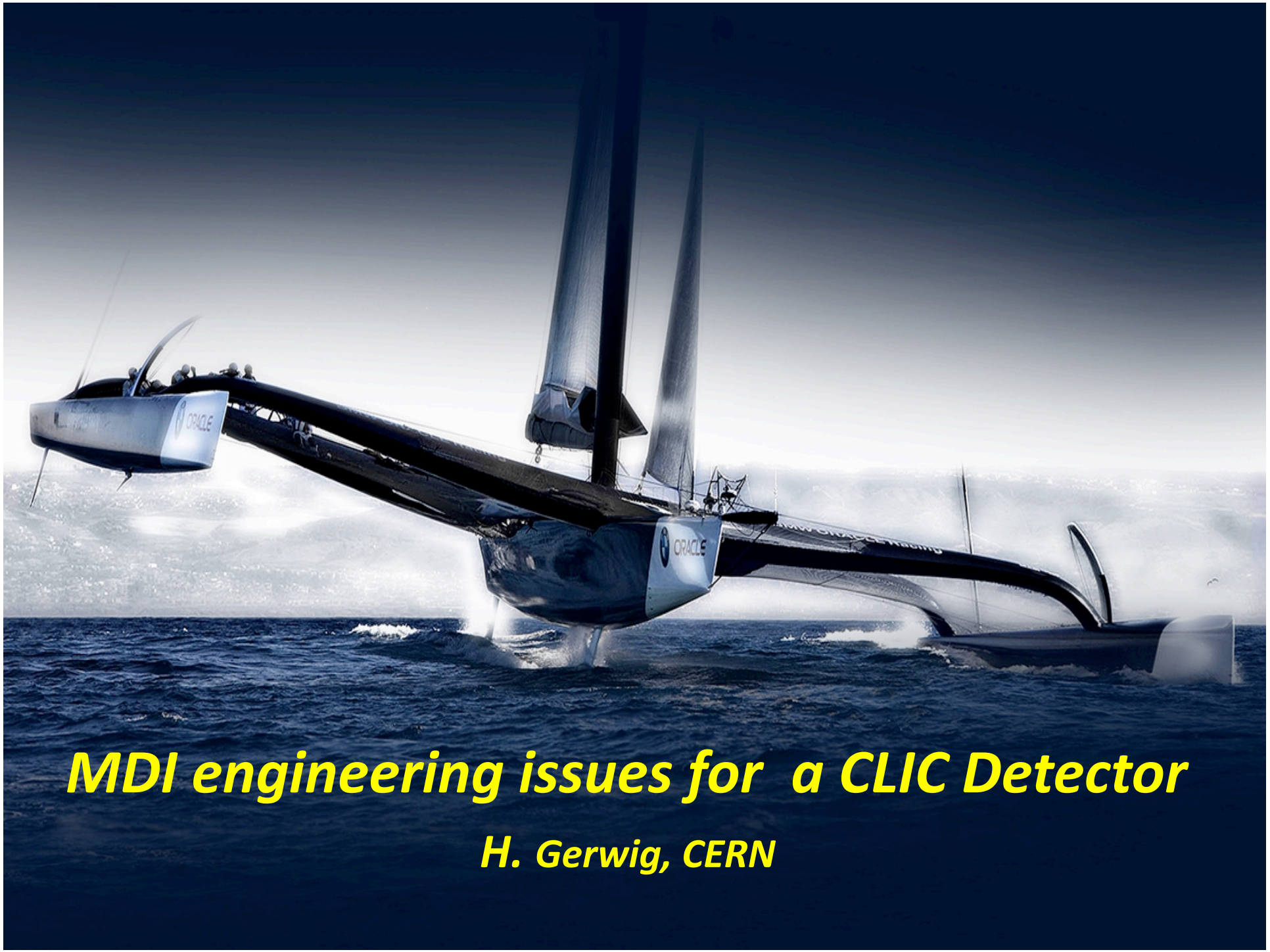


MDI engineering issues for a CLIC Detector

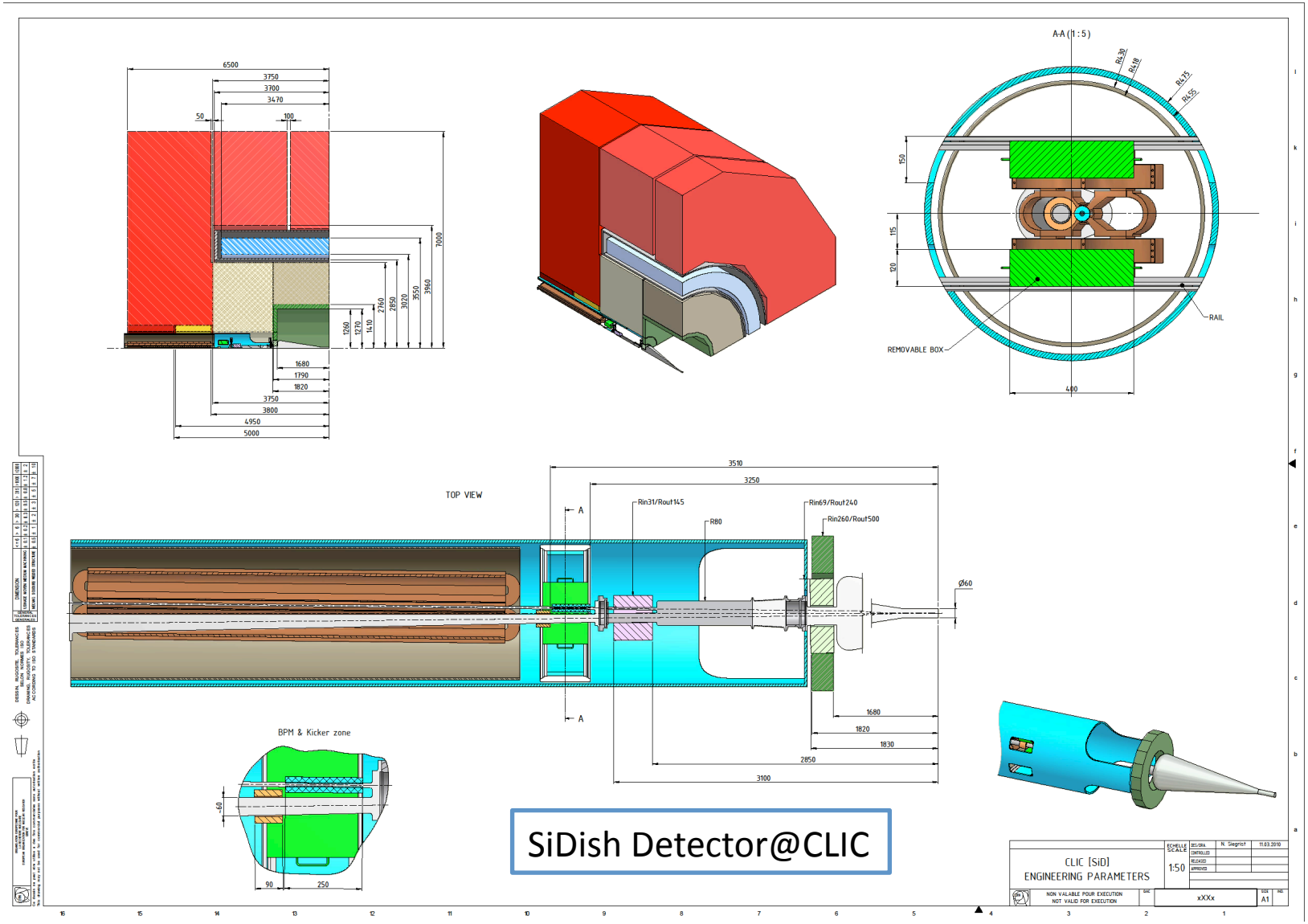
H. Gerwig, CERN

MDI – or when tunnel meets cavern

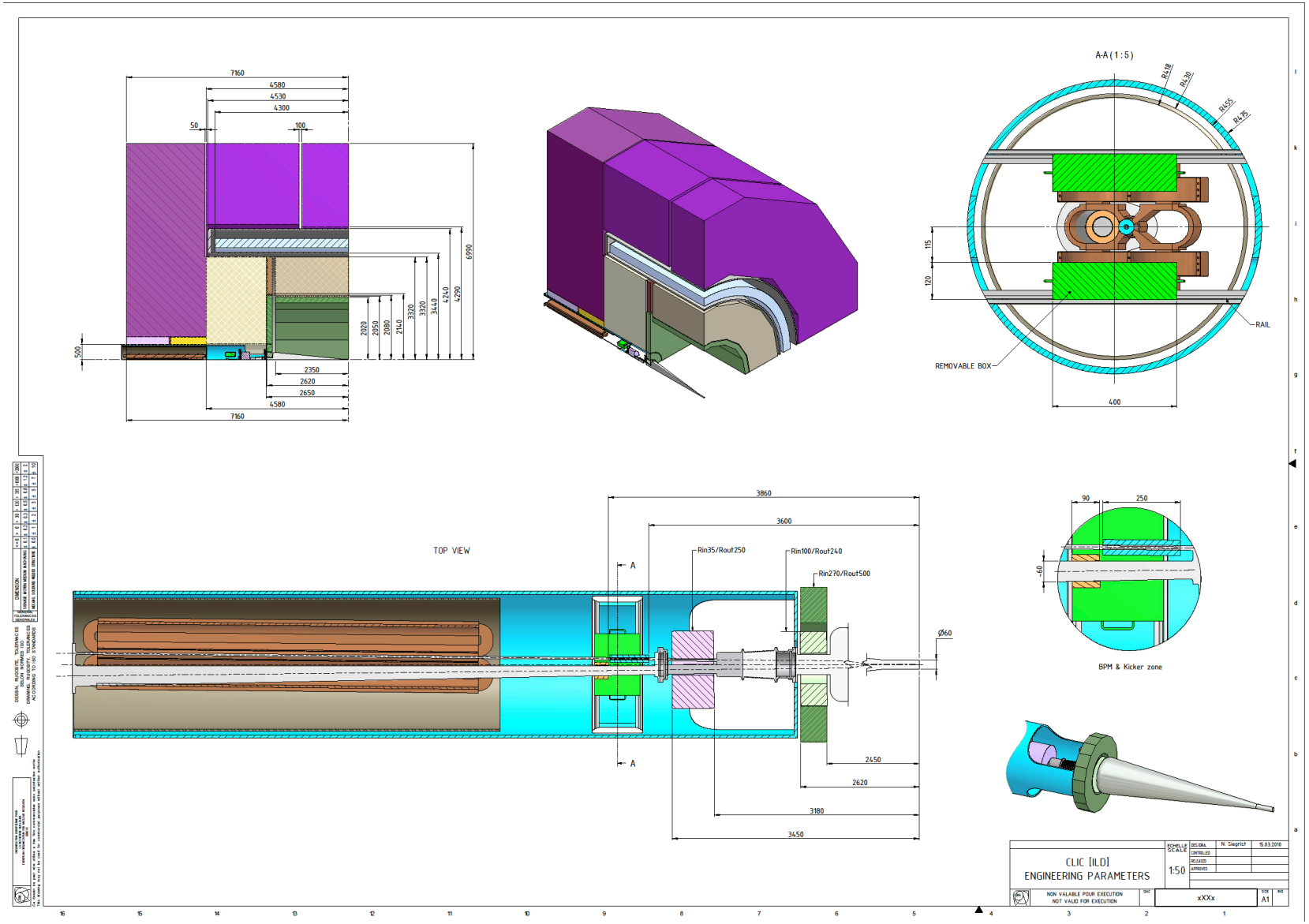
- Stable and precise support of QD0
- Beampipe sectorisation, Vacuum valves, pumps & access
- Kicker & BPM and its electronics
- Crossing angle and split beam pipe
- Opening of the detector
- Push-pull, moving platform, connection tunnel/cavern
- Alignment issues
- Self-shielding detector, safety
- Experimental cavern, access, services, cranes, safety

Satisfy all the requirements in a way that it just works fine!

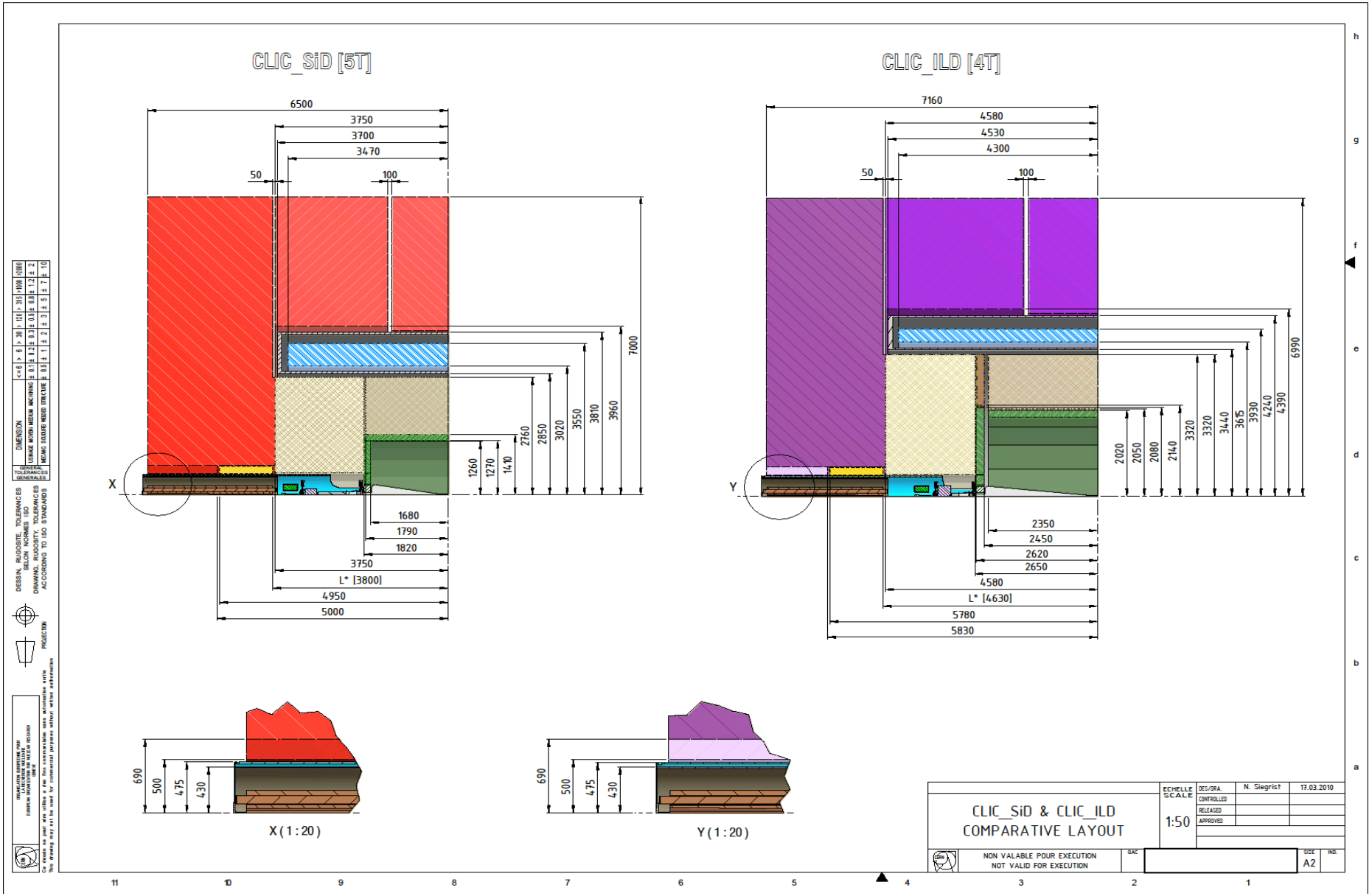
Parameter drawings for 2 detectors @ CLIC



CLIC_ILDish Detector



CLIC detector comparison



Requirement: ILC – CLIC stabilisation

- ILC = 50 nm
- CLIC < 0.5 nm

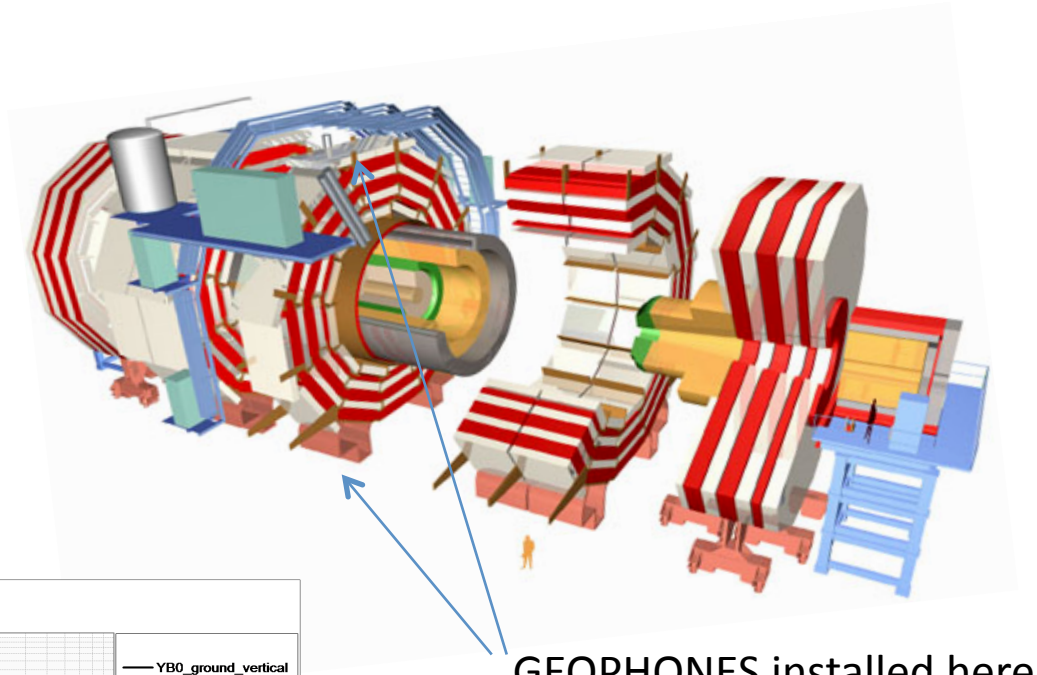
This is a factor 100 less for CLIC !

You can't do 100 times better just by saying we will chose higher quality material, tighter tolerances, pushing more to limits etc.

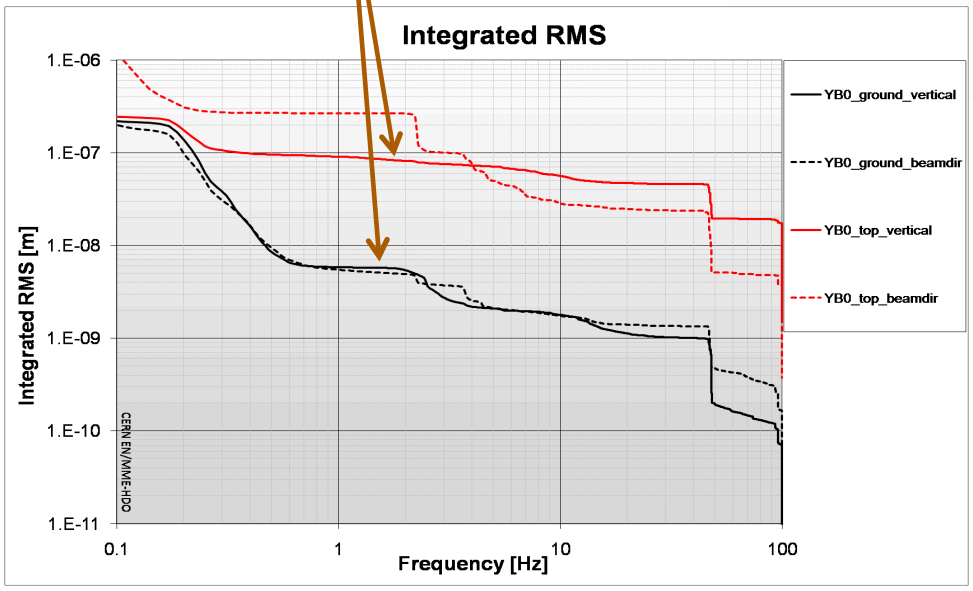
You need a new strategy!

Facts: Vibration measurements at CMS

Roughly speaking 15 times bigger amplitudes on top of YB0 than on the ground



GEOPHONES installed here



A.Kuzmin, Report on EDMS

CERN — European Organization for Nuclear Research

EN/MME
Laboratoire de Mesures Mécaniques / *Mechanical Measurement lab*
Rapport expérimental / *Investigation report*

Author:	*Date:*	*EDMS Nr :*	*Approved by :*
A.KUZMIN	*07-12-2009*	*1027459*	*M.GUINCHARD*

Customer: *Alain Herve*

Distribution list: *C. Hauviller - CERN, K. Artoos - CERN, C.Collette – CERN, R.Folch-CERN, O. Capatina – CERN, M. Sylte-CERN; A. Ball – CERN; H. Schmickler - CERN; J.-P. Delahaye – CERN; D. Schulte- CERN.*

Ground vibration measurements and Experiment parts motion measurement at CMS

1 Abstract

1. Limit vibration by construction !

- Abandon opening on IP thus making the QD0 support short (L^3)
- Use a two-in-one support tube scheme (idea of H. Yamaoka)
- Tune tube's eigenfrequency (train repetition rate - 50Hz)
- Avoid cooling liquids (permanent magnet)
- Keep also the end-caps compact in Z (with endcoils)
- Reduce to the max the gap between detector & tunnel (no pacman)
- Support QD0 from a passive low frequency pre-isolator in the tunnel

About the pre-isolator

We are proposing a pre-isolator system with

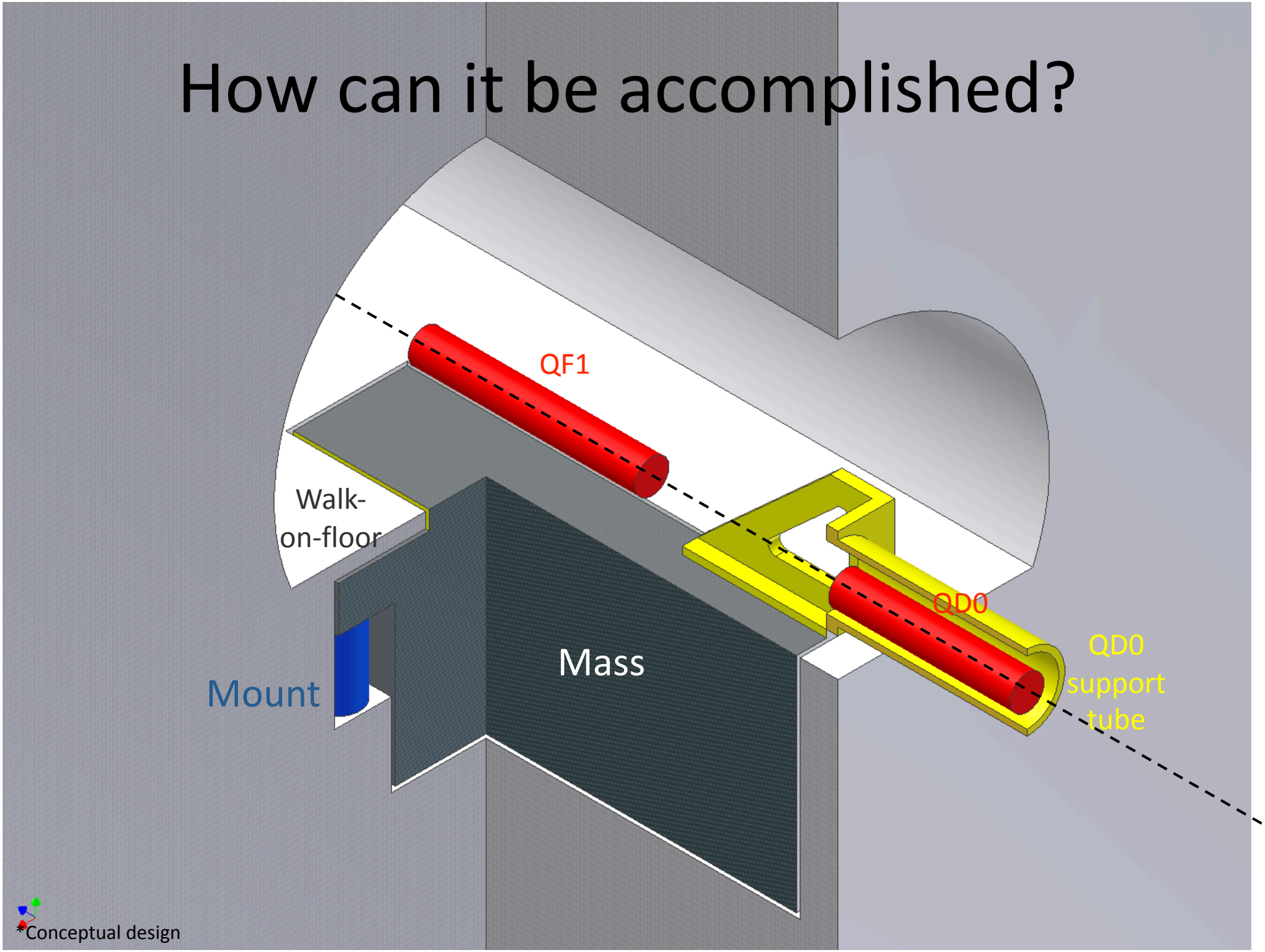
Low natural frequency (around 1 Hz)

and

Large mass (50 to 200 ton)

This system will act as a low-pass filter for ground motion
that is able to withstand external disturbances (air flow, acoustic pressure, etc.)

How can it be accomplished?

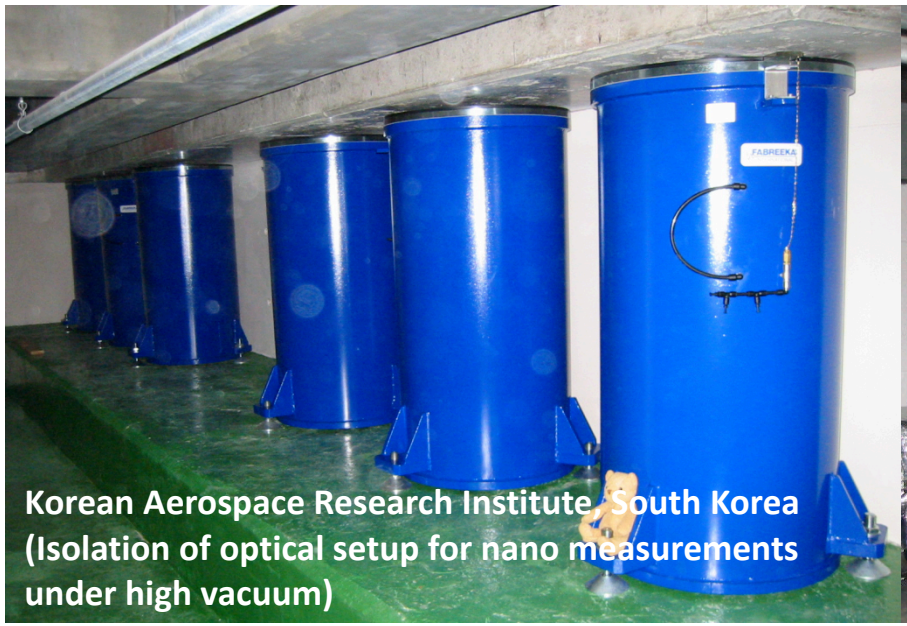


*Conceptual design

So, is this concept being used anywhere?

Yes

This approach is being, for example, widely used as a first "layer" of vibration isolation in nanotechnology labs

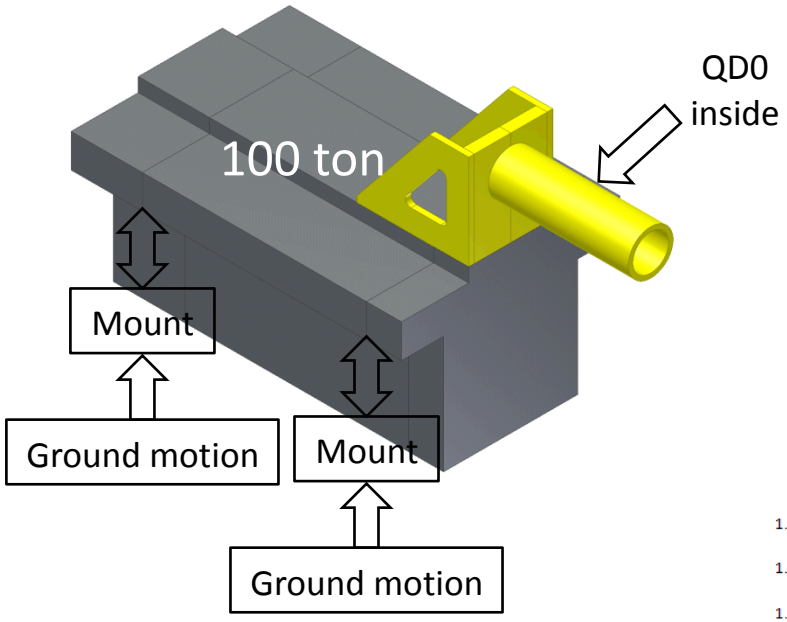


Korean Aerospace Research Institute, South Korea
(Isolation of optical setup for nano measurements under high vacuum)

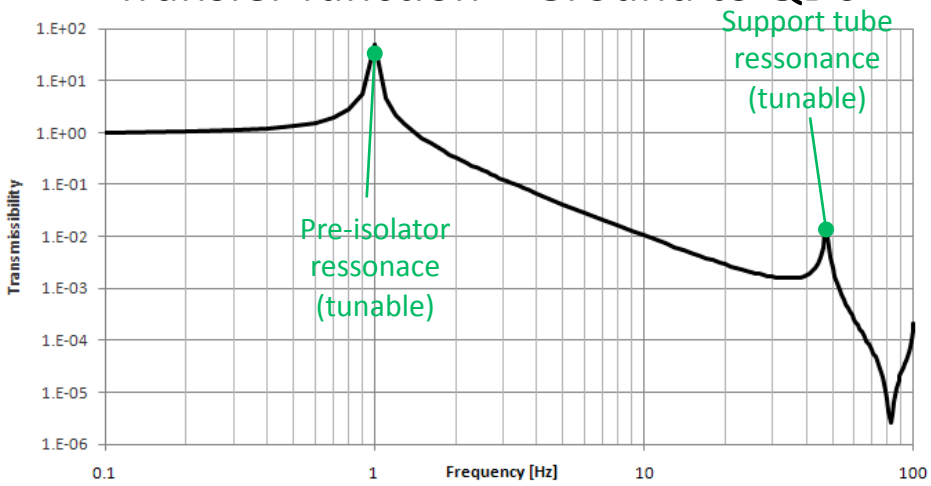
University of Huddersfield, United Kingdom
(Ultra-low frequency vibration isolation for sub-nanometer measurement, inspection and manufacturing)

FEM Simulations of gain

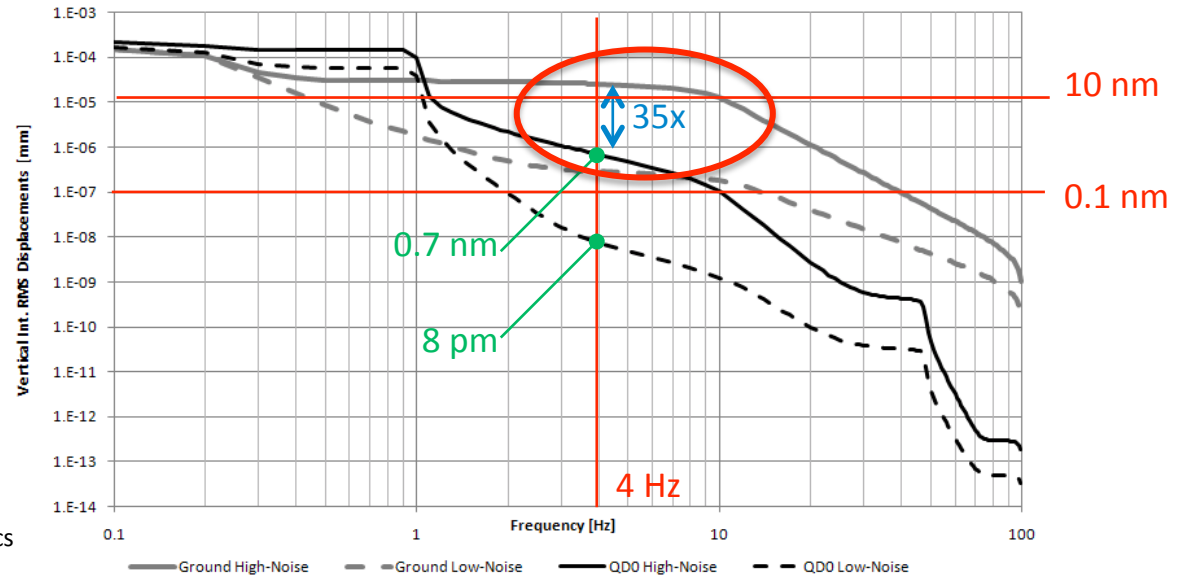
Model



Transfer function – Ground to QD0



Integrated R.M.S. displacements @QD0 (vertical)



*Input ground motion from: C. Collette, ILC-CLIC LET Beam Dynamics Workshop (23-25 June 2009)

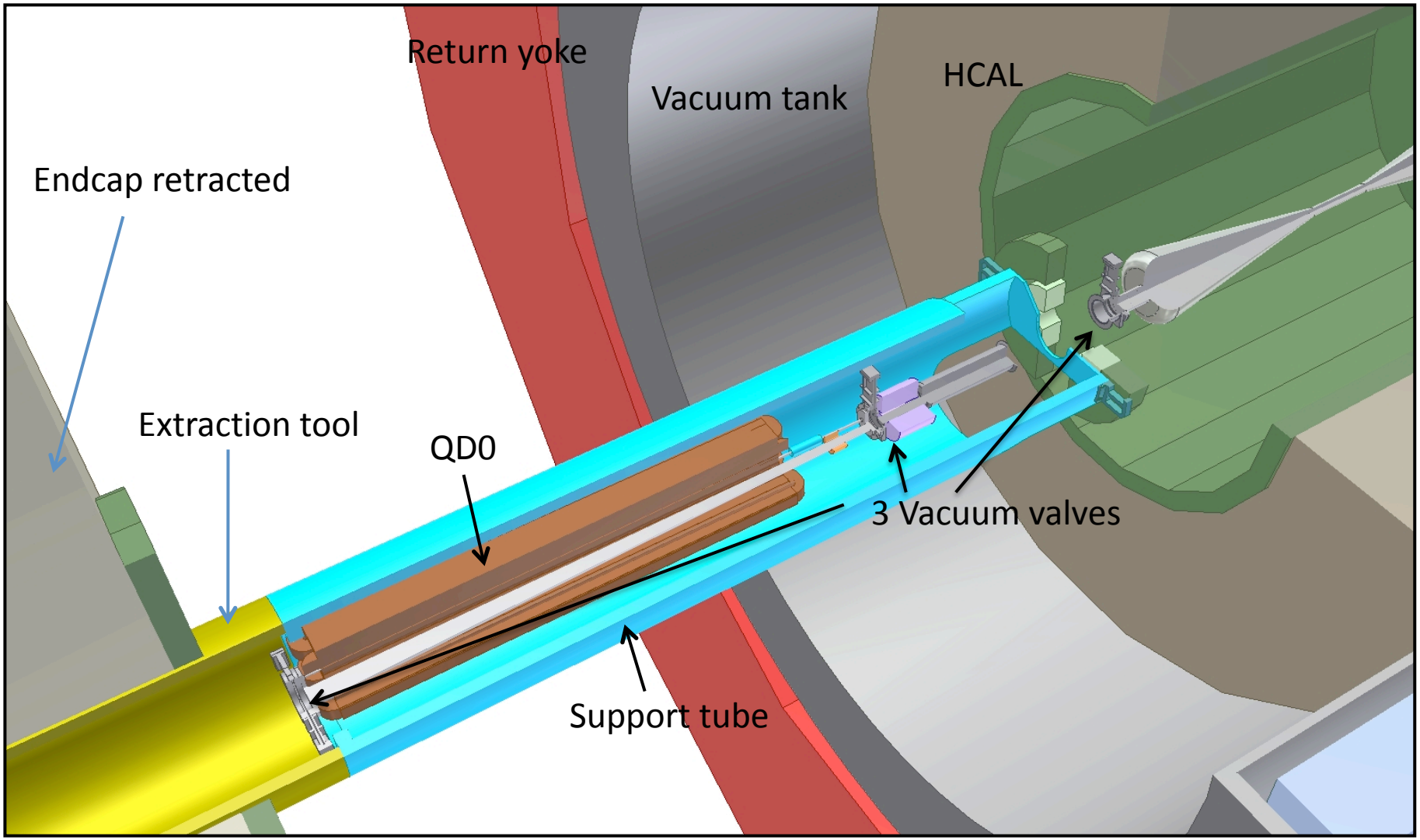
2. Limit vibration by active intervention

- Active stabilisation with piezo - actuators
- BPM – beam kicker feedback loop

We rely on three independent stabilization techniques:

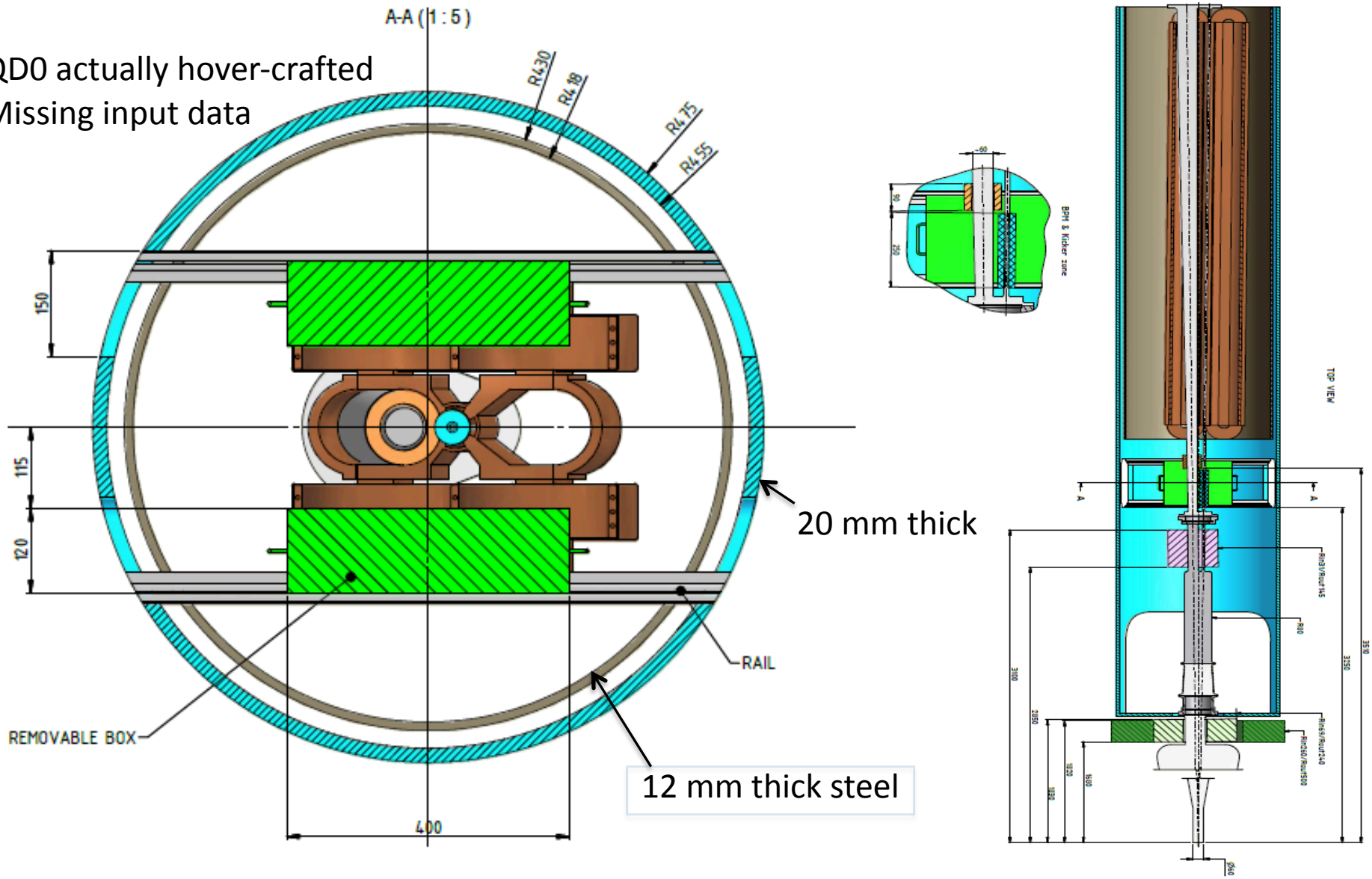
1. pre-isolator
2. Piezo-actuators
3. Beam kicker

Situation inside support tube



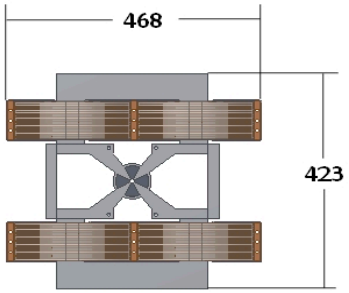
Cross-section support tube, dimensions

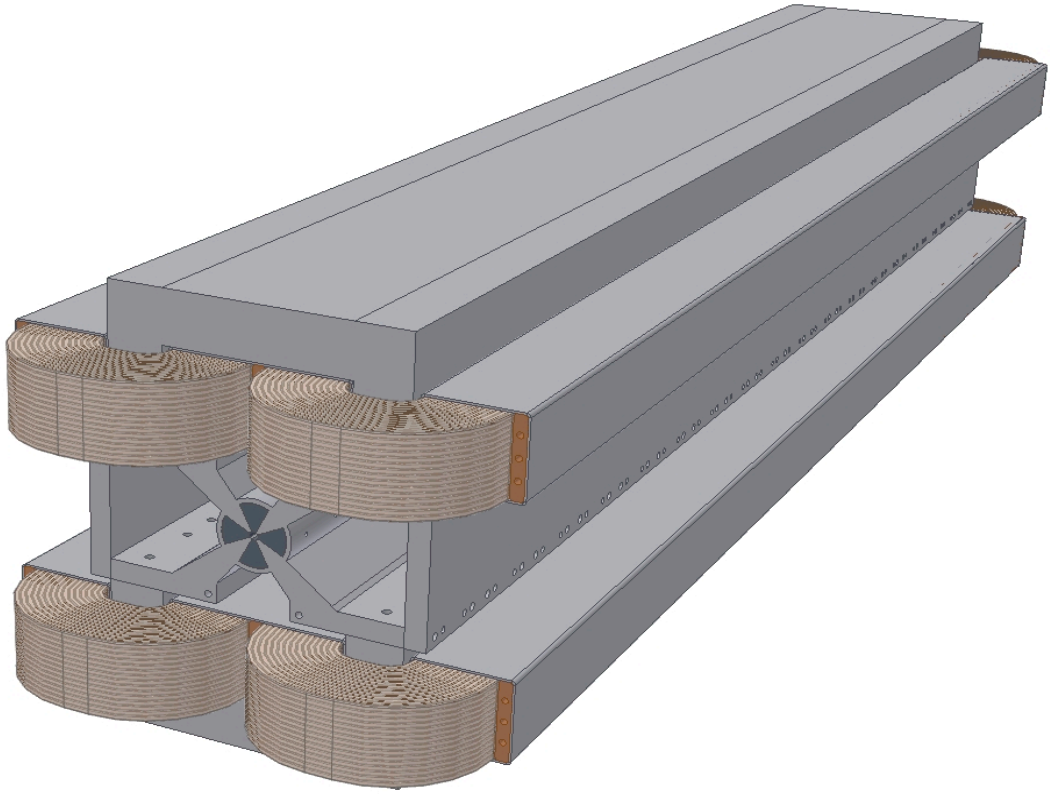
QD0 actually hover-crafted
Missing input data



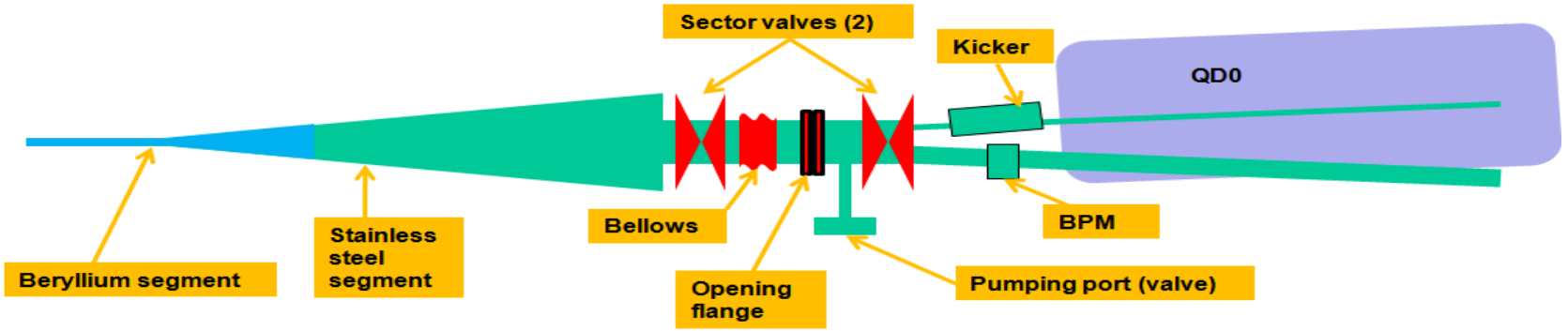
QD0 layout, courtesy M. Modena

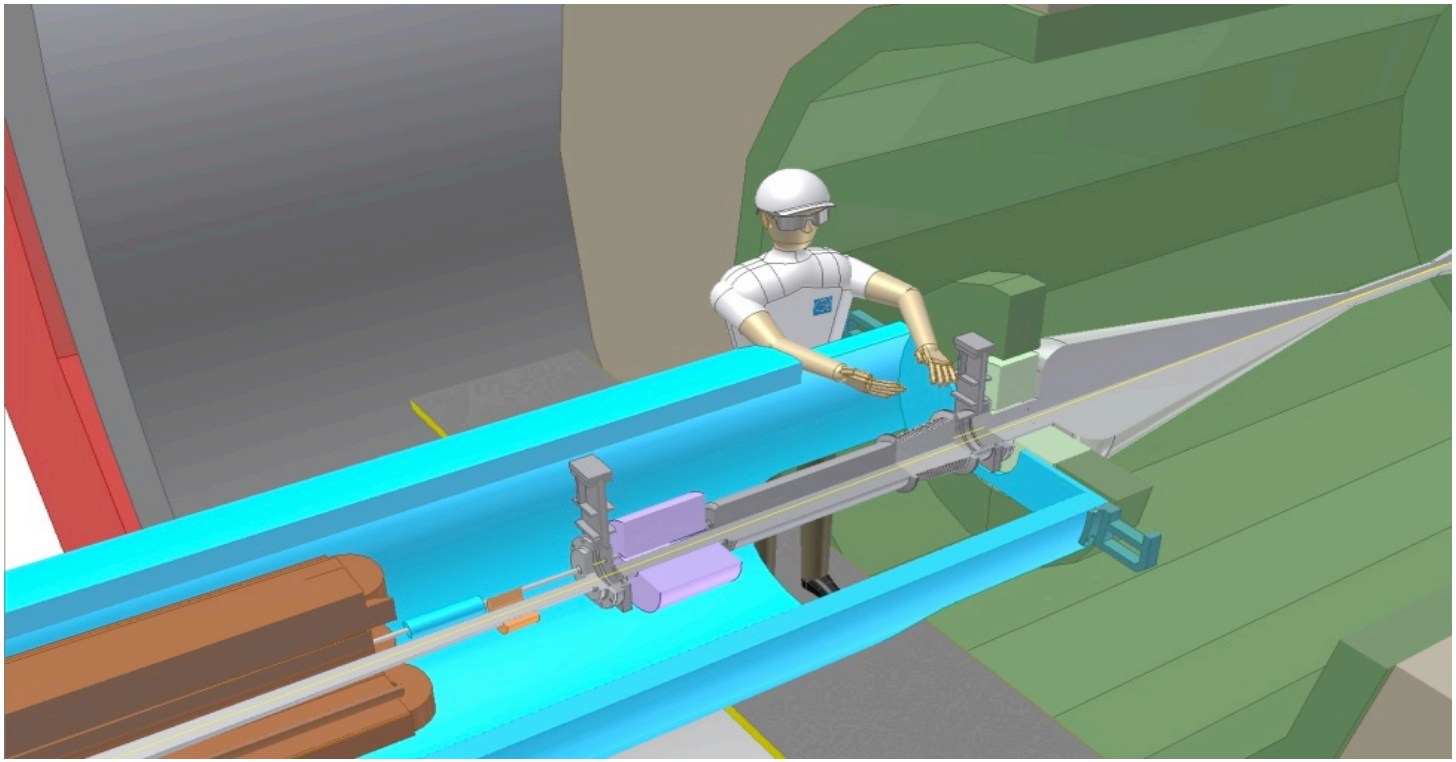
Permanent magnet with additional coils





Vacuum schema & implementation (draft)

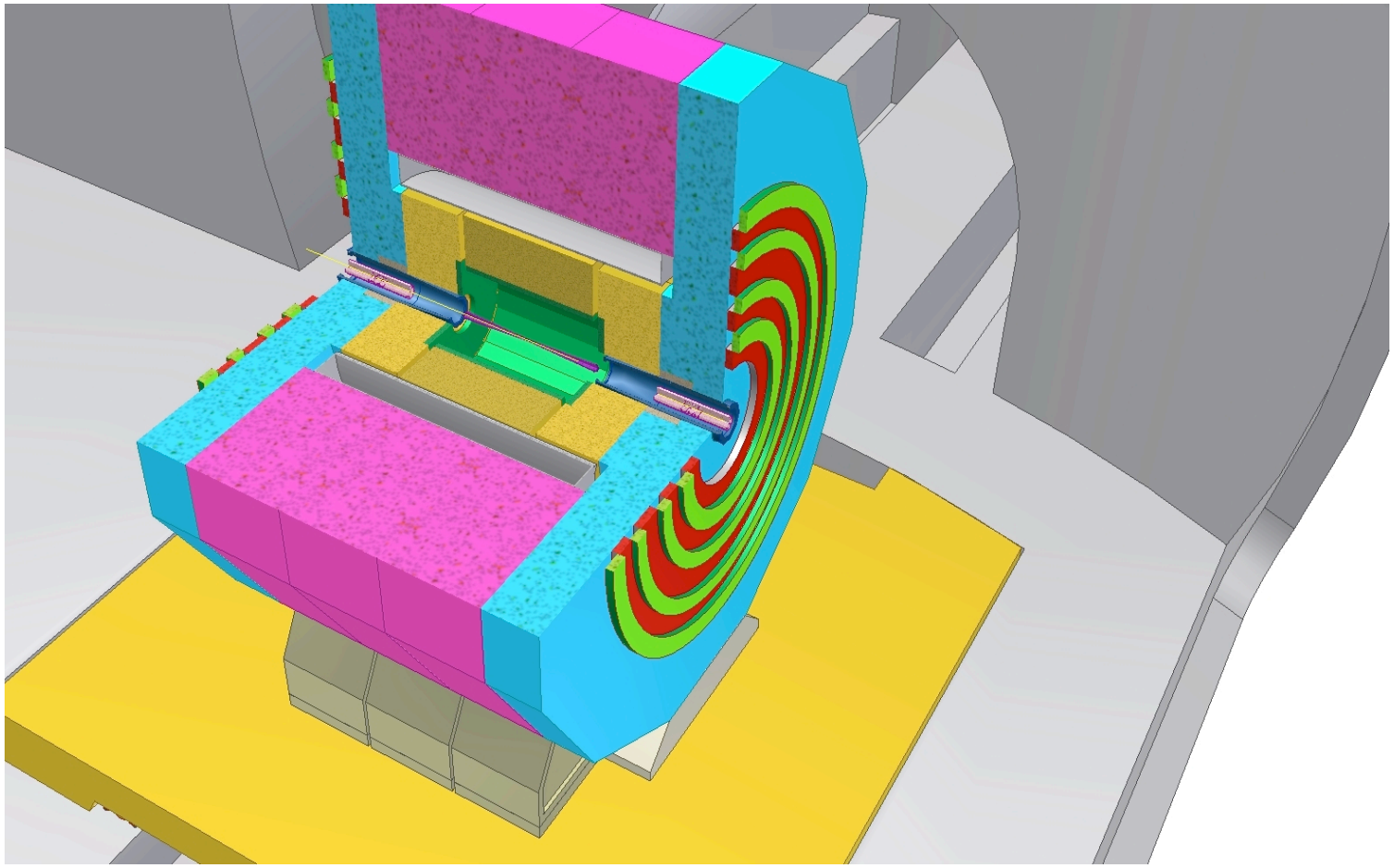




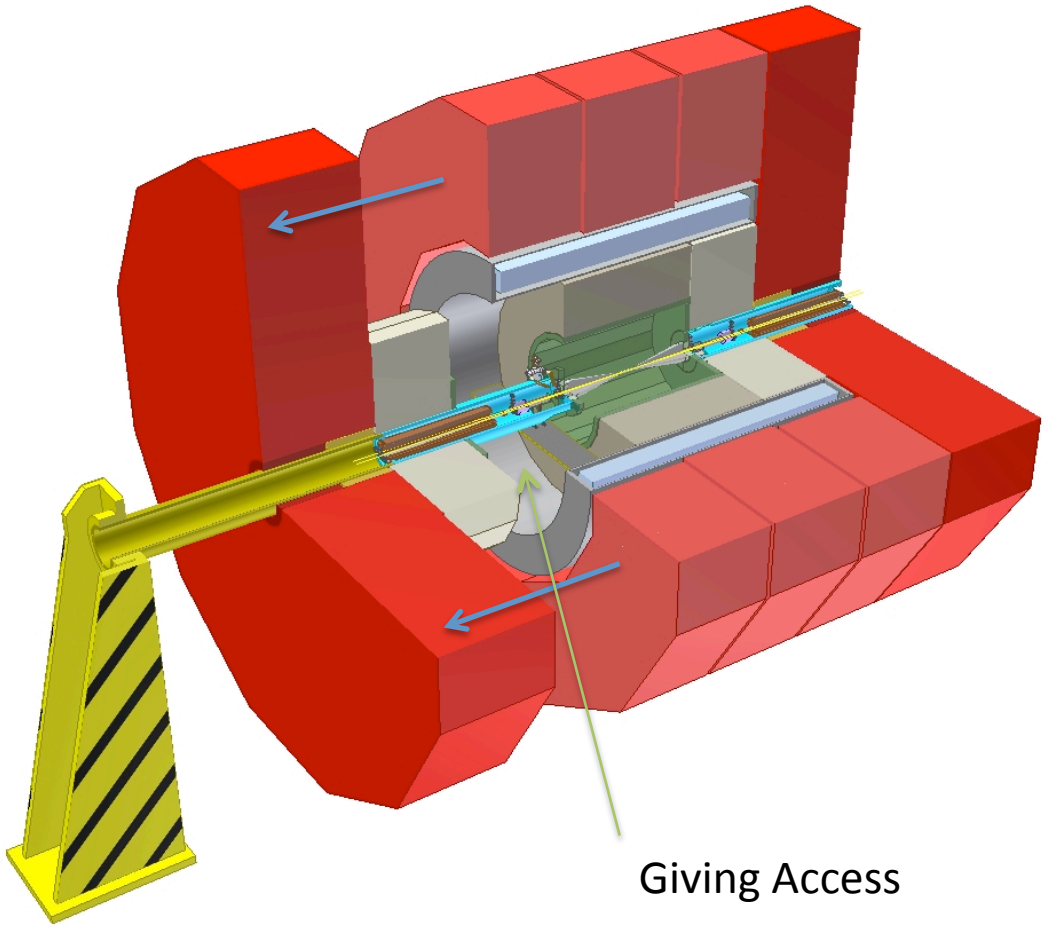
Detector & Experimental Area

- During its transfer from IP to garage position, the QD0 support is hold inside the endcap by hydraulically or pneumatically motorized supports
- An extraction tool allows the endcap to open with QD0 support staying in place thus giving access to the valves and Lumical
- After opening of Lumical and valve, Support tube can be taken away by crane

Step 1: Detector from IP -> Garage position



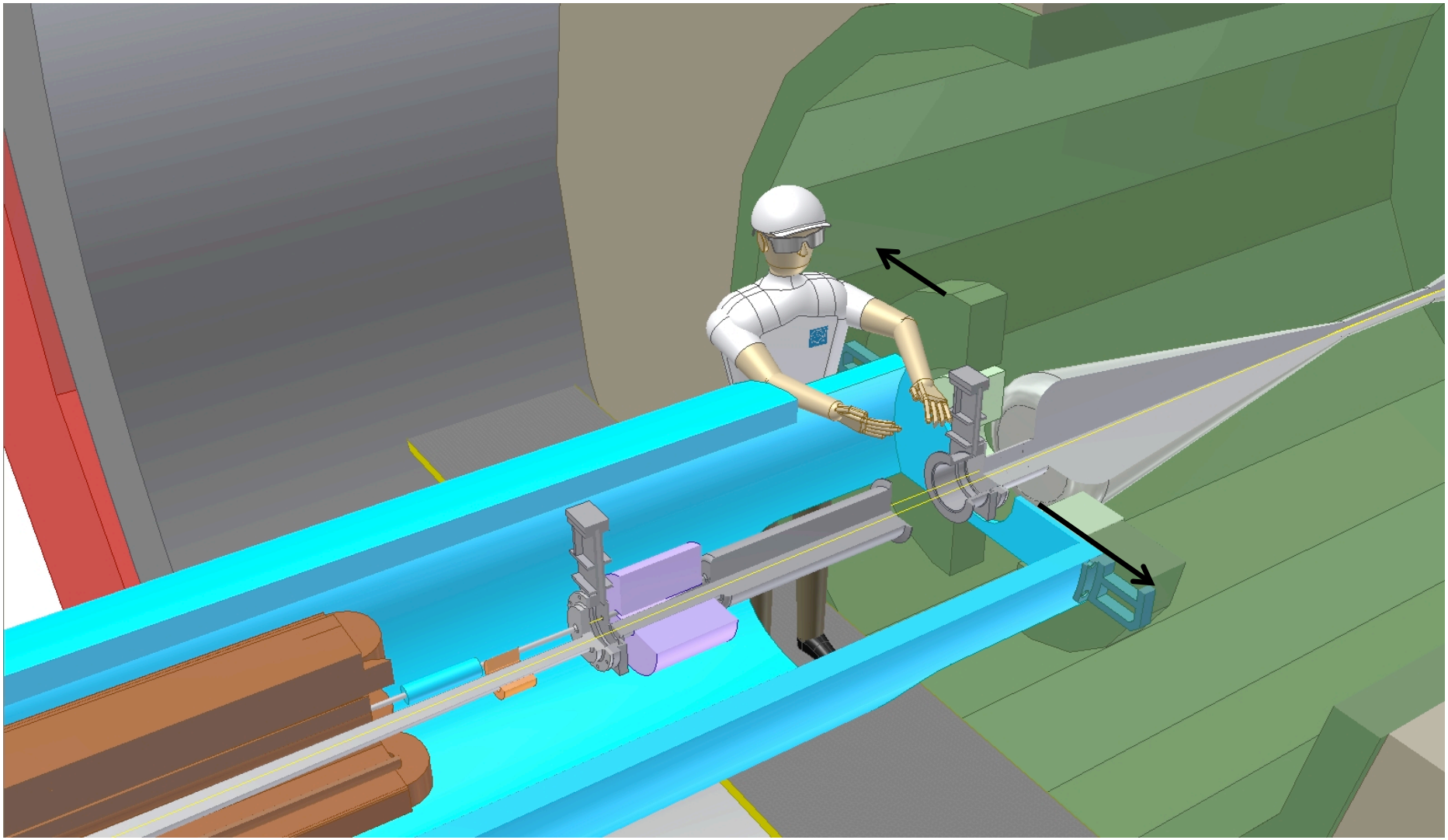
Step 2: Installation of Extraction tool, opening, support tube does NOT move



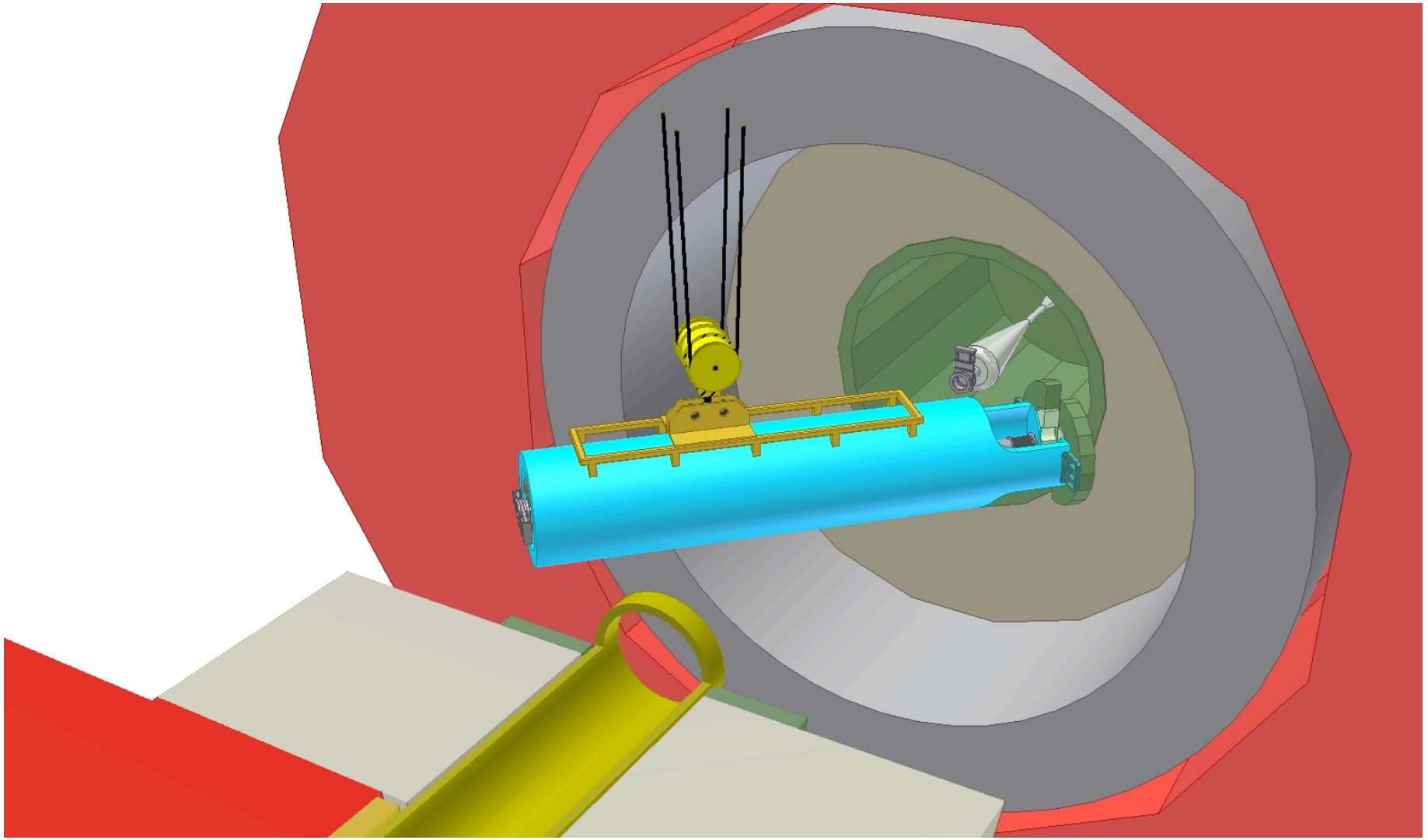
Extraction tool for
Support tube

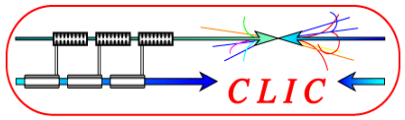
Giving Access

Step 4: Disconnect Beampipe and Open Lumical



Step 7: Full Access, work can start





Experimental Area proposal

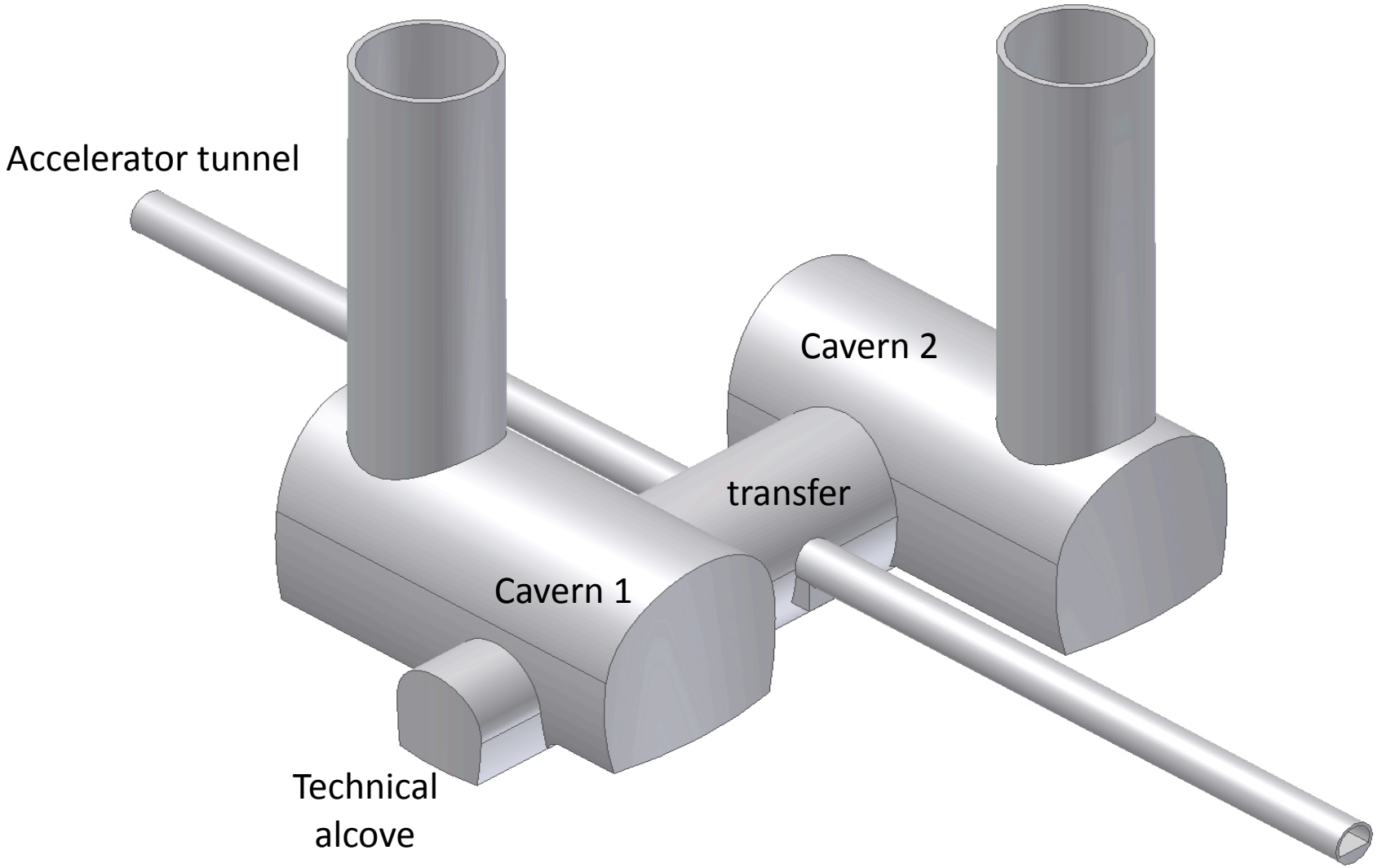
Experimental area has been designed with

2 working caverns and 1 transfer tunnel

Its characteristics are:

- no pacman shielding – instead chicanes between endcap/tunnel
- Very smooth end-wall of tunnel
- Longer experiment adapts via end-coils to shorter experiment
- Radiation shielding1 is a ring chicane on the endcap
- Radiation shielding2 is a sliding concrete wall integrated into cavern
- Provision of 2 x 75 m^3 volumes in the tunnel to house a possible massive pre-isolator of up to 200 tons each

EA seen from 'outside'



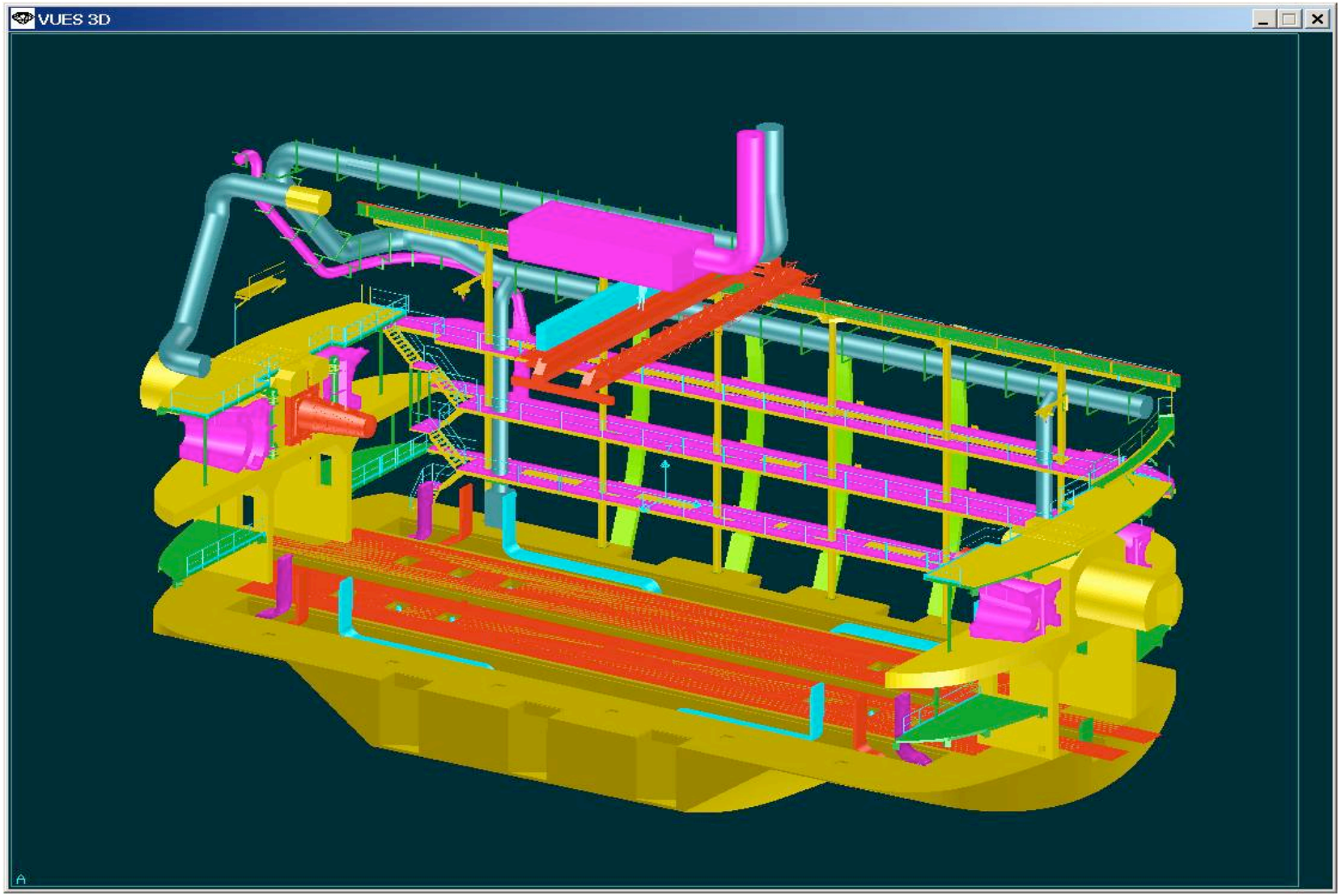
A word to Push-Pull

- Work experience in CMS and elsewhere showed that the mechanical movement is very short with respect to all the hidden tasks and other losses.

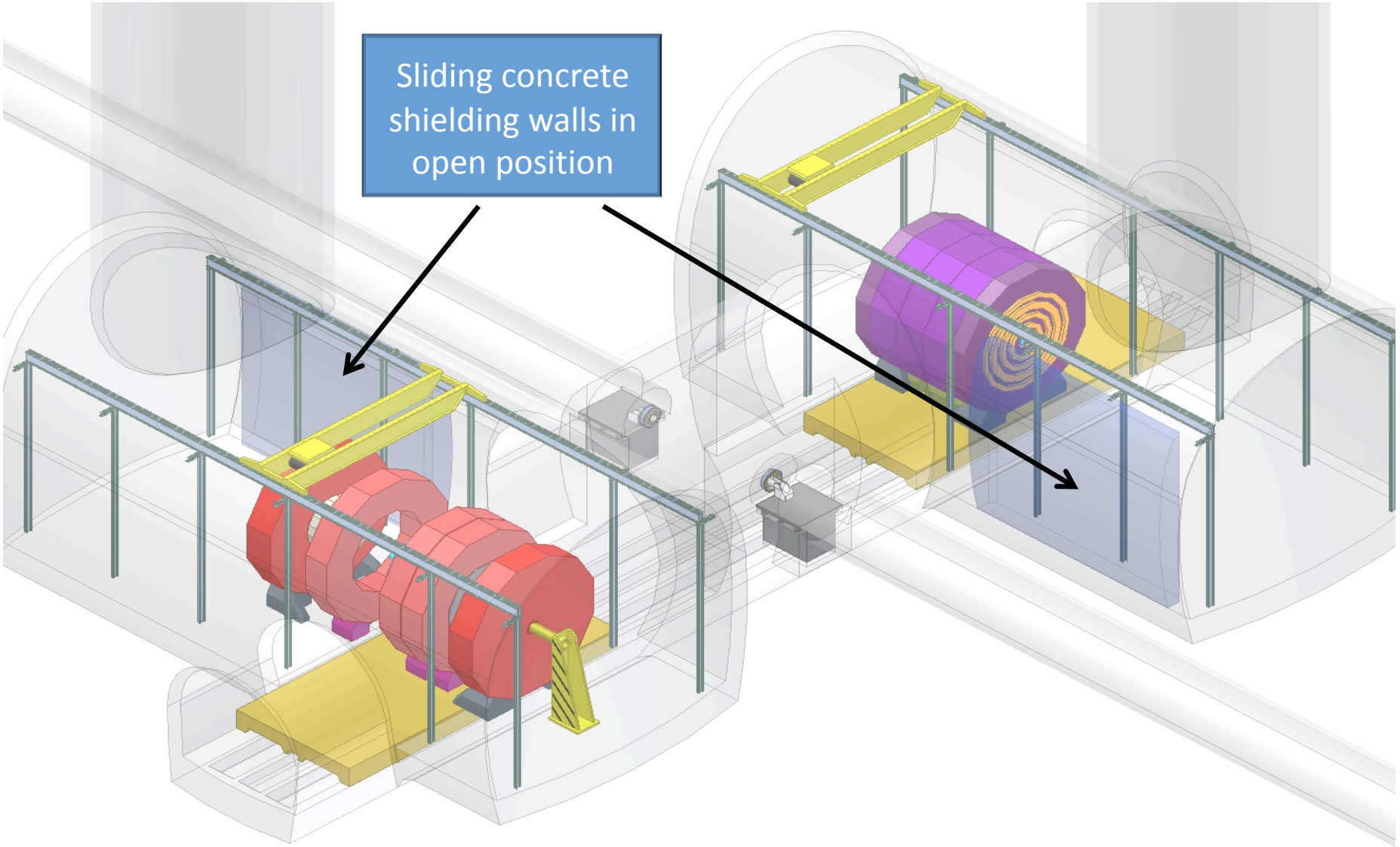
- To perform well in a push-pull scenario, one has carefully to study in terms of speed for:
  - powering the magnet, cooling, vacuum pumping and radiation shielding for safety in order not to loose the time there!

The real move and precision positioning of the detector within 1 mm is feasible in 1 day

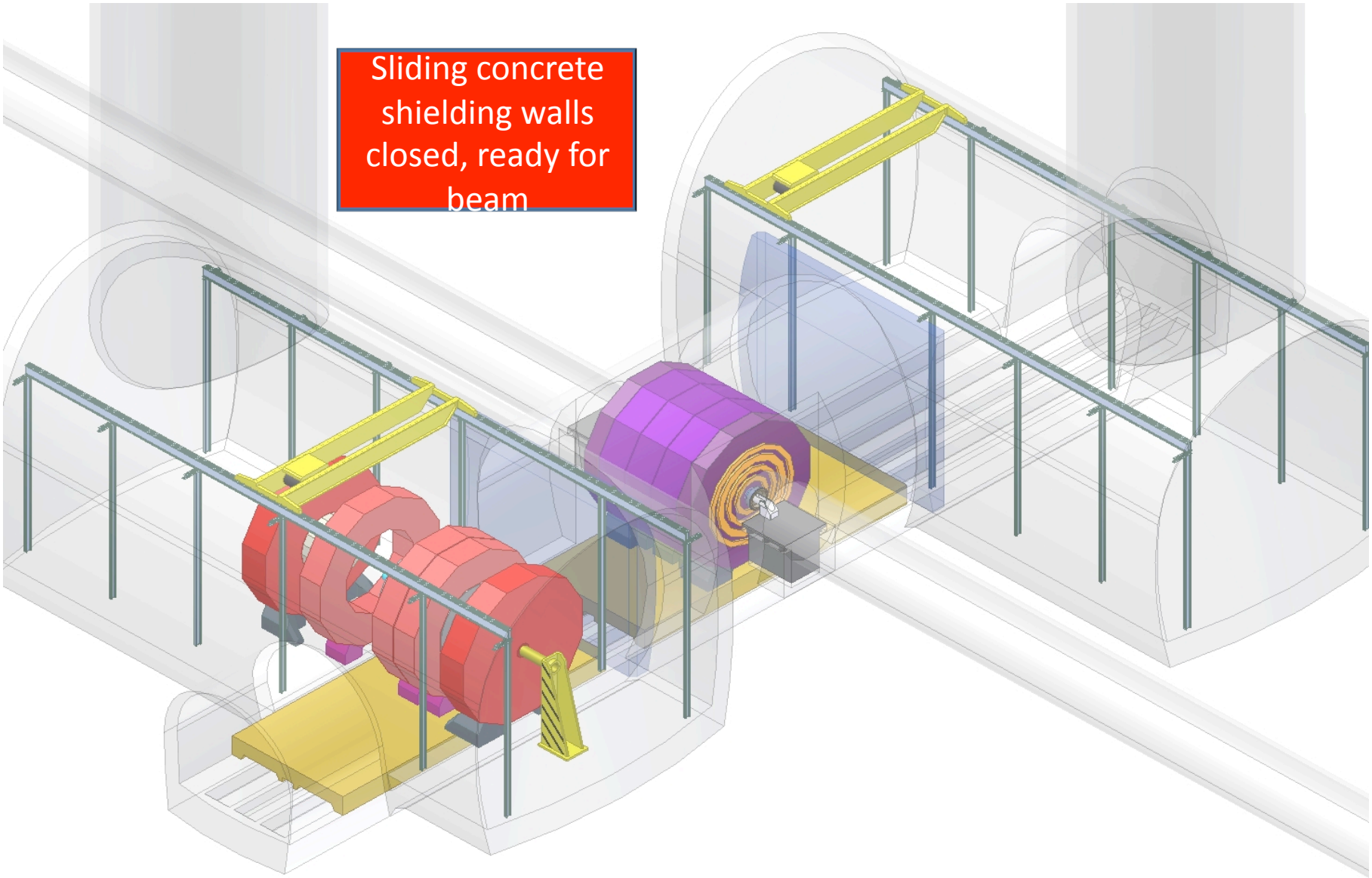
A cavern only is empty directly after CE



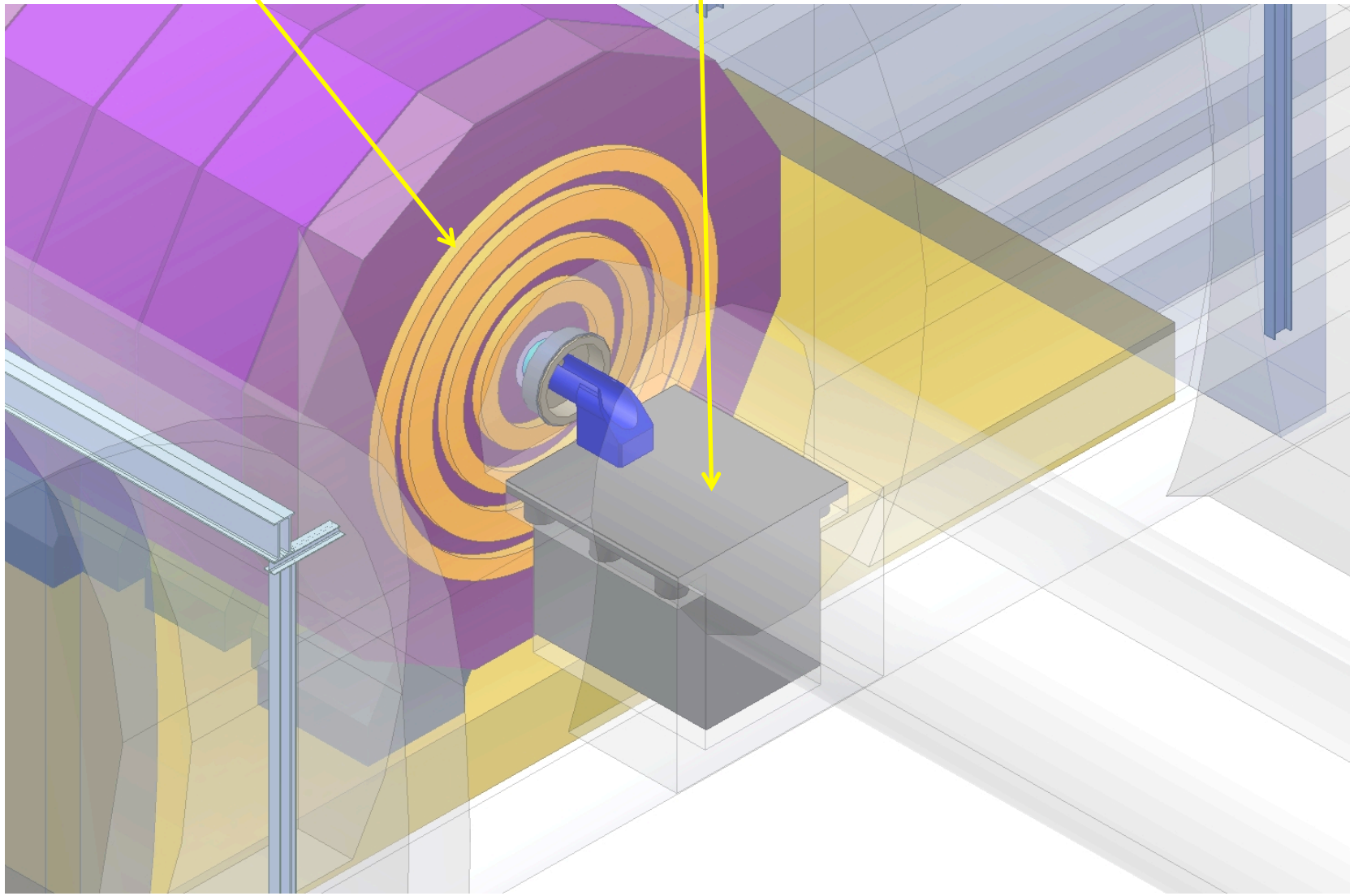
EA looking inside



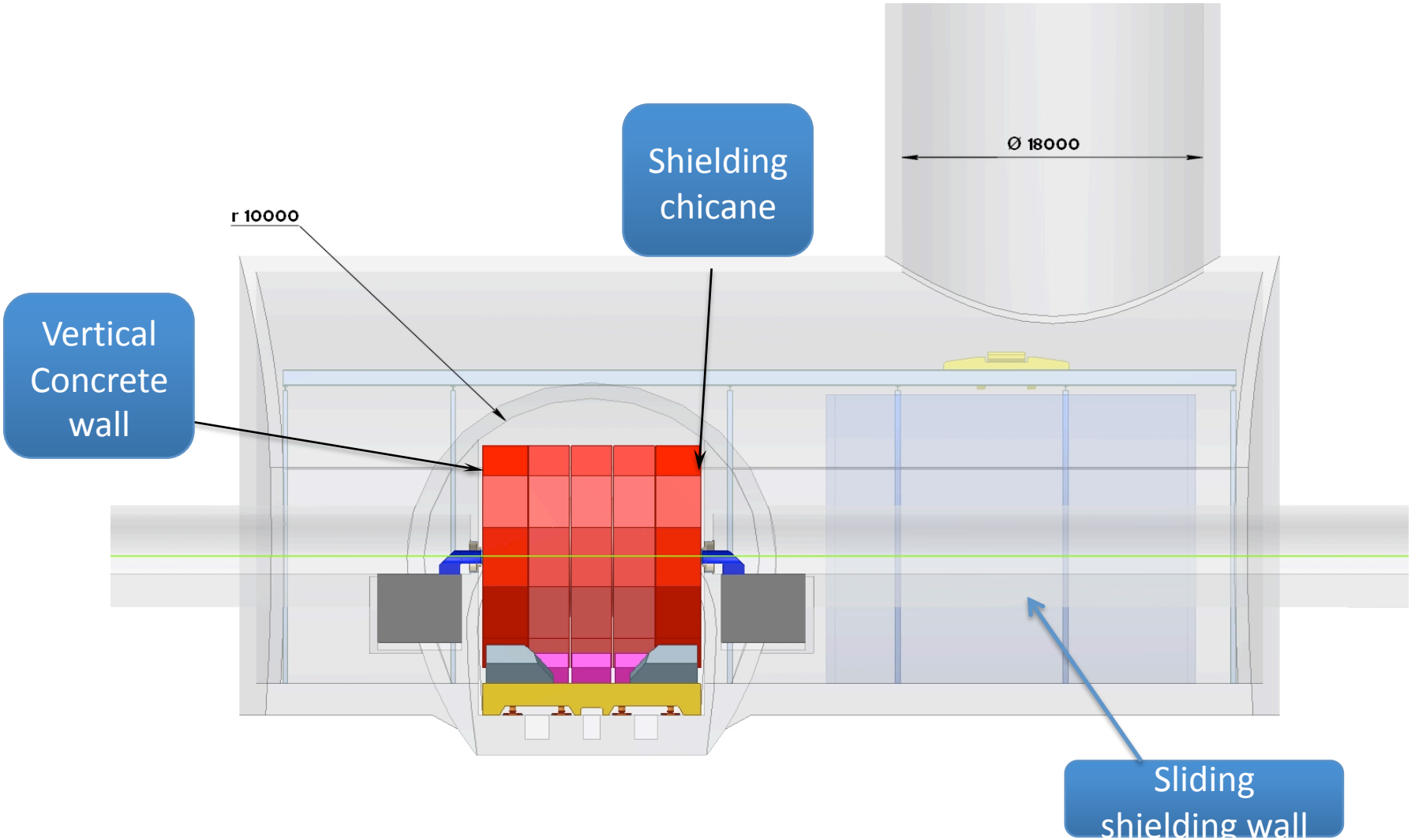
Experiment 2 sliding on IP, shielding walls closed



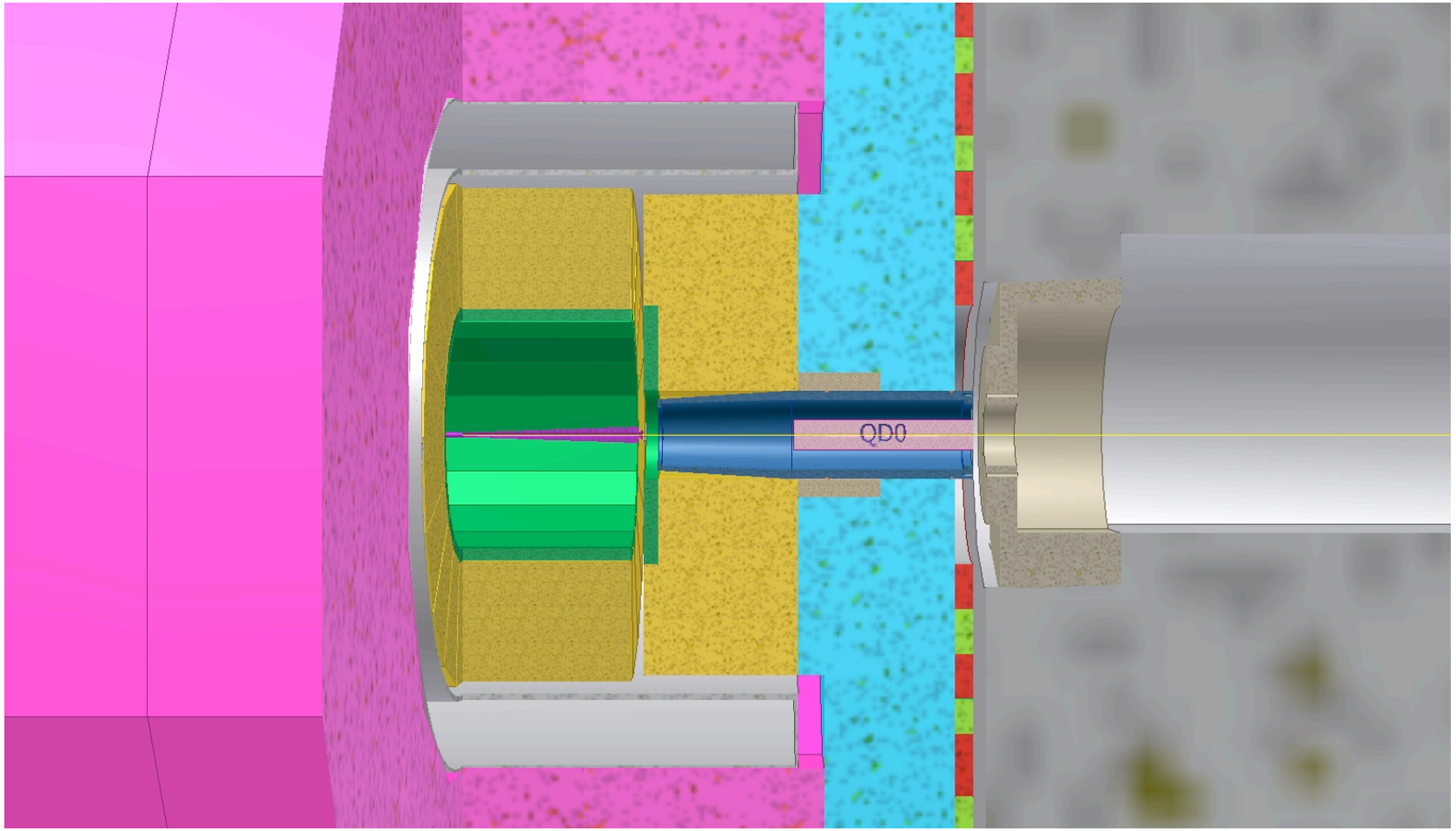
End-coils and isolator basic layout



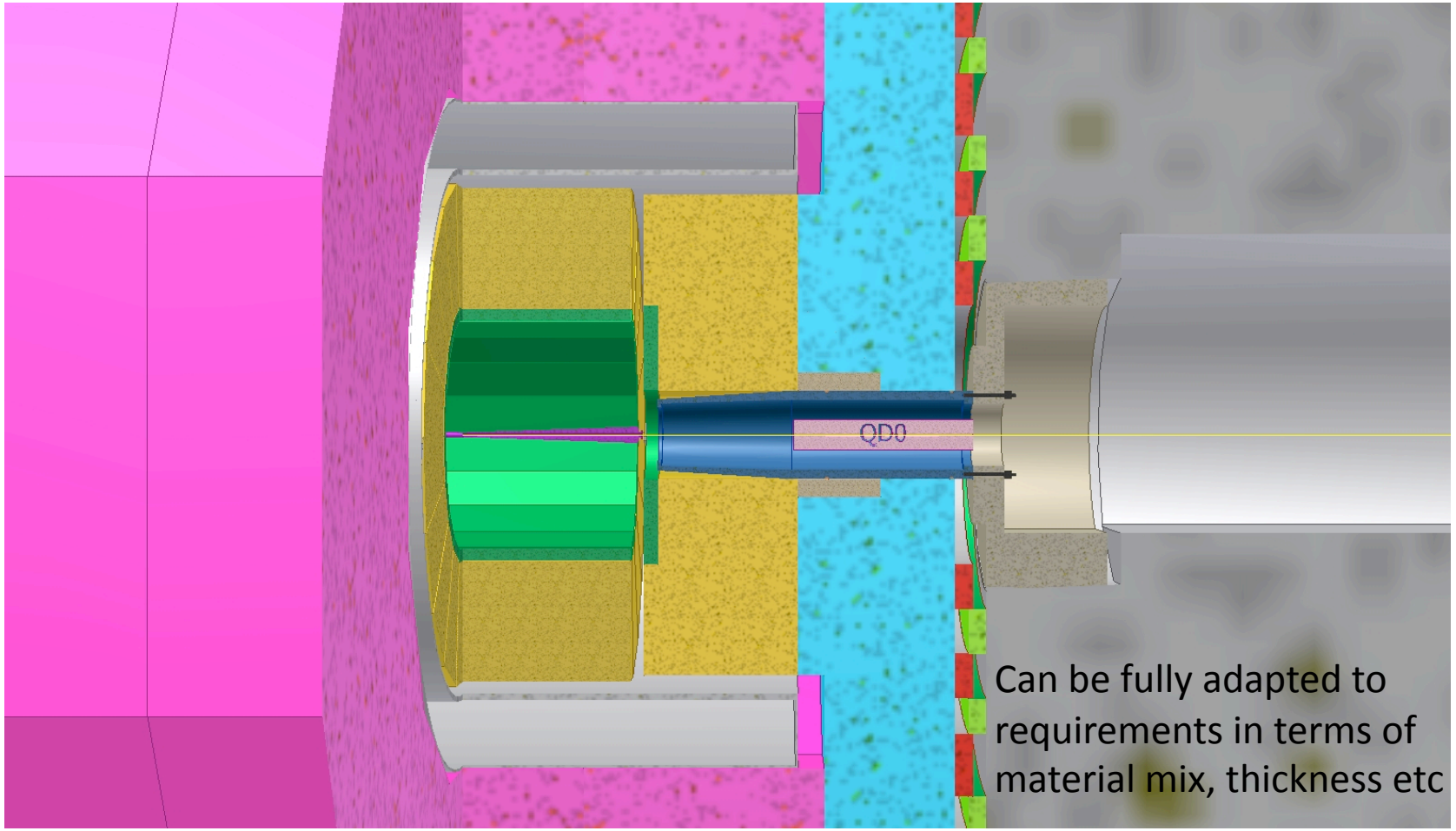
Cut view of transfer tunnel



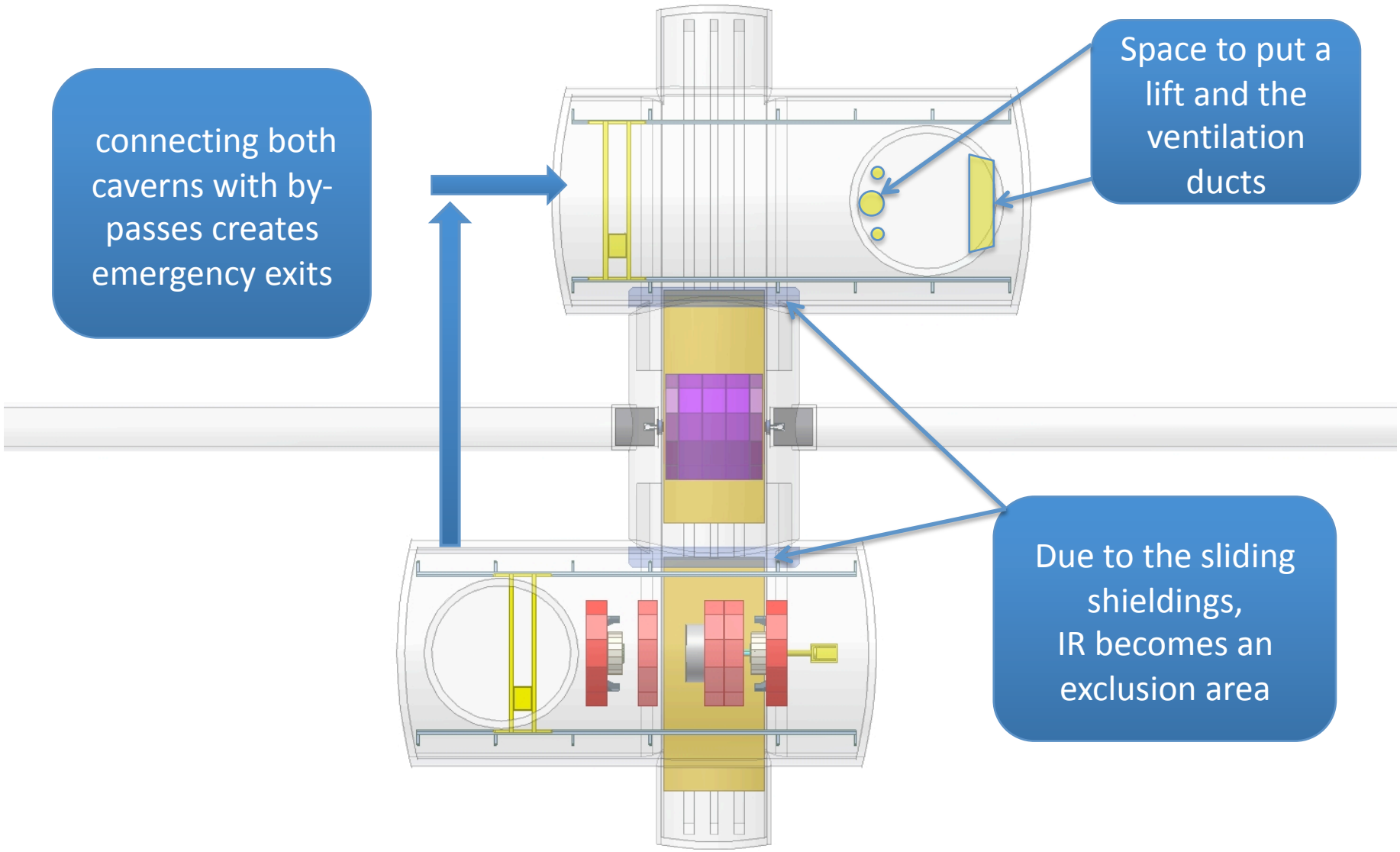
Radiation chicane retracted



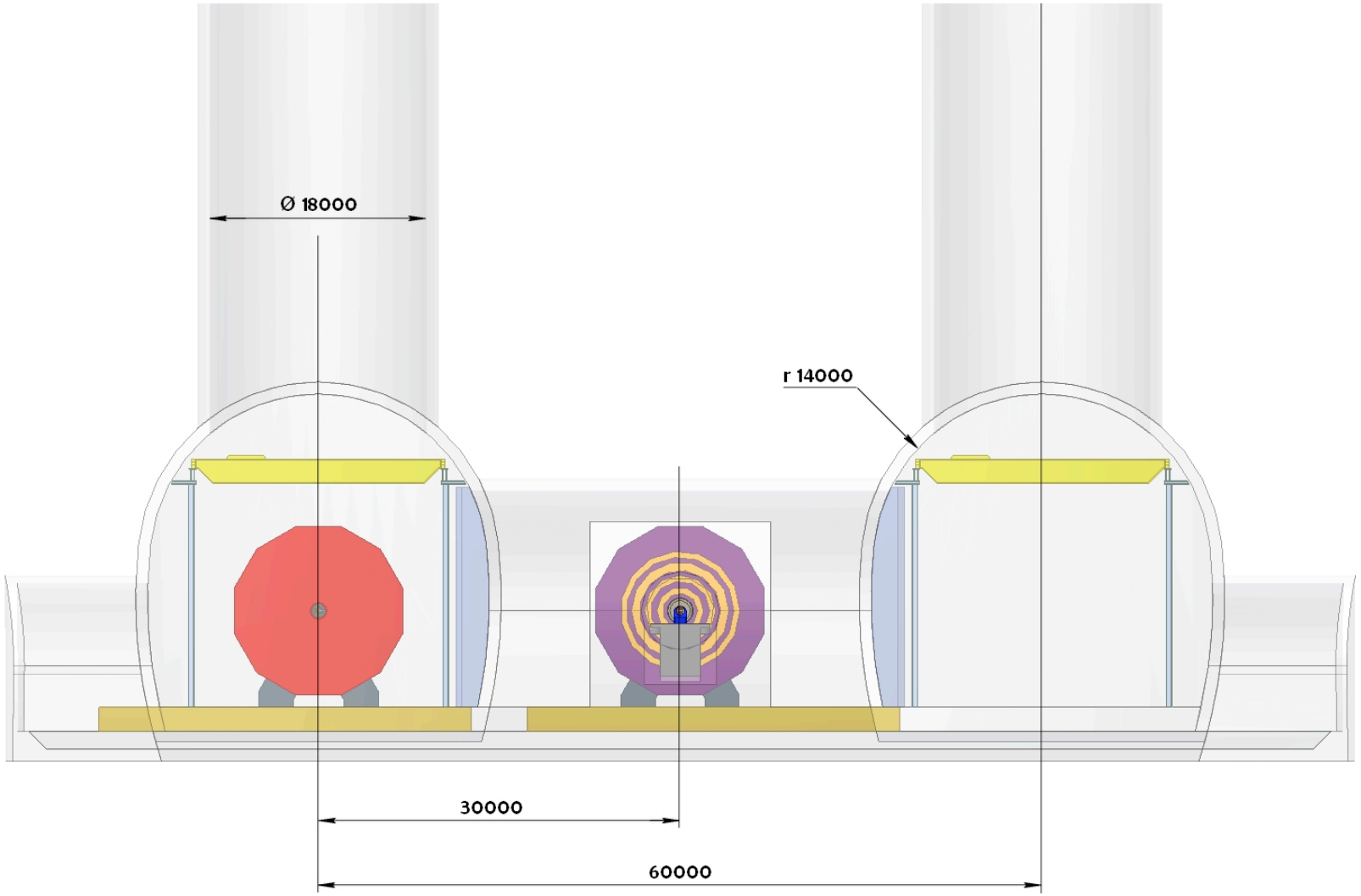
Radiation chicane switched on



Top view of a CLIC EA layout



Main dimensions proposal CLIC EA



Thank you for your attention