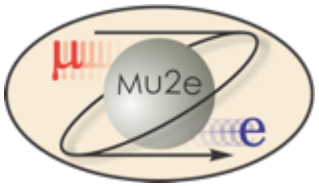
Fermilab

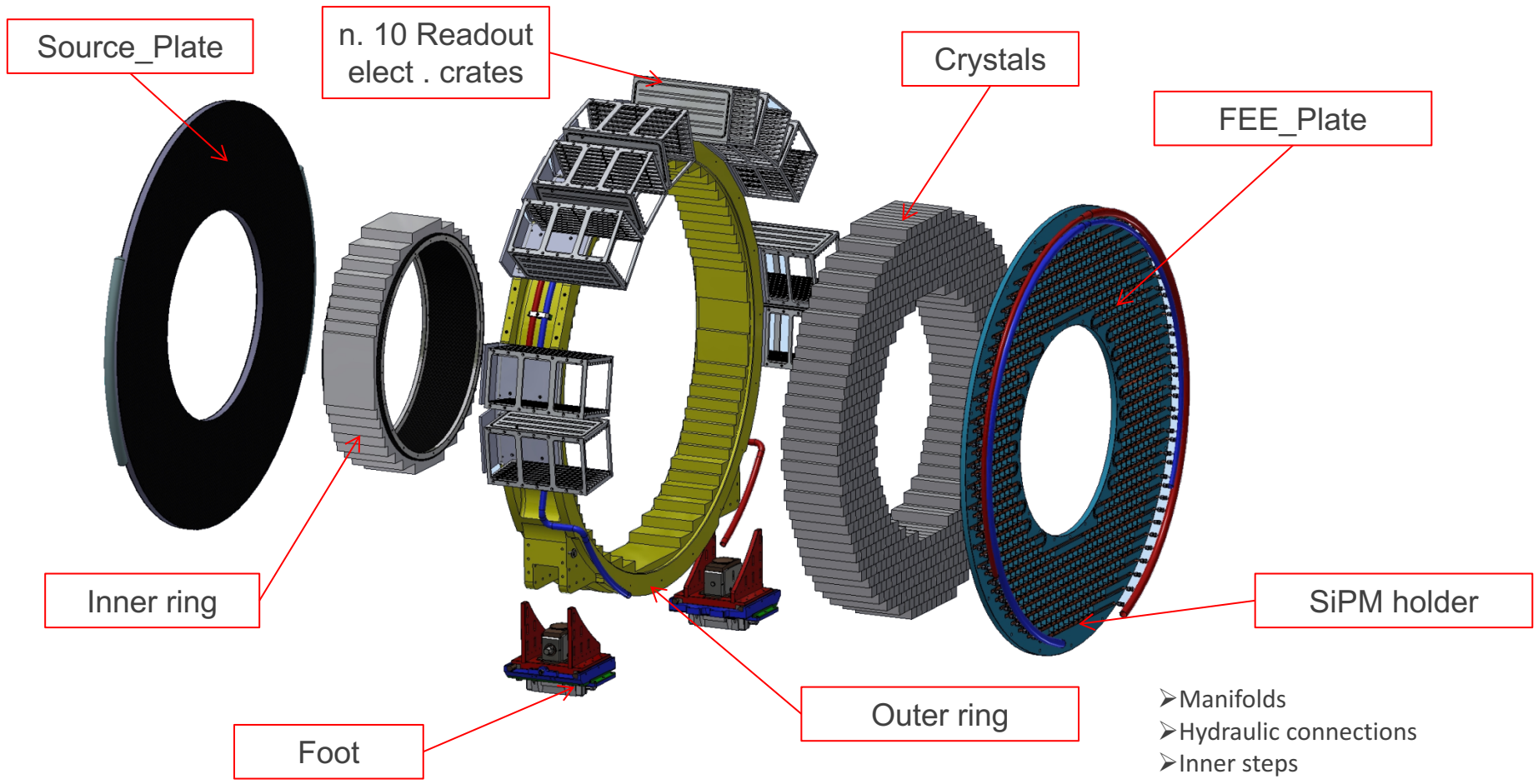
Mu2e Calorimeter mechanics activities and plans. Module 0 and Mock up assembly

F. Happacher
LNF INFN, Italy



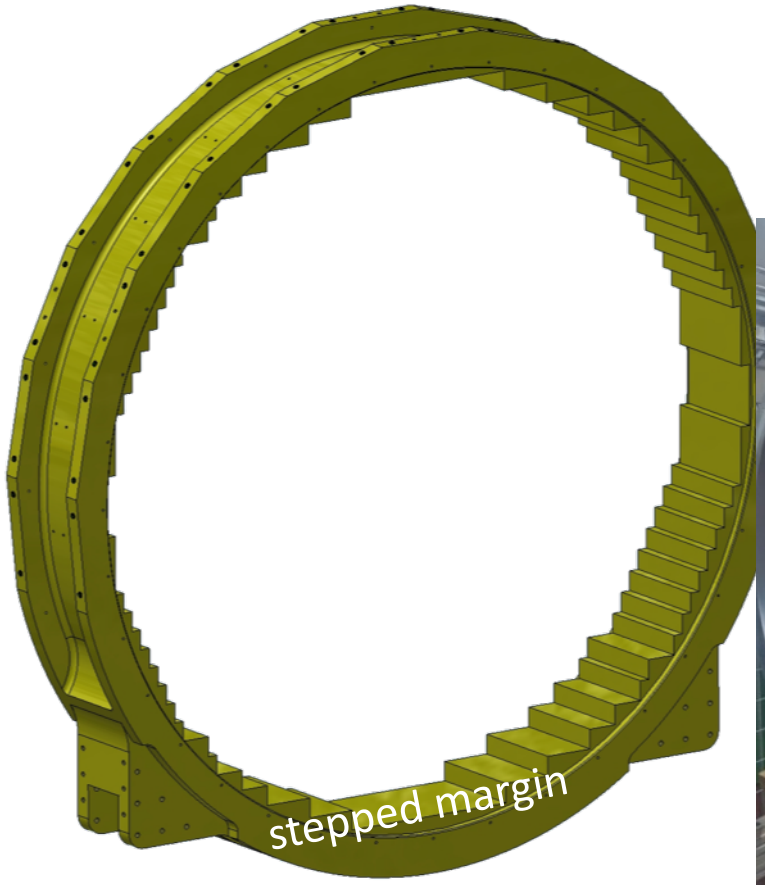
Main components

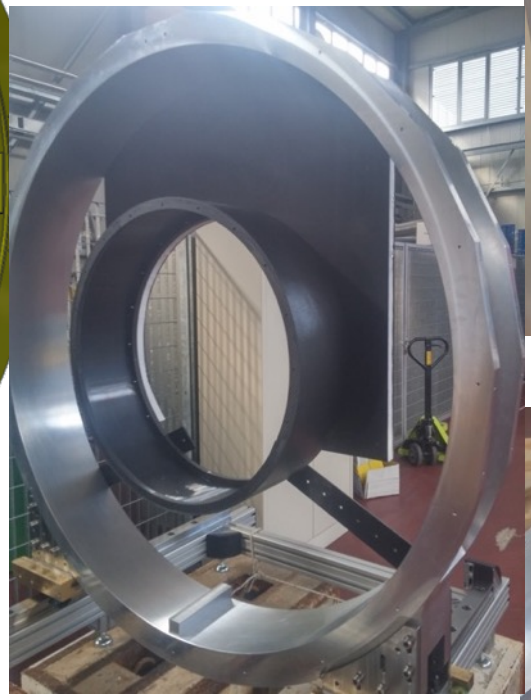
The calorimeter consists of two disks each one composed of:

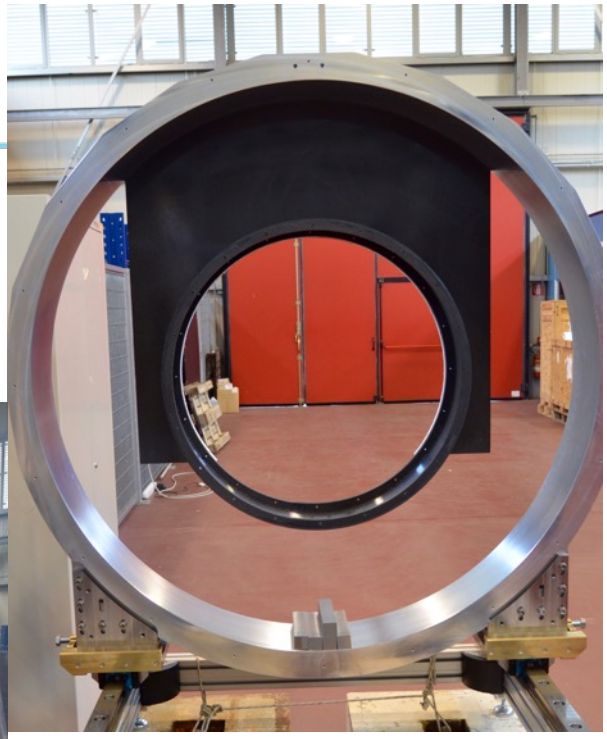


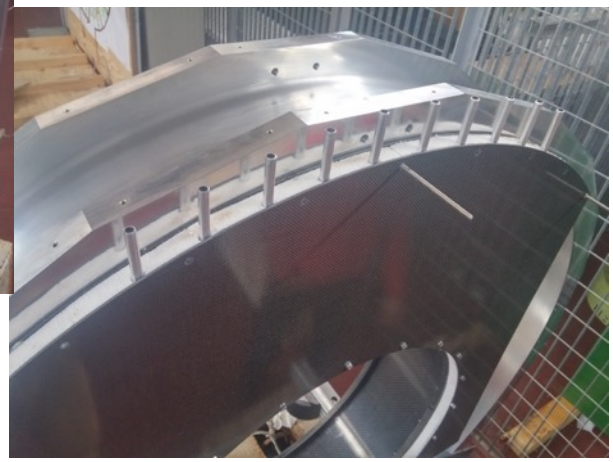
- Manifolds
- Hydraulic connections
- Inner steps
- Outer steps
- Alignment targets

Support rings









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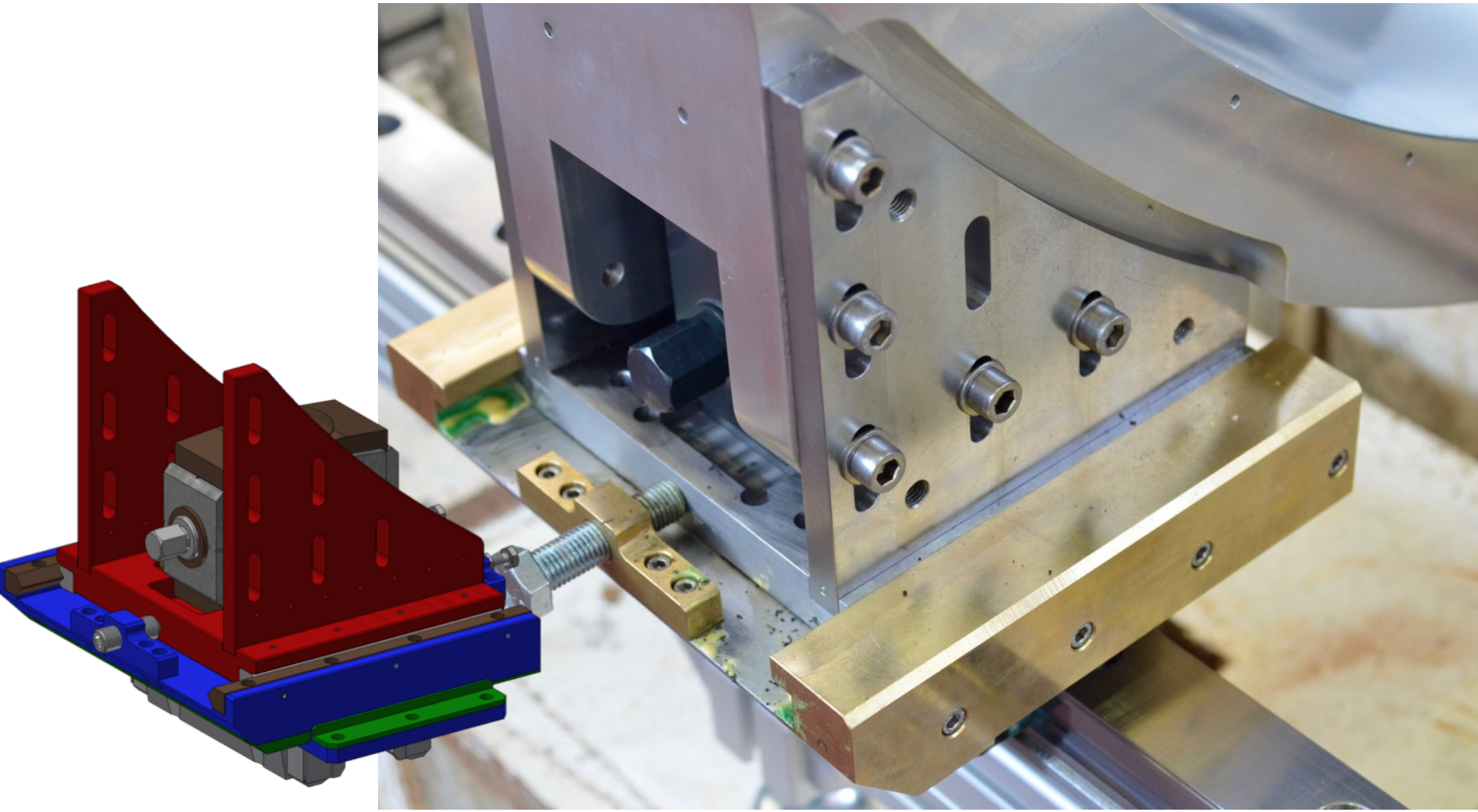
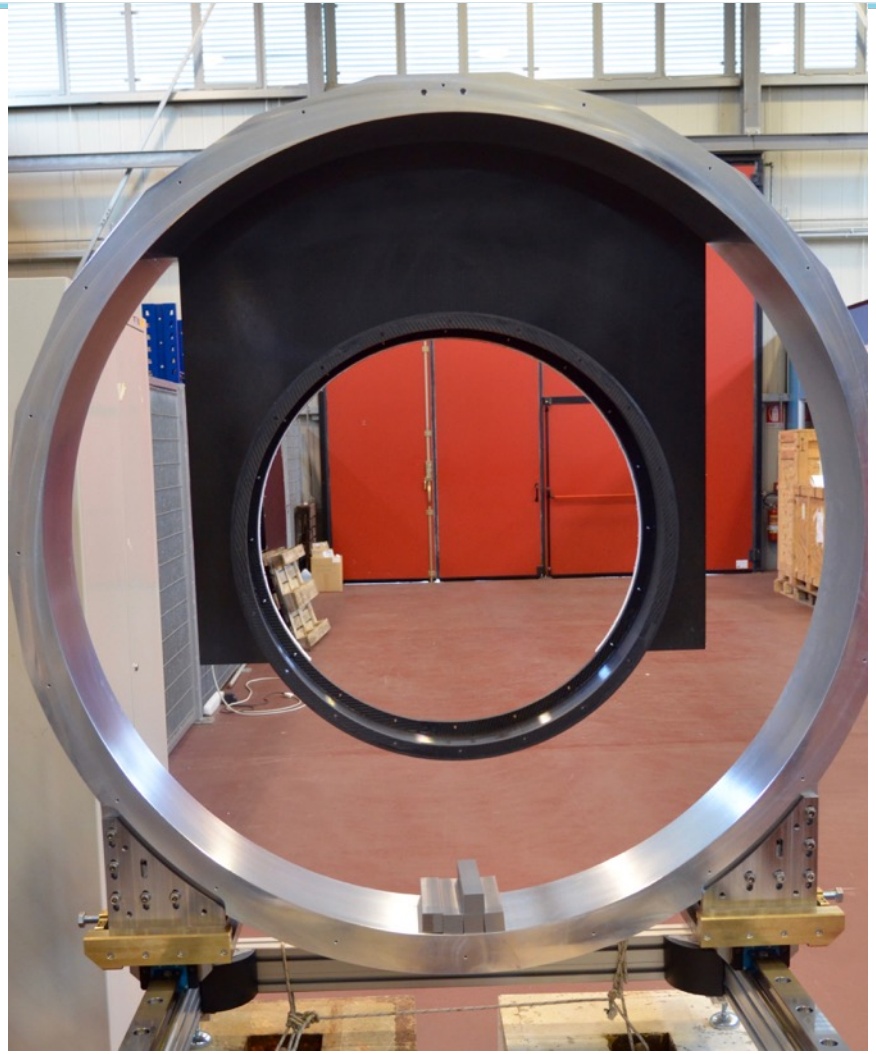
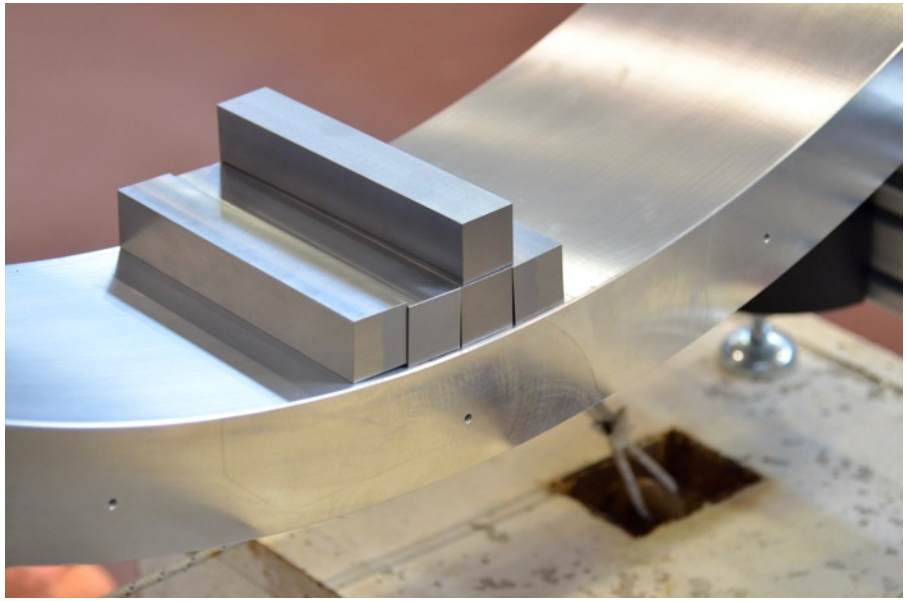
Mock -up





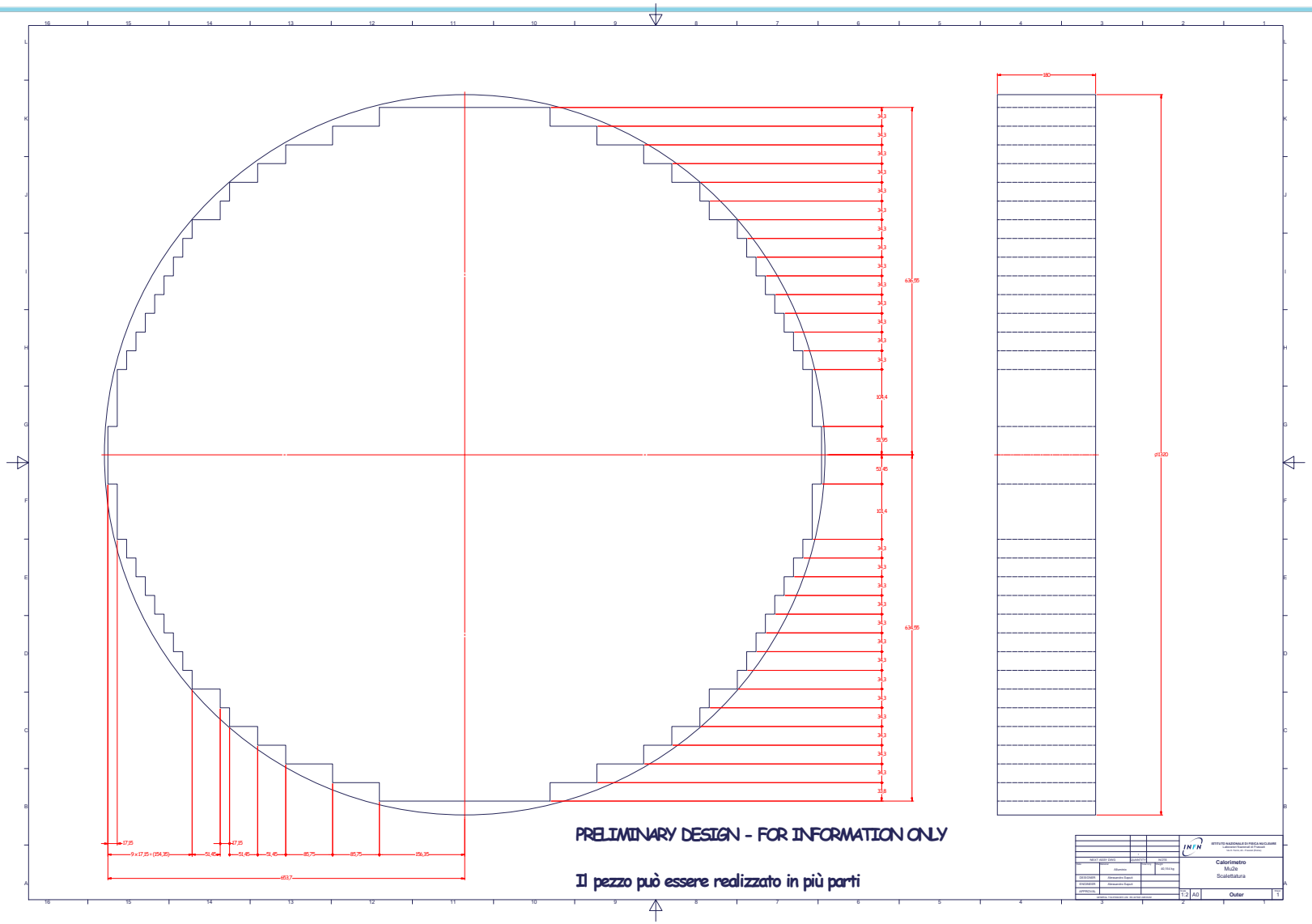


Mock up activities

- The prototyped outer cylinder doesn't have the stepped profile to arrange the crystals:
  - We just made an order to manufacture a monolithic stepped ring to insert in the outer cylinder
  - The company (DG-Technology) is the same that will produce the 2 outer rings that will come with a built-in stepped profile

- Once we have this part we start piling up the iron fake crystals wrapped with tyvek
- Measure the alignment of crystals at every row
- Build a front plate portion with the appropriate FEE apertures to check stacking tolerances

Stepped insert



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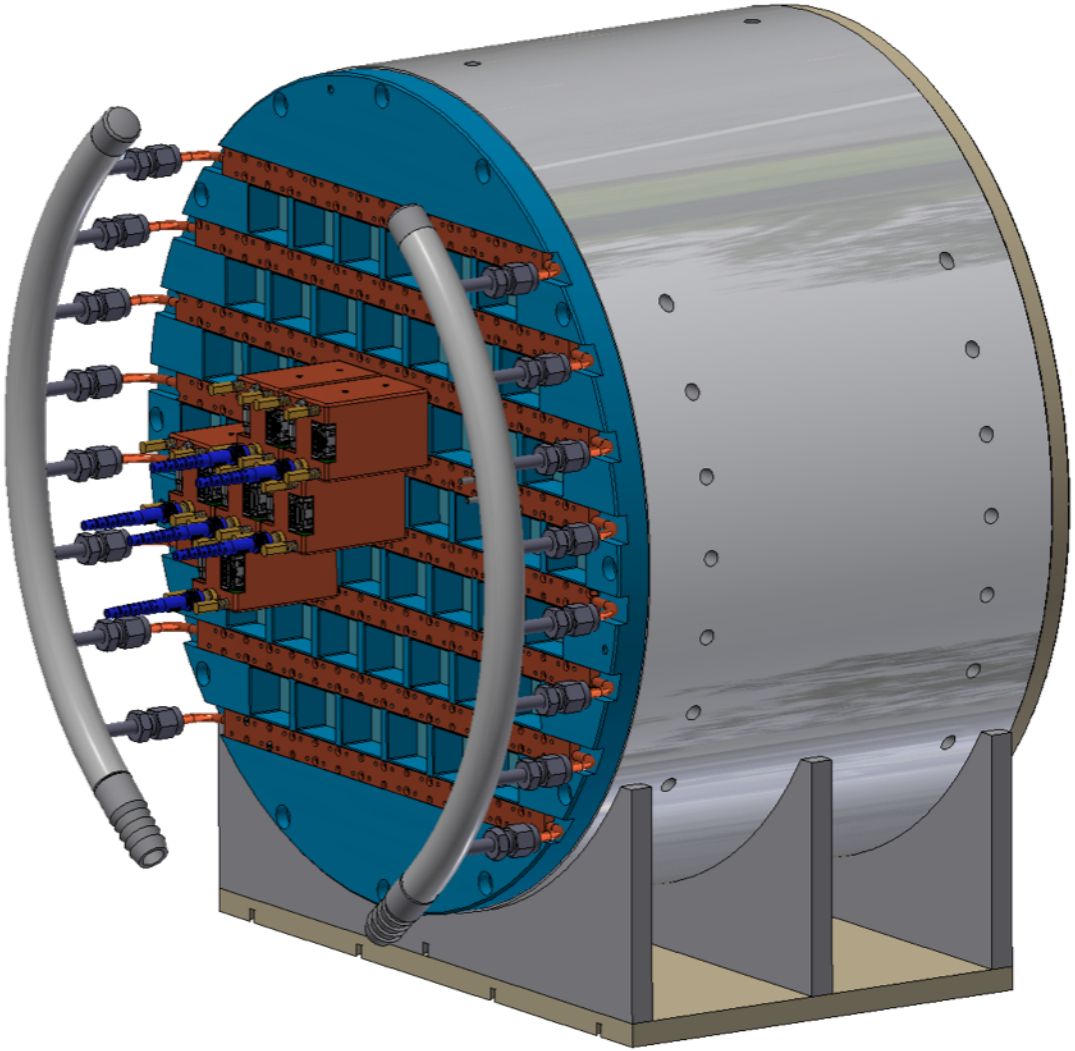
Prototyping: Module-0

- All the designed technology has been tested building a module 0 that implements all the choices of the actual calorimeter:
  - Arrangement of crystals
  - Cooling system
  - Crate prototype ?
  - FEE+Sipm housing
  - Crystal wrapping

Module - 0

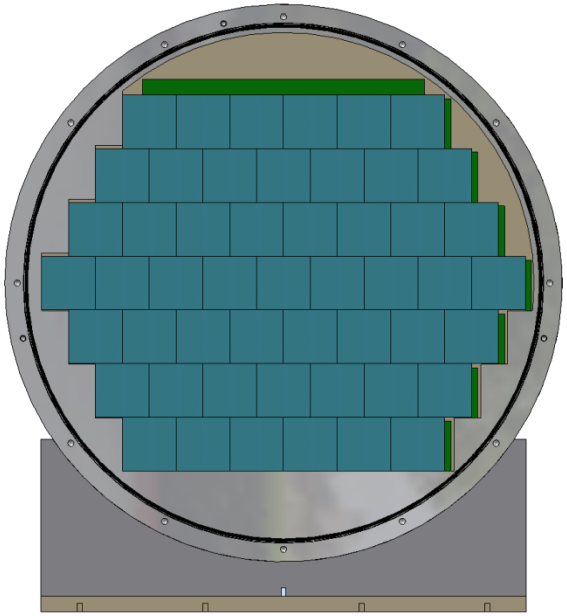


n. of crystals: 51

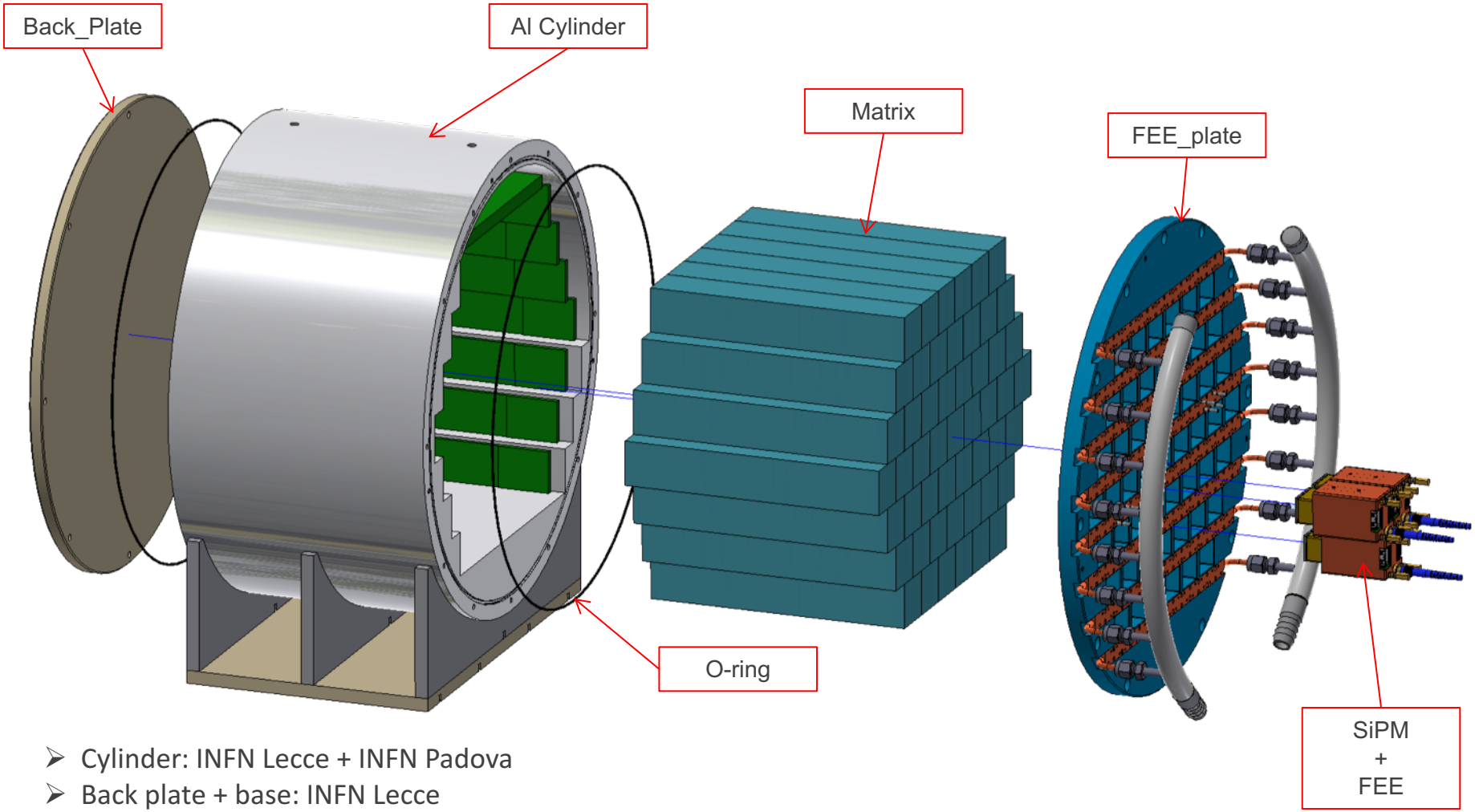
Fill Factor: ~81%

Total weight: ~70 kg

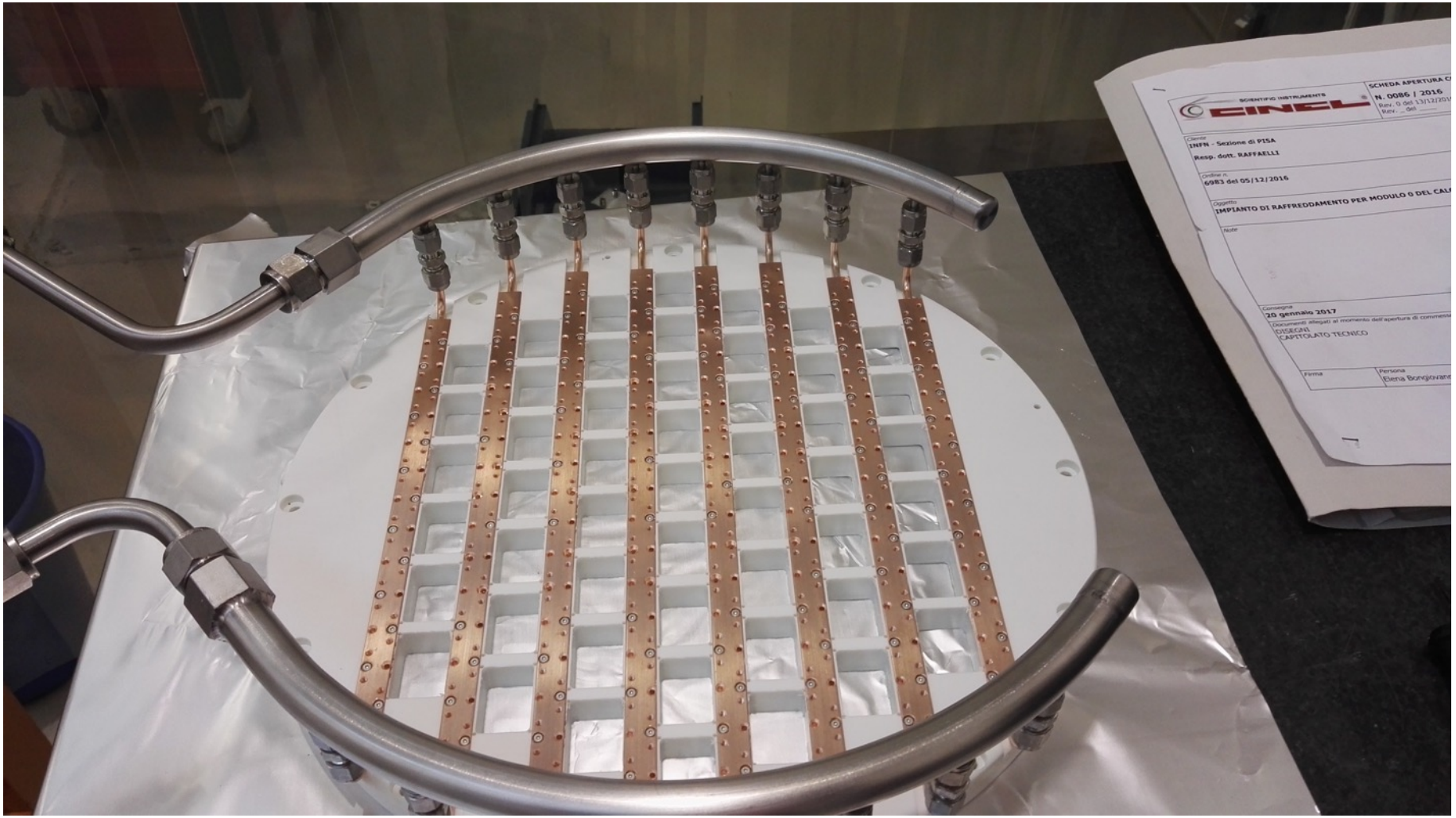
Overall sizes:
D_{out}= 356 mm
Depth = 226 mm



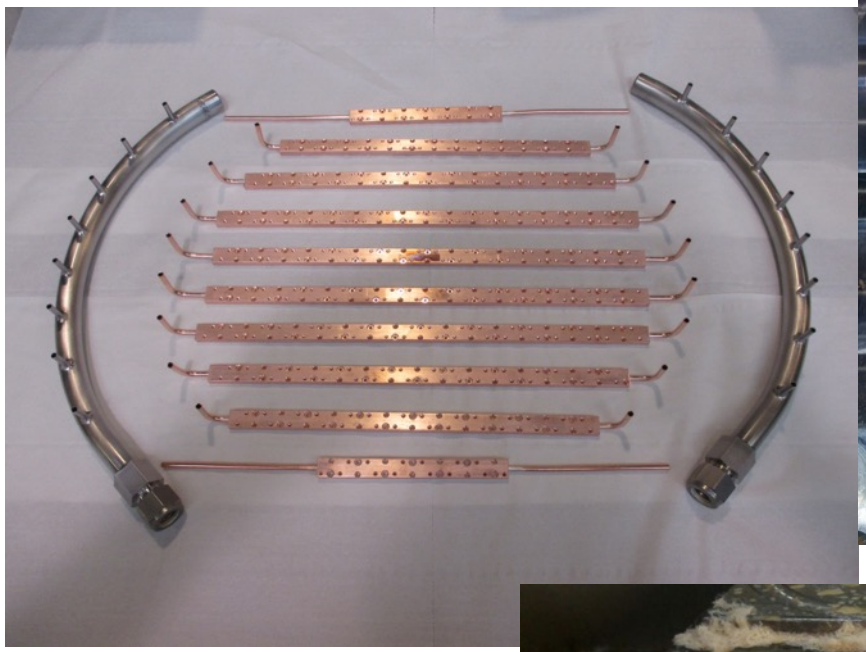
Module - 0



- Cylinder: INFN Lecce + INFN Padova
- Back plate + base: INFN Lecce
- FEE_plate: INFN Pisa
- SiPM holders: INFN/LNF
- Crystals wrapping: INFN/LNF
- Assembly: all


SCHEDA APERTURA
N. 0086 / 2016
INFN - Sezione di PISA
Resp. dott. RAFFAELLI
6983 del 05/12/2016
IMPIANTO DI RAFFREDDAMENTO PER MODULO 0 DEL
20 gennaio 2017
DISEGNI
CAPITOLATO TECNICO

Module 0 FEE plate



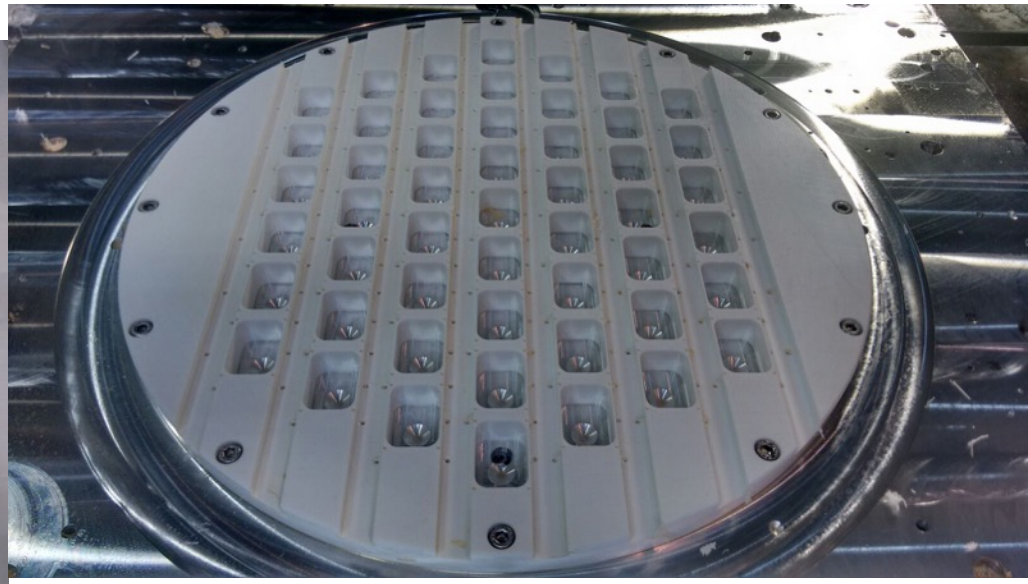
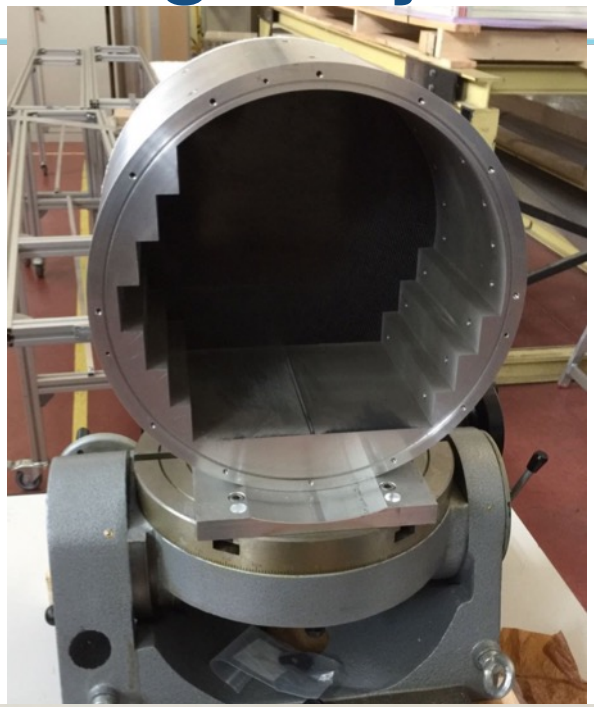
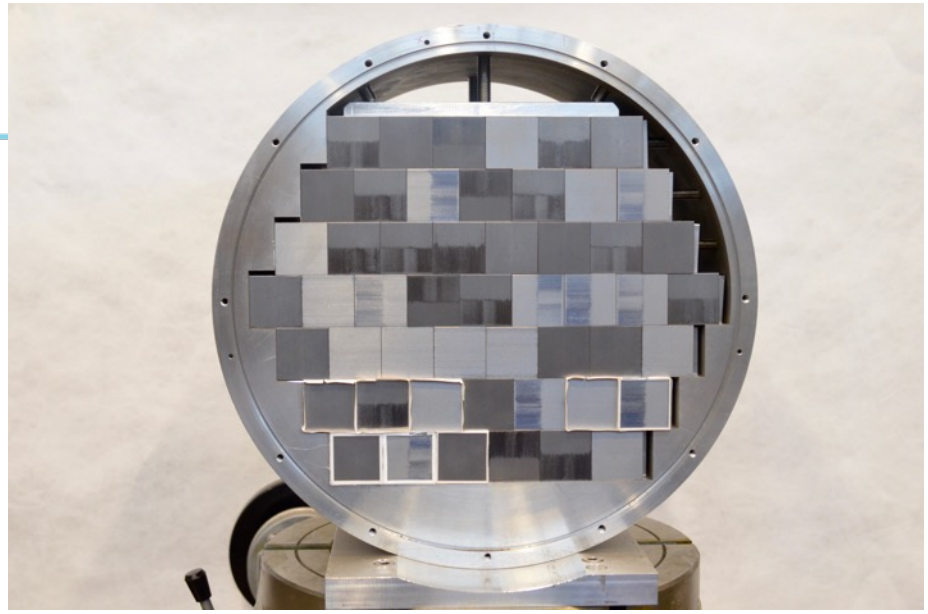
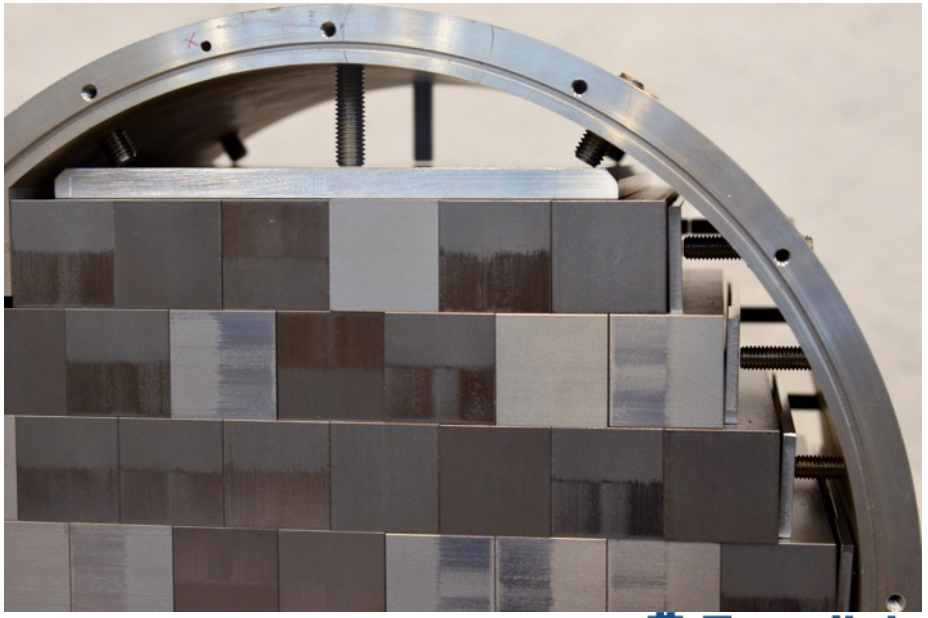


Photo gallery







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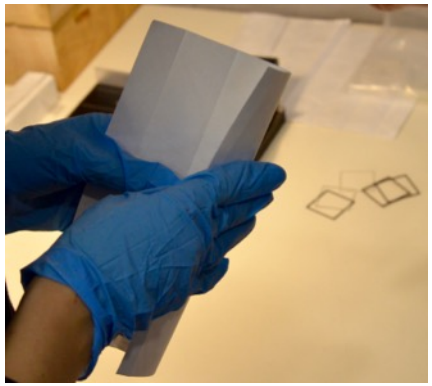
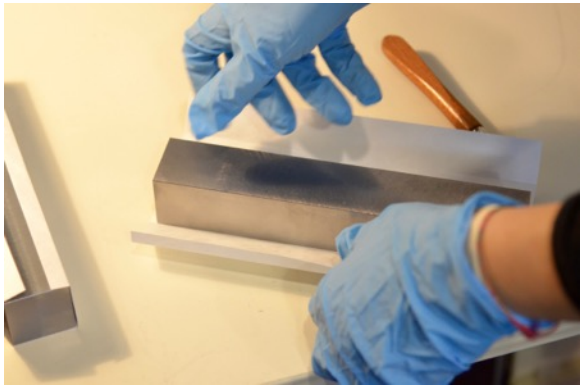
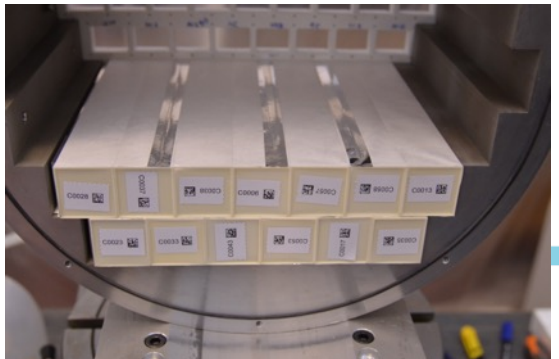
Crystal wrapping

- Use Tyvek 4173D
- Pre-shaped to obtain 90° degree fold
- We incise the foil using a Al mask with slits in correspondence of the crystal edges
- We use 3D printed frames placed on the faces of the crystal and glue the tyvek around them. Thickness of 3D frames 2 mm, width 1 mm.
- The tyvek edges are coupled, without overlapping, with 30 micron 3M Aluminum tape





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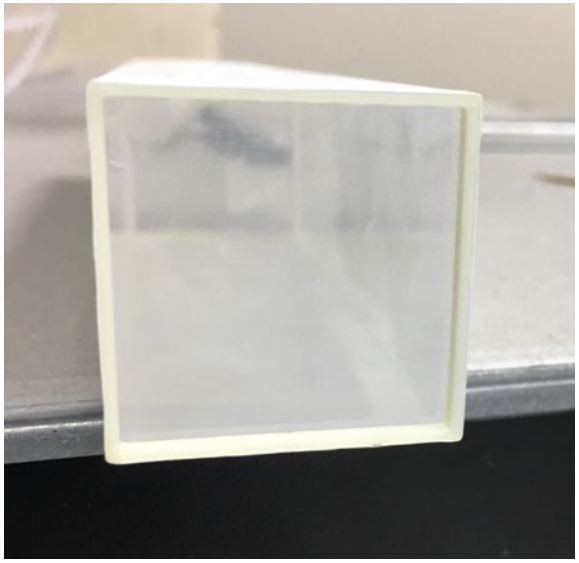
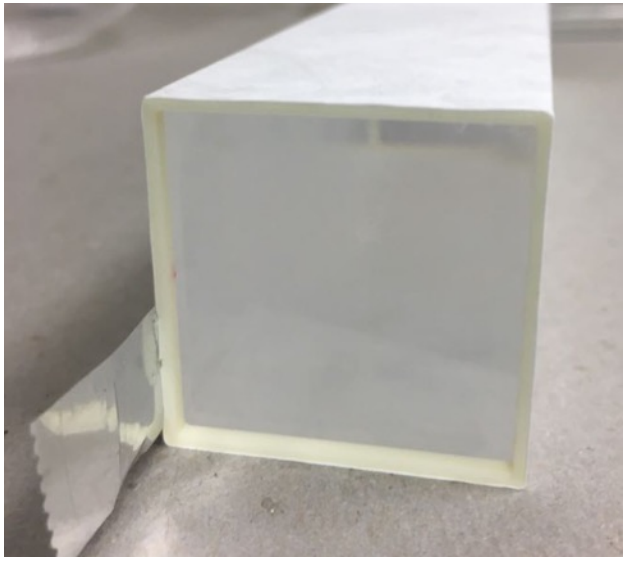
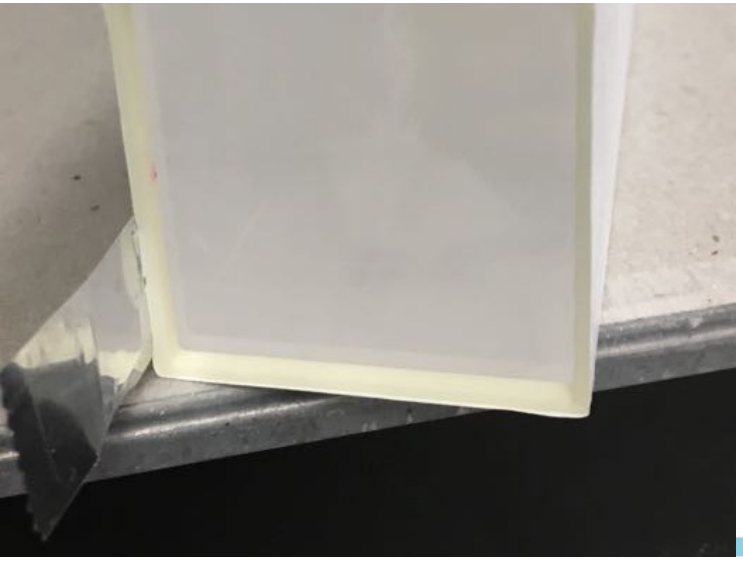
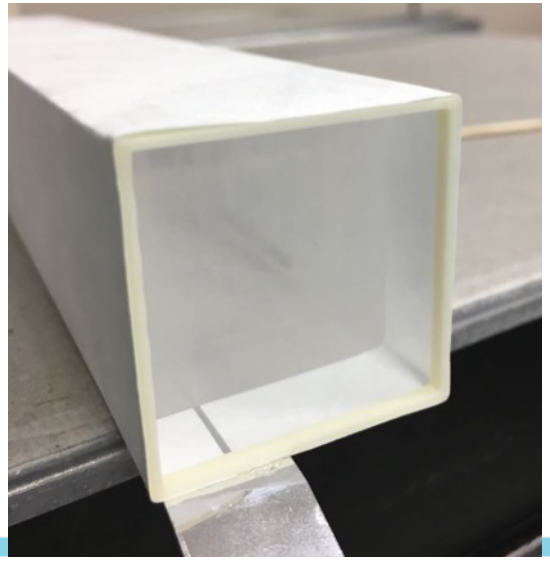
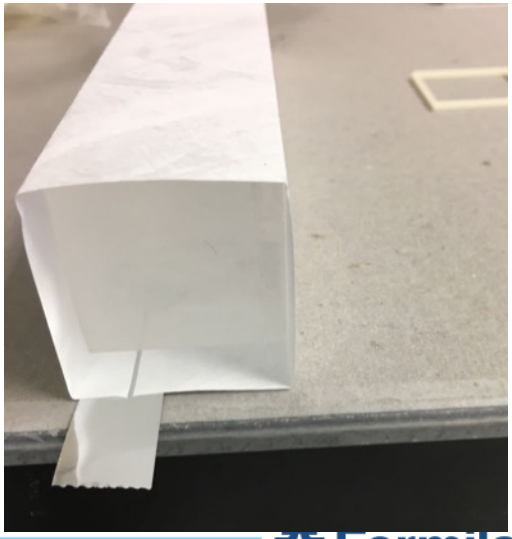
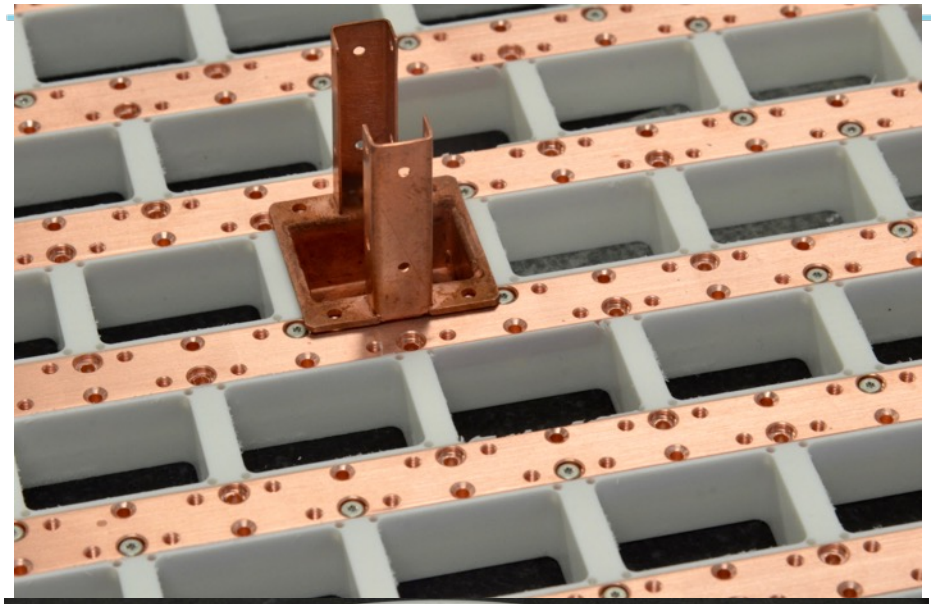
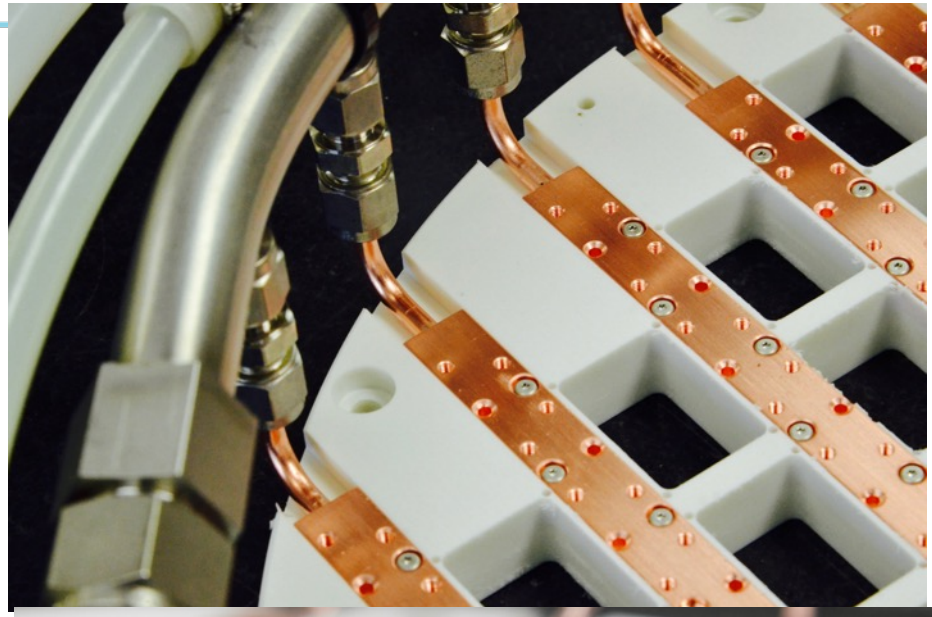
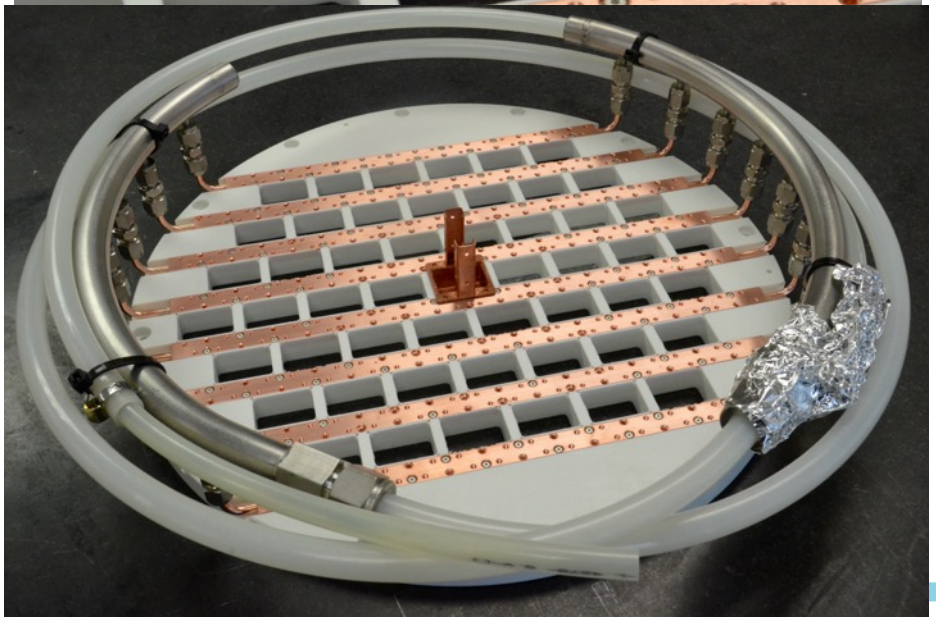
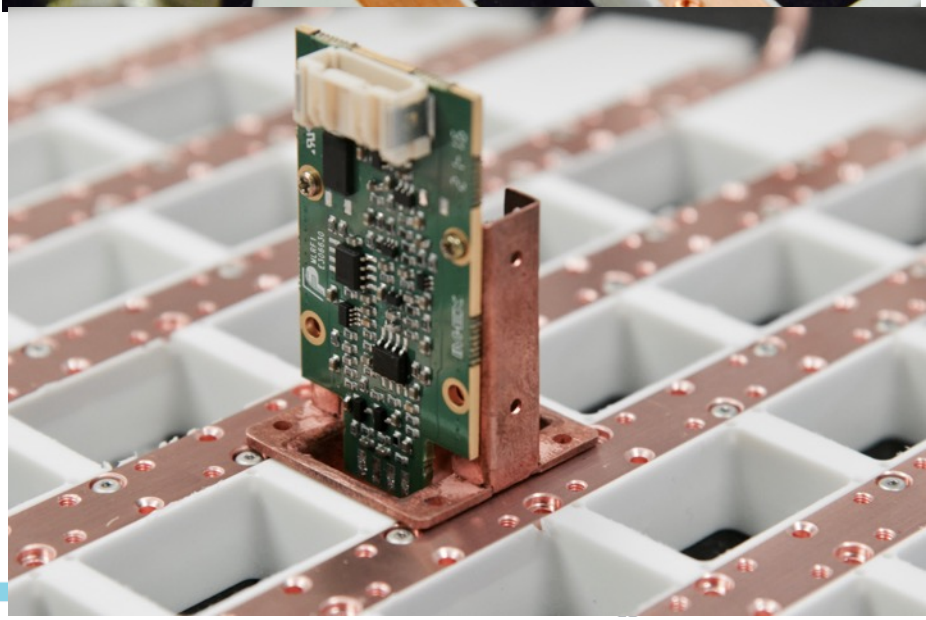
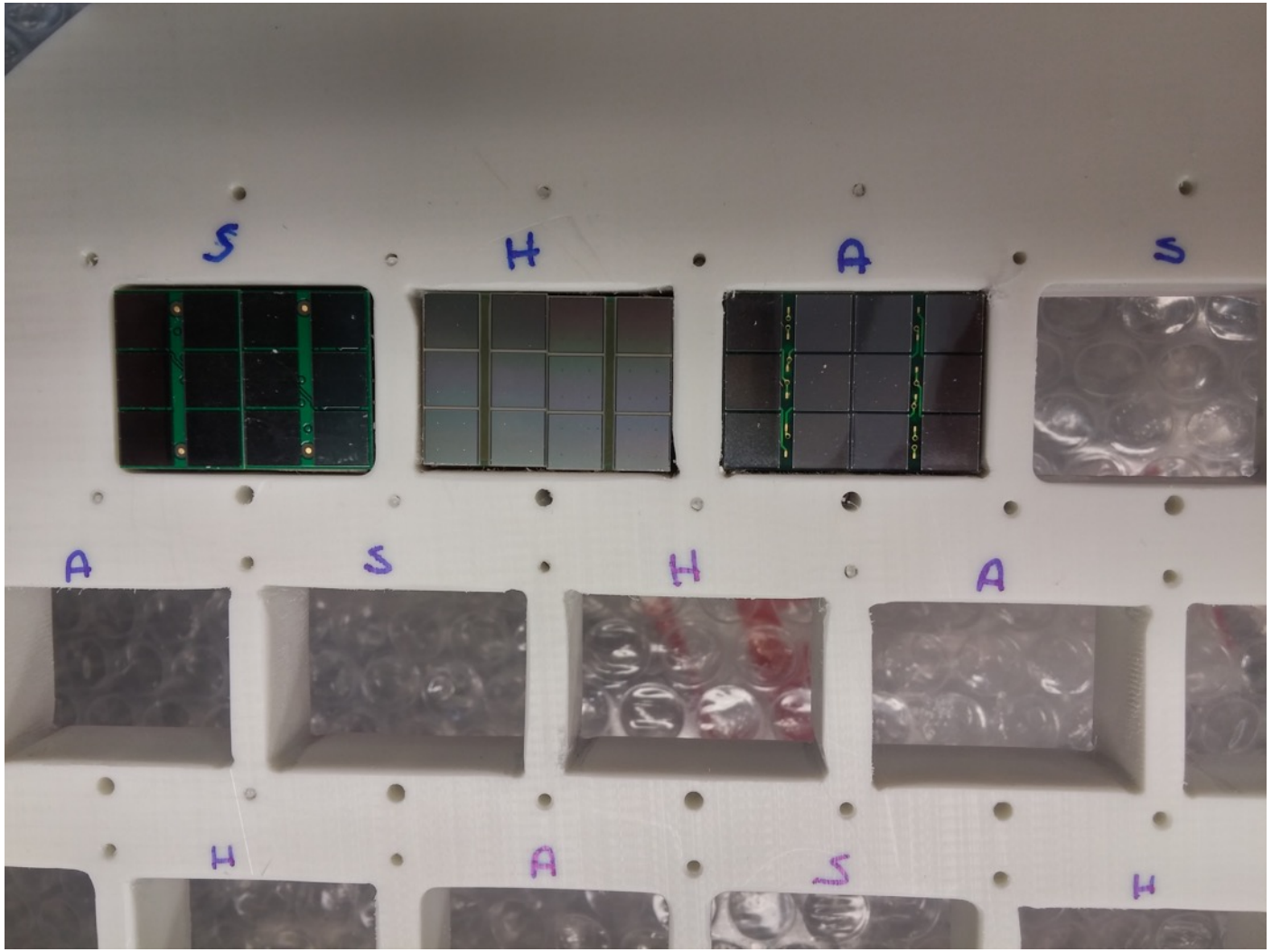








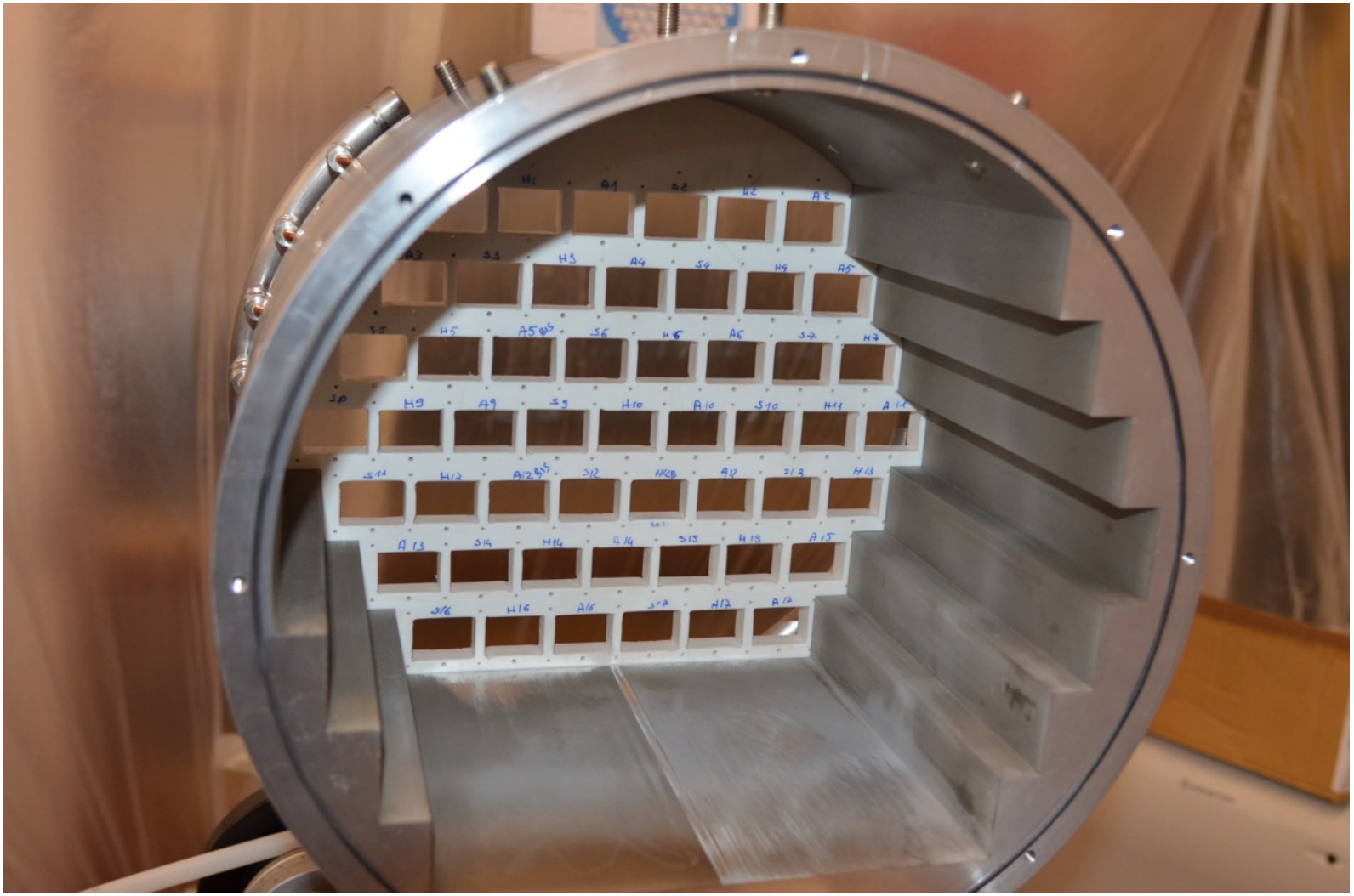




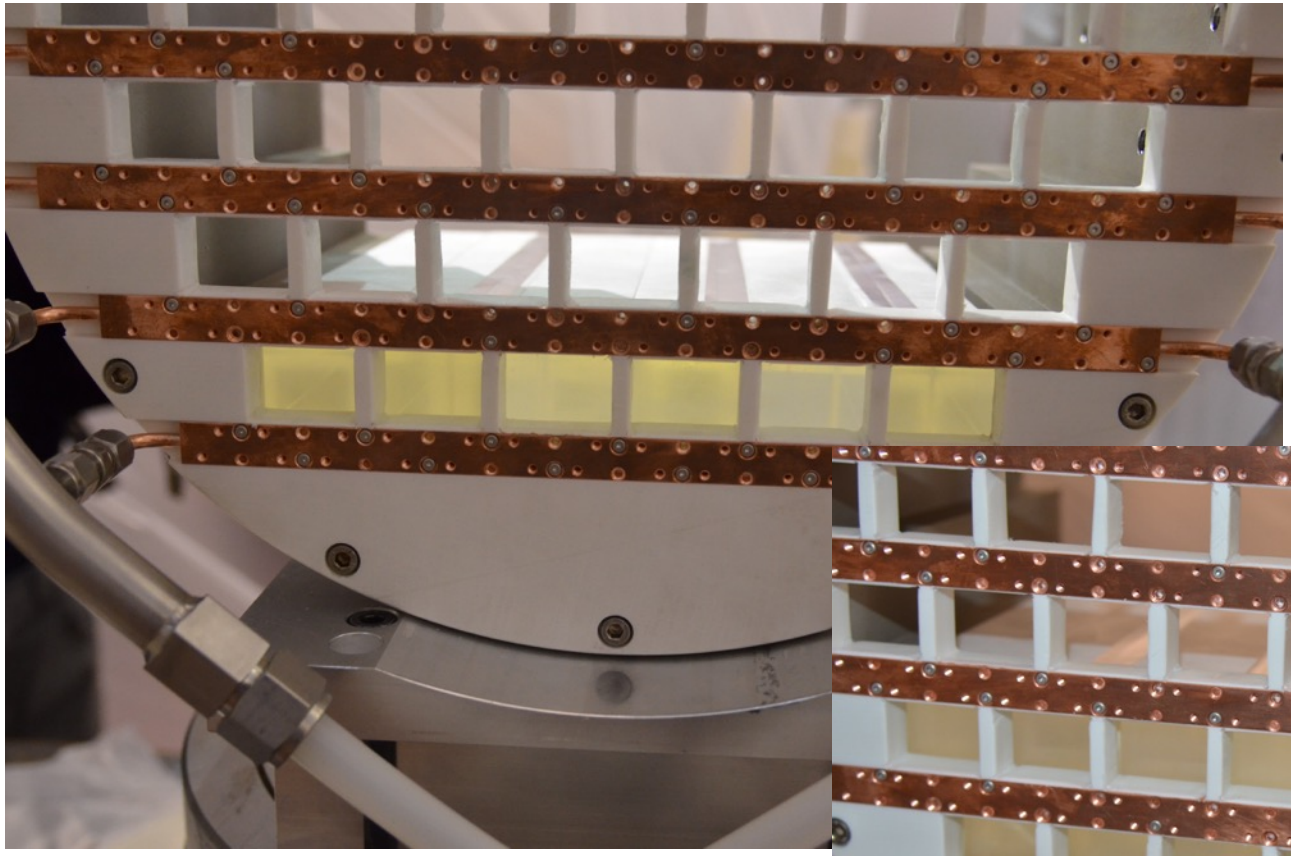


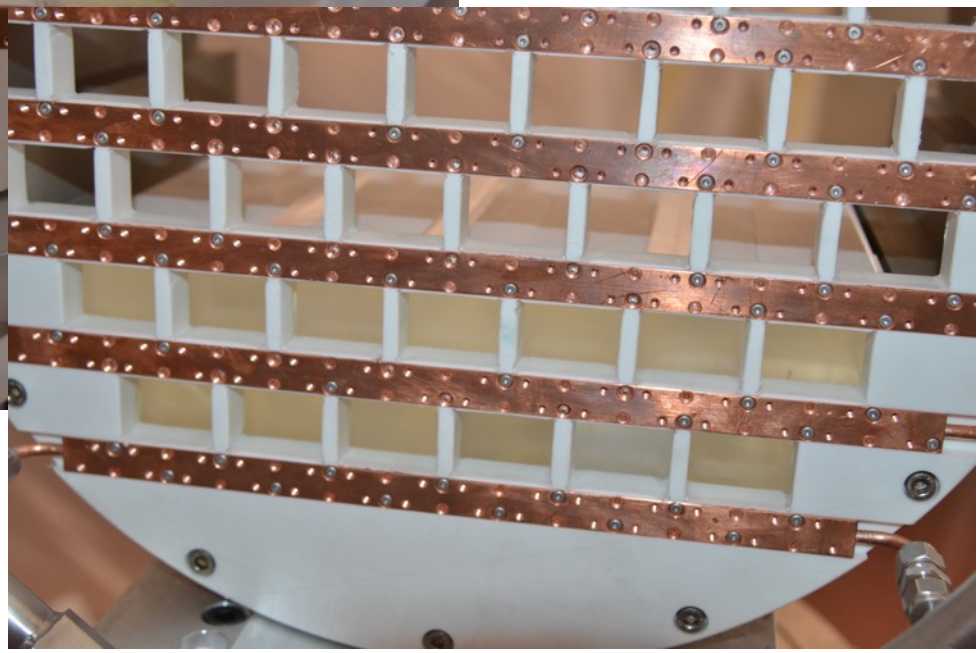

S H A S
A S H A
H A S H

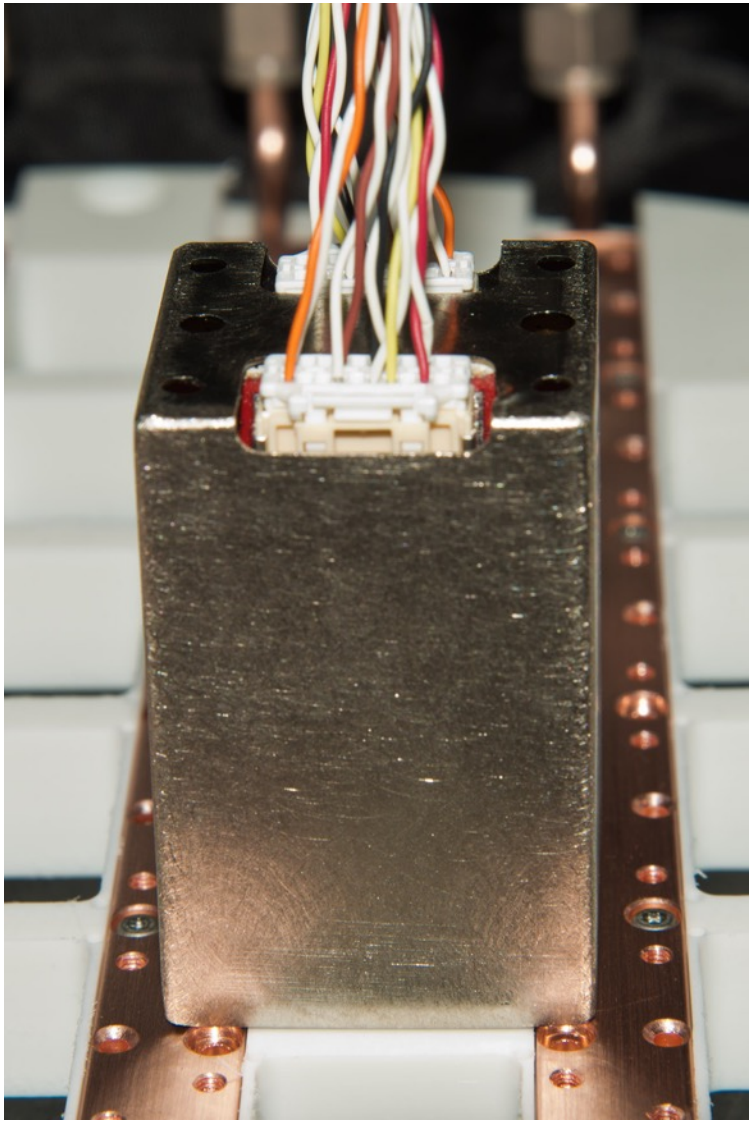
Outer Al cylinder + front plate

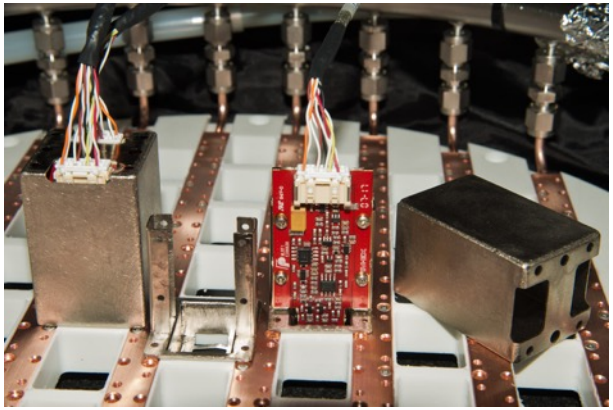


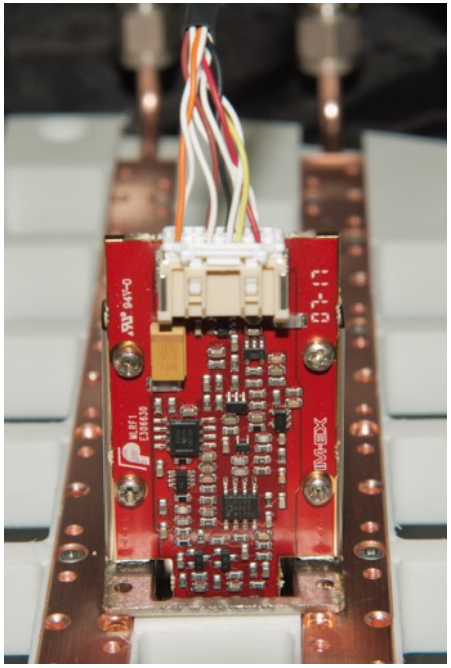
Crystal wrapped with Tyvek
3D printed frames

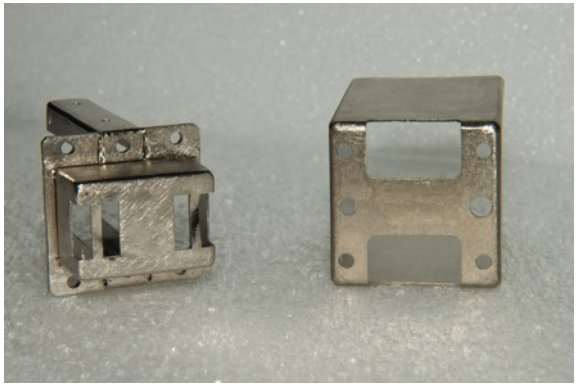


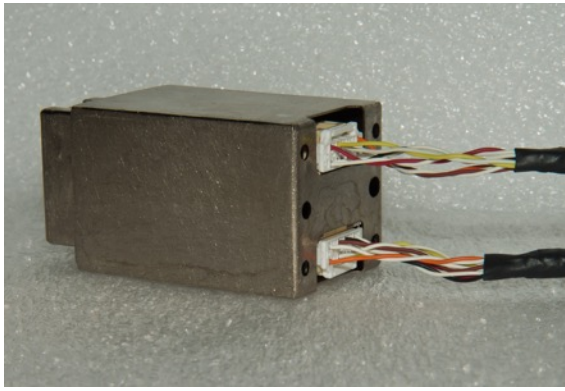












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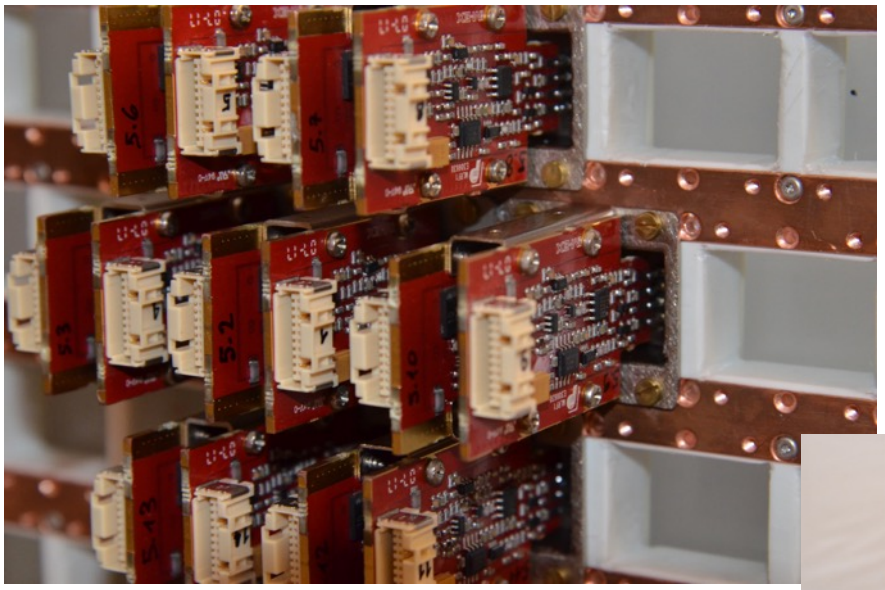
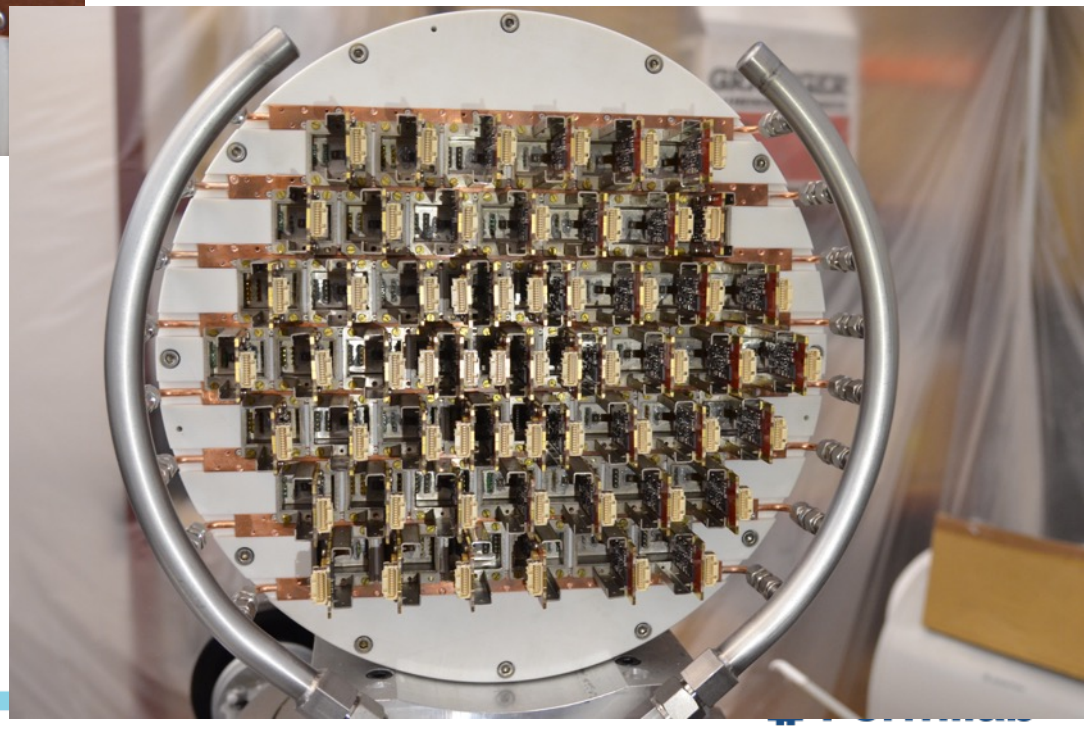
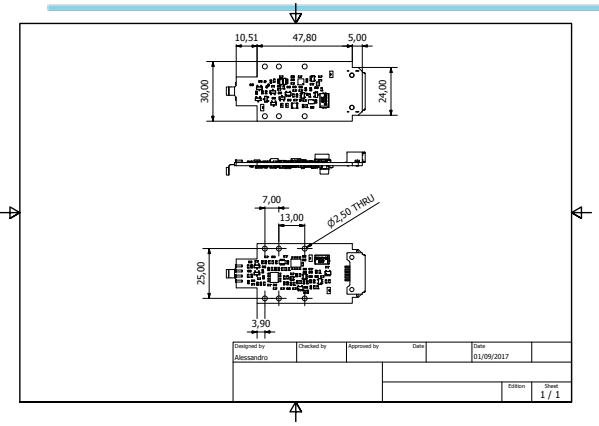
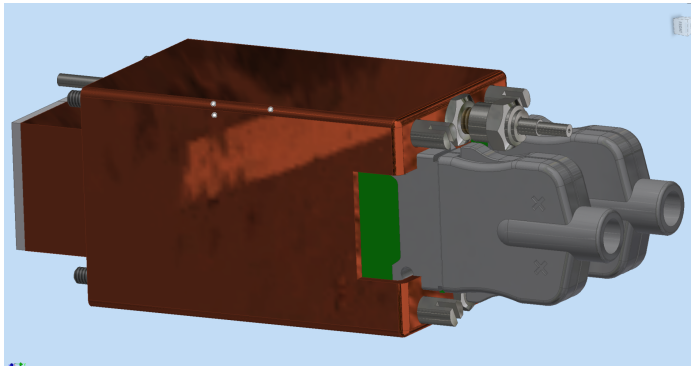


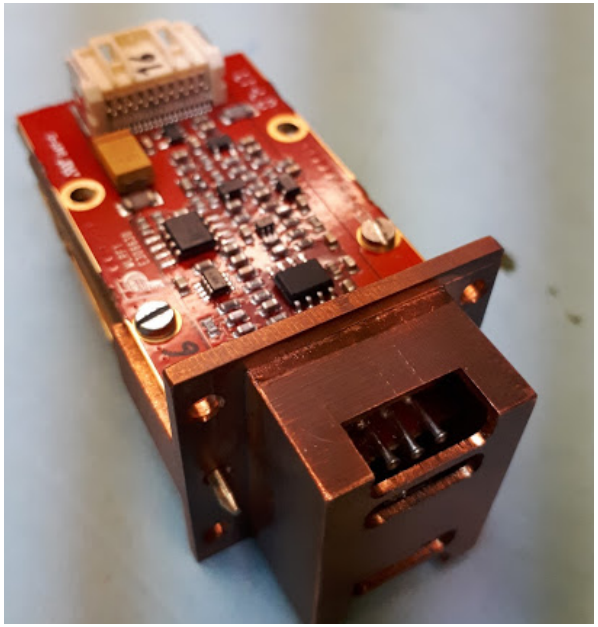



GRAINGE

SiPM +FEE holder





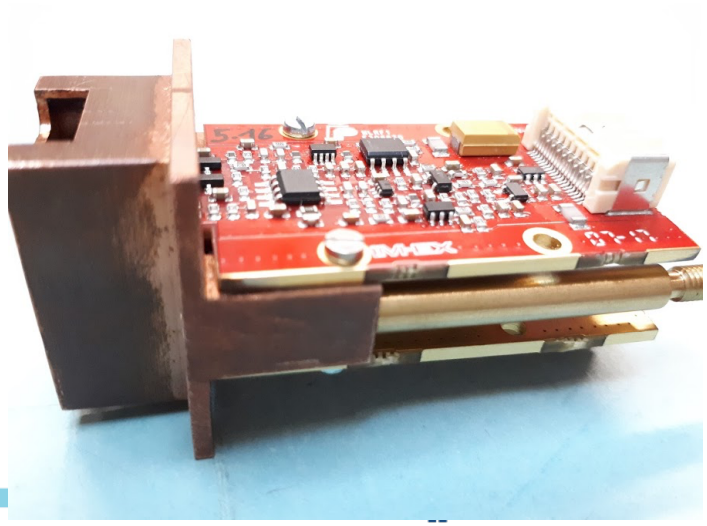


New design for the Sipm+FEE holders

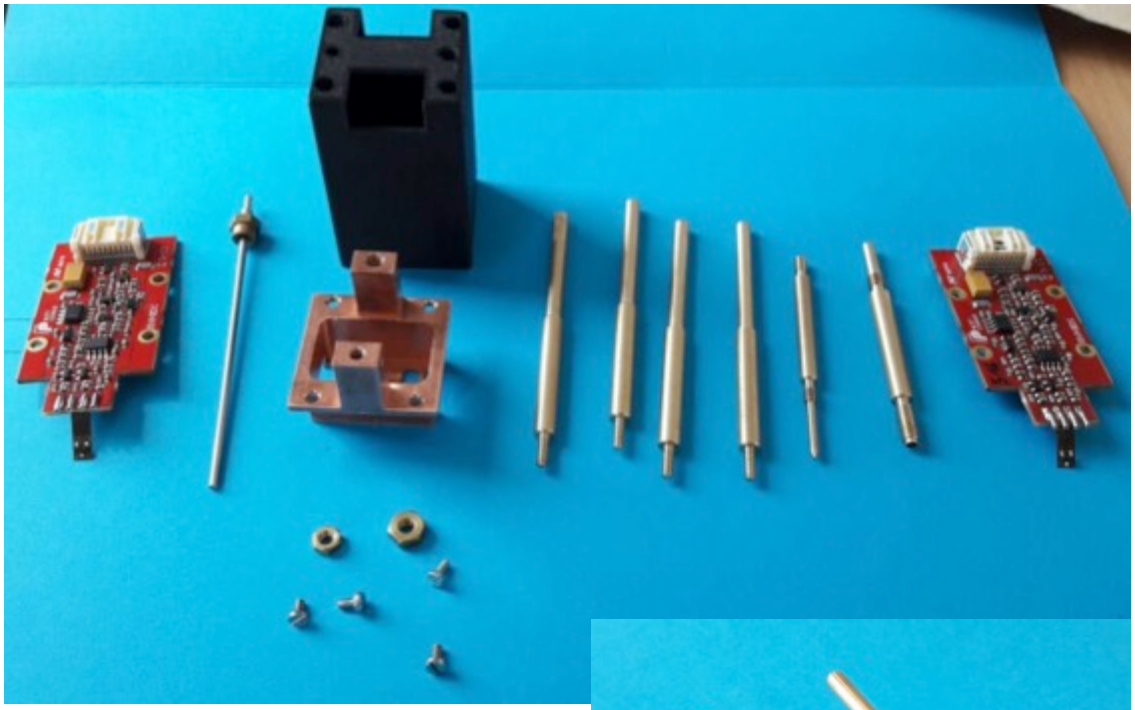
New prototype with more precise production technique

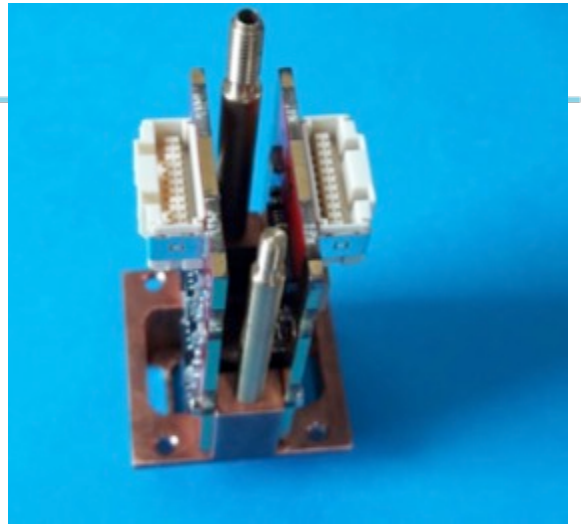
machining

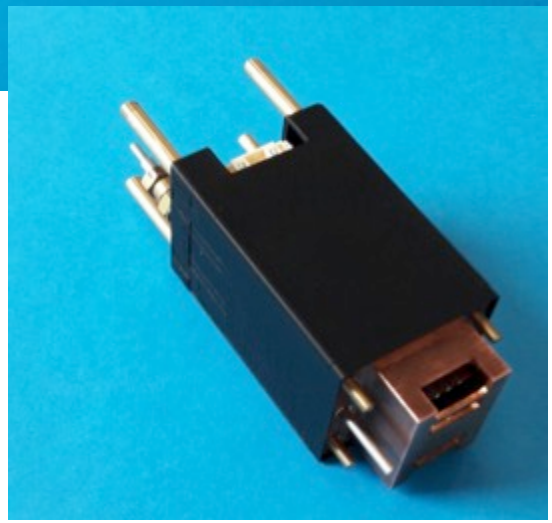
The holder dimensions are customized for the Hamamatsu SiPM.



holder







Learning 2017

- We connected directly the holders to the copper cooling bars without including the Faraday cages. We don't have yet the long screws/connectors
- Really tricky to connect the holders in this way. Need to try the final technology
- The thermal contact was good, instead.
- We had the chiller running and the SiPM temperatures were stable – within 1 degree C
- We added a water tank/buffer in the circuit to minimize on/off switching of the chiller
- Light tightness not yet achieved

Achievements and plans 2017

- In March 2017 we had the Mechanics Design Review at Fermilab
  - We are still addressing recommendations
- In April 2017, we have built the Module-0.
- The mock-up of a real size annulus is growing. We are finalizing the drawing of the back plate that houses and cools down the sensors and FEE

- Bids/prototypes

1) **A tender is out for the purchase of the 2 Outer Al Cylinder**

We need 10 kEuro extra to add stepped margin in the machining

2) Feet and adjustment mechanism tested and built – LNF workshop

3) 2 annuli connection mechanisms tested and built – LNF workshop

4) Changed manufacturing technique for SiPM + FEE holders

- we have now a first good prototype

5) Mockup: Aluminum monolithic stepped inserts for crystals arrangement in the outer cylinder - 10 kEuro order out

Bids 2017

Lecce:

- start in fall the tender for the construction of CF parts: inner cylinders and front plates
  - Raw material supplying 34kE
  - 2 front plates construction 14 kE
  - 2 inner cylinders constructions 20 k

  Includes inner stepped margins.

Pisa:

- 32 kE purchase of the Peek/G10 to manufacture the FEE plates + Machining the plate to make holes and cooling lines grooves. Design almost final. Enough to prepare a bid.

Requests and work 2018

- 2018
  - Electronics Crates design almost final – cost assessed (1800 Euro/each) – new prototype x 22 (Pisa)
  - Lecce will follow up the construction of all the CF parts
  - Frascati will start the production af the SiPM+FEE final design holders and other details (20 kEuro)
  - Frascati will build Calo supports during assembly and lifting device

Pisa will also make the bids and construction for:

- FEE cooling lines 50 kE
- FEE cooling manifolds 8 kE
- Crates cooling & manifolds 12 kE
- Wu/Cu shielding 50 kE