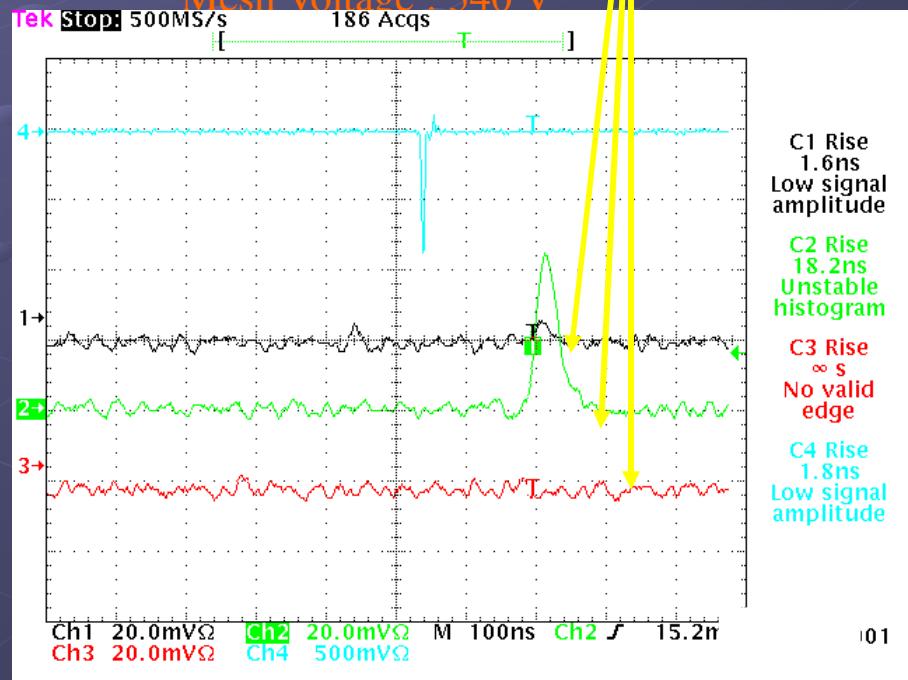
- visualisation at about 30 meters coaxial cable.
- Gaz : COMPASS.
- Beam.

No crosstalk between neighbour channels

Mesh Voltage : 340 V



Mesh Voltage : 340 V



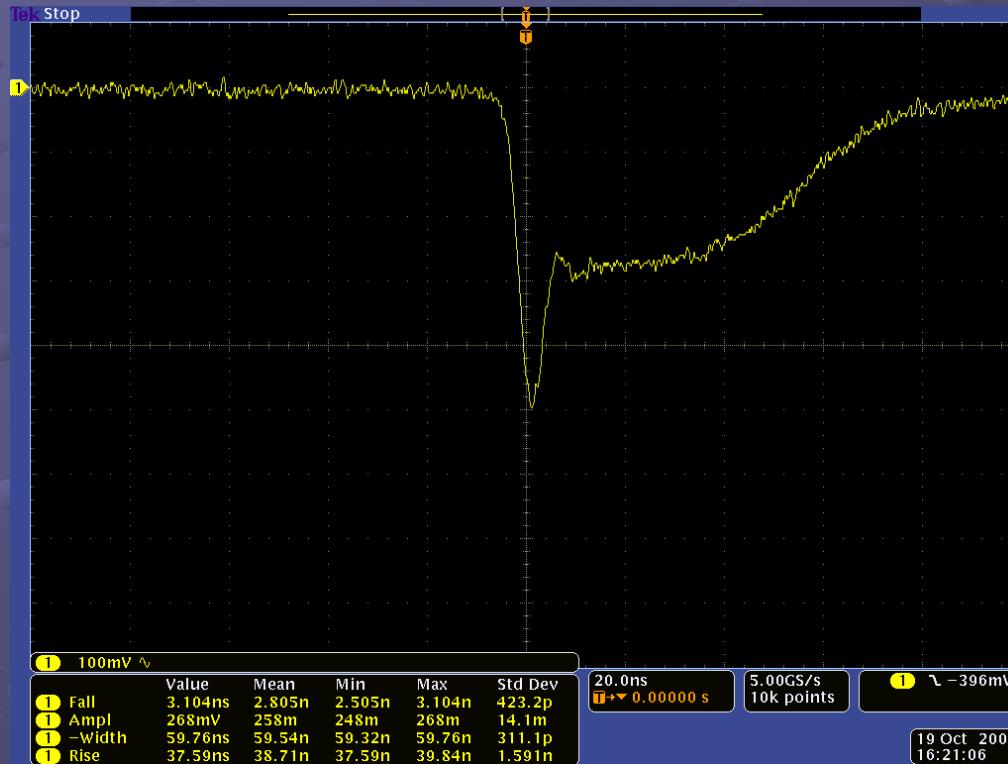
Tests on a $100 \mu\text{m}$ gap Bulk detector at GSI ... 2008, october 19th.

Test conditions :

- visualisation at about 30 meters coaxial cable.
- Gaz : P10
- Beam.

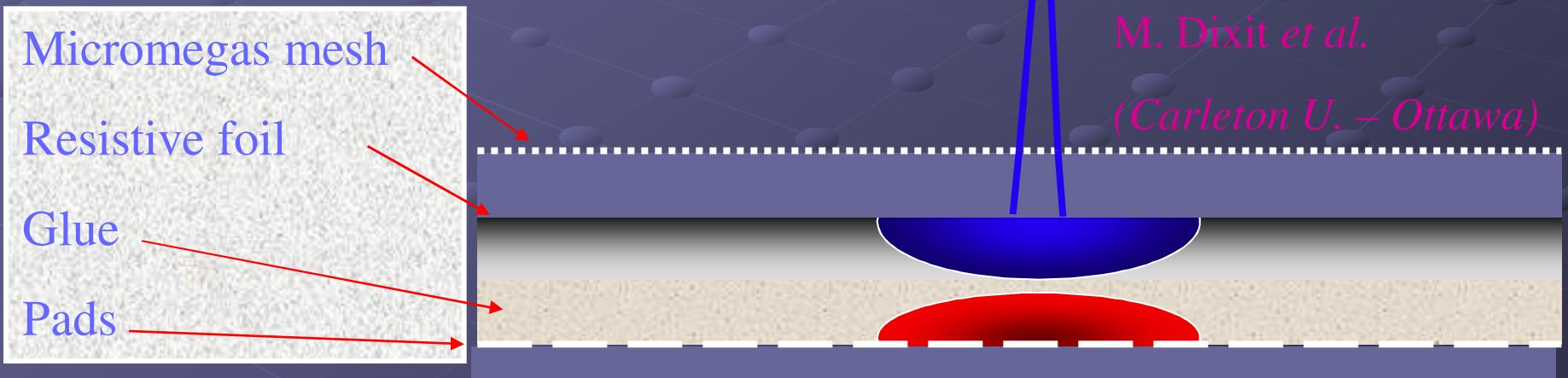
Mesh Voltage : 380 V

Drift Voltage : 2000V



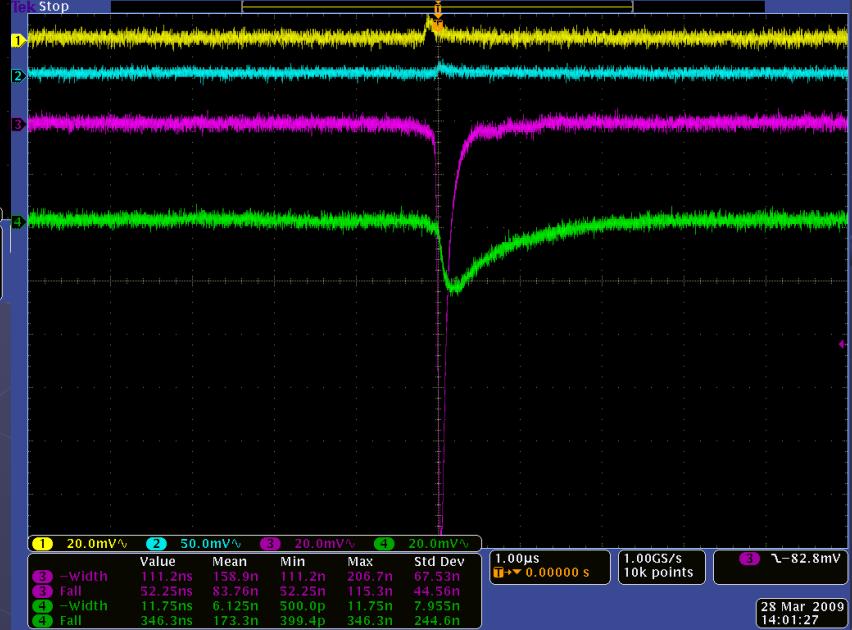
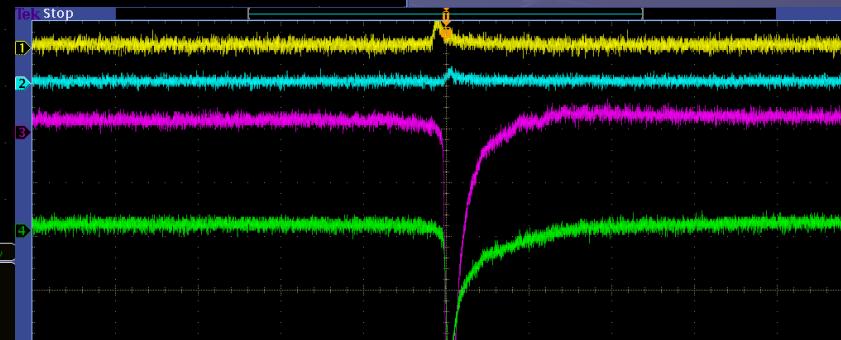
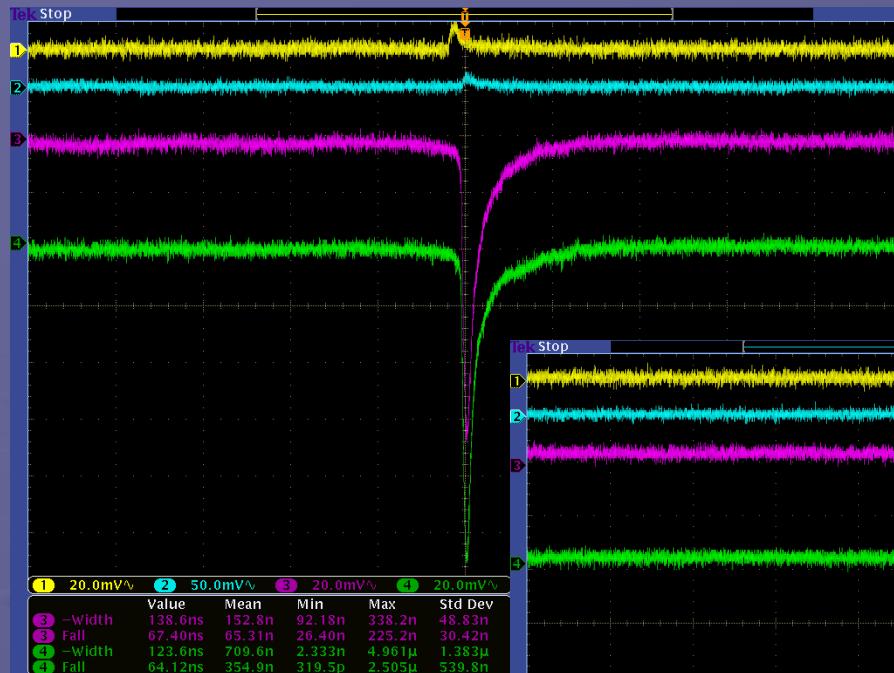
Resistive micromegas detectors

- By adding a resistive foil ($2\text{M}\Omega/\text{cm}^2$) on the strips we can spread the charge on several strips.

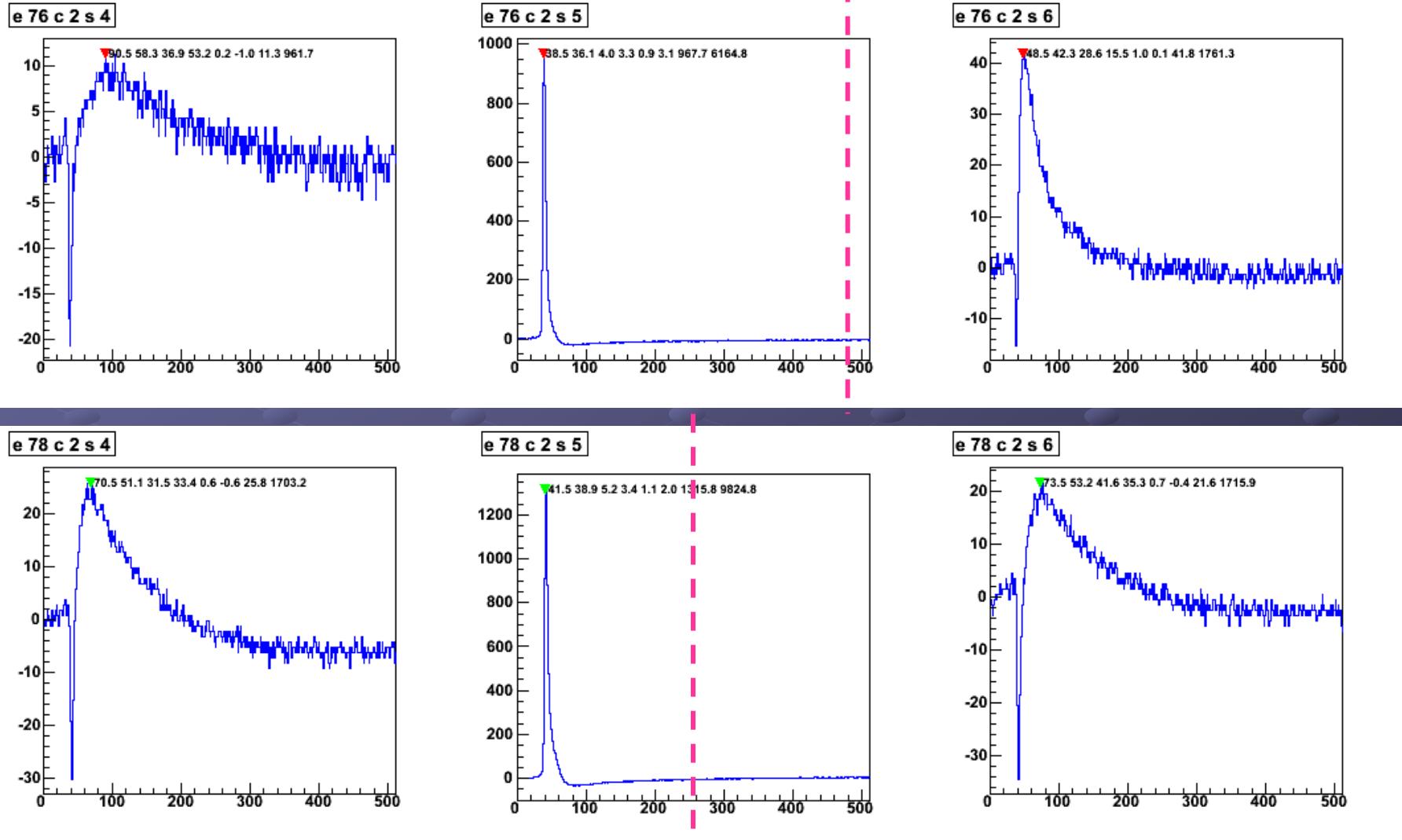


Signals on resistive Bulk detectors

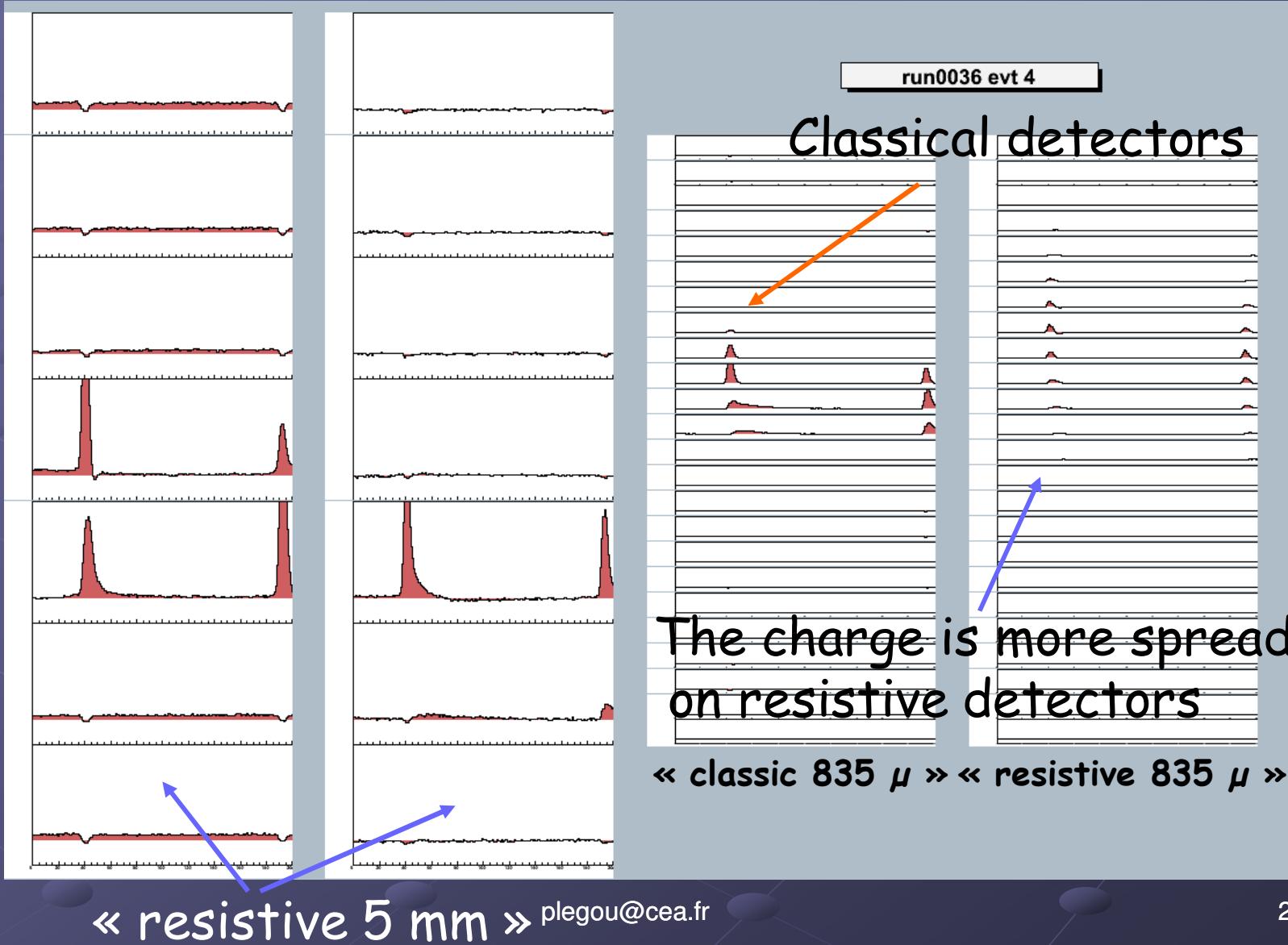
Pics from the scope of two neigbour strips



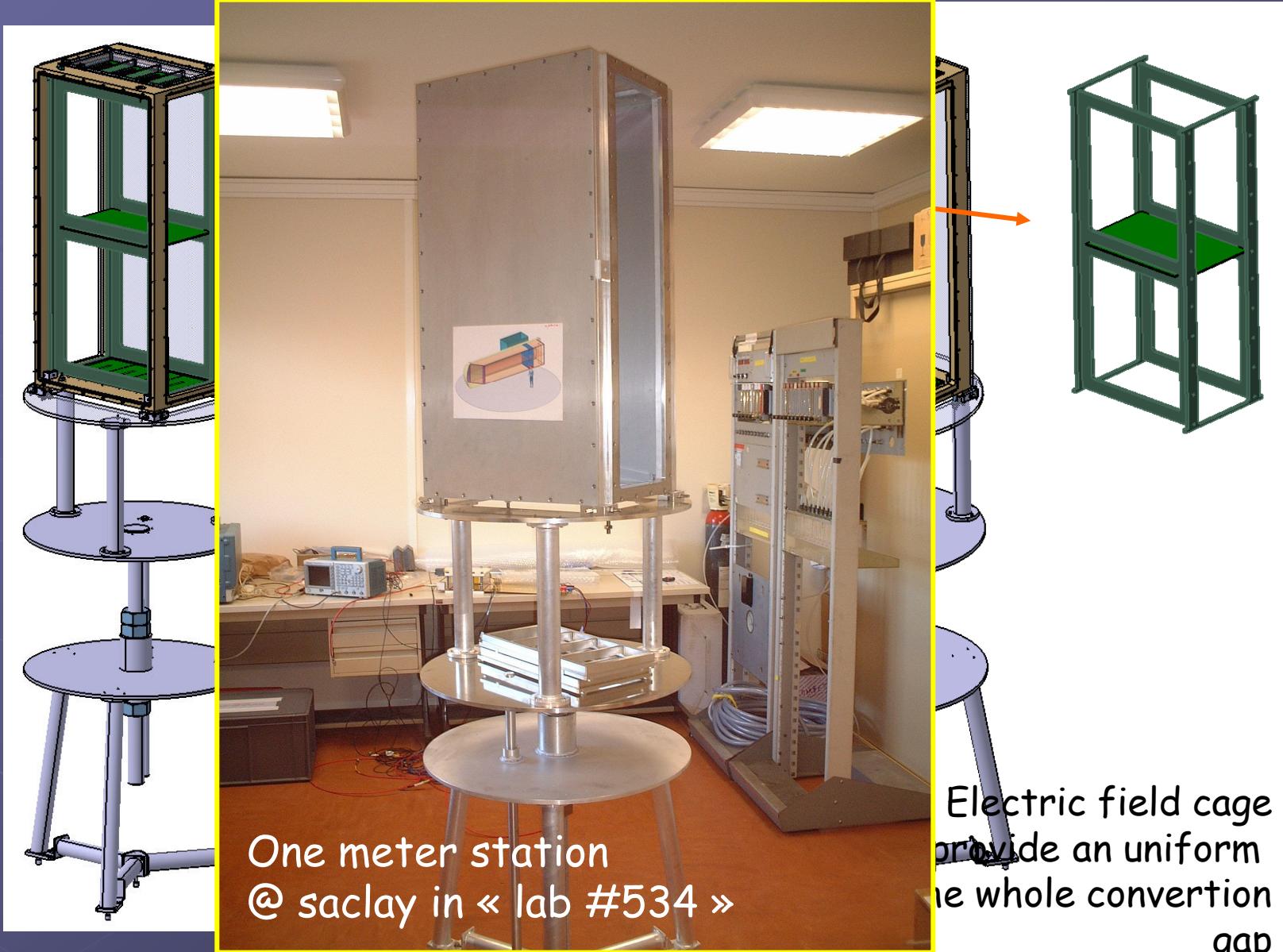
Response of three neighbour strips seen by the ADC



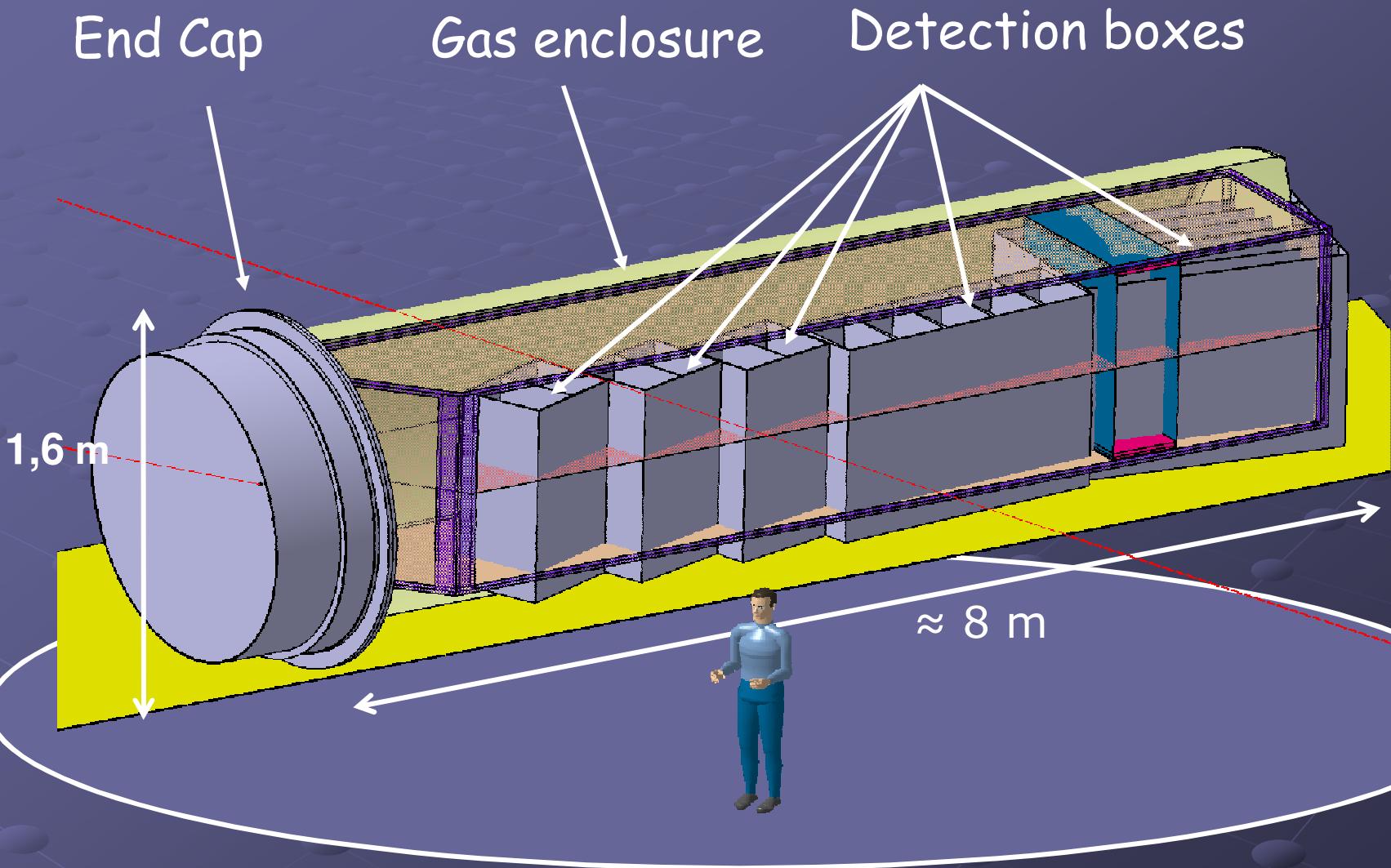
Tests on a resistive 100 μm gap Bulk detector at GSI March 2009 in Cave C.



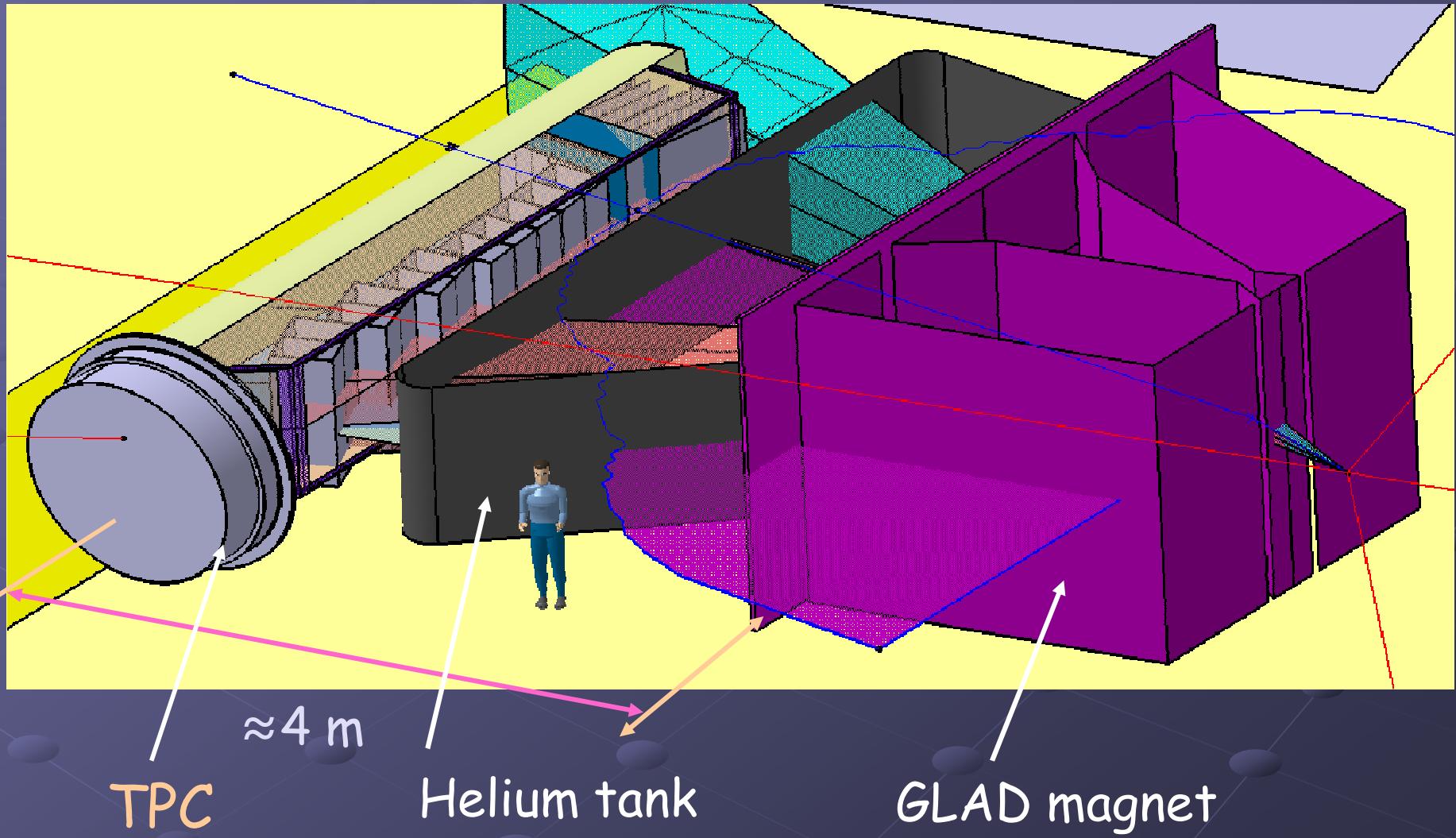
The « One meter » detector test - station



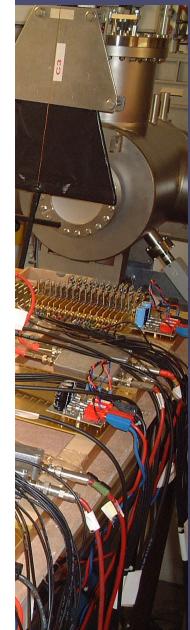
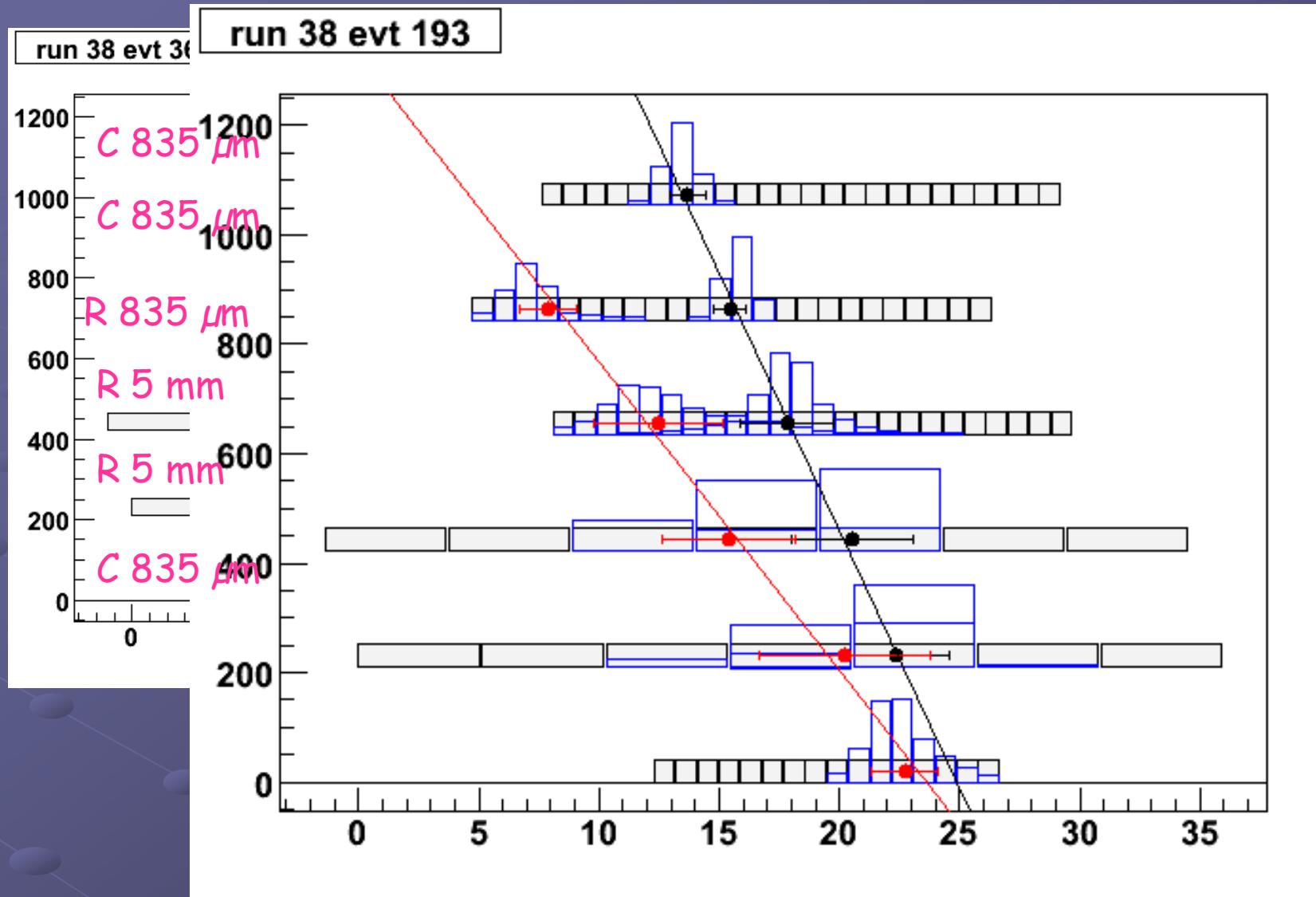
R3B - TPC @ GSI



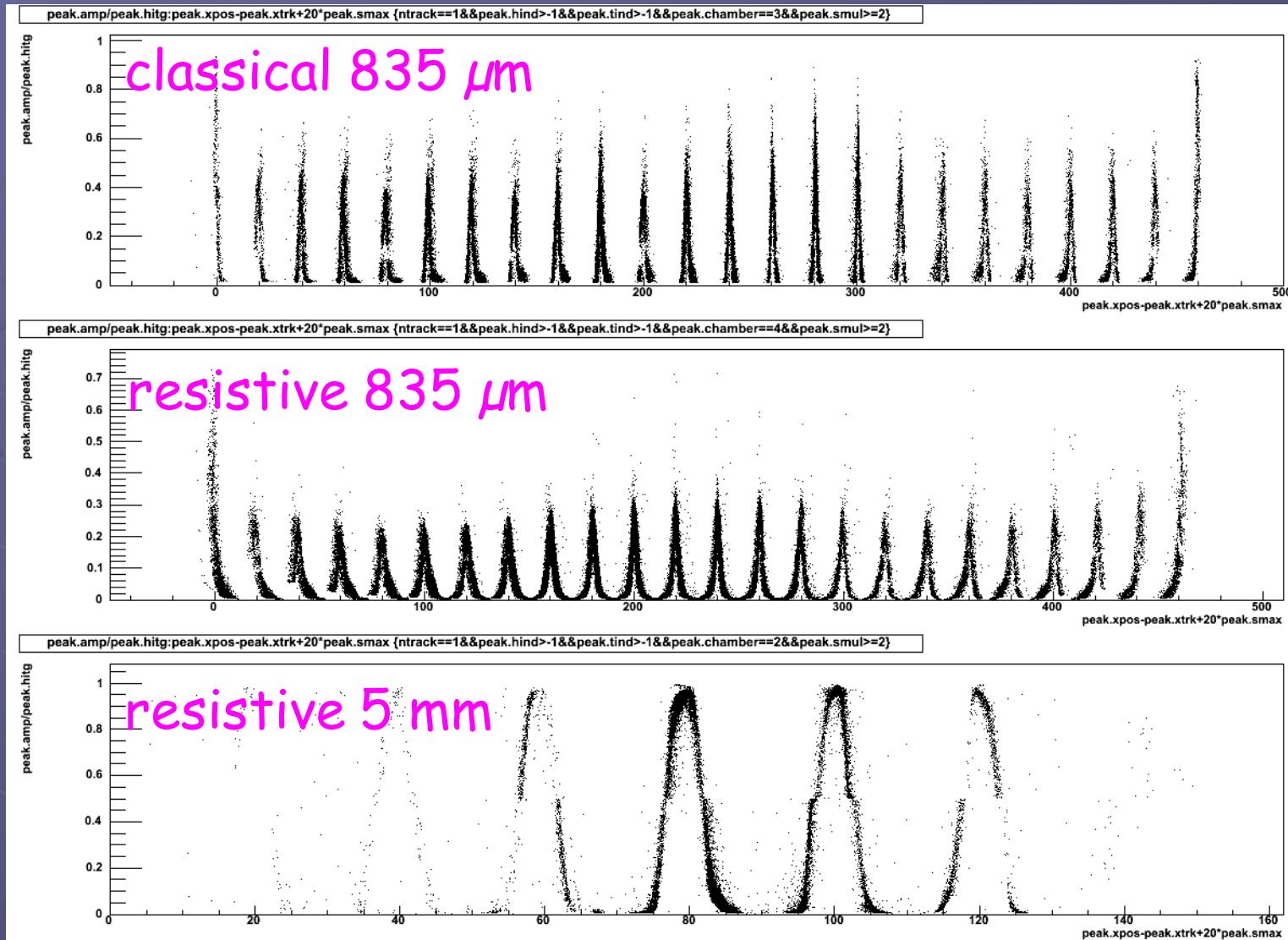
R3B TPC ... the just after GALD magnet
and the Helium tank... .

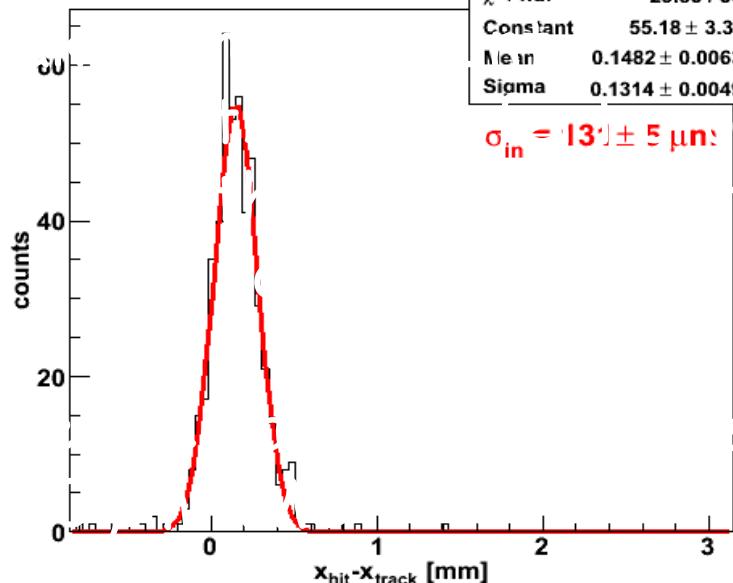
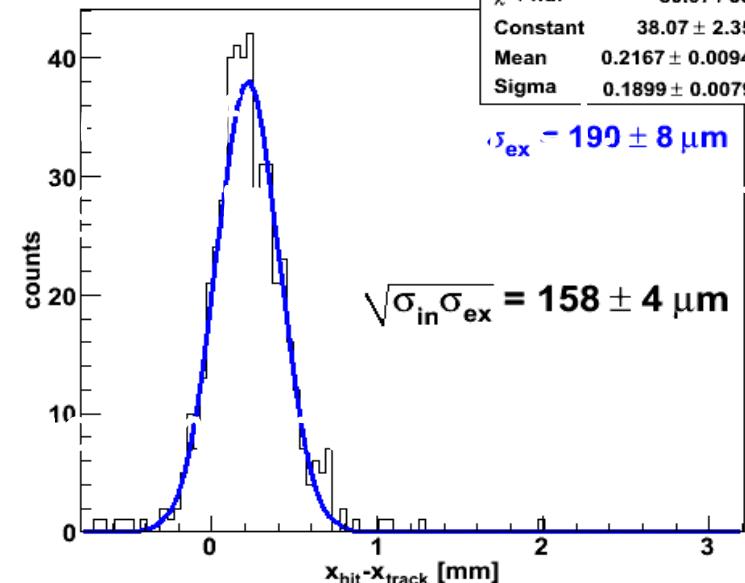
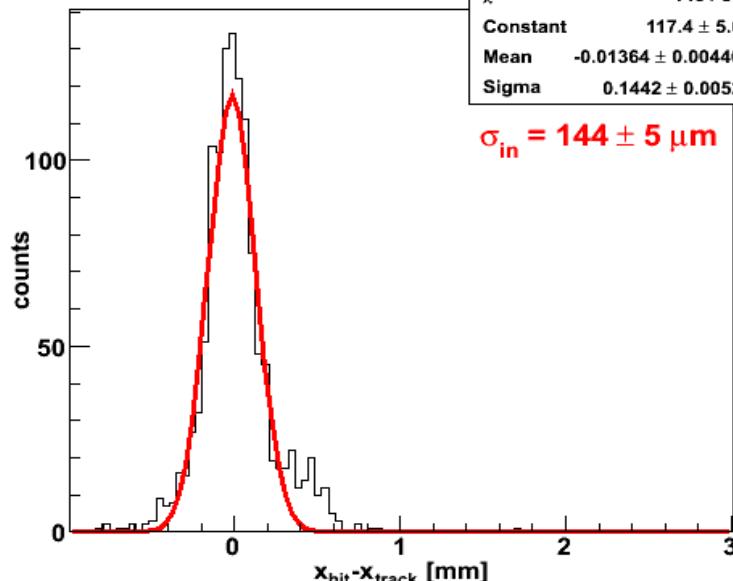


Tracks seen by all the chambers



Pads response function of the pads



STANDARD 835 μm **STANDARD 835 μm** **RESISTIVE 5000 μm** **RESISTIVE 5000 μm** 