A Large Ion Collider Experiment

MFT Disk/cone production and survey procedure

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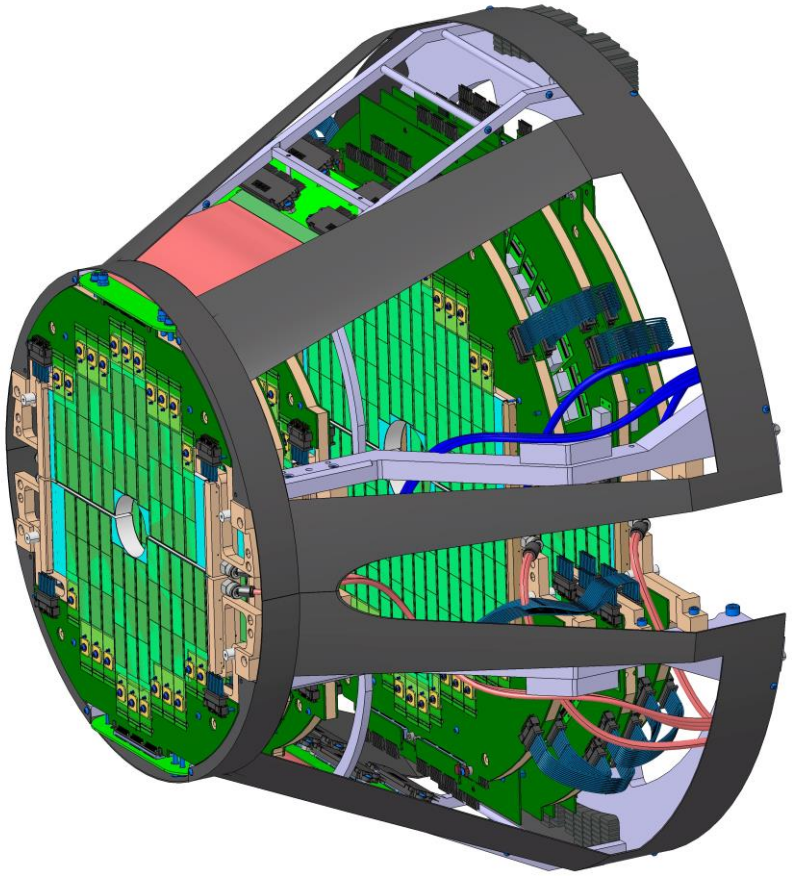
12th ALICE ITS Upgrade, MFT, and O2 Asian Workshop
Incheon, 19th – 21st of November, 2018

Outlook

- Cone design
  - General description.
  - PSU.
  - Motherboards
  - Services
  - Cone structure
- Disk design and production
  - Disk Design
  - Disk mechanical assembly
  - Disk Assembly
  - Conditioning, transport and storage of the Disks
- Disk metrology
- Summary

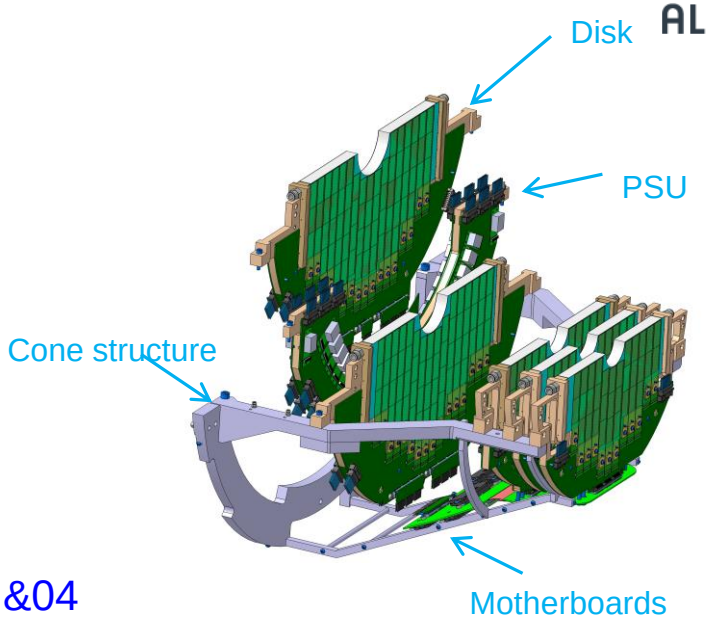
Cone design

- General description.
- PSU.
- Motherboards
- Services
- Cone structure

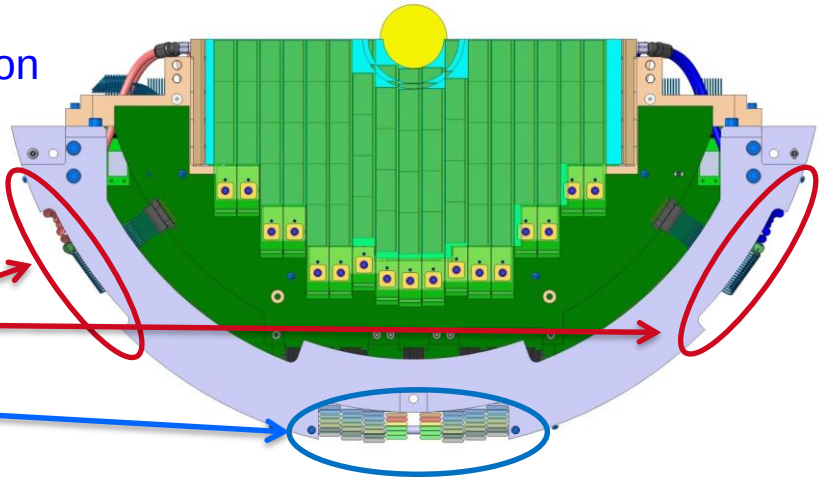


General description

- Disk
  - MFT is made of 5 detection disk
  - Four different designs
- Power Supply Unit
  - DC/DC for all half MFT
- Motherboard for Alpide readout
  - For disk 00, 01 & 02
  - Data cables directly mounted on Disk 03 &04
- Services
  - Water cooling, electrical power, air ventilation
- Cone structure

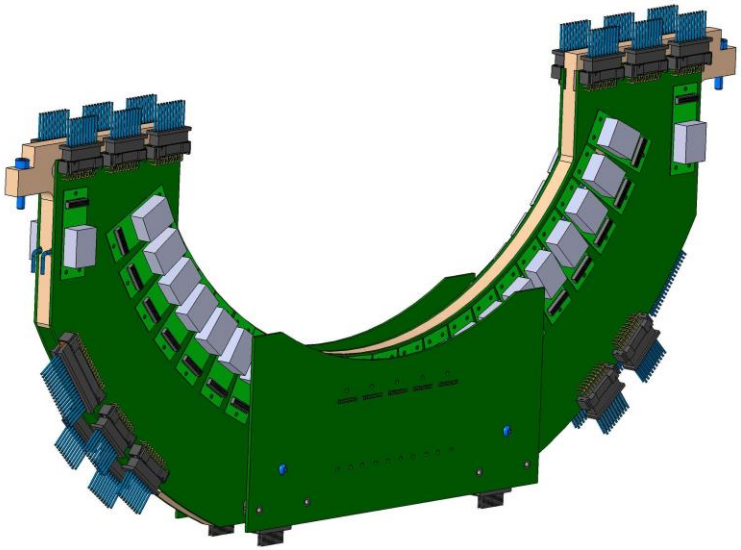


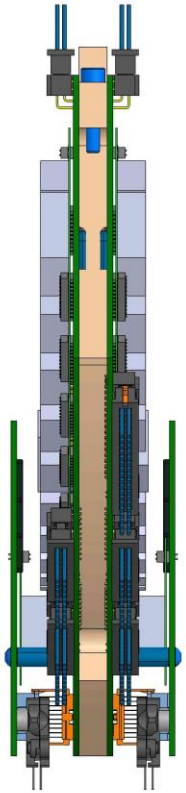
- Connection with the Patch Panel
  - For the power, cooling and air ventilation
  - For the data cables

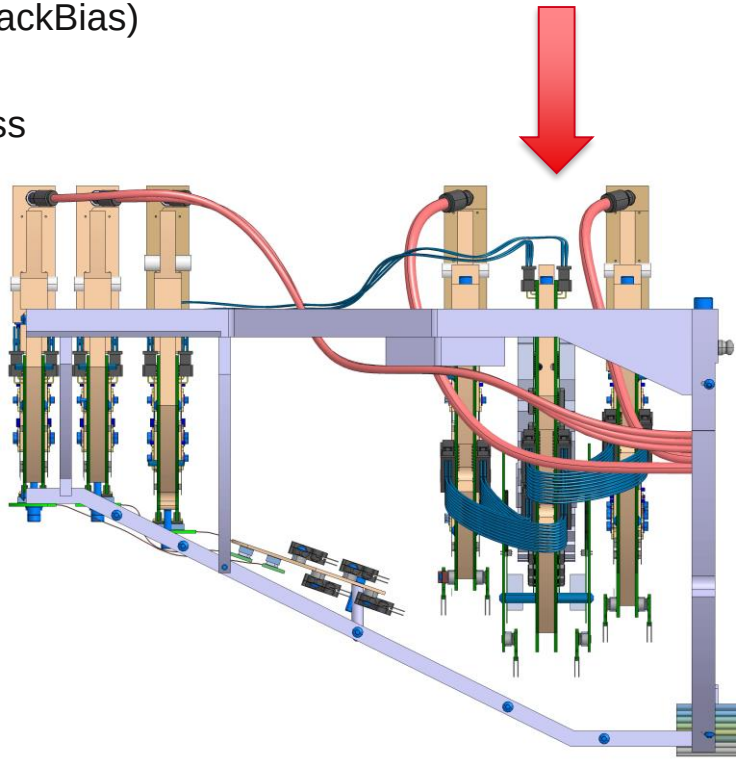


PSU

- Provide the power supply for the Alpide (AVDD, DVDD and BackBias)
- DC/DC to 1,8V (DVDD & AVDD)
- finalization of the mechanical and electronic design in progress
  - Cooling
  - Arrival of power

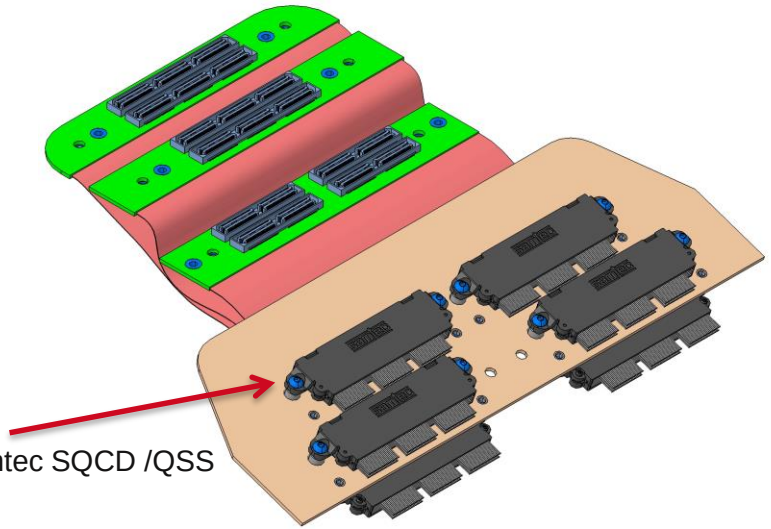


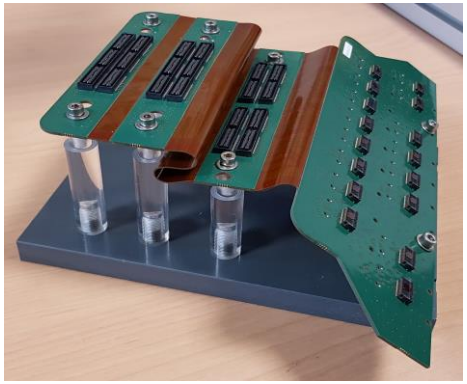




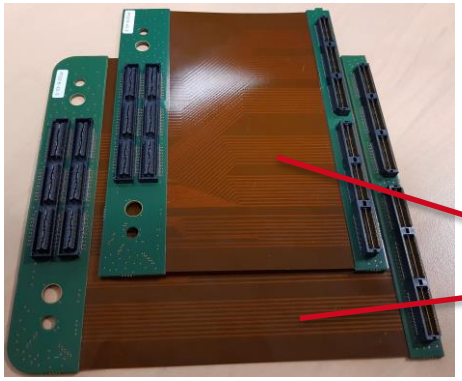
MotherBoards

- MotherBoard 00-01-02
  - New mechanical design fixed after analysis of the first prototype.
  - 2 first components of the new MotherBoard received
    - the flexibility is not good as it was expected,
    - Some modifications of the cone structure are necessary

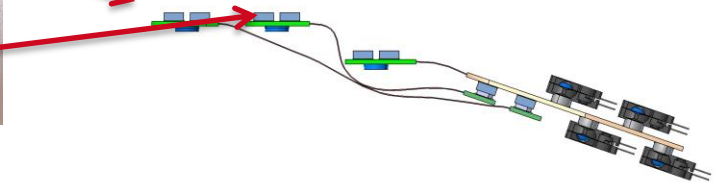




First prototype

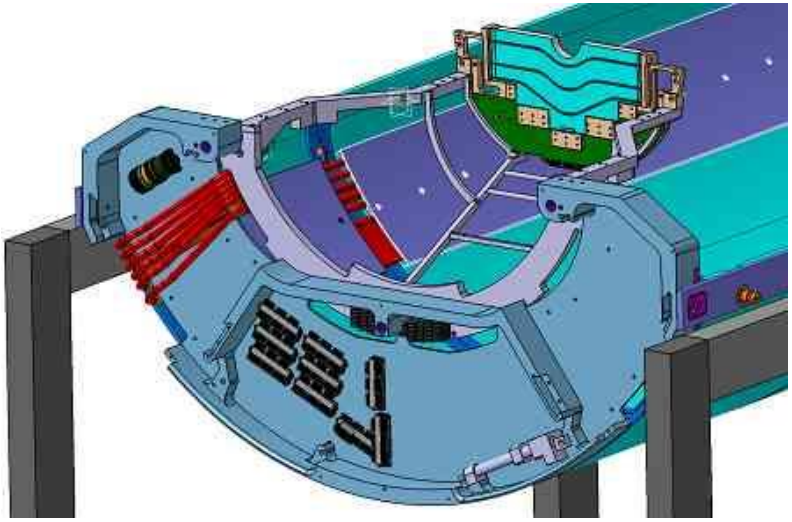


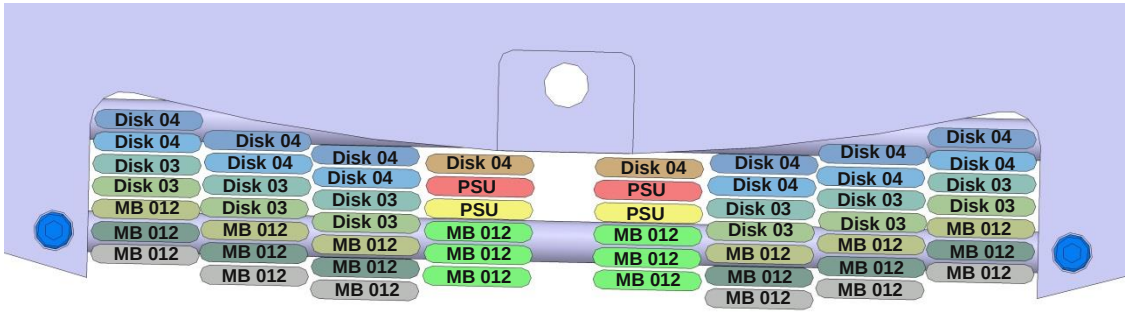
New prototype

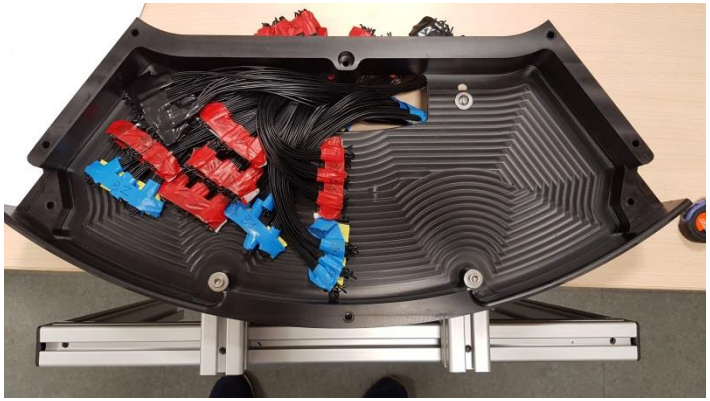


Data cables

- 54 sets of 16 twinax : 864 twinax
  - Disk 04 : 14 sets of 16 twinax
  - Disk 03 : 12 sets of 16 twinax
  - MB 012 : 24 sets of 16 twinax
  - PSU : 4 sets of 16 twinax
- Cable management
  - Test of cable management made this summer
    - No major issue
  - New test next month to set the exact length of each cable



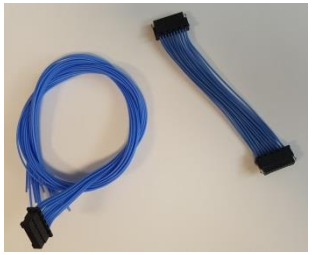


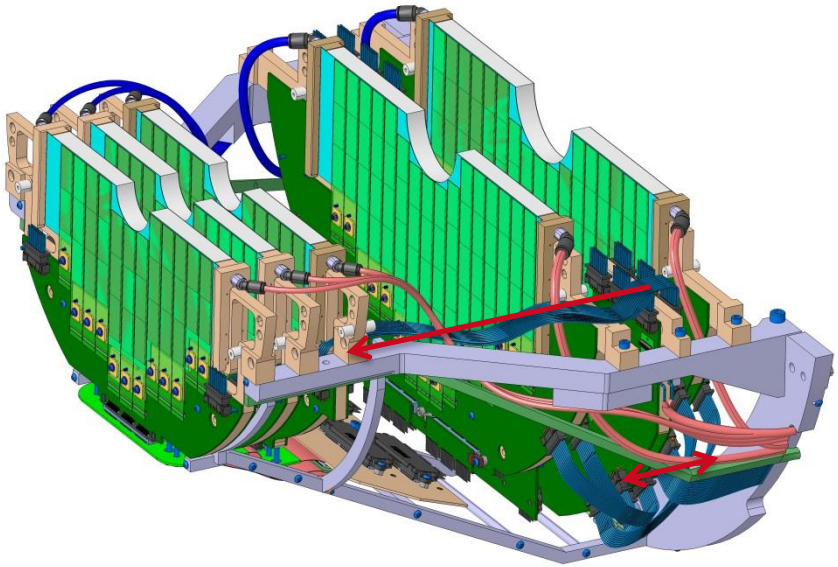


Link Cone / patchpanel

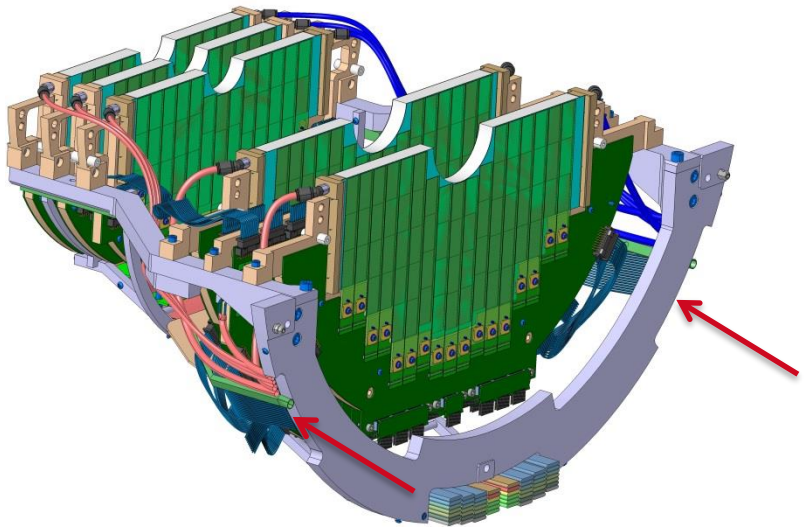
Power

- 22 sets of cables : 472 cables
  - 2 sets of 36 cables for the Power Supply Input
  - 20 sets of 20 cables for the link between PSU and Disks
- Cables and connectors T2M / S2SDT by Samtec





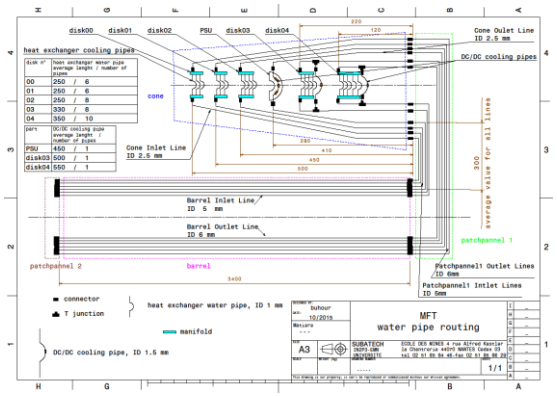
PSU Power Supply distribution



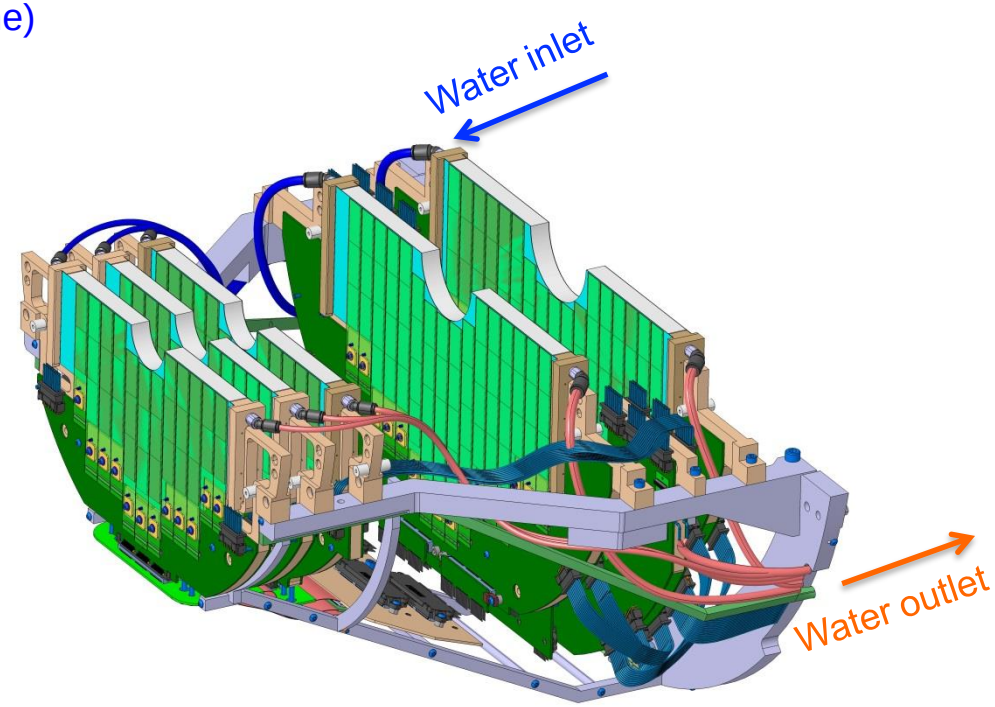
PSU Power Supply input

Water Cooling

- 6 waters pipes for the inlet and 6 for the outlet
  - Pipes Ext ø 6 mm for the Disk 03, 04 and PSU
  - Pipes Ext ø 4 mm for the Disk 00, 01 and 02
  - Pipe LeGris in Polyurethane
  - Connector Legris 3133 (inside cone)

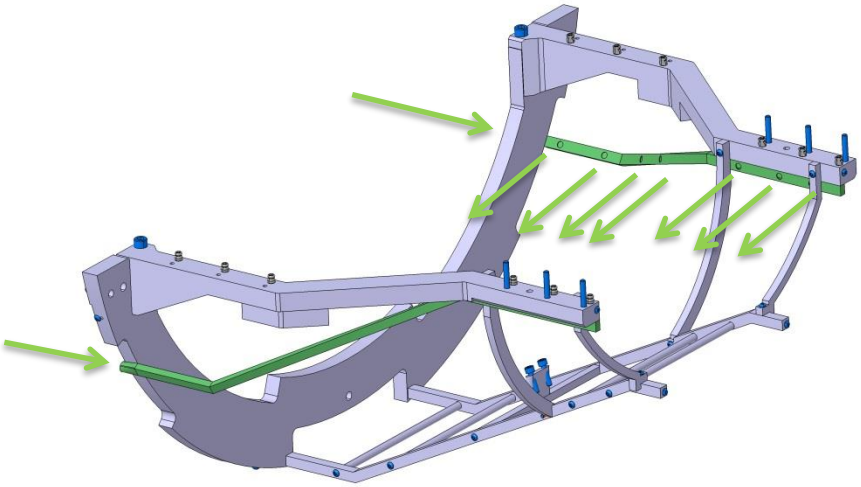


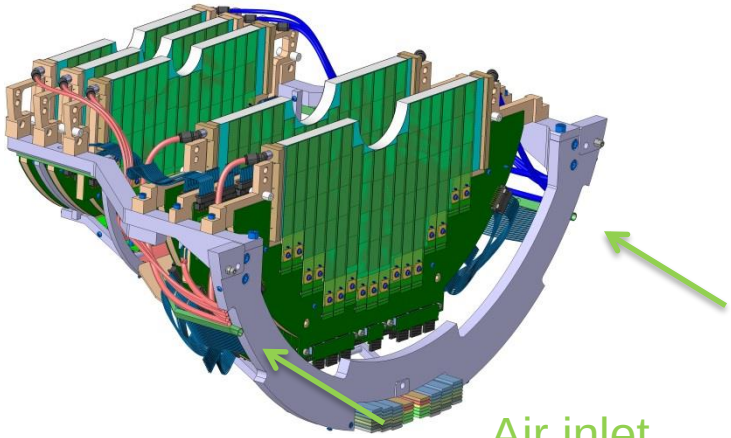
Cooling shema



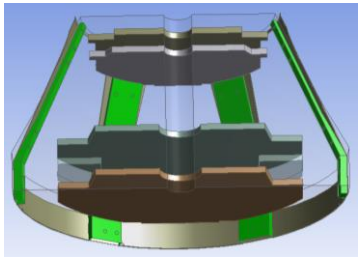
Air ventilation

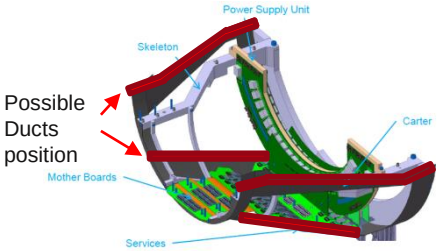
- First design
- 2 air pipes
  - Air pipes made in 3D printer





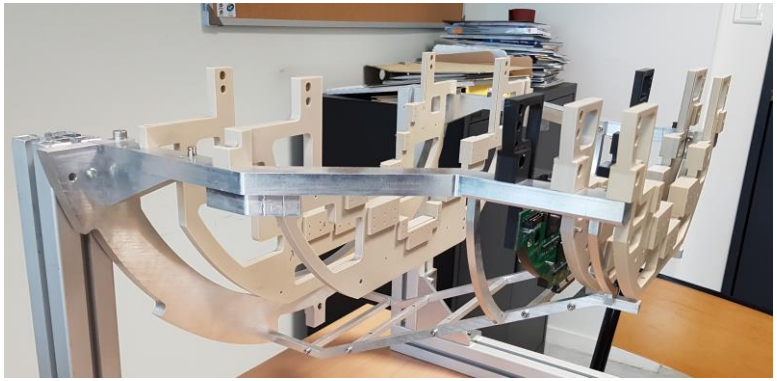
Air inlet



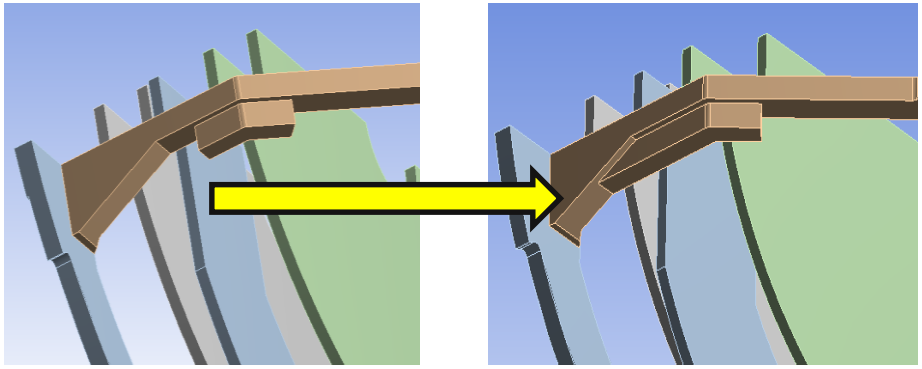


CERN proposal

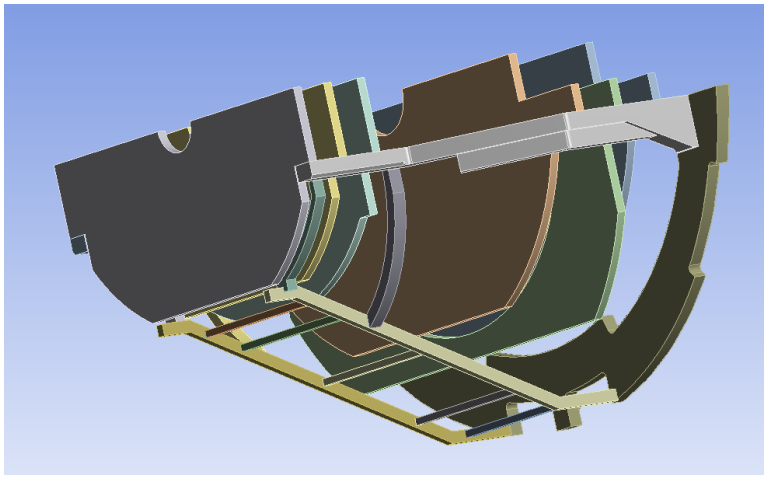
Cone Structure



- The last Cone prototype made at SUBATECH
  - For mechanical tests
  - For integration tests
  - For dimensional control
- Maximum strain is 0.167 mm
  - Too important, goal < 0.1mm
- Several shape modifications are proposed for the beam, the rib and the base plate.



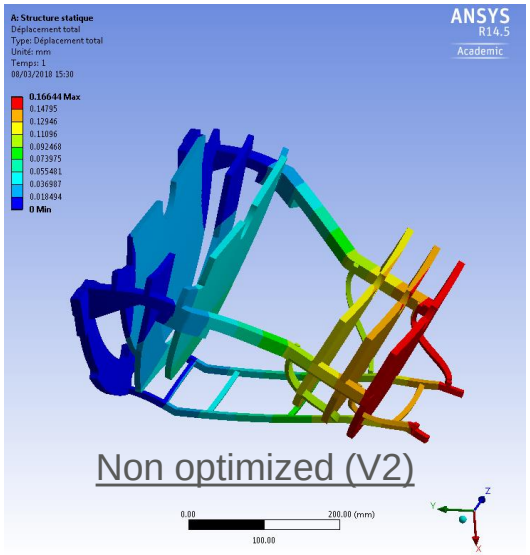
Modification example



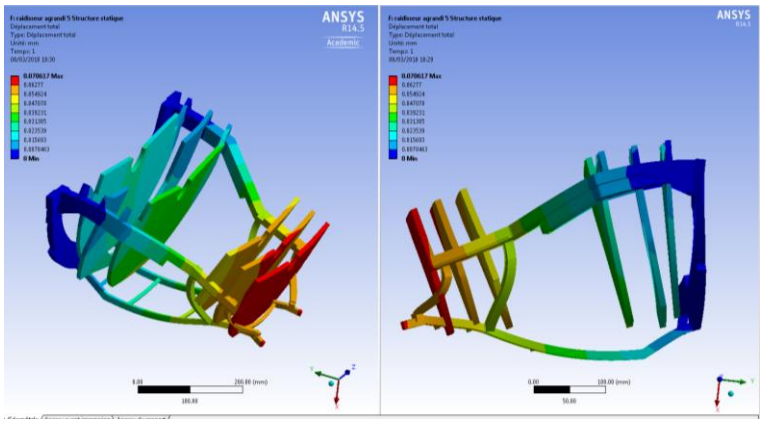
Cone Structure optimization

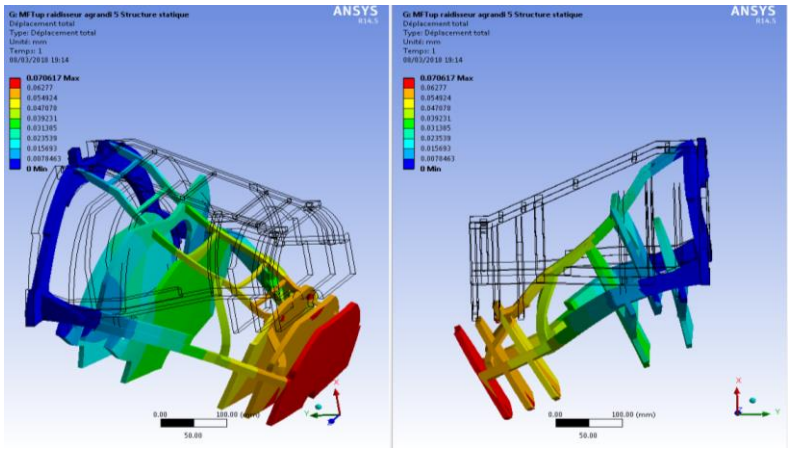
Results on optimized skeleton.

- Mechanical simulations done with the FEM software Ansys.
- Modeling of a full half cone, in volume, load taken into account are weight of PCB/disks, services, for MFT up and down
- Preliminary results : maximum deformation is 0.07 mm at the cone extremity.
- Optimized skeleton is satisfactory, with an increase of weight by 10%.
- Modifications aren't still integrated in the final design, this will be done once the design of the motherboard/PSU completed.



Non optimized (V2)



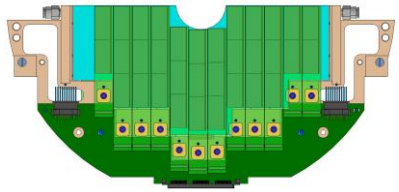


Optimized skeleton structure (V3)

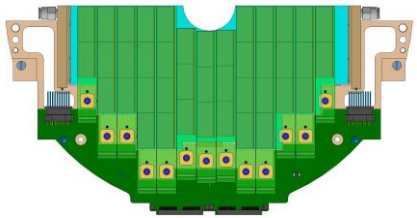
Disk Design

- MFT is made of 5 detection disks
- Disks are produced as double-sided (front/rear) half-disks (up/down):
  - Same mechanical design for up and down half disks
  - Same plane design for the front and the rear side of the disk
  - Four different designs:
    - Disk 00/01: exactly the same design, first and second half detection plane
    - Disk 02: third half detection plane
    - Disk 03: fourth half detection plane
    - Disk 04: fifth half detection plane

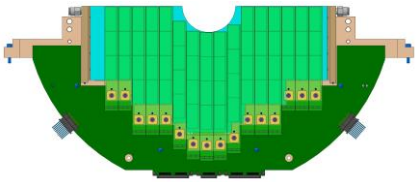
Disk00/01



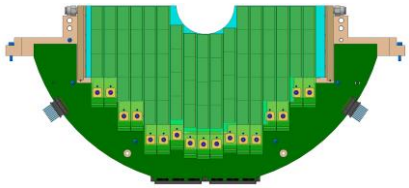
Disk02



Disk03

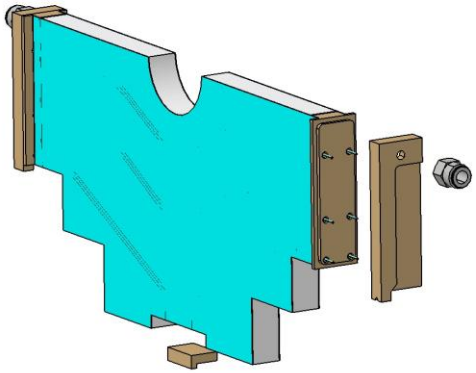


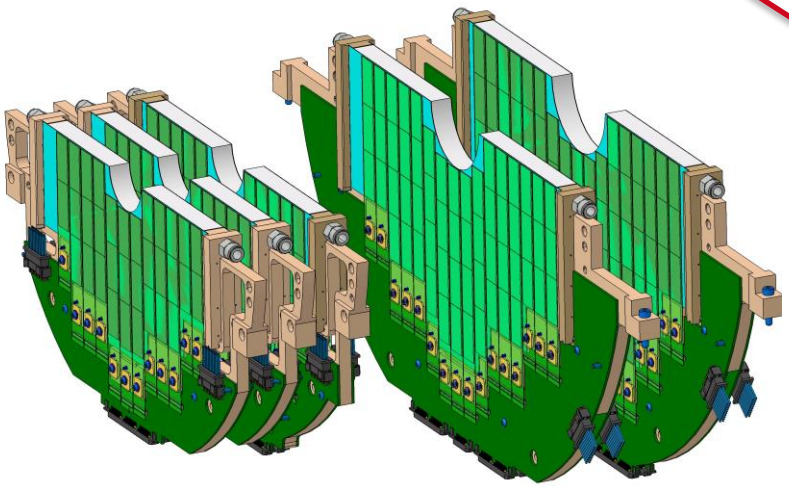
Disk04

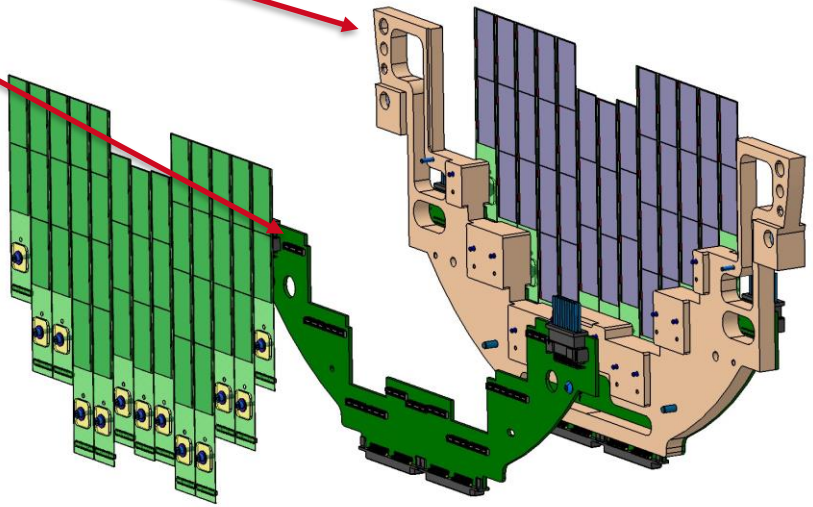


Disk Design

- Structure of disks :
  - Heat exchanger
  - Disk support
  - PCB
  - Ladders
  - Mechanical elements



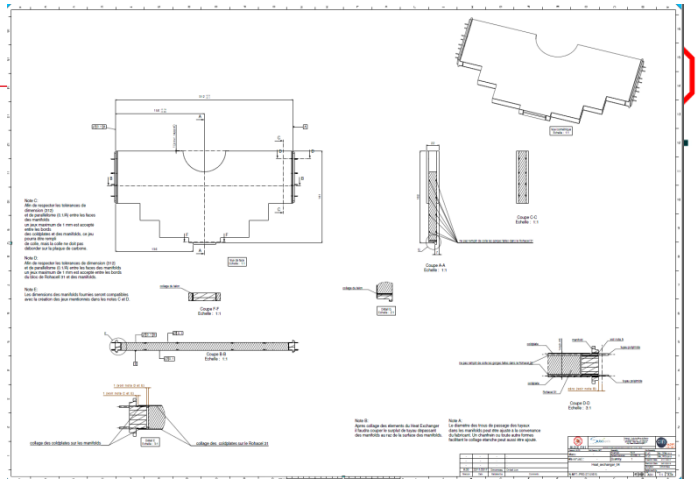




Exploded view of Disk 02

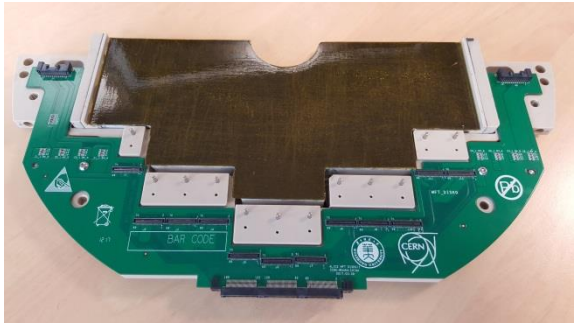
Mechanical disks fabrication

- Design and drawing done.
- DS fabrication ongoing @ subcontractor and Subatech
- HE fabrication ongoing @ subcontractor (AIC).
- Mechanical disk assembly @ Subatech.

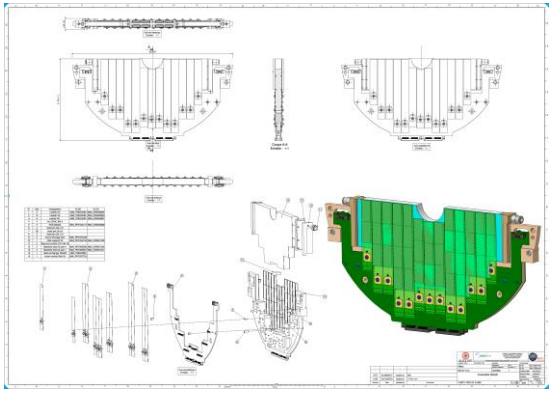


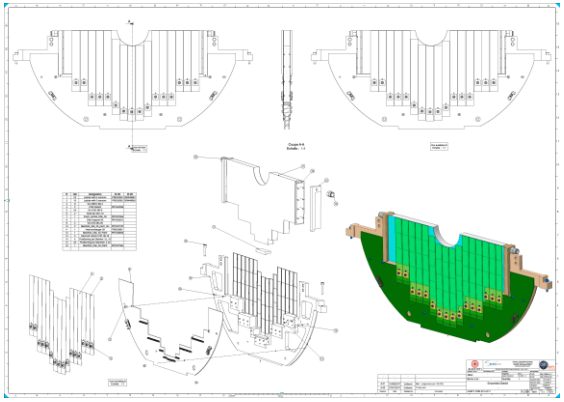
MFT HE

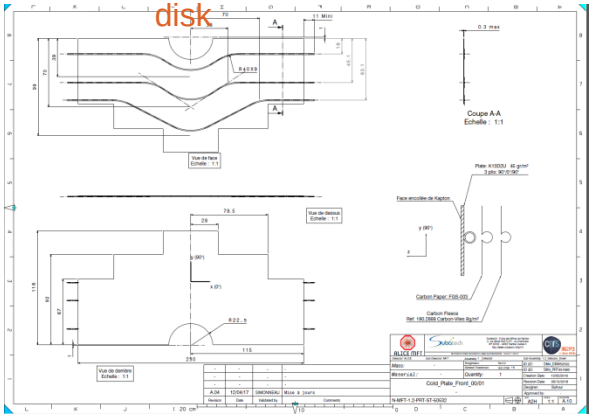
MFT DS



MFT mechanical disk







Mechanical disks fabrication planning:

- HE00-01 tooling done, series fabrication ongoing, 7 items to be manufactured for the end of 2018.
- HE04 tooling on fabrication, first HE04 planned for December 2018, 4 items to be manufactured.
- HE02 and HE03 tooling on fabrication, first HE02 and HE03 planned for January 2018, 4 items of each to be manufactured.

- All the HE00-01 fabrication scheduled for December 2018 (7 items) or early 2019.
- All the HE02, HE03 and HE04 fabrication planned for June 2019 (1 item every 2 week produced from February 2019).

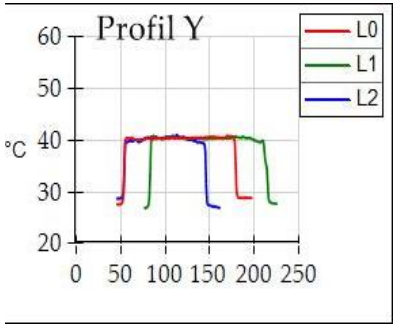
Oct 18	Nov 18	Dec 18	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19
1 HE00-01 (done)	3 HE00-01 (ongoing)	3 HE00-01 1 HE04	1 HE02 1 HE03	1 HE02 1 HE04	1 HE03 1 HE02	1 HE04 1 HE03	1 HE02 1 HE04	1HE03

- Total number planned: 7 HE00-01 (6 needed for 1.5 MFT), 4 HE02 to 04 (3 needed for 1.5 MFT).

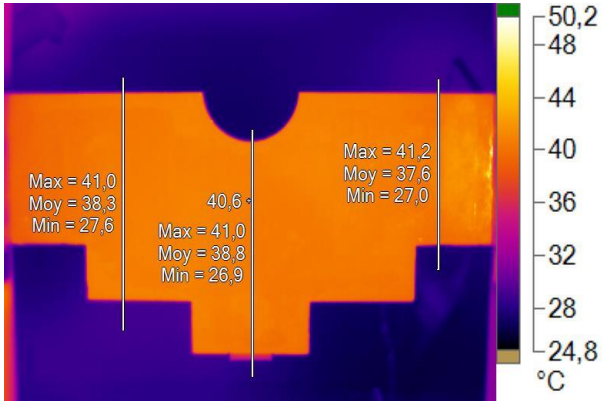
Flowrate and pressure control

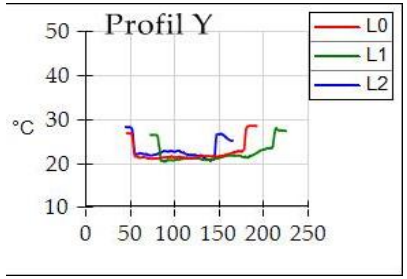
Thermal tests.

- Done on HEp6, both face tested.
  - No heated fake HIC and thermocouple glued on HE (to prevent HE surface damages).
  - Heat provided by IR lamps, measures made with IR camera.
  - HE surface heated up to 40°C (corresponding to the mean temperature reached by the heated fake HIC).
  - Cooling measurement made with a 0.2 l/mn flowrate.
  - Cooled HE mean temperature at 22.7°C with cooling water at 20°C.
  - Results are consistent with previous tests and simulations. => process ok for testing the HE production.

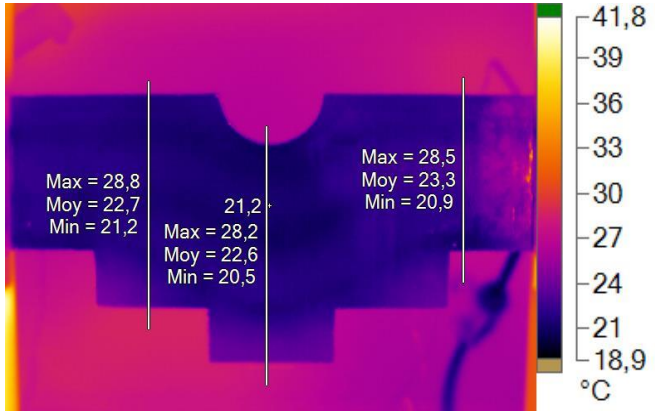


HE heated without cooling



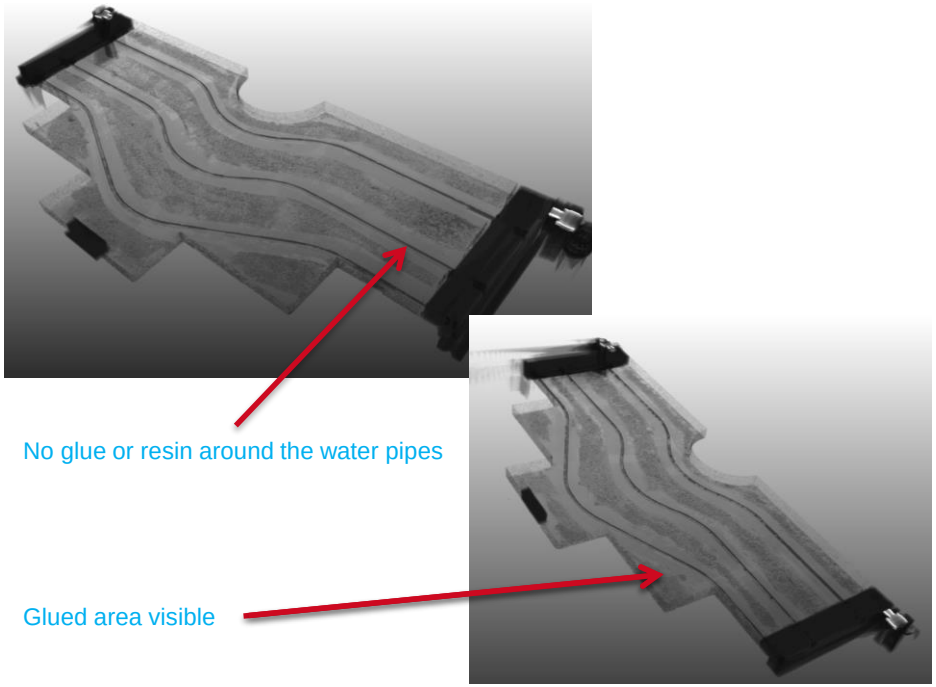


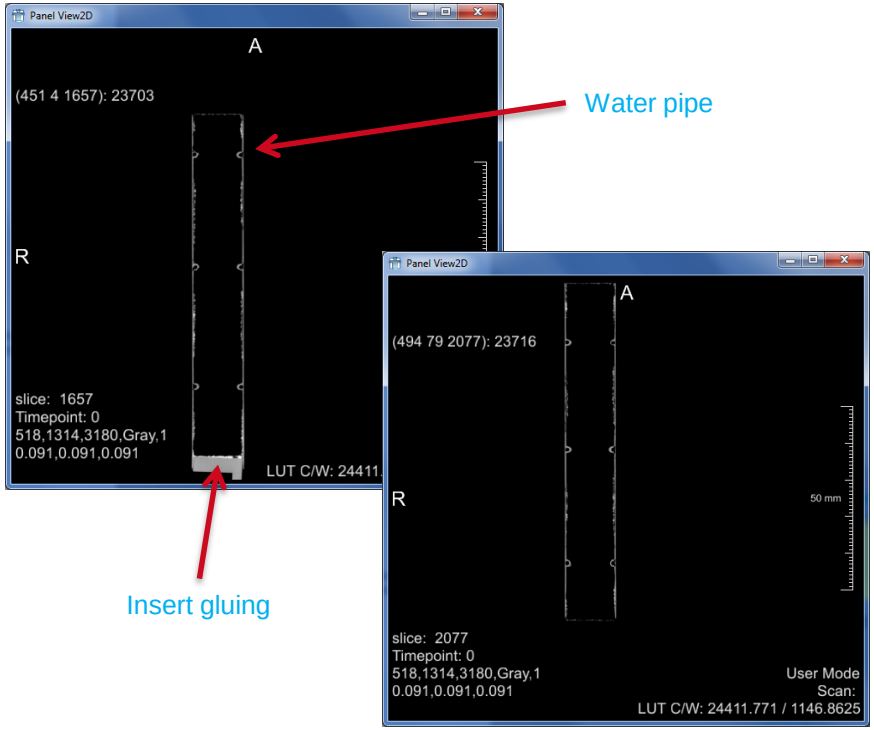
HE heated with cooling



Tomography.

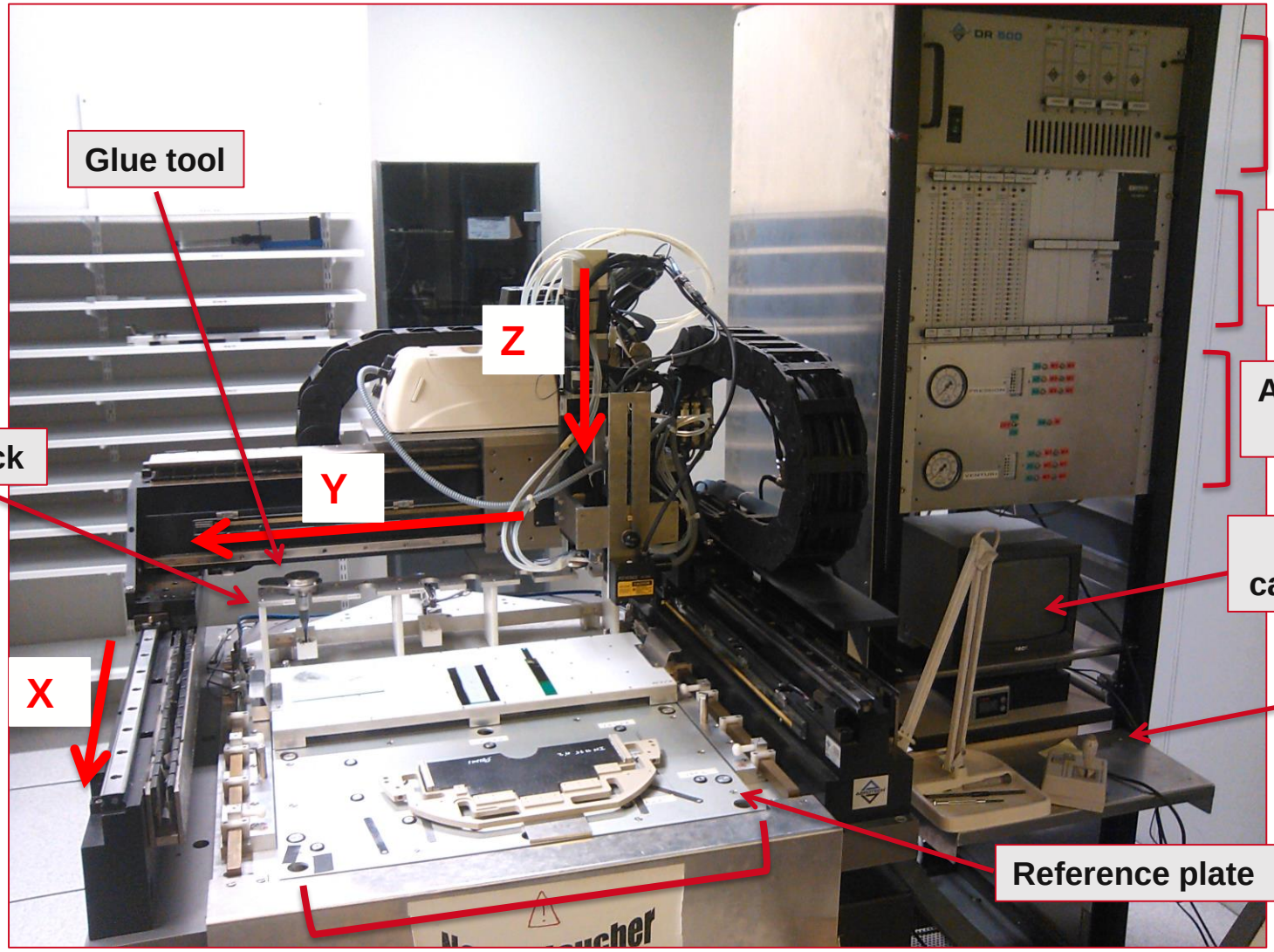
- Non destructive test done for:
  - Checking for blocked water pipe.
  - Checking the presence of glue (in the gutter, close to the insert and manifolds).
  - Done in Subatech, test duration around half a day.
  - No unwanted glue or resin leftover, water pipe visible and clean . => fabrication process ok for serie HE production.





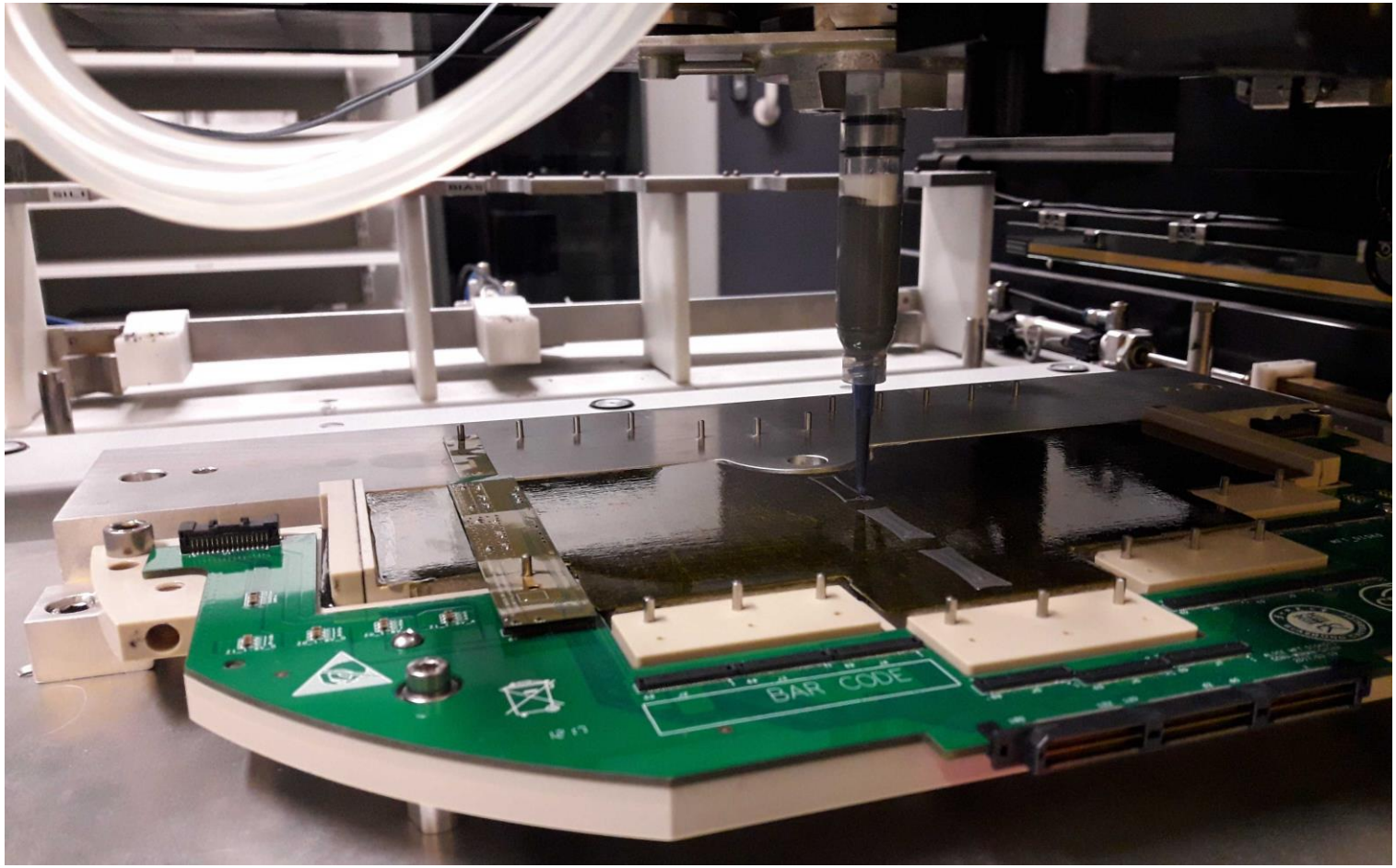
Disk Assembly

The gantry robot: 4 axes (X, Y, Z, θ)



Disk Assembly

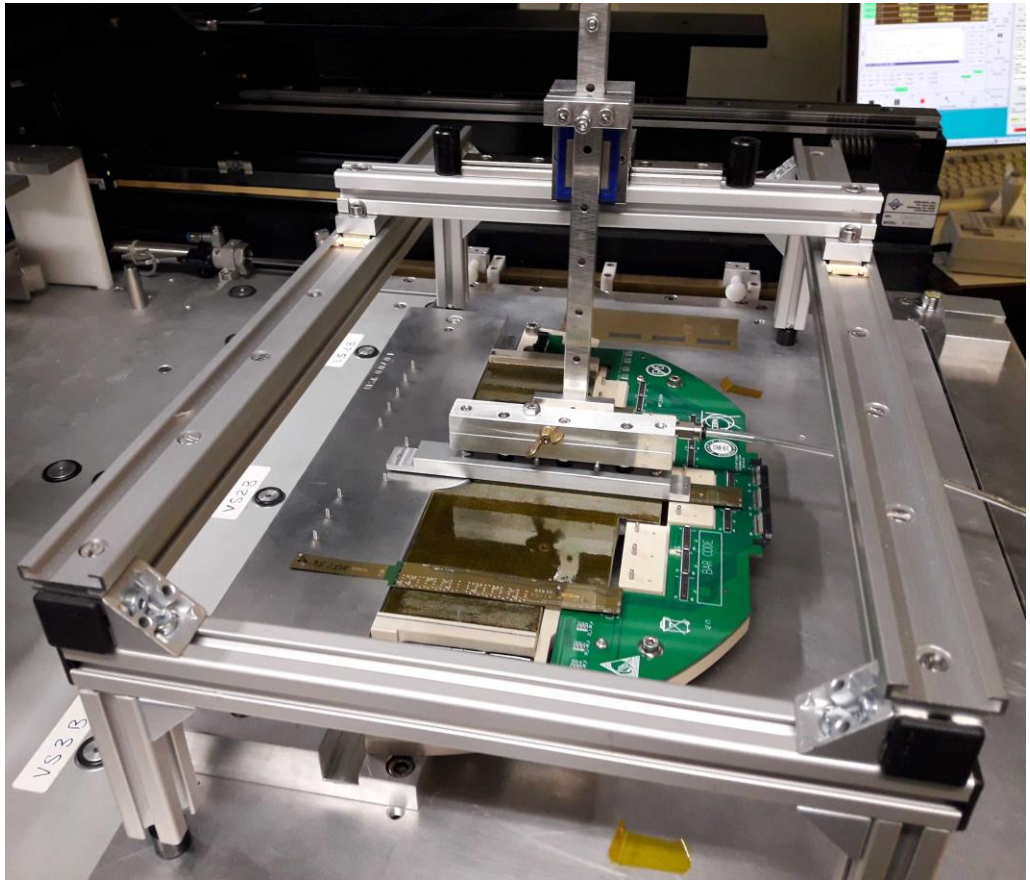
Glue dispensing on the cold plate



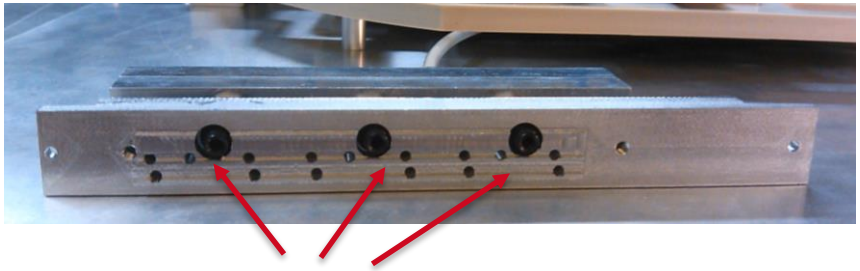
The glue dispensing is performed with a needle at 500µm above the heat exchanger

Disk Assembly

Assembly steps



3 sensor gripper



- The gripper is designed to grab the ladder in its storage box and position it on the cold plate. The glue is then crushed 30 s with a weight of 50 g/sensor.
- The ladder is connected to the PCB

Disk Assembly

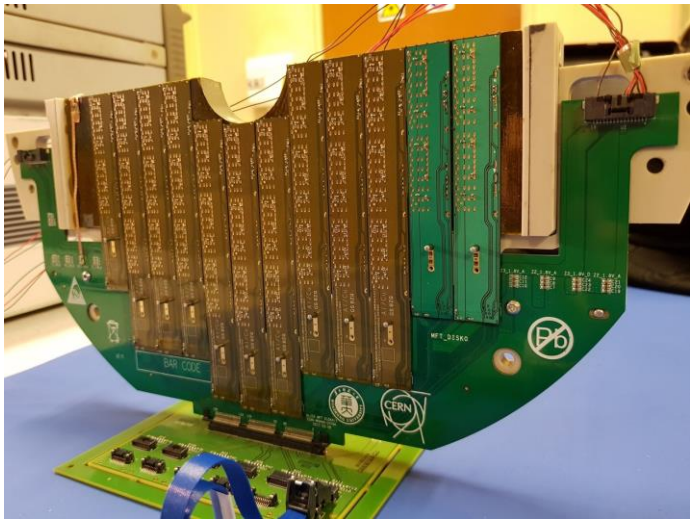
Scan of the ladder profile

- Scan of the surface of the ladder
- Heat exchanger scanned before gluing

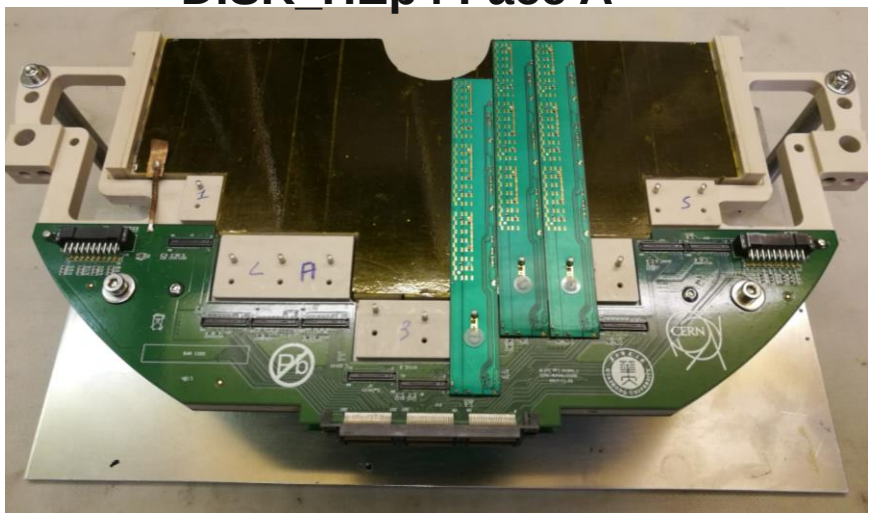
Disk Assembly

Assembly status

- First Disk PRR disk
  - assembled on both sides
- Second disk : HEp4



DISK_HEp4 Face A

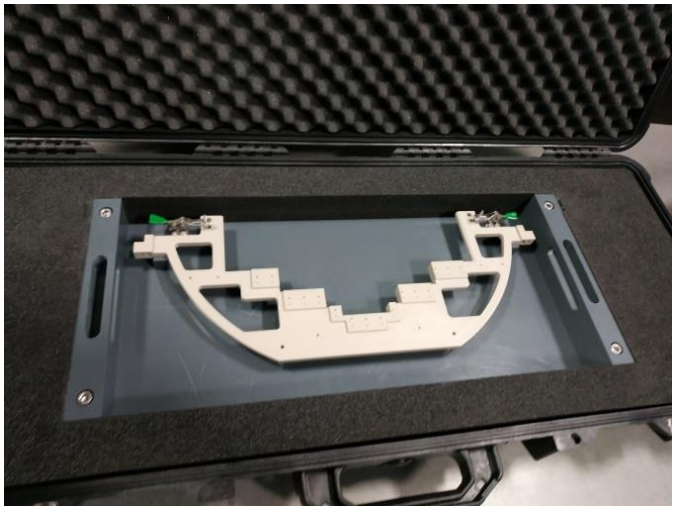


DISK_HEp4 Face B

Both have been tested under beam (see Raphael Tieulent presentation)

Conditioning, transport and storage of the Disks

- Protector case PeliCan 1700
  - Watertight, crushproof, and dustproof
  - securely store the spare disks
- Shipping between Lyon and Nantes
- Storage in good conditions the spare disks
- 10 units have been ordered and equipped

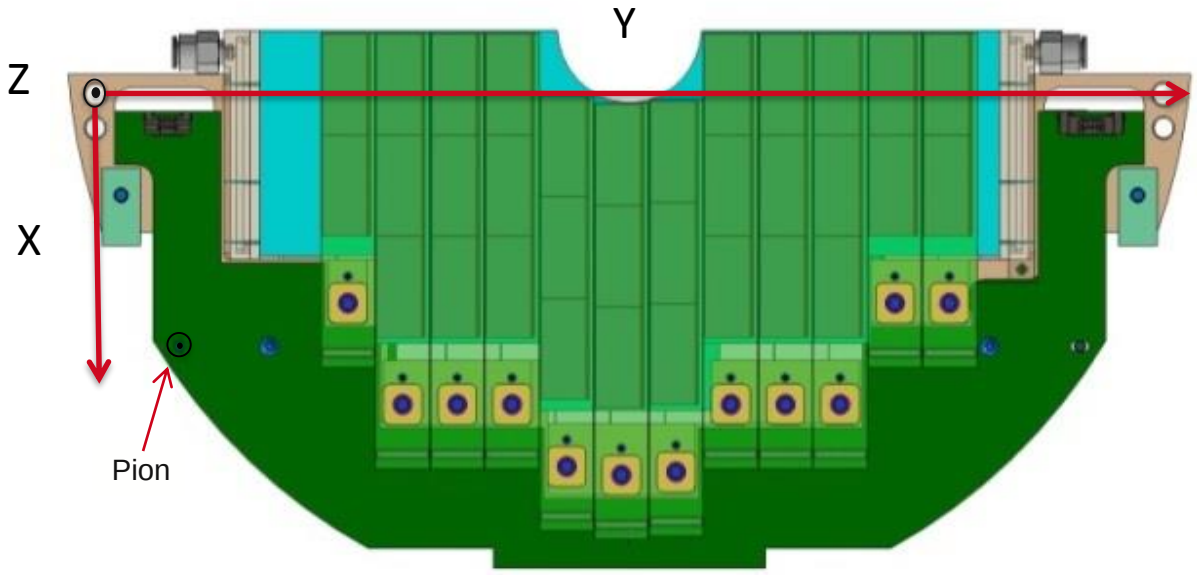


Disk transport tooling for Disk 03 and 04

Disk transport tooling for Disk 00/01 and 02

Disk metrology

Metrology of the Disk geometry

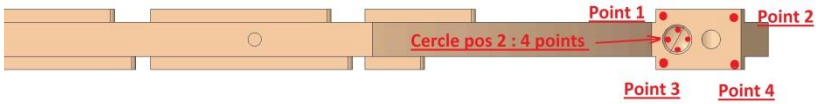


3 steps :

- Survey of the disk support
- Survey of the mechanical disk
- Survey of the sensor position

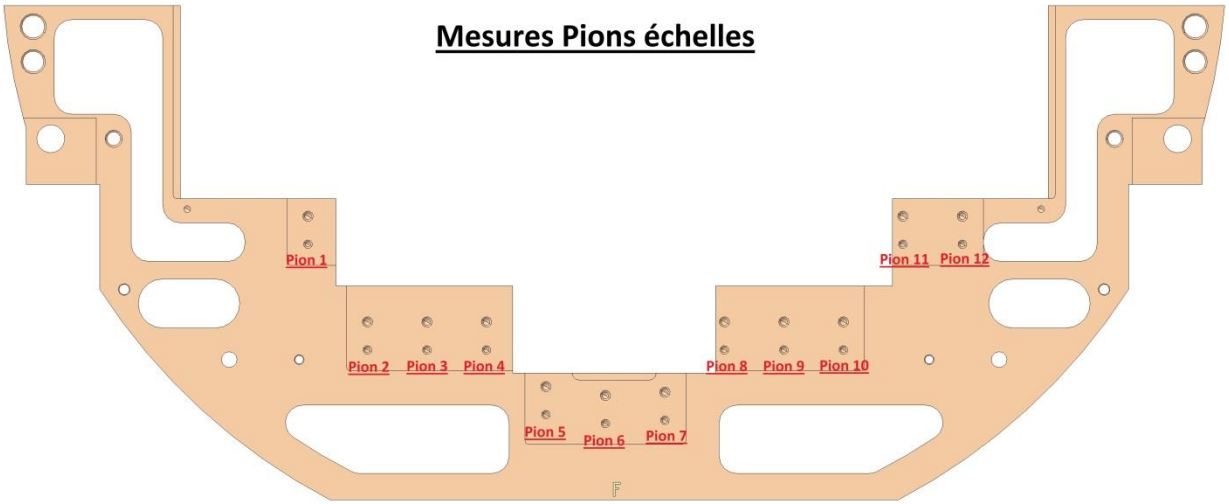
Disk metrology

Survey of the disk support



Mesure plan de pose 2

Mesures Pions échelles

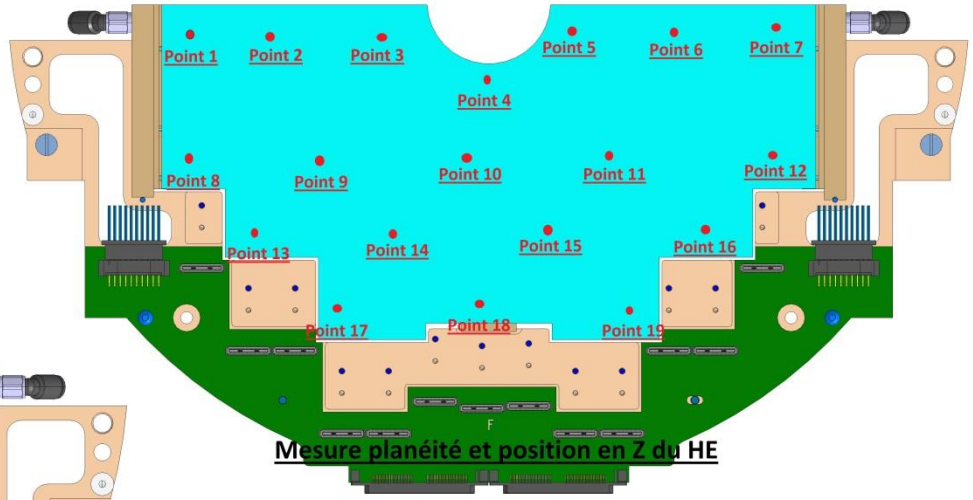


Measurements to be done :

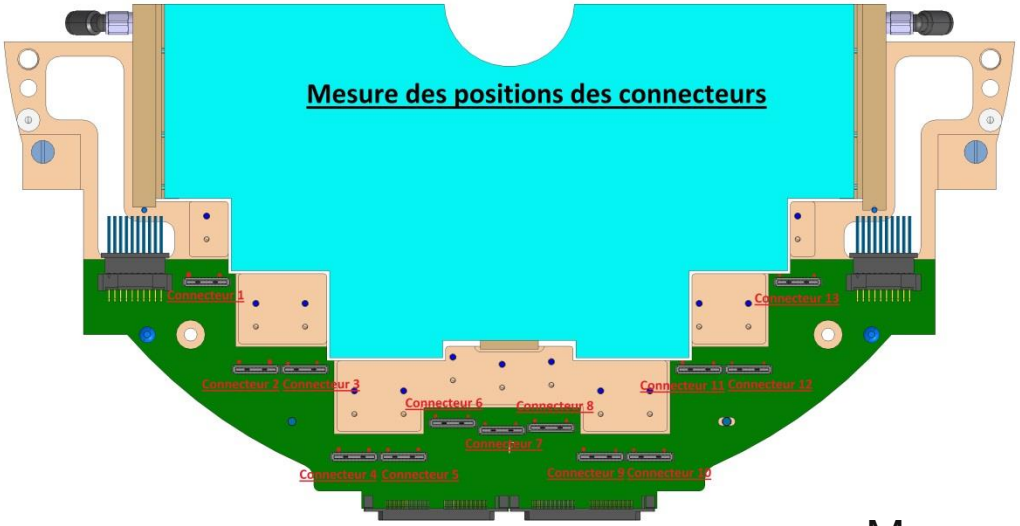
- Flatness of the disk support
- Ladder pin positions
- PCB pin position
- Reference hole and area for the disk mounting in the cone

Disk metrology

Survey of the mechanical disk



Mesure planéité et position en Z du HE

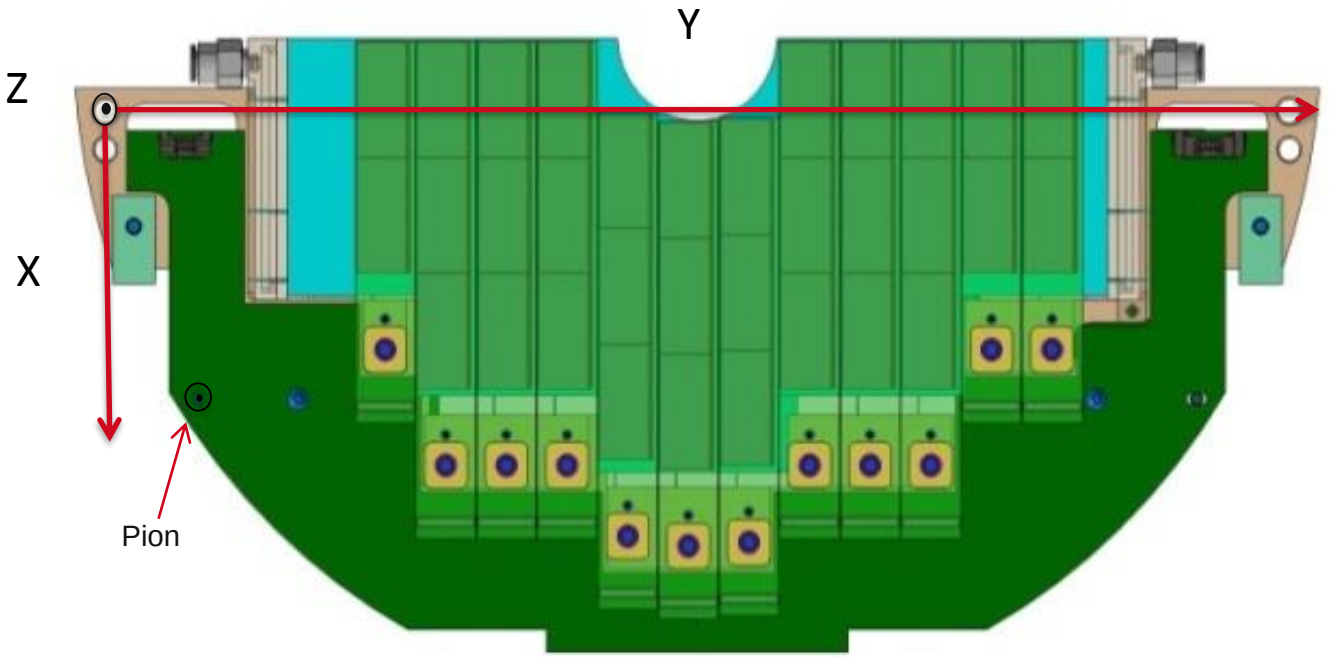


Measurements to be done :

- Position of the heat exchanger
- Positon of the PCB ladder connector

Disk metrology

Survey of the sensor position



Measurements to be done :

- Position of the sensor

Disk metrology

Status of the disk geometry

- Survey of the disk support
  - Procedure defined
  - CMM programmed and operational
  - Already used for the disk support 01 produced
- Survey of the mechanical disk
  - Procedure defined
  - CMM partially programmed
  - Next mechanical disk waited for validation
- Survey of the sensor position
  - Procedure defined
  - PRR disk waited for the programming and validation

Disk AIT defined, to be confirmed
Mitutoyo training is foreseen at the end of November

Summary

- Cone design
  - Design done, modifications needed due to the mother board
  - Integration of services done
  - Structure optimized, will be produced once the modifications done
- Disk Support Design & Production :
  - Production scheduled
- Heat Exchanger Design & production
  - Thermal tests : Satisfactory results, consistent with expectations
  - Quality control using tomography
  - Production scheduled
- Mechanical disk assembly
  - Procedure defined and validated with a first prototype (HEp4)
  - First production assembly ASAP
- Disk Assembly
  - Assembly procedure validated
  - One day necessary to assembled one disk
  - Two disk assembled with ladders
- Survey
  - Procedure defined, programming of the CMM under way
- Conditioning, transport and storage of the Disks :
  - 10 storage box equipped with tooling

Thank you

G. Bouvet, S.Bouvier, J.M. Buhour, C.Crozatier, R Della Negra, S. Fresneau, M. Guillamet, F.Manso, T.Milleto, P. Le Ray, E. Schibler, J. Simonneau

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