ILC / ILD TPC

status of the support mechanics

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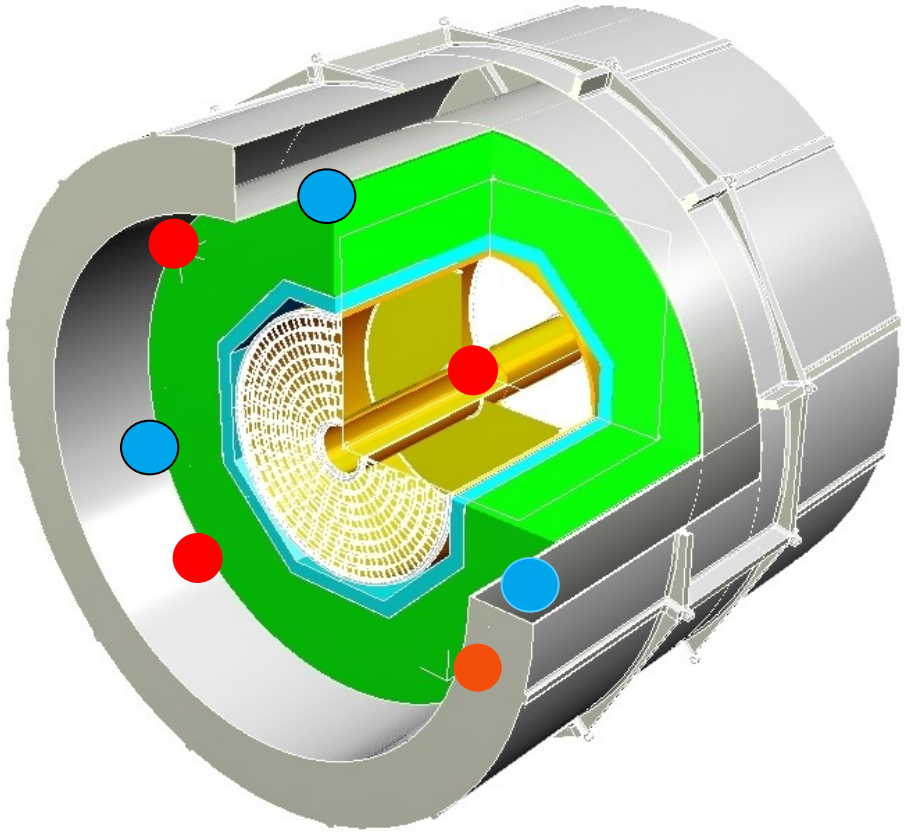
DESY

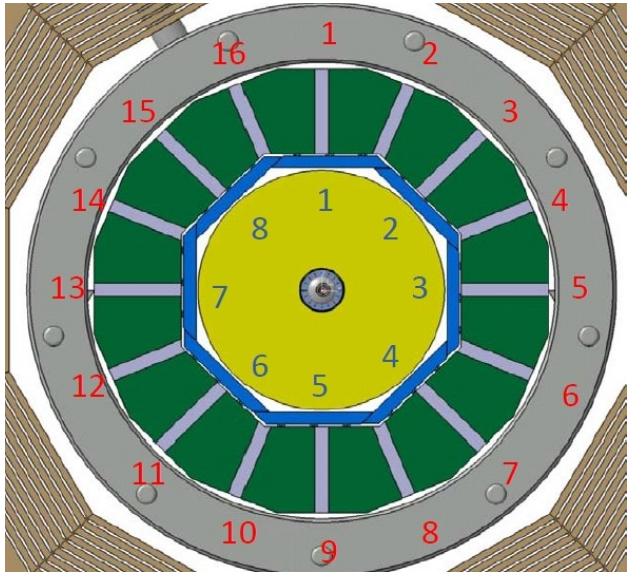
Overview

- 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
- Possible design of the support structure
- 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

Only the cryostat is foreseen to support the TPC

Pros and cons of various fixing points

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

Carbon fiber structure preferred

- Robust system in x,y,z,
- 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	South site	For the proposed Japanese sides
$A_0 < 1.5$ m/s²	$A_0 < 1.0$ m/s²	

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

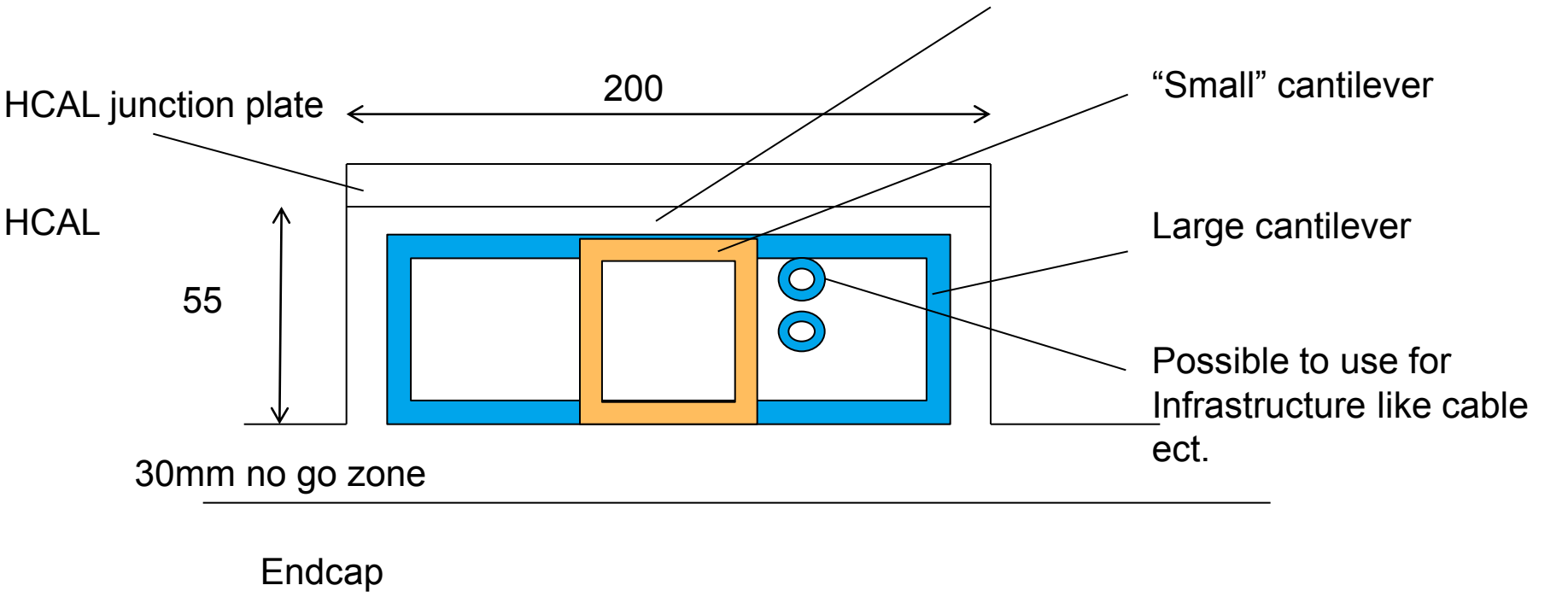
The additional force load in longitudinal direction of the cantilever support should not be an issue.

Question: Is a maximal amplitude of +/-10 mm acceptable?
Impact of this maximum amplitude on the remaining support structure

Dimensions of support structure

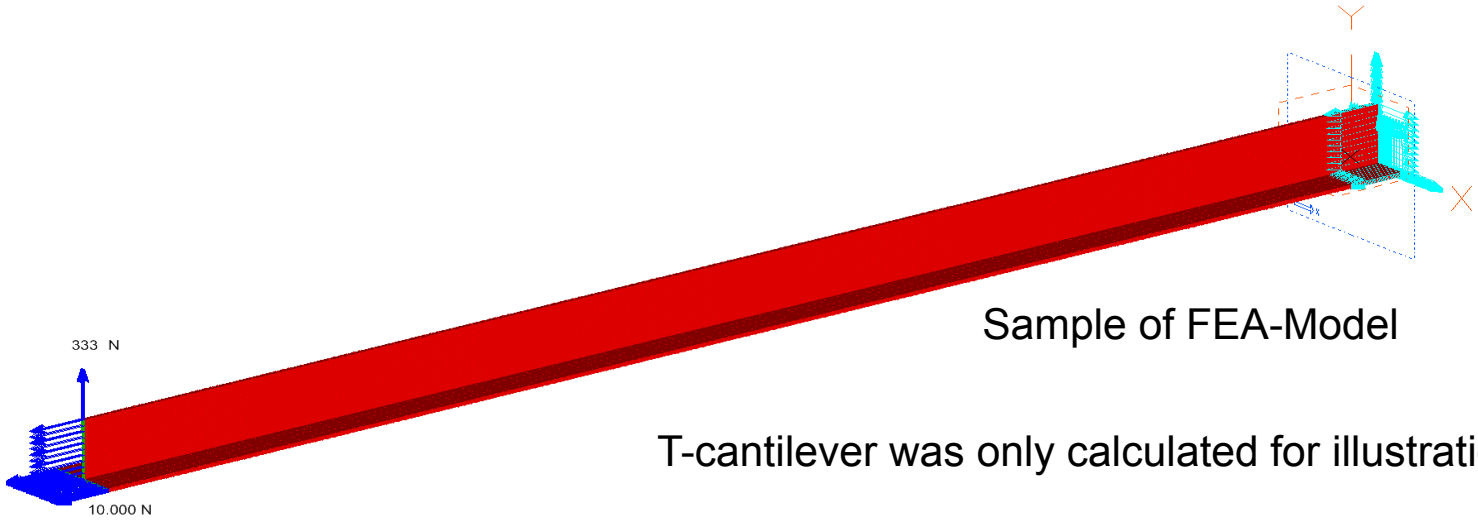
Gap size: in Z direction = 55mm, circular = 200
The 30mm “ no go zone” will be used only in a worst case

Should the support structure be as small as possible or as big as possible (with space inside used for cables, cooling etc.)



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

FEA analyses and calculation



Sample of FEA-Model

T-cantilever was only calculated for illustration

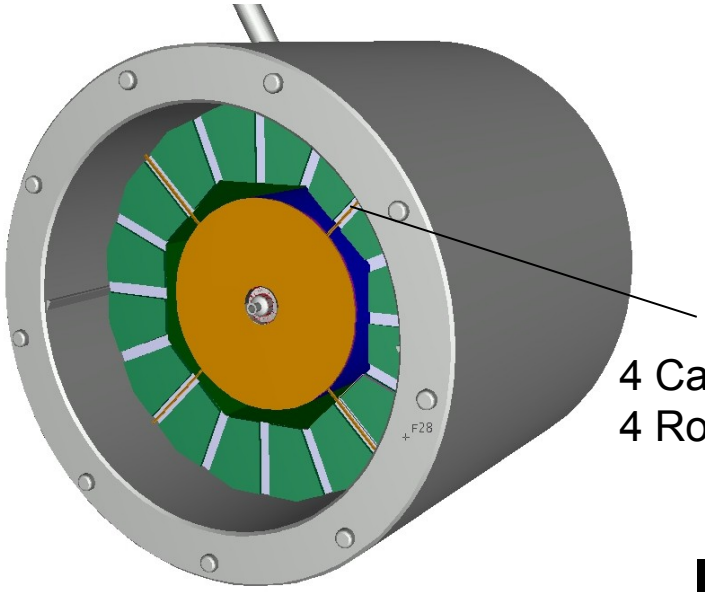
T-beam may have a buckling problem, the current model only provides basic properties.
The next calculation will be done with an rectangluar or squared hole profile.
Possible profiles will be selected with a max. deflection of *f*=10mm.

$$I = \frac{3fE}{Fl^3}$$

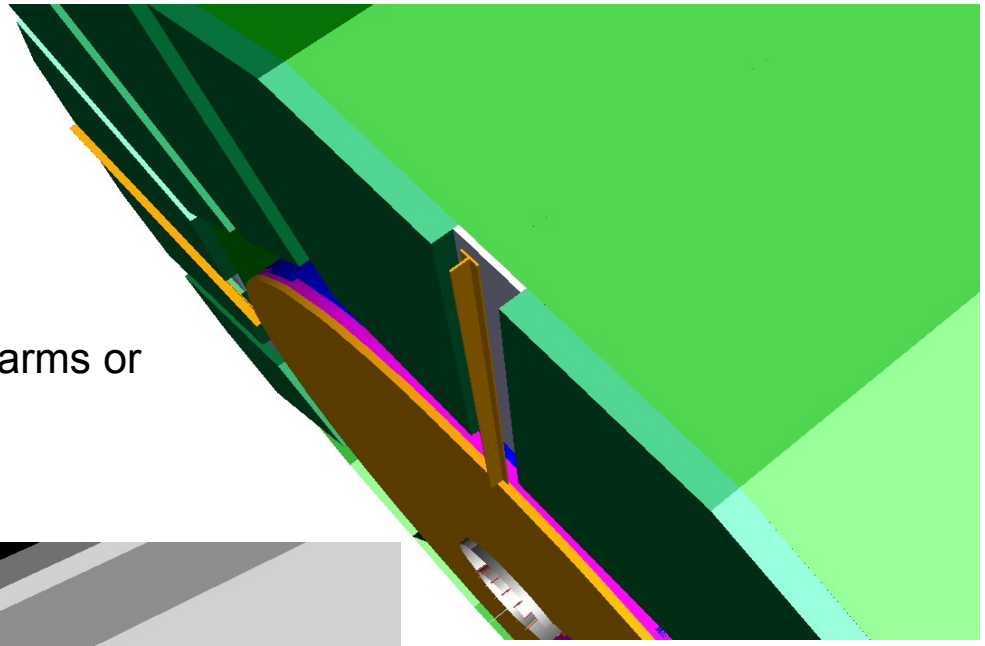
I= moment of inertia, f= deflection, E= Modulus of elasticity, F= force,
l= length of the bar

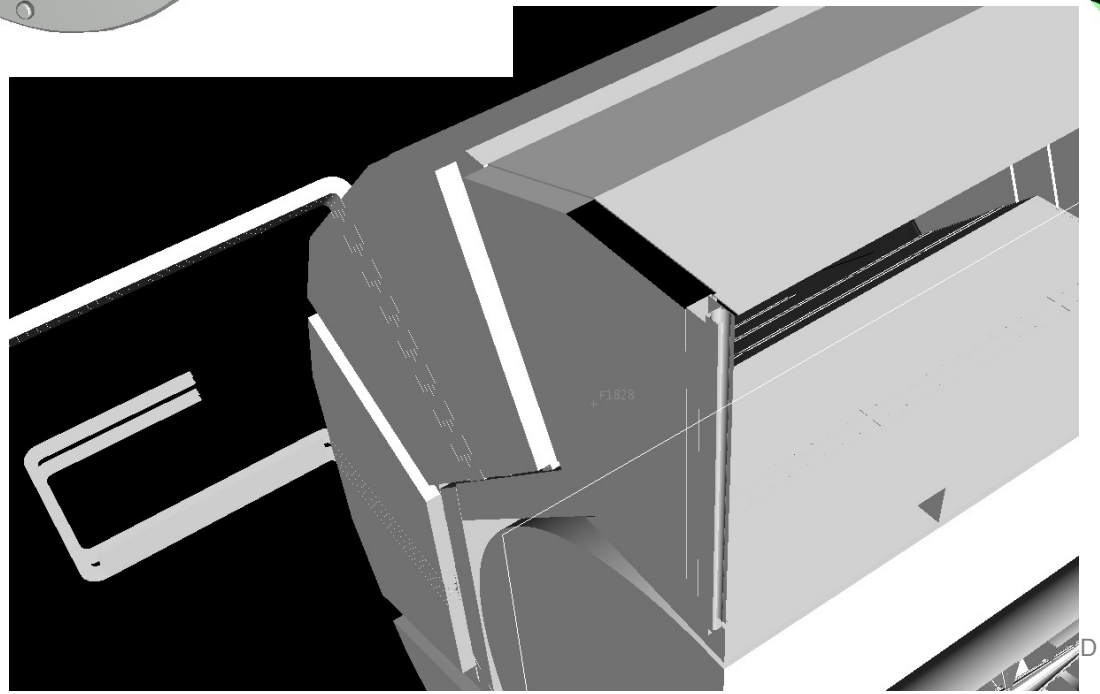
A profile with dimensions 60x60 fulfill the requirements

Possible design of the support structure

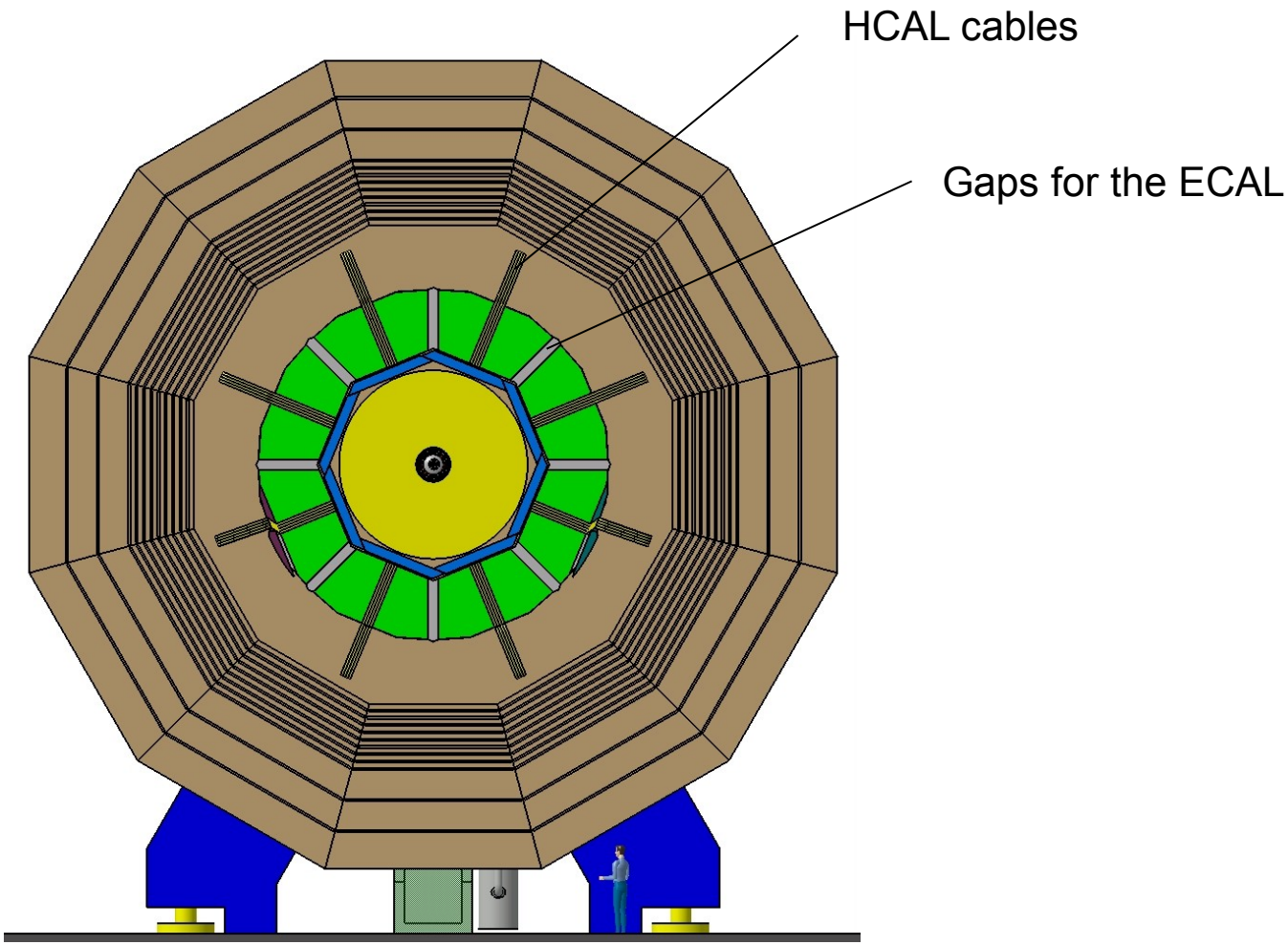


4 Cantilever arms or
4 Ropes





Endview of the support structure



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 octagons
- Alternative approaches have to be considered
- Various cross sections of the cantilever 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 cantilevers
  - Depends on the requirements
- Placeholder has to be defined before the next Integration meeting Paris