ILD MDI and Experimental Hall Issues

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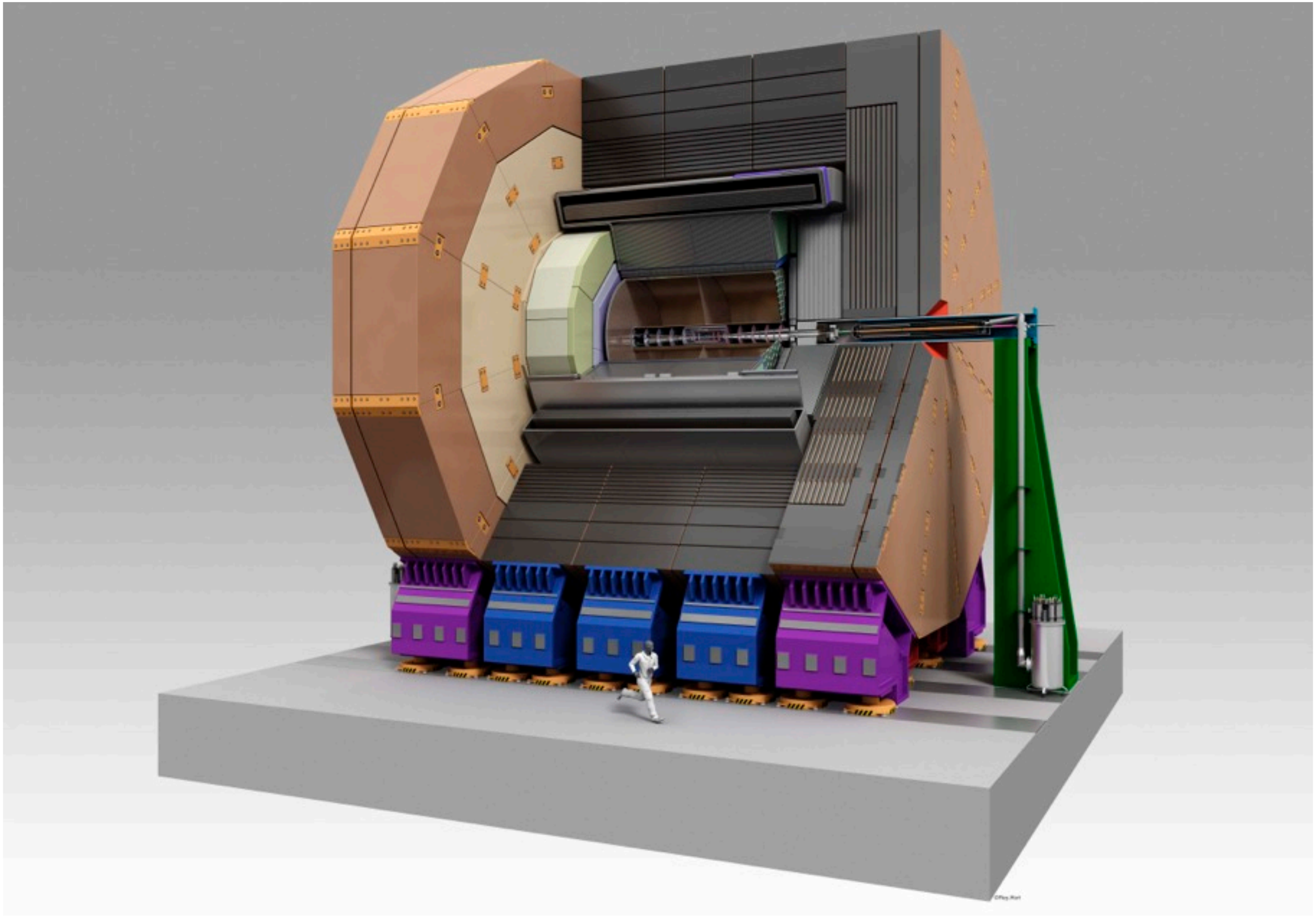
DESY

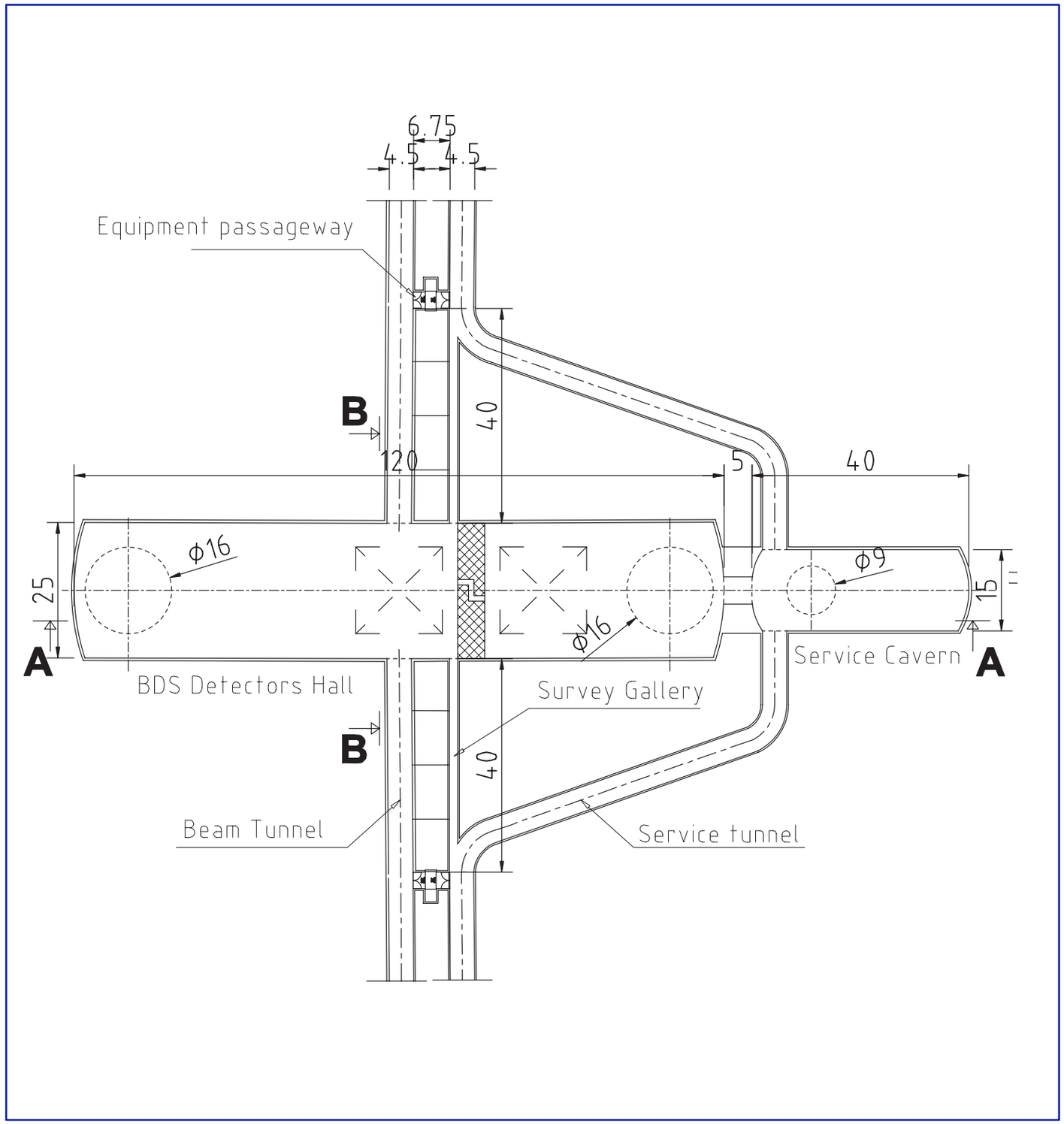
LCWS 2011
27. September 2011

The ILD Detector Concept



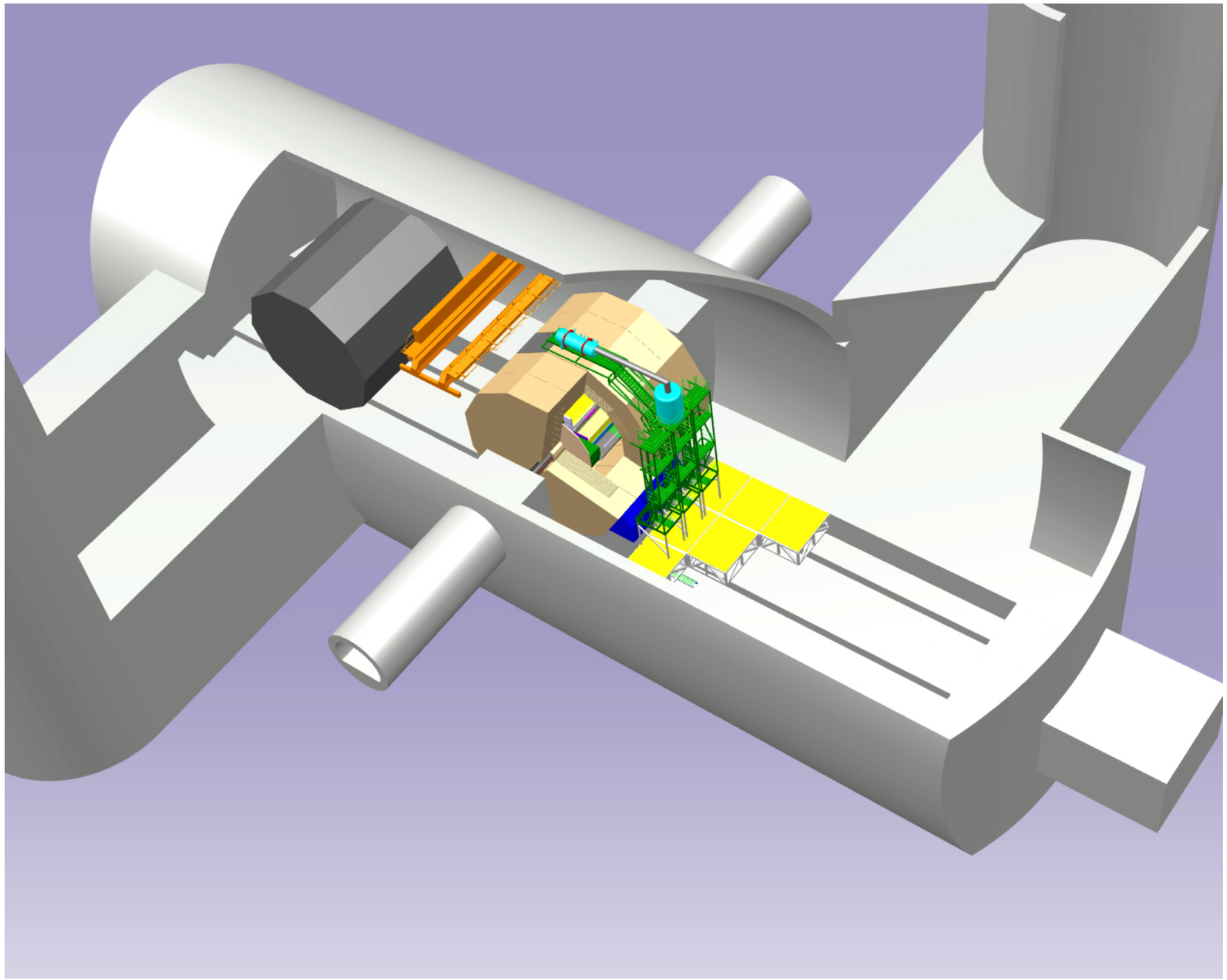
Experimental Hall (RDR Design)

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

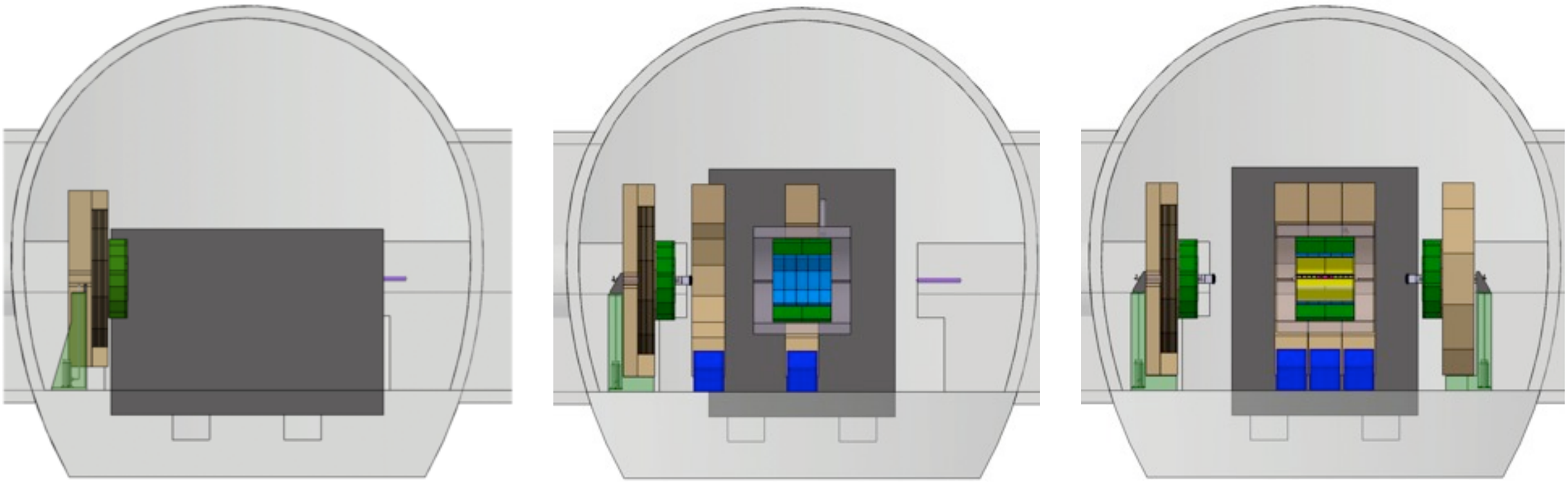


ILD Experimental Hall Design Study

- Proposed 2008
- Shafts not above experiments
- Alcoves provide access to shafts and space for detector maintenance in parking position
- Additional alcoves for detector services
- Potentially less expensive than RDR hall design (smaller volume)

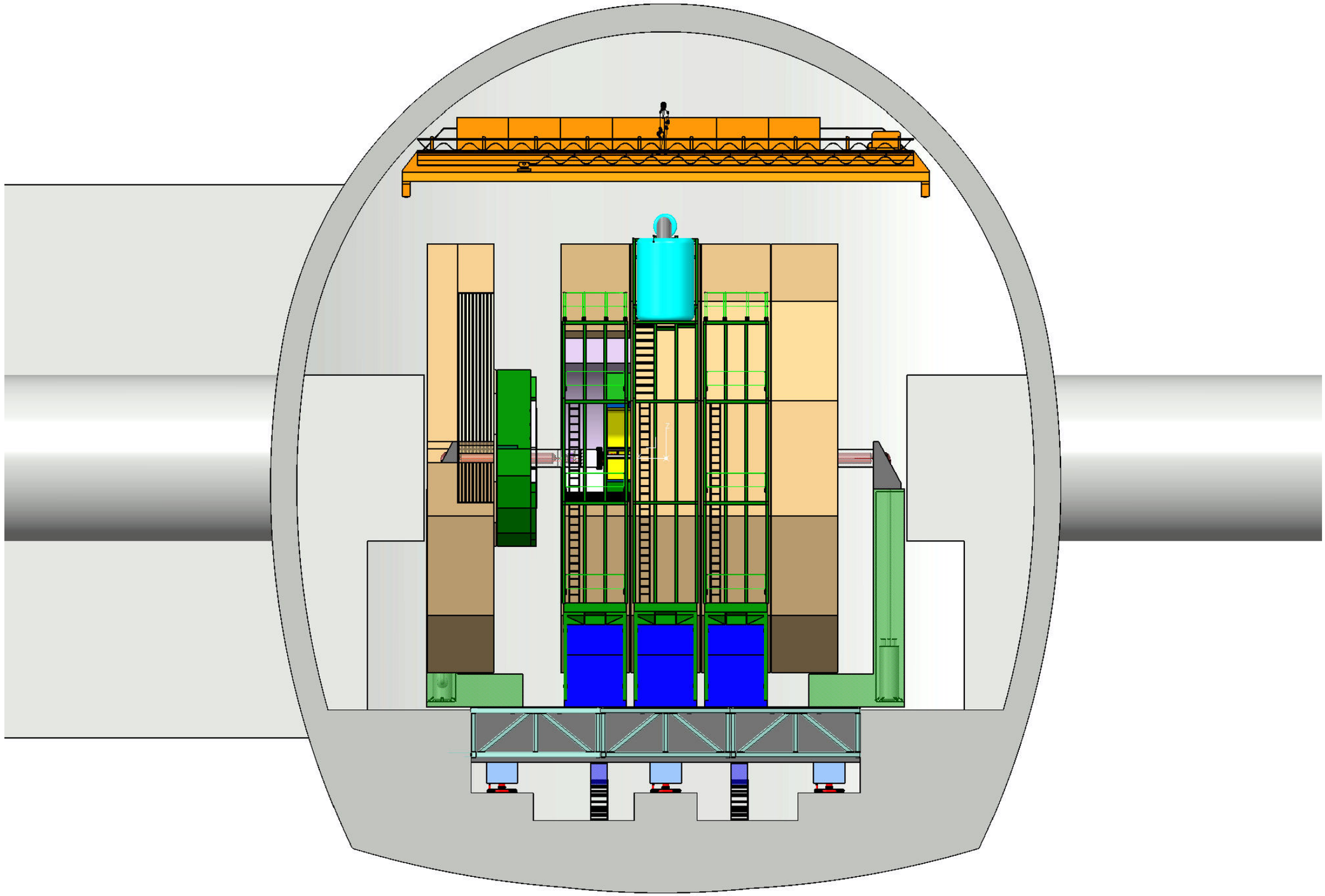


Detector Assembly CMS-Style



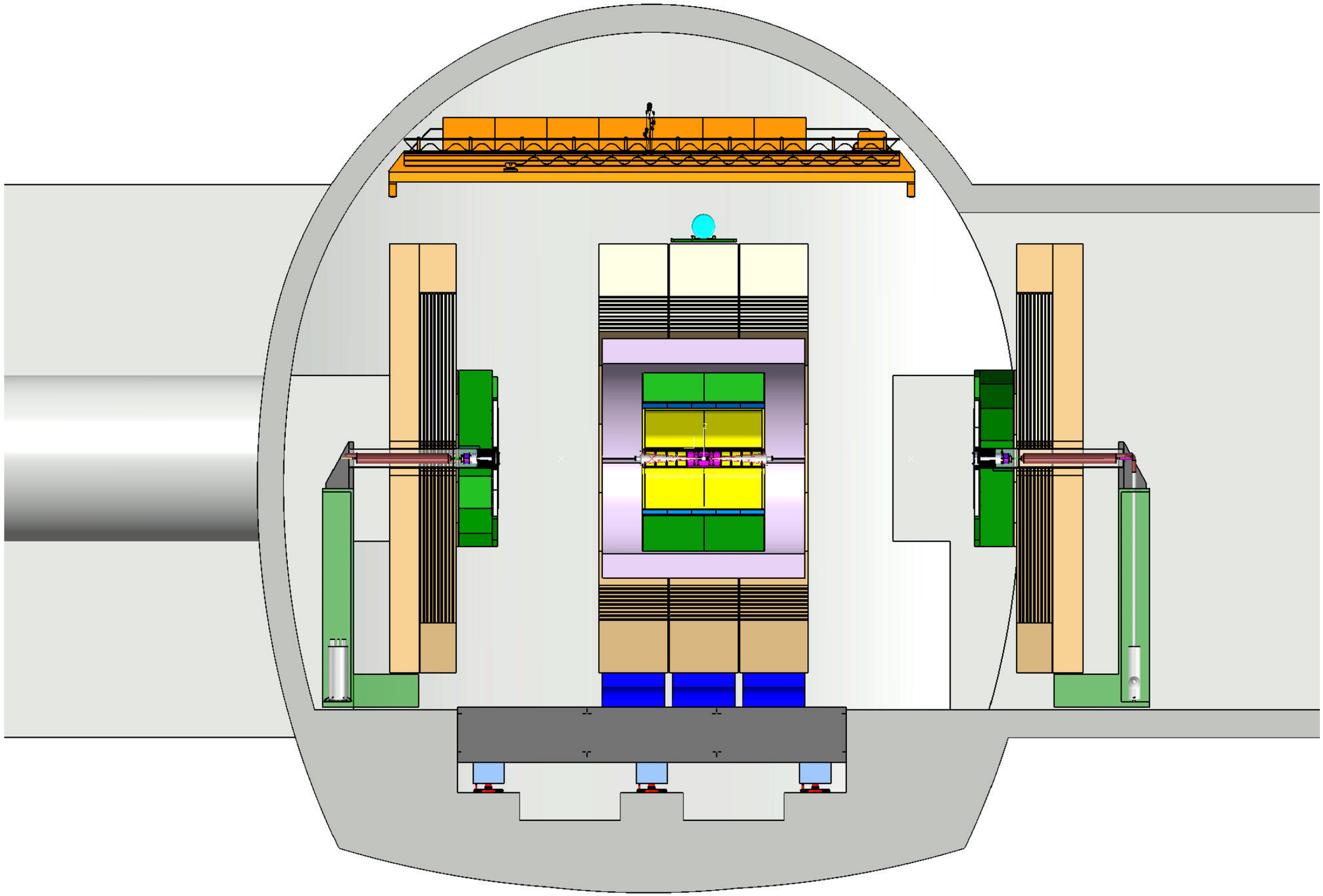
- Pre-assembly of large structures on surface
- Sub-assemblies lowered into the experimental hall
- Main parts:
  - three barrel yoke rings; central carries magnet and barrel detectors
  - two yoke endcaps
  - central tracking system (TPC)

Detector in Beam Position



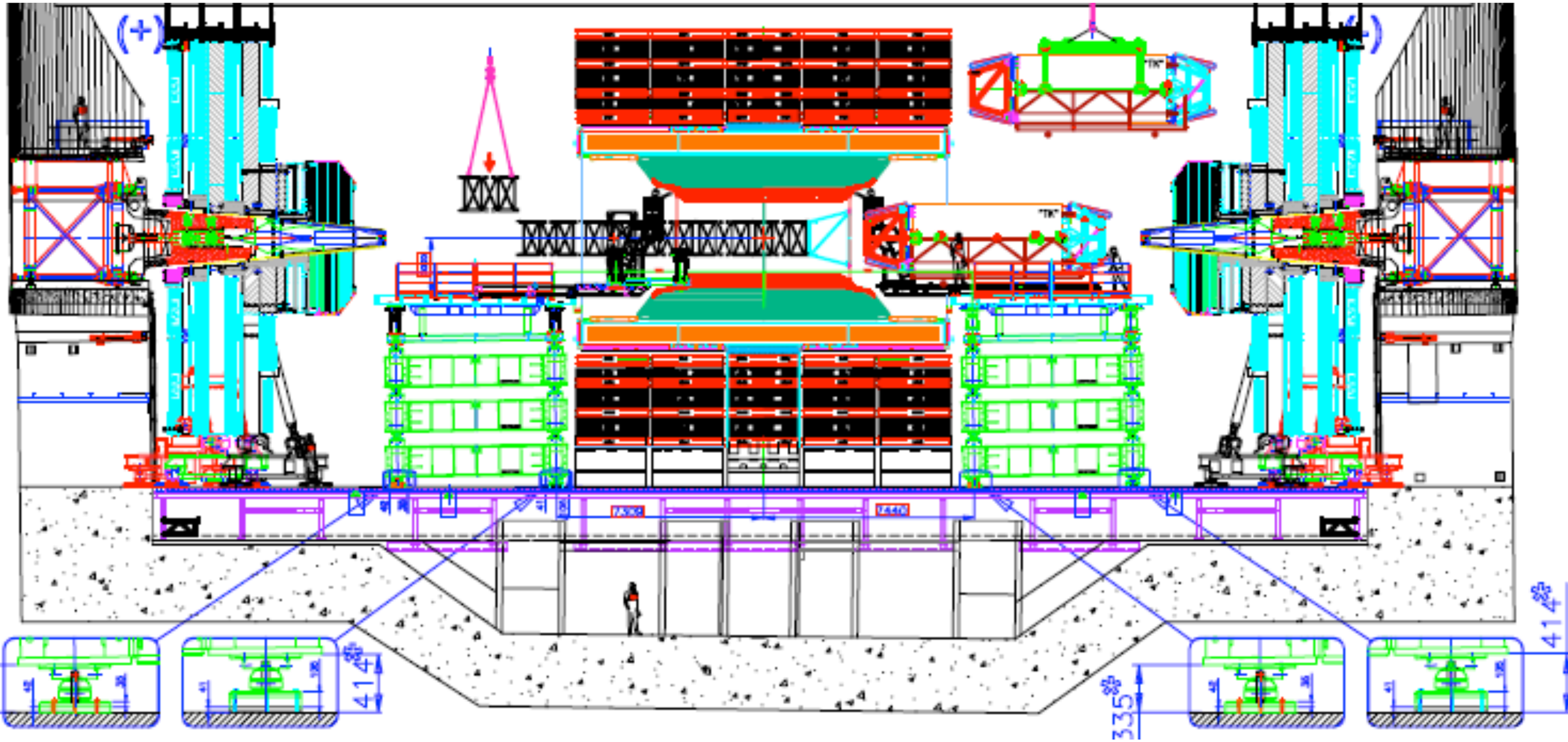
- NB: Optimised hall size

Detector Opening - Garage Position



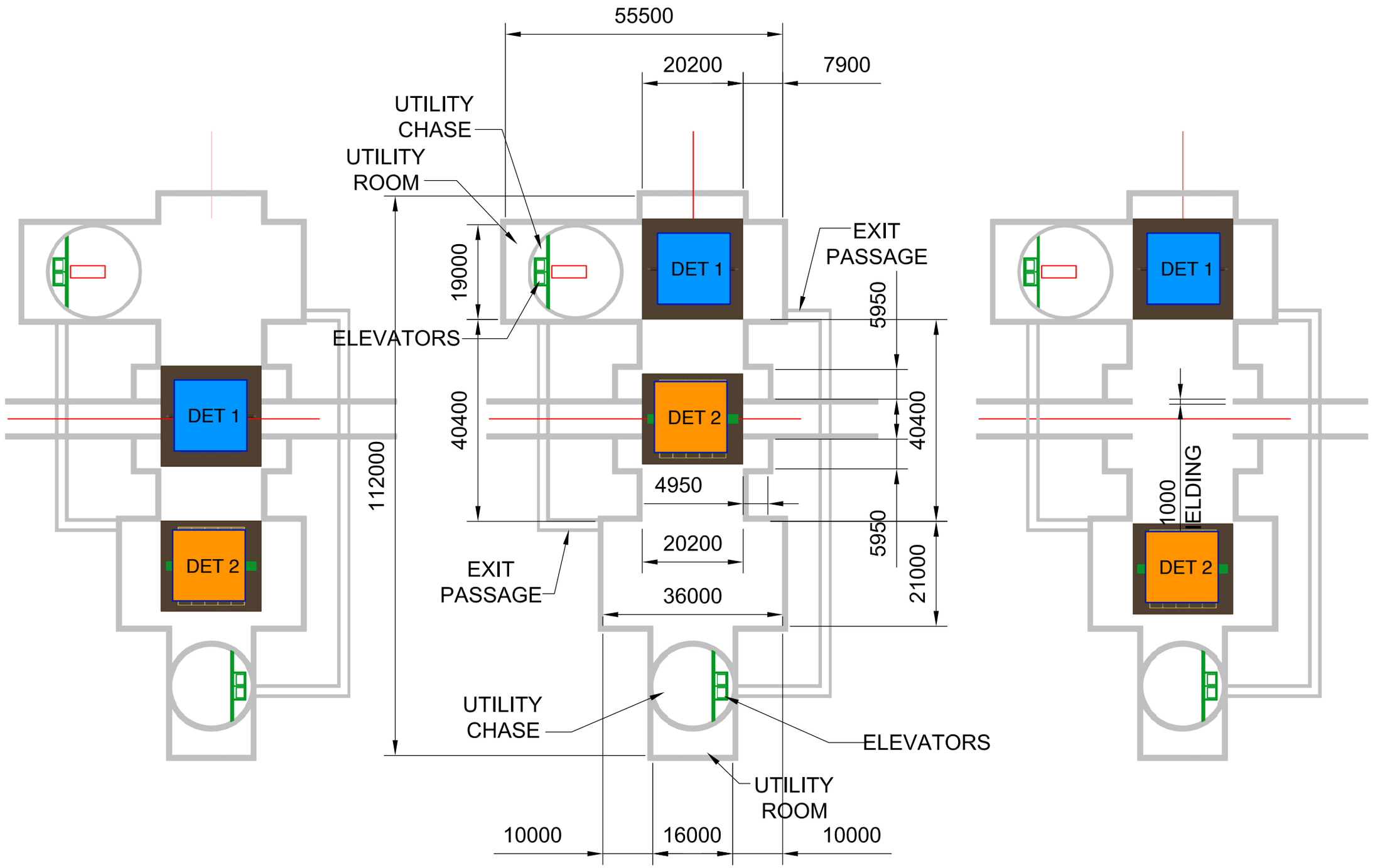
- Alcove needed for allowing access to subdetectors
  - TPC removal needs ~6m opening

Don‘t forget the tools!



- CMS in maintenance position with tooling

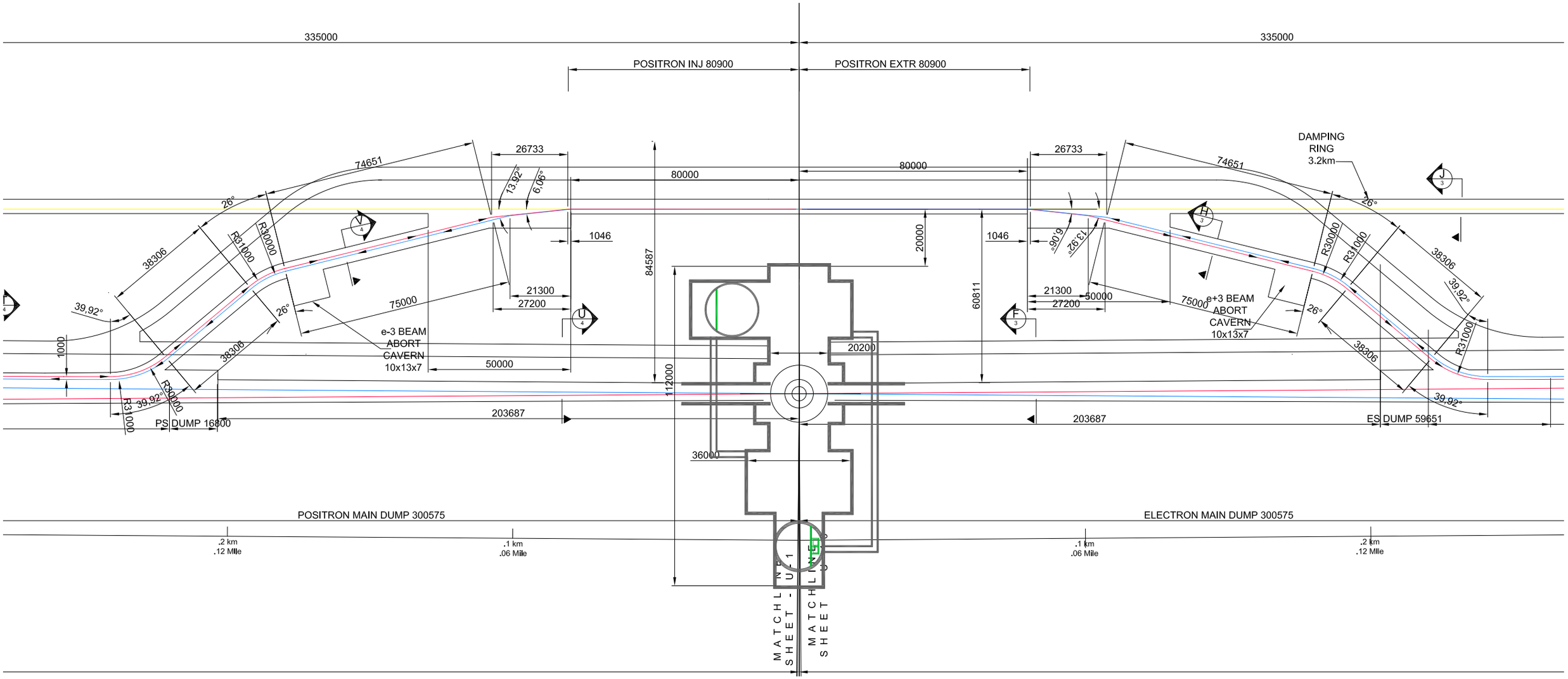
Experimental Hall Study (Draft, CFS Group)



- Study properties of z-shape and straight shape

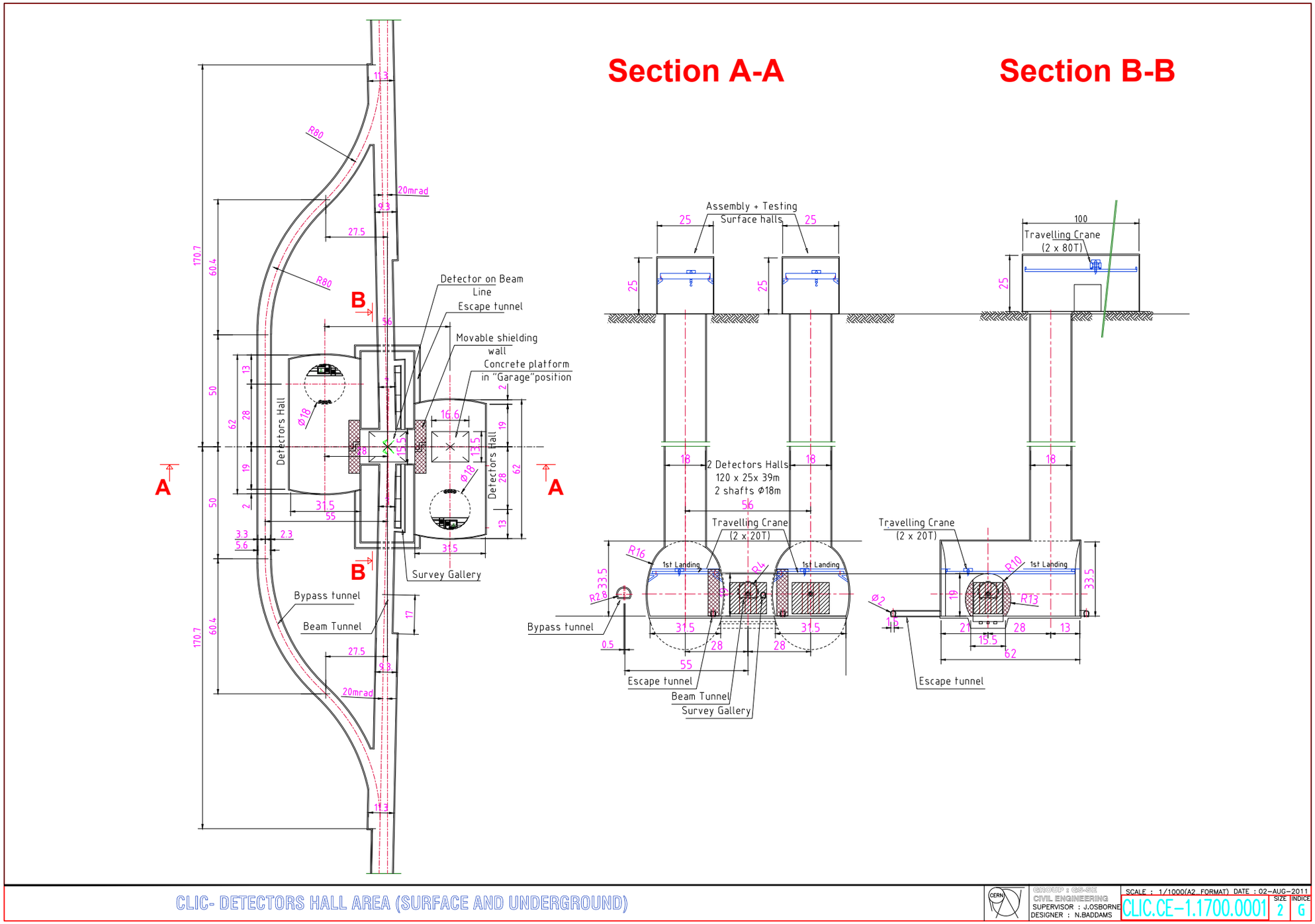
Aug. 16, 2011

Central Region Integration



- Influence on other systems needs to be studied (push-pull)
  - in direction of the damping rings, probably only z-shape would work!

Synergies with CLIC Studies



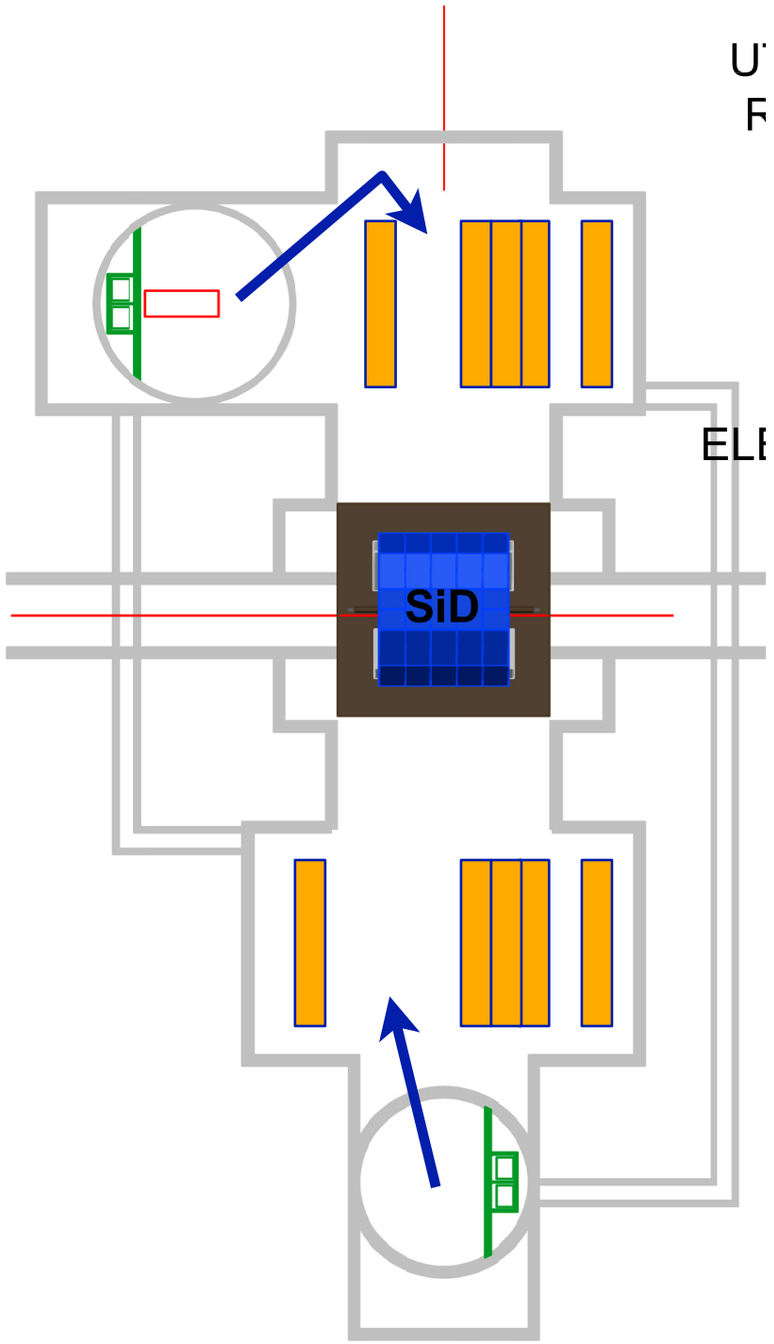
- CLIC hall is z-shaped

Z-shape or straight configuration?

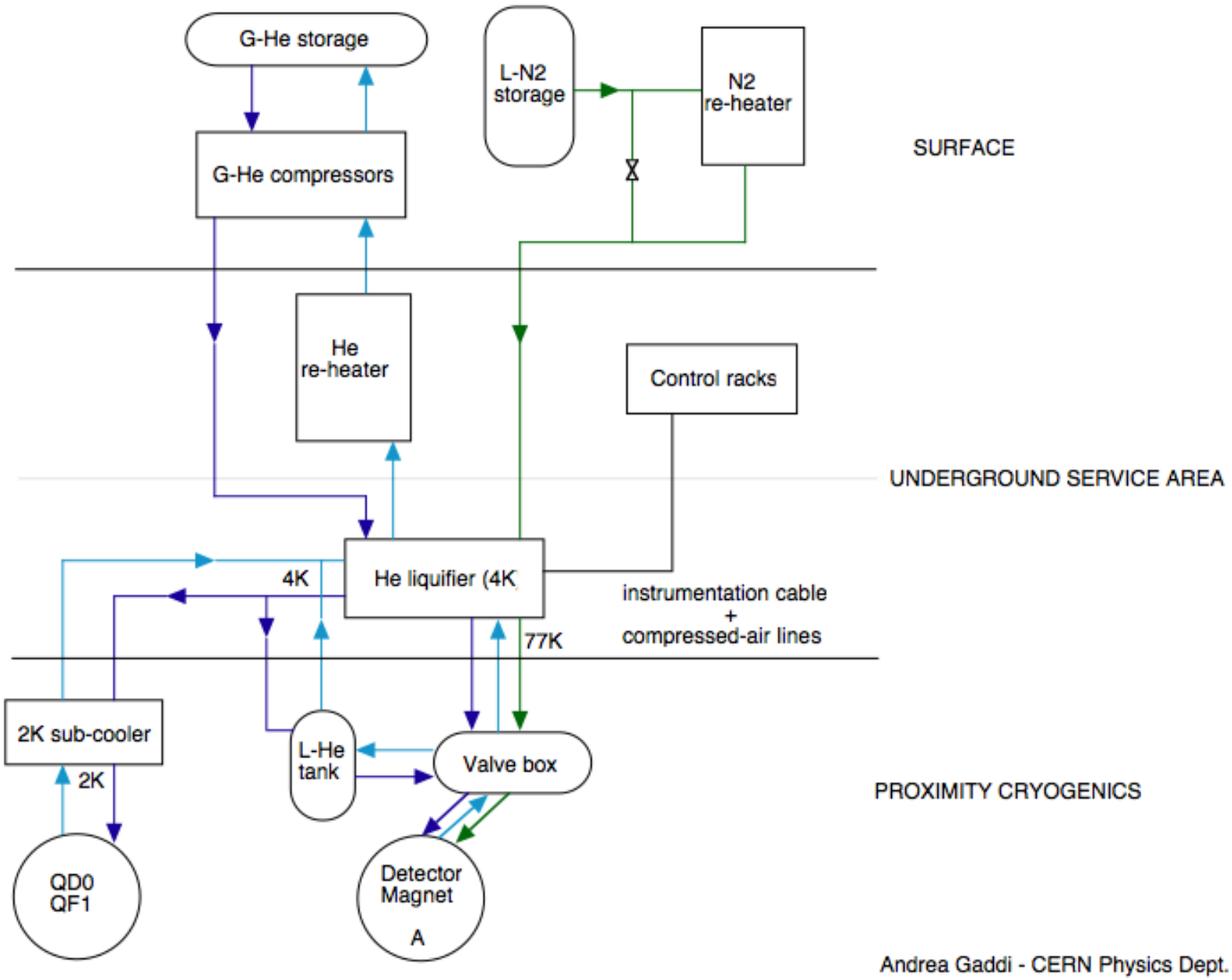
- z-shape is principally fine for ILD
  - could minimise the underground excavations -> cost
- straight hall has potential other advantages:
  - platform could be pushed under the shaft if the elevator configuration allows
  - might be easier to bring tools to the maintenance area

- This is an on-going collaborative effort: ILD-SiD-CFS

- Dedicated MDI session tomorrow



Detector Services



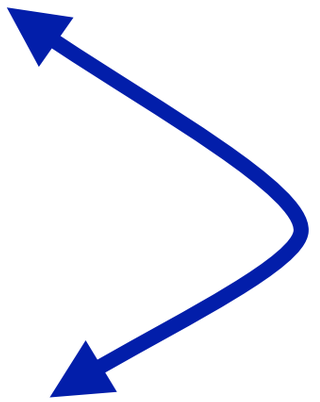
- Cryogenics for the magnets

Detector Services

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

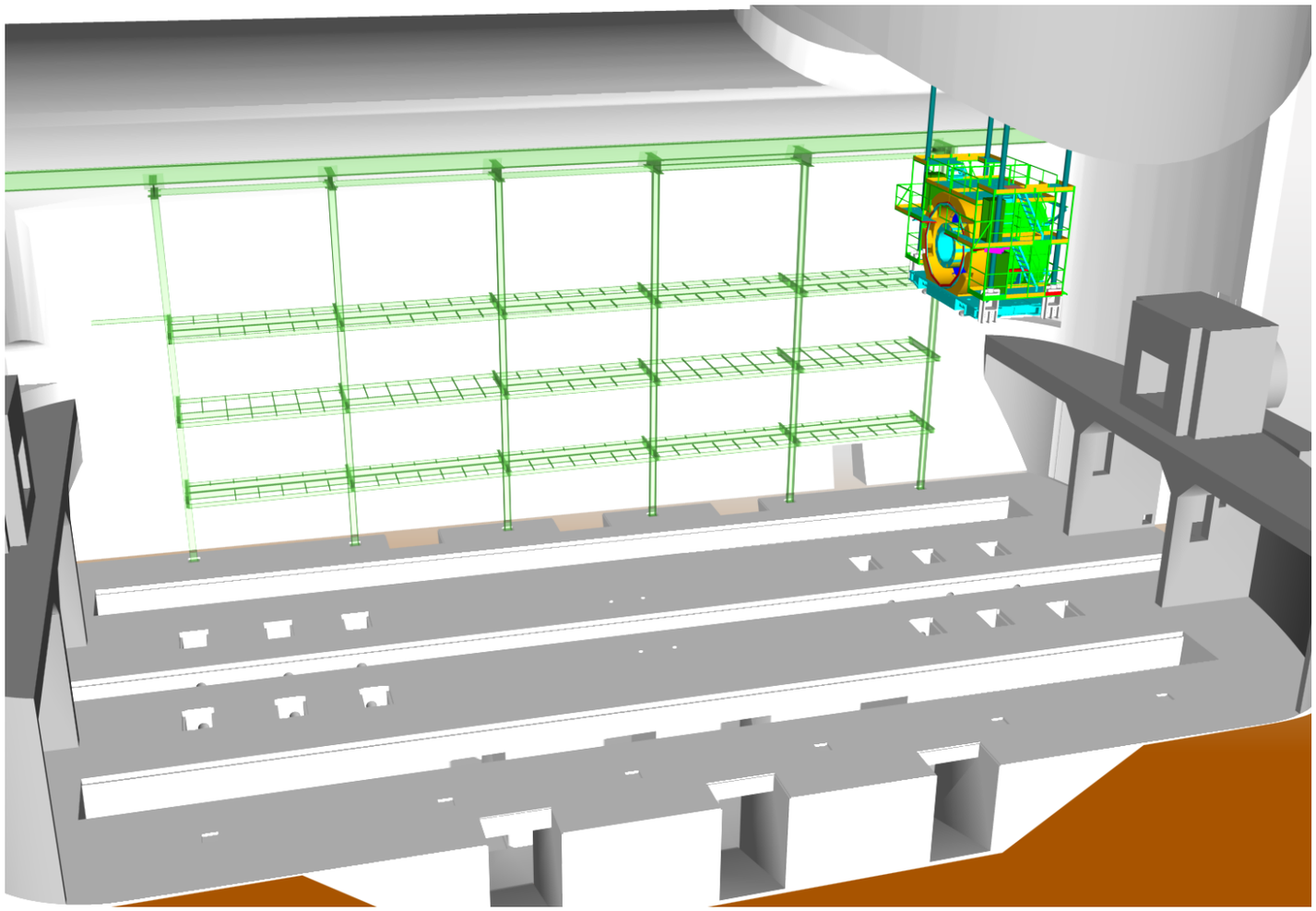
- Secondary services (underground in alcoves)
  - Cooling water
  - Power supplies
  - Gas mixtures
  - Power converters
  - Cryogenics

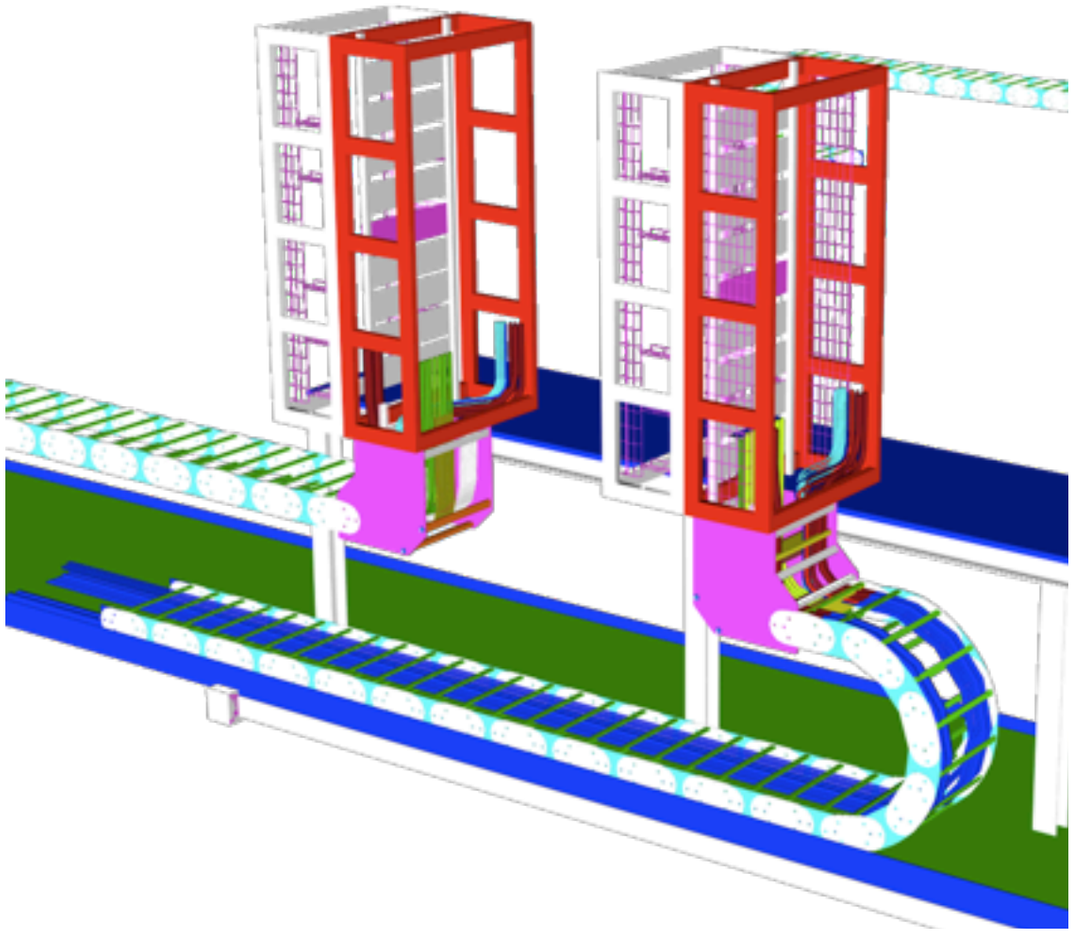
- On-board services (move with detector)
  - Electronic containers



- 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

Moving Heavy Devices is Difficult!

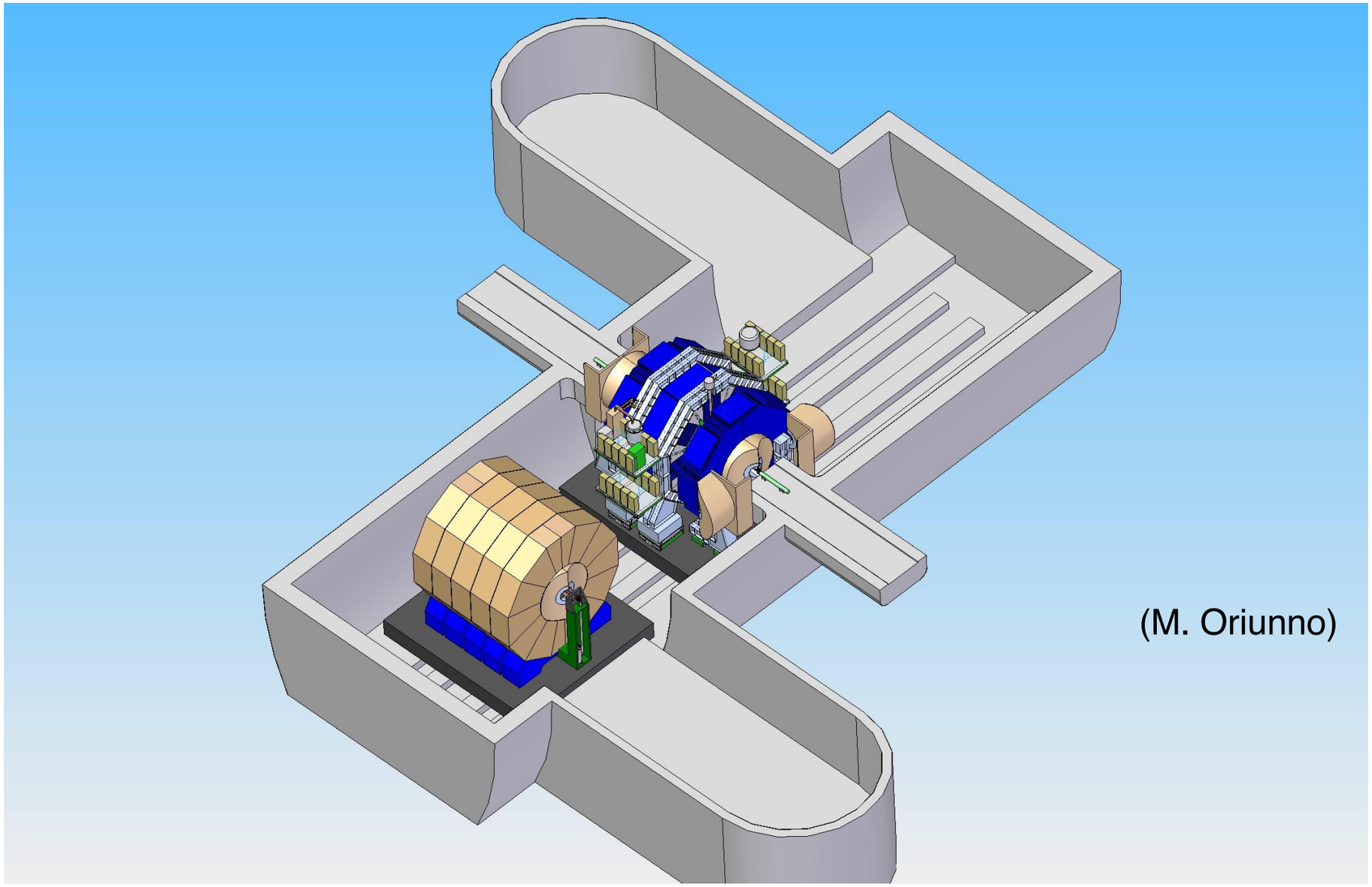
Moving Heavy Devices is Difficult!

Moving Heavy Devices is Difficult!

Platform Based Detector Motion System

ETH Institute for Particle Physics

Both detectors on a platform

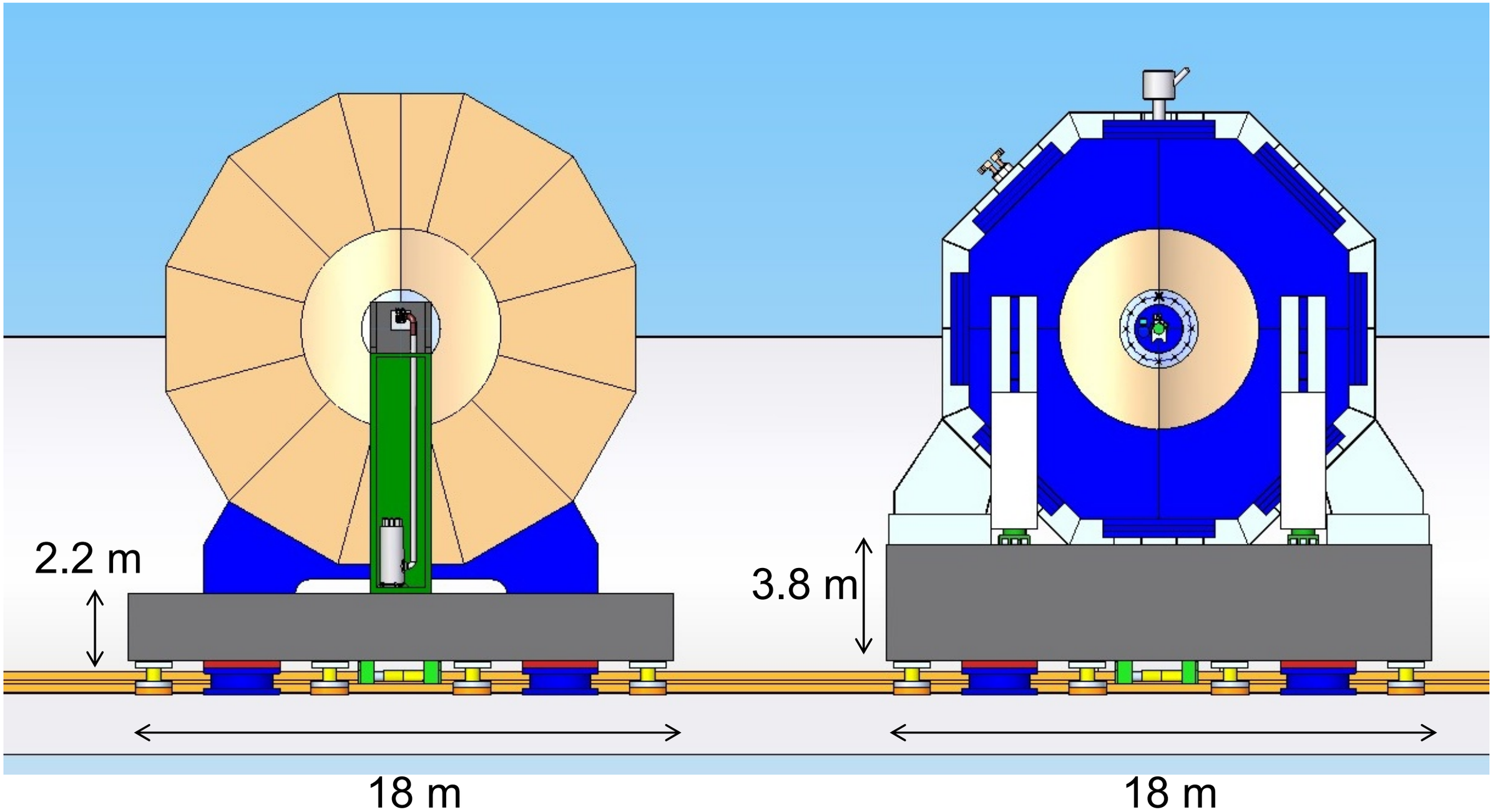


(M. Oriunno)

Alain Hervé, CLIC08 Workshop, 16 October 2008 5

- ILD prefered solution

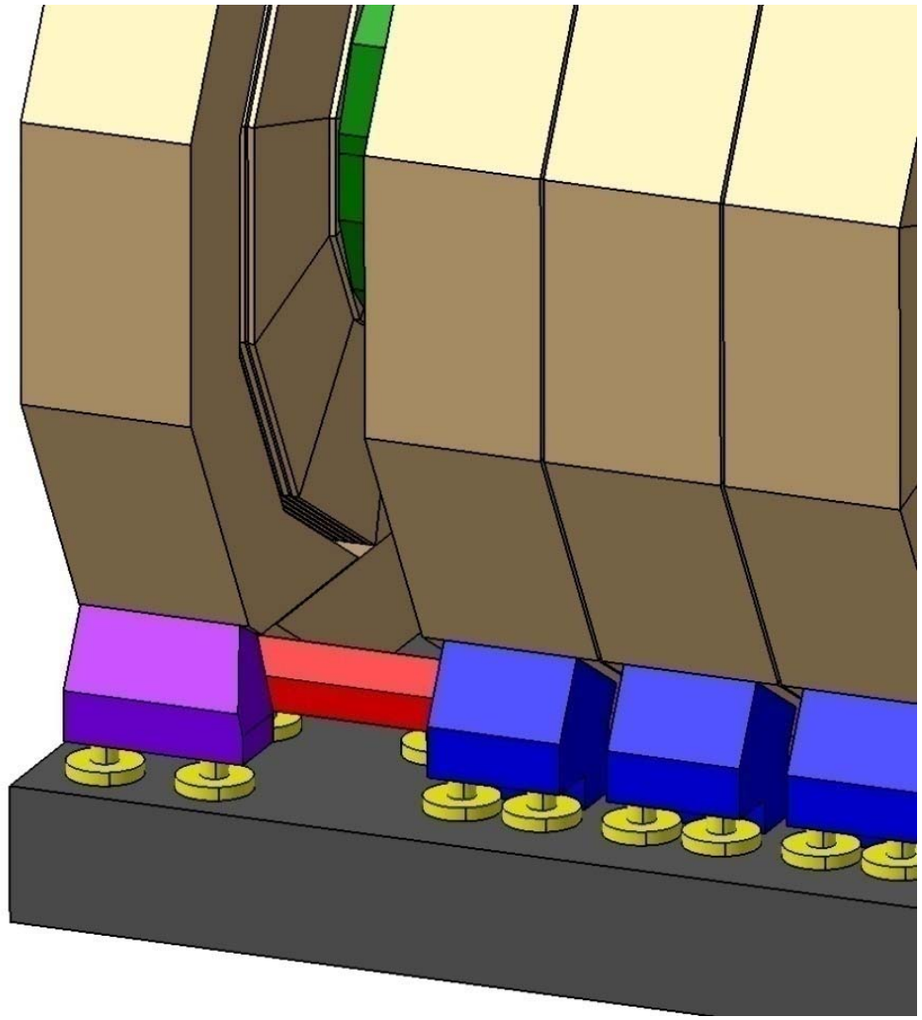
Reducing ILD Beam Height

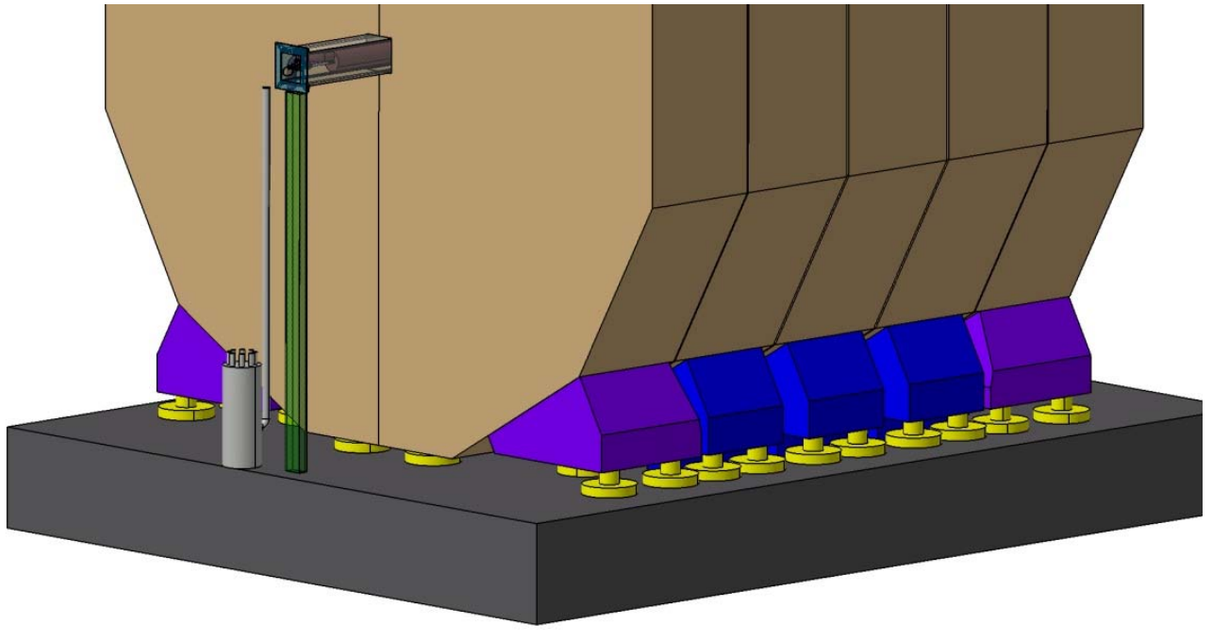


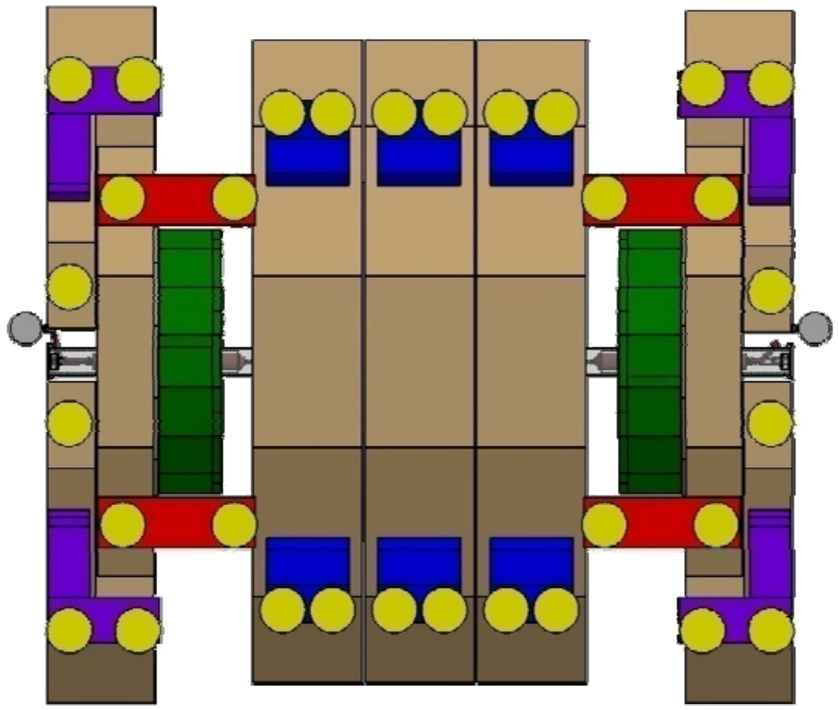
From M. Oriunno @ SiD workshop 2010 after CERN workshop

- Beam height difference between SiD and ILD: 1.6m
  - This results in different floor levels in the underground hall

Reducing ILD Beam Height

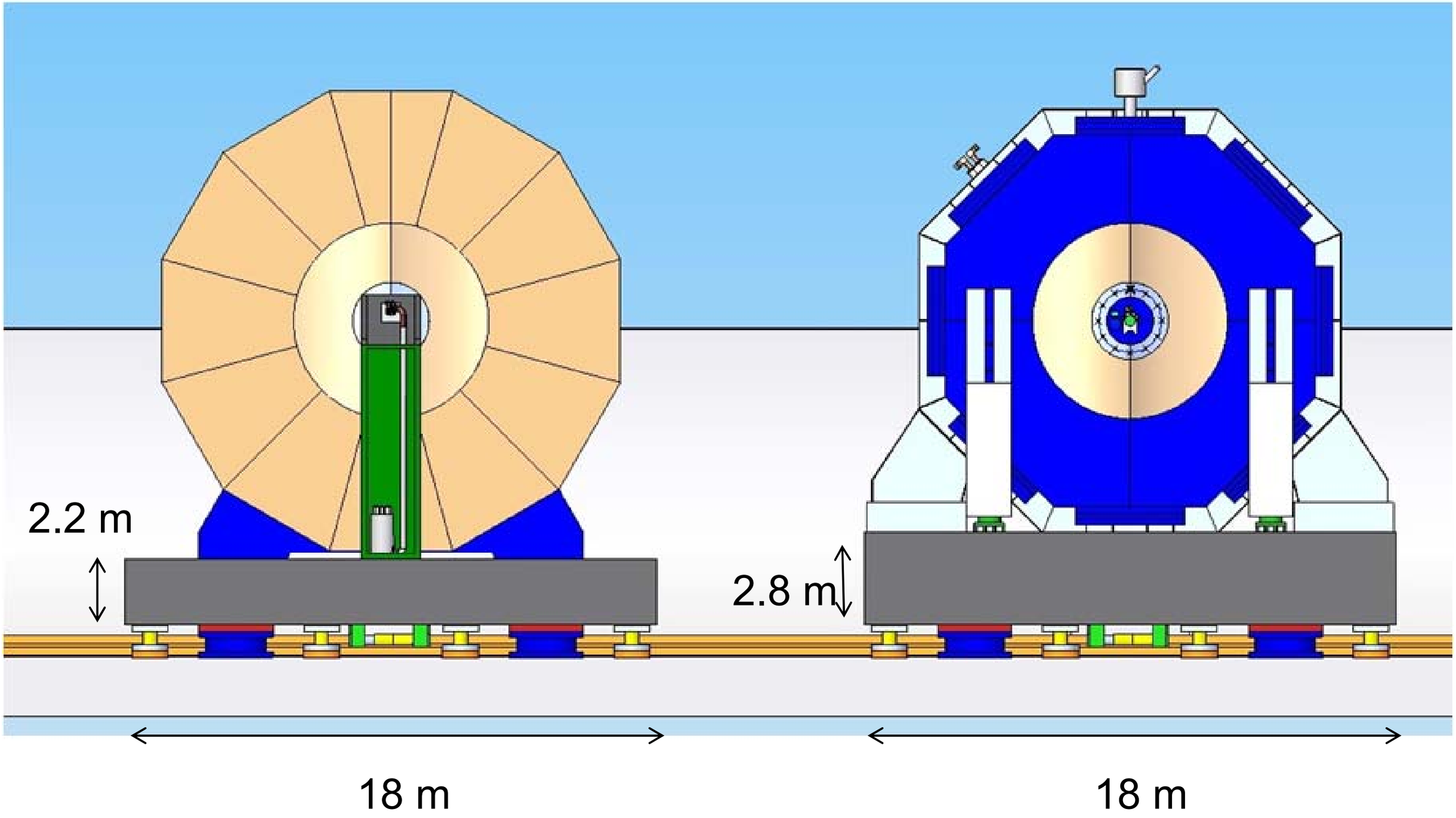






- Possible configuration of feet and airpads

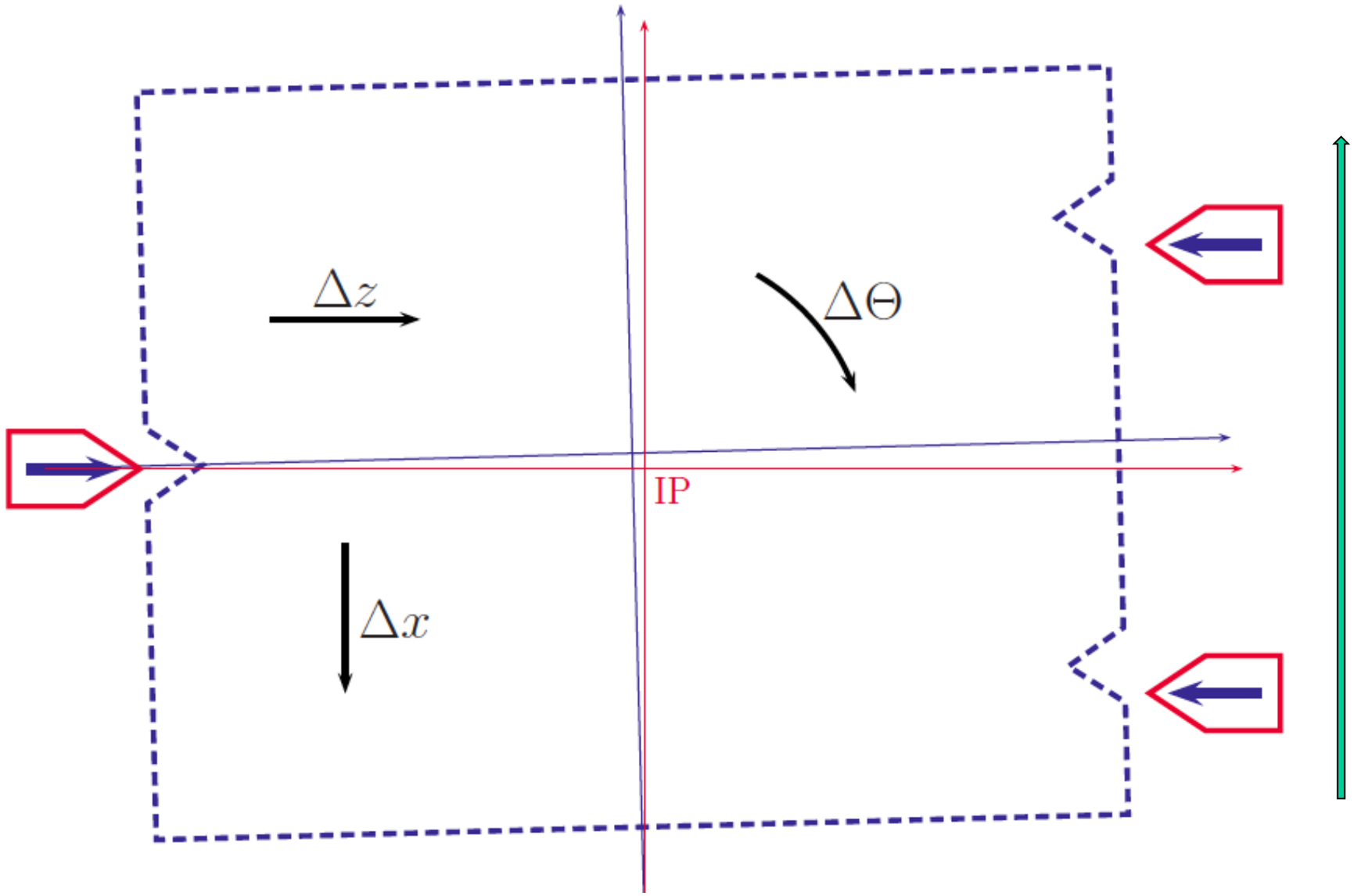
Reducing ILD Beam Height



- Reducing difference to 0.6m seems possible
  - Maybe even less if yoke instrumentation design will be changed

Platform Motion System

With Airpads a simple positive indexing **mechanism is possible giving ≈mm precision**



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- Final precision: +-1 mm and +- 0.1 mrad

Platform Motion System

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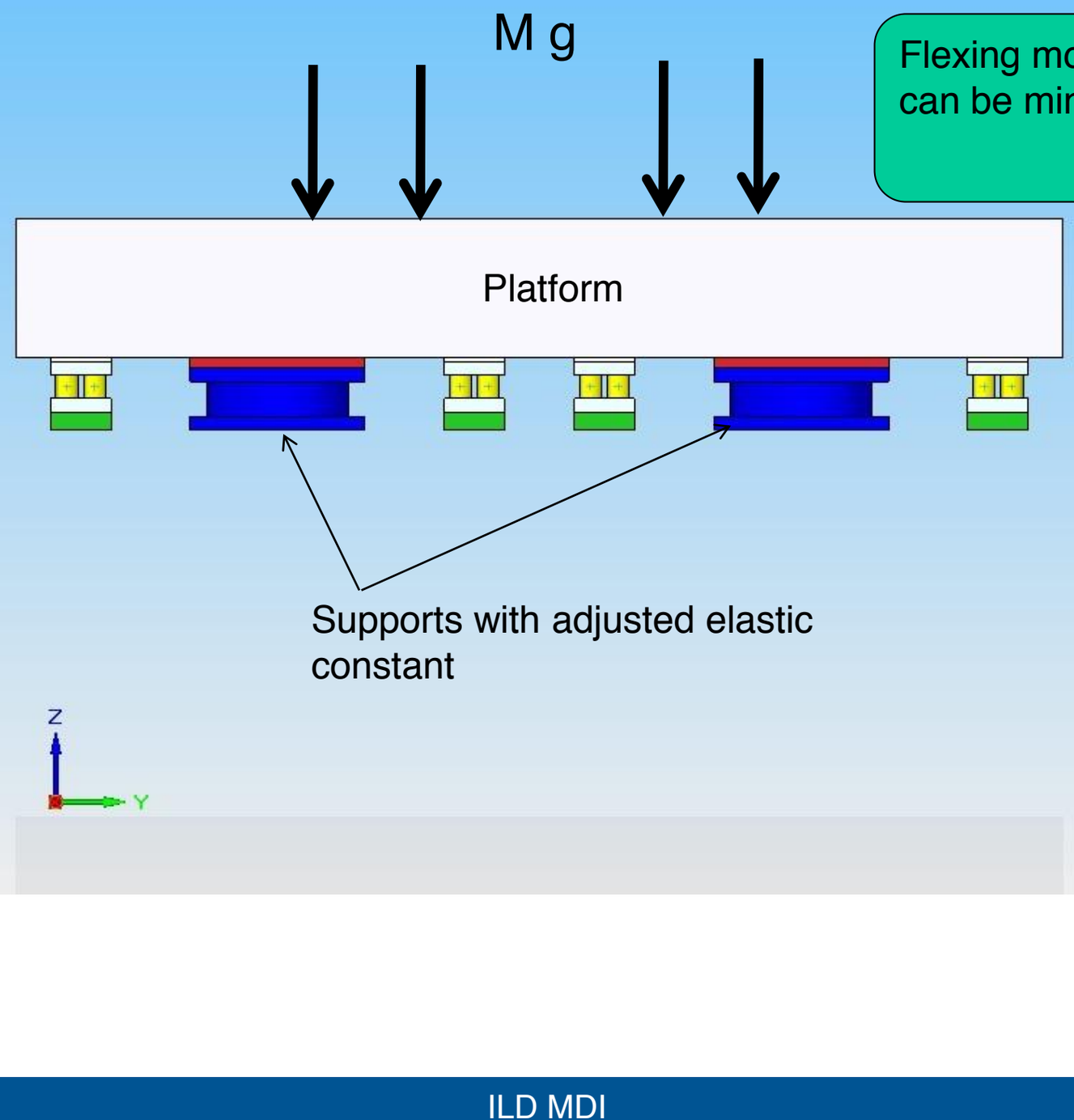
The load distribution can be optimized

Weight distribution of a typical experiment



Flexing moments can be minimized!

Alain Hervé,

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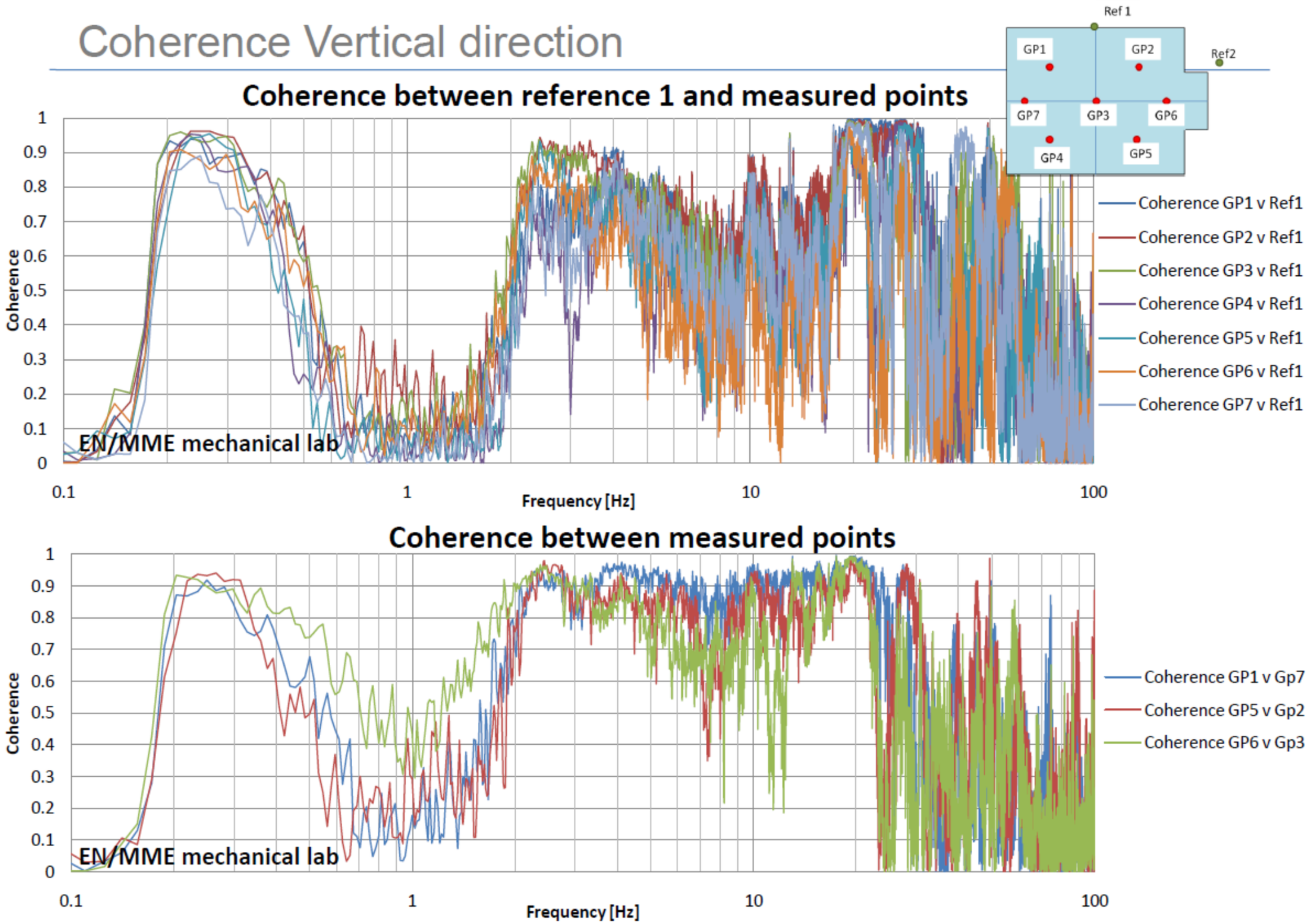
Vibration Issues

ETH Institute for Particle Physics

CMS Plug finished

Platform Vibration Measurements and Modelling

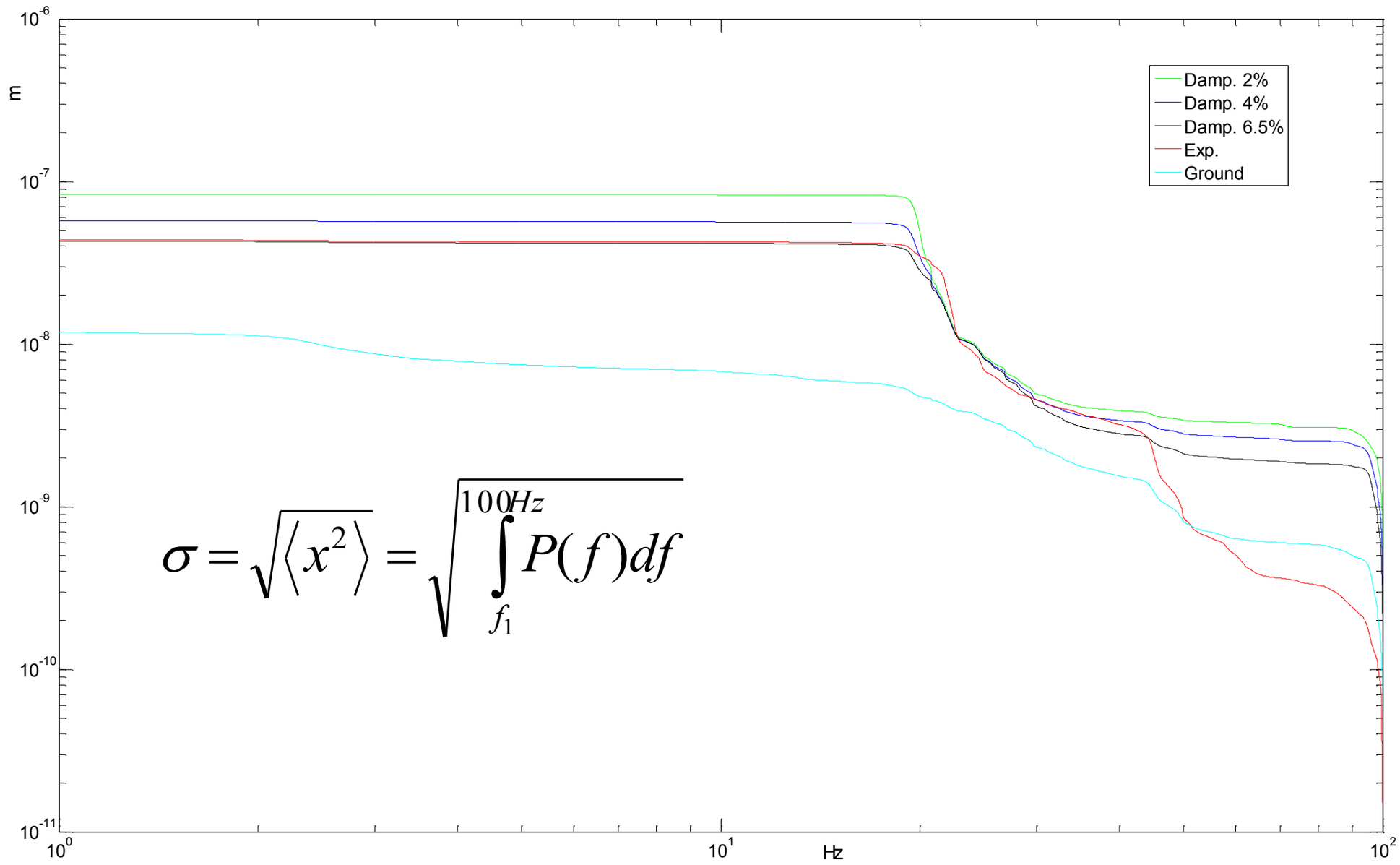
Coherence Vertical direction



- M. Oriunno

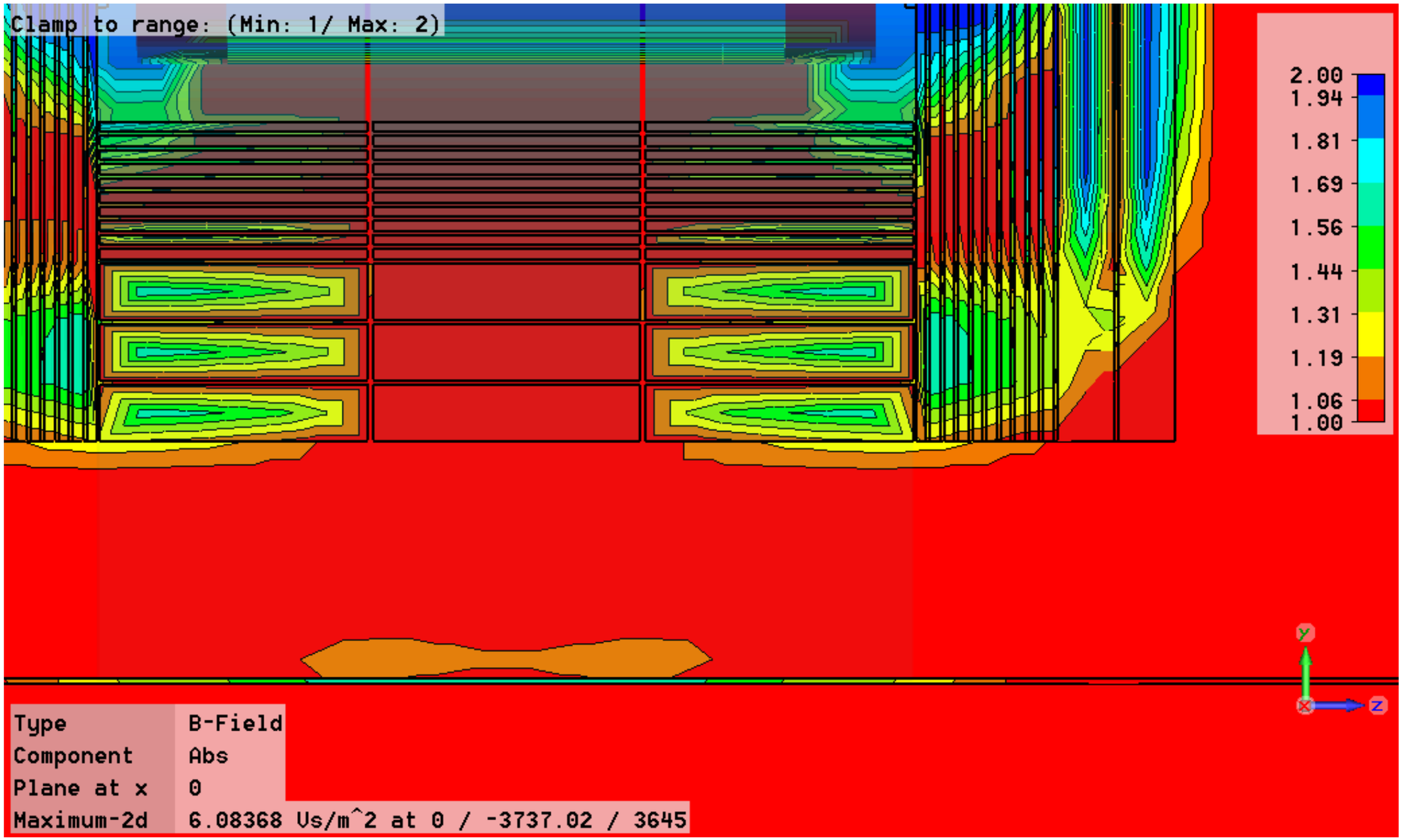
Platform Vibration Measurements and Modelling

Integrated Displacement (r.m.s.)



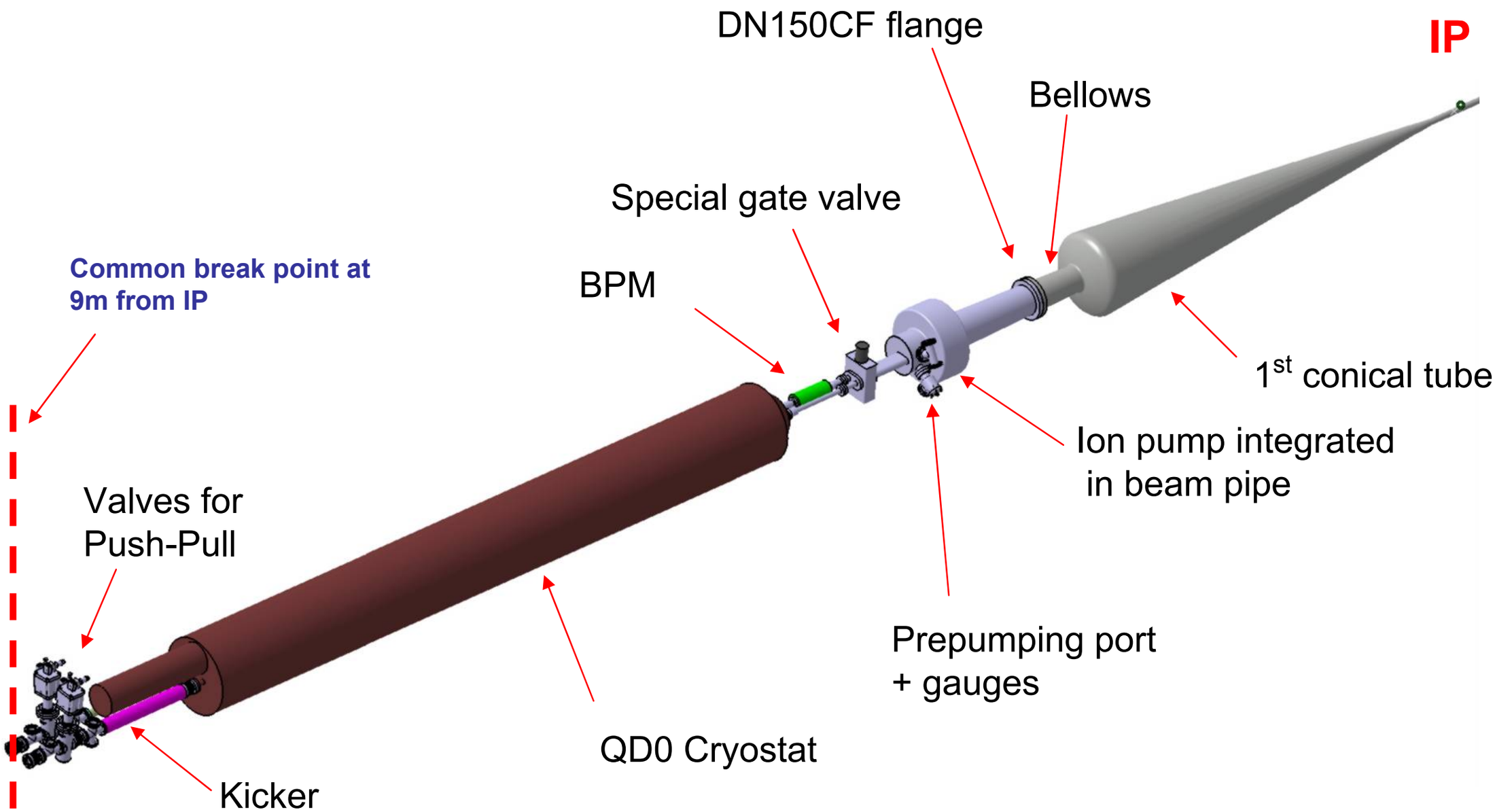
- Ground motion amplification of factor ~3

Magnetic Field on Steel Floor



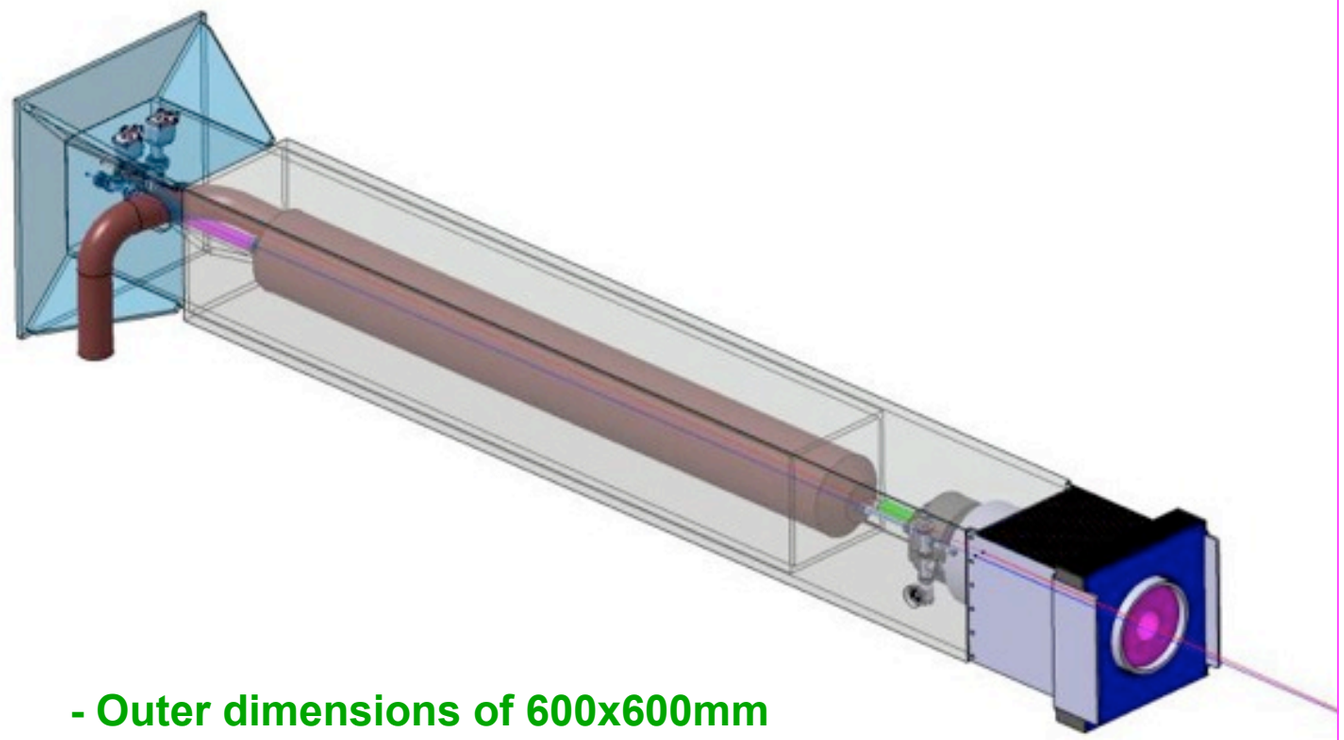
- Simulation with steel layer on platform
- Large induced magnetic fields! Might have consequence on reinforcements in concrete?

ILD Beam Line Elements

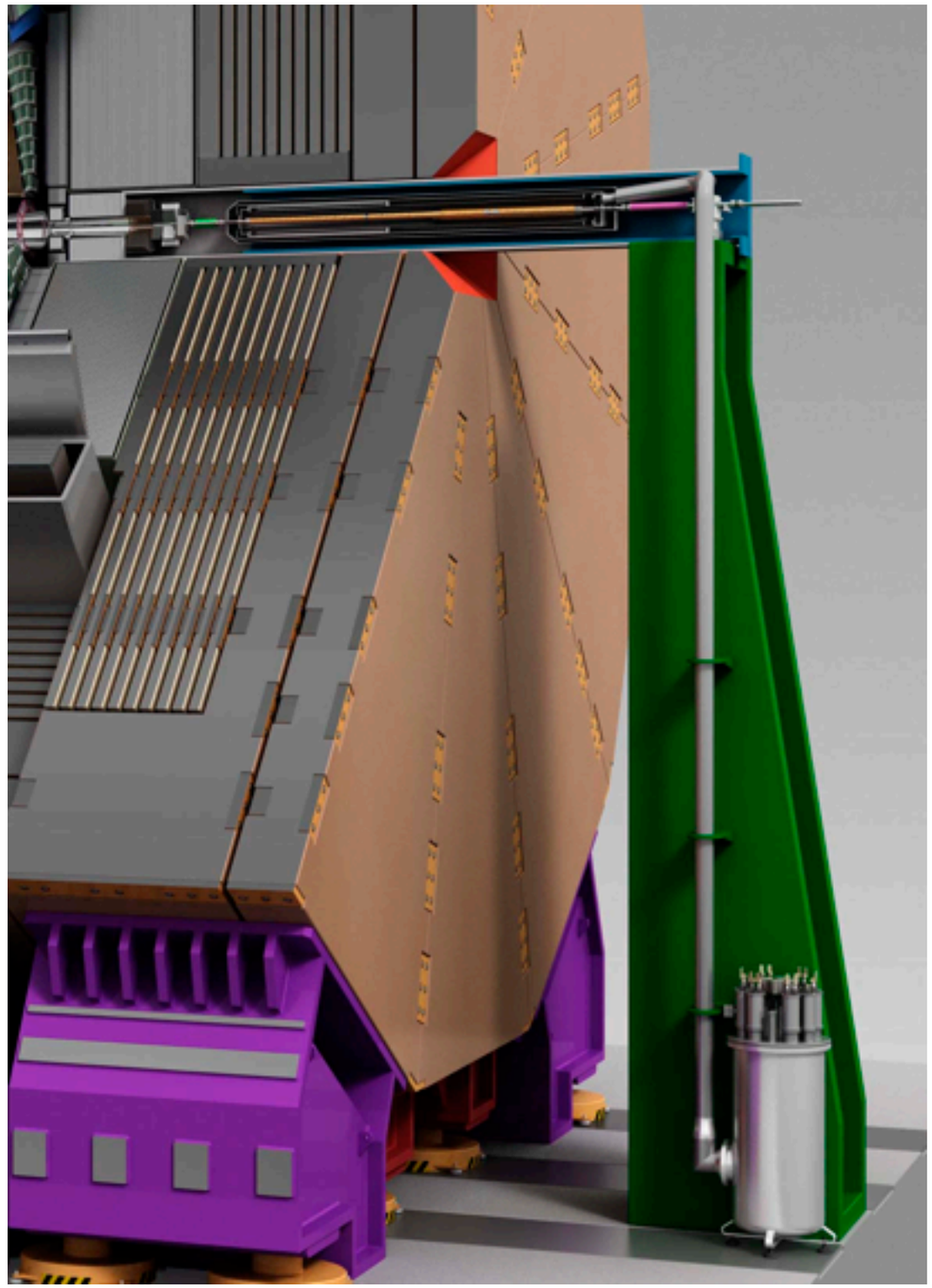


- M. Joré

QD0 Support



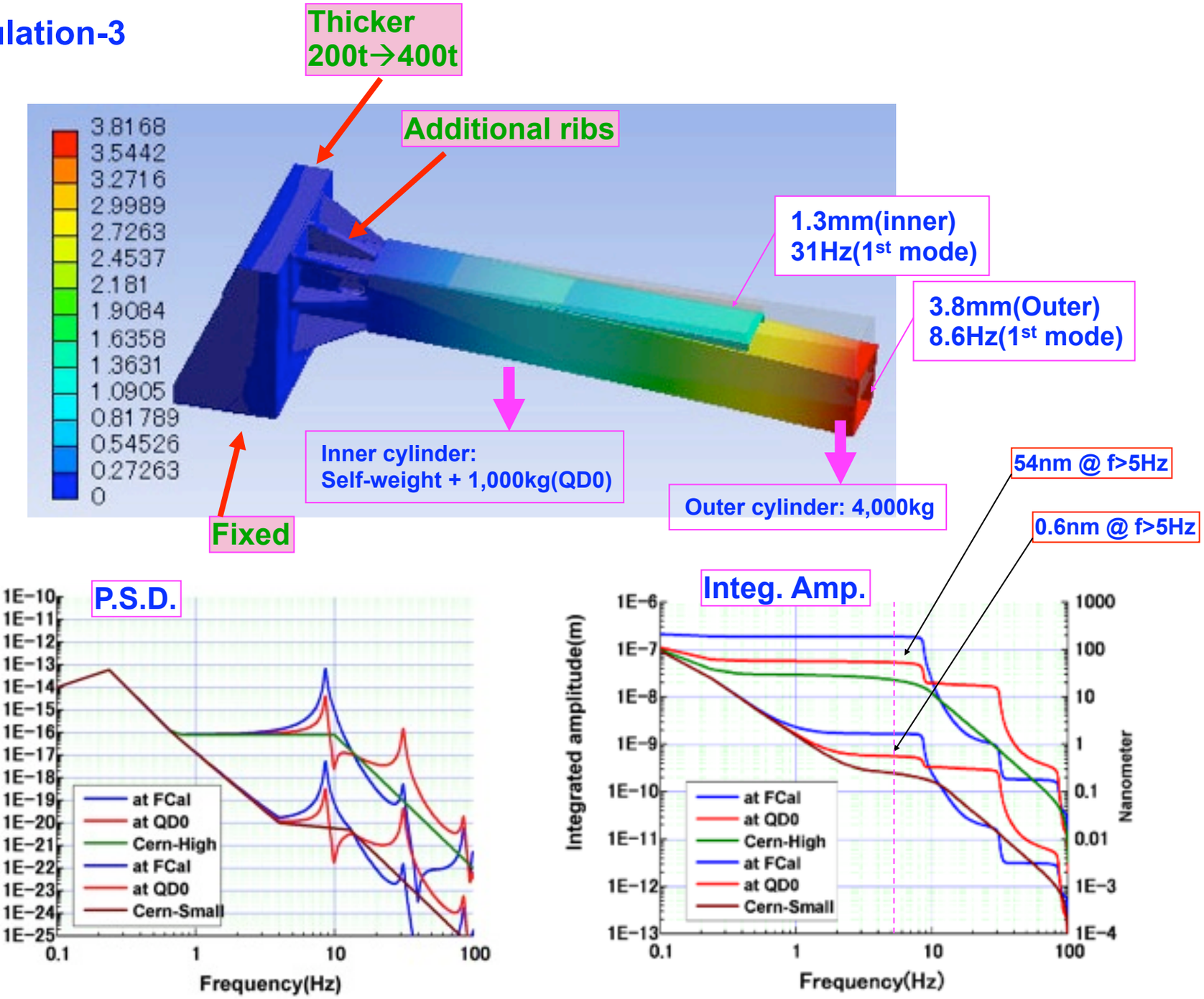
- Outer dimensions of 600x600mm
- 25mm thick



- M. Joré, H. Yamaoka

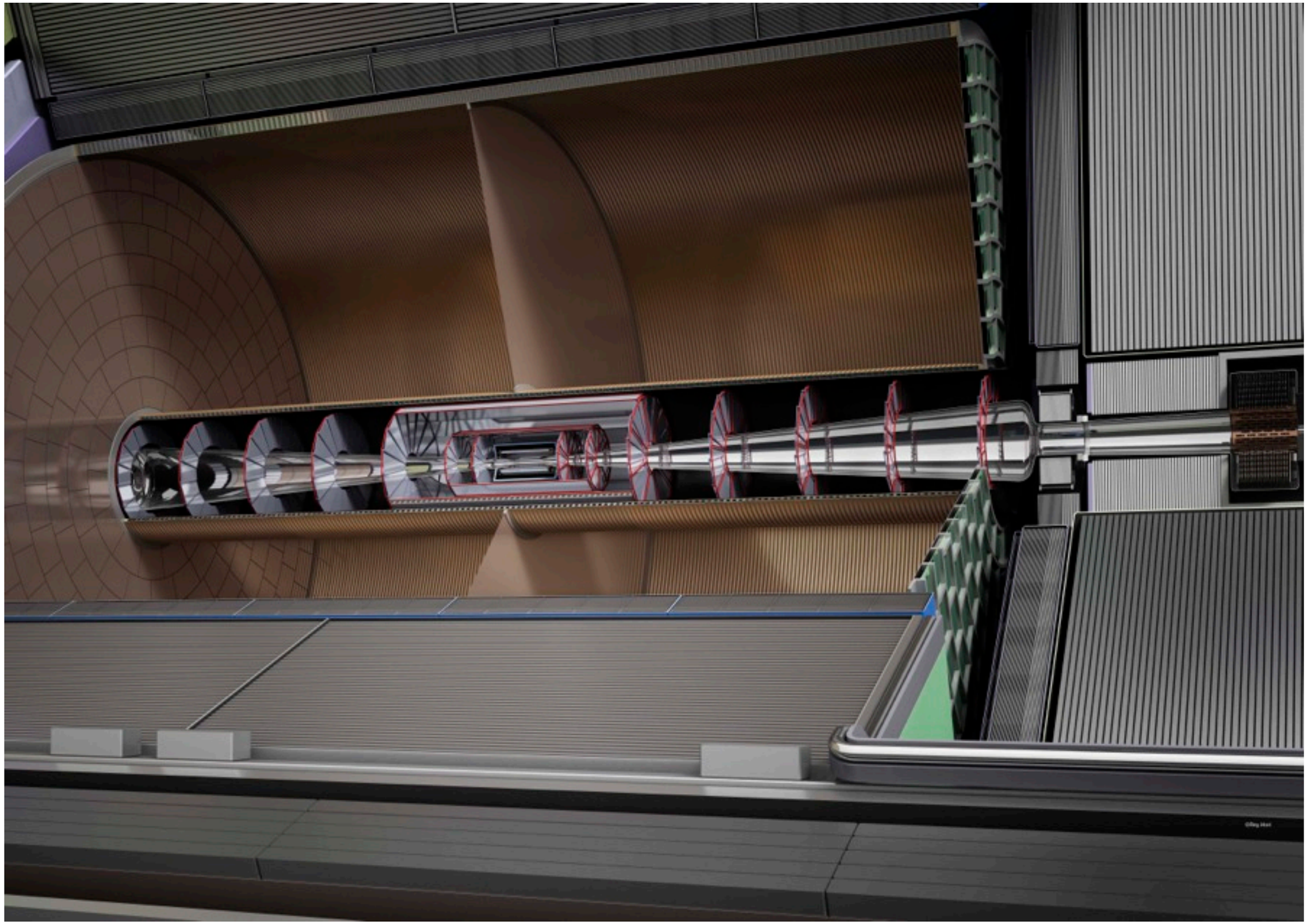
QD0 Support Vibration Analysis

Calculation-3



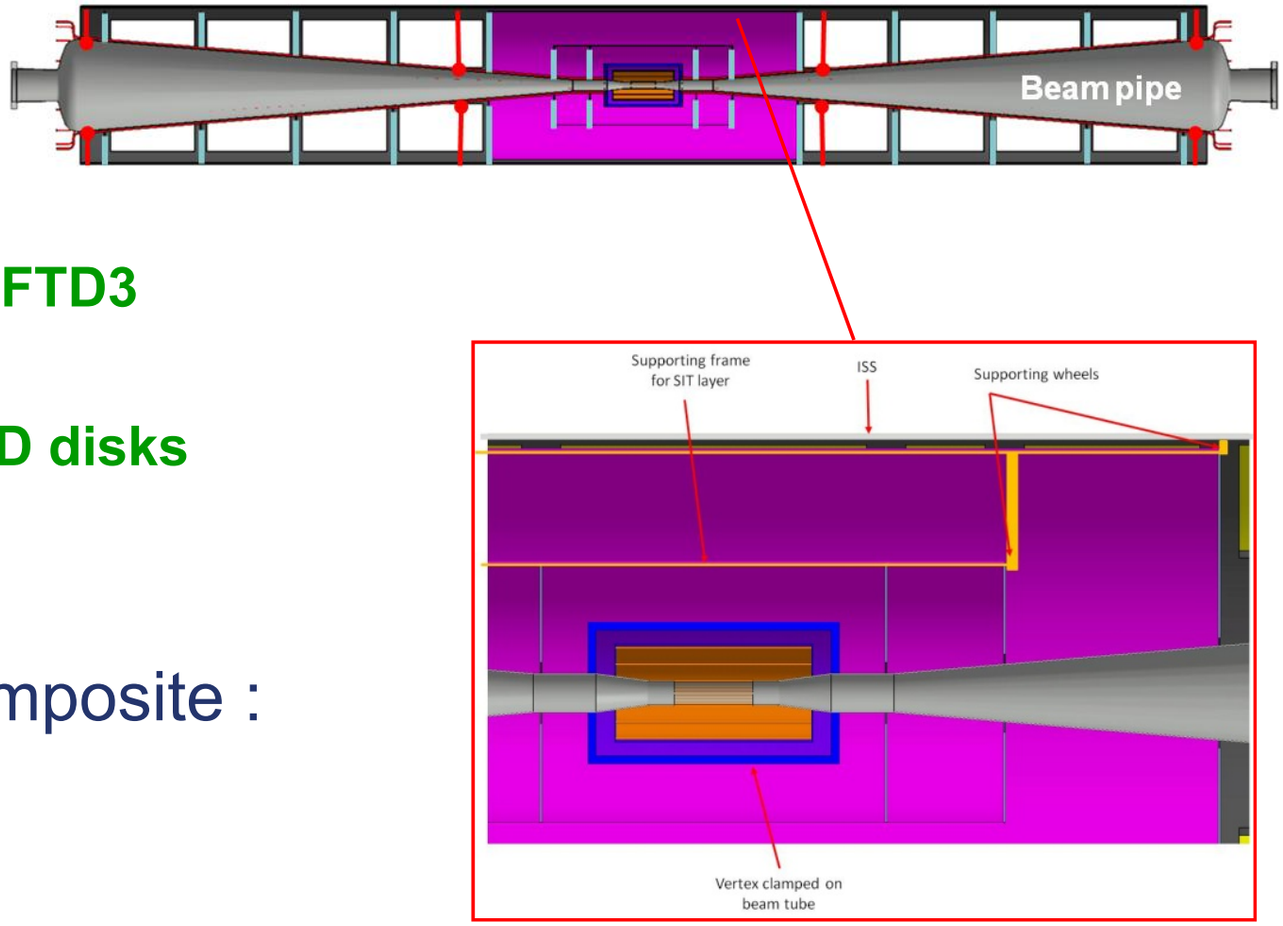
- H. Yamaoka
- Ok for quite site

ILD Central Region



Inner Region Integration Studies

- Components to be supported :
  - **Vertex : 300g supported on FTD3**
  - **FTD : 500g / disks**
  - **SIT : estimated at 5Kg supported on FTD3**
  - **Beam pipe : ab. 15Kg with wires**
  - **Cables : ab. 15Kg supported with FTD disks (ab. 1Kg/disks)**

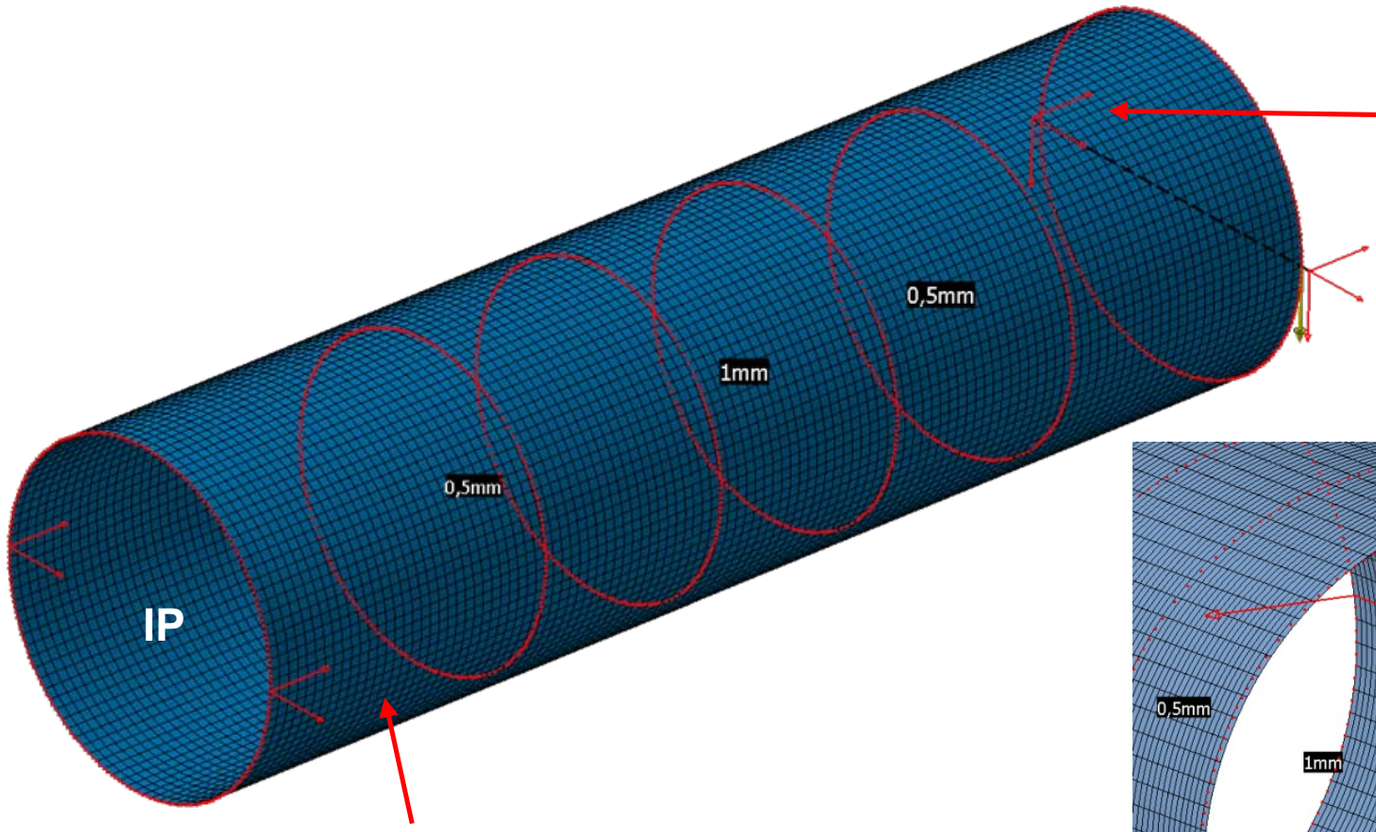


- Material : Carbone fiber / epoxy composite :
  - **Young modulus : 50GPa**
  - **Density : 1750Kg/m3**
  - **First assumed to be isotropic**
    - Realistic with the pure traction/compression loading (flexure of the tube)

- M Joré

Inner Region Integration Studies

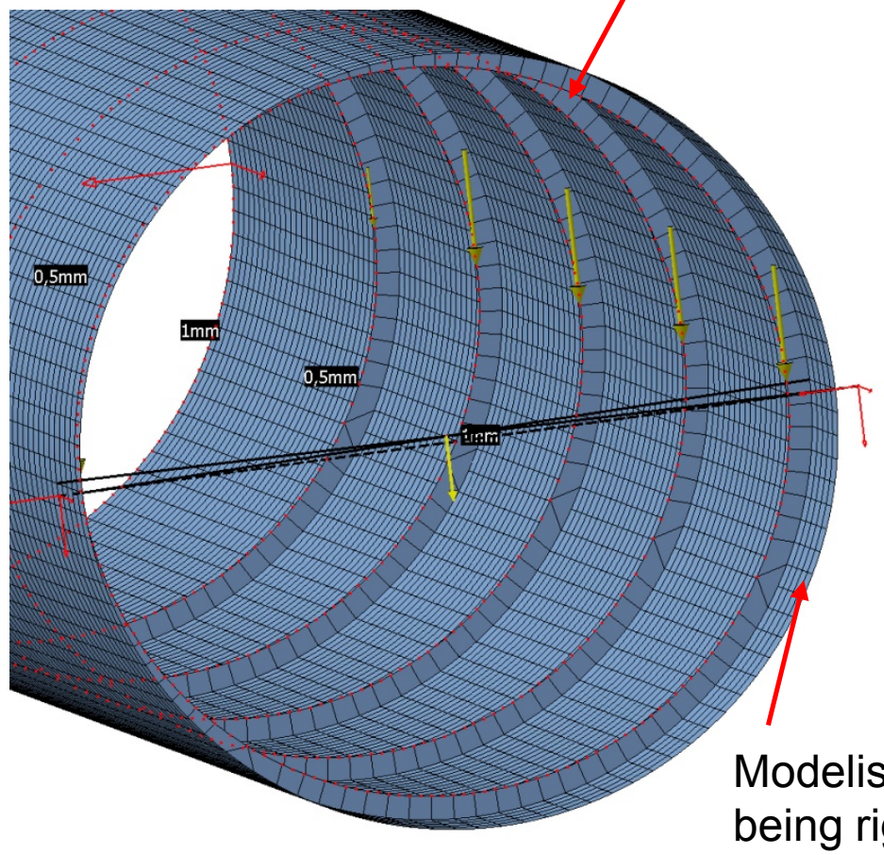
- Semi tube with reinforcement rings



Fixation on TPC

Ring 0,5mm thick

Main tube 1mm thick

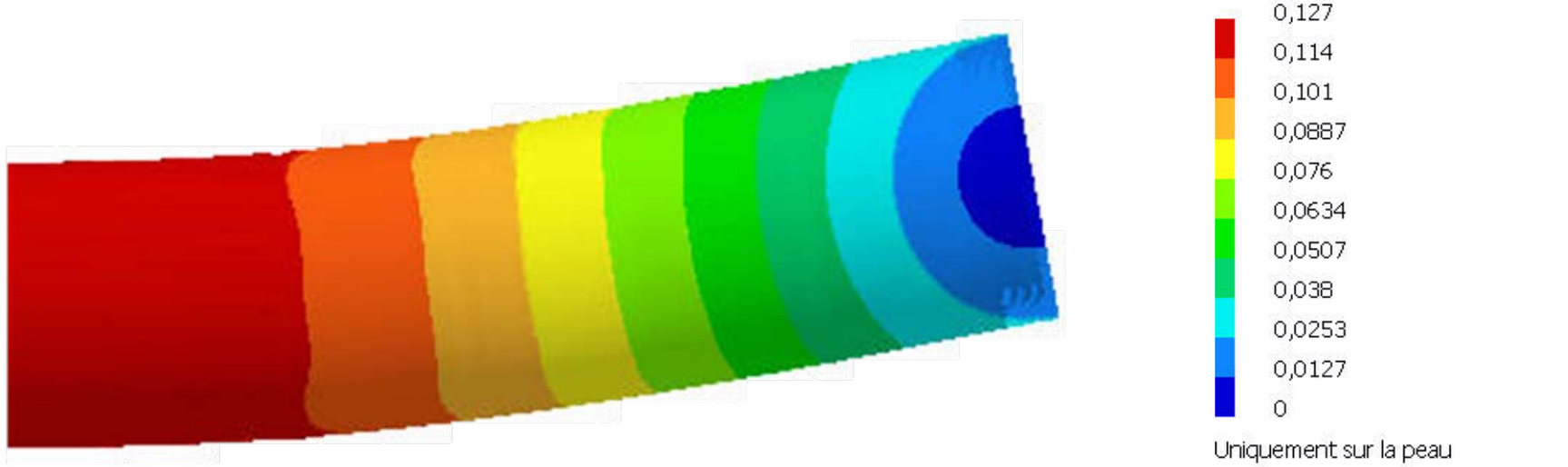


Modelised as being rigid

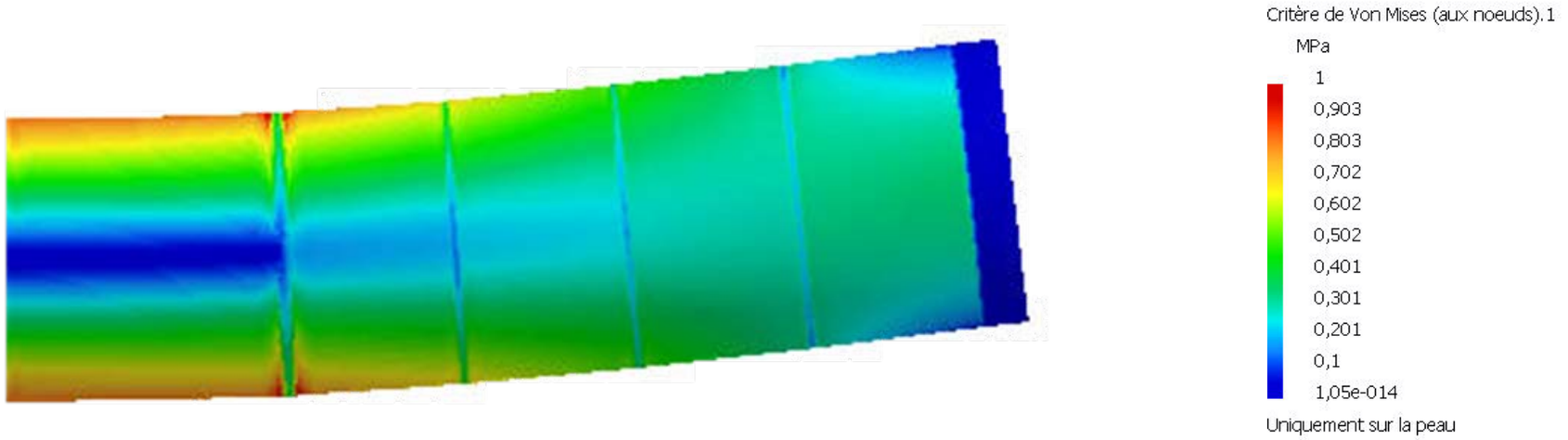
- M. Joré

Inner Region Integration Studies

- Displacement



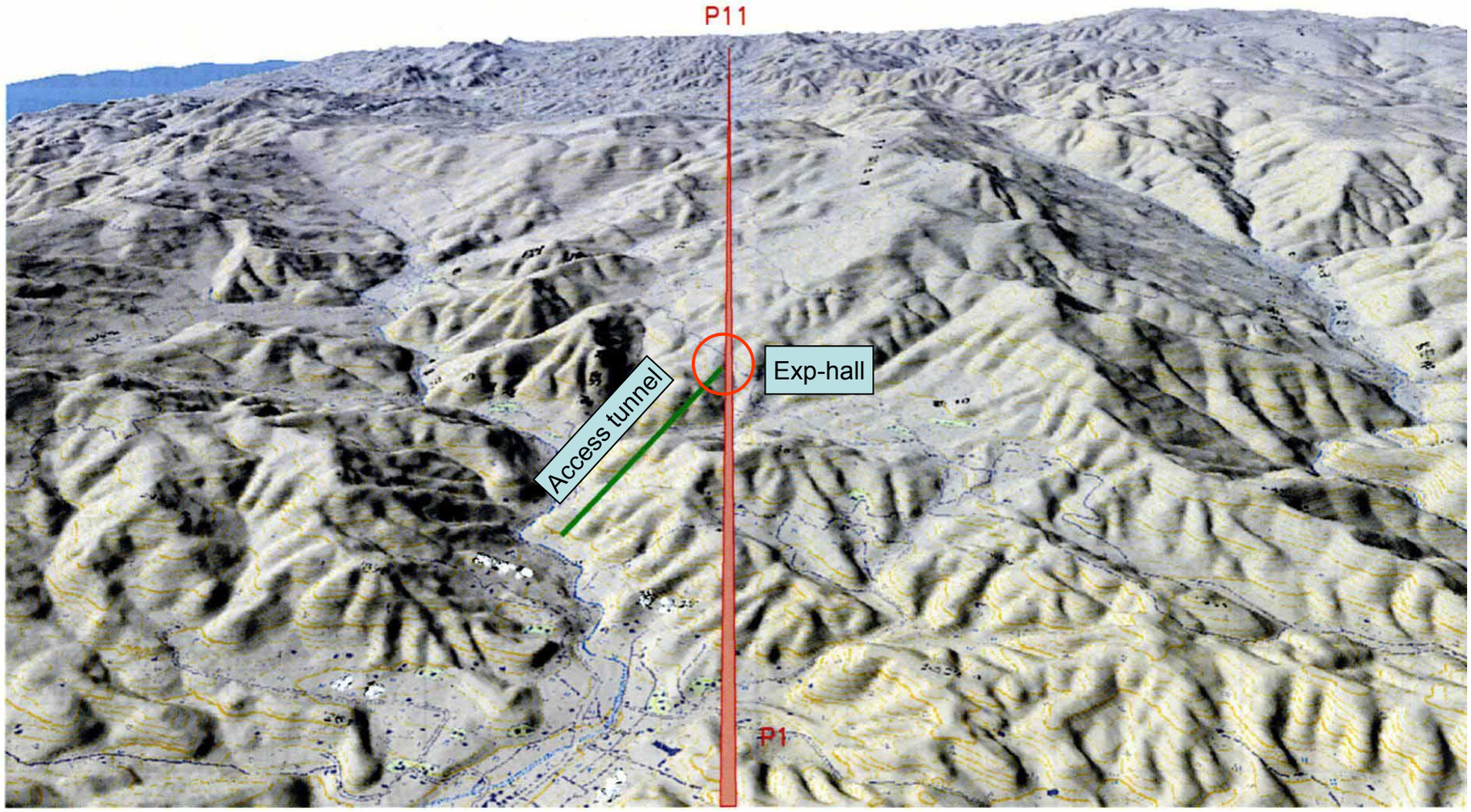
- Stress



- M. Joré

Alternative Detector Assembly Studies (Y. Sugimoto)

An example of Asian mountain site



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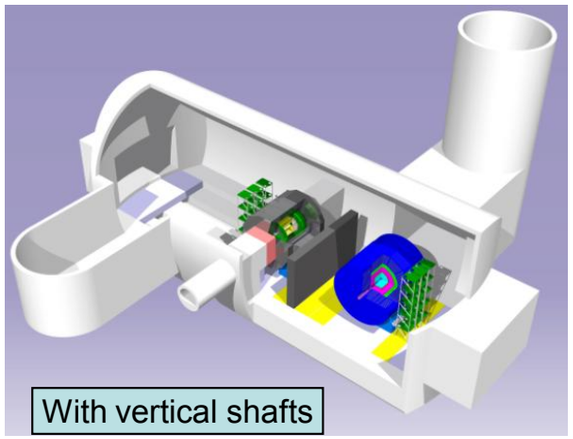
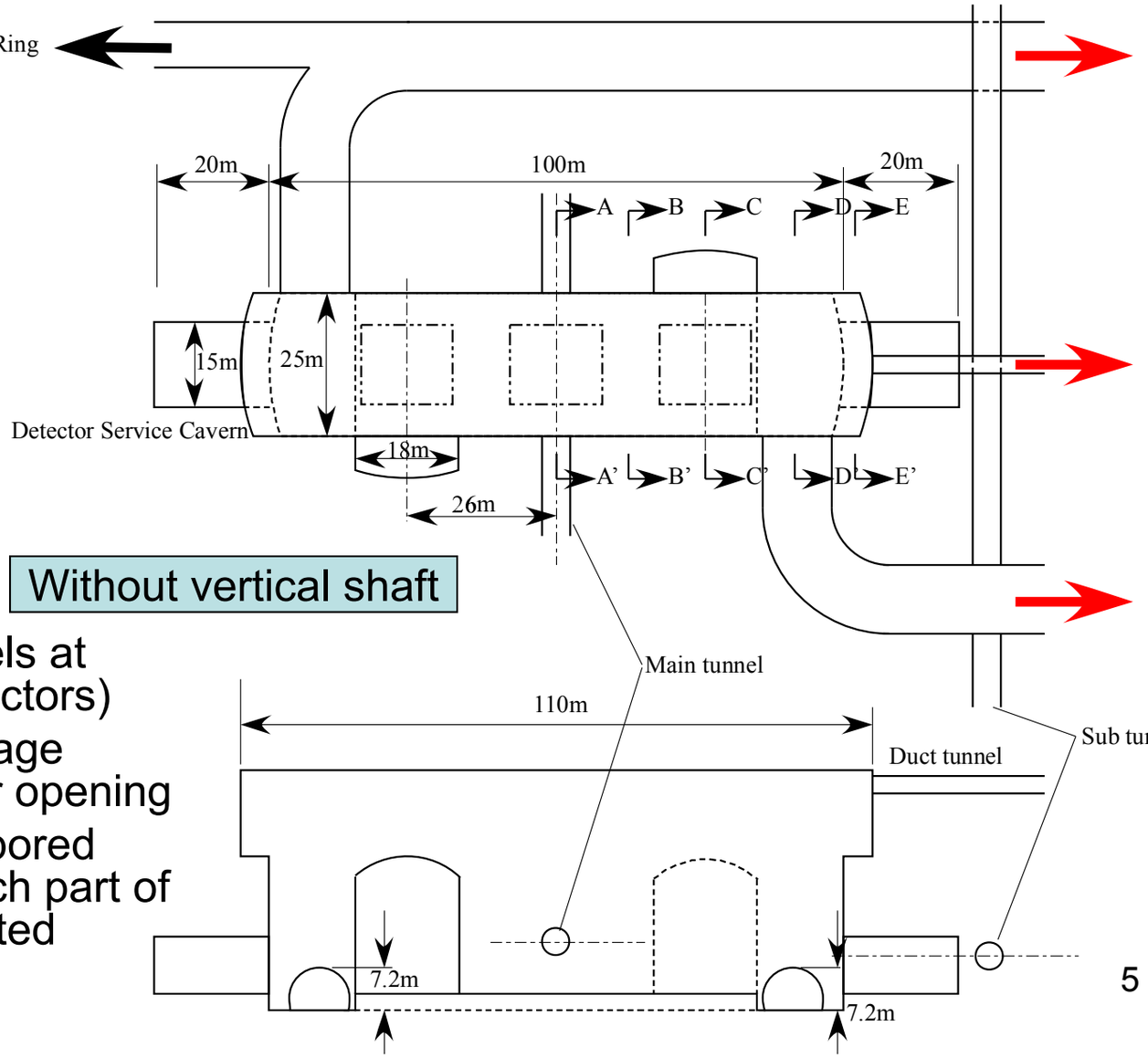
- ILC site could be quite different from „plain field“ assumptions
- No vertical access shafts (~100m) but horizontal access tunnels (~1km)
- CMS-type assembly of detector needs to be reviewed

A possible design of exp-hall





Without vertical shaft

- Bottom access tunnels at both ends (for 2 detectors)
- Small alcoves at garage positions for detector opening
- Top (duct) tunnel is bored first, and then the arch part of the cavern is excavated

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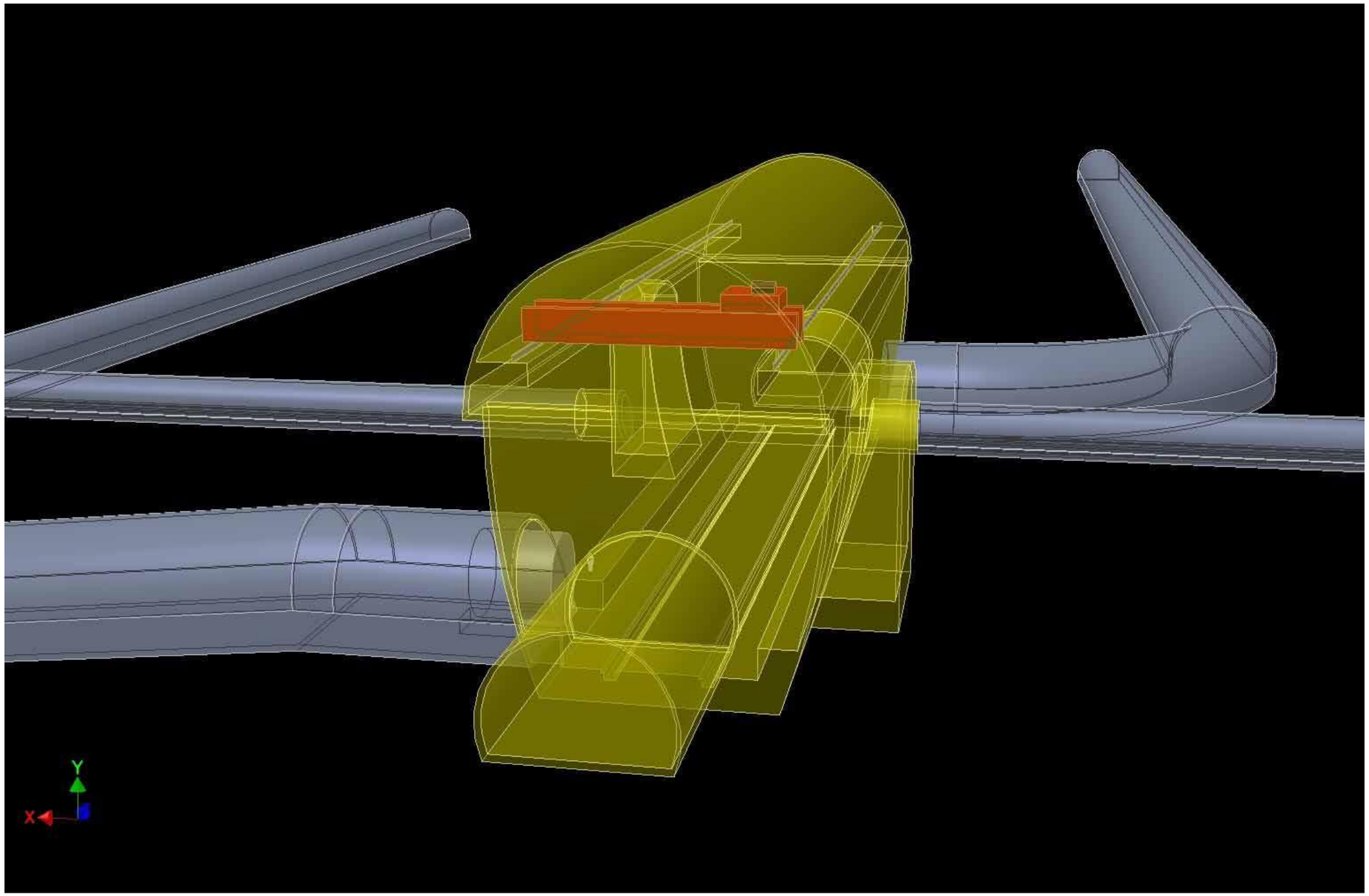
Alternative Detector Assembly Studies (Y. Sugimoto)



- Dedicated talk and discussion tomorrow

Summary

- The focus of the MDI work at ILD is now embedded in the collaborative efforts with SiD and CFS on
  - Underground experimental area design
  - Push-pull system

- A platform based push-pull motion system seems feasible but needs detailed engineering work
  - ARUP tasks

- Site-specific modifications need to be taken into account
  - e.g. mountainous site has different requirements than flat site

- Less than two years to go for the TDR/DBD!
  - work in ILD is resource driven, not task driven.....