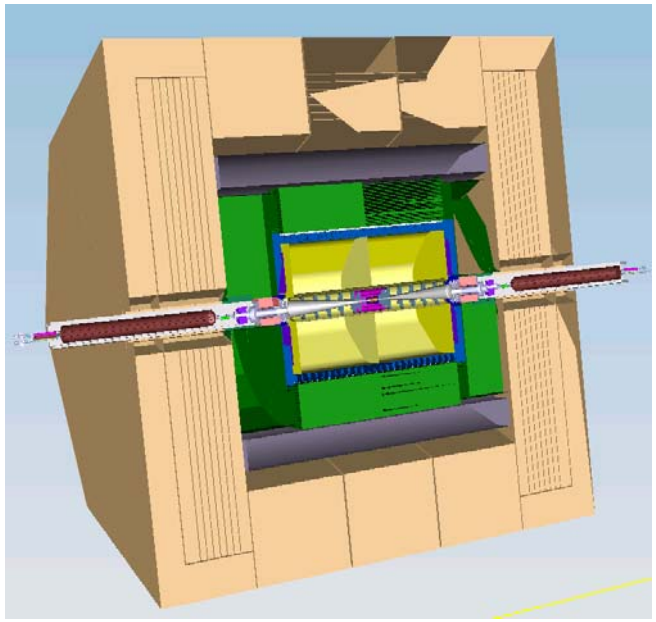
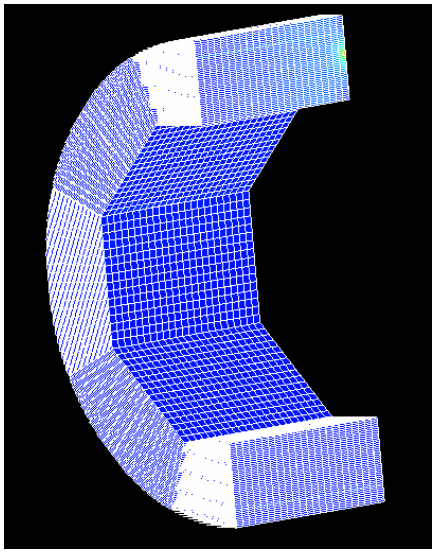
ILD HCAL
Mechanical Integration
HCAL Main Meeting



Kirsten Kschioneck,
DESY

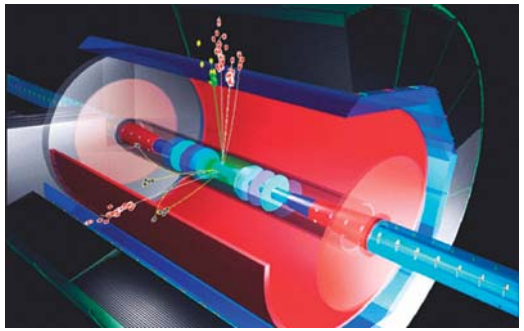


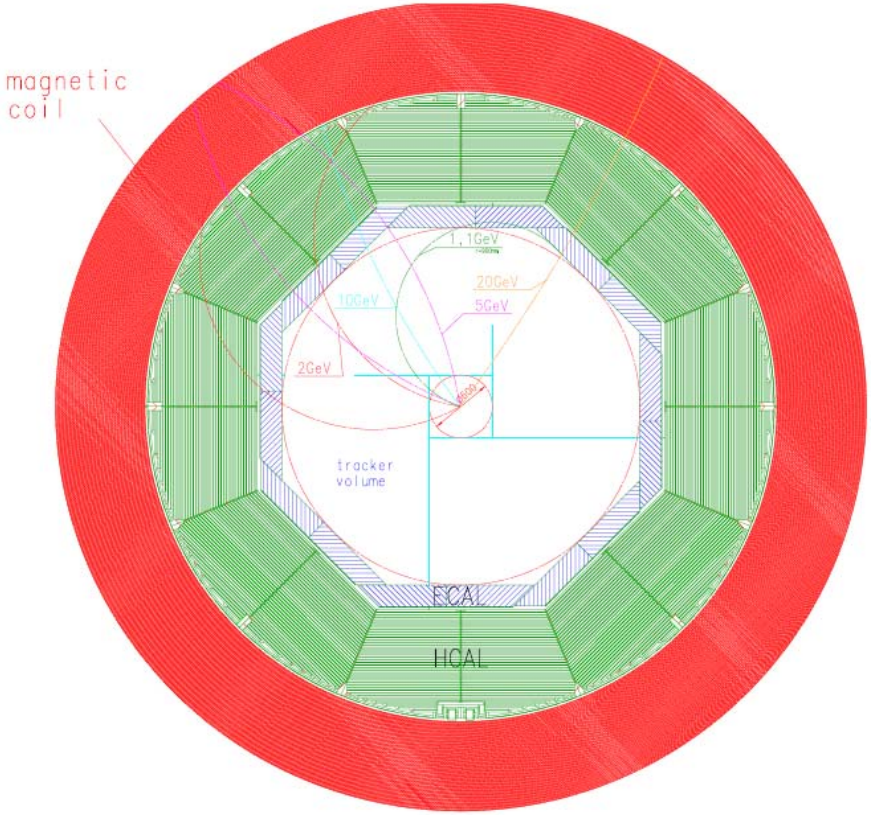
Overview

- ⇨ Principle of mechanical concept
- ⇨ Results of FEM calculation
- ⇨ Impact of results for the concept

ILD detector

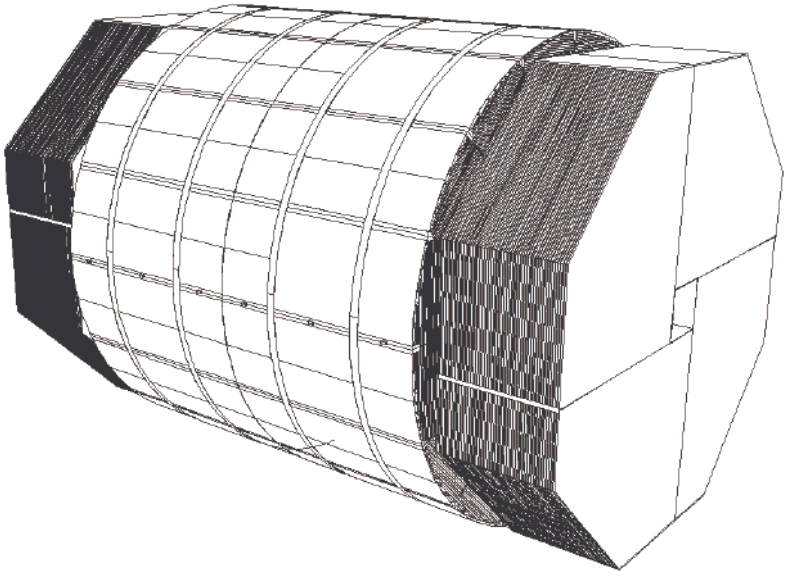
-Mechanical concept-

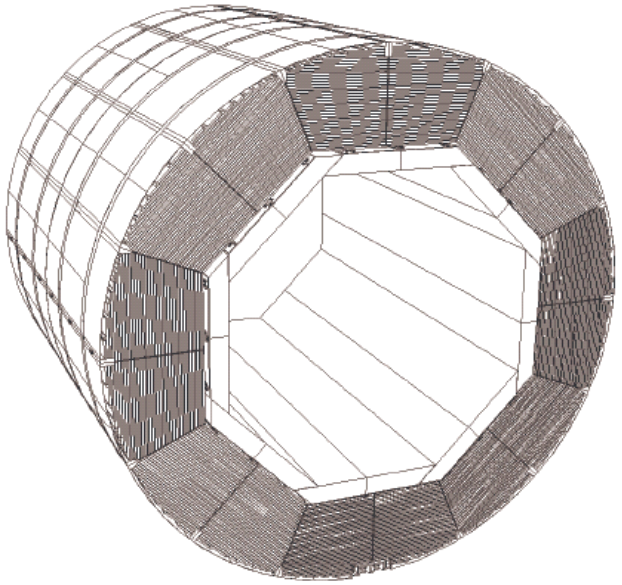




- TESLA/ ILD detector:
  Similar absorber structure
- TESLA concept existed:
  learning from TESLA concept

Calorimeter barrel

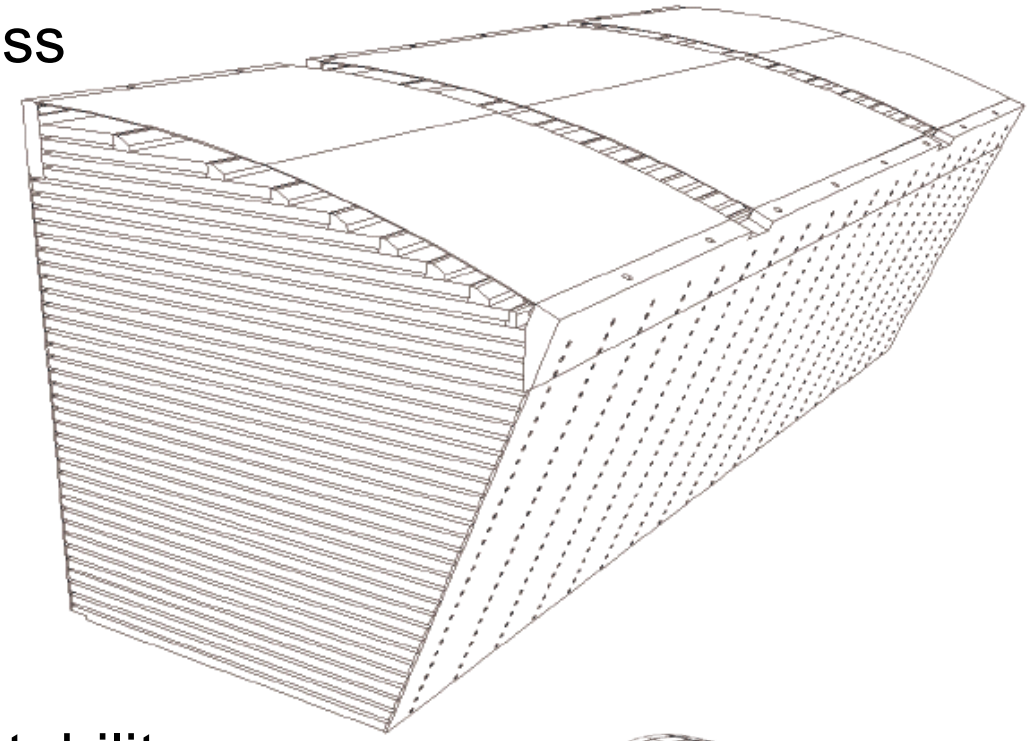




- Height/ length of barrel: 5.6 m/ 4.6 m
- Weight of one module: ≈ 14 t
- Weight of HCAL: ≈ 450 t
- Weight of HCAL + chambers + ECAL: ≈ 790 t

Calorimeter module

⇨ Side panel: 3 mm thickness
⇨ Screw size: M6

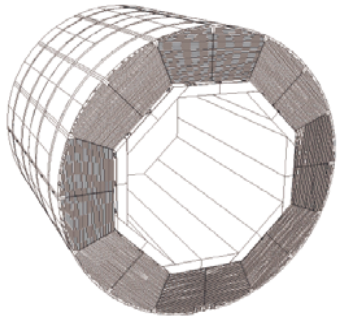


<u>Advantage</u>

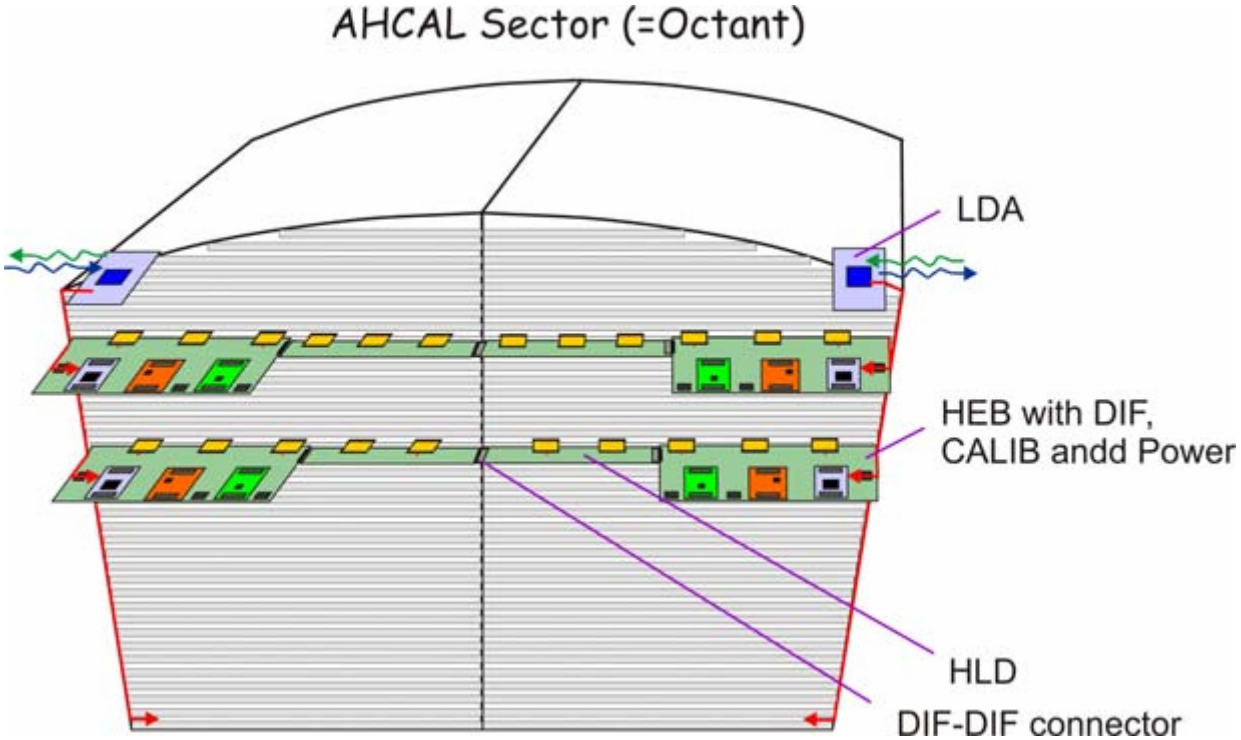
• Slim support structure (small amount of φ-cracks)

<u>Disadvantages</u>

• Uncertainties regarding stability
• High tolerance requirements (e.g. holes for screws, flatness of absorber plates)

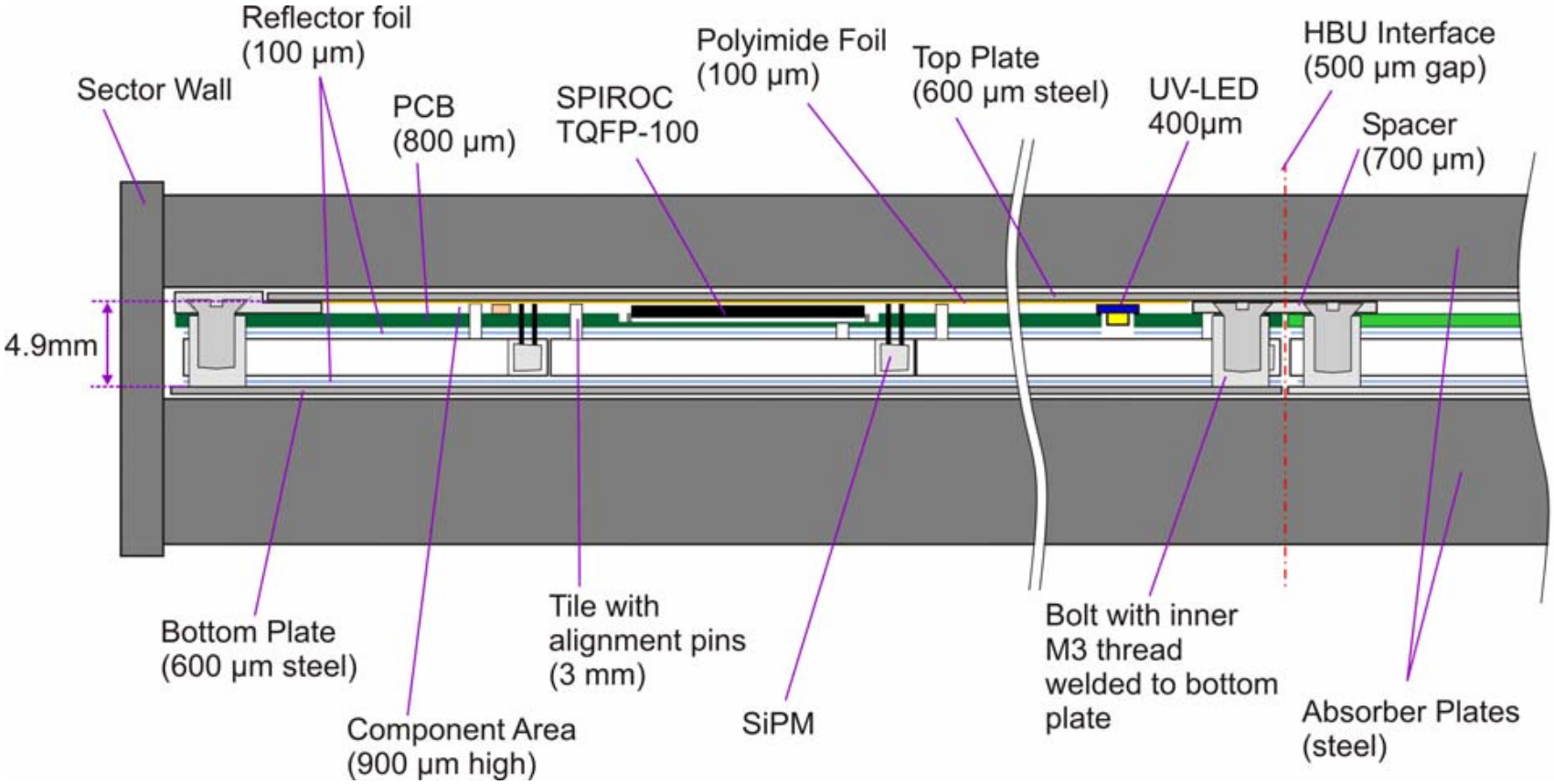


Octant with chambers



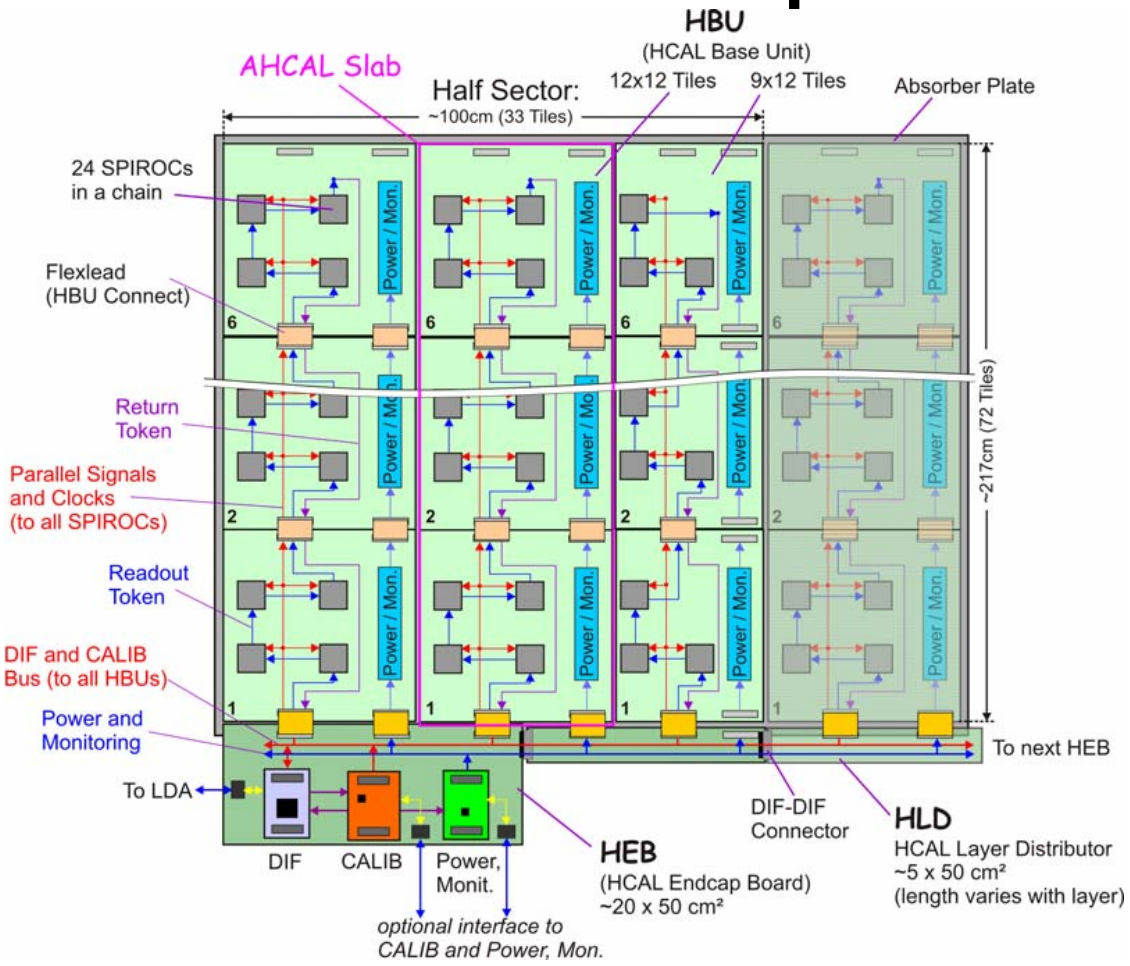
(M. Reinecke)

Chamber cross section



(M. Reinecke)

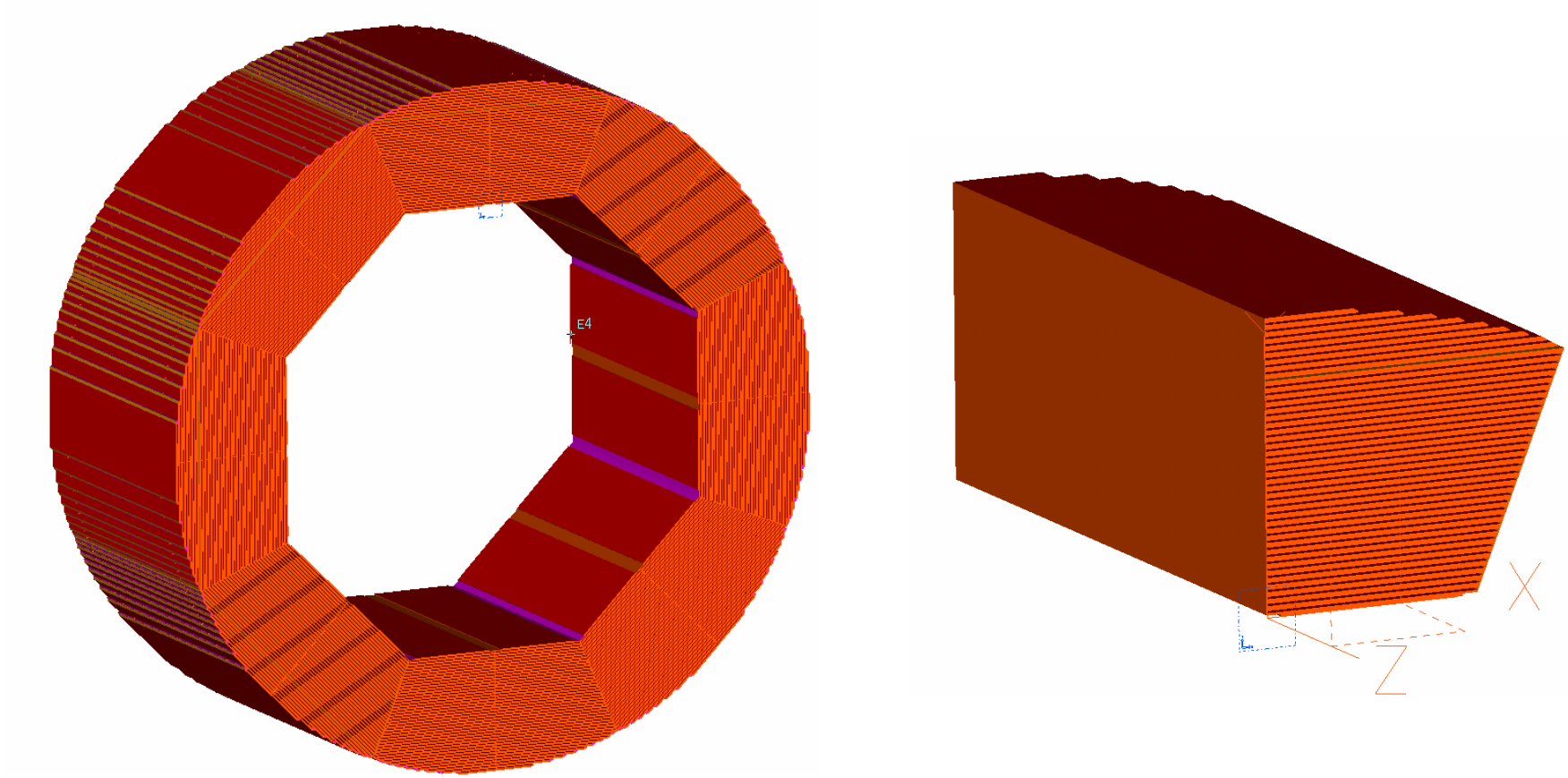
Chamber topview



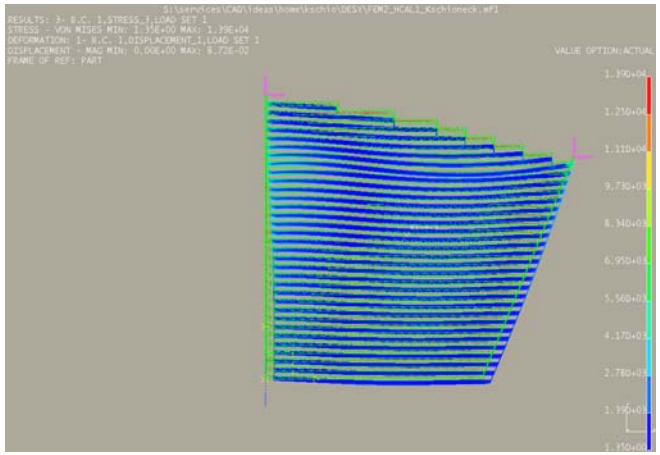
(M. Reinecke)

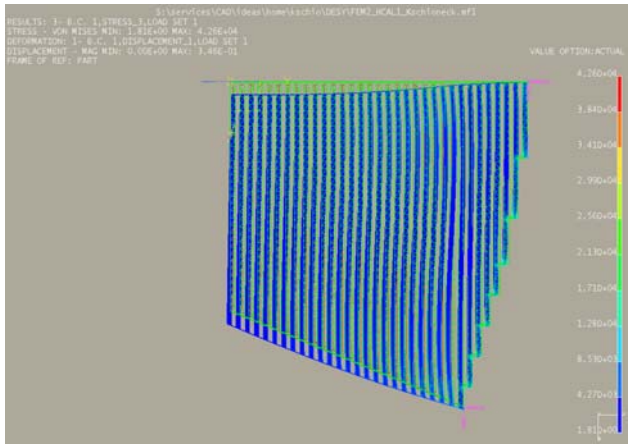
FEM calculation

-16 modules-



HCAL module





Horizontal hanging

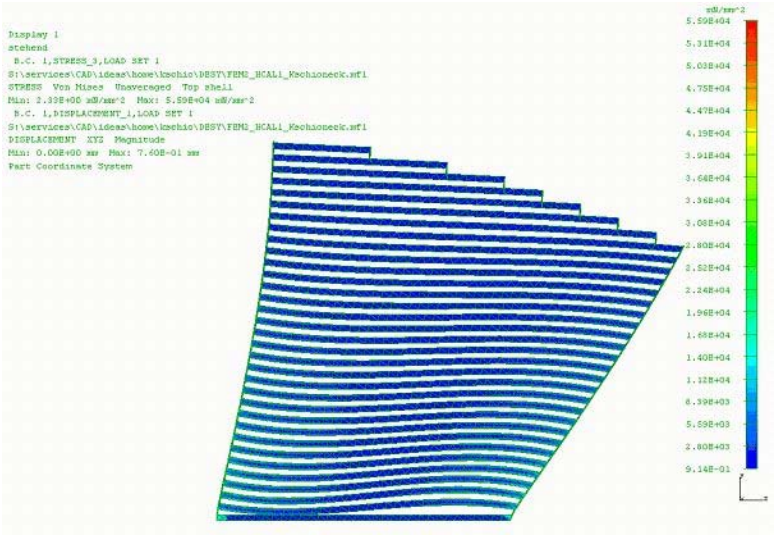
Maximum deformation: 0.09 mm

Maximum stress (von Mises): 13.9 N/mm²

Vertical hanging

Maximum deformation: 0.35 mm

Maximum stress (von Mises): 43 N/mm²

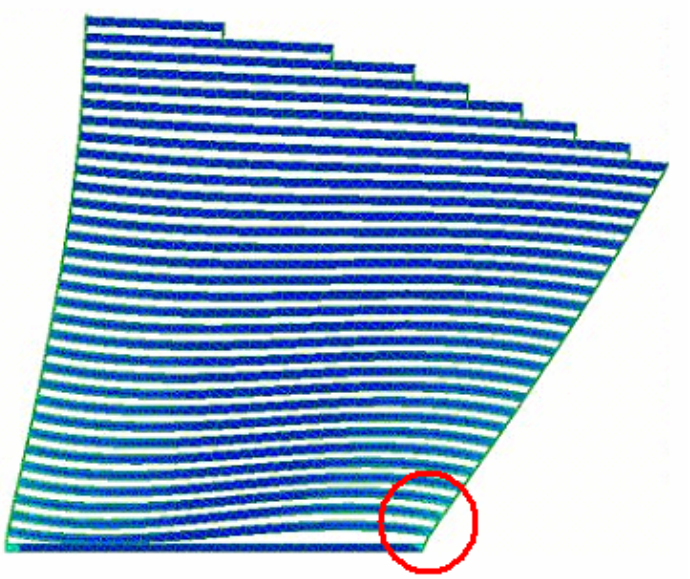


Module standing

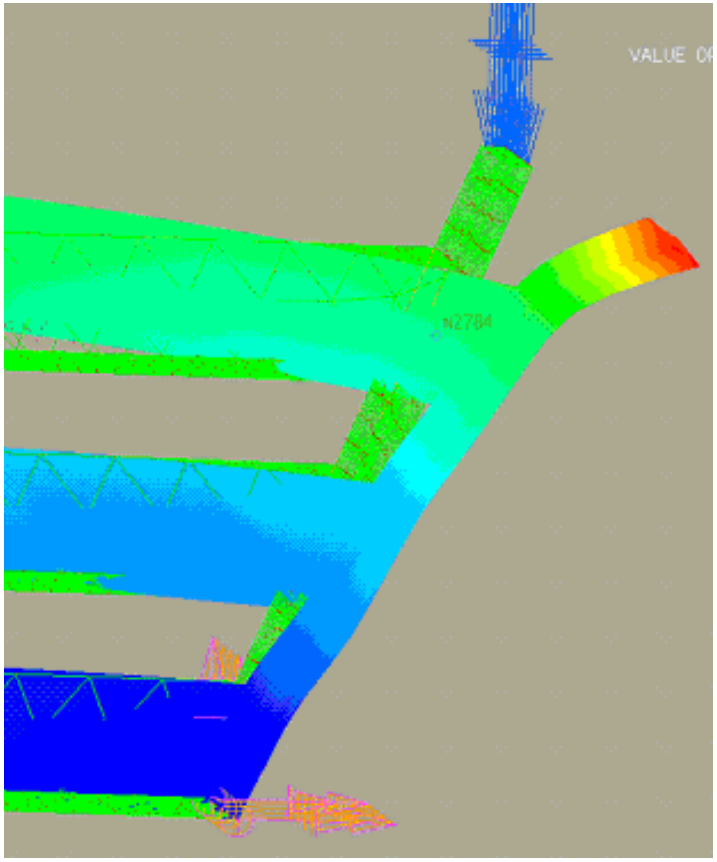
Maximum deformation: 0.7 mm

Maximum stress (von Mises): 60 N/mm²

How are these positive results possible?



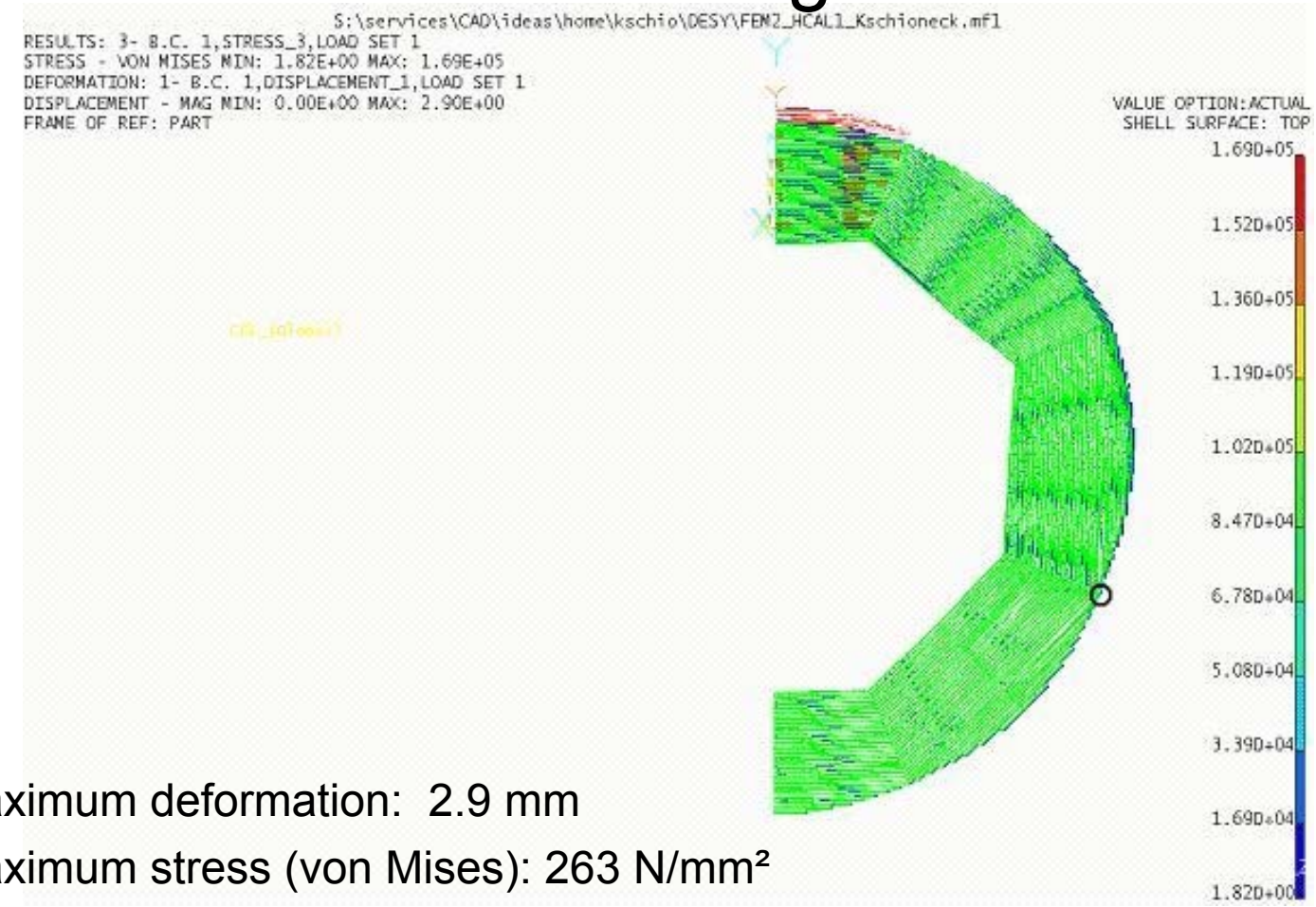
compression ↔ tensile



Barrel
-Standing-

Barrel

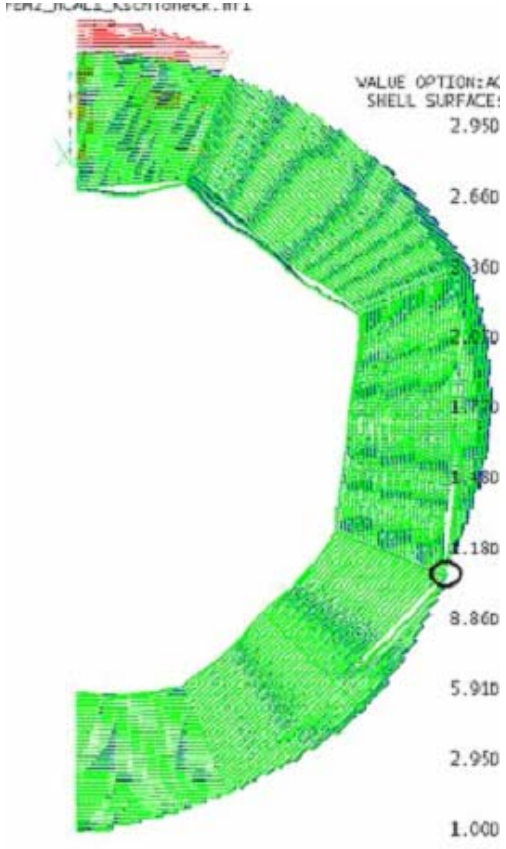
-fixation/ including chambers-

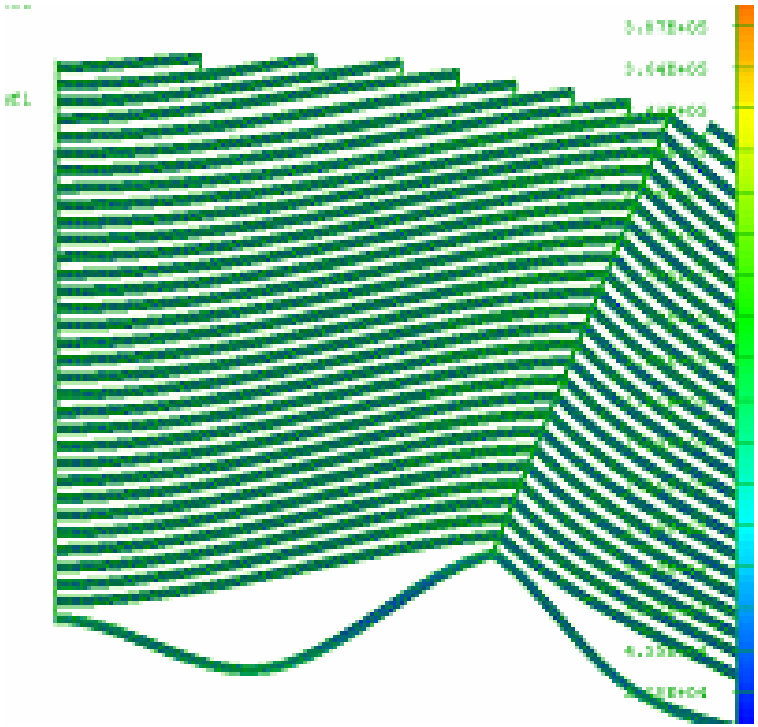


Maximum deformation: 2.9 mm

Maximum stress (von Mises): 263 N/mm²

ECAL: weight load in one line





Maximum deformation: 6.18 mm

Maximum stress (von Mises): 295 N/mm²

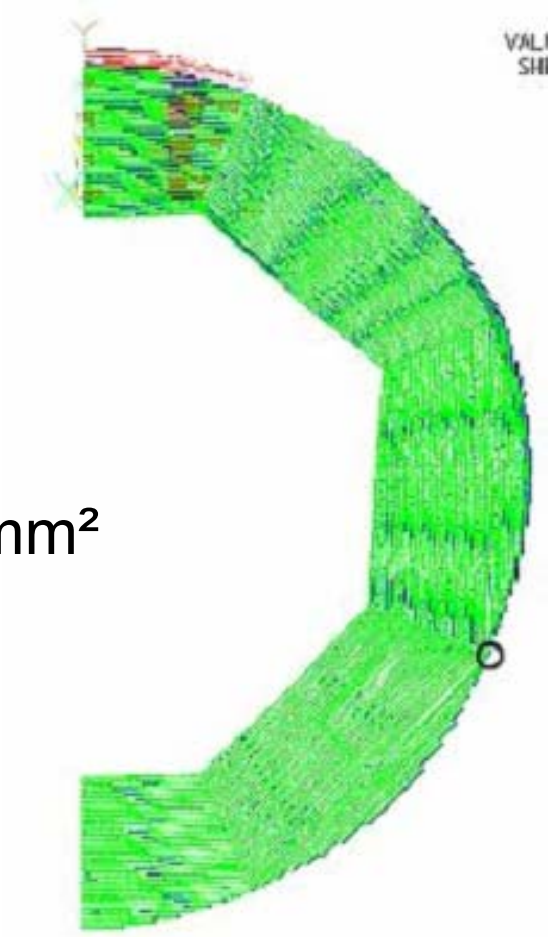
Brass

<u>Brass CuZn38Pb2</u>

Maximum deformation: 6.35 mm

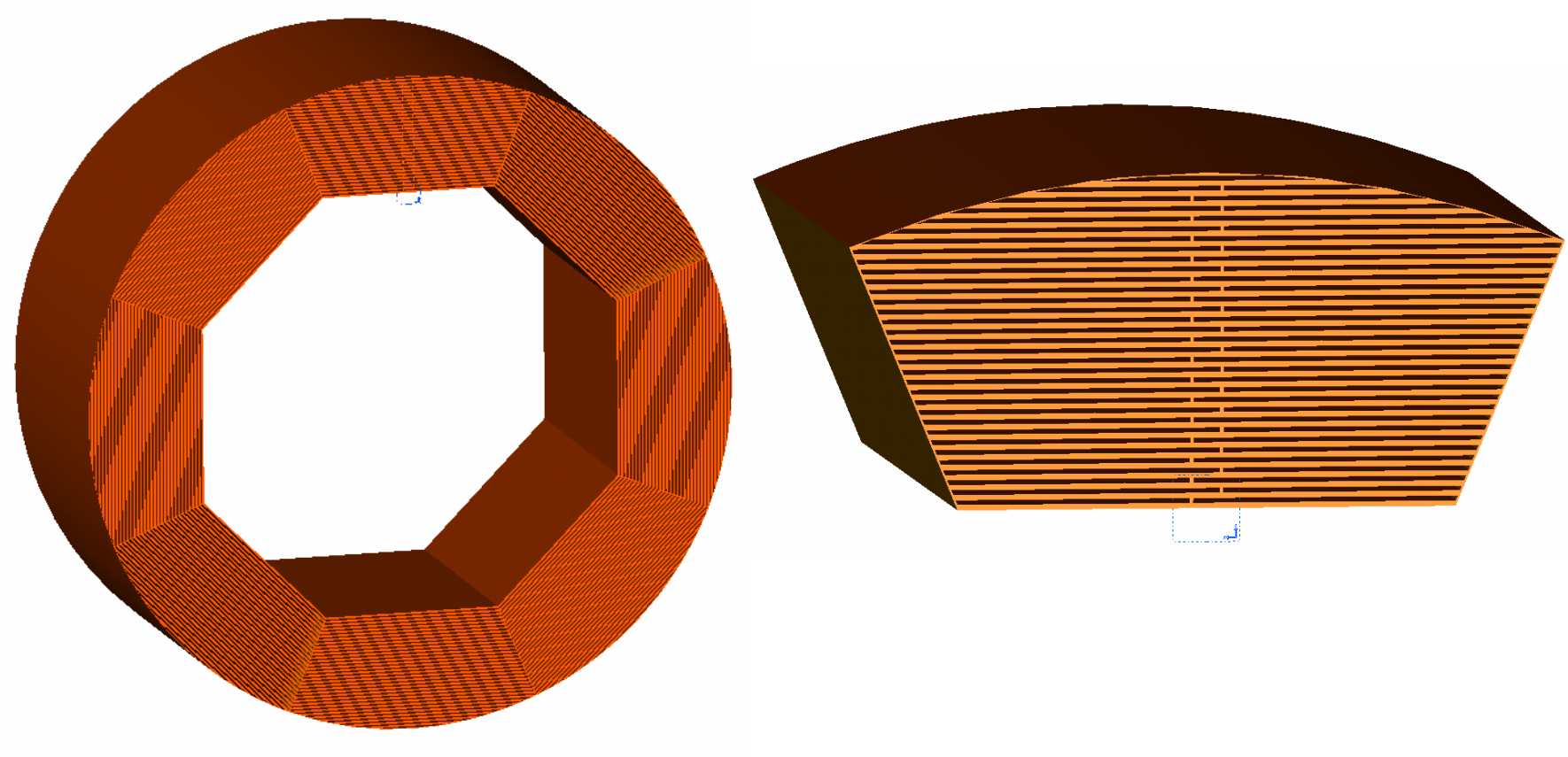
Maximum stress (von Mises): 183 N/mm²

(Steel: 2.9 mm/ 170 mm²)

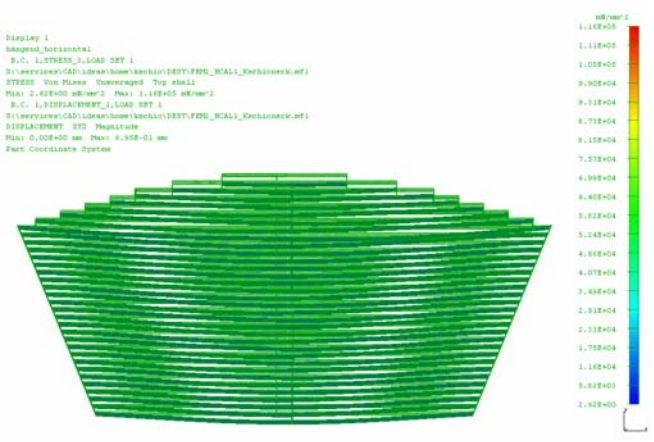


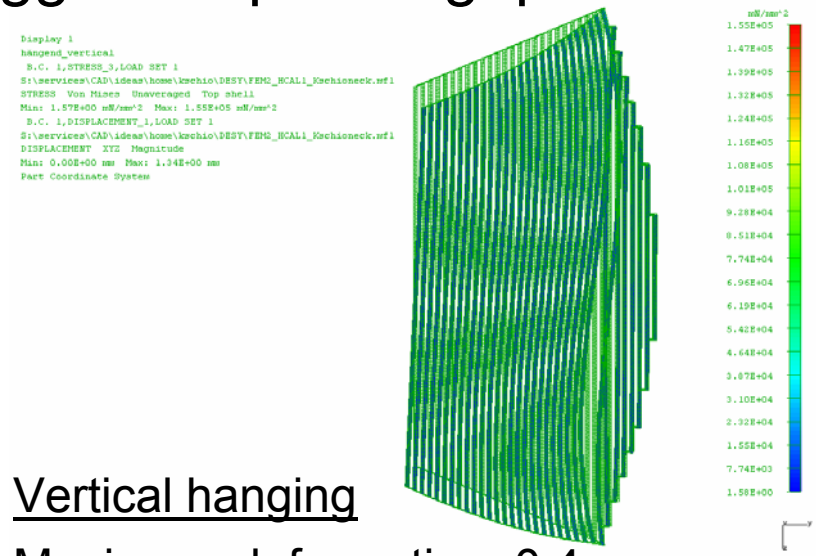
FEM calculation

-8 modules-



HCAL module -with staggered spacer/ gap 7 mm-





Horizontal hanging

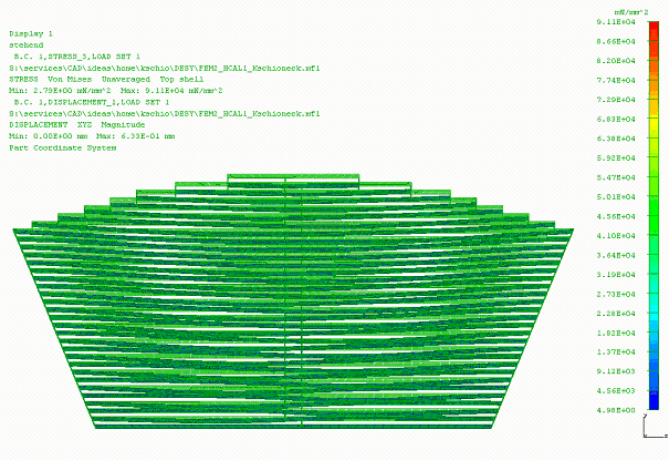
Maximum deformation: 0.7 mm

Maximum stress (von Mises): 116 N/mm²

Vertical hanging

Maximum deformation: 0.4 mm

Maximum stress (von Mises): 97 N/mm²

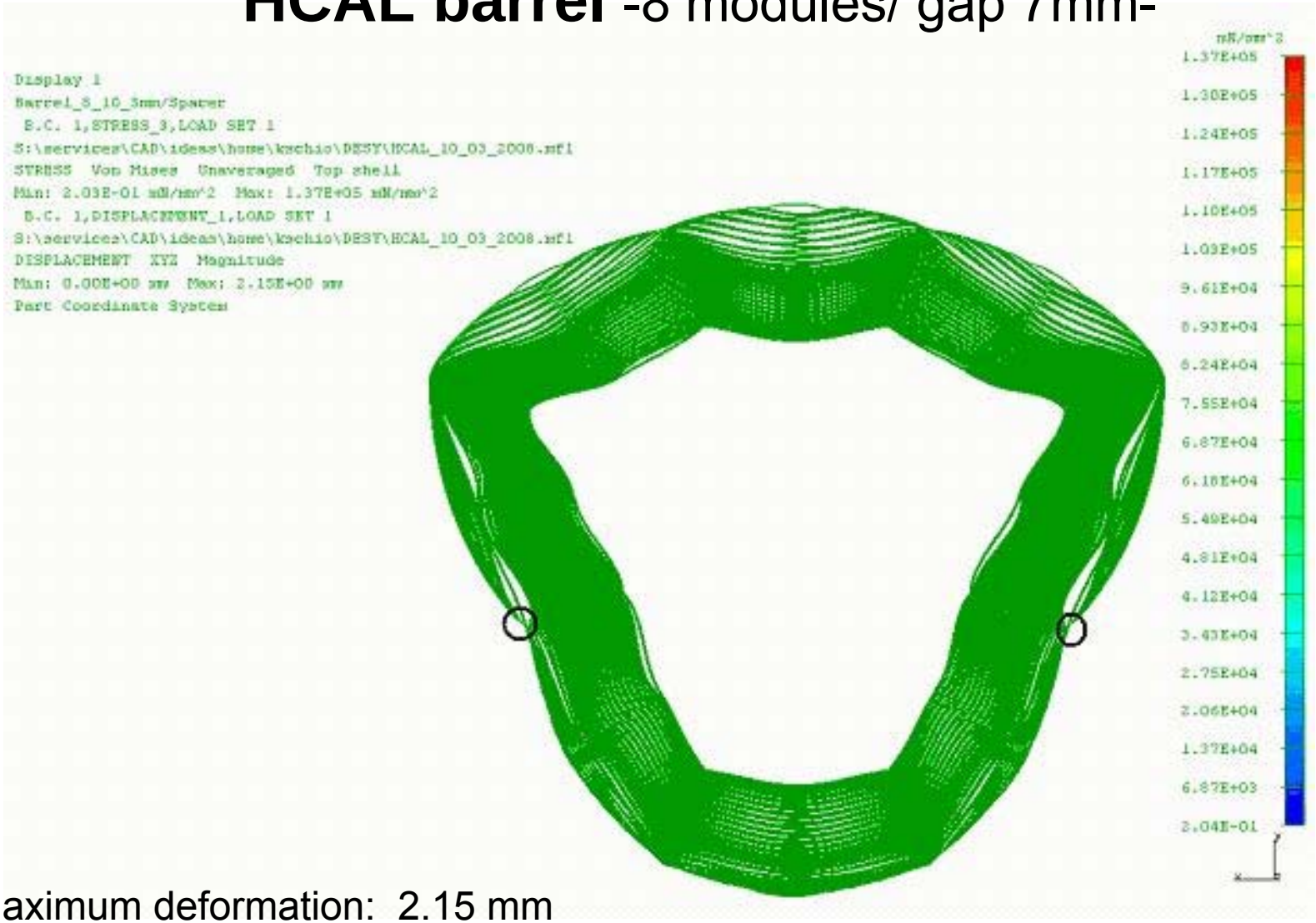


Module standing

Maximum deformation: 0.6 mm

Maximum stress (von Mises): 91 N/mm²

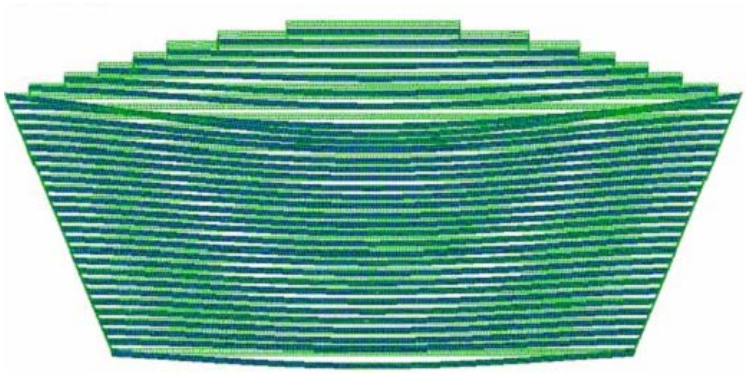
HCAL barrel -8 modules/ gap 7mm-

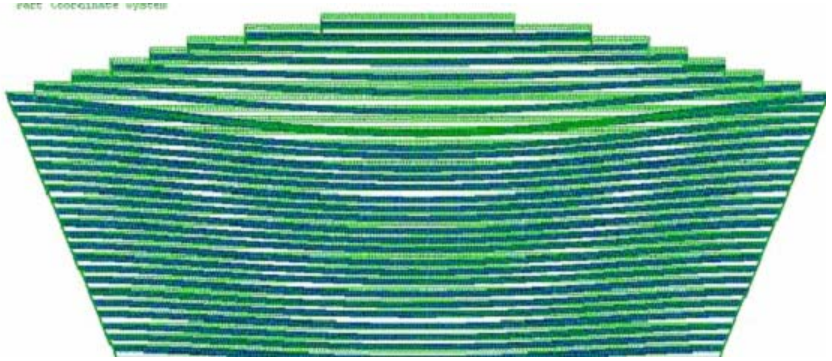


Maximum deformation: 2.15 mm

Maximum stress (von Mises): 115 N/mm²

HCAL module -without spacer/ gap 14 mm-





Horizontal hanging

Maximum deformation: 1.64 mm

Maximum stress (von Mises): 88 N/mm²

Module standing

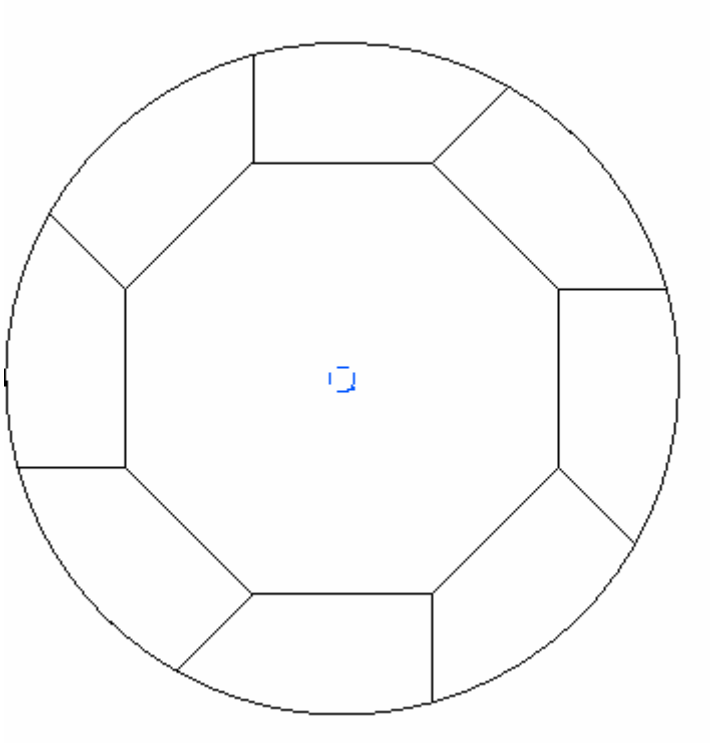
Maximum deformation: 1.38 mm

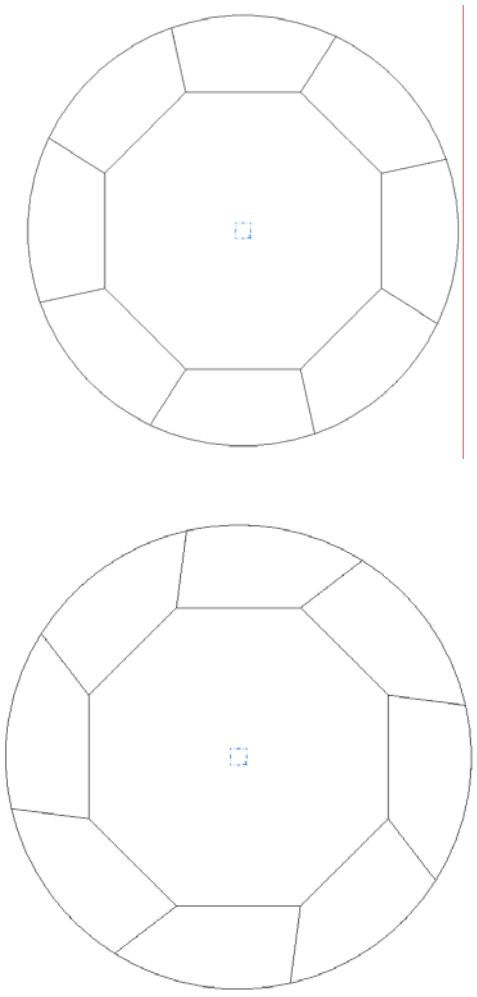
Maximum stress (von Mises): 60 N/mm²

Interesting effect:

⇨ When the side panel changes from 3 to 5 mm, the deformation changes from 1.38 mm to 1.36 mm!

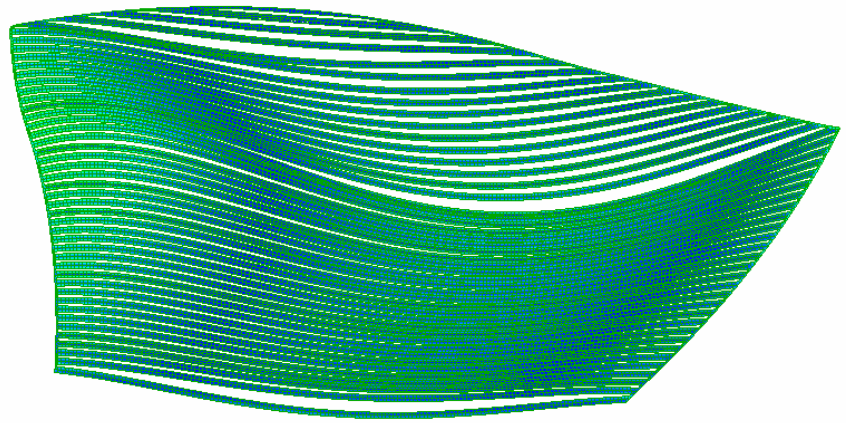
Non-pointing





⇨ From mechanical point of view possible.

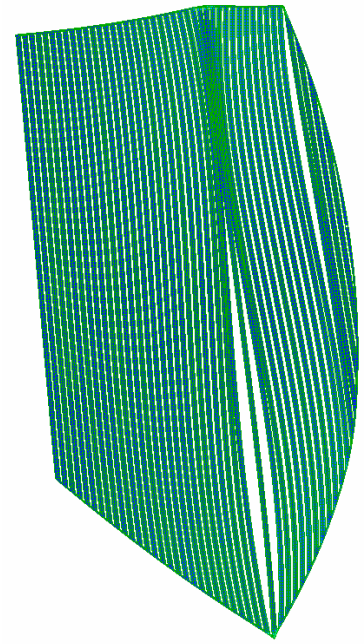
HCAL module -non pointing/ right angle-



Horizontal hanging

Maximum deformation: 1.1 mm

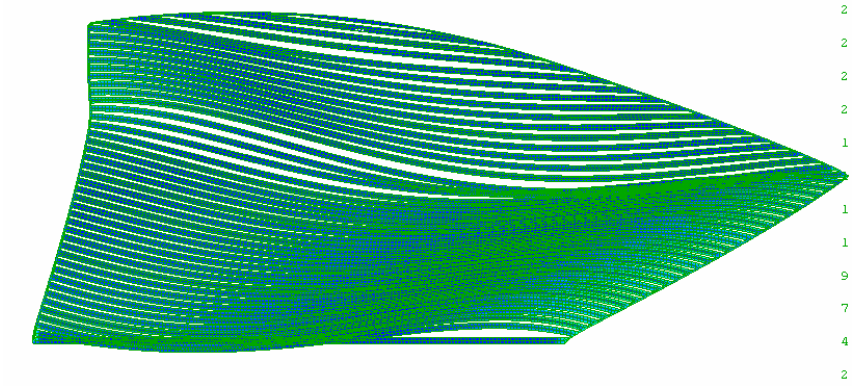
Maximum stress (von Mises): 23 N/mm²



Vertical hanging

Maximum deformation: 5.0 mm

Maximum stress (von Mises): 79 N/mm²

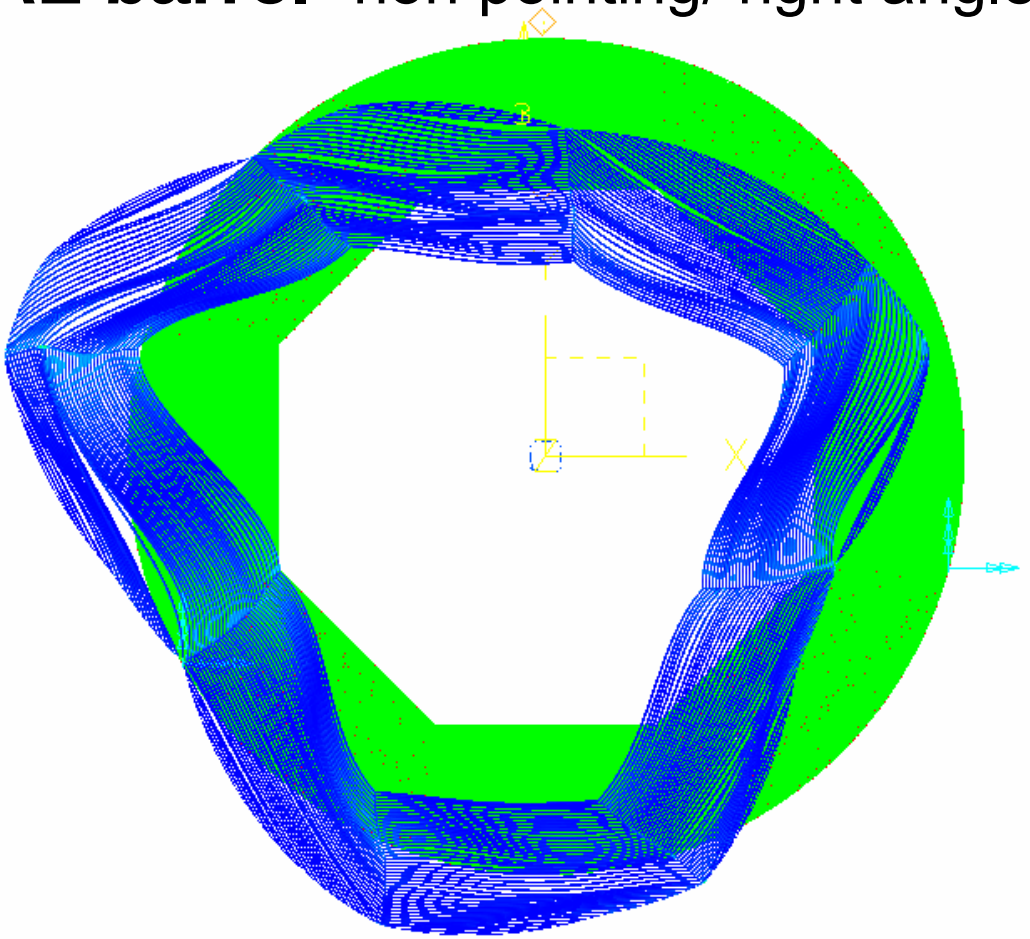


Module standing

Maximum deformation: 1.7 mm

Maximum stress (von Mises): 50 N/mm²

HCAL barrel -non pointing/ right angle-



Maximum deformation: 10.4 mm

Maximum stress (von Mises): 158 N/mm²

Effects of changed parameter

	displacement	stress
Bigger side panel (3 mm → 5 mm):	↓	↓
Spacer no → yes	↓	↓
From steel to brass:	↑	↑
Smaller gap (14 mm → 7 mm):	↑	↓
Pointing yes → no	↑	↑

↑: big change
↑: moderate change
↑: small change

Next steps

- Define more detailed design: module connection, support of HCAL inside the cryostat etc.
- Think about design and production of a model

Conclusion

- Calculations were made for a wide range of possibilities
- Concept in general is possible but challenging
- Concept is adaptable for different requirements (material; pointing/ non-ponting etc.)