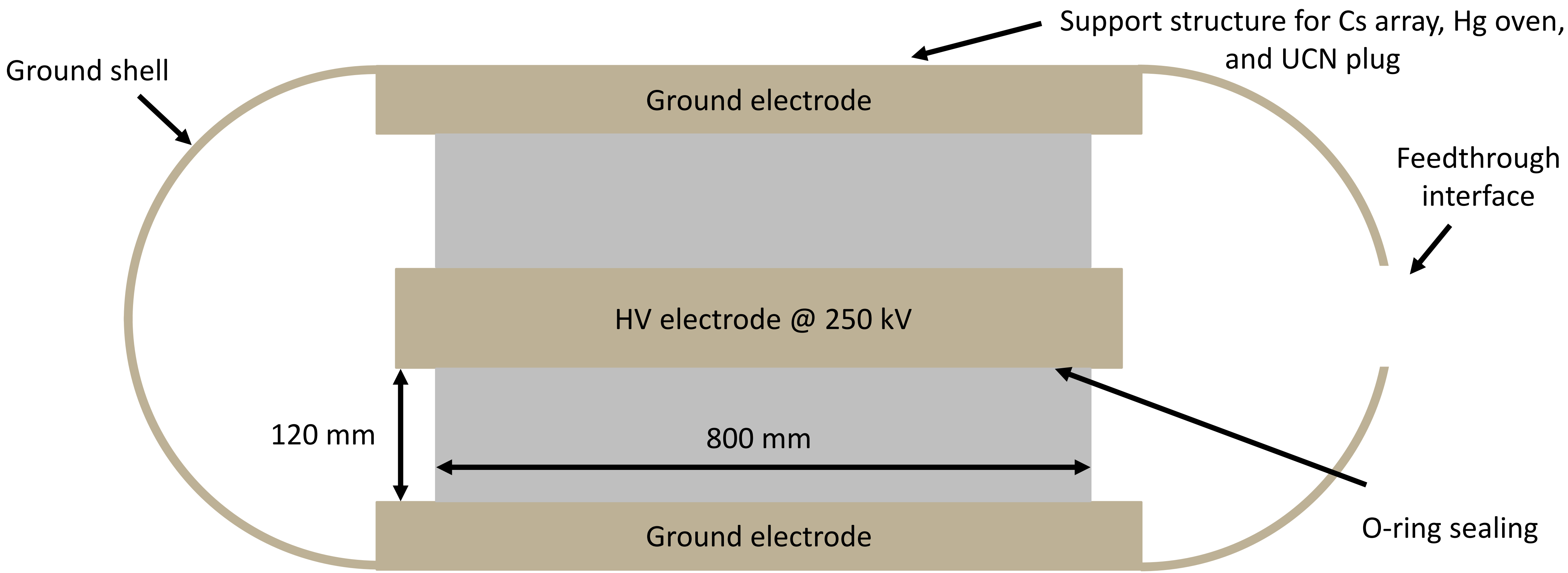
UNIVERSITÄT BERN
AEC
ALBERT EINSTEIN CENTER
FOR FUNDAMENTAL PHYSICS

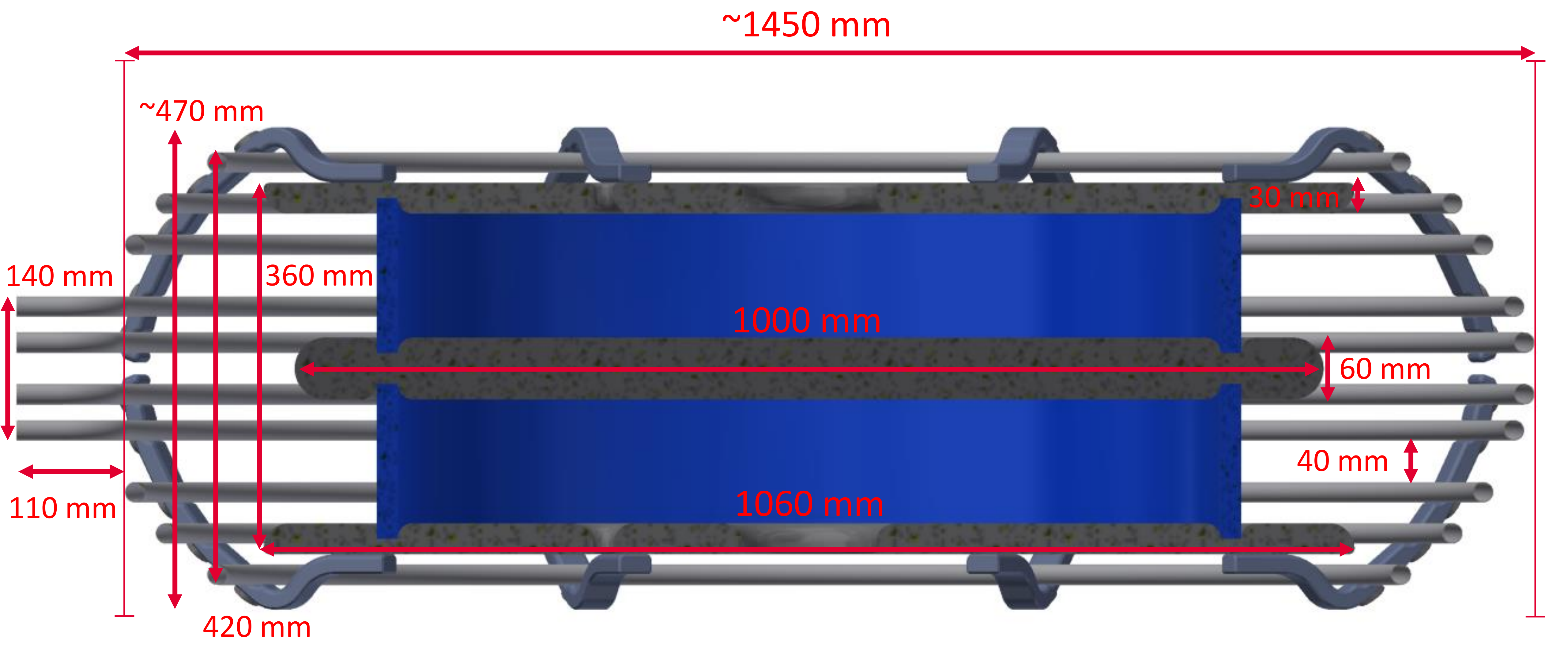
Precession chamber concept

JACOB THORNE

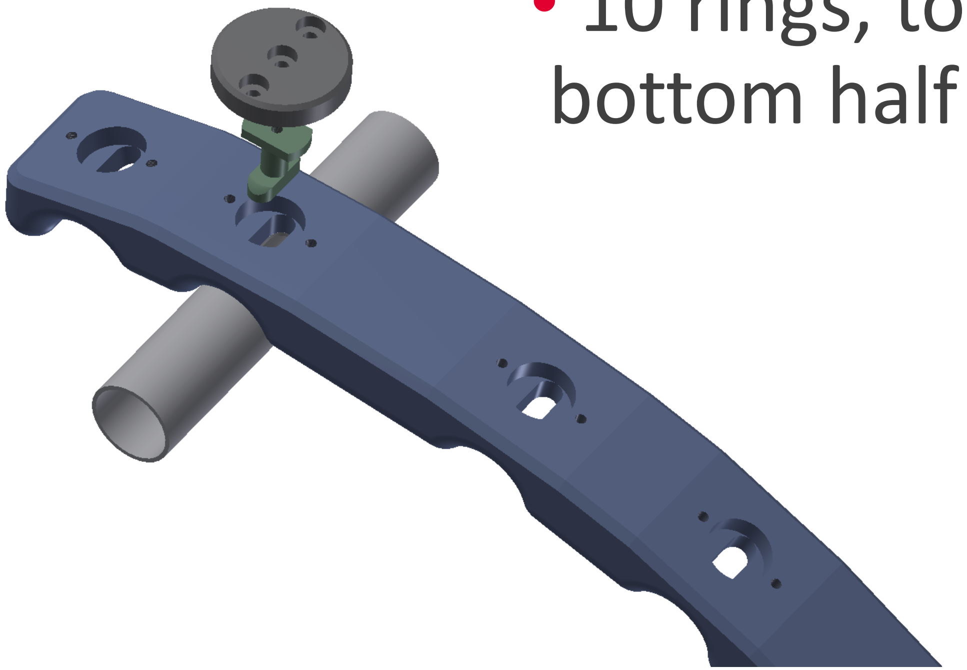
Specifications



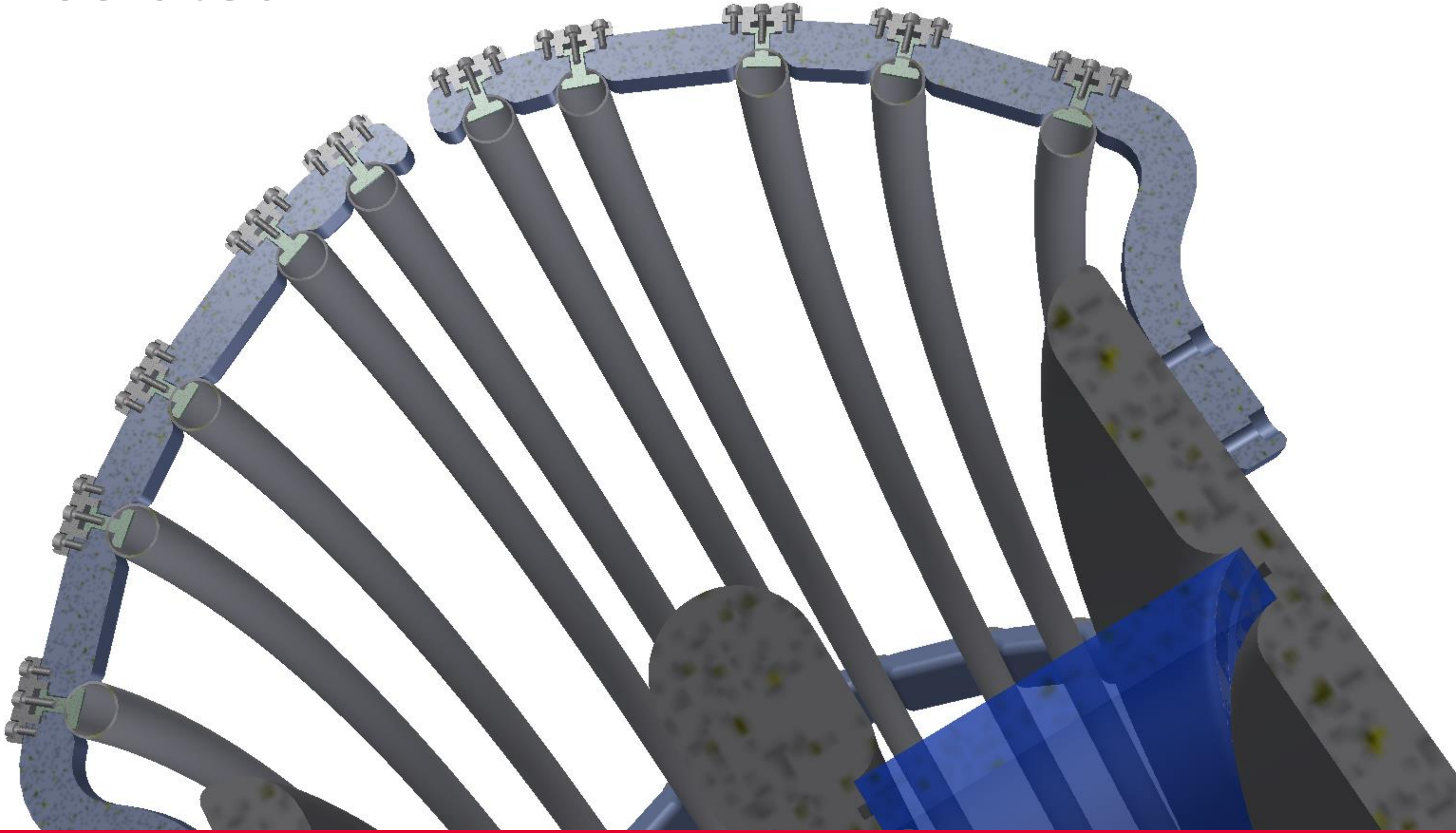
Full CAD design


~1450 mm
~470 mm
30 mm
140 mm
360 mm
1000 mm
60 mm
40 mm
110 mm
1060 mm
420 mm

Ground ring fixing



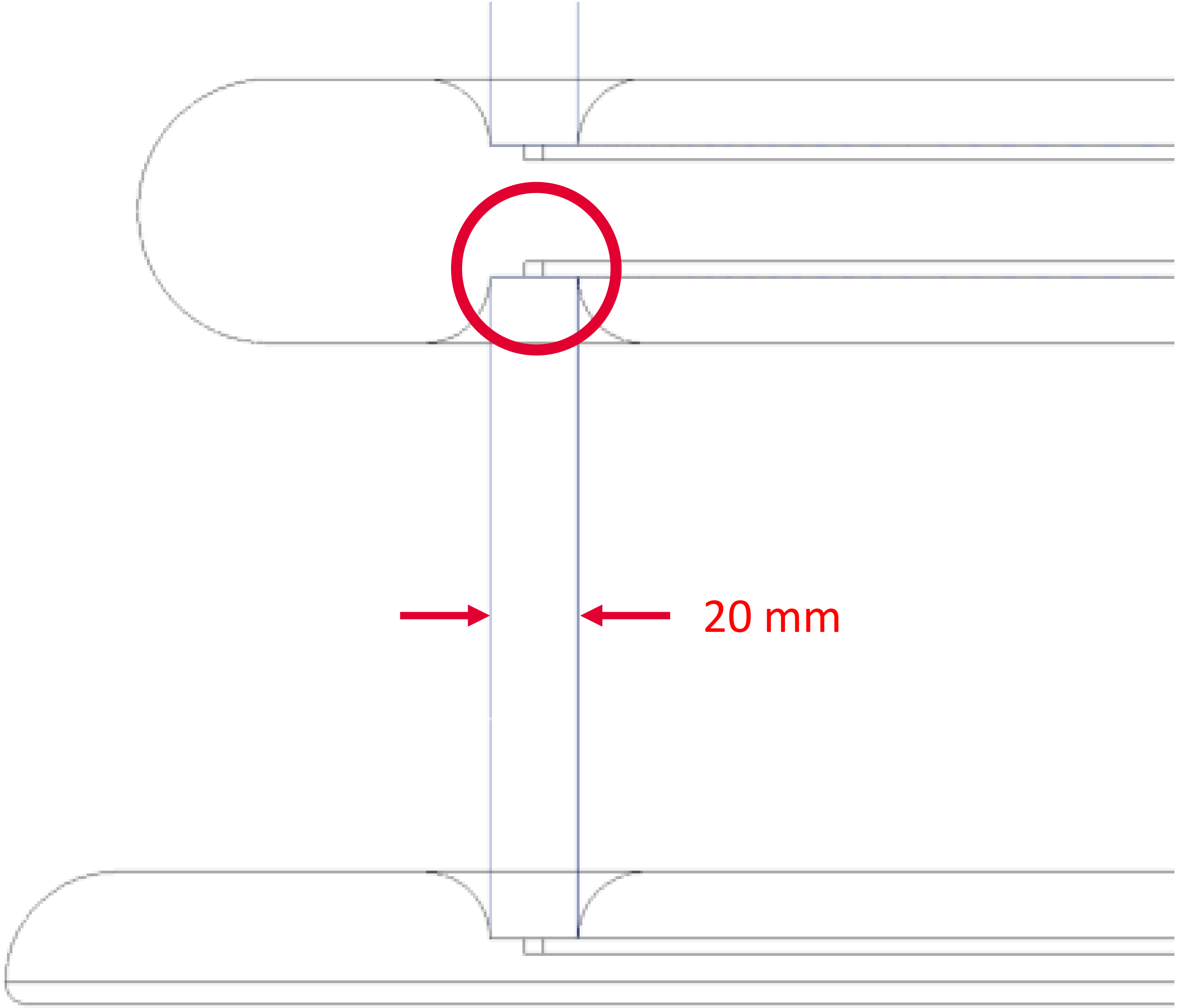
- 10 rings, top and bottom half isolated



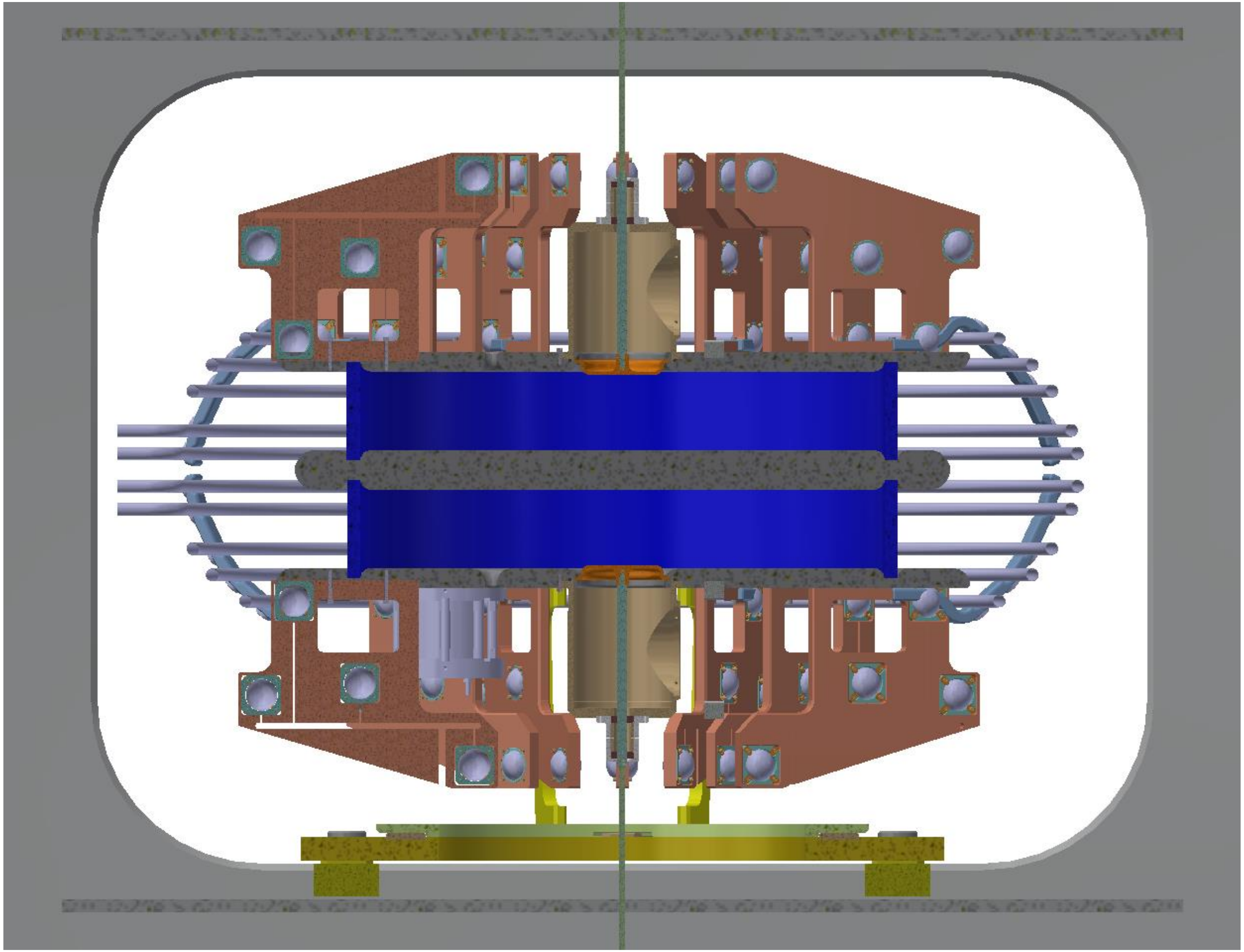
- Rings fixed by plug, bolted onto bracket

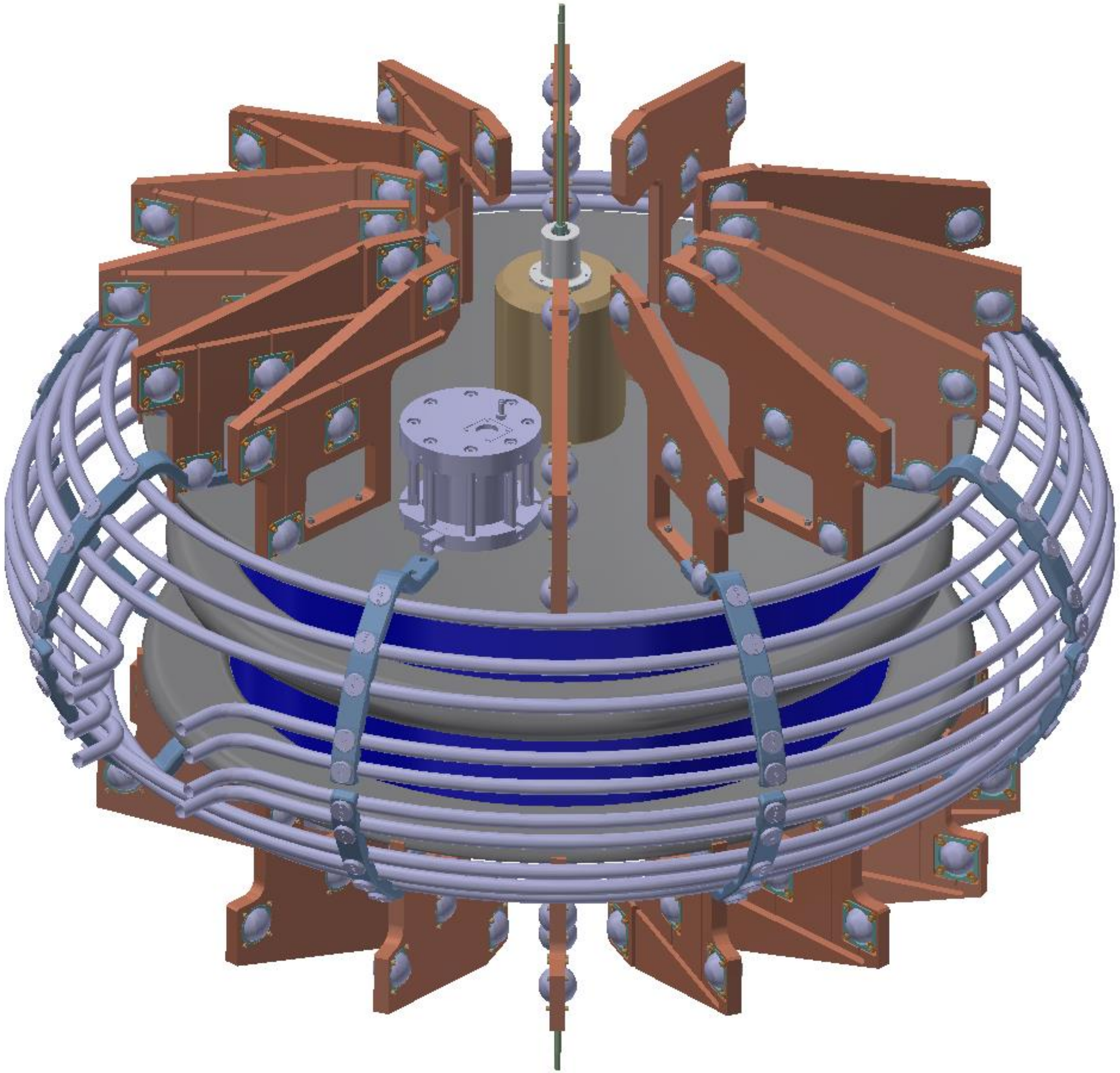
O-ring sealing

- Position moved to bottom of groove
- Compression done by weight of electrodes
- Groove designed so o-ring completely compressed and insulator is flush



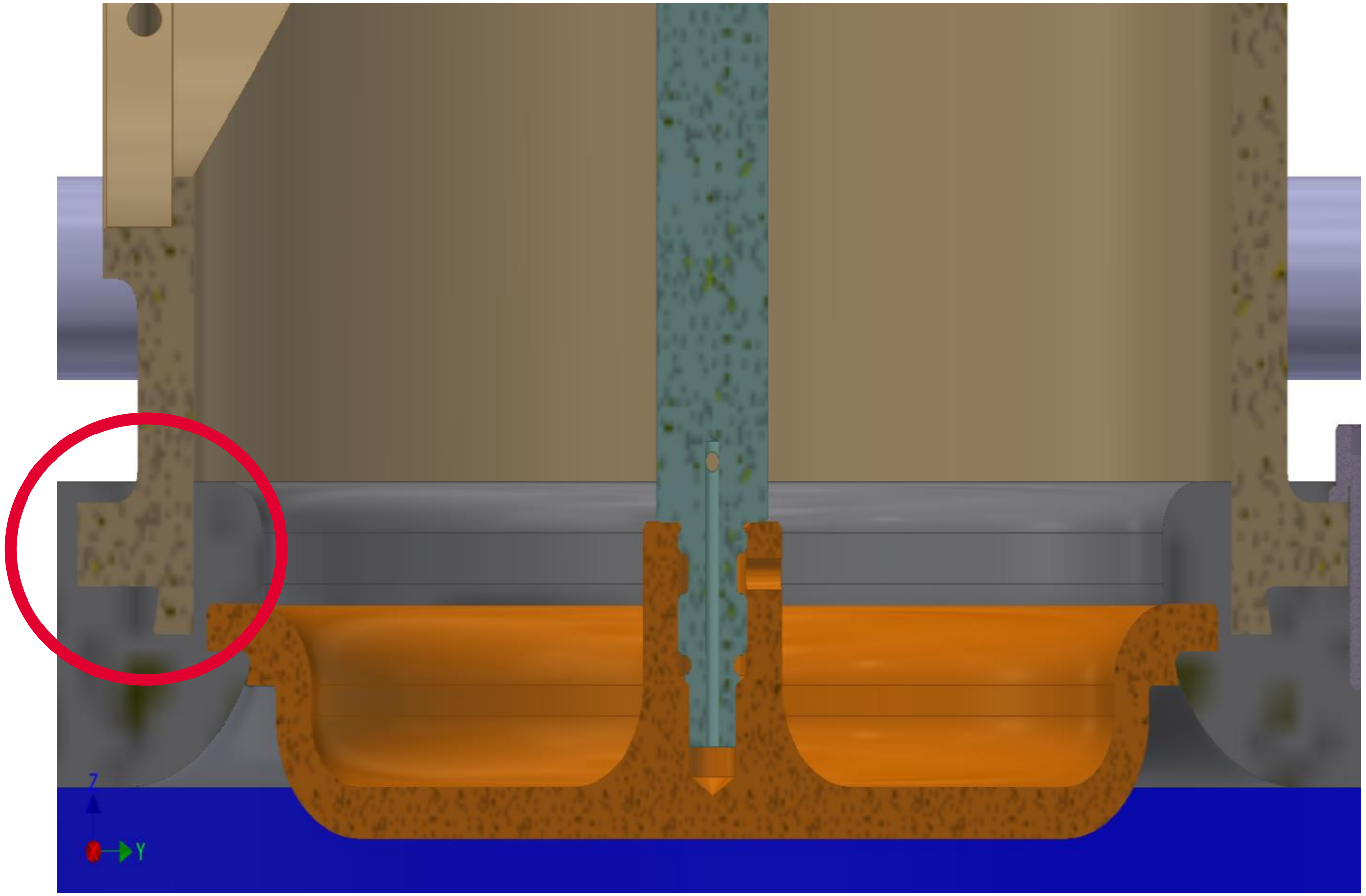
Adaptations to be discussed





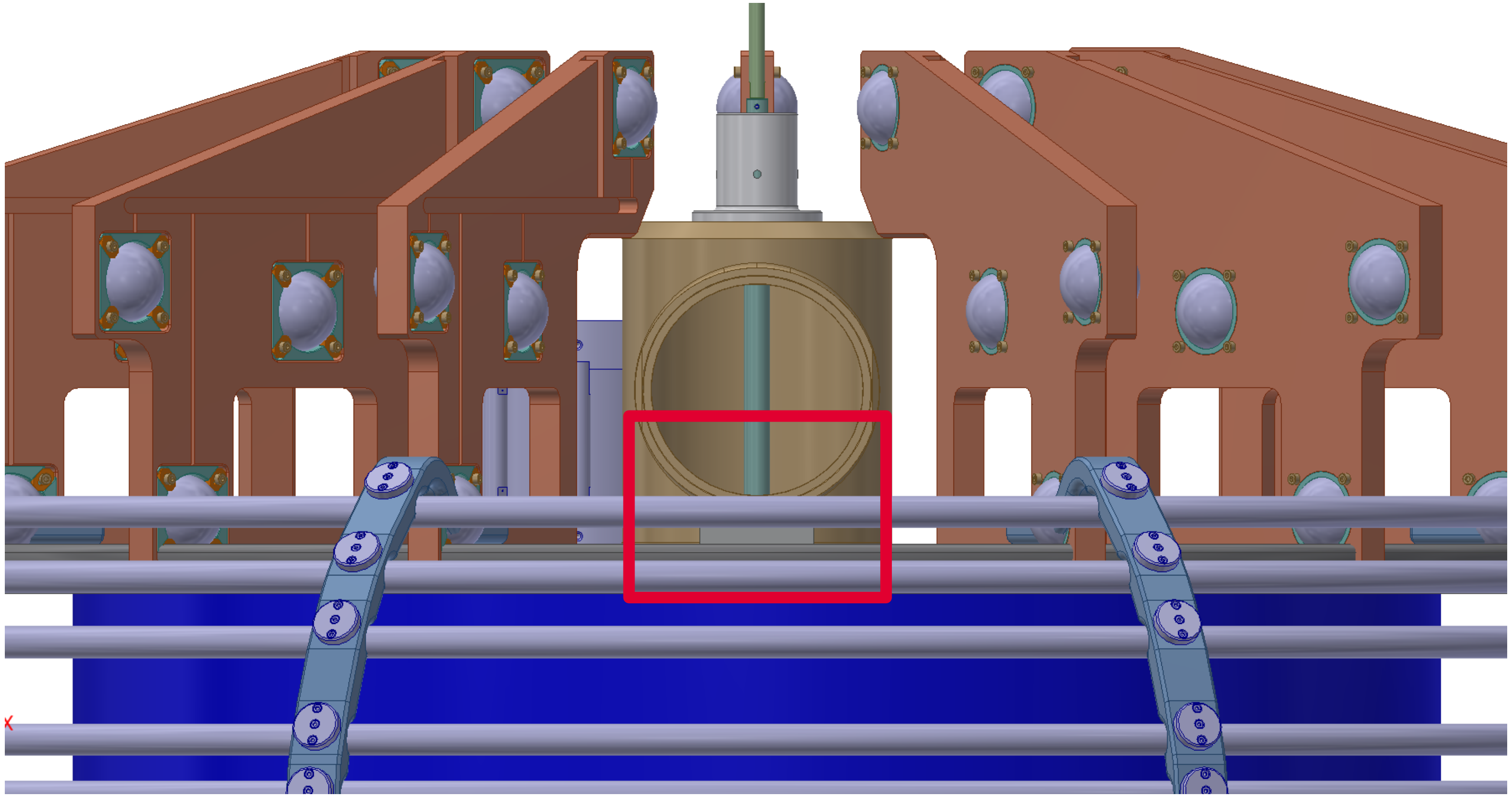
UCN plug

- Plug is 10 mm into the electrode
- Constrained by UCN guide
- Solutions: Move plug up/ cut out 10 mm from backside of electrode/ shrink plug length?



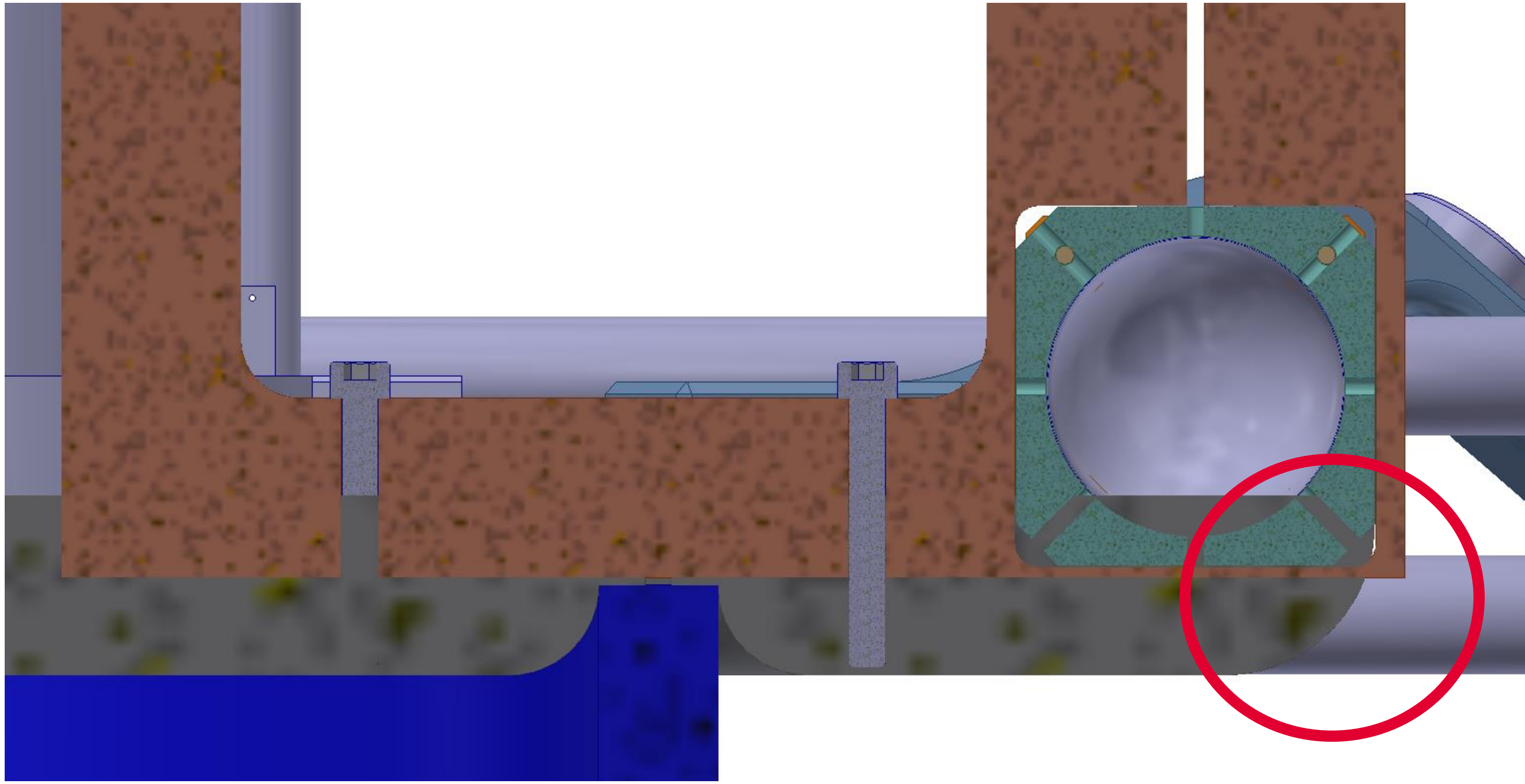
UCN guide

- UCN guide interferes with top ground ring, 10 mm movement required
- Solution: as Andrew will show, can move top ground ring down



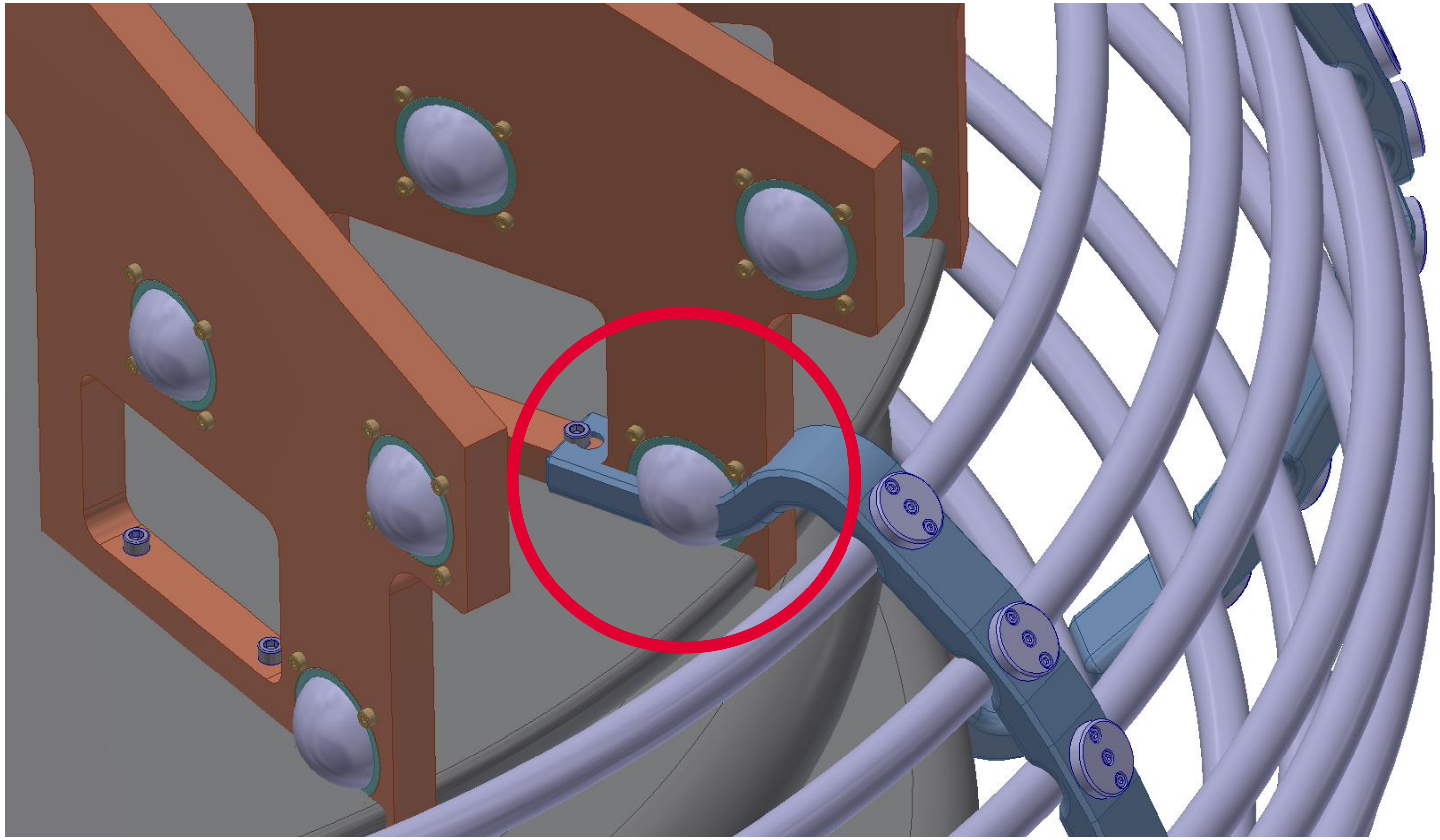
Caesium array

- Array is 14 mm into the electrode and 5 mm over the edge
- Solutions: can this be moved up and in/Cs array mounting plate?



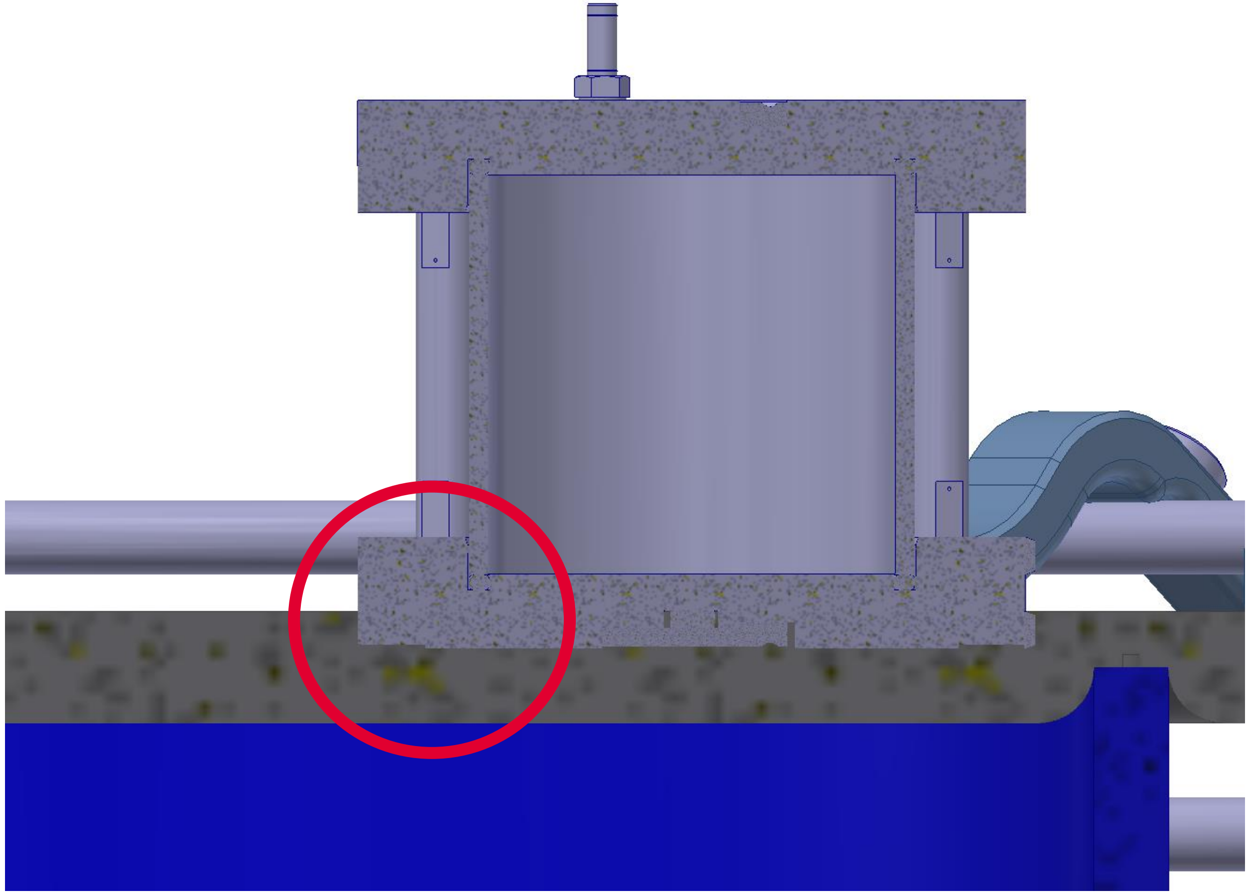
Caesium array

- Cs holders same positioning with ground ring bracket
- Solution: rotate our bracket placement by ~11°



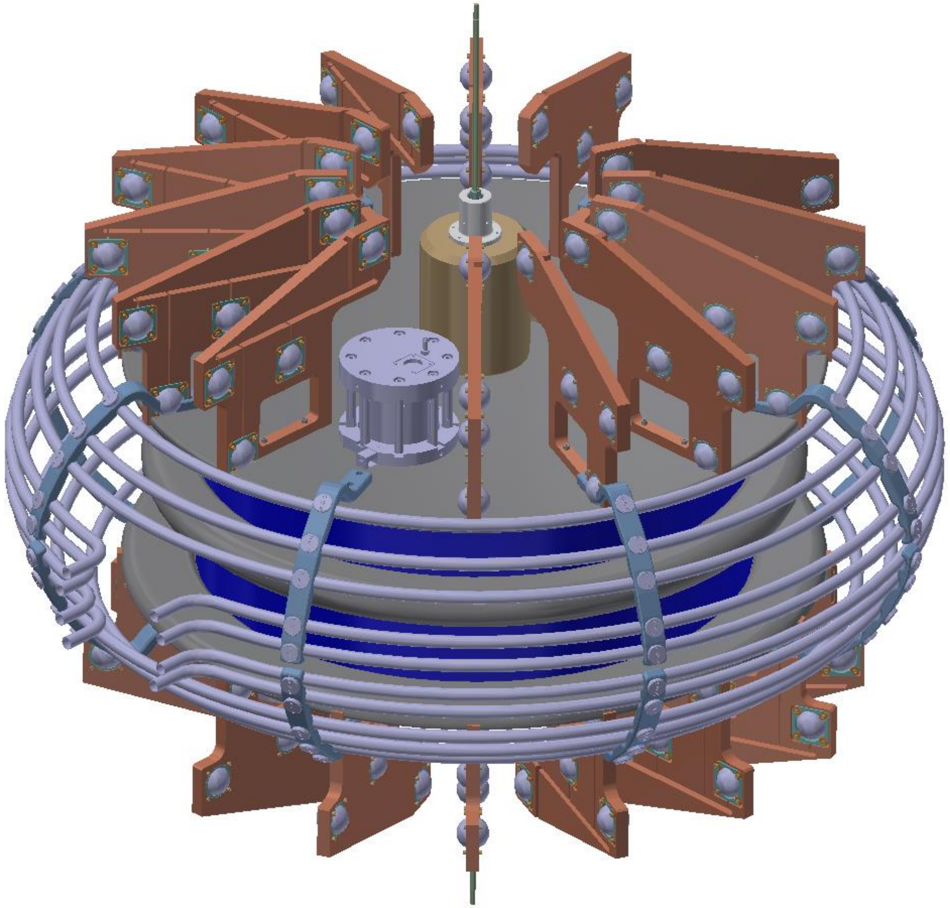
Mercury polariser

- Hg polariser sits 10 mm inside the electrode
- Solution: cut out on backside of the electrode/move it up 10 mm



Precession chamber conclusion

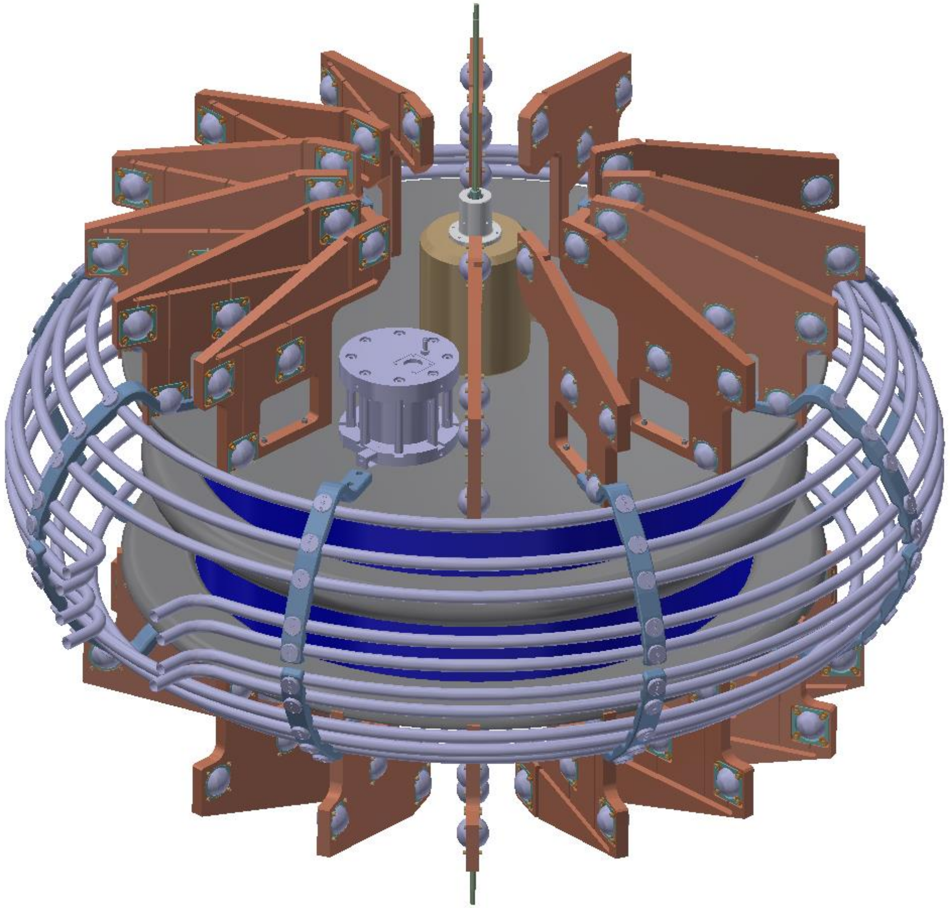
Adaptations to be discussed	Solution?
UCN plug/guide position	Move up 10 mm? Cut out backside of electrode? Shrink plug length?
Cs array	Change position?
Hg polariser	Move up 10 mm? Cut out backside of electrode?
Ground ring bracket	Rotate ~11°



Open questions – Cs array intermediate plate

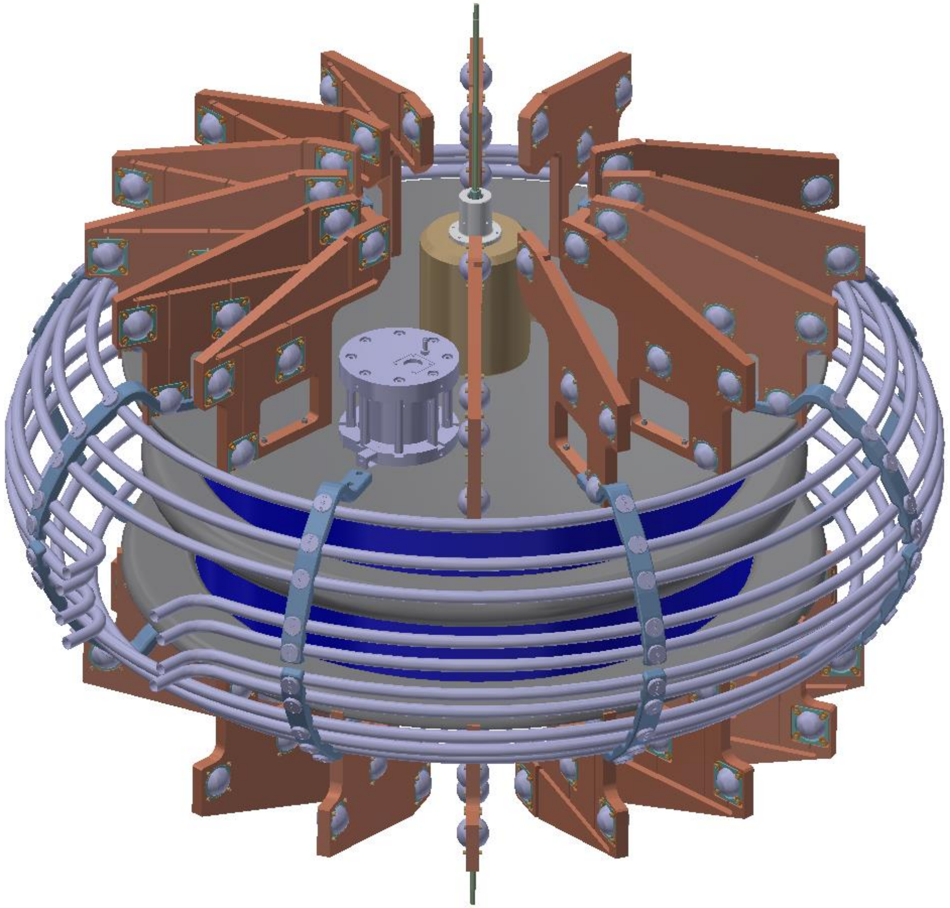
Advantages:

- less holes machined in electrodes
- placement of fins can be fixed at later stage
- easier assembly process



Other open questions

- Connection of the two ground shell halves for leakage current monitoring purposes?
- Alignment targets?
- Other questions...?



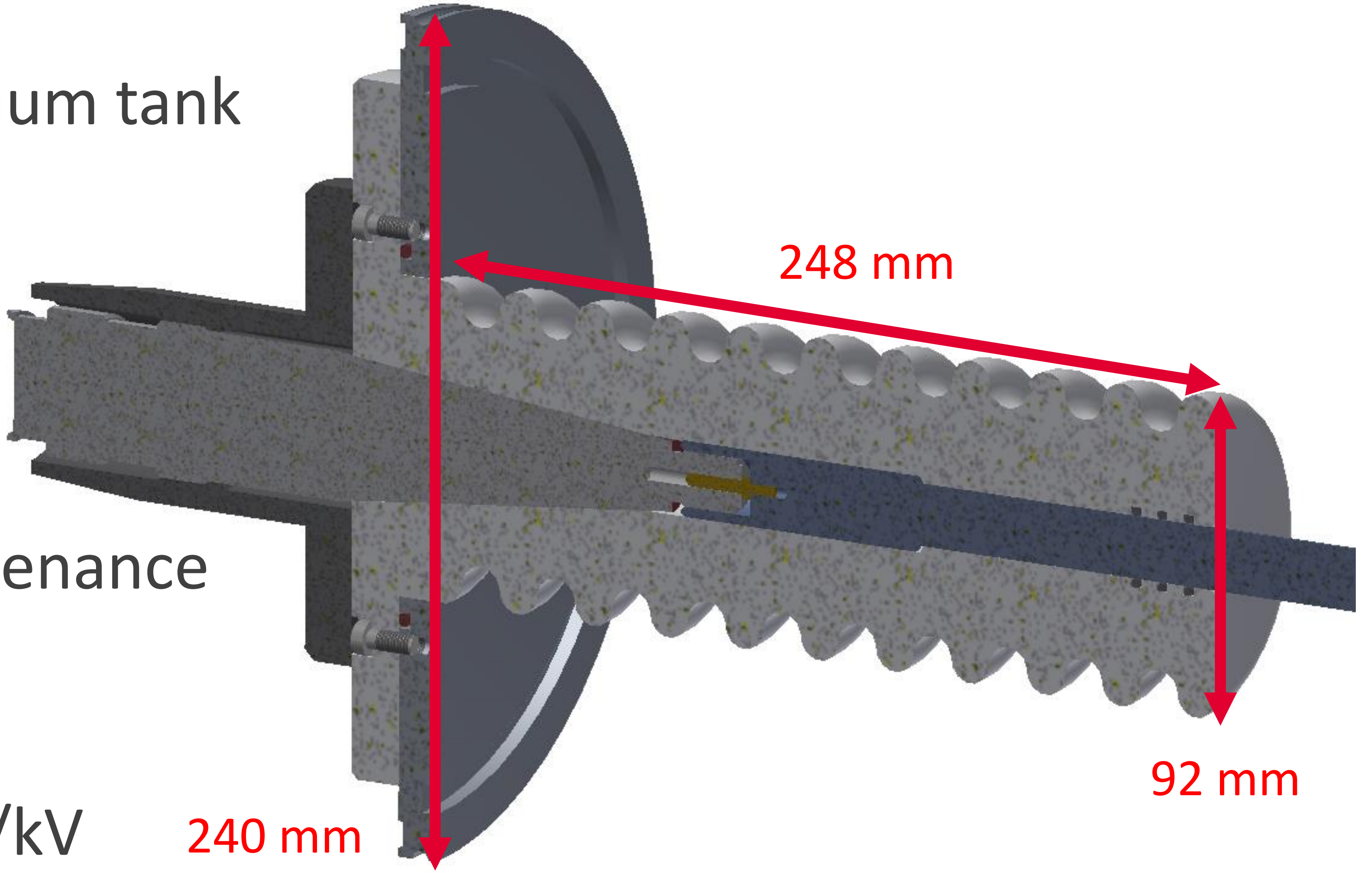
Feedthrough

50 kV prototype

- Non-magnetic construction, made of macor and aluminium
- No brazed components, modular
- Sealing with o-rings top of ceramic and in aluminium flange
- Vacuum tested: $< 10^{-9}\ mbar \cdot l/s$
- HV tested to 50kV, stable

KF50 flange

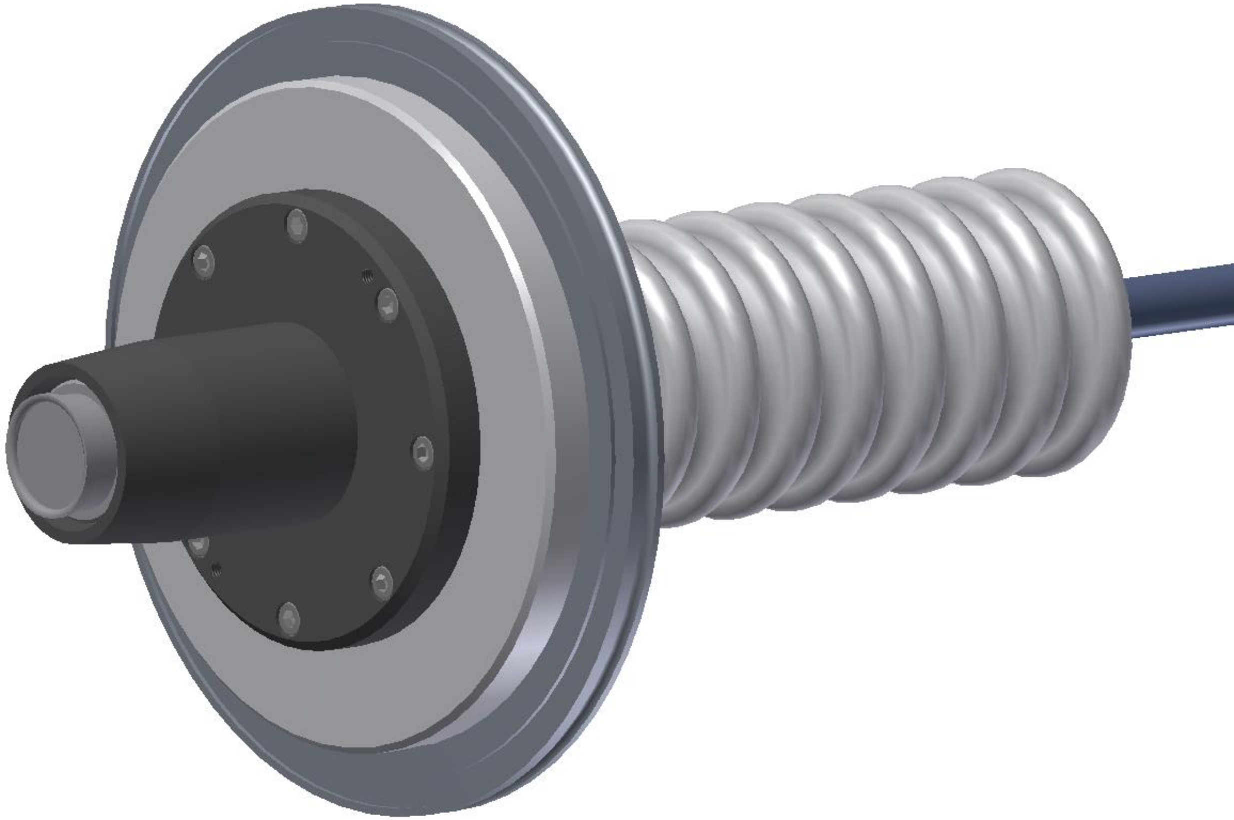
- R24 P3 connection to atmosphere side
- ISO 200 flange for vacuum tank mounting



- Every 3-6 month maintenance required (cleaning)
- Oil free
- 250 kV rating @ 2 mm/kV

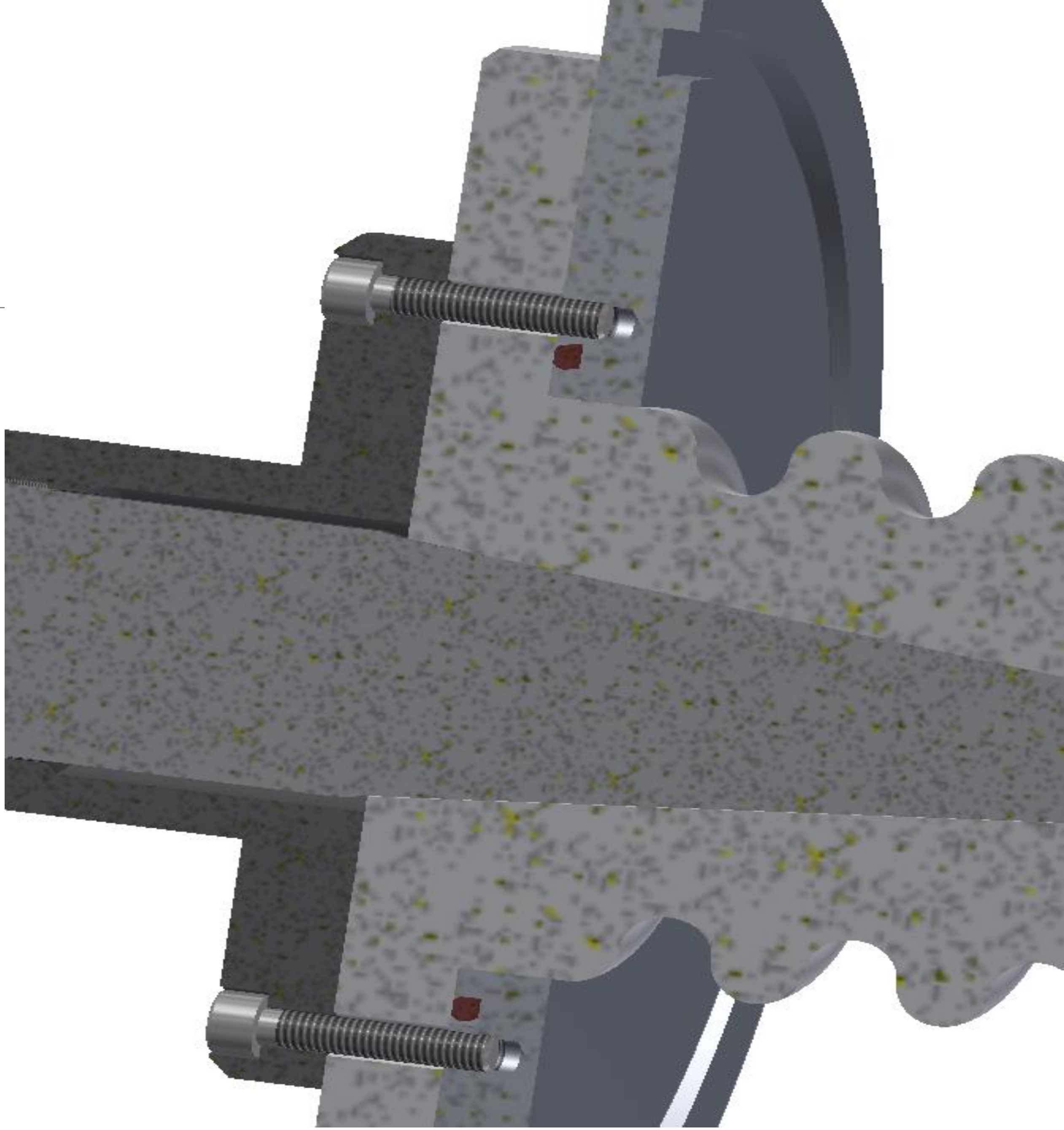
Design

- Insulator made of POM-C
- Flange and conductor constructed of aluminium
- R24 conductor contact made inside the insulator
- Vacuum seal top and bottom of the insulator body



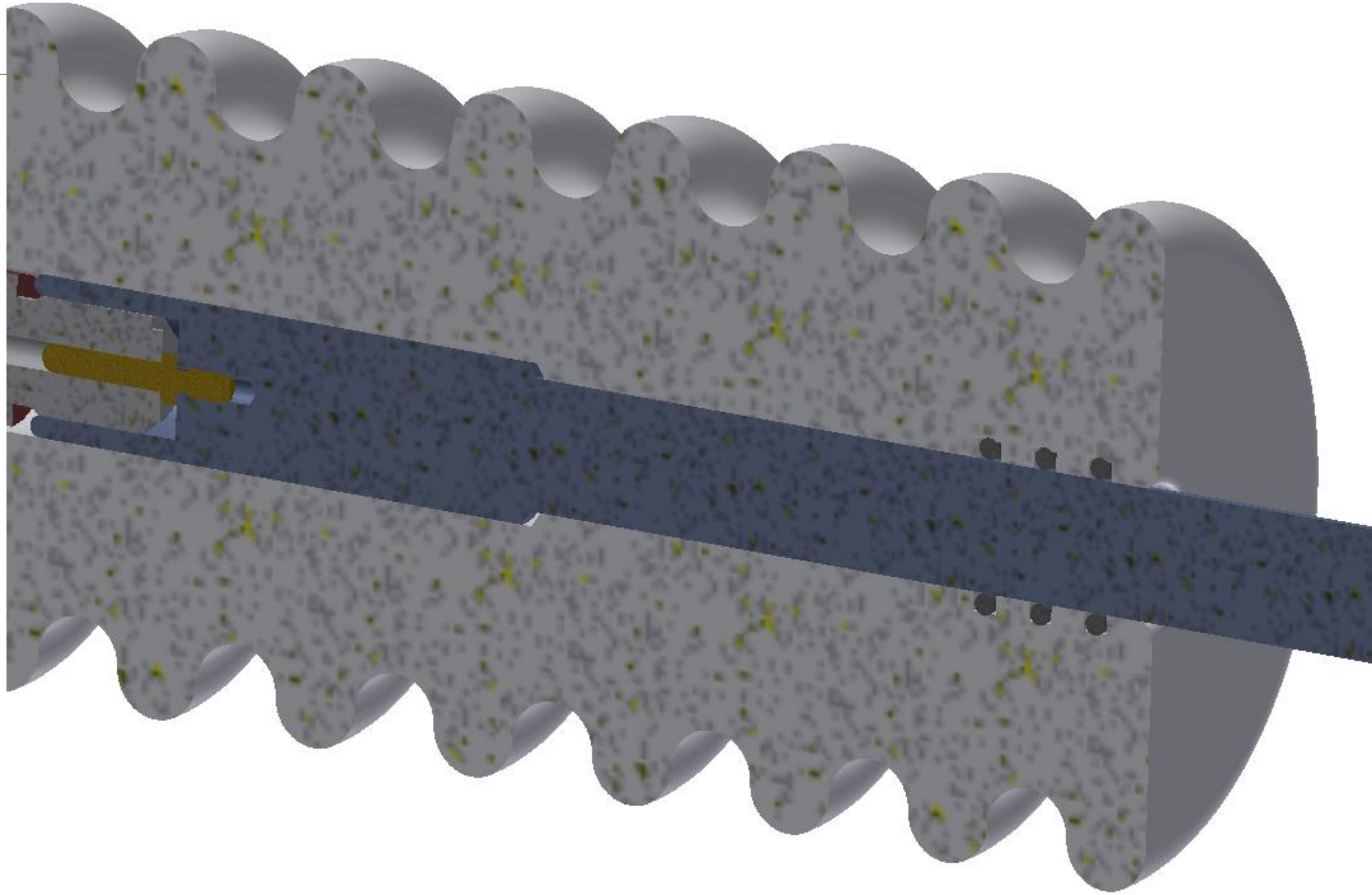
O-ring sealing

- Vacuum flange sealing to insulator body done by the flange
- Clamped down by the cable sleeve



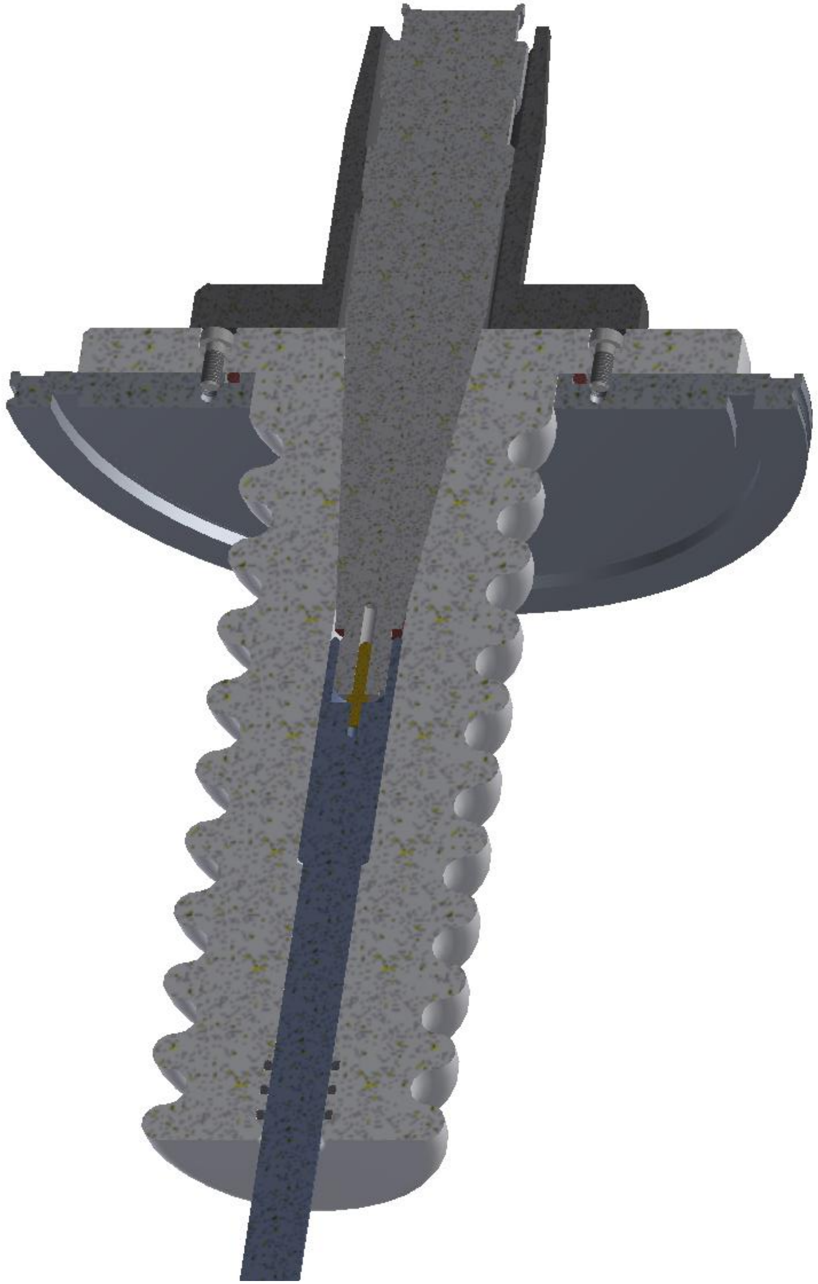
O-ring sealing

- Conductor sealed via multiple o-rings
- O-ring compression done by diameter of the conductor



Feedthrough conclusion

- Designed to hold 250 kV @ 200 μA_{max}
- Modular design, easy to remove broken parts
- Can be dismantled from outside vacuum tank
- Requires extensive testing, generally easy to achieve 50 kV, 200 kV difficult
- However, electrode interface TBD



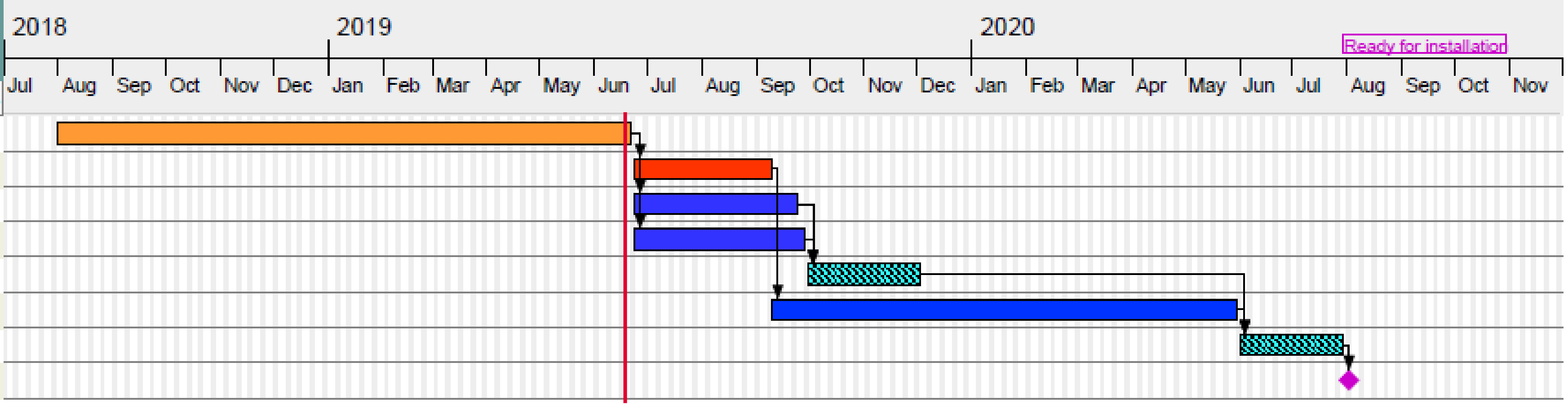
Timeline

Simplified n2EDM timeline

Jun 19, 2019

Gantt Chart

Name	Begin date	End date
Concept	1/8/18	21/6/19
Detailed precession chamber design	24/6/19	9/9/19
Feedthrough construction	24/6/19	23/9/19
1/2 scale precession chamber construction	24/6/19	27/9/19
Feedthrough & 1/2 precession cham. testing	30/9/19	2/12/19
Full scale precession cham. construction	10/9/19	29/5/20
Complete setup HV testing	1/6/20	29/7/20
Ready for installation	30/7/20	30/7/20



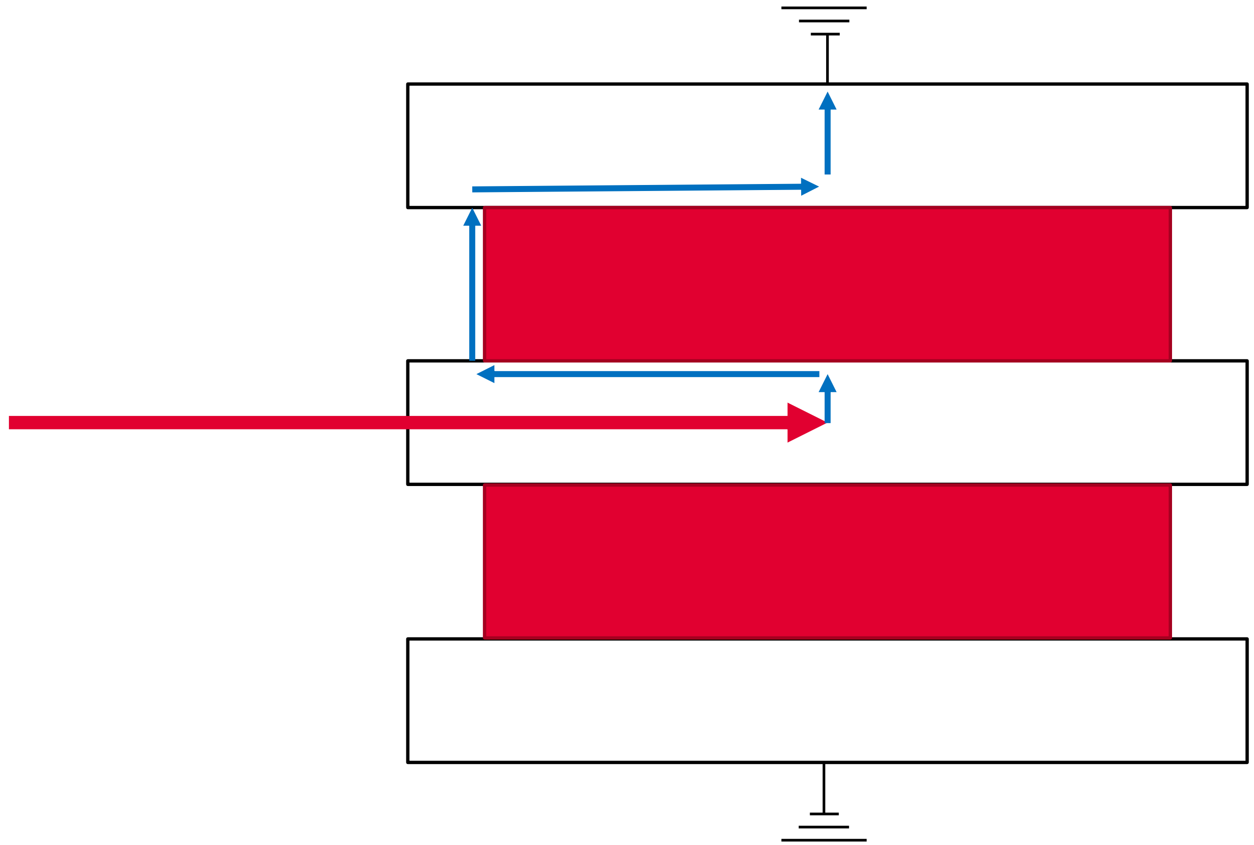
= Design concept = Detailed design* = Machining = Characterisation

*input required from collaboration

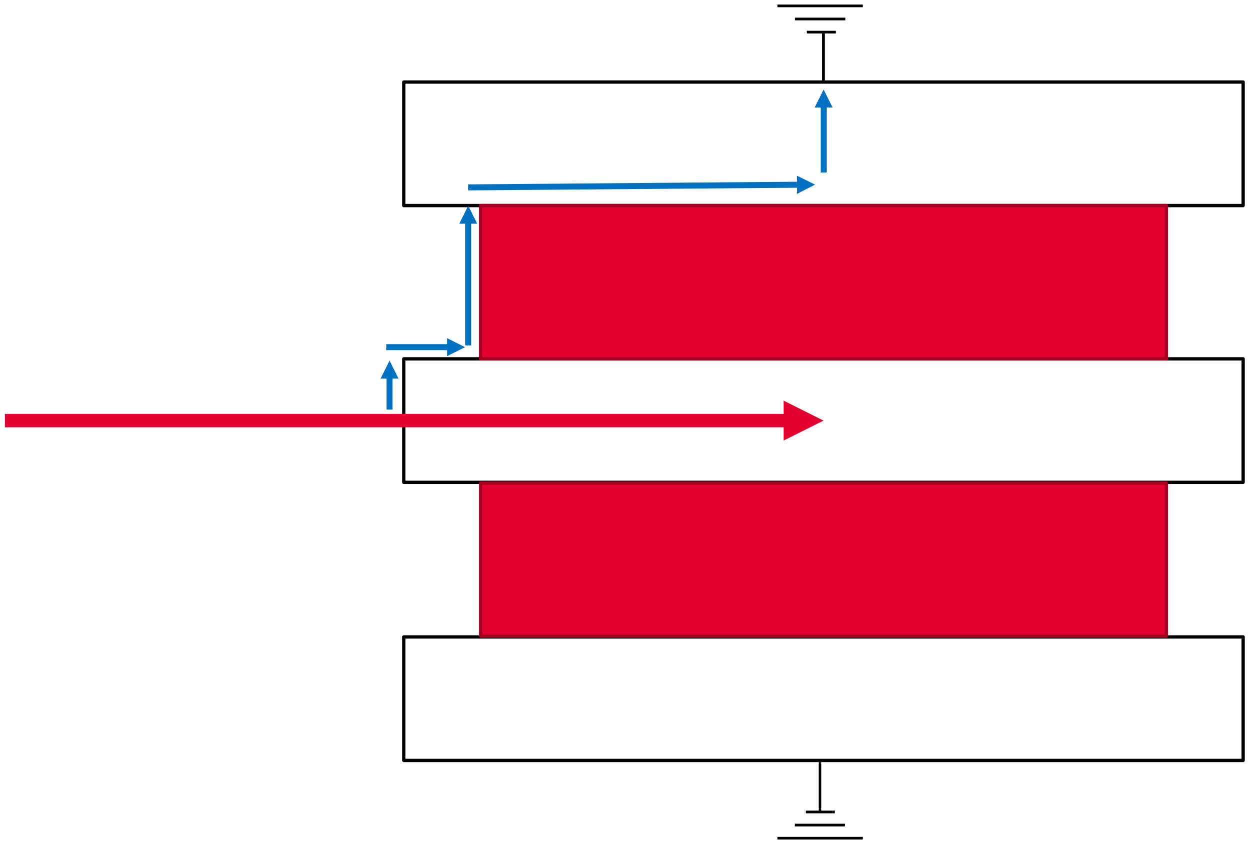
Thanks for your attention

Backup slides

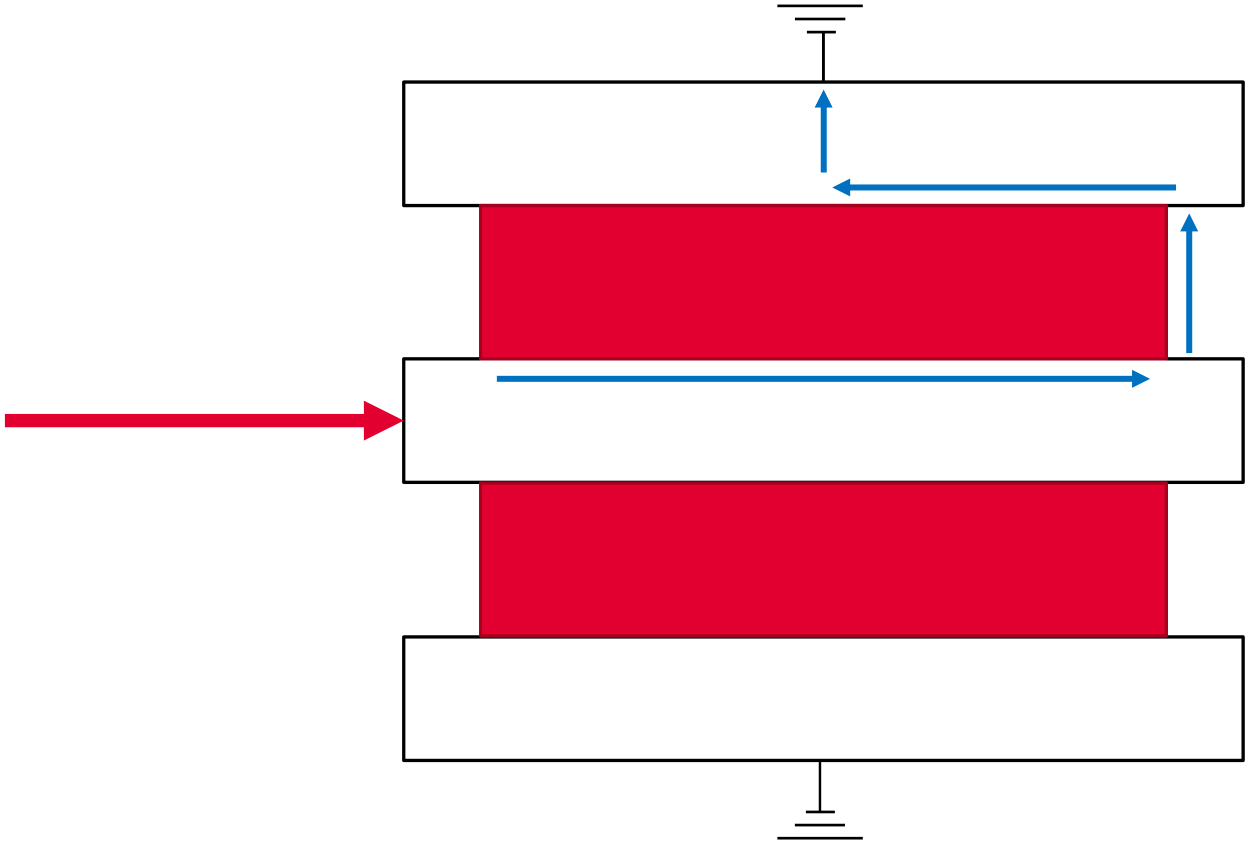
Leakage current paths



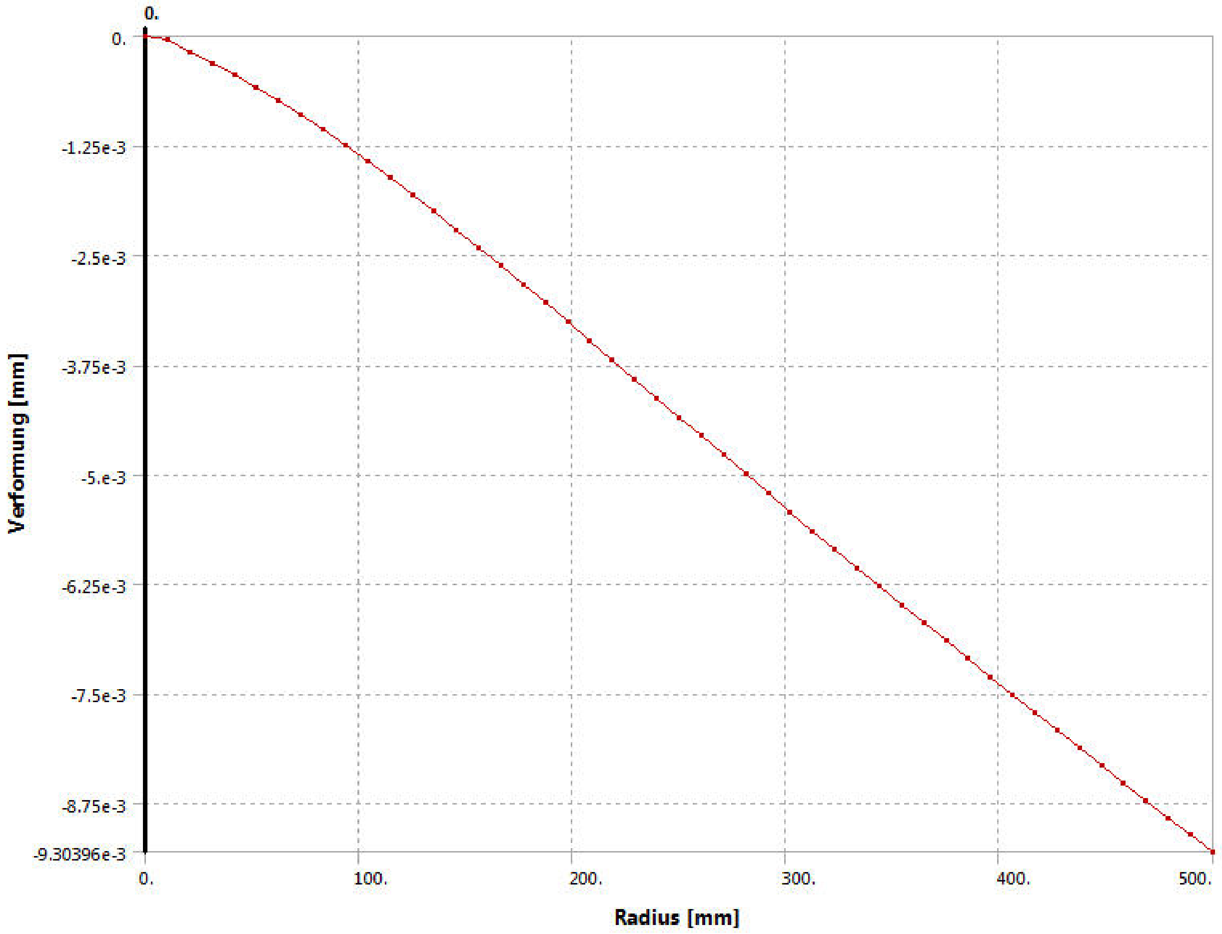
Leakage current paths



Leakage current paths

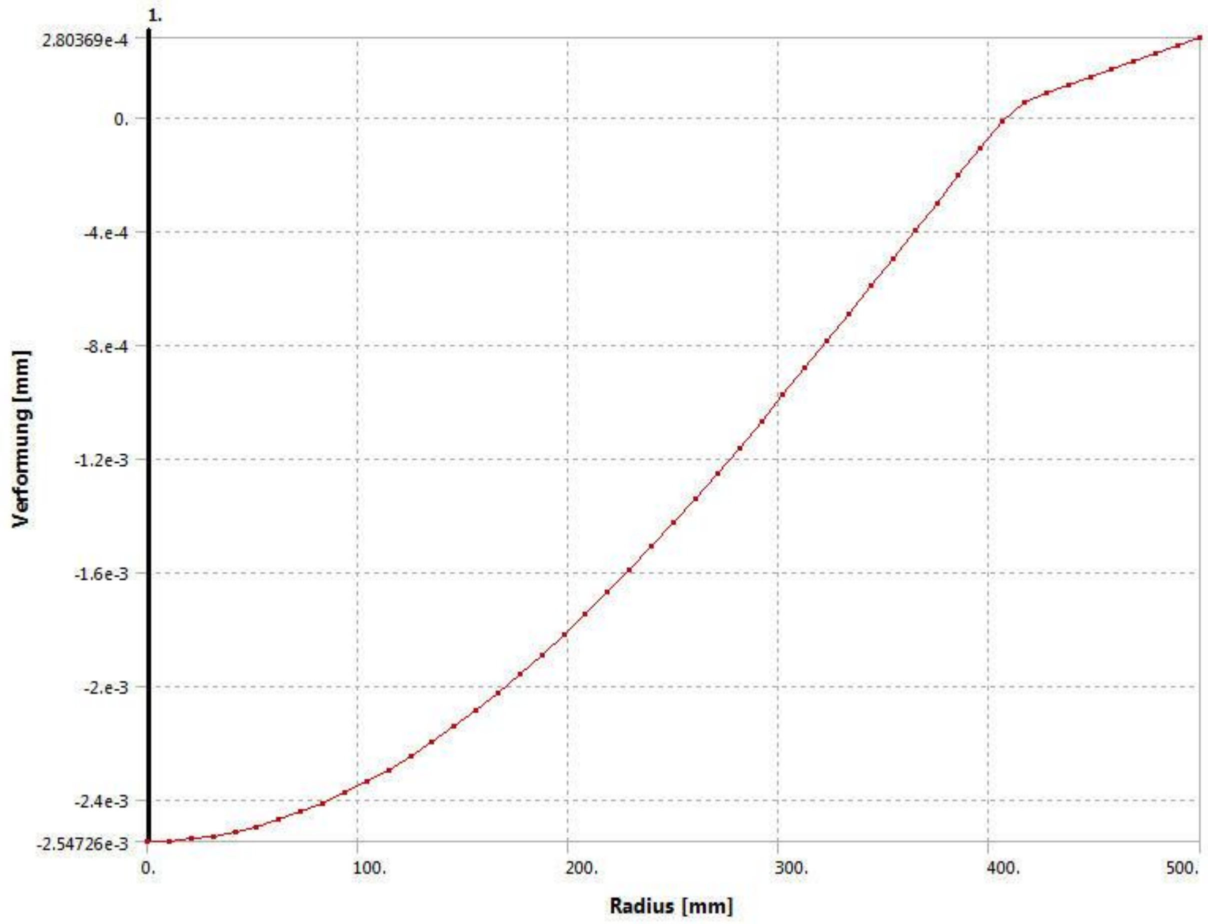


HV electrode stress analysis – supported by the insulator



Electrode thickness: 5cm

HV electrode stress analysis – supported by the outer corona



Electrode thickness: 5cm

Aluminium Grade

- 5083, 2017A, 6061, 5754, all tested to be acceptable for vacuum tank