# ILC / ILD TPC

# Requirements of the support mechanics

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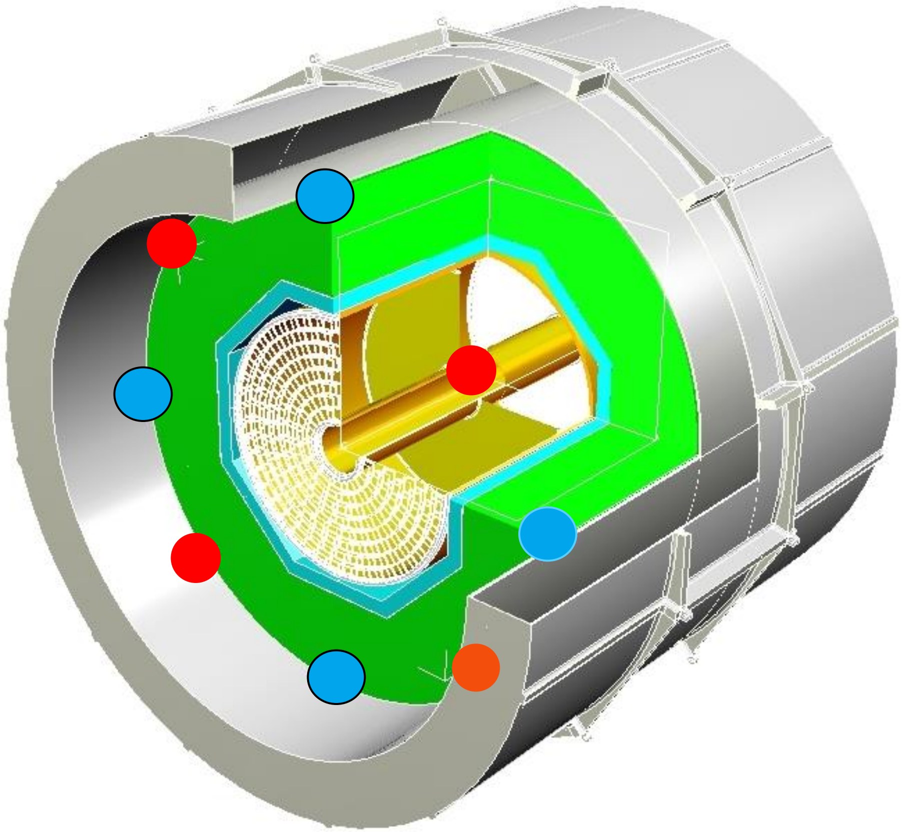
DESY

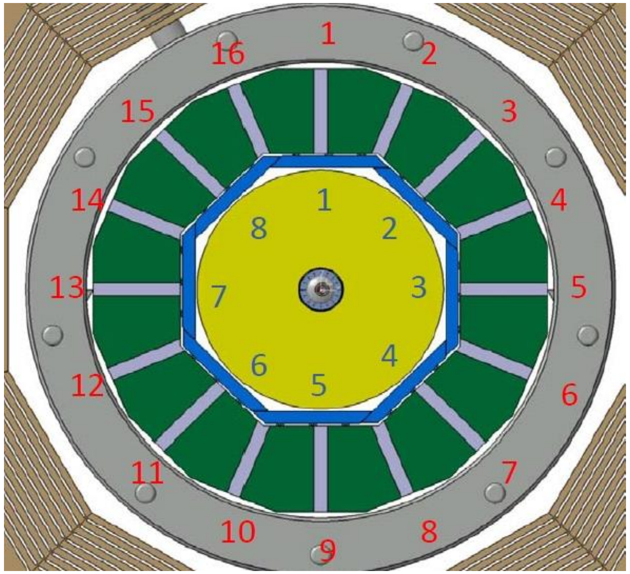
# Overview

- Fixing points and requirements of the TPC support structure
- Estimated acceleration and forces
- Various designs of the support structure
- Dimensions of the support structure of the TPC
- Flat ribbon support
- TPC cable, cooling, gas feed and routing
- HV Cable and routing
- TPC installation, mounting, tooling, support and working space
- 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




Various possible fixing points

Only the cryostat is foreseen to support the TPC

# 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

# Various designs of the support structure

Two options would be followed

Flat ribbon support

- Support in Z necessary

Bar support rectangular or double T-bar system

- Stiffness and damping in Z direction possible

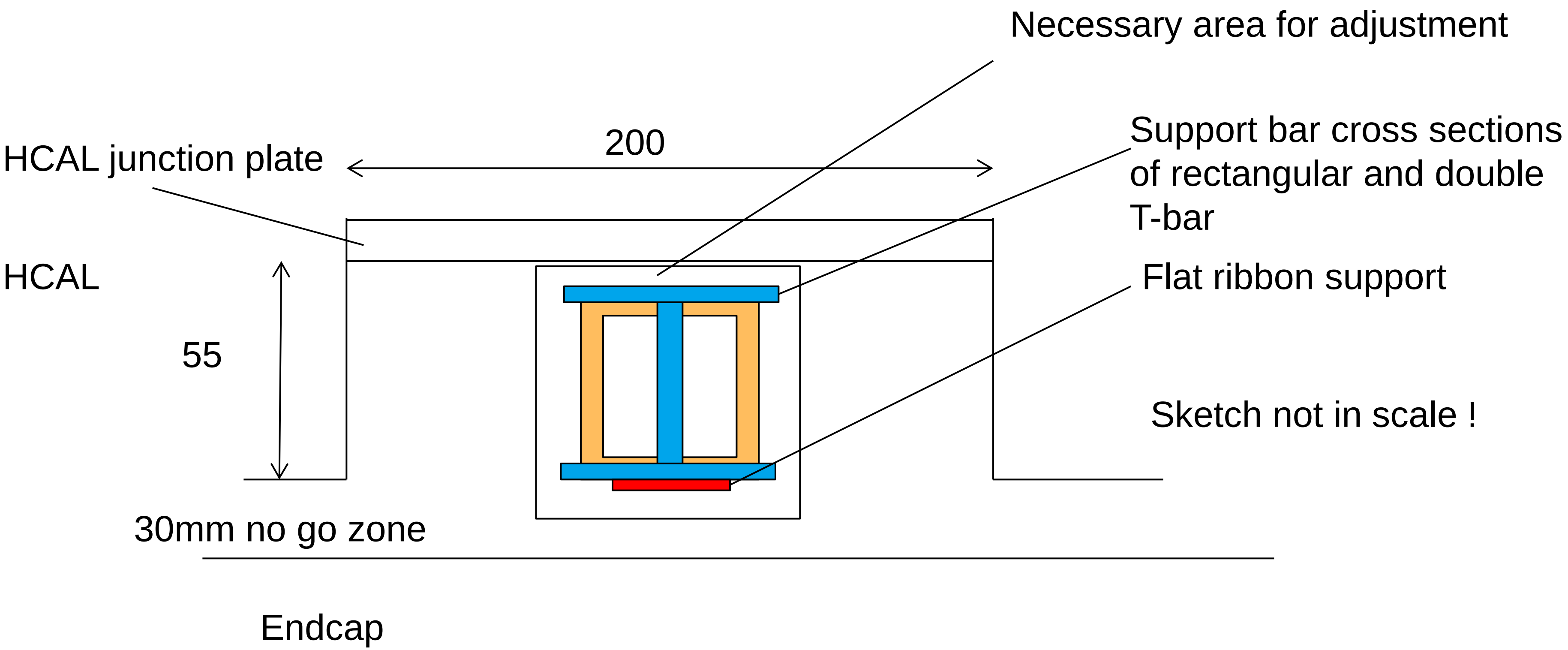
Pros and cons of the flat ribbon suspension

+ Thin and small cross section design possible
- Support system ~ 1600mm long
- Damping support in Z necessary! This can be an issue?

Pros and cons of the rectangular or double T-bar system

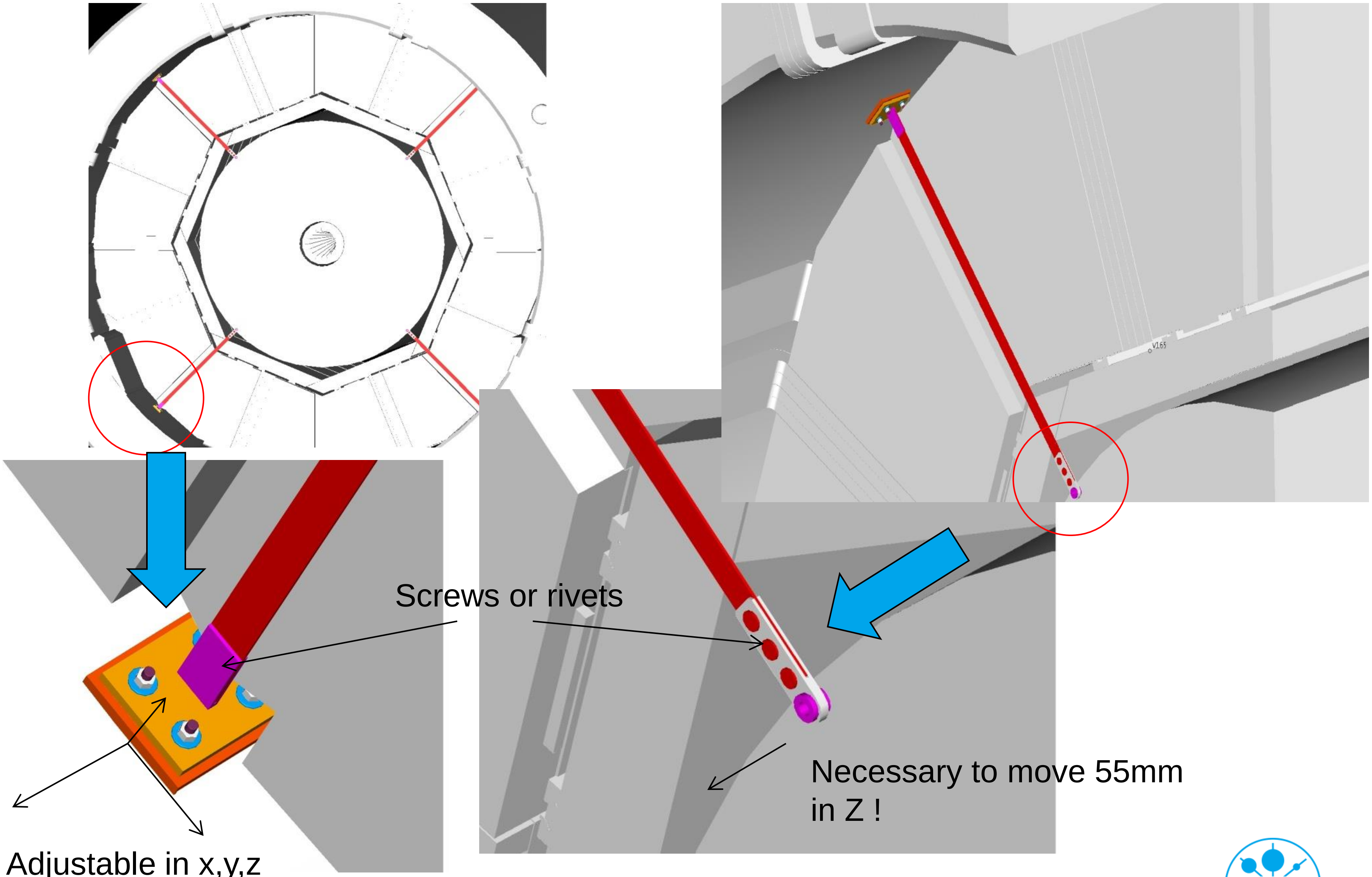
+ Damping in Z possible
- Large cross section
- Support system ~ 1600mm long
- Now this space is not available!

# Dimensions of support structure



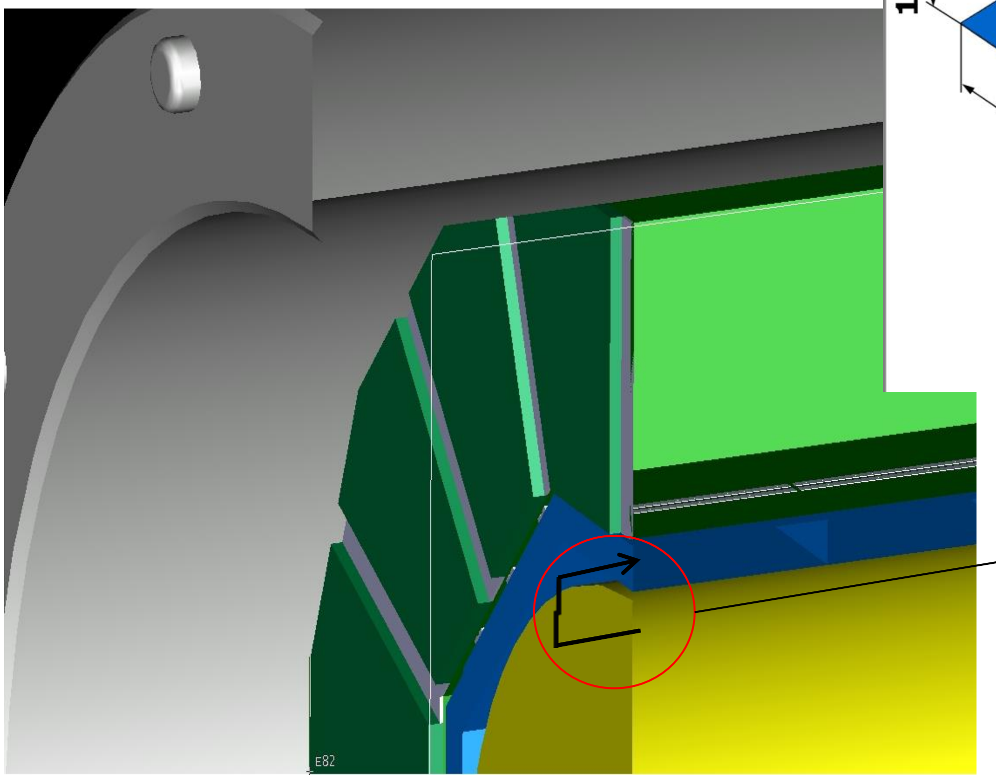

An cantilever design is only possible if minimum of 4 gaps can be used

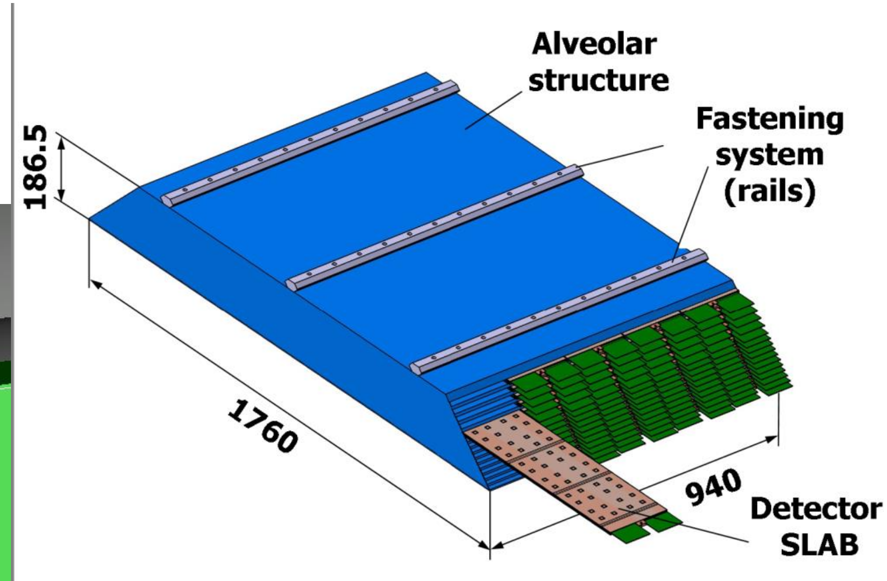
# Flat ribbon support



# Flat ribbon support

## Support in Z- direction !




- Stiff U-bracket mounted on the TPC-Endplate
- Incl. a spring to damping the TPC in Z
- Ballpoint connection will push on an plate mounted on the ECAL surface

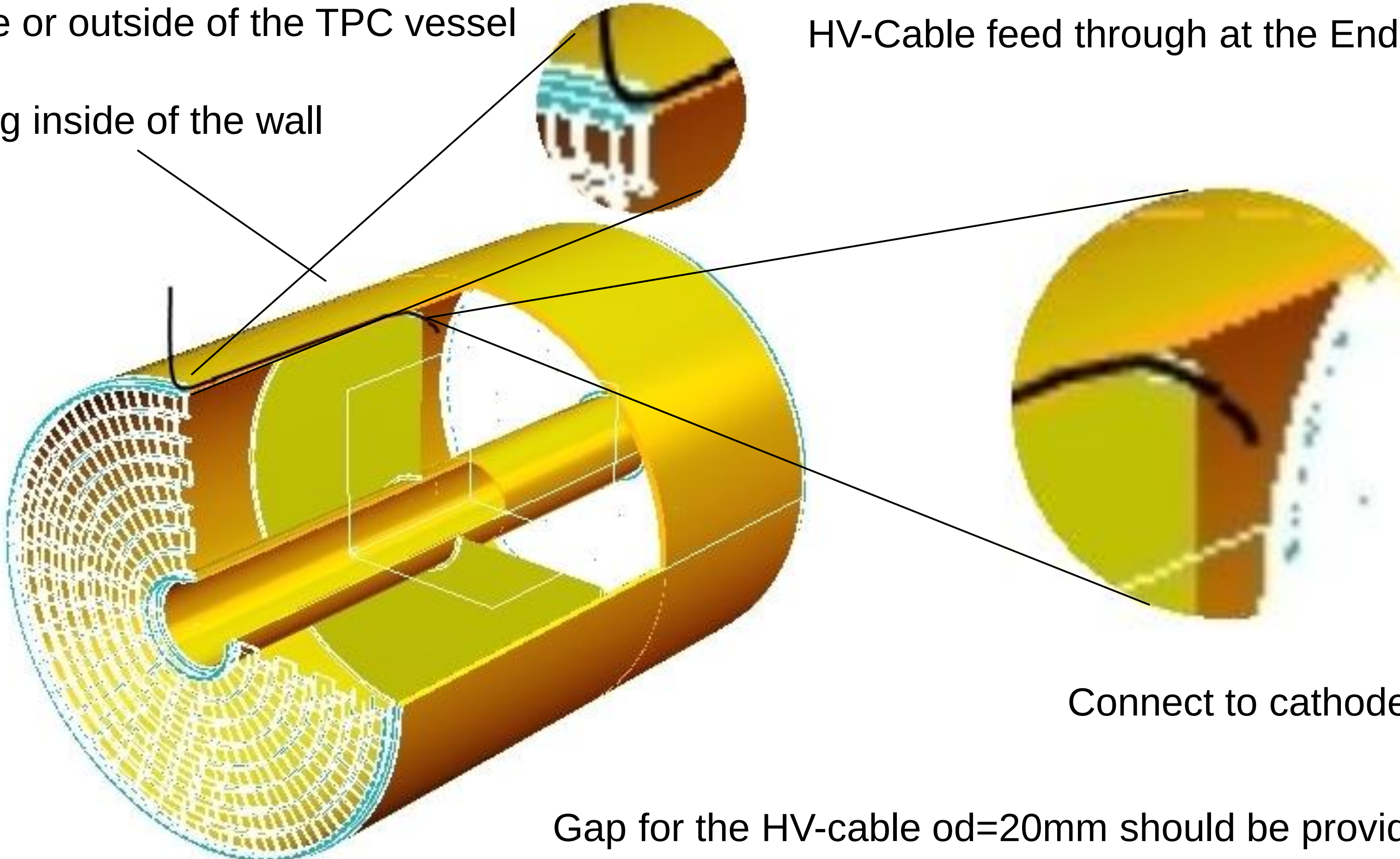
# TPC cable, cooling, gas feed and routing

TPC infrastructure needs to be defined

- Type of cable
- Number of cables
- Cross section and or diameter
- Specification of the cables
- Tubes for cooling
- Gas feed

# HV Cable and routing

Overview of an first idea of the HV-cable routing




Gap for the HV-cable od=20mm should be provide, the bending radius maybe an issue

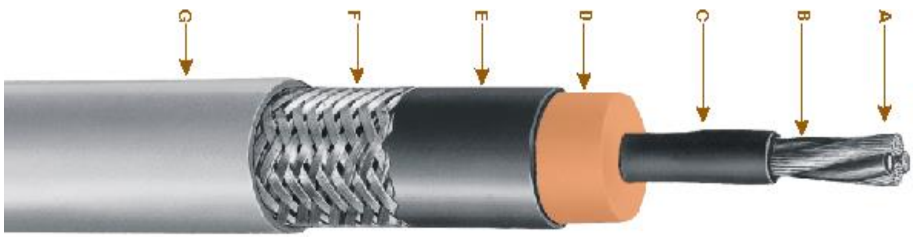
# HV Cable and routing

## Samples of HV-cables

Okonite Hi-Voltage Cable: www.okonite.com

100kV, od= 16,76mm,

bending radius = 4*od > 70mm




**A** Coated Stranded Copper Conductors
**B** Polyester Insulation
**C** Extruded Semiconducting Layer
**D** Primary Insulation – Okoguard
**E** Extruded Insulation Shield
**F** Coated Copper Braid
**G** Jacket – Okoseal

Heinzinger HVC100 Best. No.:00.220.853.9 www.heinzinger.com

100kV, od= 14mm, bending radius min. 280mm!

FUG C 2124, Mat.- No.: 0502032124

Cross section of the HV-cable: 255-300mm$^2$ necessary

http://www.fug-elektronik.de/webdir/PDF/e/Access_data_sheet.pdf

100kV, od= 11,2mm, bending radius min. 152mm

# TPC installation, mounting, tooling, support and working space

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 has to be mounted and connected with the HV-cable
  - HV-Cable glued into the TPC or fixed at the vessel
  - Patch panel necessary for the HV-cable
  - Assembling steeps of the Endplate and the inner Vessel of the TPC
  - Cabling and Cooling
  - Alignment
  - Combined sliding tool should be discussed it can be used for:
    - Mounting of the central electrode
    - TPC assembling and moving
    - Installation of the central tube
    - Something else
    - Min 3 times longer as the TPC !

# 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
- Various cross sections and materials of the support bars are calculated
- Two support systems available

## Outlook

- Availability of space in the gaps has to be evaluated
- More FEA studies in progress (I-DEAS and/or Ansys)
- Minimize the cross section of the support bars depends on the requirements
- Space for the HV-Cable necessary
- HV-cable bending radius can be an issue
- Field cage vessel studies should start