Machine and Detector Integration

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DESY

ALCPG 2011 Workshop
22. March 2011

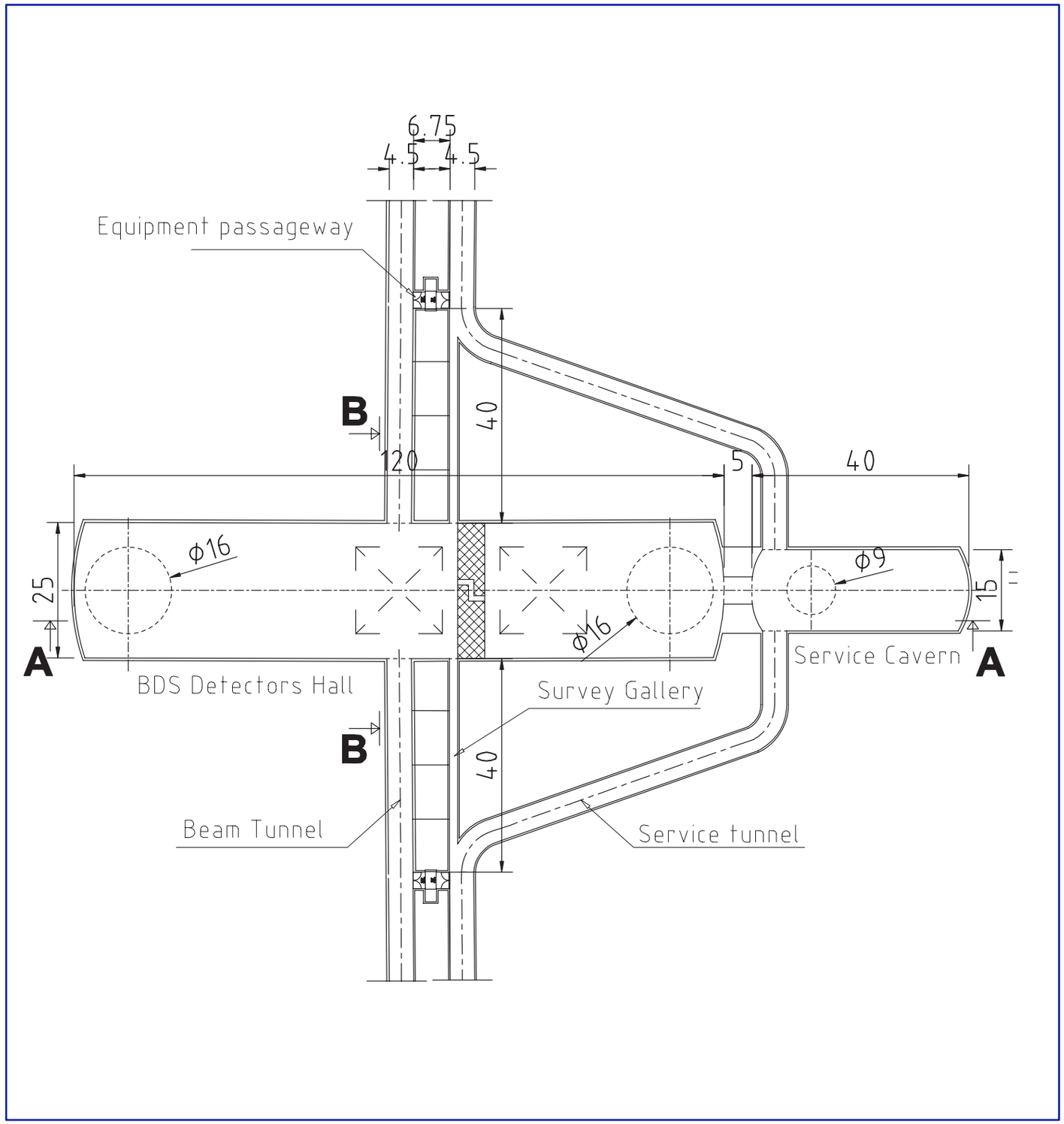
High Priority Items

- Together with SiD and CFS
  - Define underground experimental area design
    - Common platform based push-pull detector motion system
    - Detector services and their impact on CFS issues
  - React on site-specific requirements (e.g. mountainous site boundary conditions)
- ILD internal
  - Design 1st-order engineering model of integrated detector
    - Subdetector services and supplies
    - Cable ways, cooling, support structures
  - Integrate with simulation model
    - Detector integration model in EDMS
    - „Synchronisation“ with MOKKA
  - Define the required documents and parameters for the DBD
    - Use the Work Breakdown Structure in ILC-EDMS

- Status:
  - The MDI group is working with all its resources on these topics
  - Unfortunately the resources are small....

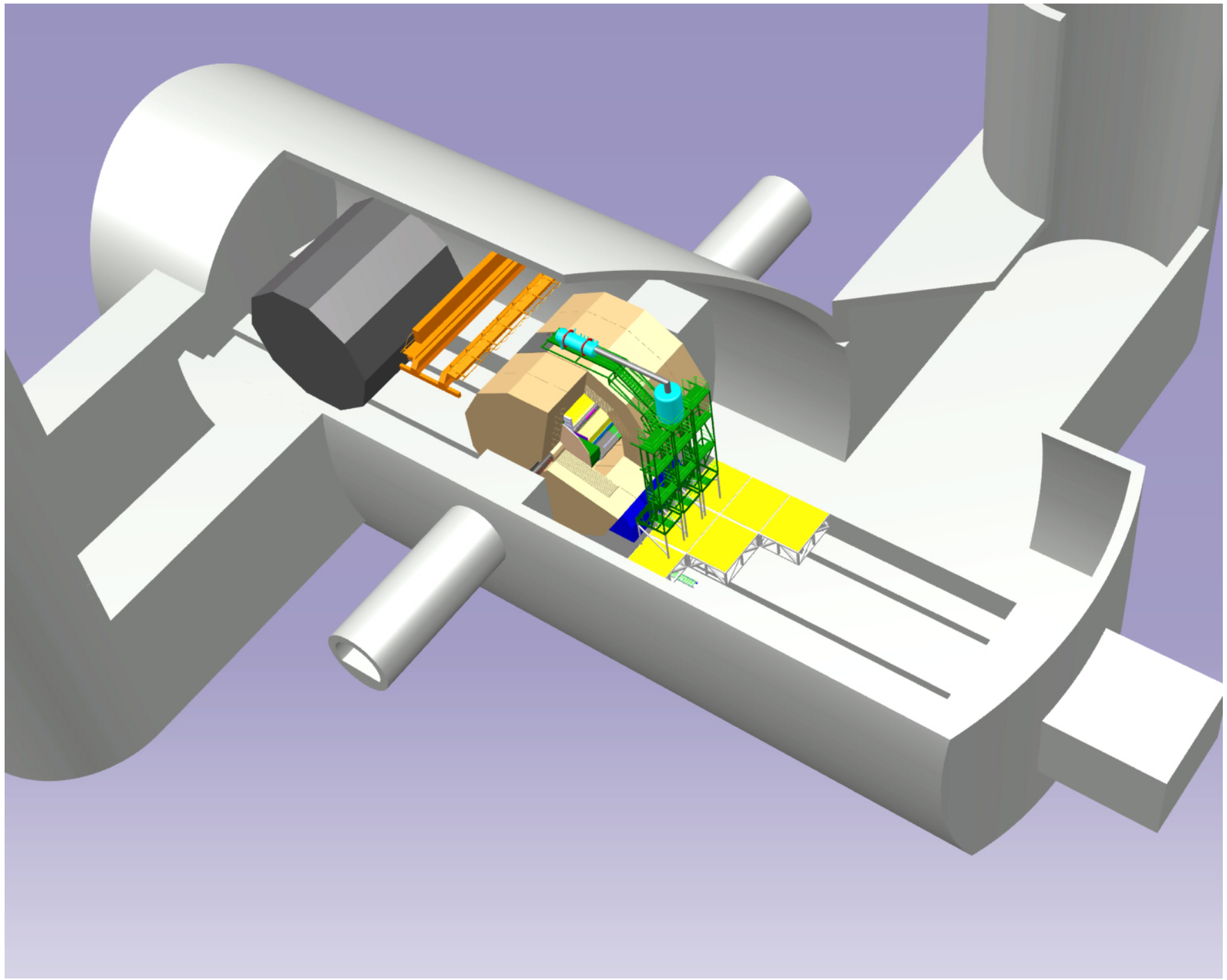
Experimental Hall (RDR Design)

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



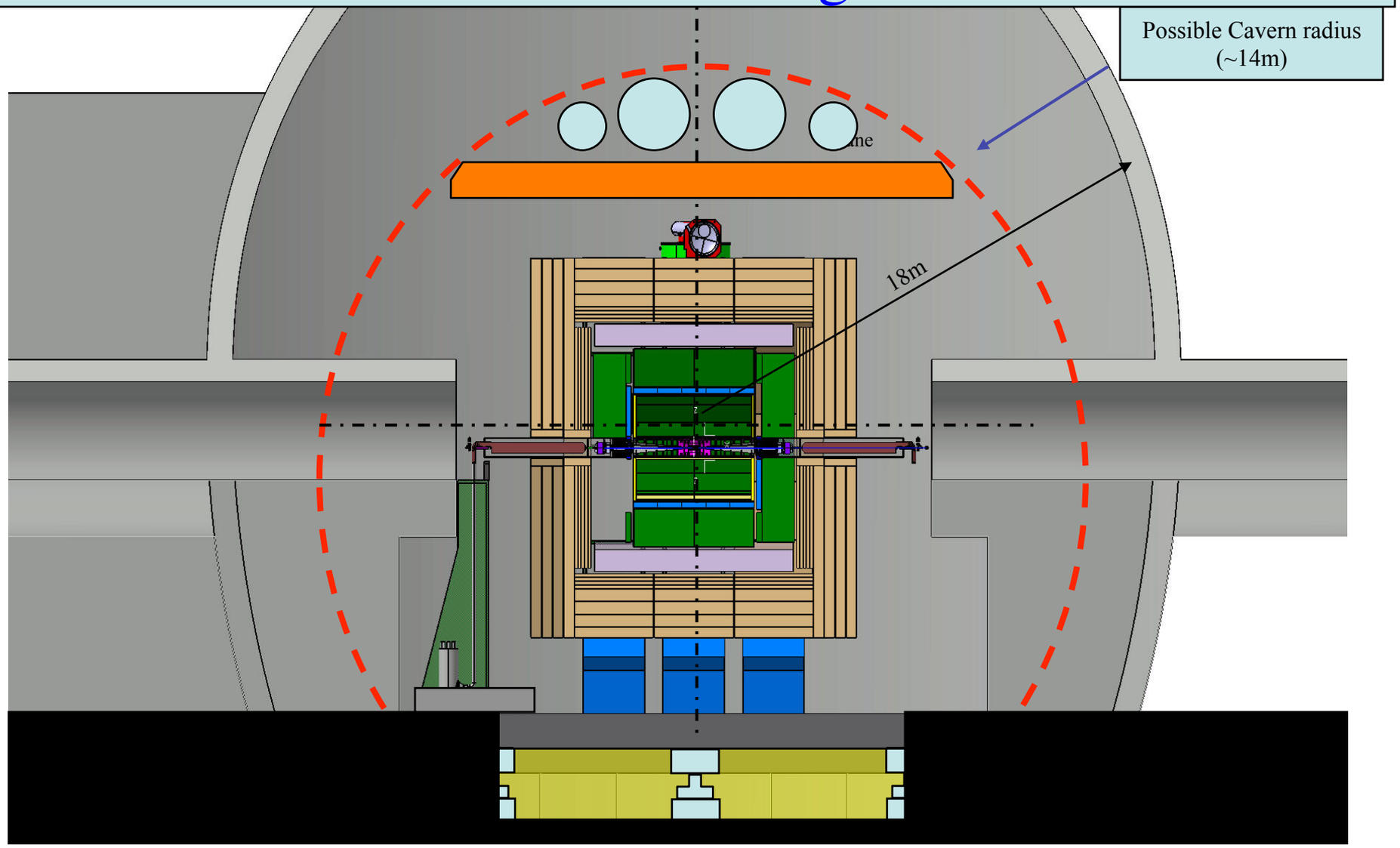
ILD Experimental Hall Design Study

- 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)



Cavern Size

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

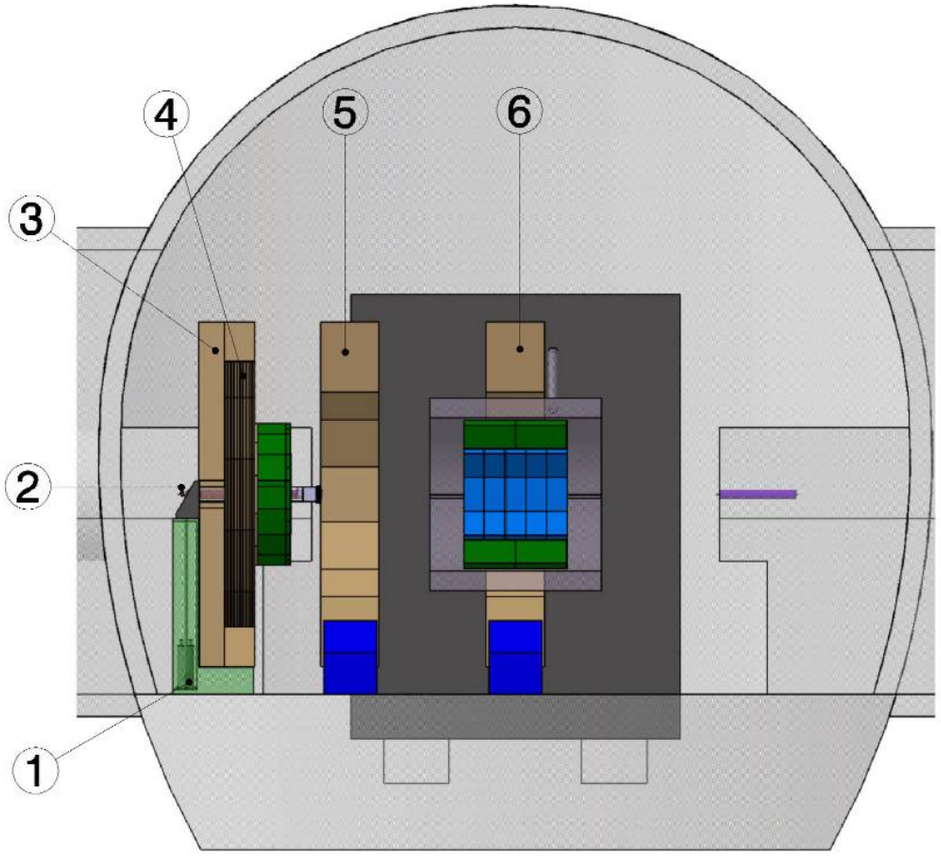


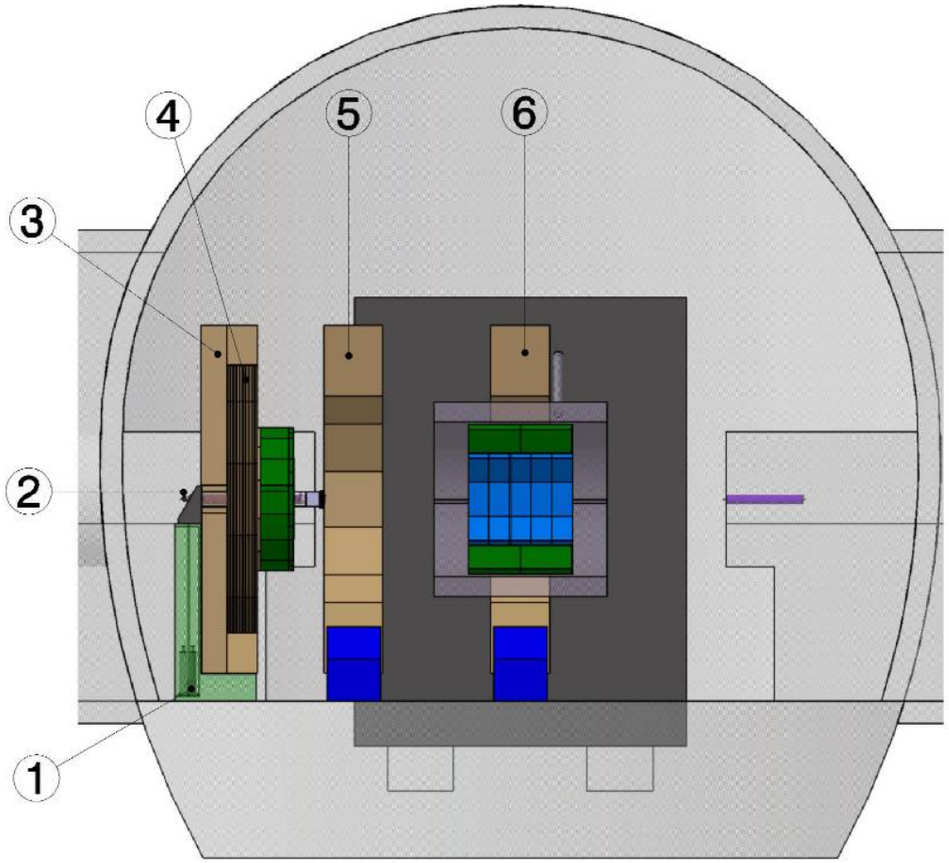
4366-ILD-T-Platform-and-environment.ppt A. Hervé

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

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

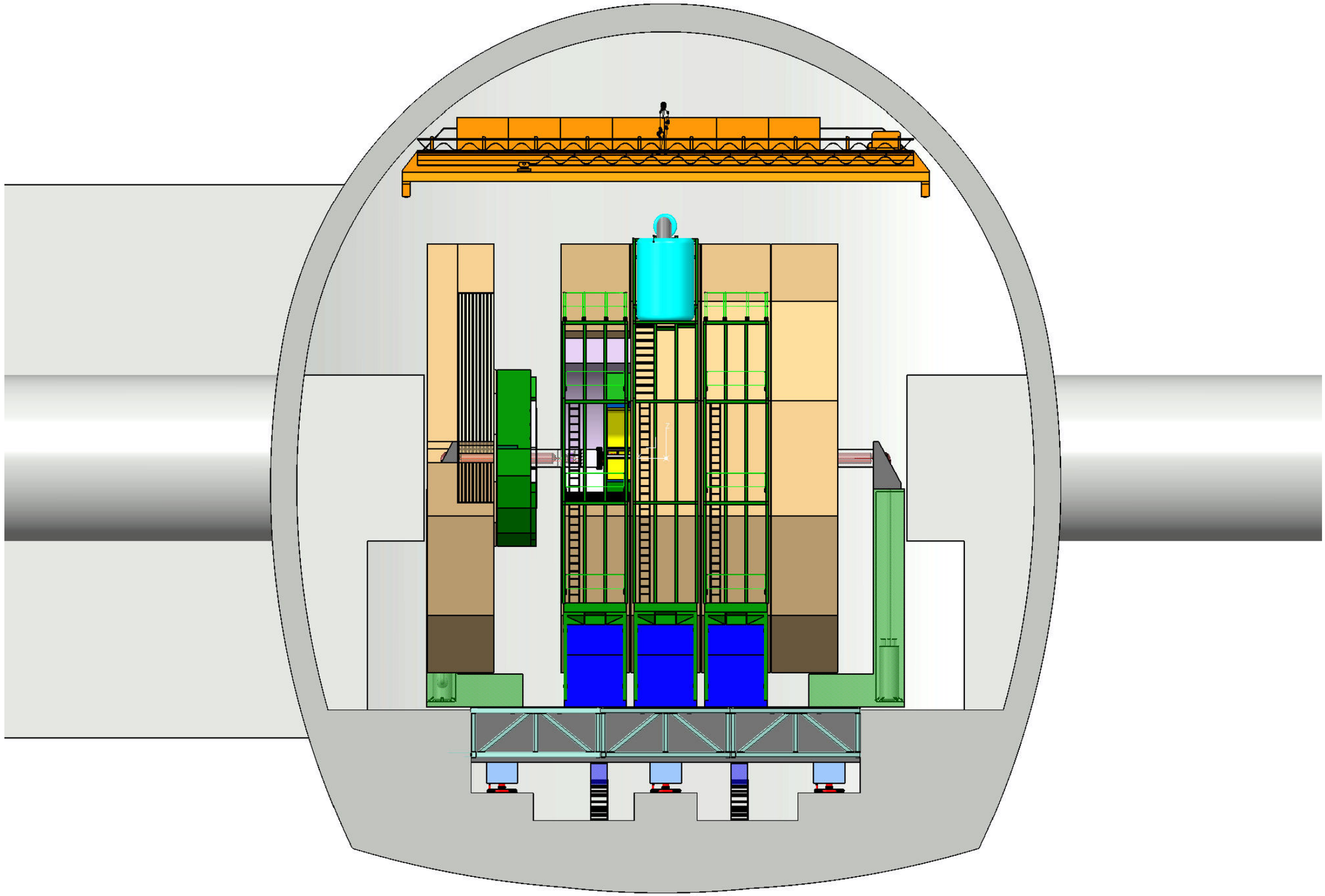
Detector Assembly CMS-Style





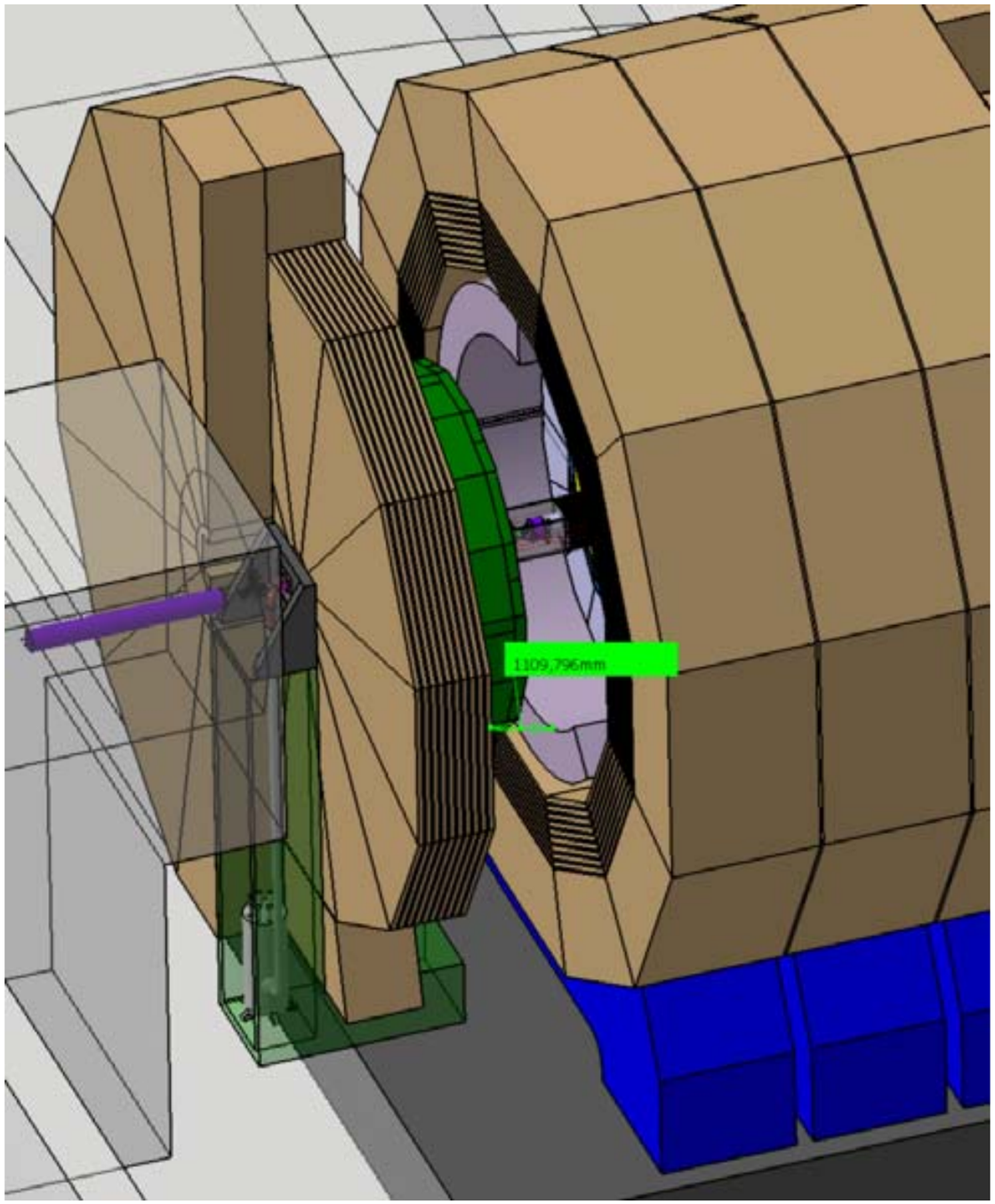
- Pre-assembly of large structures on surface
- Sub-assemblies lowered into the experimental hall
- Main parts:
  - three barrel yoke rings; central carries magnet and barrel detectors
  - two yoke endcaps
  - central tracking system (TPC)

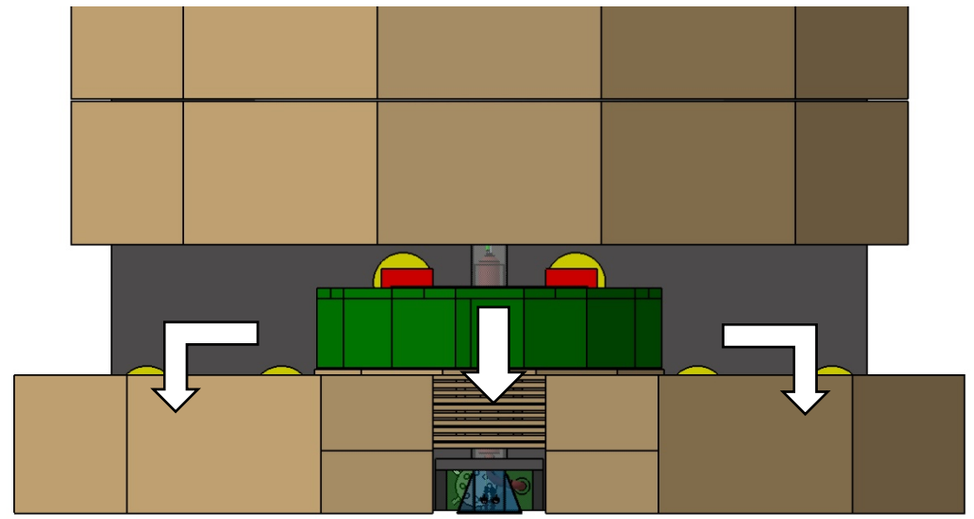
Detector in Beam Position



- NB: Optimised hall size

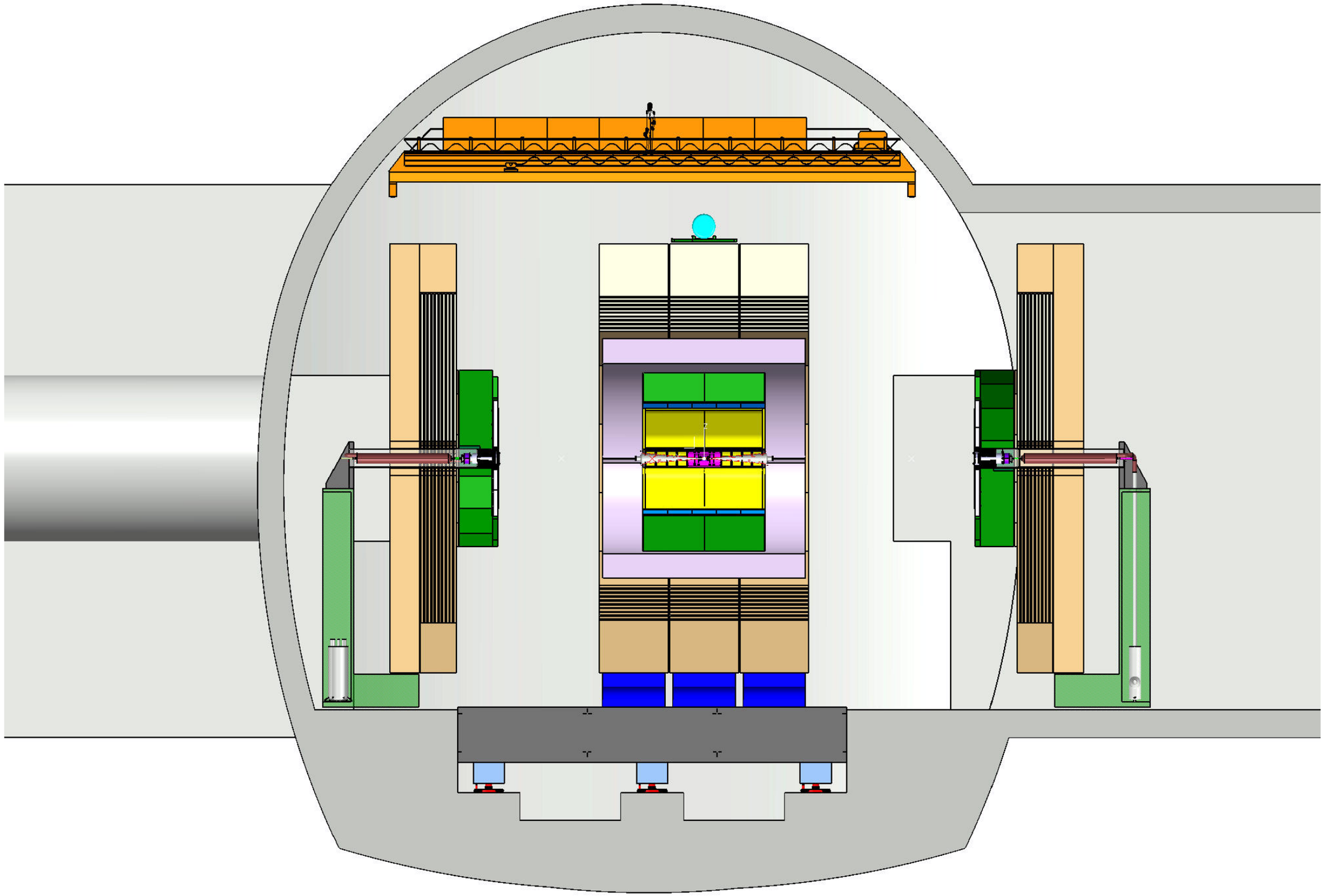
Detector Opening - Beam Position





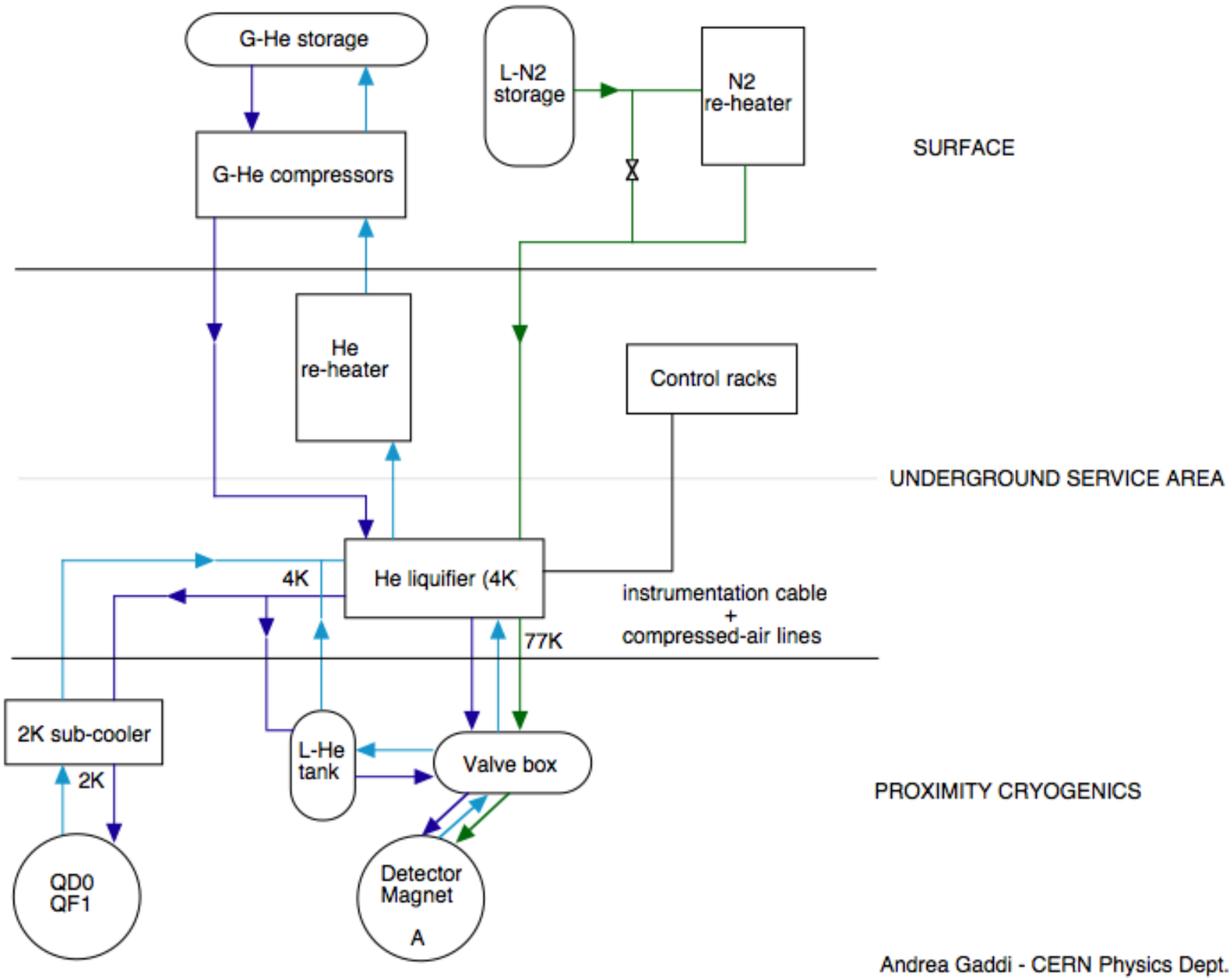
- Option to open the endcap in the beam position for limited access
  - Still under discussion; might not be needed if push-pull concept is taken seriously

Detector Opening - Garage Position



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

Detector Services

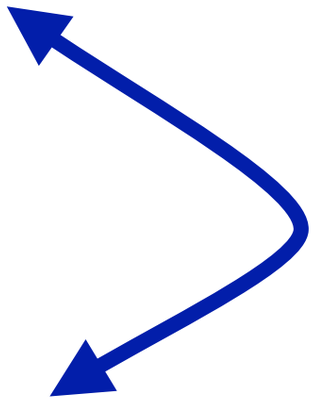


- Cryogenics for the magnets

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



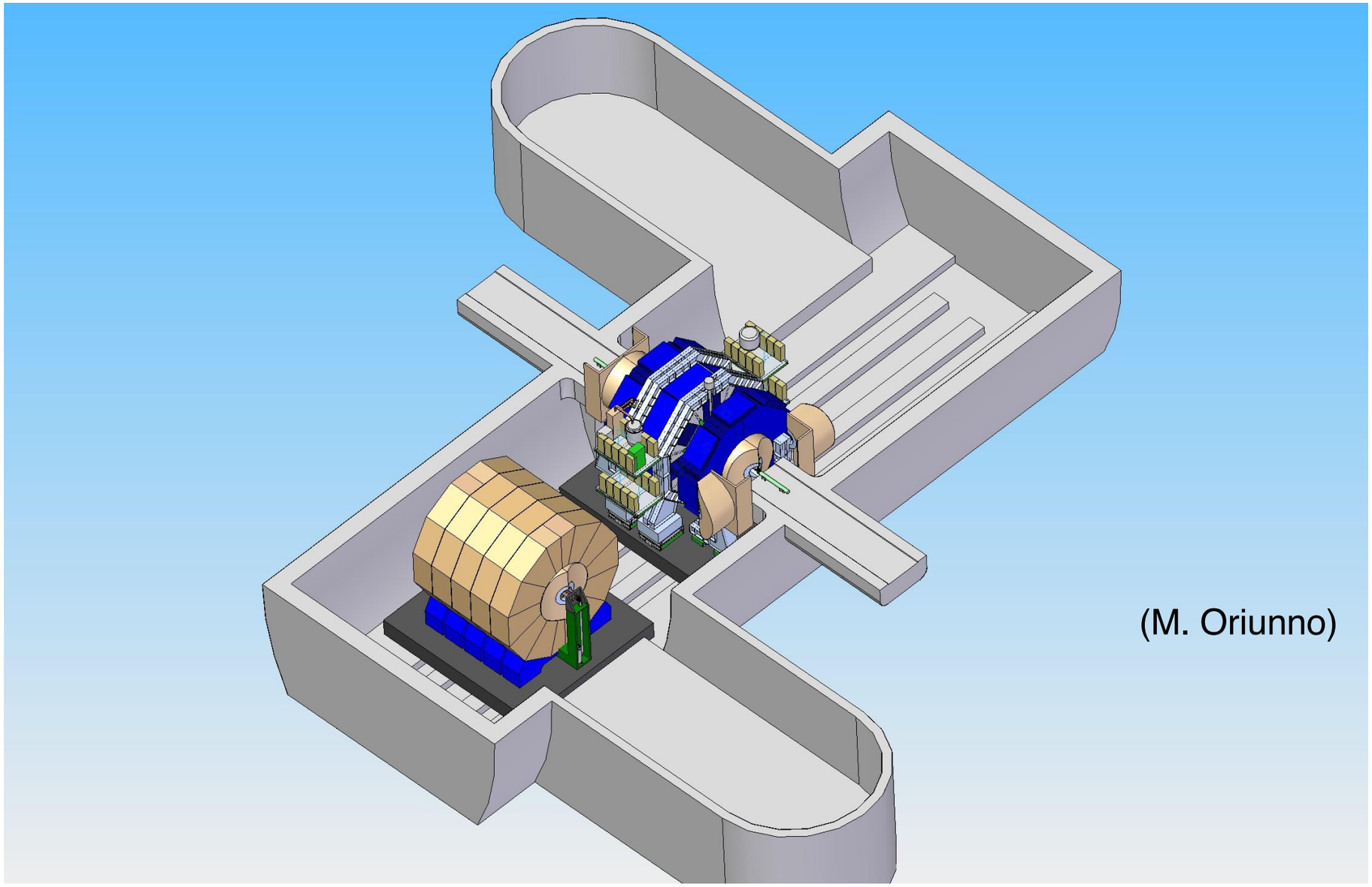
- On-board services (move with detector)
  - Electronic containers

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

Platform Based Detector Motion System

ETH Institute for Particle Physics

Both detectors on a platform

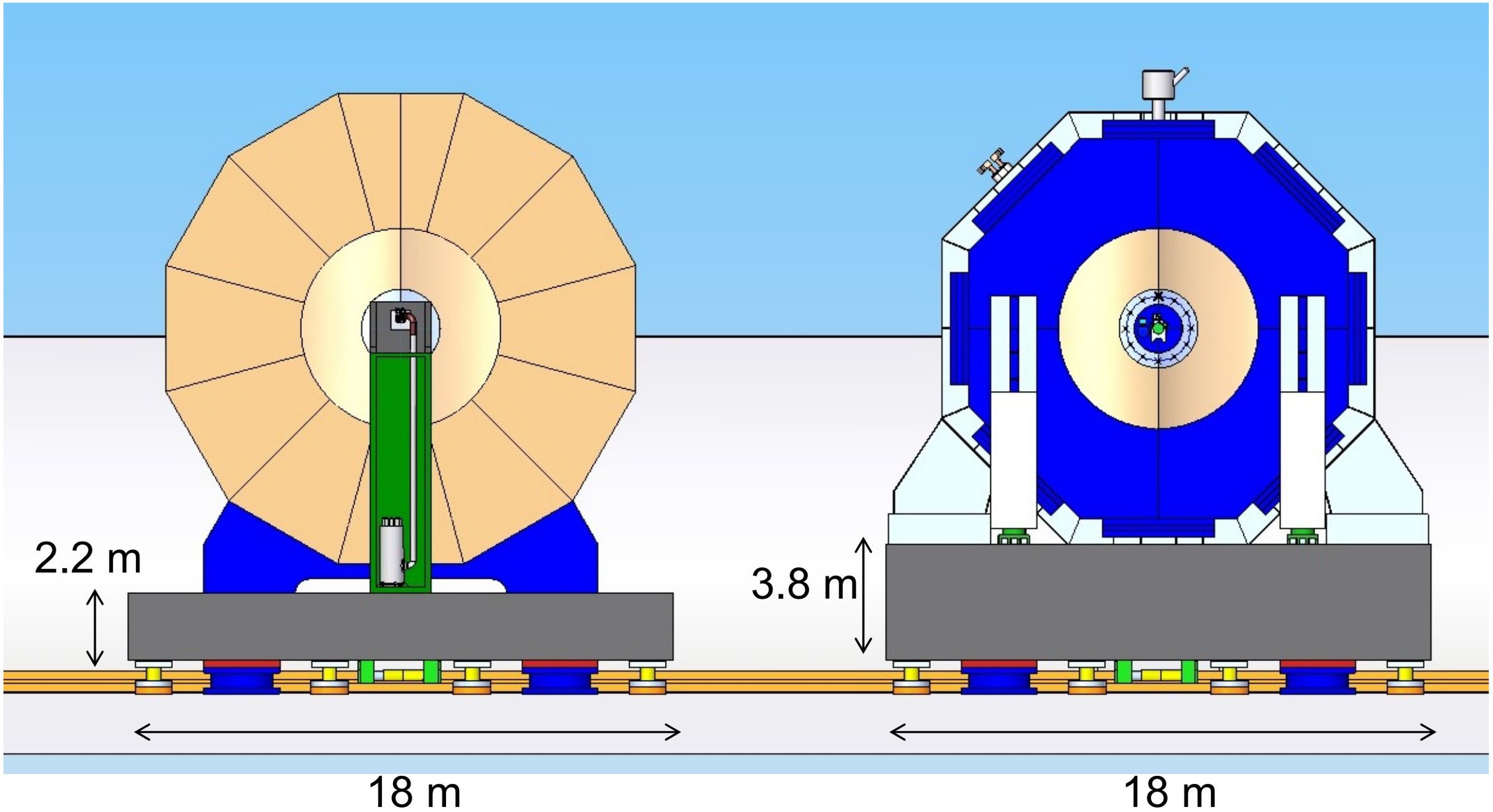


(M. Oriunno)

Alain Hervé, CLIC08 Workshop, 16 October 2008 5

- Common working assumption

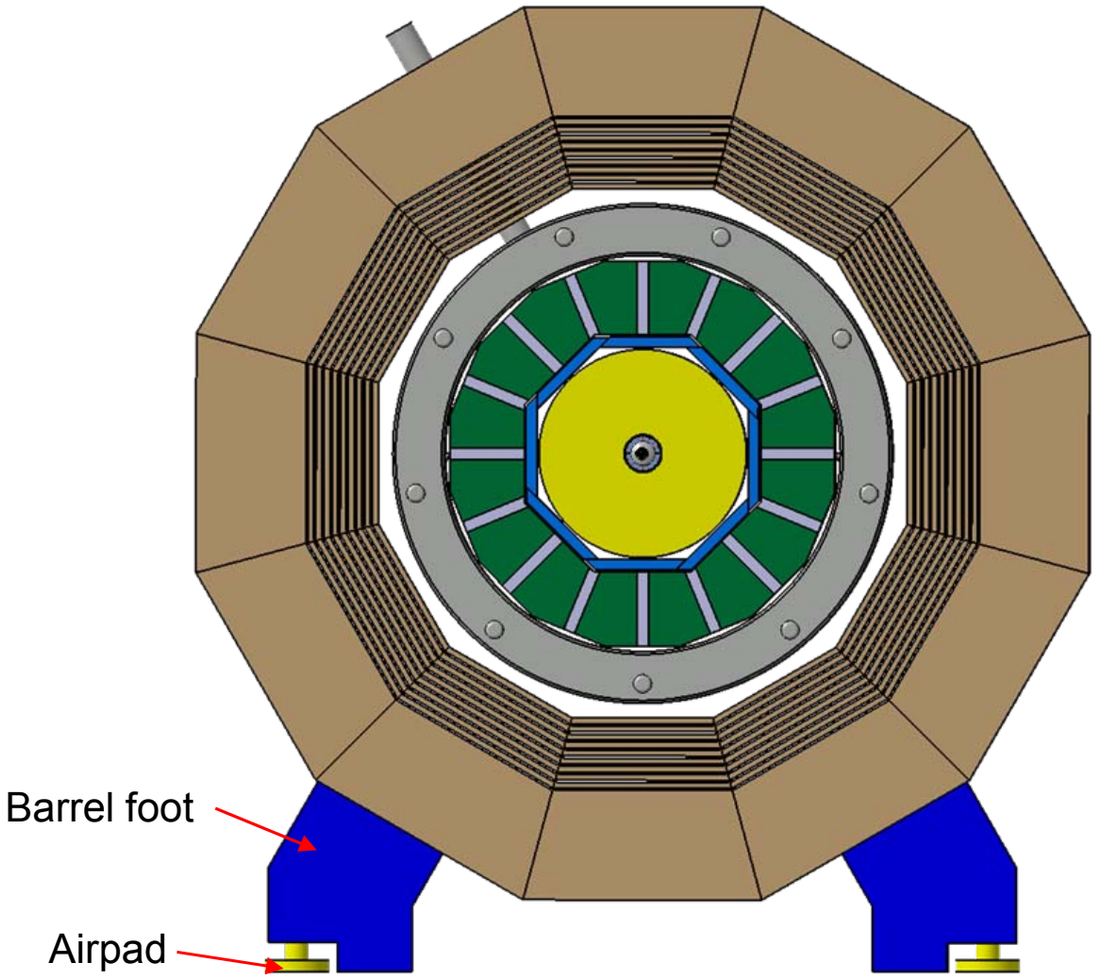
Reducing ILD Beam Height

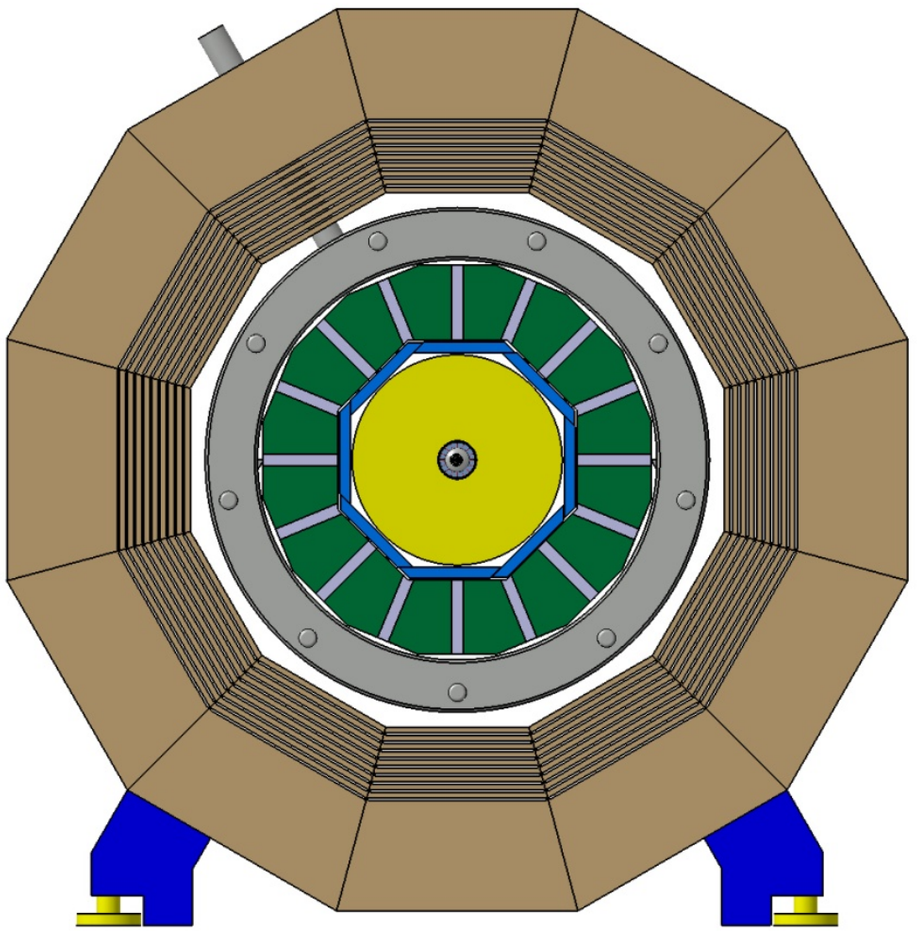


From M. Oriunno @ SiD workshop 2010 after CERN workshop

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

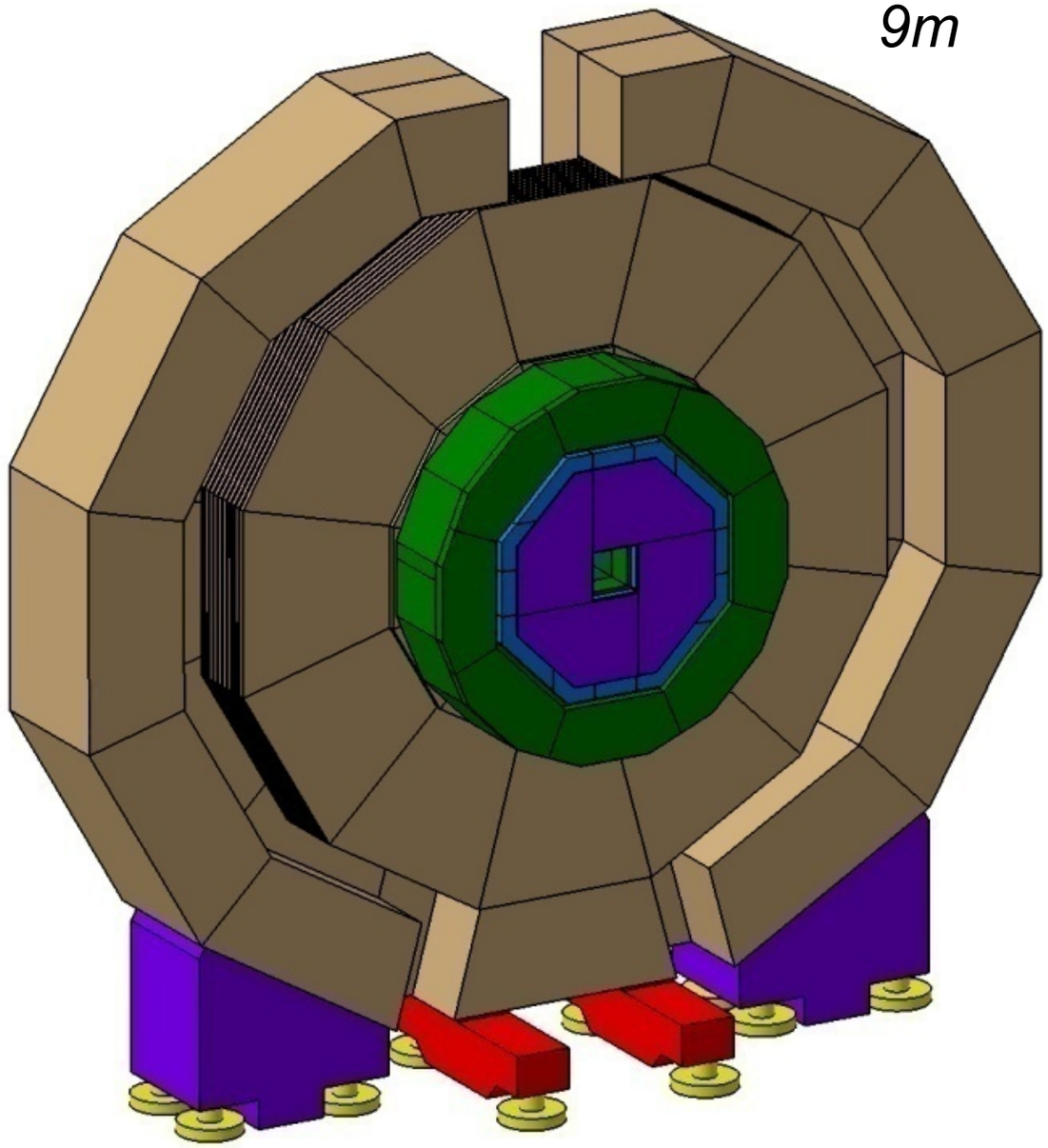
Reducing ILD Beam Height

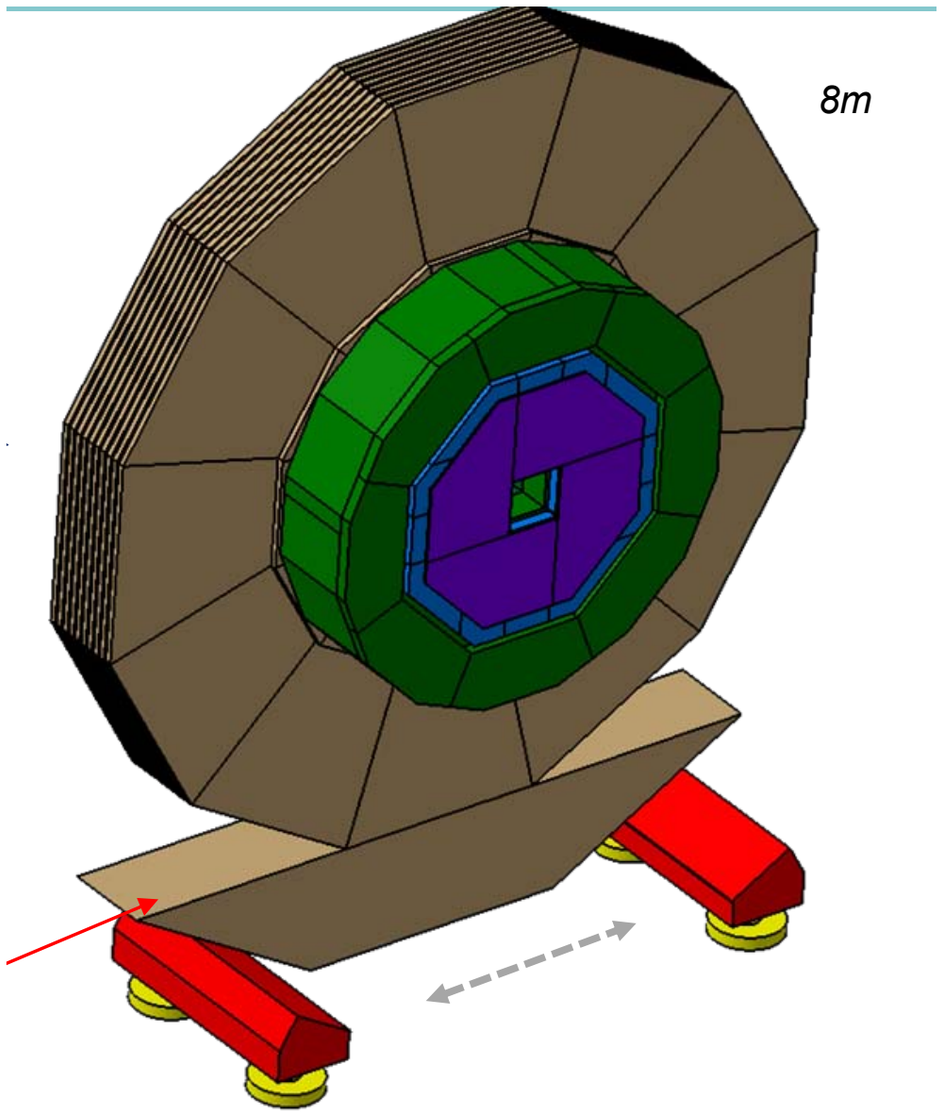




- Barrel yoke modification

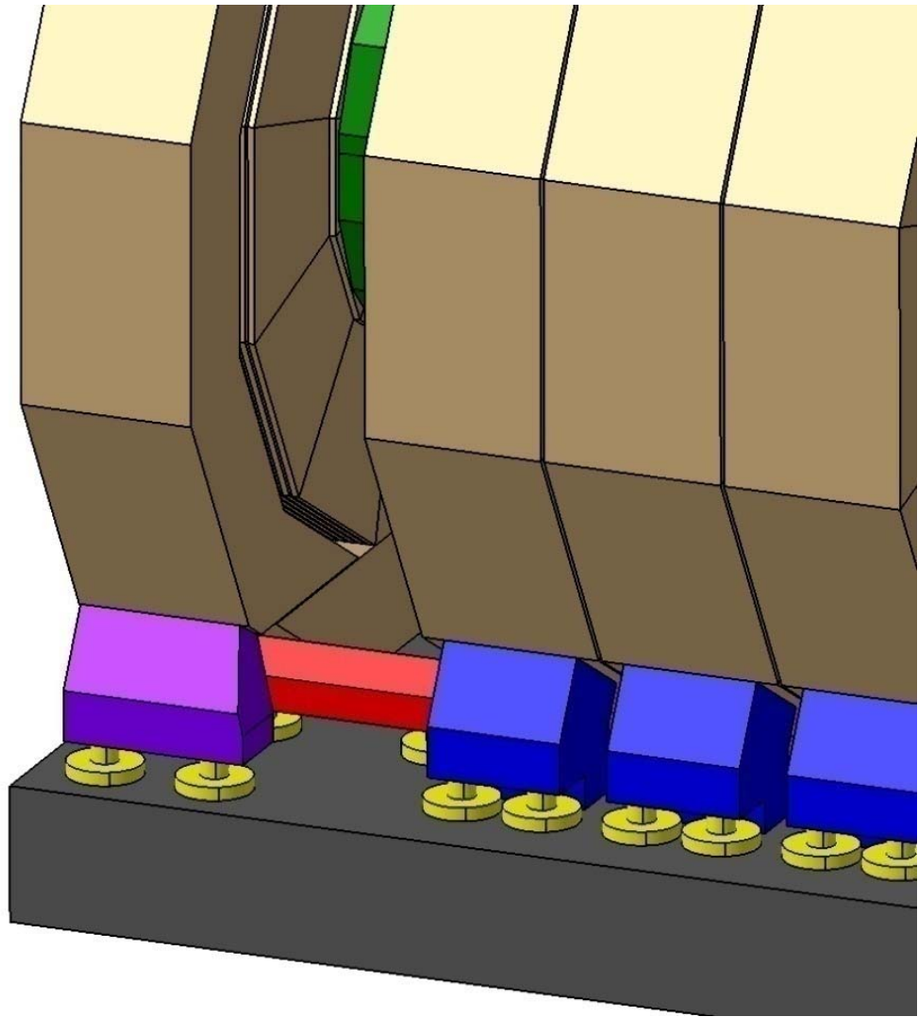
Reducing ILD Beam Height

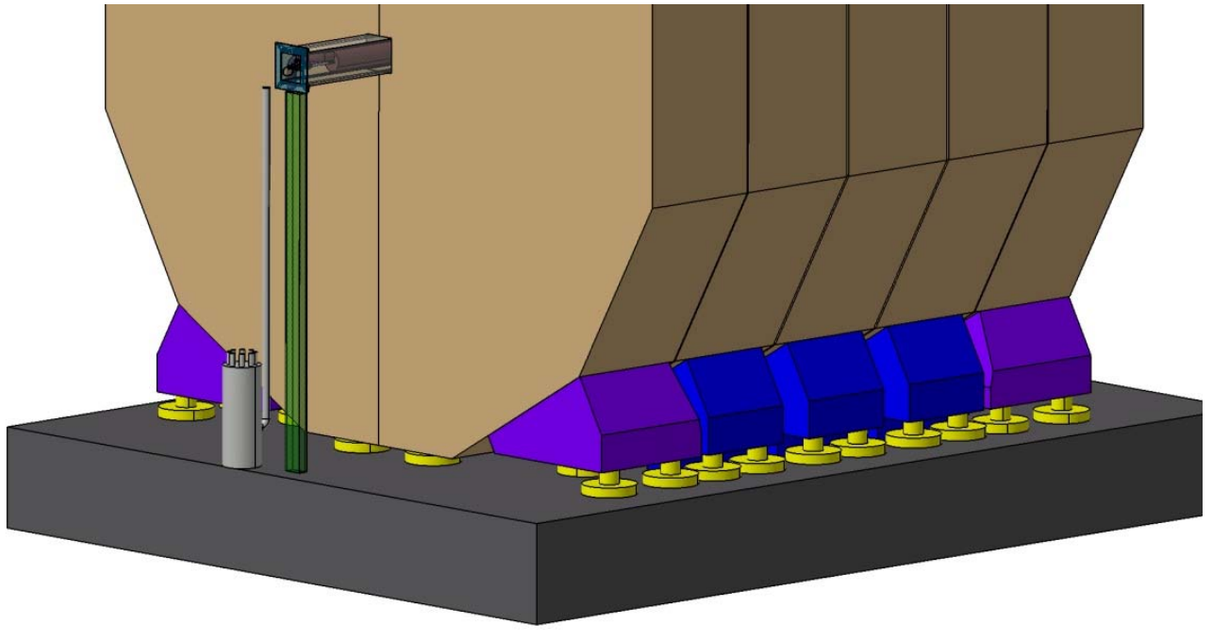


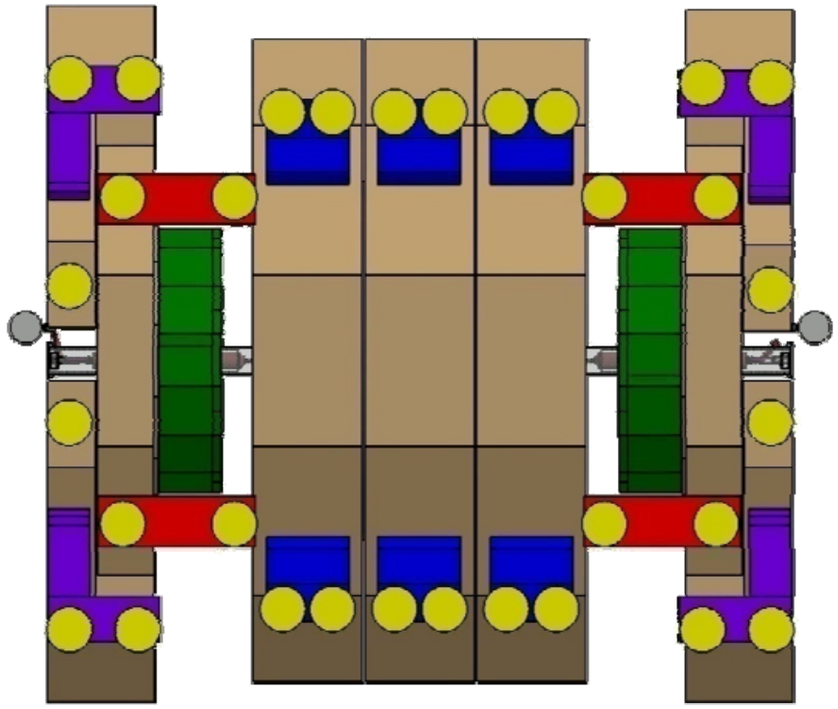


- Endcap yoke is more problematic
  - Split endcap design gets complicated

Reducing ILD Beam Height

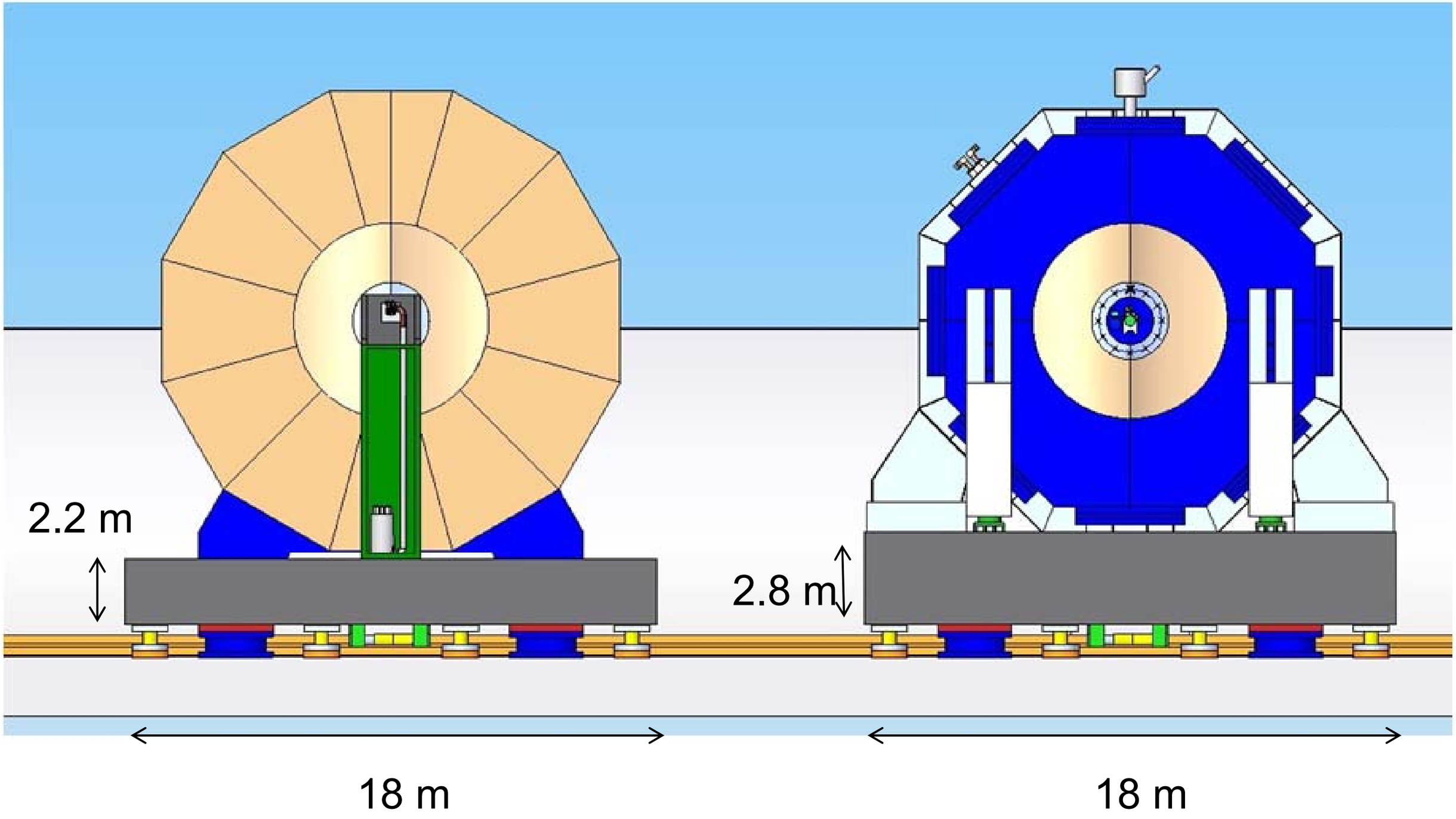






- Possible configuration of feet and airpads

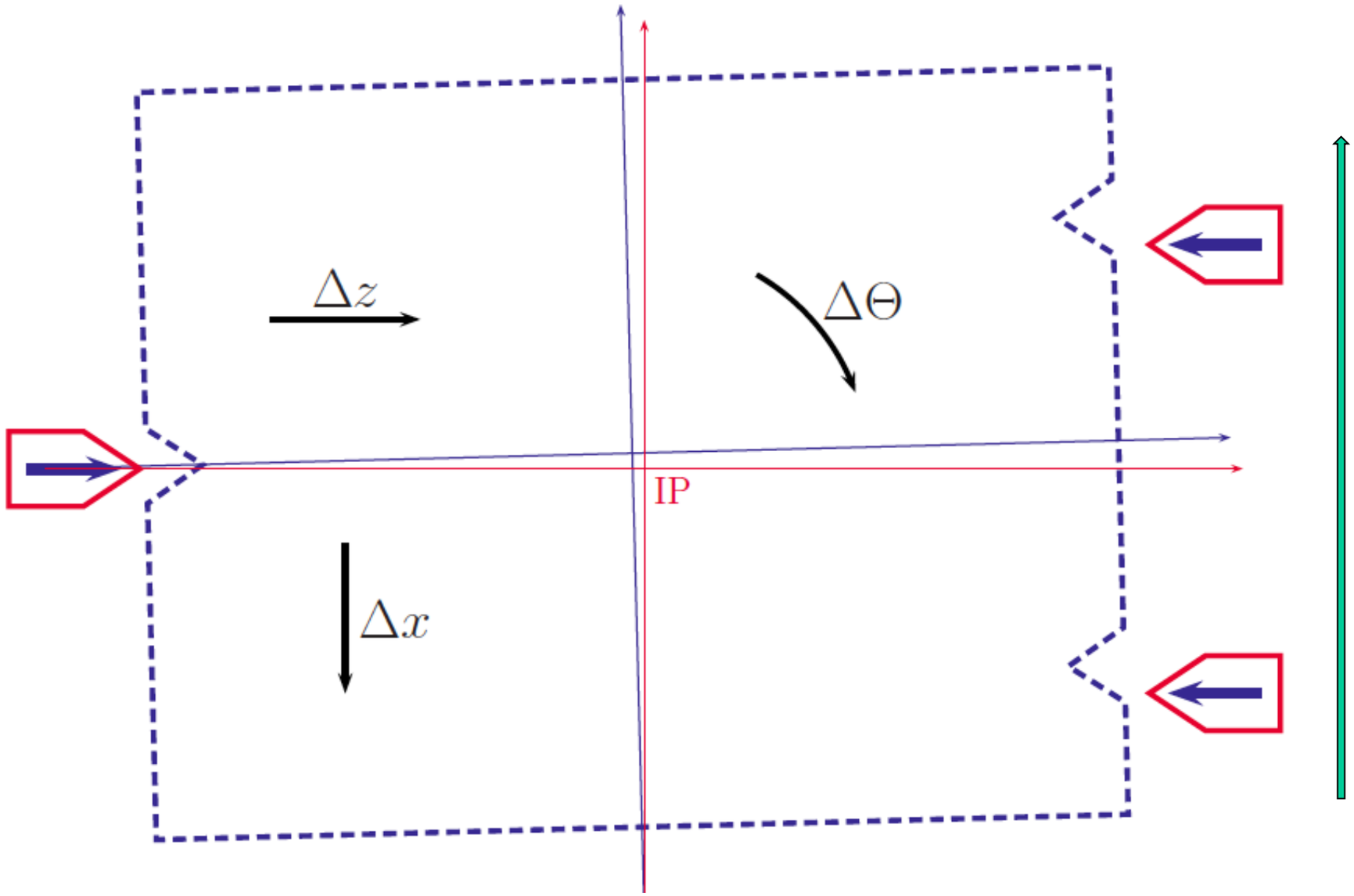
Reducing ILD Beam Height



- Reducing difference to 0.6m
  - 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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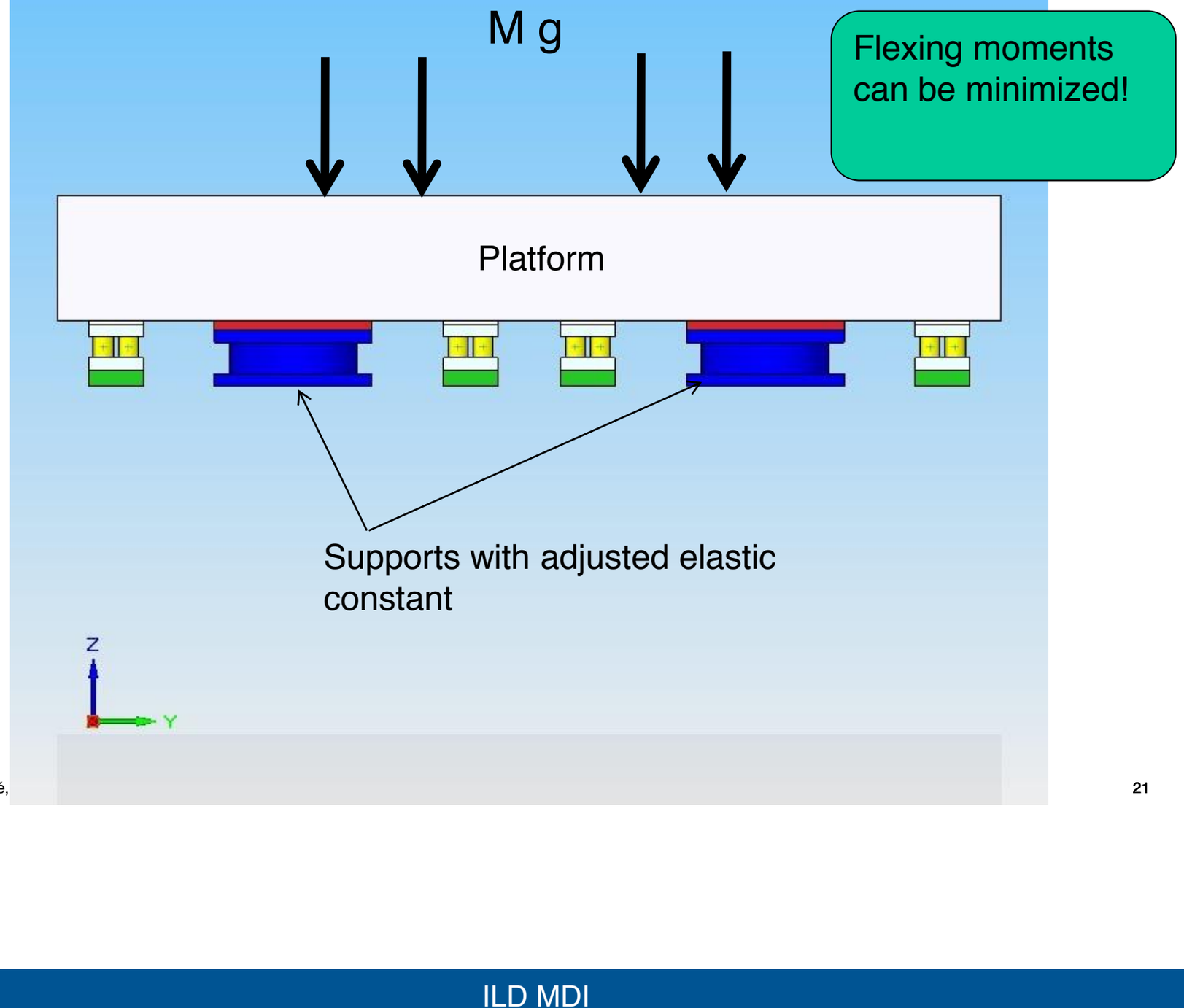
- Final precision: +-1 mm and +- 0.1 mrad

Platform Motion System

ETH Institute for Particle Physics

The load distribution can be optimized

Weight distribution of a typical experiment



Flexing moments can be minimized!

Alain Hervé,

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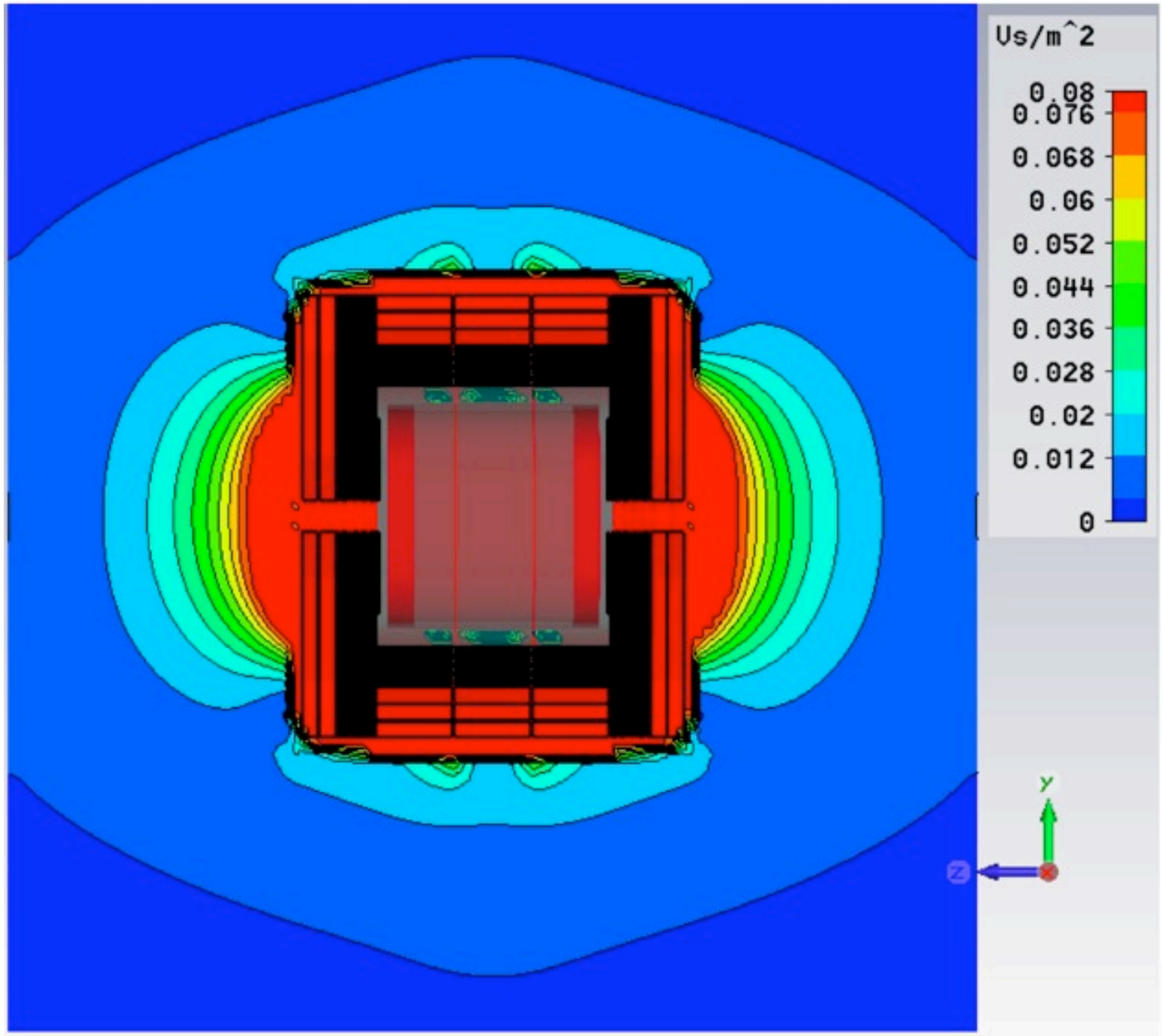
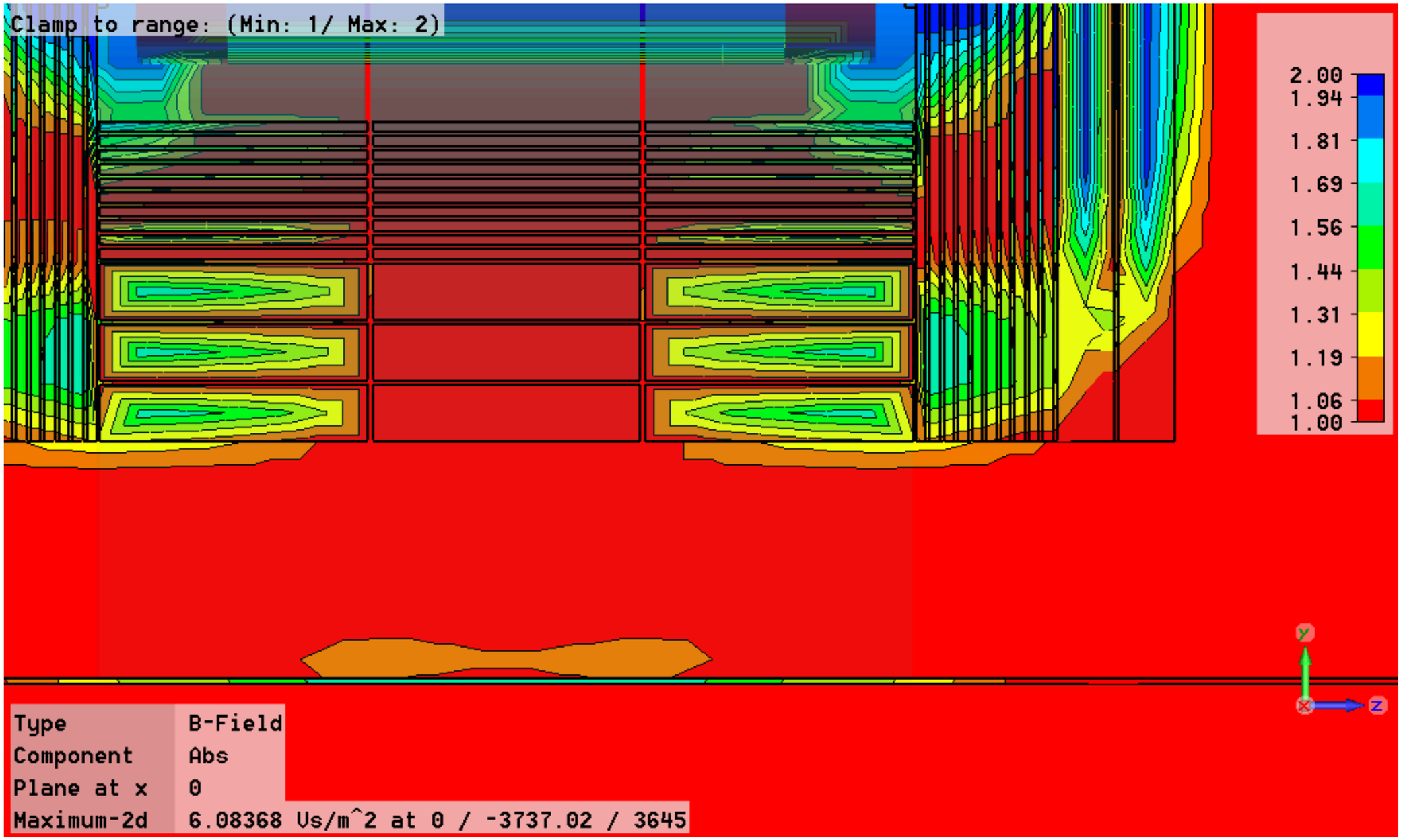
ILD Magnetic Stray Fields



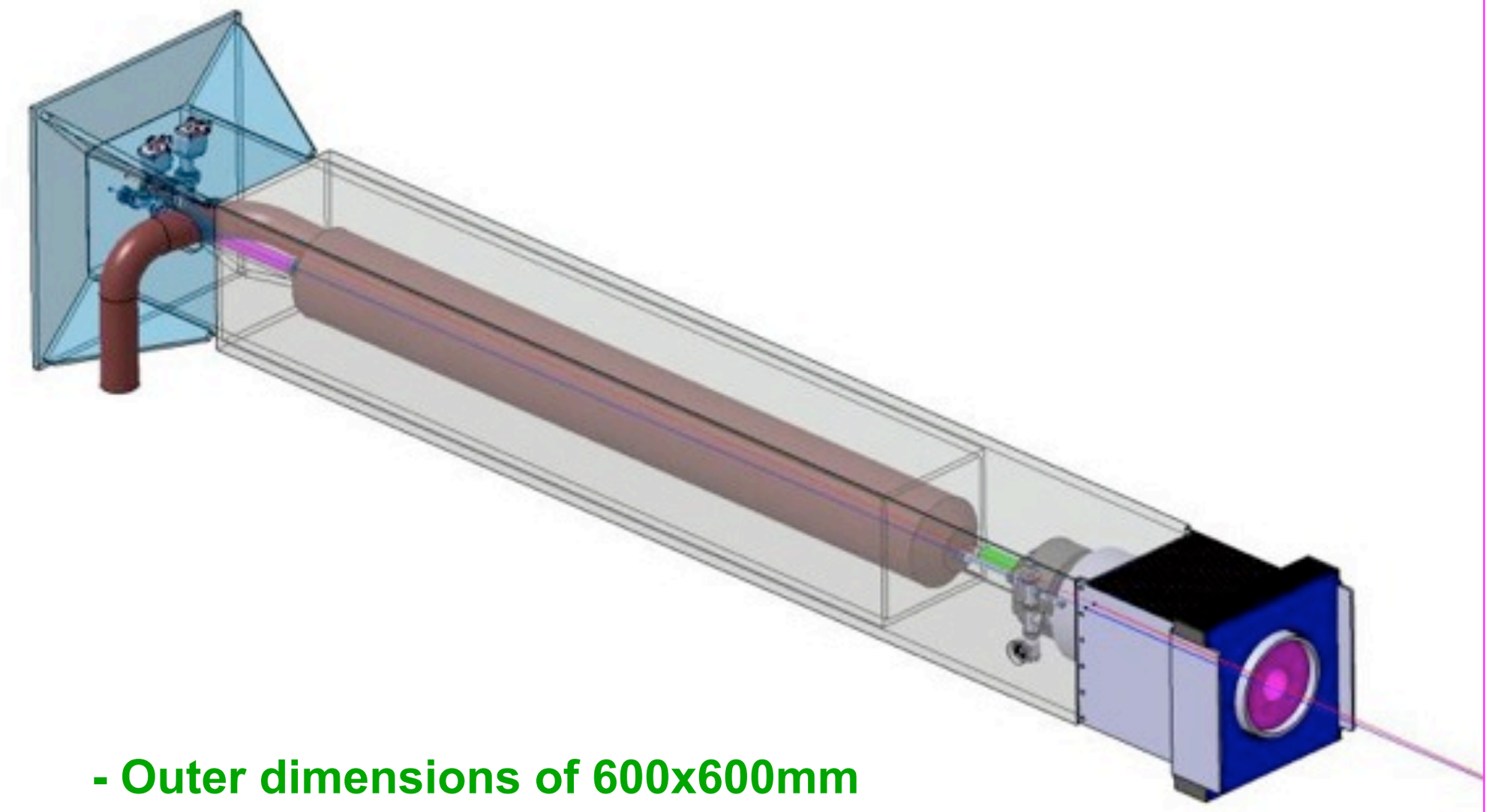
- ILD barrel yoke: ~3m of iron to ensure 5mT at 15m from beam pipe
  - main cause of ILD mass: ~15000 tons

Magnetic Field on Steel Floor



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

QD0 Support

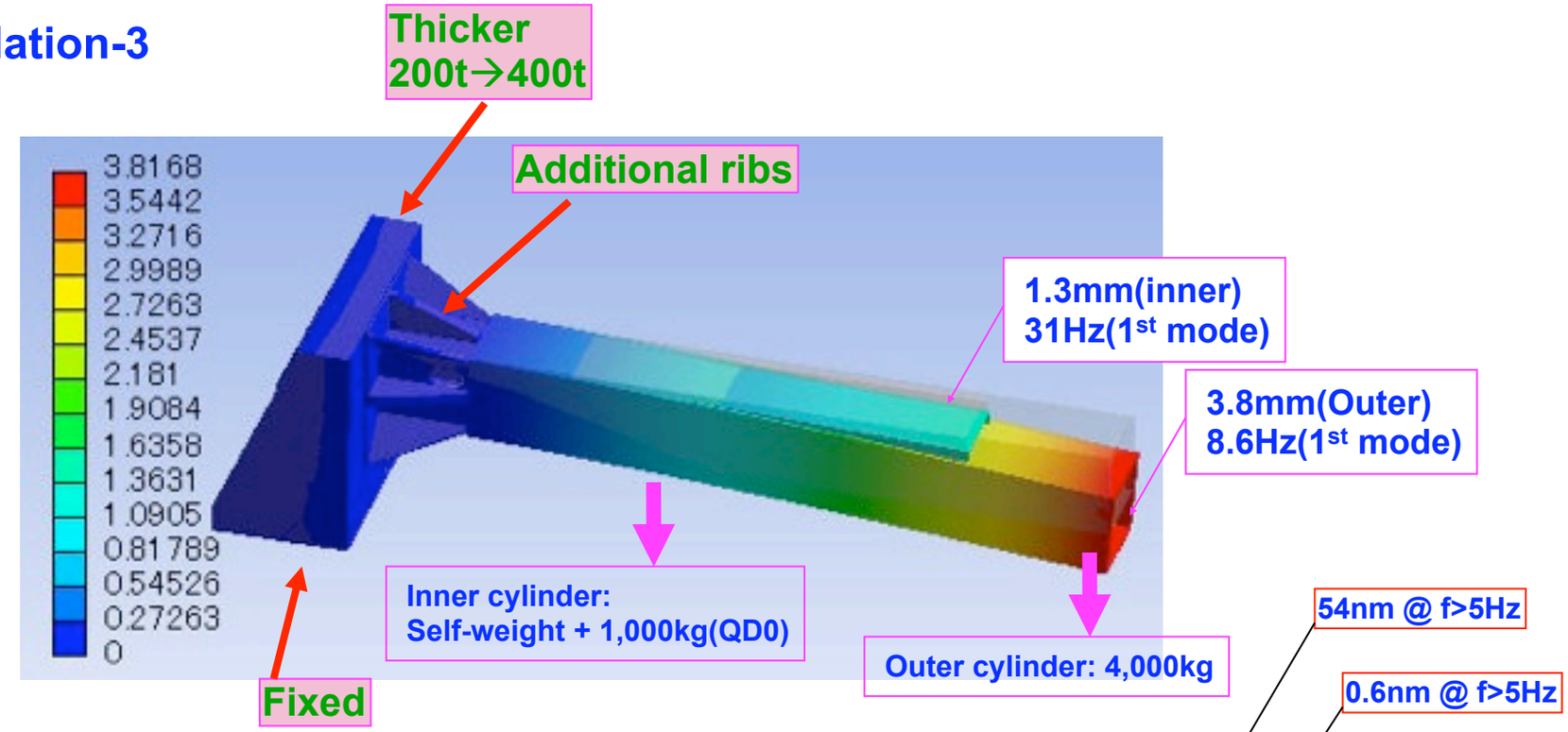


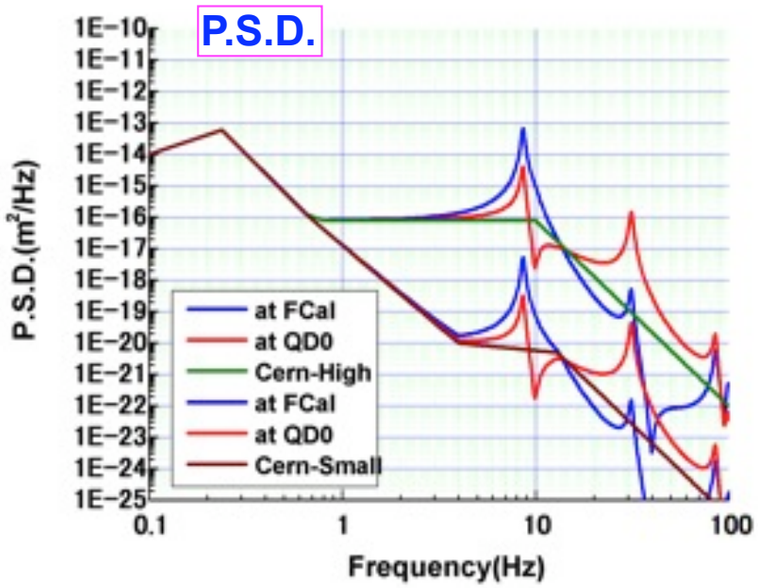
- Outer dimensions of 600x600mm
- 25mm thick

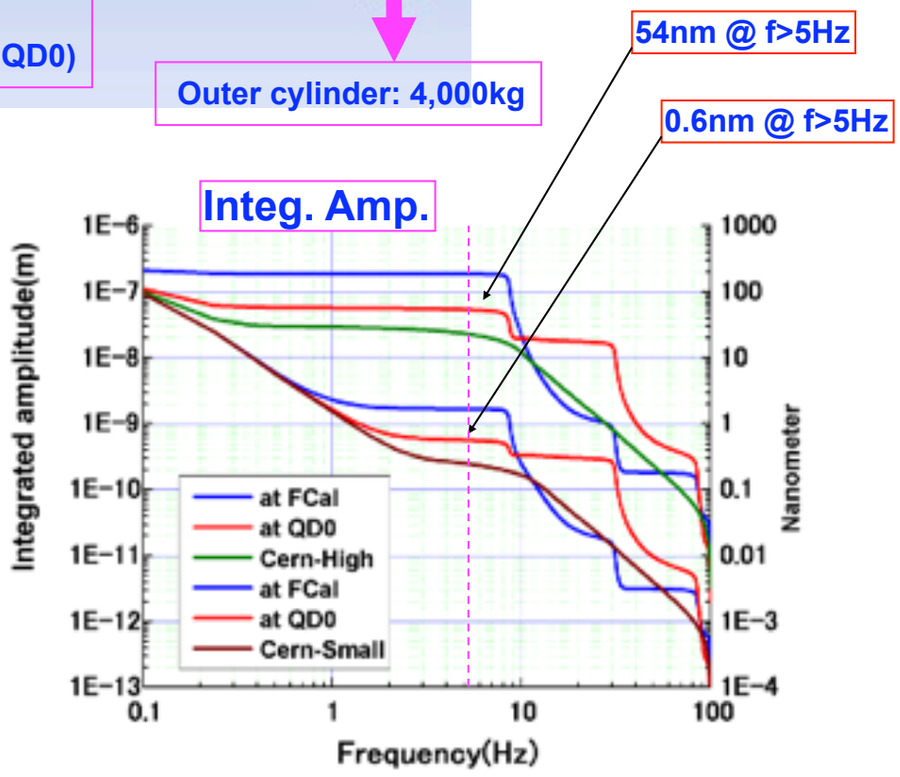
- M. Joré, H. Yamaoka

QD0 Support Vibration Analysis

Calculation-3







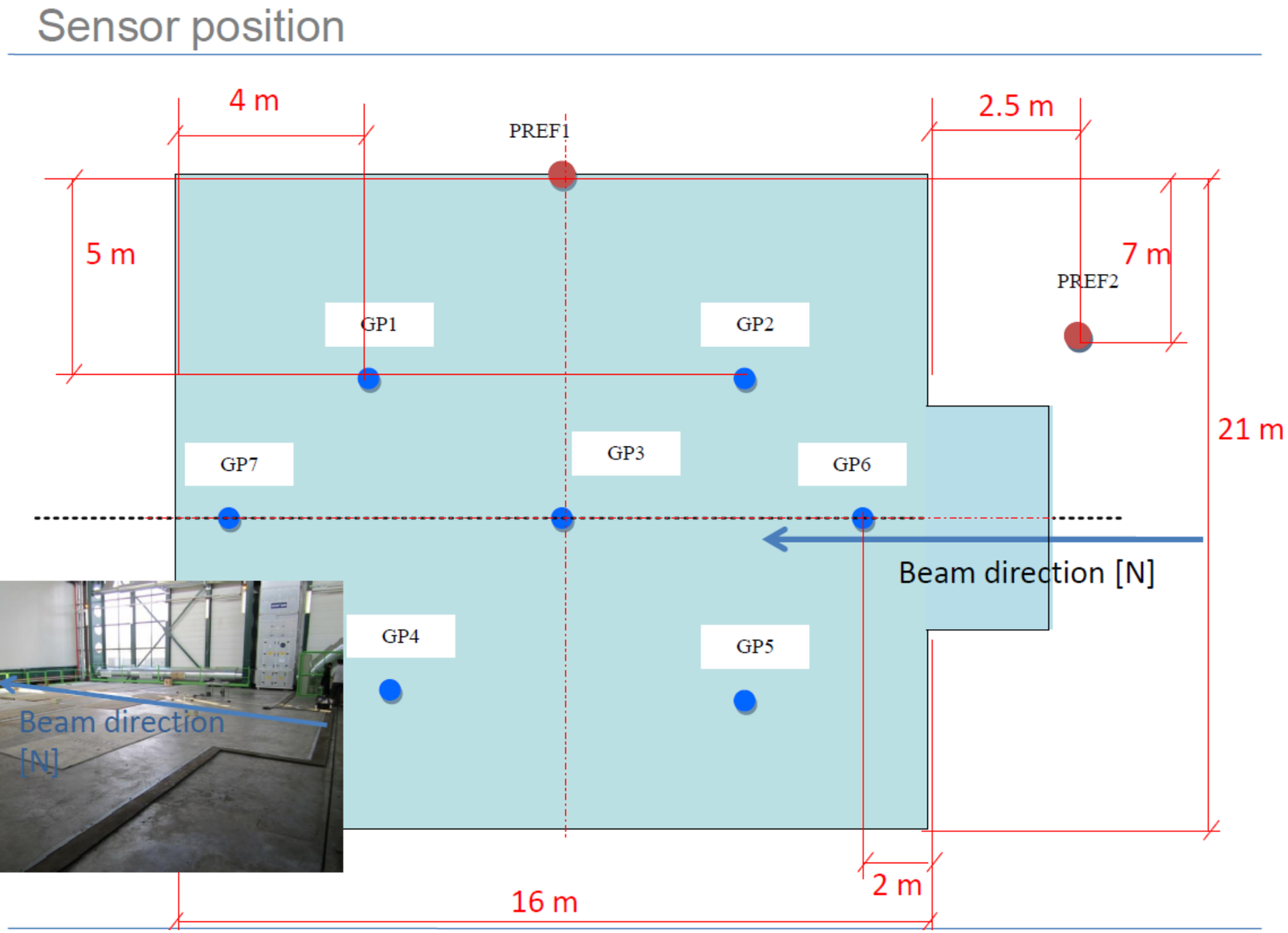
- H. Yamaoka
- Ok for quite site

Vibration Issues

ETH Institute for Particle Physics

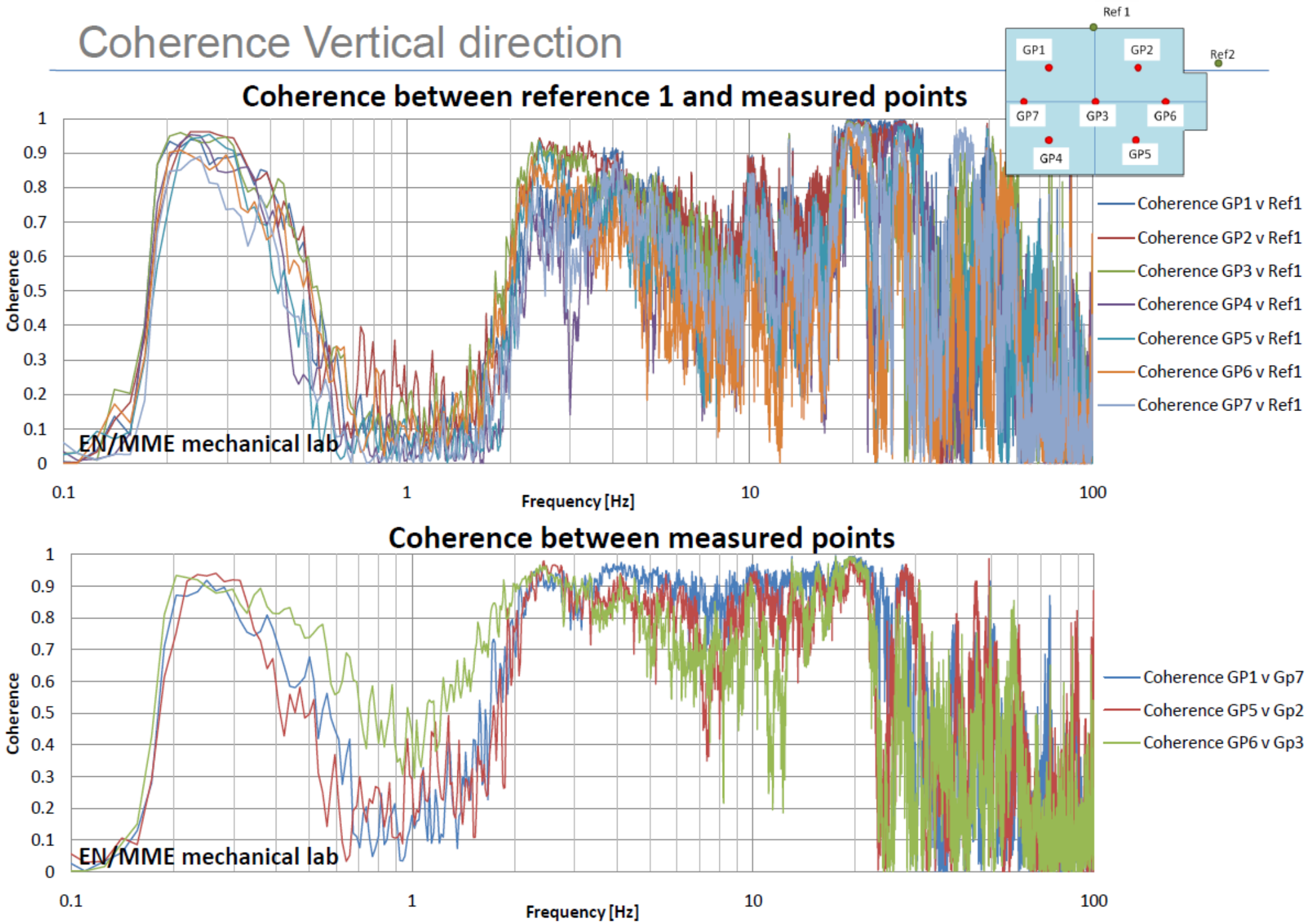
CMS Plug finished

Platform Vibration Measurements and Modelling



- M. Oriunno

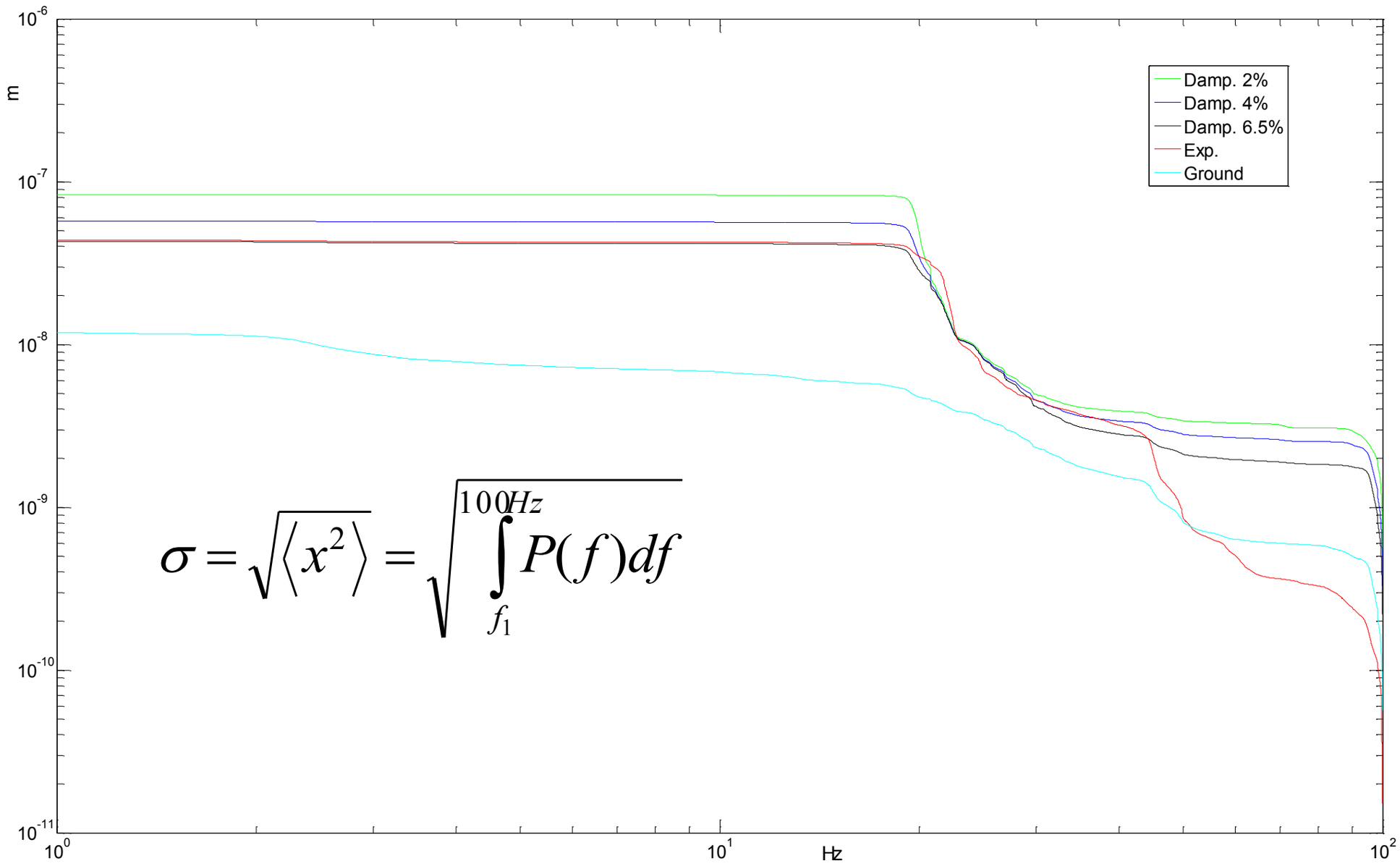
Platform Vibration Measurements and Modelling



- M. Oriunno

Platform Vibration Measurements and Modelling

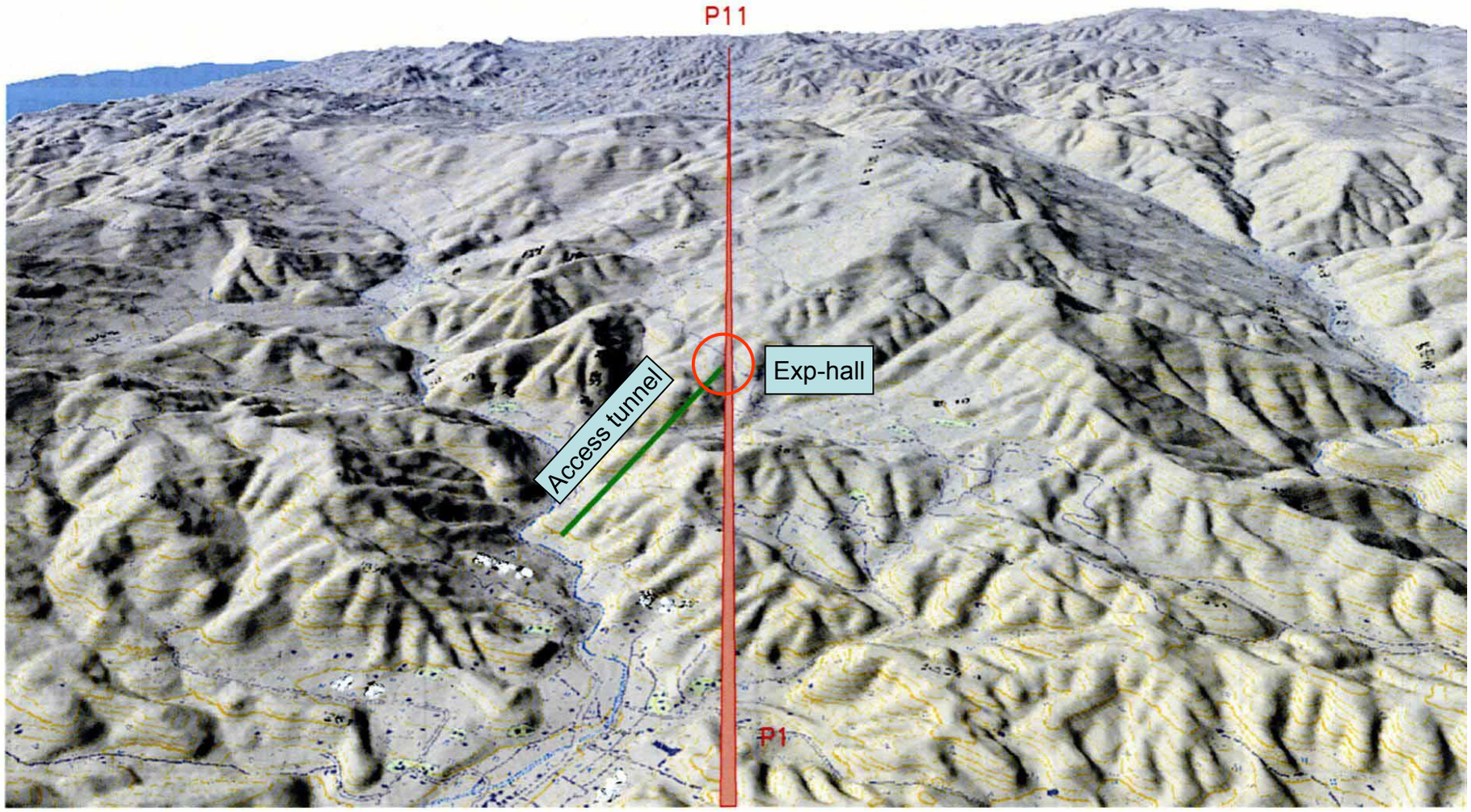
Integrated Displacement (r.m.s.)



- Ground motion amplification of factor ~3

Alternative Detector Assembly Studies (Y. Sugimoto)

An example of Asian mountain site



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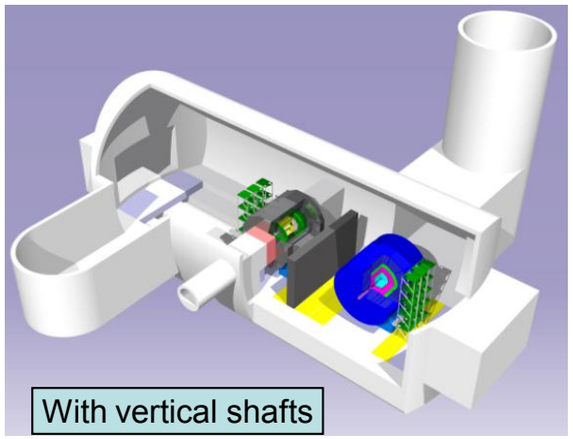
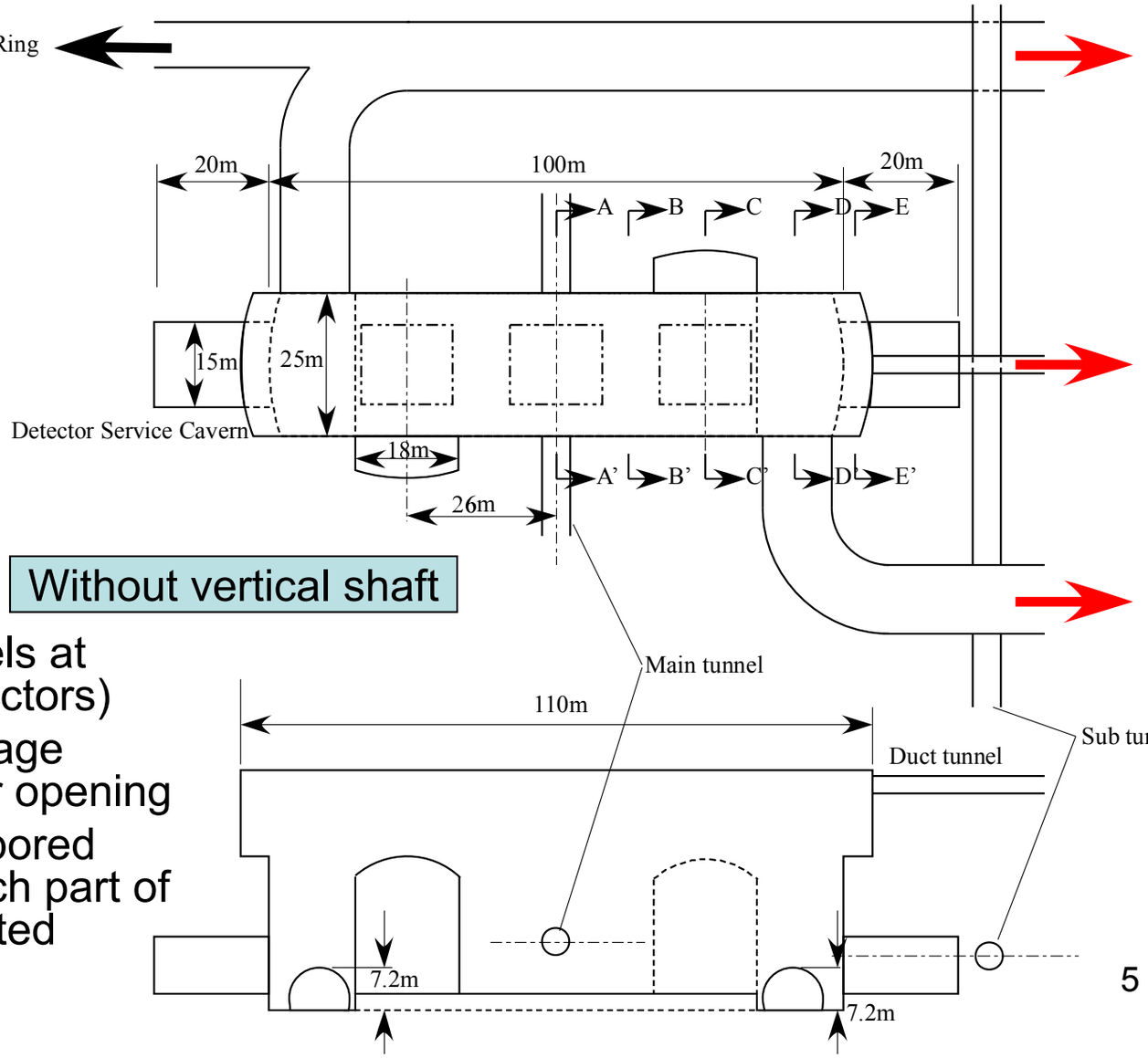
- ILC site could be quite different from „plain field“ assumptions
- No vertical access shafts (~100m) but horizontal access tunnels (~1km)
- CMS-type assembly of detector needs to be reviewed

Alternative Detector Assembly Studies (Y. Sugimoto)

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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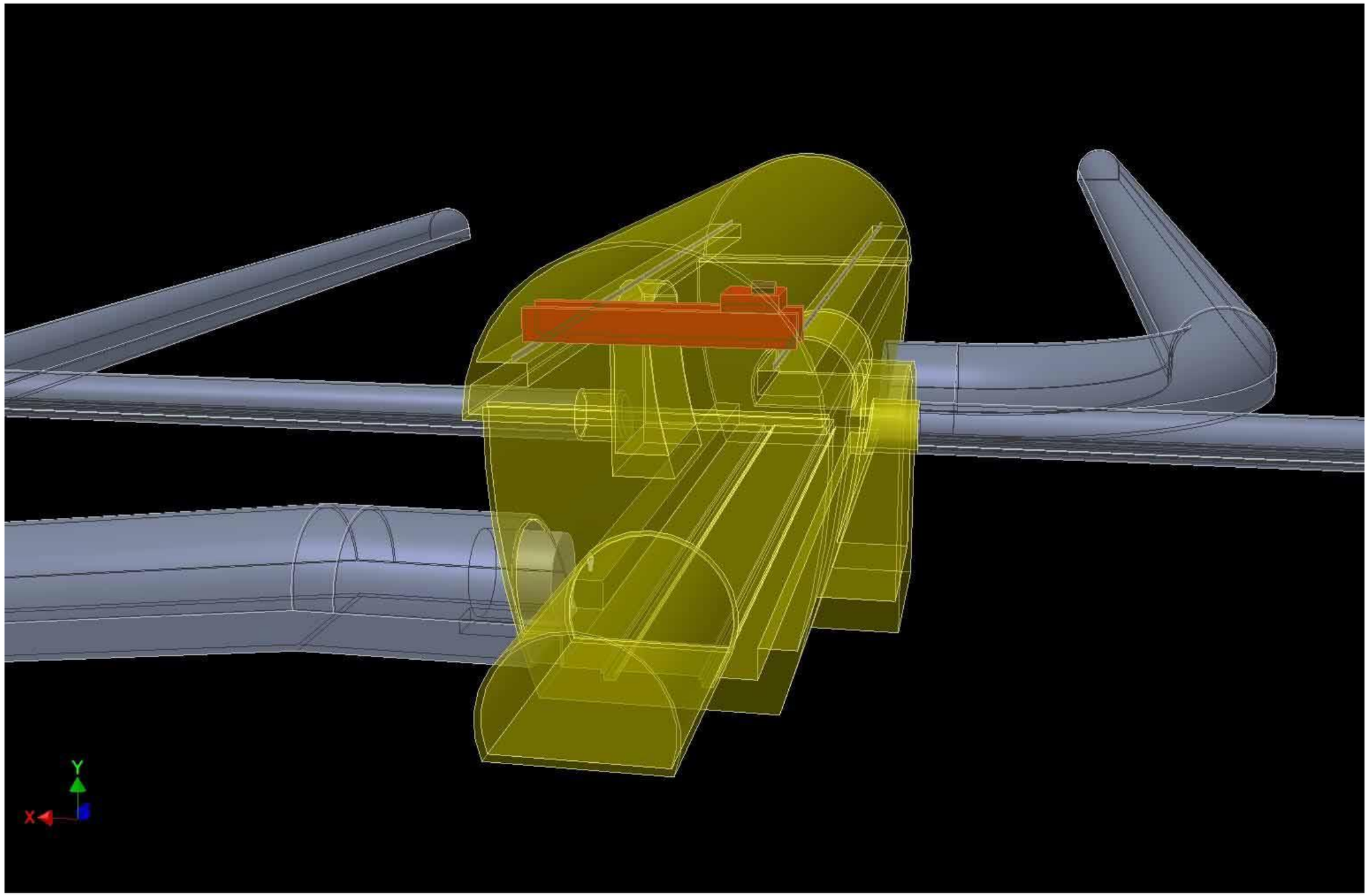
Alternative Detector Assembly Studies (Y. Sugimoto)



Who is doing what in ILD

- Hall design and push-pull system:
  - MDI group: ETH-Zürich, LAL, LLR, DESY, CERN, KEK
  - Collaboration with SiD, GDE-CFS, GDE-BDS and CLIC is natural
- Vibration studies:
  - System: ground - platform - detector - FF magnets
  - Simulations at KEK, LAL and SiD
  - Measurements at CERN (CMS)
- Magnet and Yoke
  - Magnet: CEA, ETH-Zürich, CERN
  - Yoke: DESY
- Subdetector integration mostly done in the R&D collaborations:
  - CALICE, LC-TPC, SILC, FCAL, Vertex
  - Coordination of subdetector design and ILD integration model is not always easy
- Detector models
  - Detailed CAD model of ILD: LAL (M. Joré)
  - Integration model defining workspaces for subdetectors and supplies: DESY (R. Volkenborn)
  - EDMS integration: Work Breakdown Structure, Required Documents: LLR, DESY

Summary

- The list of tasks is long, the time to the DBD/RDR is short:
  - The underground hall design presented in the RDR is not optimal for ILD
    - Common design needed that fits ILC, SiD, ILD and is aligned with the push-pull paradigm
    - Common collaboration between ILD, SiD, ILC-BDS and ILC-CFS started
    - Site-specific modifications need to be taken into account
  - A platform based push-pull motion system seems feasible but needs detailed engineering work
    - Common collaboration between ILD, SiD, ILC-BDS and ILC-CFS started
    - Detector integration is ongoing
      - close collaboration with R&D collaborations
      - CAD/EDMS process is evolving
      - Need to define list of required supporting documents for the WBS

- All tasks are unfortunately resource-driven and not goal-driven
  - The content of the DBD will be defined by the work done, not by the work planned