Experimental hall in Japanese mountain site

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@KILC2012

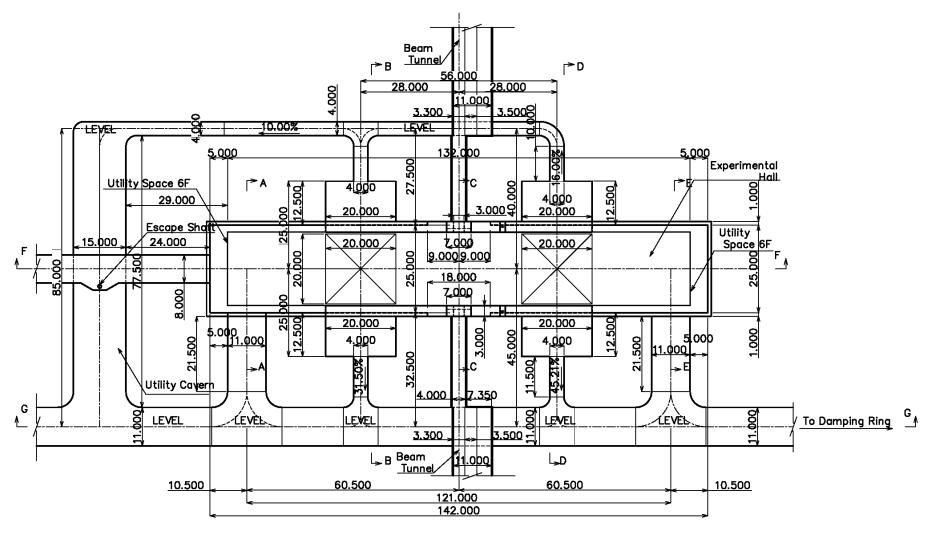
Outline

- 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



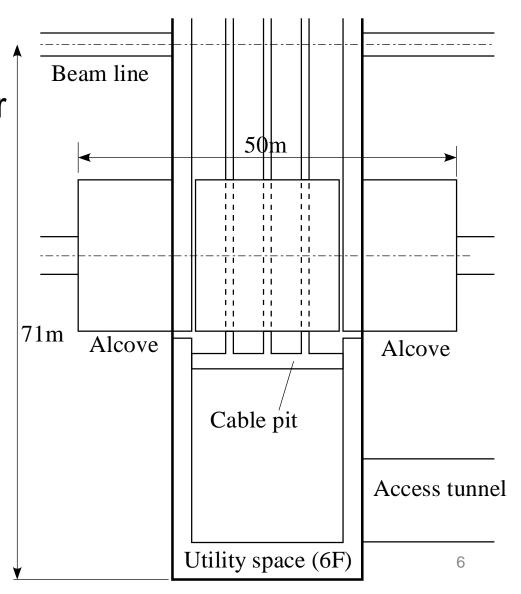
Plan

Design shown at CFS BTR



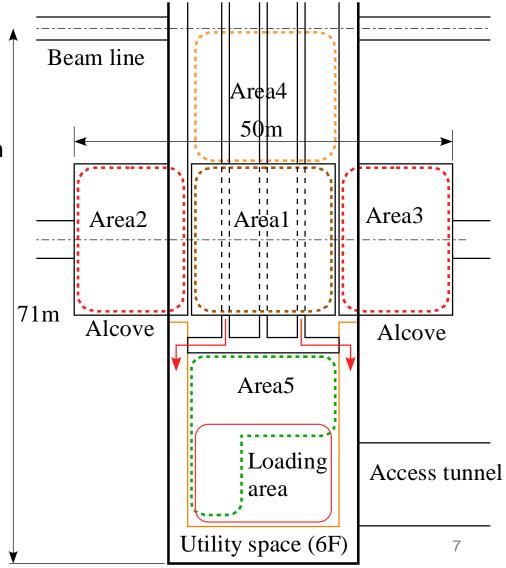
Underground detector assembly

 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



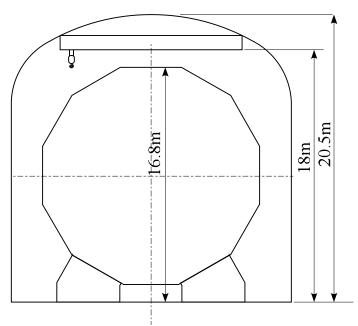
Boundary conditions

Cranes

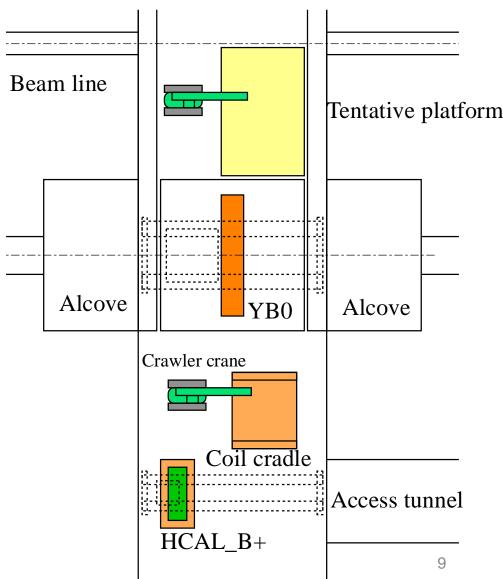
- 250 ton crane for each detector on beam line side
- 30 ton crane for each detector on loading area side
- 2.8 ton crane in each alcove
 - In order to minimize the size of alcoves, the crane rails should be supported from the arch part → Only small cranes can be used
 - The height of alcoves have to be increased from 19.6m to 20.5m (for ILD) to let the crane girder pass over the detector

Work conflicts

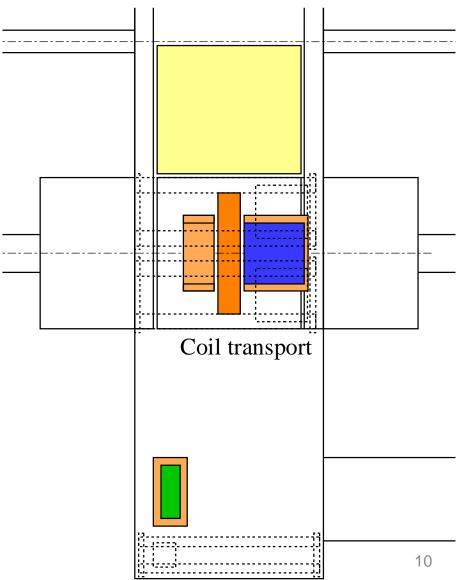
 In order to avoid conflicts of parallel works, first few hours of each working day should be dedicated to transportation to each assembly area



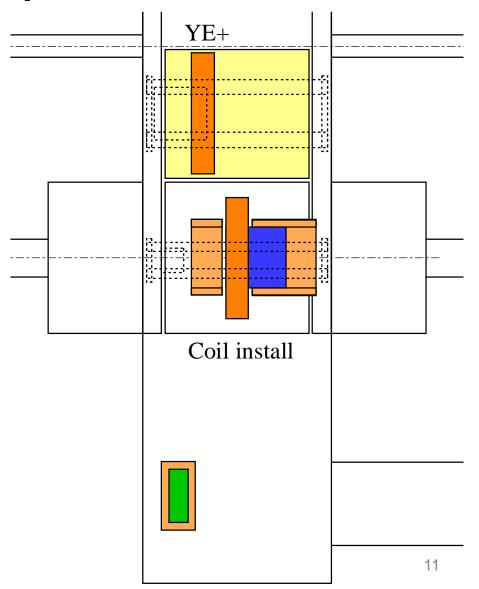
- Tentative platform is assembled in Area4 using a crawler crane
- Central barrel yoke YB0 is assembled on the platform using 250 ton crane
- HCAL modules are assembled to a ½-z ring in Area5 using 30 ton crane
- Cradle for coil installation is assembled in Area5 using a crawler crane



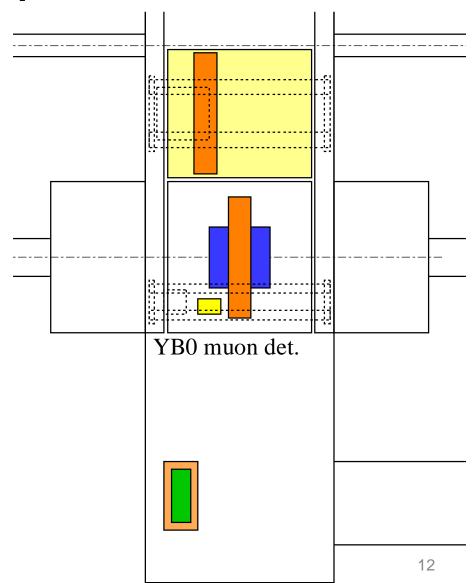
 Solenoid coil is moved to the platform using two sets (one from SiD) of 250 ton crane



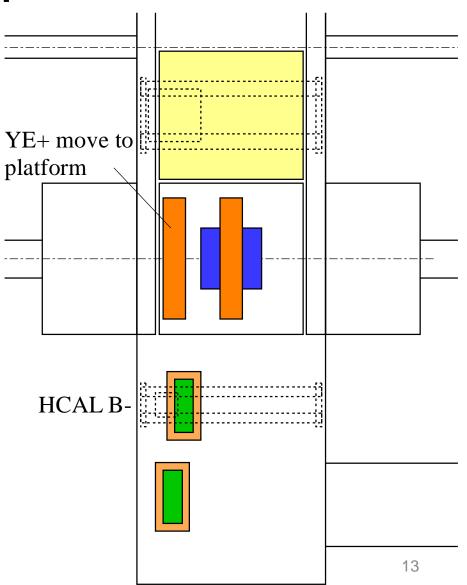
- Endcap iron yoke
 (YE+) is assembled
 in Area 4
- Solenoid coil installation to the YB0 in Area 1



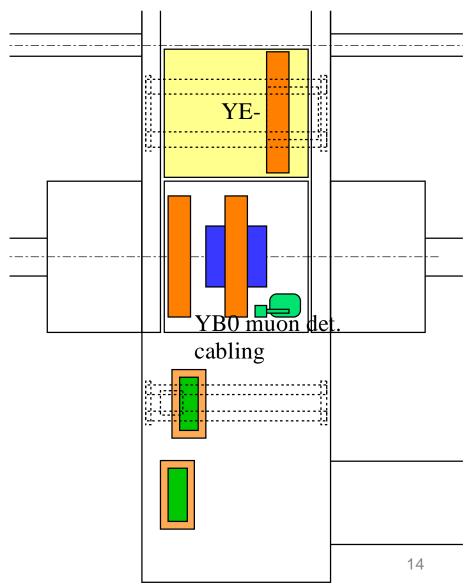
 Muon detector installation to YB0



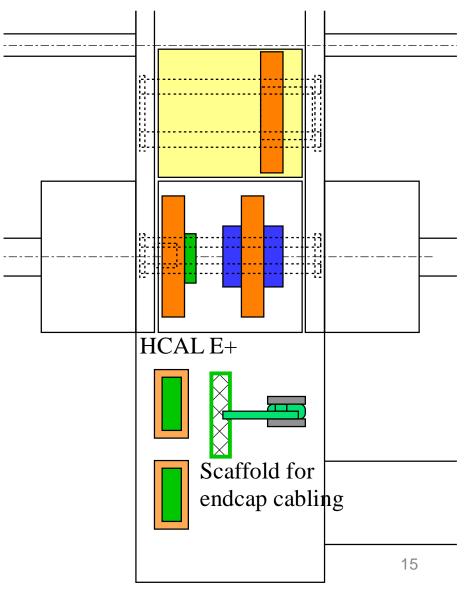
- YE+ is moved to platform using airpads after muon detector installation
- HCAL barrel ½-z ring is assembled in Area 5



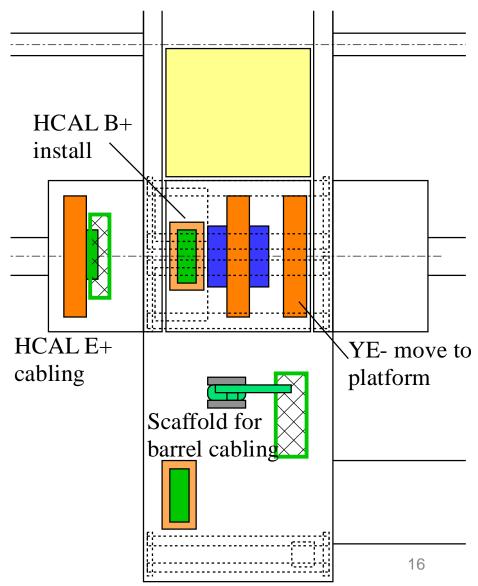
- Endcap yoke YE- is assembled in Area4
- Muon detector of YB0 cabling
- HCAL barrel ring assembly in Area5



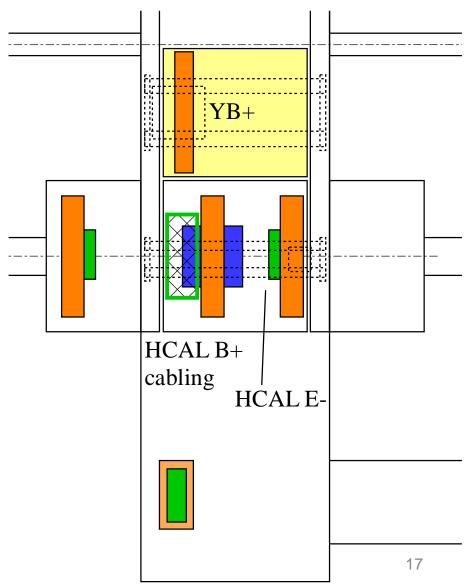
- YB0 shifted in z direction
- Endcap HCAL installation in Area 1
- Scaffold for endcap cabling is assembled in Area 5



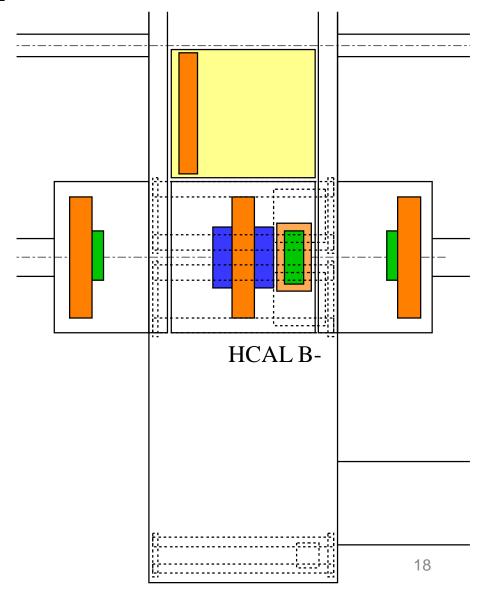
- YE- is moved to platform
- ½ of barrel HCAL is moved to platform using two 250 ton cranes, and installed
- Endcap yoke (+) is pushed into Area 2
- Endcap HCAL cabling in Area 2
- Scaffold for barrel cabling is assembled in Area 5



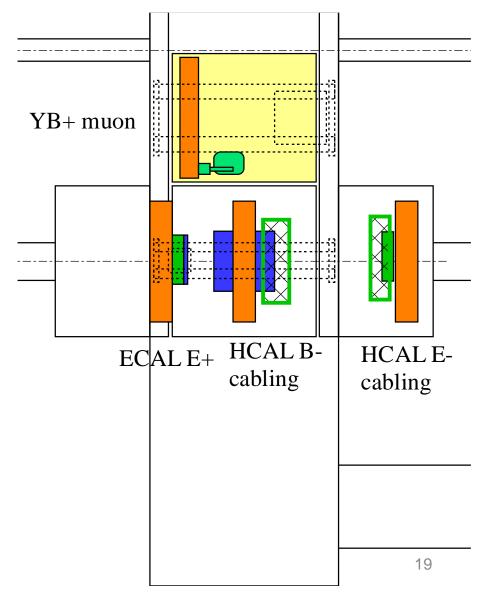
- Another barrel yoke ring YB+ is assembled in Area 4
- Central barrel YB0 is shifted in z direction
- Barrel HCAL (+) cabling in Area 1
- Endcap HCAL (-) installation in Area 1



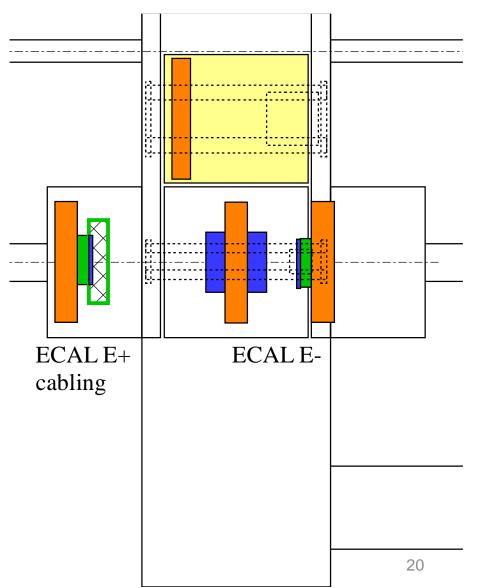
- Endcap yoke (-) is pushed to Area 3
- ½ of barrel HCAL is moved to platform using two 250 ton cranes, and installed



- 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



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

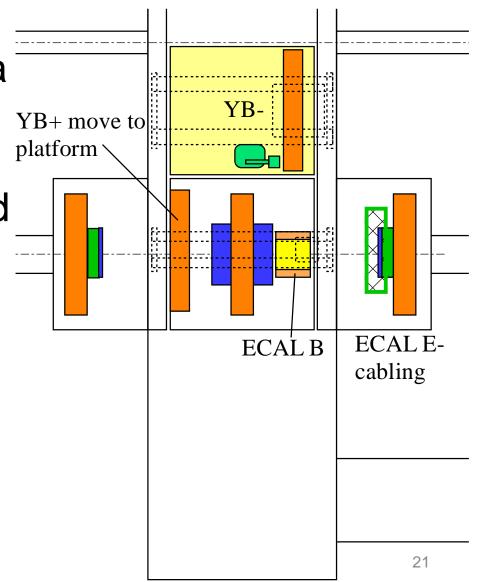


YB+ is moved to Area1

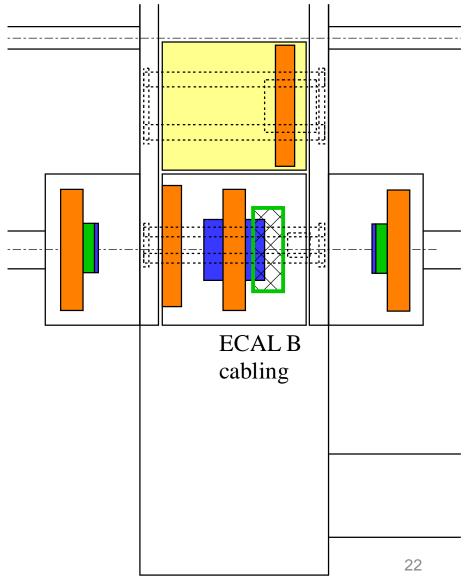
 Another barrel yoke ring YB- is assembled and muon detectors installed in Area 4

 Endcap ECAL (-) cabling in Area 3

 Barrel ECAL is installed in Area 1



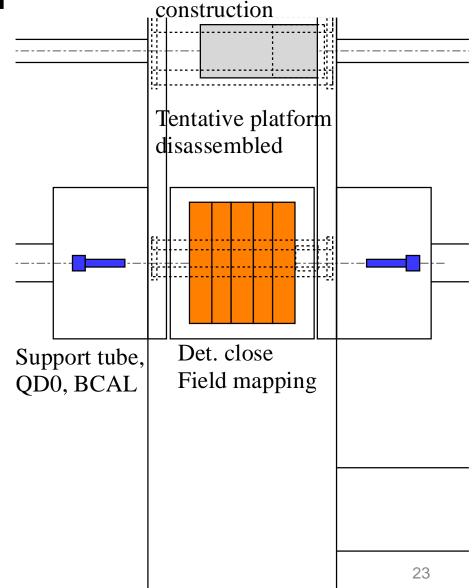
 Barrel ECAL cabling in Area 1



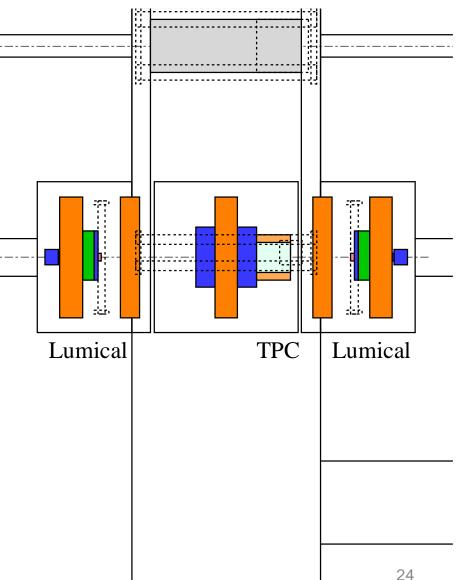
Beam line shield

 Detector is closed and field mapping is performed

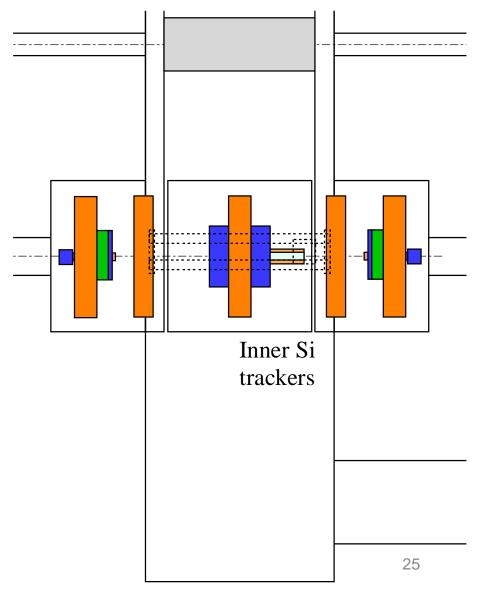
- QD0 support tubes assembly in Area 2/3
- QD0 and BCAL installation/cabling in Area 2/3
- After removing the tentative platform in Area 4, beam line shield is constructed



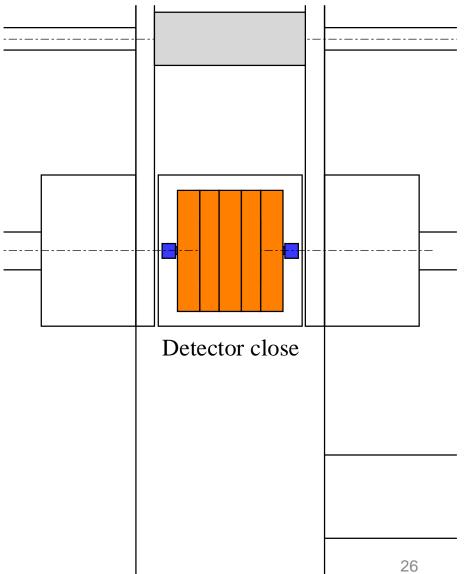
- Detector is opened again
- TPC installation in Area 1
- Lumical installation using 2.8 ton cranes in Area 2/3



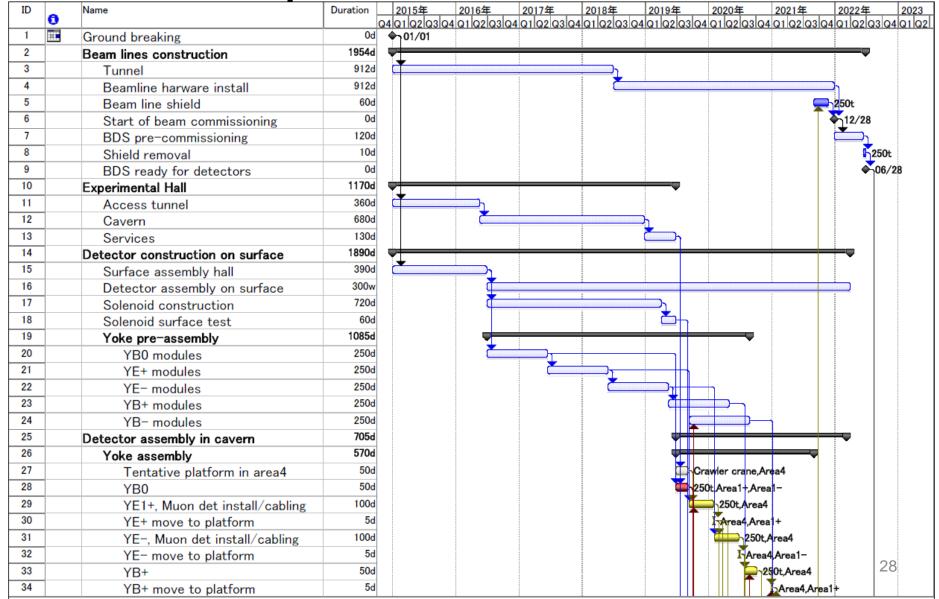
 Si inner trackers are installed in Area 1



 Detector is closed again and ready for detector precommissioning



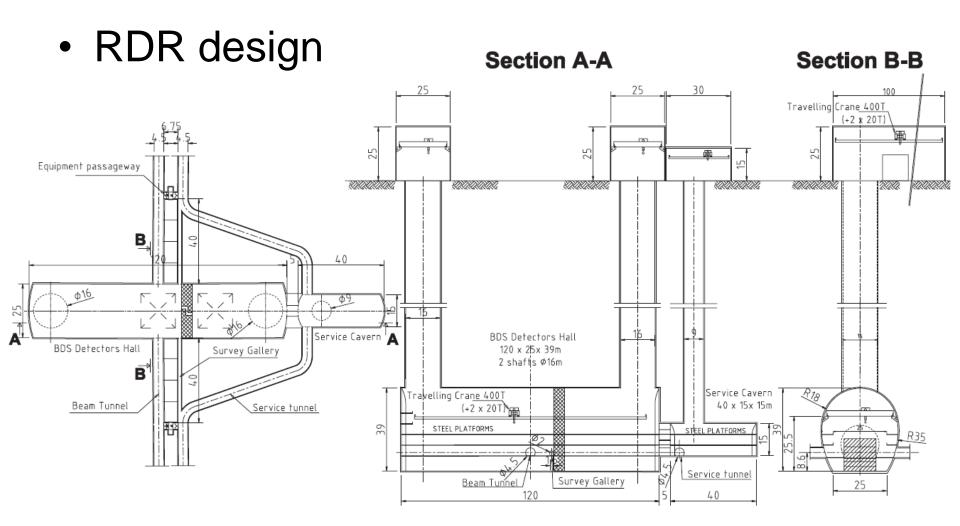
- Assumptions
 - YB rings: 50d each
 - YE: 100d each including muon detector installation/cabling
 - Muon detector: 20d+20d for each barrel ring
 - Liquid He becomes available 8 months after the cavern gets ready
 - Field mapping will be done after ECAL installation and cabling: 20d for cool down, 60d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



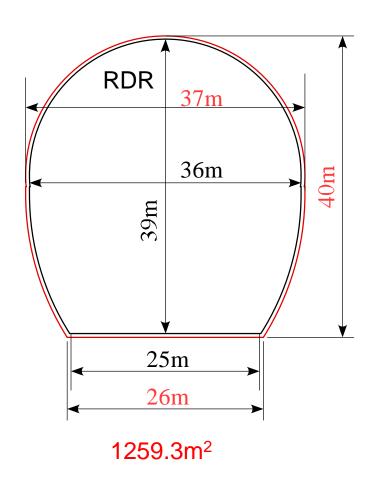
ID	0	Name	Duration	04	2015年	2016年	2017年	2018年	2019年	2020年	2021年 2022年 2023 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
35		YB-	50d	X-1	G I WZ WO W	G FIGZIGSIG*	GIIGZIGSIG	TIGITIGE IGO G	TIGTIGZIGOIC	4 4 1 142 143	250t,Area4
36		YB- move to platform	5d								<u>I</u> Area4,Area1−
37		Tentative platform disassemble	30d								250t,Area4
38		Solenoid	640d						<u> </u>		
39		Infrastructure	175d								
40		Coil transport	5d						F	250t,Area1	
41		Coil install	60d						<u> </u>	<mark>⊒-30</mark> t,Area1	+,Area1-
42		Coil cool down	20d							<u> </u>	
43		Coil test	20d							Area	ı1 <mark>⊢,Ar</mark> ea <mark>1+ </mark>
44		Coil warm up	20d								
45		Detector closing	10d								Area1+,Area1-
46		Coil cool down	20d								
47		Field mapping	60d								Area1+,Area1-
48		Coil warm up	20d								
49		Barreal detectors	535d								
50		HCAL barrel+z assembly	60d							301,Area5	
51		HCAL barrel+z install	10d								250t <mark>A</mark> rea1+
52		HCAL barrel+z cabling	50d								Afea1+
53		HCAL barrel-z assembly	60d							⊊ +30t,∧	rea5
54		HCAL barrel-z install	10d								5250t Area 1-
55		HCAL barrel-z cabling	50d								Area1
56		ECAL barrel install	90d								30t,Area1-,Area1+
57		ECAL barrel cabling	30d								Area1-,Area1+
58		Muon detector YB0 install	20d							0 30t,Area	1+Areal-
59		Muon detector YB0 cabling	20d							Area 1	+ <u>Ar</u> ea1-
60		Muon detector YB+ install	20d								250t,Area4
61		Muon detector YB+ cabling	20d								Area4
62		Muon detector YB- install	20d								250t,Area4
63		Muon detector YB- cabling	20d								Area4
64		Barrel inner detectors	80d								
65		TPC install/cabling/test	40d								
66		SIT/FTD/VTX install/cabling/tes	40d								30t,Area1+,Area1
67		Endcap detectors	260d							<u> </u>	
68		HCAL endcap+z install	60d							* 3	Ot Area1+

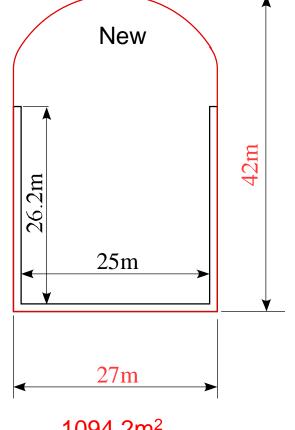
ID		Name	Duration		2015年	2016年				2020年	2021年	2022年	2023
	0			Q4	<u> Q1 Q2 Q3 Q4</u>	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4			Q1 Q2 Q3 C	24 Q1 Q2
69		HCAL endcap+z cabling	60d			8 8 8 8 8				₽ \\	ea2		
70		HCAL endcap-z install	60d								0t Area1-		
71		HCAL endcap-z cabling	60d							₫.	Area3		
72		ECAL endcap+z install	10d							<u> </u>	Area1+,30t		
73		ECAL endcap+z cabling	60d							Č	Area2		
74		ECAL endcap-z install	10d								Area1−,30t		
75		ECAL endcap-z cabling	60d								Area3		
76		QD0/FCALs install/cabling/test	180d								<u>-</u>	ריי	
77		Supprt pillar/tube assemble	30d								<u></u> 2.8t+,∤	rea2,Area3,2	2.8t-
78		QD0 install	30d								<u></u> 2.8t+	Area2,Area3	3,2.8t-
79		BCAL install	30d								<u>Ö</u> 2₁8	+,Area2,Are	a3,2.8t-
80		Detector opening	5d								B	Area1+,Area	1-,Area2,
81		LUMICAL install	30d								Č	28t+,Area2	2,Area3,2.
82		Commissioning	210d									4	ᅻ
83		Detector pre-commissioning	100d										
84		Detector roll-in	30d									្ន	
85		Detector check-out	20d									ď	
86		Final beam commissioning	60d									Č	<u>_</u>
87		Ready for physics run	0d										12/2

- Detector can barely be ready for physics run within 8 years from the ground breaking
- If GDE intends to change the schedule of accelerator construction and commissioning, it should be discussed with physics groups



Cavern cross section for excavation





1094.2m²

Cost consideration for experimental cavern

		RDR	New	Difference
Mai	n 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 (m³)	151080	157560	+6480
Alco	oves		(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 (m³)	8440	9013/8213	+8786
Cav	vern total			
	Excavation volume (m³)	159520	174786	+15266
	Cost (Oku-Yen)			~+X

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*	уу**	-17
Util	ity 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