FEE cabling

Mu2e Calorimeter Meeting

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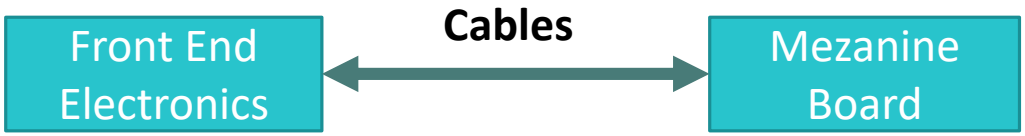
23rd April 2019

Overview

- Intro
- Technical specifications
- Design solution
- Naming proposal
- Mechanical support
- Mock up
- Next steps

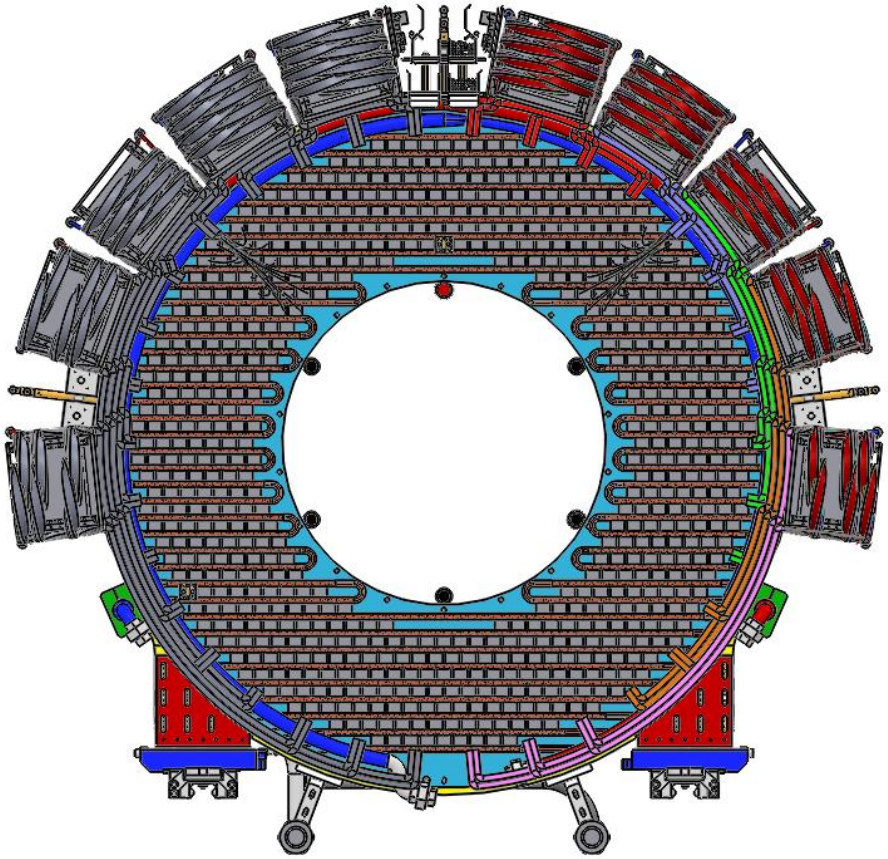
Intro

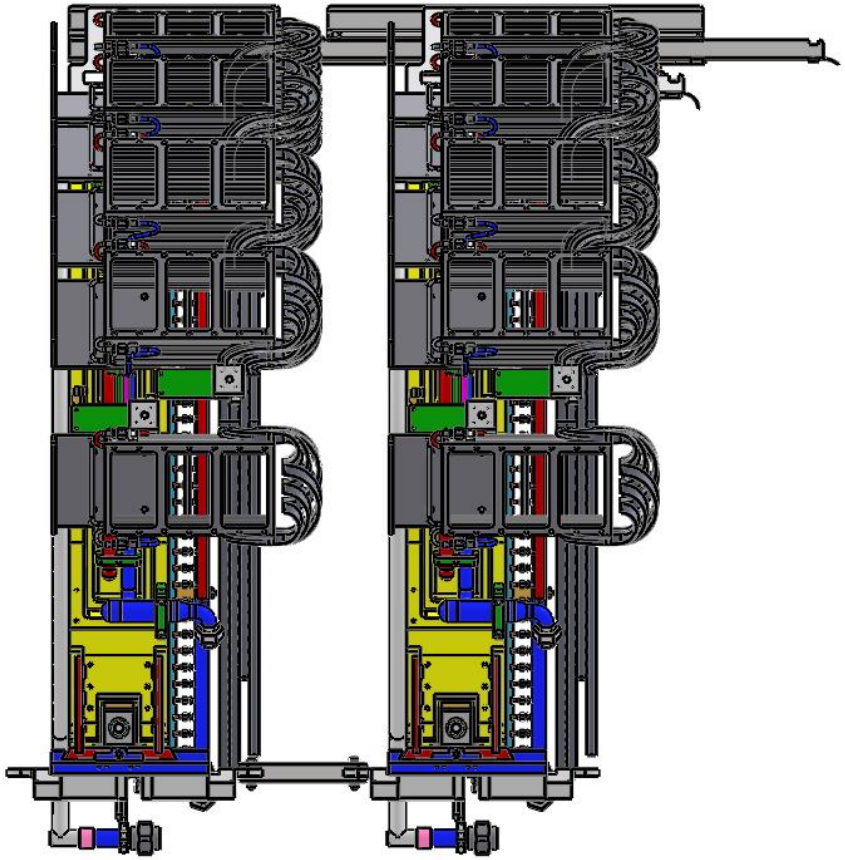


FEE-MB cabling

- Should be **robust** and **easy** to handle in the SiPM region
- Should be organized in **circular sectors** to distribute throughput in the DIRAC boards
- Should be divided tightly in **Left/Right** SiPMs groups
- Keep **same cable length** for channels inside a sector.
- Should be as **grouped** as possible
- Should have reduced **outgassing**
- Should be cabled in a way that provide **easy recognition**
- Should be **easy to disconnect** also in the crate regions
- Should **spare cables** already in position

Position





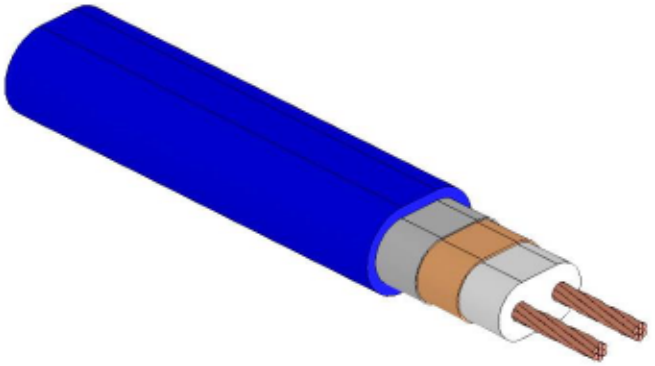
Cable

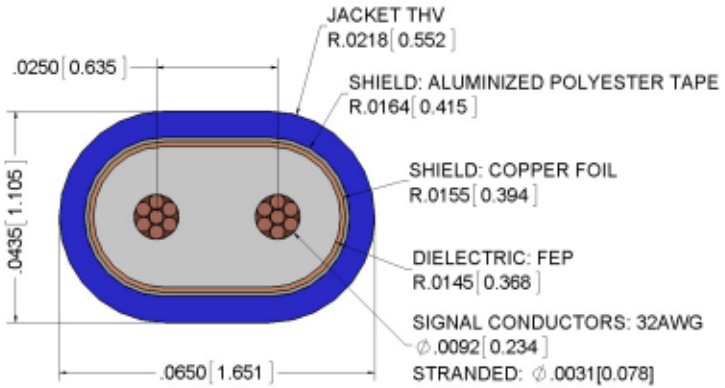
TTF-32100-12-T01-TB: 100 Ohm, 32AWG Micro Twinax Cable HT-THV

PERFORMANCE DATA

Capacitance: 14 pF/ft (nominal)
Skew: 10 ps/m within pairs
Propagation Delay: 1.46 ns/foot
Flex Cycles: 8,000 cycles, single*
Current Rating: Single Conductor = 2.2 Amps*
Two Conductors = 1.6 Amps*
Shield DCR: 120Ω/1000ft
CC DCR: 164Ω/1000ft
Min. Bend Radius: .125"
Availability: Single, tape bonded
Temperature Rating: -40°C to 140°C, UL VW-1 Tested ***
DWV Working Voltage: 250 V****
Performance Rating:

IL	.25m	1m
-3dB	14GHz	4GHz
-7dB	>20GHz	13GHz





Cable

TTF-32100-12-T01-TB: 100 Ohm, 32AWG Micro Twinax Cable HT-THV (Samtec-patented)

- Outgassing THV (Blue) - *Performed by factory*:
- Pressure $8.1 \cdot 10^{-6}$ torr
  - Total Mass Loss (TML): < 1.00%
  - Collected Volatile Condensable Material (CVCM): < 1.00%
- Radiation Hardness
  - Specimens have been irradiated -> to be tested

FEE Connector

ECDP-04-L2

- 1 connector per SiPM/Channel

SPECIFICATIONS

For complete specifications see www.samtec.com?ECDP

Cable:
30 AWG twinax cable
Plating:
Edge Card = ENIG, 3-10 microinches
Operating Temp Range:
-25 °C to +105 °C
Current Rating:
2.3 A per pin
(2 adjacent pins powered)
Impedance:
100 Ω Differential
Bend Radius:
(3.18 mm) .125"
Pinout Map:
See web address above
RoHS Compliant:
Yes

RECOGNITIONS

For complete scope of recognitions see www.samtec.com/quality

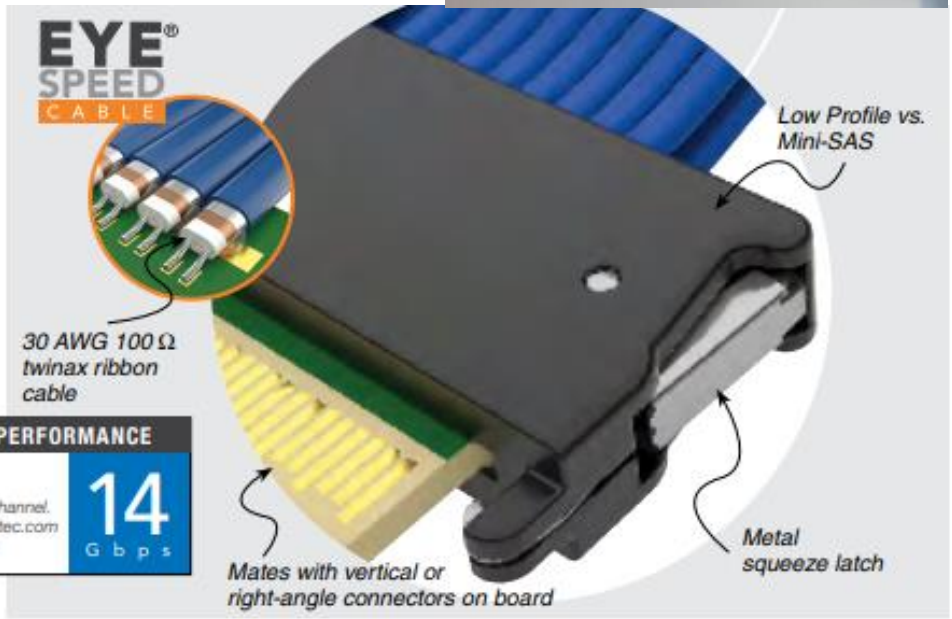
Mates with:
HSEC8 (–L2 option),
HSEC8 (–BL option)

HIGH-SPEED CHANNEL PERFORMANCE

ECDP

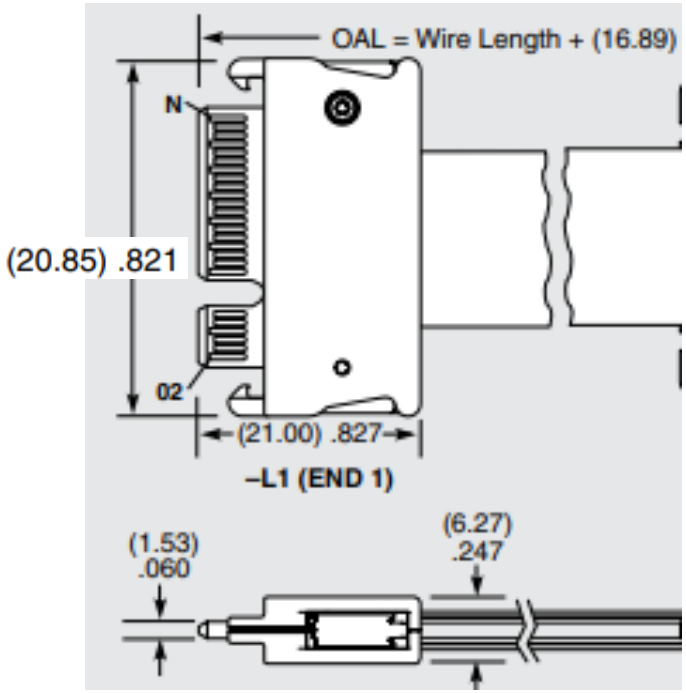
Rating based on Samtec reference channel. For full SI performance data visit Samtec.com or contact SIG@samtec.com

14 Gbps



FEE Connector

ECDP-04-L2



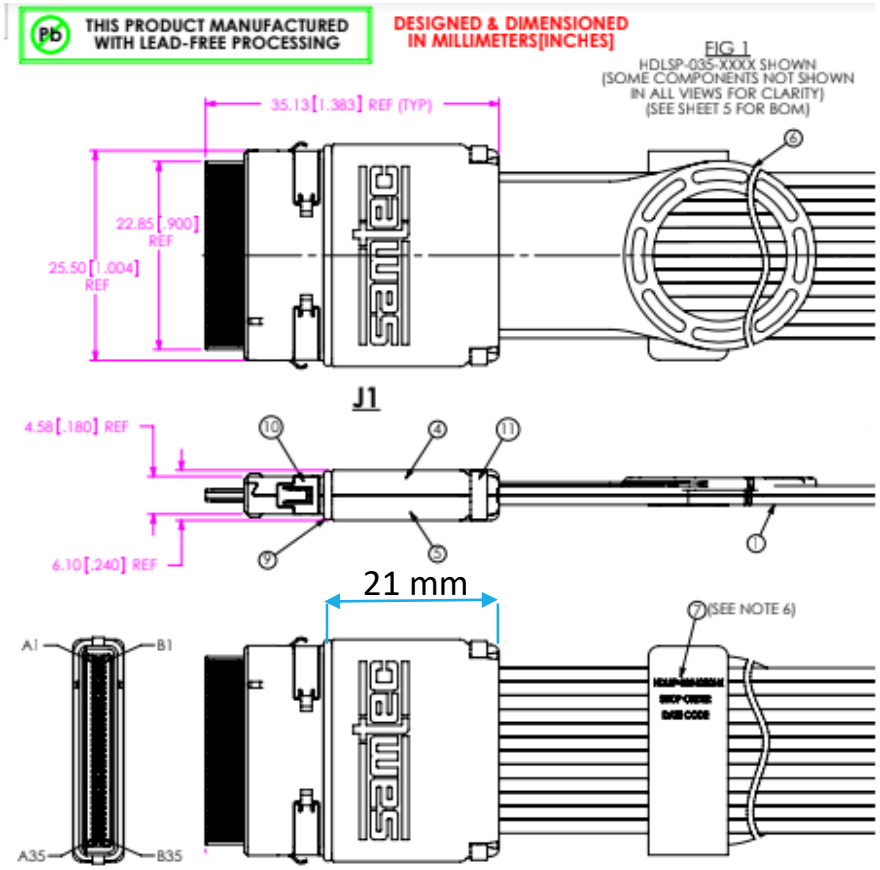
MB Connector

HDLSP

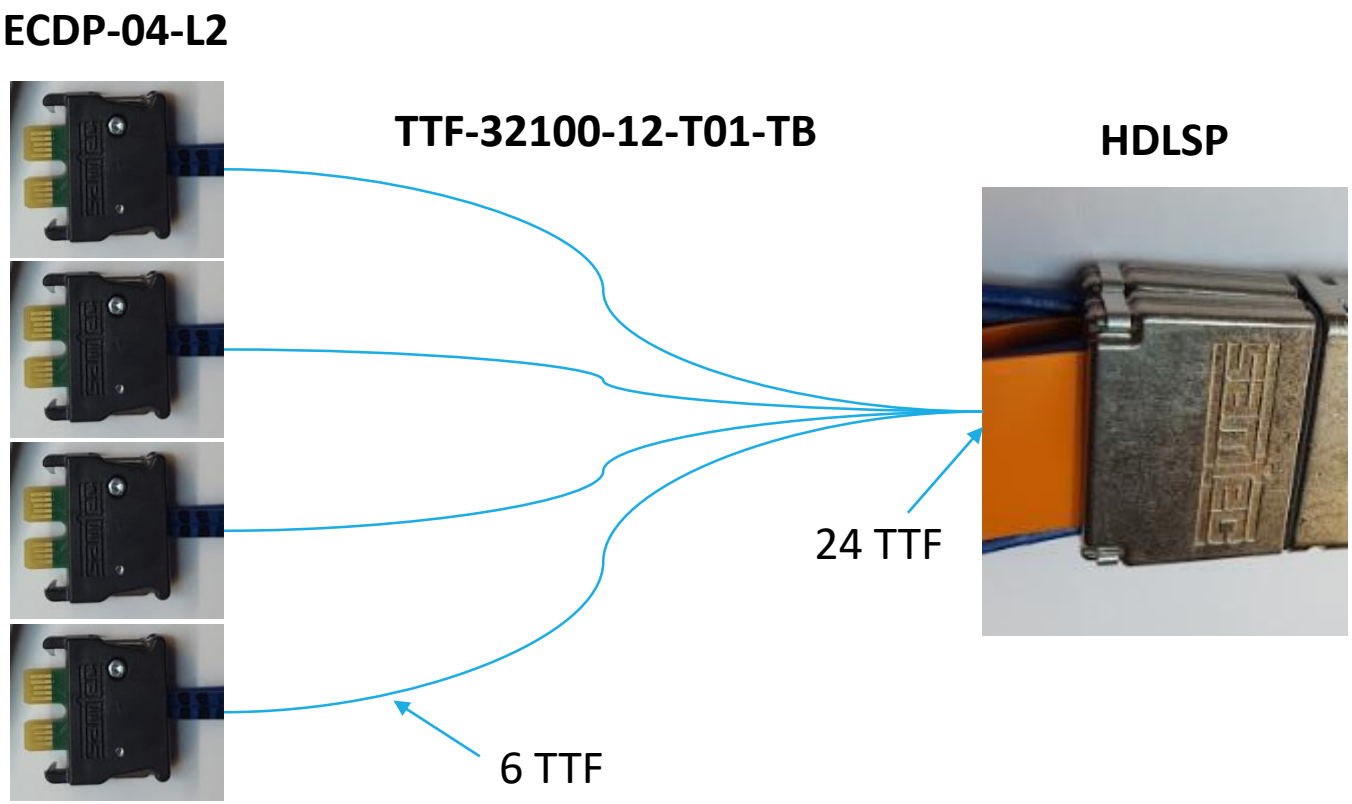
- 1 connector per 4 SiPMs/channels
- 5 connector per Mezanine board
- 2 x 12 TTF

MB Connector

HDLSP



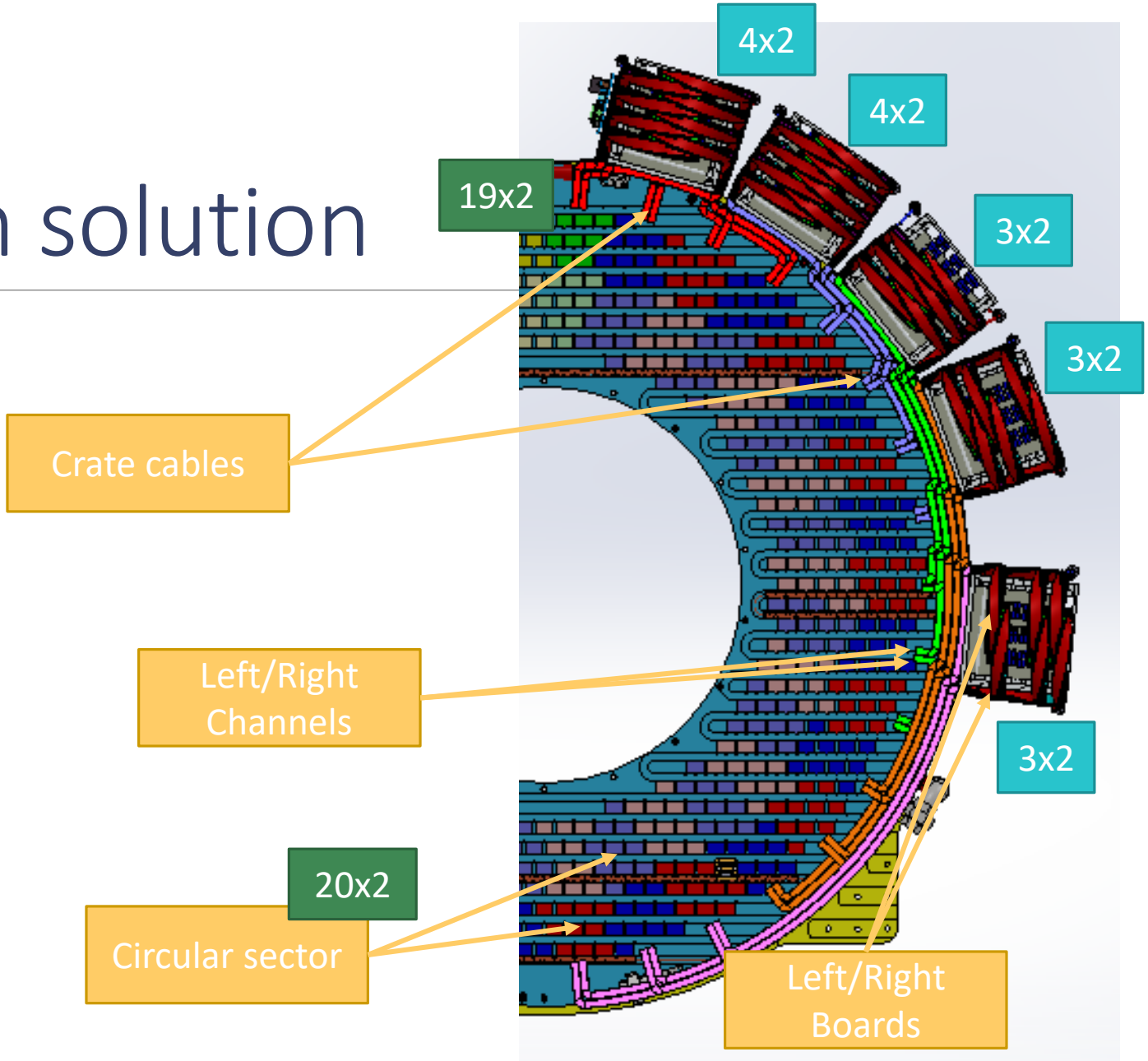
FEE Cable



Design solution

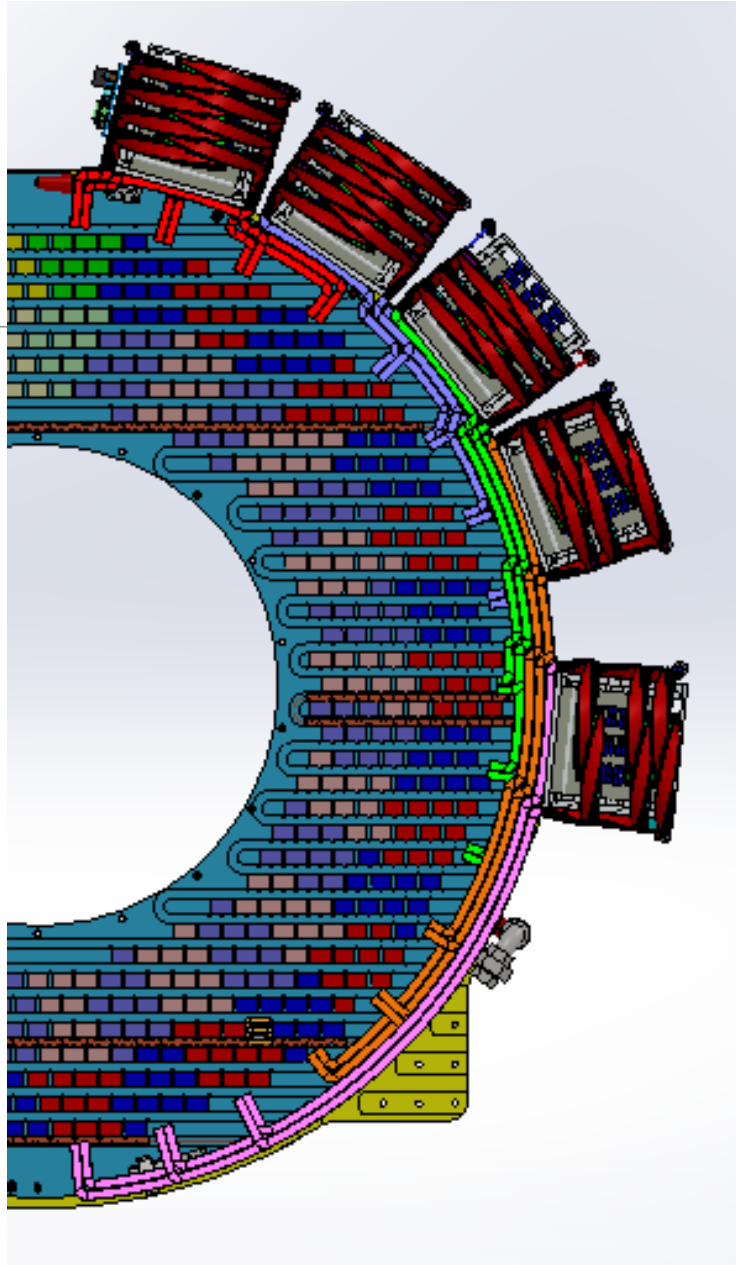
- Each disk is divided in two half, each made of 17 circular sectors
- Each board supplies a circular sector of 20 channels on 20 different crystals (apart 4 boards per disk which supply 19 channels)
- In each crate, half of the boards will supply the left channels, and the other half will supply the right ones.
  These boards will be adjacent between them.
- There will be 8 boards in 4 crates and 6 boards in 6 crates
- We would like to use 1 spare cable per board
- We will use the vertical symmetry to route the cables

Design solution

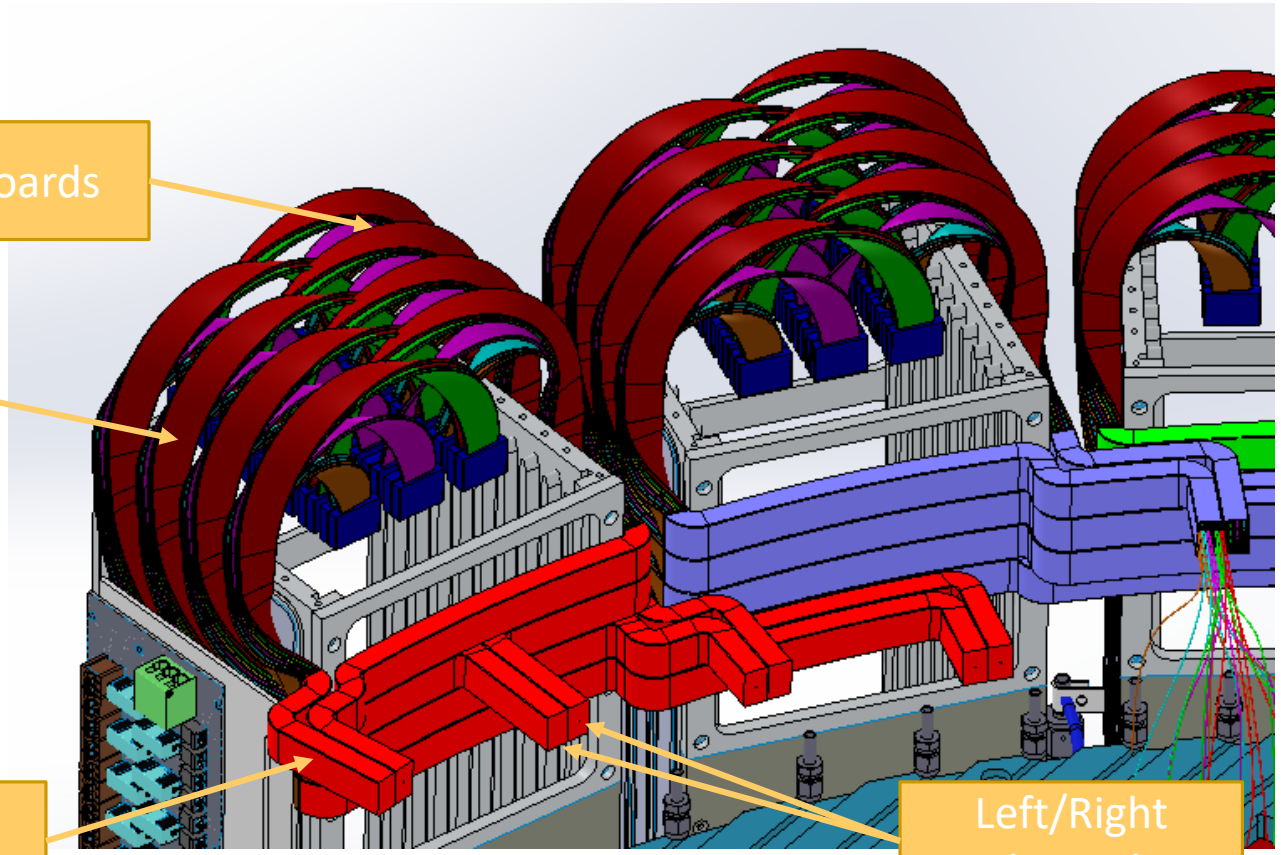


Design solution

- Bundles end where SiPMs start (radially) to help the maintenance process
- Bundles at outer radius to minimize interference with FEE
- Very low overlapping of cables

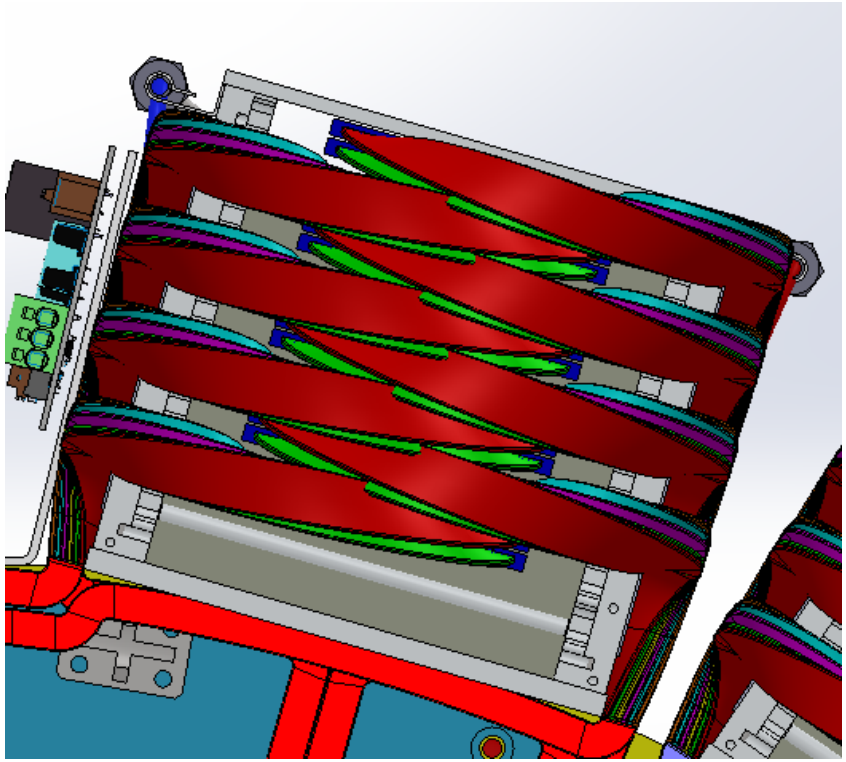


Design solution



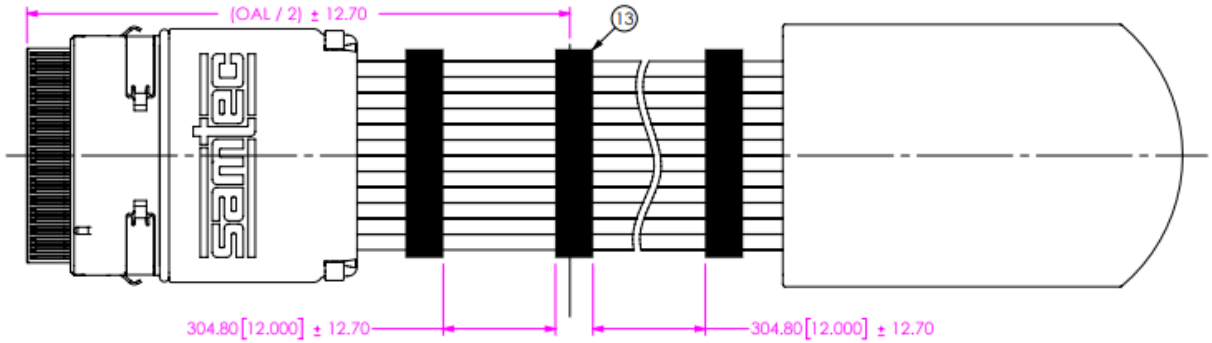
Design solution

- Each board cables doesn't interfere with the others
- Extraction of one board requires to disconnect just 5-6 connectors
- Preparation/formation of the cables on a dummy crate before to install on the calorimeter
- Cable lengths equal board by board



Bundle

- Each cable is composed by 24 TTF mini-cables that are free to move between them.
- They can be hold together with tape, directly placed by the manufacturer.
- The tape can be applied all long one side of the cables (and removed when not necessary) or all around every fixed length
- 3M™ Acetate Cloth Electrical Tape 11, 1/4”



Spare

- We would like to have one spare cable per board
- It can be mounted together with the others and fixed in a dummy female connector (already present in each board)
- To be verified in the mockup if it can be done easily
- **Alternative**: To route spares with the crate bundle, and connect it freely if and when necessary -> we can use less spare cables or we can use more spare per board if necessary

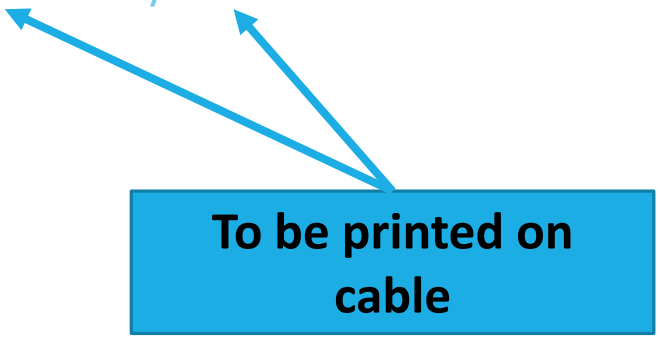
Length and Weight

Considering one disk and 20% of spares cables (1 per board):

- The total cables length is 500 m (46 kg)
- 408 MB connectors (5.5 kg)
- 1632 FEE connectors (4.5 kg)
- Total weight: **56 kg**

Naming proposal

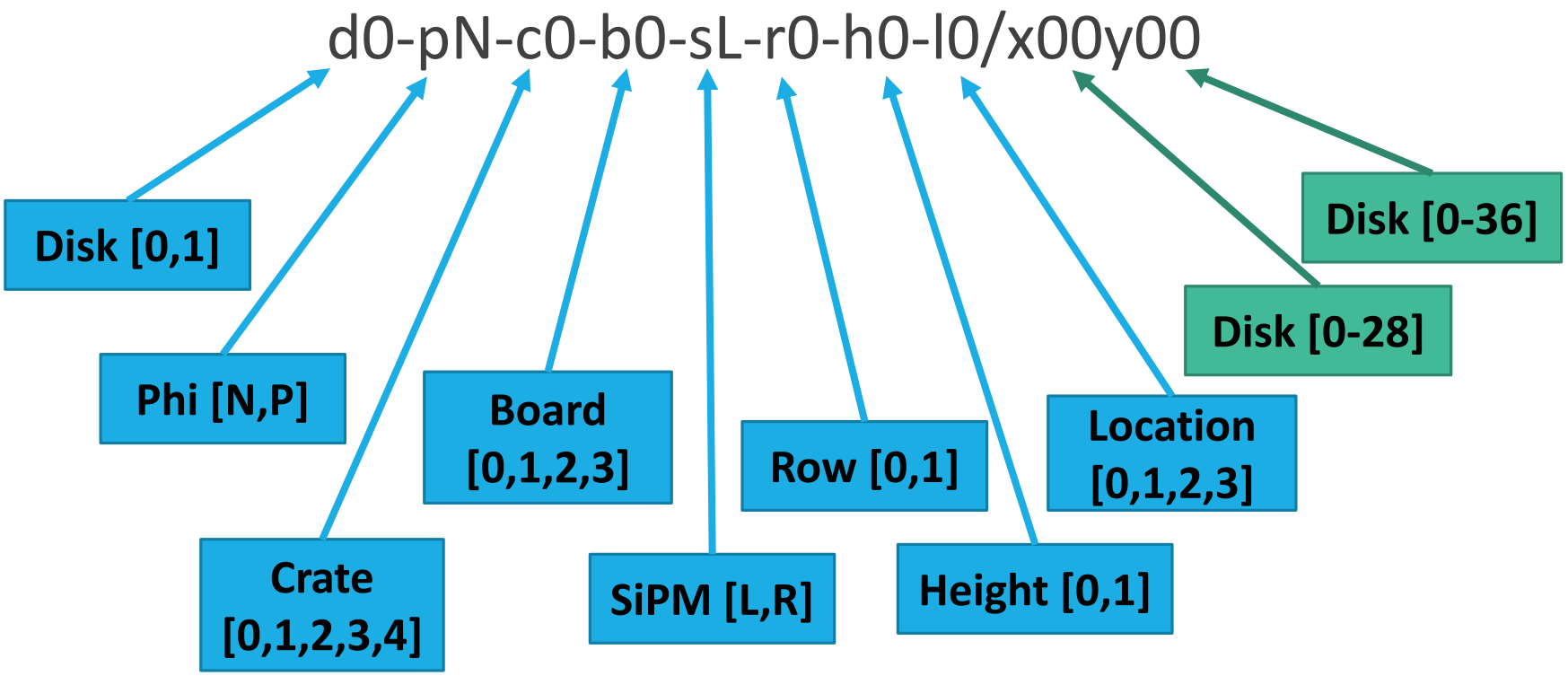
- **Extended Name**
  d0-pN-c0-b0-sL-r0-h0-l0/x00y00
- **Squeezed Name**
  0N-00L00-0/0000
  ⋮ ⋮
  1P-43R21-3/3674



Alternative (just numbers)

- **Extended Name**
  d0-p0-c0-b0-s0-r0-h0-l0/x00y00
- **Squeezed Name**
  00-00000-0/0000
  ⋮ ⋮
  11-43121-3/3674

Naming proposal



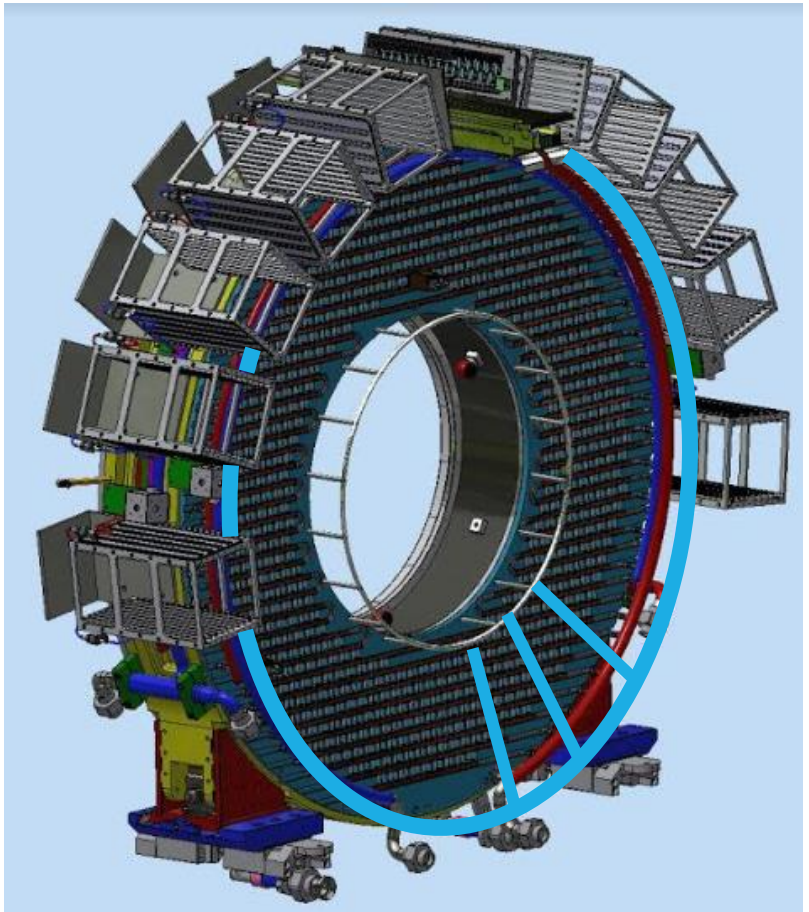
Go to back-up slides for a better explanation

Labeling

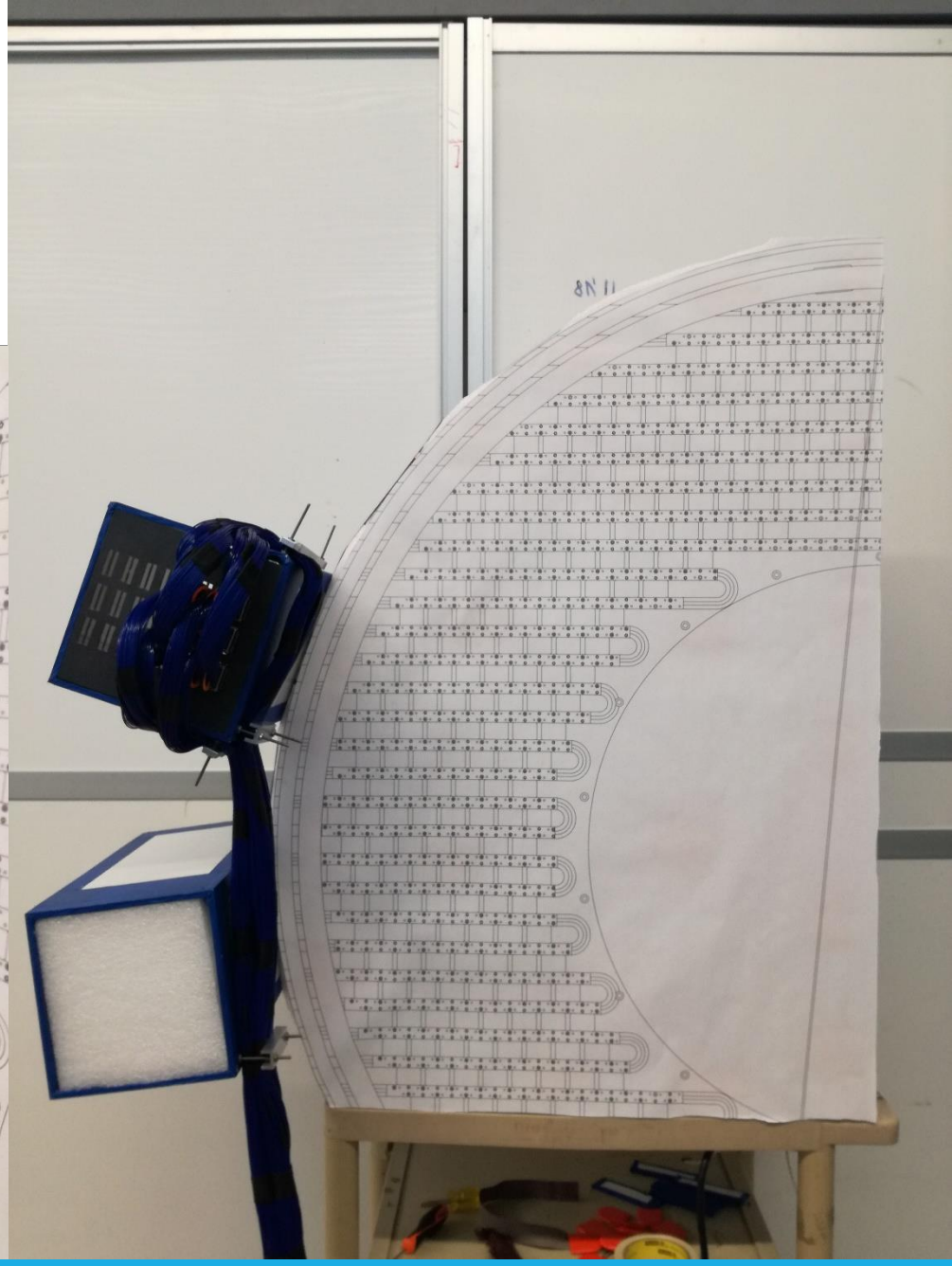
- We would like to silk-screen print the cable code directly on the connectors, to avoid plastic labels
- We cannot print on the cables because of its form
- We are discussing this solution with the factory

Mechanical support

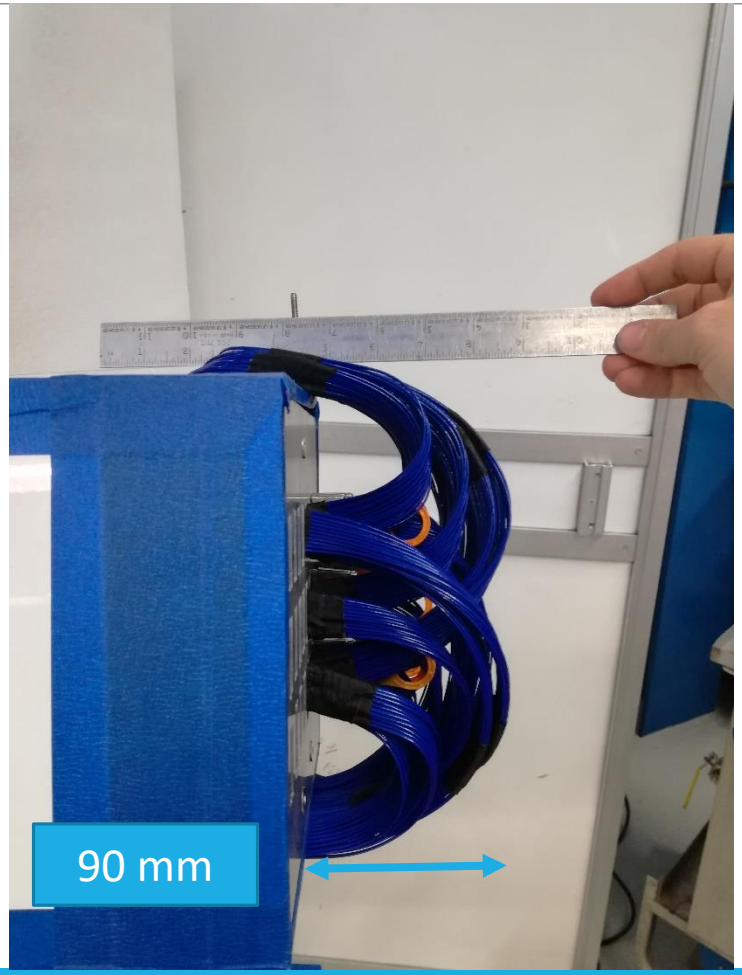
- Structure to hold cables
- Internal ring, fixed on the back-plate
- Outer ring, fixed under the crates and on the back-plate
- Small beams for connecting the 2 supporting rings
- 1 beams per sector
- Work in progress



Mock up



Mock up



Mock up

Accessibility

Next steps

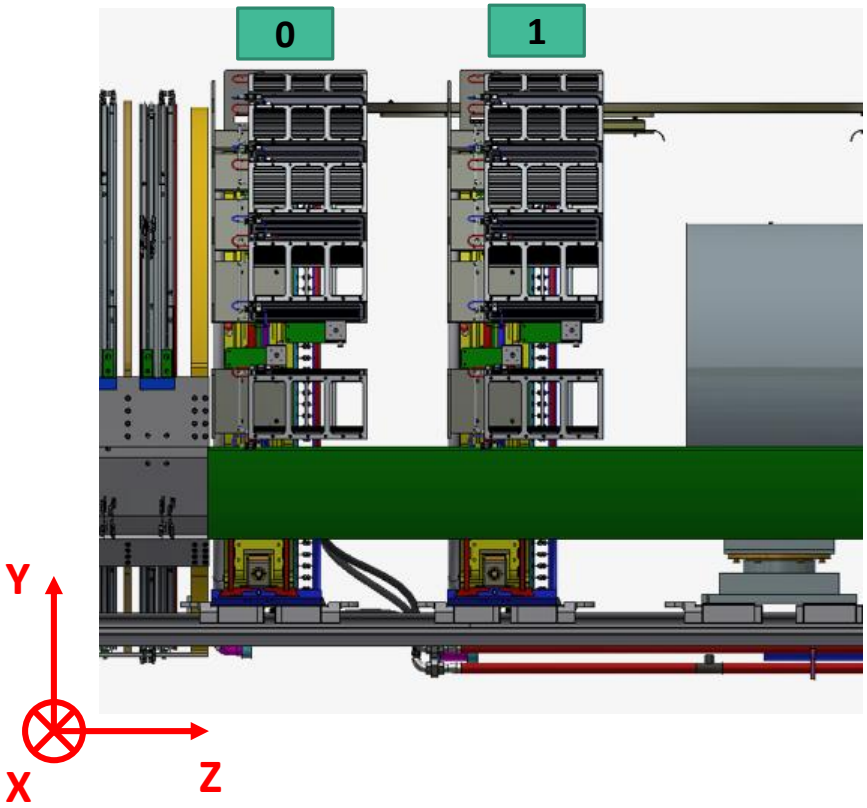
- Finish outgassing and radiation hardness of all cable components
- Mock-up for cable bends (for the FEE side)
- Mock-up for final evaluation of access and feasibility with pipes, SiPM holders and fibers
- Finishing design for supports

Back up slides

Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

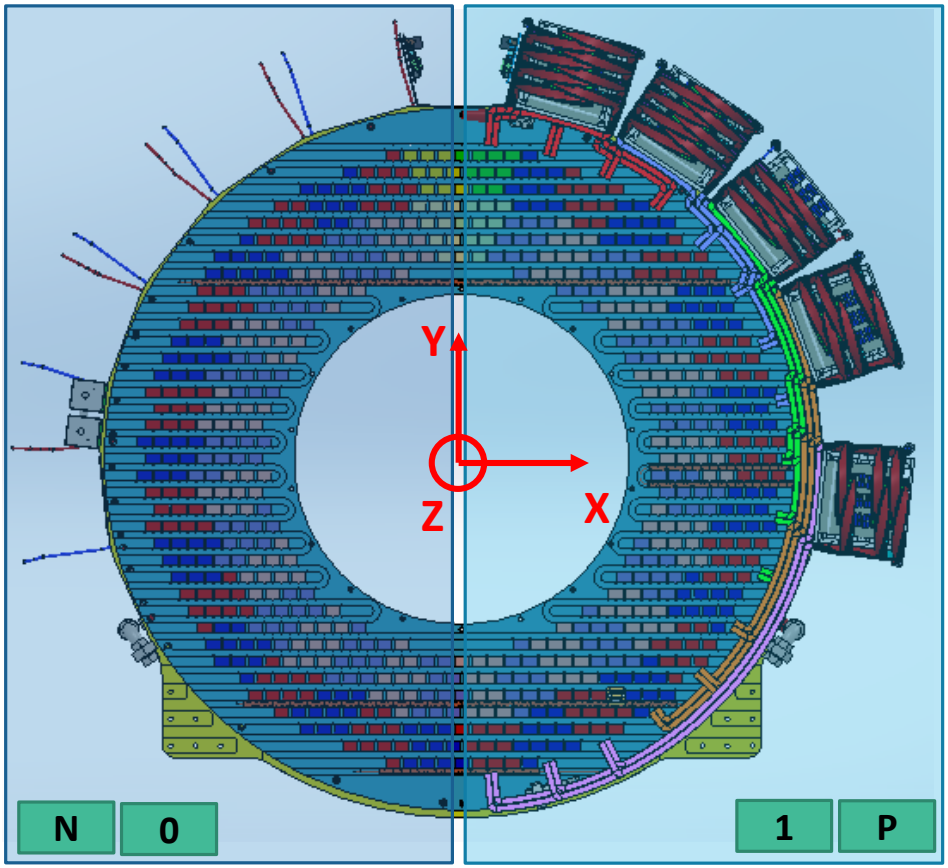
- disk [0,1]



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

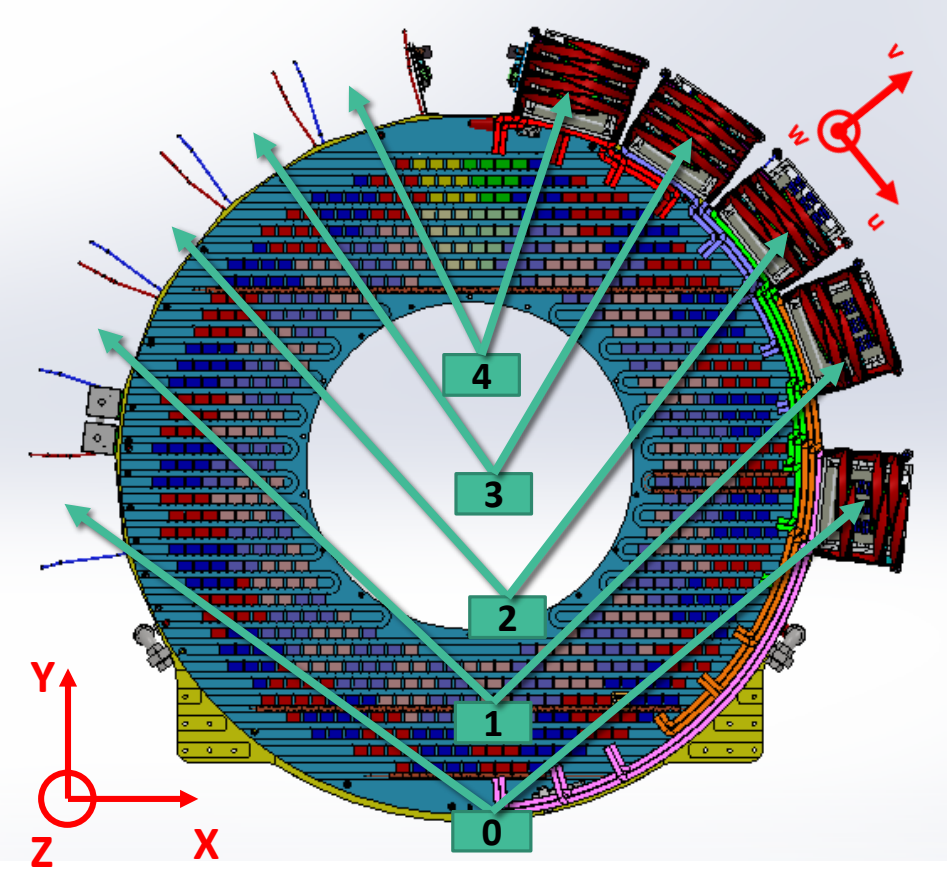
- phi [P,N] (Positive, Negative)
- Alternative N=0, P=1?



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

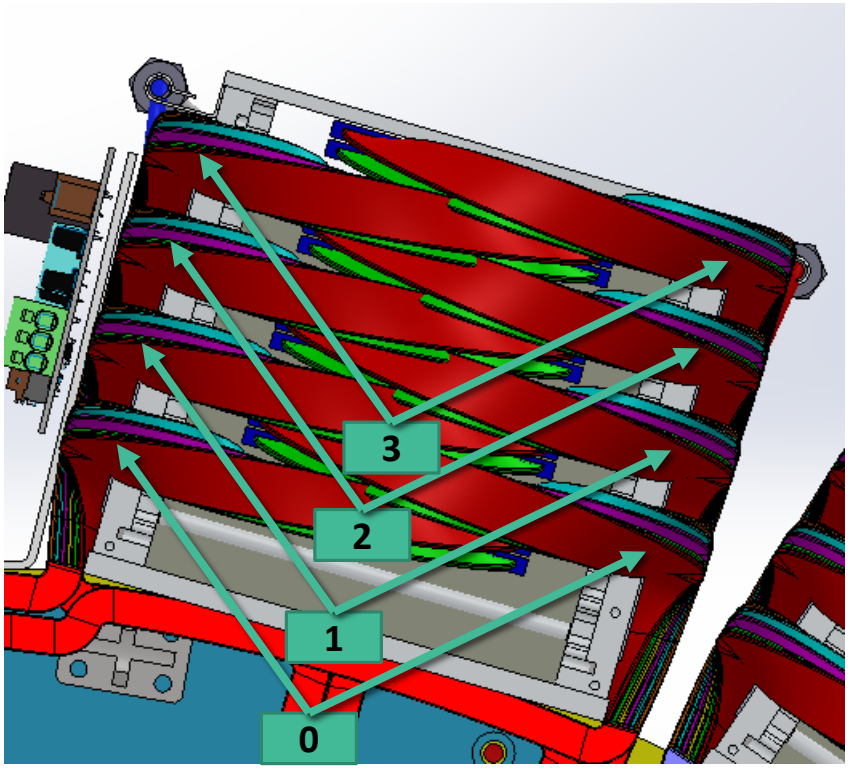
- crate [0,1,2,3,4]



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

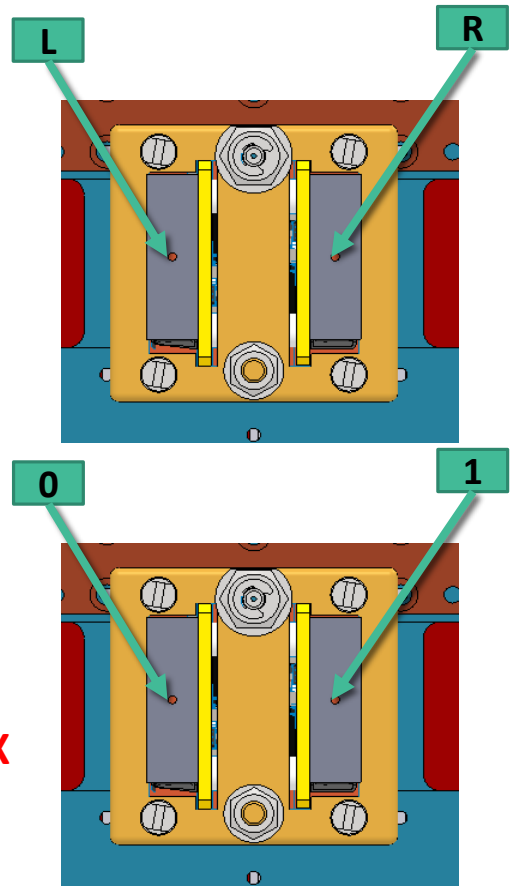
- board [0,1,2,3]



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

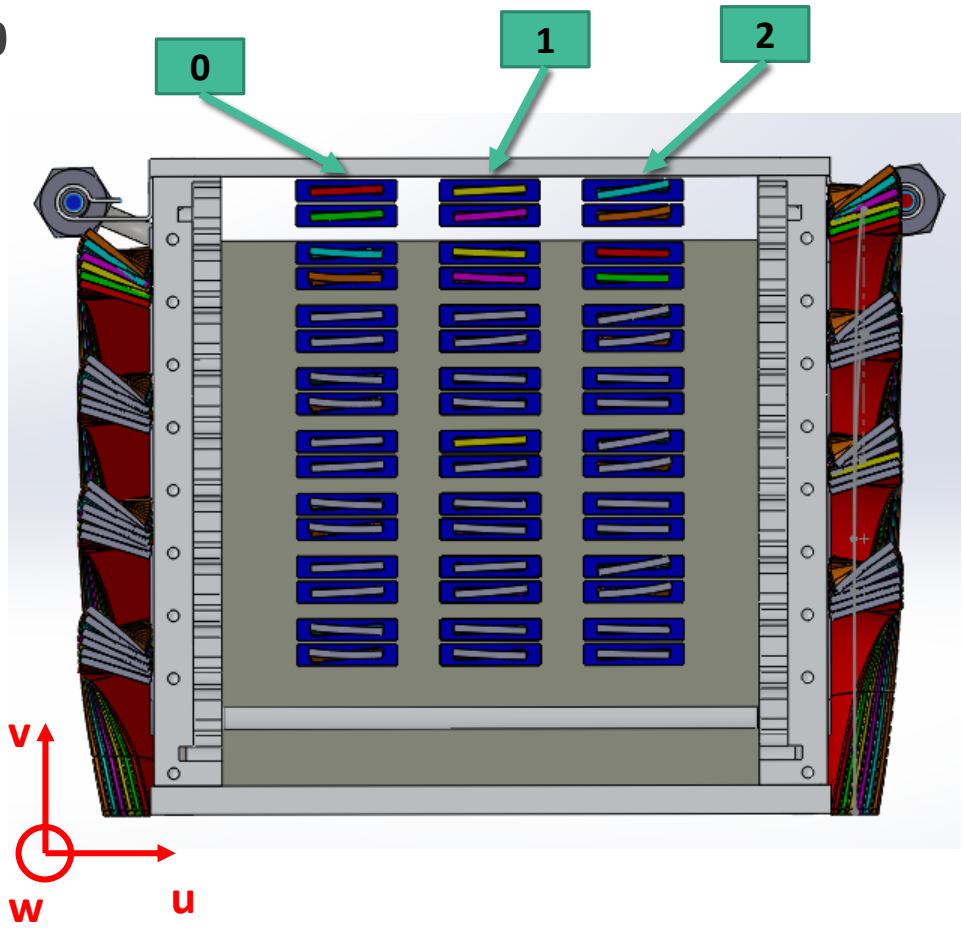
- sensor [R,L] (Right, Left)
- Alternative L=0, R=1?



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

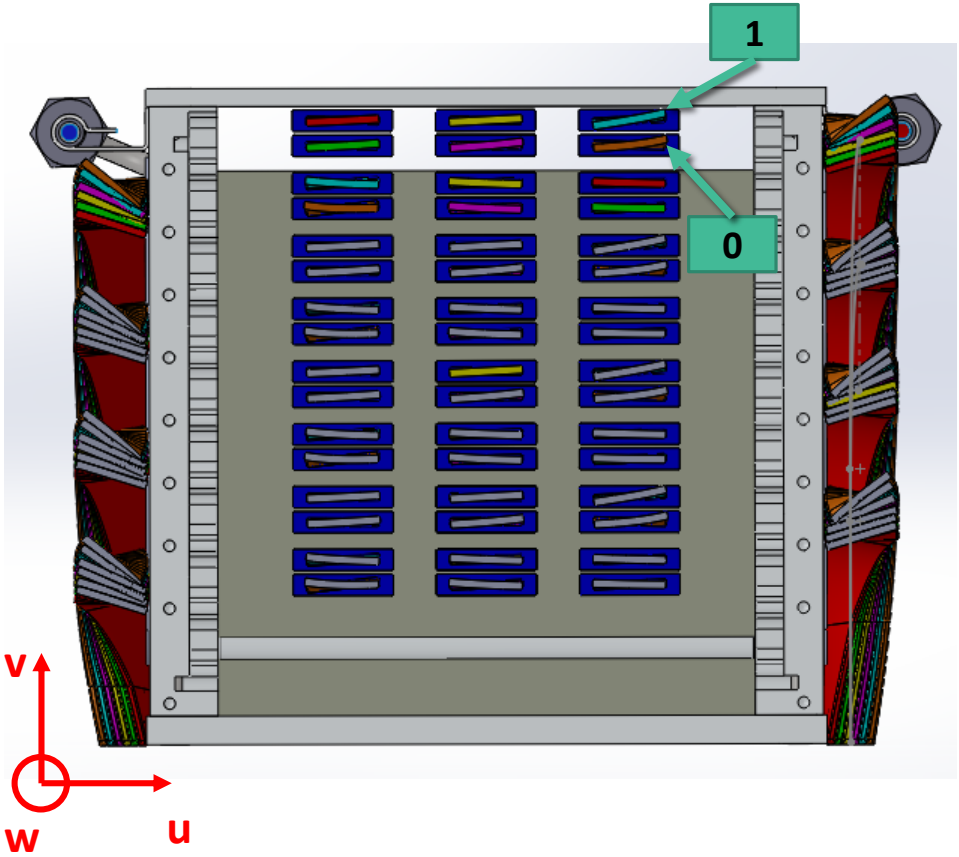
- row [0,1,2] (per board)



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

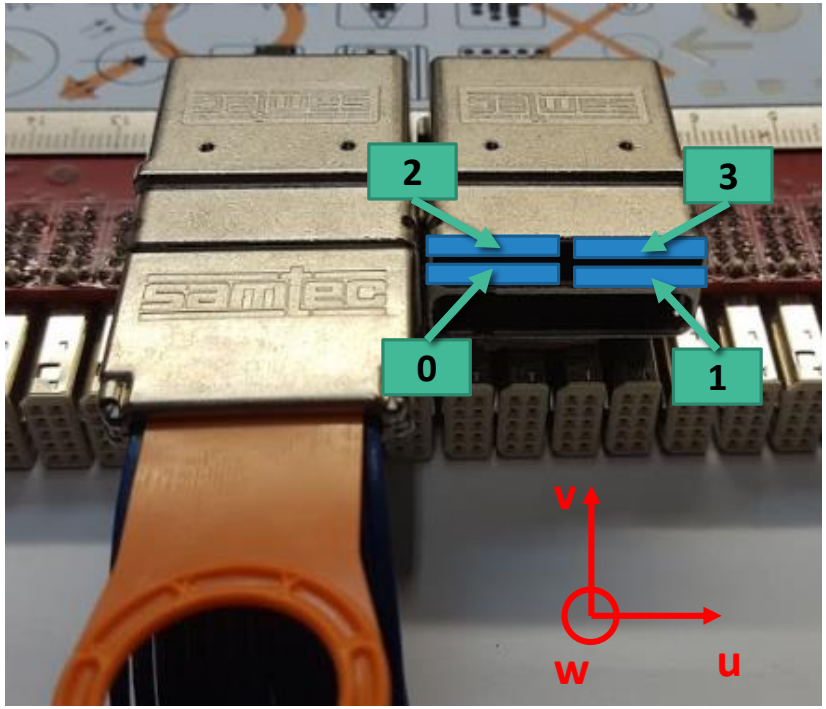
- height [0,1] (per board)



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

- location [0,1,2,3]

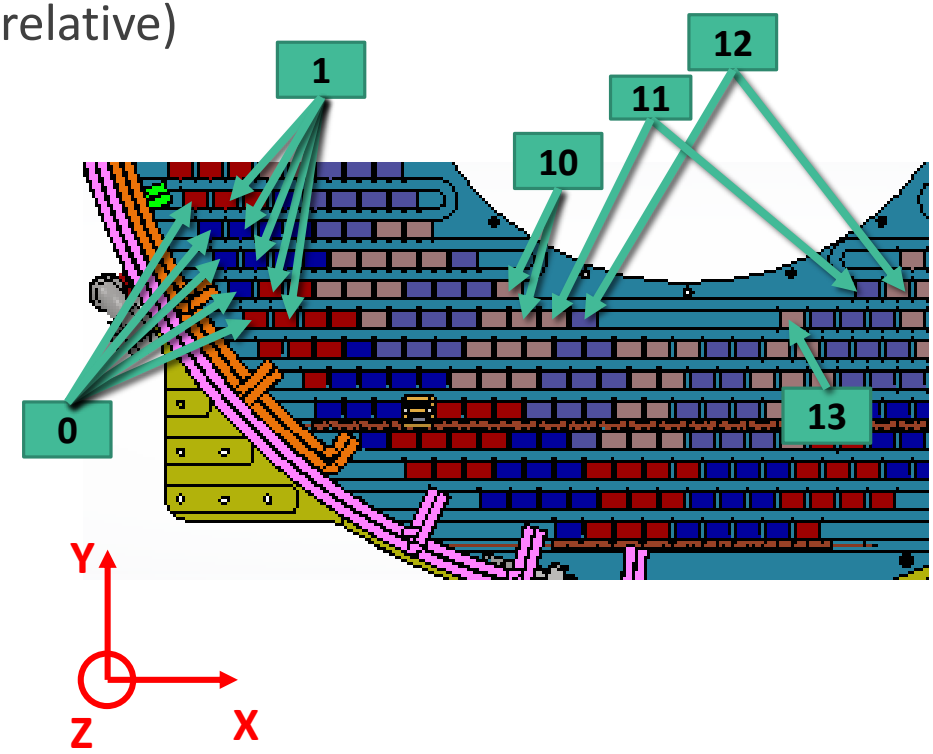


Naming

Alternative

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

- X column coordinate [0-28] (relative)

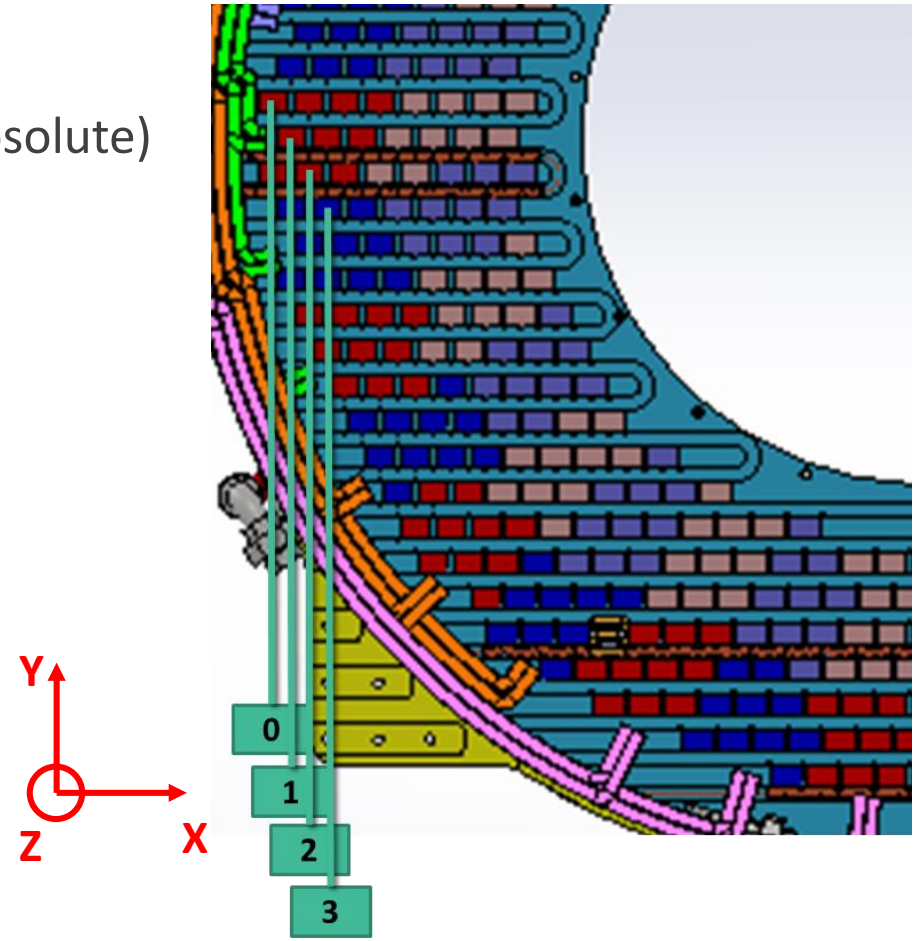


Naming

Alternative

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

- X column coordinate [0-74] (absolute)



Naming

d0-pP-c0-b0-sR-r0-h0-l0 / x00y00

- Y row coordinate [0-36]