



Status and plans of the SDHCAL-GRPC

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Outline

- Reminder of R&D activities
- Status of the 1m²
- Preparation of the 1m³ technological prototype

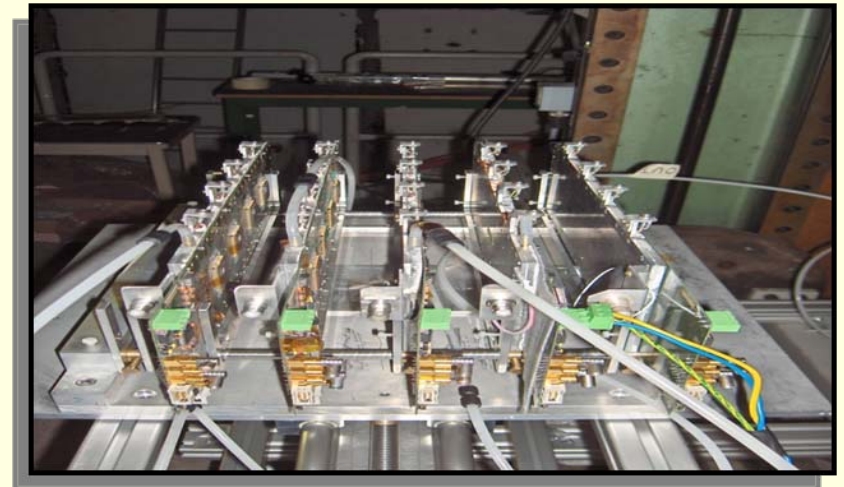
Reminder : Mini-SDHCAL

- HR1 ASIC designed and produced in 2007
- Numerical card based on FPGA-USB architecture was conceived in 2007.
- Electronics boards hosting 4 HR1 and the numerical card were produced in 2007: 8-layer, 800 μ , 6 class
- Small GRPC detectors (32X8) were produced in 2007-2008:
 - Simple Gap: Graphite (Protvino), Licron and Statguard (IPNL)
 - Multigap GRPC (Bologna)
- whole system successfully tested with cosmics and TB at CERN in 2008.

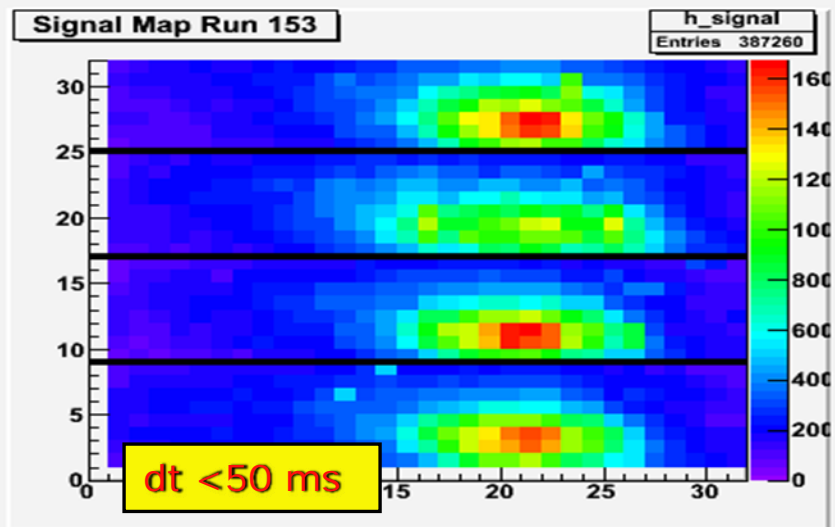
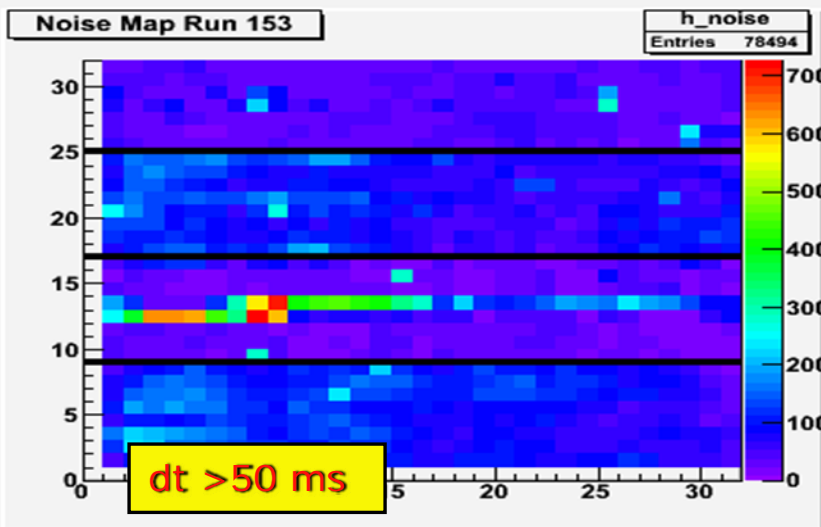
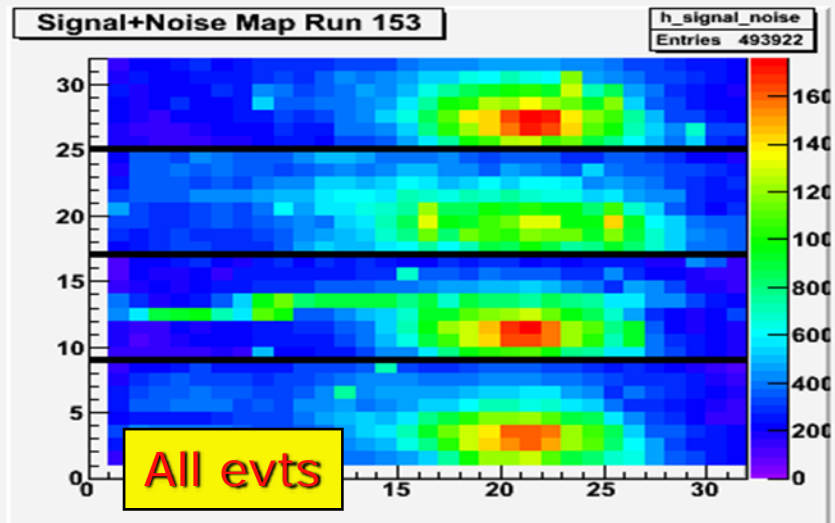
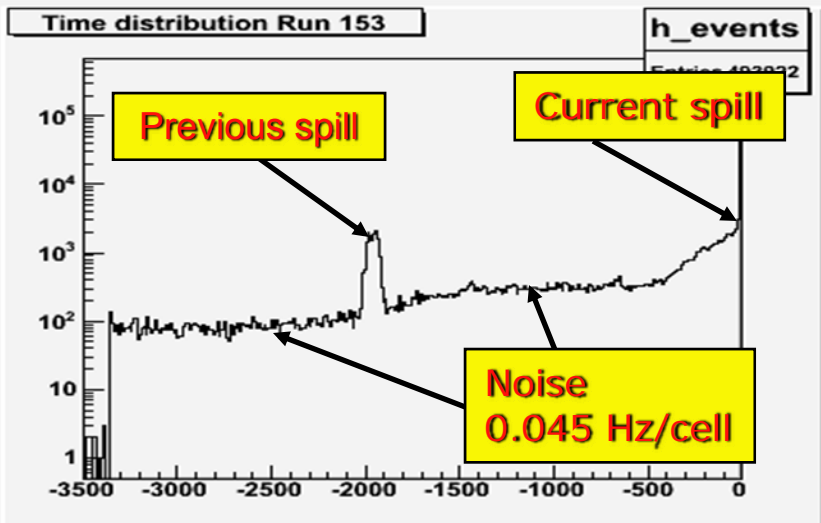
Reminder: Test Beam @PS-CERN

June-July and November
2008 TB Goals

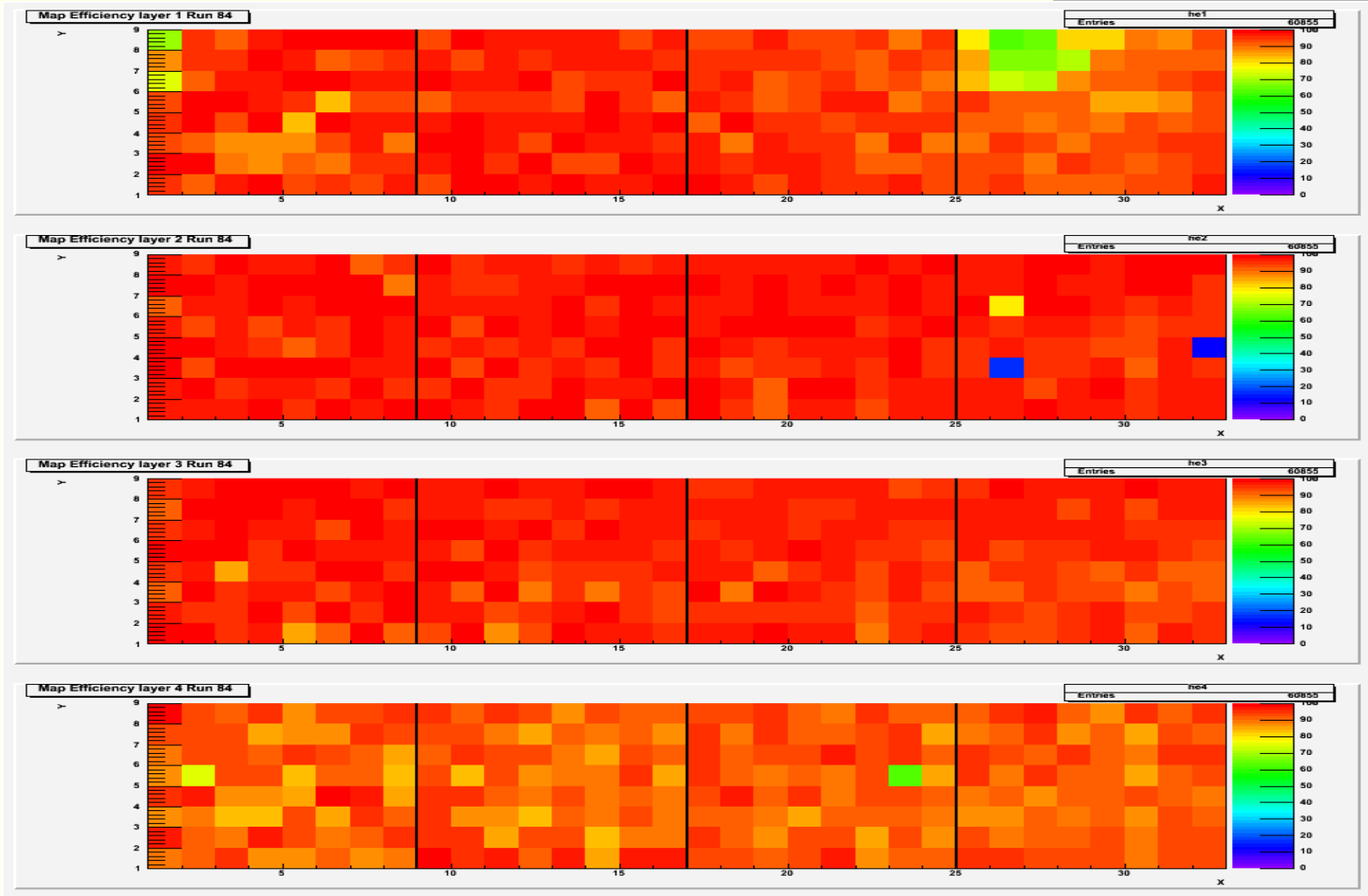
- Validate the semi-digital electronics readout system in beam conditions
- Evaluate the performance of different kinds of RPCs
- Study first phase of hadronic showers



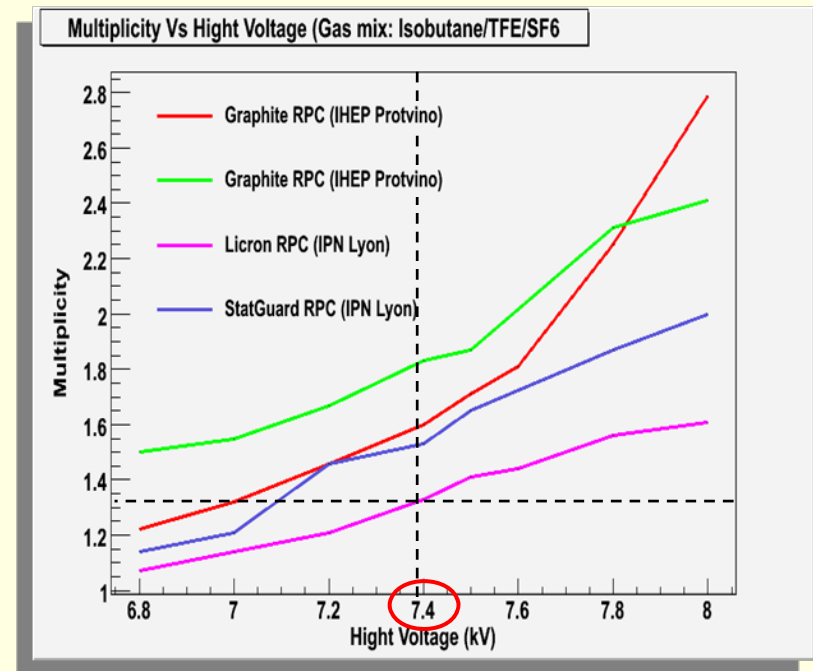
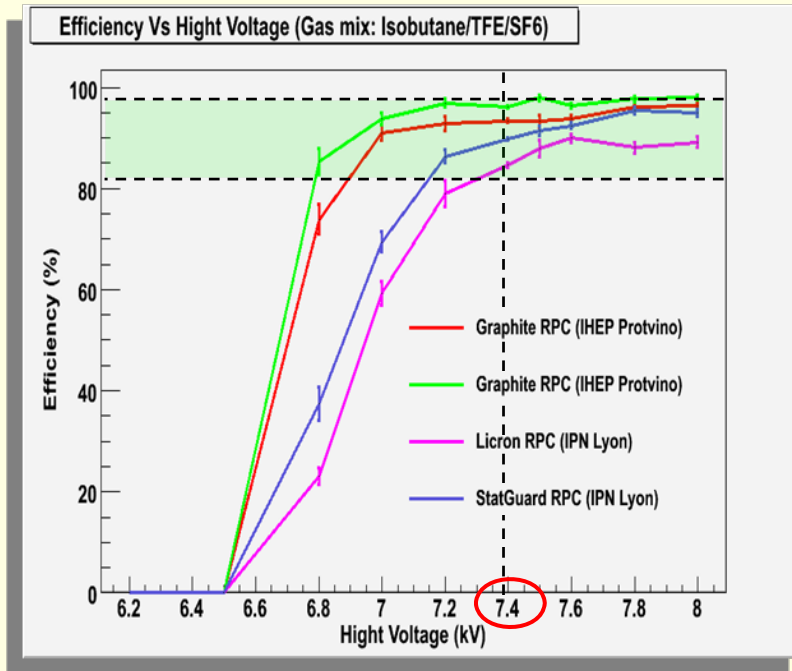
Reminder: Test Beam @PS-CERN



Reminder: Test Beam @PS-CERN

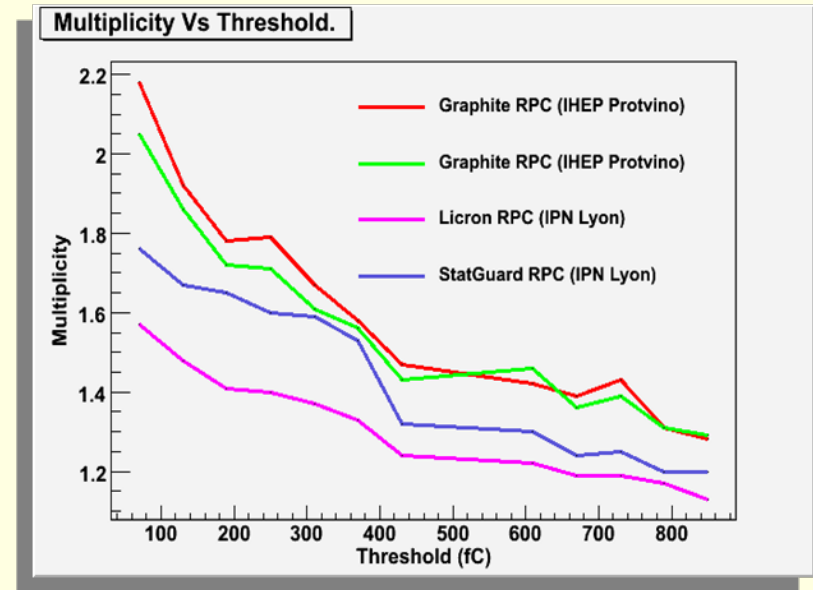
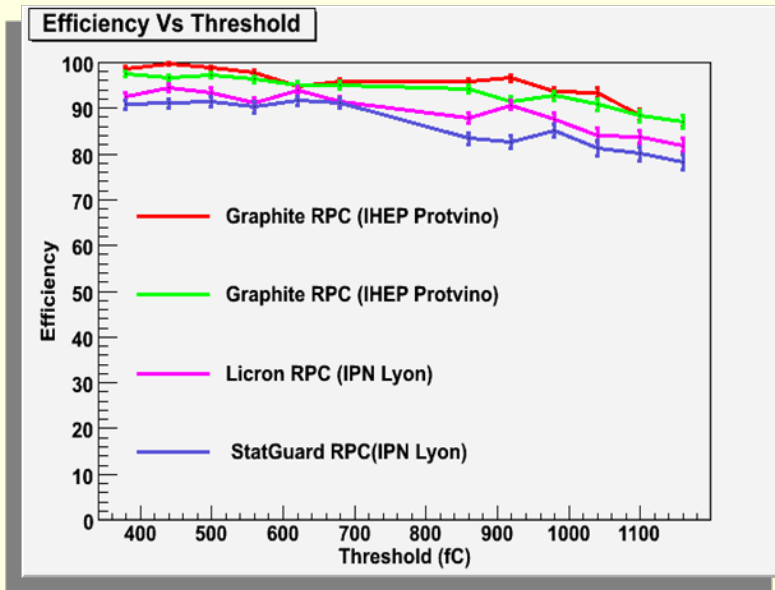


Reminder : GRPC performance



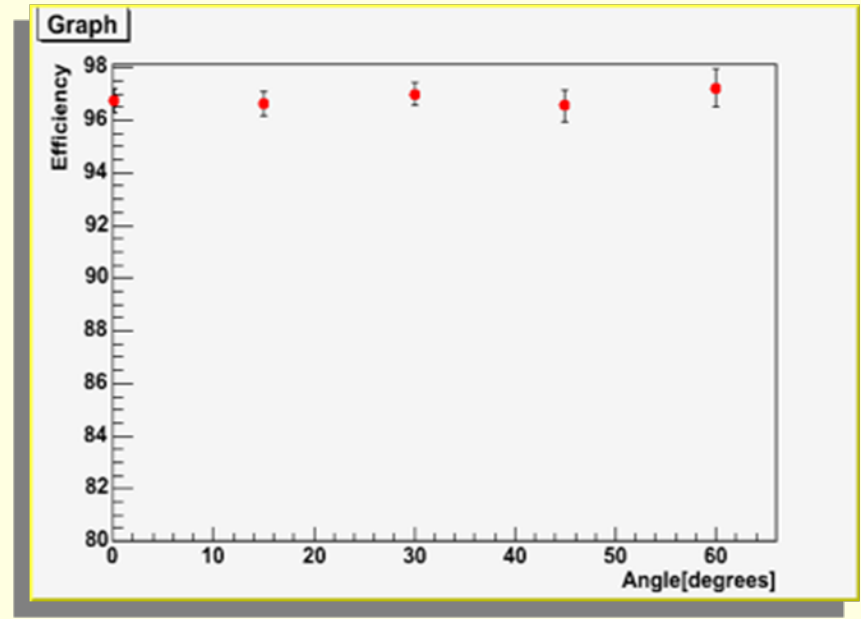
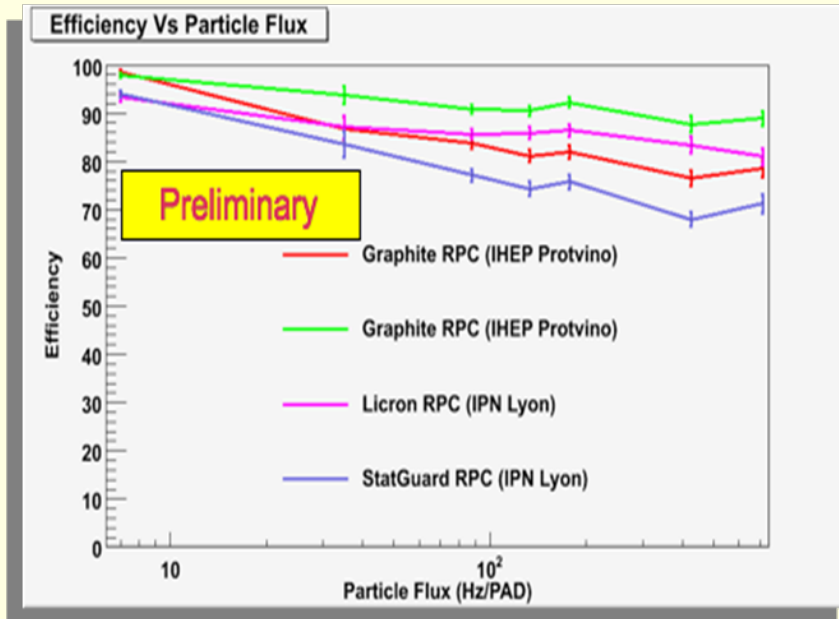
➤ Efficiency and multiplicity behavior versus H.V

Reminder : GRPC performance



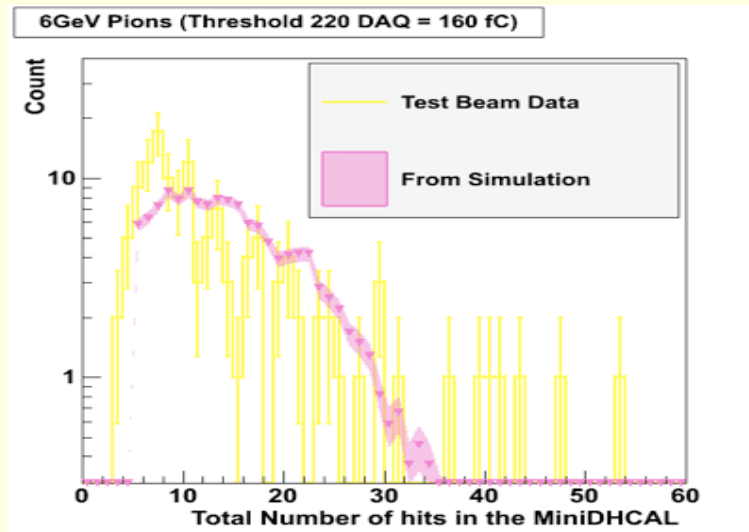
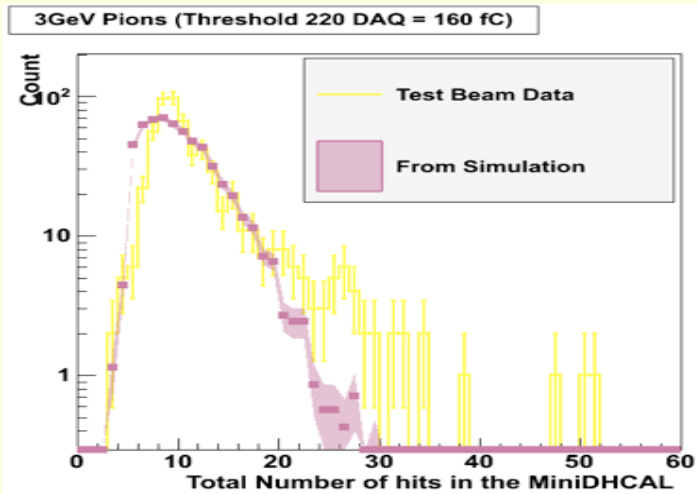
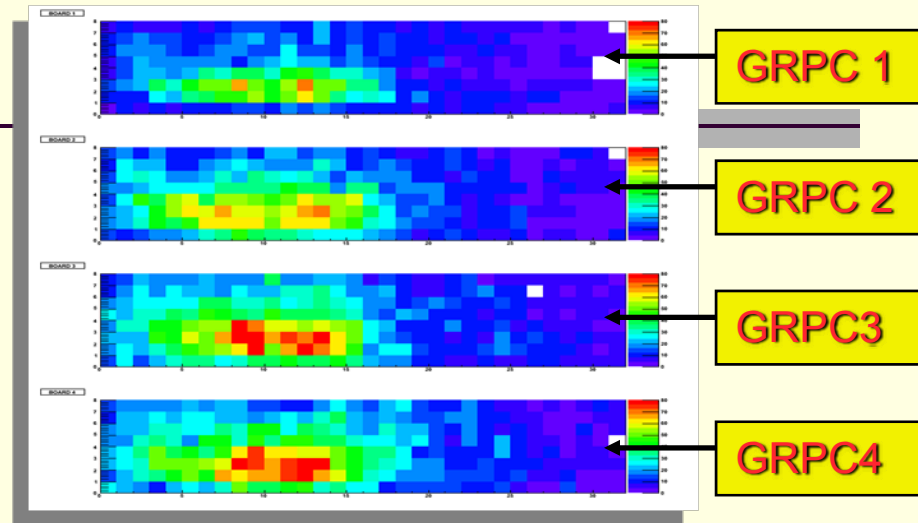
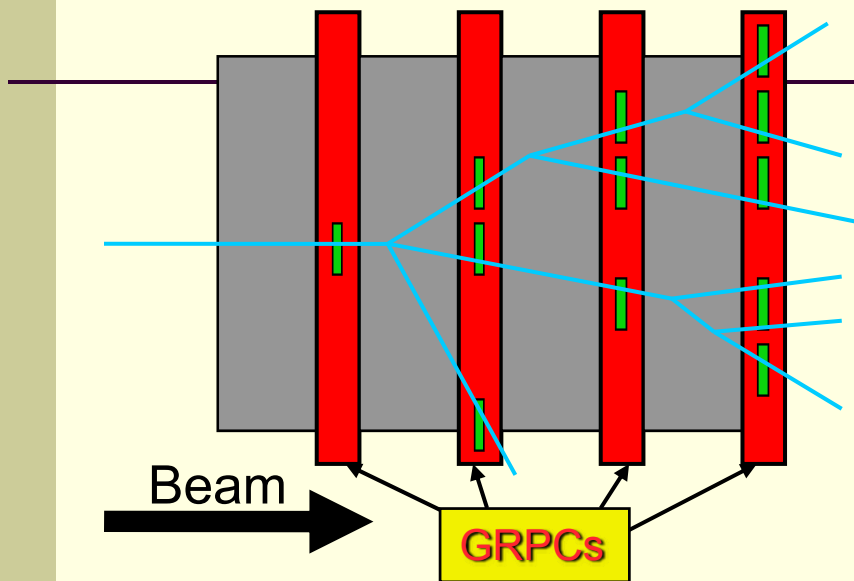
➤ Efficiency and multiplicity behavior versus threshold

Reminder : GRPC performance



- Efficiency and multiplicity behavior versus flux, angle

Reminder : Hadronic Showers



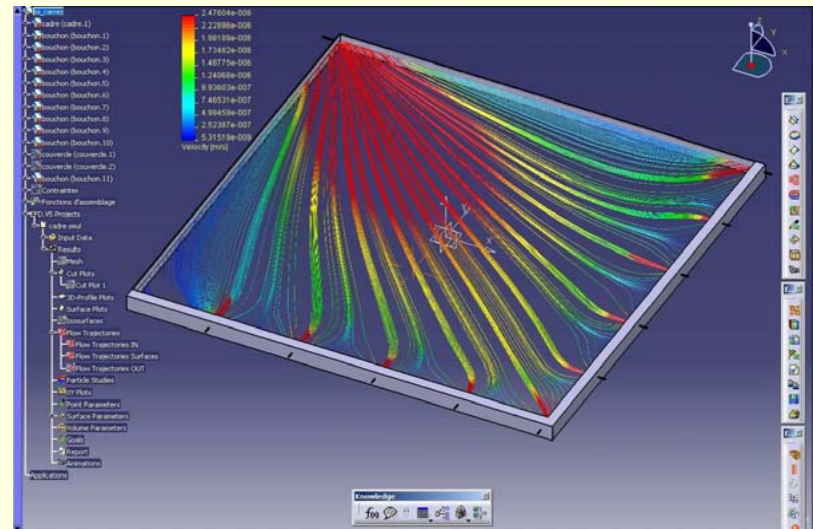
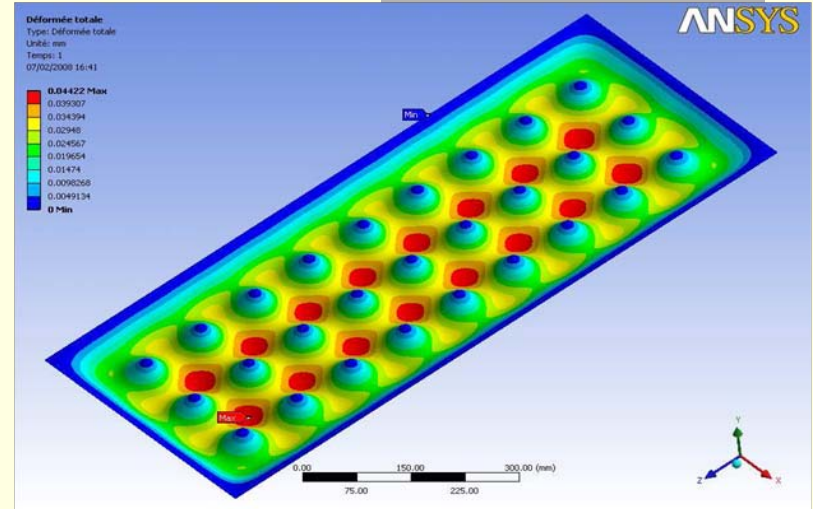
Status : 1m² detector R&D

■ Spacers:

Tiny ceramics balls to reduce dead zones. Number optimized to reduce deformation

■ Gas distribution

Few scenarios are proposed for better distribution → to reduce gas renewal



Status : 1m² detector R&D

■ Resistive paintings:

higher resistivity →

lower multiplicity

Candidates: Licron, Statguard

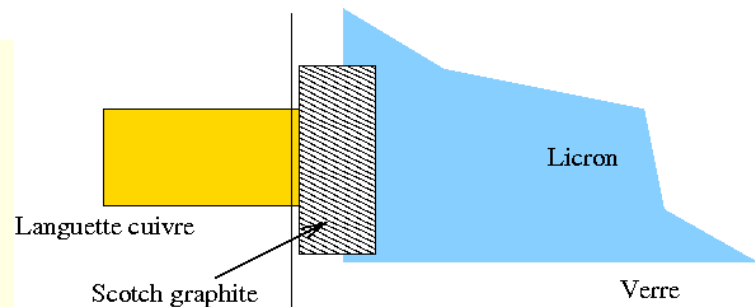
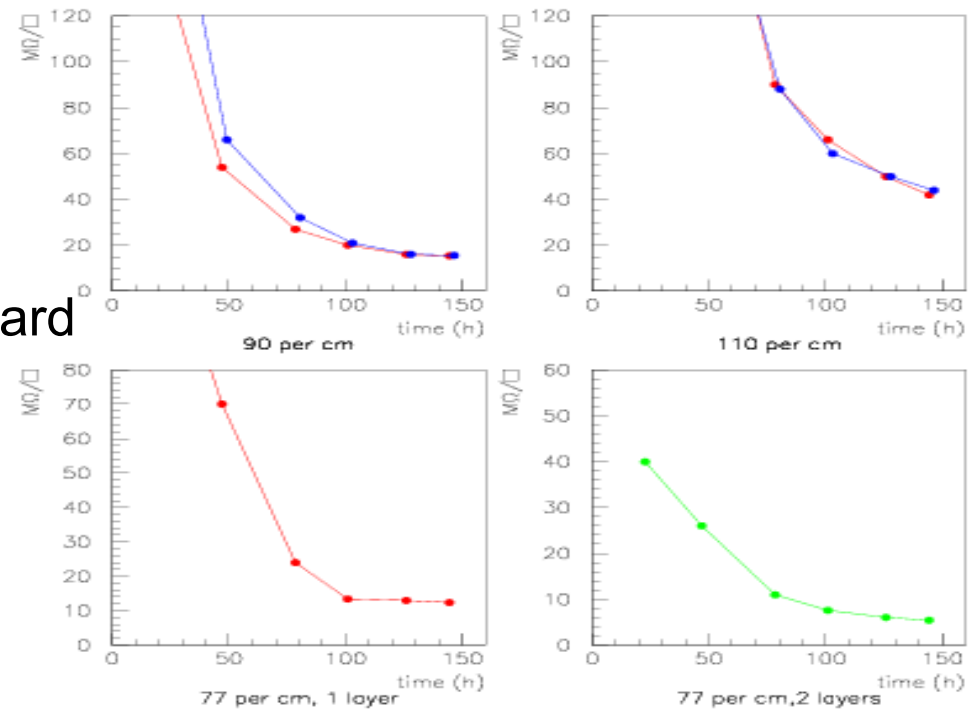
Silk screen printing

Allows better homogeneity
and resistivity control

■ High Voltage :

Stability Problems.

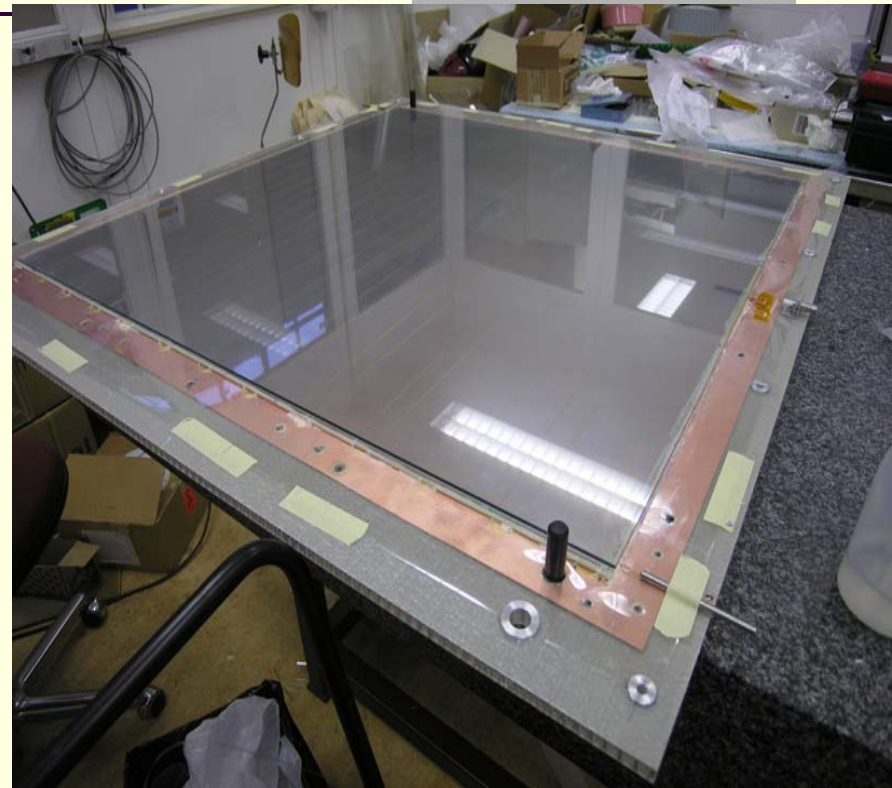
Solution found using
a special epoxy glue



Status : 1m² detector R&D

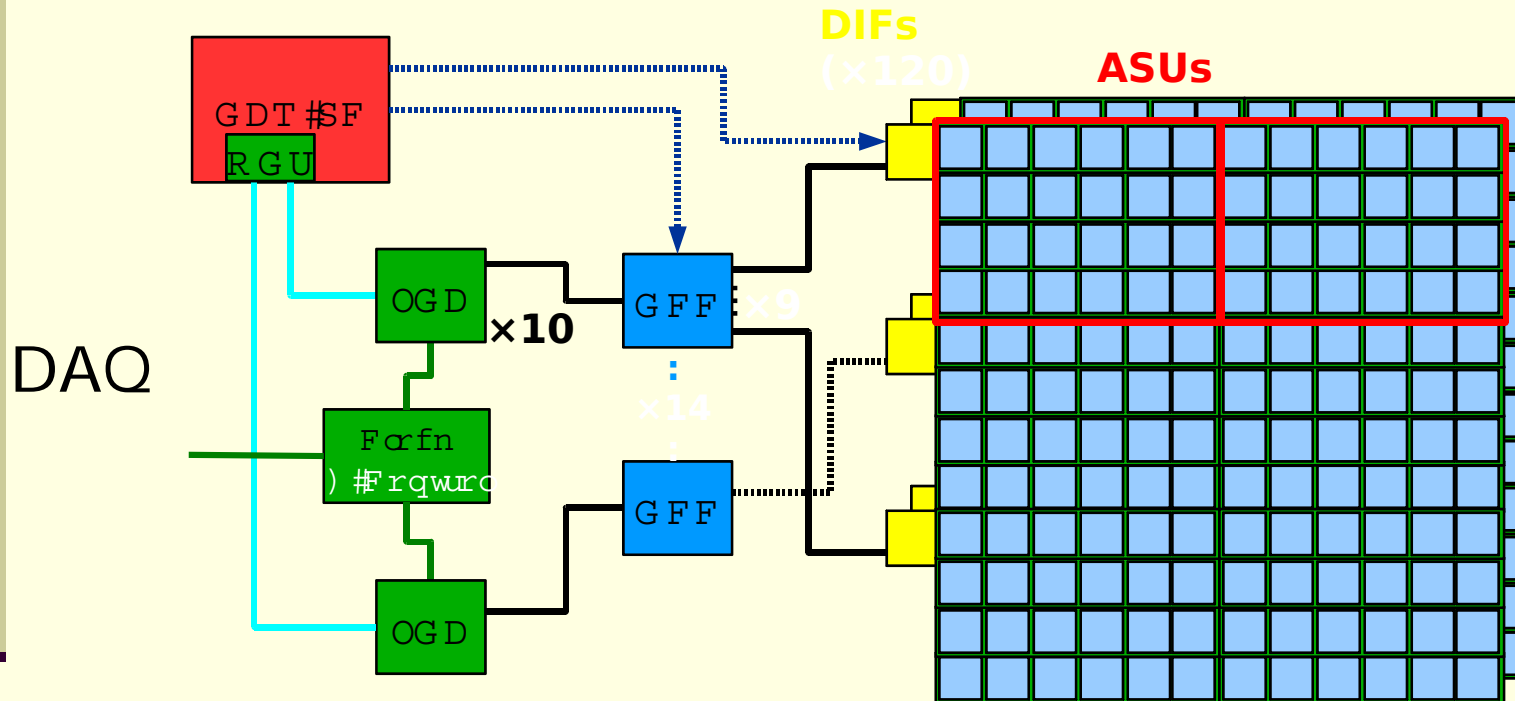


GRPC: IPNL



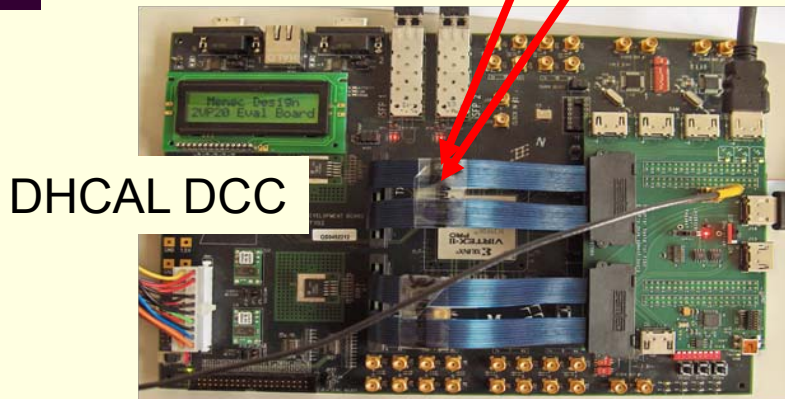
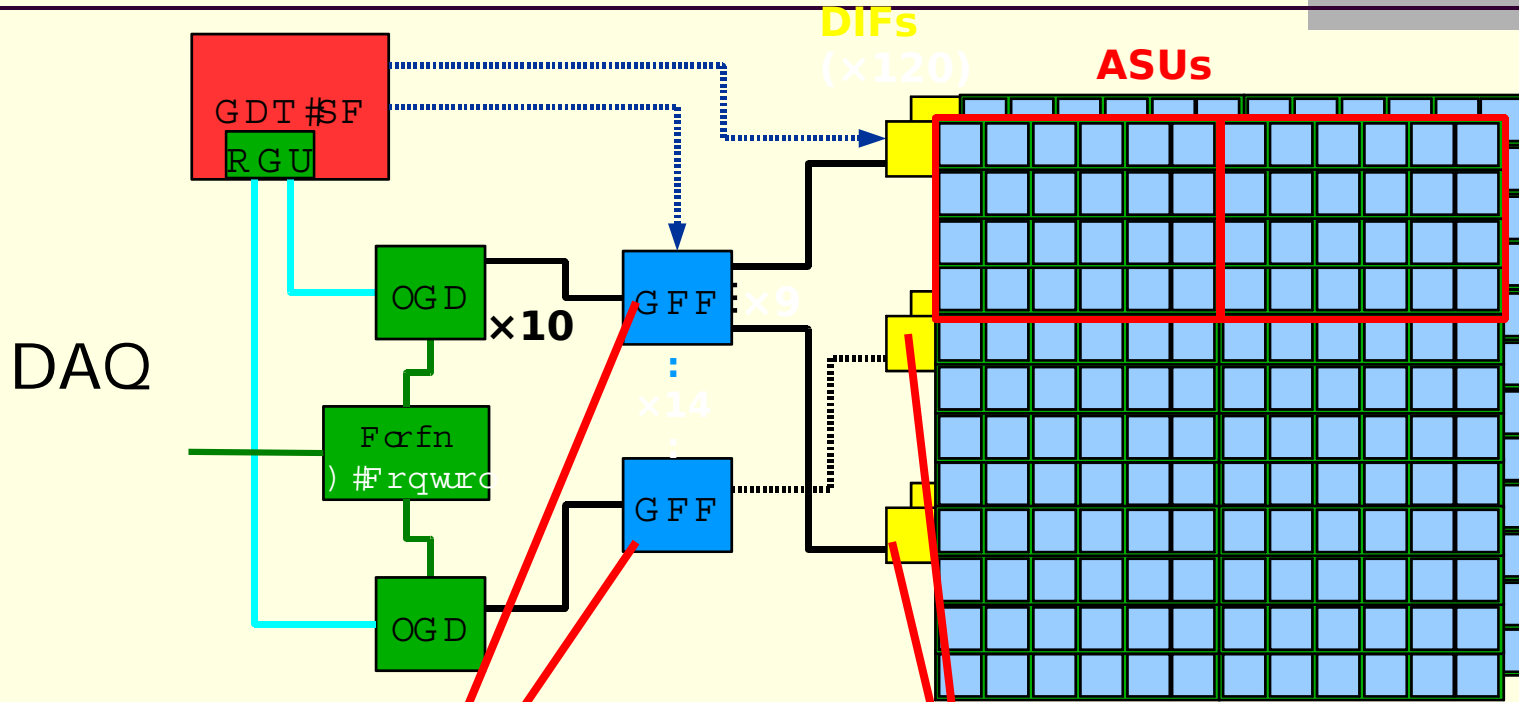
MGRPC: Bologna-CERN

Status: 1m² electronics readout R&D



Proposed readout scheme

Status: 1m² electronics readout R&D



Status: 1m² electronics readout R&D

1 M



DIF

Slab 1

Slab 2

PCBs
connected with
0 ohms
resistors

Track length = 4 M

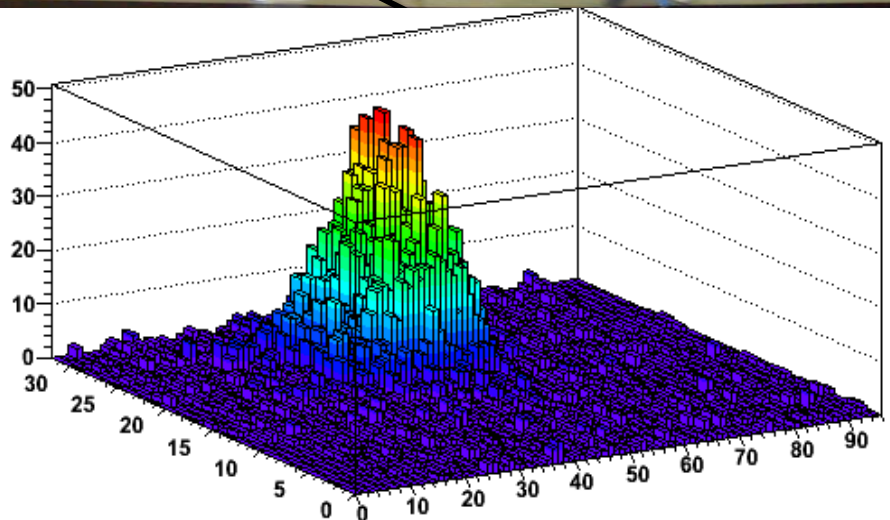
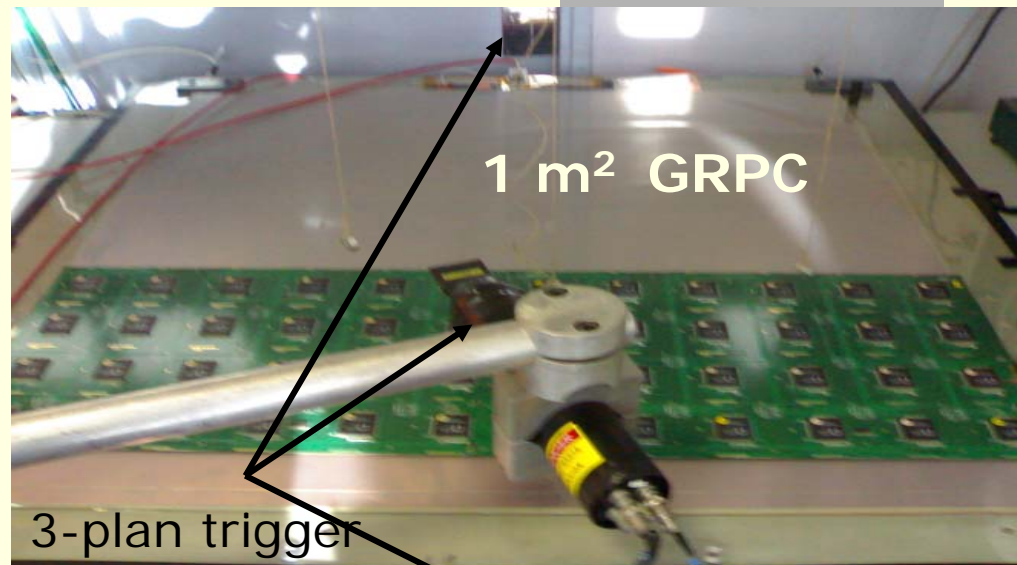
48 HARDROC1

Status: 1m² electronics readout R&D

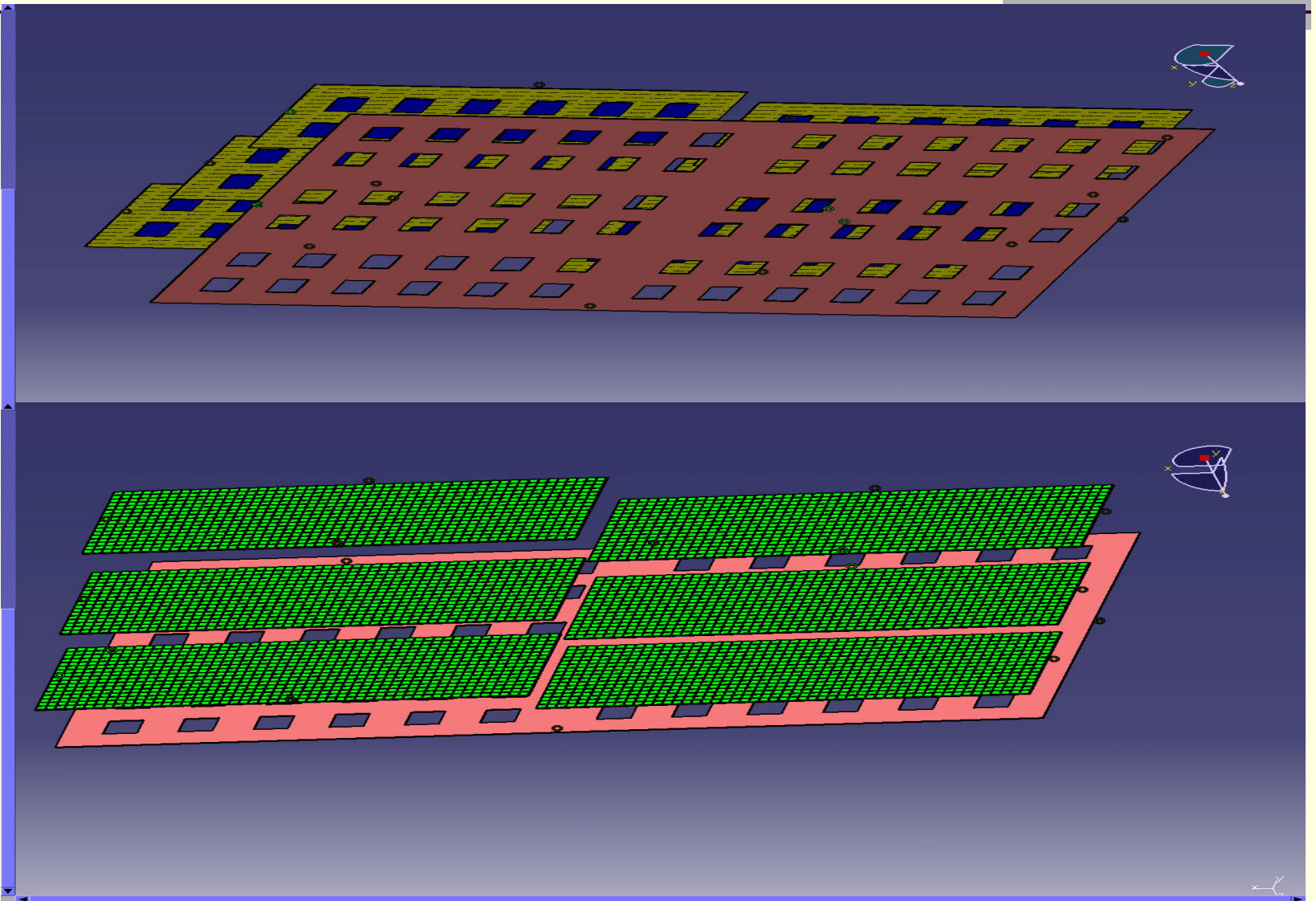
1m² GRPC chambers were tested with the small electronics board (4HR1)

PCB-doublets (3072 c) are tested independently

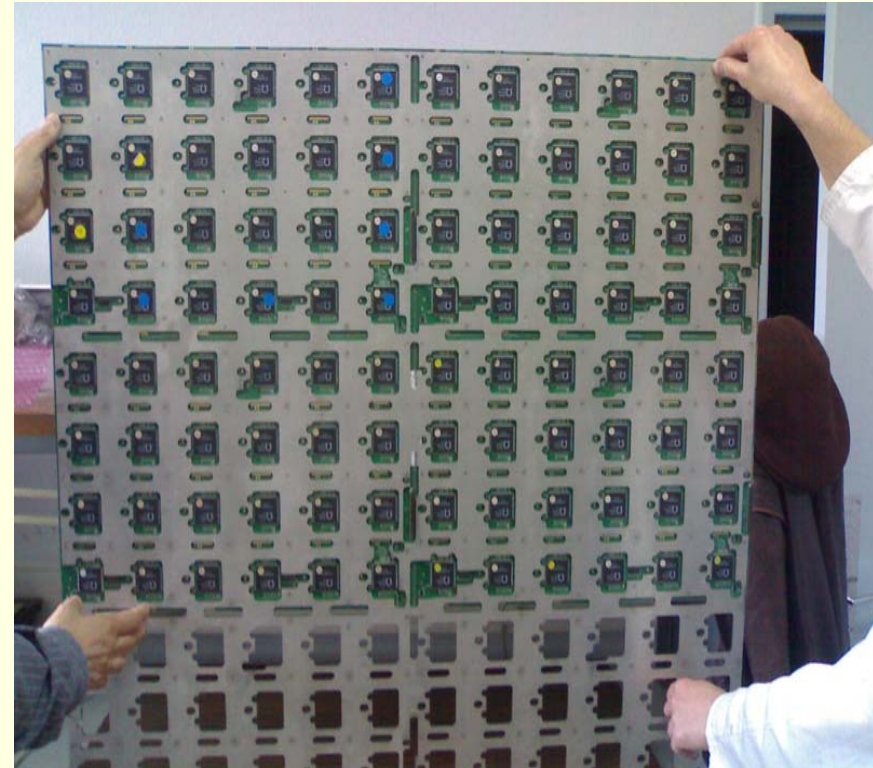
Problems with DIF firmware were found and fixed



Status: 1m² electronics readout R&D

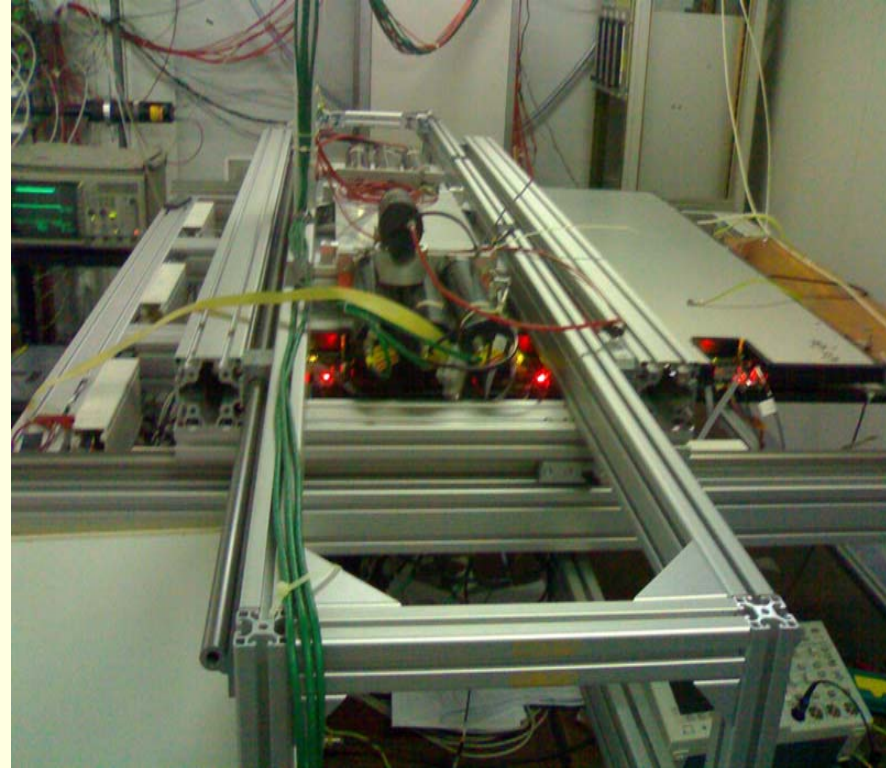


Status: 1m² electronics readout R&D



The 3X2 PCBs were mounted on the S.Steel support

Status: 1m² electronics readout R&D



Cosmic Rays bench for 1m² GRPC

Test Beam at CERN

Two periods : 18 June-3 July, 1-7 August
More than 23 shifters

Aims:

- Test the different 1m² GRPC (Licron S.G, Statguard S.G , M.G) in beam conditions
- Study hadronic showers development by placing 1,2....6 Lead walls 5 cm each in front of the 1m²

In addition

- Test the high-rate GRPC built
- using semi-conductive glass (10^{10} Ω .cm) provided by Tsinghua group

Status: 1m² electronics readout R&D

New 1m² electronics board is under construction with HARDROC2 ASIC → 3 thresholds, masks, optimized power pulsing

PCB are designed and will be produced within 1 month
The new design is intended to avoid problems met with the previous version (transmission lines impedance) which was solved by adding few buffers.

The 144 HARDROC2 will be tested using a semi-automatic procedure

Aims :

Have a final version before the 1m³ prototype

With the power pulsing scheme tested at the large scale level

Preparation for the 1M³ technological prototype

Technological prototype :

40 planes of 1M² :

16mm s.steel absorber

4mm s.steel support

6mm GRPC

Important points:

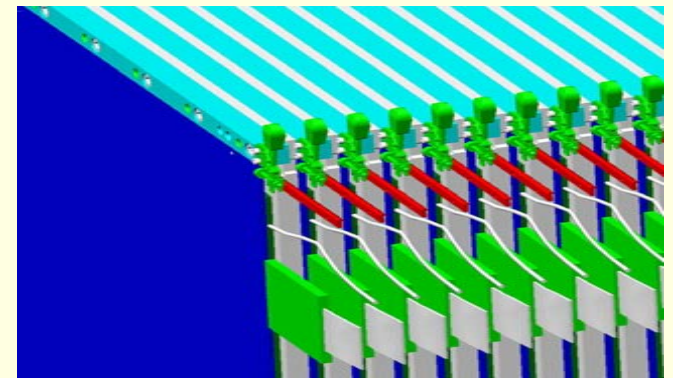
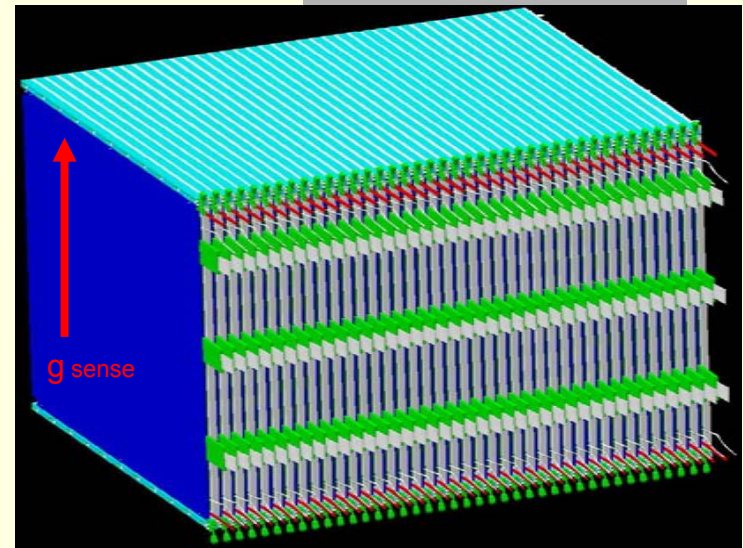
- Mechanical structure and cooling system
- Detector construction and quality control
- ASIC production and quality control
- High voltage system
- Gas distribution system
- DAQ system

Towards the 1m3 technological prototype

A mechanical structure design was proposed by CIEMAT group
It will be finalized in the near future

CIEMAT will fund the construction of the mechanical structure as well as the S.Steel plates

Cooling system study has started.
Louvain-la-neuve will be in charge of this



Towards the 1m3 technological prototype

Detectors will be built by
IPNL and Protvino and tested in IPNL

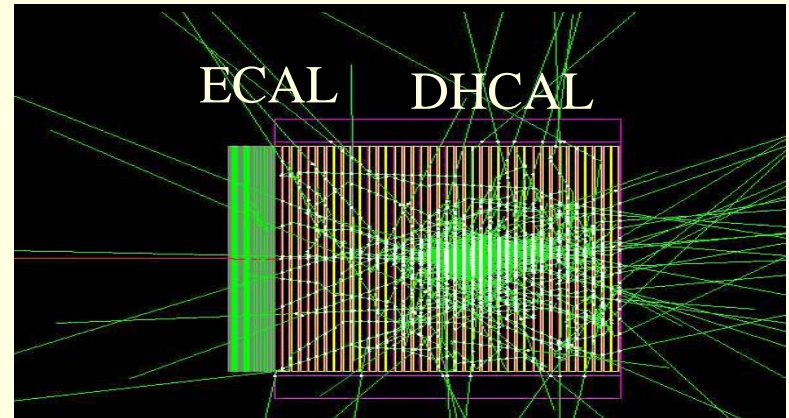
ASICs will be controlled in fully automatic
way using a robotic system used for CMS trackers
IPNL, LAL

DIF, DCC control by LLR in collaboration with LAPP
High voltage system: Cockcroft –Walton technology
Gent group required funding for this purpose

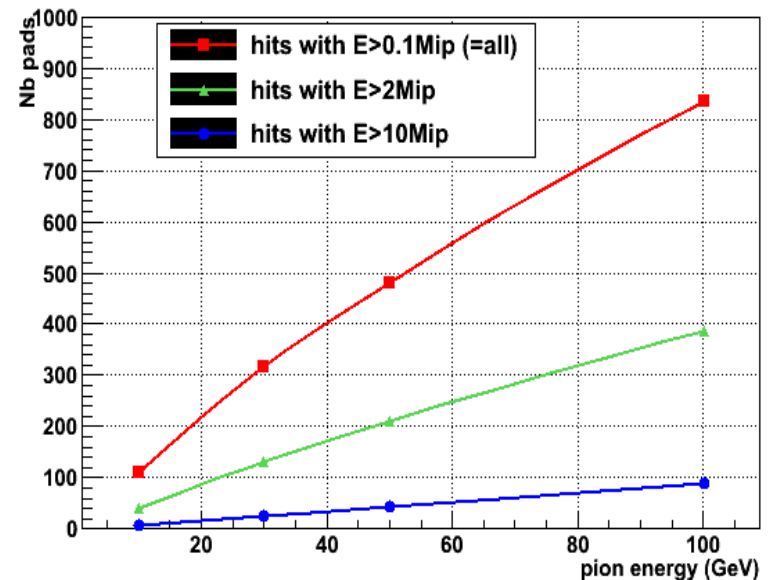
Gas distribution system: a simple one already exists.
More sophisticated one is maybe needed →
Babar drift chamber gas system?

Towards the 1m3 technological prototype

- Pions with different energies were simulated to better understand the containment
- Digitization was developed.
- Algorithms for energy reconstruction using the 3 thresholds are under development



Number of pads vs pion energy

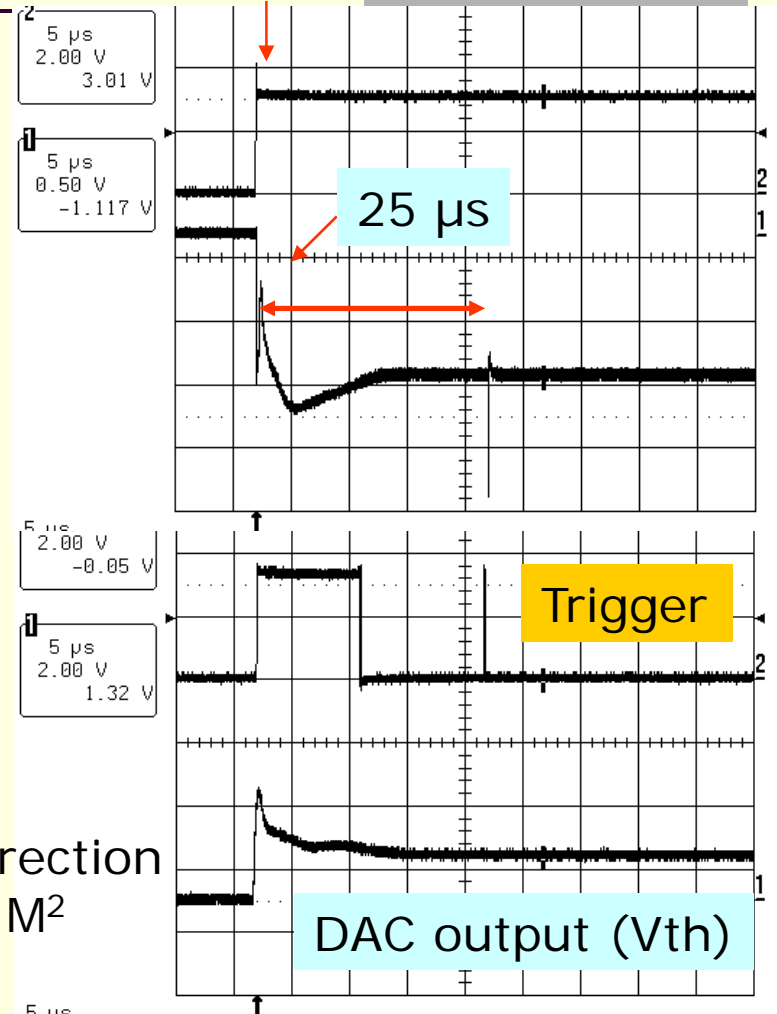
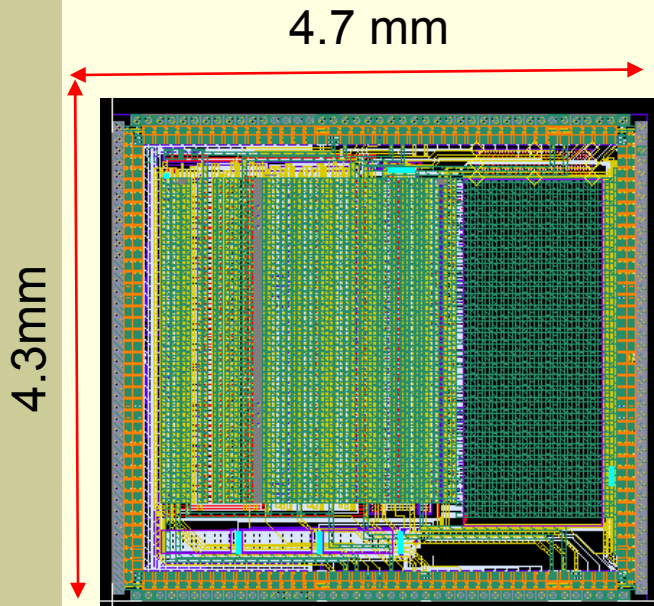


Conclusion

- Our project is progressing as scheduled
- Many problems were fixed
- Decision to build the detectors and to produce the ASICs will be taken before Septembre
- Construction will start in Octobre 2009
- Prototype expected July-Octobre 2010

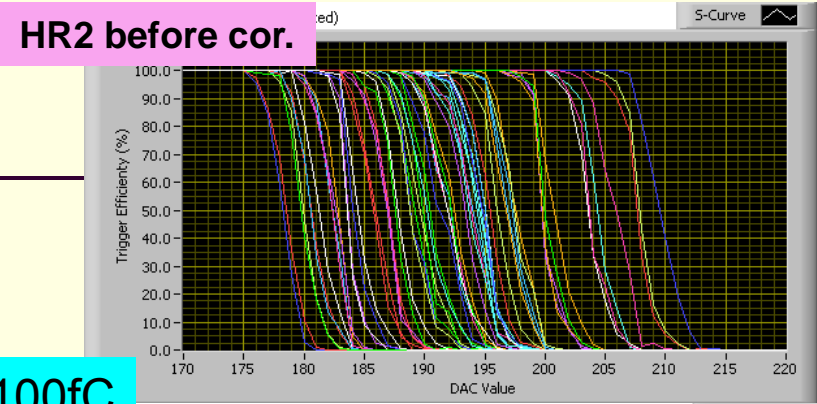
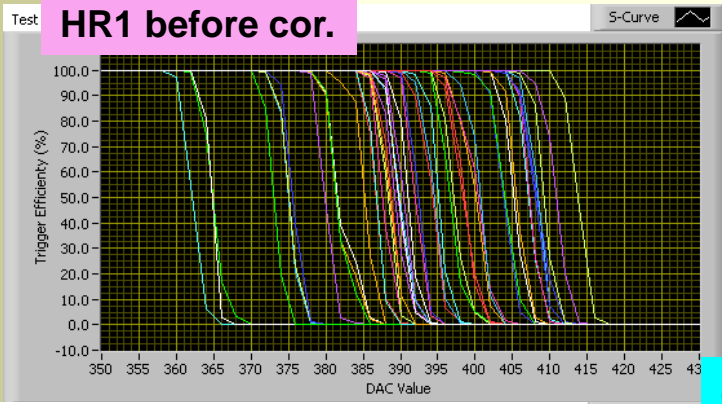
Readout electronics

PWR ON

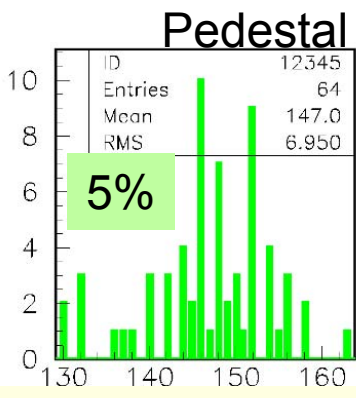
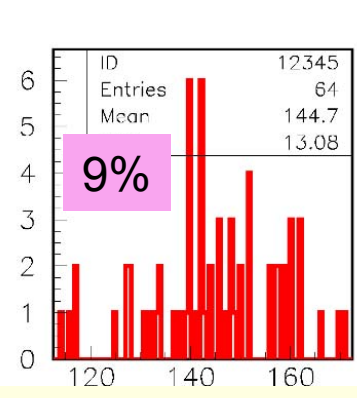
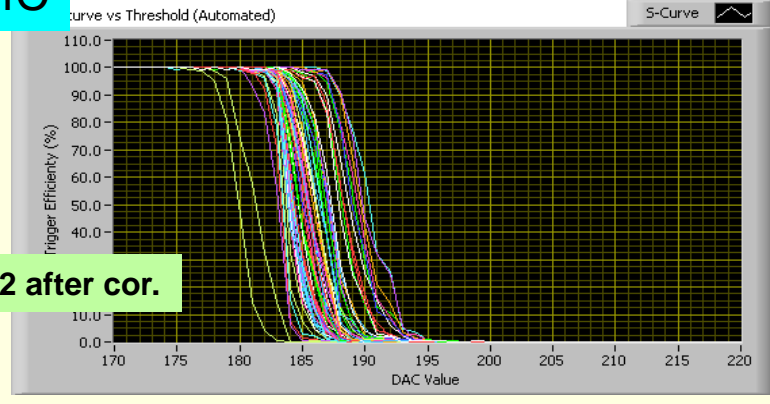
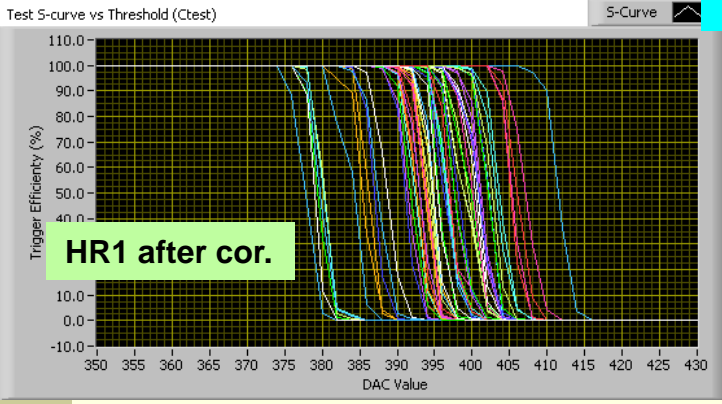


3 thresholds with "independent" gain correction
New PCBs are under design for a second M²

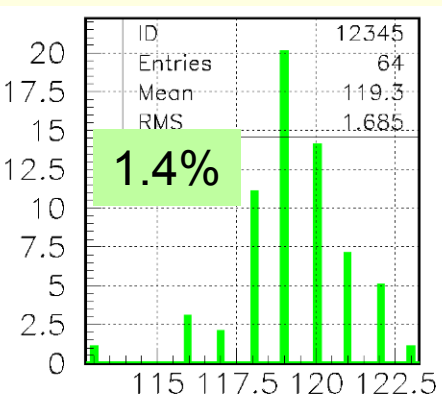
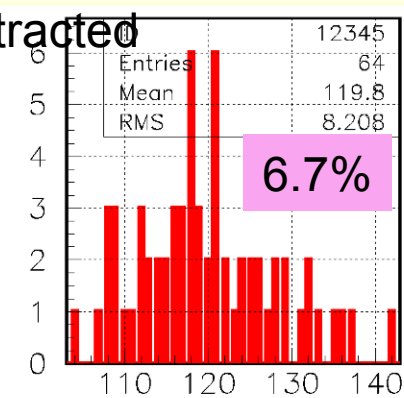
FSB0 scurves: HR1 /HR2 before and after gain correction



Qinj=100fC



Pedestal subtracted



Semiconductive glass and ceramics

Semiconductive glass

210mm*70mm*0.7mm

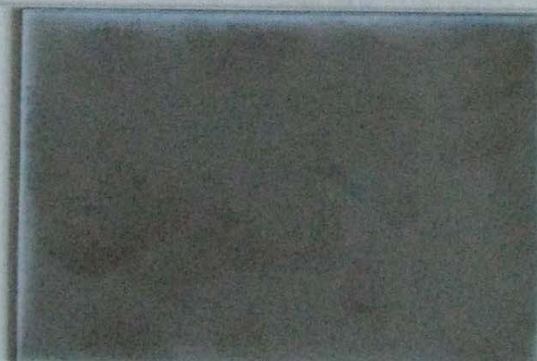
$\sim 10^{10} \Omega \cdot \text{cm}$



Semiconductive ceramics

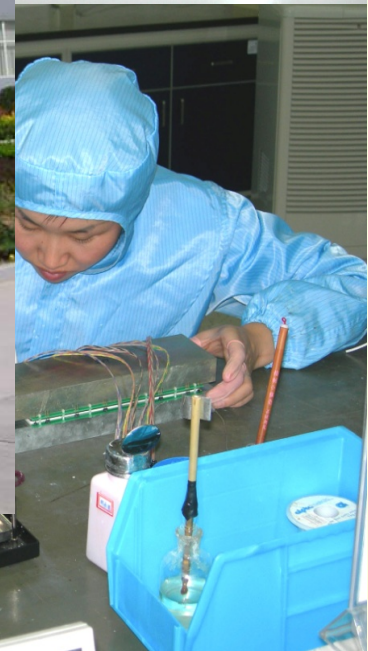
80mm*50mm*1mm

$10^6 \sim 10^9 \Omega \cdot \text{cm}$



STAR MRPC workshop @

Outer scene of the workshop



1.- Ciemat mechanical workshop.

Milling Machines:

- 1 CNC machine of aprox 4x1 m² working table. Accuracy of aprox 0.03 mm/m, with temperature compensation.



This is the machine that can be used to produce the plates for the HCAL prototype.