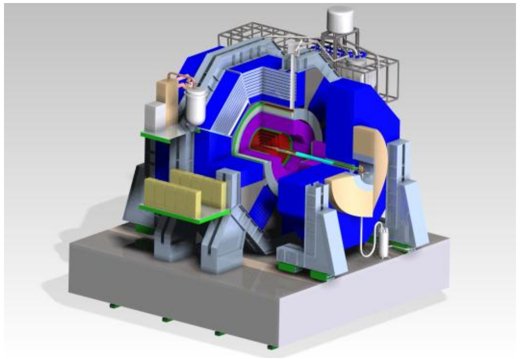


MDI Update from SiD

Marco Oriunno , SLAC

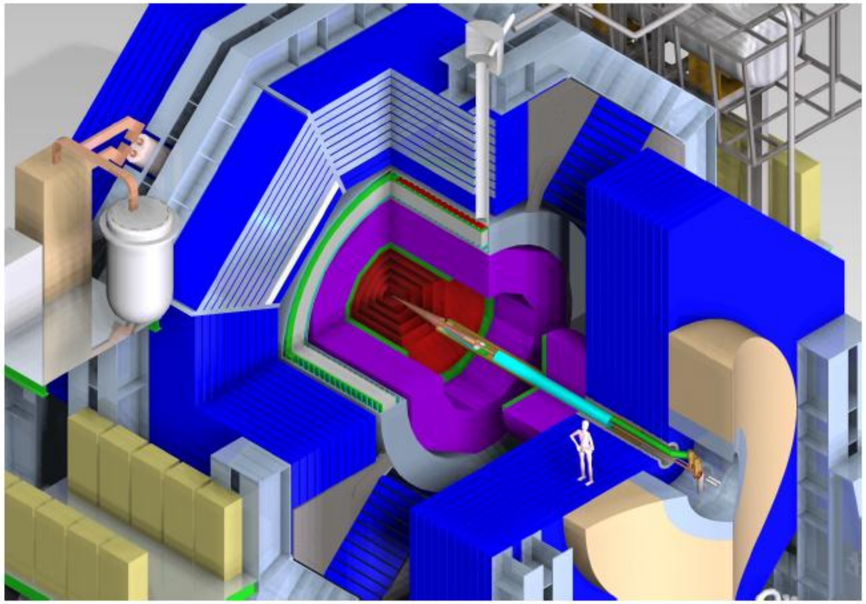
LCWS12, UTA Arlington, TX

October 22-26, 2012

U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

Detailed Baseline Document Submitted on 9/24



SiD

DETAILED BASELINE DESIGN

DRAFT SUBMITTED TO THE IDAG

24/SEPTEMBER/2012

SID key design features

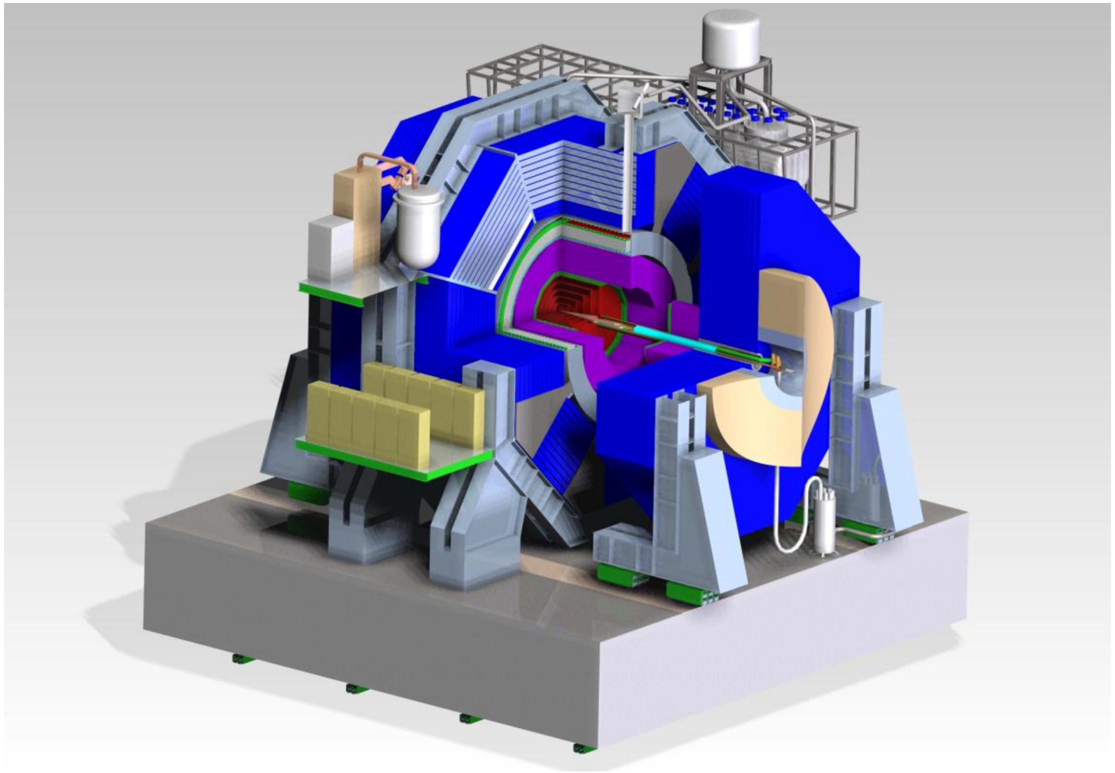
Compact design with 5 T Solenoid

Single Ring Barrel ~ 4'000 tons

Self Shielded: Stray Fields & Radiation

Short L* with QD0's supported from the doors

Barrel Ecal	60
Barrel Hcal	450
Coil	192
Barrel Iron	3287
Total Barrel	**3990**
Endcap Ecal	10
Endcap Hcal	38
Endcap Iron	2100
Pacman	100
Feet	60
BDS	5
Total Door (x1)	**2313**
Total SiD	**8615**



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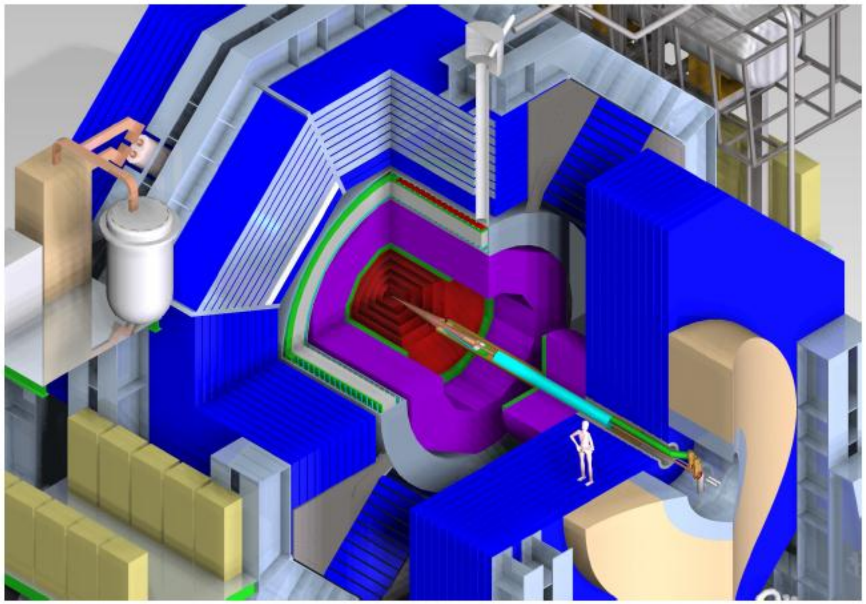

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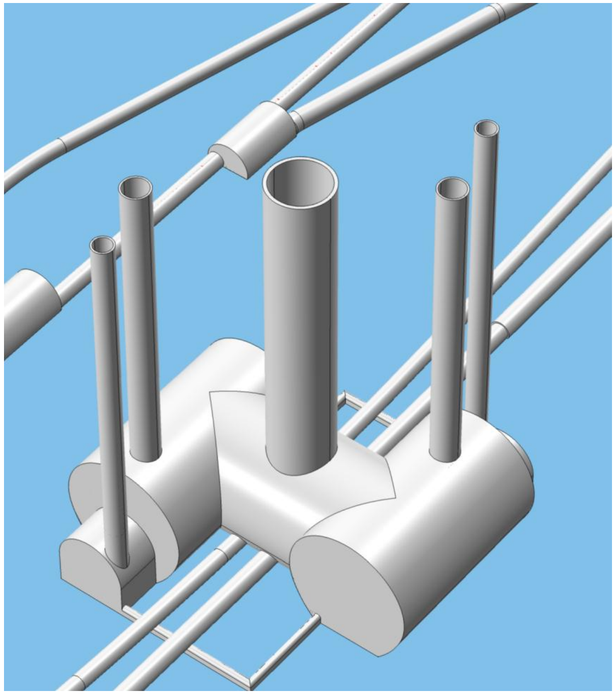
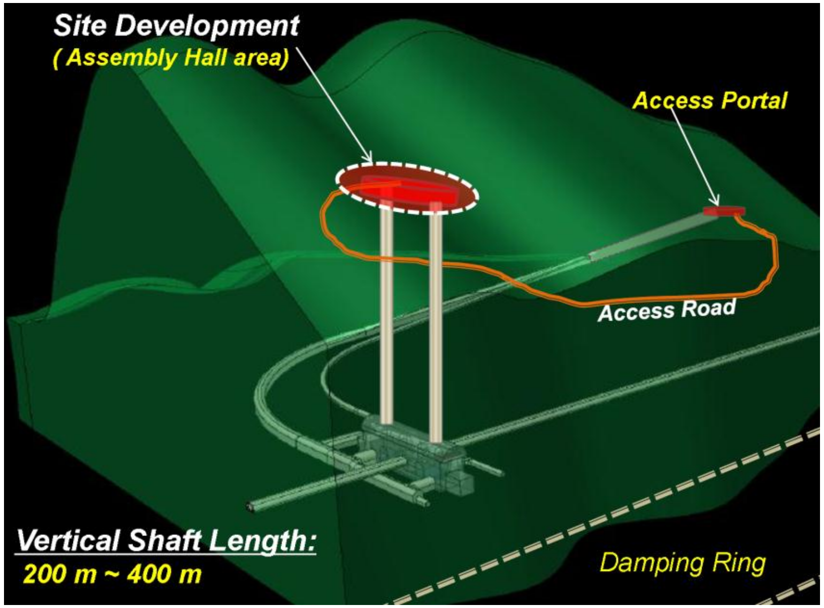
Assembly Procedures for different Sites

- The assembly procedure will be different for the two sites
- Both layouts must satisfy push-pull requirements
- The detector hall must be optimized for costs: benefits vs. features



•Vertical shafts (Europe, Americas)



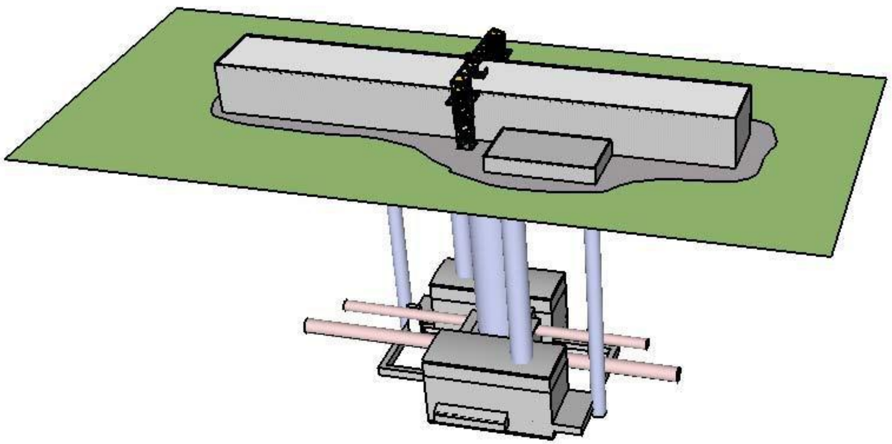
•Horizontal shafts (Japan)

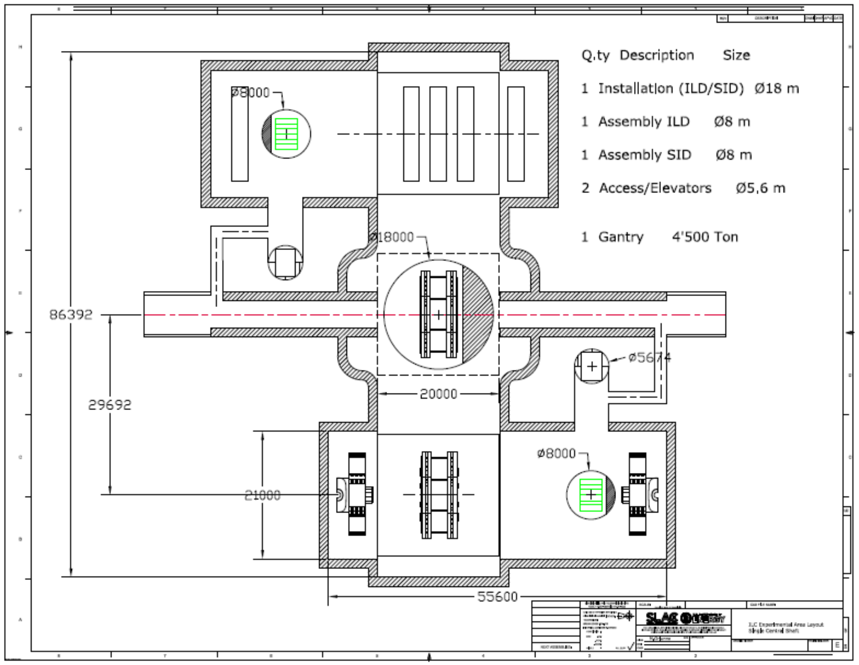
Vertical Shaft Access

Detector Hall Design

Five shafts Layout : single large shaft above the IP, two smaller shafts on the alcoves, two shafts for personnel access.

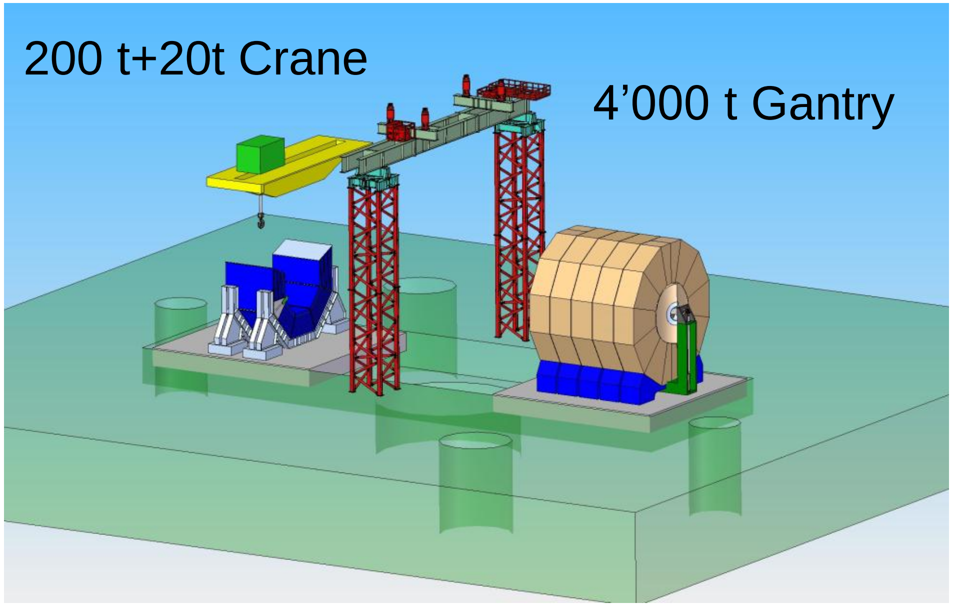
Cost optimization vs. features, like IP commissioning without detectors.

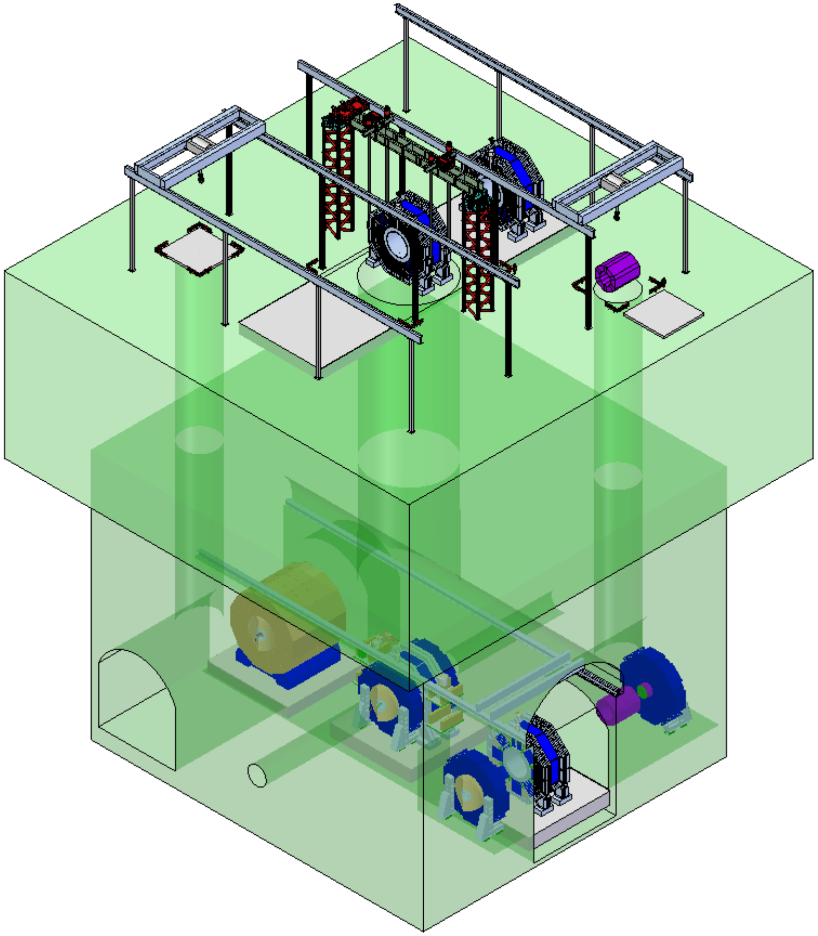




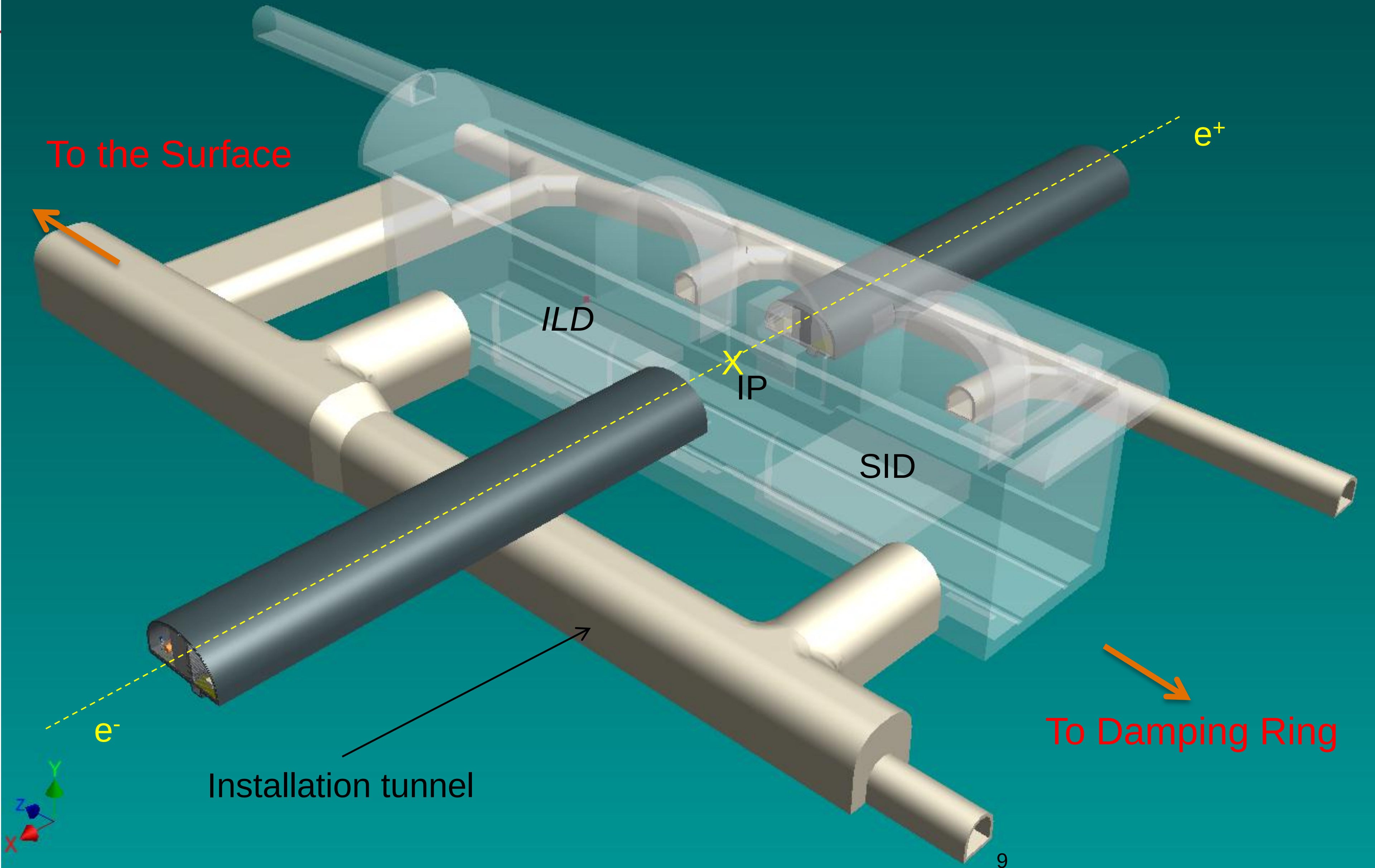
Surface assembly *a la* CMS

1. Assembly of Iron Doors+Barrel on surface
2. Commissioning of the magnet on surface
3. Large capacity gantry

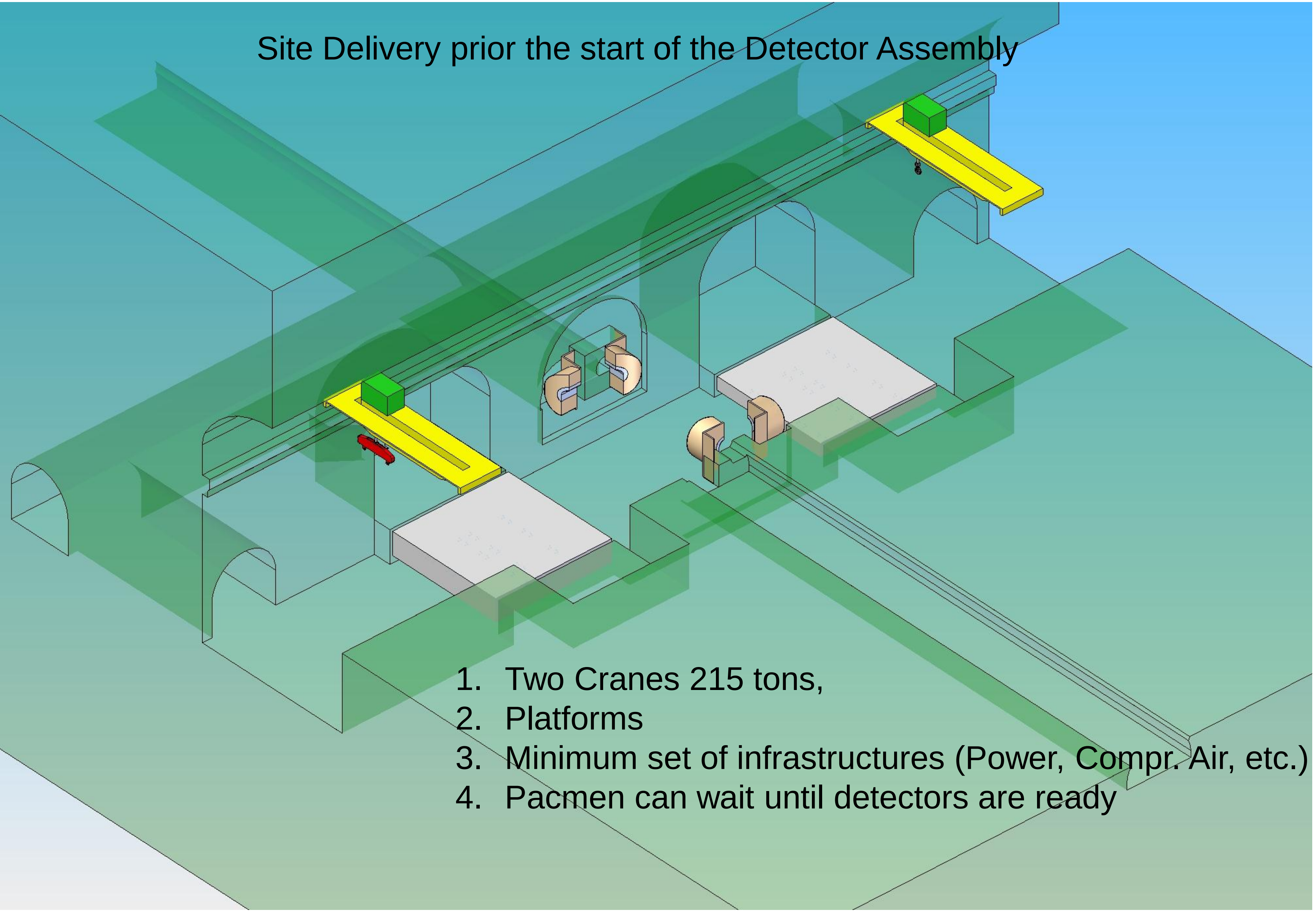




Detector Hall, Japanese Mountain Site

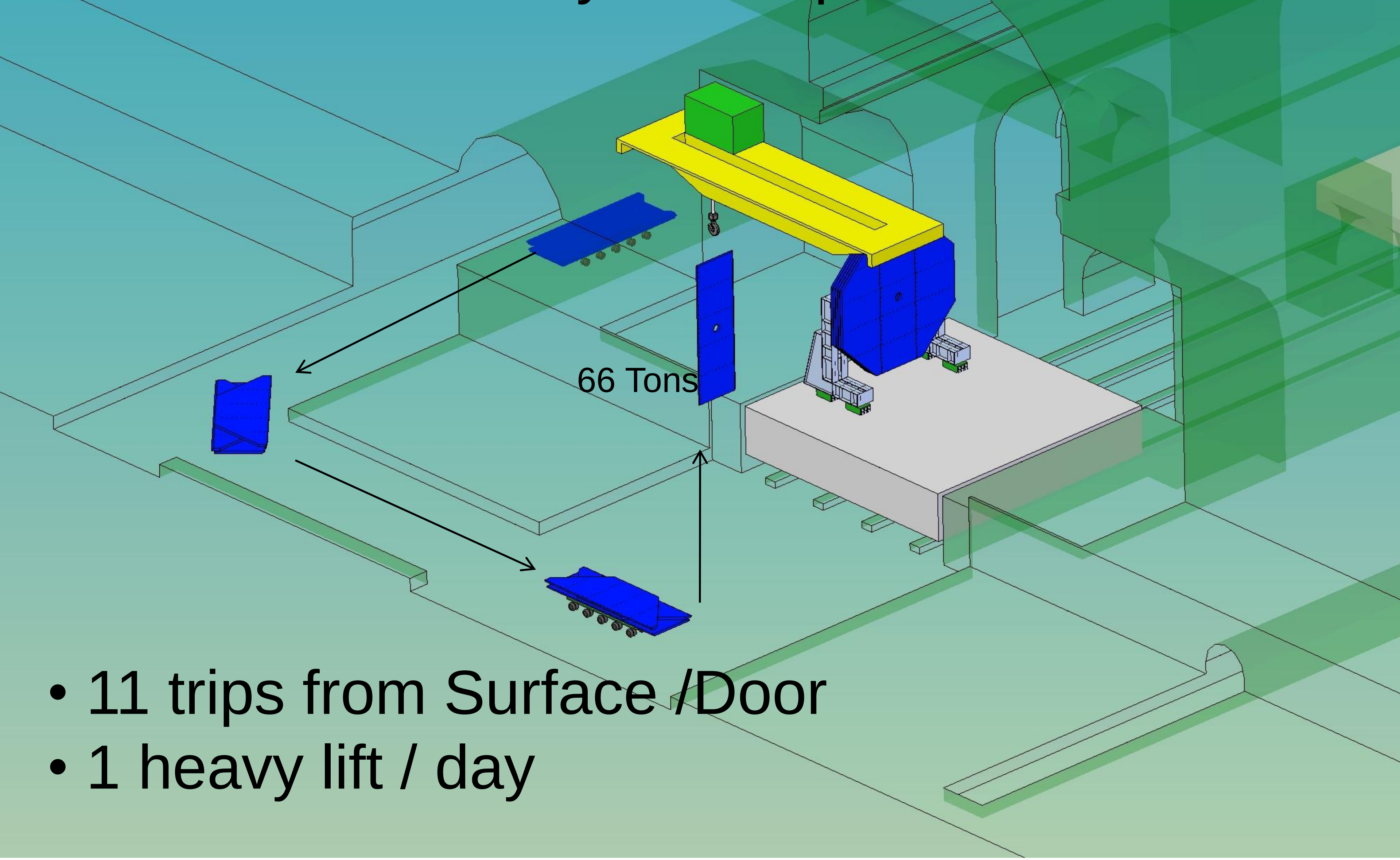


Site Delivery prior the start of the Detector Assembly

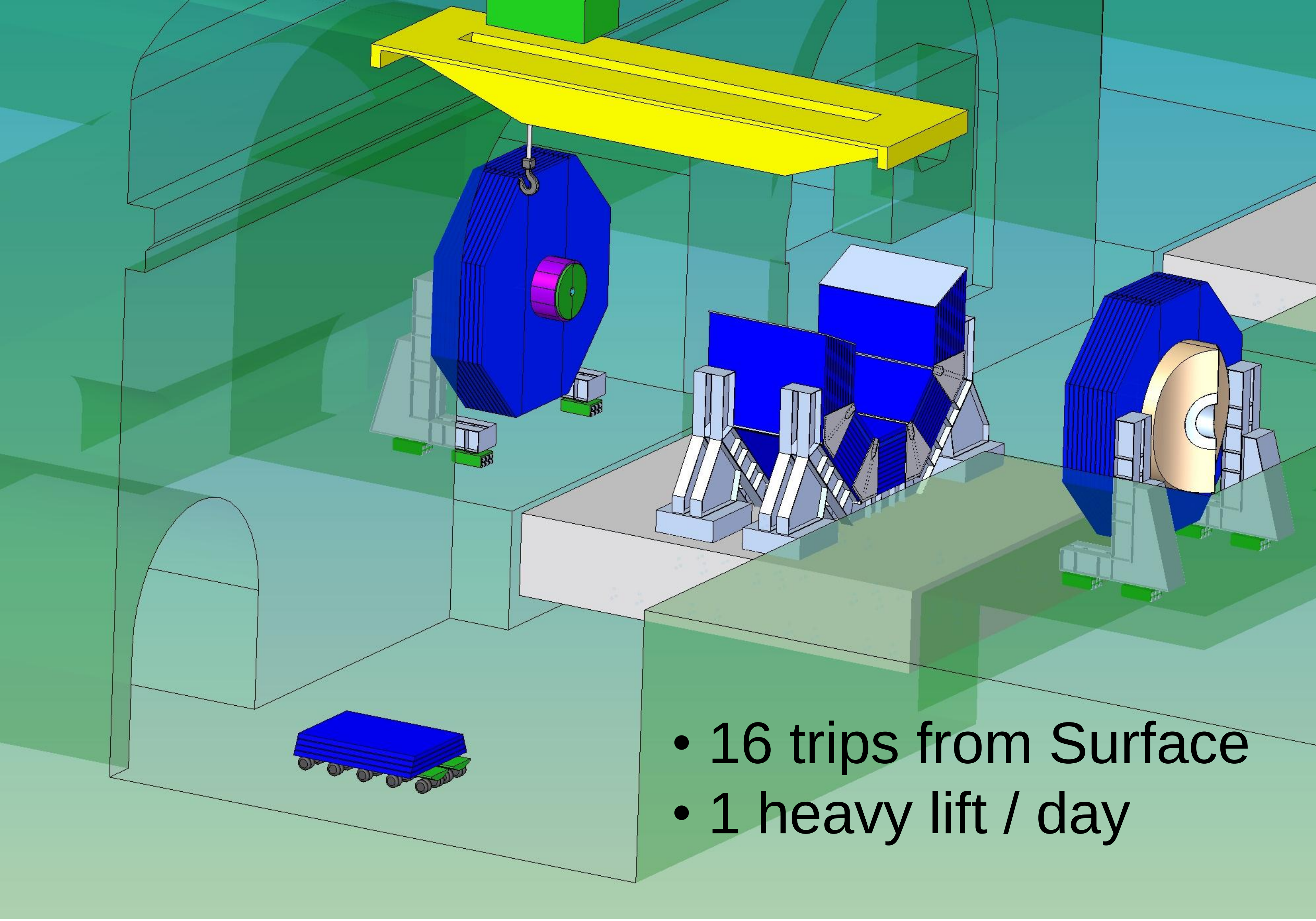


1. Two Cranes 215 tons,
2. Platforms
3. Minimum set of infrastructures (Power, Compr. Air, etc.)
4. Pacmen can wait until detectors are ready

Door Assembly on the platform

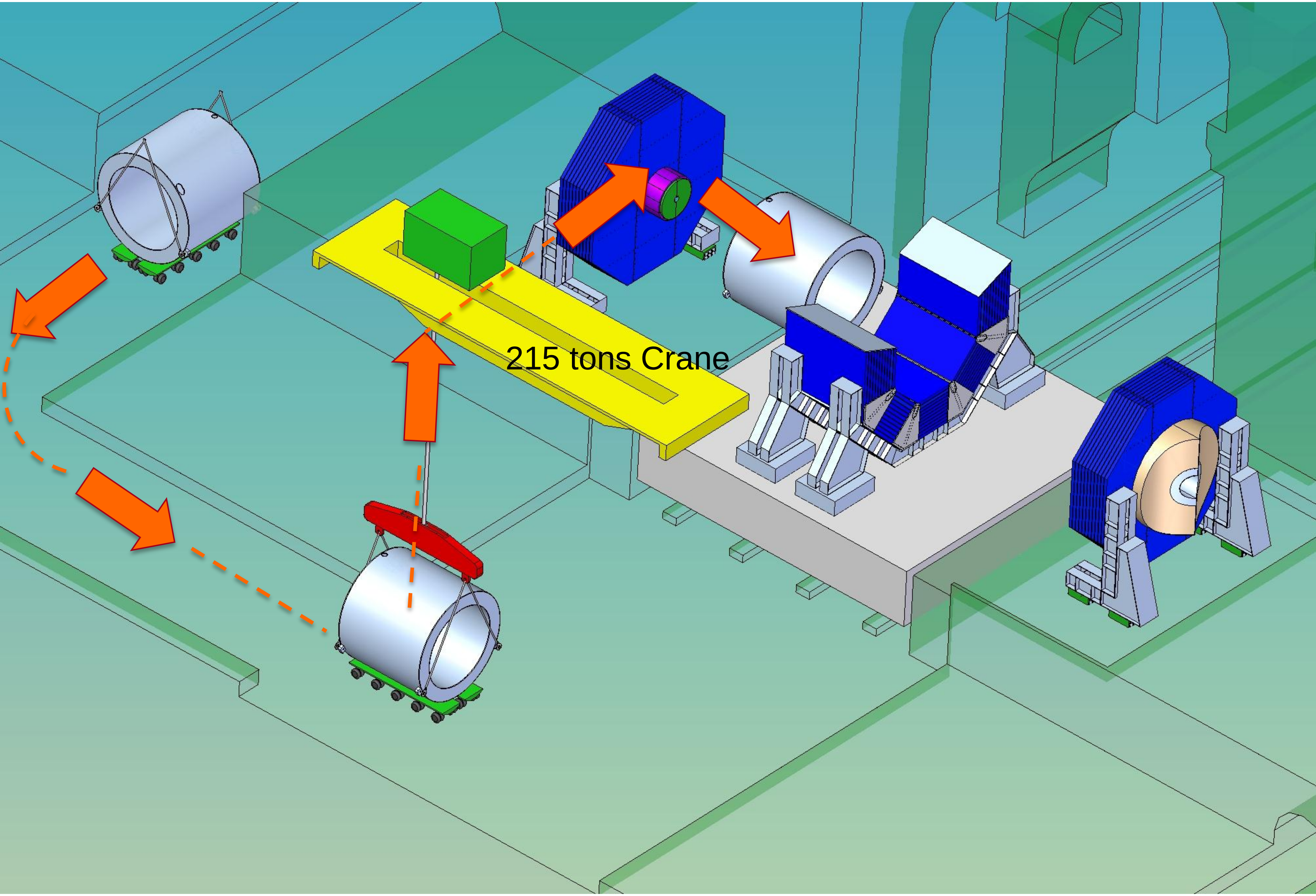


- 11 trips from Surface /Door
- 1 heavy lift / day

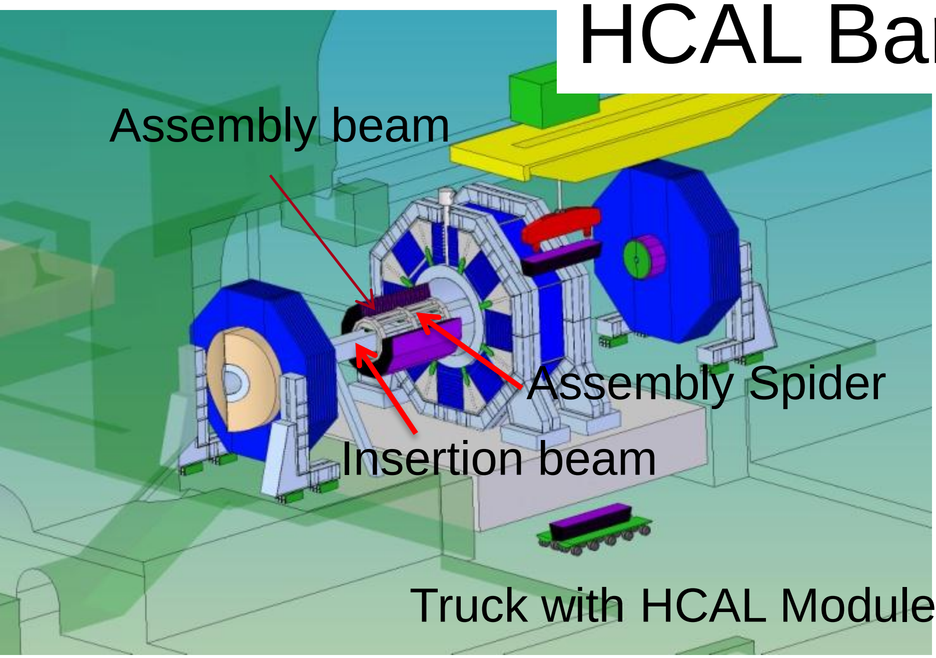


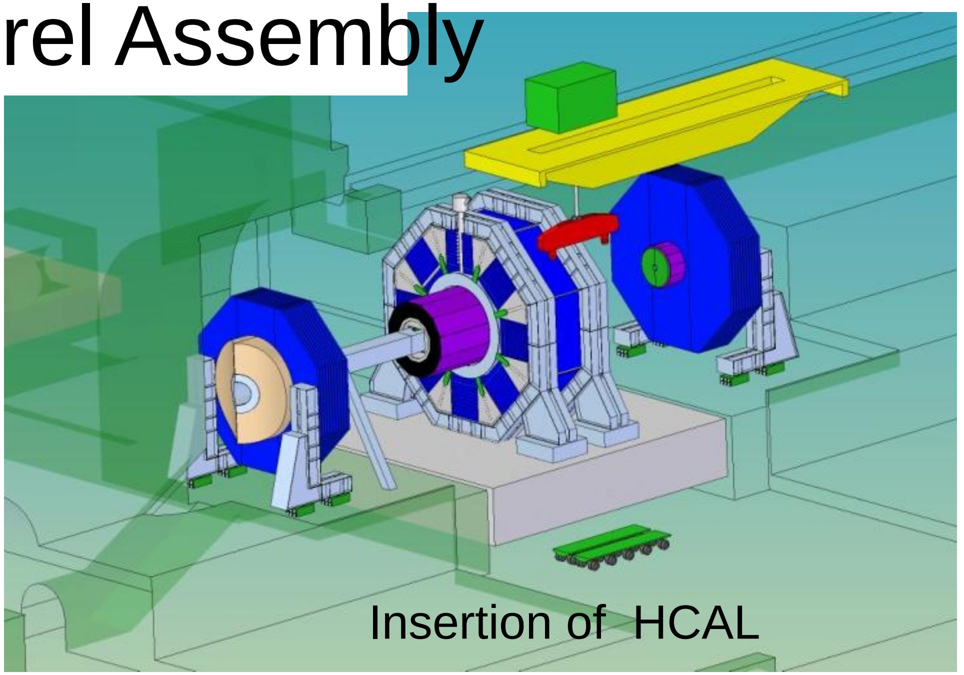
- 16 trips from Surface
- 1 heavy lift / day

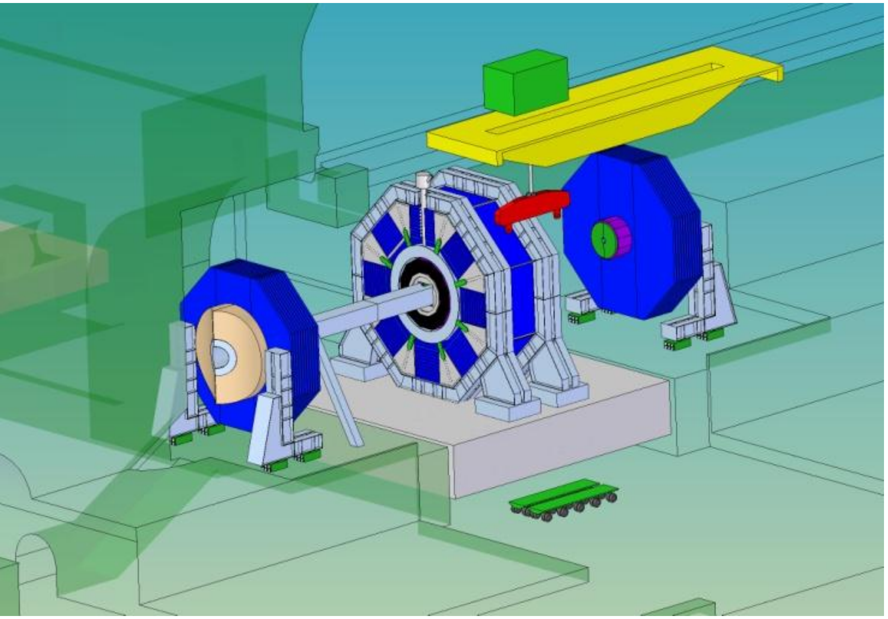
Solenoid Installation



HCAL Barrel Assembly







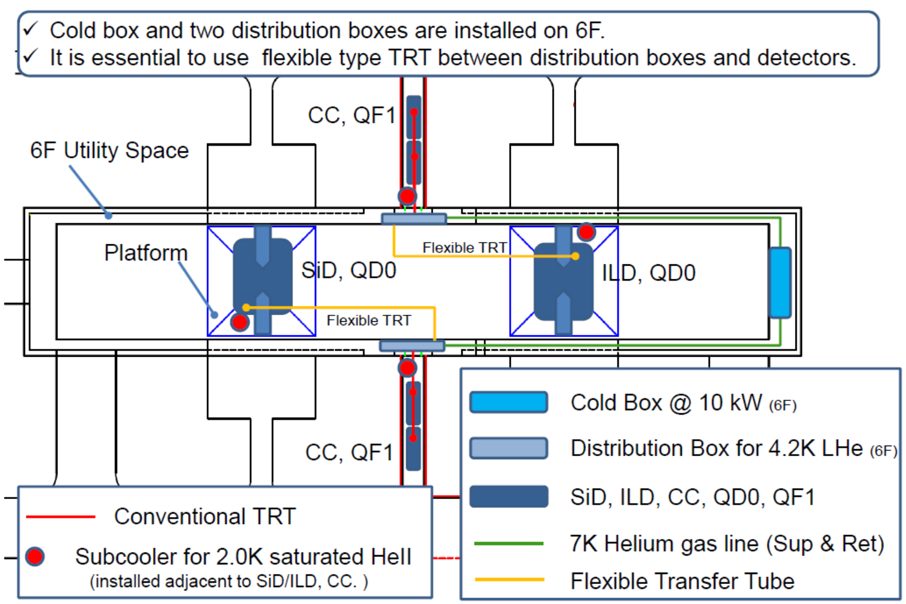
SLD, Liquid Argon Calorimeter
Assembly Beam

Cryogenic Layout : Two options

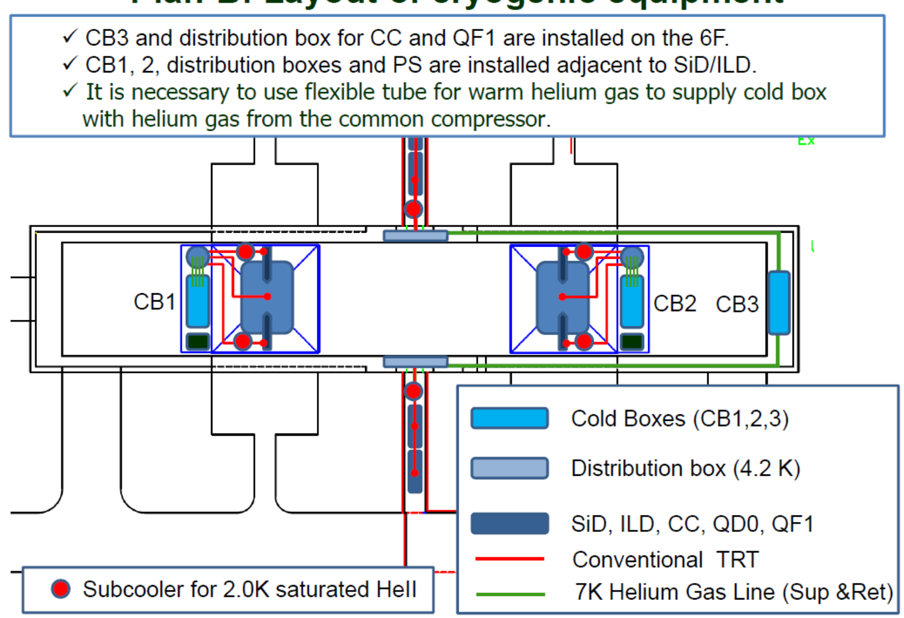
Plan A : Cold Boxes are stationary. Cold Transfer lines to each detector. Reliability for push-pull. Not off-the-shelf.

Plan B : Cold Boxes on the platform. Warm Transfer lines to each cold box. Vibrations, fringe field effects, space

Plan-A: Layout of cryogenic equipment

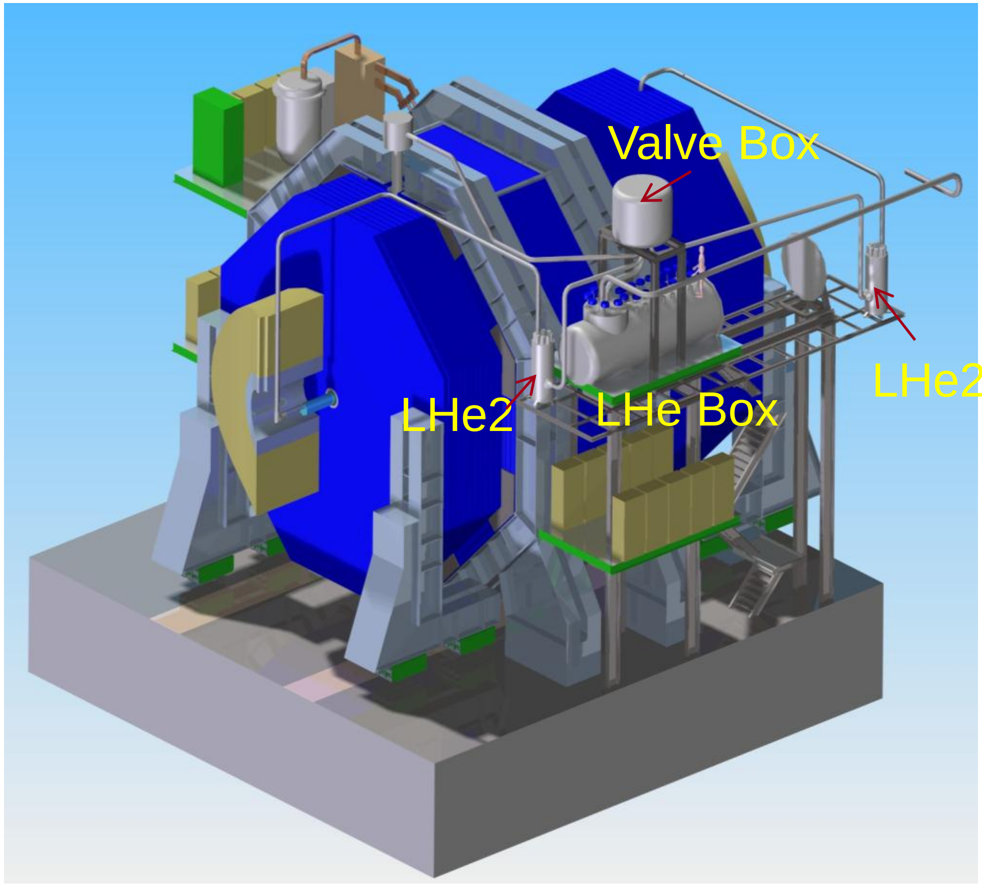


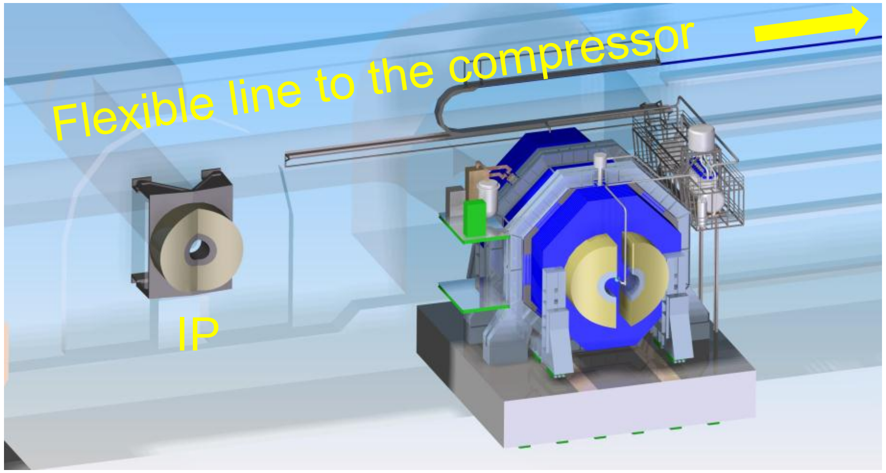
Plan-B: Layout of cryogenic equipment

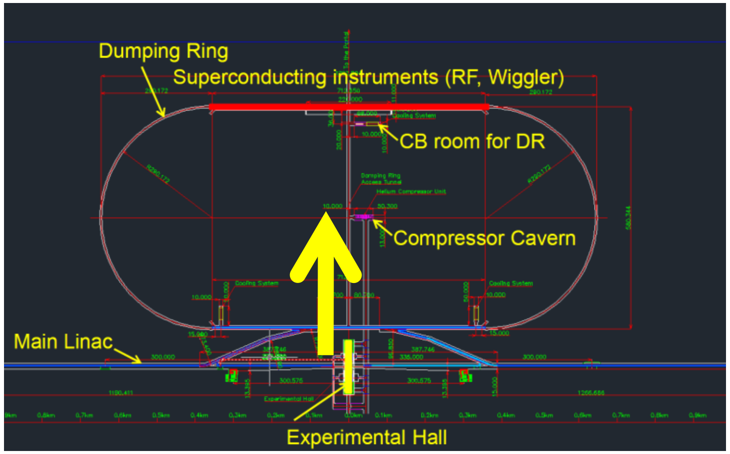


Integration of the Cryogenic plant on the platform

Main LHe refrigerator and LHe2 for the QD0's above level on metallic structure.







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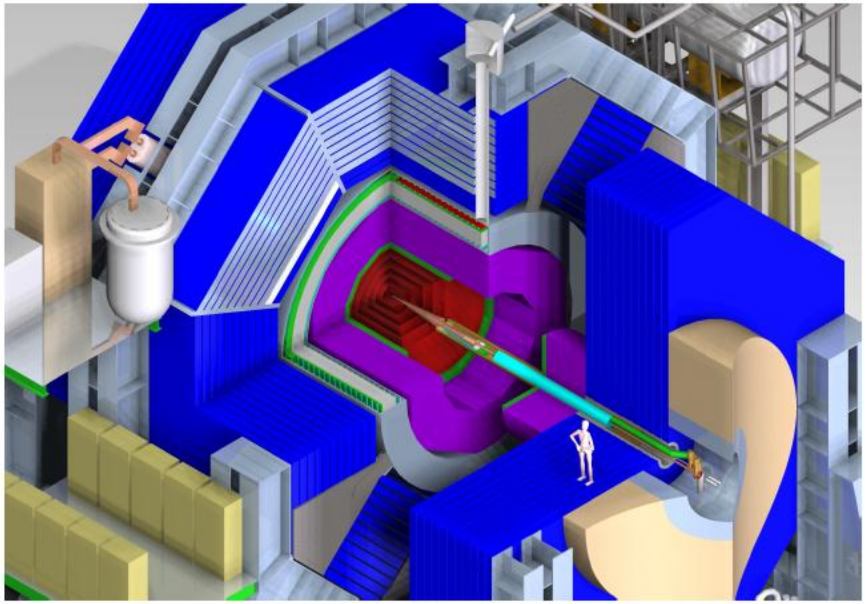

SiD

DETAILED BASELINE DESIGN

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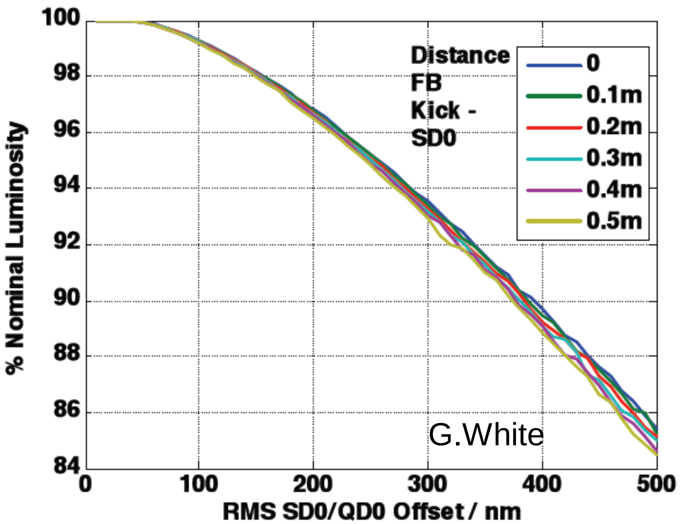
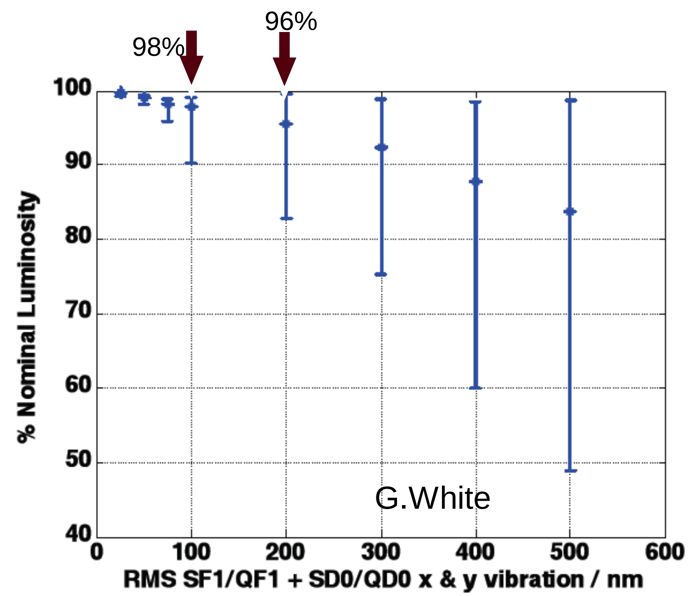
Vibrations

Most acute luminosity loss mechanism due to relative jitter of final focusing magnet elements : Ground Motion and Mechanical vibration sources

ILC has Active Fast Feedback based on beam trajectory after collision

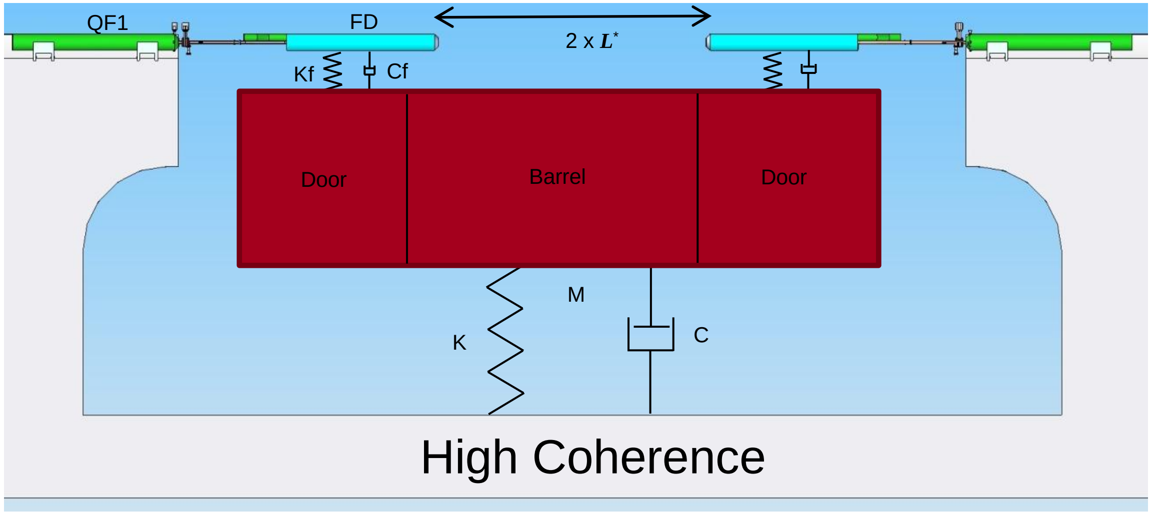
Max. Integrated displacement: 50 nm > 5 Hz





Lumi loss due to beam offset in SD0 (beamsize growth) and IP misalignment of beams

Full Dynamic Model ground-to-QD0



see C.Collette's talk in this workshop at the Joint BDS/MDI…….

Other Vibrations Study activities :

- Ground vibrations (Correlation) measurements at LHC, Point4
- Experimental vibrations of the CMS Platform
- Benchmark of FEA with concrete reinforced structure
- Ground geology modeling

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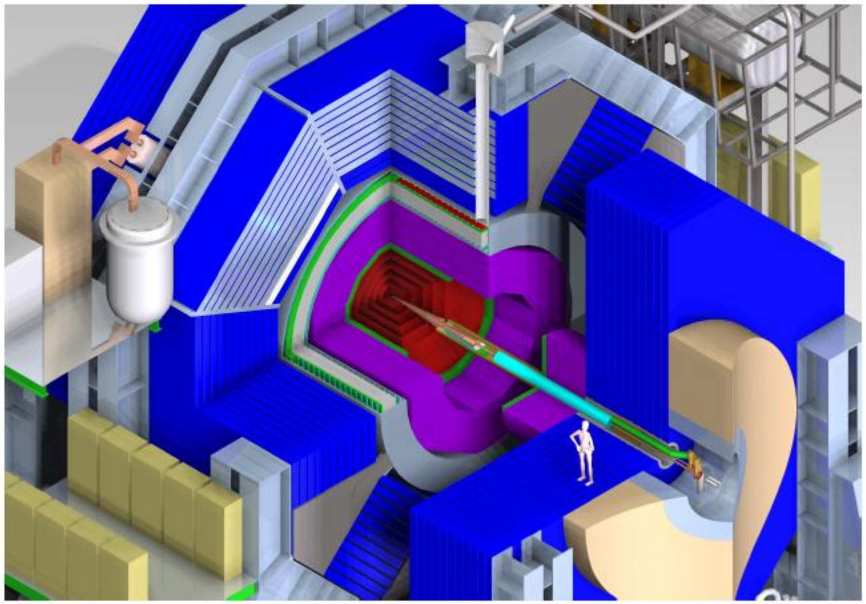

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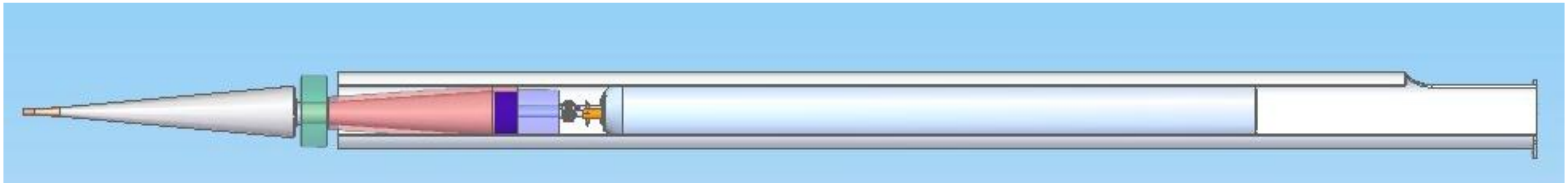
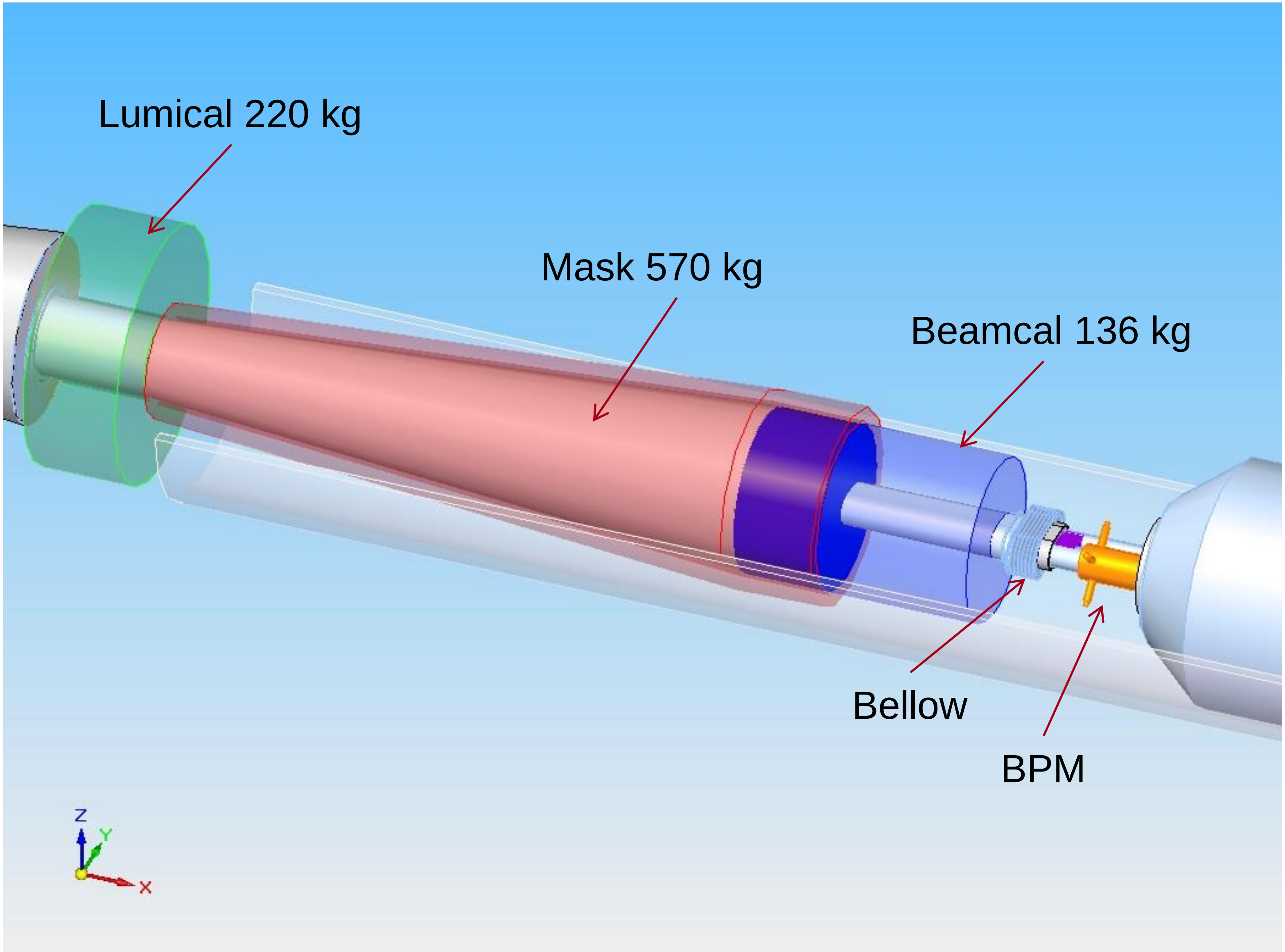
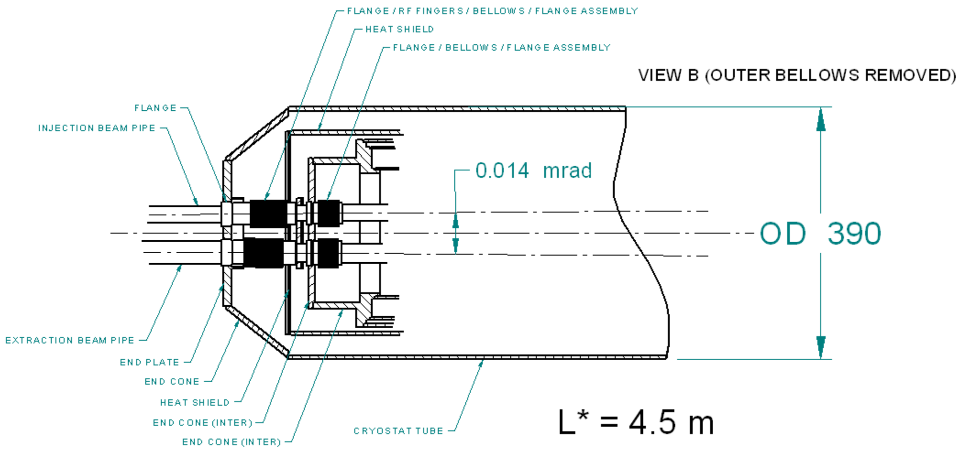


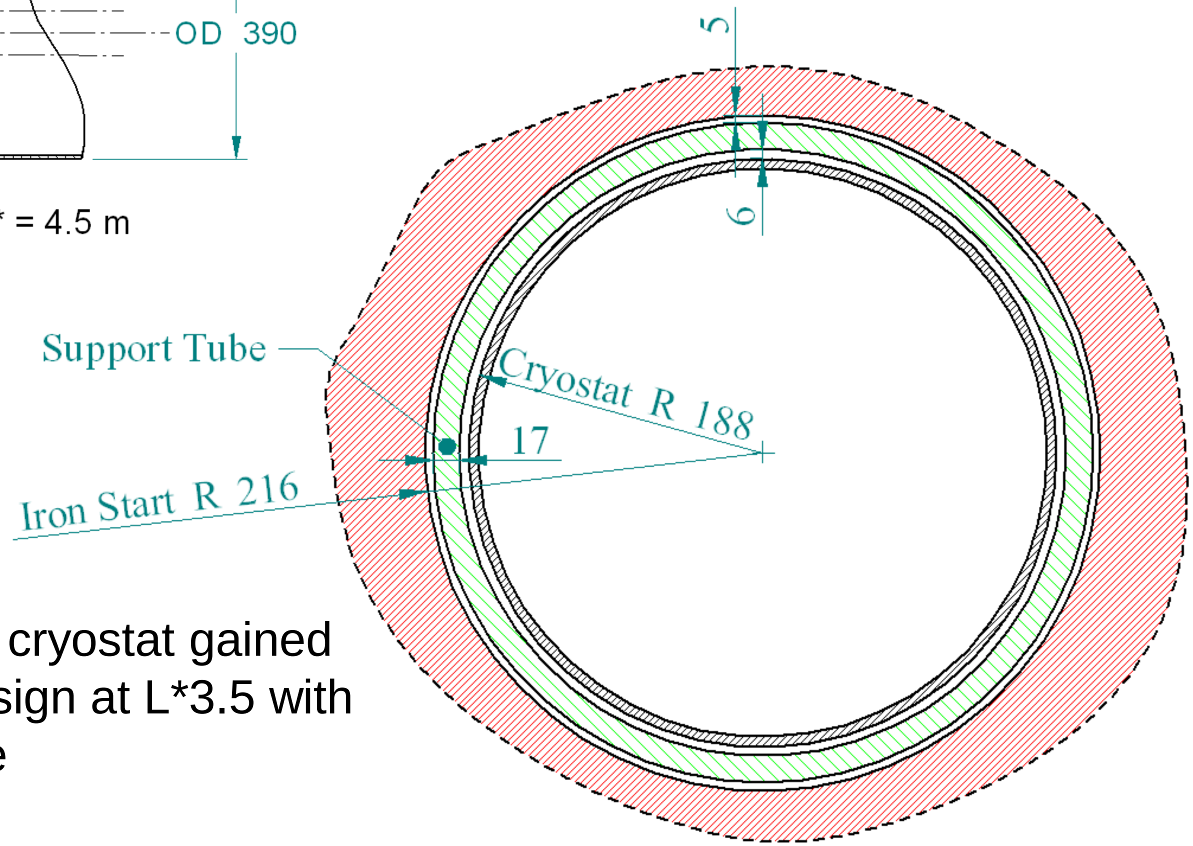

Lumical 220 kg
Mask 570 kg
Beamcal 136 kg
Bellow
BPM
Z
Y
X

Space Requirements

Current QD0 Prototype is designed for L* 4.5 m

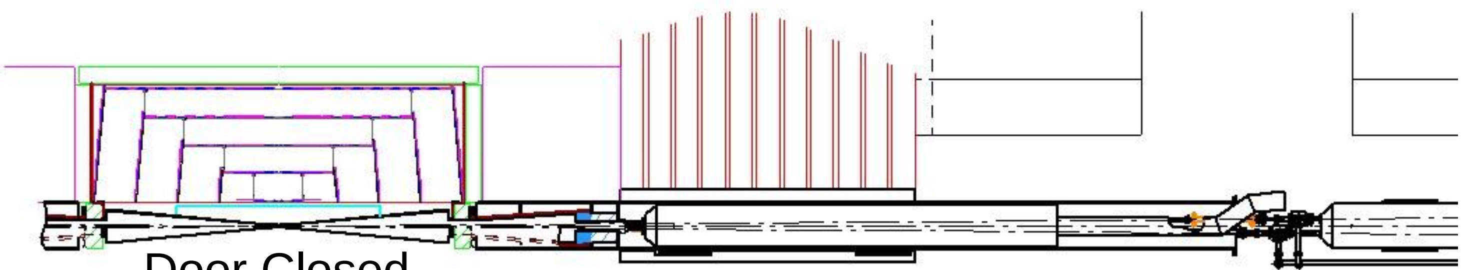


L* = 4.5 m



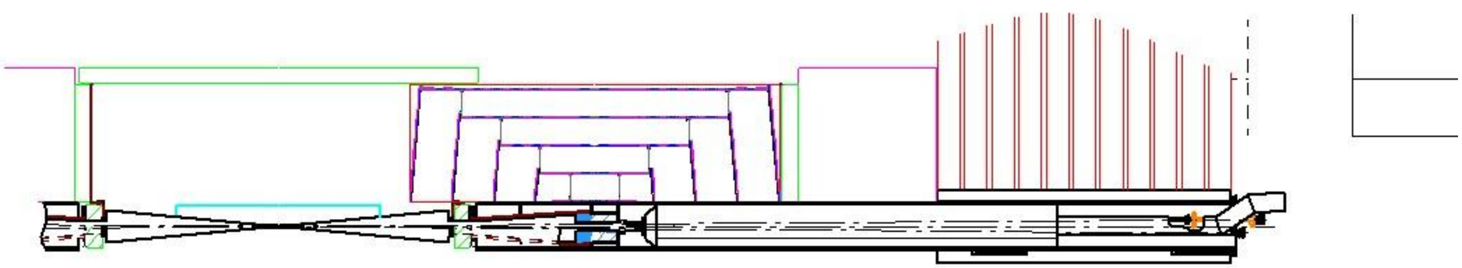
14 mm reduction of the QD0 cryostat gained moving the present QDO design at L*3.5 with the 14mrad crossing scheme
(1 m x 14 mrad = 14 mm)

L* 3.5 m cross section



Door Closed

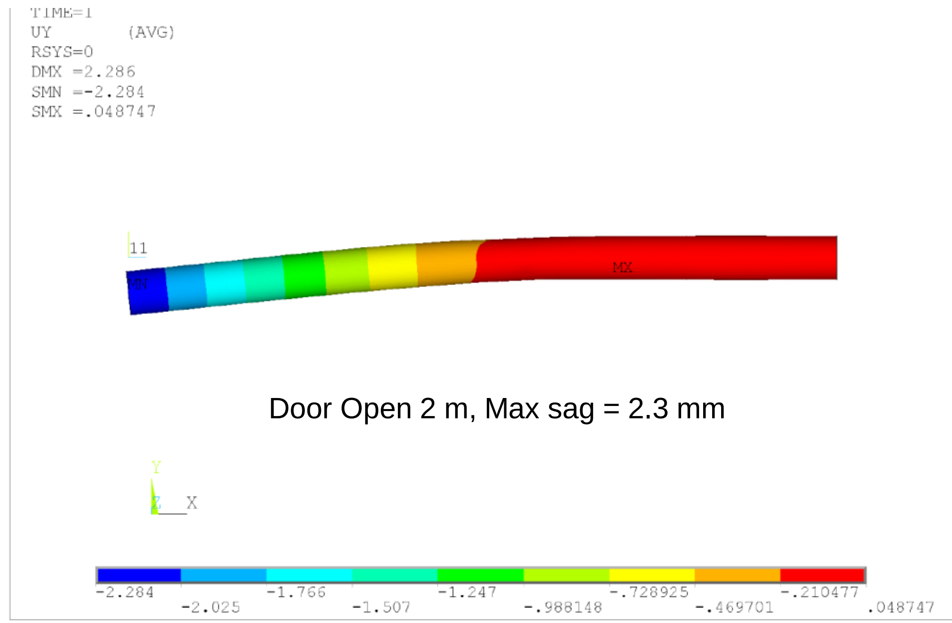
Door 2 m Open



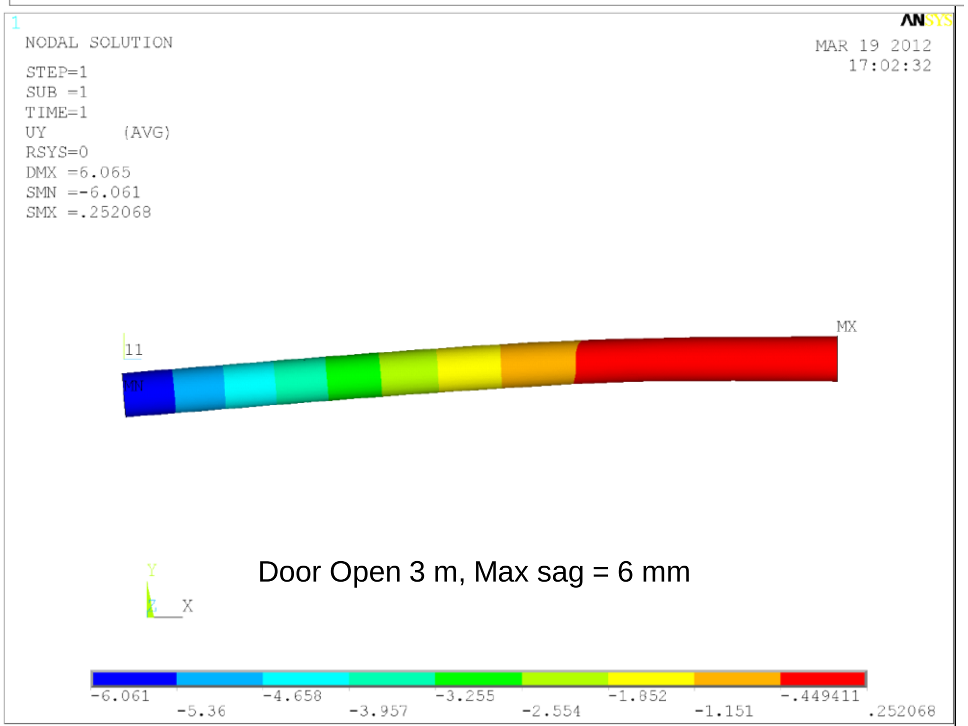
Door 3 m Open

Displacements (mm)

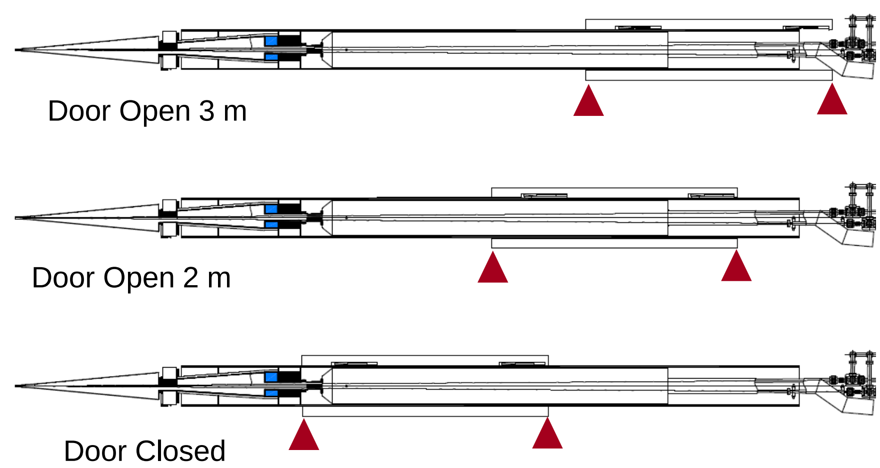
Door Closed, Max sag = 0.1 mm



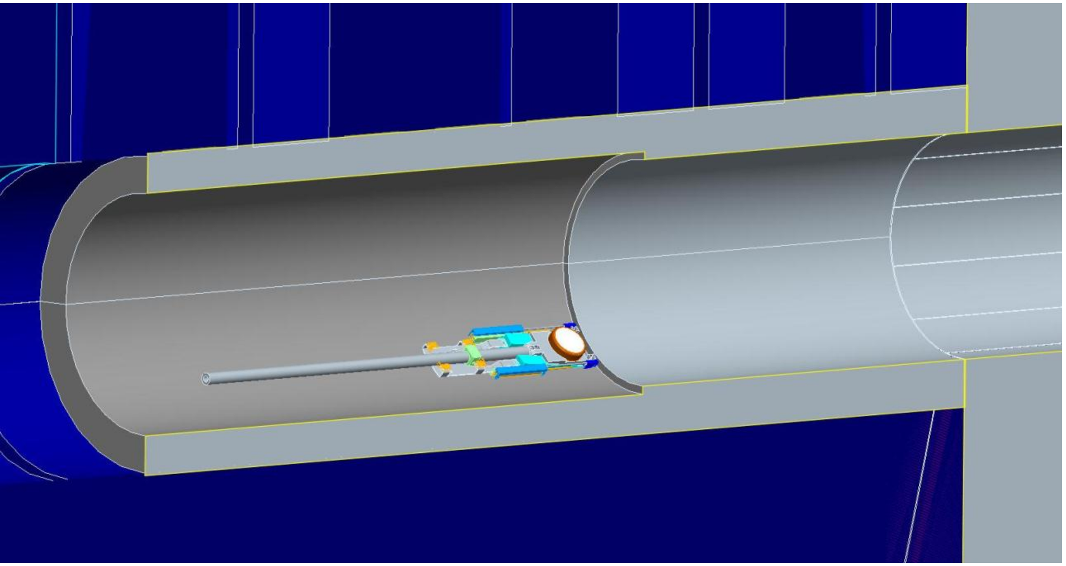
Door Open 2 m, Max sag = 2.3 mm

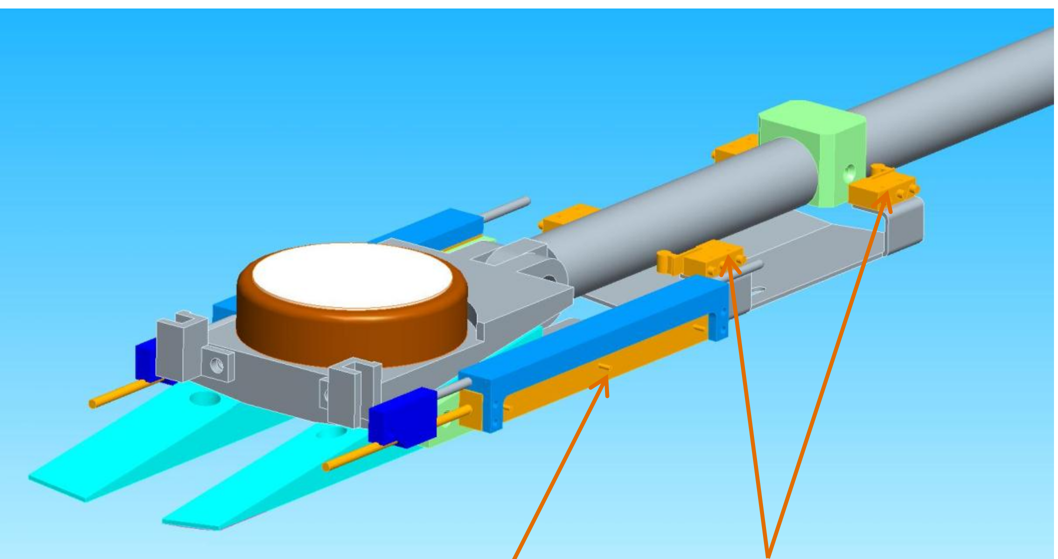


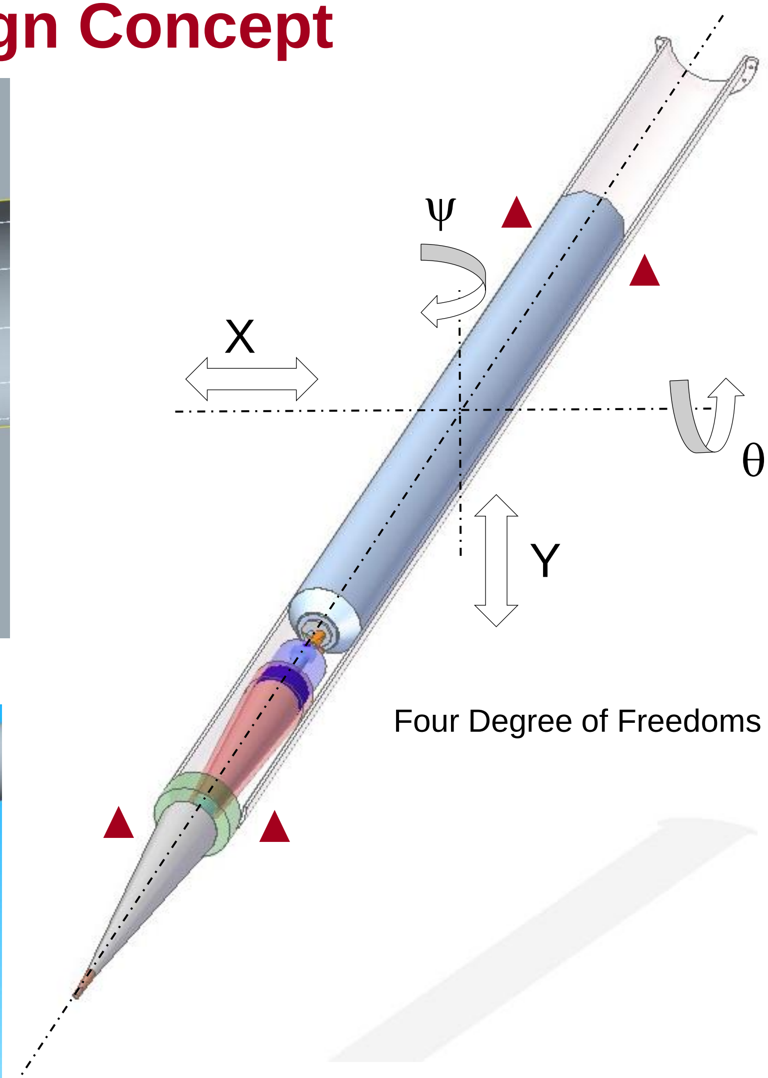
Door Open 3 m, Max sag = 6 mm



QD0 Wedge Design Concept





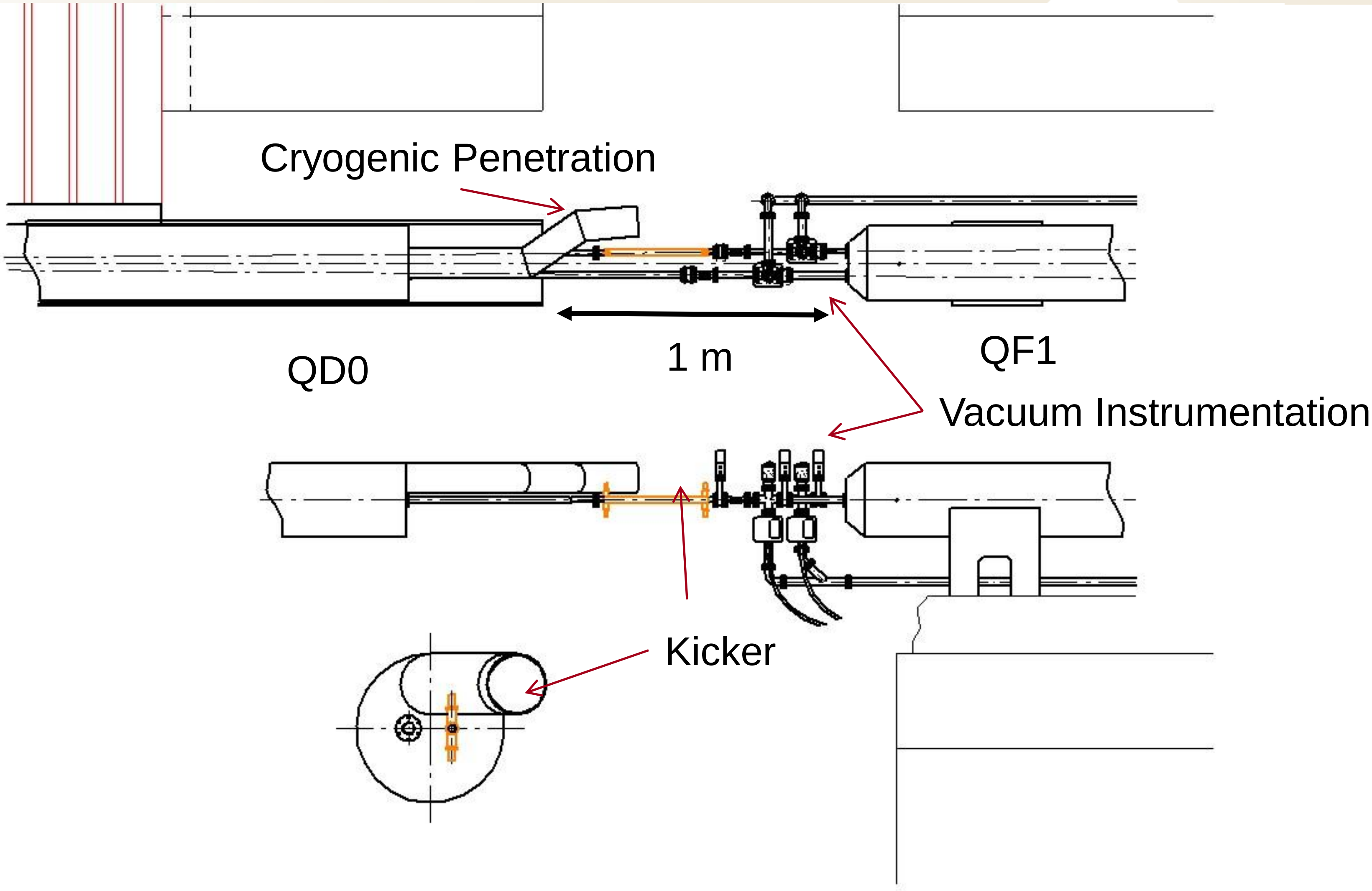


Total Pad Travel as is = .475in

Height of pad and distance of displacement will be changed pending analysis on sagging of beam line.

Conceptual design only at this point

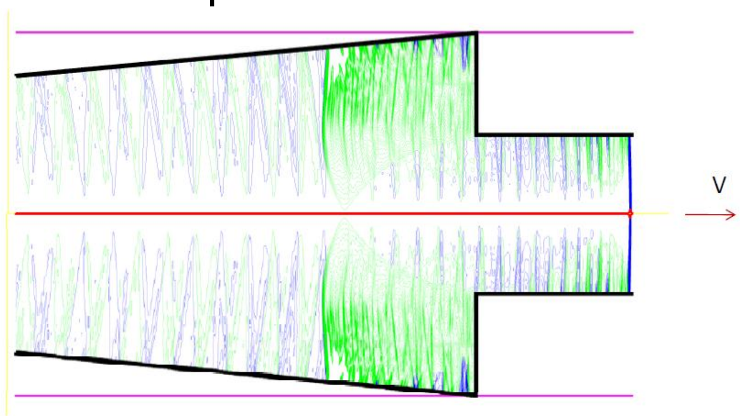
Interface QD0-QF1: Critical for Fast&Reliable Push-Pulls



HOM heating at the IP and in QD0 *(S.Novokhatski, SLAC)*

- *Beam fields*
- *Wake potentials and loss power*
- *Trapped and propagating modes*
- *Frequency spectrum*
- *Resistive wake fields*
- *Total power loss*

Example of Wakefields



- The amount of beam energy loss in IR is very small.
- Spectrum of the wake fields is limited to 300 GHz
- Average power of the wake fields excited ~30 W nominal (6 kW pulsed)
- In the QD0 region the additional losses are of 4W (averaged) .
- BPMs and kickers must be added.

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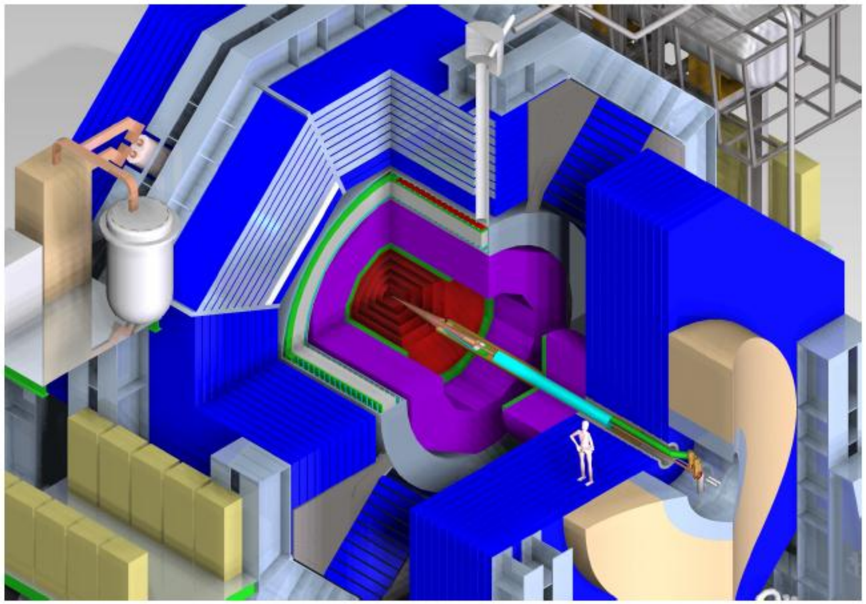

SiD

DETAILED BASELINE DESIGN

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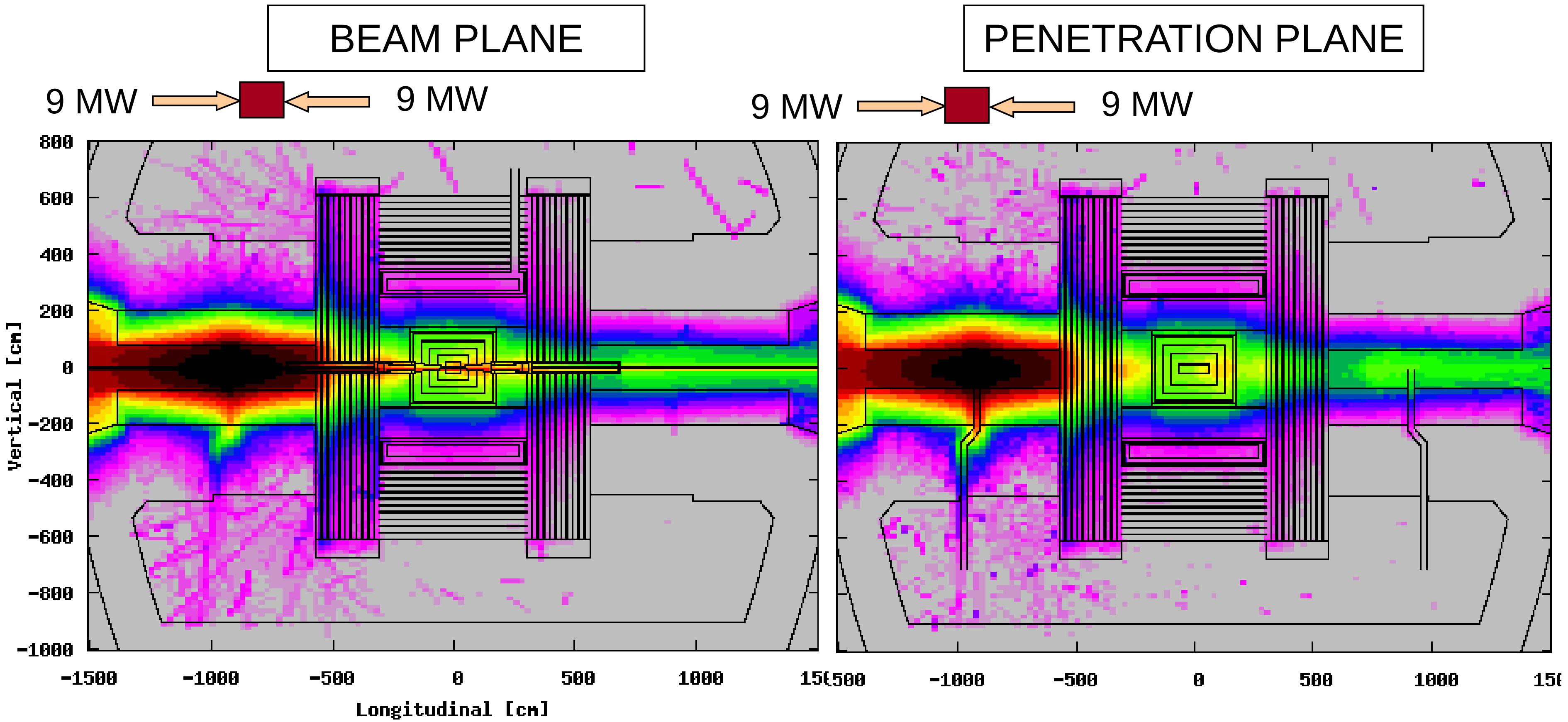
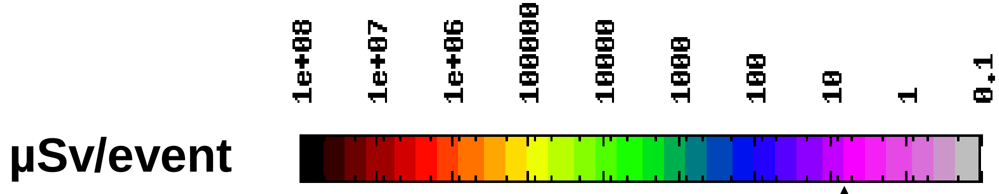
20 R.L. Cu target in IP-9 m. Large pacman.

M.Santana, SLAC



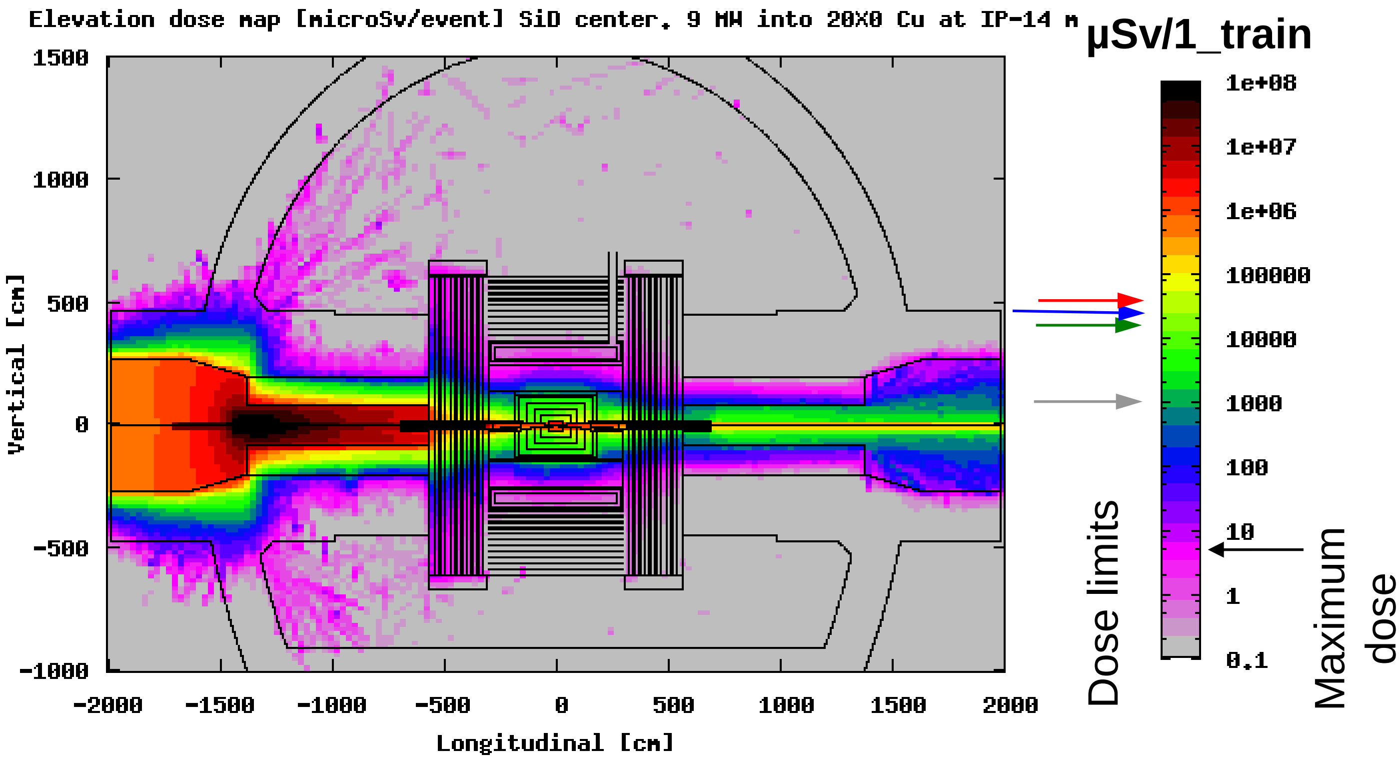


- 10 μSv/event
- 180 mSv/h

20 R.L. Cu target in IP-14 m. Large pacman.

M.Santana, SLAC

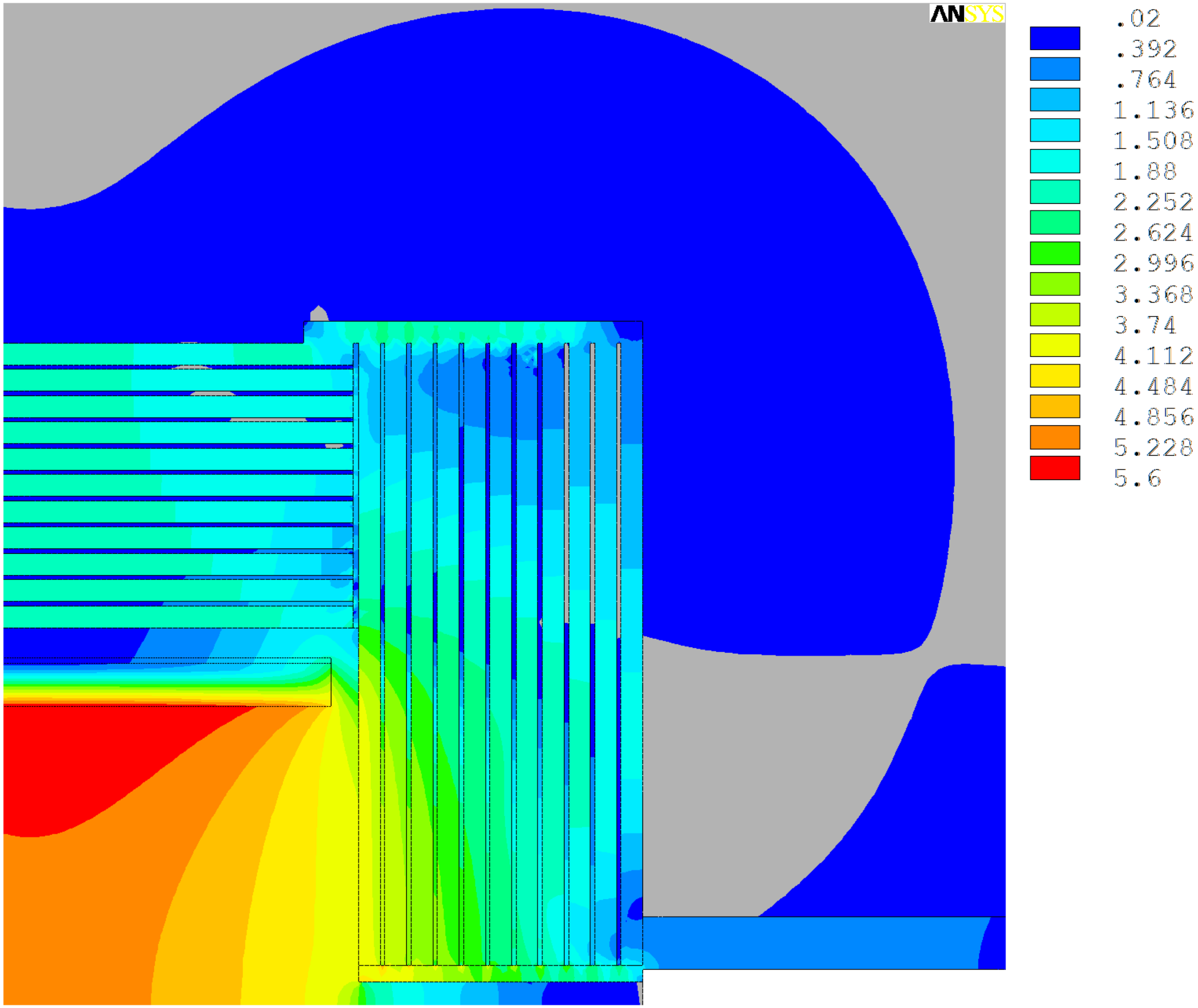
9 MW



- The maximum **integrated dose** per event is ~8 μSv << 30 mSv

- The corresponding peak **dose rate** is ~140 mSv/h < 250 mSv/h

Fringe Field for a quadrant view of SiD
Cut off @ 200 Gauss



What next:
A list of MDI and Integration issues need further development

Machine – Detector Integration

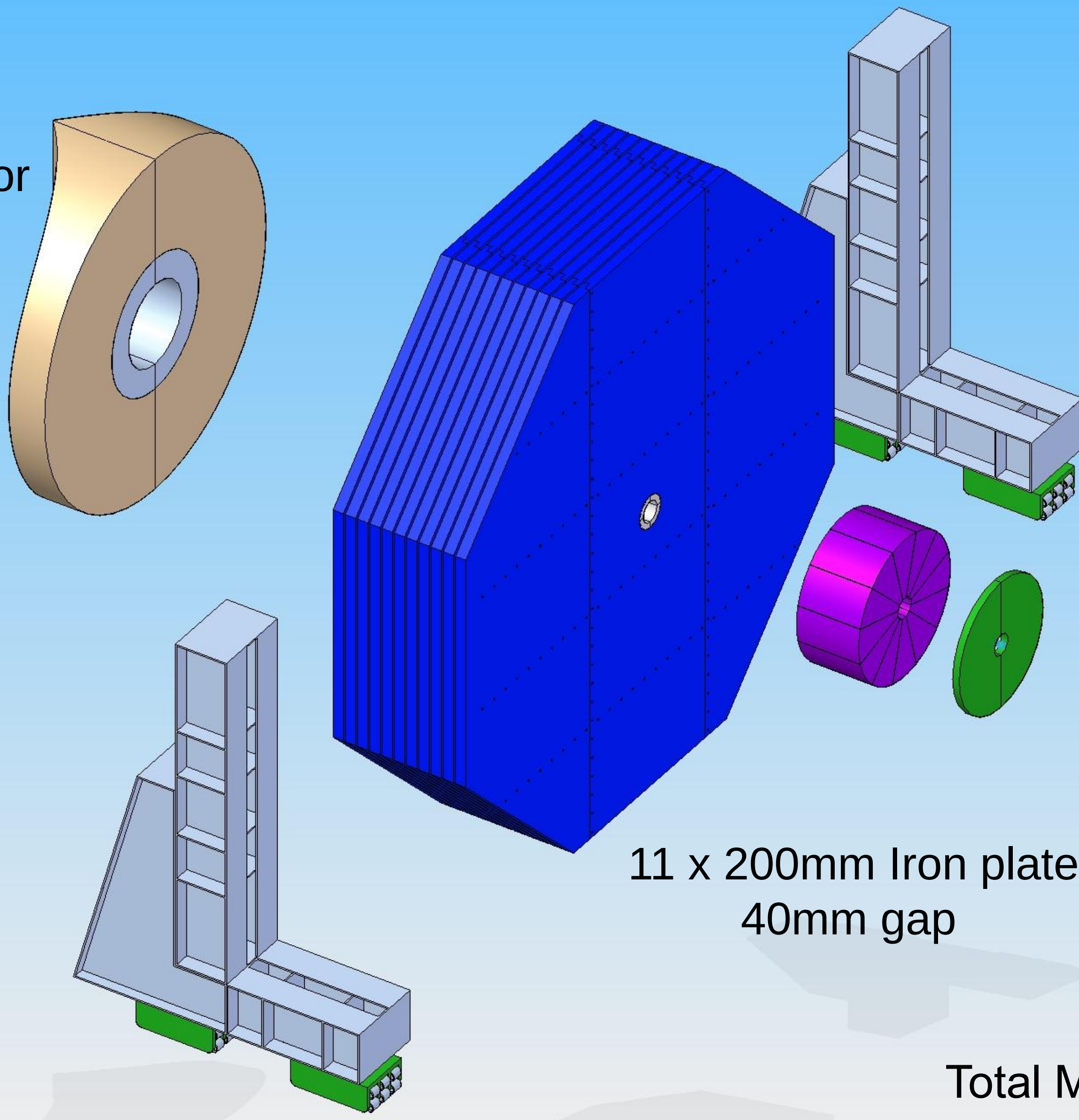
- Alignment of detector to beam line after transport on platform.
- Platform design progress.
- Surface Assembly Facilities.
- Local Control Rooms.
- Interaction Region Hall utilities:
- Welding constraints: Ventilation, permits, etc.
- Local machine shop.
- Detector access: Man lifts, crane baskets?

Detector Specific Integration

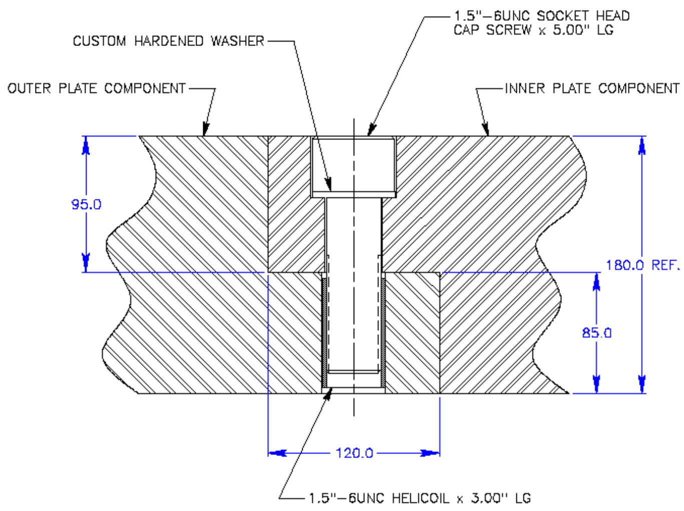
- Iron optimization: Review:
- Detector Alignment Procedures:
- Internal Detector Services:
- Vents:
    1. He
    2. Steam? (Dump resistor)
    3. Other
- Detector platforms and access stairs.

EXTRA SLIDES

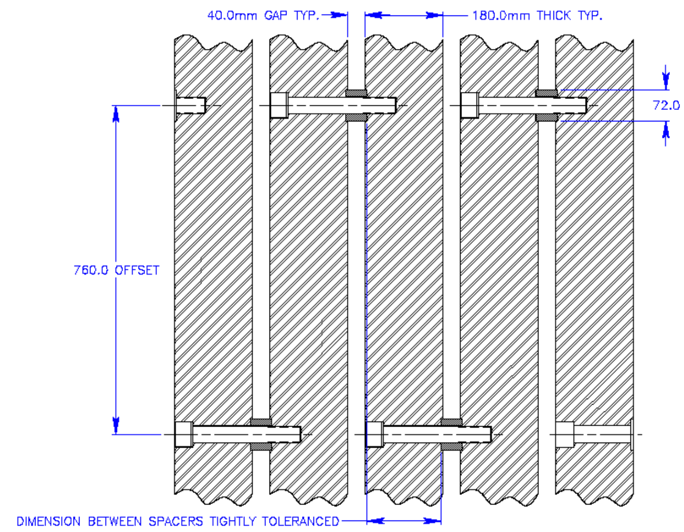
End Door



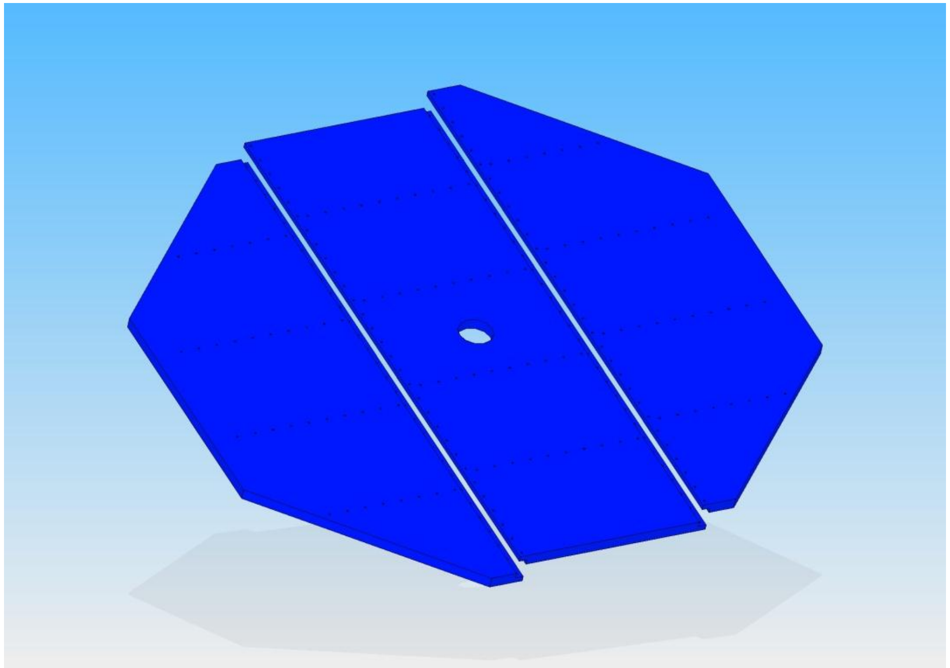
Total Mass ~ 2’300 Tons

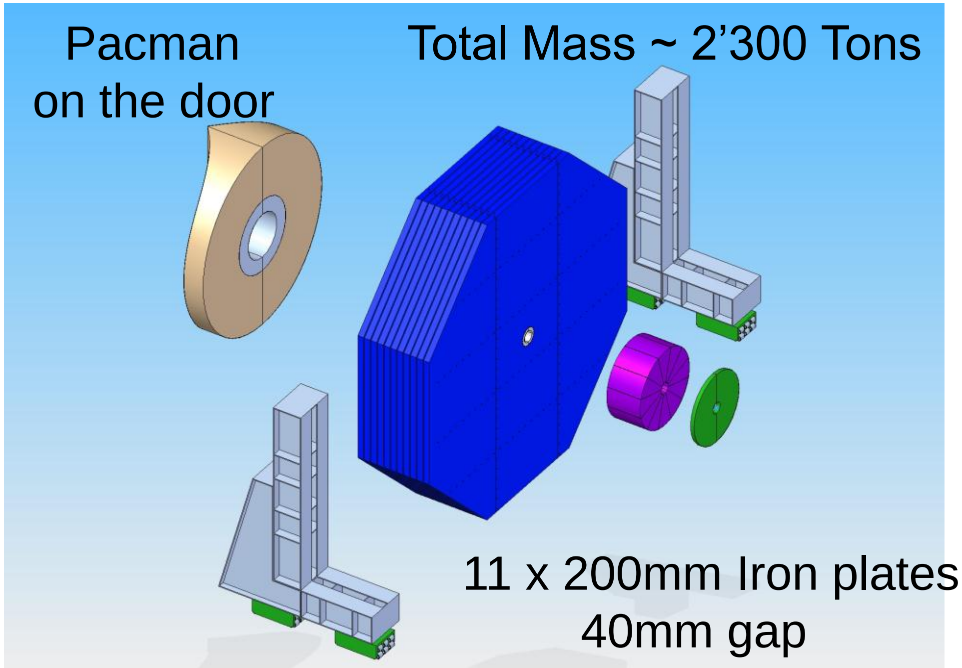


Intraplate connections

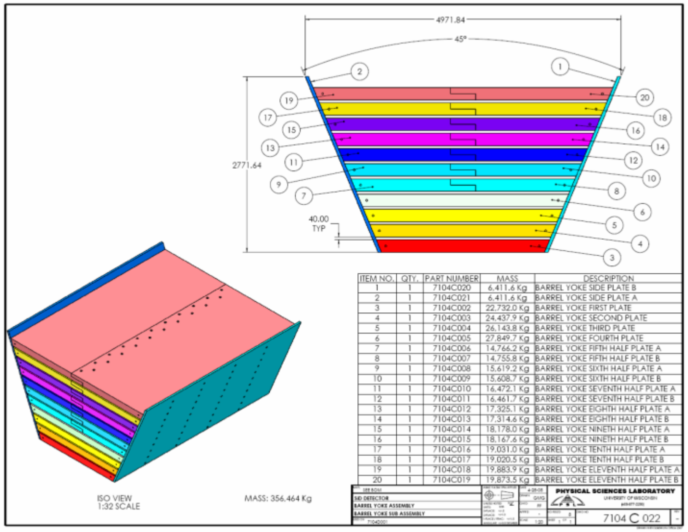


Spacer Offset





Iron Barrel Yoke layout



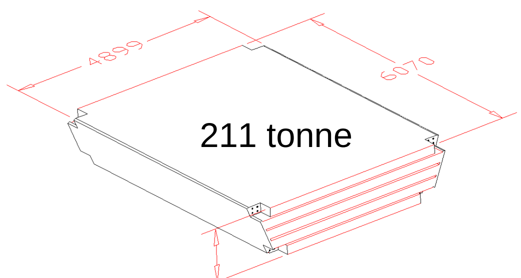
ITEM NO.	QTY.	PART NUMBER	MASS	DESCRIPTION
1	1	7104C020	6,411.6 Kg	BARREL YOKE SIDE PLATE B
2	1	7104C021	6,411.6 Kg	BARREL YOKE SIDE PLATE A
3	1	7104C002	22,732.0 Kg	BARREL YOKE FIRST PLATE
4	1	7104C003	24,437.9 Kg	BARREL YOKE SECOND PLATE
5	1	7104C004	26,143.8 Kg	BARREL YOKE THIRD PLATE
6	1	7104C005	27,849.7 Kg	BARREL YOKE FOURTH PLATE
7	1	7104C006	14,766.2 Kg	BARREL YOKE FIFTH HALF PLATE A
8	1	7104C007	14,755.8 Kg	BARREL YOKE FIFTH HALF PLATE B
9	1	7104C008	15,619.2 Kg	BARREL YOKE SIXTH HALF PLATE A
10	1	7104C009	15,608.7 Kg	BARREL YOKE SIXTH HALF PLATE B
11	1	7104C010	16,472.1 Kg	BARREL YOKE SEVENTH HALF PLATE A
12	1	7104C011	16,461.7 Kg	BARREL YOKE SEVENTH HALF PLATE B
13	1	7104C012	17,325.1 Kg	BARREL YOKE EIGHTH HALF PLATE A
14	1	7104C013	17,314.6 Kg	BARREL YOKE EIGHTH HALF PLATE B
15	1	7104C014	18,178.0 Kg	BARREL YOKE NINETH HALF PLATE A
16	1	7104C015	18,167.6 Kg	BARREL YOKE NINETH HALF PLATE B
17	1	7104C016	19,031.0 Kg	BARREL YOKE TENTH HALF PLATE A
18	1	7104C017	19,020.5 Kg	BARREL YOKE TENTH HALF PLATE B
19	1	7104C018	19,883.9 Kg	BARREL YOKE ELEVENTH HALF PLATE A
20	1	7104C019	19,873.5 Kg	BARREL YOKE ELEVENTH HALF PLATE B

Bolted assembly, 144 plates 200 mm thick, 40mm gap

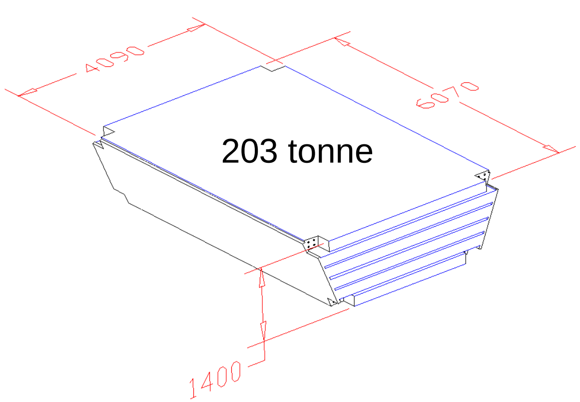
Opportunity to make blank assembly at the factory before shipping

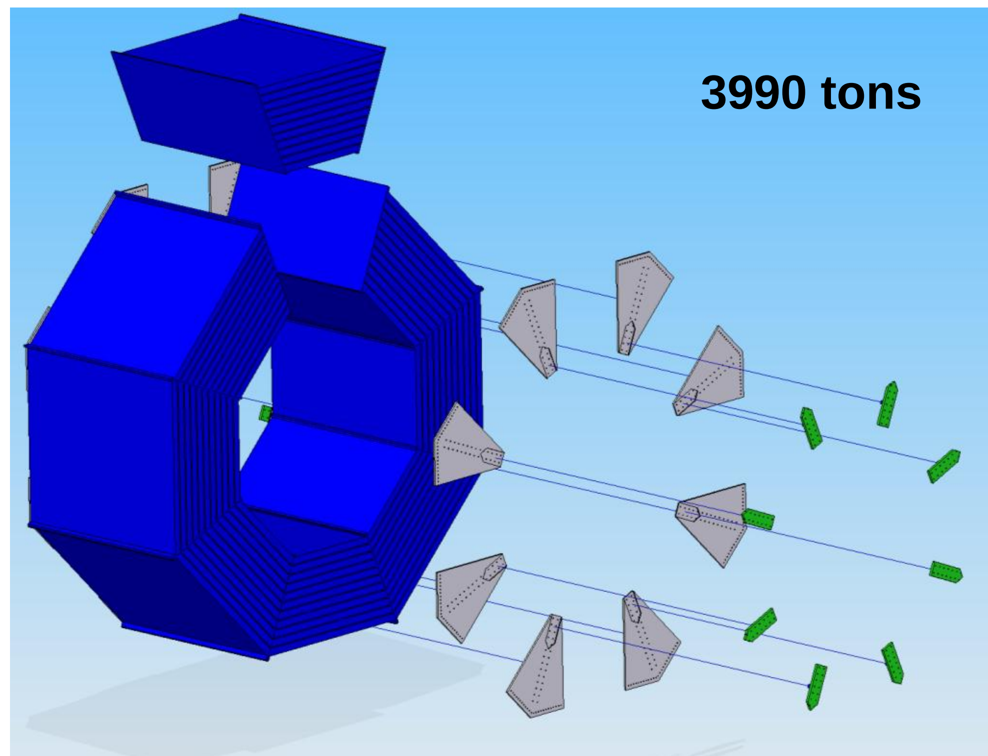
Preliminary Contacts with Kawasaki Heavy Industries

- 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)



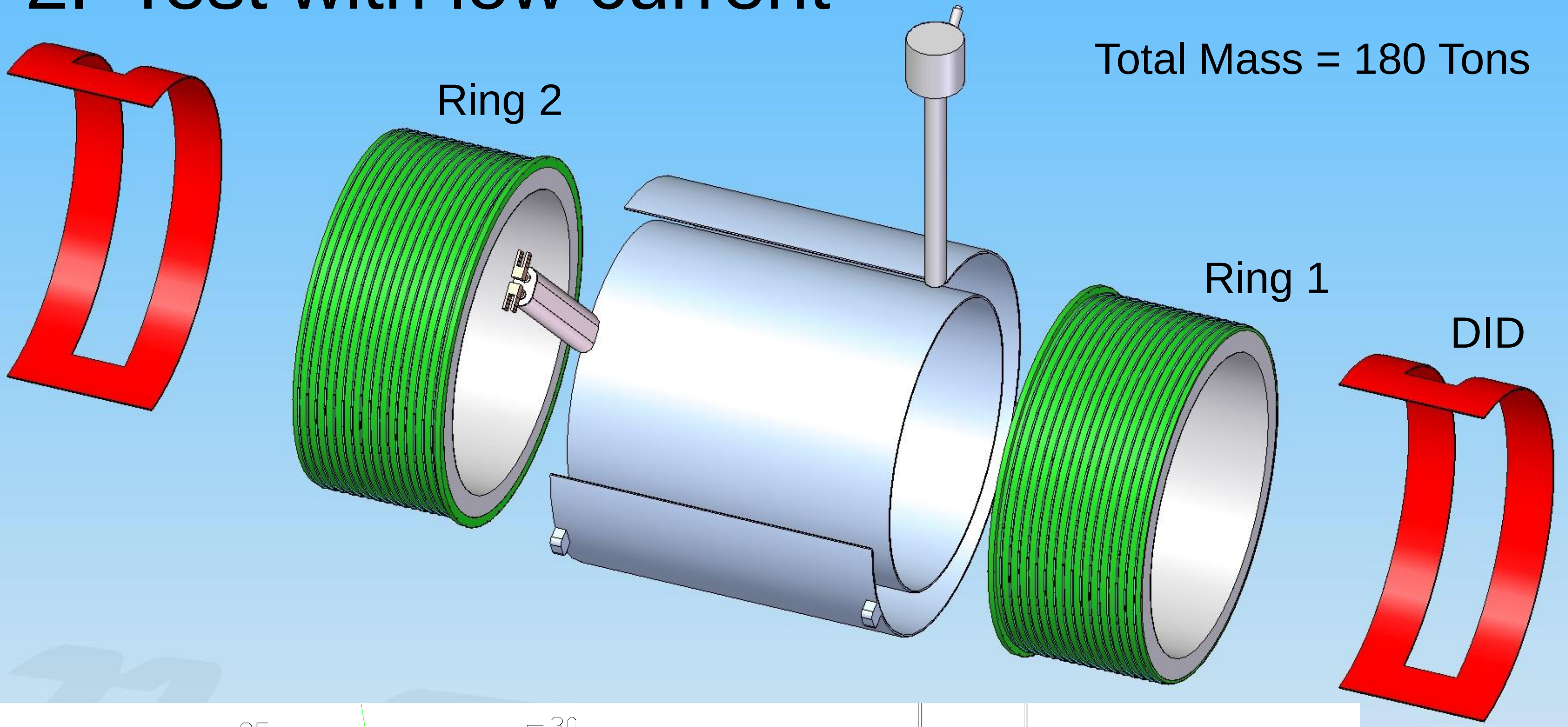
Max. Crane capacity 215 Tons

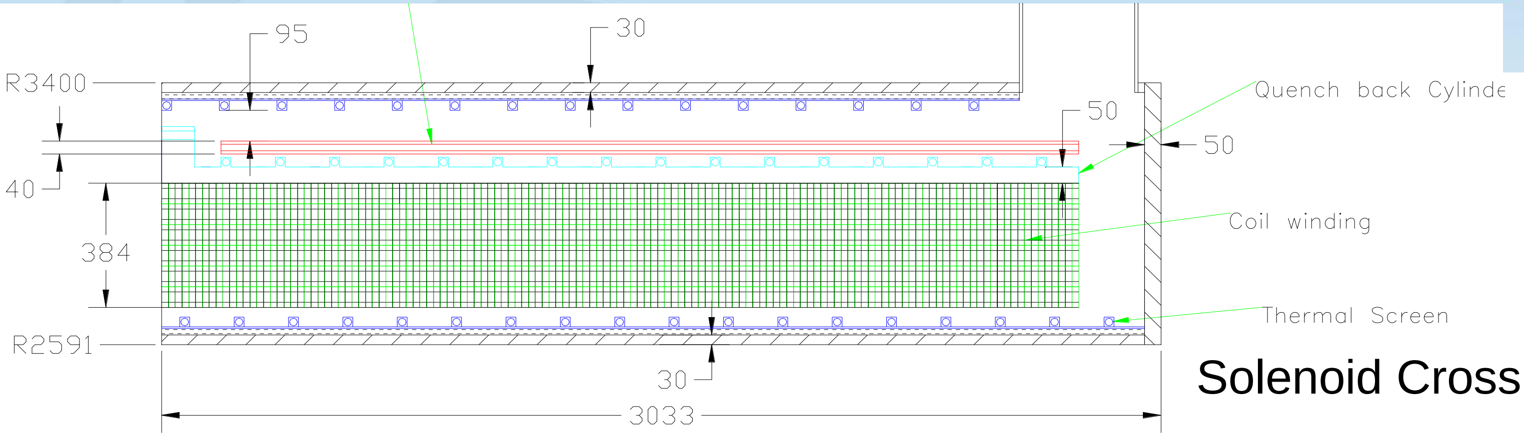




1. Assembly on Site (surface)
2. Test with low current

Total Mass = 180 Tons





Solenoid Cross section