ILD Assembly Procedures and Timelines

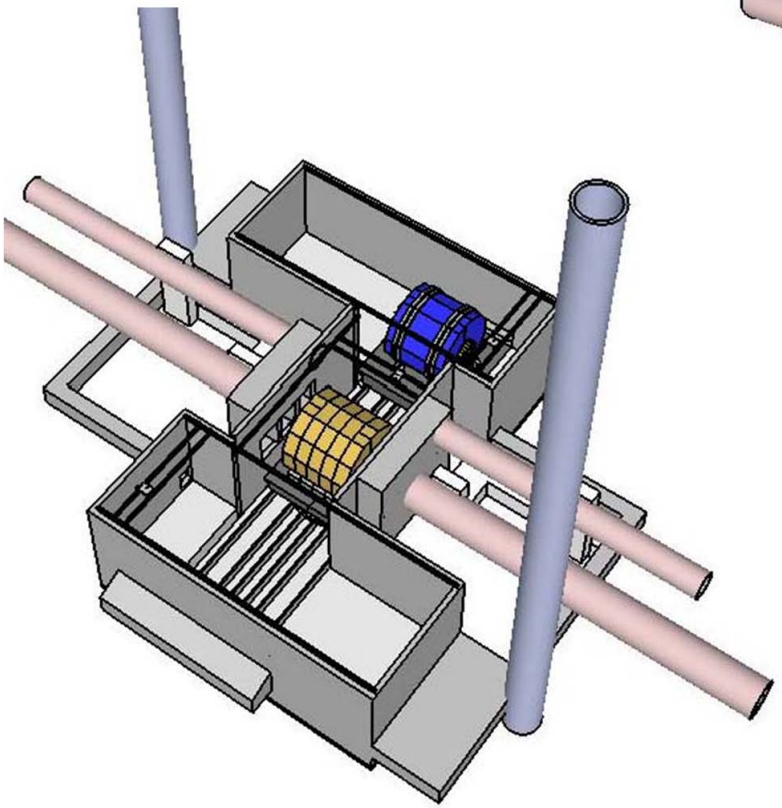
Karsten Buesser

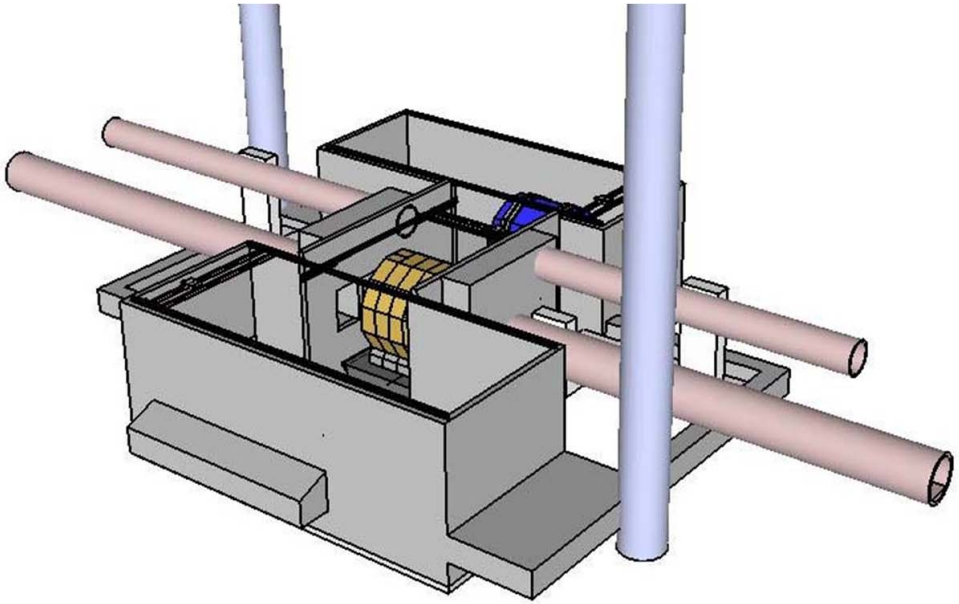
22.05.2012

ILD Workshop

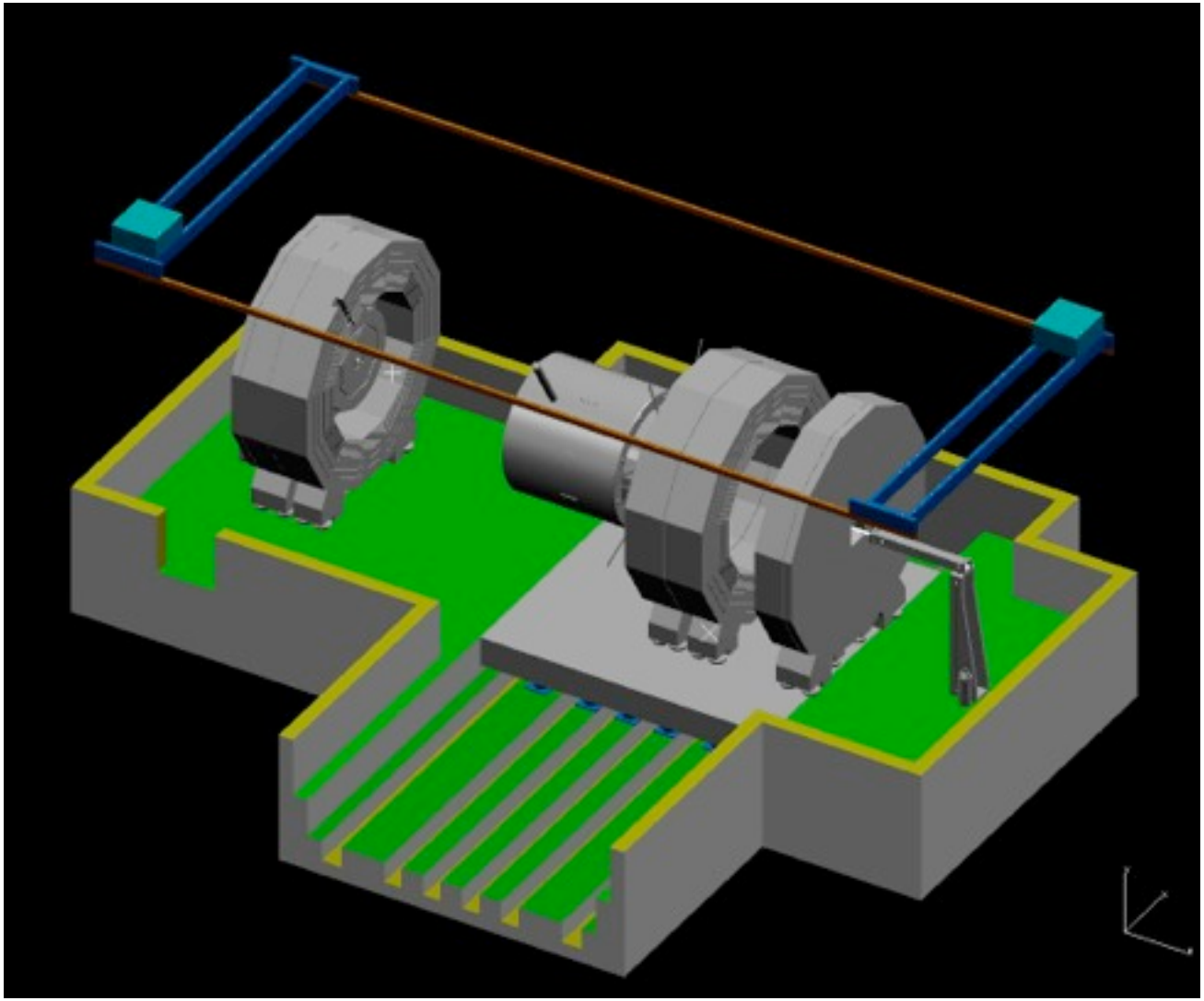
Overview

- 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
- CFS Baseline Technical Review Workshop at CERN on March 22-23
    - Discussions with GDE on cost issues continued during KILC12



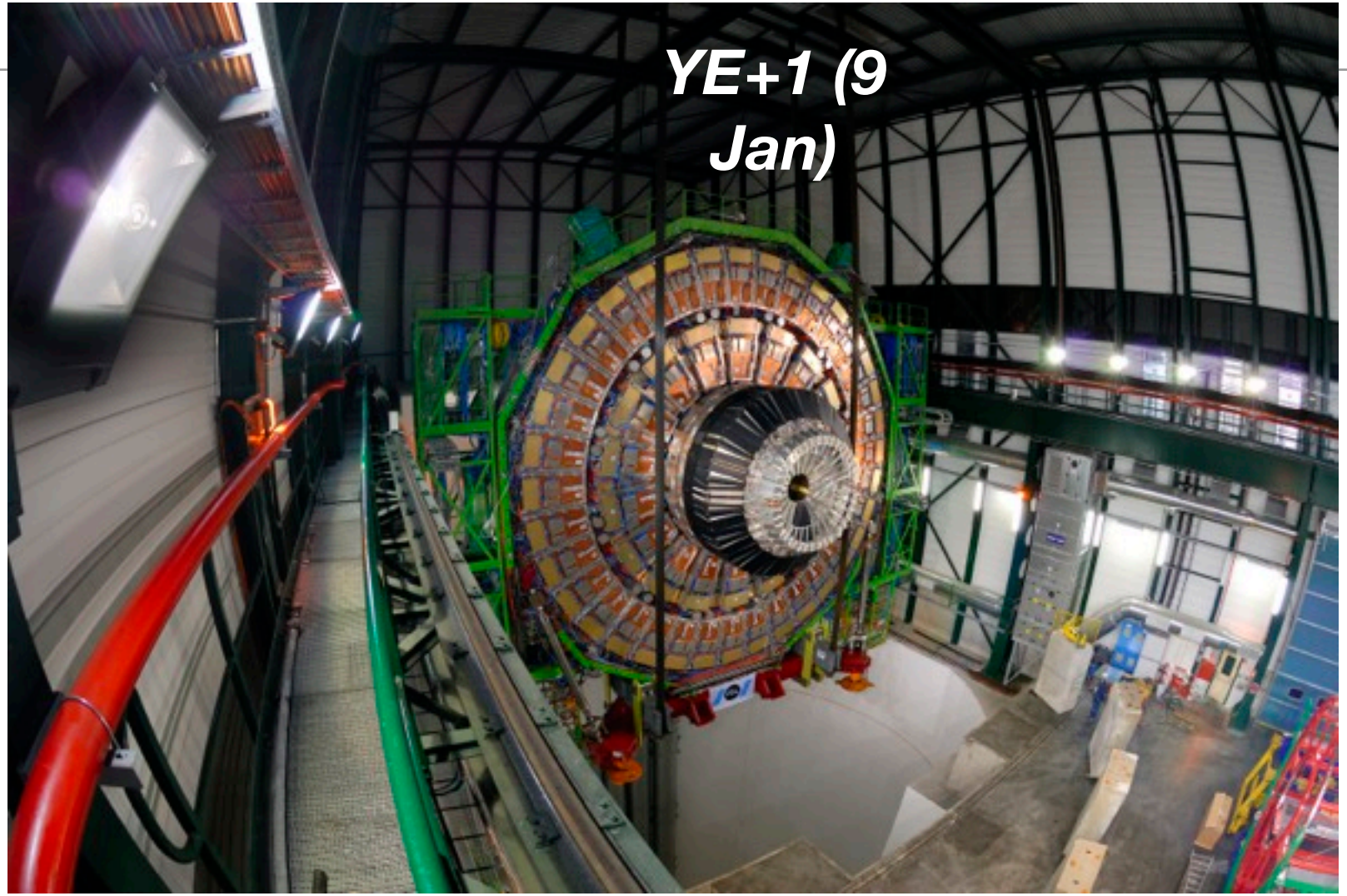


ILD in Maintenance Region (non-mountain site)

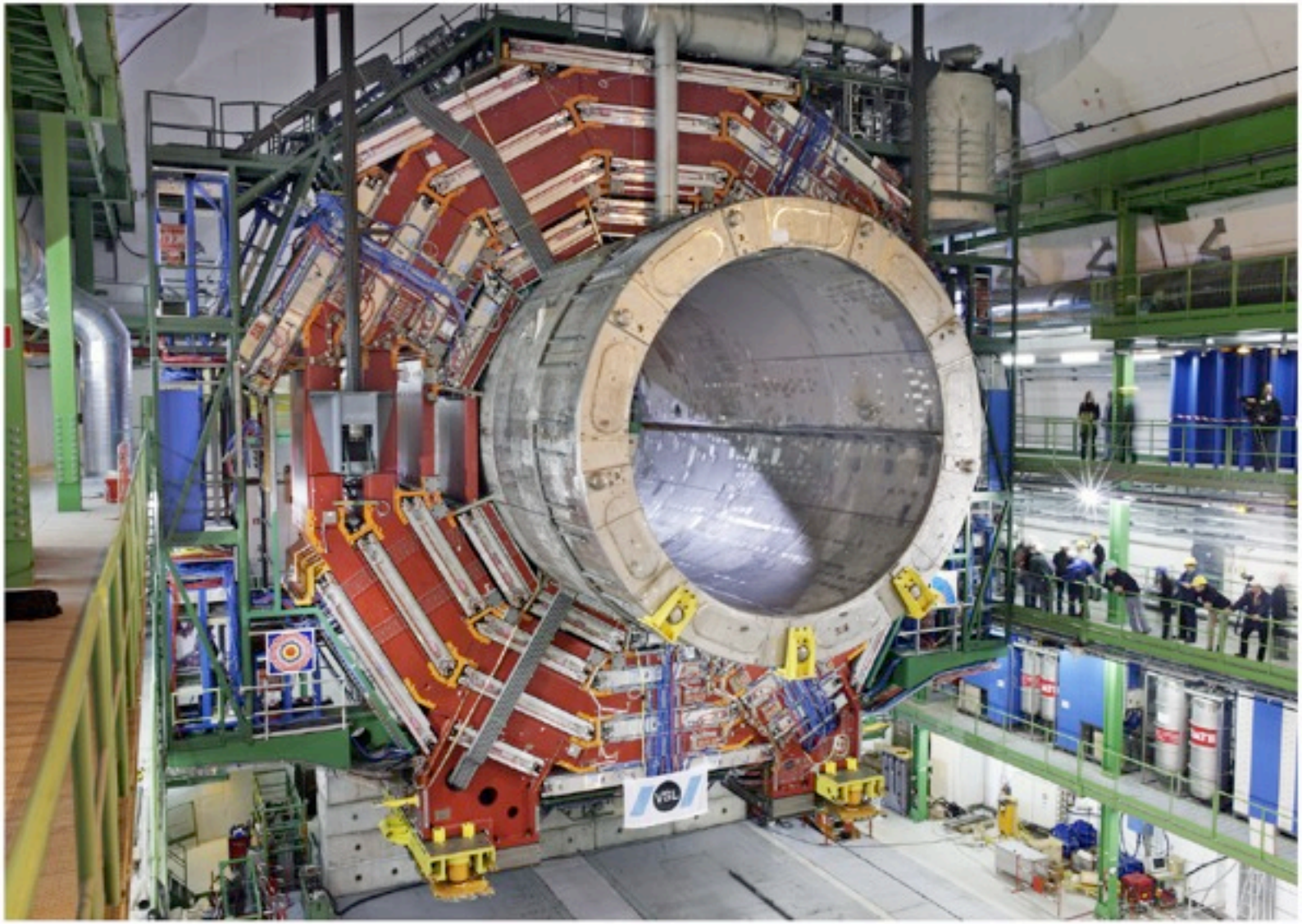


R. Volkenborn

CMS Assembly



CMS Assembly



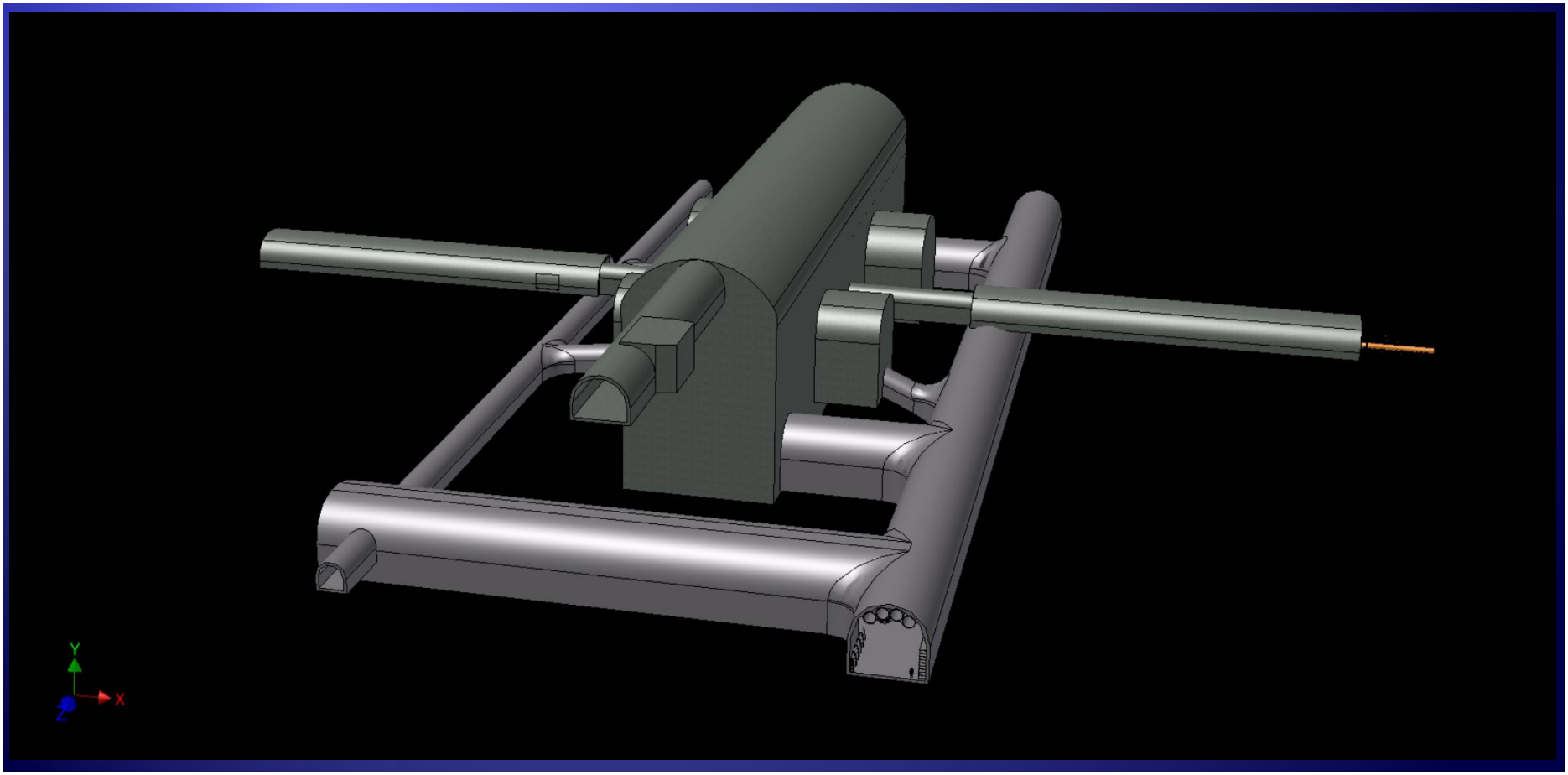
A. Hervé

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 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)

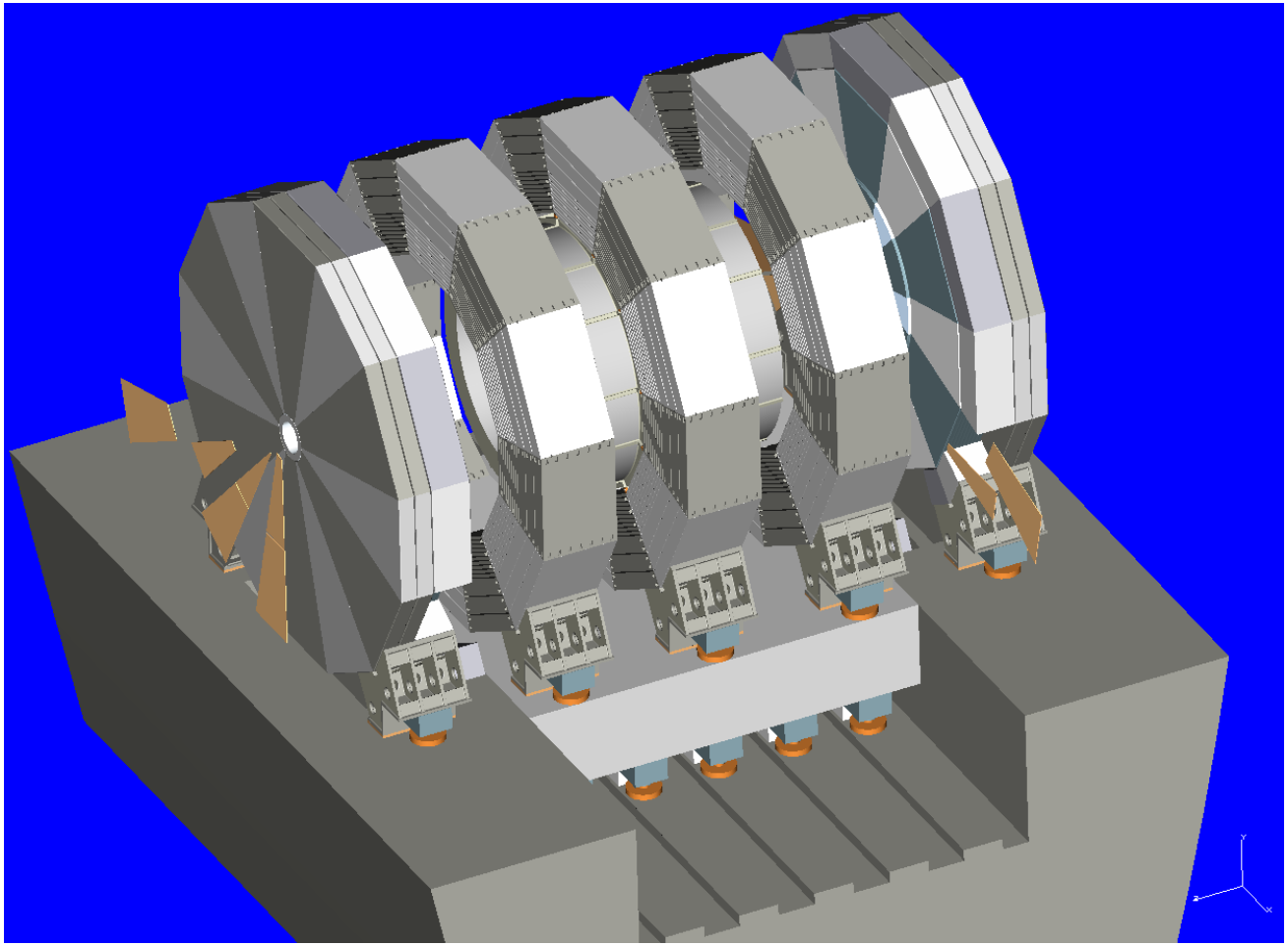


- Enlarged Alcoves
- 142 m long

G. Orukawa

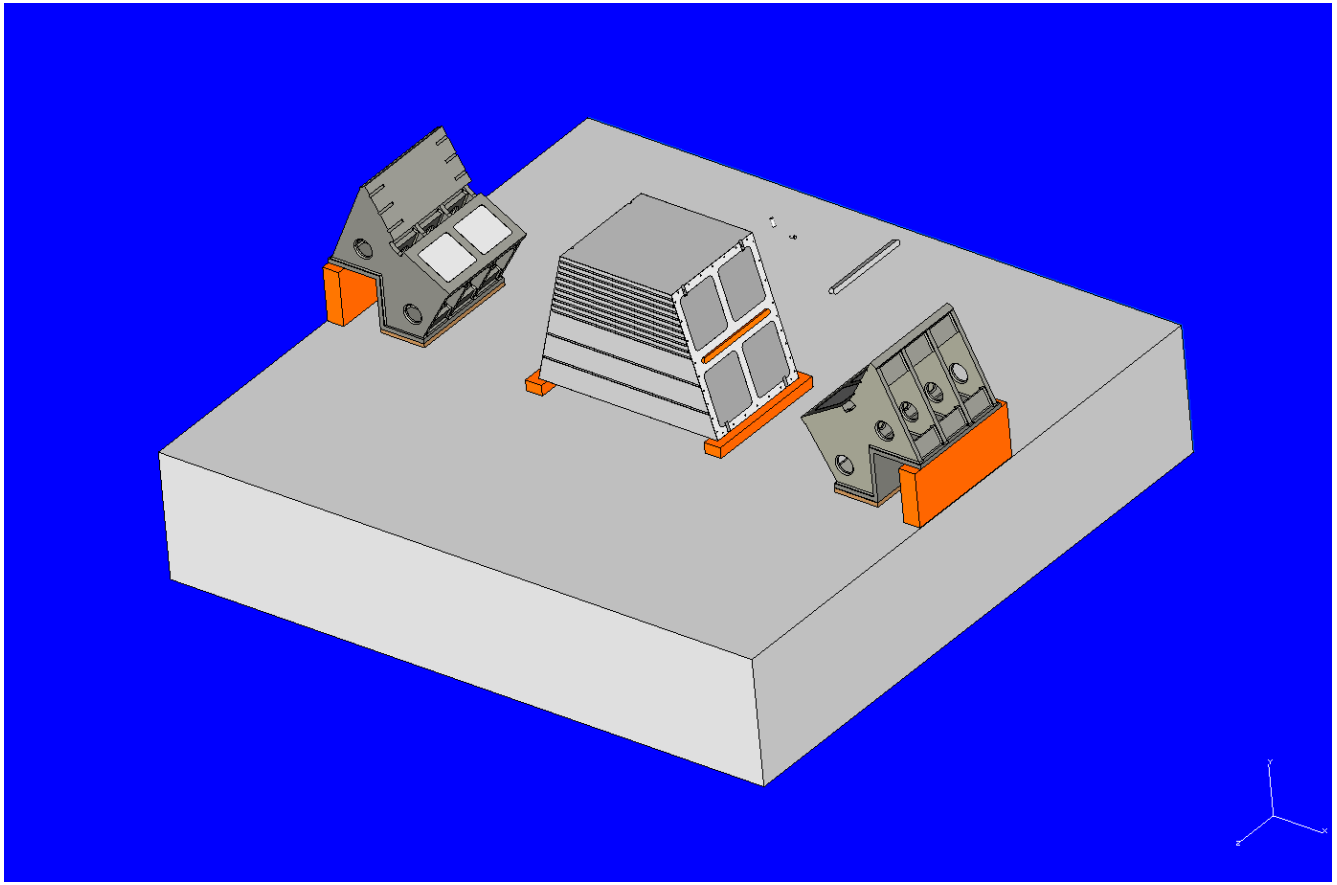
ILD Design

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



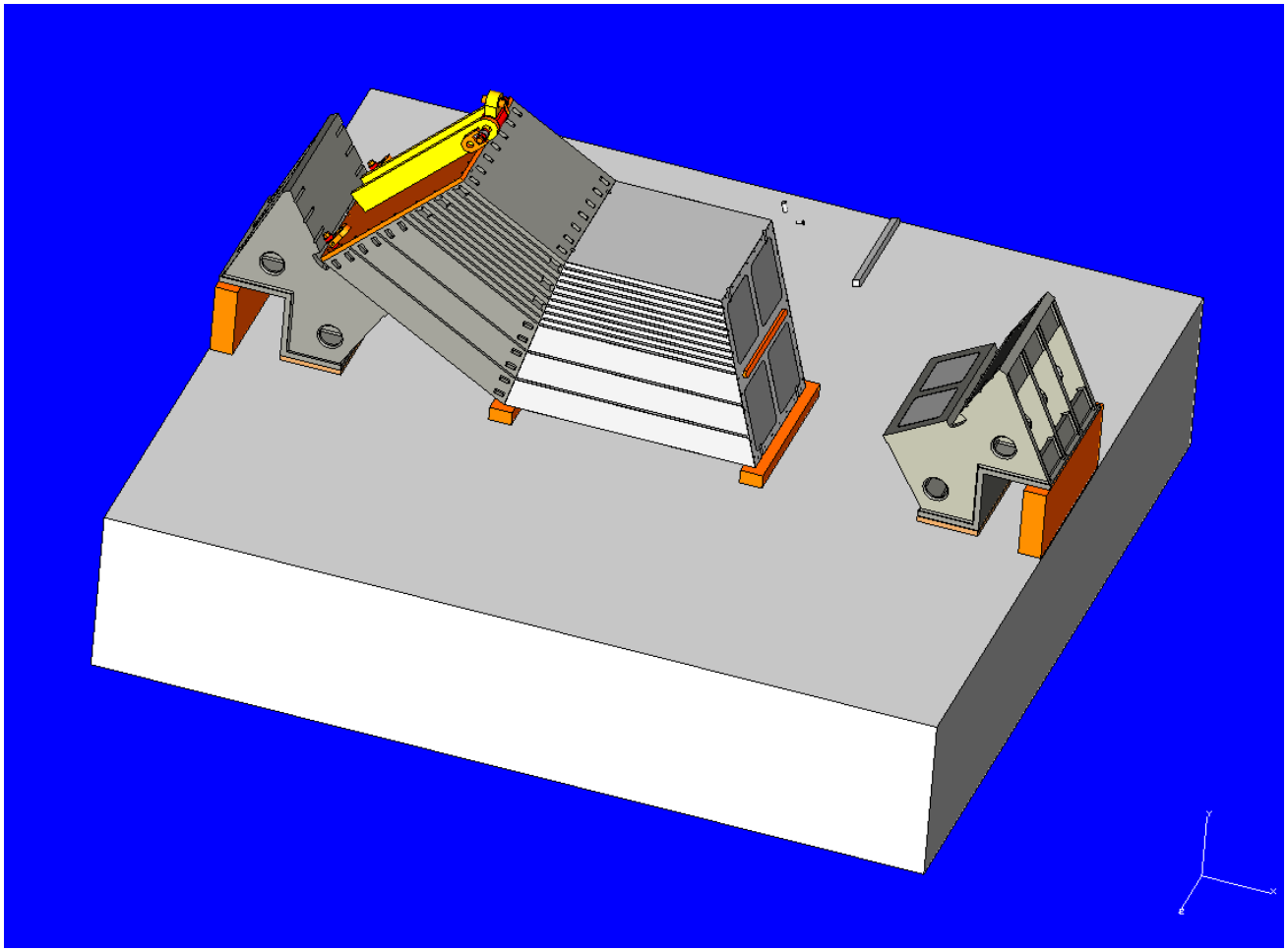
Yoke Assembly - Barrel

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

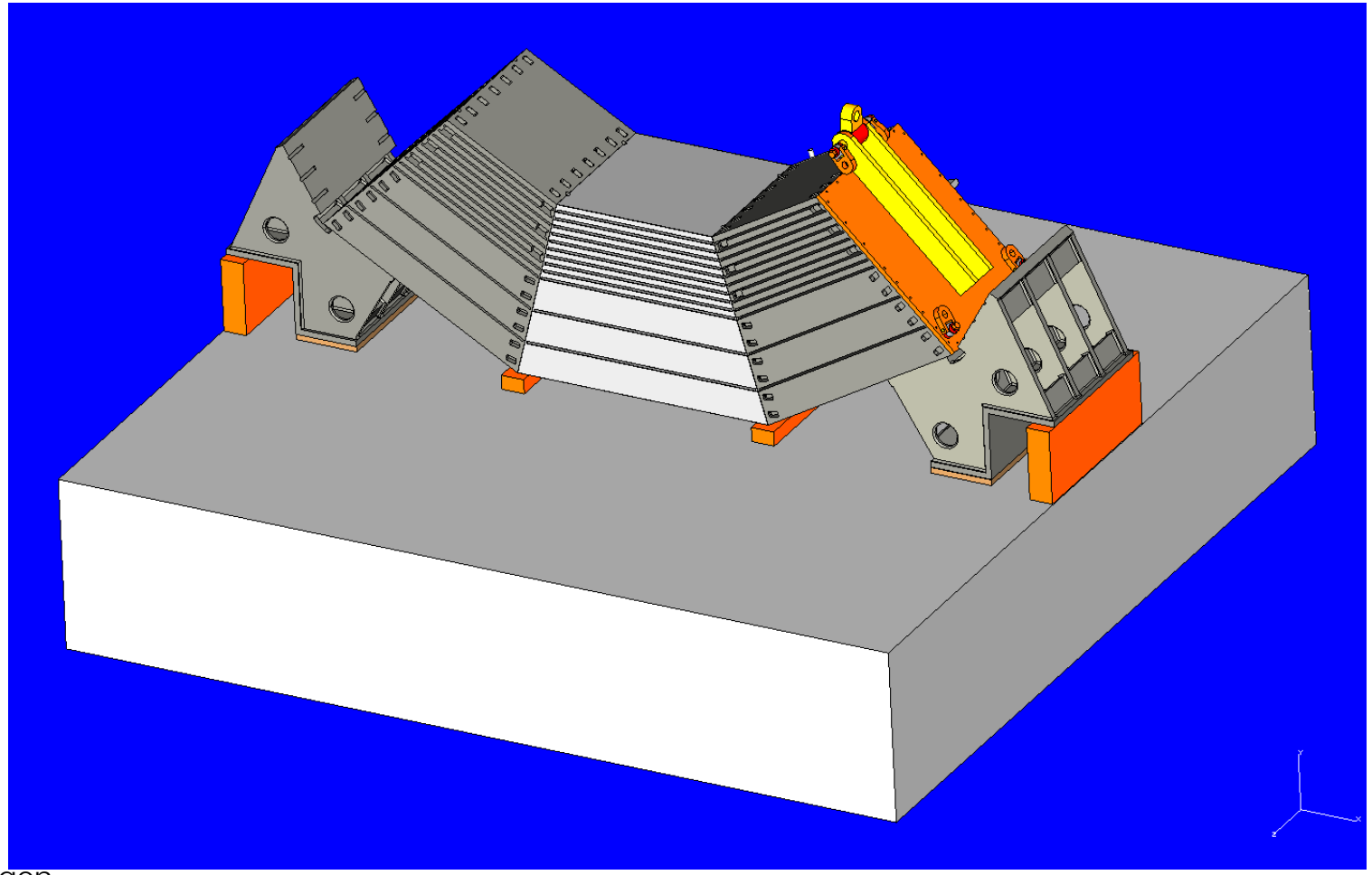


Yoke Assembly - Barrel

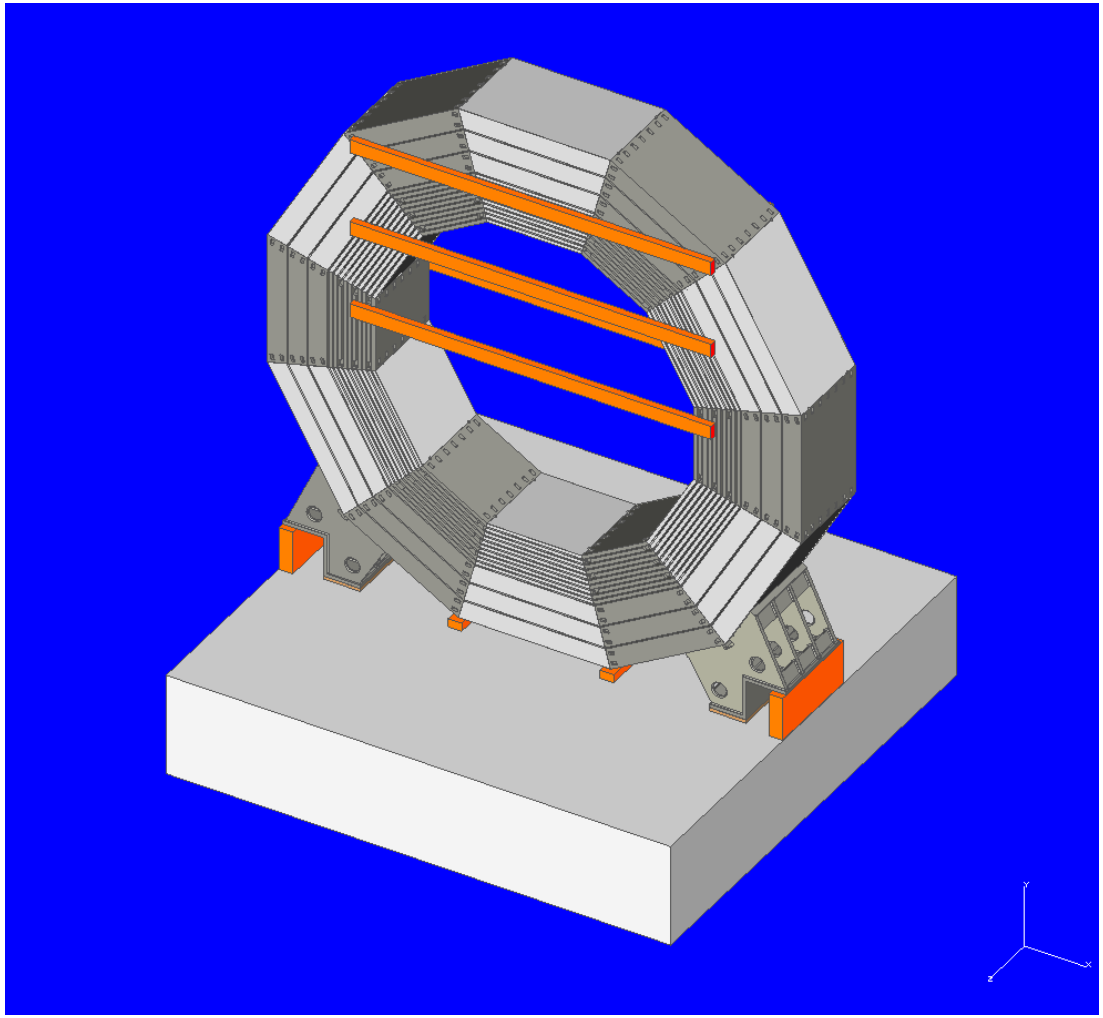
- 200t crane coverage needed



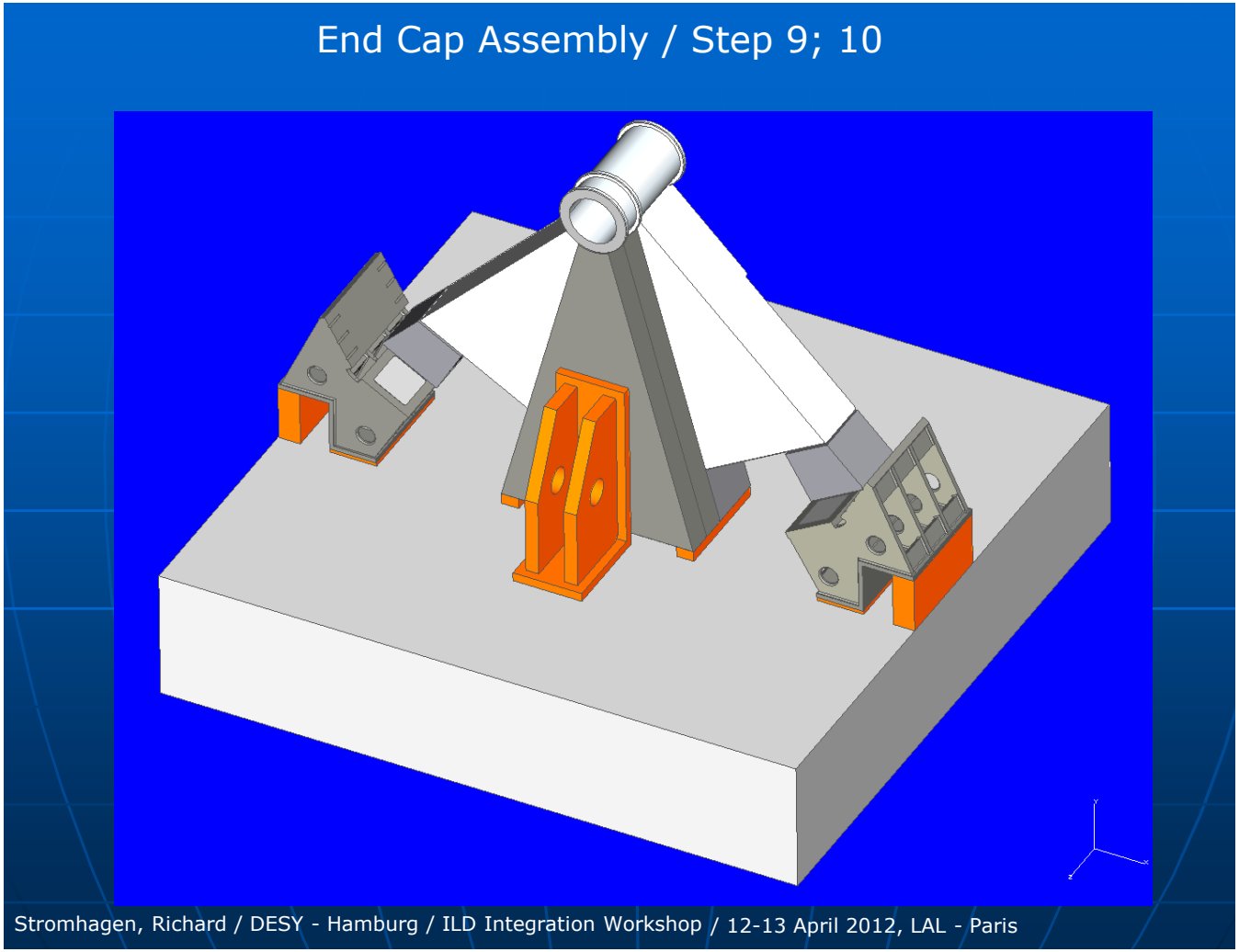
Yoke Assembly - Barrel



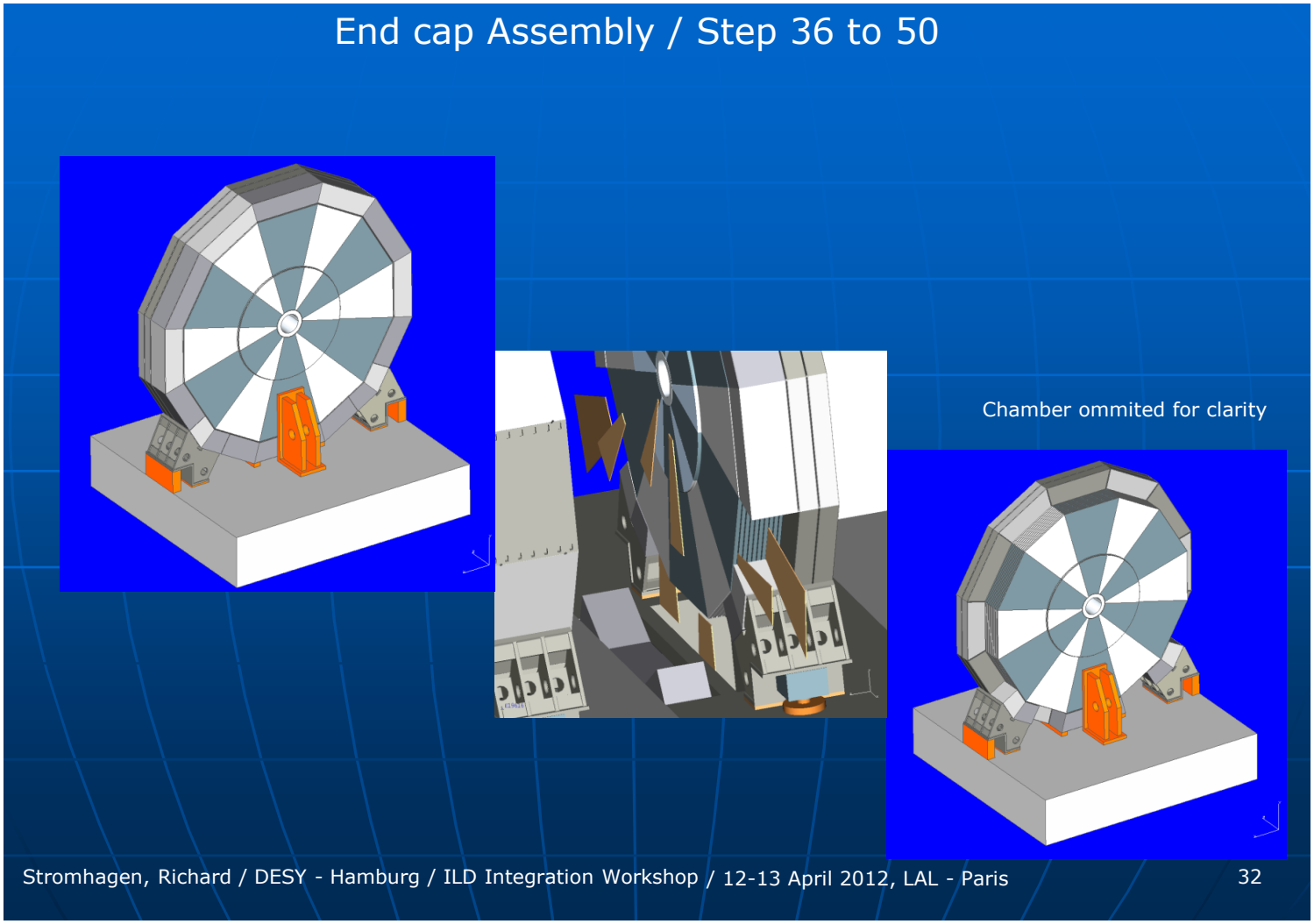
Yoke Assembly - Barrel



Yoke Assembly - Endcap



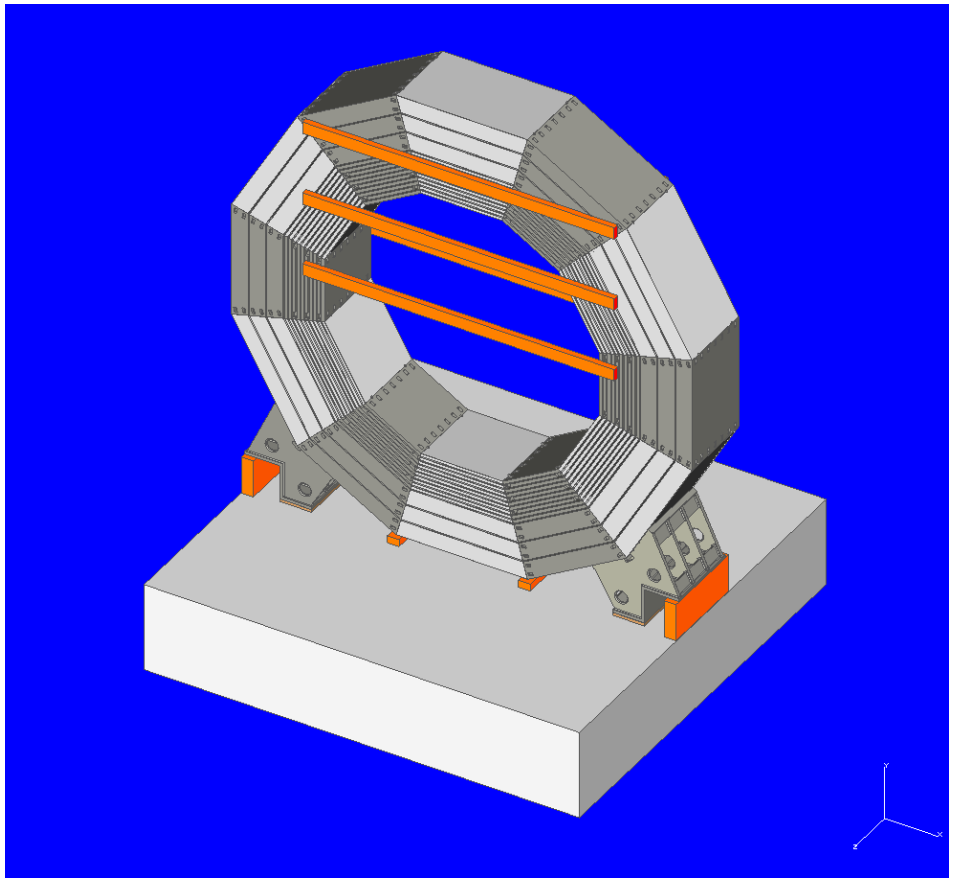
Yoke Assembly - Endcap



Yoke Assembly

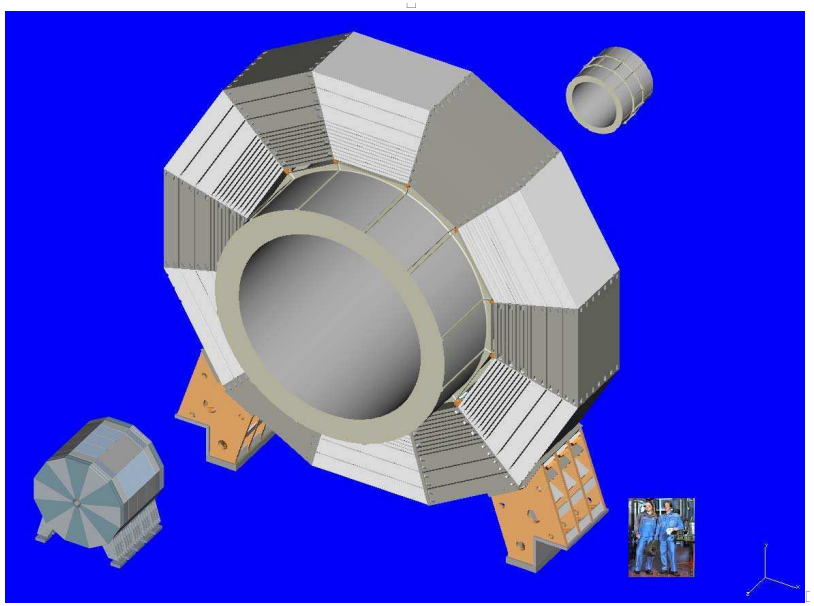
R. Stromhagen

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



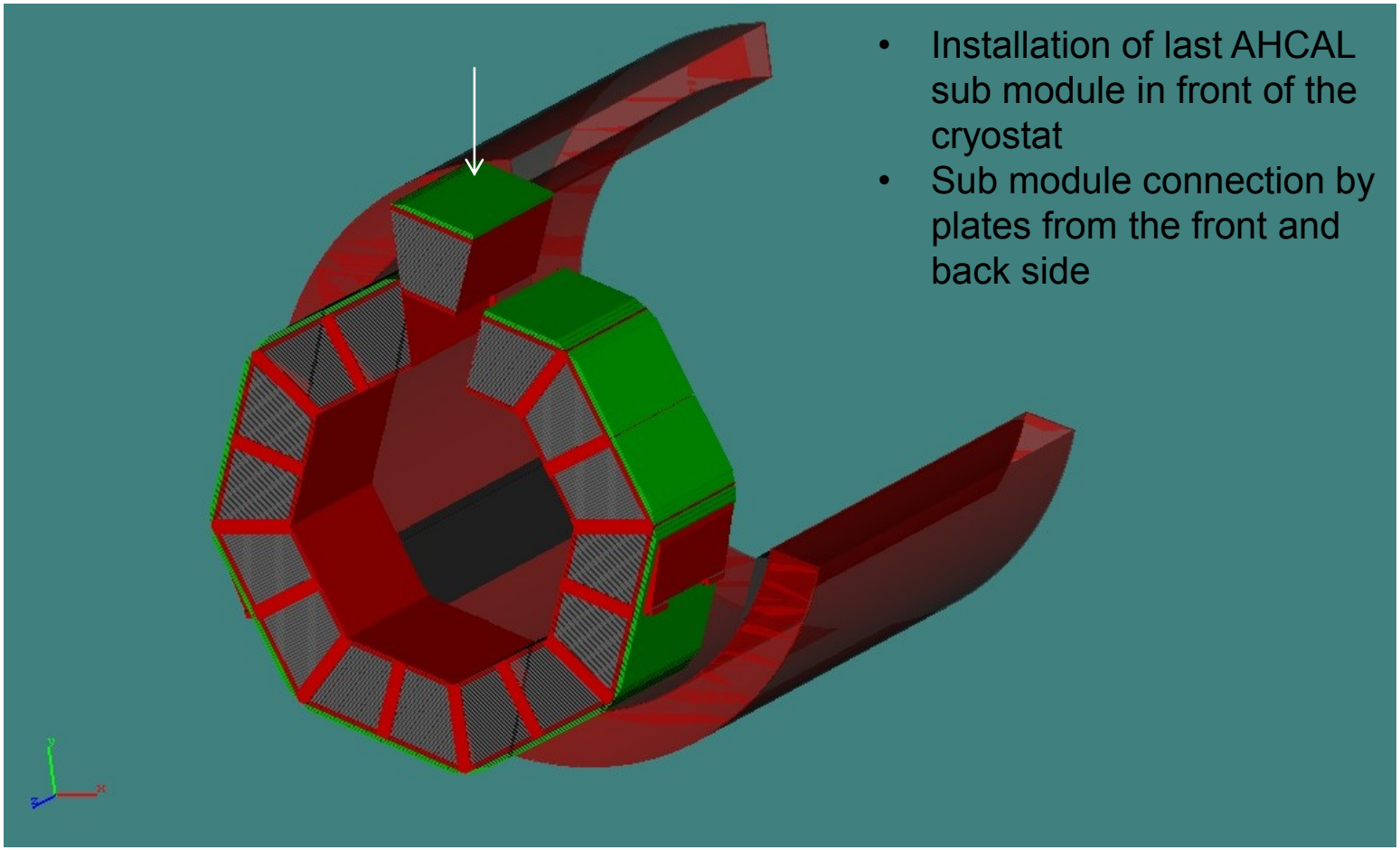
Coil Installation

- 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



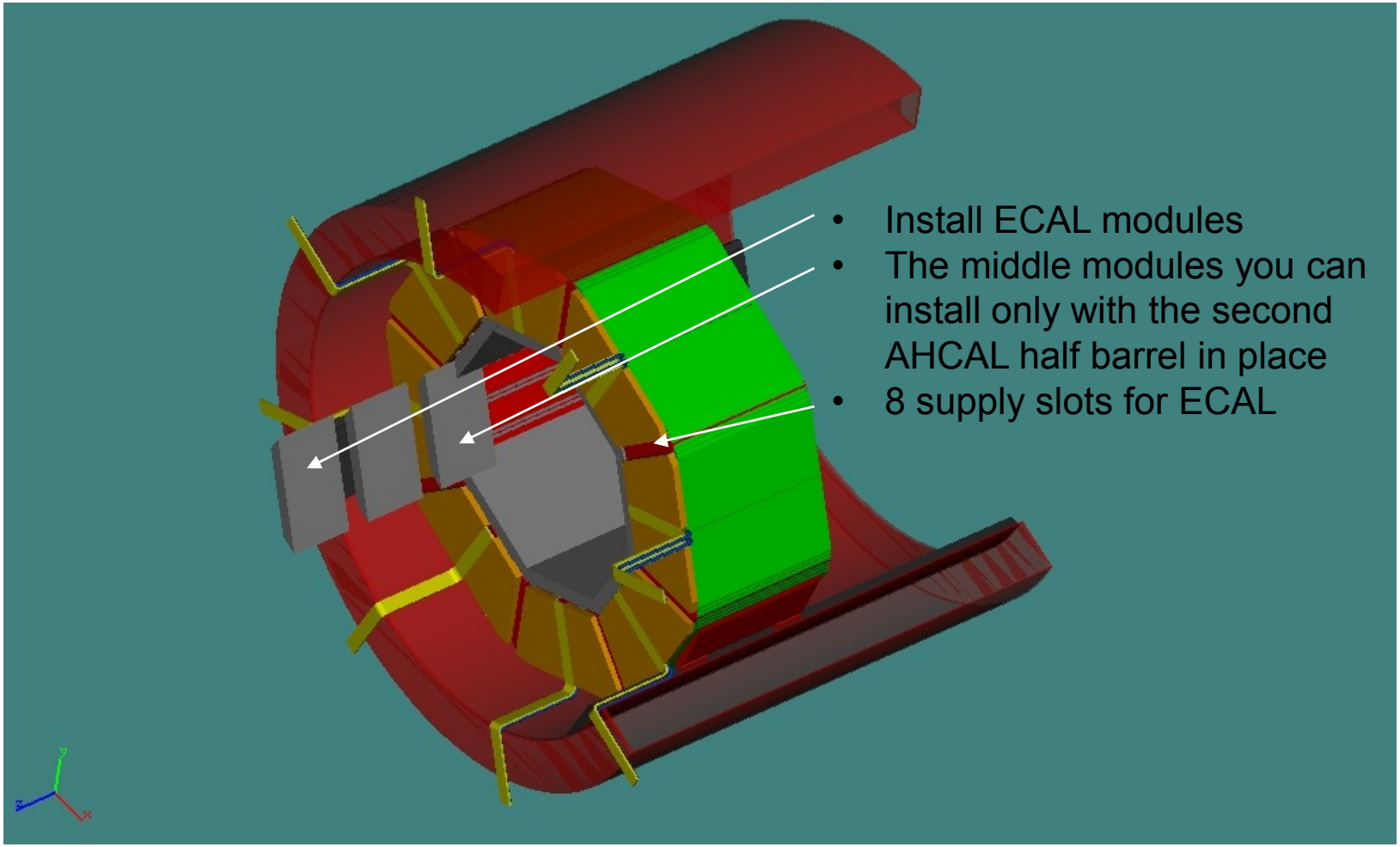
R. Stromhagen

AHCAL Installation



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

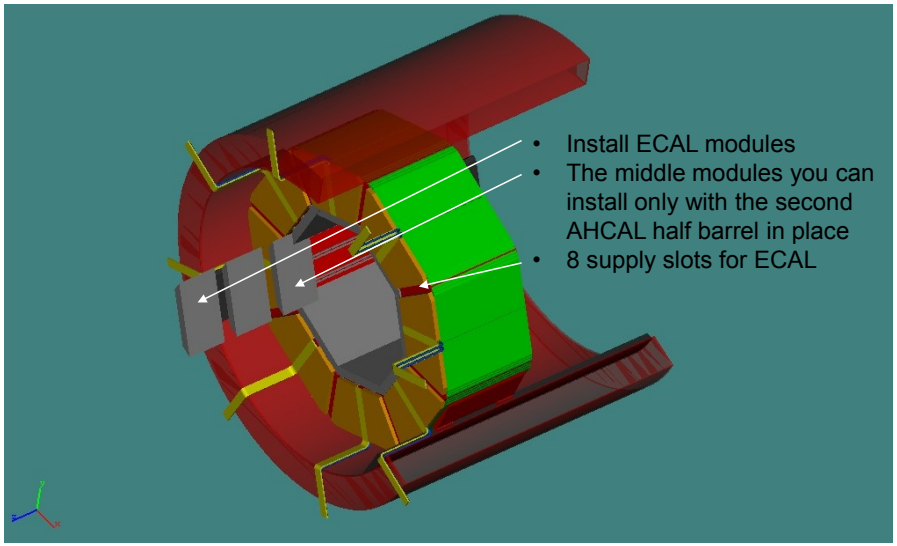
AHCAL/ECAL Installation



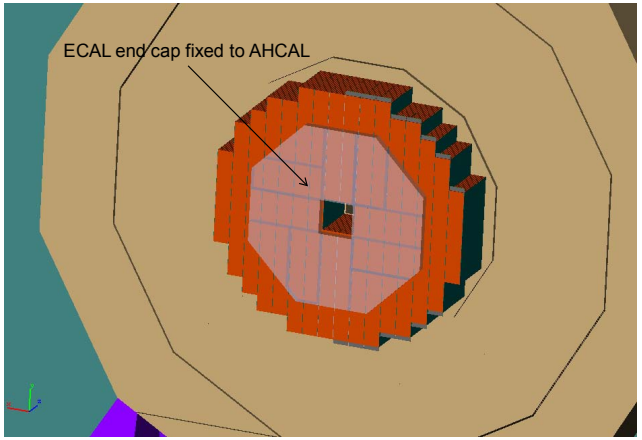
Calorimeter Installation

- 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: ?

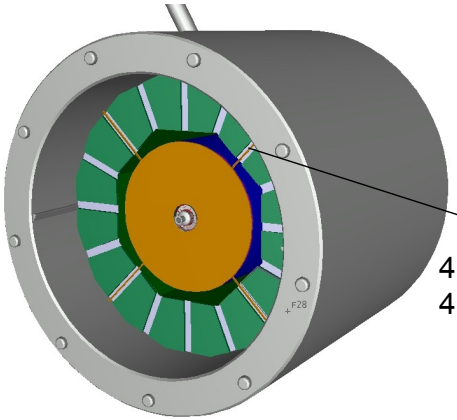


K. Gadow

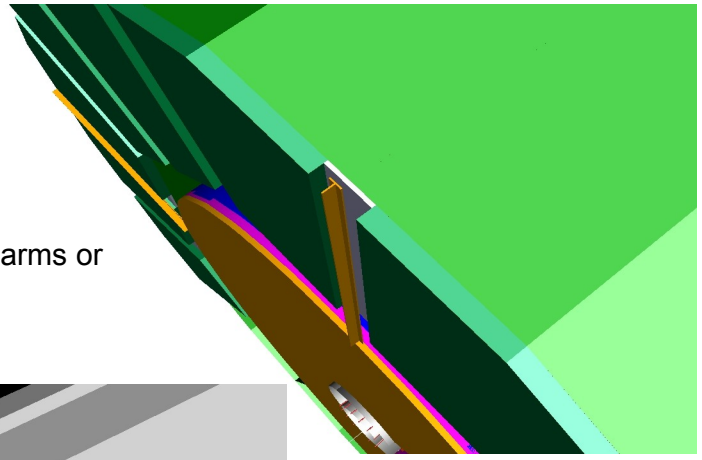


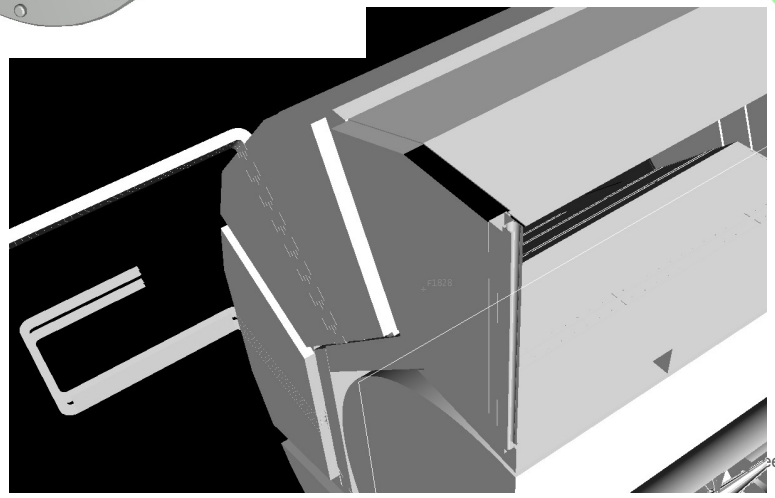
TPC Installation

Design of the support structure



4 Cantilever arms or
4 Ropes

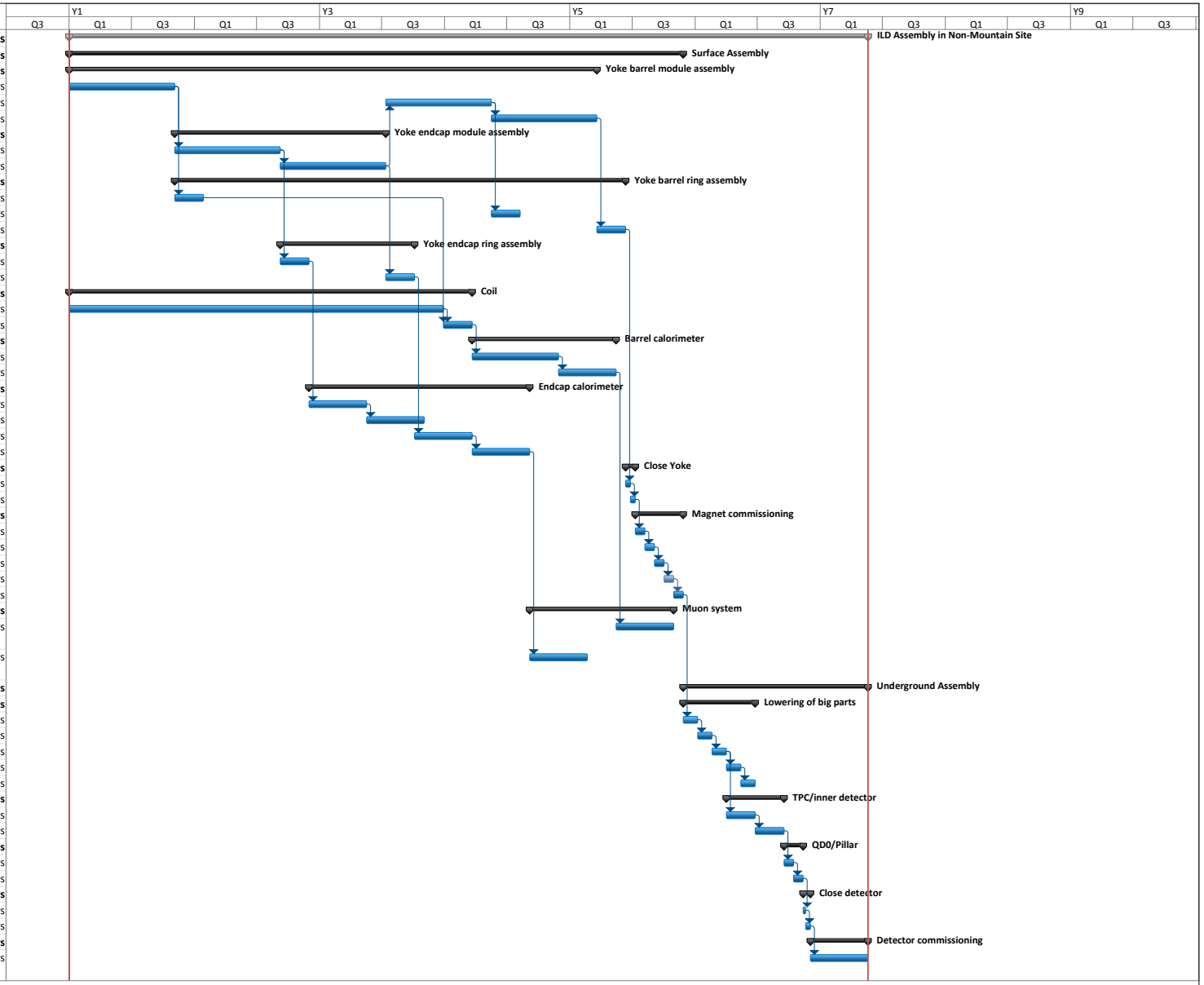




V. Prahl

ILD Assembly Time Line (Non-Mountain Sites)

ID	Task Name	Duration
0	**ILD Assembly in Non-Mountain Site**	**1665 days**
1	**Surface Assembly**	**1280 days**
2	**Yoke barrel module assembly**	**1100 days**
3	YB0	220 days
4	YB+z	220 days
5	YB-z	220 days
6	**Yoke endcap module assembly**	**440 days**
7	YE+z	220 days
8	YE-z	220 days
9	**Yoke barrel ring assembly**	**940 days**
10	YB0	60 days
11	YB+z	60 days
12	YB-z	60 days
13	**Yoke endcap ring assembly**	**280 days**
14	YE+z	60 days
15	YE-z	60 days
16	**Coil**	**840 days**
17	Coil assembly and test	780 days
18	Coil installation in YB0	60 days
19	**Barrel calorimeter**	**300 days**
20	HCAL barrel assembly/cabling	180 days
21	ECAL barrel assembly/cabling	120 days
22	**Endcap calorimeter**	**460 days**
23	HCAL +z endcap assembly/cabling	120 days
24	ECAL +z endcap assembly/cabling	120 days
25	HCAL -z endcap assembly/cabling	120 days
26	ECAL -z endcap assembly/cabling	120 days
27	**Close Yoke**	**20 days**
28	Move Ybs	10 days
29	Move YEs	10 days
30	**Magnet commissioning**	**100 days**
31	Cool down	20 days
32	High field tests	20 days
33	Field mapping	20 days
34	QD0 testing	20 days
35	Warm up	20 days
36	**Muon system**	**300 days**
37	Muon chamber barrel insertion/cabling	120 days
38	Muon chamber endcap insertion/cabling	120 days
39	**Underground Assembly**	**385 days**
40	**Lowering of big parts**	**150 days**
41	YE+z	30 days
42	YB+z	30 days
43	YB0	30 days
44	YB-z	30 days
45	YE-z	30 days
46	**TPC/inner detector**	**120 days**
47	TPC insertion/cabling	60 days
48	Inner detector insertion/cabling	60 days
49	**QD0/Pillar**	**40 days**
50	QD0 mounting	20 days
51	Forward calorimeters	20 days
52	**Close detector**	**15 days**
53	Close YEs	5 days
54	Install QD0/Pillars	10 days
55	**Detector commissioning**	**120 days**
56	Detector commissioning and testing	120 days



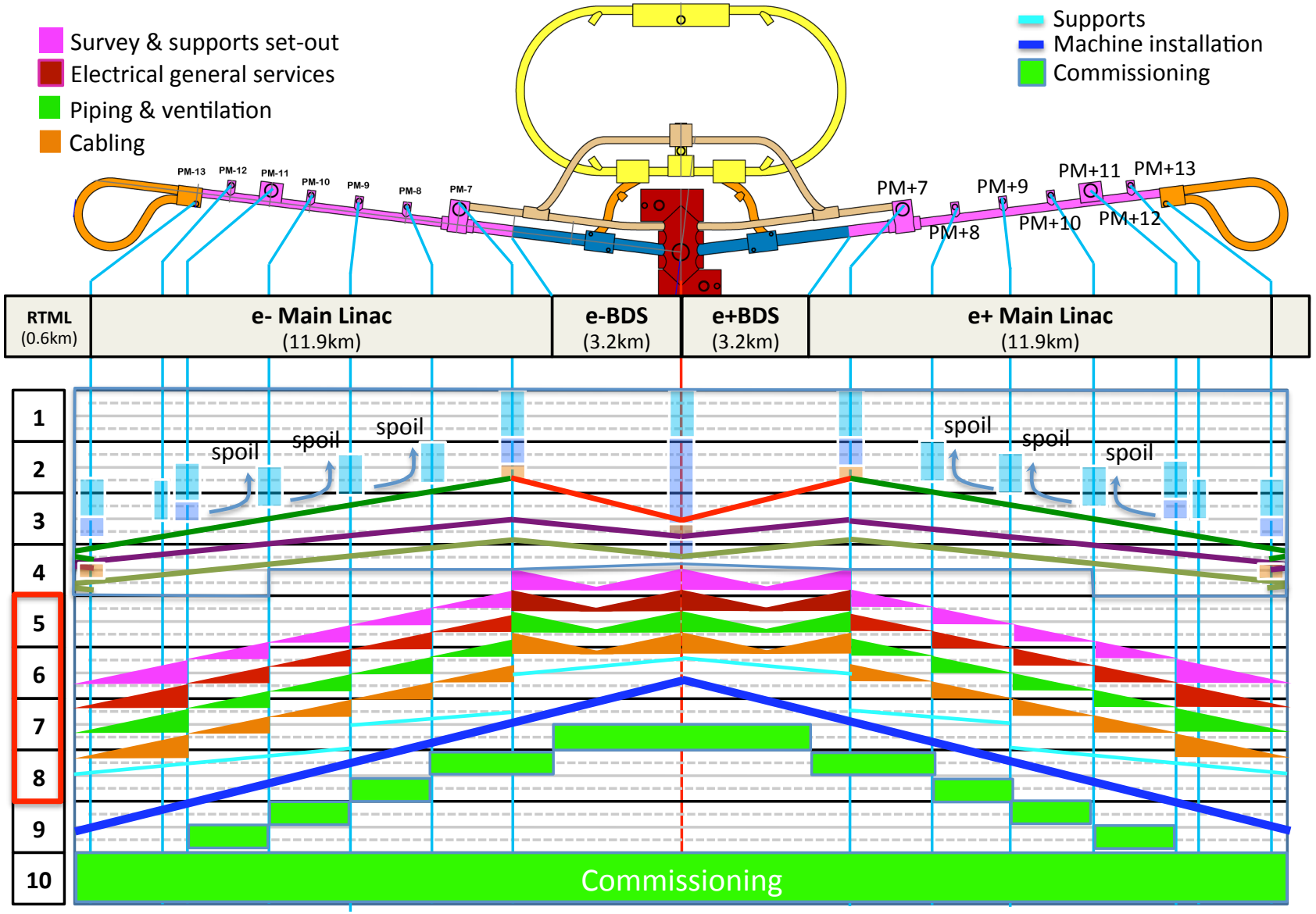
- Critical path is defined by central detector construction:
  - central yoke ring, coil, barrel calorimeter, TPC, inner detector
- Assume to build coil and yoke segments on site
  - yoke segments could also be built at vendour, but rings need to be assembled on site
- Assume ~5.25 y of surface assembly time
  - could only start after surface buildings are ready
- Assume ~1.5 y of underground assembly and commissioning time
- Total: ~7 y plus preparation of surface buildings
- So total schedule of ~8 y seems doable

ILC Construction Schedule Discussion

- GDE is looking into global construction schedules now in more detail
- Working group: PMs, E. Paterson, M. Gastal, KB (detector contact)
- Started discussions at KILC
- Webex meeting on May 8th 2012
- Will follow this up during the coming weeks

- More later....

M. Gastal (8 May 2012)



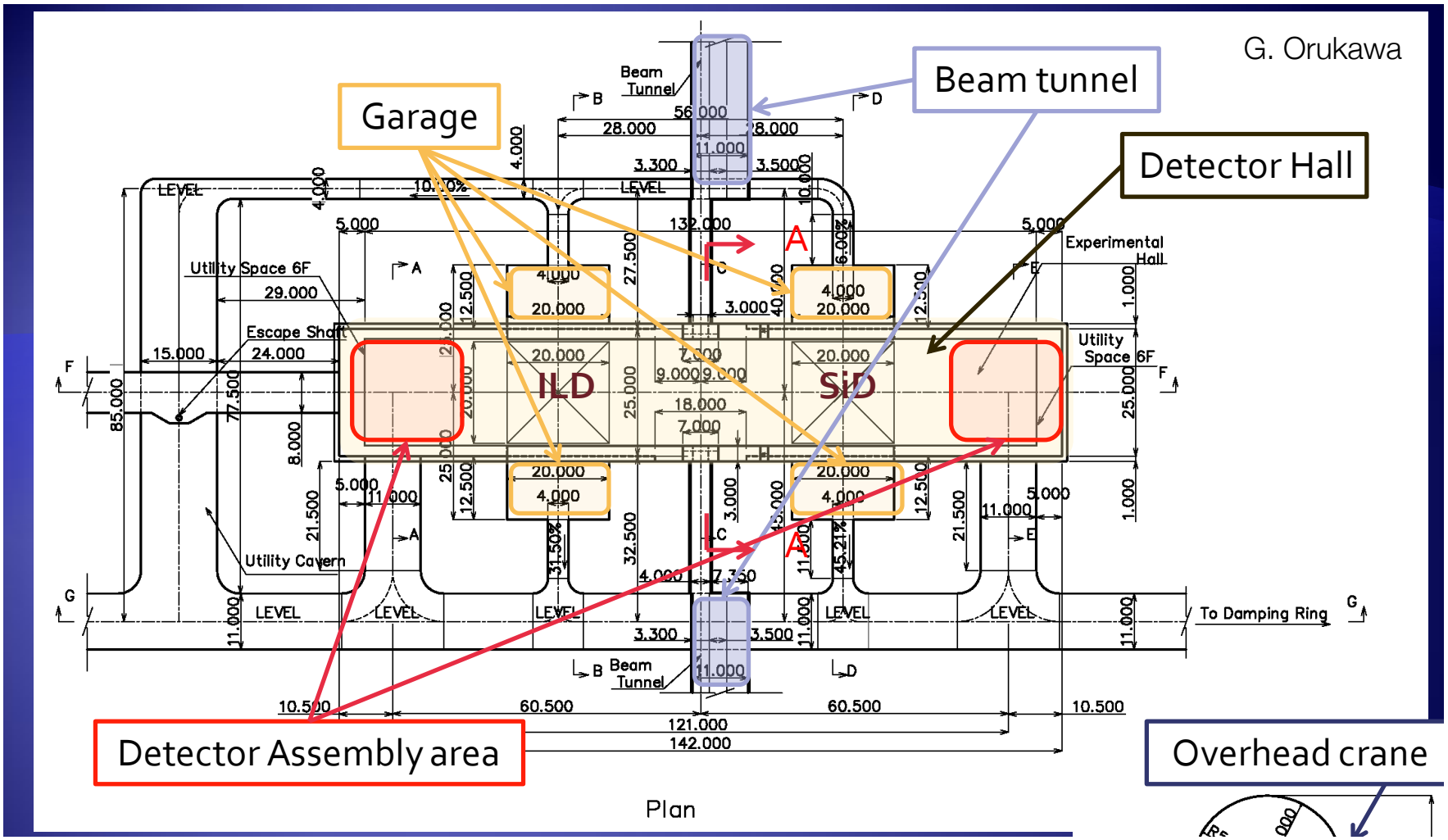
From Martin Gastal…. possible example TDR schedule (CERN site)

SUMMARY DESCRIPTION of POSSIBLE ILC CONSTRUCTION SCHEDULES

ACTIVITIES DURING YEARS X -> Y

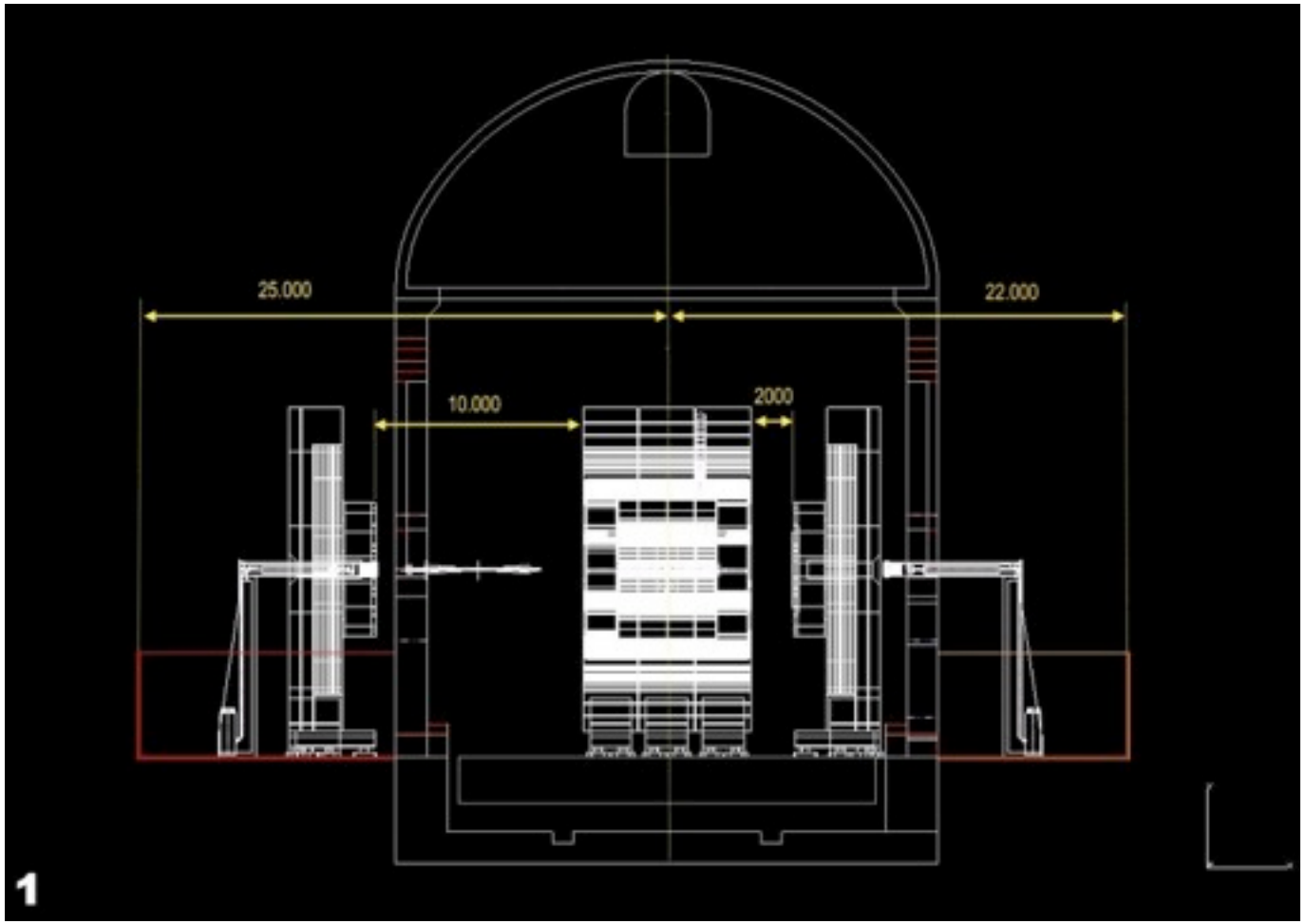
- Final Site Design and Site Preparation ? -> 1
- Civil Construction 1 -> 5
- Completion of Conventional Facilities 4 -> 8
- Production and Testing of Components 1 -> 9
- Installation of Technical Systems 6 -> 9
- In-situ Testing/Processing 7 -> 9
- Beam Commissioning of Central Region 8 -> 9
- Assembly and Installation of Detectors 2 -> 10
- ILC Beam Commissioning. Move of first Detector Online. Begin Physics Run 10

Japanese Hall Design (Status: 22.03.2012)



Maintenance Position (ILD Study)

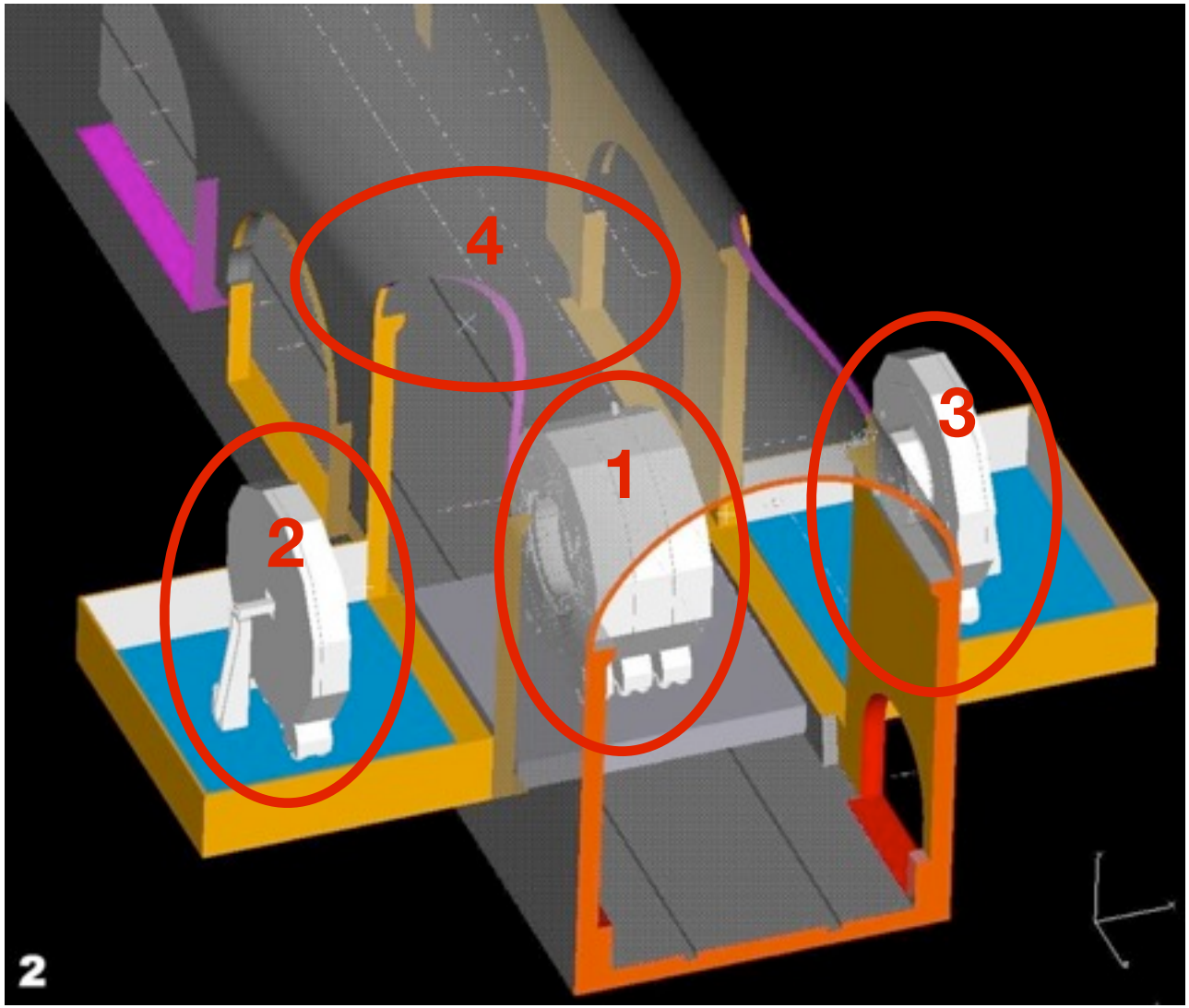
- Alcoves needed to open the detector for maintenance



R. Volkenborn

Underground Construction Space (ILD Study)

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

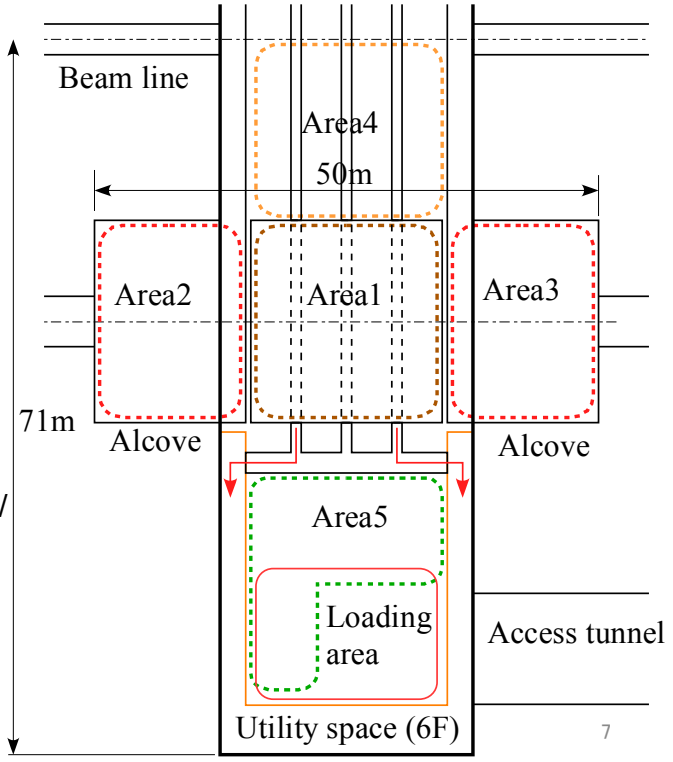


R. Volkenborn

ILD Installation Study (Preliminary)

Detector assembly area

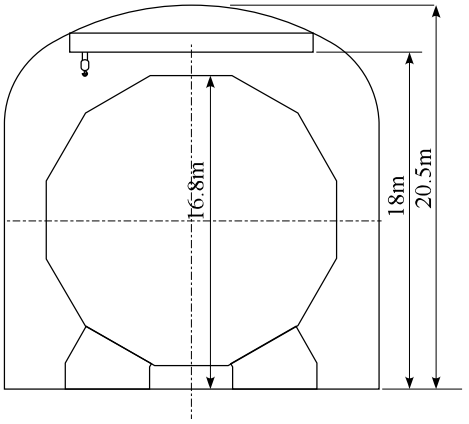
- Area 1: Platform
  - YB0 assembly
  - Barrel detectors installation/ cabling
  - Endcap calorimeters installation
- Area 2/3: Alcoves
  - Endcap calorimeters cabling
  - QD0 support tube assembly
  - FCAL install/cabling
- Area 4: Tentative platform on beam line side
  - YE, YB+, YB- (iron yoke and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



ILD Installation Study (Preliminary)

Boundary conditions

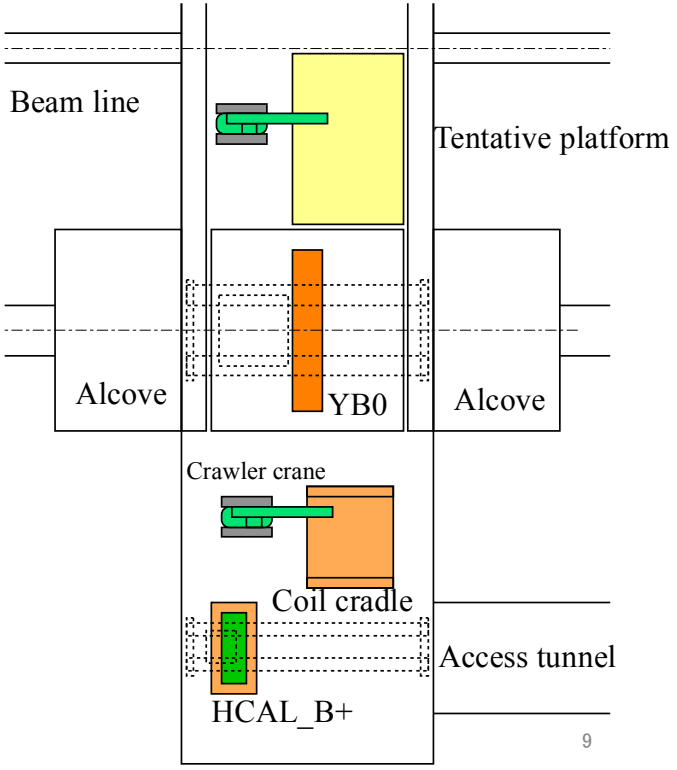
- Cranes
  - 250 ton crane for each detector on beam line side
  - 30 ton crane for each detector on loading area side
  - 2.8 ton crane in each alcove
    - In order to minimize the size of alcoves, the crane rails should be supported from the arch part → Only small cranes can be used
    - The height 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)

Step 1

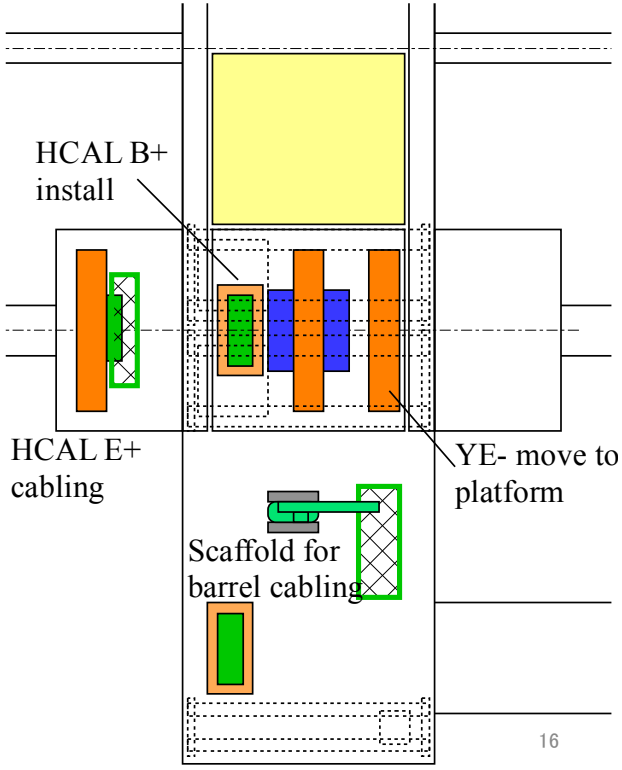
- Tentative platform is assembled in Area4 using a crawler crane
- Central barrel yoke YB0 is assembled on the platform using 250 ton crane
- HCAL modules are assembled to a ½-z ring in Area5 using 30 ton crane
- Cradle for coil installation is assembled in Area5 using a crawler crane



ILD Installation Study (Preliminary)

Step 8

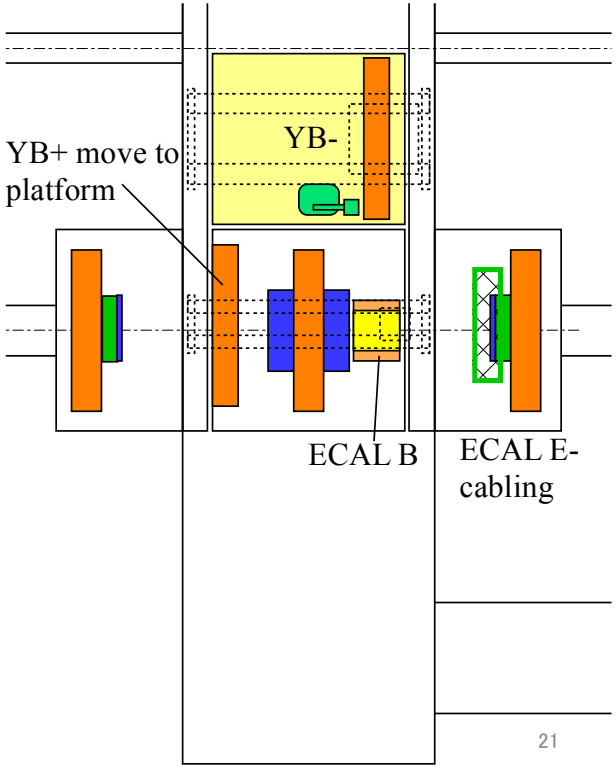
- YE- is moved to platform
- ½ of barrel HCAL is moved to platform using two 250 ton cranes, and installed
- Endcap yoke (+) is pushed into Area 2
- Endcap HCAL cabling in Area 2
- Scaffold for barrel cabling is assembled in Area 5



ILD Installation Study (Preliminary)

Step 13

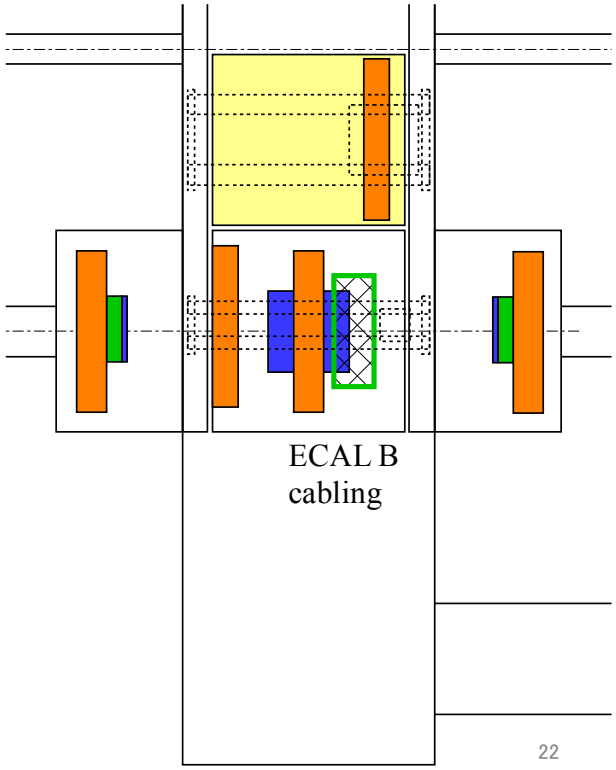
- YB+ is moved to Area 1
- Another barrel yoke ring YB- is assembled and muon detectors installed in Area 4
- Endcap ECAL (-) cabling in Area 3
- Barrel ECAL is installed in Area 1



ILD Installation Study (Preliminary)

Step 14

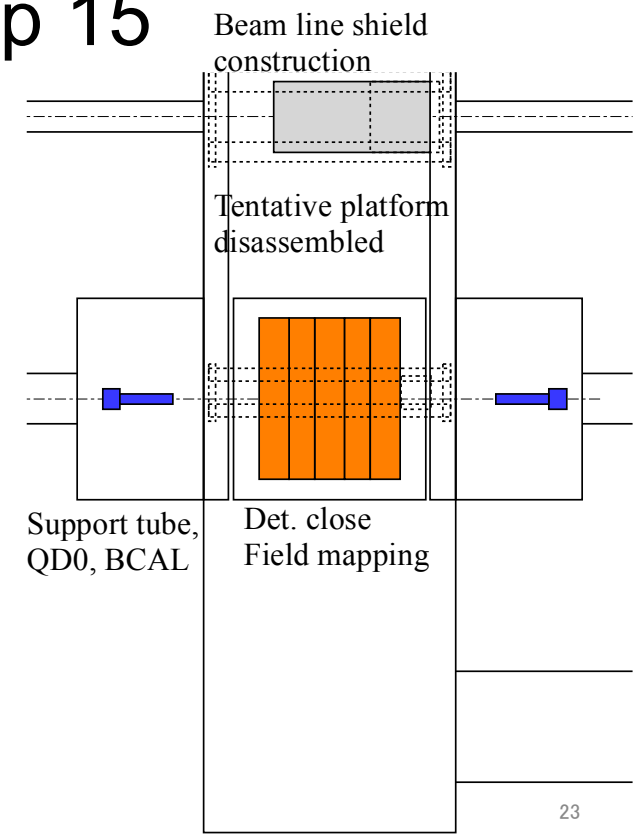
- Barrel ECAL cabling in Area 1



ILD Installation Study (Preliminary)

Step 15

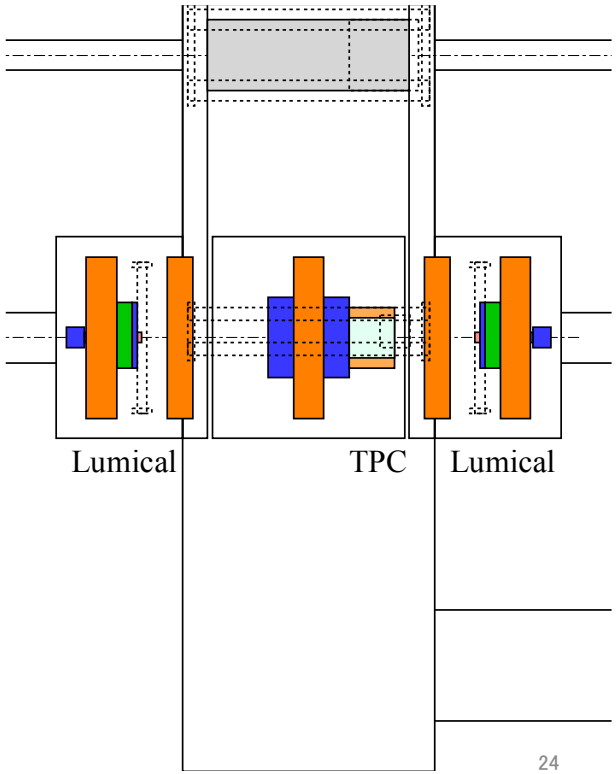
- Detector is closed and field mapping is performed
- QD0 support tubes assembly in Area 2/3
- QD0 and BCAL installation/cabling in Area 2/3
- After removing the tentative platform in Area 4, beam line shield is constructed



ILD Installation Study (Preliminary)

Step 16

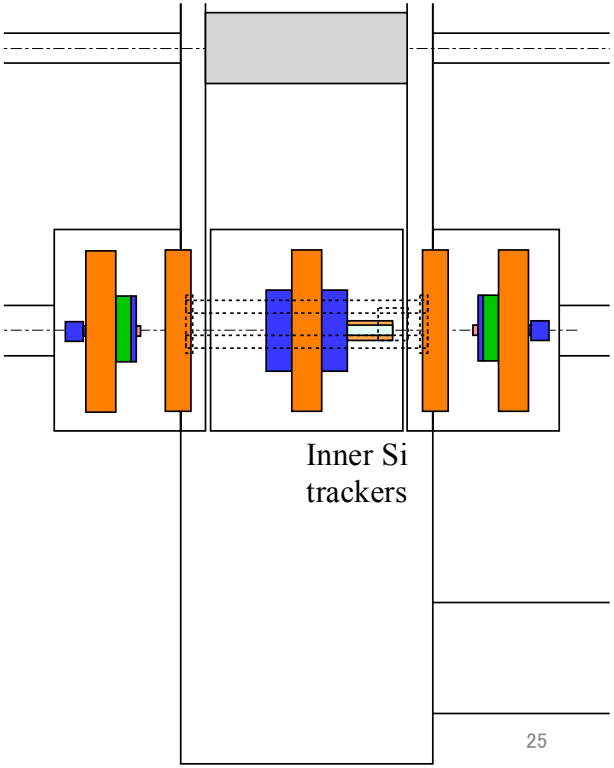
- Detector is opened again
- TPC installation in Area 1
- Lumical installation using 2.8 ton cranes in Area 2/3



ILD Installation Study (Preliminary)

Step 17

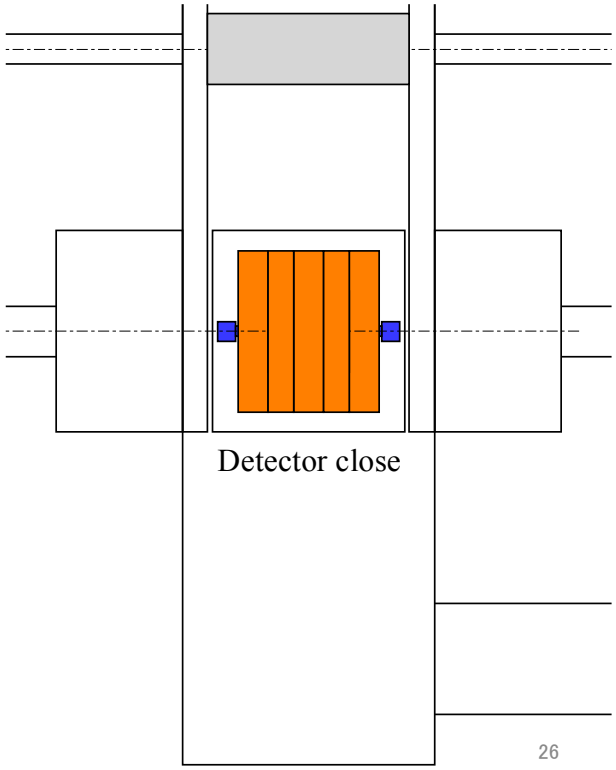
- Si inner trackers are installed in Area 1



ILD Installation Study (Preliminary)

Step 18

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



ILD Installation Study (Preliminary)

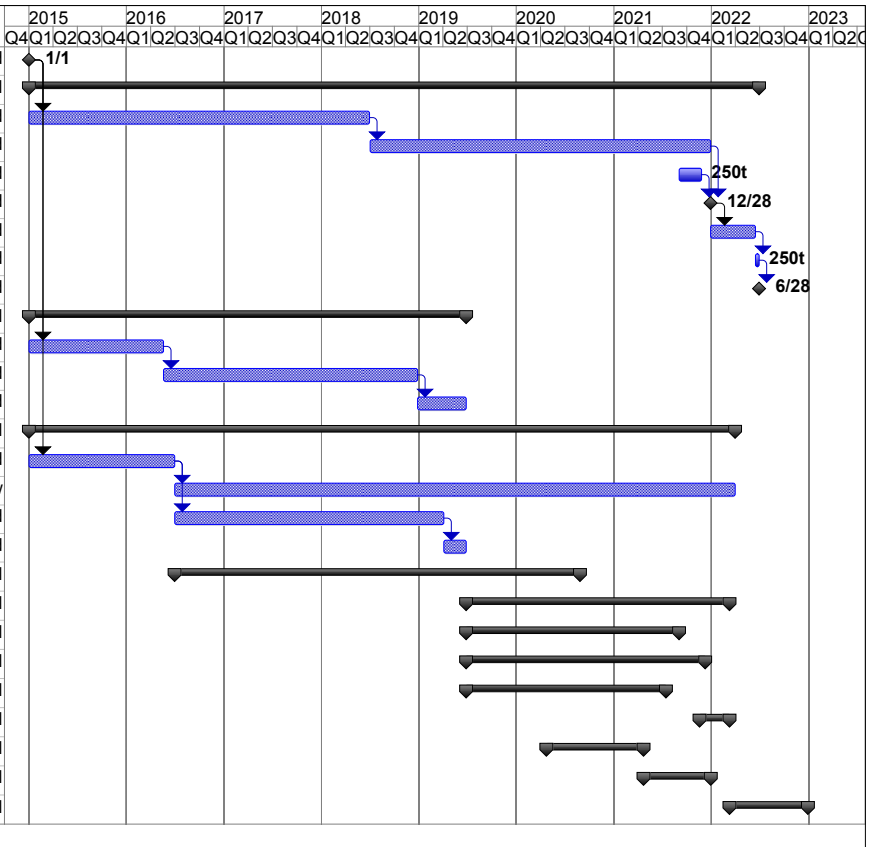
- Installation studies are still work in process
- Cross-checks with 3D models are yet to be done
- Implications of common infrastructure use (access tunnel, cranes) not studied yet
    - Might need buffer space

- Clearly: installation of ILD in the mountain site hall is a challenge!

ILD Time Line Study (Mountain Sites)

Y. Sugimoto

ID	Name	Duration
1	Ground breaking	0d
2	**Beam lines construction**	**1954d**
3	Tunnel	912d
4	Beamline harware install	912d
5	Beam line shield	60d
6	Start of beam commissioning	0d
7	BDS pre-commissioning	120d
8	Shield removal	10d
9	BDS ready for detectors	0d
10	**Experimental Hall**	**1170d**
11	Access tunnel	360d
12	Cavern	680d
13	Services	130d
14	**Detector construction on surface**	**1890d**
15	Surface assembly hall	390d
16	Detector assembly on surface	300w
17	Solenoid construction	720d
18	Solenoid surface test	60d
19	**Yoke pre-assembly**	**1085d**
25	**Detector assembly in cavern**	**705d**
26	**Yoke assembly**	**570d**
38	**Solenoid**	**640d**
49	**Barreal detectors**	**535d**
64	**Barrel inner detectors**	**80d**
67	**Endcap detectors**	**260d**
76	**QD0/FCALs install/cabling/test**	**180d**
82	**Commissioning**	**210d**



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

Questions

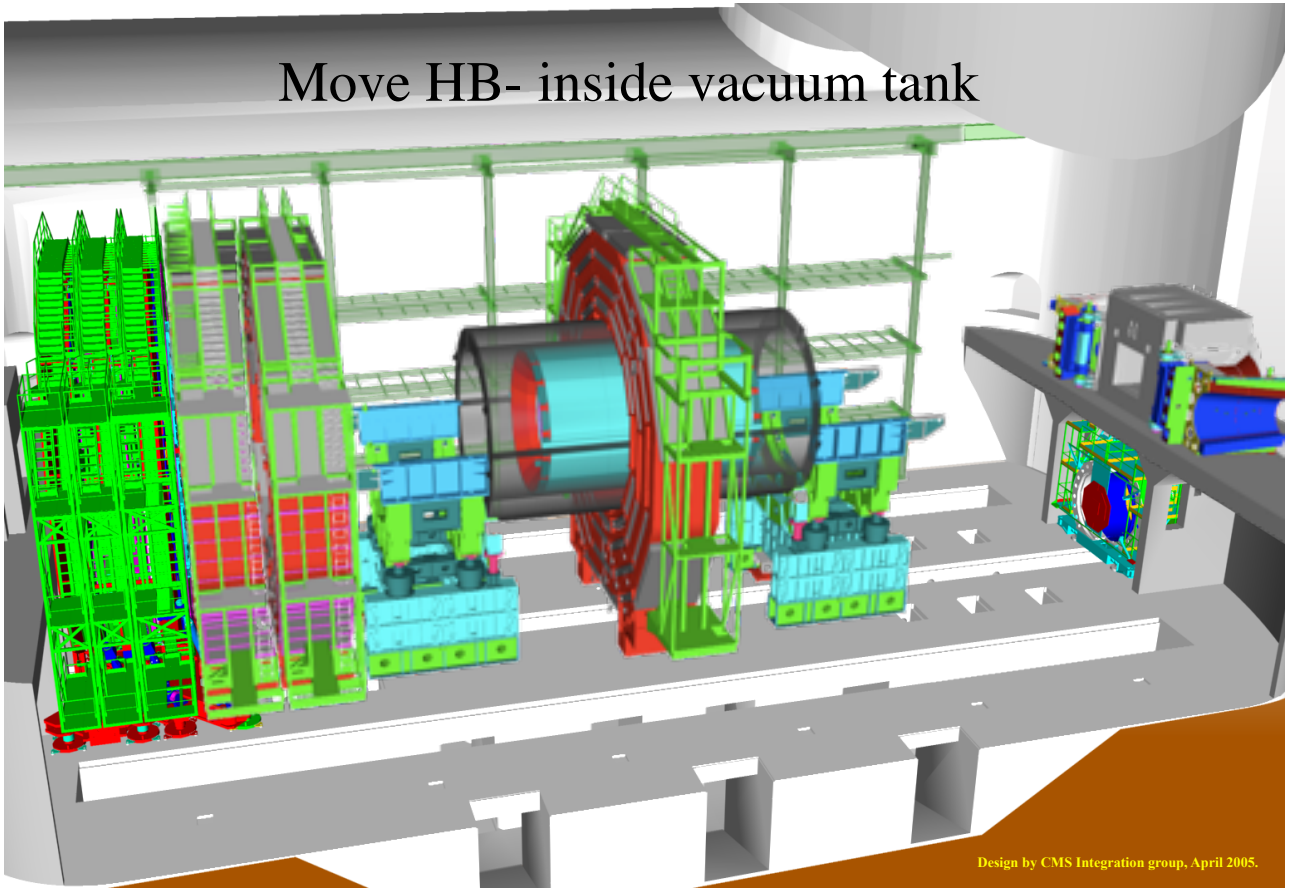
- Can we consider for today's discussion that the schedule as shown (in slides 2,3 and some explanatory text) to be TDR ready for "flat" sites?
- Can we make a corresponding schedule for a mountainous site with similar end dates and stages?
- Does this require a second detailed diagram schedule or can the differences be covered with text only? (This is to avoid detailed site dependencies)
- The same questions apply for the detector assembly and test schedules.

DISCUSSION

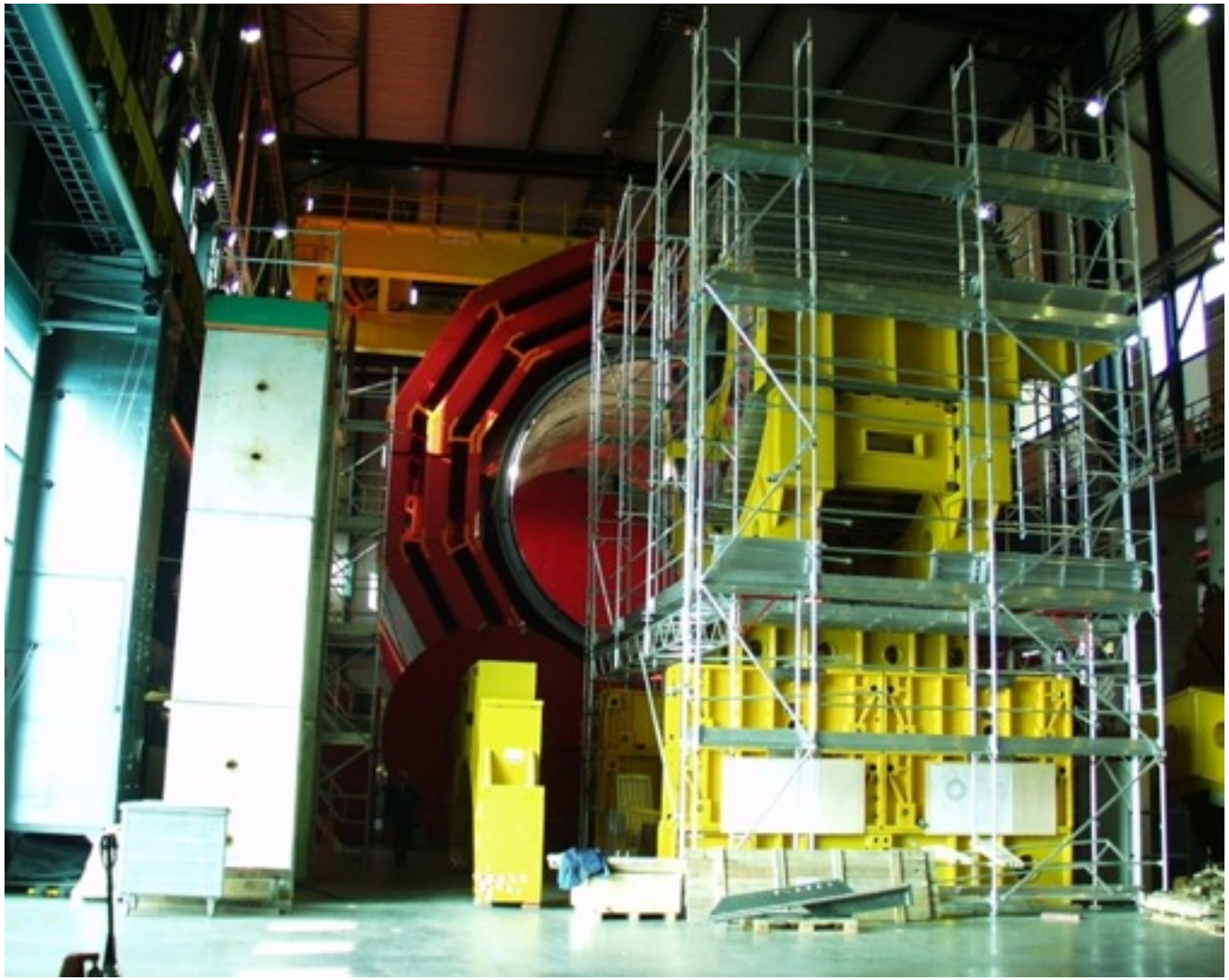
- The "flat" site schedule can be generic as it assumes location of shafts as fixed and that TBM's are used for most tunnel construction.
- For "mountain" sites the location of access tunnels are optimized for local geography and therefore site dependent. It is assumed that with the flexibility of NATM tunneling and the larger tunnels, that the overall civil construction schedules are very similar. We need some text explaining this!
- Schedule for civil construction of IR hall, associated alcoves and tunnels, and the assembly of the detectors can be comparable for flat and mountain sites. Ref Sugimoto at KILC 12, April 25

- If the above statements are all valid, then the durations of the different activity stages may be somewhat site dependent, but the overall schedule should be the same.
- Can we make this statement in the final TDR?

CMS Assembly - Tooling



CMS Surface Assembly Hall



Summary and Outlook

- 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
- We need to understand better the implications of the common use of the infrastructures (e.g. the access tunnel) during the assembly of
  - ILD
  - SiD
  - Machine
- Started to write the DBD....