

A 3D CAD model of the AHCAL Barrel in ILD, showing a complex, multi-layered structure with various components and connections. The model is rendered in a dark gray color with some red highlights on the bottom right. It is set against a white background with a faint grid pattern.

The AHCAL Barrel in ILD

Design Status Report

ILD Software and Integration Workshop 2010
@DESY 06.-08.07.2010

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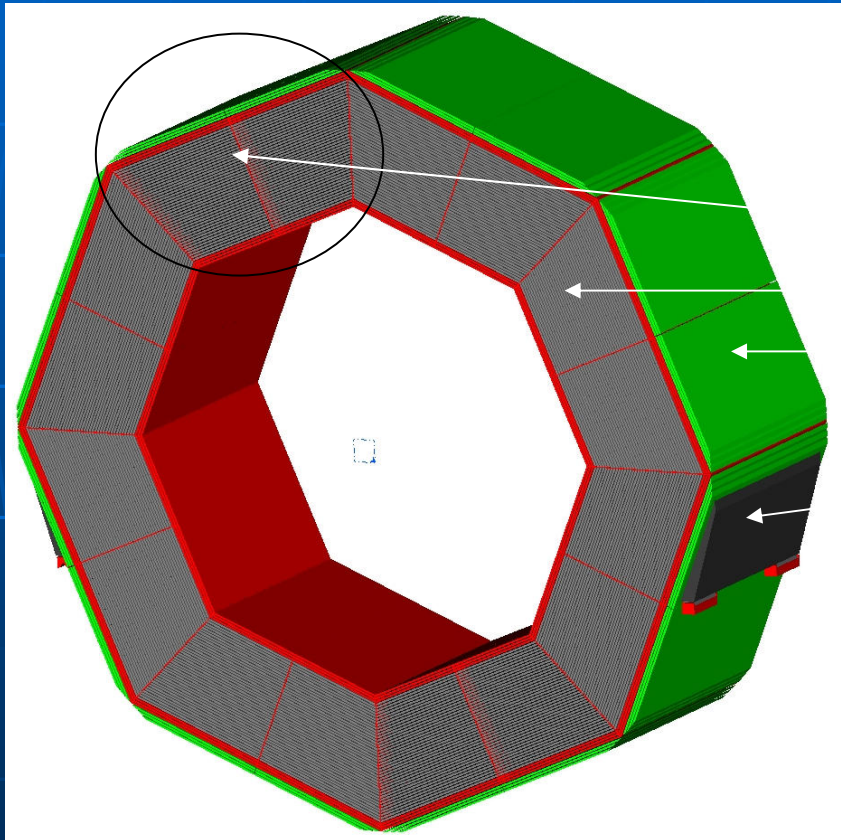
AHCAL barrel data set 1

to start the mechanical design

(first loop since 01.2009)

- After the first loop through the "*Workflow to design a HCAL barrel absorber structure for the ILD*" based on [LDC01_05Sc](#) I got following HCAL barrel data set 1
 - 1. HCAL barrel material
 - stainless steel 1.4401 or 1.4435
 - 2. HCAL barrel dimensions
 - inner radius : 2000 mm
 - absorber thickness : 18 mm
 - absorber plate thickness : 16 mm
 - sensitive layer cover thickness : 2 mm
 - number of sensitive layers : 48 layers
 - sensitive layer gap thickness : 6,5 mm
 - number of absorber plates : 49 plates
 - outer radius : 3378 mm
 - Length of one absorber module: 2350 mm
 - 3. HCAL barrel shape
 - Octagonal inner shape , nearly circular outer shape
 - 2 sub-modules per octagon module
 - total : 2 barrel absorber structures x (8 modules x 2 sub-modules) = 32 sub-modules
 - pointing cracks 2 x (3 mm side plate + (7 mm spacer ?)) = 20 mm + air gap (5 mm)
 - 4. HCAL sensitive layer
 - scintillator plates read out by SiPMs

HCAL barrel absorber structure mechanical design overview (first loop)



■ AHCAL barrel absorber structure (1wheel of 2)

- module
- sub-module
- backpack
5,2 λ slim version
- support

4 feet per AHCAL half barrel
load per foot $960 \text{ t} / 8 = 120 \text{ t}$

2 x 320 t (AHCAL half barrel) = 640 t

AHCAL work flow 1.loop

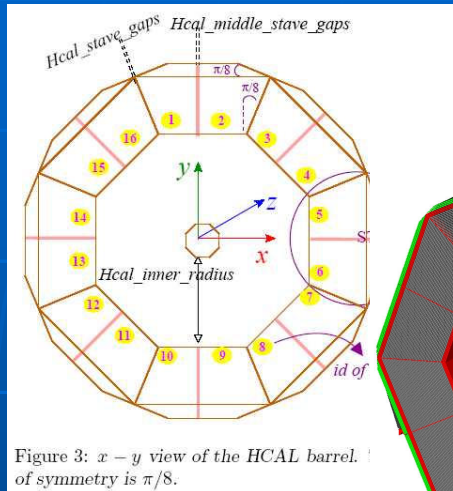
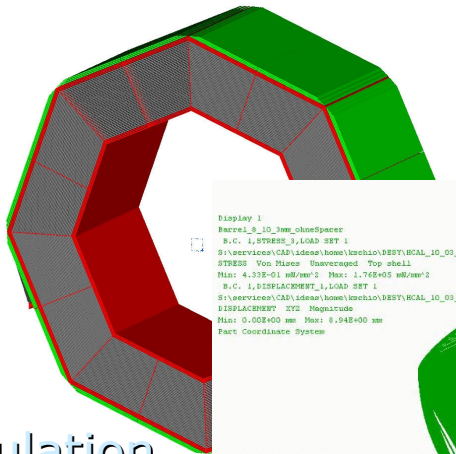
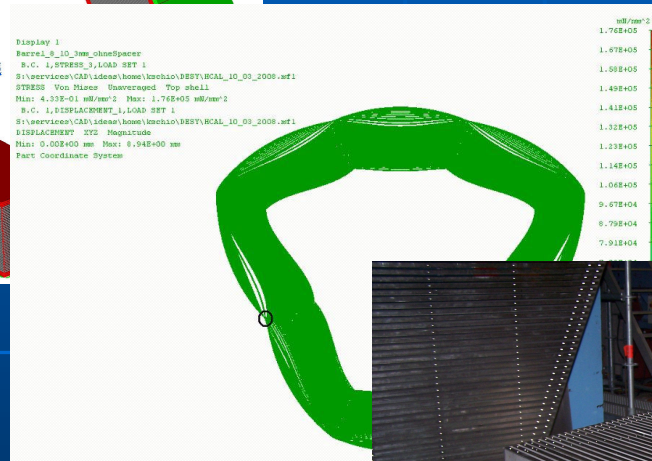


Figure 3: $x - y$ view of the HCAL barrel. of symmetry is $\pi/8$.

3D Design



FEM studies

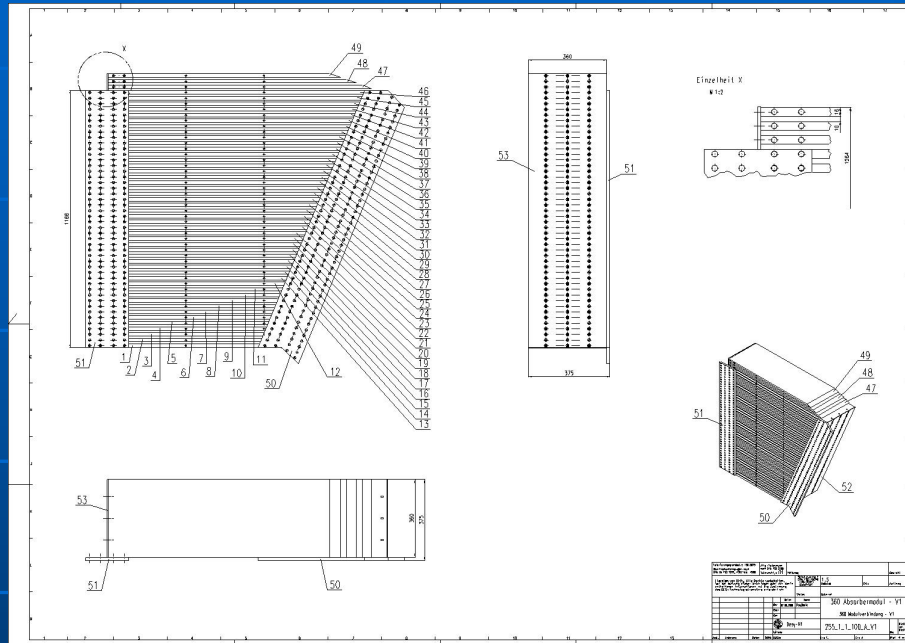


real size prototyping

Physics simulation



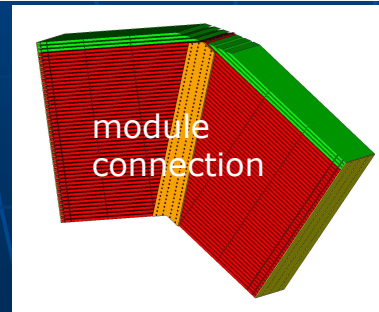
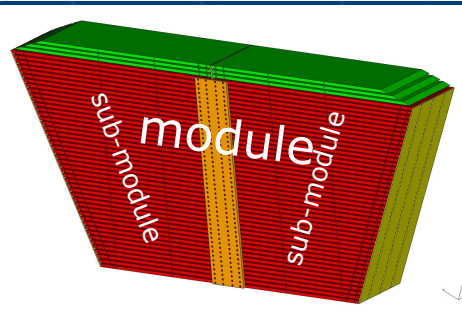
real size test setup vertical



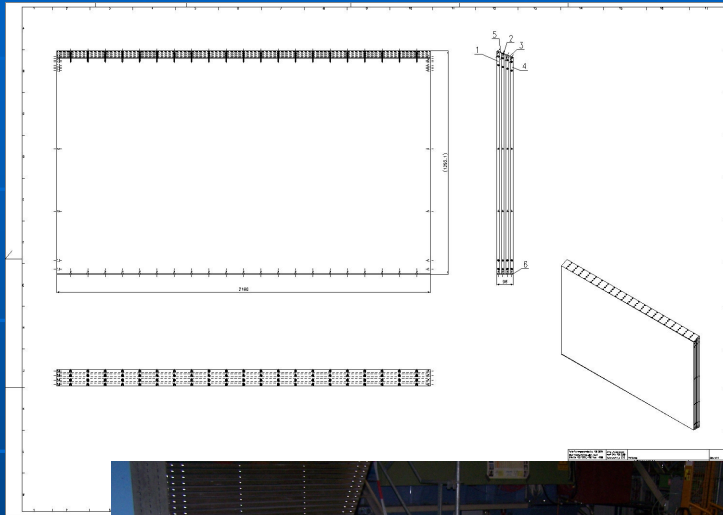
2 short length (360 mm) absorber sub-modules mounted to a short length module
 $360 \text{ mm} = 1 \text{ HBU length}$

- **delivery tolerances**
flatness, thickness
- **machining**
tendering, processing, handling, tolerances, costs
- **sub-module mounting**
stacking and shape tolerances, module interconnection, stability
- **sensitive layer installation**
handling, tolerances, vertical and horizontal layer connection, cabling and cooling routing

- flatness measured of raw plates 3000 mm x 1500 mm
- sup-module 2 plates are roller leveled
- water cut to individual plate size
- flatness measured for each plate before machining
- sub-module mounting in horizontal position
- gap size measured in horizontal position (front)
- sub-module turned vertical
- gap size checked by cassette prototype
- 2 positions in sub-module 1 found, where the cassette does not fit into the gap
- all sub-module 1 plates were roller leveled
- measuring and reassembly of sup-module 1 starts next week



real size test setup horizontal



4 full length (2160 mm) absorber plates mounted to a fraction of a sub-module

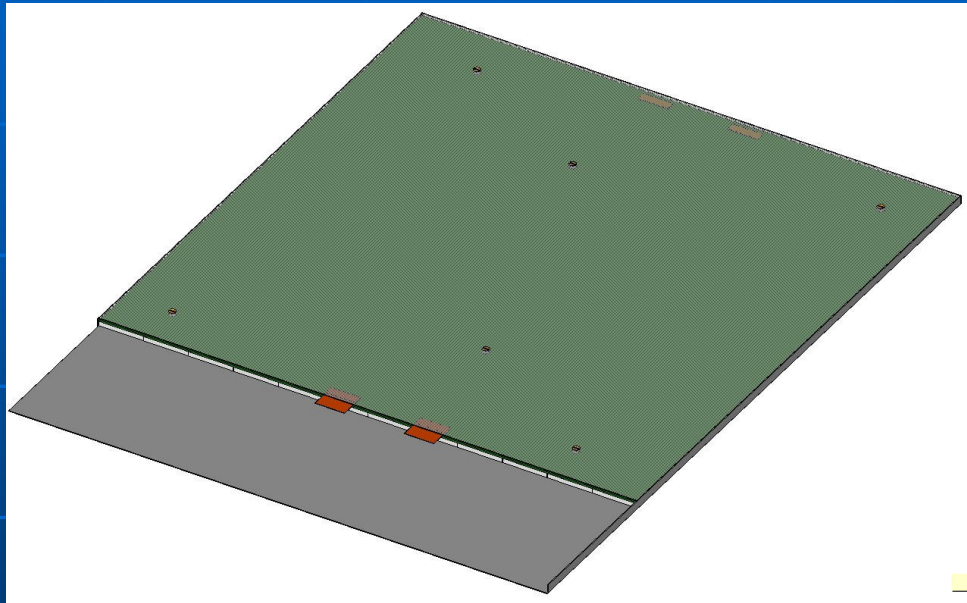
2160 mm = 6 HBU
outer position = broadest plates
(~ 1300 mm)

- **delivery tolerances**
flatness, thickness
- **machining**
tendering, processing, handling, tolerances, costs
- **sub-module mounting**
stacking and shape tolerances, module interconnection, stability
- **sensitive layer installation**
handling, tolerances, vertical and horizontal layer connection, cabling and cooling routing

2160 mm sub-module plates layer 43 to 46

- flatness measured from 4 raw plates 2500 mm x 1500 mm Order 1 batch 1 (not roller leveled)
- order 1 batch 1 water cut to individual size
- flatness measured for each plate
- roller leveling done
- flatness measured
- horizontal mounted

AHCAL sensitive layer housing



- 362 mm x 462 mm standard width housing

- contains 1 HBU unit for 360 mm sub-module
- 0.5 mm stainless steel
- One side border per bottom/cover plates
- 100 mm bottom plate extension for front end electronic
- 6 point welded fixation/distance bolts per HBU unit
- Cover plate and HBU fixed by 6 M2.5x4 screws per HBU unit
- total thickness 7 mm +-0.1 mm

- 362 mm x 2260 mm standard width housing

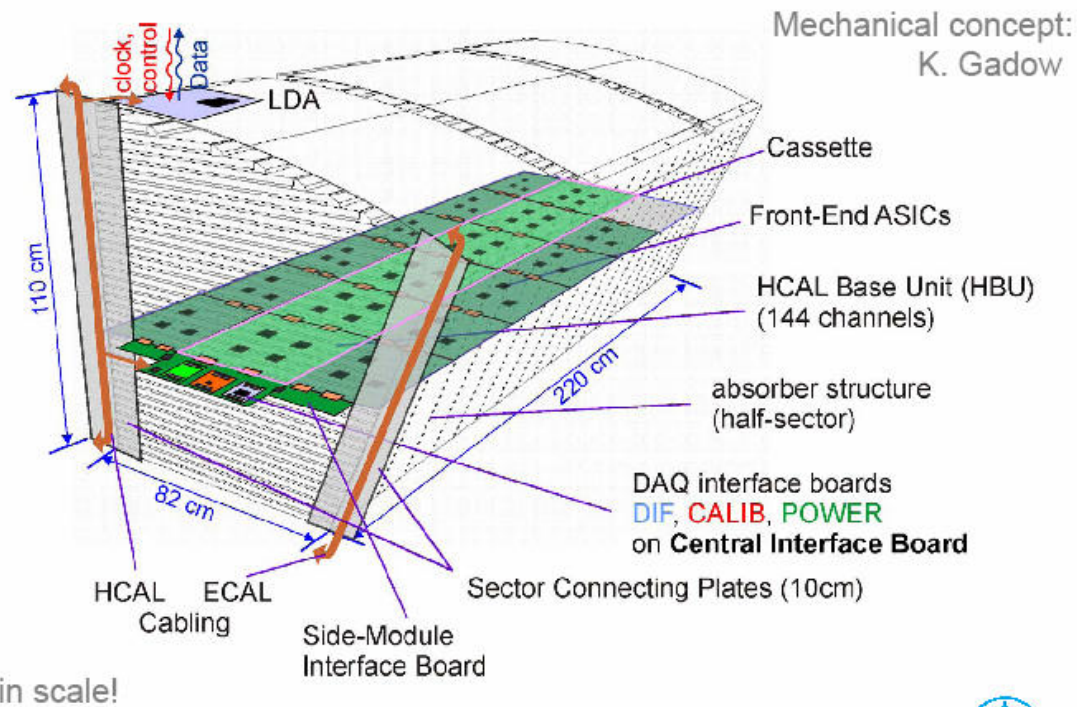
- contains 6 HBU units for 2160 mm sub-module
- other parameters see above

1HBU and 2HBU standard width housing prototypes available

AHCAL sensitive layers

Mathias Reinecke

The Next Generation



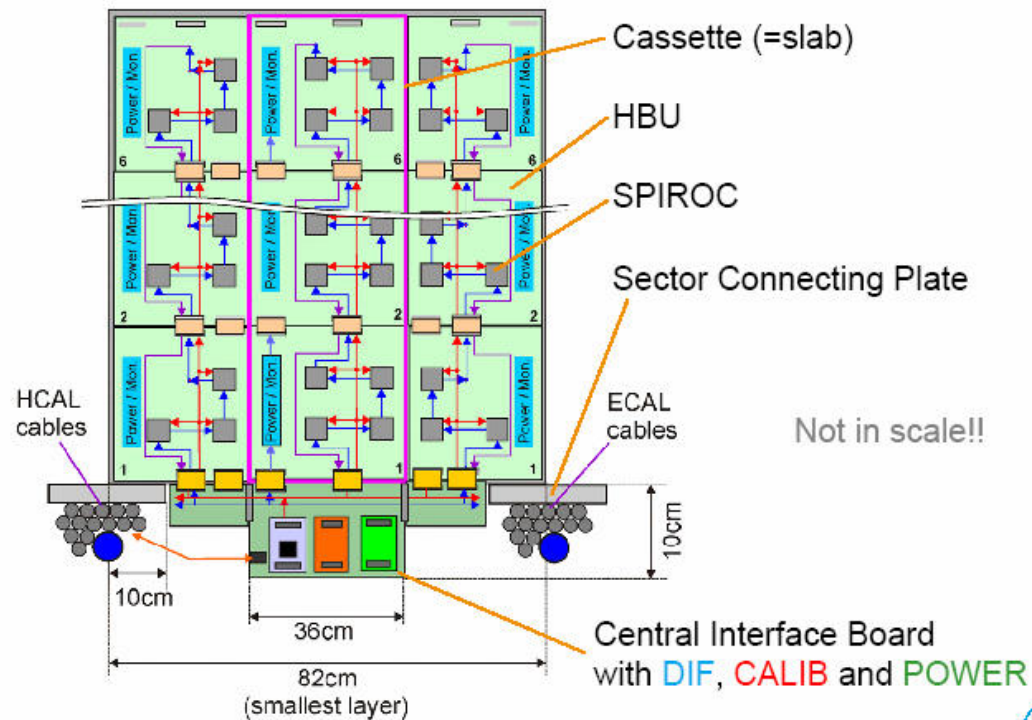
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AHCAL sensitive layers

Mathias Reinecke

The Next Generation



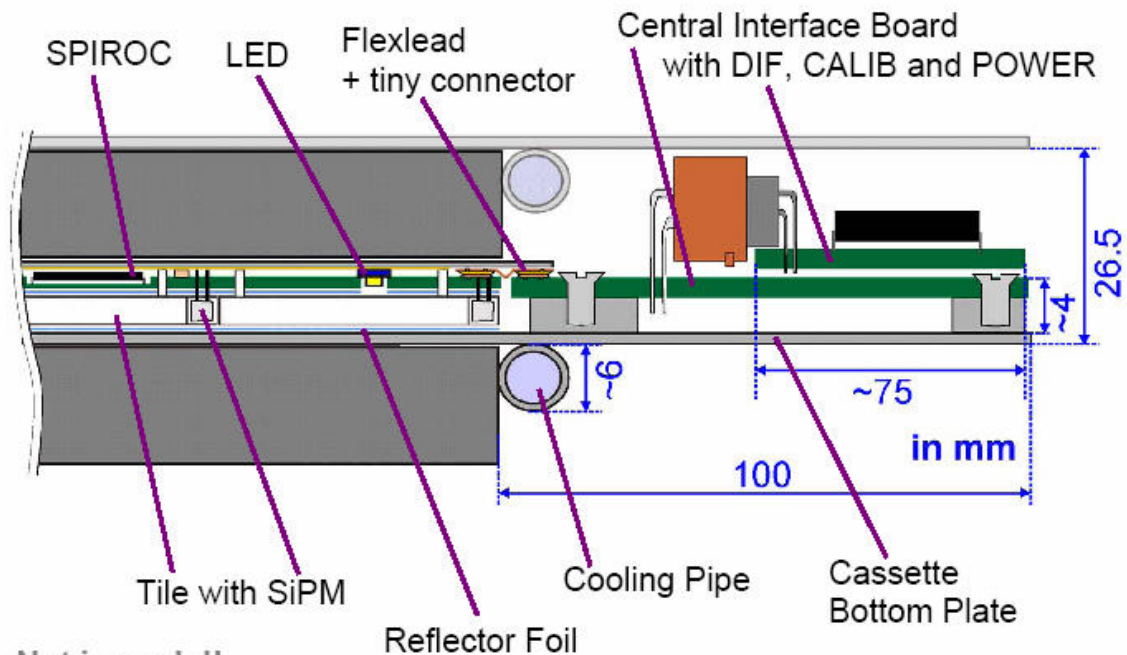
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AHCAL sensitive layers

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The Next Generation



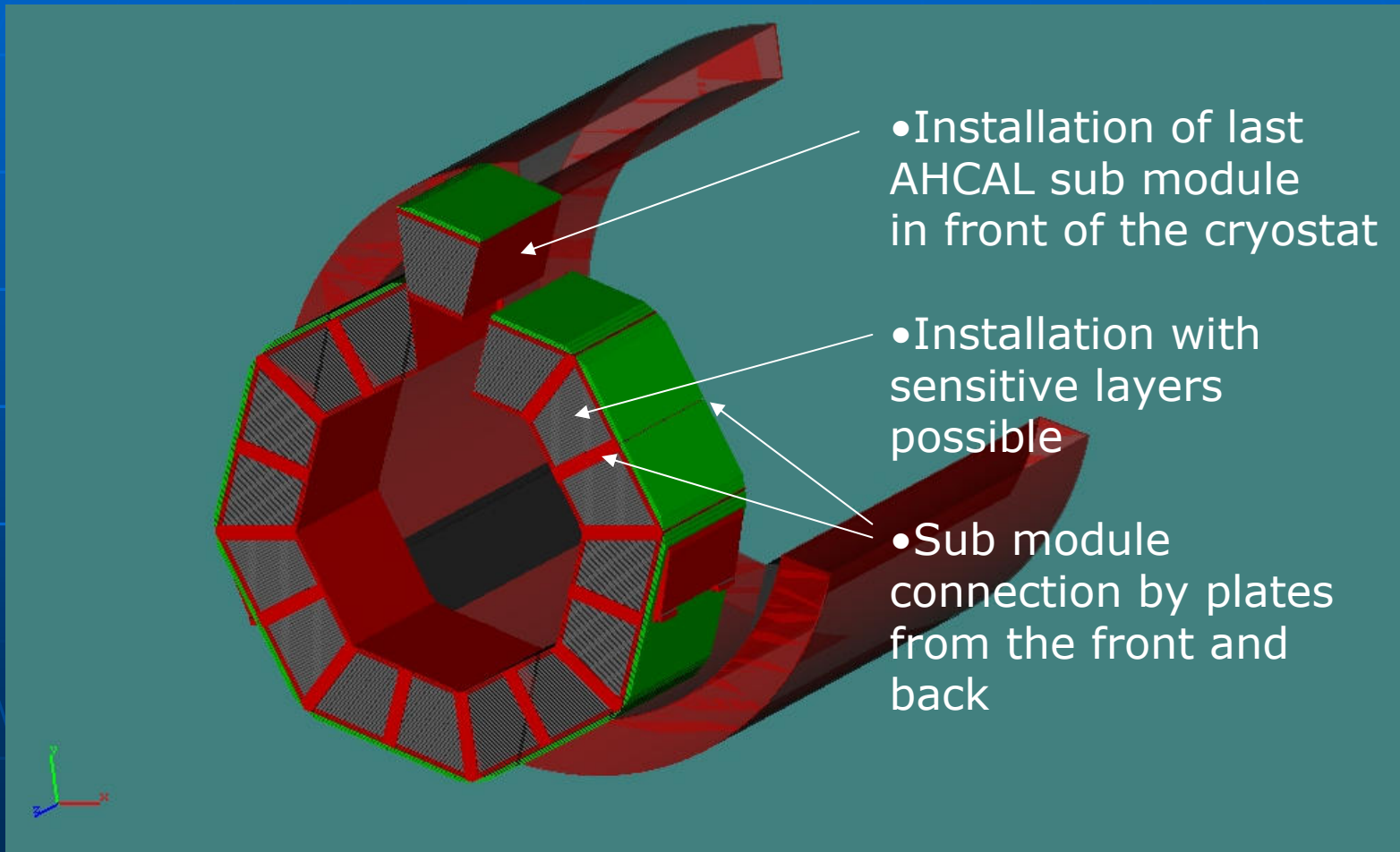
Not in scale!!

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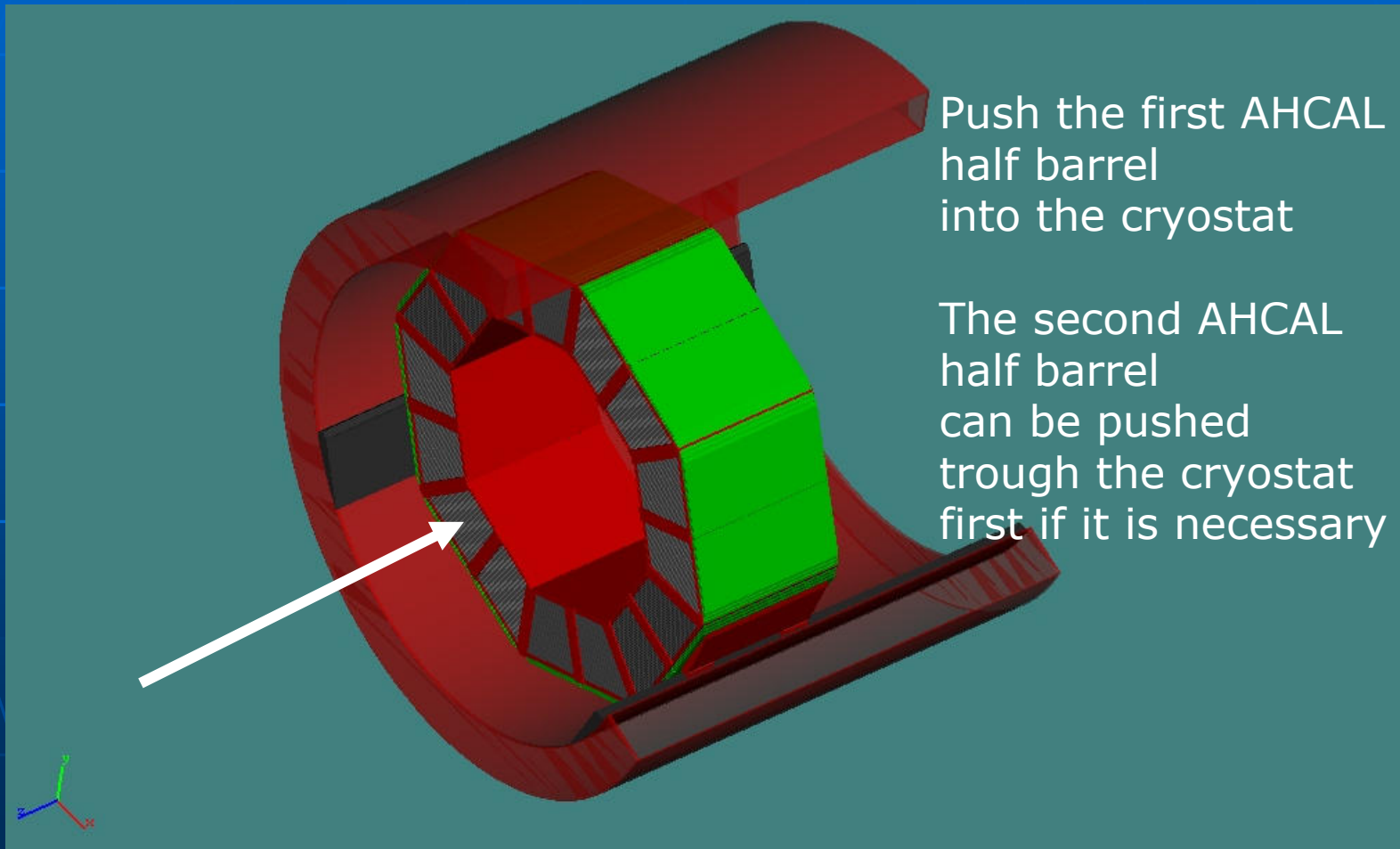


AHCAL barrel integration in ILD

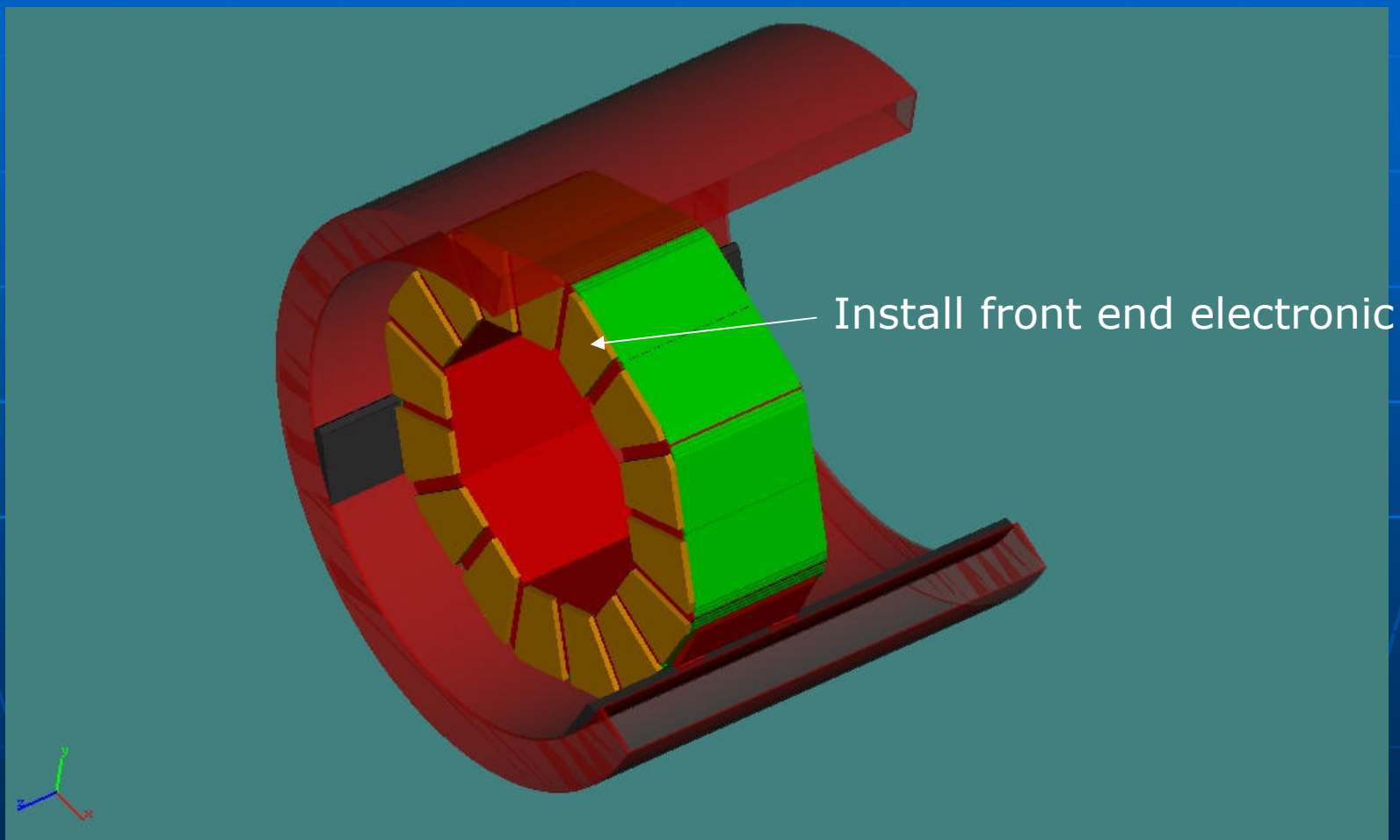
step 1



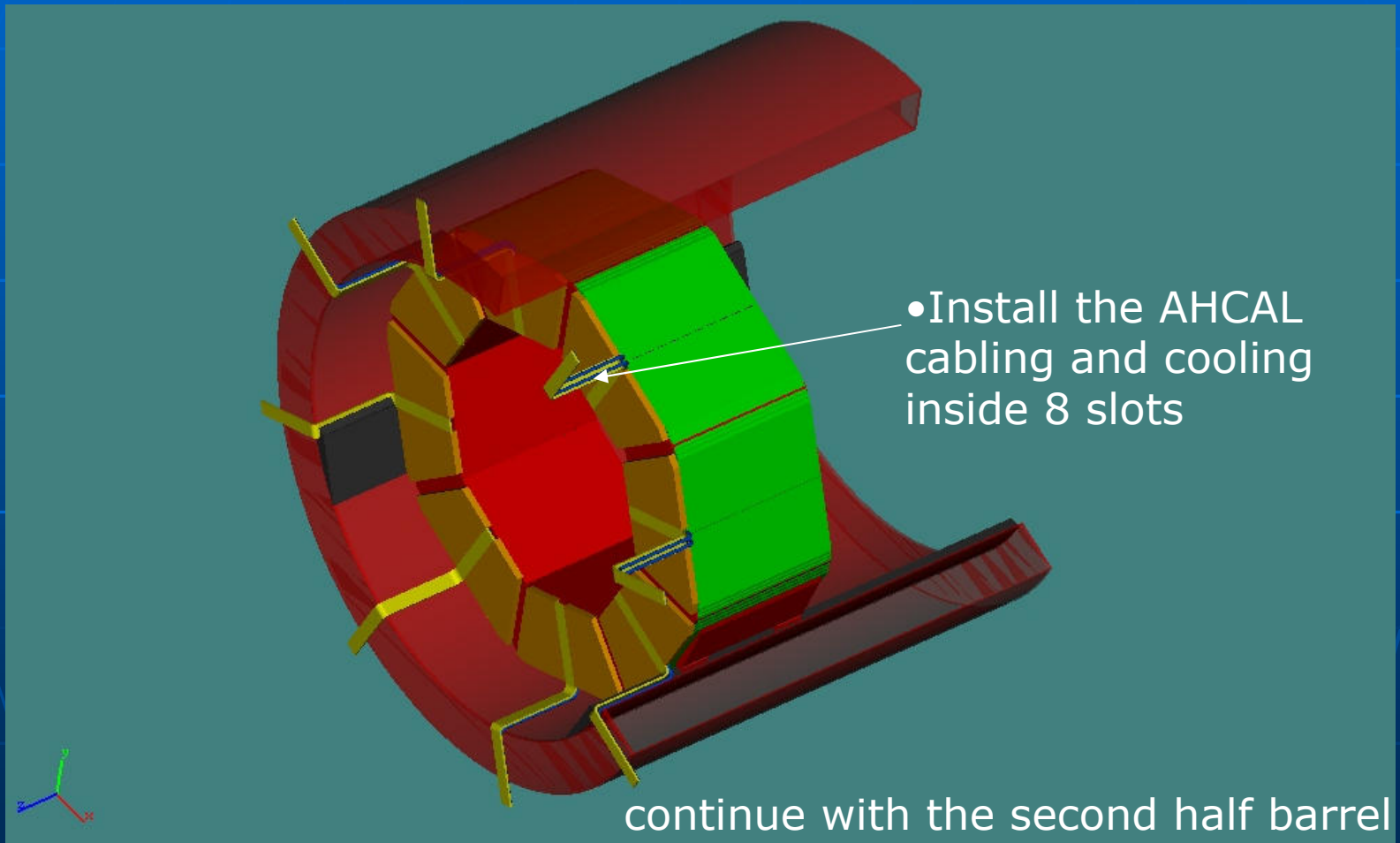
AHCAL barrel integration in ILD step 2



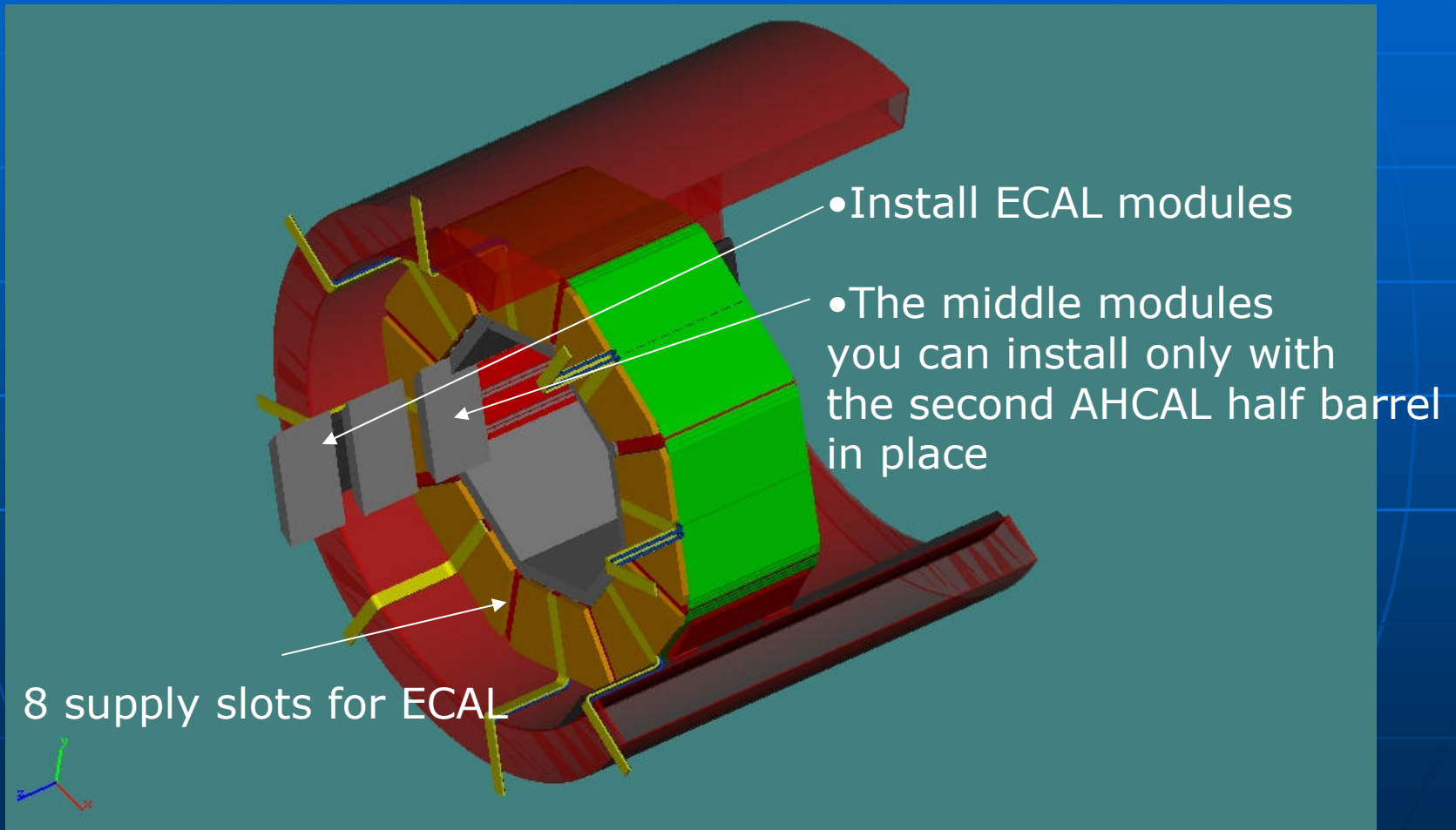
AHCAL barrel integration in ILD step 3



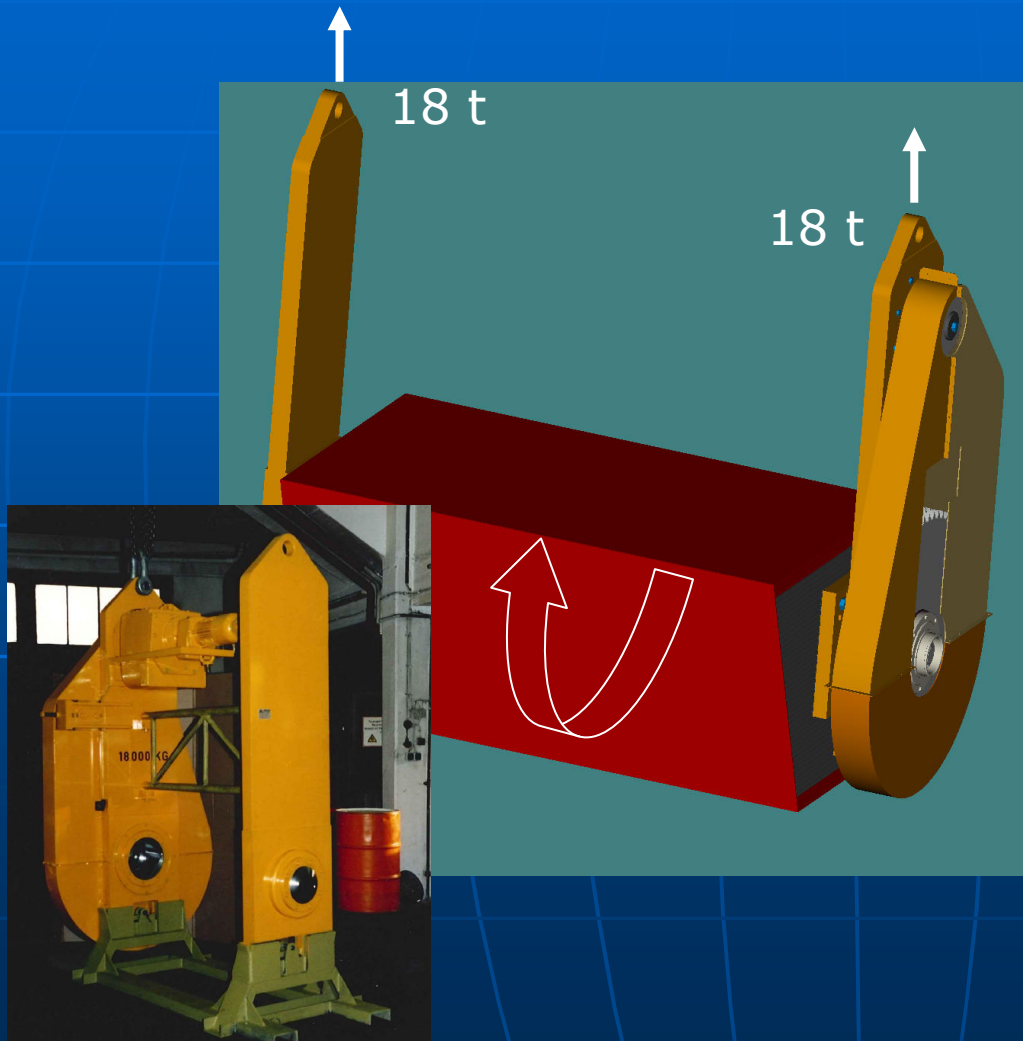
AHCAL barrel integration in ILD step 4



ECAL barrel integration in ILD



AHCAL barrel integration tools



- lifting and turning tool for AHCAL barrel absorber sub-modules available
 - 2 x 18 t capacity
 - operation with 2 hooks (z angle adjustment)
 - precise motor controlled turning
 - design for adaptation for sub-modules with and without sensitive layers started
- mounting, support and insertion frame
 - one frame for everything
 - design will start soon
- push and pull tool available
 - must be modified to the rail distance and rail shape/size

AHCAL barrel integration in ILD with communication and documentation (EDMS)

The screenshot displays the EDMS interface for a project titled "Baugruppe , D0000000873853,A,1,1 , Objektinformation : Zusammenfassung". The interface includes a navigation menu on the left, a top navigation bar with options like "Suchen" and "Home", and a main content area with several tabs: "Zusammenfassung", "CAD Baugruppenstruktur", "Eigenschaften", "Relationen", "Zuweisung", "Classification", "Prüfer/Genehmiger", and "Alle Versionen".

The "Eigenschaften" tab is active, showing the following details:

- Name: HCAL_barrel
- Aktives Rechtsschema: Team: ILD_CAD_Integration_Team
- Vorgesehenes Rechtsschema (Projekt):
- Ersteller: Welle_Norbert
- Arbeitsstatus: In Arbeit

The "Relationen" tab shows a table of relationships:

Name	Relationen
CAD Working Data...	

The "Zusammenfassung" tab shows a hierarchical tree structure:

- ILD
 - Calorimeters
 - ILD Barrel Calorimeters
 - ILD Barrel ECal
 - ILD Barrel HCal
 - ILD Endcaps Calorimeters
 - Forward Region
 - ILD Documentation
 - Inner Region
 - Integration
 - Liaison Office
 - Outer Tracking
 - Physics & Optimization
 - Project Management
 - Solenoid
 - System Tests & R&D
 - Yoke

The "AHCAL" section is expanded, showing a list of components:

- Geometry and Parameters
- Absorber
- Sensitive Layer
- Frontend electronics
- Supply
- Support
- Interaction
- Simulation
- Management
- Dokumentation

On the right side of the interface, there is a 3D CAD model of the AHCAL barrel, which is a green, cylindrical structure with a central opening.

conclusions

- We know how to build the absorber structure and what are the costs
- the sensitive layers mechanics are known and the electronics is still evolving
- the design of the integration tools is in good progress
- but we have to improve the interplay with the other detector components (EDMS)

outlook

- Check AHCAL structure into EDMS
- Implement the AHCAL into the Coil/Joke model
- Implement the ECAL into the AHCAL
- Implement the TPC model into the barrel system
- Load all last versions from EDMS and check for collisions or gaps
- start stress test with real size modules
- locking forward to start the second loop