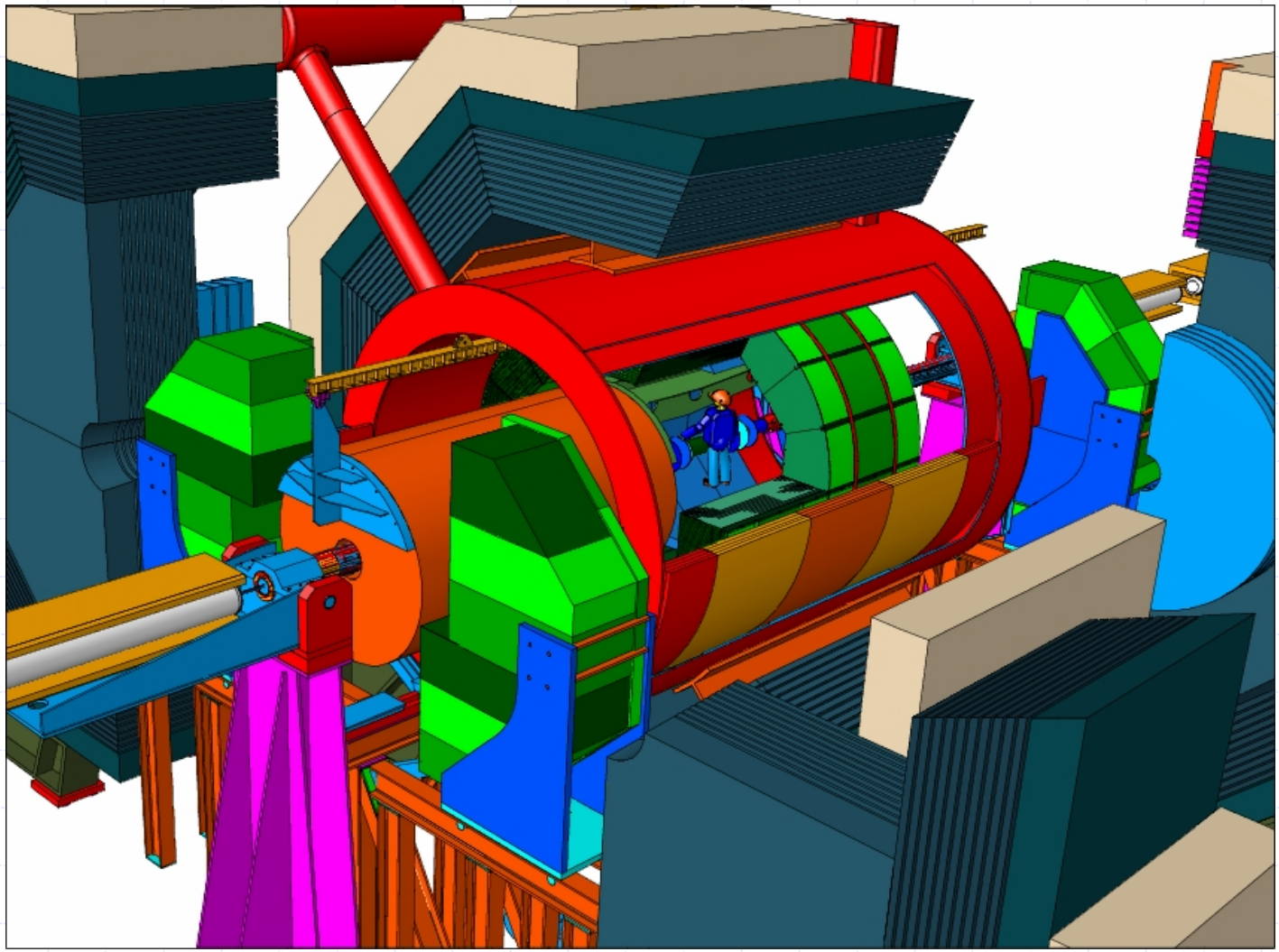
Norbert Meyners, MEA

LDC Engineering Design (Status)

Base

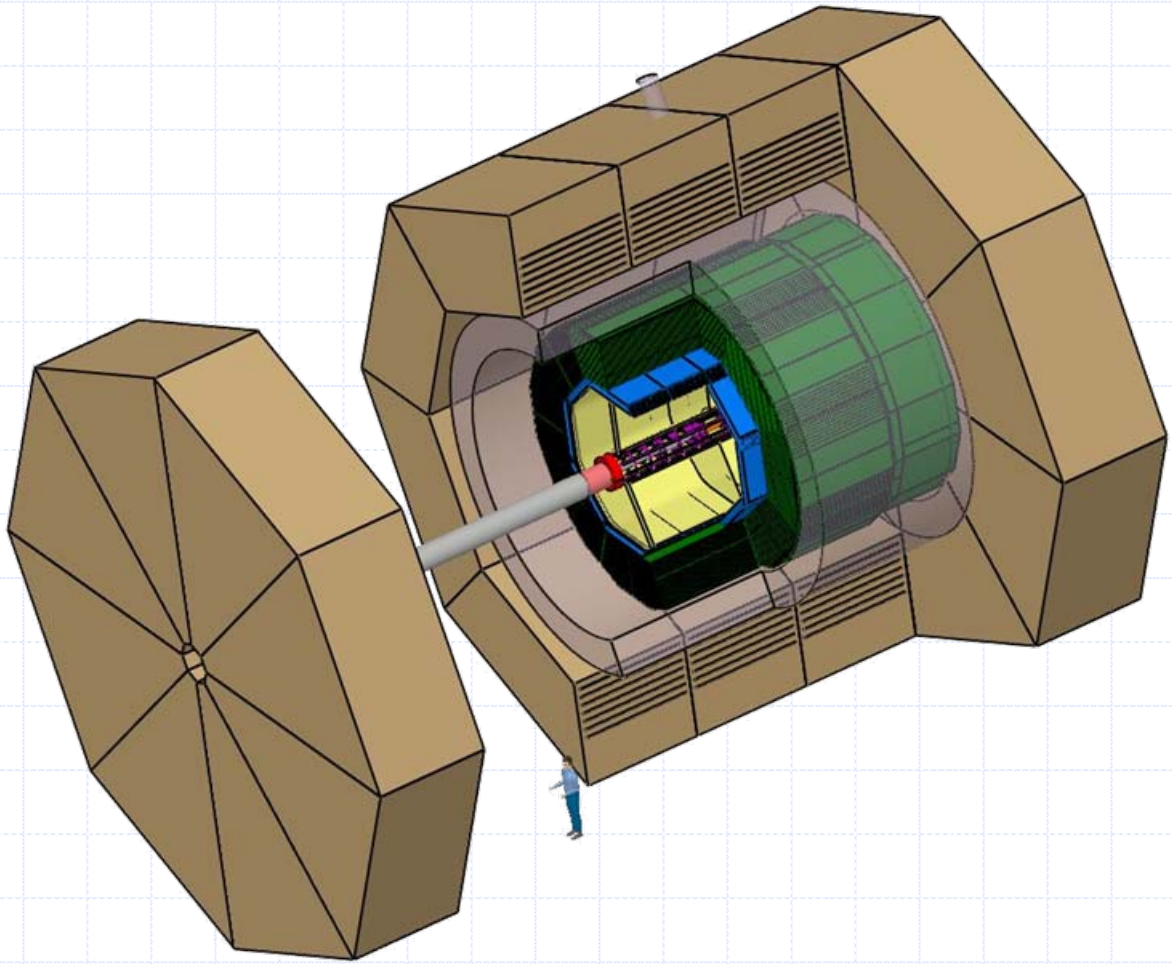
The LDC concept is evolved from the TESLA detector concept.



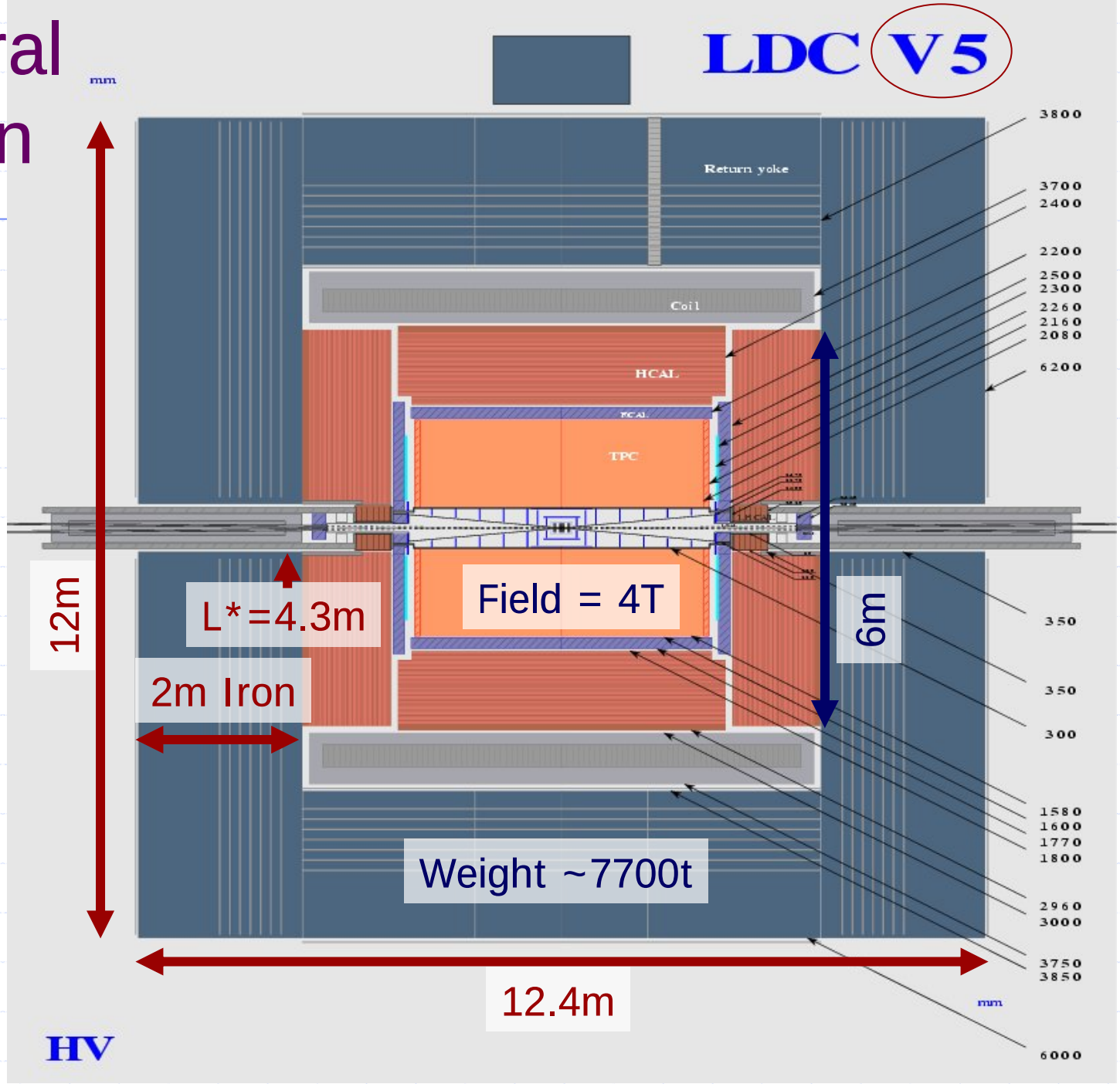
Picture from “Mechanical Concept of the TESLA Detector” (LC-DET-2001-045)

Now (Work in Progress)

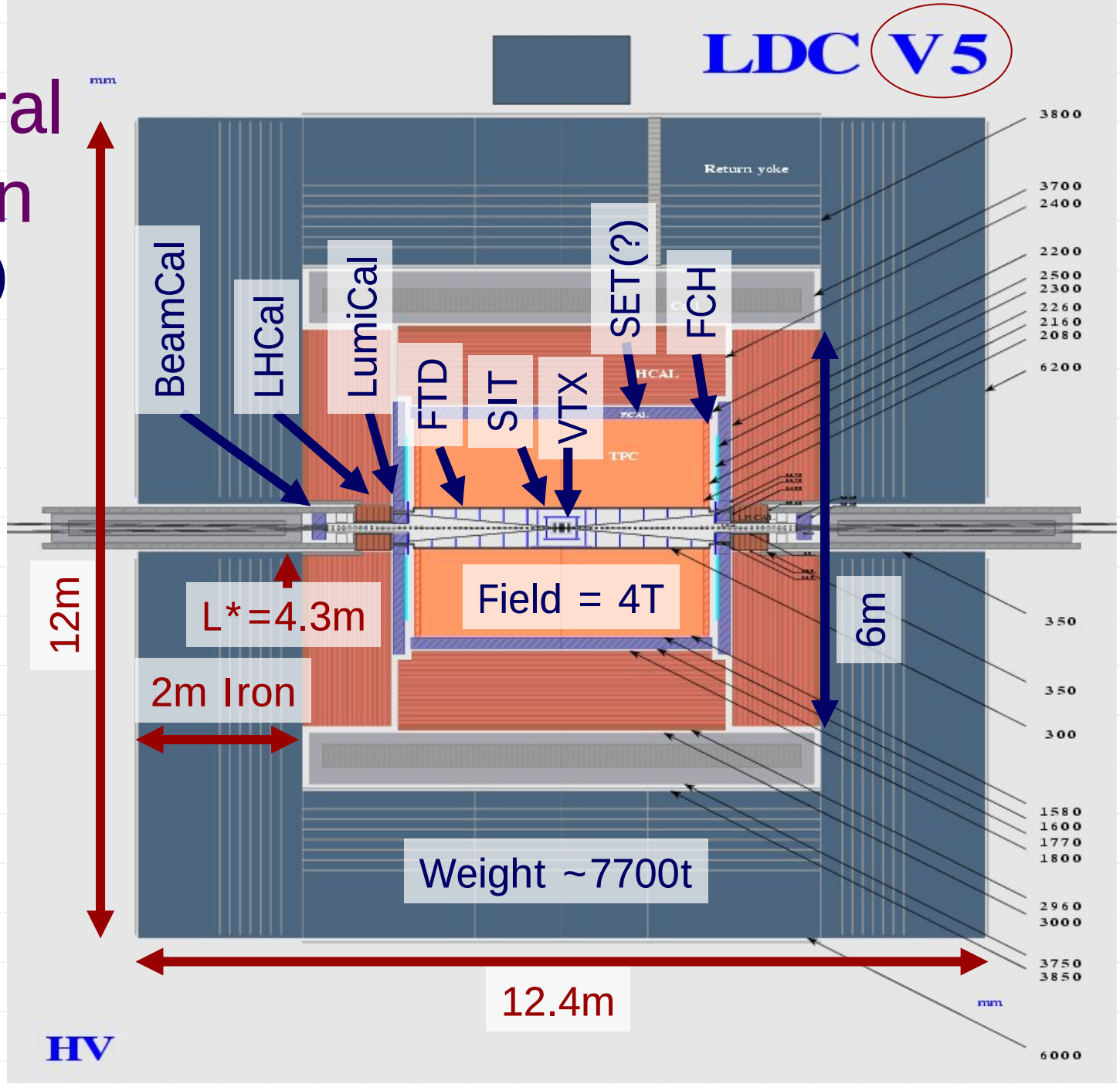
H. Videau, C. Clerc, M. Anduze, LLR; M. Jore, LAL; K. Sinram, N.Meyners, DESY; work on the Engineering Model (all part time)



General Design



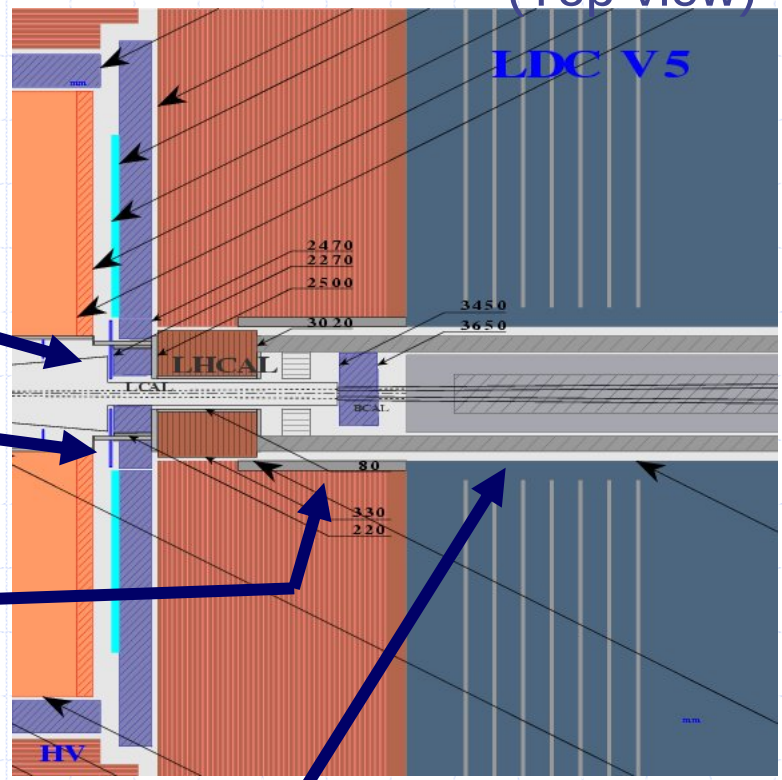
General Design (cont'd)



General Design (Forwards Region)

14mrad solution

(Top view)



LumiCal smaller!

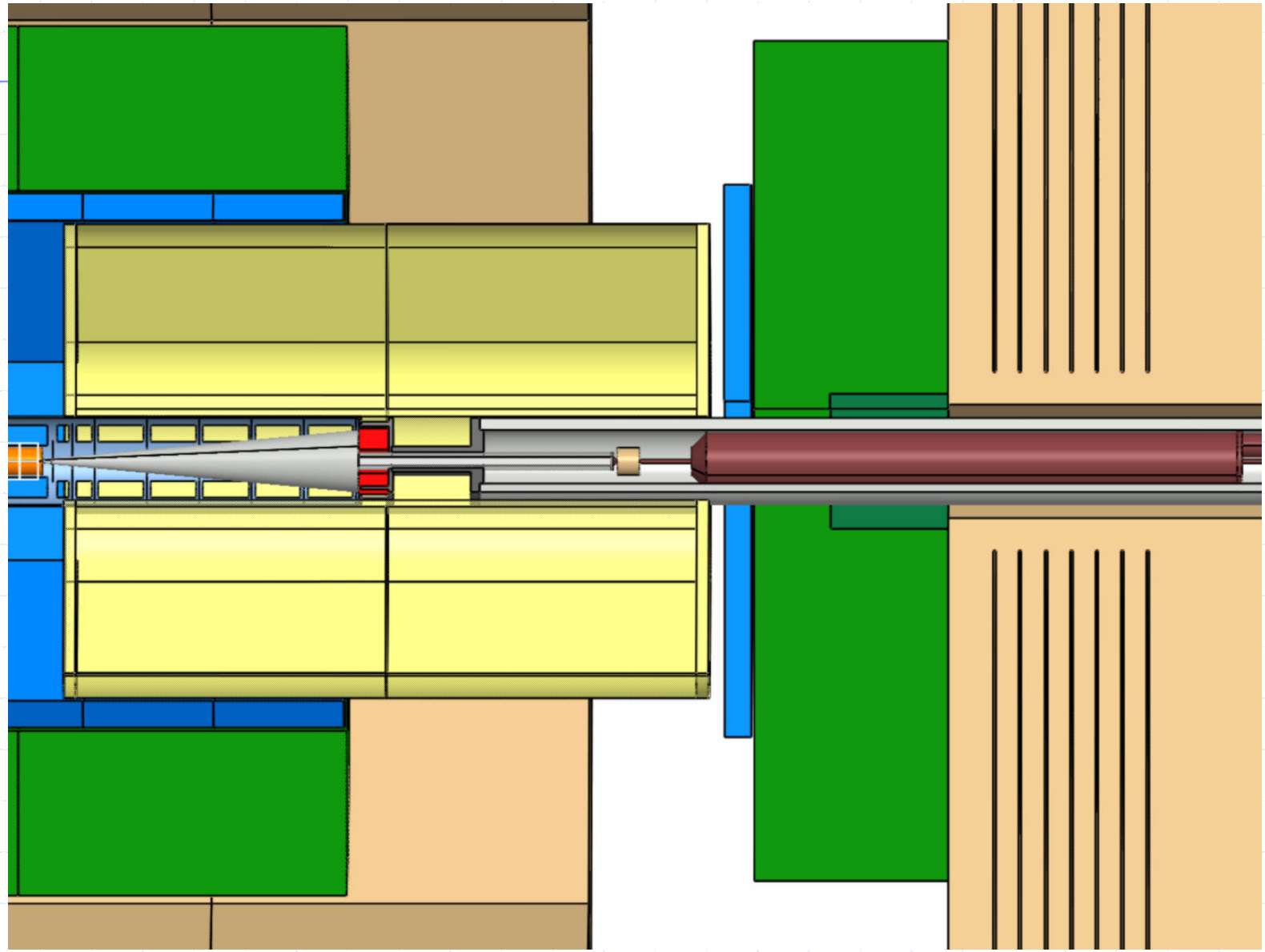
Intermediate ECAL closes gap between ECAL and LumiCAL

Tungsten Shielding (>6cm; Between LHCAL and BeamCAL; Gap at the BeamCAL to filled)

Support Structure for QD0, BeamCAL, LHCAL, LumiCAL, Central Beam Pipe

Goal: Vertex Detector Maintenance

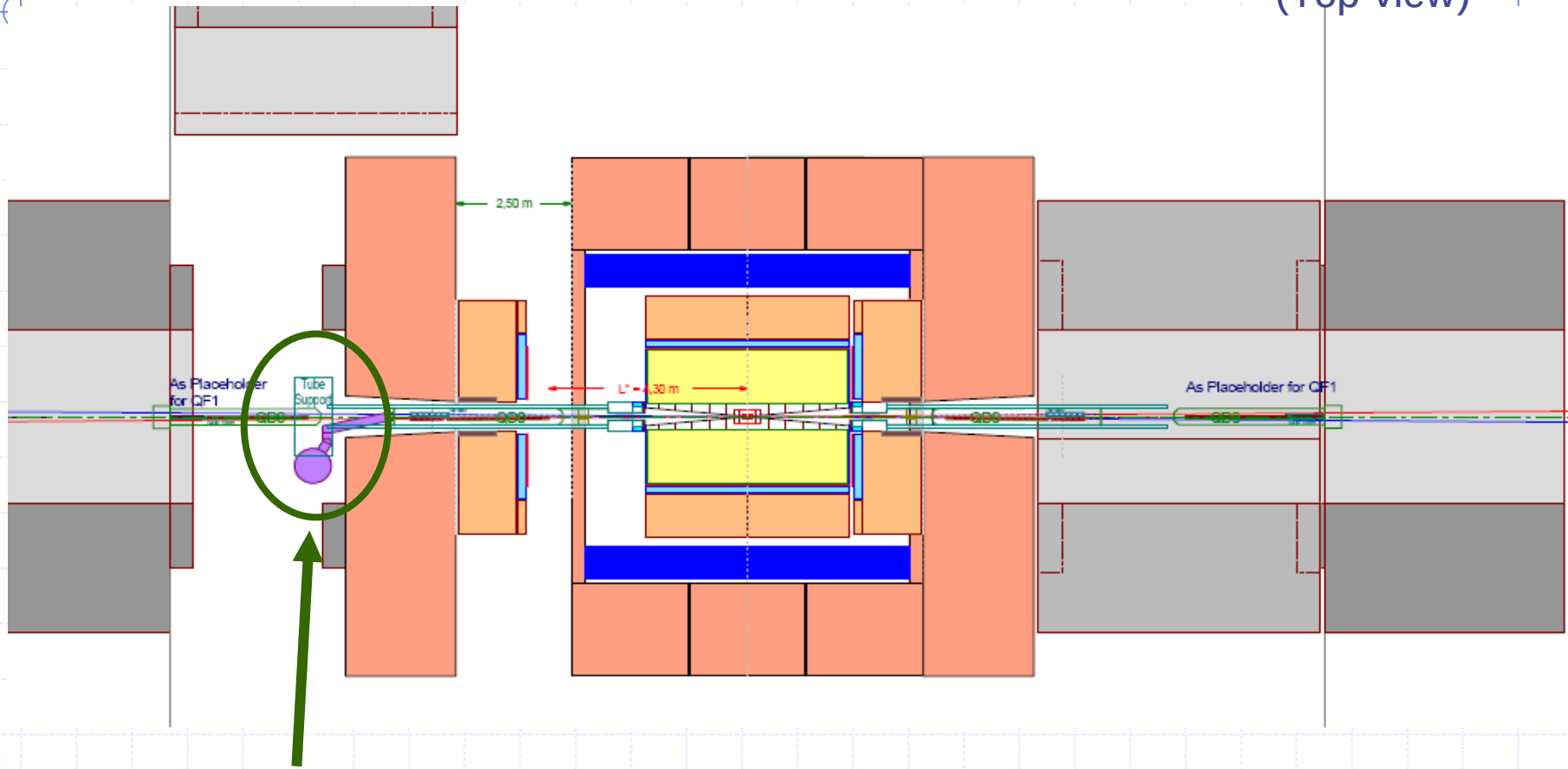
without breaking the vacuum i.e. warming up QD0



Detector Opening (Beam Position)

Need 2.5-3m to access the detector

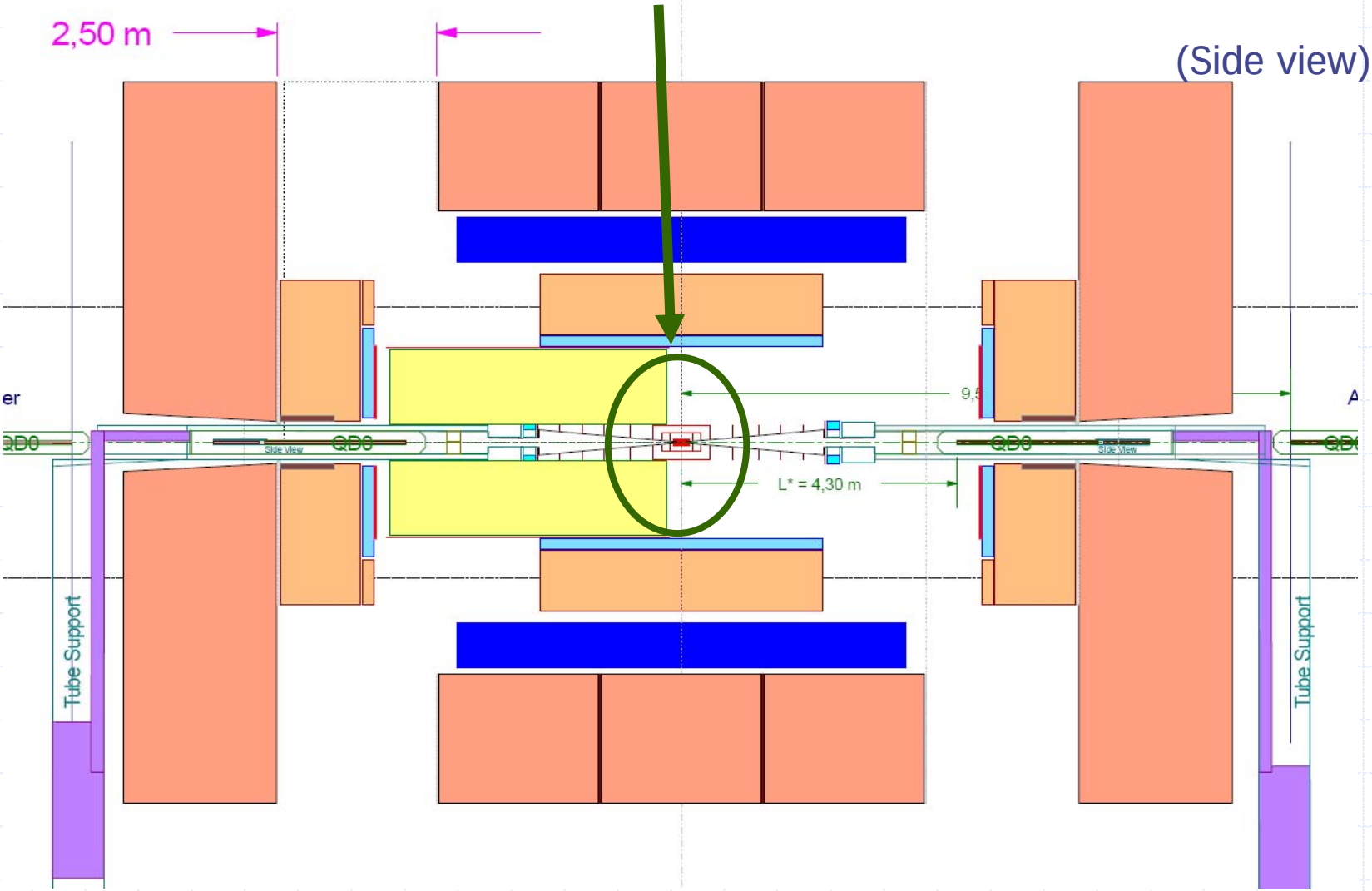
(Top view)



- Support Structure Support
- Service Cryostat
- Supply Line close to QF1

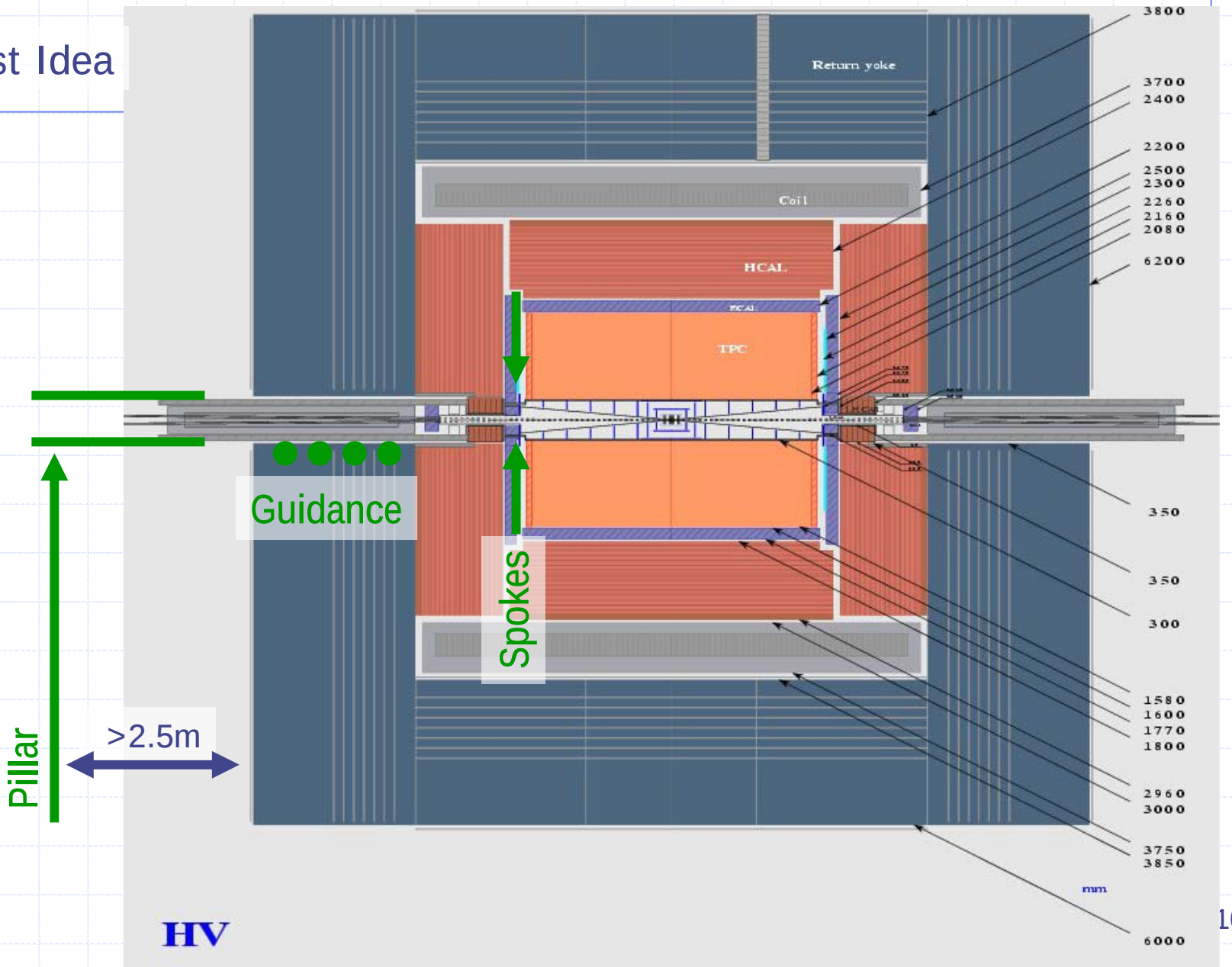
Detector Opening (Vertex Detector Maintenance)

2.5m detector opening would just allow to maintain the vertex detector in the garage position without breaking the vacuum.
(Pumping the central beam pipe is assumed to be very time consuming.)



Support Structure Supports

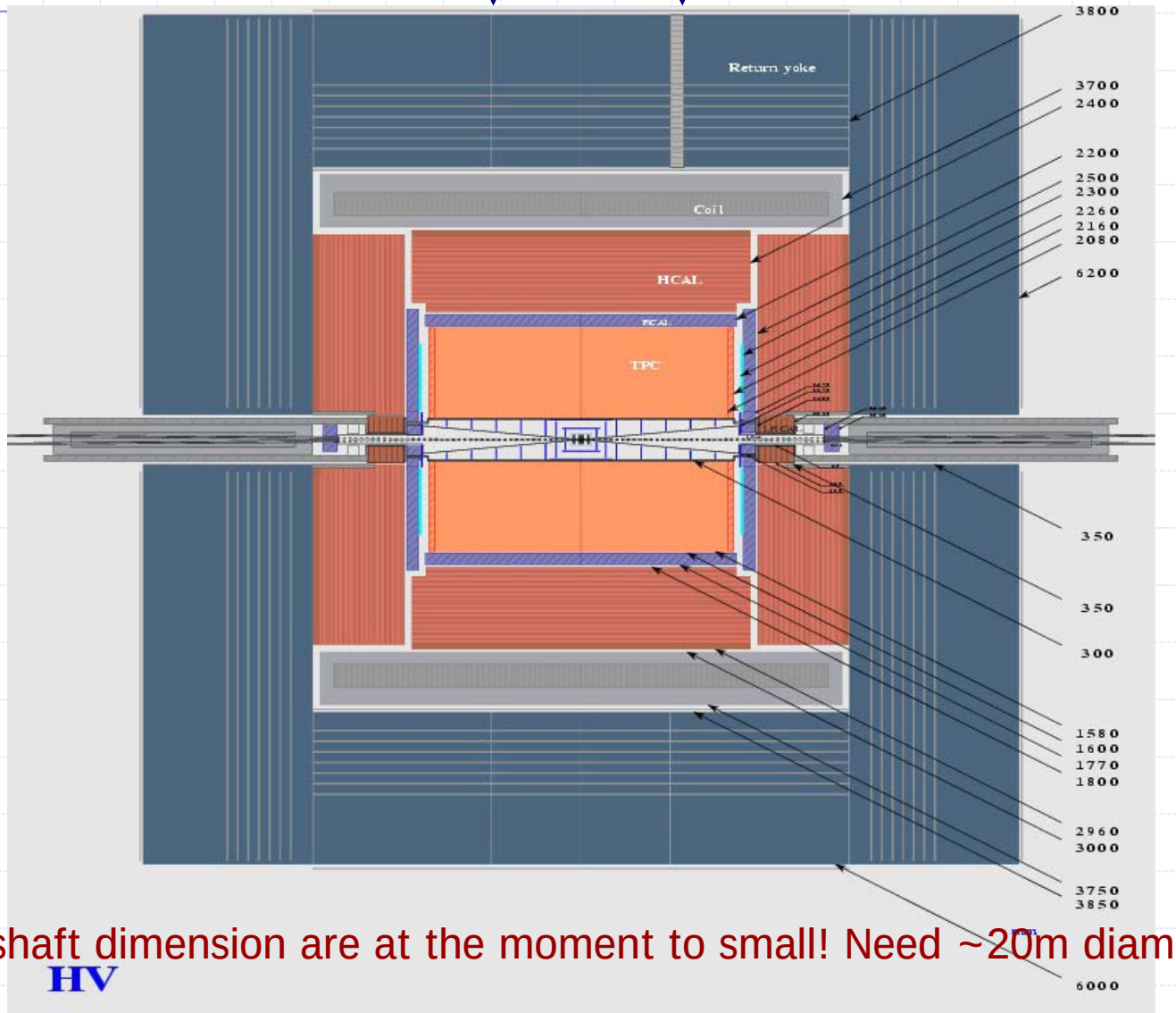
First Idea



Surface Assembly a la CMS

Clear preference!

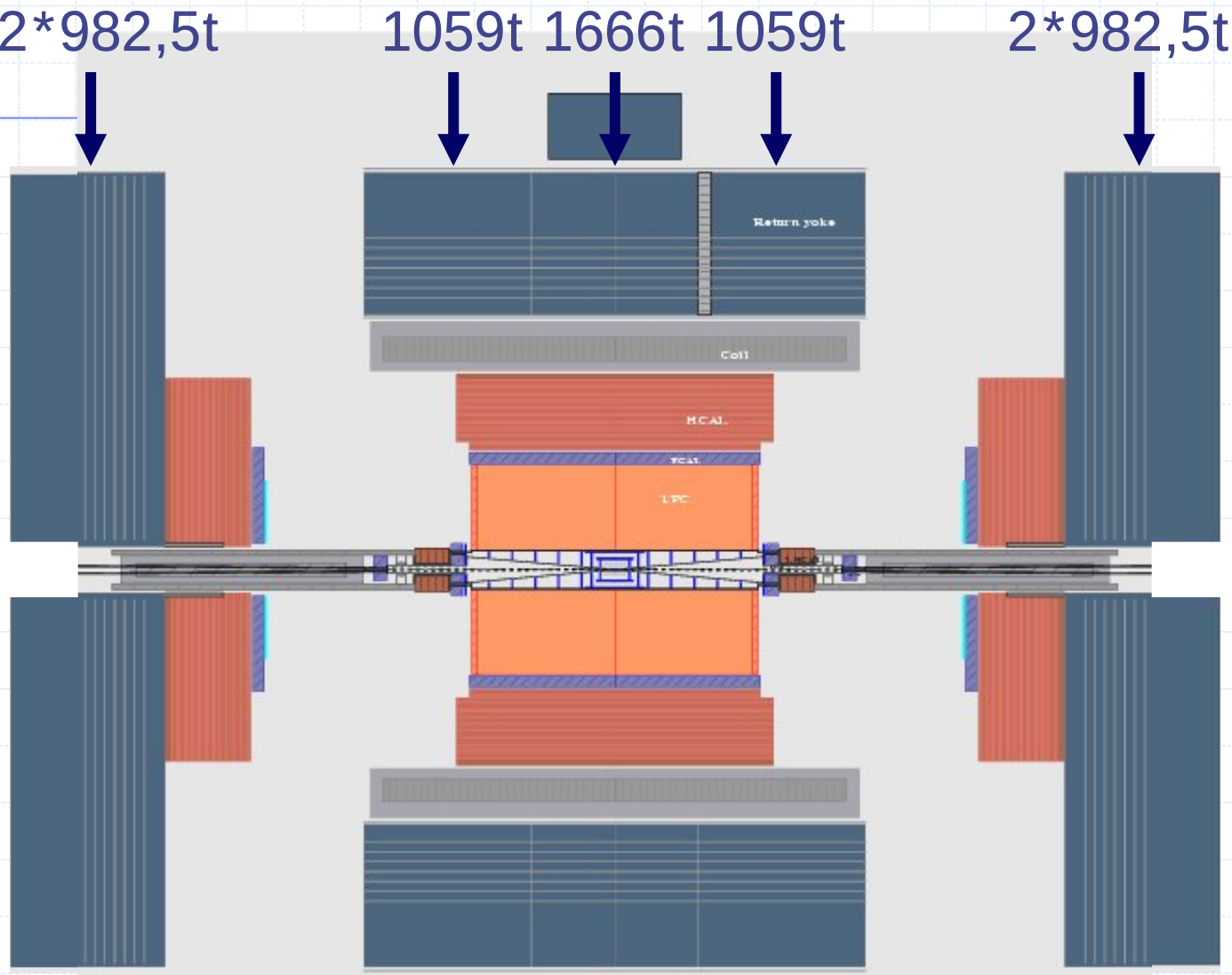
We split the barrel yoke in three rings and do it like CMS.



The shaft dimension are at the moment to small! Need ~20m diameter!

HV

Surface Assembly a la CMS



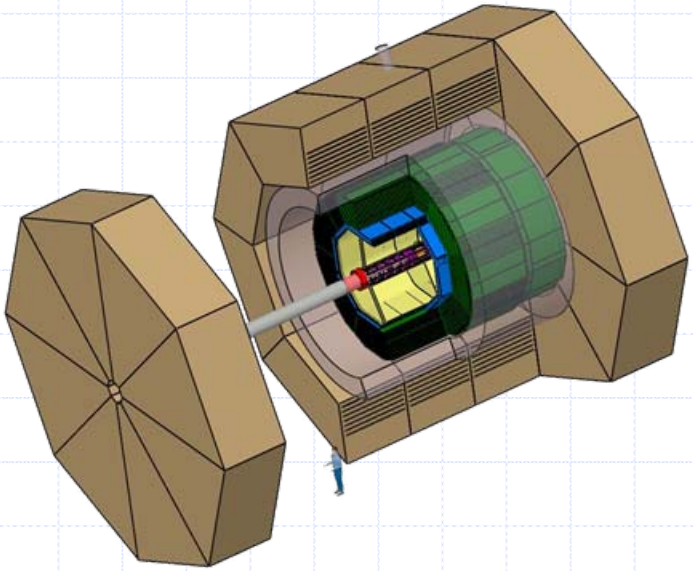
If not split the end cap pieces would be the heaviest part to be lowered!

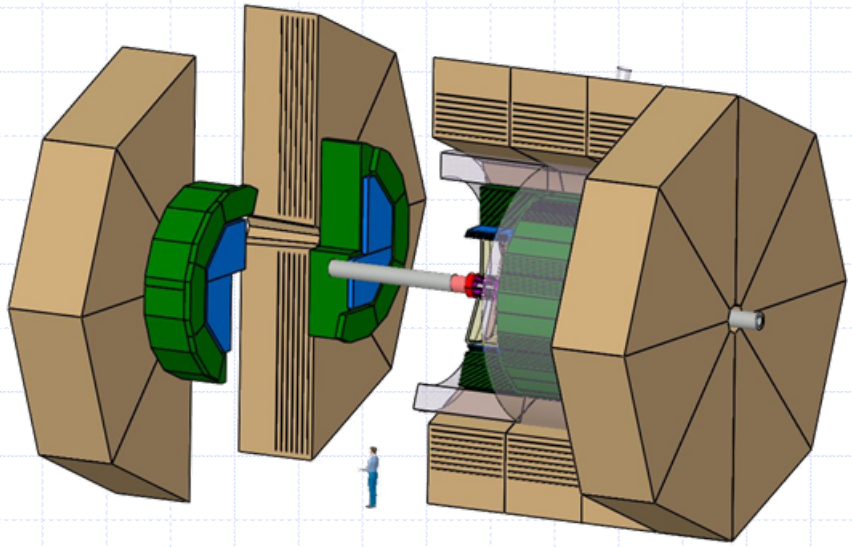
End Cap Yoke split or not

Under Study!

- The structure of the detector should allow both.

  Factor 2 more bending if split!

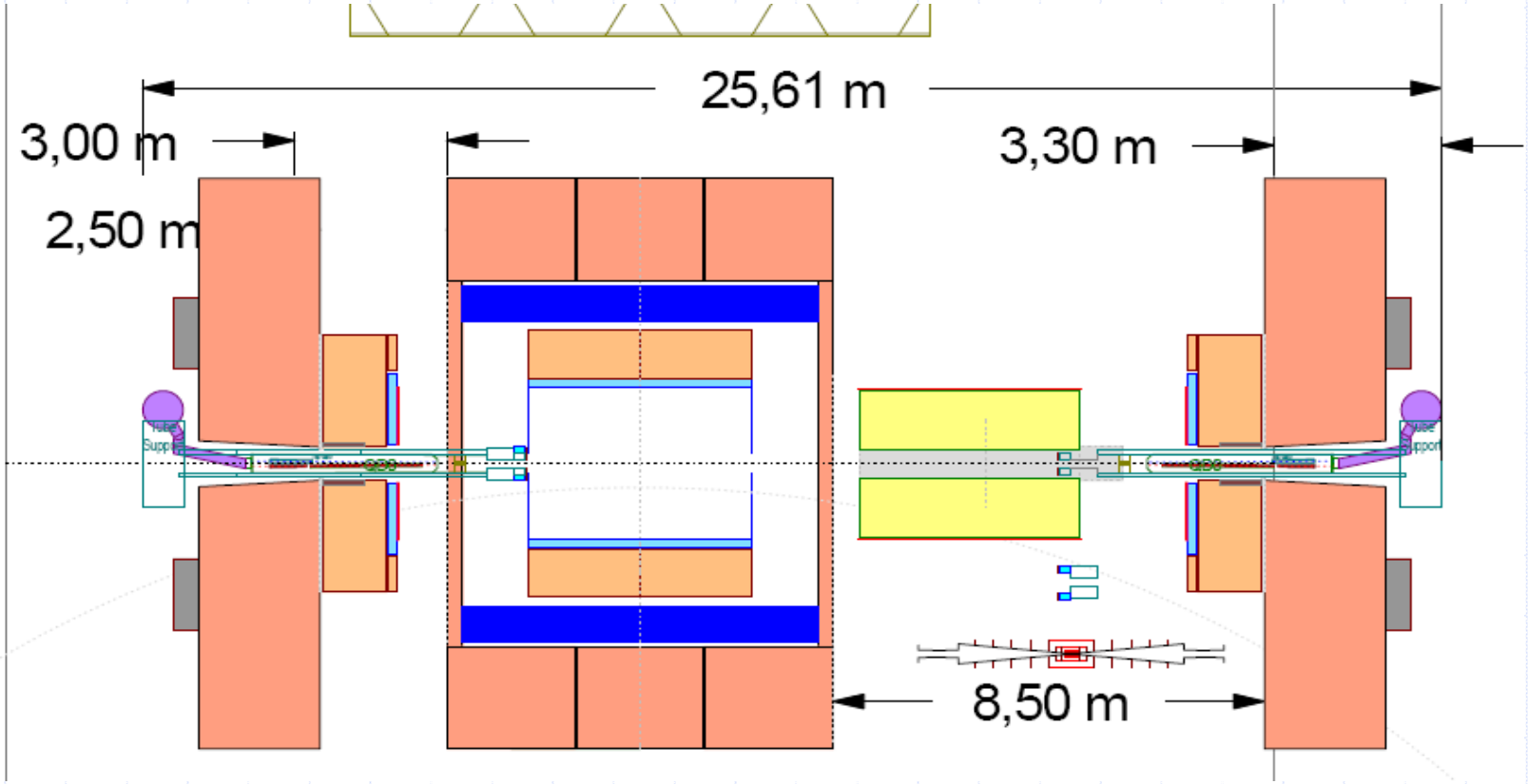




At the moment we prefer end cap halves bolted together with the possibility to open in an major operation if necessary!

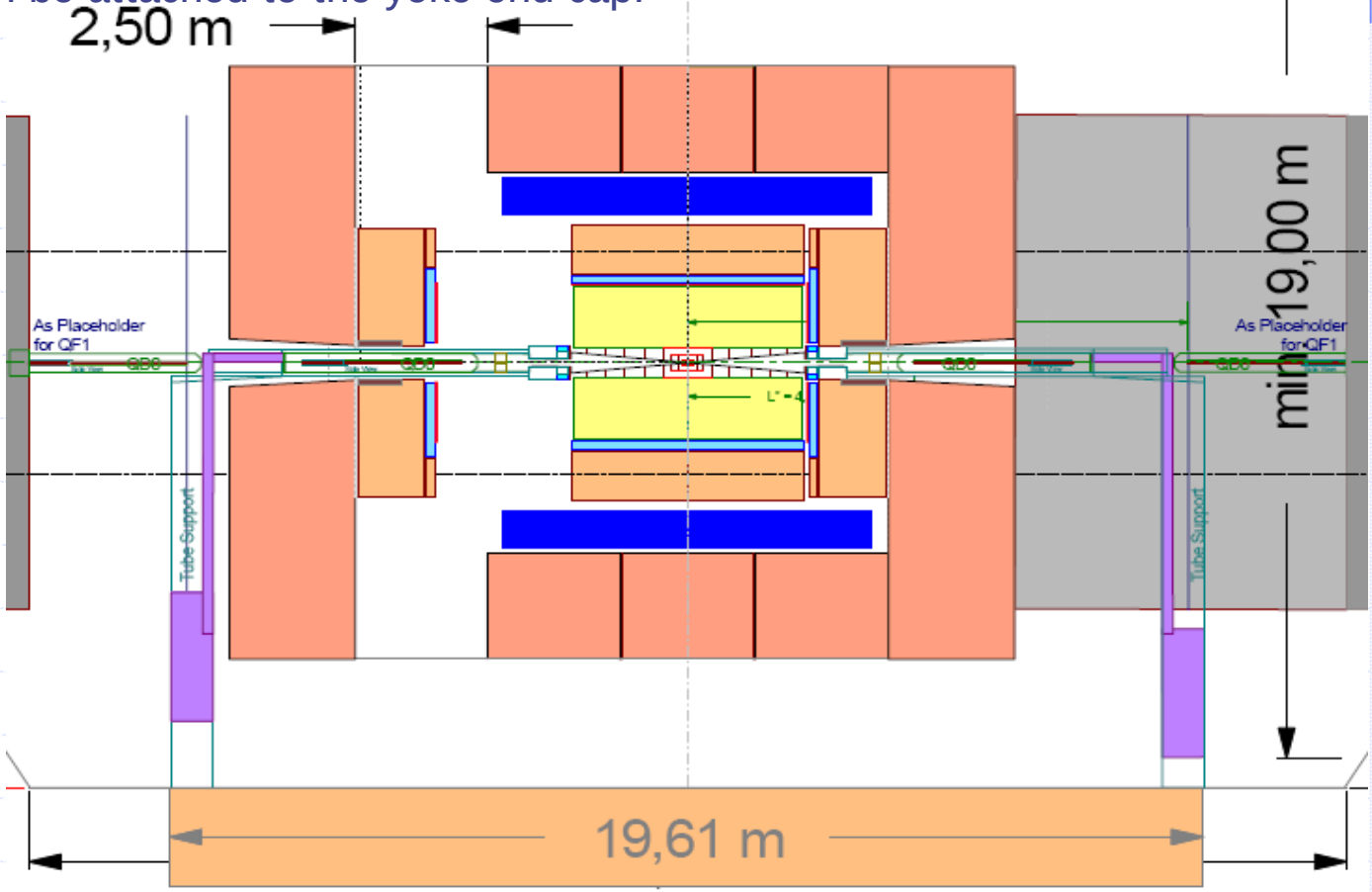
Detector Opening (End Cap Yoke NOT split)

- ➔ If not split, the end cap yoke has to be moved 8,5m longitudinal (or aside) for TPC exchange!
  - ➔ QD0 and service cryostat have to go with the end cap yoke while the Helium supply line is not cut!



QD0 Supply, “Umbilical”

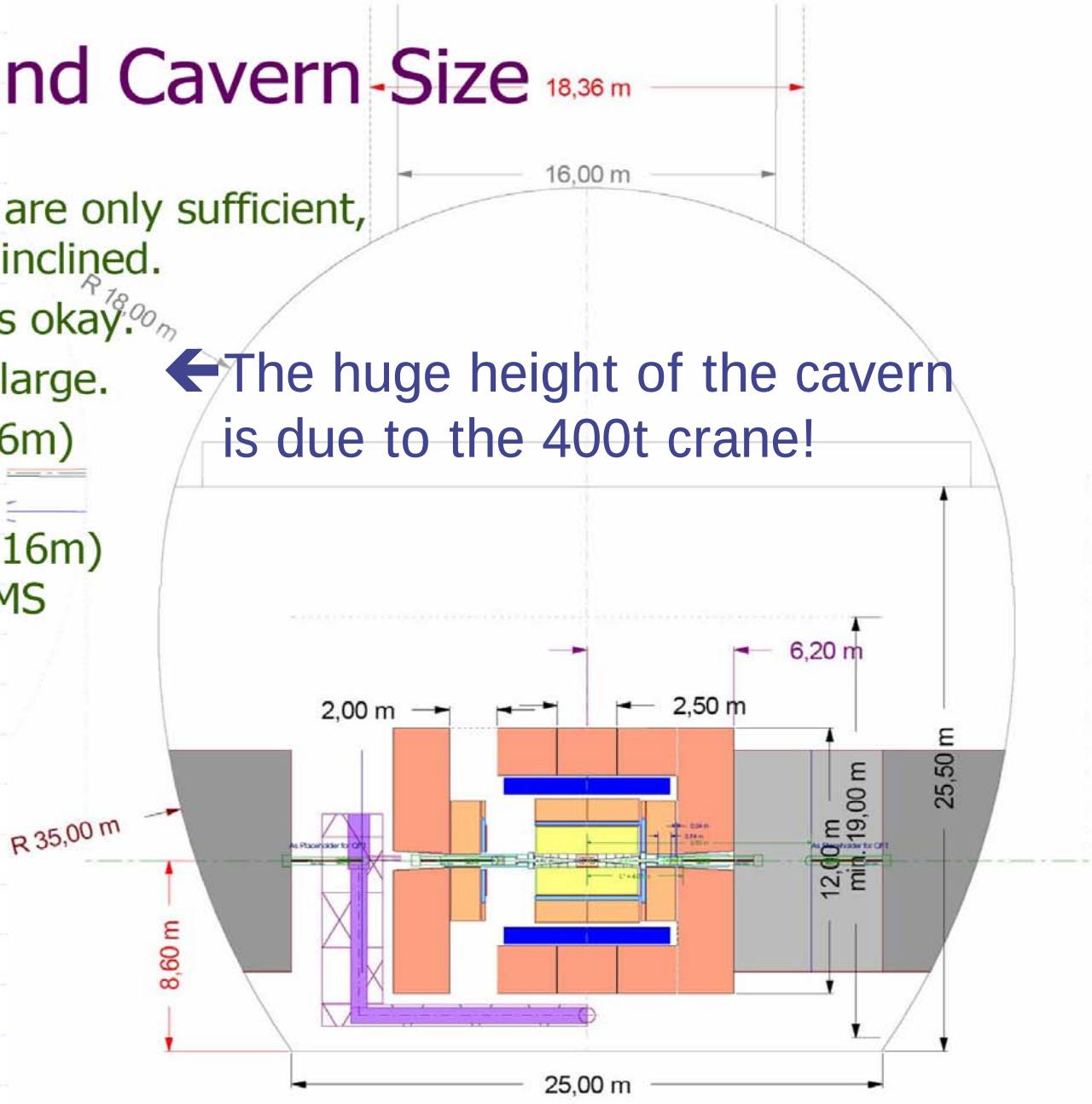
- The supply lines from the service cryostat to the QD0s go from the bottom through the shielding.
- The cryostats are connected via flexible lines to Helium supply.
- To allow a further opening the service cryostat and the QD0 can be attached to the yoke end cap.



You may remember my July talk (page 14)

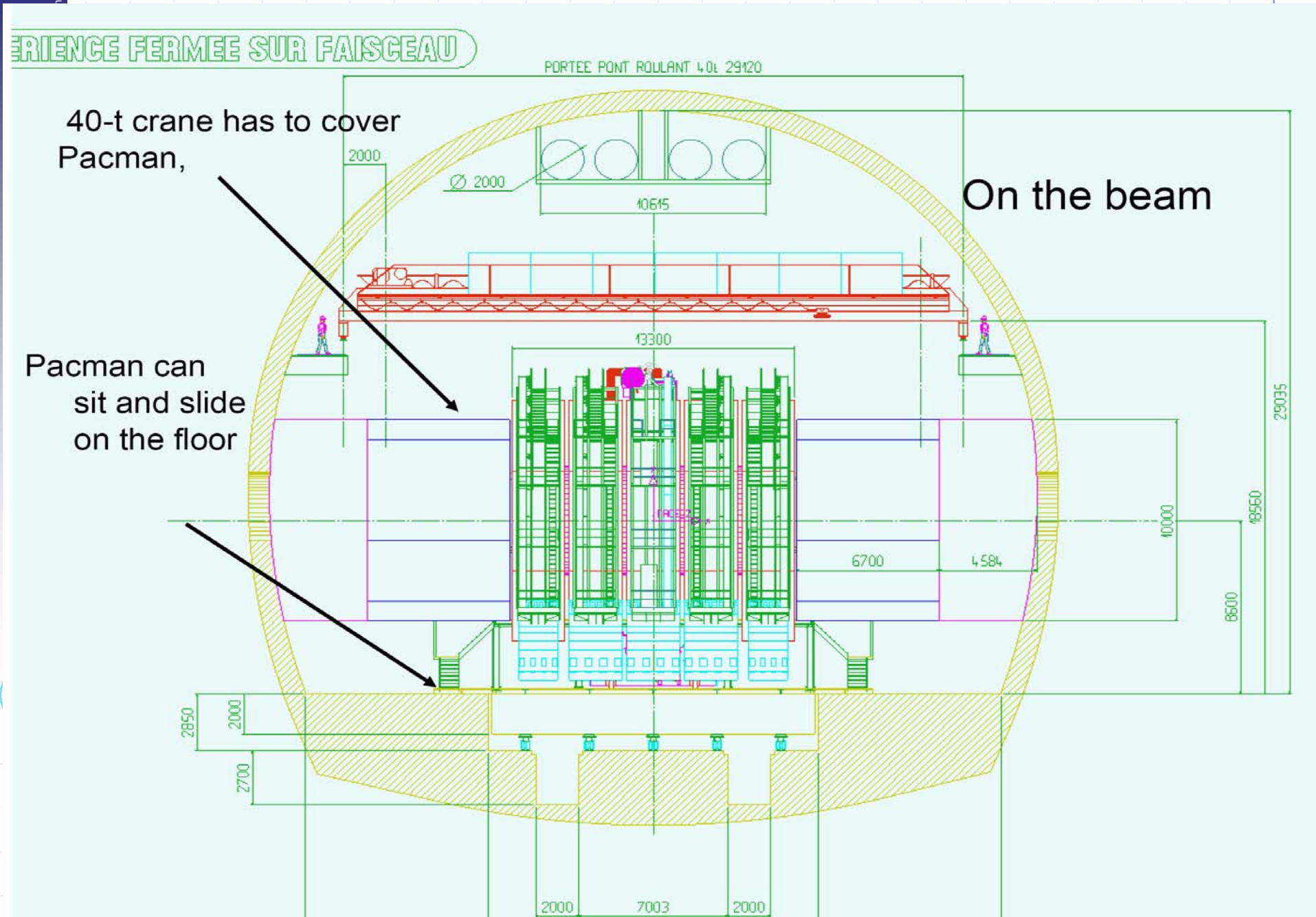
Underground Cavern Size

- 25m floor width are only sufficient, if the walls stay inclined.
- Length (120m) is okay.
- Height (39m) is large.
- Beam height (8.6m) is just sufficient.
- Shaft diameter (16m) is to small for CMS style surface assembly (min. 19.4m).



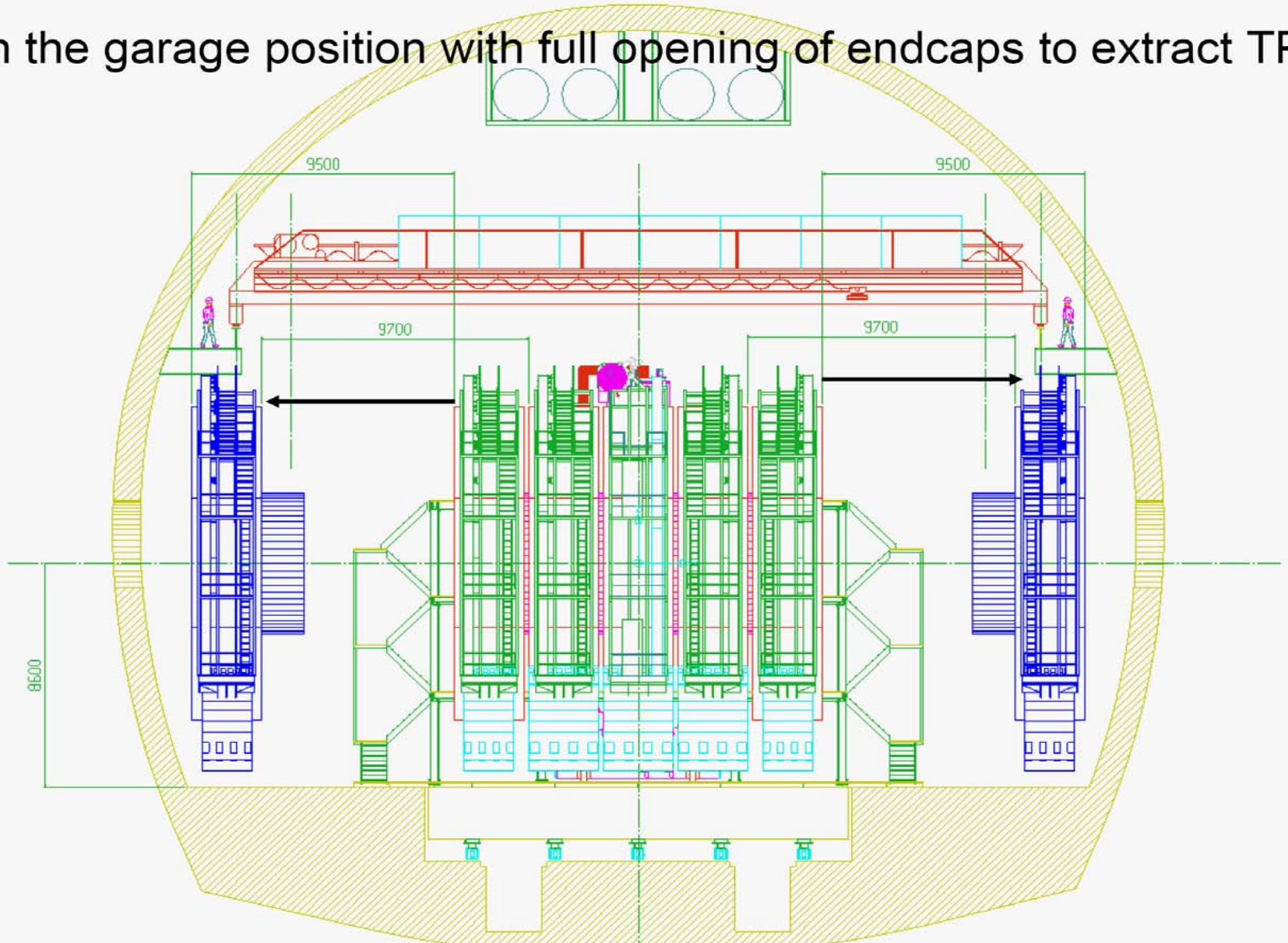
The huge height of the cavern is due to the 400t crane!

Herve's suggestion has ~15% less volume!



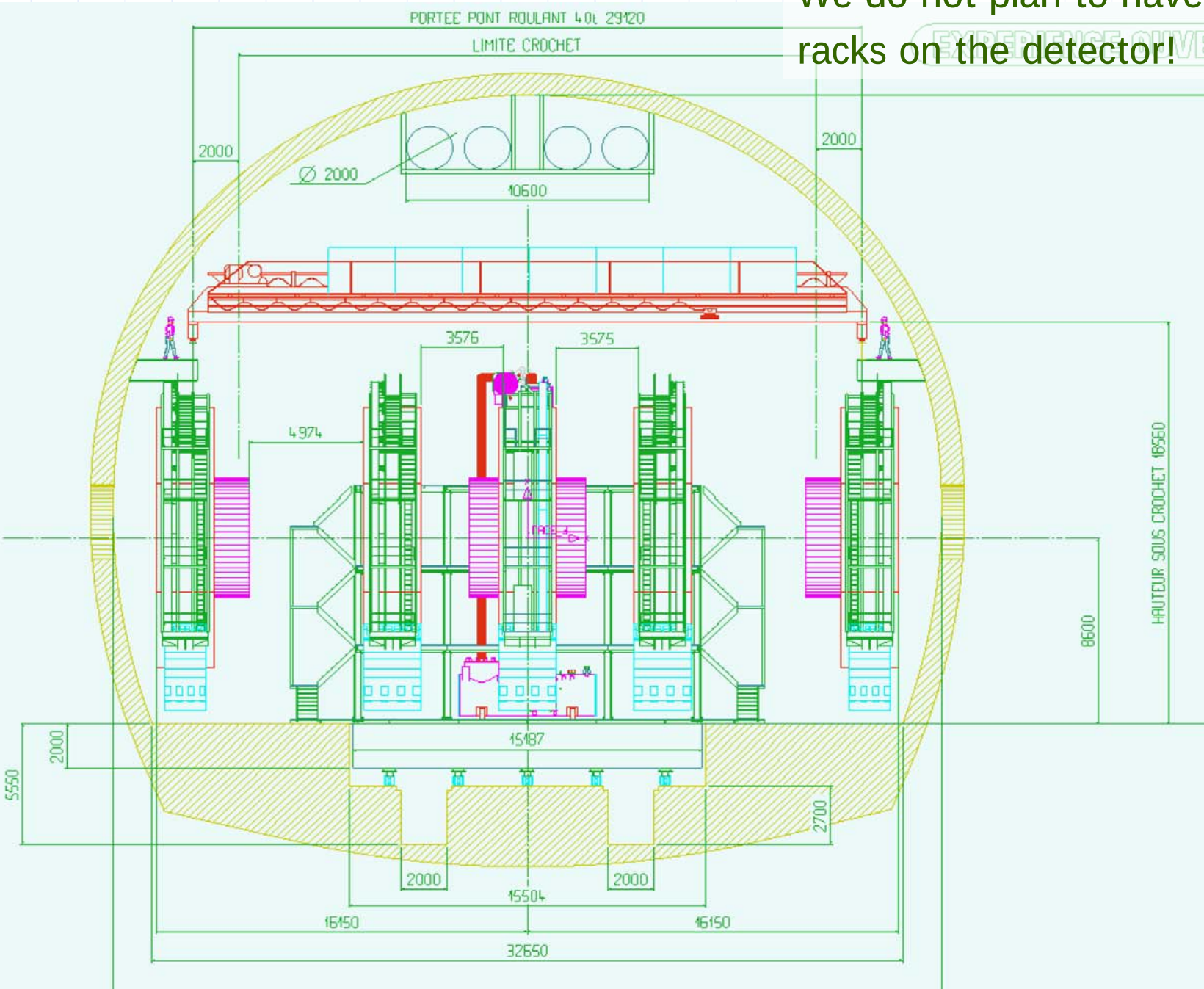
... and would allow TPC exchange ...

In the garage position with full opening of endcaps to extract TPC



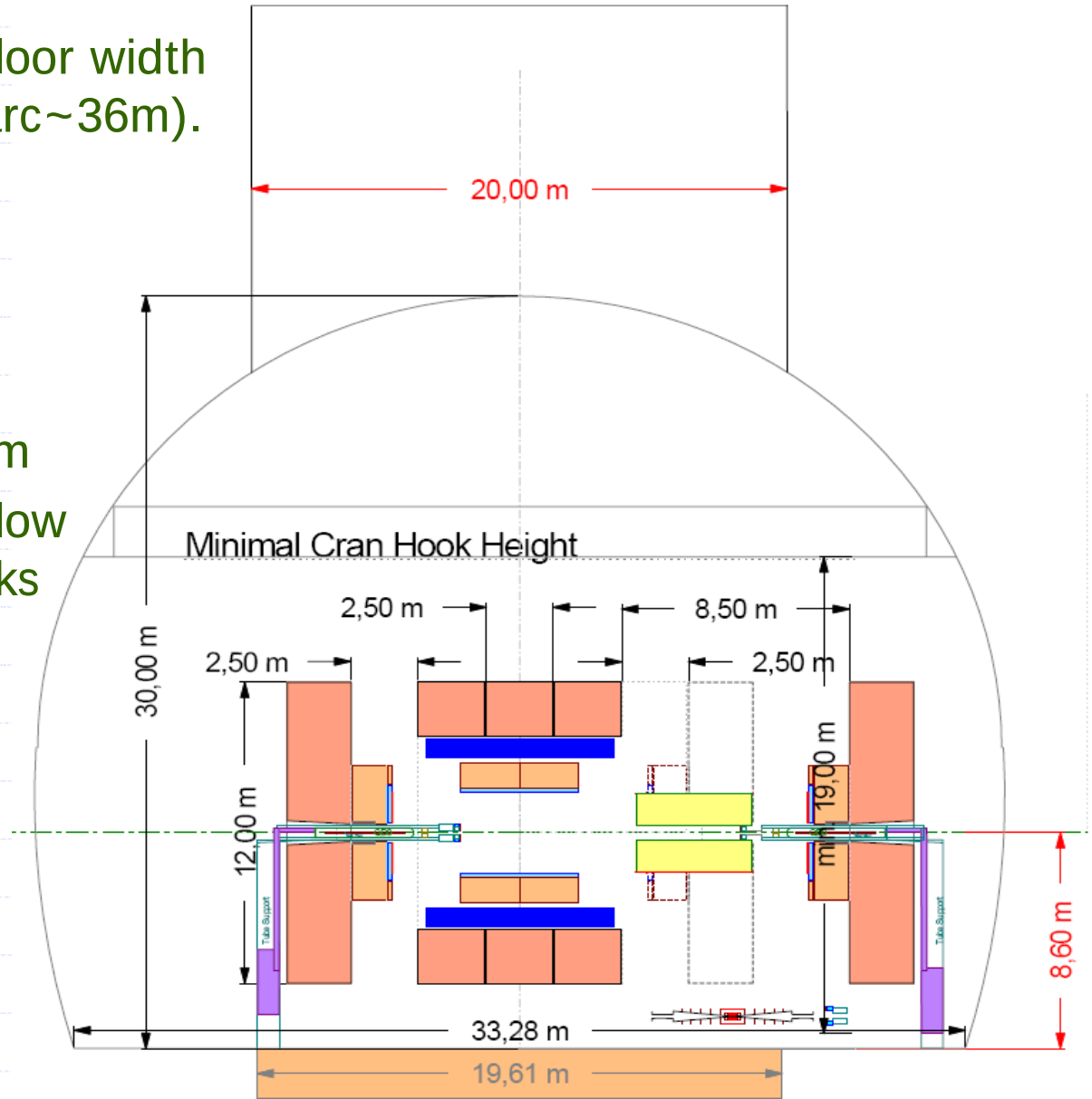
... or muon chamber maintained.

We do not plan to have racks on the detector!



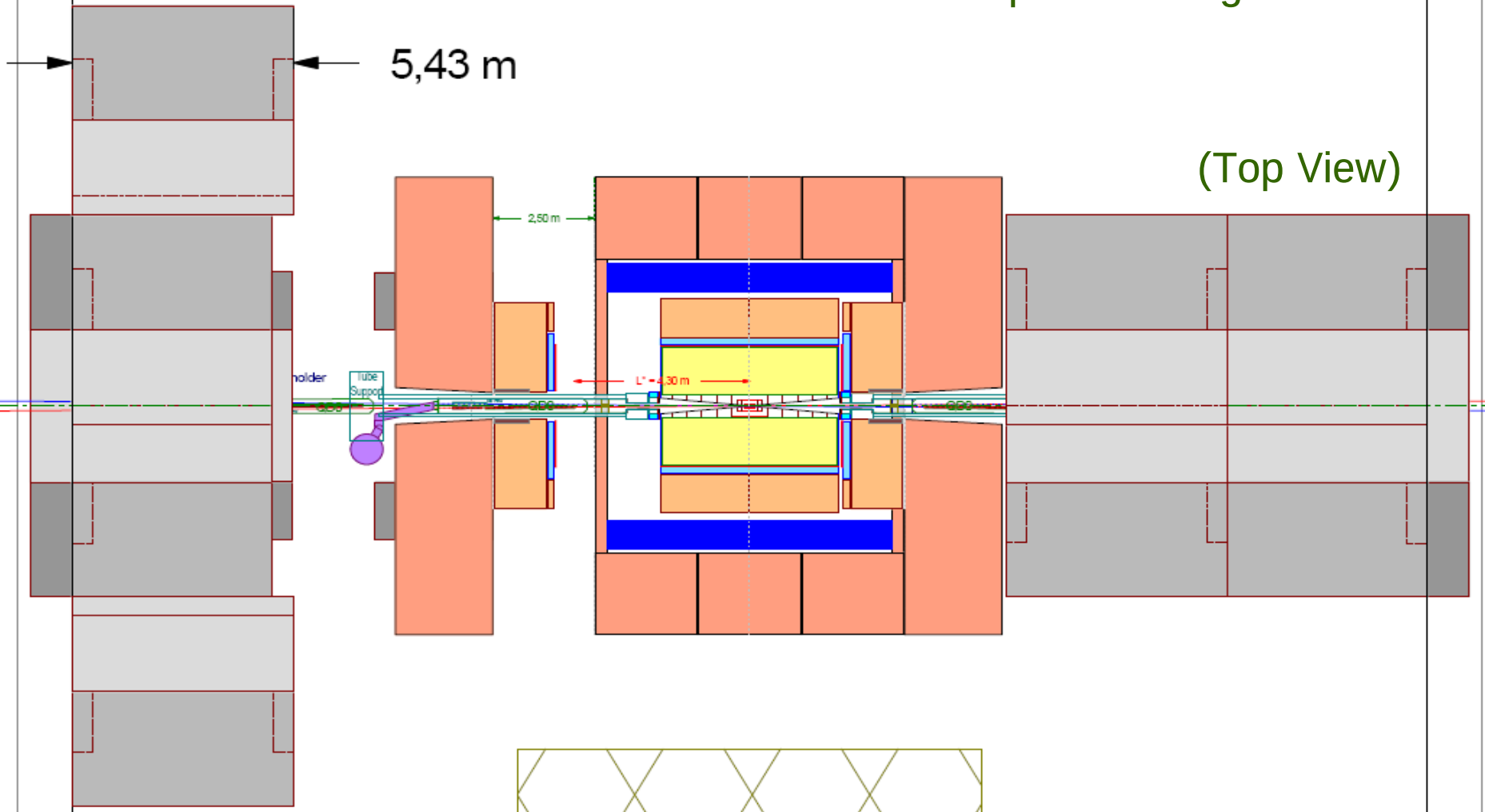
Underground Cavern Size

- Recommend ~30m floor width with inclined walls (arc~36m).
- Length: 120m
- Height: 30m
- Beam height (8.6m) is just sufficient.
- Shaft diameter: >20m
- Two 80t cranes to allow bigger shielding blocks (2 x 40t enough for LDC)
- ~19 hook height
- Floor prepared for air pad use



Underground Cavern Size (contd.)

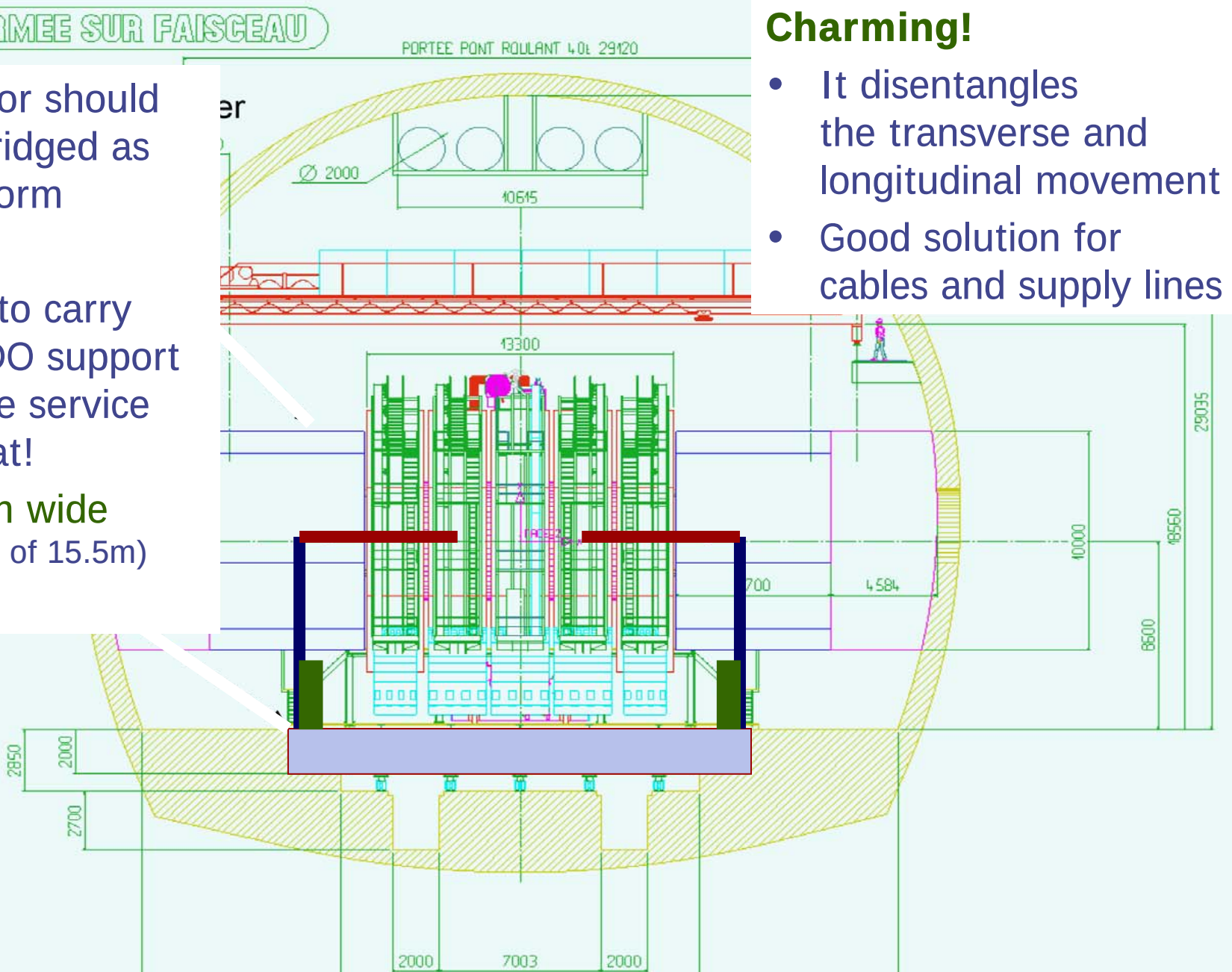
- A wider floor would allow a simple shielding solution



Platform

- Detector should be as ridged as a platform
- It has to carry the QDO support and the service cryostat!

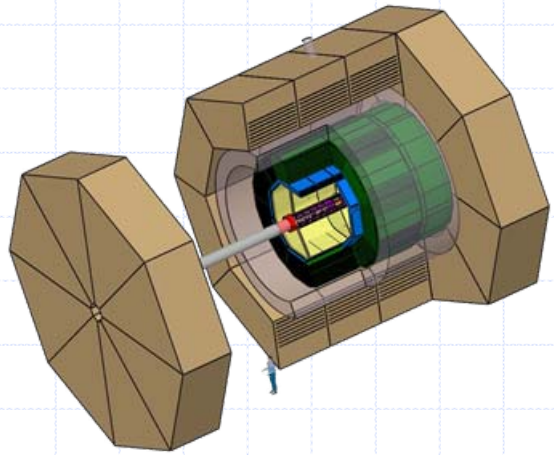
  ➔ 20m wide
  (Instead of 15.5m)



Charming!

- It disentangles the transverse and longitudinal movement
- Good solution for cables and supply lines

Locations



Trailer (going with the detector; water cooled, air conditioned)

- All electronics
- All subdetector power supplies

(We do not plan to have racks on the detector!)

On/at the Detector

- Dump Resistors
- LHe Dewar

At Surface

- Control Room

Open

- PC Farm

In the Service Cavern

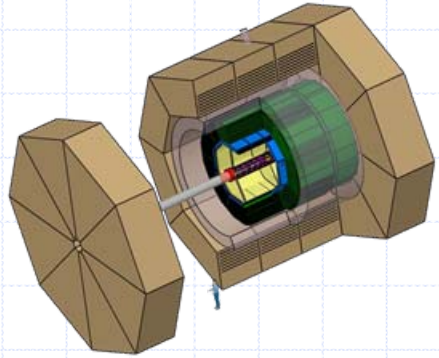
- Solenoid Power Supply
- Cooling Systems (Water, etc.)
- Helium Supply
- Gas Supply
- Mains Supply (Transformer etc.)

= **Services**

Detector / Trailer ←→ Cavern

(No guesses at this stage!)

Services Detector ↔ Trailer



Prelimary Numbers:

AHcal : tile+SS,

- Cooling :Heat flows each end of gap
- Power :Per channel : P=40µW, then for **5,8Mch = 232 W**
  with 25µW from ASIC (power pulsing) + 15µW from HV (50V*0.3µA))
- FE : 10300 FPGA; Layer concentrator (1/4FPGA) = 2578;
  1 data concentrator per module (≈70) and
  2 cables par LDA, 1 optical fiber

➔ So full **Hcal : 150 cables + 75 optical fiber + cooling**

Ecal :

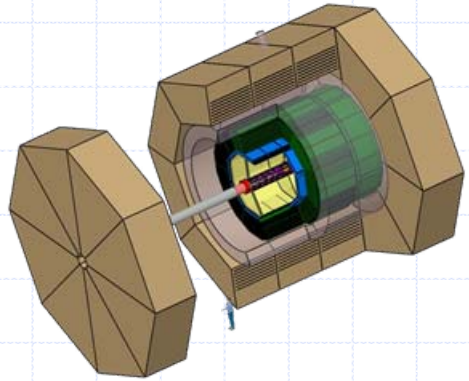
- 80Mchannels with 25 µW per channel (power pulsing): **2kW**,
- Cooling :Heat flows each end alveolas
- 1 data concentrator per 30 alveolas :
  then 2 exit cables per concentrator :
- **barrel: 560 cables, 280 optical fiber + cooling**
- **endcaps : 218 cables, 109 optical fiber + cooling**

This numbers are a lower limit.
If the sensor size changes it could double
and it scales with size which may increase.

From C.Clerc

Services Detector ↔ Trailer (cont'd)

Prelimary Numbers:



No data for inner and forward detectors!

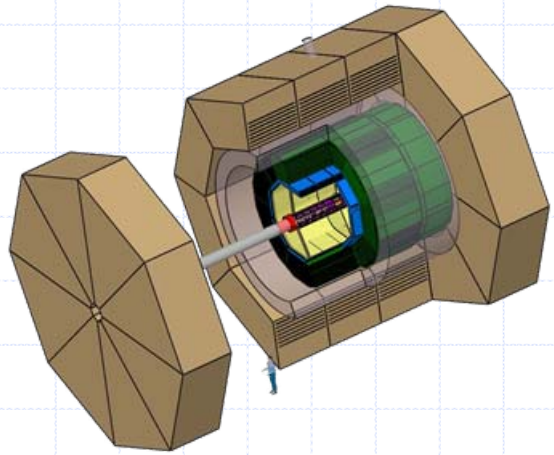
TPC :

- **200W per end plate**; Air cooled!
- No decision about electronics yet;
  1.guess: 100-200 optical fibers per end plate
- Gas supply
- HV supply (1 big cable)
- Alignment laser
- 50-200kW racks (trailer) From R.Settles

LumiCAL:

- **2 x 20W**, water cooled
- >100cm² cable & cooling From W.Wirba

Safety

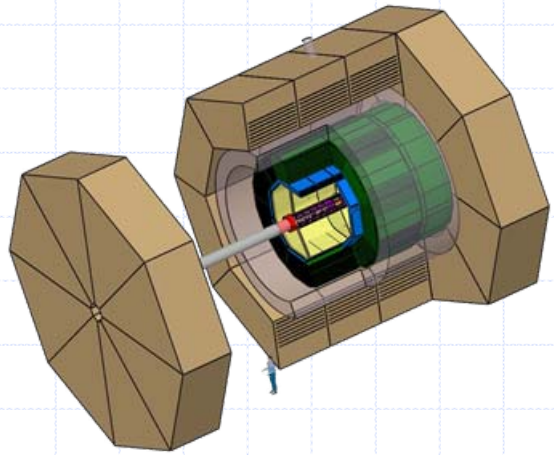


As described in the interface document:

- Non-flammable gas
- Halogen-free cables/materials
- Very early fire detection
- Fire extinguishing systems
- Low oxygen inside detector

- Short escape routes
- Second exit possibility

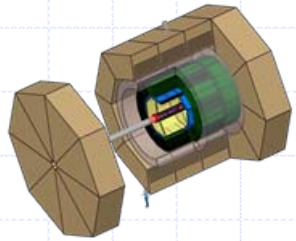
Ventilation:
Temperatures / Humidity



- That normal human being can work!
- That humidity does not condense!
- What can be provided? CMS standard?

- What about smoke removal?

Assumptions



• Surface Assembly:	**in pure CMS style**
• Surface Assembly Hall:	**100m x 30m; Crane 2x80t, hook: 19m(h)**
• Moving:	**Air Pads**
• Main Solenoid Charge/Discharge:	**~>4 hours**
• Push/Pull Scenario:	**~30 days running or maintenance 3-4 days detector exchange**
• Push/Pull accuracy:	**1mm**
• Vertex Detector maintenance:	**Once a year**
• Vertex Detector/ Beam Pipe Exchange:	**Very likely!**
• TPC Exchange:	**Very unlikely!**
• Vacuum:	**Flange and ion pump behind the LumiCAL**
• Small Vacuum Pump:	**Necessary; Ion pump, No Vibration!**

Personal Comment (NM)

Interface Document:

It is quiet good already!

"Calibration of detector.

- After routine push pull operation or other routine switch of the magnetic field is performed with data tracks, at nominal or other energy. This operation is the detector collaboration choice and responsibility and **its time is not counted as push-pull operation.**"

Ähh!! NO, NO, NO!

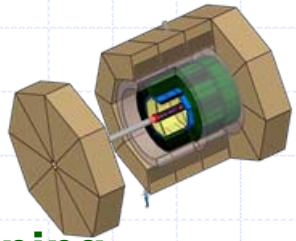
Push/Pull lasts is from end of data taking to start of data taking!

What is this good for?

Machine against detector?

Let push/pull look better?

Assumptions (cont'd)



- Minimum L* 4.3m
- QD0 Supply:

*** Has to allow >2.5m opening of the End Cap**
*** Permanent supply from Service Cryostat,**
*** flexible line to Service Cryostat**

- QD0 Support
- LumiCal Support
- Central Beam Pipe Support (incl. Detectors)

By a support structure

- Support of Support Structure

With spokes between TPC and ECAL
Pillar close to QF1
and guided in the end cap!

- Long. Position BeamCAL

Variable; constrained by Pump, Flanges etc.

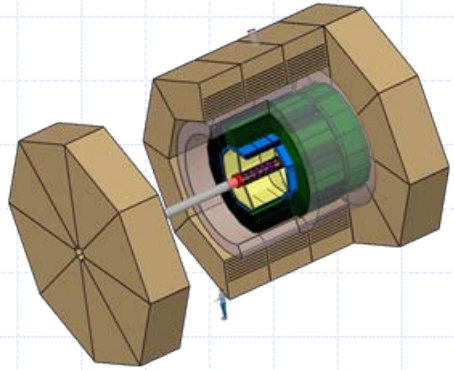
- Background Shielding

Prelimary

From LumiCal to BeamCal, min. 6cm thick, attached to the HCAL

Open Points

Under Study



- End Cap Yoke split

  Not mandatory, if 2.5-3m opening is possible!

- Platform

  Charming

- Anti-Solenoid

  Machine Item (and Cost)

- Anti-DID

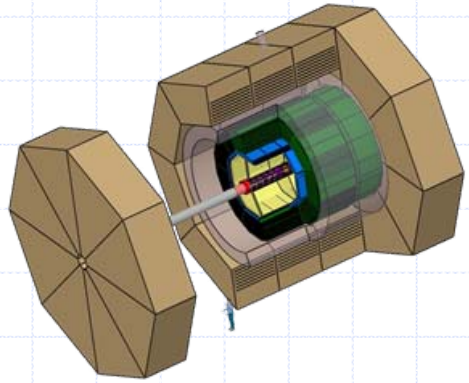
  Interesting option

- Magnetic HCAL end cap

  Really necessary (TPC field quality)?

- ...

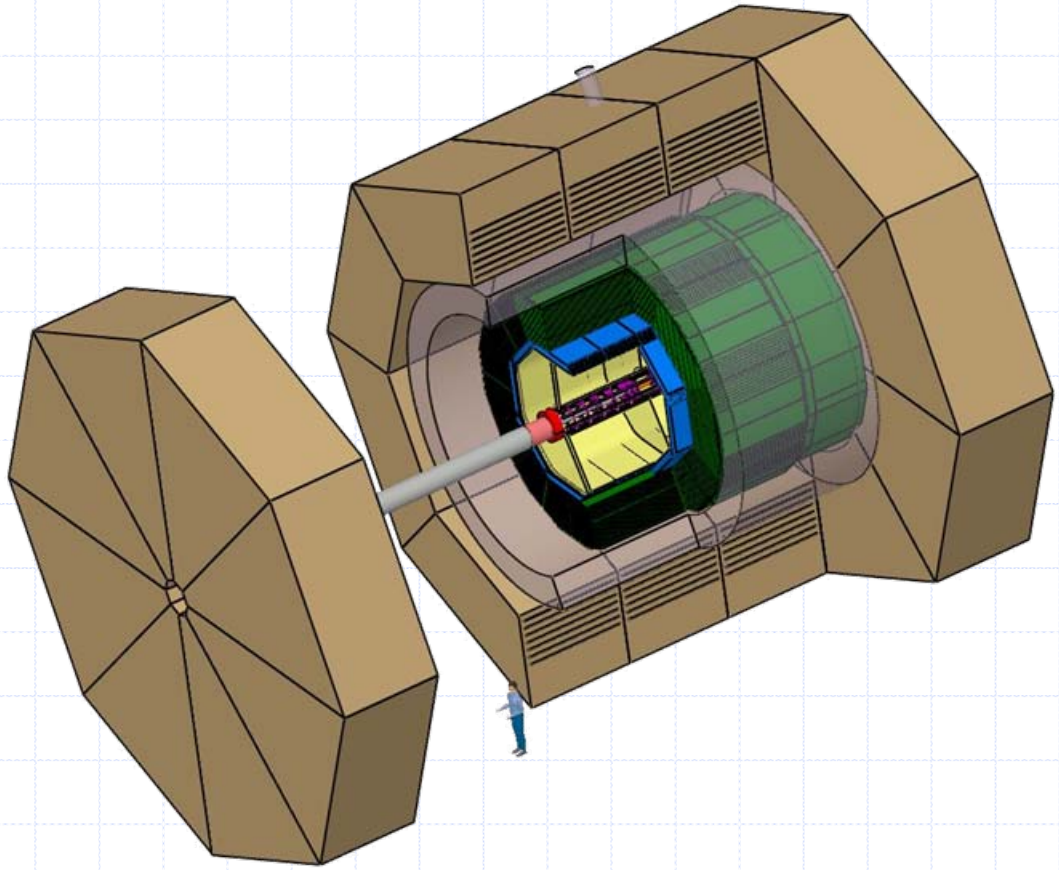
Conclusion



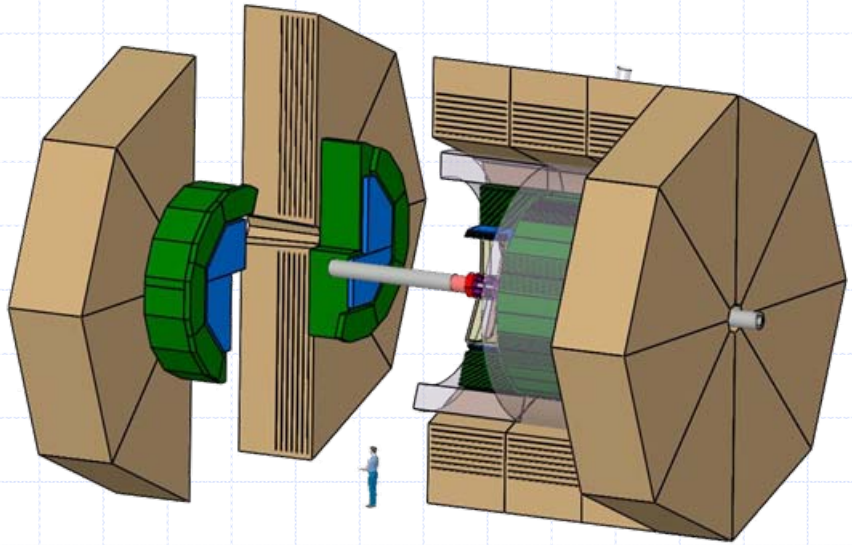
- Engineering Design is continuing
- Some Questions have been answered
  - Good information about FD magnets and cryo supply
    (Dimensions, positions etc.)
- Still several open questions
  (internal, external and mixed; GLD/LDC merge)
- Question about ‘door splitting’ or
  ‘to use a platform’ are under study.
  Need further information, discussion and engineering

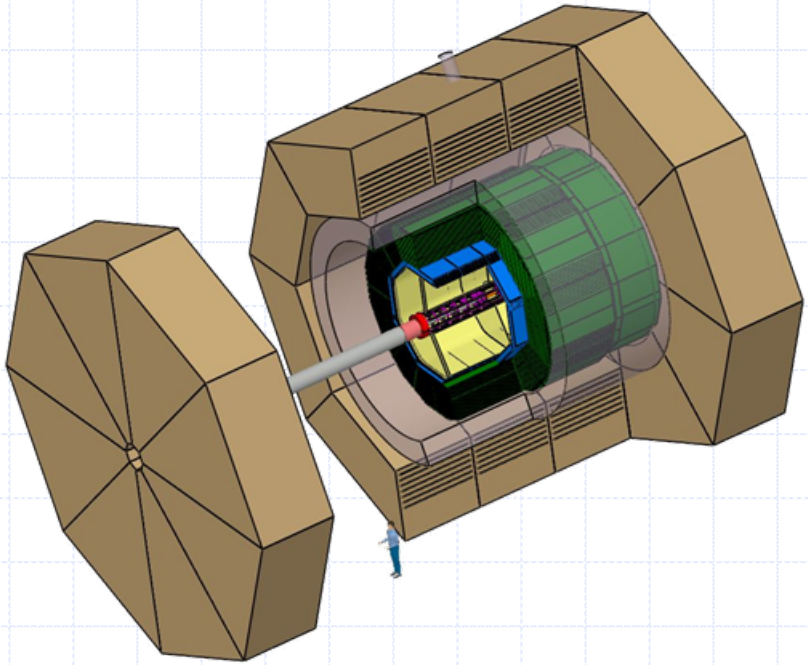
End

Thank you for your attention



Additional Material

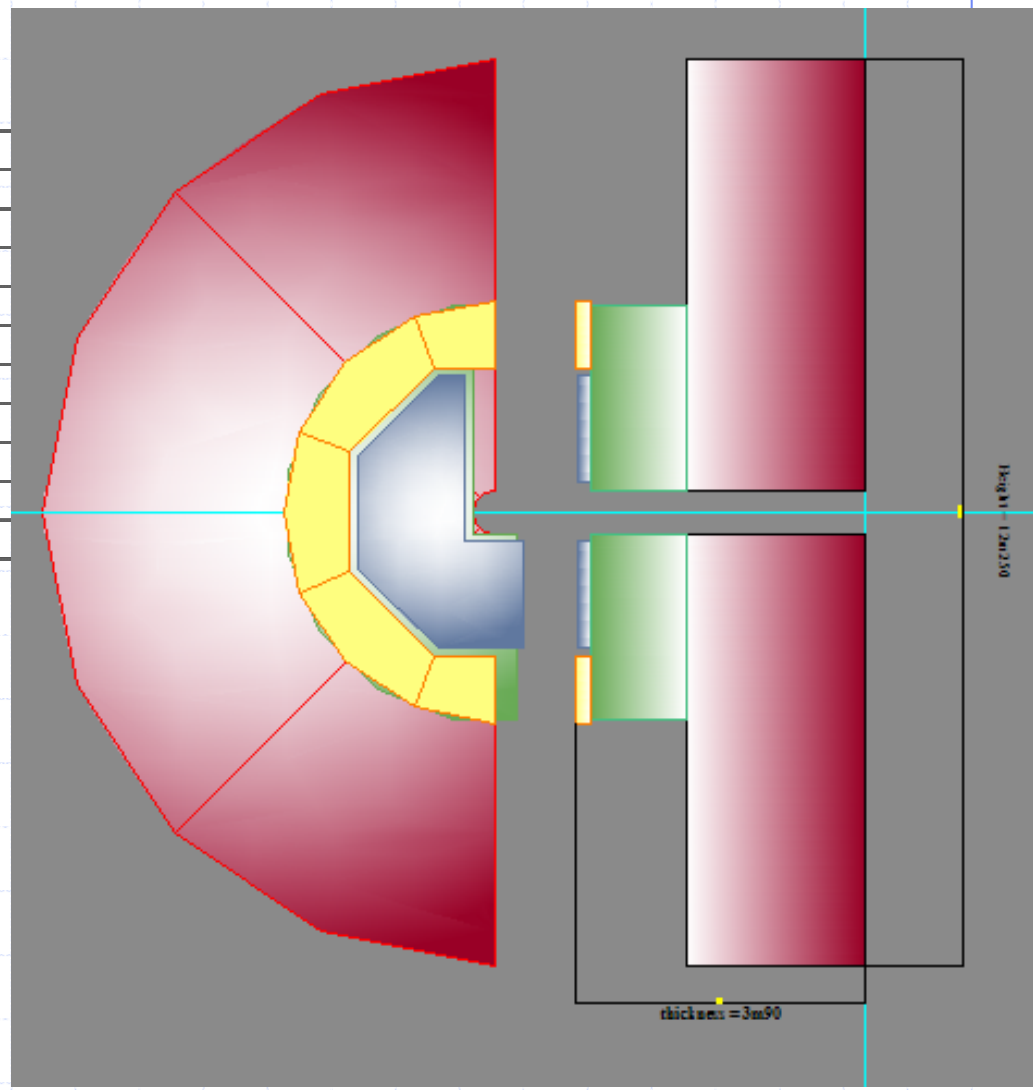




Half End Cap

	total	half	
Yoke	1750	875	
Hcal	187	93,5	
ring	12	6	
Ecal	16	8	
	Σ =	982,5	tonnes
height		12m250	
Thickness		3m90	

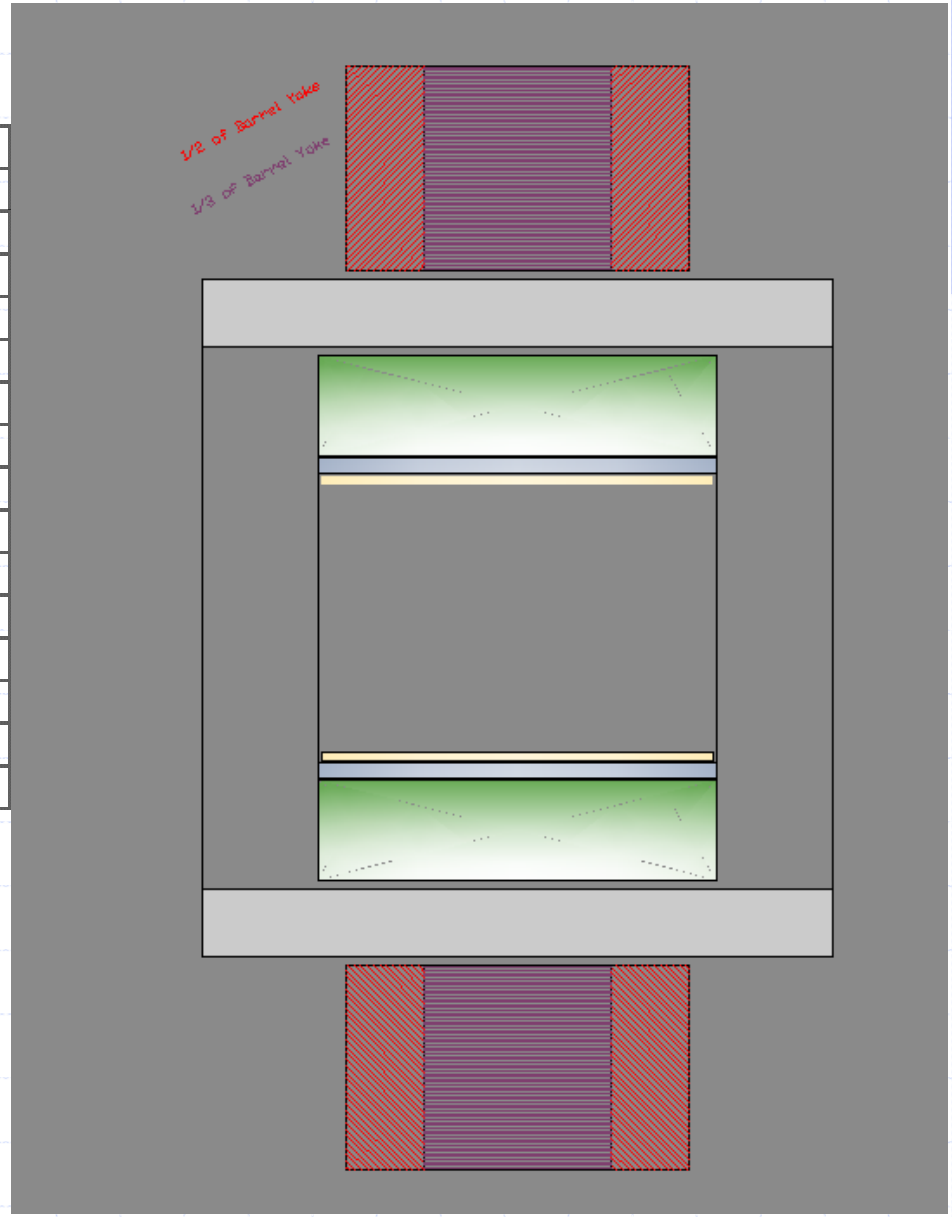
From C.Clerc, LLR



Central Barrel

1/2 Barrel Yoke	1588	
Coil	130	
Hcal	395	
Ecal	82	
Σ =	2195	
1/3 Barrel Yoke	1059	
Coil	130	
Hcal	395	
Ecal	82	
Σ =	1666	

From C.Clerc



LumiCAL & LHCAL

From H.Videau