ProtoDUNE-SP, IFIC
11/04/2017

T-gradient monitor (transparent design)

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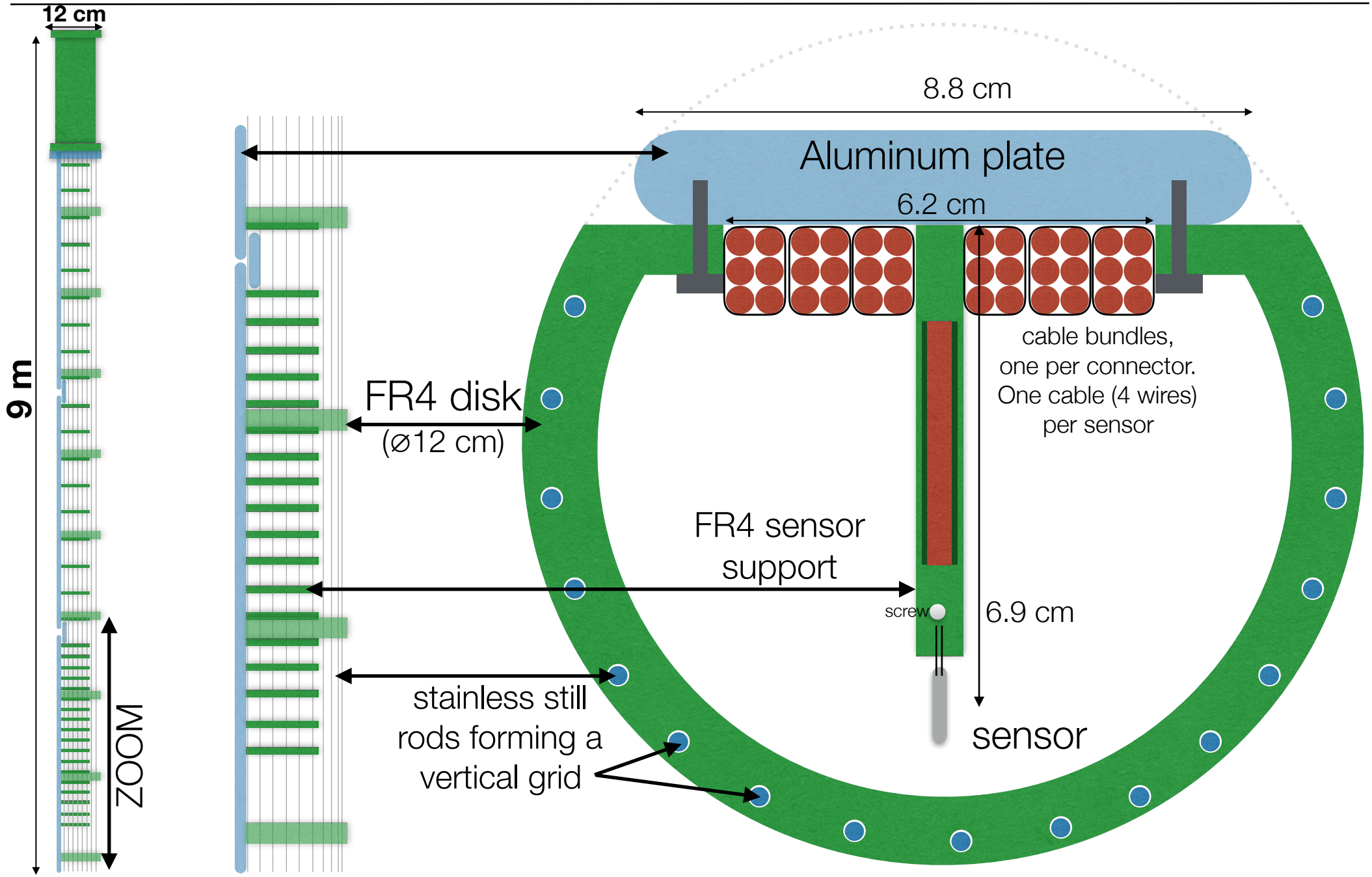
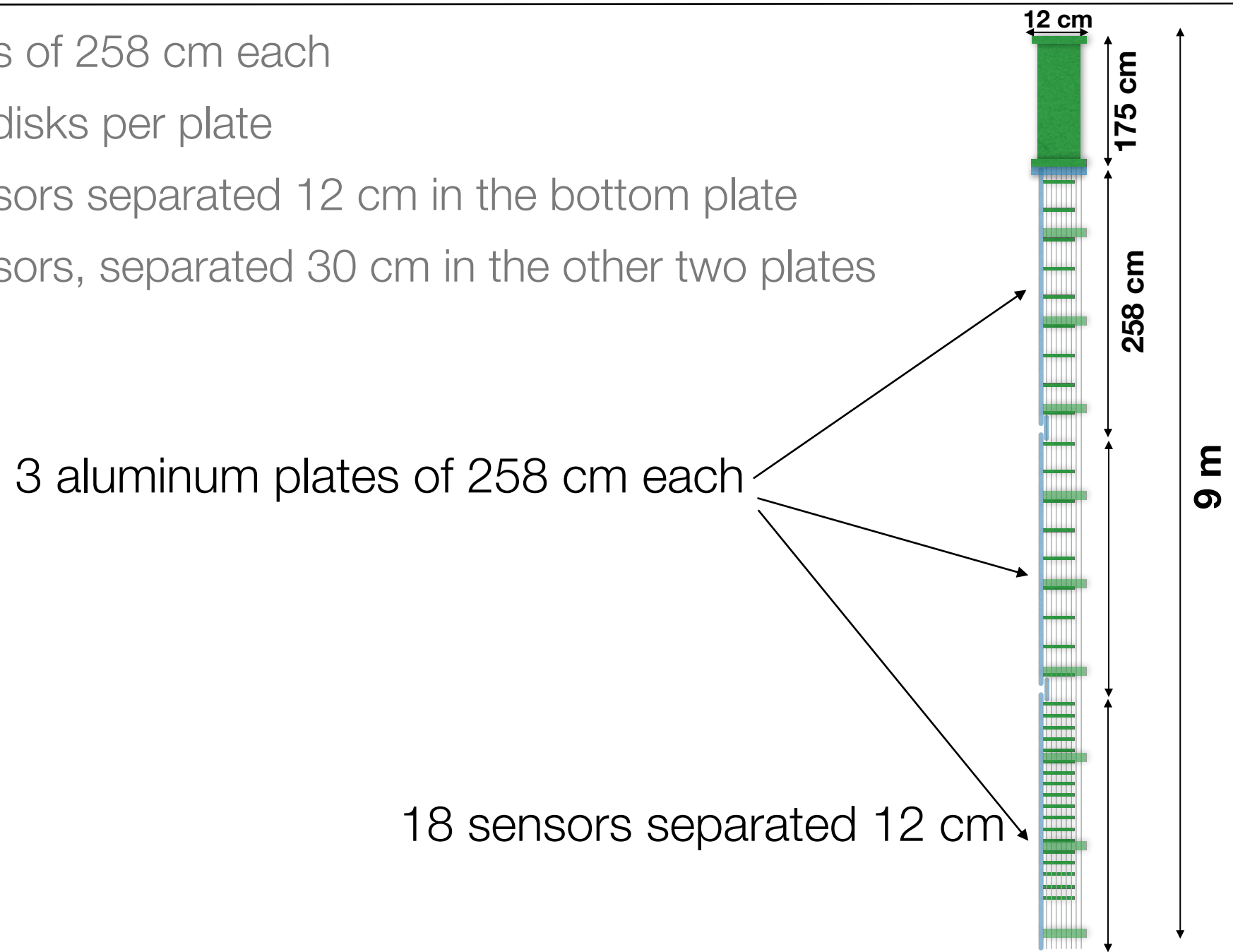
IFIC - (CSIC & Univ. Valencia)

Conceptual design



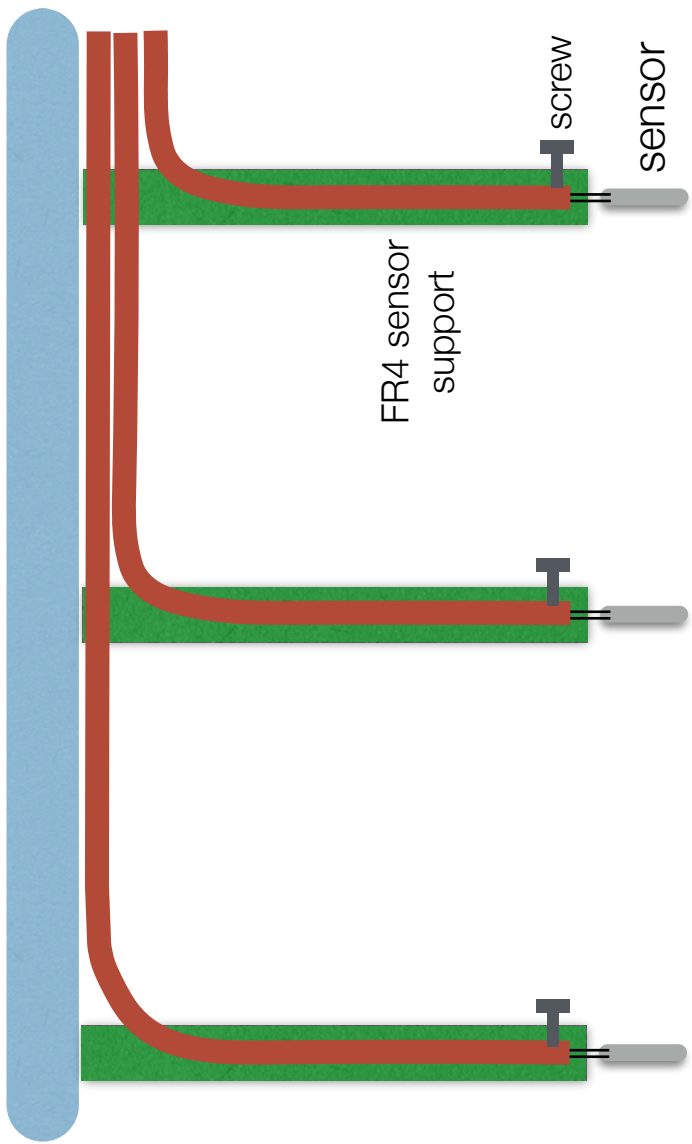
Posible configuration

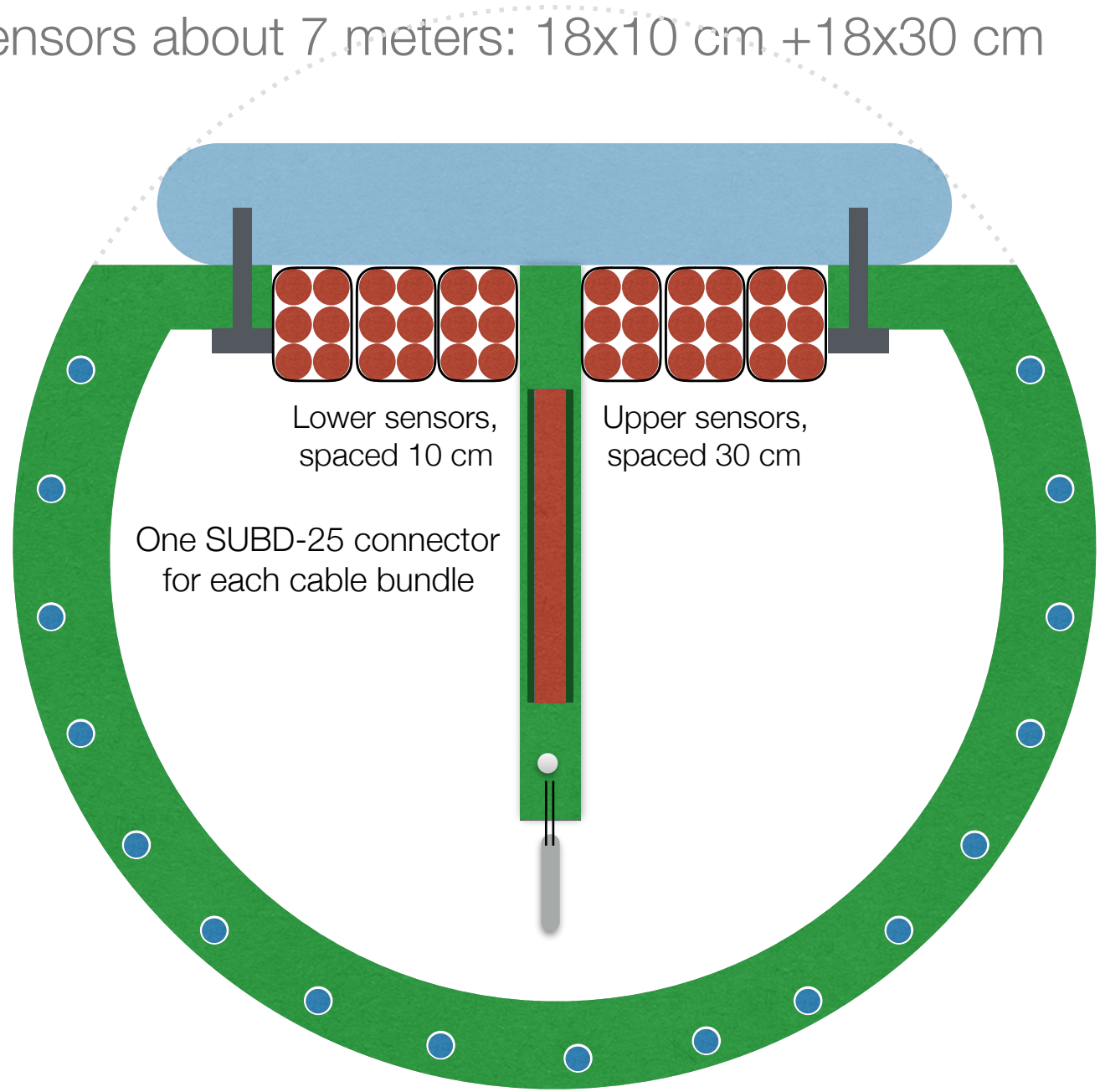
- 3 plates of 258 cm each
- 3 FR4 disks per plate
- 18 sensors separated 12 cm in the bottom plate
- 18 sensors, separated 30 cm in the other two plates



Cables and sensors

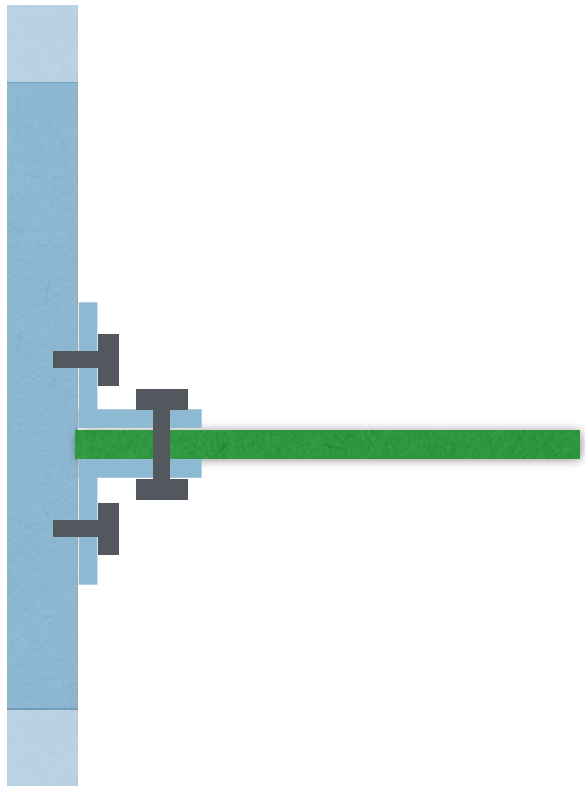
- We should cover with sensors about 7 meters: 18x10 cm +18x30 cm

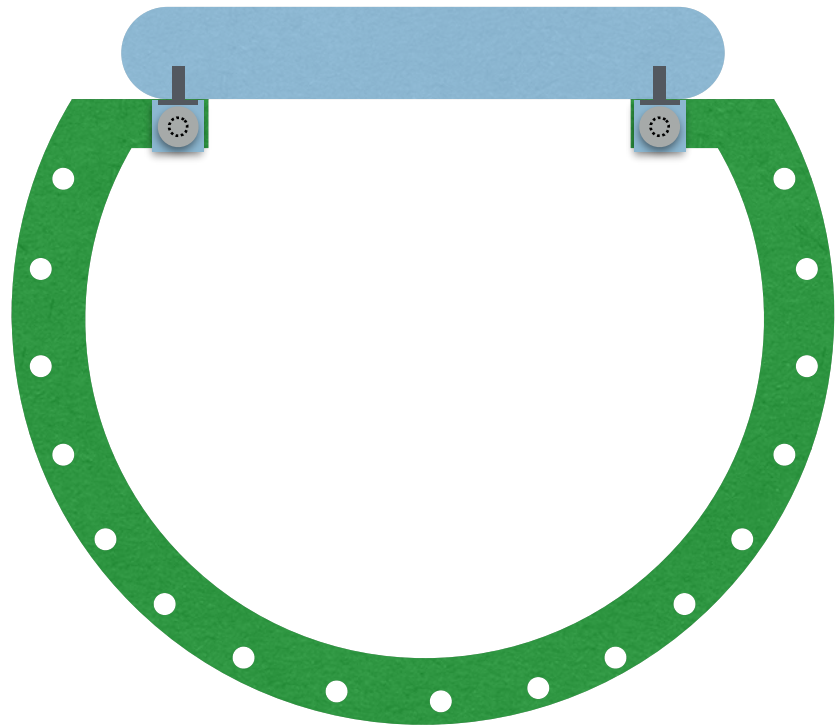




FR4 disks

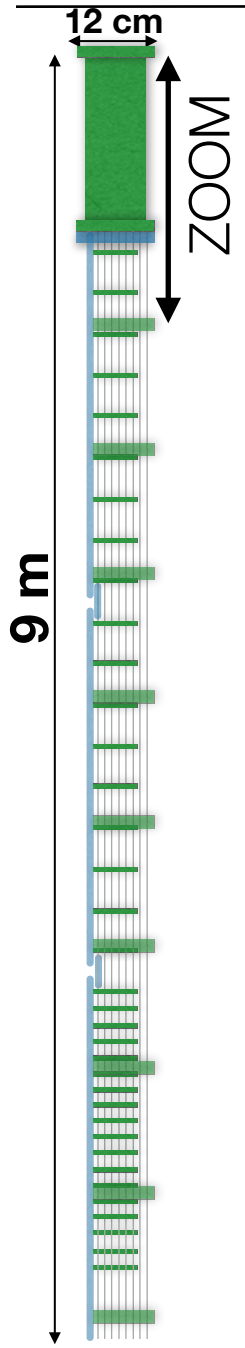
- How thick should they be ?
- Can we fabricate them at IFIC as PCBs ?
- If so, we probably need a different system to attach them to the aluminum plates

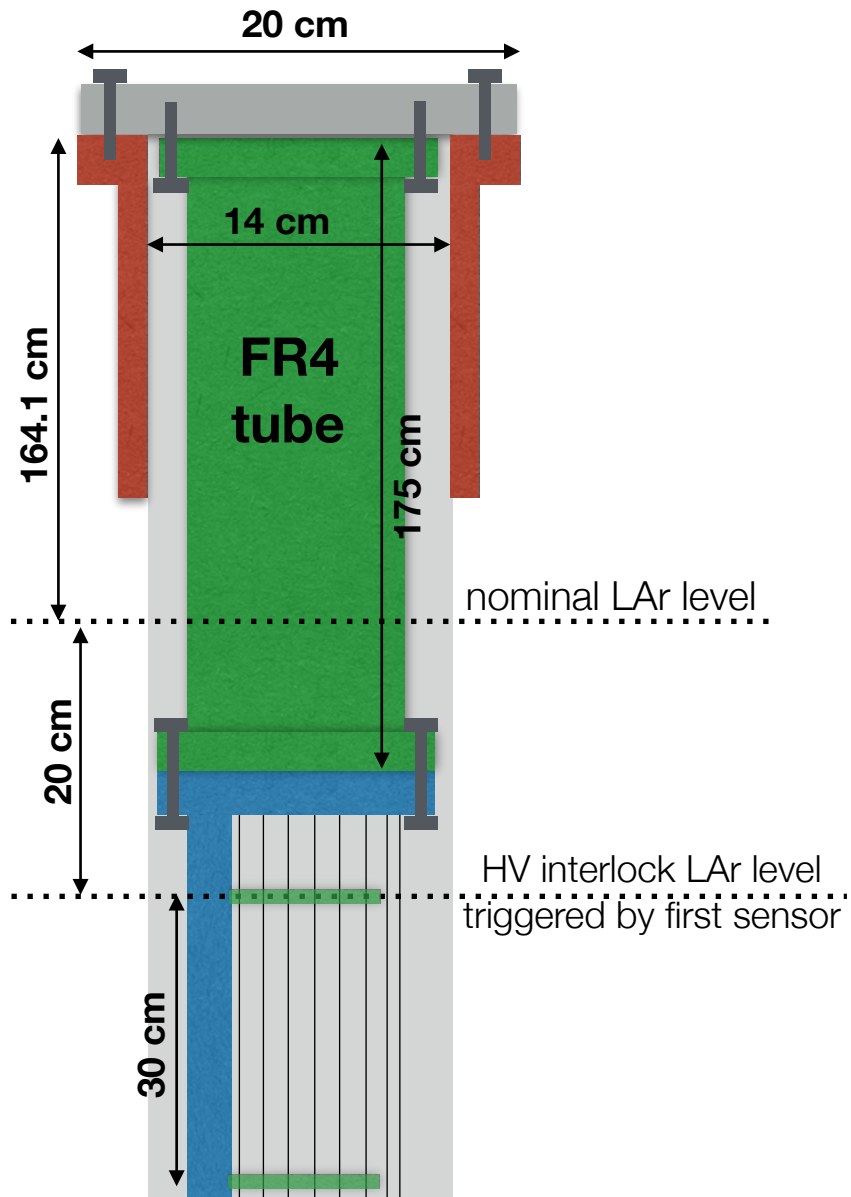


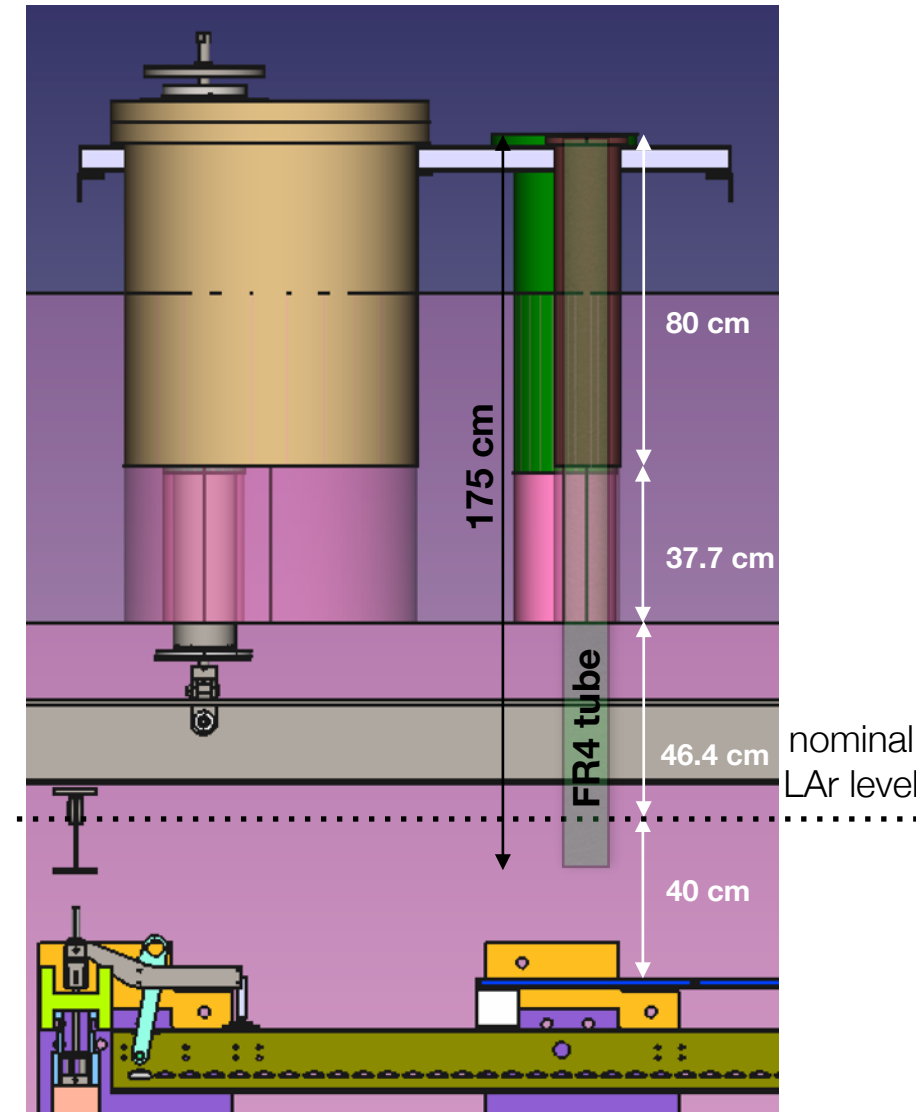


Top section

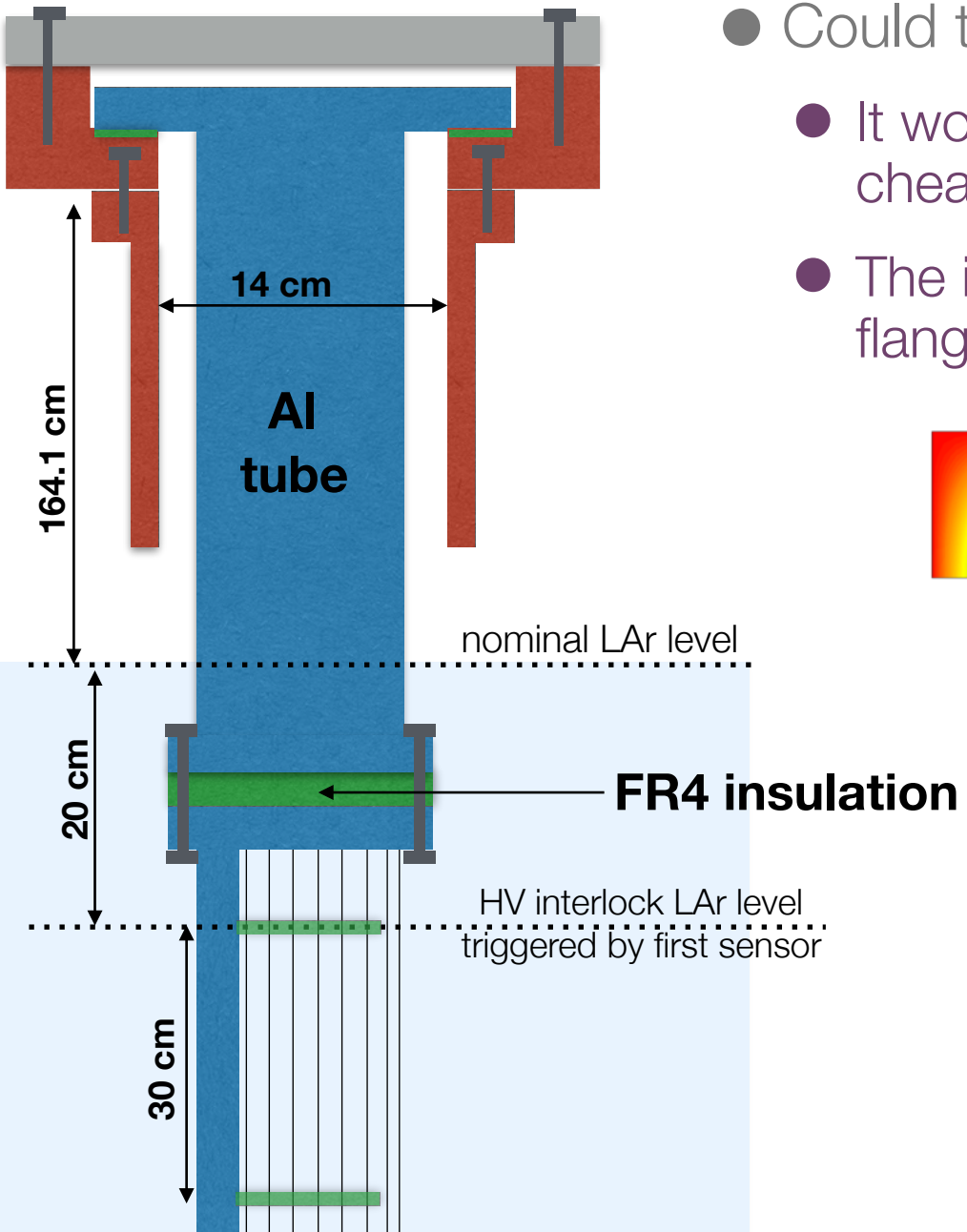
- A FR4 tube with only cables inside, to insulate aluminum structure from flange



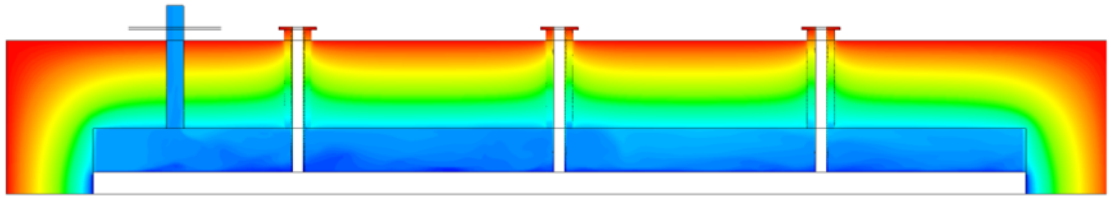


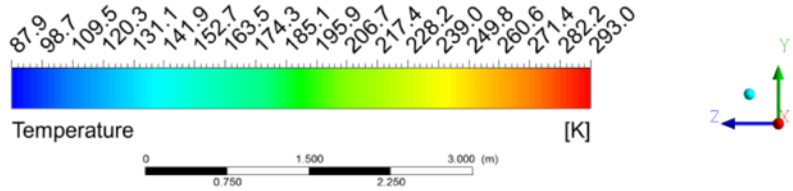


Question ?



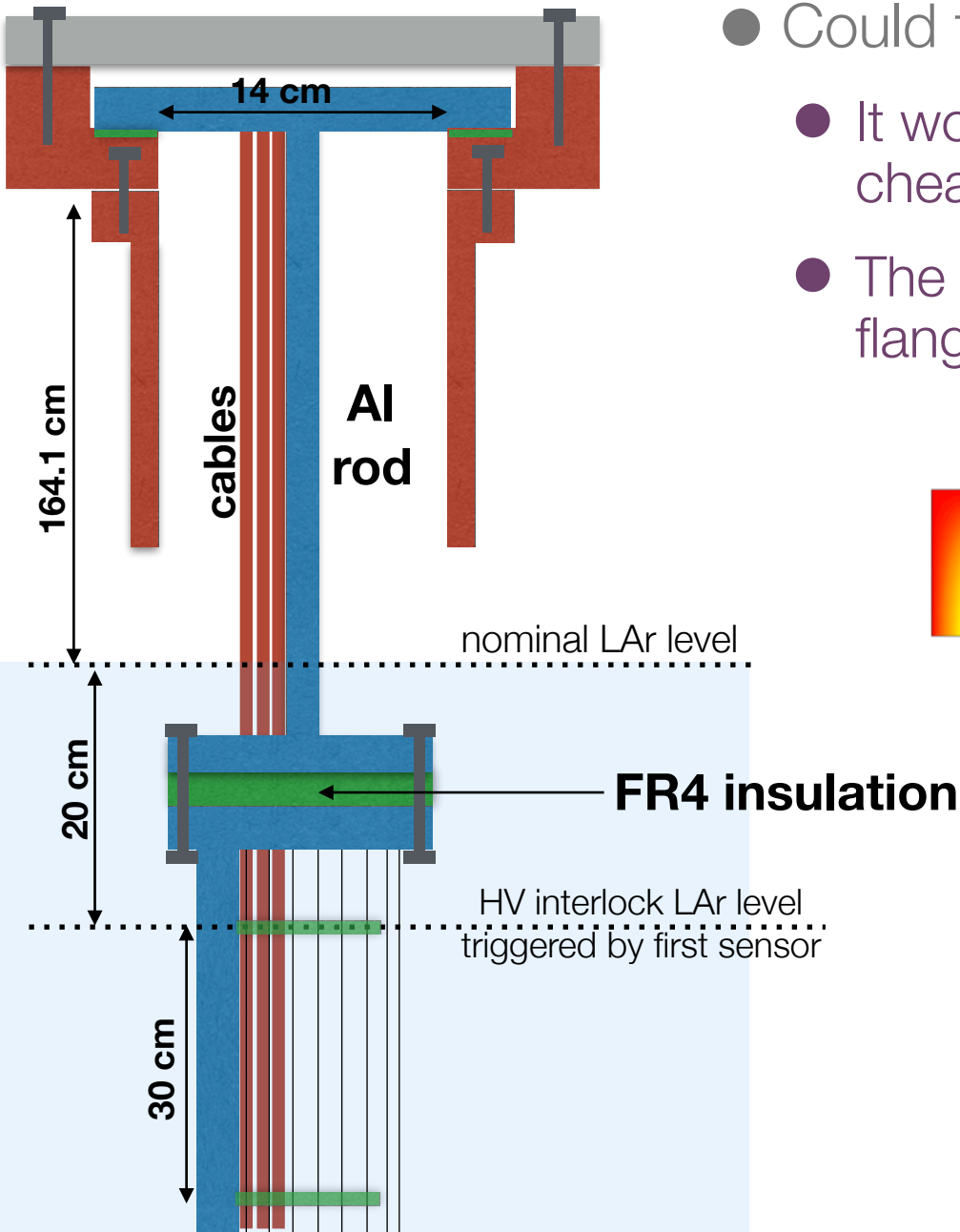
- Could the top tube be made of aluminum ?
  - It would be much easier to machine and cheaper
  - The issue could be the heat flux from the flange (at room temperature) to the LAr





waiting for answer

Question ?



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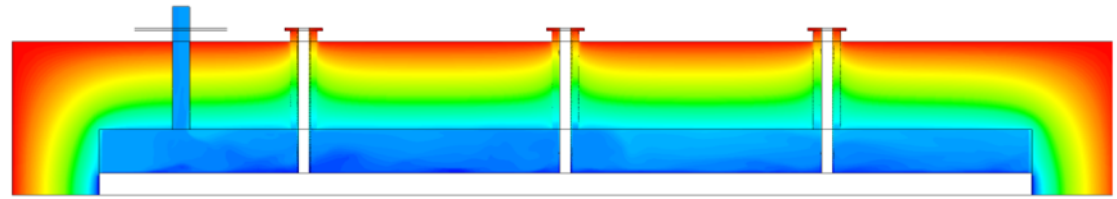
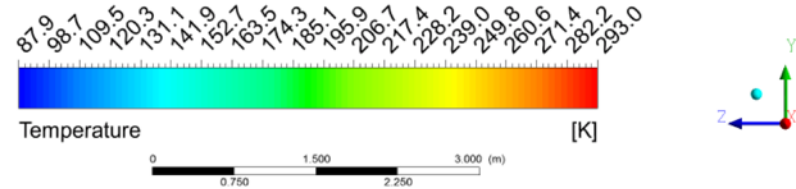
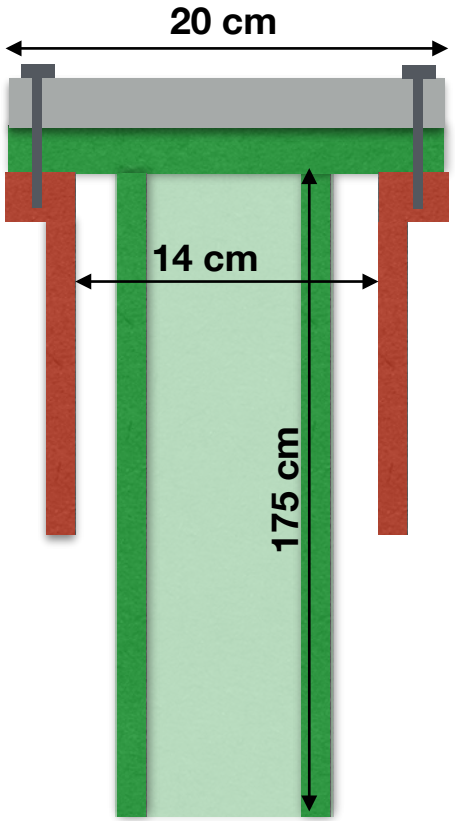


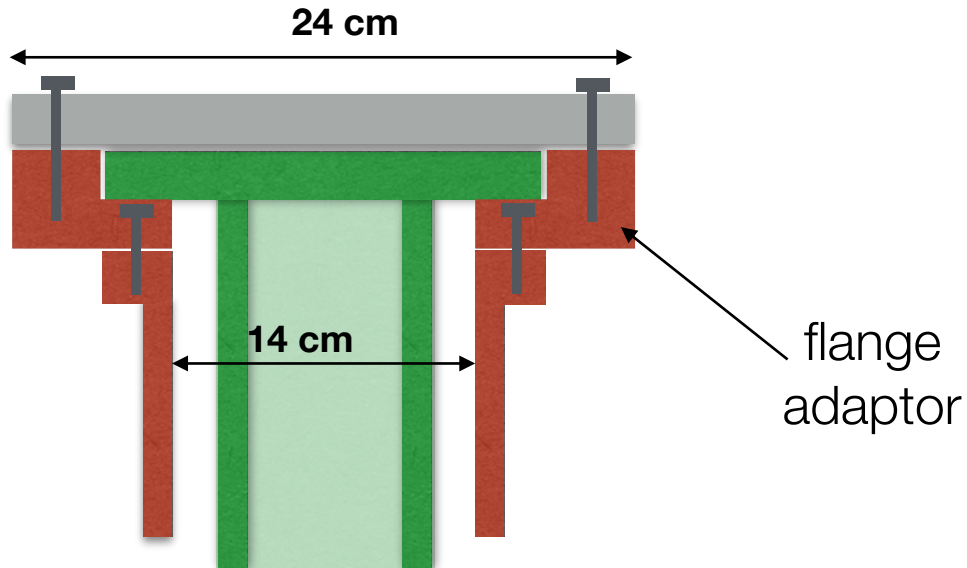


Flange interface



- This is another option, in which the FR4 module rests on top of the chimney
- Is this posible ?
- If yes, it would be great since flange and T-gradient monitor would be independent
  - We could for example open the flange to check the connections
- If that's not possible a flange adaptor can be used

waiting for answer

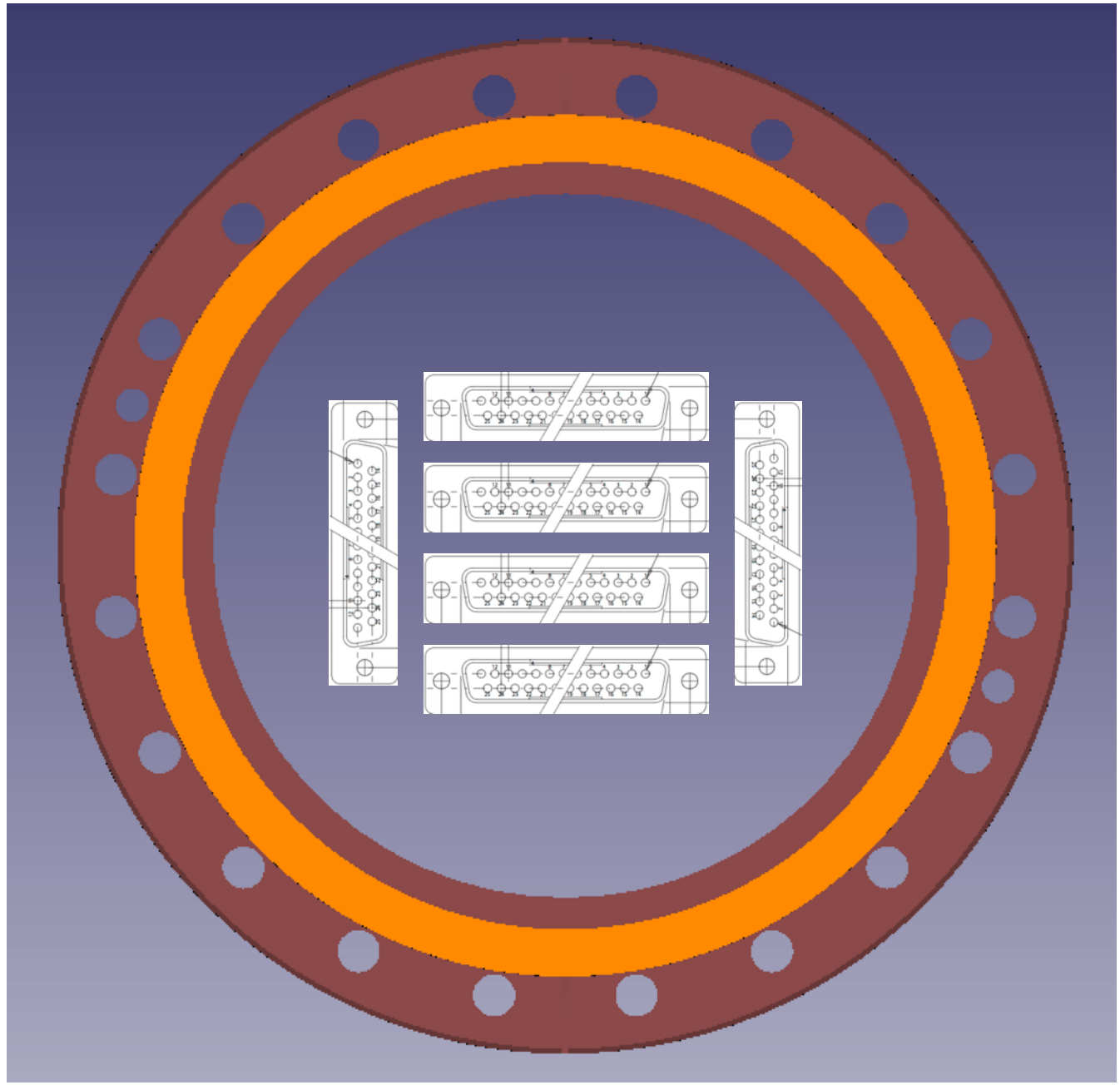


Connectors

36 sensors

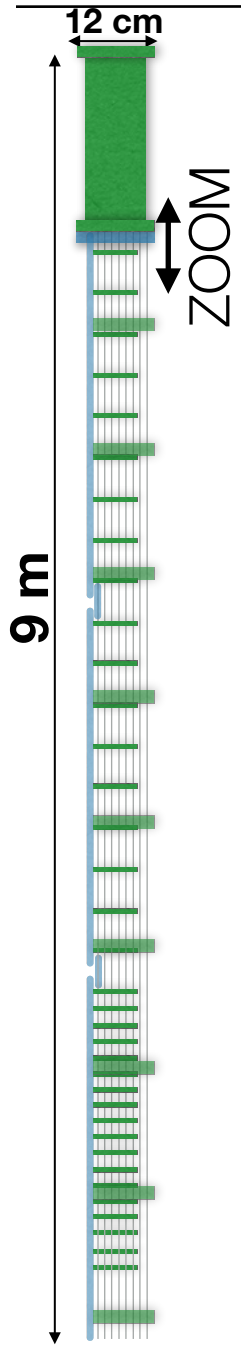
144 wires

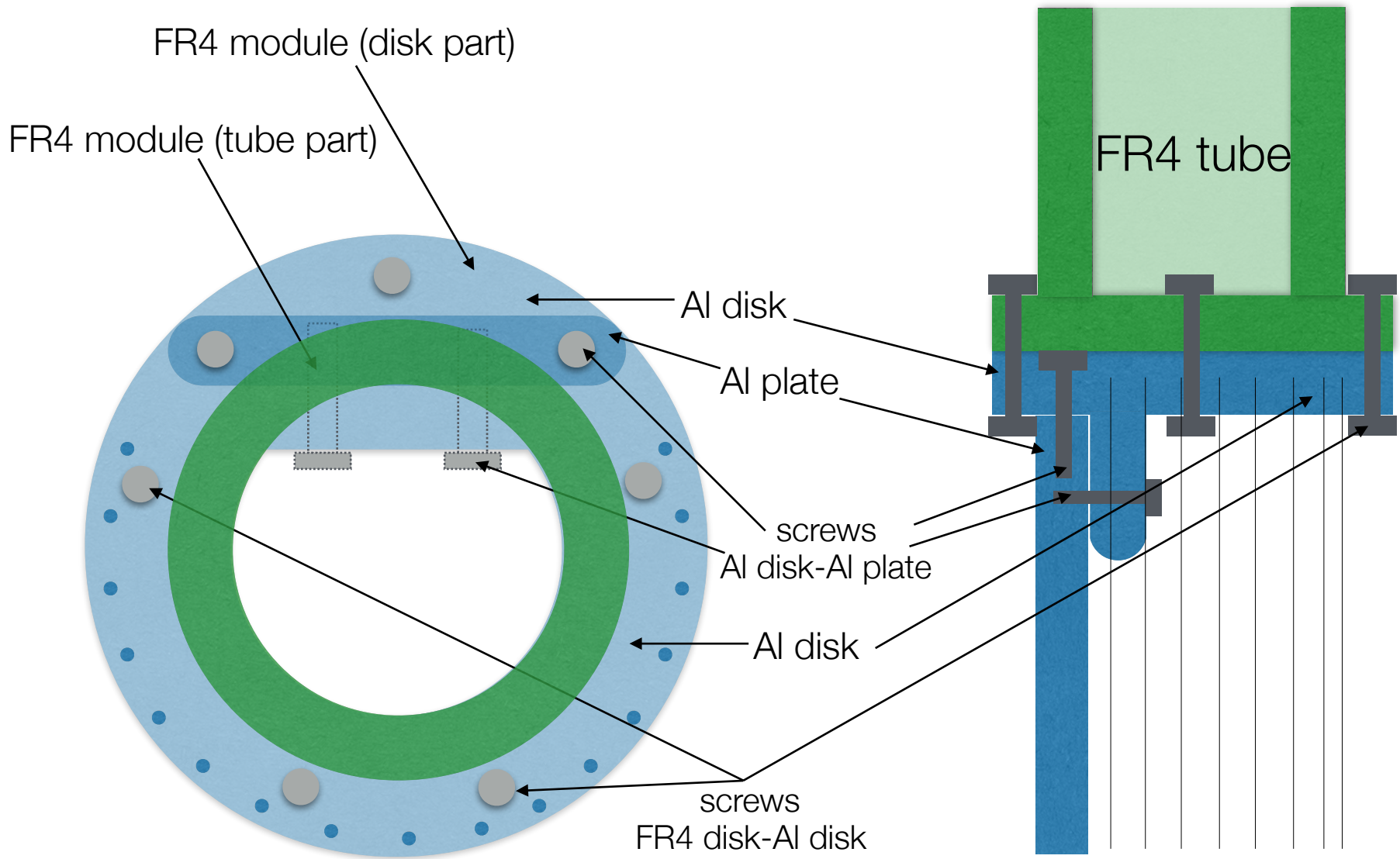
6 SUB-D 25 pin



FR4-Aluminum interface

- Stainless still rods are screwed (?) onto the aluminum disk, which is screwed to the FR4 tube and the aluminum plate

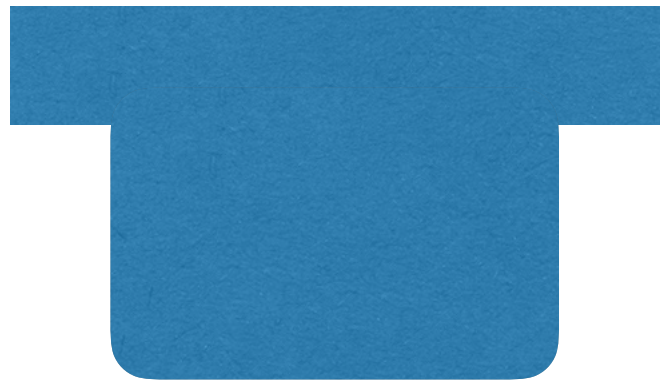




Aluminum interface disk

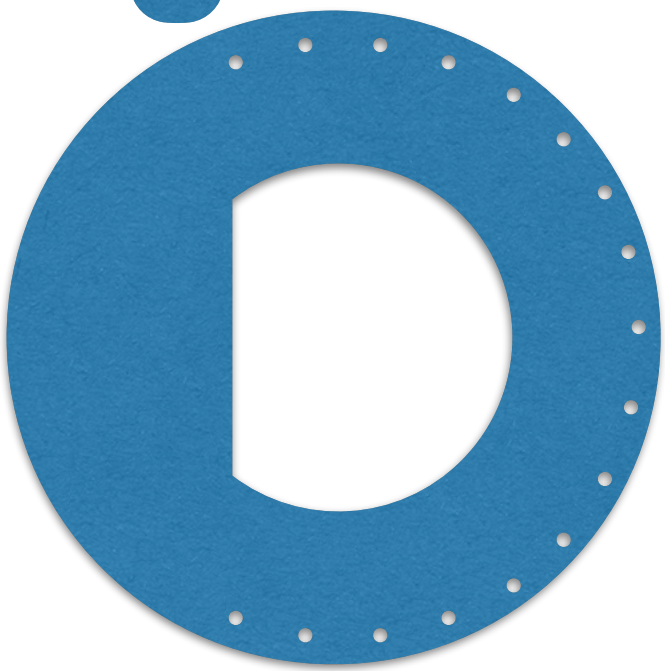
- We have to see how those sharp corners work from the electrostatics point of view. This piece is above the field region but that field might not be 0. They could be rounded as well if needed

side view

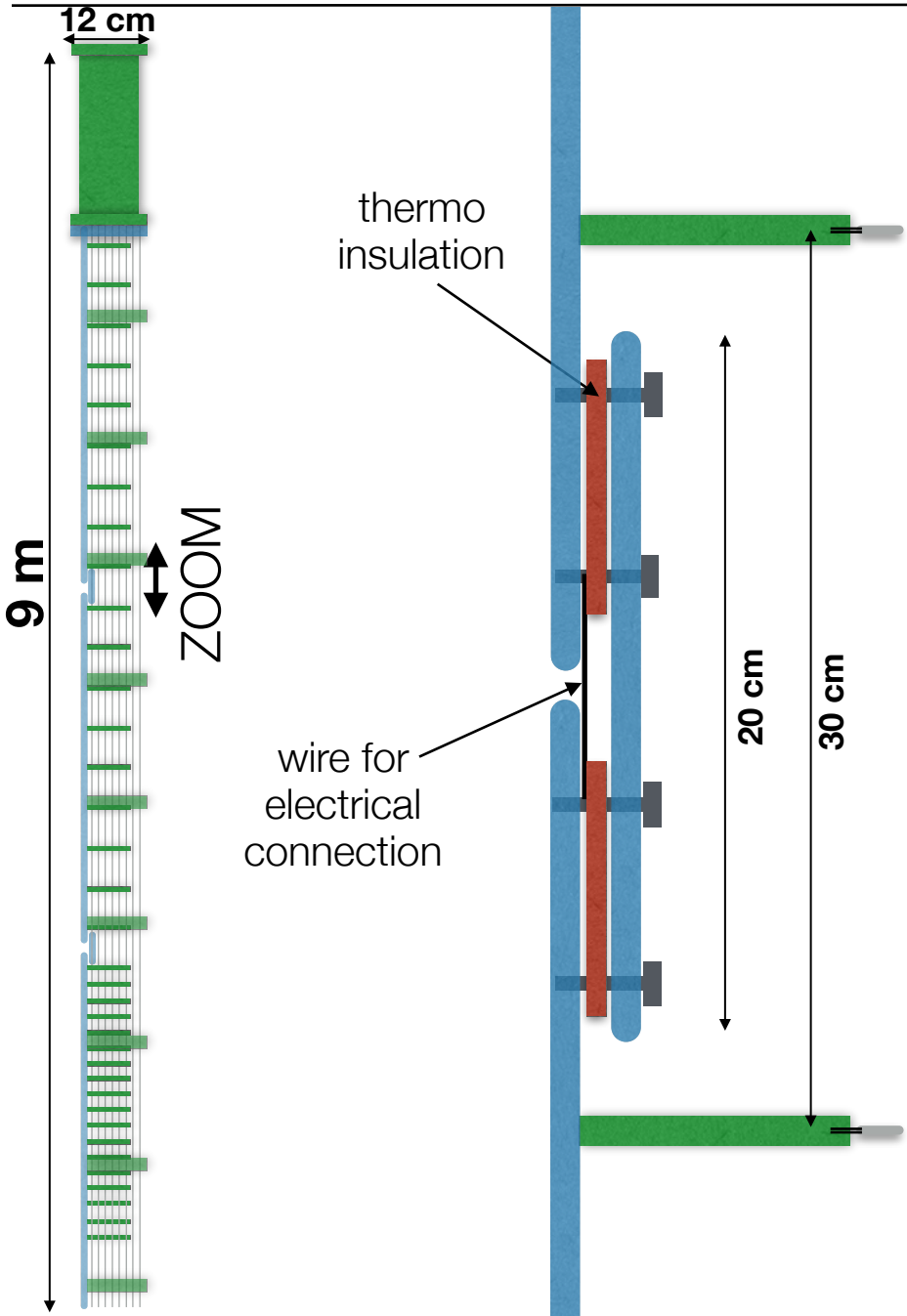


front view

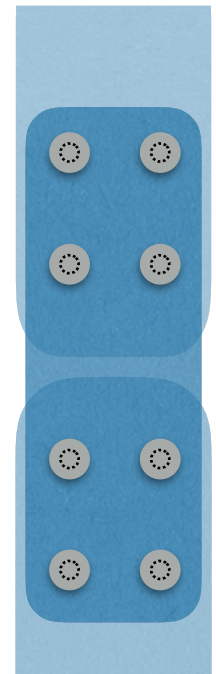
top view



Connection between sections



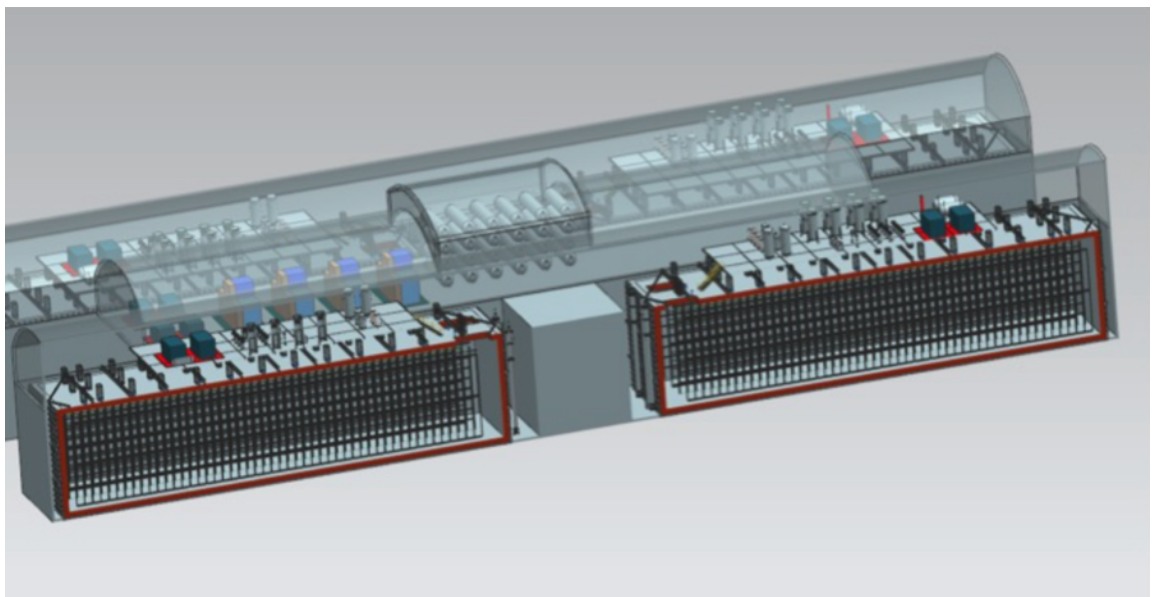
- We probably need **insulation** between plates to avoid thermal coupling, or a FR4 connection instead of aluminum
- If **two screws** are used vertically in each side we have to be **careful with shrinking**
- An **electrical connection** to guaranty all plates are at **ground**
- We need a proper design with rigidity studies

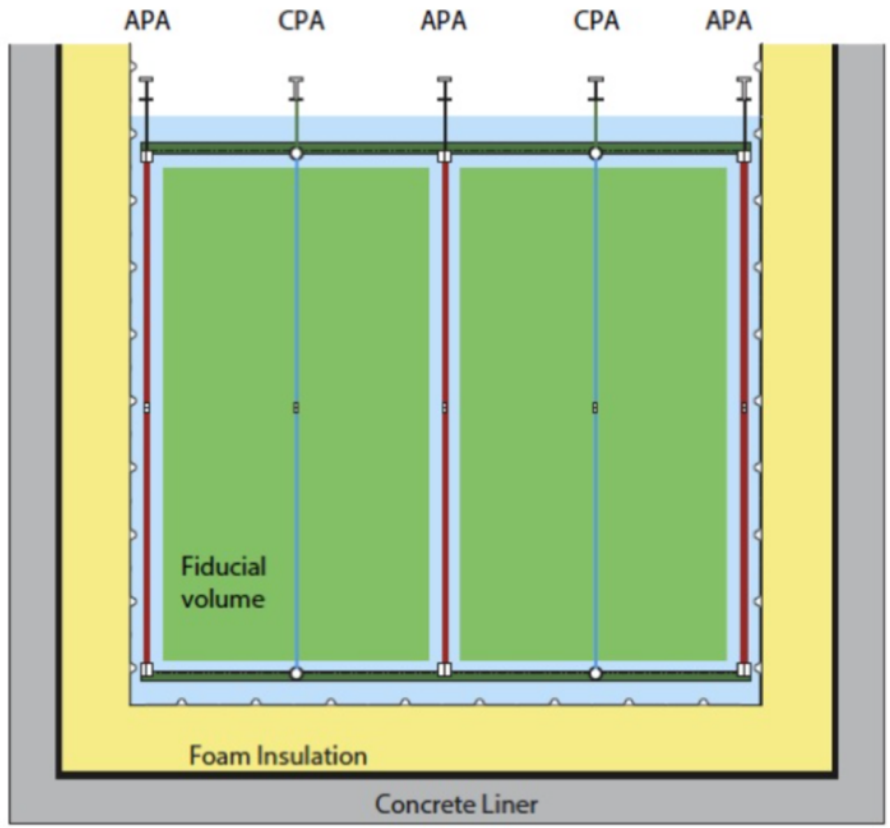


front view

Extrapolation to DUNE

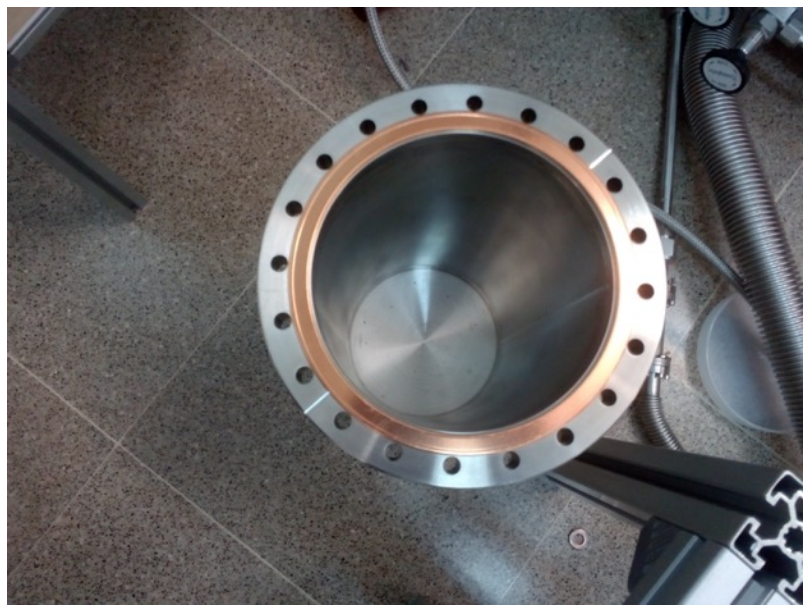
- DUNE has a different configuration, with all anode planes facing the lateral walls:
  - No need for E-field shielding
- Basically everything can be reused except the grid. This simplifies things. We don't need modularity in the grid, as I was suggesting last week.



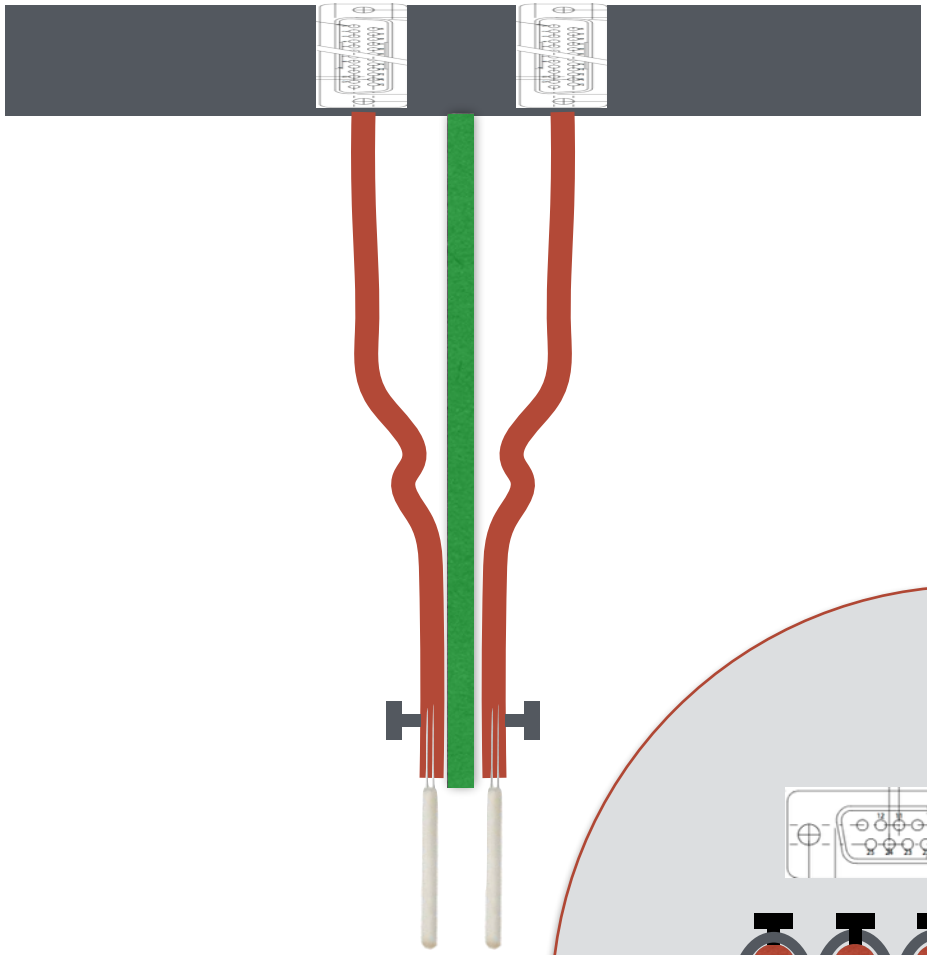


Sensor calibration

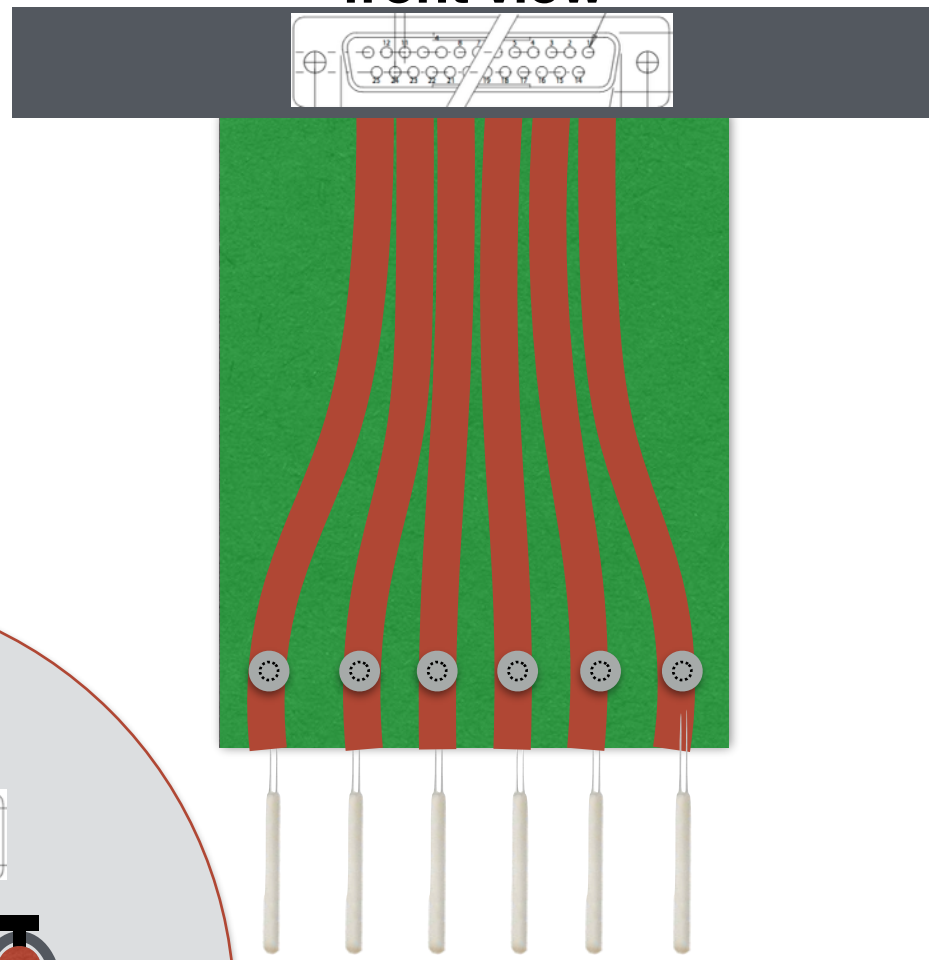
- Lakeshore calibrated sensors are 5 times more expensive (>500 €)
- A small dewar (16 cm opening) available in Valencia (up to 15 atm)
- The idea is to use LAr as bulk
- Use LN2 and a heater to vary slightly the temperature (±5 k)
- The flange and the system to hold the sensors needs to be designed
- Initial tests with no flange will begin soon (May)

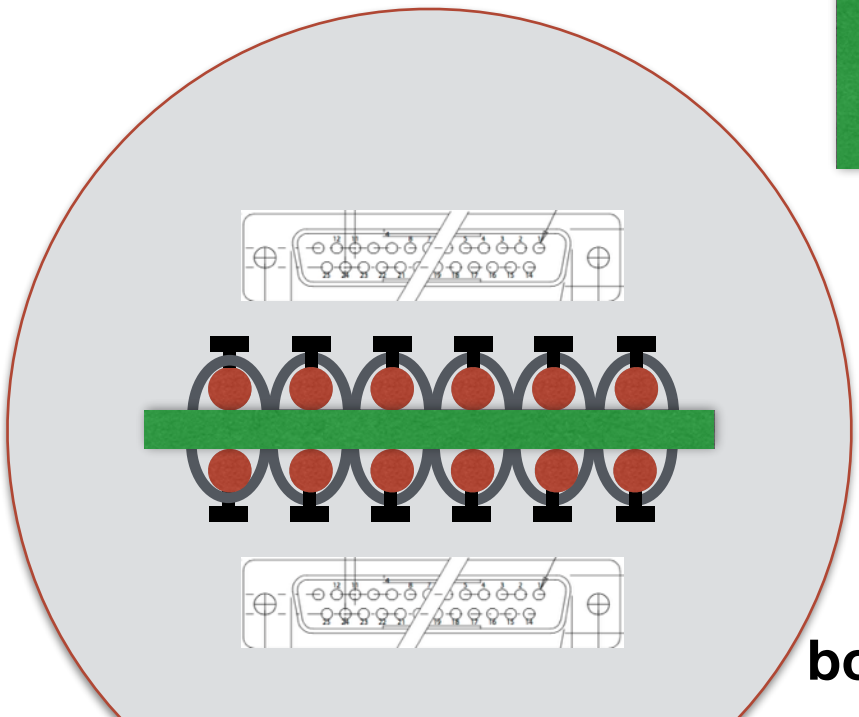


side view

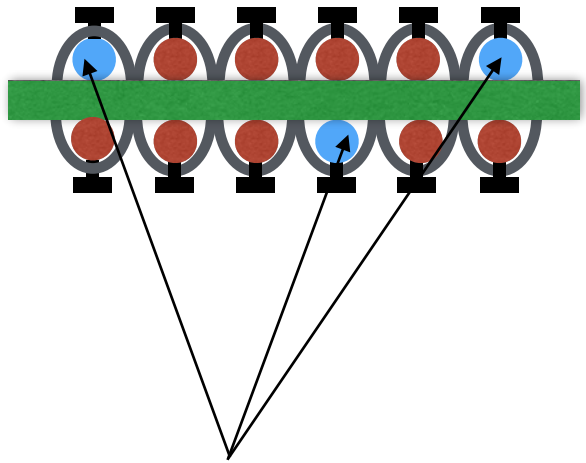


front view

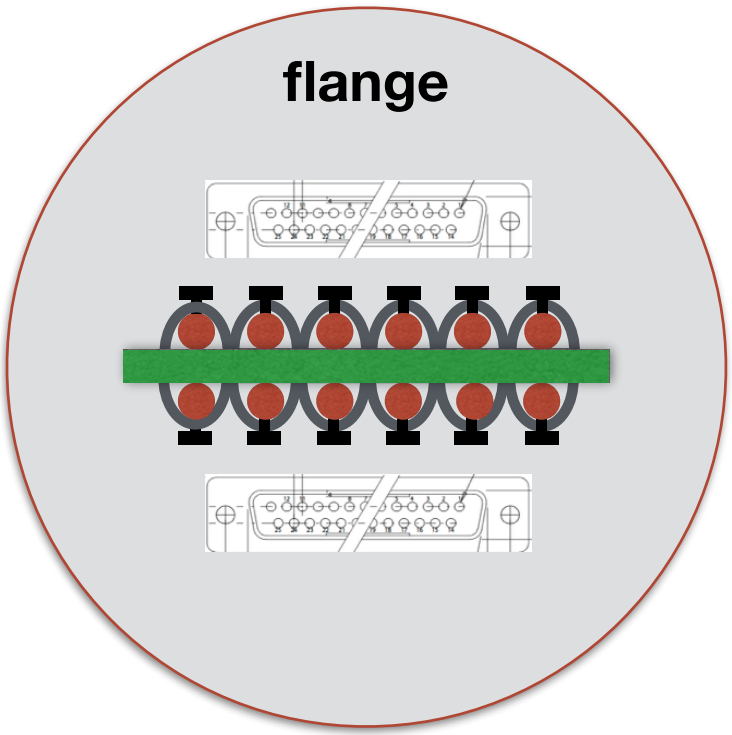


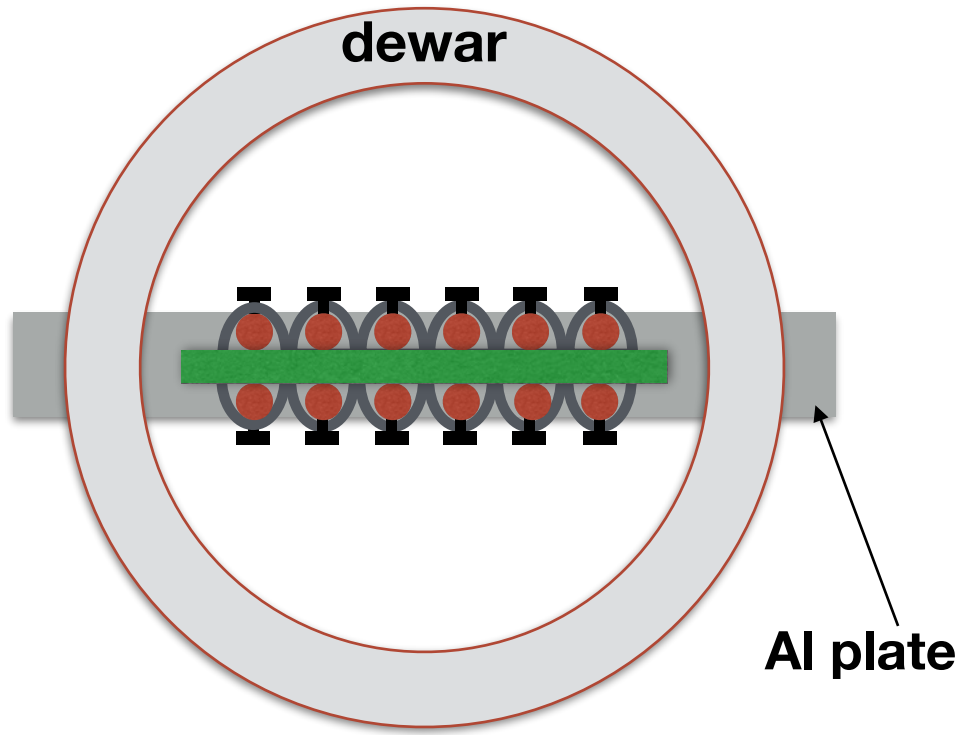


bottom view


calibrated

- We are ready to calibrate from April 27th, when I come back from CERN with the readout system
- The flange will arrive later, so we need some temporary solution
  - We should be able to screw the PCB(?) holding the sensors either to the flange or to an Aluminum (?) plate at the top of the dewar





Calibration strategy & schedule

- Calibrate all sensors inside the dewar
  - Perform reproducibility tests with different kind of connections, including different soldering, different cables, etc
- Solder sensors to their final cables (up to 9 meters long) and calibrate them again, to test the effect of the cable (all cable submerged in LAr)
  - Perform reproducibility tests, comparing with the previous calibration, connecting and disconnecting, etc
- If possible bring the calibration system to CERN and do a definitive calibration with the final readout system mounted on the rack
- **Schedule**:
  - We will get the readout system from CERN on April 26th
  - We already have four sensors (one of them calibrated)
  - Will build a small support for the sensors before the end of the month
  - We can start playing with the system at the beginning of may

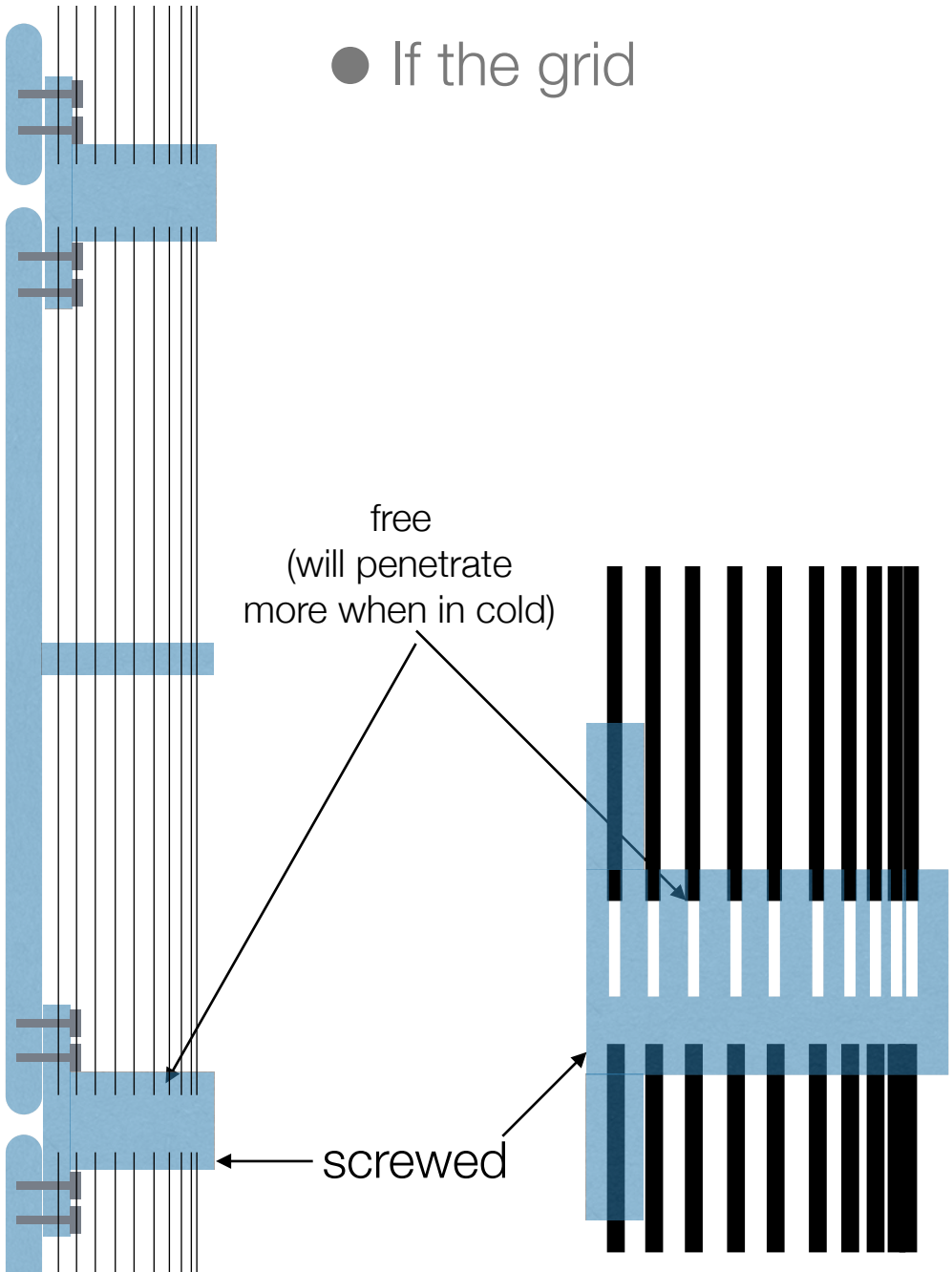
schedule

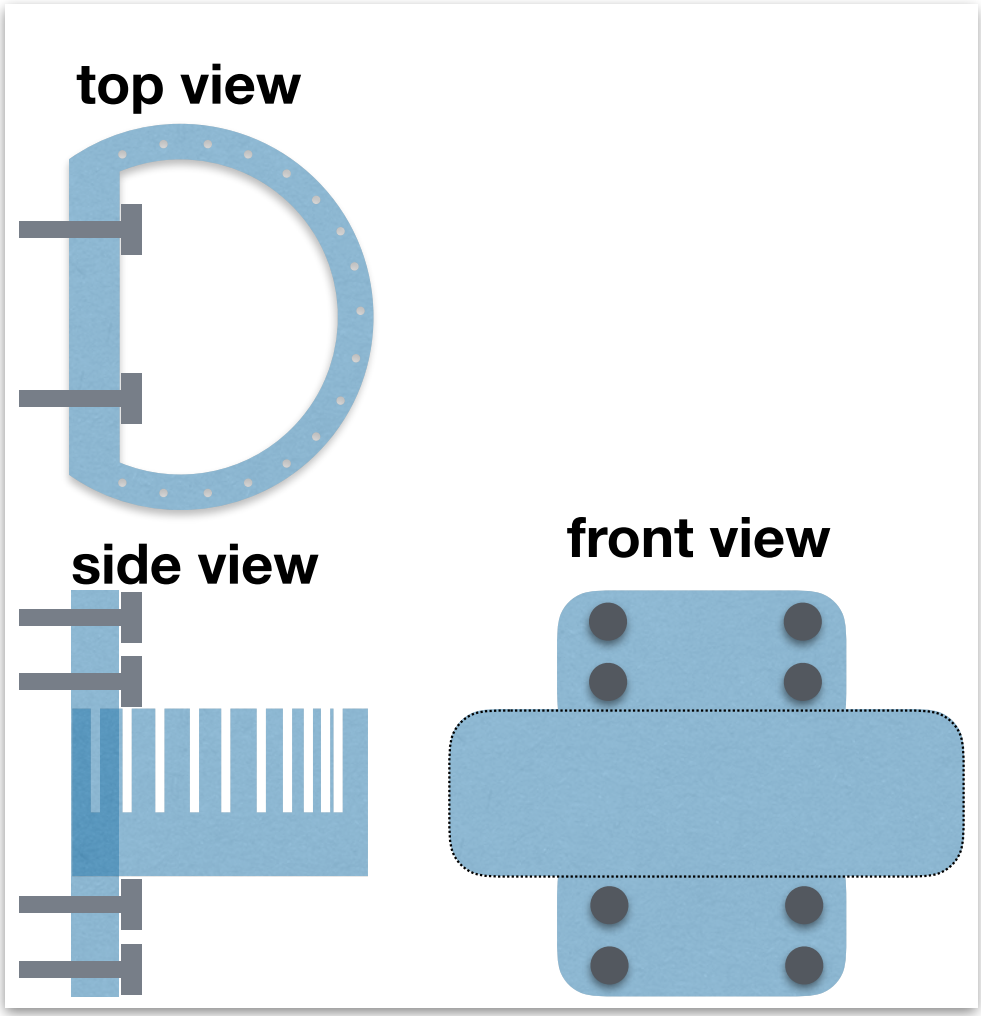
	2017									2018				
	Apr	May	Jun	Jul	Aug	Set	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Conceptual design	x													
Engineering design	x	x												
Prototiping			x	x	x									
Design calibration system	x													
calibration comissioning		x												
Sensor calibration			calibrate “other” sensors			x	x	x						
Fabricate mechanical structure						x	x	x	x					
cable preparation and sensor-cable calibration									x					
sensor-cable assembly into mechanical structure										x				
tests in Valencia										x	x			
test at CERN												x	x	
installation														x

backup

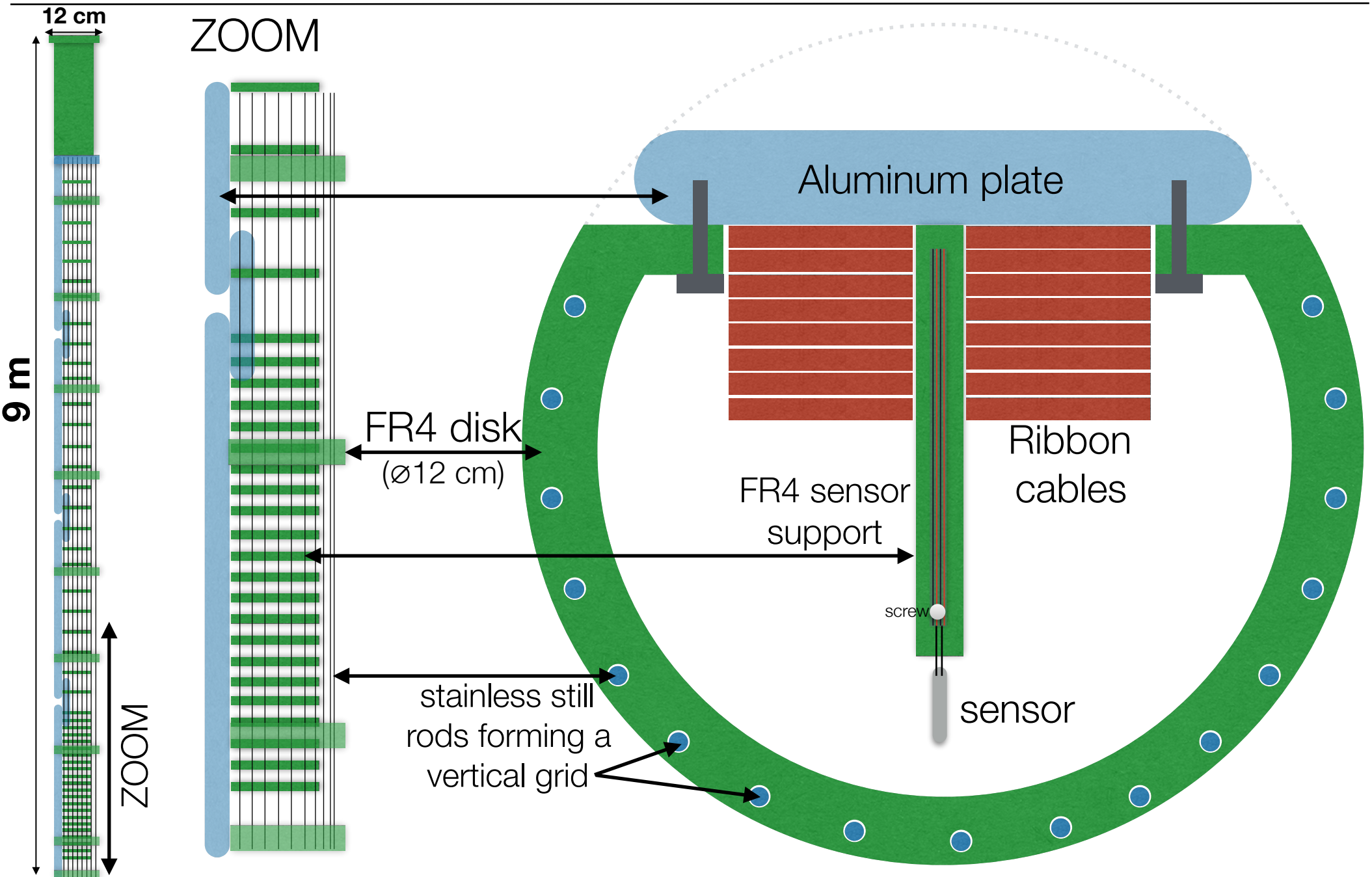
Modular option

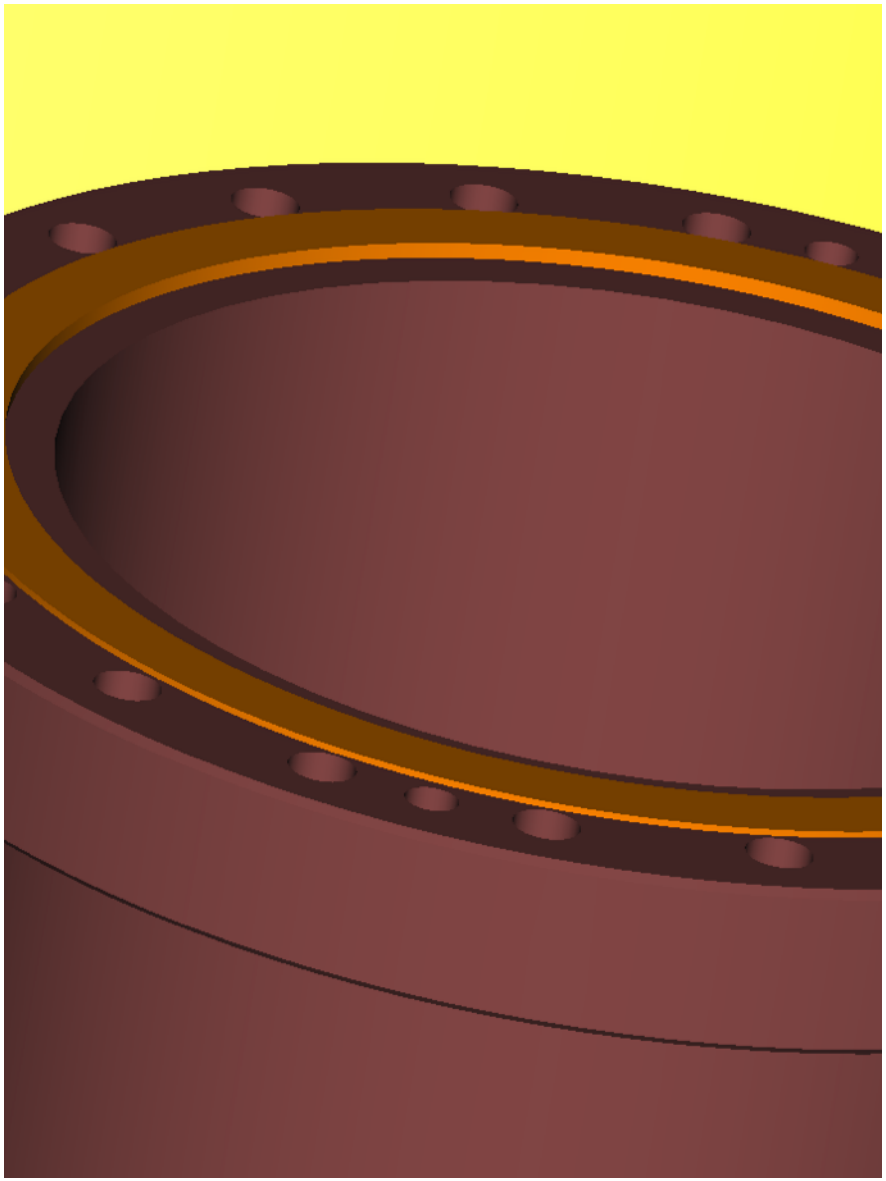
- If the grid

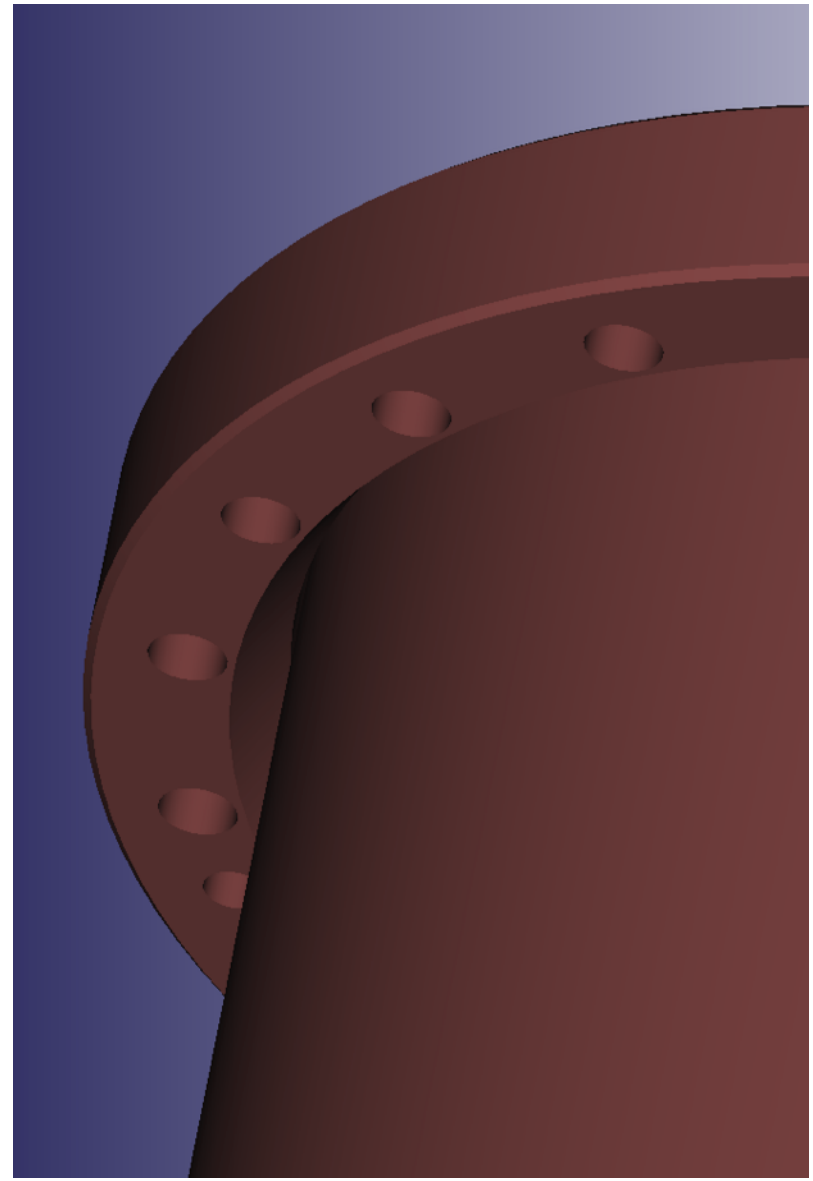




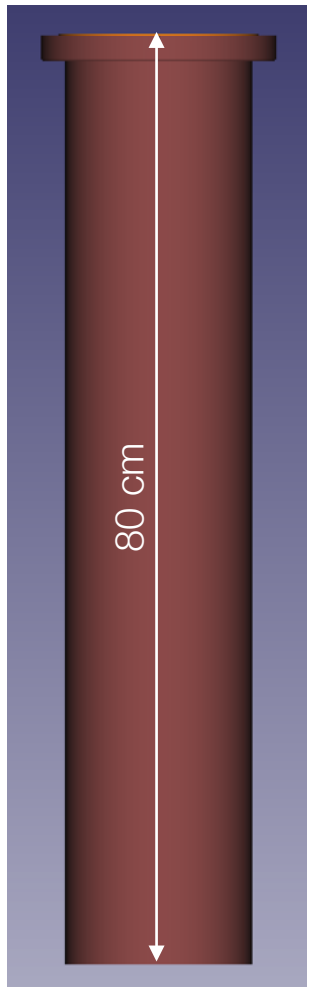
System conceptual design

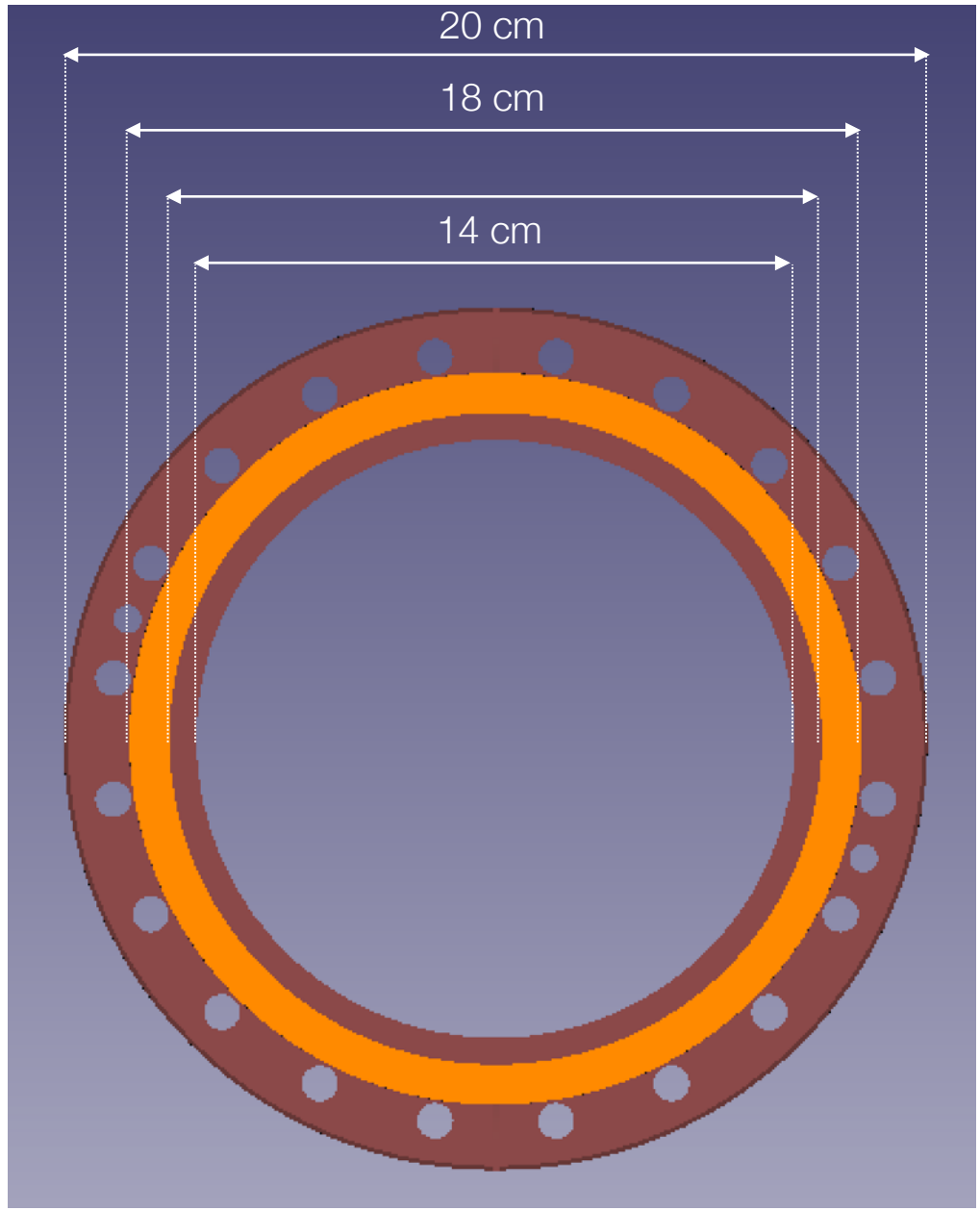


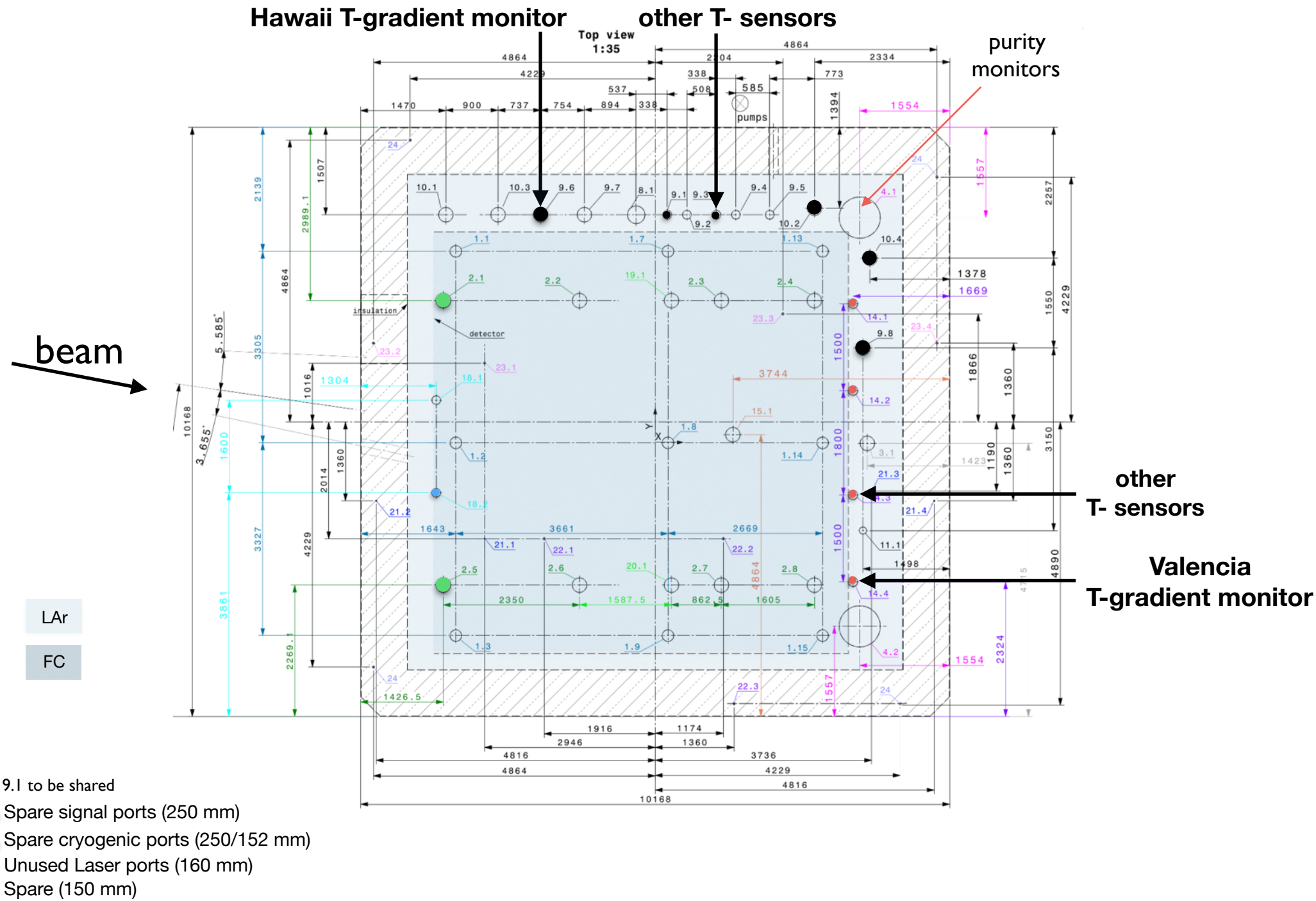





2 cm


80 cm


20 cm
18 cm
14 cm


Hawaii T-gradient monitor
other T- sensors
purity monitors
Top view
1:35
beam
pumps
insulation
detector
other
T- sensors
Valencia
T-gradient monitor
LAr
FC
9.1 to be shared
Spare signal ports (250 mm)
Spare cryogenic ports (250/152 mm)
Unused Laser ports (160 mm)
Spare (150 mm)