

# ILD MDI Update

Assembly and Detector Hall Issues

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Karsten Buesser

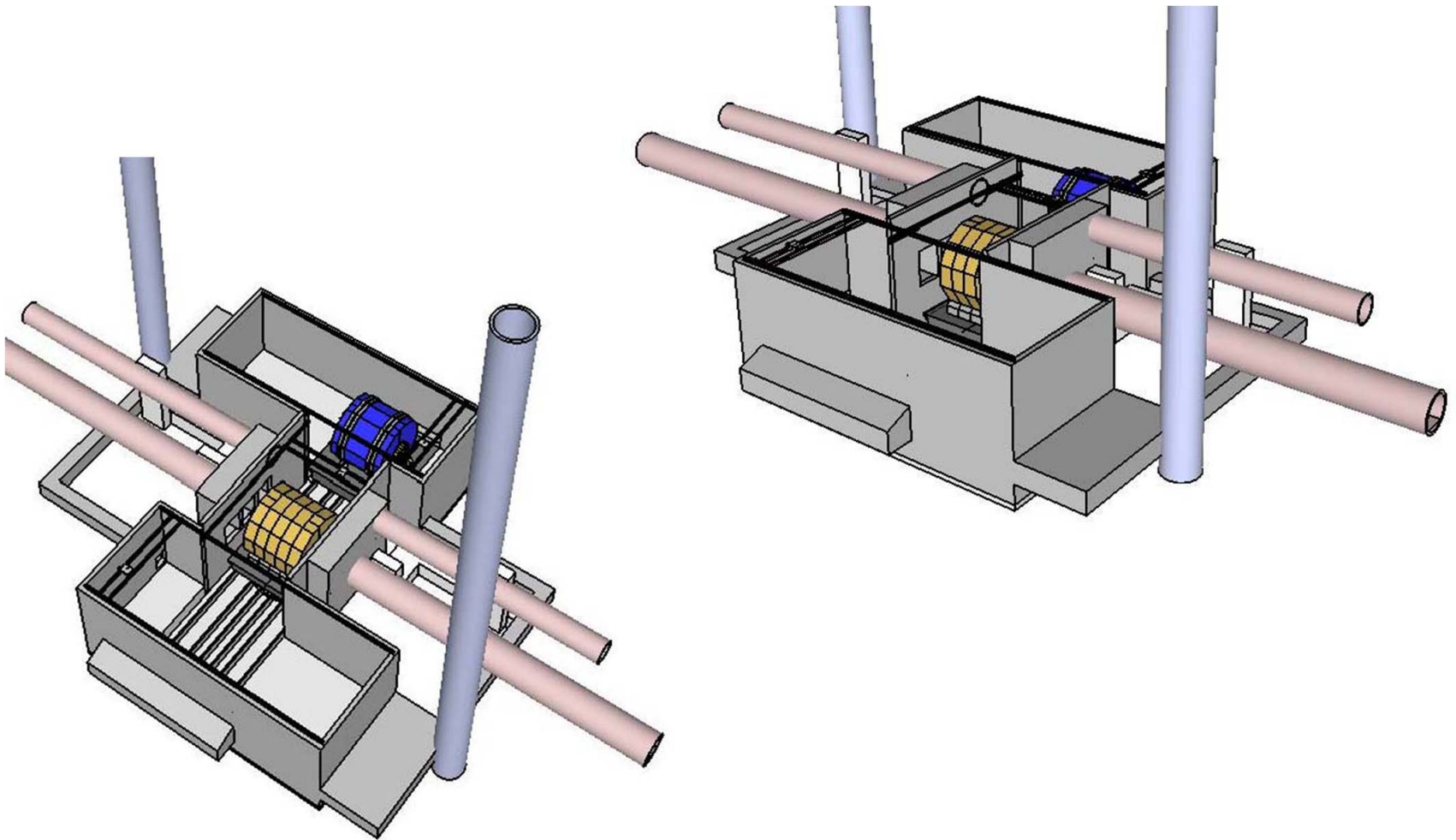
24.04.2012

KILC12

# Overview

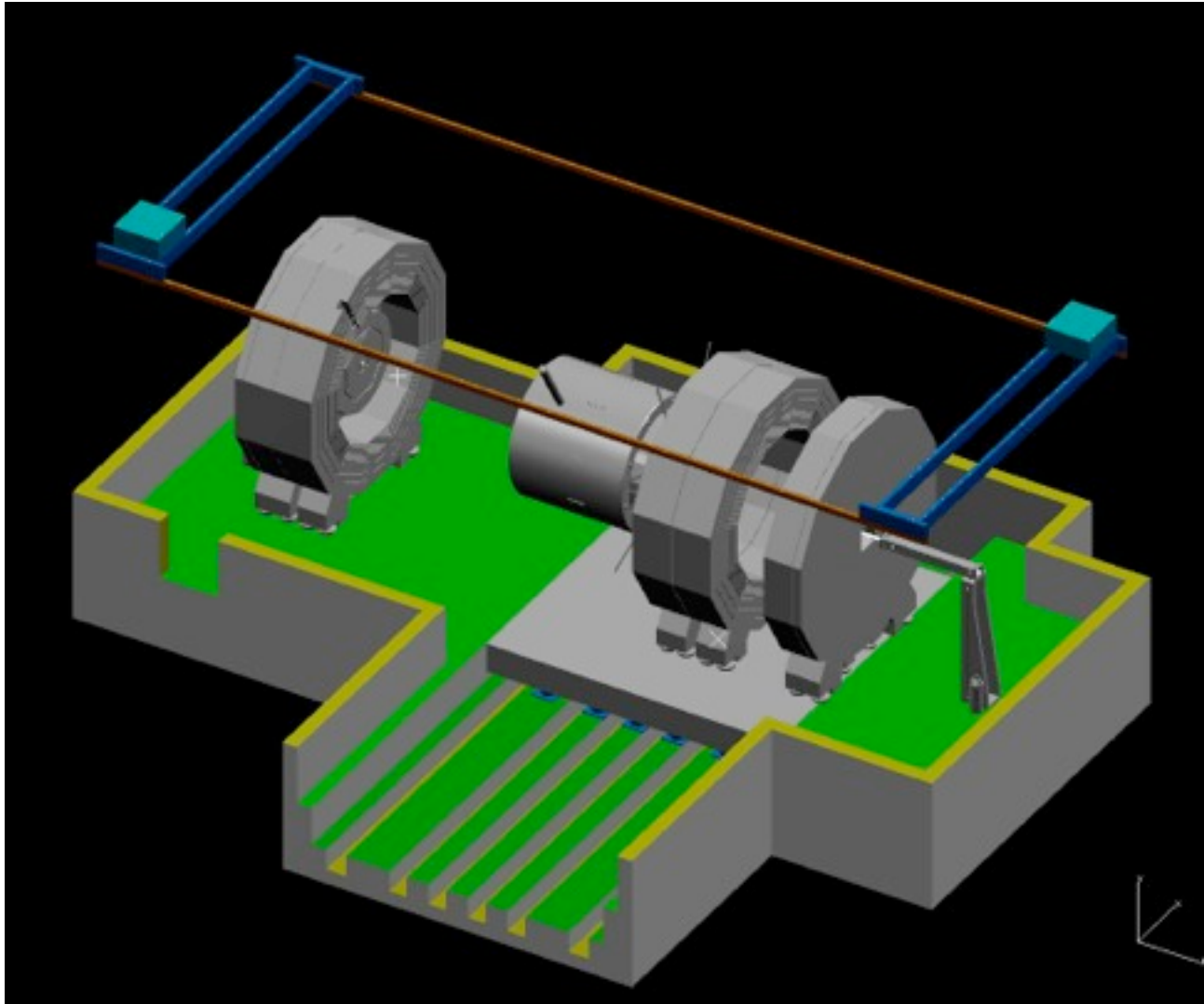
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- Machine group is finalising the design of the civil facilities for the TDR/DBD
- This is in the focus of the ILC management: cost drivers!
- Discussions between detector concepts (SiD/ILD) and ILC CFS group have been intensified since Granada
- Dedicated meeting in December at SLAC: final input from detector groups
- Started with the „non-mountain“ sites - hall design finalised
- Japanese site requirements are different
- CFS Baseline Technical Review Workshop at CERN on March 22-23
  - Discussions with GDE on cost issues!

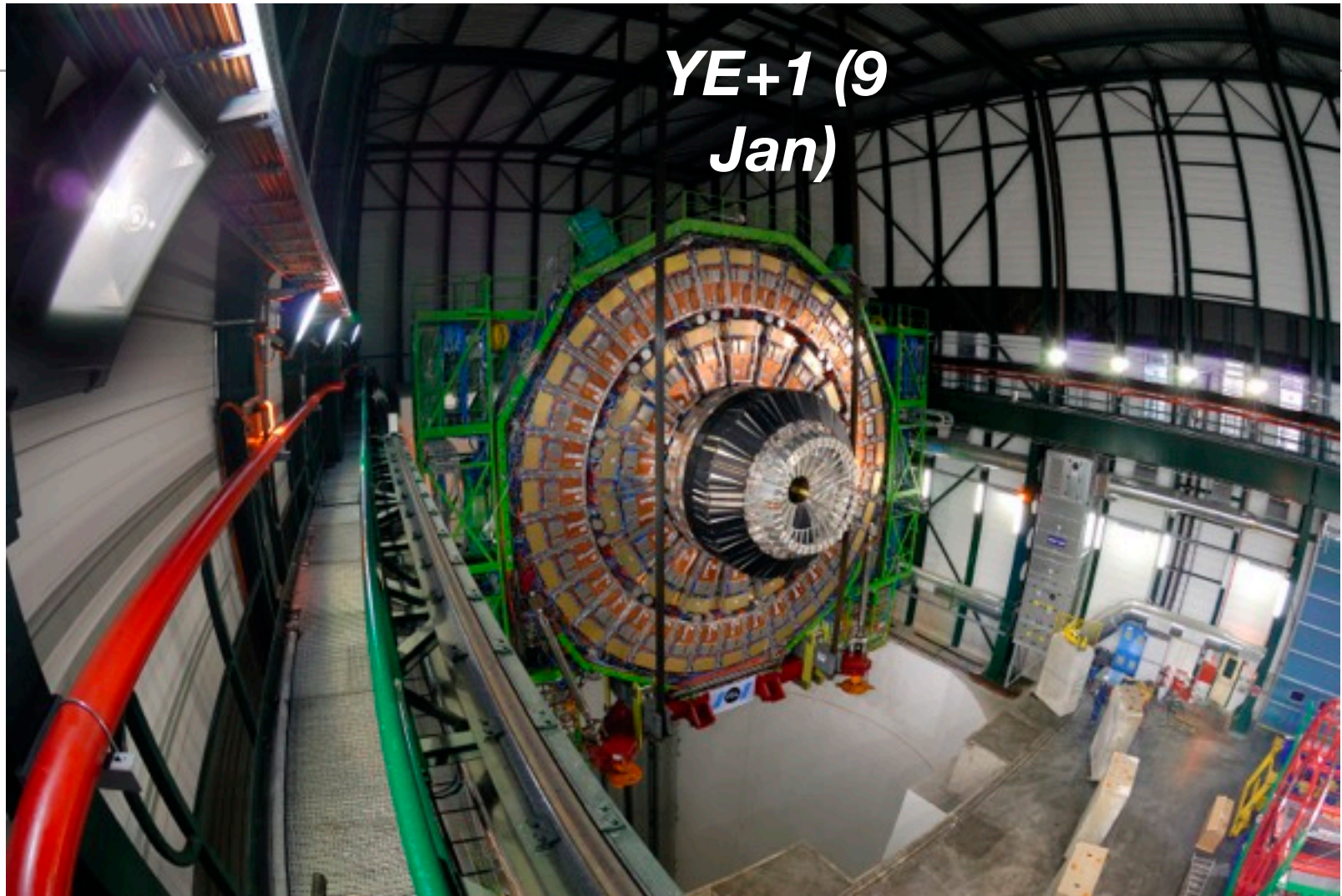


# ILD in Maintenance Region (non-mountain site)

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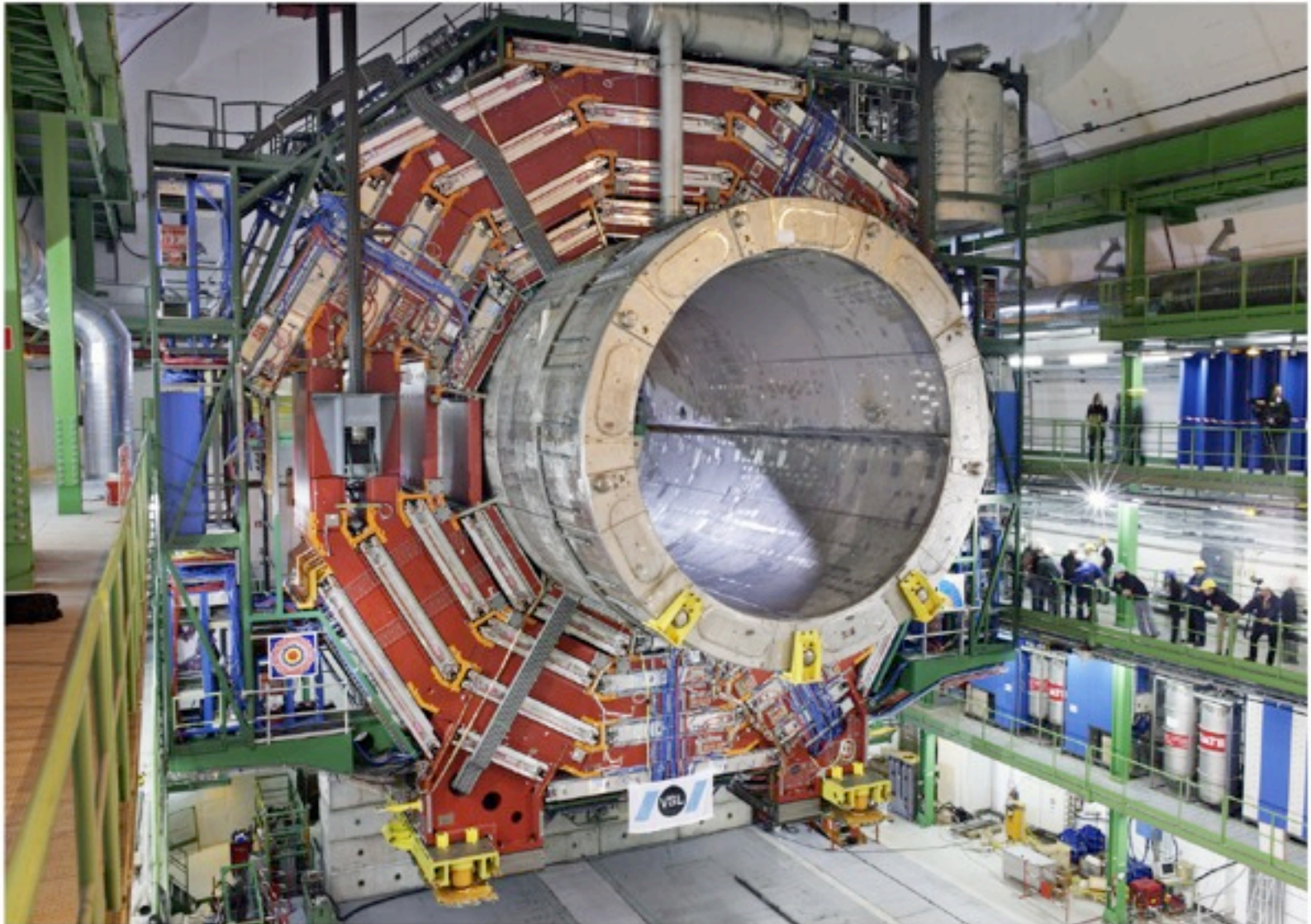


# CMS Assembly





# CMS Assembly



A. Hervé

YB0 landing in the CMS experiment hall

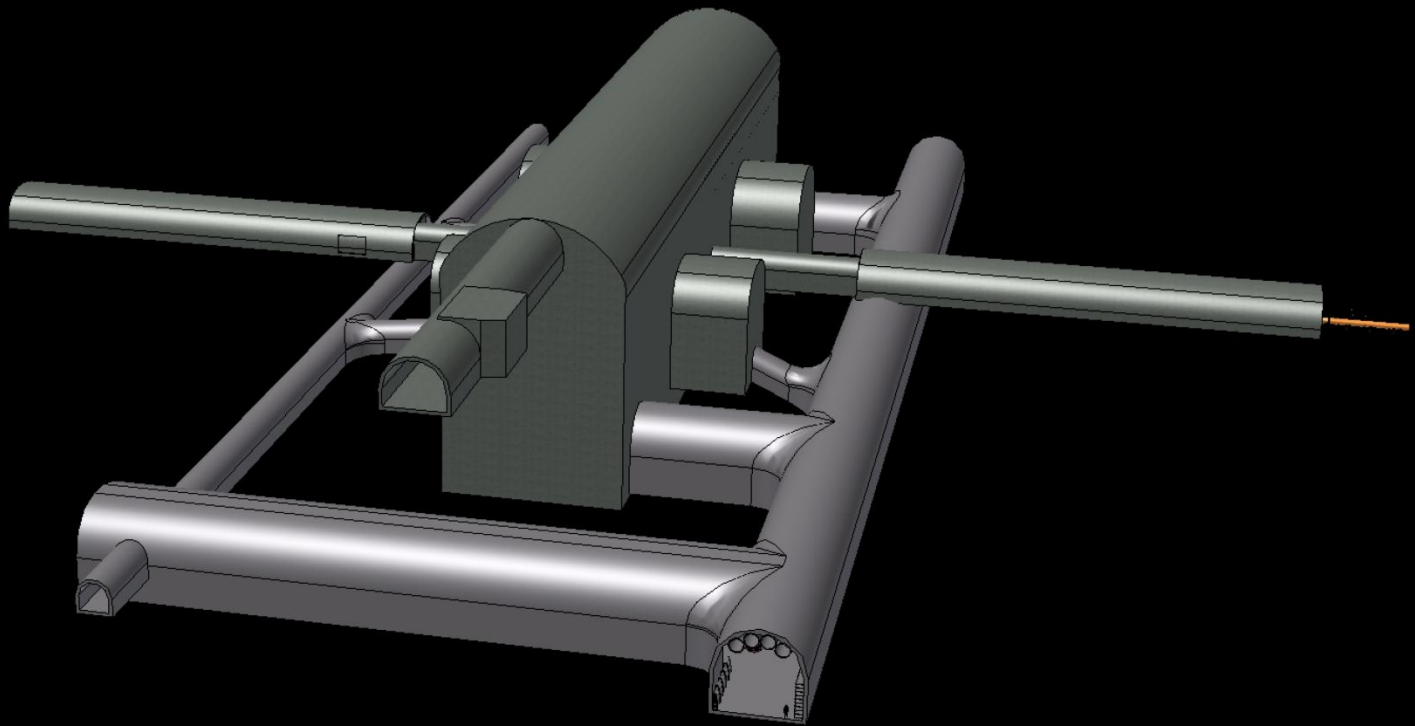
# ILD Assembly

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- CMS-type assembly for non-mountain sites:
  - Pre-assemble and test ILD components on surface as far as possible
  - Lower five yoke rings with pre-installed detector components
  - About one year of assembly underground
- Non-CMS-type assembly for mountain sites:
  - Part sizes are limited by access tunnel
  - Yoke rings need to be built underground
  - Sub-detectors mostly installed underground
  - Need more time (~3y) and more underground space

# Japanese Hall Design (Status: 22.03.2012)

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- Enlarged Alcoves
- 142 m long

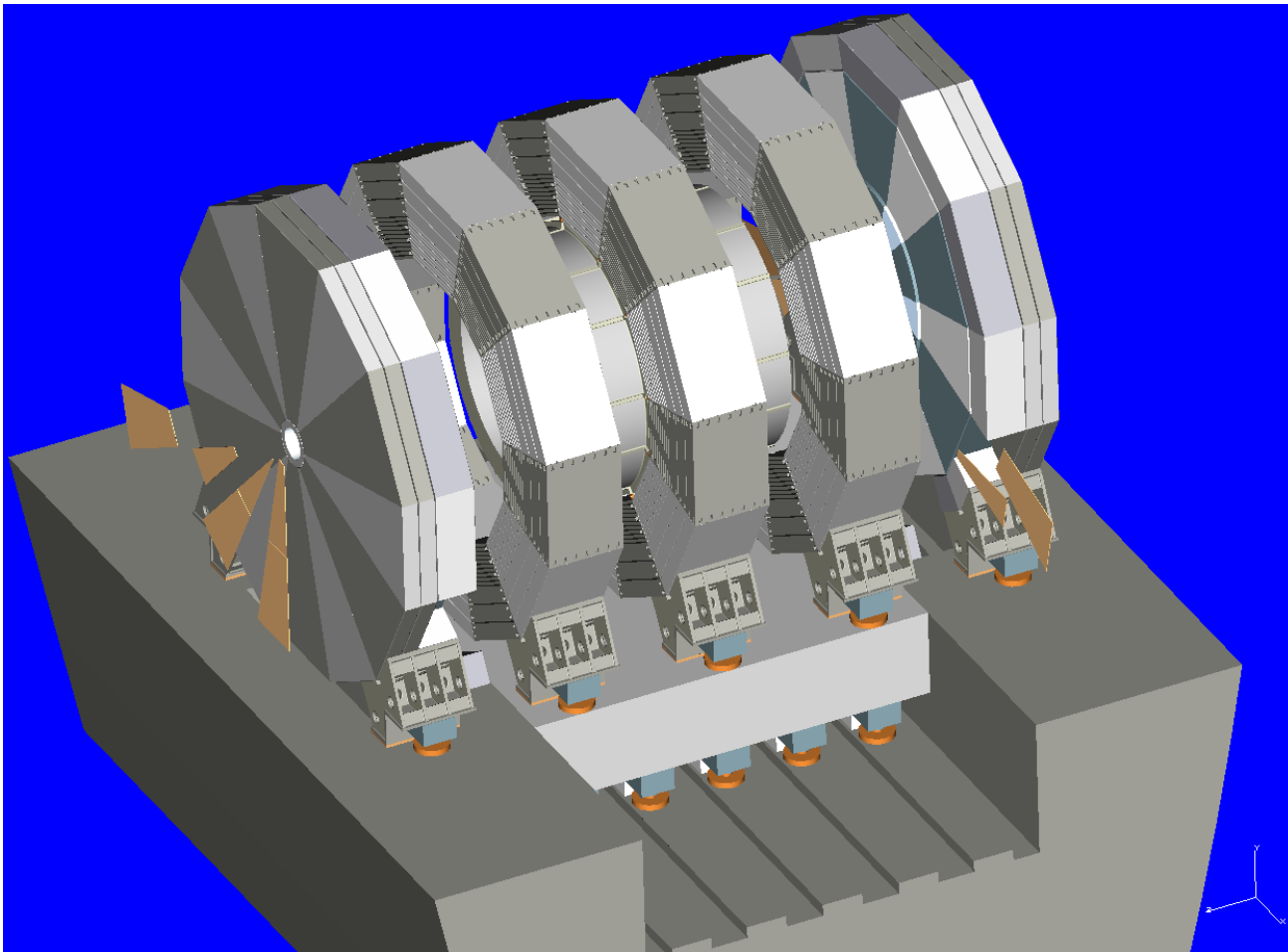
G. Orukawa



# ILD Design

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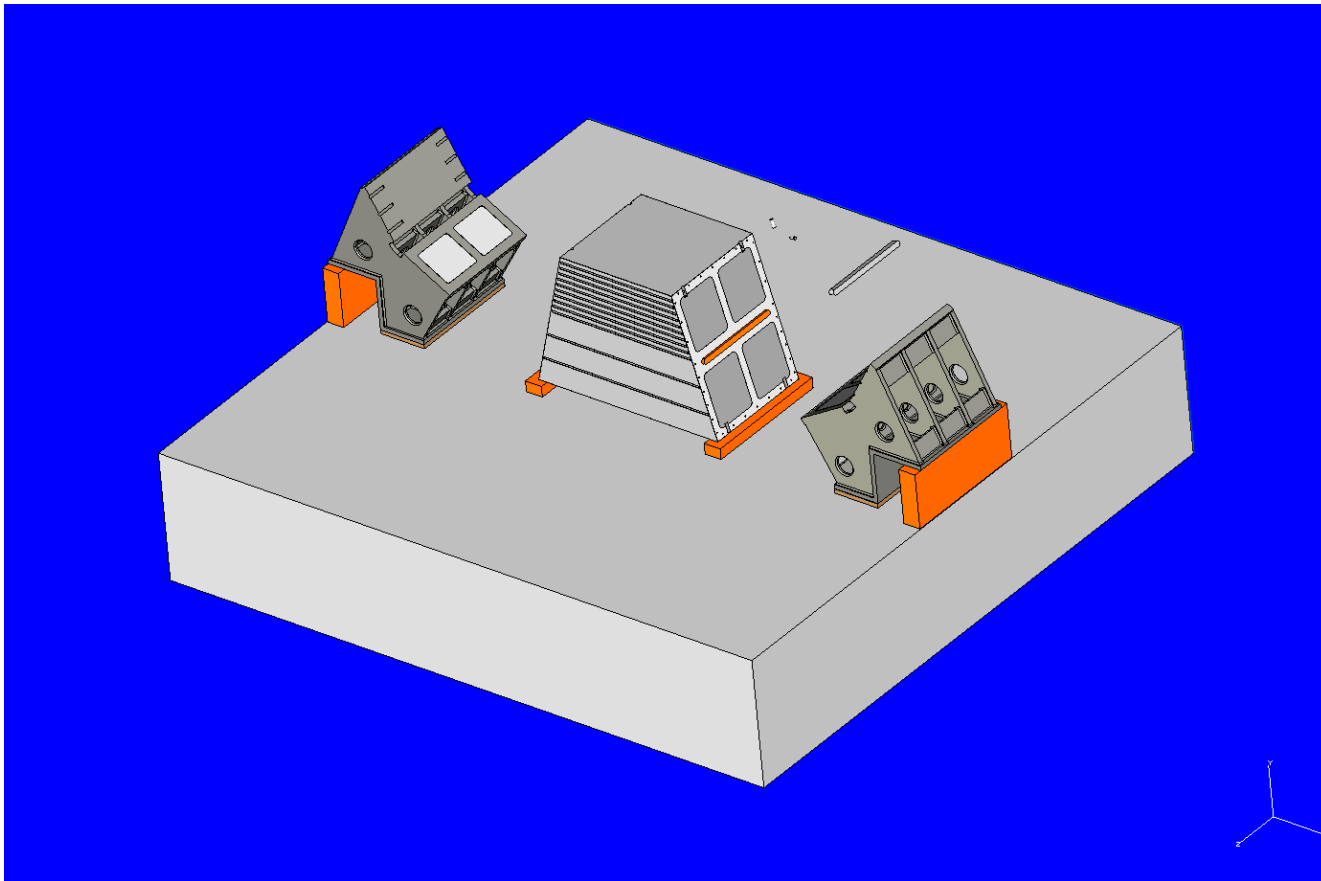
- Assumption: basic detector model will not change for mountain sites



# Yoke Assembly - Barrel

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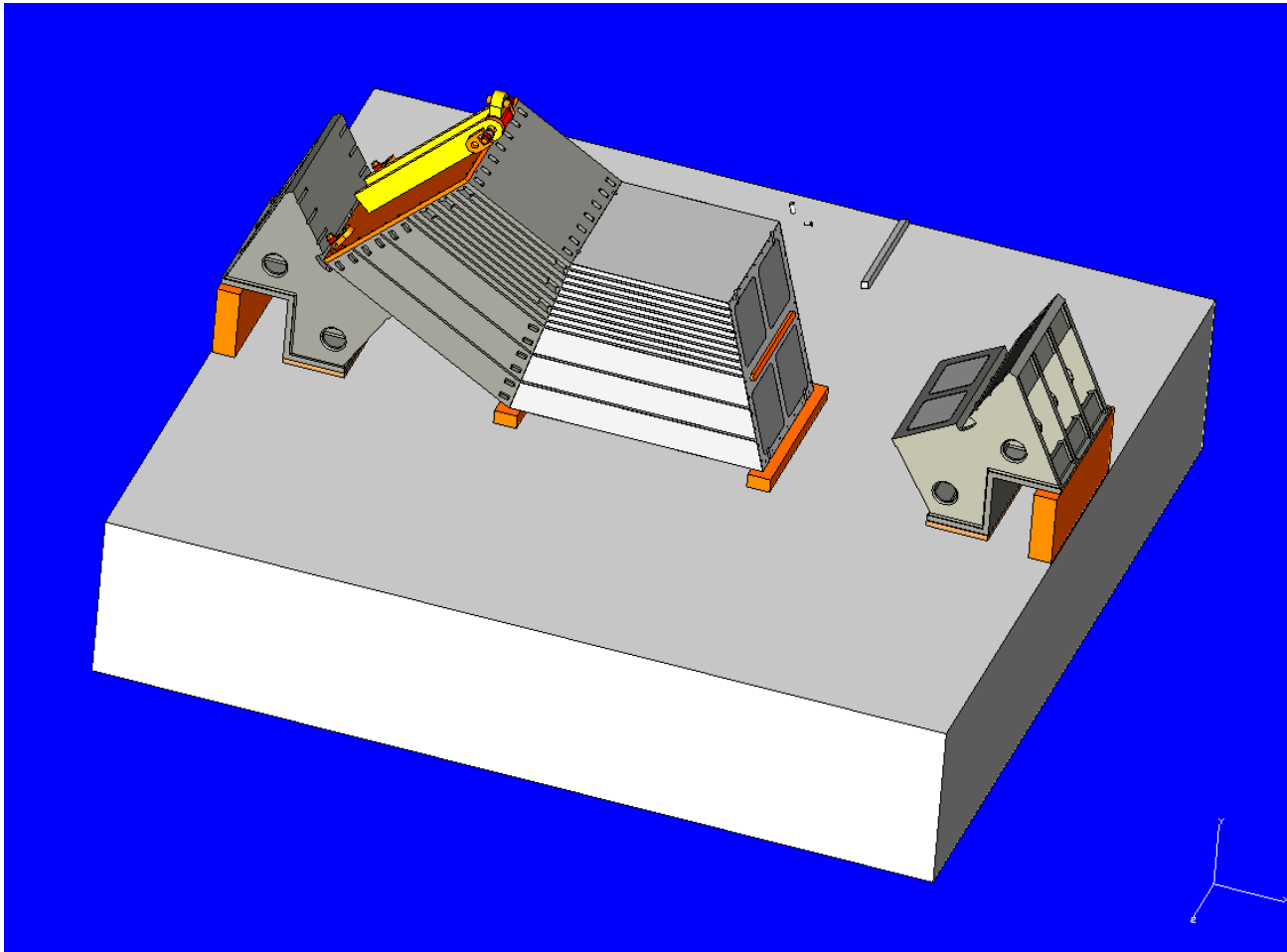
- Start with central ring on platform
- Space needed for: tools, scaffolding, surveying equipment



# Yoke Assembly - Barrel

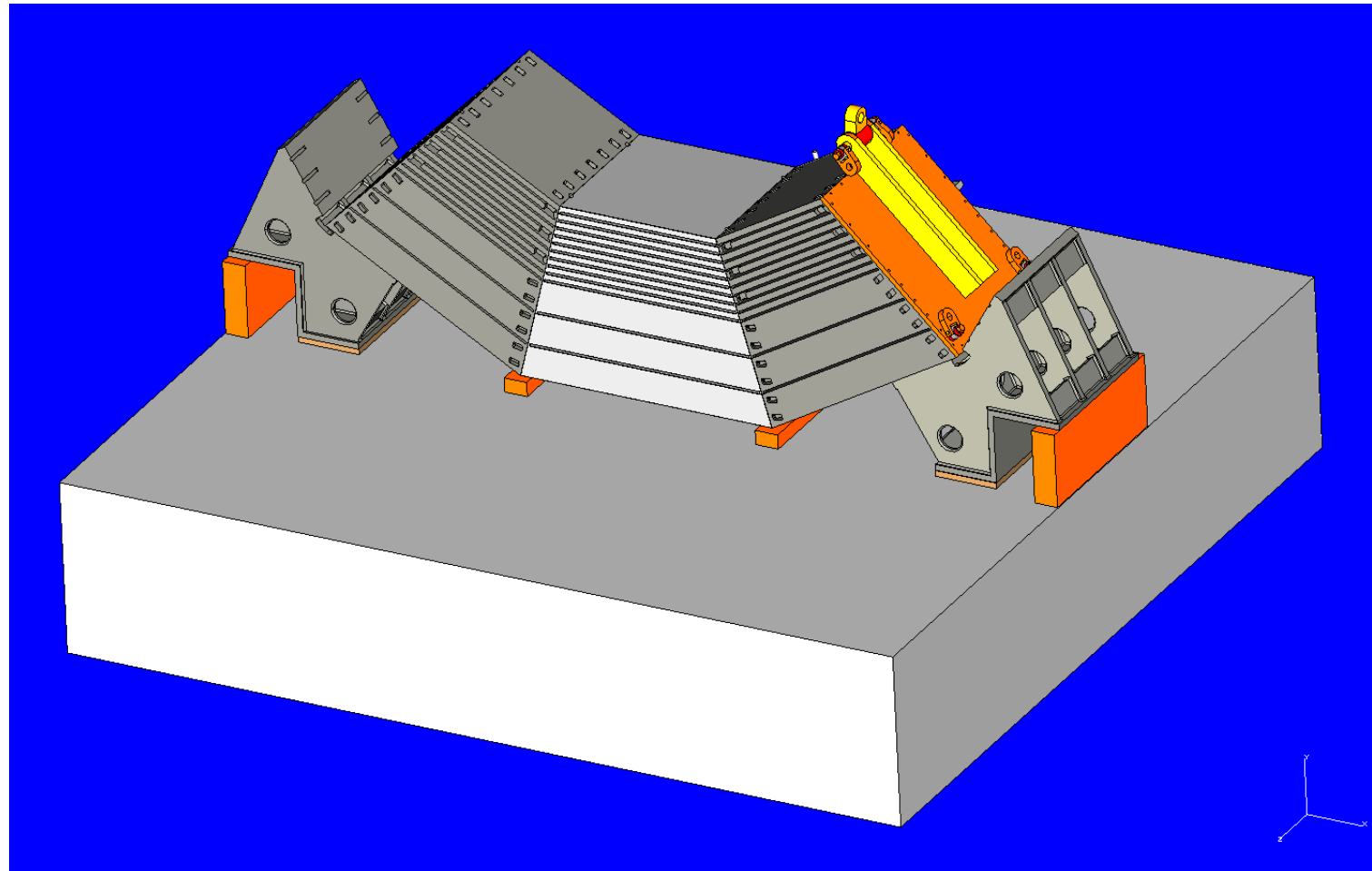
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- 200t crane coverage needed



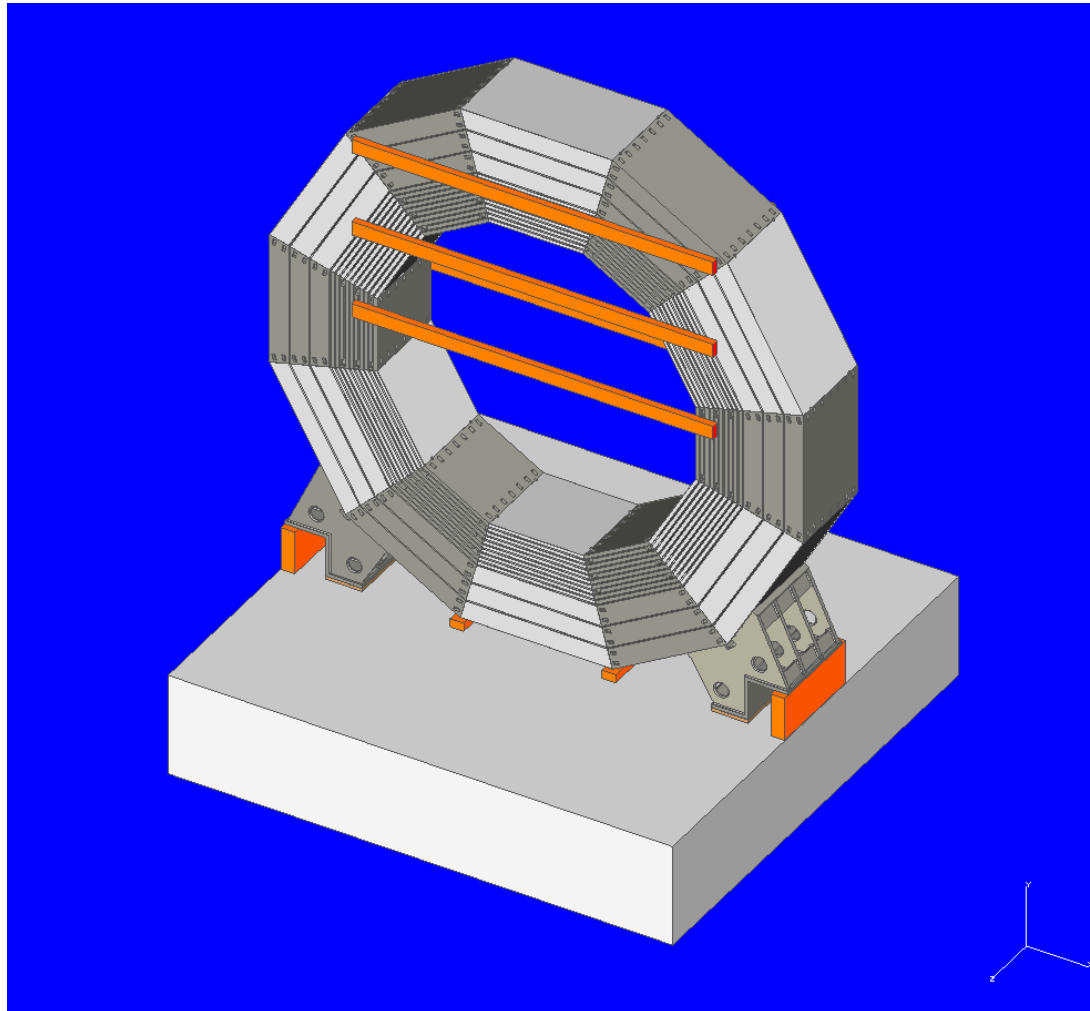
# Yoke Assembly - Barrel

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# Yoke Assembly - Barrel

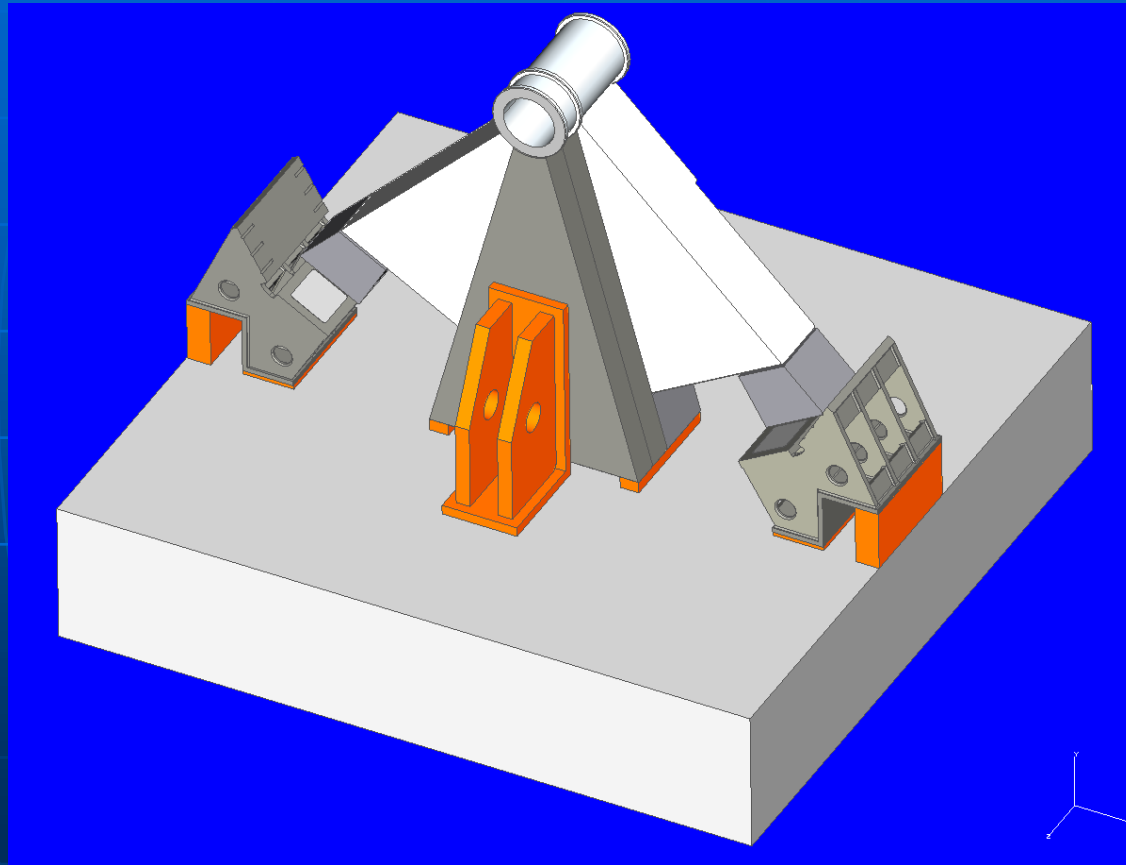
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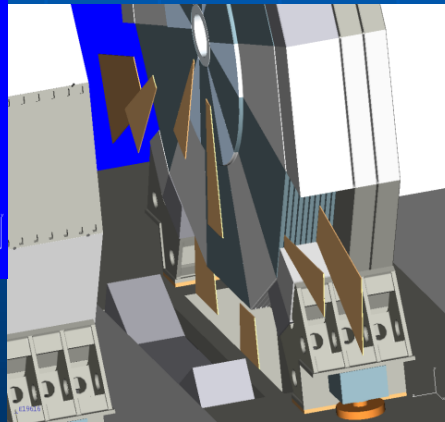
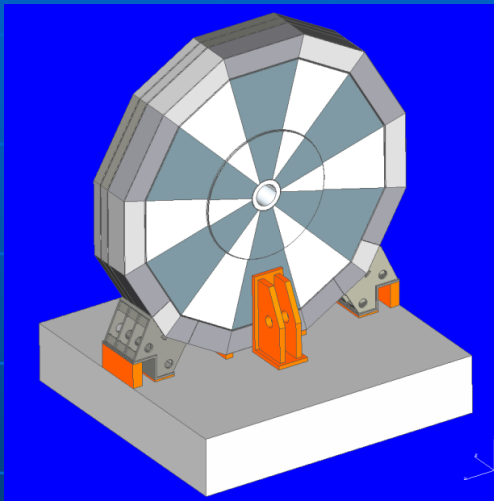
# Yoke Assembly - Endcap

End Cap Assembly / Step 9; 10

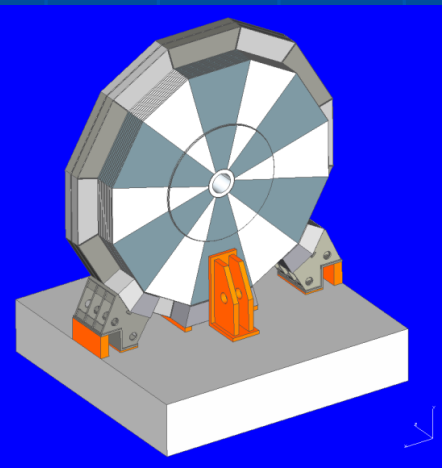


# Yoke Assembly - Endcap

## End cap Assembly / Step 36 to 50



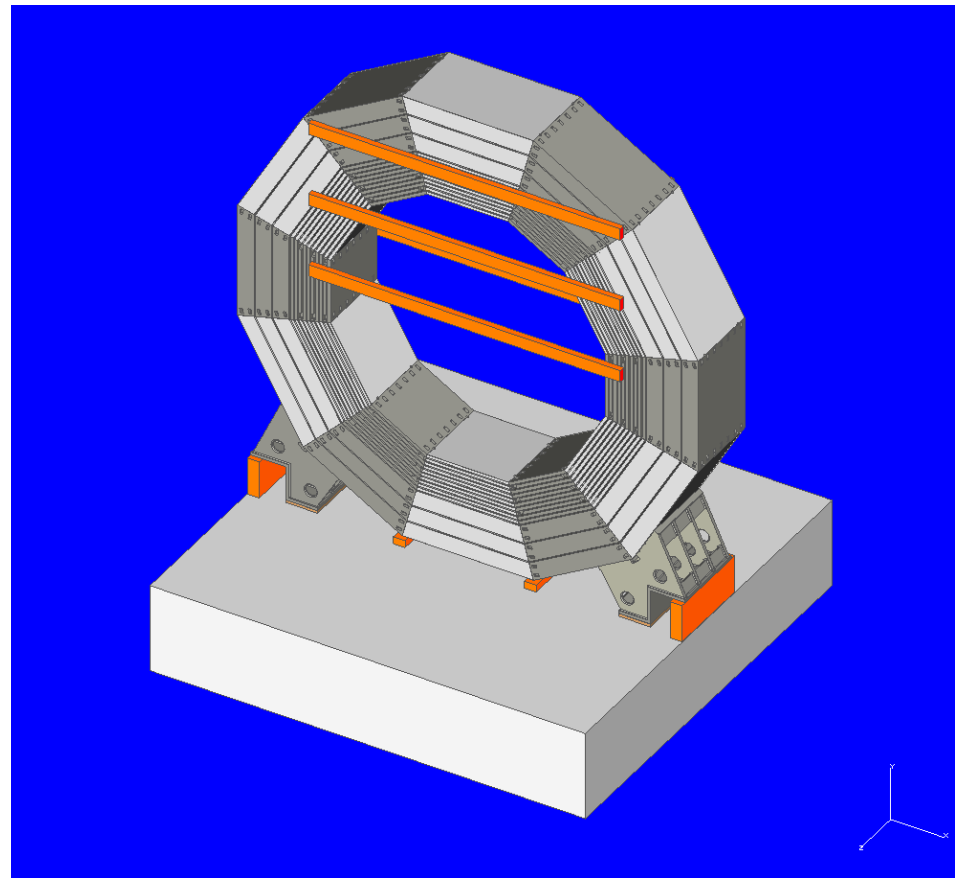
Chamber omitted for clarity



# Yoke Assembly

R. Stromhagen

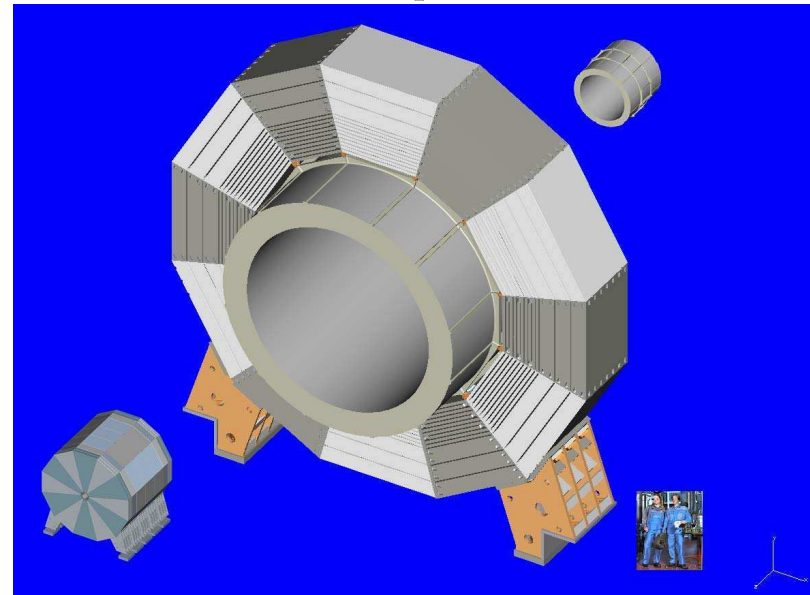
- Tolerances of the ring segments need to be better than 1 mm
- Laser surveying needed during full assembly
- Tools needed
  - 200t crane
  - chain hoists
  - tailored tools: beams etc.
  - hydraulics
  - surveyors
- Time estimate: 60 working days per ring



# Coil Installation

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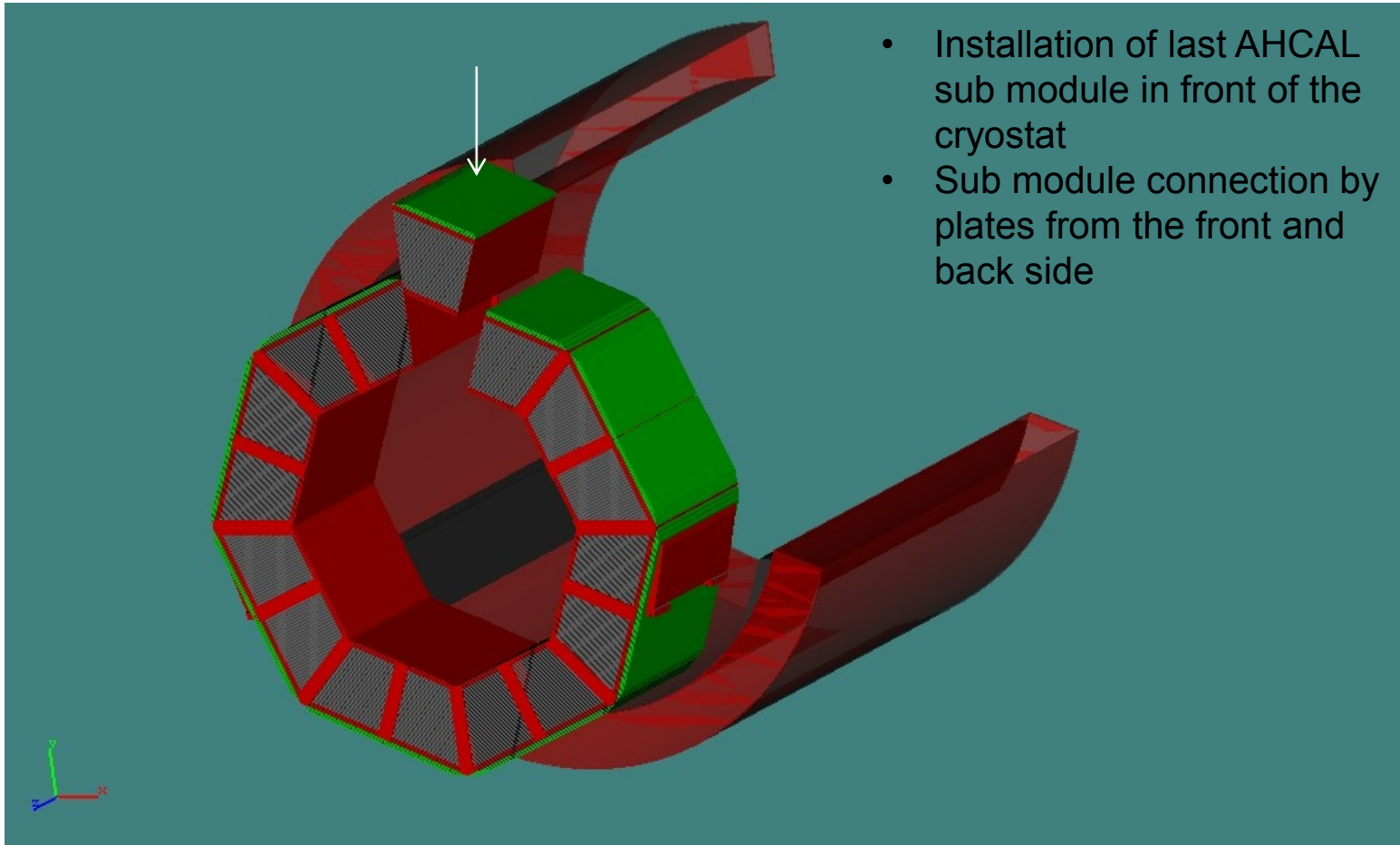
- Coil can only be transported without its ancillaries (cold box, chimney)
- Functional test needs to be done underground after installation into central barrel yoke ring
  - very low fields, yoke will not be ready by then
  - Takes >3 months (incl. cool-down and warm-up)
- Test of field mapping equipment is needed at the same time
  - ALEPH experience



R. Stromhagen

# AHCAL Installation

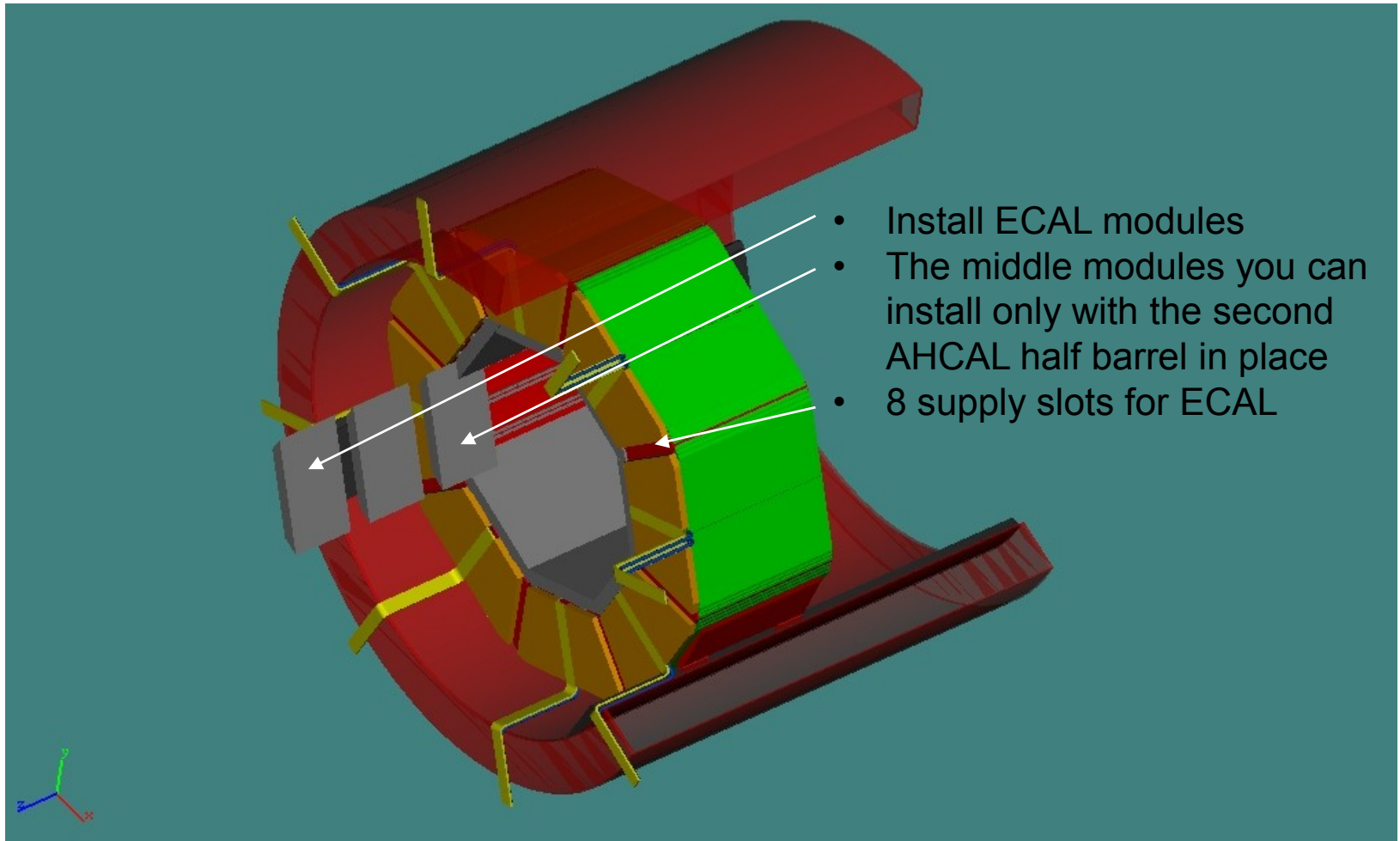
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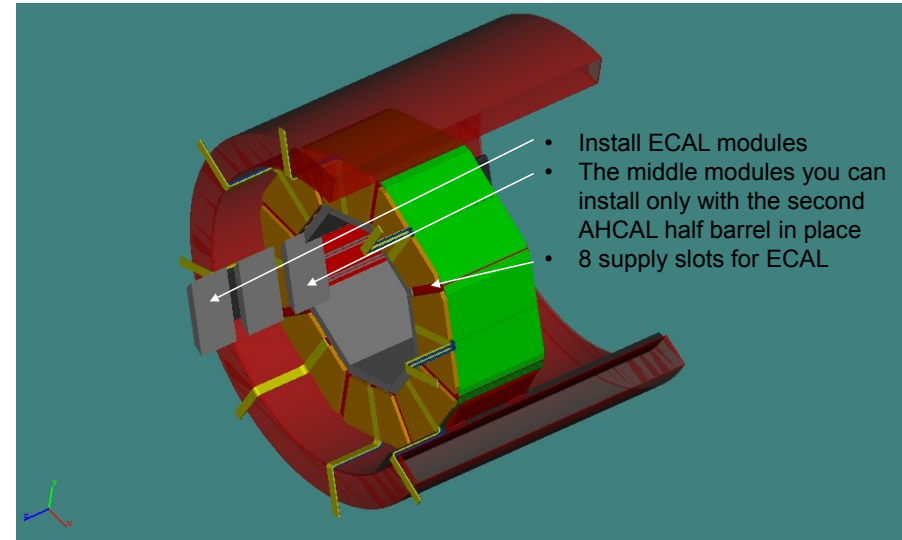
# AHCAL/ECAL Installation

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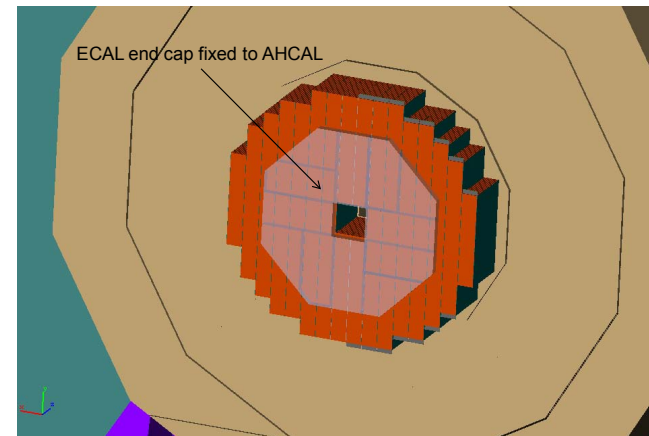


# Calorimeter Installation

- Special tooling needed:  
support cradle, directly mounted to the coil
- Crane coverage
- Surveying equipment
- Time estimate for AHCAL barrel:
  - 180 working days
- ECAL barrel:
  - probably less
- Endcaps: ?

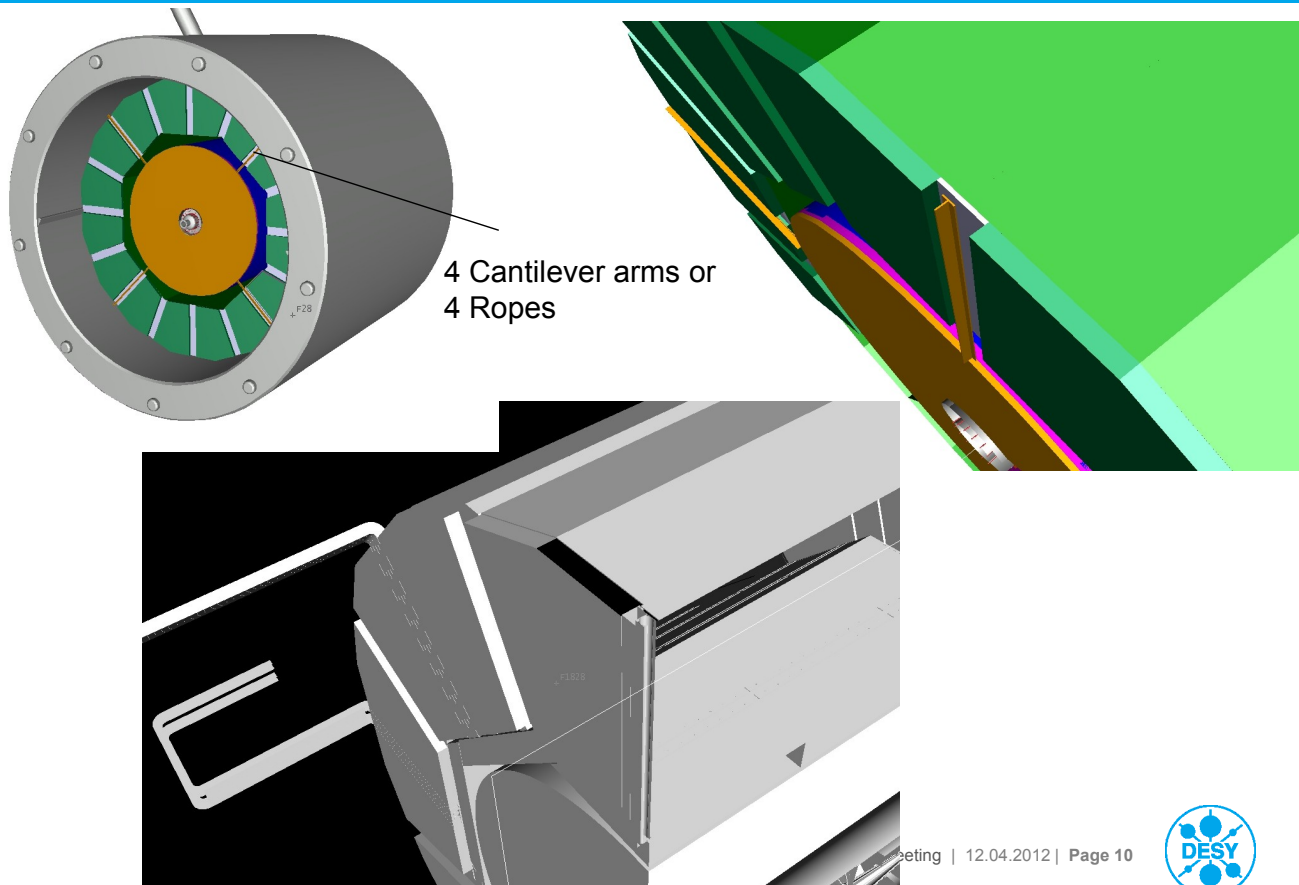


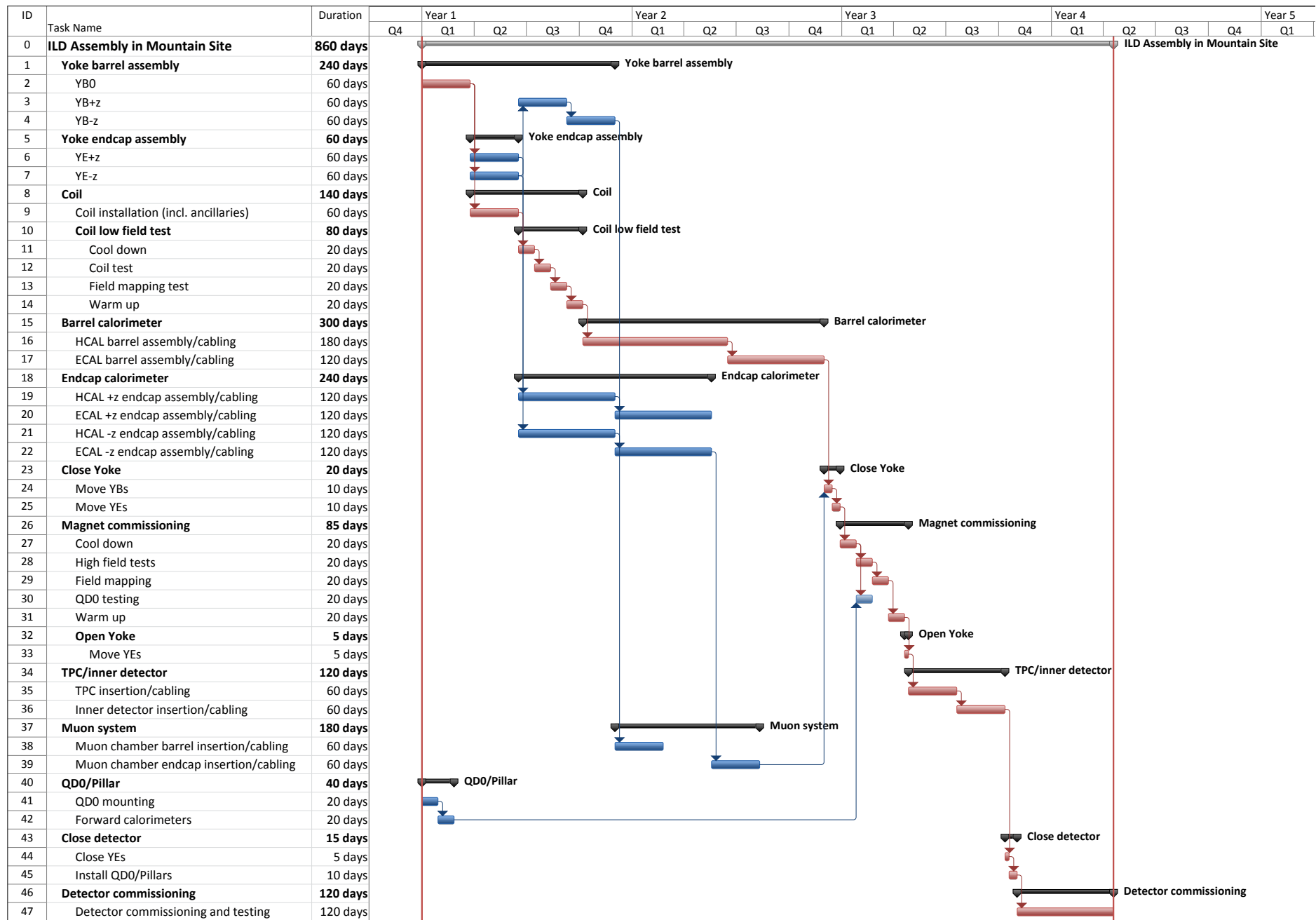
K. Gadow



# TPC Installation

## Design of the support structure



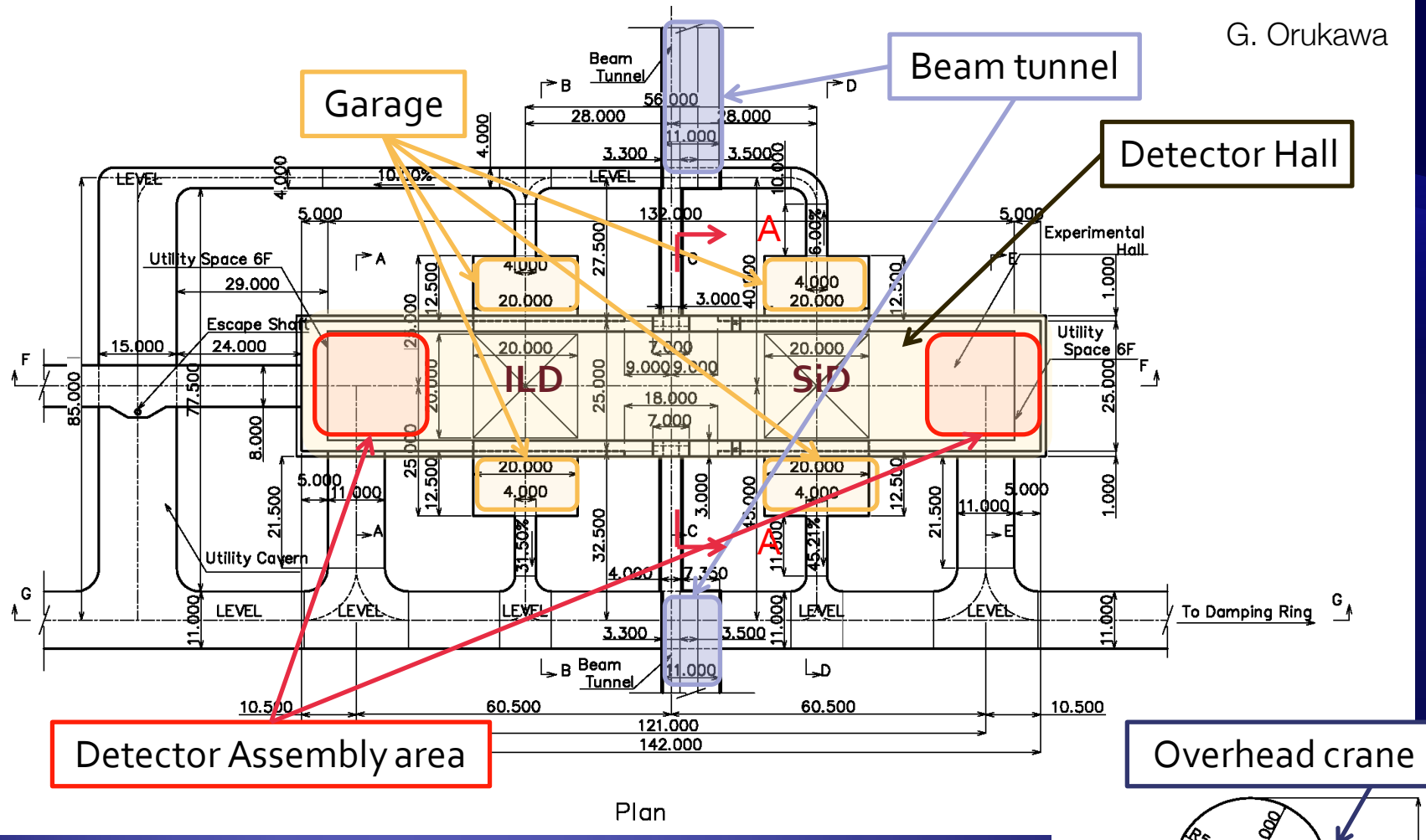


- Critical path is defined by central detector construction:
  - central yoke ring, coil, barrel calorimeter, TPC, inner detector
- Will have several coexistent major „construction sites“ at the same time in the underground hall:
  - barrel part, both endcaps
  - consecutively: two other barrel yoke rings, QD0 pillar, forward calorimeter
- Time estimate: 3.25 years
- But: need sufficient underground space!
- There are remaining open questions:
  - how does the crane and transport capacity interfere with this plan?
  - when will the cryo services underground be ready (coil test)?
  - ...



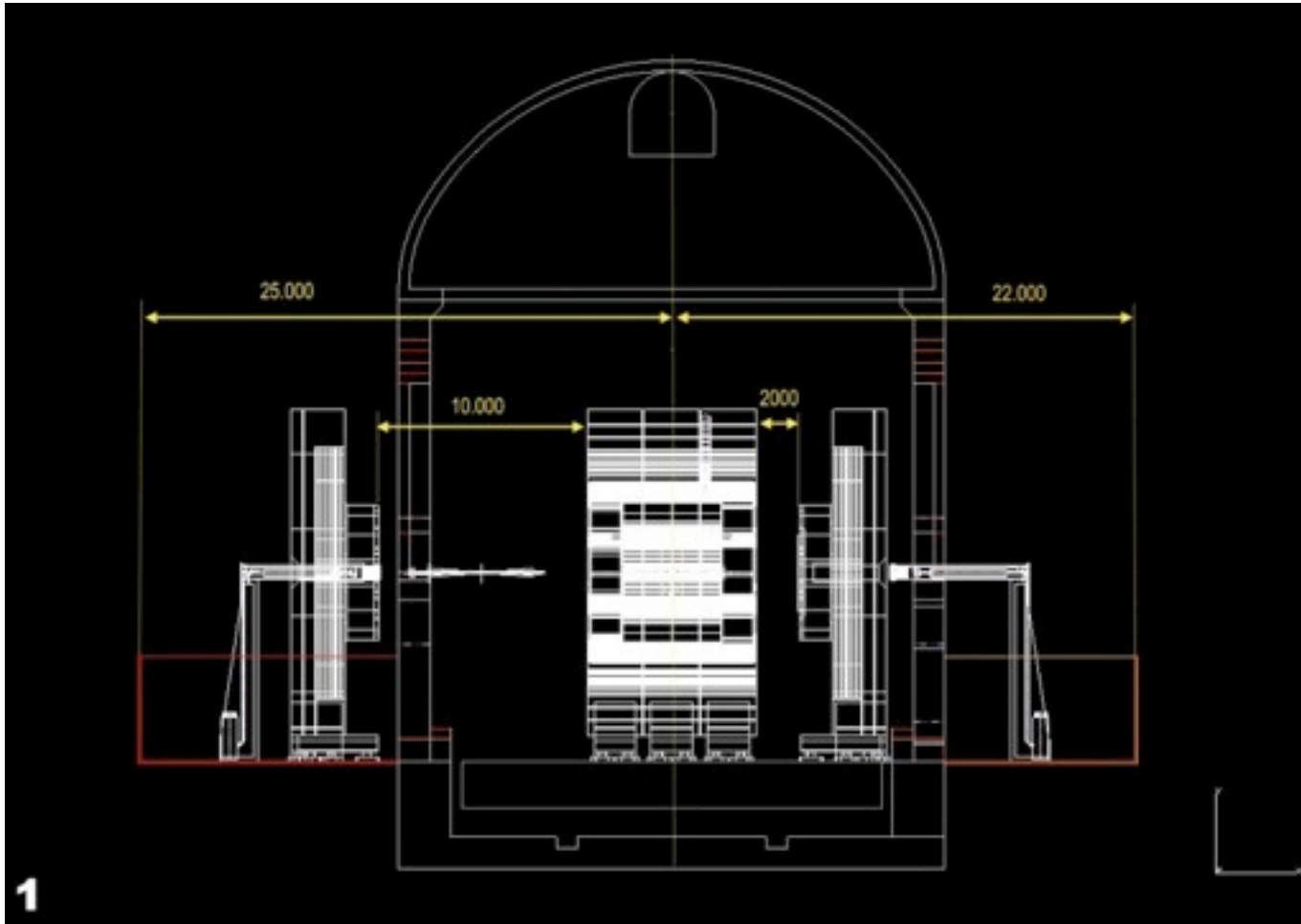
# Japanese Hall Design (Status: 22.03.2012)

G. Orukawa



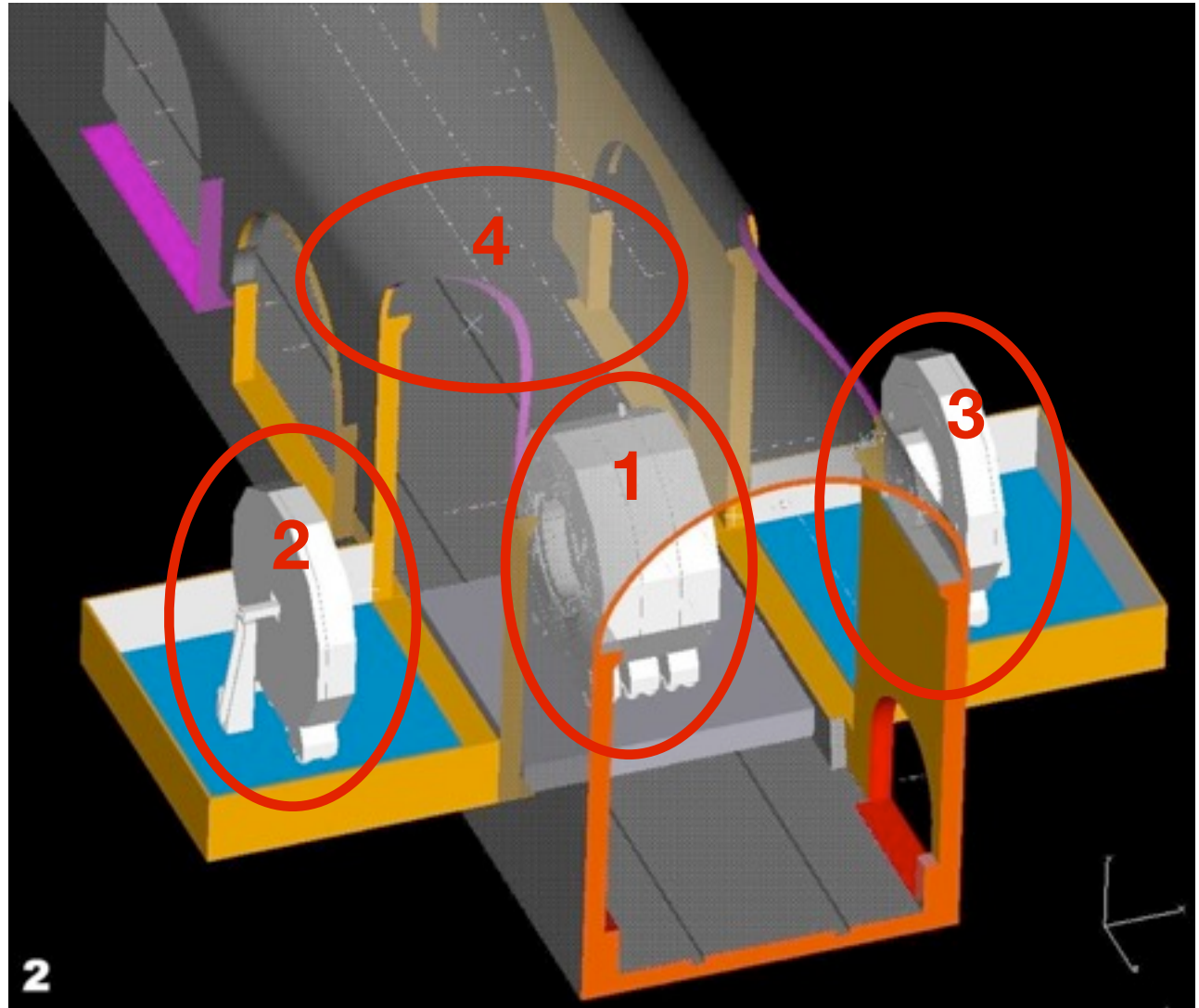
# Maintenance Position (ILD Study)

- Alcoves needed to open the detector for maintenance



# Underground Construction Space (ILD Study)

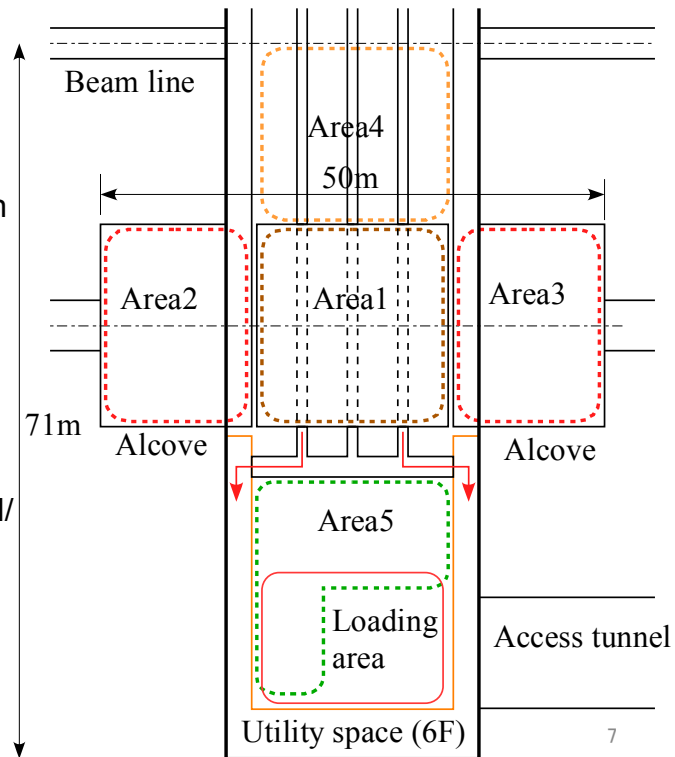
- Need several assembly areas in the hall
- Studies on space, transportation and time requirements are on going



# ILD Installation Study (Preliminary)

## Detector assembly area

- Area 1: Platform
  - YB0 assembly
  - Barrel detectors installation/cabling
  - Endcap calorimeters installation
- Area 2/3: Alcoves
  - Endcap calorimeters cabling
  - QD0 support tube assembly
  - FCAL install/cabling
- Area 4: Tentative platform on beam line side
  - YE, YB+, YB- (iron yoke and muon detector) assembly/install/cabling
- Area 5: Loading area side
  - HCAL rings assembly
  - Tooling assembly
  - Storage area

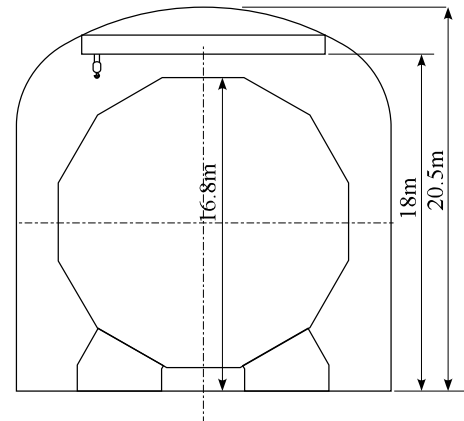


# ILD Installation Study (Preliminary)

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## Boundary conditions

- Cranes
  - 250 ton crane for each detector on beam line side
  - 30 ton crane for each detector on loading area side
  - 2.8 ton crane in each alcove
    - In order to minimize the size of alcoves, the crane rails should be supported from the arch part → Only small cranes can be used
    - The height of alcoves have to be increased from 19.6m to 20.5m (for ILD) to let the crane girder pass over the detector
- Work conflicts
  - In order to avoid conflicts of parallel works, first few hours of each working day should be dedicated to transportation to each assembly area



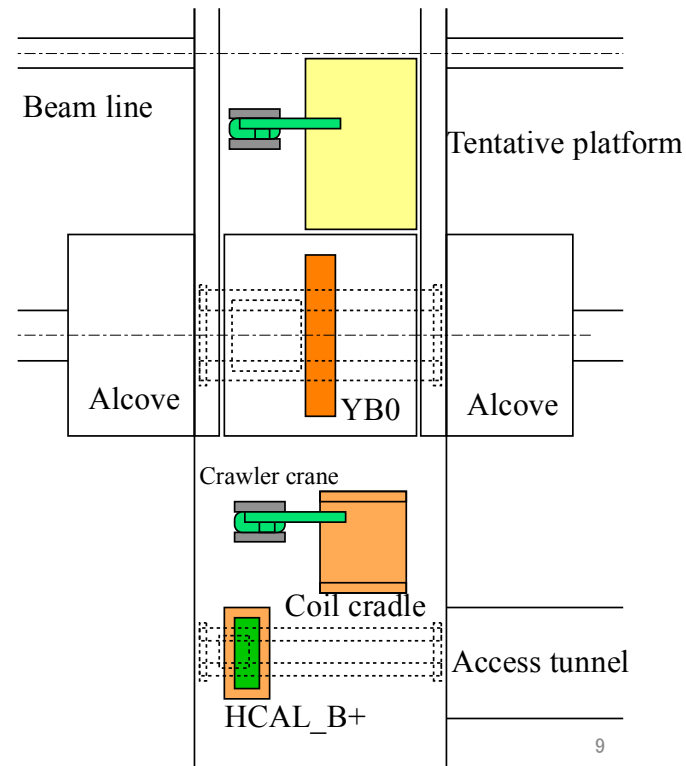


# ILD Installation Study (Preliminary)

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## Step 1

- Tentative platform is assembled in Area4 using a crawler crane
- Central barrel yoke YB0 is assembled on the platform using 250 ton crane
- HCAL modules are assembled to a  $\frac{1}{2}$ -z ring in Area5 using 30 ton crane
- Cradle for coil installation is assembled in Area5 using a crawler crane

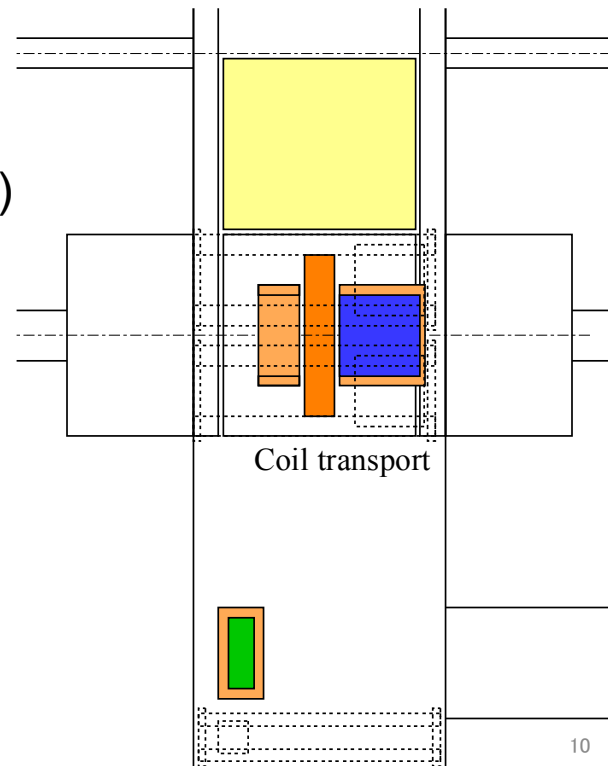


# ILD Installation Study (Preliminary)

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## Step 2

- Solenoid coil is moved to the platform using two sets (one from SiD) of 250 ton crane

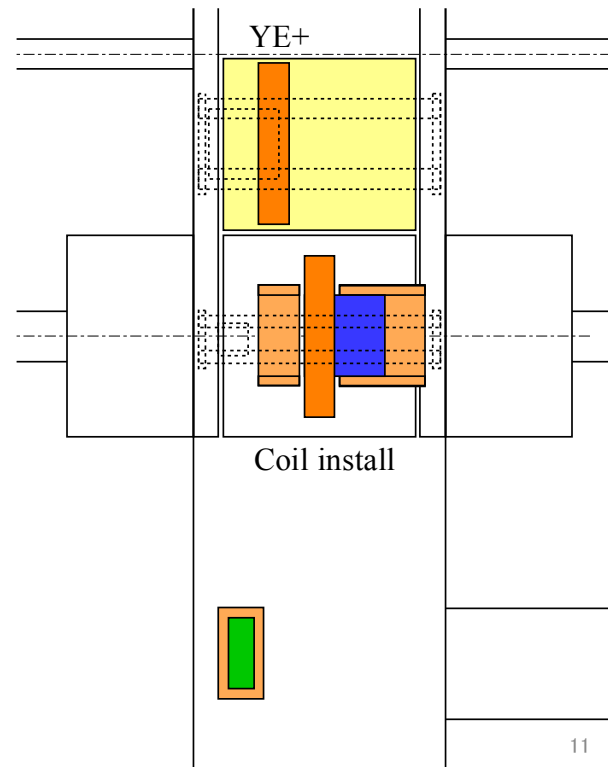


# ILD Installation Study (Preliminary)

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## Step 3

- Endcap iron yoke (YE+) is assembled in Area 4
- Solenoid coil installation to the YB0 in Area 1

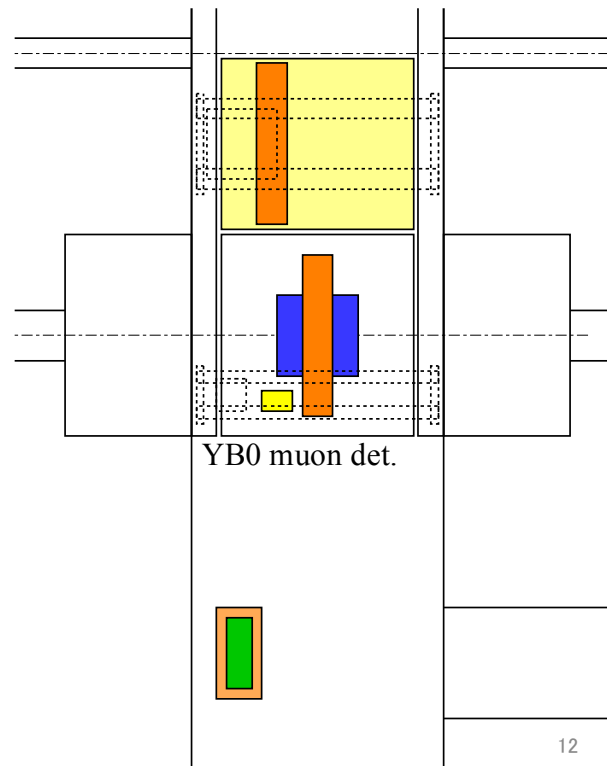


# ILD Installation Study (Preliminary)

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## Step 4

- Muon detector installation to YB0

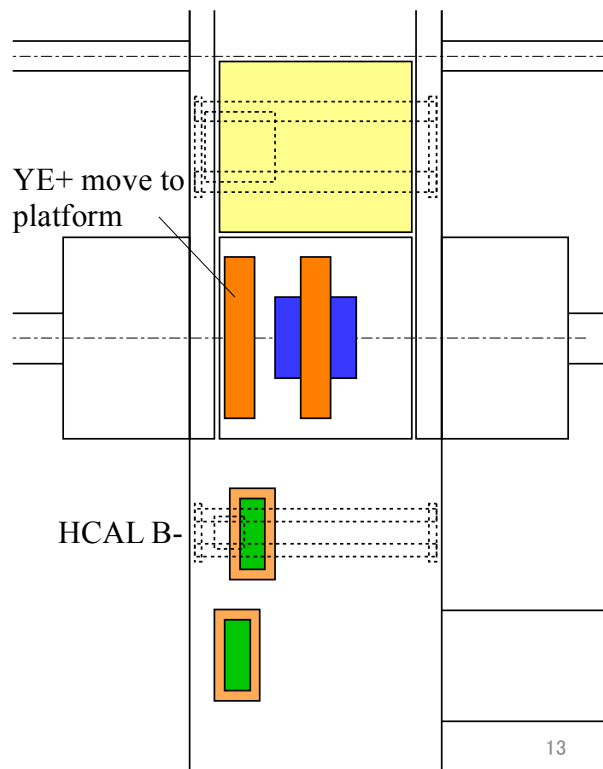


# ILD Installation Study (Preliminary)

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## Step 5

- YE+ is moved to platform using air-pads after muon detector installation
- HCAL barrel  $\frac{1}{2}$ -z ring is assembled in Area 5

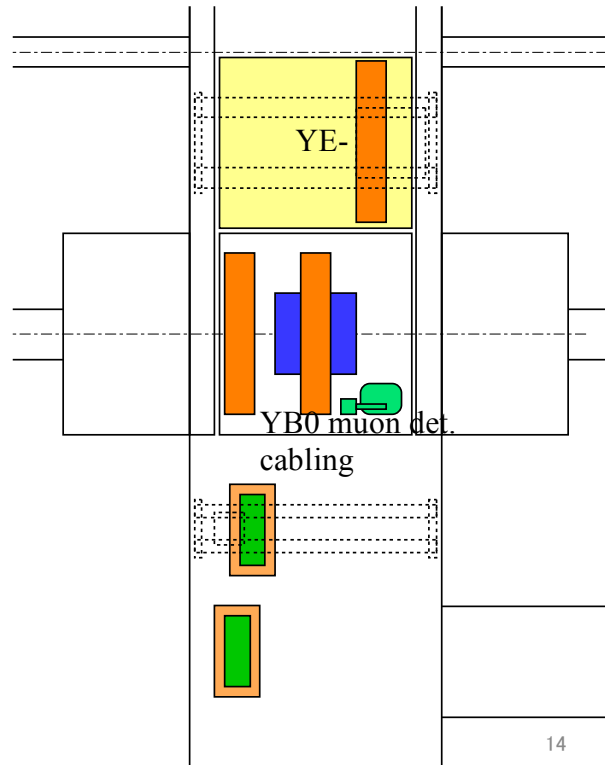


# ILD Installation Study (Preliminary)

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## Step 6

- Endcap yoke YE- is assembled in Area4
- Muon detector of YB0 cabling
- HCAL barrel ring assembly in Area5

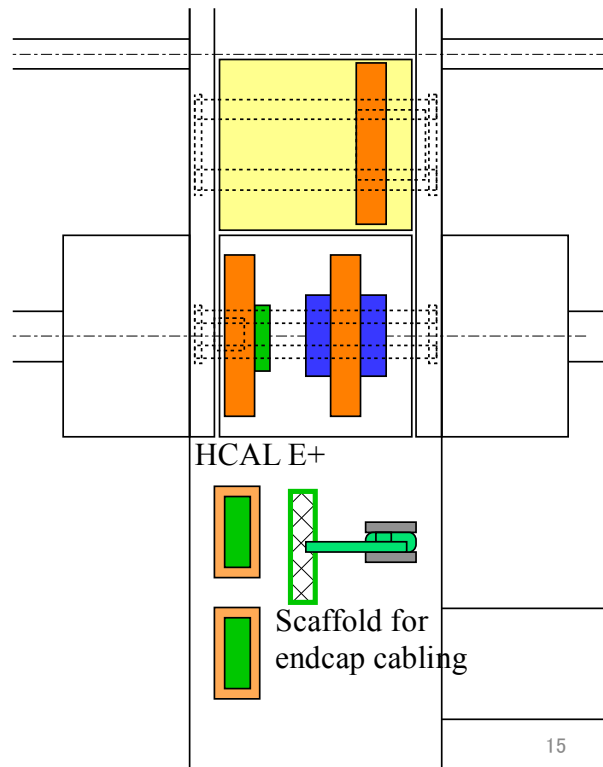


# ILD Installation Study (Preliminary)

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## Step 7

- YB0 shifted in z direction
- Endcap HCAL installation in Area 1
- Scaffold for endcap cabling is assembled in Area 5

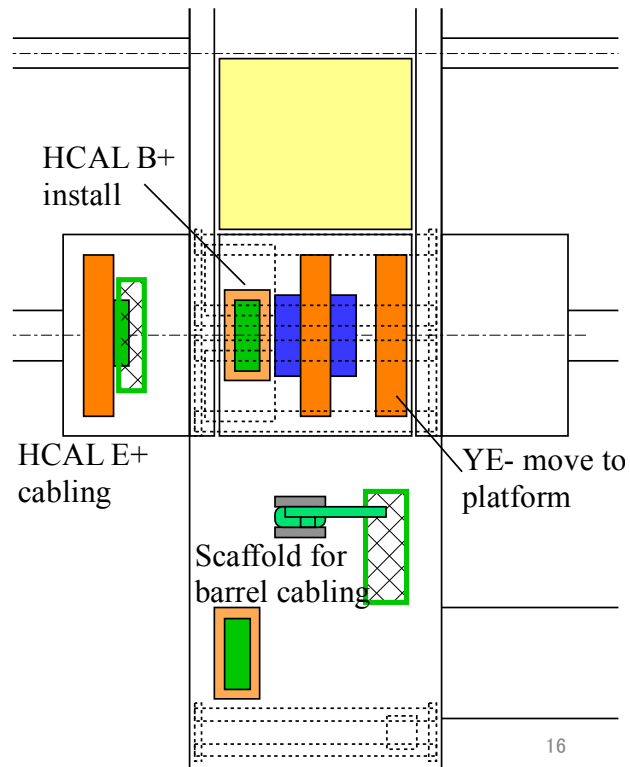




# ILD Installation Study (Preliminary)

## Step 8

- YE- is moved to platform
- $\frac{1}{2}$  of barrel HCAL is moved to platform using two 250 ton cranes, and installed
- Endcap yoke (+) is pushed into Area 2
- Endcap HCAL cabling in Area 2
- Scaffold for barrel cabling is assembled in Area 5

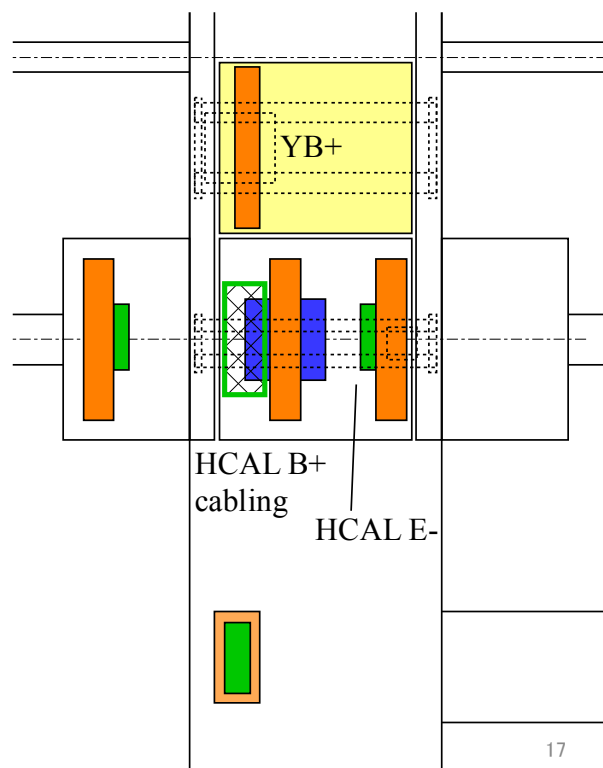


# ILD Installation Study (Preliminary)

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## Step 9

- Another barrel yoke ring YB+ is assembled in Area 4
- Central barrel YB0 is shifted in z direction
- Barrel HCAL (+) cabling in Area 1
- Endcap HCAL (-) installation in Area 1

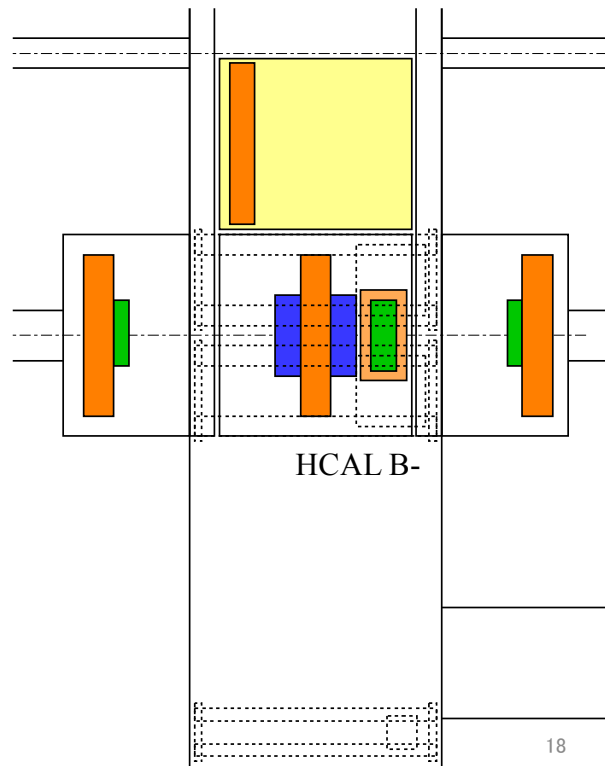


# ILD Installation Study (Preliminary)

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## Step 10

- Endcap yoke (-) is pushed to Area 3
- $\frac{1}{2}$  of barrel HCAL is moved to platform using two 250 ton cranes, and installed

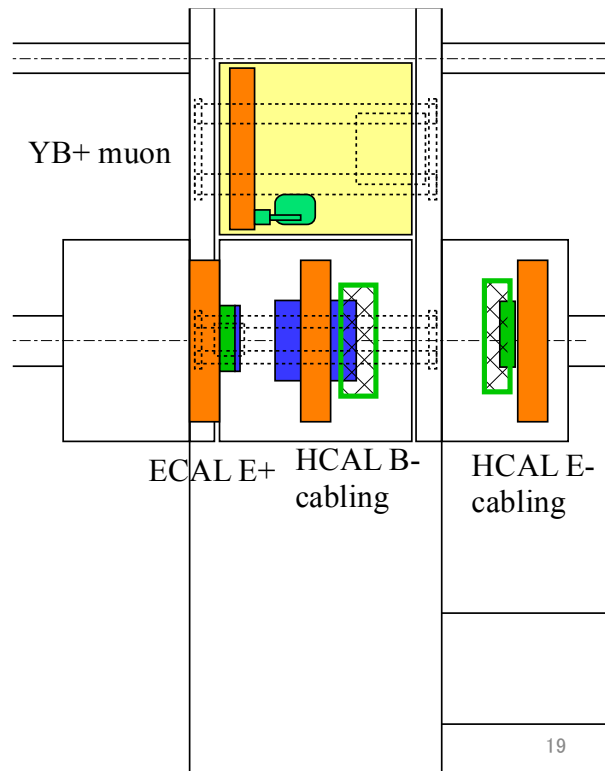


# ILD Installation Study (Preliminary)

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## Step 11

- YB+ muon detector installation and cabling in Area 4
- Endcap ECAL (+) installation using 30 ton crane in Area 1
- Barrel HCAL (-) cabling in Area 1
- Endcap HCAL (-) cabling in Area 3

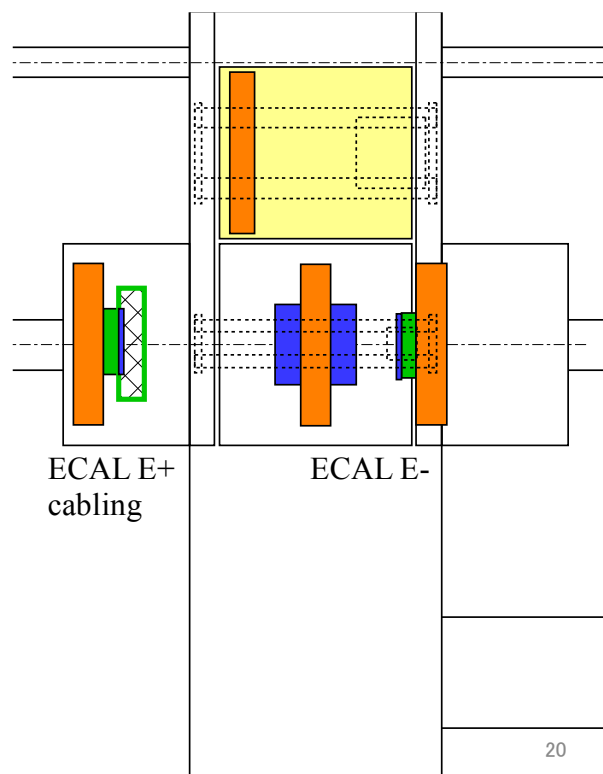


# ILD Installation Study (Preliminary)

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## Step 12

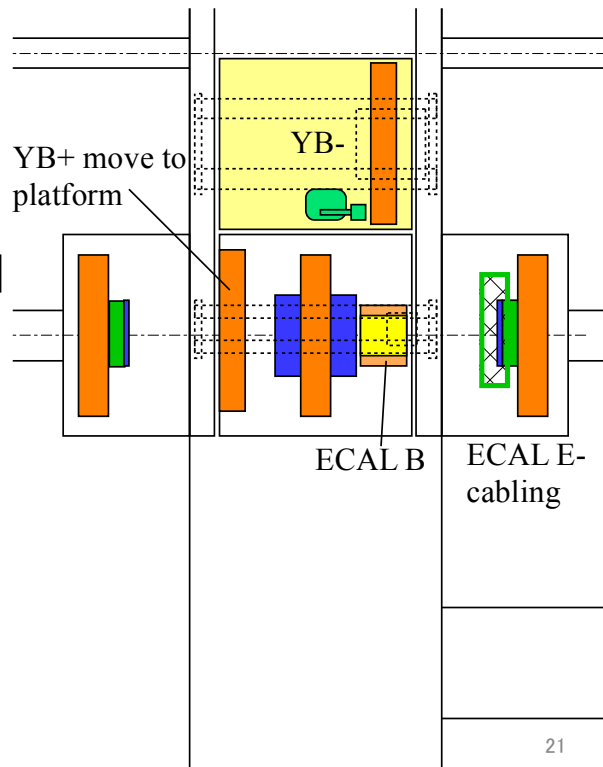
- Endcap yoke (+) pushed into area2
- Endcap ECAL(+) cabling
- Endcap ECAL(-) installation in area1 using 30 ton crane



# ILD Installation Study (Preliminary)

## Step 13

- YB+ is moved to Area 1
- Another barrel yoke ring YB- is assembled and muon detectors installed in Area 4
- Endcap ECAL (-) cabling in Area 3
- Barrel ECAL is installed in Area 1

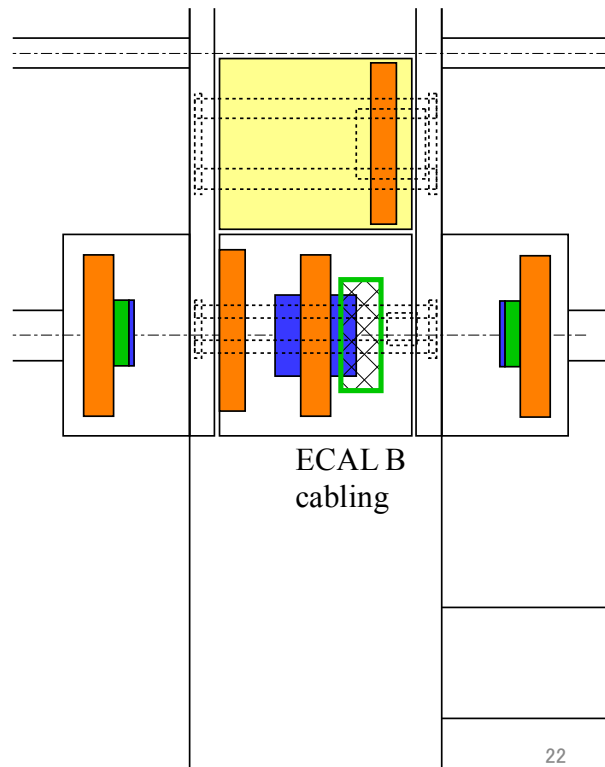


# ILD Installation Study (Preliminary)

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## Step 14

- Barrel ECAL cabling in Area 1



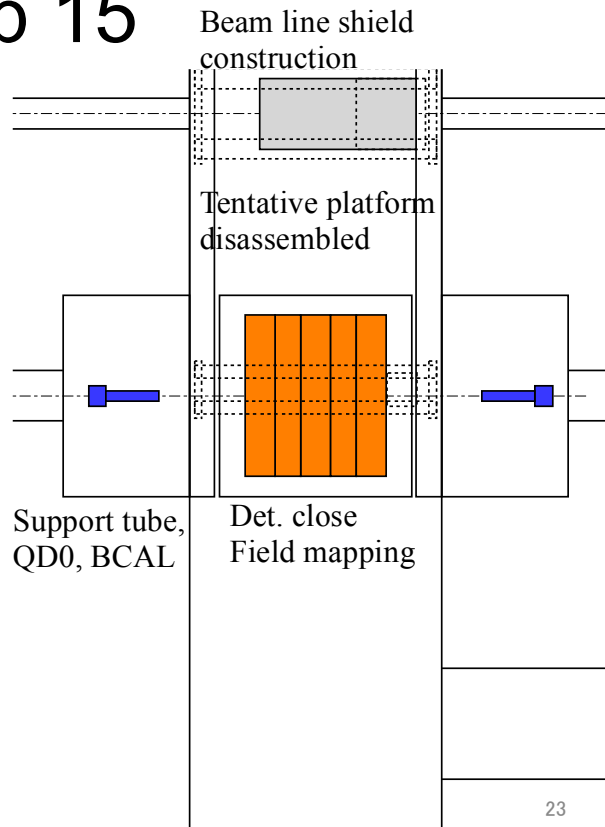


# ILD Installation Study (Preliminary)

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## Step 15

- Detector is closed and field mapping is performed
- QD0 support tubes assembly in Area 2/3
- QD0 and BCAL installation/cabling in Area 2/3
- After removing the tentative platform in Area 4, beam line shield is constructed

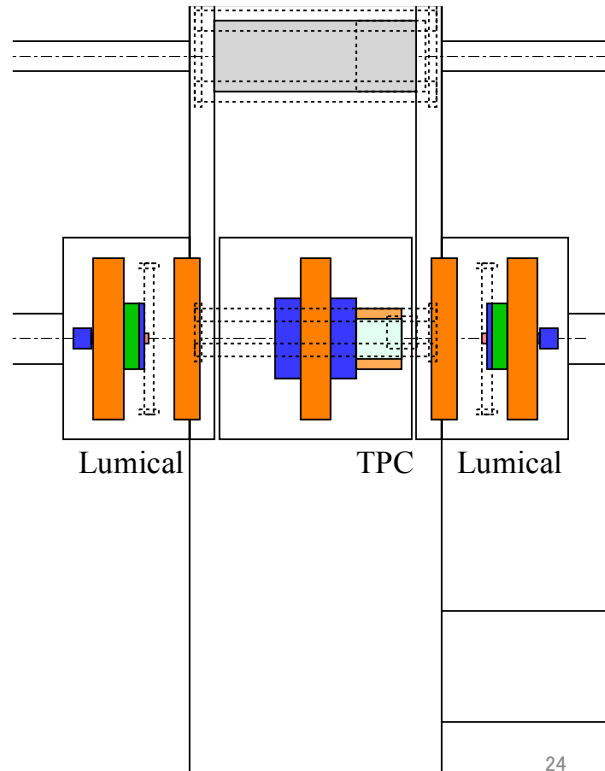


# ILD Installation Study (Preliminary)

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## Step 16

- Detector is opened again
- TPC installation in Area 1
- Lumical installation using 2.8 ton cranes in Area 2/3

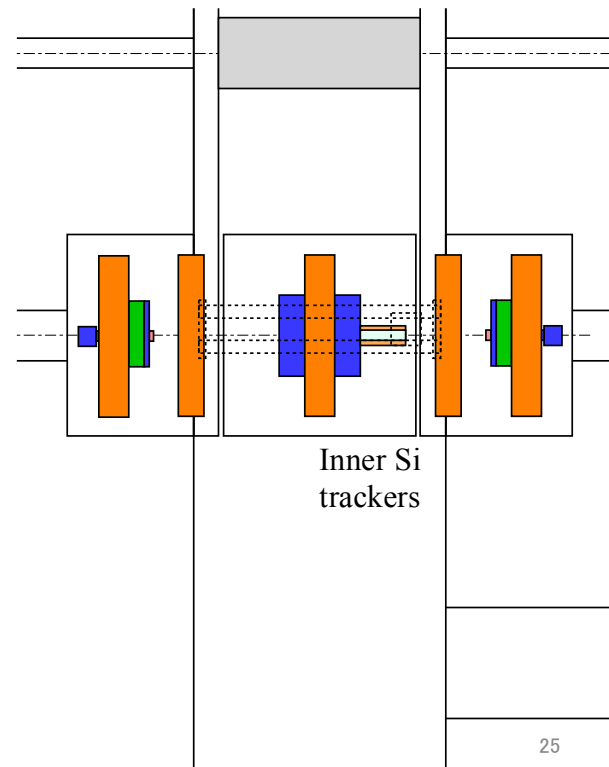


# ILD Installation Study (Preliminary)

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## Step 17

- Si inner trackers are installed in Area 1

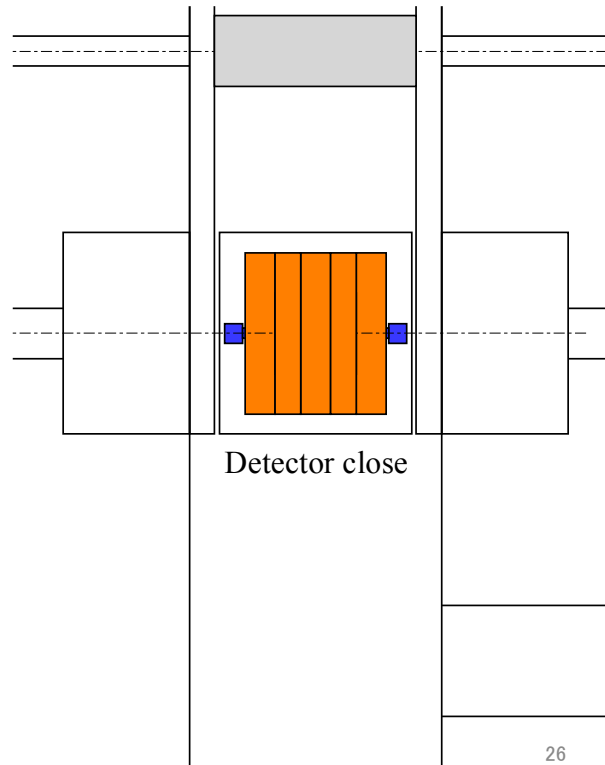


# ILD Installation Study (Preliminary)

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## Step 18

- Detector is closed again and ready for detector pre-commissioning



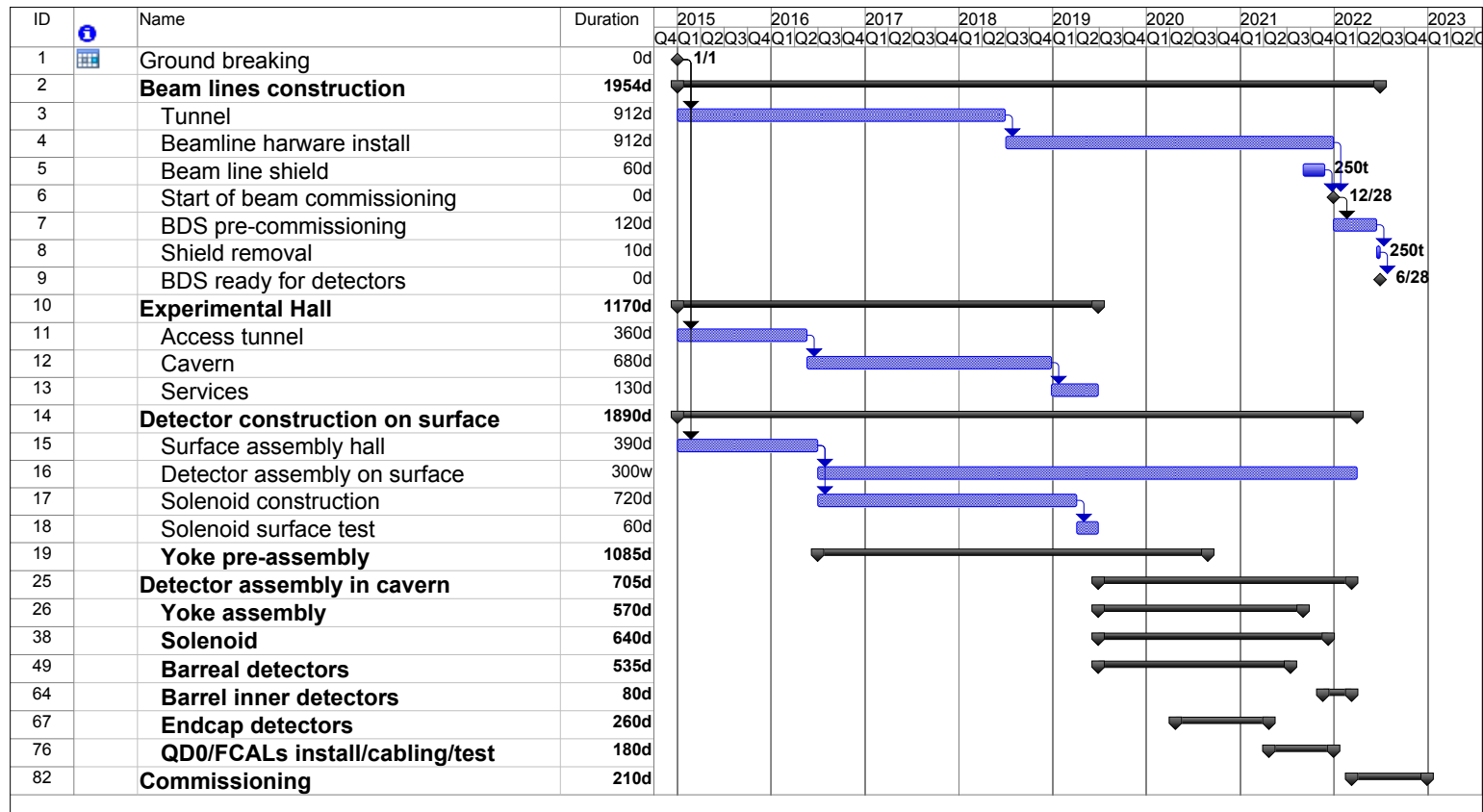
# ILD Installation Study (Preliminary)

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- Installation studies are still work in process
- Cross-checks with 3D models are yet to be done
- Implications of common infrastructure use (access tunnel, cranes) not studied yet
  - Might need buffer space
- Clearly: installation of ILD in the mountain site hall is a challenge!

# ILD Time Line Study

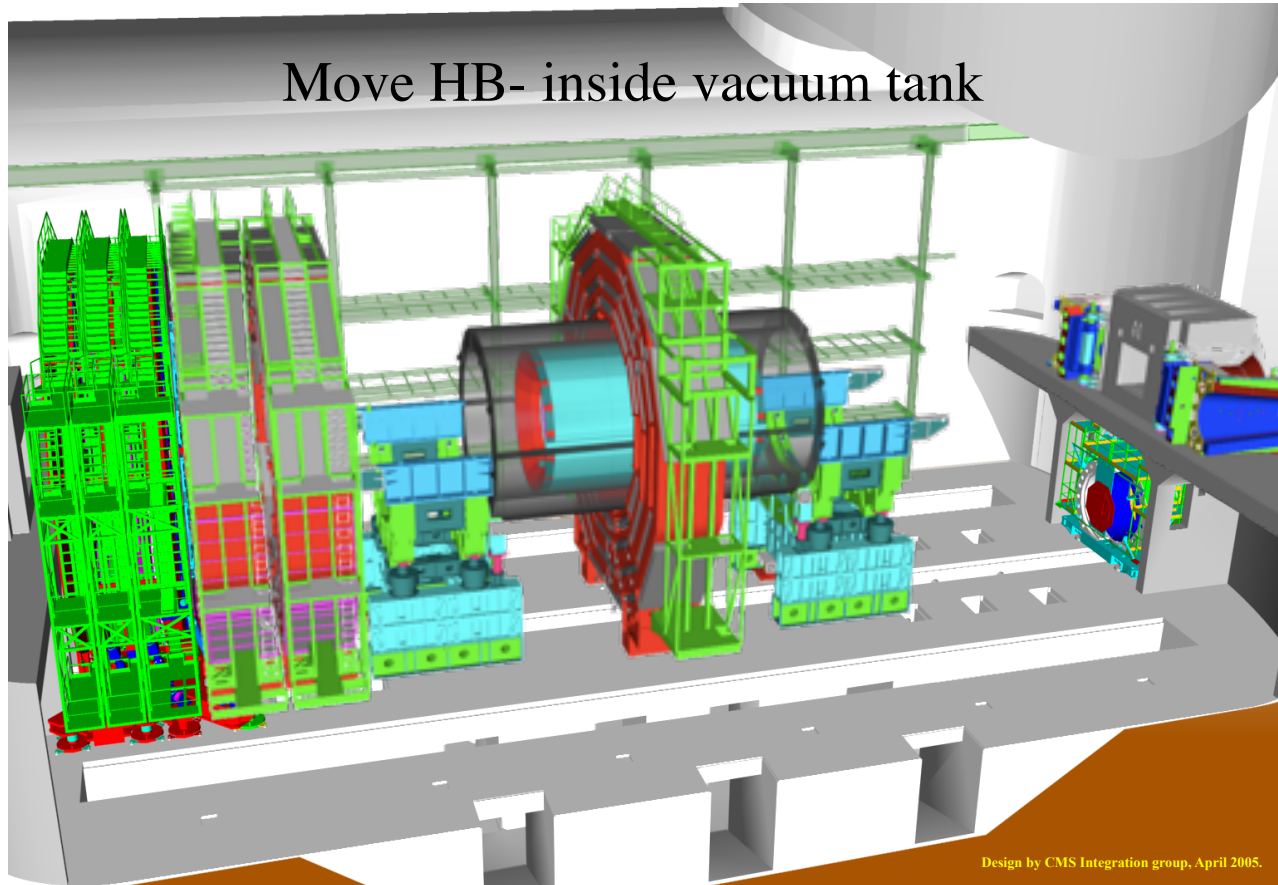
Y. Sugimoto



- Total construction time: ~8 years
- Detector underground construction: ~3 years

# CMS Assembly - Tooling

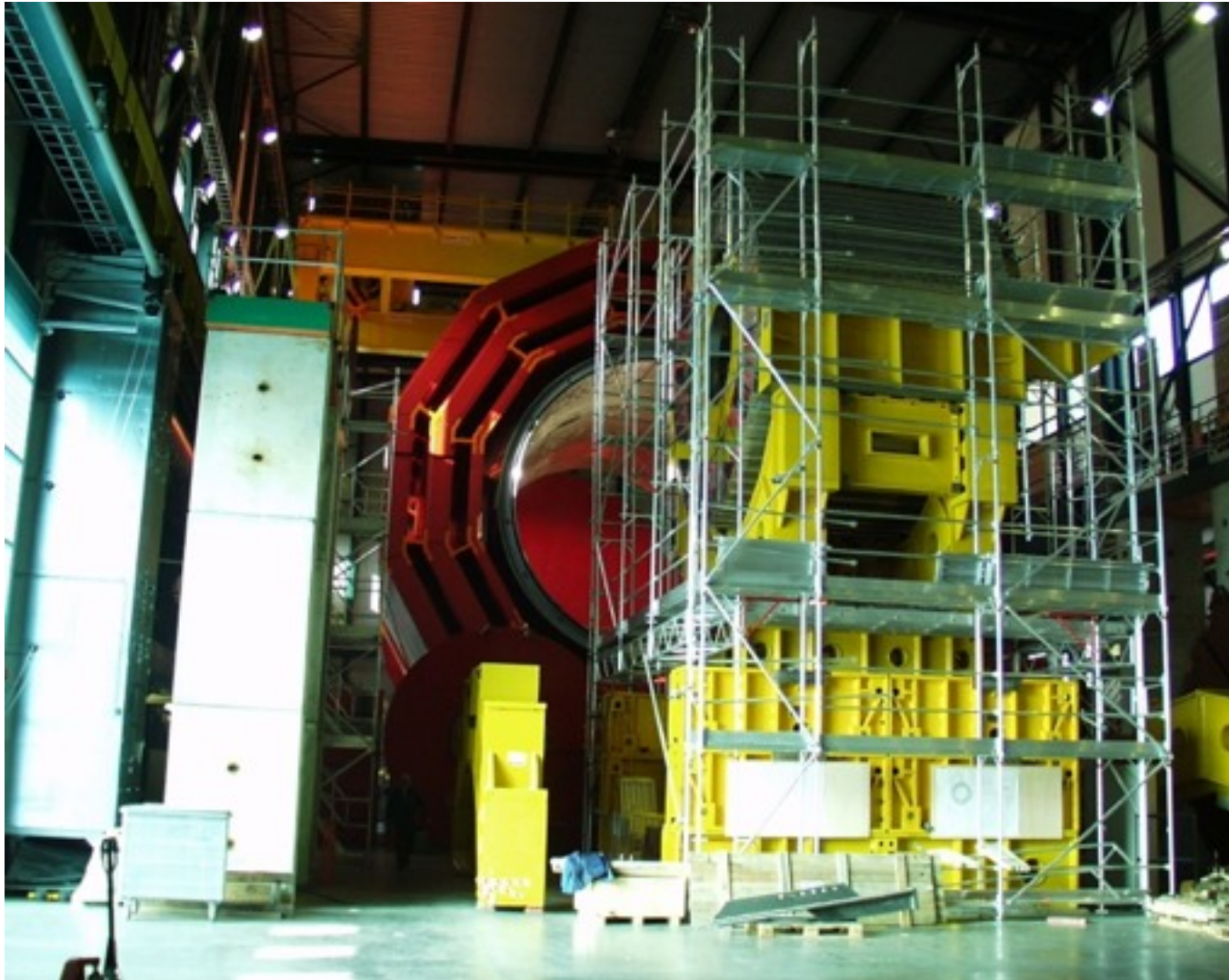
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# CMS Surface Assembly Hall

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# Summary and Outlook

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- ILD MDI work is concentrating on integration issues in the Japanese mountain site hall now
  - Underground facilities are cost drivers!
- We are studying the ILD assembly in the Japanese hall
  - First studies done on 2D models
  - Conclusion expected for ILD workshop May 23-25 2012 (Fukuoka, J)
- We need to understand better the implications of the common use of the infrastructures during the assembly of
  - ILD
  - SiD
  - Machine
- Started to write the DBD....