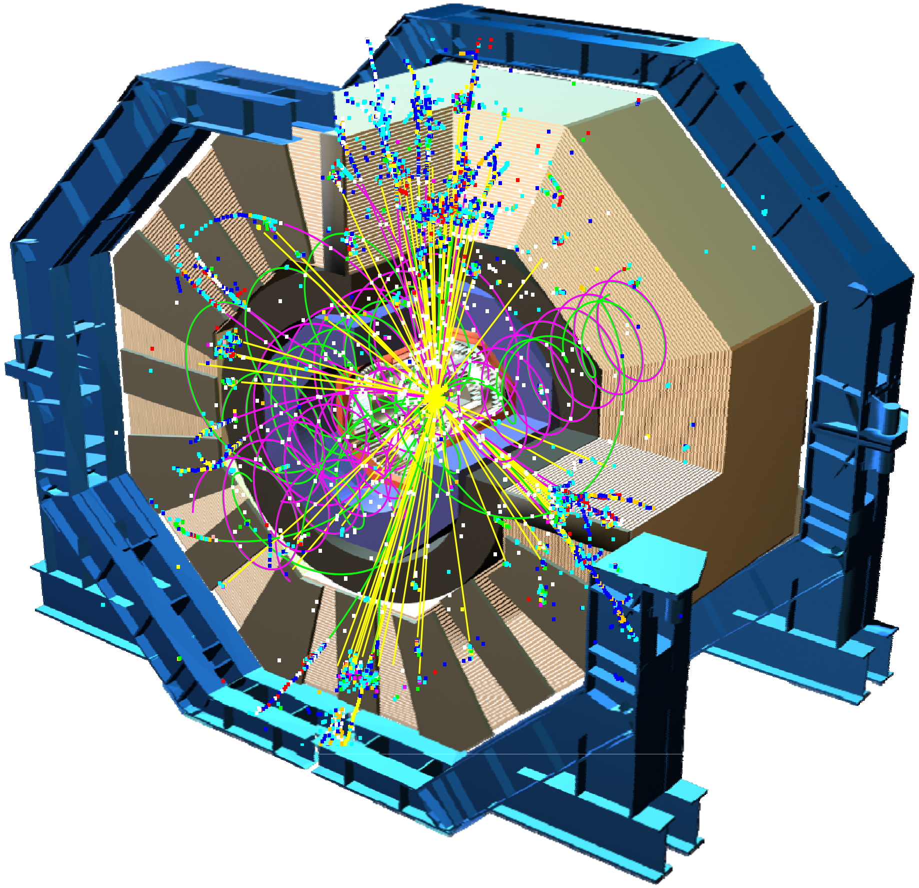
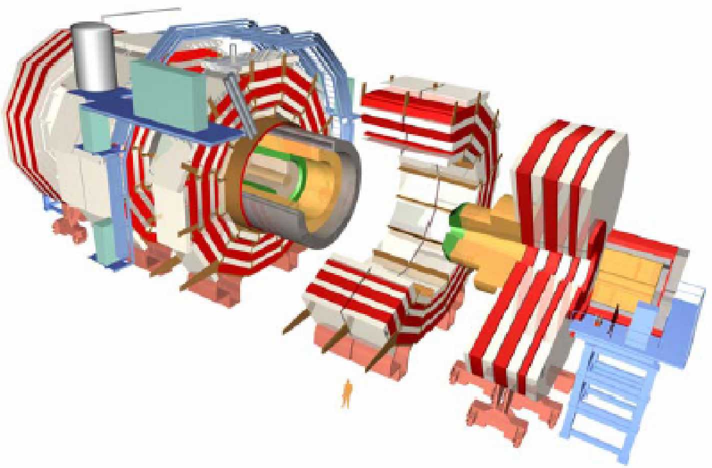
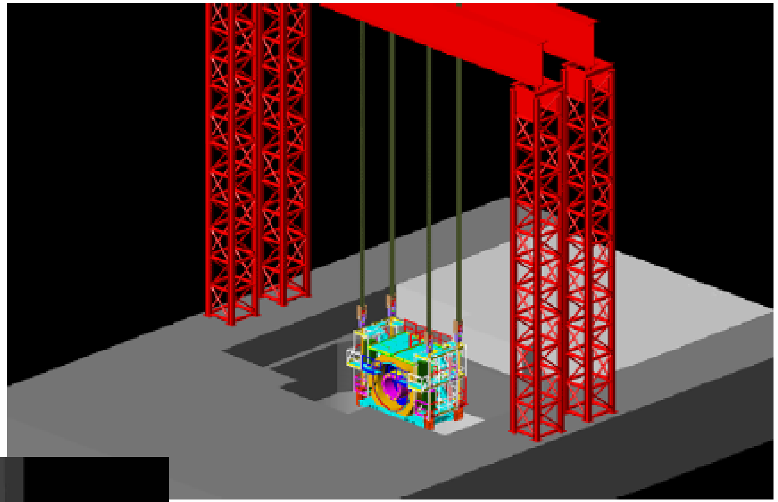
SiD Surface Assembly

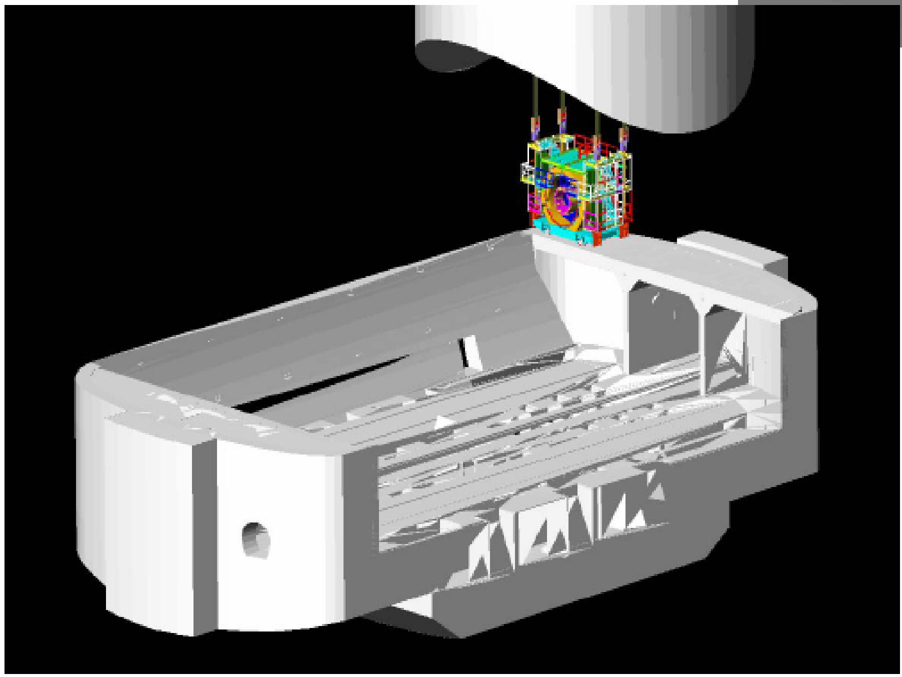


On-surface (a la CMS) assembly

- According to tentative CF&S schedule, the detector hall is ready for detector assembly after 4y11m after project start
- If so, cannot fit into the goal of "7years until first beam" and "8years until physics run"
- Surface assembly allows to save 2-2.5 years and allows to fit into this goal
- The collider hall size is also smaller in this case
  - A building on surface is needed, but savings are still substantial





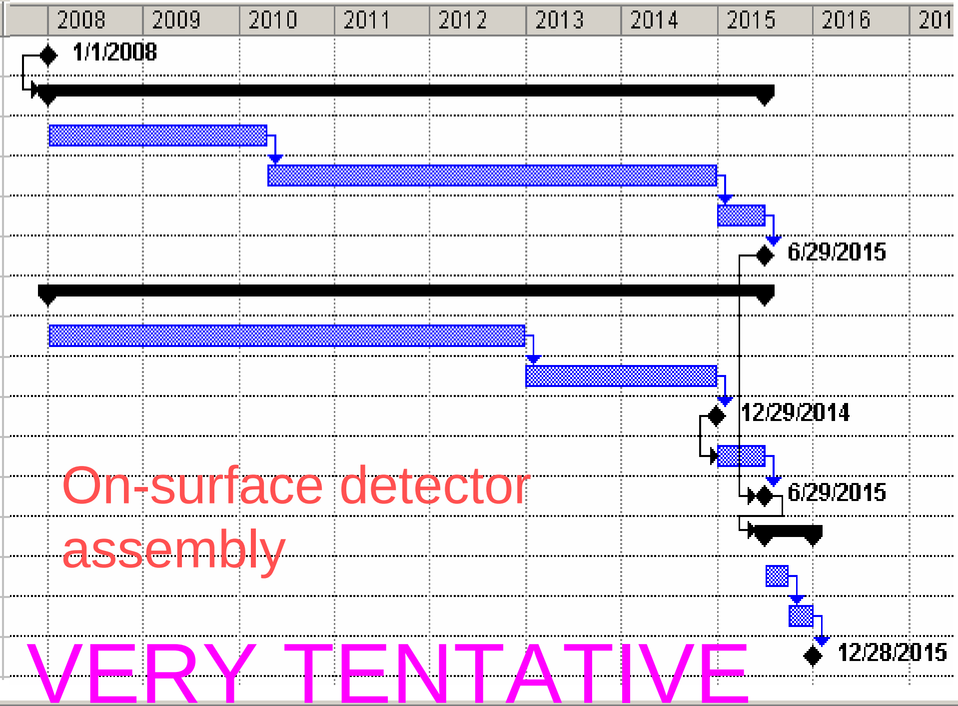


CMS detector assembly approach:

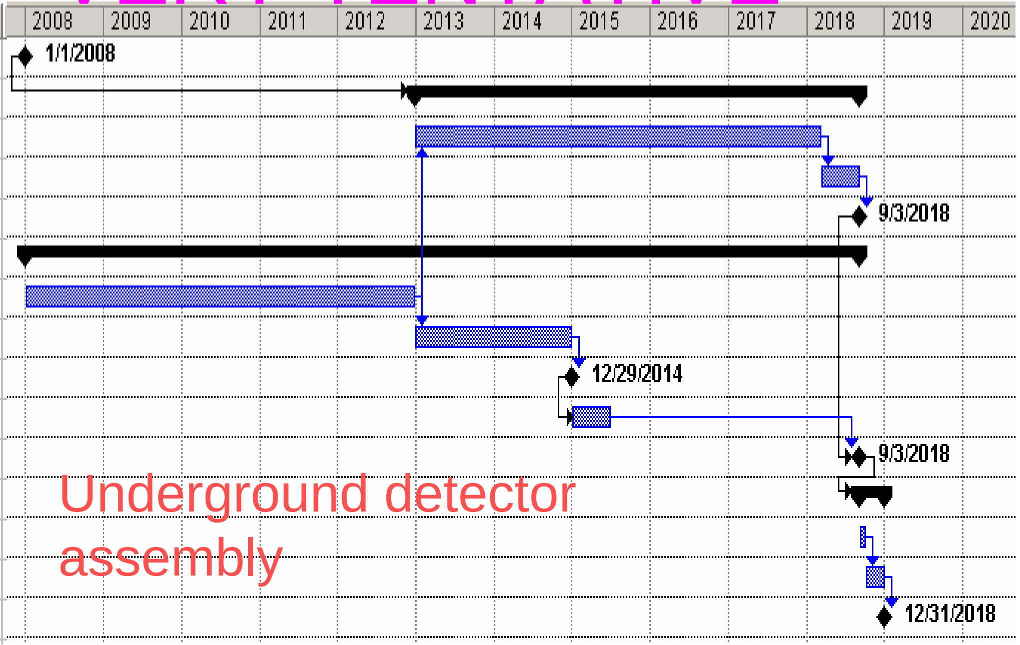
- Assembled on the surface in parallel with underground work
- Allows pre-commissioning before lowering
- Lowering using dedicated heavy lifting equipment
- Allows saving up to 3years of time
- Reduce size of underground hall required

- Accepted by MDI panel for ILC

Task Name	Duration	Start	Finish
Project approved	0 days	1/1/2008	1/1/2008
Construct detector	**391 wks**	**1/1/2008**	**6/29/2015**
prepare surface building for detector	120 wks	1/1/2008	4/19/2010
detector assembly	245 wks	4/20/2010	12/29/2014
detector surface commissioning	26 wks	12/30/2014	6/29/2015
Detector ready for BDS	0 days	6/29/2015	6/29/2015
Construct beamlines	**391 wks**	**1/1/2008**	**6/29/2015**
prepare underground tunnels	260 wks	1/1/2008	12/24/2012
beamline hardware installation	105 wks	12/25/2012	12/29/2014
Start of beam commissioning	0 days	12/29/2014	12/29/2014
BDS beamline pre-commissioning	26 wks	12/30/2014	6/29/2015
BDS ready for detector	0 days	6/29/2015	6/29/2015
Final assembly & commissioning	**26 wks**	**6/30/2015**	**12/28/2015**
Detector underground assembly	13 wks	6/30/2015	9/28/2015
Final beam commissioning	13 wks	9/29/2015	12/28/2015
Ready for physics run	0 days	12/28/2015	12/28/2015



Task Name	Duration	Start	Finish
Project approved	0 days	1/1/2008	1/1/2008
Construct detector	**297 wks**	**12/25/2012**	**9/3/2018**
detector assembly	271 wks	12/25/2012	3/5/2018
detector underground commiss.	26 wks	3/6/2018	9/3/2018
Detector ready for IP	0 days	9/3/2018	9/3/2018
Construct beamlines	**557 wks**	**1/1/2008**	**9/3/2018**
prepare underground tunnels	260 wks	1/1/2008	12/24/2012
beamline hardware installation	105 wks	12/25/2012	12/29/2014
Start of beam commissioning	0 days	12/29/2014	12/29/2014
BDS beamline pre-commiss.	26 wks	12/30/2014	6/29/2015
IP ready for detector	0 days	9/3/2018	9/3/2018
Final assembly & commissioning	**17 wks**	**9/4/2018**	**12/31/2018**
Detector moved to IP	4 wks	9/4/2018	10/1/2018
Final beam commissioning	13 wks	10/2/2018	12/31/2018
Ready for physics run	0 days	12/31/2018	12/31/2018

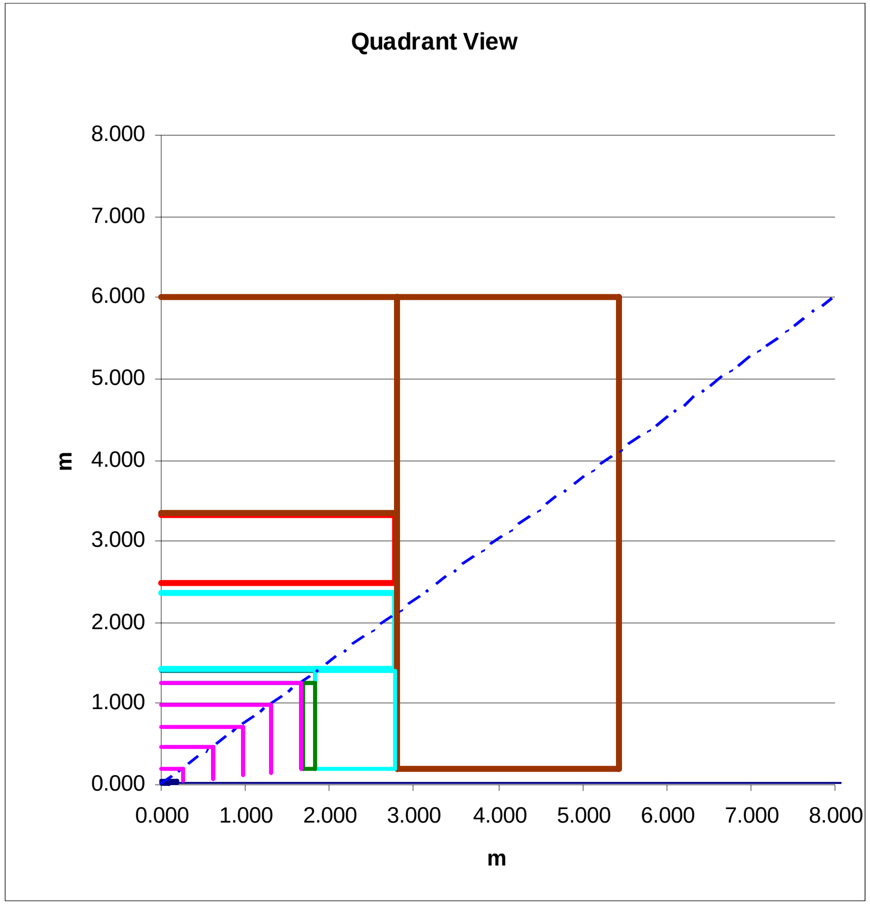


Item	SiD	LDC	GLD	CMS	Vancouver WBS (for each hall)	For Valencia Config.A (for single common hall)	Config.B (for single common hall)	Determined by
Parameters that define the underground hall volume								
IR Hall Area(m) (W x L)	28x48 (18x48)	30x45	25x55	26.5x53 max	32x72	25x110	25x110	Detector concepts
Beam height above IR hall floor (m)	7.5	8	8.6	8.79m	8.6	8.6	8.6	Concepts, BDS
IR Hall Crane Maximum Hook Height Needed(m)	5m above top of detector	19	20.5	18 m	30	20.5	20.5	Detector concepts
Largest Item to Lift in IR Hall (weight and dimensions)	100t PACMAN shielding	55t, 3m x 3m x 1,5m, E/HCAL end cap quadrant	Pieces of yoke 400t	20t instal tool 7x4m		400t	100t	Detector concepts
IR Hall Crane	100t/10t aux.	80t (2x40t)	400t	20t	20t x 2	400t +2*20t	100t +2*20t	Detector concepts
IR Hall Crane Clearance Above Hook to the roof (m)	TBD by engineering staff	6	TBD	5 m	5	14.5 (includes arch)	12.5 (includes arch)	CF&S group
Resulted total size of the collider hall (W x L x H)	28x48x30 (18x48x30)	30x45x25	25x55x35	53x26x25	32x72x35	25x110x35	25x110x33	Concepts & CF&S group
Parameters that define dimensions of the IR hall shaft and the shaft crane								
Largest Item; Heaviest item to Lower Through IR Shaft (weight and dimensions)	Coil package 600t – size End-dors 2000t each/halfs	Central Part ~2000t; 12-14m x 7m;	270t coil 9*9m Iron-15m	1950t		9*9m 400t	4*16m 2000t	Detector concepts

IR Shaft Size(m)	9 may work	⌀18,4 (16x9)	20 Surf ace 16 Hyb rid	20.4m	15	16	20	Detector concepts
IR shaft fixed surface gantry crane. If rented, duration	1kt * 1.5years?	2kt * 1.5years?	2kt* 1.5y r/ 400t	2kt * 1year	1kt * 1.5years?	None	2kt* 1.5ye ars	Detector concepts
Surface hall crane should serve IR shaft		Yes				Yes	Yes	Detector concepts
Other shafts near IR hall for access	TBD	Yes		Yes 12m	9m in service cavern, one per two halls	No	No	Detector concepts & BDS area
Elevator and stares in collider hall shaft	Cost decision	?		no	No	Yes	Yes	Detector concepts & BDS area
Parameters that define dimensions of the surface assembly building and its crane								
Surface Assembly Building Area(m) (W x L)	TBD	30 x 60	TB D	23.5 x 93 inner, 23.5 x 140 outer	25 x 100	25x20 0	25x20 0	Detector concepts
Largest Item To Lift in SurfAsm. Bldg. (weight and dimensions)	100t	70t *;7,5x7 inner vac tank 60t one coil module 55t; 3m x 3m x 1,5m E/HCAL end cap quadrant		120t 13x7 inner vac tank 60t one coil module		400t	100t	Detector concepts
Surface Assembly Crane	100t/10t aux. (TBD)	2x80t* min 2x60t	400t	80t x 2	80t x 2	400t + 2*20t	100t + 2*20t	Detector concepts
SurfAsm. Crane Maximum Hook Height Needed(m)	20m TBD	19 m *		18.3 m	18	18	18	Detector concepts
SurfAsm. Crane Clearance Above Hook to the roof (m)	ME/Civil to determine	5 m to ceiling*		5.7 m to outside	5	8	6	CF&S group
Resulted volume of surface assembly building (m) (W x L x H)		30 x 60 x 24		23.5 x 100 x 23.5 outer	25 x 100 x 23	25 x 200 x26	25 x 200 x24	Concepts & CF&S group
Parameters that define crane access area and clearance around detector								
SurfAsm. crane accessible area (needed) / available (m) (W x L)	CG of load on 150ton trailer	56 x 28		19 x 92 m		(20x1 02m?) 15 x 184 m	(20x1 02m?) 20.5 x 192 m	Detector concepts & CFS

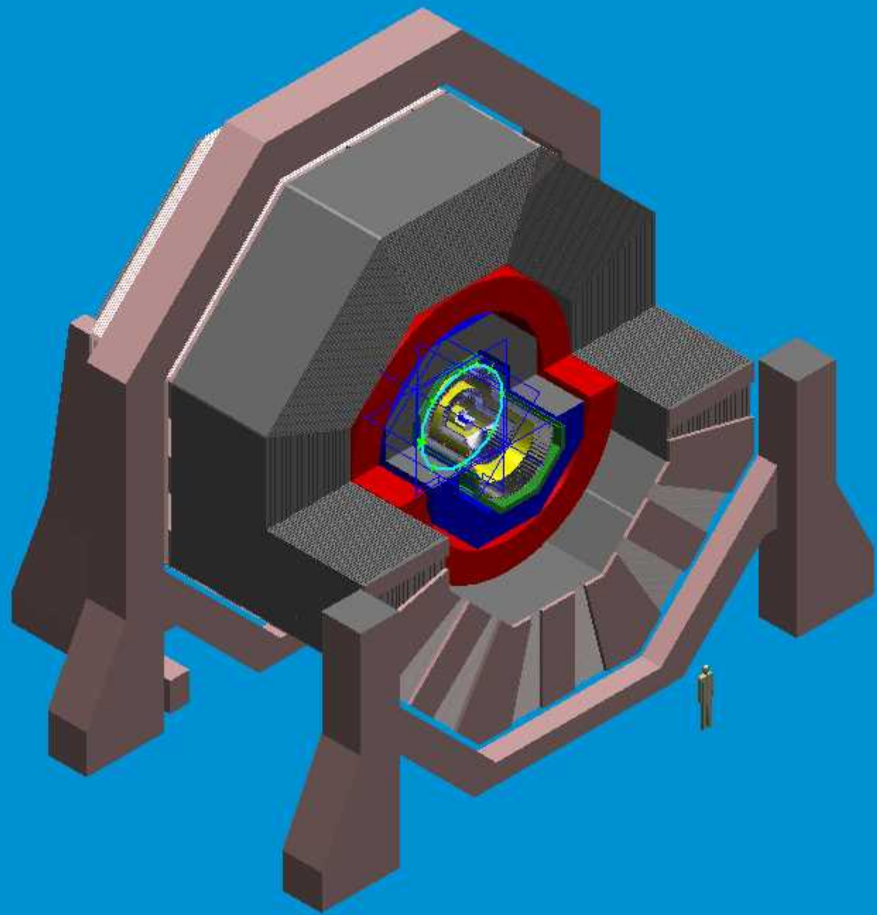
SurfAsm. crane accessible area (needed) / available (m) (W x L)	CG of load on 150ton trailer	56 x 28		19 x 92 m		(20x102 m?) 15 x 184 m	(20x 102 m?) 20.5 x 192 m	Detector concepts & CFS
IR hall crane accessible area (needed) / available (m) (W x L)	TBD	28 x 41 min 25 x 35*		17 x 42		(20x102 m?) 19 x 96 m	(20x 102 m?) 22 x 98 m	Detector concepts & CFS
Maximum Detector Height(m)		16 m		16.9				Detector concepts
Detector Diameter (m)	12.9	13 m	15.3	16 m				Detector concepts
Minimum Detector Clearance (m) (W x L x H)		15x18.4x16 (without scaffold + 3m each side)						Detector concepts
FILL IN OTHER IMPORTANT PARAMETERS WHICH ARE MISSING								
Electronic hut size		~18 x 9 x 10m						
Electronic hut location		TBD. Possibly, connected to the side of detector if it is self shielded						
When the electronic hut is installed underground		After assembly of detector						

SiD Quadrant View



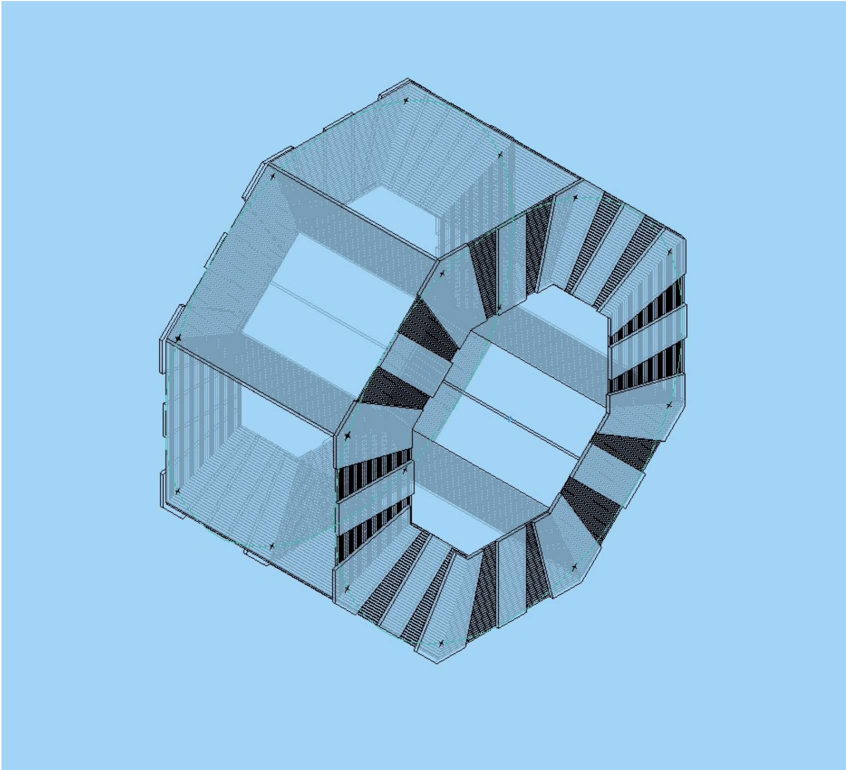
Solid Edge Model

This model will be used for an assembly animation, perhaps even this CY!



SiD Door Concept

Flux Return



The only input (so far) is enough steel to nominally return the flux, and 10 cm laminations w 5 cm gaps all the way through. The gaps make the radiation physicists looking at self-shielding nervous! We should collapse the un-needed gaps in the next iteration – how about 3 stations of 2 gaps for muons??

A Starting Plausible Sequence (Maybe)

- On the surface
  - Flux return modules are assembled and muon trackers tested.
  - HCal & EMCal modules are assembled and tested.
  - Assemble upper halves of end frame and lower segments of flux return to form nest for the coil.
  - Install coil in nest (temporarily). Test coil at low excitation.
  - Insert HCaL using threaded beam. Load is taken by the cryostat.
  - Insert EMCal using threaded beam. Load is taken by HCal.
- Lower:
  - Lower halves of end frame into pit and temporarily brace. Lower flux return segments are attached to the frames.
  - Coil into new nest and attach.
  - Upper frame segments and attach.
  - Upper flux return segments and attach.
- It is assumed that the tracker and the VXD are too late for surface assembly, and they must be installed in the pit!!

Doors

- The strategy depends on the hoist capacity. It appears each door weighs ~ 2200 tonnes. If the hoist can manage this mass, each door can be lowered totally pre-assembled.
- Each door (might, maybe, possibly could) consist of two leg assemblies and 4 flux return segments. Each goes down individually.

SiD Installation Mass, Stainless HCal

Installation								
		R_Trkr=	1.25	m		Stainless	Hcal Radiator	
	Component masses (tonnes)							
	Barrel	Endcap						
EMCal	59	19						
Hcal	354	33						
Coil	160							
Iron	2966	2130		Support structure is not included. Probably ~10% more				
Coil Installation Package Mass				574				
Endcap Package Mass				2182				

SiD Installation Mass, Tungsten HCal

Installation								
		R_Trkr=	1.25	m		W	Hcal Radiator	
	Component masses (tonnes)							
	Barrel	Endcap						
EMCal	59	19						
Hcal	438	46						
Coil	140							
Iron	2370	1690		Support structure is not included. Probably ~10% more				
Coil Installation Package Mass				637				
Endcap Package Mass				1755				

Comments

- The diagonal of the coil package is 8.7 m. There are other services in the main shaft (elevator, stairs), but this is relatively modest. (Presumably the coil goes down with its axis horizontal!)
- The "diagonal" of the door is ~11 m, with ~2 m more needed for leg extensions. Probably the door should go down in pieces.
- Appears that 1000 tonne hoist should be adequate.
  - It is not obvious that a traveling gantry would be more expensive than a traveling floor over the shaft (cf CMS). If the detectors are self-shielded, then a cover is not required.
- A surface building ~30 x 40 m seems adequate. Careful study is needed before committing!
- A super crude guess is ~ 2 years of pit access would be enough for final assembly and commissioning.
- This scenario is plausible but far from unique. Real engineering is needed.
- Surface assembly seems ok, but will require careful planning.