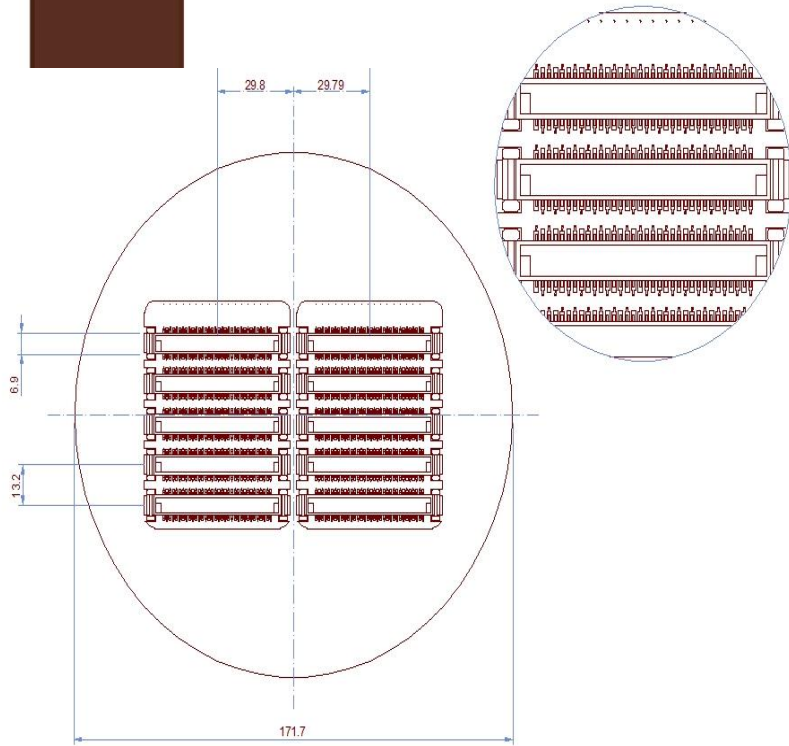
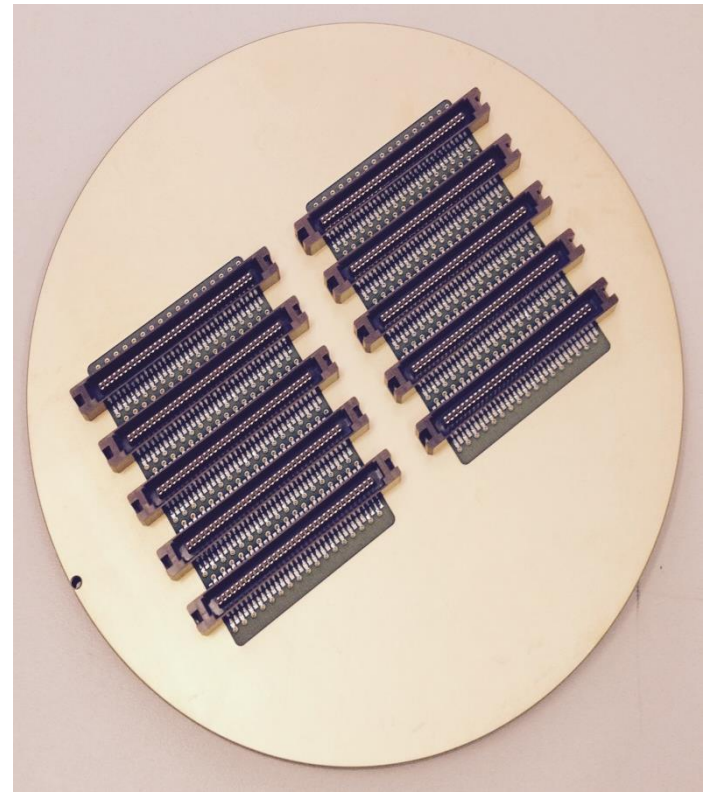
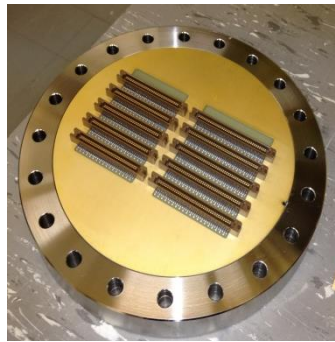
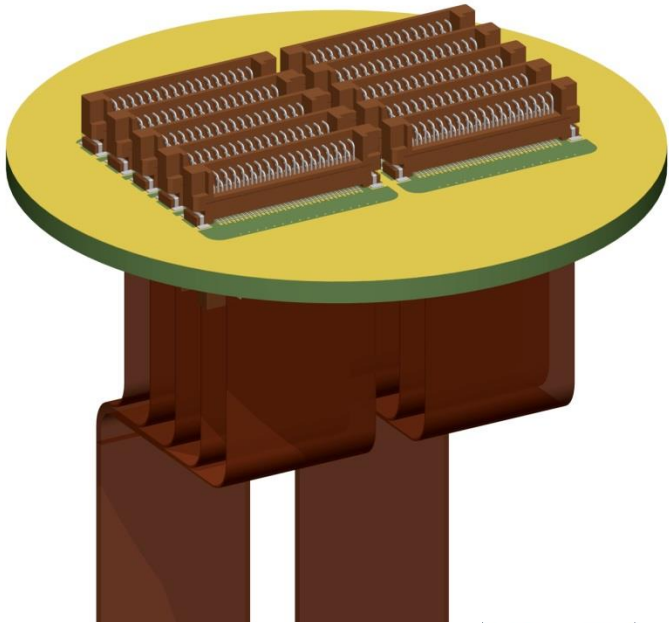


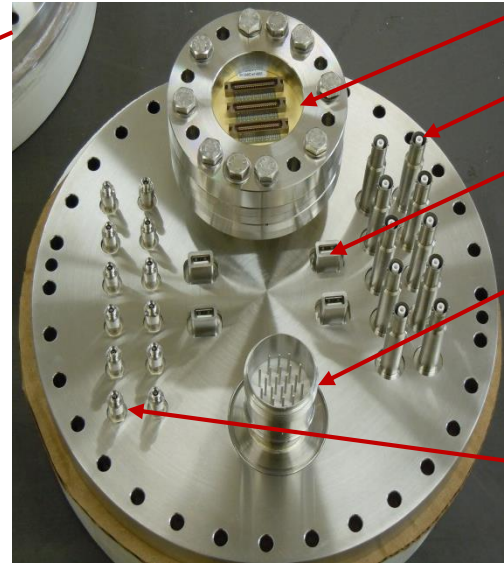
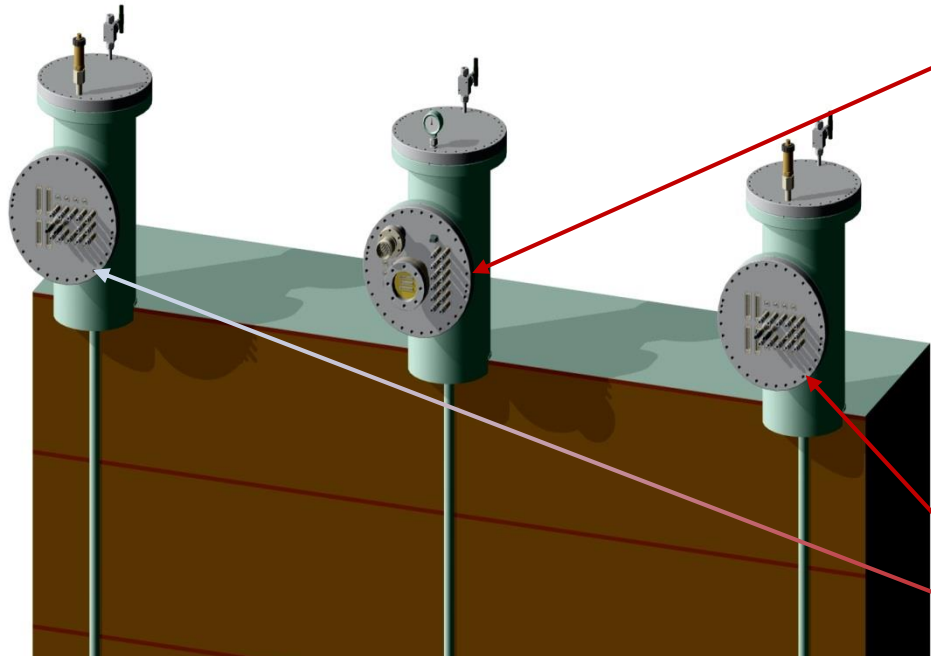
# Summary of the Electrical Feedthroughs



SFT - 320 Channels for the 3x1x1  
 m<sup>3</sup> N. 6 cold + N. 6 warm  
 on a D=222mm flange  
 (each with 20x68pin connectors)

## B. Slow Control FT chimneys

N. 3 for the 3x3x3 (Calibration, SHV20kV, SHV10kV, SMA, USB, D-SUB50, Power)



Calibration

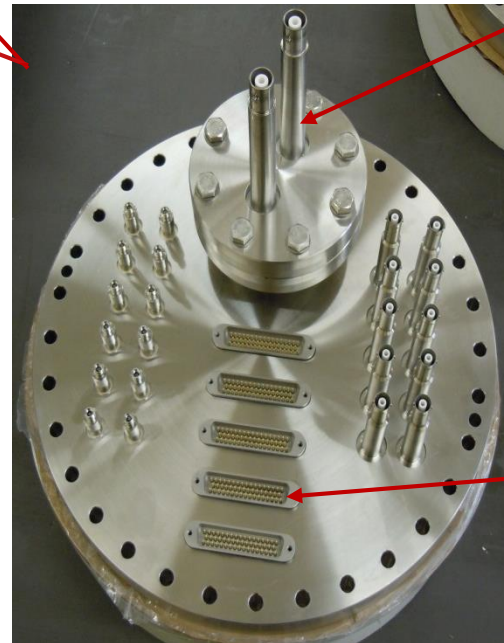
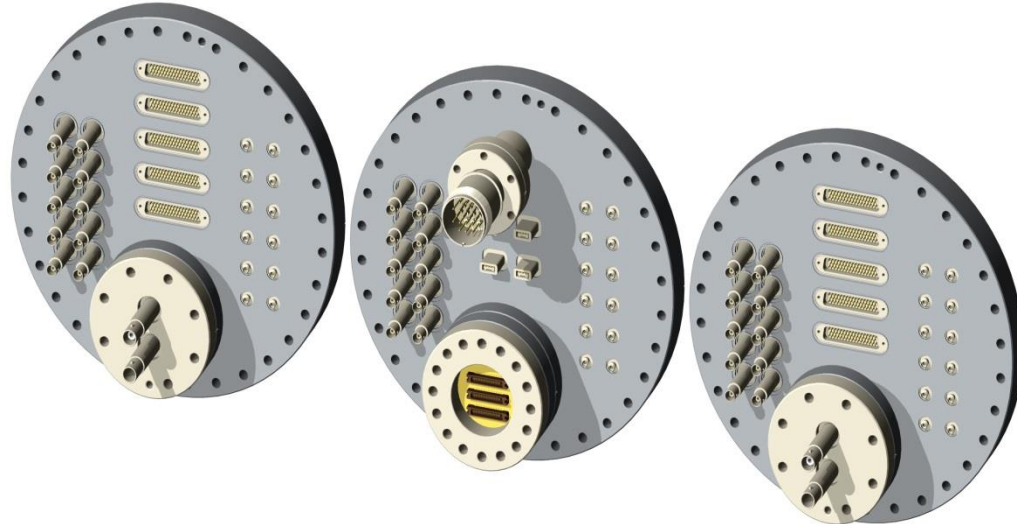
SHV10kV

USB

Power

SMA

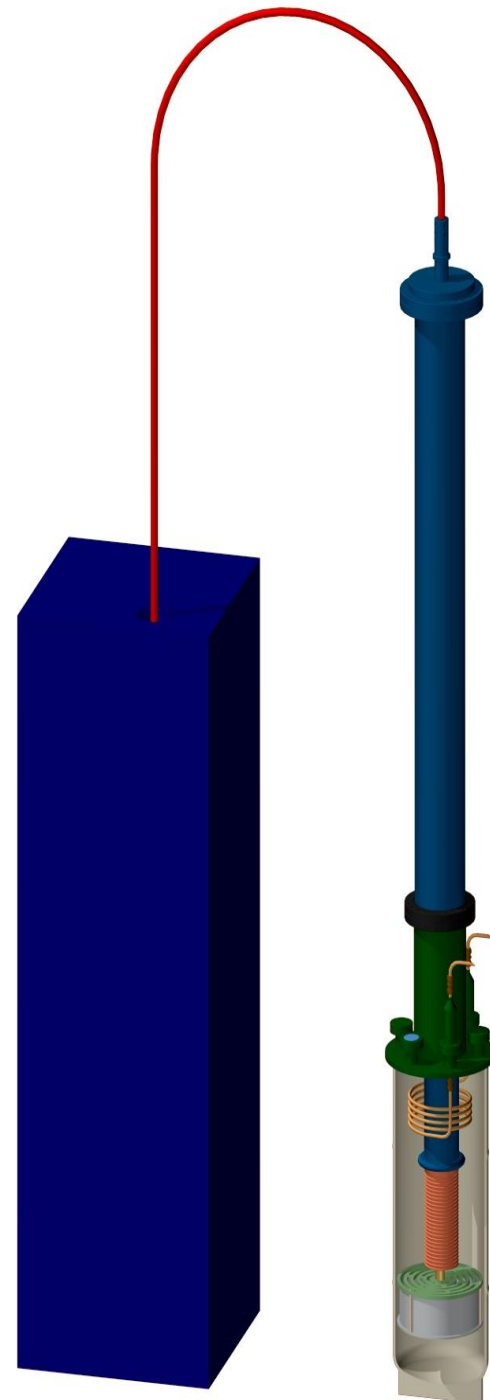
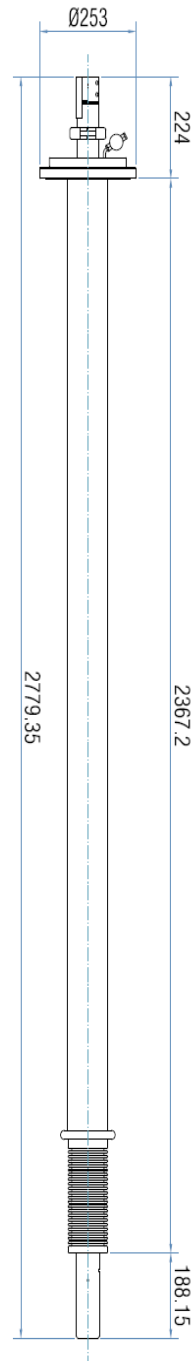
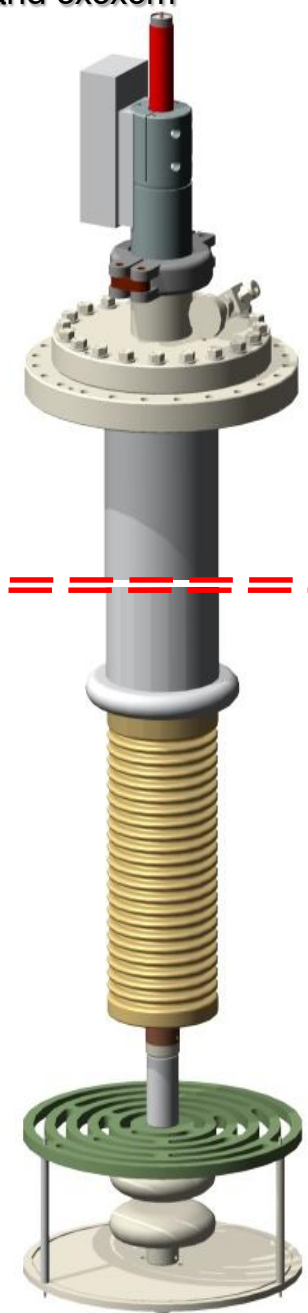
SHV20kV



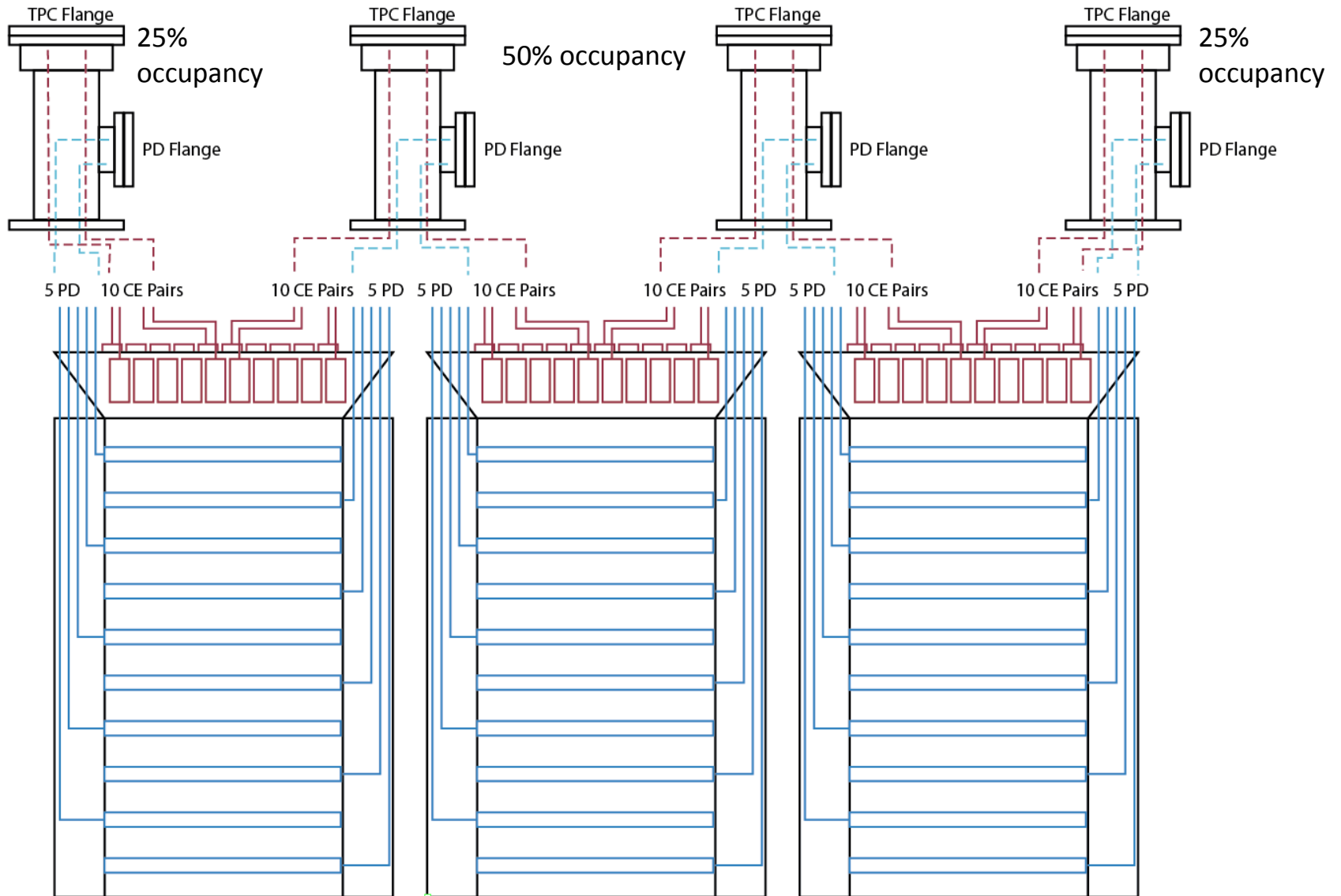
Dsub-50pin

# HV FT for the 3x1x1m<sup>3</sup> and 6x6x6m<sup>3</sup>

HVFT for 300kV  
with Rogowsky  
profile electrodes



# ProtoDUNE APA Cable Routing Concept

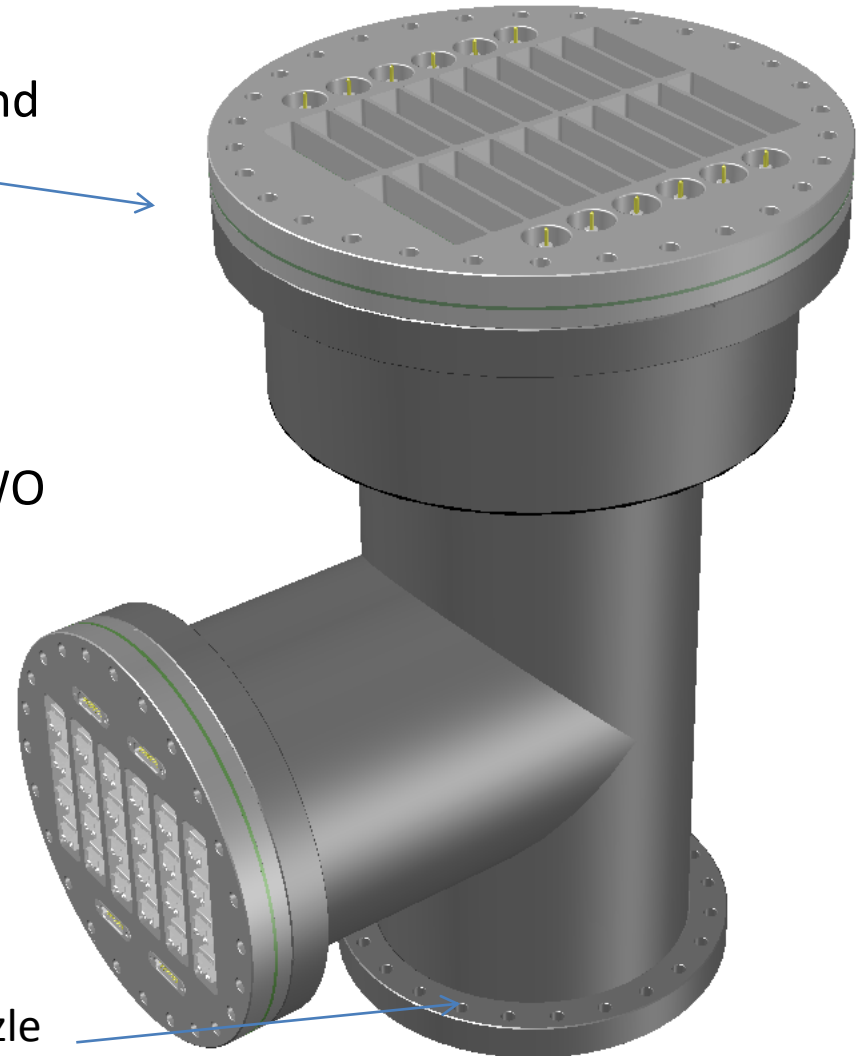


# A Combined TPC + PD Nozzle

14" CF flange for the cold electronics and bias cables from TWO APAs

10" CF flange for the PD cables from TWO APAs plus 4 DB15 connectors

8" pipe, 10" CF flange for the cryostat nozzle



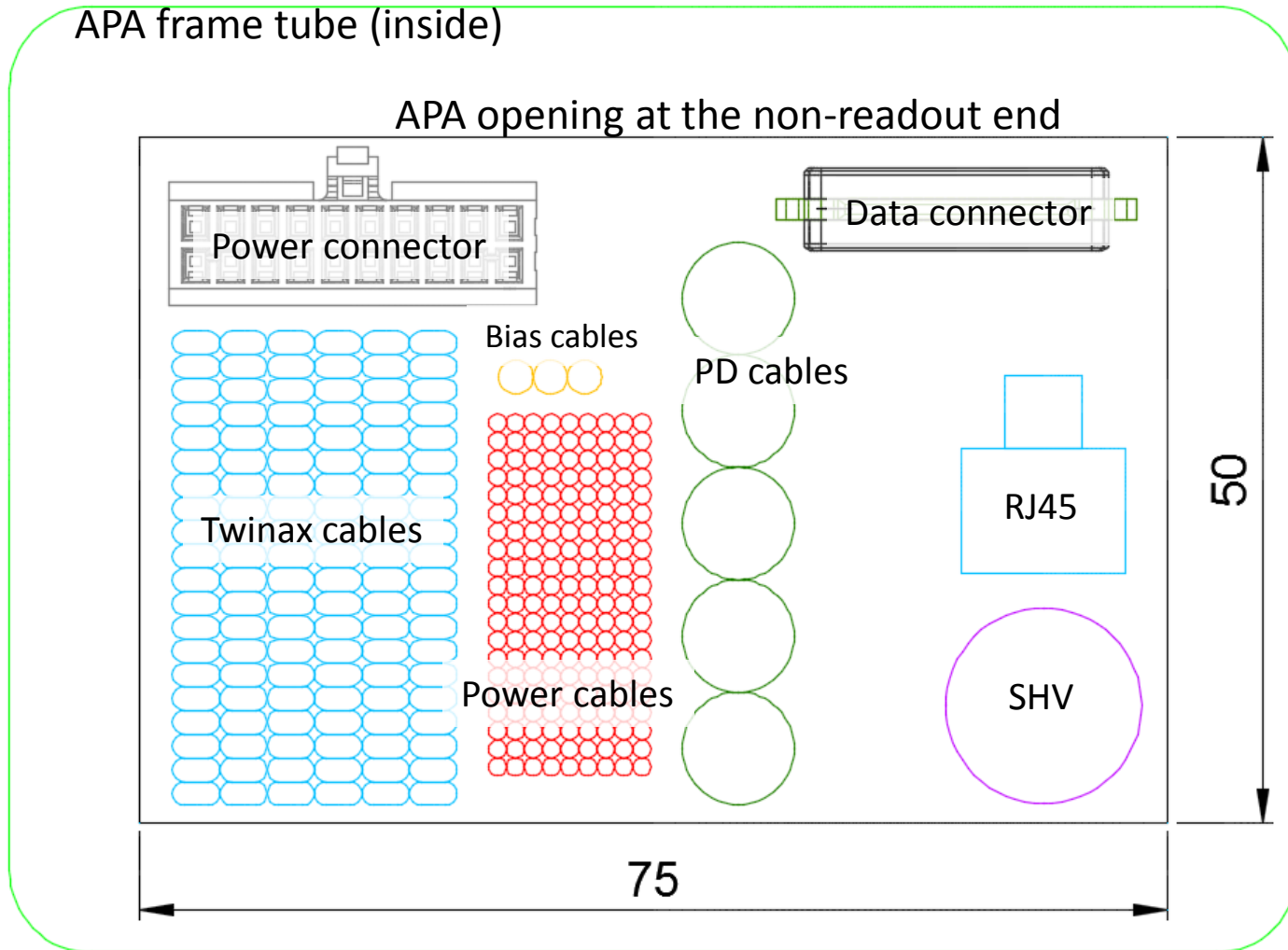
Lifting the field cage panels through these ports remains possibility.

# TPC +PD Cable Cross Section

<b>Signal Cable (twinax)</b>	Length [mm]	3.45
	Width [mm]	1.73
	Area [mm <sup>2</sup> ]	5.97
	# of Cable per FEMB	12.00
	# of FEMB per APA	20.00
	Xsec per APA [cm <sup>2</sup> ]	14.32
<b>Power Cable</b>	Outer Diameter [mm]	1.32
	Area (square) [mm <sup>2</sup> ]	1.37
	# of Cable per FEMB (incl. ext. cal.)	18.00
	# of FEMB per APA	20.00
	Xsec per APA [cm <sup>2</sup> ]	6.27
<b>Wire Bias Cable</b>	Outer Diameter [mm]	2.5
	Area (square) [mm <sup>2</sup> ]	6.25
	# of Cable per APA	6
	Xsec per APA [cm <sup>2</sup> ]	0.38
<b>PD Cable</b>	Outer Diameter [mm]	8.13
	Area (square) [mm <sup>2</sup> ]	66.1
	# of Cable per APA	10
	Xsec per APA [cm <sup>2</sup> ]	6.6
	Total Xsec per APA [cm <sup>2</sup> ]	28

# Cable Size vs APA Opening:

Can we route lower APA cables through the frame?



This graph shows the size of cable bundles of **HALF** of all cables for an APA compared with a few key dimensions.

Also included are the cross sections of the connectors used. They do not have to pass through the opening all at once.

The upper opening where the electronics plate meet the frame tube also needs careful consideration to allow all cables to pass through.



# Cryostat Environmental Requirements

- Filtered Lighting: If the PDs are to be exposed to ambient light for any length of time the light must be filtered to eliminate UV light <400nm. Suggested filters include:
  - <http://www.gamonline.com> T1510 - UV Shield
  - TAPR50-T8-4 UV Light Filters 24/case from: <http://www.ergomart.com/>
- Humidity: PDs are shipped in a dry nitrogen environment. Humidity must be controlled for periods of long exposure. The exact specification is being investigated, but provision will be required to control the humidity inside the cryostat during installation.
- Dust: During periods of long exposure, filtered air supplies should be used to keep the environment inside the cryostat equivalent to a class 100,000 clean room or better.

# Power, Rack Requirements (ProtoDUNE)

- Cold Electronics
  - 4W per FEMB x 120 = 480W
  - 25W per WIB x 30 = 750W
  - ⇒ 4 MPV8016 modules (<1 MPOD chassis, 8U)
- Wire bias
  - 6 per APA (1 MPOD module, 8ch) x 6, no current draw, <2kV
- PD Readout
  - 4x1U SSP module per APA, 1A @ 220V