Purity monitors for ProtoDUNEs

Status update

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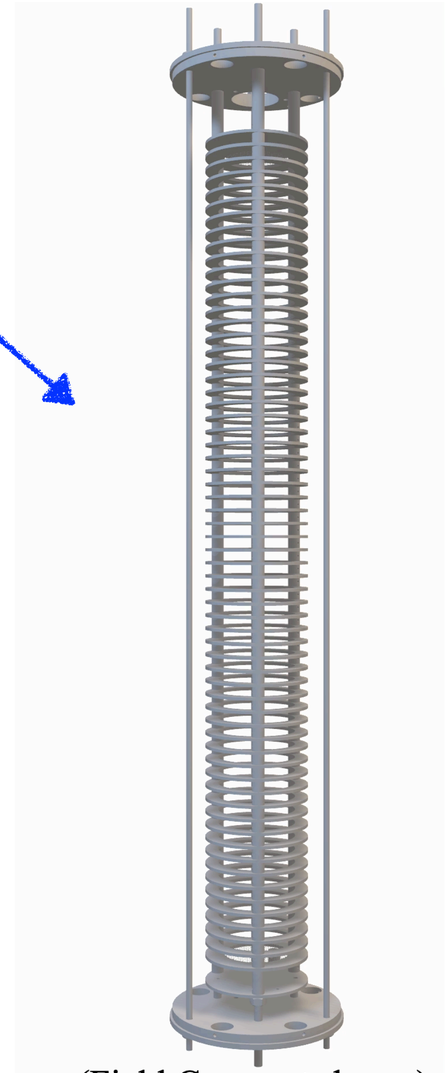
Overview

ProtoDUNE-II HD

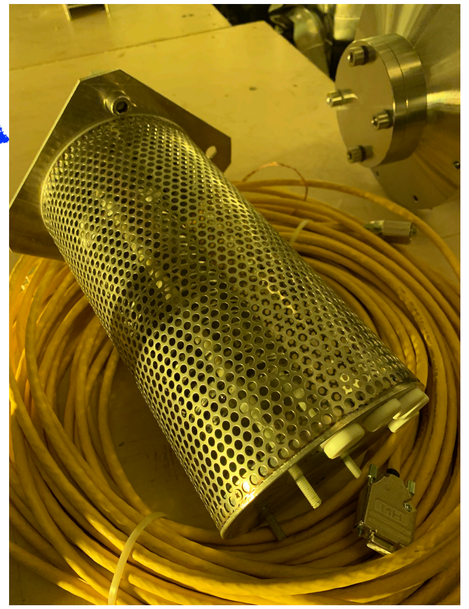
- 2 of the 3 PrMs from ProtoDUNE-I SP will be re-used.
- A long purity monitor (75 cm) will be installed as the new middle PrM, in order to reduce the systematic uncertainty in the absolute lifetime measurement.



(Field Cage not shown)

ProtoDUNE-II VD

- 3 PrMs from ProtoDUNE-I DP will all be re-used.
  - Two short PrMs, drift length ~20 cm (UCL)
  - One long PrM, drift length ~50 cm (UCI)

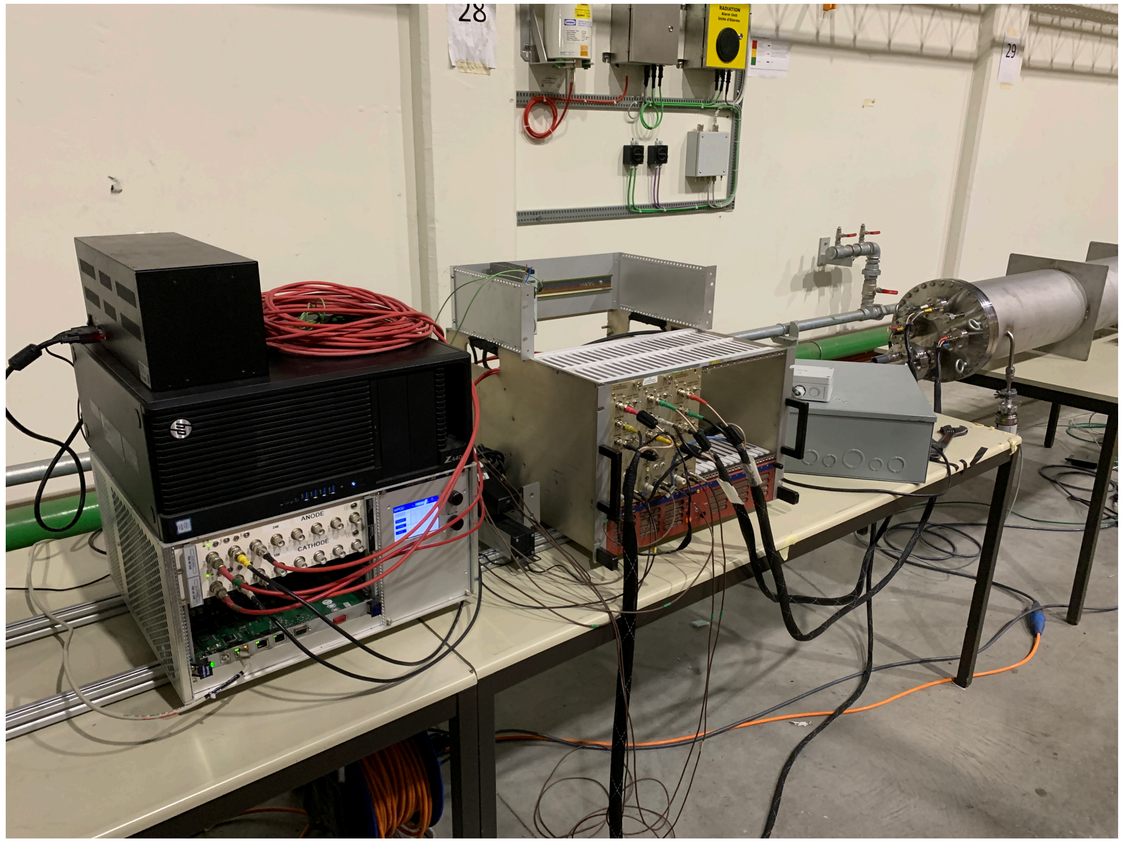


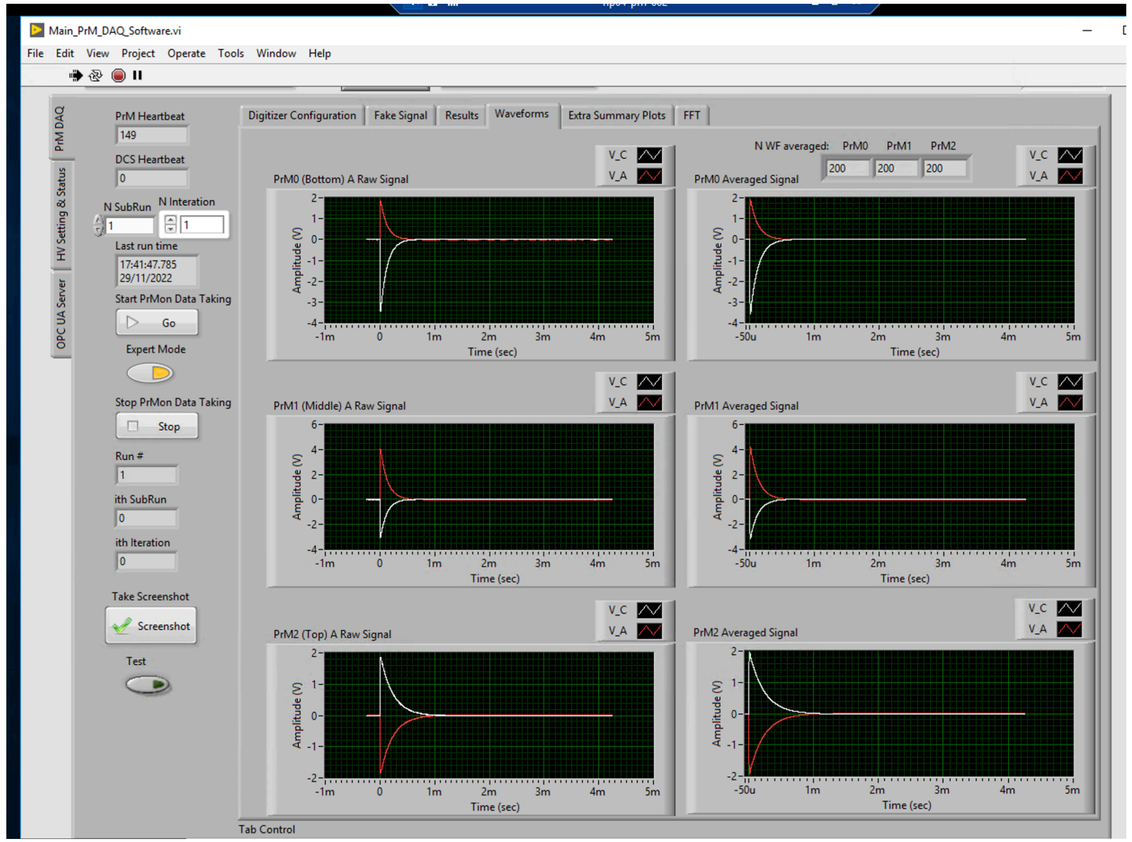
ProtoDUNE-II HD

- The three PrMs are stored in the long pipe and waiting for inserting to the cryostat.
  - Storing PrMs in a vacuum environment is better for preserving the performance of the photocathode.
  - The insertion will wait until the filling.

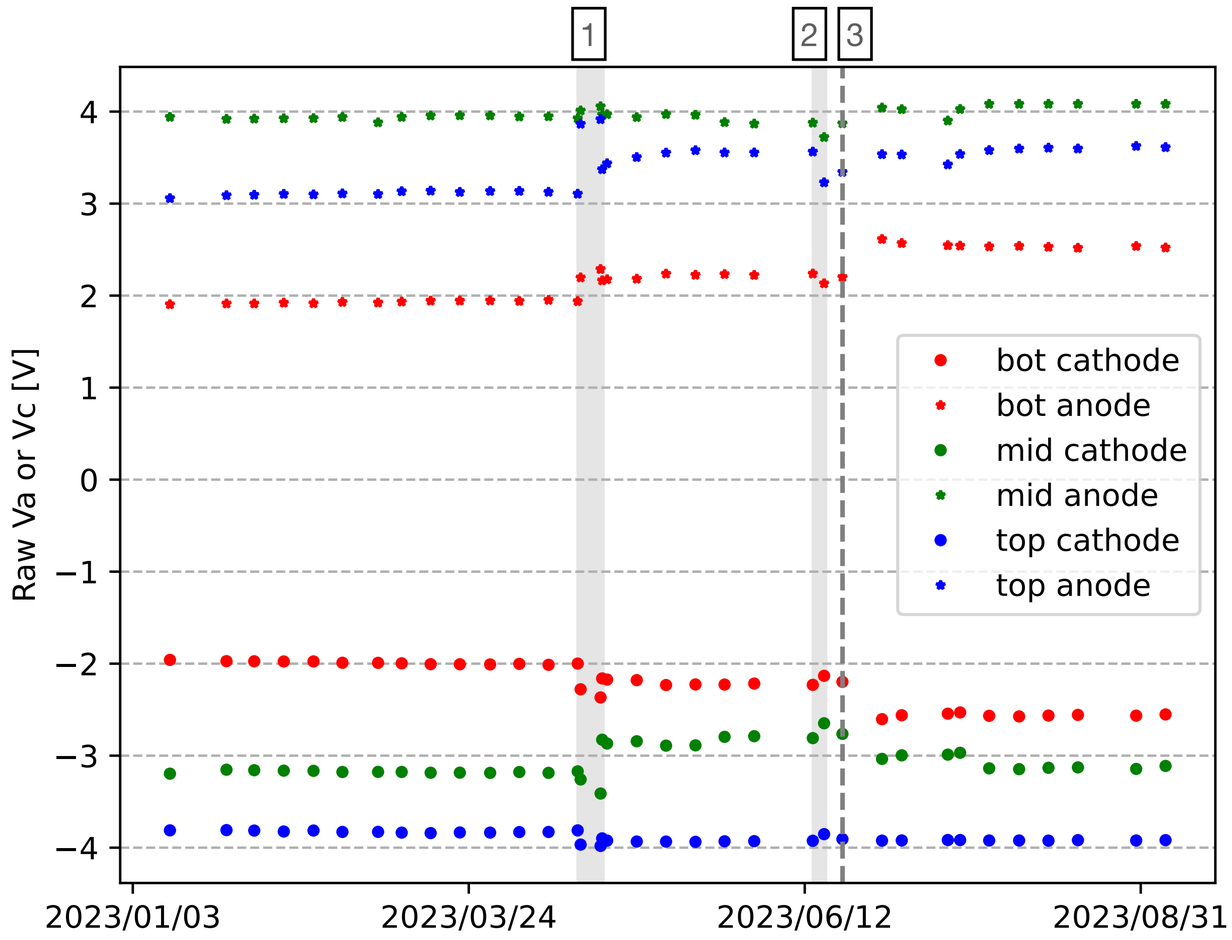
ProtoDUNE-II HD

The readout is connected to the DCS so we can remotely monitor the performance





ProtoDUNE-II HD



1 Disturbance from moving the long pipe: vacuum condition, optical fiber location

2 Interruption from testing of the VD long PrM

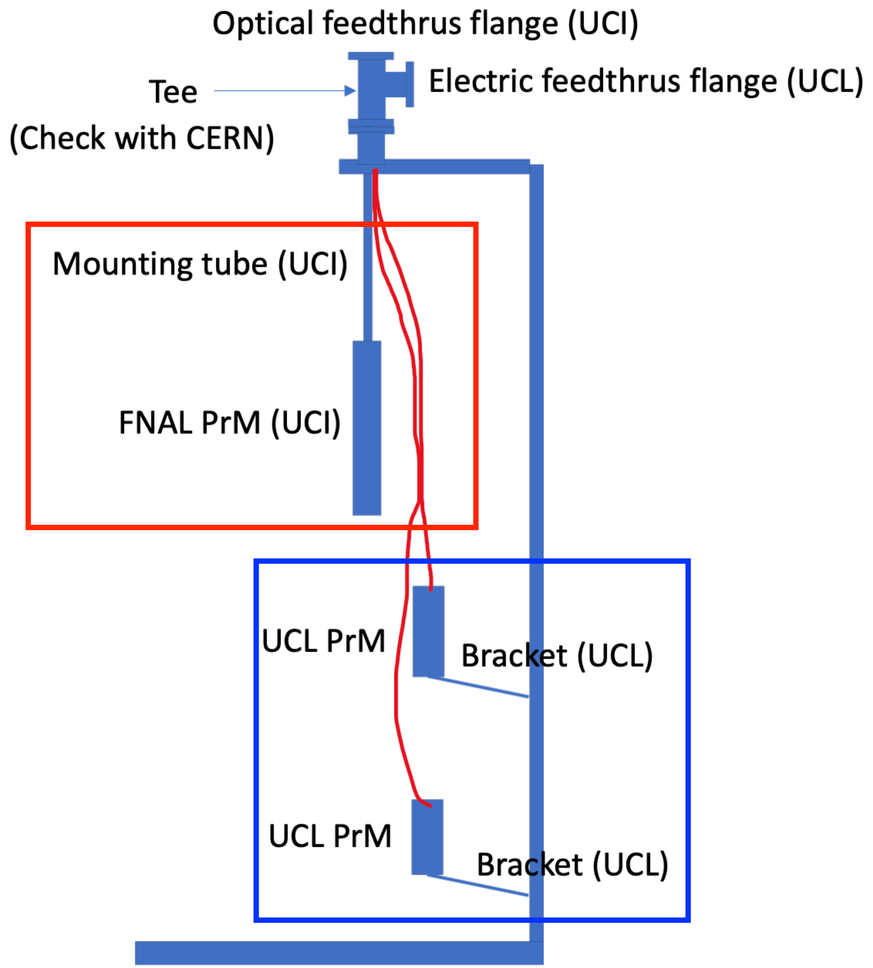
3 Switch of the pump for the beam plug study: re-establish the vacuum condition

In general, the photocathodes are performing as good as from the beginning.

No sign of degradation so far.

ProtoDUNE-II VD

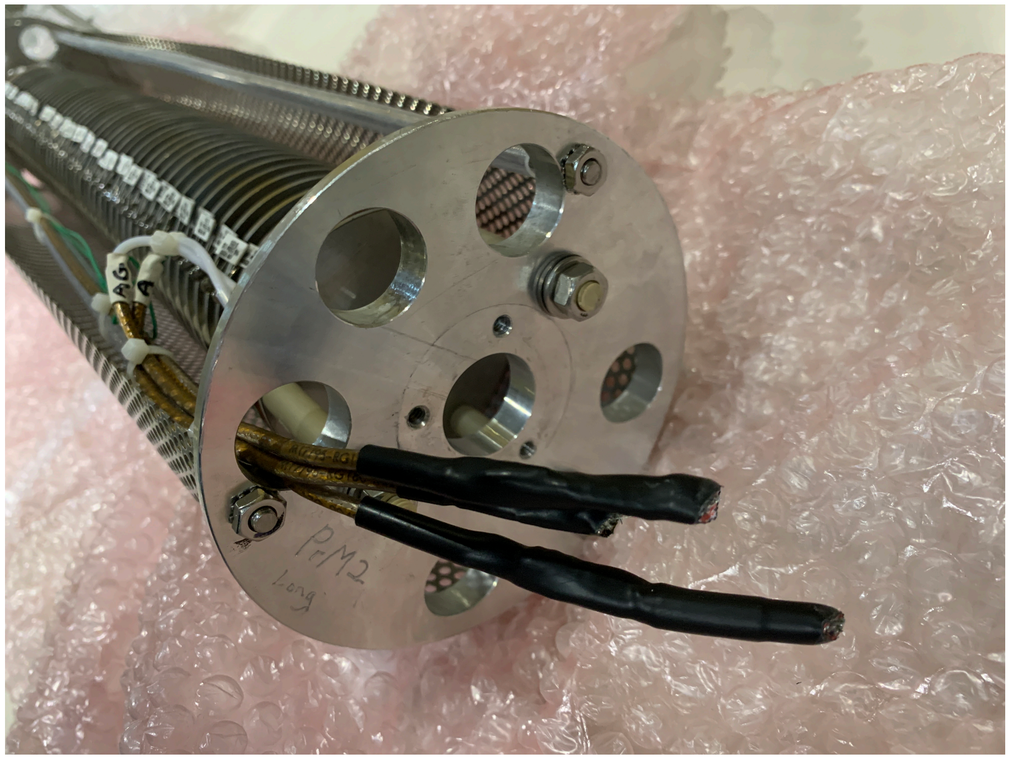
- The three PrMs are disassembled. They need to be re-furbished and re-installed this year.
- Each of the two short PrMs will be supported by a bracket mounted to the wall.
- The long PrM will be mounted from the top flange by a mounting tube.



Status of long PrM after the disassembly

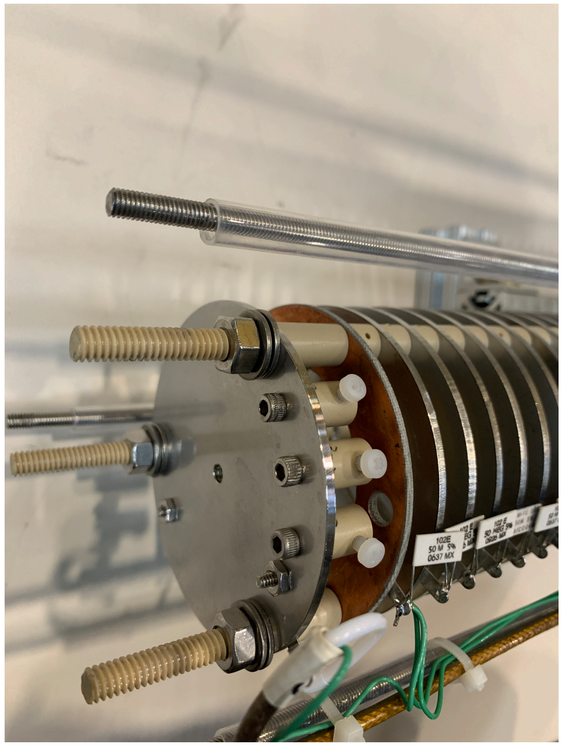
- Cables were cut off
- Photocathode was off the position
- Faraday cage was not complete

- Steps for refurbishment
  - Take apart of the cathode end-cap and cathode disk
  - Replace the cables, with the new grounding scheme and connection method
  - Replace the photocathode and fiber holder
  - Vacuum test in a small test stand

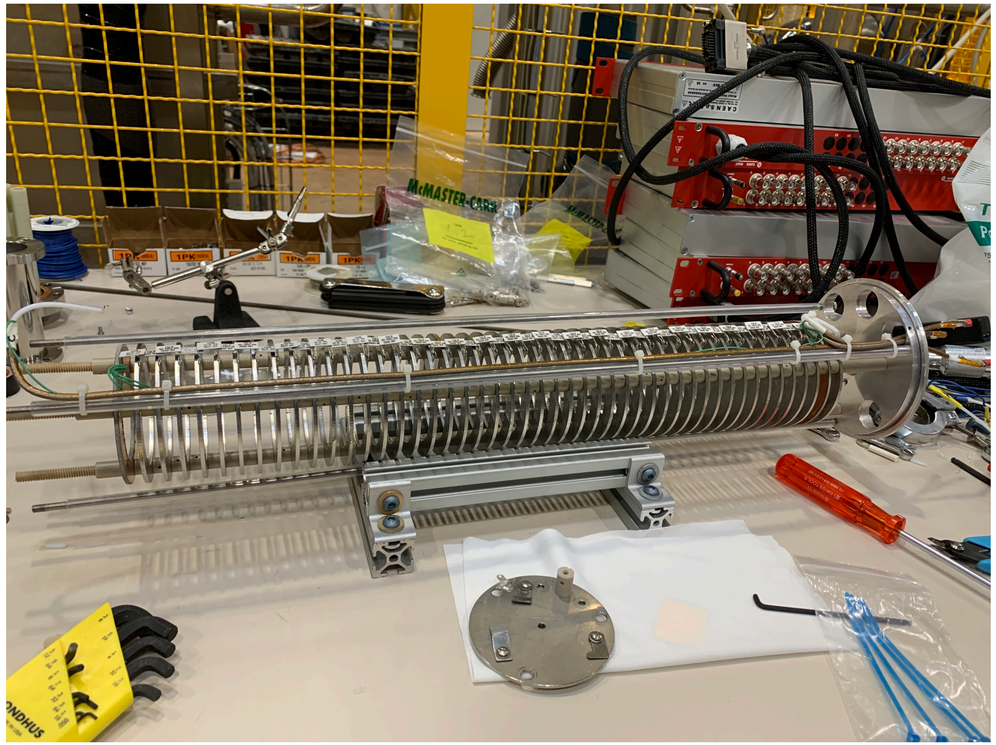


Refurbishment of the long PrM

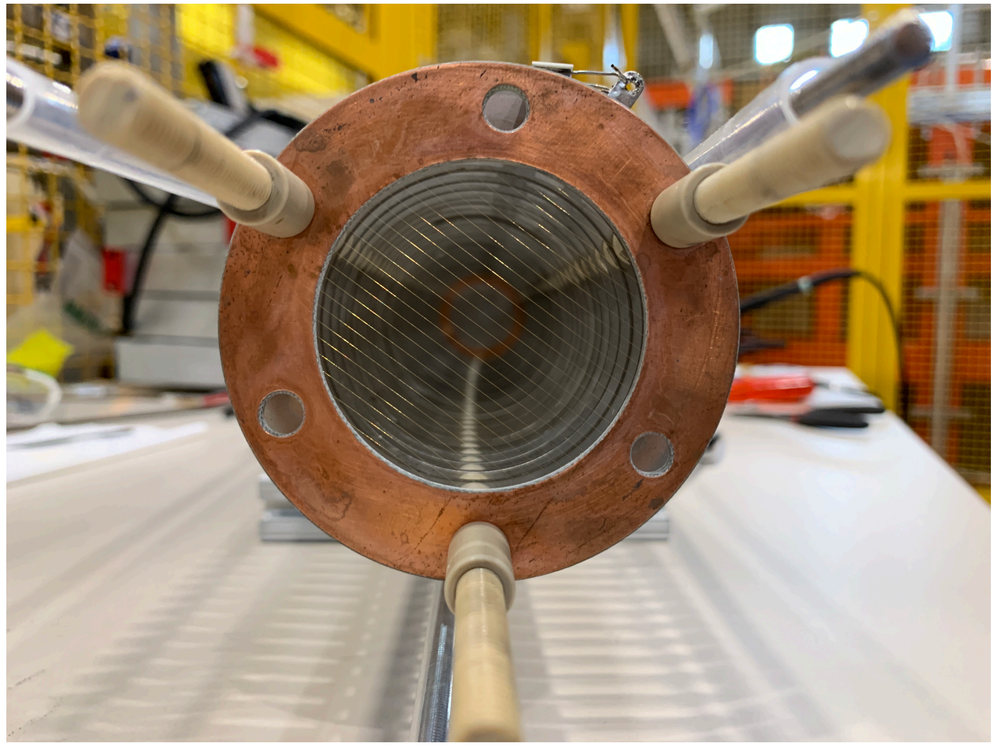
End-cap off



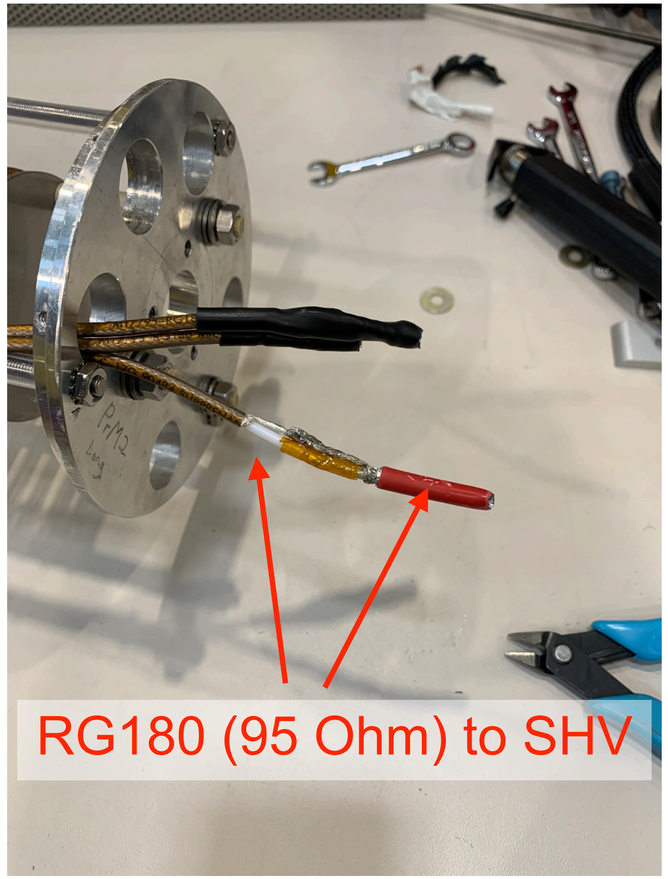
Supported by aluminum profiles

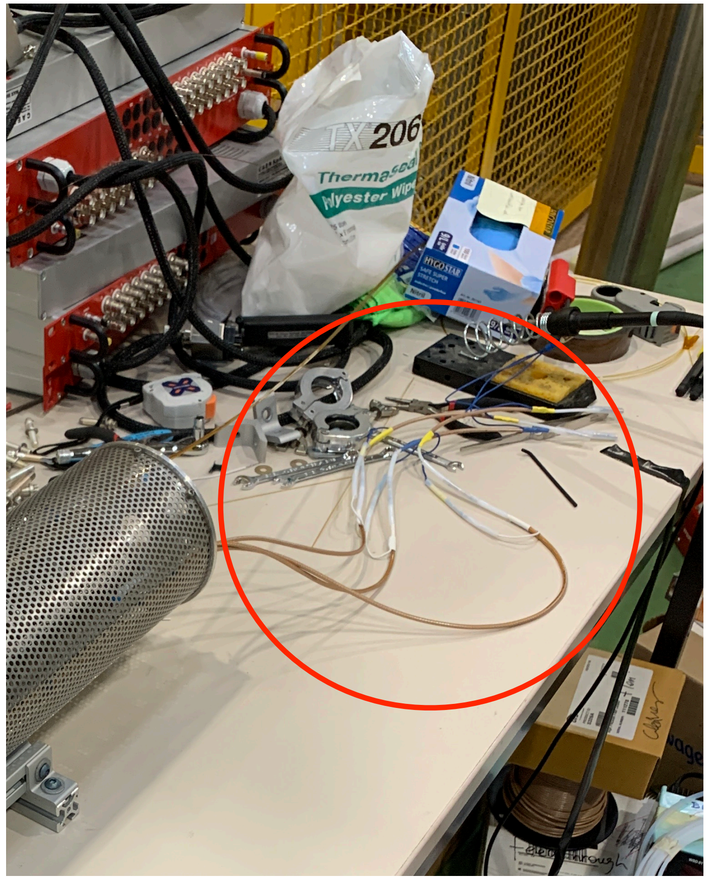


Cathode disk off



Refurbishment of the long PrM





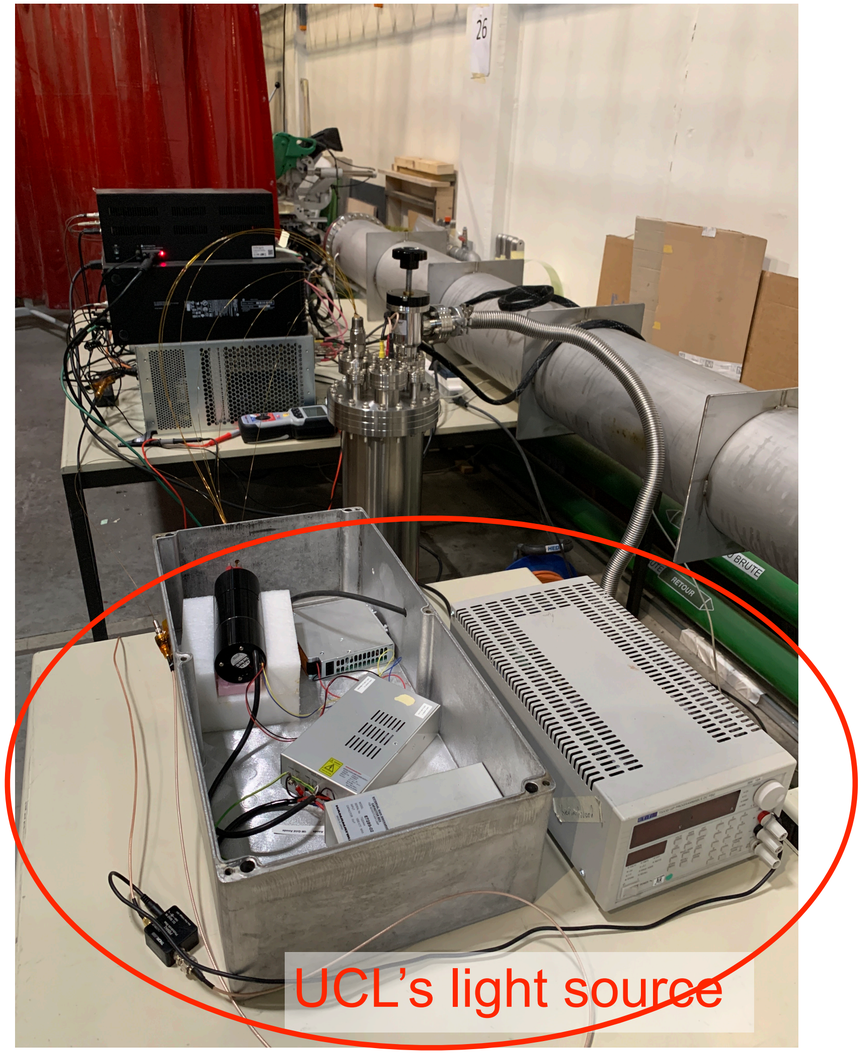
All RG180 cables

Connecting by pin-socket pairs

Refurbishment of the long PrM

- With the full set of the Faraday cage now
- The connection of all resistors is working
  - 46*50 MOhm ~ 2.3 GOhm

Vacuum test

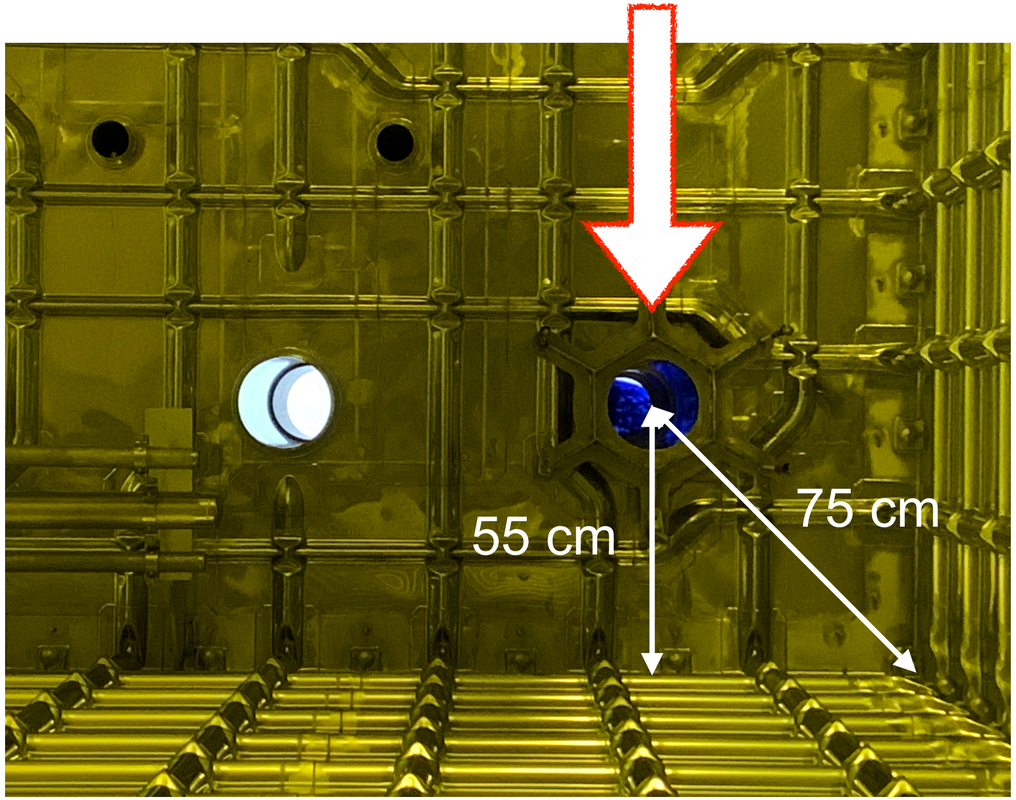


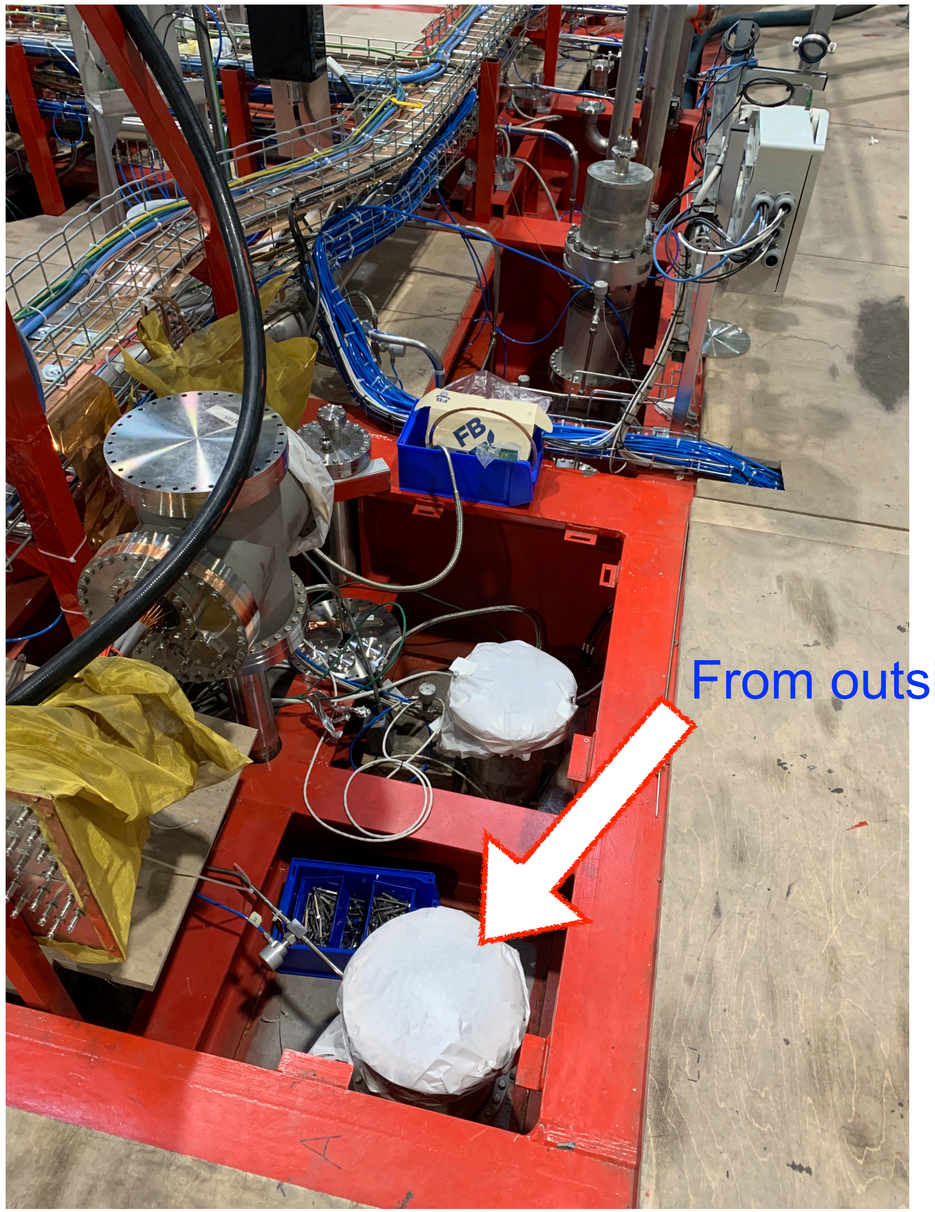
- Used UCL's light source.
- Temporarily used the HV, electronic box, and digitizer for the bottom purity in the long pipe.

Port reserved for PrMs

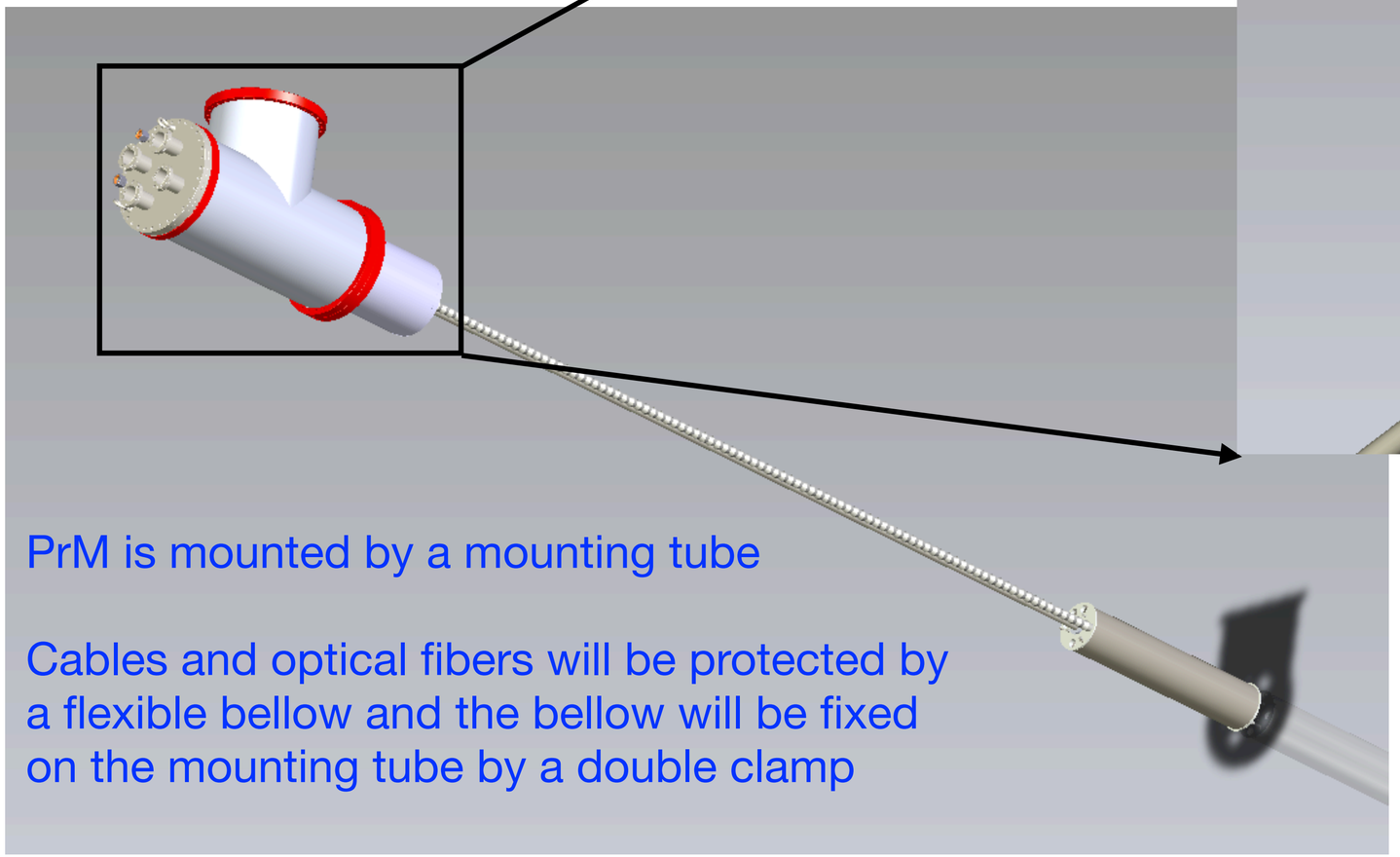
Port 12.1 is reserved for PrMs

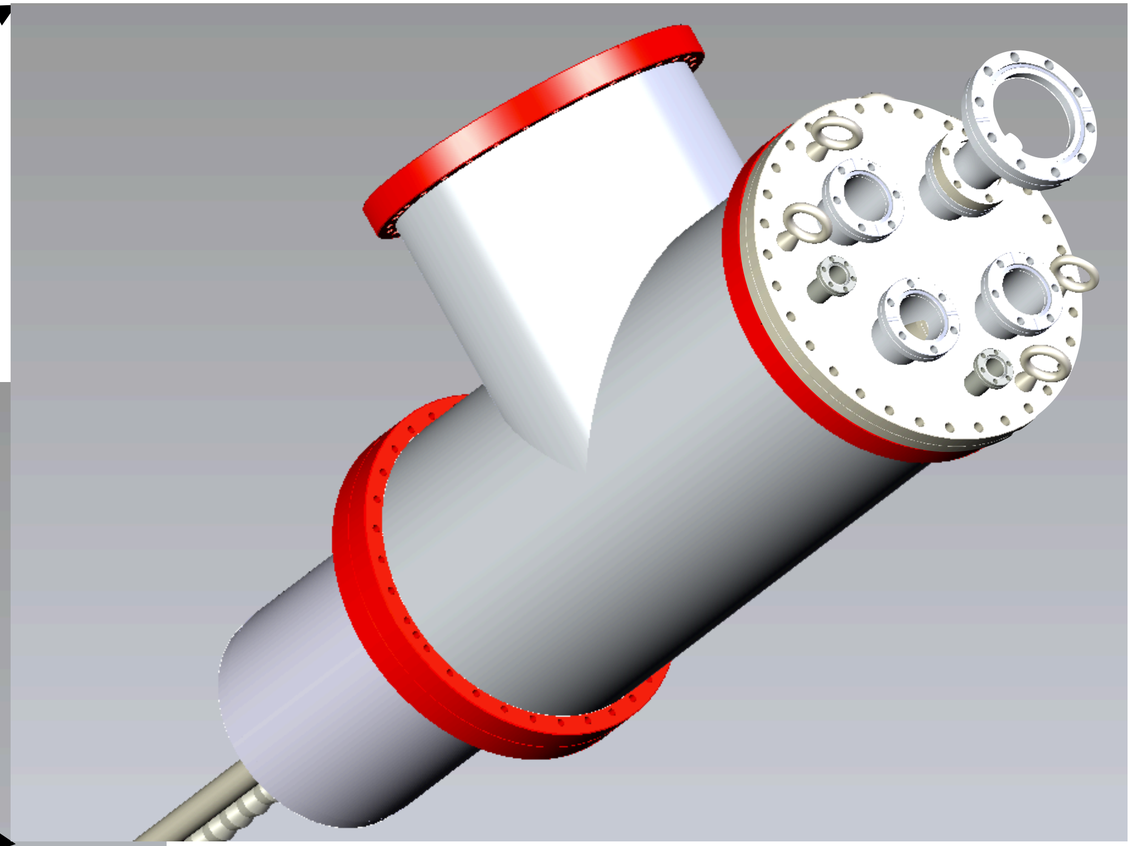
From inside





Assembly drawing





PrM is mounted by a mounting tube

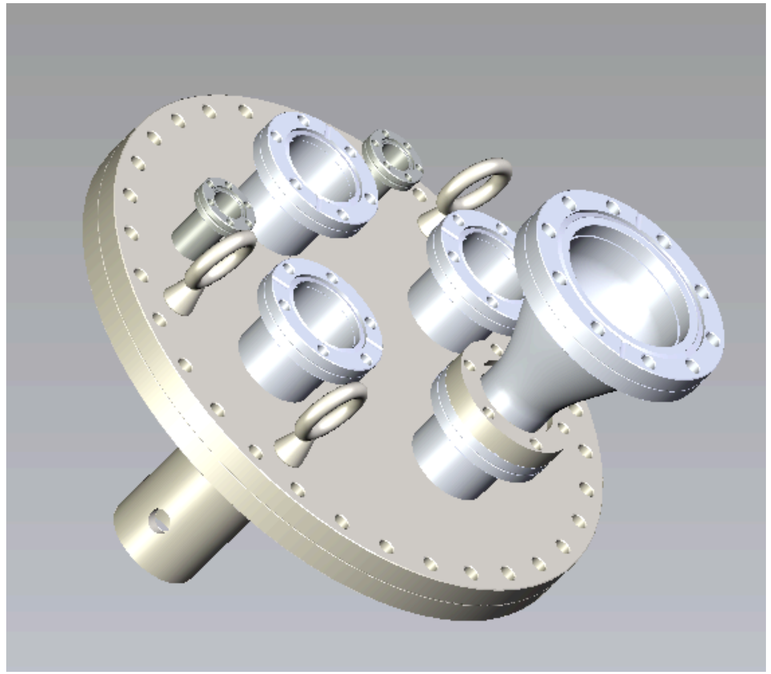
Cables and optical fibers will be protected by a flexible bellow and the bellow will be fixed on the mounting tube by a double clamp

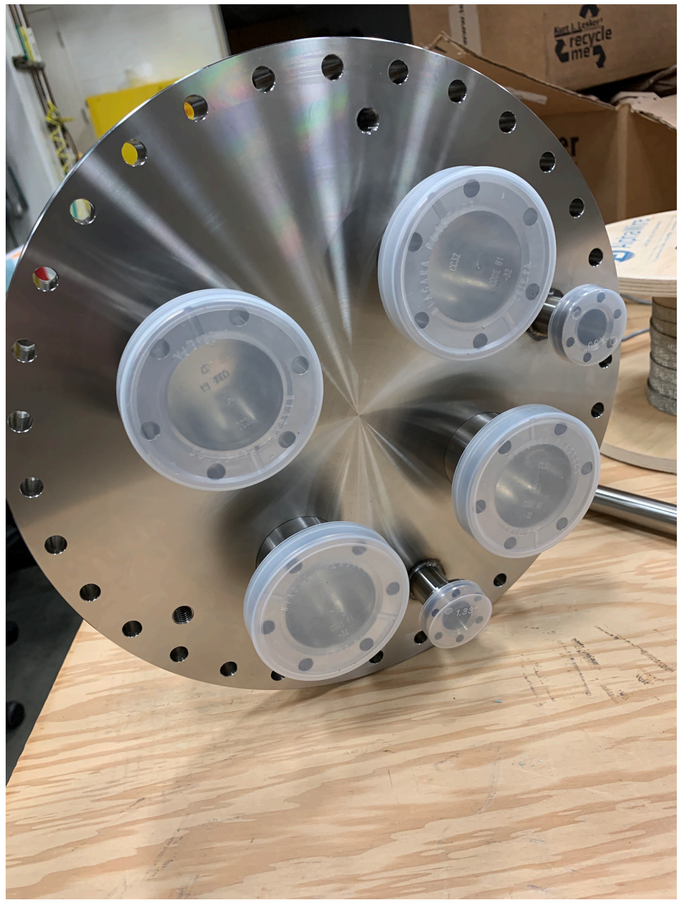
An extension pipe will be manufactured in order to incorporated all feedthroughs

- 3 for electric feedthroughs
- 1 for optical fiber feedthrough
- 2 extra 1.33CF for redundancy

Assembly drawing

The top flange has been fabricated, and will be tested at Irvine.





Summary

- PrMs for HD are sitting in the vacuum pipe, waiting for insertion.
  - No sign of degradation of the photocathodes.
- The purity monitors for VD are refurbished and will be reinstalled.
  - The top flange has been fabricated.
  - Will assemble the purity monitor and test the performance.
- The filling schedule is not fully clear right now, but we’re aiming to have everything ready between October and the end of this year.

Backup

Motivation of purity monitors

- Detector and cryogenic operation: alert pump and cryogenic accidents during operation, alert unexpected contamination in the cryostat.
  - Incidents alerted by PrMs in ProtoDUNE-SP include filter saturation, level gauge fake measurements, pump stoppage, etc.
- Provide benchmarks of LAr purity for circulation studies and TPC calibration.
- Measure e-lifetime for data quality, calibration and analysis. Impurities measured by purity monitors and TPC/CRT are in good agreement in ProtoDUNE-SP.
  - Provided PrM lifetime to the analysis group for run-by-run lifetime calibration.
- Measure purity stratification and validate Computational Fluid Dynamics (CFD) simulations.