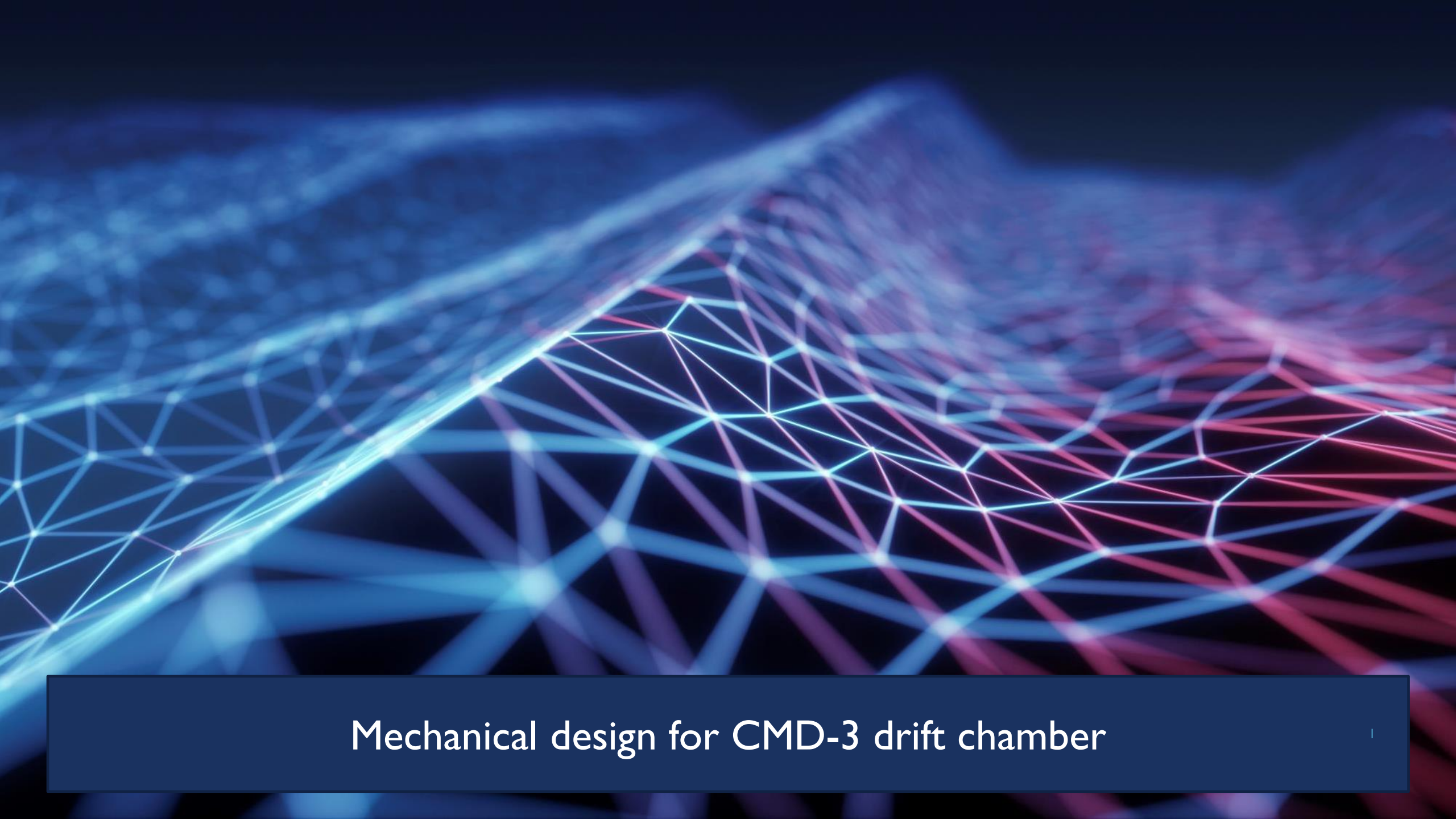
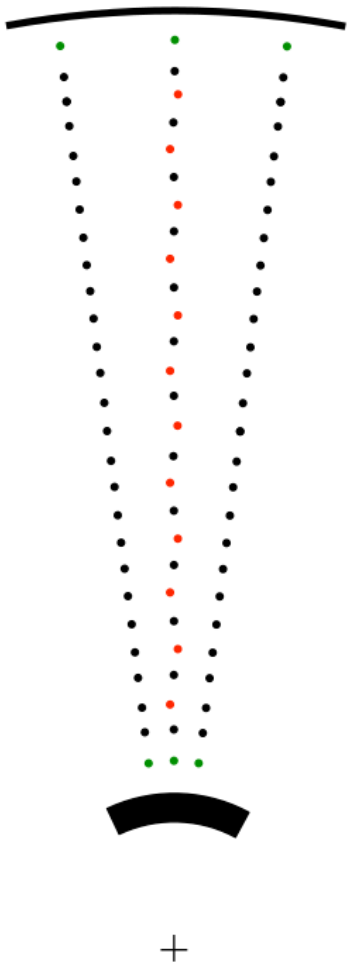


Mechanical design for CMD-3 drift chamber

15° sector A



R_{cyl} = 120 mm
ΔR = x mm

h_{cell} = 7 mm
w_{cell} = 28.4 mm

- sense wire 20 µm
- field wire 80 µm
- guard wire 120 µm

h_{cell} = 7 mm
w_{cell} = 8.25 mm

R_{in} = 20 mm
ΔR = 5 mm

15° sector B
4 cells

4 layers
w_{cell} =
8.66÷10.54 mm

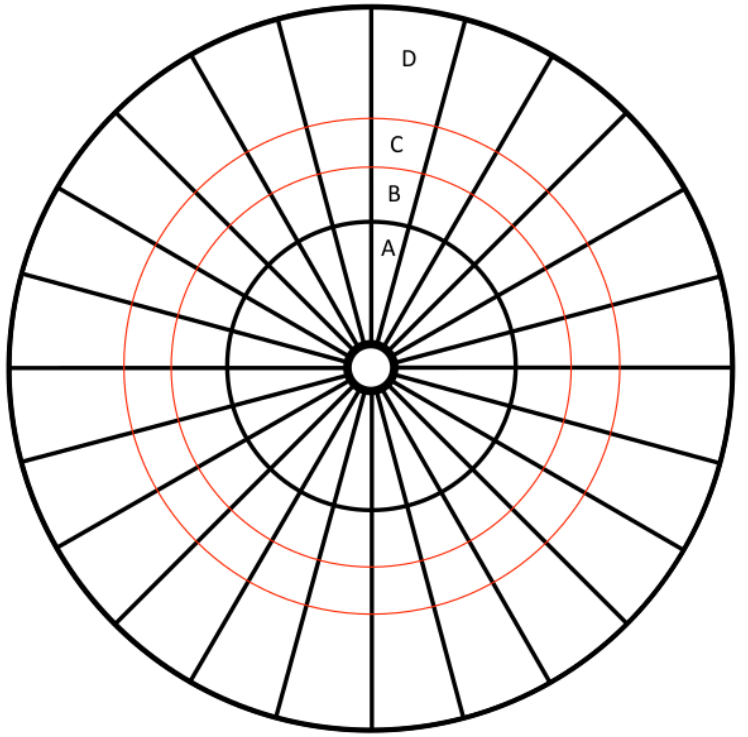
15° sector C
5 cells

4 layers
w_{cell} =
8.94÷10.46 mm

15° sector D
6 cells

8 layers
w_{cell} =
9.15÷12.42 mm

Details about the cell structure in chamber sectors.



SPIDER WEB STRUCTURE

A:
jet cell axial-layer
12 sense per cell
1 cell per sector

B:
4 single wire cell
±stereo-layers
4 cells per sector

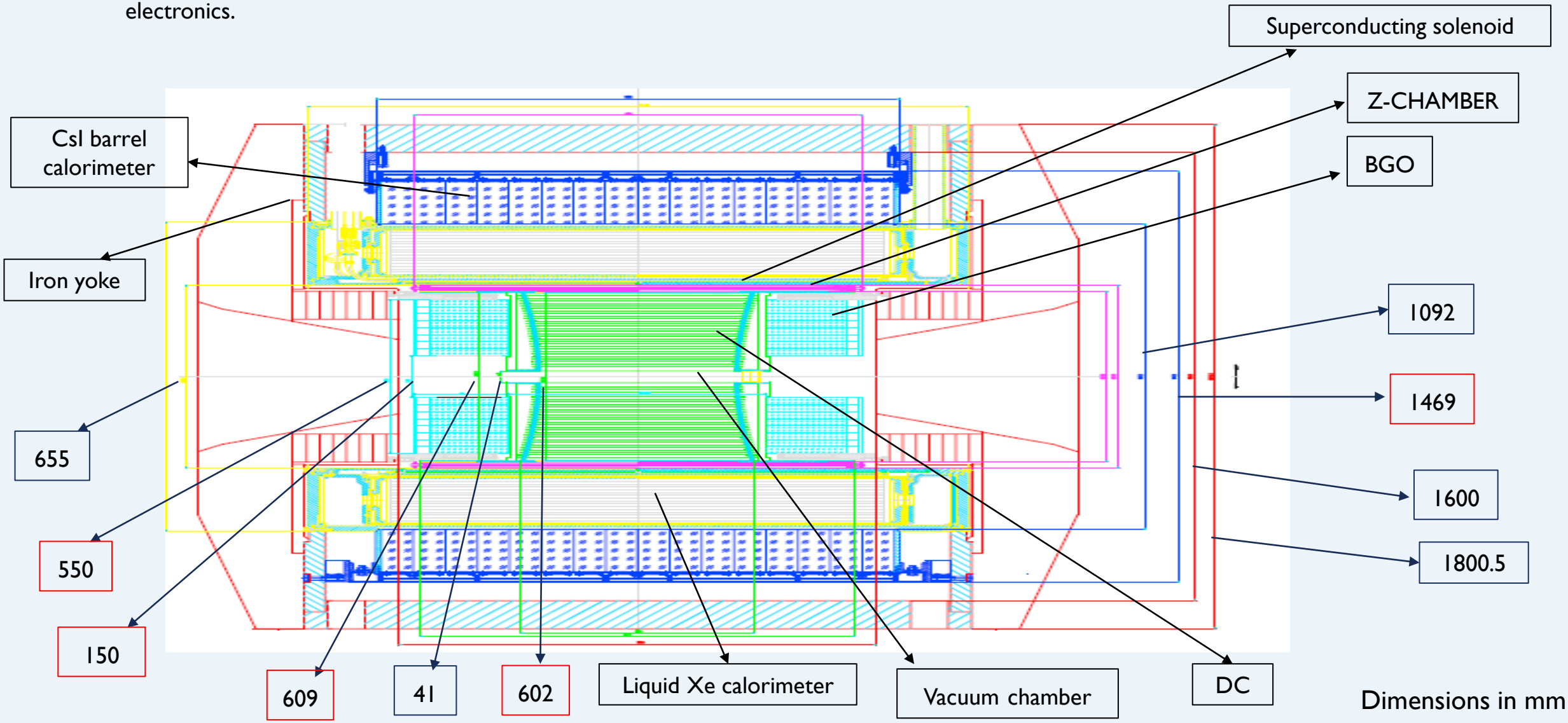
C:
4 single wire cell
±stereo-layers
5 cells per sector

D:
8 single wire cell
±stereo-layers
6 cells per sector

DIMENSIONS

- Along beam axis (distance between end-cap calorimeter) = 484 mm
- Transverse direction (diameter) = 609 mm
- Inner shell= 41 mm

The size along beam will be change not more than **5-15 mm**, due to the optimization of BGO electronics.



Dimensions in mm

The «pierced» spokes for sector A: 24 spokes-48 PCB

The construction of the chamber is driven by three main purposes:

1) The high transparency.
2) The correct positioning of wires on precise coordinates in the space.
3) The mechanical stability of the whole structure.

We intend to make a rectangular hole inside the spokes.
24 of the 48 PCB will be inserted in the 24 **pierced** spokes.
The other 24 will be placed between two adjacent spokes.

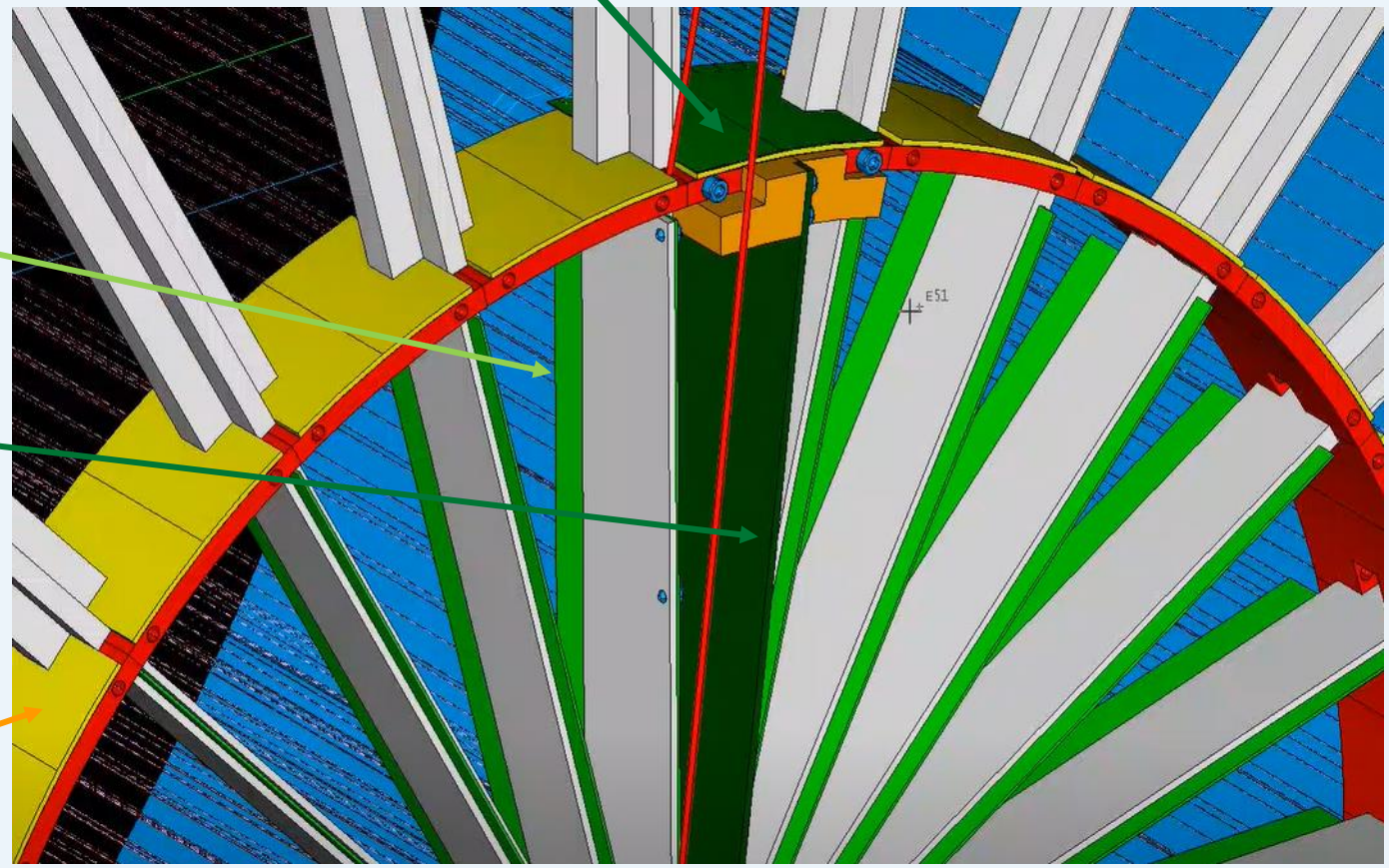
Wire PCB for sector B

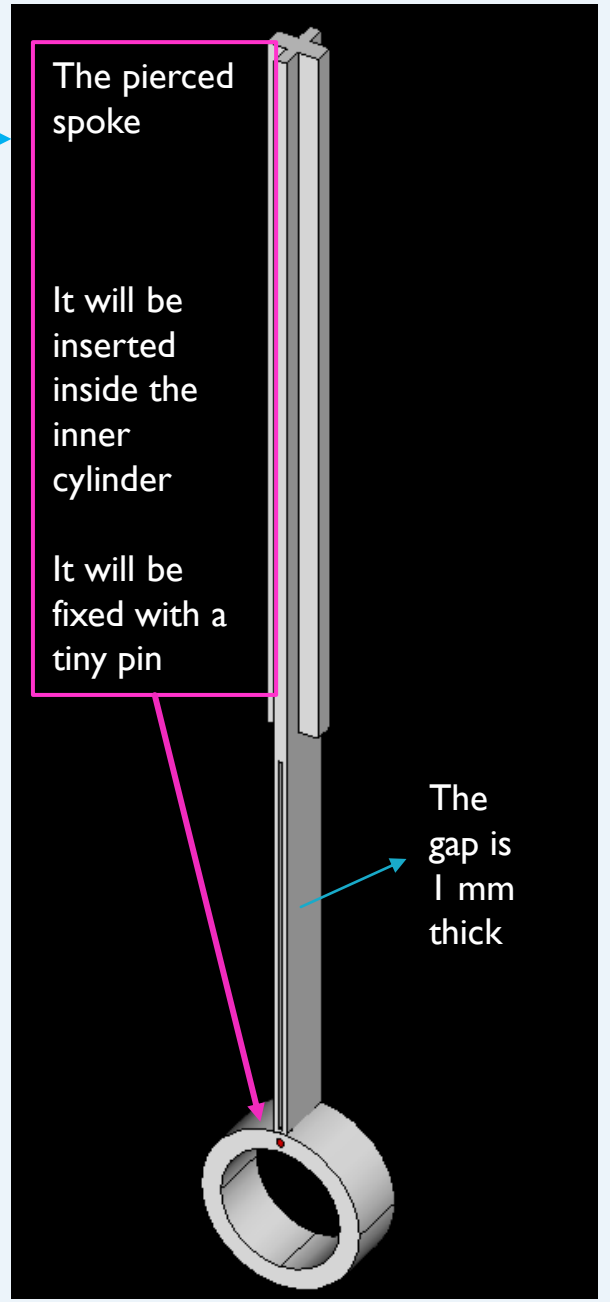
We intend to use two different thickness for PCBs

The ones inside spokes: 400 μm

The ones between two adjacent spokes :1 mm

Support for PCB



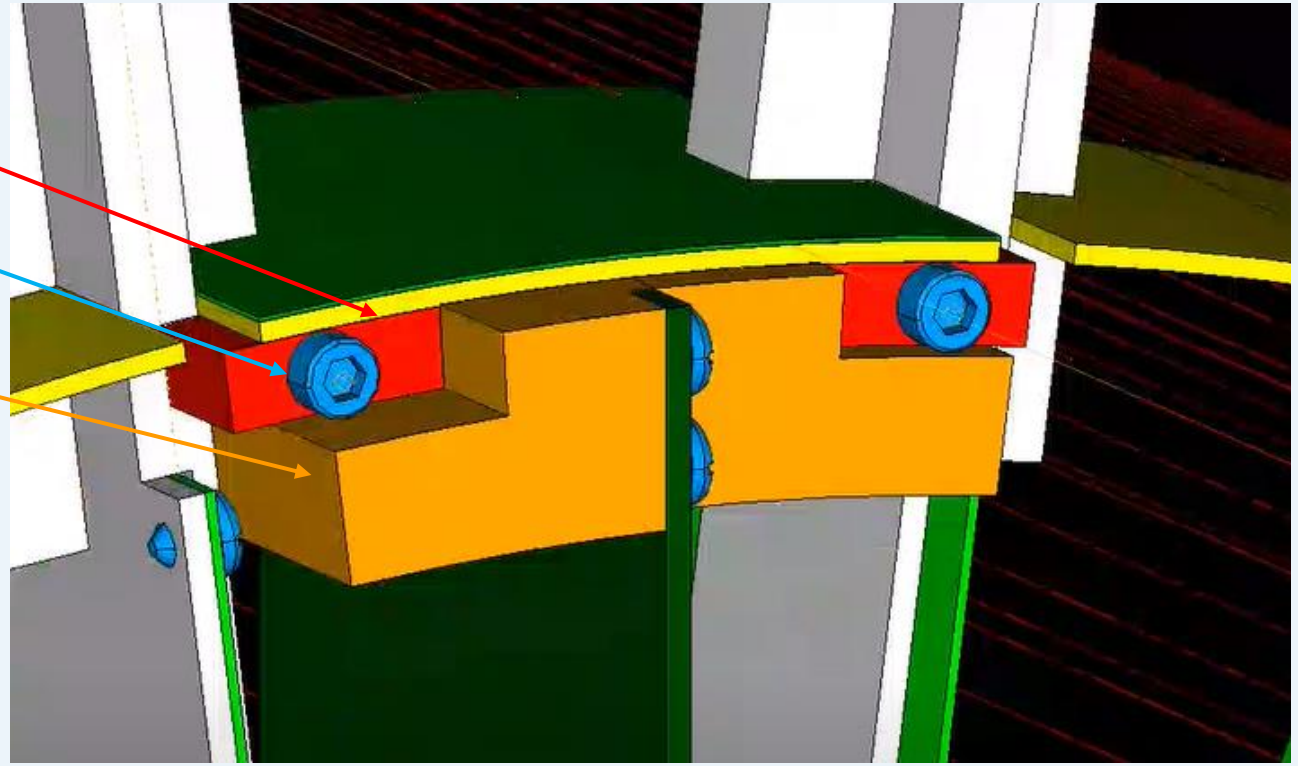


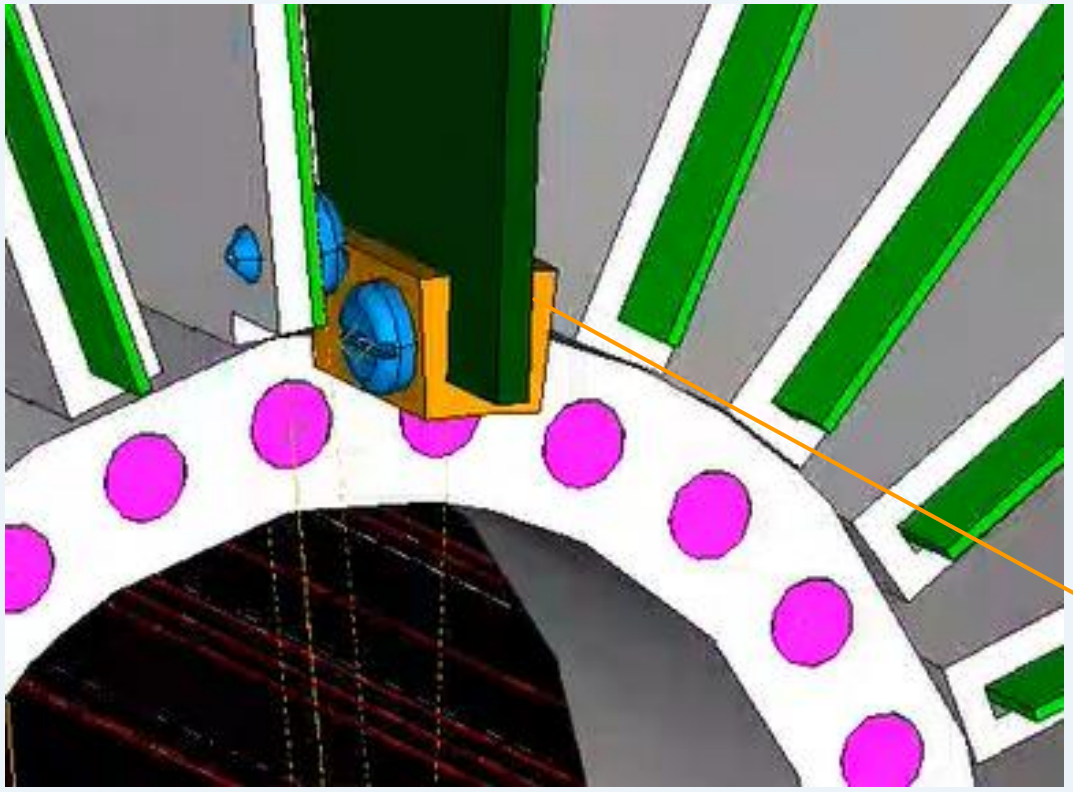
Details about the wire PCBs between two spokes

We intend to divide the middle cylinder in segments

Each segments will be fixed to the spokes with pins.

The PCB support will be built with a suitable shape to host the PCB.



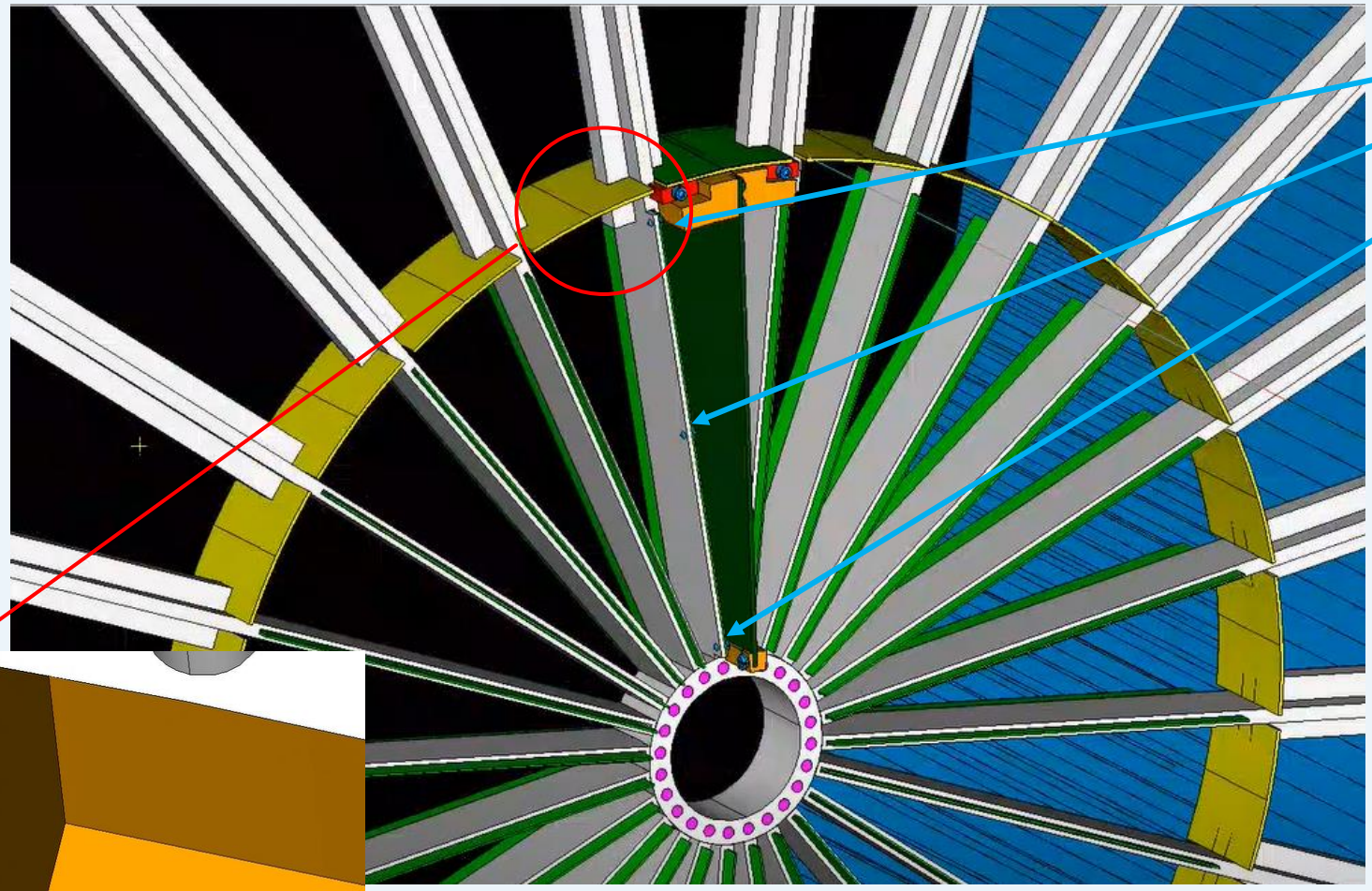


At the inner cylinder, we will insert the PCB into a tiny support and fix it with a pin.

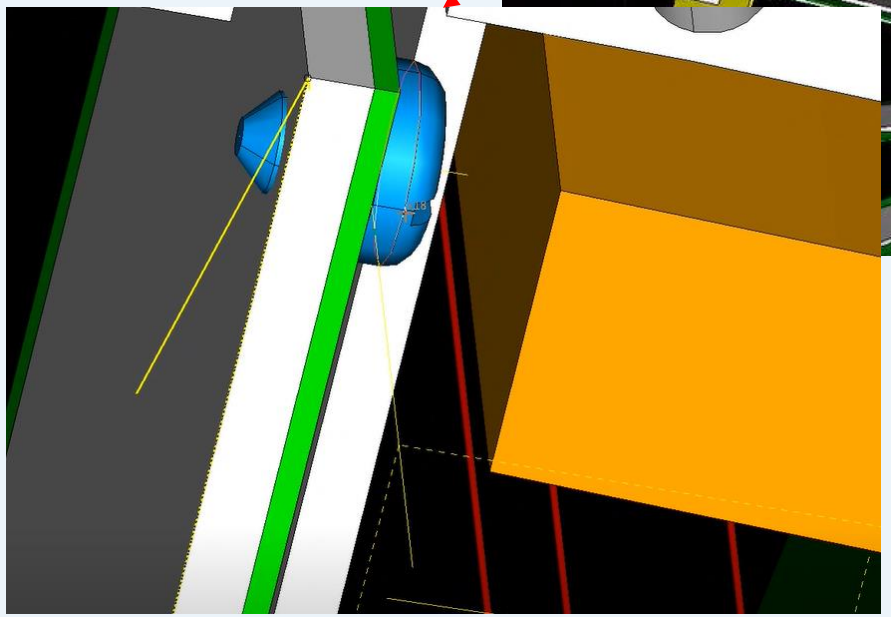
This structure helps us during the construction of the chamber.

- We will start from the PCB inside the spokes.
- Then we will insert the PCB between the spokes, the support and the segment of the cylinder **from above** .

Details about fixing the wire PCBs inside the pierced spokes



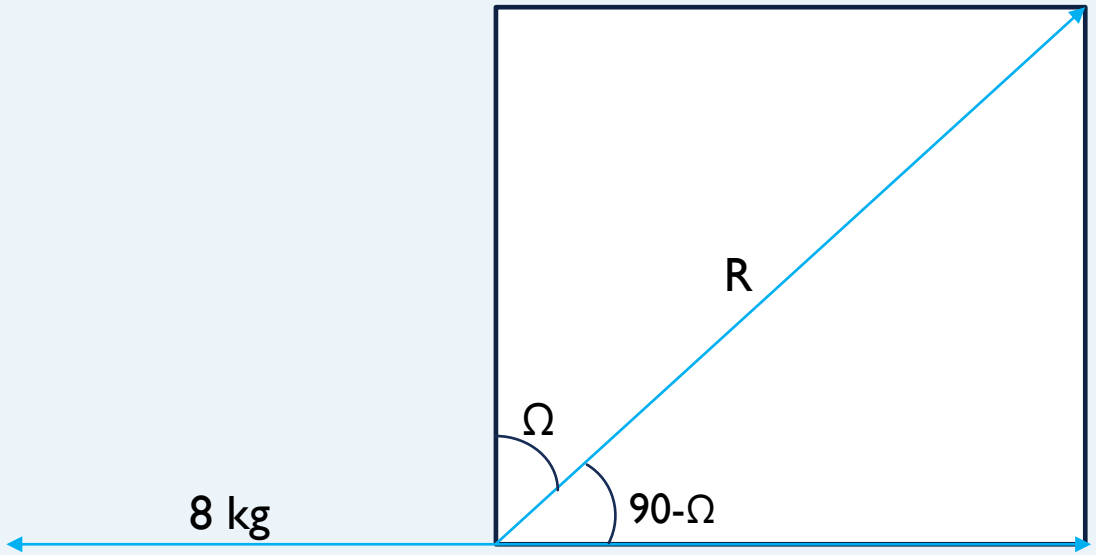
We will fix the PCB to one side of the spokes, inside the hole, with 3 pin.



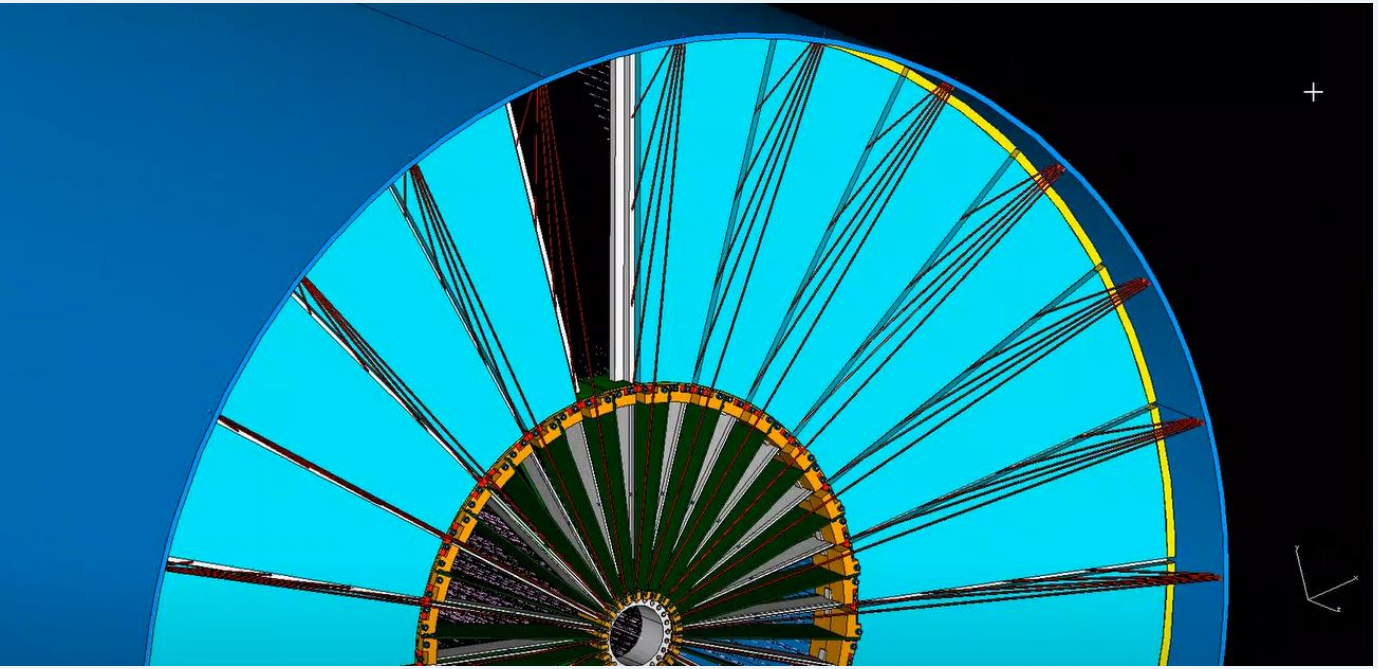
Tie rod to prevent deformations

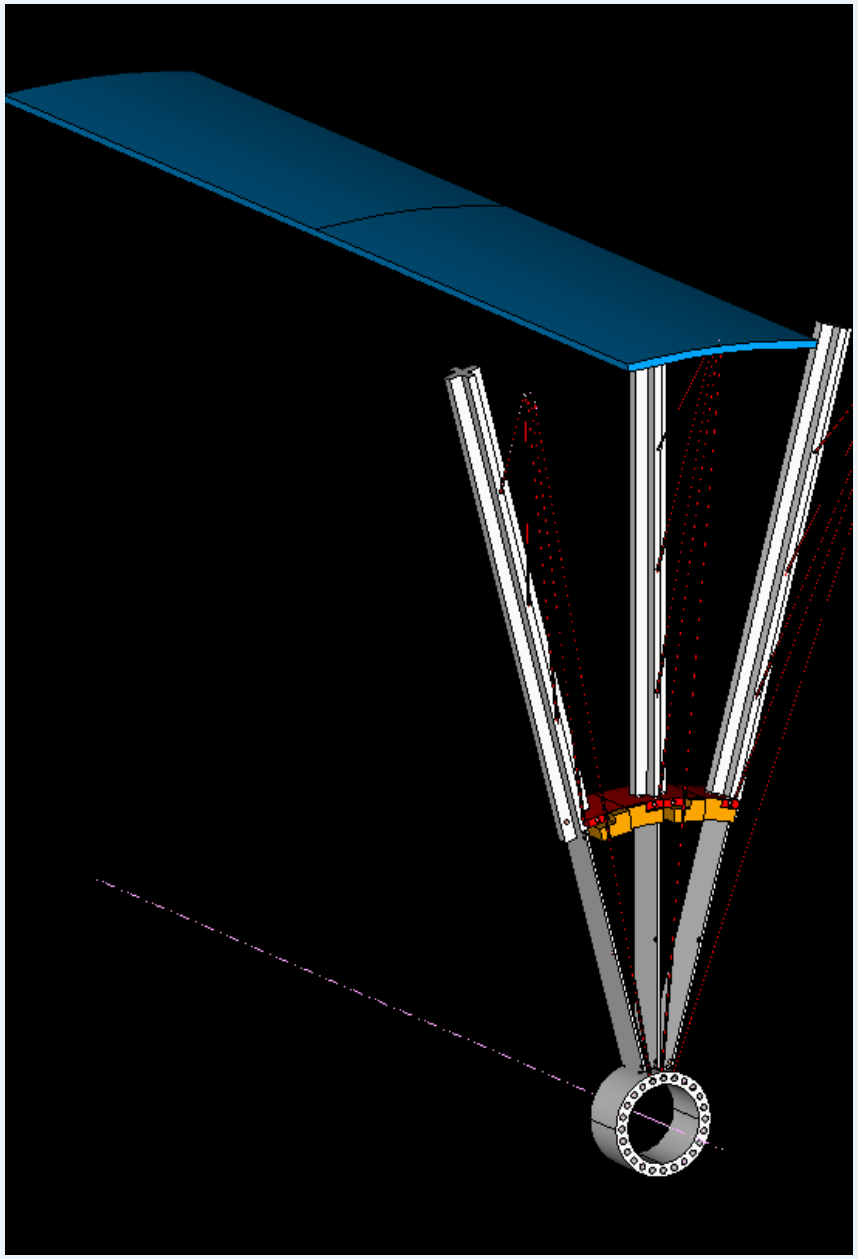
Due to the wire loads, the end-plates are affected by **deformations**.
We intend to install 5 tie rods per spokes to minimize the deformations due to the wire load.
We simulate the spokes behavior with a load of **40** kg (**2 times higher than the expected value**).

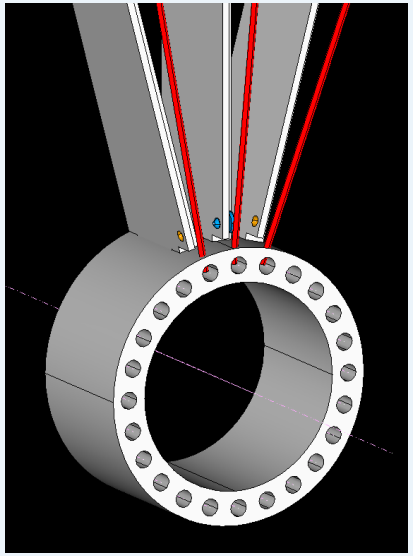
Number of tie rods	Ang(deg) Ω	load (kg)	Compl. Ang. (deg)	Compl. Ang. in rad	R(kg)
1	40	8	50	0.87	12.45
2	24		66	1.15	19.67
3	17.43		72.57	1.27	26.71
4	14		76	1.33	33.07
5	9		81	1.41	51.14



Tie rod to prevent deformations



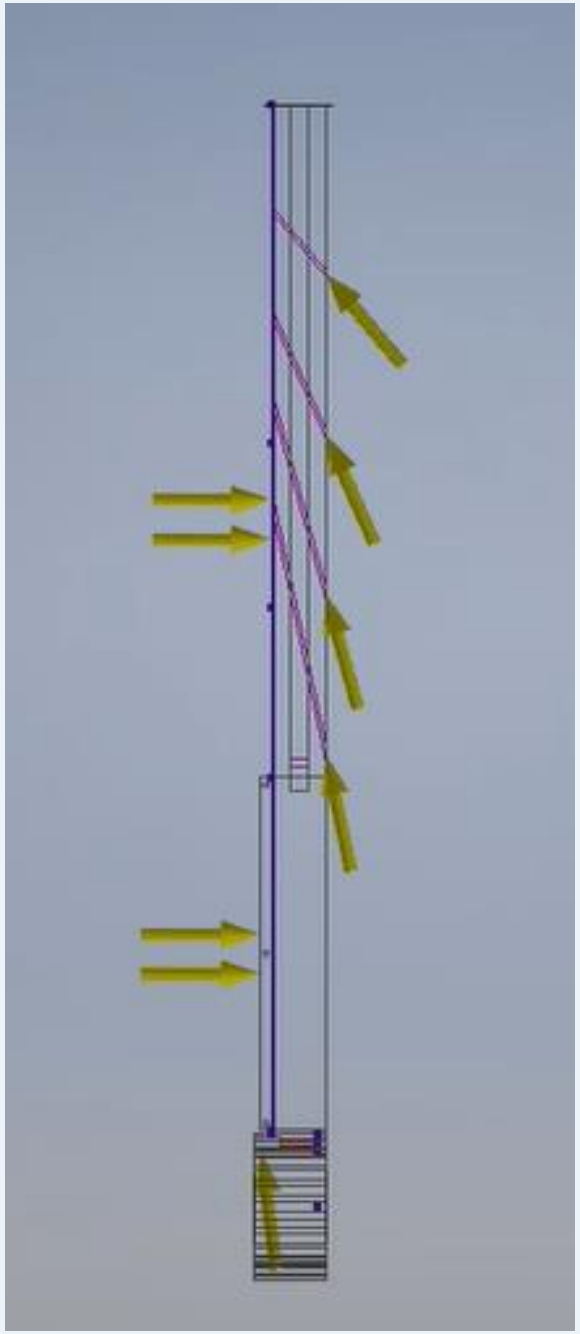




Here you can see how we intend to fix the 5 tie rods on the outer and on the inner cylinder.

The tie rods will preserve the transparency and the mechanical stability of the chamber.

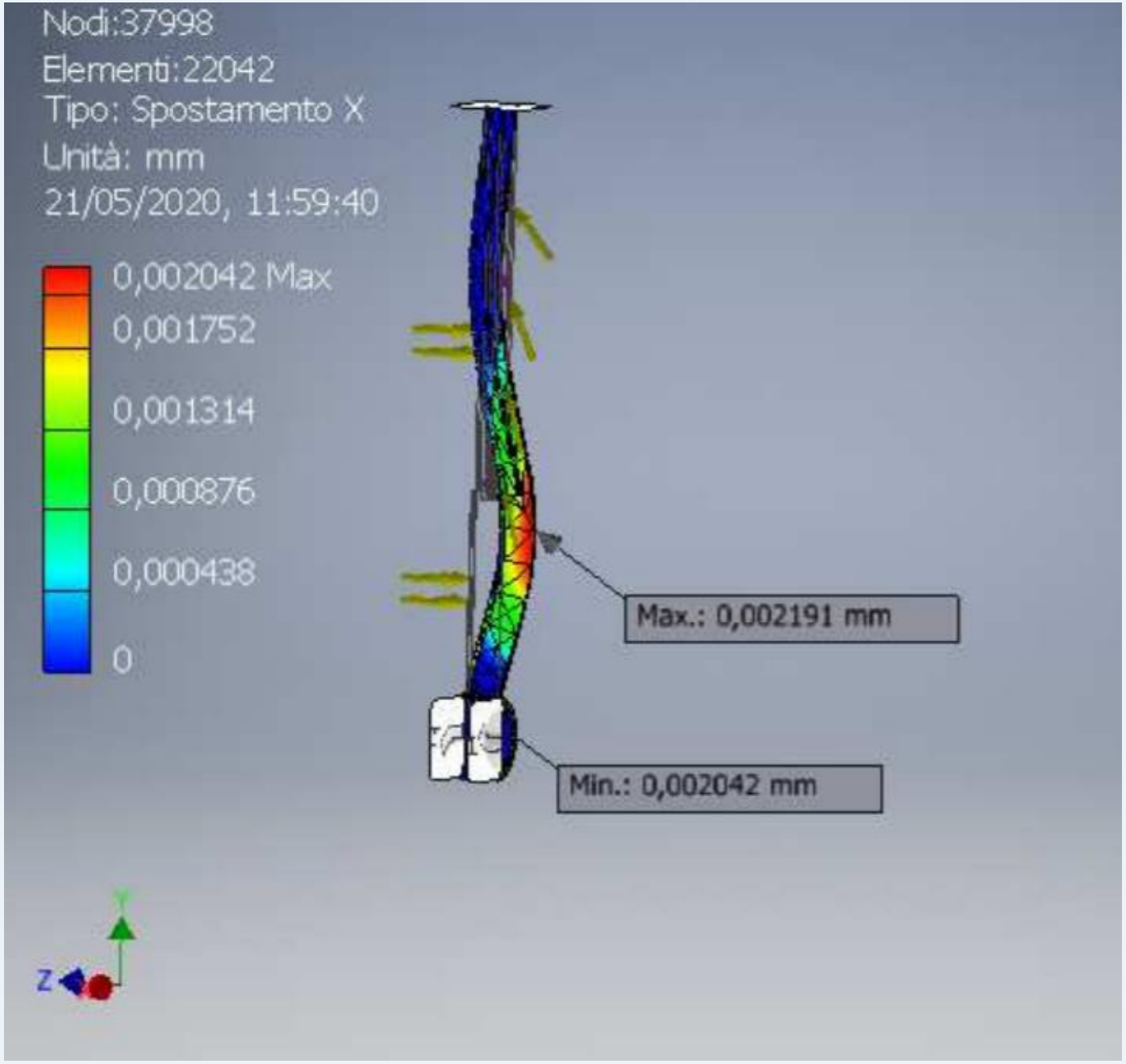
Simulations results

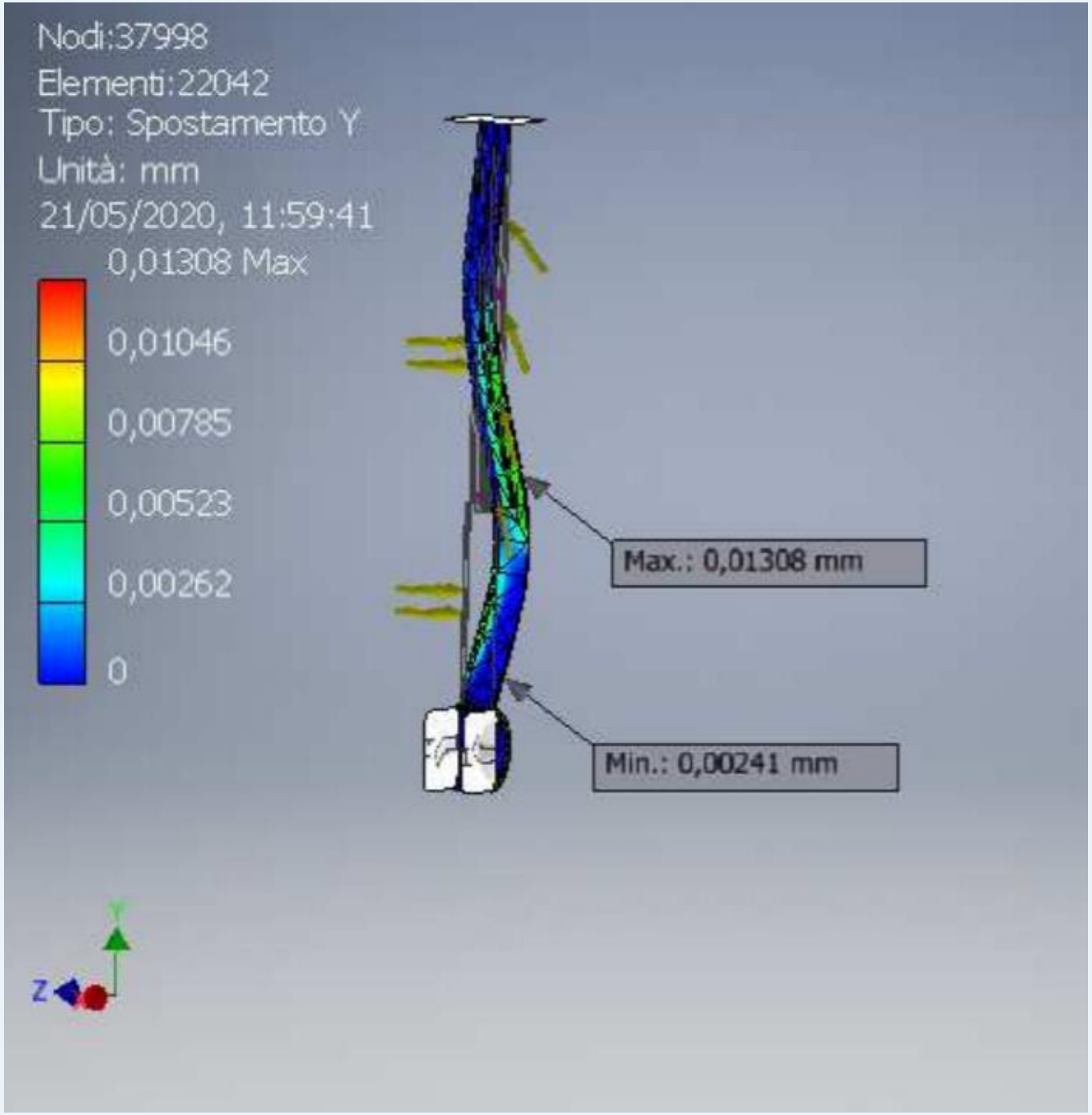


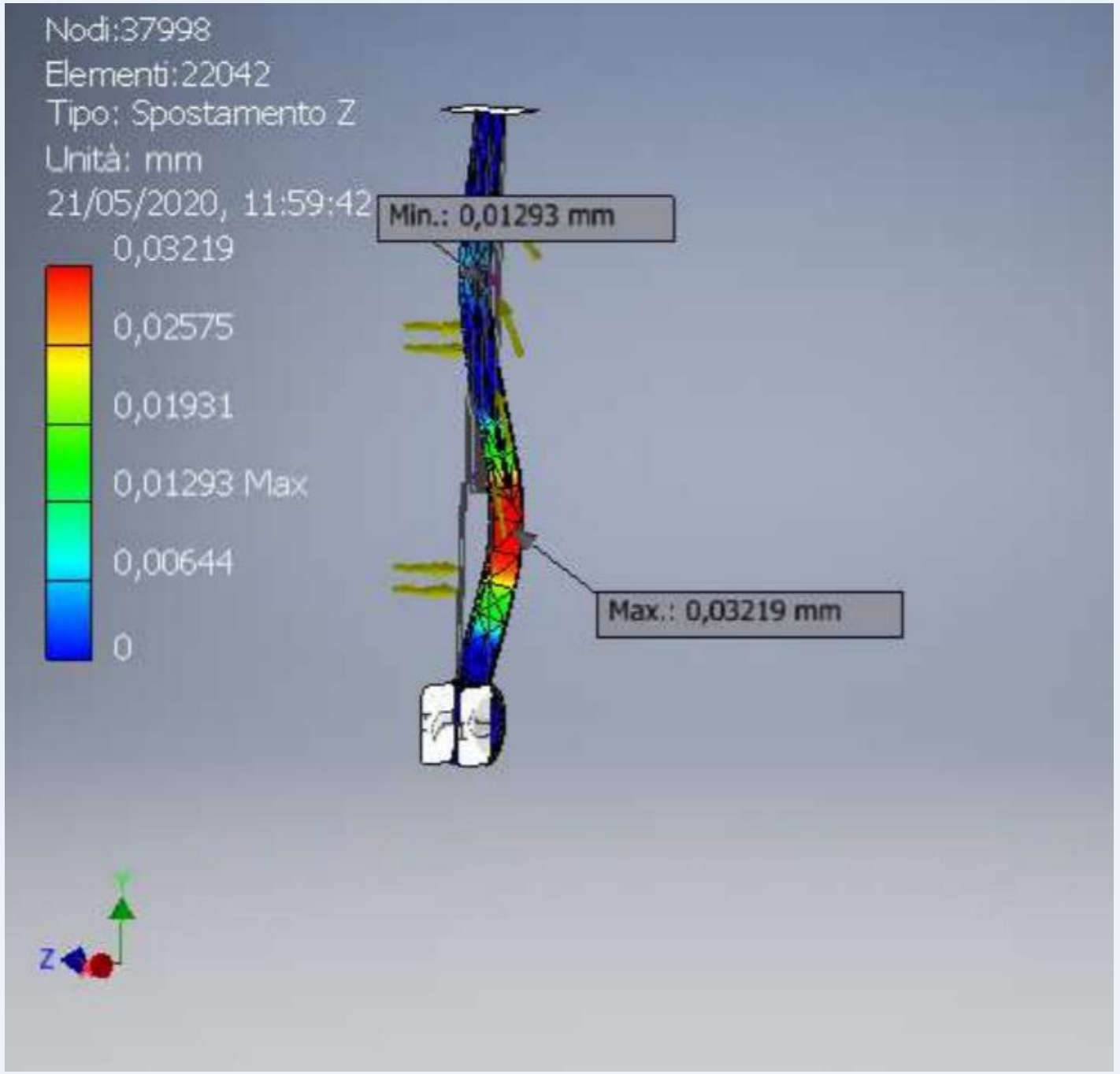
We simulated the spokes behavior with wire load (40 kg) and the load correction made by the 5 tie rods.

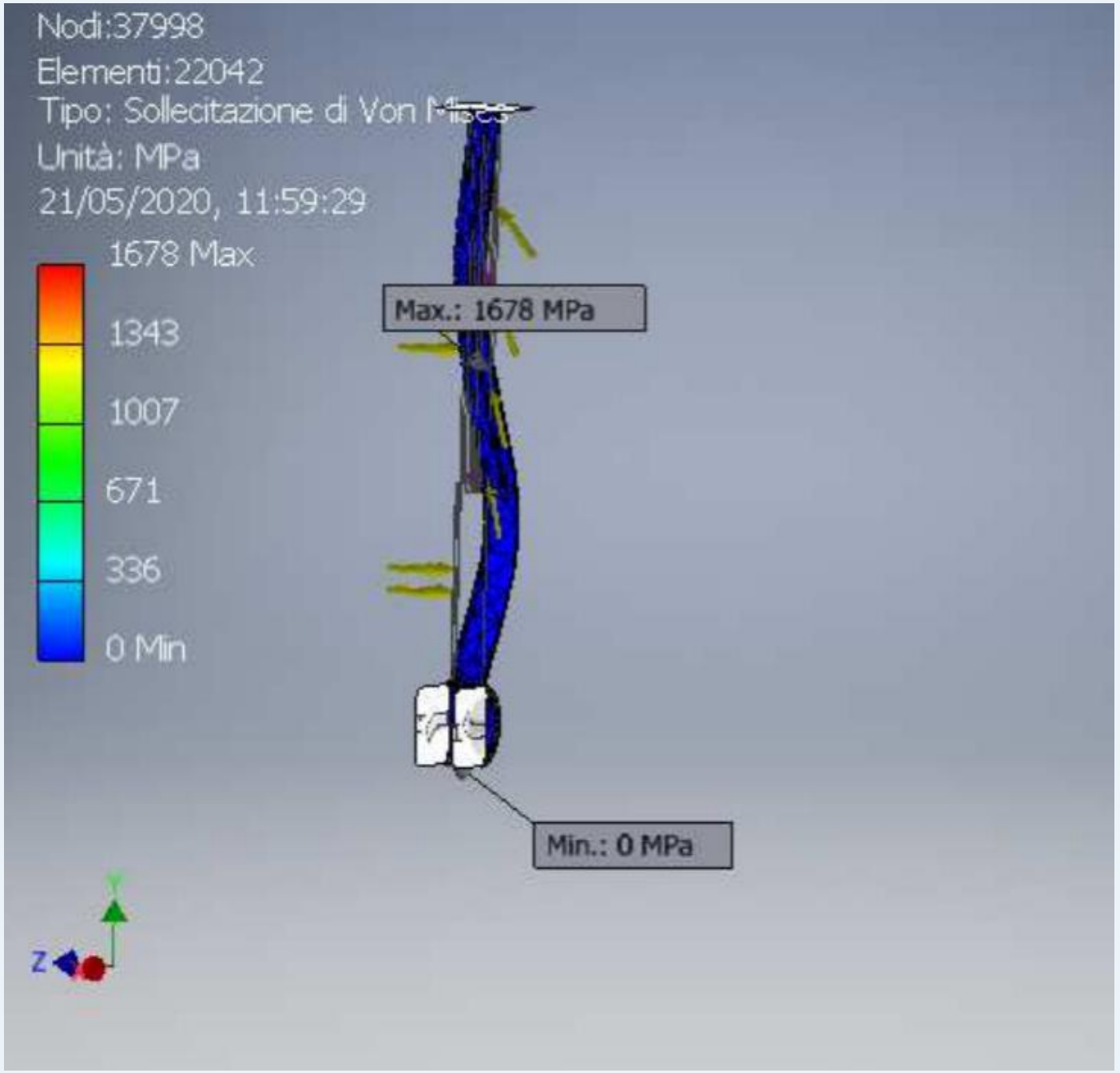
Nome	CFRP	
Generale	Densità della massa	1,43 g/cm^3
	Resistenza allo snervamento	300 MPa
	Resistenza massima a trazione	577 MPa
Sollecitazione	Modulo di Young	133 GPa
	Coefficiente di Poisson	0,39 su

	Modulo a taglio	47,8417 GPa


Nodi:37998
Elementi:22042
Tipo: Spostamento X
Unità: mm
21/05/2020, 11:59:40
0,002042 Max
0,001752
0,001314
0,000876
0,000438
0
Max.: 0,002191 mm
Min.: 0,002042 mm
Z


Nodi:37998
Elementi:22042
Tipo: Spostamento Y
Unità: mm
21/05/2020, 11:59:41
0,01308 Max
0,01046
0,00785
0,00523
0,00262
0
Max.: 0,01308 mm
Min.: 0,00241 mm
Y
Z

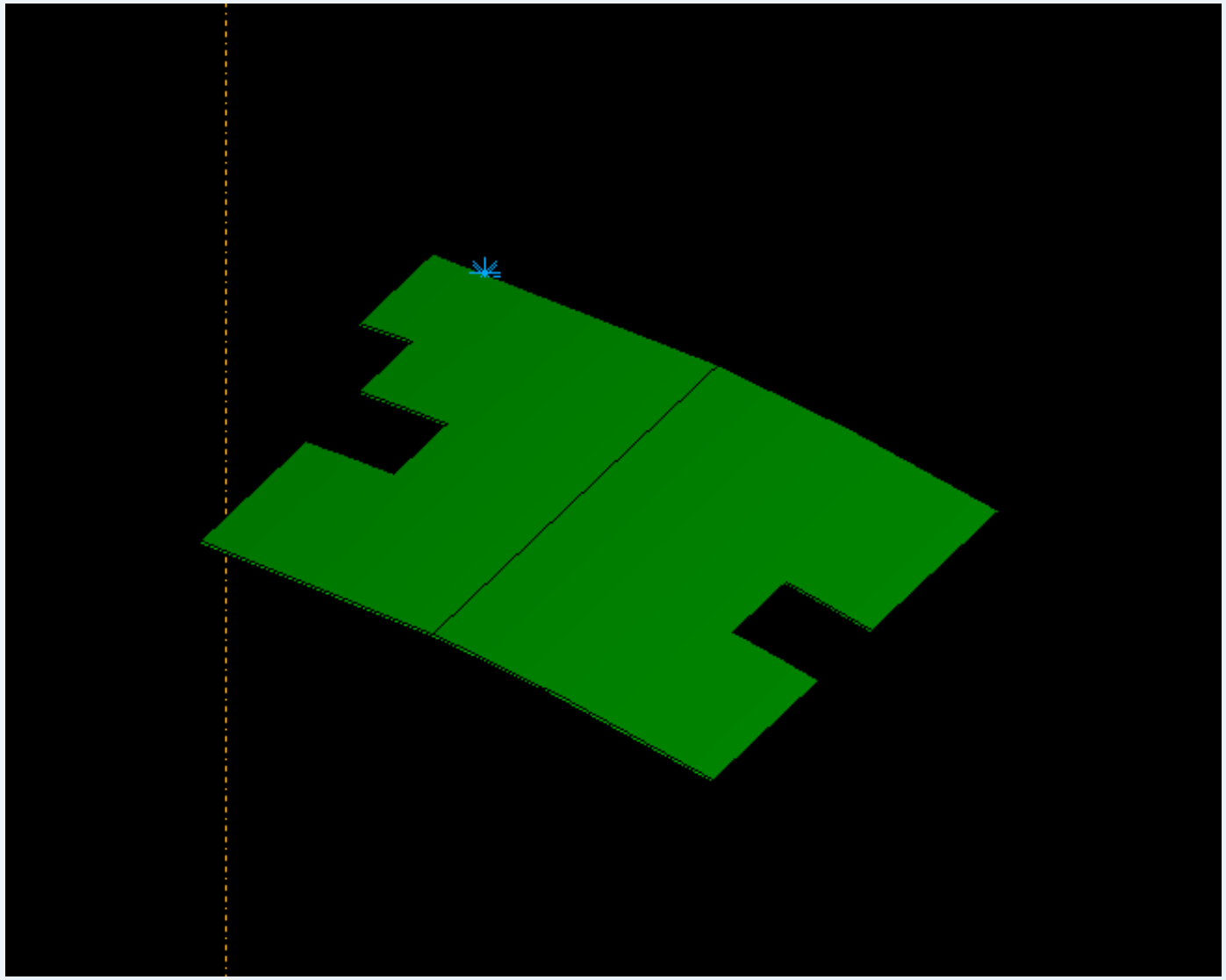

Nodi:37998
Elementi:22042
Tipo: Spostamento Z
Unità: mm
21/05/2020, 11:59:42
0,03219
0,02575
0,01931
0,01293 Max
0,00644
0
Min.: 0,01293 mm
Max.: 0,03219 mm
Z


Nodi:37998
Elementi:22042
Tipo: Sollecitazione di Von Mises
Unità: MPa
21/05/2020, 11:59:29
1678 Max
1343
1007
671
336
0 Min
Max.: 1678 MPa
Min.: 0 MPa
Z

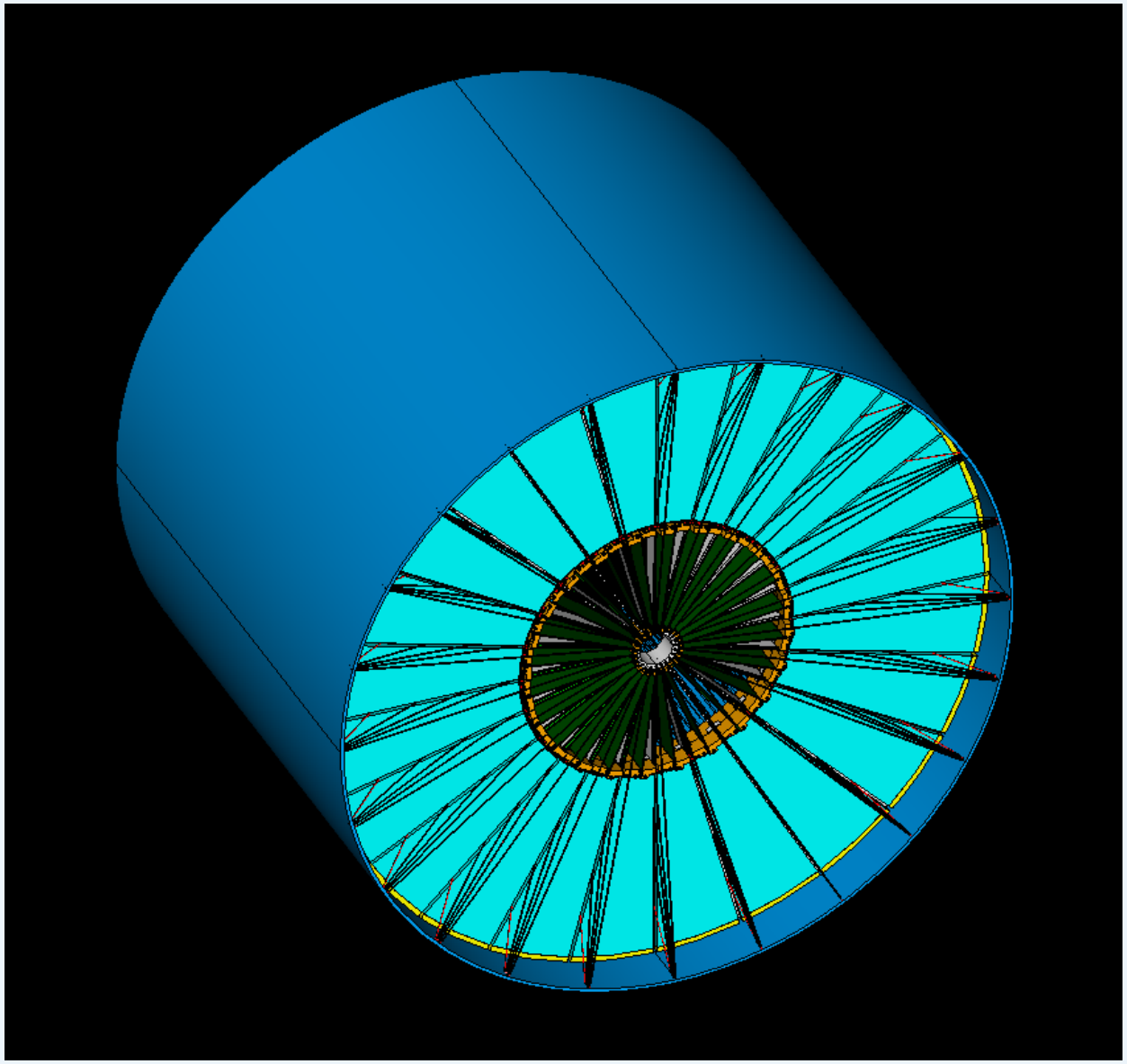
Sector B

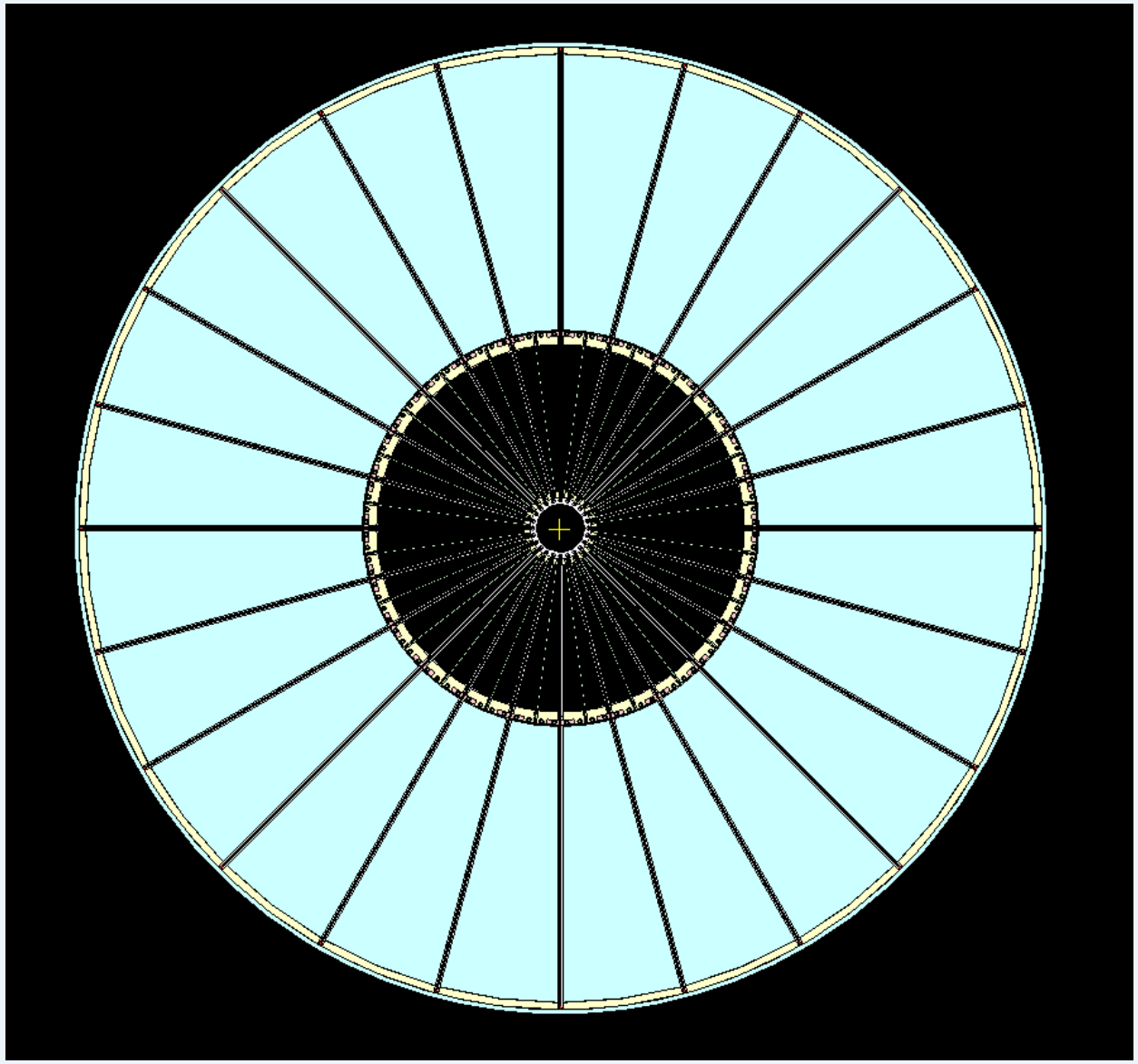
Sector B has a structure similar to MEG

PCB with asymmetrical shape for the correct positioning of the wires



Final view of the chamber





BACKUP SLIDES

Simulation Von Mises

Von Mises stress is a value used to determine if a given material will yield or fracture.
It is mostly used for ductile and isotropic materials, such as metals, when subjected to a complex loading condition.
The von Mises yield criterion states that if the von Mises stress of a material under load is equal or greater than the yield limit of the same material under simple tension — which is easy to determine experimentally —, then the material will yield.

The simulations tell us the position in which the spokes have the higher deformation!

For more details: https://www.simscale.com/docs/content/simwiki/fea/what-is-von-mises-stress.html