

Semi-Digital Hadronic CALorimeter Technological prototype

I.Laktineh

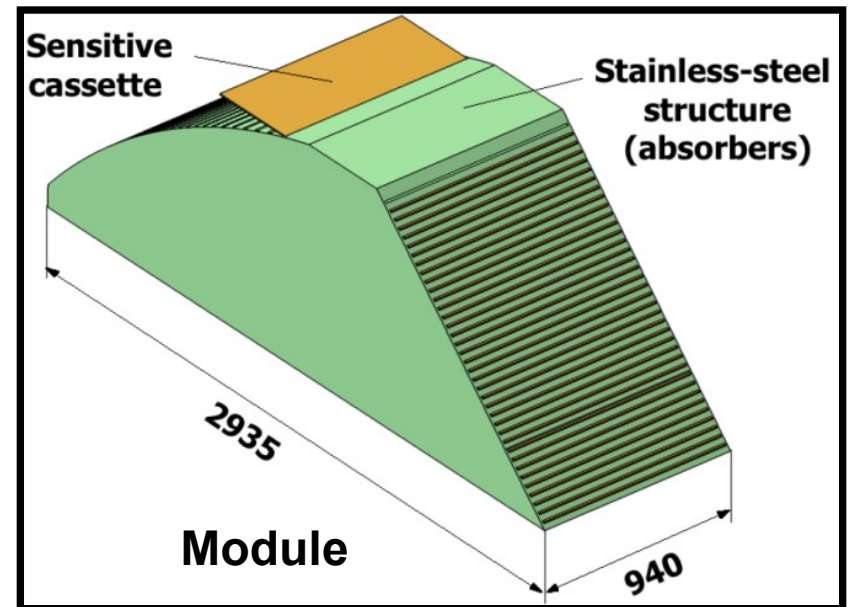
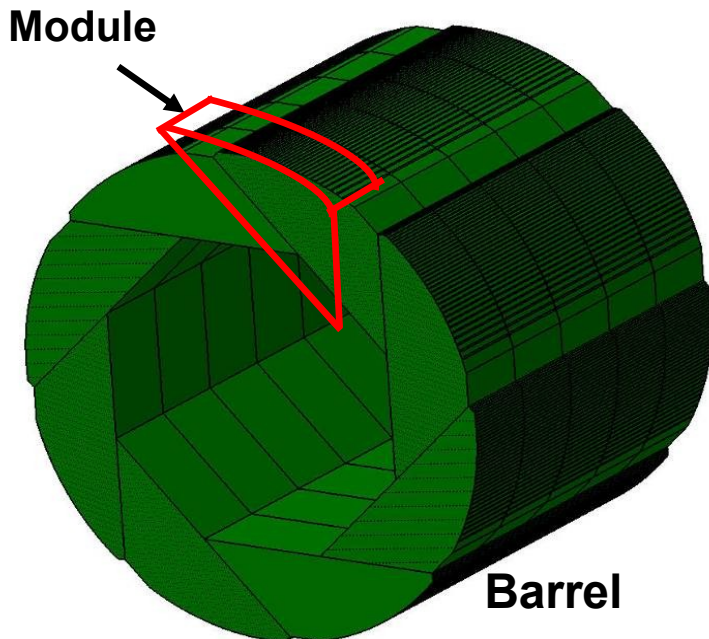
CIEMAT, Gent, IPNL, LAL, LAPP, LLN, LLR, LPC, Protvino, Tsinghua, Tunis

Objectives

The Semi-digital GRPC-based HCAL was proposed and accepted as one of the two HCAL possible options in the **ILD Letter Of Intent**

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

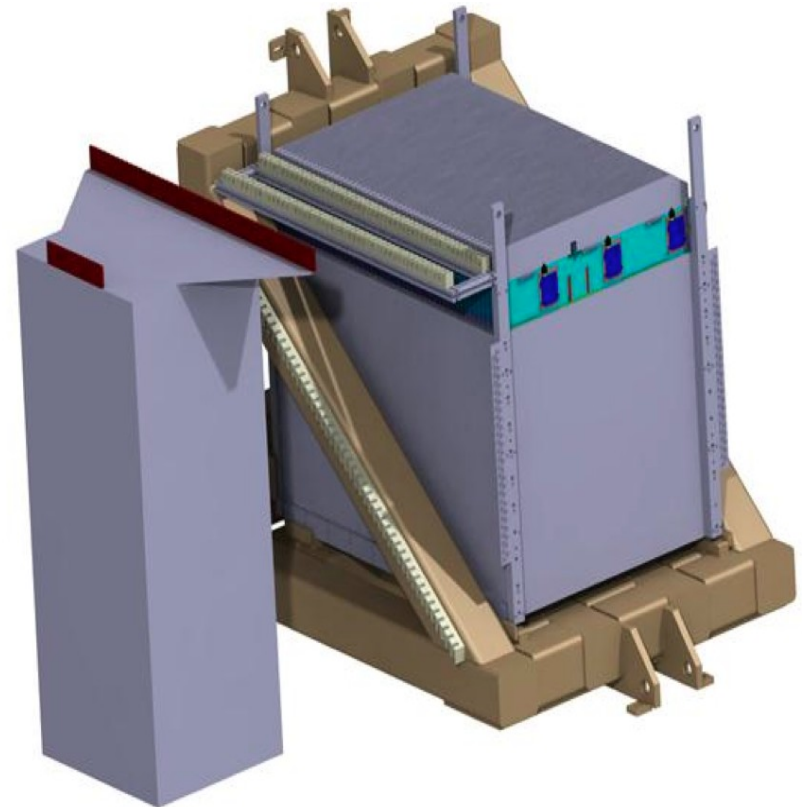
We intend to validate the **SDHCAL** concept by building a prototype which is **as close as possible** to the proposed **SDHCAL for ILD** to understand key issues of integration and operation :**Technological prototype**

- **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 cm² transversal granularity

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



Realizations

To build a **technological prototype** we achieved the following :

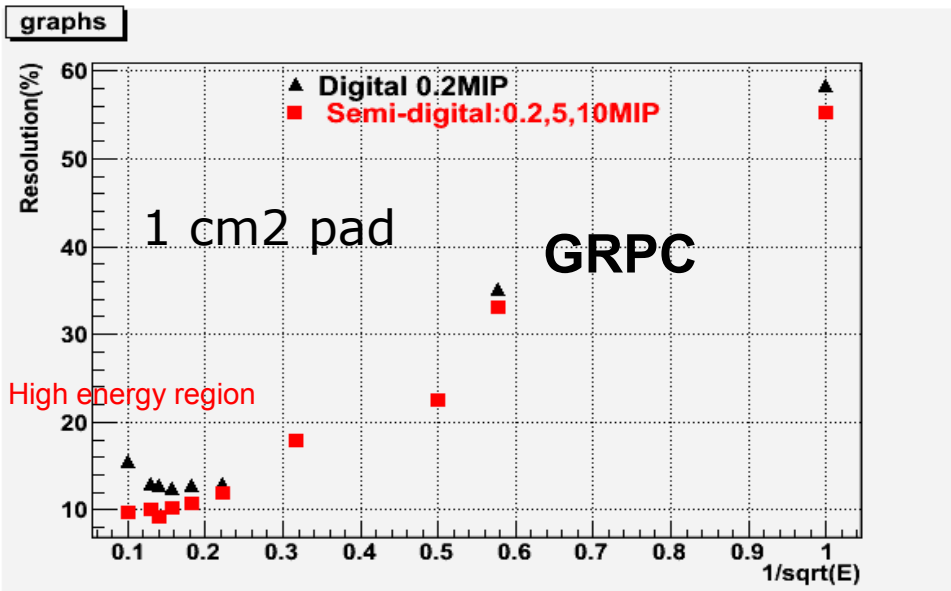
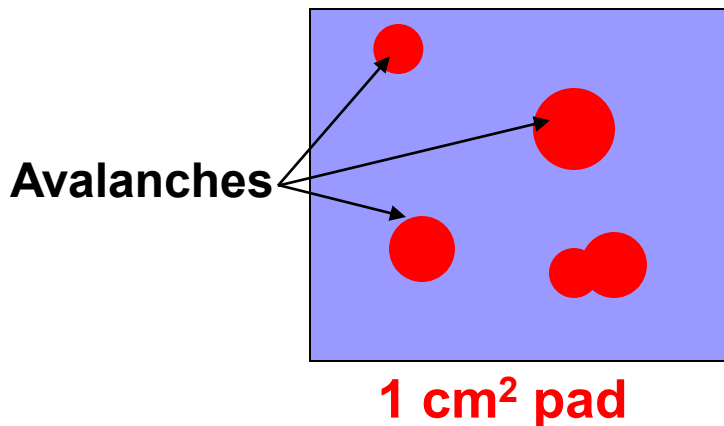
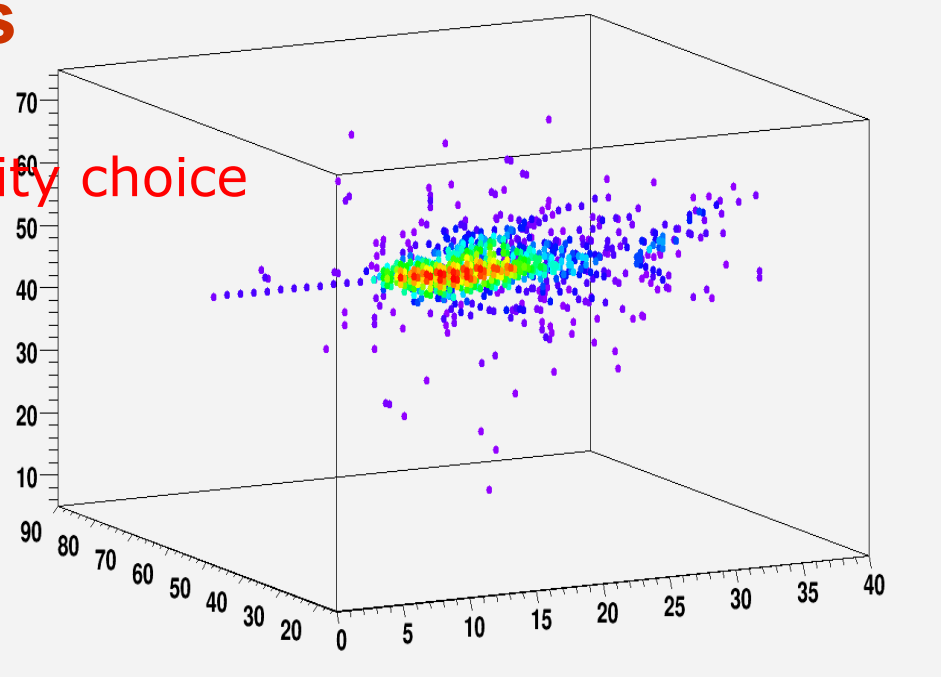
- 1- Large detector (1m²) with almost **no dead zones** :
- 2- **Large** and **thin embedded** electronics board
- 4- **One-side services** : readout, gas outlets..
- 5- **Self-supporting** mechanical structure
- 6- **Power-pulsed, 2-bit** electronics
- 7- New generation of **DAQ** system

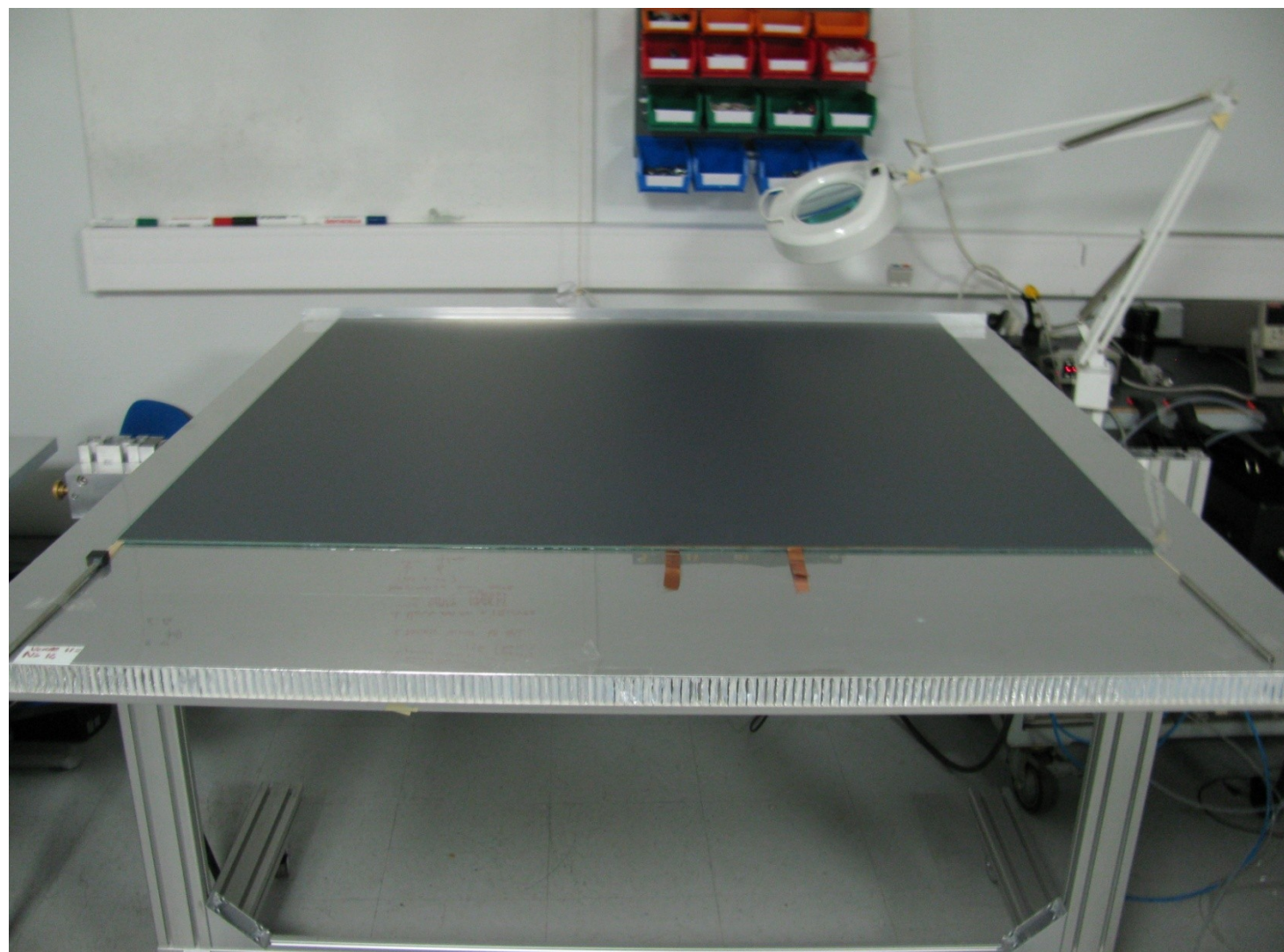
2-bit Readout Electronics

Electronics readout and granularity choice

At high energy the shower core is very dense (up to 50 pc/cm²)

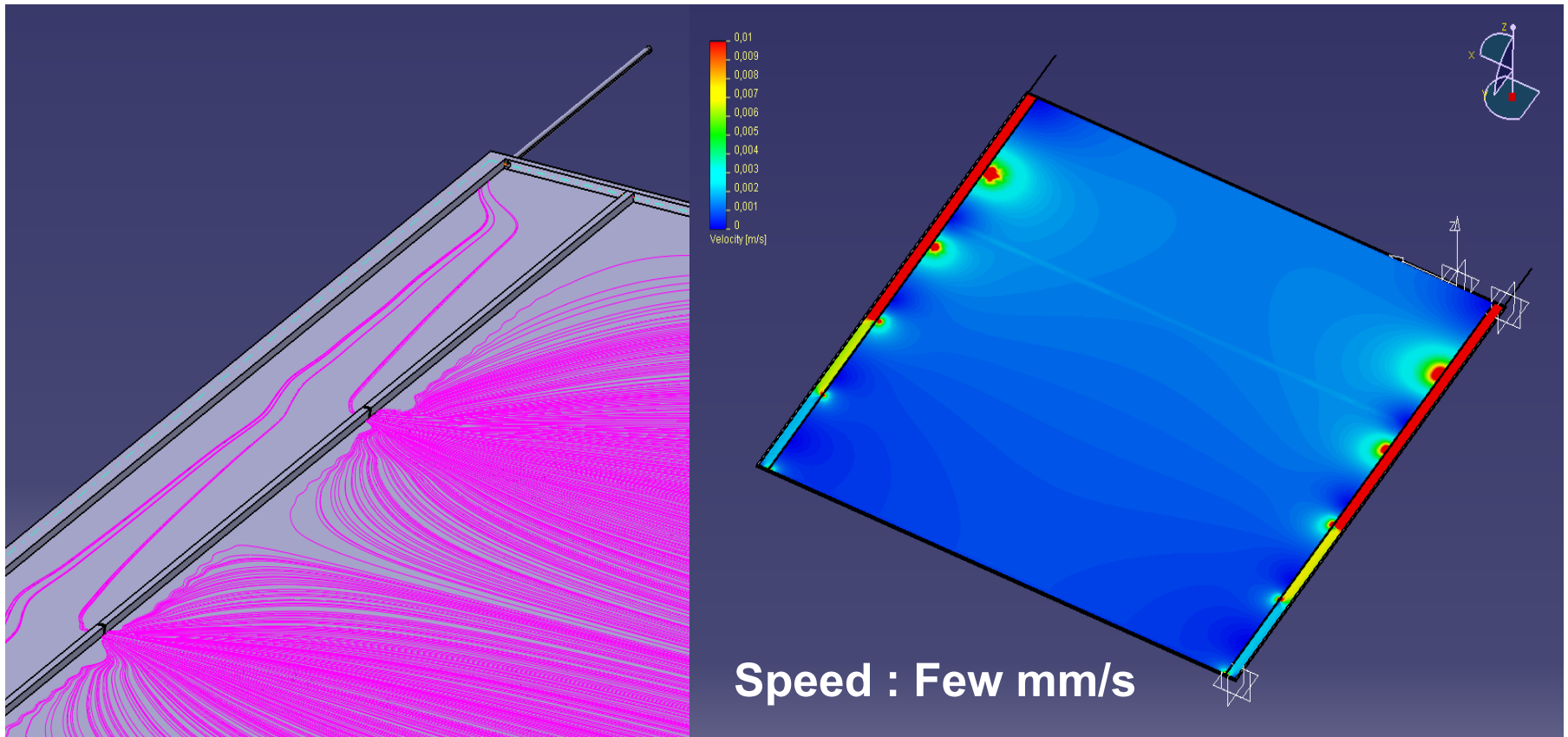
- simple binary readout will suffer saturation effect
 - semi-digital readout (2-bit) can improve the energy resolution at high energy
- By improving counting capability





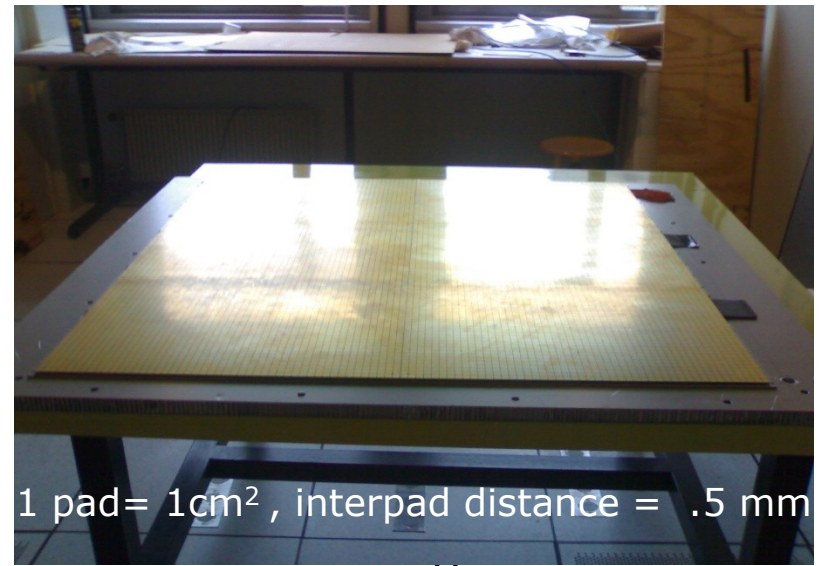
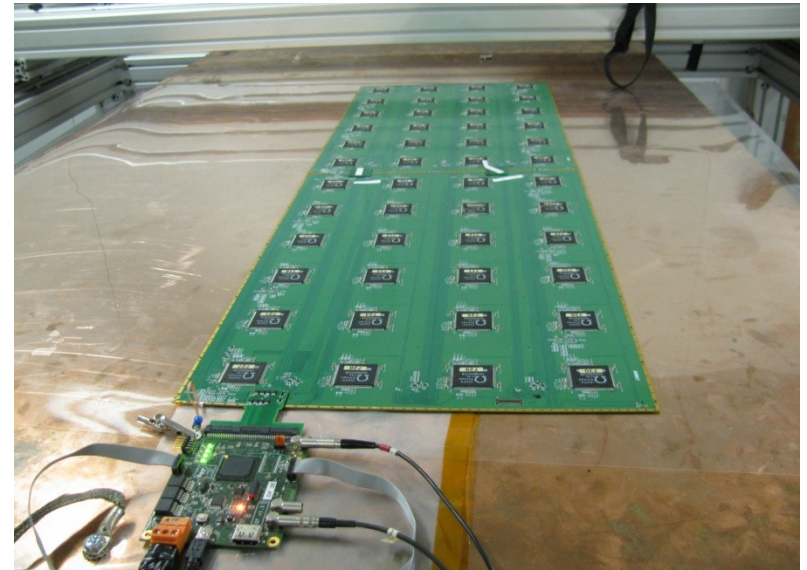
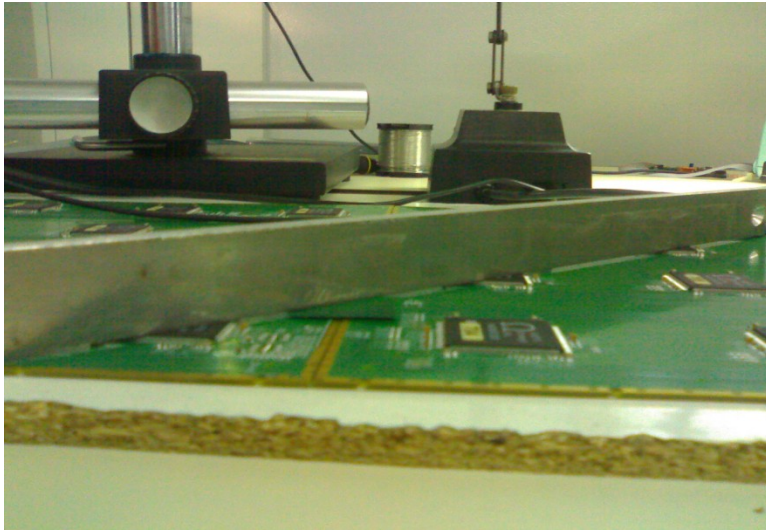
1m2 GRPC

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

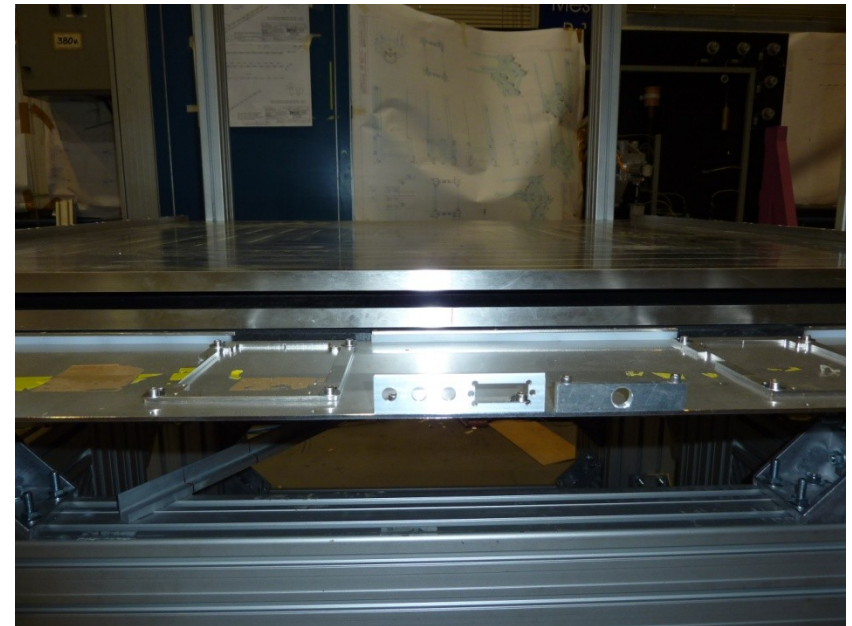
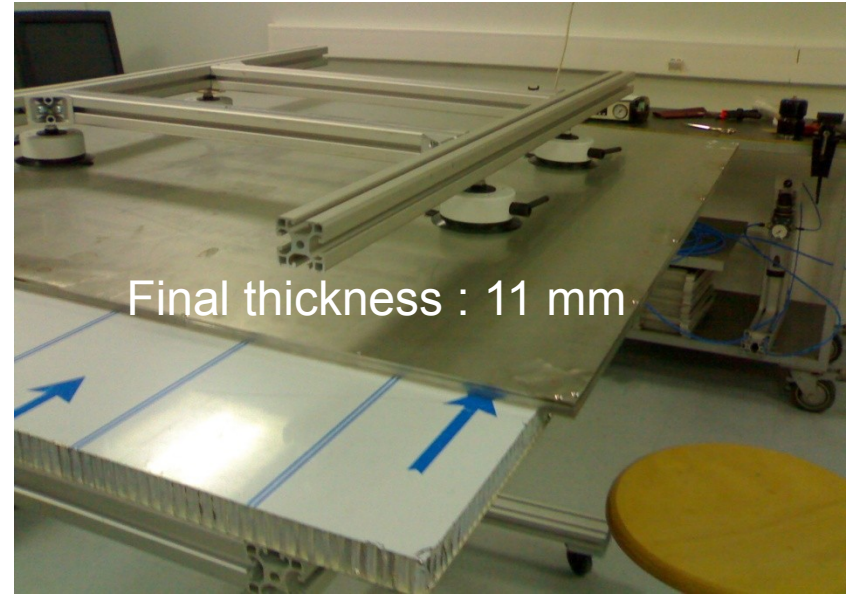


When **diffusion** is included → Homogeneity is even better

Final version of electronics using new generation of connectors



Assembling procedure

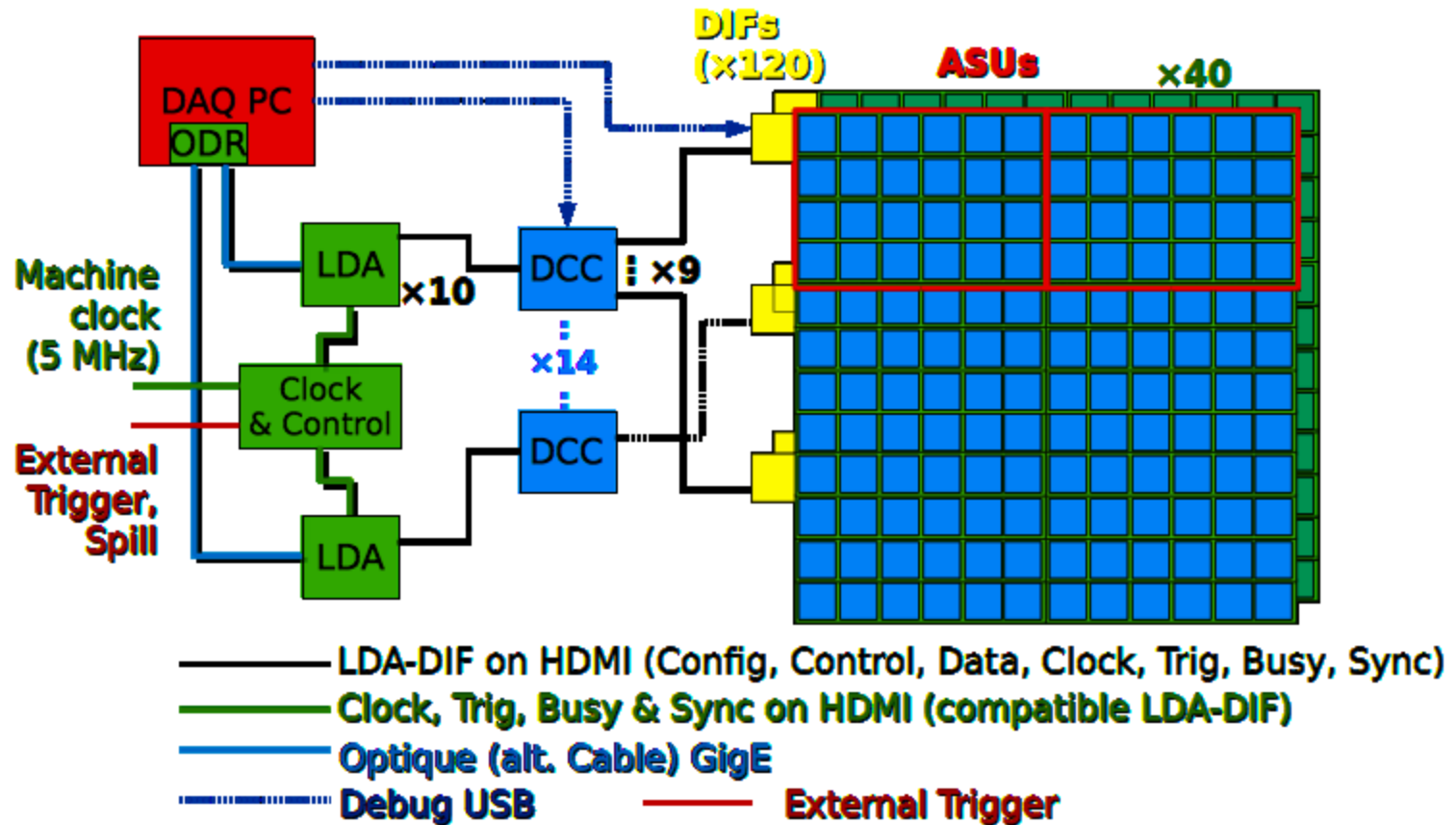




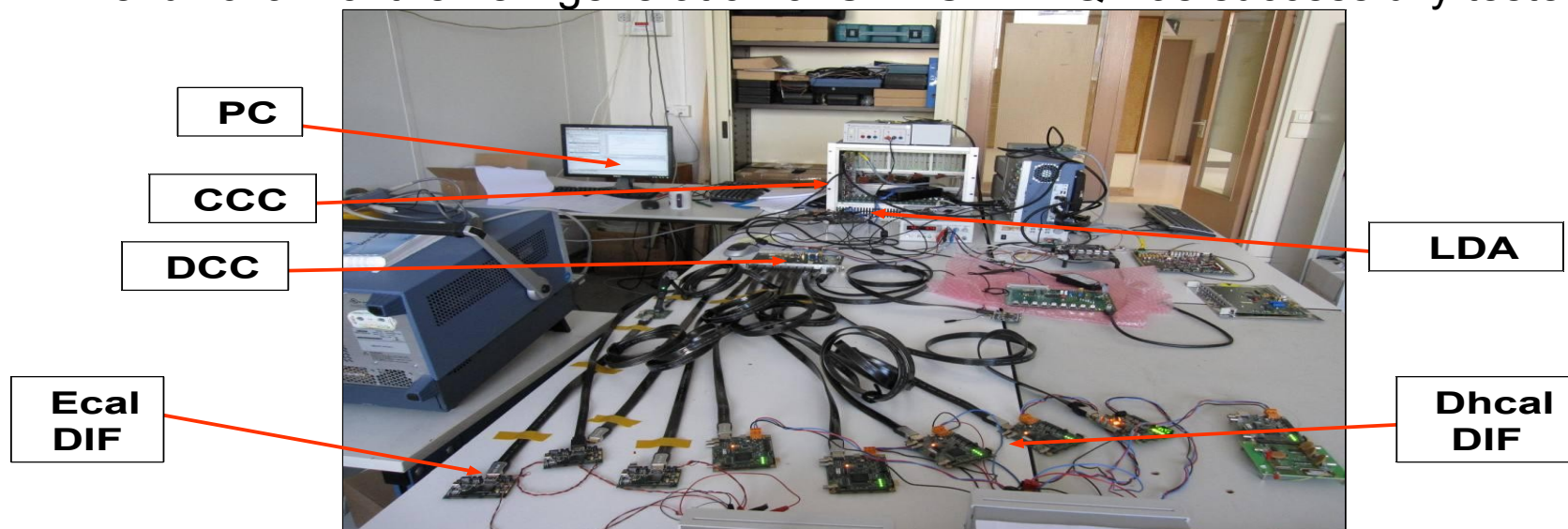
Cassette and GRPCs are being built and assembled

Acquisition system

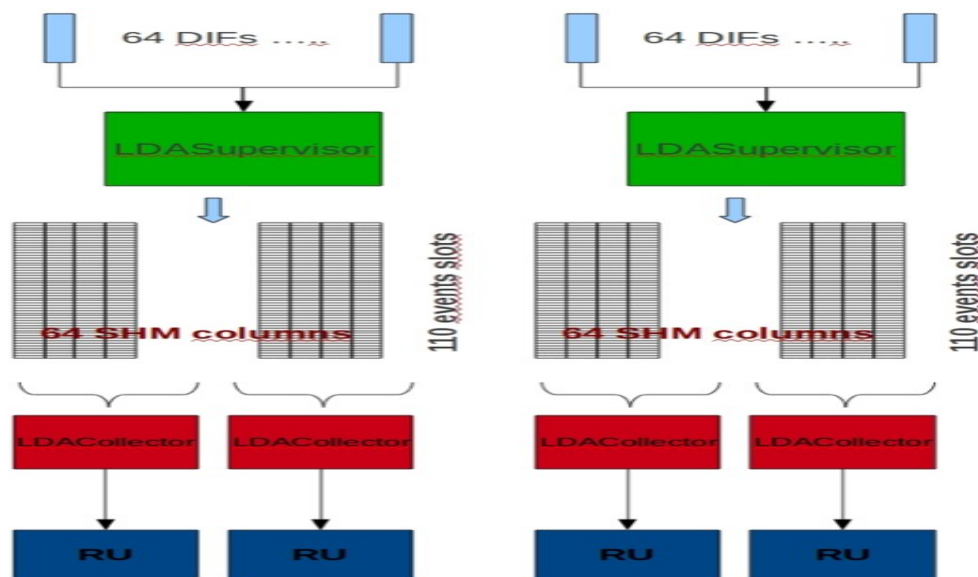
An acquisition system developed within CALICE collaboration will be used



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



Software based on the Xdaq of CMS tracker is used :

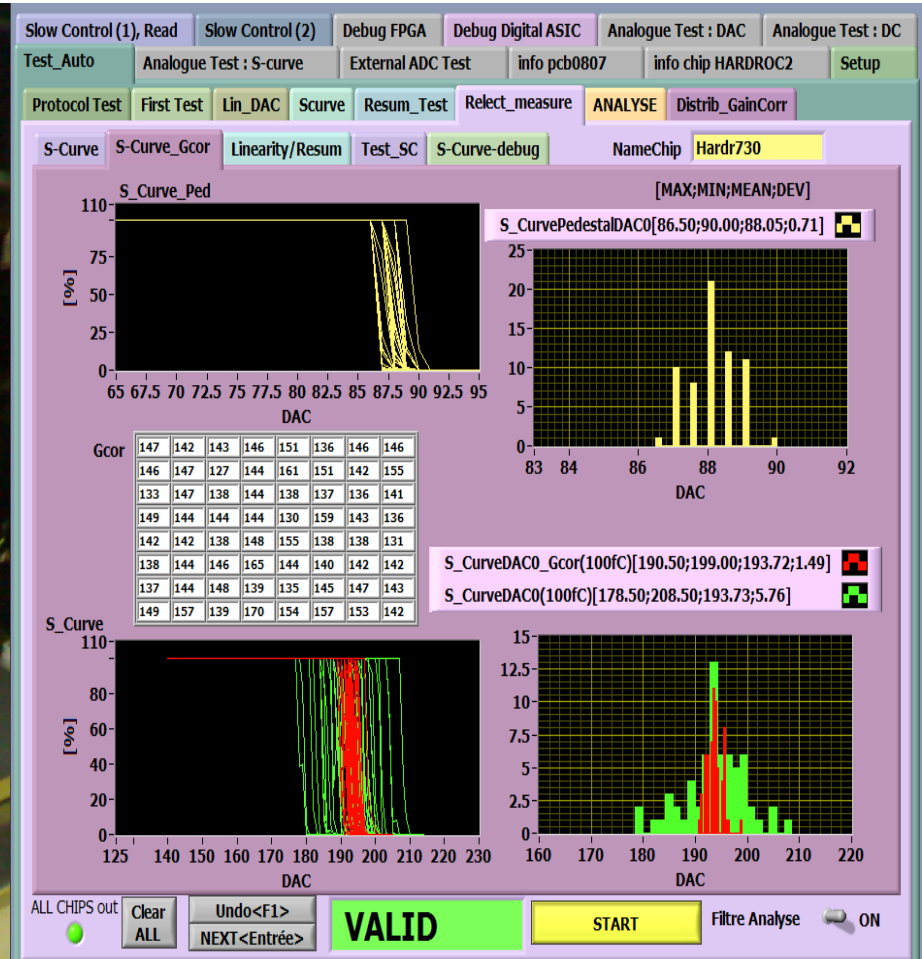
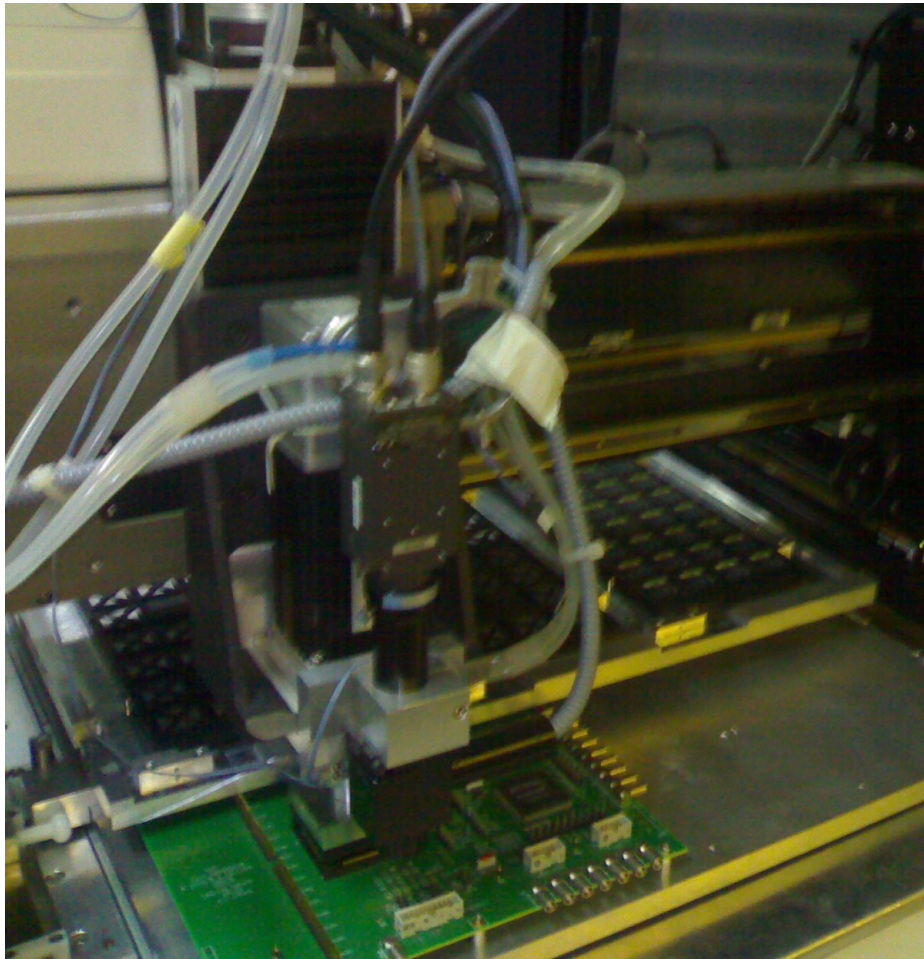


Electronics: ASICs stand test

A robot was used to test the 10500 ASICs

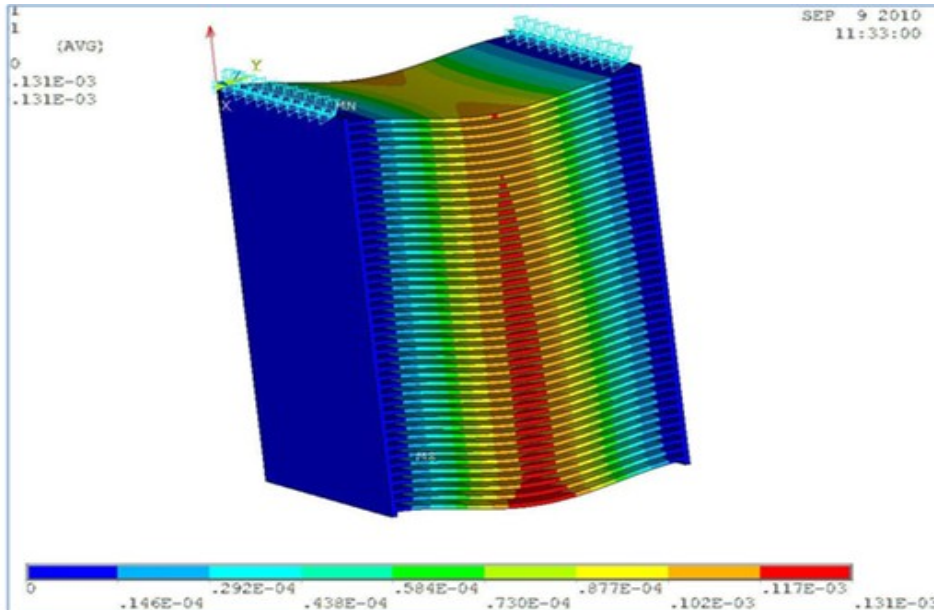
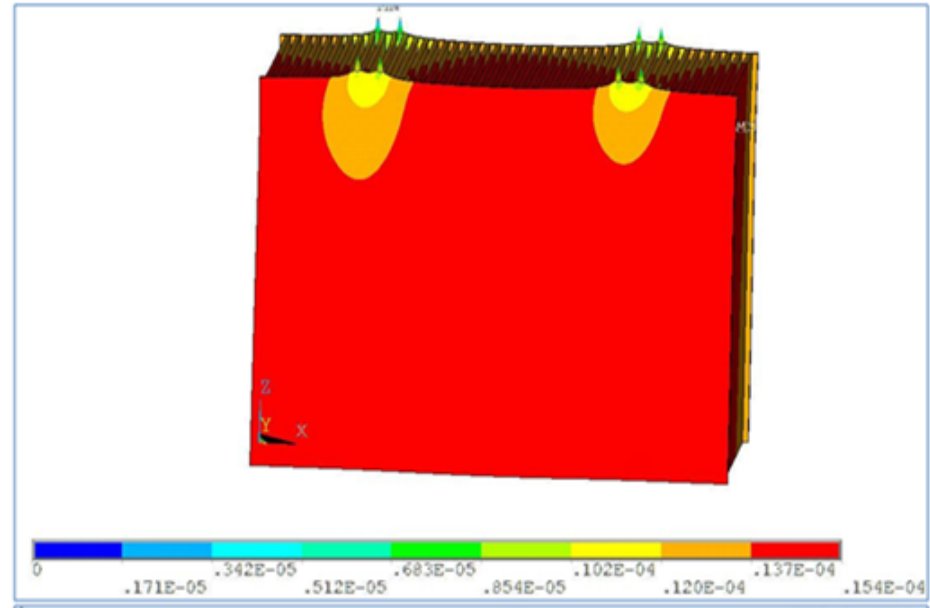
The procedure allows to select the good ASICs and calibrate them

Yield 93%



Detailed mechanical deformation study was performed in different Configurations of the prototype.

Maximum deformation was found To occur during manipulation (rotation, transport) but still with no effect on the cassettes.

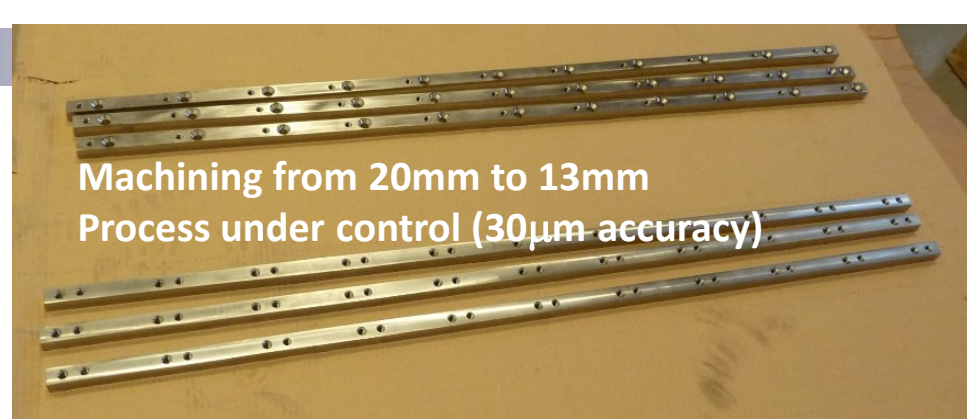


A rotation tool will allow to use the prototype to study cosmic rays... tests will be conducted during assembling to check this possibility.

CIEMAT Workshop



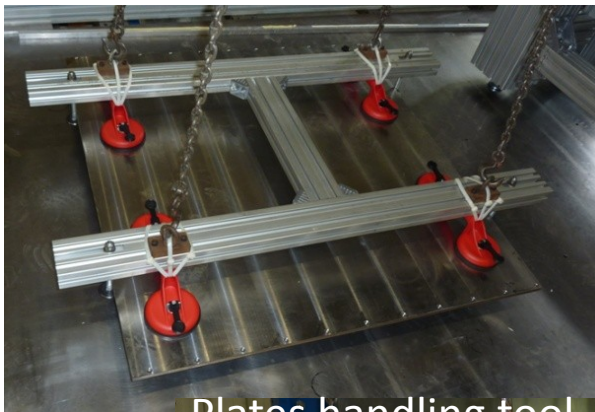
Spacer



Machining from 20mm to 13mm
Process under control (30 μ m accuracy)

Absorbers assembled together using lateral **spacers** fixed to the absorbers through bolts.

Assembling the mechanical structure



Plates handling tool



Suction pad

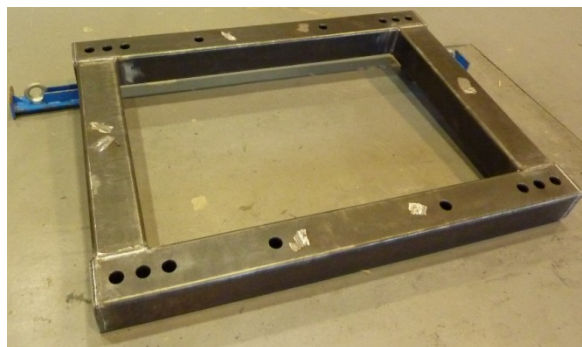
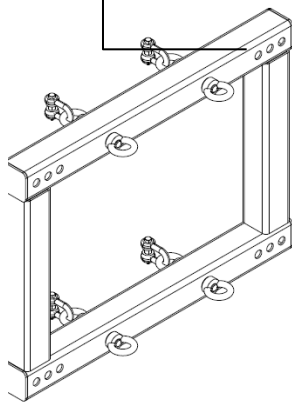
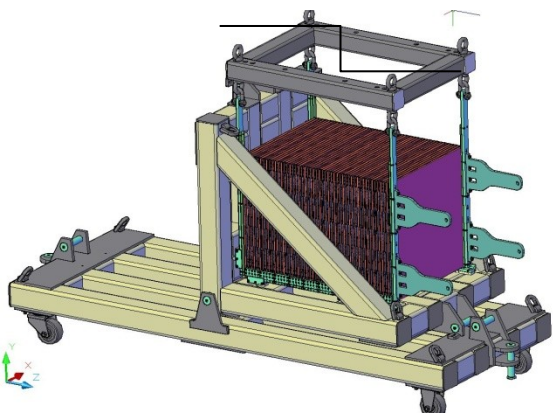
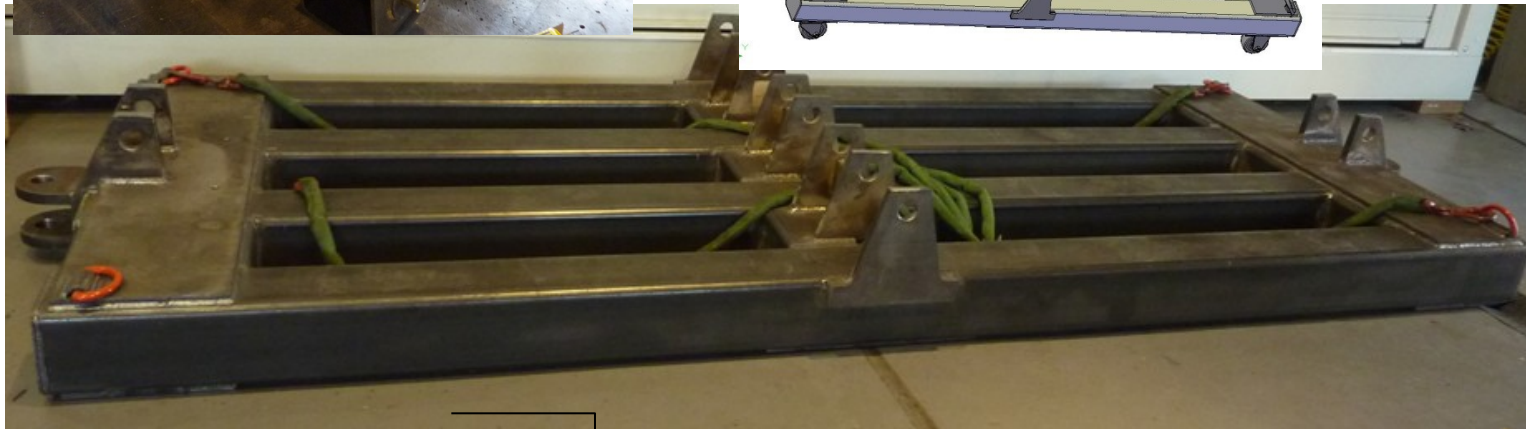
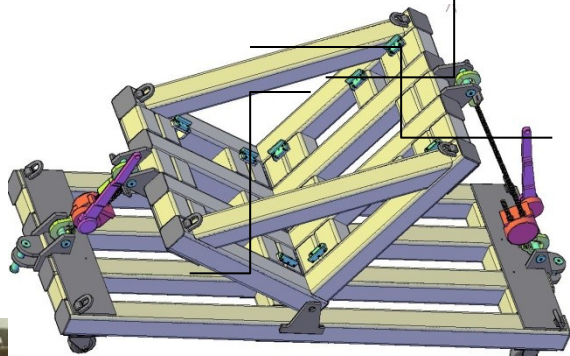
Security System



Special table to support the 8-ton prototype

Rotation tool being assembled

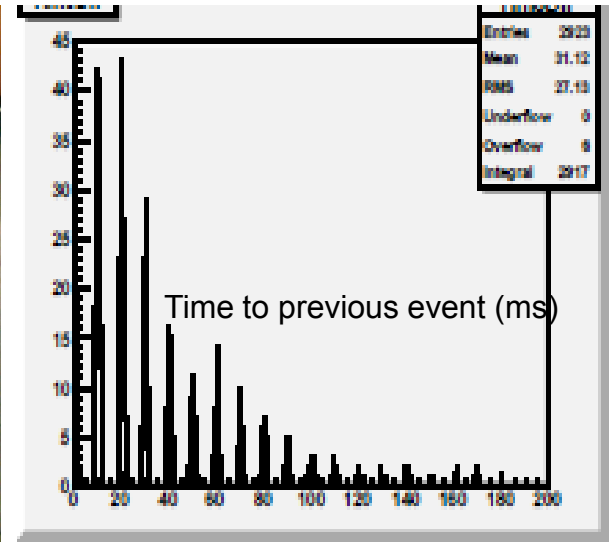
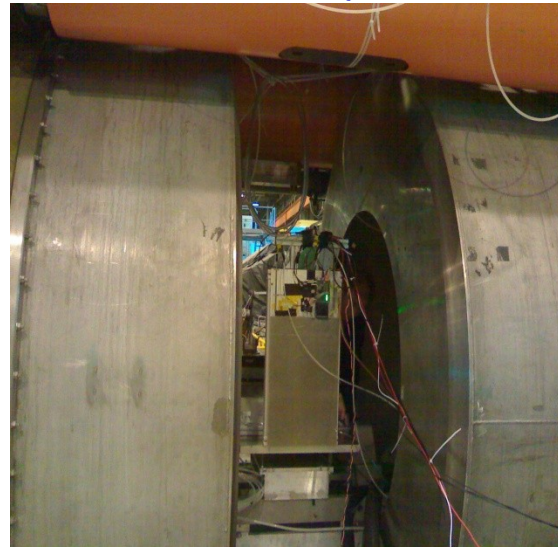
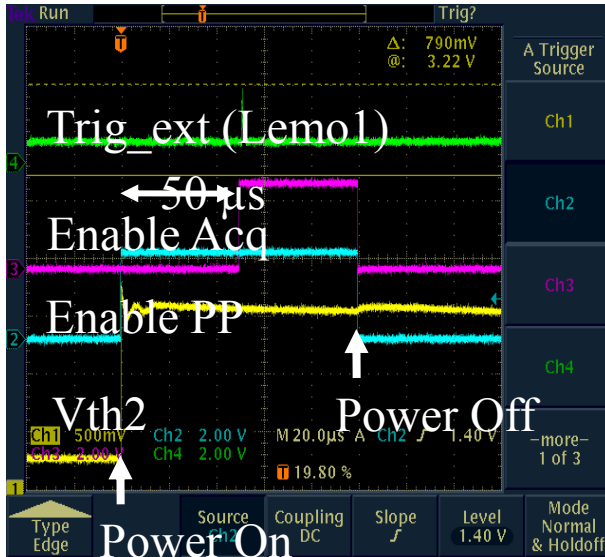
Expected to be finished during March



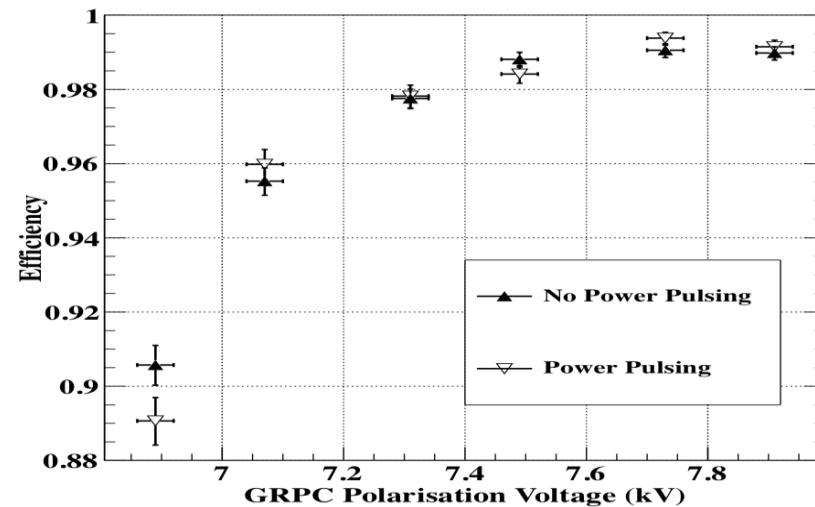
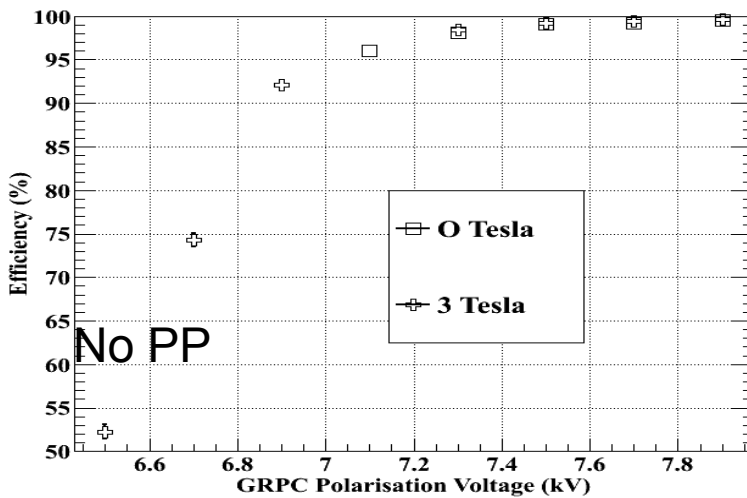
Power-pulsing test

Time between 2 bunch crossings:

337 ns



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



Conclusion

- The Construction of the SDHCAL technological prototype has started after a successful campaign of TB of the large GRPCs equipped with the new generation of the readout electronics.
- A self-supporting mechanical structure is being built.
- The new generation of DAQ is being tested.
- The prototype is expected to be ready in May
- Services are being worked out.
- One month commissioning will allow to prepare the TB foreseen in June and October 2011 at CERN.