Activities of the digital hadronic calorimeters in AIDA

I.Laktineh

CIEMAT, IPNL, LAL, LAPP, LLR, UCL

OUTLINE

- Goals
- Present developments
- Future developments

Goals

Two major objectives are being followed:

1- Complete the construction of a technological prototype of hadronic calorimeter of 1 m^3 with multi-threshold readout to validate the SDHCAL concept for ILD

2- Build few large chambers of GRPC (2-3 m^2) equipped with last generation electronics to demonstrate the capability to build the future ILD SDHCAL.

International Large Detector

-The Semi-Digital HCAL is one of two options proposed in the ILD LOI. It aims at applying the PFA.

It uses gaseous detectors as sensitive medium v embedded readout electronics providing 1cm2 lateral segmentation.

-A genuine mechanical structure is proposed for the SDHCAL.

GRPC was chosen as the baseline :

-Cost-effective

-High efficiency

-Adequate resolution

Similar developments proposing MicroMegas detectors for SiD (LAPP)

Challenges

-homogeneity for large surfaces

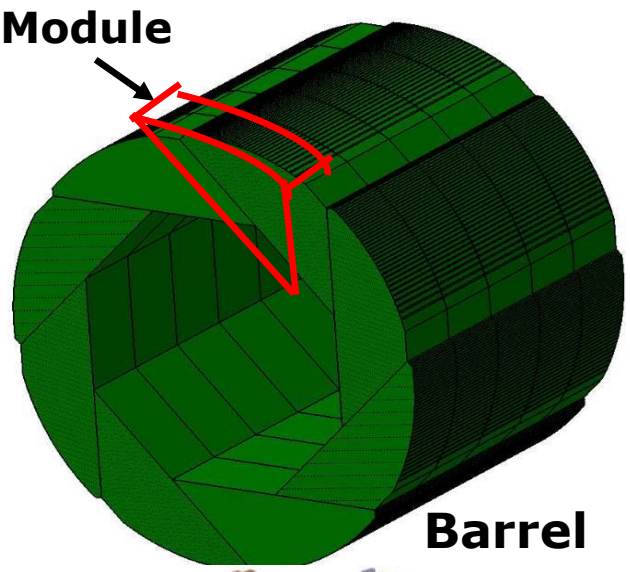
-Thickness of only few mms

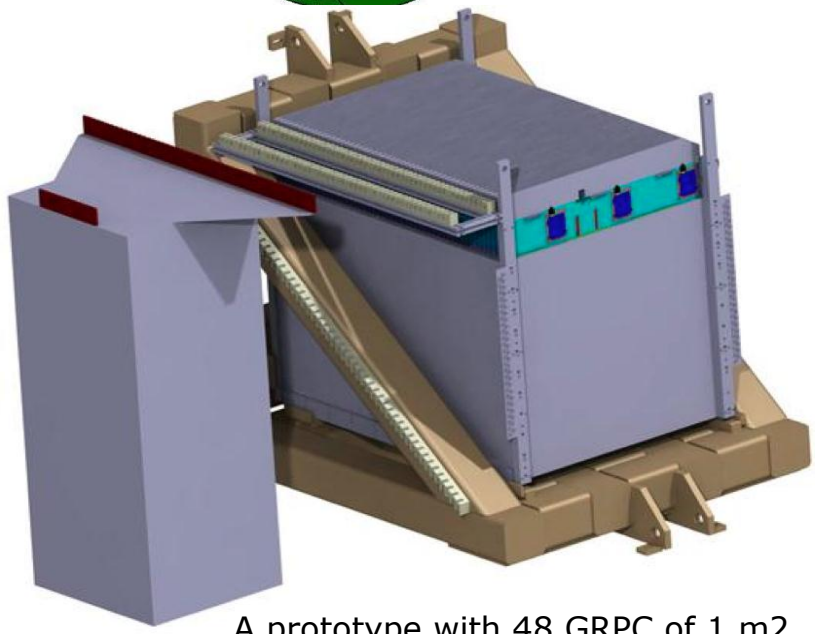
-Services from one side

-Embedded electronics

(France, China, Belgium, Spain, Russia)

NB: A physics prototype using GRPC was Successfully built and run by the American colleagues





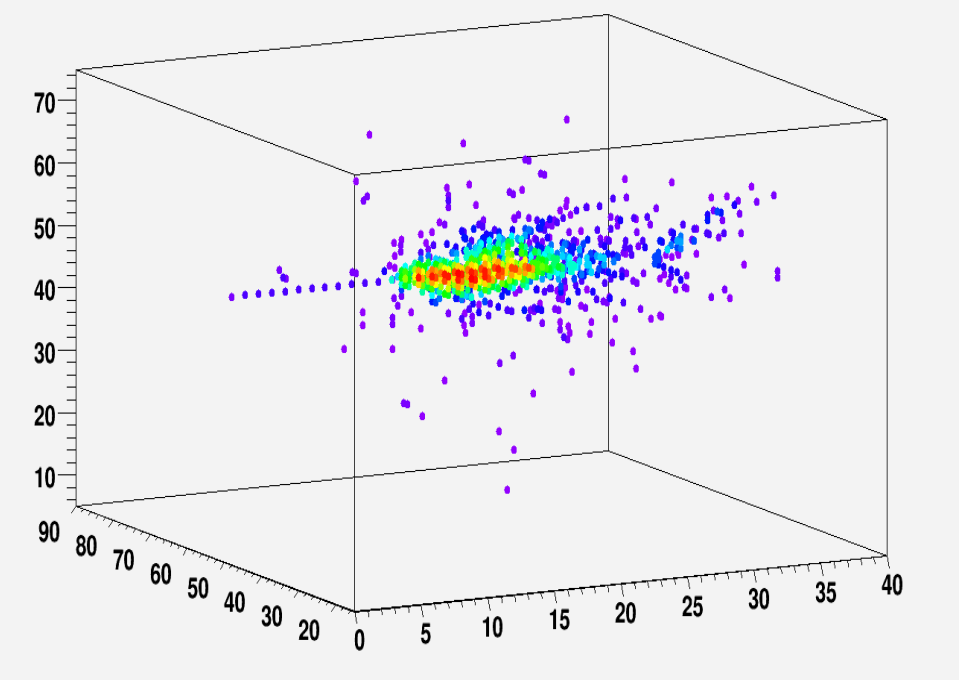
A prototype with 48 GRPC of 1 m2 was conceived as a demonstrator

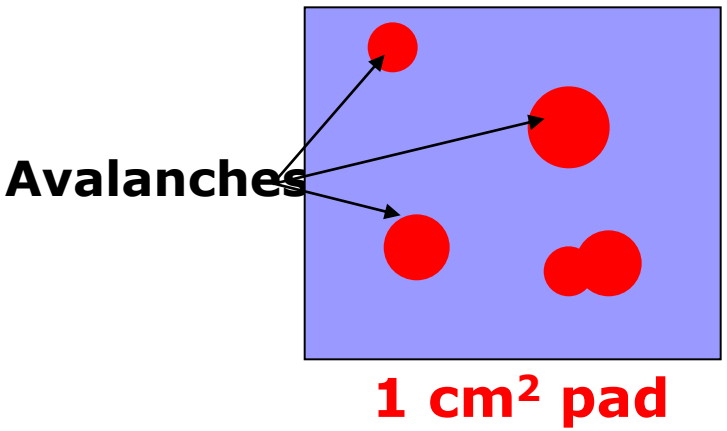
Motivation

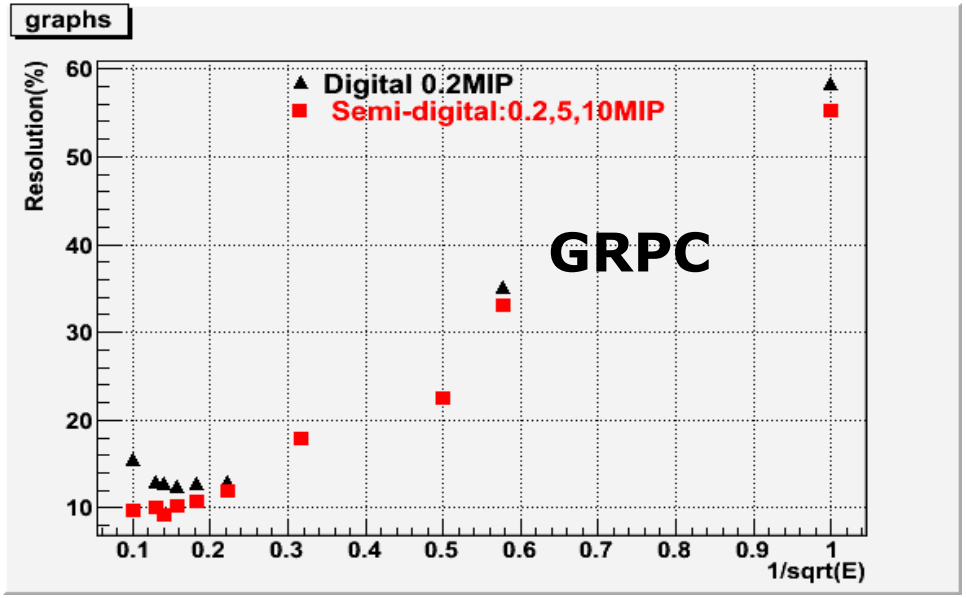
Electronics readout choice

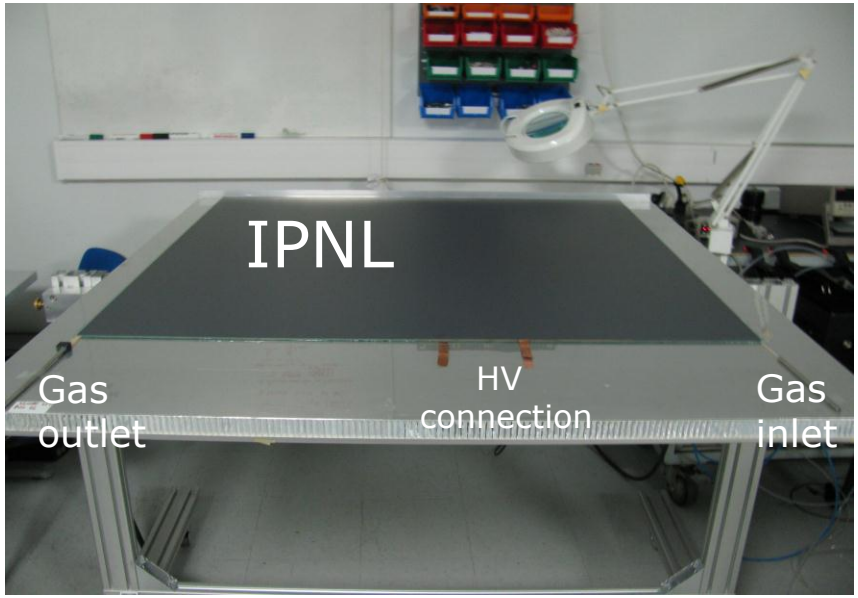
At high energy the shower core is very dense→ simple binary readout will suffer saturation effect

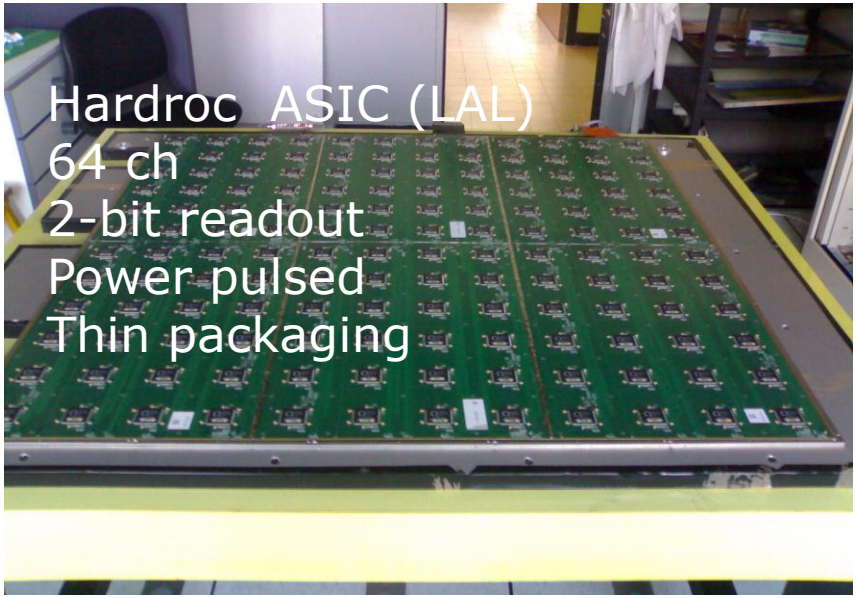
→ semi-digital readout (2-bit) can improve the energy resolution.



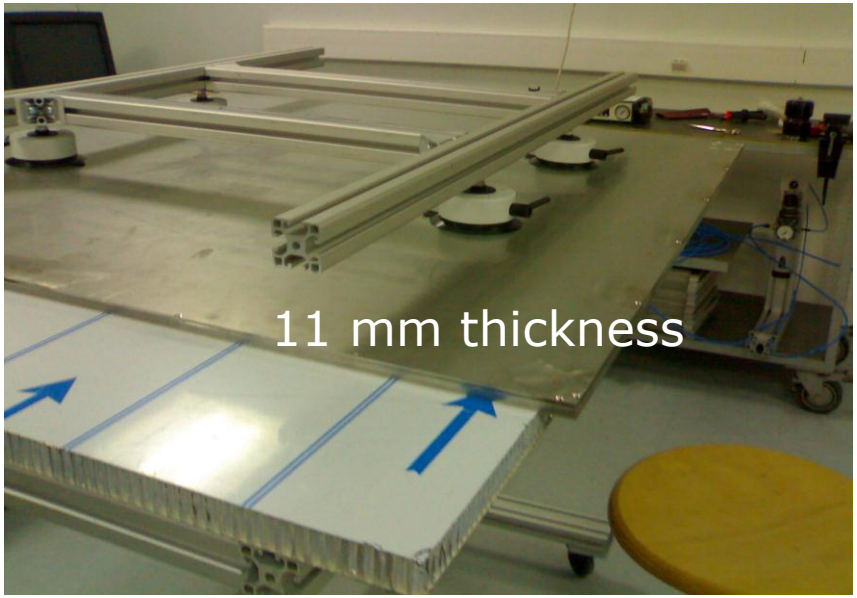





IPNL
Gas outlet
HV connection
Gas inlet

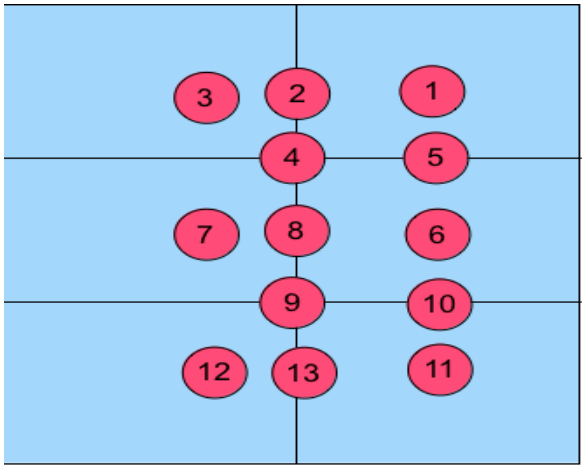

Hardroc ASIC (LAL)
64 ch
2-bit readout
Power pulsed
Thin packaging

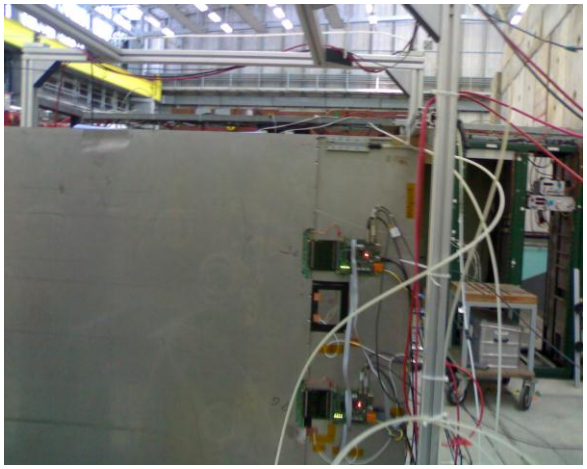

9216 ch/m2


11 mm thickness

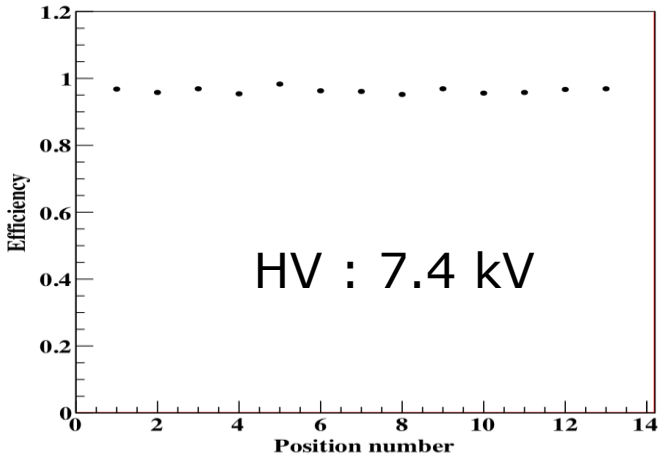
Validation

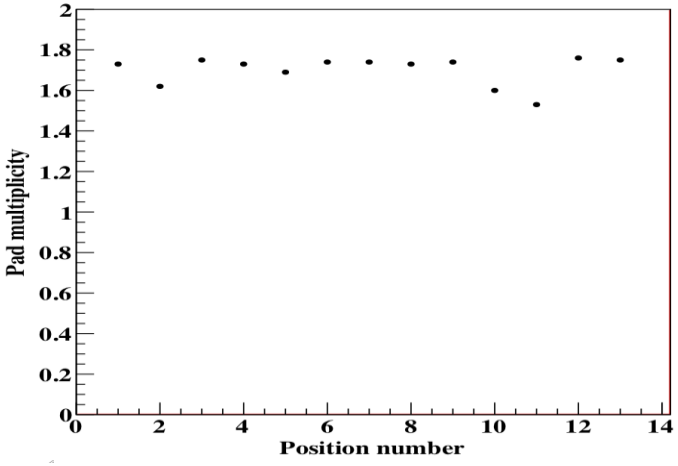
A full cassette was successfully tested at T9-PS May 2010
and H4-SPS in September 2010





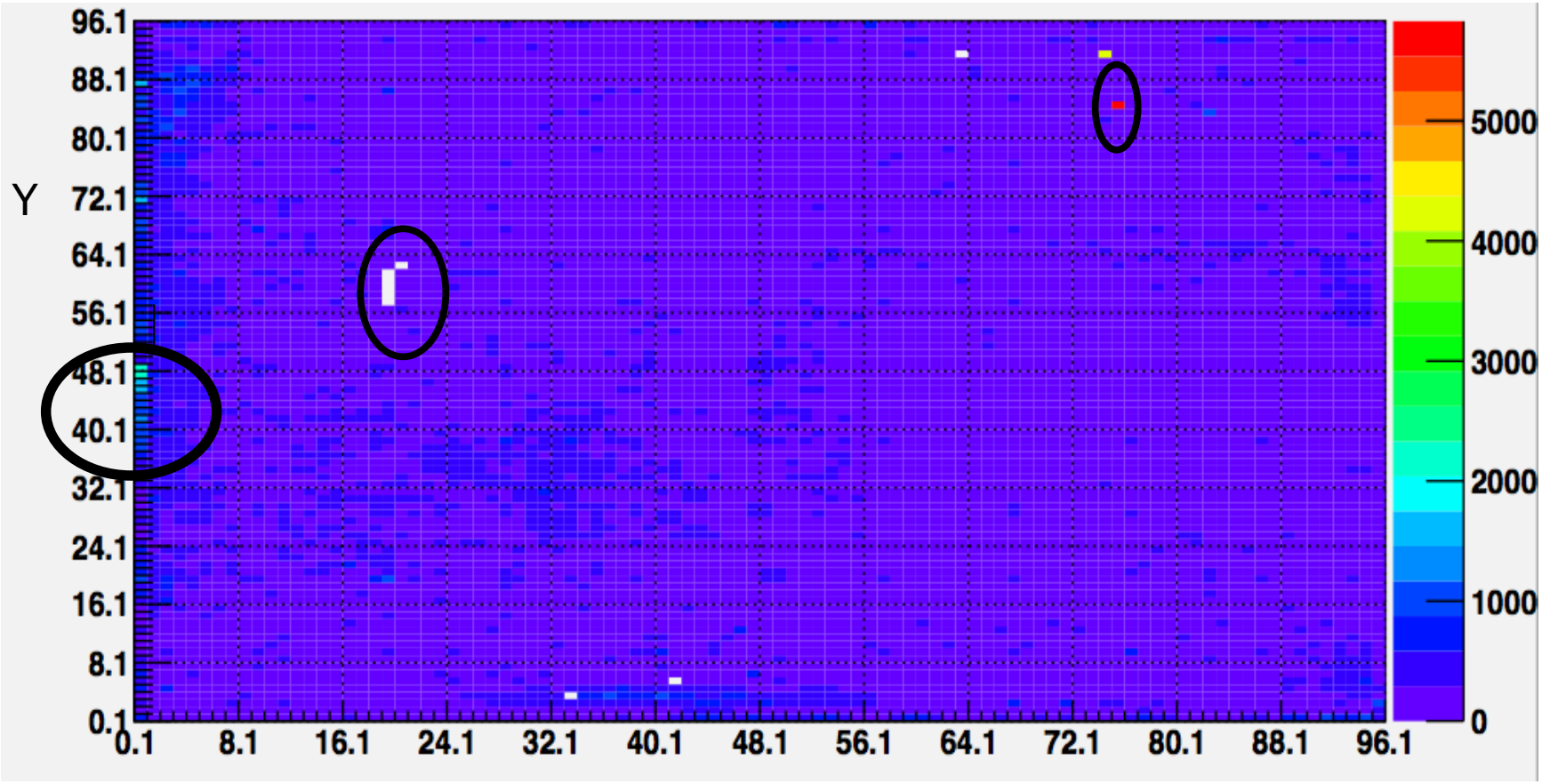
Gas mixture
TFE :93 %
CO_2 : 5 %
SF_6 : 2 %





Validation

Noise was measured and found to be < 1 Hz/cm2 outside the channeling tubes and HV connection zones



Noise Map

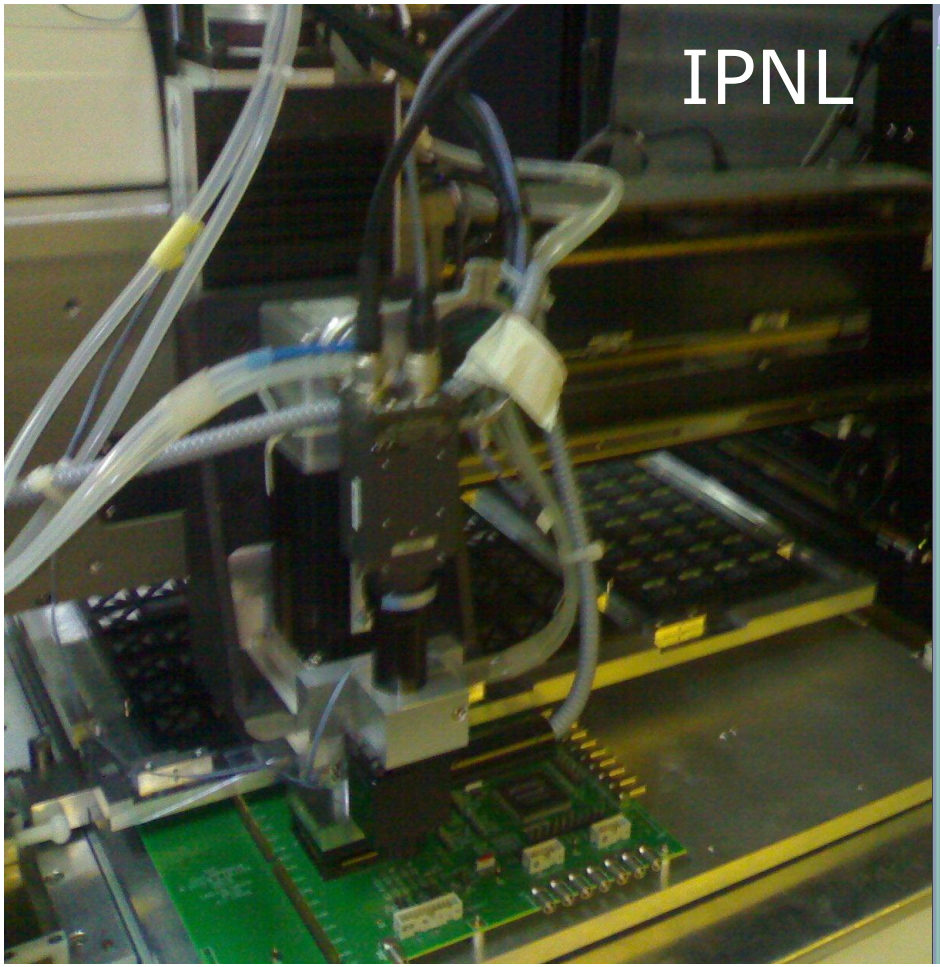
X

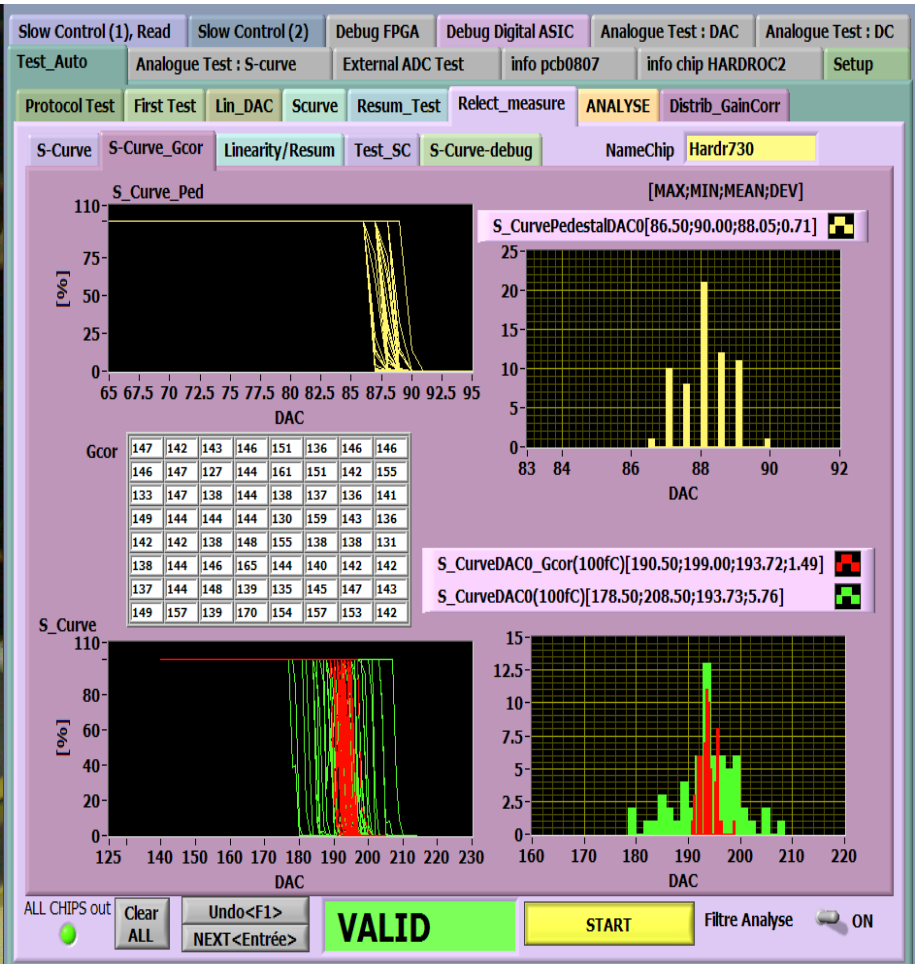
Electonics: ASICs stand test

A robot was used to test the 10500 ASICs

The procedure allows to select the good ASICs and calibrate the

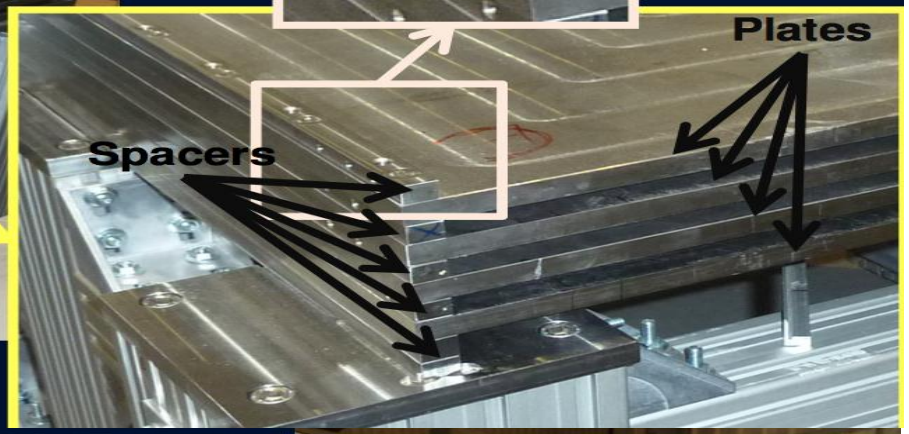
Yield 93%





50 Chambers are built and will be used in the SDHCAL prototype in the coming days..

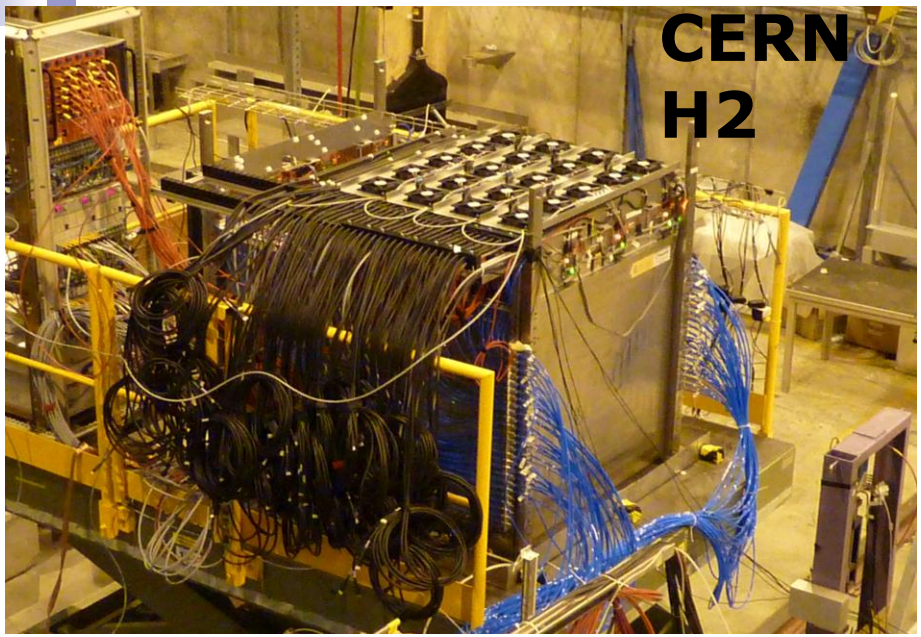

Bolts


Plates
Spacers


Planarity Verification

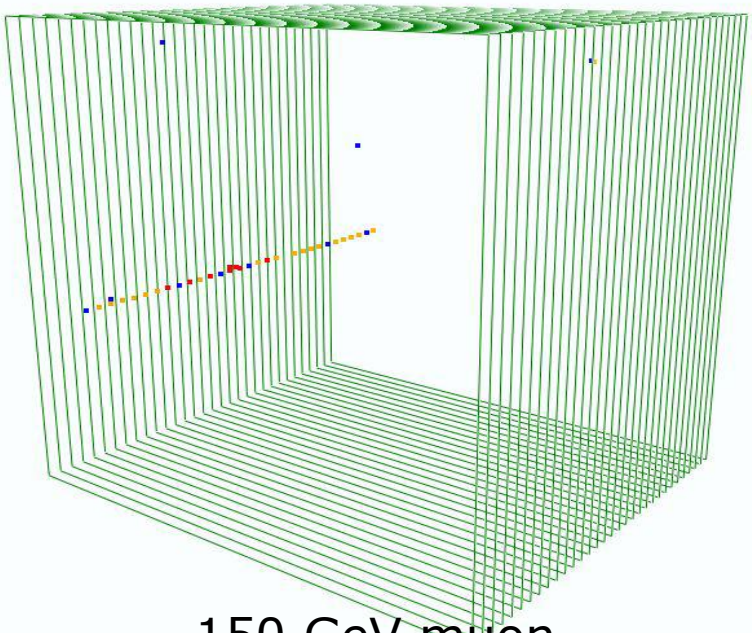

CIEMAT

Cassettes insertion in the mechanical structure at CERN

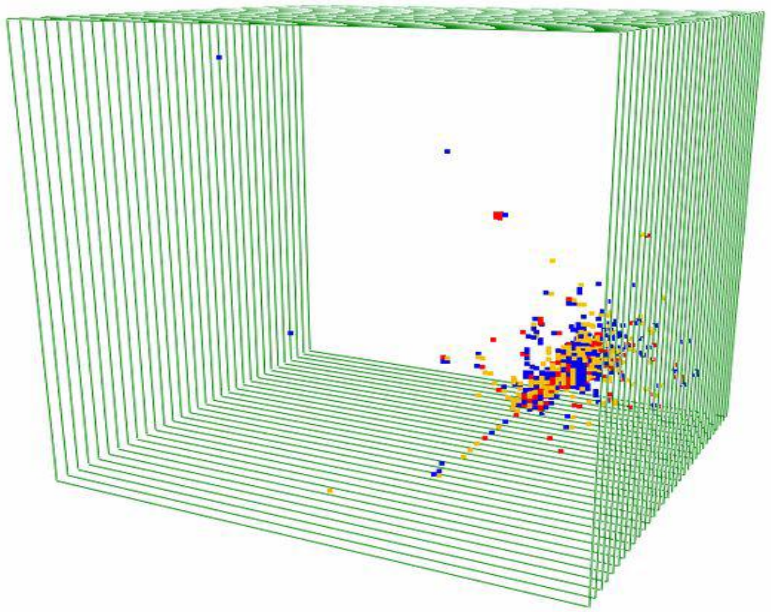


50 cassettes were produced
42 were inserted in a self-supporting mechanical structure. Commissioning was performed at CERN.

DAQ was based on
USB system
No cooling system was used

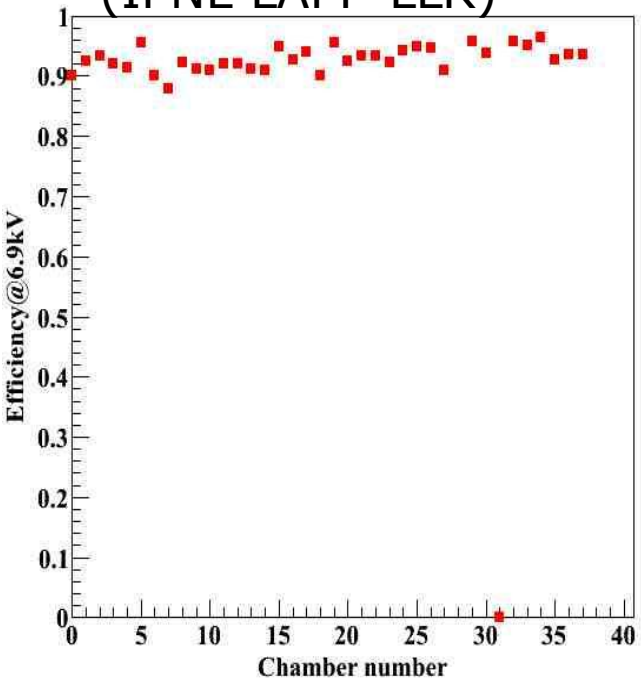


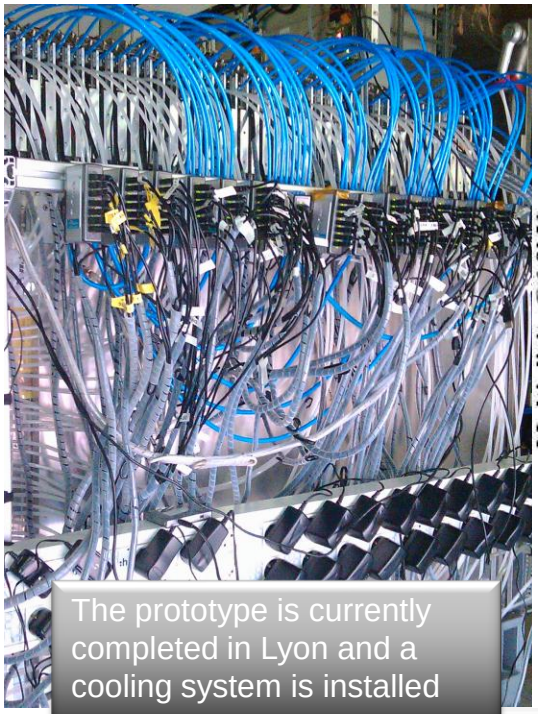
150 GeV muon



150 GeV pion

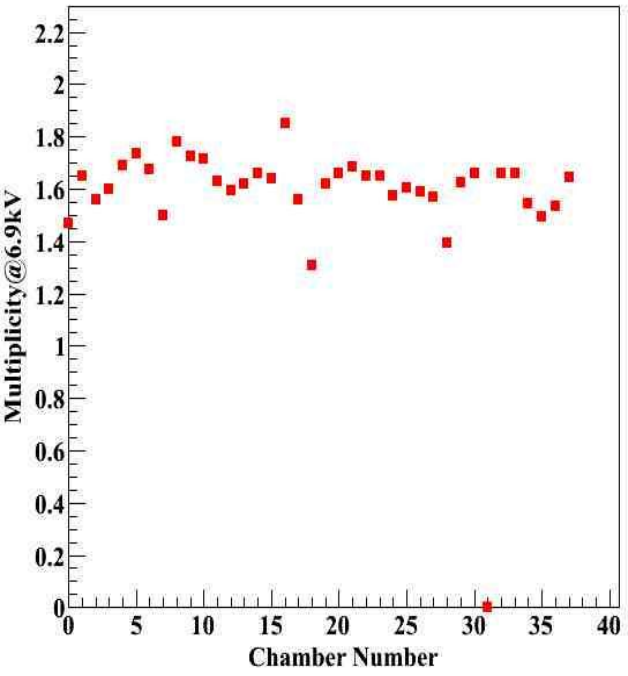
New DAQ system was developed. It is a hybrid system (USB-HDMI) (IPNL-LAPP-LLR)

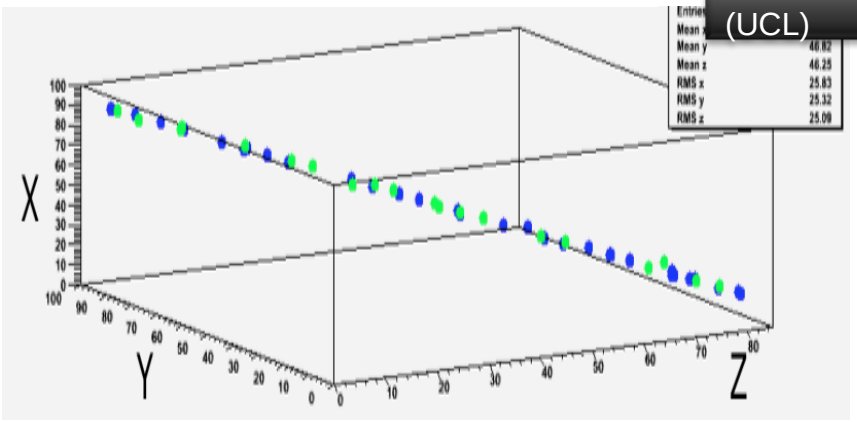


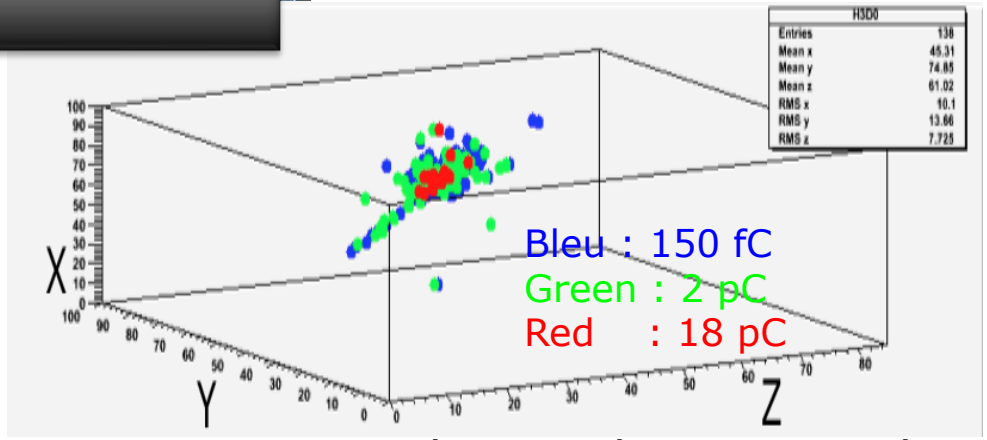


The prototype is currently completed in Lyon and a cooling system is installed

(UCL)

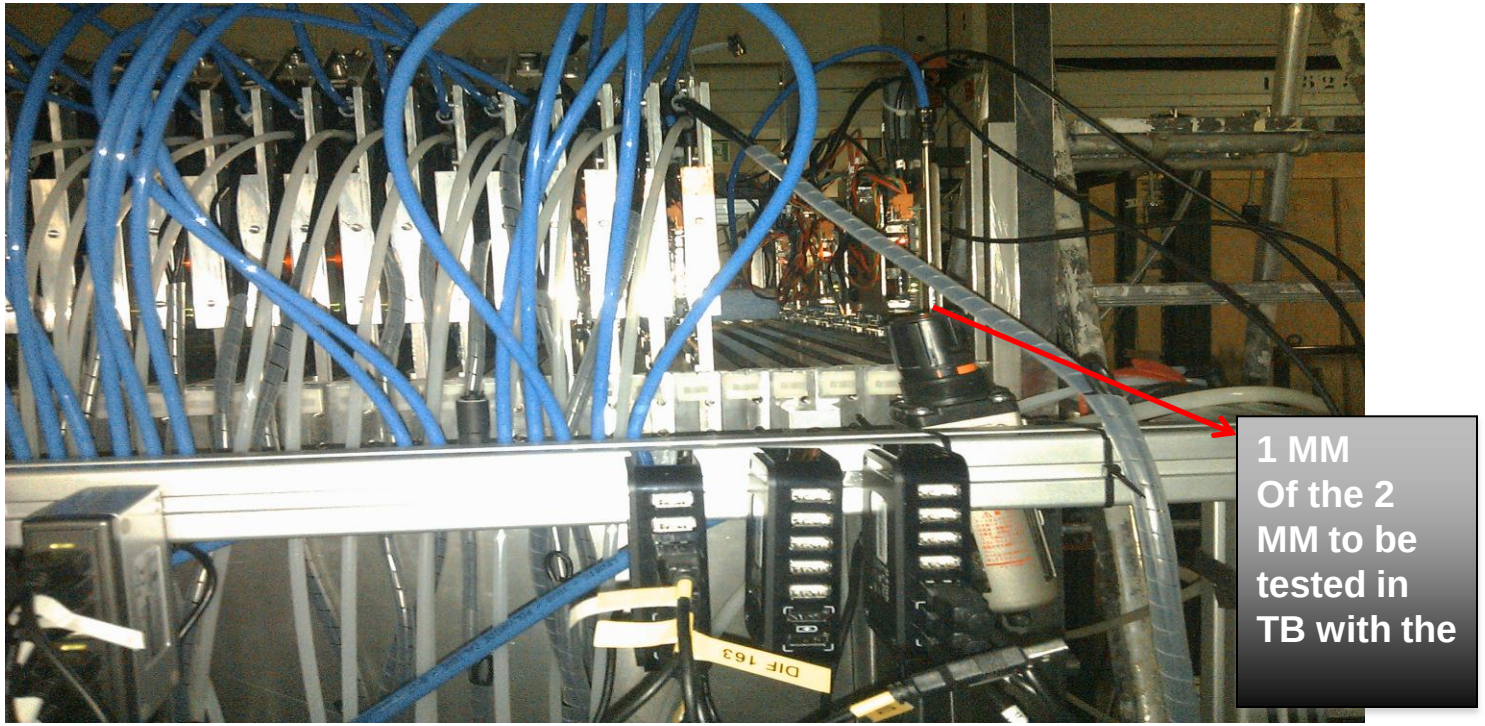






Cosmics are used to monitor the GRPCs. Power Pulsing is being tested

In addition to the GRPC development, another gaseous detector (MICROMEGAS) is developed by LAPP. 2 detectors of 1 m^2 were built. They are read by a new ASIC similar to the HR ASIC with an appropriate dynamic range (> few fC).
The results obtained are very promising and make of the MM a very good choice for digital calorimeters.



Beam tests with 48 GRPC+2MM will take place soon at CERN

Future developments:

First steps in building large GRPC (> 2 m^2) have started. It includes

1- A new generation of the HARDROC ASIC with I2C protocol, circular memory, channel-based memory (LAL-IPNL).

2- Design large electronics board to host 300-450 ASICs (20000-30000 channels) (IPNL).

2- New acquisition board based on TCP-IP protocol (CIEMAT).

3- Design large GRPC detectors and the mechanical structure (IPNL, UCL, CIEMAT).

Conclusion

Important efforts are ongoing to complete the construction of a technological HCAL to validate this ILD option

Beam tests will take place very soon at CERN to validate the Semi-Digital Hadronic CALorimeter concept.

Designing and building very large GRPCs has started. It allows to develop the need techniques for the construction of the future SDHCAL for ILC.