Introduction to Experimental Hall Issues

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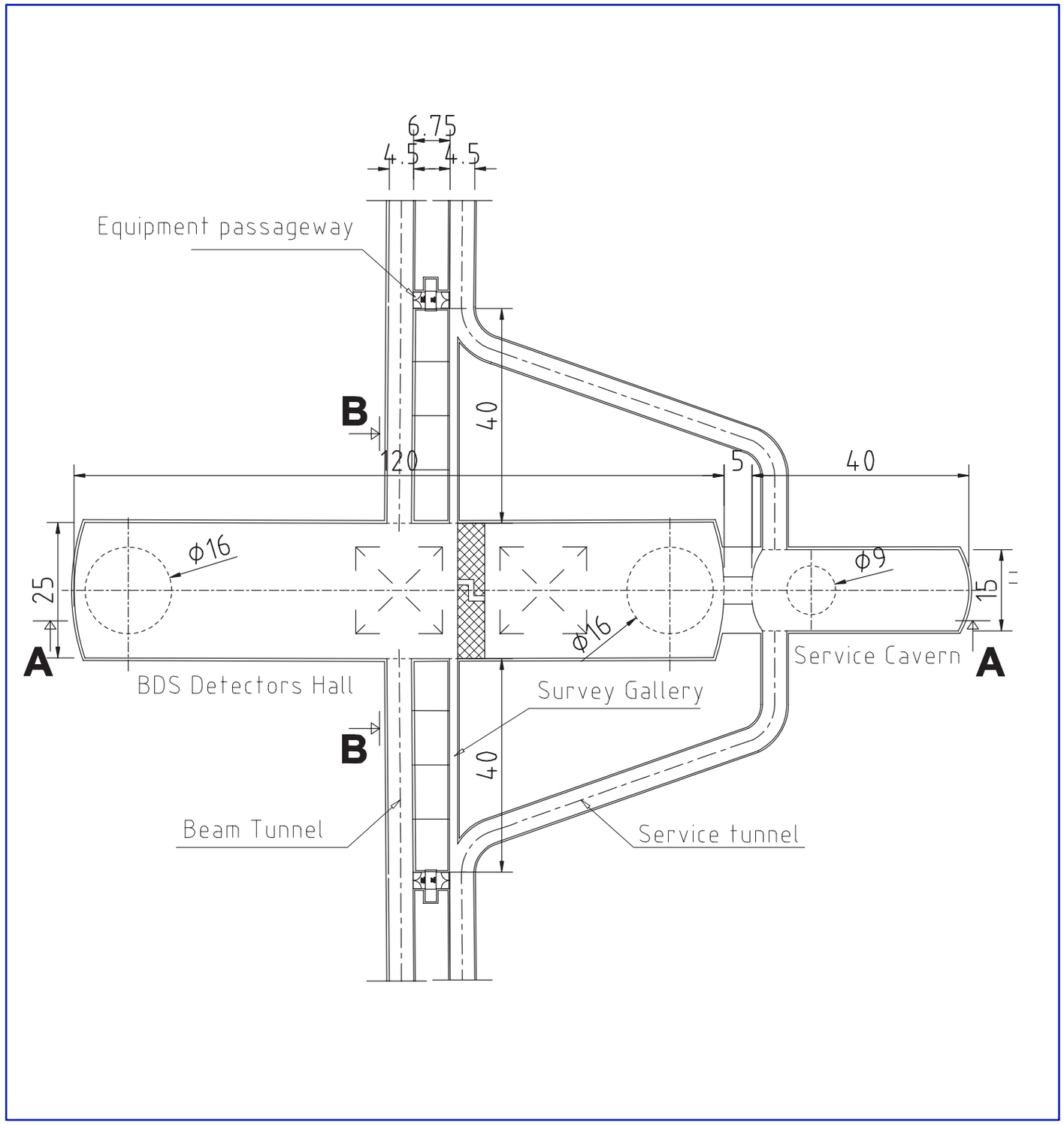
DESY

MDI/Integration Pre-Meeting
22. May 2011

Experimental Hall (RDR Design)

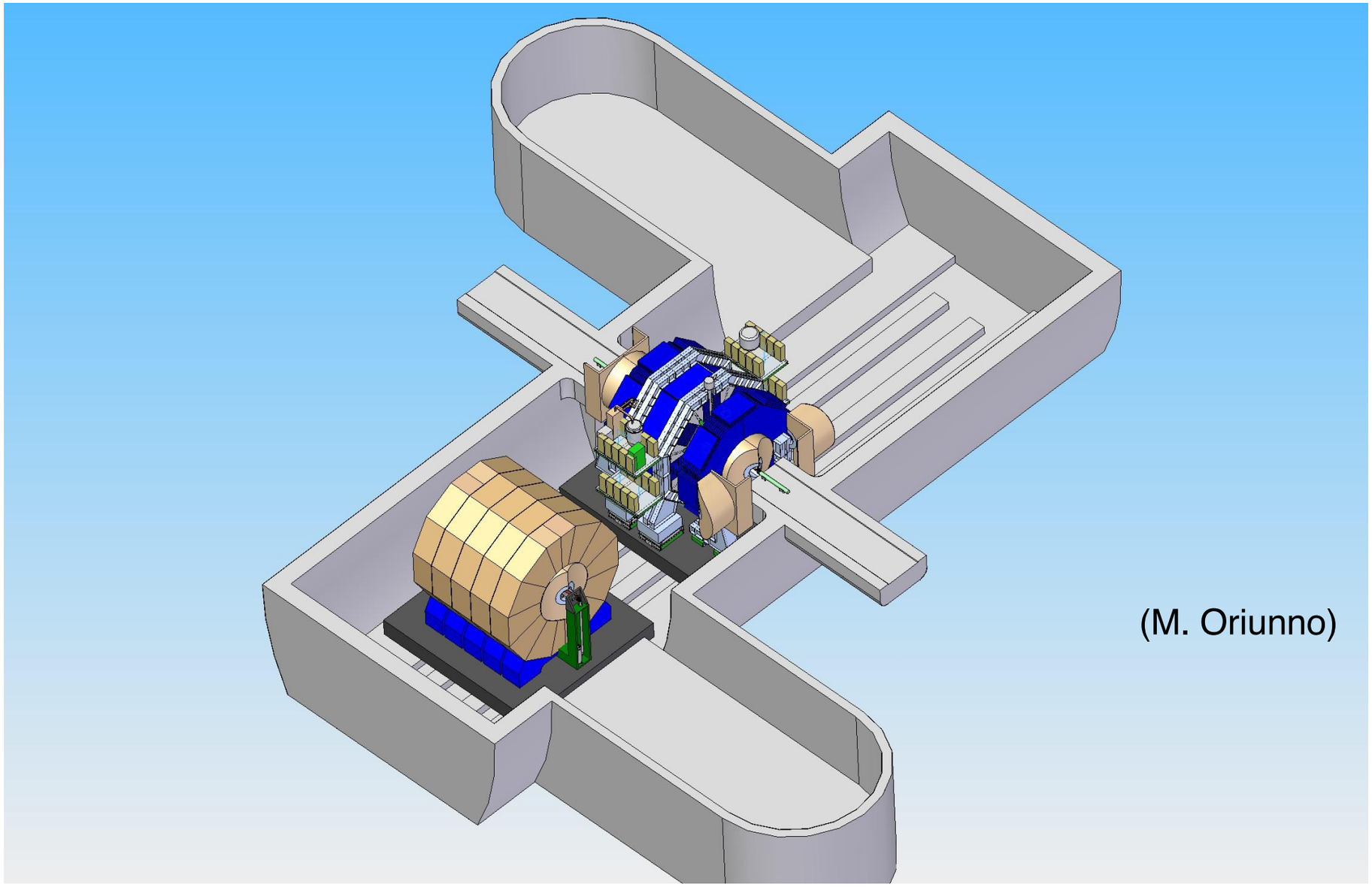
- Rather large (120m)
- Shafts above experiments
- Not enough space for detector maintenance in parking position
- Unnecessary shielding wall
- No service caverns for detectors



Hall Design Study

ETH Institute for Particle Physics

Both detectors on a platform

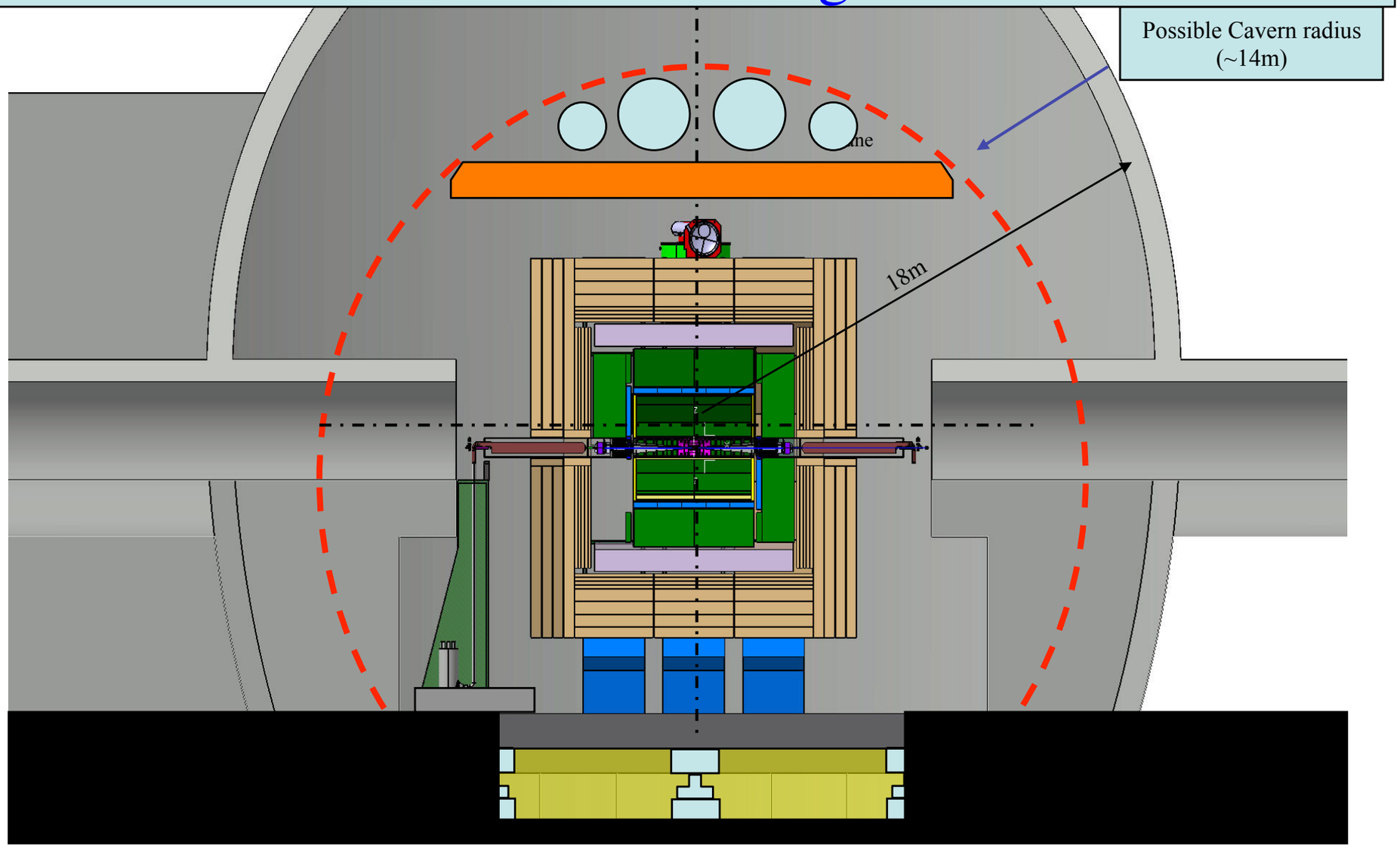


Alain Hervé, CLIC08 Workshop, 16 October 2008 5

- ILD Hall Design Study (A. Hervé et al.)

Cavern Size

An effort has been made to reduce
the radius of the Underground Hall

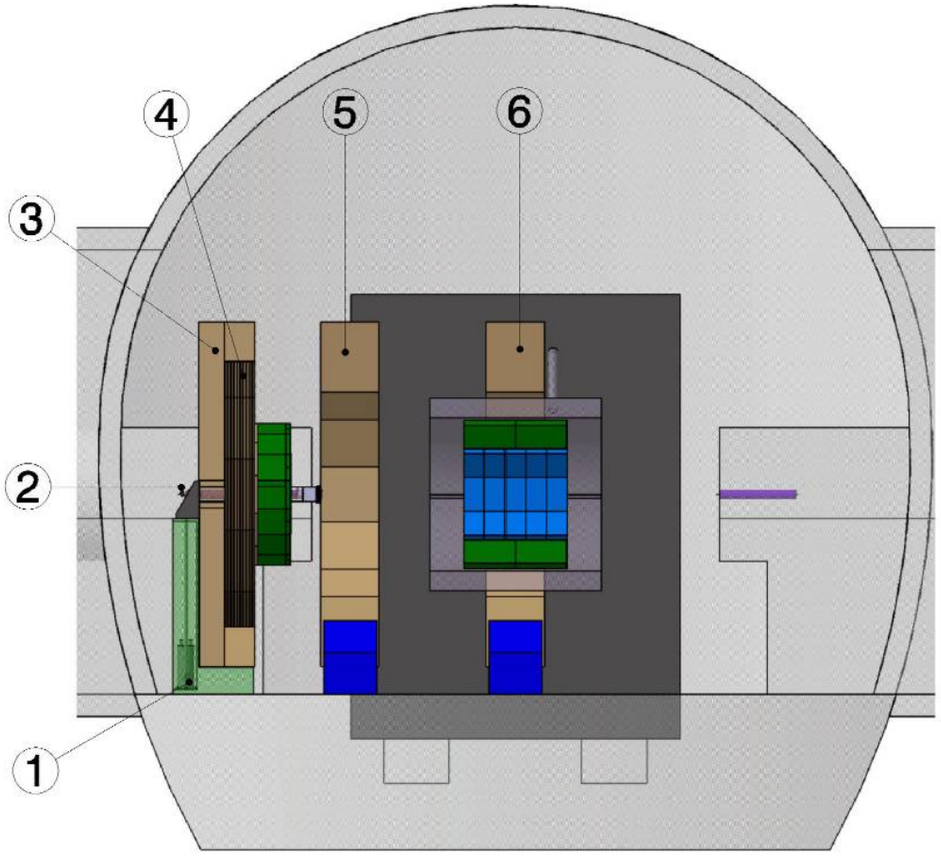


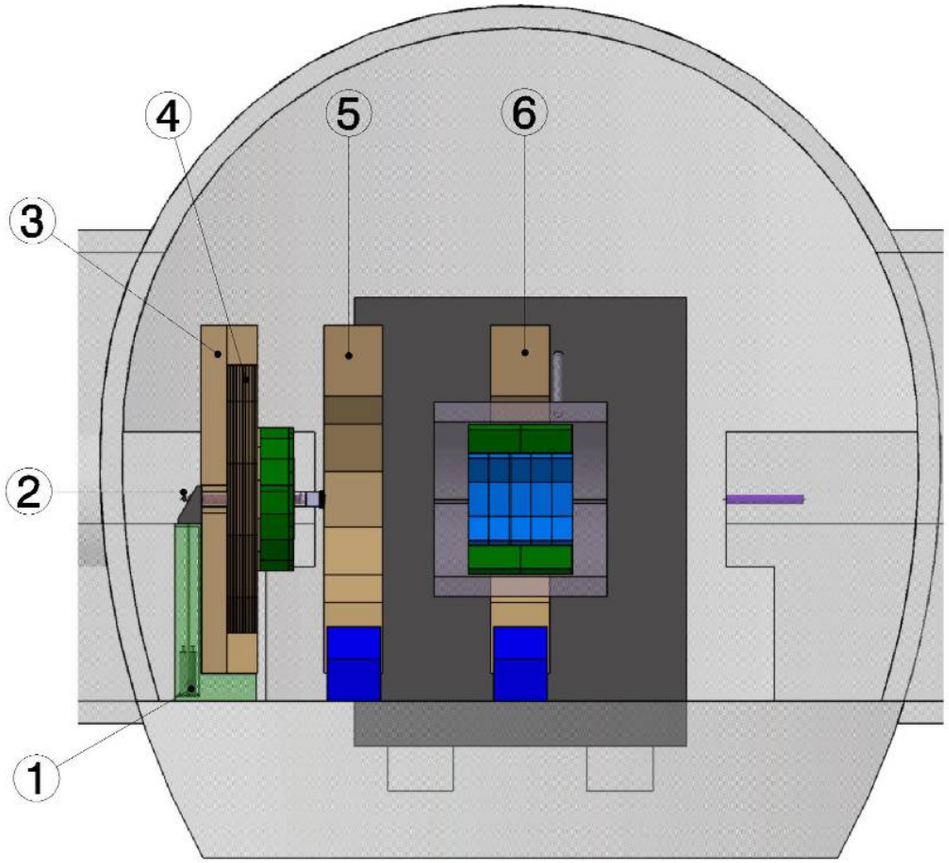
4366-ILD-T-Platform-and-environment.ppt A. Hervé

Design N.S. ETH-Z, January 2009.

- Radius of experimental hall could go down from ~18 to ~14m

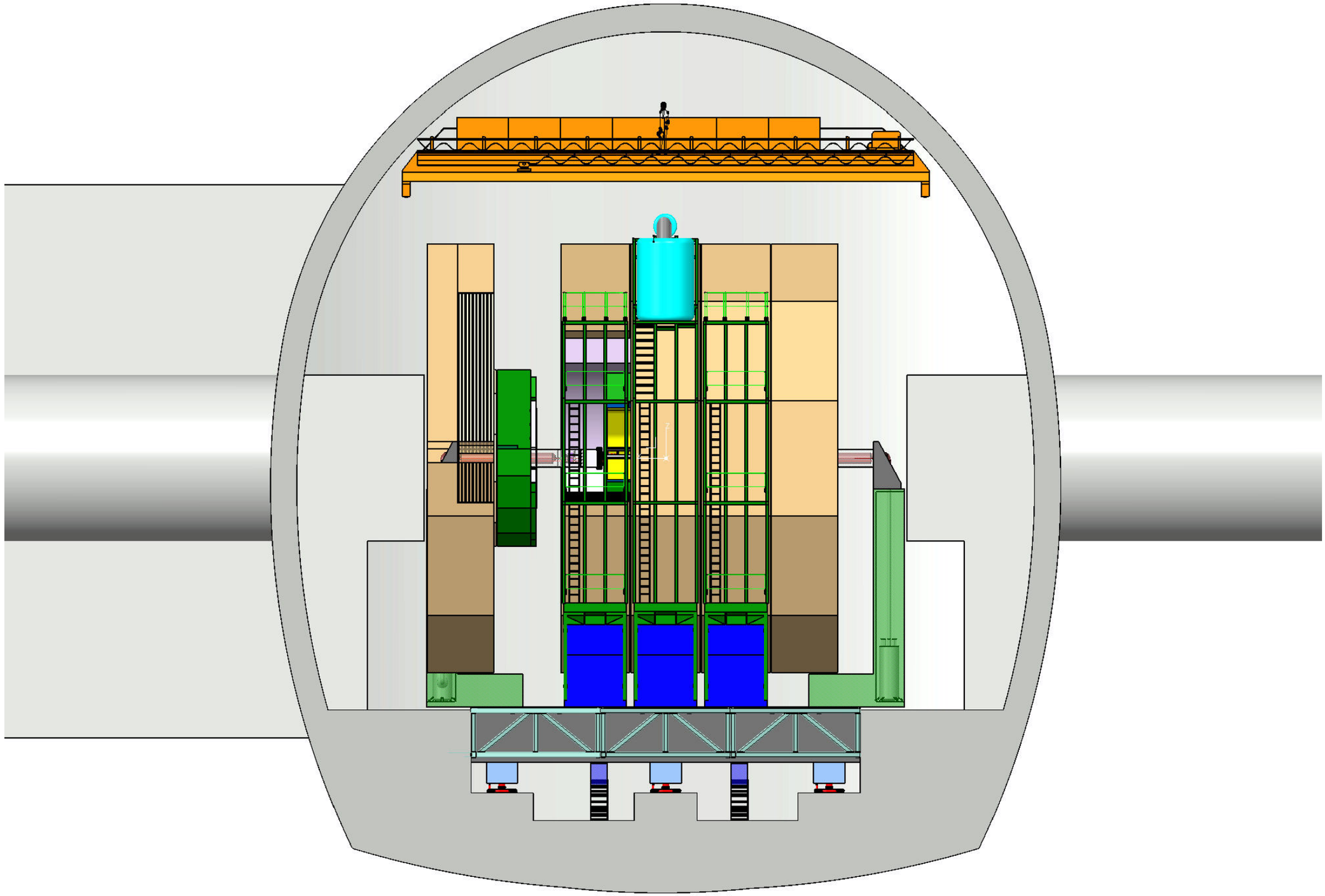
Detector Assembly CMS-Style





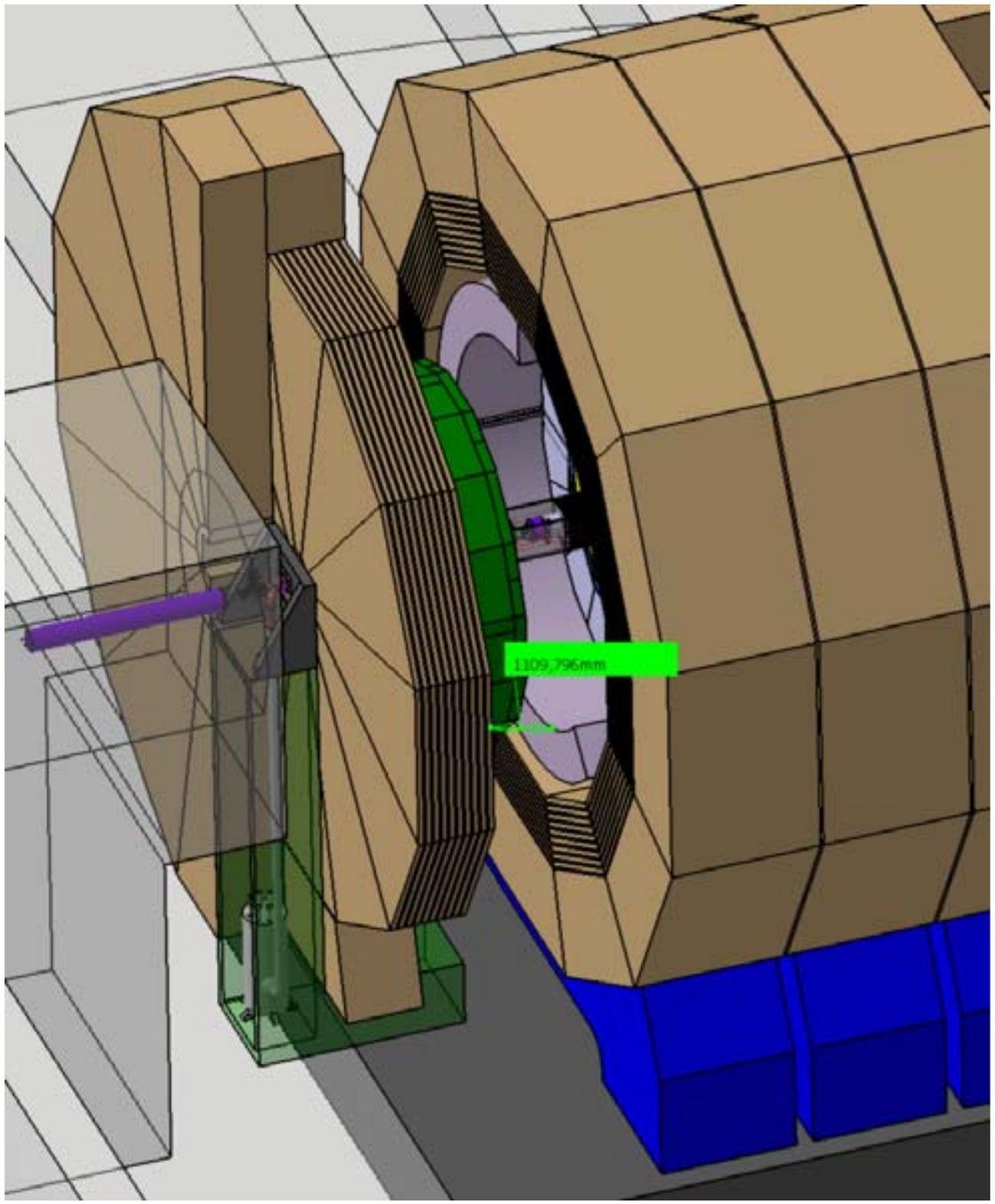
- Pre-assembly of large structures on surface
- Sub-assemblies lowered into the experimental hall
- Main parts:
  - three barrel yoke rings; central carries magnet and barrel detectors
  - two yoke endcaps
  - central tracking system (TPC)

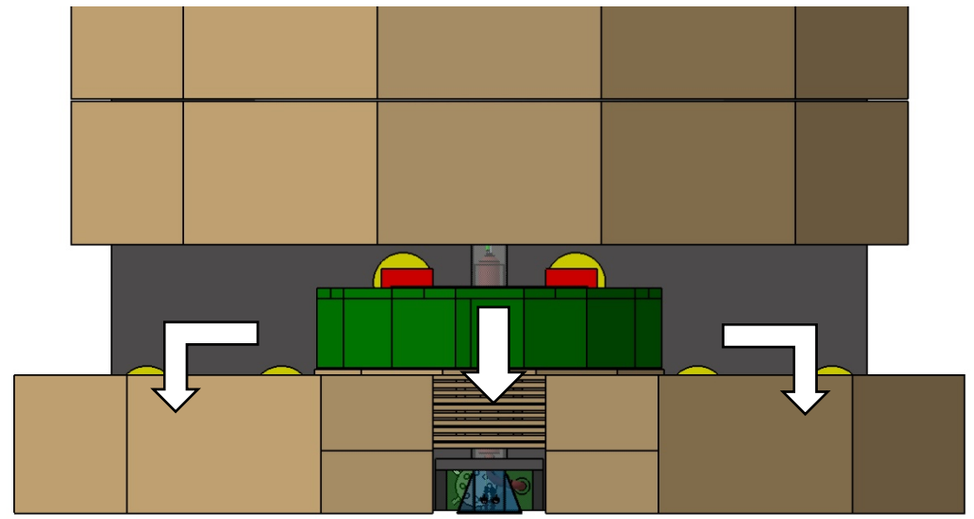
Detector in Beam Position



- NB: Optimised hall size

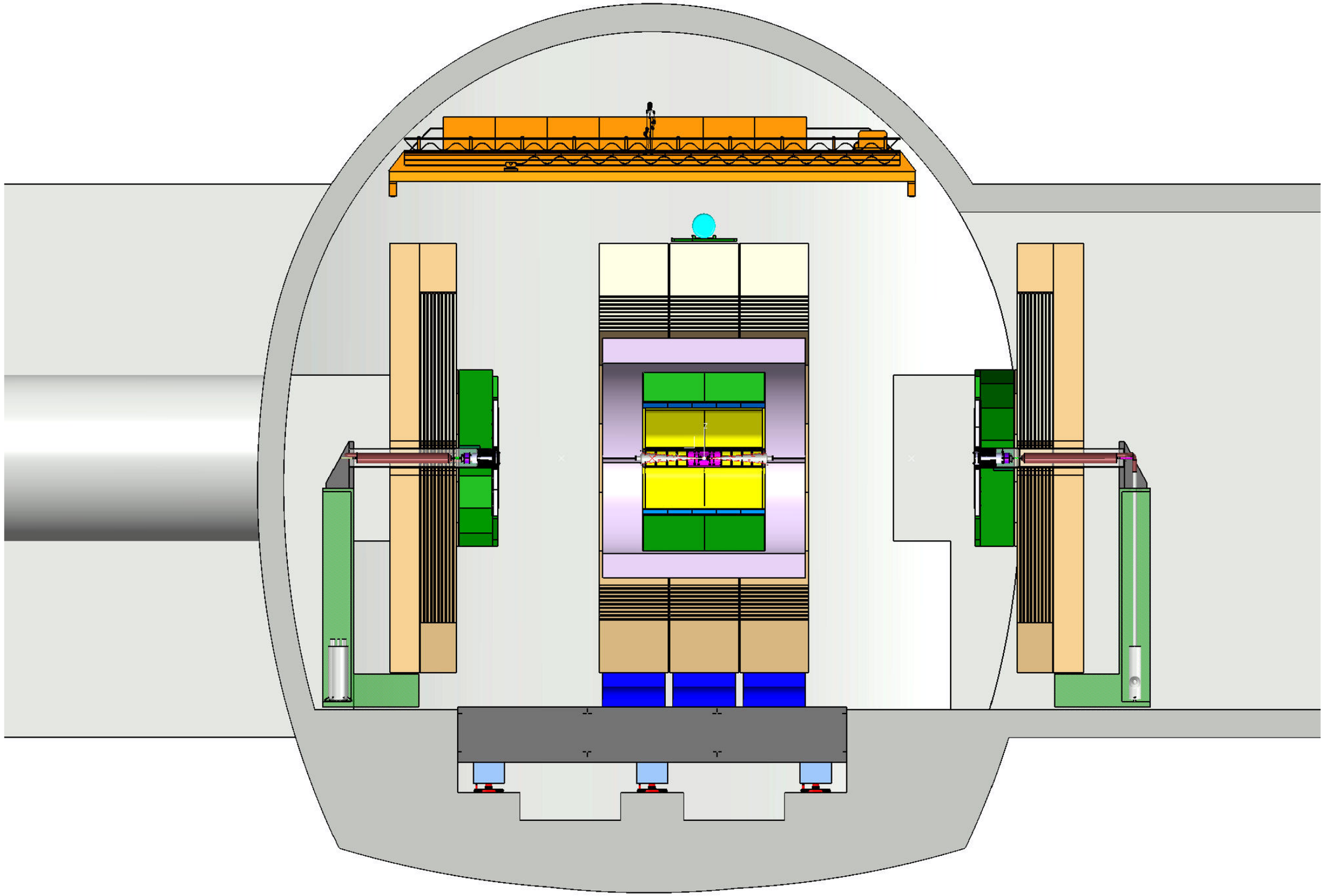
Detector Opening - Beam Position





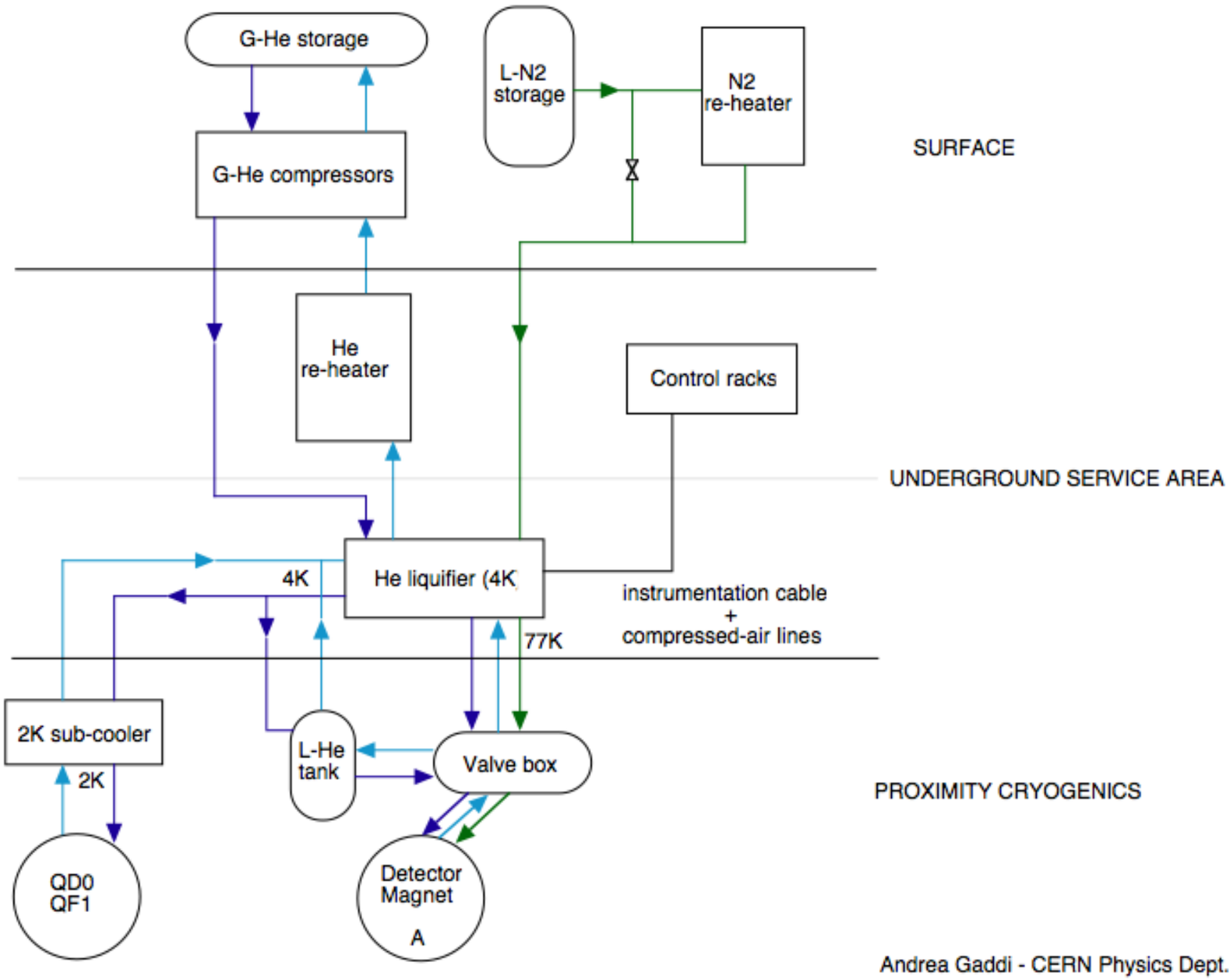
- Option to open the endcap in the beam position for limited access
  - Still under discussion; might not be needed if push-pull concept is taken seriously

Detector Opening - Garage Position



- Alcove needed for allowing access to subdetectors
  - TPC removal needs ~6m opening

Detector Services

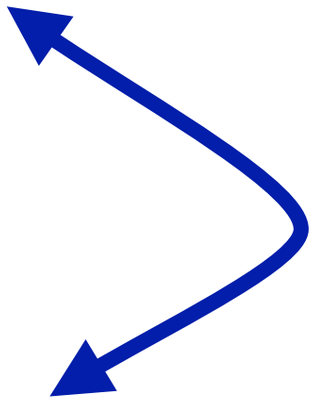


- Cryogenics for the magnets

Detector Services

- Primary services (on surface)
  - Water chillers
  - HV transformers
  - Diesel and UPS facilities
  - He storage and compressors
  - Gas storage

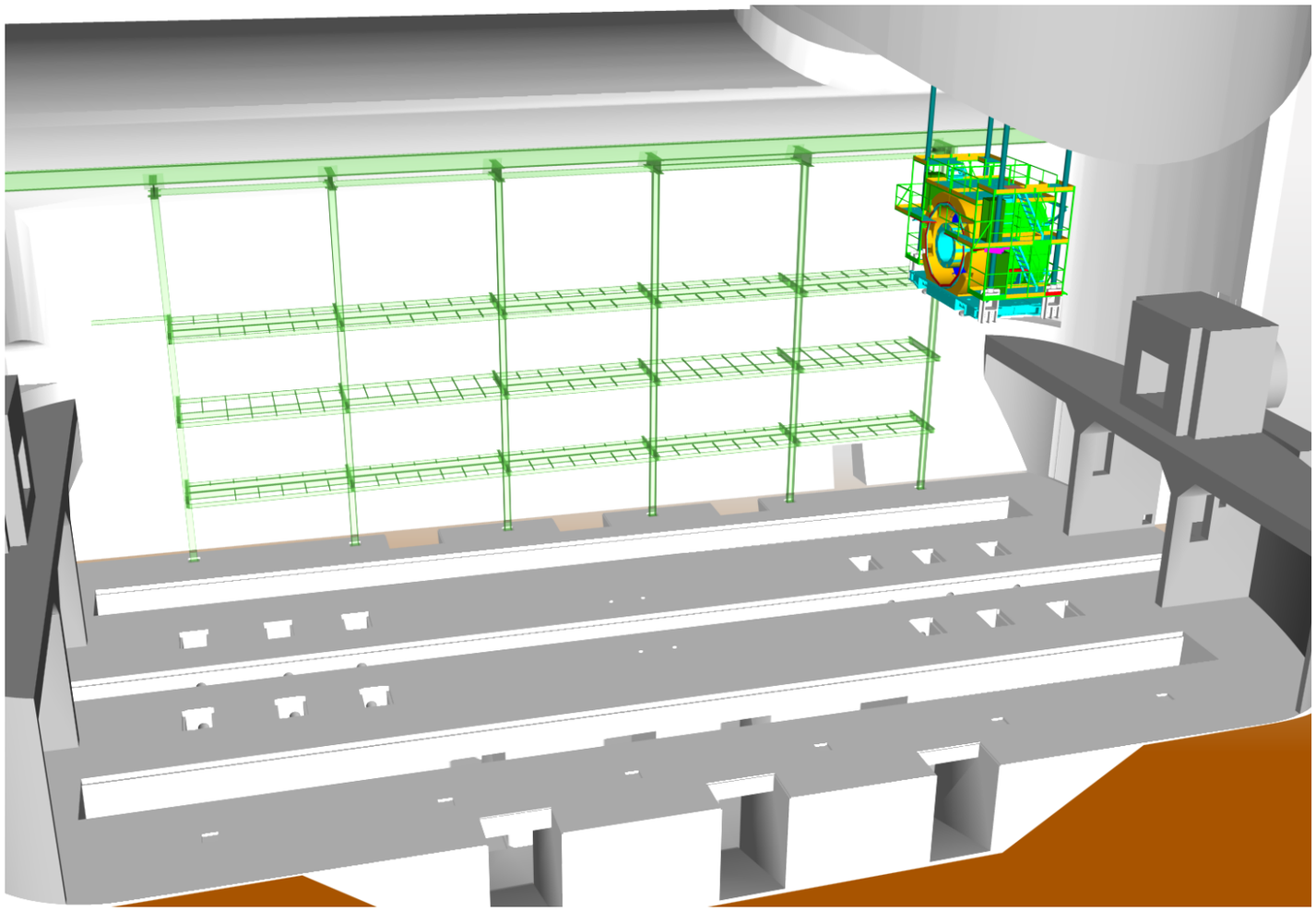
- Secondary services (underground in alcoves)
  - Cooling water
  - Power supplies
  - Gas mixtures
  - Power converters
  - Cryogenics

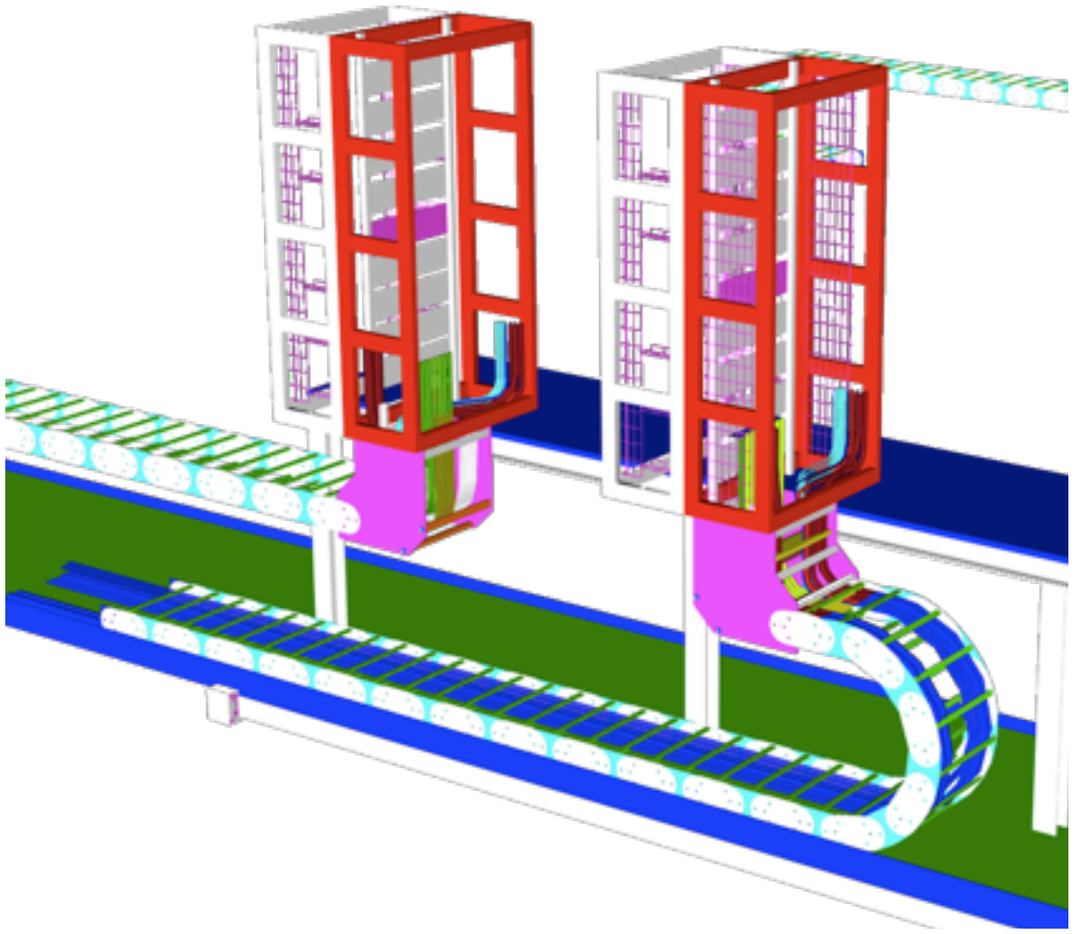


- On-board services (move with detector)
  - Electronic containers

- Need an integrated approach to the service needs of ILD and SiD!

Cable Ways and Supplies

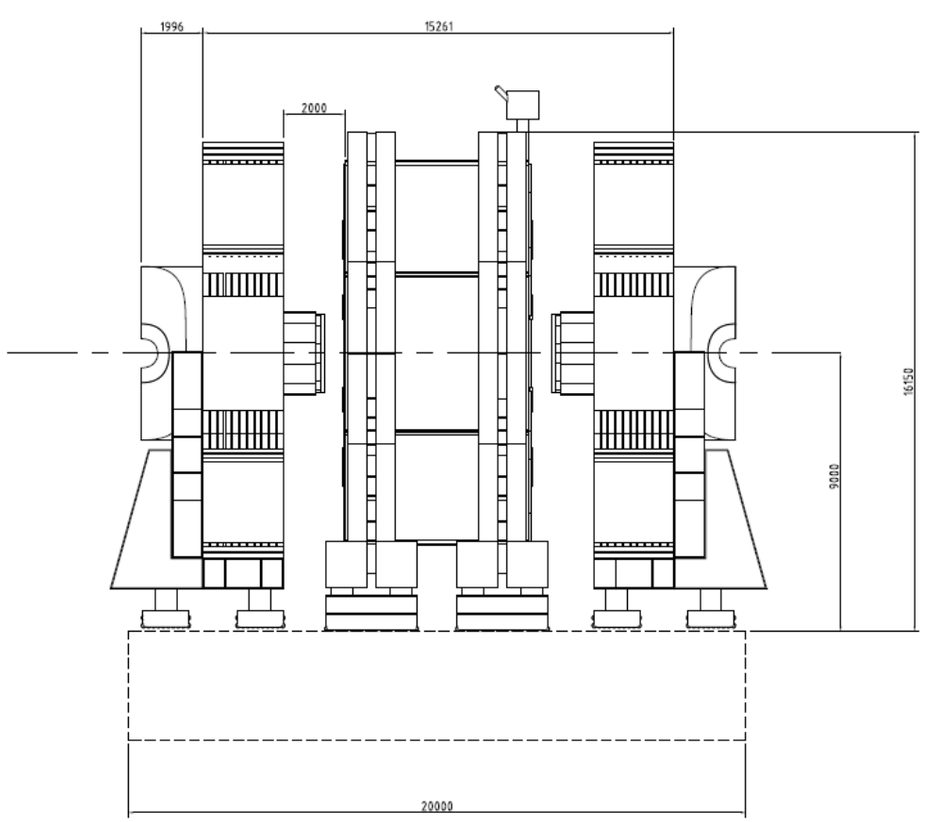


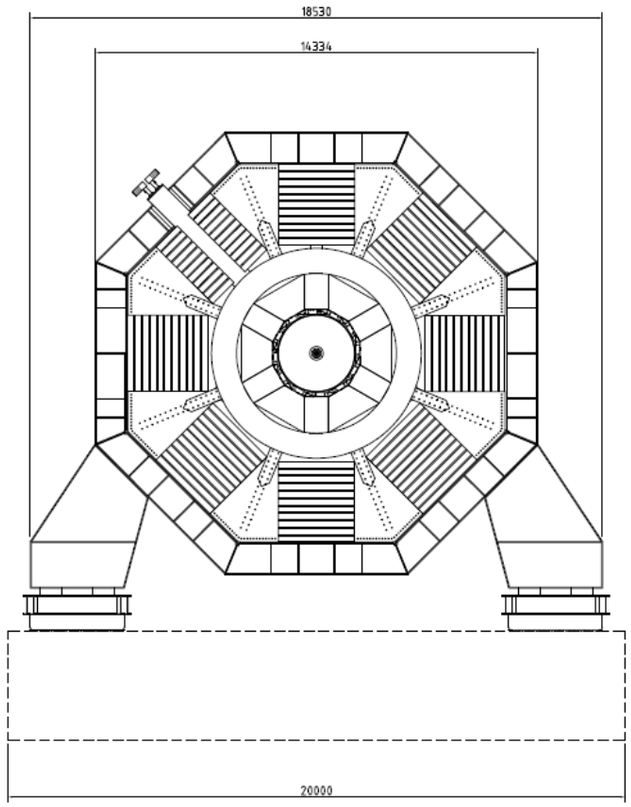


- CMS Example
- Trenches are needed under a platform: cables, safety, motion system access

SiD Platform Requirements

SiD Platform Functional Requirements





SiD nominal mass: Barrel 5000 T; (each) Door 2500 T

Dimensions:

Z = 20.0 m
X = 20.0 m
Delta Y = 9 m (Top of Platform to beamline)

Positioning Tolerance on beamline

Consider points Z=+-max, X=0. Position to + 1mm wrt references in X,Y,Z
Consider points Z=+-max, X=+-max: Position to +- 1 wrt references in Y.

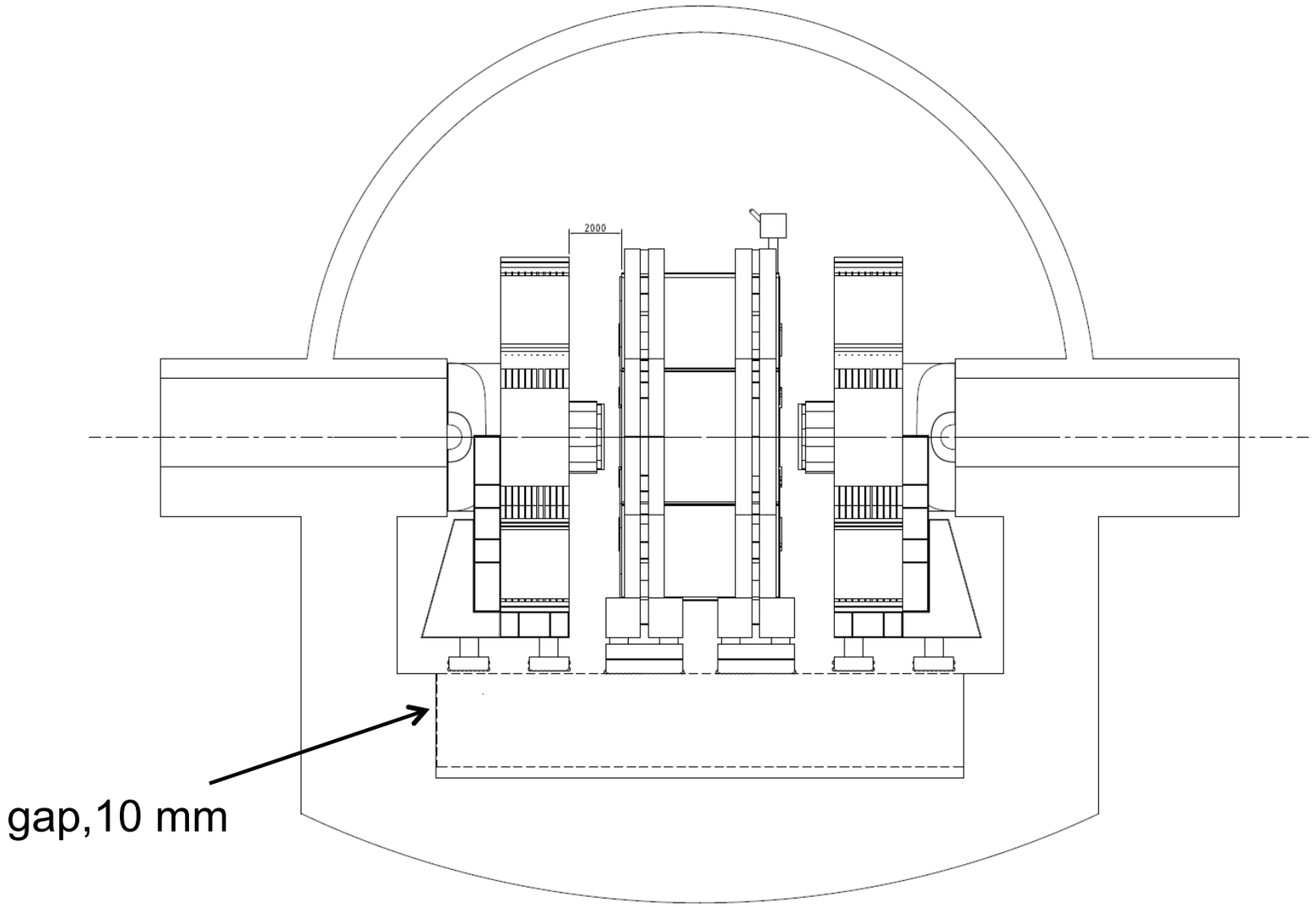
Static Deformations: <+-2 mm

Vibration budget < 50nm between 1 and 100 Hz, at the QD0's (relative)

Seismic stability: Appropriate for selected site. (Beamline must be designed with sufficient compliance that VXD will survive)

M. Oriunno

SiD Platform Functional Requirements



Wall clearance ~10 mm. Platform comes to side wall, there is no apron or apron matches platform elevation.

M. Oriunno

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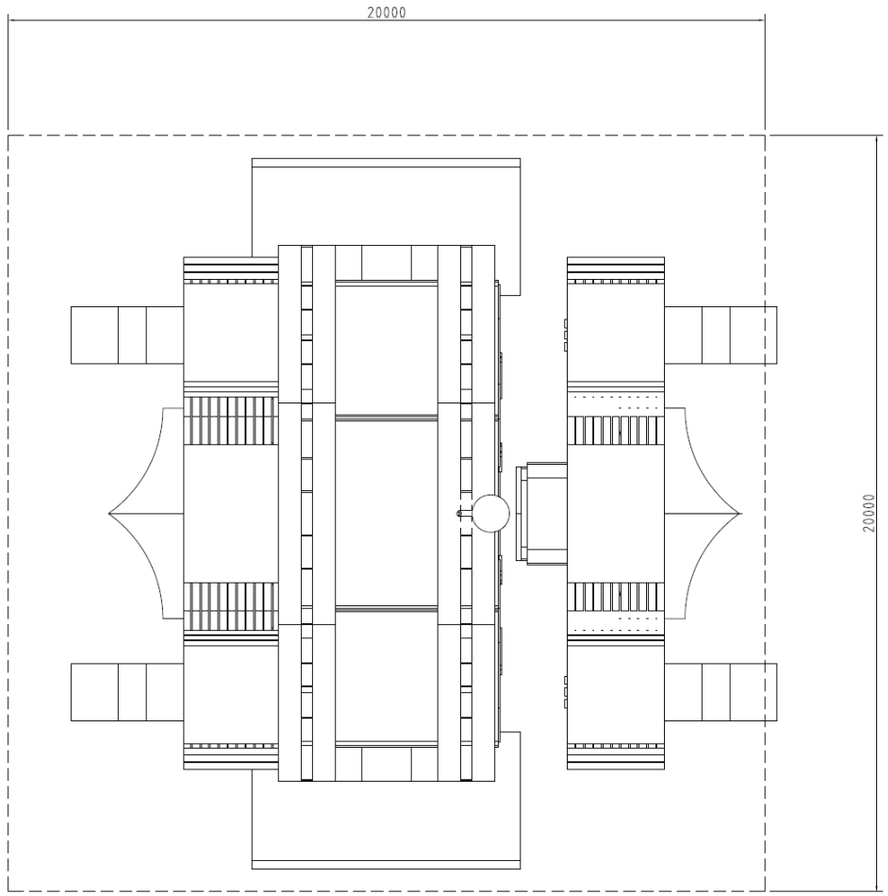
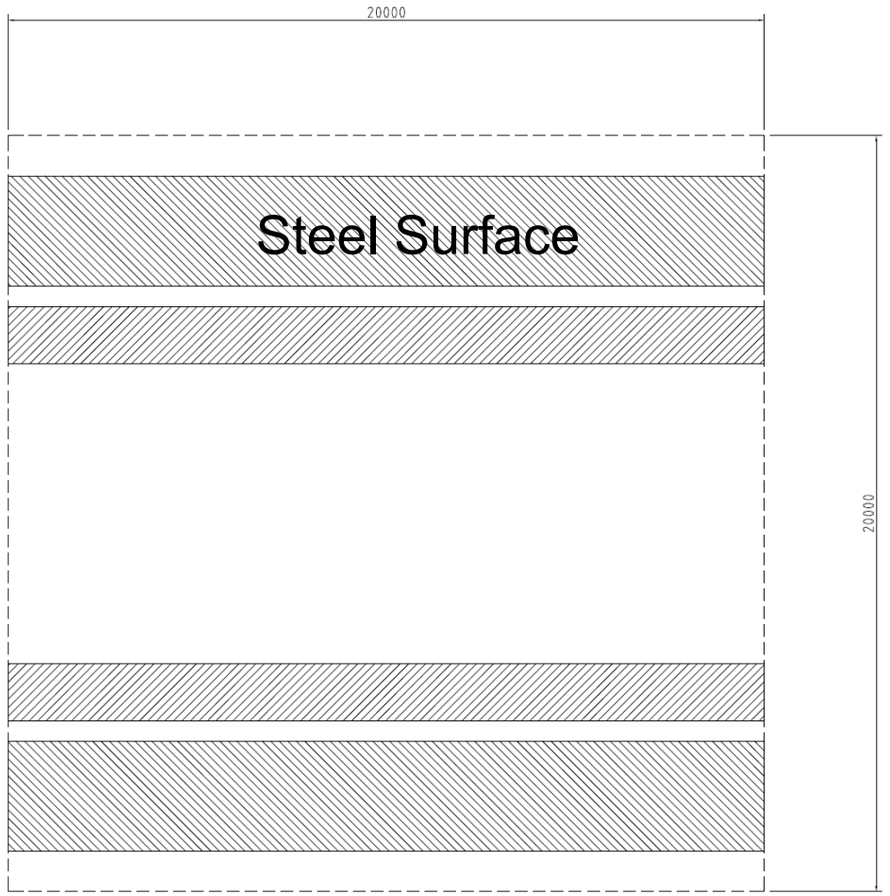


Detector on platform Top View



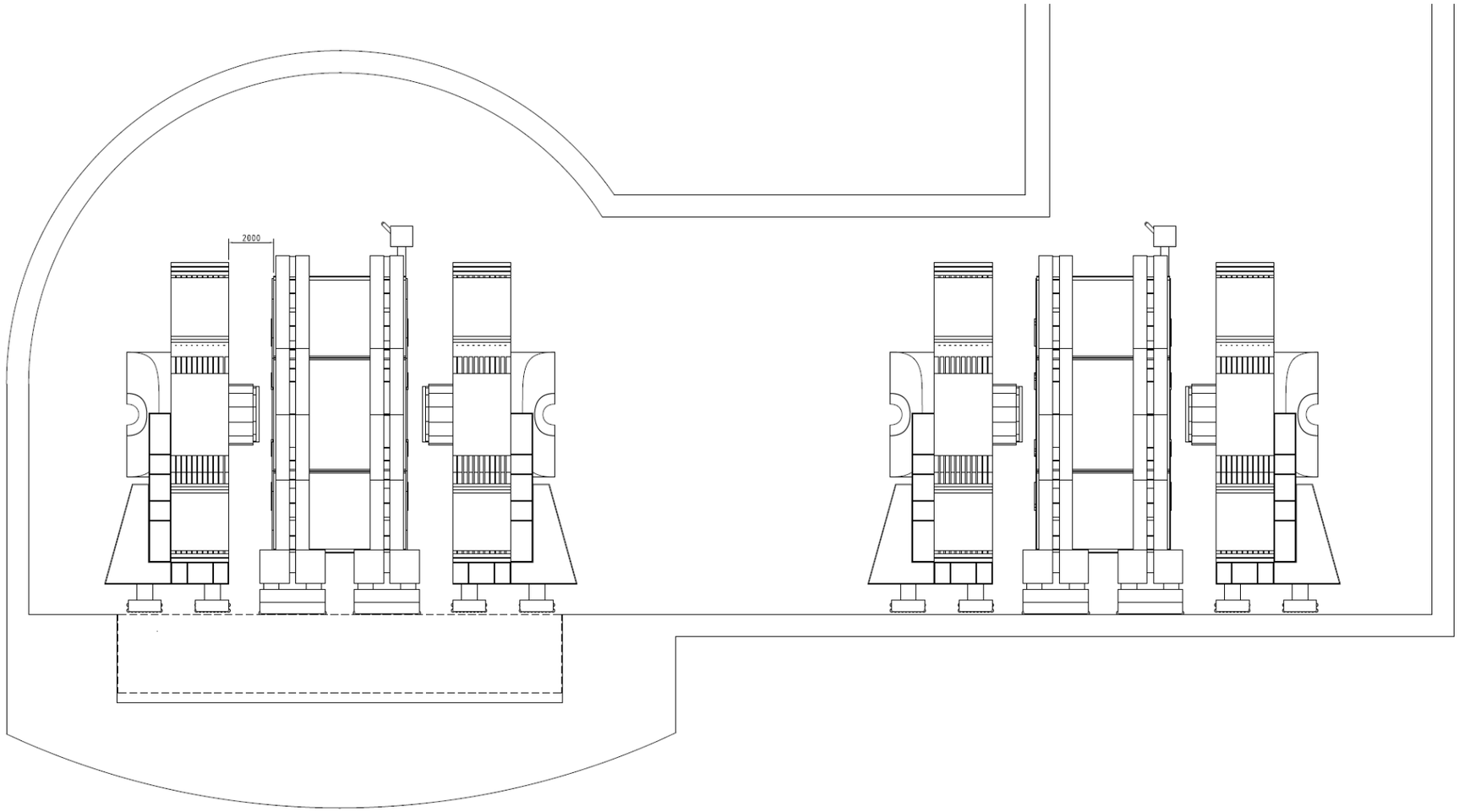
Platform Top View

Surface Features:

- Steel Surface near legs
- Steel rails for doors
- “Receptacles” for tie seismic tiedowns of SiD Barrel and Doors
- Removable Safety railings

M. Oriunno

SiD Platform Functional Requirements



M. Oriunno

Accelerations: <1 mm/s^2

Transport velocity: V>1 mm/s after acceleration

Life: 100 motion cycles.

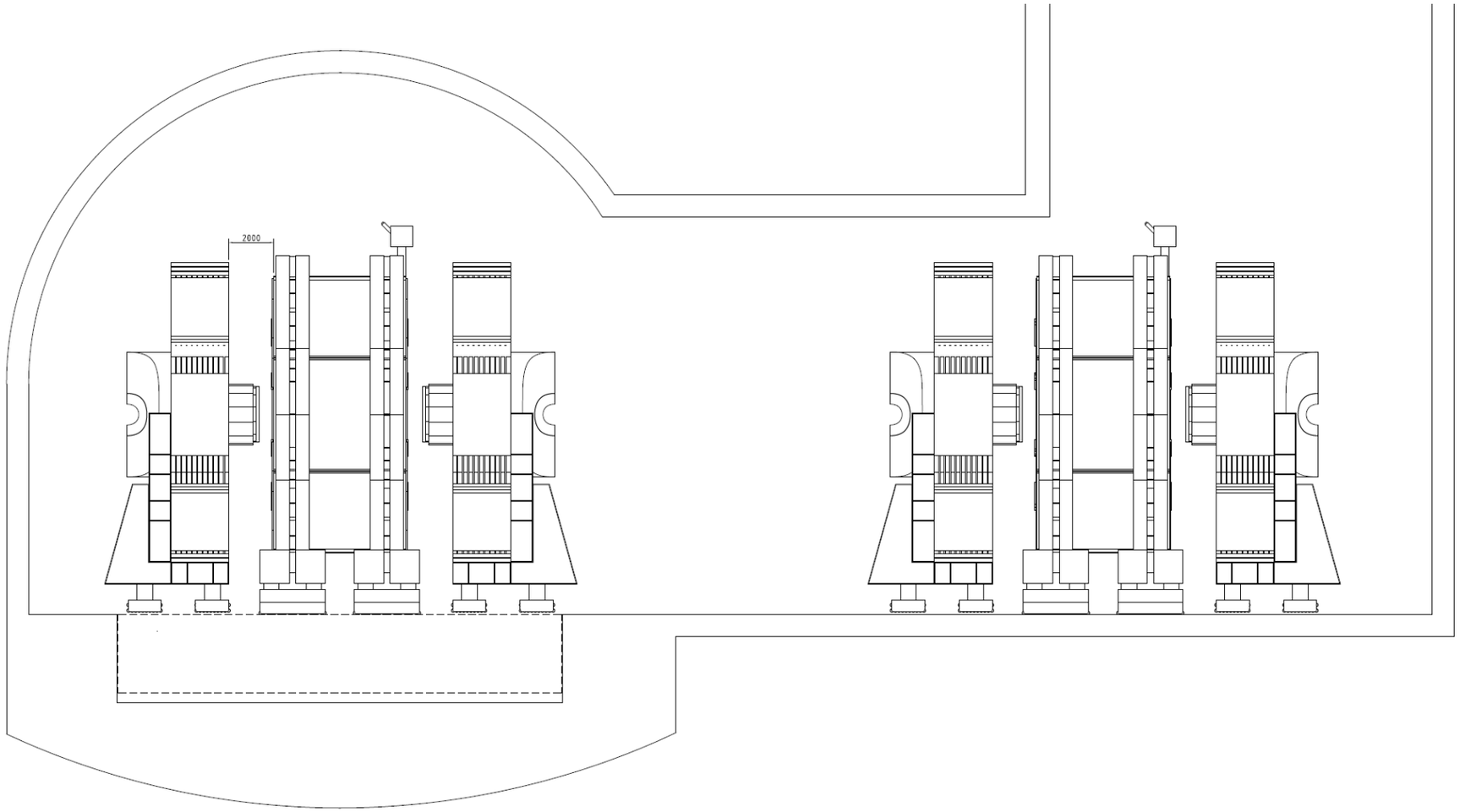
Reliability: Transport modularity must be such that repairs/ replacement/maintenance can be accomplished in garage position and within 20 elapsed days.

Any equipment required for transport shall reside below the platform surface.

Transport equipment shall not eject particulates that reach platform surface (need spec on how much)

SiD Platform Requirements

SiD Platform Functional Requirements



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h)

We can probably say yes to these requirements as well!

J. Osborne at ALCPG'11: Discussions with ARUP

Task 1 - The design of the underground concrete platforms required to transport each of the two Linear Collider Detectors on and off the beam-line position.

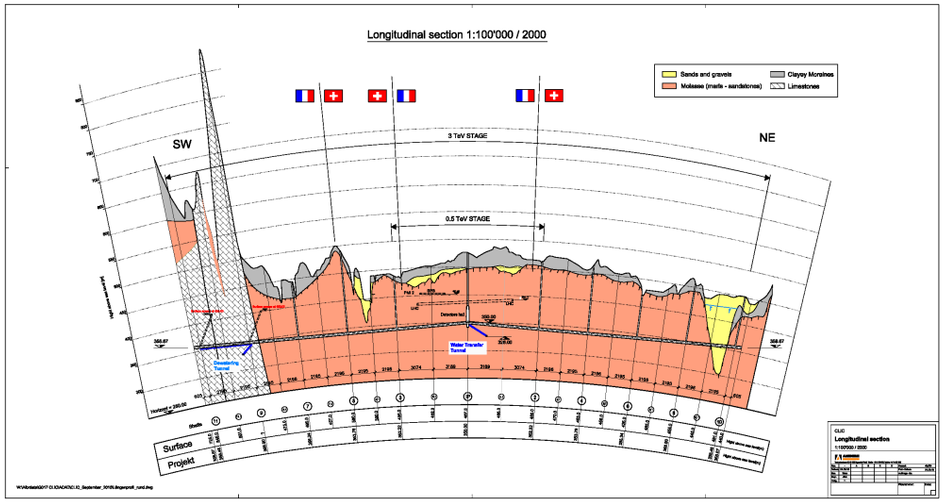
- Two platforms would be required, one for each detector.
- Load of each detector, excluding platforms, of approximately 14,000tons
- Intermediate supports determined by the preferred movement system.
- Platform movement on/off the beamline to be moved over a period of the order of five hours,
- Up to 20 movements per year during machine operation.
- Accelerations of the detector during movement to be limited to 0.5g
- Location of the platforms to within +/-1mm and +/-0.1 milli-rads of their target location relative to final focus quadrupole base slab.

ARUP's were asked to tender for 4 distinct tasks

J. Osborne at ALCPG'11: Discussions with ARUP

Task 2 - A detailed study of the potential behaviour of the rock mass surrounding the experimental area during the estimated 20-year life span of the machine.

- Experience from other cavern rock related mass conditions should be taken into account e.g LHC.
- 2D and 3D effects to be assessed.
- The study should assume that the experimental area is to be built in CERN geology, in the Molasse Rock
- The long-term behaviour of the excavation



J. Osborne at ALCPG'11: Discussions with ARUP

Task 3 - Passive isolation slab design

- Required maximum relative rms displacement of the beams is 0.1nm.
- Below 4Hz, vibration can be mitigated by active systems through steering the beam.
- Provide passive isolation at the end of each accelerator tunnel, where the beams emerge from the tunnel before entering the detector.
- Slab could be approximately 50 – 100 tons of concrete, resting on several springs and dampers – this will be assessed through our evaluation, as outlined below.

Task 4 - Review of the Experimental Area design

- Layout of the shafts/cavern based on available geotechnical information and current space proofing.
- Review of suitability of various strata depths for cavern location

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J. Osborne at ALCPG'11: Discussions with ARUP

Budget for this Linear Collider IR study needs to be sourced :

- Possible cost sharing CERN & Fermilab

Some key decisions for ILC to resolve first, in order to allow a more 'useful' study :

- Are both detectors using the "concrete" platform strategy
- Are the level of the platforms the same
- For the overall layout :
  - Gantry crane capacity in the experimental hall
  - Should shafts be directly over the cavern or offset
  - Self shielding detectors

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  - Self shielding detectors — Yes

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Outlook

Within MDI Common Task Group:

- Agree on set of functional requirements for push-pull platform and for experimental areas
- Collaborate with ILC-CFS group on the evolving design

Within ILD:

- Understand better the needs and requirements of ILD w.r.t.
  - Platform
  - Detector Services
  - Experimental Area