MDI and Integration in the LoI

Overview and Summary

Karsten Buesser

ILD Workshop

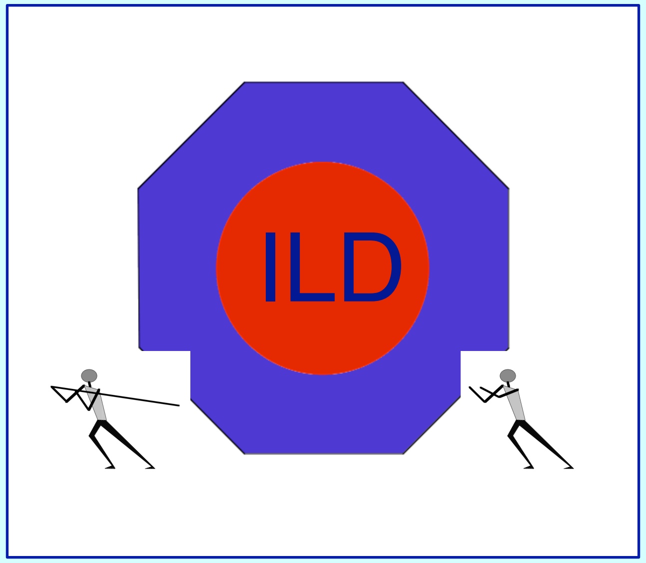
Seoul

18.02.2009

LoI Sections

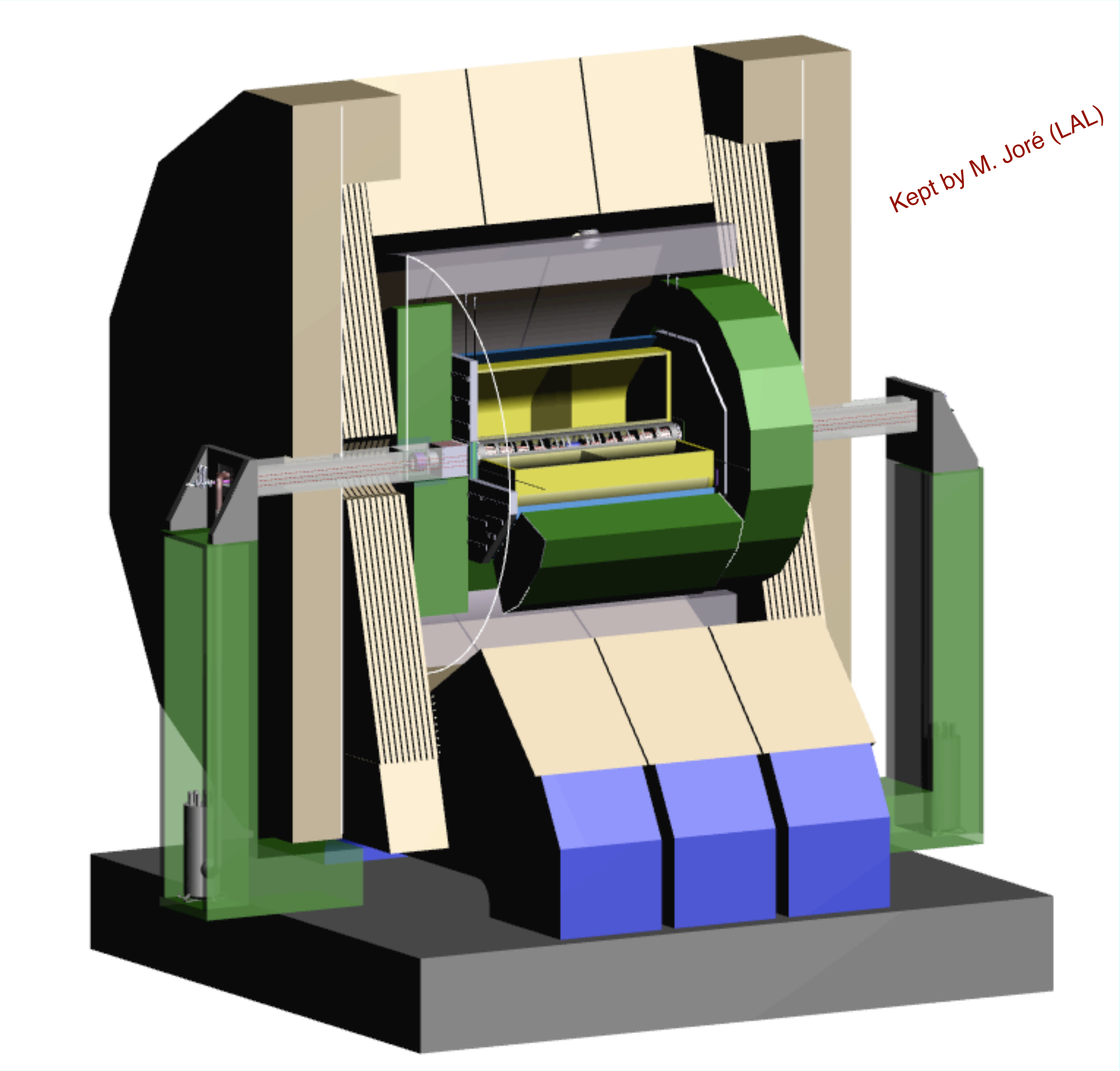
- Detector Integration
  - Mechanical concept
    - Cabling scheme
  - Detector assembly and opening
  - Civil facilites and services
    - Detector services
    - Surface assembly hall
    - Underground experiment hall
  - Push-pull operations
    - Moving ILD
    - Shielding
    - Alignment and Calibration
- Integration with the accelerator (MDI)
  - Interaction region
    - Beam pipe
    - Masking scheme
    - Support of final focus magnets
  - Machine induced background
  - Provisions for Low-P parameter set
  - Measurement of energy and polarisation

Coil and Yoke chapter not part of this talk!



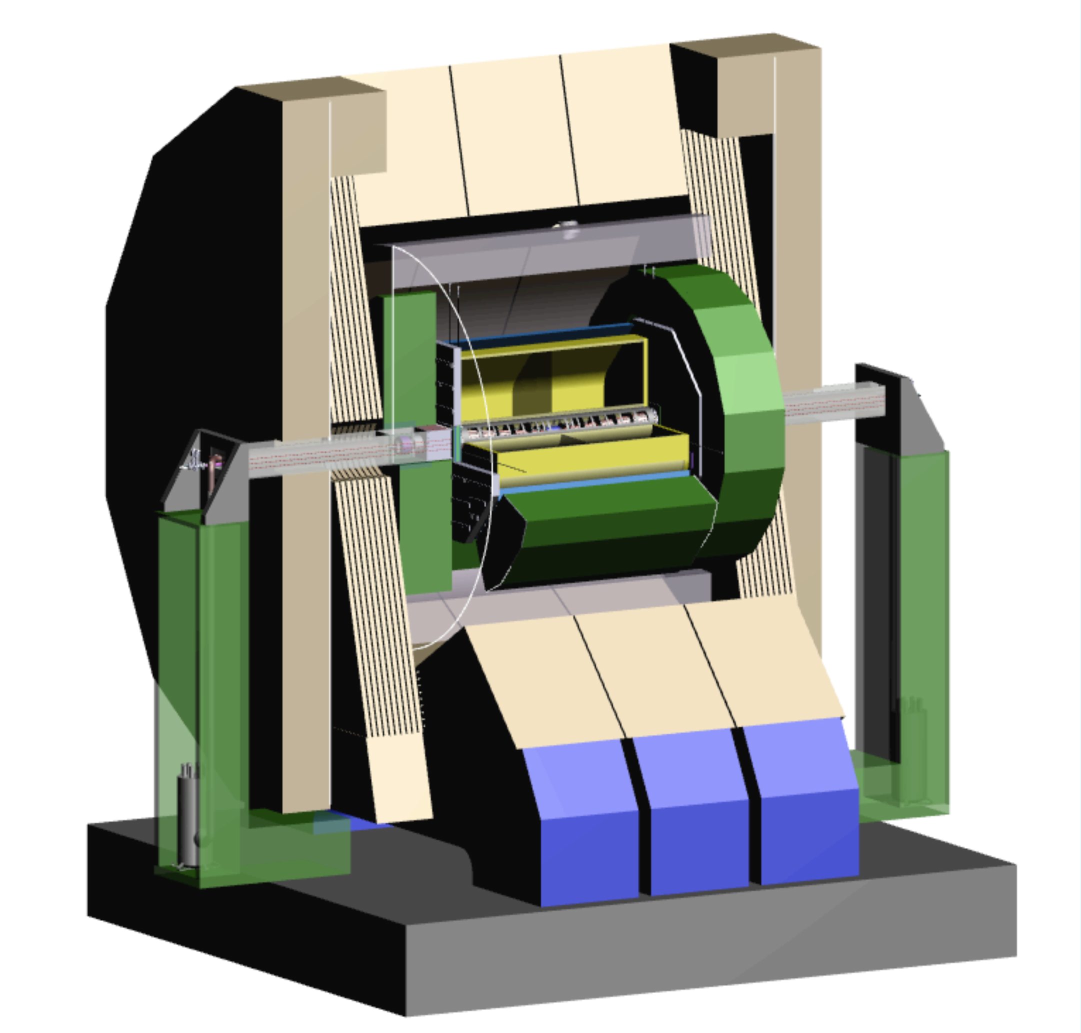
A. Gaddi

ILD Detector Model

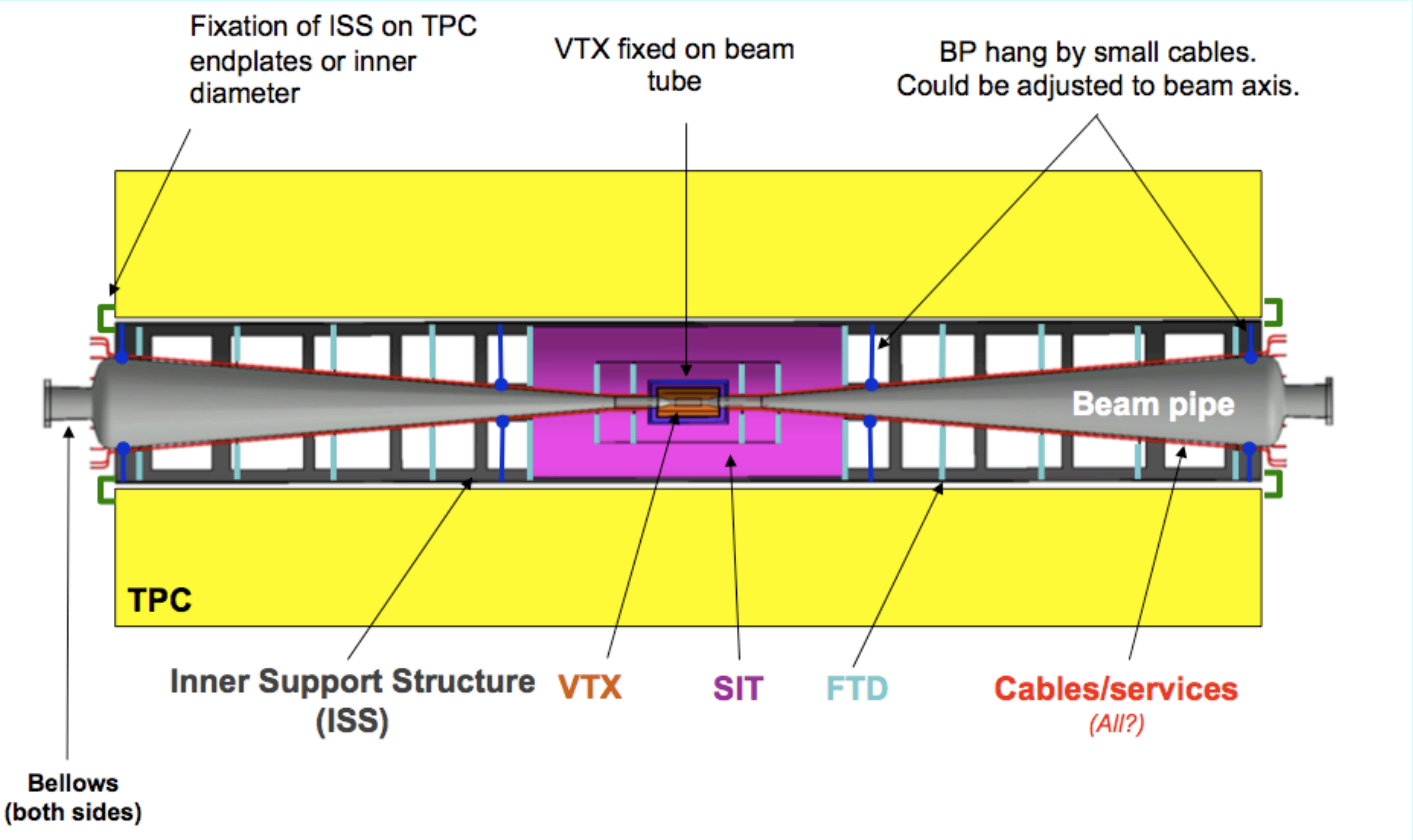


Mechanical Concept

- platform for push-pull
- 3 barrel yoke rings, 2 endcaps
- central yoke ring carries cryostat with coil and barrel calorimeters
- endcap yoke carries endcap calorimeters
- TPC and SET suspended from cryostat
- Inner silicon detectors in support structure (CFRP) supported from TPC
- QD0 magnet and forward calorimeters carried by pillar, suspended from coil cryostat with tie-rods

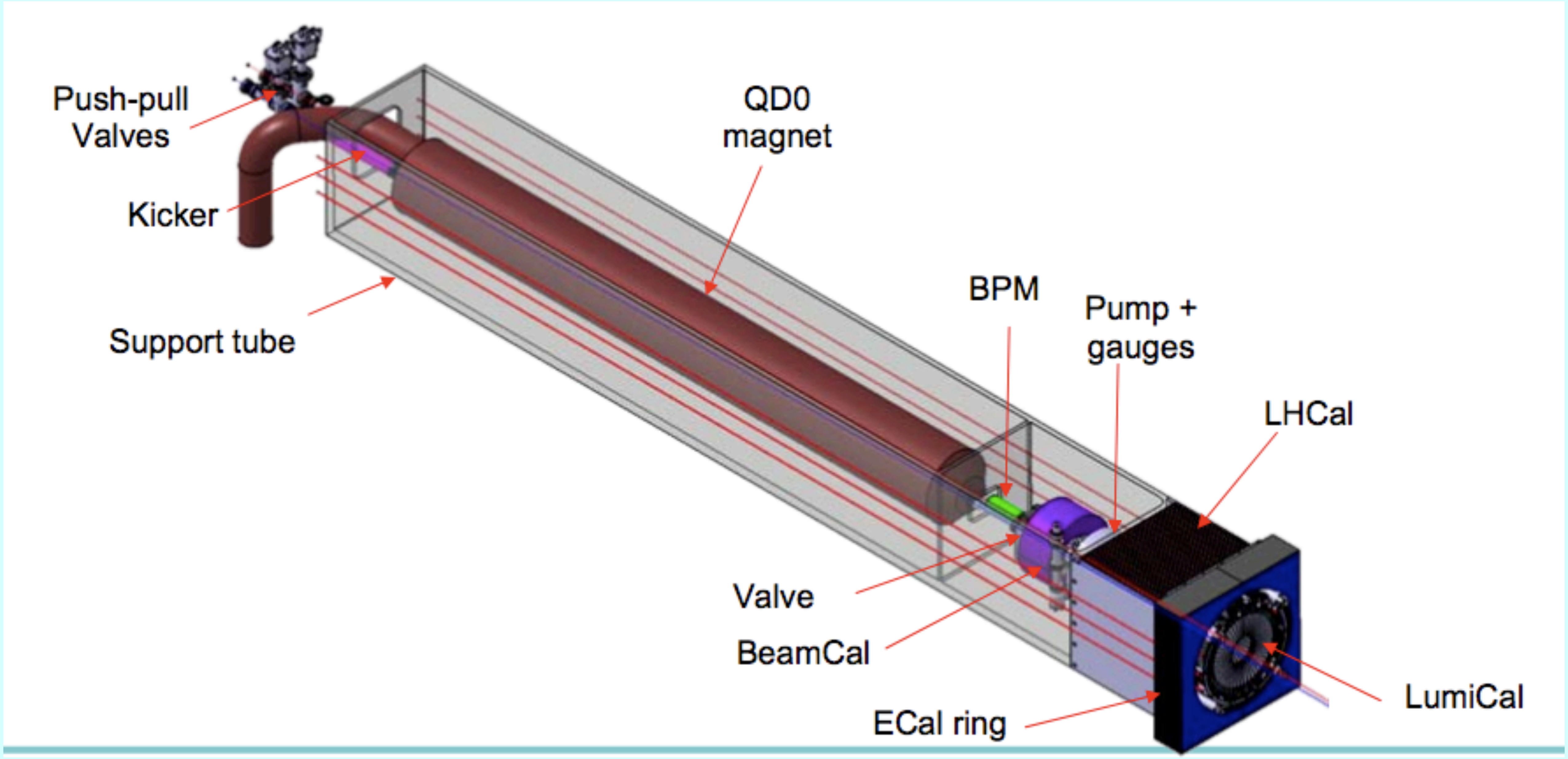


Inner Detector Support

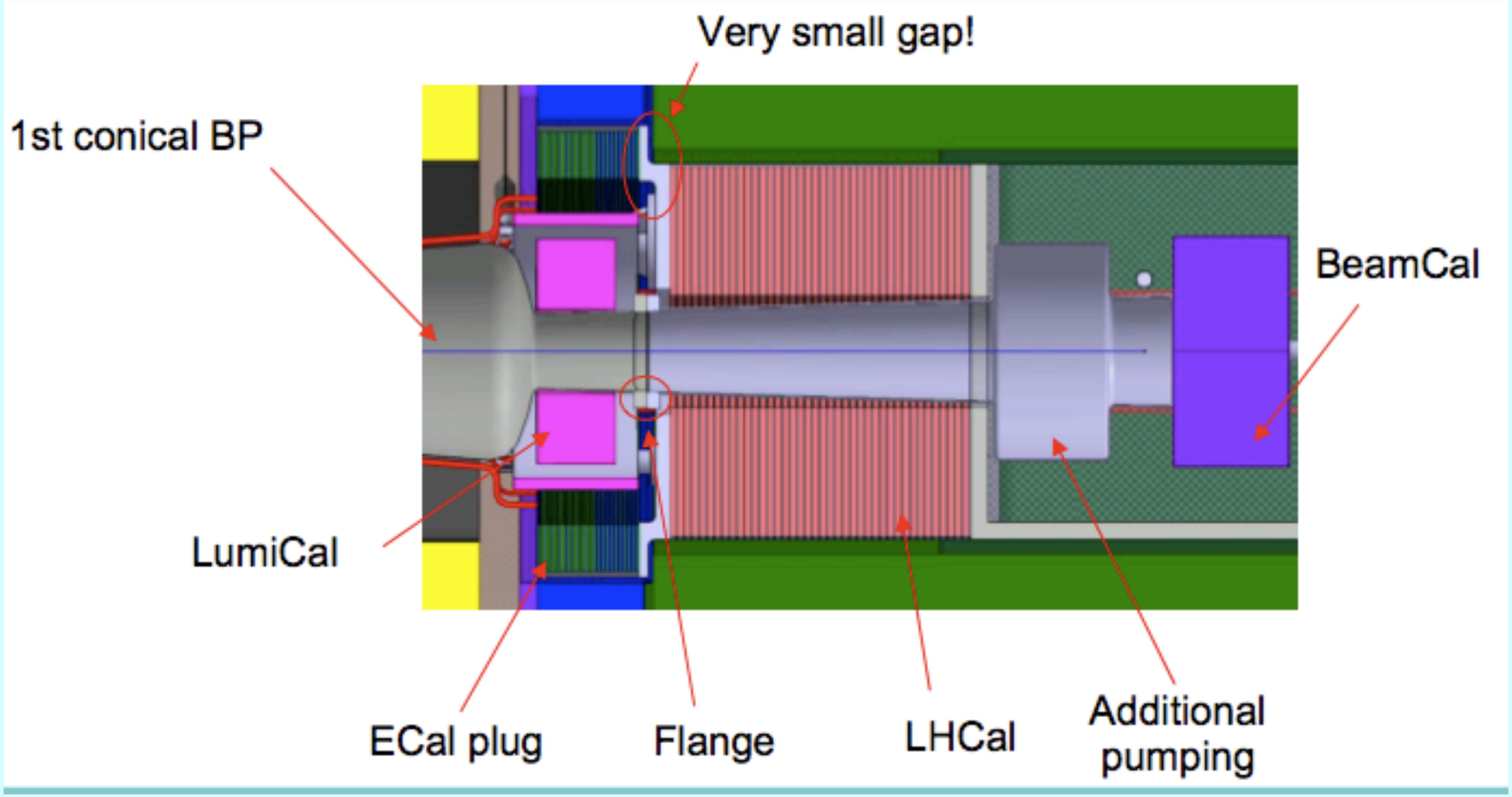


QD0 Support

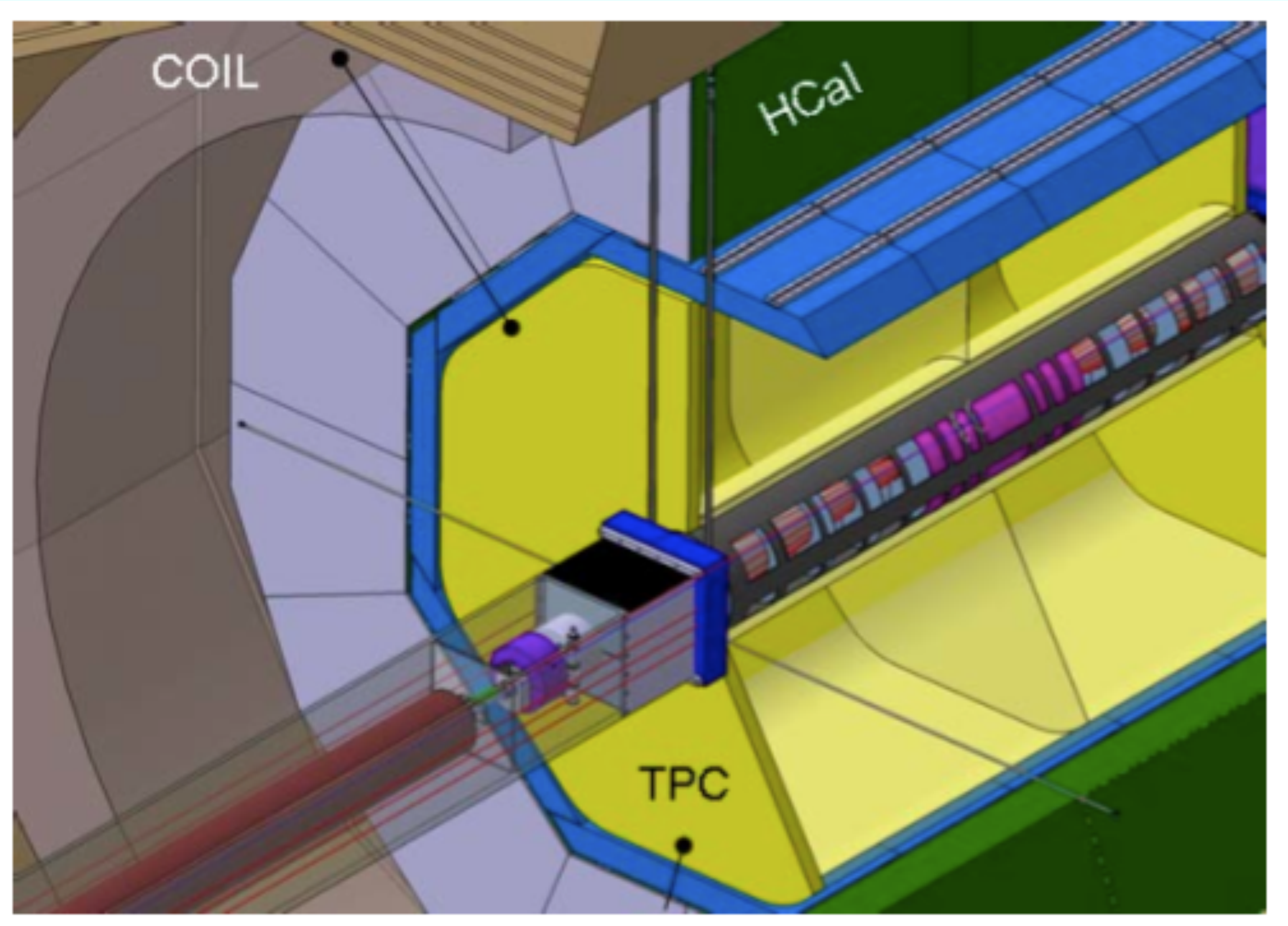
- Suspended from pillar and tie-rods

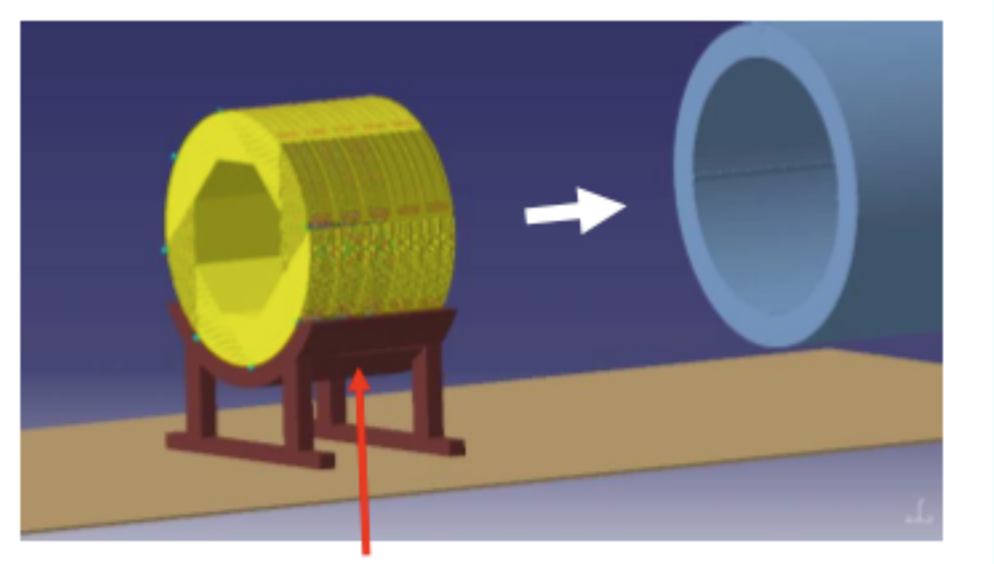


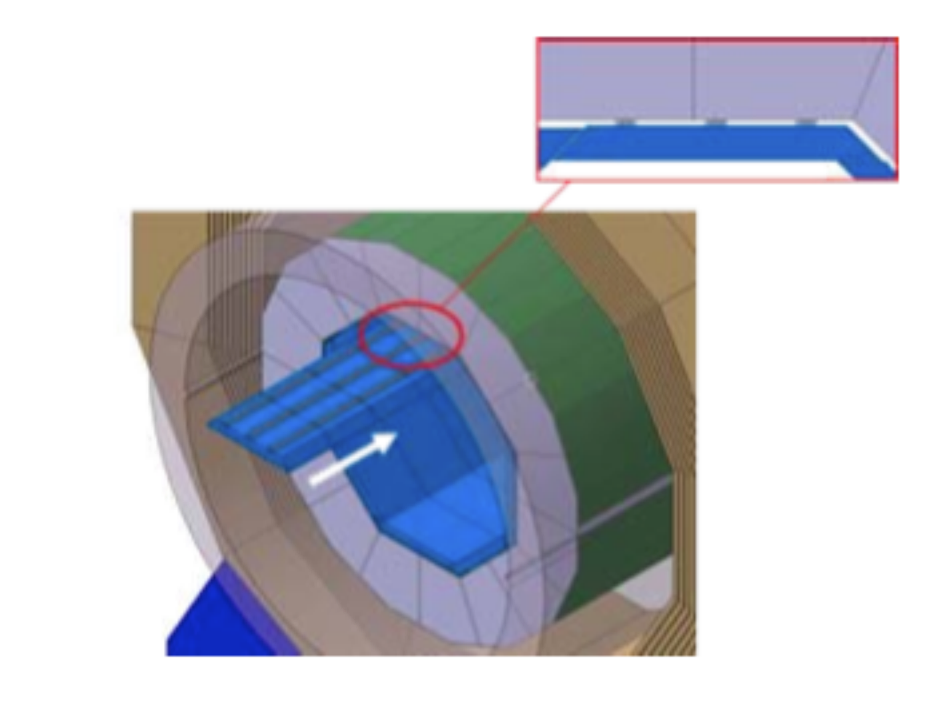
Forward Calorimeters



TPC and Barrel Calorimeters







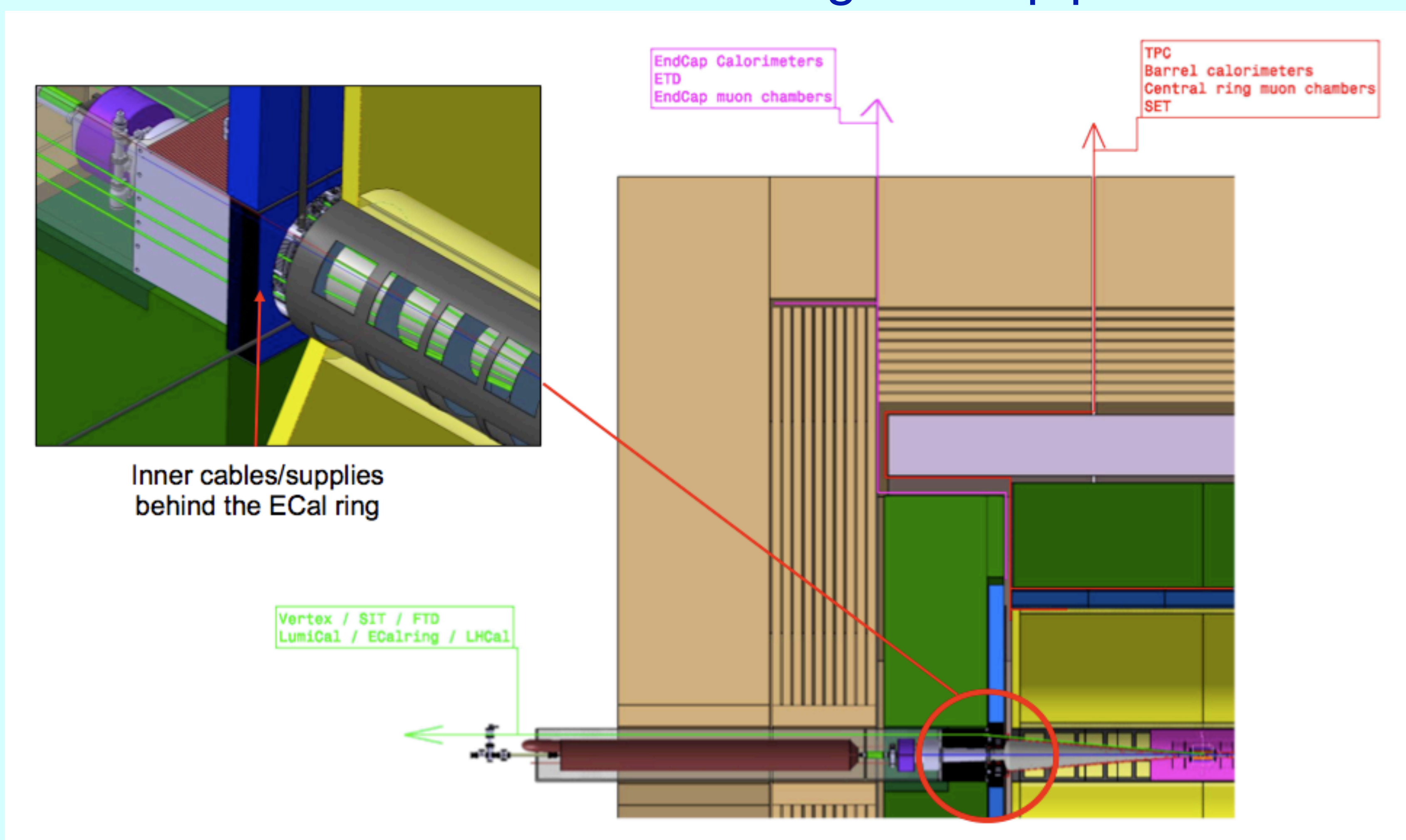
- We have found a conceptual design which is sufficient for the LoI
- R&D is needed for an engineering solution

Cabling Scheme

- Barrel detector cables will be routed between cryostat and barrel yoke to gap between barrel yoke rings.
- Space needed between barrel and cryostat:
- Gaps between barrel rings: 50mm
- Gaps between barrel yoke and endcap not large enough (25mm)
  - possible solution: route cables through four channels: 100 mm x 825 mm
- Cables of inner silicon detectors routed along beam pipe:

	d(mm)	
Component services	34	
Barrel yoke vertical deformation	6	taken fr
Assembly tolerances	5	
Deformation of outer cryostat	10	CMS
Clearance for moving barrel ring	50	CMS
Space for inner muon chambers	50	
Sum	155	

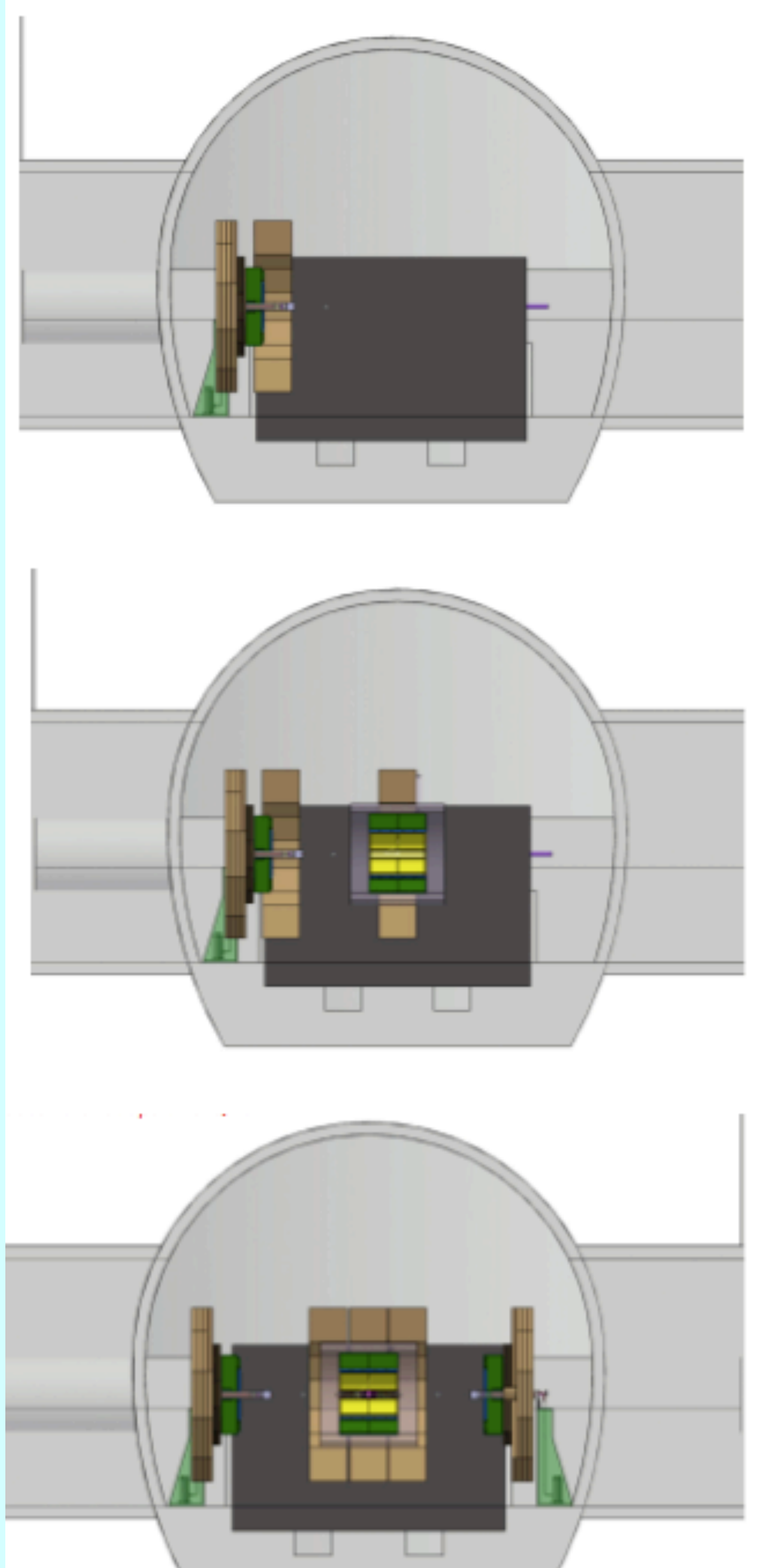
U. Schneekloth



Inner cables/supplies behind the ECal ring

Detector Assembly and Opening

- Detector assembly on the surface à la CMS
- Underground assembly:
  - Install QD0 support pillar
  - QD0 with support structure
  - end cap yoke
  - endcap calorimeters
  - first barrel yoke ring
  - central yoke w. coil and barrel carlorimeters
  - TPC
  - inner part: silicon detectors, beam pipe
  - second yoke endcap
  - second pillar, QD0
- Needs 30m hall space (RDR hall has 25m)

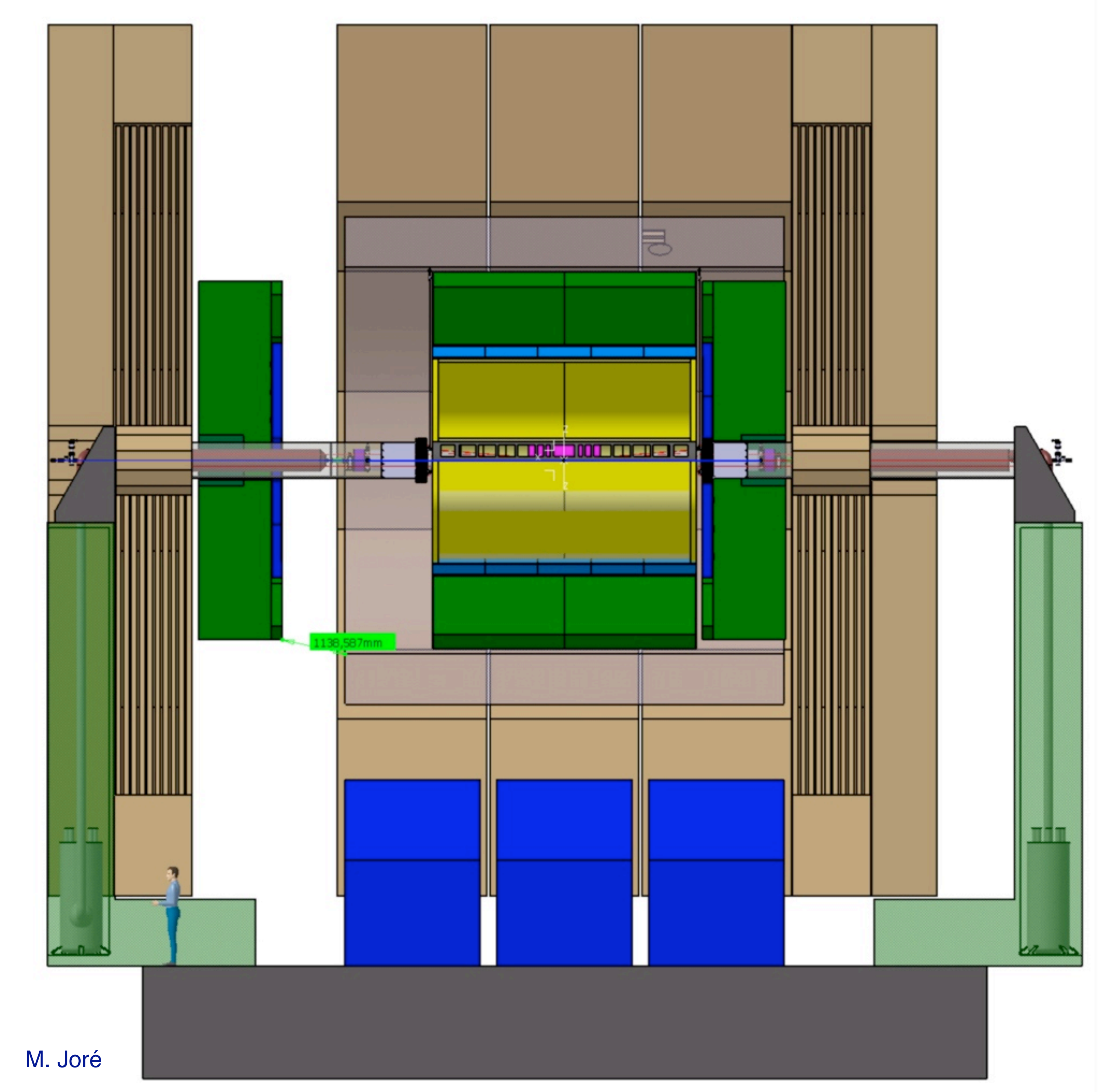


C. Clerc

Opening on the Beam

- Endcap yoke partially split allows ~1m access
- Allows for short maintenance in the beam position
- Every major work will be done in the parking position

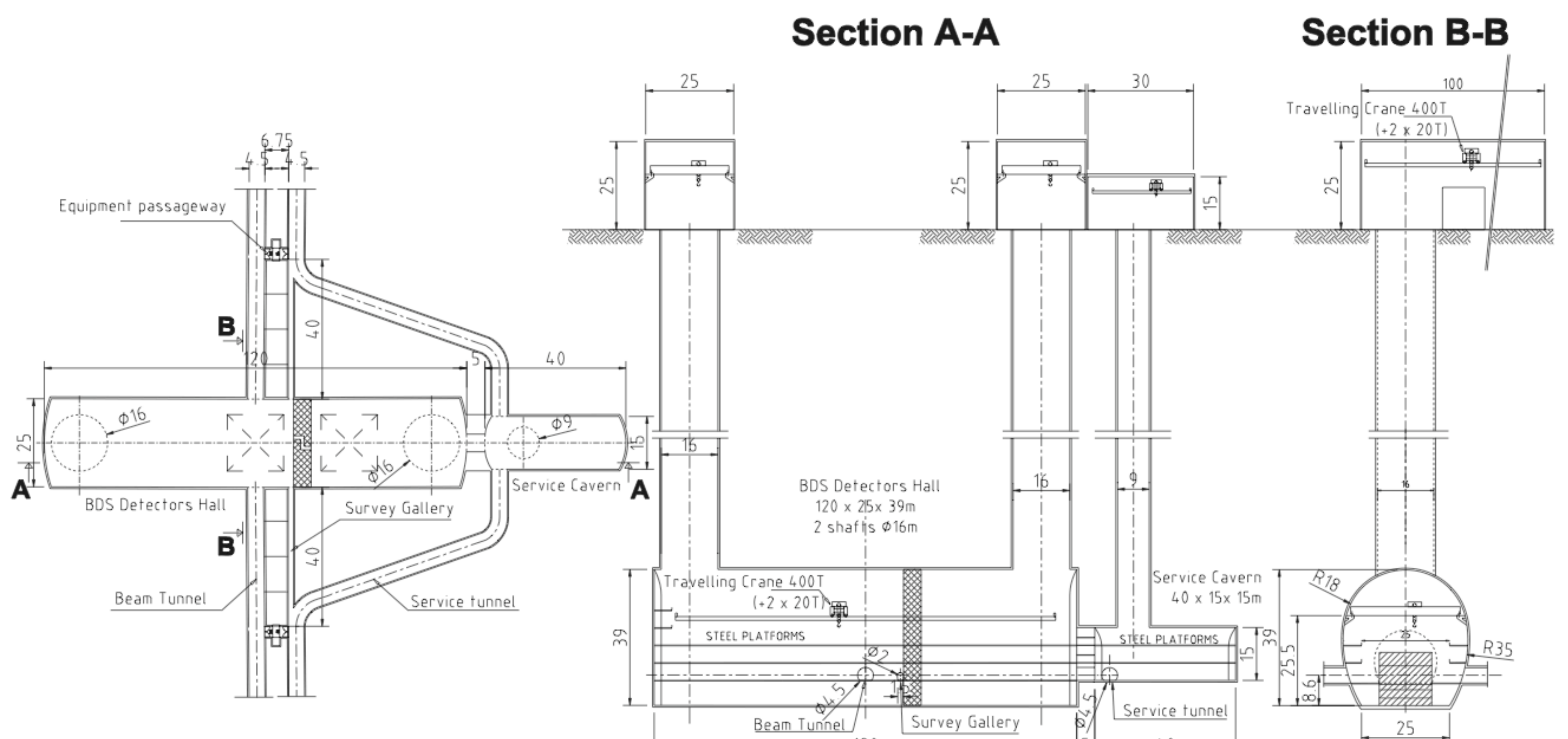
- Removing the pillar would allow a non-split endcap
  - mechanically nicer
  - needs other QD0 support



Detector Services

- Primary services located on surface, e.g.:
  - Water chillers
  - Power transformers
  - UPS facility
  - Helium storage and compressor plant
- Secondary services close to the detector (underground but not on-board):
  - voltage supplies
  - AC/DC converters and cryogenics for coil
  - vacuum services
  - computing and data links
- On-board services, e.g.:
  - QD0 cryogenics
  - cold box and valve box for coil

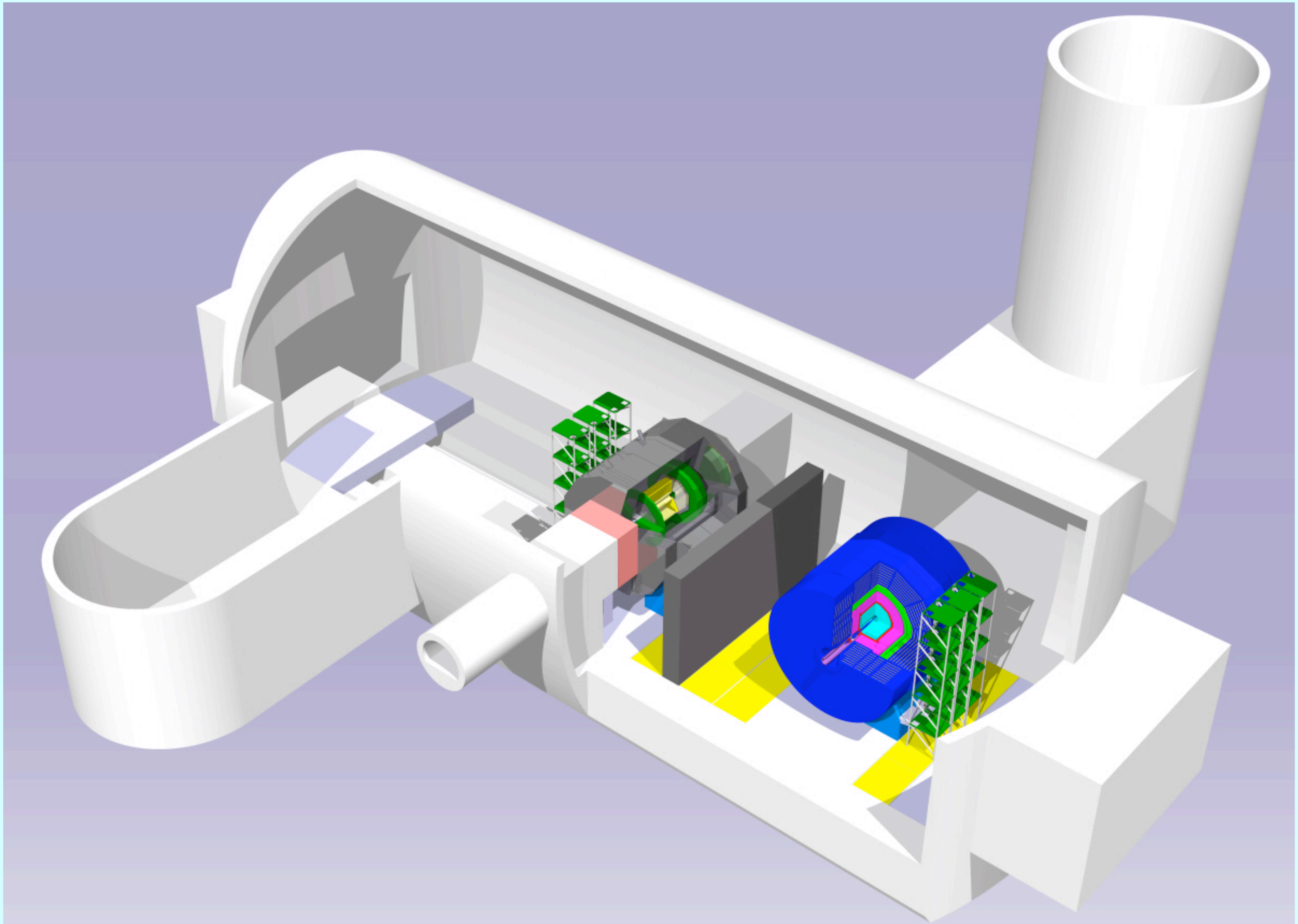
RDR Underground Cavern



ILC RDR

- just 25m wide
- shafts above hall
- large volume (due to 400t crane)
- just one service cavern

Underground Cavern Design Study



A. Hervé et al.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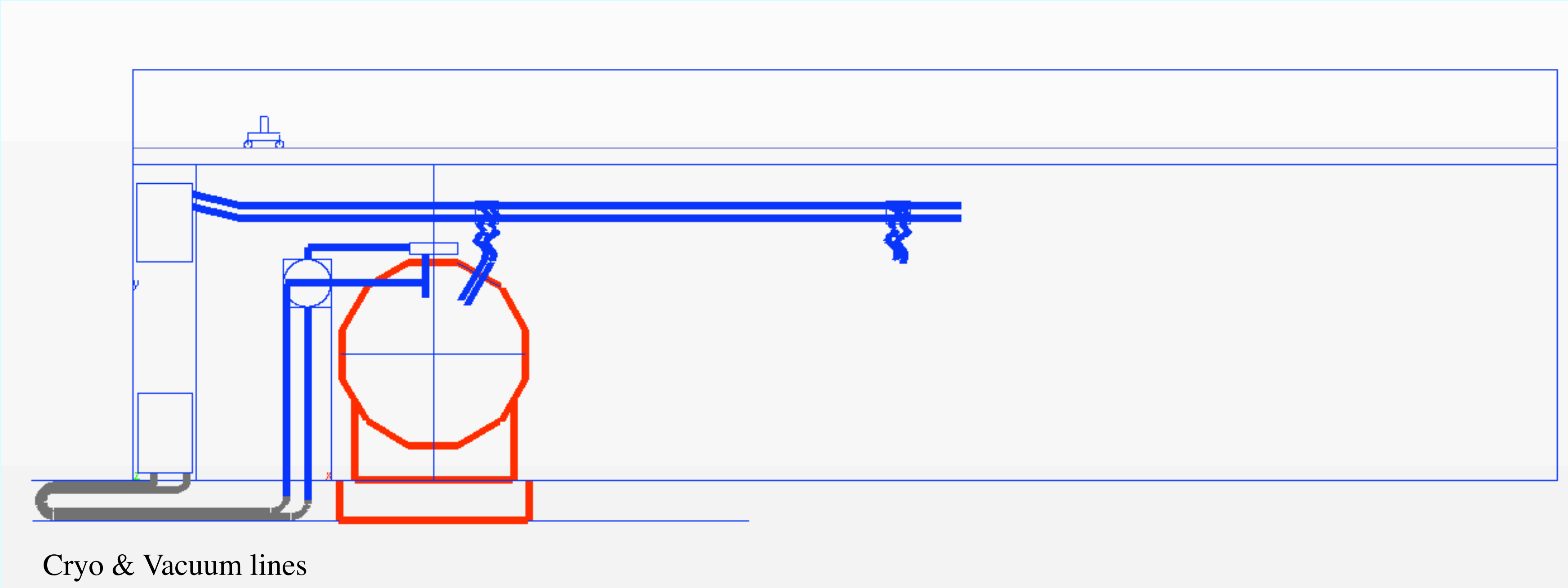
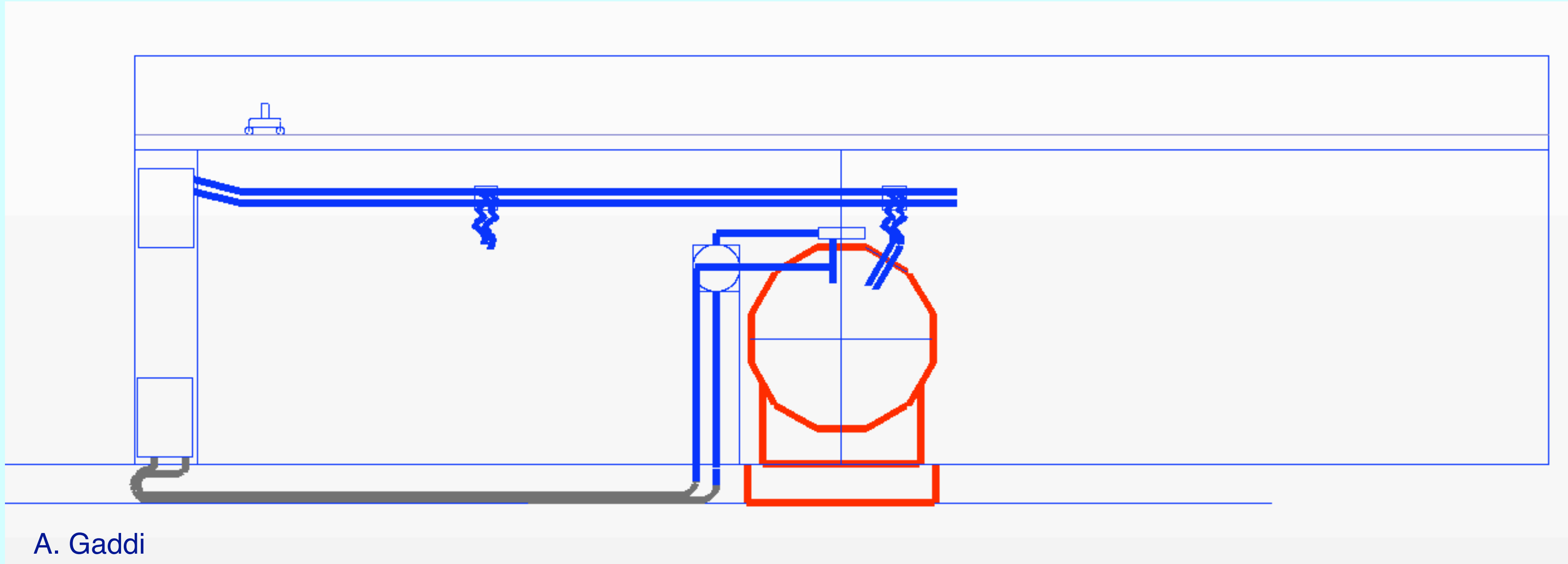
Push-pull Operations

- Detector services are provided using cable chains
- Few on-board services needed (QD0 supply)
- Flexible helium lines needed
  - either cold
  - or warm
  - R&D needed in any case!
- Bus bar connection for coil

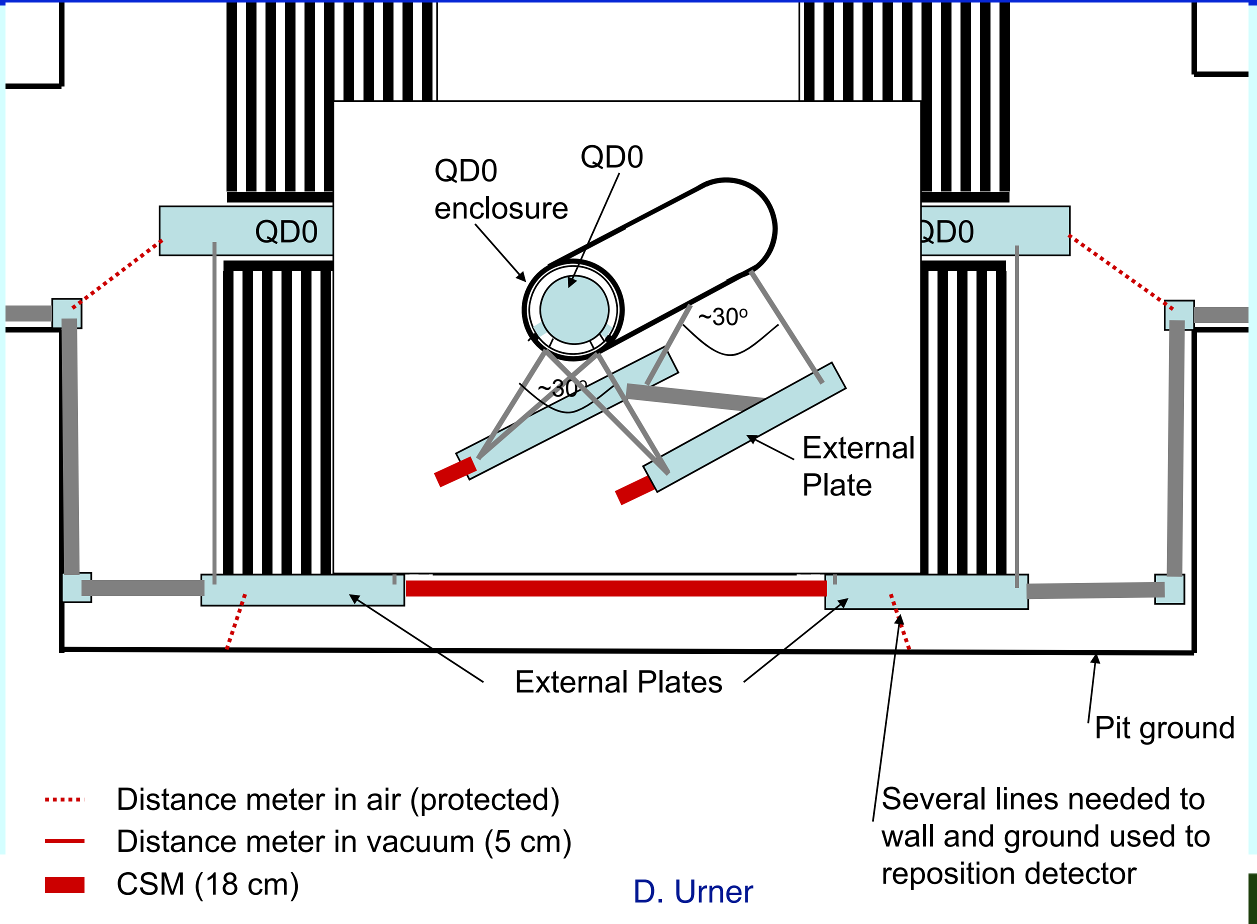


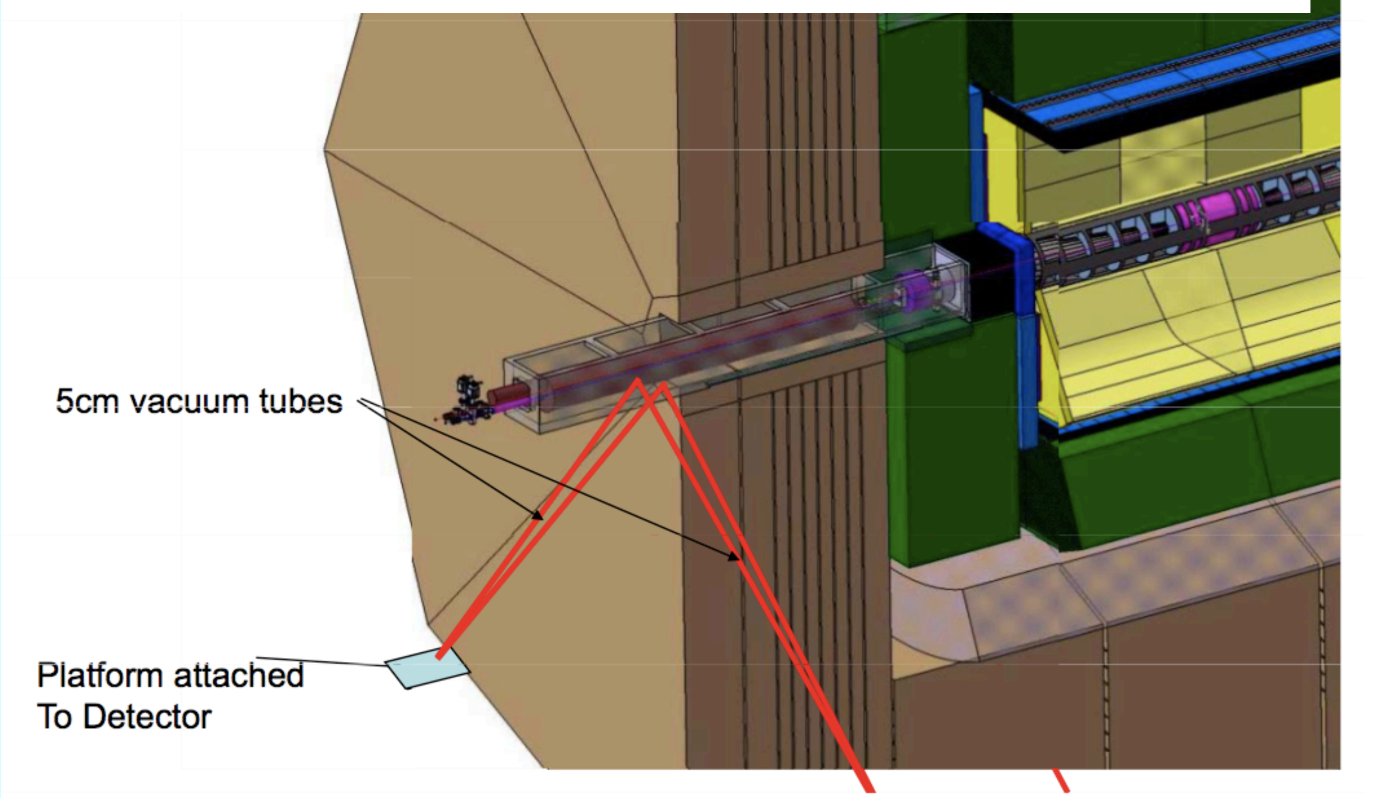


Push-pull Operation

- Moving out:
  - power down the coil (~4h)
  - remove radiation shield (pacman)
  - disconnect local supplies (bus bar)
  - disconnect beam pipe between QD0 and QF1
  - move detector towards garage position on platform
  - connect local supplies in garage position
- Moving in:
  - reverse procedure as above
  - alignment and calibration using e.g. MONALISA
- Total time: 2 days (one for movement, one for alignment)
- Note: this relies on the assumption that the coil and its ancillaries can be kept cold during the movement
  - This needs careful R&D
  - Will not be resolved before the submission of the LoI

- MONALISA interferometric laser system could be used to align both QD0 magnets with respect to each other and to the beam axis
- Could also be used to align the detector itself
- Conceptual studies have started
- Again, full engineering study is needed to study access of laser beams in vacuum to the magnets (not on LoI timescale!)





Alignment Requirements

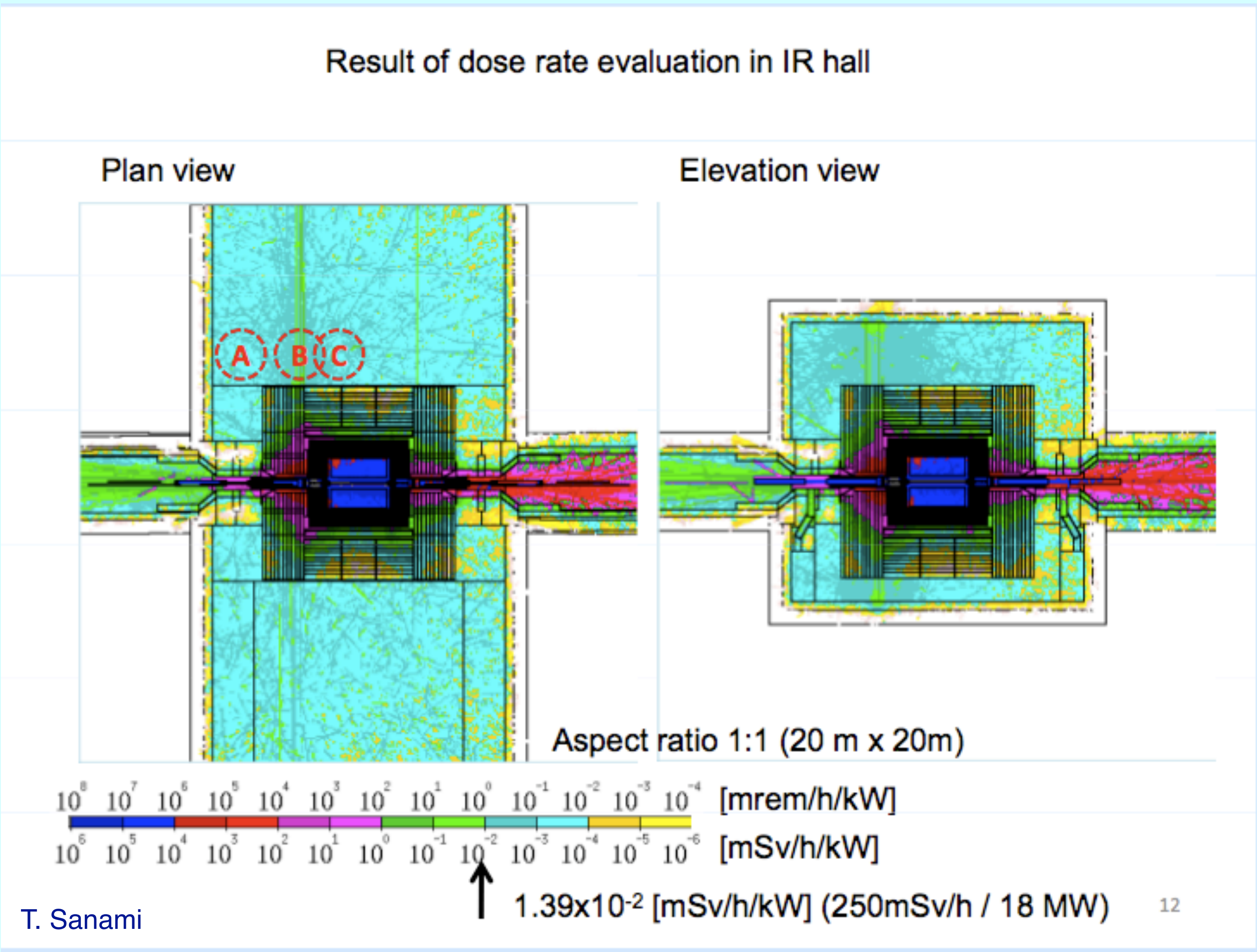
- Detector axis:
  - ±1mm and 100 µrad w.r.t. line defined by QF1
  - detector height adjustment range: ± several cm, depending on geological requirements
- QD0 alignement:
  - ±200nm and 5 µrad w.r.t. line defined by QF1
  - QD0 vibration: less than 50 nm within 1ms bunch train

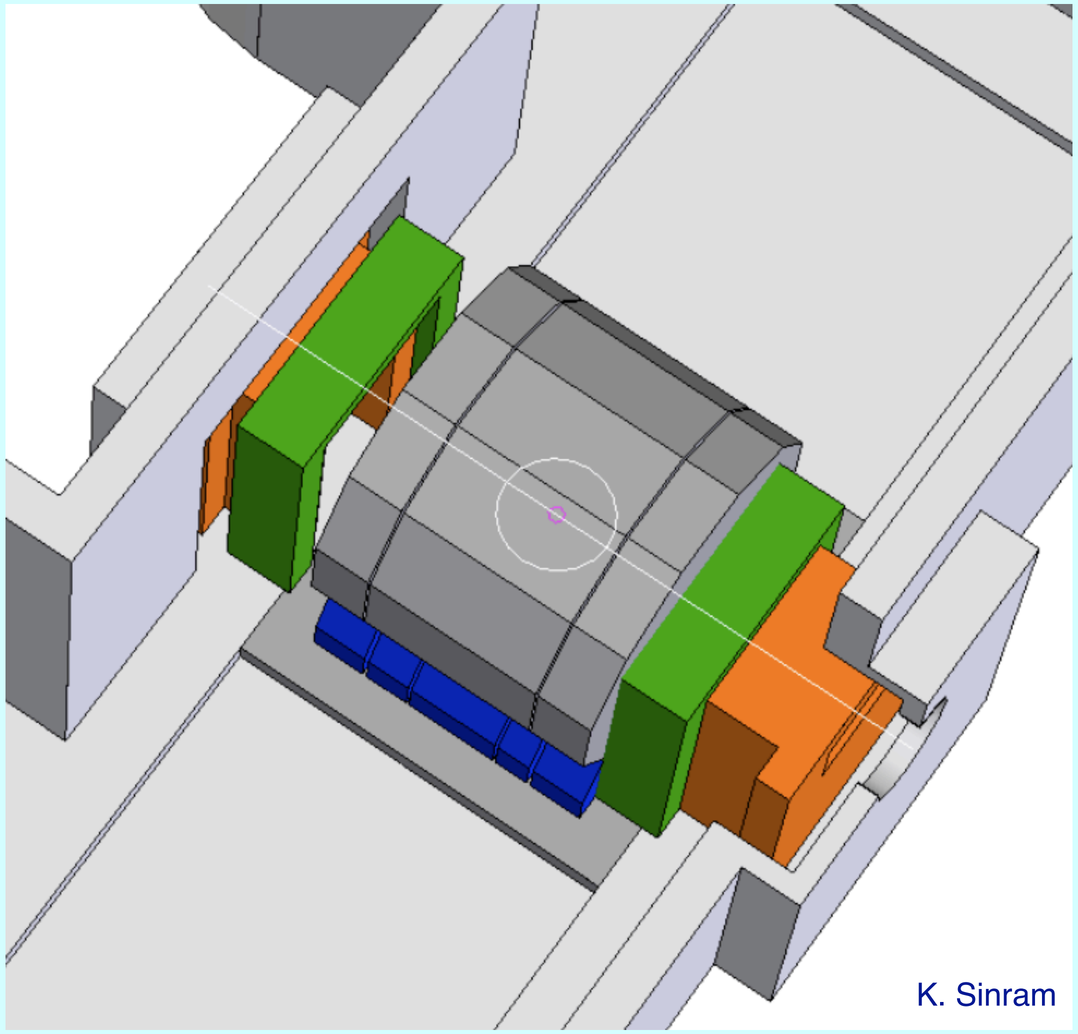
  - degrees of freedom: 5
  - Range per d.o.f: ±2mm
  - Step size: 0.05 µm

  - Control of the mover system will remain under control of BDS system and might be adjusted during the run

Shielding

- ILD will be self-shielding (tech. note by T. Sanami in preparation)
- ‚Pacman‘ shielding could be simple concrete portal
- Detailed simulation with updated geometries needed



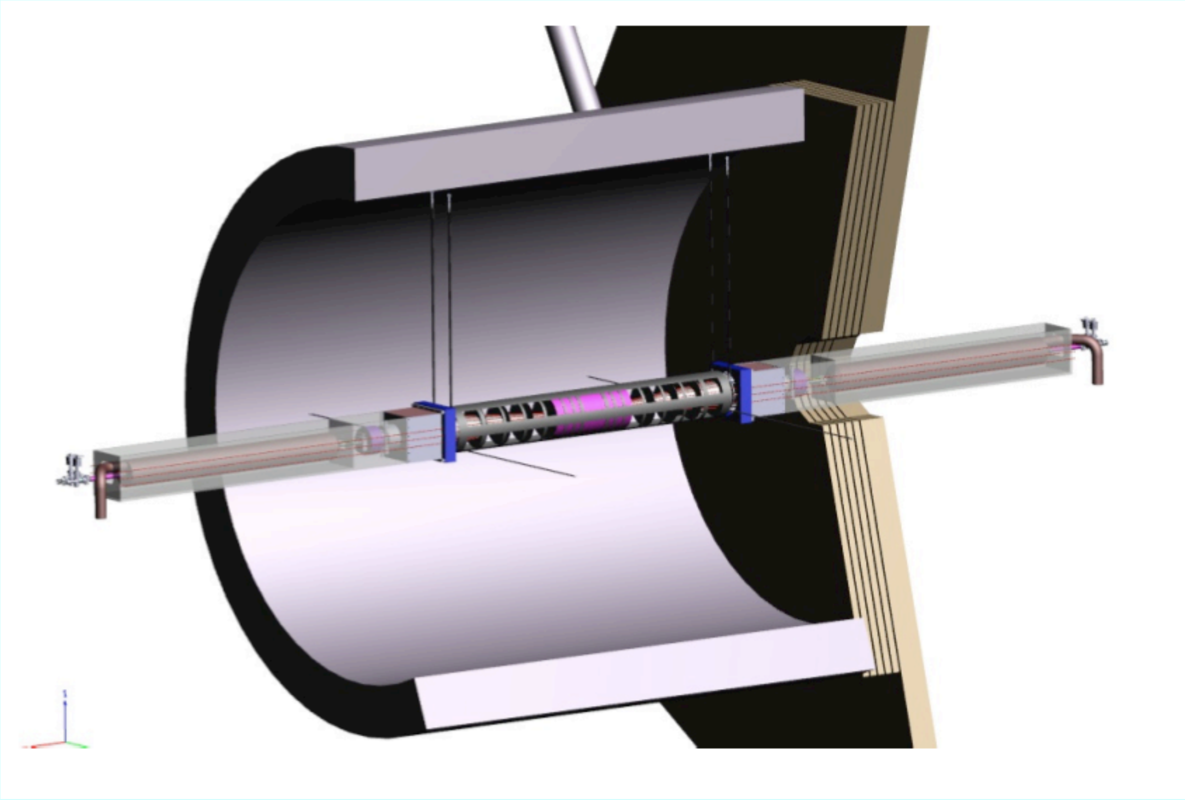


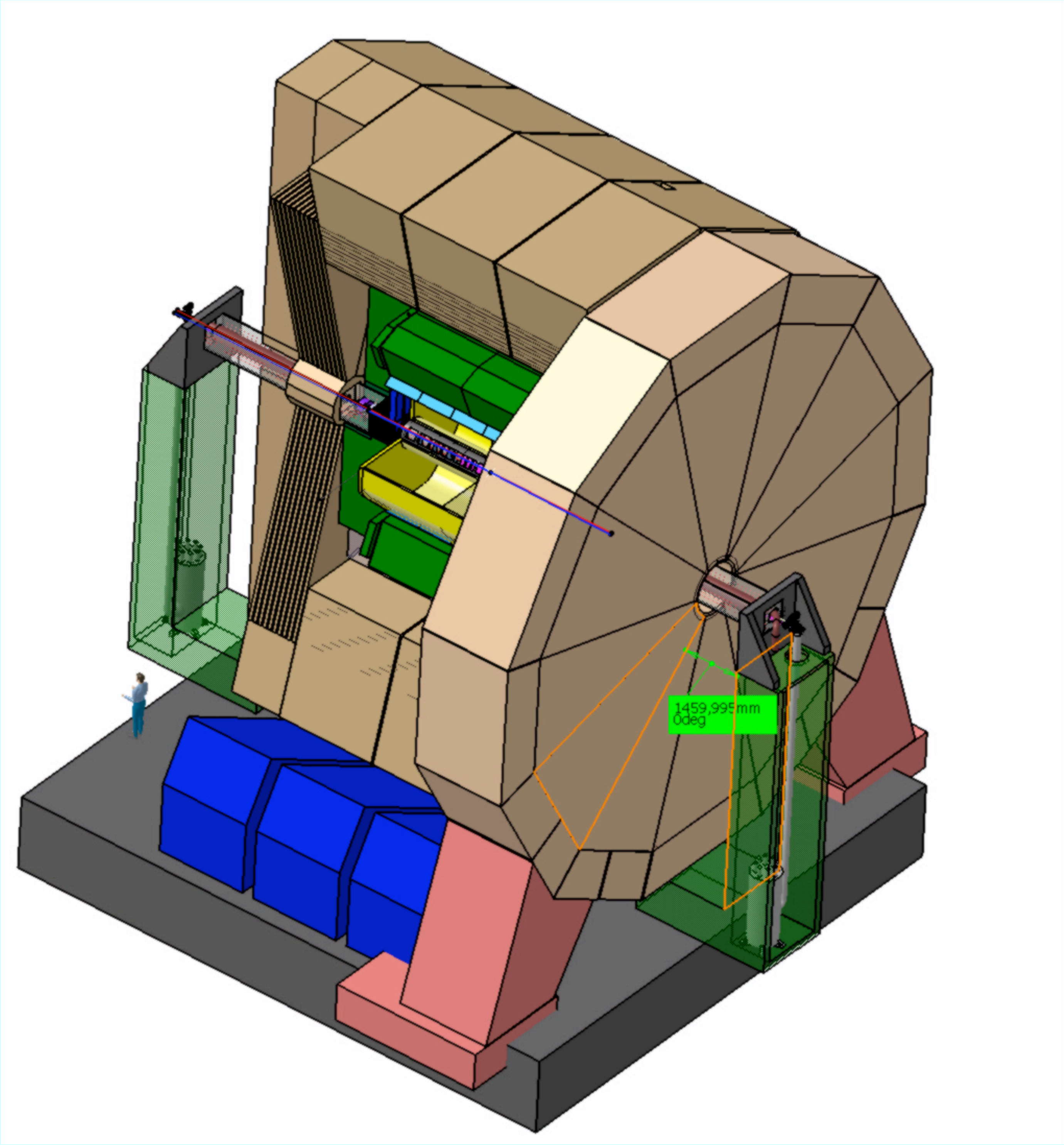
Integration with the Accelerator (MDI)

- The Interaction Region:
  - QD0 integration
  - Beam pipe
    - Talks by H. Videau and Y. Suetsugu
  - Background suppression

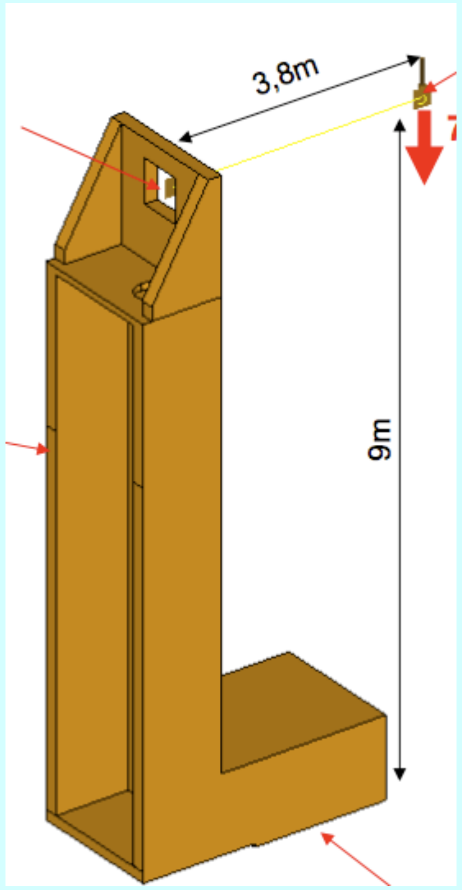
QD0 Support

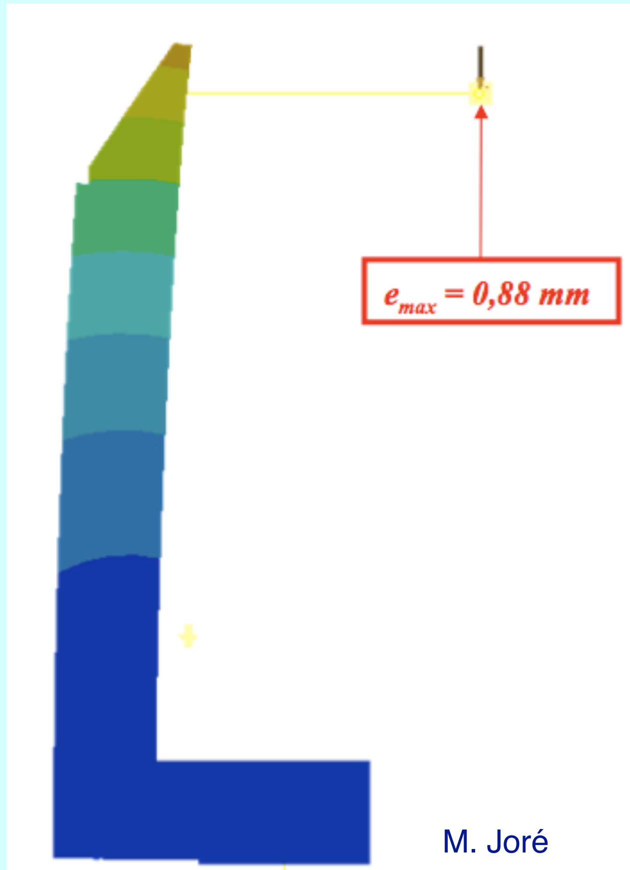
- QD0 supported by pillar outside of the detector and suspended on tie rods from the cryostat
- Monitored by MONALISA, placed on actuators for alignment



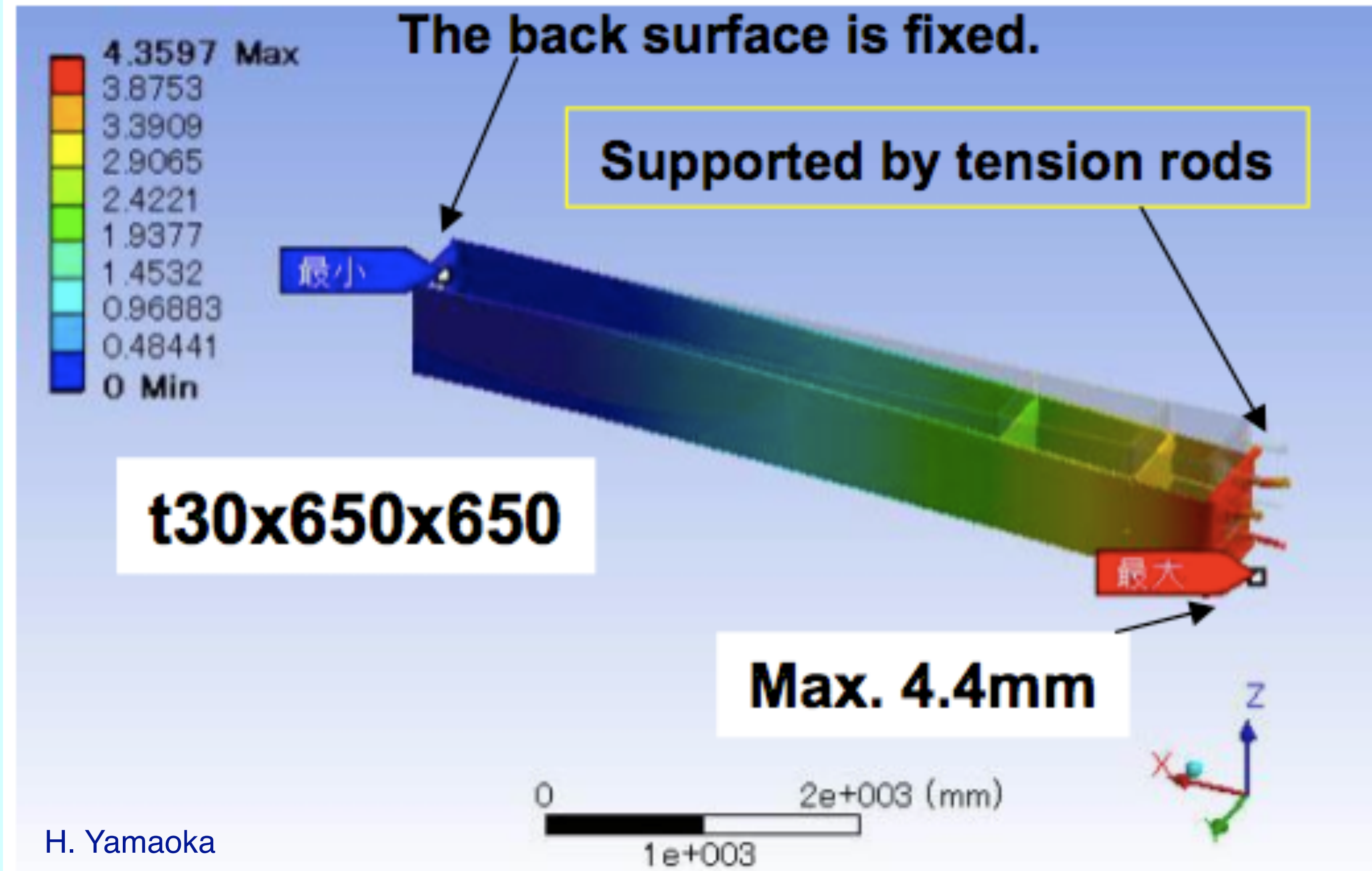


QD0 Support



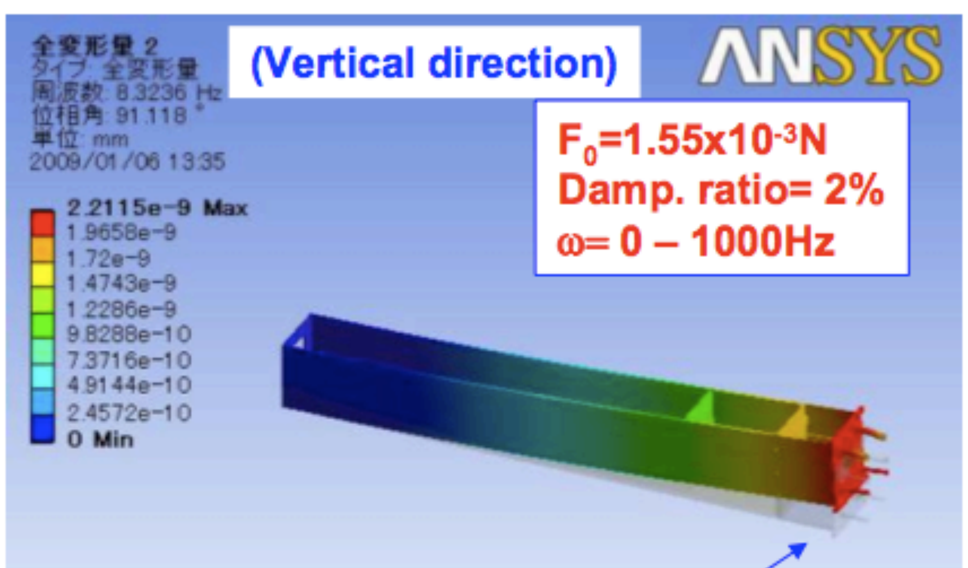


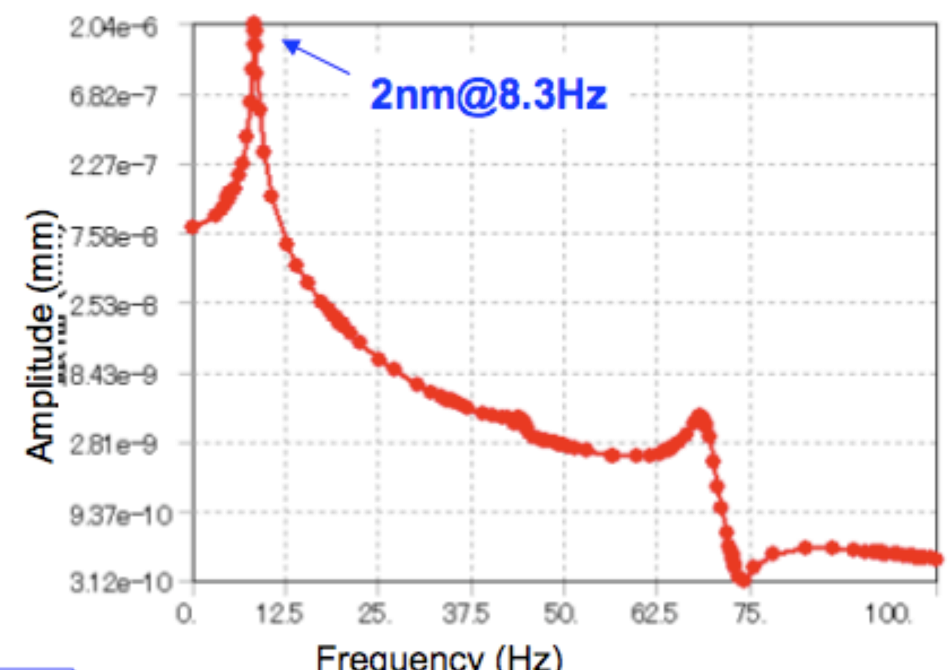
M. Joré



H. Yamaoka

Amplitude due to ground motion



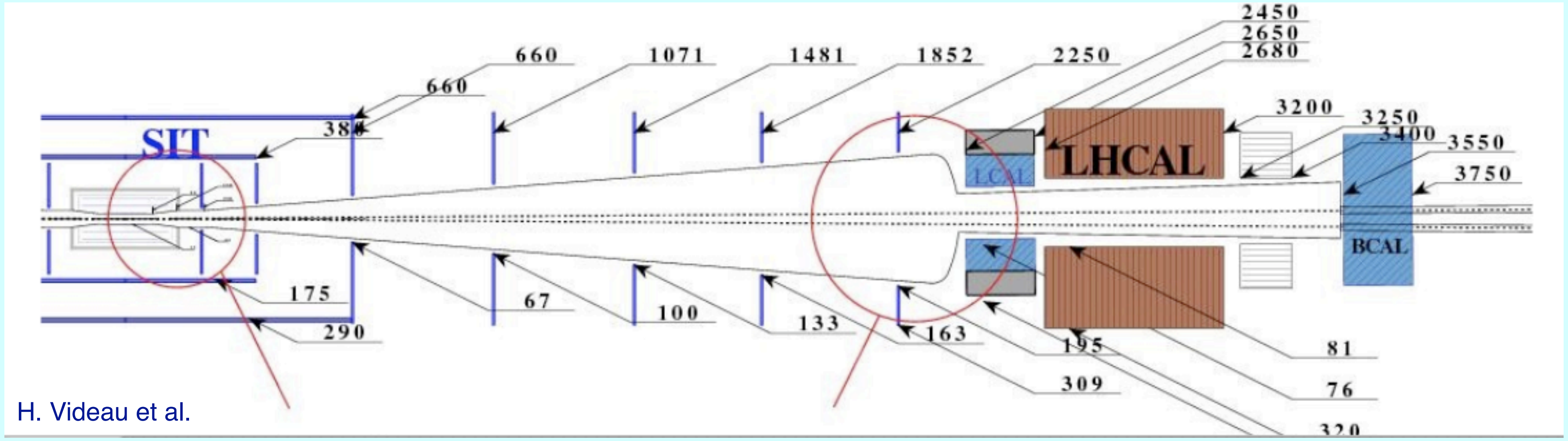


→ Amplitude: 2nm< 50nm @8.3Hz (Vetical direction)

H. Yamaoka

Beam pipe design

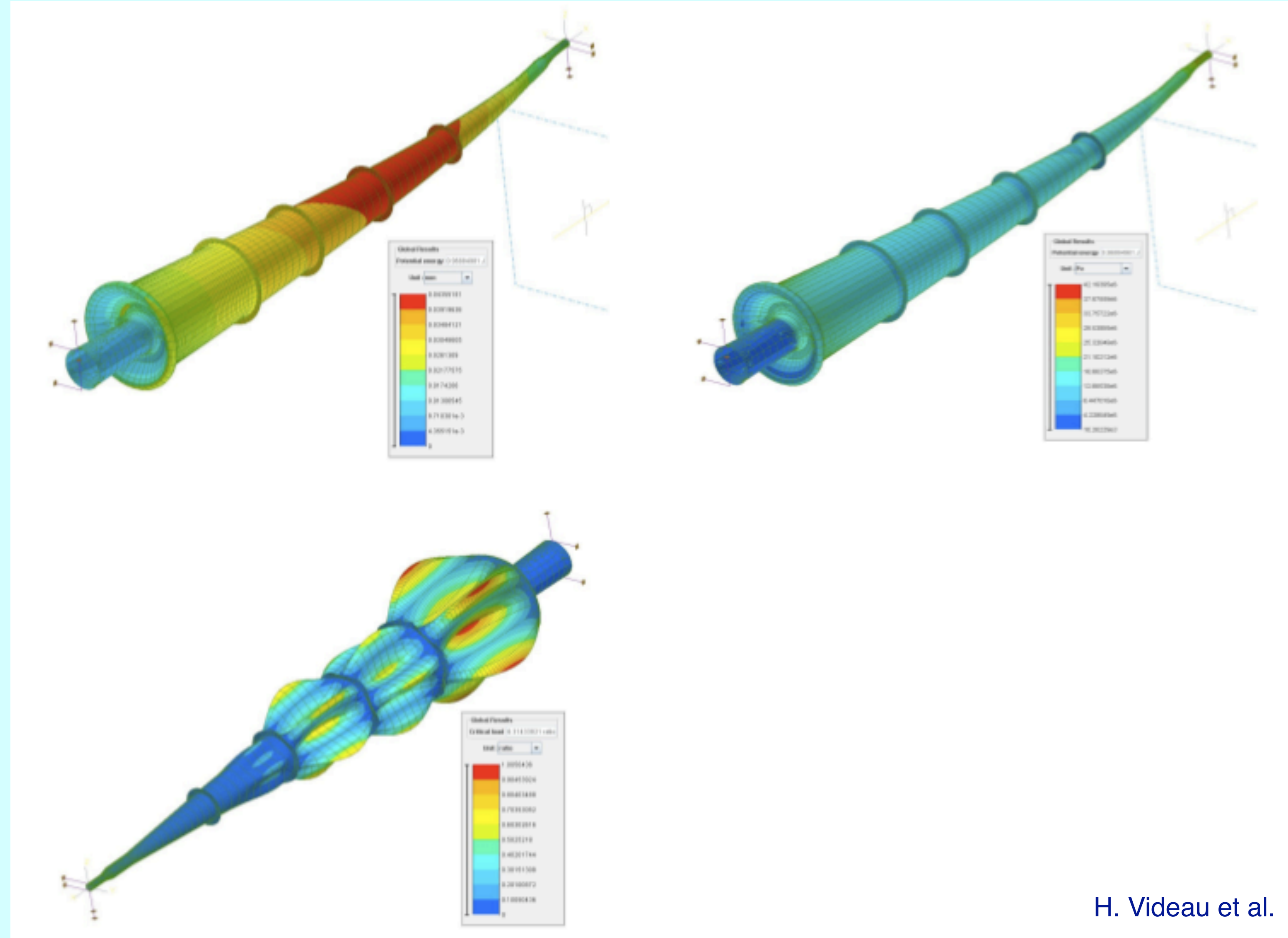
- Design principles:
  - no interference with luminosity
  - no interference with pairs while having a small radius for vertexing
  - compliant with 7 mrad crossing angle
  - as less material as possible (photon conversions, hadron interactions, vacuum)
  - low em heat load
  - vaccum requirements (pumping)
- Made from Beryllium with some support rings (8 kg total mass)
- Mechanical behaviour studied
- Heat load below 20W
- Engineering design needs a lot more effort, close collaboration with manufacturer
- Cost around 1-1.5 MEUR (sic!)

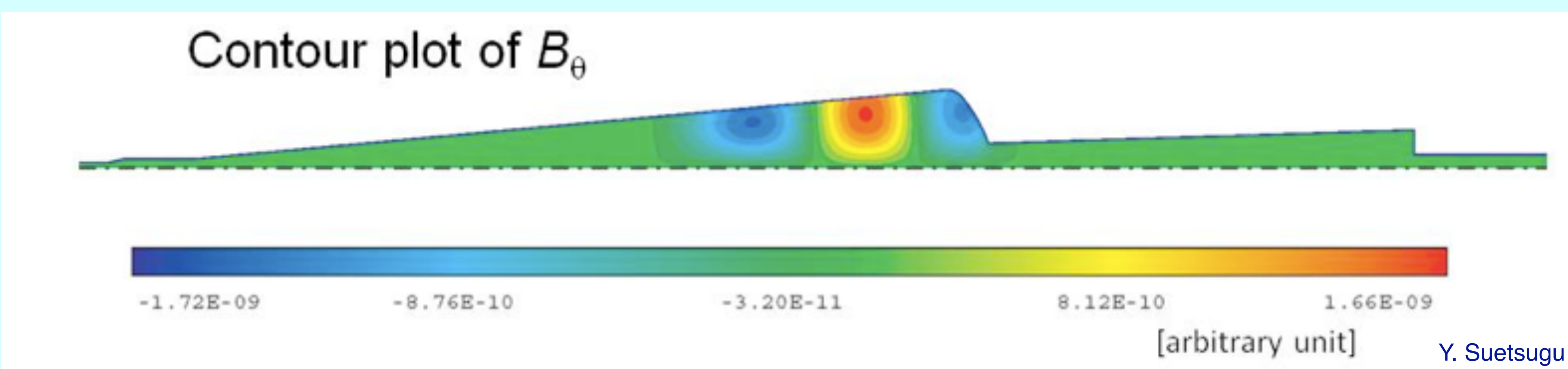


H. Videau et al.

Beam pipe studies

- Detailed studies done at KEK (Y. Suetsugu) and in France (H. Videau et al.)
- Two notes exist!





Machine Induced Backgrounds

- Team at DESY and IReS working on simulations of pair backgrounds
- This table hopefully filled soon:

Subdetector	Nominal 500	Nominal 1000	Low-P	Tolerance
Vertex Detector				
SIT				
FTD				
TPC				
ECAL				
HCAL				

TABLE 7.2-1
Pair induced backgrounds in the subdetectors.

- What about other backgrounds: SR, muons, etc.?
  - Nothing in the LoI so far....
  - Is this needed, who is working on it?

Provisions for Low-P Parameter Set

- Nothing written yet, waiting for the results of the background simulations

- What needs to be changed for Low-P?
  - Larger radius for vertex detector?
  - Modifications in the beam pipe?
  - Anything else?

Measurement of Energy and Polarisation

- Agreement in MDI-D common task group:
  - all concept groups will refer to a common technical note written by the polarisation and energy measurement group:
    - ILC-NOTE-2009-049
  - we will just quote that note in the LoI

February, 2009

Polarimeters and Energy Spectrometers for the ILC Beam Delivery System

S. Boogert[1], M. Hildreth[2], D. Käfer[3], J. List[3], K. Mönig[3], K.C. Moffeit[4], G. Moortgat-Pick[5], S. Riemann[3], H.J. Schreiber[3], P. Schüler[3], E. Torrence[6], M. Woods[4]

[1]Royal Holloway, University of London, UK
[2]University of Notre Dame, USA
[3]DESY, Hamburg and Zeuthen, Germany
[4]SLAC National Accelerator Laboratory, Stanford, USA
[5]IPPP, University of Durham, UK
[6]University of Oregon, USA

Abstract

This article gives an overview of current plans and issues for polarimeters and energy spectrometers in the Beam Delivery System of the ILC. It is meant to serve as a useful reference for the Detector Letter of Intent documents currently being prepared.

MDI Issues

- Hitoshi's List from Chicago:

- Push-pull ✔
  - Stability and speed of switch
- Detector assembly and integration ✔
  - Surface assembly, etc.
- IR components and support structures ✔
  - Beampipes, final quads, support tubes, etc.
- Forward detectors ✔ (not in MDI)
  - FCAL, BCAL, GAMCAL, LCAL, etc.
- Energy-Luminosity-Polarization ✔ (tech. note)
  - Upstream and downstream measurements
- Beam diagnostics near IP — nothing done, really needed?
  - Beam profile measurements, etc.
- Machine backgrounds
  - SR, pairs, beam particles, neutrons, muons, EMI…

IDAG Questions with MDI/Integration relevance

(2) Plans for getting the necessary R&D results to transform the design concept into a well-defined detector proposal.

- Partially done

(3) Conceptual design and implementation of the support structures and the dead zones in the detector simulation.

- CAD model exists

(4) Sensitivity of different detector components to machine background in the context of the beam parameter space considered in the RDR.

- Work in progress

(5) Calibration and alignment schemes.

- Partially done

(6) Estimates of overall size, weight, and requirements for crane coverage and shielding.

- Information exists

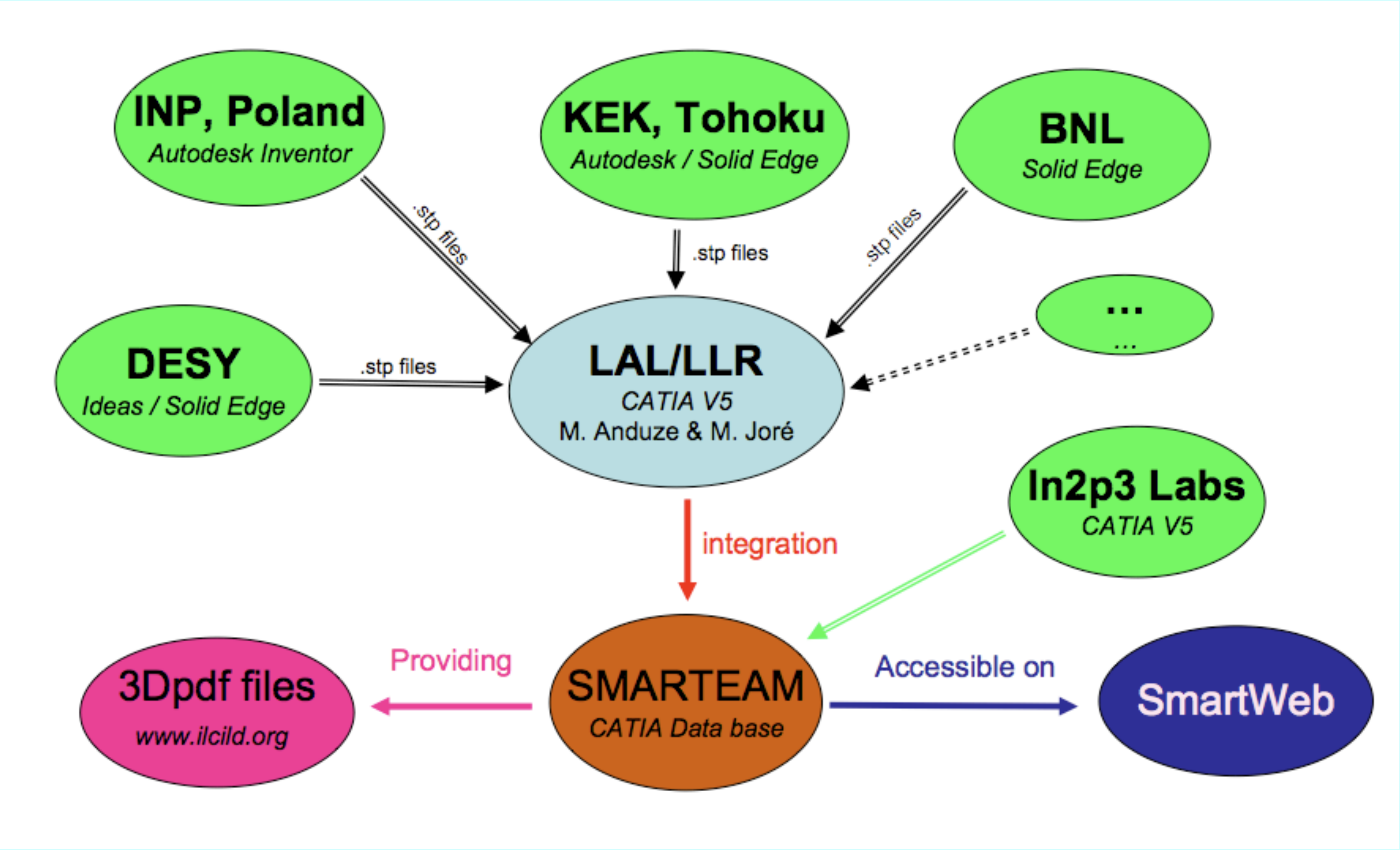
(7) Push-pull ability with respect to technical aspects (assembly areas needed, detector transport and connections, time scale) and maintaining the detector performance for a stable and time-efficient operation.

- Conceptual design done

R&D Topics

- Will be reported by the technical coordinators in this session

- Working solution found:



- at some point the ILC EDMS needs to come into play

IR Interface Minimum Requirements

ILC-Note-2009-nnn
March 2009
Version 2, 2009-01-29

Functional Requirements on the Design of the Detectors and the Interaction Region of an e^+e^- Linear Collider with a Push-Pull Arrangement of Detectors

B.Parker (BNL), A.Mikhailichenko (Cornell Univ.), K.Buesser (DESY), J.Hauptman (Iowa State Univ.), T.Tauchi (KEK), P.Burrows (Oxford Univ.), T.Markiewicz, M.Oriunno, A.Seryi (SLAC)

- Define minimum requirements which need to be respected by all detector concepts:
  - Available space for detectors
  - Requirements on alignment and vibrations for machine magnets
  - Time methodologies for push-pull
  - Radiation environment
  - Beam parameters
- Requirements have been discussed in Warsaw, Chicago and on Webex....
- New draft has been agreed upon, will be circulated to ILD hopefully very soon

Summary

- LoI chapters for Integration and MDI are maturing slowly
- Work on real MDI issues is still ongoing, e.g. backgrounds
- Lively discussions here in Seoul
- Need to converge on the LoI content soon