Drift cage design

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Drift 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
~3500mm Height

• 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)

All connections:
- G10 inserts
- FRP Rod and Nuts
• FRP skeleton consists in 8 identical modules
• Each module has 3 sub-modules
• Hanging system is Stainless Steel
SS Hanging System

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

Cathode Connection

All connections:
- G10 inserts
- FRP Rod and Nuts
• Sub-Modules of the Field Cage

<table>
<thead>
<tr>
<th>Sub Module</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
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</thead>
<tbody>
<tr>
<td>1st Sub-Module</td>
<td>2180</td>
<td>3050</td>
<td>165</td>
</tr>
<tr>
<td>2nd Sub-Module</td>
<td>1980</td>
<td>3050</td>
<td>165</td>
</tr>
<tr>
<td>3rd Sub-Module</td>
<td>1980</td>
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<td>165</td>
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Profile design

Profile 45deg shape design

70mm Clip Profile.
Hanging System

Hanging and lifting System

Top SS I-Beam

SS L connection to 1st Module

6 Inch module I-Beam

Connection between modules

Lifting

X and Y adjustment

FC Fixing

12 x FC SPFT

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

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 overlap 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
Overview

Beam Plug

- Single Phase Design less challenging
- 1.7m Length
- Filled with Nitrogen Gas (~1 bar)
- HV Degrader from 0 to 124.5 KV
- 13 Field Rings
- Fixed at the Cryostat Corner (as for the cryogenic pipes fixation can be done) → decoupled from Drift cage

N2 Gas Inlet

124.5 KV
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

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
• 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 length machined in order to accommodate 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