ILD in Mountain Site Hall

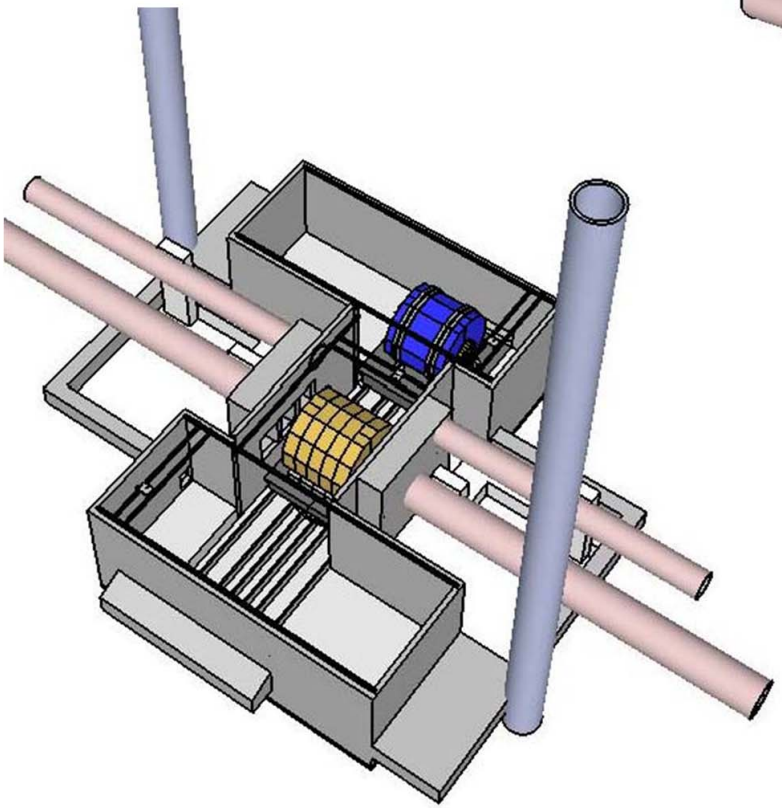
Karsten Buesser

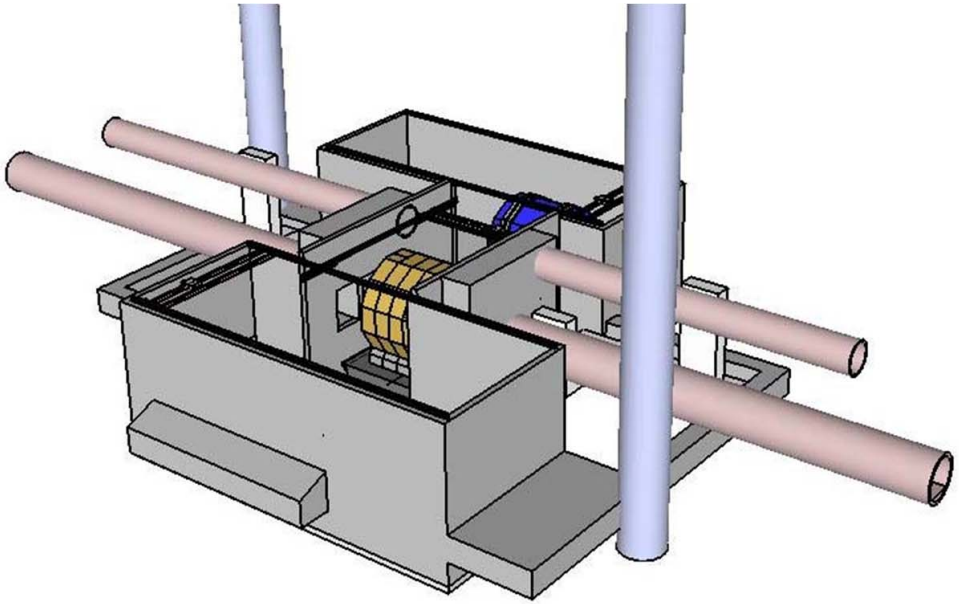
12.04.2012

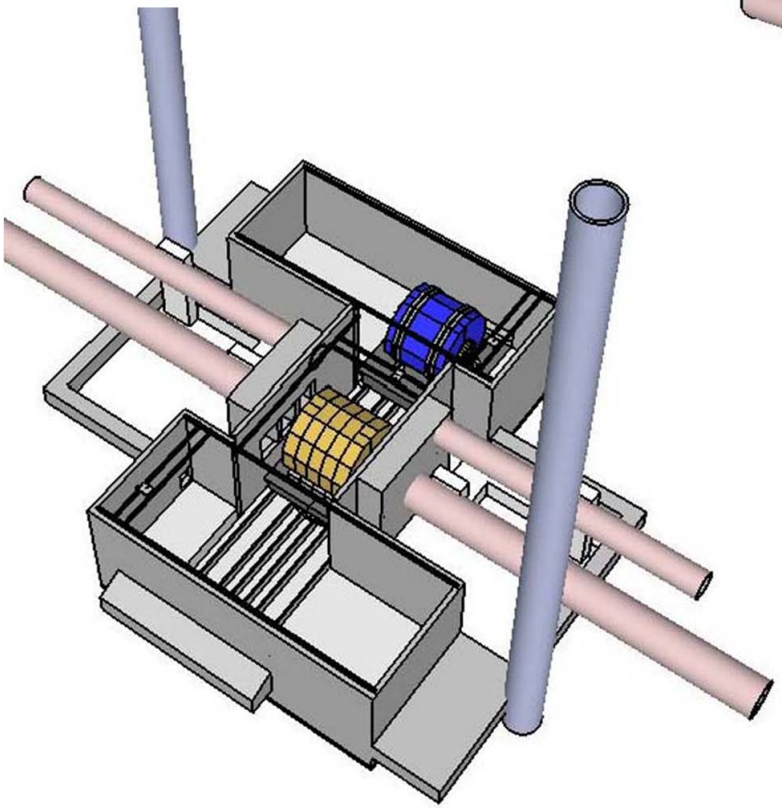
ILD Regional Integration Meeting

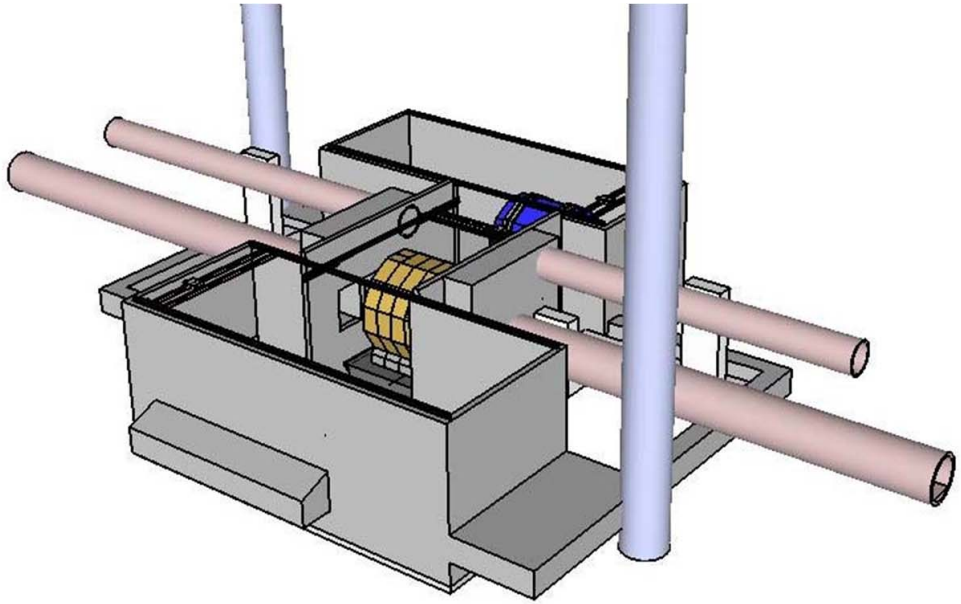
Overview

- 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
- Discussed ILD assembly at last integration meetings (Paris, Webex)
- CFS Baseline Technical Review Workshop at CERN on March 22-23
    - Discussions with GDE on cost issues!



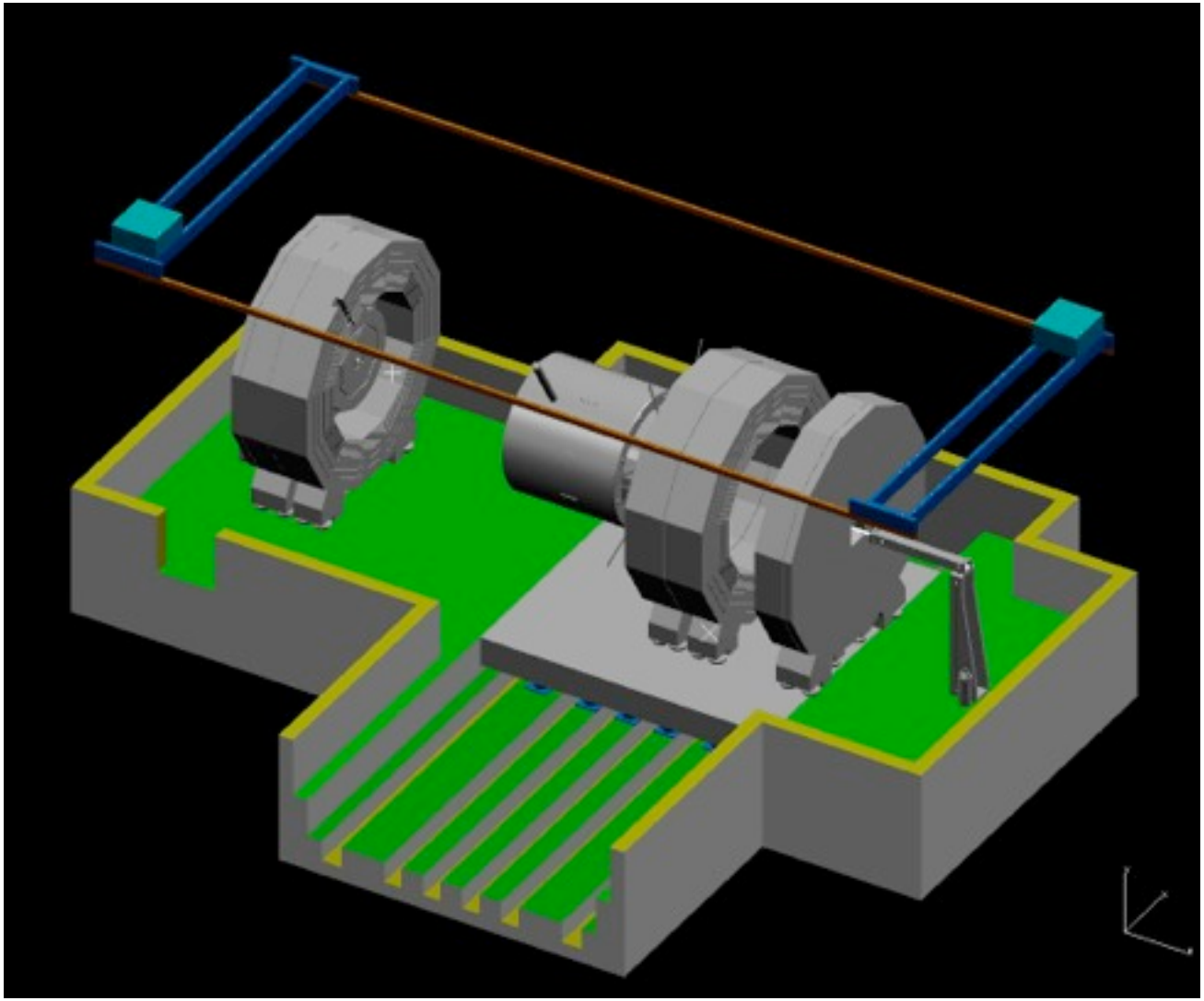






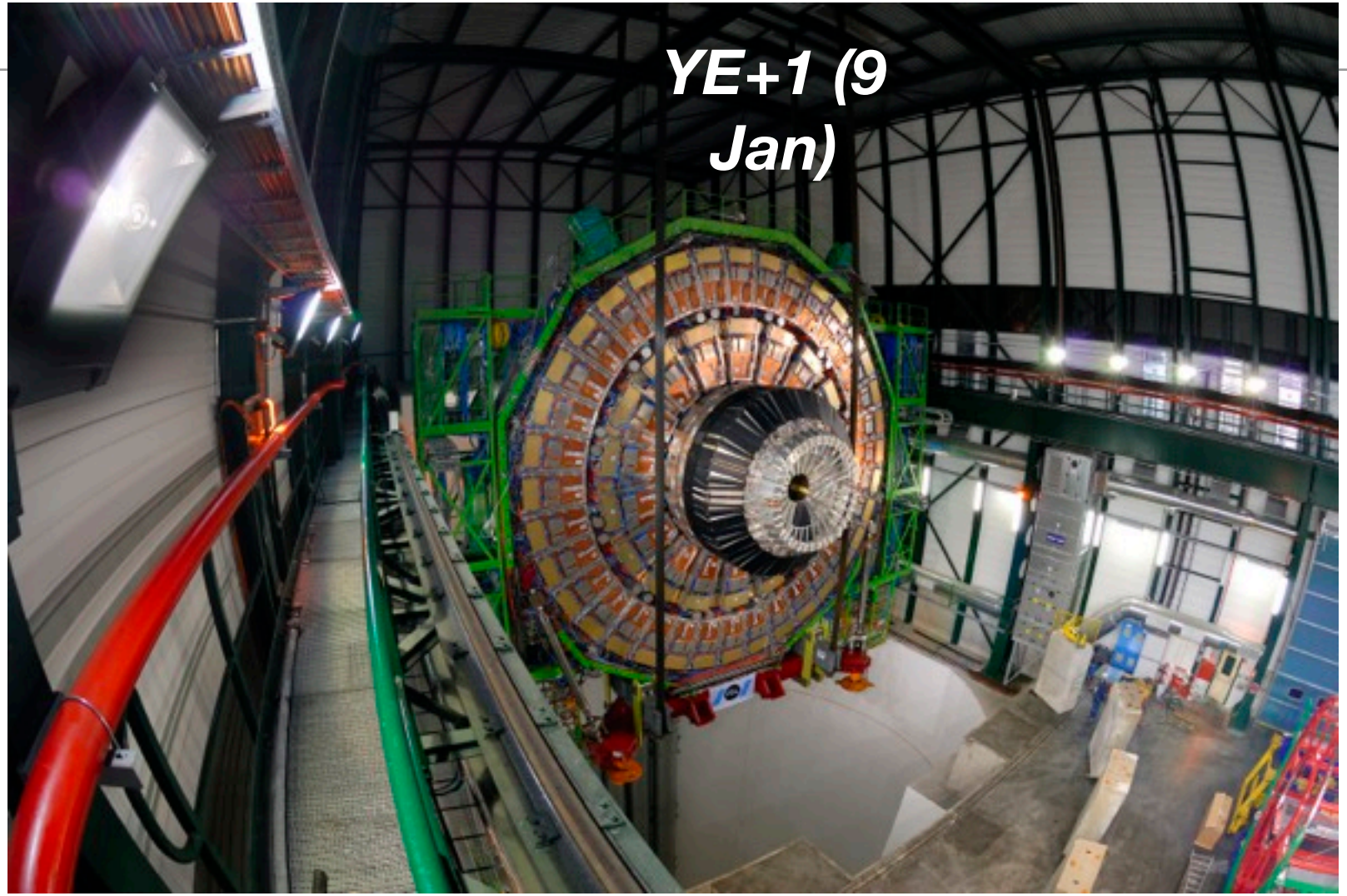
Optimisation for ILD requirements important!

ILD in Maintenance Region (non-mountain site)



R. Volkenborn

CMS Assembly



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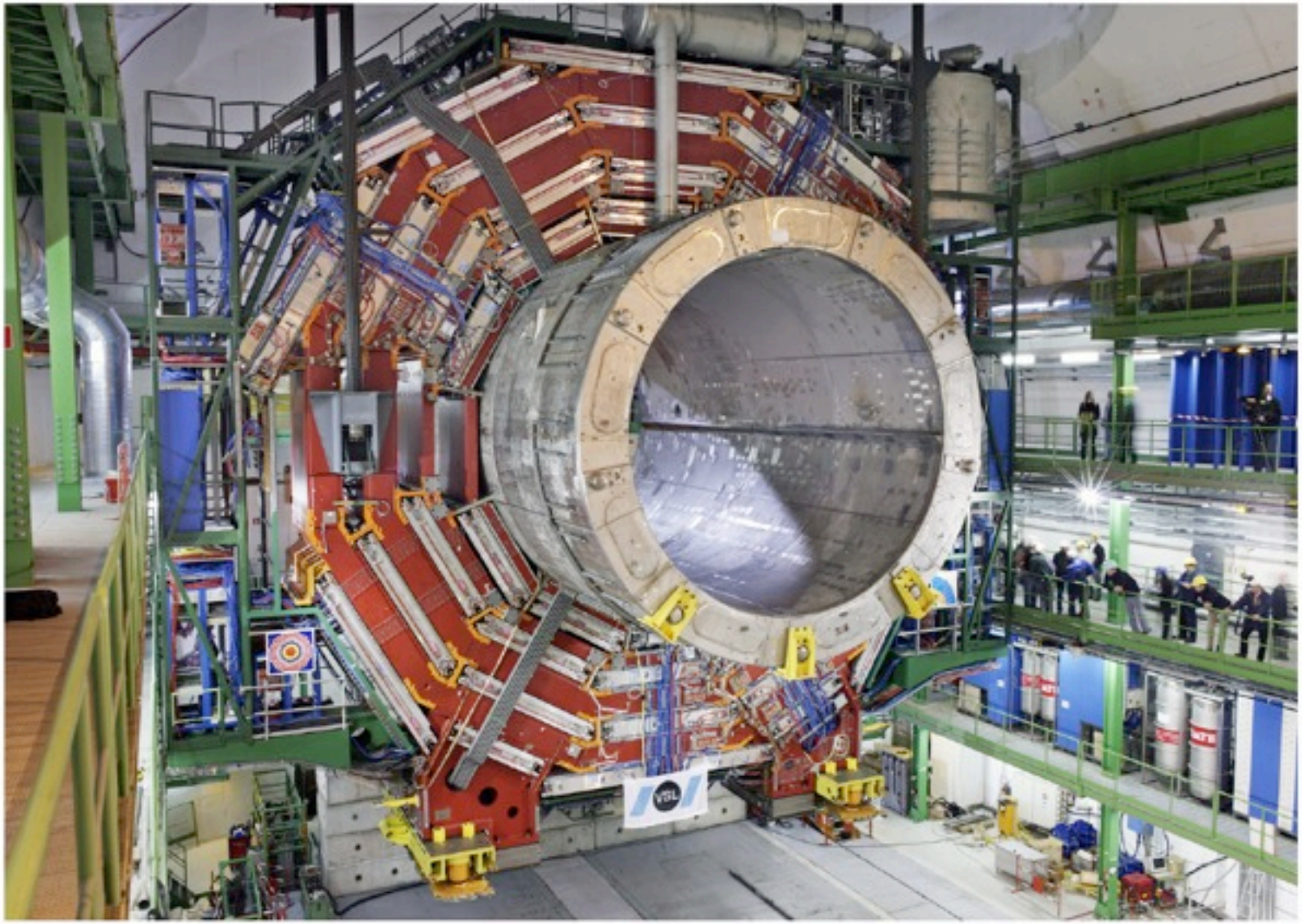


A. Hervé

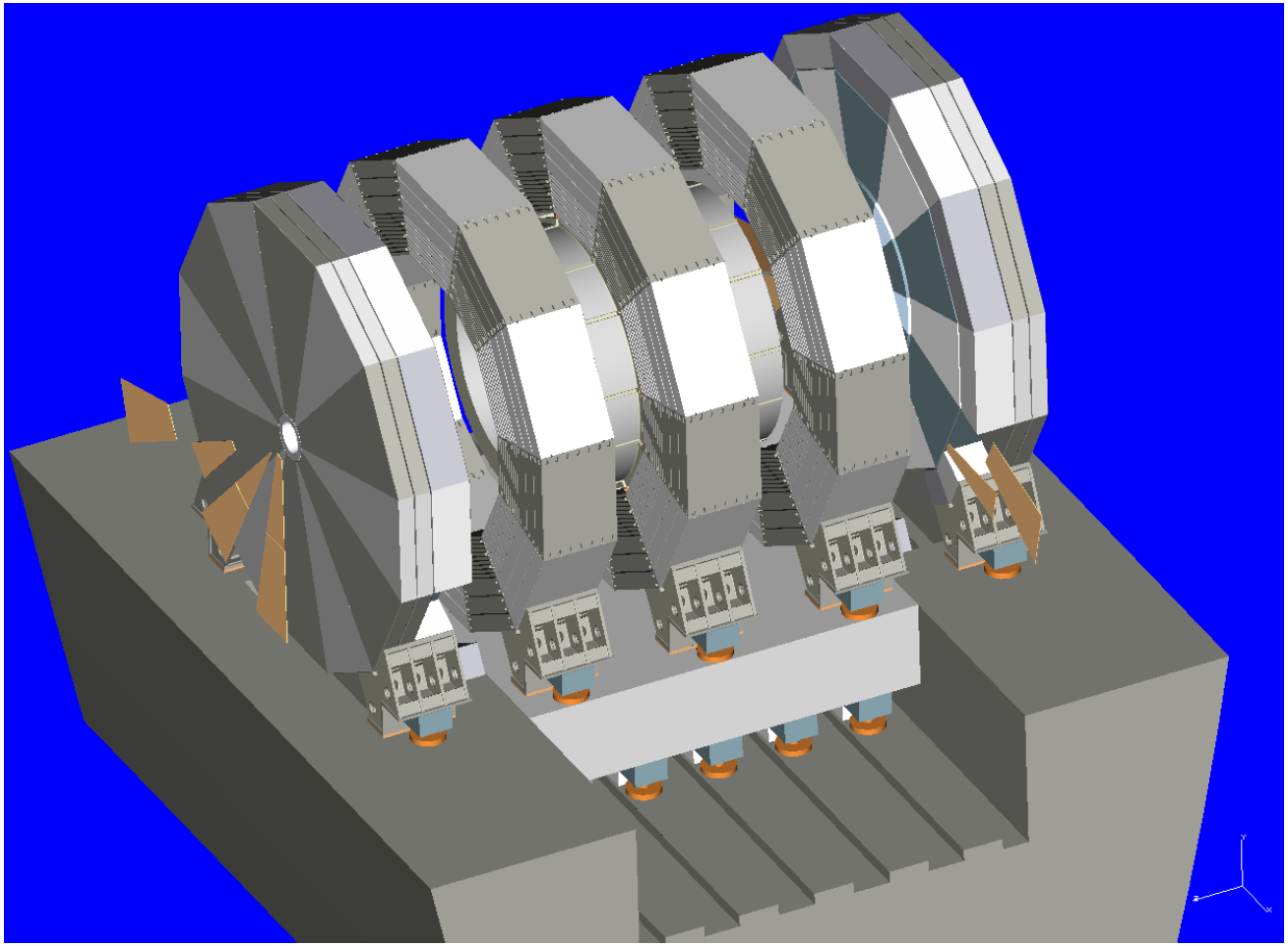
YB0 landing in the CMS experiment hall

ILD Assembly

- 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 mountian 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

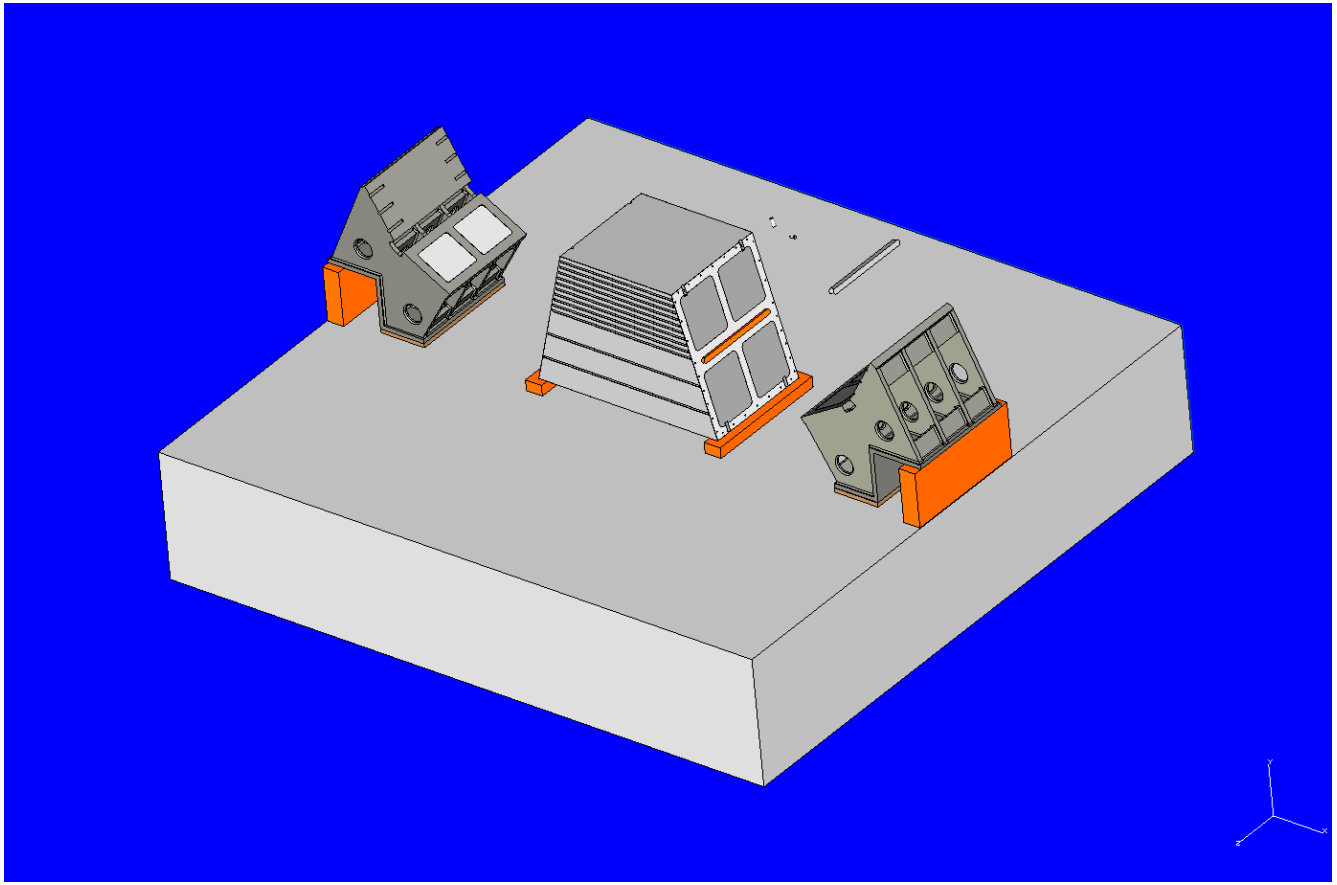
ILD Design

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



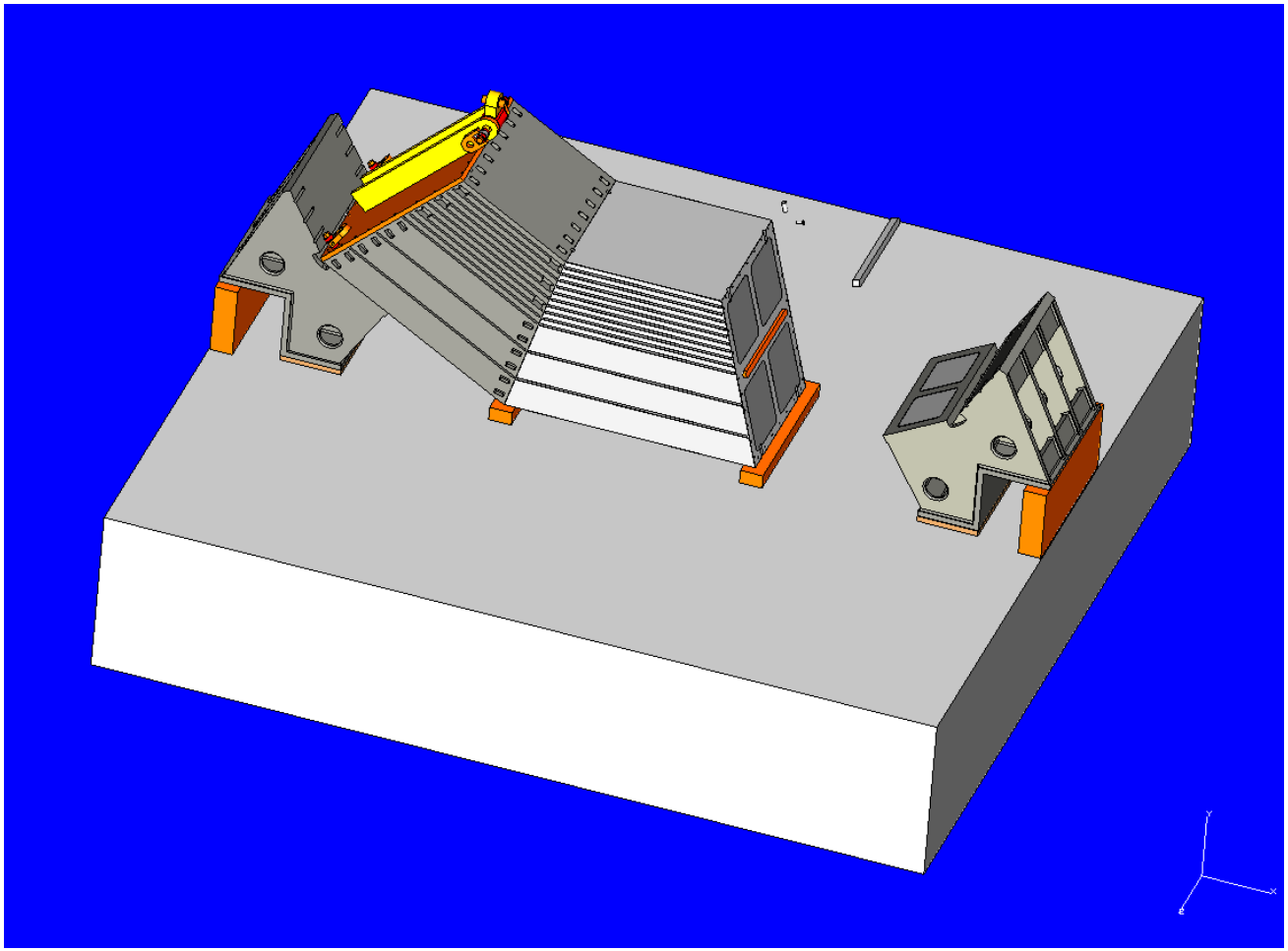
Yoke Assembly - Barrel

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

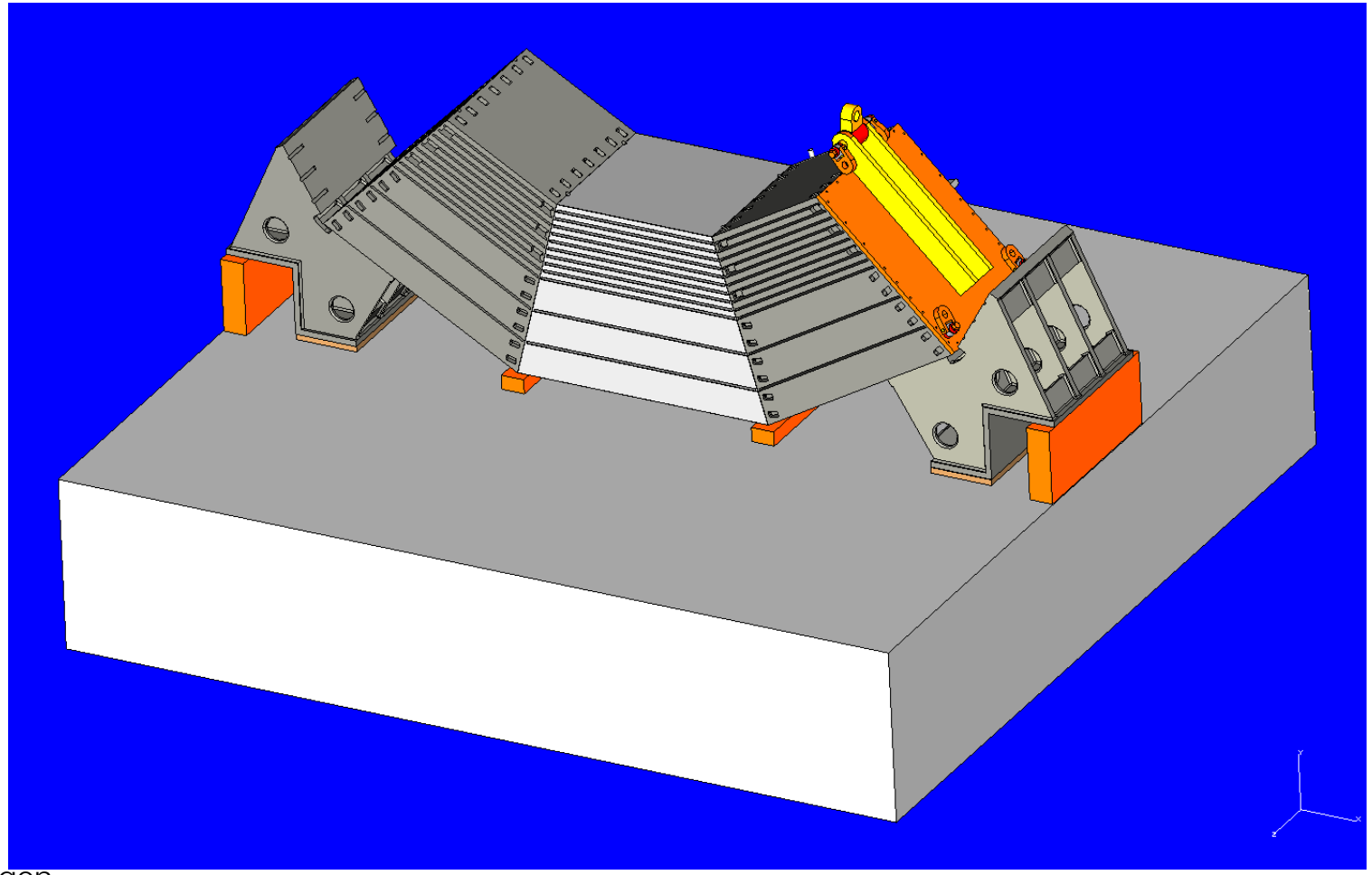


Yoke Assembly - Barrel

- 200t crane coverage needed

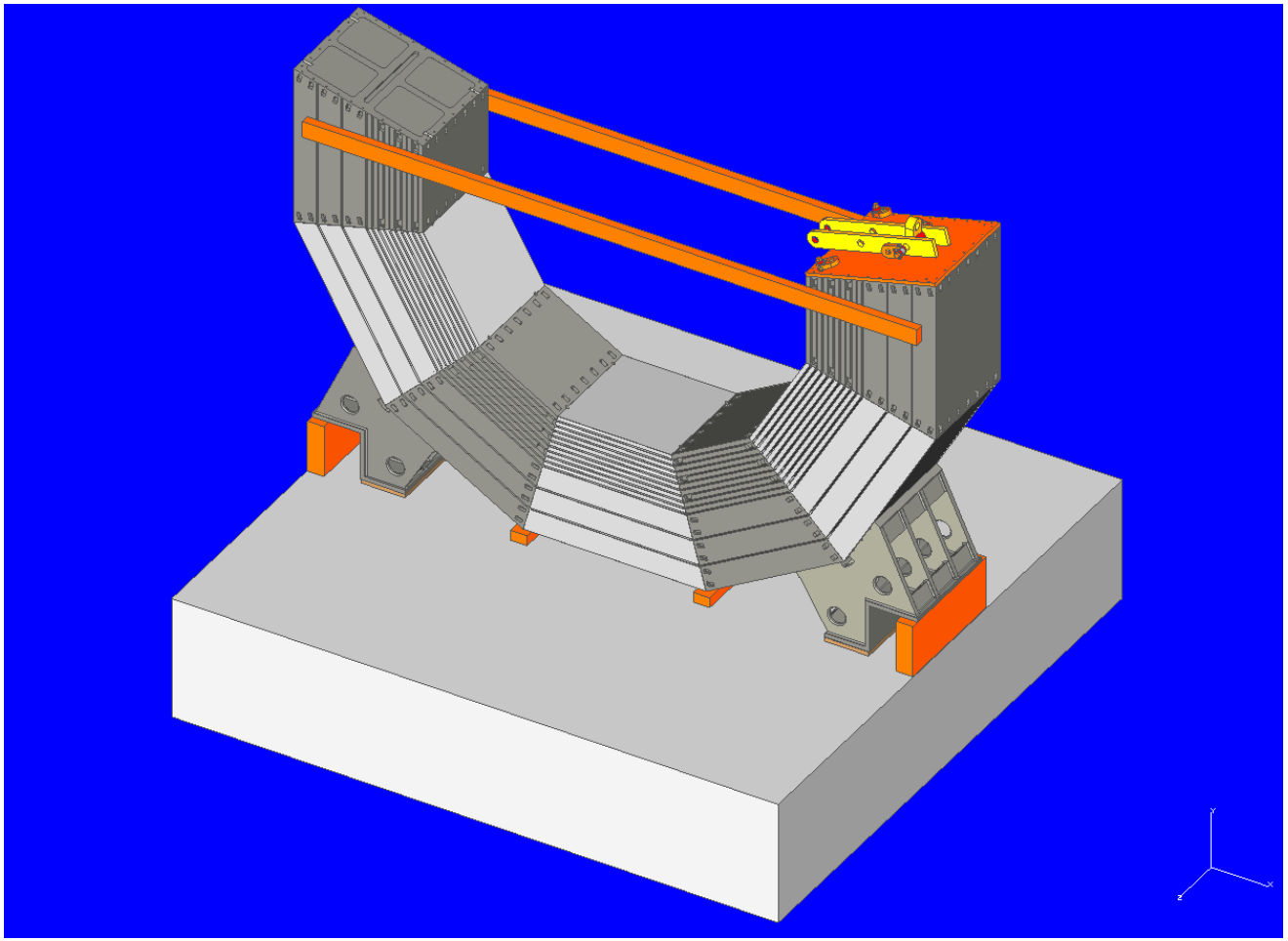


Yoke Assembly - Barrel

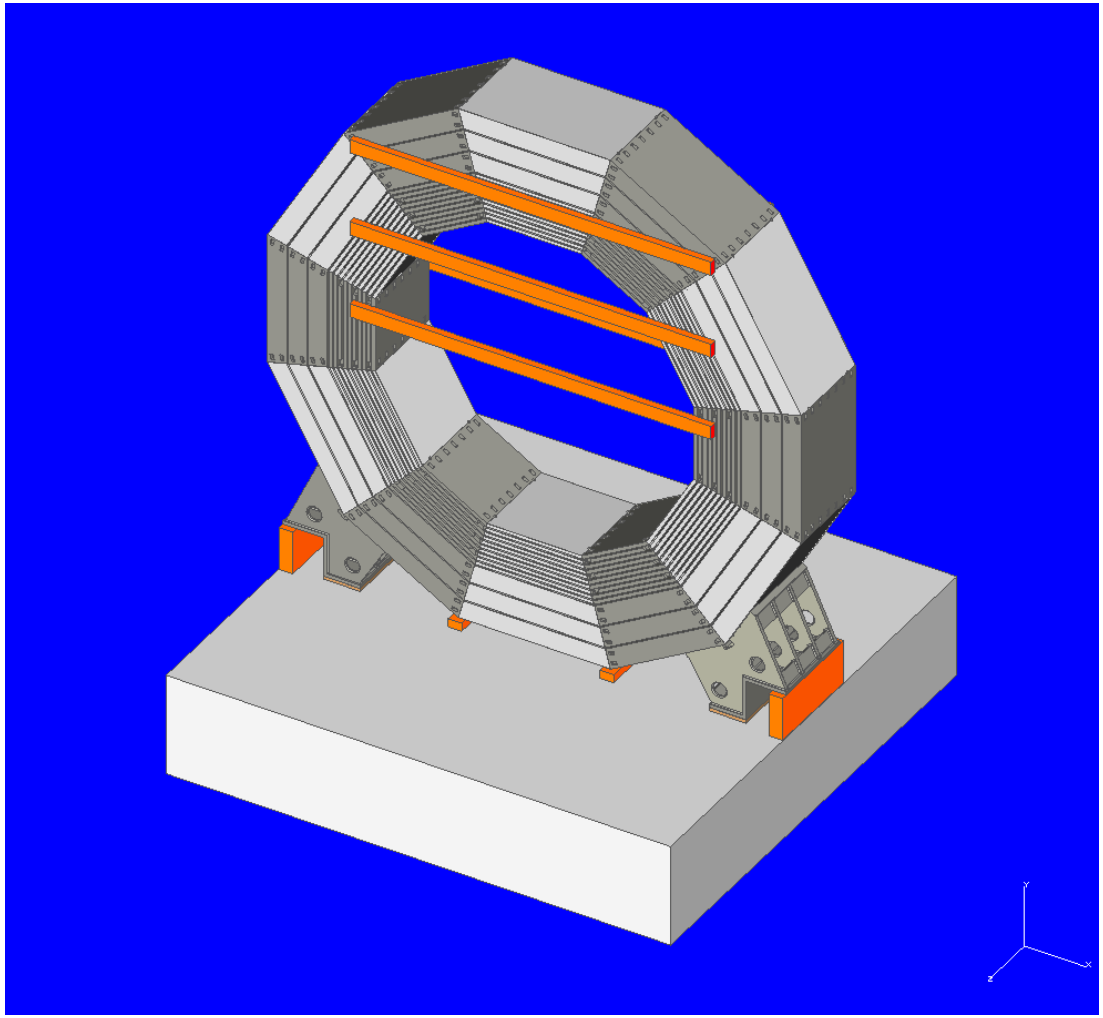


Yoke Assembly - Barrel

- Tooling needs still under study



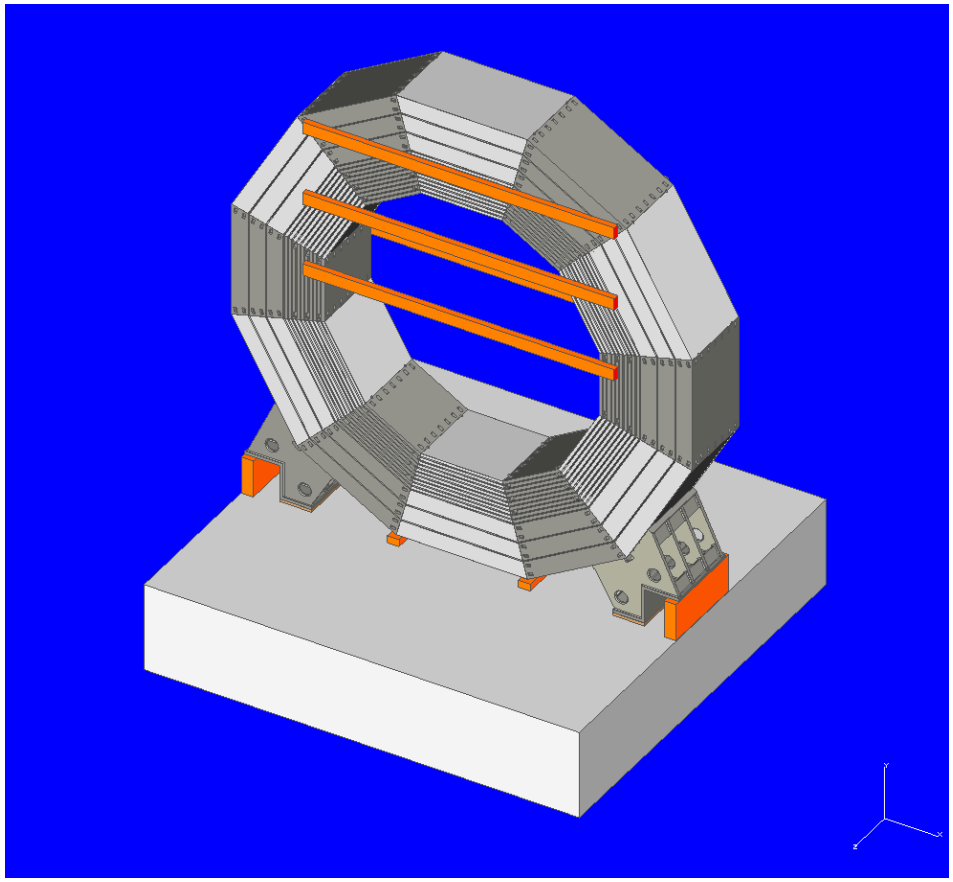
Yoke Assembly - Barrel



Yoke Assembly

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

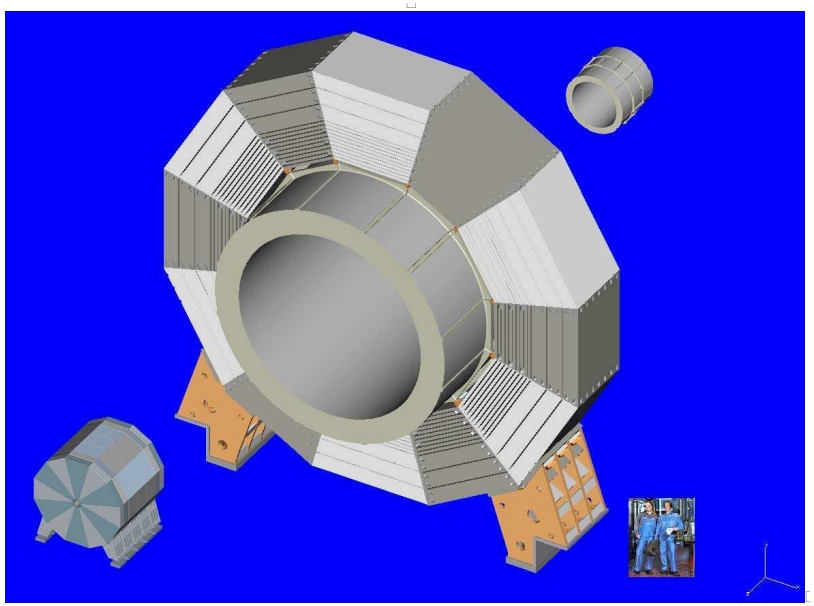
R. Stromhagen



Endcaps: see R. Stromhagen‘s talk

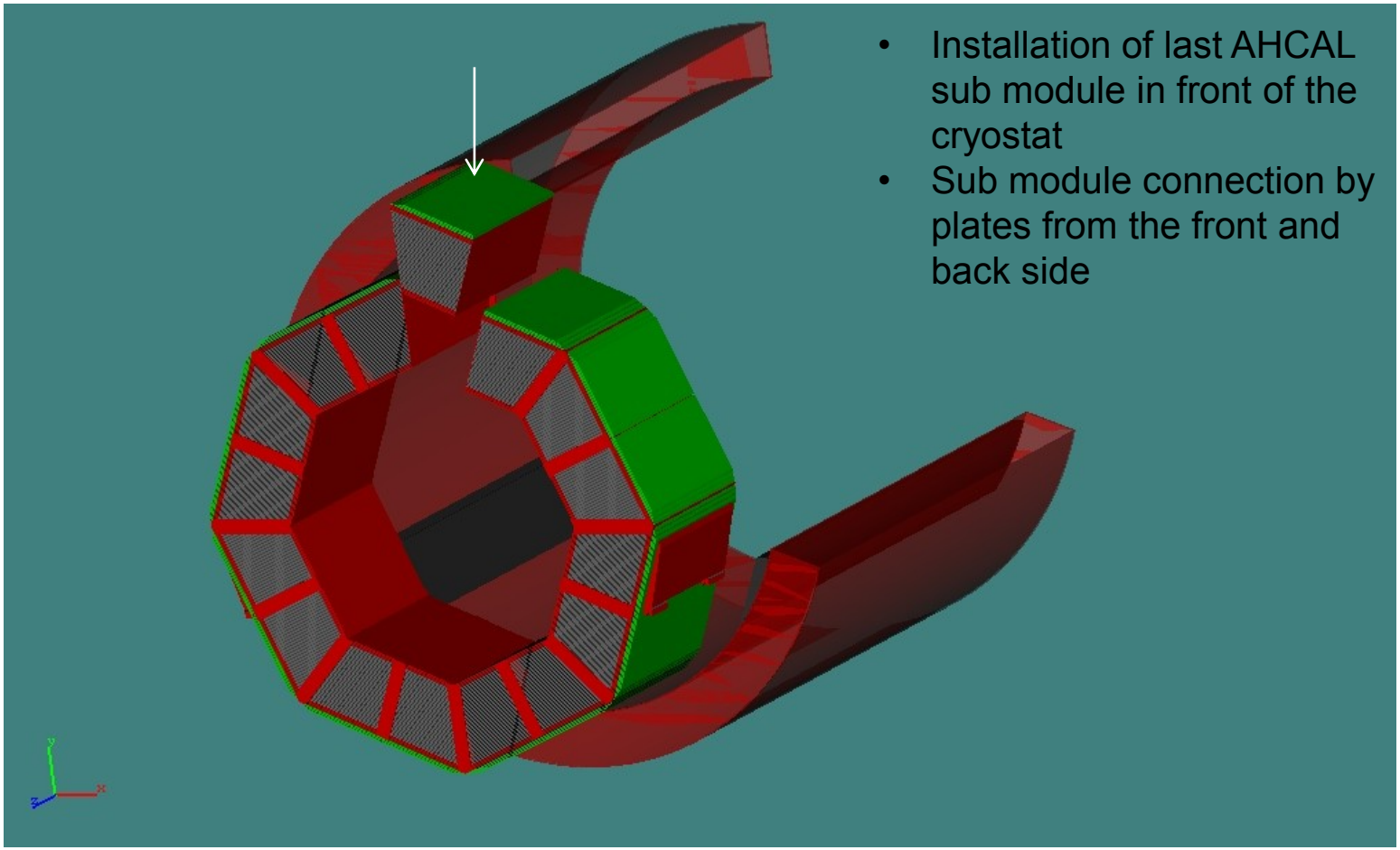
Coil Installation

- 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



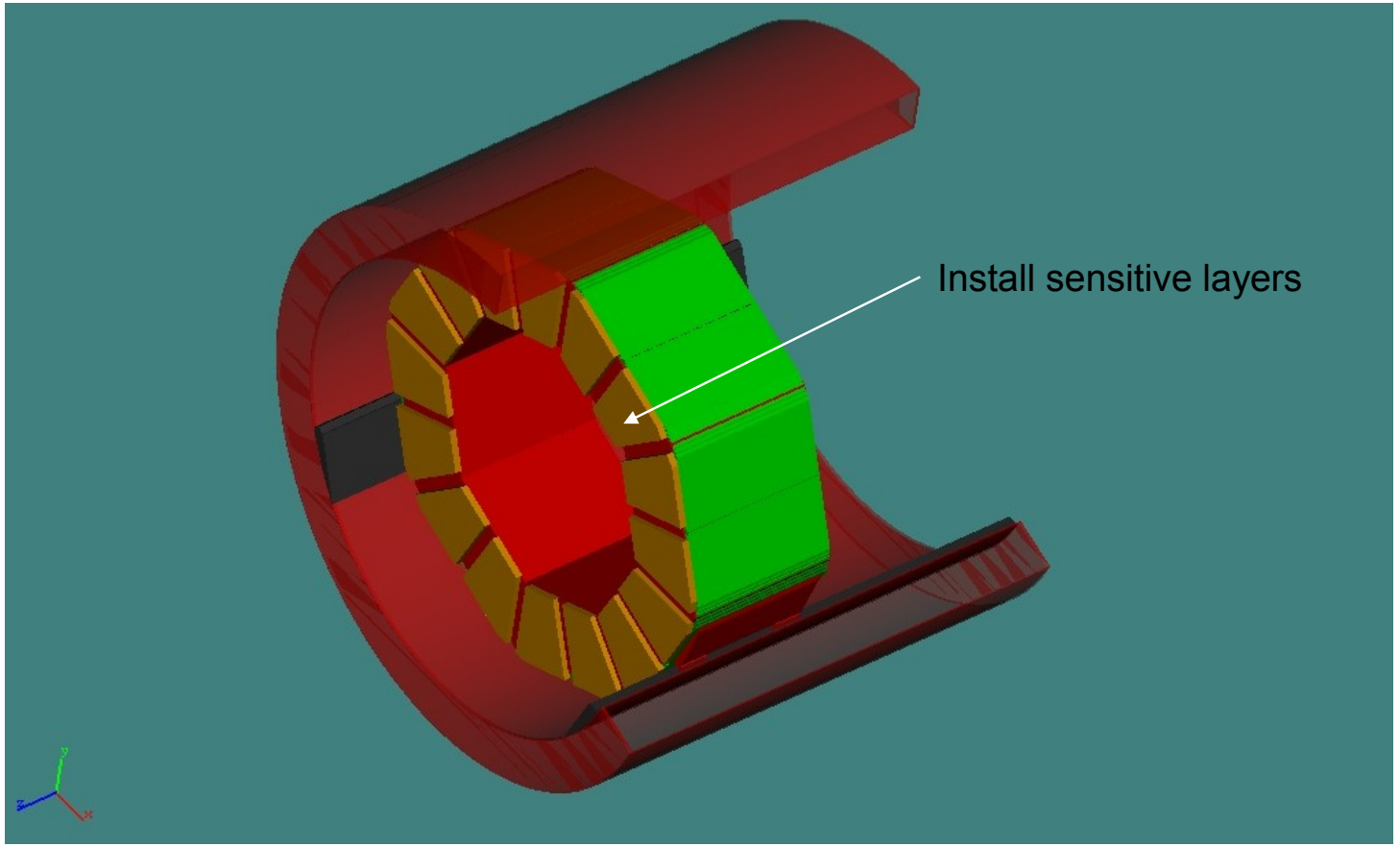
R. Stromhagen

AHCAL Installation

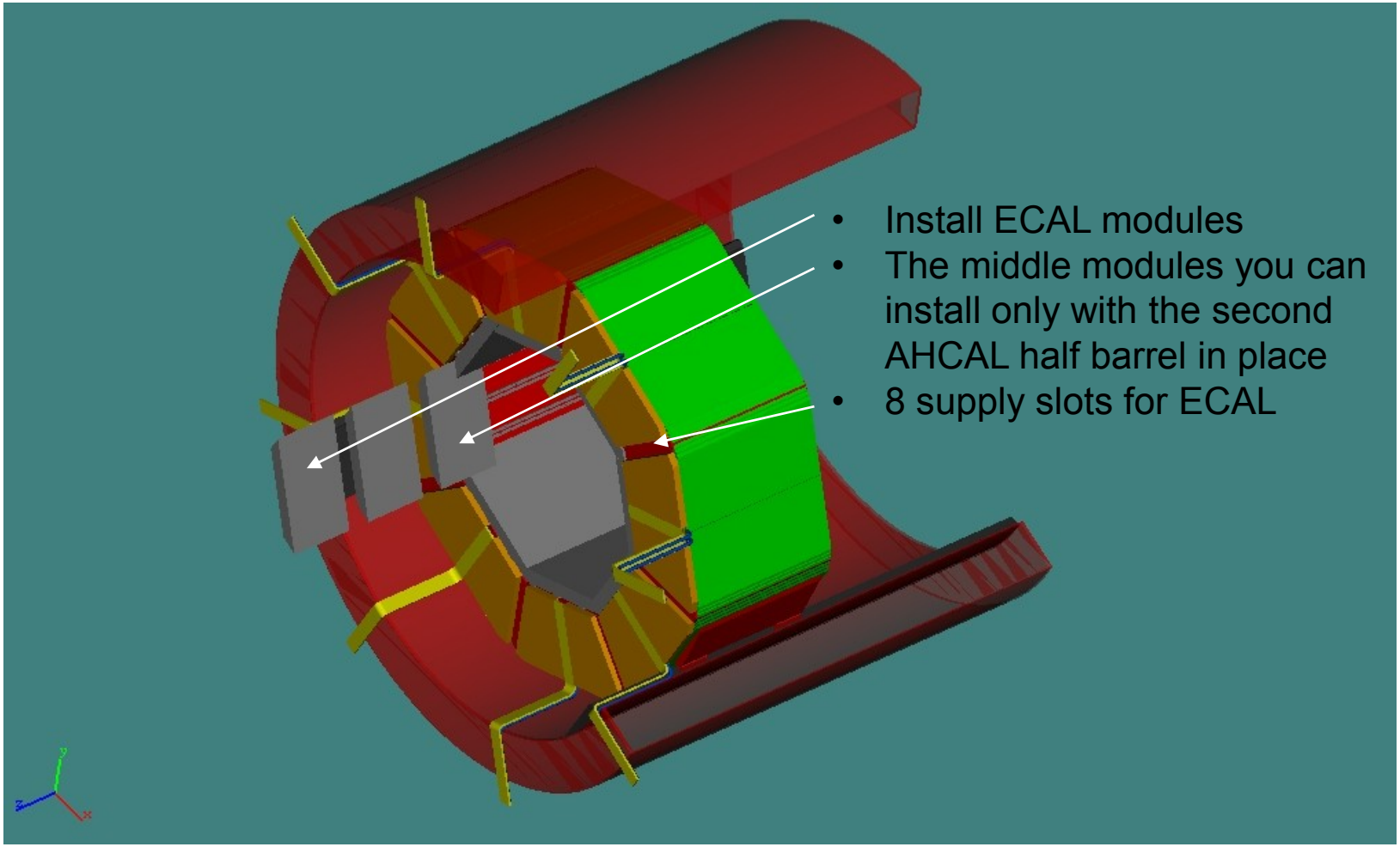


- Installation of last AHCAL sub module in front of the cryostat
- Sub module connection by plates from the front and back side

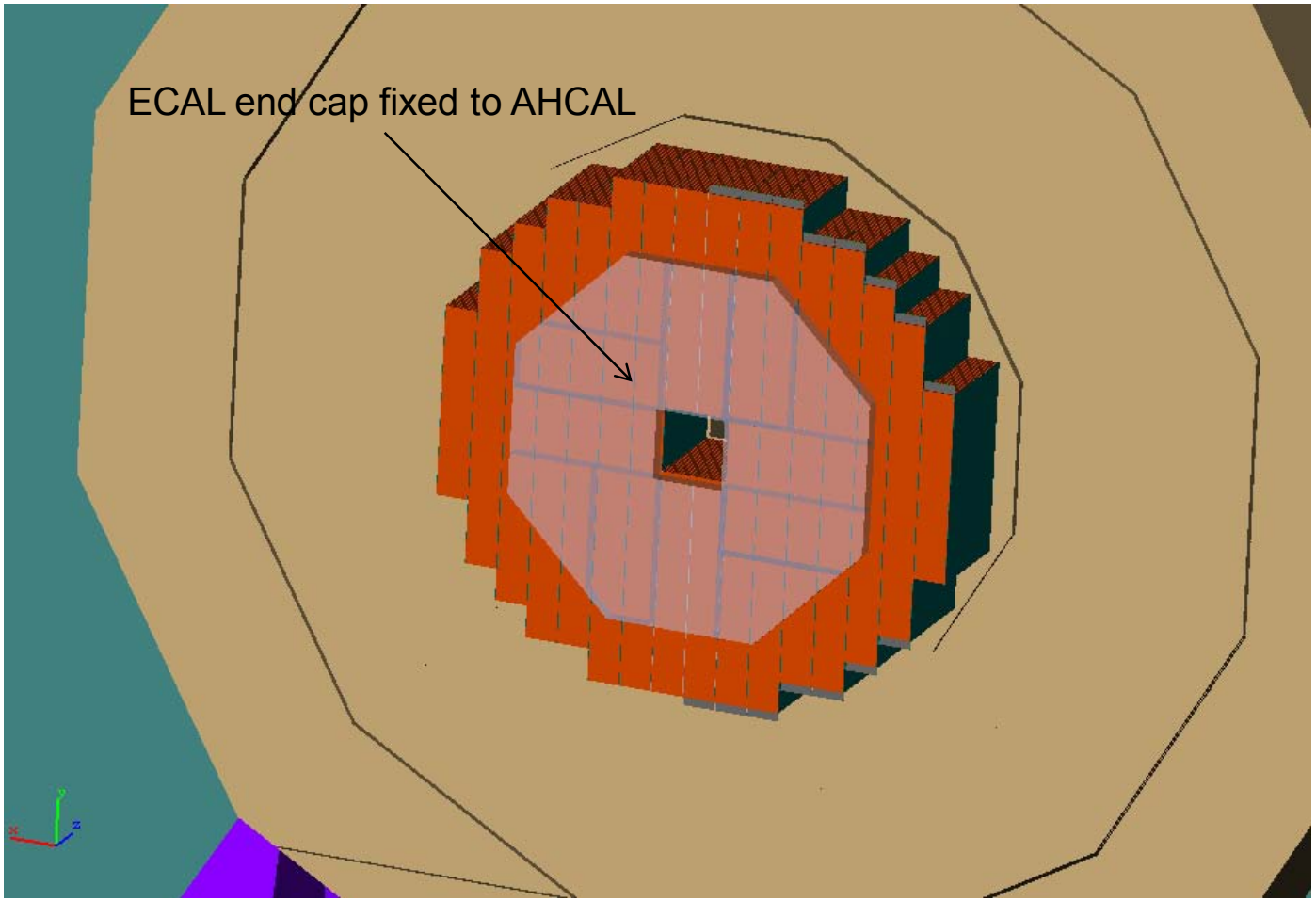
AHCAL Installation



AHCAL/ECAL Installation



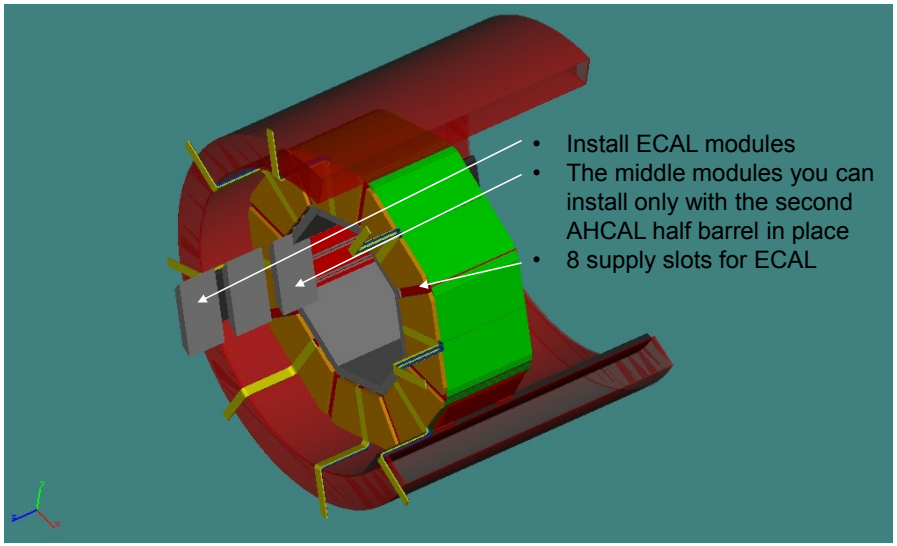
Endcap Calorimeter Installation



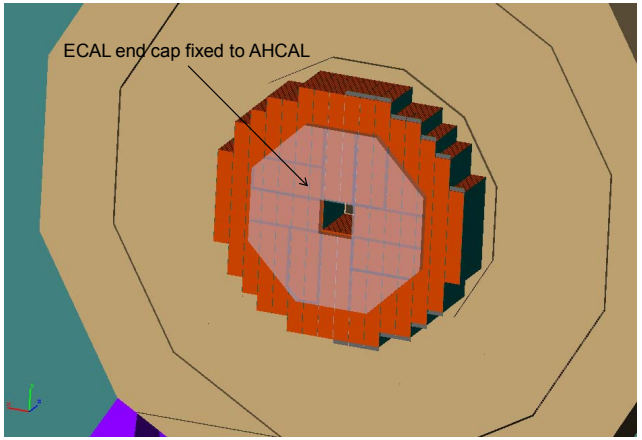
Calorimeter Installation

- 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: ?



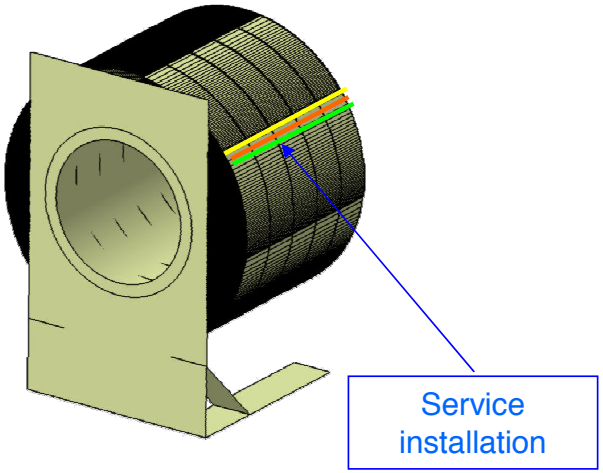
K. Gadow



SDHCAL Installation

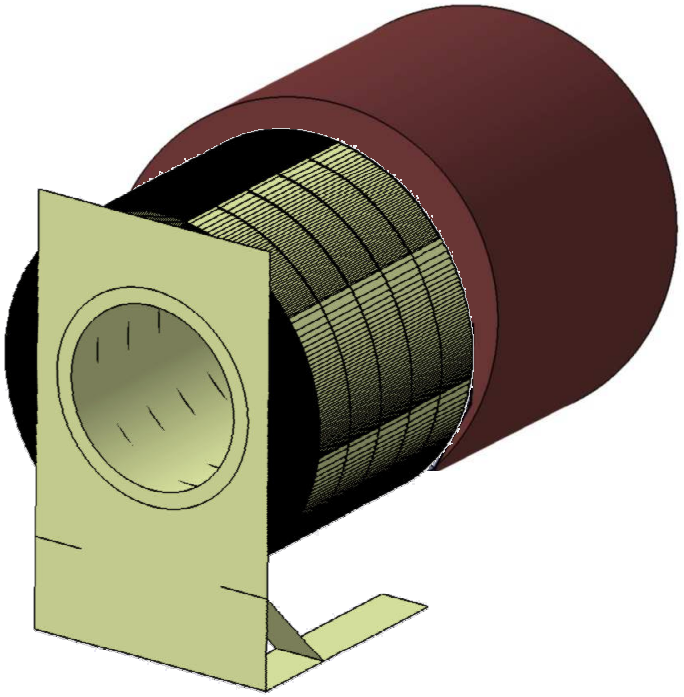
Barrel design : ILD integration

- Barrel with 5 wheels into the ILD



-Wheels are linked together

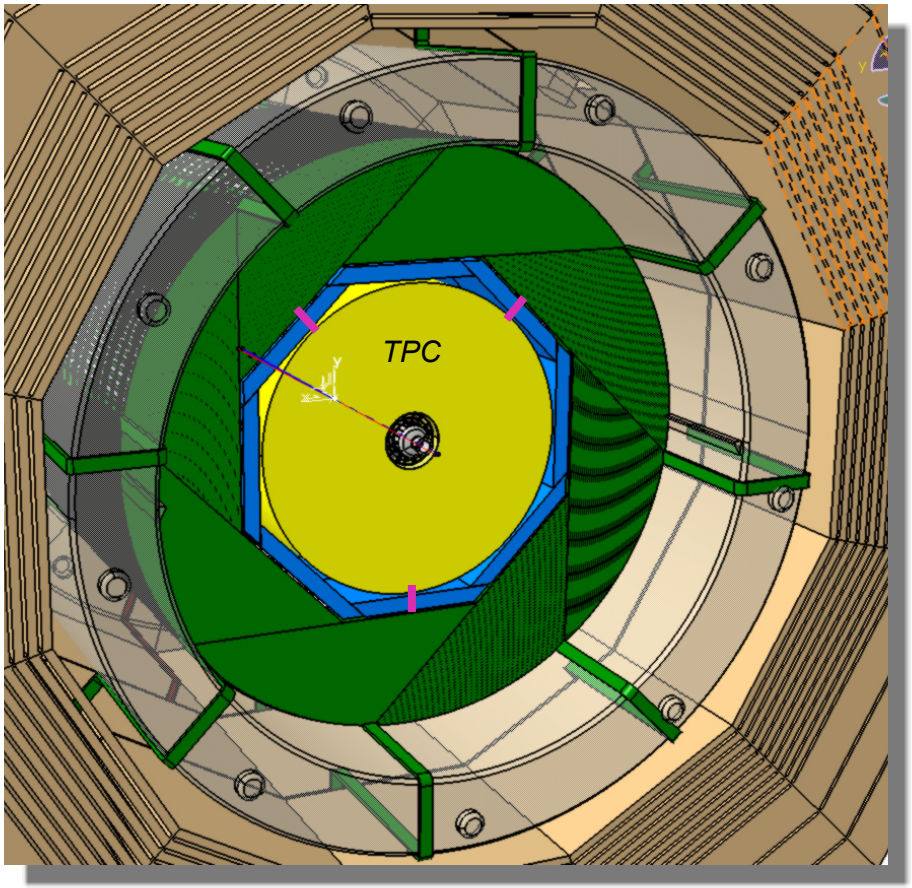
-Services installed then and connected between wheels

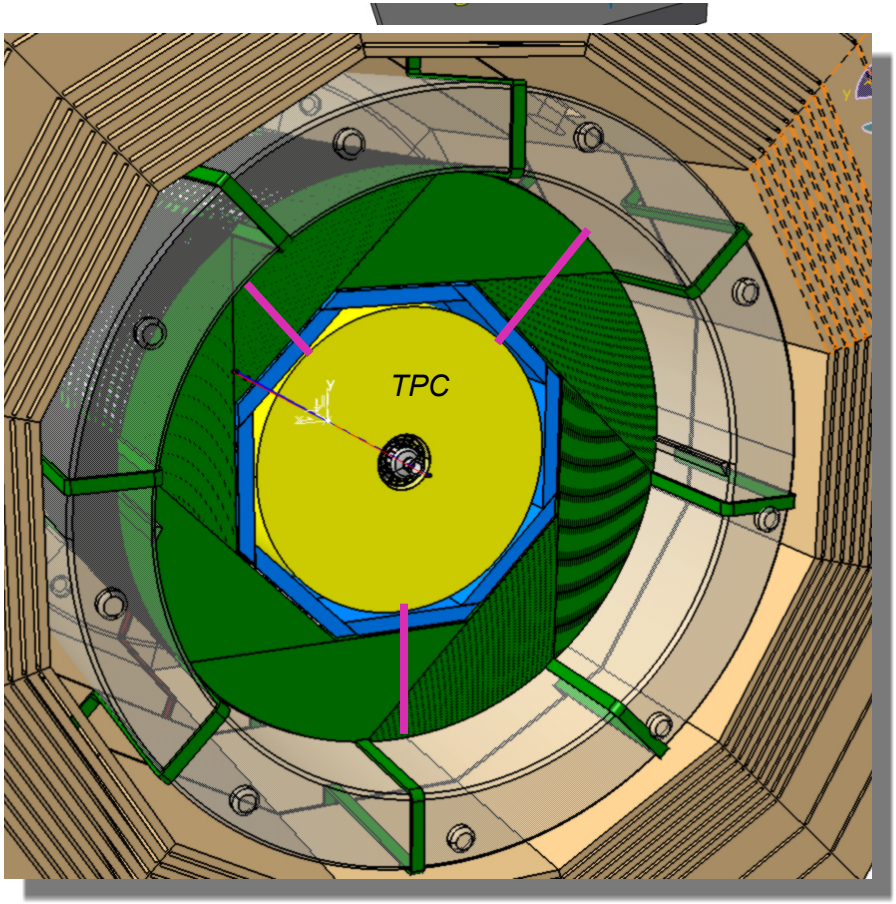


-Barrel ready to be connected put in front of the coil

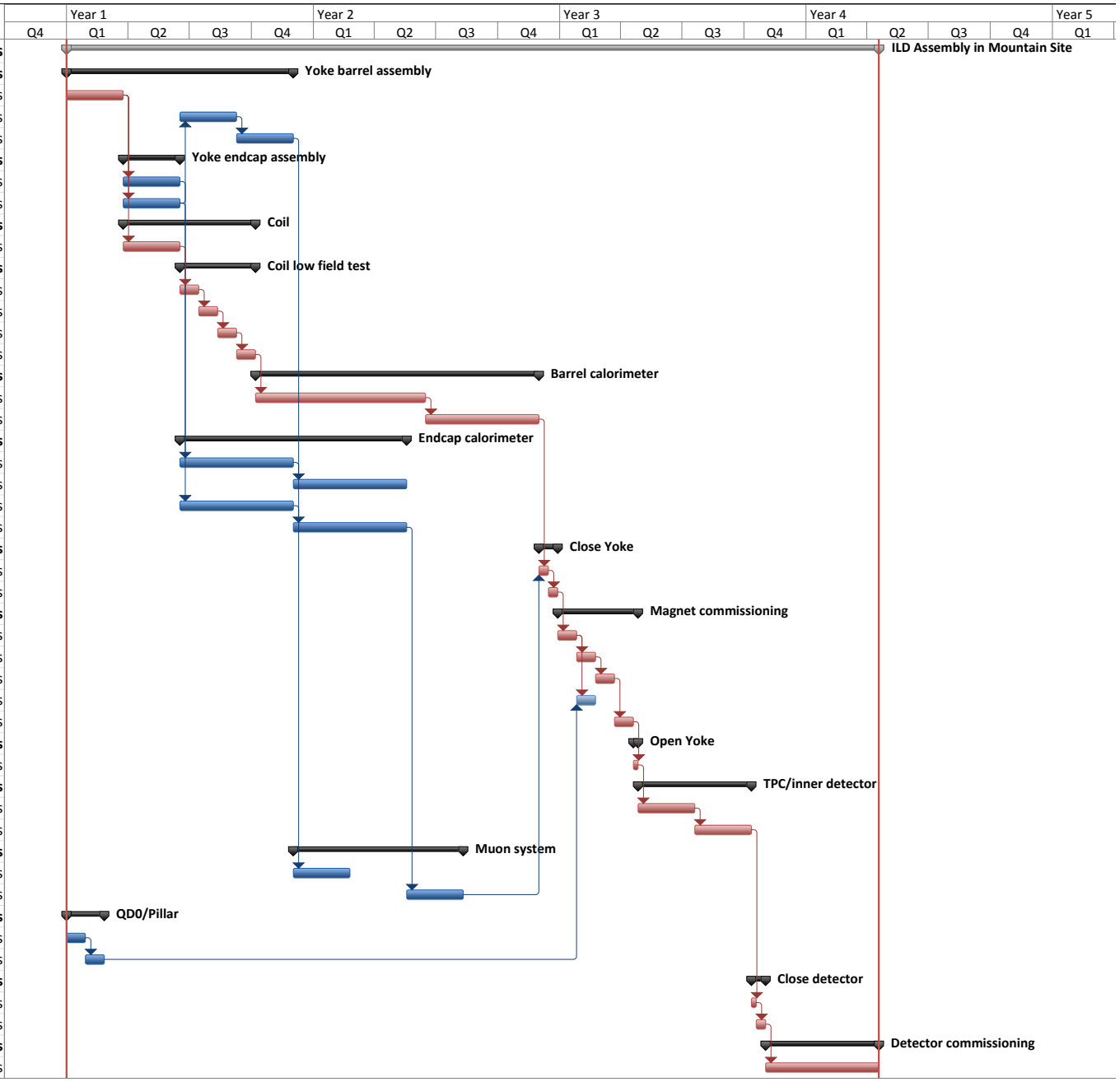
-Insertion on the rails with tool

TPC Installation





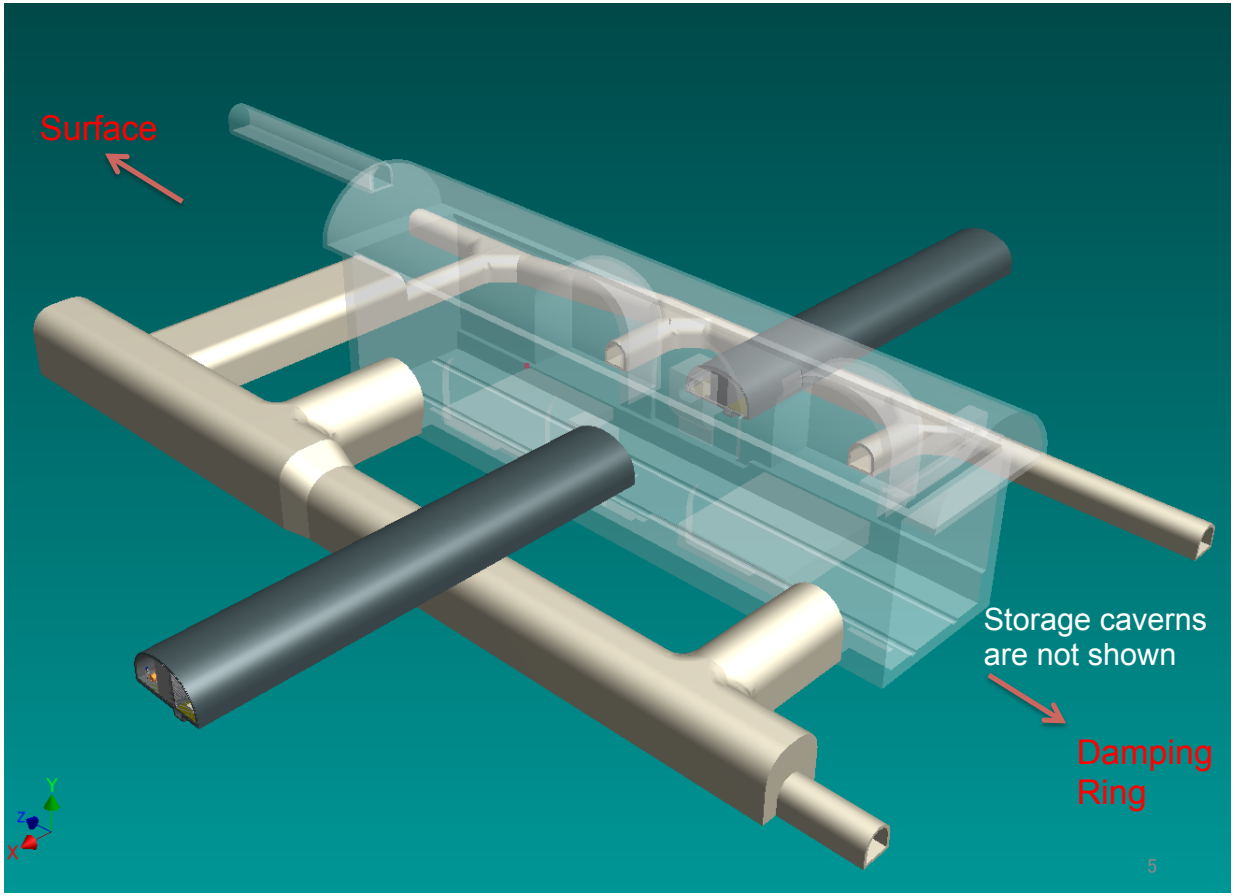
ID	Task Name	Duration
0	**ILD Assembly in Mountain Site**	**860 days**
1	**Yoke barrel assembly**	**240 days**
2	YB0	60 days
3	YB+z	60 days
4	YB-z	60 days
5	**Yoke endcap assembly**	**60 days**
6	YE+z	60 days
7	YE-z	60 days
8	**Coil**	**140 days**
9	Coil installation (incl. ancillaries)	60 days
10	**Coil low field test**	**80 days**
11	Cool down	20 days
12	Coil test	20 days
13	Field mapping test	20 days
14	Warm up	20 days
15	**Barrel calorimeter**	**300 days**
16	HCAL barrel assembly/cabling	180 days
17	ECAL barrel assembly/cabling	120 days
18	**Endcap calorimeter**	**240 days**
19	HCAL +z endcap assembly/cabling	120 days
20	ECAL +z endcap assembly/cabling	120 days
21	HCAL -z endcap assembly/cabling	120 days
22	ECAL -z endcap assembly/cabling	120 days
23	**Close Yoke**	**20 days**
24	Move YBs	10 days
25	Move YEs	10 days
26	**Magnet commissioning**	**85 days**
27	Cool down	20 days
28	High field tests	20 days
29	Field mapping	20 days
30	QD0 testing	20 days
31	Warm up	20 days
32	**Open Yoke**	**5 days**
33	Move YEs	5 days
34	**TPC/inner detector**	**120 days**
35	TPC insertion/cabling	60 days
36	Inner detector insertion/cabling	60 days
37	**Muon system**	**180 days**
38	Muon chamber barrel insertion/cabling	60 days
39	Muon chamber endcap insertion/cabling	60 days
40	**QD0/Pillar**	**40 days**
41	QD0 mounting	20 days
42	Forward calorimeters	20 days
43	**Close detector**	**15 days**
44	Close YEs	5 days
45	Install QD0/Pillars	10 days
46	**Detector commissioning**	**120 days**
47	Detector commissioning and testing	120 days



- Critical path is defined by central detector construction:
  - central yoke ring, coil, barrel calorimeter, TPC, inner detector
- Will have three 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 12/2011)

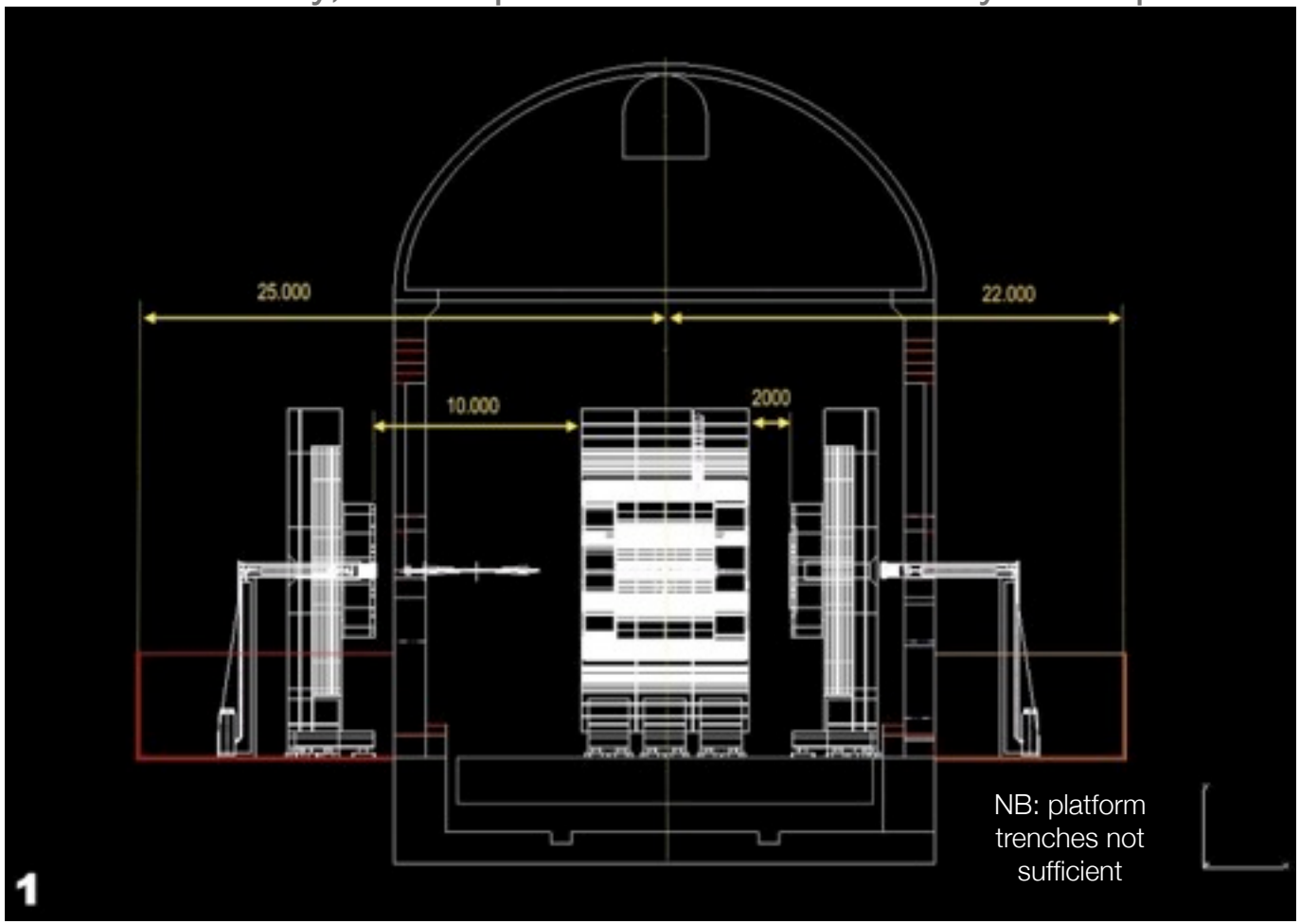
Y. Sugimoto



- Probably not enough space for detector assembly and regular maintenance

Maintenance Position (DESY Study)

- Changed hall model to enlarge alcoves in parking position (47m lateral space)
  - maintenance only, more space needed if assembly takes place in alcoves

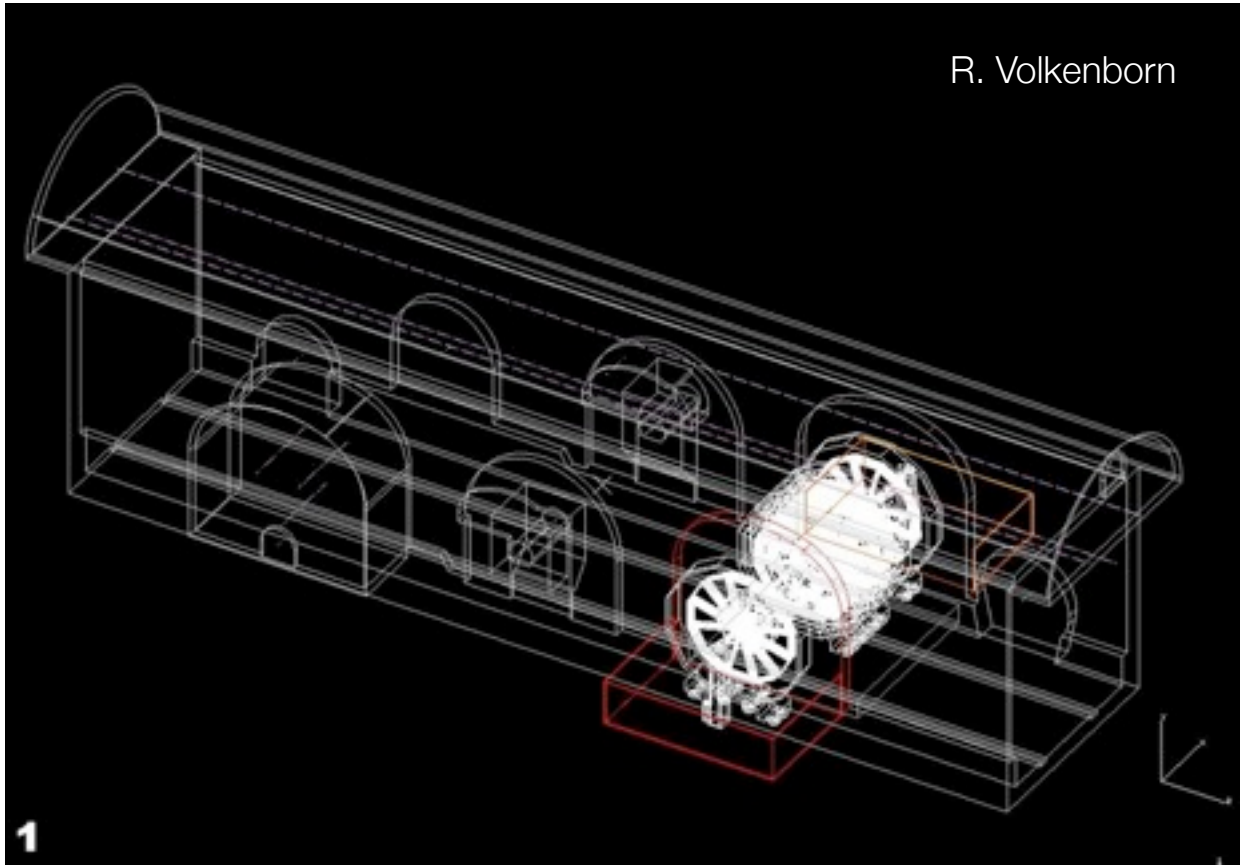


R. Volkenborn

Larger Parking Position (DESY Study)

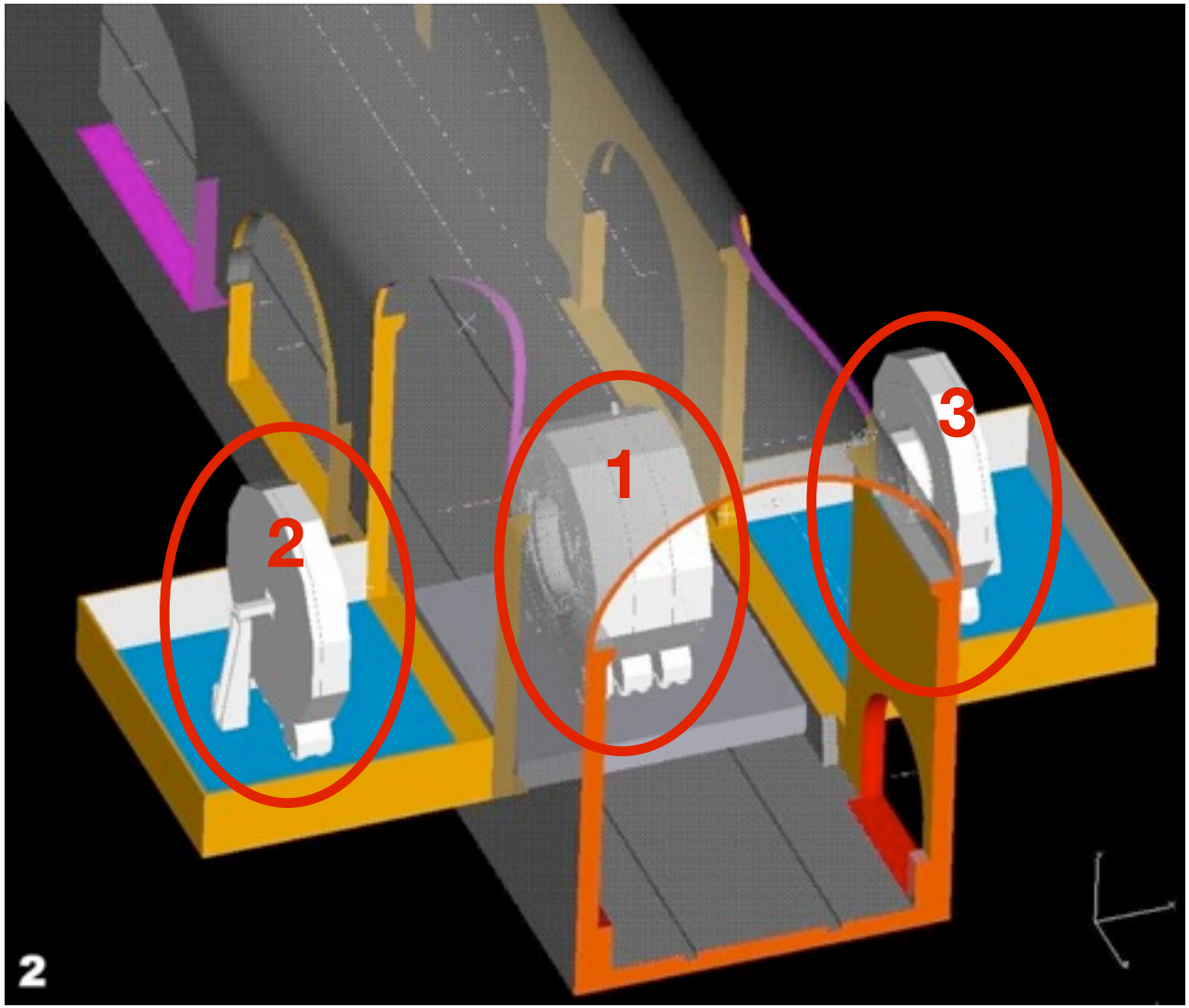
- Lateral space is needed to open the detector, remove QD0 magnets, inner detector, TPC

- Alternative: rotate the detector by 90 deg before opening
  - Almost impossible
  - need to disconnect cable chains and possibly cryo lines
  - warm-up the coil



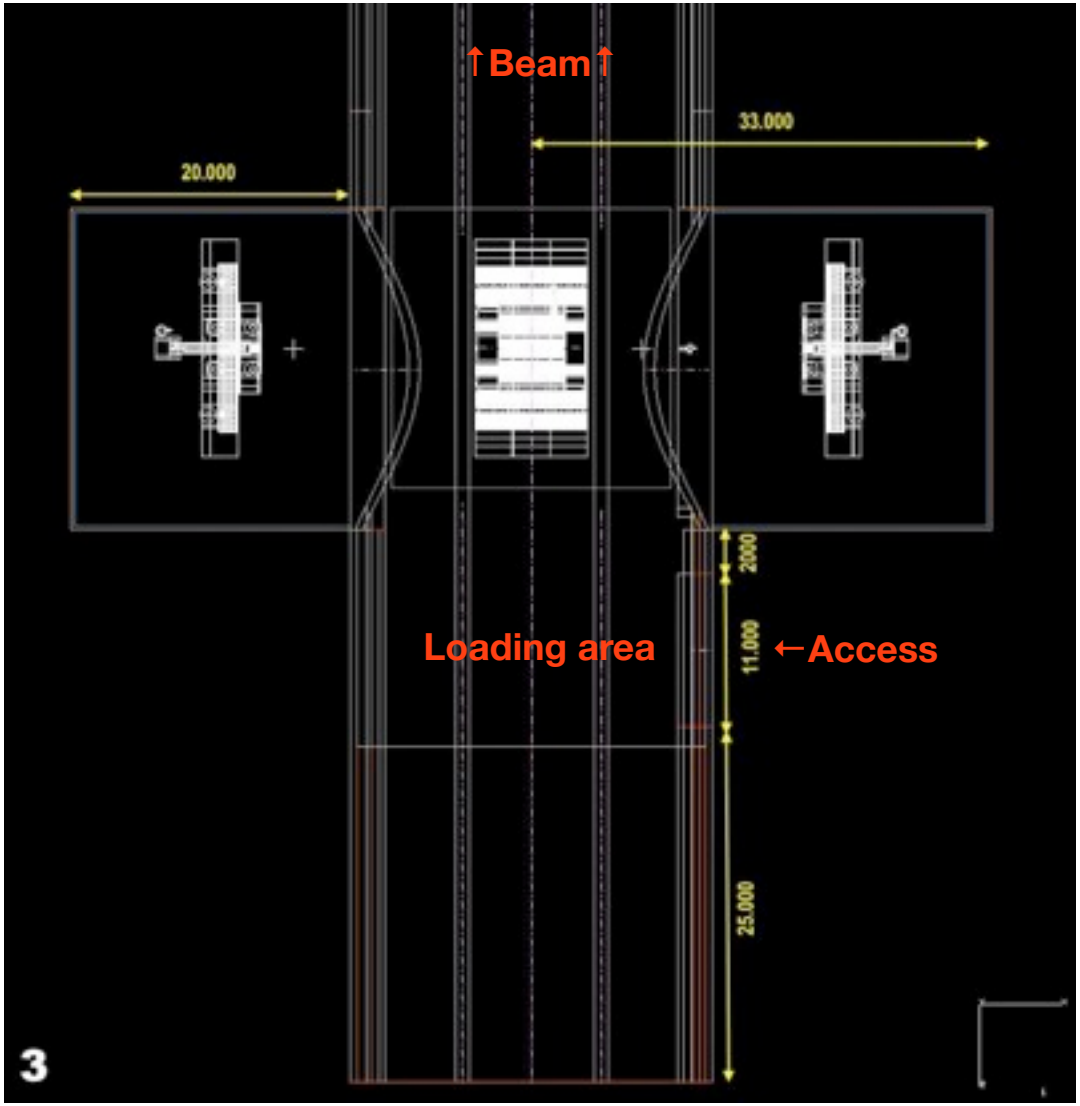
Underground Construction Space (DESY Study)

- Three „construction sites“
- Platform (1): central yoke ring, coil, barrel detector
- Alcoves (2,3): endcaps: yoke, calorimeter
- Crane coverage:
  - 200t in main hall
  - 100t in alcoves



Underground Construction Space (DESY Study)

- Three underground „construction sites“ are minimum
  - Alcoves need to be enlarged (>53m lateral space)
- Fourth might be needed for YB+/- barrel yoke rings, QD0 pillars, etc.
- For comparison: CMS surface assembly hall : ~25m x ~90m
  - we need about the same - underground



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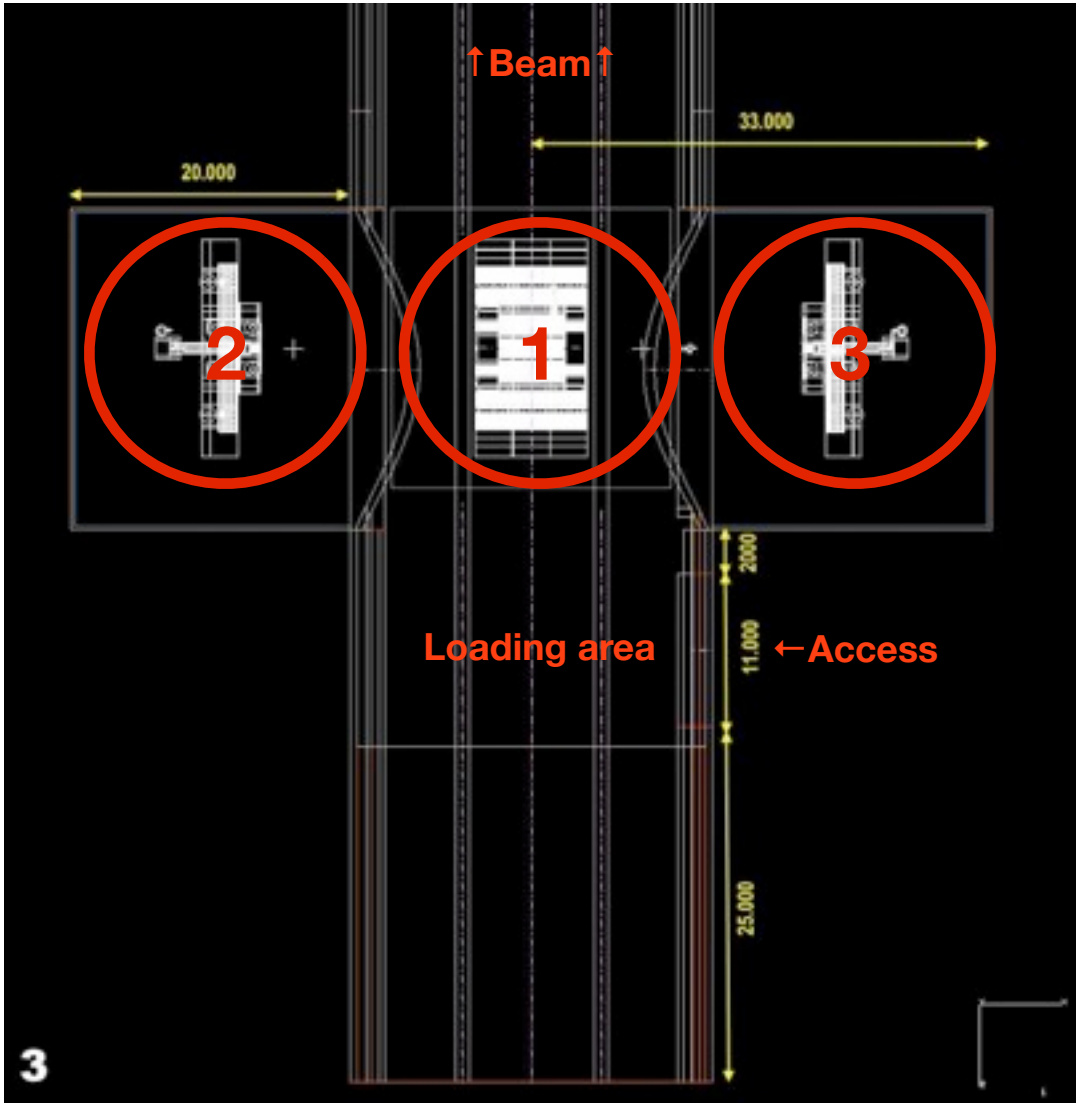

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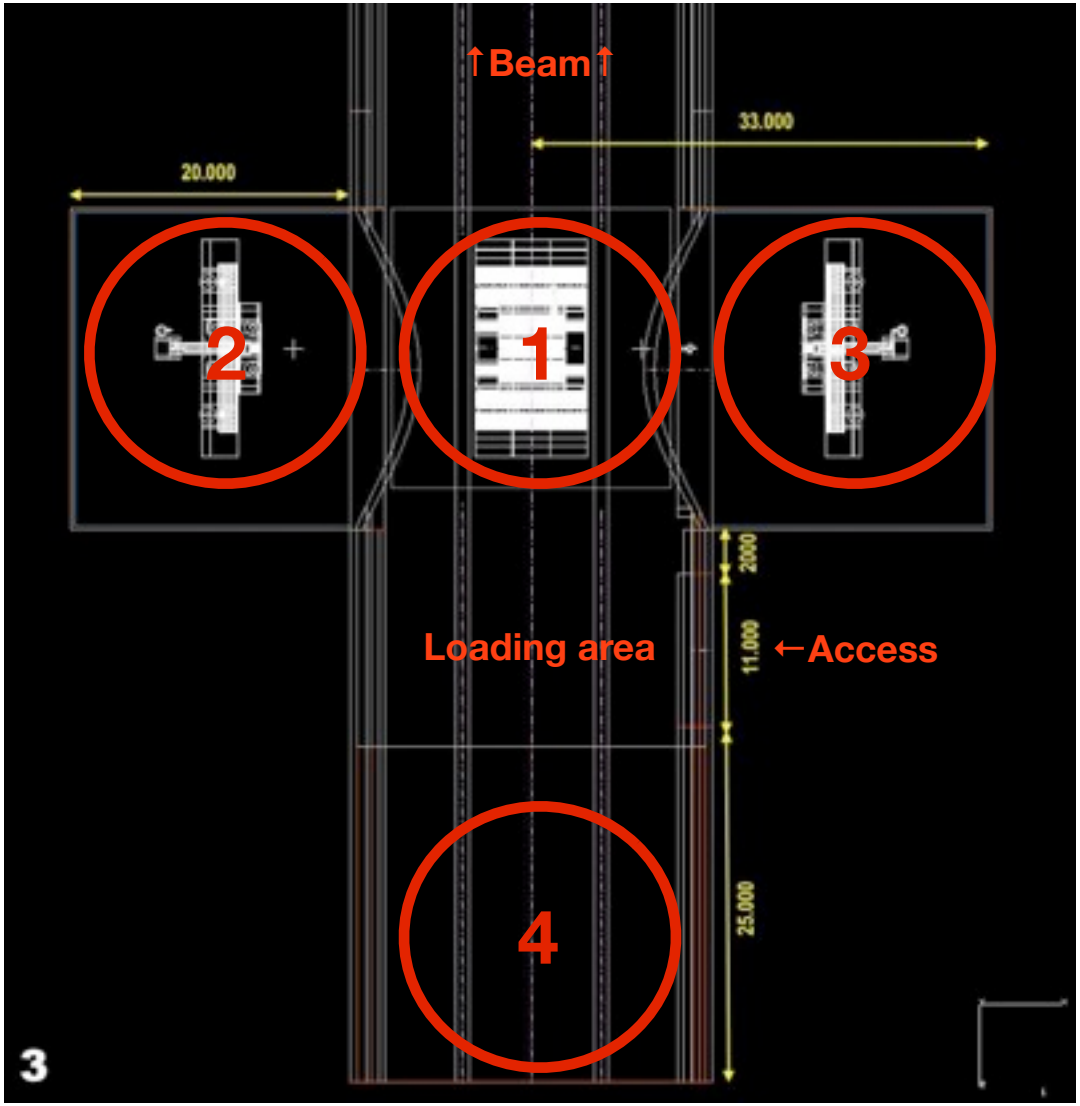
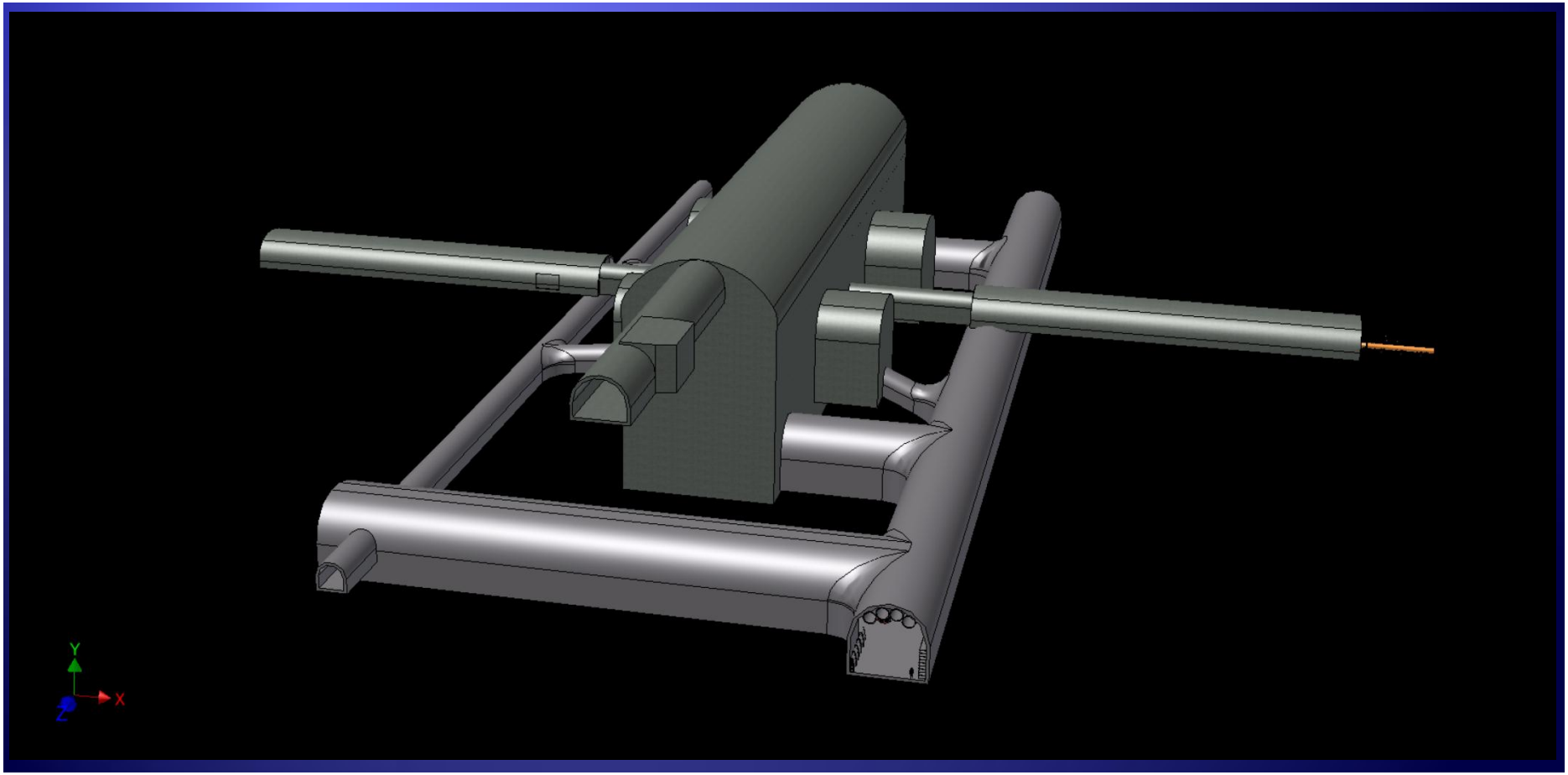


R. Volkenborn

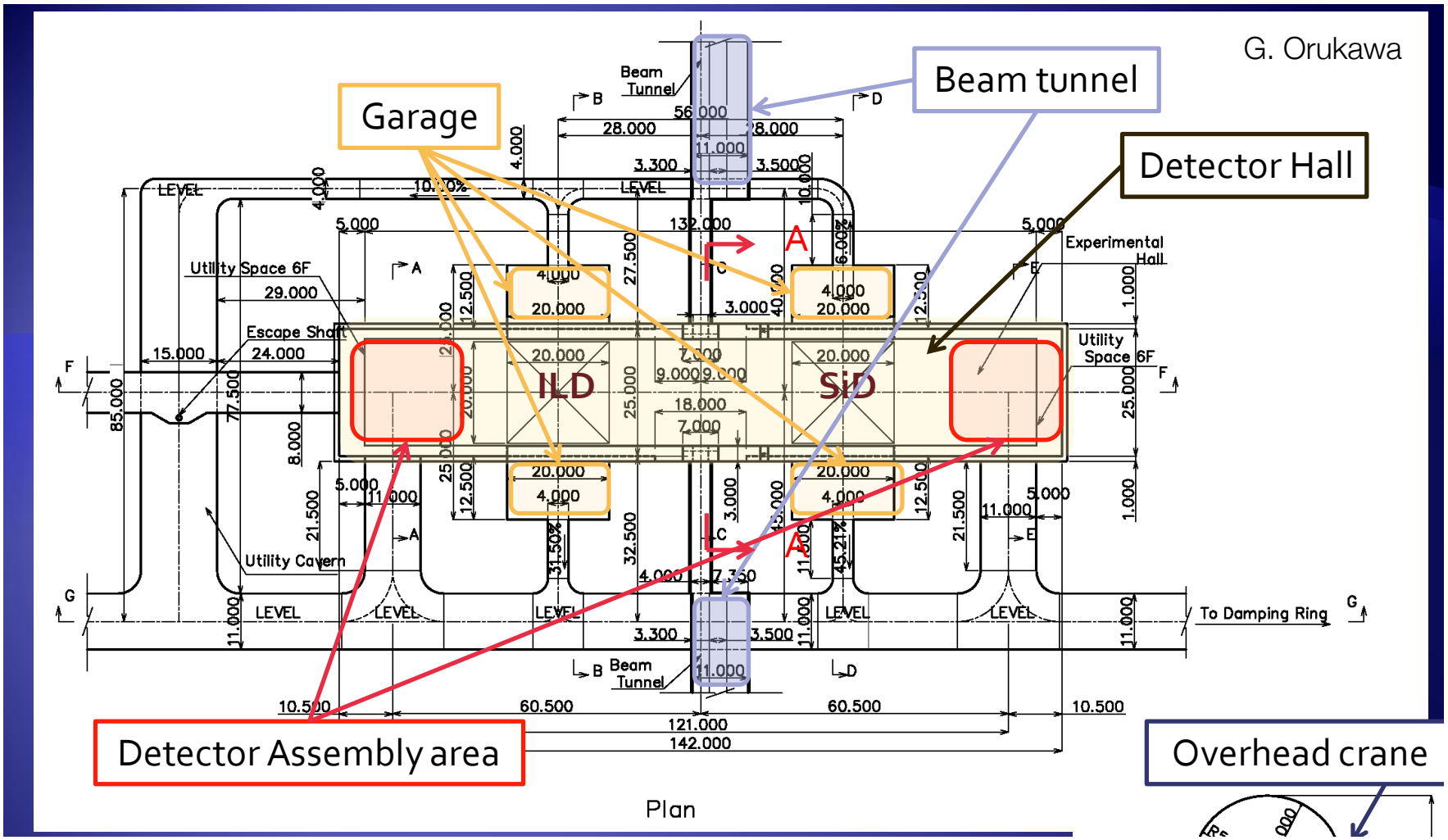
Japanese Hall Design (Status: 22.03.2012)



- Enlarged Alcoves
- 142 m long

G. Orukawa

Japanese Hall Design (Status: 22.03.2012)



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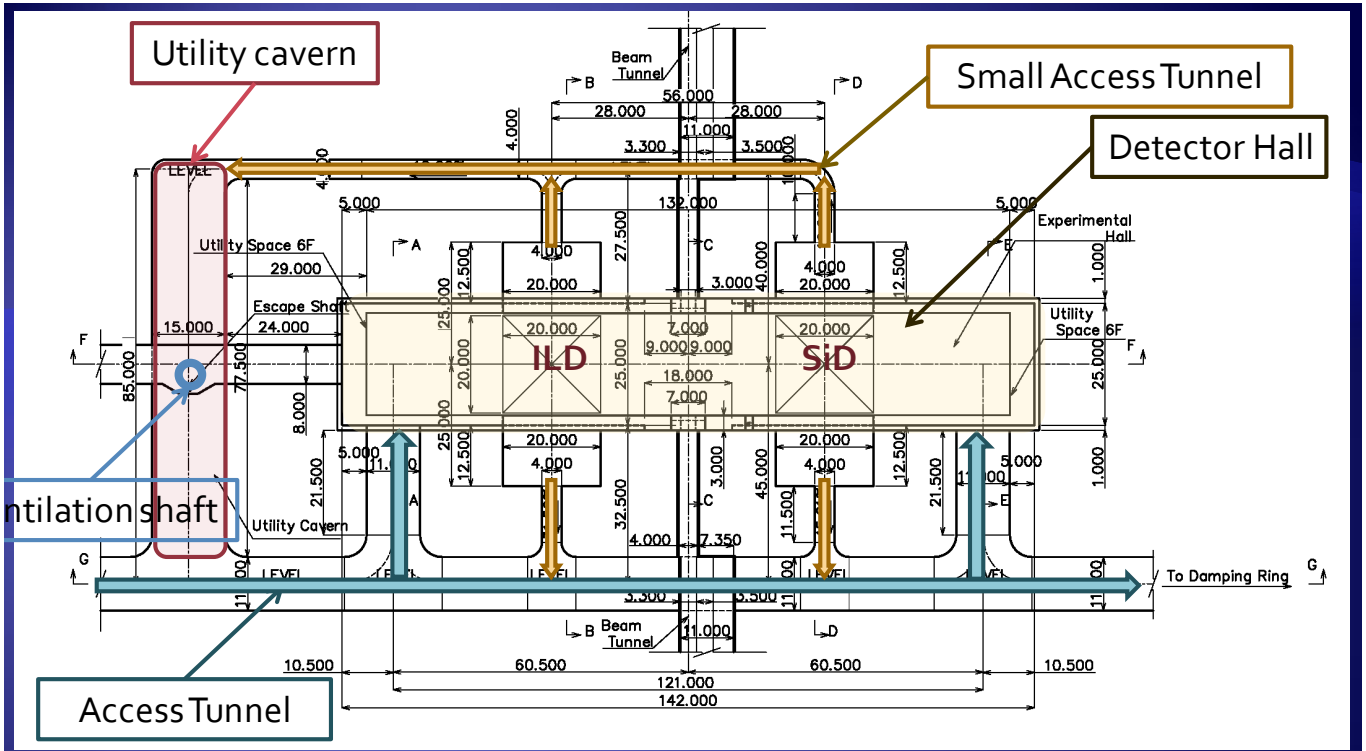
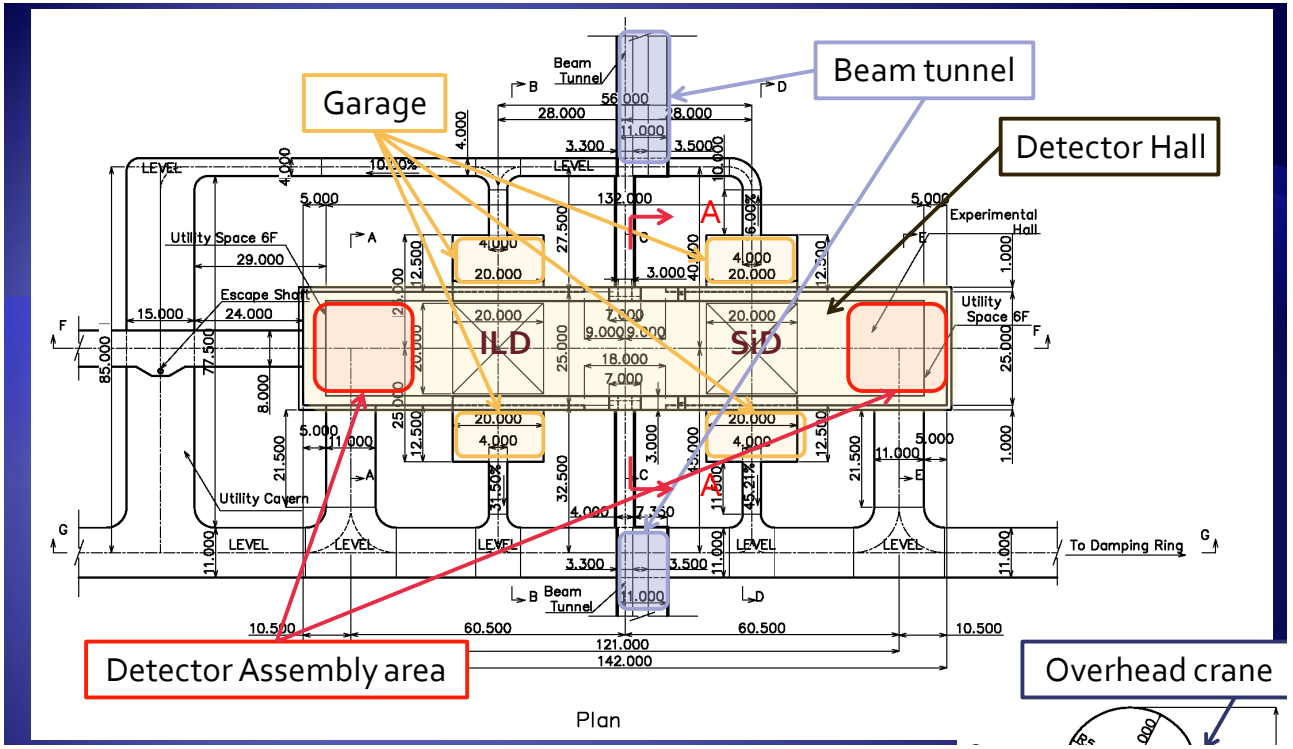


- With 11m width access tunnel for SiD and ILD installation
- Two access tunnels are connected on the same side of cavern
- Access tunnels are connected at the same floor level of cavern's bottom floor
- Utility cavern is placed for utility (electric facilities, parking, various rooms…)
- Small access tunnels are connected to the garages for the pass
- Ventilation shaft is placed at utility cavern

Japanese Hall Design (Status: 22.03.2012)



- Alcove areas still too small (need >53m across)
- Loading zone and assembly area interfere
  - transportation of large items through the assembly zone difficult

An alternative plan of exp hall in mountain sites

2012/4/5

Yasuhiro Sugimoto

Response at CFS BTR

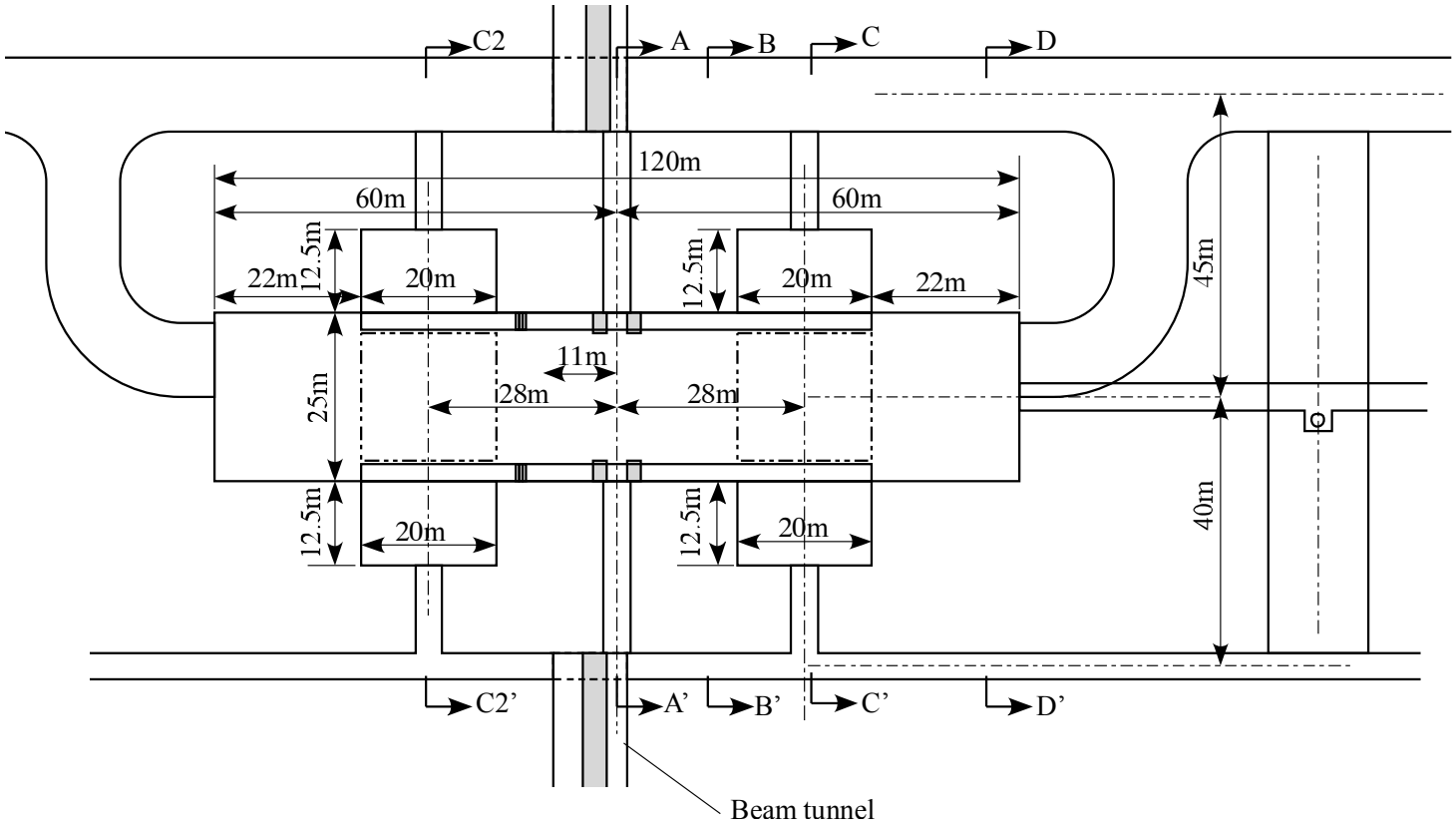
- GDE
  - Cavern is too large to keep cost containment
- ILD
  - Cavern is too small to keep enough assembly area

➔ Design is modified to satisfy the both requirements

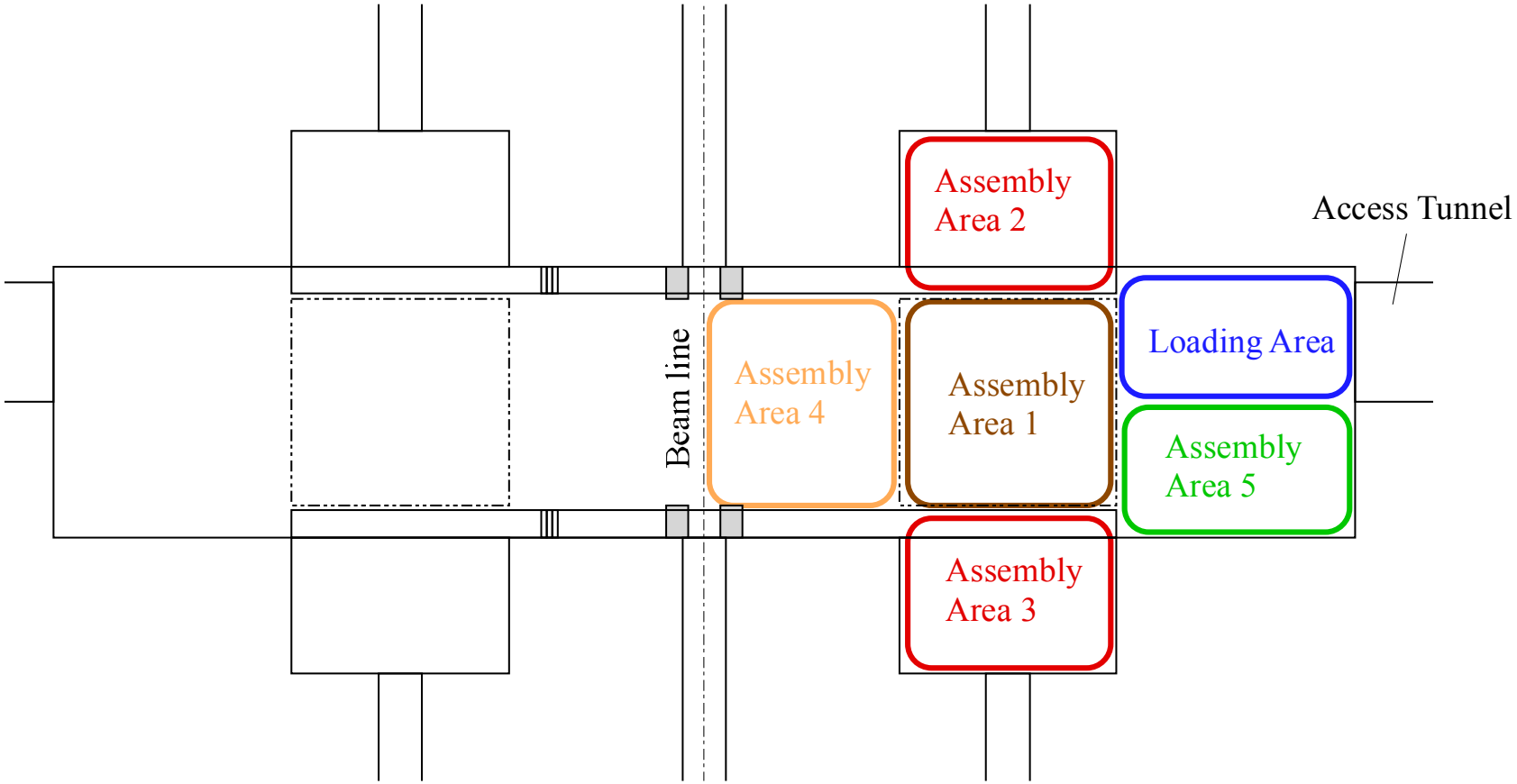
Key points

- Space between the garage and the beam line is used for the detector assembly
- The length of the cavern is reduced to 120m, which is same as the RDR
- Access tunnels are connected to both ends of the cavern to keep the strength of the cavern (90 degrees difference)
  - Rotating table for the detector solenoid may be necessary for installation
- Two crane girders per detector to make it possible to do two assembly works in parallel

Plan view


C2
A
B
C
D
120m
60m
60m
22m
12.5m
20m
12.5m
20m
22m
45m
11m
28m
28m
25m
12.5m
20m
12.5m
20m
40m
C2'
A'
B'
C'
D'
Beam tunnel

Assembly area

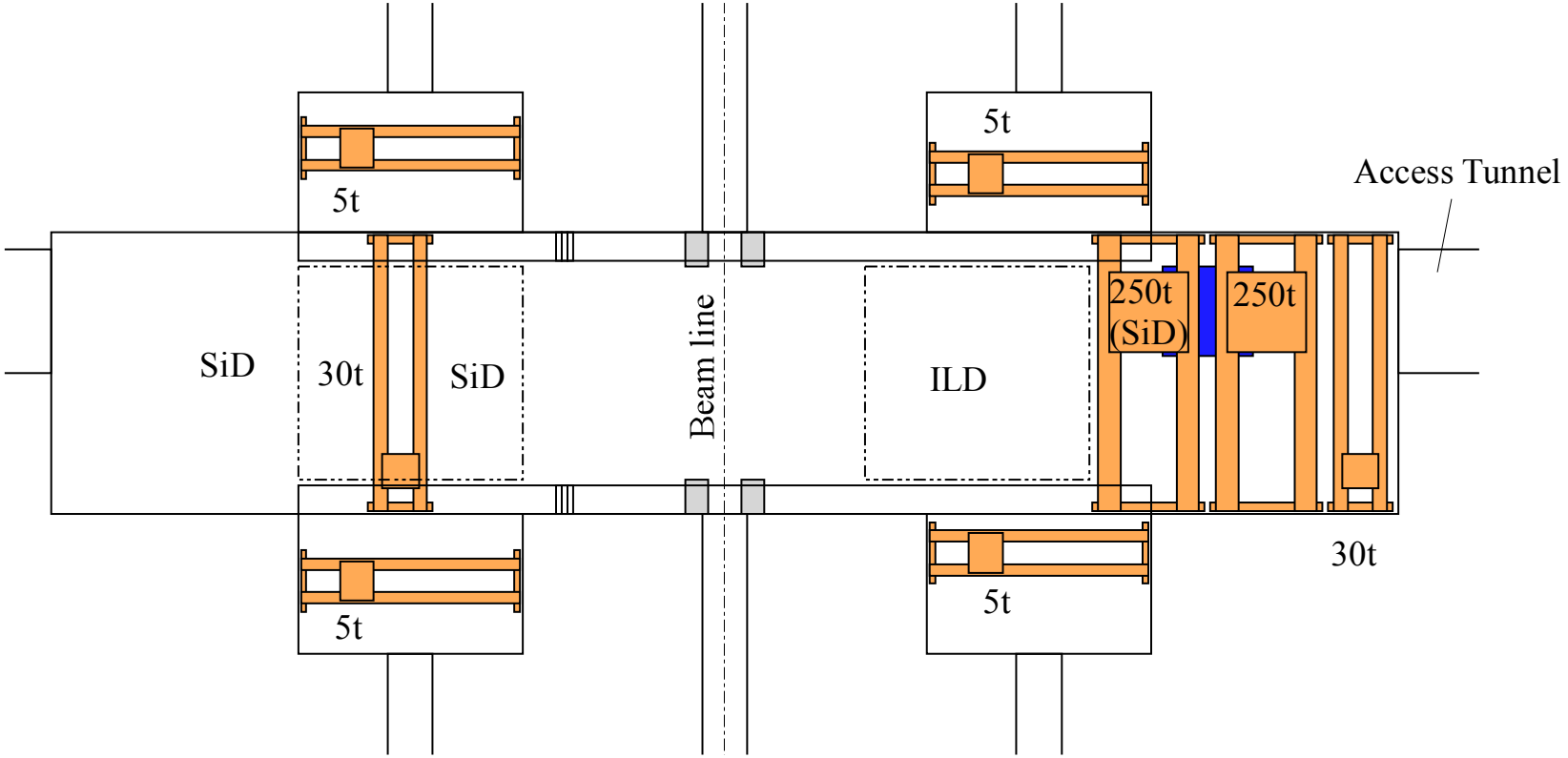


Assembly area

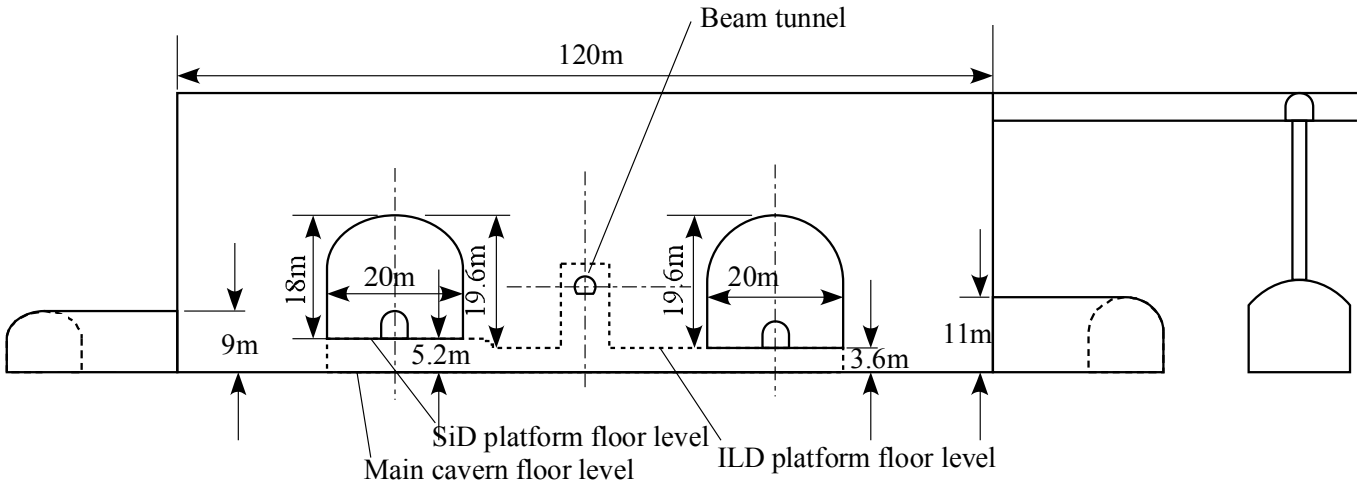
- Area 1 (Platform):20mx20m
  - Yoke assembly
  - Barrel detector installation/cabling
- Area 2/3 (Garage):20mx15m each
  - End cap CAL installation/cabling
- Area 4 (Beam line side): 20mx18m
  - Yoke assembly
  - Tentative platform should be constructed after solenoid transport
- Area 5 (Access tunnel side): 22mx12m
  - CAL assembly (modules→ring)
  - Tentative platform
- **Assembly area total ~ 20mx80m**

- Loading are ~ 22mx11m

Crane


5t
5t
5t
Access Tunnel
SiD
30t
SiD
Beam line
ILD
250t
(SiD)
250t
30t
5t
5t

Elevation view



My Status Summary

- We are converging on a detailed design for the Japanese underground hall
- There is pressure from the GDE to reduce complexity, i.e. cost
- First iteration on hall design was triggered by first assembly studies:
  - larger alcoves, 3-4 assembly areas in the hall
  - this has been presented at CFS BTR -> triggered cost discussion
- Yasuhiro has shown updated version that should have lower cost
- Clearly, we have to take the cost argument seriously
- Clearly, we need to find a solution for ILD in the mountain site!

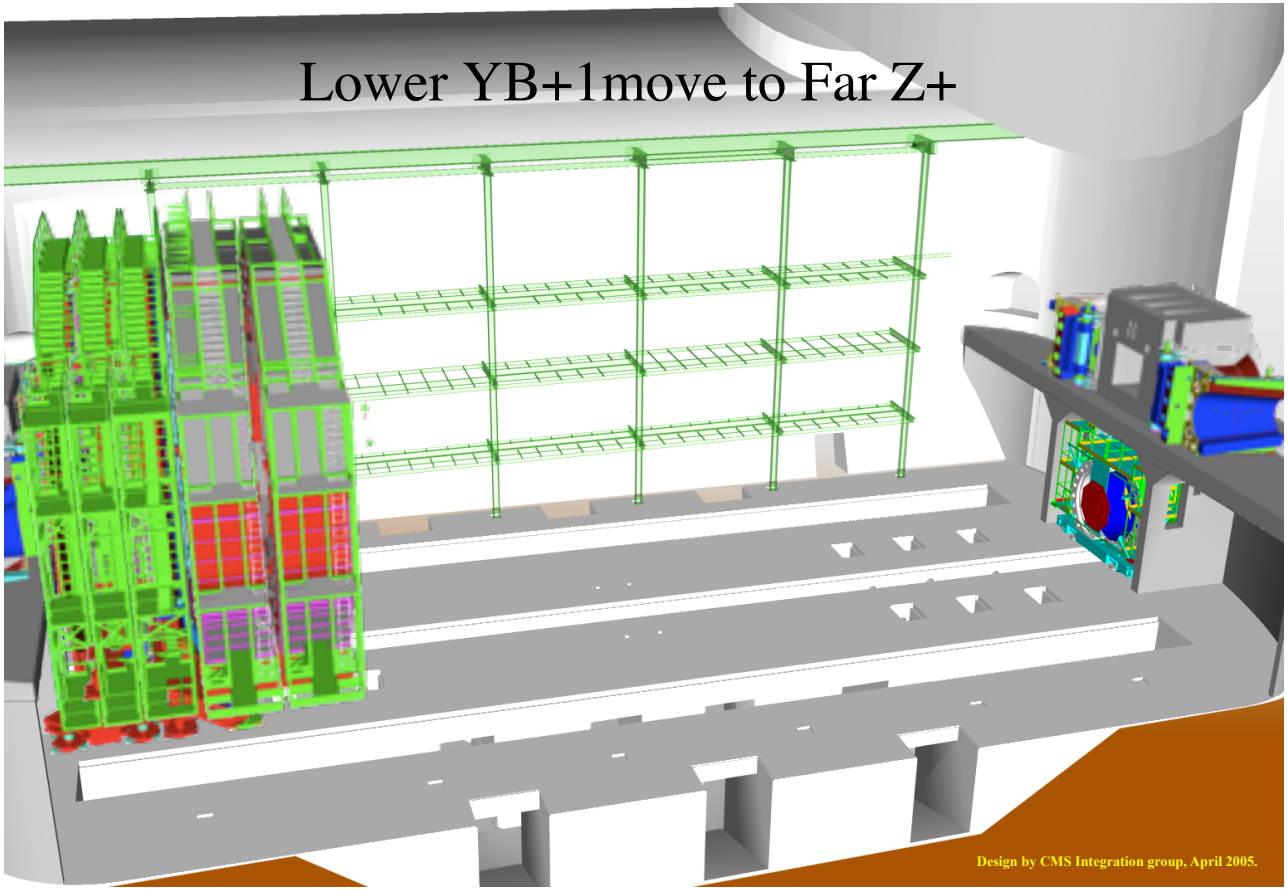
My Status Summary (Cont.)

- I see some problems with the current proposal:
  - alcove areas are needed for the endcap installation, they need to be high enough and have 100t crance capacity (c.f. talk by R. Stromhagen)
  - Interference between loading zone and assembly area 1 is an issue: we need to share the crane capacity and the transport space
  - the assembly areas 4 and 5 need temporary platforms that must be able to carry the weight of up to two barrel yoke rings (~2 kt). At least the platform in area 4 needs to be disassembled before the detector could be moved into the beam. How do we do that?
  - How do we share transportation capacity in the access tunnel between SiD, ILD and the machine?
- We should be sure that we can assembly ILD in the available space now. We will never be able to ask for more space later....

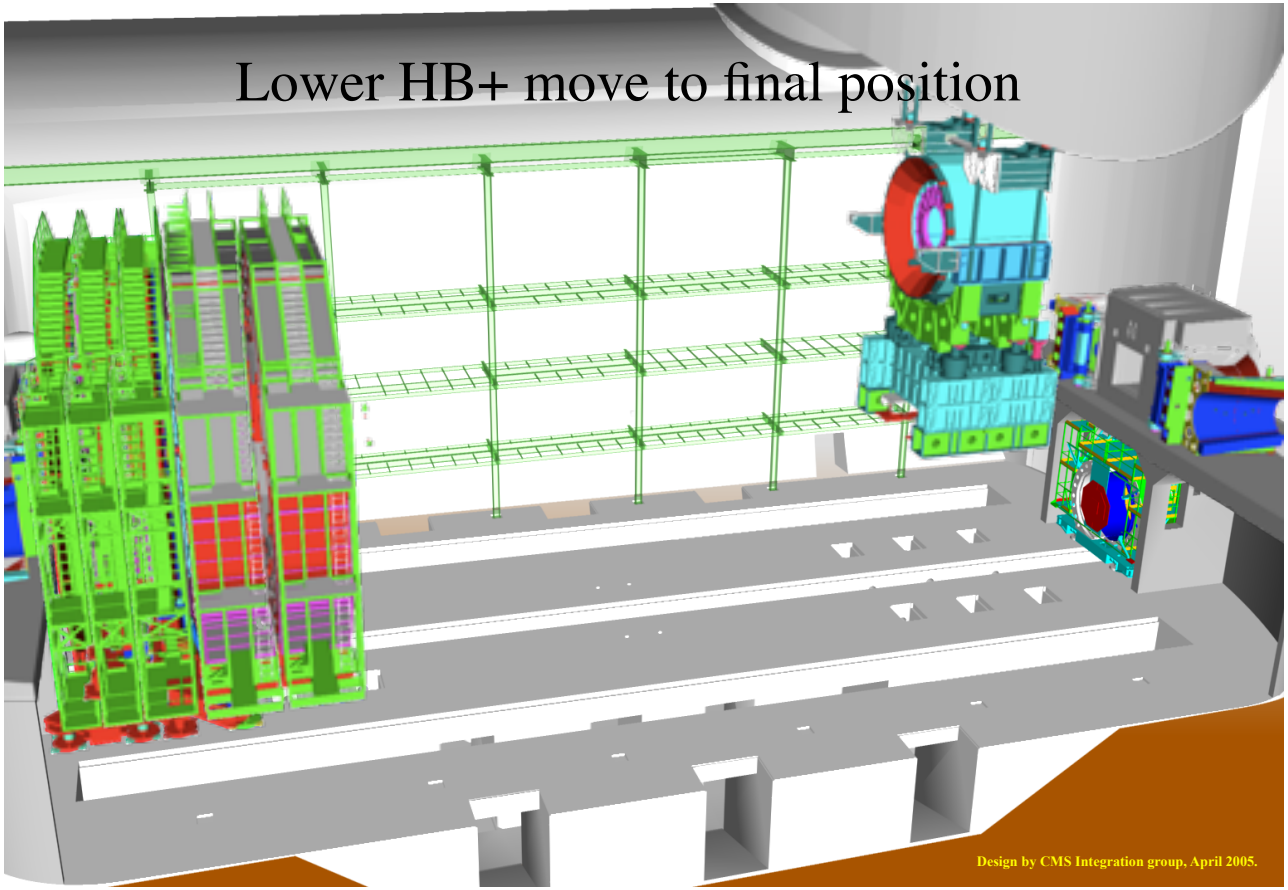
Example: Installation Sequence of CMS (part.)

- Courtesy: CMS (A. Gaddi, H. Gerwig)

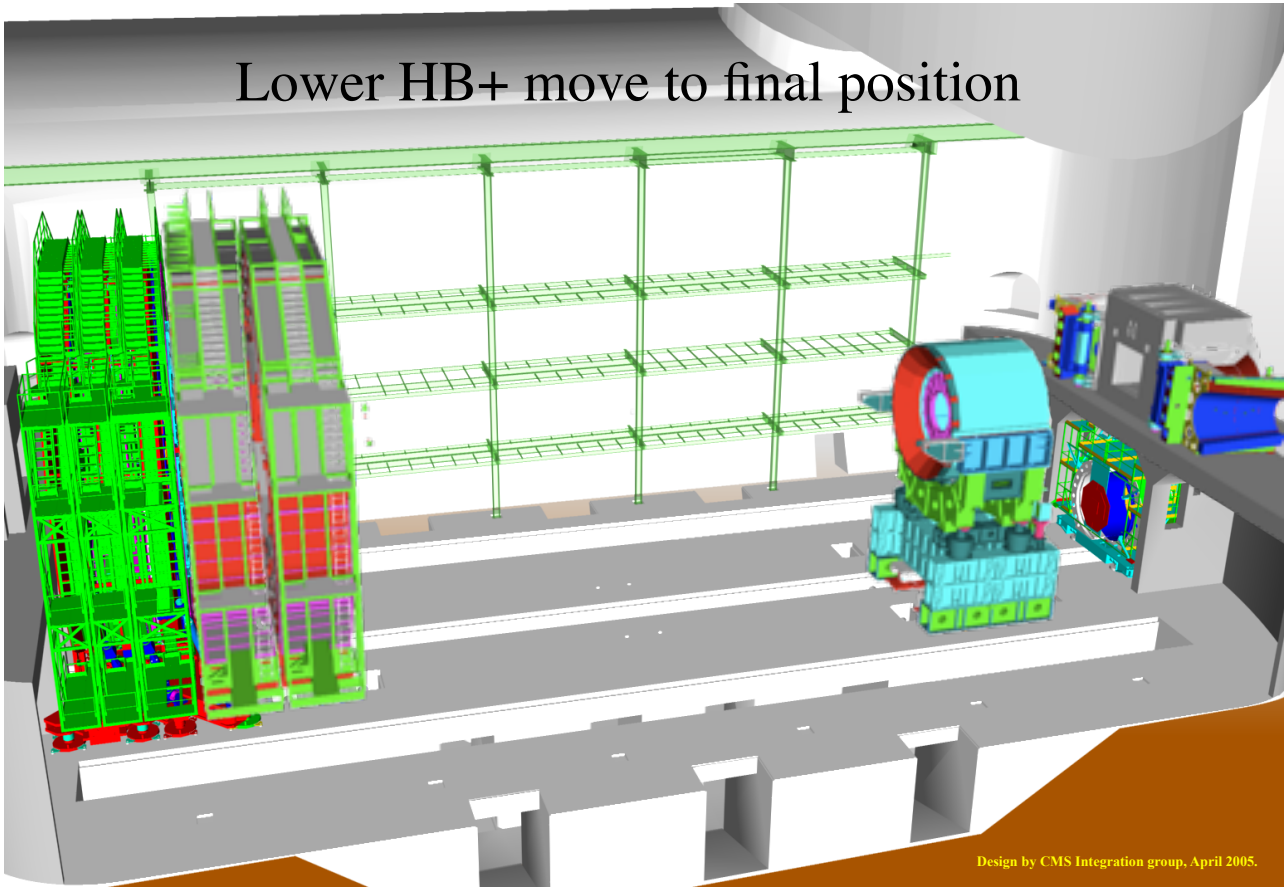
Lower YB+1move to Far Z+



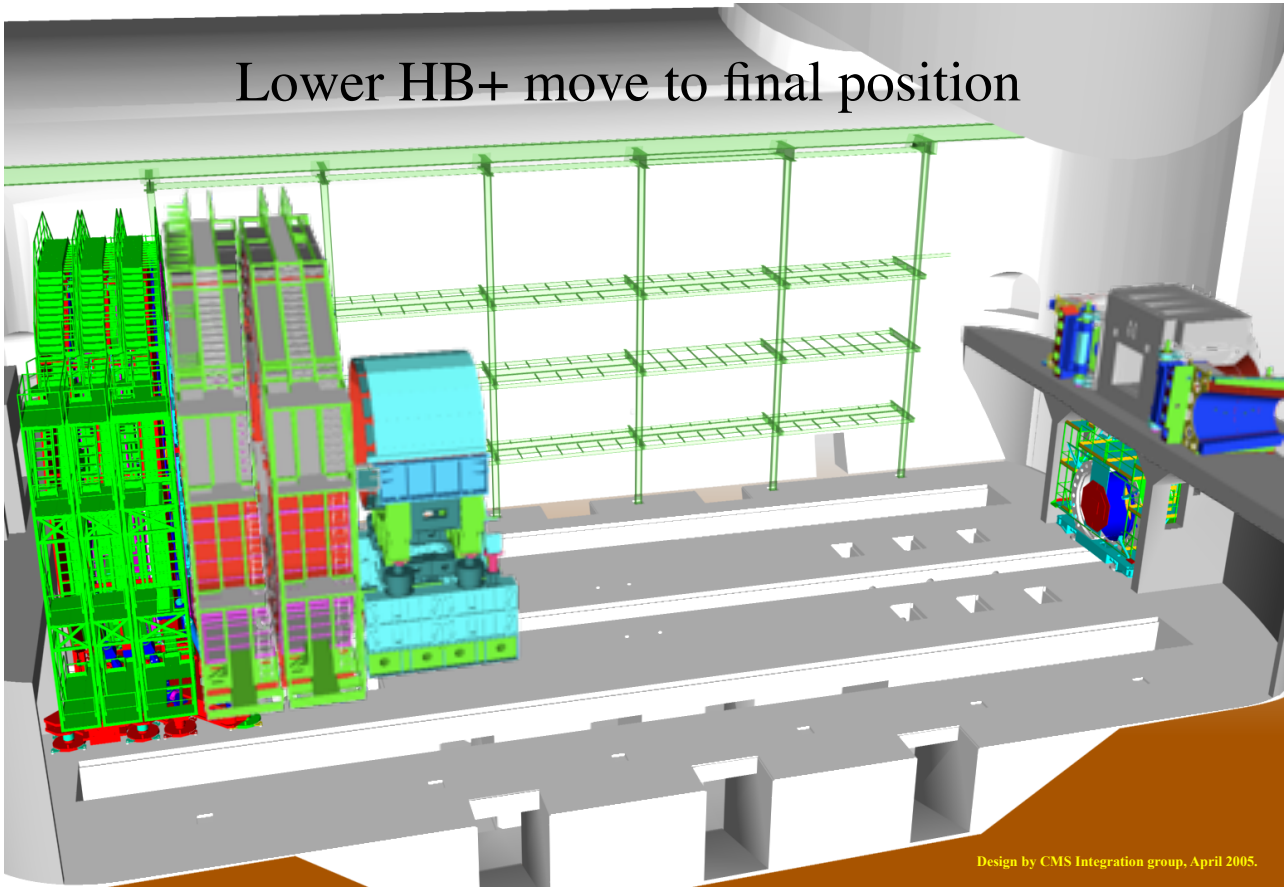
Lower HB+ move to final position



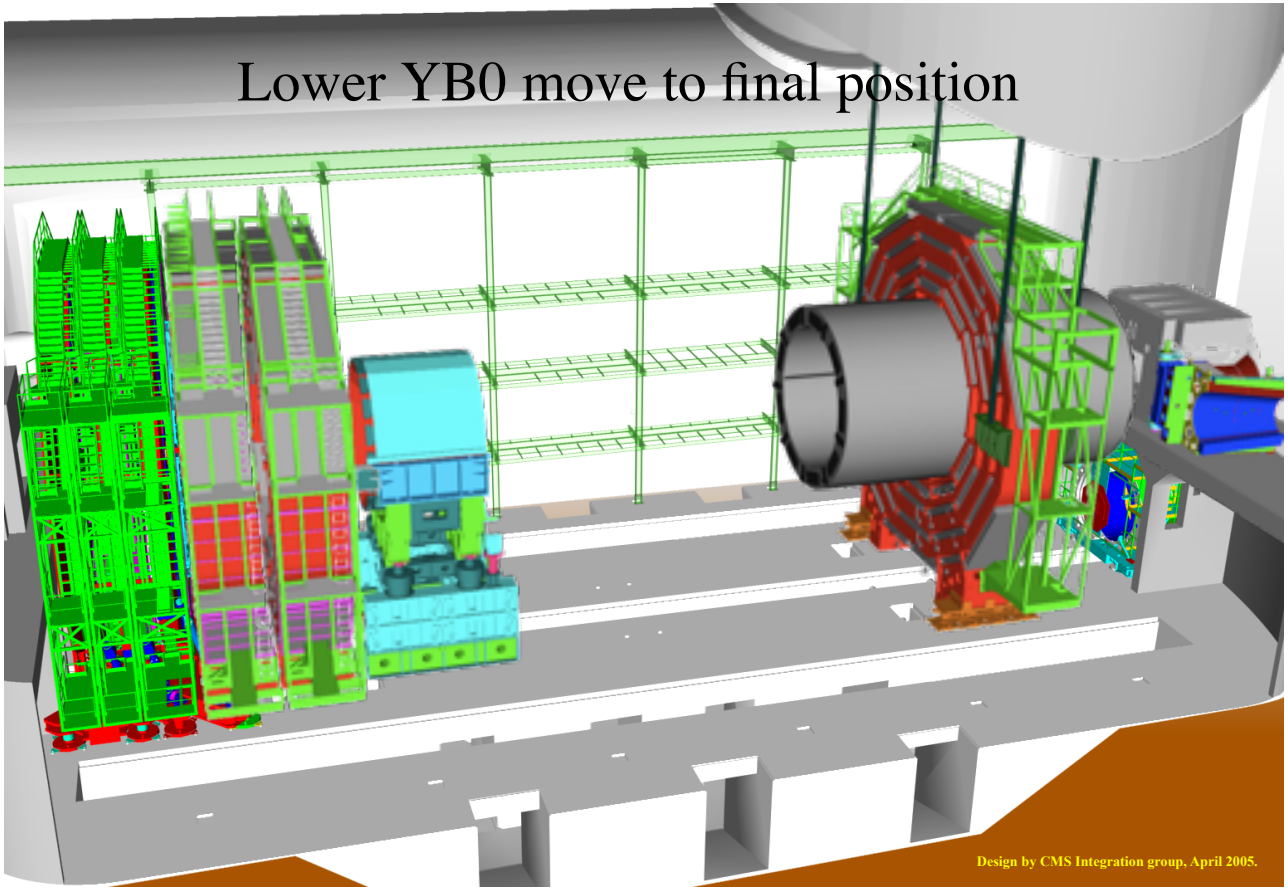
Lower HB+ move to final position



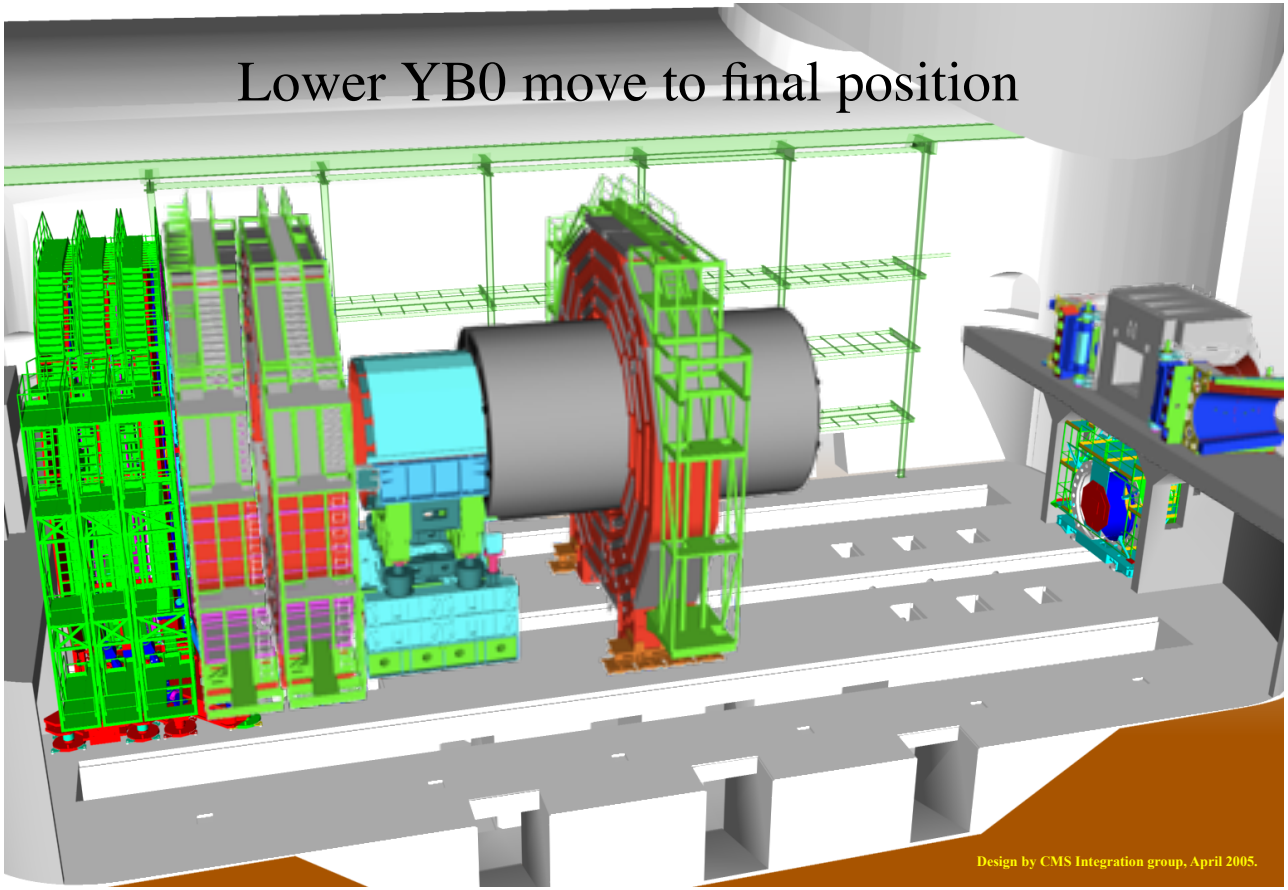
Lower HB+ move to final position



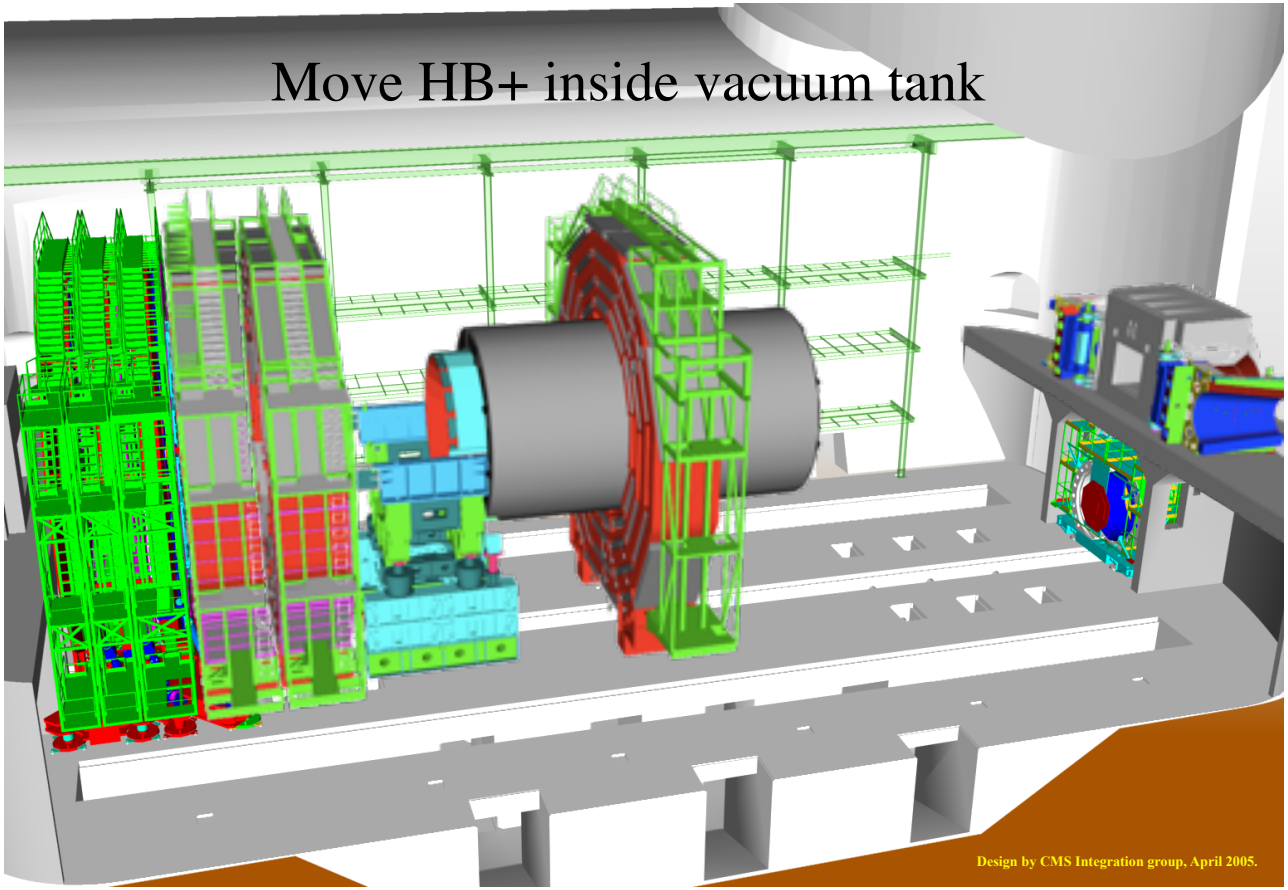
Lower YB0 move to final position



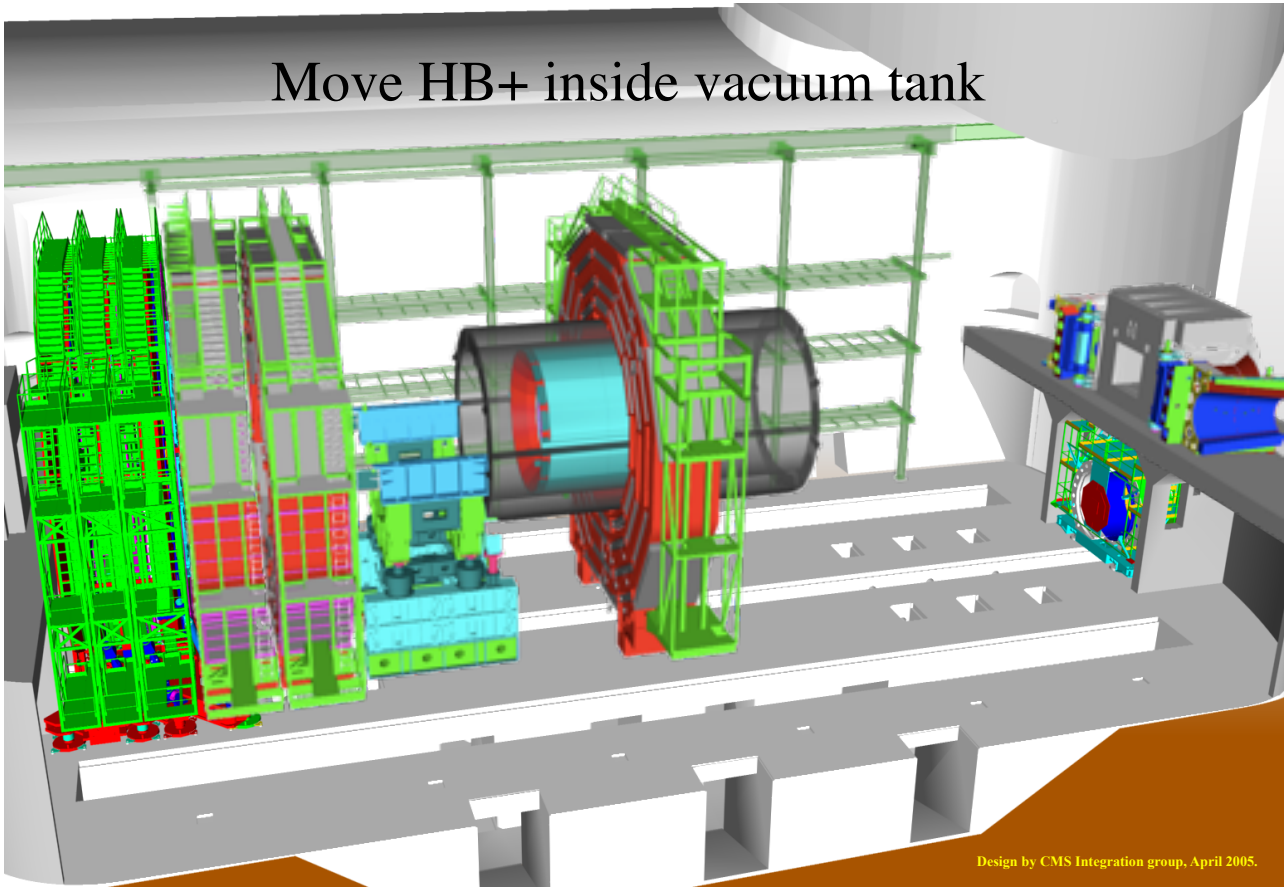
Lower YB0 move to final position



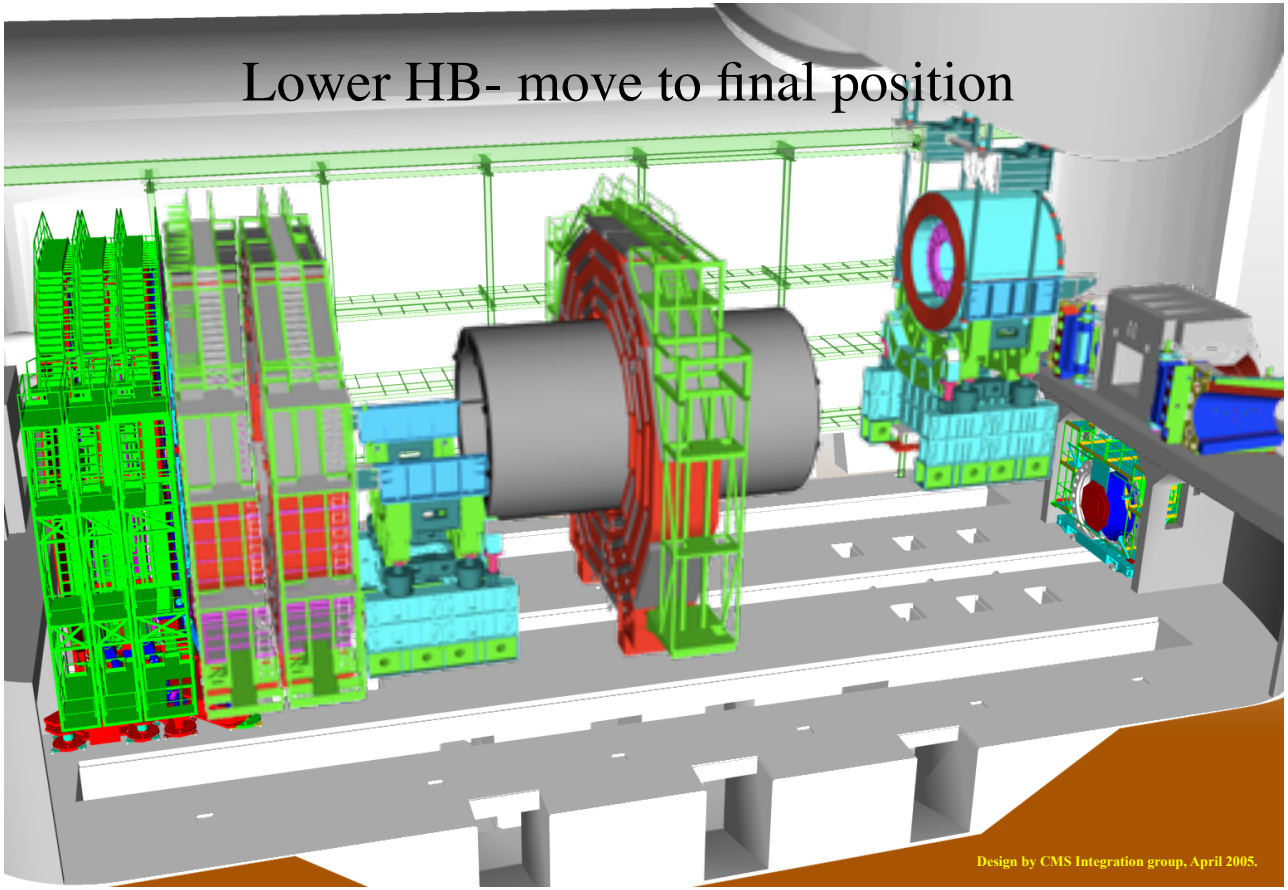
Move HB+ inside vacuum tank



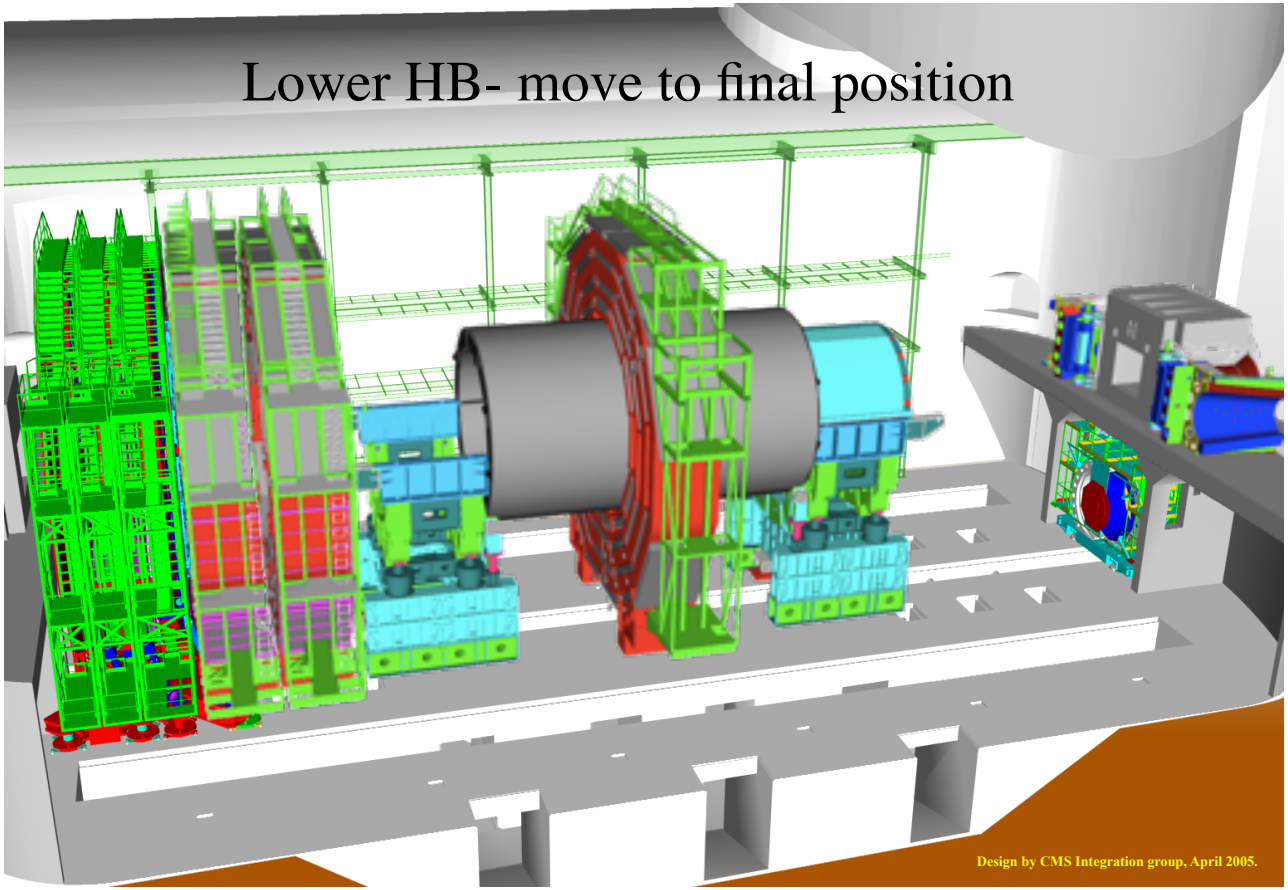
Move HB+ inside vacuum tank



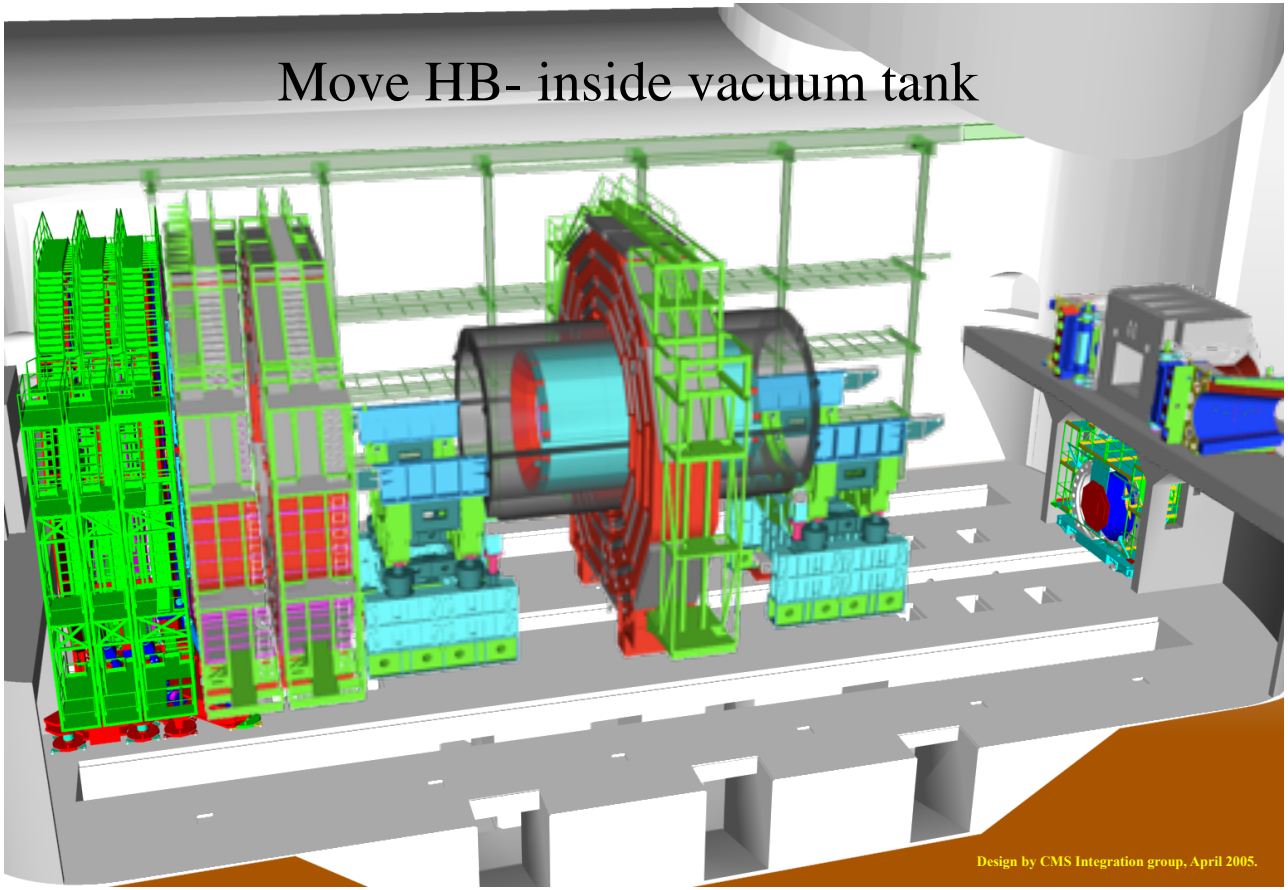
Lower HB- move to final position



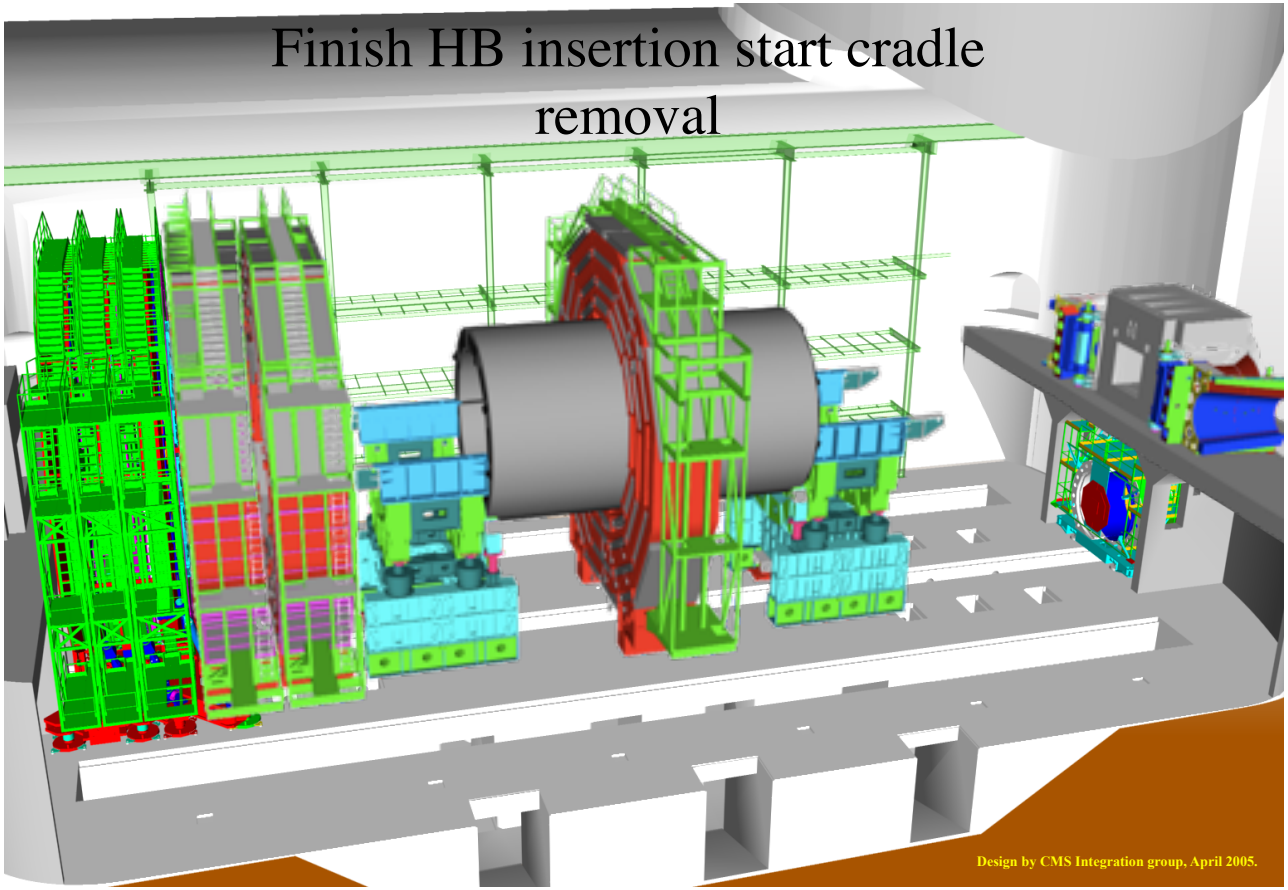
Lower HB- move to final position



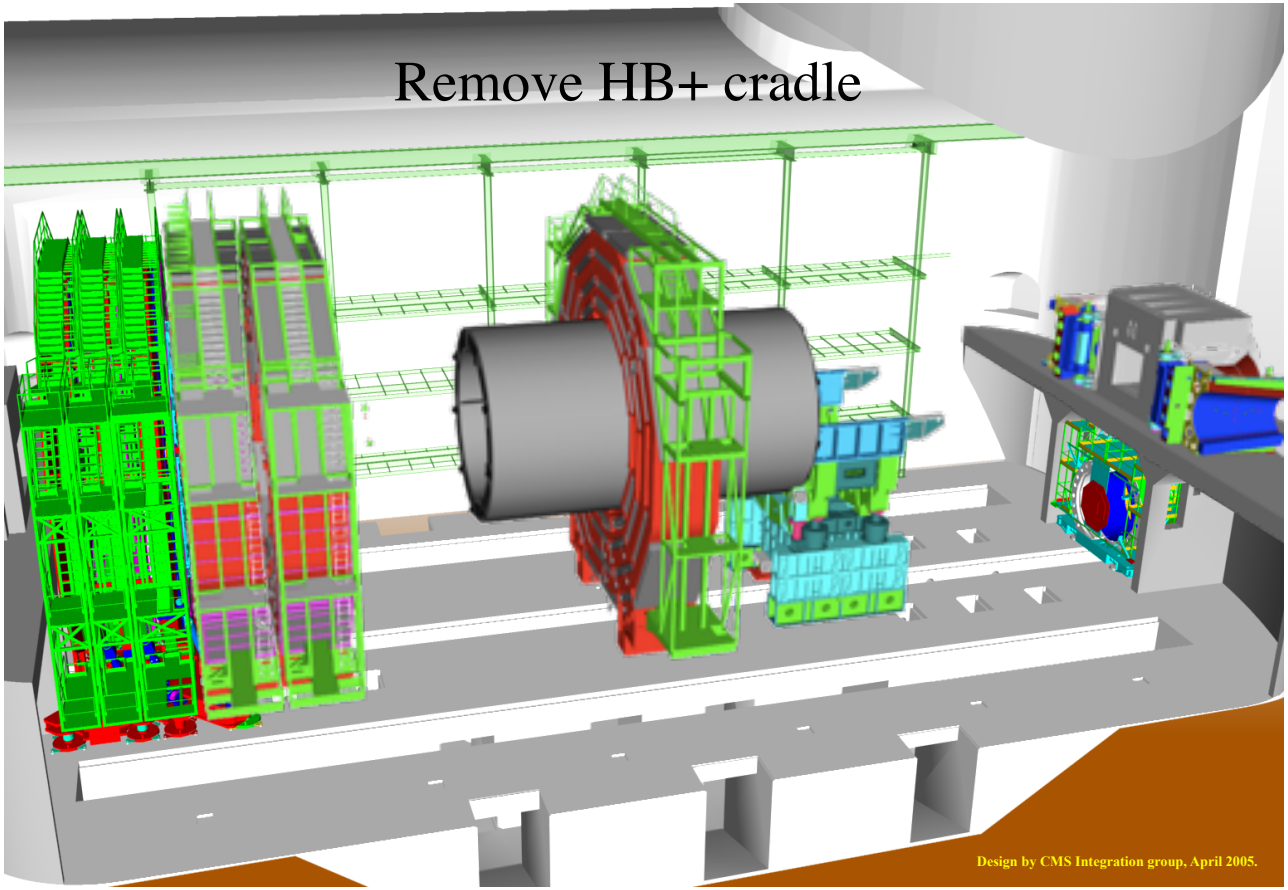
Move HB- inside vacuum tank



Finish HB insertion start cradle removal

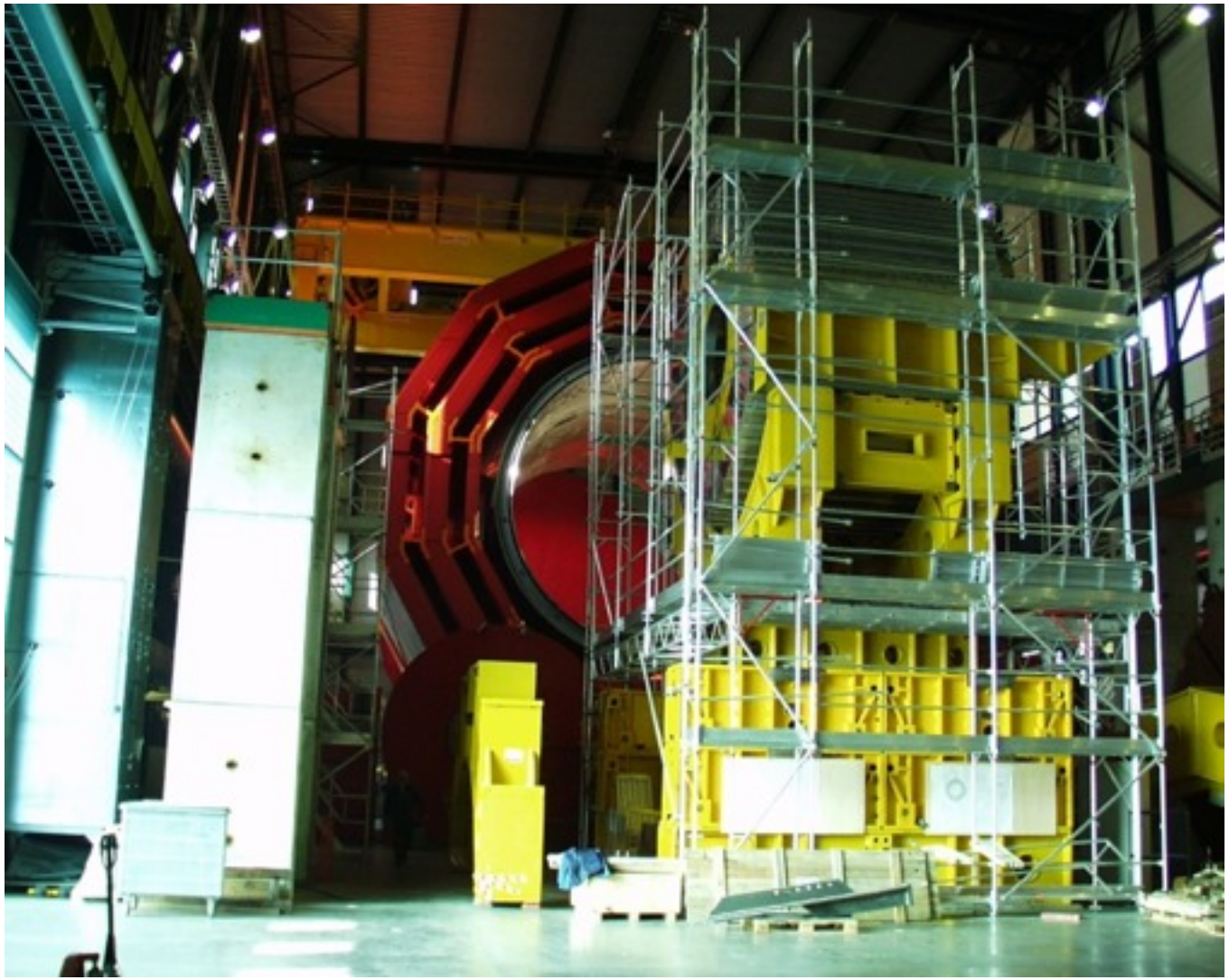


Best: if we could do the same 3d simulation for ILD!



CMS Surface Assembly Hall

CMS Surface Assembly Hall



CMS Surface Assembly Hall

Outlook

- There will be a review session at KILC12 for underground hall issues:
  - GDE Project Managers, MDI CTG, CFS group
- We should make sure that we make the case for the needs of the detectors
  - SiD is involved in the discussions, they are basically fine with the proposed design (modulo some details, e.g. height of alcoves)

- How do we proceed?