Construction of a Semi-Digital Hadronic CALorimeter Technological Prototype

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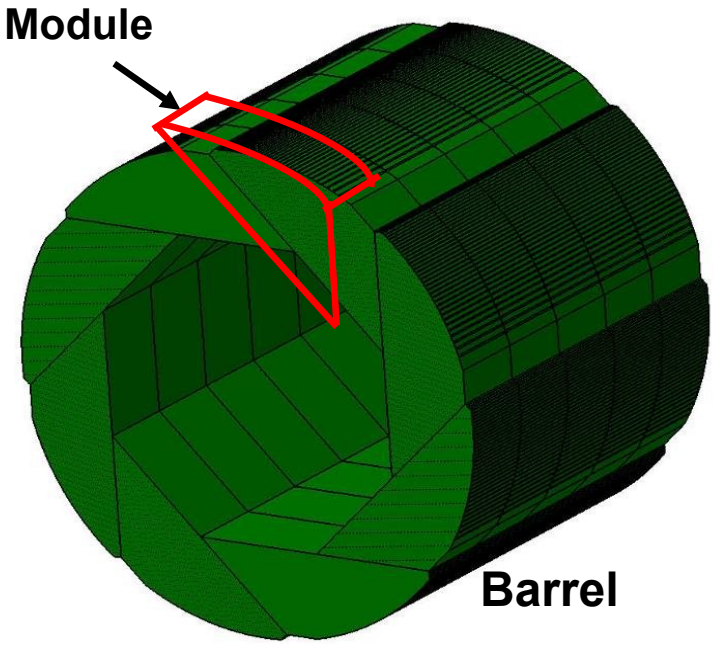
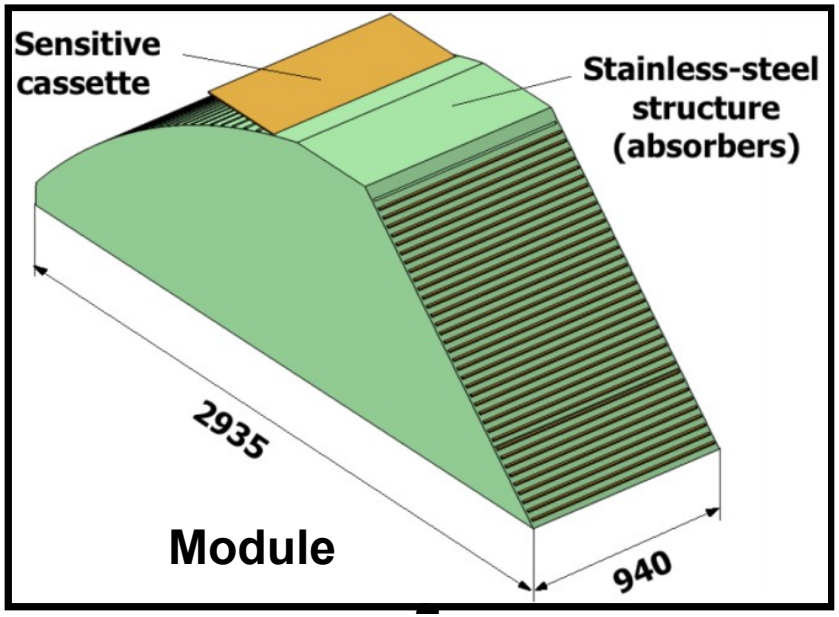
Objectives

The Semi-digital GRPC-based HCAL was proposed and accepted as one of the two HCAL possible options in the **ILD L**etter **O**f **I**ntent

A genuine mechanical structure was also proposed

- It is self-supporting
- Has negligible dead zones
- Eliminates projective cracks
- Minimizes barrel / endcap separation (services leaving from the outer radius)





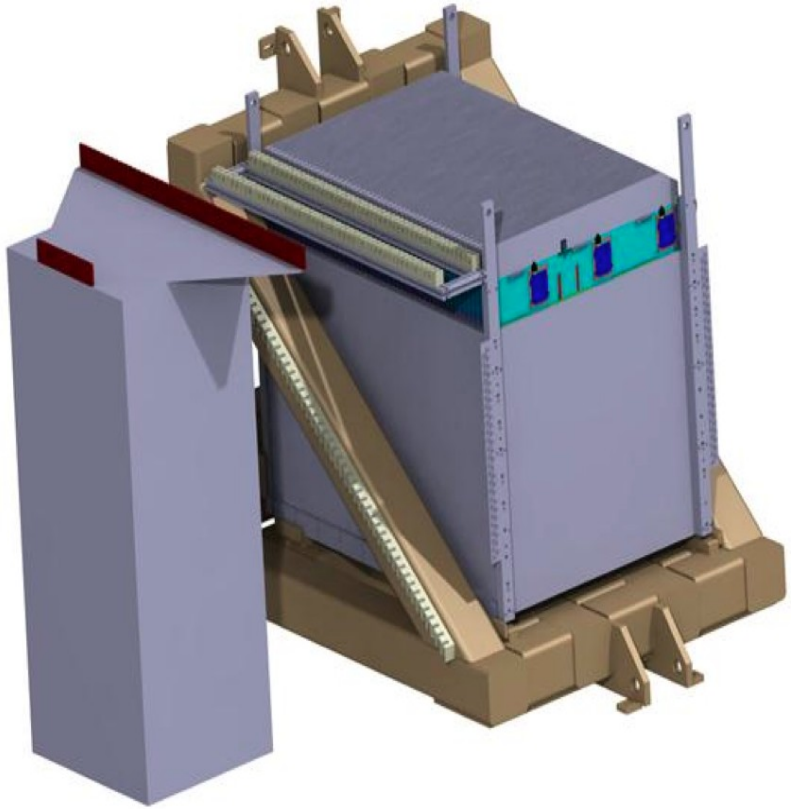
Objectives

We intend to validate the **SDHCAL concept** by building a prototype which is **as close as possible to the proposed SDHCAL for ILD to understand key issues of integration and operation :Technological prototype**

→ **Self-supporting mechanics**
→ **Minimized dead zone**
→ **Minimized thickness**
→ **One-side services**
→ **Power pulsed electronics**

The prototype will be made of 48 units. Each unit is made of :
2 cm absorber
+ **0.6 cm sensitive medium**
1 cm^2 transversal granularity

This is about **$6\lambda_I$**
and **442368** channels



Challenges

To build a **technological prototype** one needs:

1- Large detector ($1m^2$) with almost no dead zones :

2- Large and thin embedded electronics board

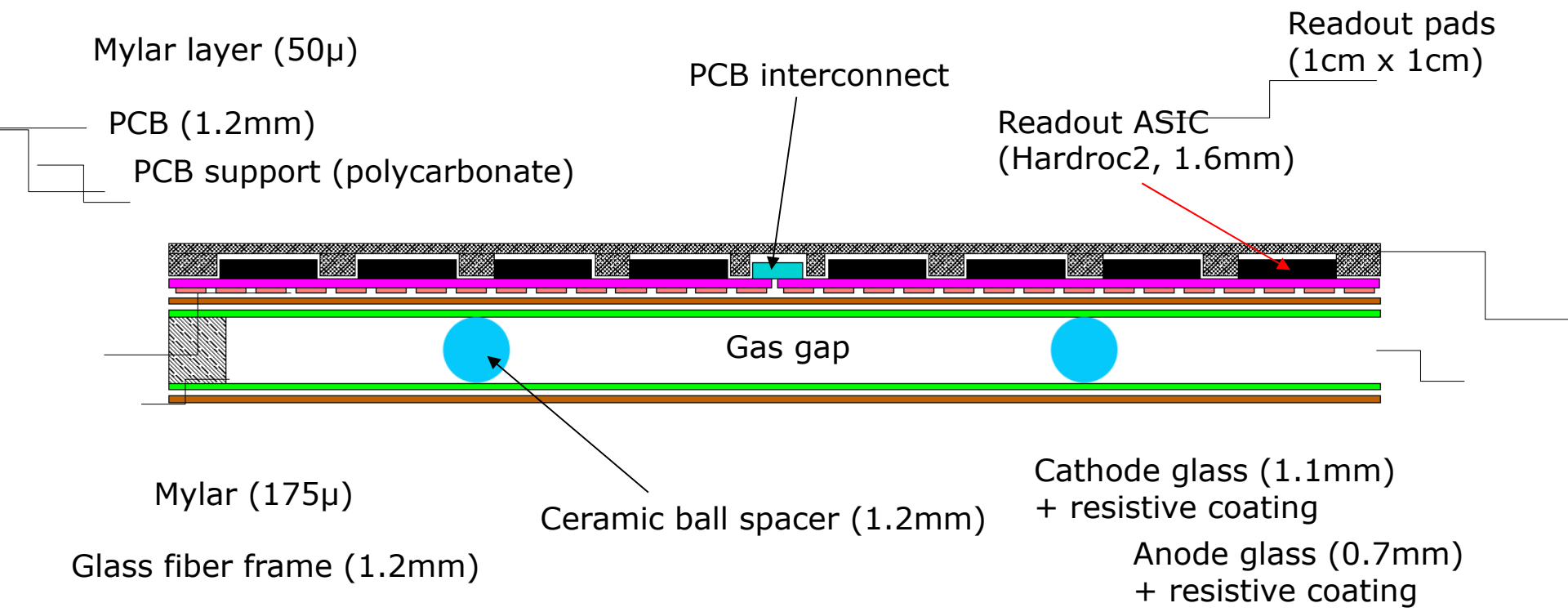
4- One-side services : readout, gas outlets..

5- Self-supporting mechanical structure

6- Power-pulsed, 2-bit electronics

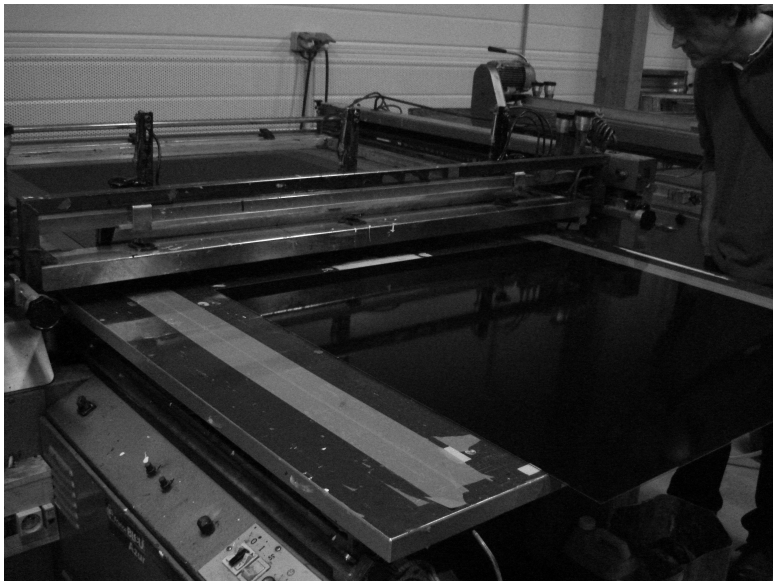
7- New generation of DAQ system

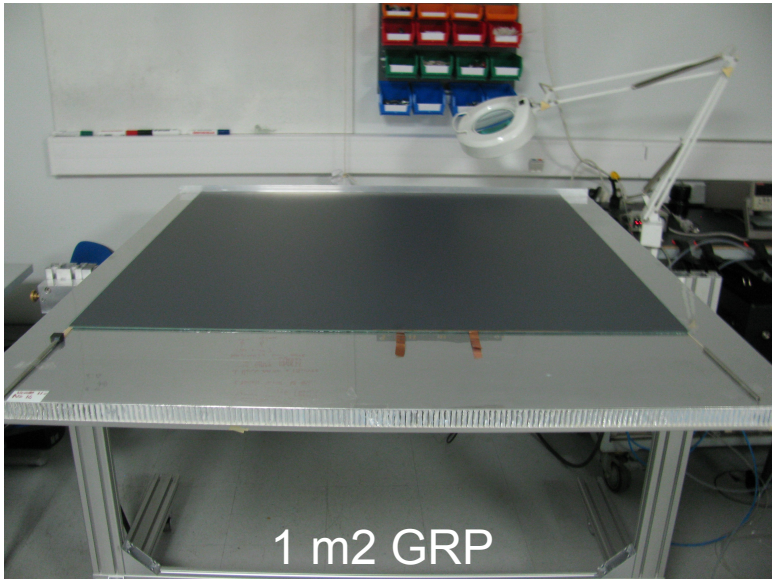
Cross-section of Lyon 1m^2 glass RPCs

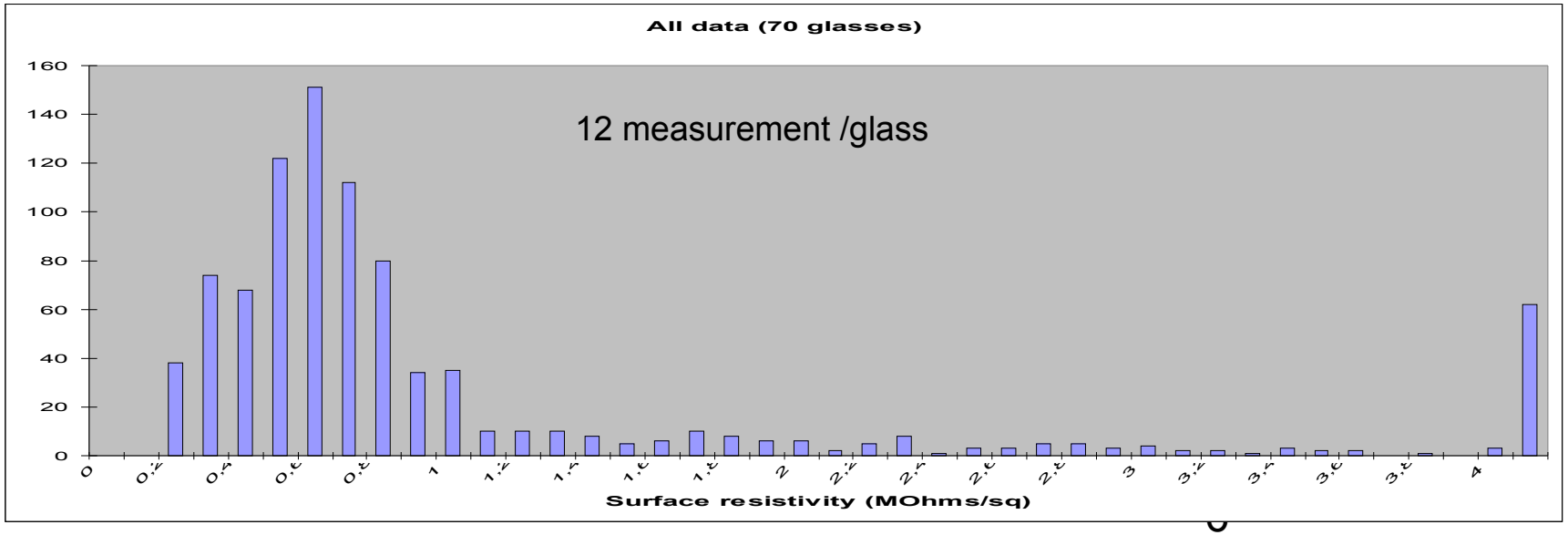


Total thickness: 6.0mm

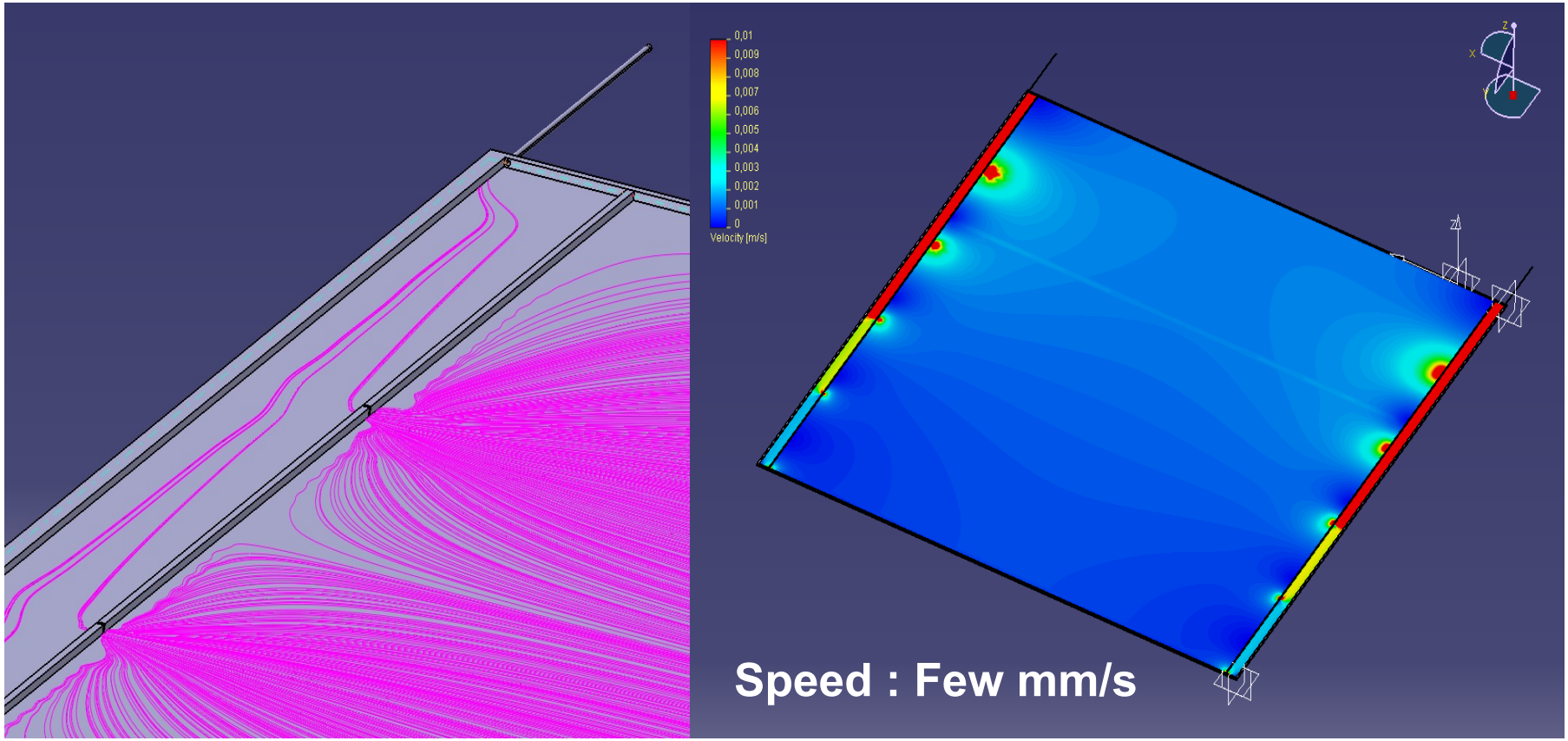
The choice of ceramic balls rather than fishing lines aims at reducing both dead zones and noise.




1 m2 GRP

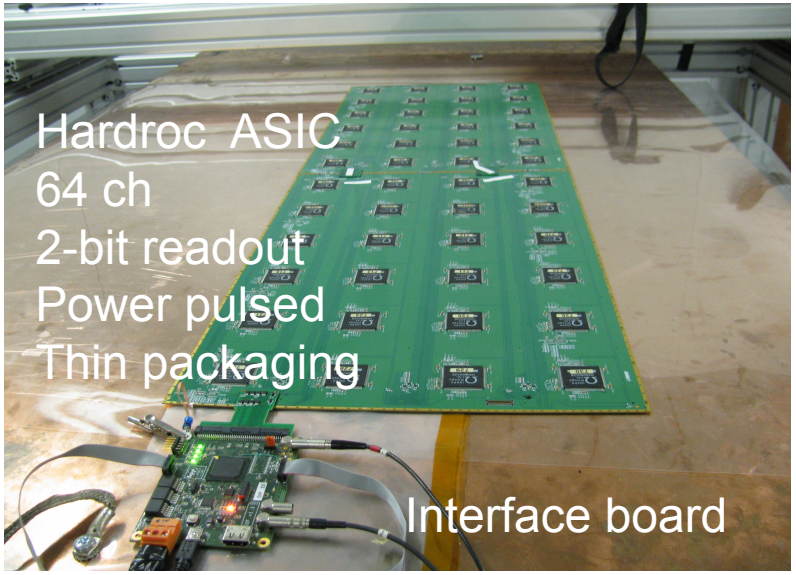

All data (70 glasses)
12 measurement /glass
160
140
120
100
80
60
40
20
0
Surface resistivity (MOhms/sq)

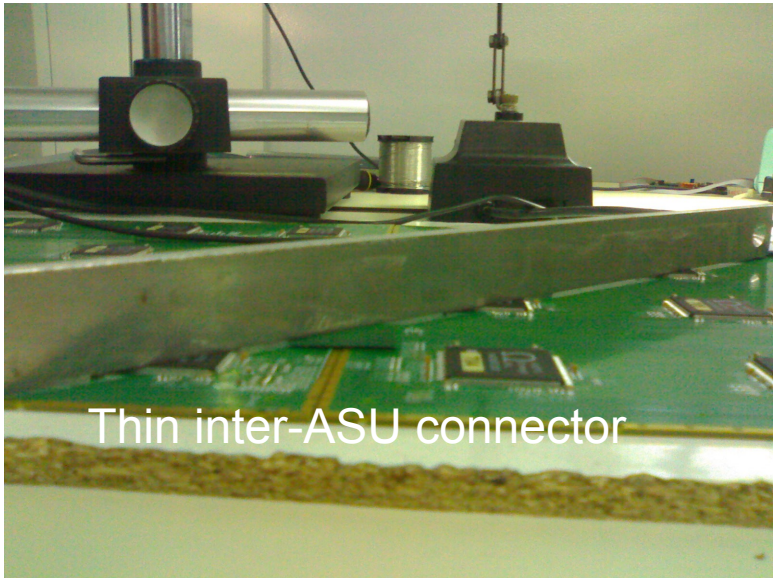
Gas circulation system was conceived and checked with sophisticated simulation tools with the aim to reduce gas consumption and to guarantee a well distributed gas

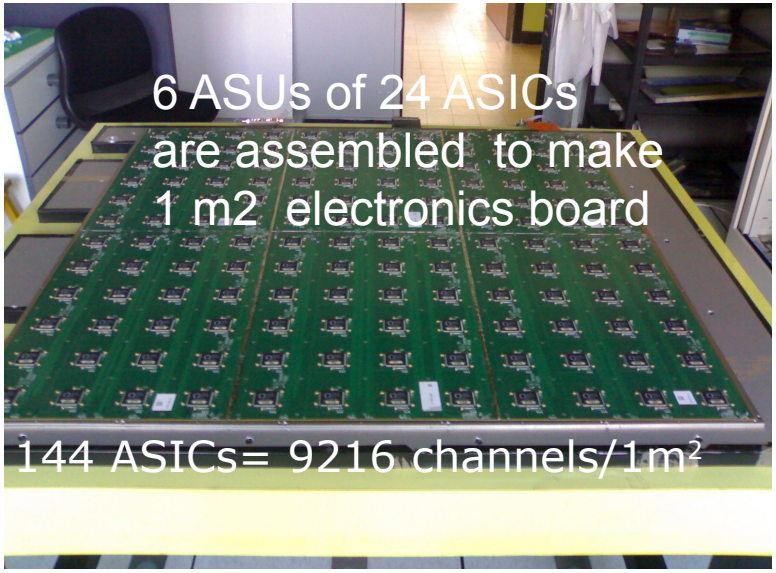


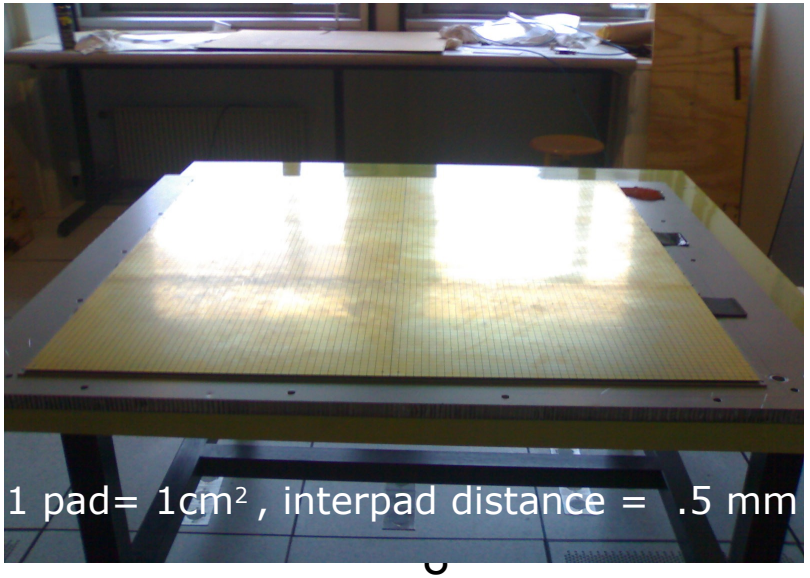
When diffusion is included→ Homogeneity is even better

Final version of electronics using new generation of connectors





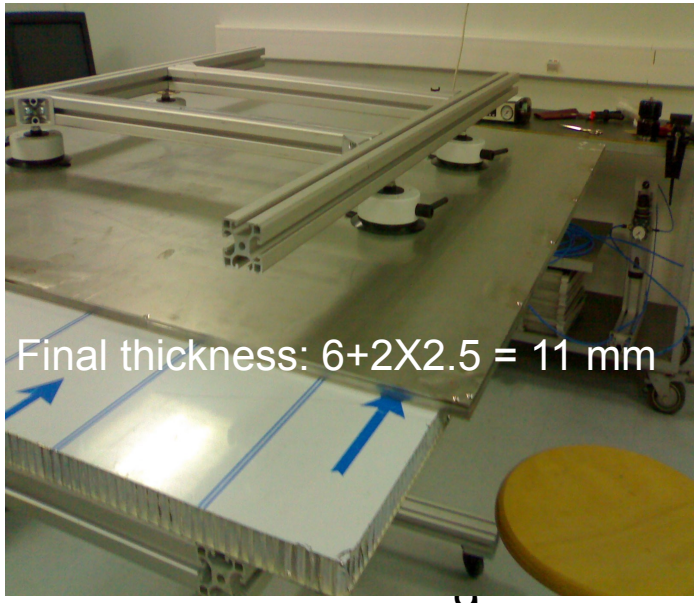




Cassette construction

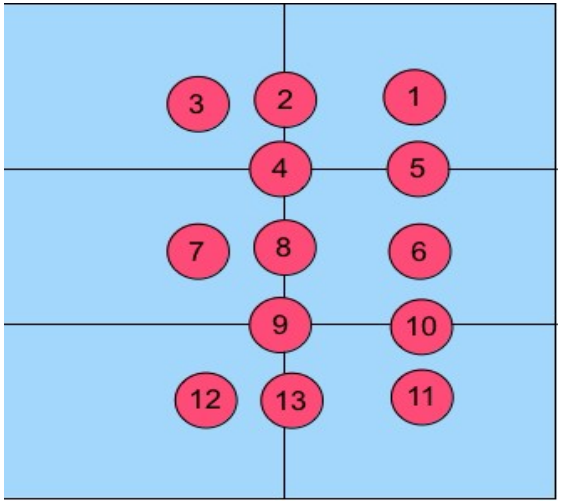
-The 1m2 electronics board is fixed on 2.5 mm thick stainless steel plate using 1.6 mm screws (4X6)
-The detector is cast into pool made of 2.5 mm thick stainless steel plate and 6X6 mm2 section stainless steel bars
- A mylar foil of 175 mm separates the detector from the plates and the walls
-The electronics plate is then fixed on the detector plate using 3 mm screws
-Detector InterFace (DIF) boards are also fixed on the detector plate

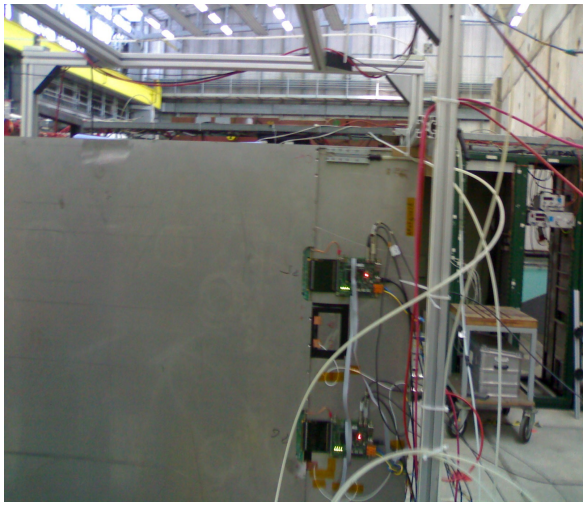
This scheme allows to replace the GRPC detector by another one of the same dimensions

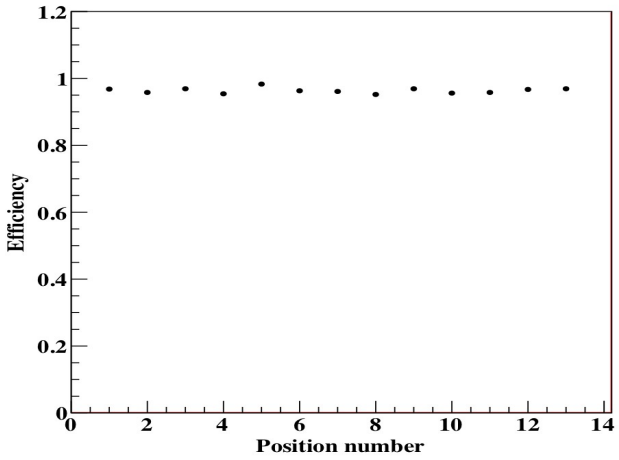


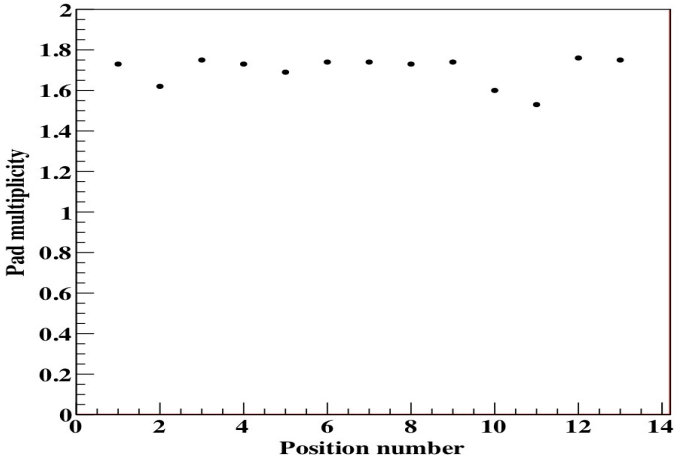
TestBeam Validation

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







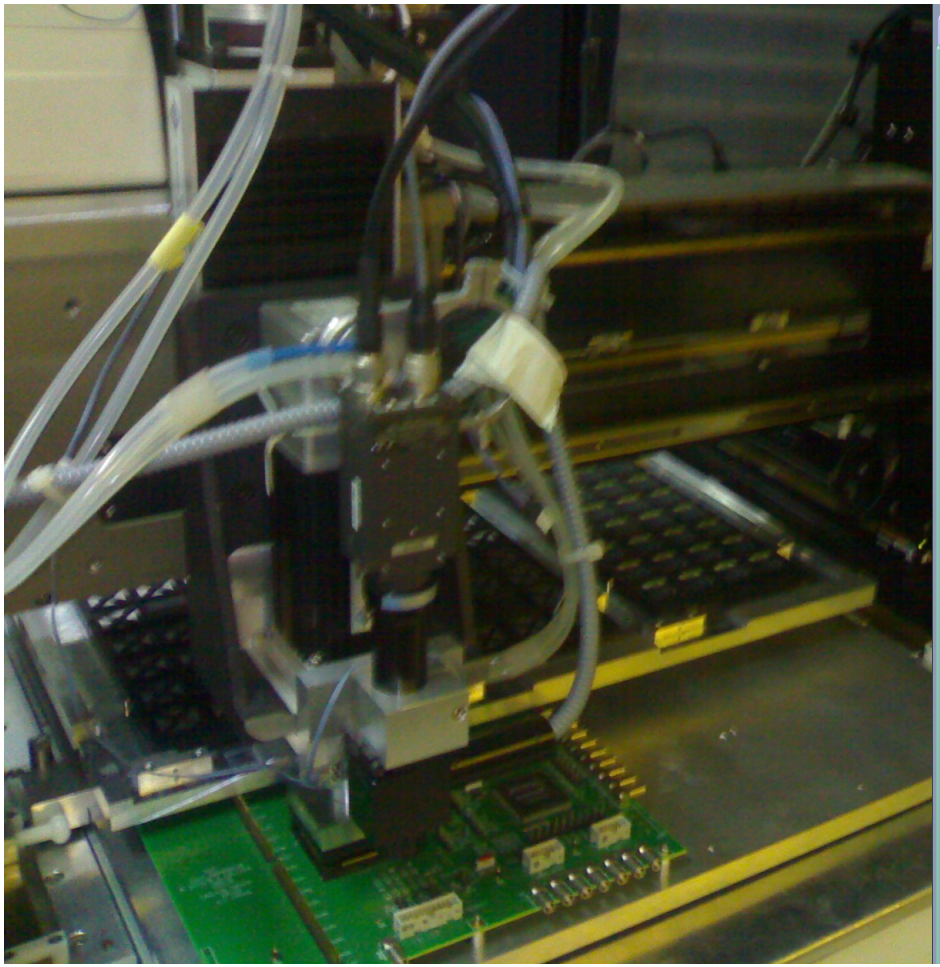


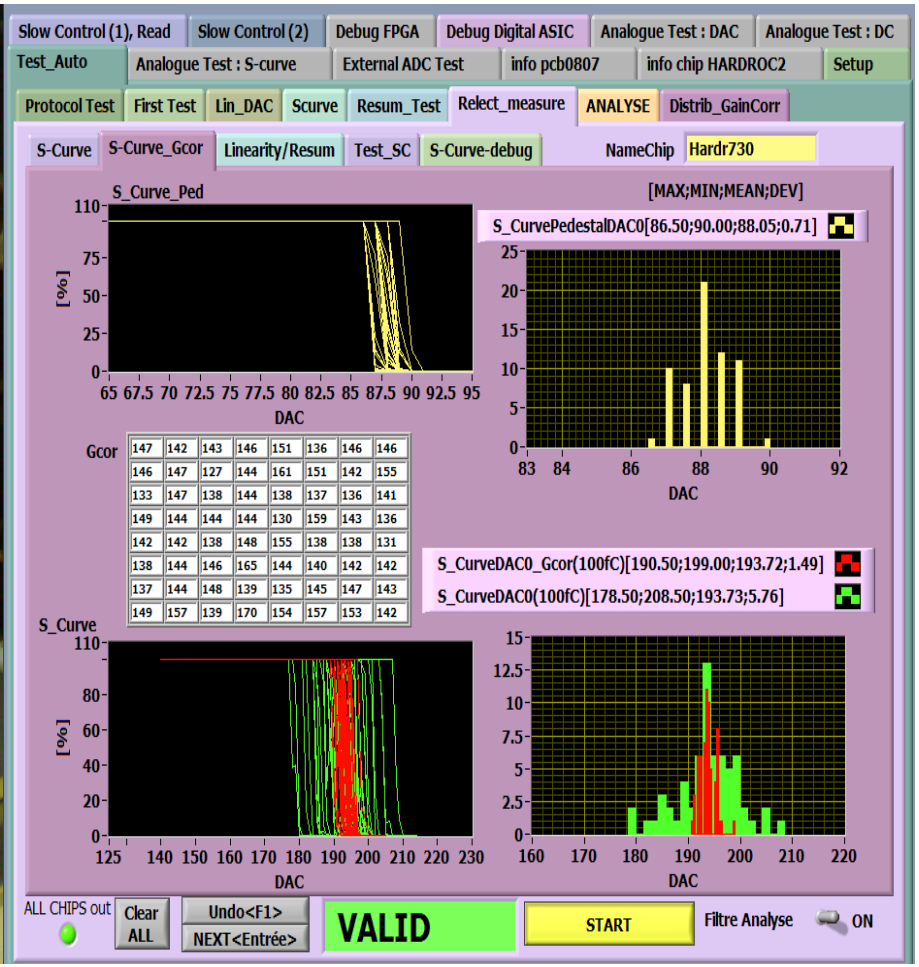
Electonics: ASICs stand test

A robot was used to test the 10500 ASICs

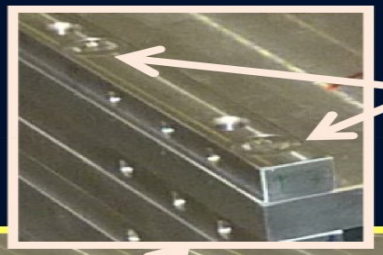
The procedure allows to select the good ASICs and calibrate them

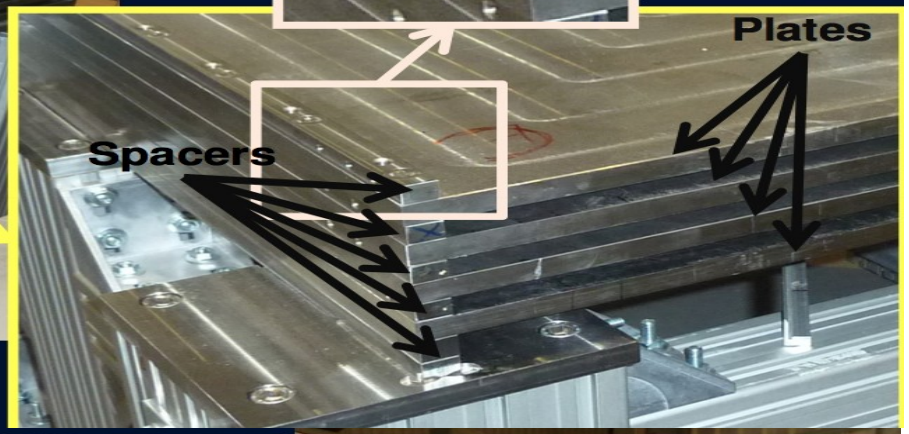
Yield 93%





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

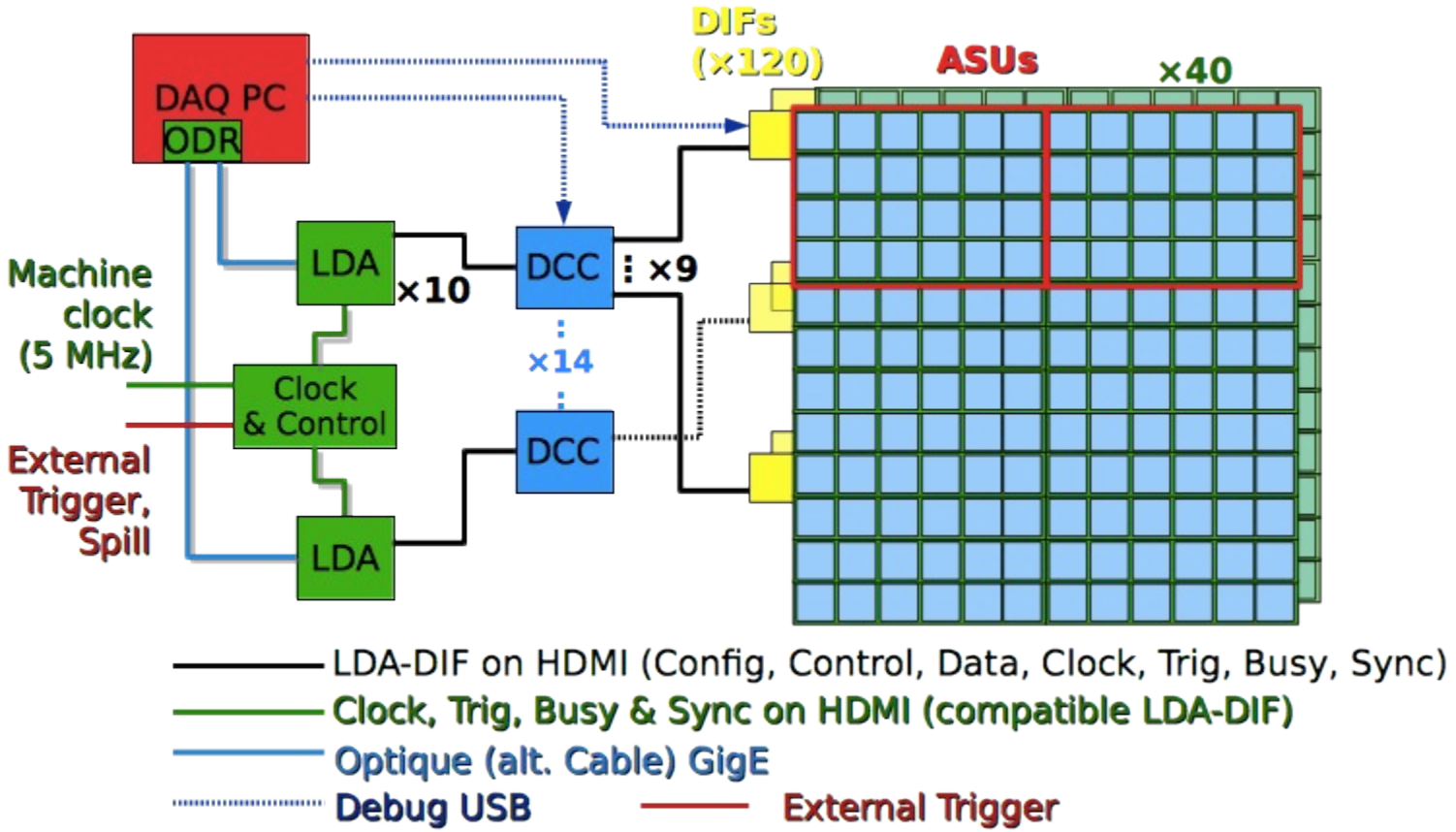

Bolts


Plates
Spacers

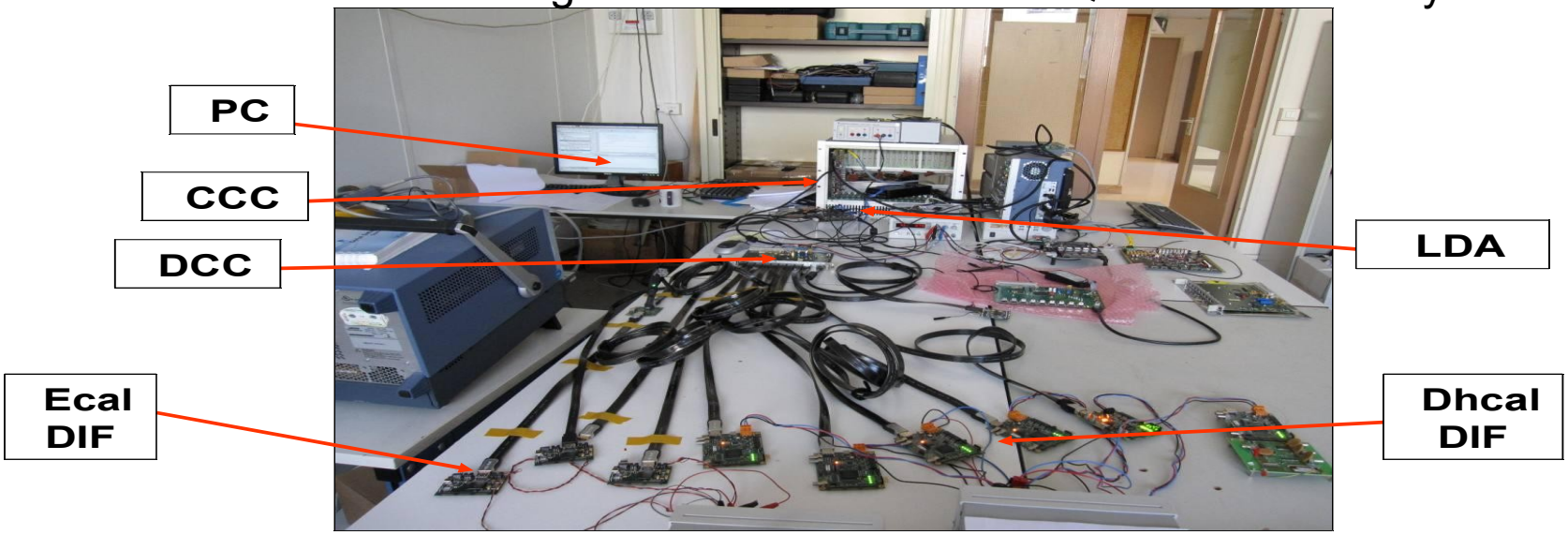

Planarity Verification

Acquisition system

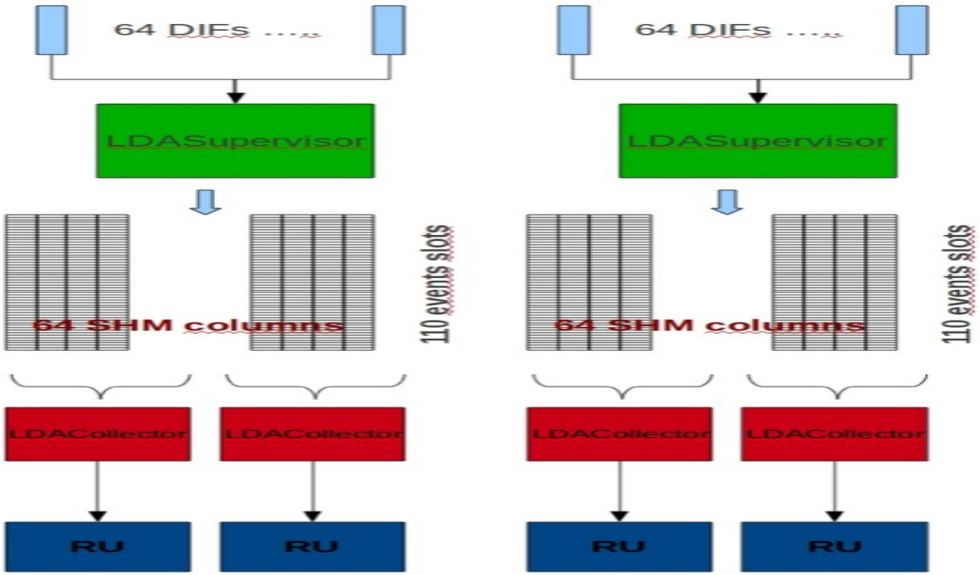
An acquisition system developed within CALICE collaboration will be used



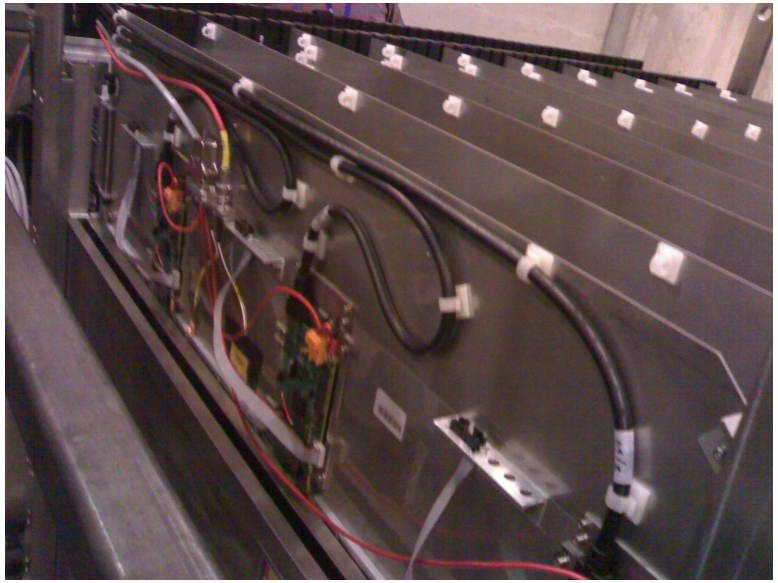
The full chain of the new generation of CALICE DAQ was successfully tested

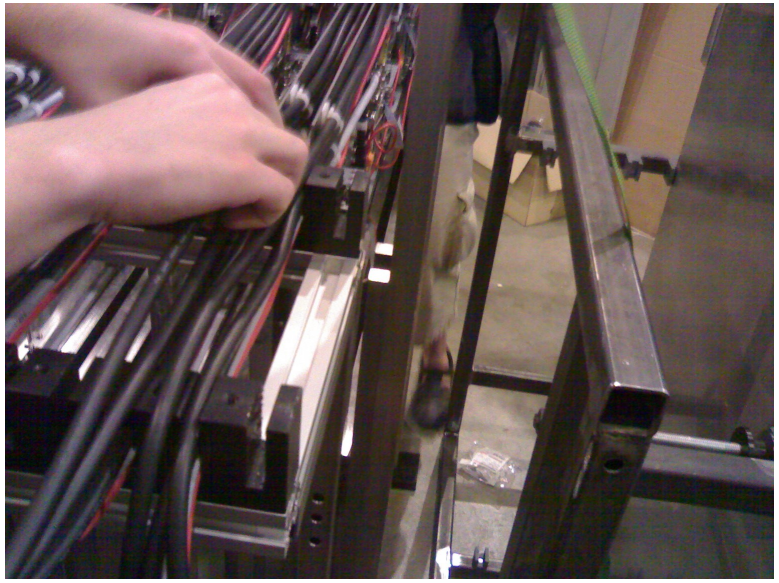


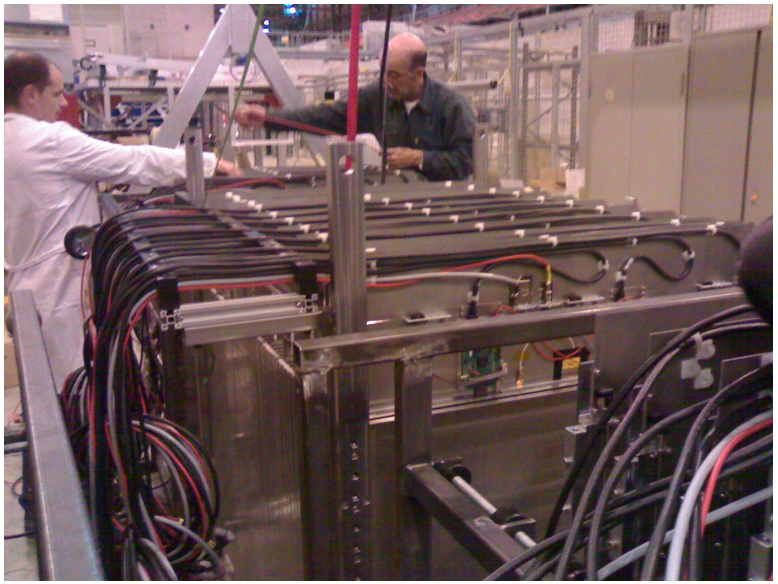
Software based on the Xdaq of CMS tracker is used :



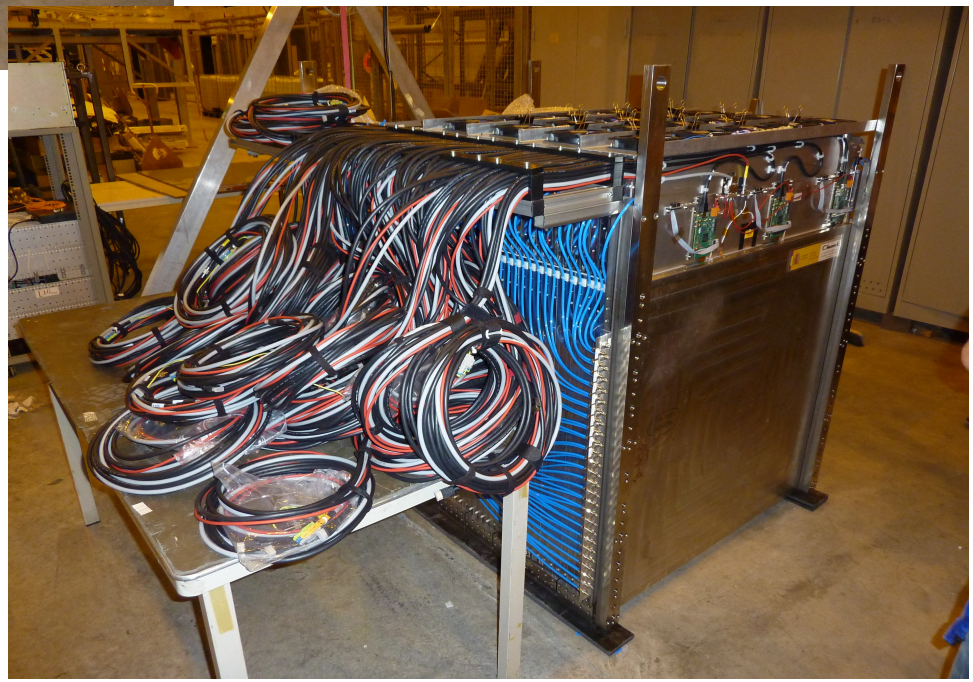
Cassettes insertion in the mechanical structure at CERN







40 cassettes will be inserted before June 17th



Conclusion

-The Construction of the SDHCAL technological prototype is almost completed.

-This is the result of 4 years of R&D followed by a successful campaign of TB of the large GRPCs equipped with the new generation of the readout electronics.

- A self-supporting mechanical structure is built.

- The new generation of DAQ is ready and the software is being finalized.

- The prototype is to take data next week.....

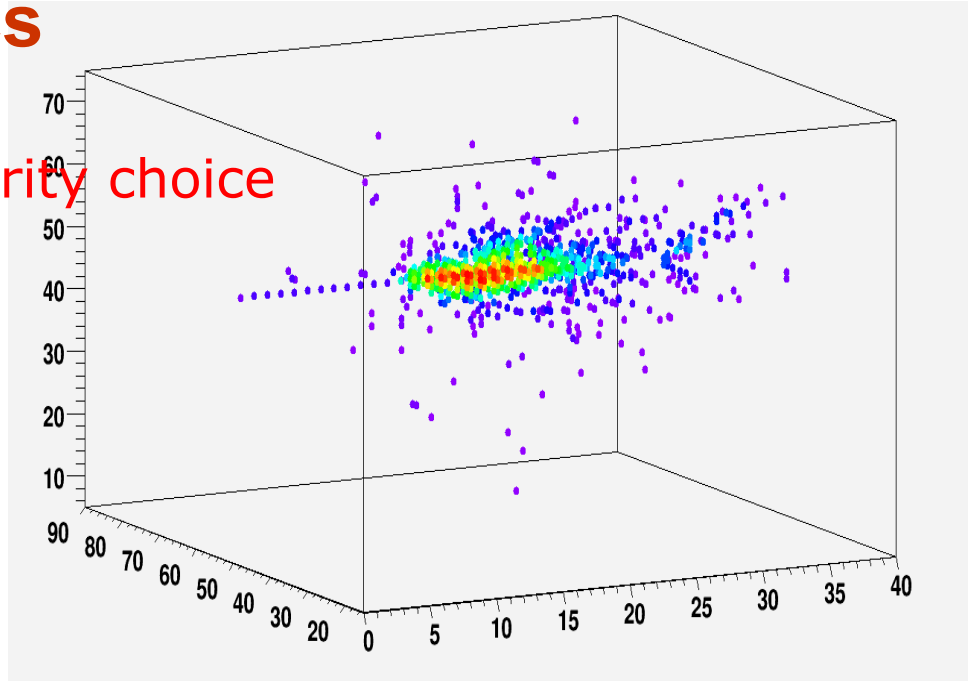
2-bit Readout Electronics

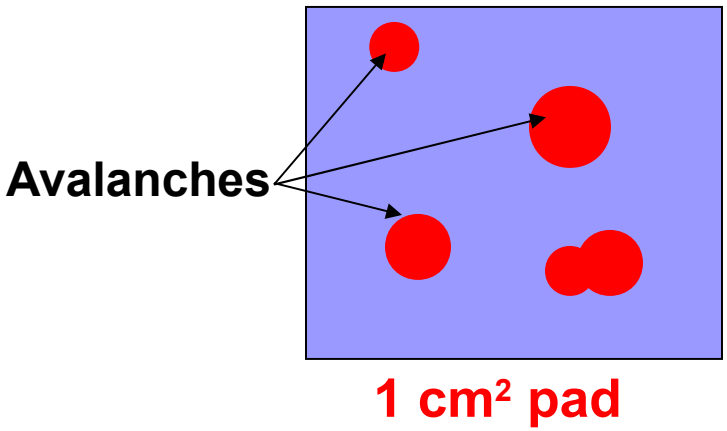
Electronics readout and granularity choice

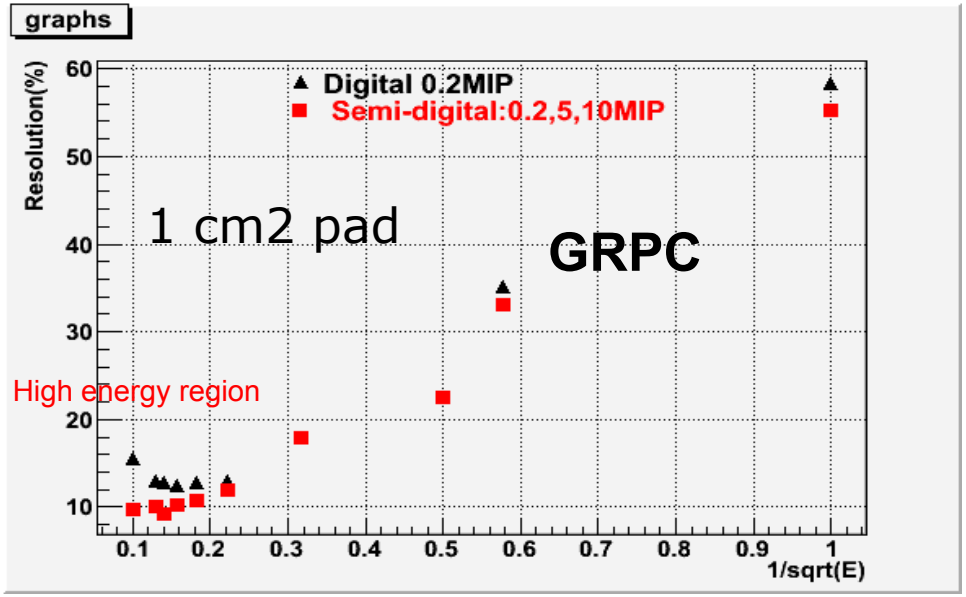
At high energy the shower core is very dense (up to 50 pc/cm^2)

- → simple binary readout will suffer saturation effect
- → semi-digital readout (2-bit) can improve the energy resolution at high energy

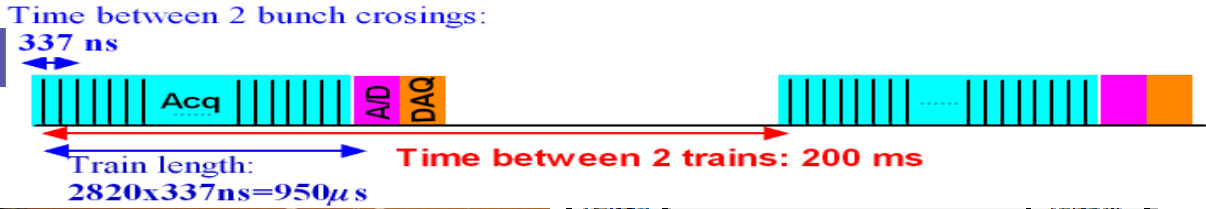
By improving counting capability

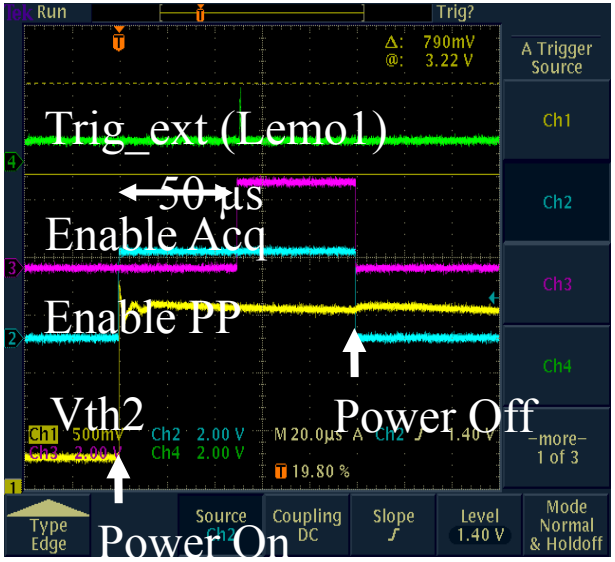


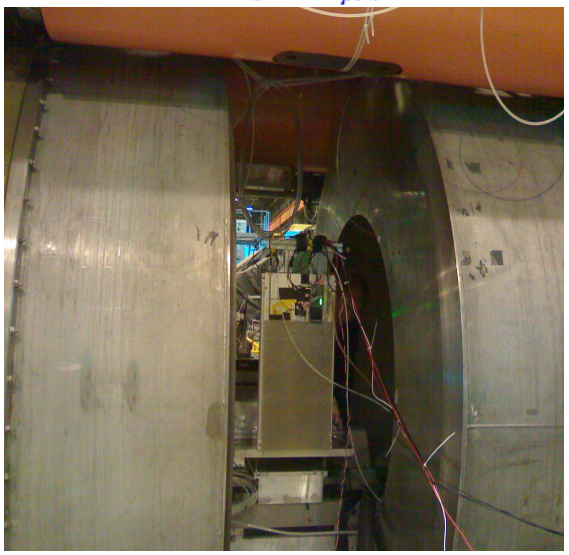


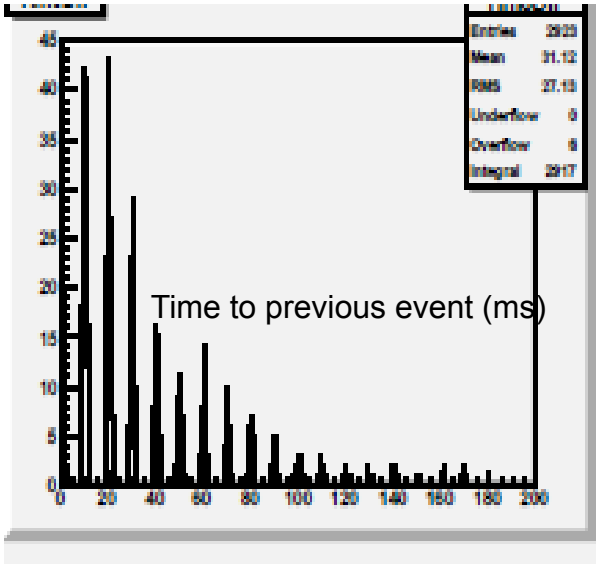


Power-pulsing test









PP is on during 2 ms every 10 ms rather than every 200 ms for ILC