

## CRB and detector installation sequence in cryostat

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**ETH** zürich

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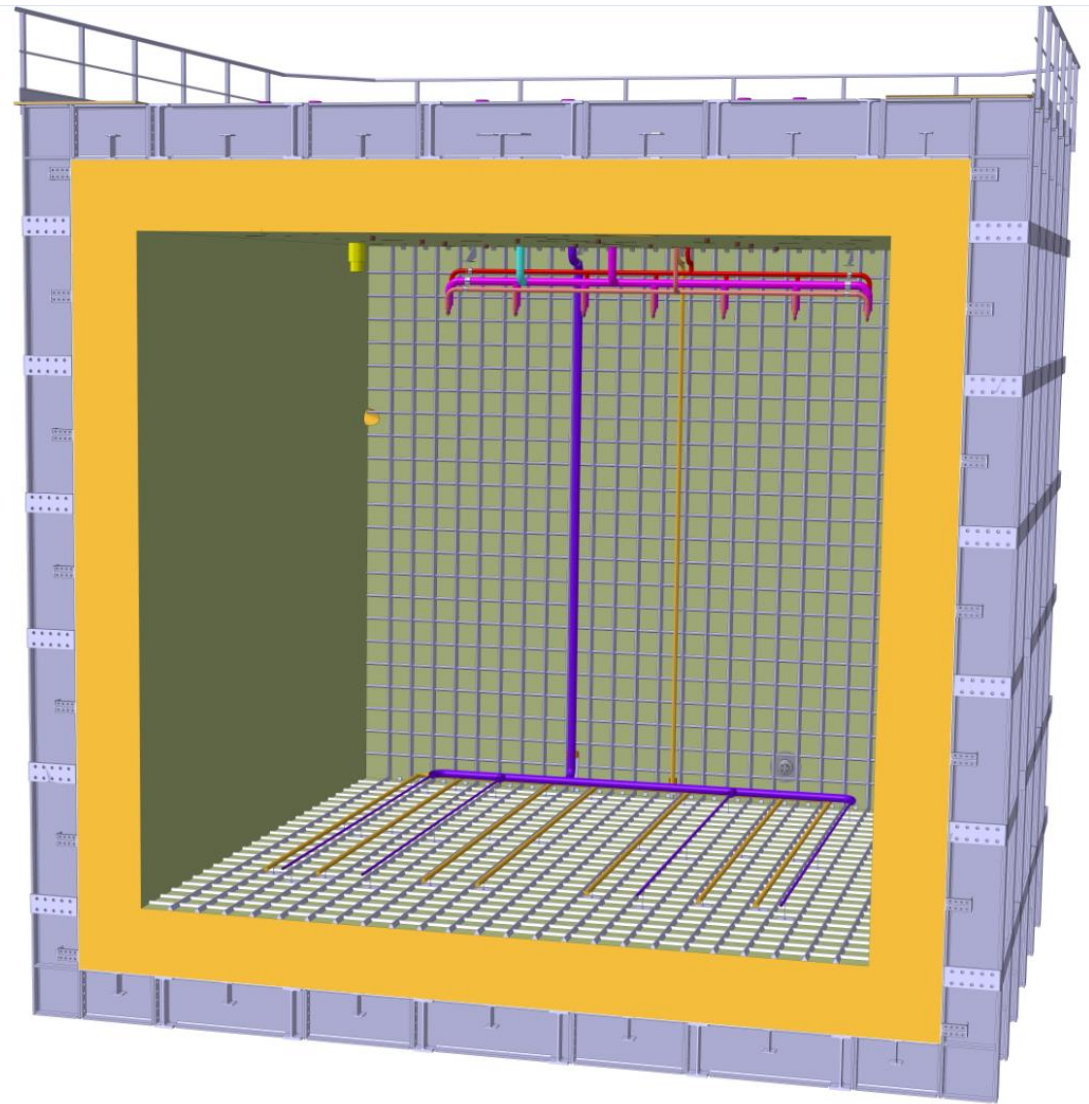
23.03.2017

## INSTALLATION SEQUENCE:

0. Internal Cryogenic pipes, Temporary Construction Floor and CRB
1. FTs Installation
2. CRP- 3X3 m<sup>2</sup> (LAPP talk - *CRP: plans for assembly and installation*)
3. Field Cage Installation
4. Cathode and Groundgrid
5. Removal of Temporary Construction Floor
6. PMTs and Groundgrid
7. Closure of the TCO

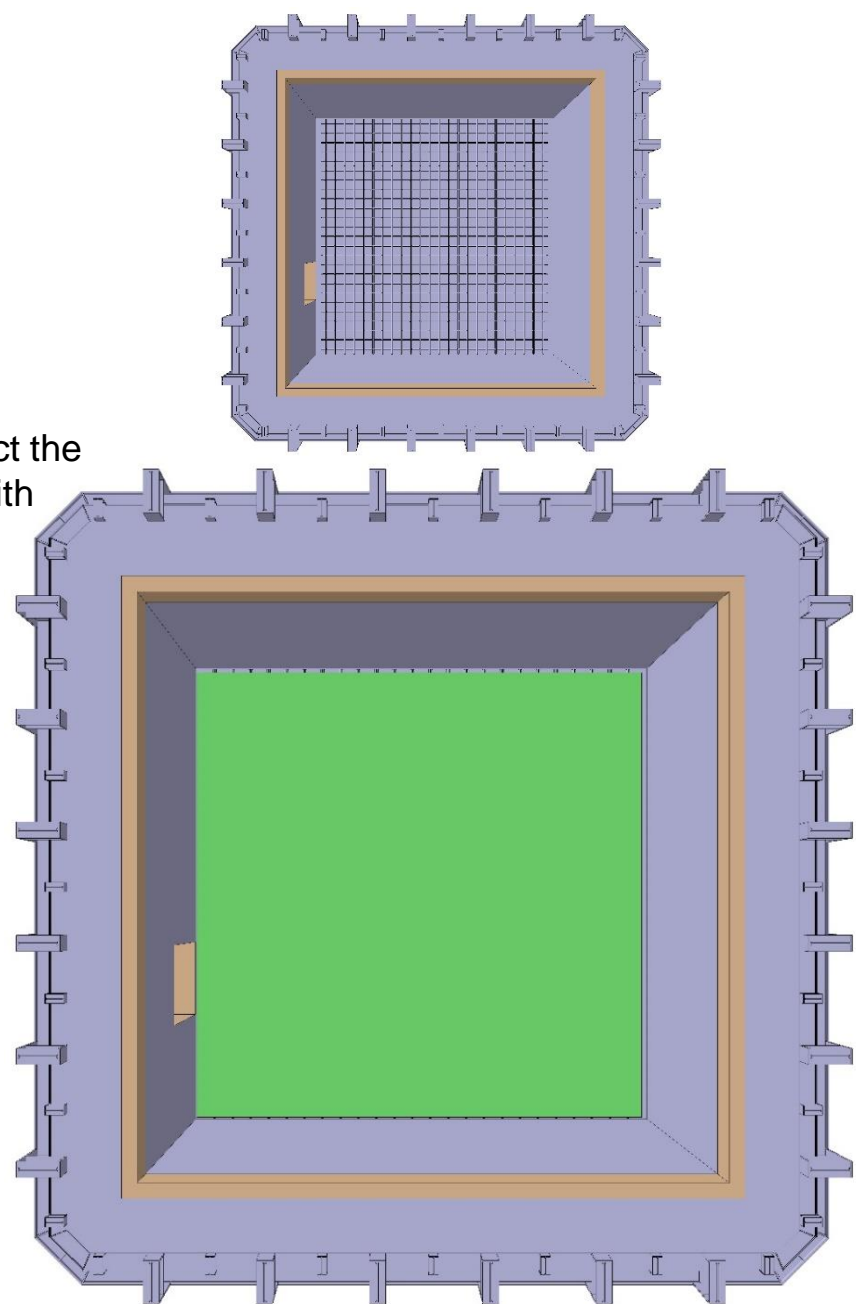
## 0) Internal Cryogenic Pipes

- Internal Cryogenic Pipes will be installed before the Temporary Construction Floor.



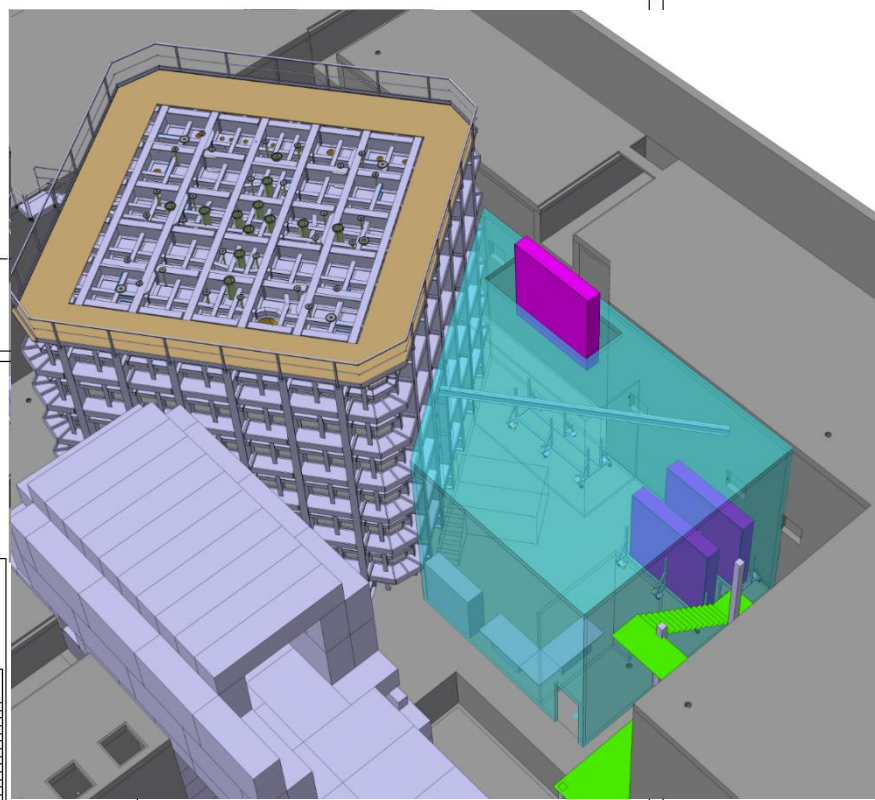
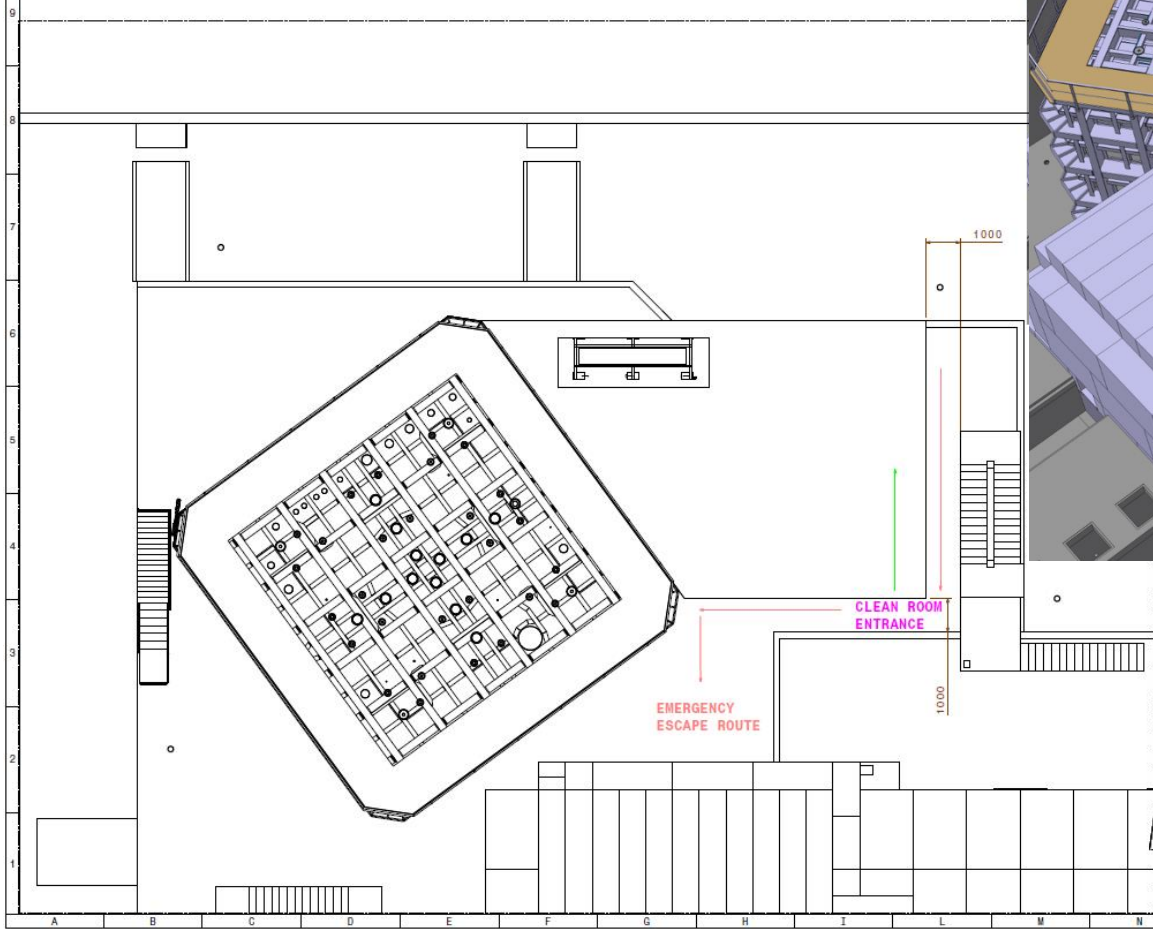
## 0) Temporary Construction Floor

- Cryostat is used as a clean Room
- Field Cage, CRP are installed inside
- Temporary construction floor is needed to protect the bottom membrane and be able to work inside with personnel lift
- Floor will be at the level of the TCO height



# 0) CRB – Clean Room Buffer

- Roof Hatch at the Top for lowering the various Boxes. (**MAX Size: 3,2x3,2x0.5 m**)
- Clean air from Manhole keeping the cryostat in overpressure  
→ prevent dirty air to go inside the Cryostat

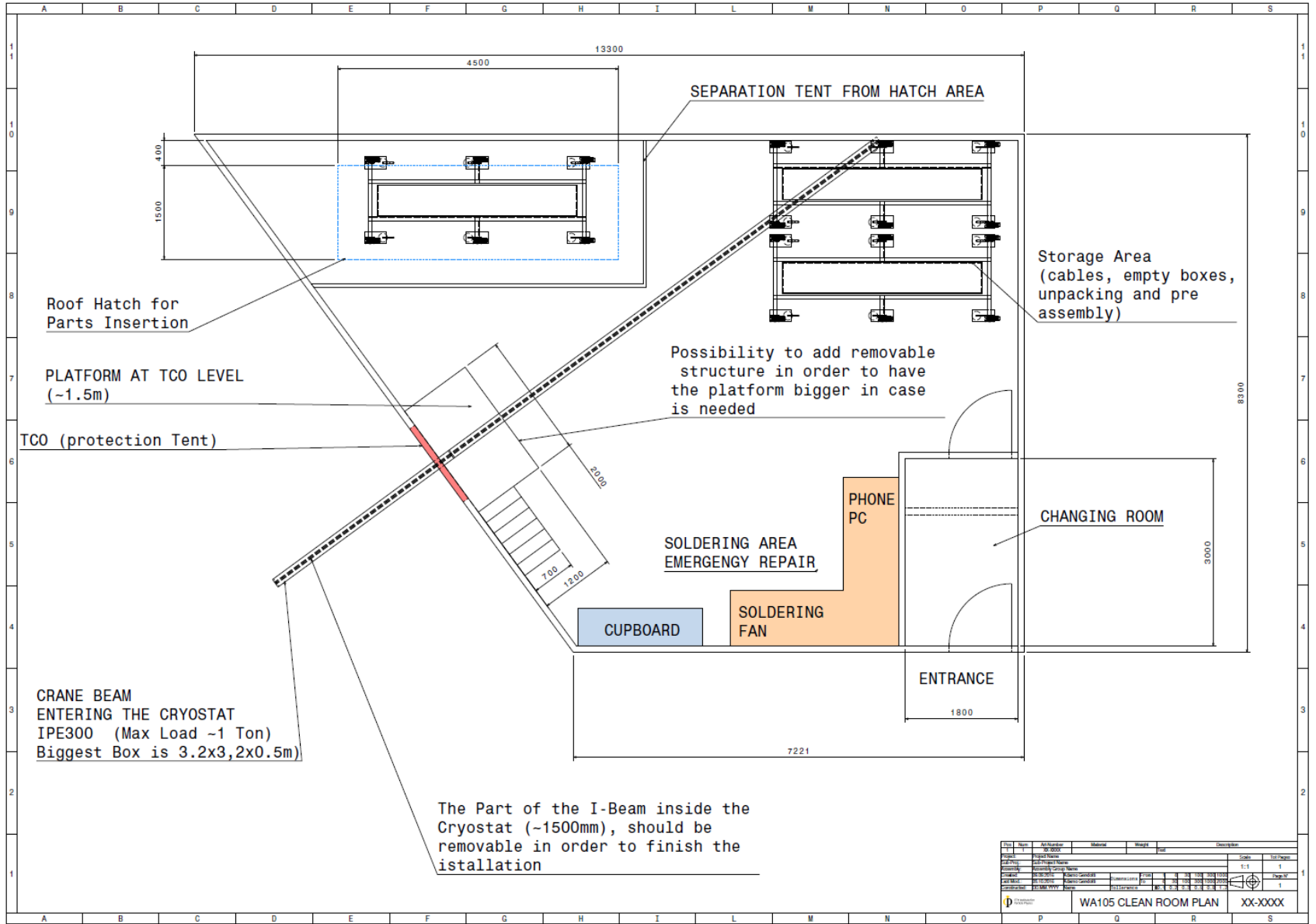


Item	Name	Alt Number	Material	Weight	Unit	Description
1	Roof Hatch	00-0000				
2	Emergency Escape Route					
3	Staircase					
4	Manhole					
5	Equipment					
6	Roof Hatch					
7	Manhole					
8	Equipment					
9	Roof Hatch					
10	Manhole					
11	Equipment					

ETH-Zürich OVERVIEW IN EHN1 XX-XXXX

# 0) CRB – Clean Room Buffer

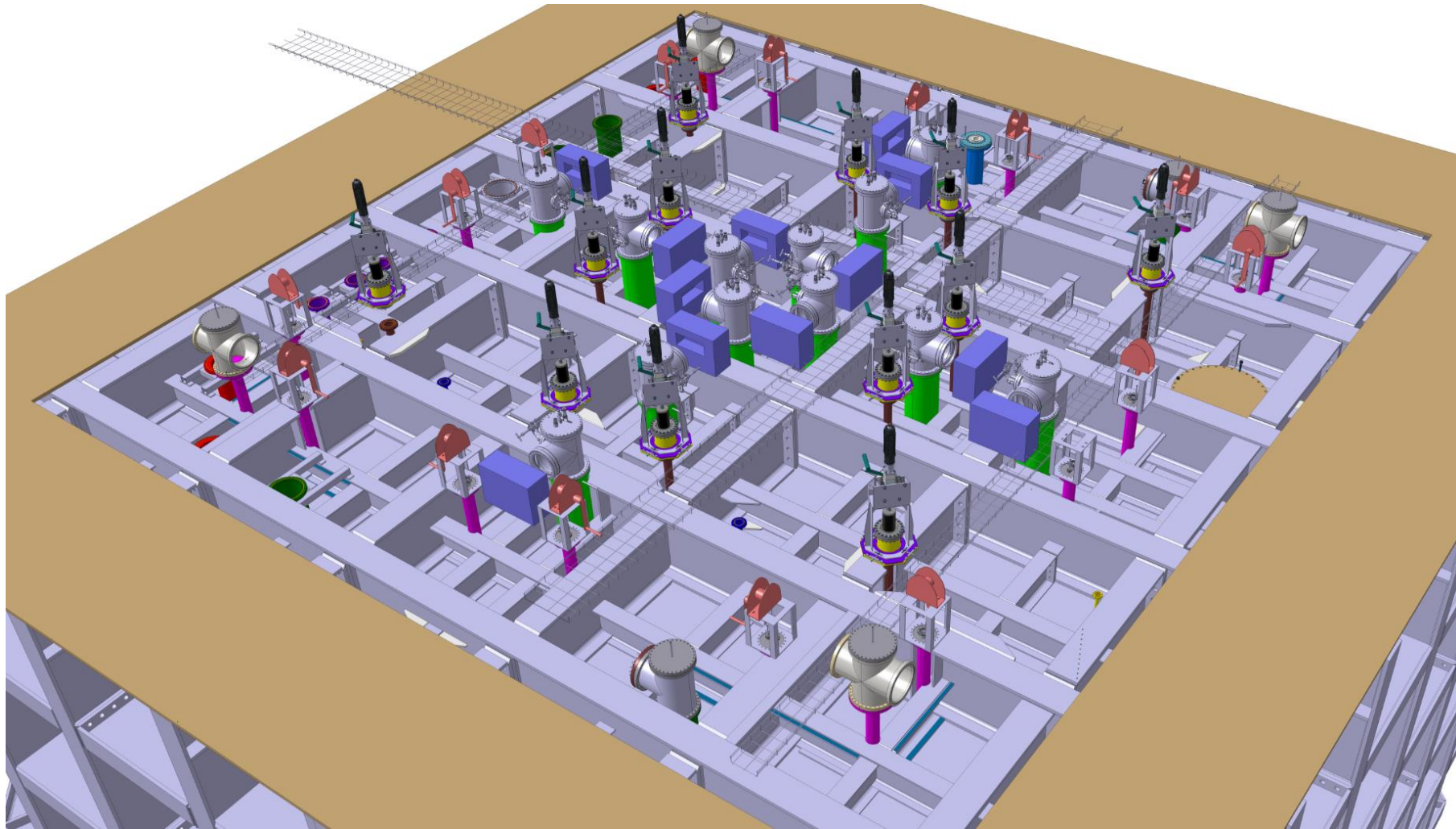
- CRB internal layout proposal





# 1) FTs Installation

- SGFT, SPFT-CRP and CRP-INS FTs needs to be there at the beginning
- SPFT-FC are for the Field Cage installation
- HVFT after the FC is installed
- TANK-INS could be installed during the PMTs installation



# Equipment needed Inside the Cryostat



- 2x personnel lift

- 2 x Movable stair (demountable)
- Max Heigh ~1.5/1.7 m
- Installation of the last parts (personnel lift already out)

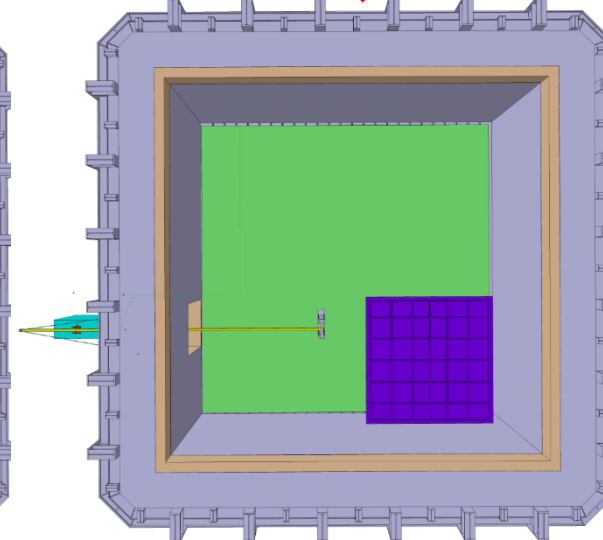
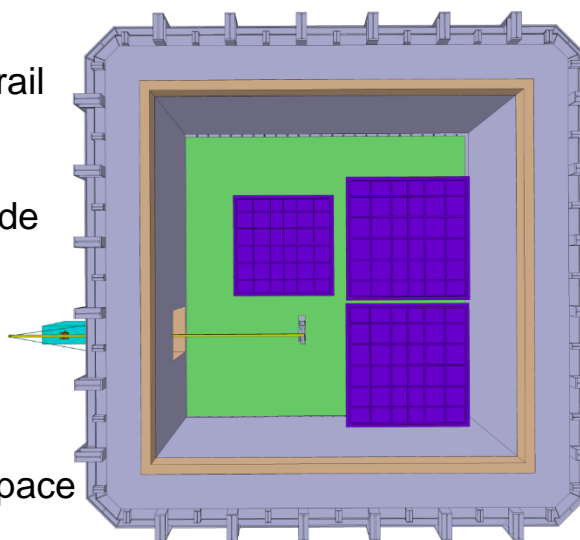
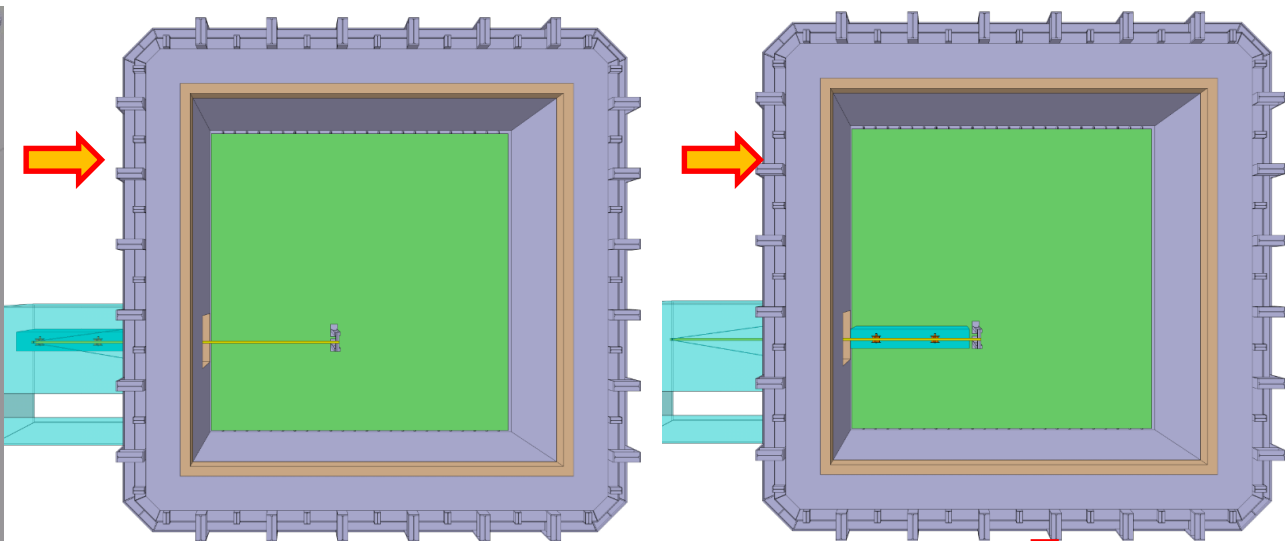
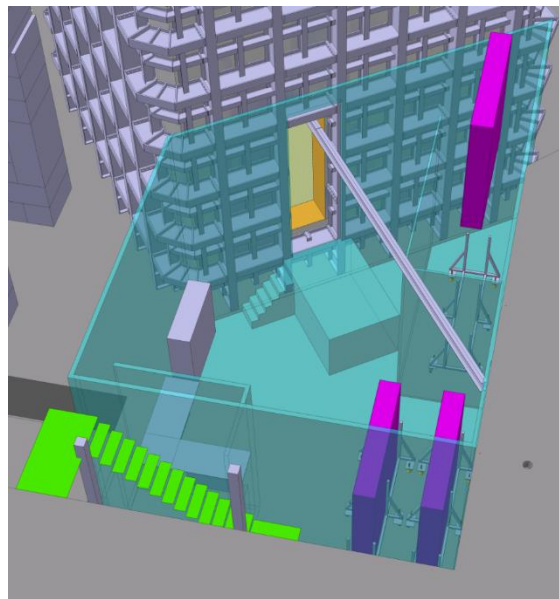
Max Height 6.5 m



< 1m - In order to fit bewteen FC and Cryostat walls



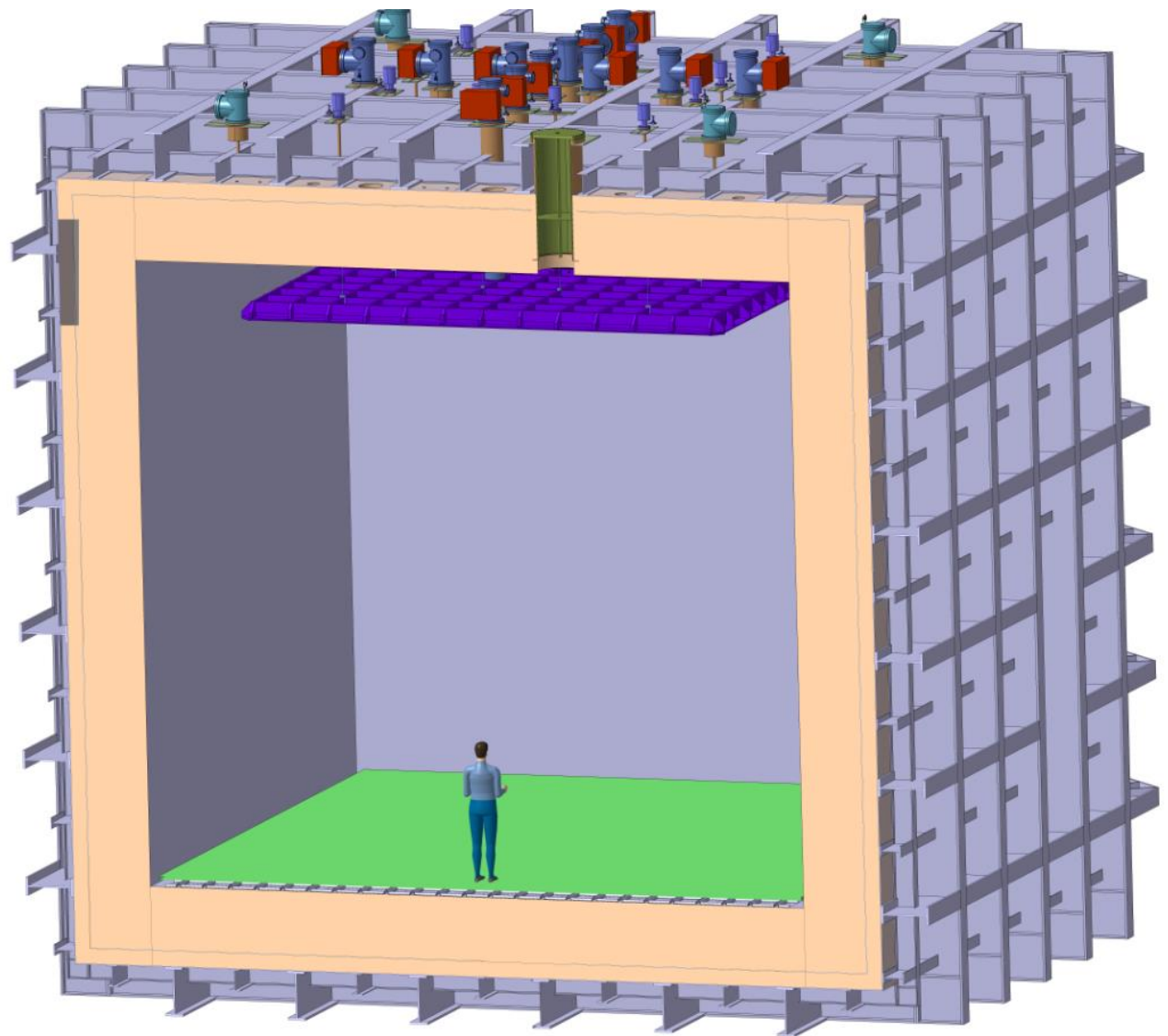
## 2) CRP 3X3 m<sup>2</sup>



1. CRP Box inside the cryostat on the rail (BOX SIZE 3.2m x3.2 mx 0.5m)
2. Lowered, rotated and unpacked inside the cryostat
3. Placed in Position ready to be lifted (using wheels)
4. CRP Lifted in order to have all the space free on the floor

## 2) CRP 3X3 m<sup>2</sup>

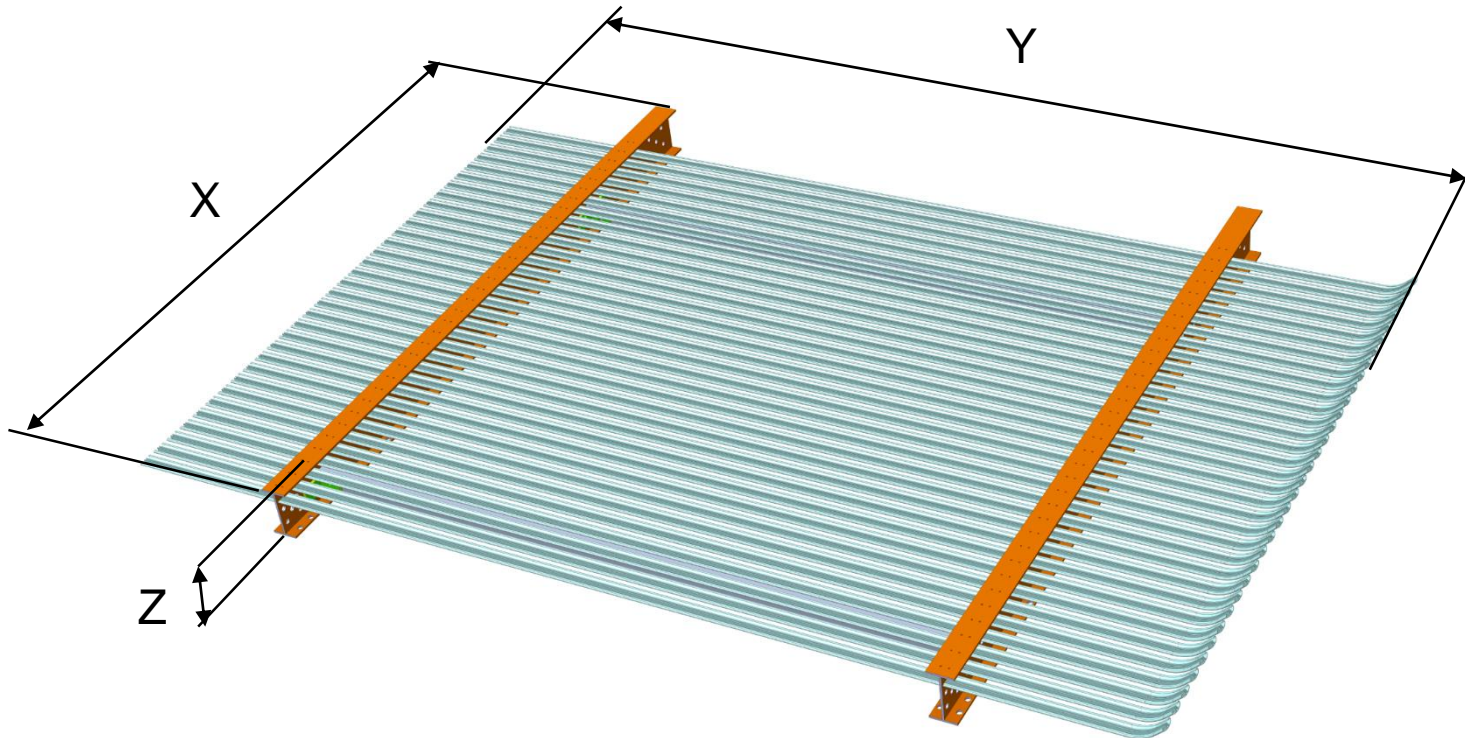
- All CRPs fixed on nominal Position



### 3) Field Cage

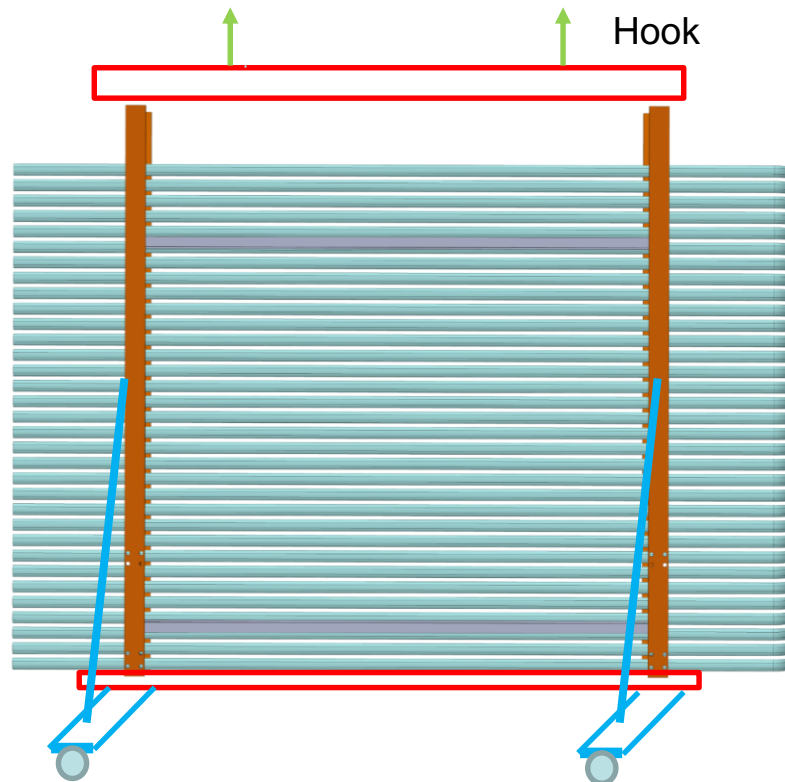
- Sub- Modules of the Field Cage

Sub Module	X	Y	Z
1st Sub-Module	2180	3050	165
2nd Sub-Module	1980	3050	165
3rd Sub-Module	1980	3050	165



### 3) Field Cage

- Assembly of the Sub Modules inside the CRB → 2 Person 1 Module per day
- Transfer of the Sub Modules inside the Cryostat without Box: Reinforcement is needed.

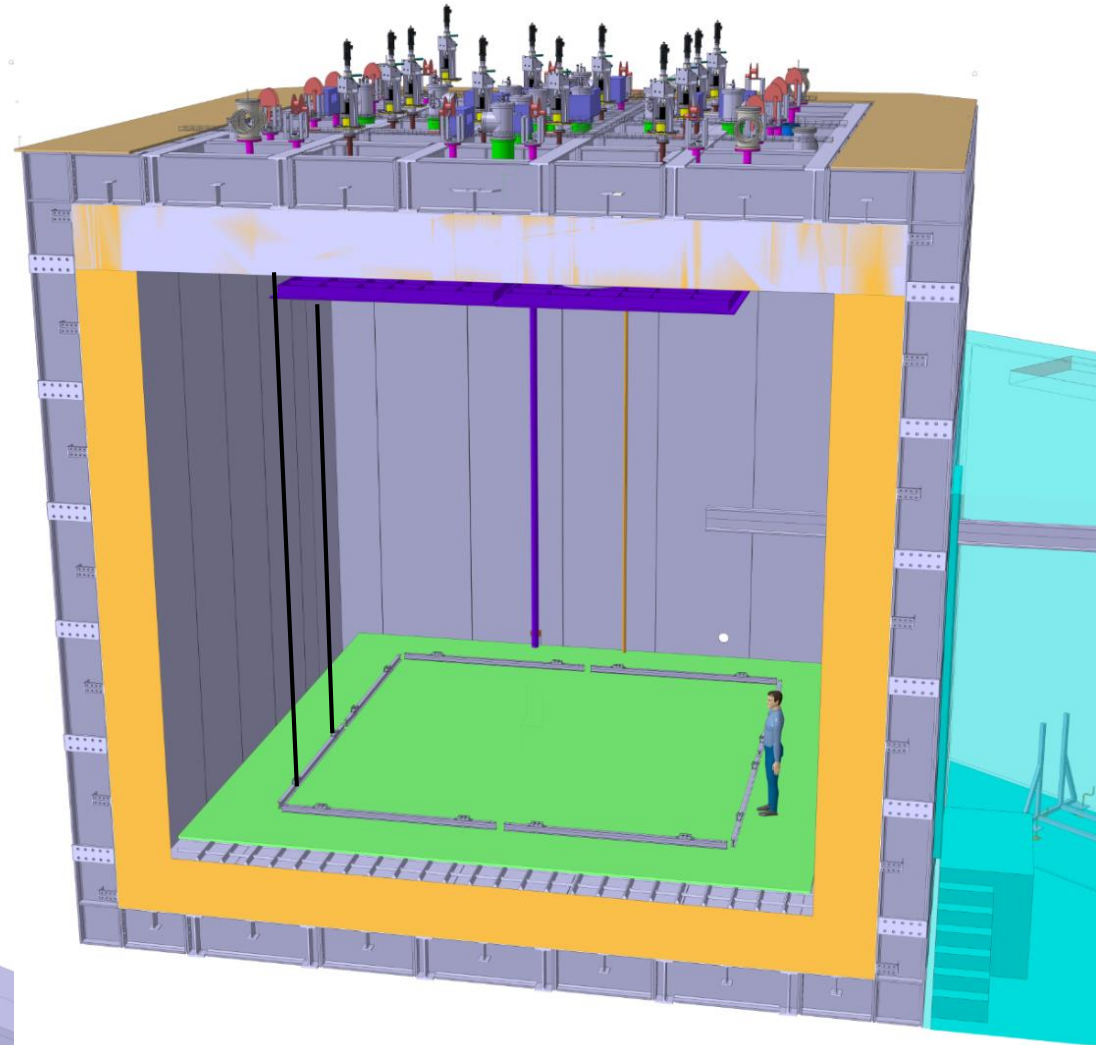
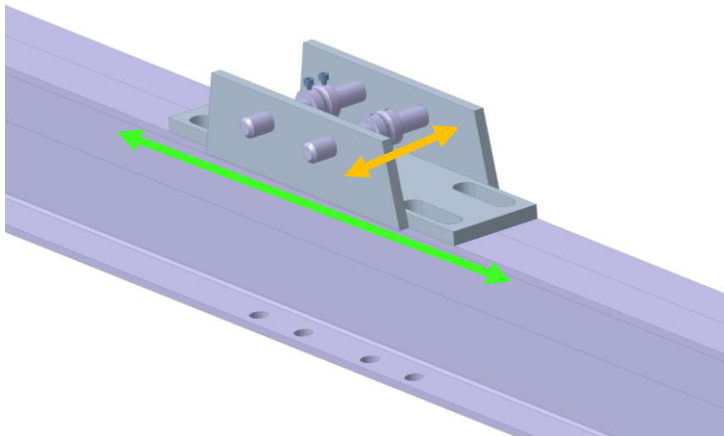


Steel Reinforcement using the sub modules connection holes

- Once inside mount wheels on bottom reinforcement in order to move the sub module on place.

### 3) Field Cage

- Accordingly to the position of the CRP  
→ Mark the position of the field cage on the construction floor
- Position the SS I-Beam (hanging system) in the right position
- Lower the hanging SS wire and connect to the I-Beam → Connection point centered at the wire



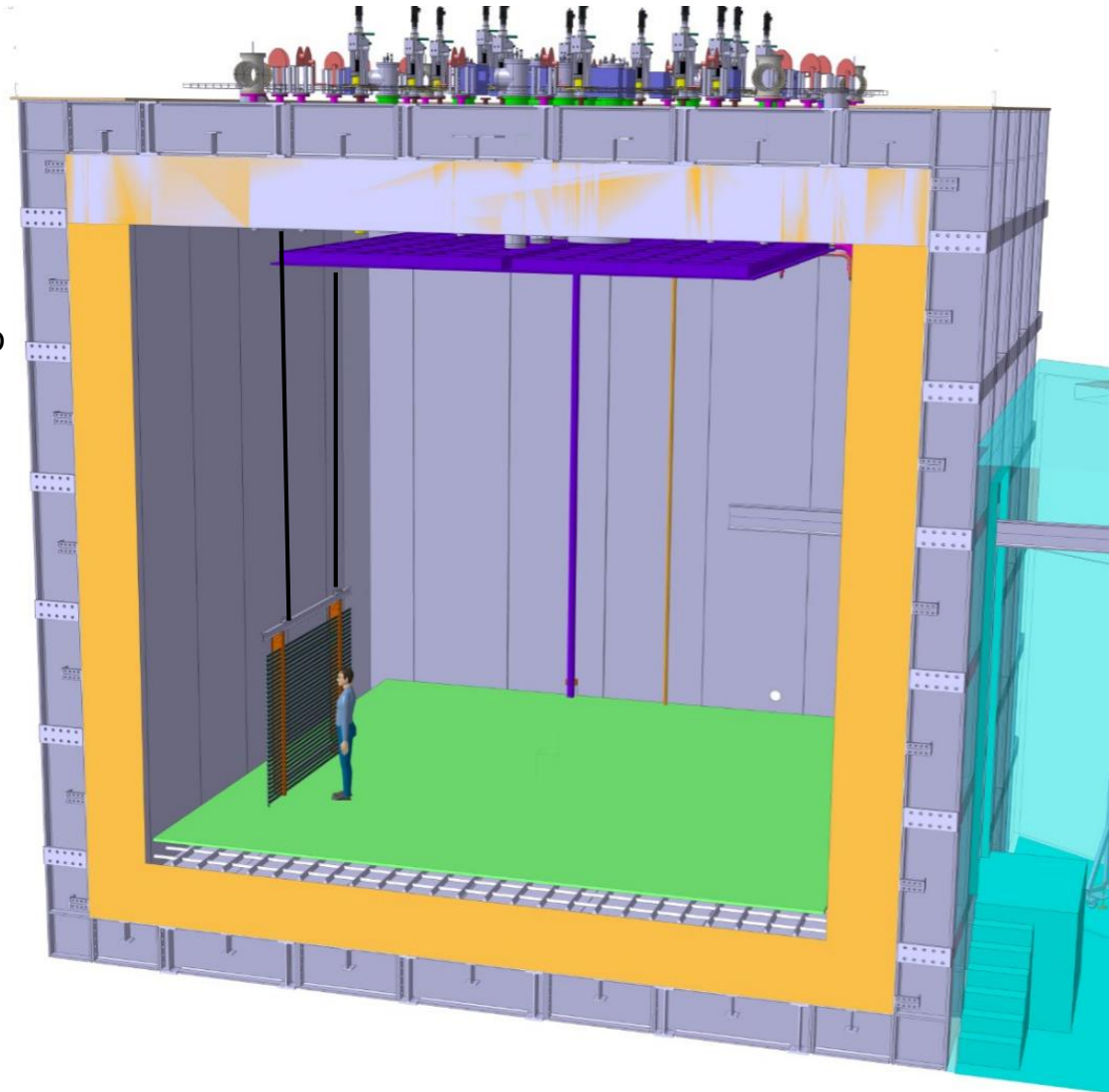


### 3) Field Cage

- Lift the I-Beam ~2.5 m
- Bring in first sub modules and connect to hanging system
- Already install the PCB boards of the HV divider (if it's needed in module)

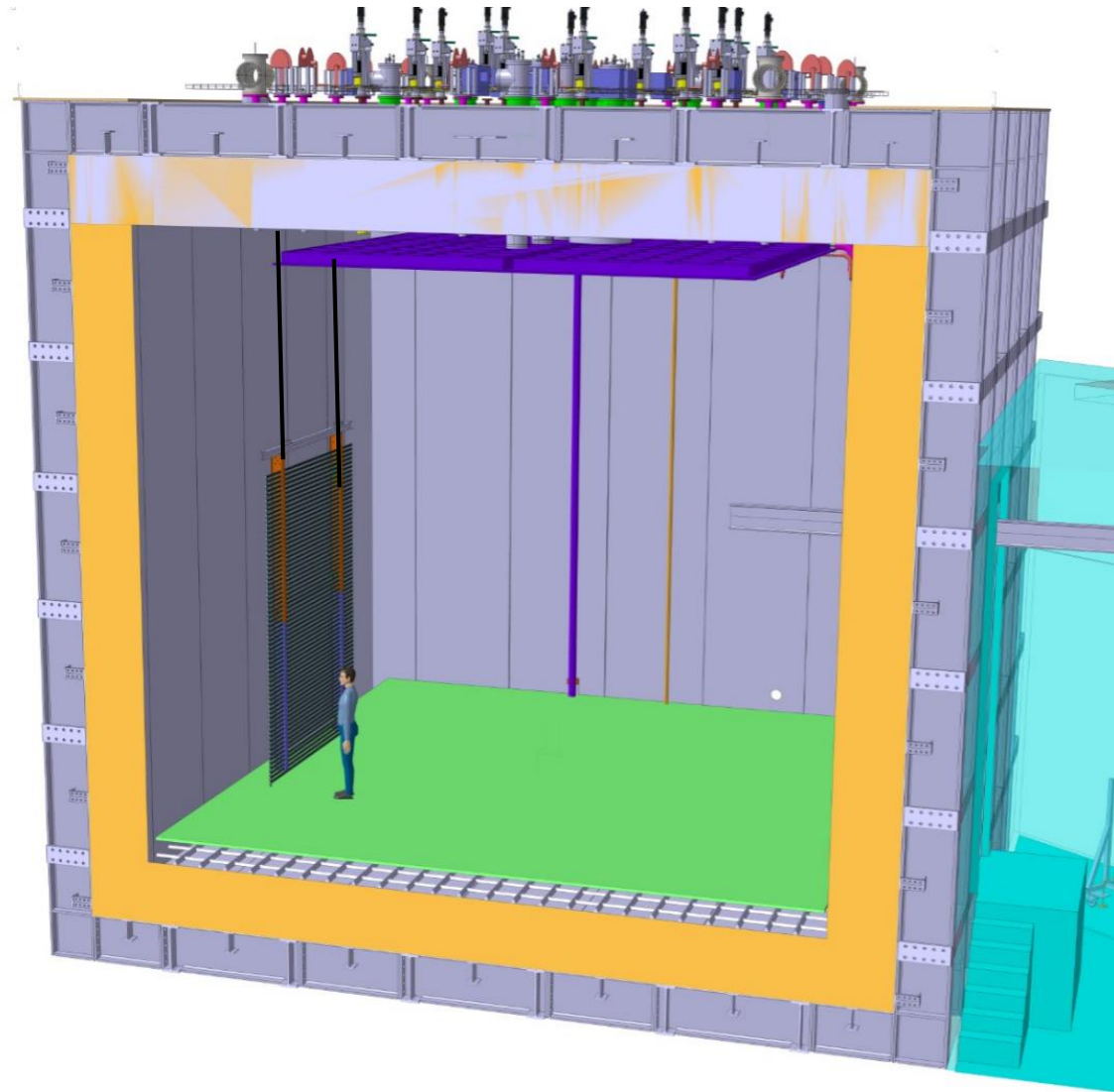
#### Sub module Installation:

- 2 Person on Top Lifting
- 2 Person inside the Cryostat



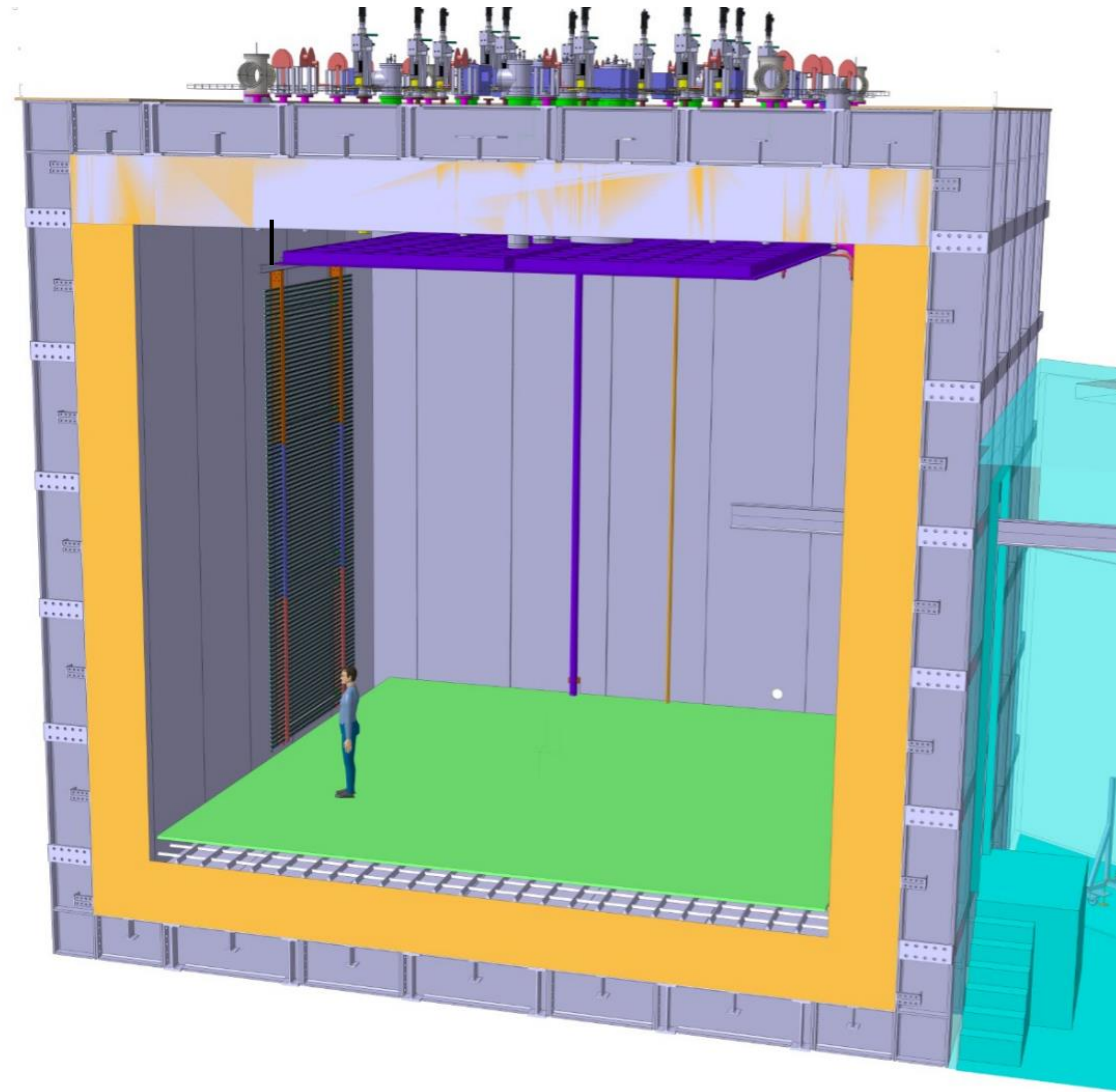
### 3) Field Cage

- Same for 2nd sub module
- Already install the PCB boards of the HV divider (if it's needed in module)
- Lift for another 2.5m



### 3) Field Cage

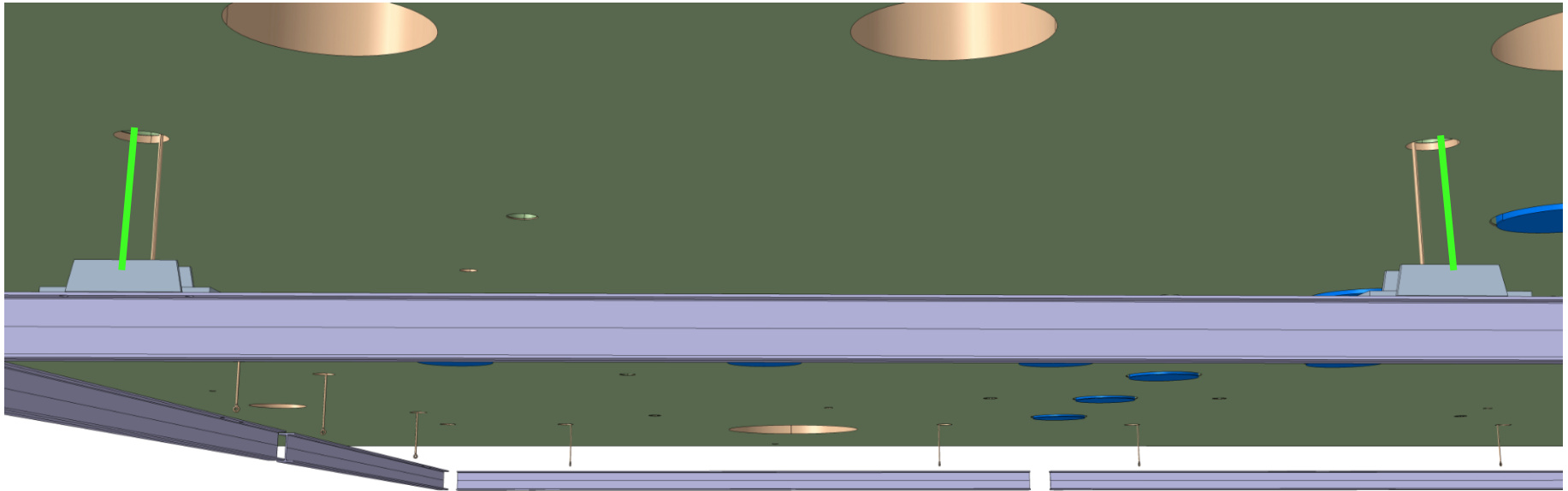
- 3rd sub module
- Lift the entire module at his nominal position



### 3) Field Cage



- After the Field Cage is fully installed and in the final position
- Final wires are installed with possibility to fine tune the length
- Installation wires are then removed



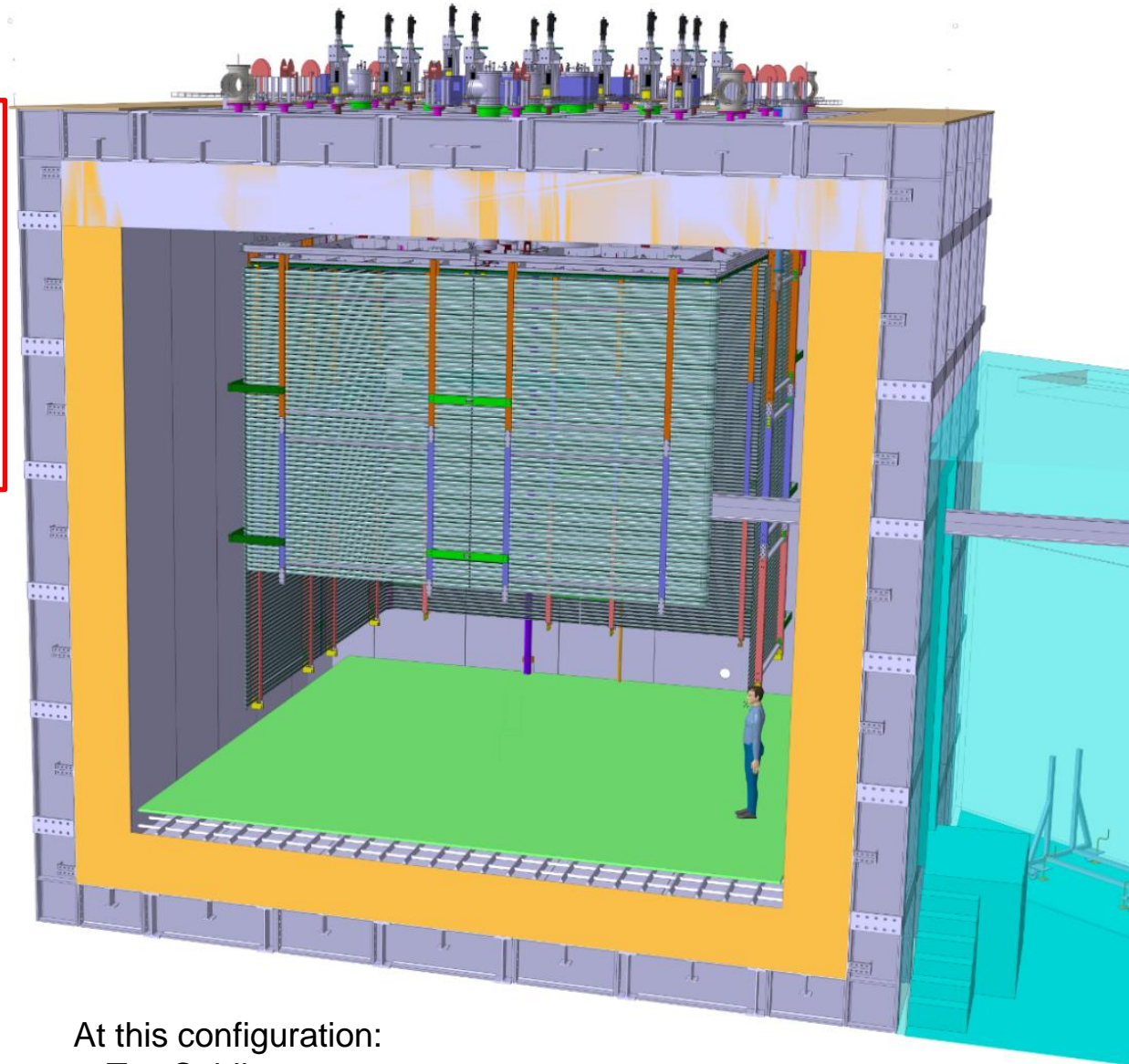


### 3) Field Cage

- 5 X Modules complete
- 2 x Modules 2/3 completed
- 1 Module missing (TCO Side)
- Install where is possible Clips and reinforcement.

### 4) Cathode and Groundgrid

- Bring in the 5 x FC Sub Modules left and place them vertically at the side of the Cryostat
- Bring in Cathode and Ground Grid Modules
- Assemble Cathode and Ground Grid connected together on wheels supports and move it to a corner



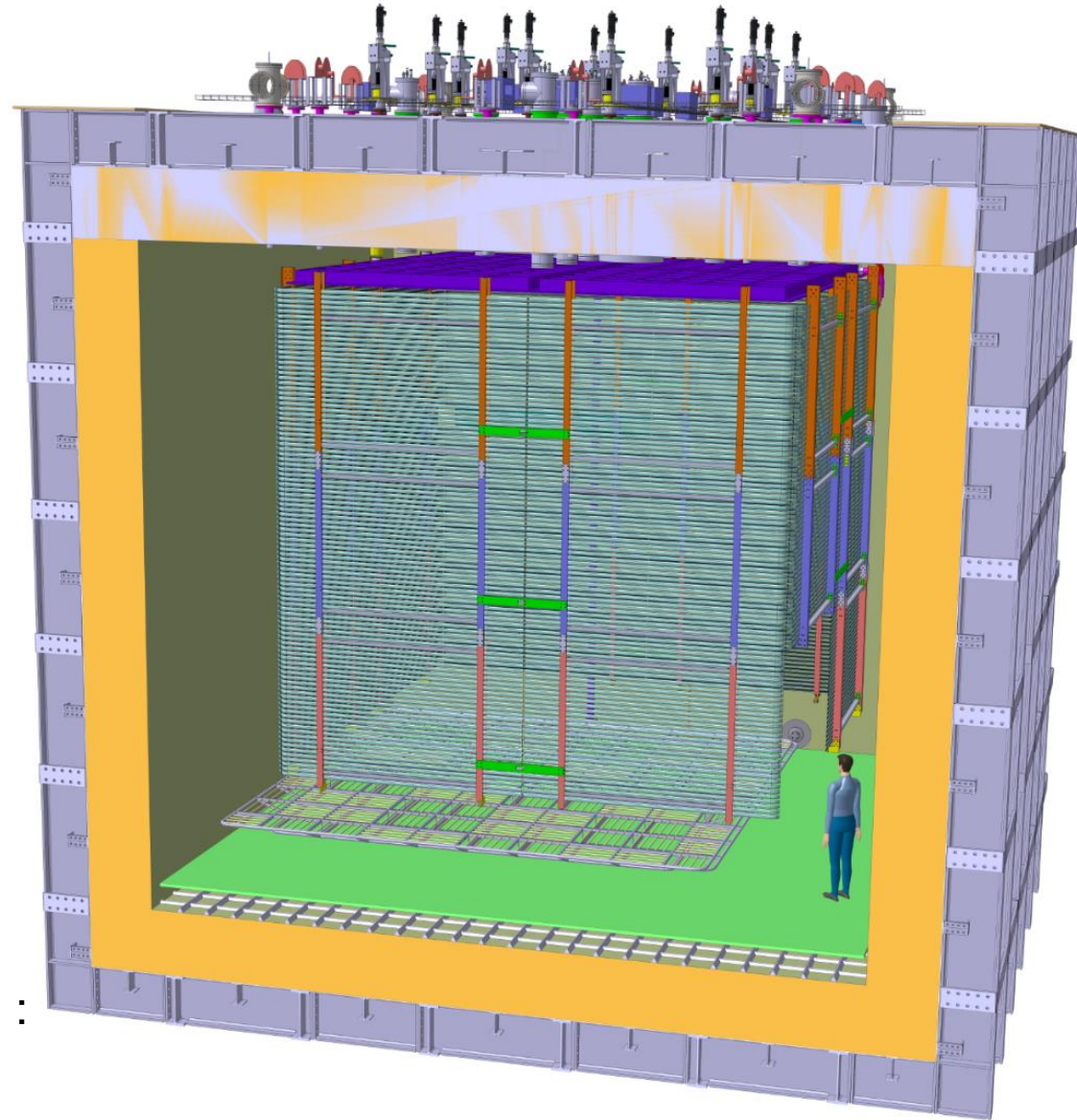
At this configuration:

- Top Cabling
- Beam Plug Installation



## 4) Cathode and Groundgrid

- Remove Crane I-Beam inside the Cryostat
- Install 4 Sub modules + missing reinforcement Clips, etc..
- Sub module in front of the TCO still not installed
- Cathode+Groundgrid in a corner leave ~1m space on both side of the FC modules

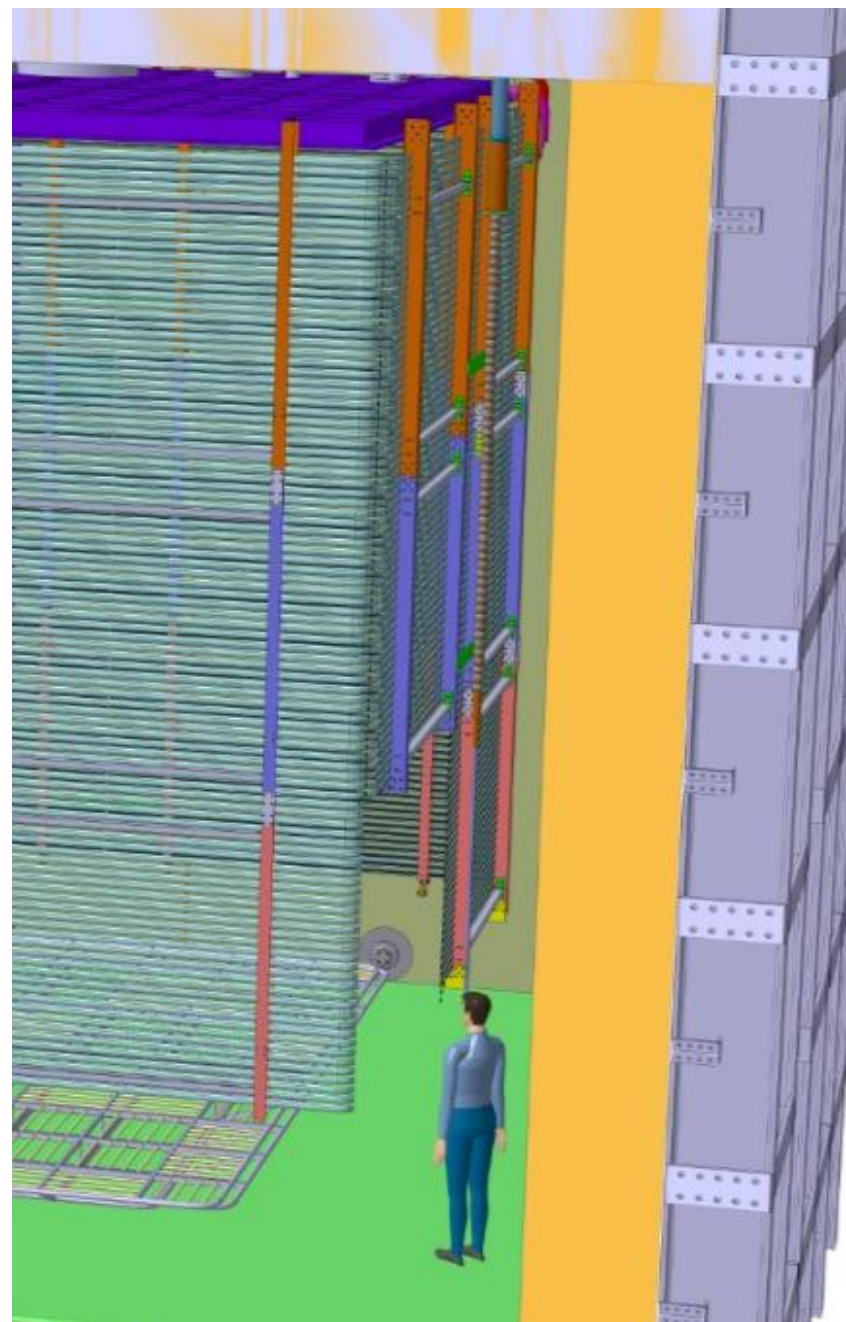


### Clips and Reinforcement Installation :

- 1 Person Inside the field cage
- 1 Person Externally of the field cage

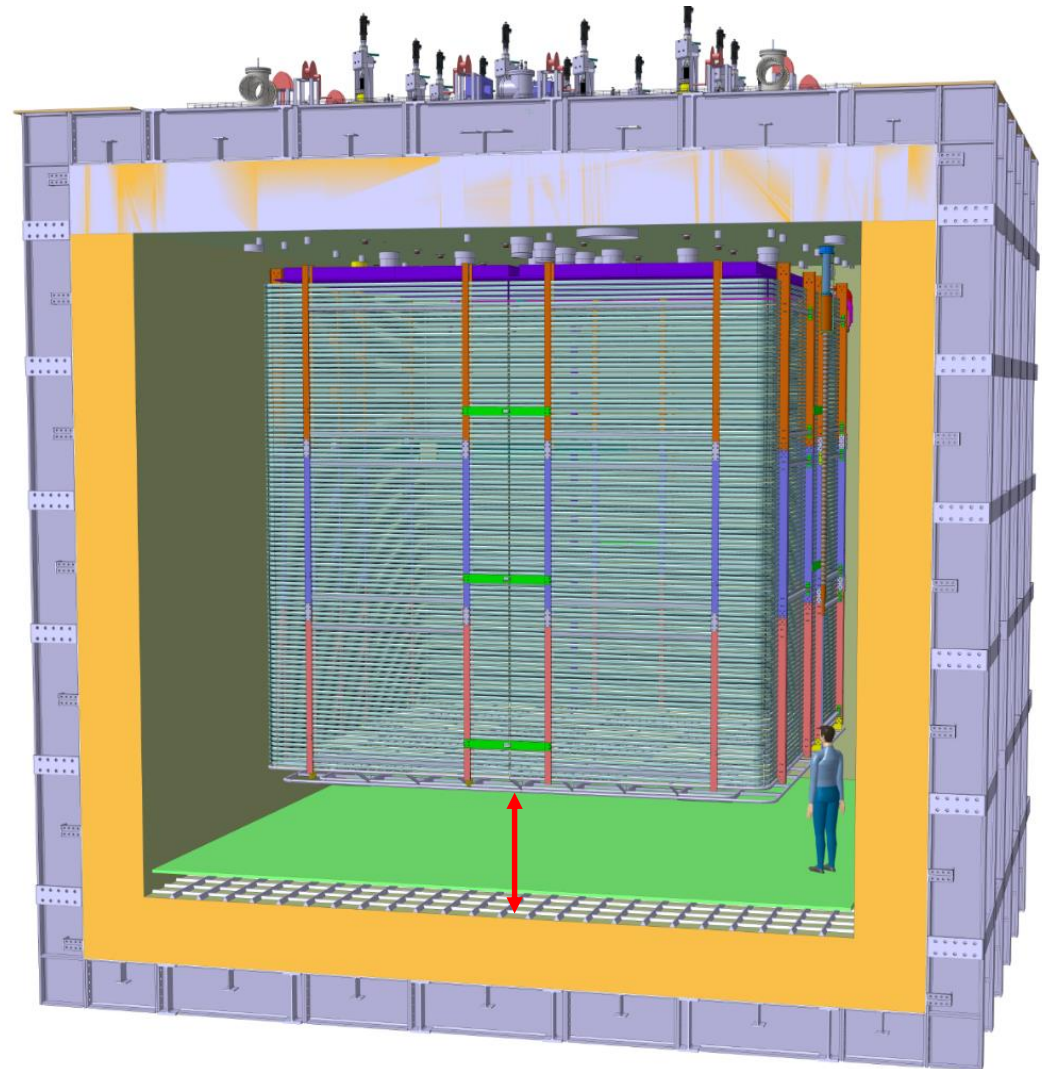
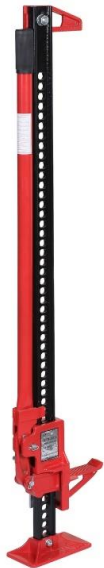
## 4) Field Cage, HV degrader and HVFT

- Install first 2/3 of the HV Degrader
- Insert HVFT
- Bring out personnel lift



## 7) Field Cage, Cathode and Groundgrid

- From this point movable stair will be used
- Install last sub modules
- Install missing clips and reinforcement
- Complete the degrader installation
- Lift the Cathode+Groundgrid and fix it to the field cage (manual lifter)

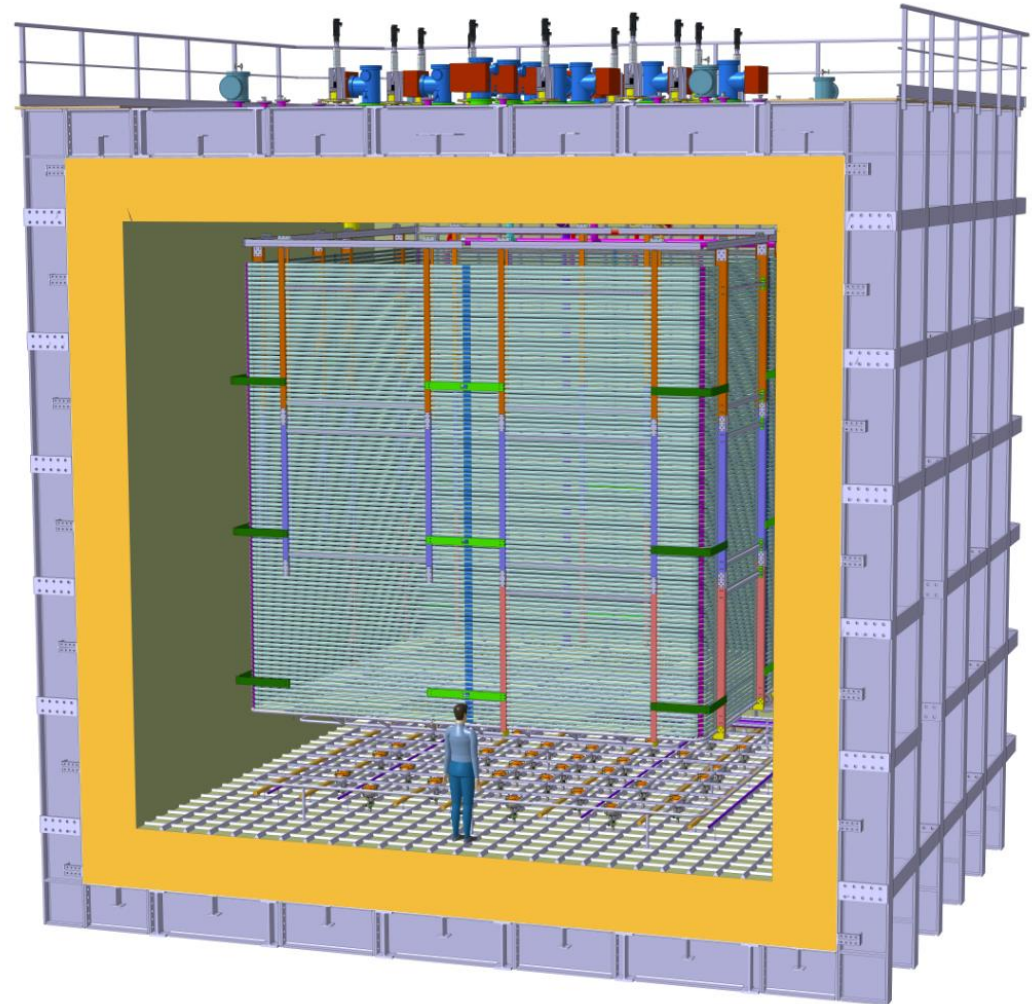


Membrane - Ground Grid distance: ~1.2m



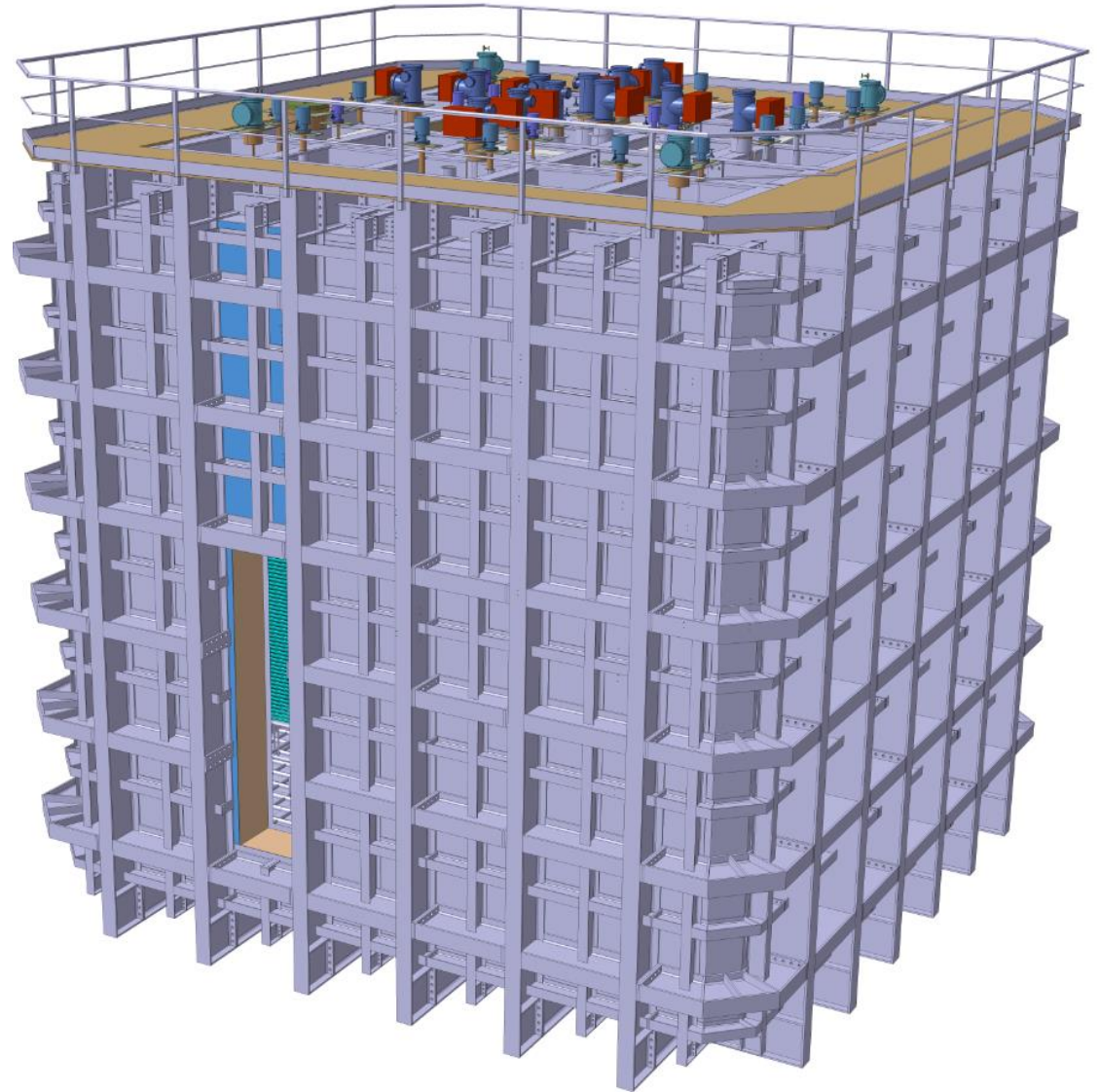
## 8-9) Removal of Construction Floor Groundrid and PMTs

- Removal of the Construction Floor
- Installation of the PMTs  
→ ~1.2m flat membrane to Groundgrid
- Positioning of the Groundgrid pillars
- Lowering of the Ground Grid
- PMTs cabling



## 10) Closure of the TCO

- TCO closed





Thank you

### Assembly in CRB 2 FTE

1 module per day 2 FTE. 24 modules->**24 days with 2 FTE**

### Installation in cryostat 4 FTE (can be parallelised with assembly in CRB)

bring inside, put in place hook and lift. 2 people bottom, 2 people top.

-1 week for lifting 8 submodules (1 row) 4 FTE

-1 week for lifting the next 8 submodules (2nd row) 4FTE

-1 week for fixing clips + contacting divider (2 scissor lifts with one person on each side of drift cage) 2 FTE

-2 weeks to bring and install cathode + GND grid 4FTE?

-1 week for installing last row 4 FTE

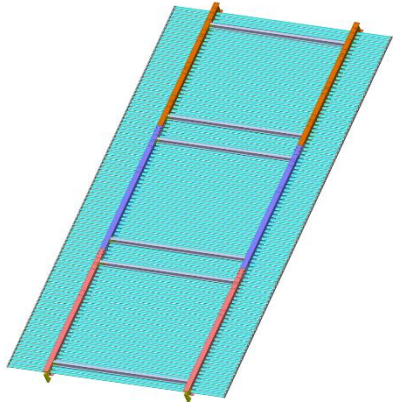
-1 week for fixing clips + electronics on last row 4 FTE

-1 week HVFT + degraders 2 FTE?

-1 week beam plug 2 FTE?

**=>Total installation in cryostat 9 weeks 4 FTE in average**

# Preliminary weight Calculation of the Detector:

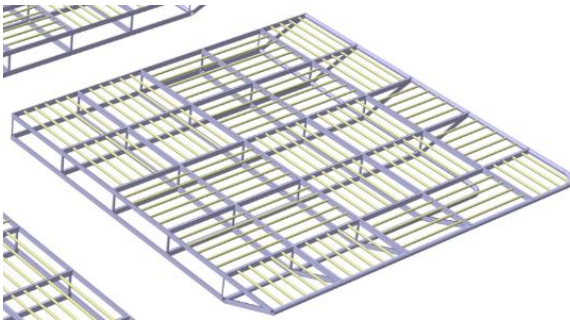


- 98 SS Profiles:  $1.2 \text{ Kg} \times 98 = 81 \text{ Kg}$
- FR-4 Beams and Reinforcements 65 kg

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FC Module  $146 \text{ Kg} \times 8 \text{ Modules} = 1168 \text{ Kg}$

Sub module weight:  $\sim 50 \text{ Kg}$



- Cathode Module: 136 Kg
- Pipe Grid 35 Kg

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Module weight  $171 \text{ Kg} \times 4 \text{ Modules} = 684 \text{ Kg}$

- Additional FC reinforcement  $\sim 100 \text{ Kg}$
- Hanging System  $\sim 100 \text{ kg}$
- Details (HV divider, small connection, bolts etc..)  $\sim 100 \text{ Kg}$

Total FC weight estimation  $\sim 2,2 \text{ Tons}$