1m^3 SDHCAL Mechanical Structure

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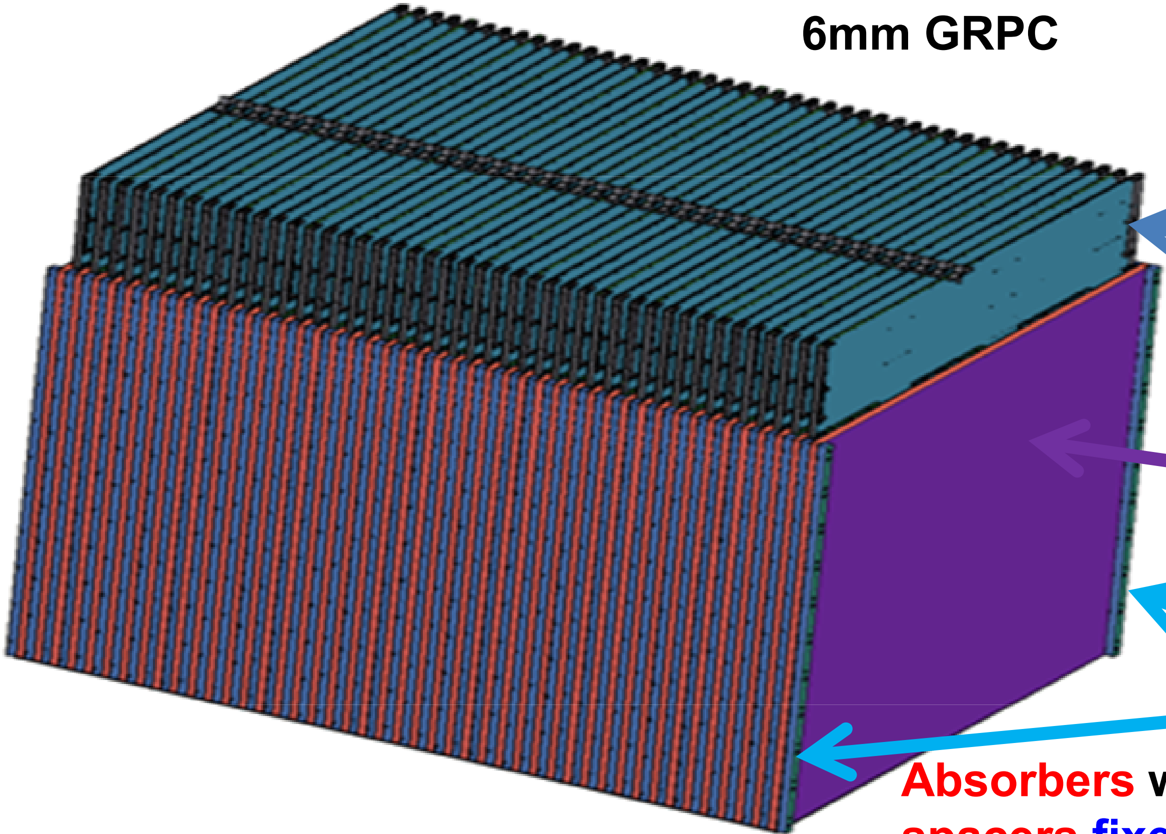
Towards a Technological Prototype

Technological prototype : **45 detector plans of 1m² :**

20mm stainless steel (absorber + cassette support)

6mm GRPC

The design allows the insertion and further extraction of the cassettes



Cassettes. Electronic side

Absorber plate

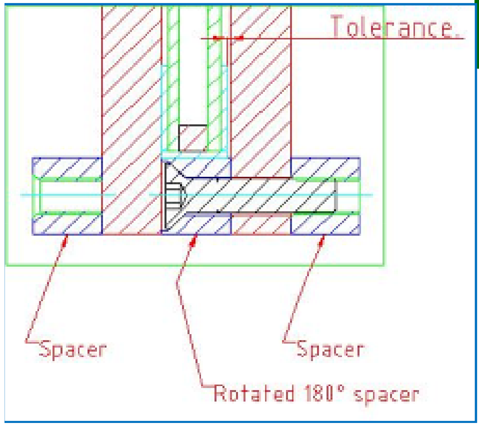
Spacers

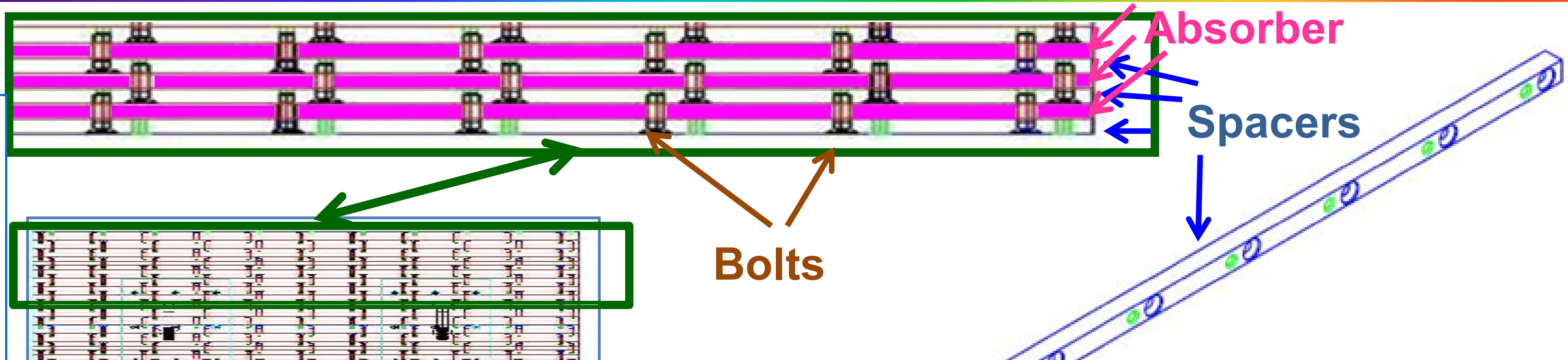
Absorbers will be assembled together using lateral spacers fixed to the absorbers through bolts.

The dead spaces have been minimized as much as possible taking into account the mechanical tolerances (lateral dimensions and planarity) of absorbers and cassettes to ensure a safe insertion of the cassette.

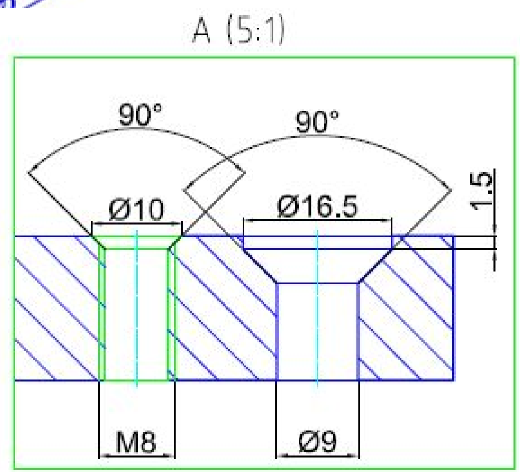
Design independent of the detector technology to be used (RPC and MICROMEGAS)

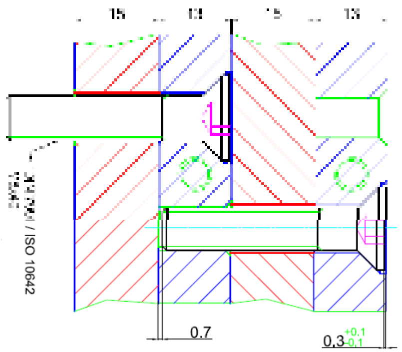
Absorber Mechanical structure – Details

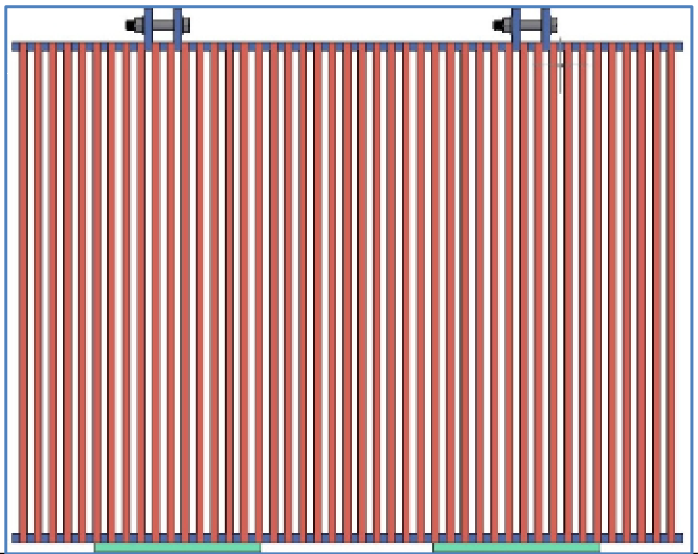




2x11 bolts/plane
M8







Absorber Plates:

1011 x 1054 mm^2 lateral dimensions

15 ± 0.05 mm thick

Surface Planarity < 350μm

Spacers: 13 mm thick

Material: Stainless steel 304L (permeability , as measured, 1.5 ➔ it allows to use it in B=4T)

Plates & Quality Control

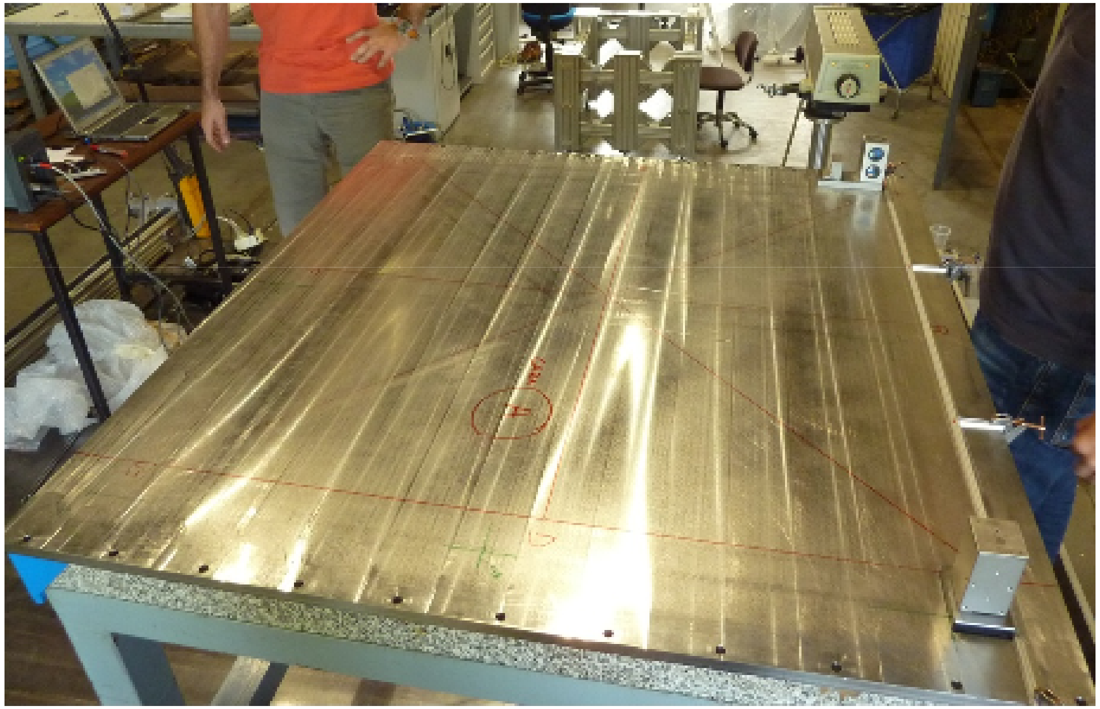
To reduce the gaps it is needed a good planarity of the absorbed plates.

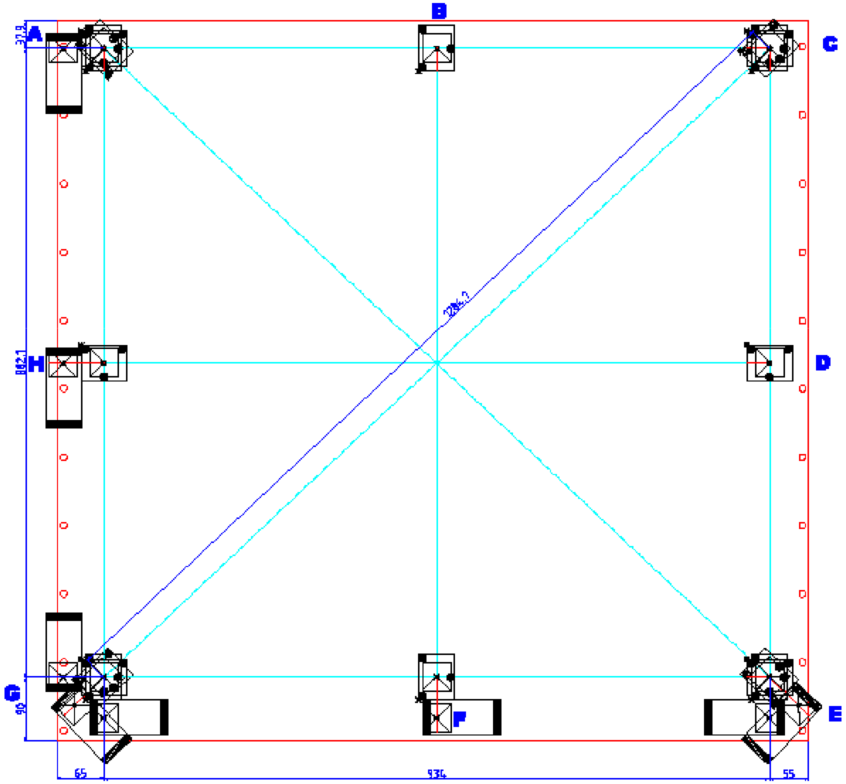
The tolerances of the standard market are higher (several mm) than our needs(hundred of microns), the plates need to be further machined to achieve the precision we are interested in

It is not easy to achieve the precision.

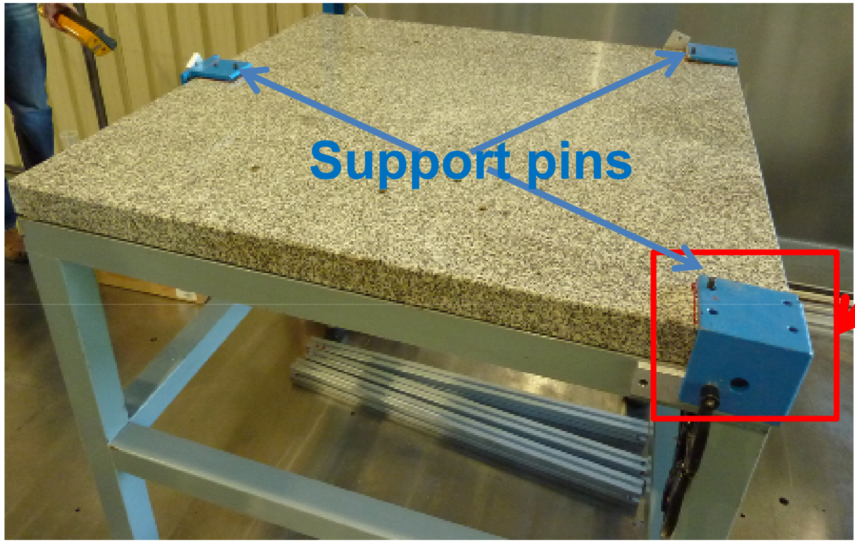
Tests done at different companies to find a supplier that guarantees our needs.

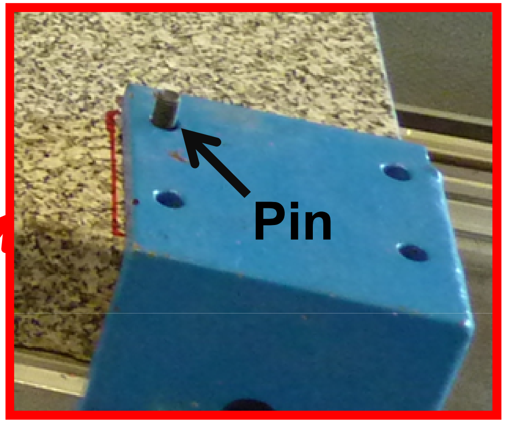
Quality control during the mass production of the plates will include verification by the company, both of the thickness and the planarity, and then a crosscheck will be performed at CIEMAT by using a laser interferometer system (Precision 30-40 μm for the planarity measurement)..





Plates - Planarity measurement procedure



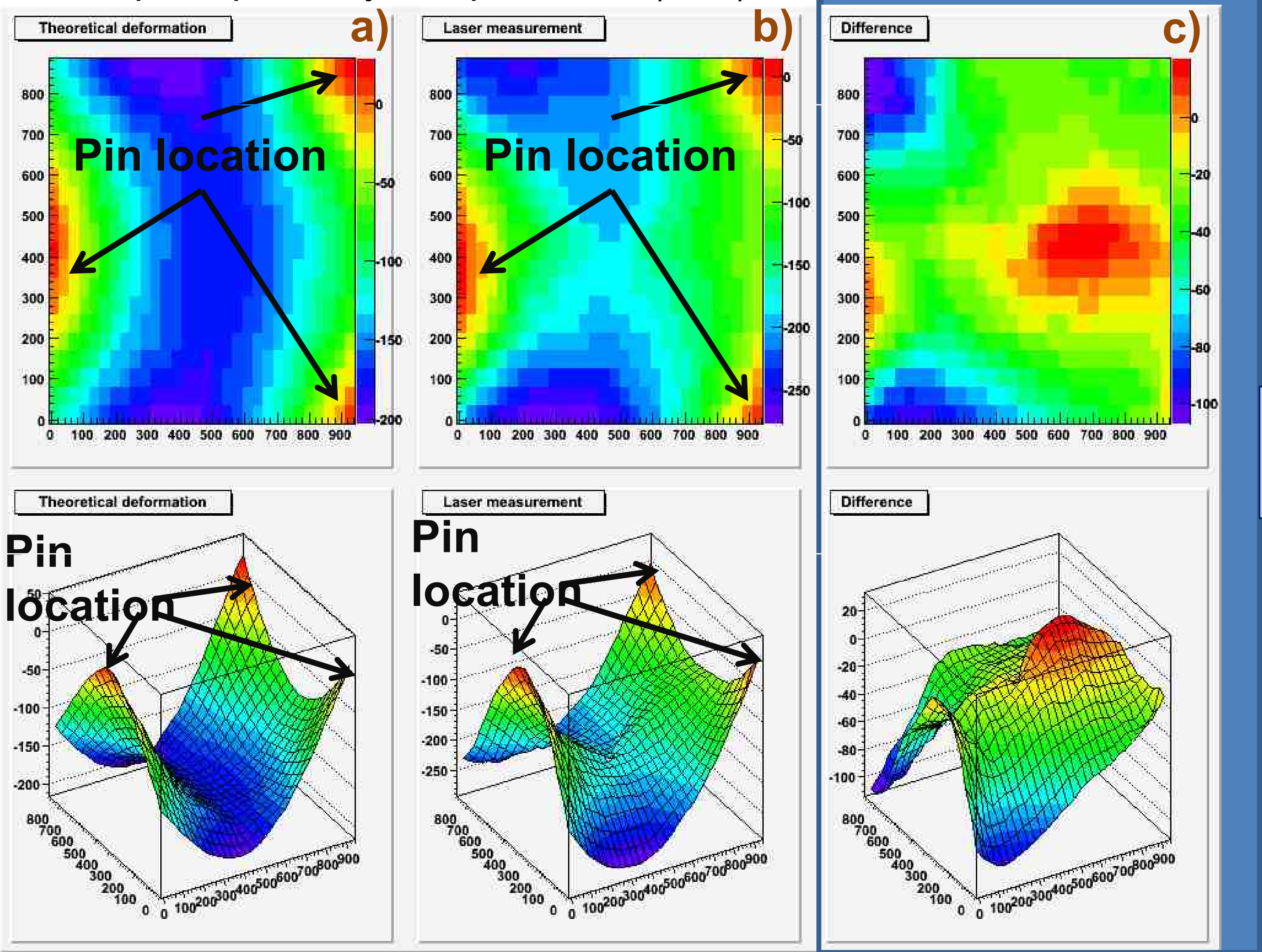


3 pins support the plate

In order to disentangle the planarity measurement from the table shape

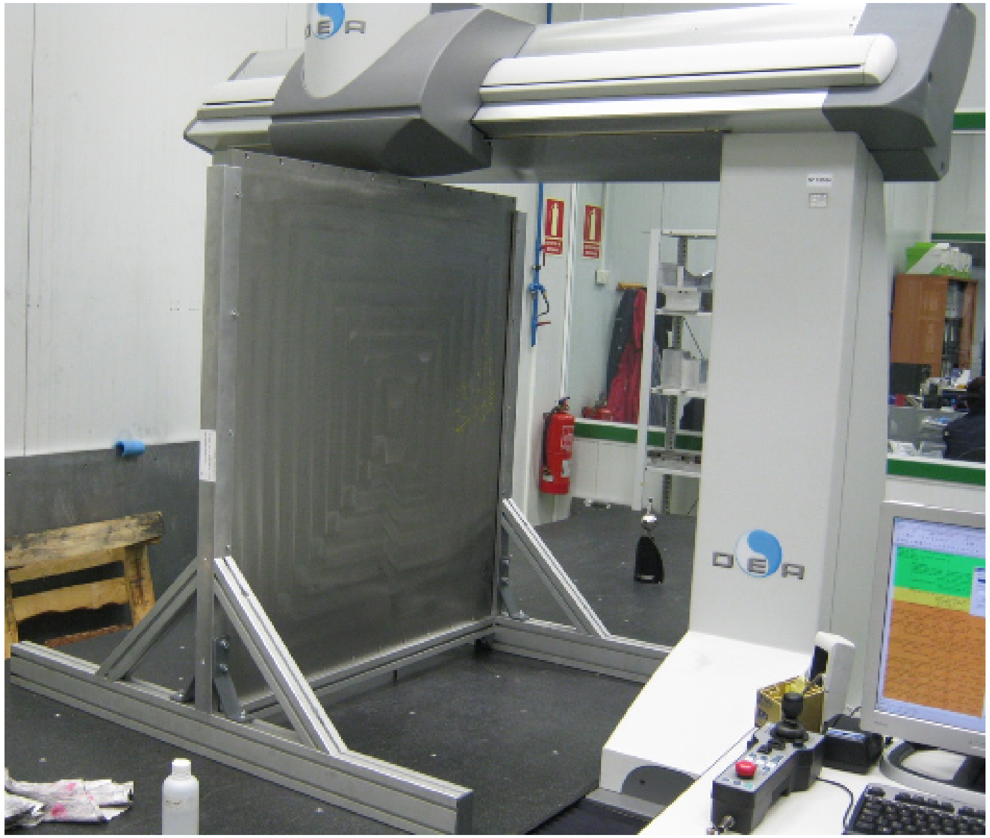
Plates - Planarity measurement results

a) Theoretical deformations computed for the plate supported by the three pins.
b) Laser measurements of the surface of a real plate
c) Surface plate planarity computed as b) – a)



Planarity values

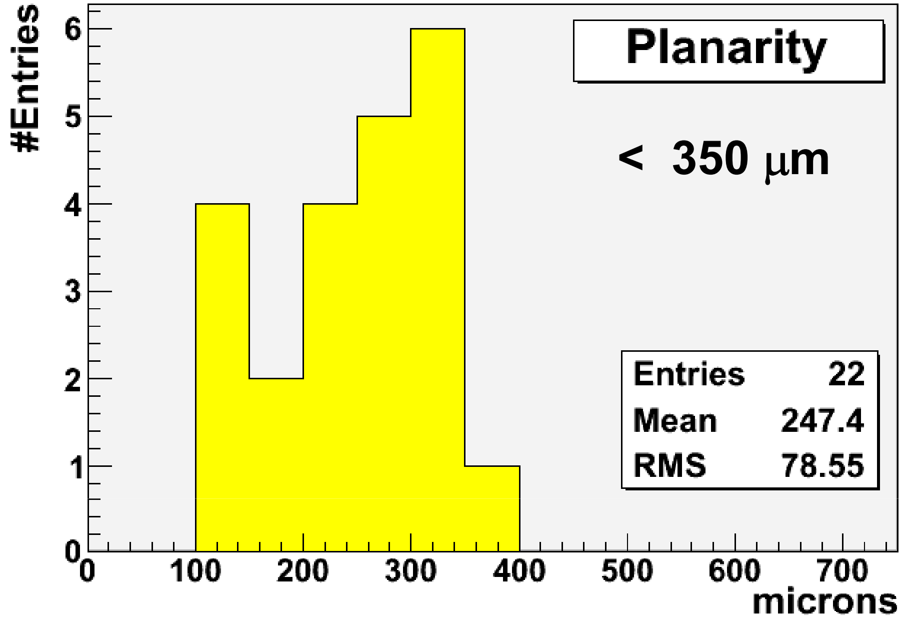
Plates – Quality Control by the company



Planarity and thickness measurements (#49 points) performed in vertical on both sides

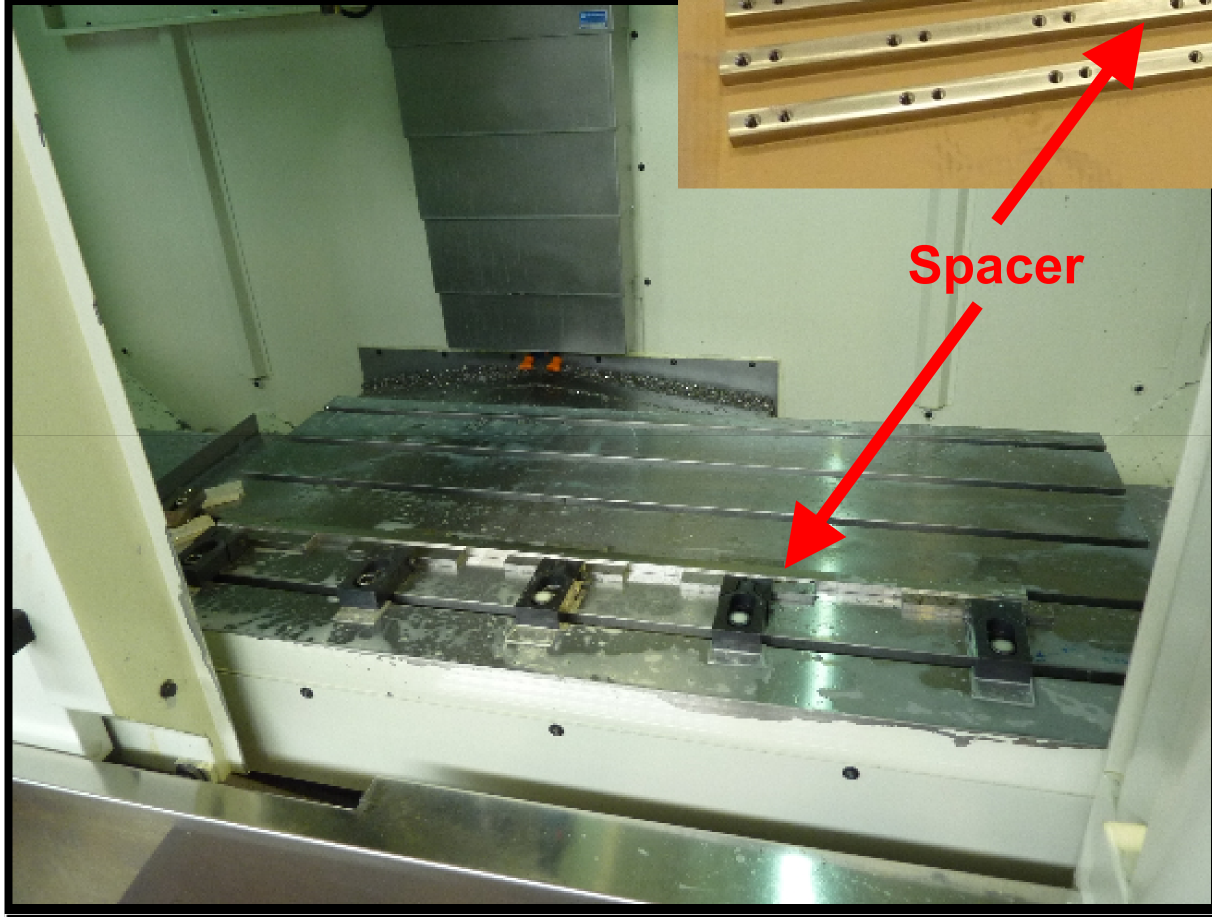
Thickness 15 ± 0.05 mm

Maximum planarity deviation for 11 plates x 2 sides



Spacers

CIEMAT Workshop

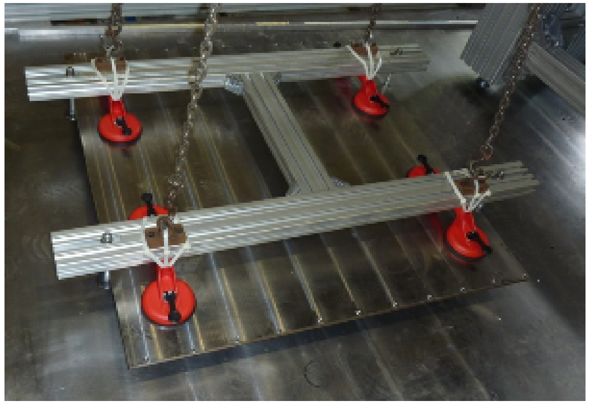


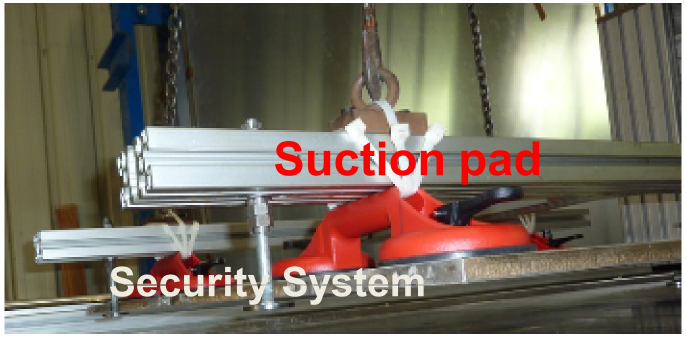
Machining from 20mm to 13mm
Process under control (30μm accuracy)

From now on 3-4 spacers at the same time

Assembly tests & tooling

A specific tool for handling the plates has been designed and built



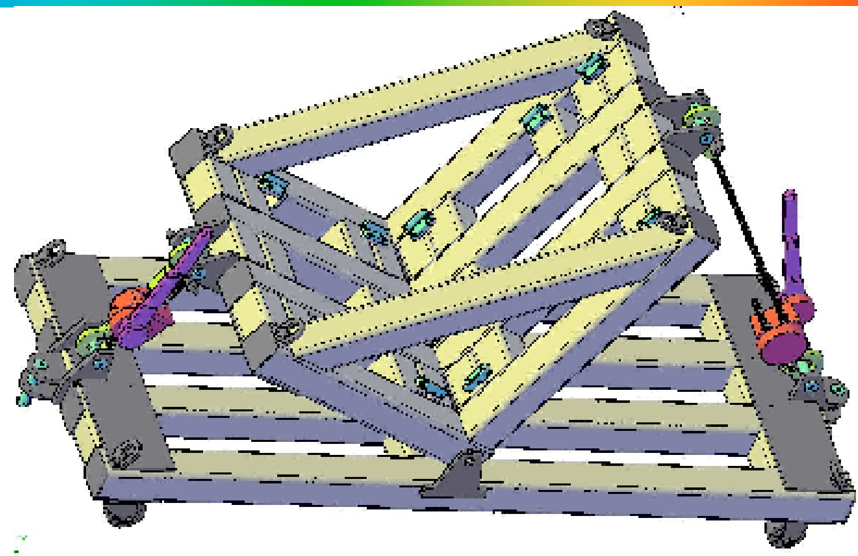


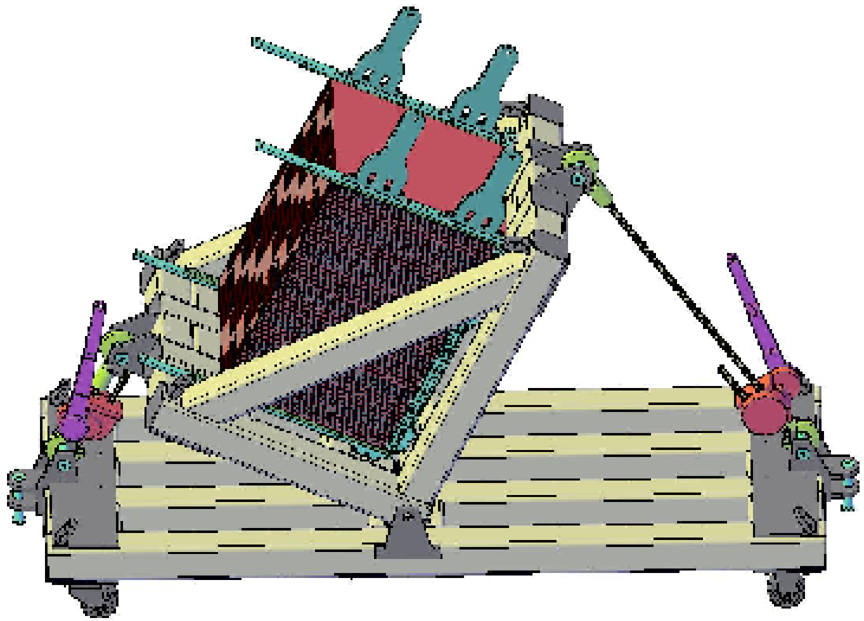
4 absorber plates (bad quality) assembled to test the procedure

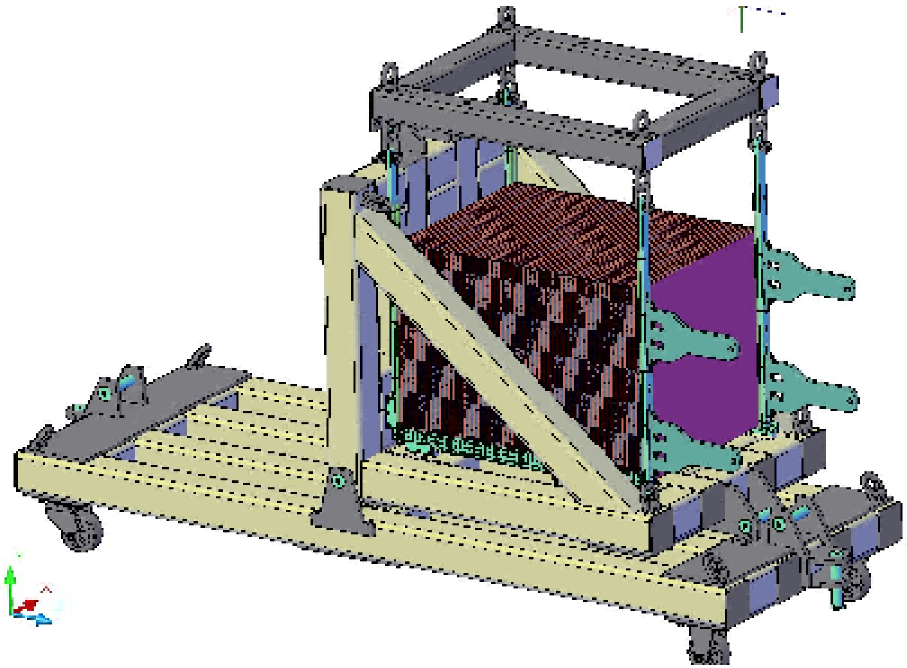
The mechanical structure should be finished by April

Rotation tool

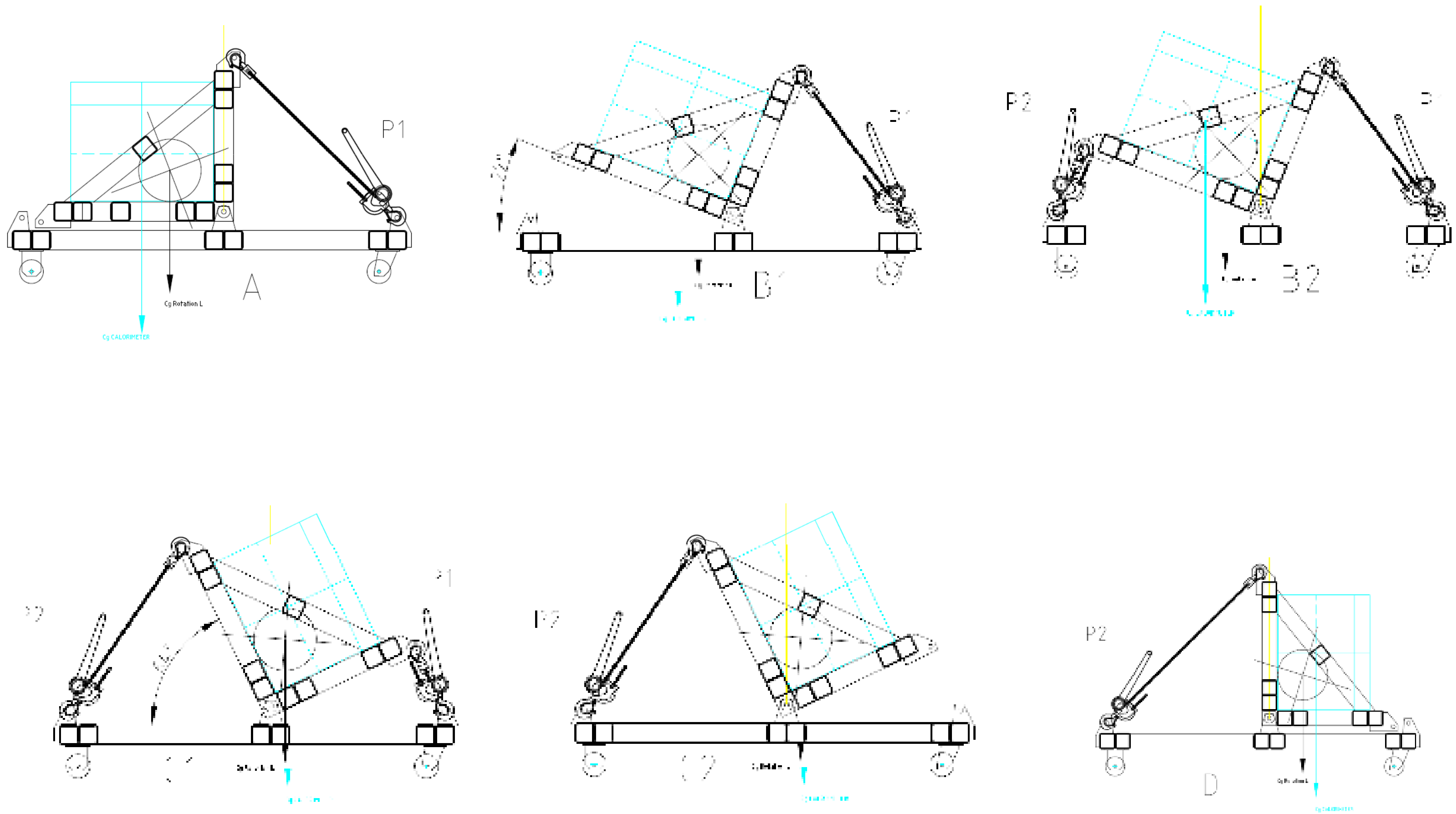
The 1m3 prototype is a heavy structure (~8500 Kg) that we need to move and eventually rotate (for cosmic tests at the lab for example).



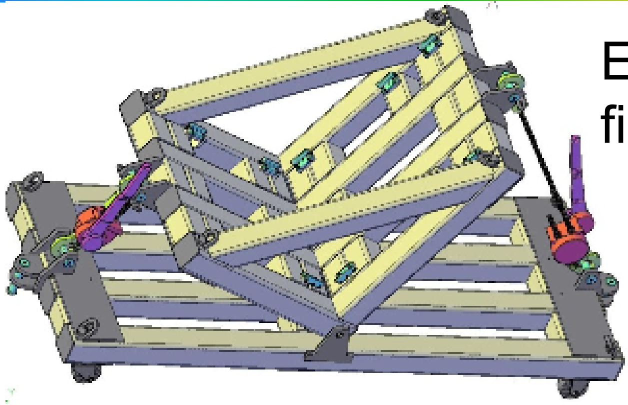




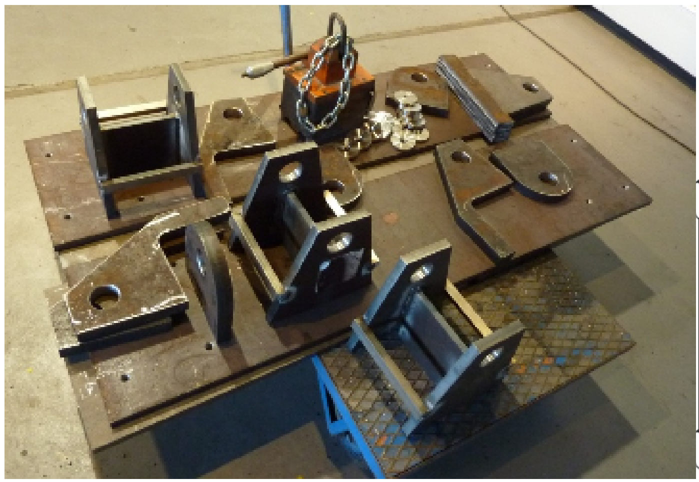
Rotation Procedure

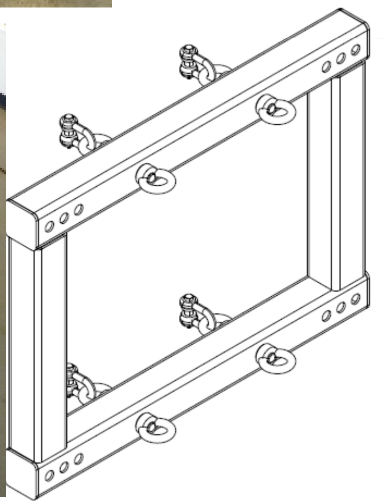


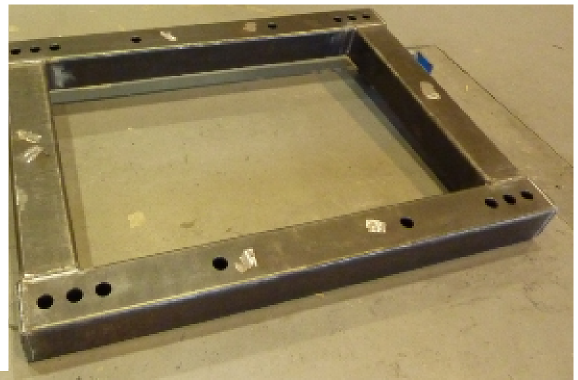
Rotation tool being assembled (welding) at CIEMAT



Expected to be finished by March







Status & Schedule

- **Plates**:
  - Already finished: **14 (at CIEMAT) + 7 being shipped**
  - Full production (#46) finished **around mid of March**
- **Spacers**:
  - **4+8 finished**
  - Full production expected to be finished by **beginning of April**
- **Assembly**
  - Will proceed in parallel with the production of plates and spacers.
  - Should be completed by **April**
- **Rotation tool**
  - Being assembled.
  - To be finished **by March** (except paint it , this will be done after test it)
  - **Tests of rotation tool**
    - It requires tool + prototype

To be sent to Lyon by May

BACK UP

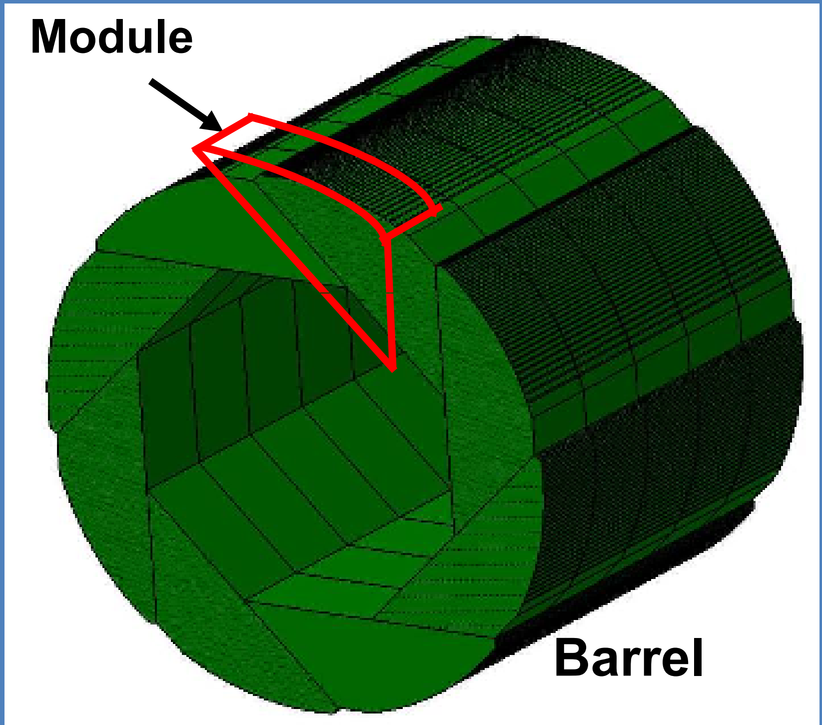
Towards a Technological Prototype

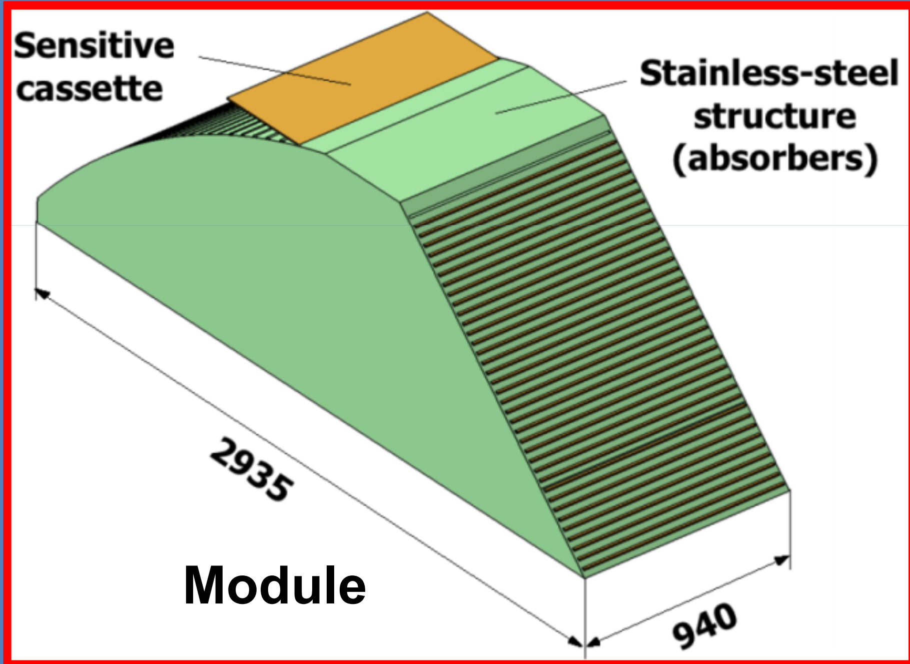
The aim is to build a realistic prototype as close as possible to the solution proposed for the ILD concept.

➔ Validate the technological solution

- ✓ Self-supporting mechanics
- ✓ Minimize dead zone
- ✓ One-side services

ILD - SDHCAL LOI design





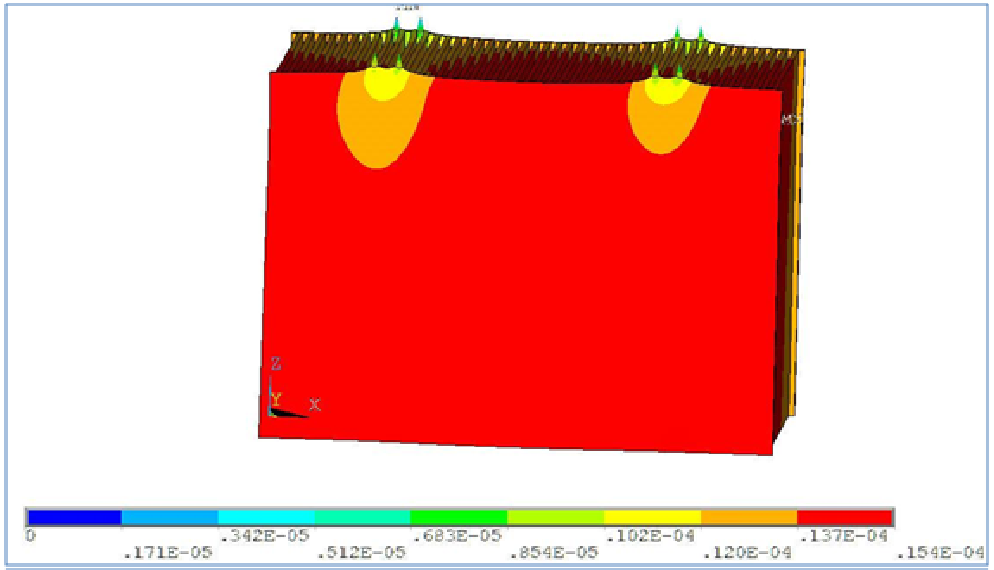
Simulations

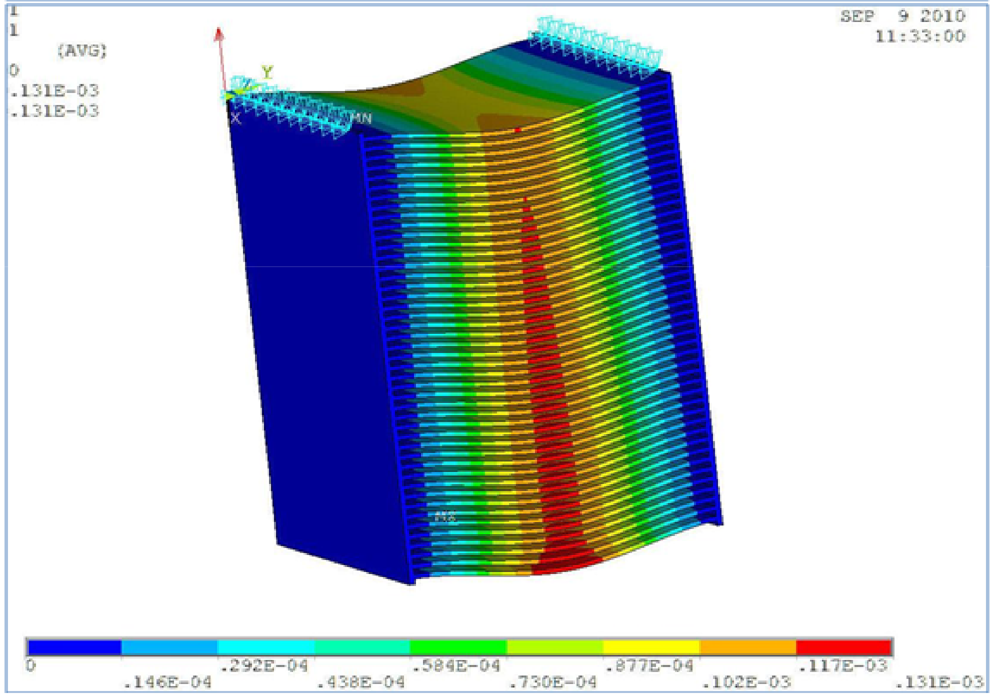
Detailed study has been made to evaluate the robustness of this structure in different positions. It is important to evaluate the deformations and the stress that the structure can suffer when moving and rotating, the deformations will be also transferred to the GRPC detector

ANSYS numerical simulations performed on the deformation and stress

Max. deformations don´t exceed 150 microns.
The punctual max. stress it is only 74 Mpa, well away from the elastic limit of the material

The max. reactions on the M8 bolts are:
Fx= +/- 17955 N, Fy= - 694 N, Fz= +/- 2249 N
M8 bolt have the elastic limits, function of the material, between about 10000 N to 40000 N.
This is the situation more adverse for the M8 bolts.

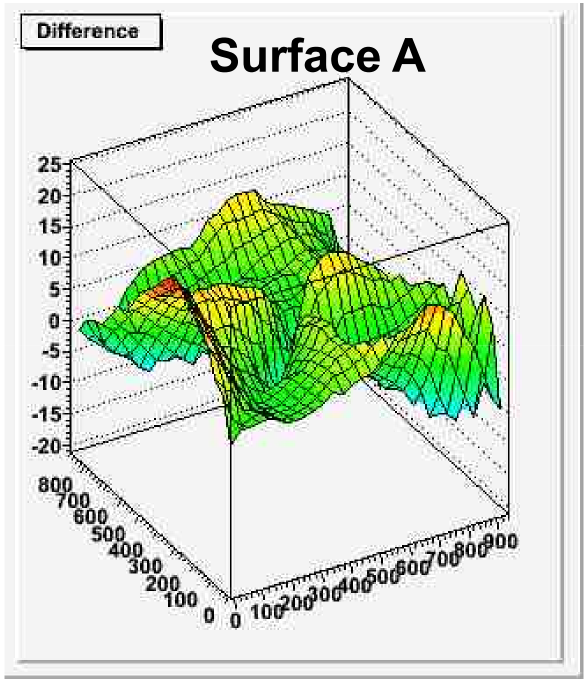


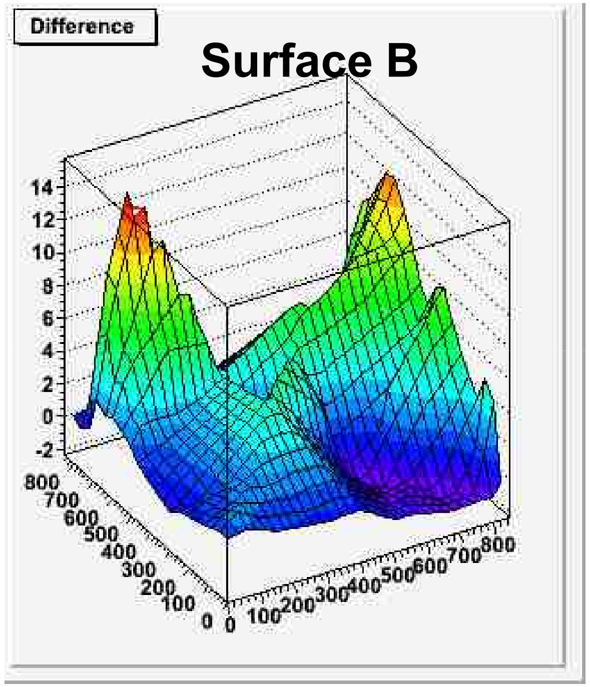


Plates - Planarity measurement errors

In order to check the accuracy and stability of the measurements the same plates have been measured several times in the same conditions and also supported by the pins in different positions.

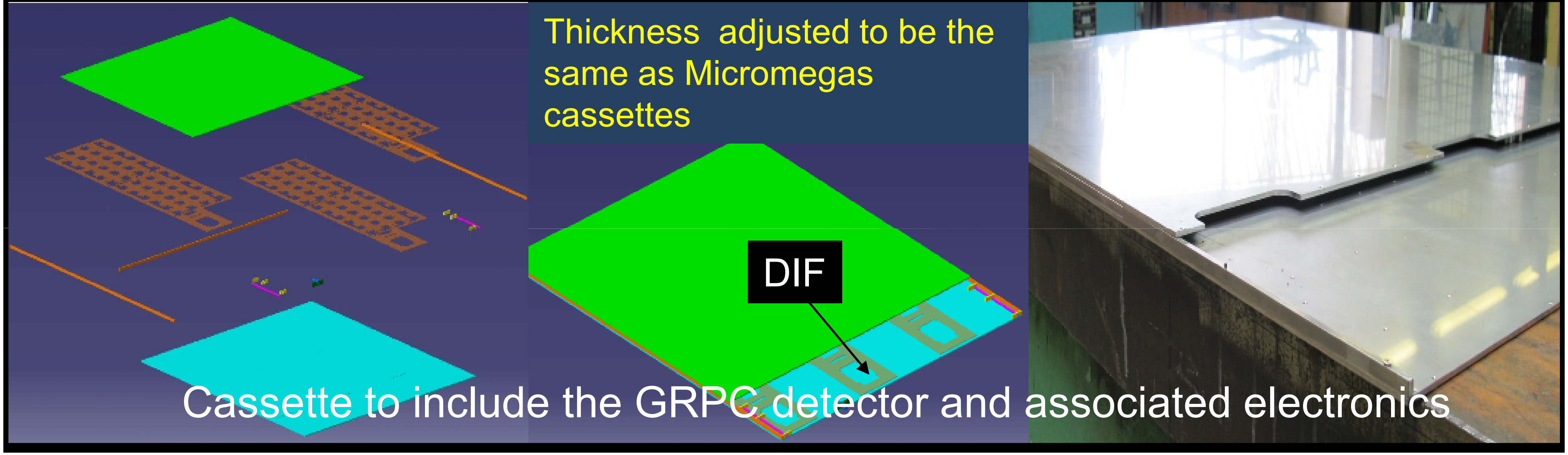
The differences between the different measurements are inside the 30-40 μm error provided by the laser interferometer system.

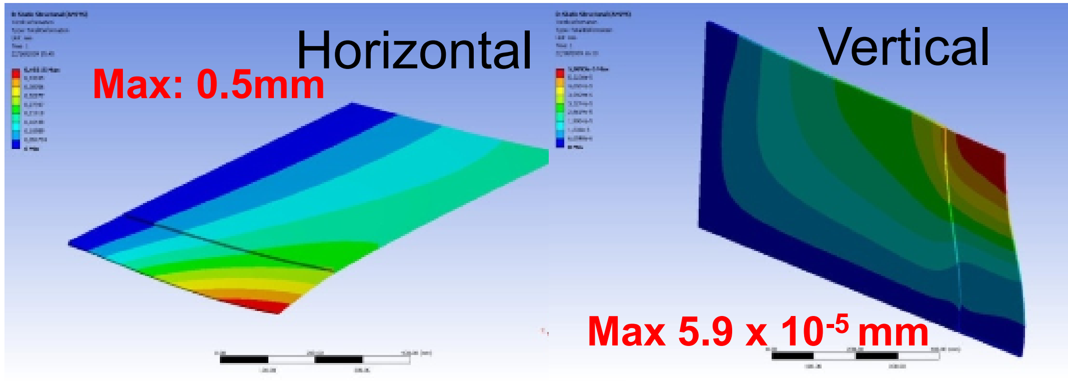




Differences between two measurements of the surface plate performed with support pins in different positions with respect to the plate. For both surfaces of the plates.

Towards the 1m^3 prototype: GRPC Mechanical structure - Cassette





Deformation under its own weight as a function of storage orientation