NP04 Beam Plug System

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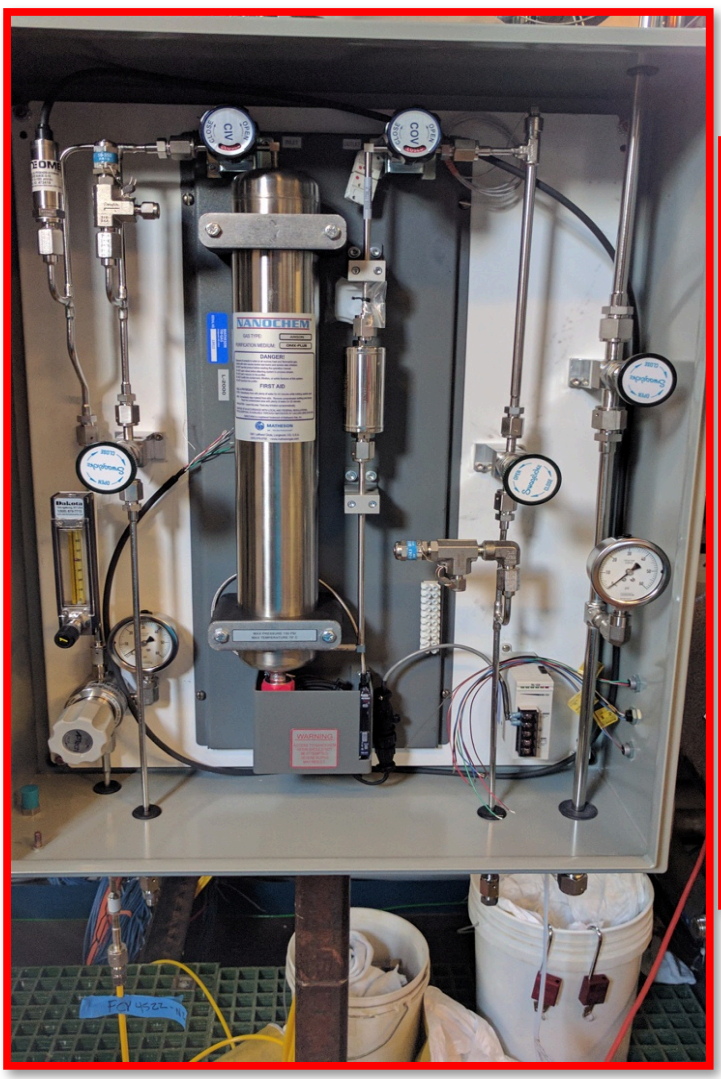
Electrical and Grounding Connections Review

CERN

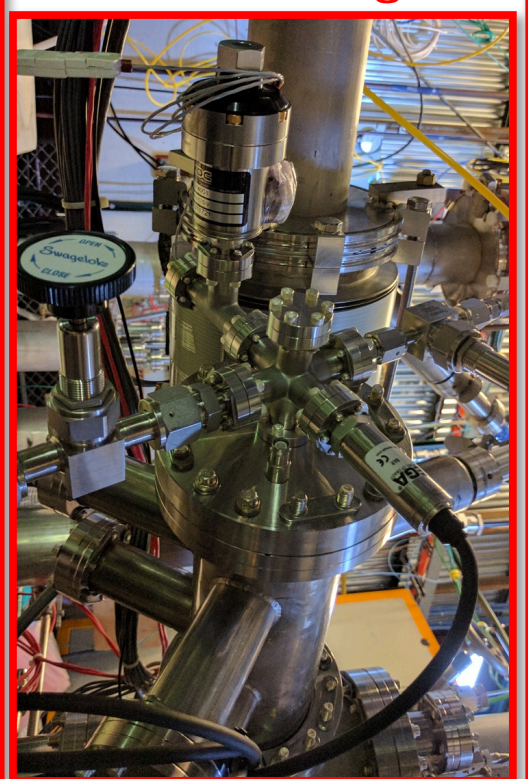
26-September 2017

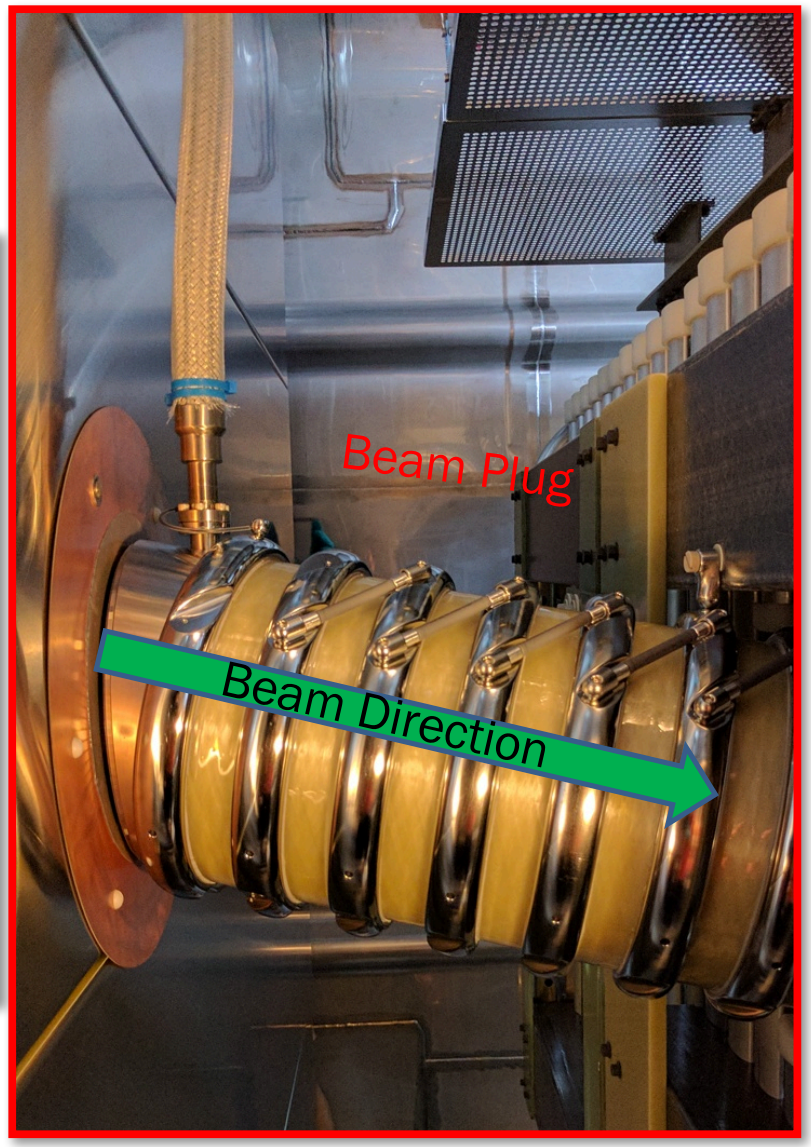
Main Components of the Beam Plug System

Nitrogen Gas Control Panel

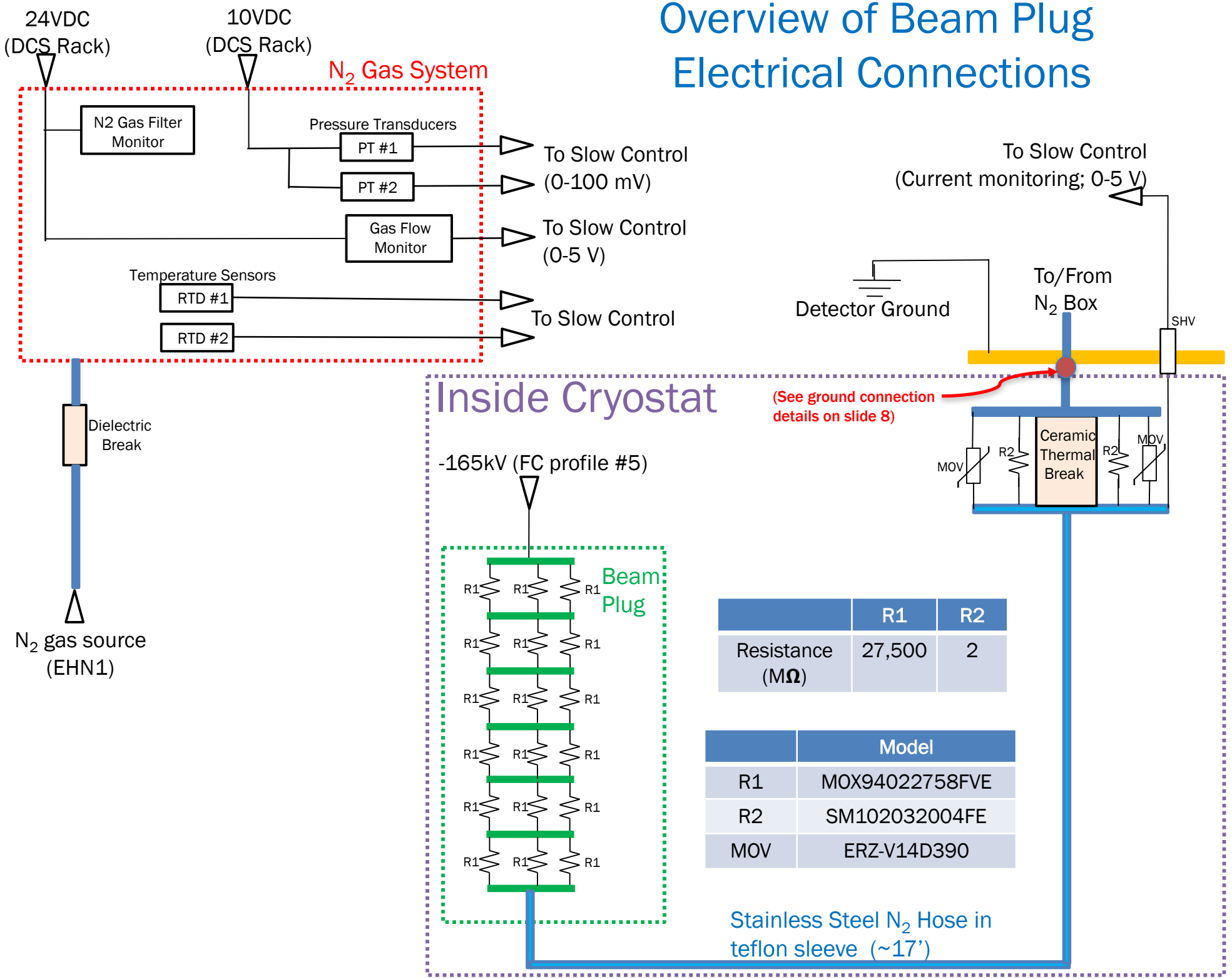


Gas Feedthrough





Overview of Beam Plug Electrical Connections



	R1	R2
Resistance (MΩ)	27,500	2

	Model
R1	MOX94022758FVE
R2	SM102032004FE
MOV	ERZ-V14D390

Stainless Steel N_2 Hose in teflon sleeve (~17')

Electrical Connection Procedures for Beam Plug

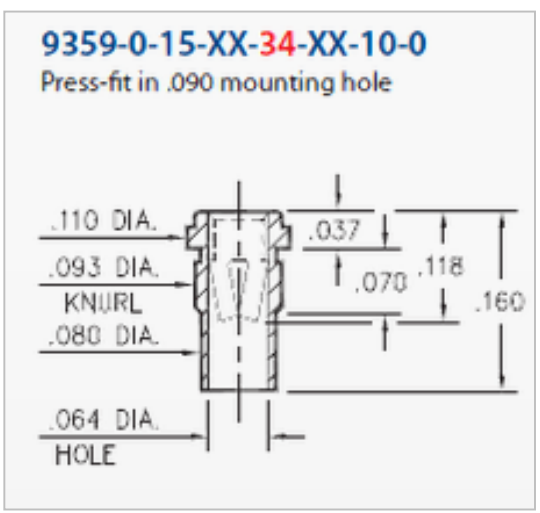
Inside the clean room in EHN1 after beam plug is installed on the end-wall subpanel:

1. Install 18 SuperMox resistors on the beam plug
2. Make the electrical connection from the first electrode ring to FC profile # 5
3. Screw in grounding stud on the last electrode ring. The other end of the connection to the staineless steel N_2 hose will be made later inside the cryostat
4. Check resistance measurement between profile # 5 and the last beam plug ring is consistent with 55GΩ

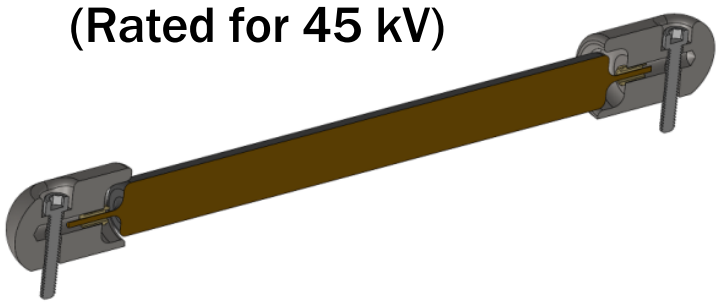
Use Keithley 6517B resistance meter at 40V setting to check all electrical connections
(It's a great meter, thanks Roberto A.)

Resistor Mount Design

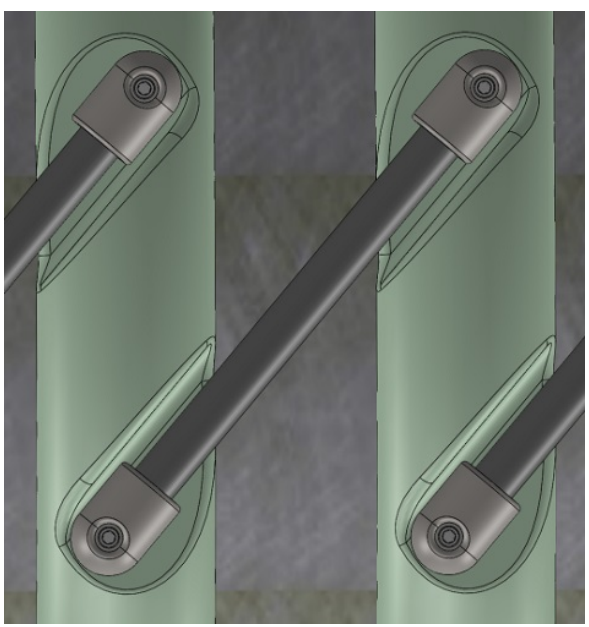
- Beam plug is using OHMITE 940 series 27.5GΩ resistors. Rated for 45kV.
- Resistors are mounted in a metal cap and “secured” using Mill-Max receptacles. The Mill-Max receptacles allow for thermal contractions/expansion and maintain good electrical contacts
- Tested performance in warm and in LN_2 via resistance and continuity measurements
- Tested in LAr in BLANCHE and 35-ton cryostat at Fermilab



Ohmite MOX940 27.5 GΩ
(Rated for 45 kV)

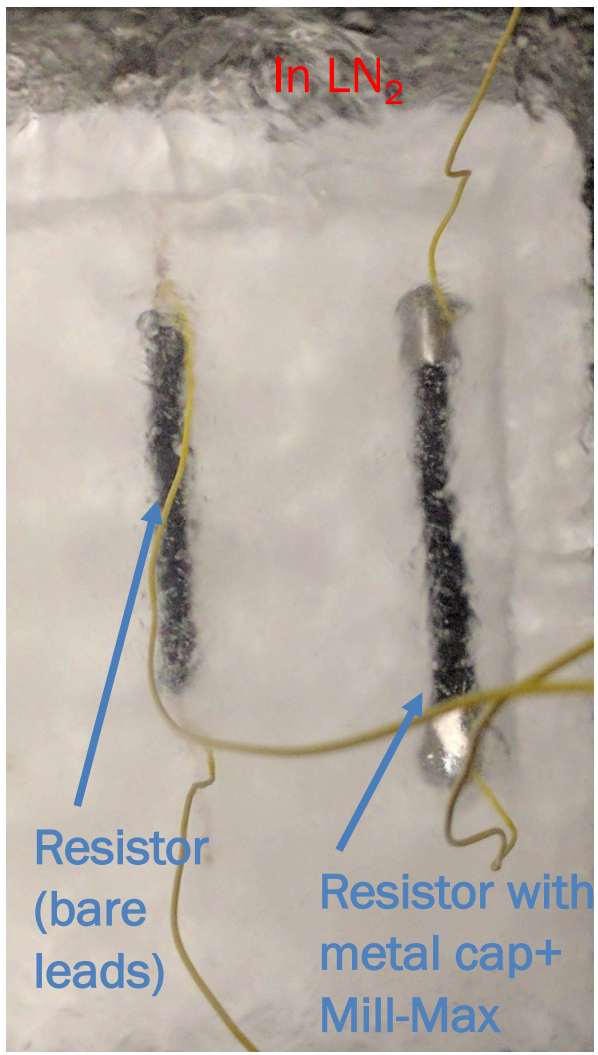


(W. Waldron, T. Loew)



Resistor Mount Test

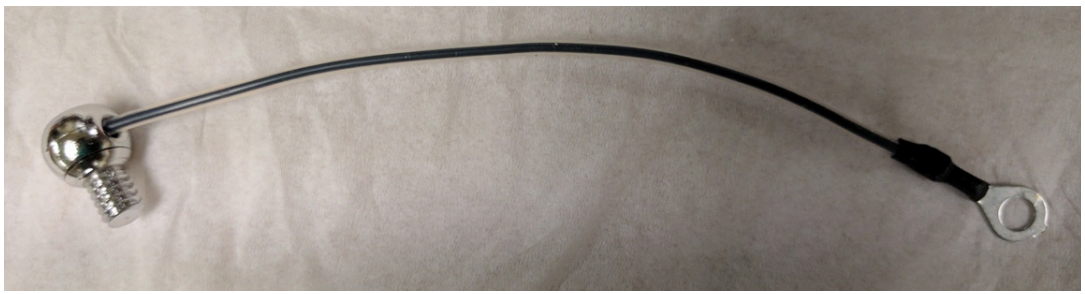
Measure current draw (5nA resolution) as a function of applied voltage

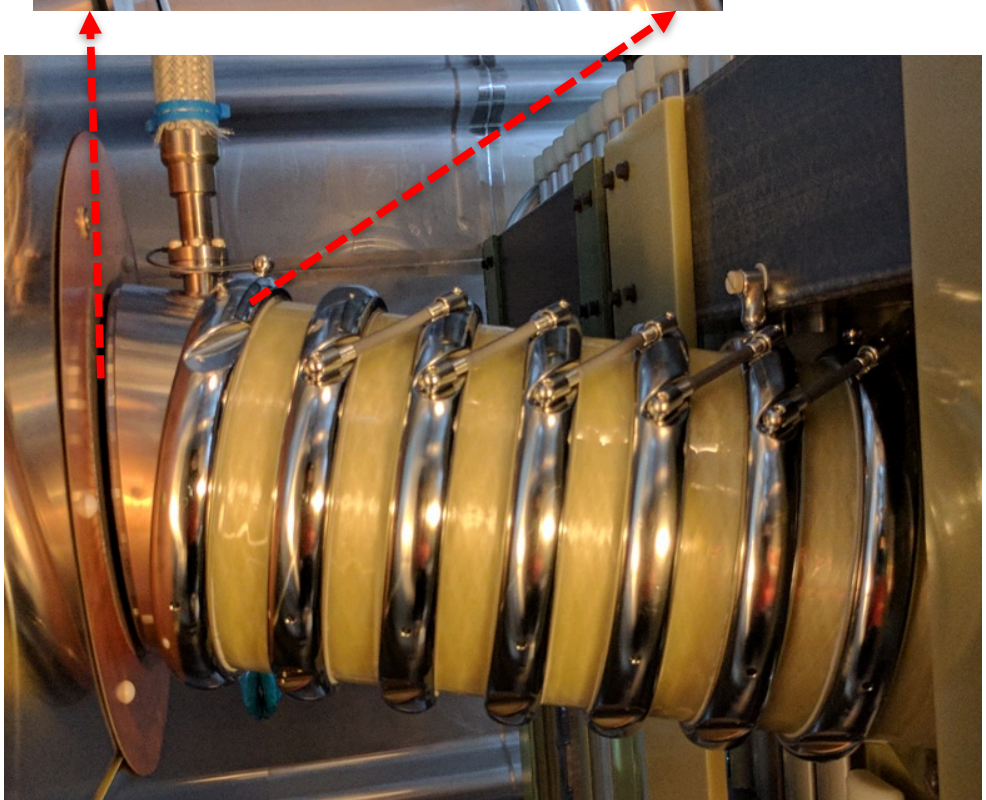


3-ring prototype unit tested in liquid argon

Will thermal cycle all production resistors and mounts in LAr

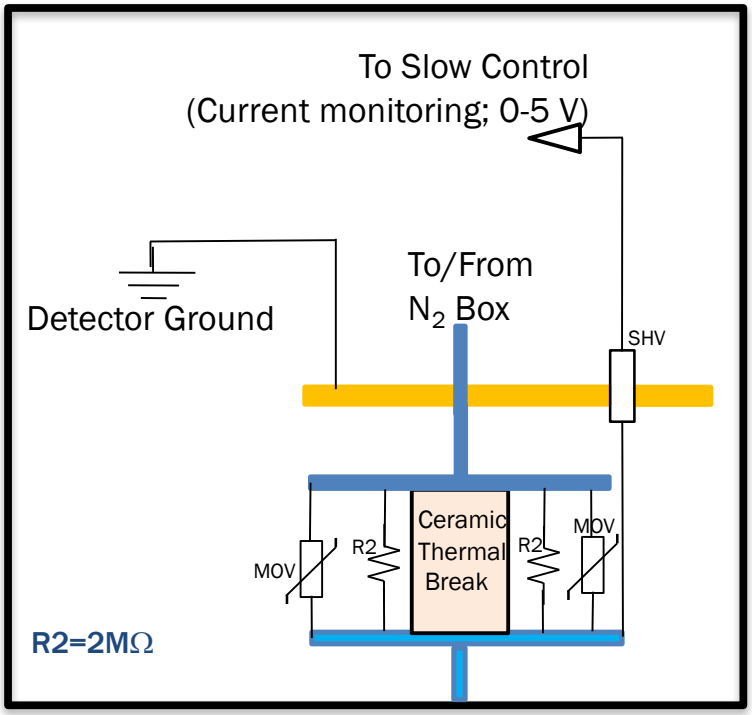
Connections to Profile and Metal Endcap



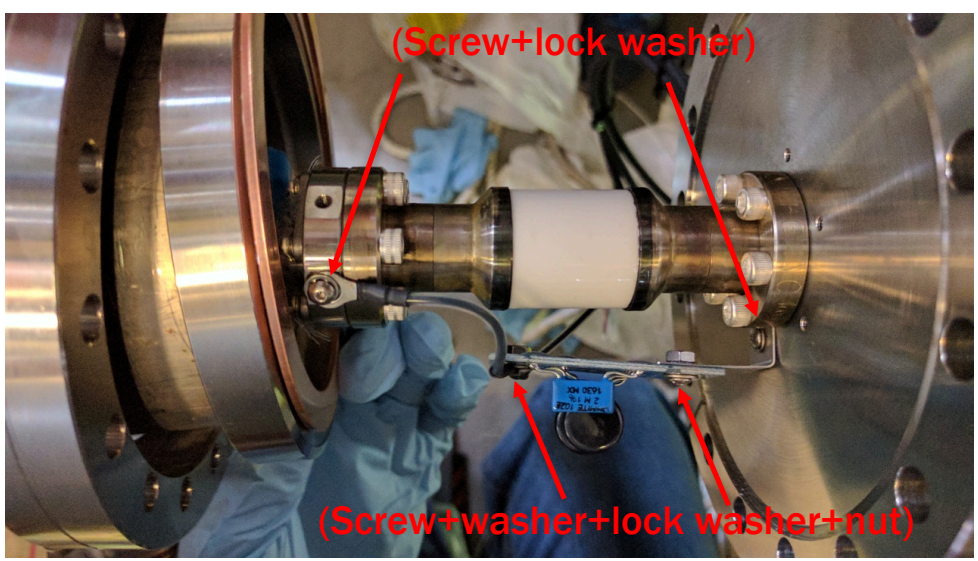


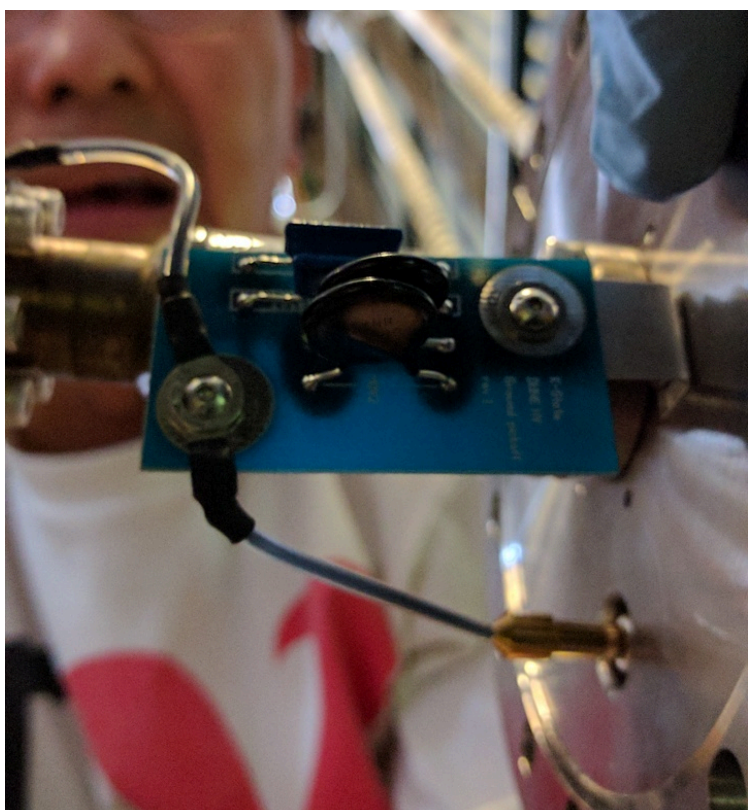
- Mini HV cable. Same cable as the half-resistor board cable for the FC
- Same type of connection to the profile and the SS hose
- Last electrode ring is in electrical contact with the metal endcap. The additional wire connection is for redundancy

Electrical Connections for the Current Monitor (Inside cryostat connection)



- Connections can be made and checked before hand on a bench top
- Connection verified before and after the flange is installed on the feedthrough port on top of the cryostat
- Circuit sits in a relatively warm part of the cryostat





Final Electrical Connection Check

After the end-wall with beam plug is in the final position inside the cryostat and the S.S. N_2 hose is bolted onto the beam plug:

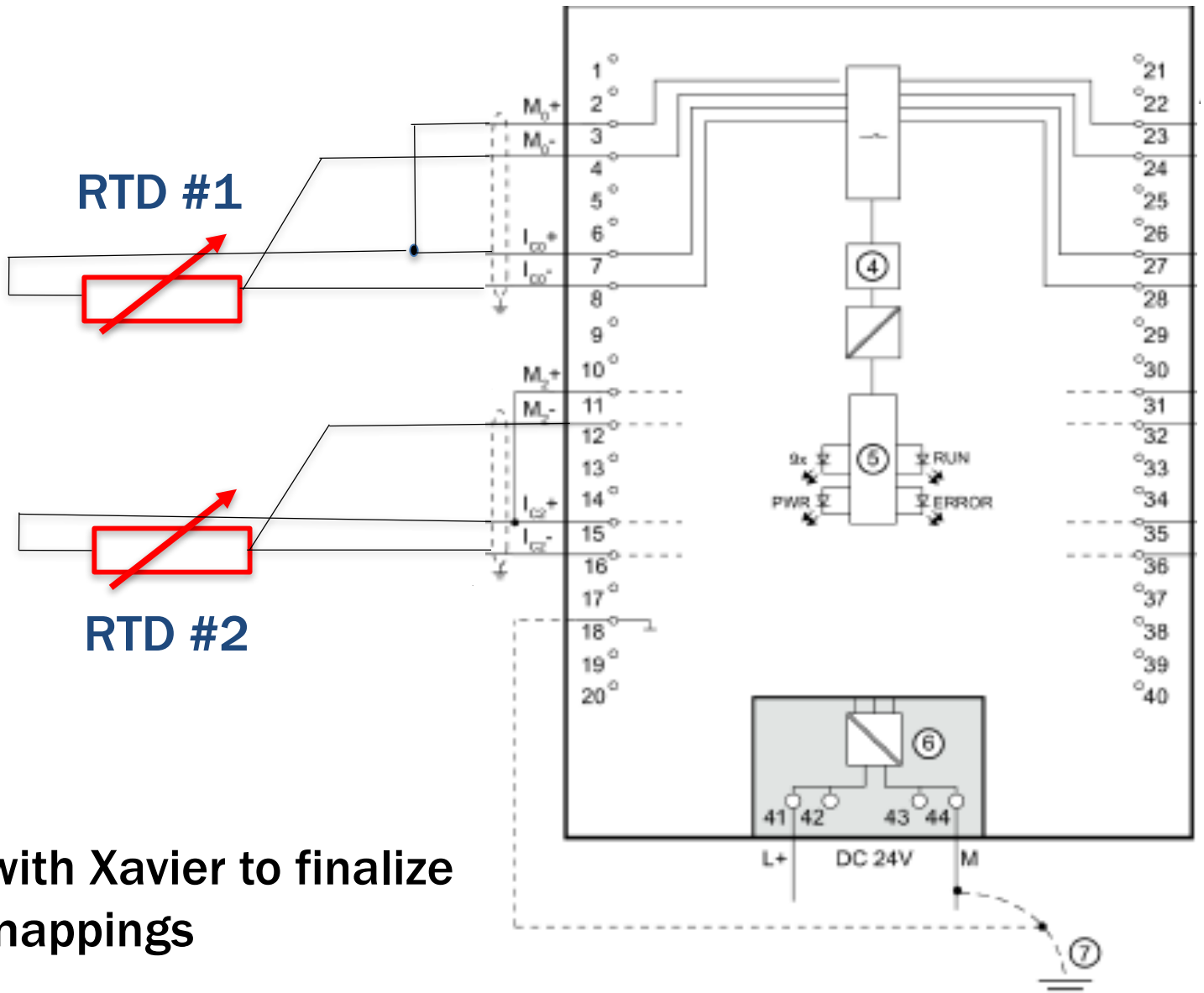
1. Check resistance between profile # 5 and the cryostat membrane is consistent with 55GΩ using the Keithley 6517B meter
2. Check resistance between the SHV center conductor and detector ground is 1M
3. Check resistance between the SHV center conductor and profile # 5 is consistent with 55GΩ
4. Some of the steps above can be repeated later on right before the cryostat is sealed

Interface with the Slow Control

- Beam plug system has eight monitoring sensors:
  - Two temperature sensors:
    - Omega RTD-810-B model (three leads)
    - Resistance of 100.00±0.12 Ω at 0°C, alpha=0.00385 Ω/°C
  - Two pressure transducers:
    - Omega PXM409-010BGV
    - Output voltage signal range (0 – 100 mV)
  - One beam plug current monitor:
    - Voltage divider with output voltage signal range (0 – 5 V)
  - One N_2 gas flow meter:
    - Omega FMA-A2402-SS (or equivalent)
    - Voltage output (0 – 5 V)
- Tap into DCS power distribution rack#11 for 24VDC and 10VDC (floating ground)
- In the current scheme, all sensors are tied to the detector ground at the DCS rack side
- Only current monitor ”sensor” is inside the cryostat. All other sensors are outside the cryostat

RTD Interface with Slow Control Module

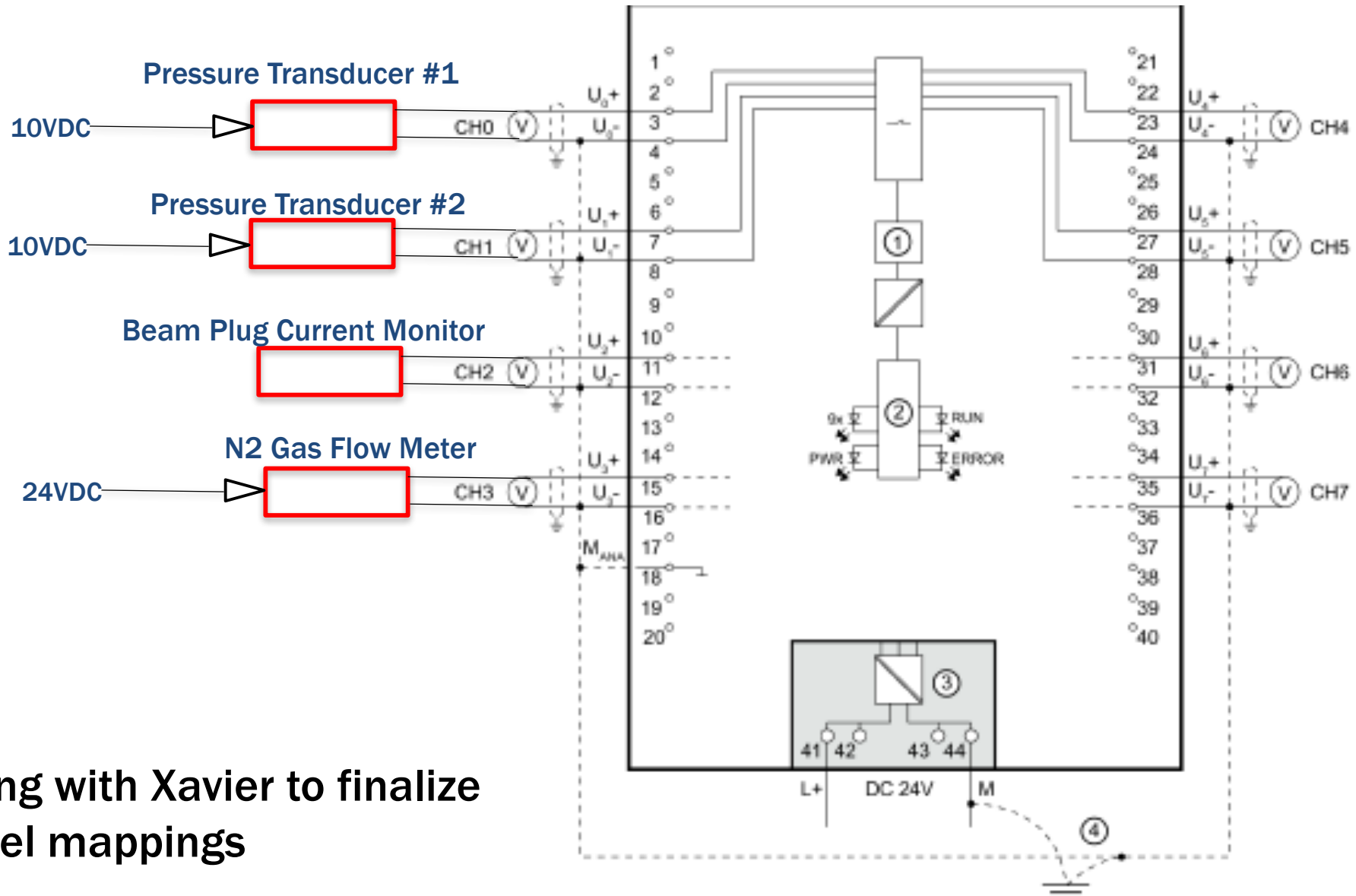
Siemens 6ES7531-7KF00-AB0 module



Working with Xavier to finalize channel mappings

Beam Plug Sensors Interface with Slow Control Module

Siemens 6ES7531-7KF00-AB0 module

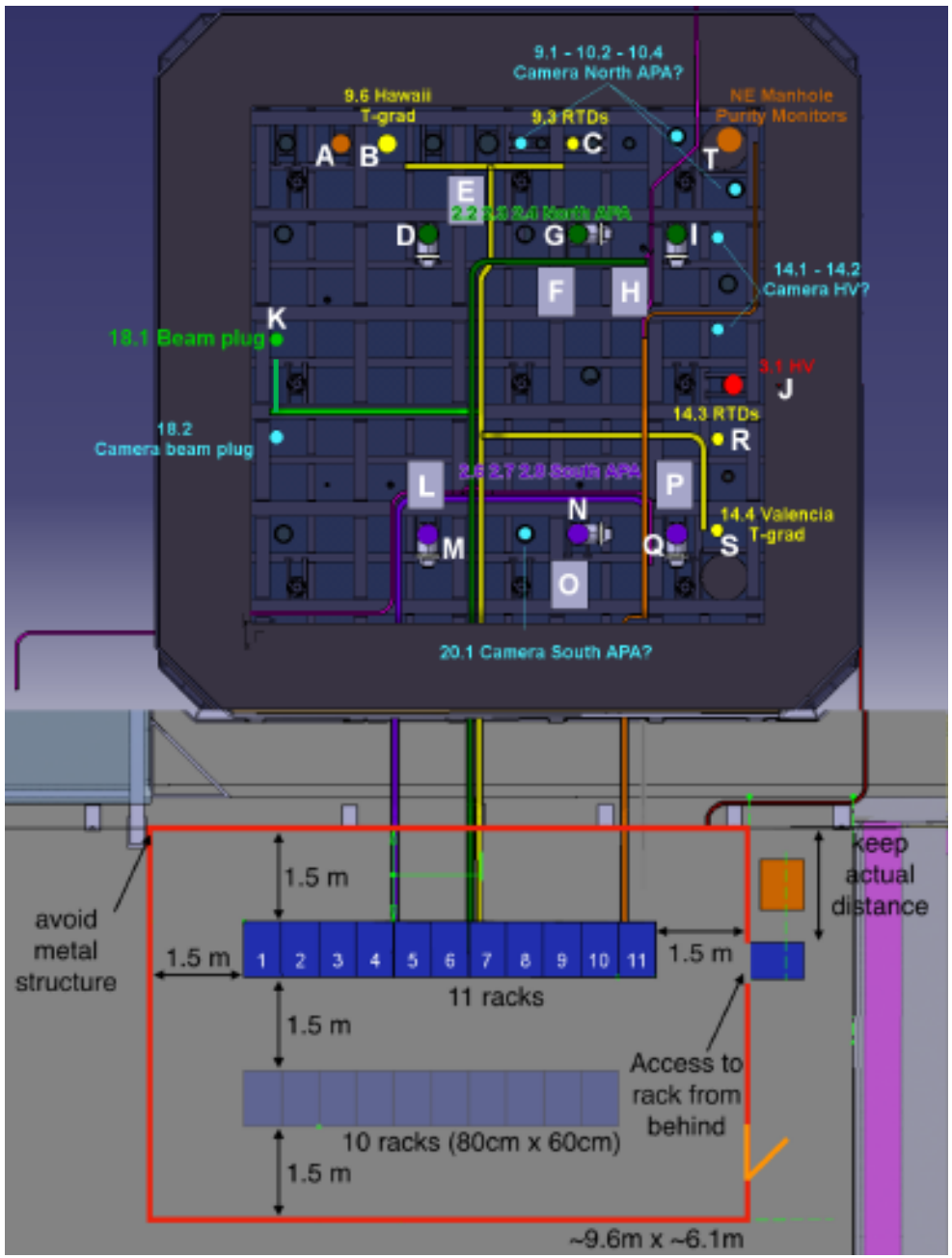


Working with Xavier to finalize channel mappings

Cable Routing from Gas Panel to DCS Racks

- Distance along cable tray from K to rack#7 is 13.6m. 24/10 VDC cables need to extend to rack #11
- ~20m cable length is needed
- 14 AWG (0.16 Ω /20m) wires for the DC power should be more than adequate
- Choice of cables still need to be finalized

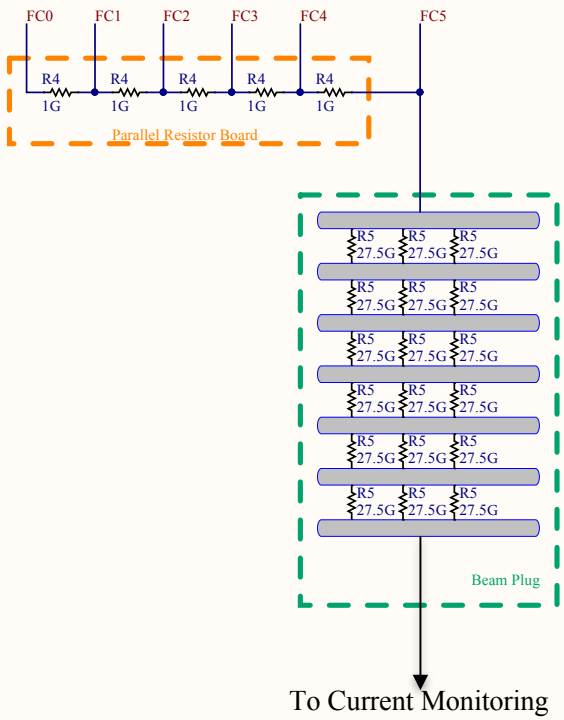
Sensor	Power Requirement
Pressure Transducer	10VDC @ 2mA
Flow Meter	24VDC @ 150mA (max)
N2 gas filter sensor	24VDC @ 29mA (max)



Summary

- Presented electrical connections for the beam plug system
- Current grounding scheme (still under discussion):
  - Beam plug resistor chain is grounded to the cryostat flange
  - Monitoring sensors are tied to detector ground at the DCS rack
- Have well defined plans to verify the connections after installation and before the cryostat is sealed
- Working on finalizing the cable mapping with Slow Control and Monitoring Group
- Working on documenting all the procedure in details

BACKUP SLIDES



Fermilab
Fermi National Accelerator Laboratory
United States Department of Energy
PPD Electrical Engineering Department

Size	Rev	Beam Plug Resistors	ENGINEER: *
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