

# ILD and SiD in Japanese site

(from discussions in SiD/ILD E/D Interface Working Meeting)

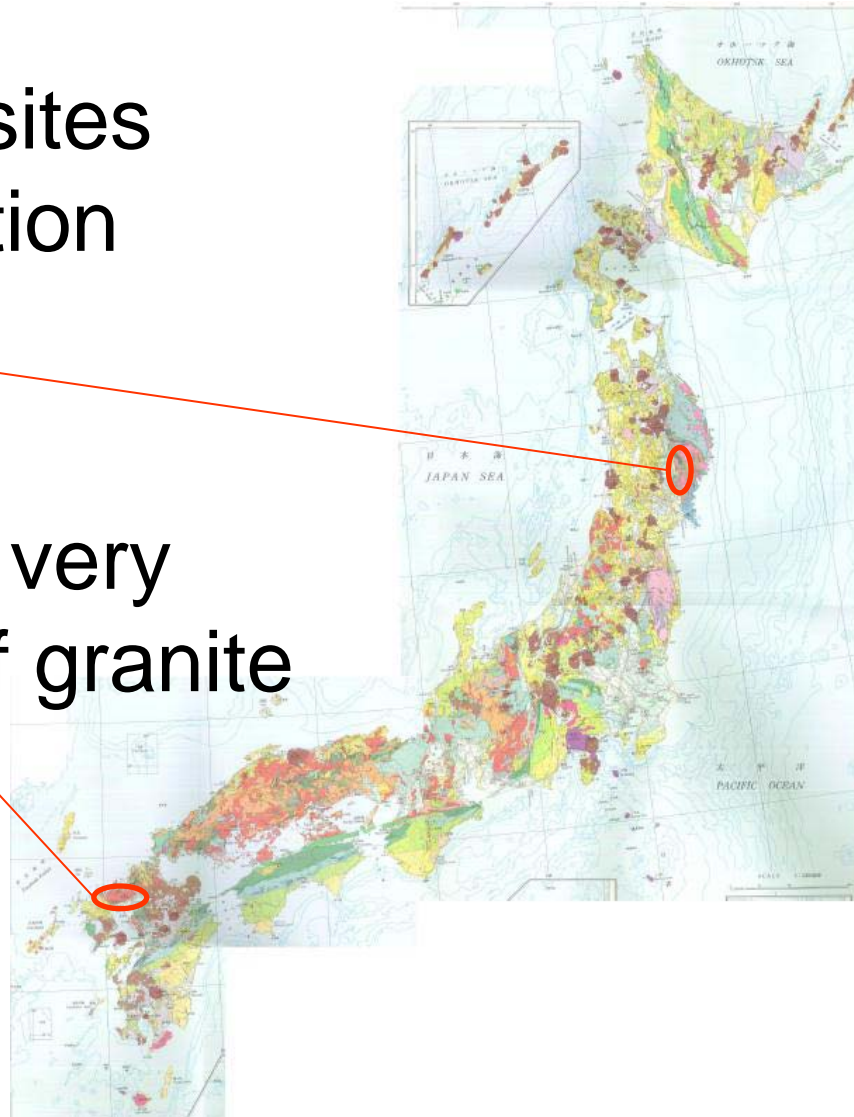
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2011/12/15

SiD Workshop@SLAC

# Japanese candidate sites

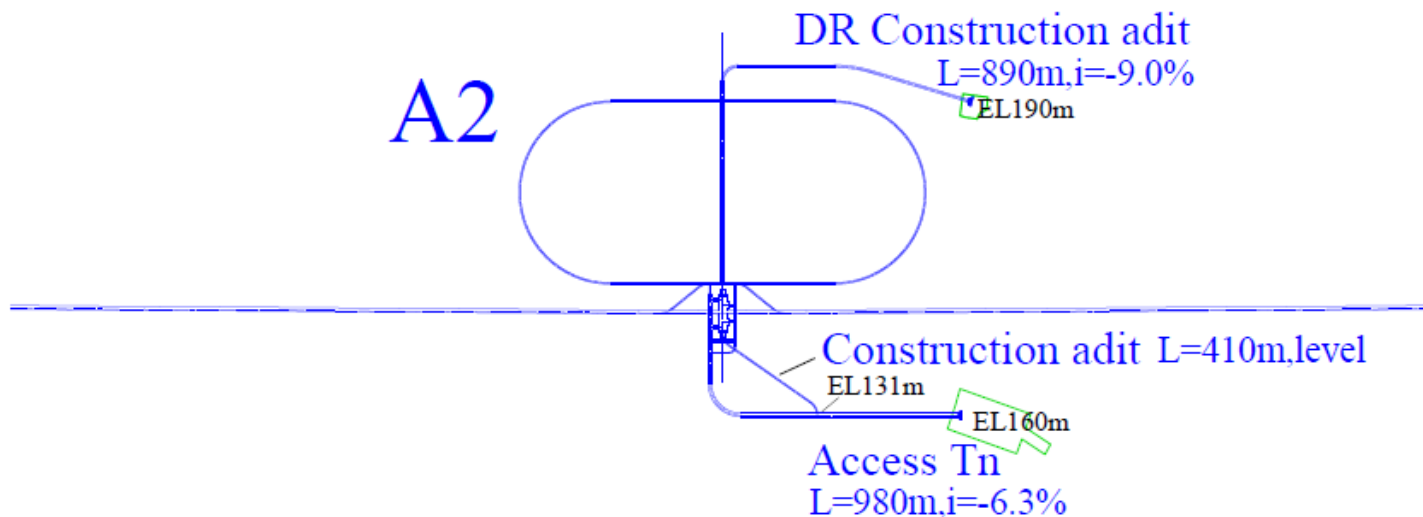
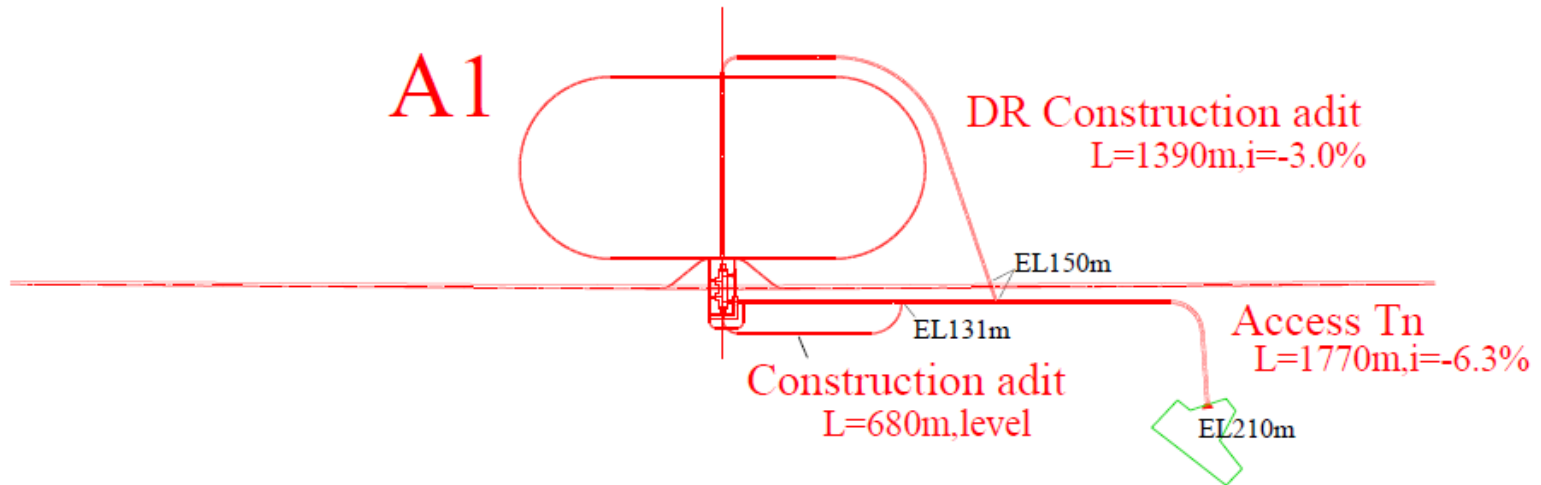
- Two candidate sites under investigation
  - Kitakami
  - Sefuri
- Both sites have very good geology of granite

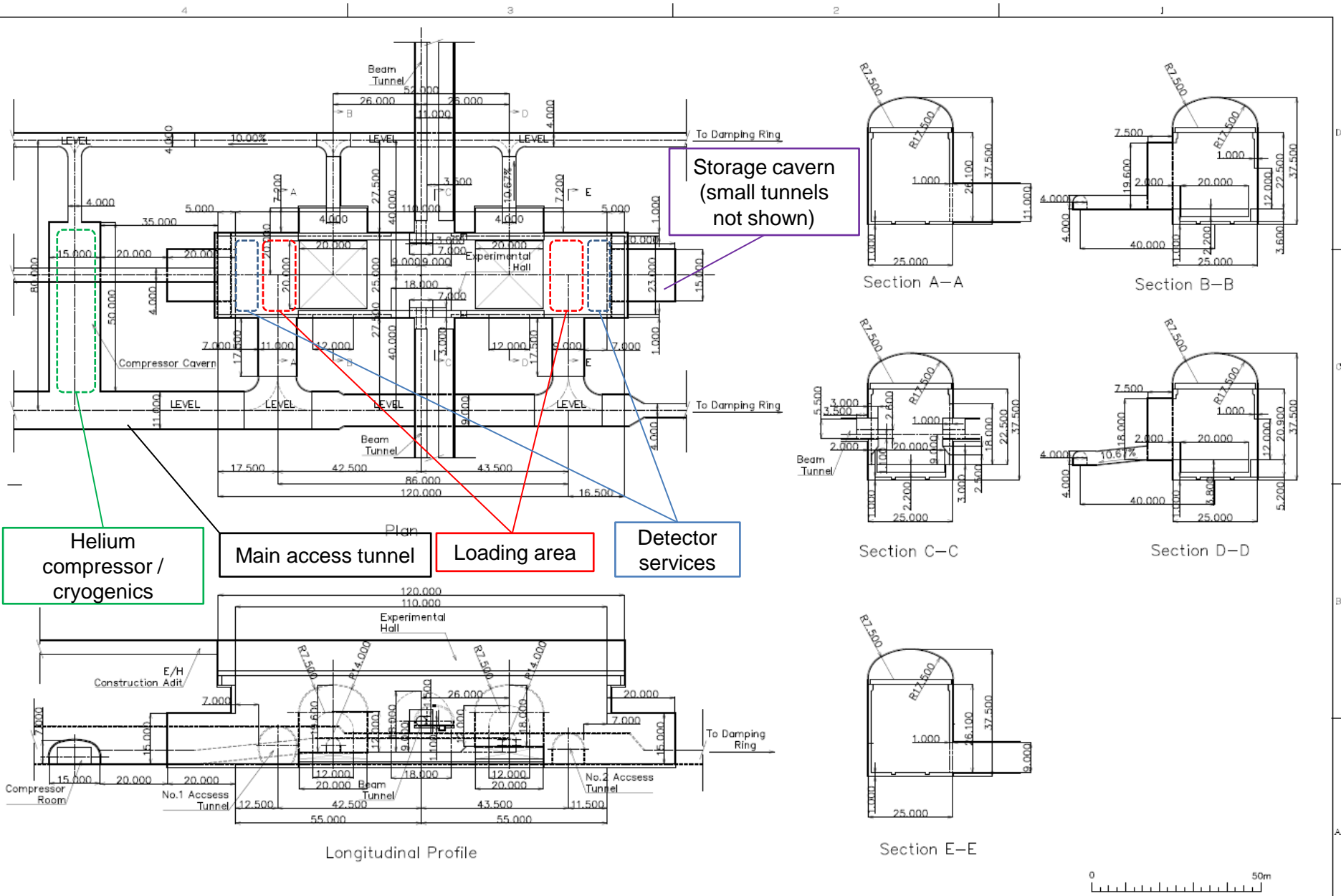


# Detector hall in Japanese sites

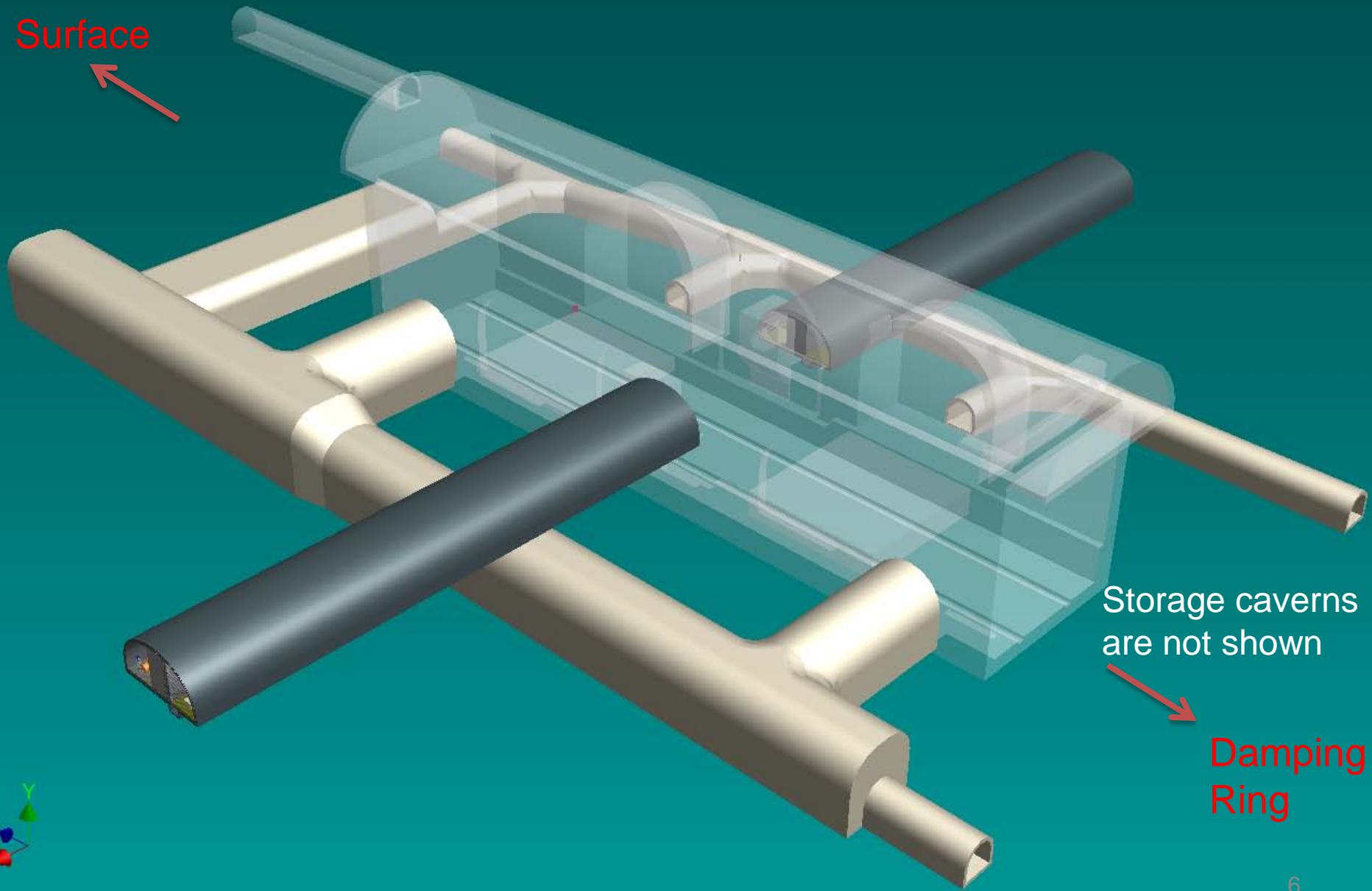
- Earth covering depth is quite large:  
200~500m
- Therefore, (inclined) horizontal tunnel is used for access instead of vertical shafts
- Length of the access tunnel is 1000~1700m, depending on the detail of the site
- In addition to the main cavern, storage caverns and a compressor cavern will be build

# Tunnel layout examples





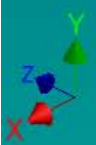
Surface



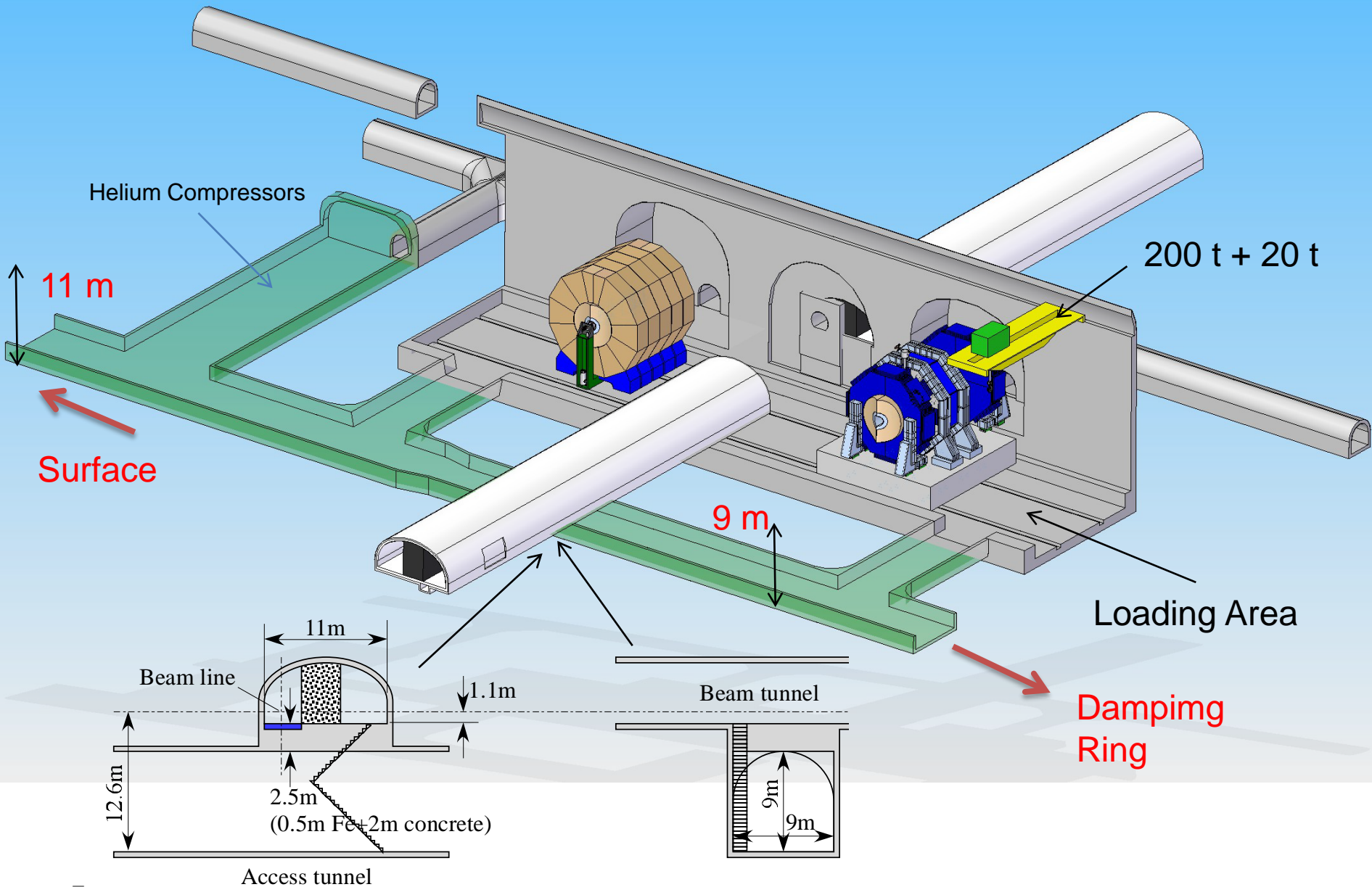
Storage caverns are not shown



Damping Ring



# IR hall Specifications



# Main cavern

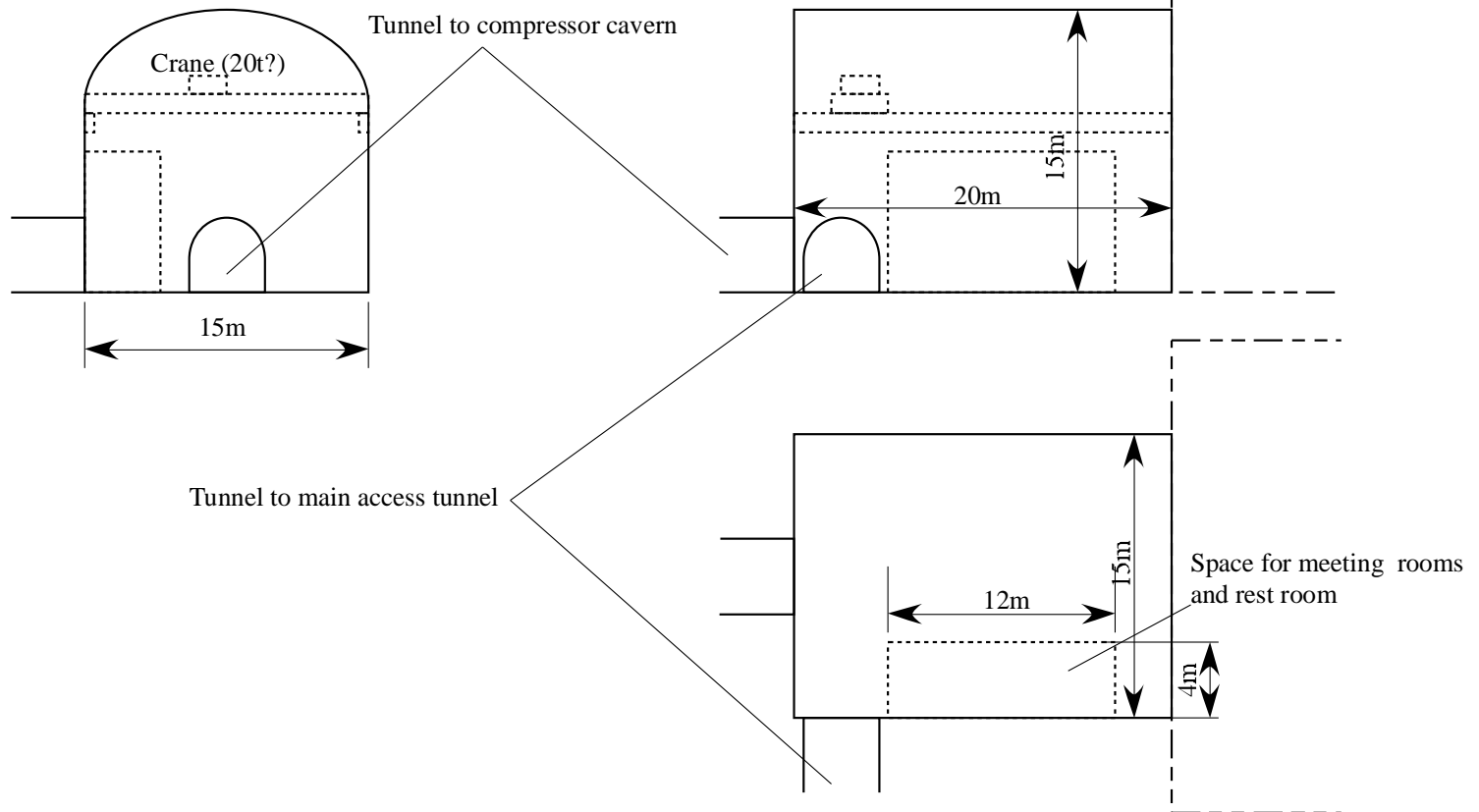
- I-shape, 25m(W)x110m(L)x37m(H)
- Access tunnels from a side wall
- Construction adit at the top of the cavern
  - After construction, it will be used for a duct tunnel and a path of smokes/He gas in emergency
- Alcoves (7.5m depth) at the garage positions
- Storage caverns (alcoves) at both ends
- Two sets of ~250 ton crane with smaller sub-crane
- 1 m thick side walls supporting crane rails
- Floor level is 12.6 m (=9+2.2+1.4) below the beam line



# Storage cavern

- Purpose
  - Storage of detector pieces before installation
  - Preparation/storage of tools for detector assembly/installation
  - Meeting rooms and rest room can be build in this cavern
- Size:15m(W)x20m(D)x15m(H)
- Connected to the main access tunnel by a small tunnel
- ILD storage cavern is connected to the compressor cavern by a small tunnel

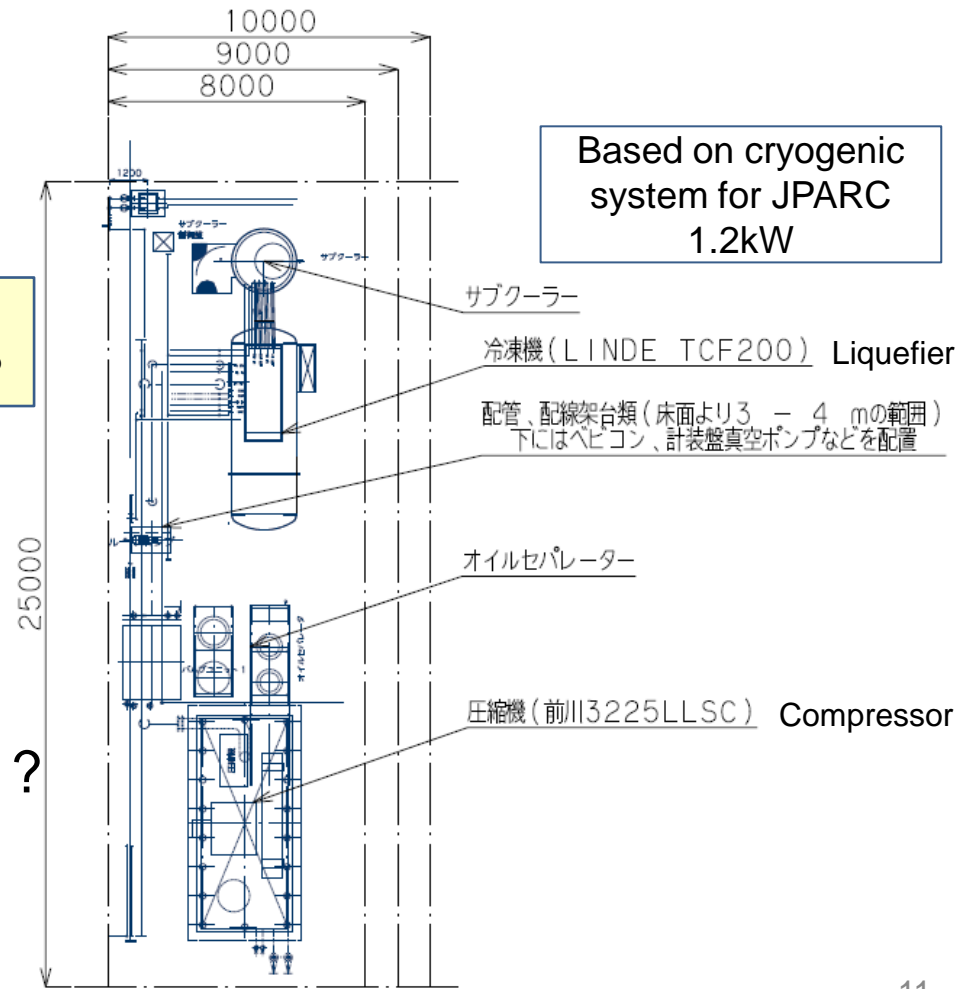
# Storage cavern



# Compressor cavern

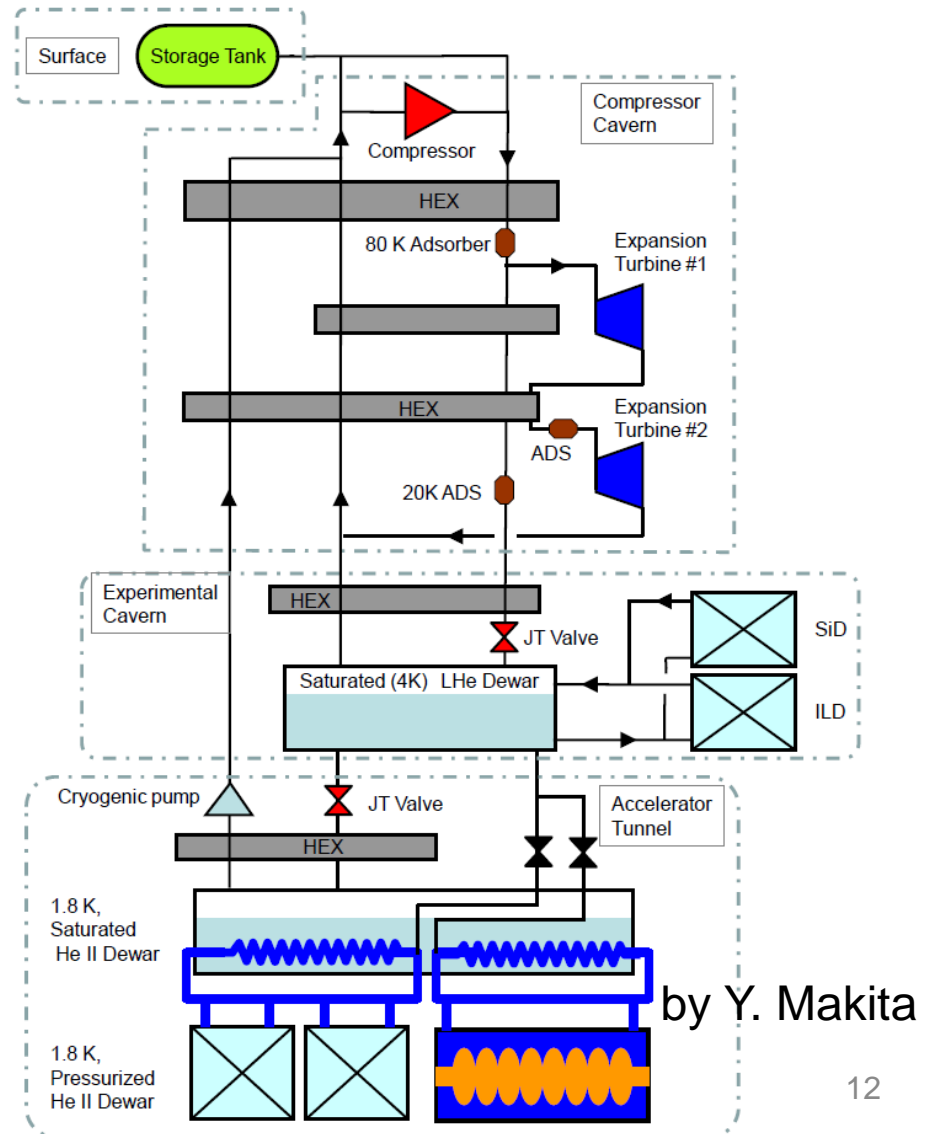
- 15m(W)x50m(L)x7m(H)
- Helium compressor and liquefier for
  - ILD/SiD solenoid
  - QD0/QF1
  - Crab cavity
- Requirements:
  - 400kW electric power
  - 300L/min cooling water
  - 10000m<sup>3</sup>/h air ventilation
- Air compressor for air-pads ?

Common or independent ?



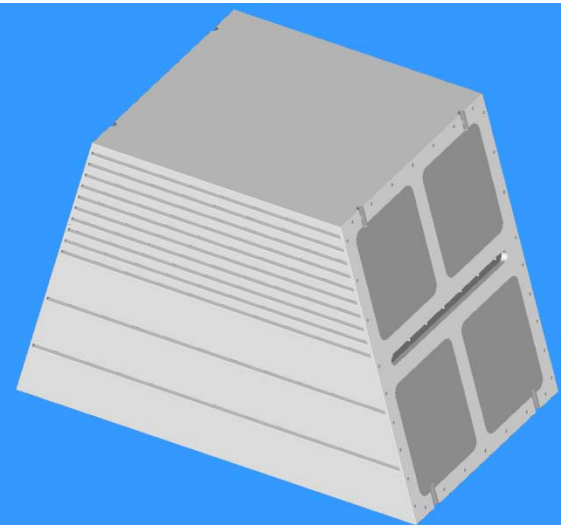
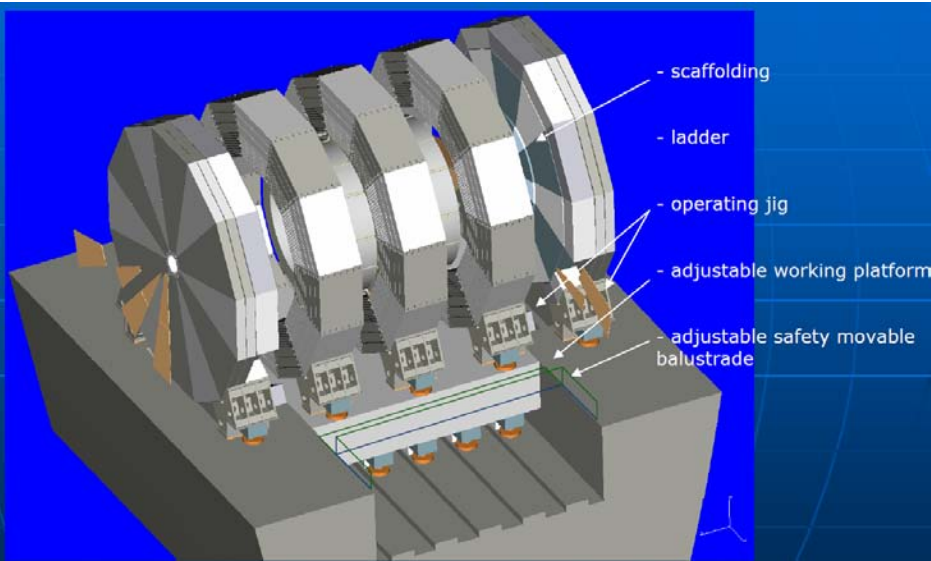
# Cryogenic system

- Helium gas storage tank on surface
- Compressor and liquefier in the compressor cavern
- 4K saturated liquid helium tank in the main cavern or in the (ILD) storage cavern
- 2K sub-coolers in (near) the beam tunnels
- We need more discussions to make the detailed design



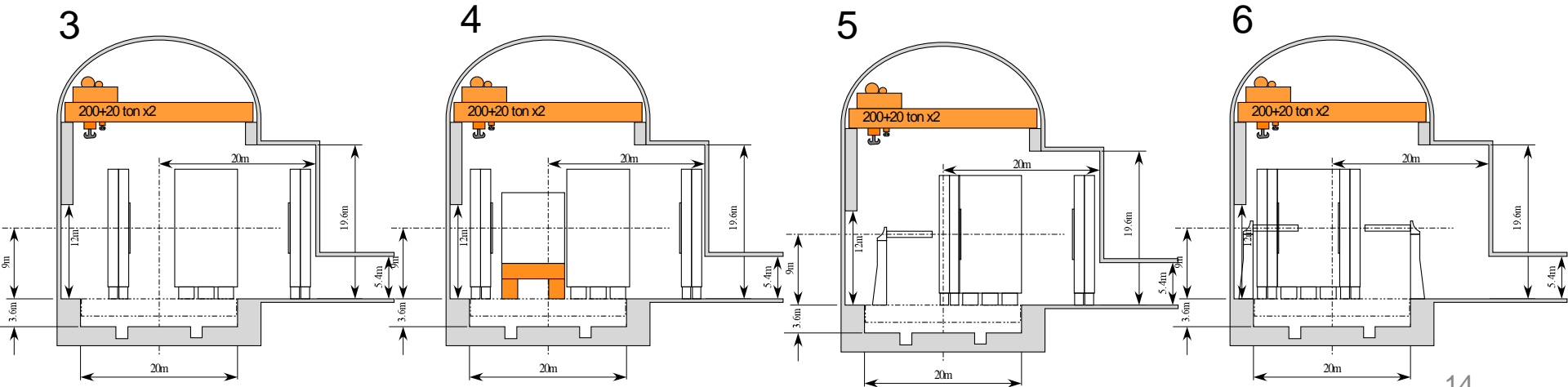
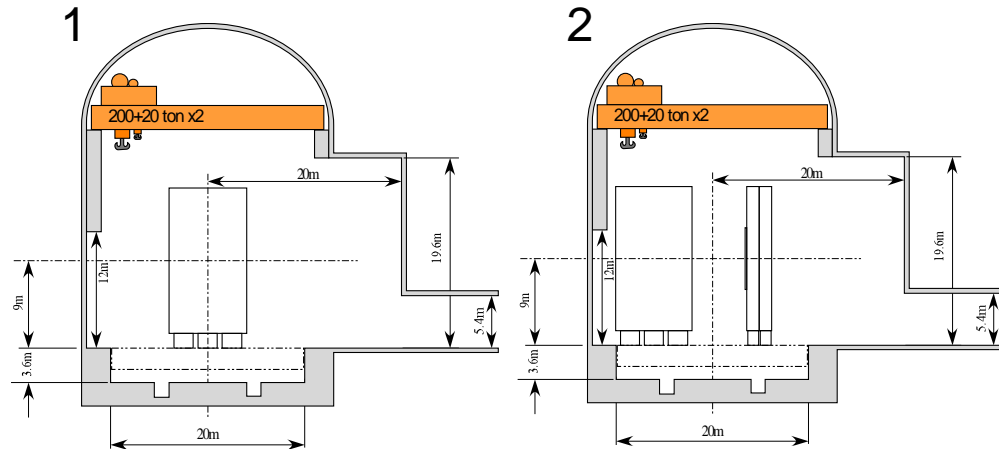
# ILD Detector assembly

- Solenoid
  - Wound, assembled, and tested on surface
  - Carried into the cavern as a whole
- Return yoke
  - Pre-assembled on surface as relatively small blocks ~200 tons
  - Each ~200 ton block is carried into the cavern one by one and assembled into one barrel
  - No gap in the barrel yoke → Less leakage field
- Large assembly hall on surface is necessary

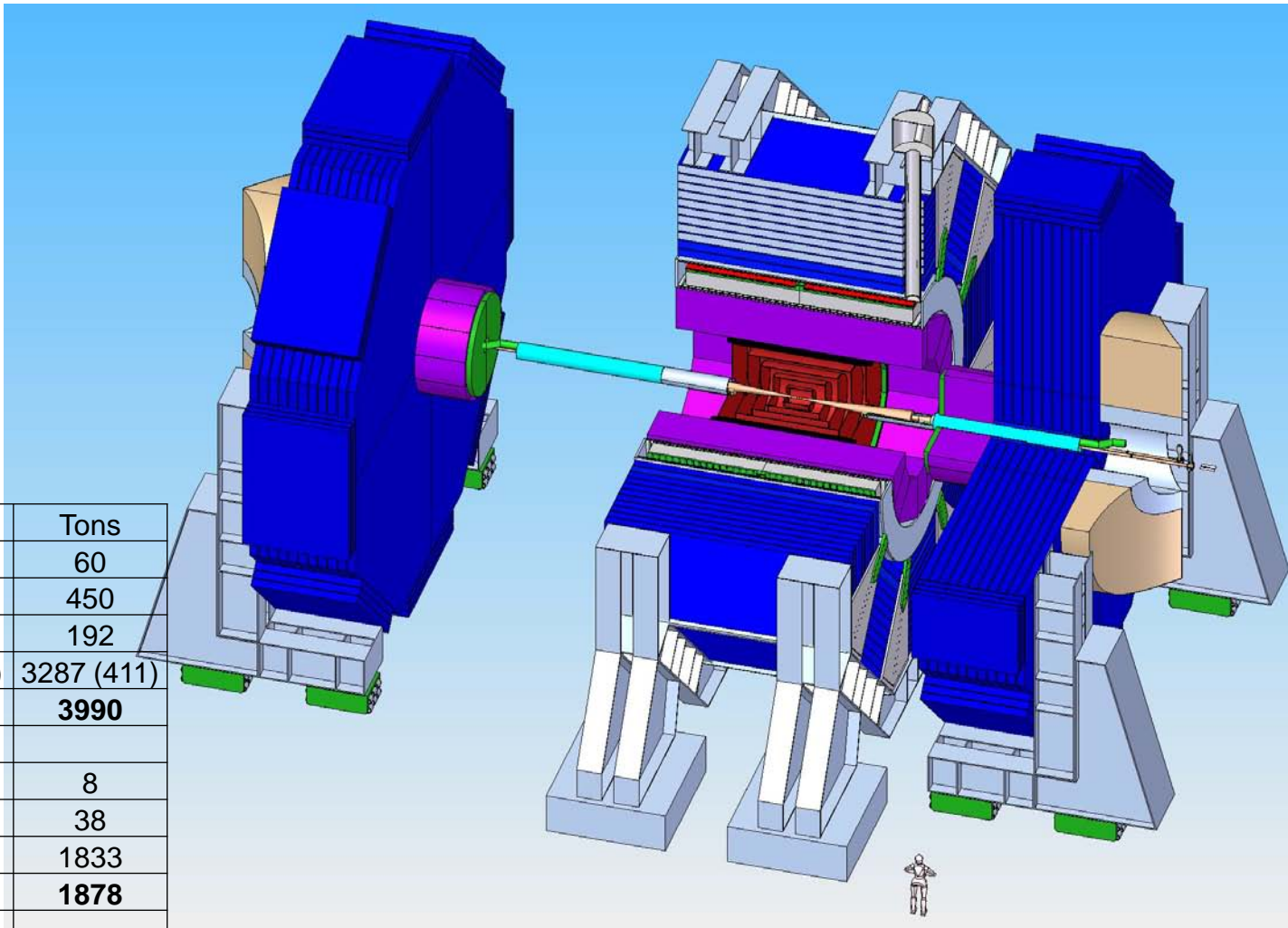


# ILD Detector assembly

1. Barrel assembly
2. Endcap (+) assembly
3. Endcap (-) assembly
4. Solenoid installation
5. QD0 support tube (-) assembly
6. QD0 support tube (+) assembly
7. Sub-detector installation

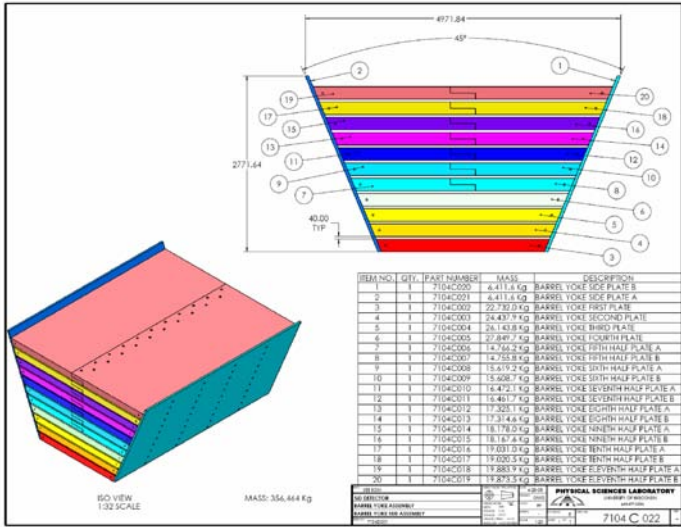


# SiD Detector assembly



Part	Tons
Barrel Ecal	60
Barrel Hcal	450
Coil	192
Barrel Iron x 8 (1/8)	3287 (411)
<b>Total Barrel</b>	<b>3990</b>
Endcap Ecal	8
Endcap Hcal	38
Endcap Iron	1833
<b>Total EndCap x1</b>	<b>1878</b>
<b>Total SiD</b>	<b>7746</b>

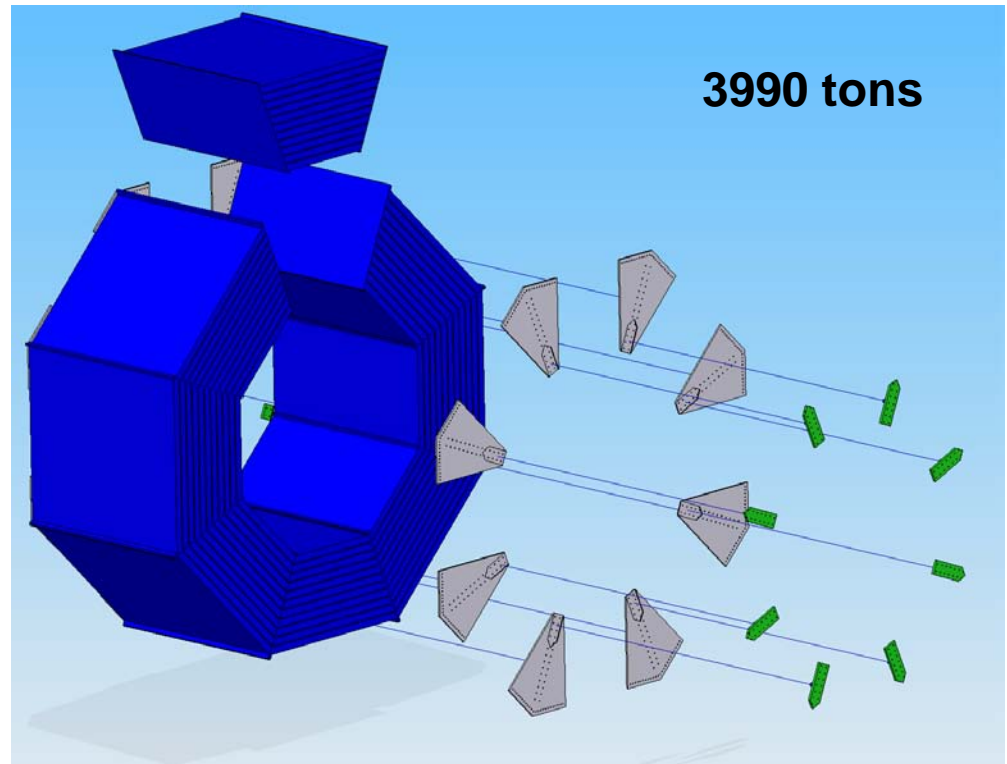
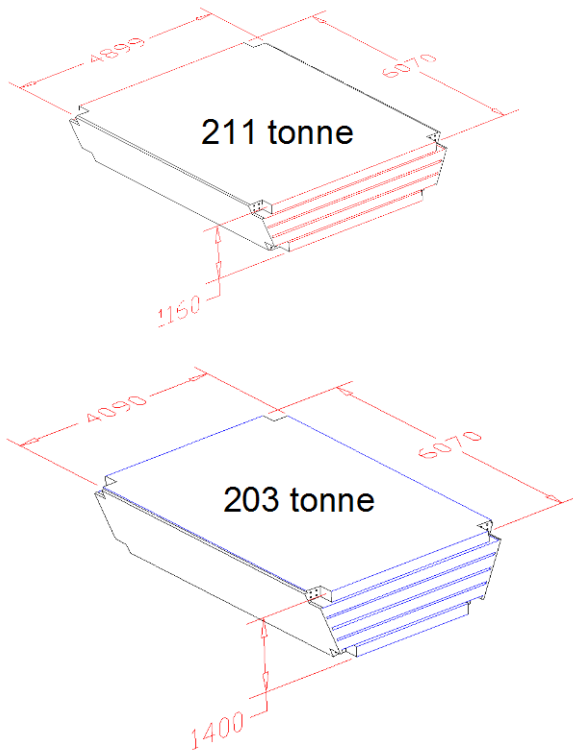
# Iron Barrel Yoke layout



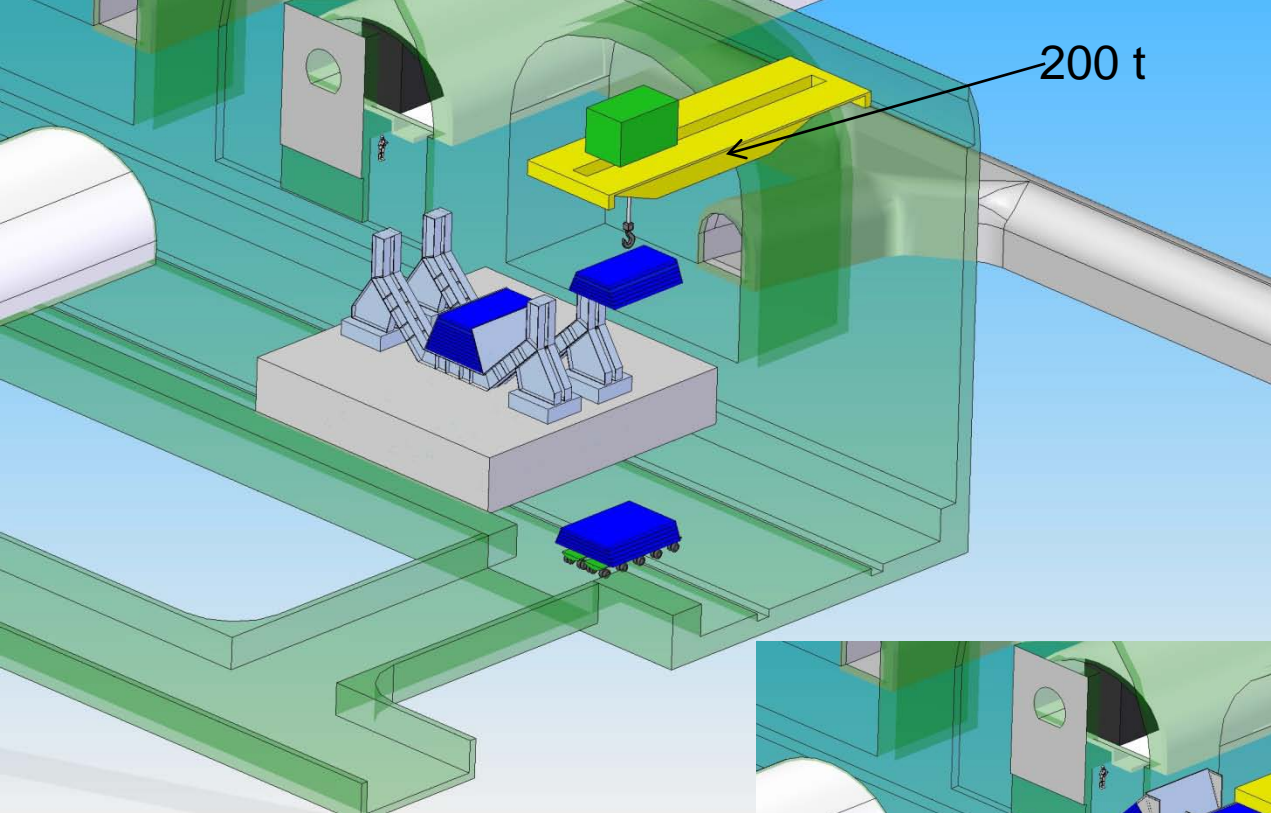
Bolted assembly, 144 plates 200 mm thick, 40mm gap  
Opportunity to make blank assembly at the factory before shipping

Preliminary Contacts with Kawasaki Heavy Industries

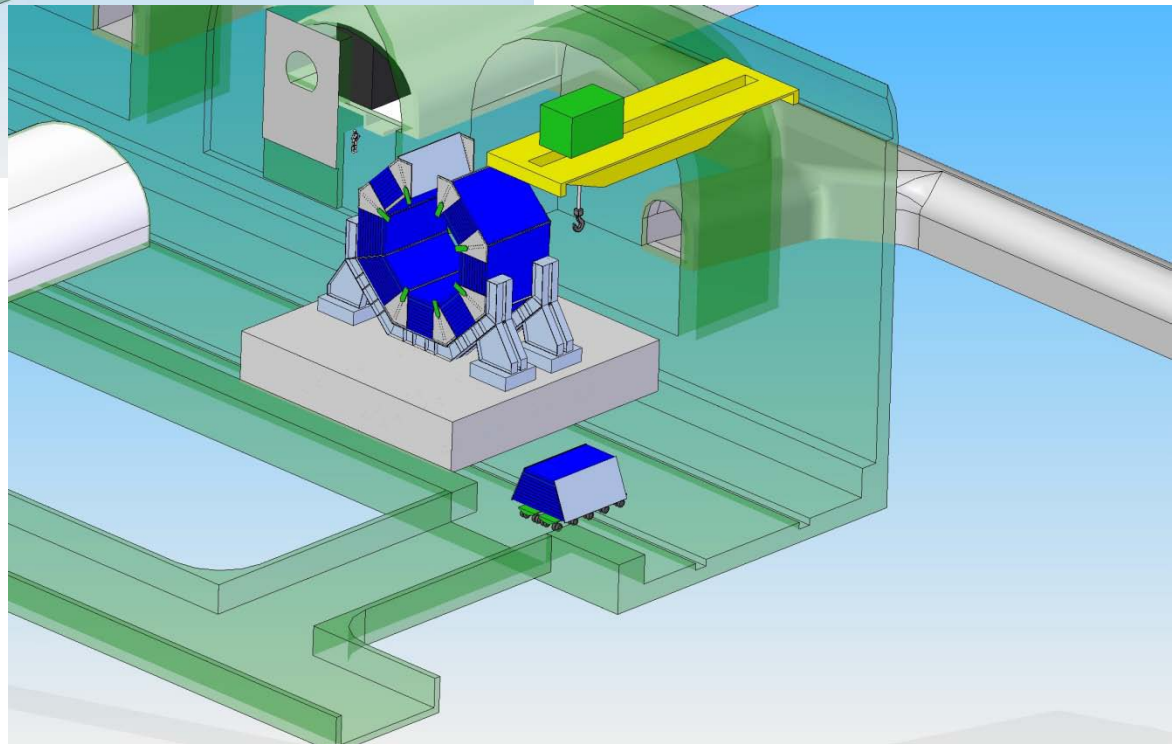
- Plate thickness tolerance for each: 0.1mm
- Plate flatness: 4mm (in a plate)
- Fabrication (assembling & welding) tolerance: 2mm
- Full trial assembly: capable (but need to study)



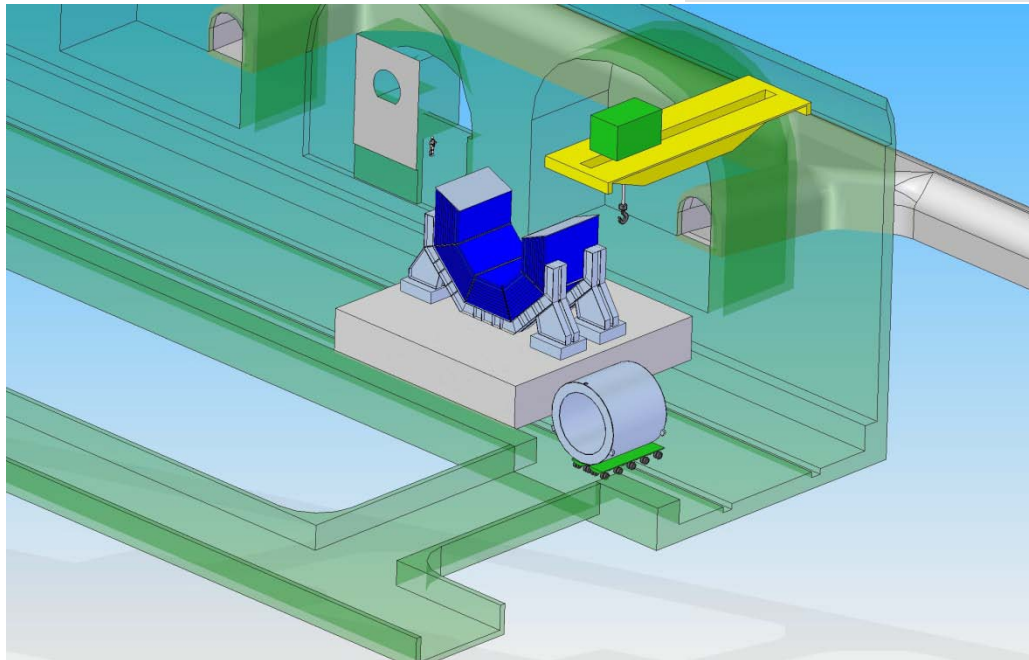
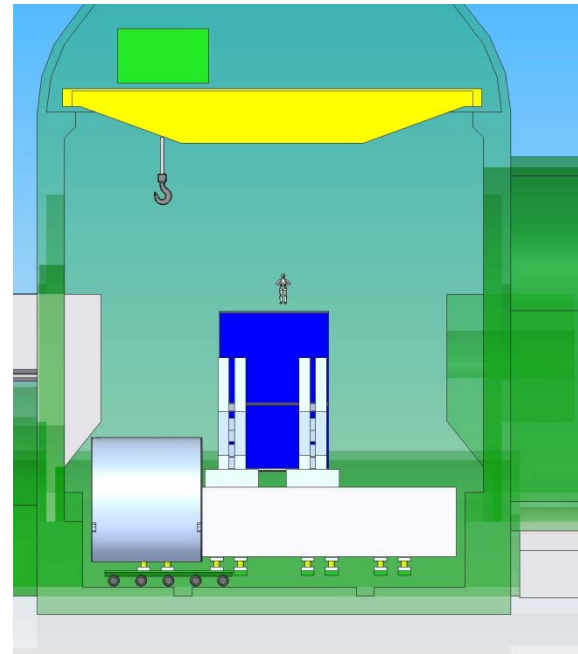
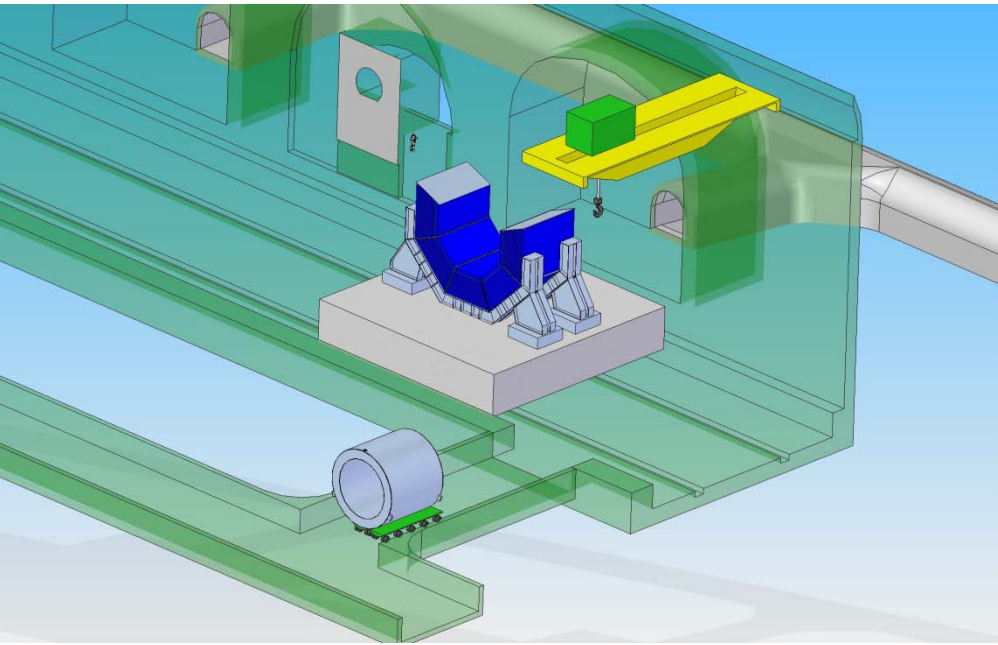




~ 8 x 410 tons trips along the transfer tunnel

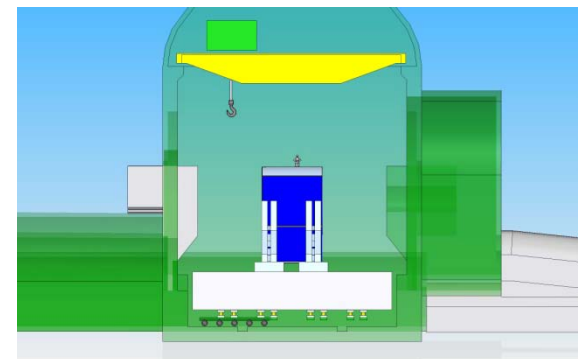
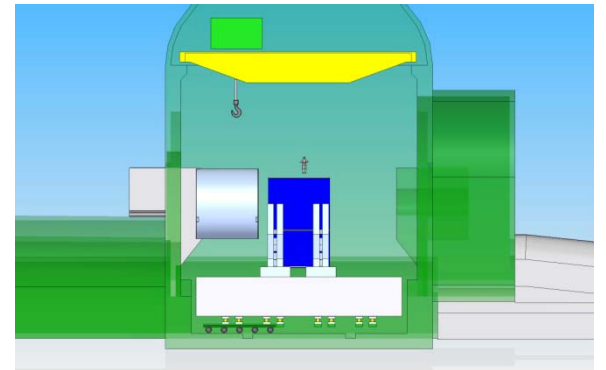
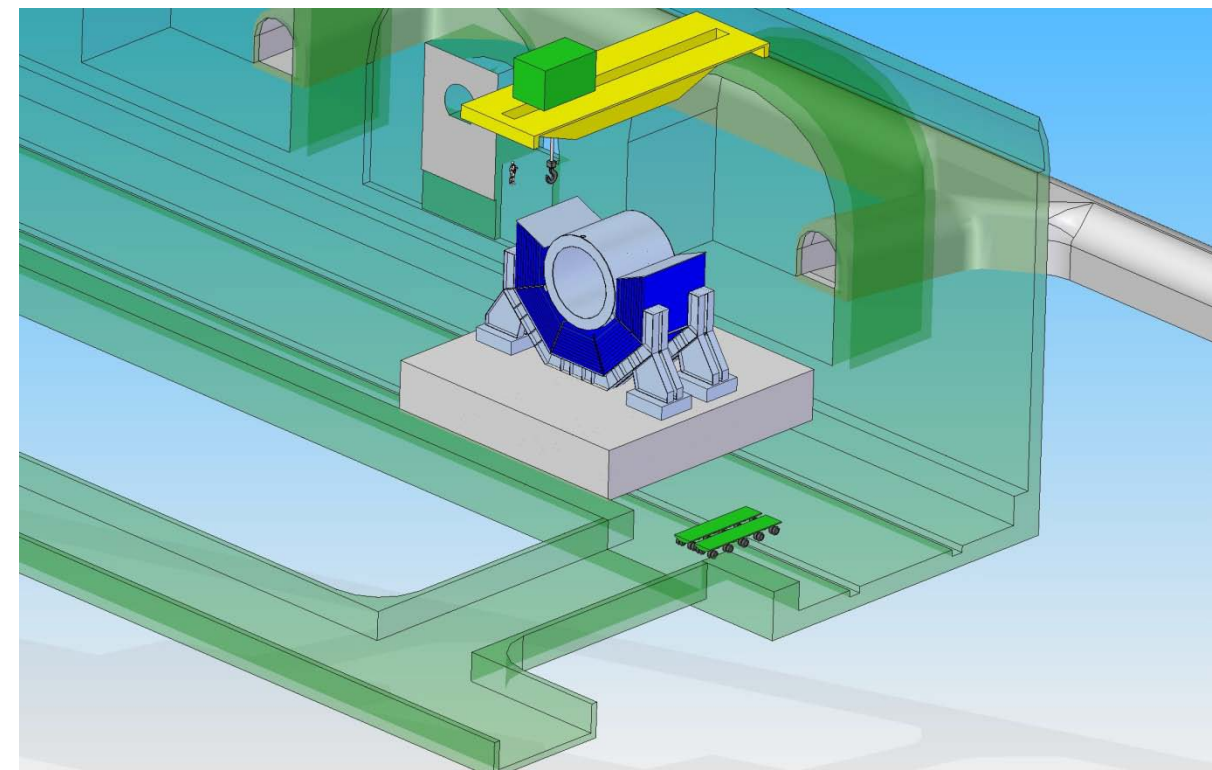
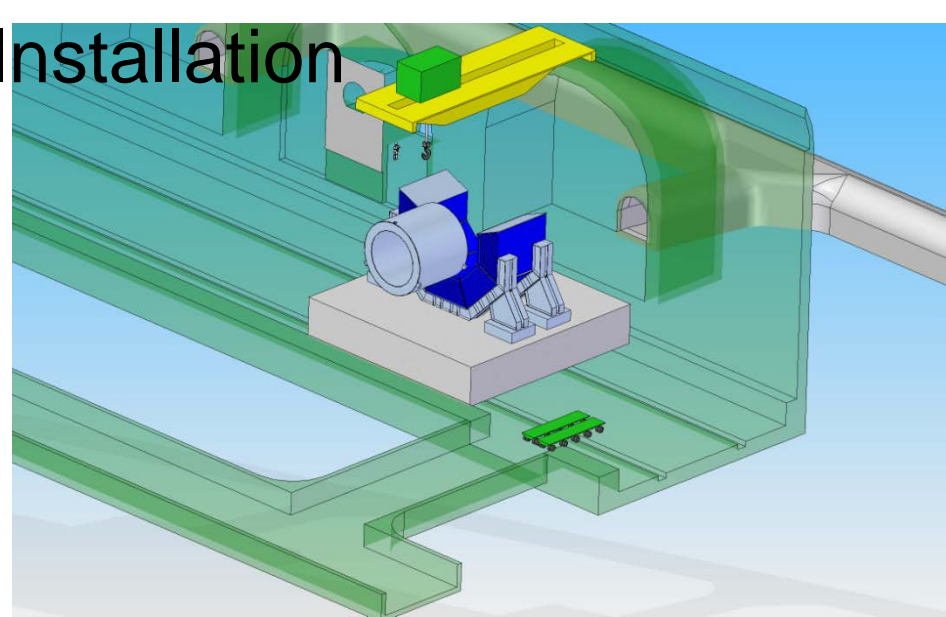
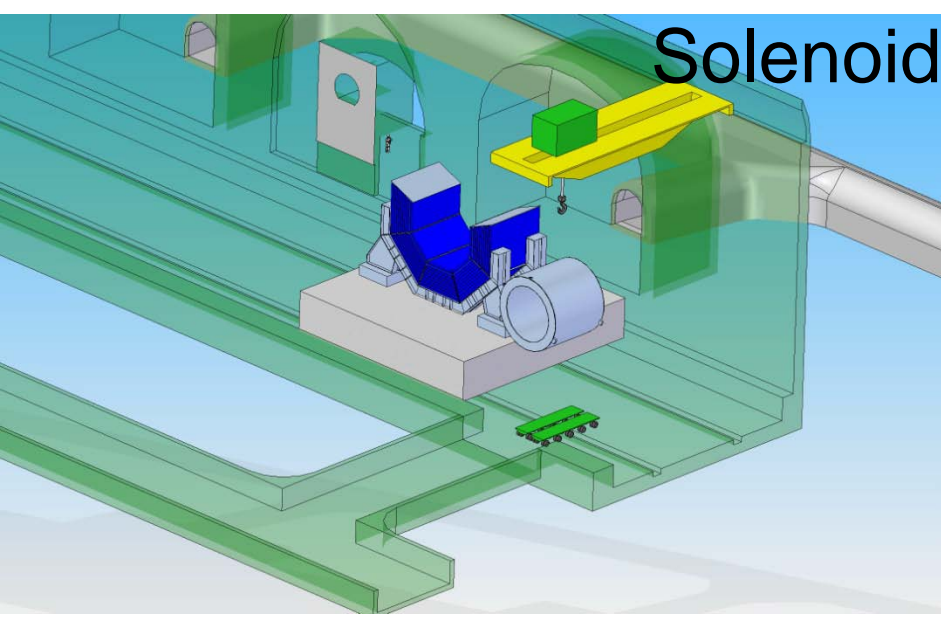


# Solenoid Installation

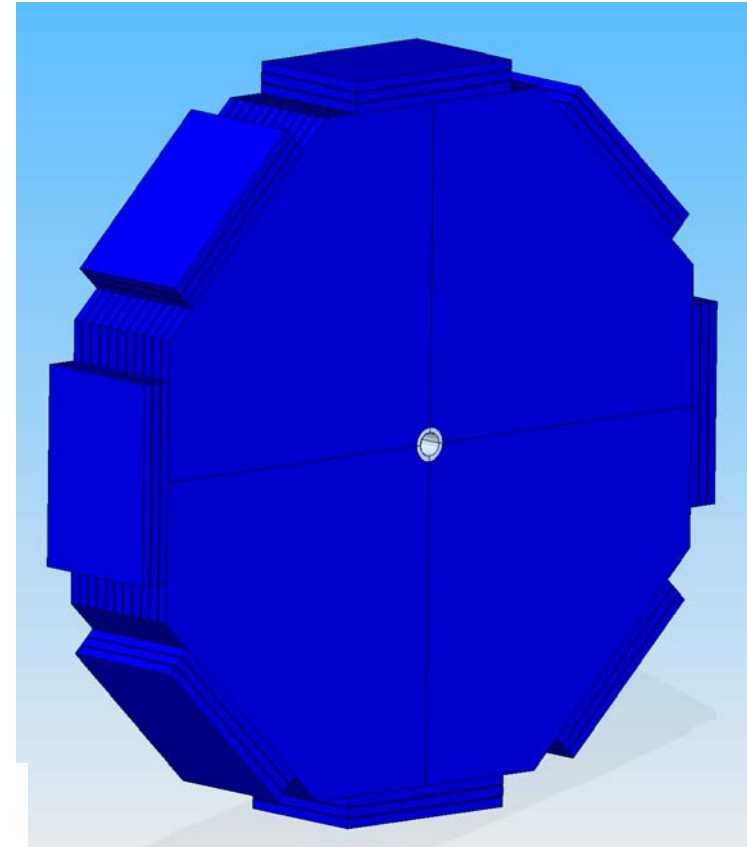
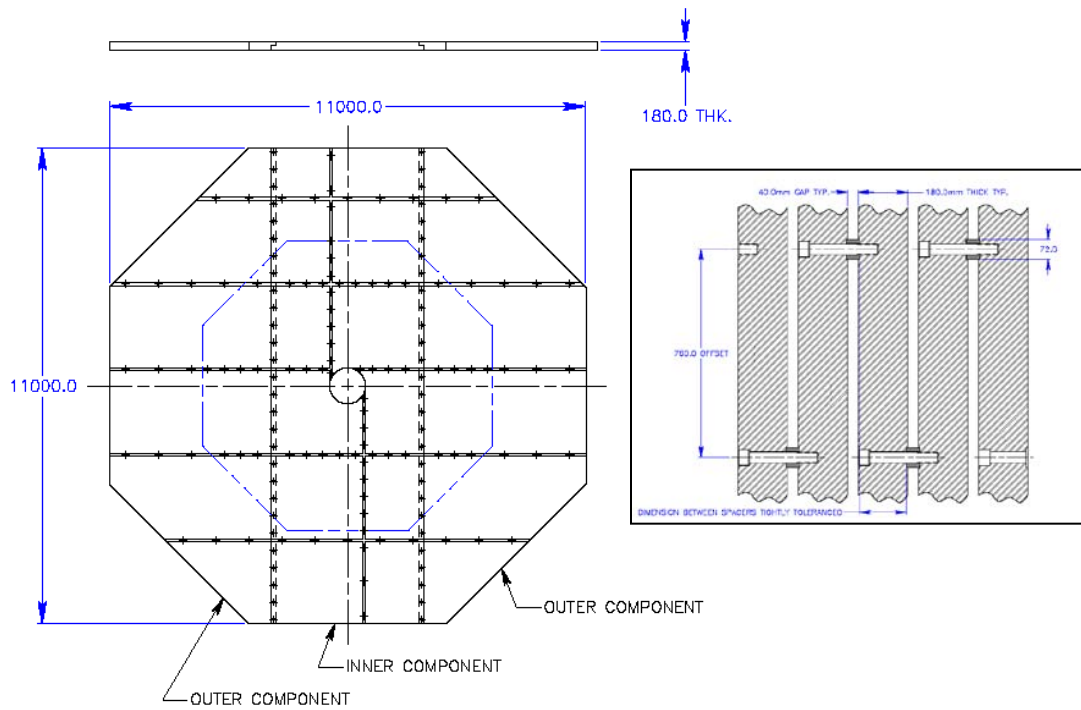




# Solenoid Installation

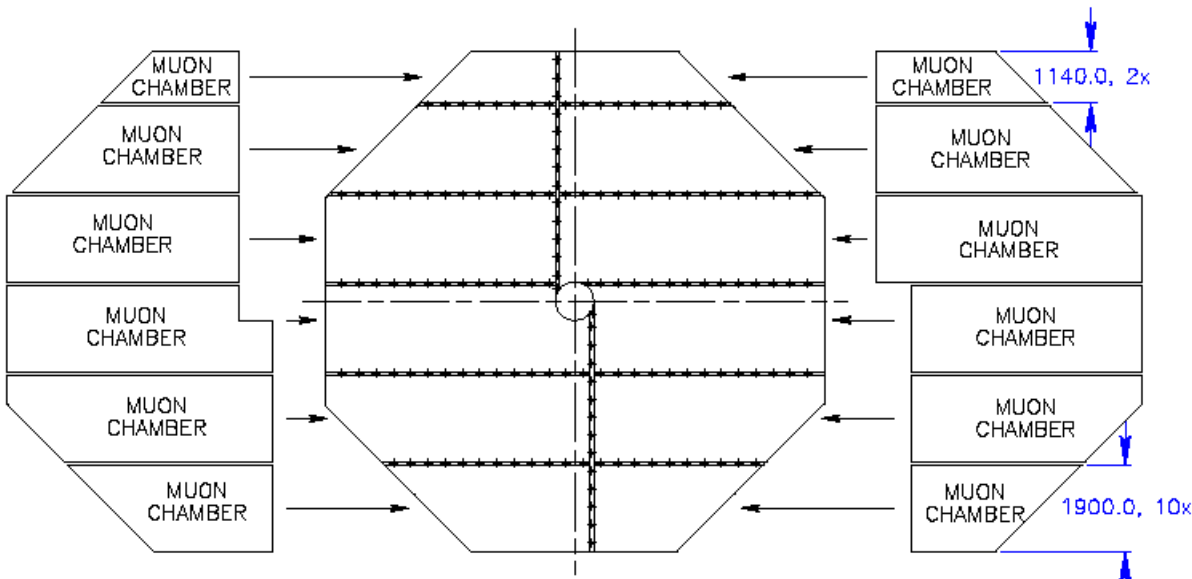


# Iron Door Yoke, Bolted assembly, no vertical split

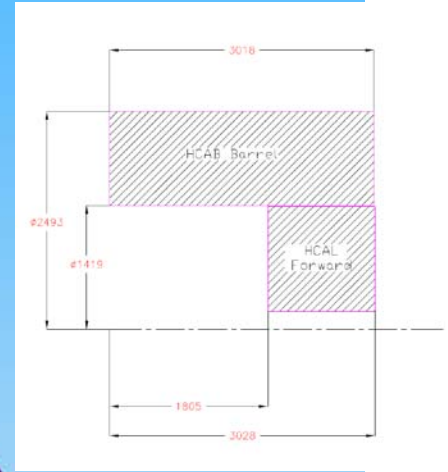
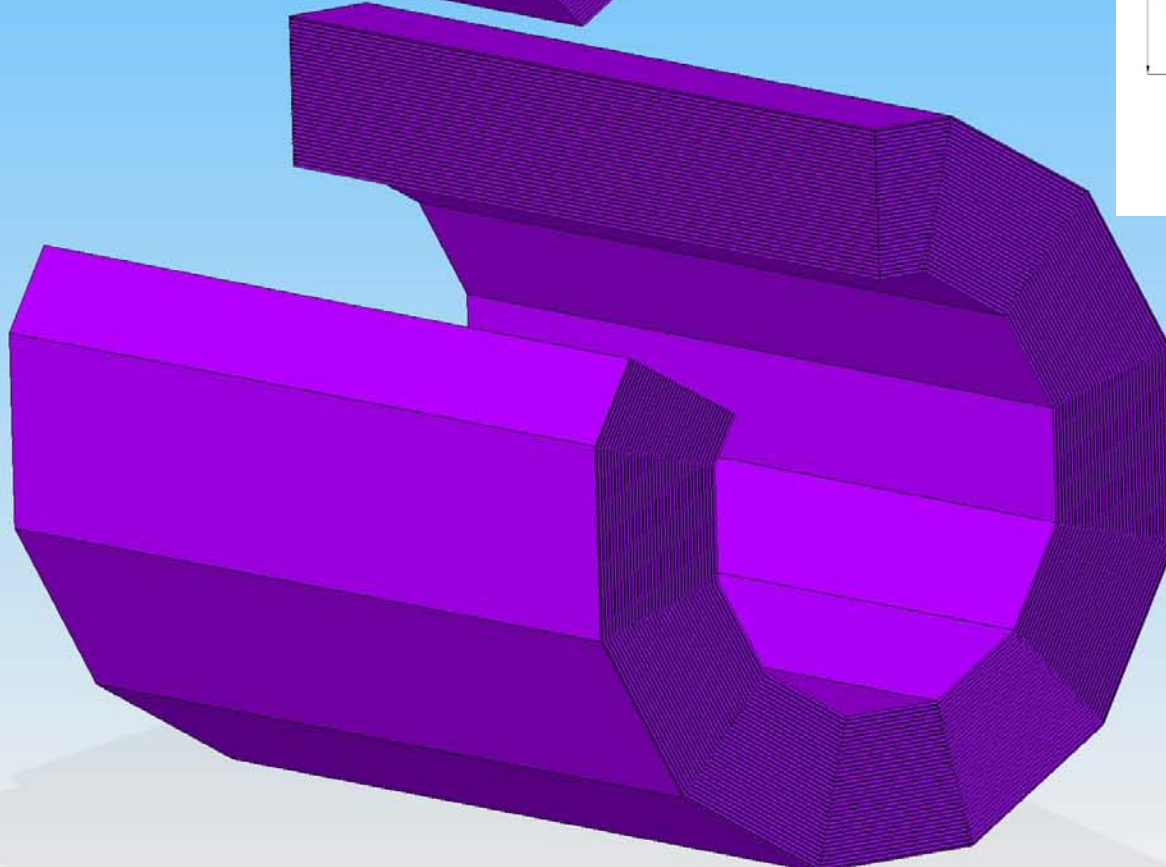
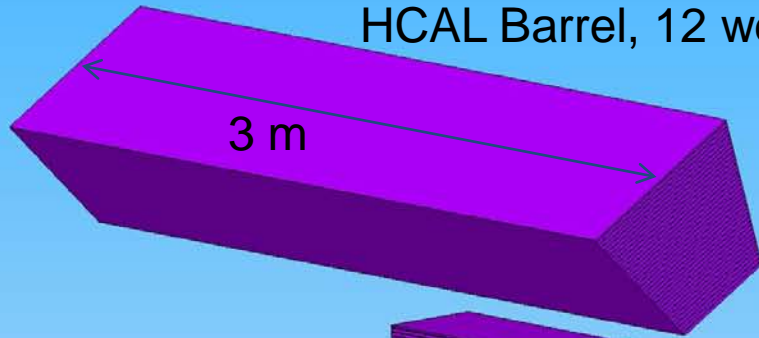


**1878 tons**

- Uses continuous cast steel plates rolled to 200 mm thickness
- 40mm gaps for muon identification chambers
- Plate-to-plate spacers are staggered for better muon identification coverage
- Bolted construction
- 100mm thick inner support cylinder

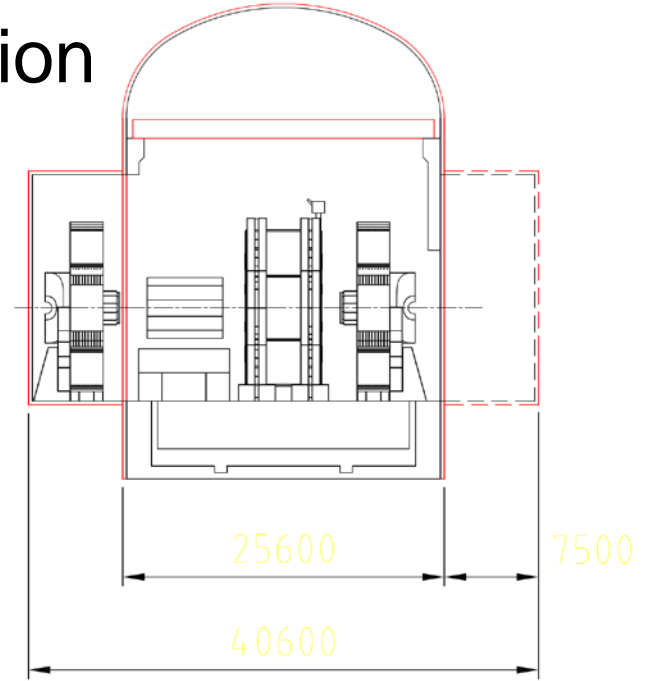
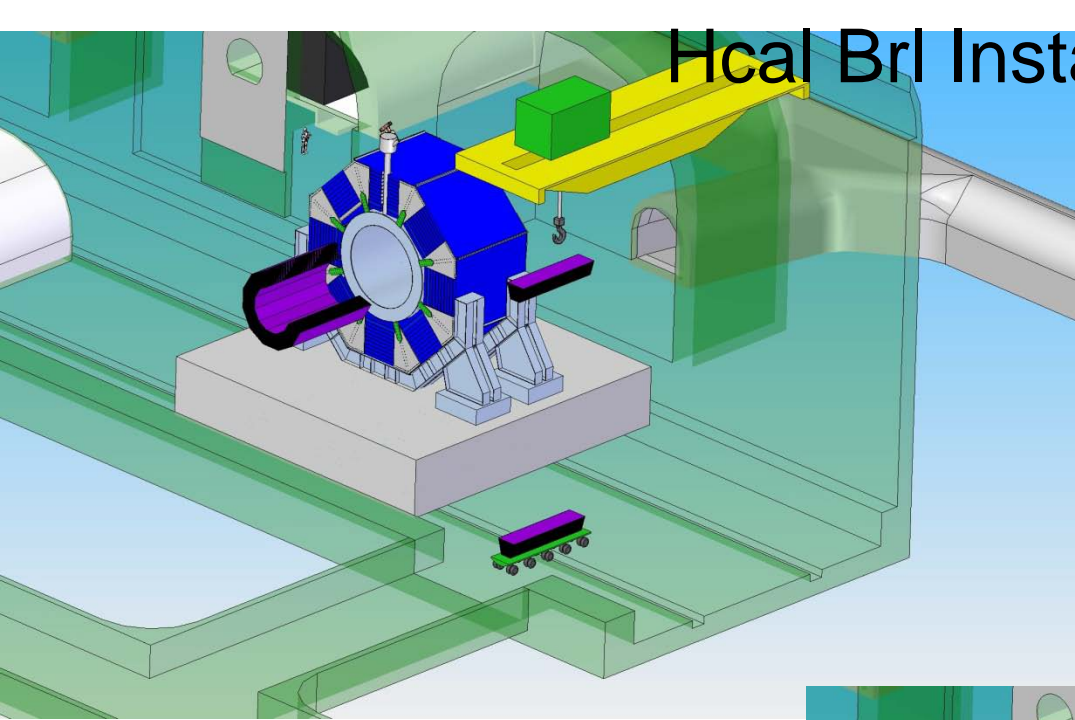


# HCAL Barrel, 12 wedges x 38 tons

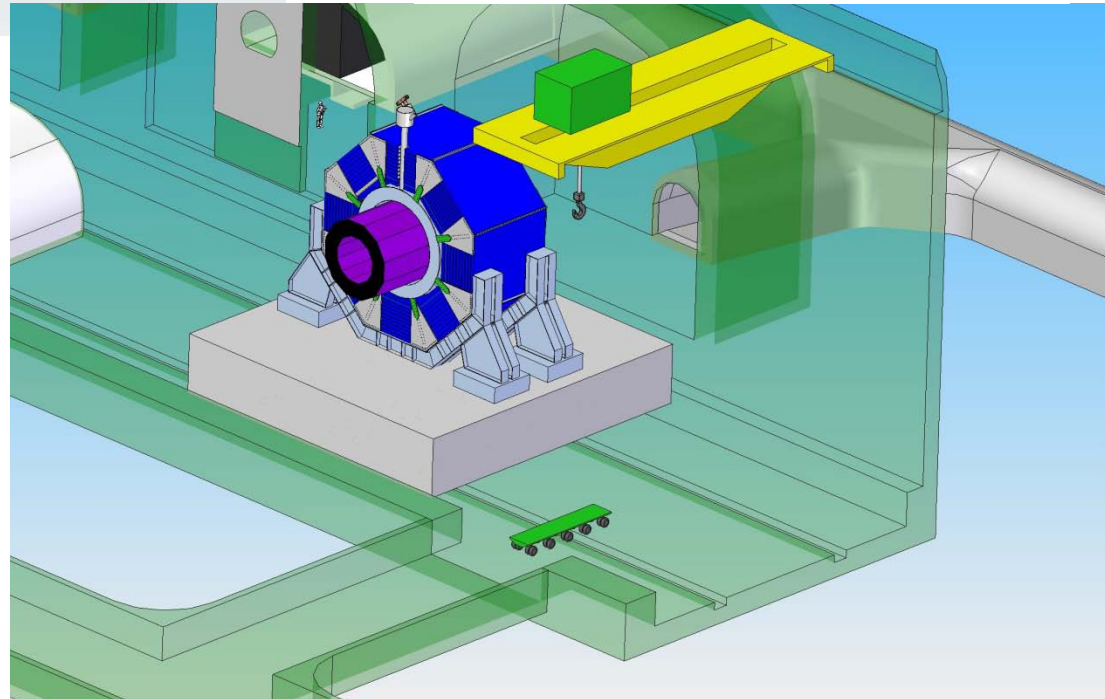




# Hcal Brl Installation

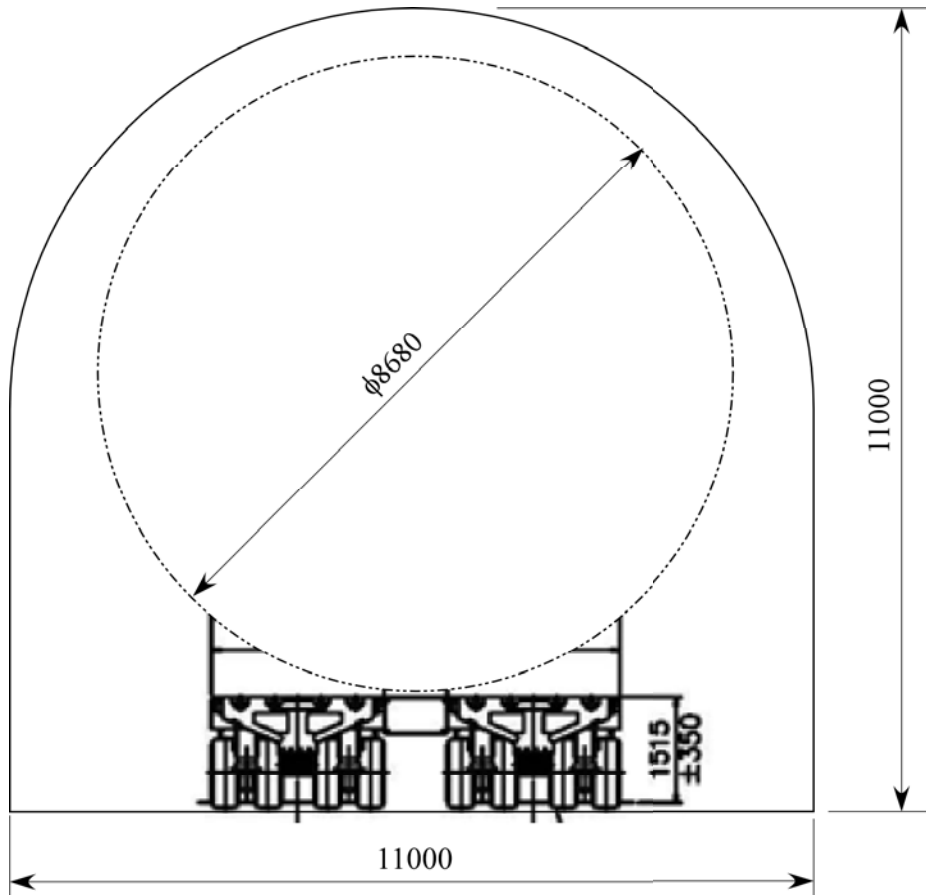


~ 12 x 38 tons trips along the transfer tunnel

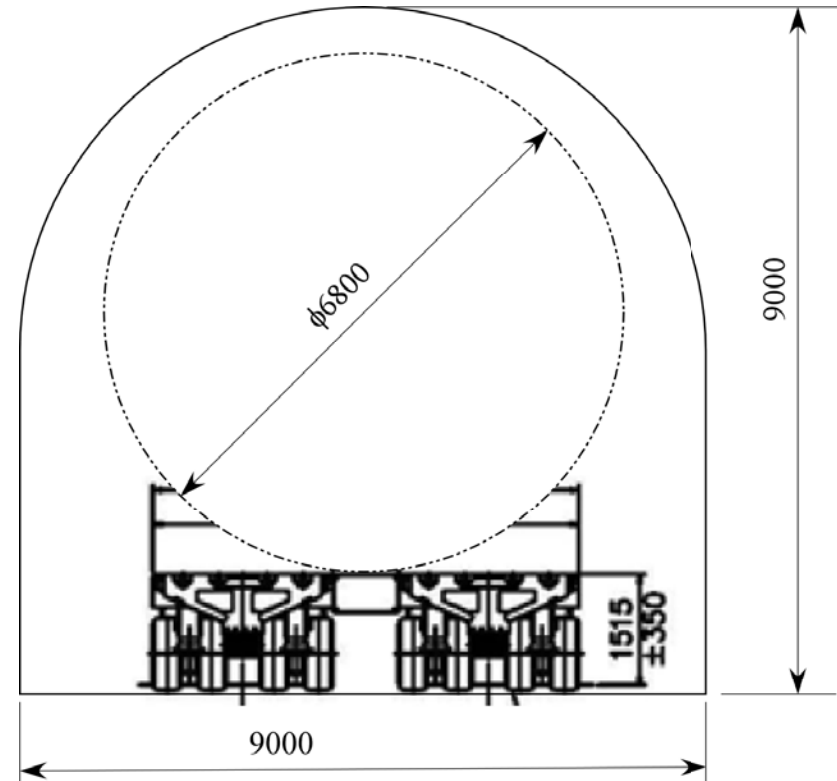


# Access tunnel

ILD

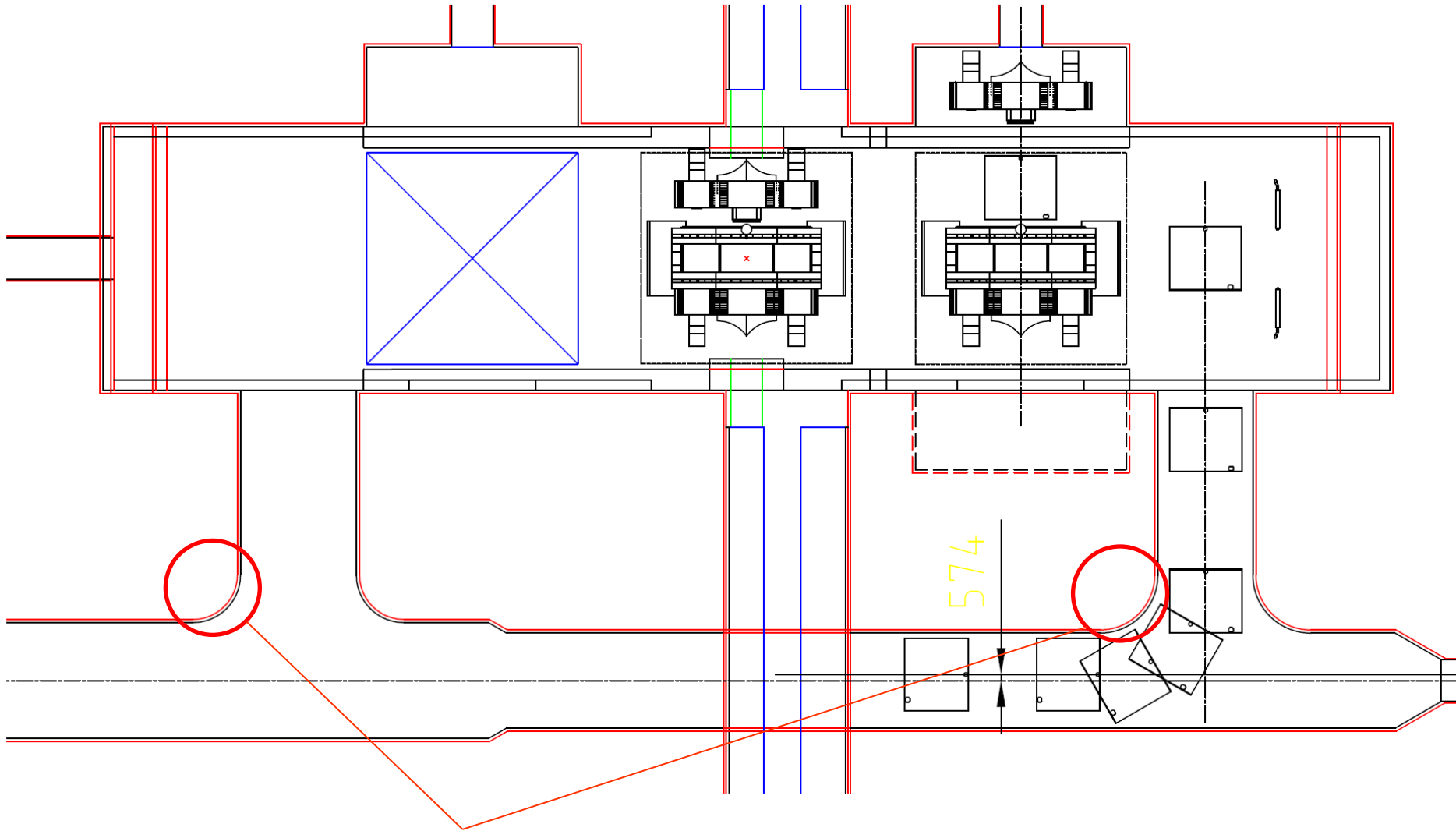


SiD



A trailer with lower deck height  
would reduce the tunnel size

# Access Tunnel, Coil



Corners should have larger R



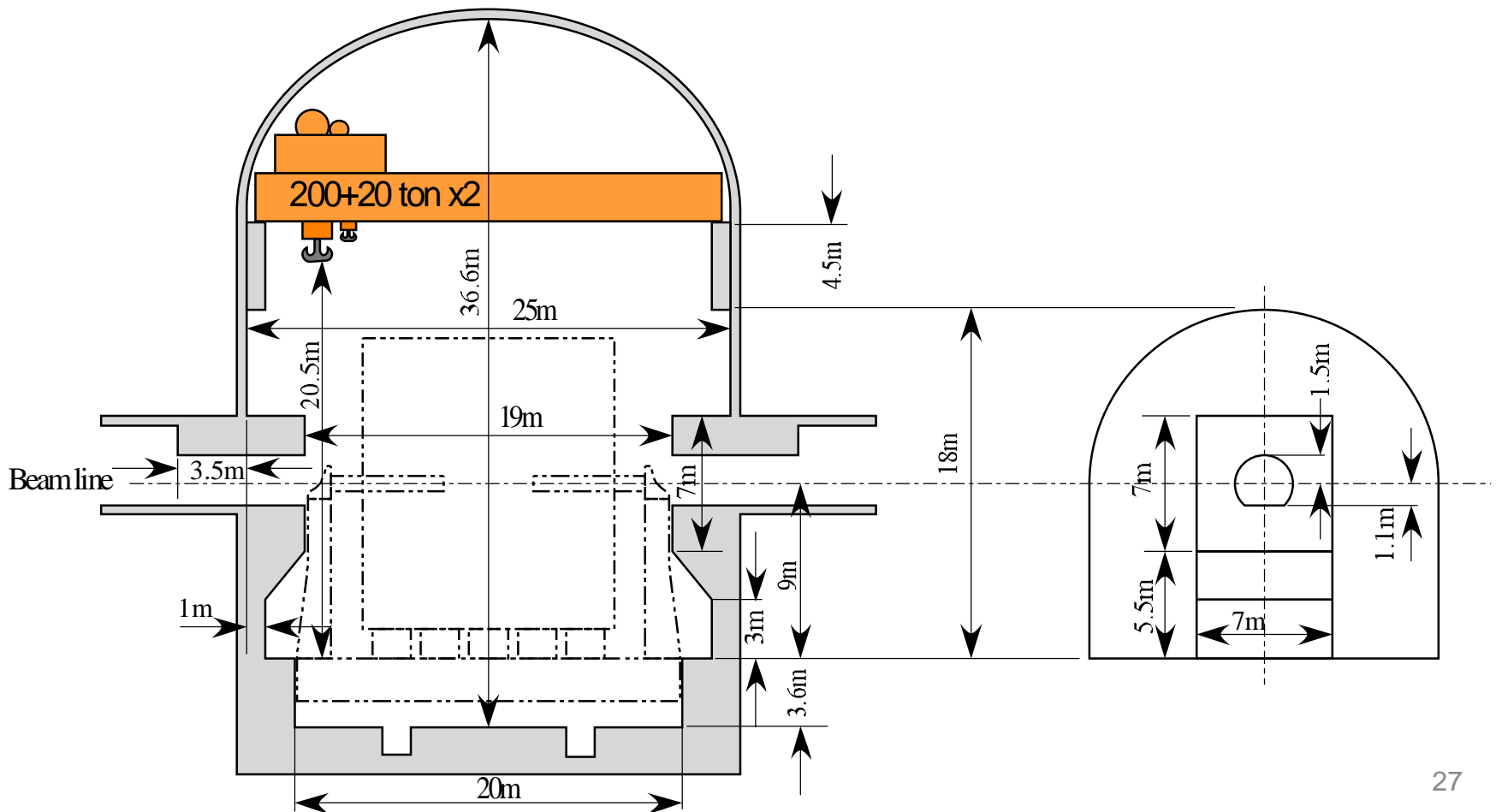
# Summary

- In Japanese site, horizontal access tunnel, rather than vertical shafts, is used for detector installation
- In addition to the main cavern, storage caverns and a compressor cavern will be made
- Detectors are pre-assembled to relatively small (<~250 ton) pieces on surface, and assembled to complete detectors underground
- SiD and ILD have rough detector assembly procedures compatible with the experimental hall with horizontal access tunnel
- More detailed procedure should be established for DBD

# Backup slides

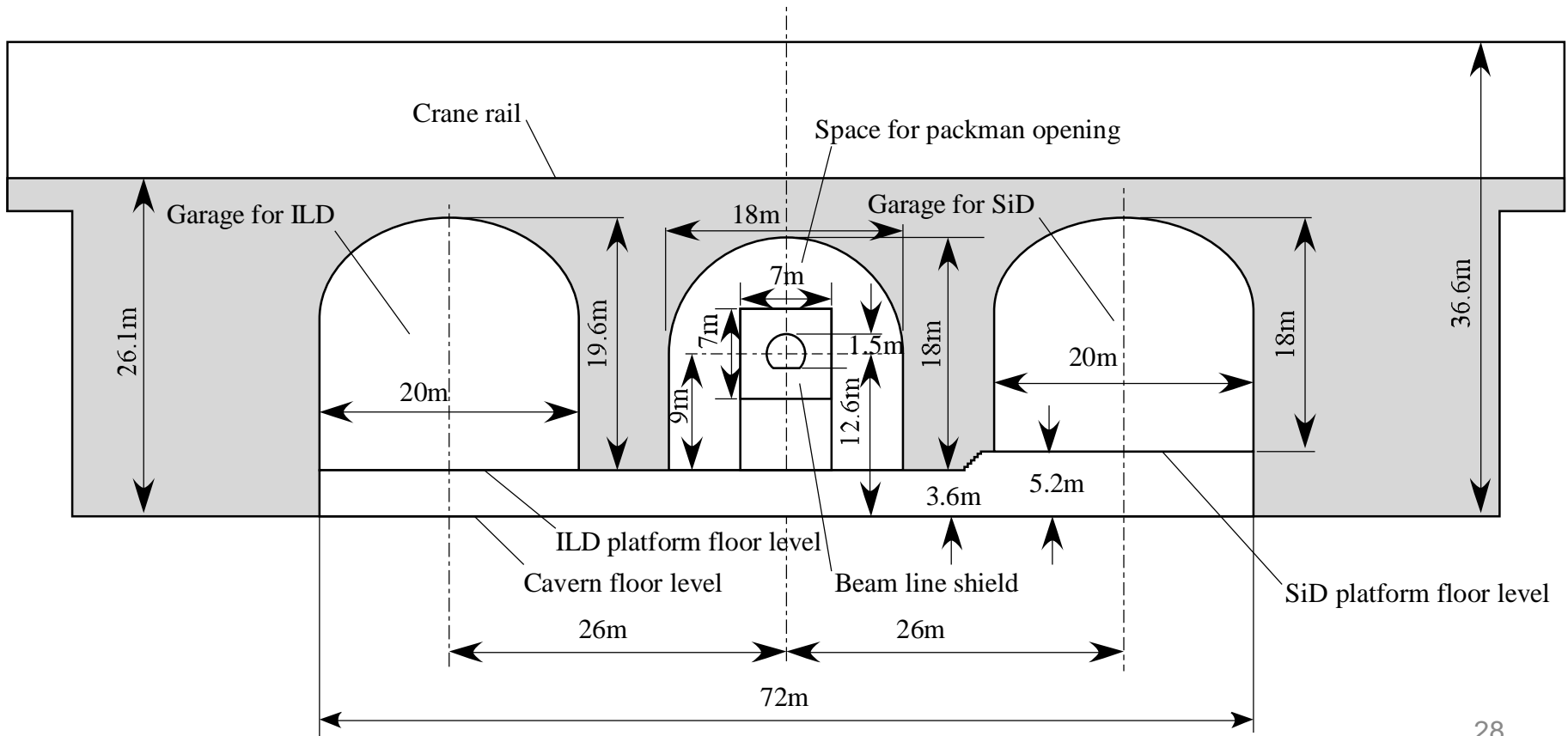
# Main cavern

- Cross section view along the beam line



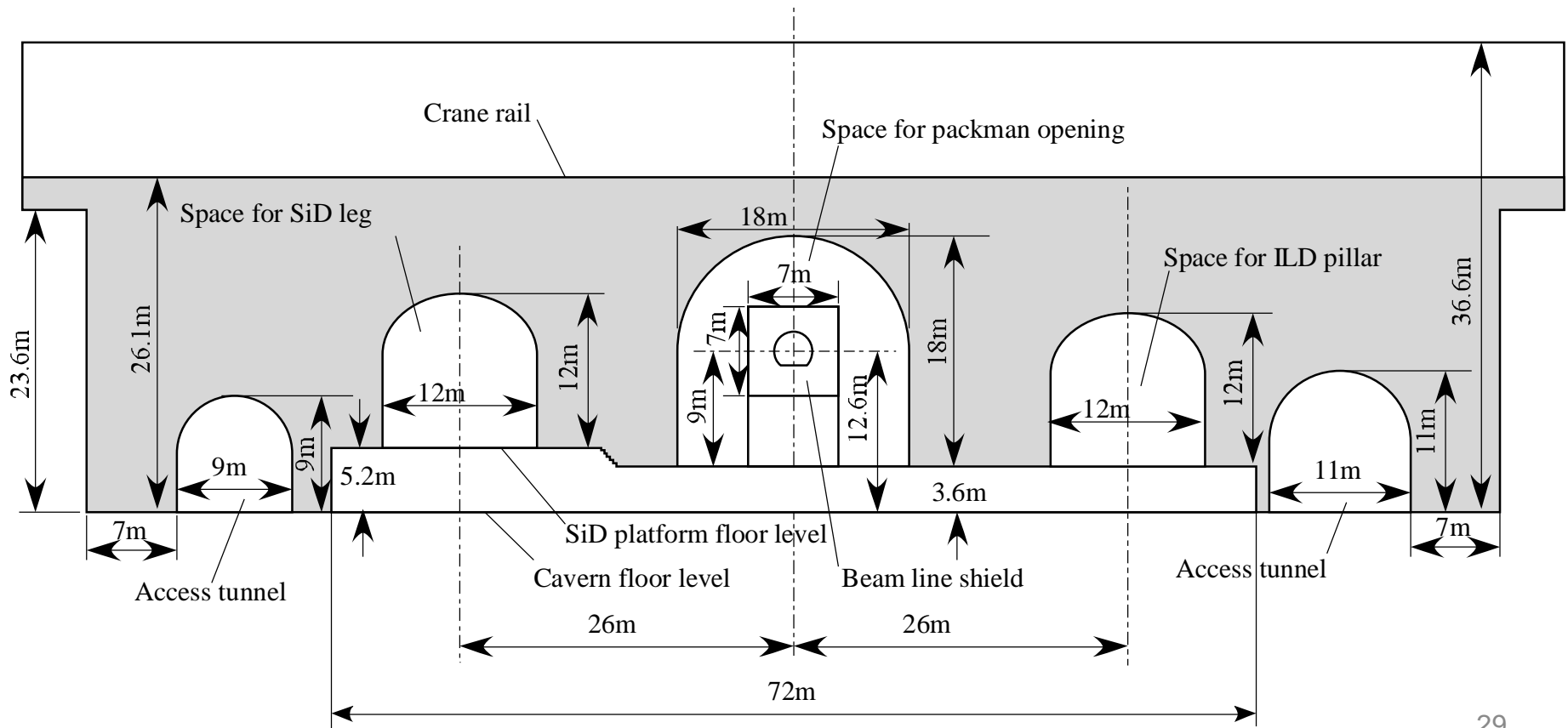
# Main cavern

- Side wall – garage side (view from inside)



# Main cavern

- Side wall – access tunnel side



# Access tunnel parameters

- There are several options for the ILC route and the location of the IP, and the **optimization is not done yet**
- Parameters listed below are just for some examples of the access tunnel to the experimental hall

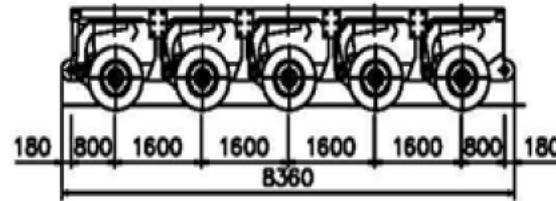
Site	Option	Length	Slope	Earth covering*	Beam line elevation
A	1	1770 m	6.3%	~300 m	110 m
	2	980 m	6.3%	~200 m	110 m
B	1	1420 m	7%	~550 m	-30 m
	2**	1470 m	7%	~400 m	-21 m

(\*) Vertical distance between the cavern ceiling and the surface  
These values changes largely with the IP location

(\*\*) Main linac is inclined by 0.03%

# Access tunnel

- Trailer truck for transportation
  - 225t/5axles → 450t with 2 trailers
  - Capability of ~7% slope

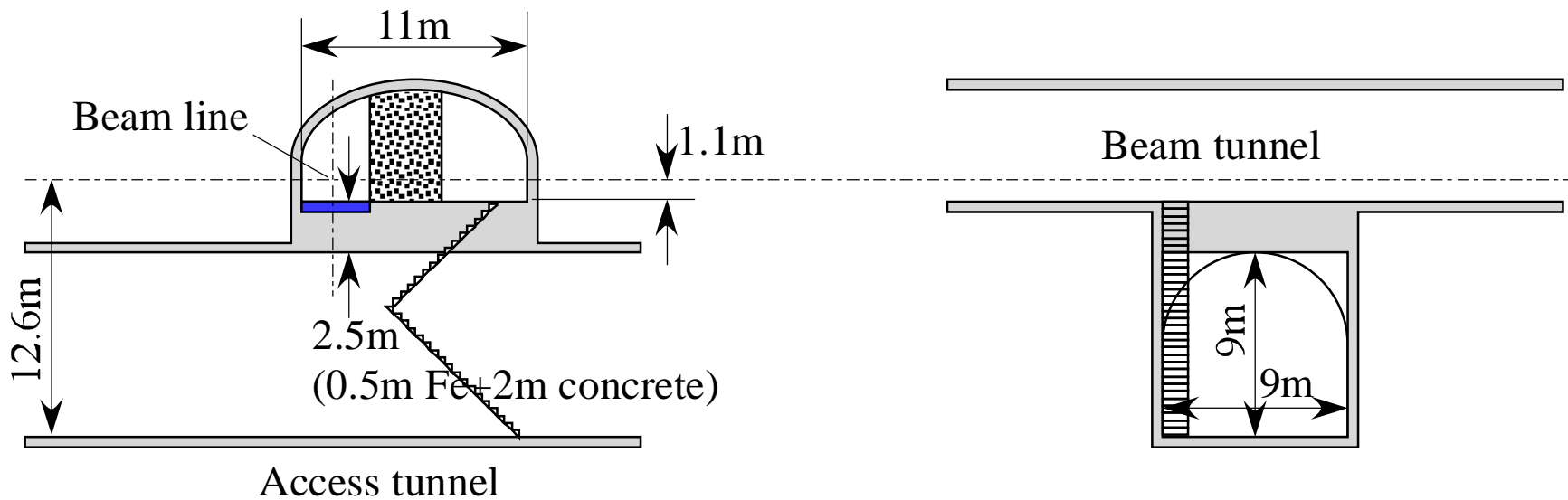


- Gear track (Abt system) is also suggested



# Access tunnel

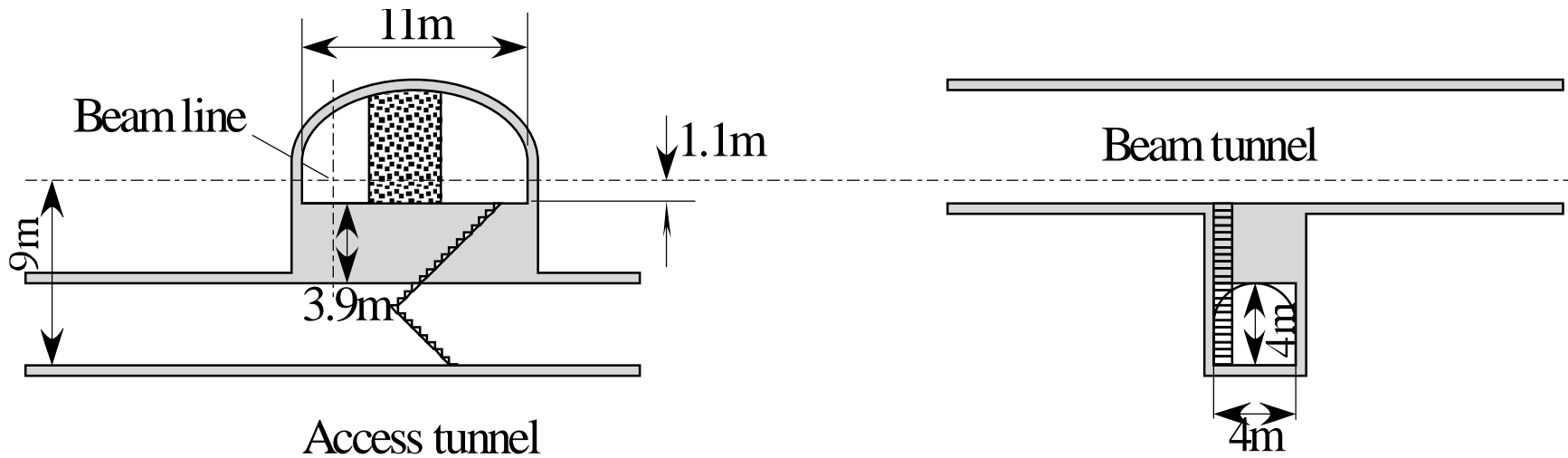
- Crossing with main access tunnel





# Access tunnel

- Crossing with sub access tunnel



# Safety issues

- Ventilation
  - Smoke and Helium gas will go out through the construction adit connected at the top of the cavern, and will not flow into the access tunnel
  - Small vertical shaft for GPS alignment may be used for ventilation
  - Amount of Helium gas ~ 20000m<sup>3</sup> (CMS: 2x250m<sup>3</sup>x20bar =10000m<sup>3</sup> at 1bar, x2 for SiD+ILD) =25mx100mx8m → No problem
- Escape in emergency
  - Enough number of electric cars equipped with oxygen masks will effectively take people to the surface

# Electric cars



Mitsubishi



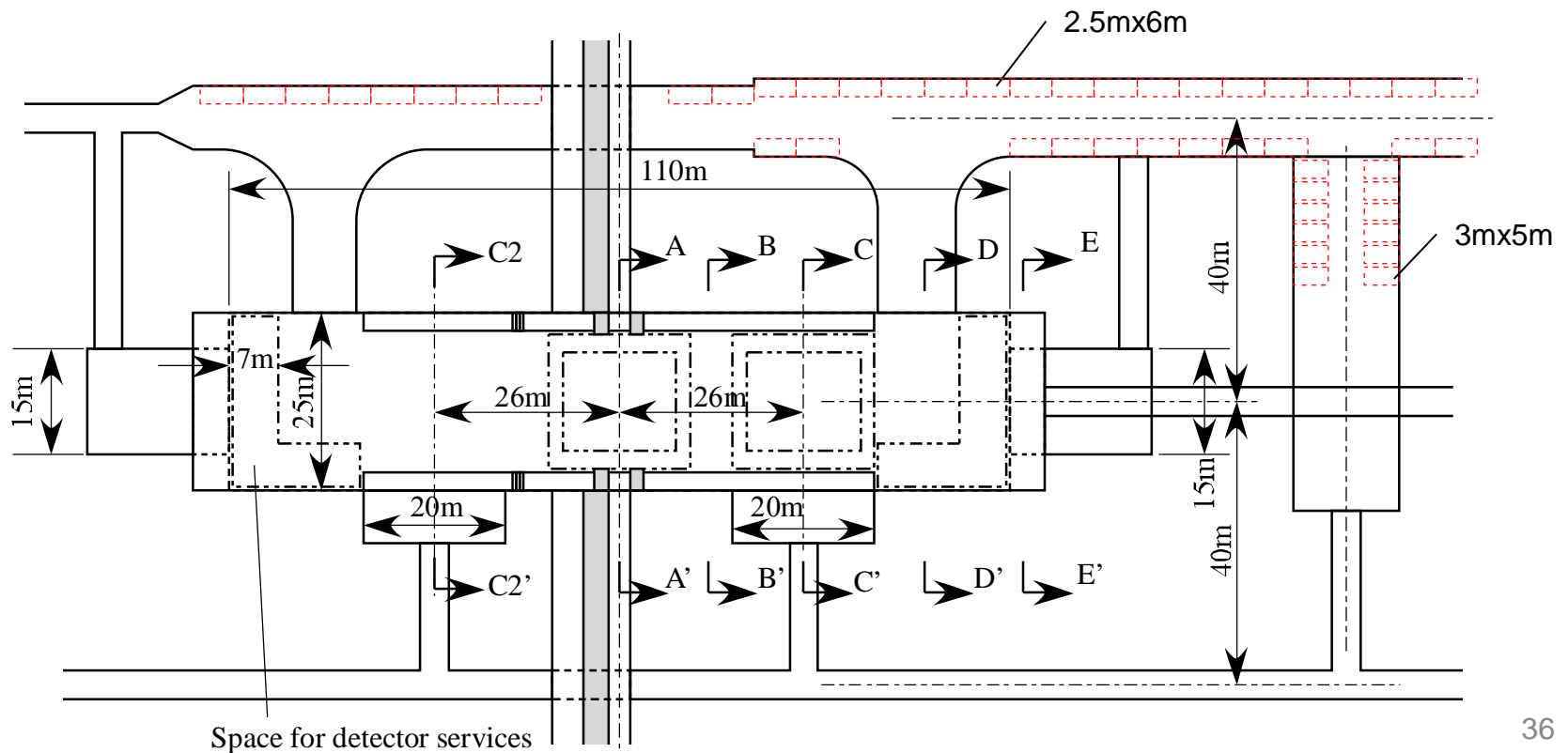
TOYOTA



Nissan

# Parking area

- Main access tunnel and compressor cavern are large enough for parking space of >50 cars



# Things to do

- More considerations and studies on
  - Safety issues (evacuation of people in emergency)
  - Vehicles for transportation of heavy elements (gear track?)
- Parameters to be specified
  - Crane capacity
  - Temperature and dew point in the cavern
  - Requirements for electric power, cooling water, and air conditioning
- Estimations to be made
  - Ventilation speed of smoke/He
  - Stress and deformation of the cavern with complete design
  - Cost and construction period