ILD - Assembly, Transportation, Hall Design

Personal Thoughts

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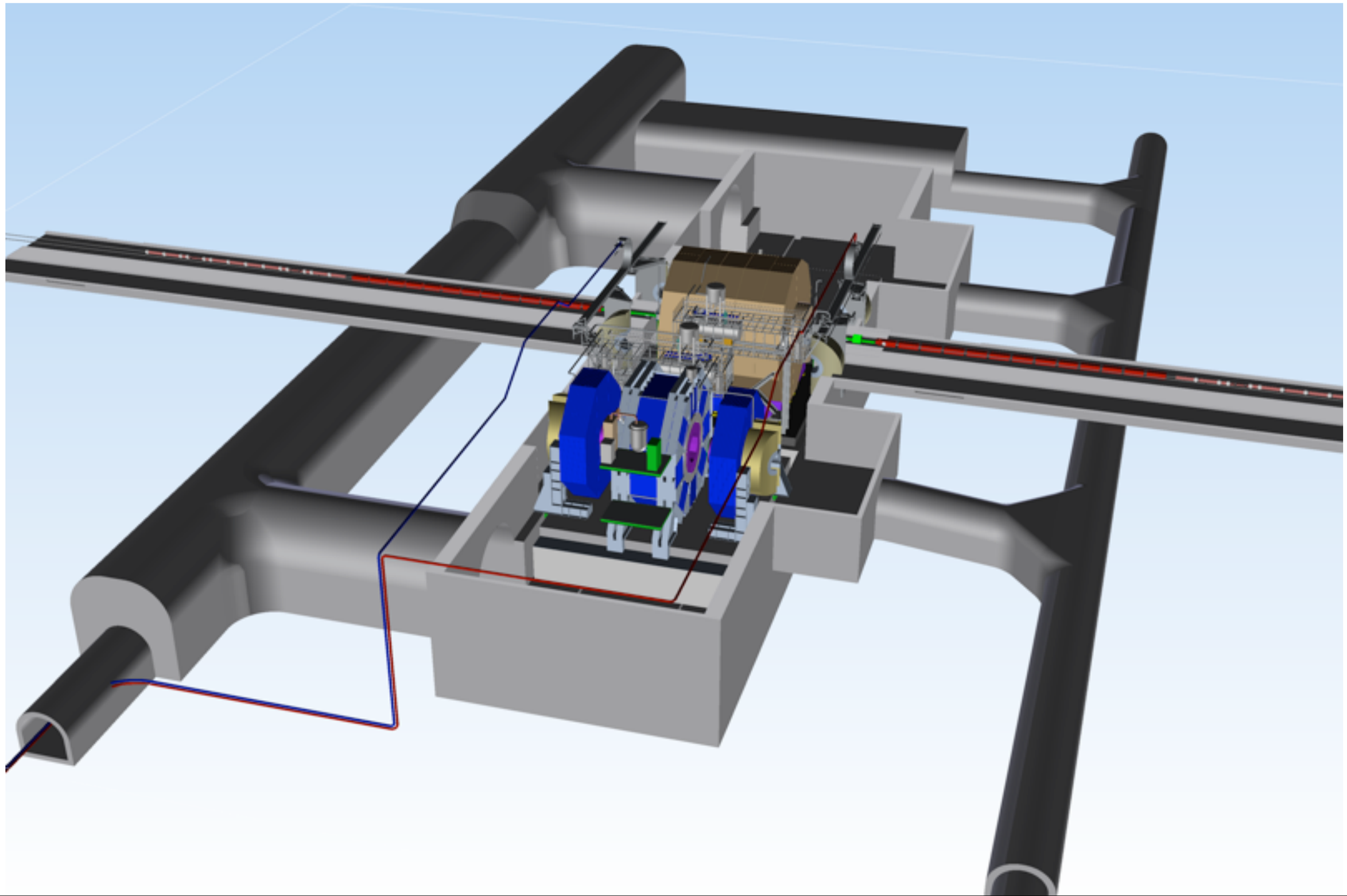
MDI WG Meeting

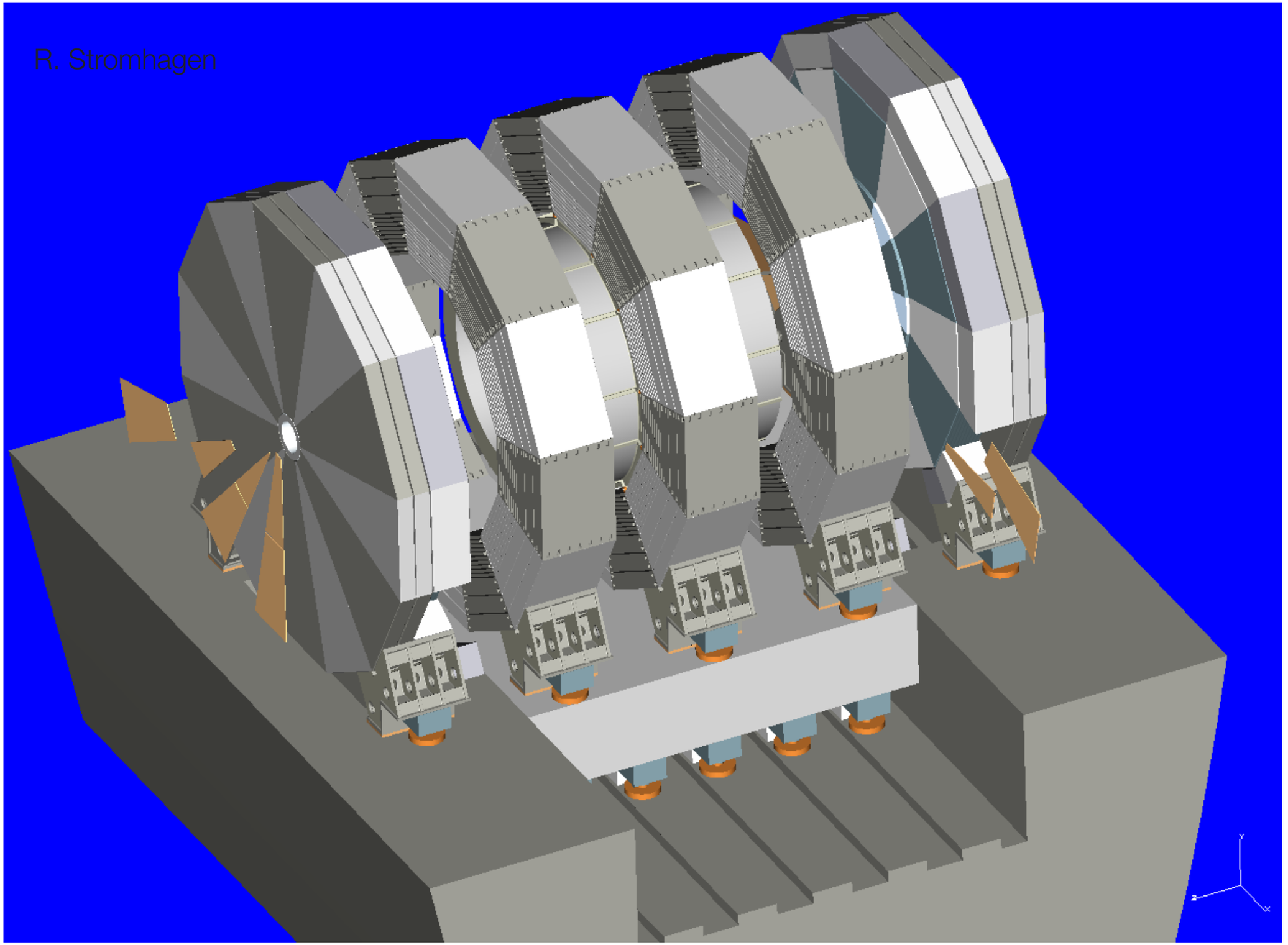
ILD in its Natural Environment...



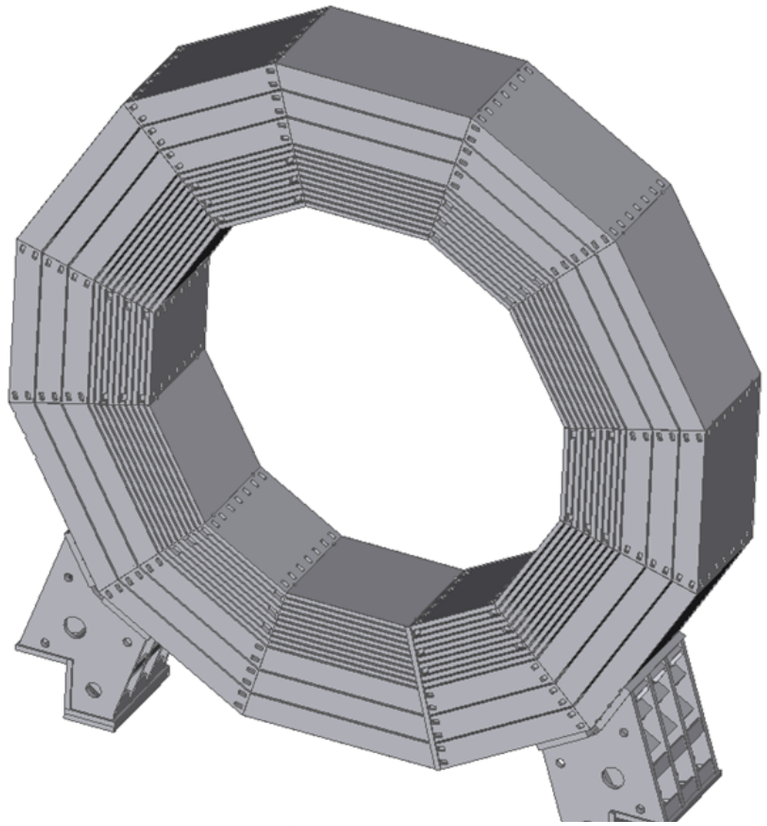
Baseline in TDR

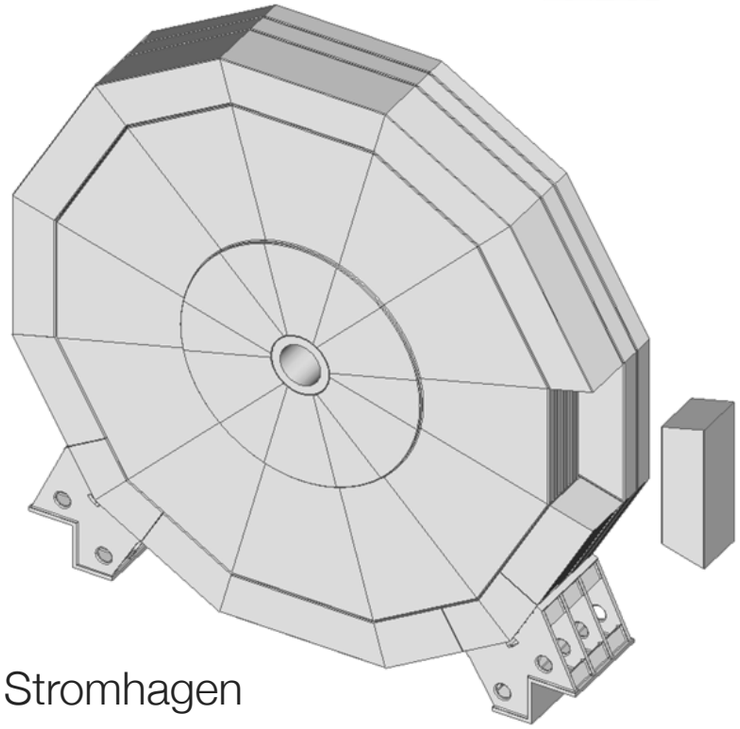
- When TDR was written, the site selection in Japan had not been done
- We assumed that VS cannot be done at all
  - partly to avoid giving arguments to the on-going process in Japan
  - VS excluded in Sefuri, but looks at least thinkable in Kitakami
- The selected Kitakami-site offers the chance to have a second look at the possible access to the underground hall. CFS group considers now:
  - 5 vertical shafts (5VS)
  - One horizontal tunnel for detectors (HT)
  - Hybrid solution (HT+VS)
- The boundary conditions for all solutions are not fully understood at this time
- It might well be that geological, financial, political or any other reasons that are beyond our studies will force a decision. In that case we will adapt.
- This should not stop us from looking at the best solution for both experiments.

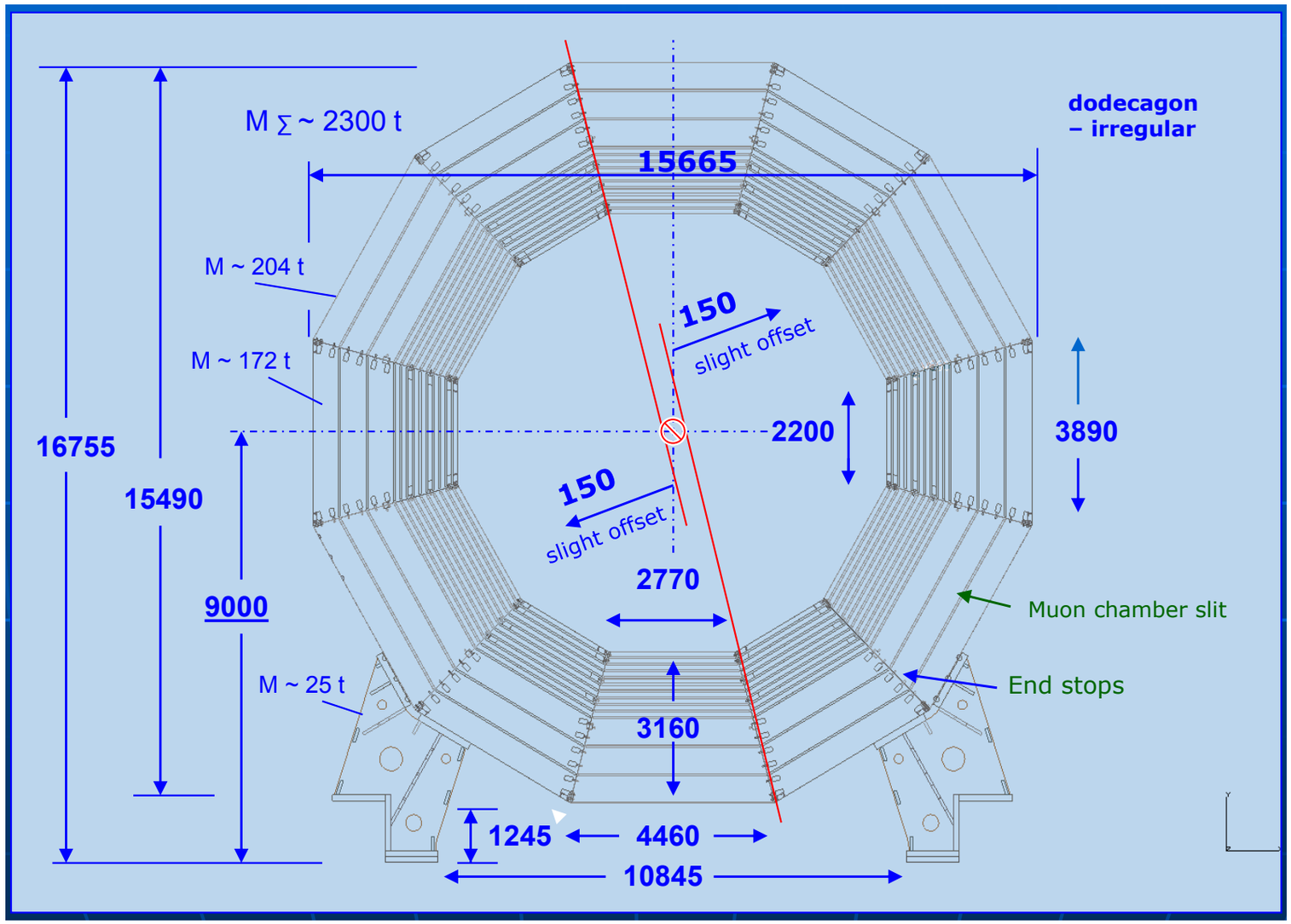
ILD Mechanical Design



Yoke

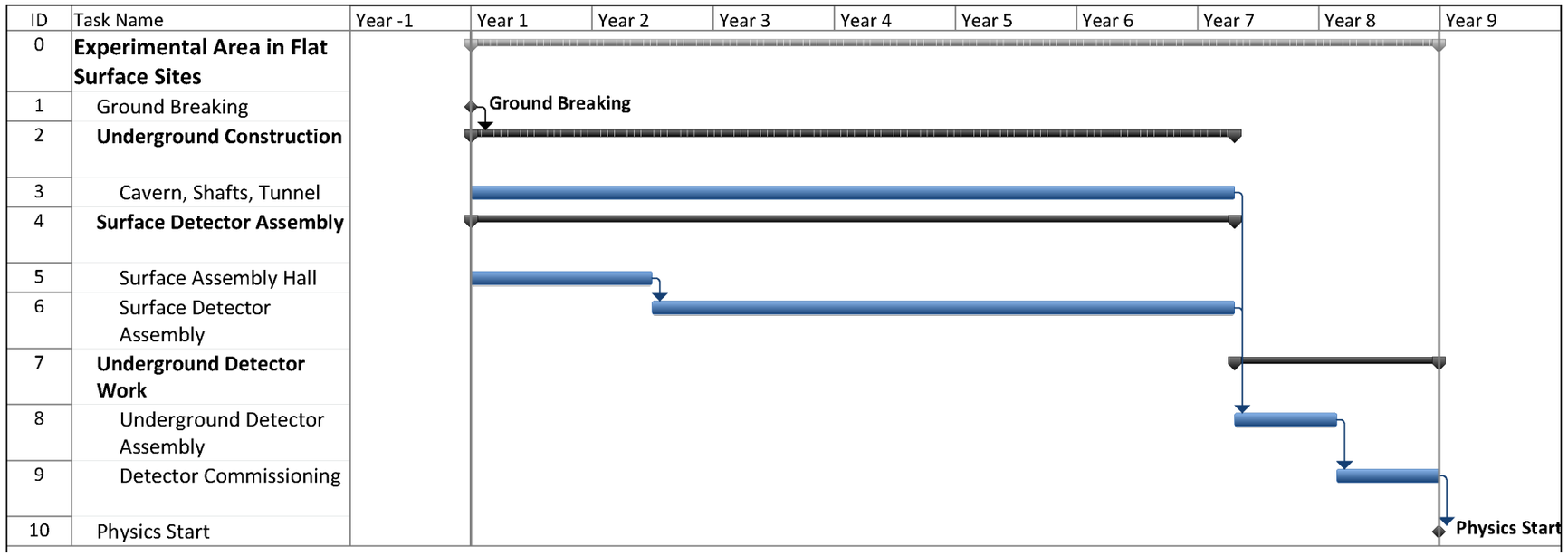


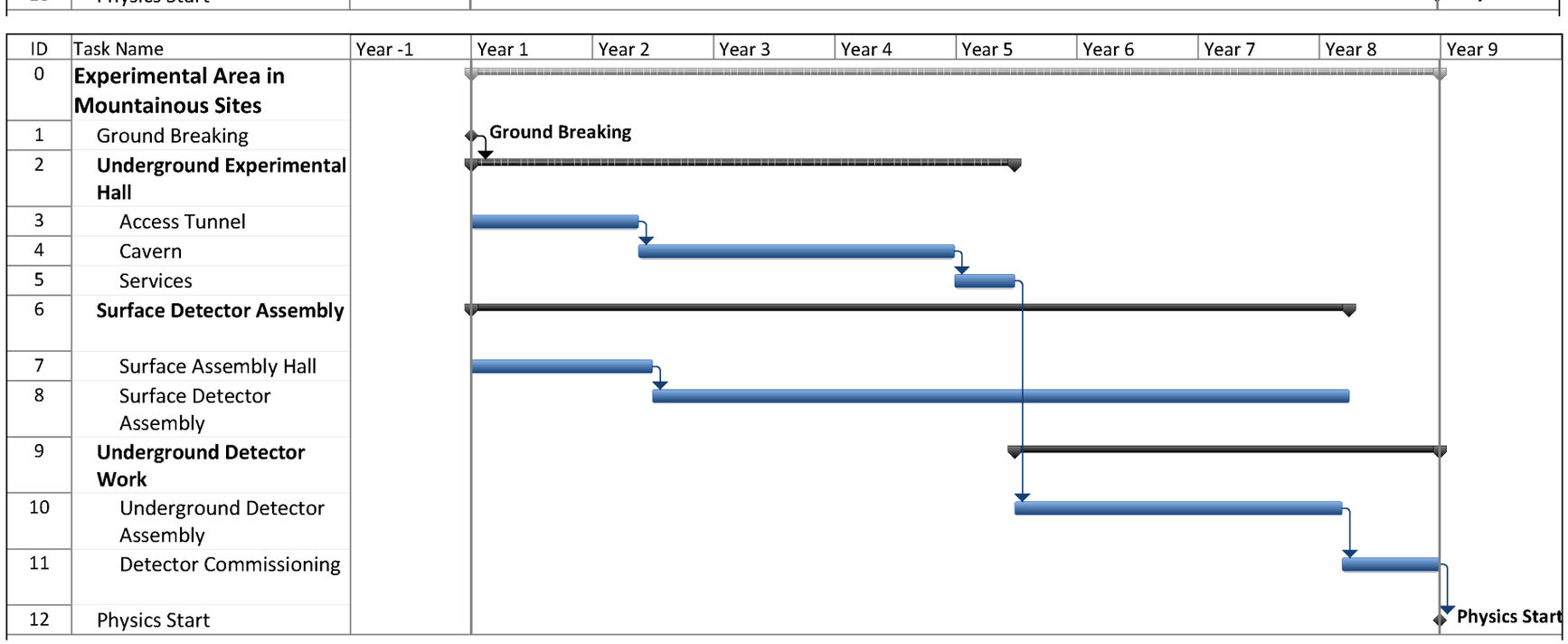




R. Stromhagen

ILD Installation Timelines



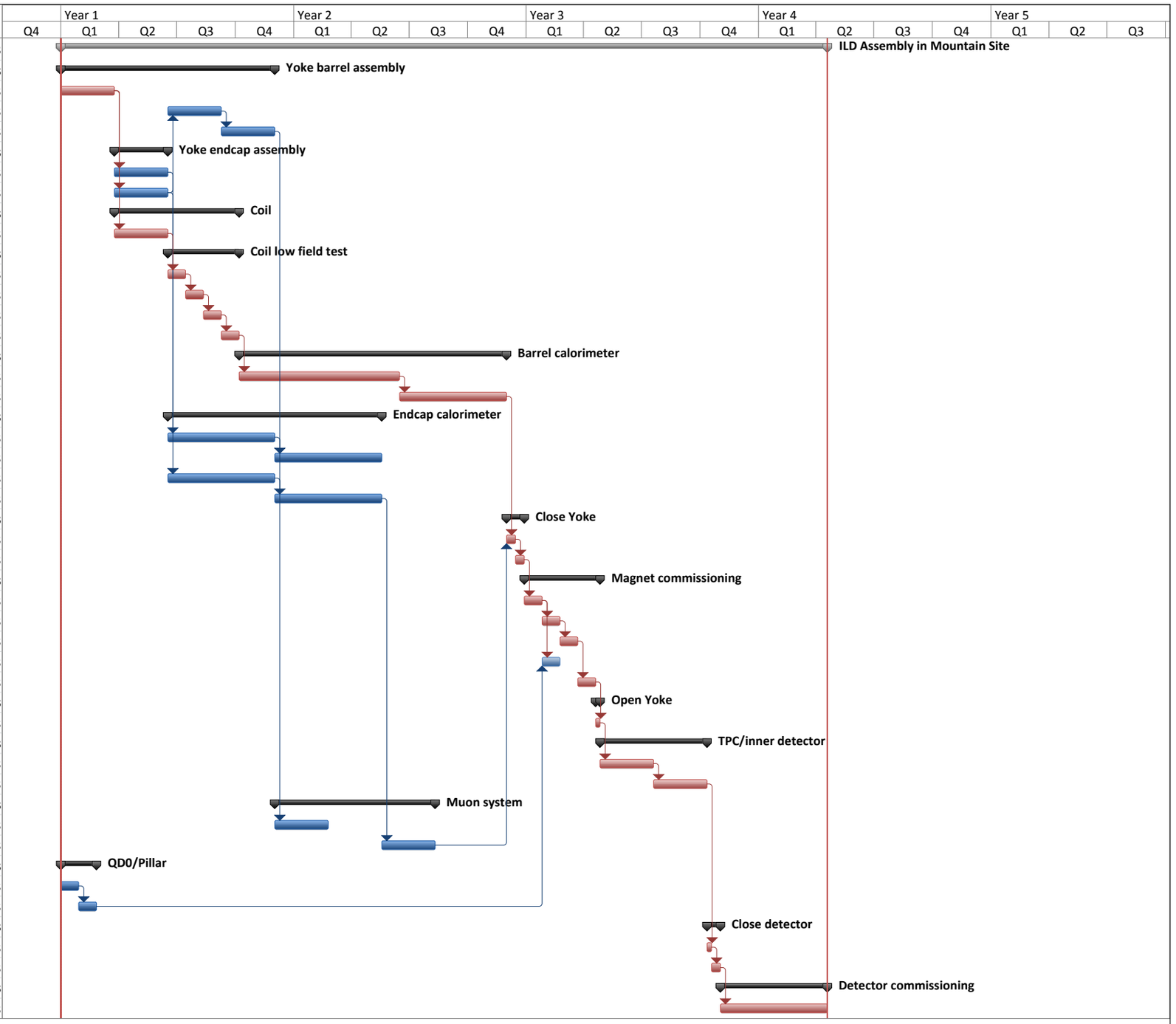


- Underground work VS: 1y assembly, ~1y commissioning
- Underground work HT: 3y+ assembly, ~1y commissioning

HT ILD Assembly

- Only underground work shown…

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

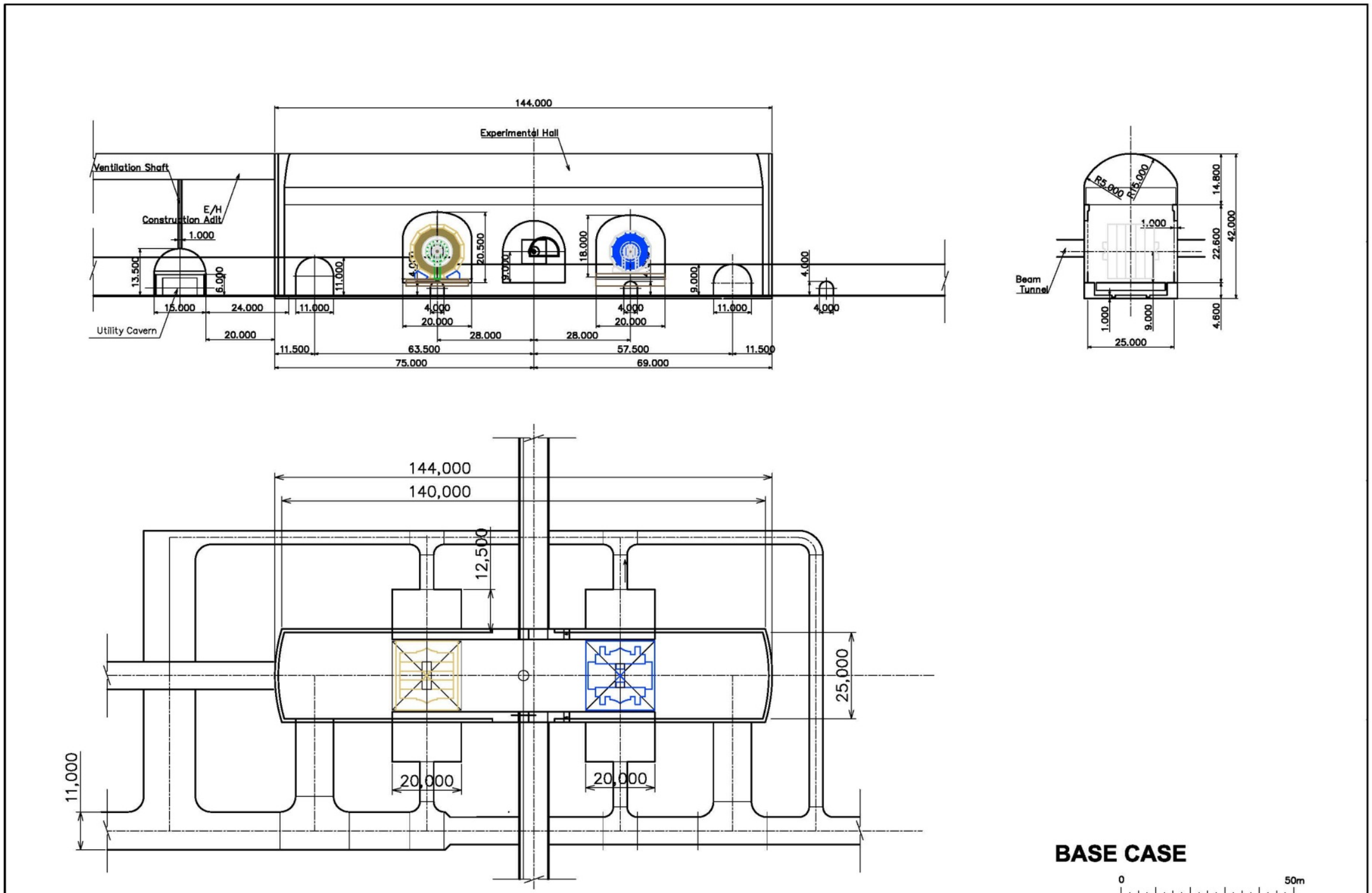


Biggest Parts: Yoke and Coil

- In each case: need to test the coil on site
- For high-field tests this requires the existence of a yoke
  - VS: yoke parts will be delivered from vendor to assembly hall
  - Yoke will be pre-assembled in assembly hall
  - Coil will be assembled from modules and then tested in yoke on surface
    - requires cryo installations on surface in-time

- HT: yoke needs to be pre-assembled somewhere (surface hall or at vendor)
- Yoke parts need to be transported through HT
- Yoke rings will be assembled in underground hall
- Coil will be assembled from modules in underground hall and then tested in yoke
  - requires cryo installations in underground hall in-time
- If anything does not work as predicted, it needs to be transported back to the surface for modification

HT Hall Design



Liniar Colider Collaboration **ASIA REGION**	**ASIAN ILC BASIS OF COST** **DETECTOR HALL - PLAN & SECTIONS**	KEK	**DRAWING NO.** U - 41 **SCALE** 1/1000	**REVISION** **DATE** 30 Nov. 2012

HT Design for ILD

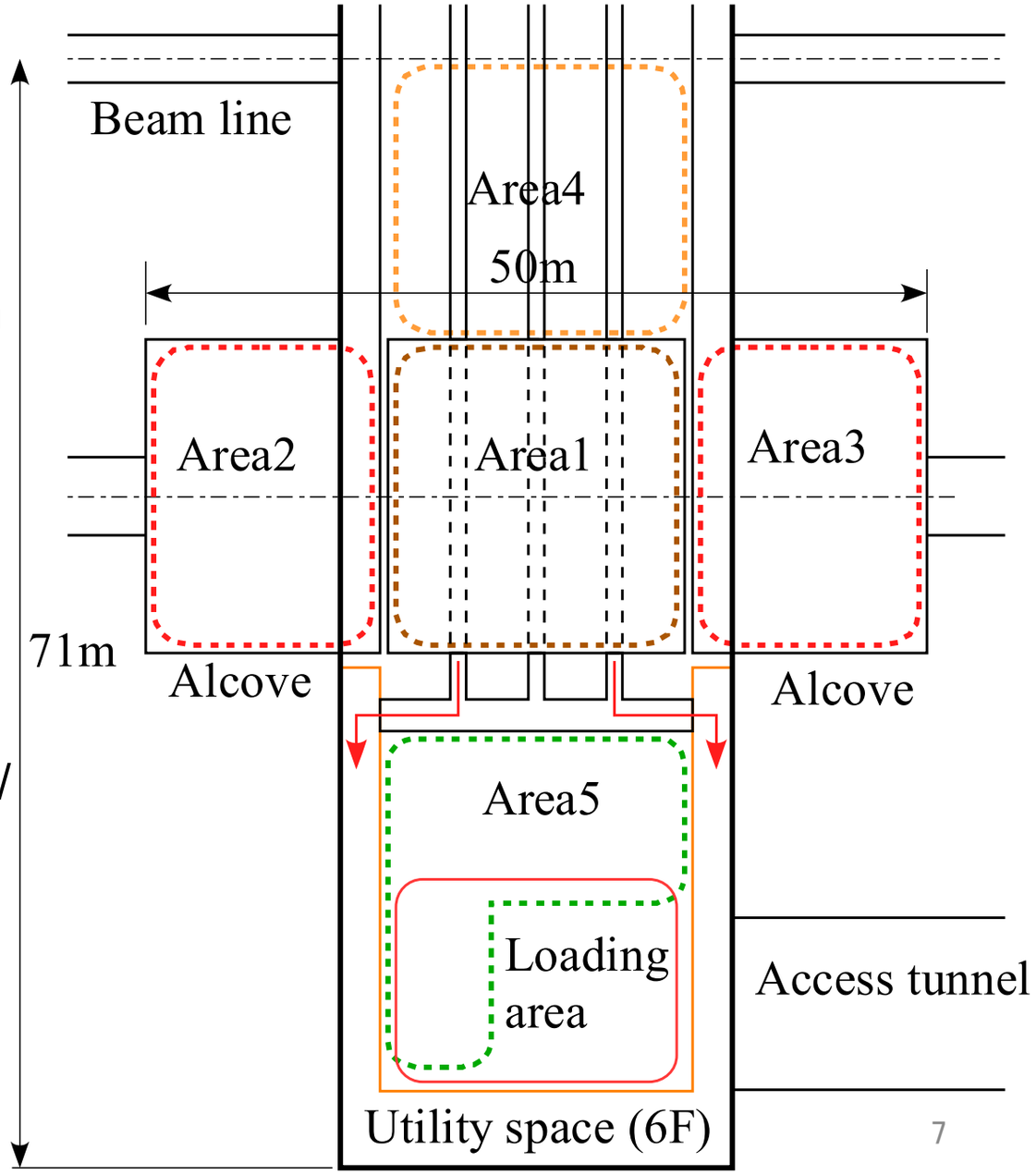
- Floor space is probably ok
  - detailed assembly study still pending
- 250t crane coverage needed along main hall (second 250t crane for SiD)
- some crane coverage in alcoves
- crane hook height needed is defined by:
  - detector height: 17m above platform
  - yoke segment height: 3.5m
  - tools, traverse, etc: 2m
  - in current design: 22.6m, so just ok
- Cryogenics infrastructure needed right after underground hall has been handed over to detector collaborations

ILD Installation Study (Preliminary)

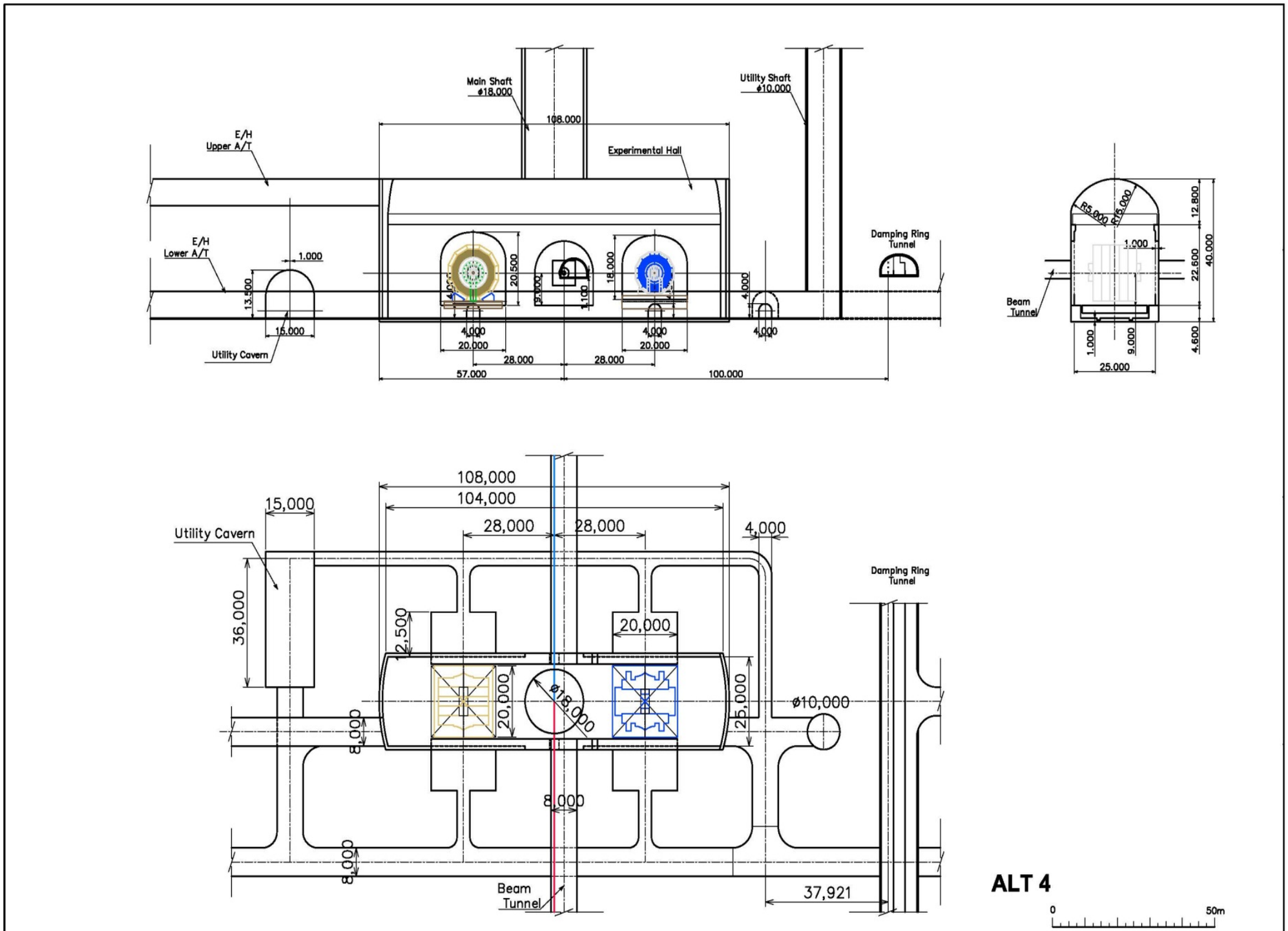
Detector assembly area

Y. Sugimoto

- 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



Hybrid HT+VS Hall Design



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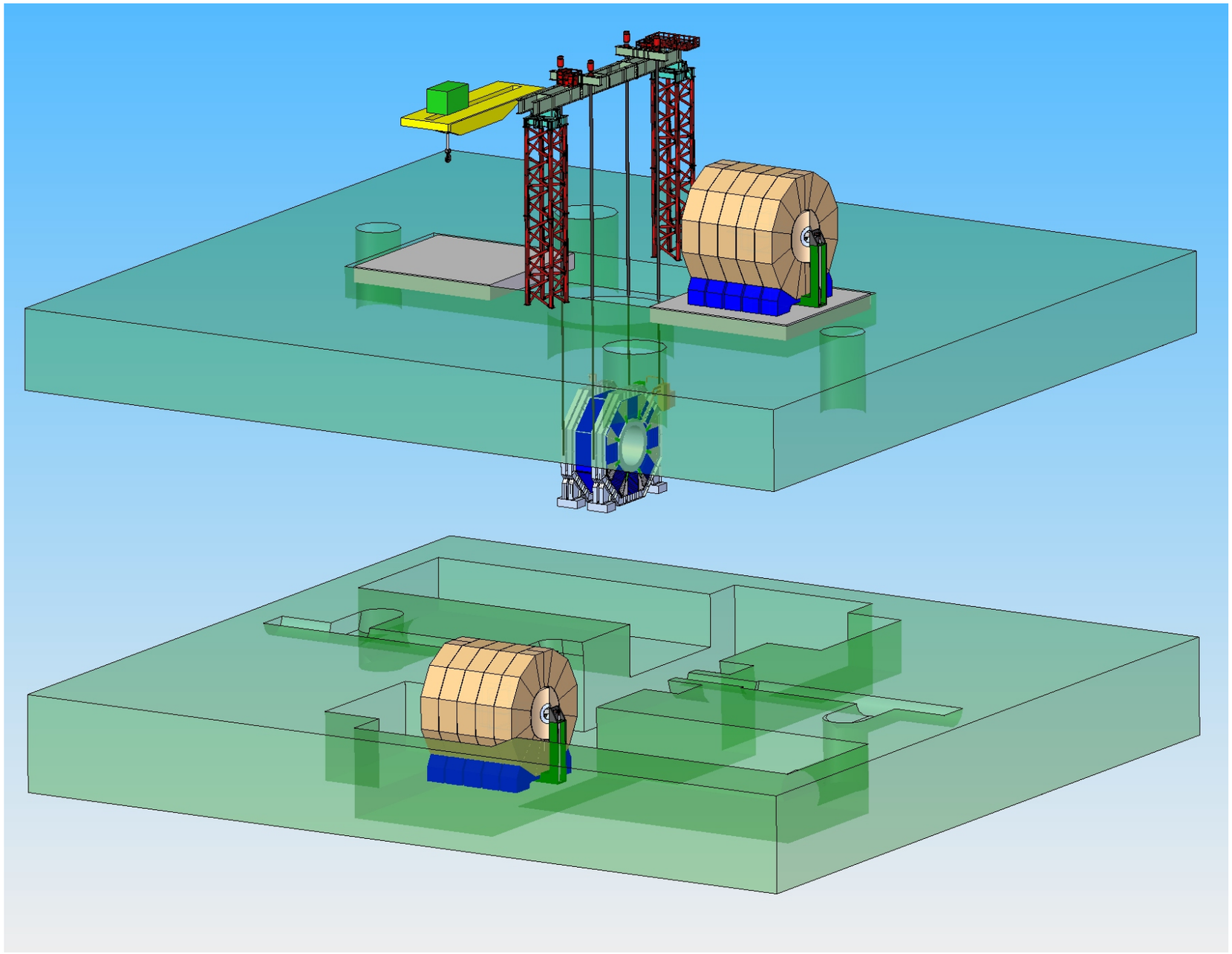
HT+VS Design for ILD

- Floor space is probably ok
  - detailed assembly study still pending, but much easier than at HT
- 2x40t crane coverage along main hall
- some crane coverage in alcoves
- crane hook height needed is defined by:
  - detector height: 17m above platform
  - some height above detector: 2m
  - in current design: 22.6m, so could be reduced
- Cryogenics infrastructure needed later

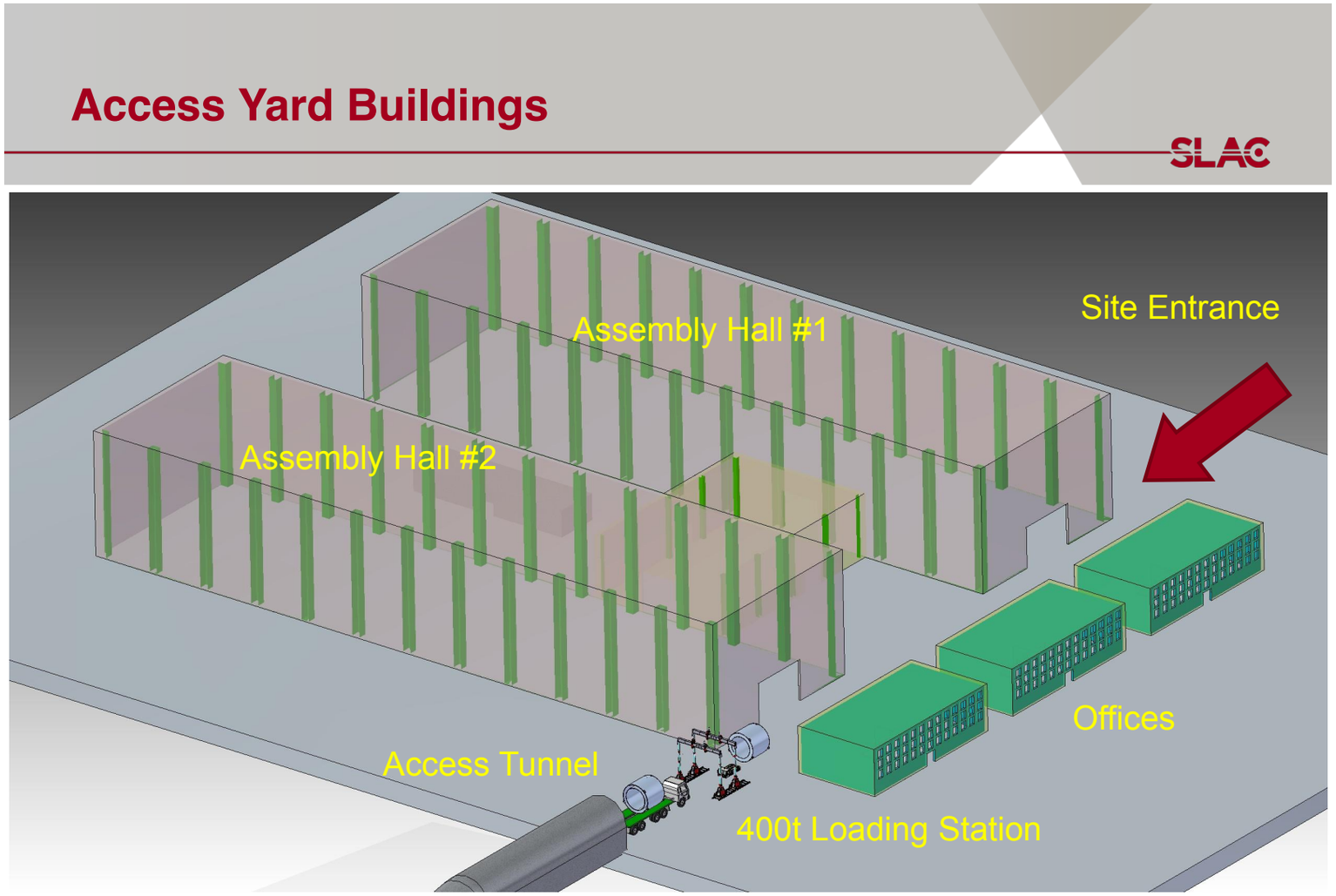
Surface Installations VS

- Need temporary gantry crane for ~3500t
- 250t hall crane in surface hall, extends over shaft (plus one for SiD)
- Surface hall needs one platform
  - SiD will be constructed on it
  - ILD parts can be moved on platform after SiD has been lowered
- Alignment of surface halls and underground hall is coupled by VS



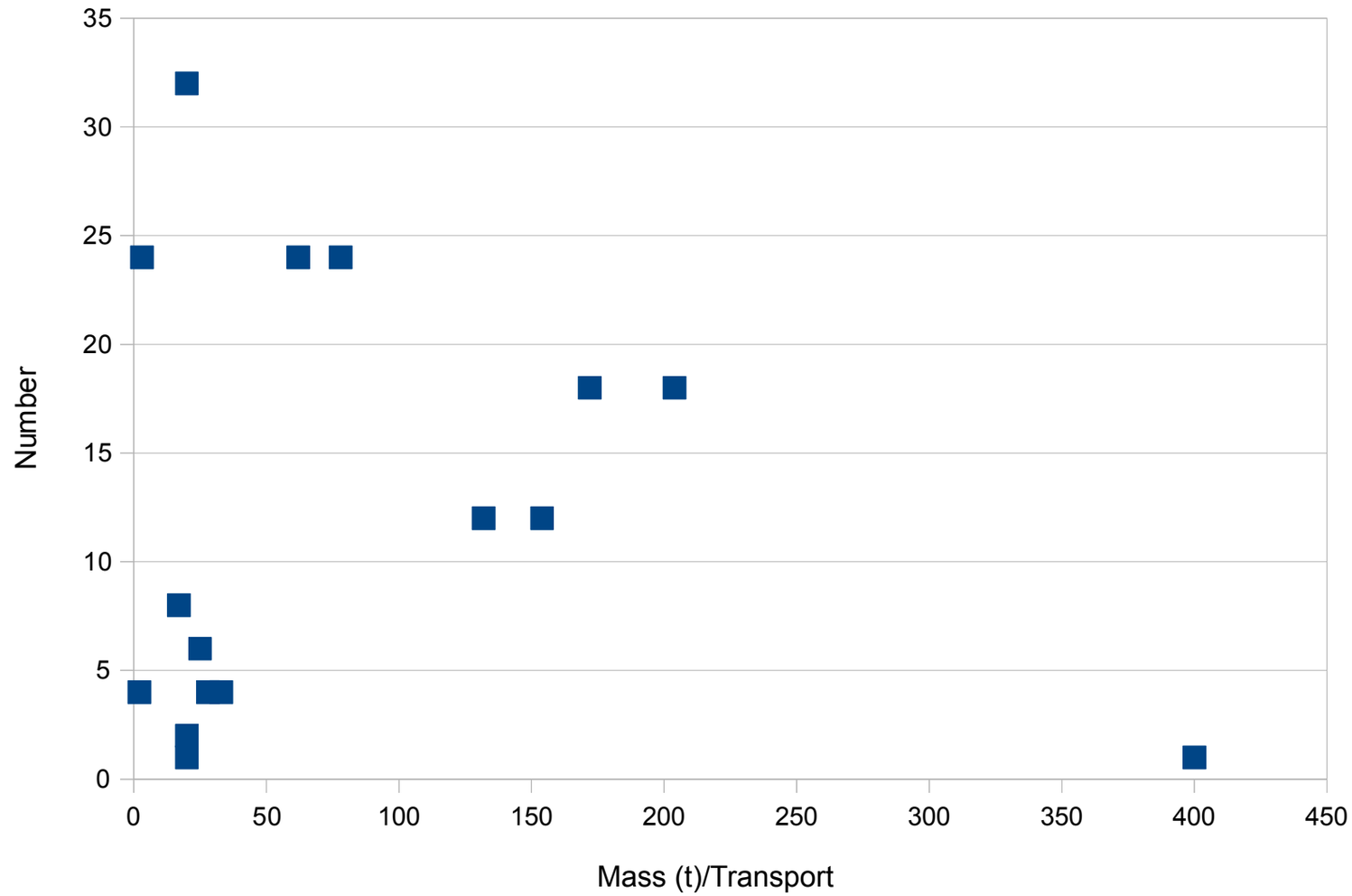
Surface Installations HT

- Size of surface halls probably similar to VS case
  - height could be reduced if yoke has been pre-assembled at vendor
  - storage (buffer) space
- 250t crane needed in surface hall (plus one for SiD)
  - handling of yoke elements
  - handling of coil elements
  - loading of detector parts on tunnel transportation system
- 2x20t crane for subdetector assemblies
- If tunnel transportation system can be extended to outside, detector hall can be further away from tunnel portal (if needed)



Transportation Issues

- Only for detector elements:
  - ~200 heavy weight transports
  - 61 transports with more than 100t
- Plus:
  - toolings, etc.
  - services
  - ...

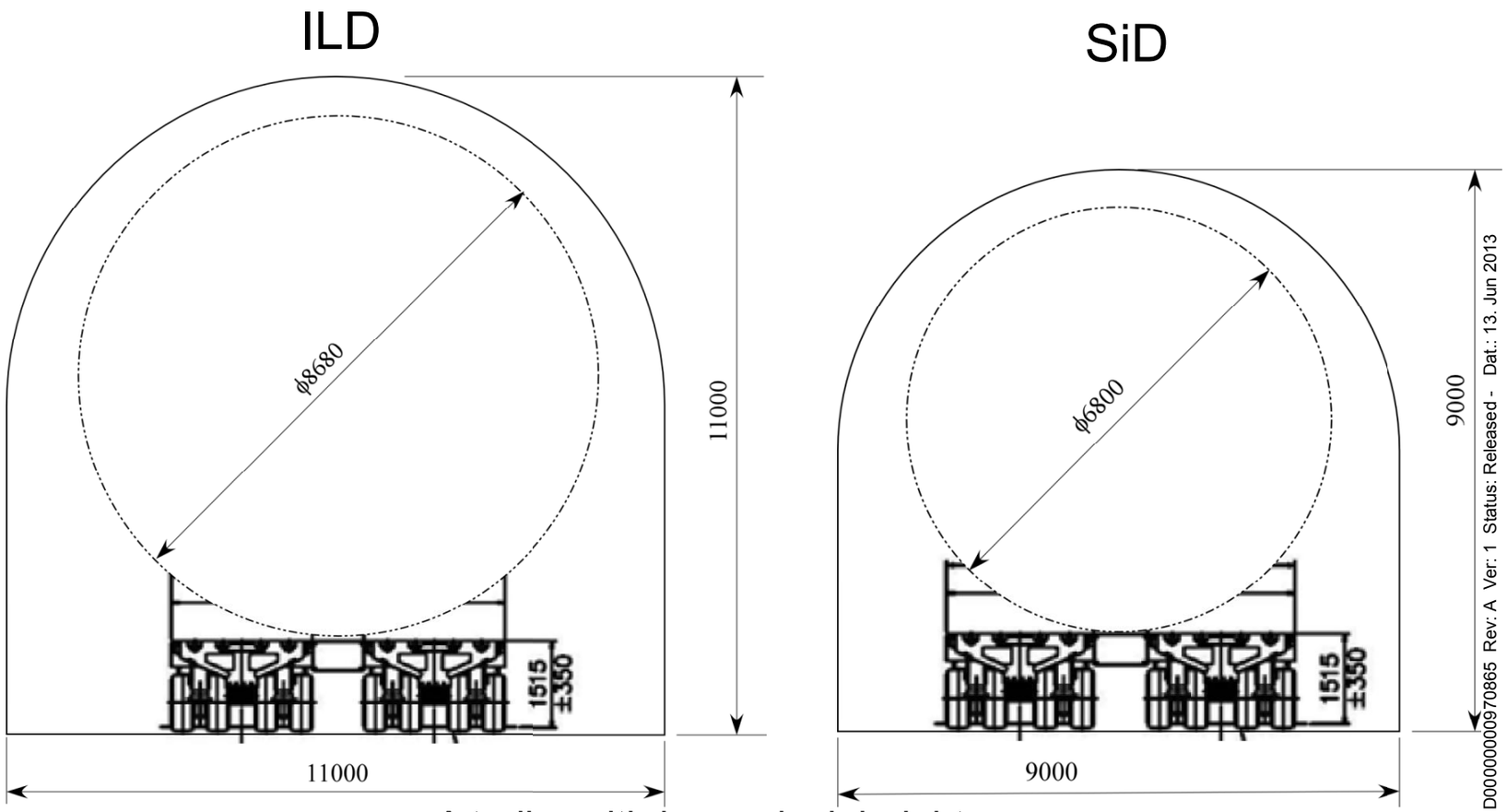


- Important:
  - What can be built on-site (on surface)?
  - What needs to be built in factories far away?

Tunnel diameter

- Early study (Y. Sugimoto), but 11m for HT and 9m for HT+VS seems reasonable if SiD choses not to use VS at all.

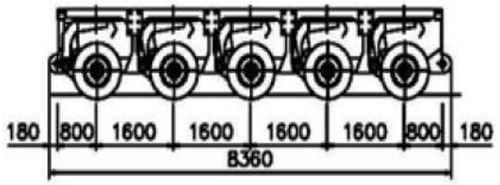
Access tunnel



A trailer with lower deck height would reduce the tunnel size

Tunnel Transportation System

- Is this a realistic solution?

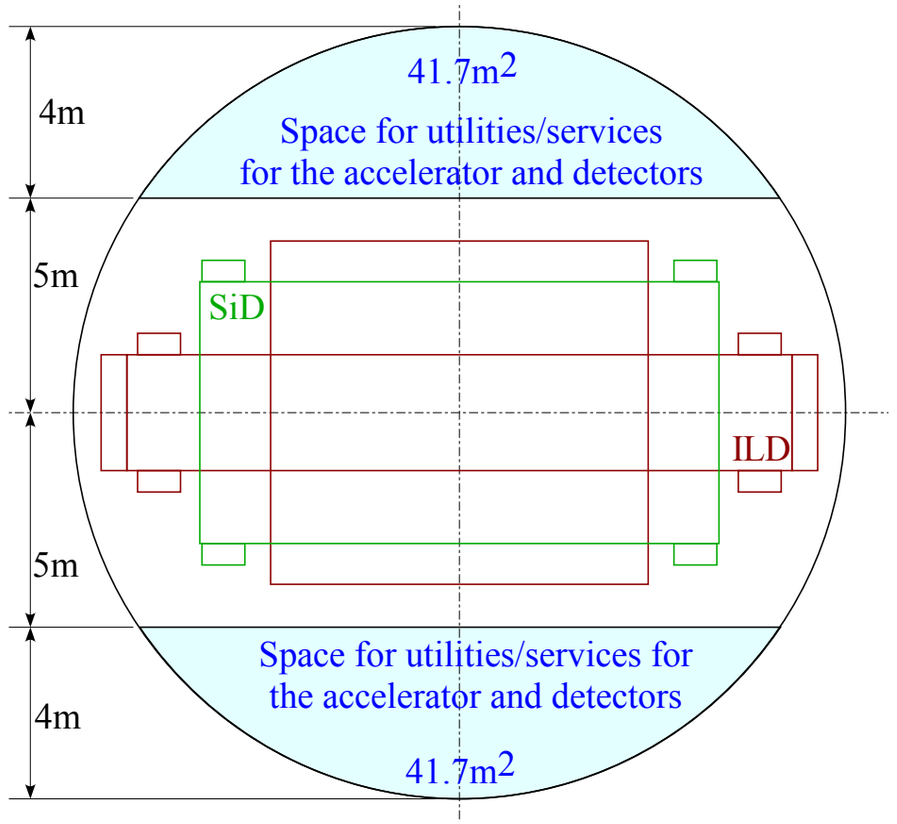


- 225t/5axles → 450t with 2-trailers
- Capable of ~7% slope

- What about safety (brake failures, etc.)? Maybe need cog rail? Or hoists?
- If HT is a serious option, this needs to be worked on.

Service Paths

- How much space is needed for service paths into the central region?
  - Study from Nikken-sekkei: 10m (78,5m^2) shaft would accommodate elevator plus all services for accelerator (cooling, air ducts, cables, etc.)
  - Removing the elevator and adding detector services, this would mean that 10m tunnel diameter is already needed for services
- AFAIK this is not included in the current designs with two tunnels (HT for detector hall, second HT for damping rings)
- Preliminary study (Y. Sugimoto) shows that there is much space available for services in VS



Other aspects (odds and ends)

- HT+VS:
  - if machine commissioning is done w/o detectors, installation (QD0, shielding, instrumentation) can be delivered via VS directly to the IP
  - two independent access ways into the hall might provide more safety

- HT:
  - assembly halls don’t have to be at the tunnel portal provided the transportation system in the tunnel can be extended outside

- Both:
  - tunnel provides efficient access to the underground areas during operations. Most equipment needed for maintenance, repairs, etc. can be driven into the hall w/o the need of cranes, elevators, etc

Summary

- We support to study the possible realisation of a hybrid VS+HT access in the Kitakami area
- Cons:
  - Surface infrastructure potentially more complex: platform in assembly hall
  - Assembly halls are geographically fixed directly above the experimental hall
  - HT part might be compromised by not optimal paths
- Pros:
  - ILD assembly much easier with VS
  - Transportation system in HT is not defined and could be a major technical and safety headache; gantry crane for VS successfully done at CMS
  - More space available for machine and detector service lines
  - Less underground volume necessary
  - Smaller crane (2x40t) instead of 250t in underground hall
  - Time lines of both detector and machine installations are largely decoupled