

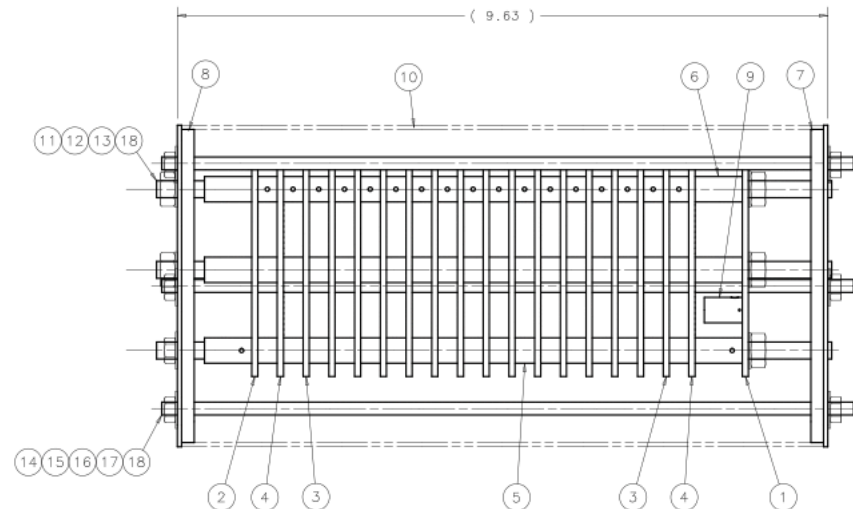
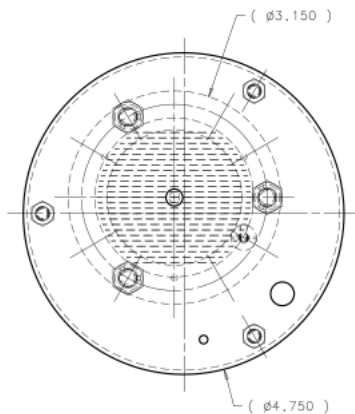
Purity Monitor Installation in DUNE SP FD

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Dimensions of the monitors.

- Length:
 - Top, bottom purity monitors (standard): 25cm
 - Middle purity monitors (long): 75cm
- Diameter:
 - All purity monitors: OD 12 cm



Standard length purity monitor

How are they installed in the cryostat

Purity monitors can be the last or almost last detectors installed before close the cryostat

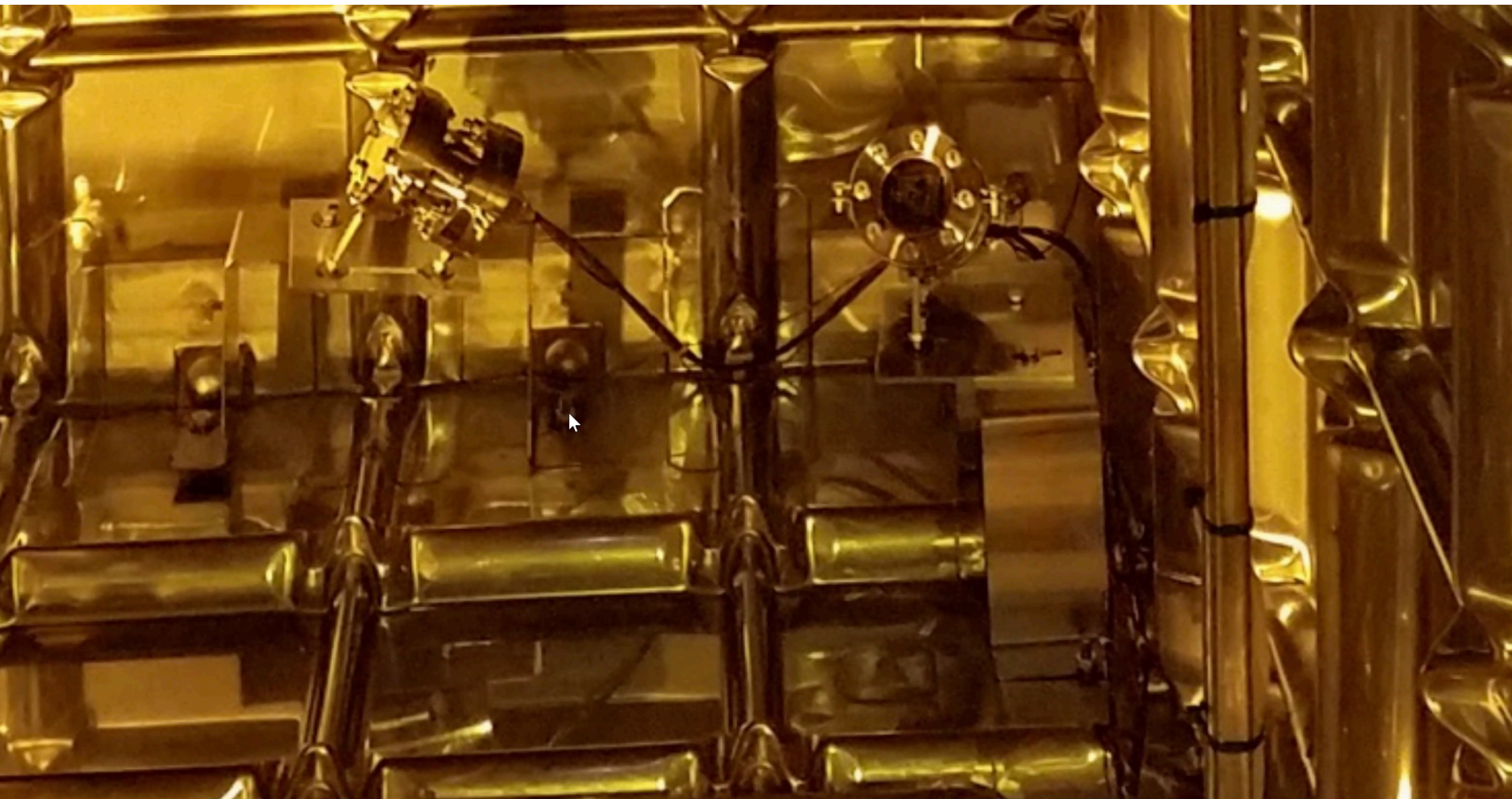
Onsite tests to make sure purity monitors work properly after shipment before installation

- Mechanical cold test for each individual PrM
- Clean PrMs with 200 proof ethanol
- Vacuum tests with PrMs on short assemblies in short Dewar
- Assemble the PrMs on the two long assemblies to be inserted into the cryostat
- Test PrM long assemblies in long vacuum tubes before installation
- Keep the PrM assemblies in the long vacuum tubes before installation

How are they installed in the cryostat

Installation procedure for each PrM string

- Move PrM assembly to the corridor
- Use crane, move PrM assembly to the top of installation port on DUNE cryostat. If clearance from DUNE cryostat to ceiling is not enough, need to design joints on PrM support tubes
- Start to insert the assembly into port
- Test connections on each PrM during insertion
- After insertion, test overall resistance and capacitance with electrometer and capacitance meter
- Mount NIM bin and Xe flash lamp on PrM rack on cryostat (Dim of rack).
- Connect cables
- Connect PrM optical fibers to Xe flash lamp
- Make connections to power supplies and slow controls interfaces on DCS rack



ProtoDUNE-SP PrM mechanical cold test (CERN892)

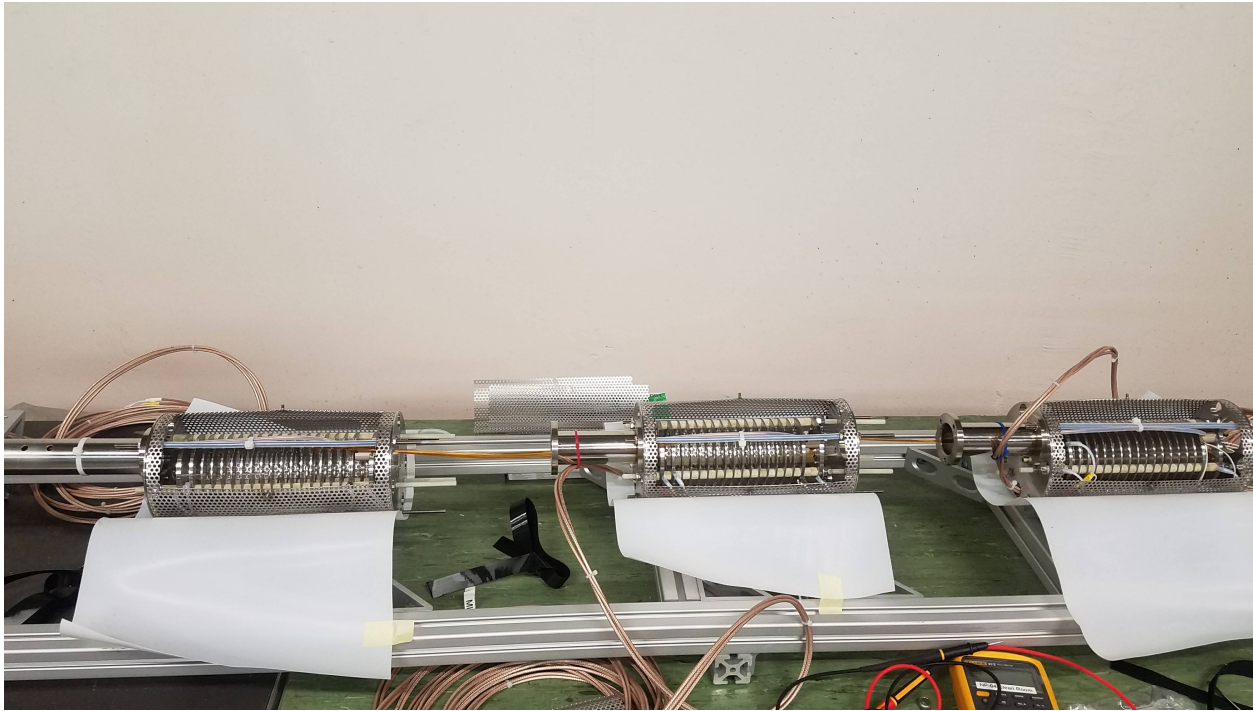
LAr supply and dewar at CERN892



Test under low temperature:

- Soldering
- Electric connection
- Fiber-cathode distance
- PrM frame and Faraday cage

Vacuum test with PrMs on short assemblies in short Dewar

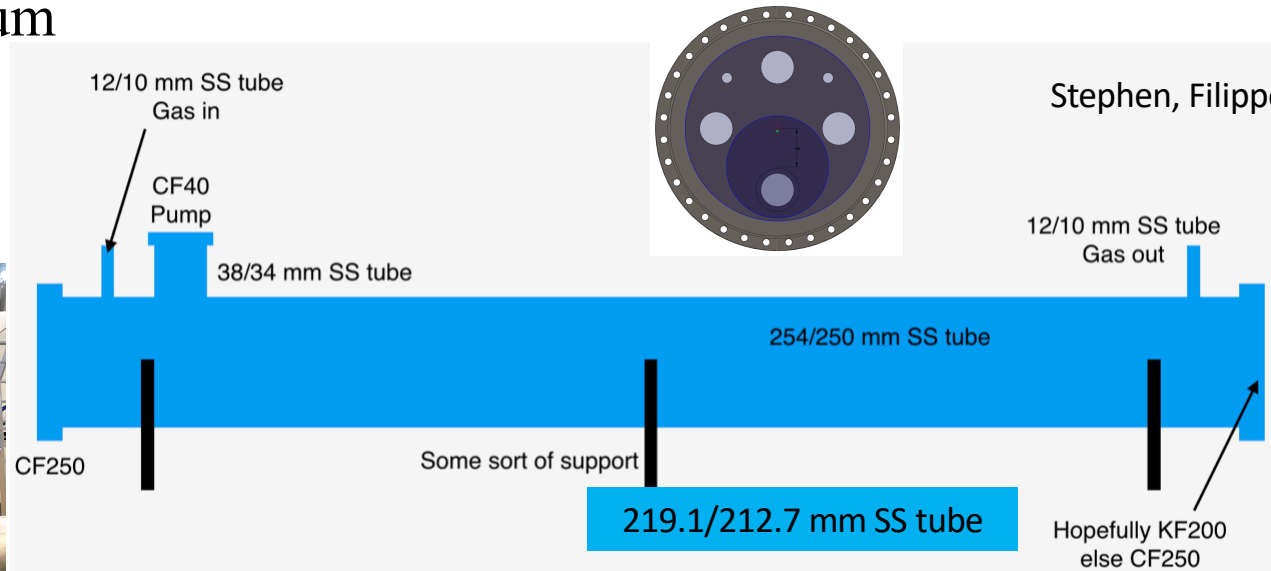


Assemble the PrMs on the two long assemblies
to be inserted into the cryostat



Test PrMs in long tube

- After assemble PrMs on long supporting rods, test the full assembly in vacuum



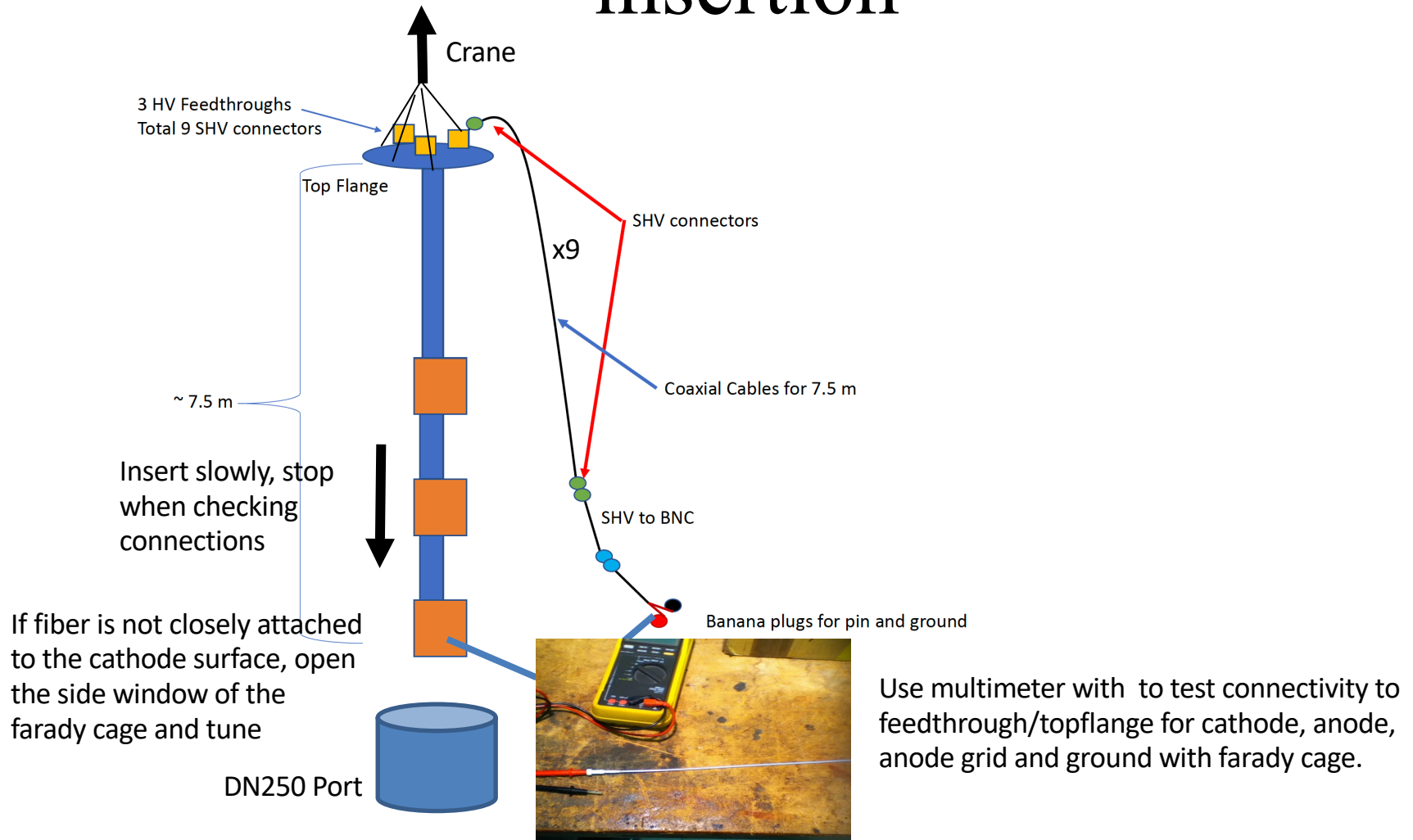
Before insertion, move the assemblies out of the long vacuum tubes, cover the assemblies to keep the assembly clean



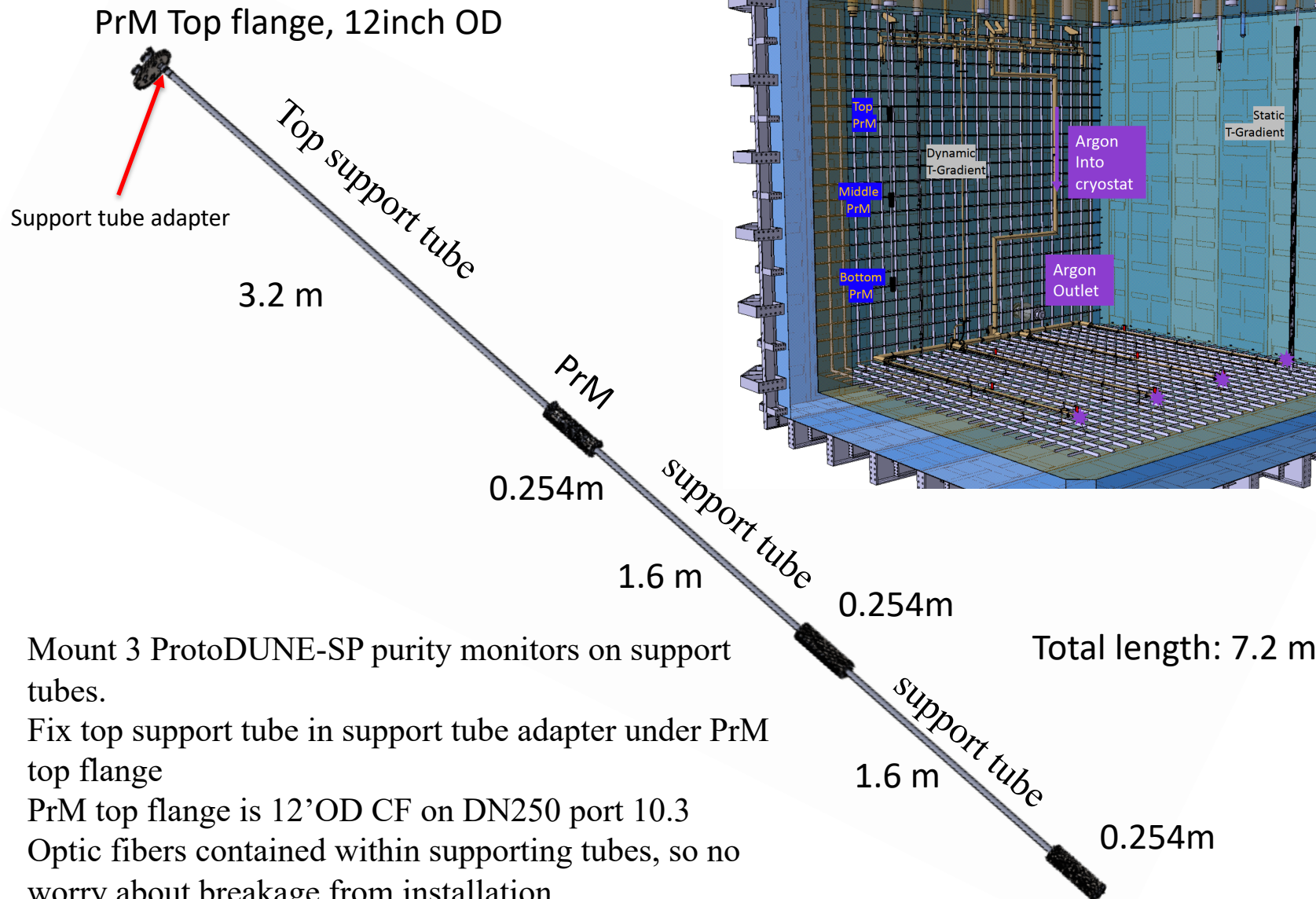
Move the PrM assembly to the corridor
Use crane, lift and rotate the assembly 90 degrees
Use crane, move the assembly to the top of port
Use crane, start to insert the assembly into port



Check connections one by one during insertion



How are they mounted in ProtoDUNE-SP



- Mount 3 ProtoDUNE-SP purity monitors on support tubes.
- Fix top support tube in support tube adapter under PrM top flange
- PrM top flange is 12'OD CF on DN250 port 10.3
- Optic fibers contained within supporting tubes, so no worry about breakage from installation
- Electric cables tied to the outside of the supporting tubes

ProtoDUNE-SP Installation environment

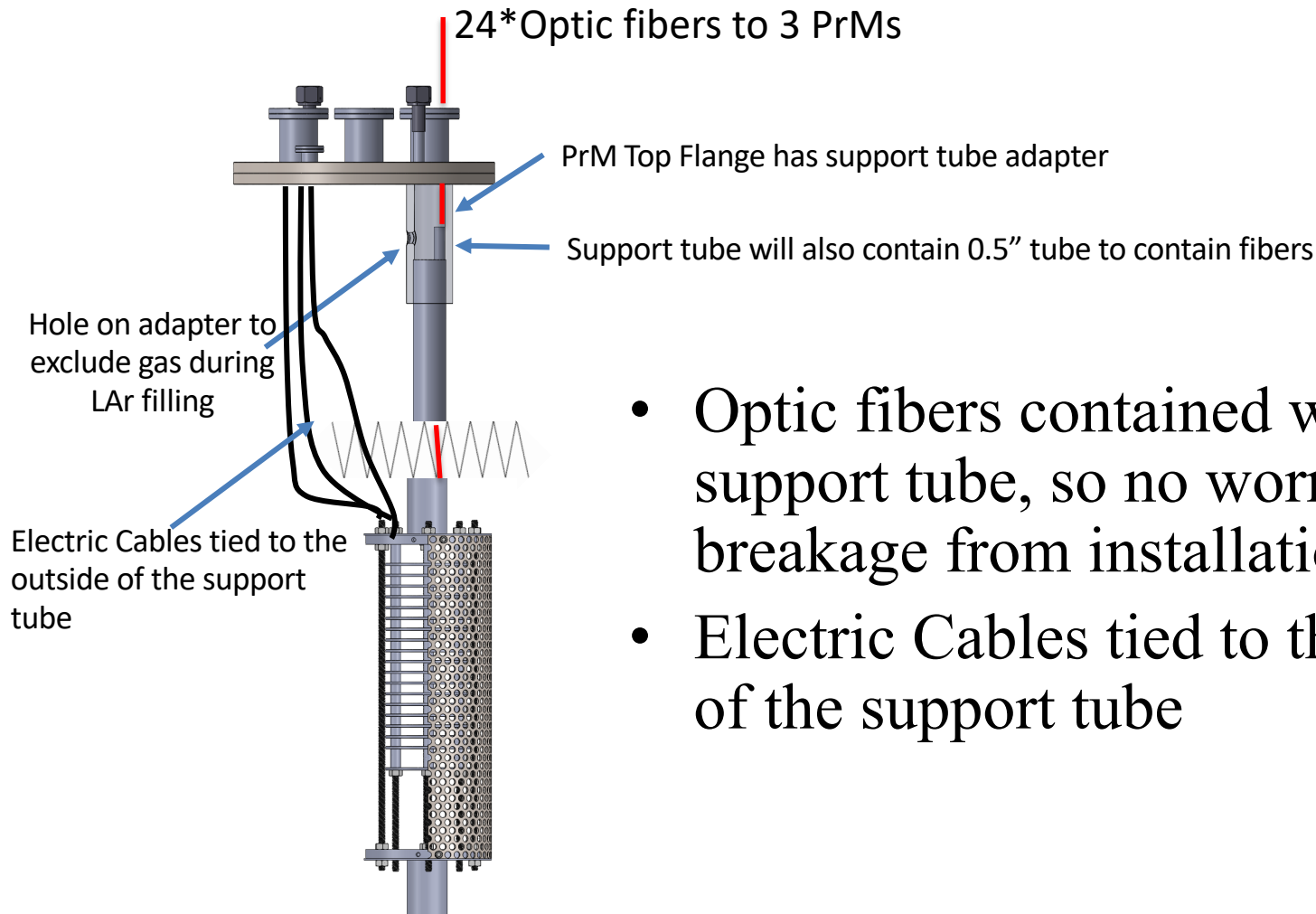
Overall



Rack for PrM Front-End electronics and Xenon Light source

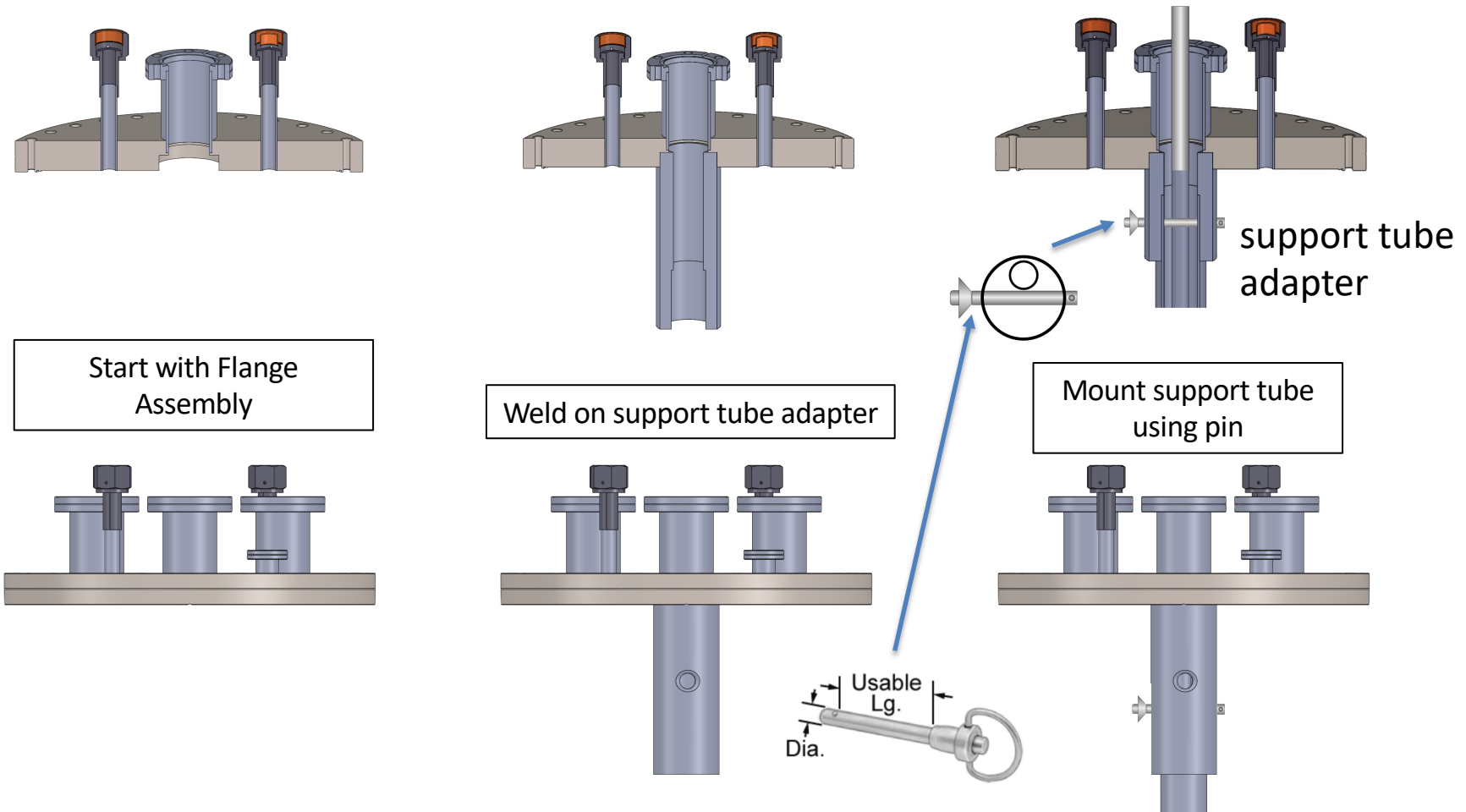


ProtoDUNE-SP PrM Top Flange and Mounting Parts



- Optic fibers contained within support tube, so no worry about breakage from installation
- Electric Cables tied to the outside of the support tube

Fix top support tube in support tube adapter under PrM top flange

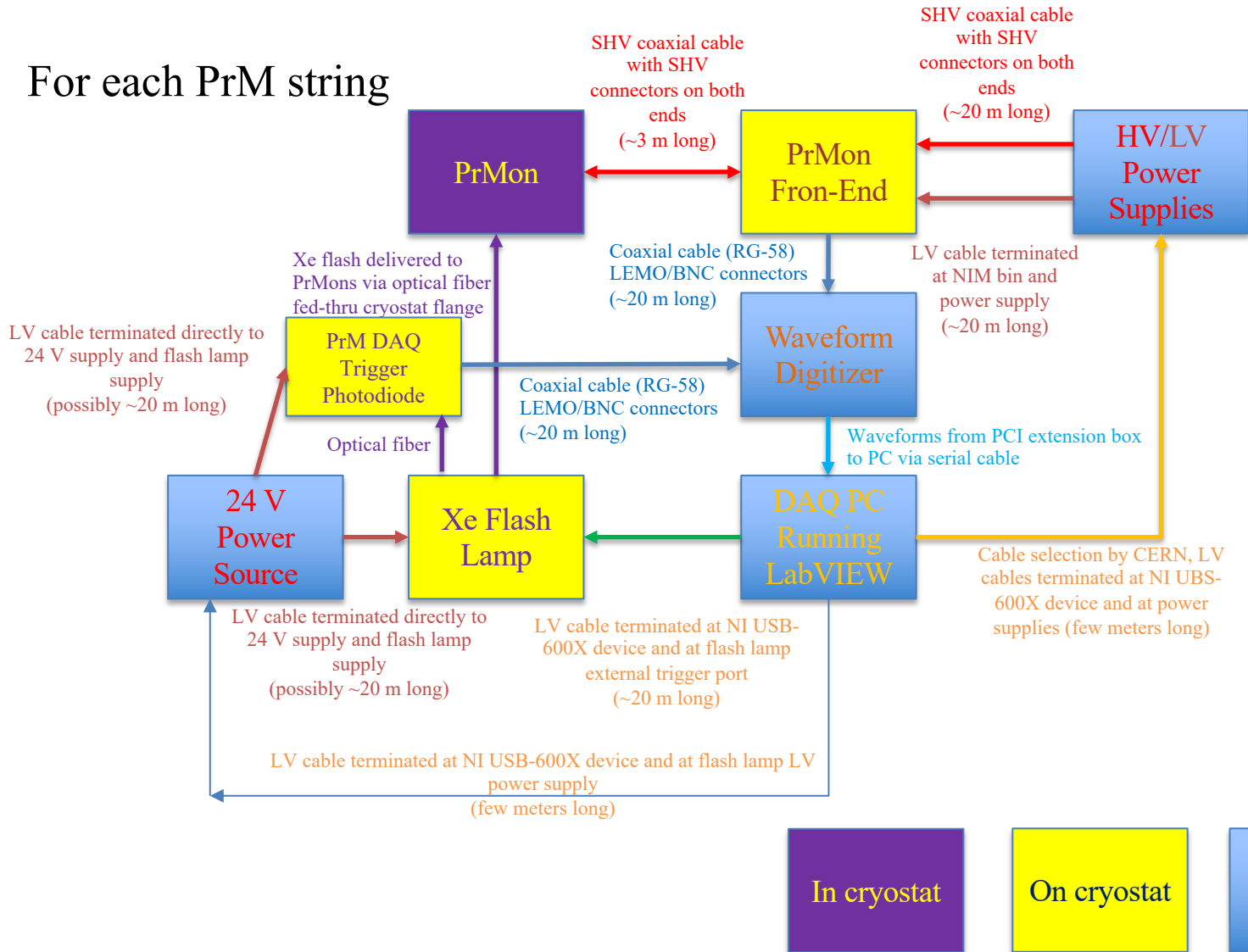


Ring-Grip Push-Button Quick-Release Pin Heavy Duty 17-4 PH
Stainless Steel, 1/4" Diameter, 1-1/2" Usable Length

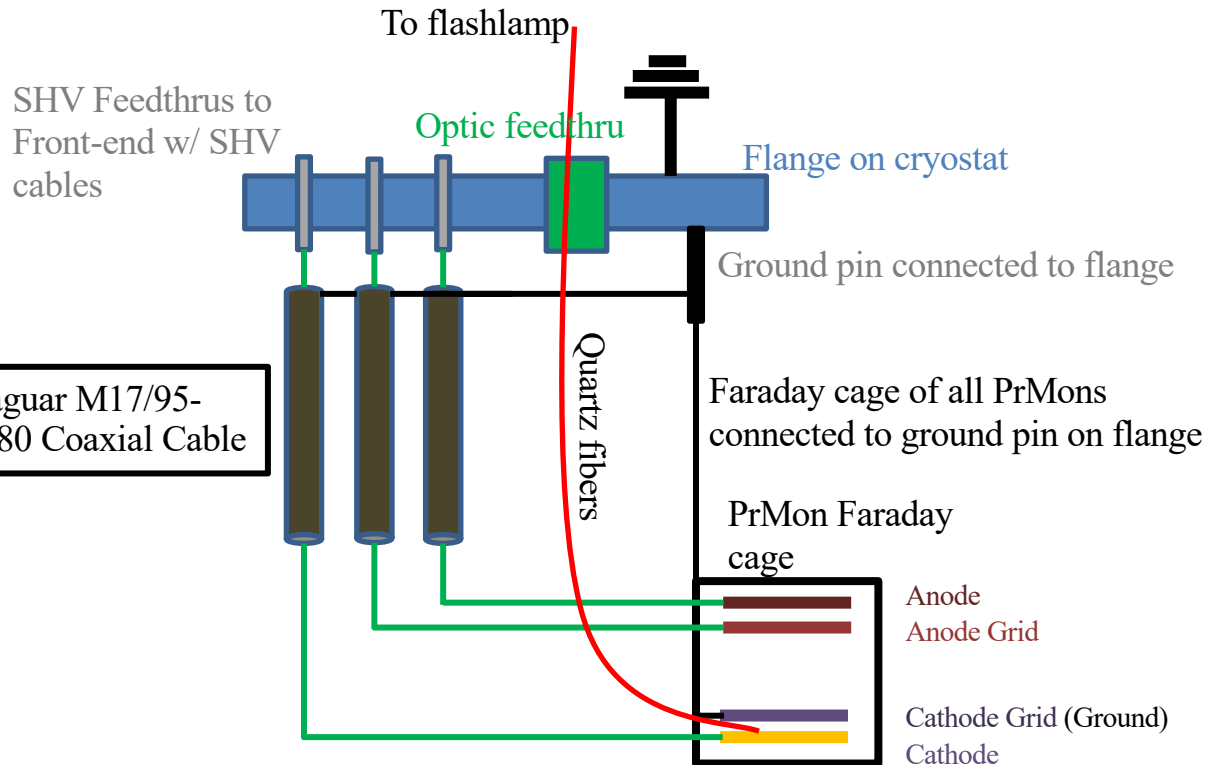
Pin <https://www.mcmaster.com/#92384A036>

Cable definitions: Electric Connection Scheme Outside Cryostat

For each PrM string



Cable definitions: Electric/Optic connections for each purity monitor in cryostat



For each PrM:

- Bias HV and anode/cathode signals fed-in and read-out through SHV feedthrus (3 for each PrMon)
- Coaxial cables inside cryostat, conductor connects feedthru pins to cathode, anode and anode grid
- Shield of cables connected to flange on feedthru side
- Other side of shield not connected anywhere
- Cathode grid connected to cryostat ground through PrMon Faraday cage

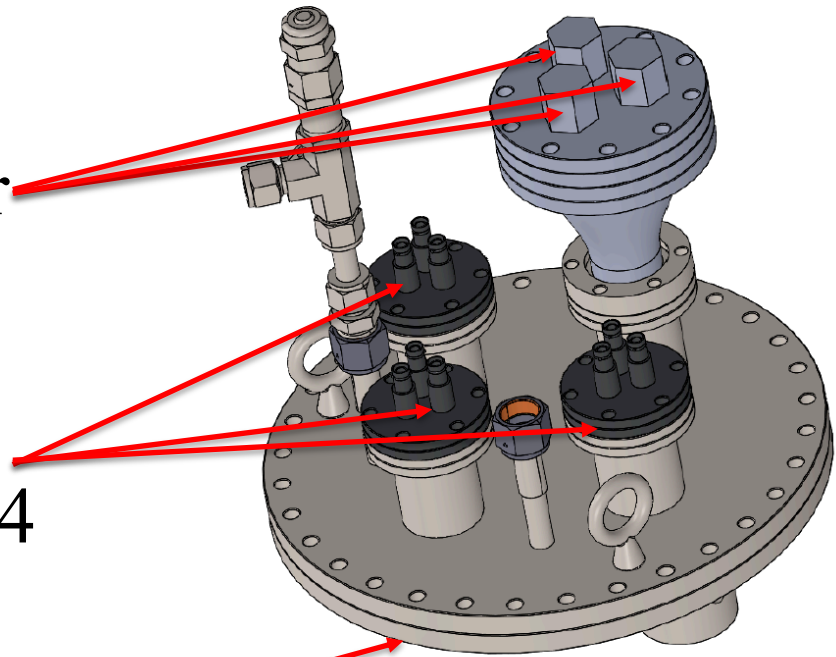
Purity Monitor Cables (inline PrMs included)

Cable Description (What is purpose of the cable?)	Location of endpoint 1 (Provide enough info to identify location - piece of equipment, power supply, rack ...)	Location of endpoint 2 (Provide enough info to identify location - piece of equipment, power supply, rack ...)	Quantity Required (not including spares)	Approximate Length (m)	Describe, if any, length constraints	Is Cable in Warm or Cold?	EDMS Entry describing cable (includes specifications of cable/wire, connectors, pinouts, and shield connections)
PrM Signal/HV cable in cryostat	Purity monitor (PrM)	Electric feedthrough on PrM top flanges	24	12		cold	Jaguar M17/95-RG180 Coaxial Cable
PrM Singnal/HV cable outside cryostat	electric feedthrough on PrM top flanges	PrM Front-End electronics in PrM rack on cryostat	24	2<5m		warm	RG180 cable, RG-58 cable, SHV coaxial cable with SHV connectors on both ends
Signal cable for amplified PrM signal	PrM Front-End electronics in PrM rack on cryostat	Waveform Digitizers in PrM DAQ Rack	16	20		warm	Coaxial cable (RG-58) LEMO/BNC connectors
Signal cable for DAQ trigger photodiode	DAQ trigger photodiode in in PrM rack on cryostat	Waveform Digitizers in PrM DAQ Rack	3	20		warm	Coaxial cable (RG-58) LEMO/BNC connectors
HV power cable	PrM Front-End electronics in PrM rack on cryostat	HV power supply in PrM DAQ Rack	16	20		warm	SHV coaxial cable with SHV connectors on both ends
110V power cable for PrM NIM bin	NIM crate in PrM rack on cryostat	110V power suppy in PrM DAQ Rack	3	20		warm	Standard supplied by vendor
24V power cable for Xenon light source	Xenon light source in PrM rack on cryostat	24 V Power supply in PrM DAQ Rack	6	20		warm	Standard supplied by vendor
24V power cable for DAQ trigger photodiode	DAQ trigger photodiode in in PrM rack on cryostat	24 V Power supply in PrM DAQ Rack	6	20		warm	Standard supplied by vendor
Control cable for HV power supply	HV power supply in PrM DAQ Rack	NI UBS-600X device in PrM DAQ PC in PrM DAQ Rack	2	3		warm	Standard supplied by vendor
Control cable for 110V power supply	110V power supply in PrM DAQ Rack	NI UBS-600X device in PrM DAQ PC in PrM DAQ Rack	3	3		warm	Standard supplied by vendor
Control cable for 24V power supply	24V power supply in PrM DAQ Rack	NI UBS-600X device in PrM DAQ PC in PrM DAQ Rack	3	3		warm	Standard supplied by vendor
Control cable for Xenon light source	Xenon light source in PrM rack on cryostat	NI UBS-600X device in PrM DAQ PC in PrM DAQ Rack	3	20		warm	Standard supplied by vendor

Needed feedthrus

Two PrM strings, for each string:

- Three optic fiber feedthrus on a reducer connected to a 2-3/4 inch CF half nipple
- Three 3-pin HV cable feedthrus on three 2-3/4 inch half nipples
- All feedthrus on the 12 inch OD PrM top flange



Modules in racks



PrM Rack for PrM
Front-End electronics
and Light source on
cryostat

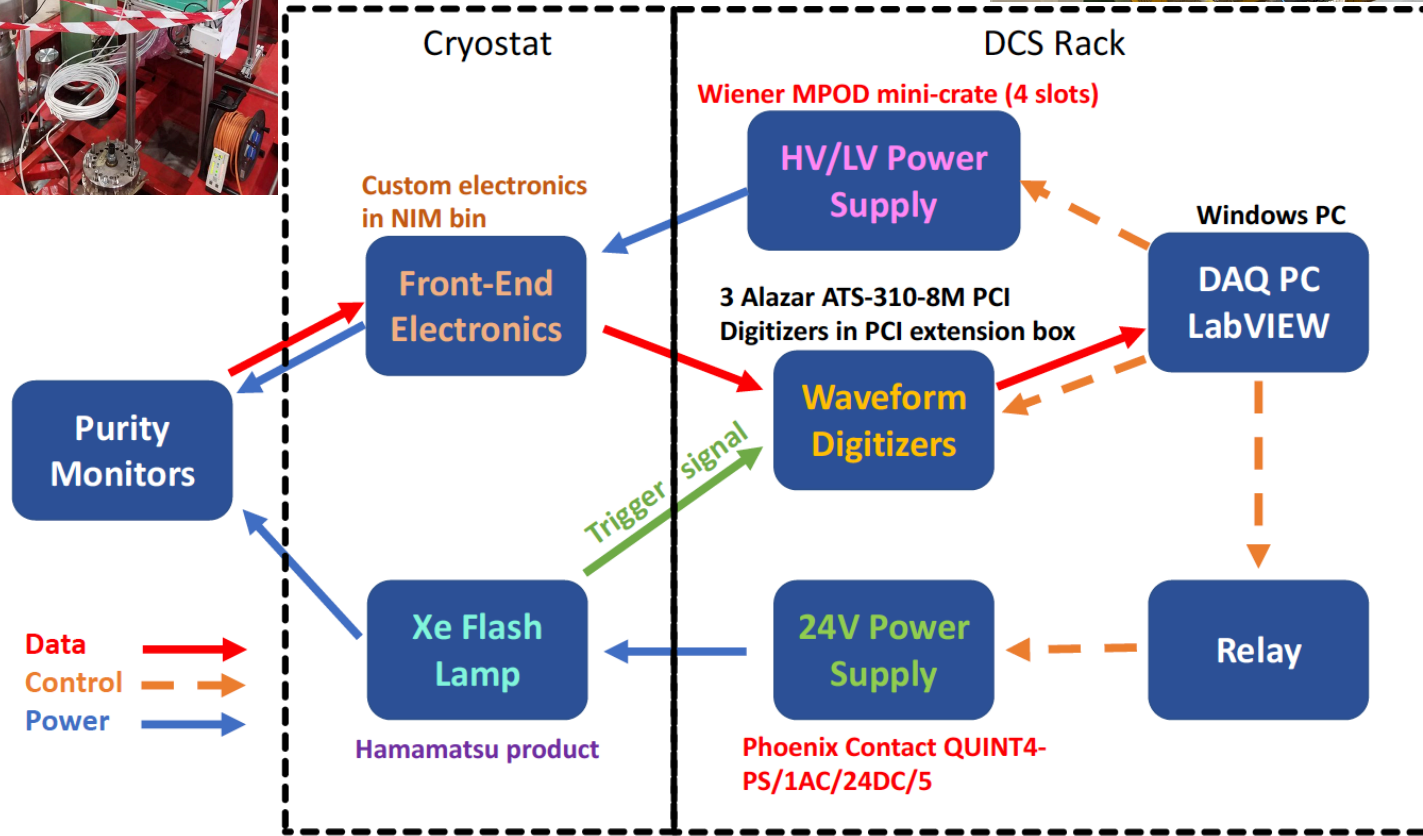
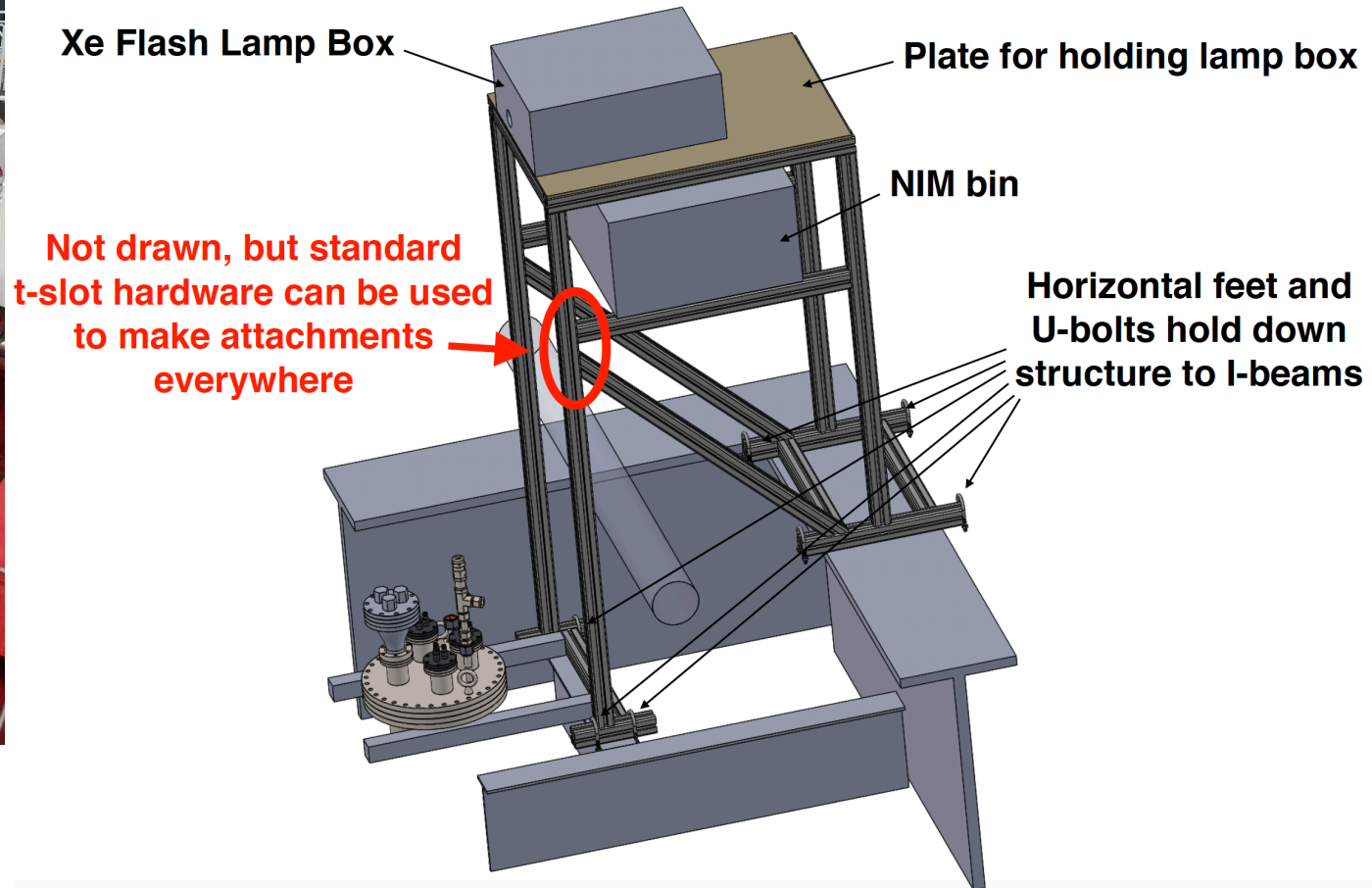
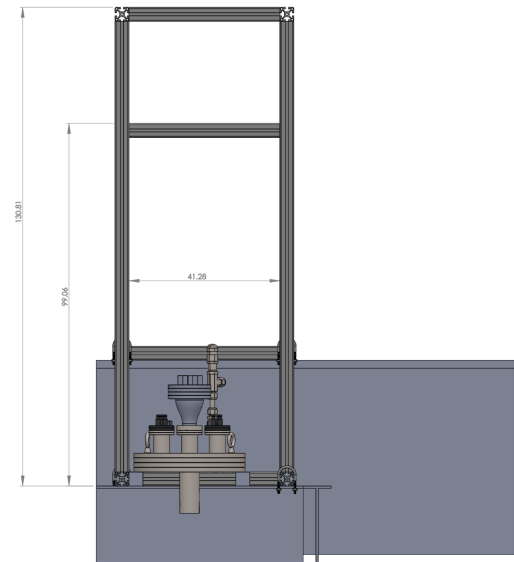
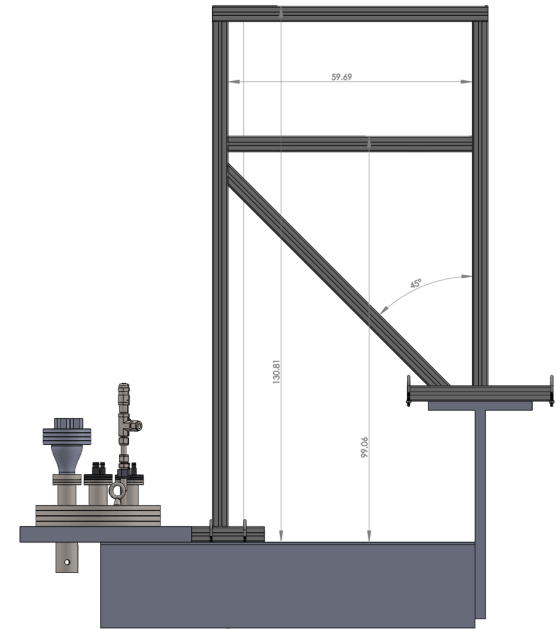
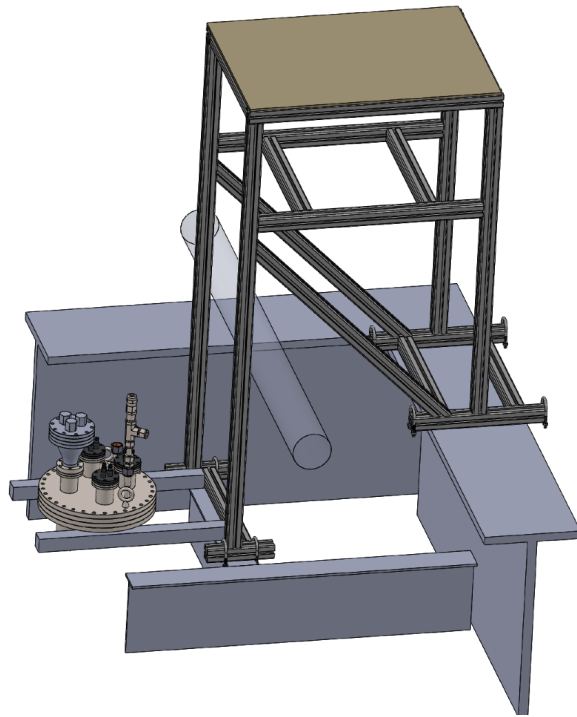


Figure 1.9: Block diagram of the purity monitor system.

PrM Rack for PrM Front-End electronics and Light source on cryostat



PrM Rack for PrM Front-End electronics and Light source on cryostat



Modules in racks

- DCS Rack
 - PC running DAQ software
 - Programmable HV/LV Power Supplies for PrM Front-End electronics
 - 24 V Power Source for Xenon Light Source and trigger photodiode
 - Waveform Digitizers in two digitizer Houses
- Rack for PrM Front-End electronics and Light source on cryostat, one rack for each PrM string
 - Customized PrM Front-End electronics in a NIM bin
 - Xenon light source
 - Trigger photodiode