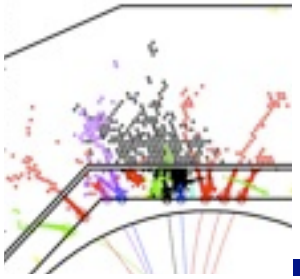
AHCAL engineering model

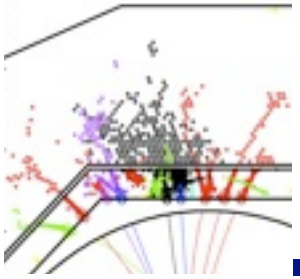
Felix Sefkow

ILD workshop at Kyushu
May 21, 2012

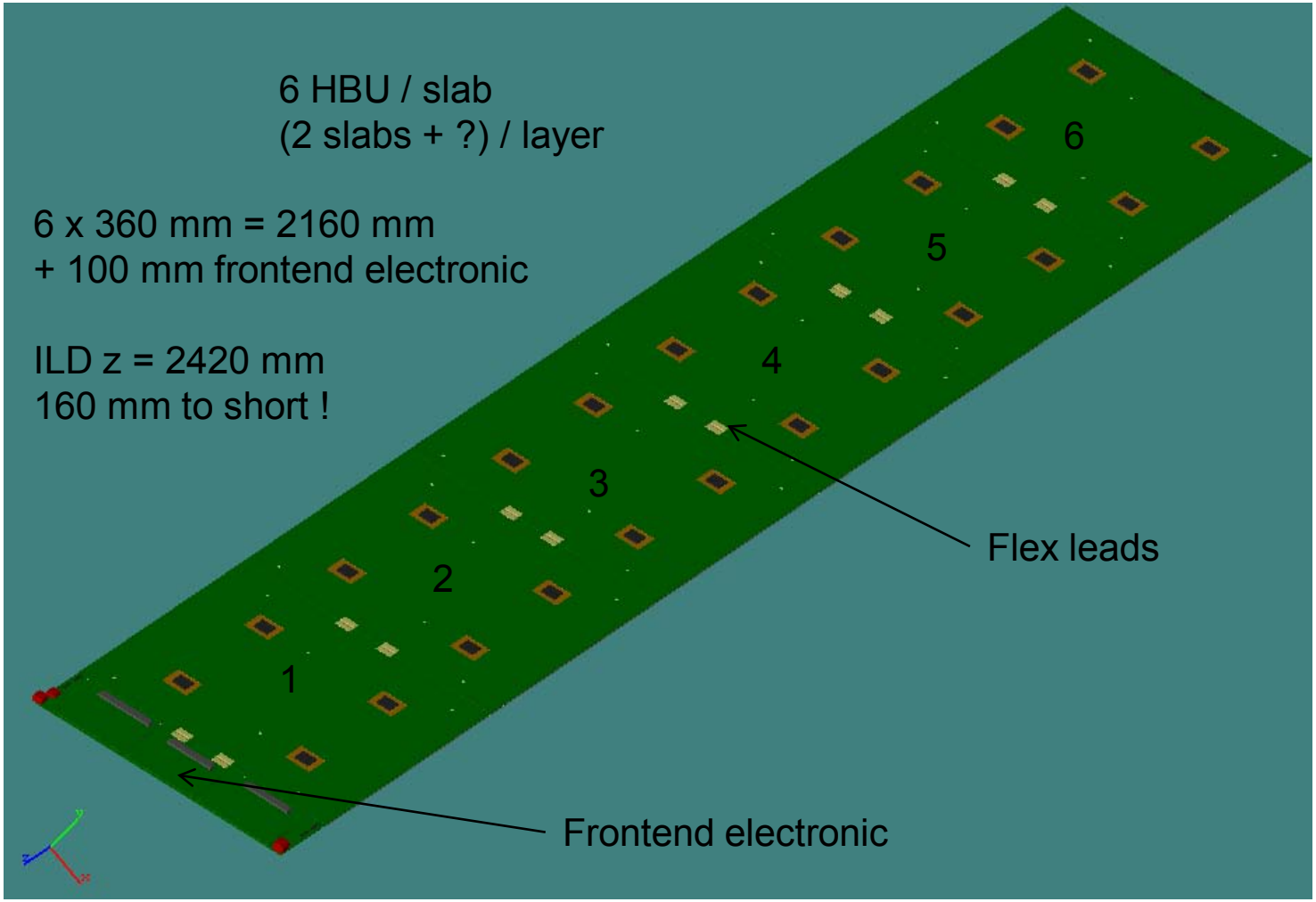


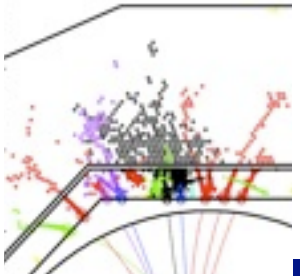
Outline

- Overview and status of barrel and endcap
  - design, integration, installation, prototypes
- Topical issues:
  - rotation of the barrel
  - stability, TPC support
- Work done and pictures made by **Karsten Gadow, DESY**

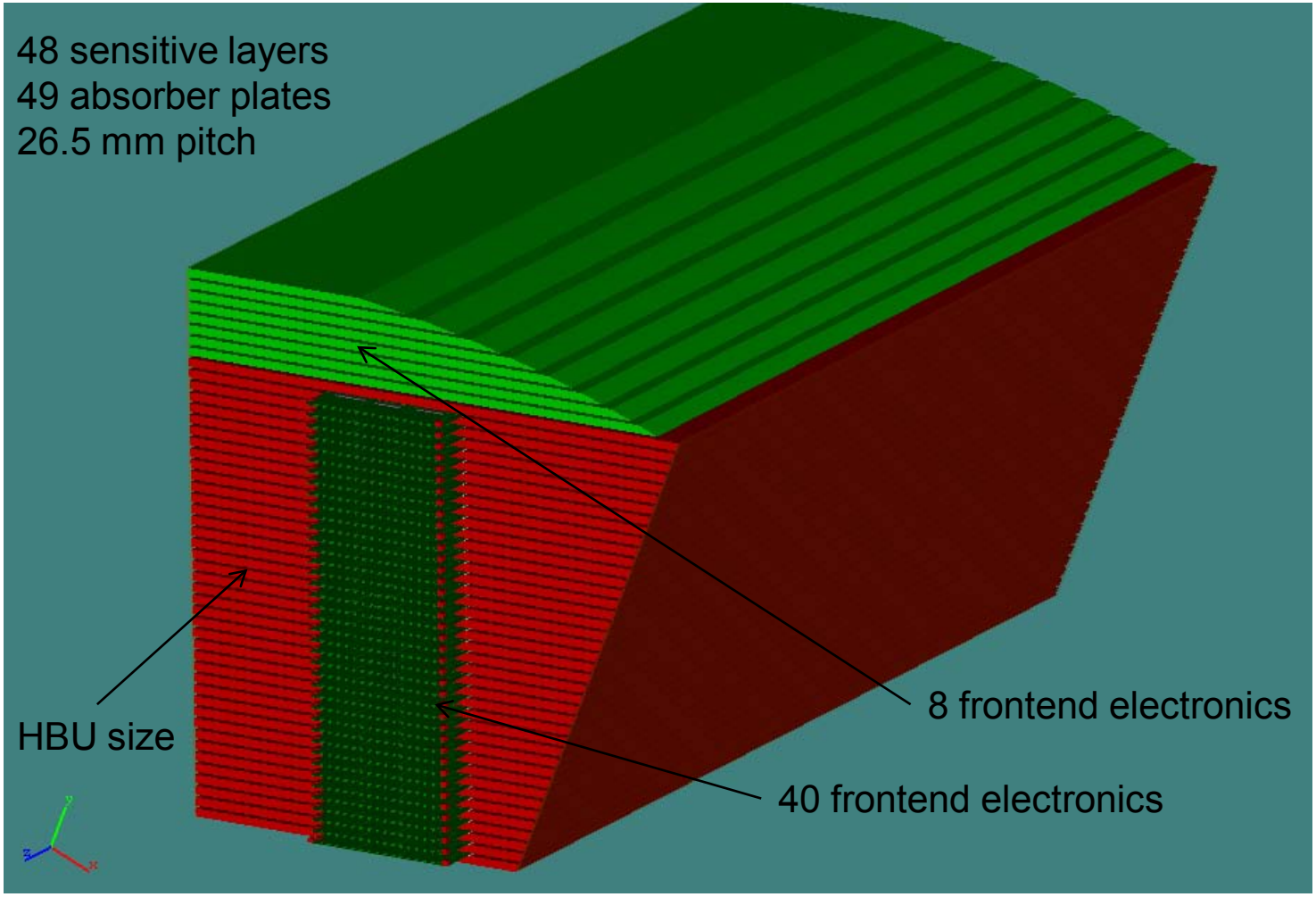


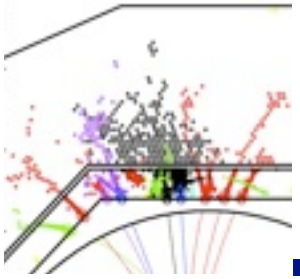
Active layer slab



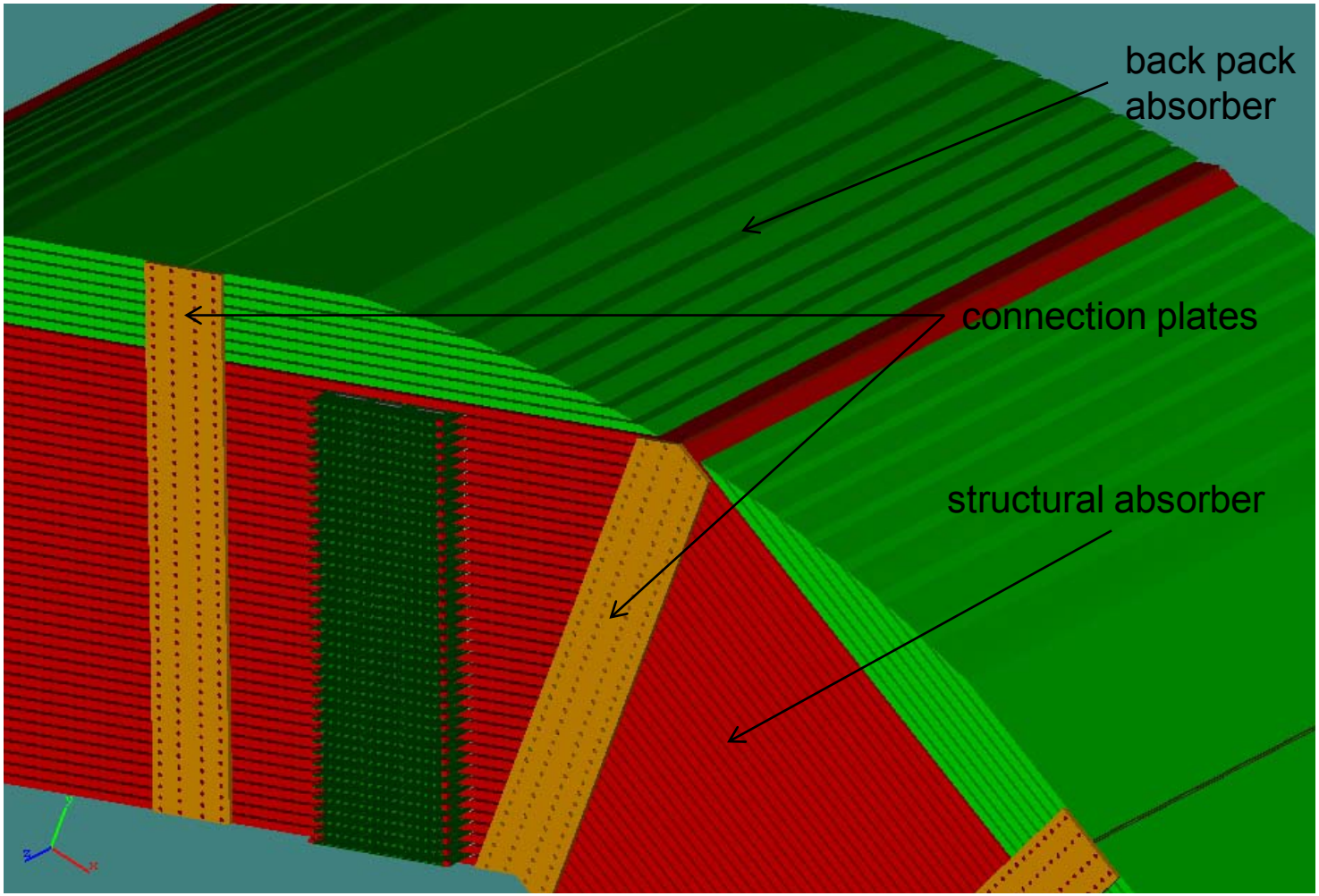


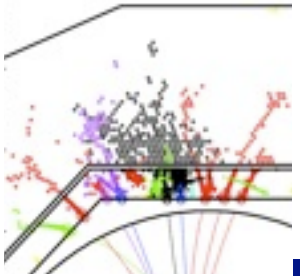
Barrel stack



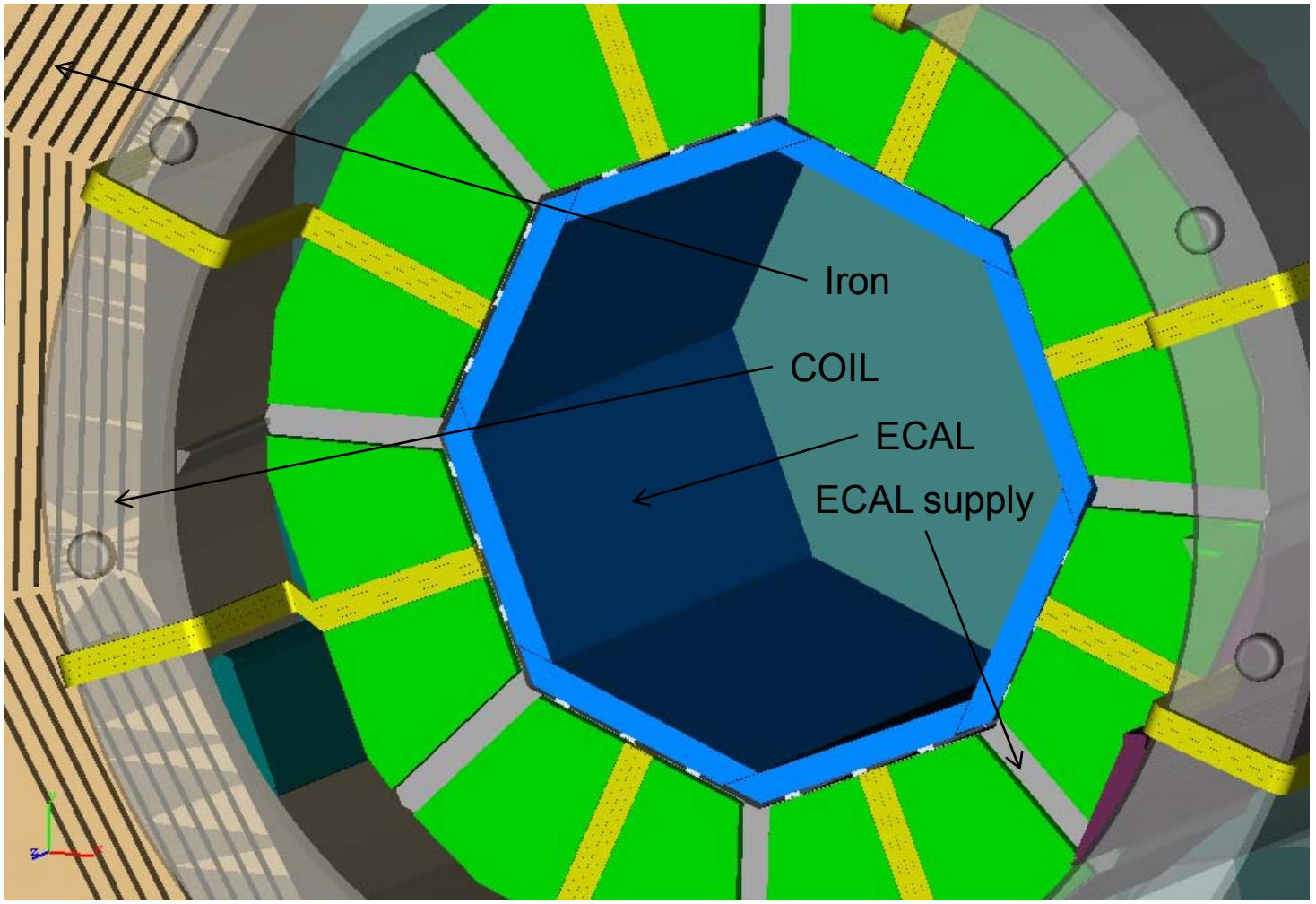


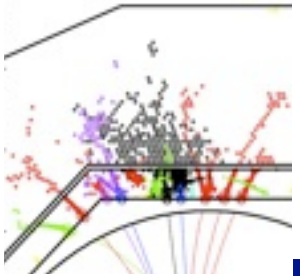
Barrel absorber structure



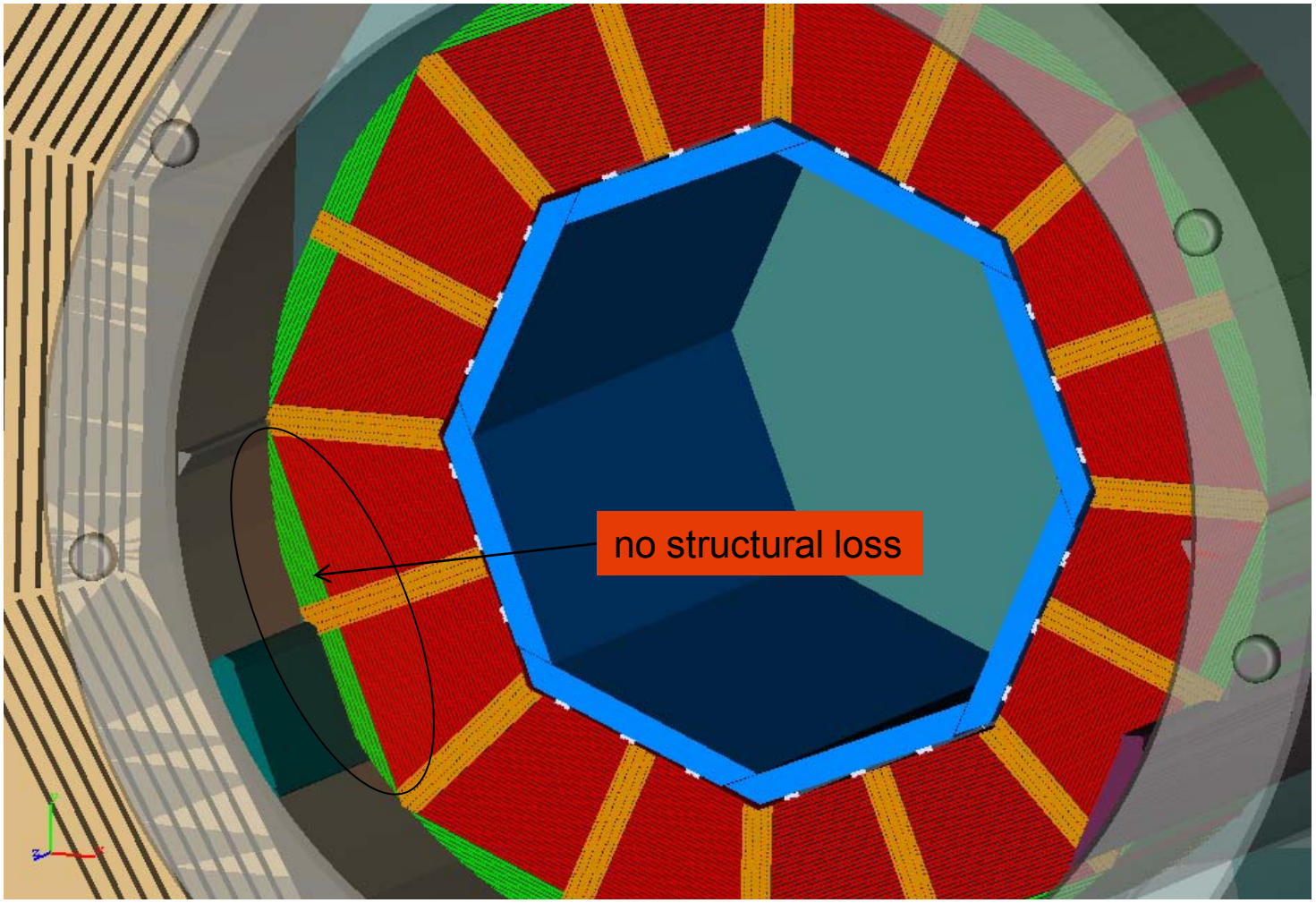


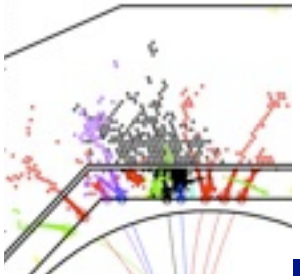
Intergration with ECAL in ILD





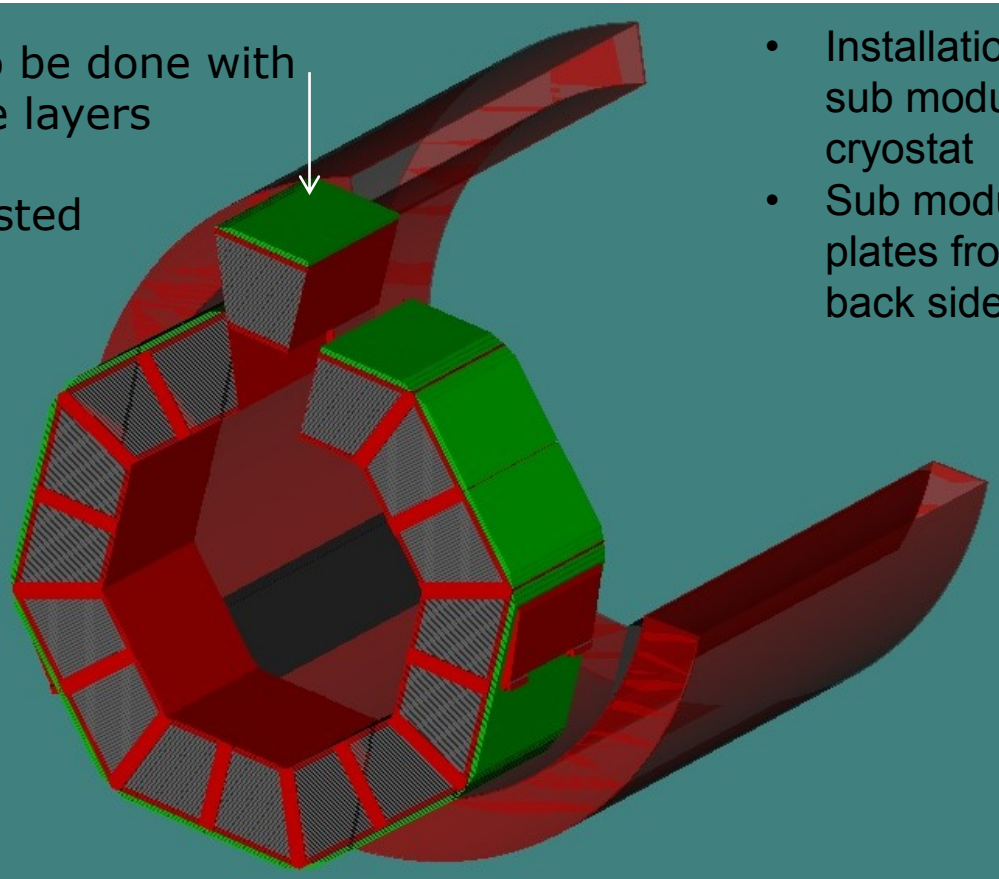
Support in cryostat



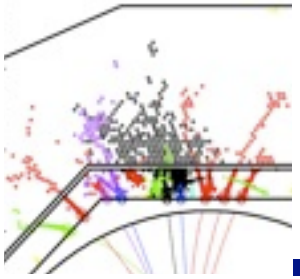


Installation of modules

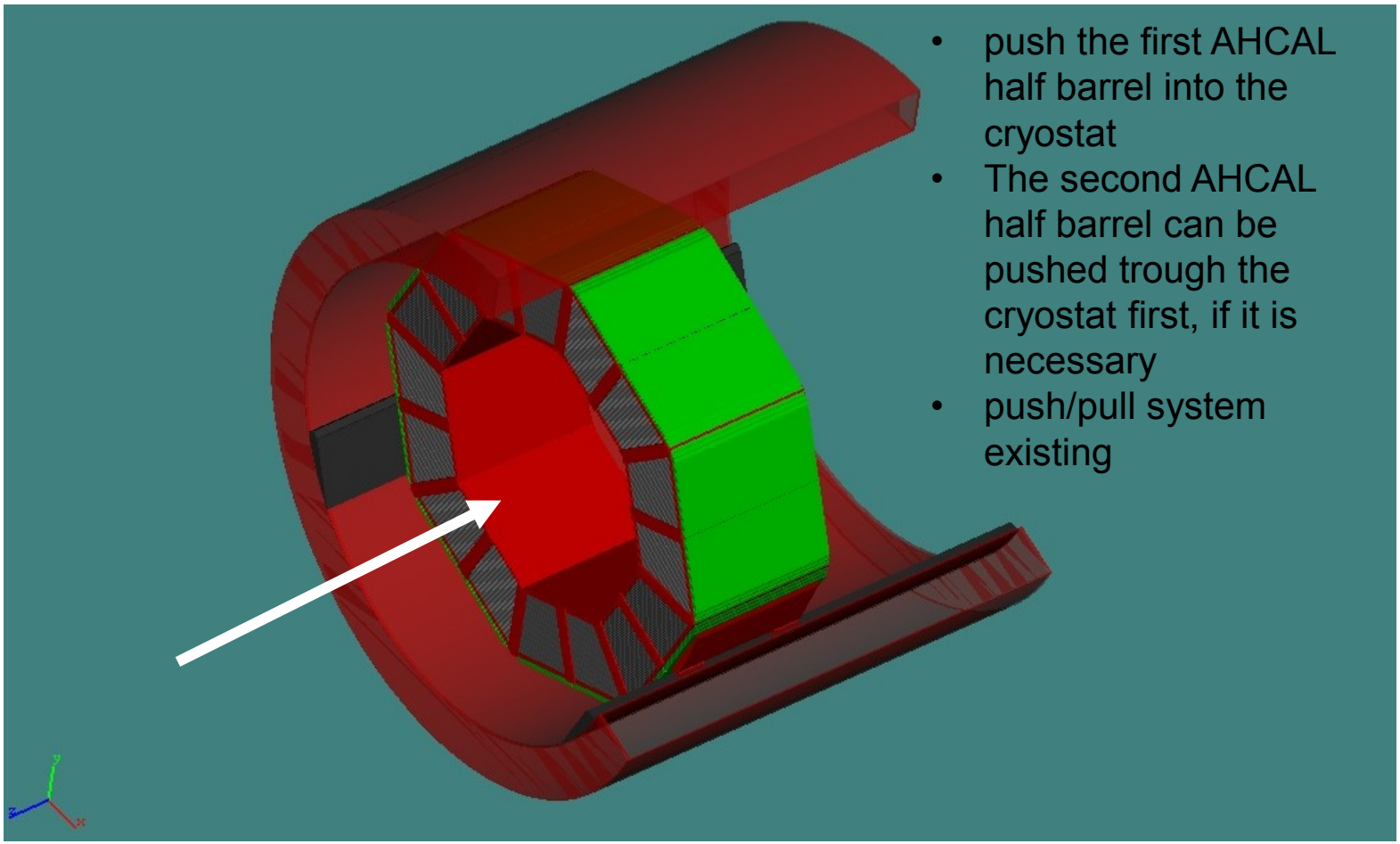
Can also be done with sensitive layers in place
- and tested before



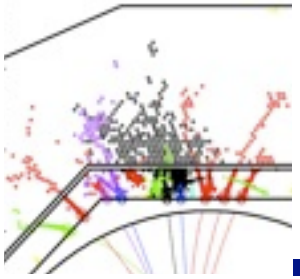
- Installation of last AHCAL sub module in front of the cryostat
- Sub module connection by plates from the front and back side



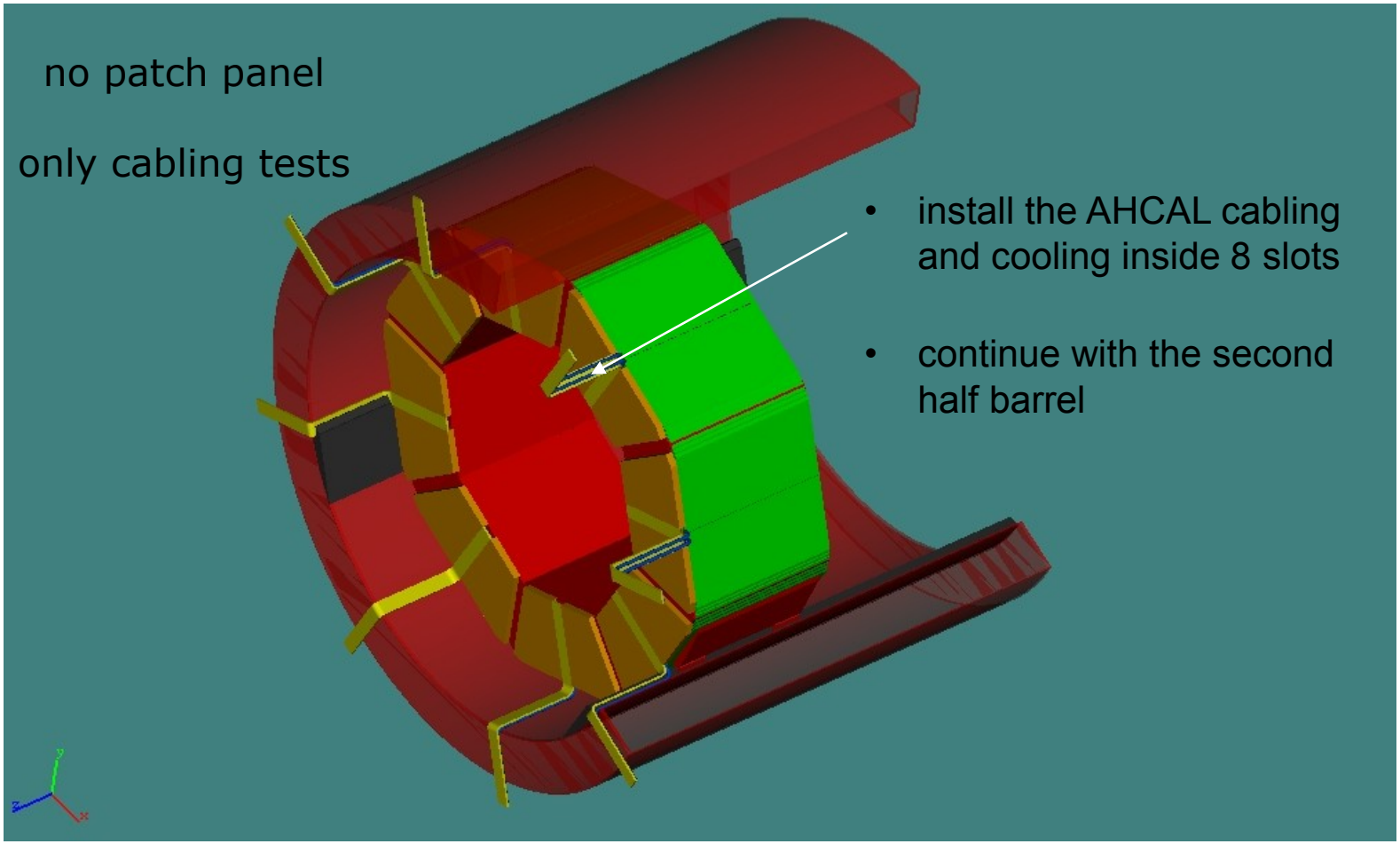
Insertion of half barrel

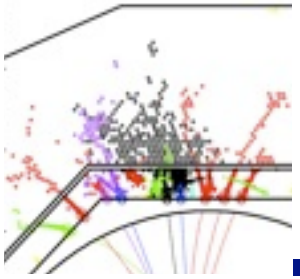


- push the first AHCAL half barrel into the cryostat
- The second AHCAL half barrel can be pushed trough the cryostat first, if it is necessary
- push/pull system existing

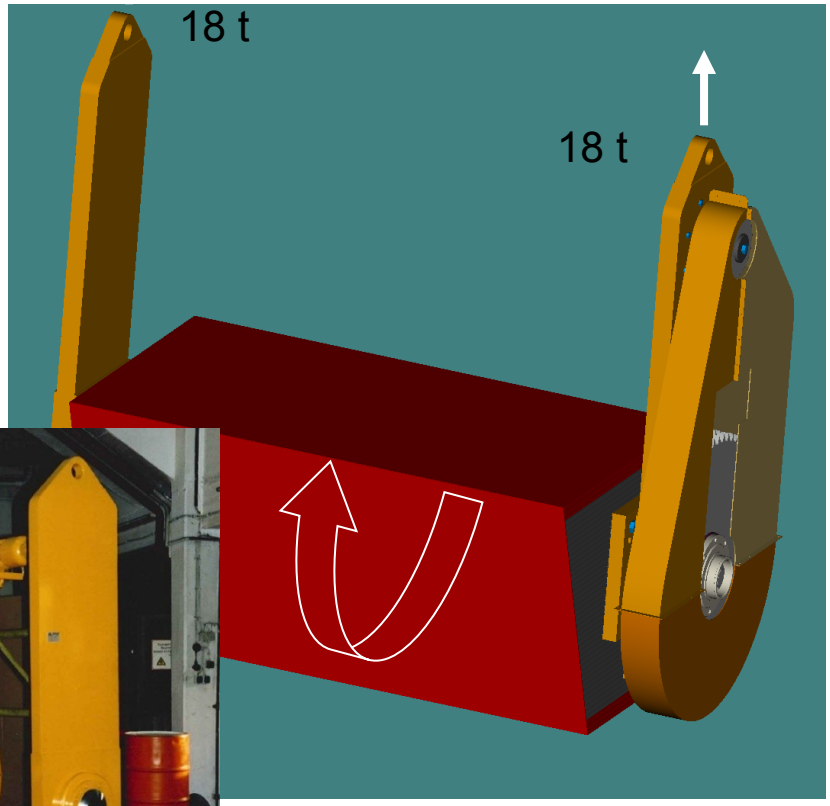


Cabling and services

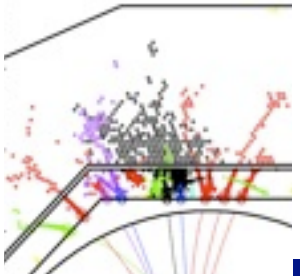




Installation tooling

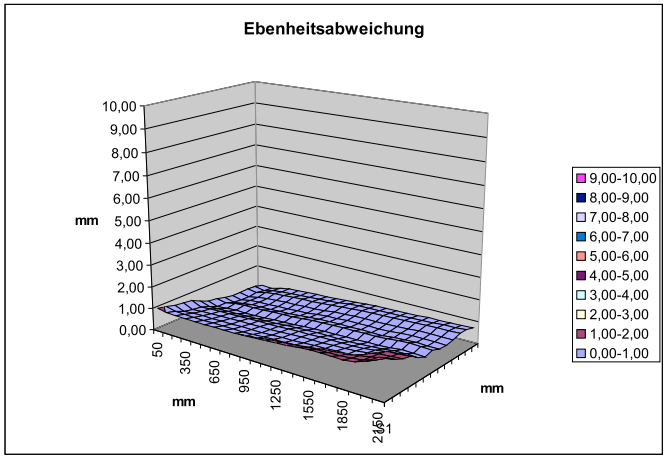


- lifting and turning tool for AHCAL barrel absorber sub-modules available
  - 2 x 18 t capacity
  - operation with 2 hooks (z angle adjustment)
  - precise motor controlled turning
  - design for adaptation for sub-modules with and without sensitive layers started
- mounting, support and insertion frame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

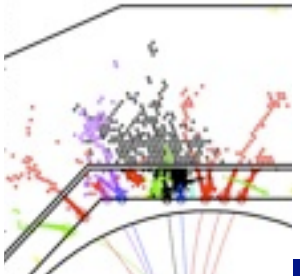


Prototypes

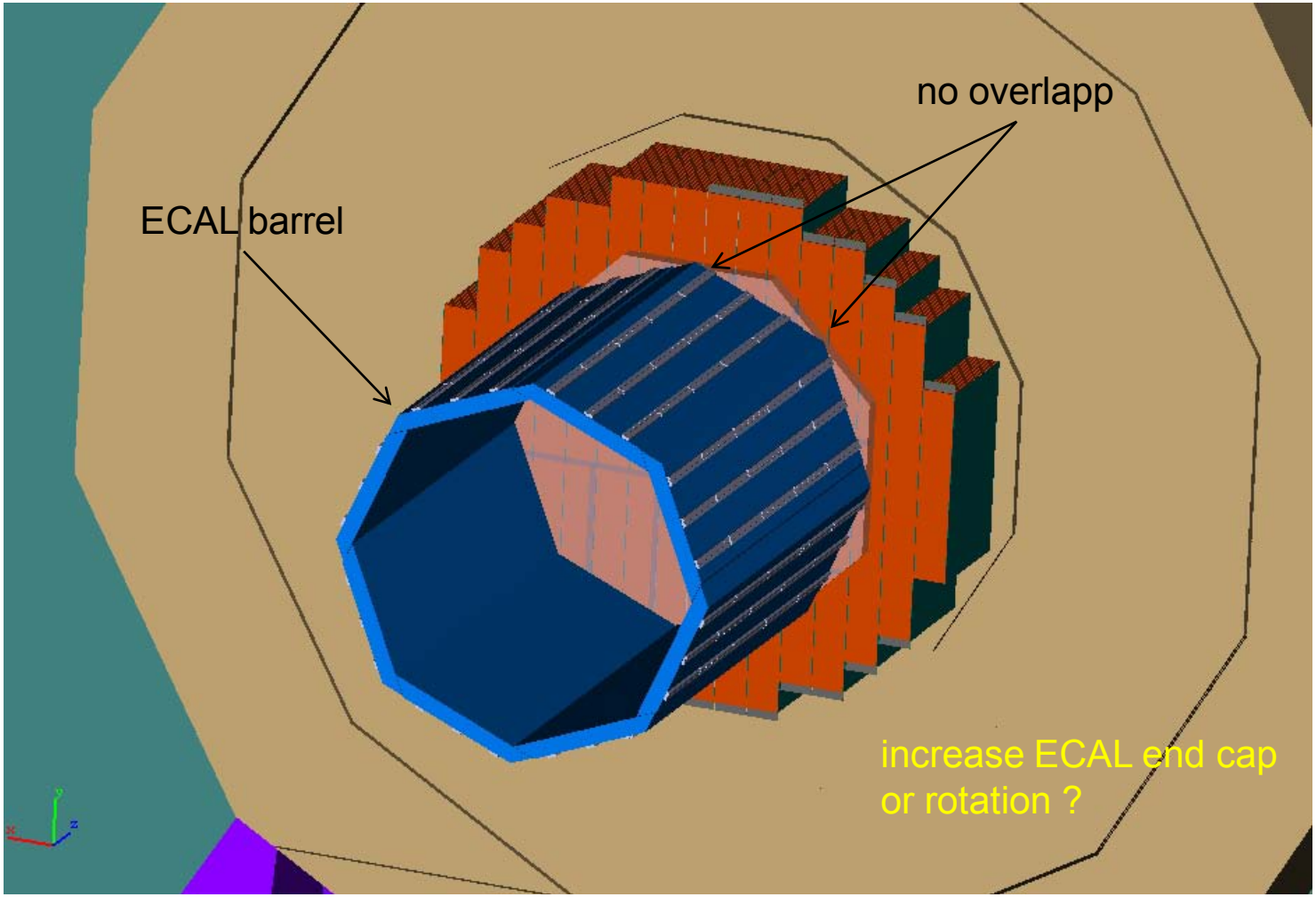
- Horizontal and vertical test structures built
- Flatness measurements confirm tolerances

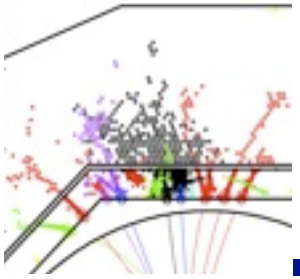


2160 mm sub-module plates after roller leveling max 1 mm deviation



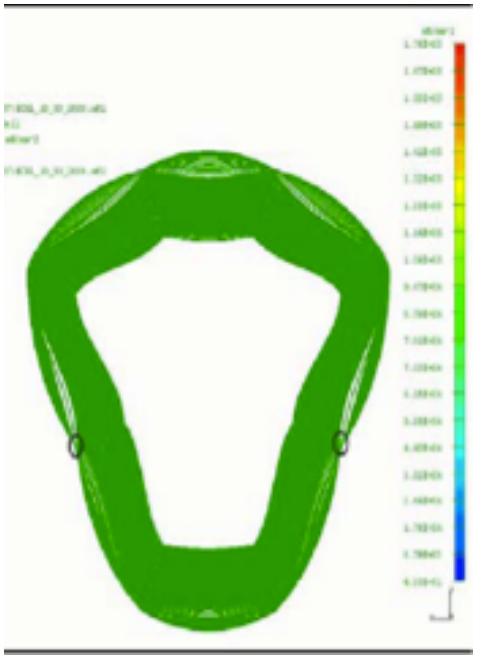
Barrel and endcap

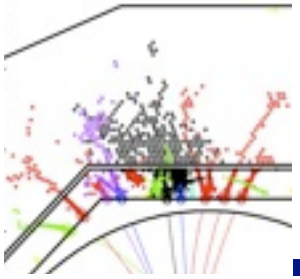




HCAL rotation

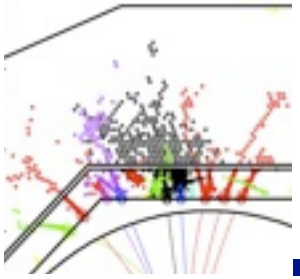
- Detailed FEM calculations have shown that the barrel deformations are about 2x as large if it is not placed on the tip but on a flat side
  - less advantageous, but could be compensated
- For the ECAL end cap this implies a slight increase of un-instrumented regions at the outer perimeter and a larger number of different wafer geometries
  - less advantageous, but could be tolerated
- Both orientations are in principle possible.
- In the final design the ECAL endcap should follow the HCAL barrel orientation
- Unfortunately, we have no consistent version for the DBD





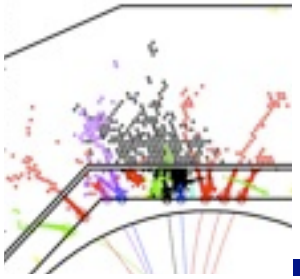
Alignment and stability

- The absorber structure does not move during operation
- The gravitational deformations are a few mm maximum
- They appear after installation and remain stable
- There may be small changes of the deformations during and after push-pull operation
- Therefore we do not recommend to use the HCAL barrel absorber as basis for the TPC support

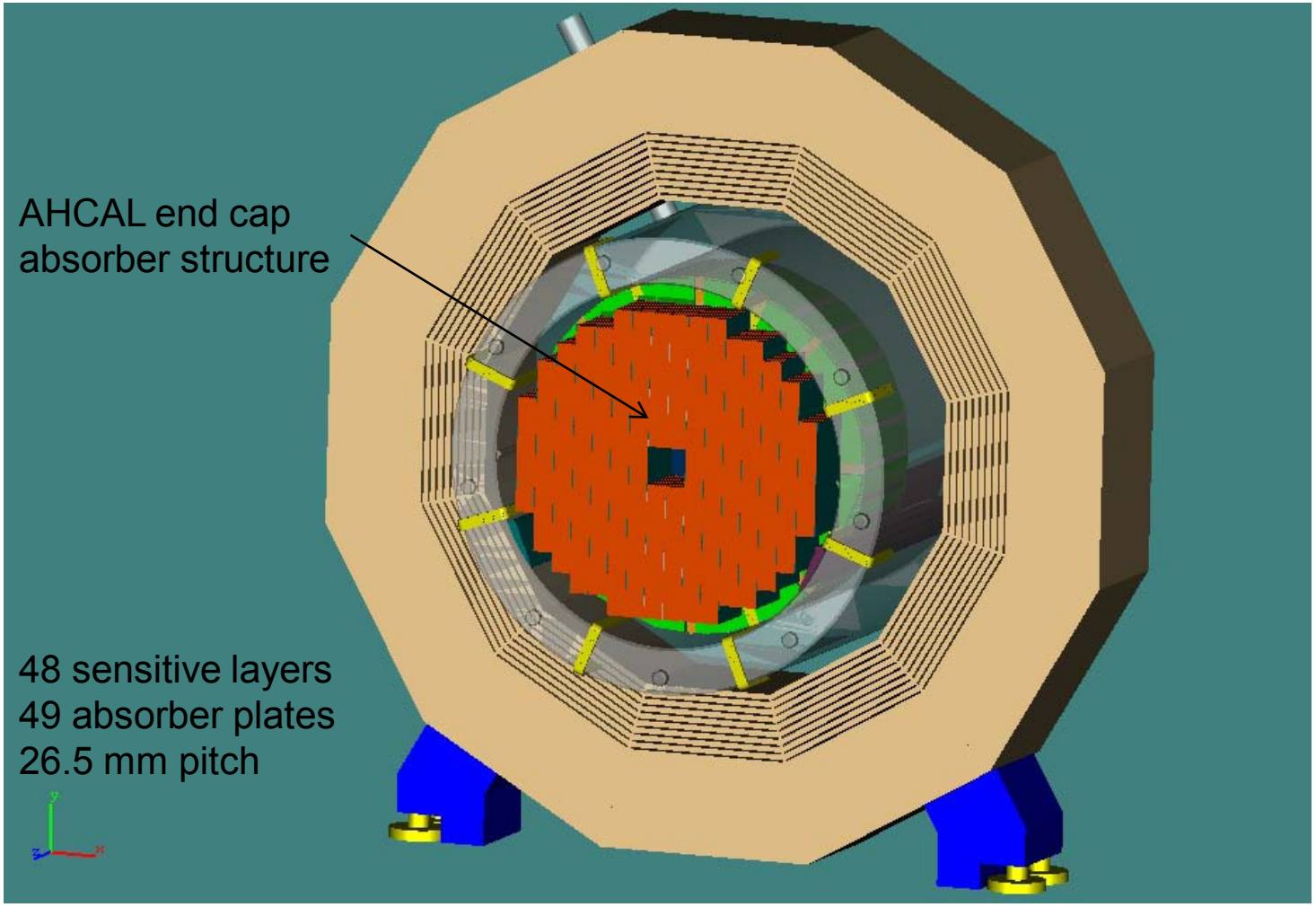


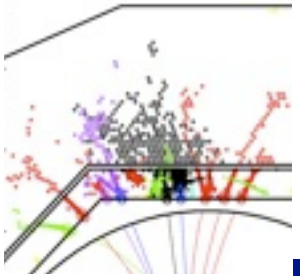
Barrel summary

- The barrel HCAL in the "T" version is a very ambitious design with a minimum of un-instrumented volume
- There are no gaps. The "cracks" are filled with steel
- The main advantage is the accessibility of all connections and interfaces for data and power which affect the functionality of entire layers
- The design was demonstrated to match required tolerances with rolled steel plates and screws for interconnection - which brings significant cost advantages with respect to welding and machining
- It is in principle suitable for analogue and digital read-out
- Compared with the "V" design, the structure is less rigid
- The rigidity can be enhanced by moderate addition of material - without giving up the cost advantages

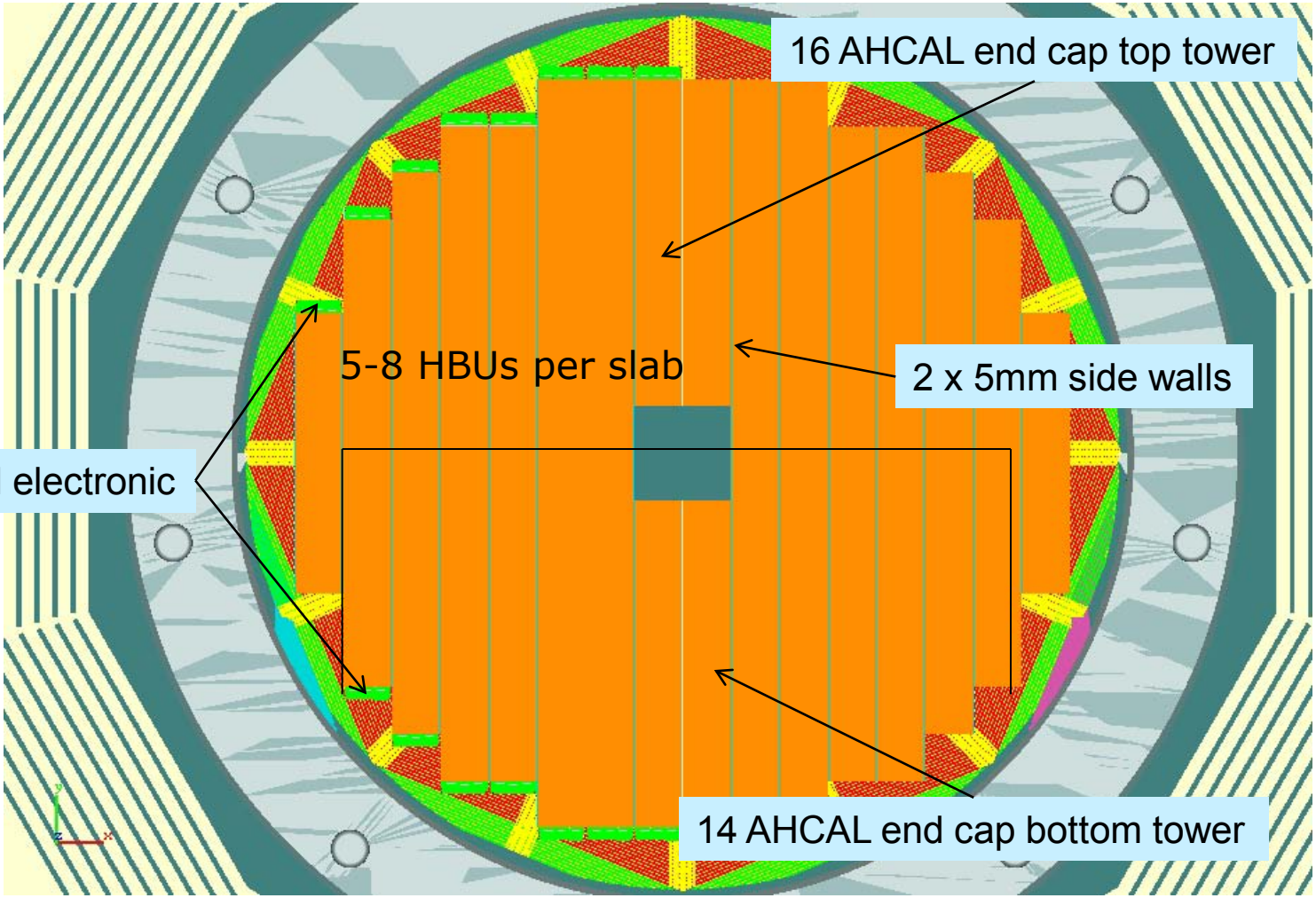


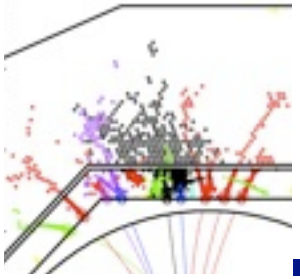
End cap absorber structure



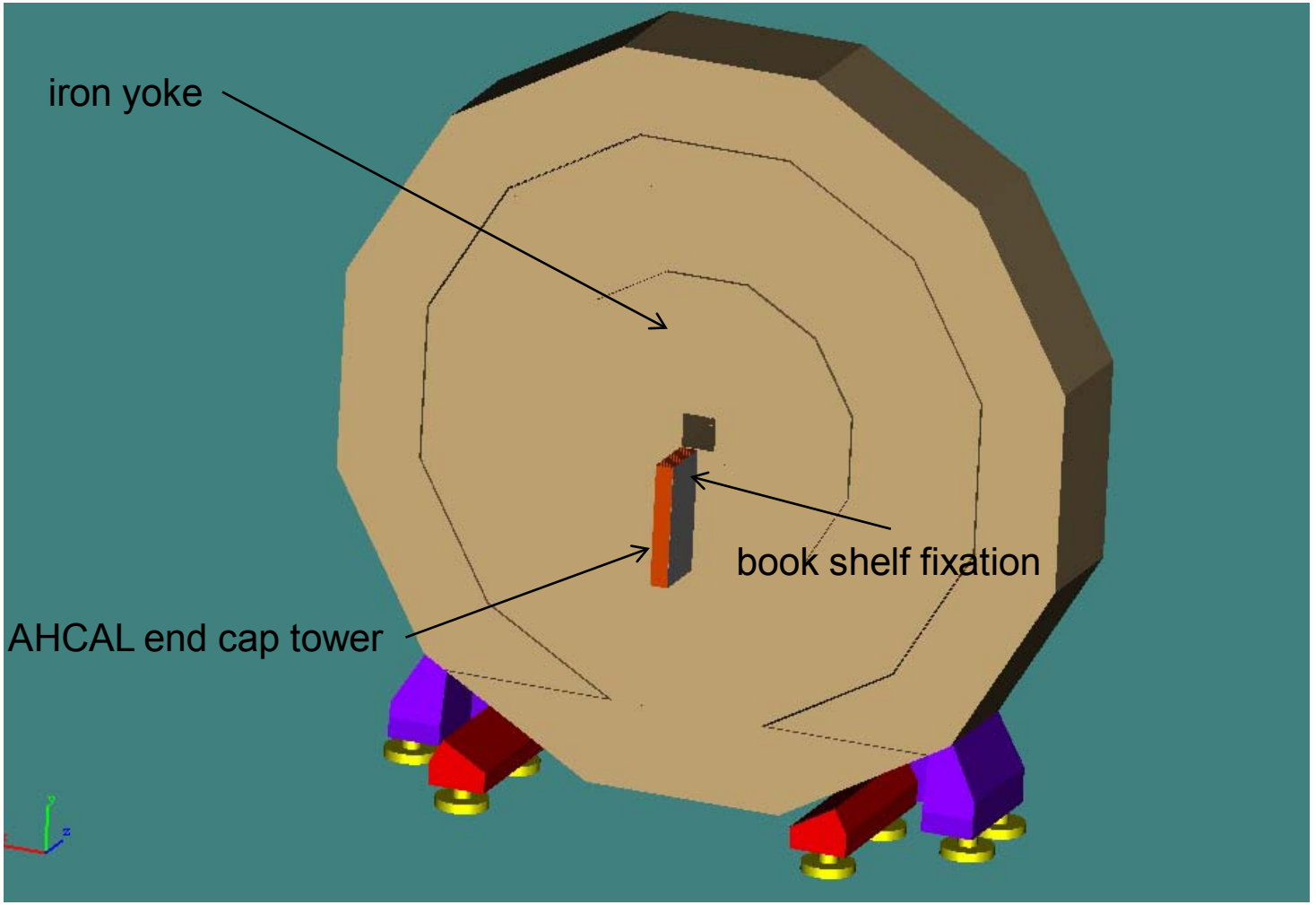


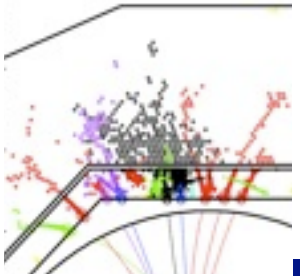
End cap segmentation



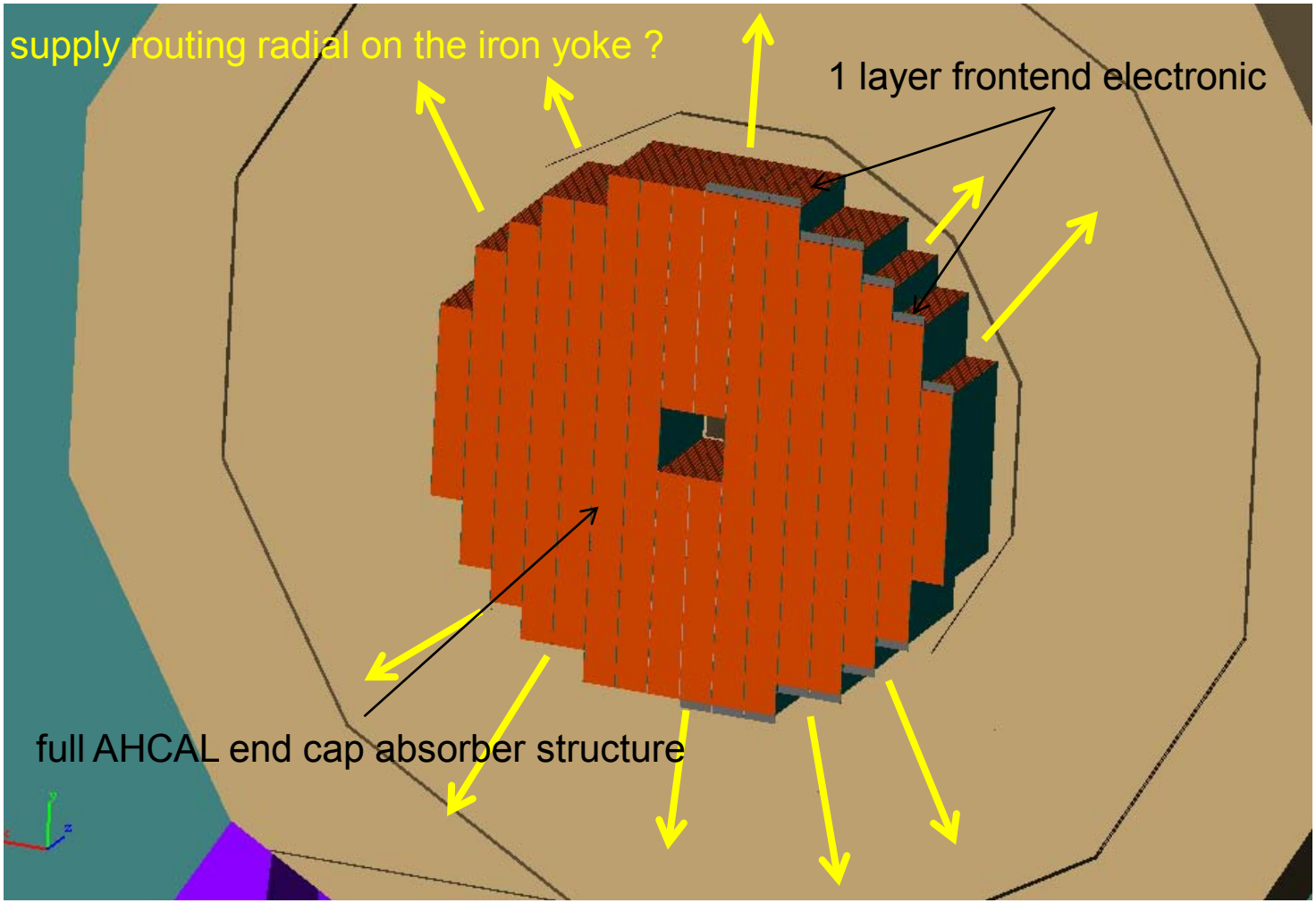


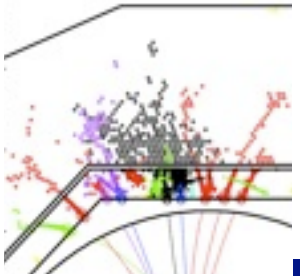
End cap support





End cap supplies





Summary

- Barrel 90% done
- End cap 60% done
  - supply lines to be done
- Ring: to be done

- Rotation: some inconsistency, but not critical
- Cost: to be discussed

- Open issues post-DBD:
  - Measurements of deformations for inter-connected modules, validation of FEM calculations
  - re-optimize barrel stability

Back-up slides