The AHCAL Barrel in ILD

Design Status Report

ILD Software and Integration Workshop 2010
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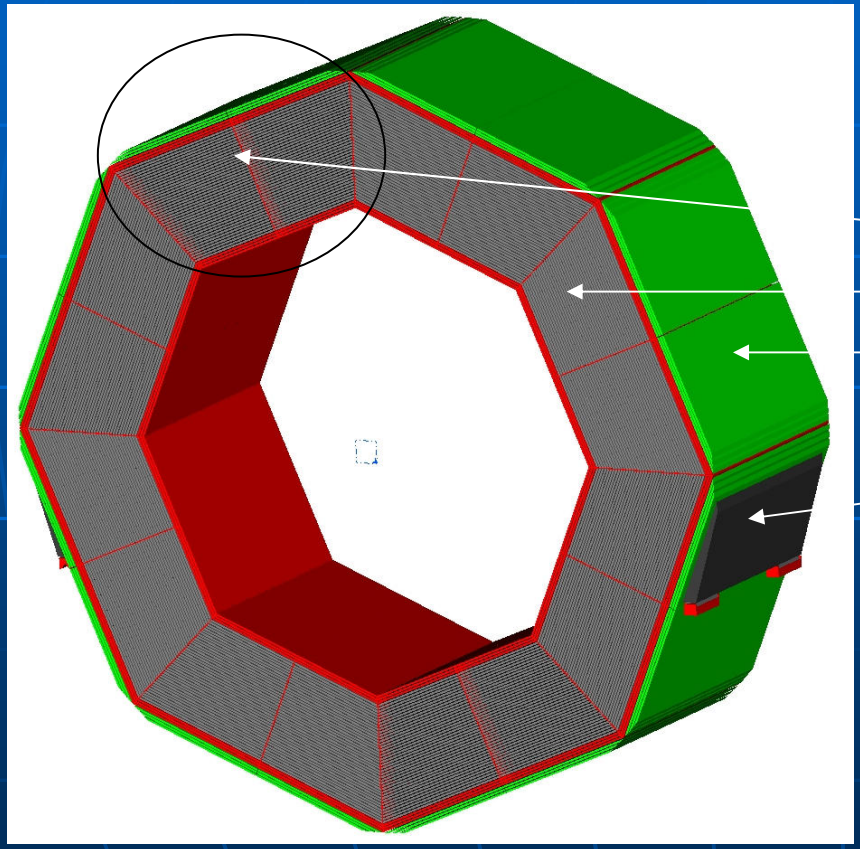
AHCAL barrel data set 1 to start the mechanical design

(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
    - scintilator 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 t / 8 = 120 t
    2 x 320 t (AHCAL half barrel) = 640 t

AHCAL work flow 1.loop

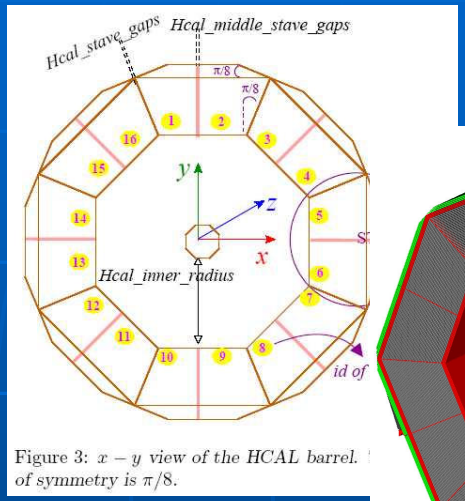
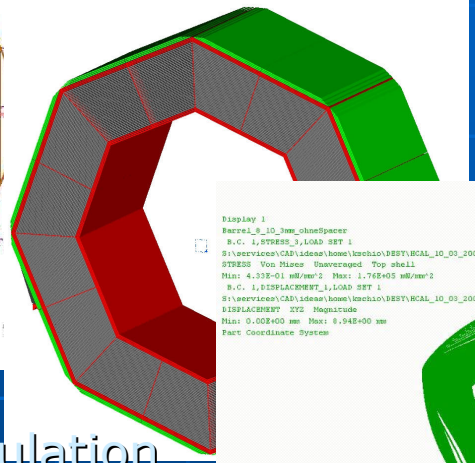
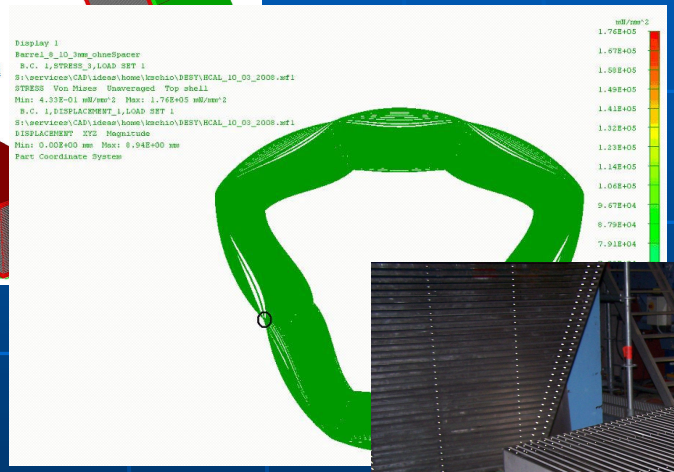


Figure 3: $x-y$ view of the HCAL barrel. of symmetry is $\pi/8$.

3D Design

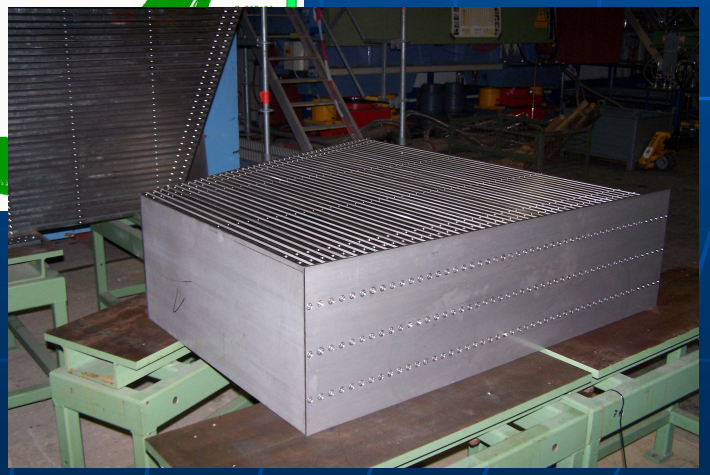


FEM studies

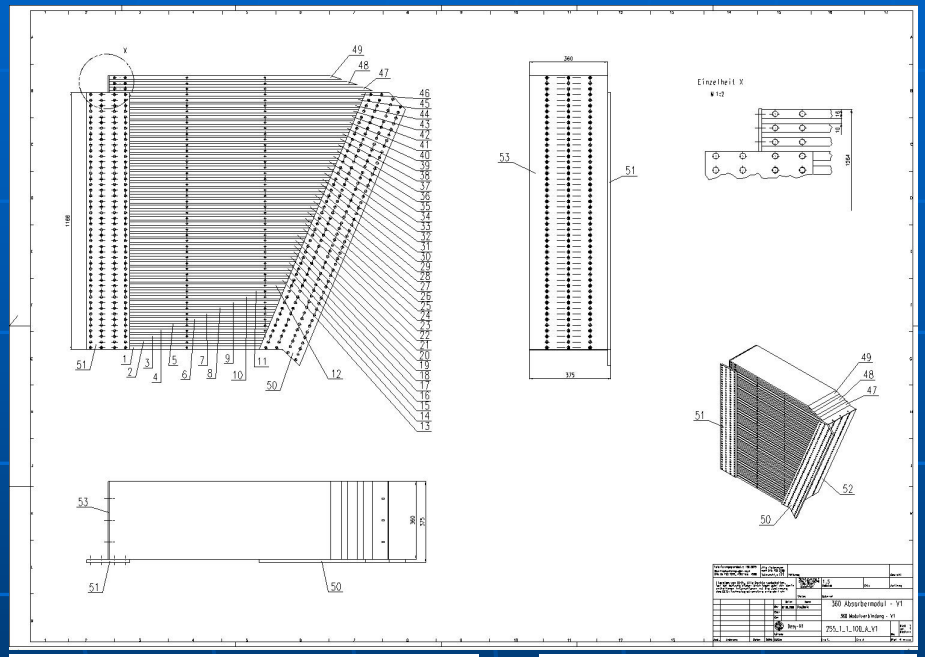


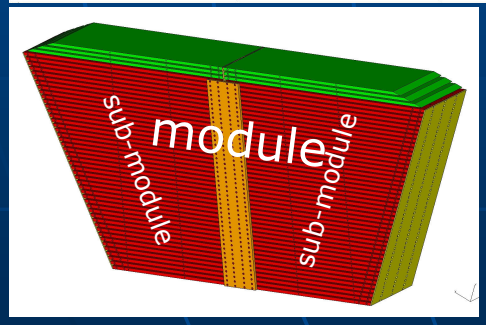
Physics simulation

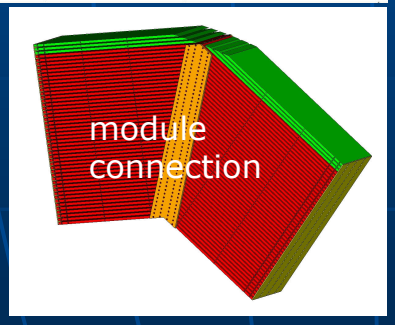
real size prototyping



real size test setup vertical







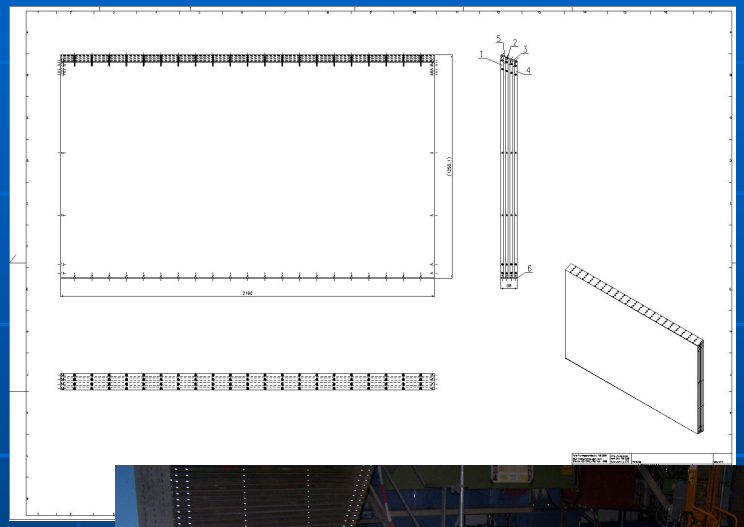
2 short length (360 mm) absorber sub-modules mounted to a short length module

360 mm = 1 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 where 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

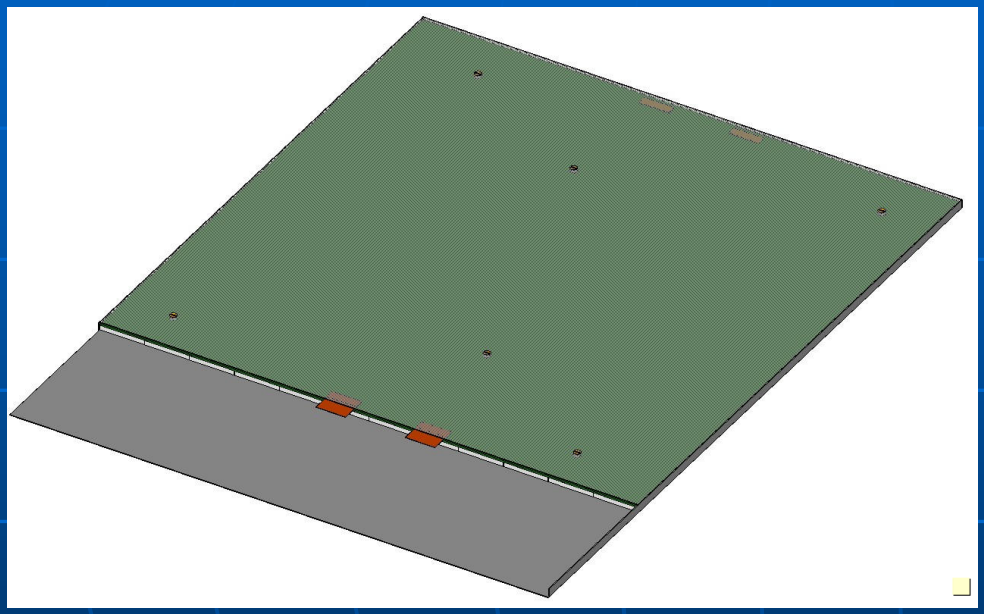
outer position = broadest plates (~ 1300 mm)

- **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

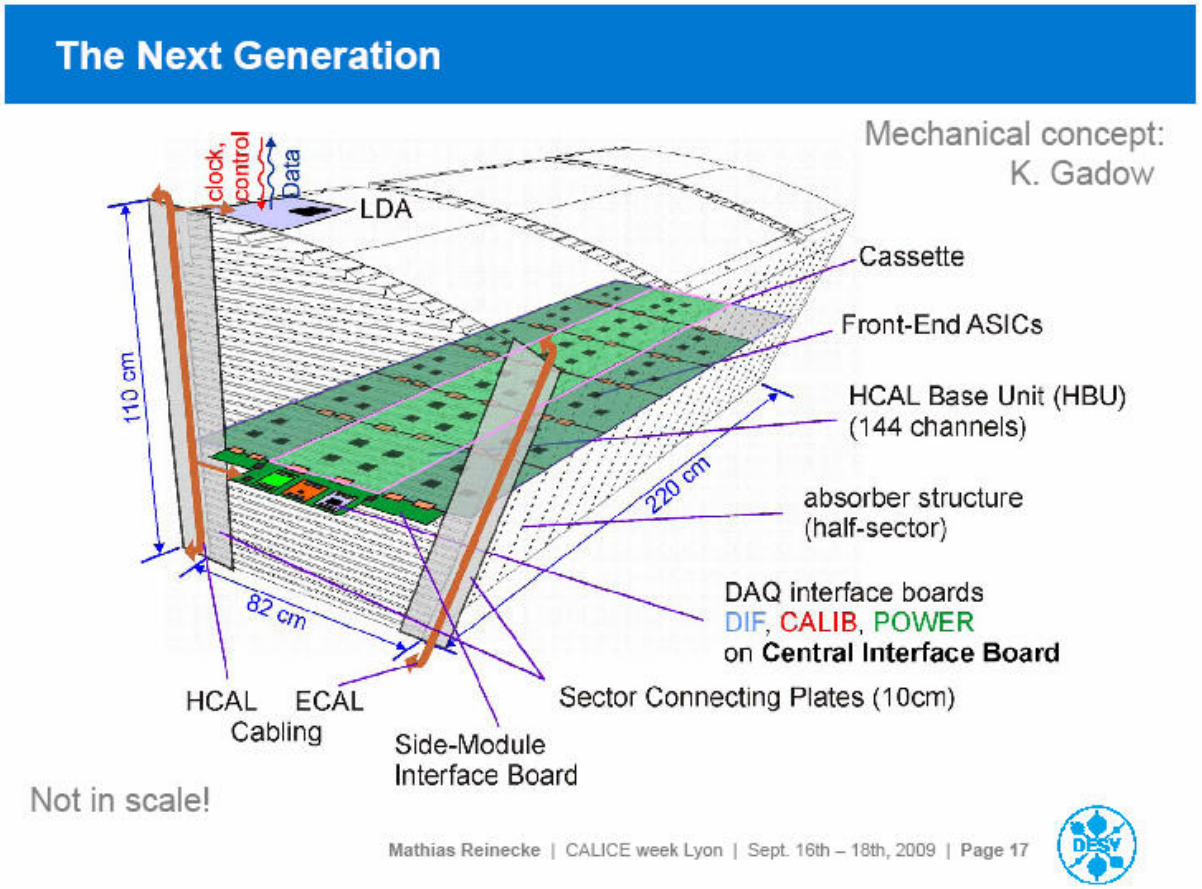


1HBU and 2HBU standard width housing prototypes available

- 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 bolds 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

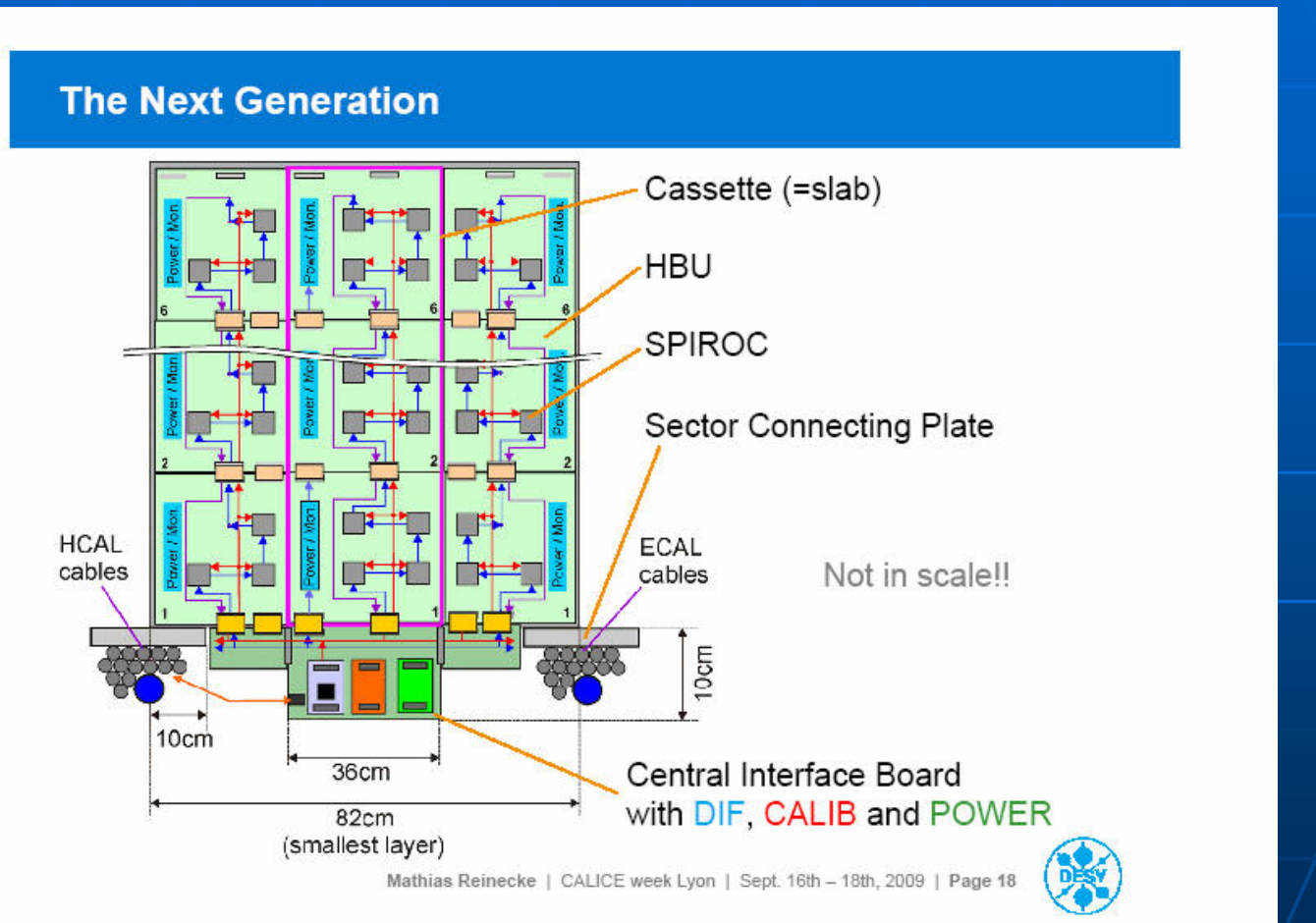
AHCAL sensitive layers

Mathias Reinecke



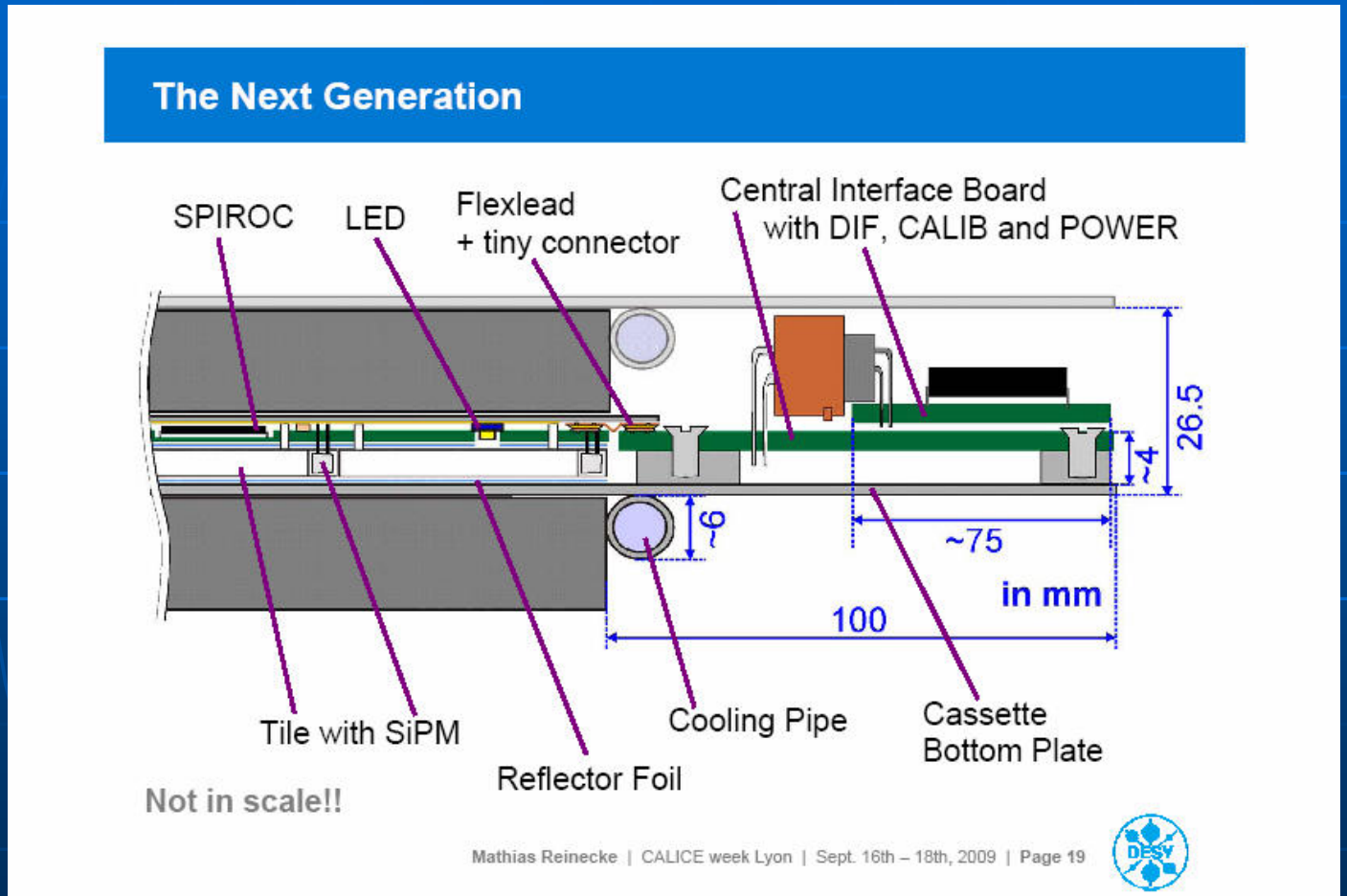
AHCAL sensitive layers

Mathias Reinecke

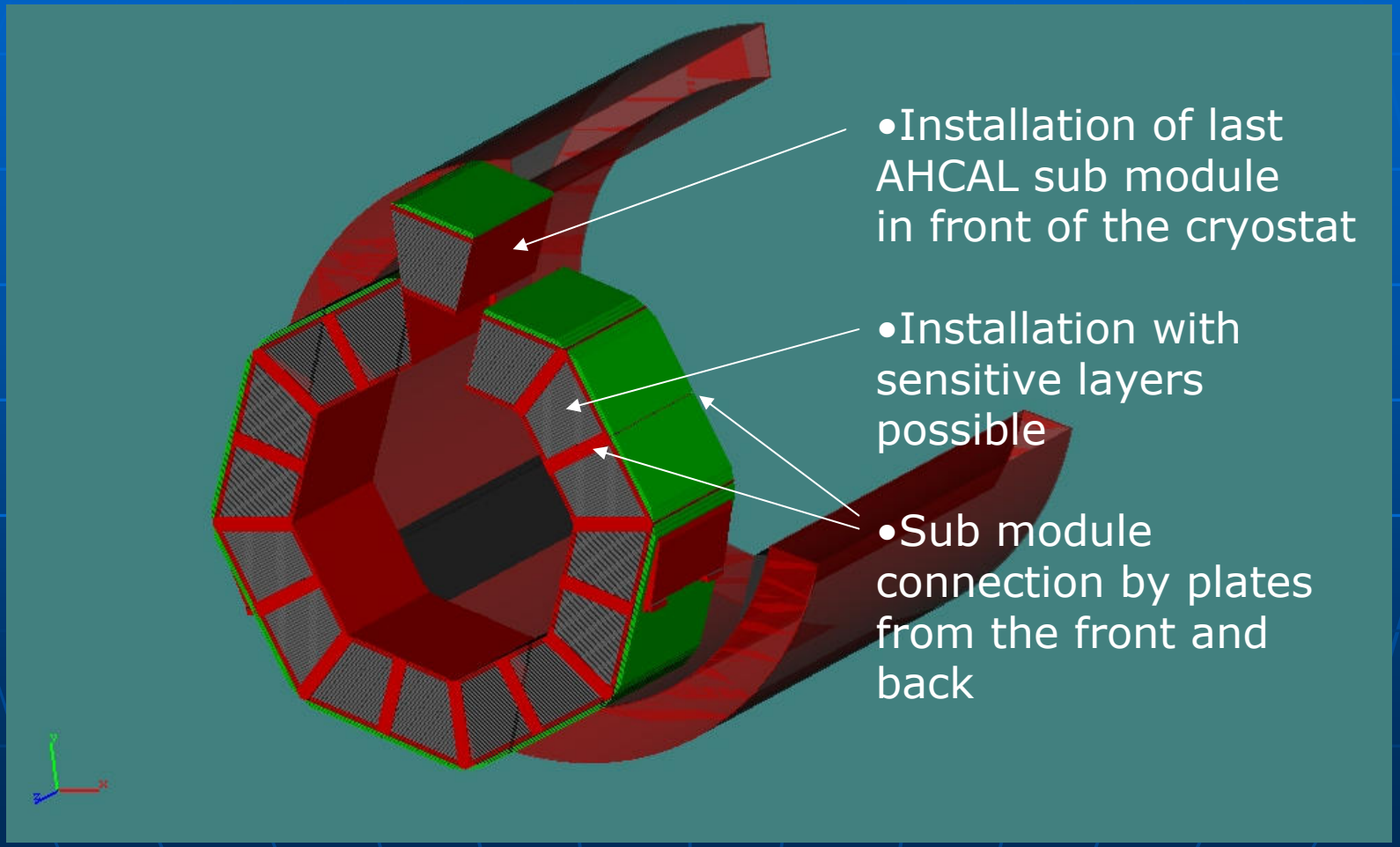


AHCAL sensitive layers

Mathias Reinecke

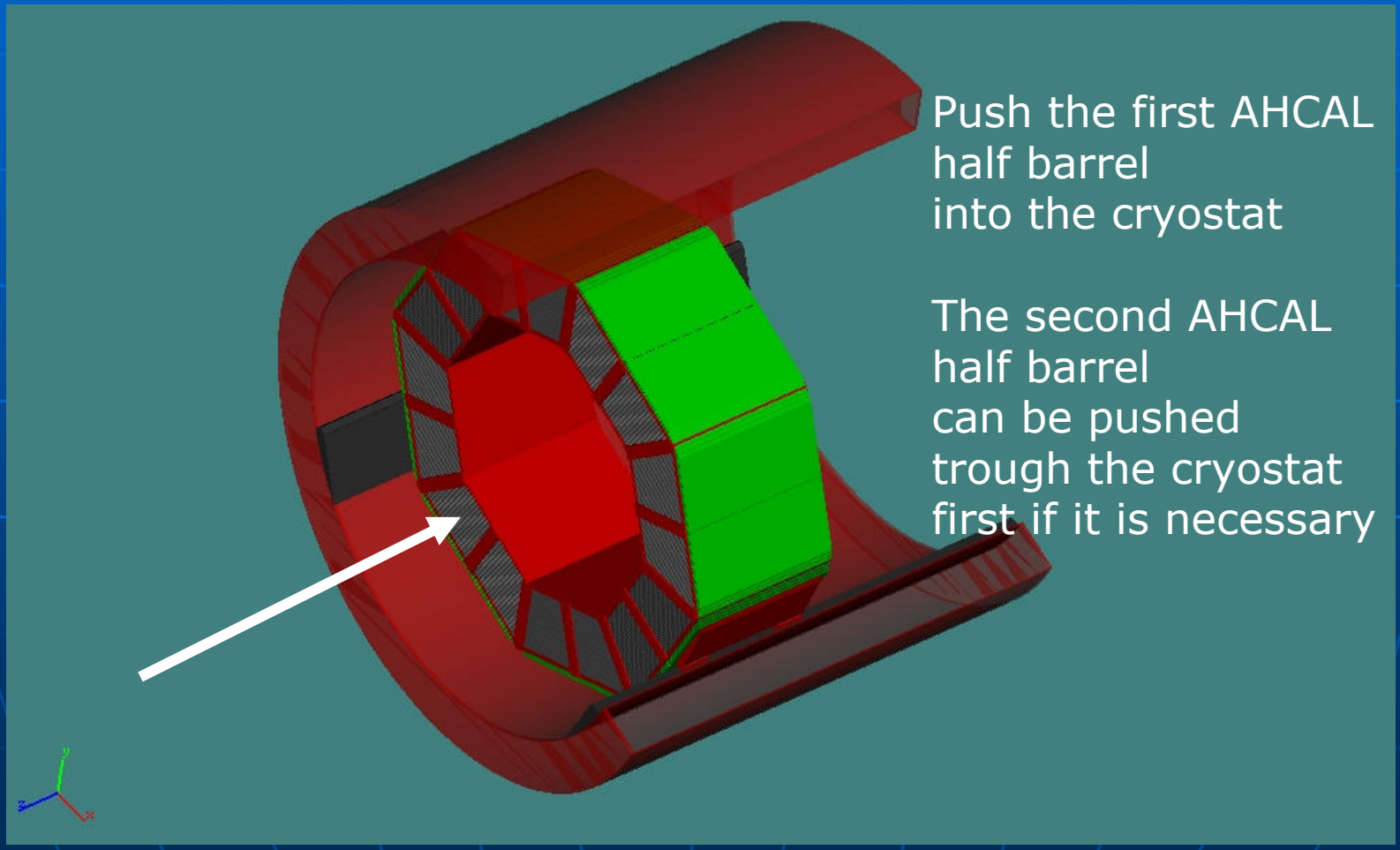


AHCAL barrel integration in ILD step 1



- Installation of last AHCAL sub module in front of the cryostat
- Installation with sensitive layers possible
- Sub module connection by plates from the front and back

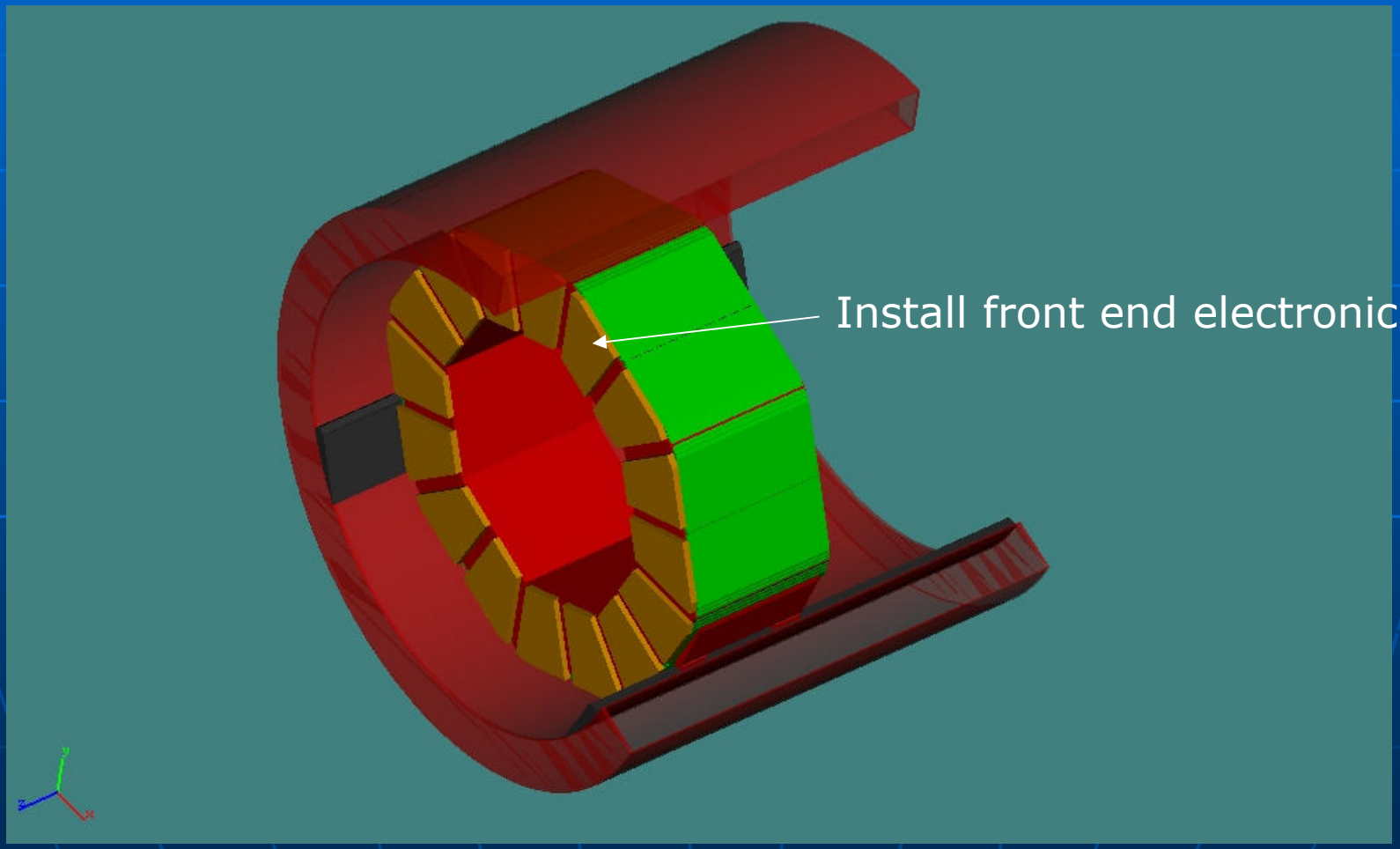
AHCAL barrel integration in ILD step 2



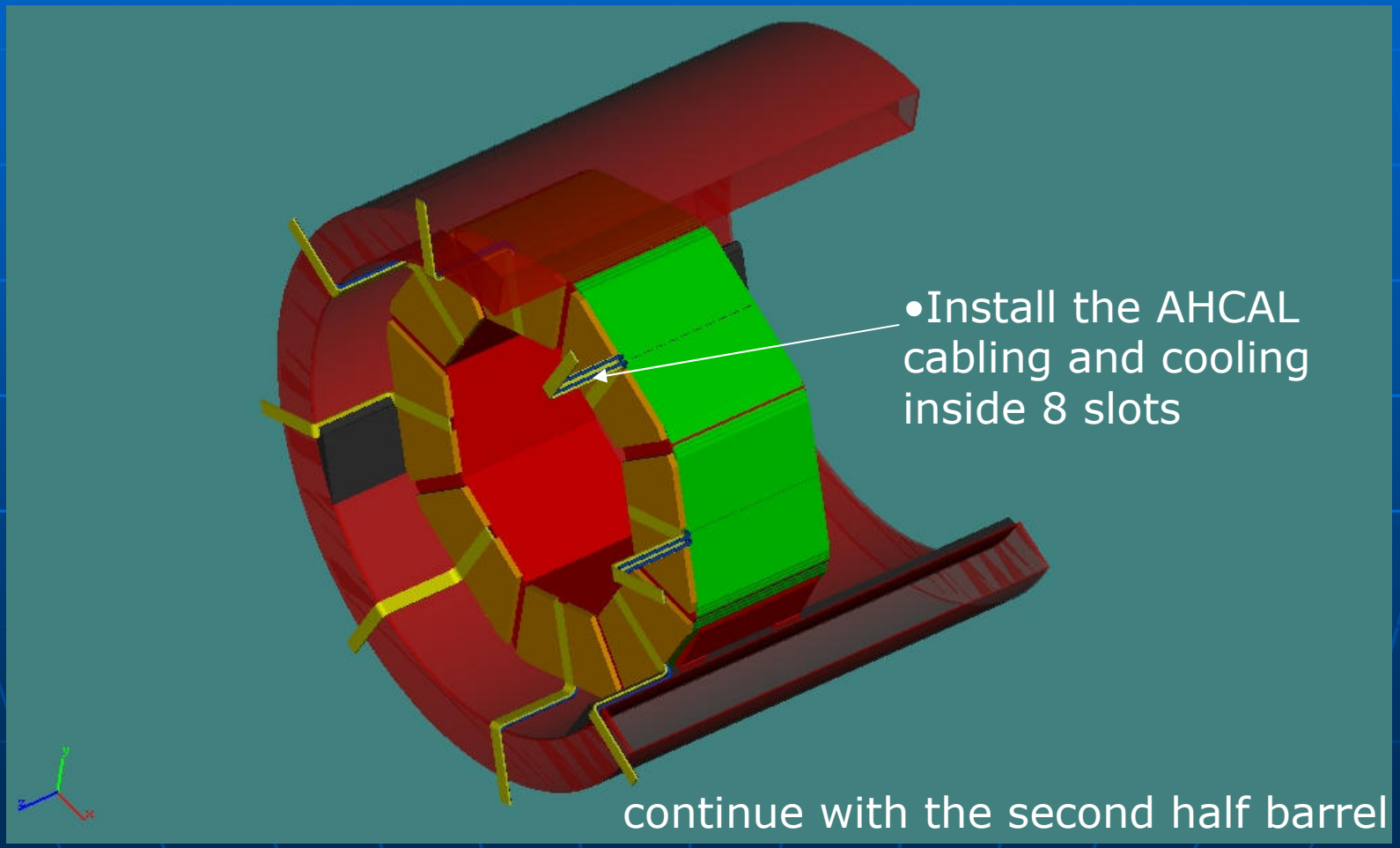
Push the first AHCAL half barrel into the cryostat

The second AHCAL half barrel can be pushed trough the cryostat first if it is necessary

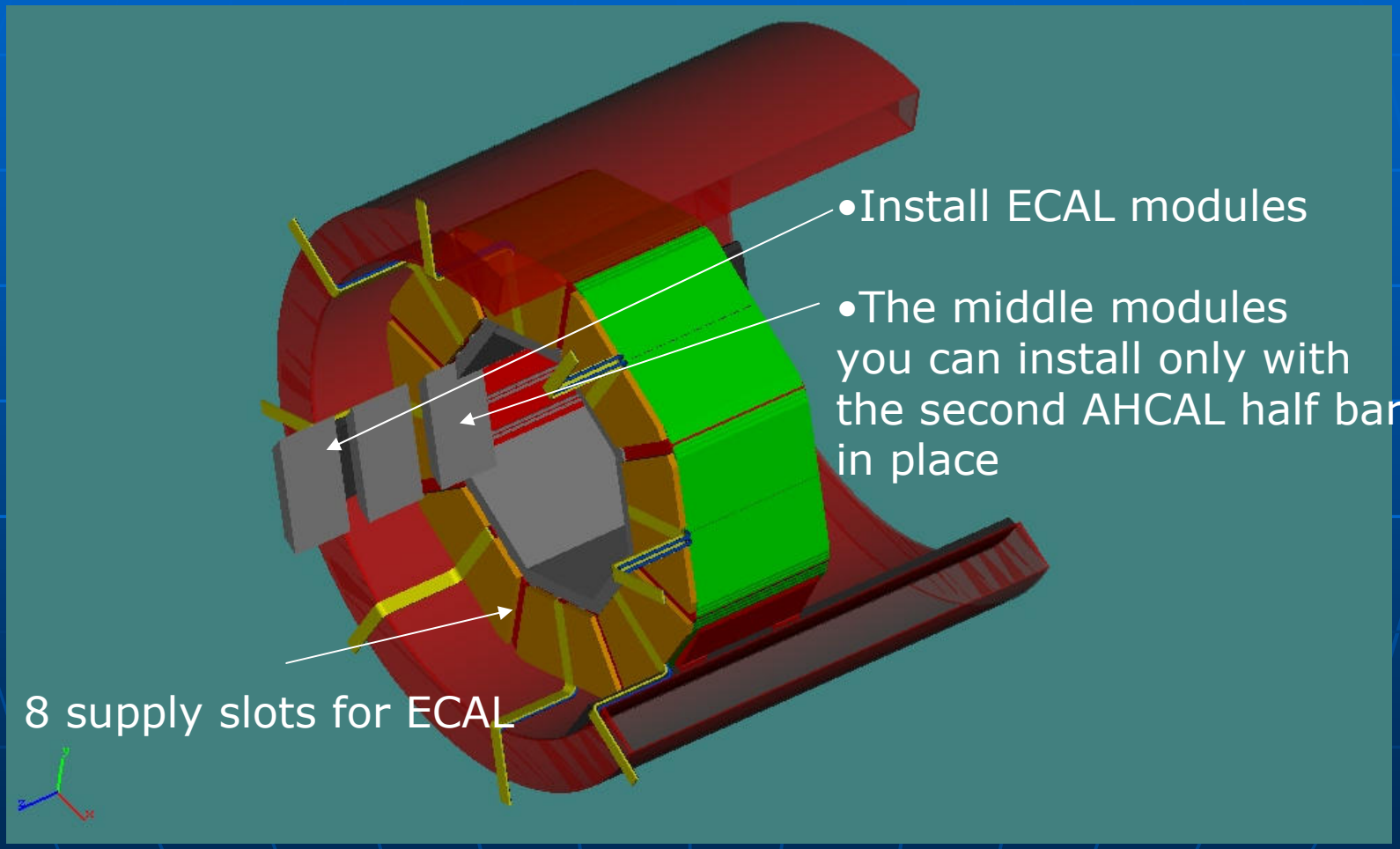
AHCAL barrel integration in ILD step 3



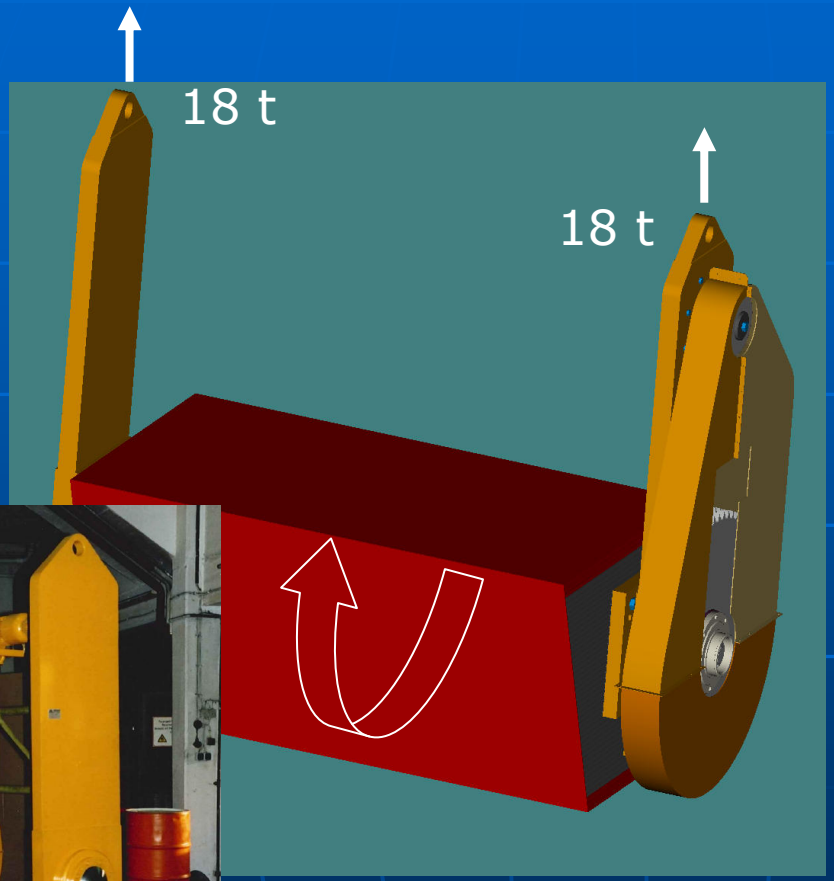
AHCAL barrel integration in ILD step 4



ECAL barrel integration in ILD

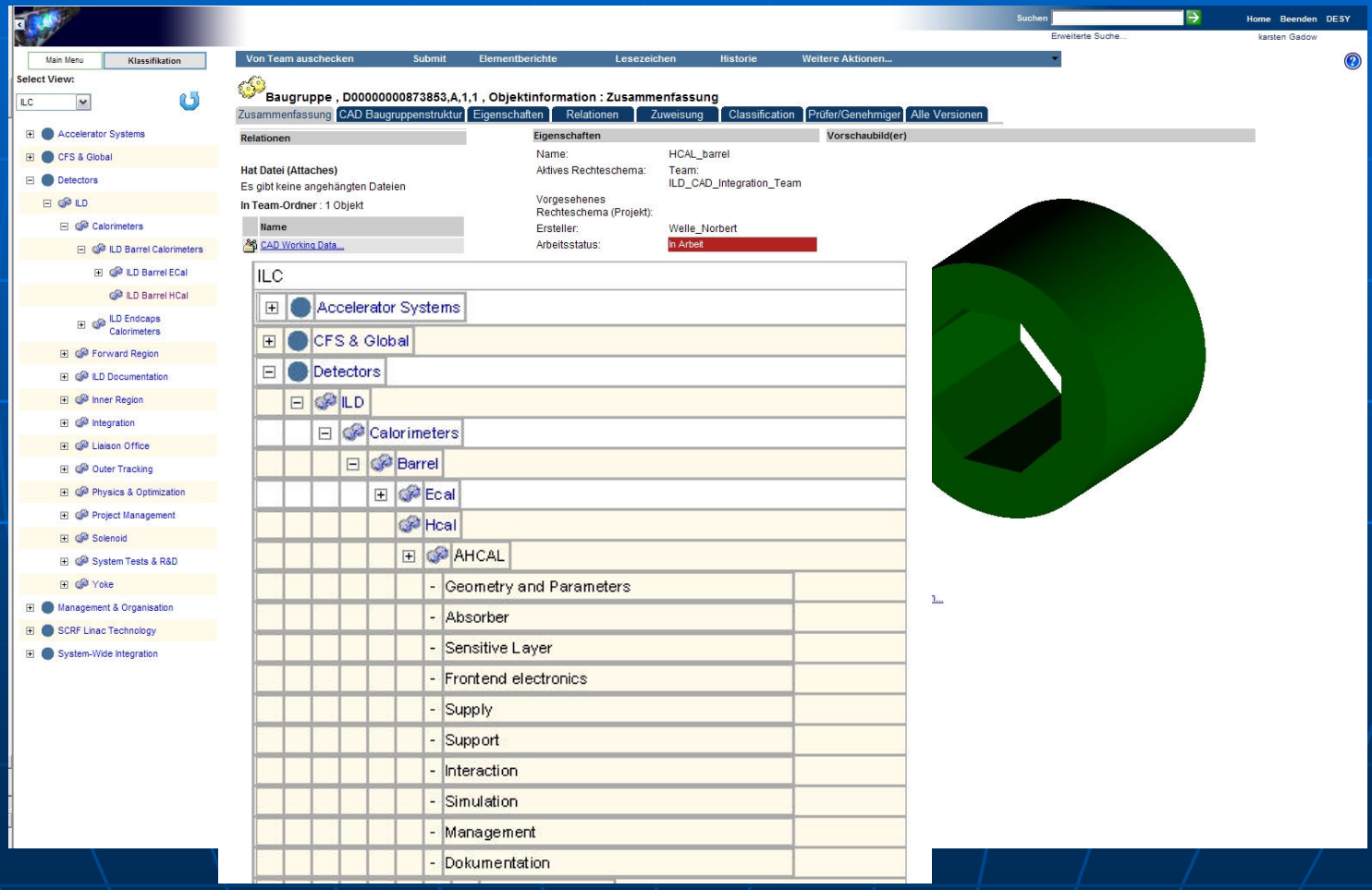


AHCAL barrel integration tools



- 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)



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