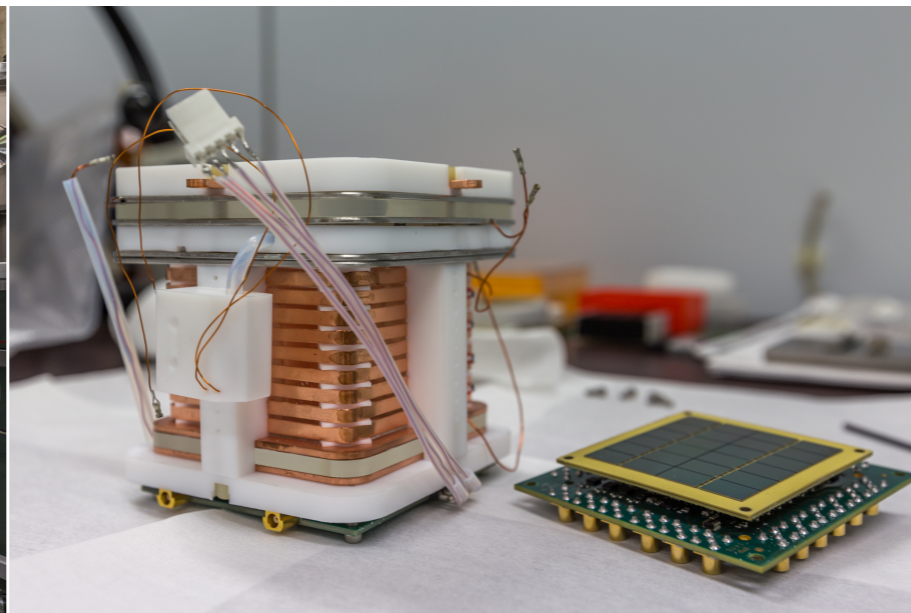
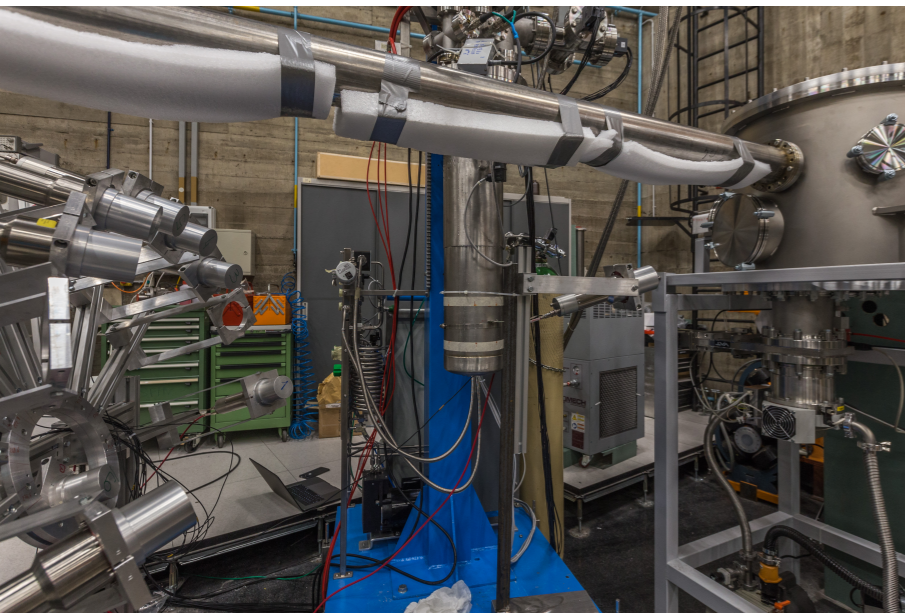


# ReD

# Current Status & Future



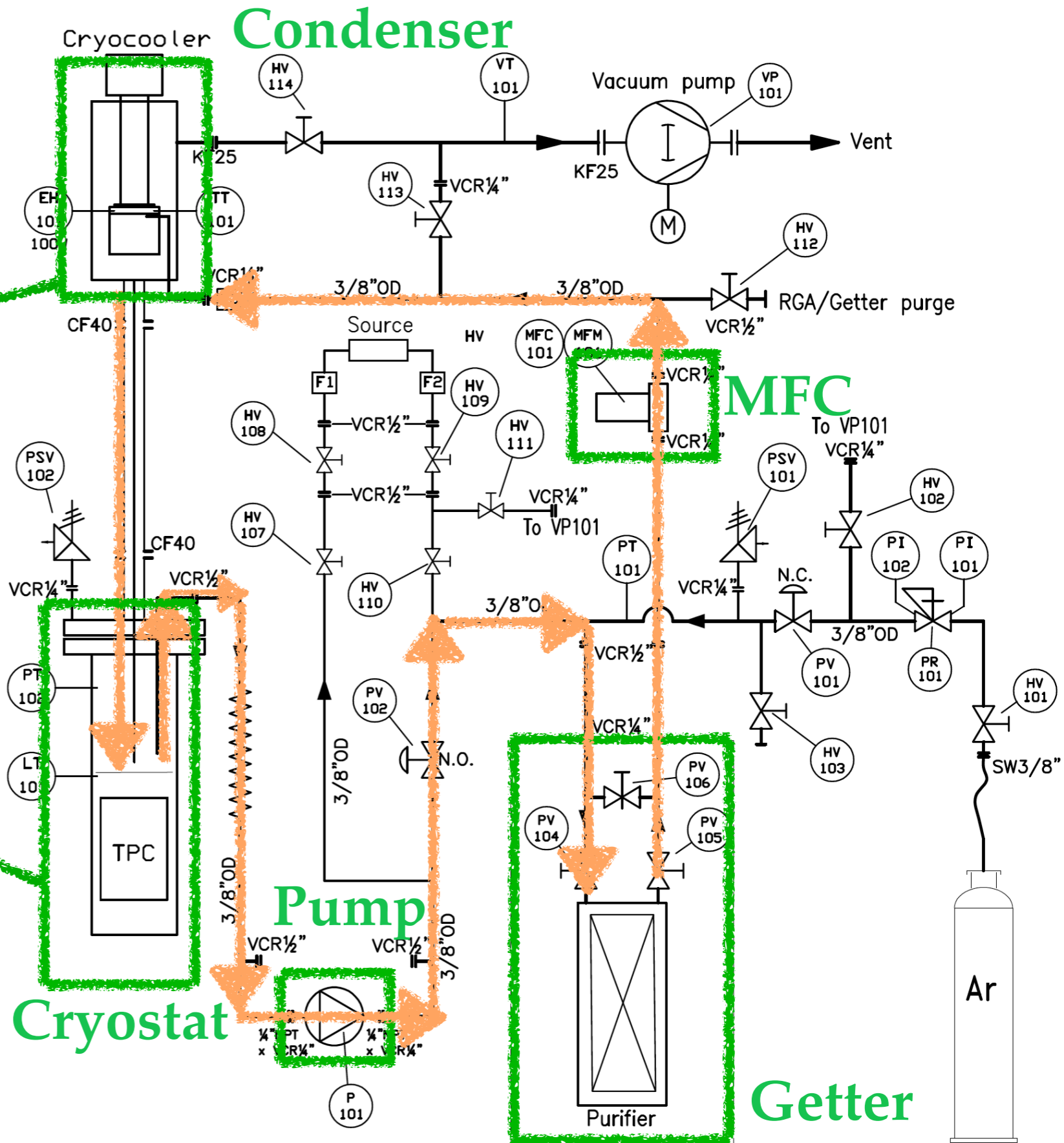
Bianca, Mauro, Simone, Yi, Yura  
on behalf of ReD collaboration

December 19th, University of Naples Federico II, Naples

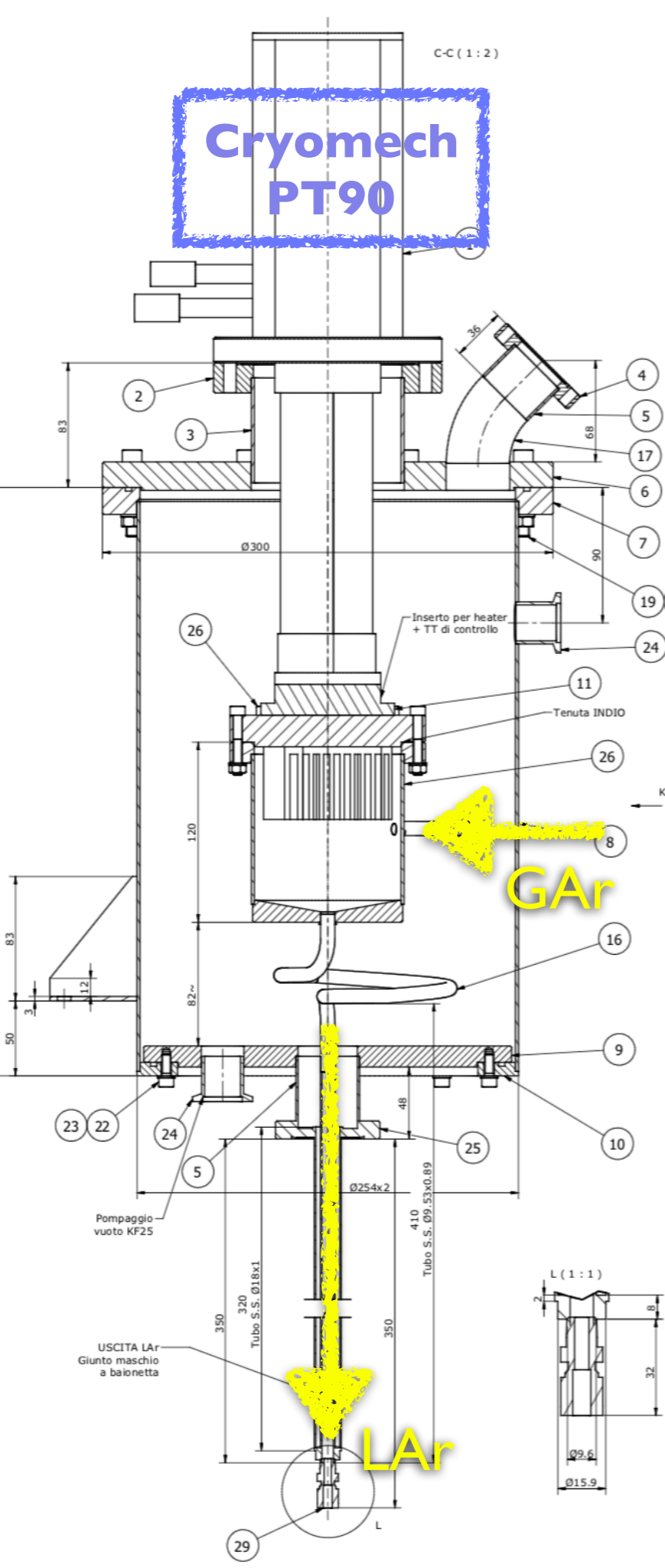
# ReD 2018 Timeline

Feb-March	- Last modifications, fabrication and test of the cryogenic system at Criotec.
March 29	- New Cryogenic system arrival to Naples.
Aprile 6	- New TPC arrival in Naples.
Aprile 11–20	- Cryo system Leak test.
Aprile 20	- First cool down.
May 8–11	- Cleaning, Assembly and mounting for the TPC.
May 18	- The very first run ( with 4 ch bottom tile only).
May 21	- The top tile 24ch is ready to be installed, TPB issue observed.
May 31	- Commissioning of the Cryo + TPC, first S2.
June 07	- First run with Neutron Gun.
June 11–13	- Packing for Catania.
June 18–24	- 1st run in Catania, issue with TPB.
July 2–13	- 2nd run in Catania, HHV issue.
July 16	- the TPC is back to Naples for inspections.
August 24	- Top tile check up and tests at Gran Sasso.
September 4-14	- 1st HHV dry and cold tests of the TPC in Naples.
September 18	- Change of the windows for the September run in Catania.
September 19–30	- 3rd run in Catania (till 3rd of Oct.).
October 3	- the TPC is back to Naples, TPB issue with the second set of windows.
October 7	- 2nd round of the HHV tests on Anode in Naples.
October 8–12	- TPB re-coating at Gran Sasso with Nicola Canci.
October 16	- Packing the system in Catania to go back to Naples.
October 29	- System is back at Naples.
October 7–15	- Set of dedicated HHV test of the anode window, cold & warm.
November 8-9	- 3rd set of HHV test, inclusion newly coated window.
November 28–30	- Assembly, installation, tests, cool down in Naples.
December 5	- Start of new data taking campaign in Naples ( <b>ongoing</b> ).

# ReD. The cryo system concept



# ReD. Condenser



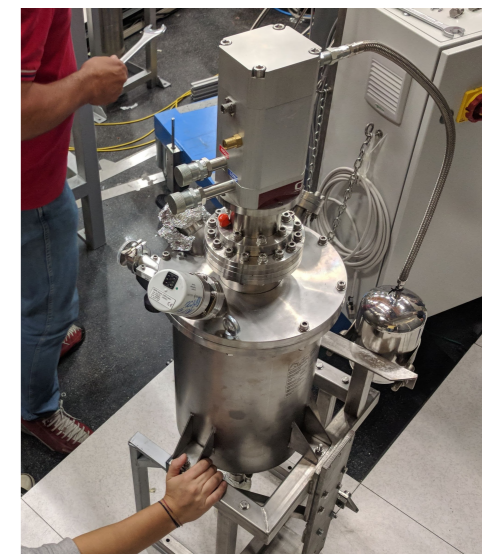
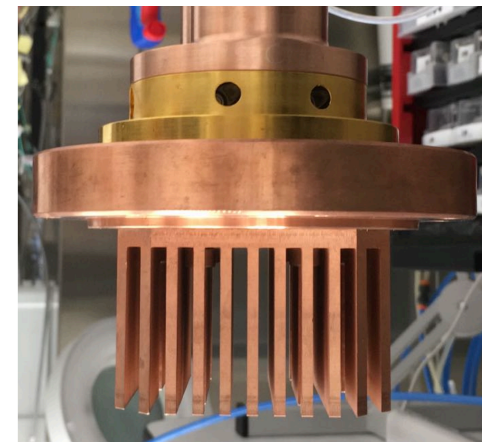
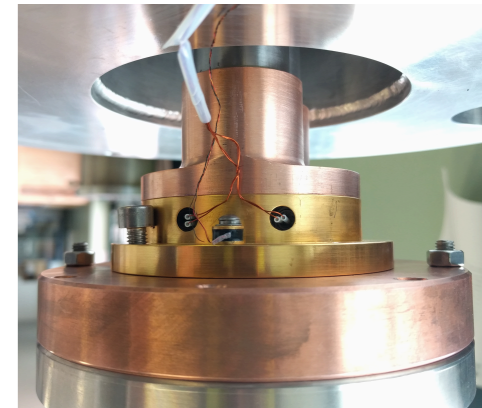
Custom made Ar Condenser (on our design).

Cooling power provided by the Cryomech cold head PT90 (90W), coupled with air-cooled compressor CP2800.

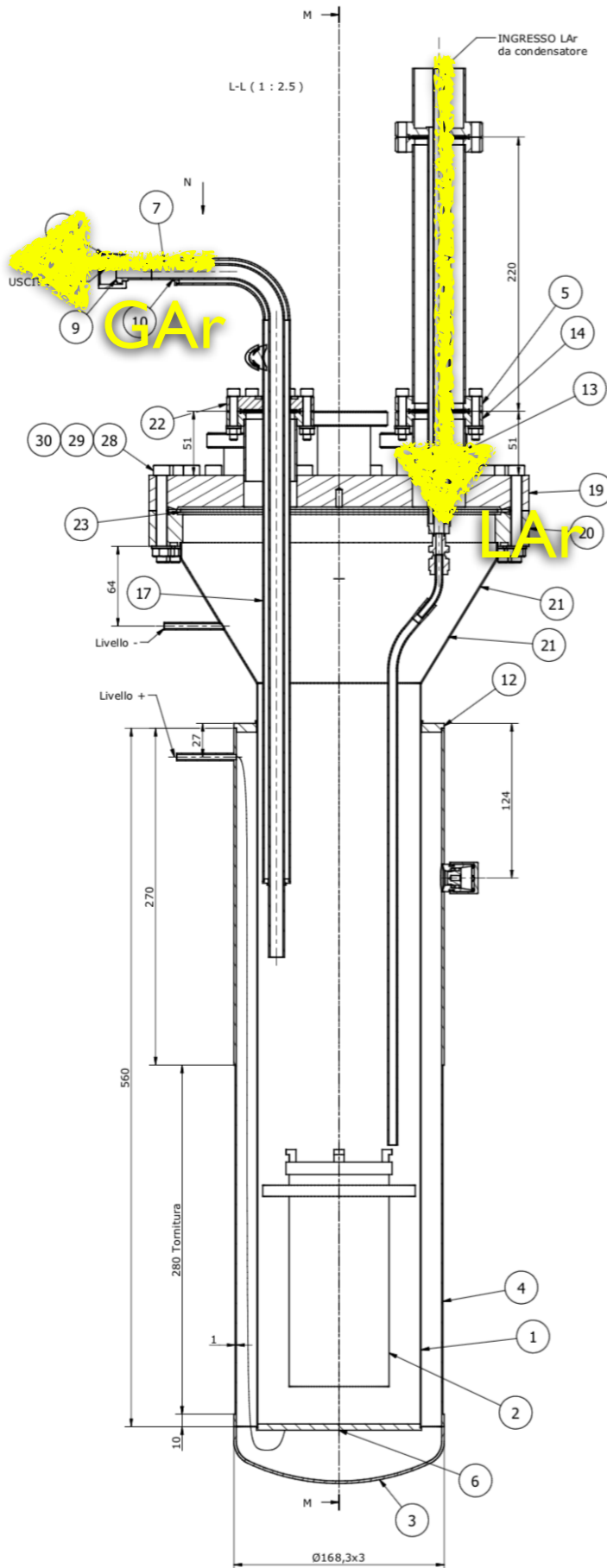
The cryomech cold head temperature is controlled by the heater.

Super insulation layers on the inner chamber. Indium foil for the proper copper parts coupling.

Cool down time: down to 87K in 1h.  
Filling speed: 5 LAr in ~10h.



# ReD. Cryostat

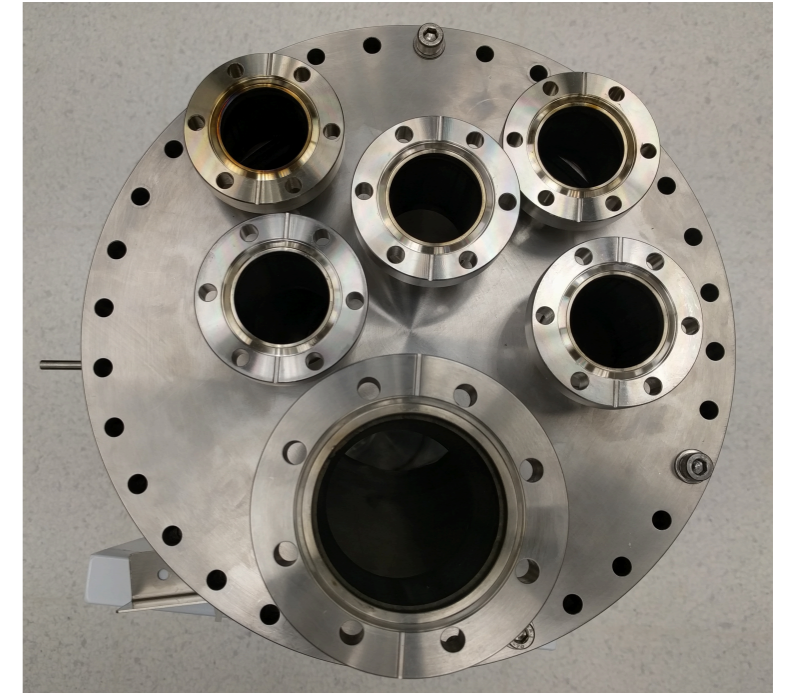


Double wall cryostat. 13 cm inner diameter, ~ 7.5 L.  
CF 250 top flange (copper seal).

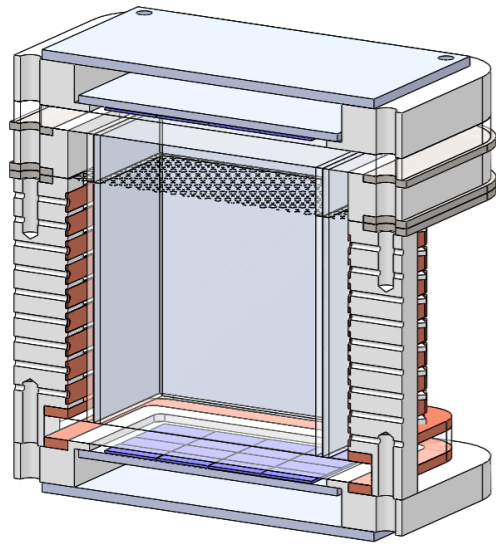
5 CF40+1 CF63 service flanges.

Integrated level measuring system (based on dP).

Double wall LAr inlet line and outlet line for GAr.



# ReD. Time Projection Chamber



- The  $10 \times 10 \times 10 \text{ cm}^3$  external ( $5 \times 5 \times 6 \text{ cm}^3$  LAr volume) double phase LAr TPC designed & constructed @ UCLA (Yi Wang and Hanguo Wang).

- Teflon pillars structure. Four internal (at the corners) and four external to hold the copper drift field shaping rings and the inner cube.

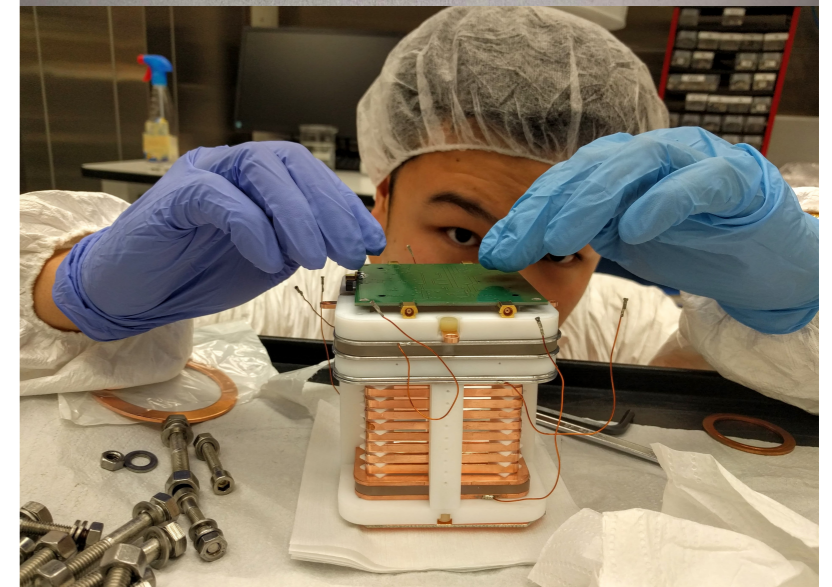
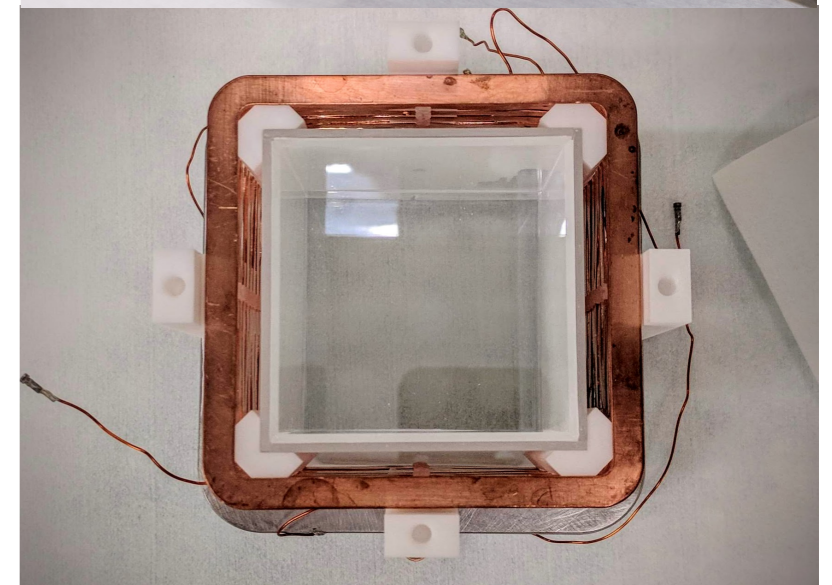
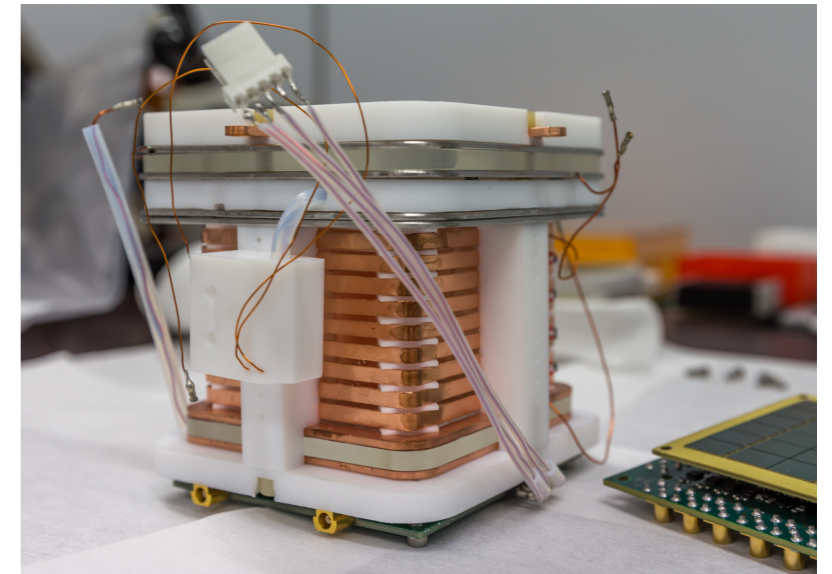
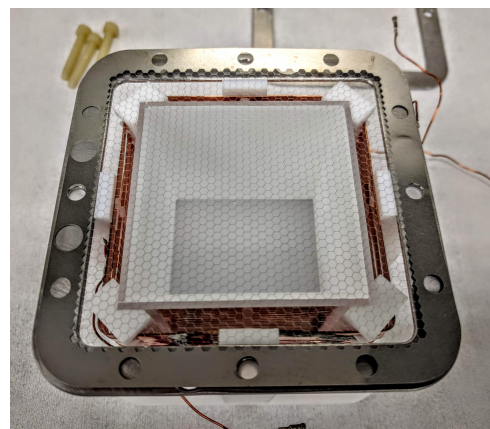
- Acrylic-ESR 3M sandwich reflective panels as walls to delimit the LAr volume on four sides.

- Acrylic Anode ( $10 \times 10 \times 0.45 \text{ cm}^3$ ) and Cathode ( $7.6 \times 7.6 \times 0.45 \text{ cm}^3$ ) coated with ITO (both side) and TPB (one side),

- Hexagonal stainless steel mesh for the greed,

- Teflon holders for the top and bottom SiPM sensors.

- Teflon bubbler with pt1000 to boil off the LAr and diving bell (1 cm high, gas pocket of 0.7cm).



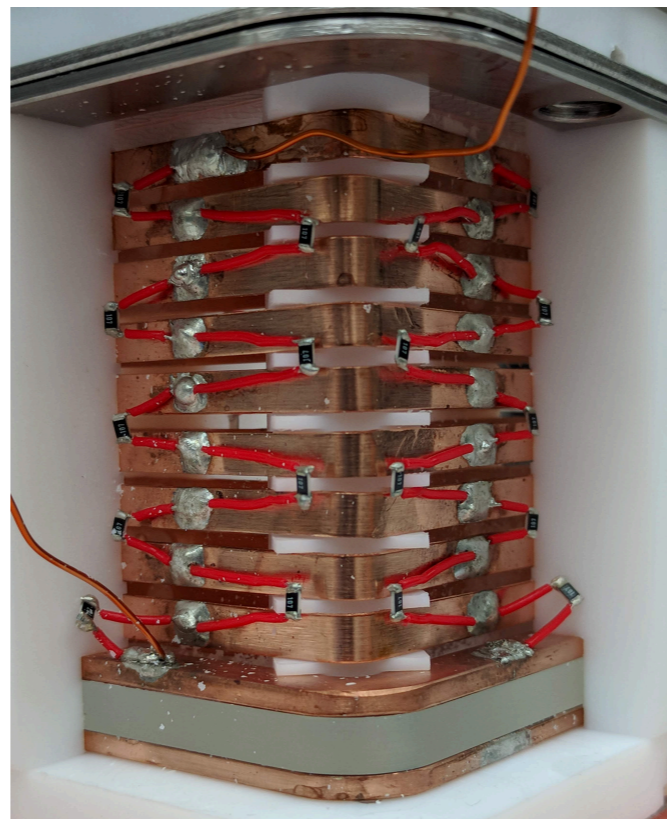
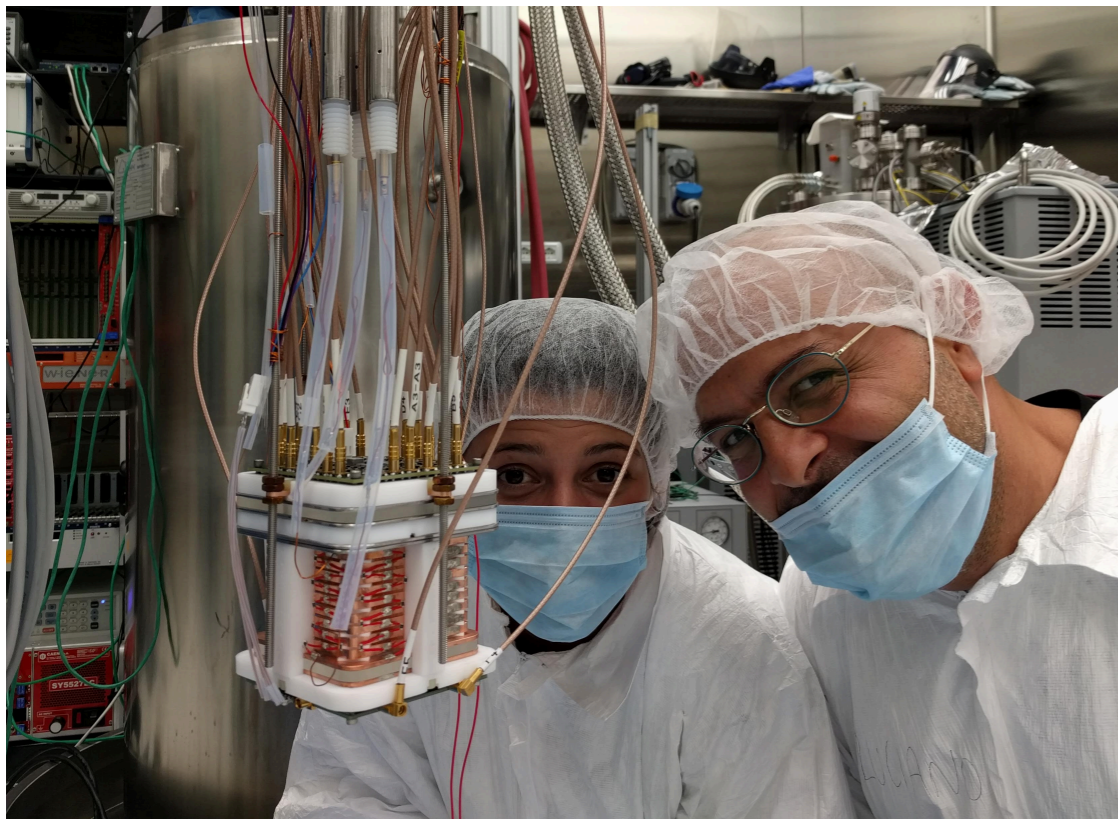
# ReD. High Voltage

Custom made three rails HHV feedthrough (UCLA), SS + teflon, cryo-fit, CF40 flange for connection.

All rails can deliver up to 5 kV.  
Three SHV20 connectors on warm side.

Cathode (-814V), Anode (+3.8kV), 1<sup>st</sup> ring (+85V).

200V/cm drift and 4.2kV/cm extraction filed.  
HHV values simulated and tuned by the Comsol.



# ReD. Light and electronics readout

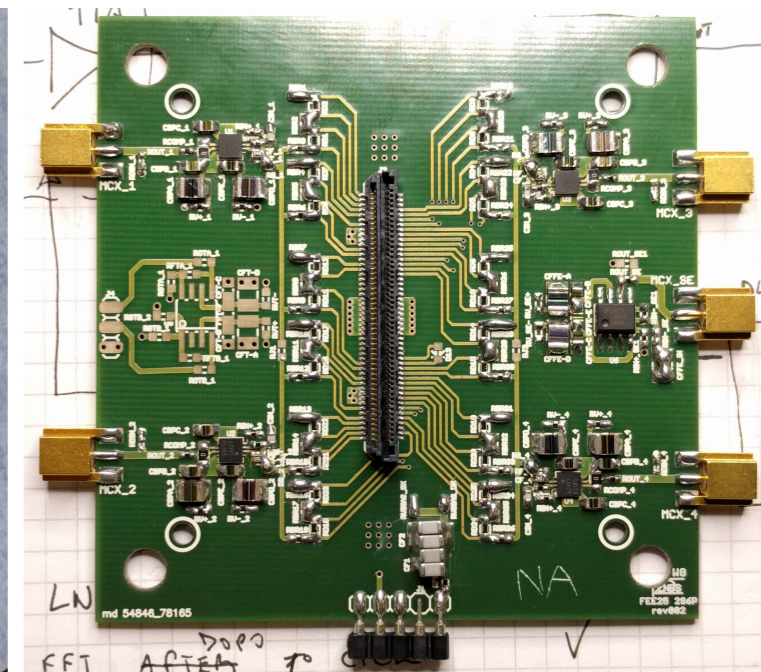
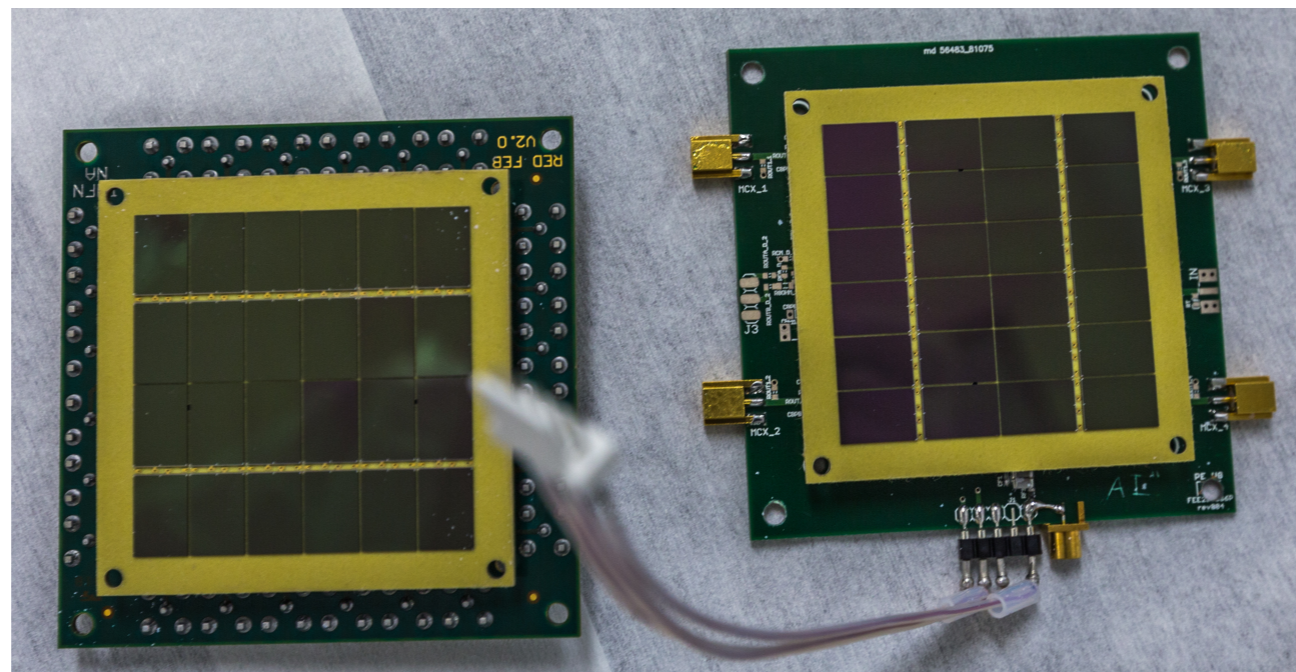
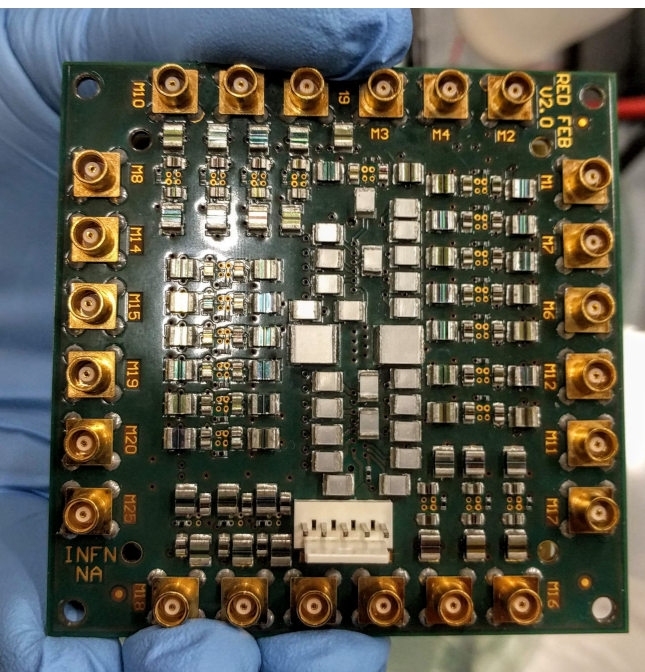
## Light readout:

The Silicon Photo Multipliers developed in collaboration with Fondazione Bruno Kessler (FBK),  
Two 5x5 cm<sup>2</sup> tiles with 24 individual rectangular SiPMs of 12x8 mm<sup>2</sup>. The 10 M $\Omega$  quenching  
resistance, 25x25  $\mu$ m<sup>2</sup> cell, triple doping, arlon substrate.

Front end board electronics designed by INFN-Napoli + INFN-Bologna + LNGS.

On the Top: FBK Tile coupled with 24 channel readout FEB (to improve x-y).

On the Bottom: FBK Tile coupled with 4 channel readout FEB.



## Electronic readout:

CAEN FADC boards VI730, 500 MHz sampling rate (data rate of 40MB/s).

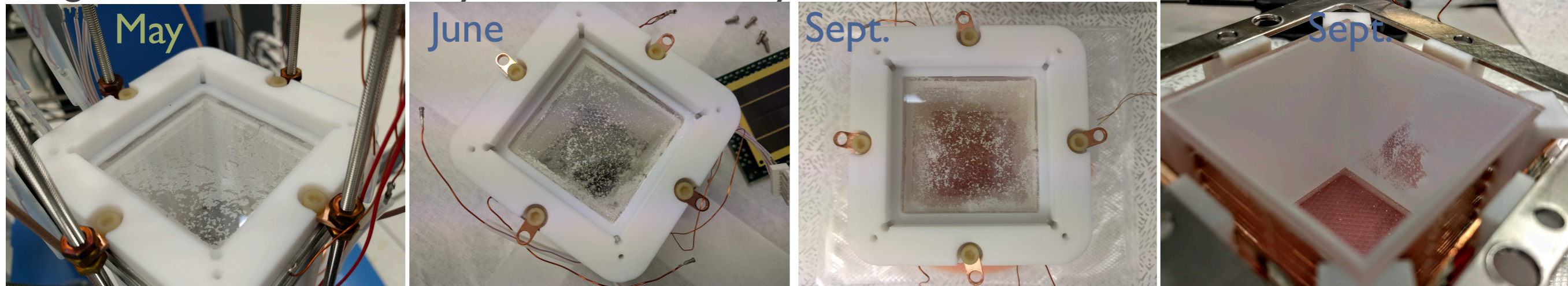
Power supply for the pre-amplifiers  $\pm$ 2.5V and for the Vbias of 34 V.

Both arrays works fine at LAr temperature (87K). DR  $\sim$  1 Hz/cm<sup>2</sup>.

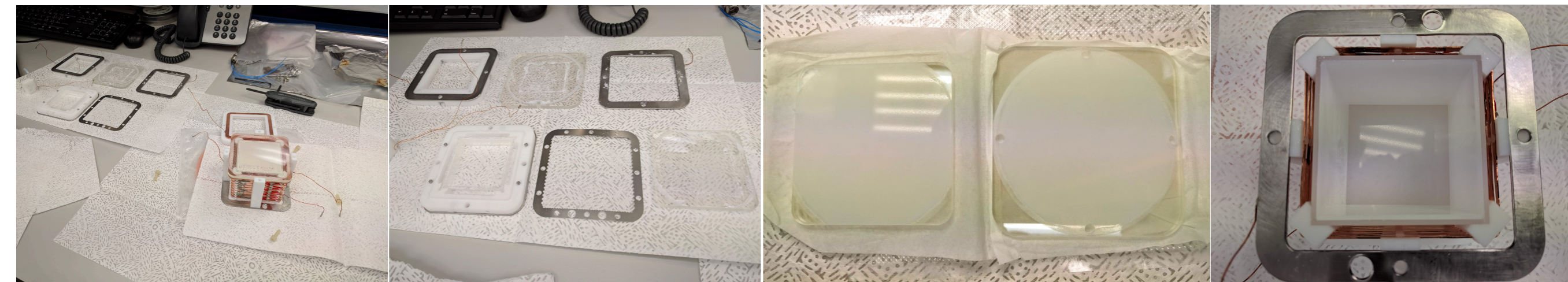


# TPB issue

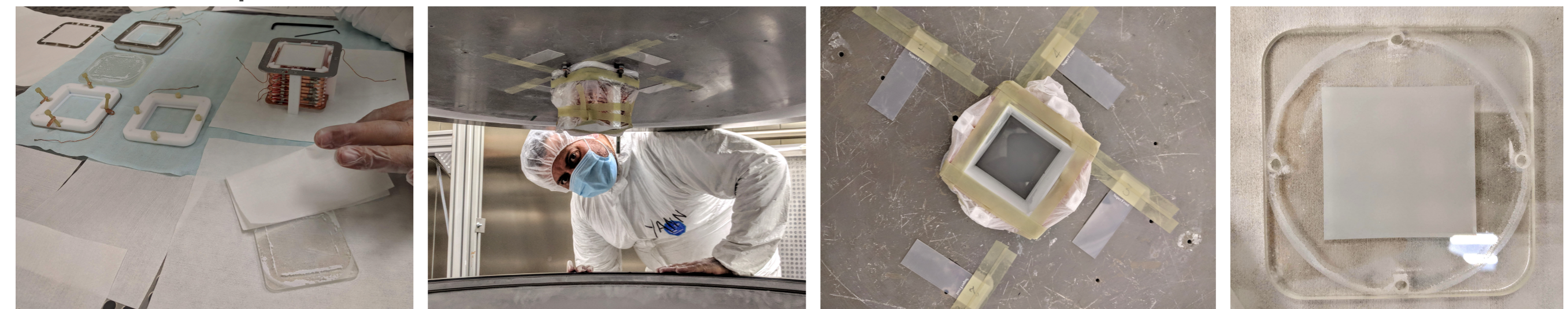
Degradation of the TPB layer from the 1st cycle.



New set of windows starting from 18th of Sept.



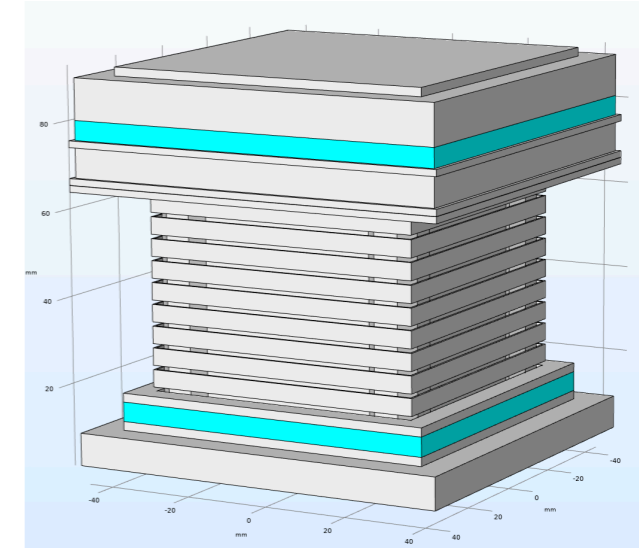
New TPB deposition on the old windows at Gran Sasso on Oct. 8-12.



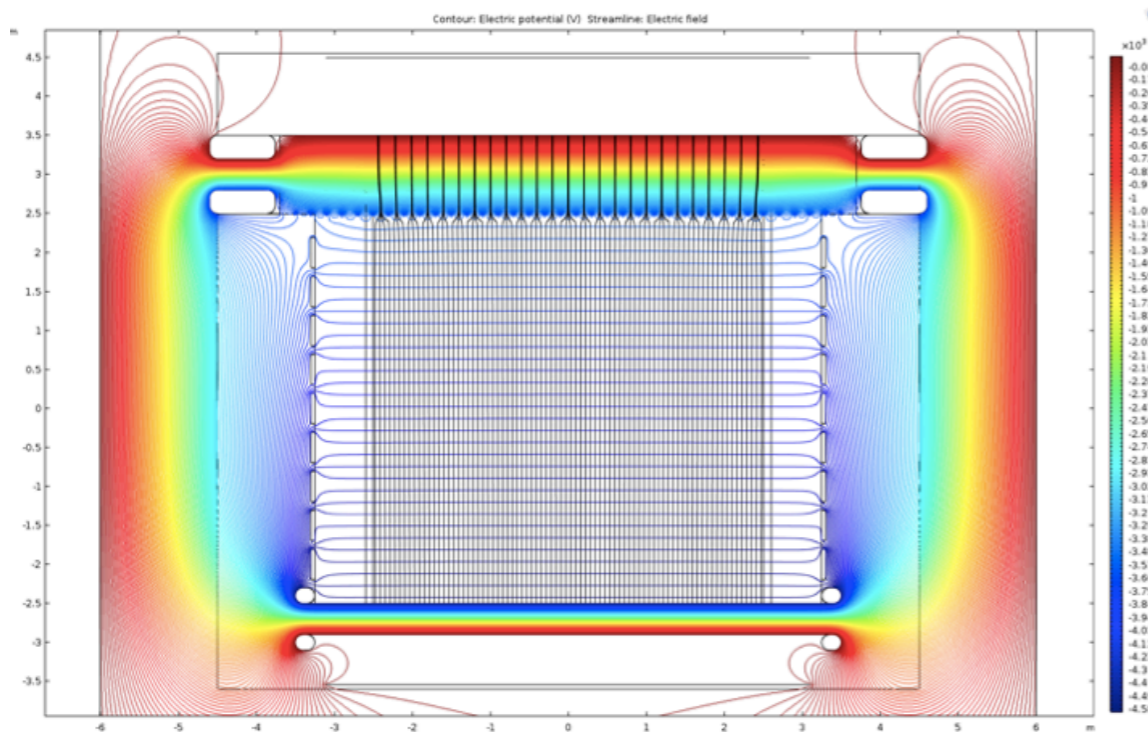
# HHV issue

ReD TPC COMSOL 3D Geometry

Discharge at 7kV on Anode in July Catania run.  
Check of the setting numbers, original number from Yi simulation.  
Simulations cross check with Valerio, later on with Jeff.  
Trigger from Jeff on the power supply usage.  
Detail investigation with CAEN.  
Upgrade of the HHV filer with the 10 GOhm resistance on 1st ring.  
Maximum fields are applied in liquid yesterday, now issues.



$$P=15.6 \text{ psi } E_{\text{drift}}=200 \text{ V/cm } E_{\text{el}}=4.2 \text{ kV/cm}$$
$$V_{\text{anode}} = 3780 \text{ V } V_{\text{grid}}=0 \text{ V } V_{\text{first ring}}=85 \text{ V } V_{\text{cathode}}=-815 \text{ V}$$



- A. Cathode
  1. Height: 11.9mm
  2. Thickness: 4.5mm
  3. Voltage: -815V
- B. Rings (Starting from bottom at 19.4mm; each are 4mm and have 1mm spacing)
  1. -715V
  2. -615V
  3. -515V
  4. -415V
  5. -315V
  6. -215V
  7. -115V
  8. -15V
  9. +85 V
- C. Grid
  1. Height: 66.4mm
  2. Thickness: 0.05mm
  3. Voltage: +195V
- D. Anode
  1. Height: 76.45mm
  2. Thickness: 4.5mm
  3. Voltage: +3780V
- E. Liquid Argon
  1. Height: 71.46mm (5mm above top of grid)

# ReD. Current status

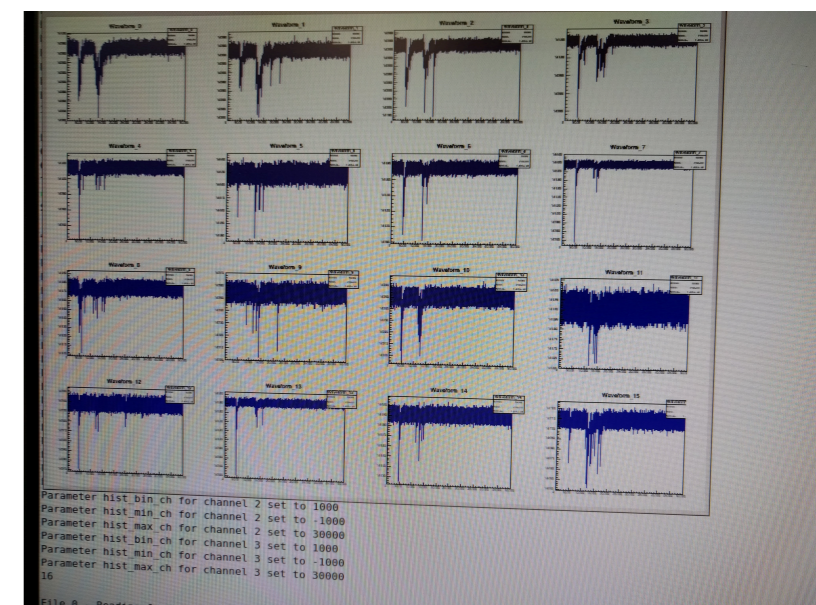
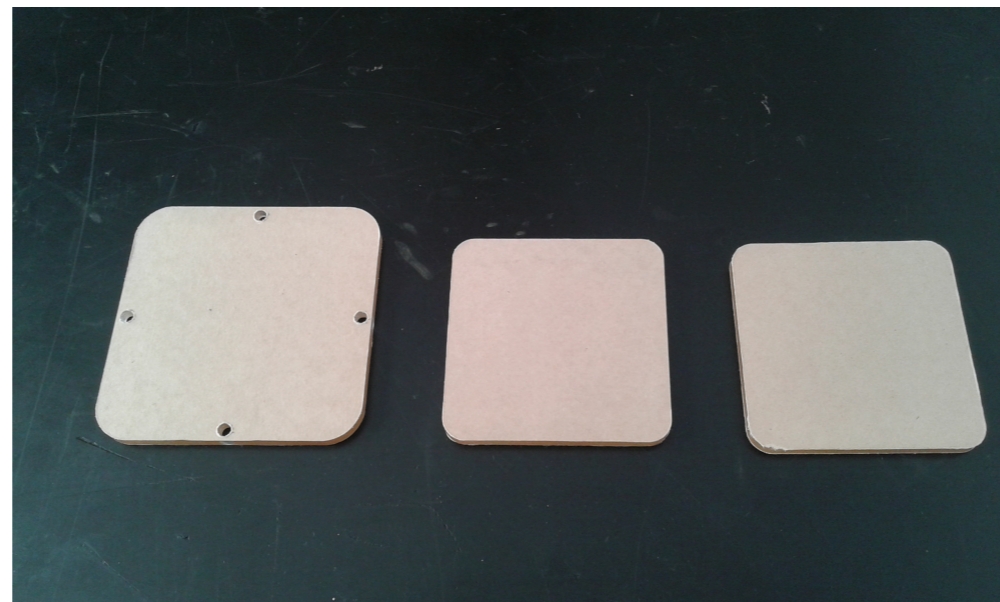
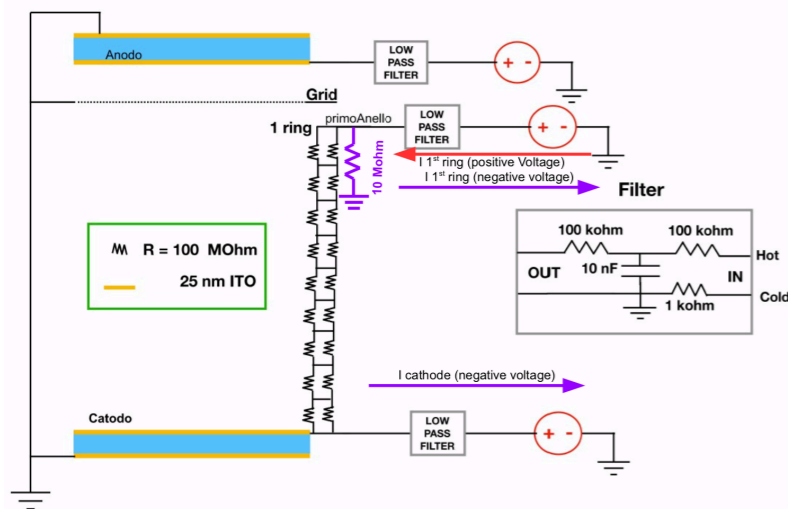
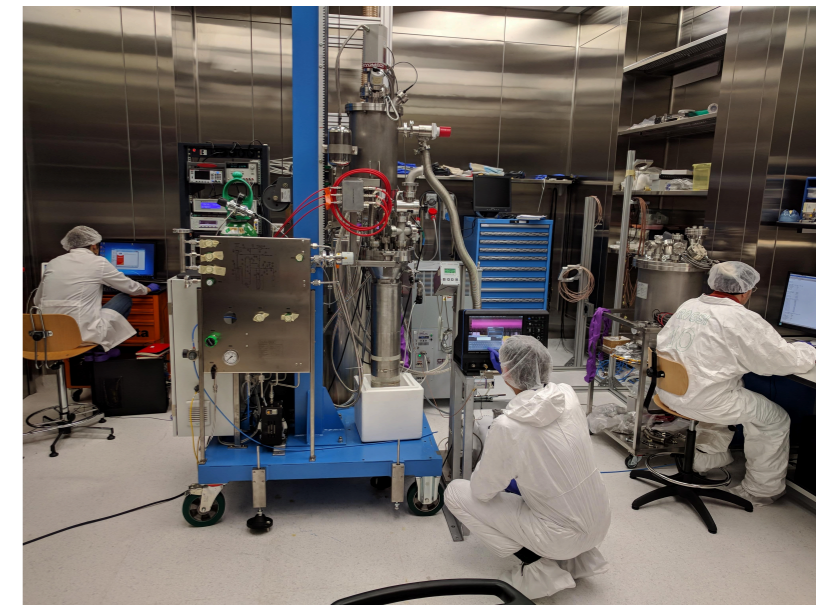
See Mauro's talk

Since December 5 the system is in the new data taking campaign.  
Detailed study of the TPC in single phase - done.

HHV filter upgraded according to CAEN suggestions.

Anode and Cathode windows: New acrylic from McMaster, 3 sets of windows made. Order for new windows with ITO is finalised (two acrylic + two silica).

Kr-83 source is on its way to Naples.



# What next? *See Bianca's talk*

Detailed characterisation of the TPC in double phase (see Mauro's talk).

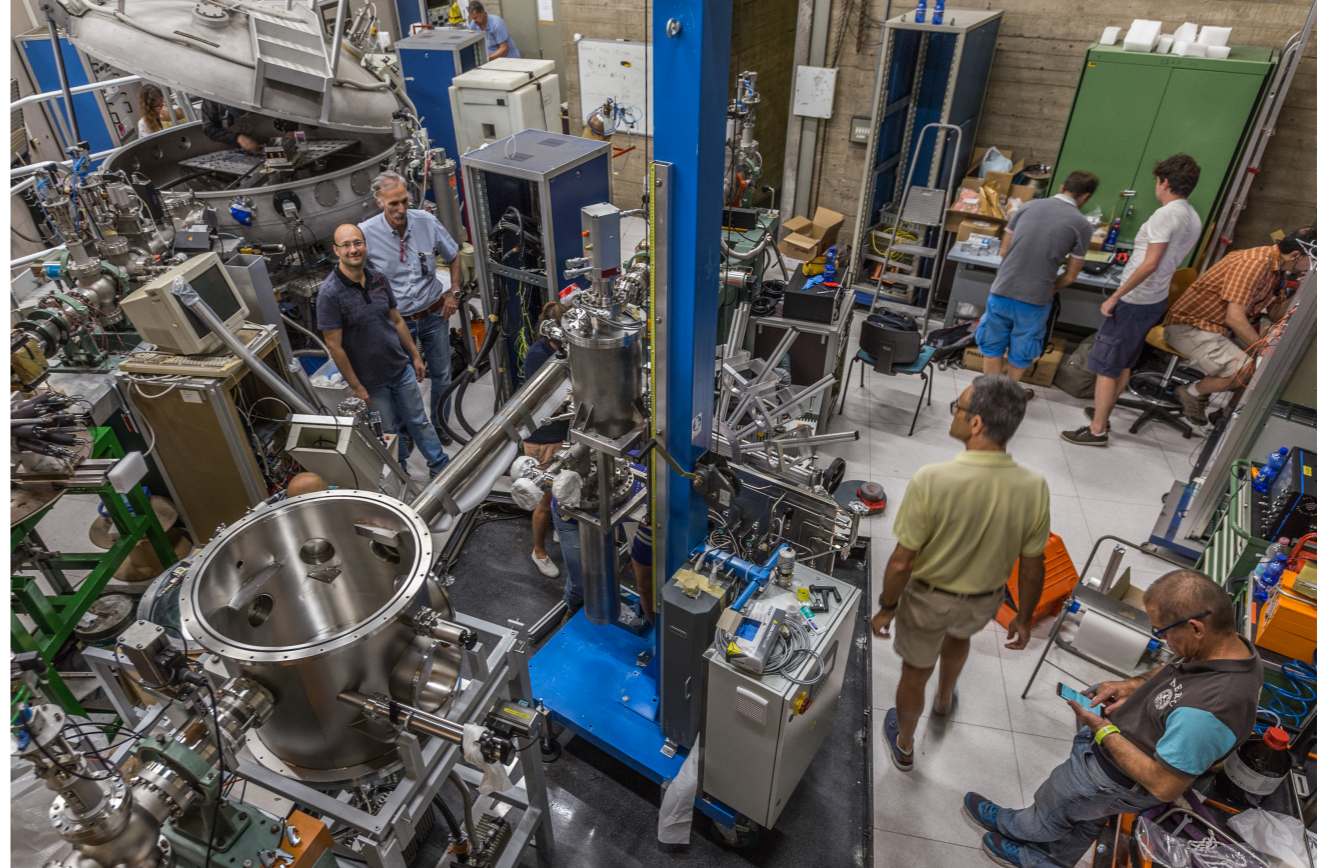
Introduction of the Kr 83 source loop.

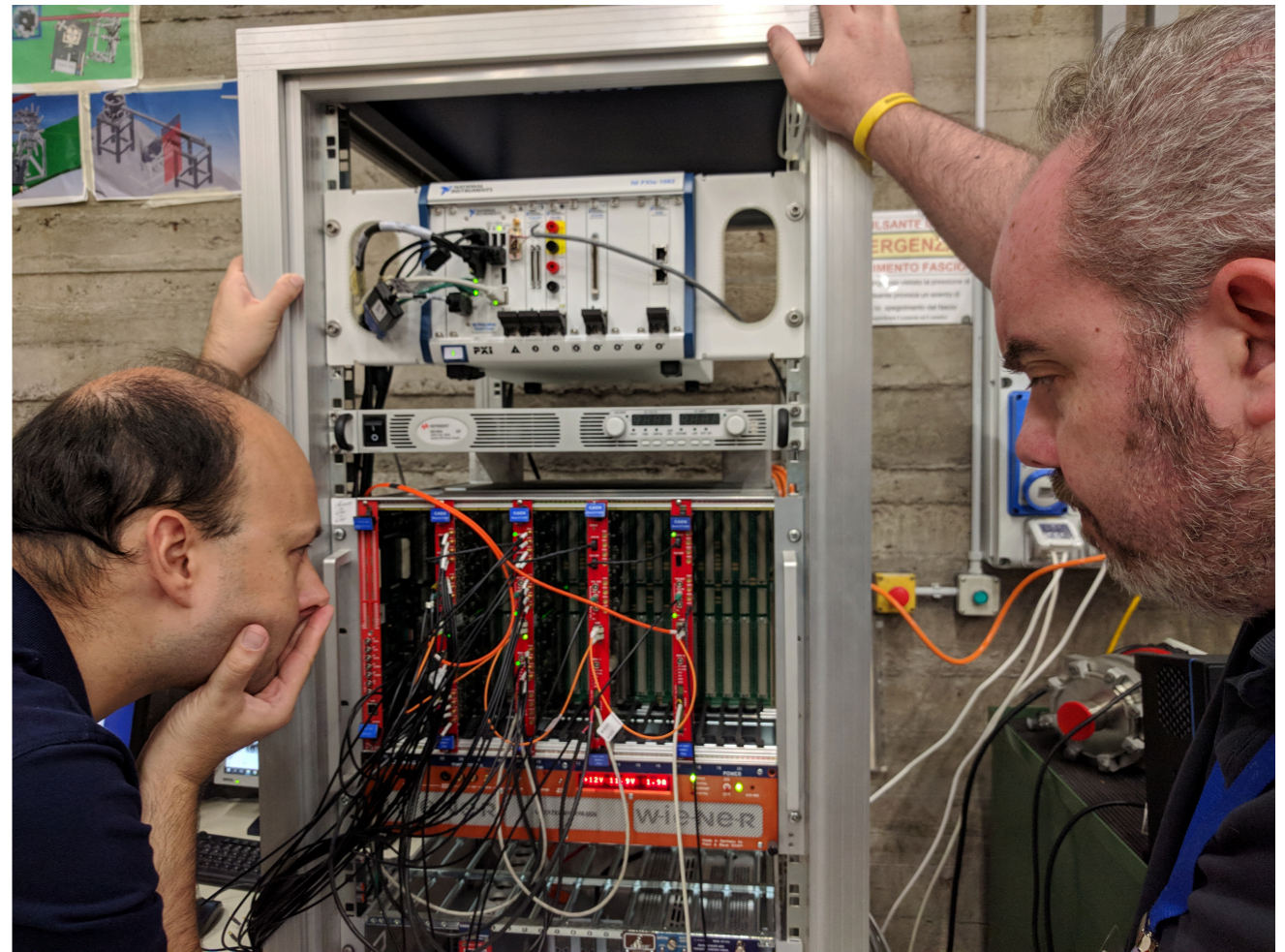
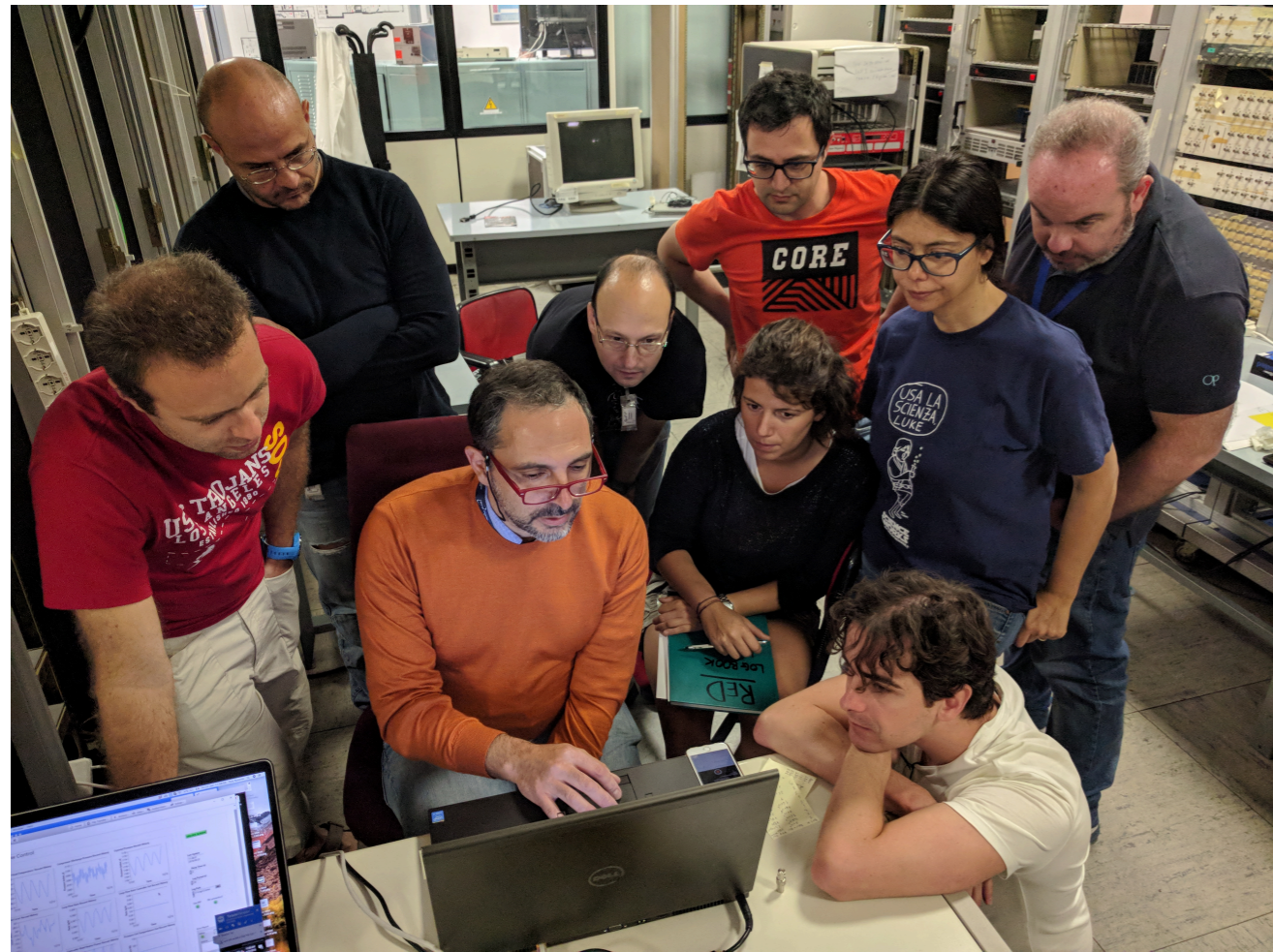
Aperture of the cryostat and the change of the windows (January).

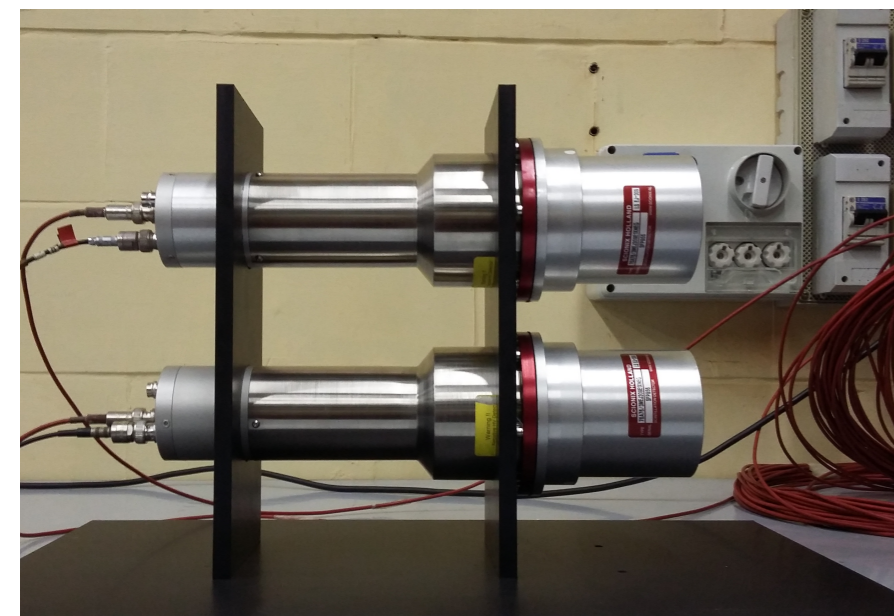
Next assembly, fill and run.

Upgrade of the system (automatic fill option).

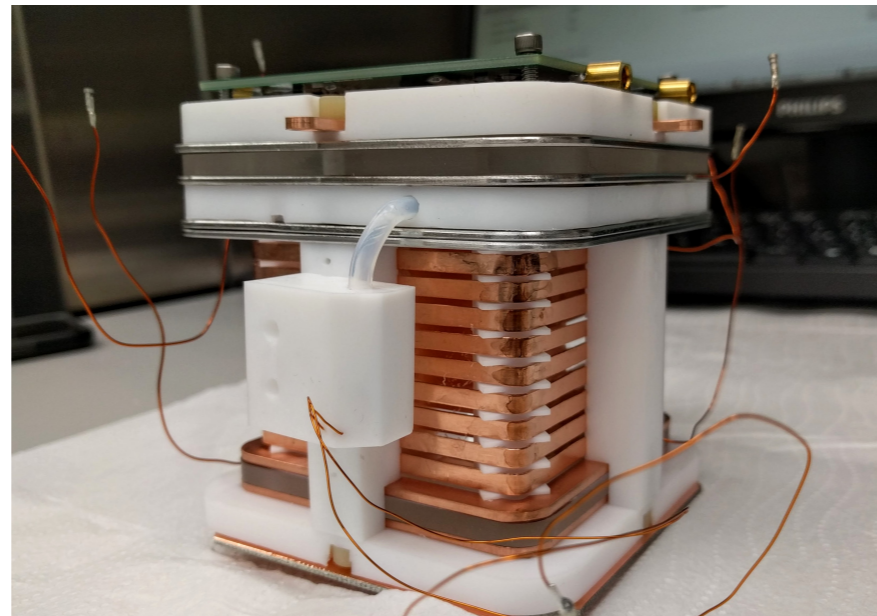
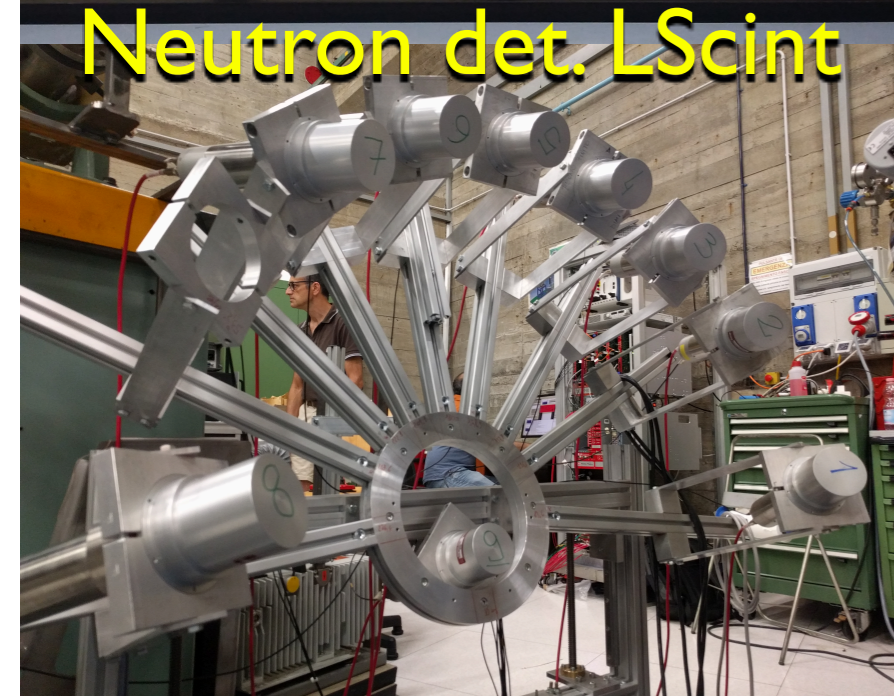
Be ready for the next year run on the beam at LNS.



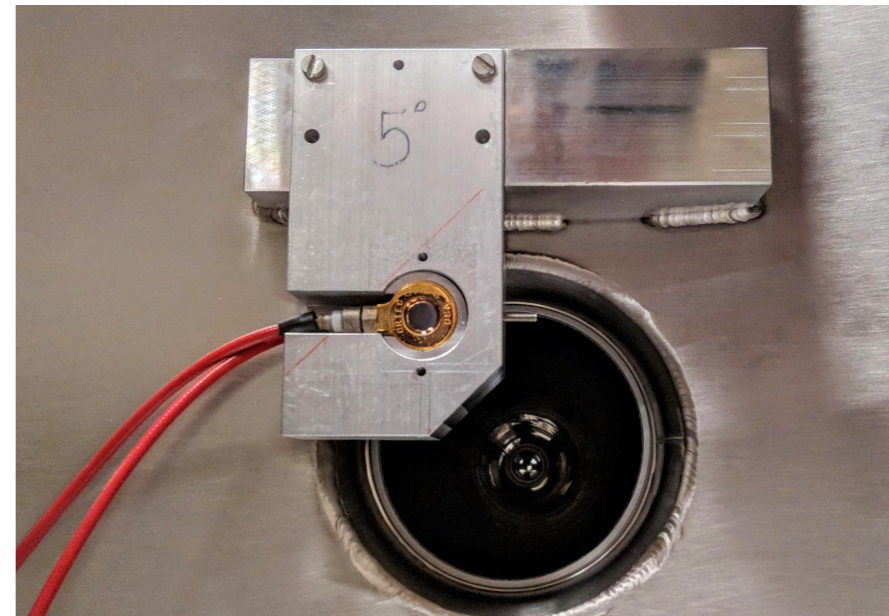




Neutron det. LScint



TPC & Crio system



Scattering chamber

