

Experimental hall in Japanese mountain site

Y. Sugimoto

2012.4.25

@KILC2012

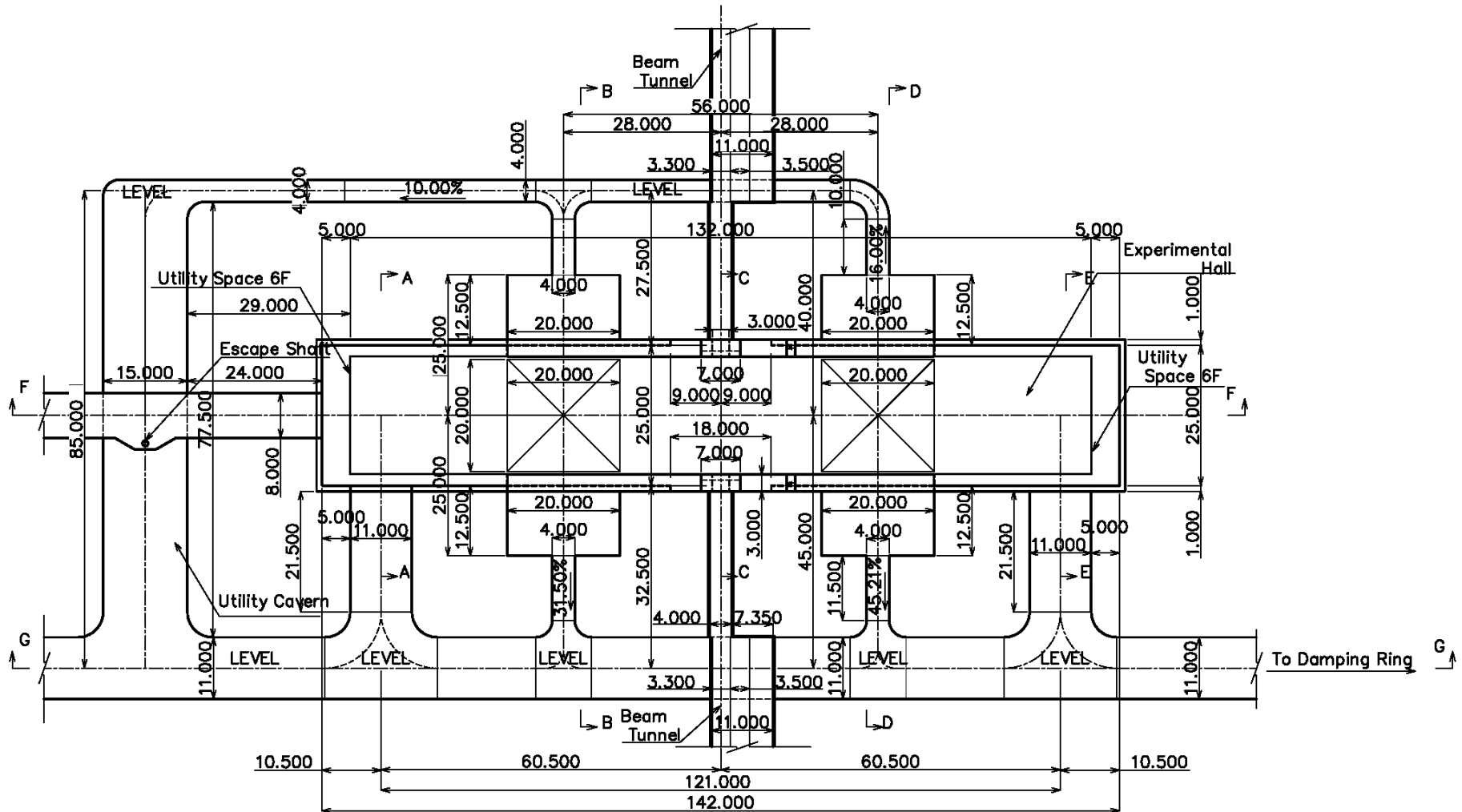
Outline

- Design criteria
- Underground detector assembly
 - Assembly area
 - Timeline
- Comparison with RDR design

Design criteria

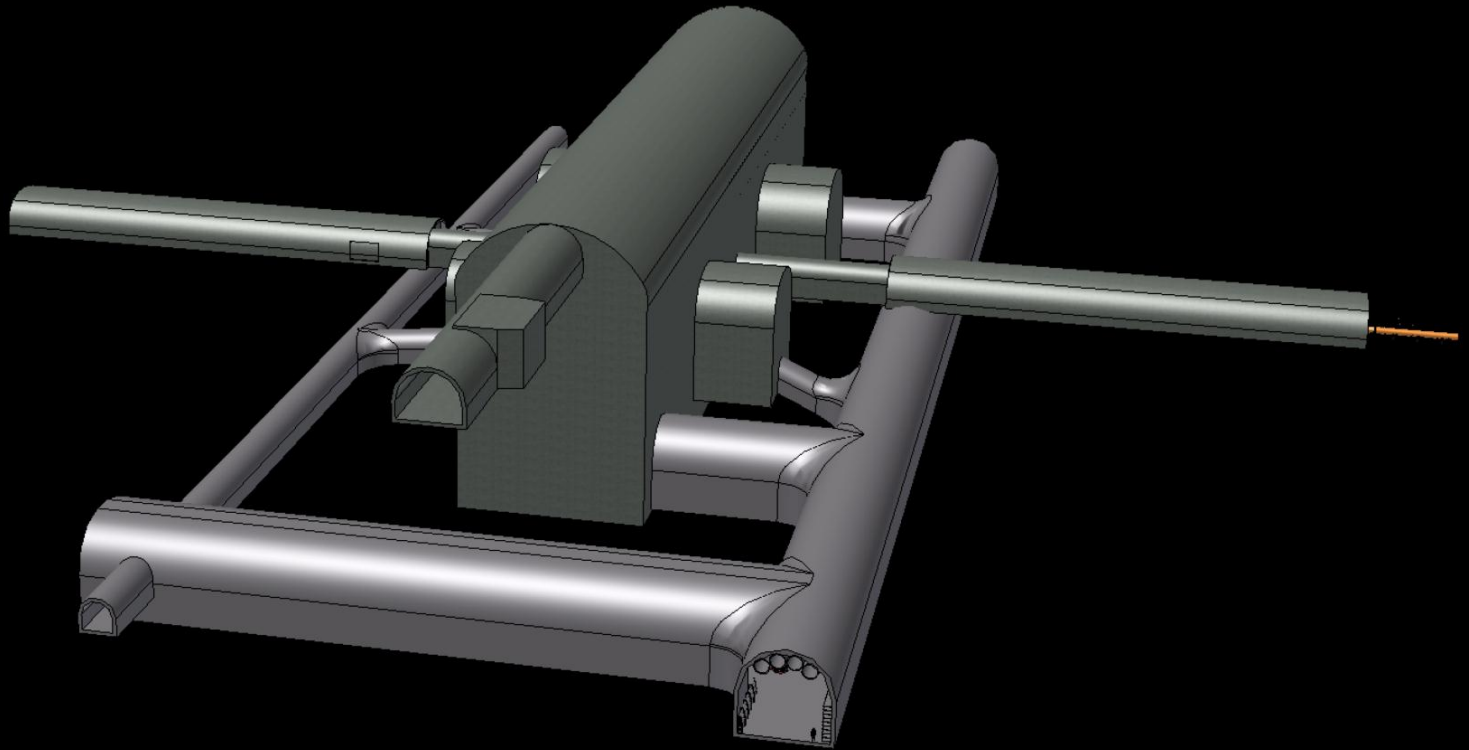
- Experimental hall in Japanese mountain site could be quite deep (>100m) → Horizontal access tunnel instead of vertical shafts
- Since “CMS style assembly” is not applicable, we need enough space in the cavern for detector assembly
- Enough size of alcoves is necessary for assembly and maintenance (opening) of detectors
- Good geology of granite allows bullet shape cavern rather than egg shape cavern
- Horizontal access tunnel should be large enough (~11m) in order to let large solenoids (ϕ ~8m) go through

Design shown at CFS BTR



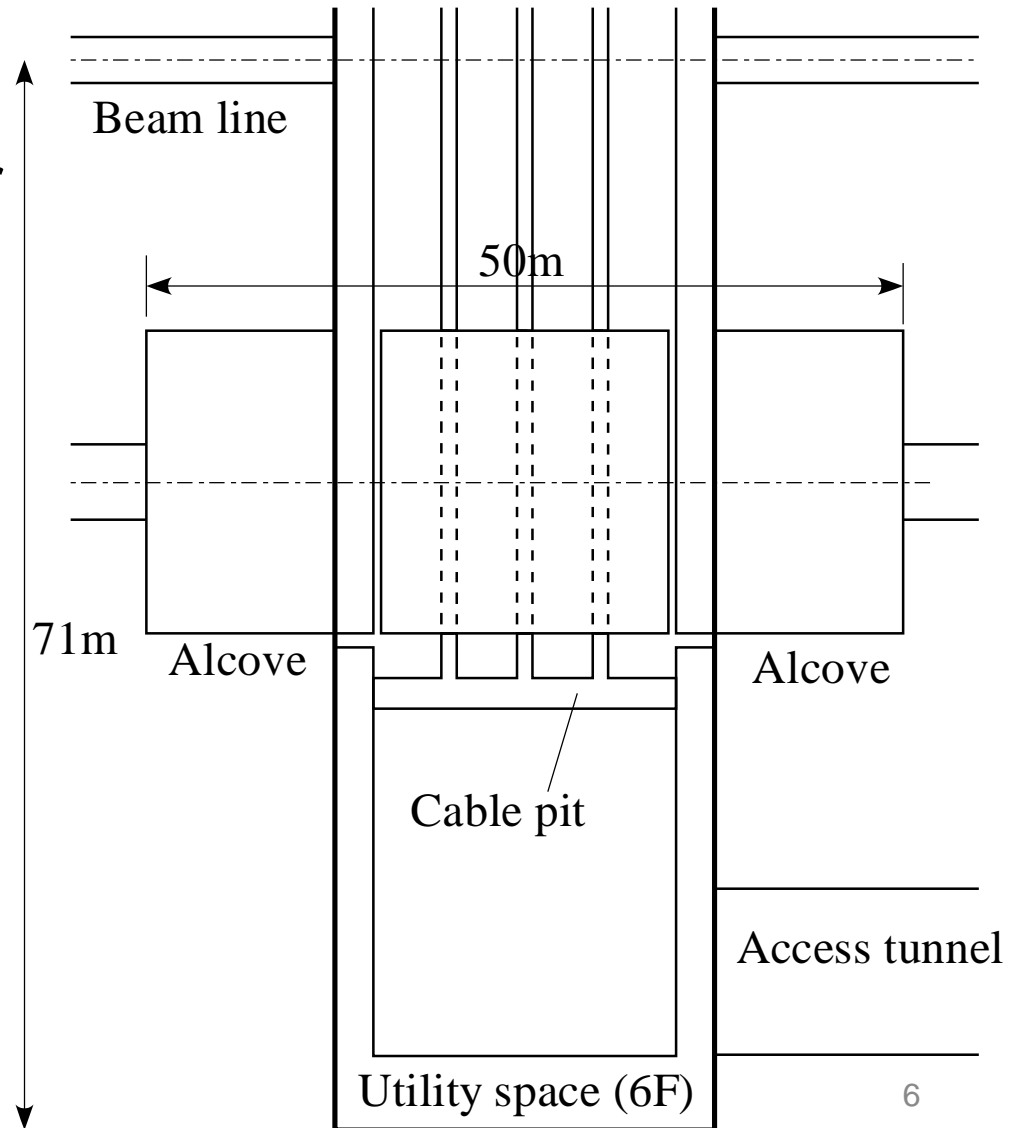
Plan

Design shown at CFS BTR



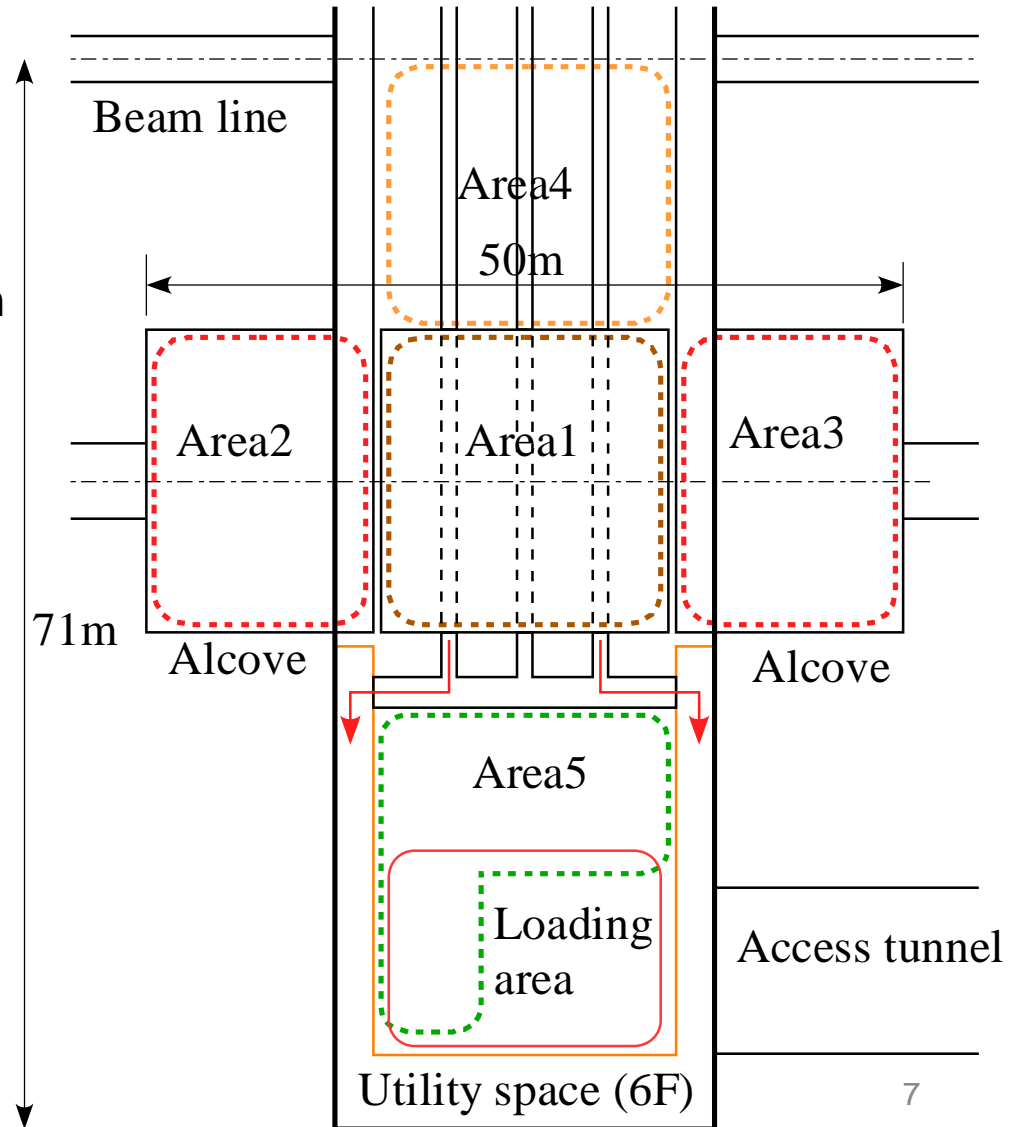
Underground detector assembly

- A possible detector assembly scenario for ILD has been drawn to see if the underground cavern area is large enough



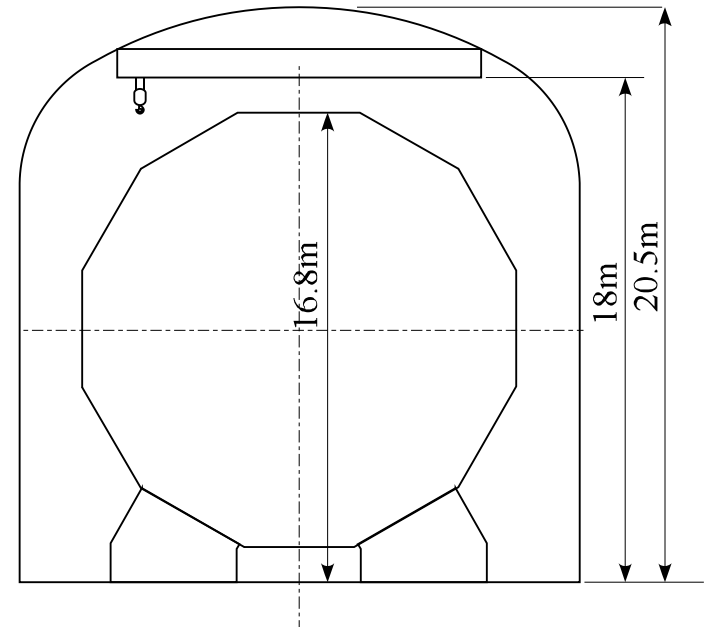
Detector assembly area

- 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



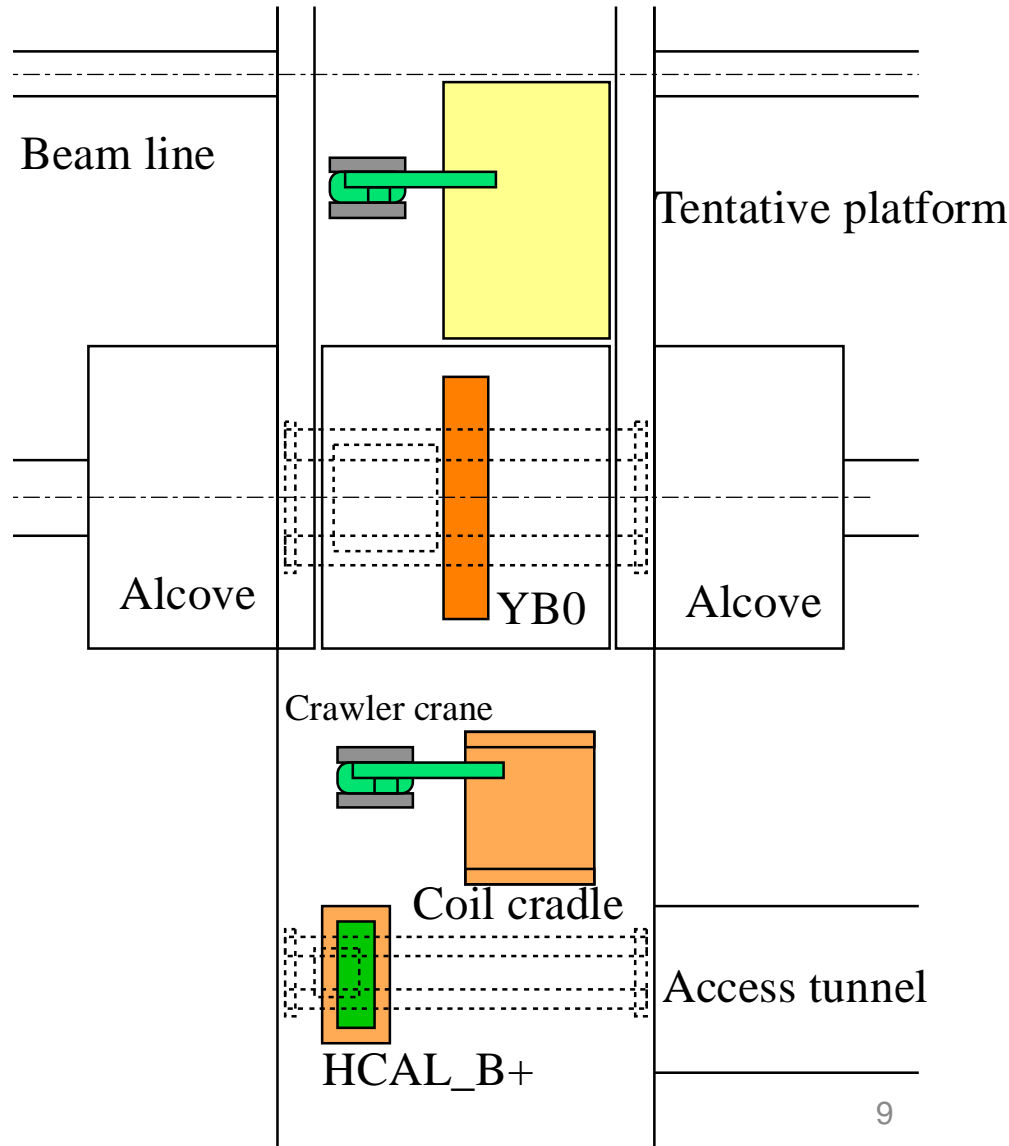
Boundary conditions

- 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



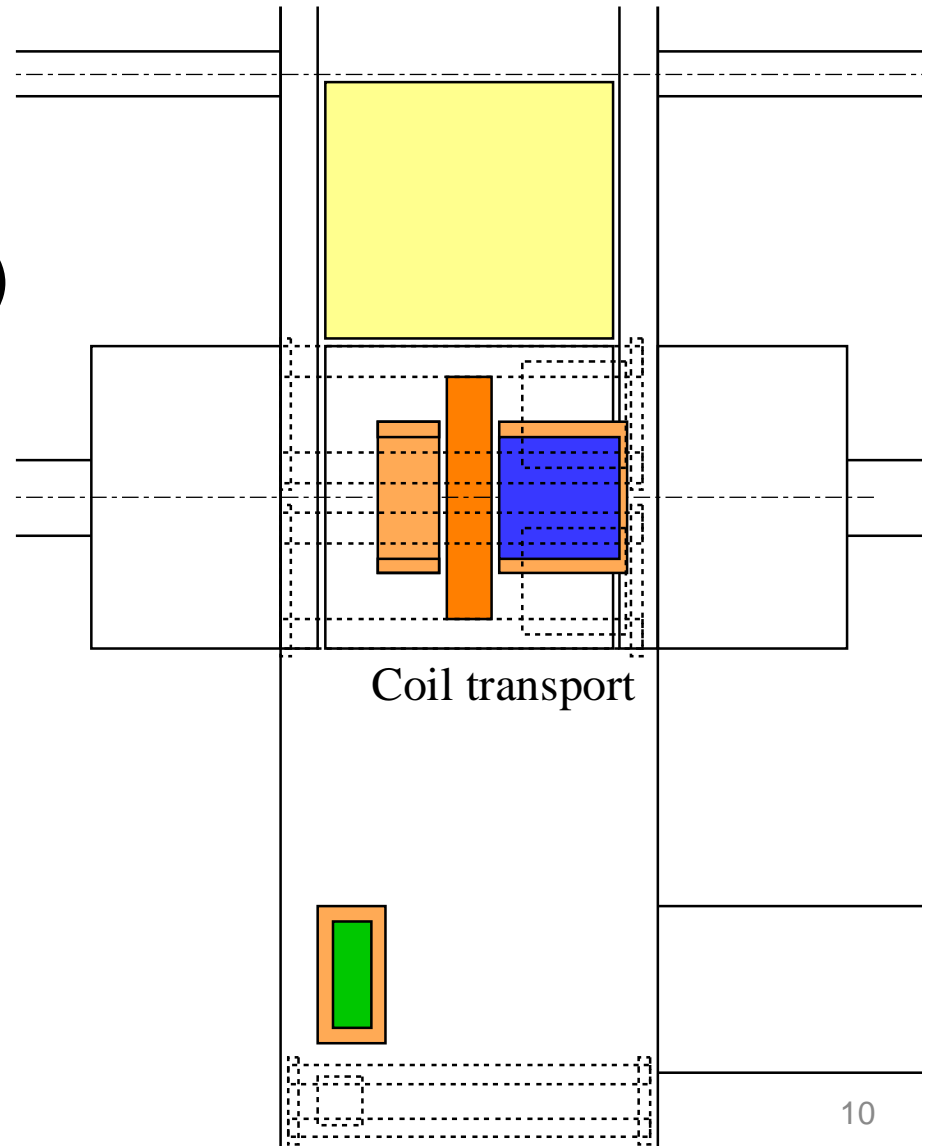
Step 1

- 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



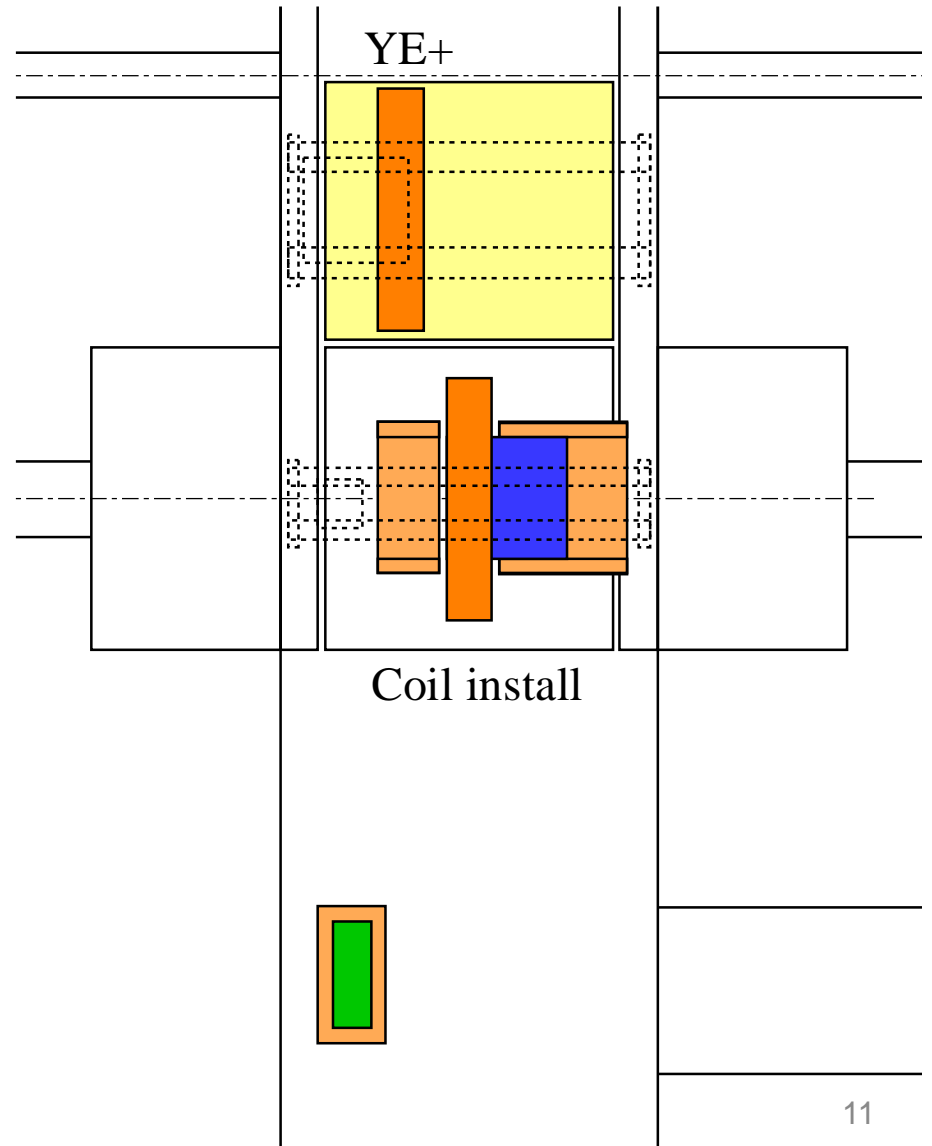
Step 2

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



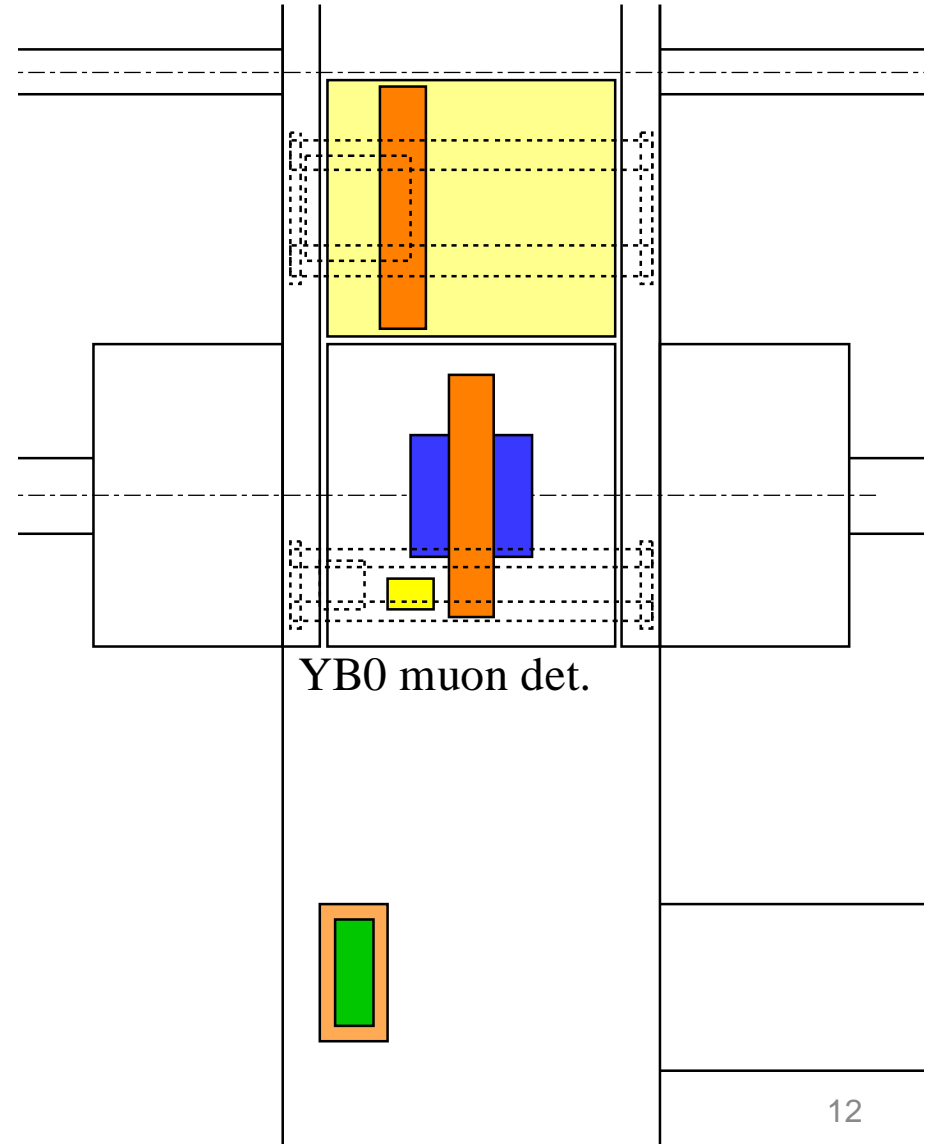
Step 3

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



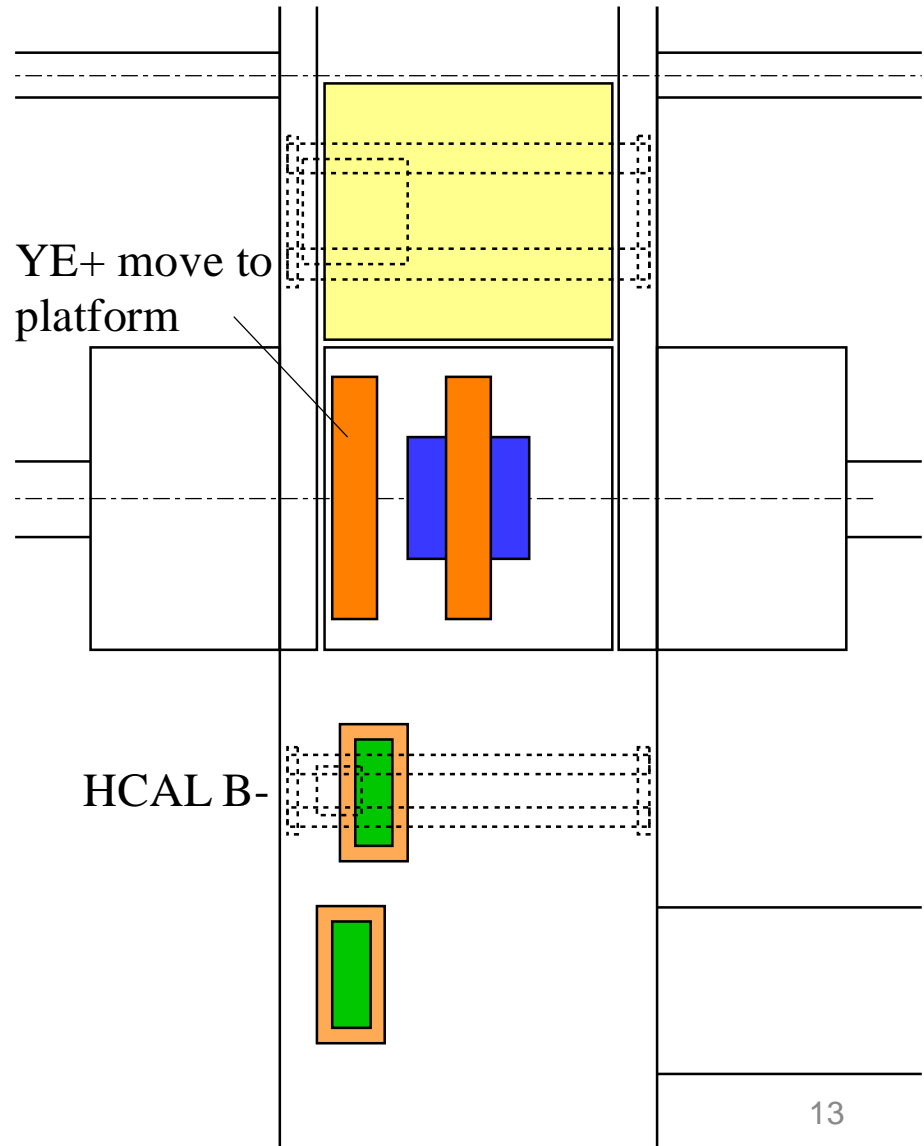
Step 4

- Muon detector installation to YB0



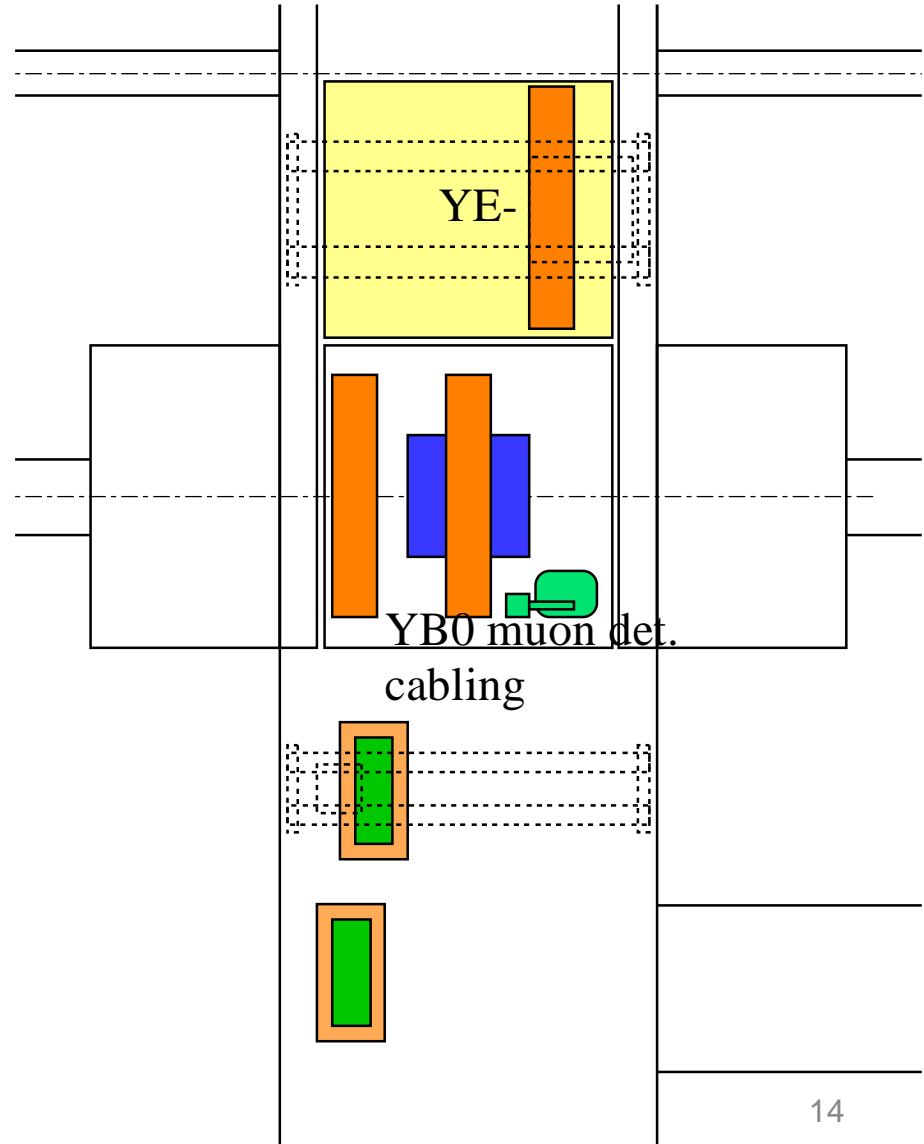
Step 5

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



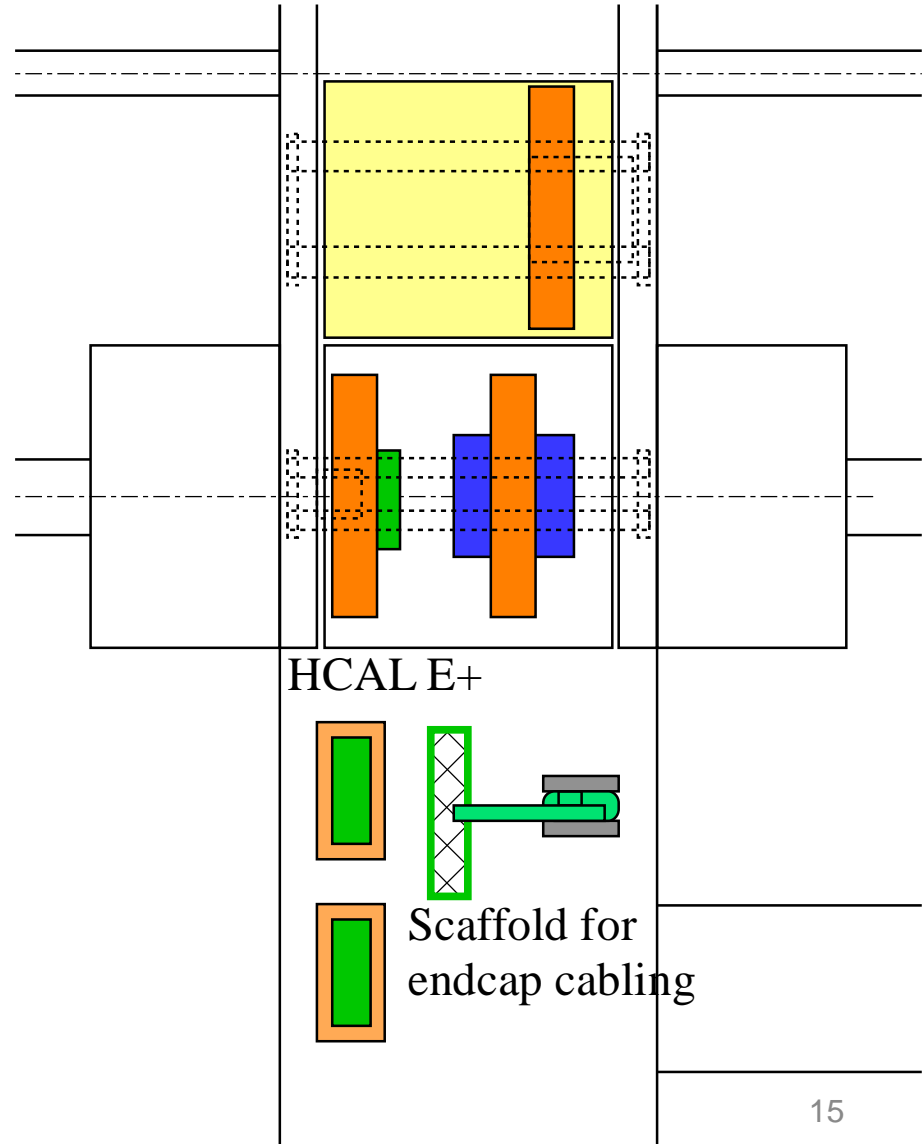
Step 6

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



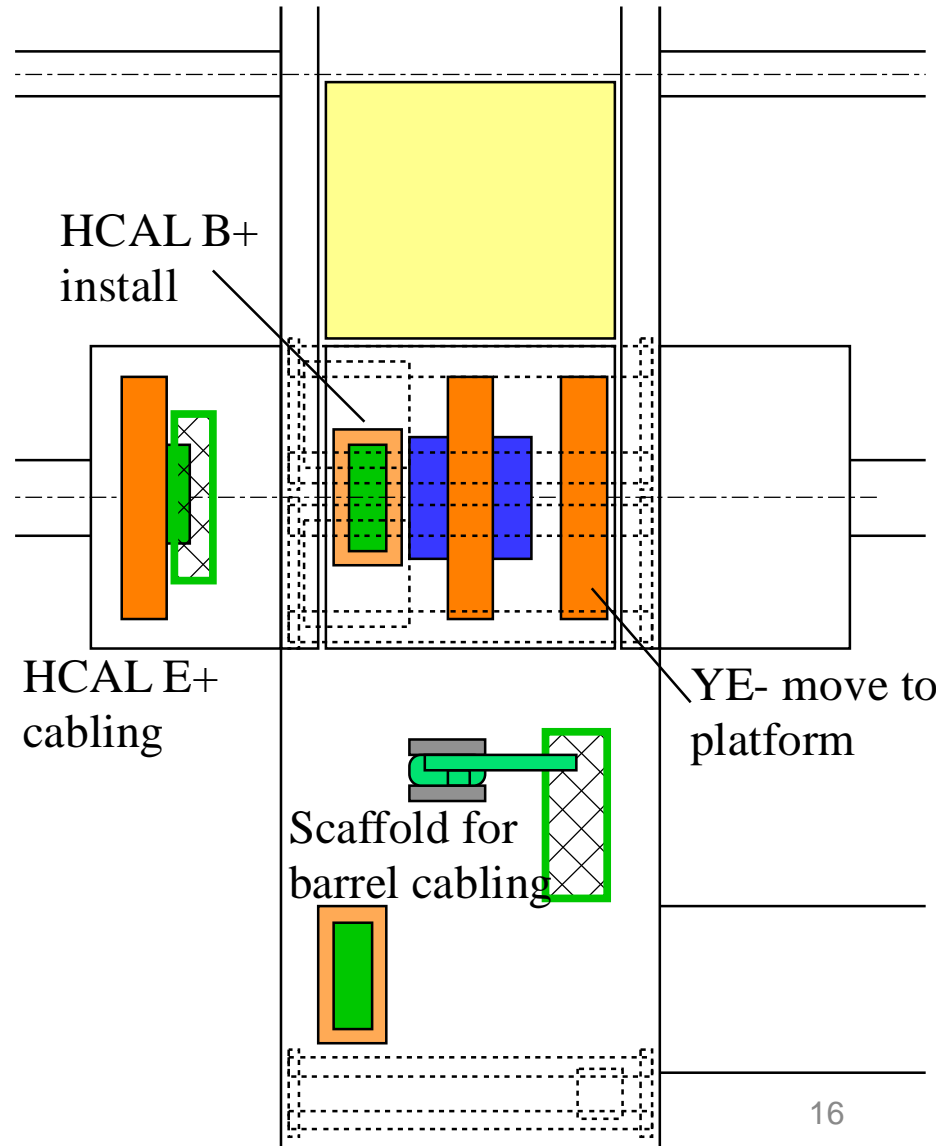
Step 7

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



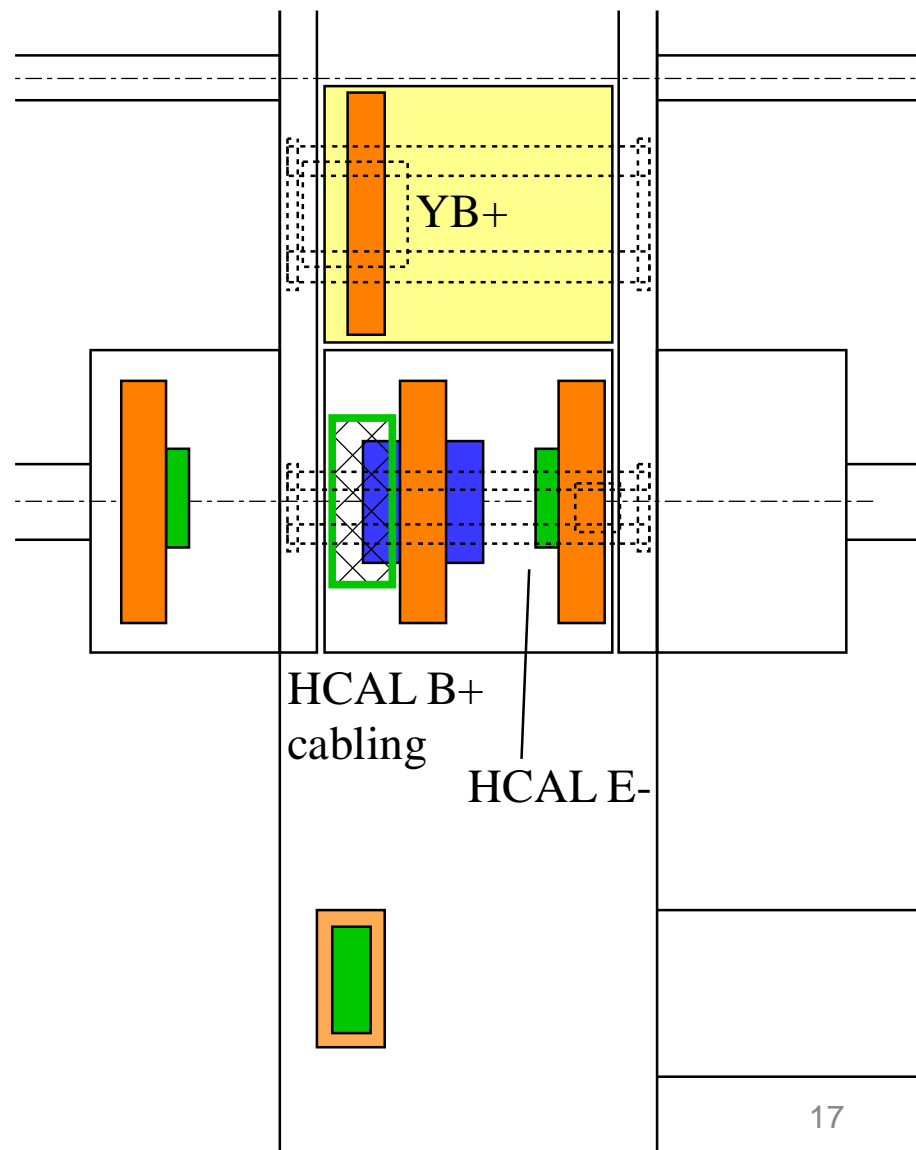
Step 8

- YE- is moved to platform
- 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



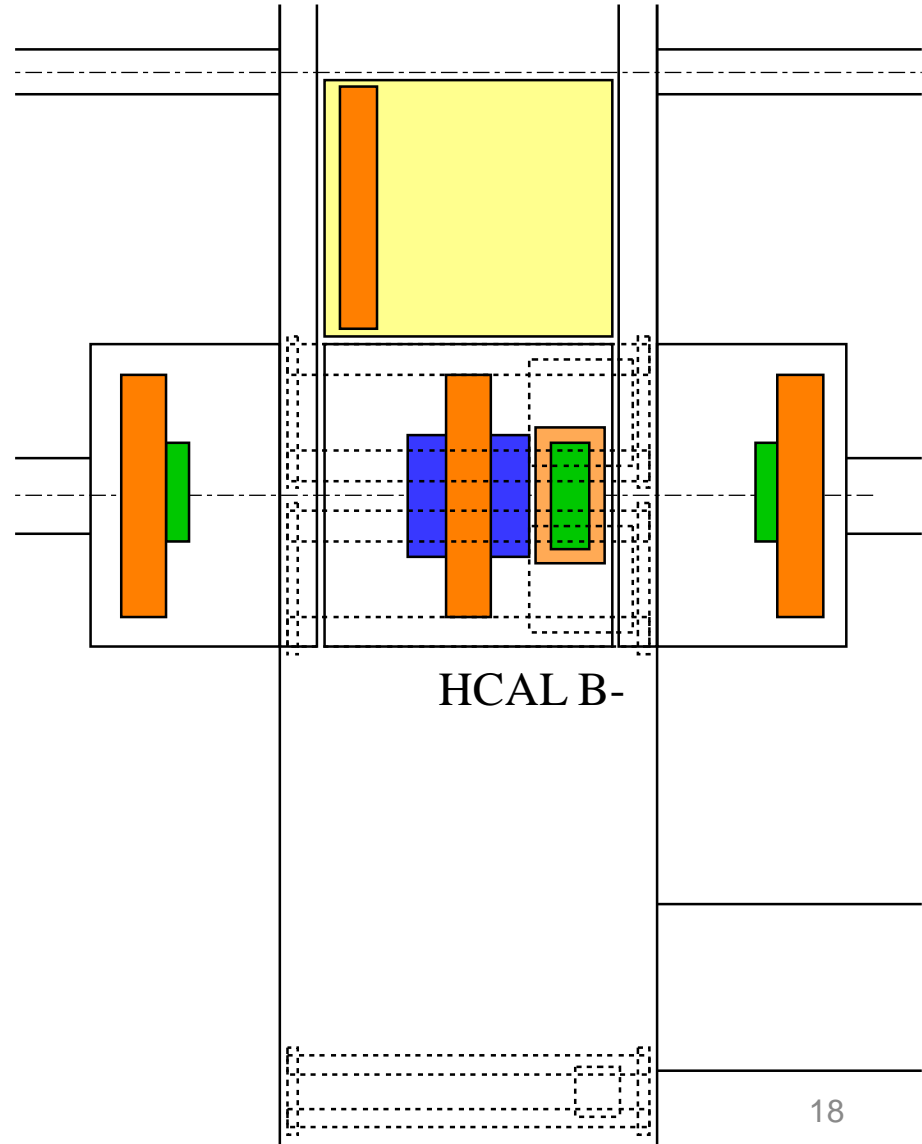
Step 9

- 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



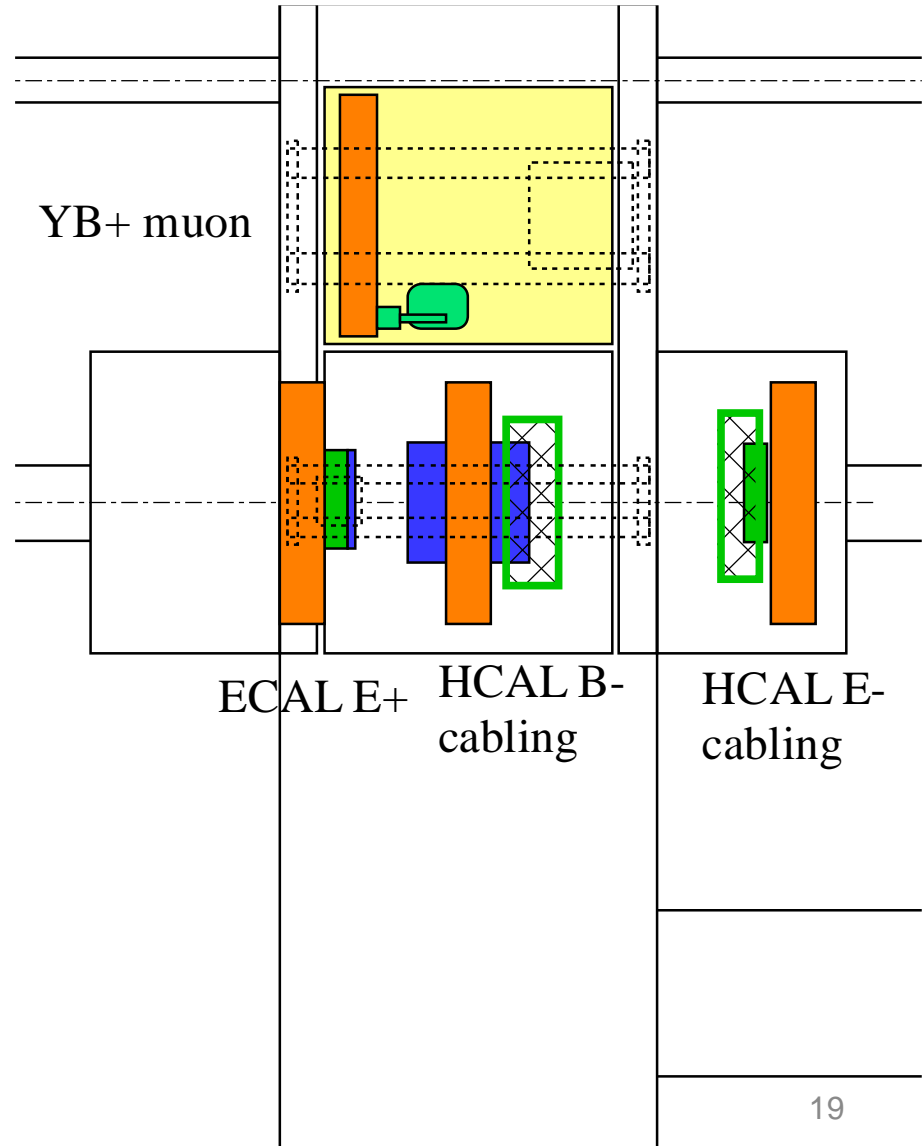
Step 10

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



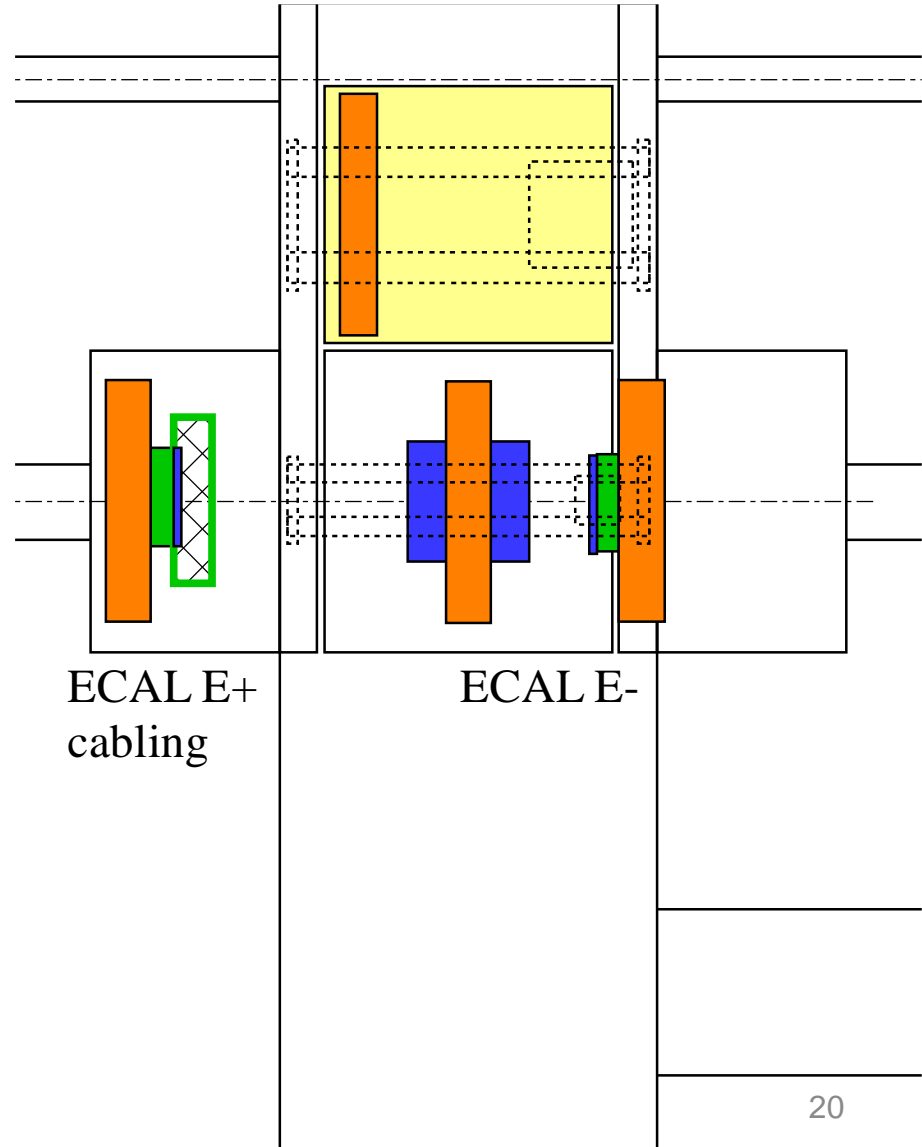
Step 11

- 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



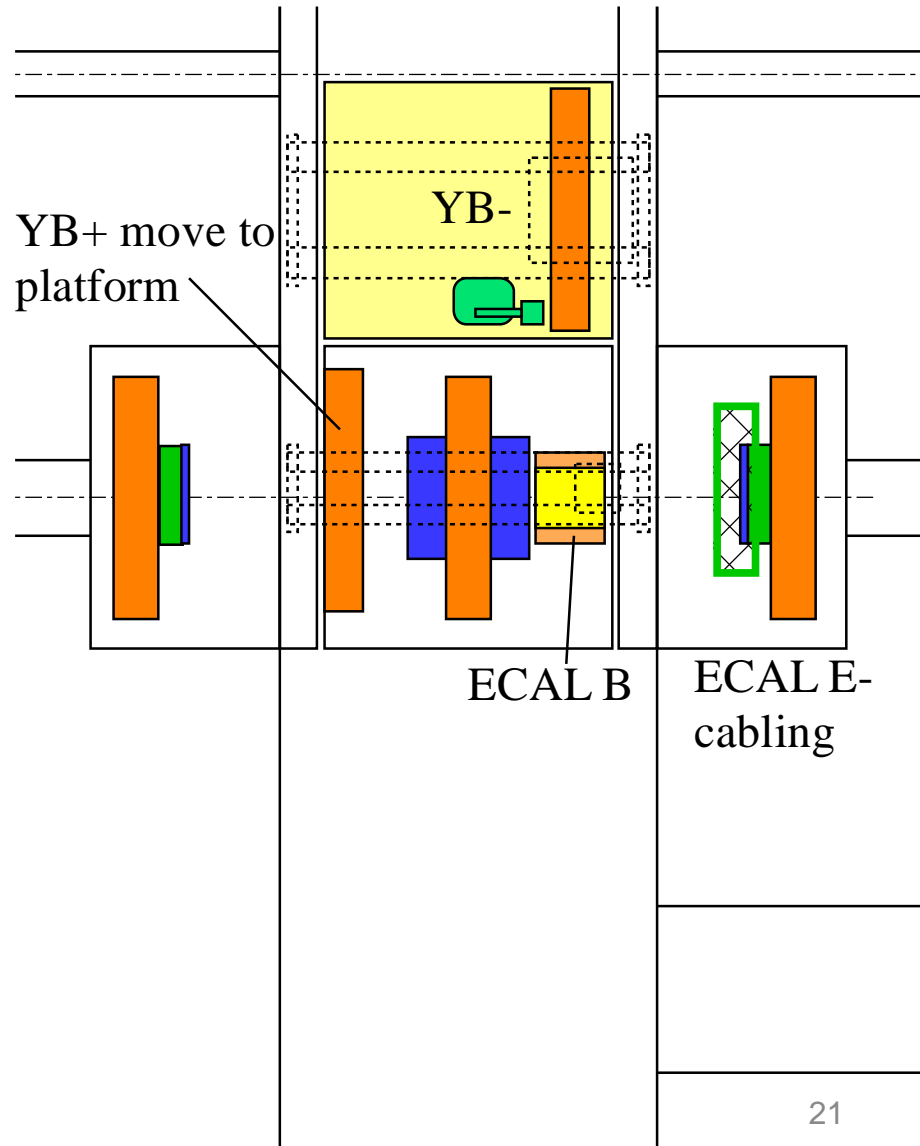
Step 12

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



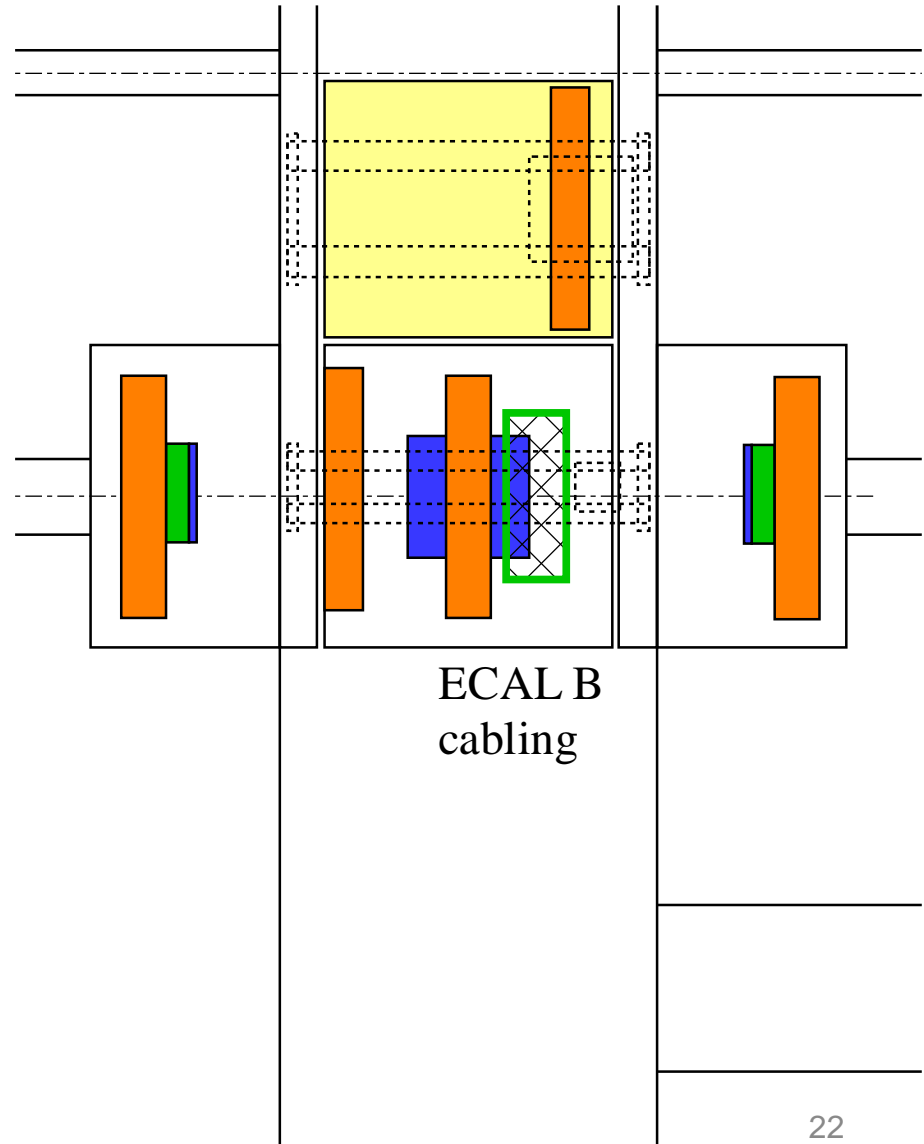
Step 13

- 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



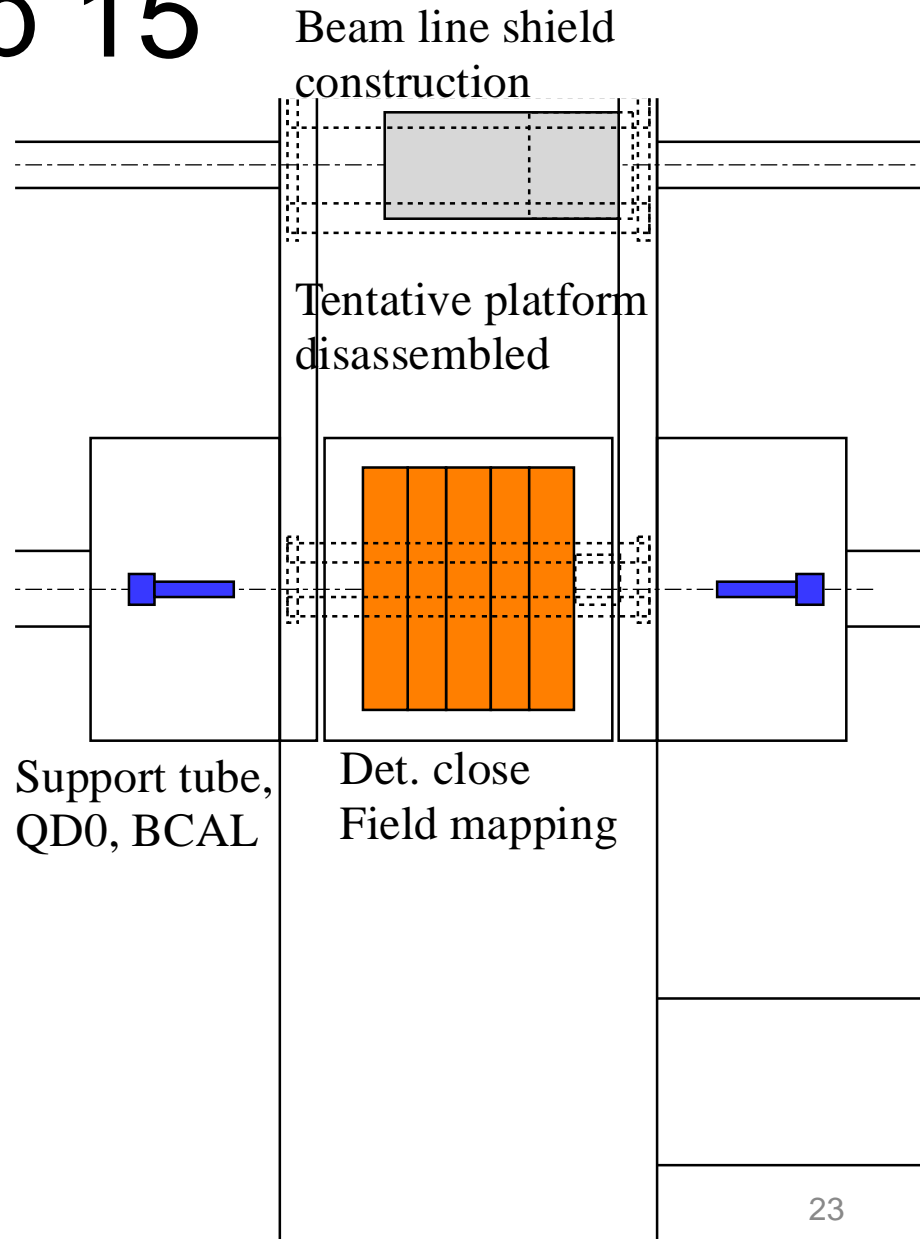
Step 14

- Barrel ECAL cabling in Area 1



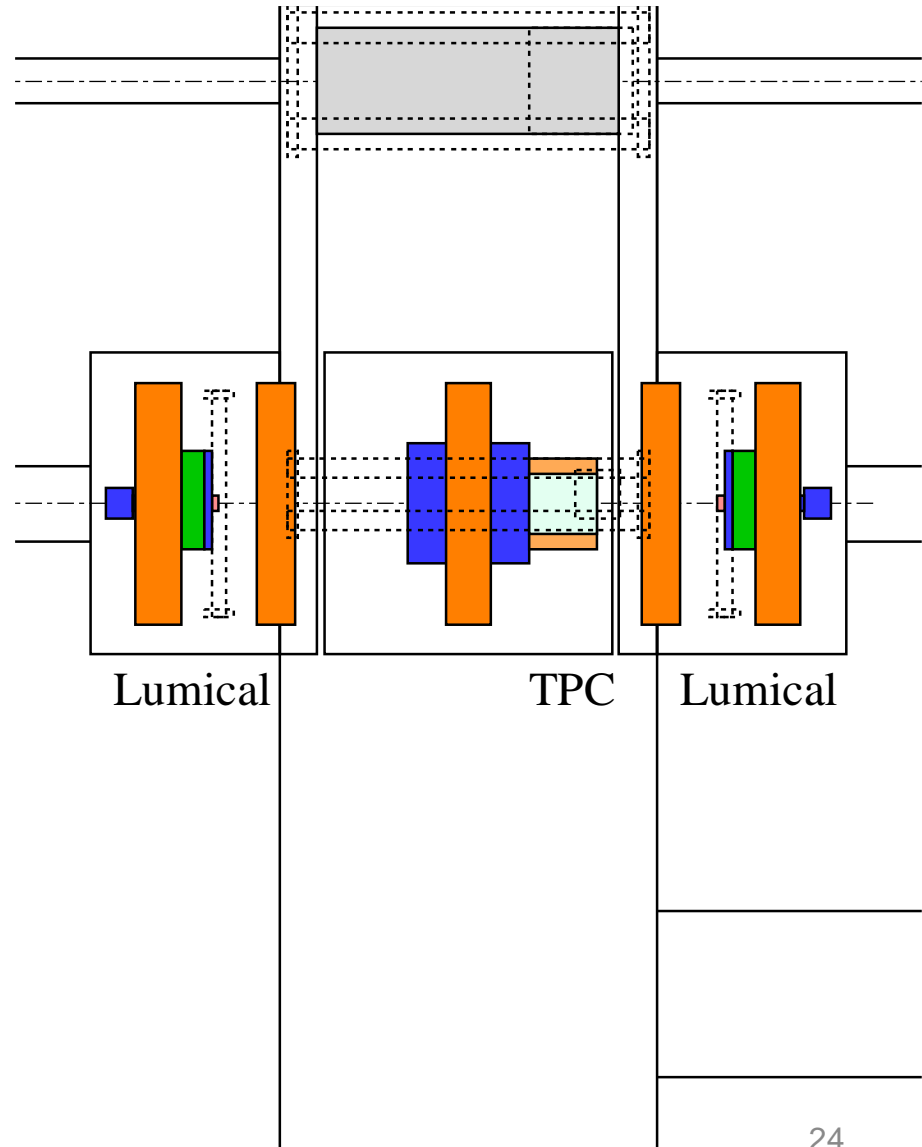
Step 15

- 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



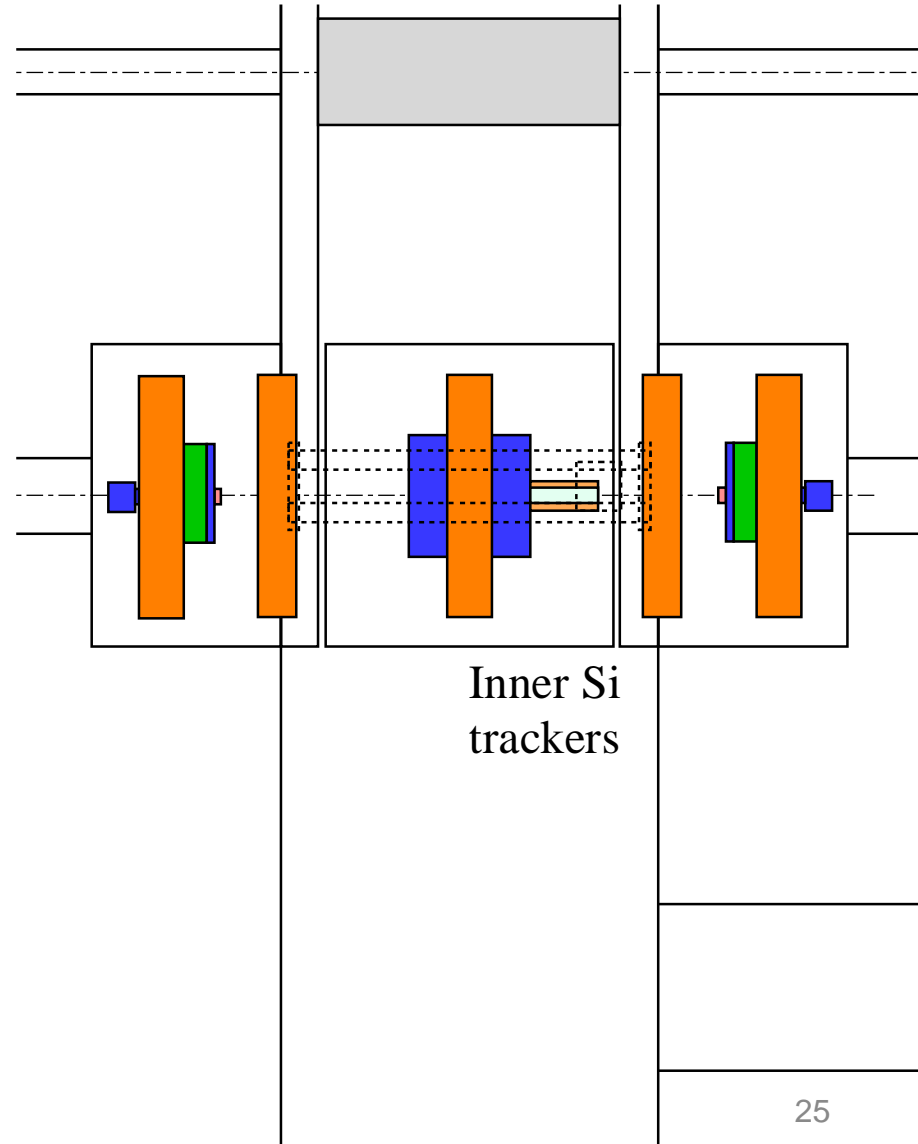
Step 16

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



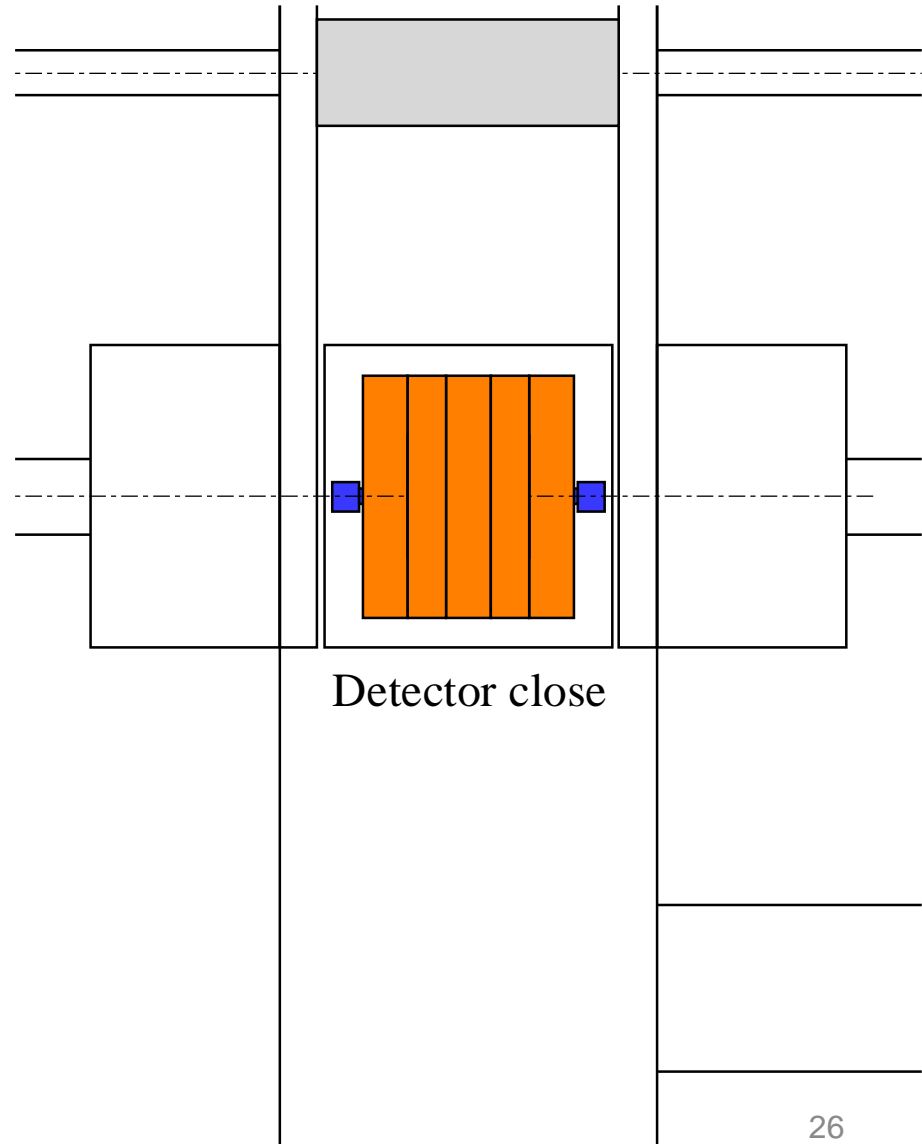
Step 17

- Si inner trackers are installed in Area 1



Step 18

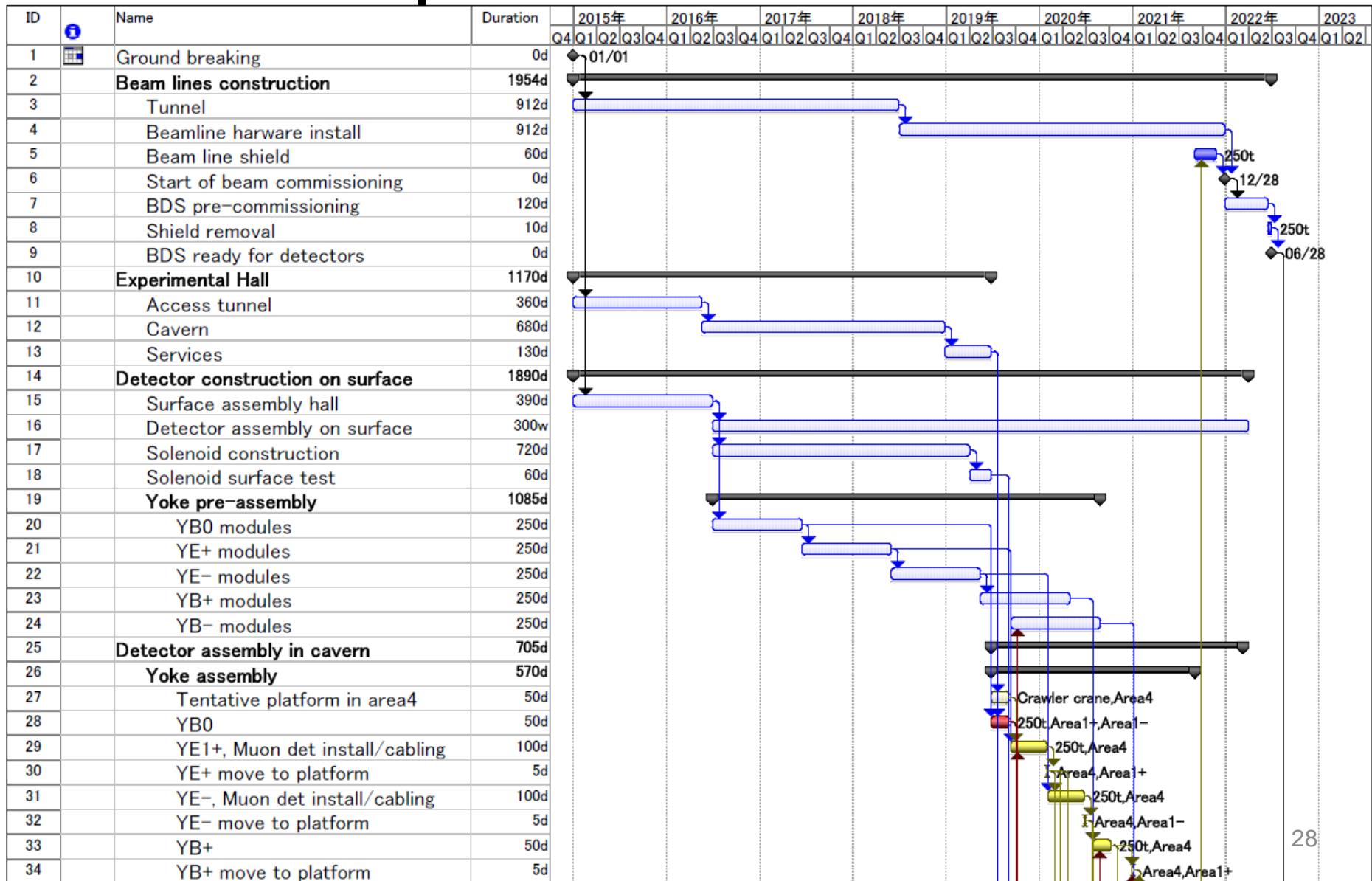
- Detector is closed again and ready for detector pre-commissioning



A possible timeline

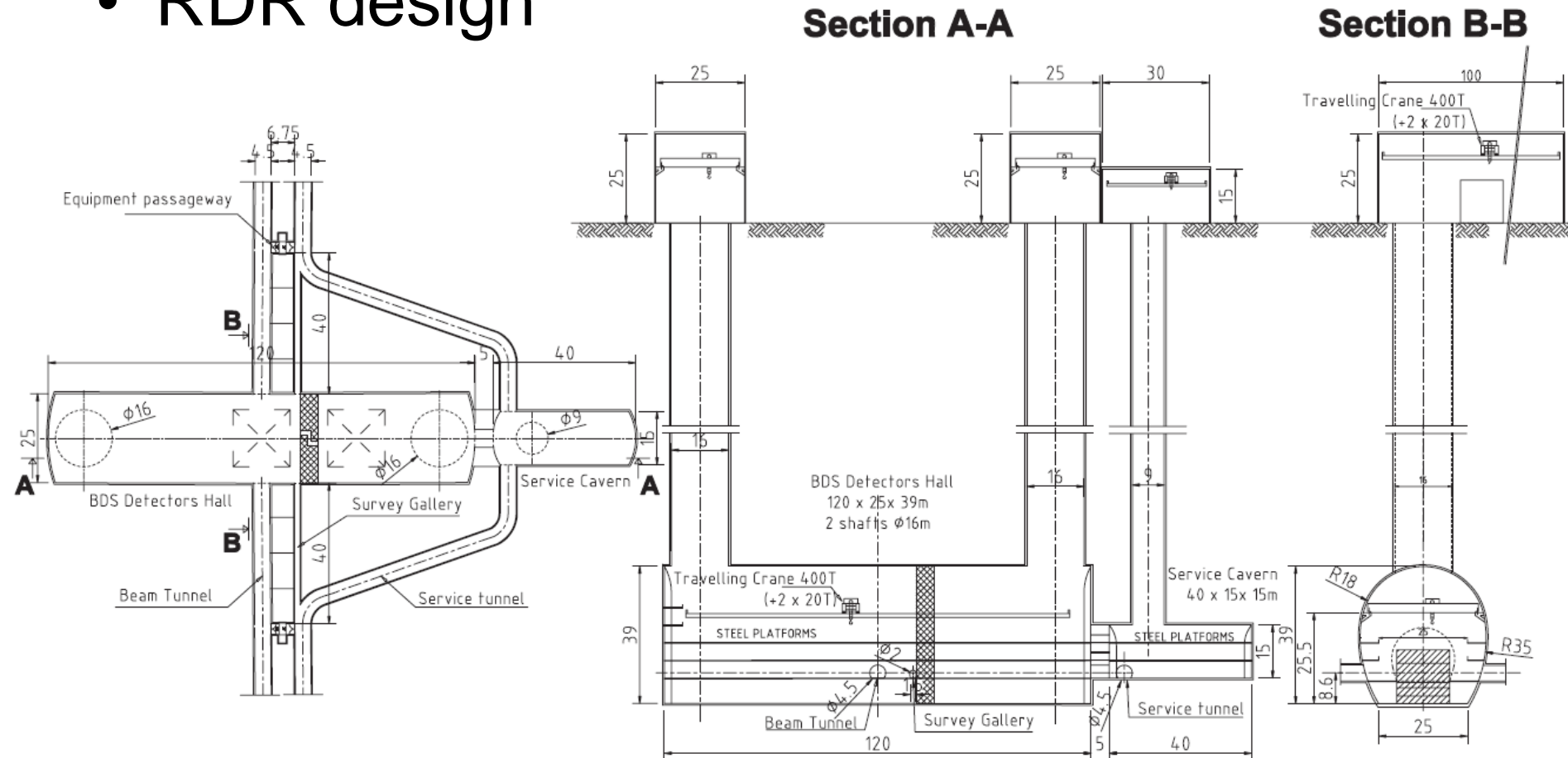
- Assumptions
 - YB rings: 50d each
 - YE: 100d each including muon detector installation/cabling
 - Muon detector: 20d+20d for each barrel ring
 - Liquid He becomes available 8 months after the cavern gets ready
 - Field mapping will be done after ECAL installation and cabling: 20d for cool down, 60d for mapping, 20d for warm up
 - Others
 - Estimation by calorimeter groups
 - Rough guess for other detectors

A possible timeline



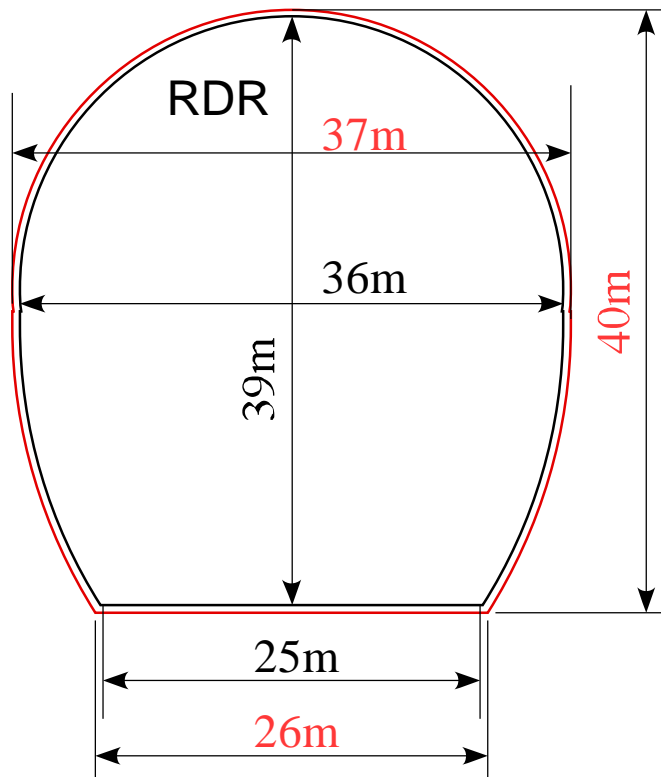
Comparison with RDR

- RDR design

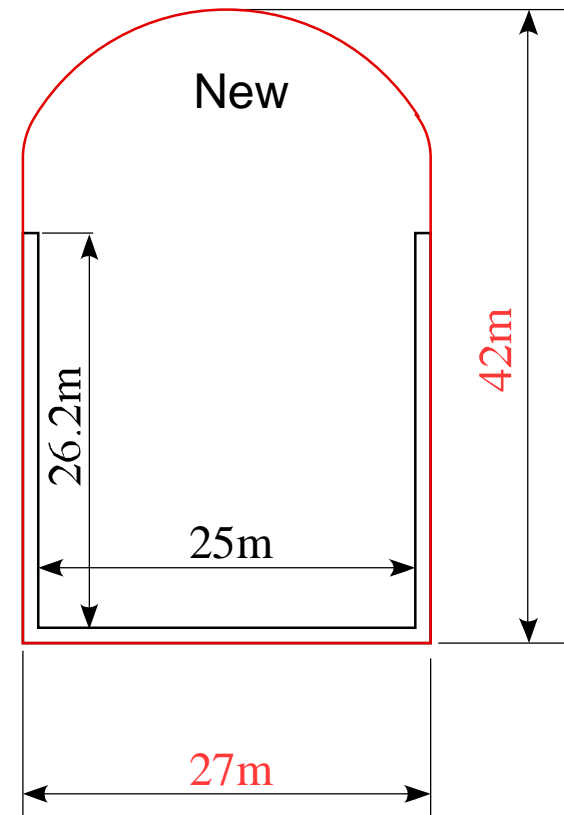


Comparison with RDR

- Cavern cross section for excavation



1259.3m²



1094.2m²

Comparison with RDR

- Cost consideration for experimental cavern

		RDR	New	Difference
Main cavern		Egg shape	Bullet shape	
	Nominal size (m)	120(L)x39(H)x25/36(W)	142(L)x42(H)x25(W)	
	Excavation cross section (m ²)	1259	1094	
	Excavation volume (m ³)	151080	157560	+6480
Alcoves			(ILD/SiD)	
	Size (m)	40(L)x15(H)x15/18(W)	12.5(L)x19.6/18(H)x20(W)	
	Quantity	1	2/2	
	Excavation cross section (m ²)	211	361/329	
	Excavation volume (m ³)	8440	9013/8213	+8786
Cavern total				
	Excavation volume (m ³)	159520	174786	+15266
	Cost (Oku-Yen)			~+X

Comparison with RDR

- Cost consideration for access shaft/tunnel and utility cavern

		RDR	New	Difference
Access route		Vertical shafts	Horizontal tunnel	
	Size (m)	φ16x100(L)	1000(L)x11(H)x11(W) + branches	
	Quantity	2	1+α	
	Total cost (Oku-yen)	~y*	yy**	-17
Utility cavern				
	Size (m)	--	77.5(L)x13.5(H)x15(W)	
	Cost (Oku-yen)	--	z**	(+z***)

* RDR estimation x 117yen/ILCU

** Estimation by J-Power

*** Utility cavern is mainly used for accelerator utilities

Summary

- The 142m option of the cavern in Japanese mountain site looks OK for detector installation of ILD without extending the original schedule (8 years from ground breaking to physics run)
- GDE should clarify the timeline for accelerator construction and commissioning, if there is some change from RDR
 - when the beamline area in the cavern should be cleared
 - when the detector can be rolled in
- Cost of the new design of experimental hall would be less than that of RDR