Drift cage design

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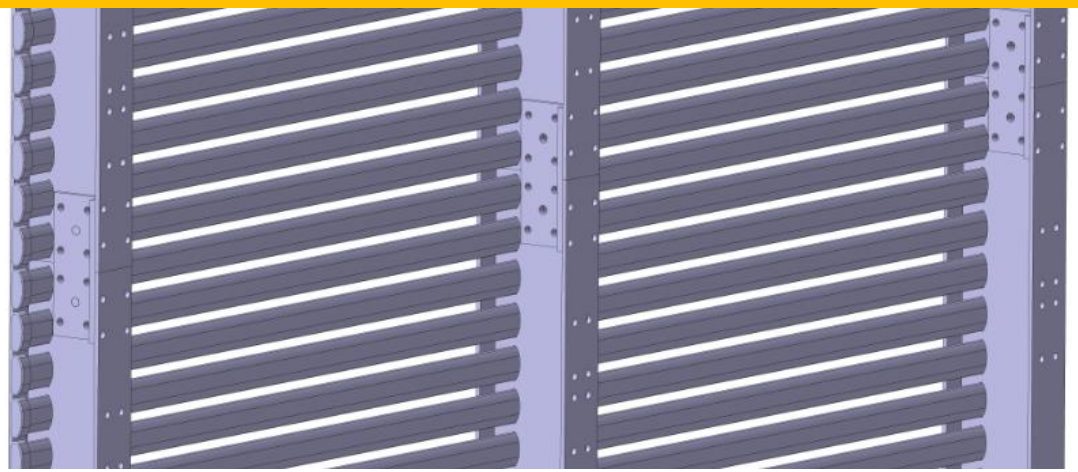
Drif cage design:

- Overview
- Modules
- Hanging System and manual Lifter
- Clips
- HV degrader connection at the Drift Cage
- PC Board Voltage divider connection

Top Field Cage Modules from Dune SP

~2300mm Width
~3500mm Height

- Collaboration with SP ProtoDune design in order to have a «common» Field Cage design
- Idea was to use similar design for SP and DP Field Cage (same construction elements)
- Possible design for the DP Drift Cage, is to use the top horizontal modules (with additional reinforcement)



Top Field Cage Modules from Dune SP

~2300mm Width
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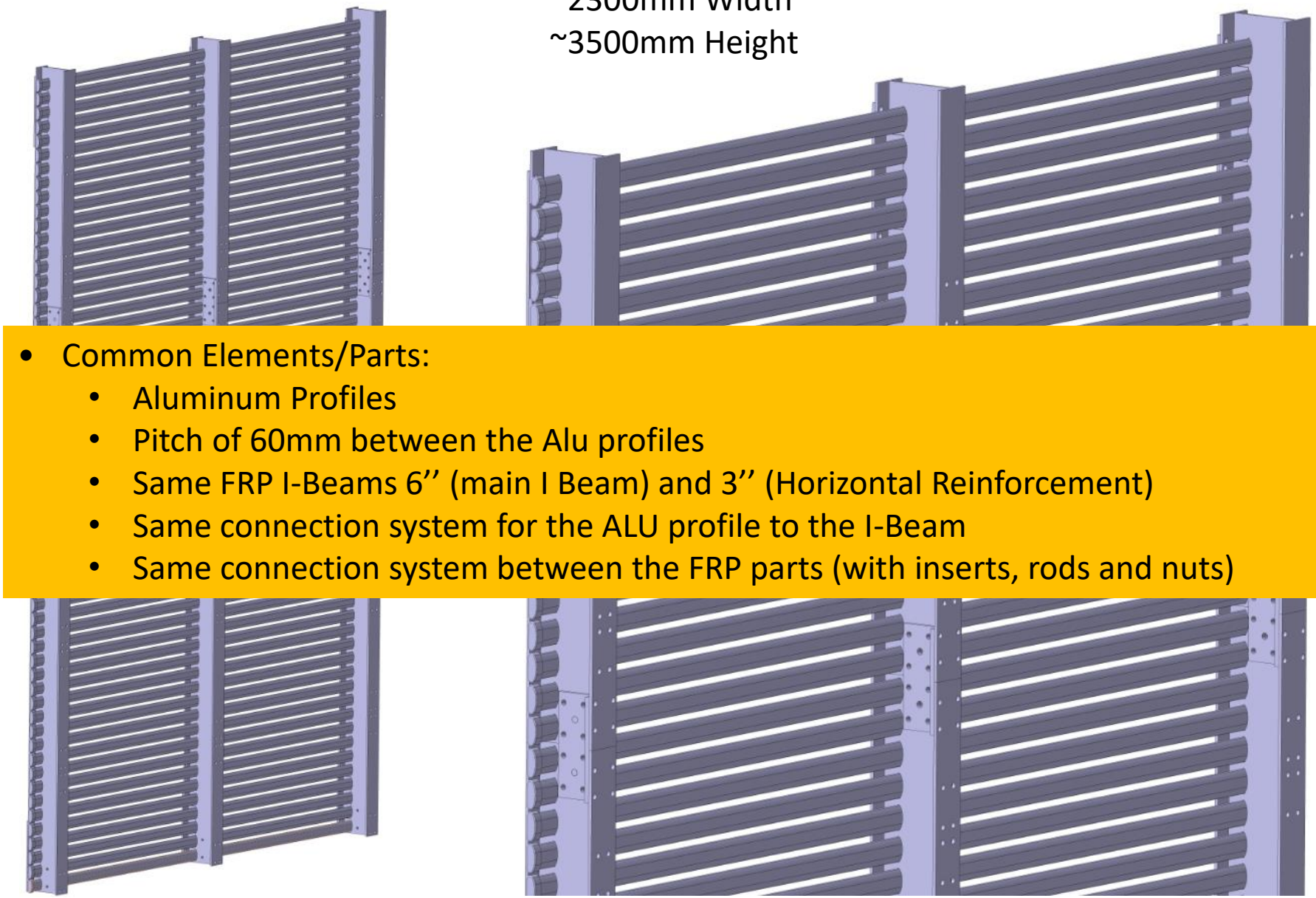
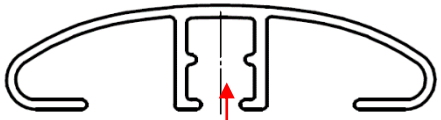


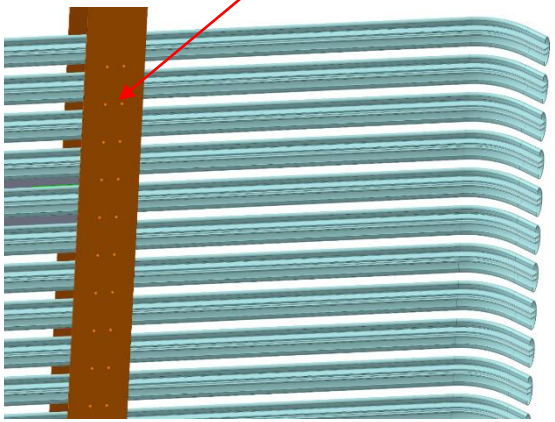
- Common Elements/Parts:
  - Aluminum Profiles
  - Pitch of 60mm between the Alu profiles
  - Same FRP I-Beams 6’’ (main I Beam) and 3’’ (Horizontal Reinforcement)
  - Same connection system for the ALU profile to the I-Beam
  - Same connection system between the FRP parts (with inserts, rods and nuts)

Overview

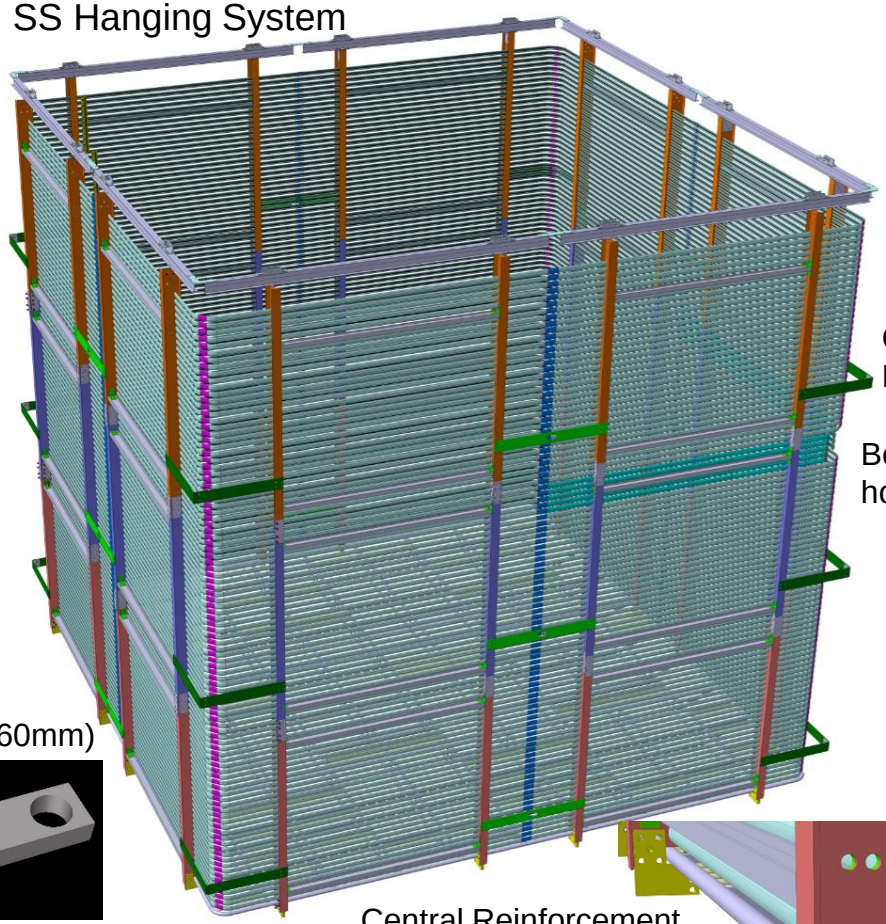
- HV divider Column



- M4 Slip nut inserted in the profile
- Alu Profiles fixed at corner side with M4 screws (reduce ALU shrinking at the corner)



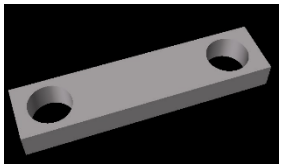
SS Hanging System



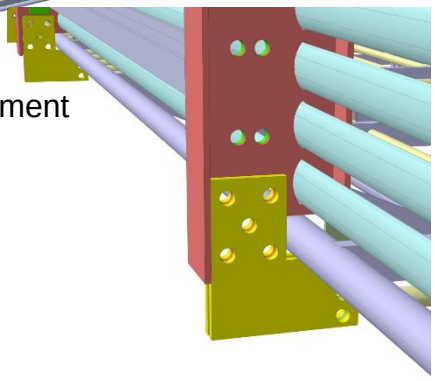
Corner Reinfocement

Beam Plug hole

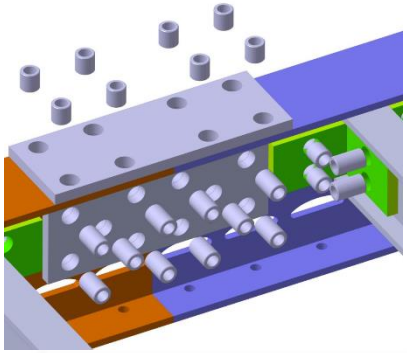
M4 slip nut (60mm)



Central Reinforcement



Cathode Connection

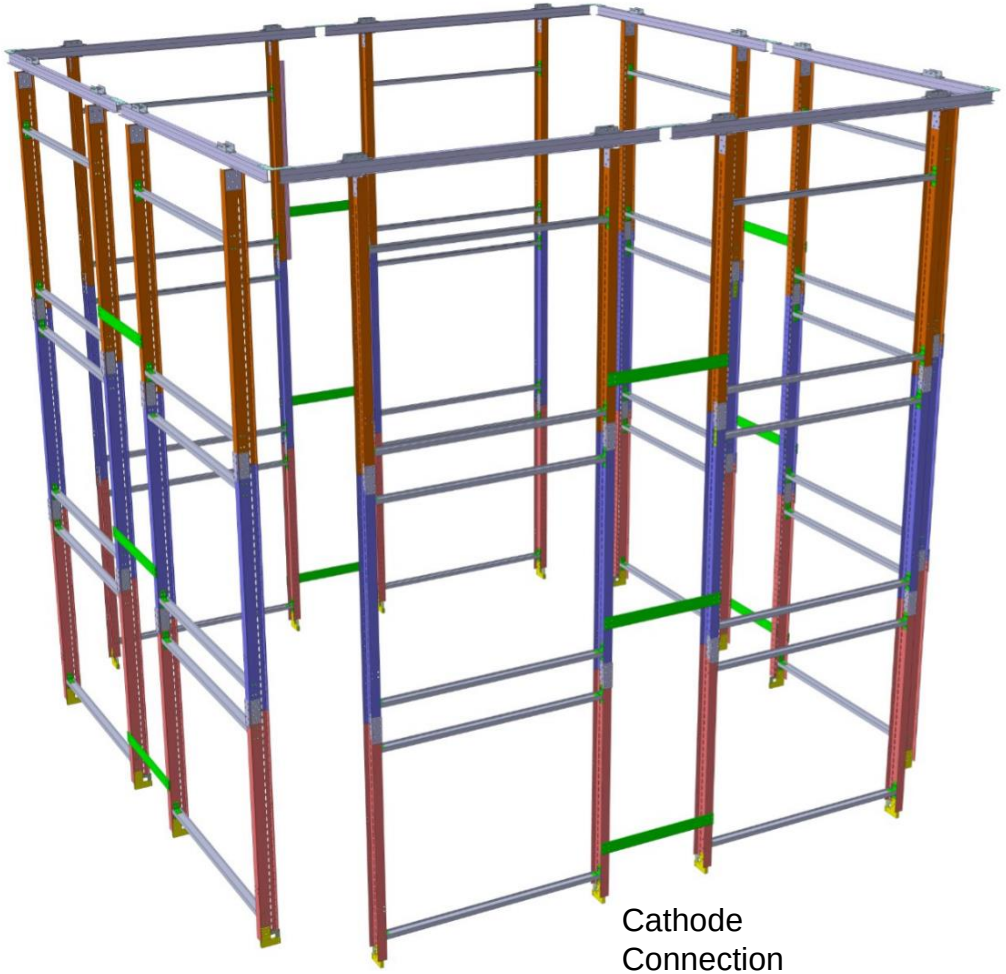


All connections:

- G10 inserts
- FRP Rod and Nuts

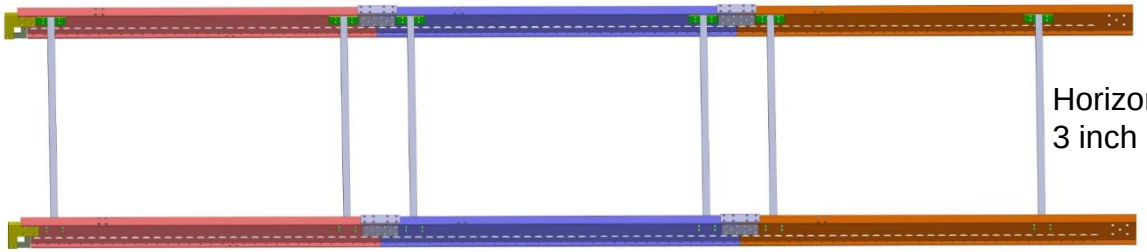
Overview

- FRP skeleton consists in 8 identical modules
- Each modules has 3 sub-modules
- Hanging system is Stainless Steel



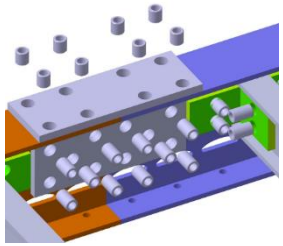
Cathode Connection

6-inch Main I-Beam



Horizontal Reinforcement
3 inch I-Beam

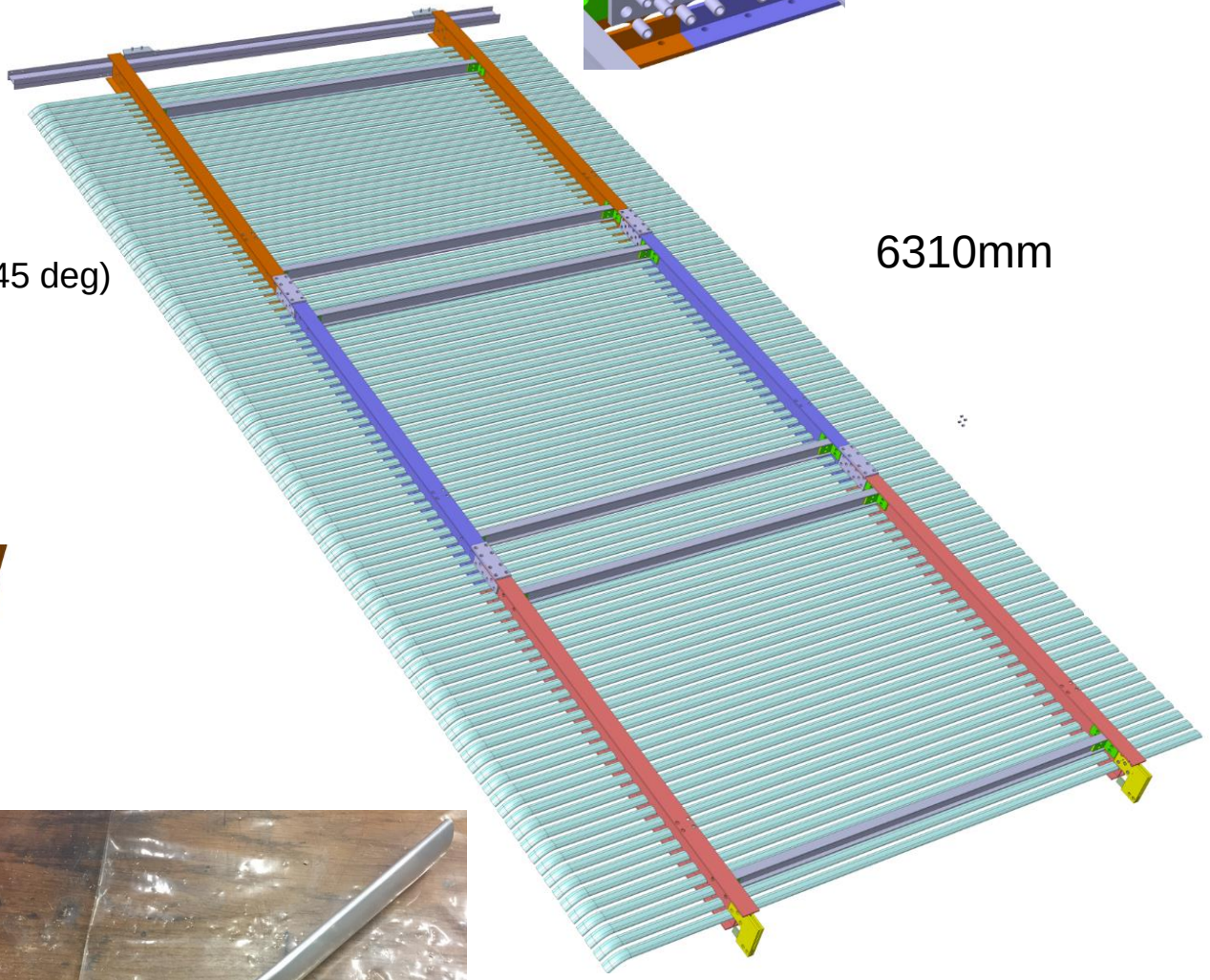
Modules



All connections:
- G10 inserts
- FRP Rod and Nuts

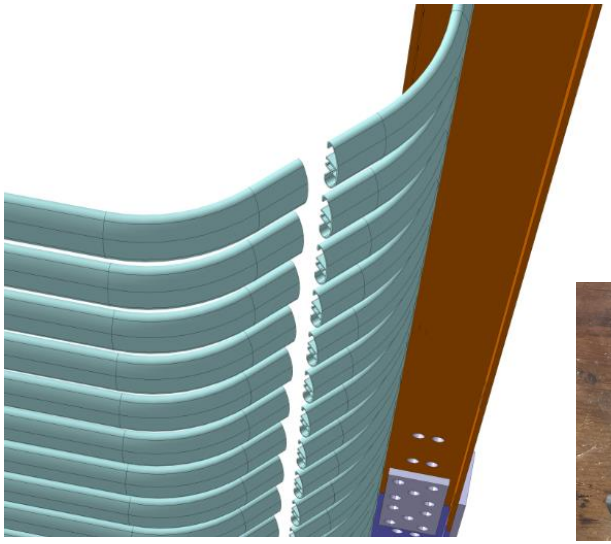
3010mm

SS Hanging System



6310mm

- 98 ALU Profile (One end bended 45 deg)
- Pitch of the Alu Profile is 60mm

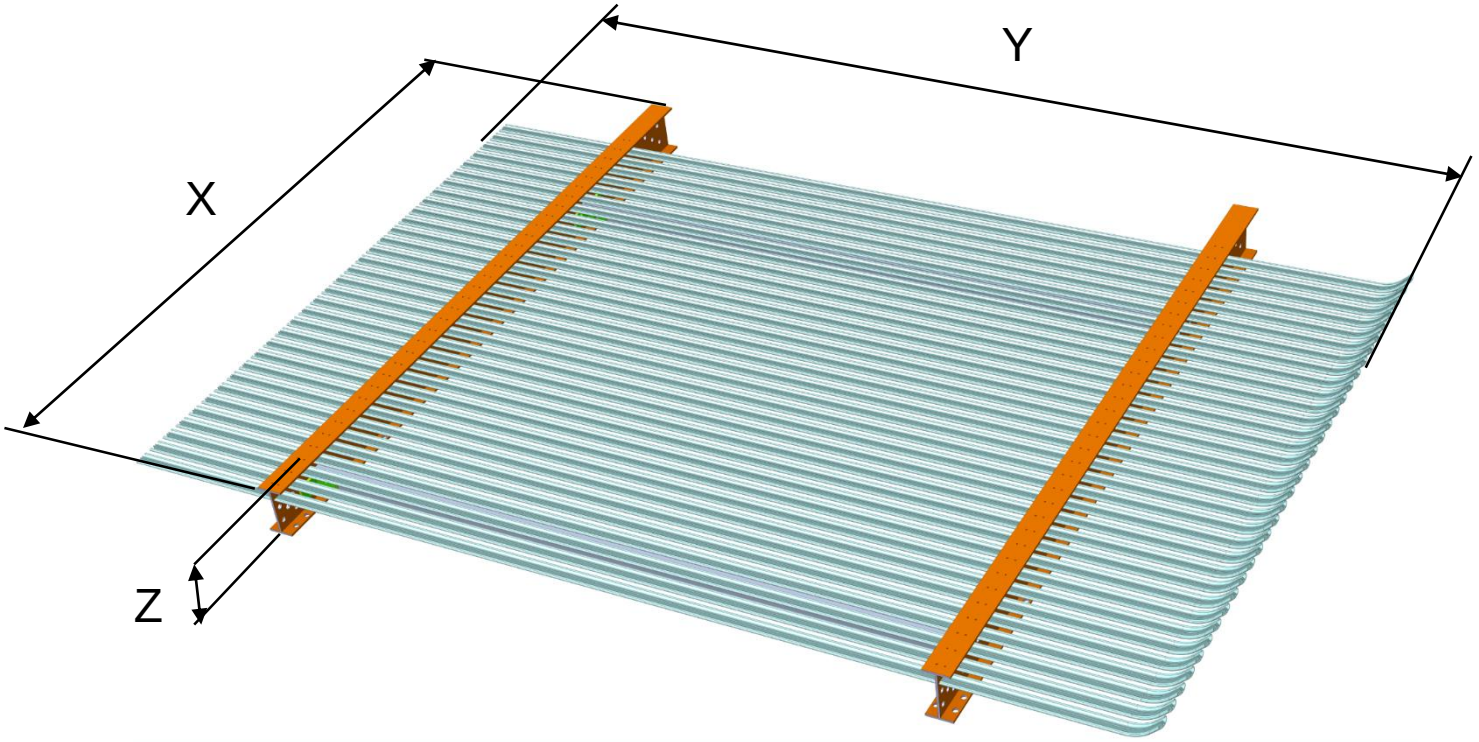


Cathode Connection

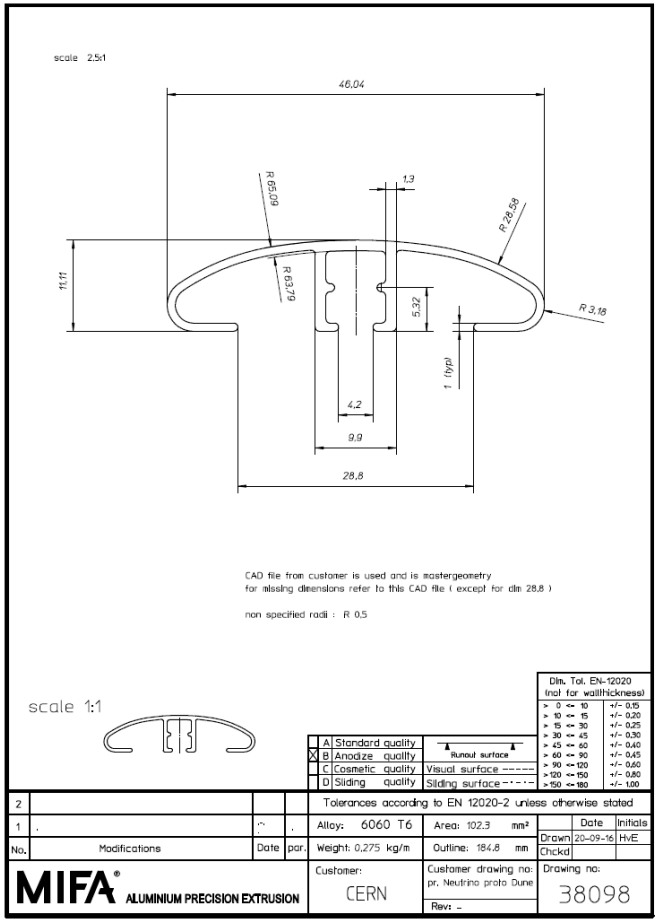
Modules

- Sub- Modules of the Field Cage

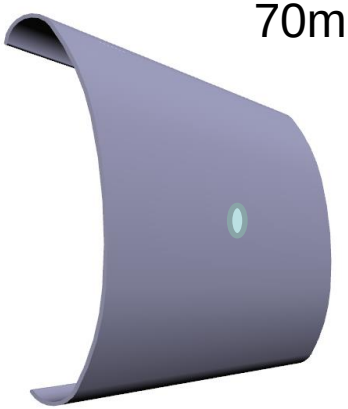
Sub Module	X	Y	Z
1st Sub-Module	2180	3050	165
2nd Sub-Module	1980	3050	165
3rd Sub-Module	1980	3050	165



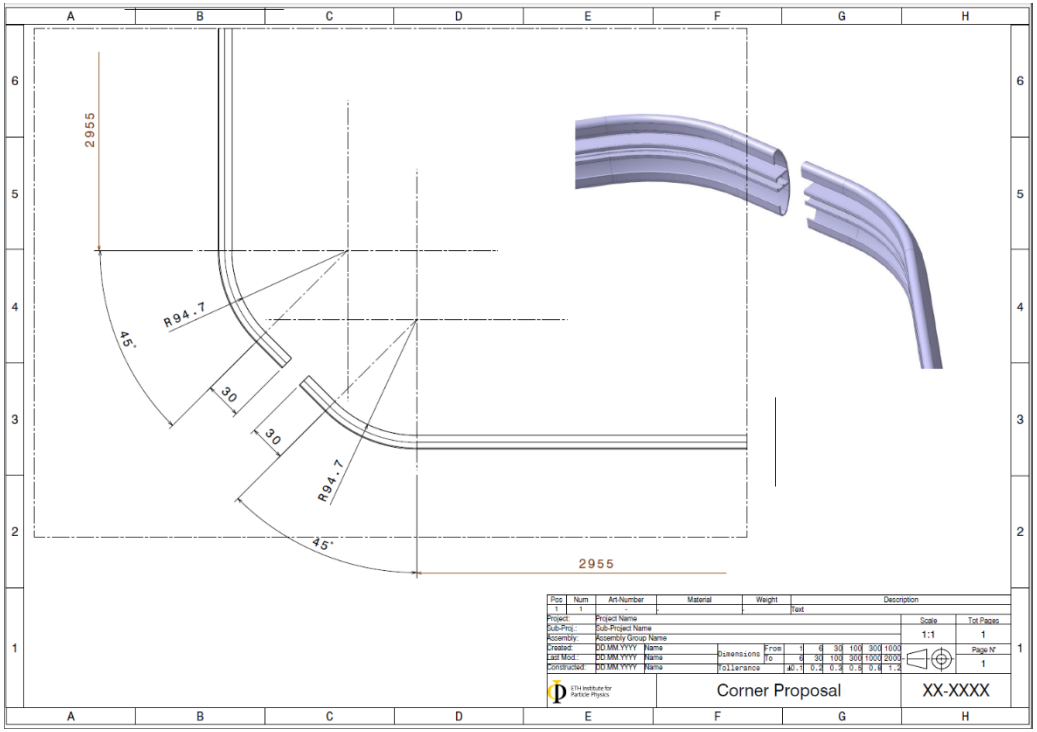
Profile design



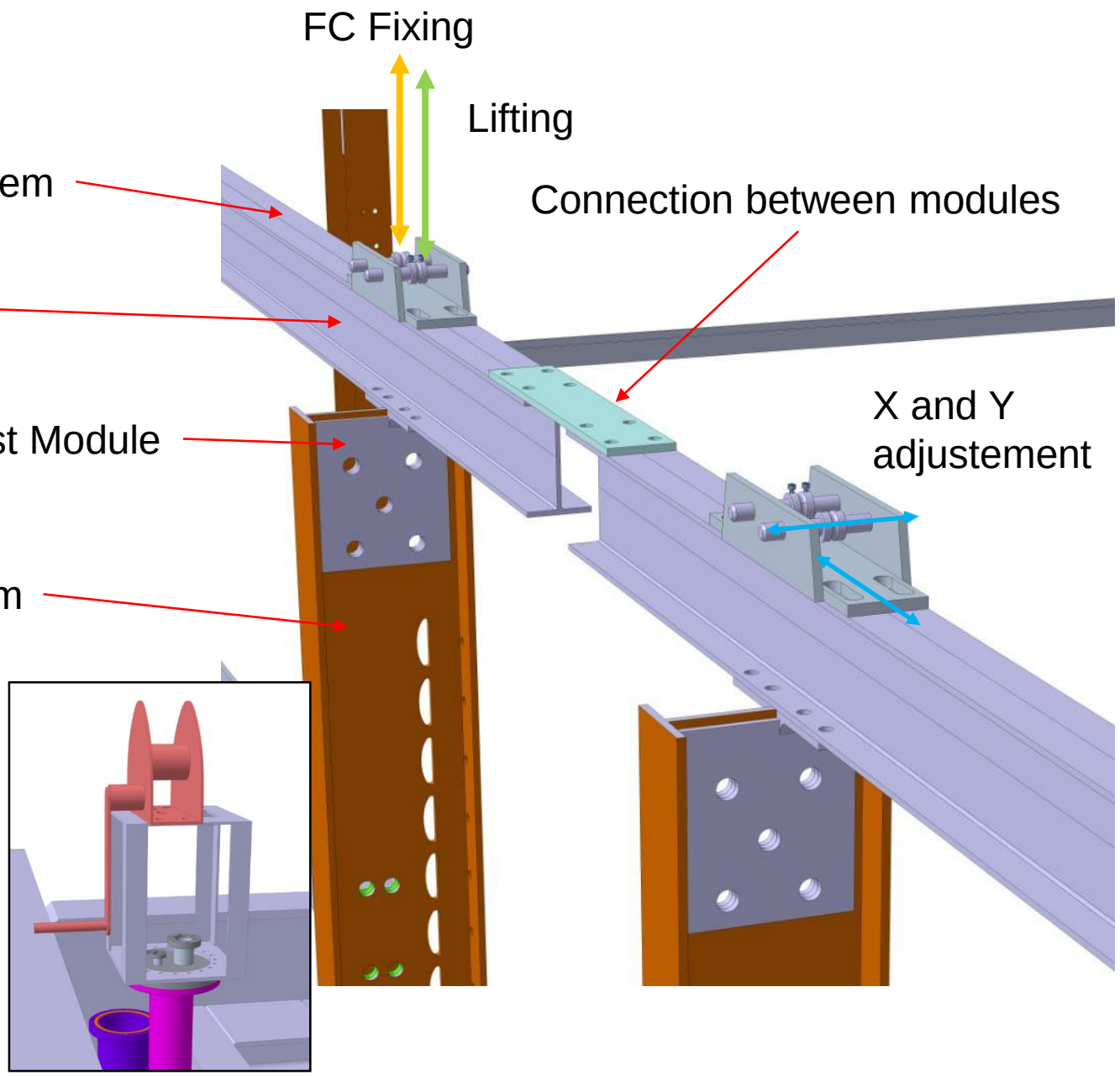
70mm Clip Profile.



Profile 45deg shape design



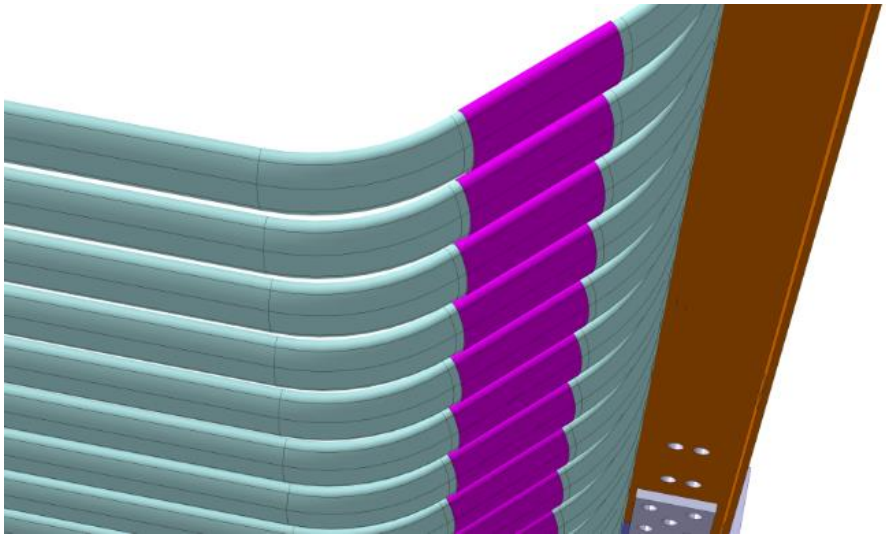
Hanging System



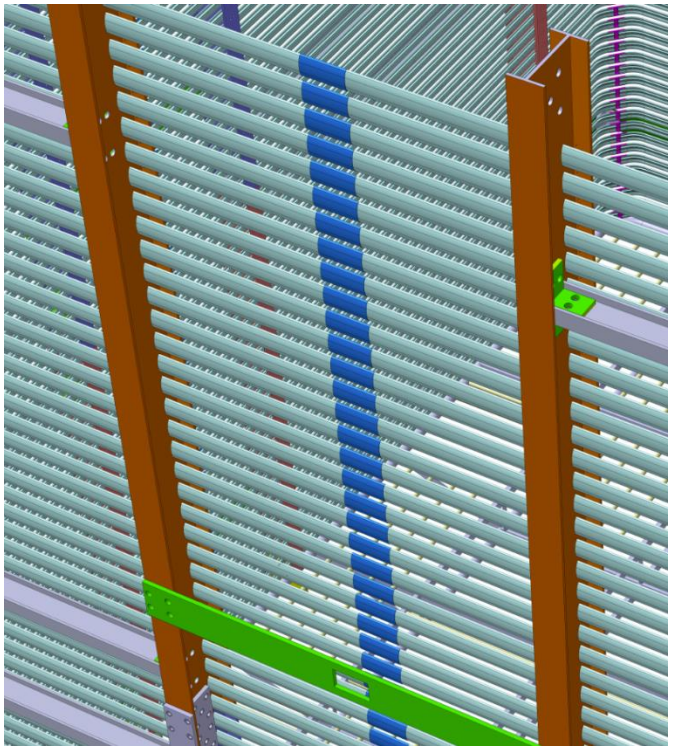
12 x FC SPFT

- CF160 with 2 Small Chimney
- CF40 Field Cage Lifting
- CF16 Field Cage fixing

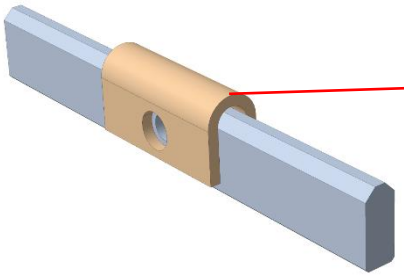
Clips

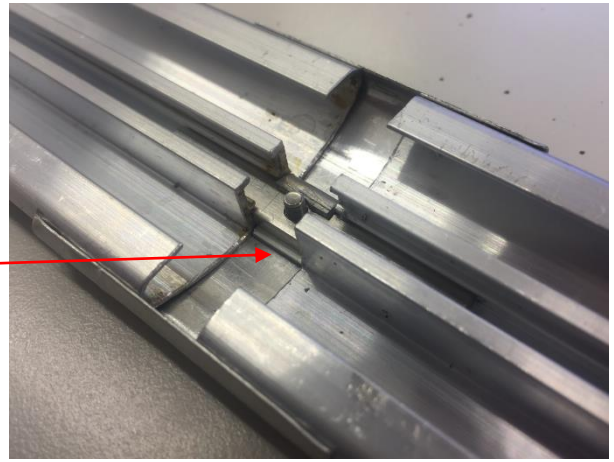


All the clips are straights



Alu Bar + spacer

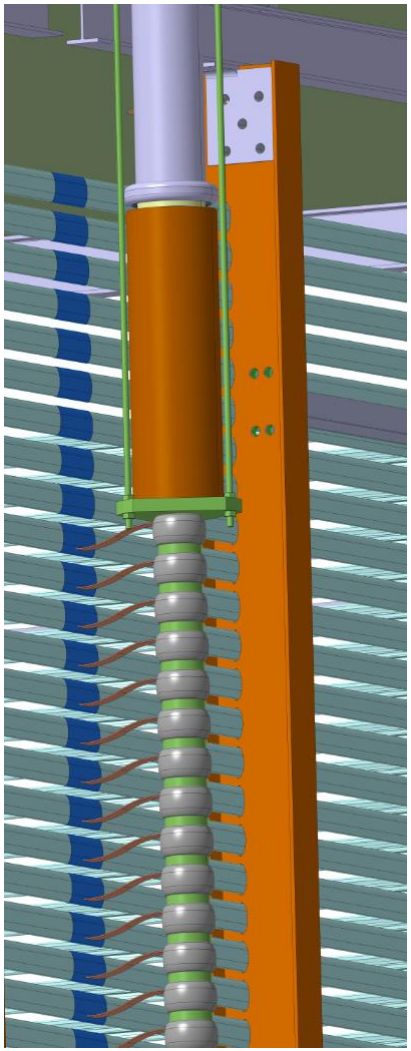




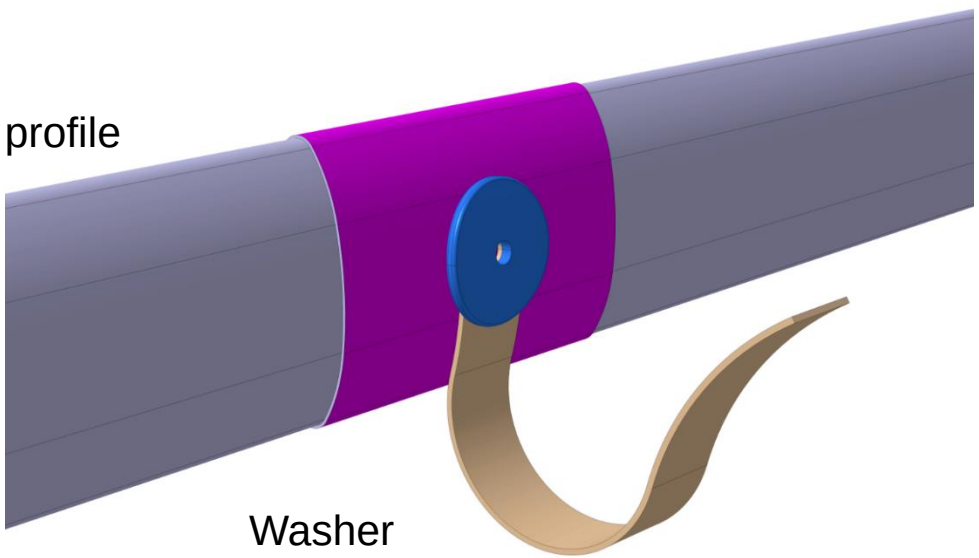
Centered with a bar in the profile and the clip is fixed to the bar with a screw → mechanical and electrical connection ensured.

HV degrader connection at the Drift Cage

HVFT



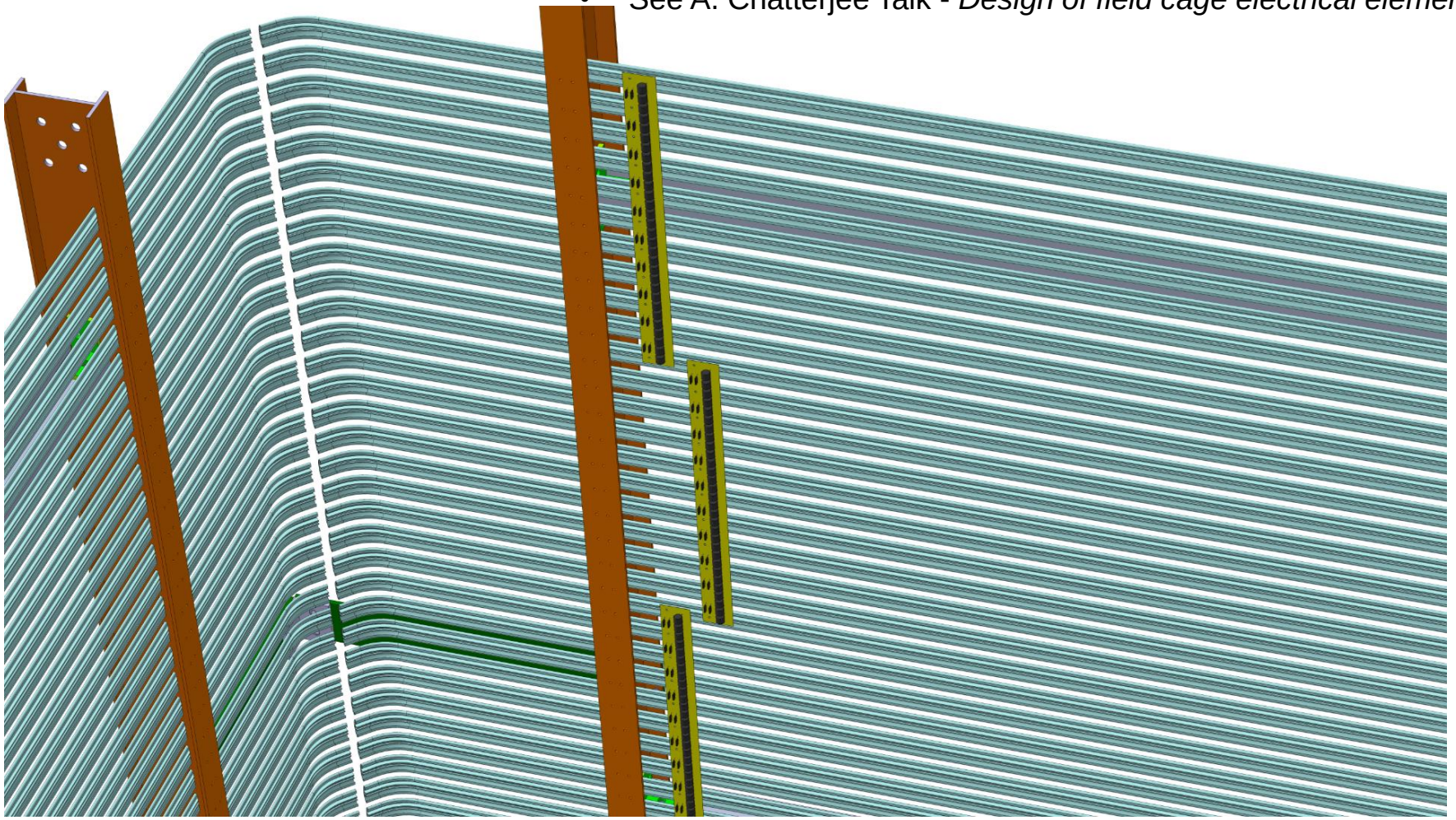
HV degrader



See L. Molina Bueno Talk - *HV system design*

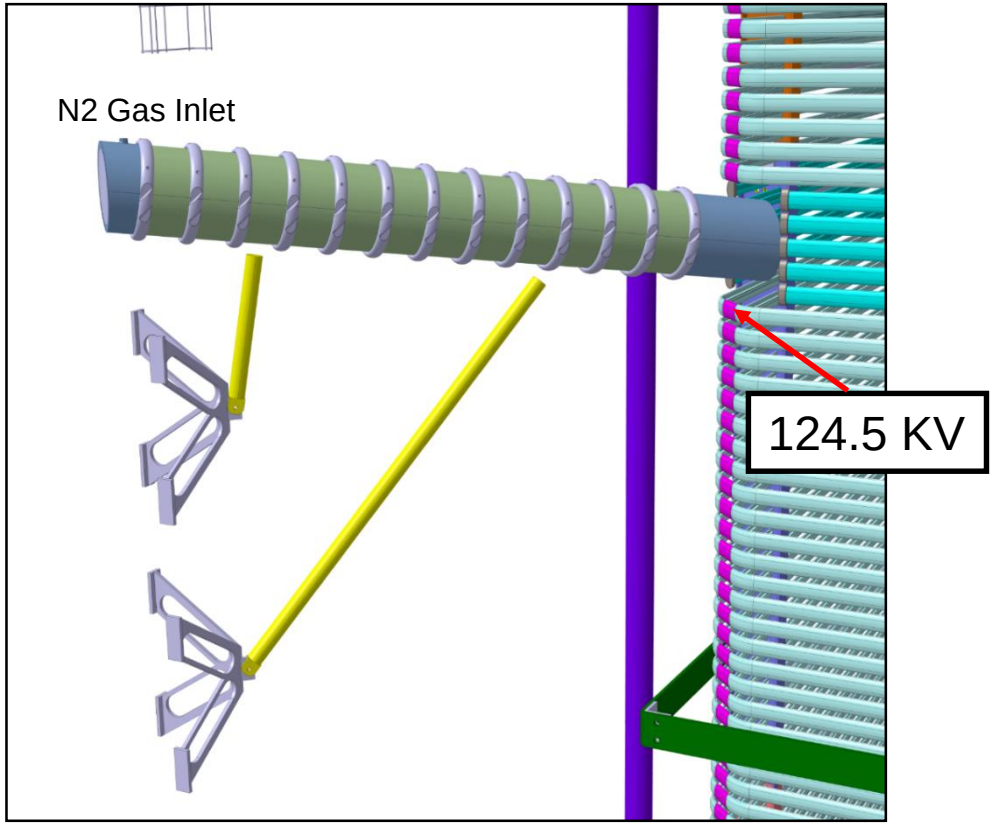
PCB Board Voltage Divider Connection

- PCB Board HV divider connect 11 profiles
- 2 Columns forseen
- Connection 1 overlapp each PCB board
- Connected with M4 Slip nuts and screw to the Alu Profile (same fastening system as for the Alu profiles- FRP I-Beam)
- See A. Chatterjee Talk - *Design of field cage electrical elements*



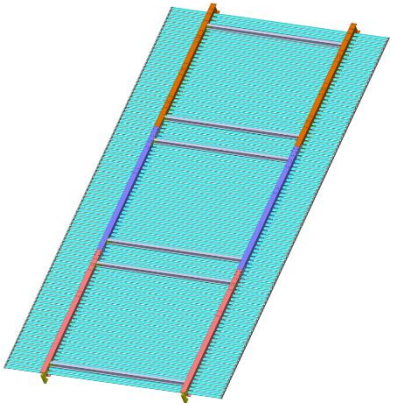
Beam Plug

- Single Phase Design less challenging
- 1.7m Lenght
- Filled with Nitrogen Gas (~1 bar)
- HV Degrader from 0 to124.5 KV
- 13 Field Rings
- Fixed at the Cryostat Corner (as for the cryogenic pipes fixation can be done) → decoupled from Drift cage



Thank you

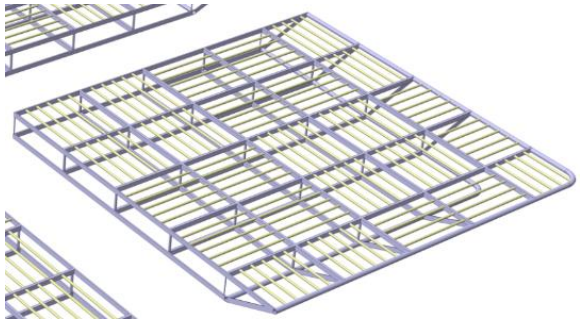
Preliminary weight Calculation of the Detector:



- 98 SS Profiles: 1.2 Kg x 98 = 81 Kg
- FR-4 Beams and Reinforcements 65 kg

FC Module 146 Kg x 8 Modules = 1168 Kg

Sub module weight: ~50Kg



- Cathode Module: 136 Kg
- Pipe Grid 35 Kg

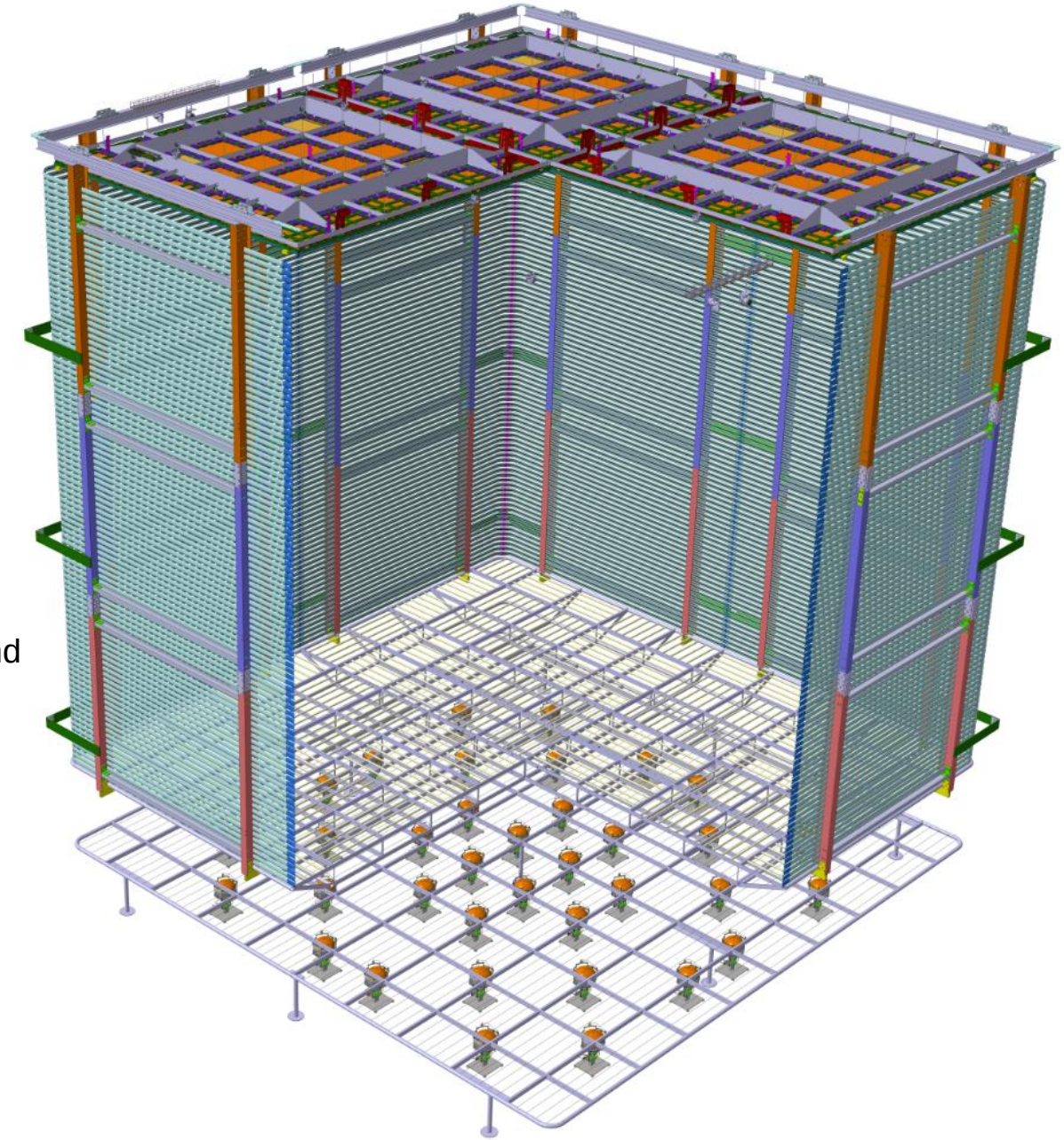
Module weight 171 kg Kg x 4 Modules = 684 Kg

- Additional FC reinforcement ~100 Kg
- Hanging System ~ 100 kg
- Details (HV divider, small connection, bolts etc..) ~100 Kg

Total FC weight estimation ~2,2 Tons

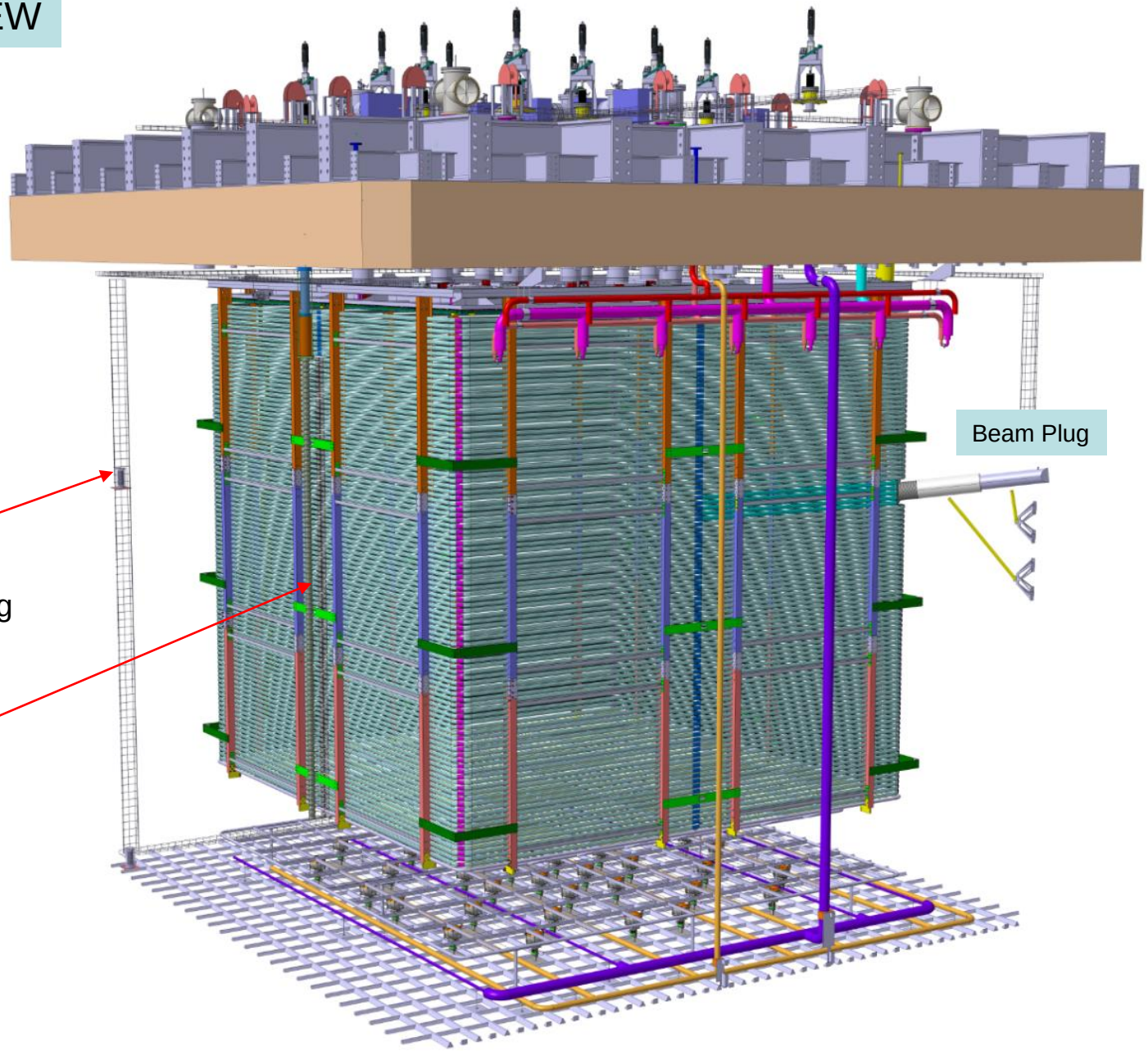
DETECTOR OVERVIEW

- 4x CRP Modules 3x3m²
  (B. Aimard - *CRP Design)*
- Field Cage (8x Modules)
- Cathode (4x Modules)
- GroundGrid (4x Modules)
- 36 x PMTs → 2 Layouts, both compatible with Internal Cryogenic and actual design of the Groundgrid



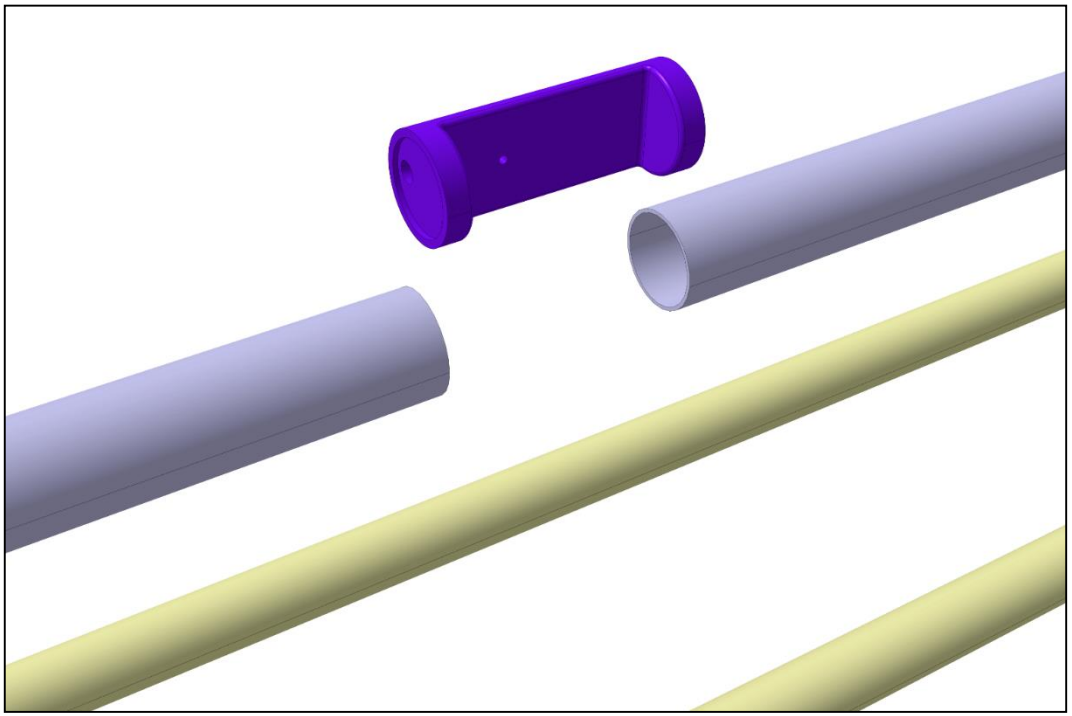
DETECTOR OVERVIEW

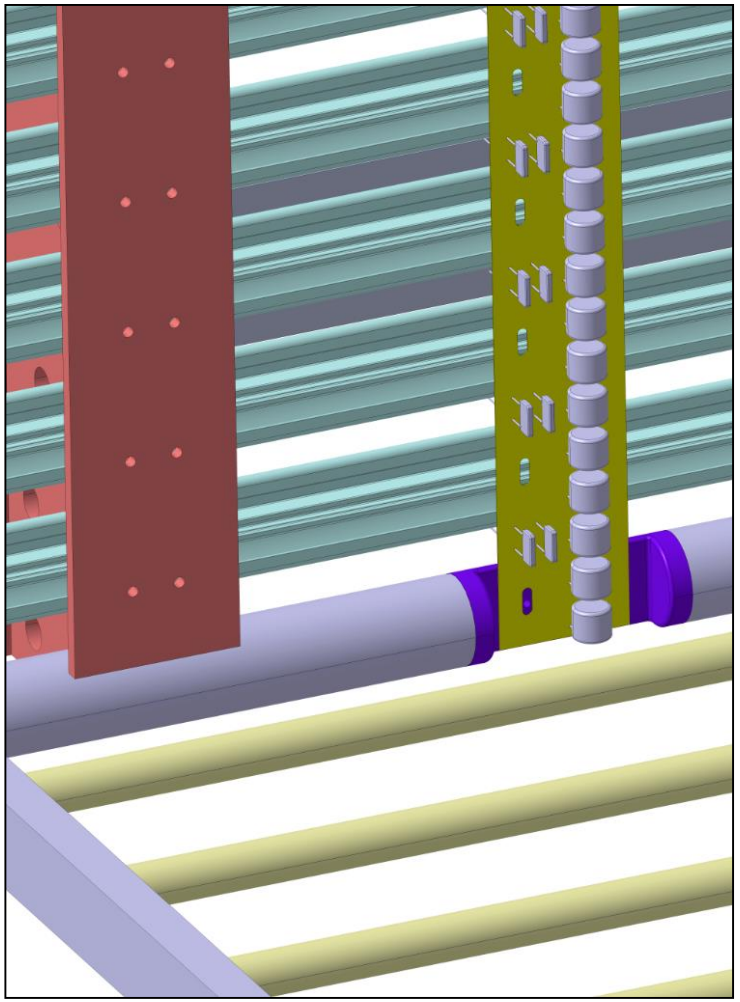
- Top FTs
- Internal Cable Trays
- 4 x Purity Monitor
- Internal Cryogenic piping
- Beam Plug
- HVFT degrader



PCB Board Voltage divider connection

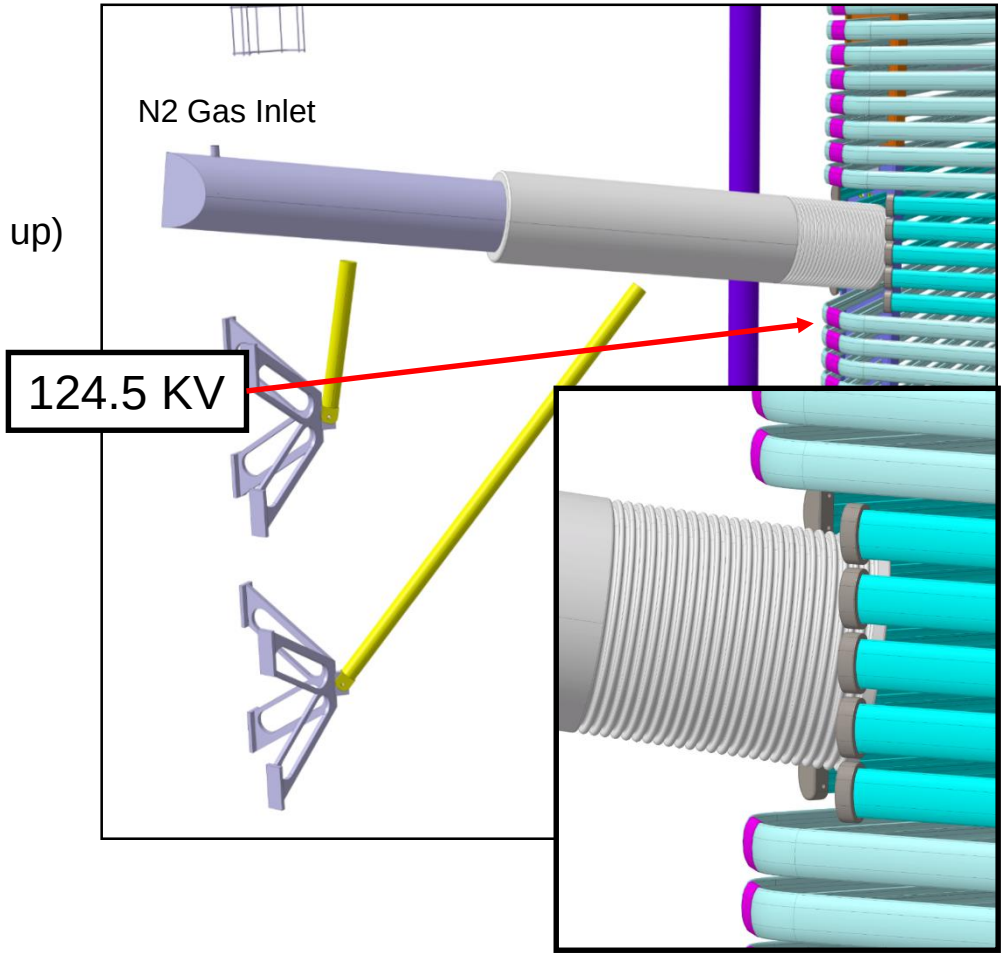
- 2 modules have special connection for the PCB Board
- Full rod (dia 40mm) insert of 100mm lenght machined in order to accomodate the PCB Board





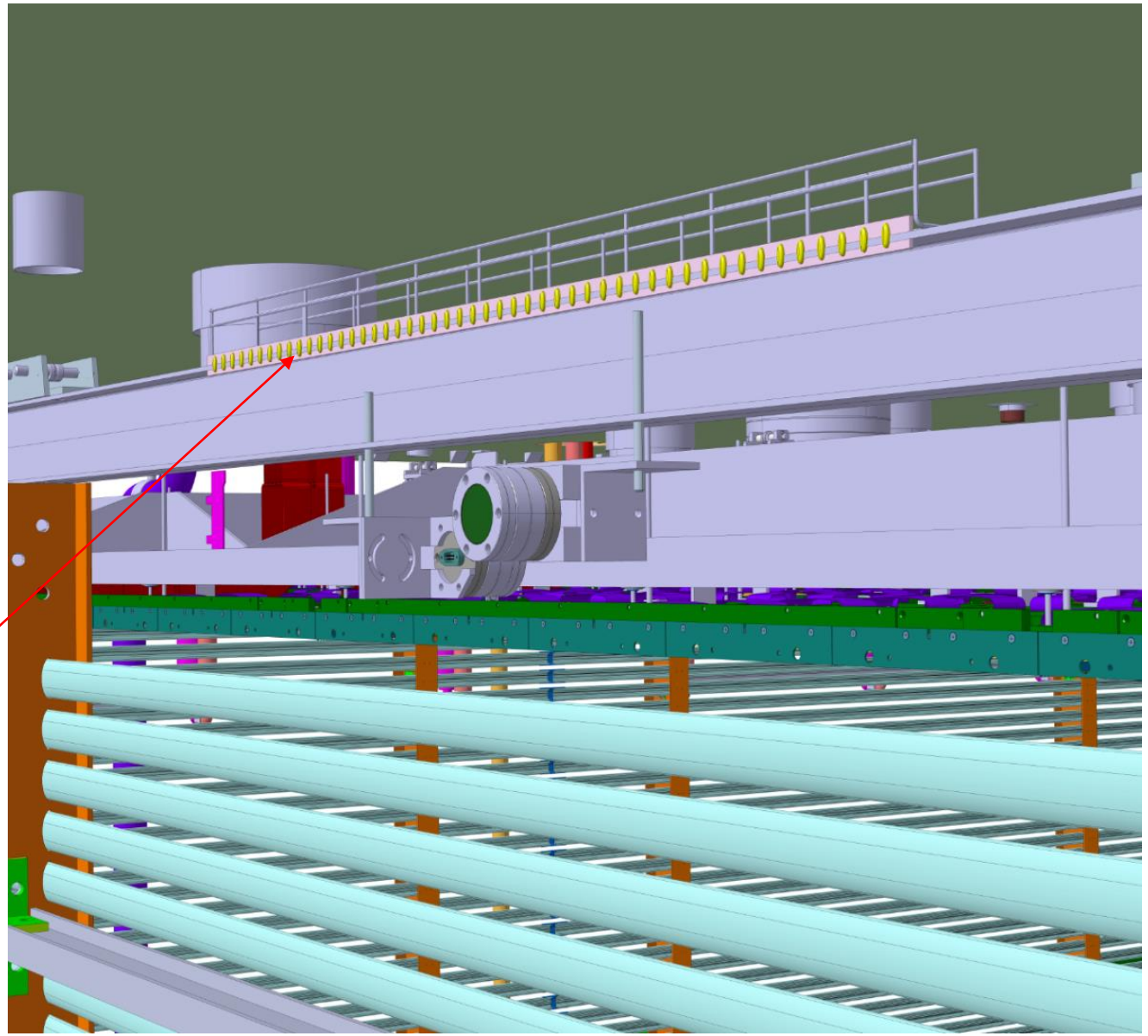
Beam Plug without HV degrader:

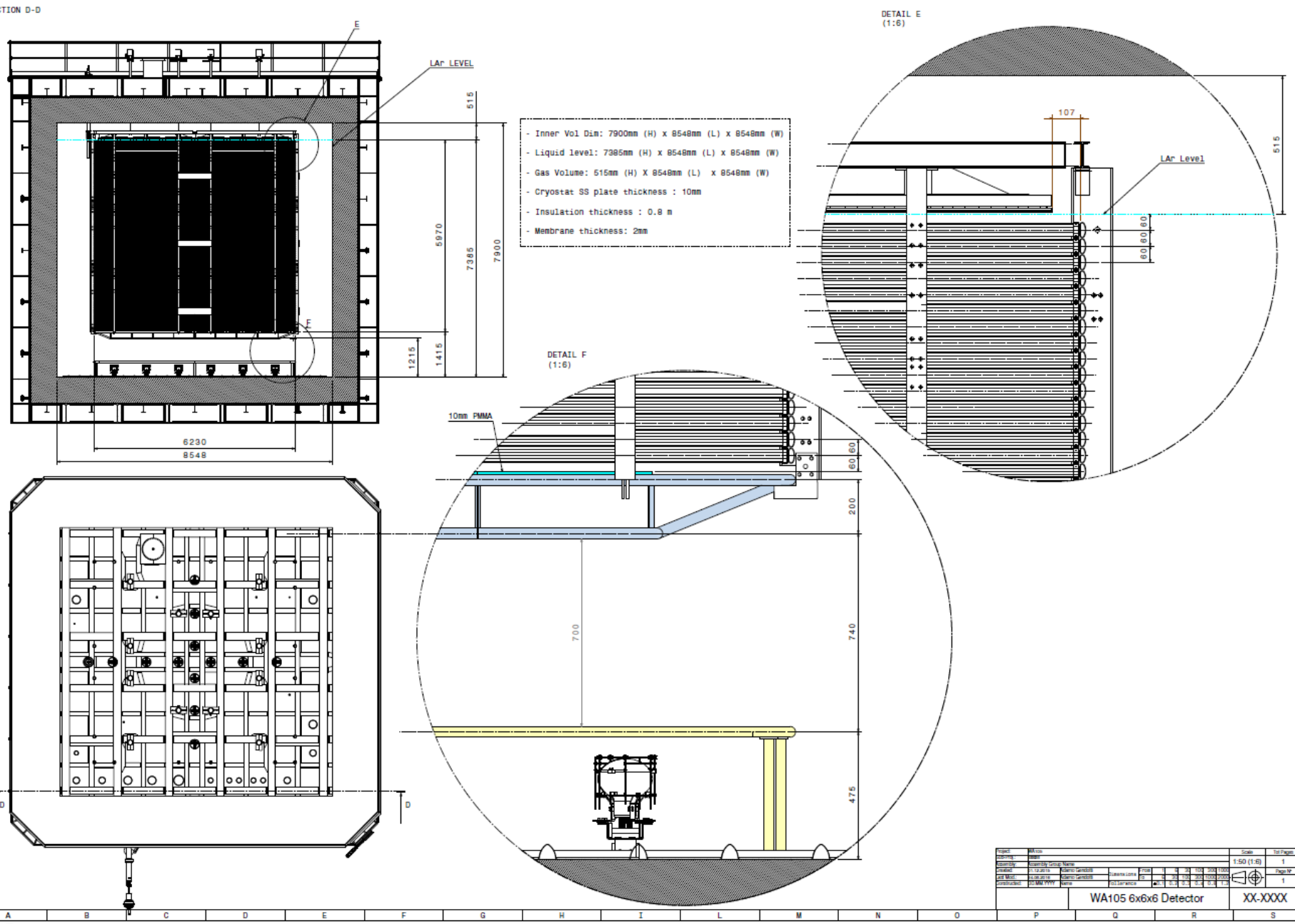
- No Voltage Degrader
- Corrugated Insulator (avoid surface charging up)
- High Molecular Density PE
- Filled with Nitrogen (~1bar)
- Fixed at the Cryostat



DETECTOR OVERVIEW

- 4 x Cryocameras
- Same design of the 3x1x1
- Fixed at the Top SS I-Beam of the Field Cage modules
- LEDs




SECTION D-D
E
LAr LEVEL
515
5970
7385
7900
1215
1415
F
6230
8548
- Inner Vol Dim: 7900mm (H) x 8548mm (L) x 8548mm (W)
- Liquid level: 7385mm (H) x 8548mm (L) x 8548mm (W)
- Gas Volume: 515mm (H) X 8548mm (L) x 8548mm (W)
- Cryostat SS plate thickness : 10mm
- Insulation thickness : 0.8 m
- Membrane thickness: 2mm
DETAIL E
(1:6)
107
LAr Level
515
60 60 60
DETAIL F
(1:6)
10mm PMMA
60 60
200
700
740
475
D
D
1:50 (1:6)
WA105 6x6x6 Detector
XX-XXXX