



WA105/ProtoDUNE-DP

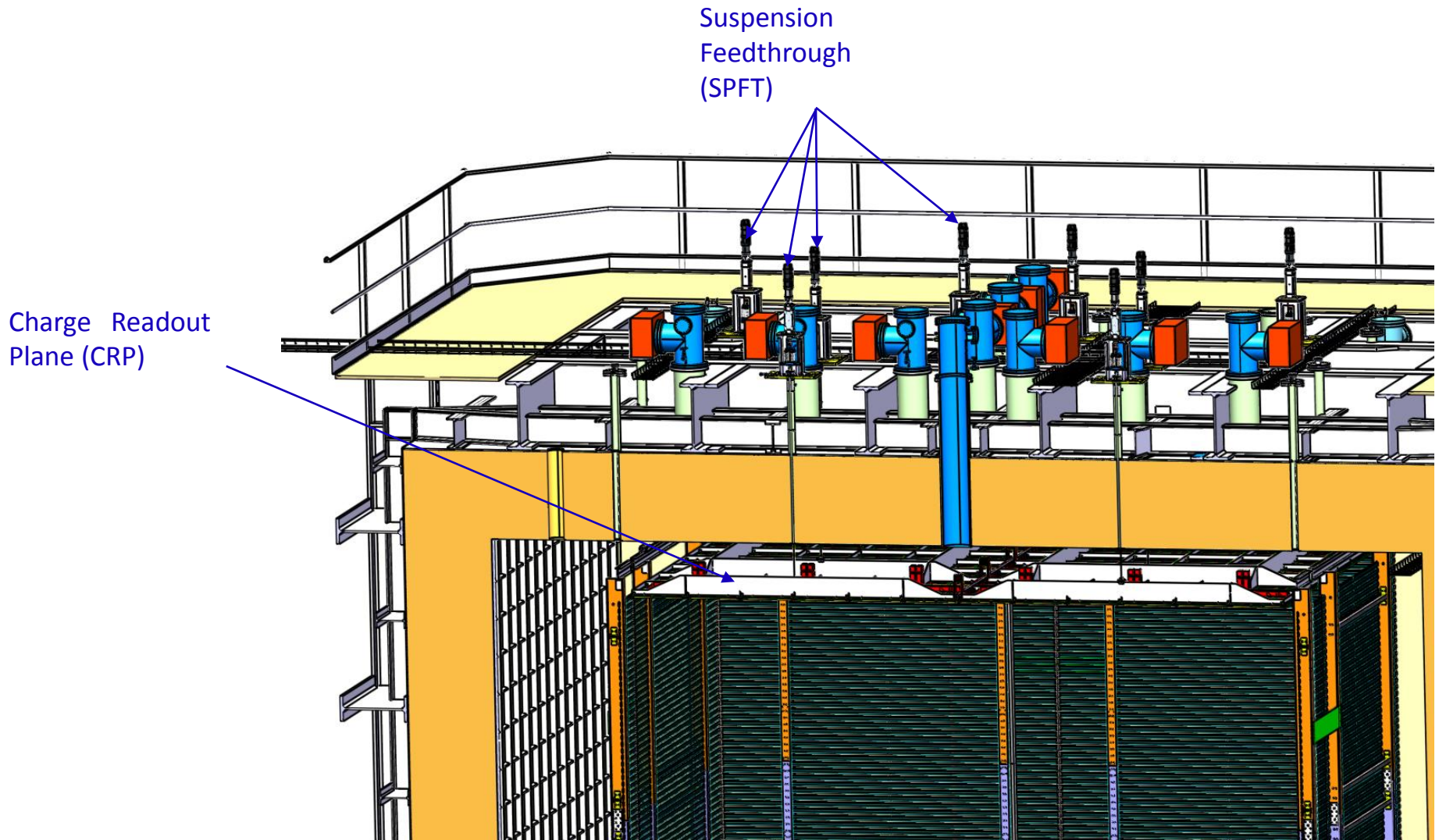
Charge Readout Plane Design

DUNE Collaboration Meeting – 22nd of March 2017

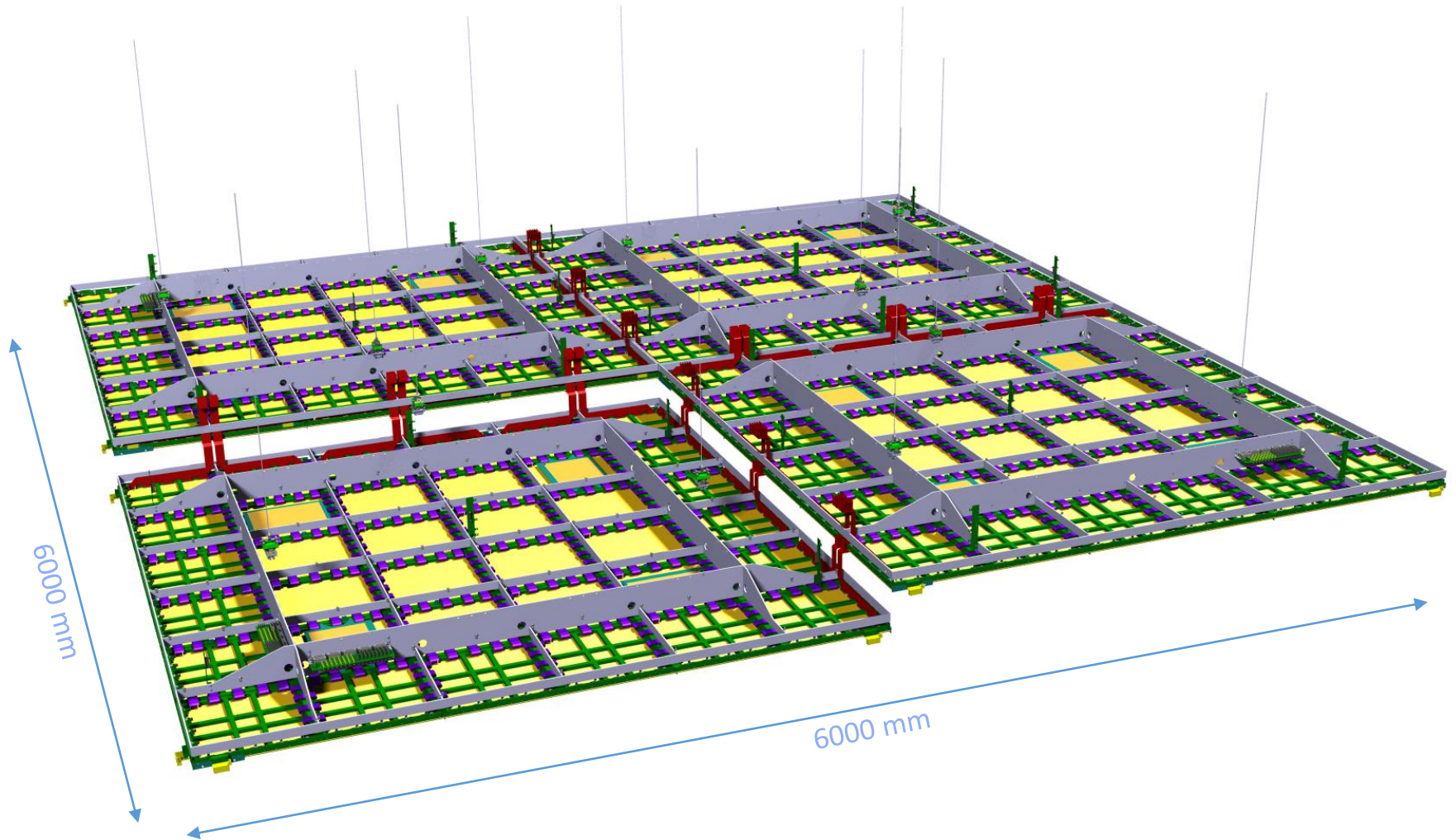
*B. Aimard, N. Allemandou, M. Cailles, G. Deleglise, D. Duchesneau,
N. Geffroy, Y. Karyotakis, T. Yildizkaya*



Detector Overview

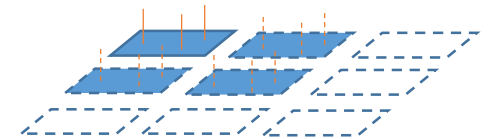
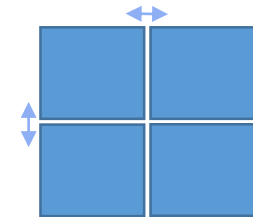
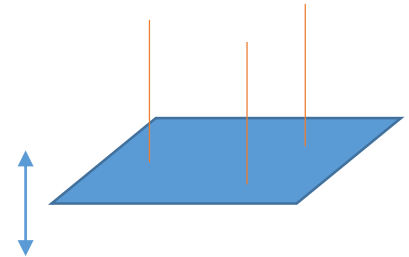
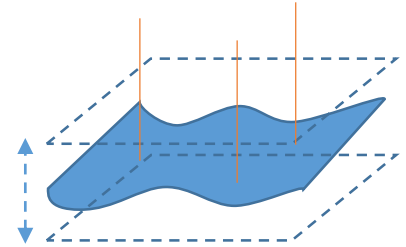


CRP Design

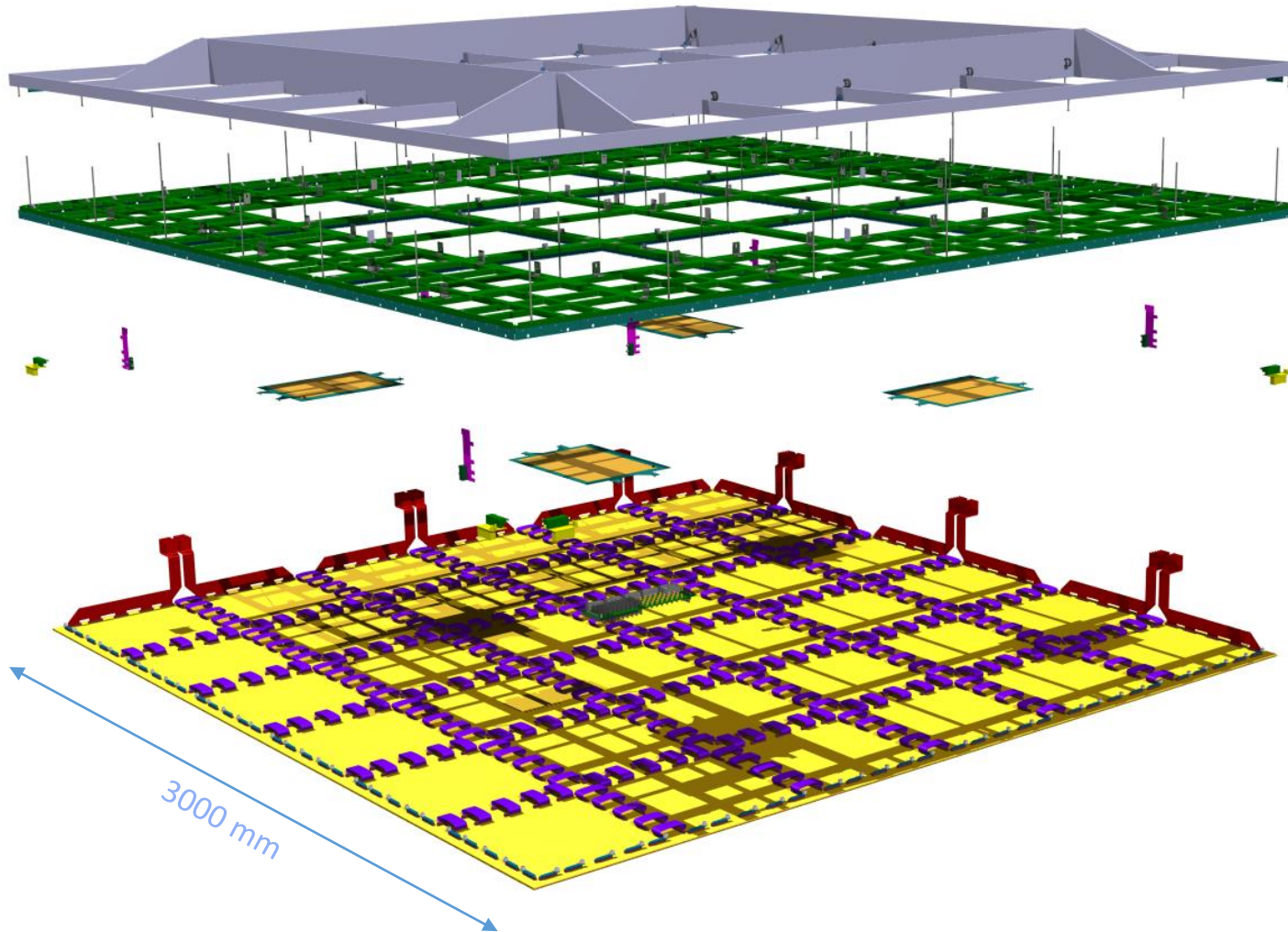


Assumptions on 6x6 anode deck design and assembly :

- *Mechanical specifications of the plane :*
 - **In planarity**
 - Specified planarity tolerance on the LEM plane is $\pm 0,5\text{mm}$
 - **In positioning**
 - Specified altitude tolerance is $\pm 0,05\text{mm}$
 - **In detection surface**
 - Minimize inter-space into 6x6m, **max. 10mm**
- Design of WA105 must be *scalable* and *re-usable* for DUNE



CRP Overview and composition



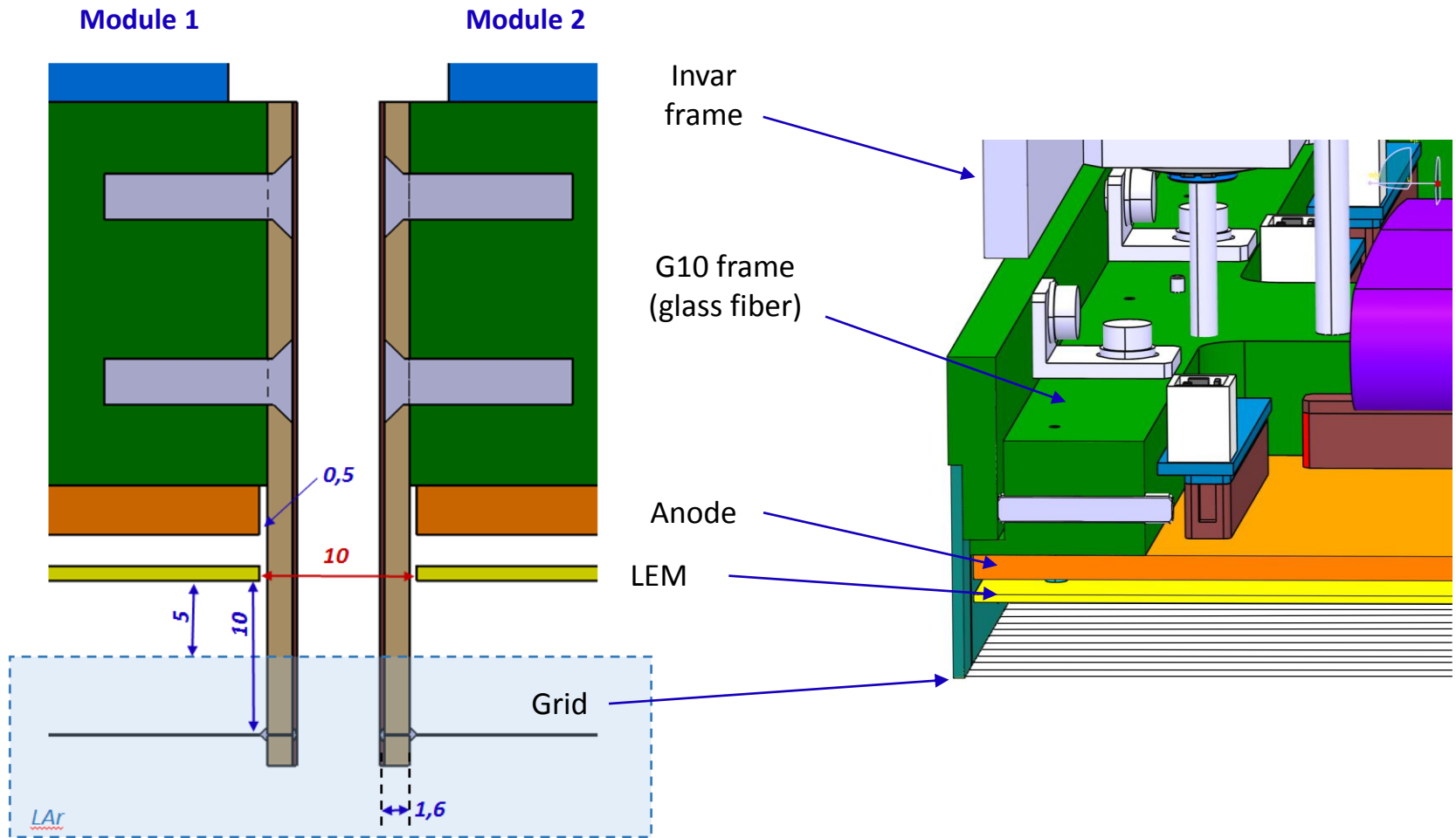
Invar Frame

G10 Frame +
Extraction Grid

Instrumentation

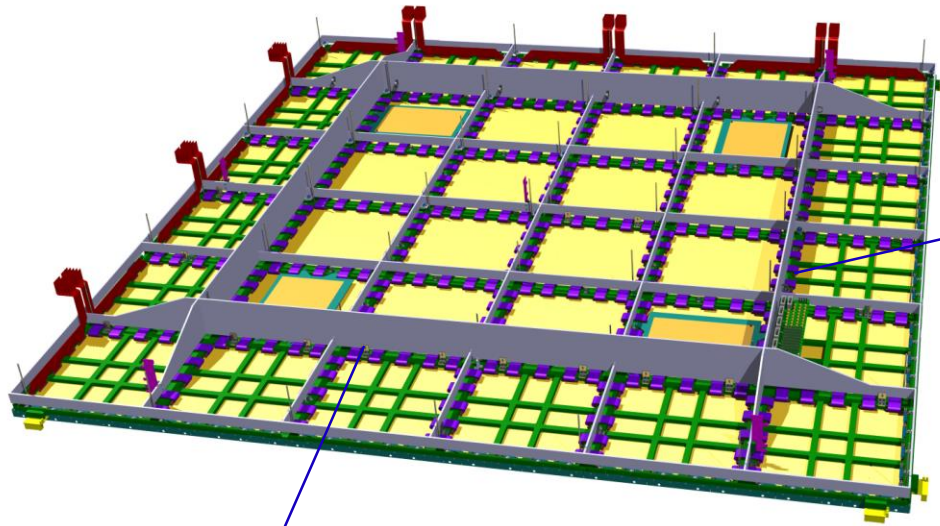
Detection plane

CRP Overview and composition

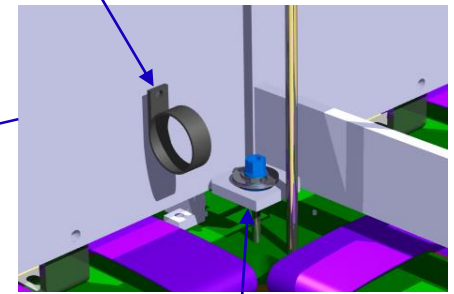


Invar Frame

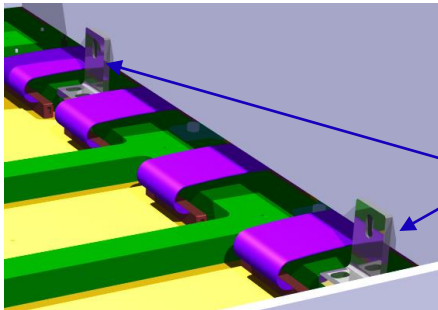
- Invar frame is the skeleton of the module
- All the frames are identical



Stainless steel adaptable Cable fixations all around the frame



Supporting plates for thermal decoupling and planarity tuning welded on the frame

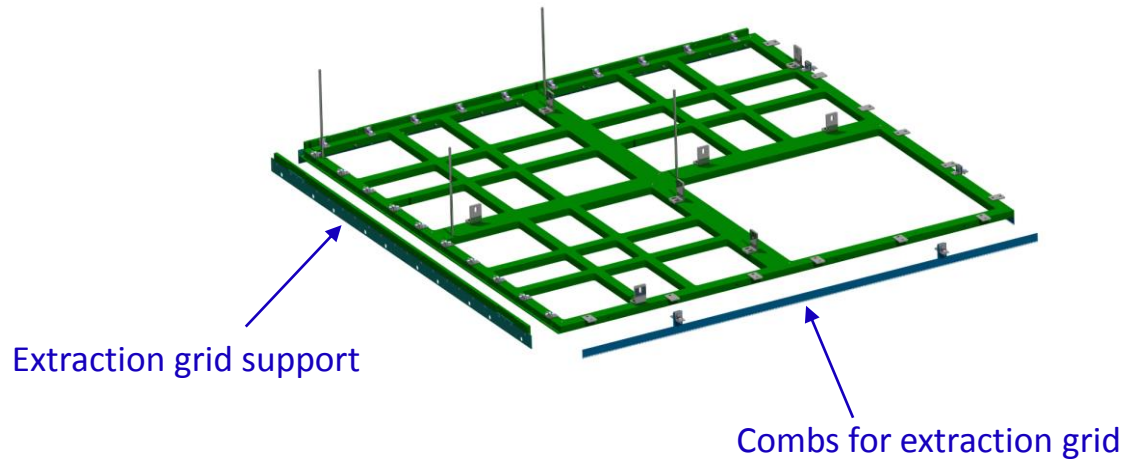
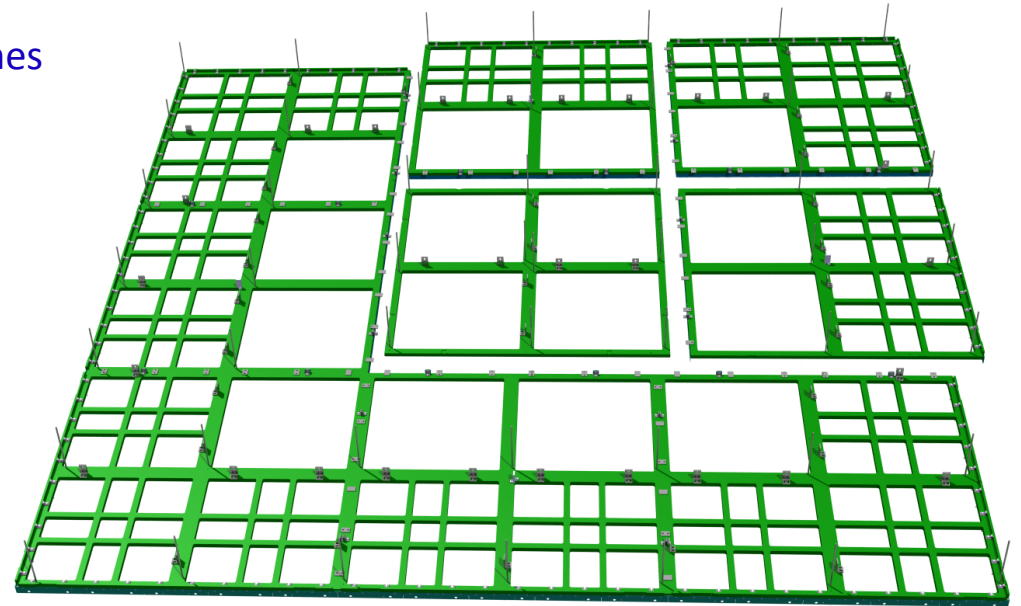
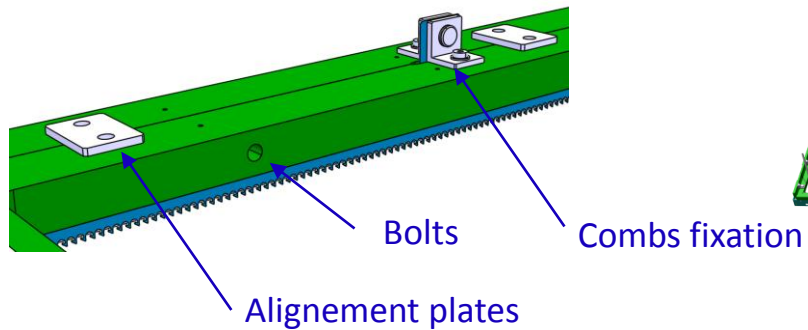


Square supports between invar and G10 for final assembly transportation

G10 Frame

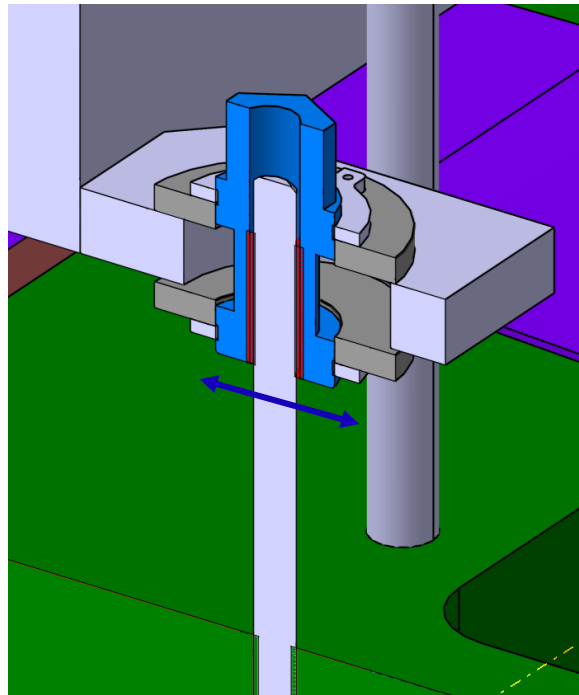
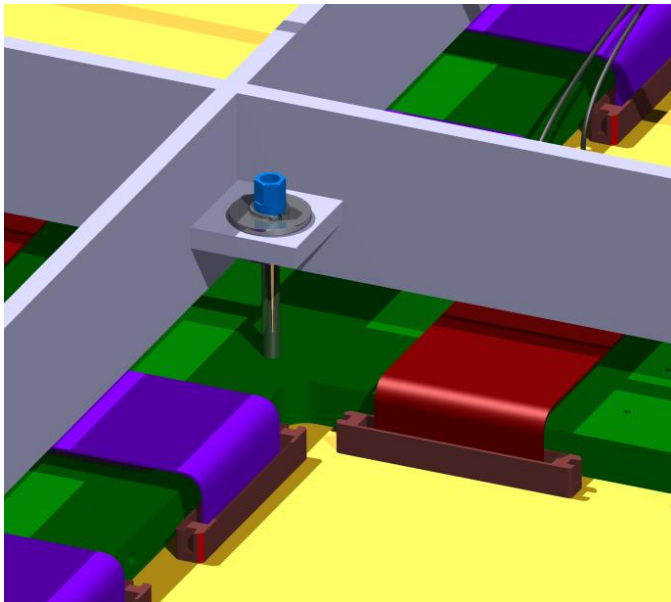
- 3x3m frame is an assembly of 1x1m frames
- Only 3 types of 1x1m frames

Junction between 1x1m frames :



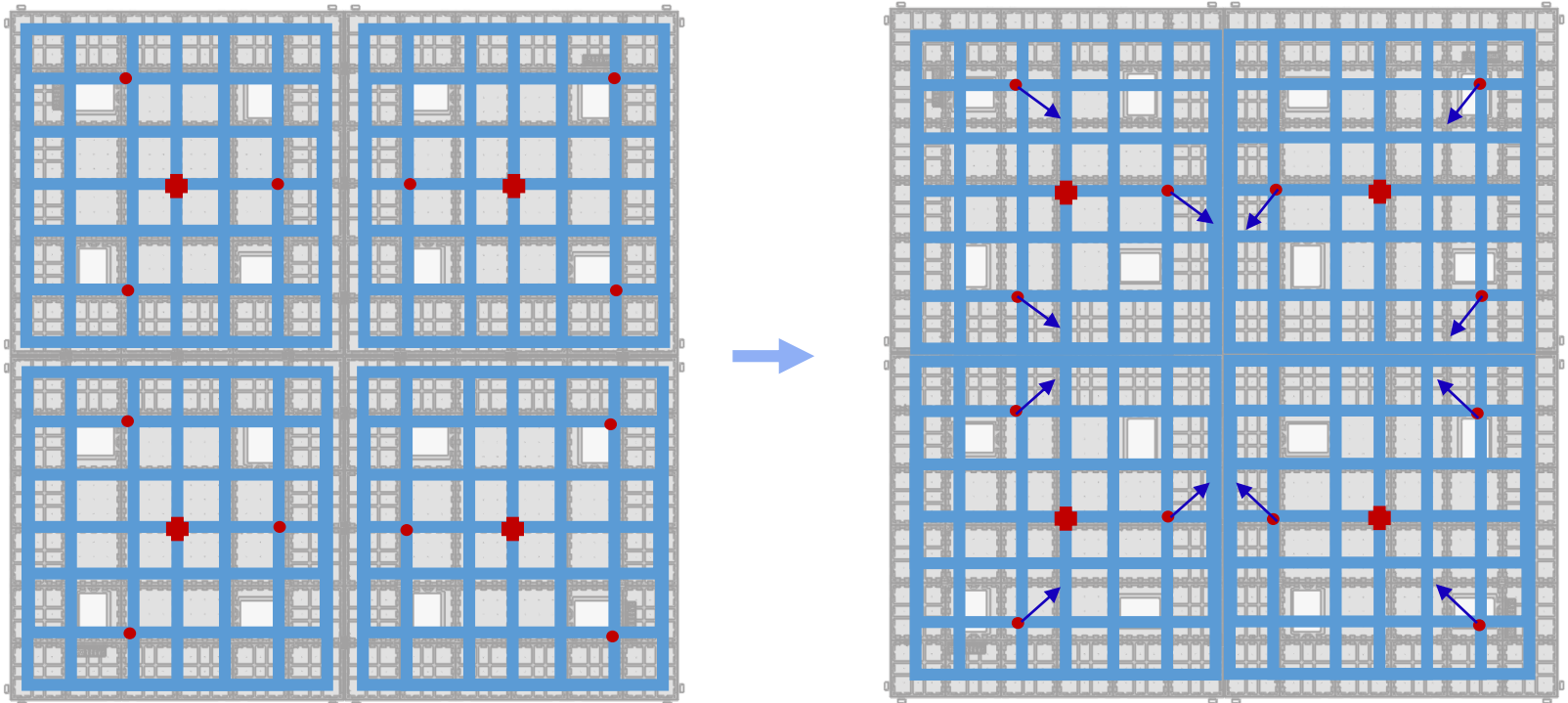
Thermal Decoupling

- During cooling, Invar is keeping its dimensions while G10 frame and LEMs/Anodes are contracting
- Thermal decoupling allows a lateral sliding of the G10 frame, conserving the altitude
- Decoupling systems are installed at each corner of the invar frame (50 systems by 3x3m module)



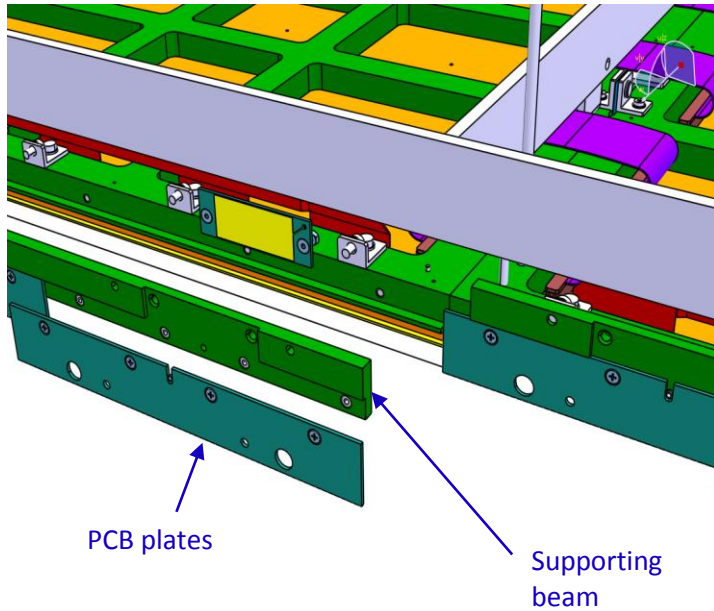
Zero inter-space thermal contraction pattern

- The contraction of each 3x3m detection plane is fixed at each modules' center
 - *G10 is contracting about seven times more than invar in cold conditions*
- Once in cold condition, modules are moved thanks to SPFT lateral movement and Distance-Meters measurements (see next slides)
- Interspaces between LEMs in cold conditions :
 - *0,5-0,8mm inside a 3x3m module*
 - *< 10mm between two 3x3m detection area*

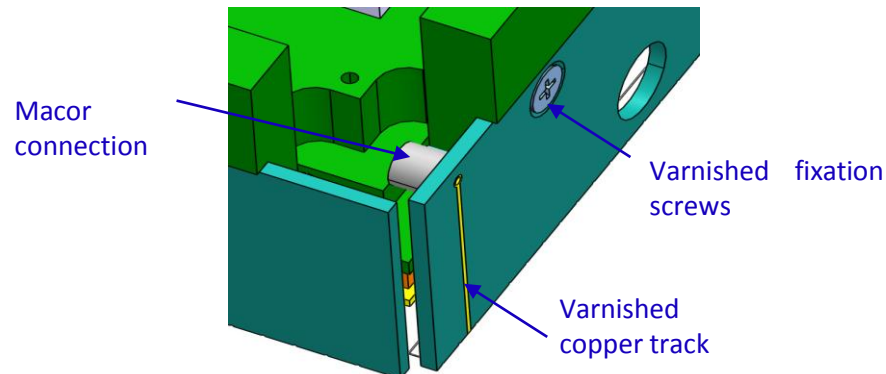
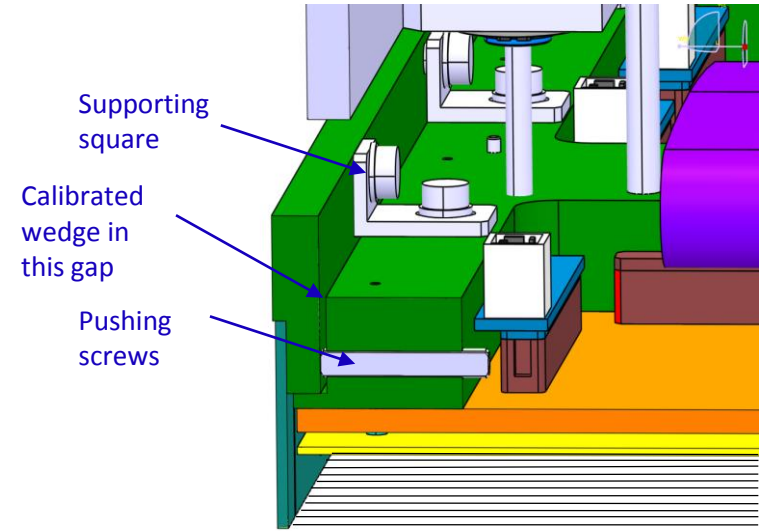


Extraction Grid

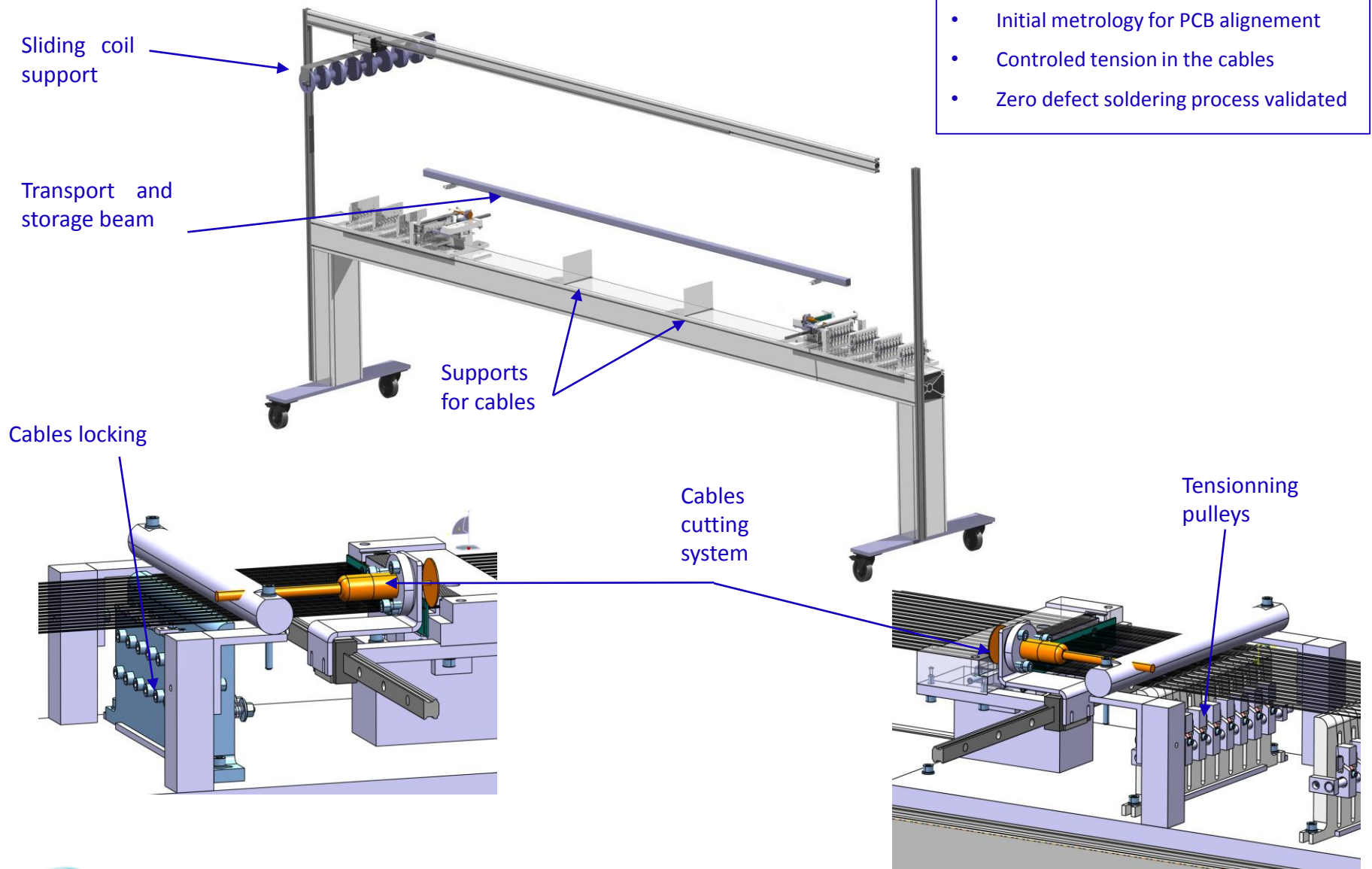
- Extraction grid's wires are soldered on supporting PCB plates, assembled on a supporting beam



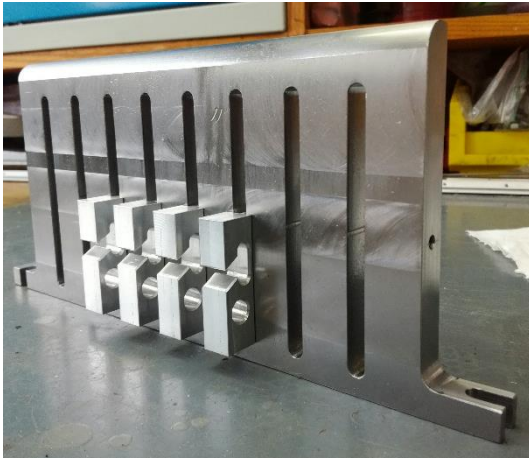
- Grid tensioning is performed by tightening « pushing screws », adding a calibrated wedge, and locking the supporting square



Tooling for Grid production



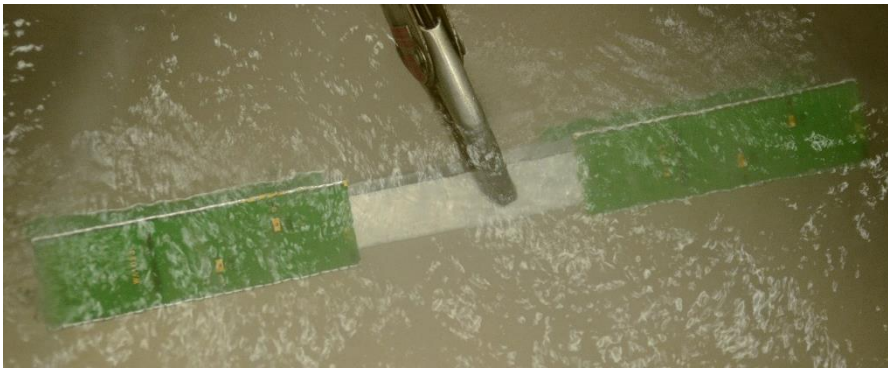
Grid production : various tests and prototypes



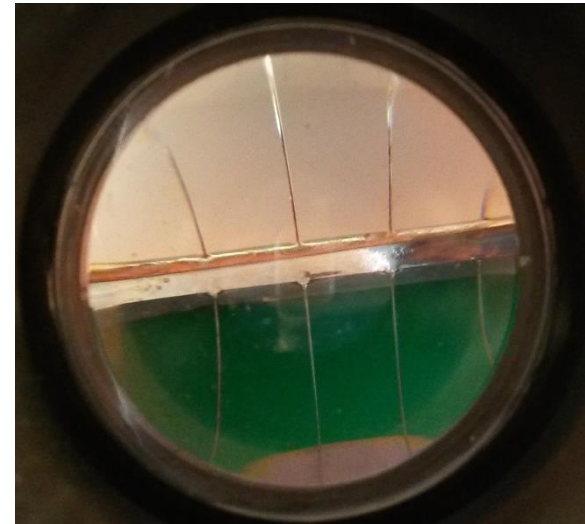
Pulleys and pulleys support for production tooling



Test of grid brazing



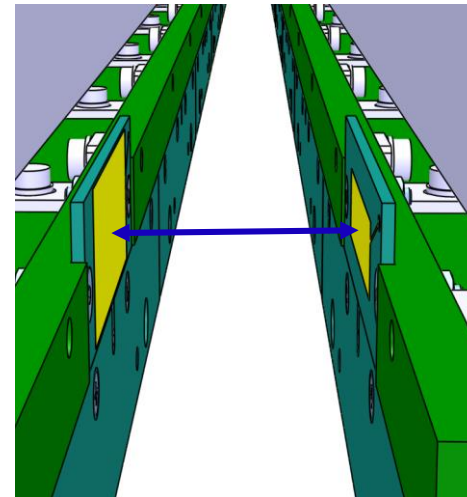
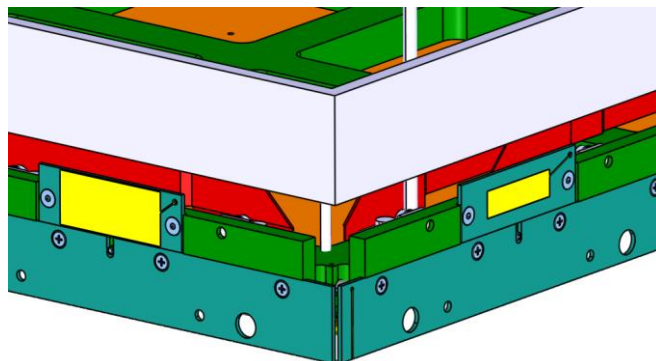
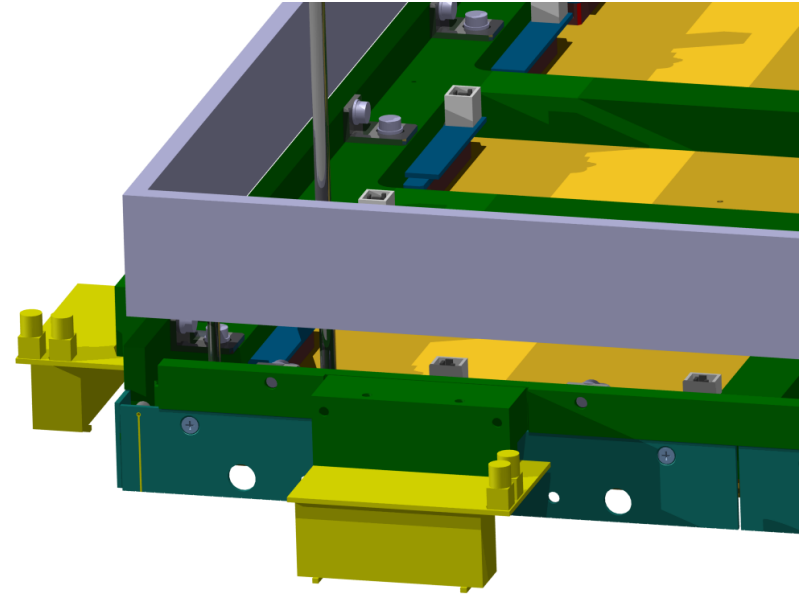
Grid prototype in liquid nitrogen, for cold test of the brazing



Test of grid brazing

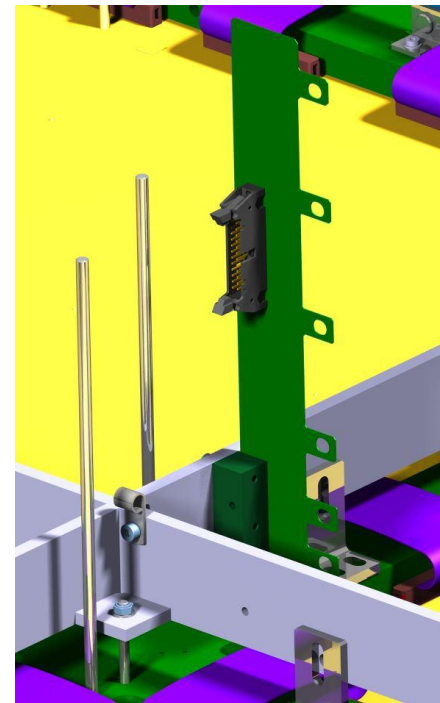
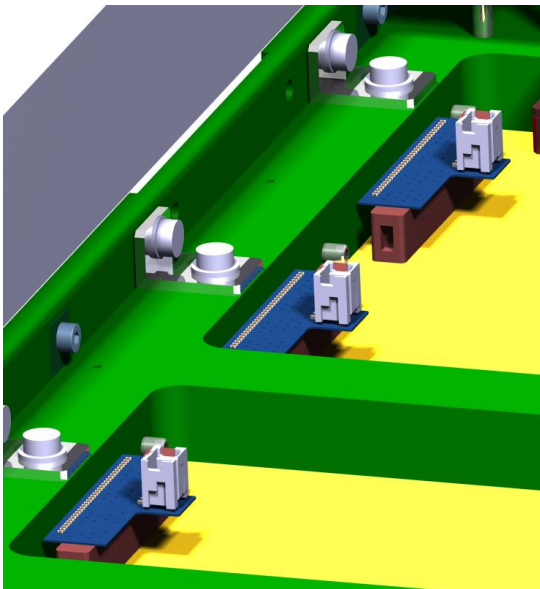
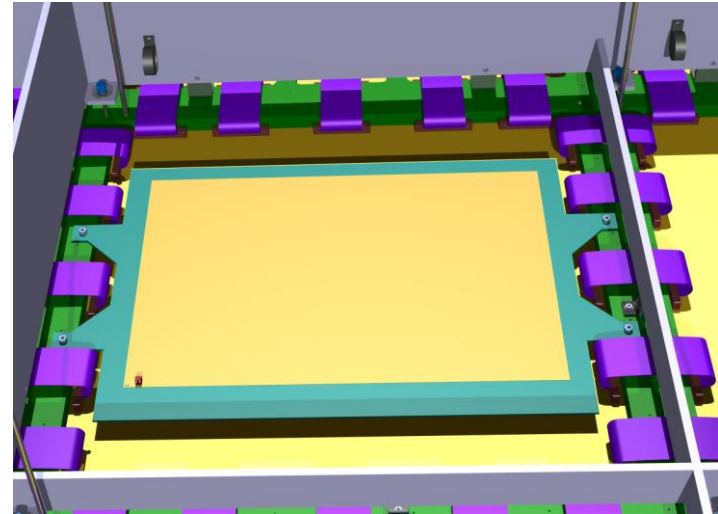
CRP position Instrumentation

- Level Meters
 - 4 devices by external side of the 6x6m
 - Fixed on a very stiff G10 support
- Distance Meters
 - Gives informations on module's relative positions
 - Capacitive measurement, no contact
 - 4 devices by 3x3m side (contact side)



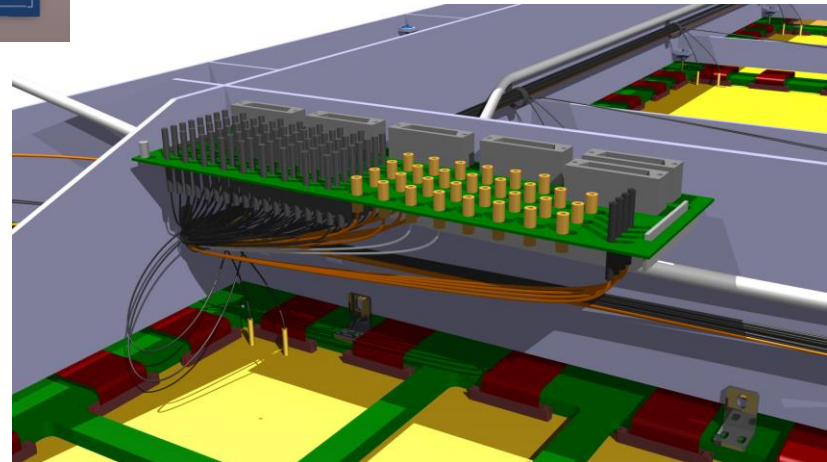
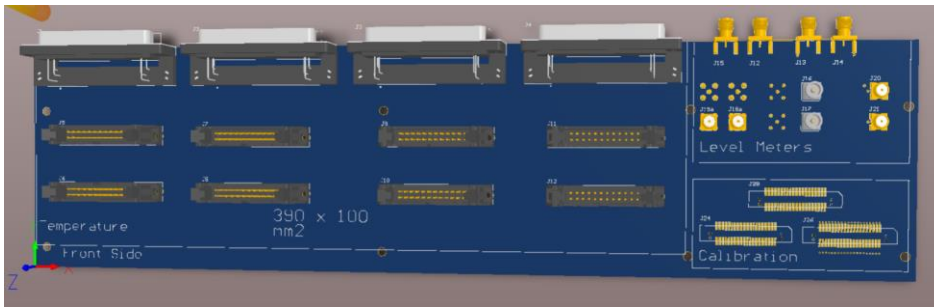
Other Instrumentation

- Heaters
 - *Fixed on a dedicated G10 plate*
- Thermometers
 - *Fixed on G10 blocs*
- Calibration boards



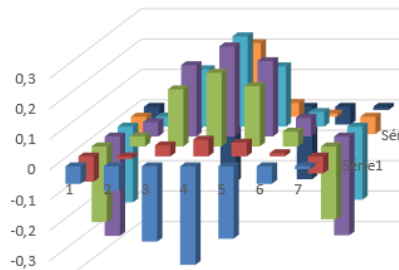
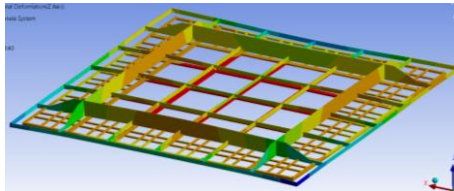
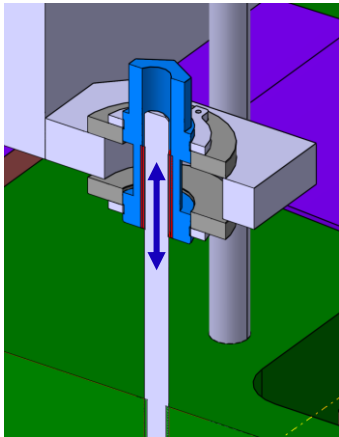
Instrumentation - Patch Panels

- Instrumentation from the module is connected first to Patch-Panel, then Patch-Panel to Cryostat
- Designed by Cosimo in collaboration with Conflectronics
 - *Signal and HV panels separated*
 - *Special Macor connector for HV*

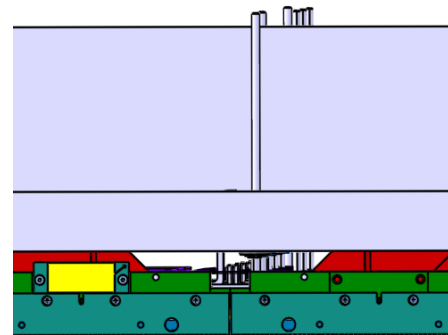
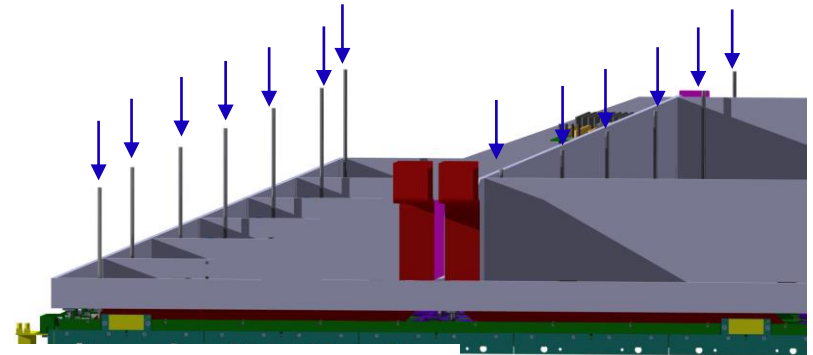


Planarity tuning

- Thermal decouplings are also used for planarity tuning
- Planarity is measured in warm condition thanks to rectified rods, seen from an optical level
- Deformation of the whole module has been calculated and optimised
 - Including extraction grid initial tension and contraction and sliding of the thermal decouplings.

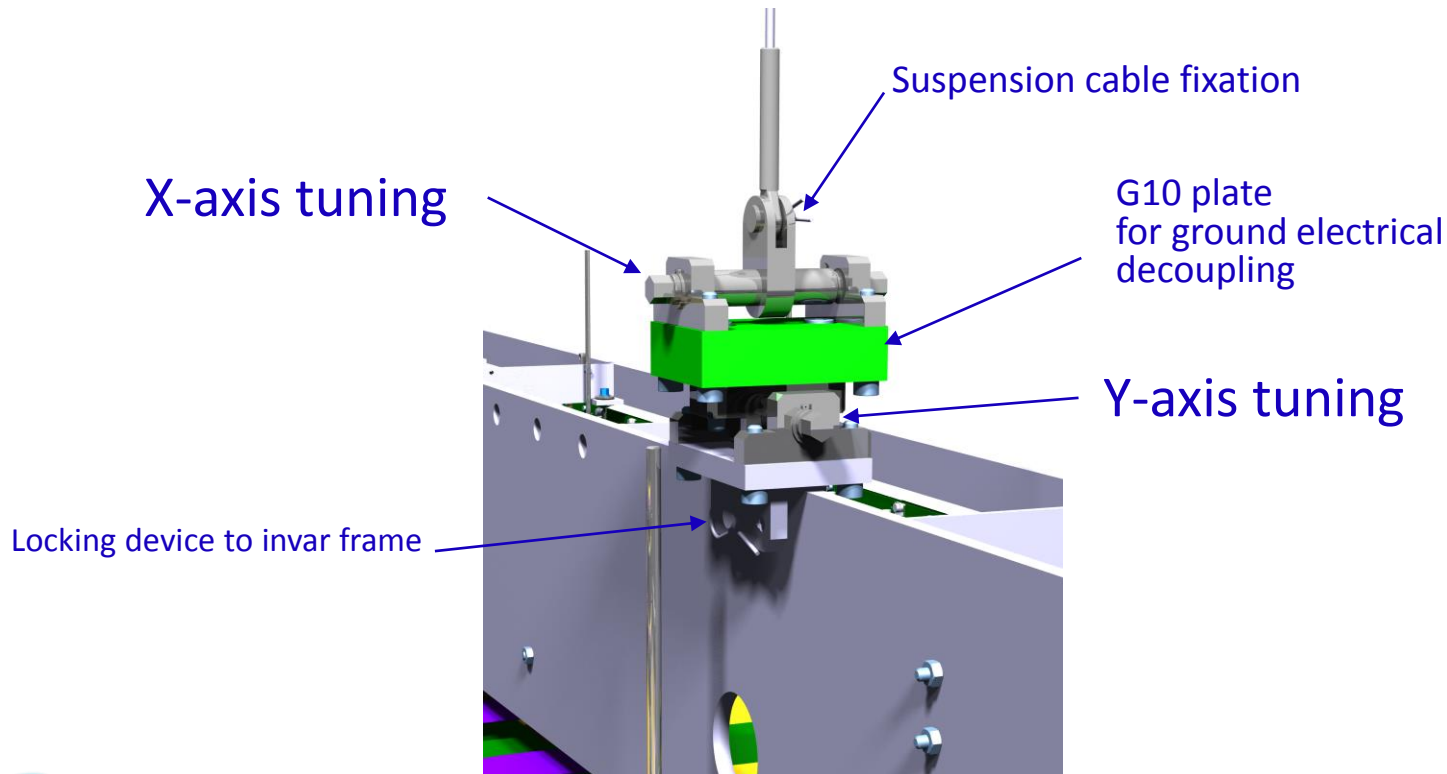
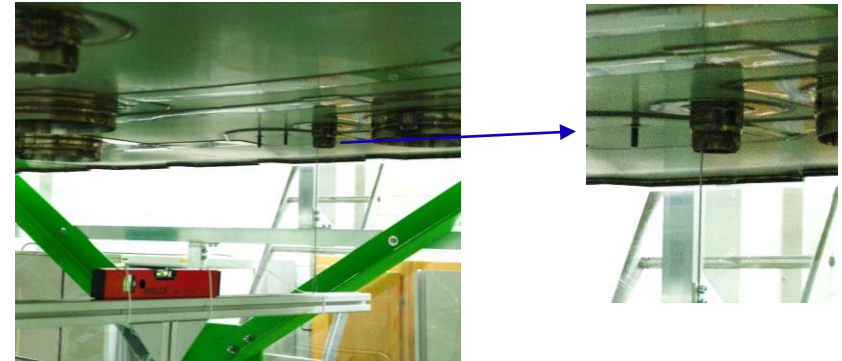


Final planarity defect calculation (mm)



Suspension cables anchoring system

- In case of variation of the cryostat pipes verticality, this system allows to change anchoring point on module, in warm conditions
- In cold conditions, this is done with SPFTs positions



Conclusions

- CRP
 - Components are about to be ordered and will be ready for installation in May
- SPFT
 - Design is ready for production, drawings are being prepared for order placement
- Grid production tooling
 - Several critical parts already produced and tested at LAPP
 - Drawings are ready for order placement
- More details on assembly and installation will be given in the dedicated talk.

Thanks for your attention

