ECal/MPD
January 2018, Rev.2.1

MPD NICA

Technical Design Report of the Electromagnetic calorimeter (ECal)

Dubna 2018

Contents

2.3 New geometry – projective

Studies of the calorimeter (MC and beam tests) showed that the initially selected geometry of the calorimeter has an unpleasant feature - the increase in the number of hits at large angles of incidence of the particles. Moreover, the part of the hits which are separated from the main shower and thus not included in the total energy deposition in the shower are also increases . This leads to a reduction of the total energy of hits collected in the cluster. Therefore, when the particle incidence angle is increased reconstructed energyis decreased.

Two different geometry was studied – no projective geometry for the modules orientation and projective geometry.

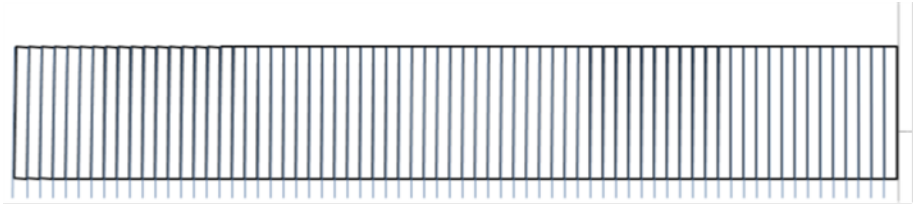


Figure 2.3.1: *View of the some modules of the non projective geometry in the Z plane.*

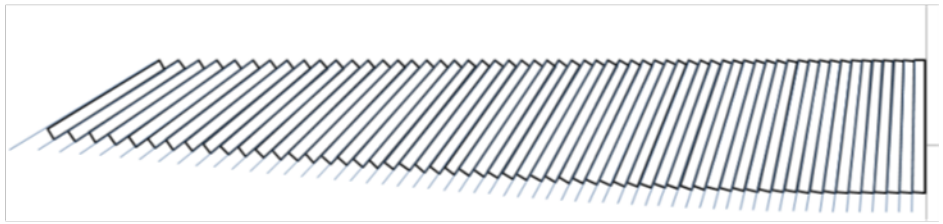


Figure 2.3.2: *View of the some modules of the projective geometry in the Z plane.*

The found effect is particularly significant for low-energy particles which dominate at MPD energies.

MC study.

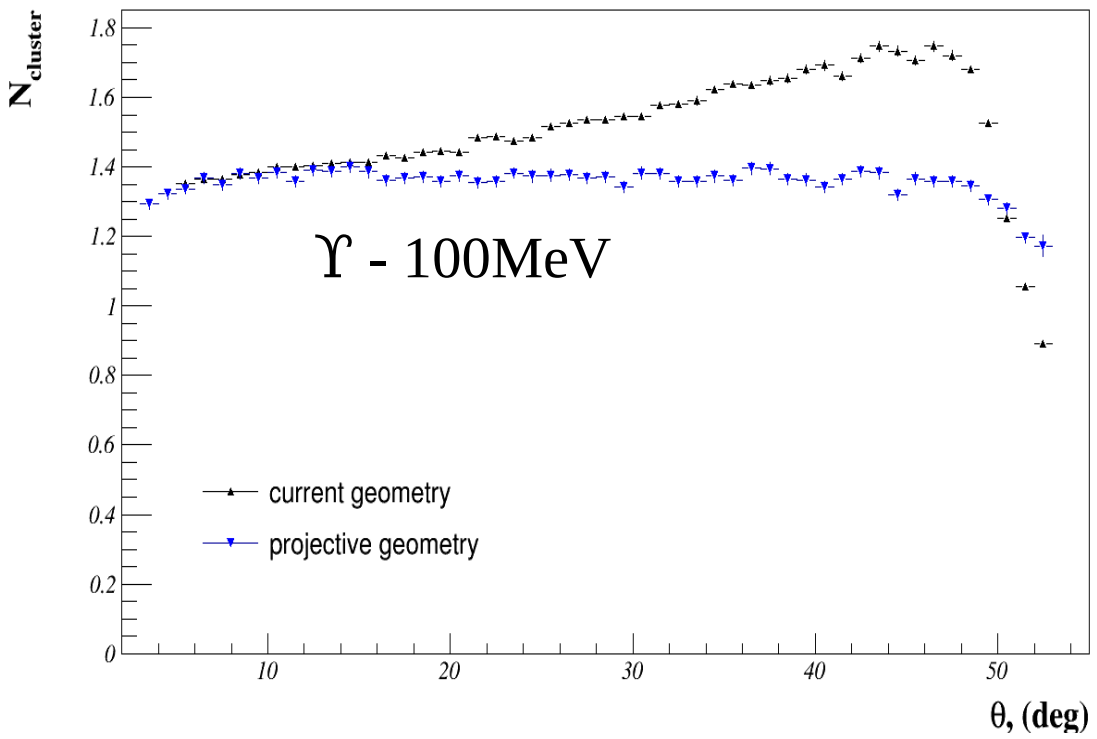


Figure 2.3.3: *Distribution of the number of clusters vs angle θ (Photons beam with energy 100MeV).*

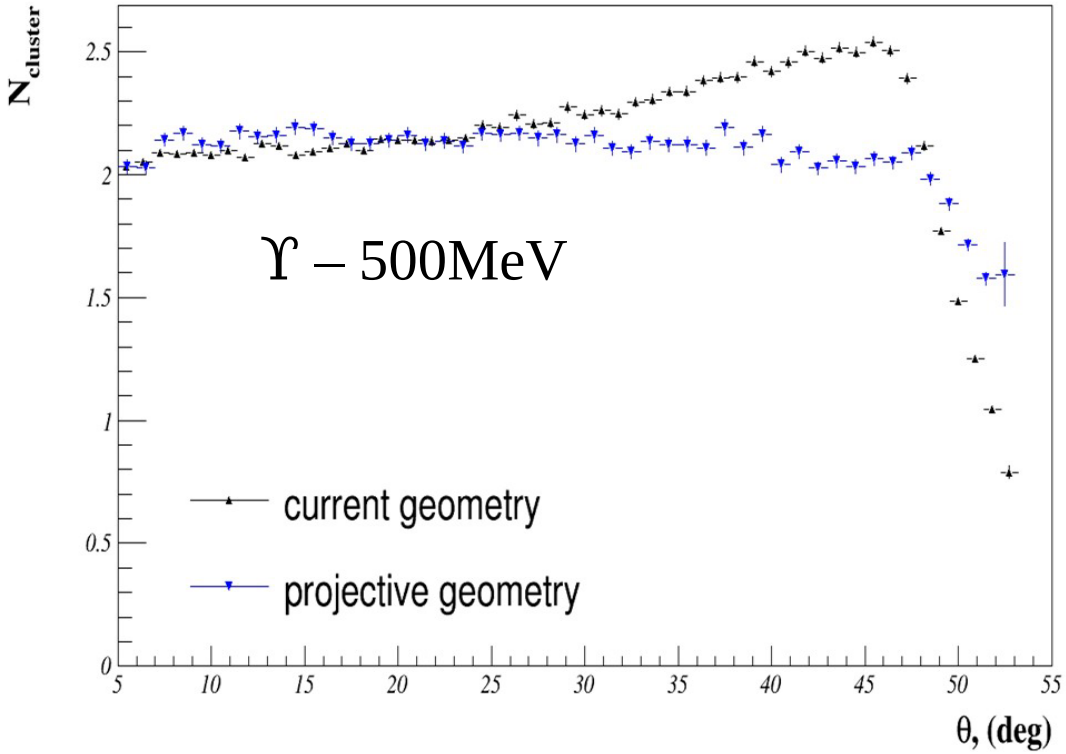


Figure 2.3.4: *Distribution of the number of clusters vs angle θ (Photons beam with energy 500MeV).*

The efficiency of detection of photons and electrons were evaluated using MC. Particles considered as a reconstructed if their energy and the coordinate of differ from the generated no more than a predetermined value. Typically this value was fixed at the level 2 σ

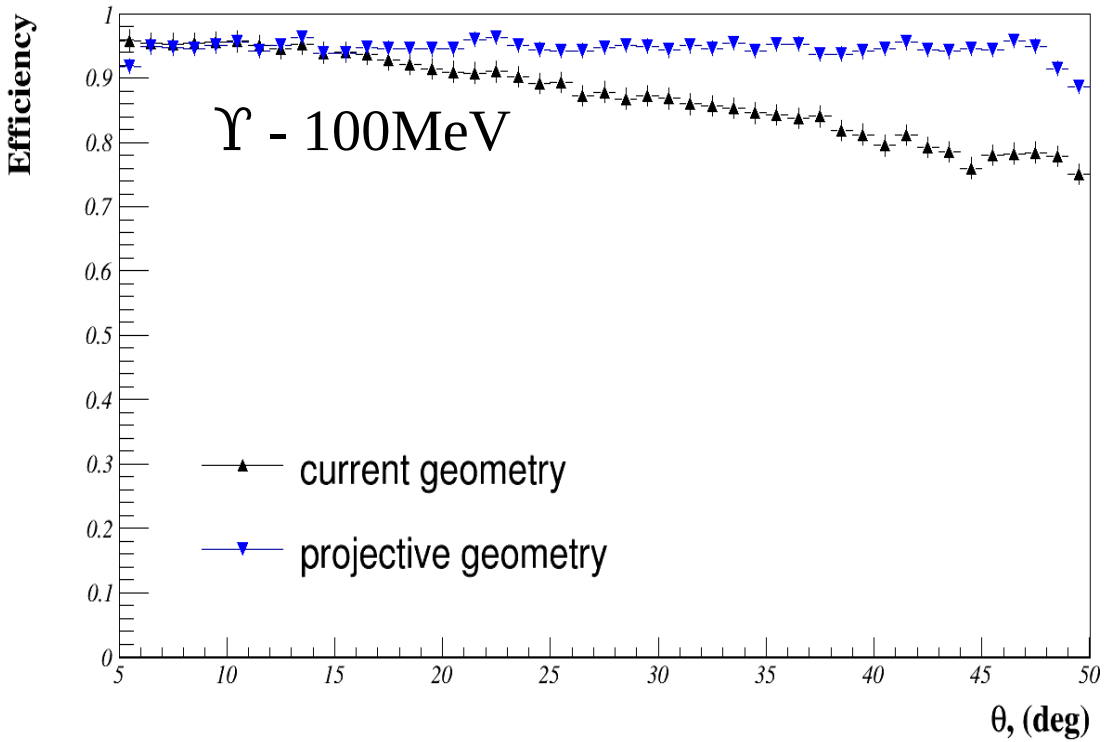


Figure 2.3.7: *Distribution of the efficiency of vs angle θ (Photons beam with energy 100MeV).*

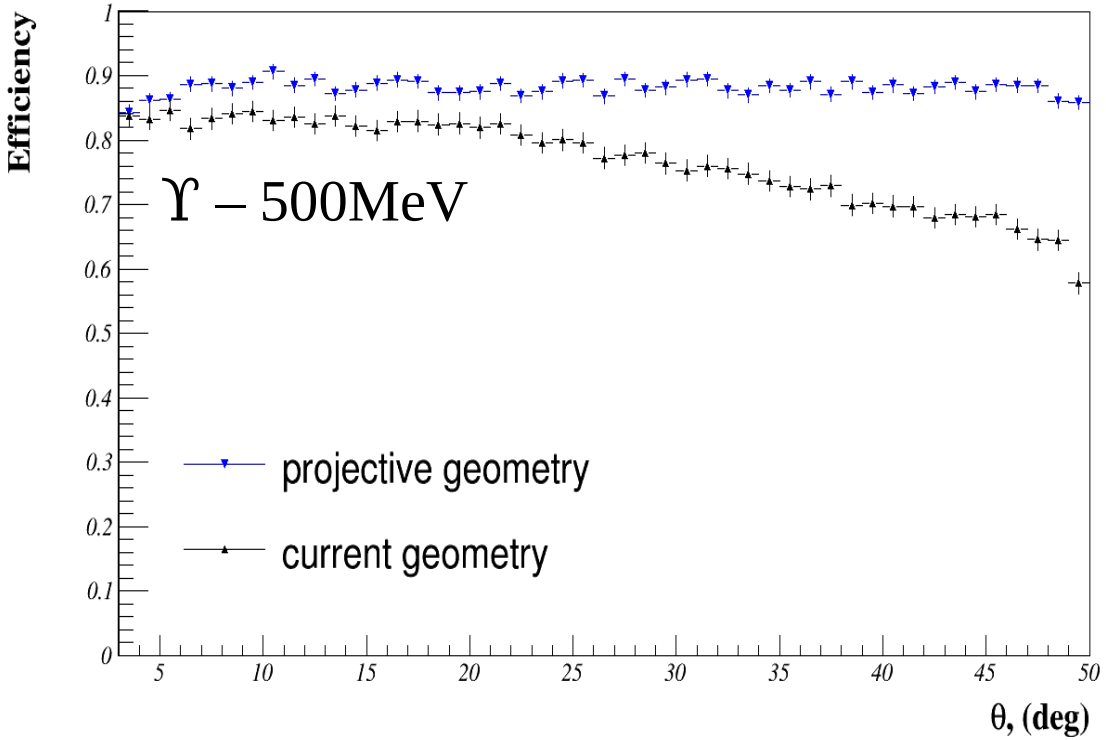


Figure 2.3.8: *Distribution of the efficiency of vs angle θ (Photons beam with energy 500MeV).*

4 Test results

4.3 Energy resolution

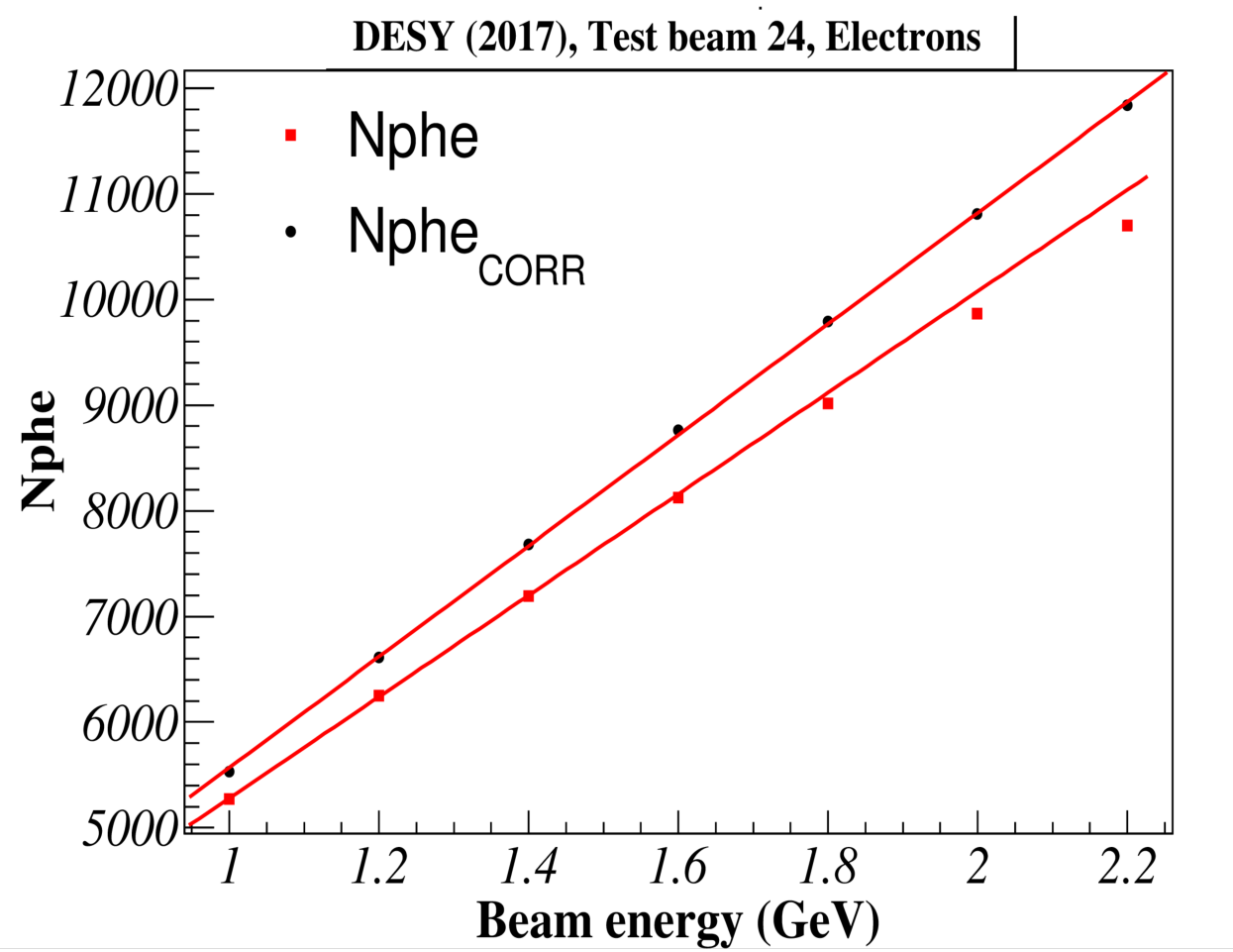


Figure 4.3.4: *Detector response to the hitting electrons of different energies.*

4.4 Time resolution

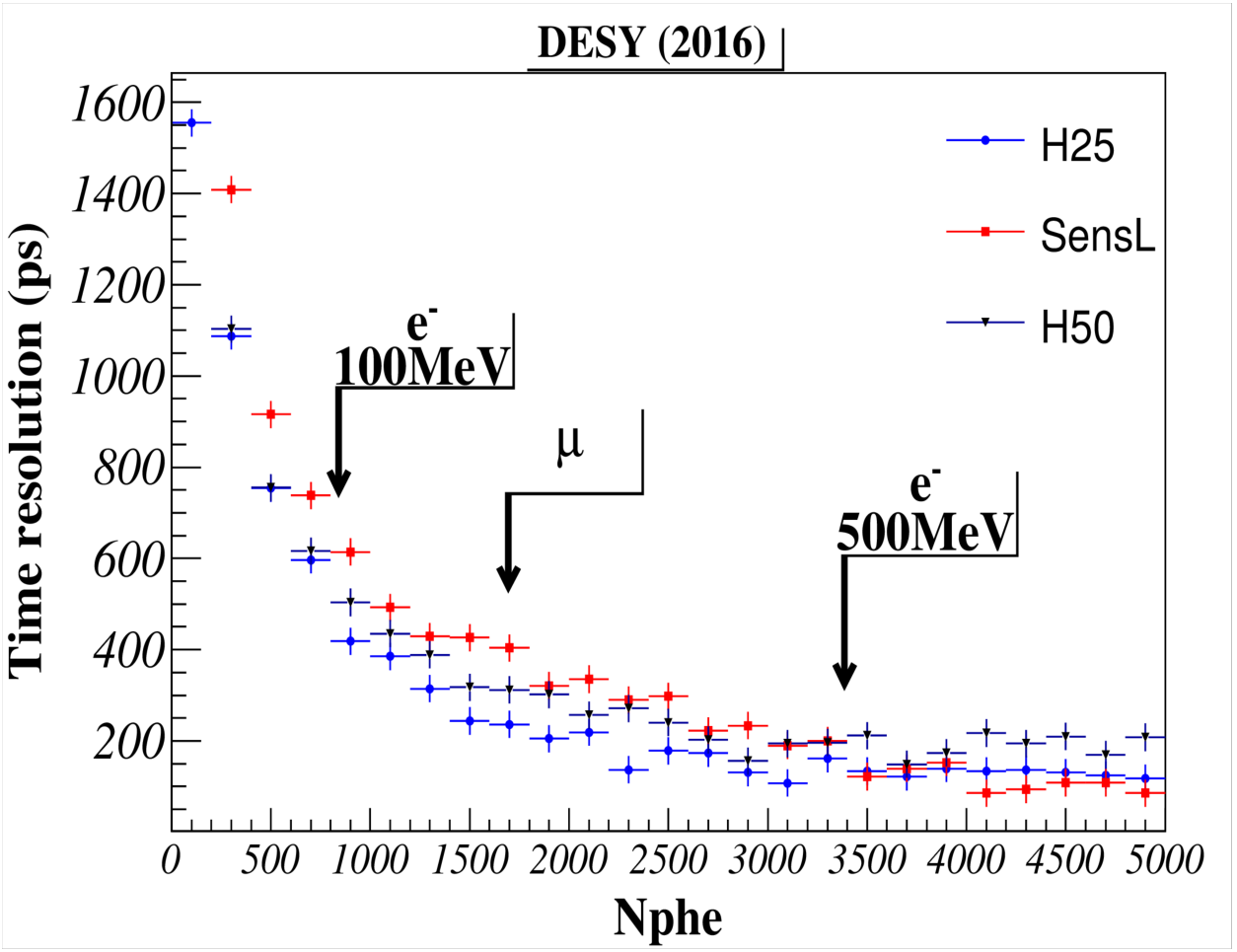


Figure 4.3.4: *Time resolution vs number of detected photoelectrons of different photo-detectors.*

5 Projective geometry

5.1 Fundamentals of the Design of the ECal

The change of the calorimeter design to the with a projective arrangement of the modules led to several important consequences. Improving the performance of the calorimeter, the emergence of additional stiffening elements in the form of a honeycomb, the possibility of placing additional components on the edges of the sectors. There is a need to make some changes in the module design, redesign readout electronics.

Calculations have been made on the choice of the angle of inclination for the modules. The aim of the calculations is to select a single for all modules tilt angle at which the deviation of the aiming point from the center of the MPD will be minimal.

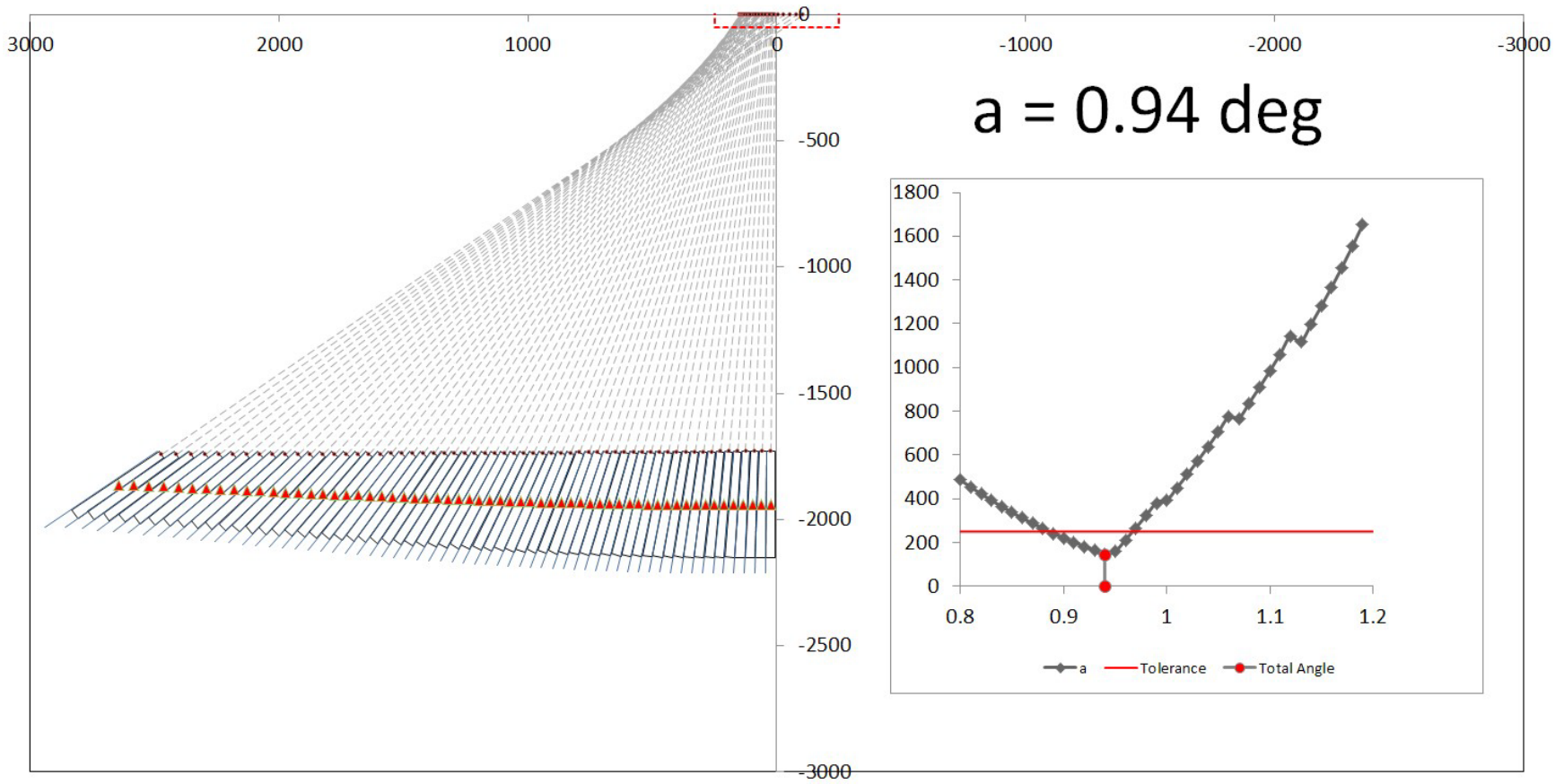


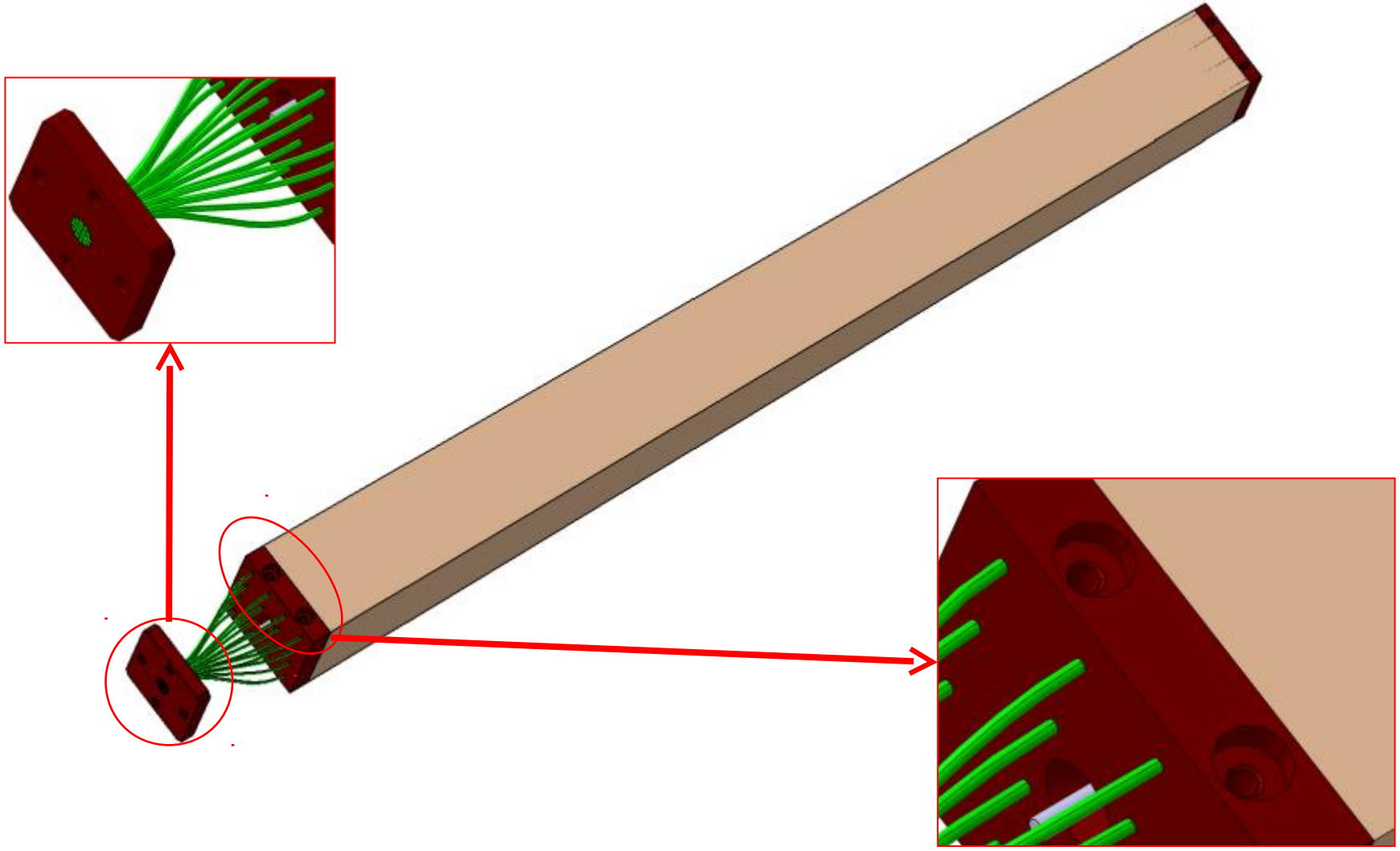
Figure 5.1.4: *Optimization of the location of ECal modules in the Z plane (a = 0.94deg).*

Calorimeter modules are collected in the cassette of 16 units - 2 rows of 8. Such a segmentation is not fundamentally important, these numbers are selected for easier organization of electronics readout.

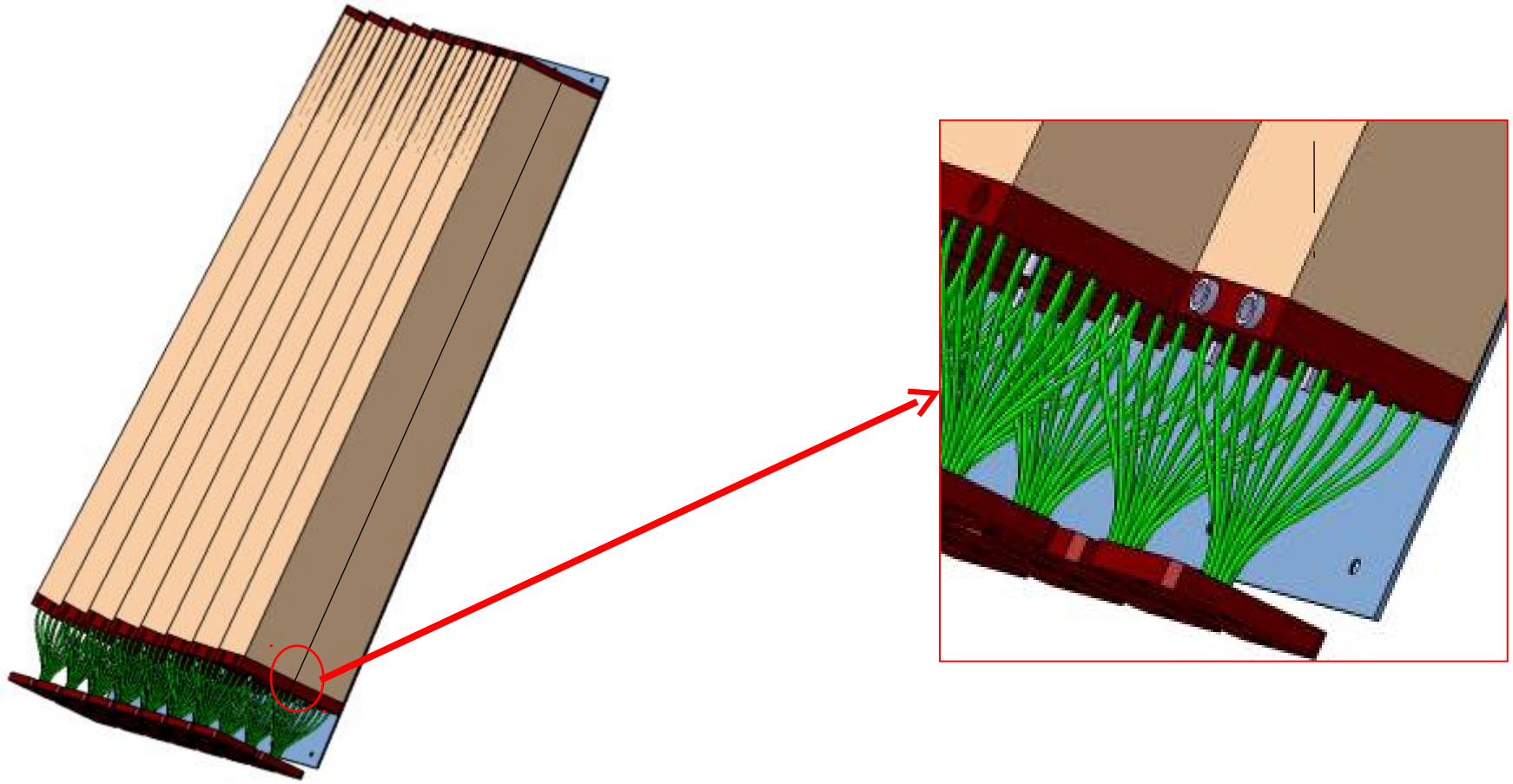
The block consists from 2 and 4 cassettes in the longitudinal dimension and 12 cassettes in the transverse dimension. These three blocks are form pro-sector with 1536 calorimeter modules.

1 sector = 2 pro-sectors = 192 cassettes = 3072 modules

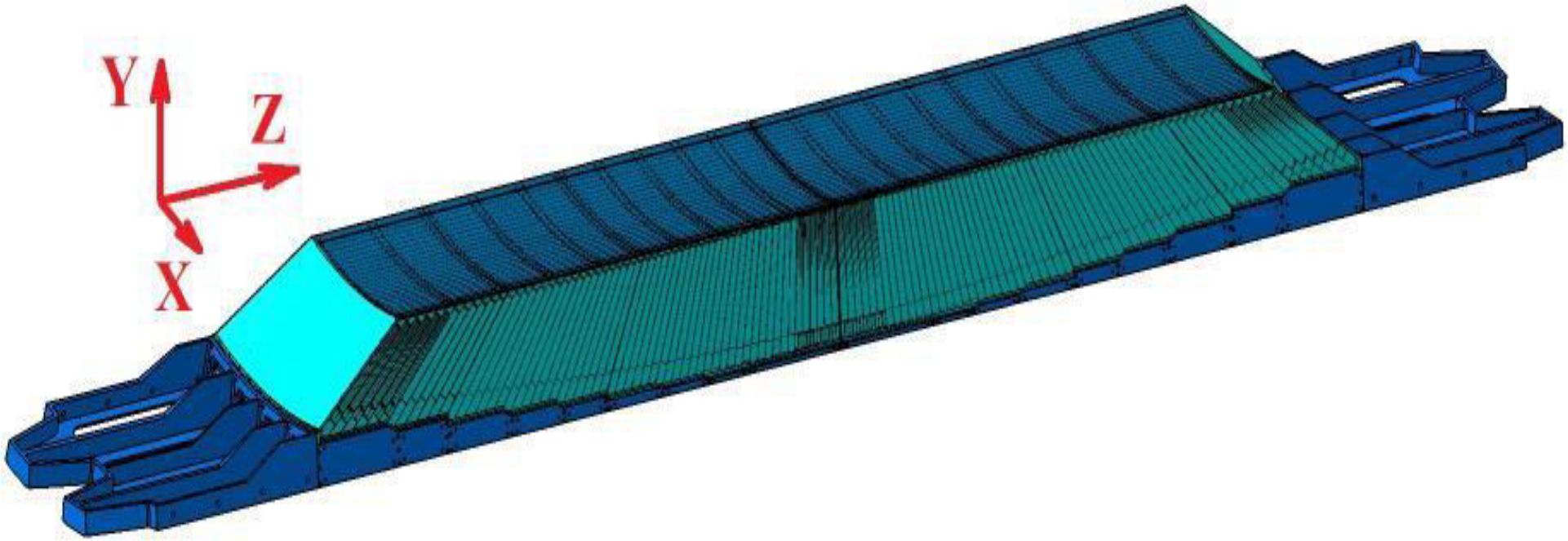
Single ECAL module



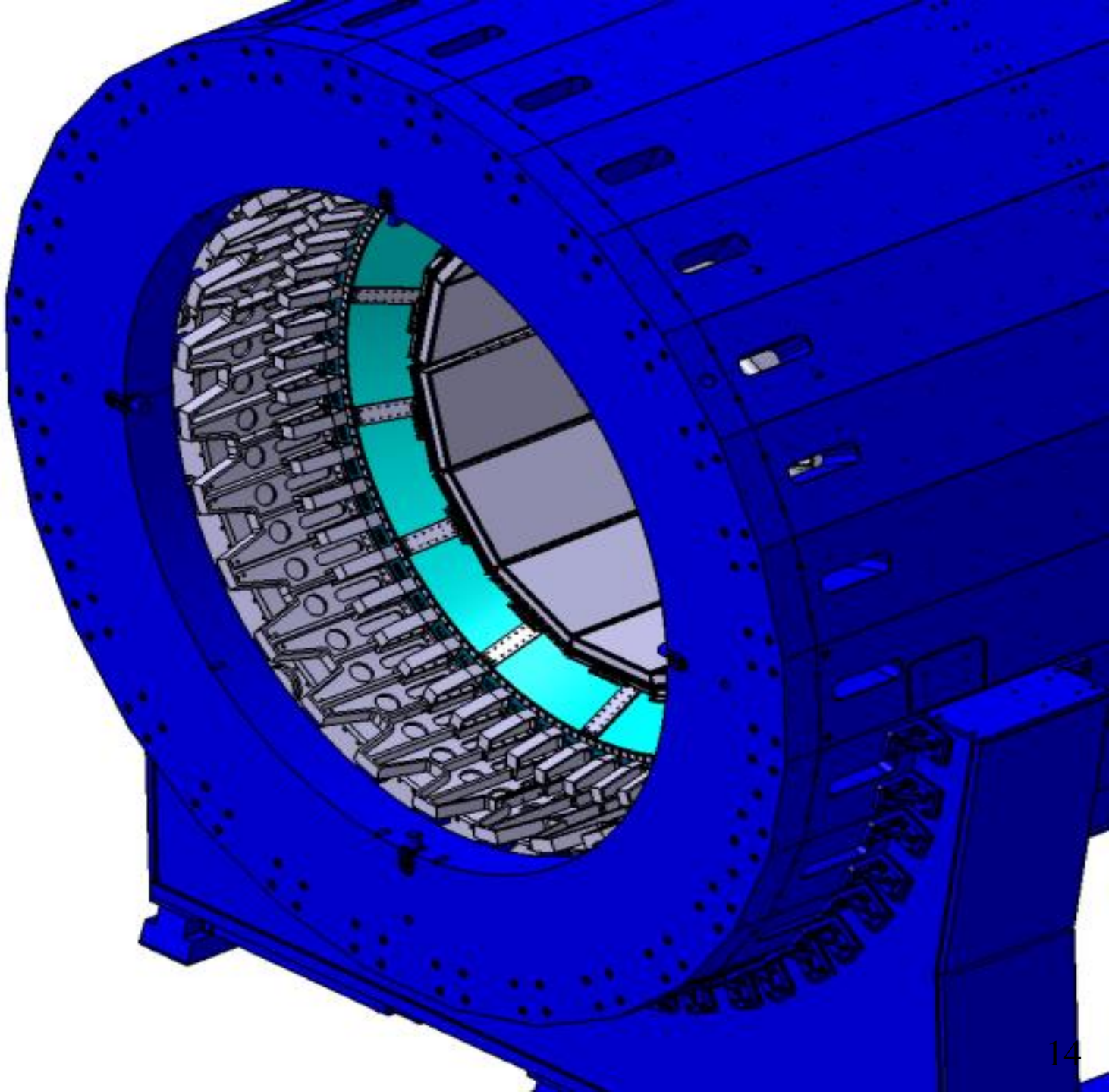
ECAL cassette



ECAL sector

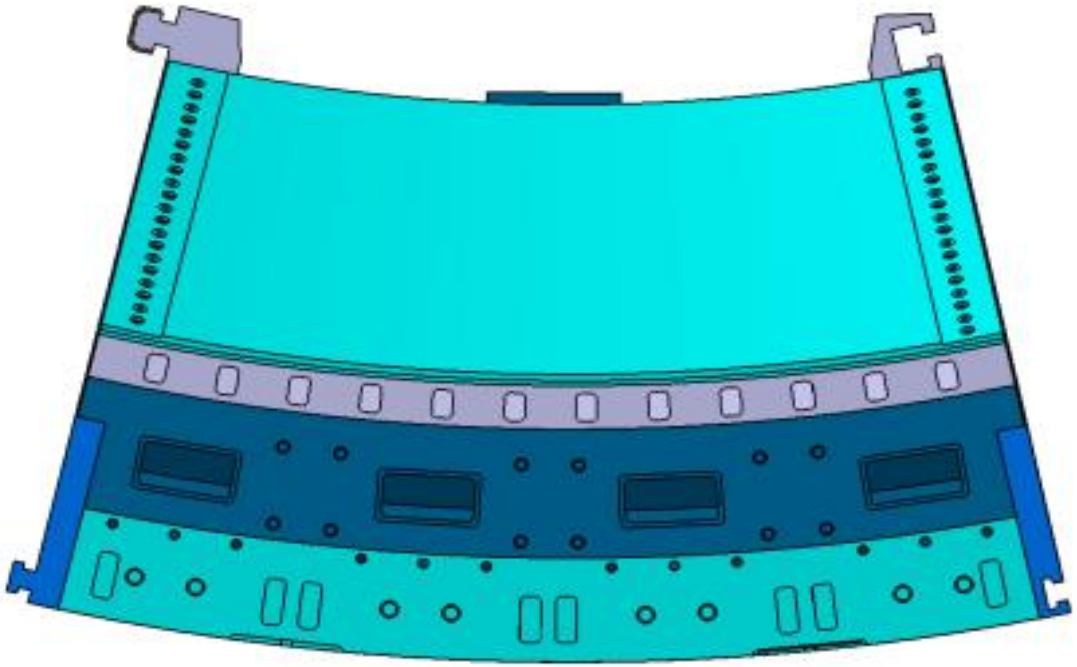


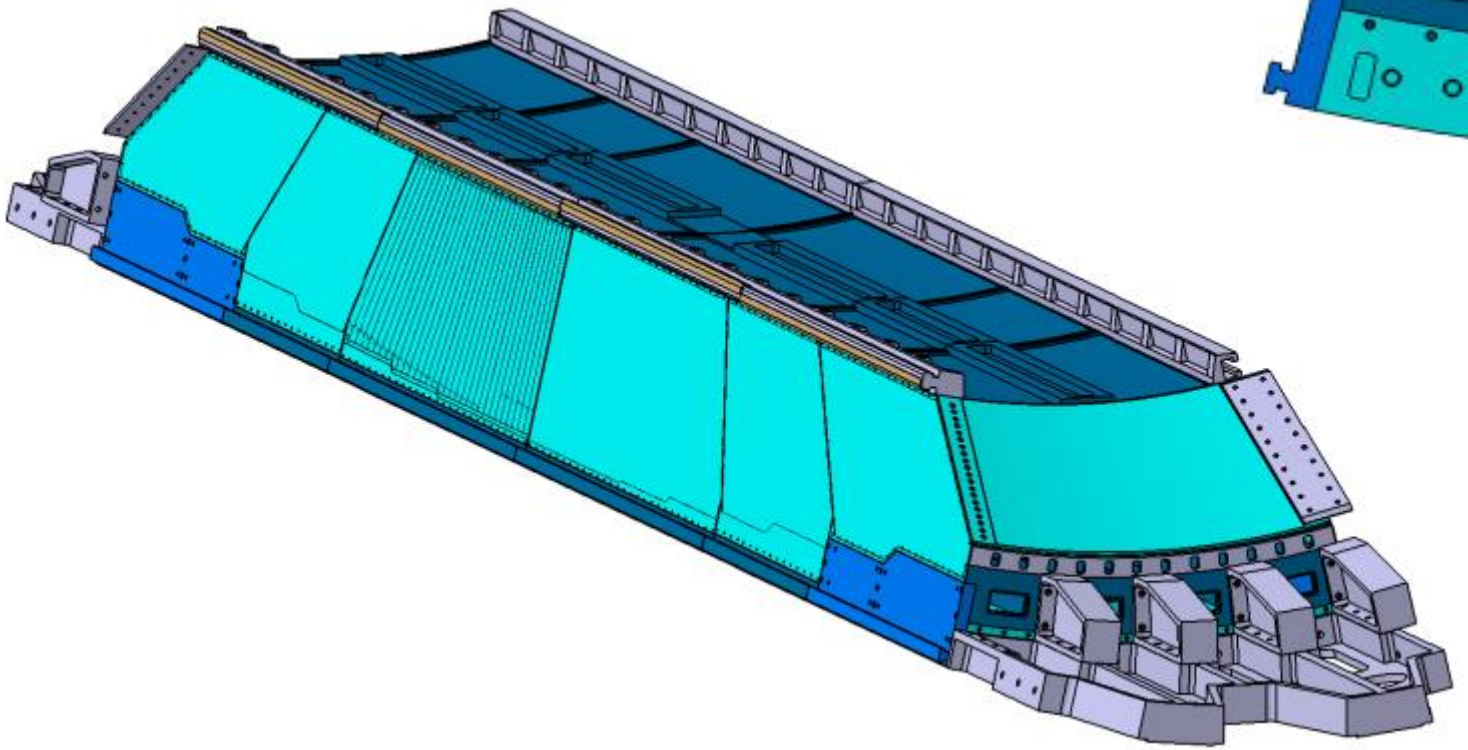
ECAL inside MPD



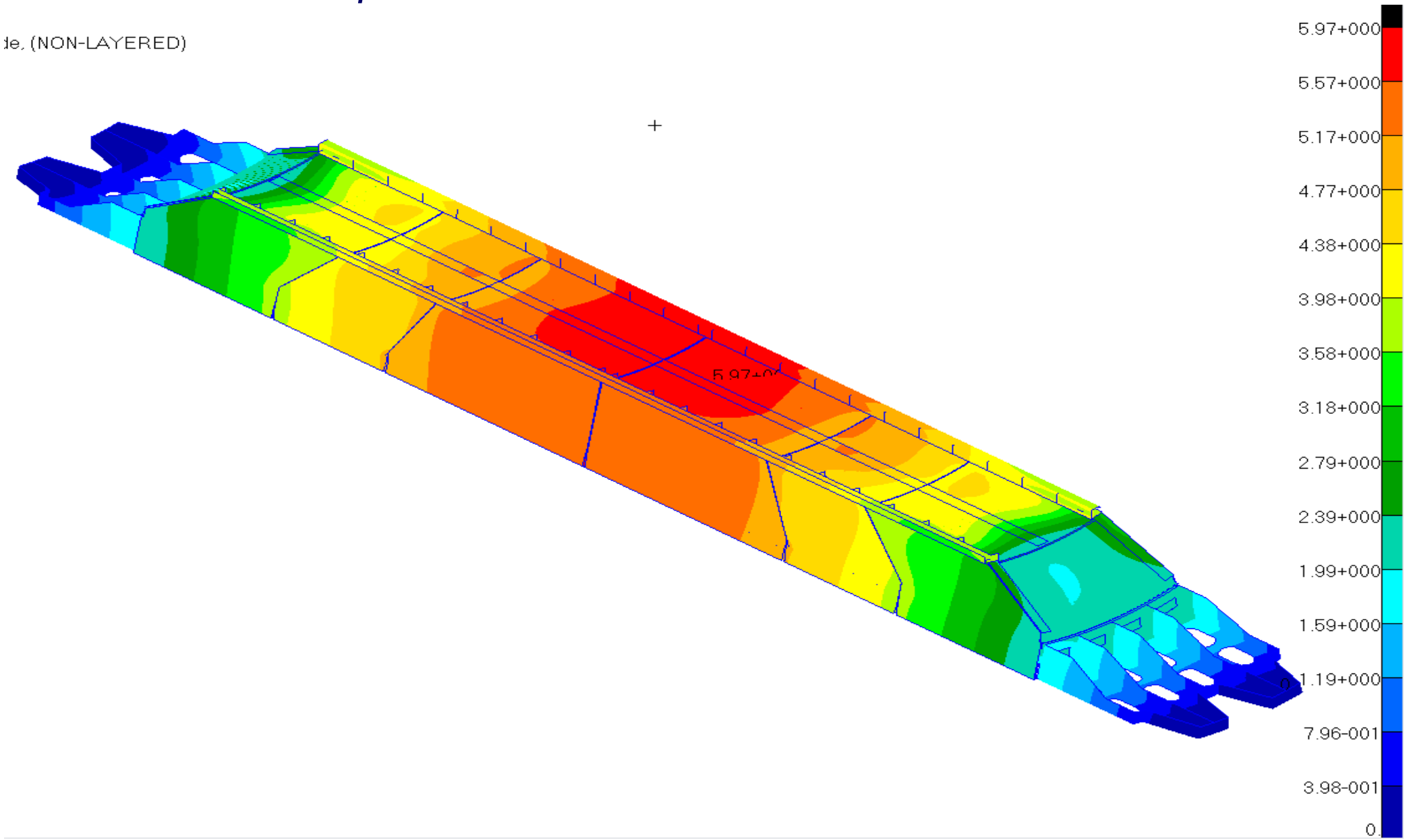
ECAL Guides

Each sector of the ECAL have a guides for setting the contiguous element (with it)

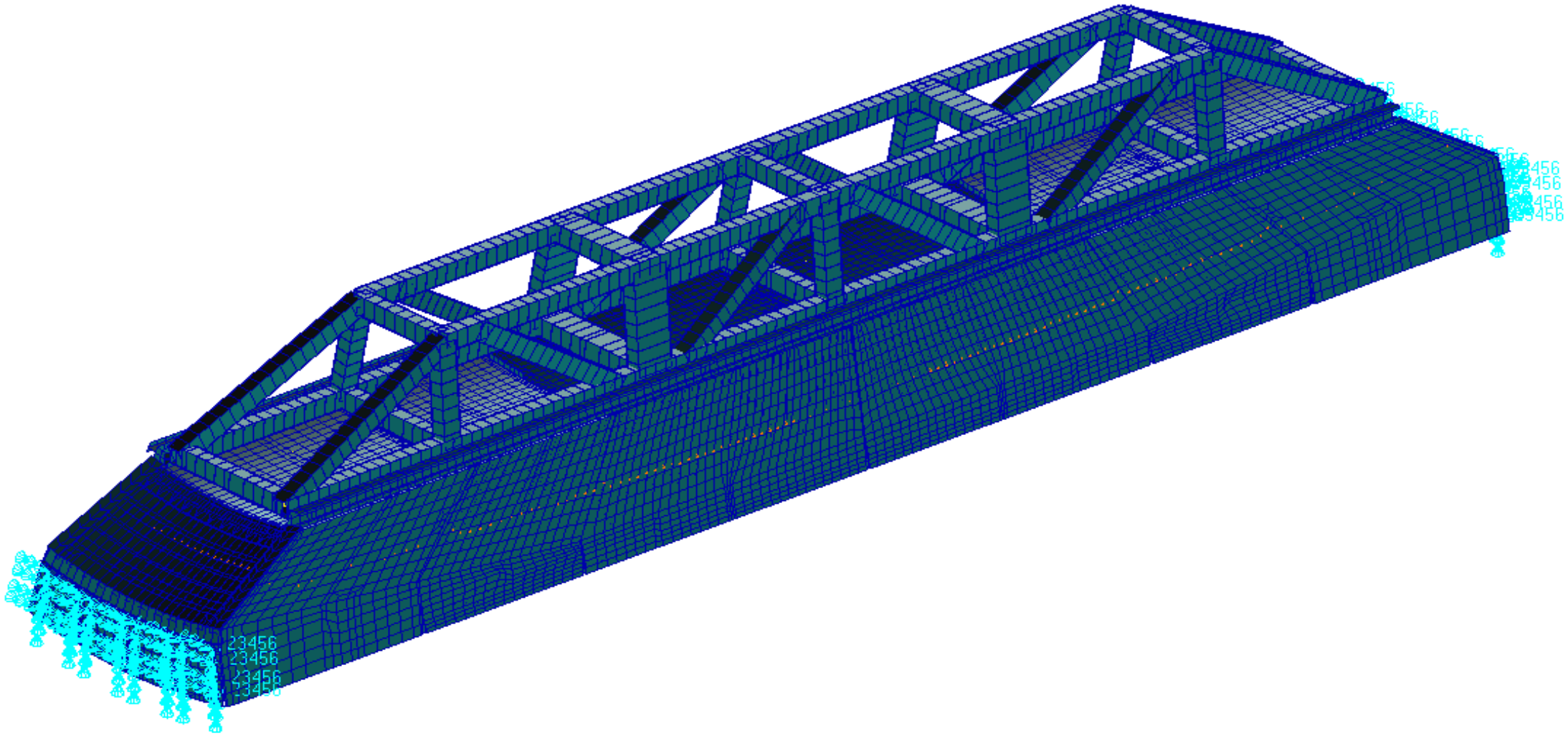




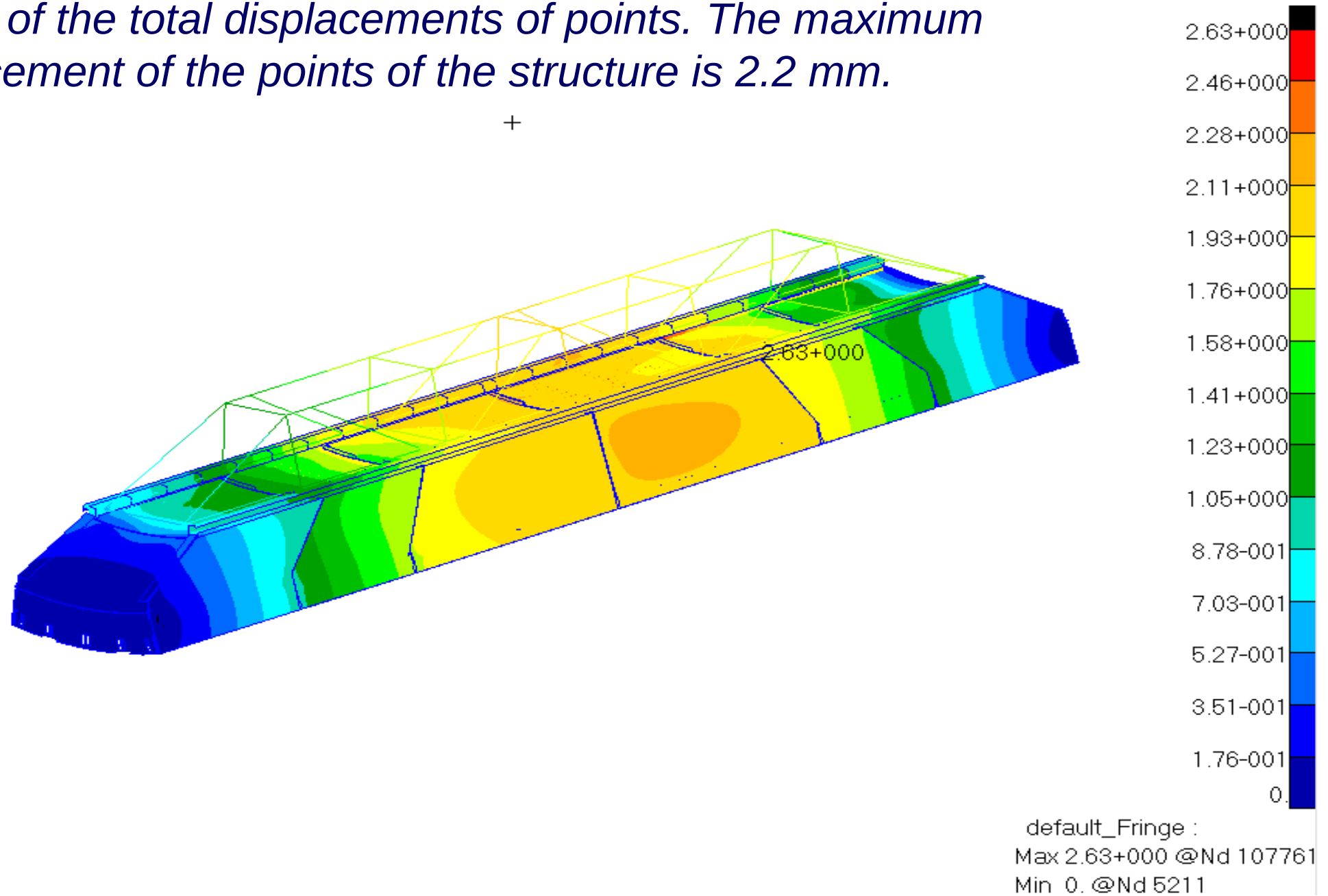
Distribution of the total displacements of points. The maximum displacement of the points of the structure is 5.97mm.



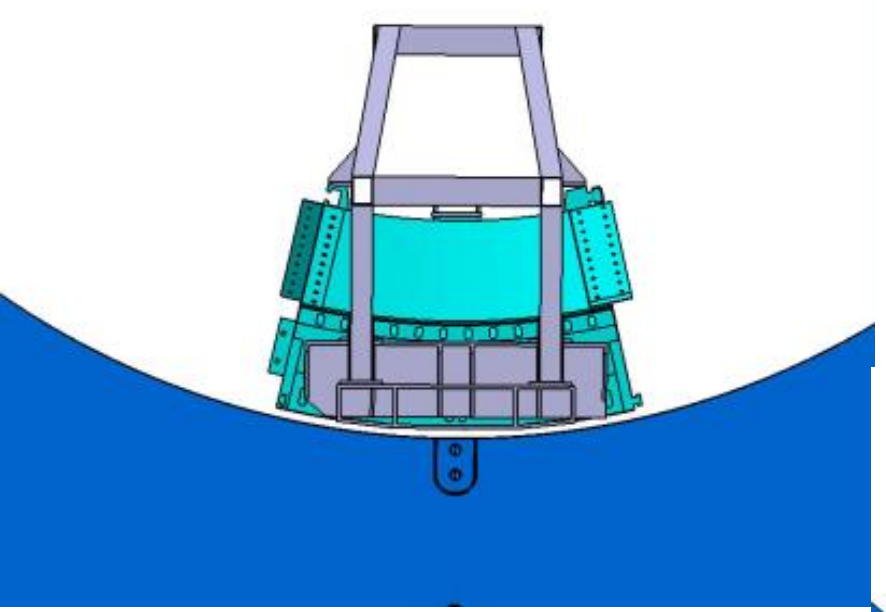
Supporting structure

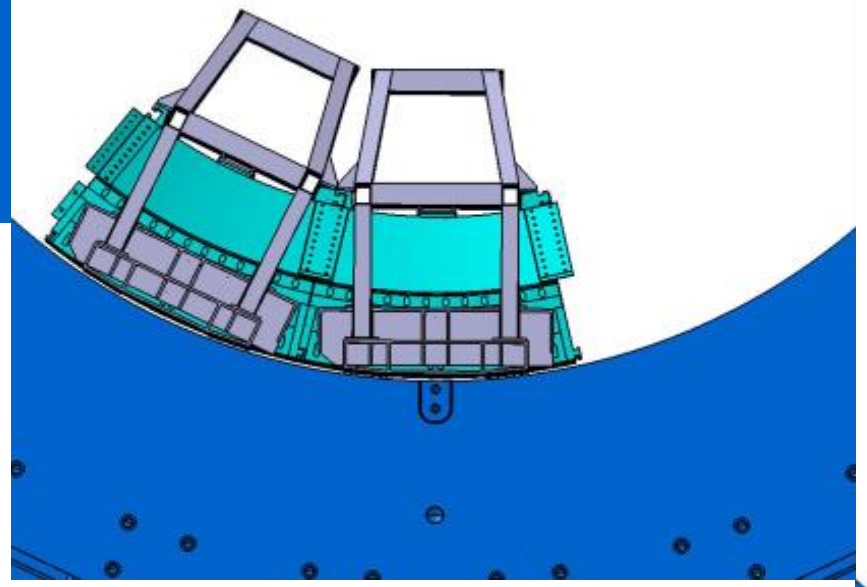


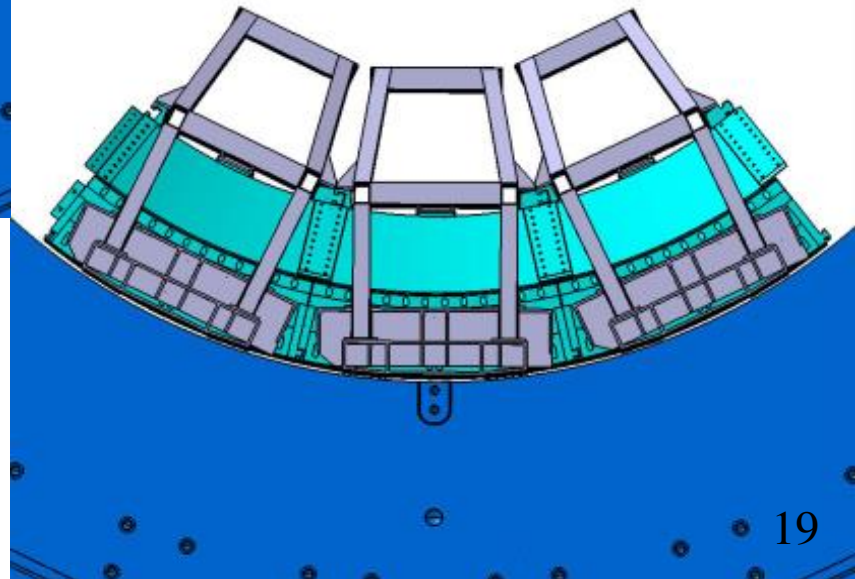
Distribution of the total displacements of points. The maximum displacement of the points of the structure is 2.2 mm.



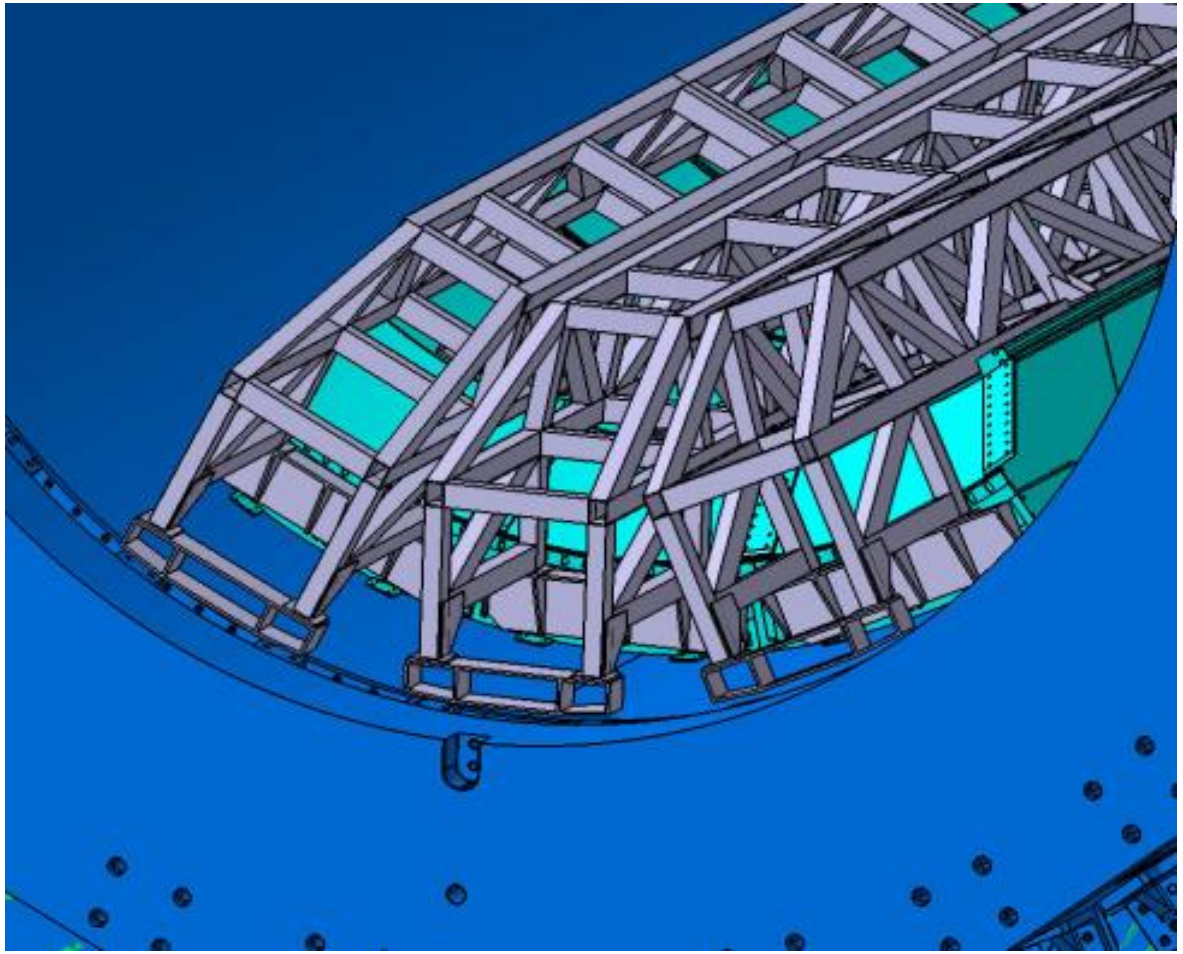
Installation of sectors 2-3 ECAL in MPD

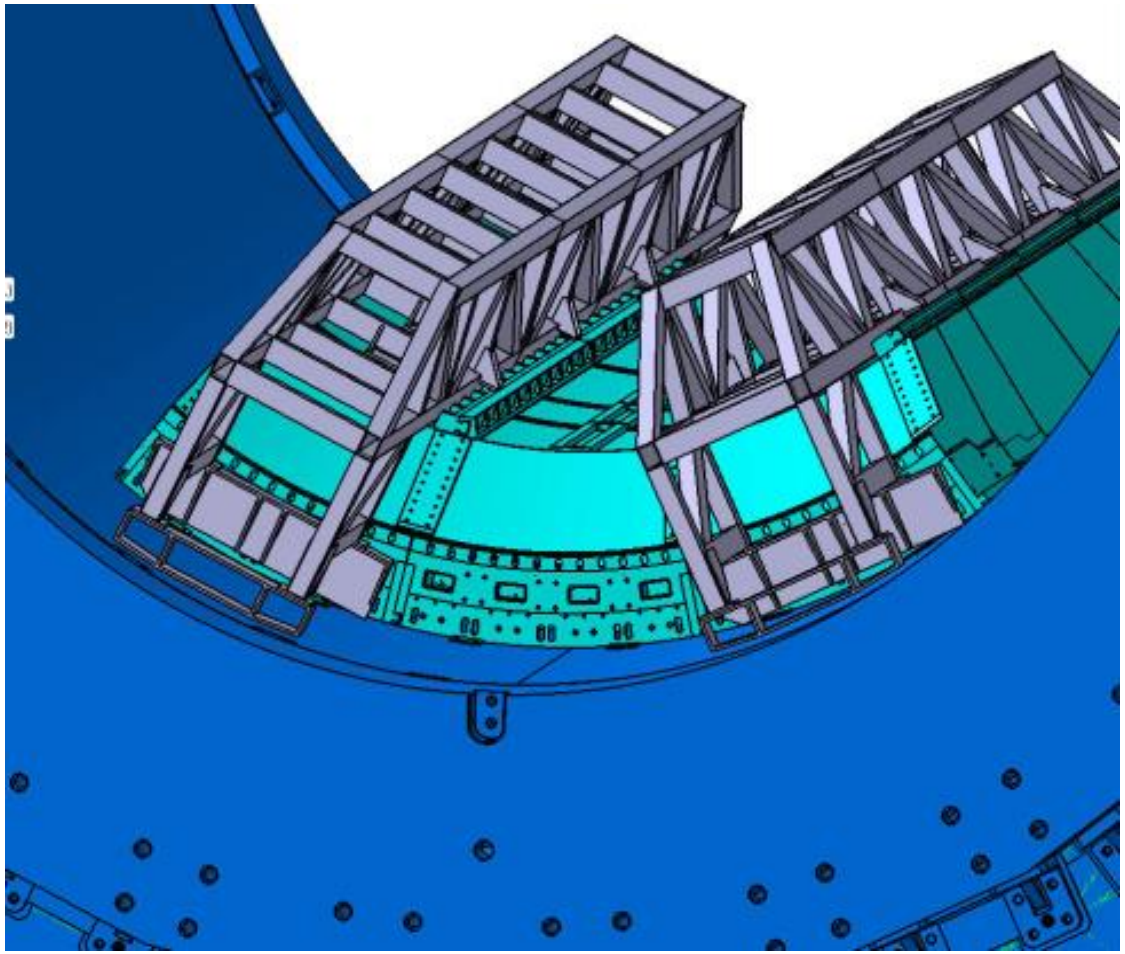




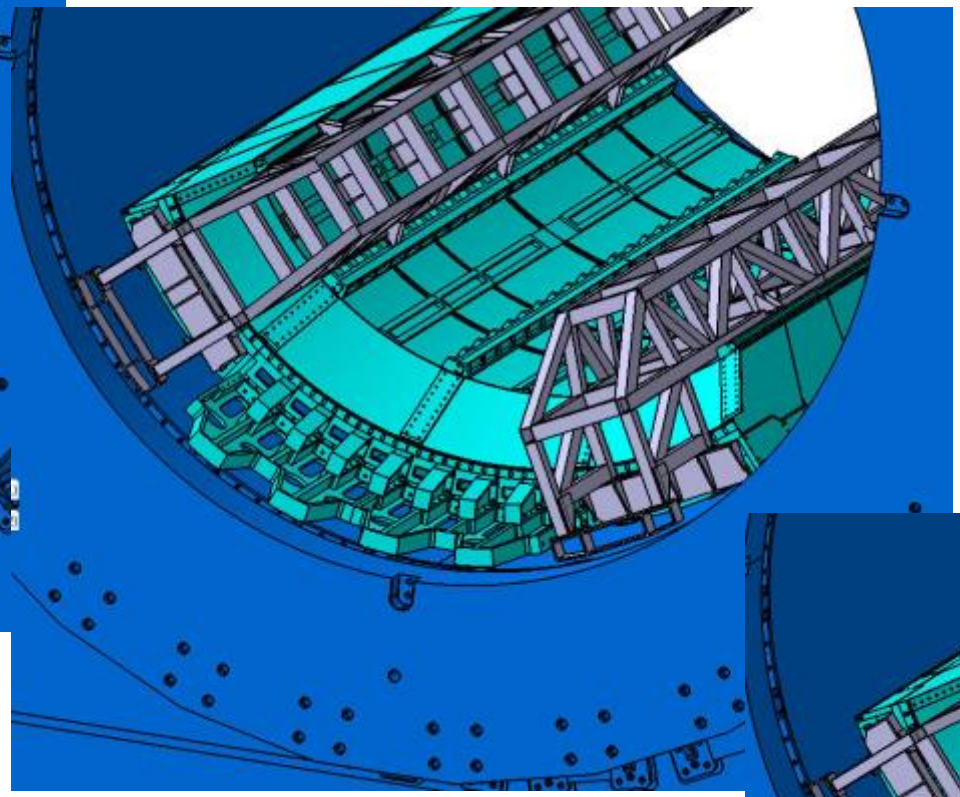


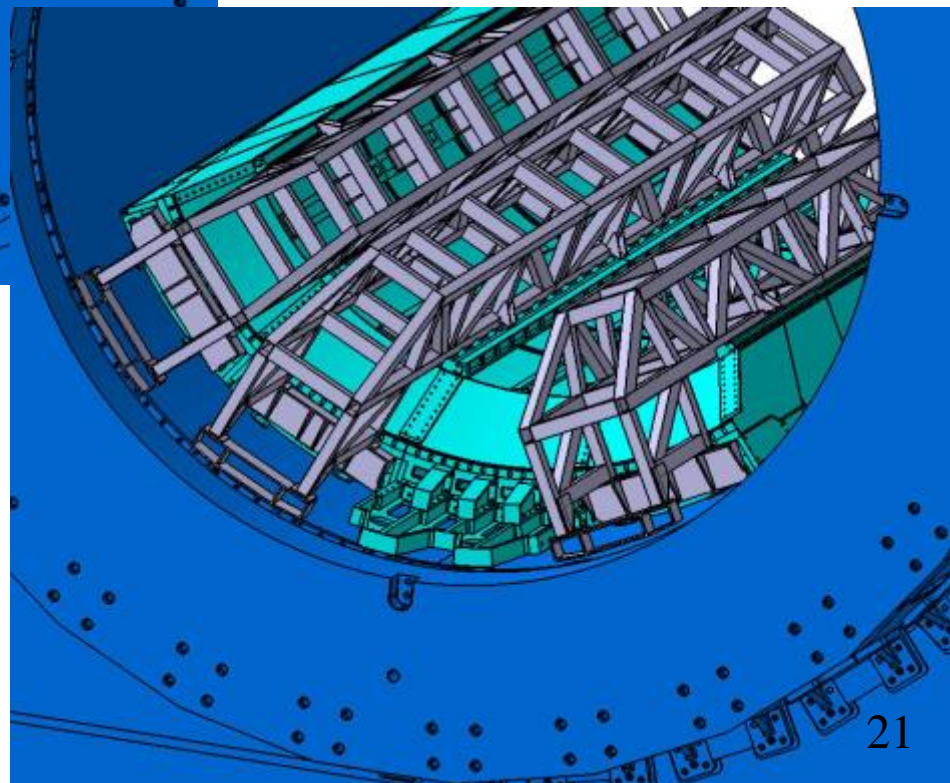
Dismantling the ECAL sector 1 farm





Dismantling the ECAL sector 2 farm

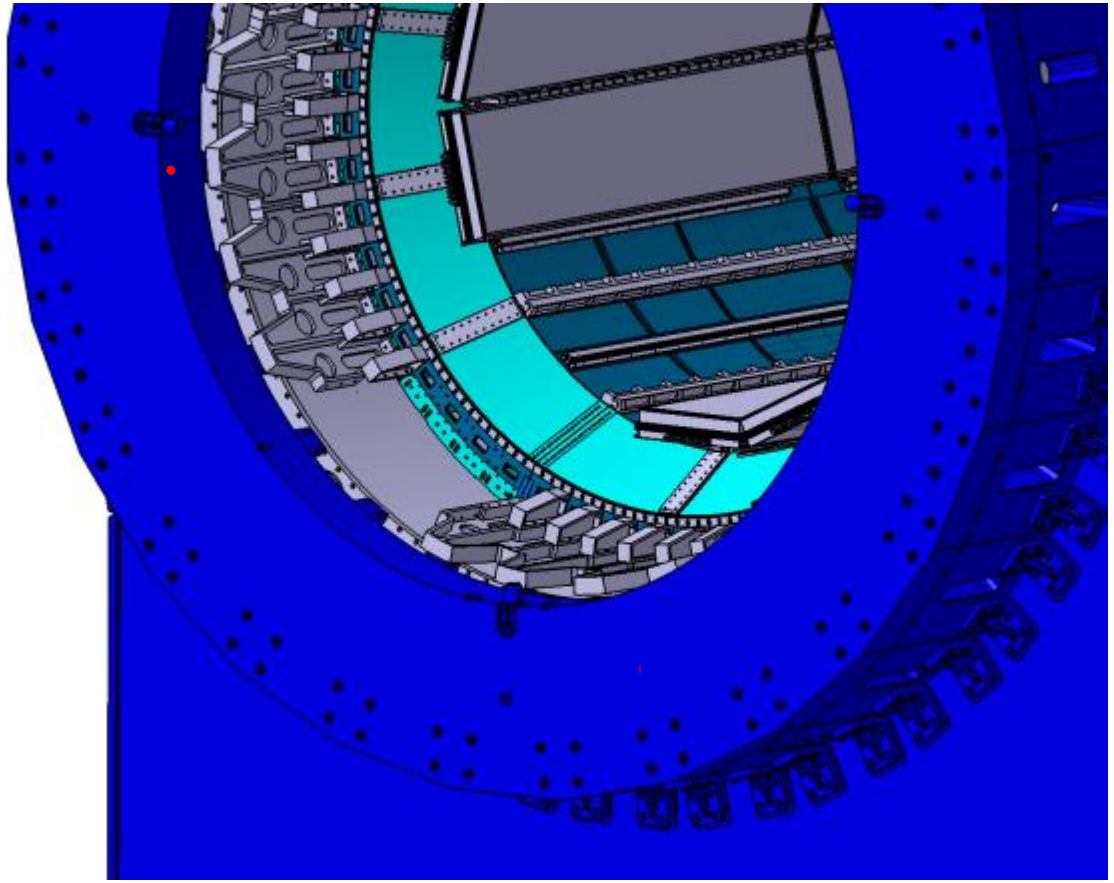




Installation of ECAL sectors 5-6

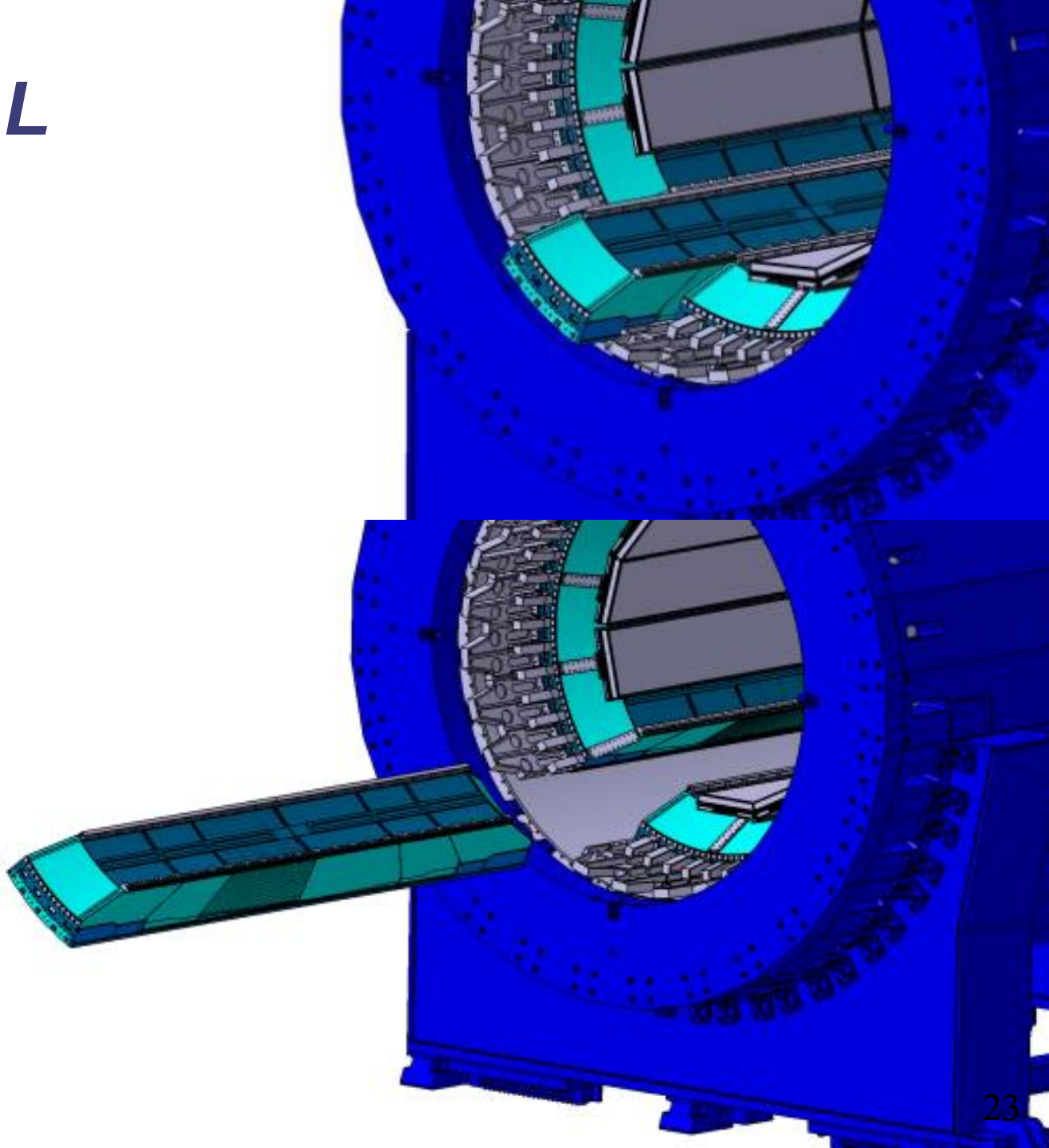
Dismantling flange ECAL

Dismantle the end flanges of the ECal sector.

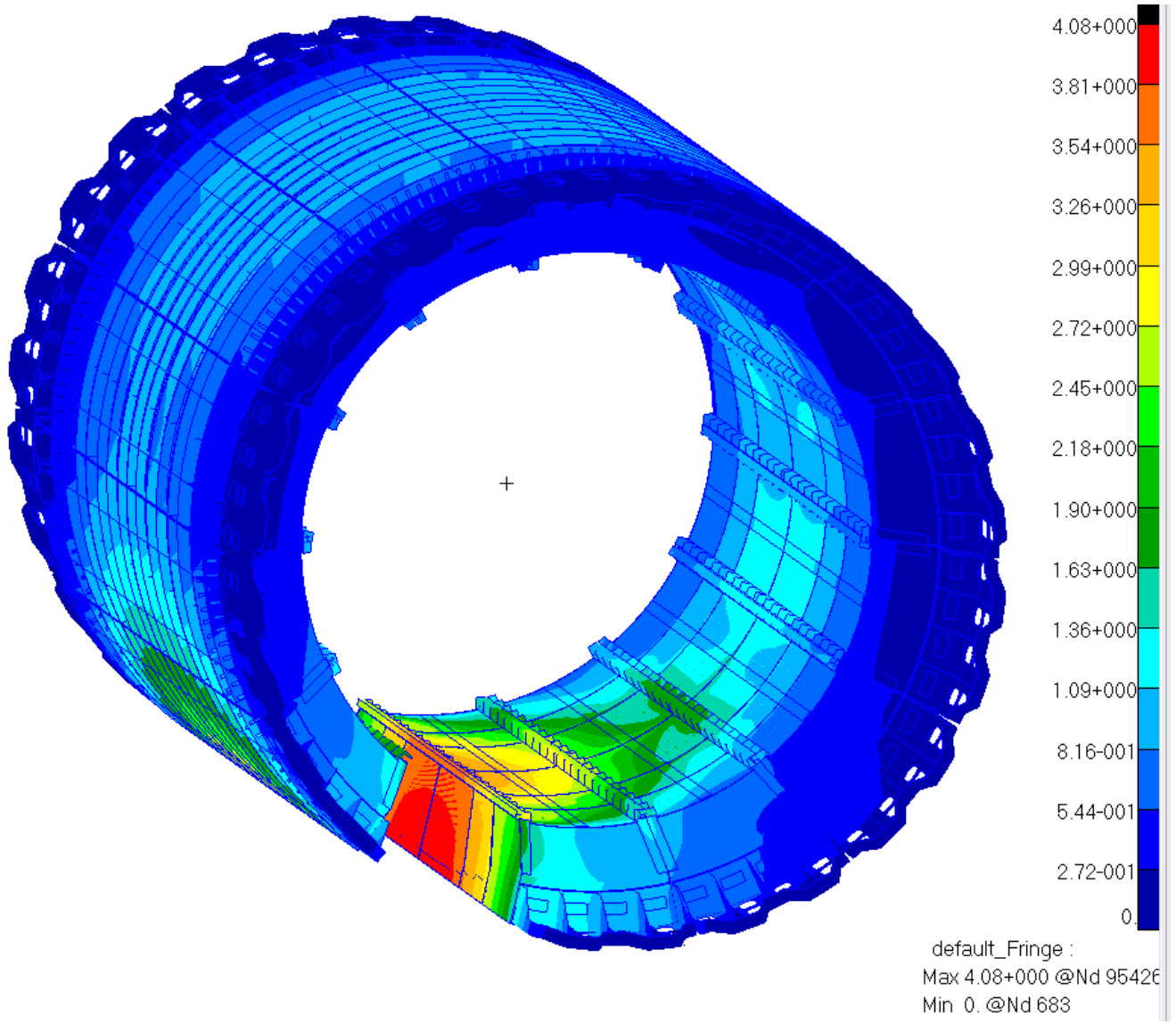


Dismantling of one ECAL sector for the repairs

The dismantling of the ECAL sectors is carried out by means of a special receiving drum located on the slipway.
This drum has the ability to rotate to receive any sector of ECAL.



The diagram of distribution of total displacements of points. The maximum displacement of the construction points is 4.08 mm.



6 Time table and cost estimation

Task Name	Total (k$)	2015				2016				2017				2018				2019				2020			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
ECal sector design																									
Detector R&D, prototyping	100.00																								
FEE R&D and prototyping	50.00																								
Pilot modules production and test	70.00																								
Slow Control R&D and prototyping	7.63																								
Infrastructure	352.62																								
Sectors assembling line test	10.00																								
ECal modules mass production	4 991.51																								
Pilot sector production, test	5.00																								
ECal sector mass production	900.00																								
Detector head production	3 200 .00																								
FEE production	4 691.51																								
Slow control production	1 400.00																								
ECal Cooling system production	300.00																								
ECal installation	150.00																								
Commissioning of ECal	150.34																								
Total (2015-2020): 16.4M$	16 378.61																								

R&D, Design, Prototyping	227.63	2010 - 2018
Production Cost	15 497.98	2016 - 2020
Infrastructure Cost	653.00	2016 - 2018
Total (k$):	16 378.61	

THANK YOU FOR YOUR ATTENTION!