Ecal integration studies
Barrel & endcaps

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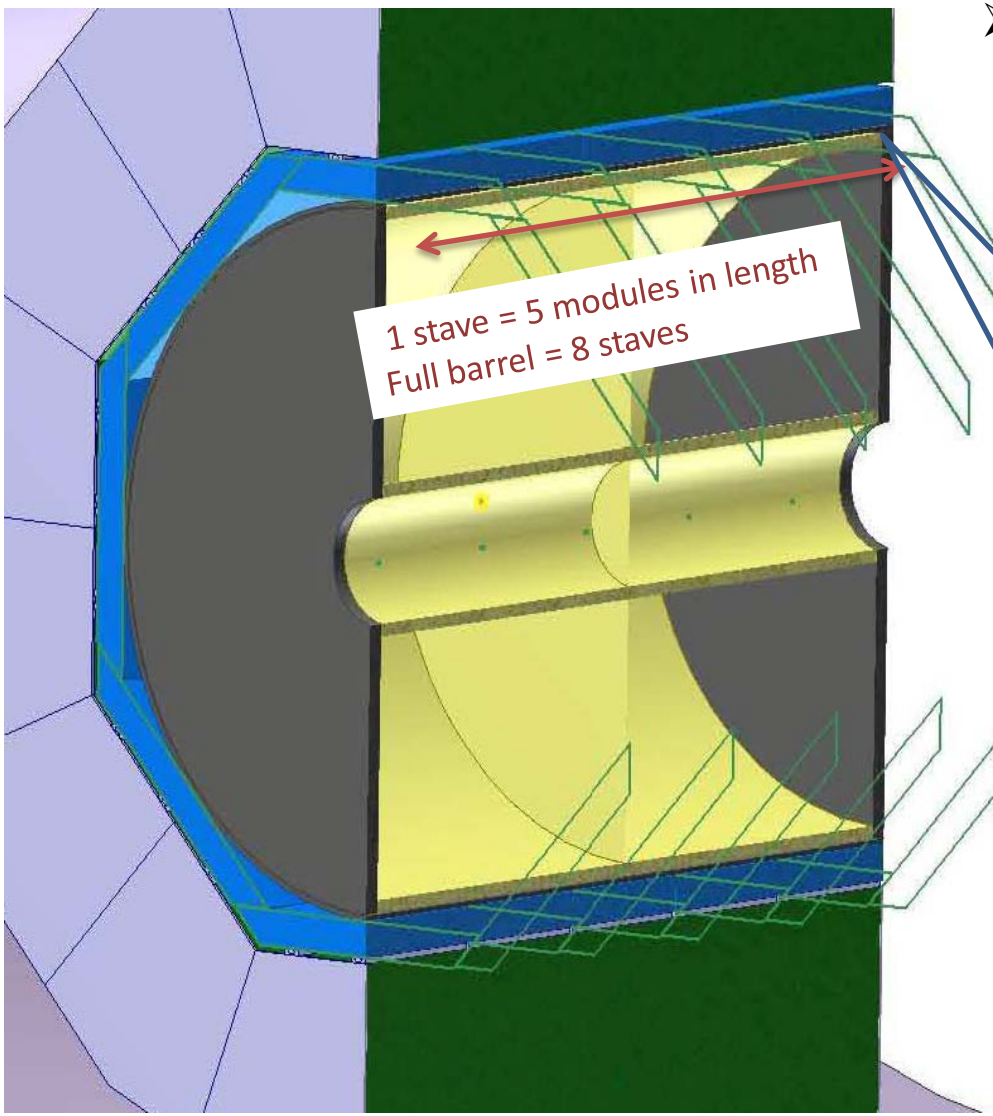
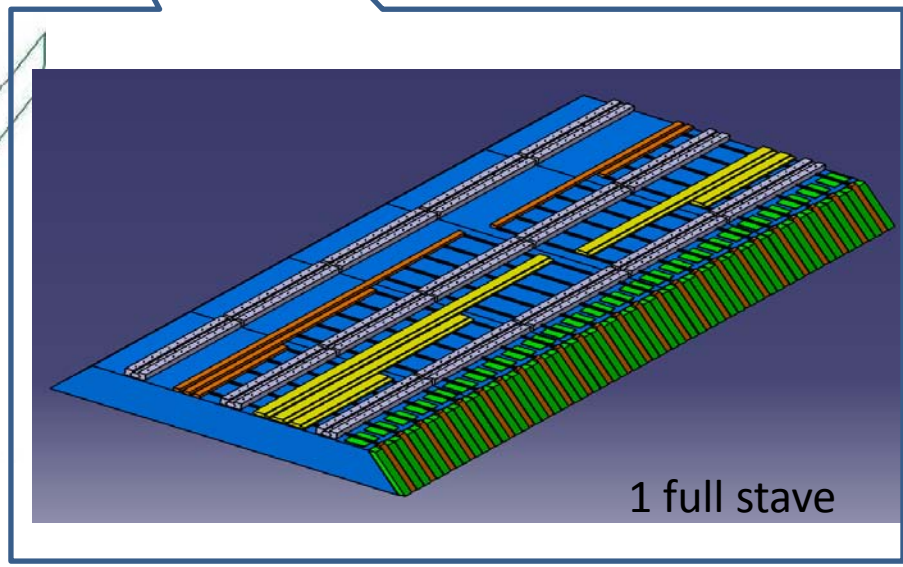
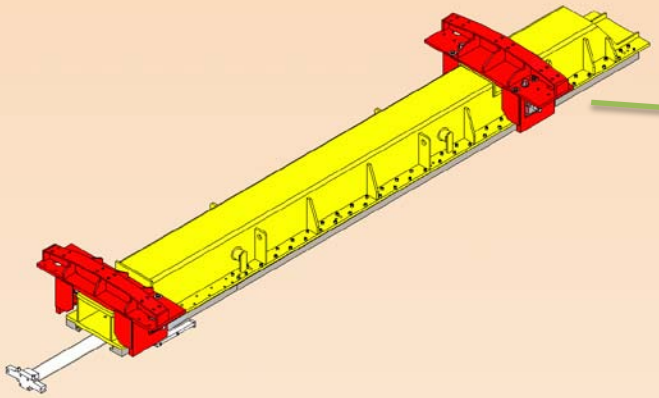
Preliminary reminders :

- The insertion tool will have to follow the angular repartition (pitch of 45 °)

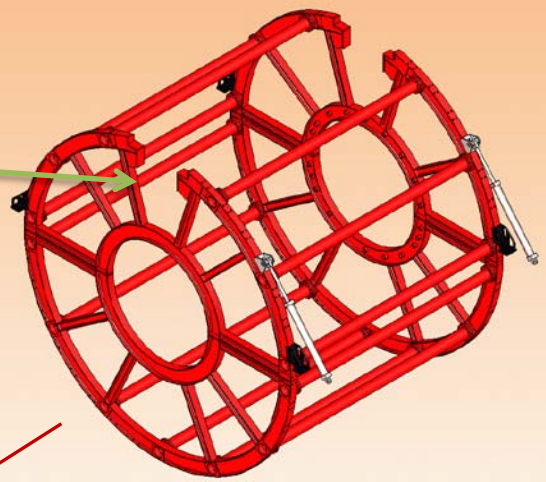




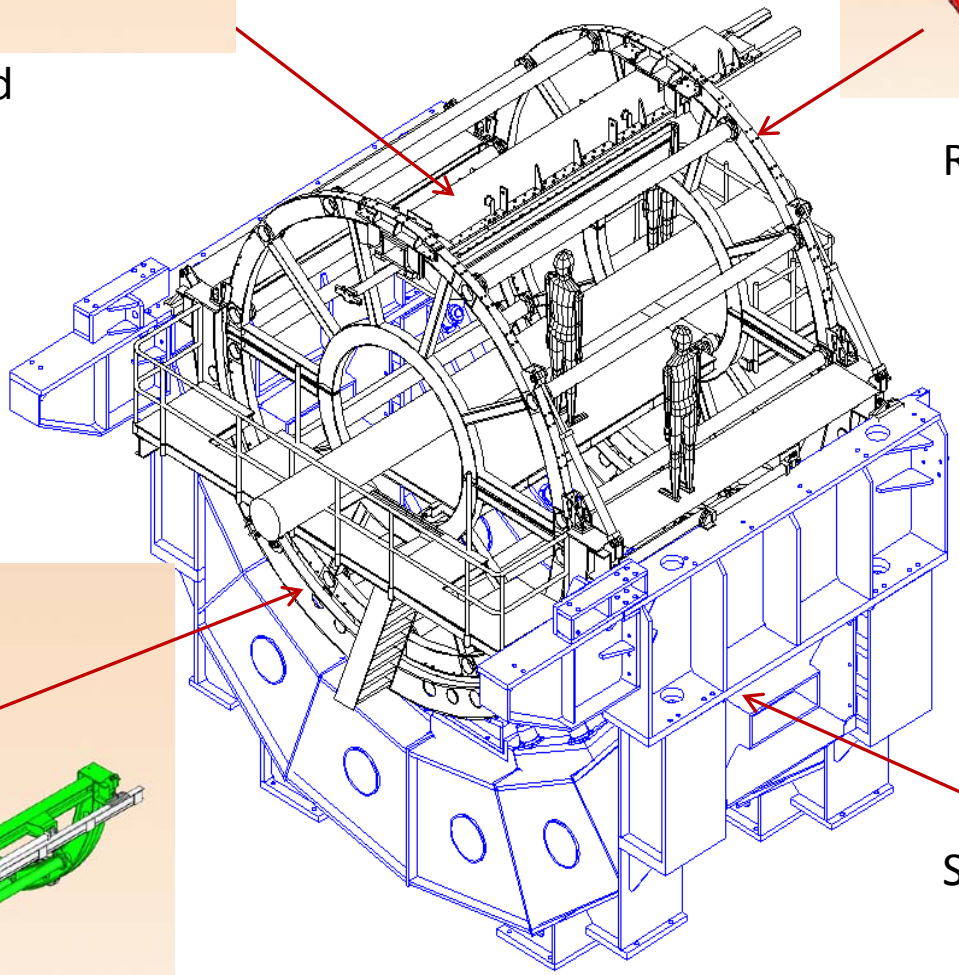


Stave pre-assembled on a frame : beam

Will be fixed at the free sector of the cage

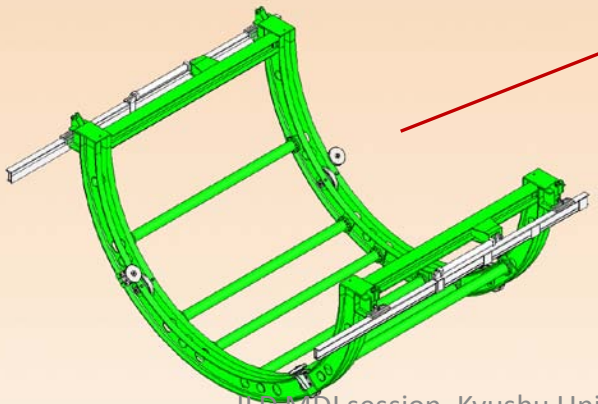


Rotating cage



Marc Anduze's proposition is to use a tool similar to the CMS Ecal insertion tool.

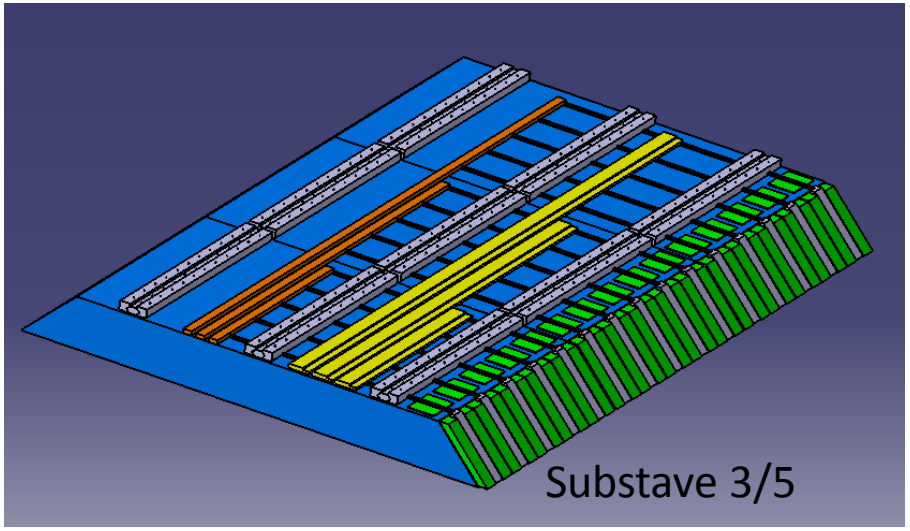
Sliding cradle

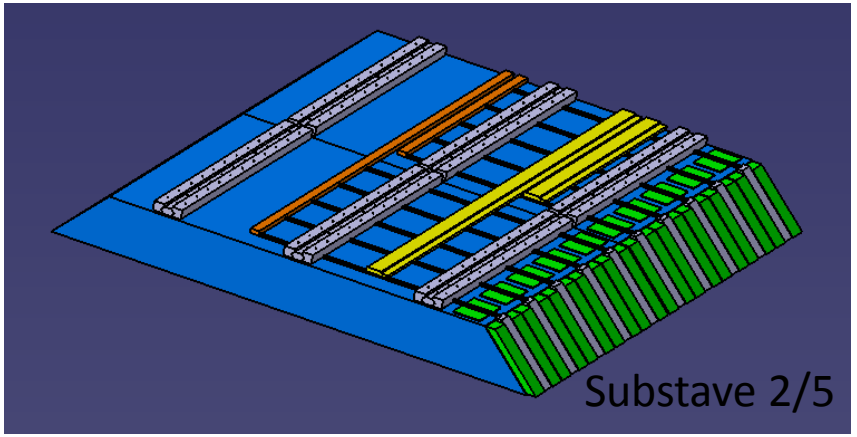


Support cradle

Slides showned in Orsay, in march,

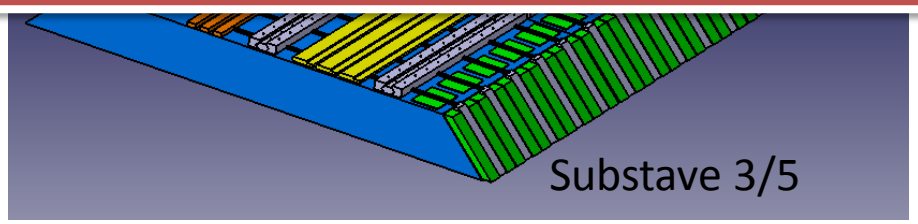
- Ecal is to be inserted into Hcal, hanging from it by rails
- The stave might be divided in two substaves composed of 2 modules and 3 modules respectively Substave 2/5 and substave 3/5.
- This subdivision is due to the fact that the services exit is share between the Z+ and Z- faces of the barrel. Thus, there is a dissymmetry of the volume of services.
- The insertion tooling will have to follow the angular repartition (pitch of 45 °)

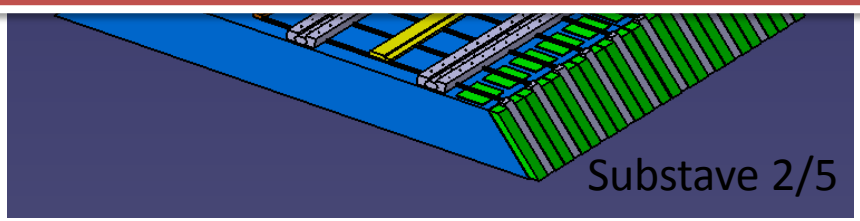




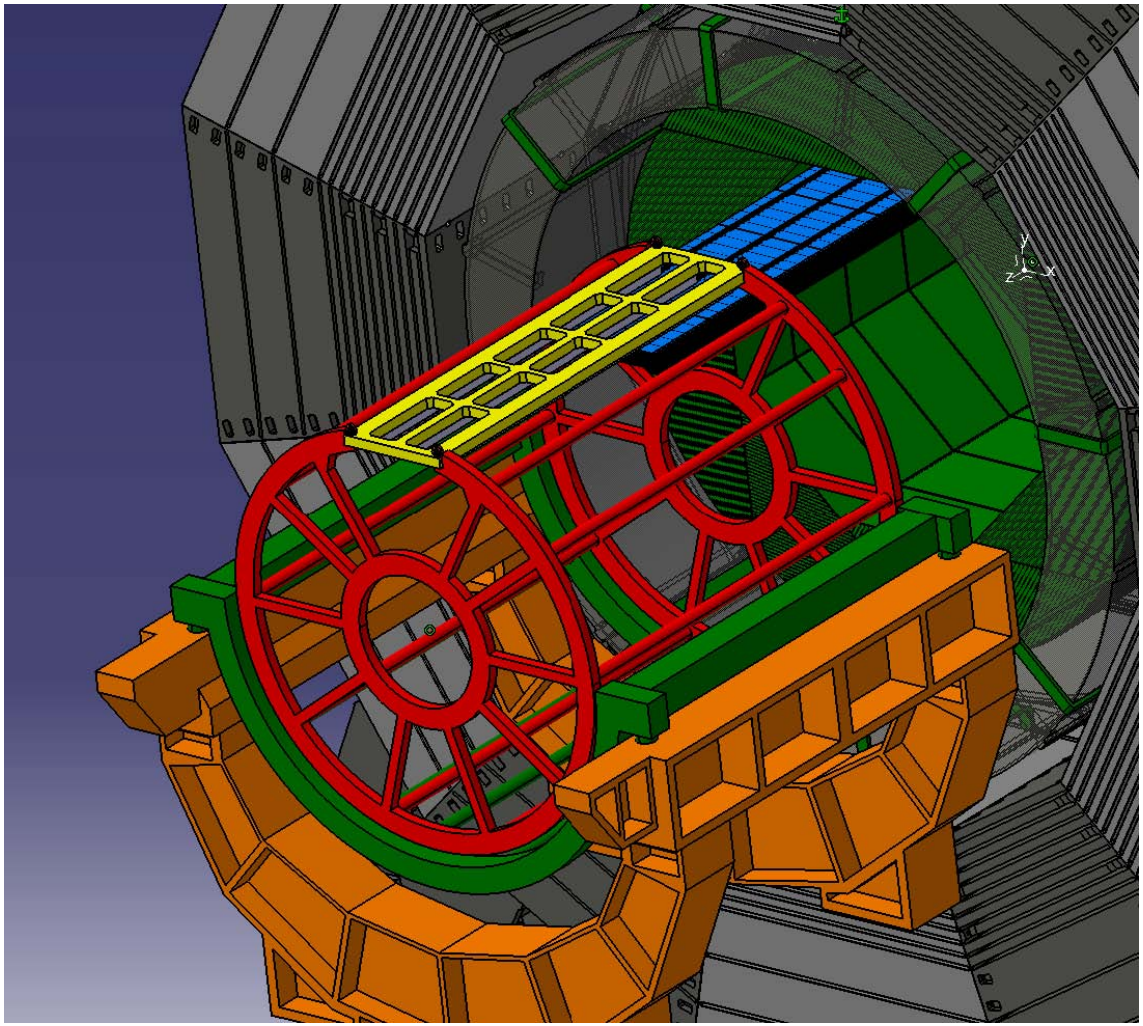
At first, due to dissymetry of the services distribution, we foresaw to subdivide the stave in two substaves and to insert them in Hcal from each side separatly.
This is still under consideration for non-mountain site.

But , as the constraints are stronger, the following slides reporte the sutdies for the Japanese site



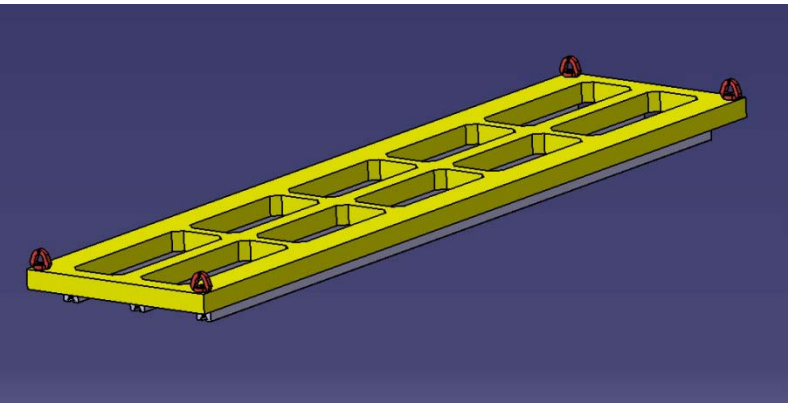


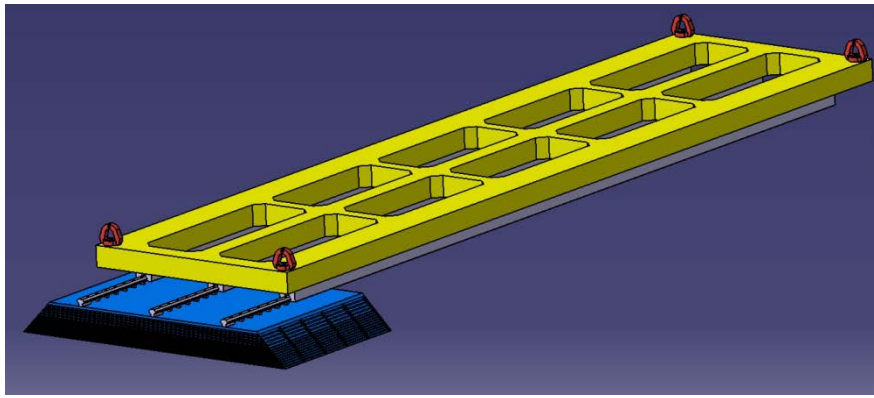
Adaptation of this tooling to the ILD considerations and to the moutain site constraints

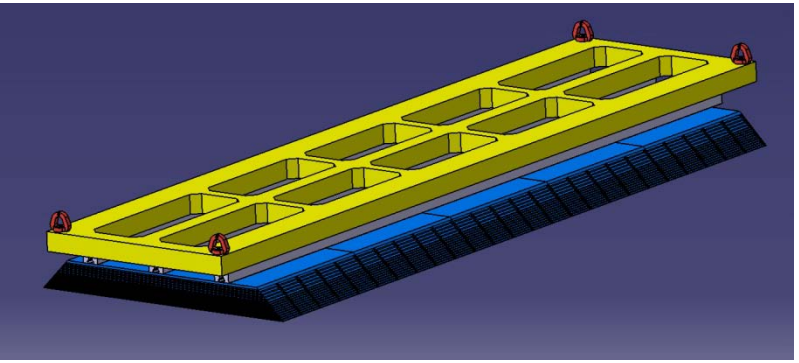


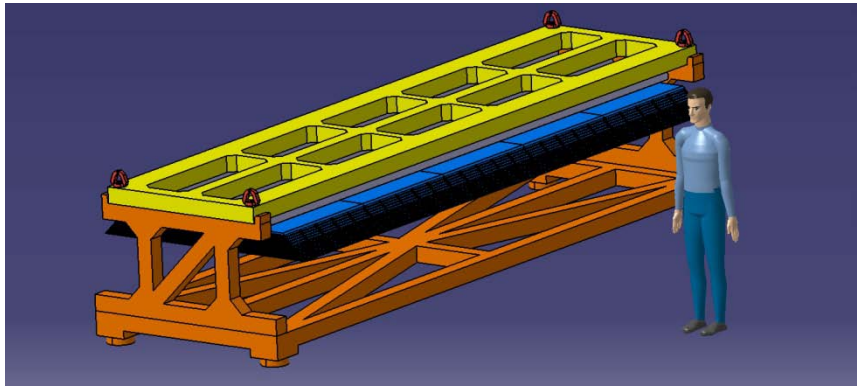
Ecal integration steps (Assembly hall) :

A full (mechanical) stave structure is mounted on a frame (yellow) making a beam
The beam is then placed on its transport and storage cradle(orange)





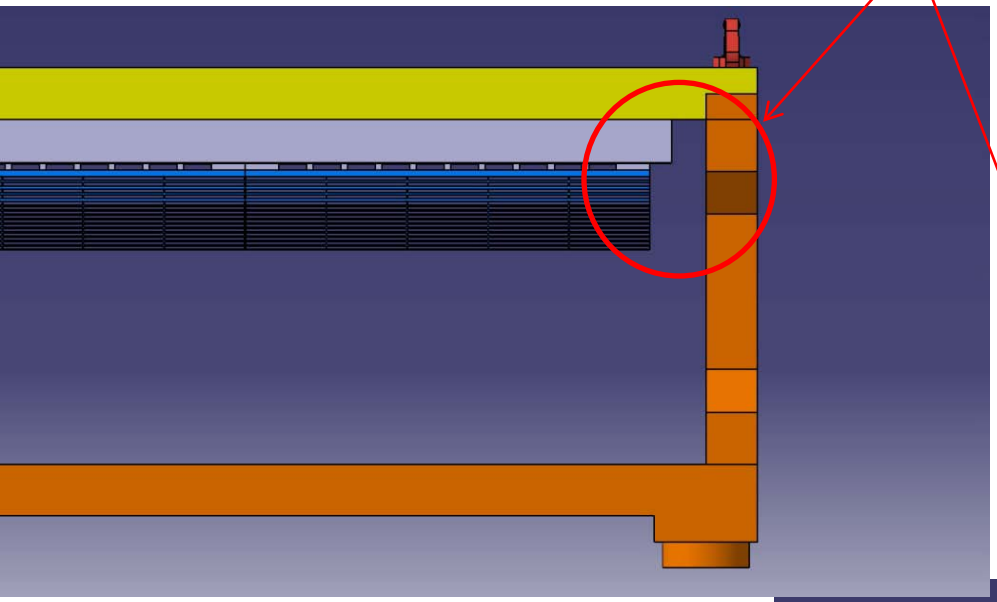


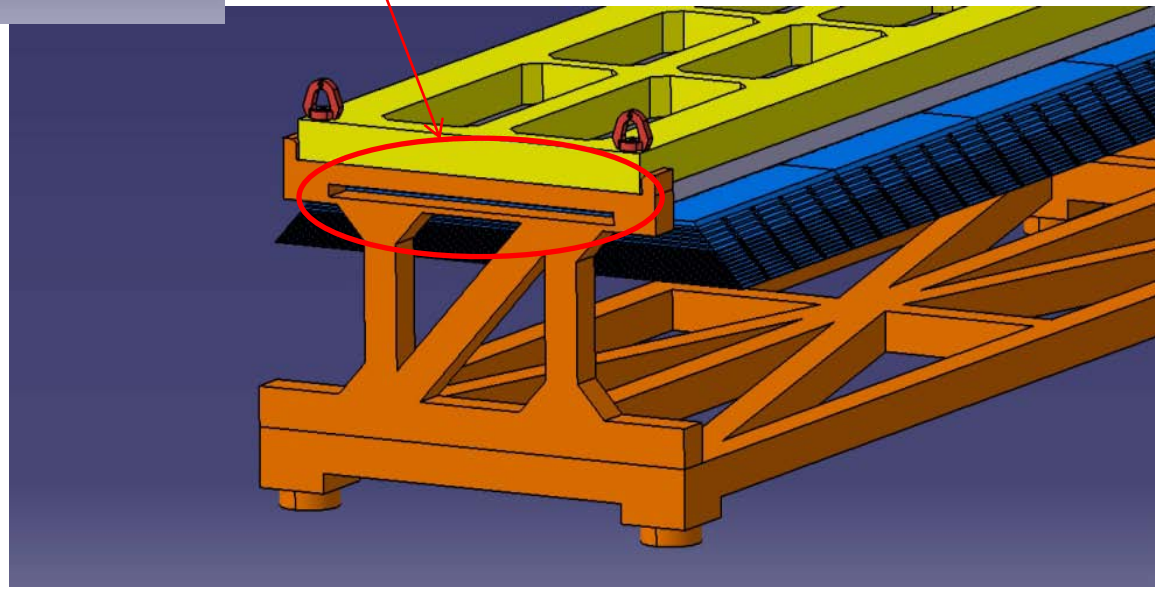


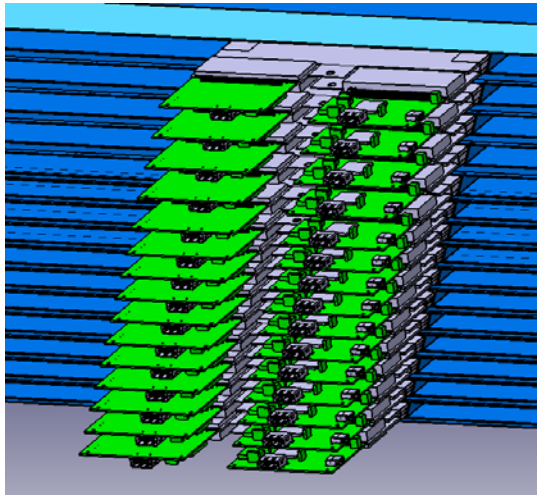
The stave is then ready to be equipped with slabs , cabled and tested

To be done 8 times

Room available for cooling pipe positioning, patch panels …etc…







Assembly of the Ecal :

Parameters :

Barrel				
	Inner radius	1843		
	Outer radius	2028		
	Total length	4700		
	Total weigth	75 t		
	Stave number	8		
Staves		Nber	Weigth	Length (in z)
		8	9,5t	4700
Modules		Nber	Weigth	Length (in z)
		40	1.9t fully equipped	940
Slabs		Nber	Weigth	Length
		3000	From 10 to 15 kg	From 1350 to 1750
Beam		8	**~12 t**	**5200**
Insertion tools			????	7500

Task	Description / constraint		tooling	FTE	Time
1	Handling of 1 (over 40) module. Weigth :1 t	repeated 5 times	Scraft, table	2 T	
2	Alignment				9 days
3	Module 1 in position on frame			2T	
4	Stave 1 and its frame on the support structure				
5	Insertion of 375 slabs per stave. 1 Slab =10 to 15 kg alignment within alveola = 500 µm over 1.8 m			2 T	
6	Electrical connections up to LDA boards			2 T	2 weeks
7	Cooling blocks (5) up to Module edge, over LDA up to main distribution line position			2 T	
8	Electrical and cooling distribution lines on top of the stave				
9	Tests (electronic and signal)			2 T part-time	**2 months**

to be repeated 8 times.

Some parts can be done in parallel

(depends on the available manpower, because not the same qualification) :

Tasks 1-4 of stave (n+1) and Tasks 5 to 9 of the stave (n)

Needed space :

For a stave assembly : 7*4 m²

Per Beam , for storage : 6*3 m²

Stave (fully equipped)+ frame + support

about 12 t

Before or In parallel : Female rails positioning inside the Hcal inner radius

It is assumed that the female parts of the rails have already been fixed on the inner face of the Hcal.
This operation certainly follows almost the same procedure and the same tooling will be used than for the preparation of the stave:

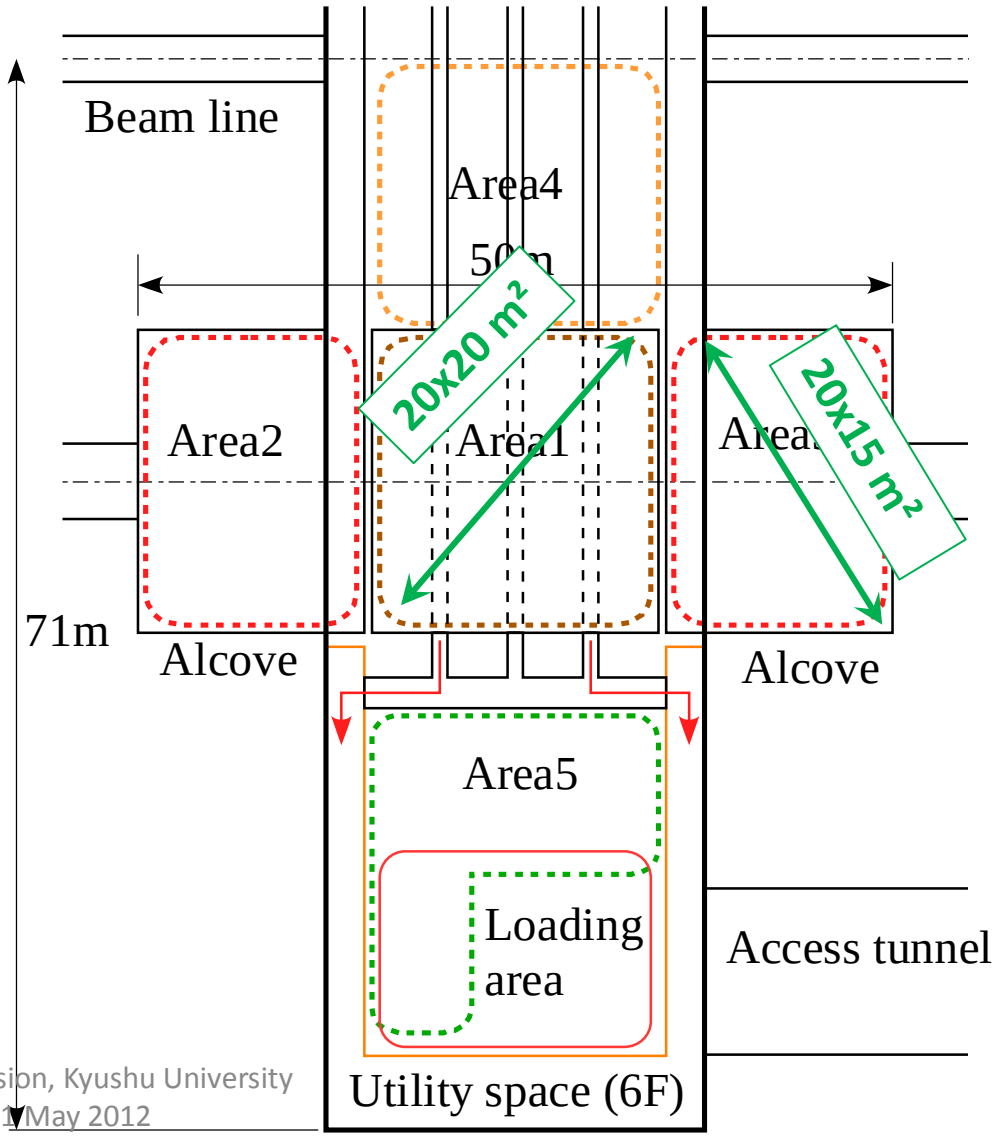
<u>To be done in the assembly hall :</u>
Rails in pairs fixed on a frame and pre-aligned : 8 times
needed space about 2m* 6m for assembly
For storage : 6*2 m² , 8 times
2 weeks

<u>To be done in the cavern :</u>
Using the insertion tool as platform , positioning of the rails inside of the Hcal
Alignment and survey
2weeks

<u>Needed space :</u> see following slides for the tooling, for the storage of the beams before installation :, the needed space shall be the same as on surface

Detector assembly area (from Y.Sugimoto @KILC2012)

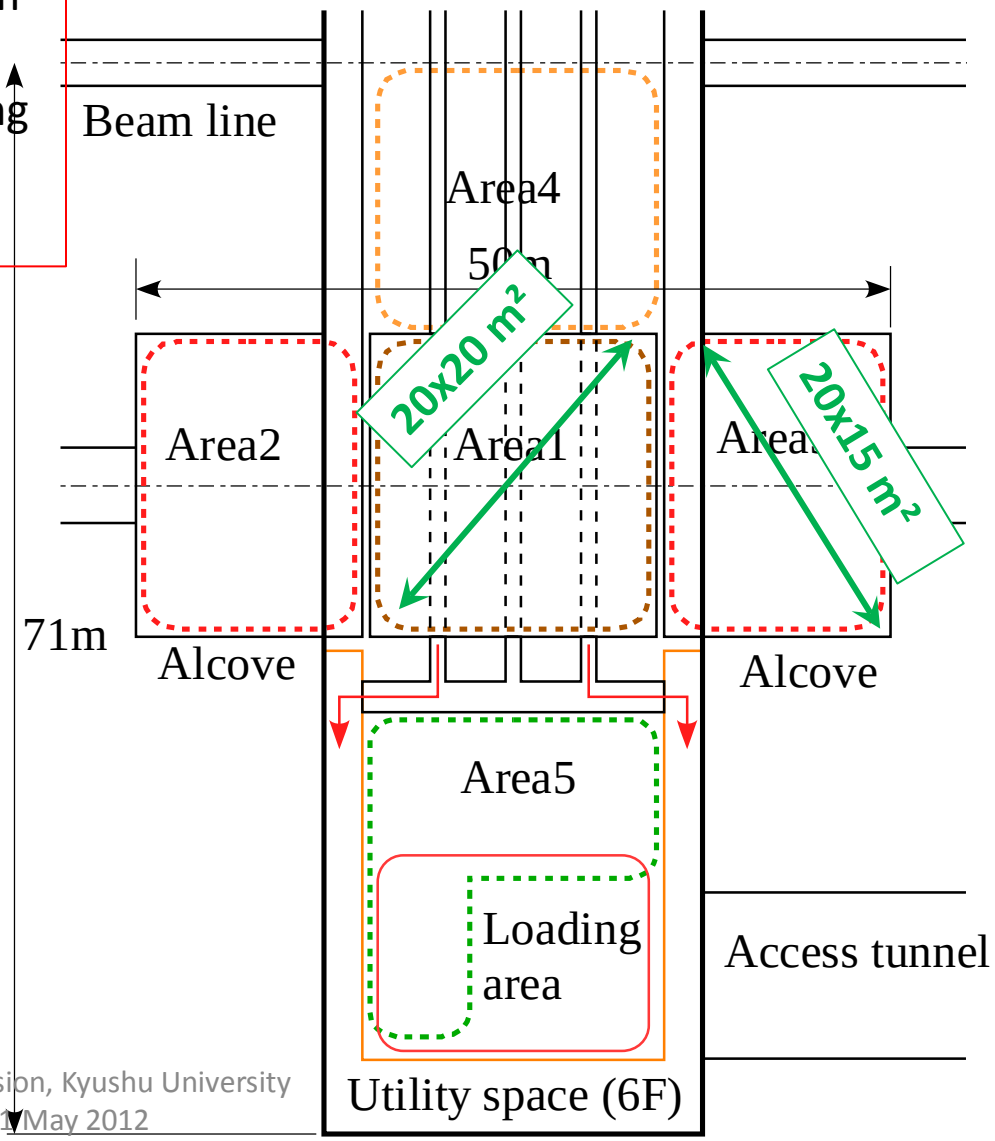
- Area 1: Platform
  - YB0 assembly
  - Barrel detectors installation/cabling
  - Endcap calorimeters installation
- Area 2/3: Alcoves
  - Endcap calorimeters cabling
  - QD0 support tube assembly
  - FCAL install/cabling
- Area 4: Tentative platform on beam line side
  - YE, YB+, YB- (iron yoke and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



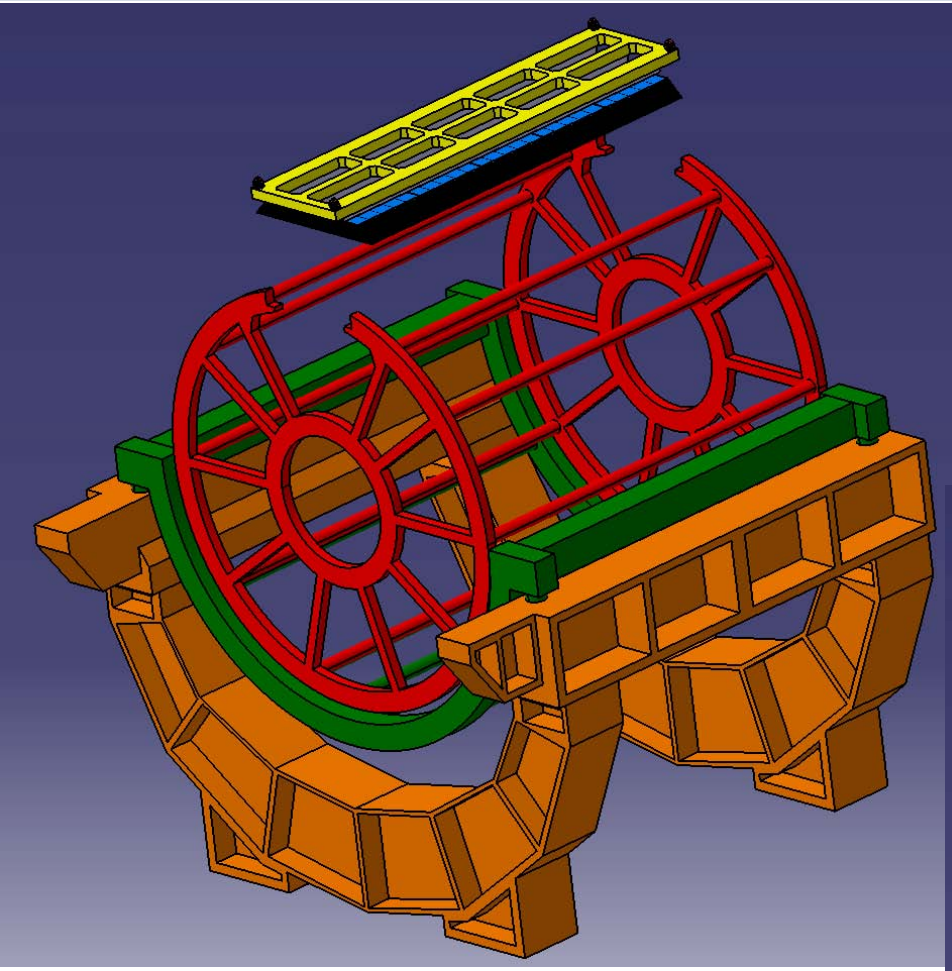
Detector assembly area (from Y.Sugimoto @KILC2012)

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

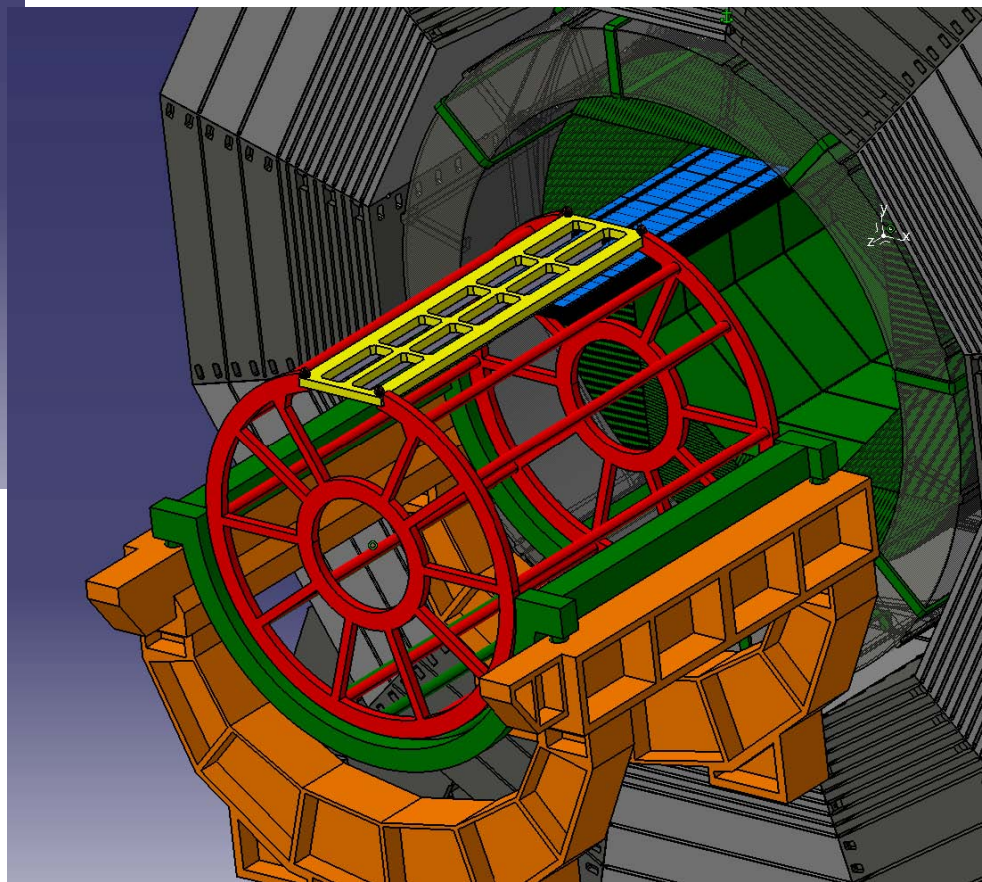


In cavern, installation of the Ecal barrel :



Beam on the rotating cage :

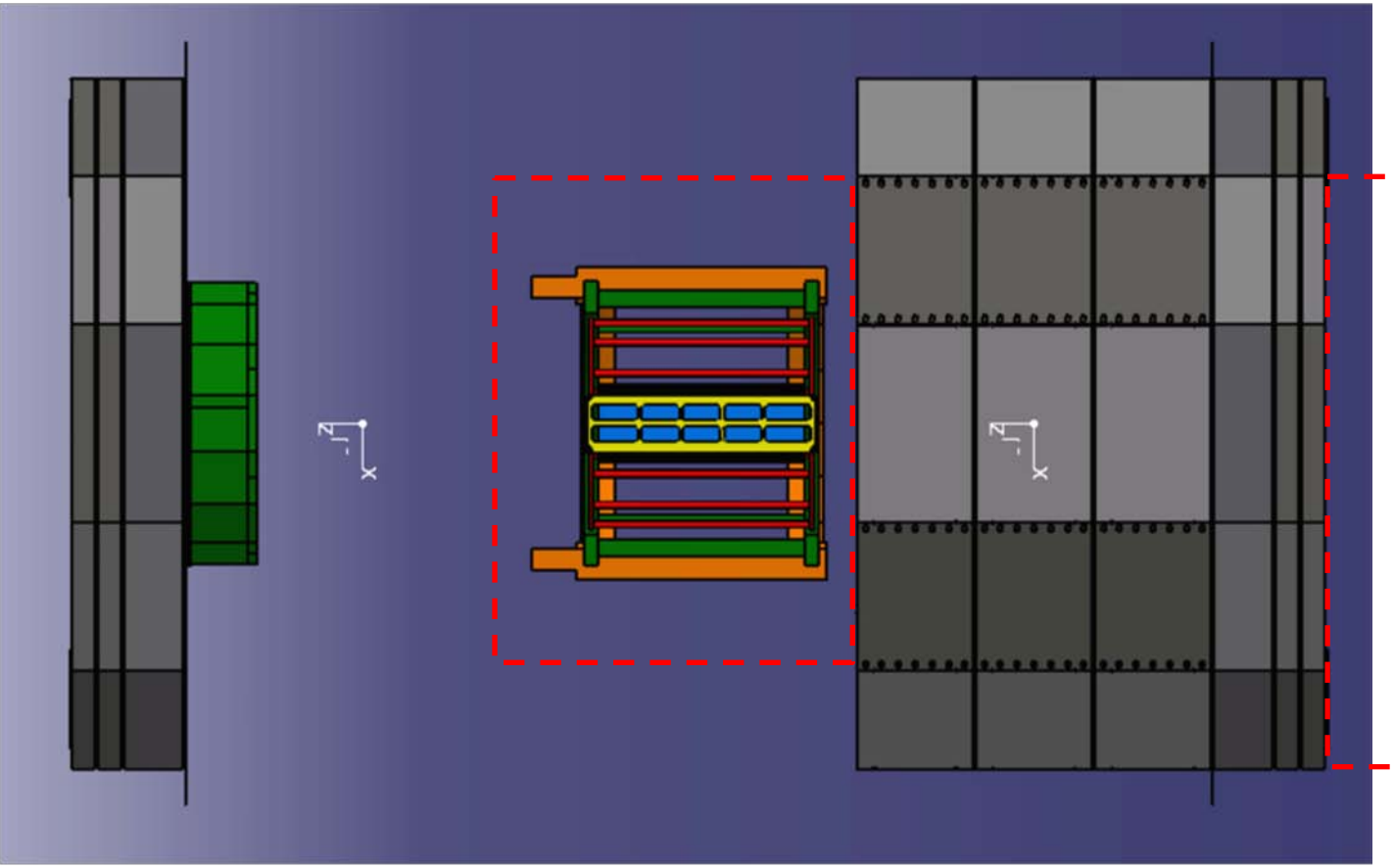
(crane of at least 12 t)



Stave slide inside the Hcal

Needed space on assembly position (area 1):

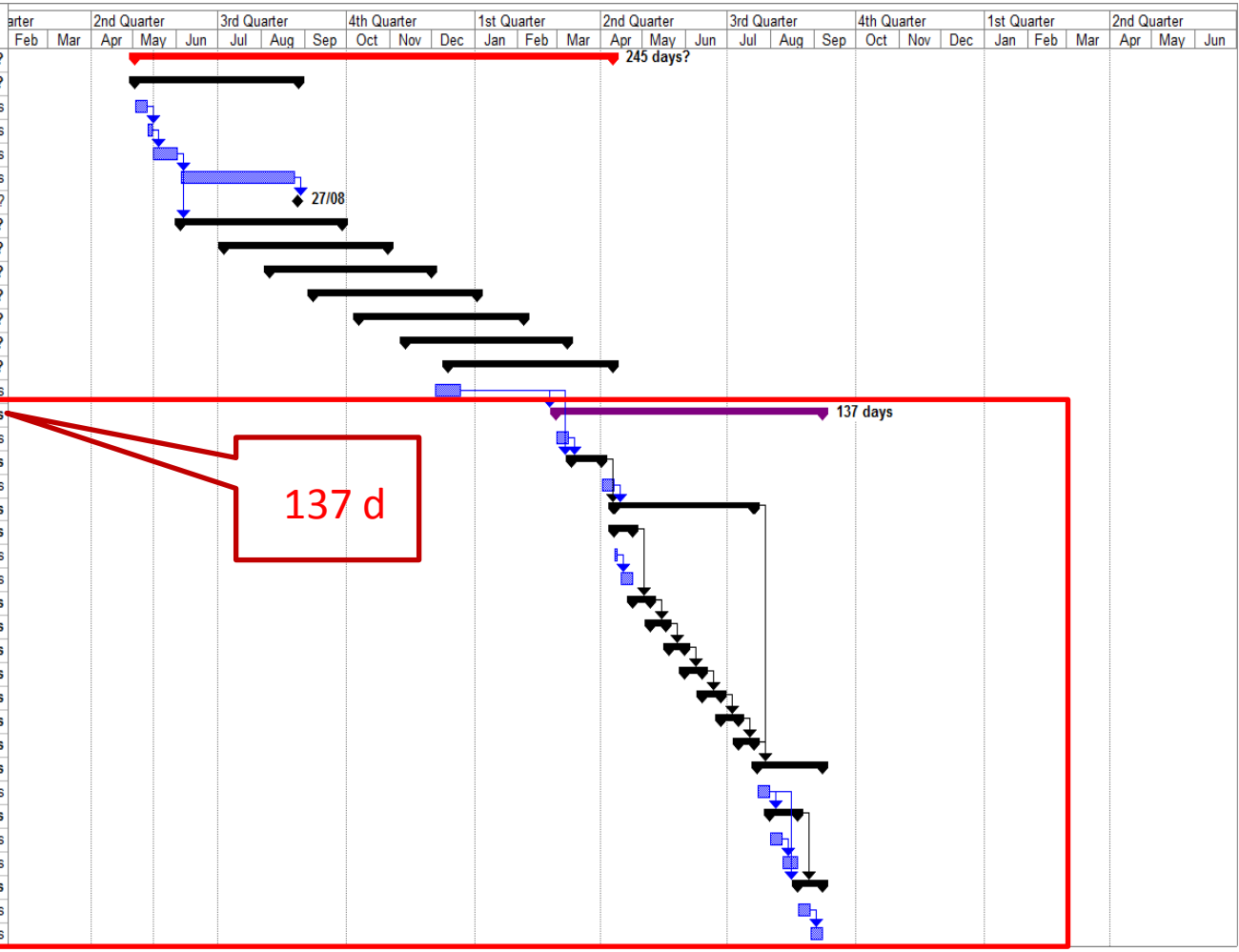
Insertion tool : ≈ 7 * 7 m weight not yet estimated
+ around this tool, space for movement of a scaffold (3 meters more all around) :
= 10*10m²



We need also the access to the opposite face of the Barrel (face Z-) for cabling , i.e. positioning of a platform + movement of a scaffold

But we need almost the same space for assembly of the tooling itself in area 5
And also for storage or dismounting.

ID	Task Name	Duration
1	**Assembly Hall**	**245 days?**
2	**Stave 1**	**84 days?**
3	Insertion of submodule 1-5 on frame	7 days
4	alignment	2 days
5	slabs insertion	14 days
6	electrical tests + acquisition tests	60 days
7	beam 1 ready	1 day?
8	**Stave 2**	**84 days?**
14	**Stave 3**	**84 days?**
20	**Stave 4**	**84 days?**
26	**Stave 5**	**84 days?**
32	**Stave 6**	**84 days?**
38	**Stave 7**	**84 days?**
44	**Stave 8**	**84 days?**
50	Female rails positioning on specific frames (8 times)	15 days
51	**Experimental Hall**	**137 days**
52	Insertion tool assembly and positionning	7 days
53	**Female rails in Hcal**	**16 days**
62	Dismountling of tooling and preparation of Insertion tooling	7 days
63	**Mechanical insertion of Ecal in Hcal**	**72 days**
64	**Beam 1 insertion**	**9 days**
65	handling of stave 1 from ass. To exp hall	2 days
66	Insertion in Hcal	7 days
67	**Beam 2 insertion**	**9 days**
70	**Beam 3 insertion**	**9 days**
73	**Beam 4 insertion**	**9 days**
76	**Beam 5 insertion**	**9 days**
79	**Beam 6 insertion**	**9 days**
82	**Beam 7 insertion**	**9 days**
85	**Beam 8 insertion**	**9 days**
88	**Wheel services connection**	**35 days**
89	Wheel geometrical survey	7 days
90	**Face Z-**	**14 days**
91	connection	7 days
92	tests	7 days
93	**face Z+**	**14 days**
94	connection	7 days
95	tests	7 days



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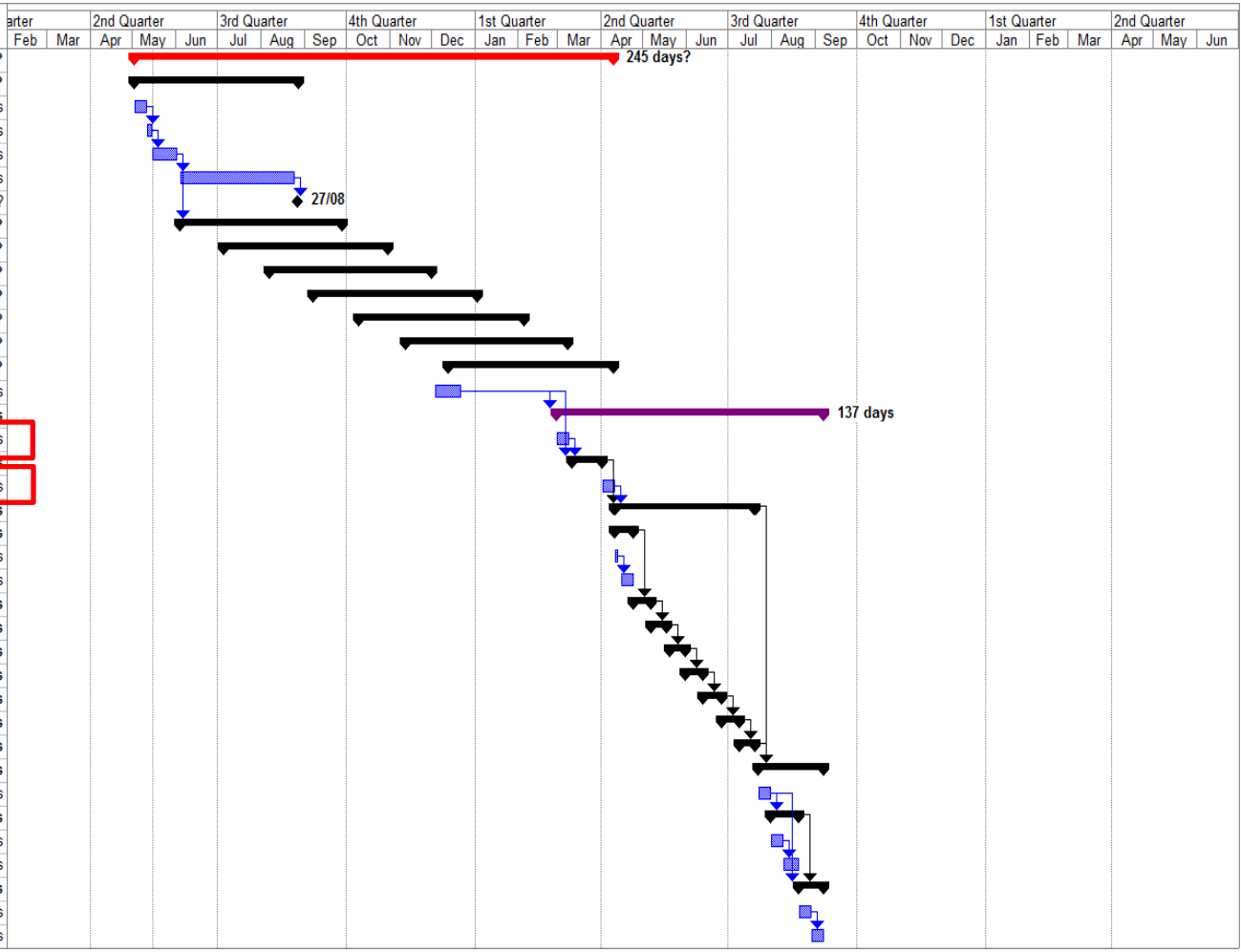

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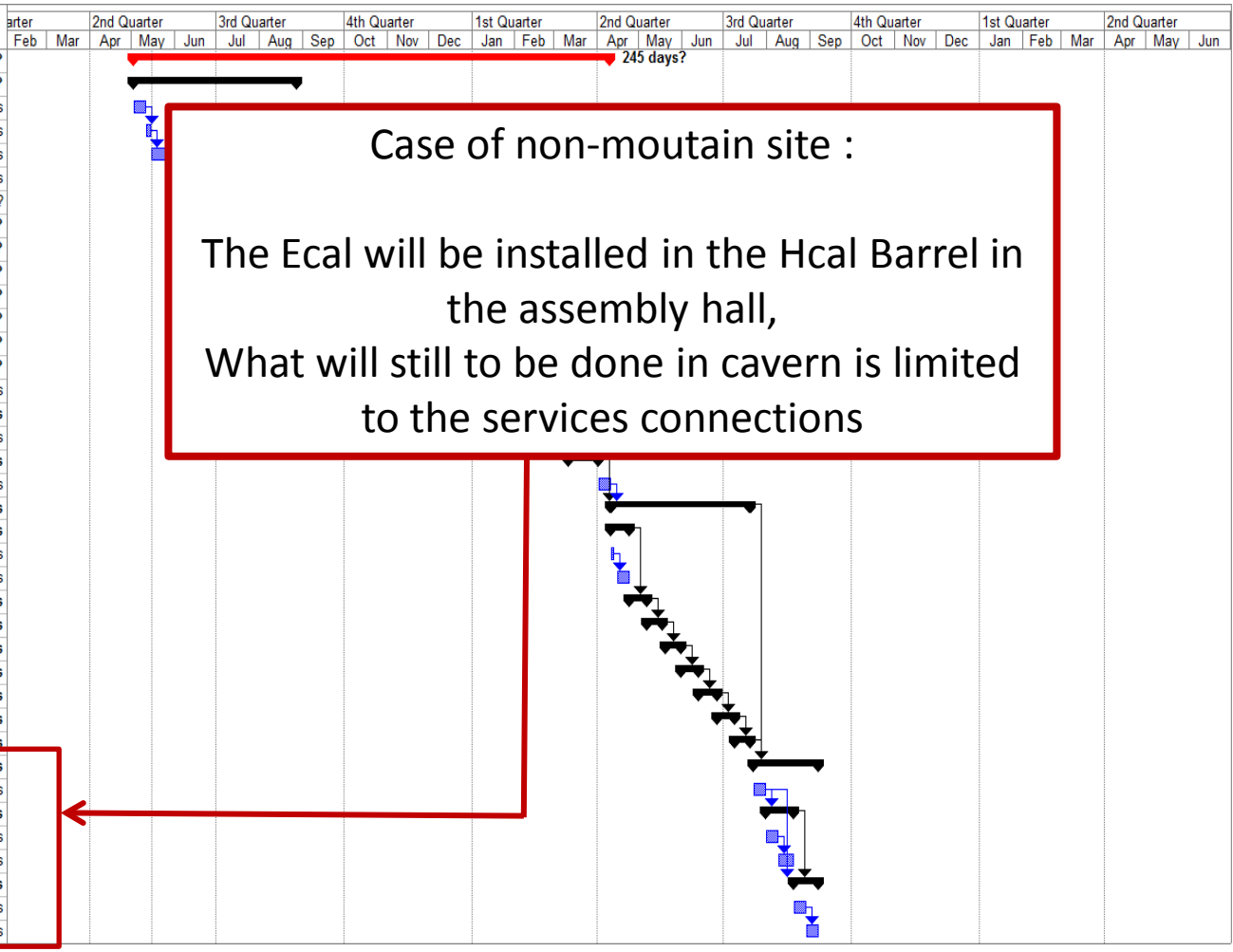
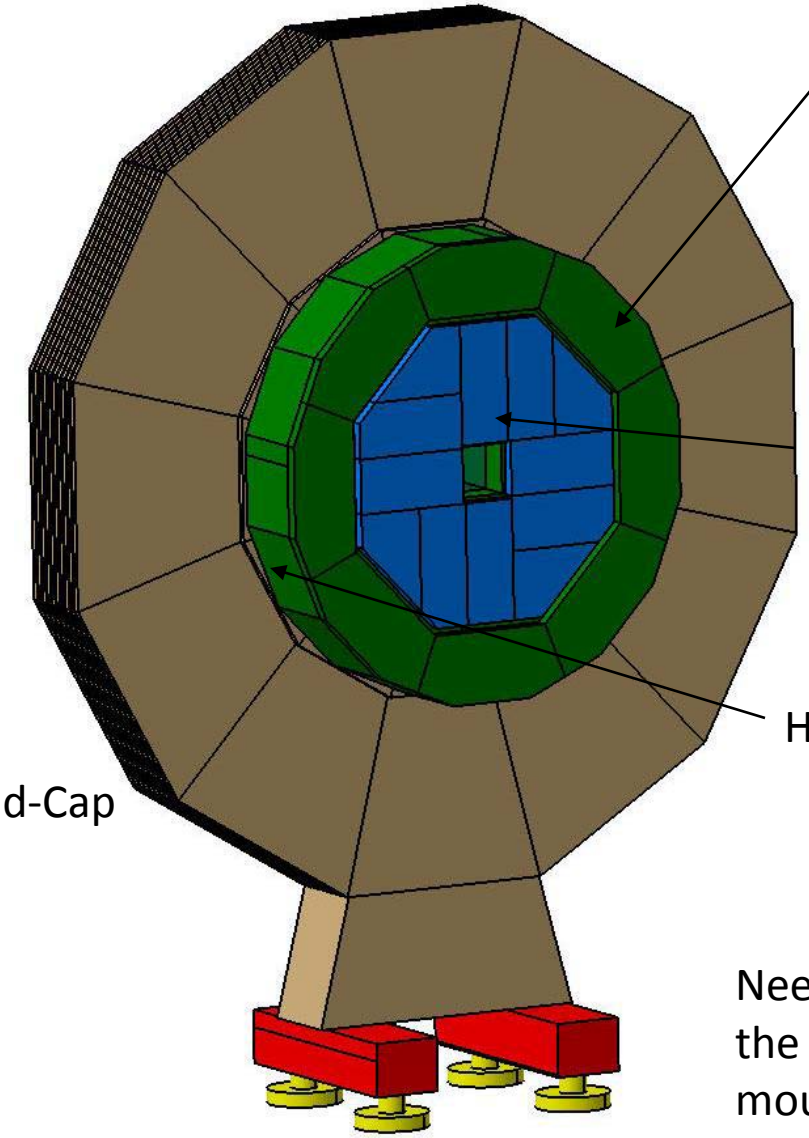


Preliminary reminders

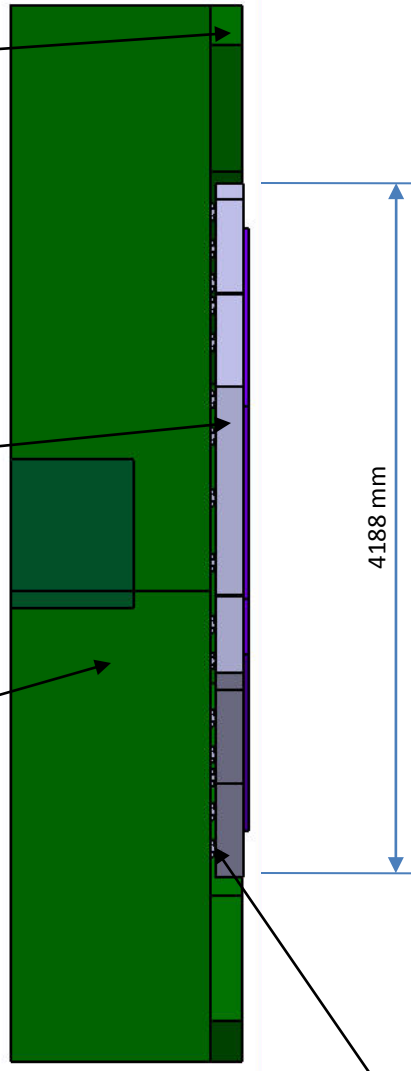


HCAL Ring

ECAL End-Cap

HCAL End-Cap

Yoke End-Cap



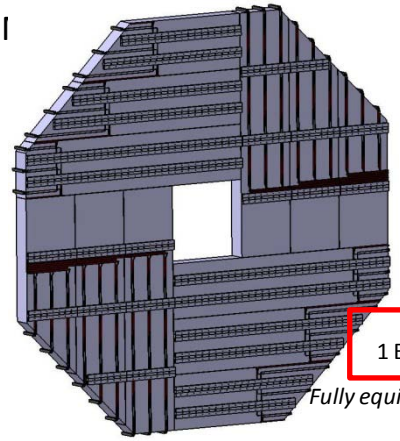
Need to know
the HCAL end cap
mounting

Alveolar W-Carbon HR modules with
Rails for Fastening system on HCAL

ECAL Fully equipped End-cap weight : ~ 25.5 T

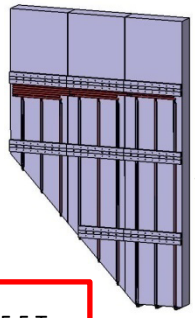
Current structure of End-Caps

Modular structure	2 End-Caps Total of 2x12 modules = 2 x [4 quarters each]

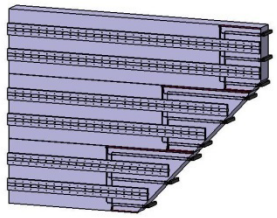


1 EC ~25,5 T

Fully equipped with slabs, rails and pipes

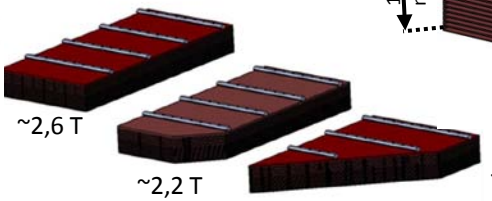


2 quarters ~6,5 T each

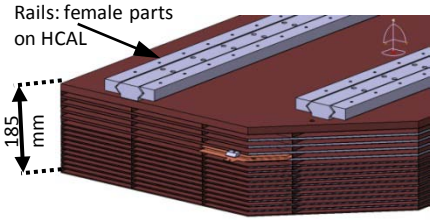


Alveolar W-Carbon HR structure with Fastening (rails) and Cooling system

3 modules in each quarter



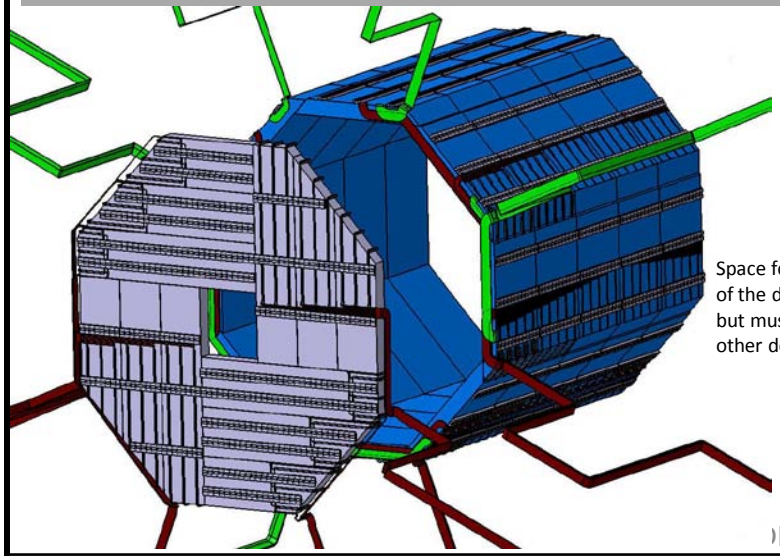
(2 orientations of rails)



1 of the 3 « standard » modules of each quarter

The assembly in quarter (2 ≠ configurations) will depend of:
- Integration process
- Maintenance scenario

ECAL General Cooling Integration - Leakless system



- Cooling system to be installed on rear face prior to insertion.
- Symmetry of onboard services,
- dissymmetry of outboard ones

Separation wall (protection / magnetic field and radiation)

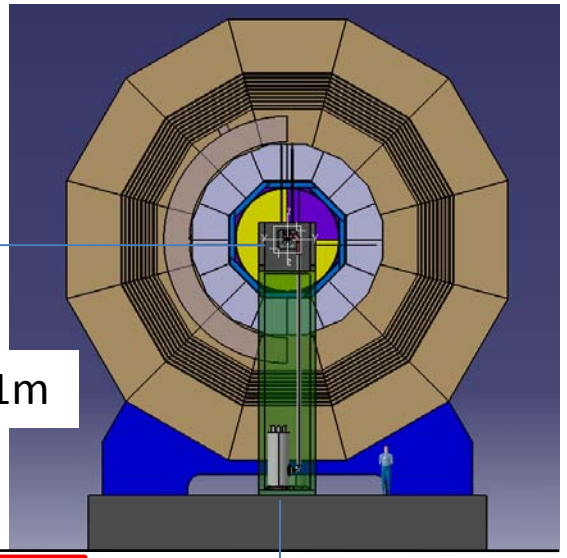
Space for pipes outwardly of the detector is limited but must be consolidated / other detectors

h≥ 11m

Cooling station

3 m x 2 m x 2 m

L ≤ 30m



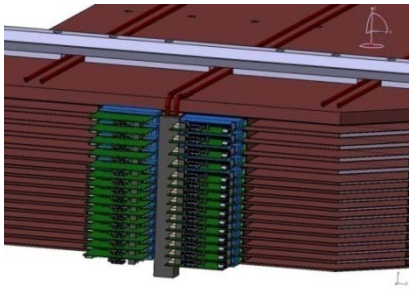
ILD MDI session, Kyushu University
21 May 2012

Synoptic for integration

1 - Assembly of modules and quarters in the assembly hall

1-1. Modules equipment and test (24)

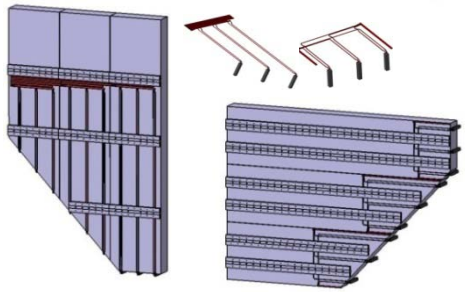
Task	Description / constraint	
1	Handling of 1 (over 24) module.	Time: 1 week
2	Insertion of 45 detectors slabs per modules.	Assembly area: 25m²
3	Electrical connections up to LDA boards	FTE: 2T
4	Cooling blocs (3) up to Module edge, over LDA up to main distribution line position	Weight per module: ~1.6 t to 2.6 t
5	Tests (electronic and signal)	



Same processes repeated 4 times per group of 3 modules (equipment of 1 End-cap)

1-2. Quarters assembly (2x4) on mounting support frame

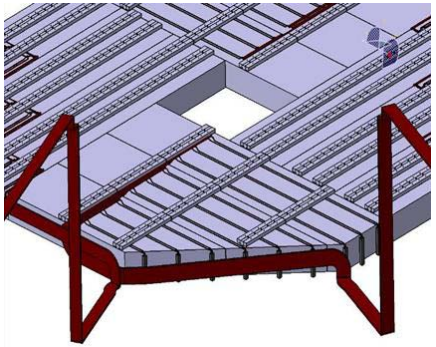
Task	Description / constraint	
1	Handling of 1 (over 24) module.	Time: 2 weeks
2	Mechanical interconnection of the modules to complete one quarter	Assembly area: 20m²
3	Cooling pipes connections over the 3 modules, Installation under rails	FTE: 2T
4	Electrical connections up to quarter edge	Total weight : ~ 6,5 t / quarter
5	alignment of rails with template	



2 - Assembly of 4 quarters on HCAL End-Cap in the cavern *(see slide 5 & 6)*

3 - ECAL *End-Cap General Cooling Integration* in the cavern on HCAL

Task	Description / constraint	FTE: 4T
1	Connection of leakless system to modules /quarters (pipes incoming by lower side of End-cap)	Time: 2 weeks
2	Full connection of 1 End-Cap: general EC integration + ***piping trough detectors to cooling station***	Time: 1 month



to be refined

Leakless system :

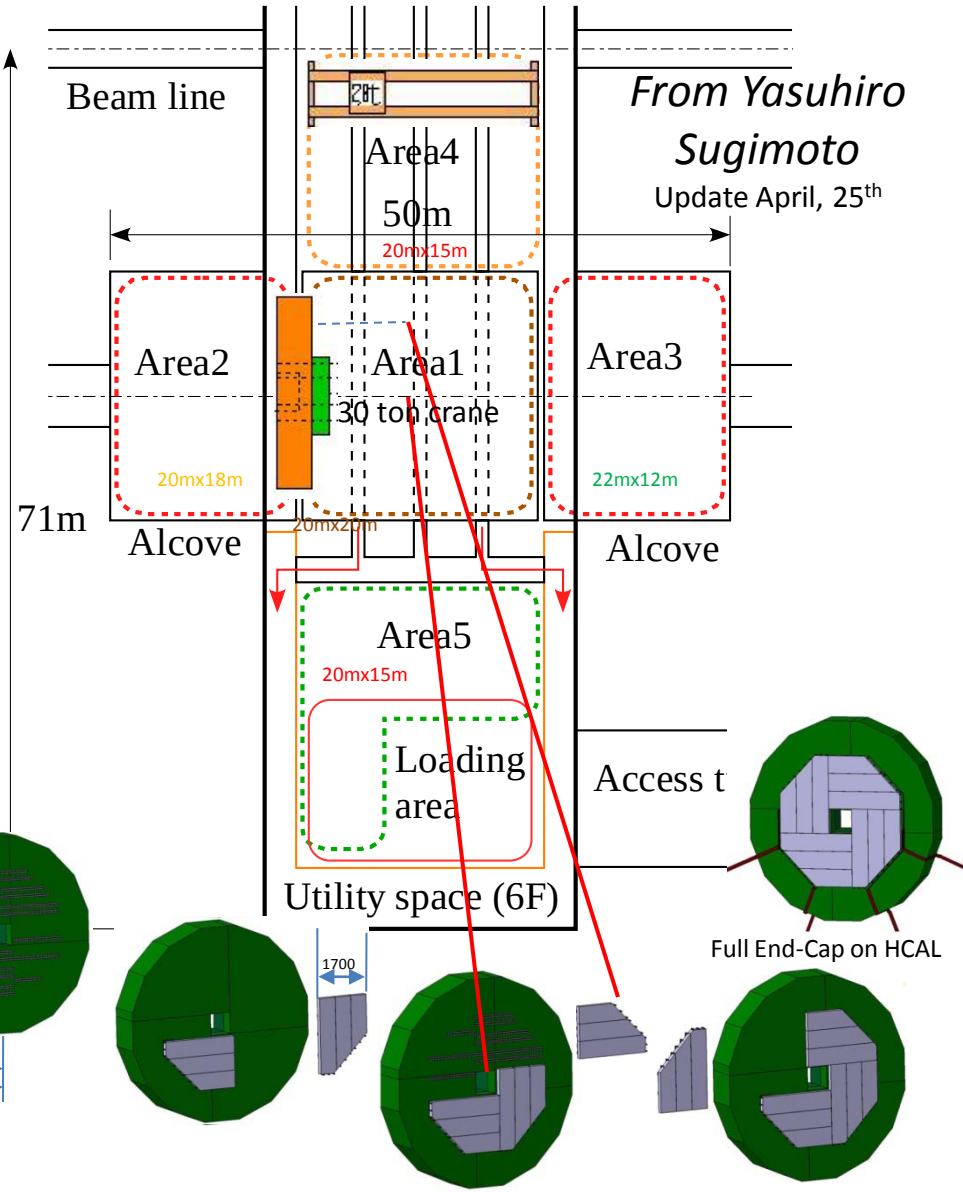
- Cooling front –end to remove the power of ECAL
- Low water speed and low temperature gradient
- Risk of spray limited - Temperature and power range adapted

ECAL End-Caps: integration area

PRELIMINARY

Construction sites dedicated to end caps
- installation area 1
- cabling: alcoves n° 2 & 3

The crane capacity in the alcoves (2,8t) is too small for quarters
(only dedicated for handling of modules if necessary and for tools)



Needed space near detector for Integration & maintenance

Minimum width = 7 m/beam line for integration
Storage area : 1 quarter=> 10 m² / 12 modules=> 50 m²
Assembly area: 25 m² / quarter - **20 m² / module**
Insertion on HCAL End-Cap on each side: per full quarters
Positioning of ECAL quarters in front of HCAL End-Cap
→ **lateral space** needed for sliding, tuning, alignment & fastening

Questions

- Modules fully equipped on surface **?**
- Sub detectors (slabs) are fully commissioned on surface **?**

ECAL End-Caps: integration overview

< 5 months / EC

N°	Major Tasks Description for 1 End-Cap (*Preliminary studies of the Ecal End-Cap assembly*)	FTE	TIME	Ressource name	
1	ECAL End-Cap Base Moving Unit / Base Moving Frame / Quarter Mounting Frame Insertion tool, transport , installation, alignment	4	**~ 1 month**	crane 1 , crane 2	Assembly Hall
2 //	Rails: fixing (female parts) on the rear face of the HCAL End-Caps: Positioning / Alignment / Checking	3	~ 1 month	Specific tooling TBD	
3	Quarter 1 (3 modules) assembly in the assembly hall, fully equipped, tested and aligned	6 //	**4 weeks**	quarter support frame 1, crane 1	
	3 Modules Equipment and test (assembly of 1 of the 3modules in the assembly hall)	2	1 week x 3		
	Tests (electronic and signal) of the 3 constitutive modules	2 //	1 week x 3		
	Quarter assembly on mounting support frame	2	1 week		
	Transportation of quarter in mountain site (or modules only / space available for tooling approach on both sides of detector in cavern)	4	2 days		
4 //	Quarter 2 (3 modules) assembly in the assembly hall, fully equipped, tested and aligned …	6 //	4 weeks	quarter support frame 2, crane 1	
5	Quarter 3 (3 modules) assembly in the assembly hall, fully equipped, tested and aligned …	6 //	**4 weeks**	quarter support frame 1, crane 1	
6 //	Quarter 4 (3 modules) assembly in the assembly hall, fully equipped, tested and aligned …	6 //	4 weeks	quarter support frame 2, crane 1	
7	Integration of 1 Ecal End-Cap on HCAL End-Cap	4	**1 month**	crane 1 , crane 2 quarter support & MF	CAVERN
	Insertion of 4 Ecal End-Cap quarters on HCAL End-Cap (quarter on its support frame) Positioning of the quarter on specific sliding tool / Pre-alignment operations / Insertion	4	2 days x 4	crane 1 , crane 2 quarter support & MF	
8	1 ECAL End-Cap general cooling integration	4	2 weeks		
9	Remove ECAL End-Cap Mounting Frame / Base Moving Frame / Quarter Mounting Frame…	4	1 week	crane 1 , crane 2	

Main issue /mechanical quarter behavior during insertion on HCAL: Quarter Mounting Frame (To Be Studied)

Step 13

(Y.Sugimoto @ KILC2012)

- 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