# ILC / ILD TPC

## status of the support mechanics

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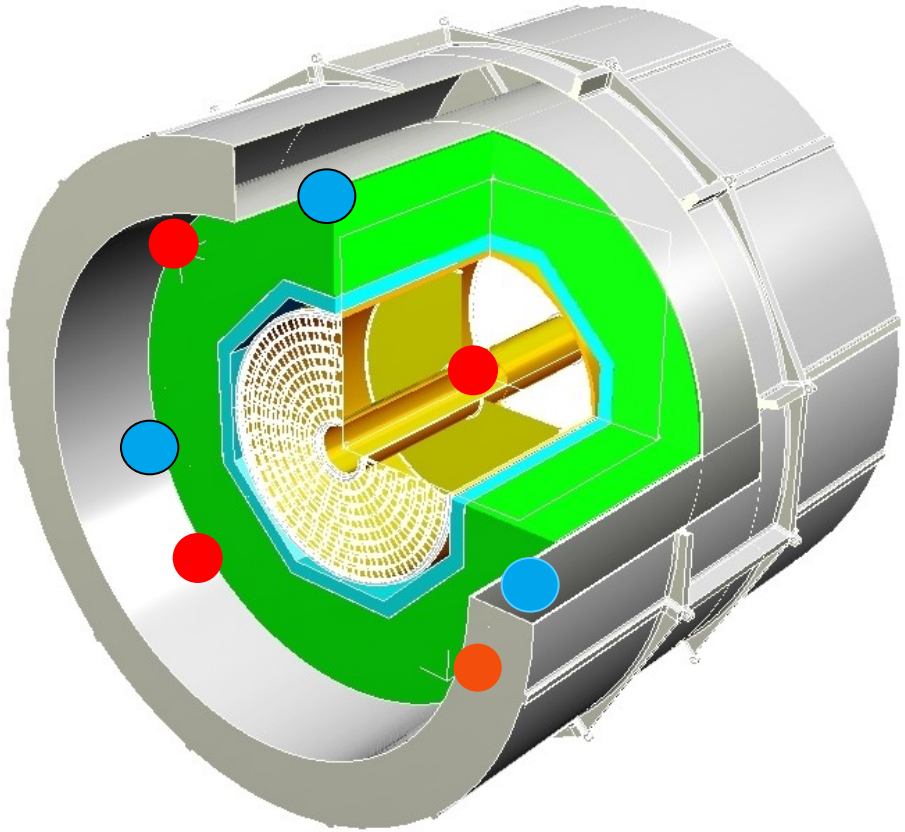
DESY

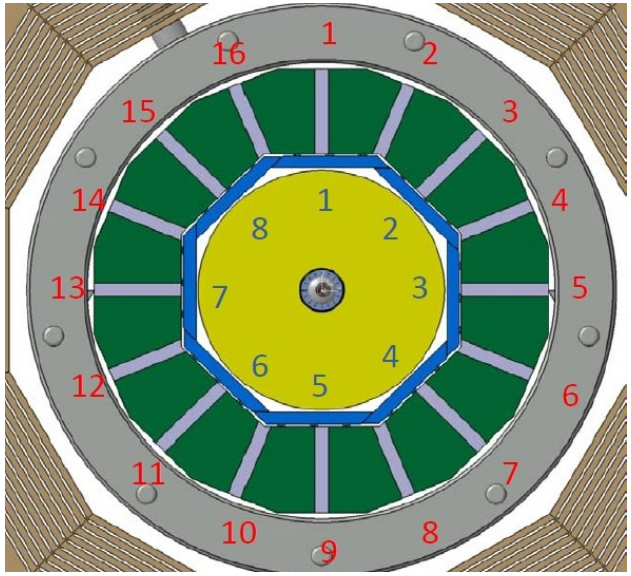
# Overview

- Fixing points of the TPC support structure
- Pros and cons of various fixing points
- Requirements of the TPC support structure
- Estimated acceleration and forces
- Dimensions of the support structure
- FEA analysis and calculation
- Design of the support structure
- TPC installation
- Conclusion and outlook

# Fixing points of the TPC support structure



Main dimensions of the TPC (outside)
Ø Od = 3616, r=1808
Ø Id = 658, r=329
Length = 4700 incl. endplate and cabling




3 Point 3x120°, preferred gaps: 1,12, 6

4 Point 4x90°, preferred gaps: 3, 15, 11, 7 but this gaps filled 100%

Only the cryostat is foreseen to support the TPC

# Pros and cons of various fixing points

| | HCAL | Cryostat |
|---|---|---|
| 3x120° | - Accuracy<br>+ Shorter support structure<br>- HCAL deformation<br>- Seismic stability | + Accuracy<br>- Longer support structure<br>+ Cryostat deformation<br>- Seismic stability |
| 4x90° | See above<br>+ Seismic stability<br>- More space required | See above<br>+ Seismic stability<br>- More space required |
| | | |

# Requirements of the TPC support structure

**The support structure has to be fulfill the following tasks**

- Non-magnetic material
- Low thermal expansion coefficient
- Robust system in x,y,z,

} Carbon fiber structure preferred

- Accuracy and stability has to be constant over the lifetime
- Earthquake-safe system
- Short support structure (more a wish than a realistic option)
- Vibration absorption in Z direction
- Required accuracy 100 µm or better for Vertex, SIT, FTD !
- Min free space of 10 mm in all directions ! Gaps !



DESY

# Estimated acceleration and forces

Values of basic peak acceleration $a_0$ [m/s$^2$]

North site
$A_0 < 1.5$ m/s²

South site
$A_0 < 1.0$ m/s²

For the proposed Japanese sides

Please have a look at the talk from **O. Ferreira, LLR Ecole Polytechnique**
http://ilcagenda.linearcollider.org/conferenceDisplay.py?confid=5524.

TPC weight for calculation: 2000 kg >20000 N (Incl. FTD, SIT, Vertex)

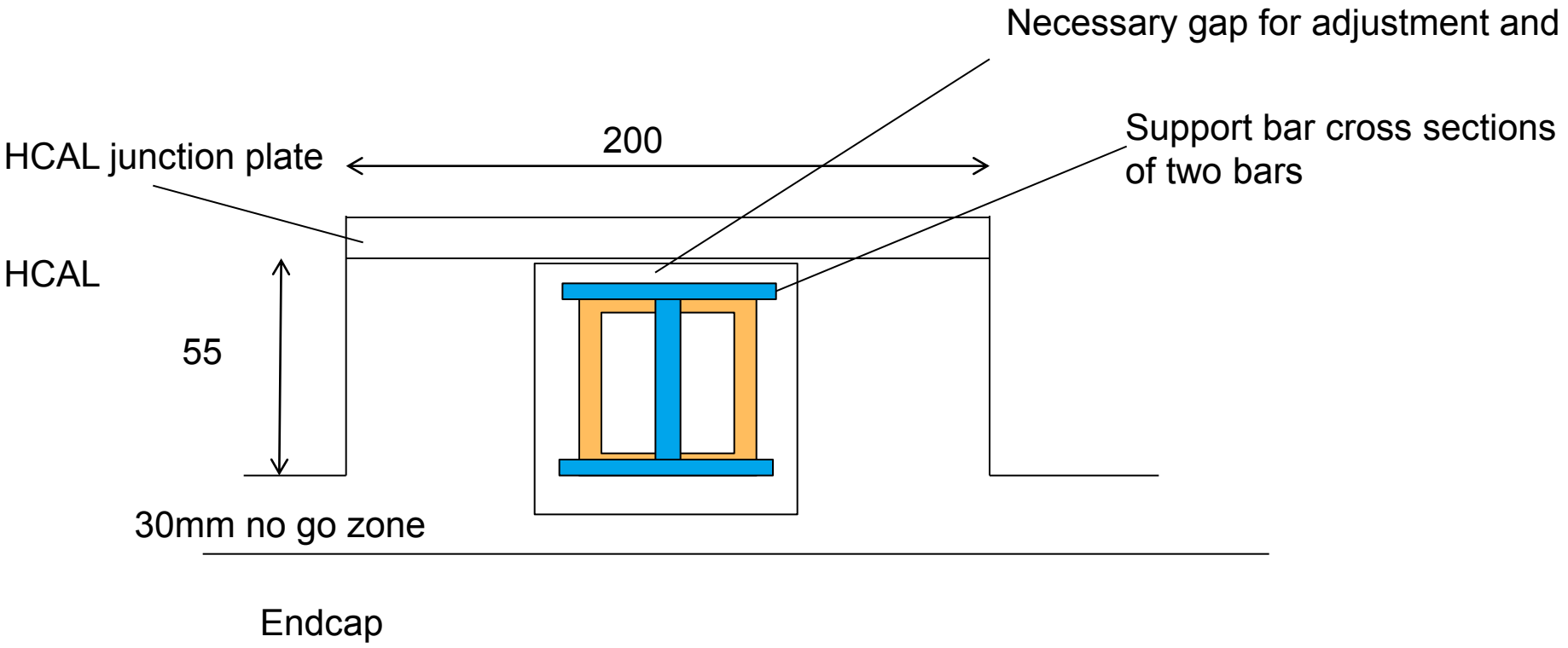
Seismic load force: 3000 N in x,y,z calculated with $A_0 < 1.5$ m/s²

The additional force load in longitudinal direction of the bar support should not be an issue.

Question: Which maximal amplitude can be accepted ?
An max. deflection of 1mm will be the aim

# Dimensions of support structure

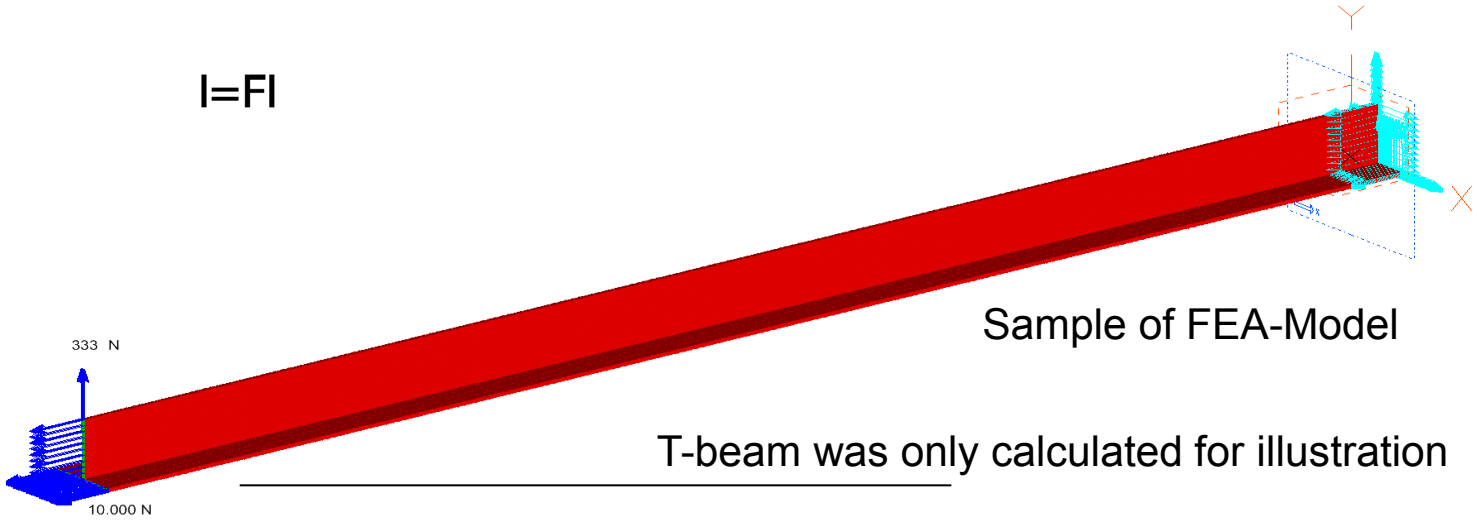
Gap size: in Z direction = 55mm, circular = 200
The 30mm “ no go zone” will be used only in a worst case




An cantilever design is only possible if minimum of 4 gaps can be used

# FEA analyses and calculation

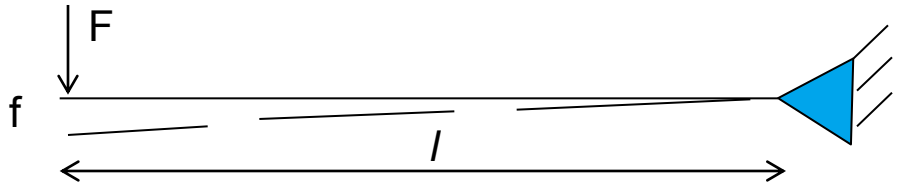
I=FI




Sample of FEA-Model

T-beam was only calculated for illustration

T-beam may have a buckling problem, the current model only provides basic properties.
The next calculation will be done with an rectangluar or squared hole profile.
Possible profiles will be selected with a max. deflection of *f*=10mm.




I= moment of inertia, f= deflection, E= Modulus of elasticity, F= force,
*l*= length of the bar

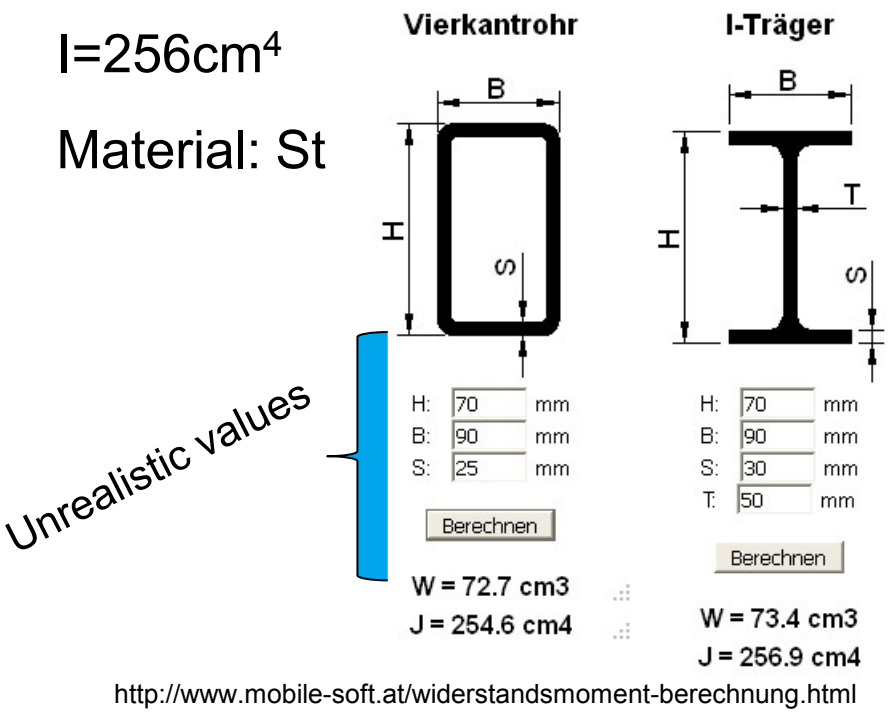
# Design of the support structure

Possible dimensions for an support beam with a deflection of 1mm during load force of 375N in Z-direction

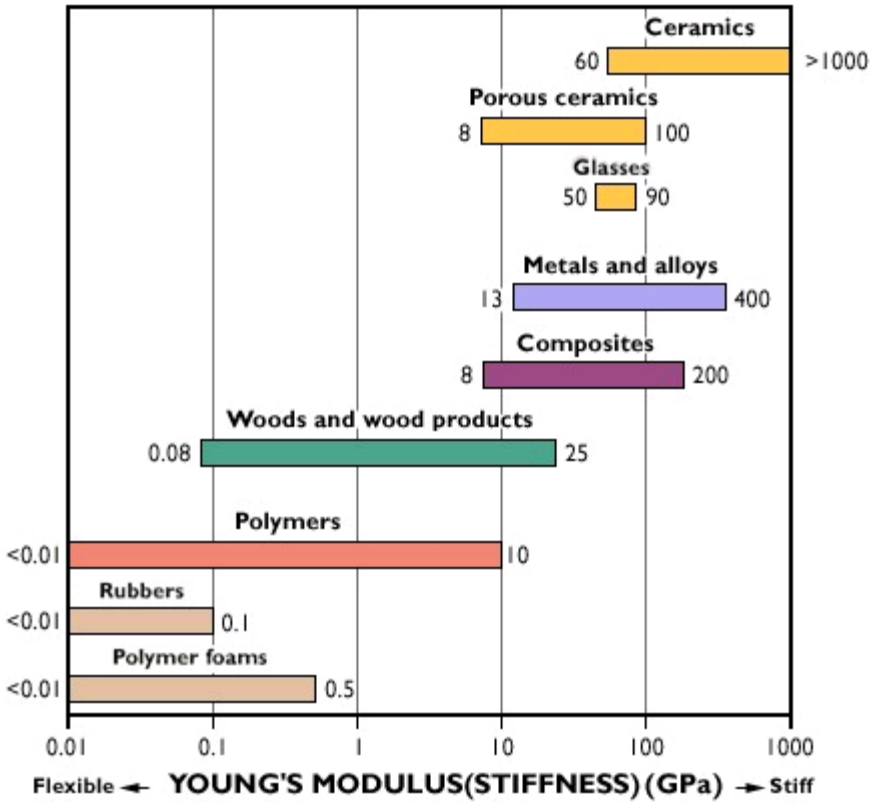
Profile double T-beam

$I=256cm^4$

Material: St



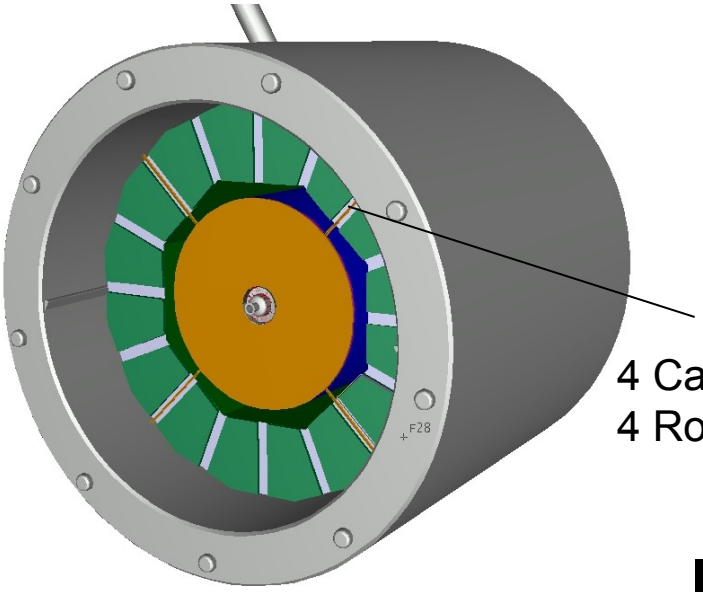

http://www.mobile-soft.at/widerstandsmoment-berechnung.html



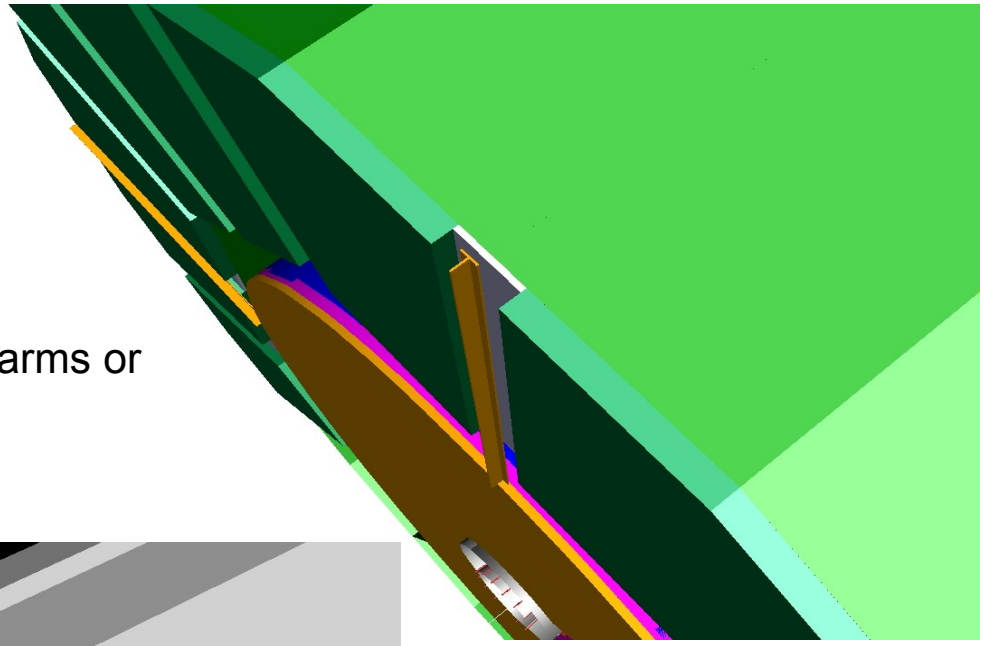

How this issue can be solved?

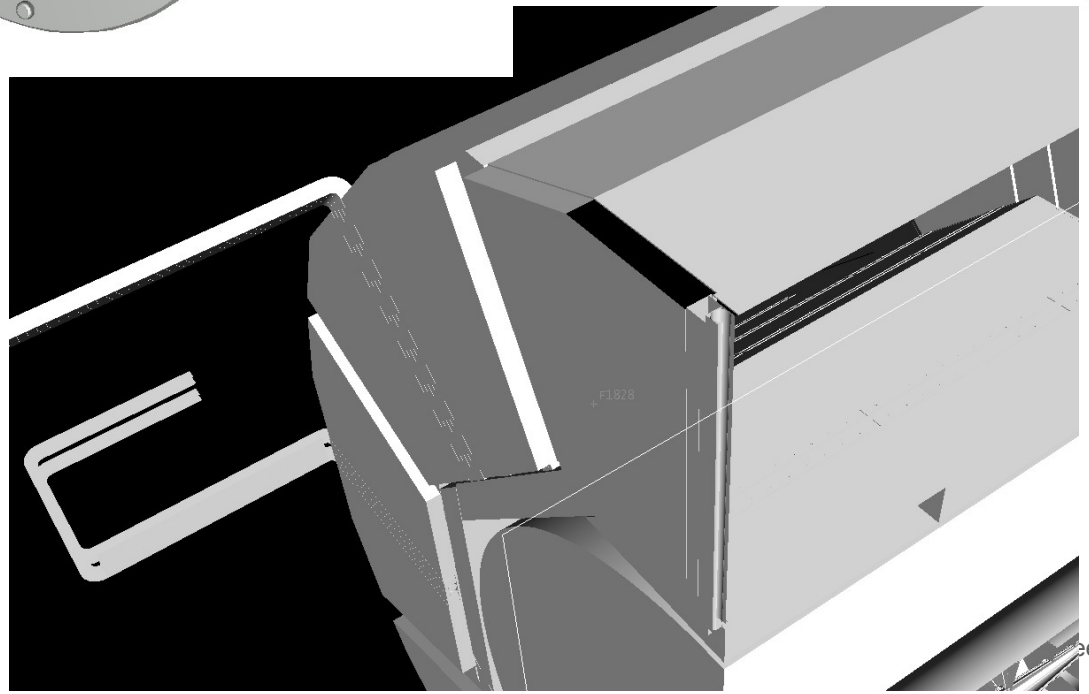
- Different material
- More than 4 bars
- Accept higher value of deflection
- Alternative support

# Design of the support structure



4 Cantilever arms or
4 Ropes

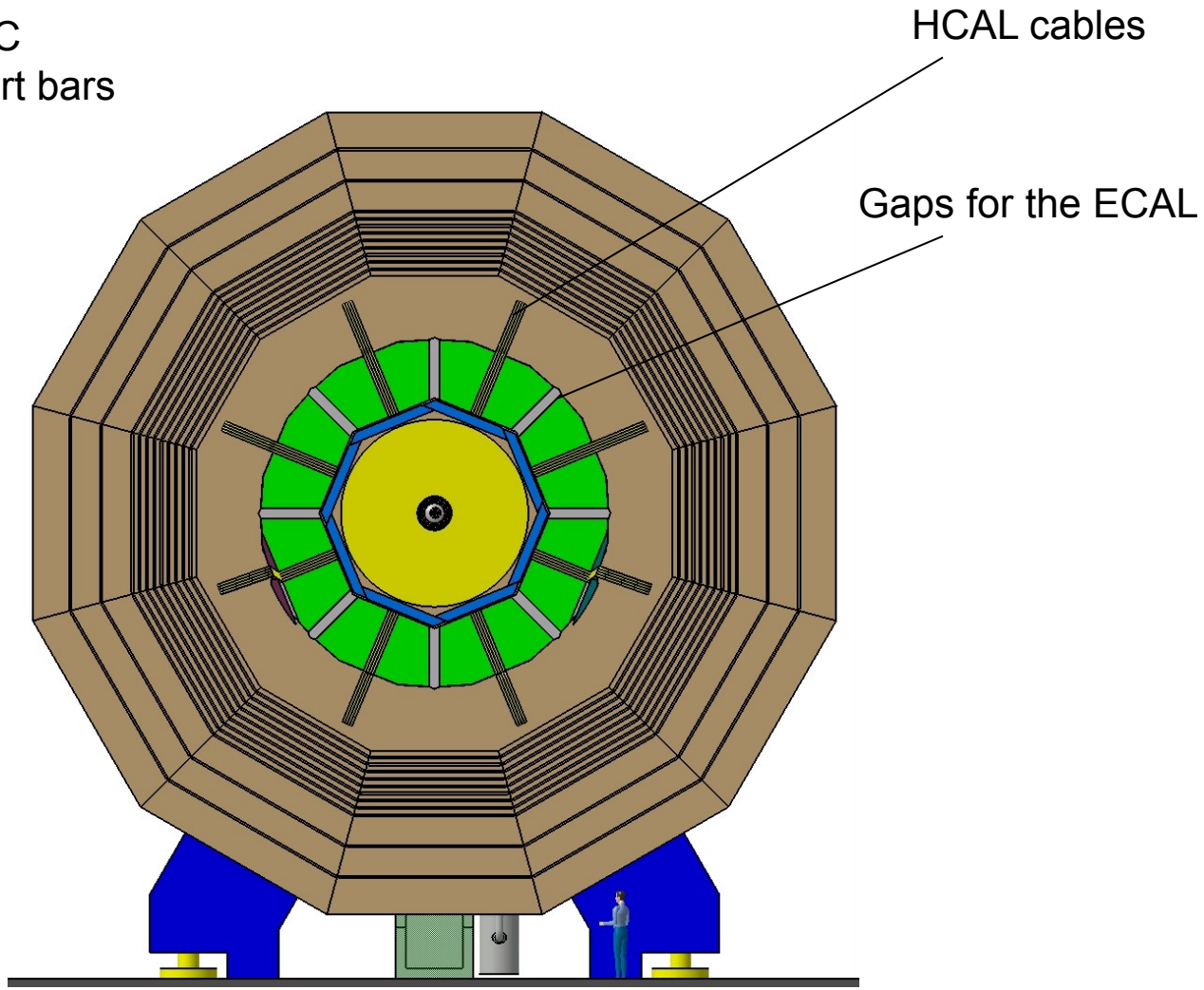




# Endview of the support structure

Necessary space for the TPC

- 4 or 5 gaps for the support bars
- Gap for the HV-Cable



# TPC installation

Basic questions has to be solved

- Installation of the inner detector (carbon fiber support tube)
  - Independent assembly from the TPC necessary
- Installation steps of the TPC
  - Central Electrode should be installed
  - HV-Cable connecting
  - Assembling of the Endplate and Modules
  - Cabling and Cooling
  - Alignment

Sliding tool is now in discussion that hold the TPC in horizontal position like a bar

# Conclusion and outlook

## Conclusion

- Support system with min. 4 bars necessary
- Required space is an issue with the infrastructure and gaps between and in the middle of the HCAL / ECAL octagons
- Alternative approaches have to be considered
- Various cross sections and materials of the support bars will be calculated
- Alternative system design maybe required

## Outlook

- Availability of space in the gaps has to be evaluated
- More FEA studies in progress
- Minimize the cross section of the support bars
  - Depends on the requirements
- Space for the HV-Cable necessary, the place holder model will be prepared soon
- Mounting tool procedure and schedule now in progress