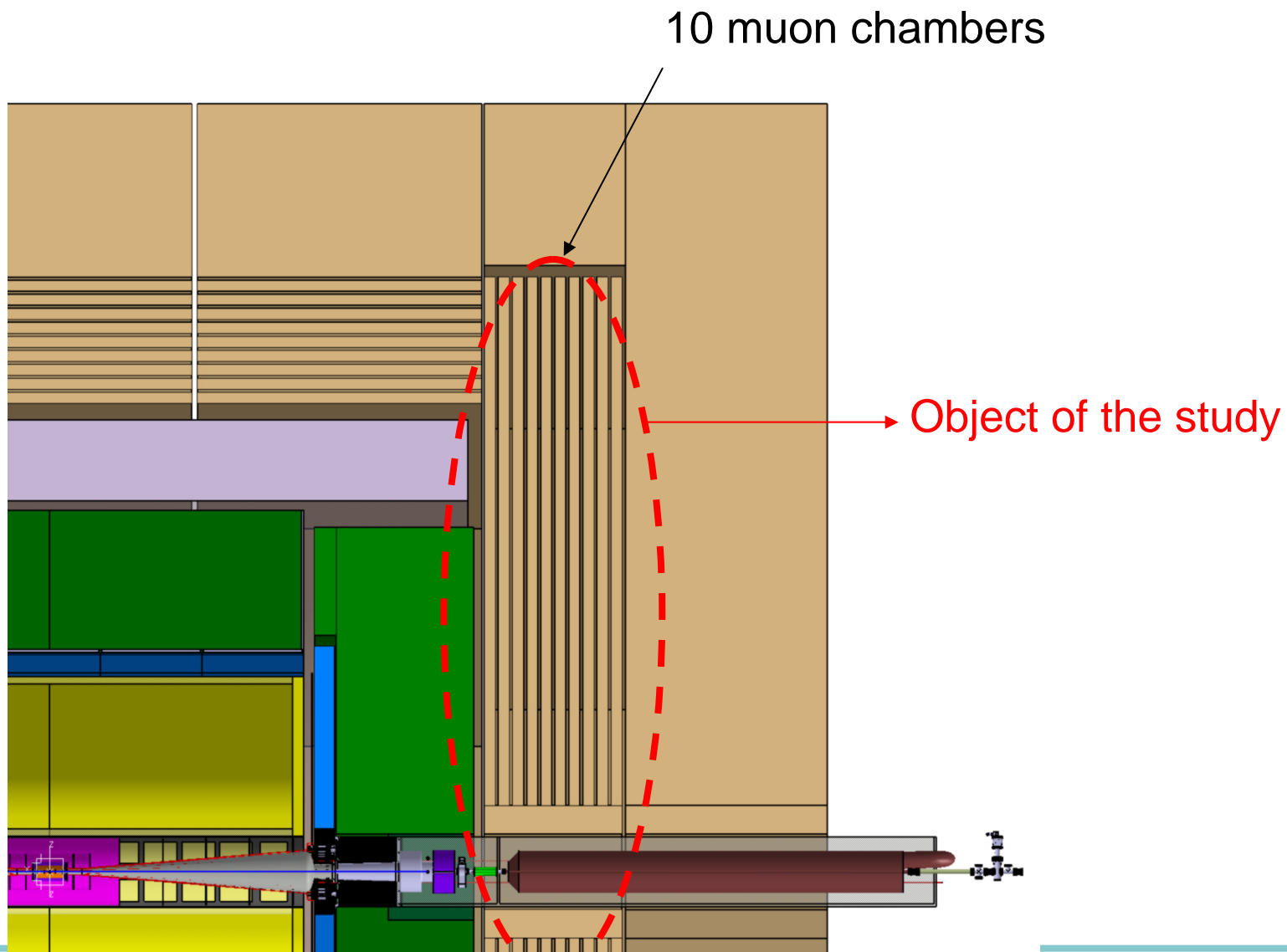# FEA calculations for different ILD EndCap yoke design

The purpose of this document is to have a rough estimation of the mechanical behavior of the 2 different EndCap design :

- Module by quarter and horizontal rips
- DESY 12 folds petal design
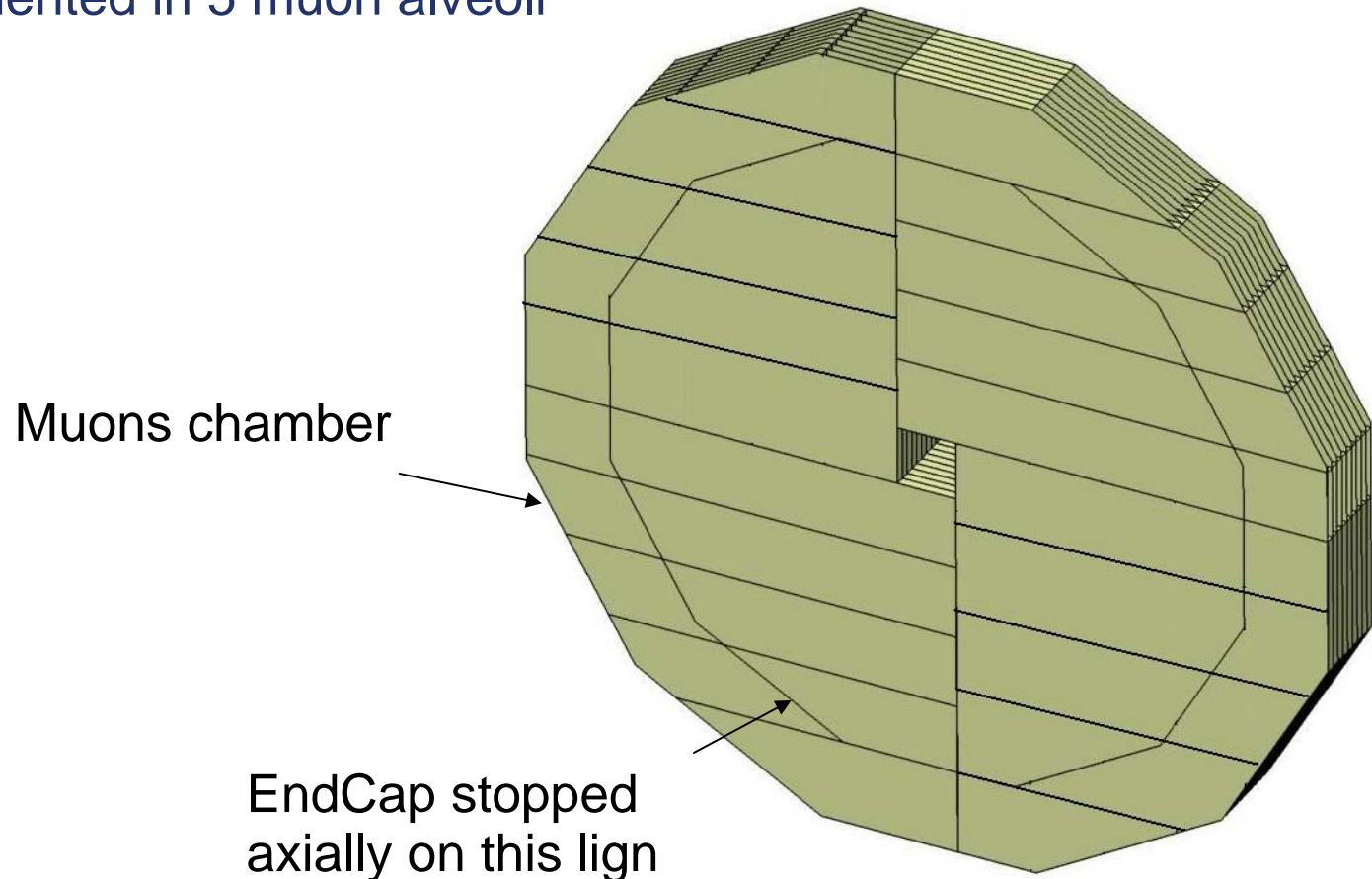
10 muon chambers

Object of the study

# Input data for both design

- The front EC yoke has no link with the back EC yoke
- Magnetic force : 24 000kt (240000kN)

  *(assumed as equally distributed on the front EC face under R4350)*
- Muon chambers : 10 layers 100mm thick
- Material :
  - **E = 200GPa**
  - **Ro = 7800kg/m3**
  - **Yield strength : 240MPa (CMS TDR)**
- Axial stopper line at R4350mm
- R5500mm is let free
- FSP & feet are not included in the calculations
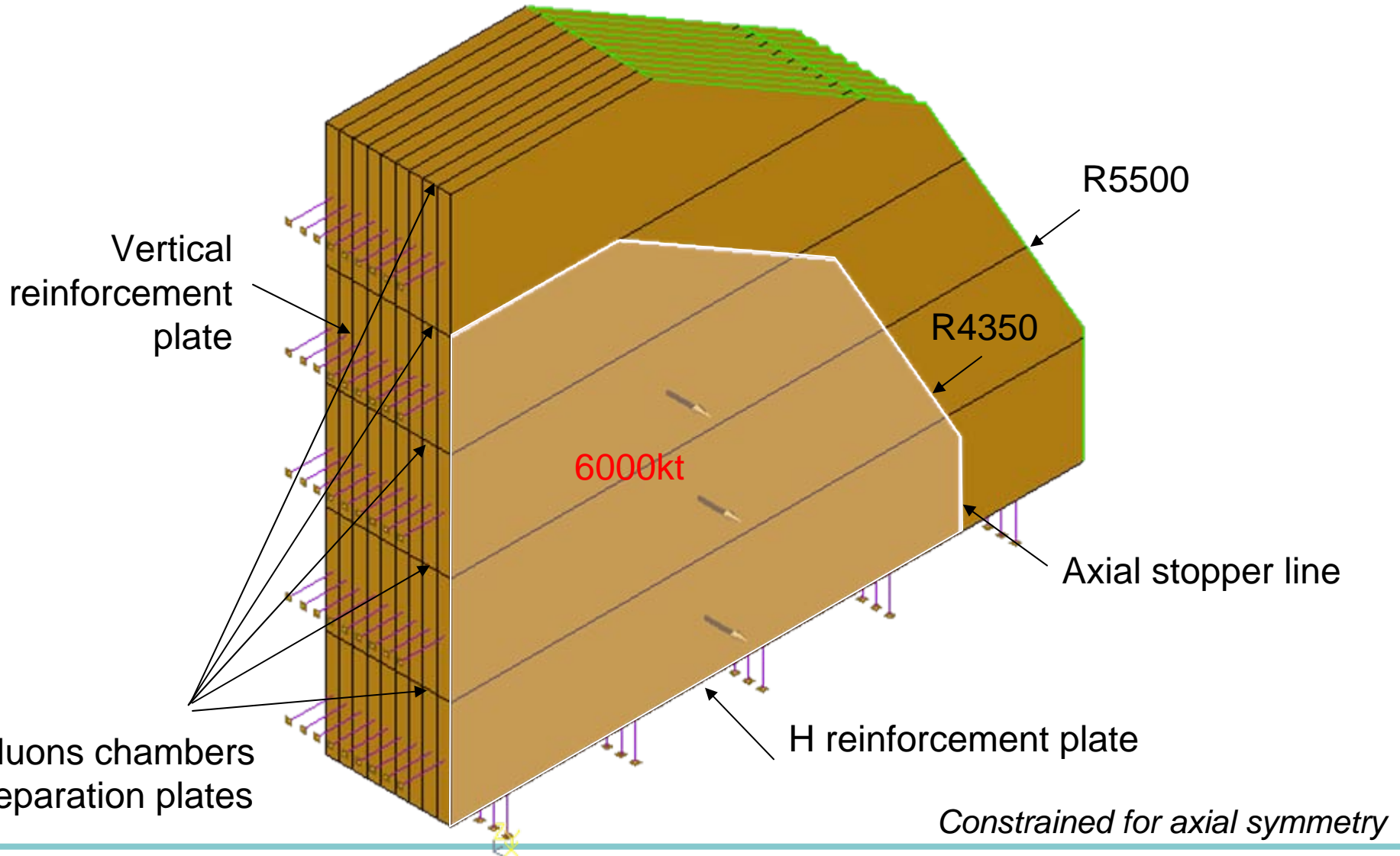- Mesh average dimension = 130mm (gap between 100mm layers)

# Quarter EndCap design

- Composed by 4 quarter parts
- Muons chambers slit horizontally
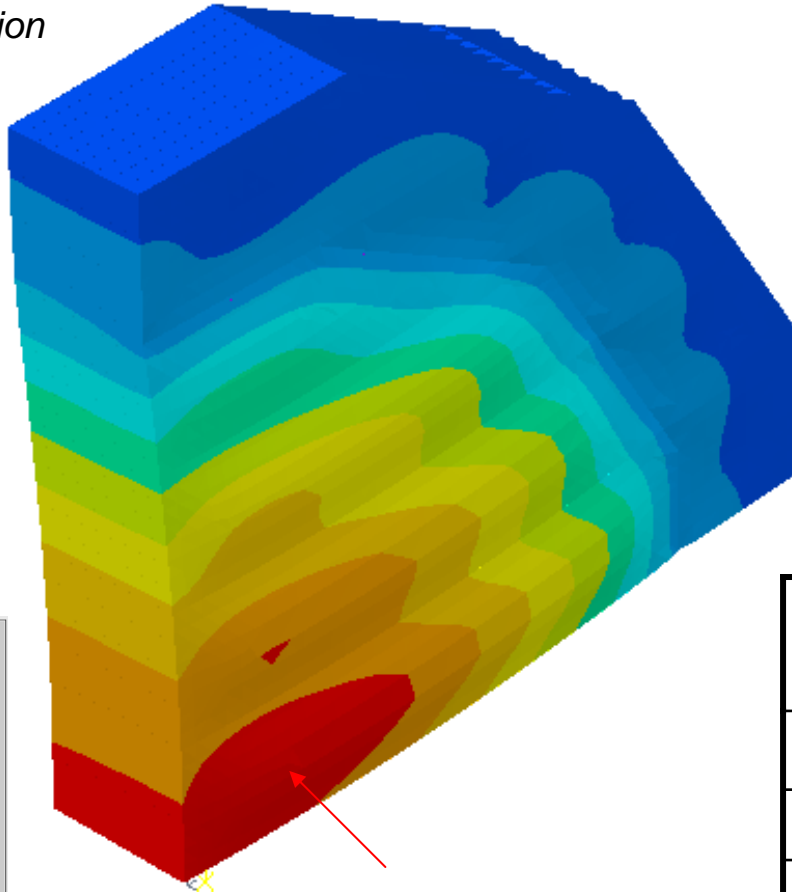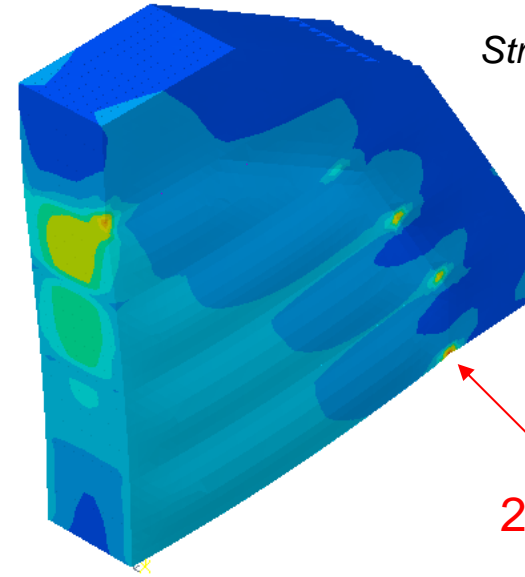- Segmented in 5 muon alveoli

Muons chamber

EndCap stopped
axially on this lign

Vertical reinforcement plate

R5500

R4350

6000kt

Axial stopper line

H reinforcement plate

Muons chambers separation plates

*Constrained for axial symmetry*

# Results

*Deformation*

*Stress*

230 MPa

6.7mm

*For 100mm reinforce plates*
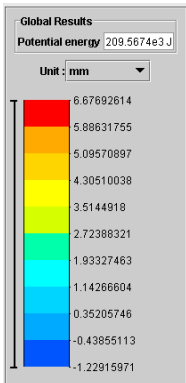
| H/V + between chambers plates thickness | Max deformation | Max stress |
|---|---|---|
| 10 | 30mm | 1300MPa |
| 50 | 9mm | 380MPa |
| 100 | 6.7mm | 230MPa |

Global Results
Potential energy 209.5674e3 J
Unit : mm

6.67692614
5.88631755
5.09570897
4.30510038
3.5144918
2.72388321
1.93327463
1.14266604
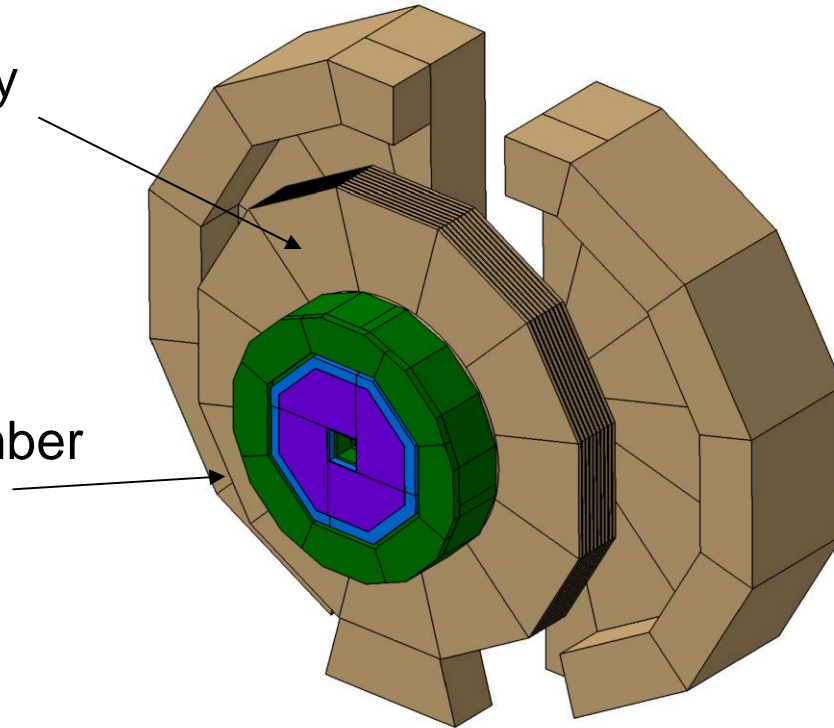0.35205746
-0.43855113
-1.22915971

# DESY petal design

- Segmented in 12 petals
- Separated with reinforcement plate (thickness?)
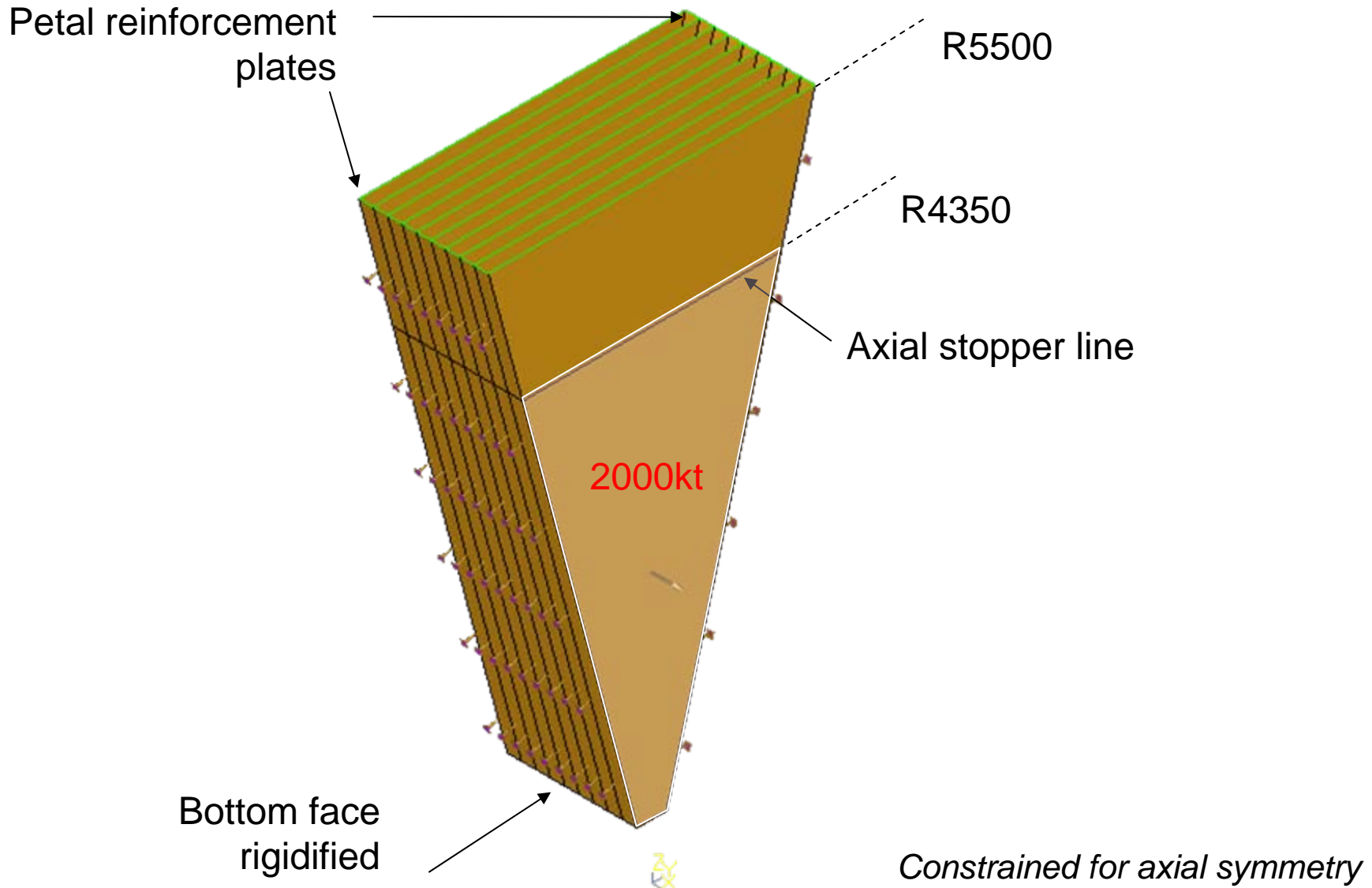- Muon chambers inserted radially
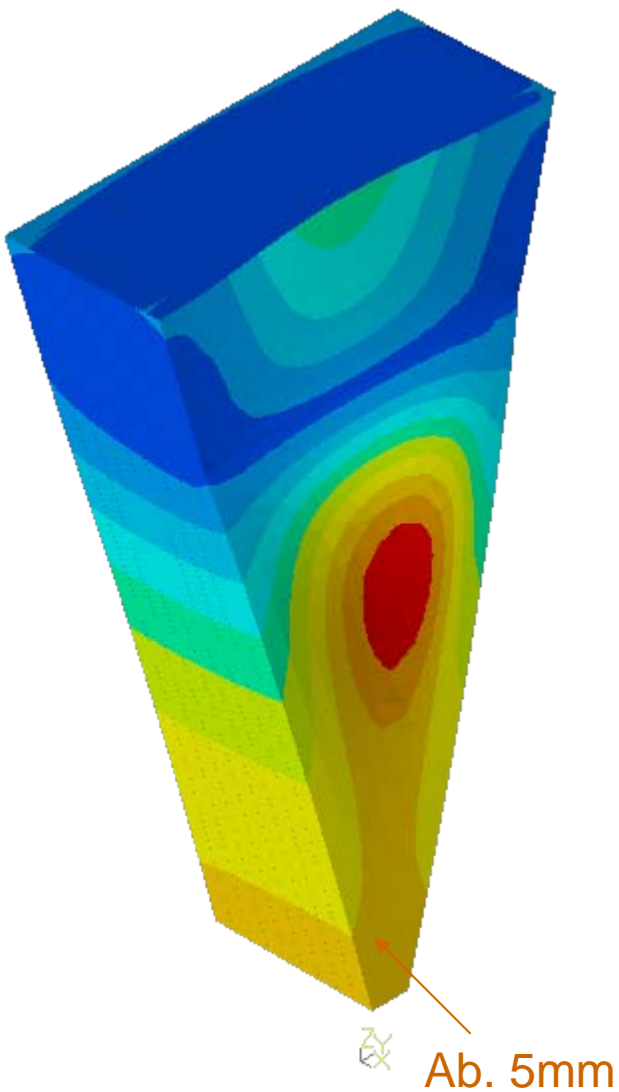
EndCap stopped axially
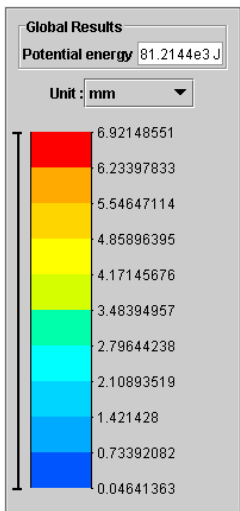at 4350mm radius

Muon chamber

# Petal EC calculation model

Petal reinforcement plates

R5500

R4350

Axial stopper line

2000kt

Bottom face rigidified

*Constrained for axial symmetry*

# Results



*Deformation*

*Stress*

**270 MPa**

**Global Results**

Potential energy 81.2144e3 J

Unit : mm

6.92148551
6.23397833
5.54647114
4.85896395
4.17145676
3.48394957
2.79644238
2.10893519
1.421428
0.73392082
0.04641363

Ab. 5mm

*For 100mm reinforce plates*
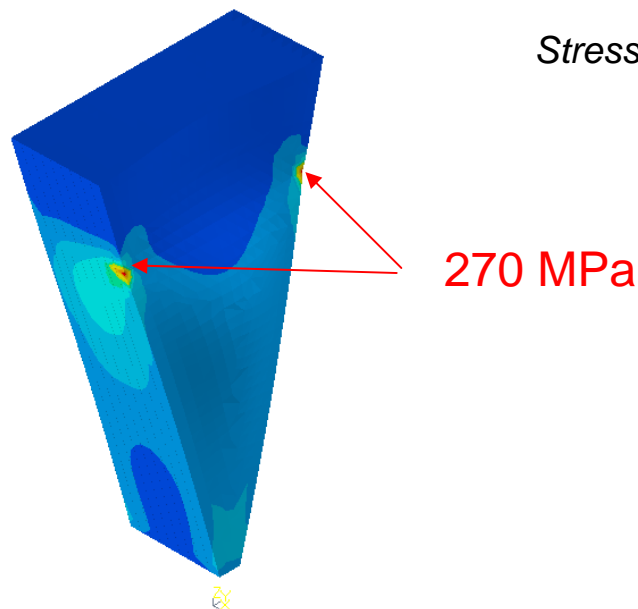
| Petal plates thickness | Max deformation | Max stress |
|---|---|---|
| 10 | 20mm | 920 MPa |
| 50 | 8.3mm | 400 MPa |
| 100 | 6.7mm | 270MPa |

# Conclusions

- 10 thin muon layers seem to be mechanical achievable

- Similar behavior between concept with large reinforce plates

- Still about 6mm deformation :
  - **Not so important**
  - **CMS has about 14mm displacement**

- Important stress at local point :
  - **Increase again the thickness ?**
  - **A calculation artifact?**

- Many difference between DESY calculations which need to be understood :
  - **Supporting method?**
  - **Using of the back part of the EC ?**
  - **Influence of the FSP**
  - **…**