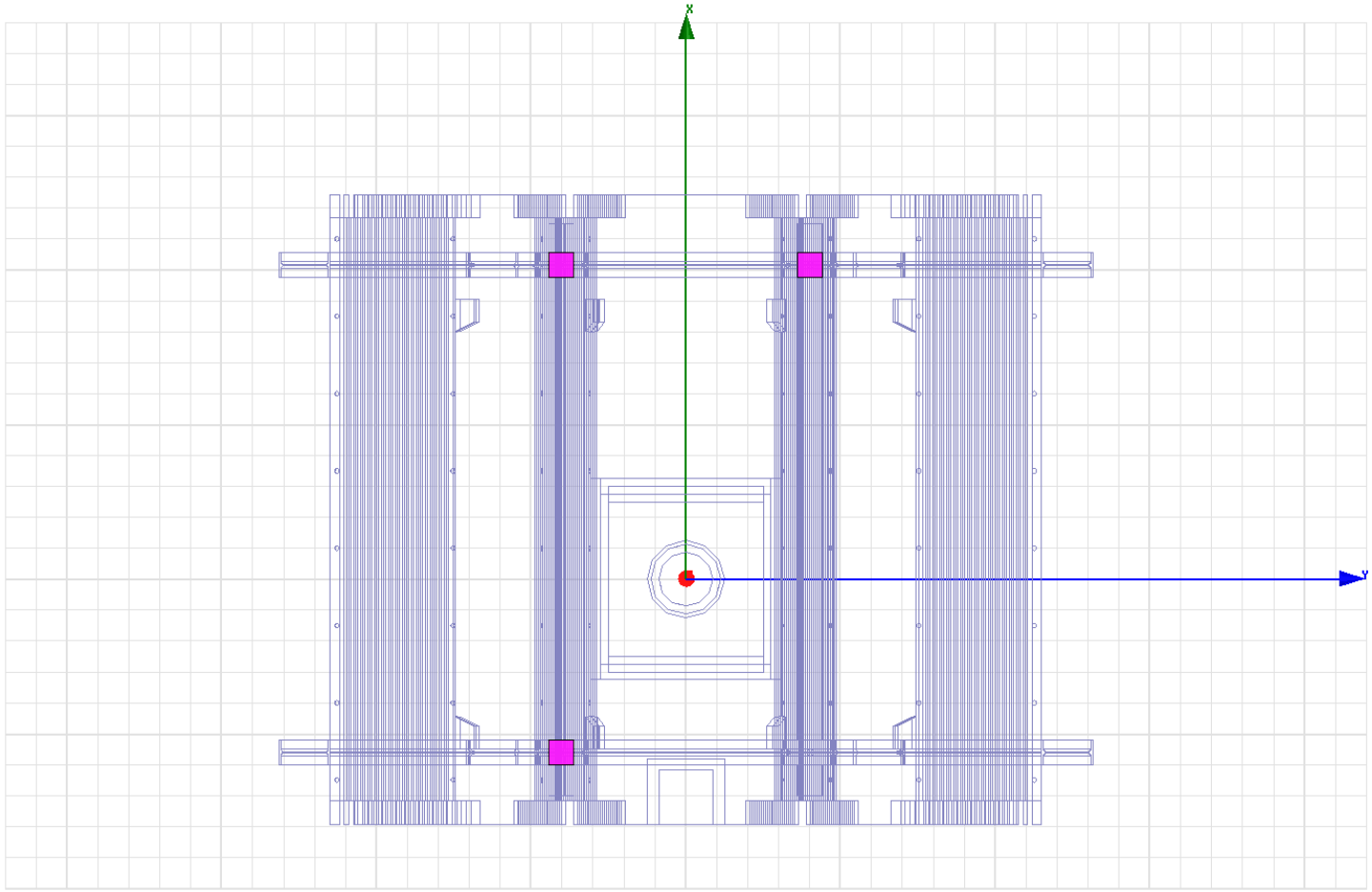
Panda iron simplified model

Renzo Parodi

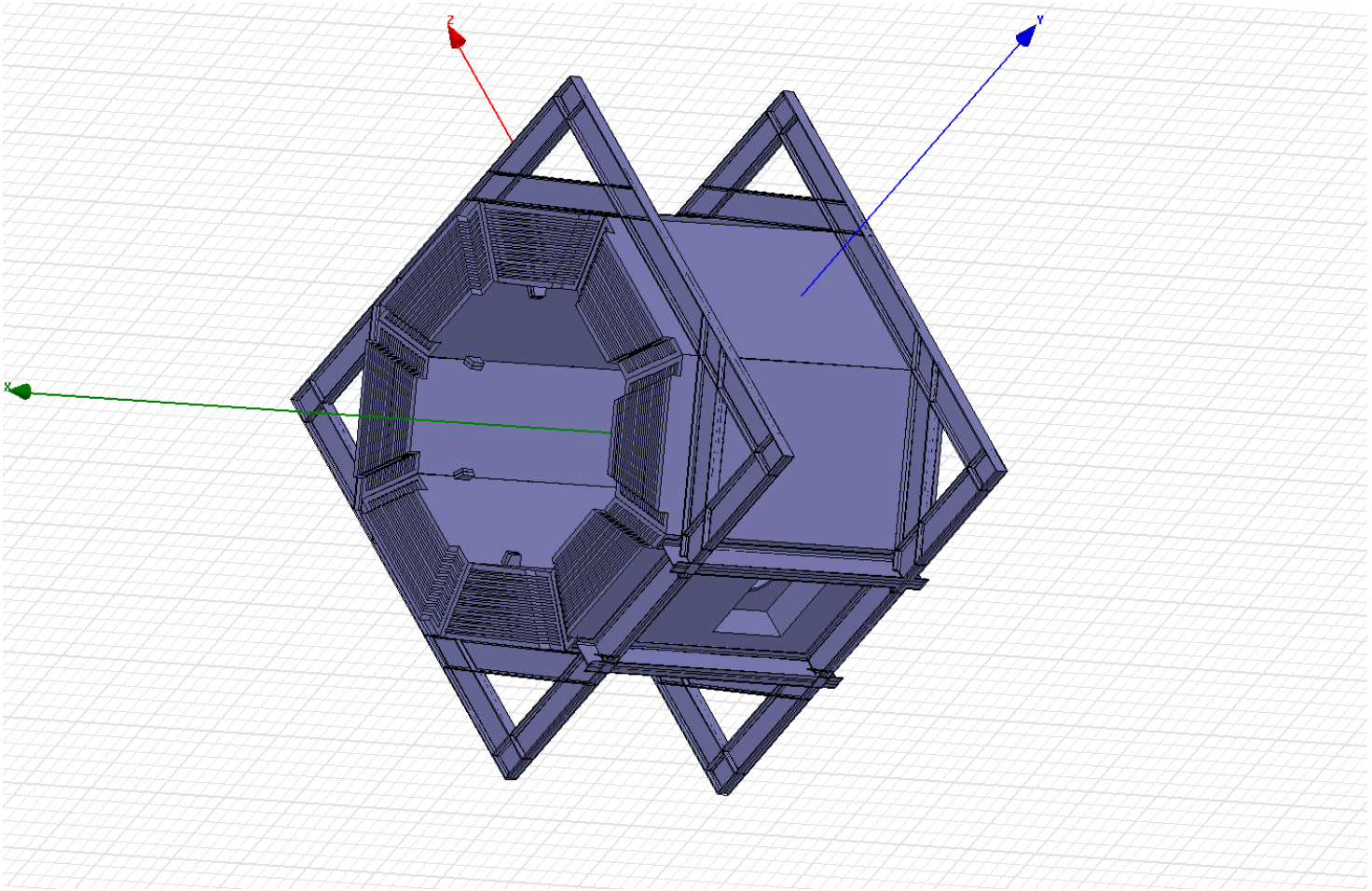
The assumptions for the symulations

- The barrel iron and the Frame are sitting on 3 10mm Thick 160x 160 mm foots placed at the intersection of the beams on the lower frame.
- We inpose ZERO displacement on the foots.
- The iron bends under the weight
- This model is by far pessimistic;
- Cryostat, doors and lower platform are supposed to react to the bending.
- Computation time 2 days
- 1150000 elements.

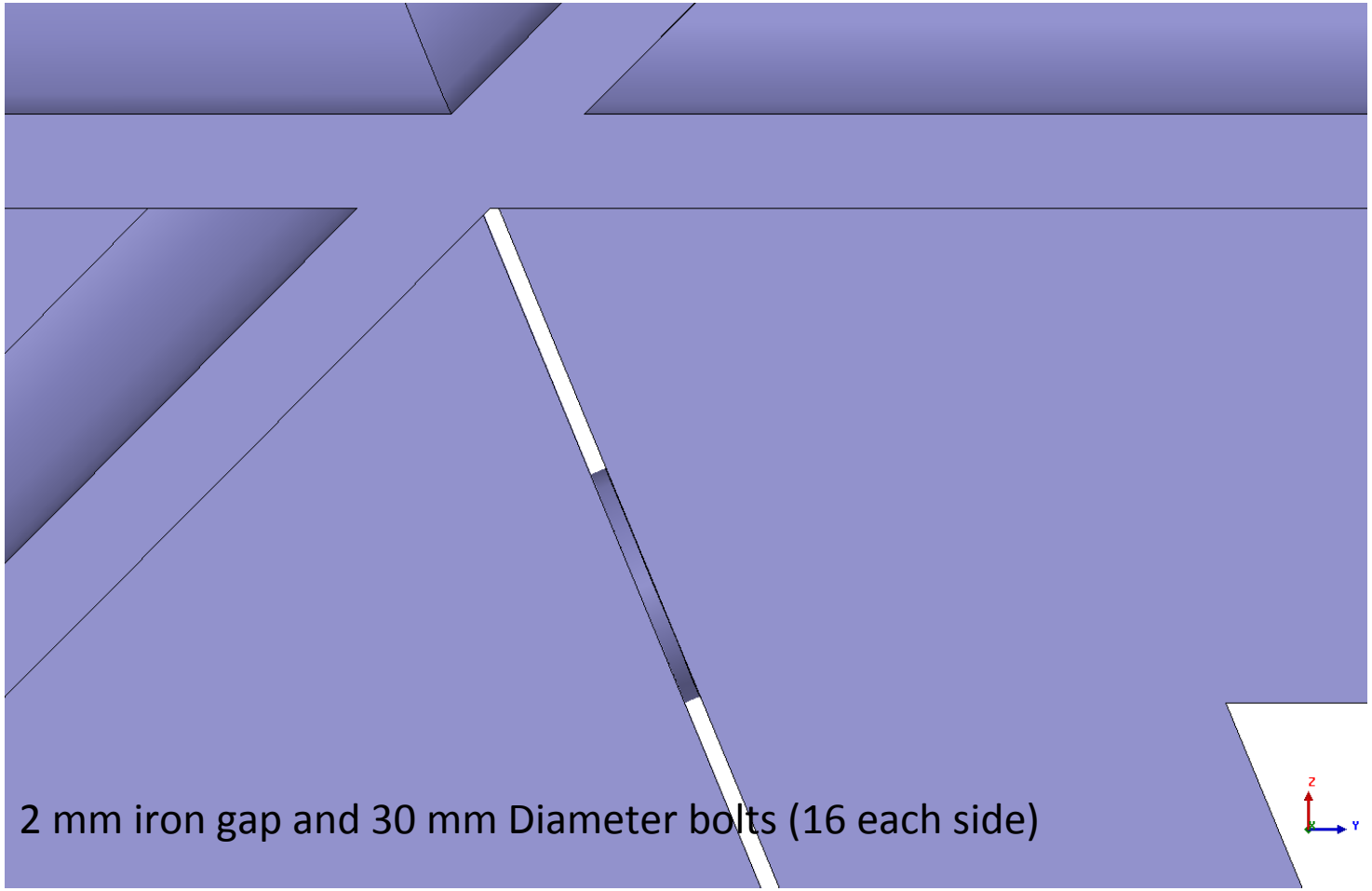
Boundary conditions



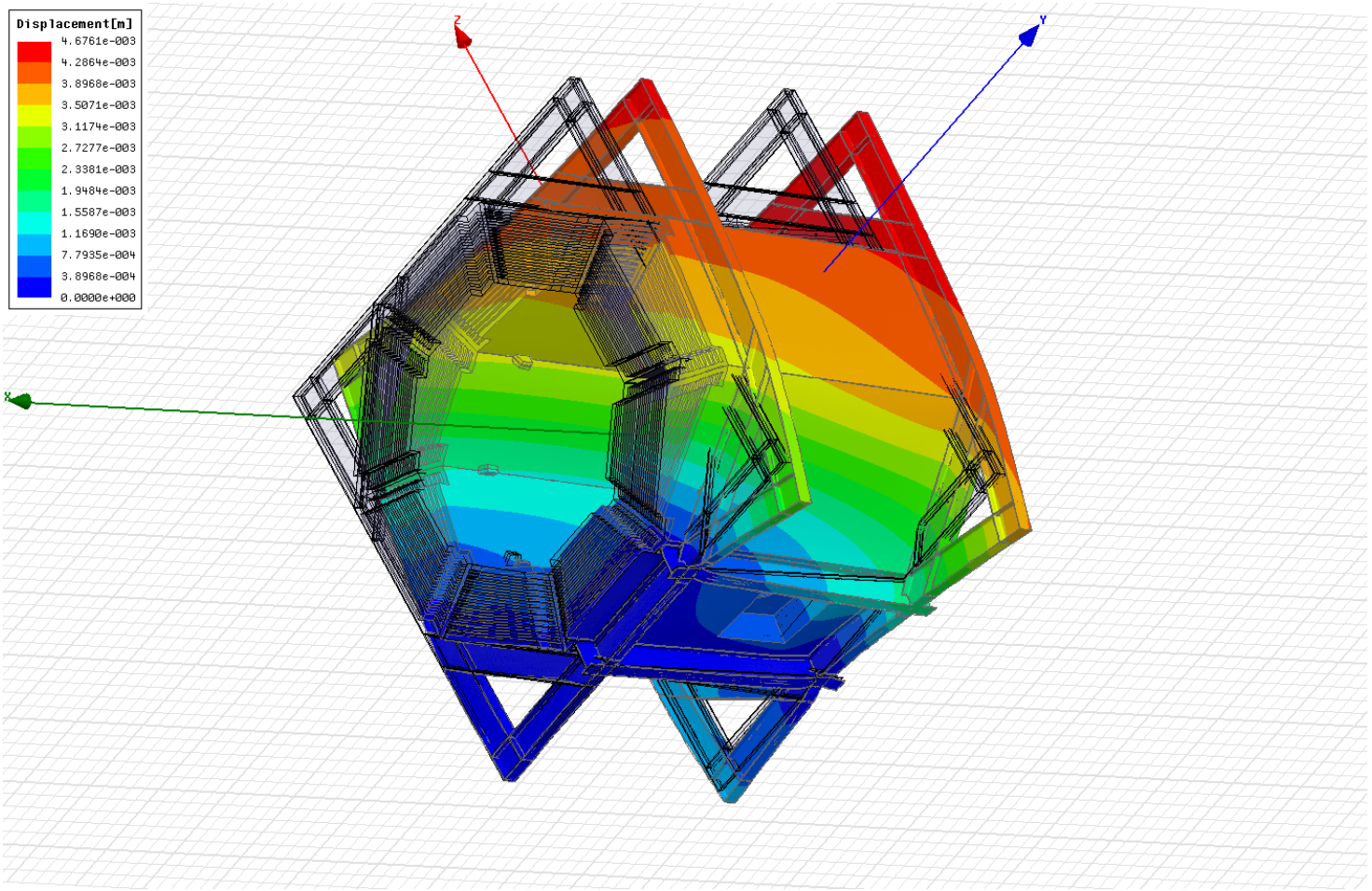
The model



How the “iron coffins” are joined

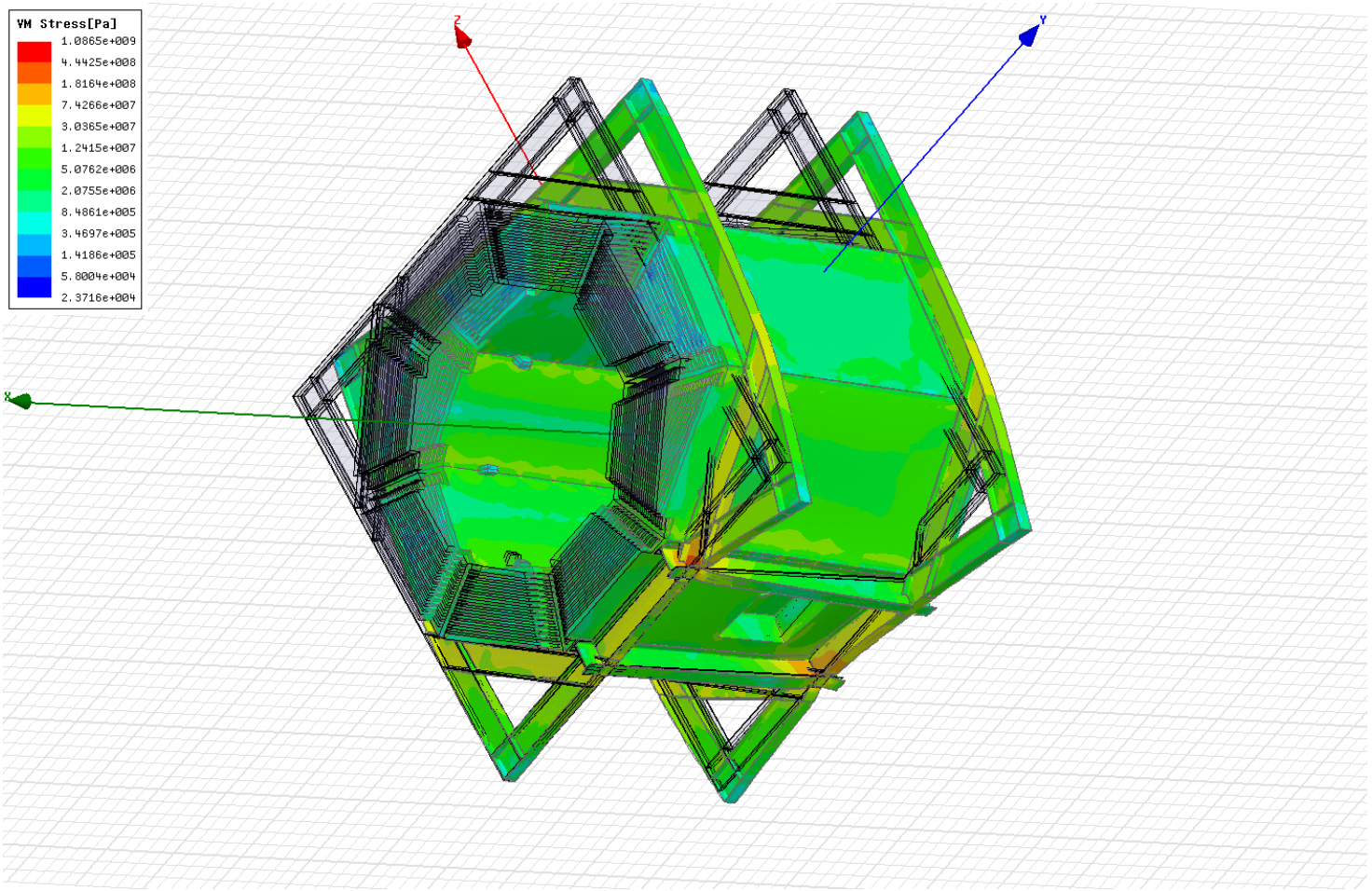


Deformation



Maximum deformation is 4.67 mm

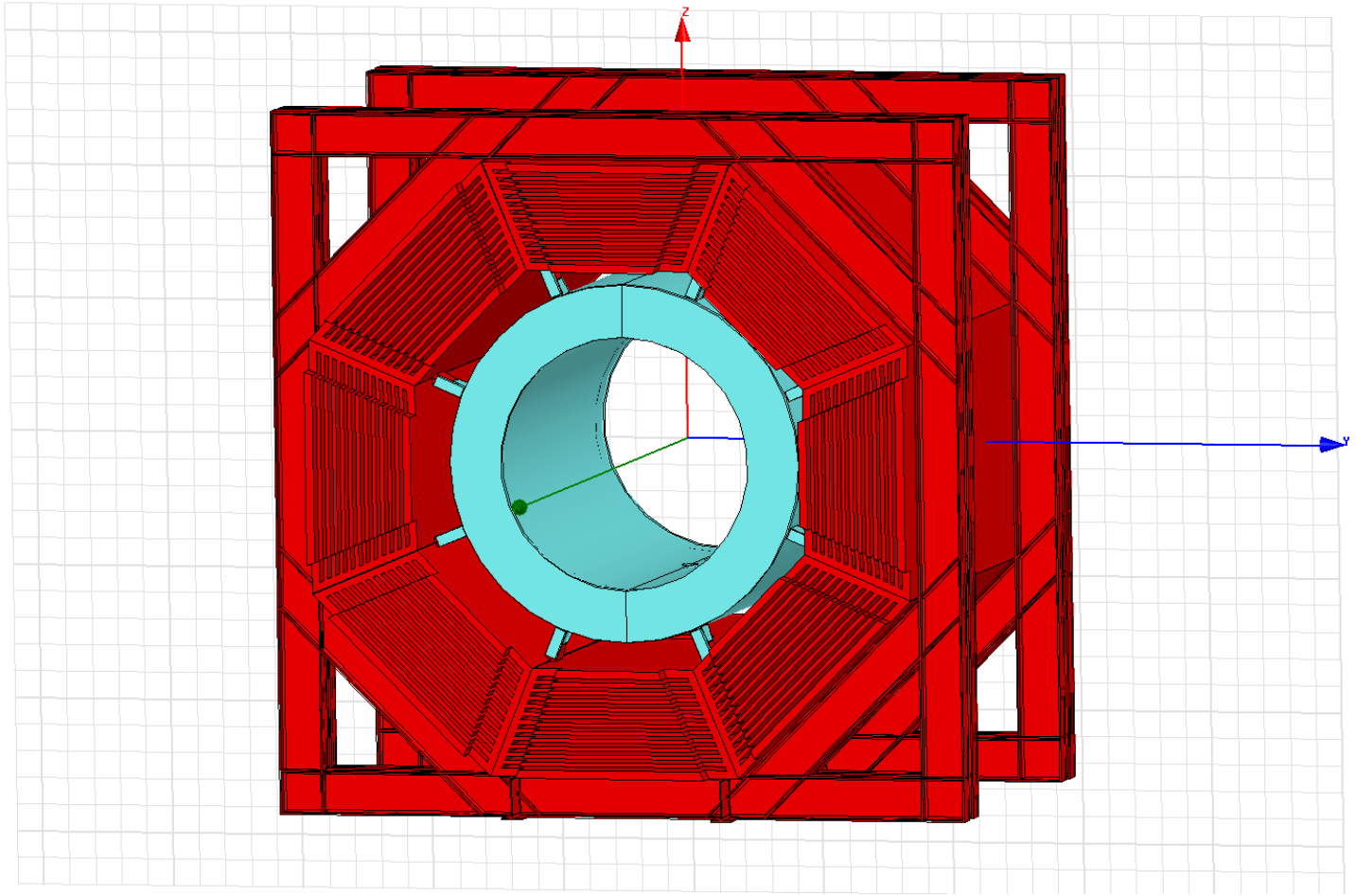
Von Mises


VM Stress[Pa]
1.0865e+009
4.4425e+008
1.8164e+008
7.4266e+007
3.0365e+007
1.2415e+007
5.0762e+006
2.0755e+006
8.4861e+005
3.4697e+005
1.4186e+005
5.8004e+004
2.3716e+004
Z
Y
X

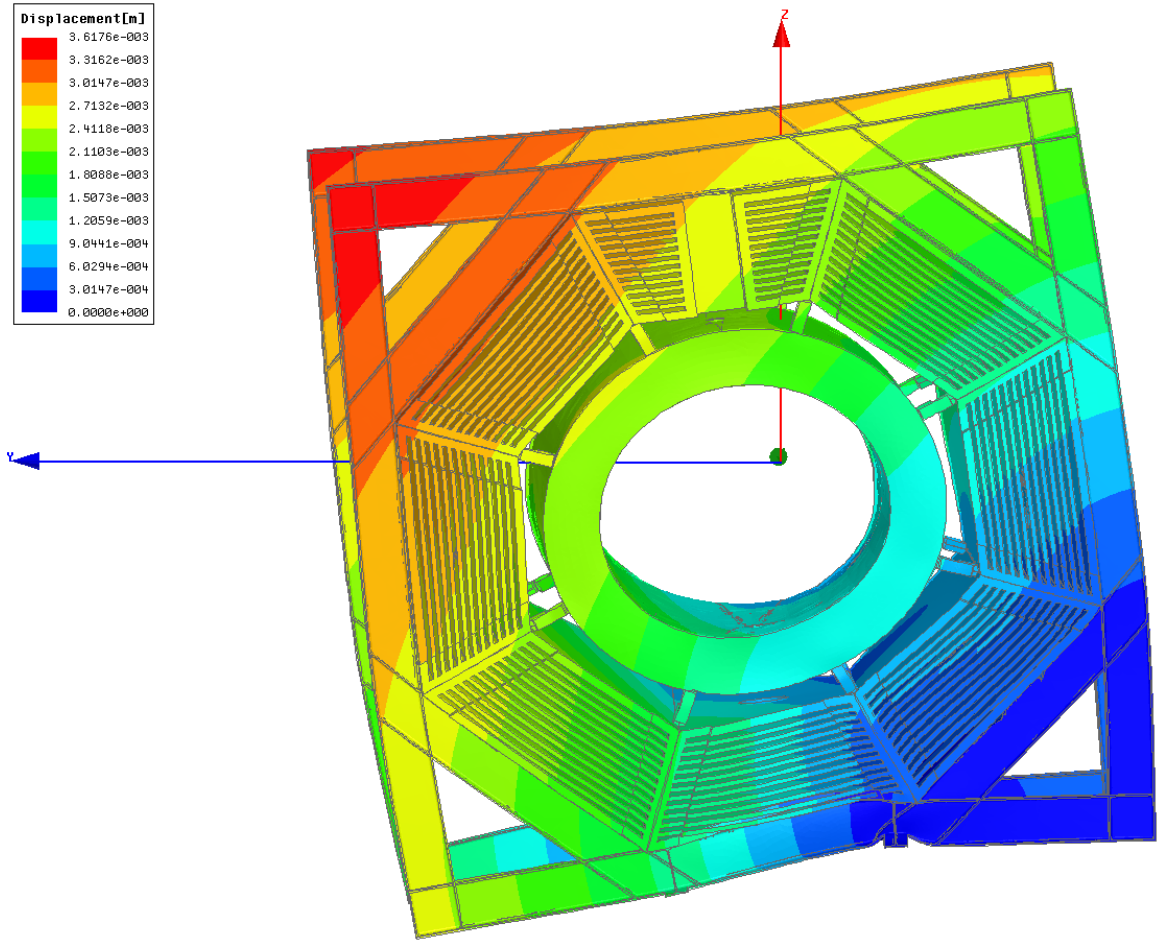
Adding the cryostat

- The Cryosat, modeled as an Aisi 304 Stainless steel Thoroidal box, is added using the proposed 16 points suspension scheme.
- The dimension and shape of the cryostat are imported from the drawings of the Autocad model stored in the magnet repository.

The iron cryostat assembly

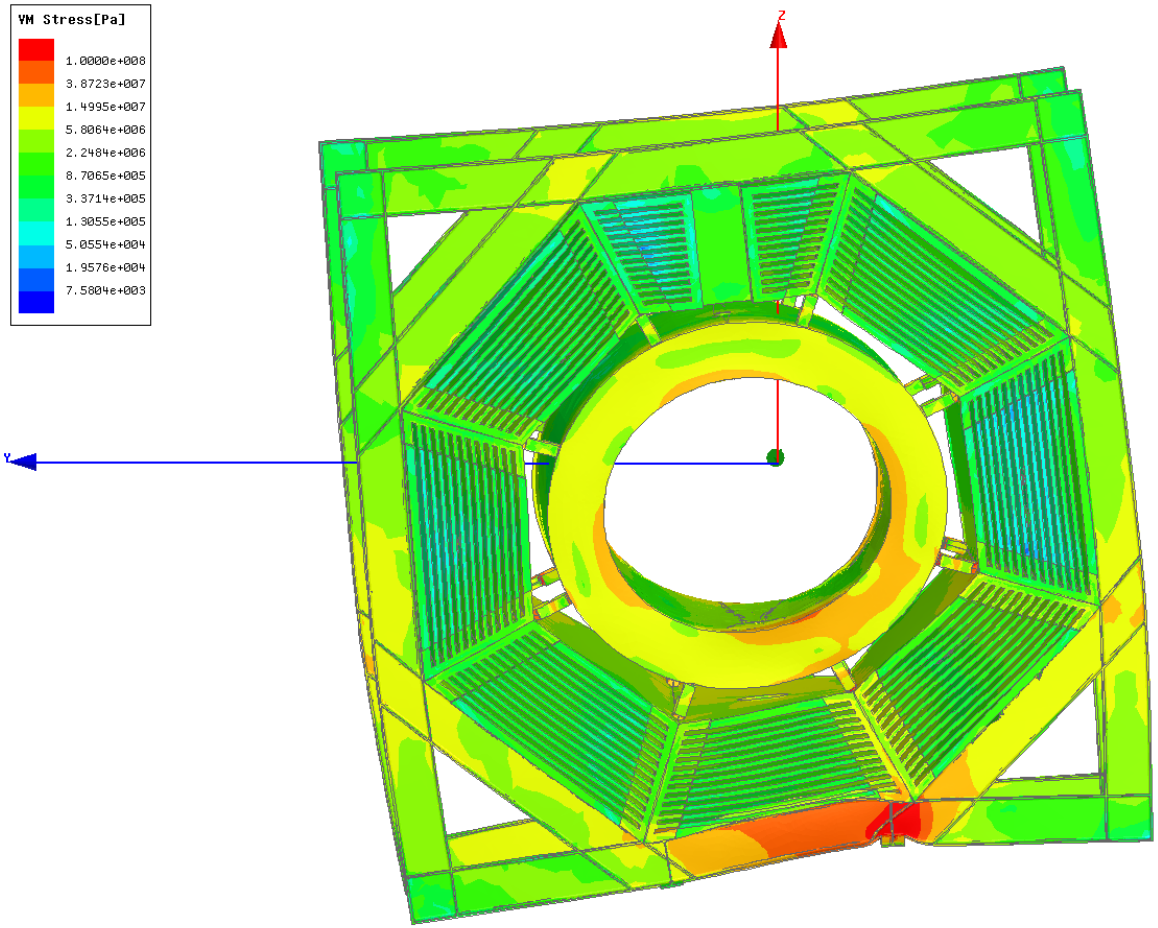


deformation



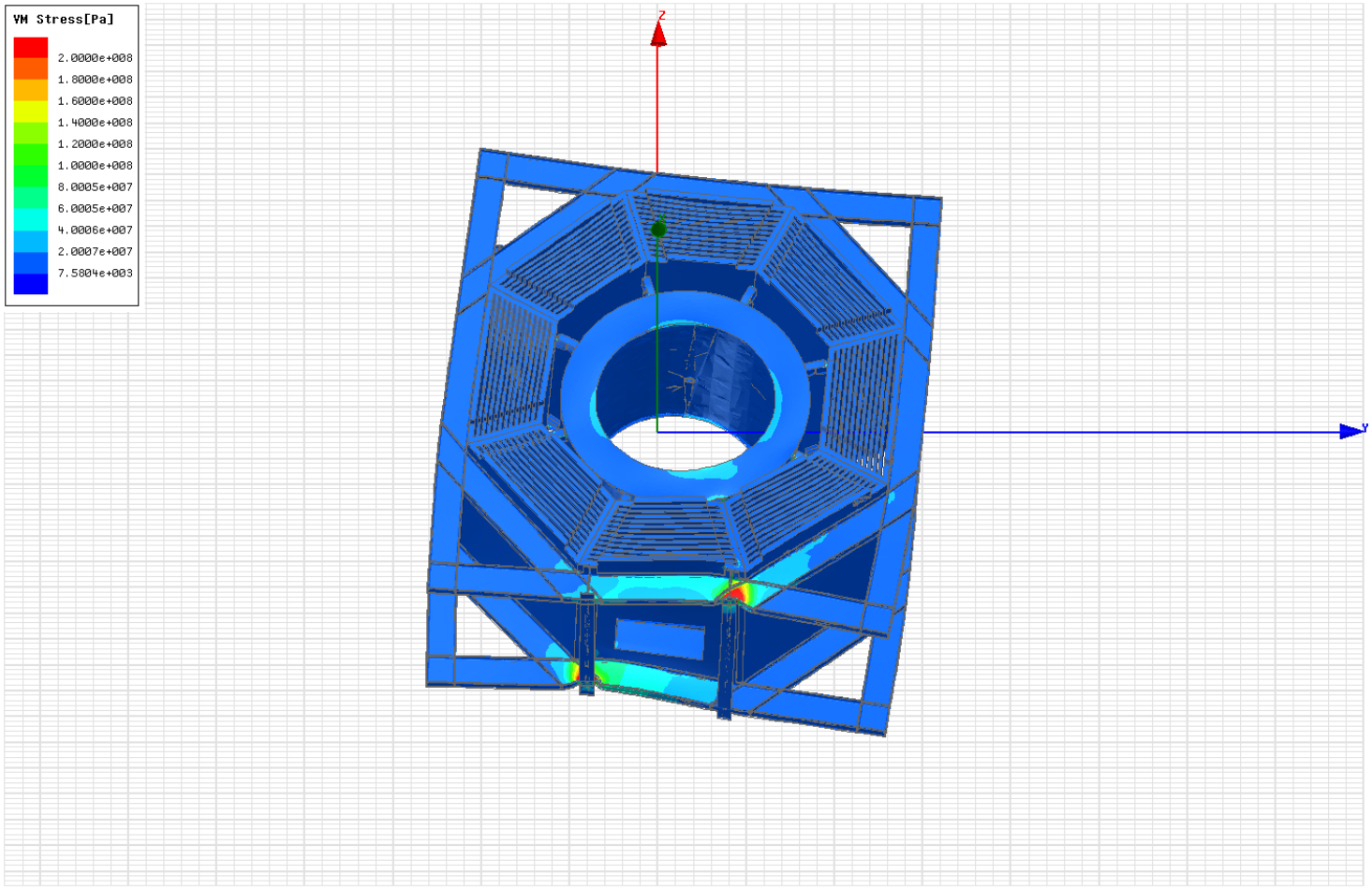
Deformation plot for the Cryostat-Iron assembly
Maximum iron deformation is 3.6mm at the upper corner
The maximum Cryostat deformation is ~2.5mm

Von Mises



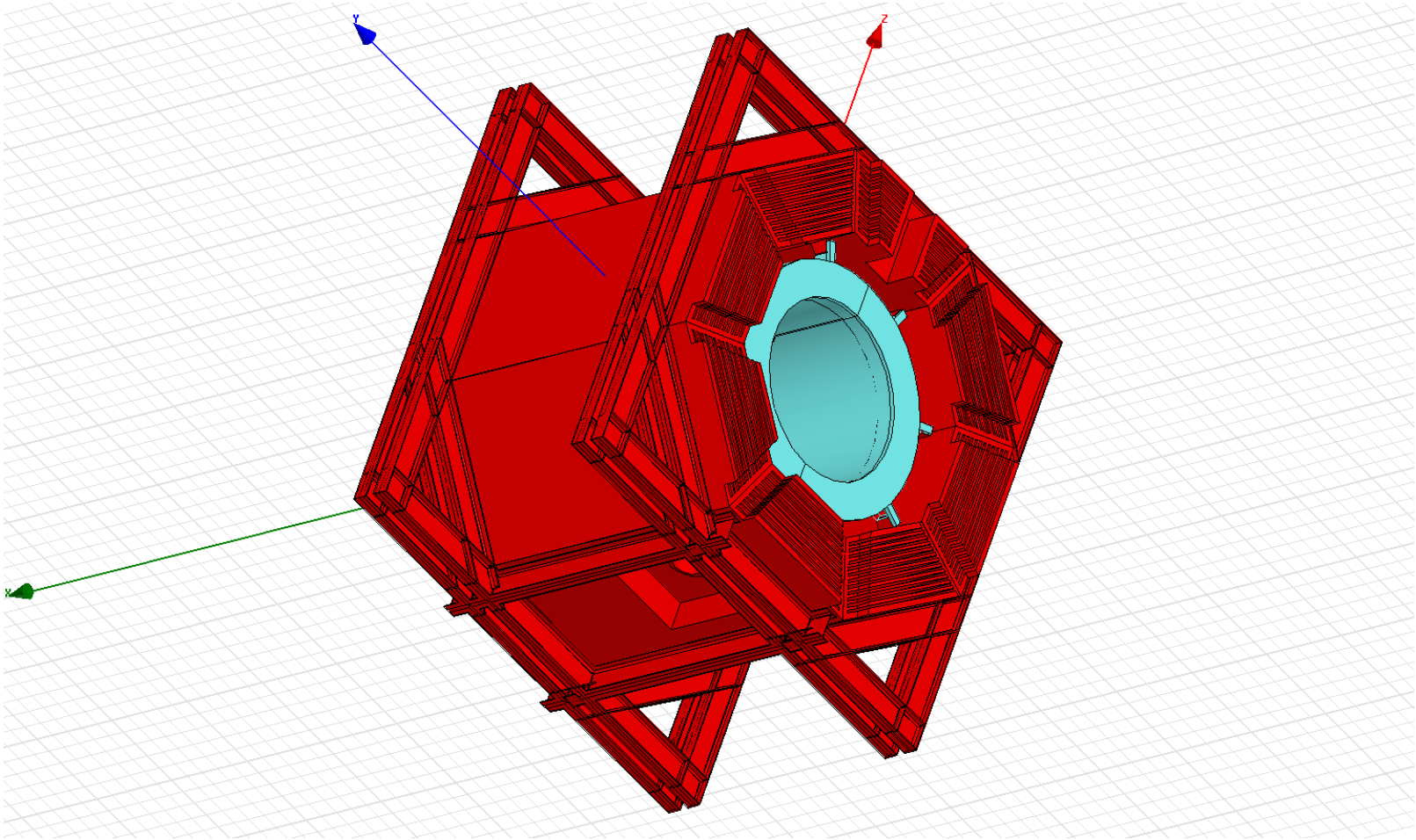
Log Plot of von Mises Stresses ranging from 7.5e3 to 1e8 [Pa]
The stresses are >100M Pa in the red region at the Lower support Beam intersection.
Maximum streses on the Cryostat and Cryostat connections are below 20 [Mpa] the maximum Value on the connection is a numeric artifact produced by the coarse mesh.

Von Mises II



Linear plot of the von Mises stresses on the coil iron assembly in the range 7.5e3-2e8 Pa.
Showing the stress concentration in the beam frame (already unrealistic)
stresses on the cryostat and cryostat iron connections are in the quite safe operation limit.

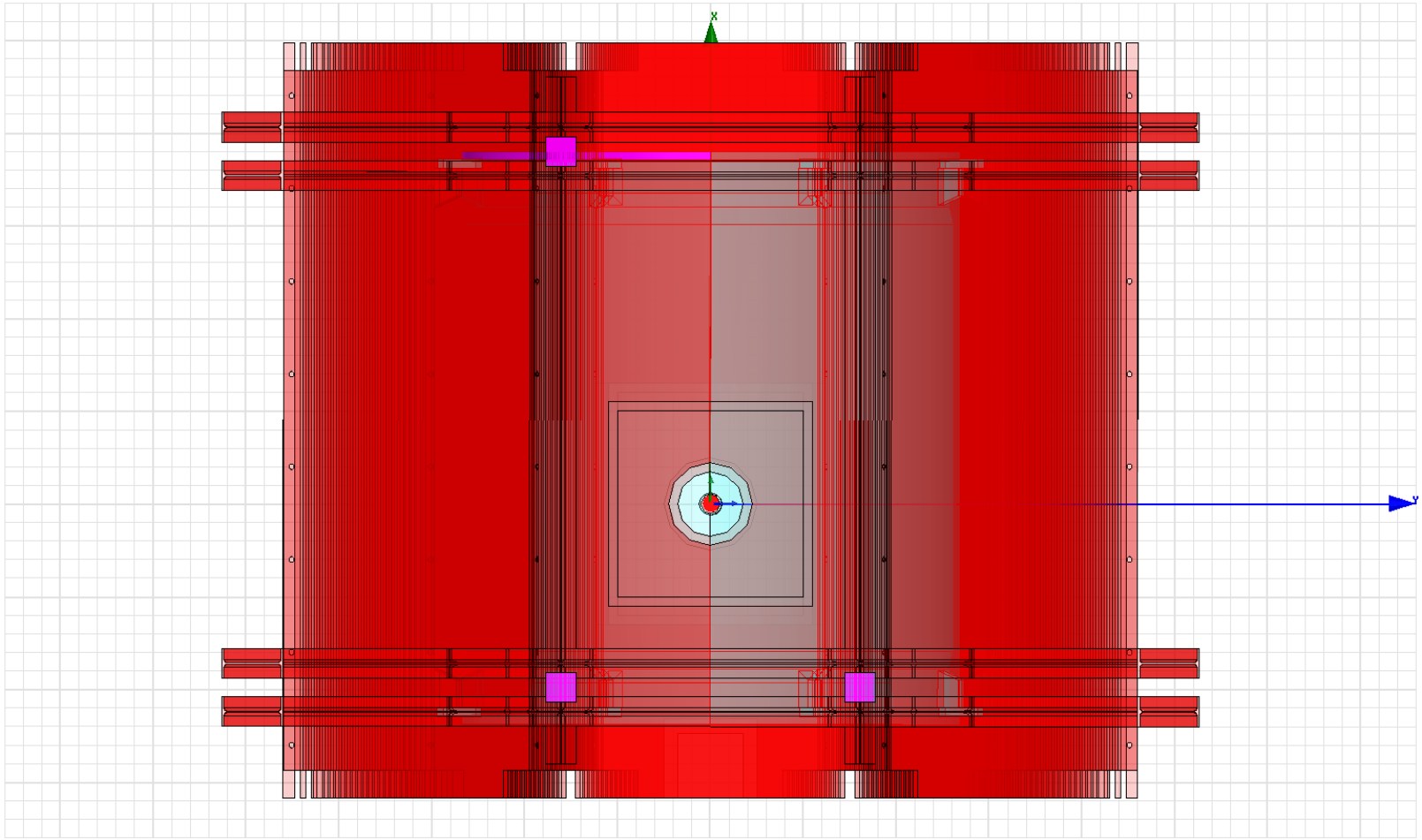
The double framed iron model



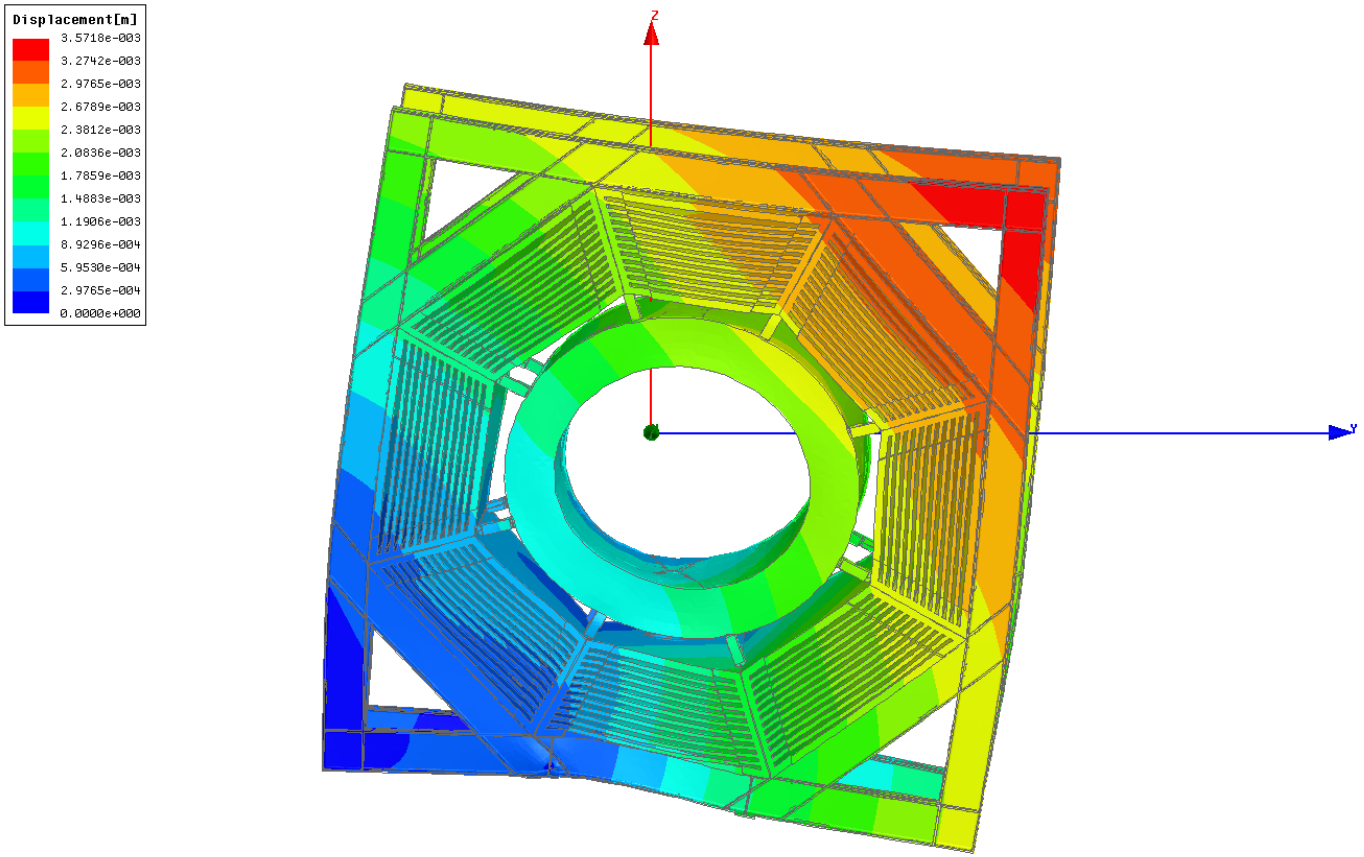
The assumptions for the symulations

- The barrel iron and the Frame are sitting on 3 10mm Thick 160x 160 mm foots placed at the intersection of the beams on the lower frame
- In the middle of the two twinn frames.
- We inpose ZERO displacement on the foots.
- The iron bends under the weight
- This model is by far pessimistic;
- Cryostat, doors and lower platform are supposed to react to the bending.
- Computation time 2 days
- 2800000 elements.

The boundary conditions

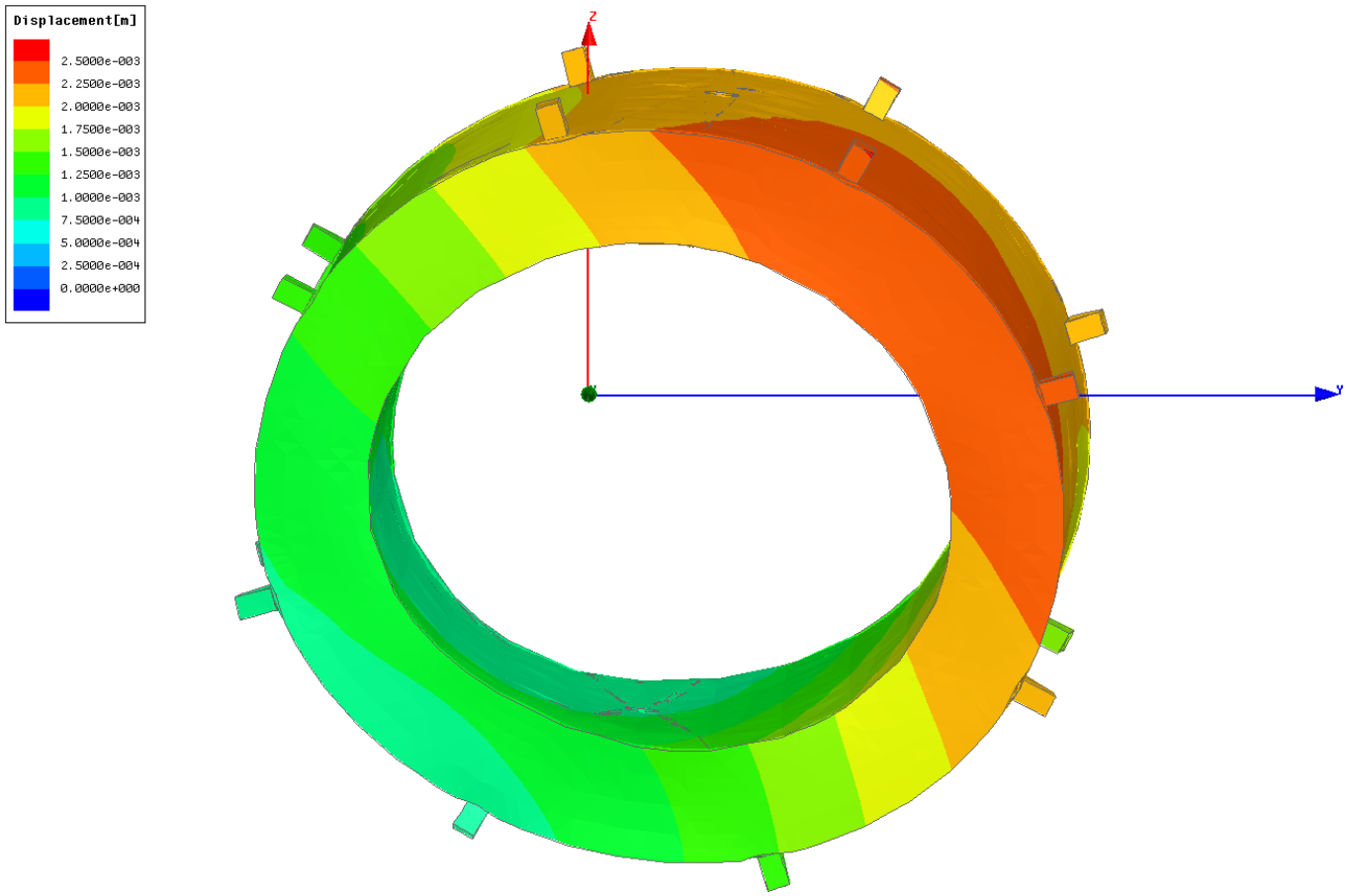


Spectrometer deformation



Deformation plot for the Cryostat-Iron assembly
Maximum iron deformation is 3.5mm at the upper corner

Cryostat deformation

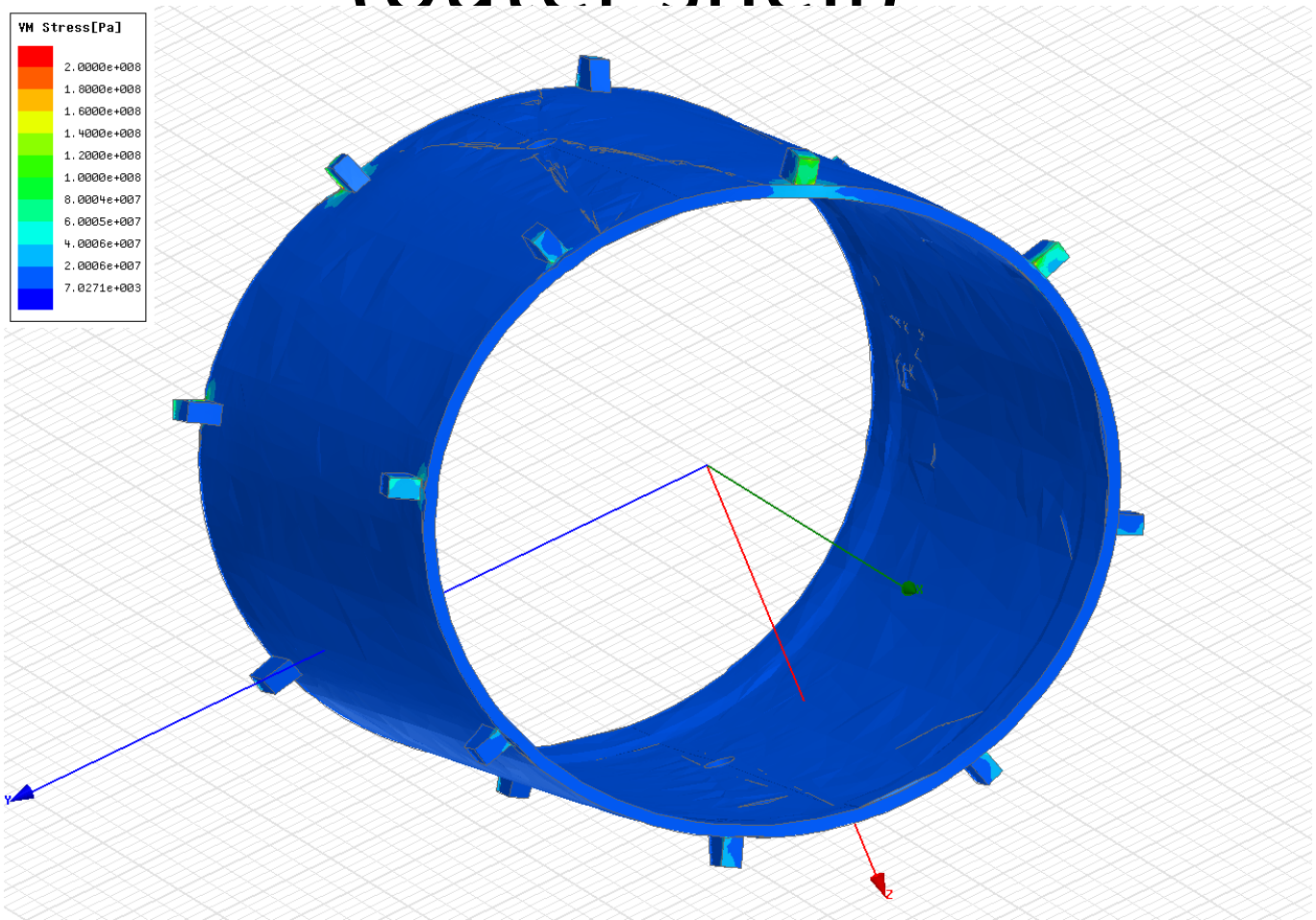


The maximum Cryostat deformation is ~2.5mm

Comments on the deformations

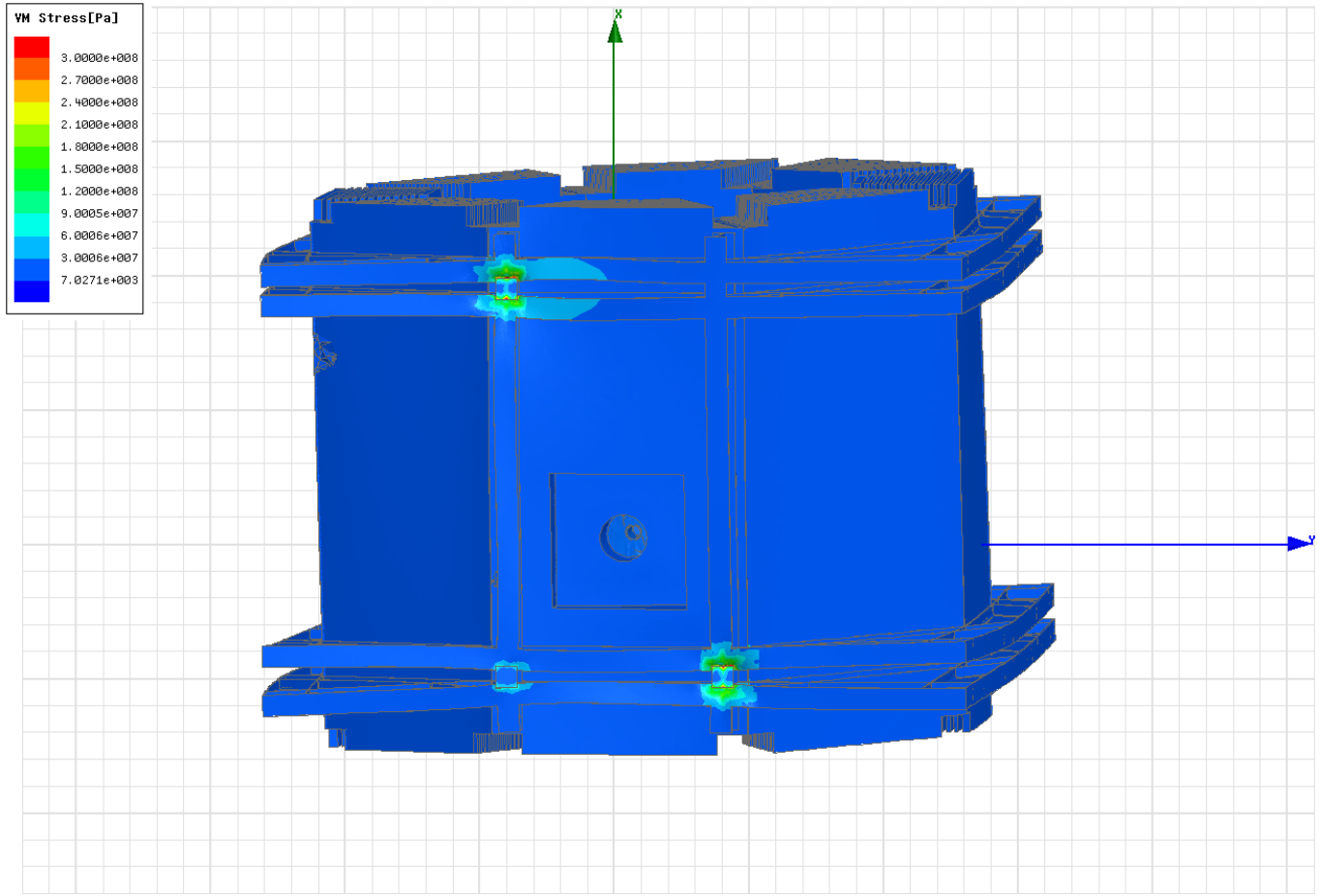
- The double frame changes nothing on the flexural deformation of the coil Cryostat.
- The deformation being mostly a torsion and a flexure of the barrel Yoke
- the obtained value are really quite close to the displacements found in the single frame model.

Von Mises Stresses on Cryostat (outer shell)



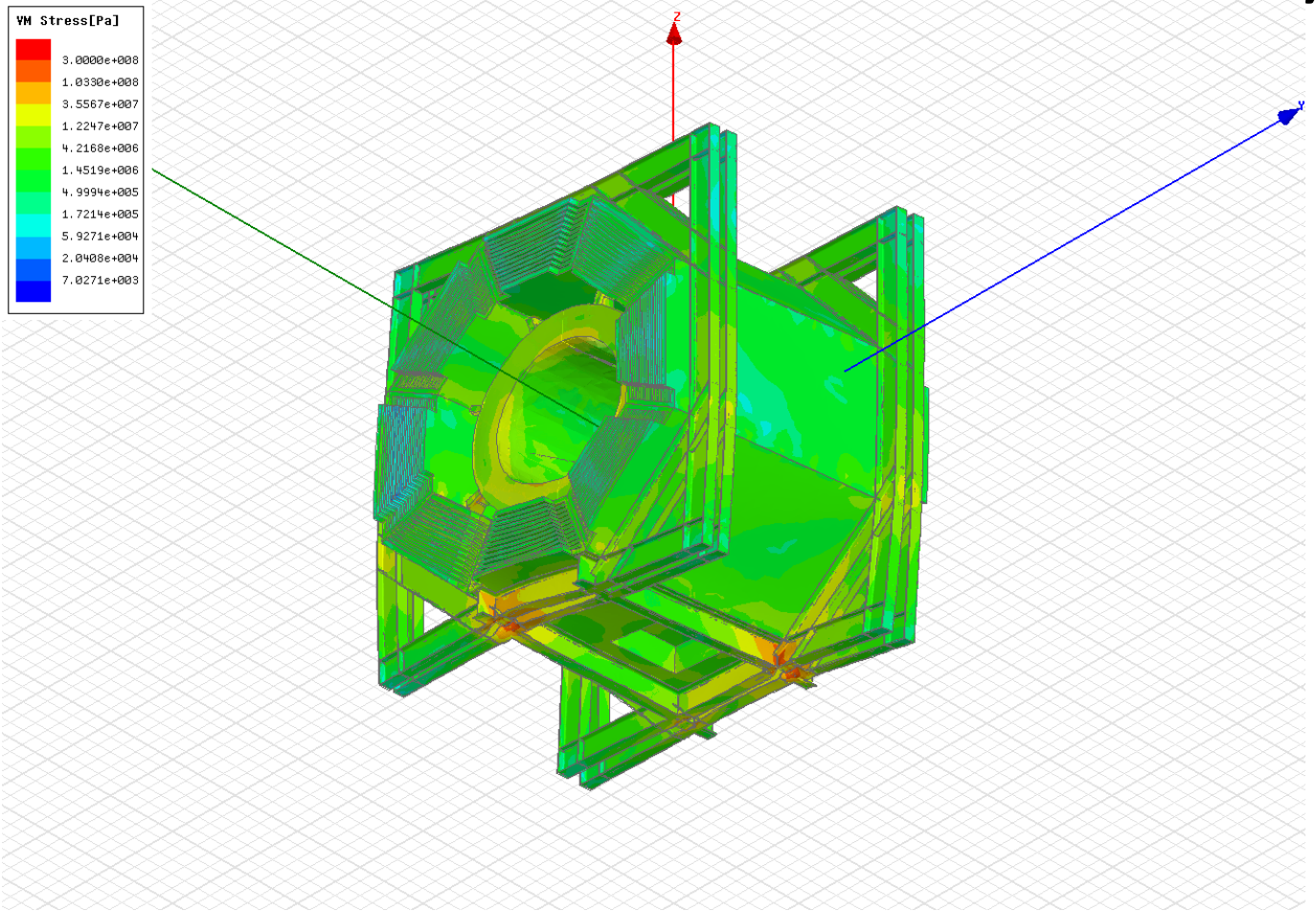
Stresses are everywere in the low scale values , on the Cryostat suspensions values are still around 100 Mpa.

Stresses in the iron



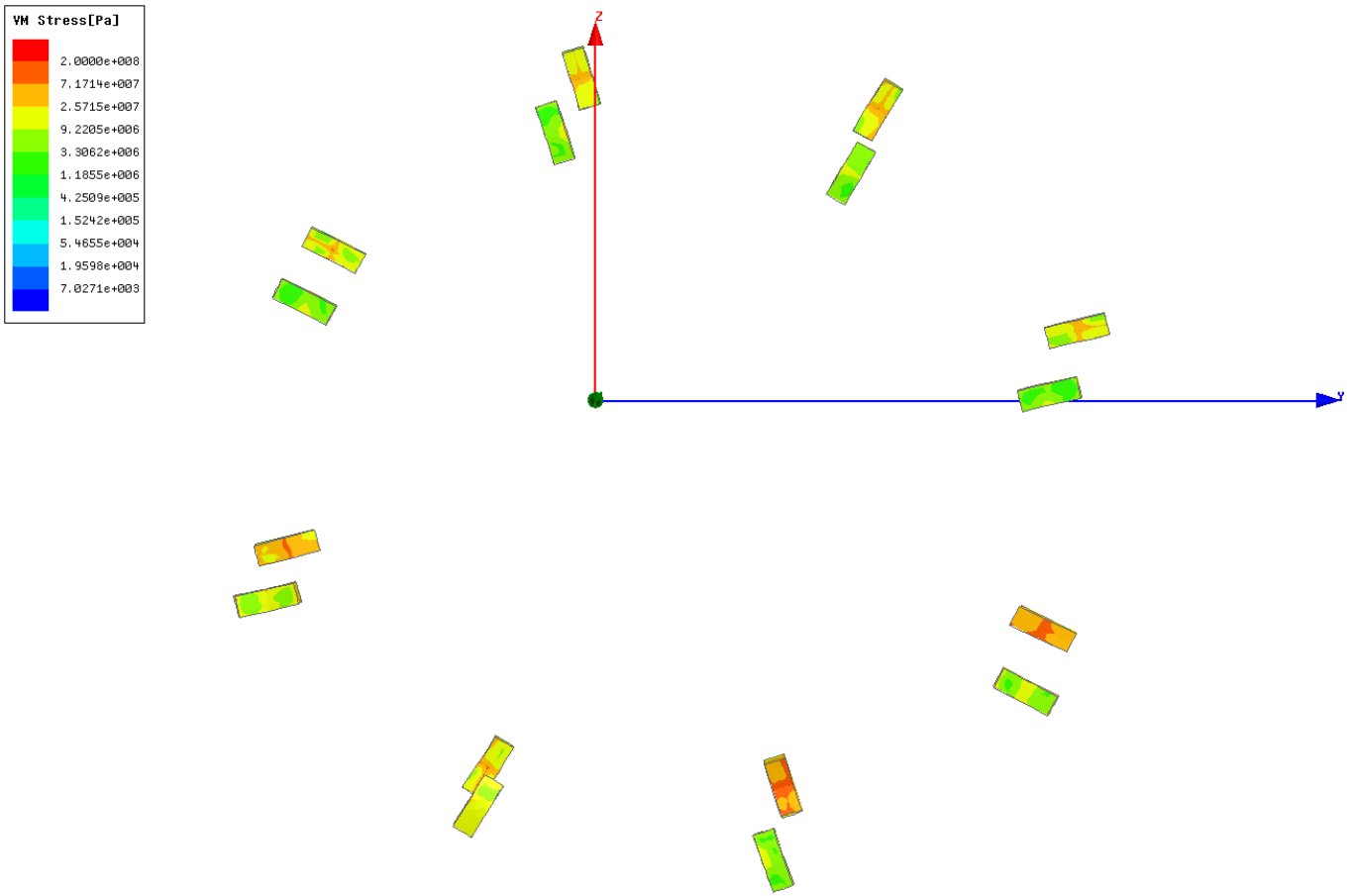
High stresses > 300 MPa are found close to the “foots”;
In the rest of the iron the stresses are < 100 MPa

Stresses in the iron (log plot)



High stresses > 300 MPa are found close to the “foots”;
In the rest of the iron the stresses are < 100 MPa

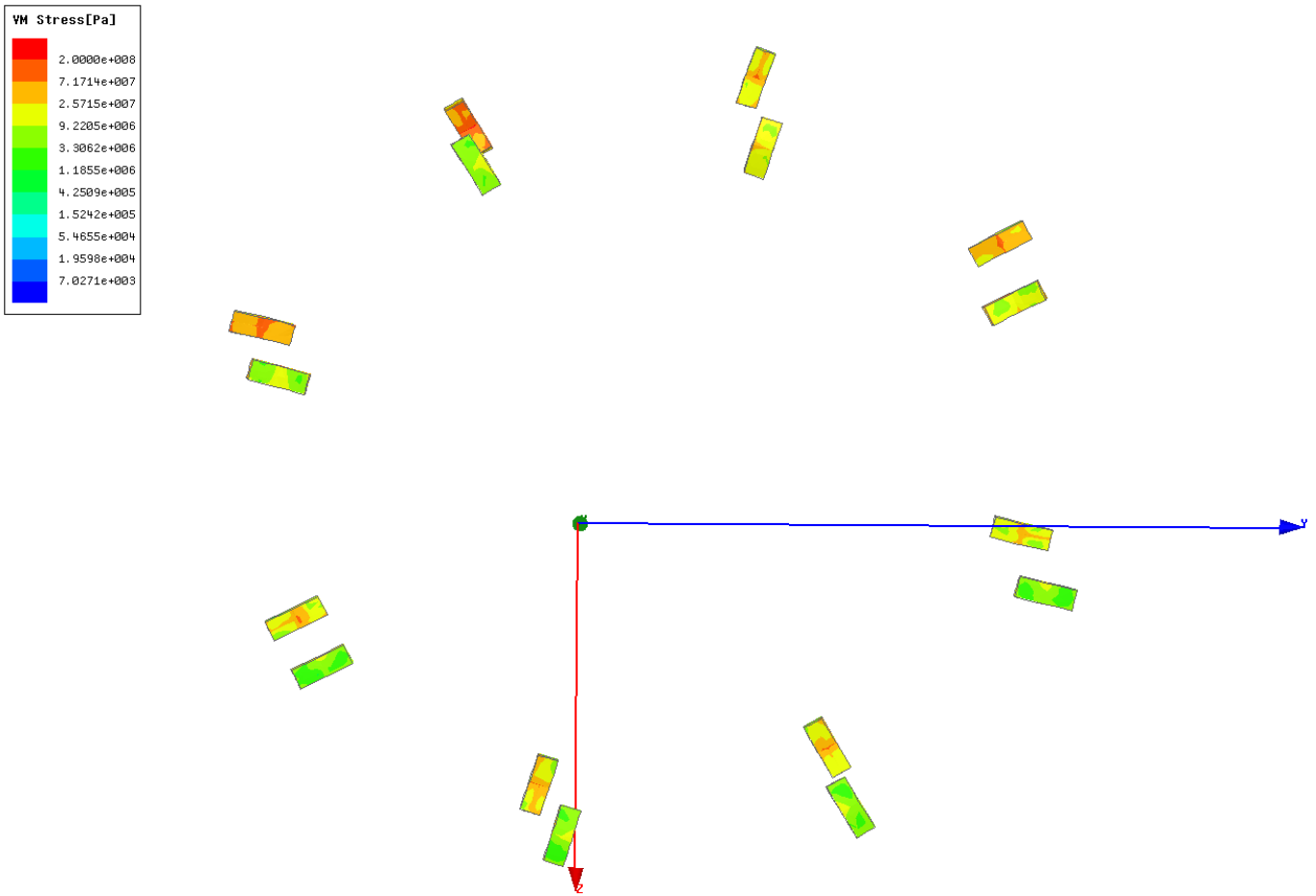
Stresses in the Connecting ties.



Seen From Downstream IP
Log Plot

Stresses in the Connecting ties.

Log plot



Seen From Upstream IP
Log Plot

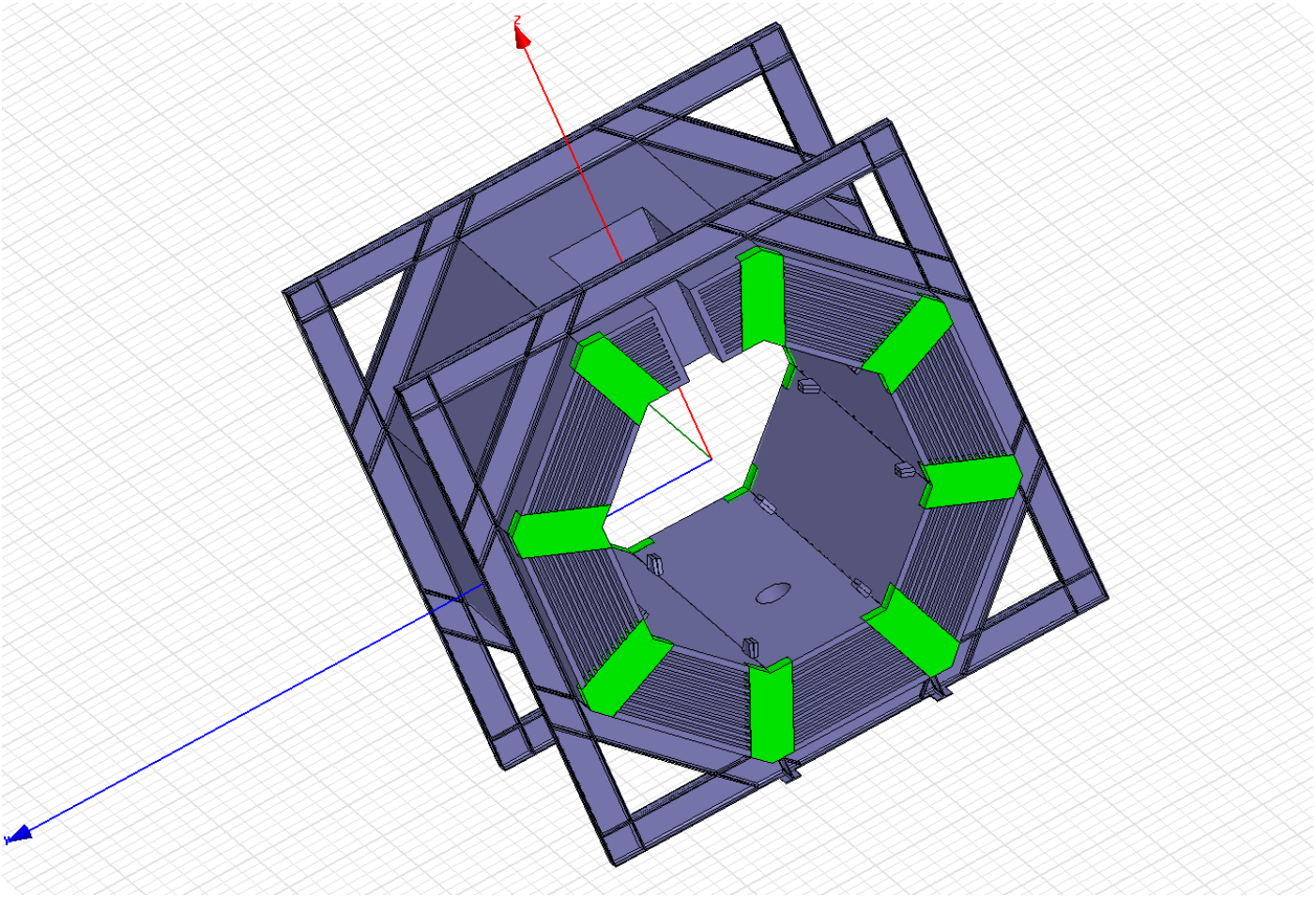
Stresses in the connecting ties

- Stresses in the ~200MPa Are found only in the TIE connecting the Cryostat to the IRON
- The value goes down by increasing the number of elements in the region, and it is probably a numerical artifact to be checked by using a proper sub modeling of the tie.
- To be on the safe side we propose to use for the TIE an High Strength Cr-V-Mo Steel like AISI H13 steel With an Yield tensile strength of 1250 MPa.

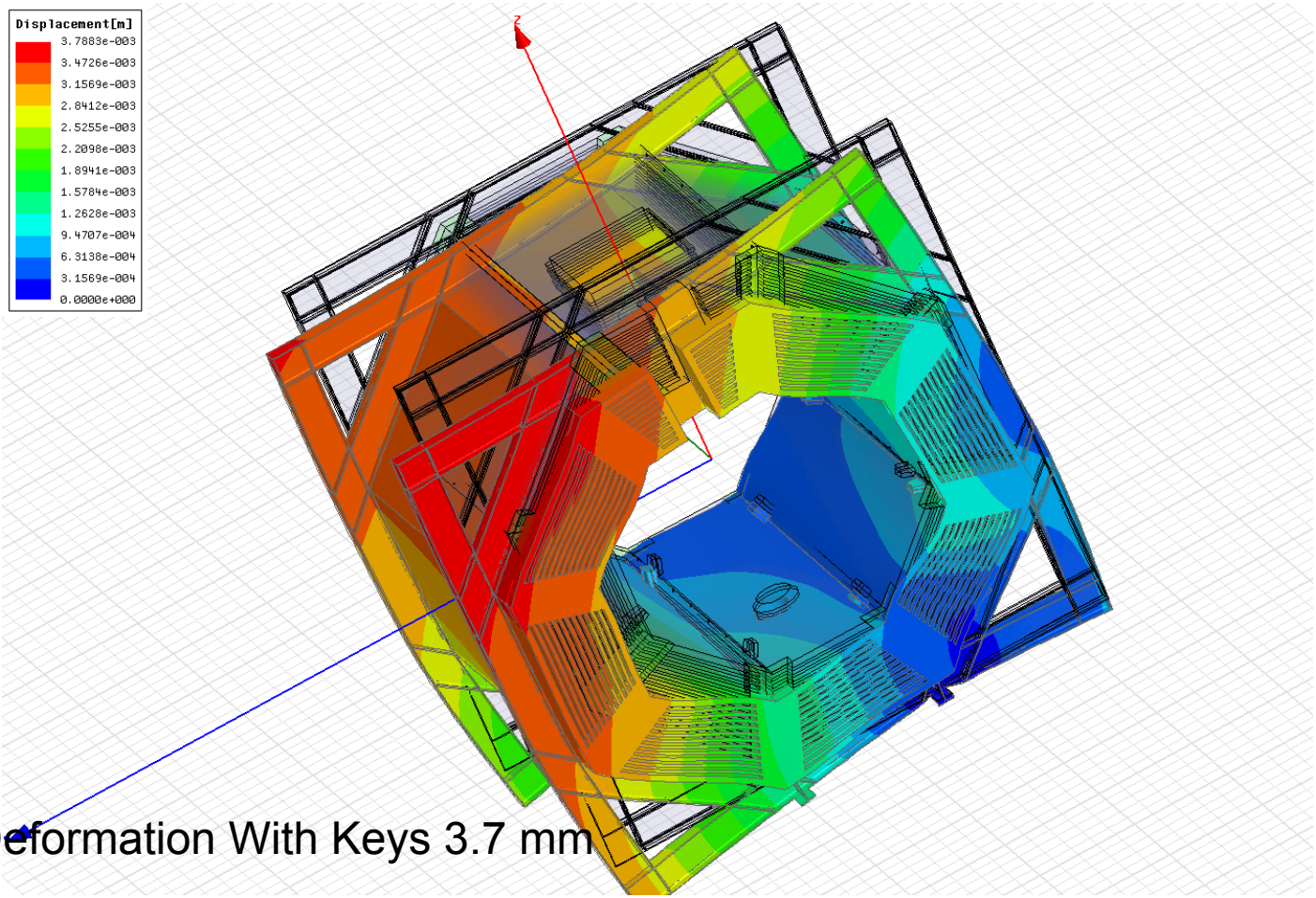
Corner Keys

Renzo Parodi

Model

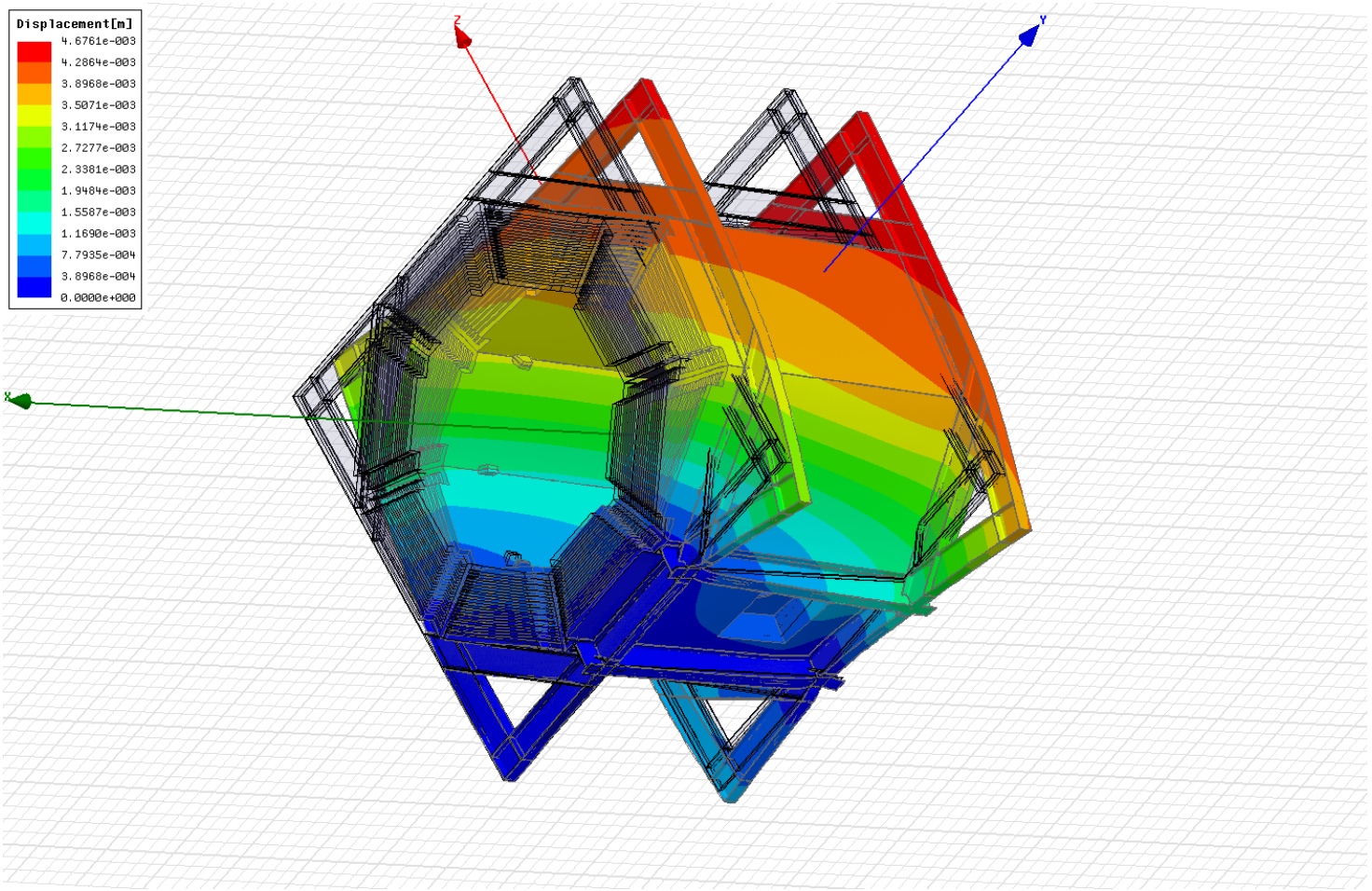


The deformation with corner Keys



Max Deformation With Keys 3.7 mm

Deformation without corner Keys



Maximum deformation is 4.67 mm