Istituto Nazionale
di Fisica Nucleare
Sezione di Milano

IV SuperB Collaboration Meeting

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UPDATE ON SVT MECHANICS IN MILANO

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INFN Milano

Summary:

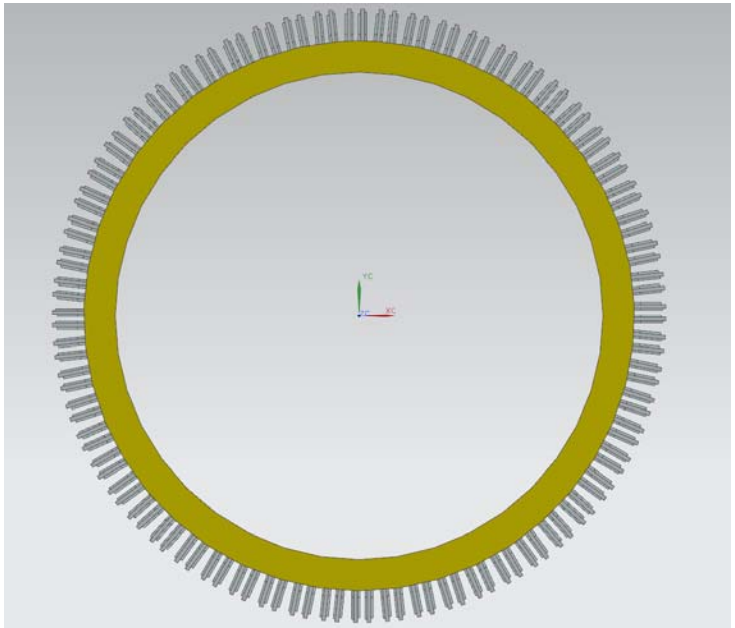
- SVT transition cards
- Geometrical disposition and relative mechanics
- Thermal cooling analysis and test prototyping
- Routing of the flat-cables from the HDI to the transition cards
- Design of the connections for Layer Lo and L1-L5
- Routing from the transition cards to the detector outside
- Integration and installation sequence for mechanics and cables
- Quick-demounting constraints on the lay-out
- HDI cooling analysis

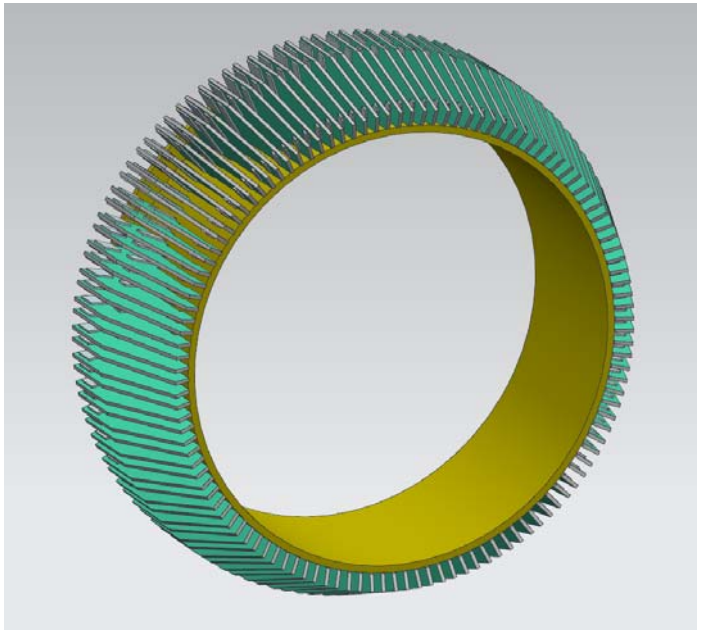
SVT transition cards

power lines for the SVT, active components, multiplexer, electrical to optical conversion, fibers connectors

Project cronology:

Starting point: 120 cards in radial disposition

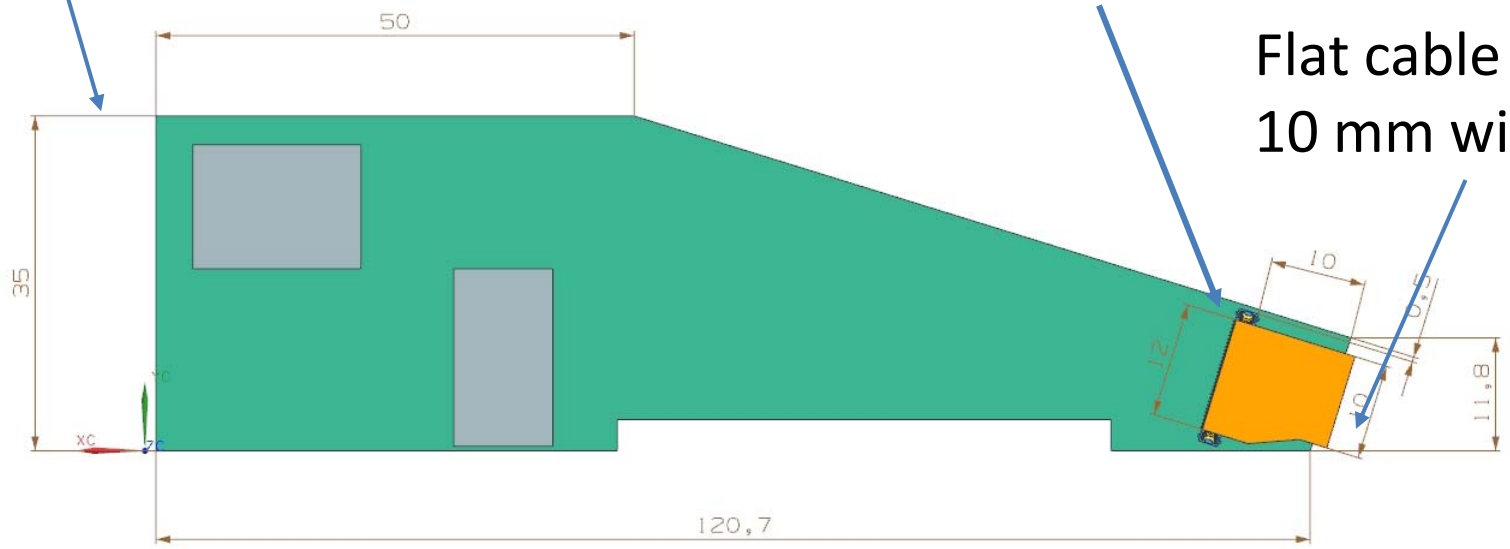




First criticality:
Electronics needs
more space

Panasonic micro-connector
60 contacts

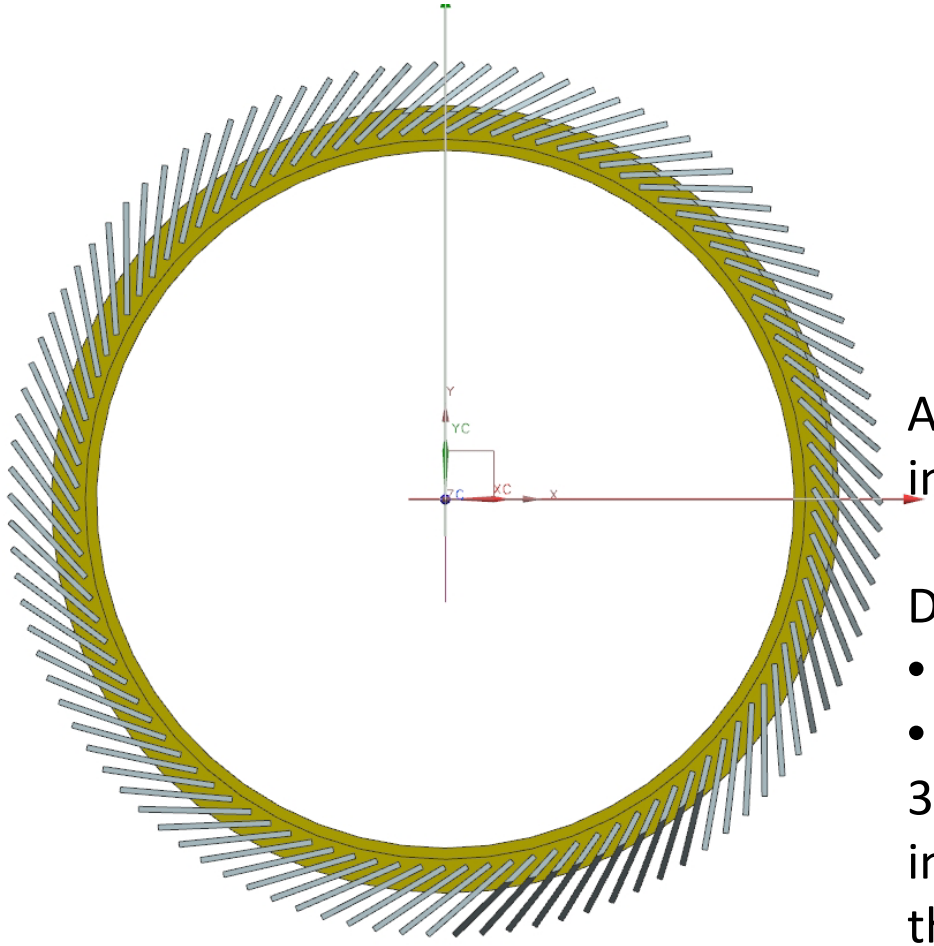
Flat cable
10 mm width

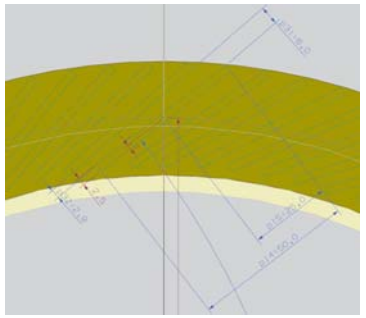


Hypotesis: ask to move back the Cryostat to increase thecard length 30÷50 mm
Needed space to place a cooling ring, too.

First step

- Layer L5 needs 18 cards instead of 36 **=> 102 cards**
- Study of a different spatial arrangement:
- Studied and excluded other possible geometrycal planes
- Choosing an **inclined card "turbine-like" disposition**



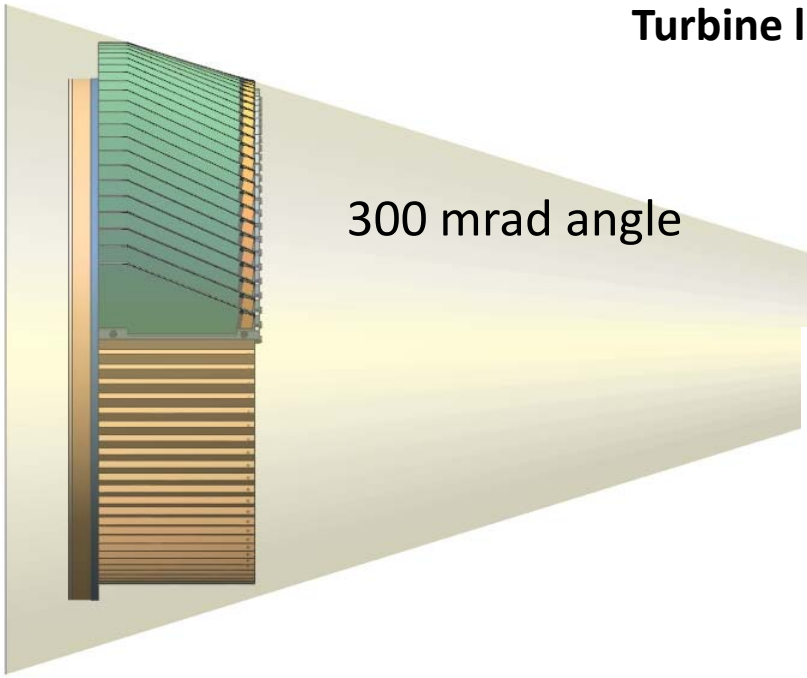


Advantage: back side 50 mm height instead of 35 mm

Disadvantages:

- More complex to fix
- Less space between the cards : from 3 to 6 mm (this value may be increased reducing the card thickness)

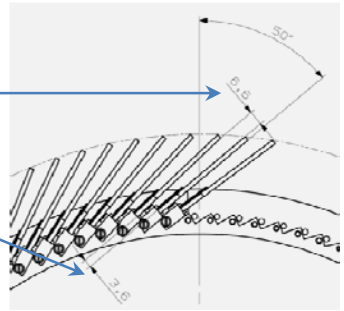
Turbine layout – n. 102 cards

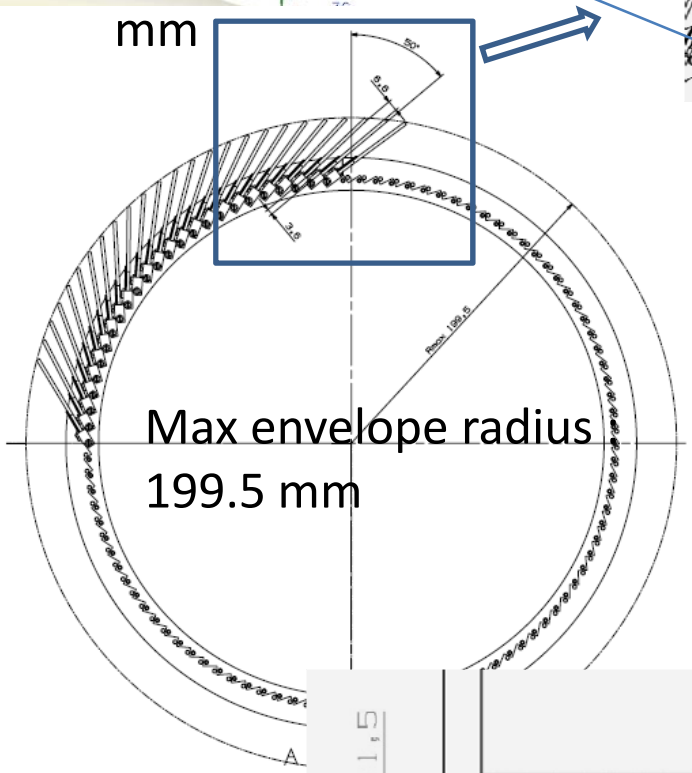


300 mrad angle

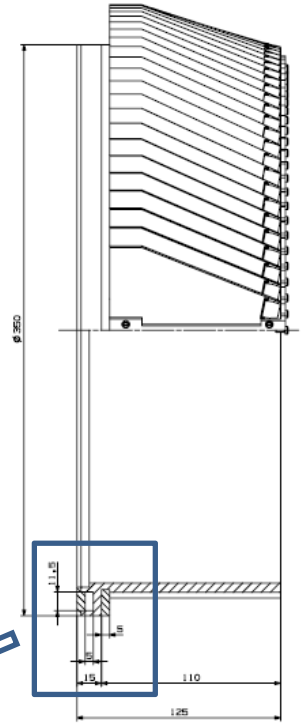
Max gap: 6.6 mm

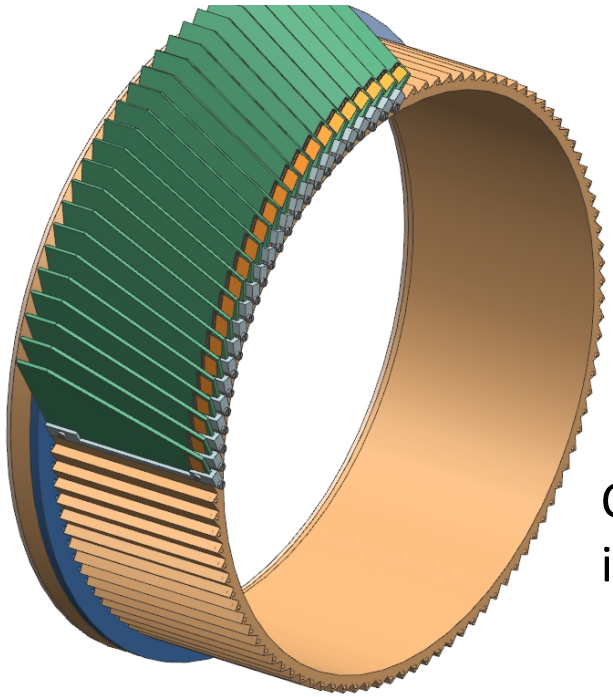
Min gap : 3.6 mm

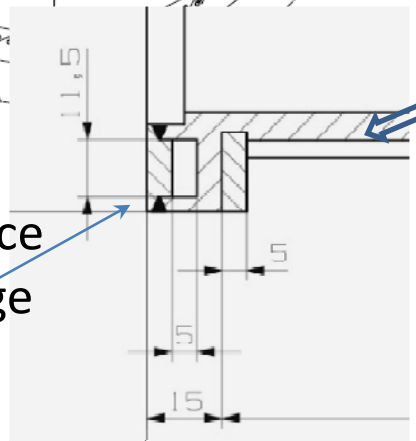




Max envelope radius 199.5 mm

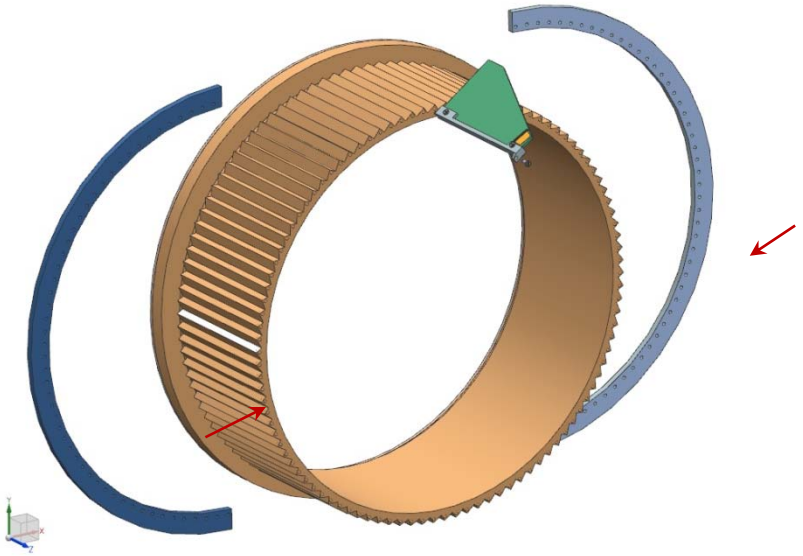




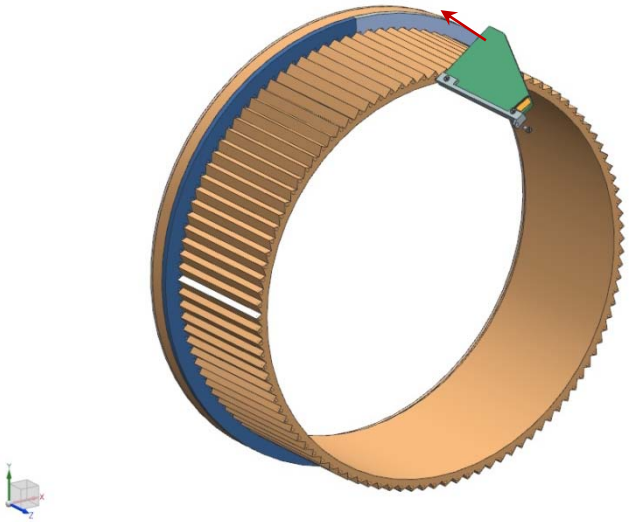


Cooling ring space in the back flange

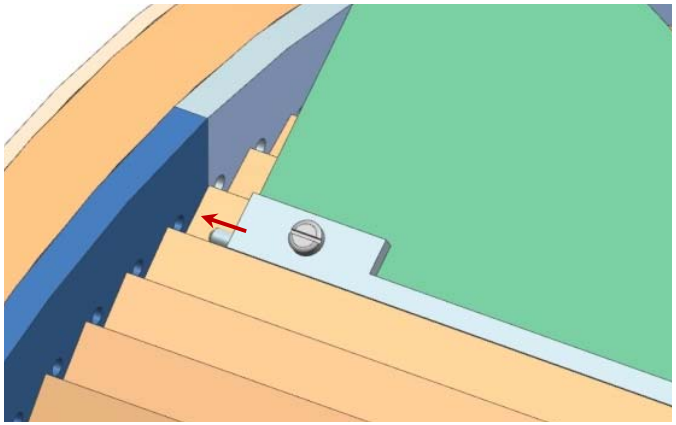
Assembling study



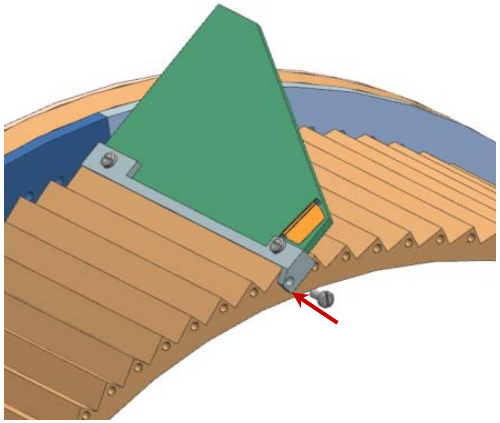
Two half ring joint



Longitudinal insertion

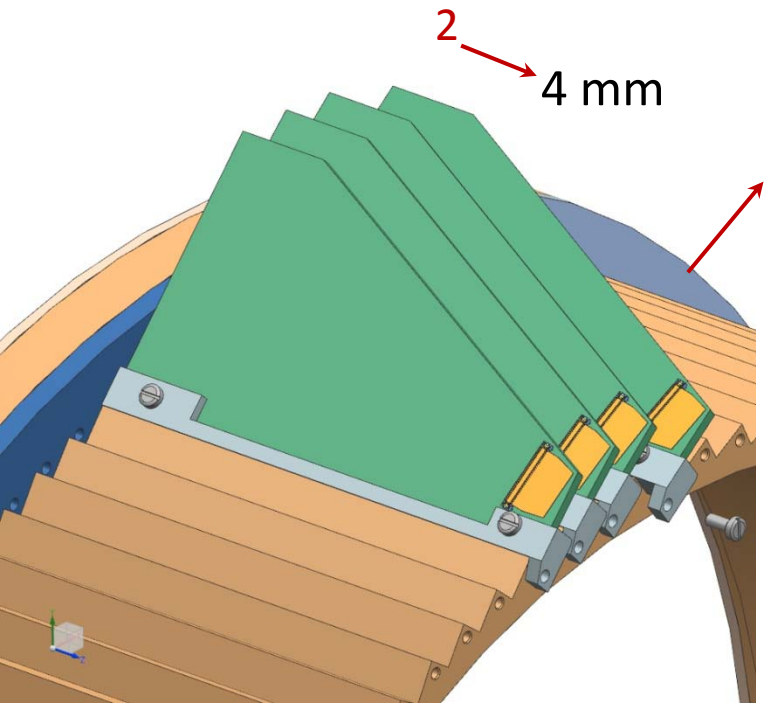


Pin insertion for positioning

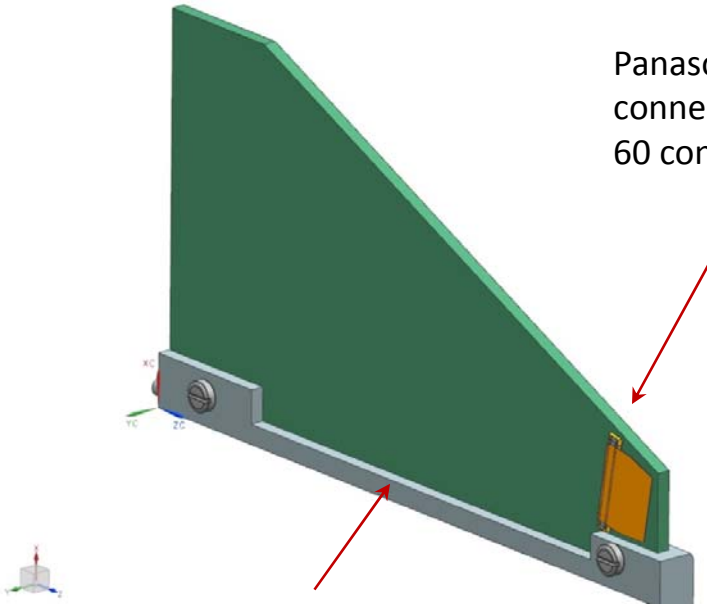


Screw locking

Transition cards mechanics

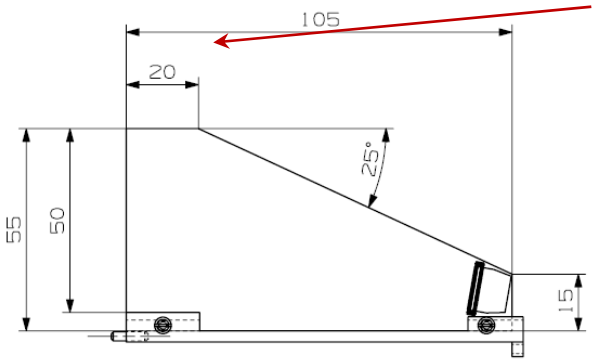


Demounting sequence



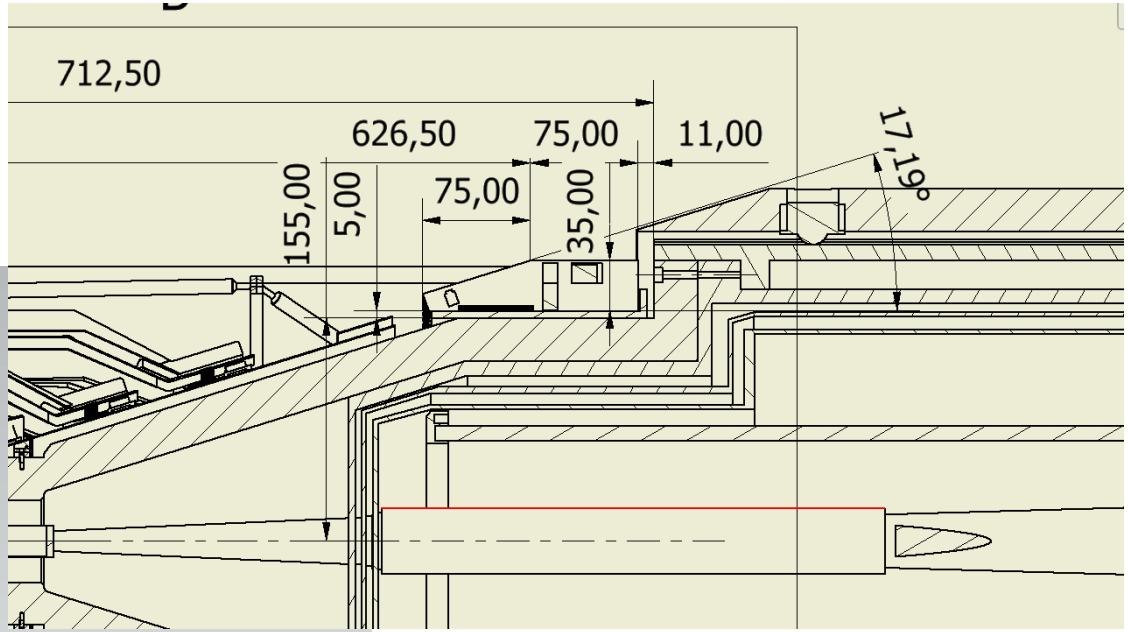
Panasonic
connector
60 contacts

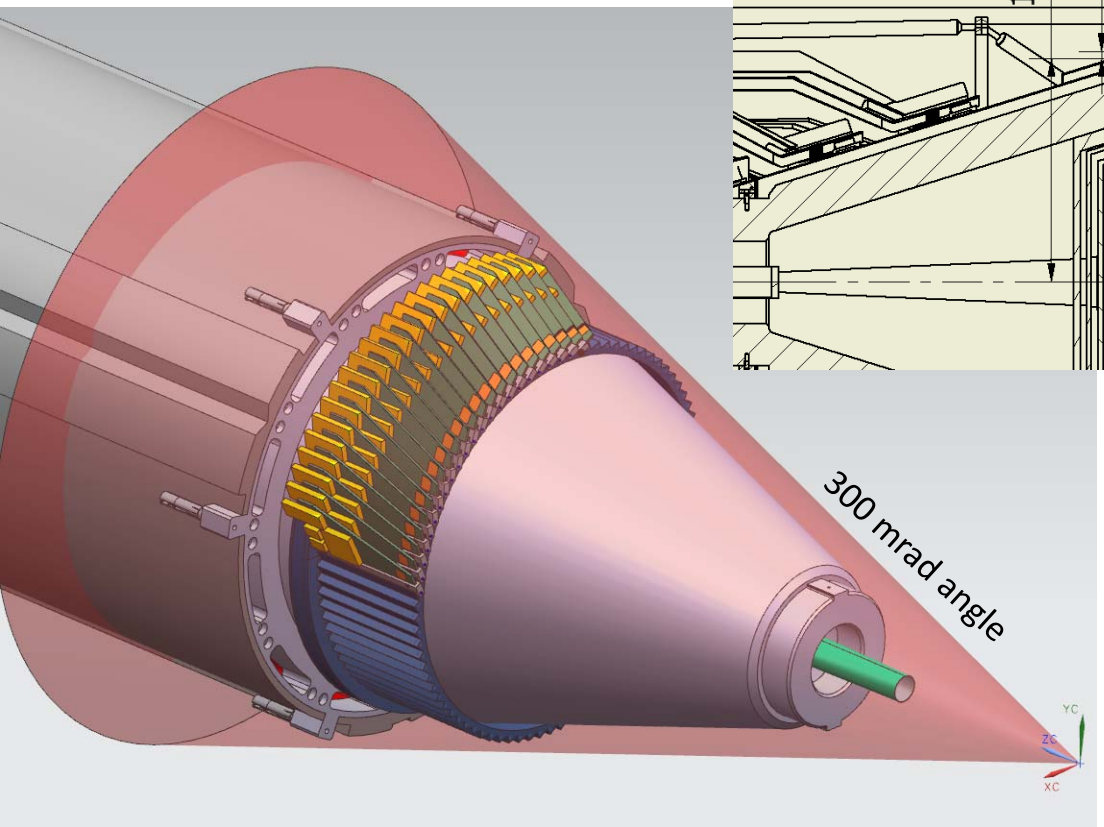
Transition card
- **structural support**
- **thermal contact**



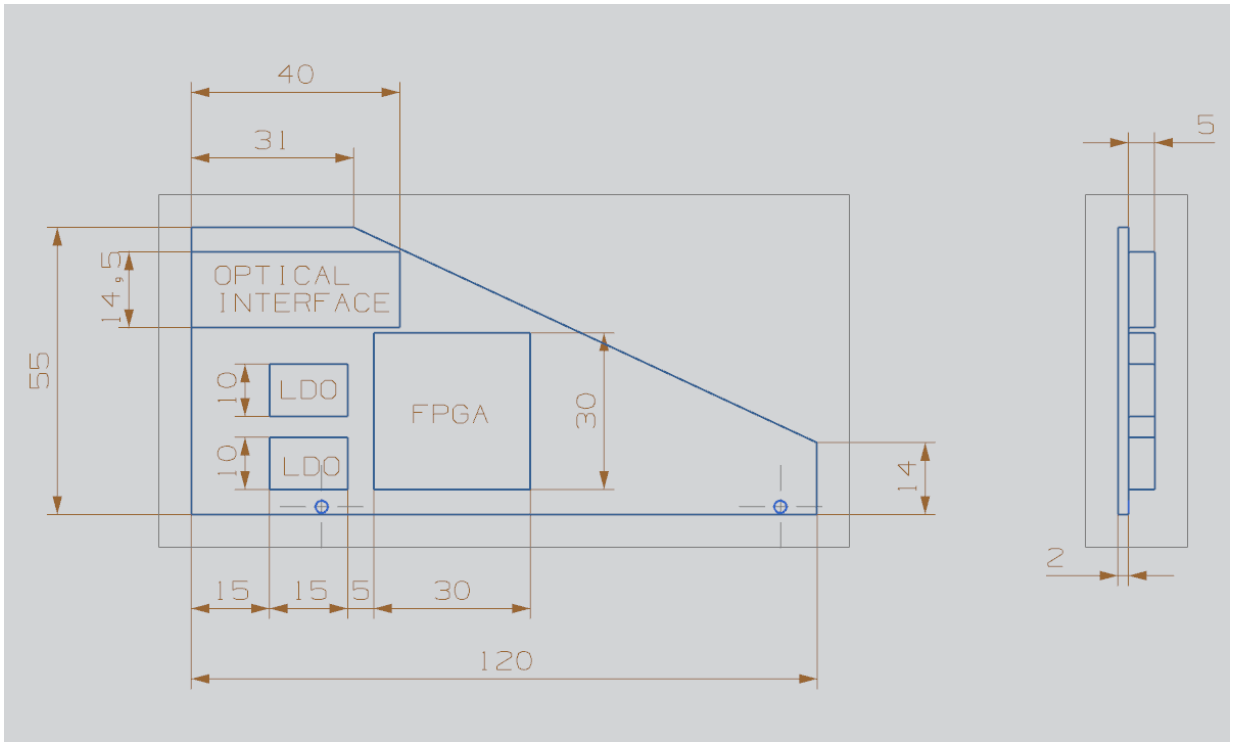
Length to be increased moving back the cryostat

- **NEW DESIGN: CRYOSTAT and W-SHIELDING MOVED BACK 30 mm**
- **NEW INPUT from Mauro Citterio: both Layers L4 and L5 need less cards => actual total number 86 transition cards**





Transition card redesigned with the new dimensions
Length increased 15 mm (from 105 mm to 120 mm)

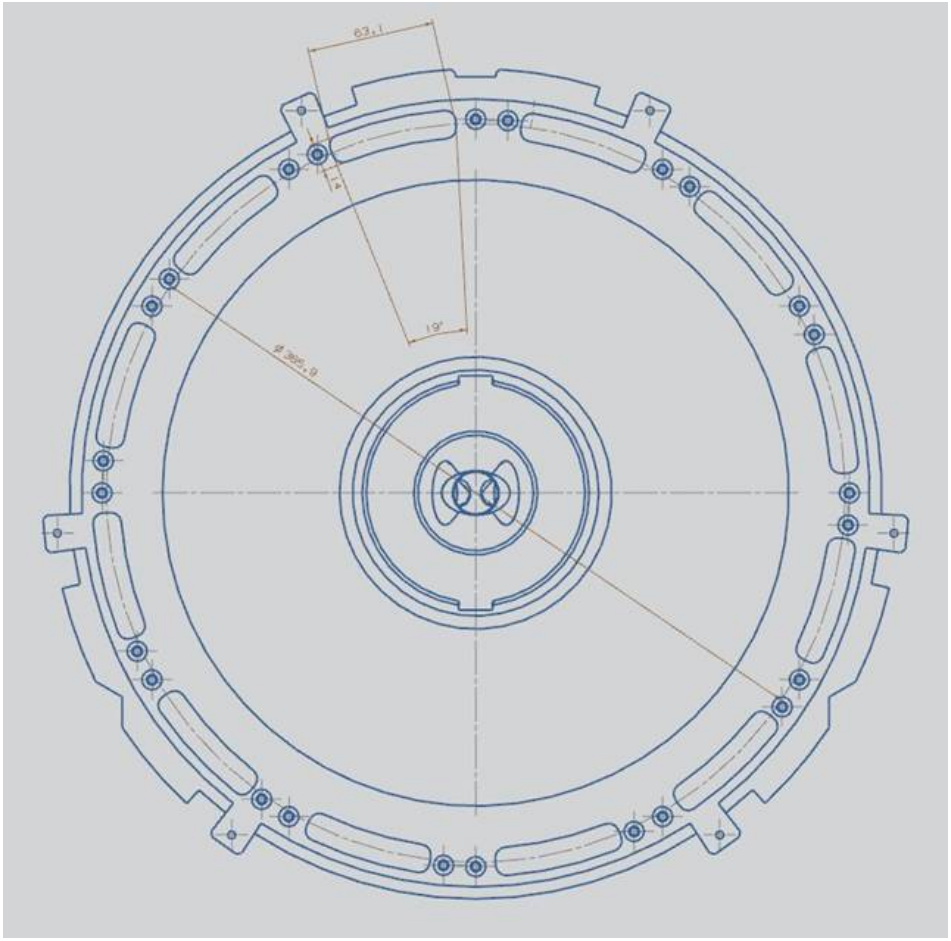


Now it's critical:

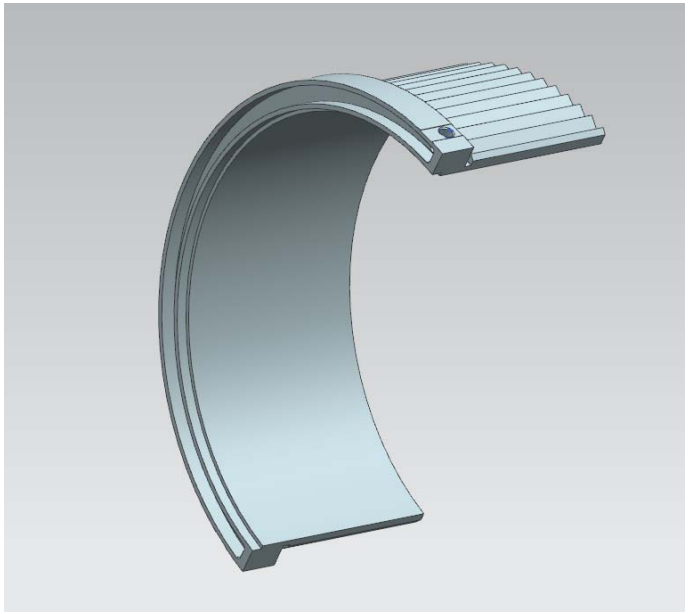
- **optical interface** dimension

- cables **bended routing** to pass through the openings in the W-shielding => see next slide

To be verified: is it possible to pass with all the cables trought the 12 slots in the W-shielding?

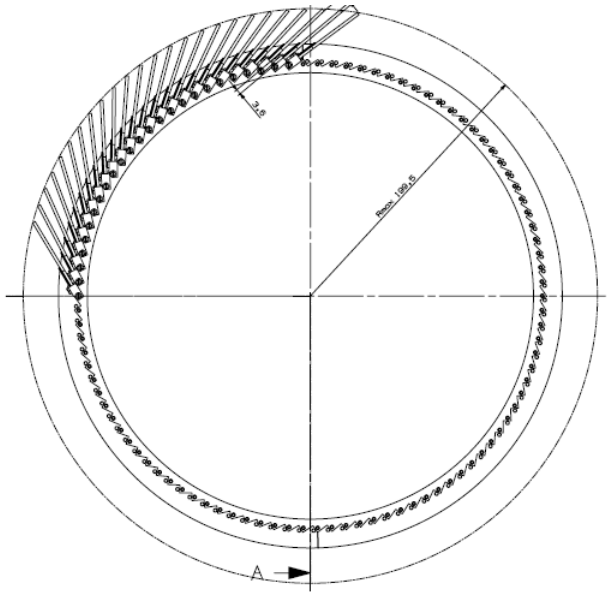


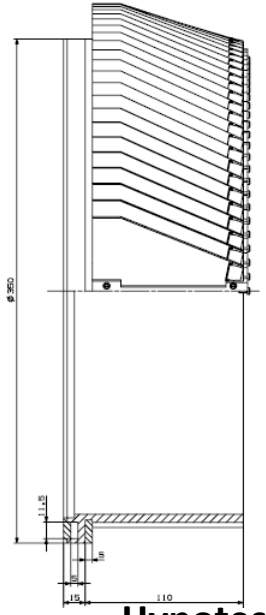
Work in progress

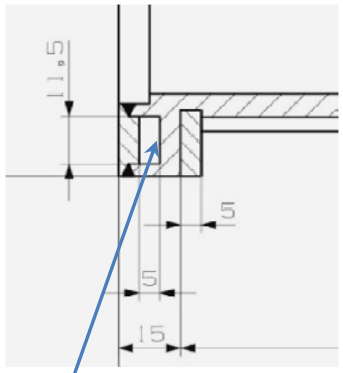


- Half flange detailed mechanical design
- cooling ring details
- Connections with fittings
- Thermal FEA to verify the cooling
- Study of the conductivity of the materials
- Dummy card and sector production to test a cooled prototype with dissipating components or heaters

Transition cards cooling
USING A WATER FLOW (10-15°C)
NO RADIATION, NO CONVECTION HYPOTHESIS (CONSERVATIVE)



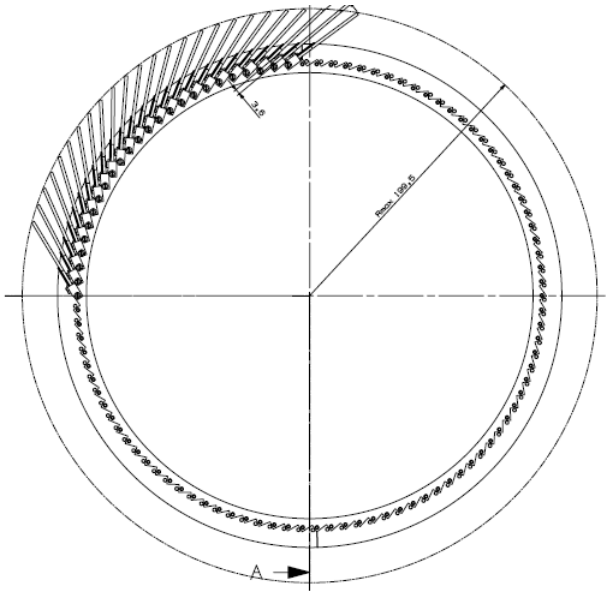


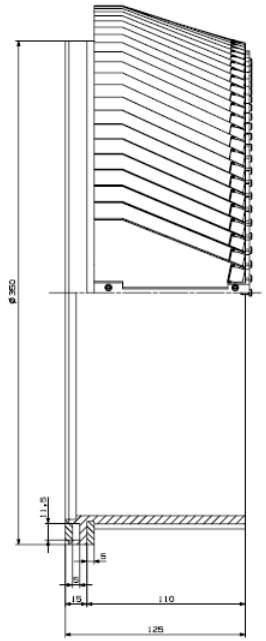


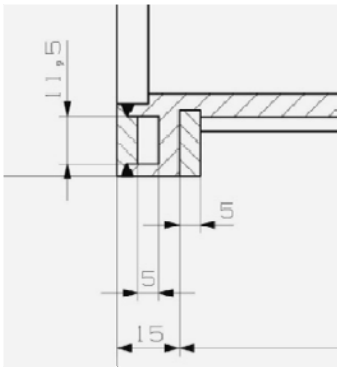
Hypotesis and data

Cross section area of the cooling ring	A = 5 mm x 11.5 mm = 57.5 mm^2 = 5.75 x 10^{-5} m^2
Transition cards Total Power	P = 1000 W (theorical, to see what happens)
Cooling fluid : water	C_p = 4186 J/ Kg °C ρ = 1000 Kg /m^3
Inlet water temperature	T_i = 10 °C
Outlet water temperature	To = 15 °C
Water ΔT in/out	ΔT = 5 °C

Transition cards cooling







$$P = \Gamma \cdot C_p \cdot \Delta T$$

$\Gamma = P / C_p \cdot \Delta T = 1000/ (4186 \cdot 5) = 4.78 \times 10^{-2}$ Kg/s — **Water mass flow**

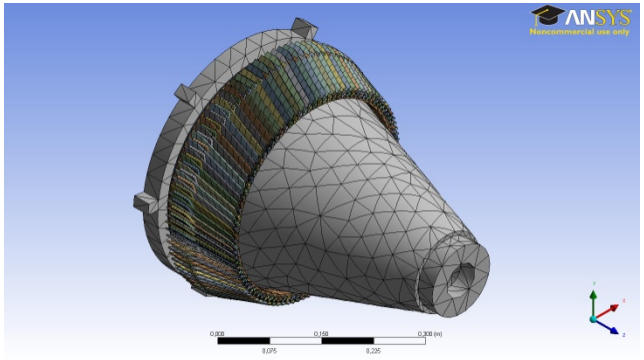
$Q = \Gamma / \rho = 4.78 \times 10^{-2} / 1000 = 4.78 \times 10^{-5}$ m^3/s $\approx$ **0.05 l/s** — **Water volumetric flow**

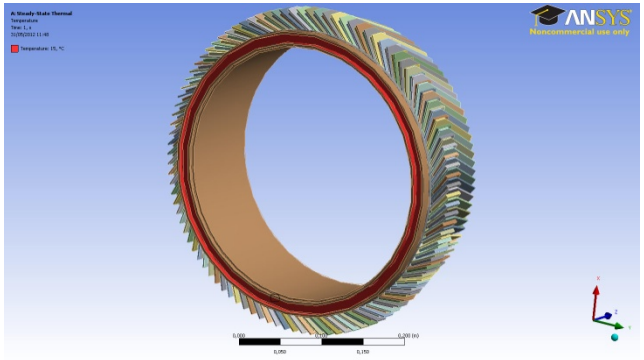
$v = Q / A = 4.78 \times 10^{-5} / 5.75 \times 10^{-5} =$ **0.83 m/s** — **Water flow velocity**

=> Around 50 g/s water flow, with a good thermal contact should be ok

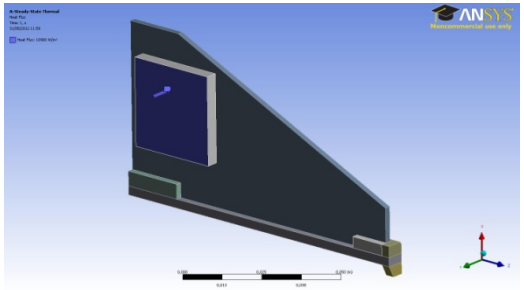
Thermal FEA and calculations show that a Printed Circuit PCB card conductivity could be critical => together with Mauro Citterio group work in progress to optimize the PCB lay-out

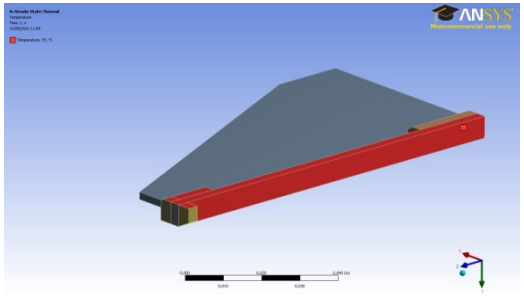
Maybe adding A DEDICATED COPPER LAYER FOR THERMAL DISSIPATION?

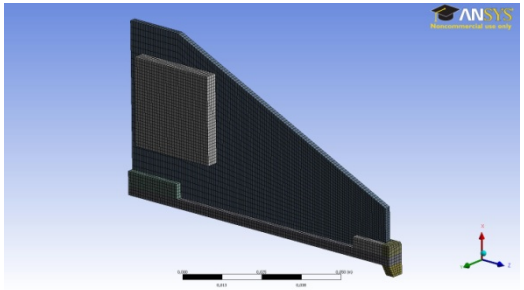




Model too complex to analyze, AnsysWB contact regions need to be semplified defeaturing)



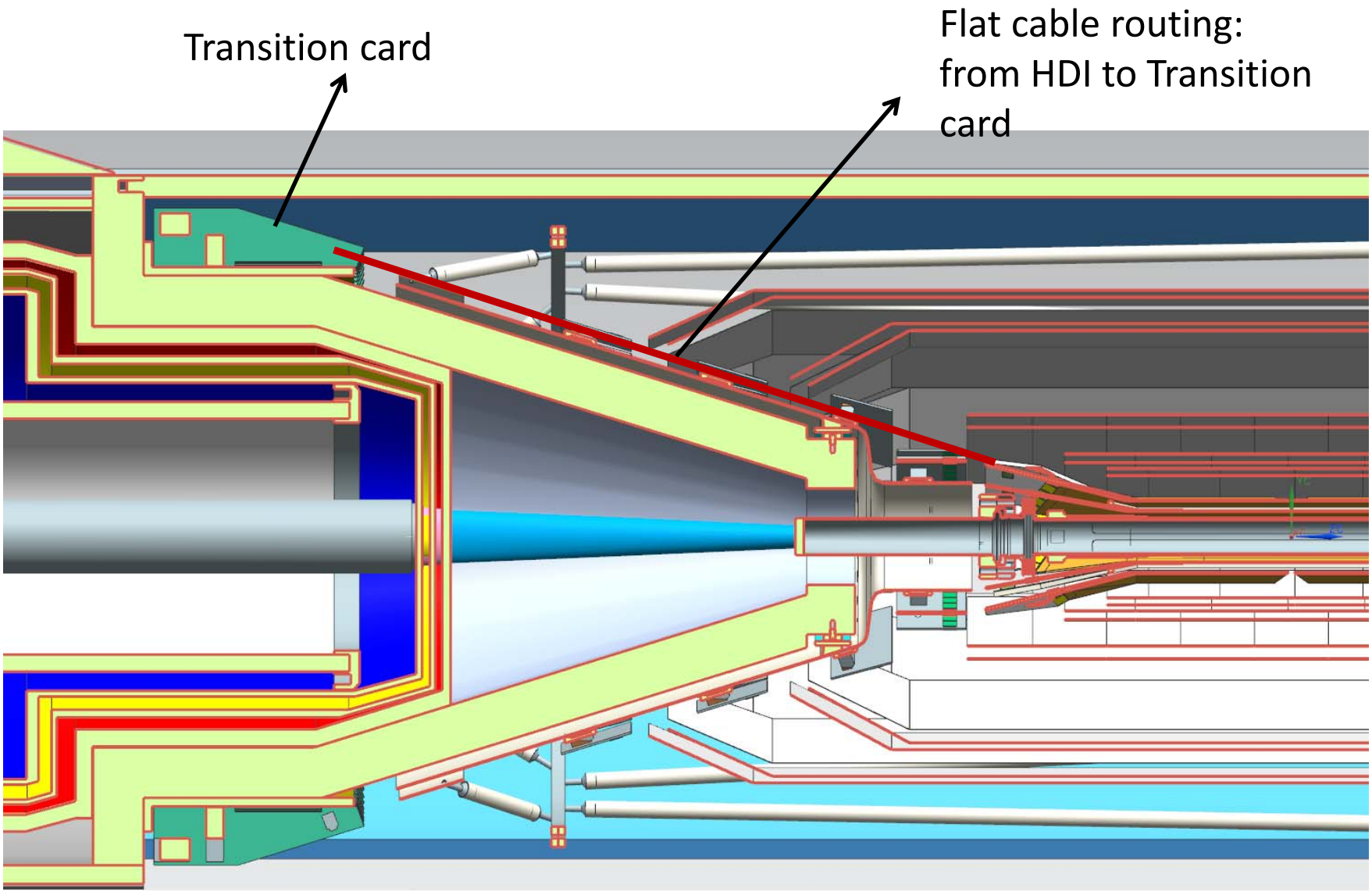




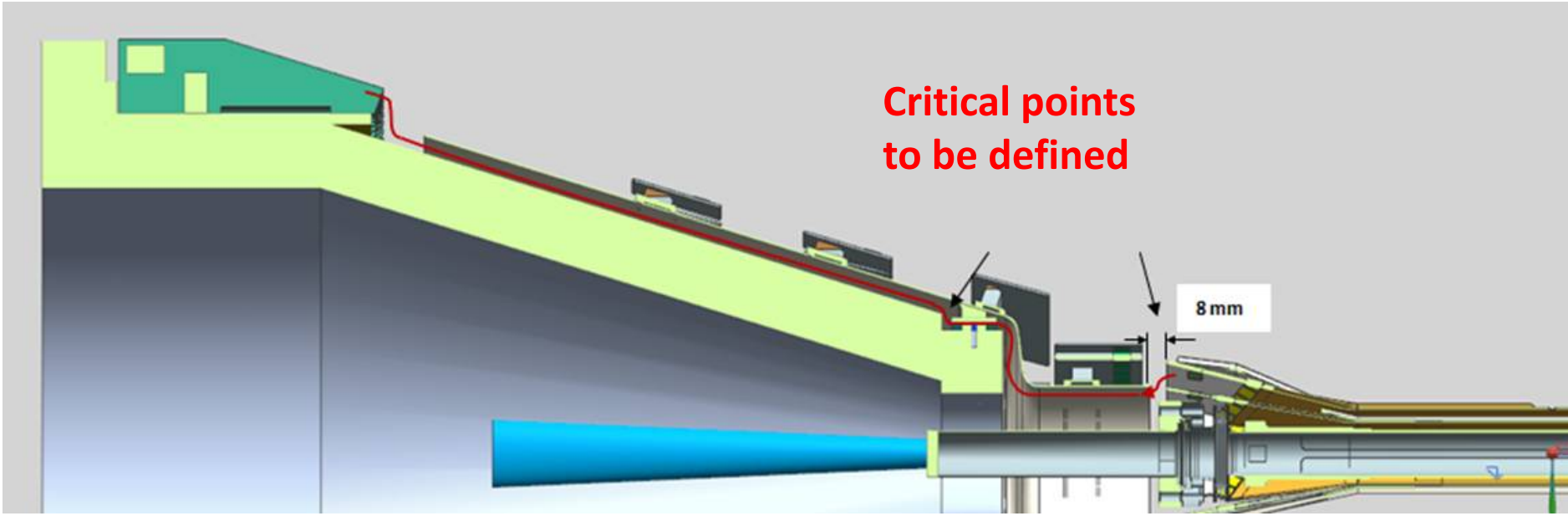
Analysis on a singlecard simplified in the conctact region

PCB CONDUCTIVITY SENSITIVITY ANALYSIS

FLAT CABLES ROUTING
WORK IN PROGRESS



Path of the flat cables

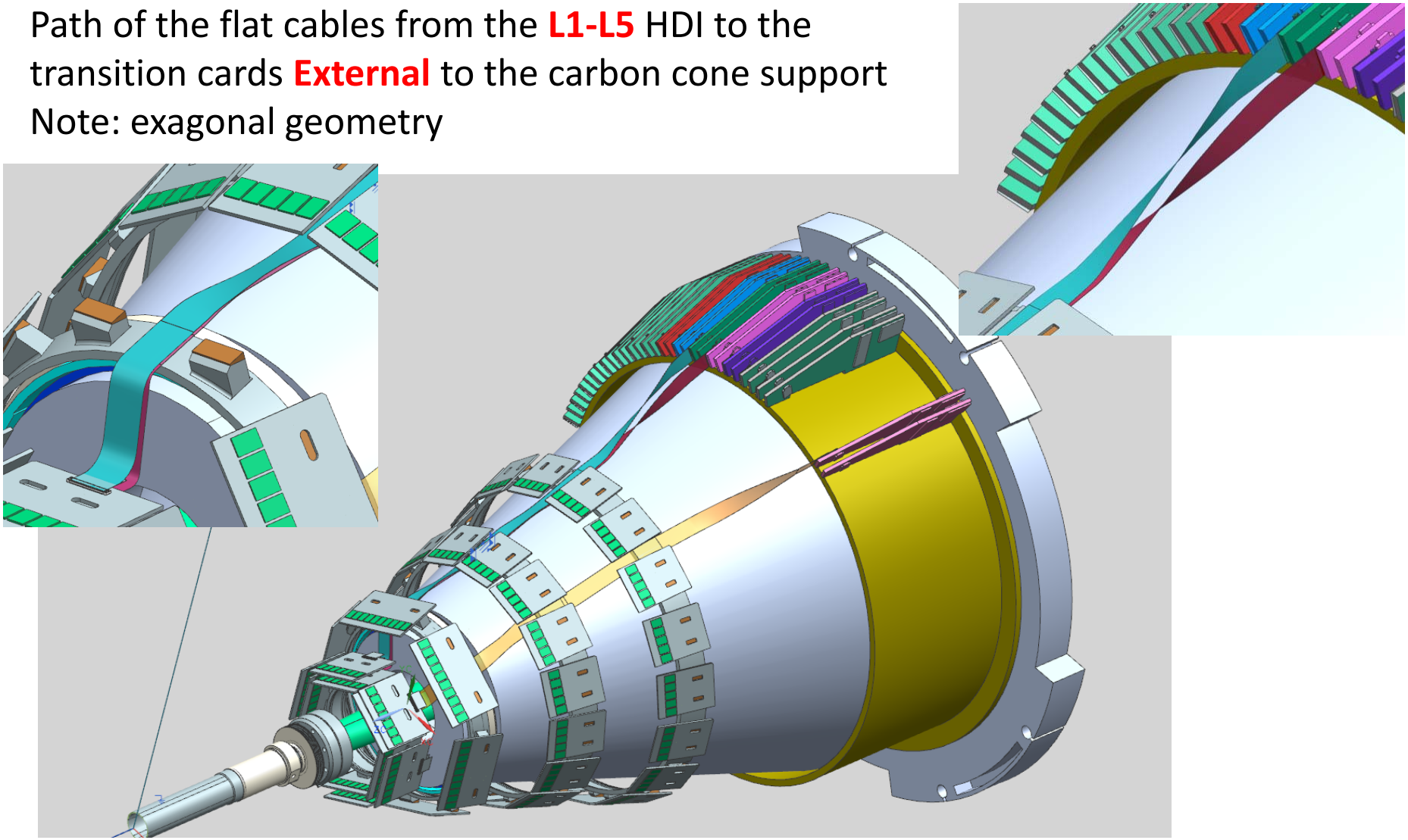


from the **L0** HDI to the transition card
between the carbon cone support and the Tungsten conical shield
Note: octagonal geometry

Criticality: width of the cables that have to pass trought dedicated openings
Now a 12 mm large cable should pass in a 8 mm slot…

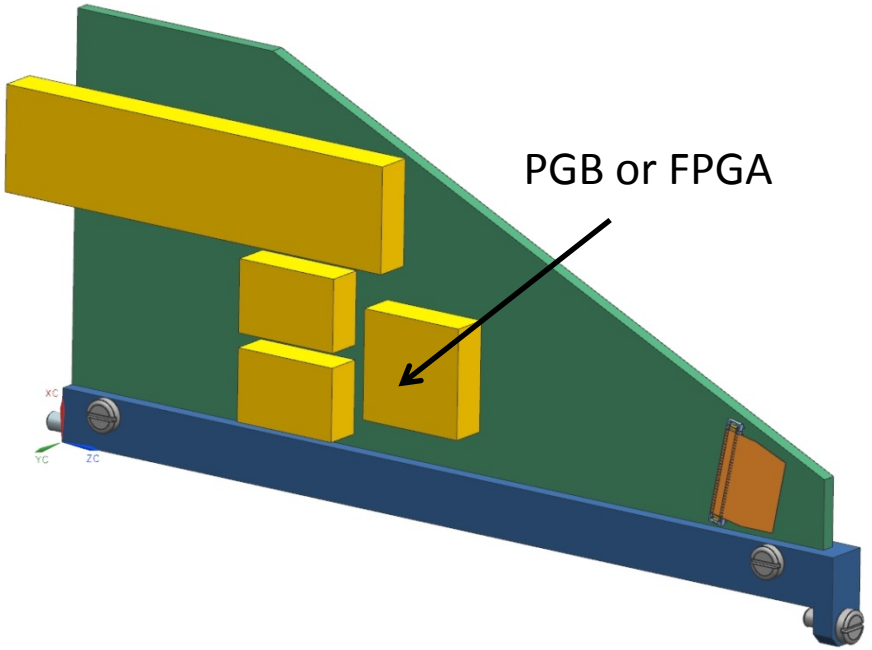
Path of the flat cables

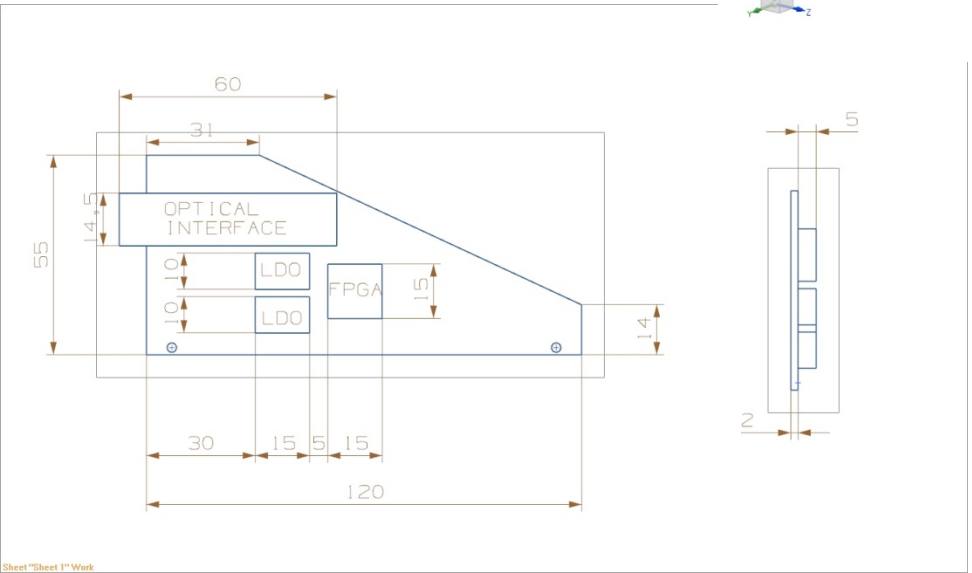
Path of the flat cables from the **L1-L5** HDI to the transition cards **External** to the carbon cone support
Note: exagonal geometry



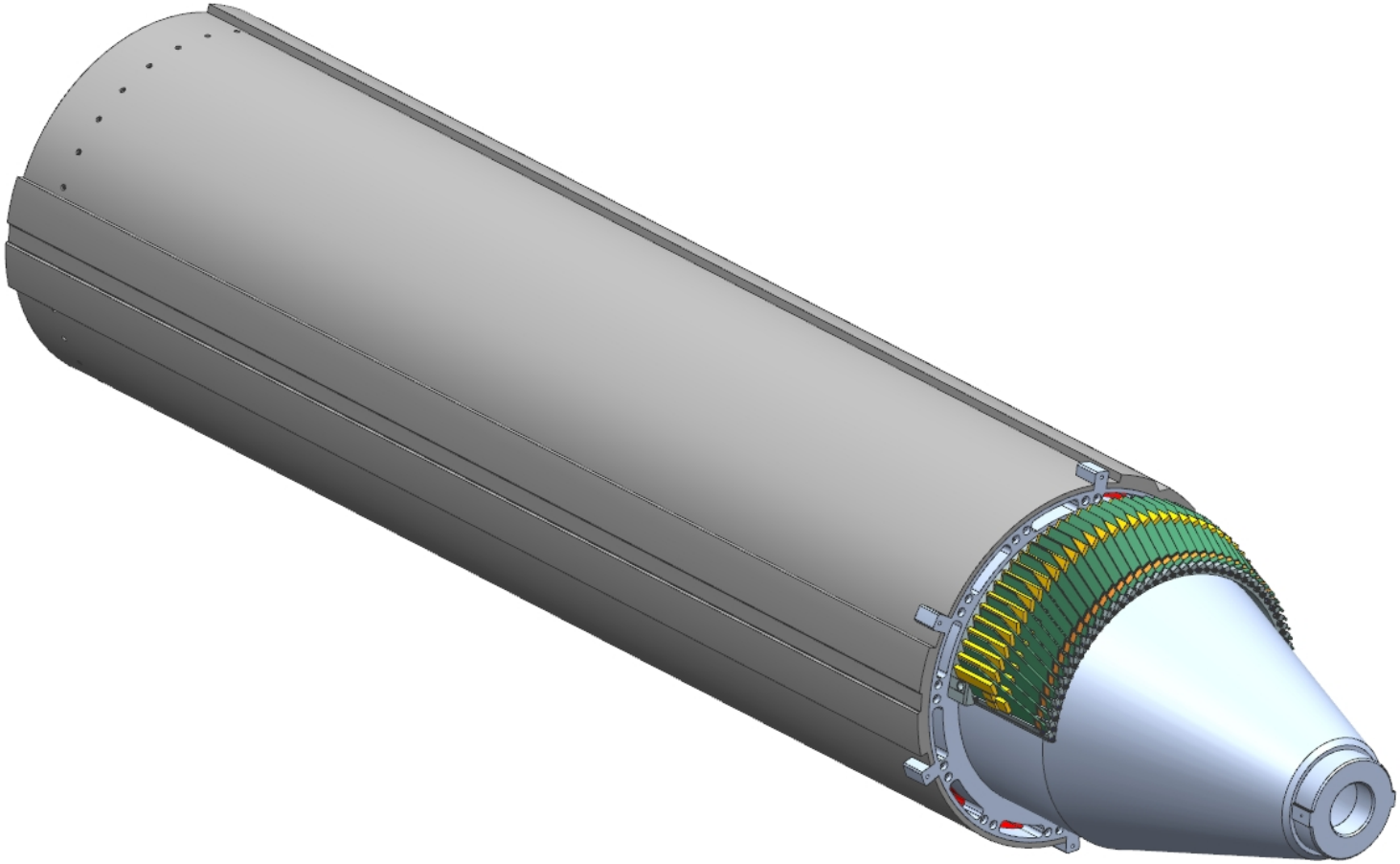
Note: UGS NX modeler now provides a specific design tool to semplify the description of these routings (extremely time consuming activity)

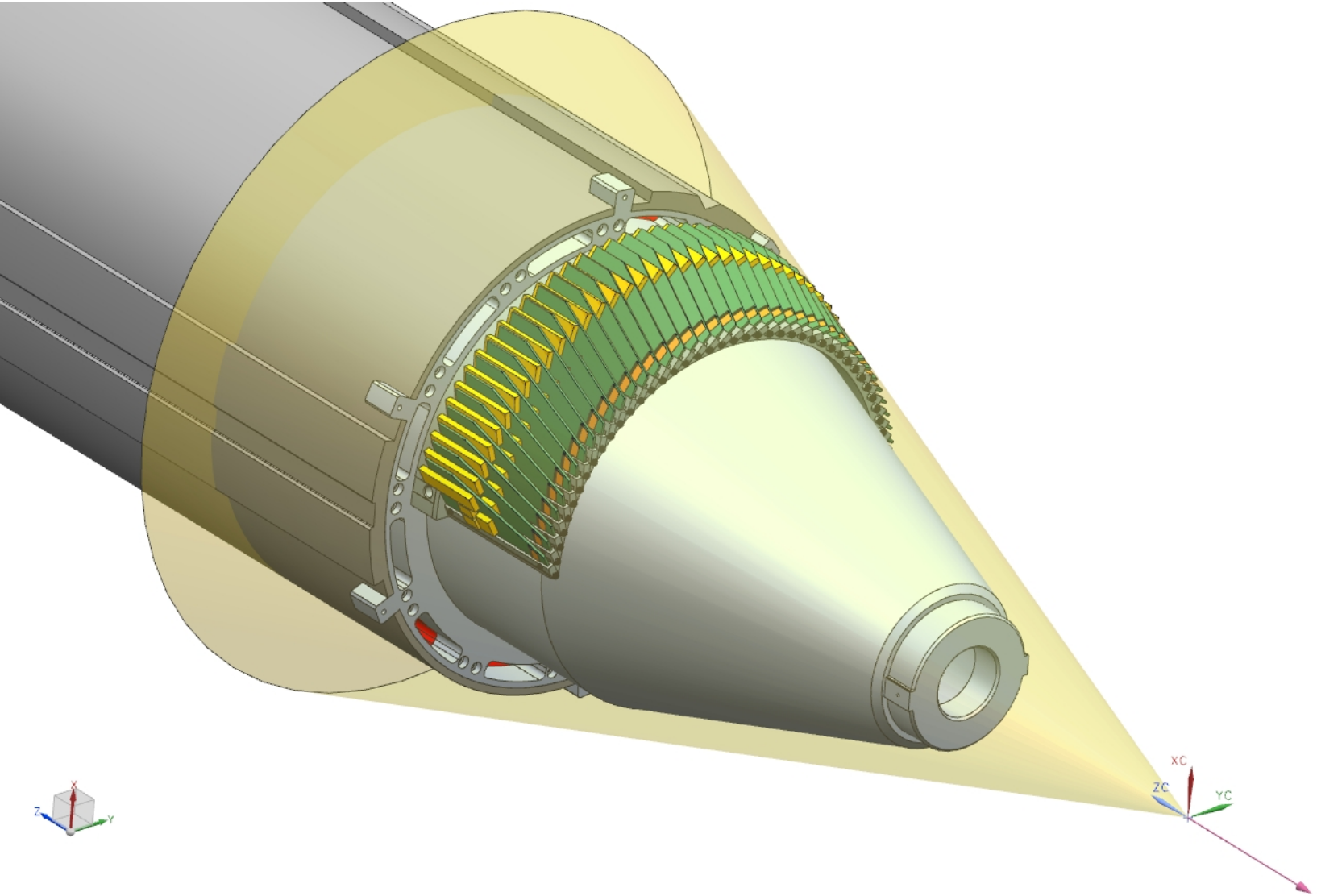
Transition card model with components having more realistic dimensions

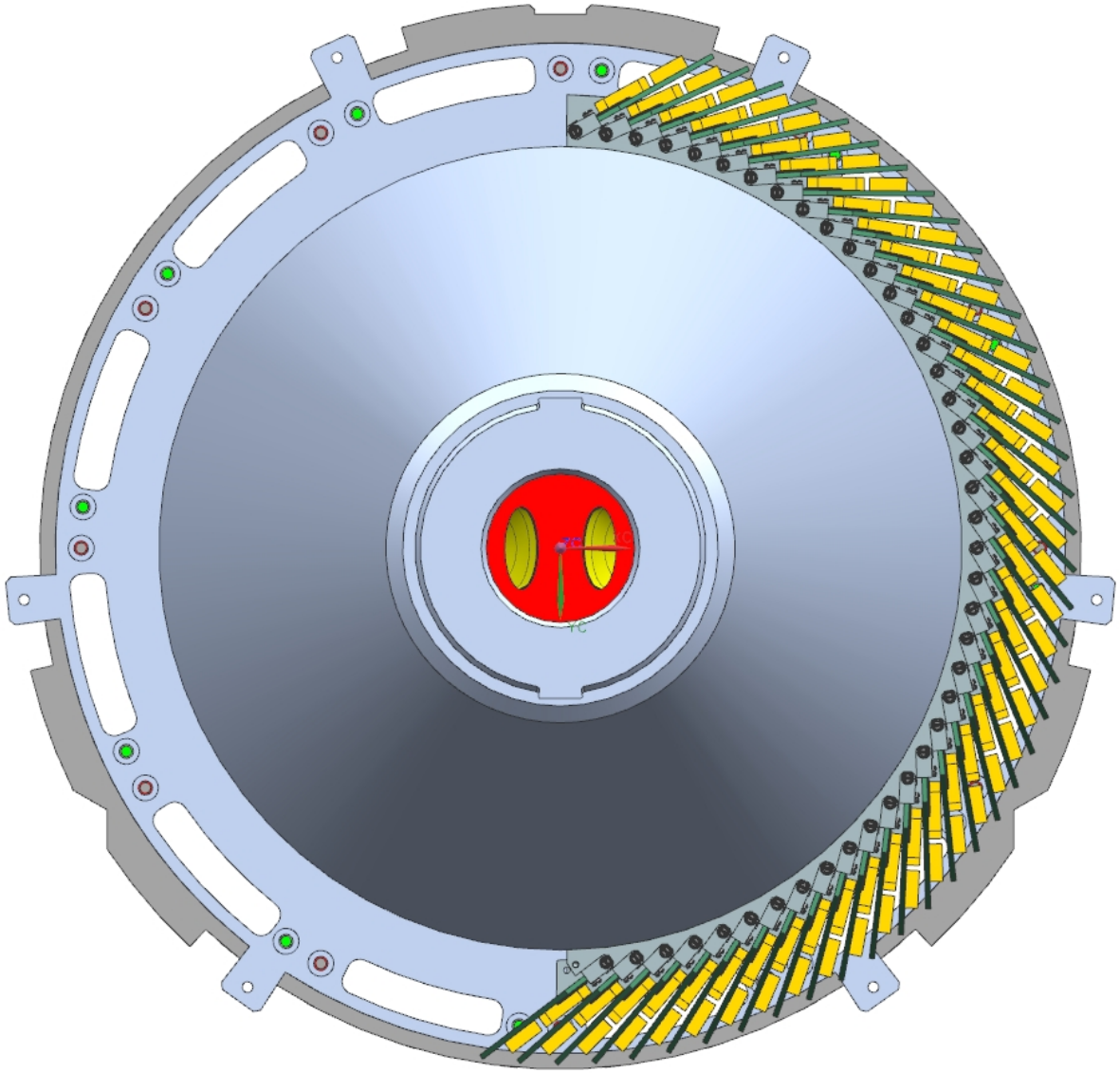


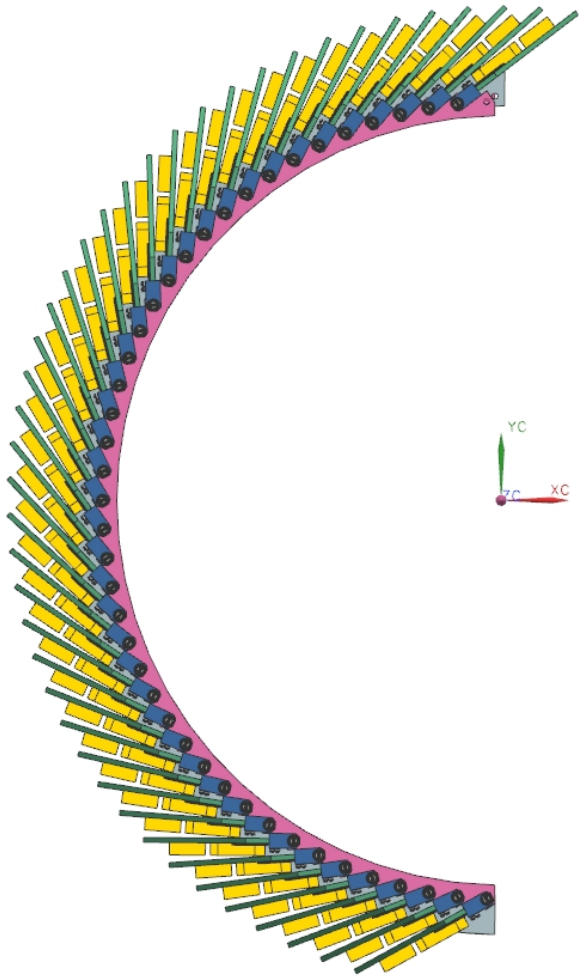


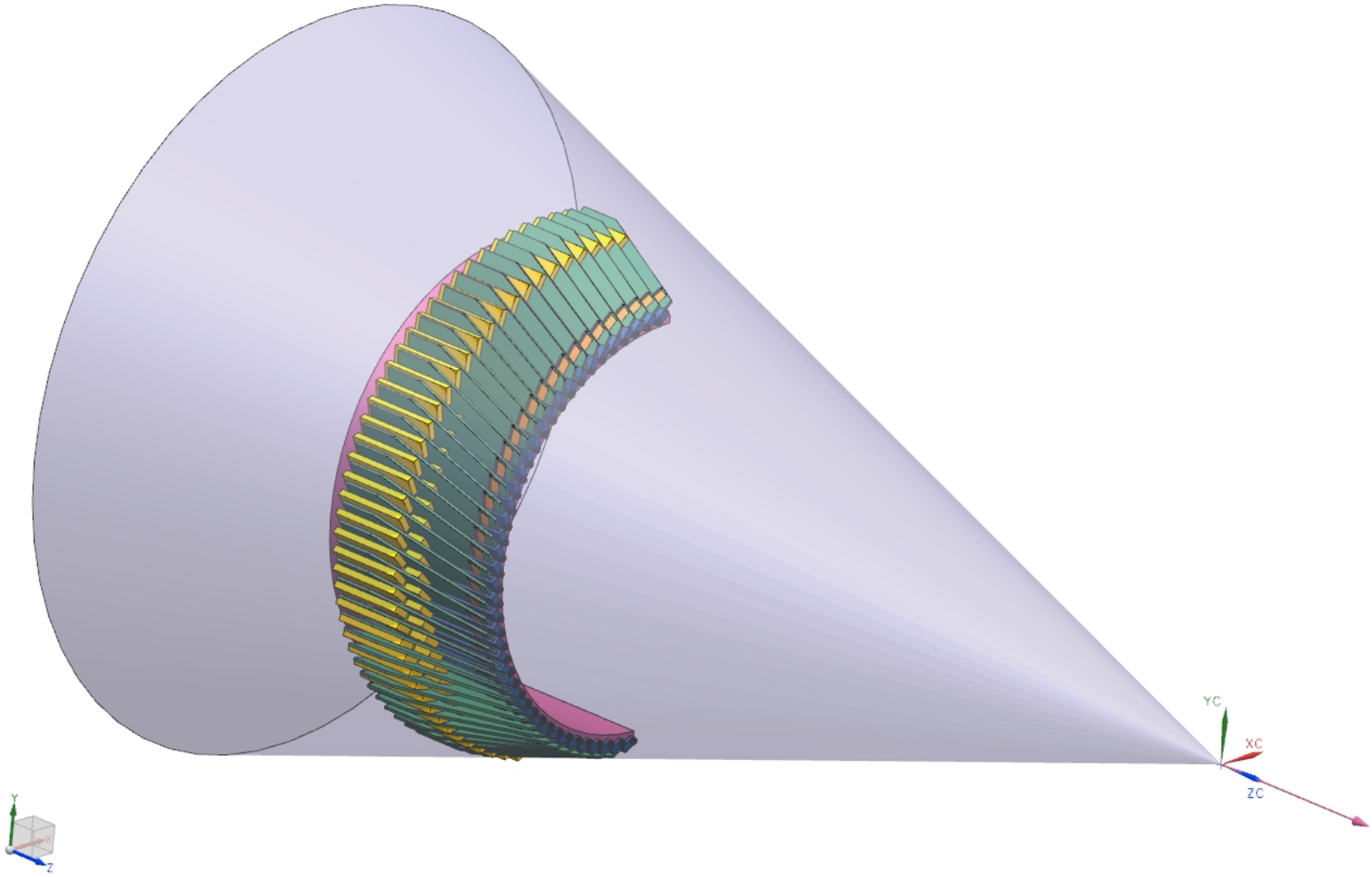
Back up slides


XC
ZC
YC
X
Z
Y


XC
ZC
YC




YC
ZC
XC


YC
XC
ZC
Y
X
Z