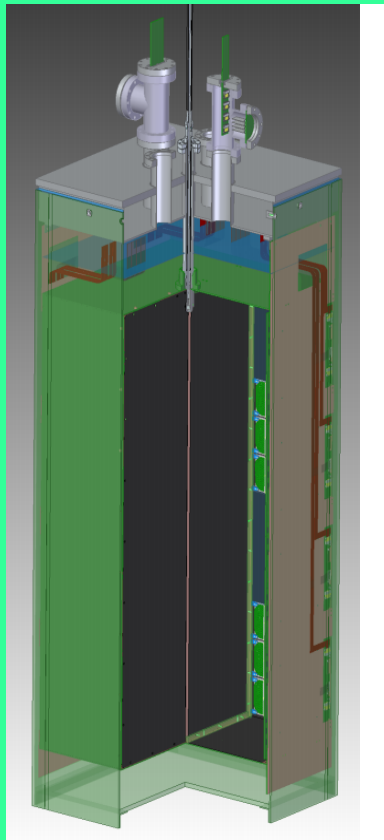


## Drift high voltage system for DUNE ND

### I. Kreslo, Uni-Bern



Drift field 0.5 — 1 kV/cm

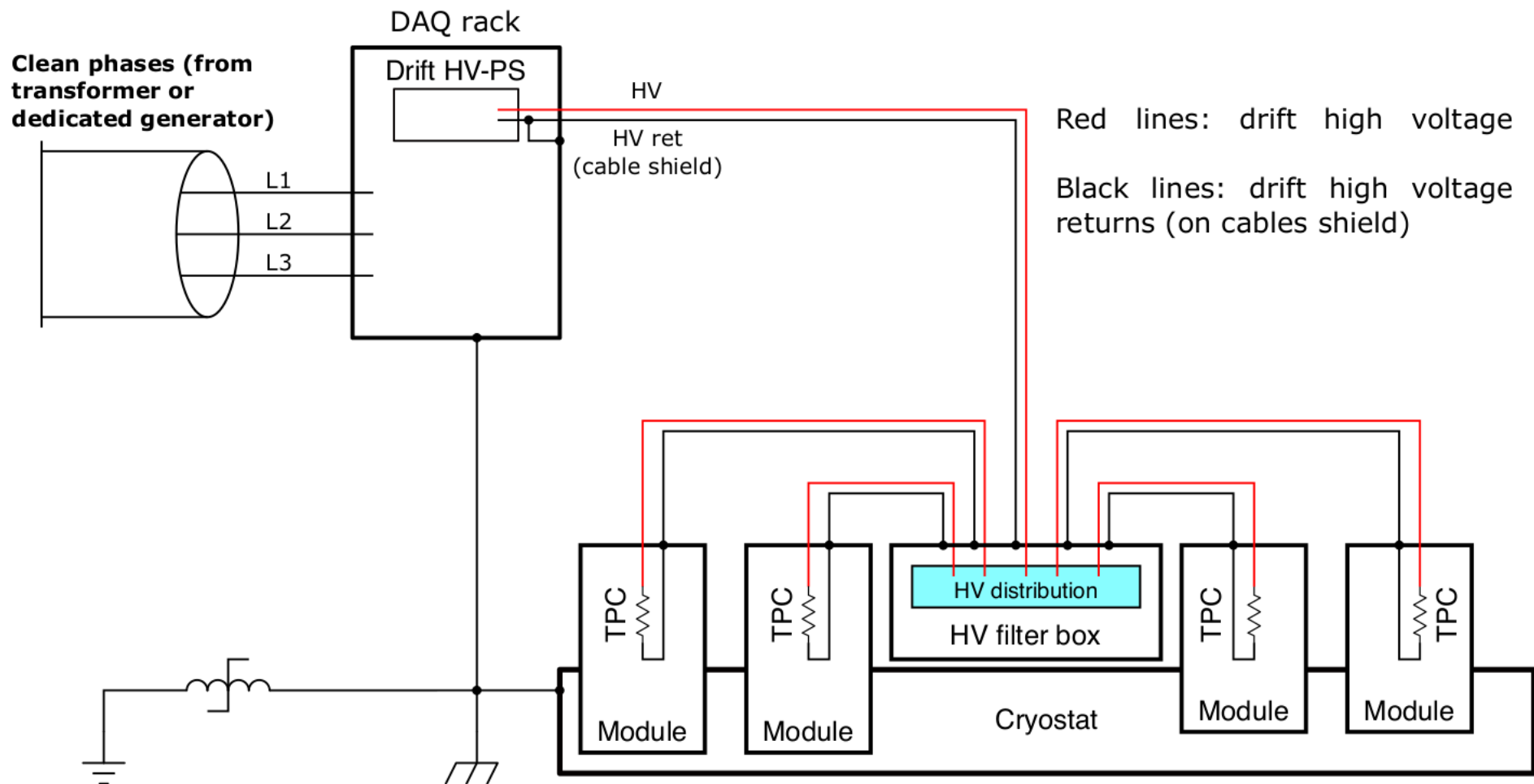
Drift distance 50 cm

Cathode voltage 25 to 50 kV

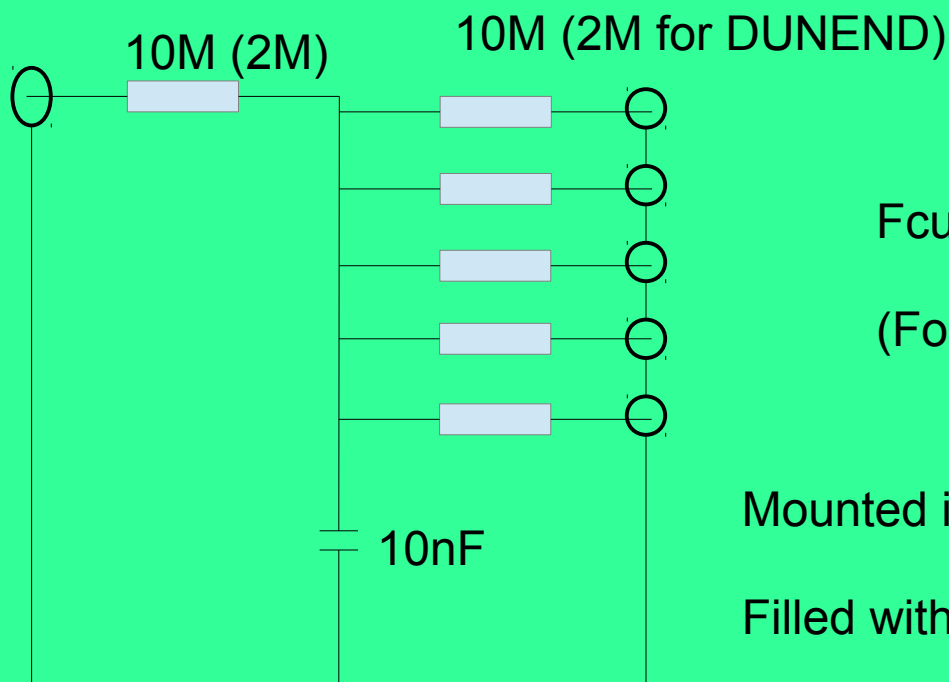
Power supply voltage up to 60 kV, 6 mA

Ripple R-C-R low-pass pot filter-distributor (PFD-4,5)

# HV in 2x2: grounding and current return Similar scheme for DUNE ND



## Pot Filter Distributor PFD-5



$$F_{\text{cut}} = 1.6 \text{ Hz}$$

(For DUNE ND 8 Hz)

Mounted in stainless steel pot

Filled with high-quality transformer oil

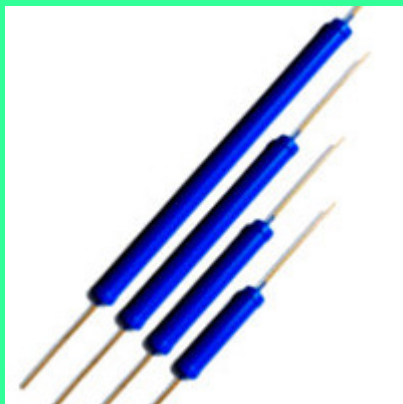
Copper foil at the flange bottom

Current return is forced via copper shunts,

No current on the pot case



TDK 60kV



Nicrom 425: 60kV

DR8: 2G/sq @1kV/cm, 5G/sq @0.5kV/cm

Field cage: 2 halves, each is 33x66x120cm,

Module represents 0.044 sq, =>

@ 1 kV/cm     $R = 88 \text{ M}$ ,  $I = 0.372 \text{ mA}$ ,  $P = 12.3 \text{ W}$ ,  $V_{\text{PS}} = 47.88 \text{ kV}$

@ 0.5 kV/cm     $R = 220 \text{ M}$ ,  $I = 0.074 \text{ mA}$ ,  $P = 1.2 \text{ W}$ ,  $V_{\text{PS}} = 19.48 \text{ kV}$

$I_{\text{PS}} = 1.5 \text{ mA}$

Spellman SL50x300: 50 kV, 6mA (ordered)

Power dissipated in filter 28W @1kV/cm makes about 43C at surface

DR8: 2G/sq @1kV/cm, 5G/sq @0.5kV/cm

Field cage: 2 halves, each is 50x100x300cm,

Module represents 0.031 sq, =>

@ 1 kV/cm  $R = 62.5 \text{ M}$ ,  $I = 0.8 \text{ mA}$ ,  $P = 40 \text{ W}$ ,  $V_{\text{PS}} = 58 \text{ kV}$

@ 0.5 kV/cm  $R = 156.3 \text{ M}$ ,  $I = 0.16 \text{ mA}$ ,  $P = 4 \text{ W}$ ,  $V_{\text{PS}} = 26.6 \text{ kV}$

Power dissipated in filter 30.7W @1kV/cm makes about 44C at surface

$I_{\text{PSmax}} = 4 \text{ mA}$

Spellman SL60x300: 60 kV, 5mA

Spellman SL50x300:

Line:  $\pm 0.005\%$  of full voltage +500mV over specified  
input range  $\Rightarrow$   $< 0.006\%$

Ripple:

0.1% p-p +1Vrms.  $\sim 0.1\%$  before the filter

Temperature Coefficient:

100ppm/ $^{\circ}\text{C}$ , assuming  $10^{\circ}\text{C}$  change  $\Rightarrow 0.1\%$

Stability:

100ppm/hour  $\Rightarrow 0.01\%$  / h

Filter:  $F_c = 1.6\text{ Hz}$

@60Hz -38dB (0.02)

@100kHz ripple -96dB (0.000016)  $\Rightarrow 1.6\text{e-}8$  w.r.t. output HV  
at 33kV ripple is 0.5 mV, pixel capacitance is  $\sim 6.6\text{ fF}$   $\Rightarrow$   
ripple-induced equivalent charge is 0.0033 fC

Filter:  $F_c=8$  Hz

@60Hz -18dB (0.1)

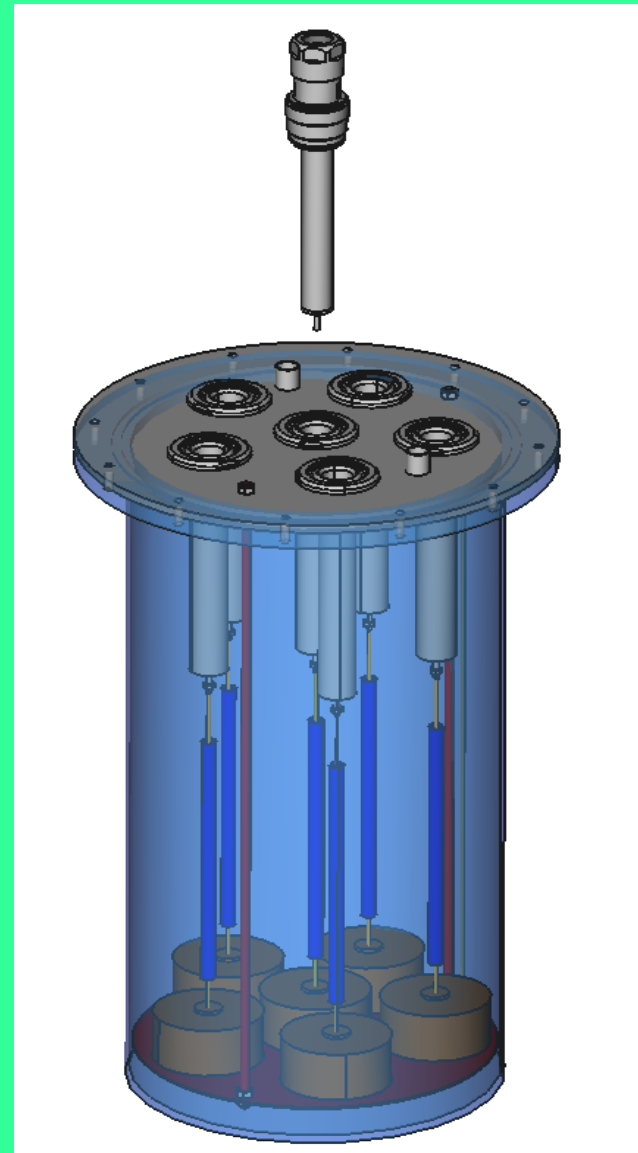
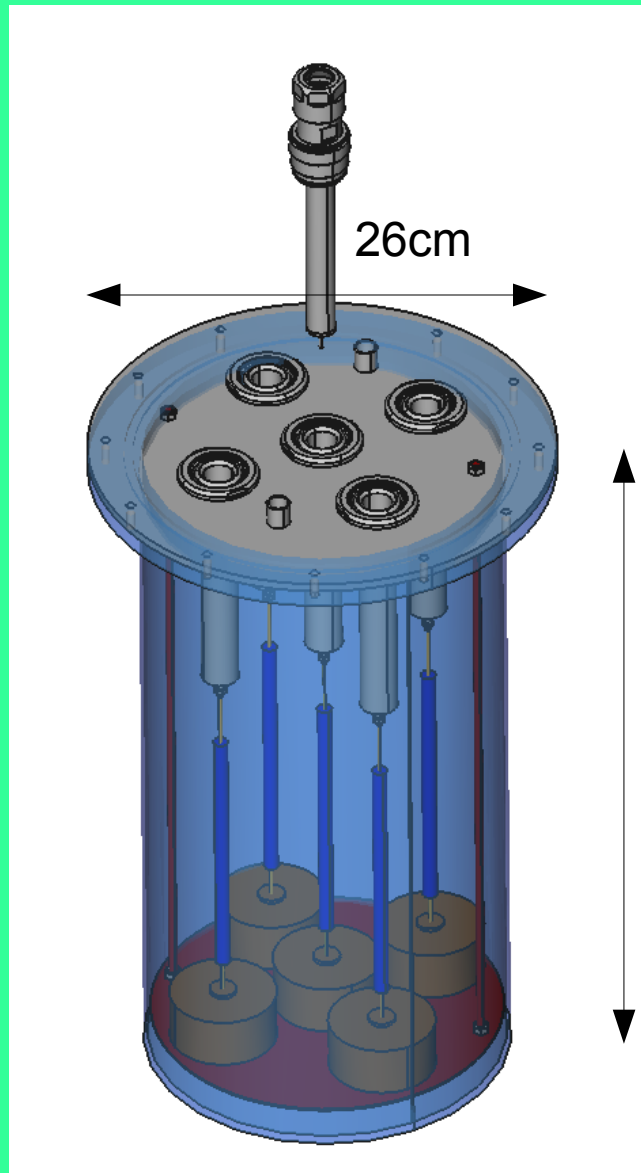
@100kHz ripple rejection 0.00008  $\Rightarrow 8e-8$  w.r.t. output HV

at 50kV ripple is 0.5 mV, pixel capacitance is  $\sim 6.6$  fF  $\Rightarrow$

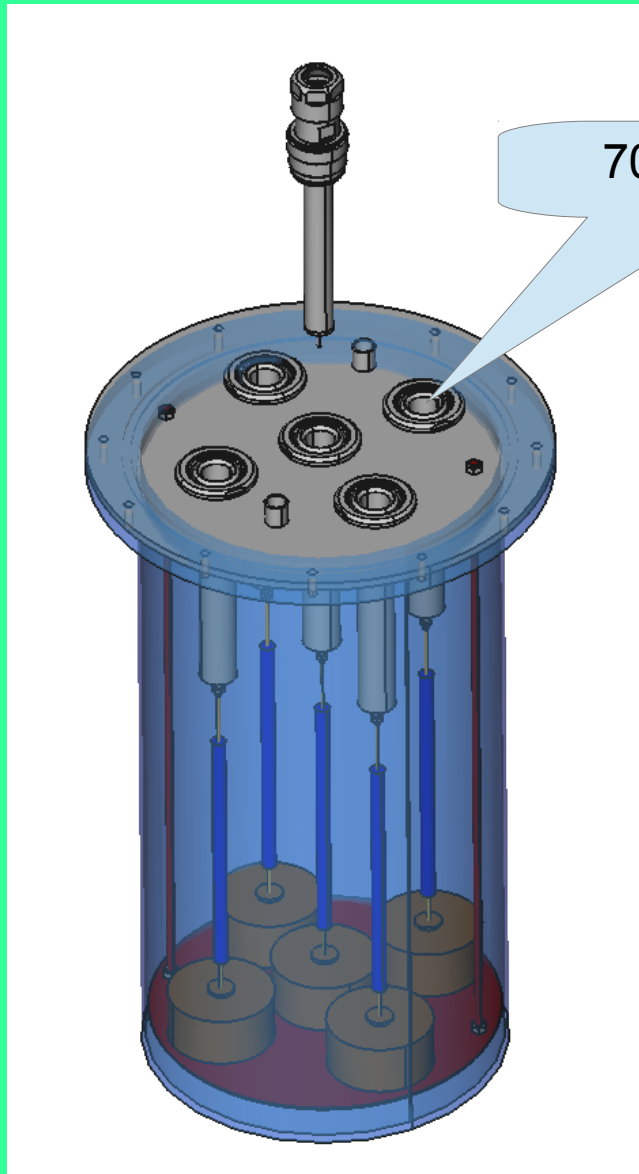
ripple-induced equivalent charge is 0.0033 fC



## HV in 2x2 and DUNE ND: PFD-4 & PFD-5

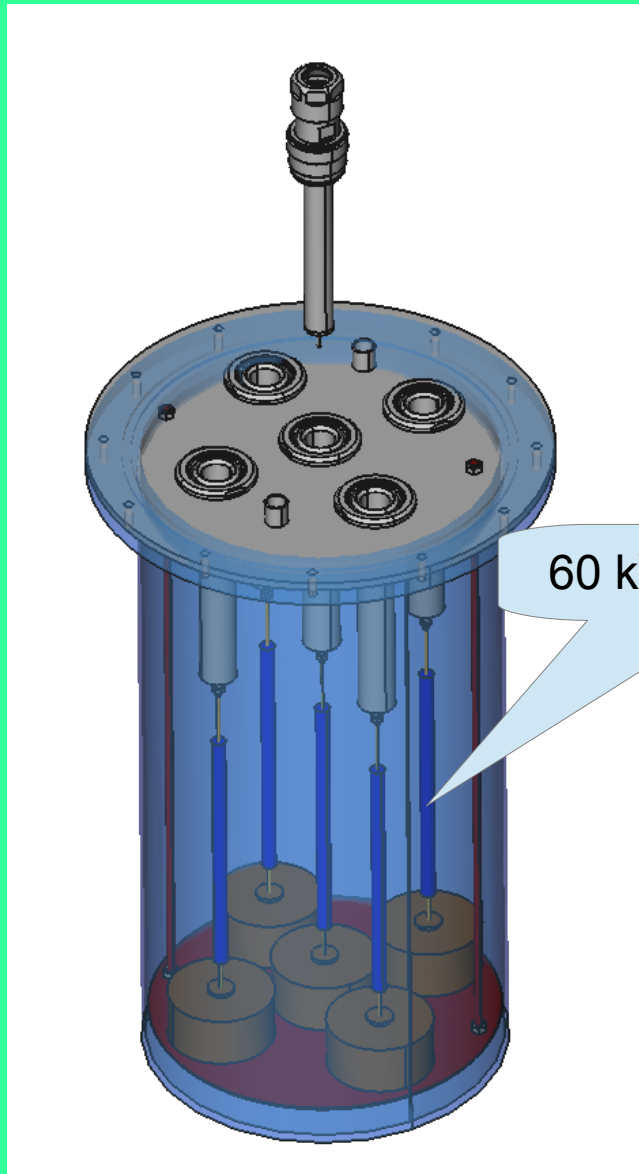


## PFD-4



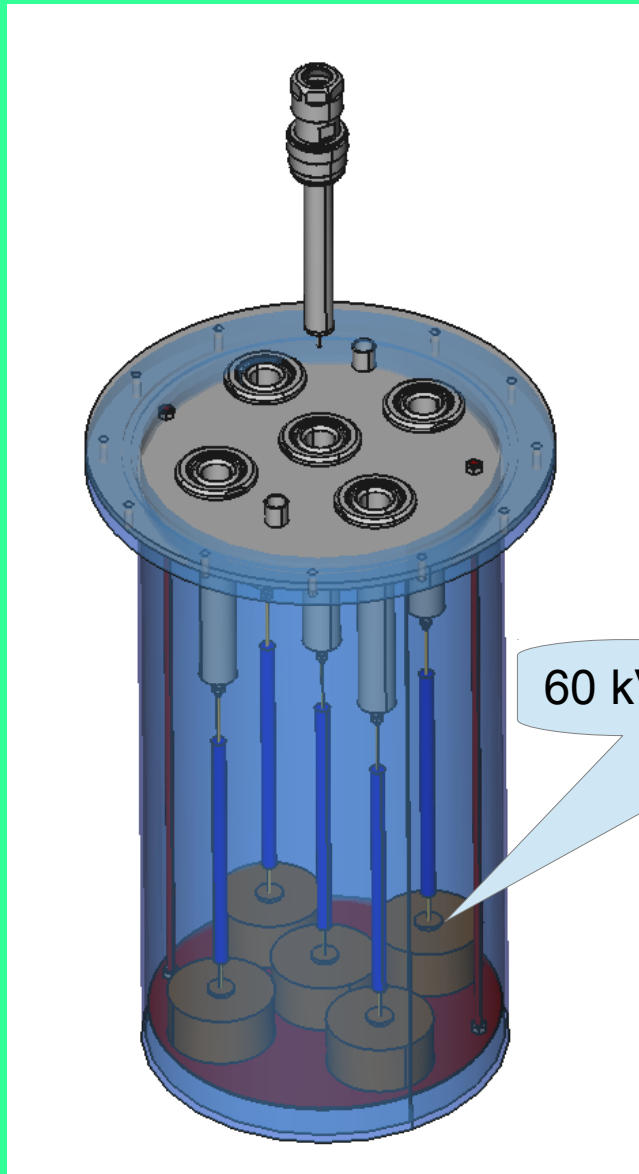
70kV connectors

## PFD-4



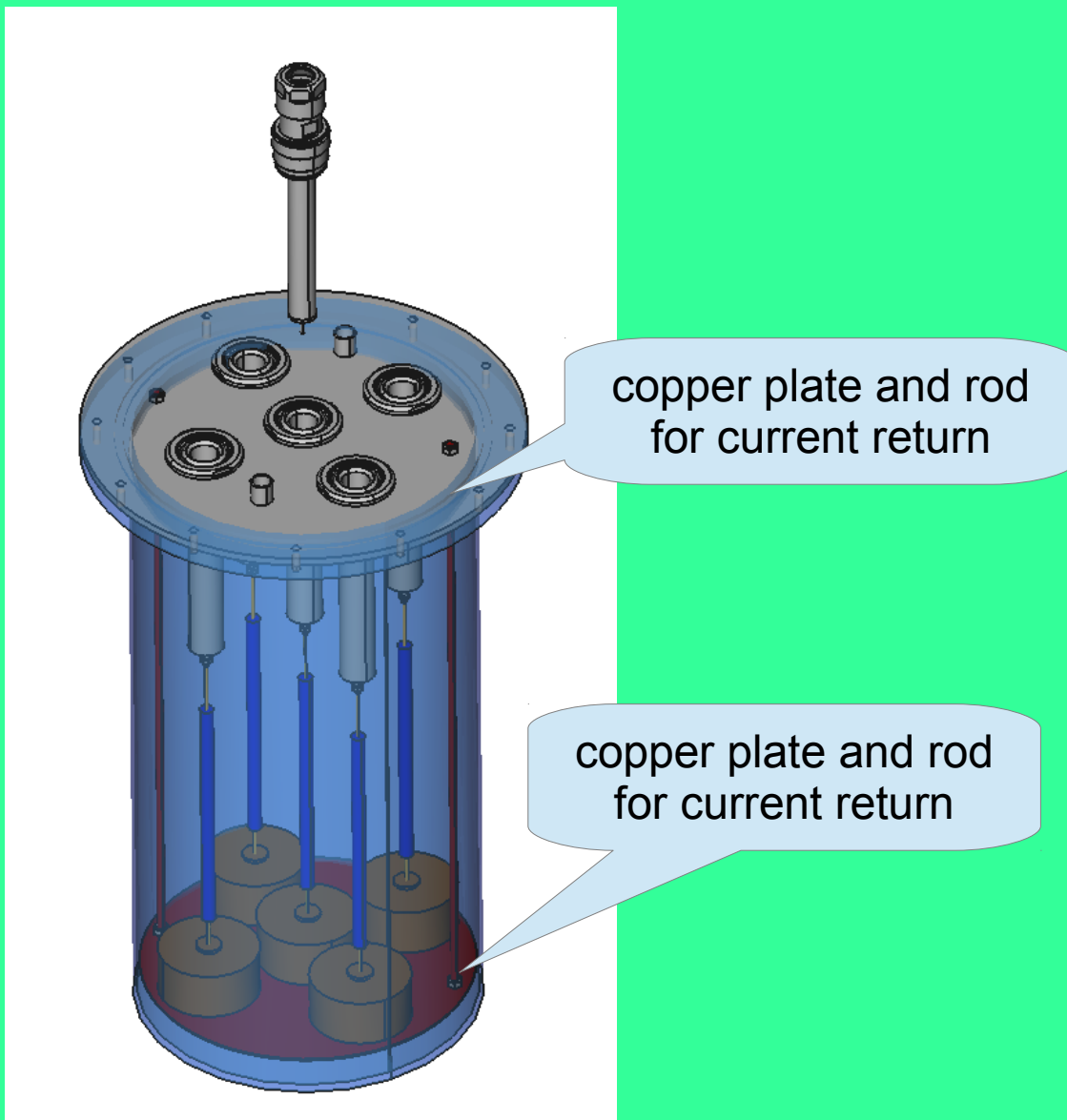
60 kV resistors, 10M

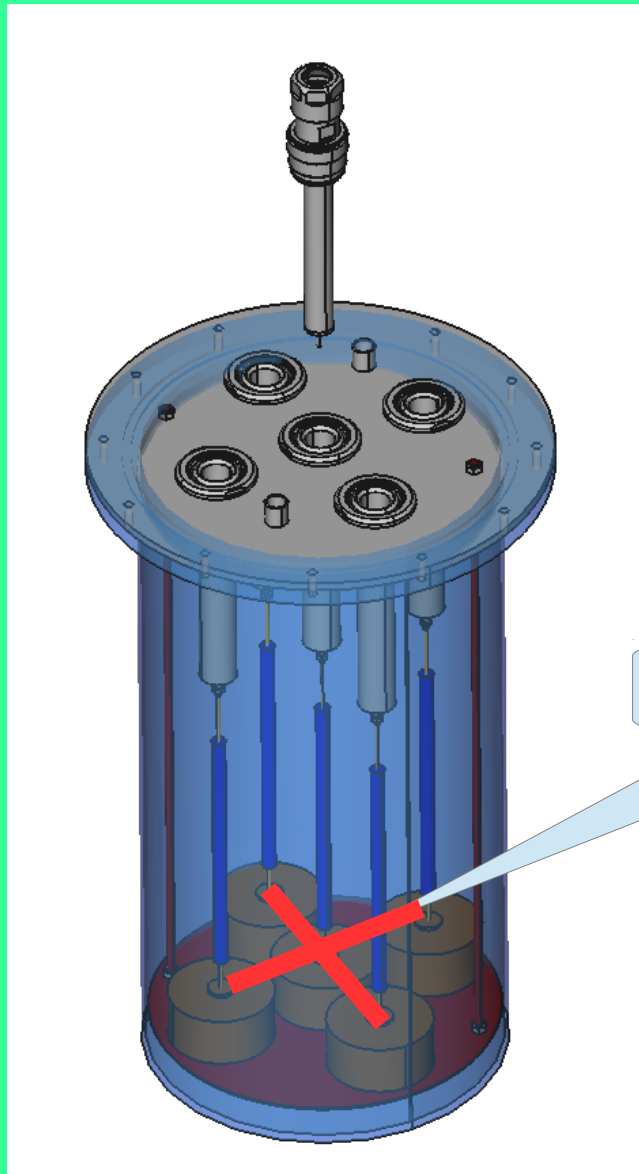
## PFD-4



60 kV capacitors, 2nF each

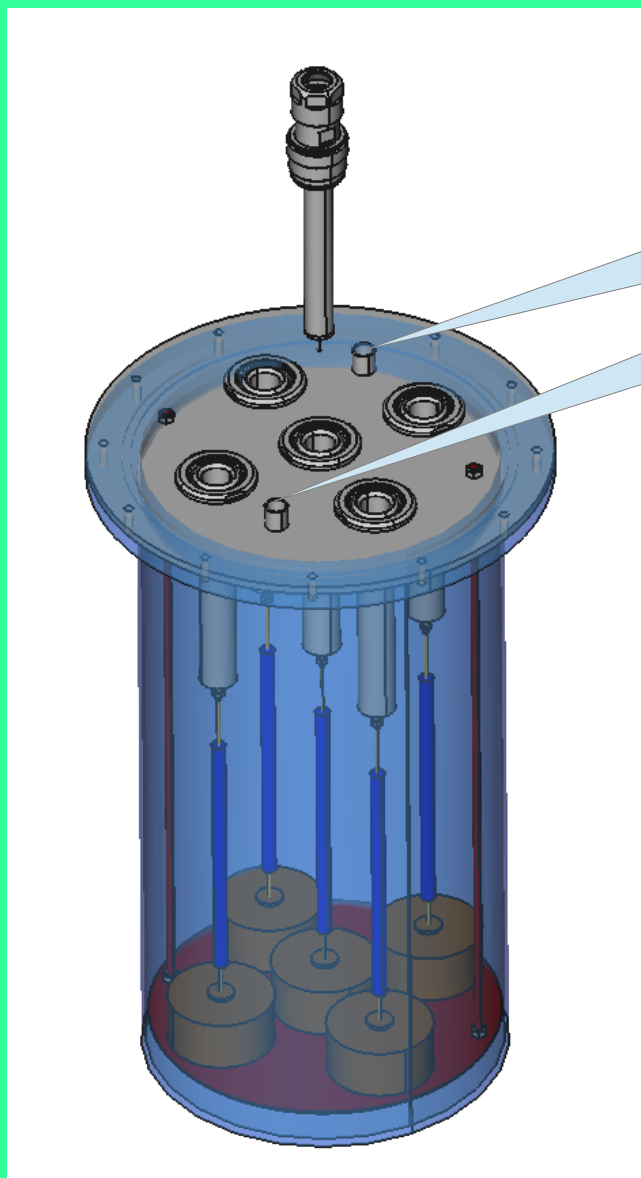
## PFD-4





copper cross-links

## PFD-4



oil filling and level  
monitoring

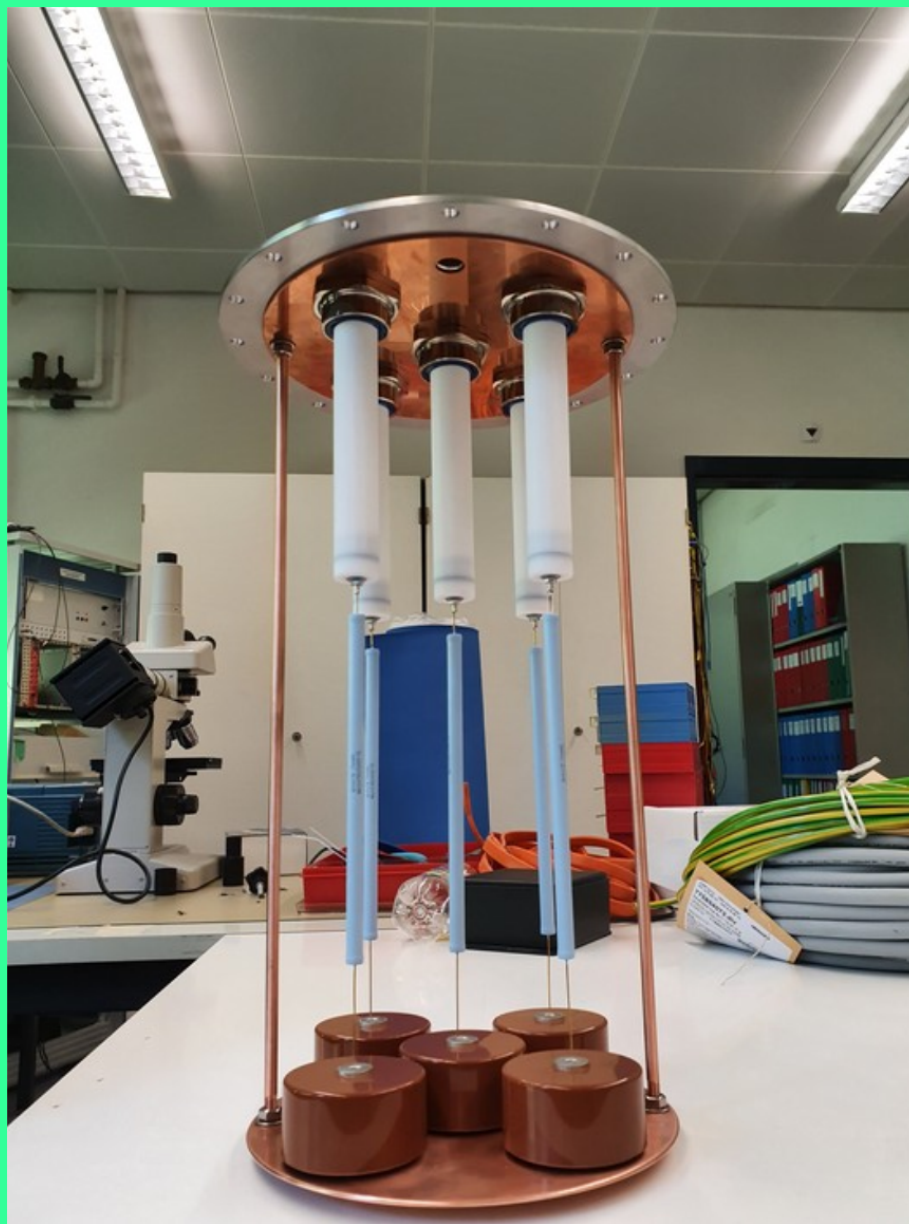
Status on 11 Sep 2020:

All components received,

The container is leak-tested

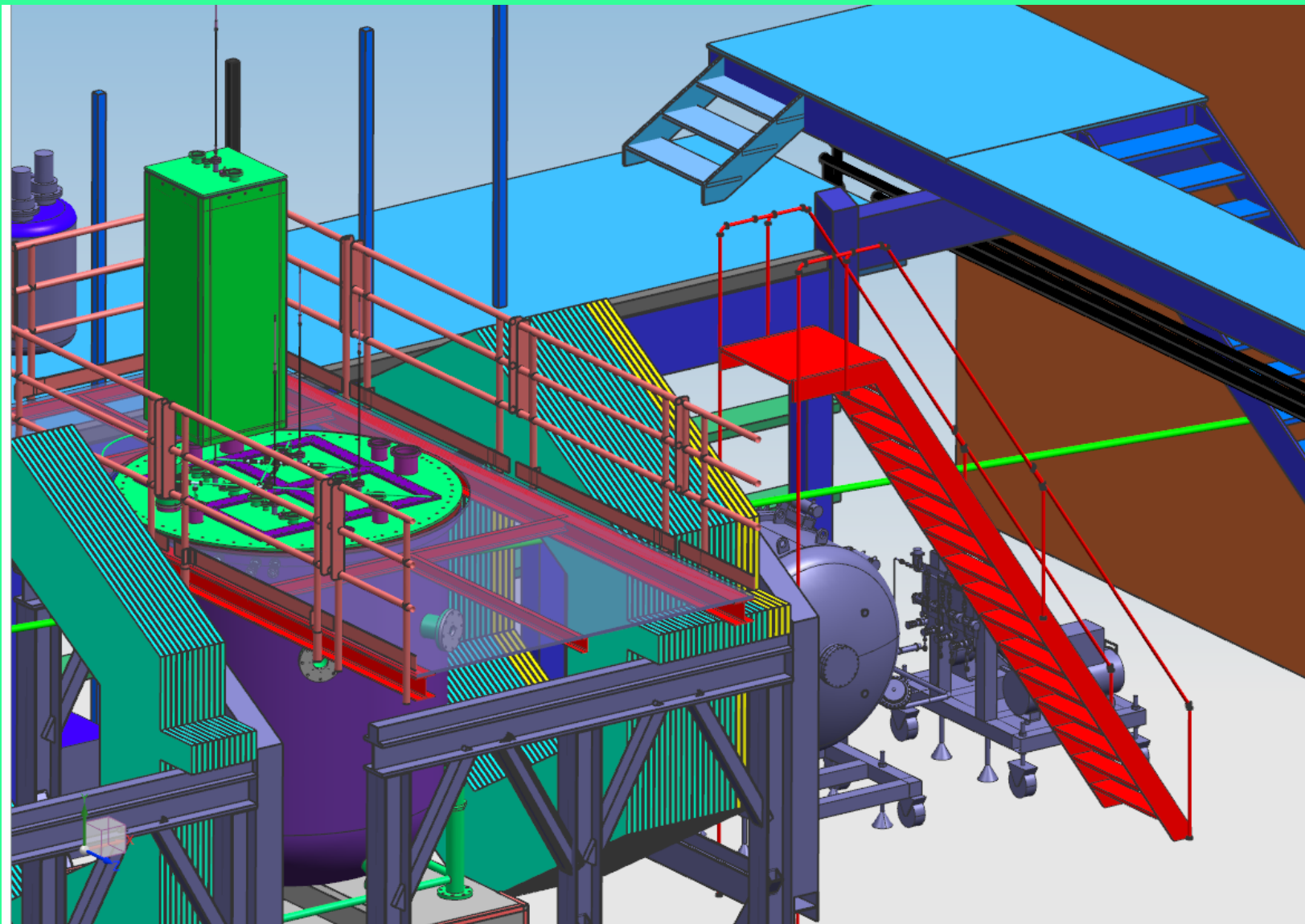
Assembly in progress.

Next week - expected done.

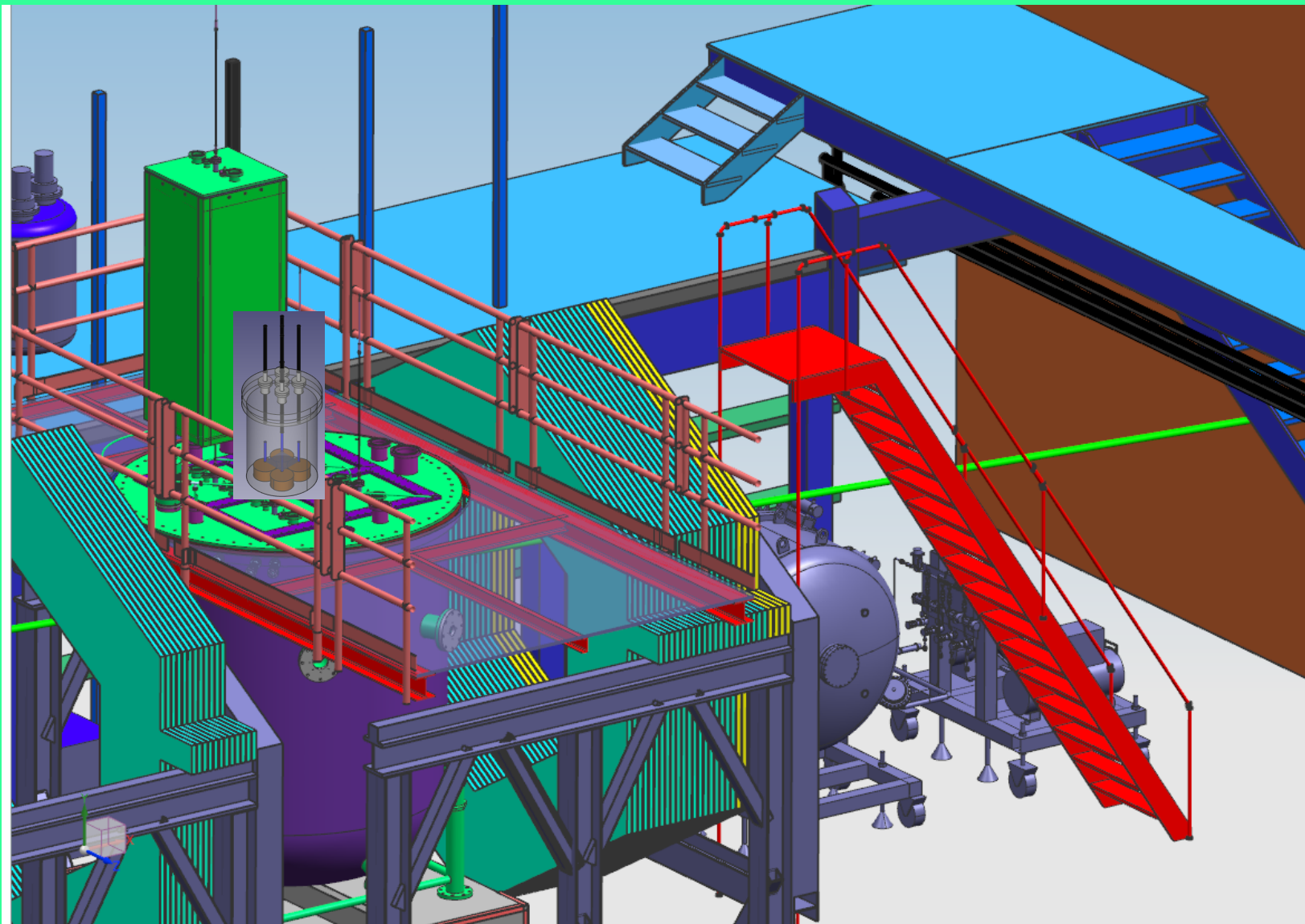




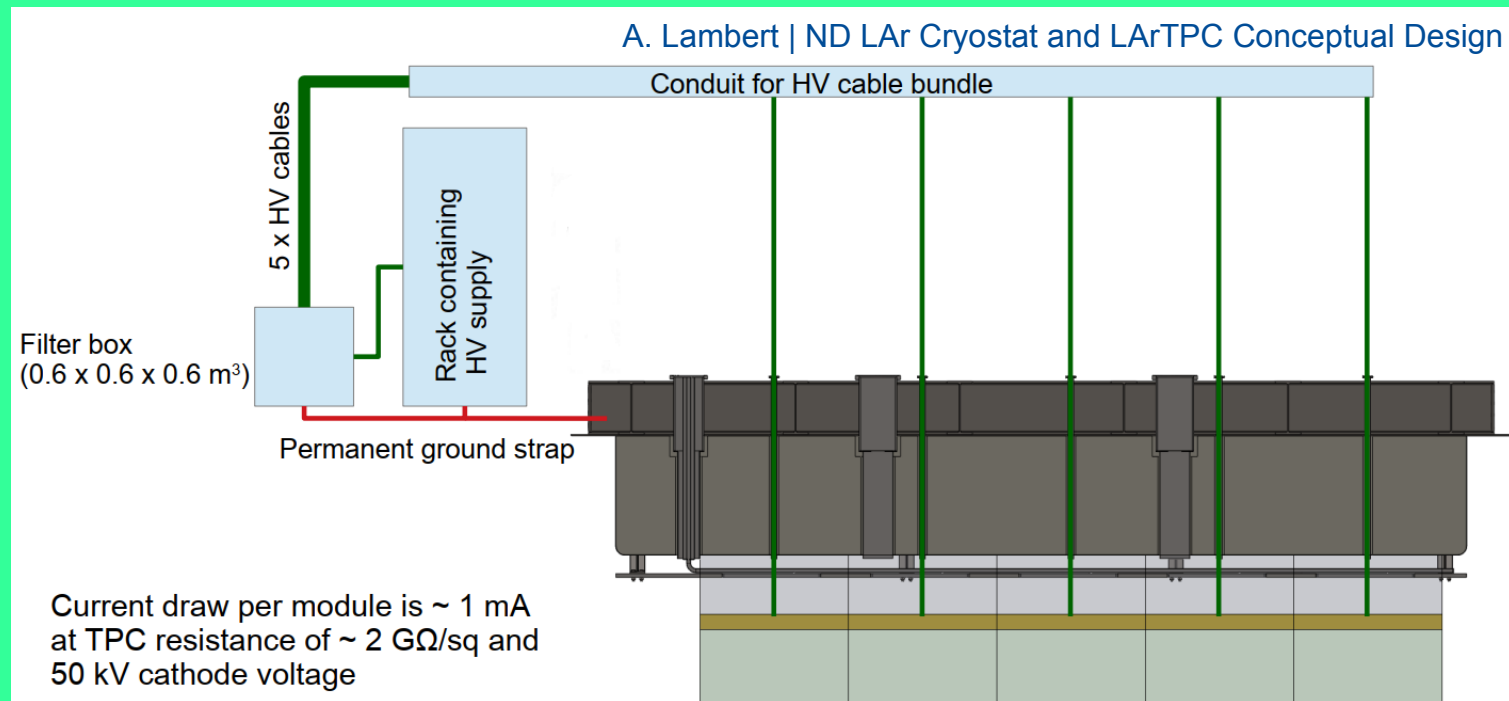
## HV in 2x2: PFD-4 location (TBD)



## HV in 2x2: PFD-4 location (TBD)



## HV in DUNE ND: PFD-5 location (TBD)



## HV in DUNE ND: PFD-5 location (TBD)

