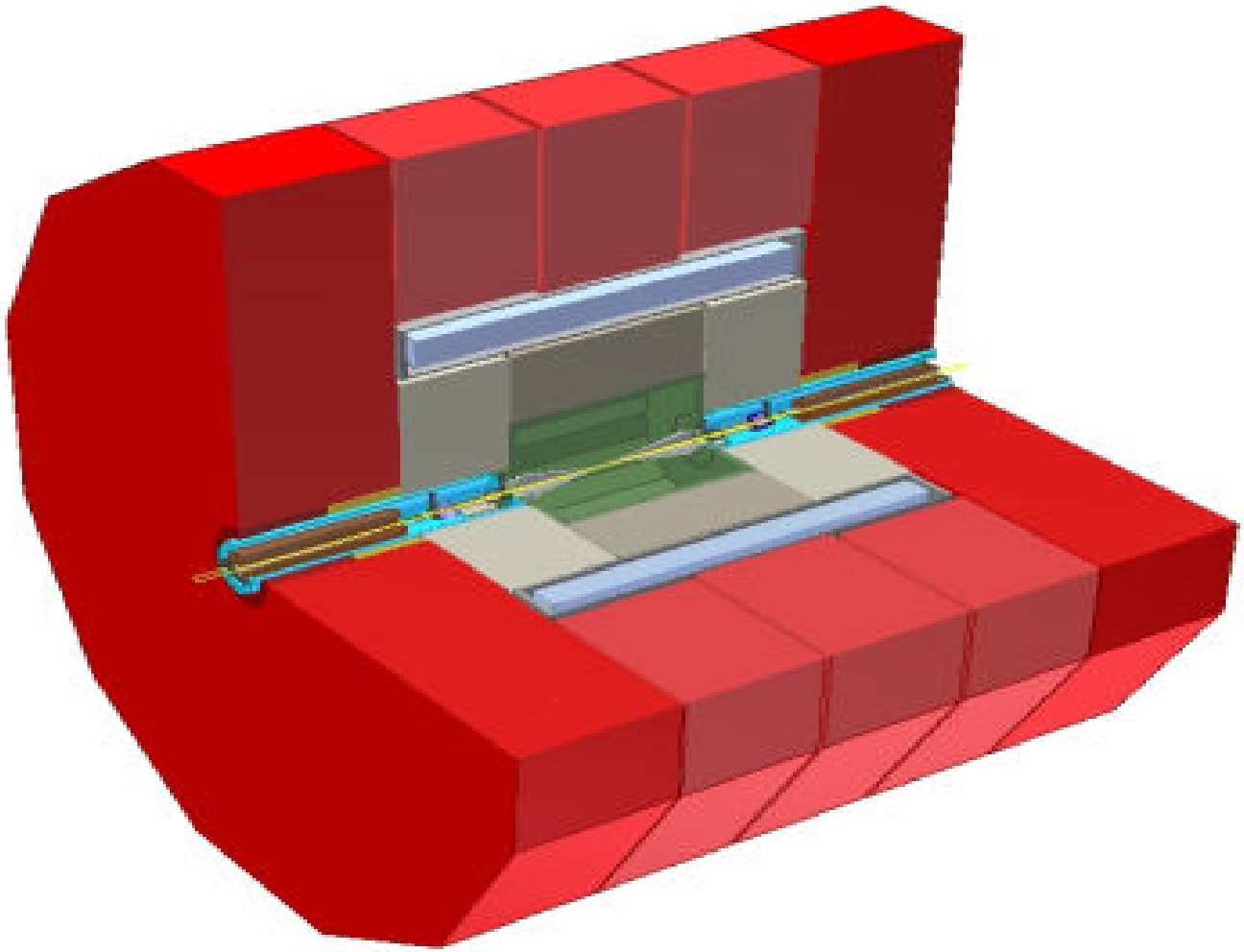
CLIC Detector MDI

A. Hervé / ETH-Zürich@CERN

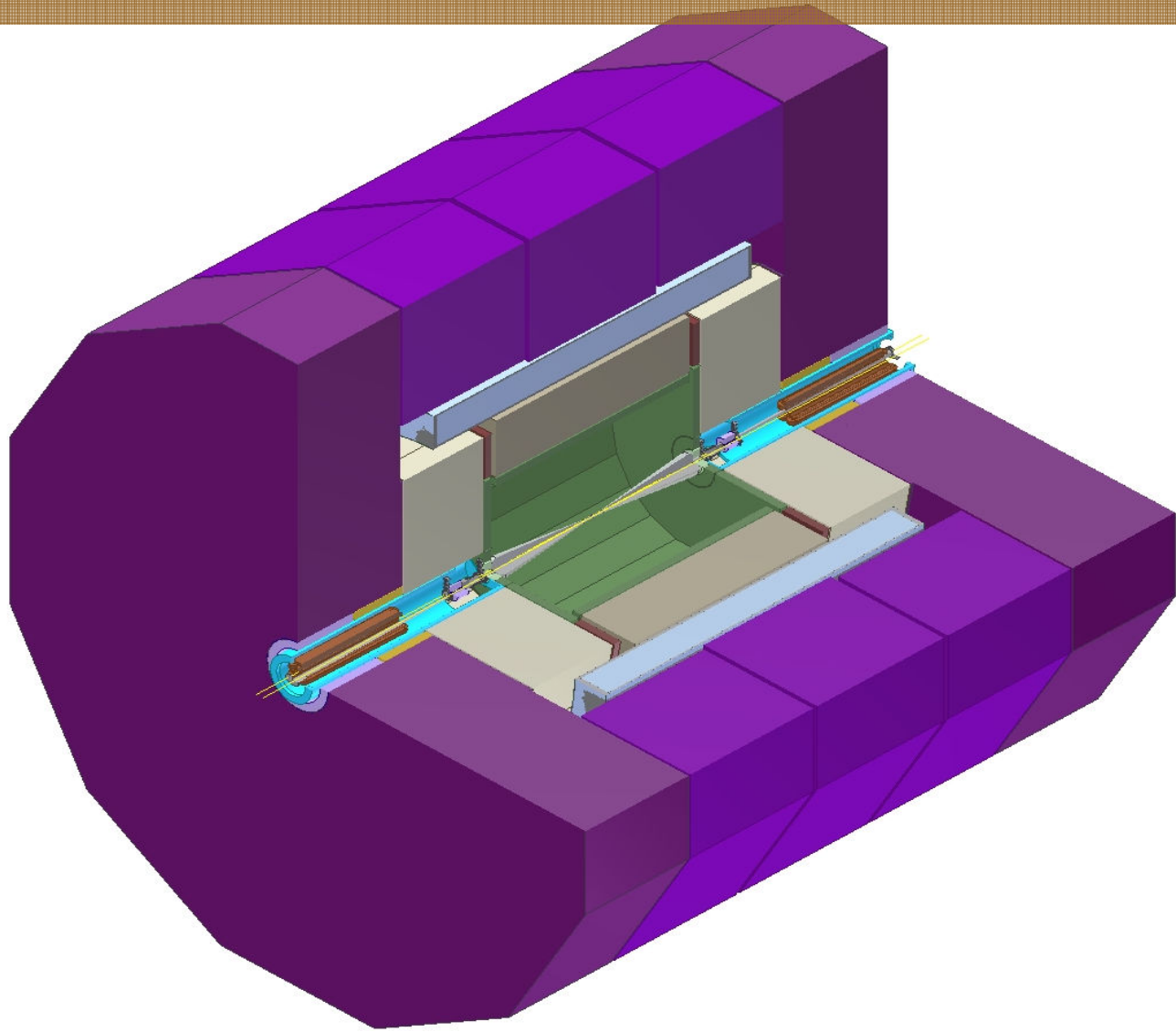
A. Gaddi & H. Gerwig /CERN

ILDWS2010-LLR17 Jan. 2010

Typical CLIC Detector SiD Like



Typical CLIC Detector ILD Like

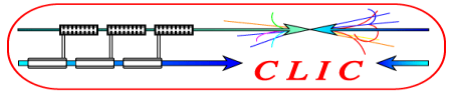


Provisional

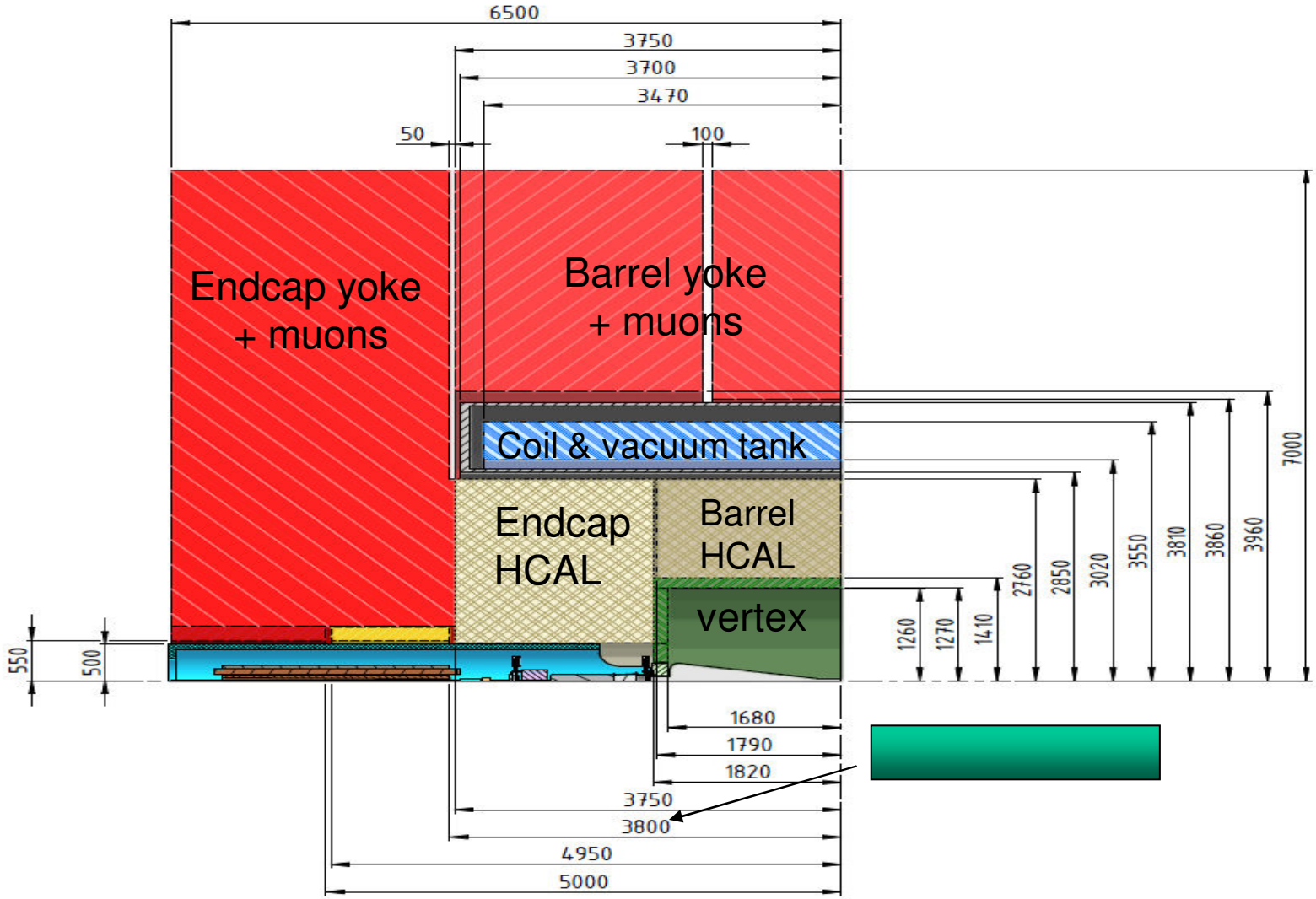
Please Note:

Details of these CLIC detectors will be presented by Lucie tomorrow.

I will concentrate on the MDI implications using the SiD like detector that is more advanced as an example, trying to emphasize the differences with ILD.



¼ Detector, details (SiD-ish)



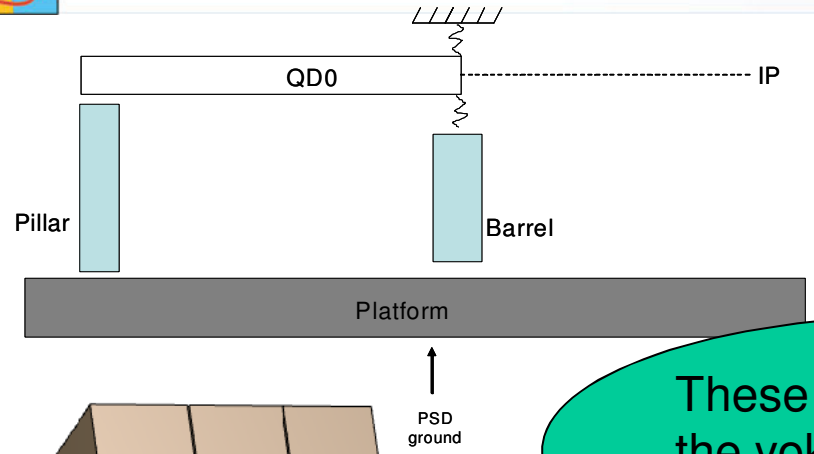
Stability of QD0s in Linear Colliders-I

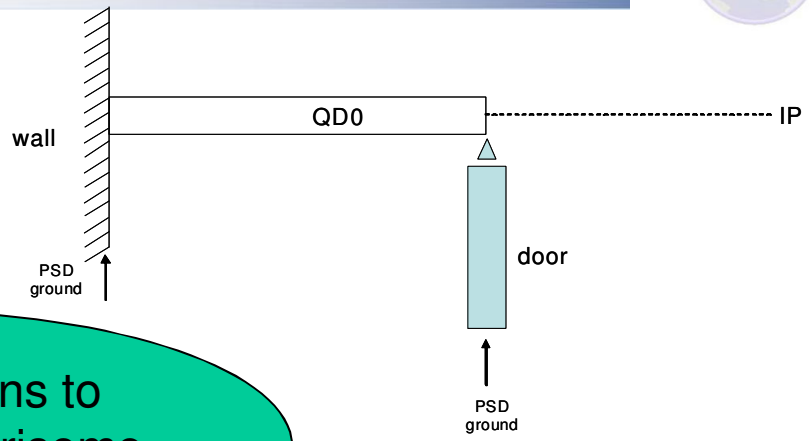
- The supporting of QD0 in LC is a critical element.
- It must provide a local “stable ground” to allow precise stabilization of the QD0 proper
- It must be compatible with the experiment lay-out.
- It must be compatible with the machine lay-out.
- It must be compatible with the push-pull scheme.

Stability of QD0s in Linear Colliders-II

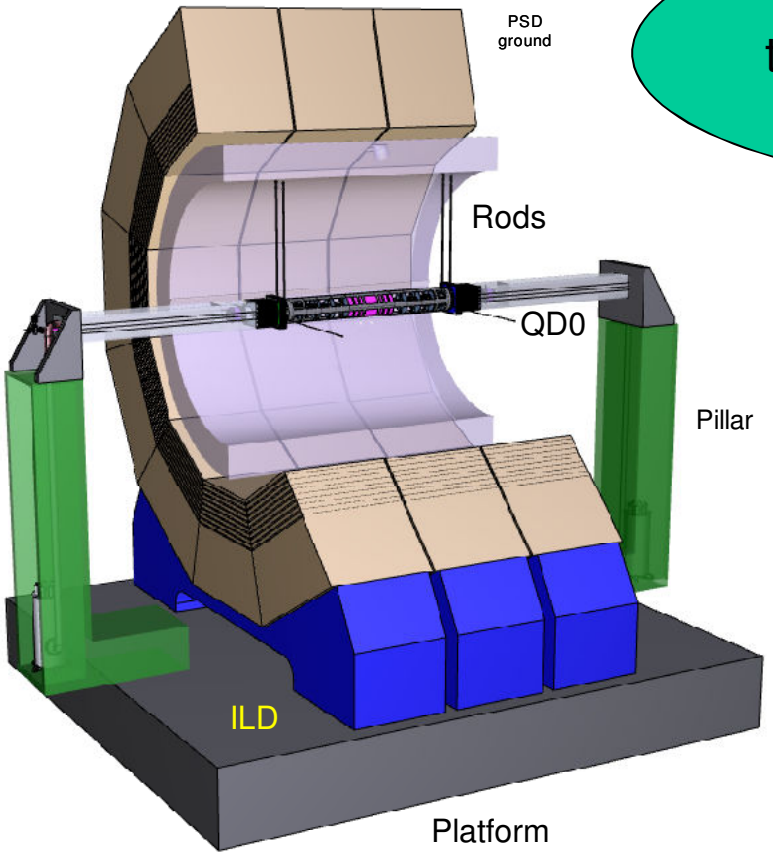
- The subject has been looked at carefully for ILC experiments since June.
- Taking into account the intra-train feed-back, a good target to reach, for the stability of QD0 in ILD is around 20 to 30 nm for the vertical position.
- Due to timing considerations the intra-train feed-back is not so efficient for CLIC, and to reach the luminosity, the vertical stability of the QD0 has to be below 1 nm!

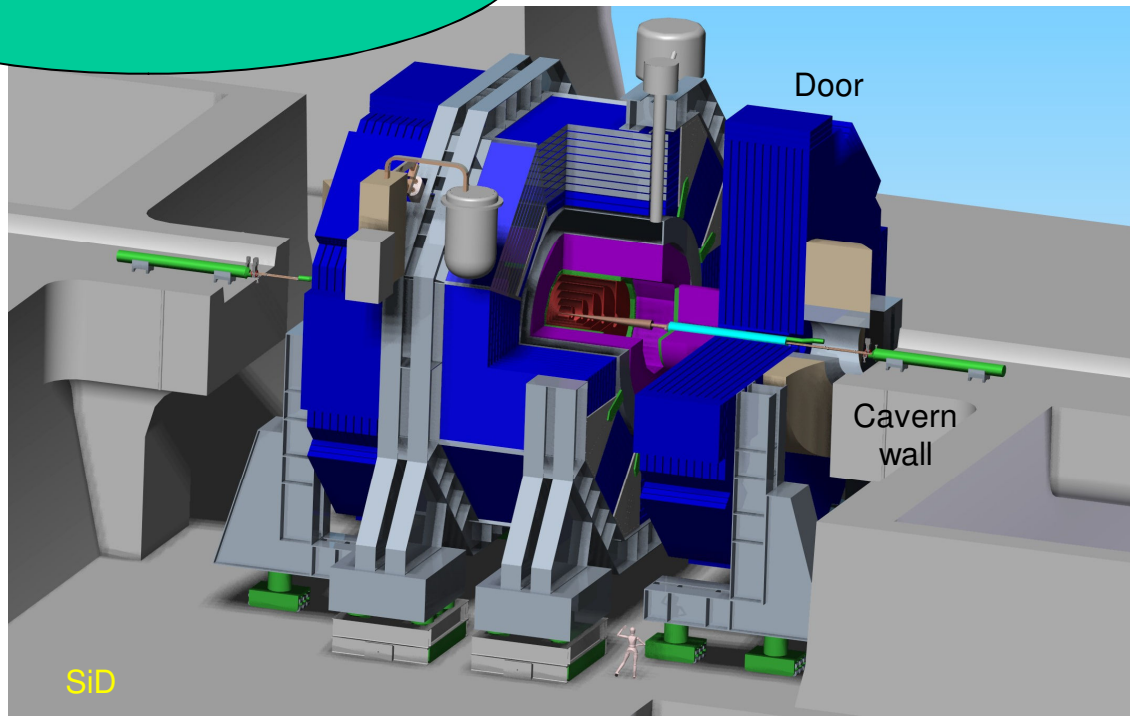
QD0 supports for ILD and SiD as in LoIs





These connections to the yoke are worrisome





Ground movements and simplified PSD Models

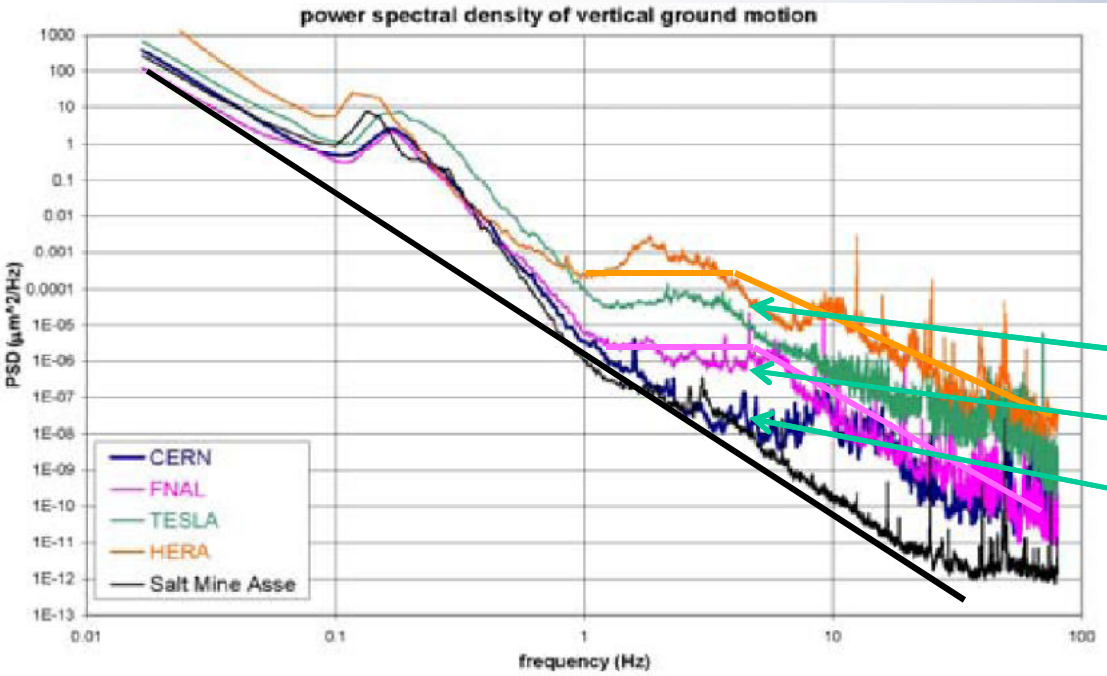
Measured at:

SLAC

DESY

CERN

KEK

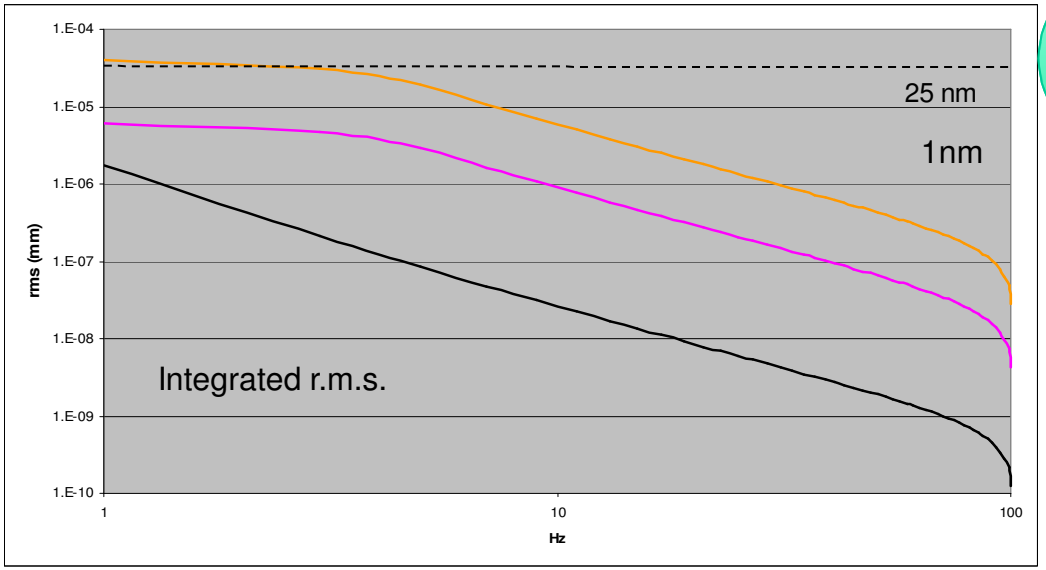


$$P(f) \approx \frac{A}{f^4}$$

Maximal ?

Reasonable ?

Minimal



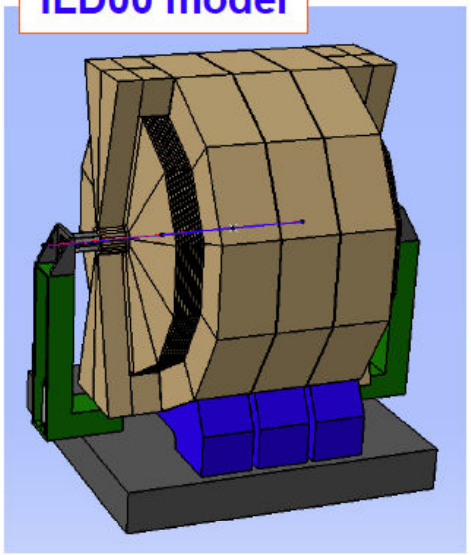
Ground movements may vary by a factor 100!

$$\sigma^2 = \left\langle x^2 \right\rangle = \int_{f_1}^{f_2} P(f)\,df$$

Vibration and Simulation for ILD (H. Yamaoka/KEK)

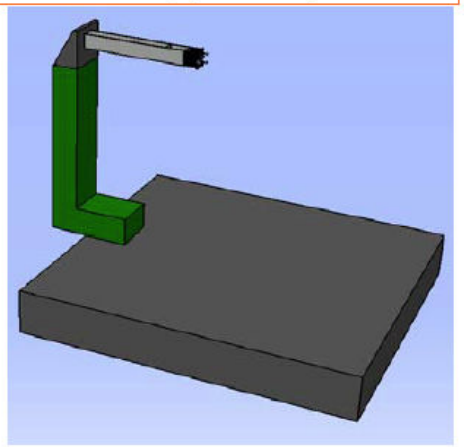
Vibration properties of the ILD QD0 support system has been studied.

ILD00 model

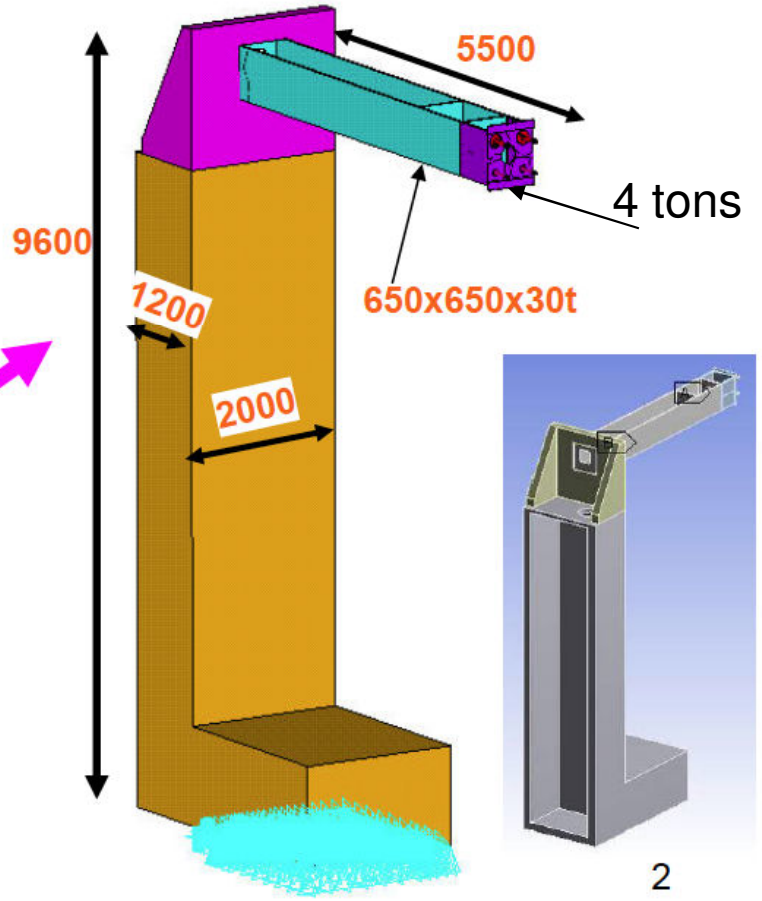


Stability is marginal and it must be improved for safety.

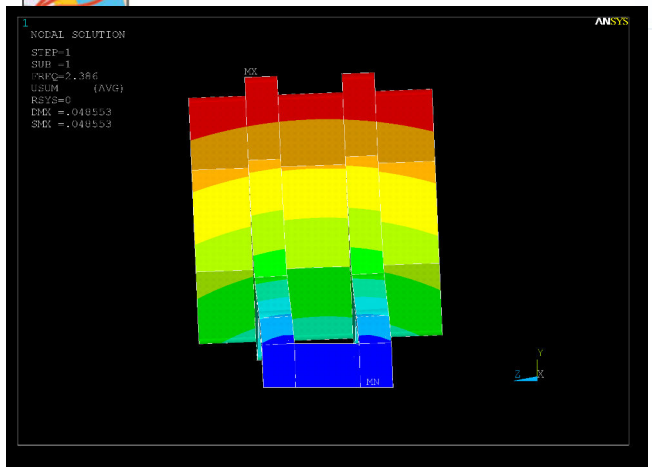
ILD QD0 support system



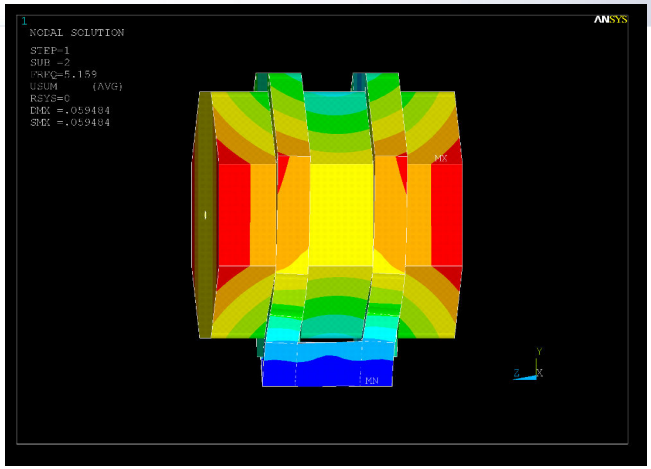
ANSYS model



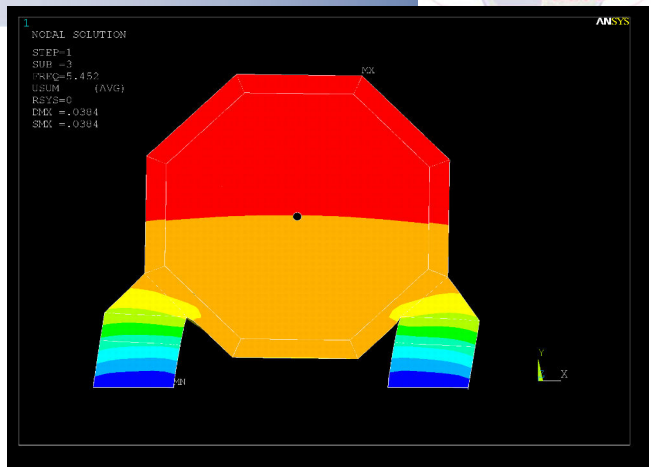
Free Vibration Mode of SiD Yoke (M. Oriunno SLAC/SiD)



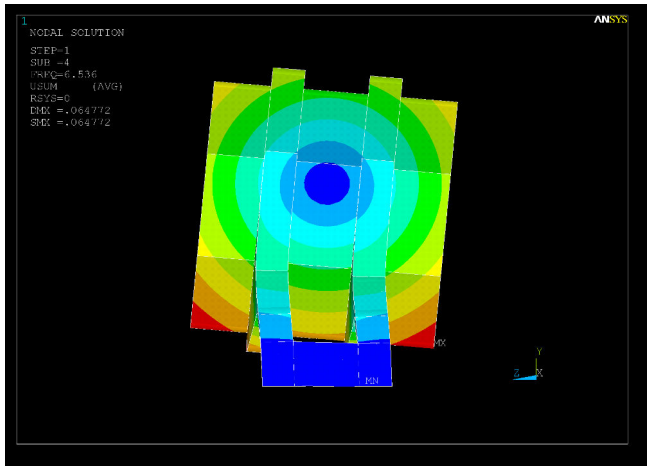
1st Mode, 2.38 Hz



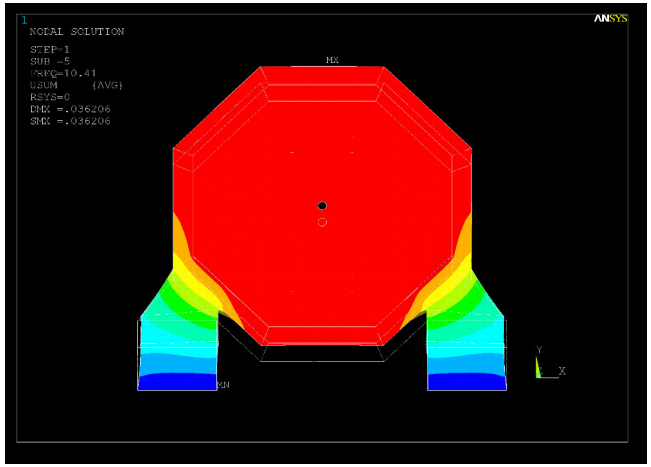
2nd Mode, 5.15 Hz



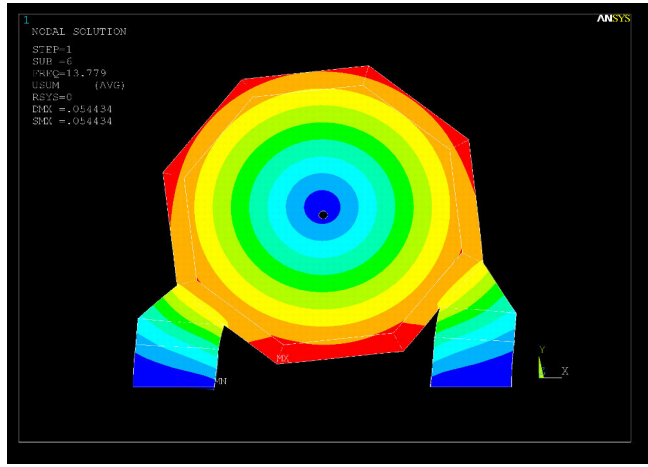
3rd Mode, 5.45 Hz



4th Mode, 6.53 Hz



5th Mode, 10.42 Hz



6th Mode, 13.7 Hz

Vertical motion

Vibrations measurement around CMS

- The study of the dynamic characteristics of elements is not sufficient to assess the quality of a given set-up.
- A realistic vibration spectrum must be assumed (and realized!) in the future experimental area.
- It was decided to make vibrations measurements in the CMS cavern and on the CMS yoke which is fairly representative of a yoke for a future experiment.

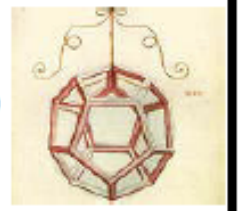
Report has been issued in Dec.

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*

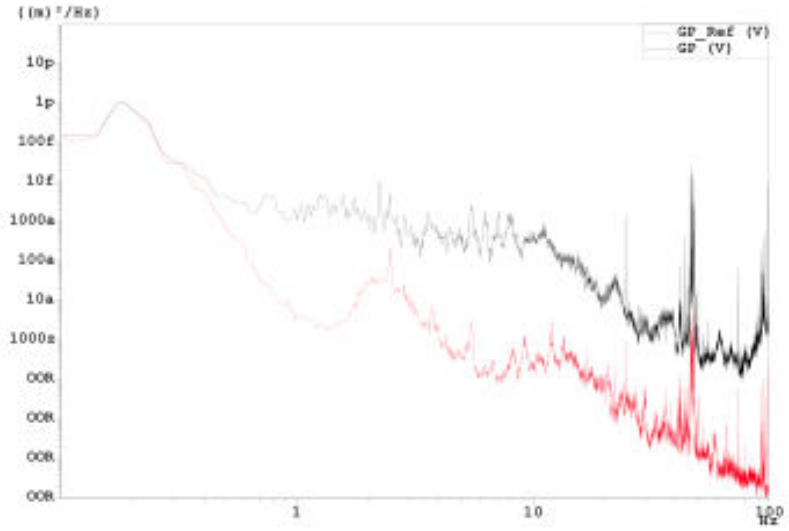
Customer:	*Distribution list:*
Alain Herve	*C. Hauviller - CERN, K. Artoos - CERN, C.Collette – CERN, R.Folch-CERN, O. Capatina – CERN, M. Sylte-CERN; A. Ball – CERN; H. Schmickler - CERN; J.-P. Delahaye – CERN; D. Schulte- CERN.*

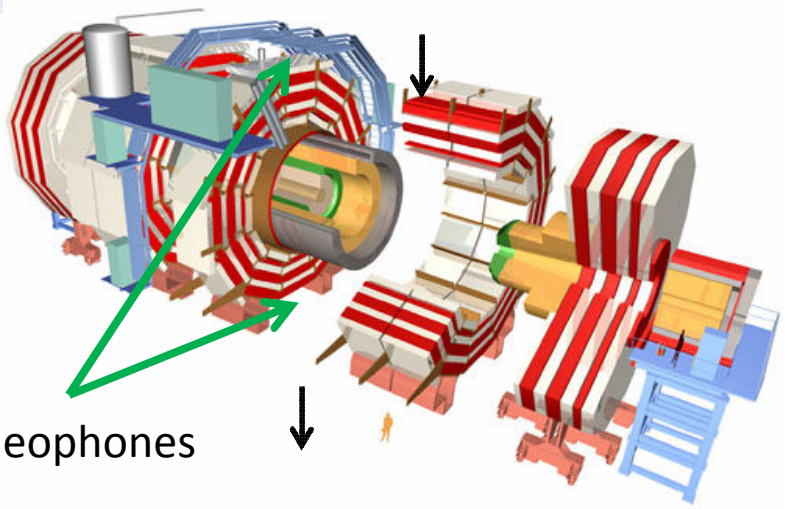
Ground vibration measurements and Experiment parts motion measurement at CMS

1 Abstract

Measurements on quiet ground and top of CMS

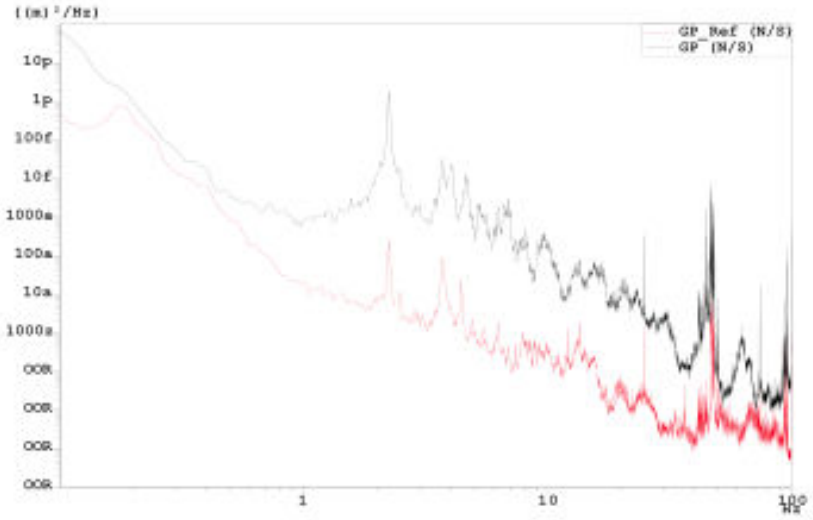
PSD of the signals Vertical direction

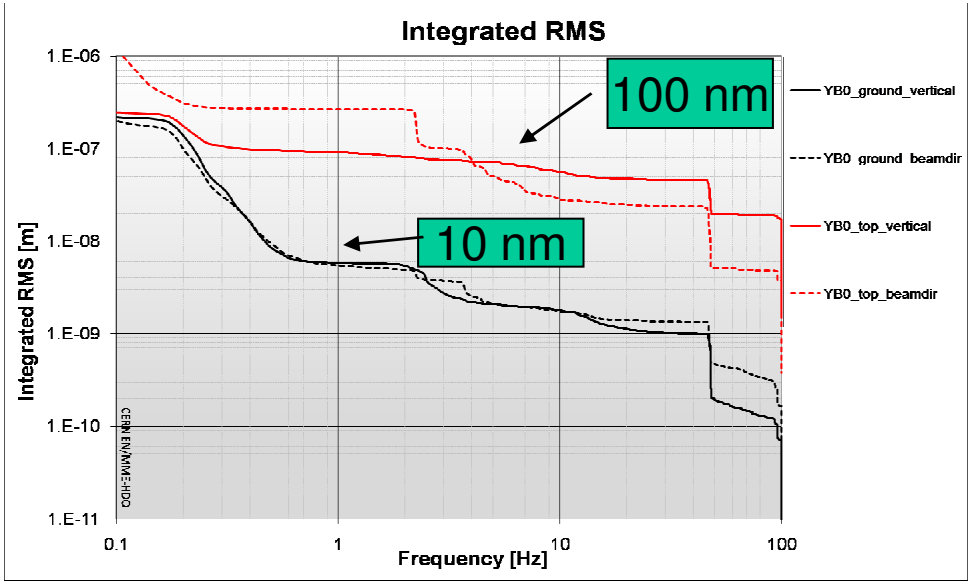




Cooling system OFF

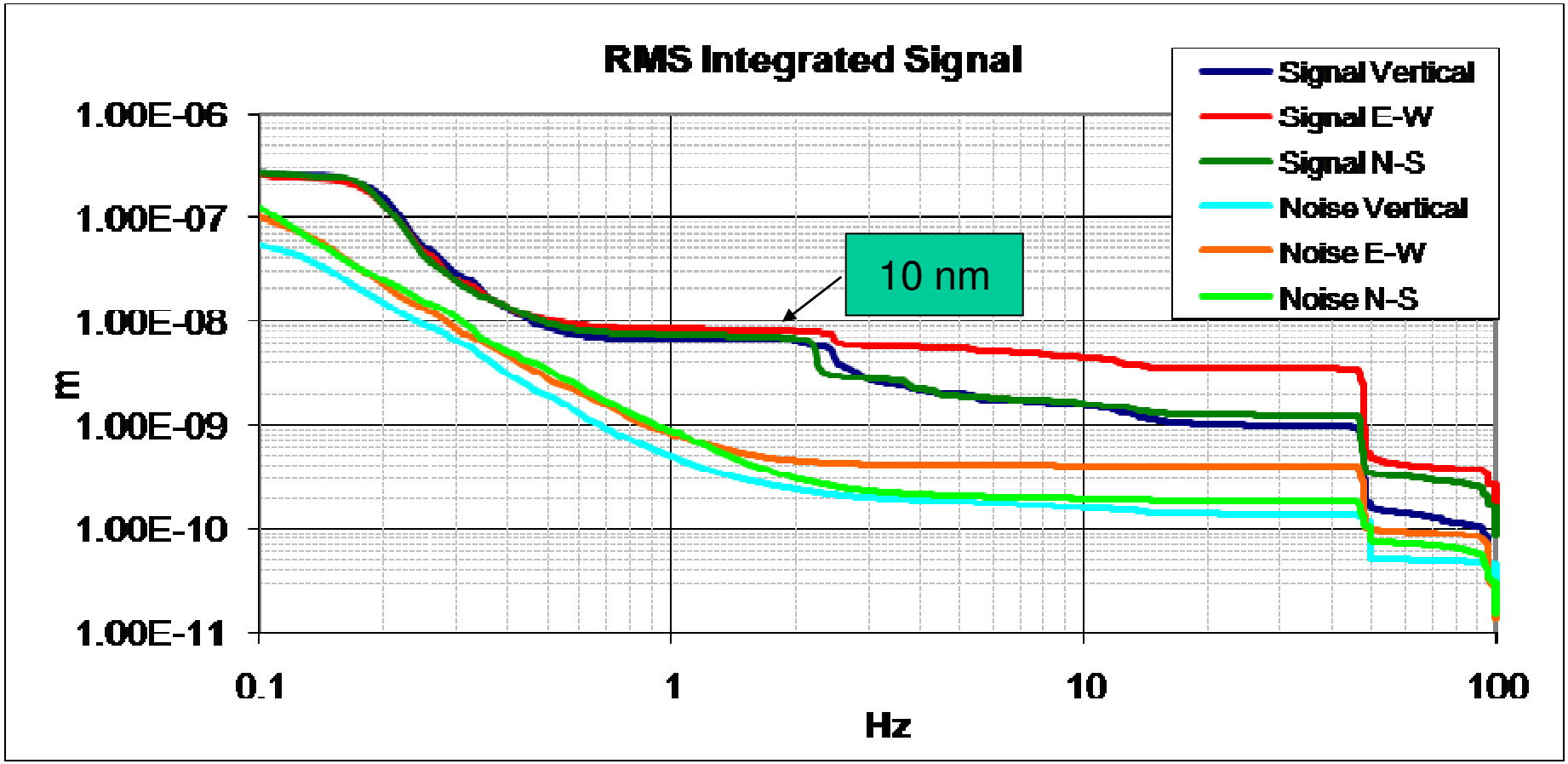
PSD of the signals Beam direction





Ground motion measurement in CMS

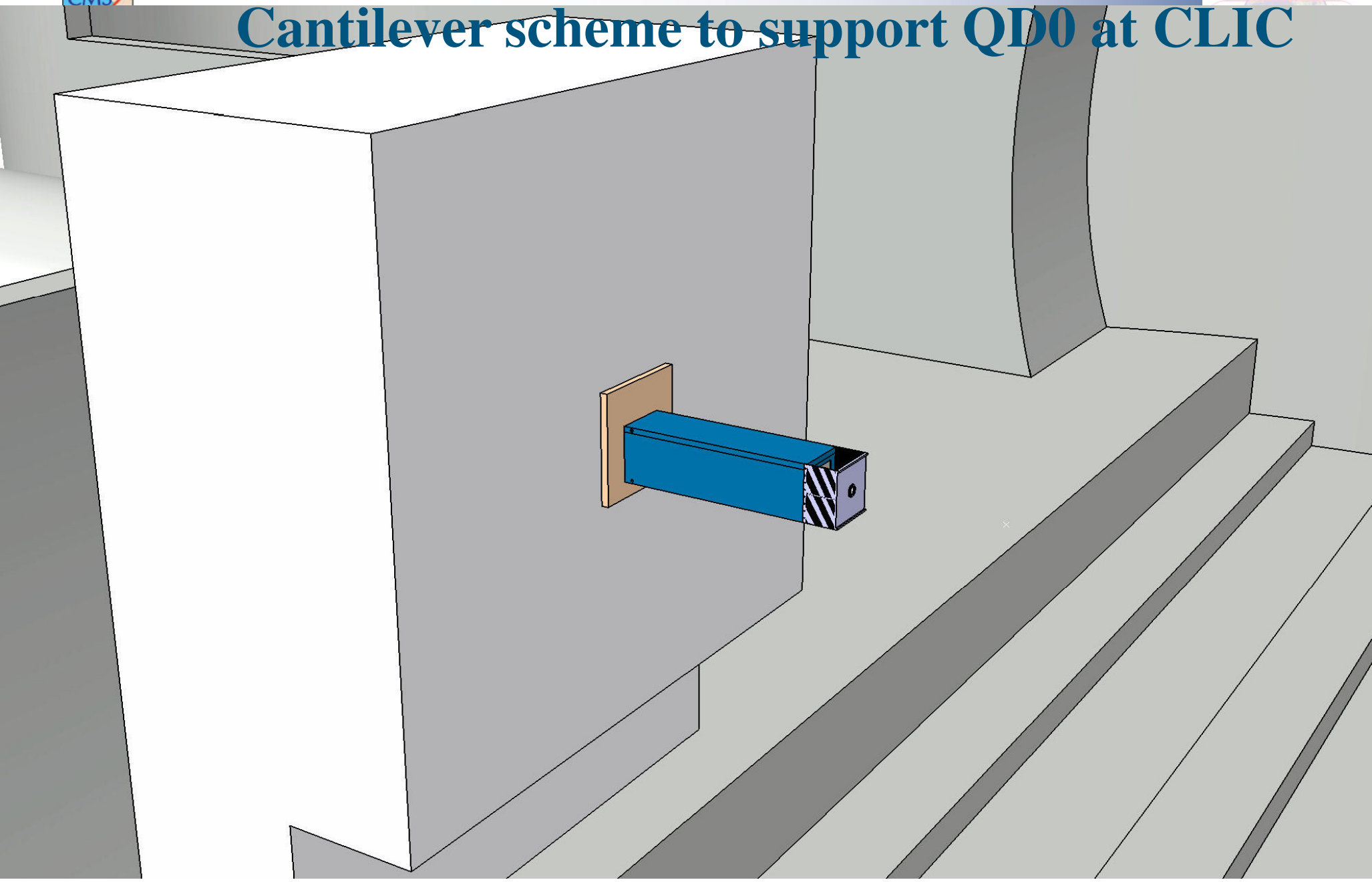
The measurements were made with **cooling systems off.**



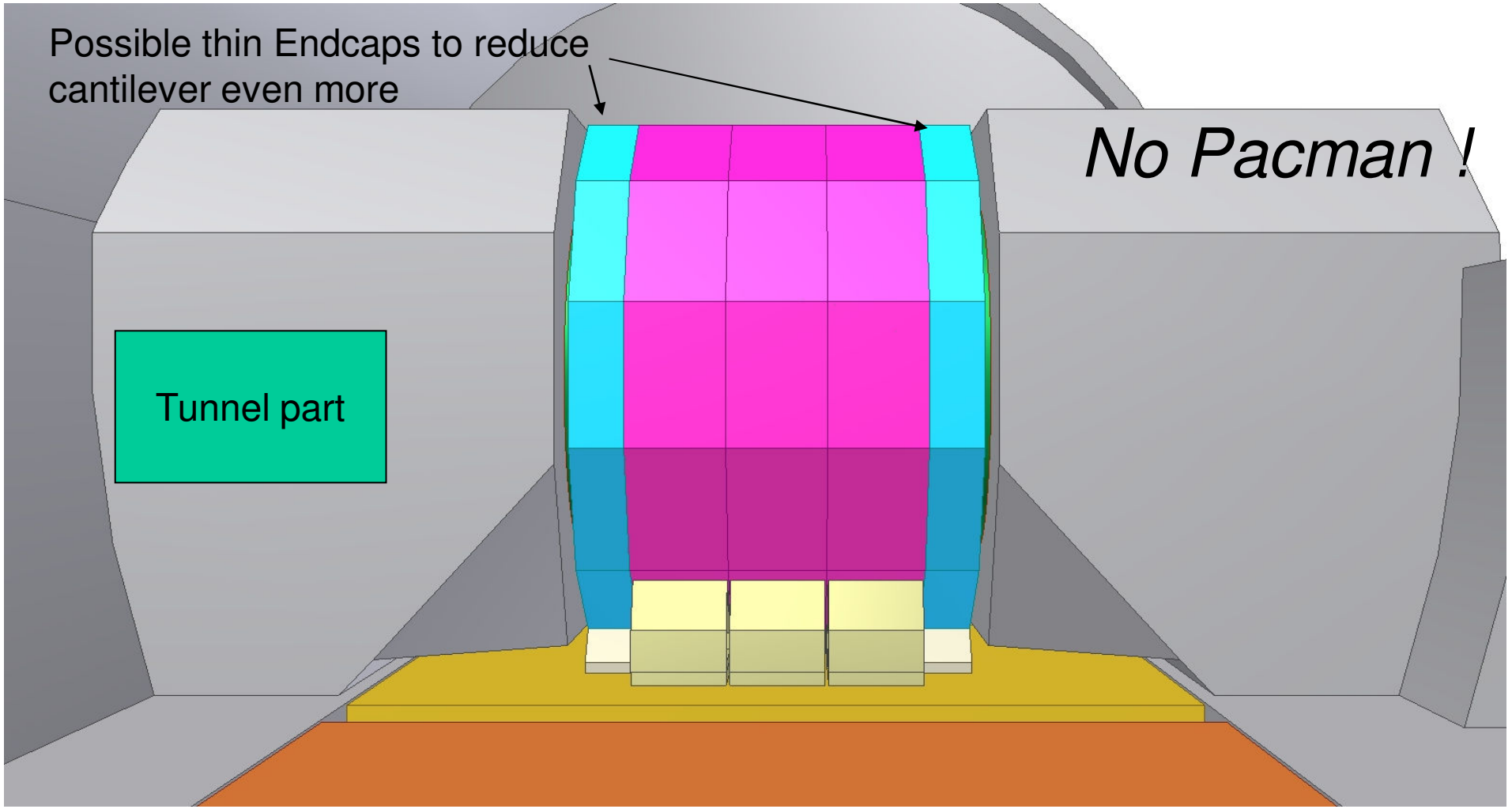
Provisional conclusions for QD0

- Measurements tend to confirm that it is better if the QD0 support does not touch the experiment. This removes also a lot of constraints on the design of the experiment.
- With some effort on the design and construction of the Experimental Area, the stability value needed for ILC is within reach.
- The value needed for CLIC detector requires supplementary efforts to stabilize correctly QD0.

Cantilever scheme to support QD0 at CLIC



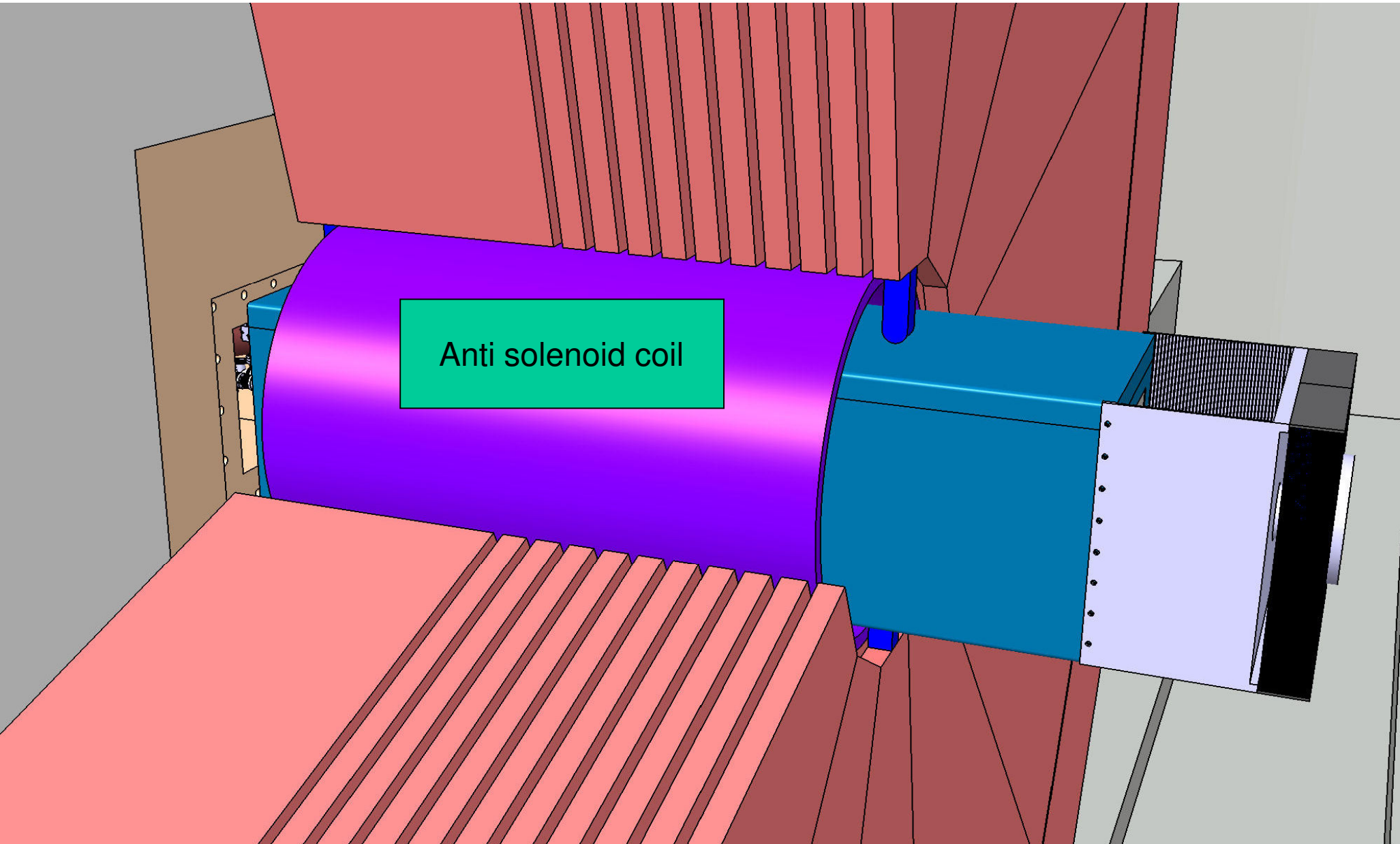
Opening on IP is abandoned as length of cantilever is an important parameter



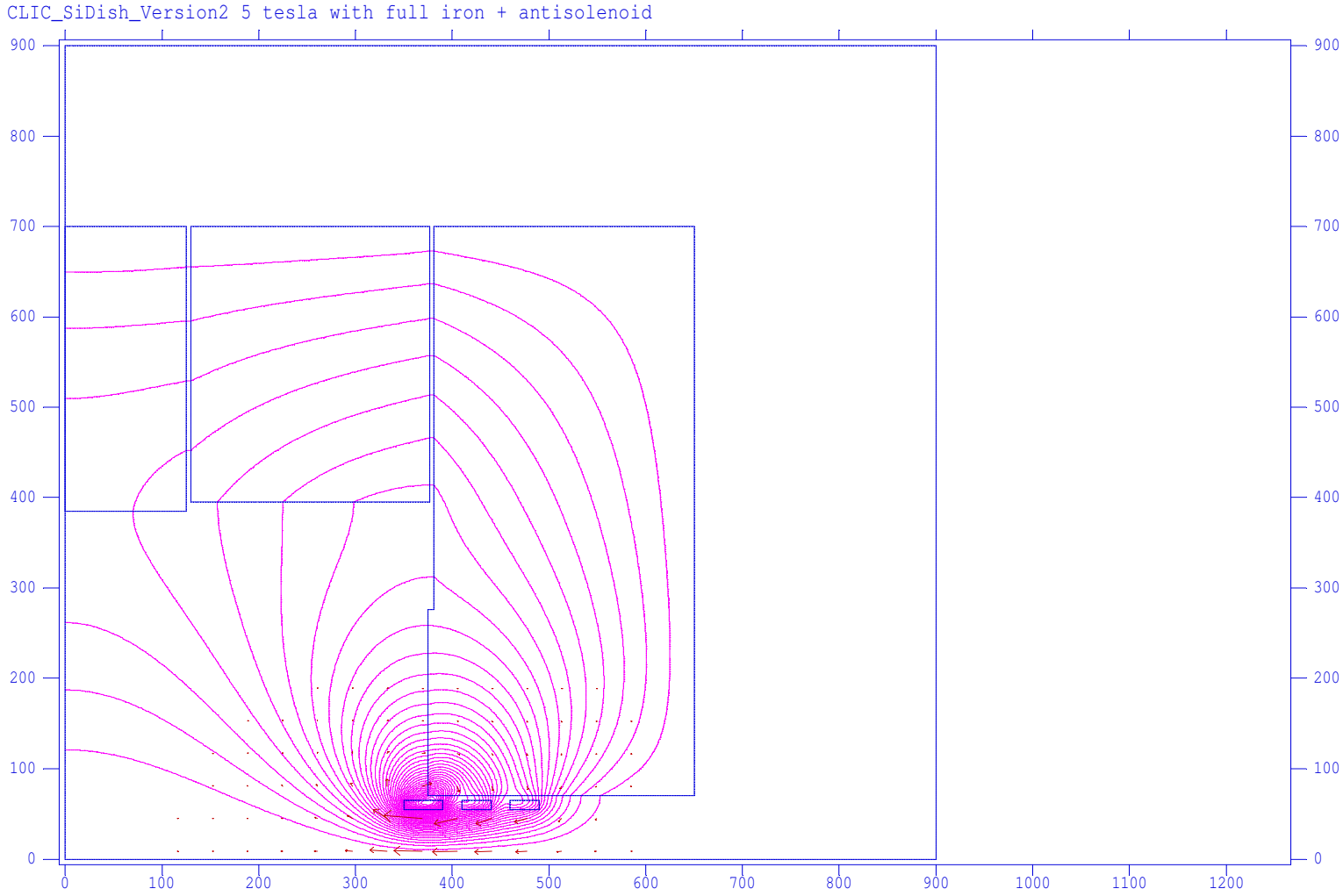
Integration Issues Specific to CLIC

- QD0 permanent magnets -> antisolenoid
- Double Support-Tube for QD0 as suggested by Hiroshi Yamaoka
- Double vacuum valves for full sectorisation of vacuum
- Access to valves, connection/disconnection
- BPM and Kicker must be both in front of QD0 for timing considerations.

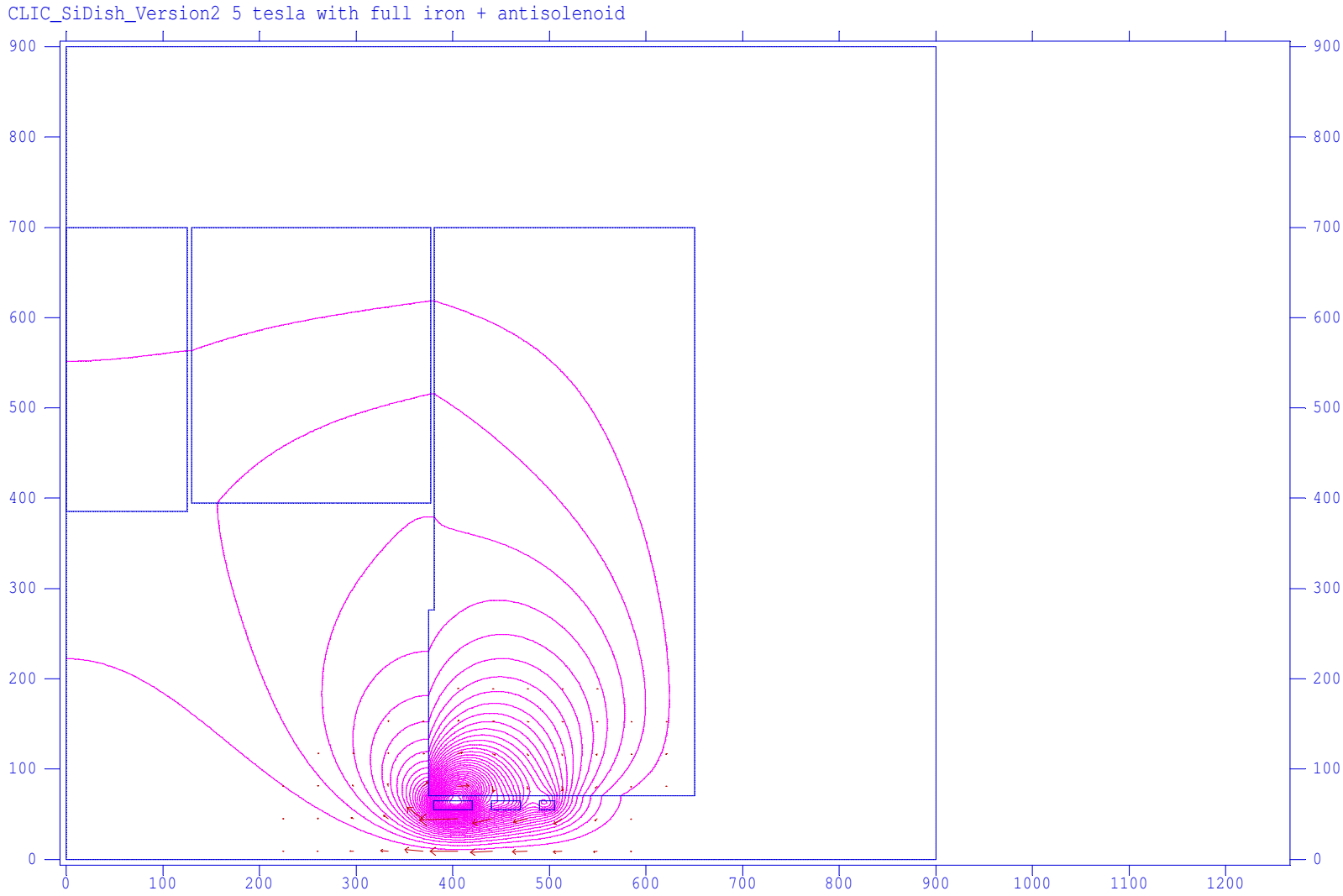
If permanent magnets are used fo QD0 an anti-solenoid is needed for H < 8 kOe



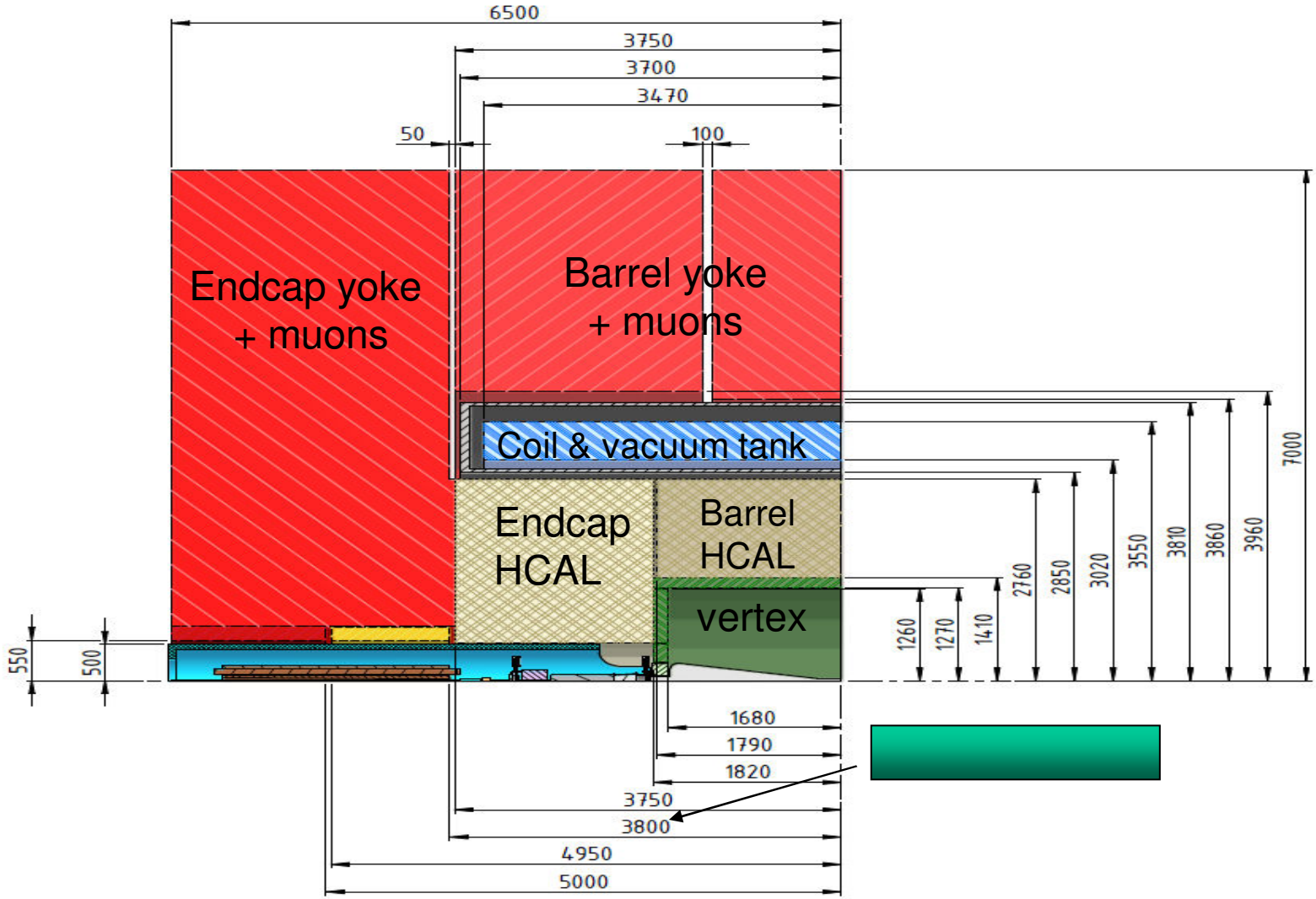
With a permanent magnet for QD0 L* of 3.5m cannot be reached



QD0 must be protected by Yoke thus the L* of 3.8m

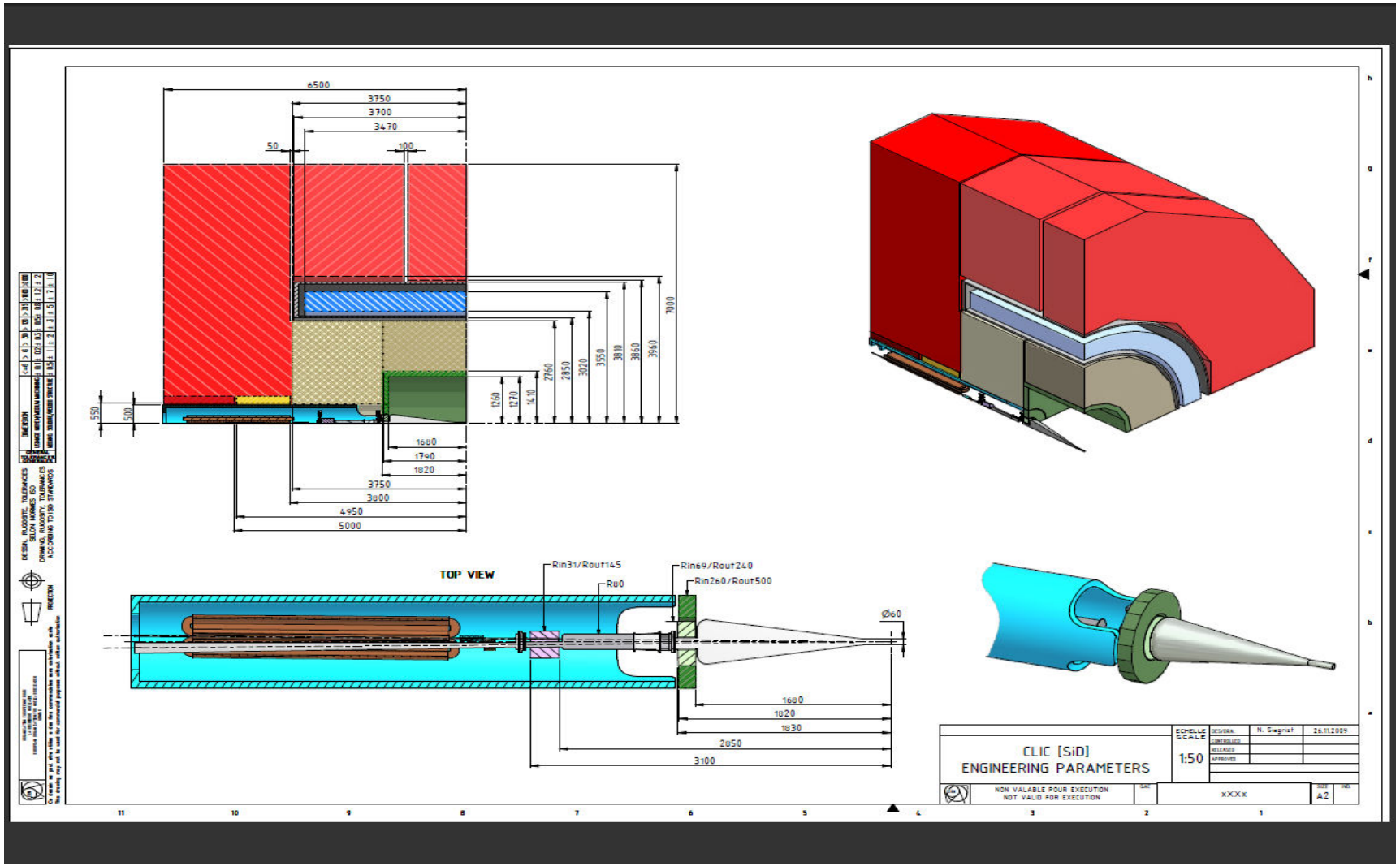


I will concentrate on the Support-Tube zone of the SiD-ish Detector



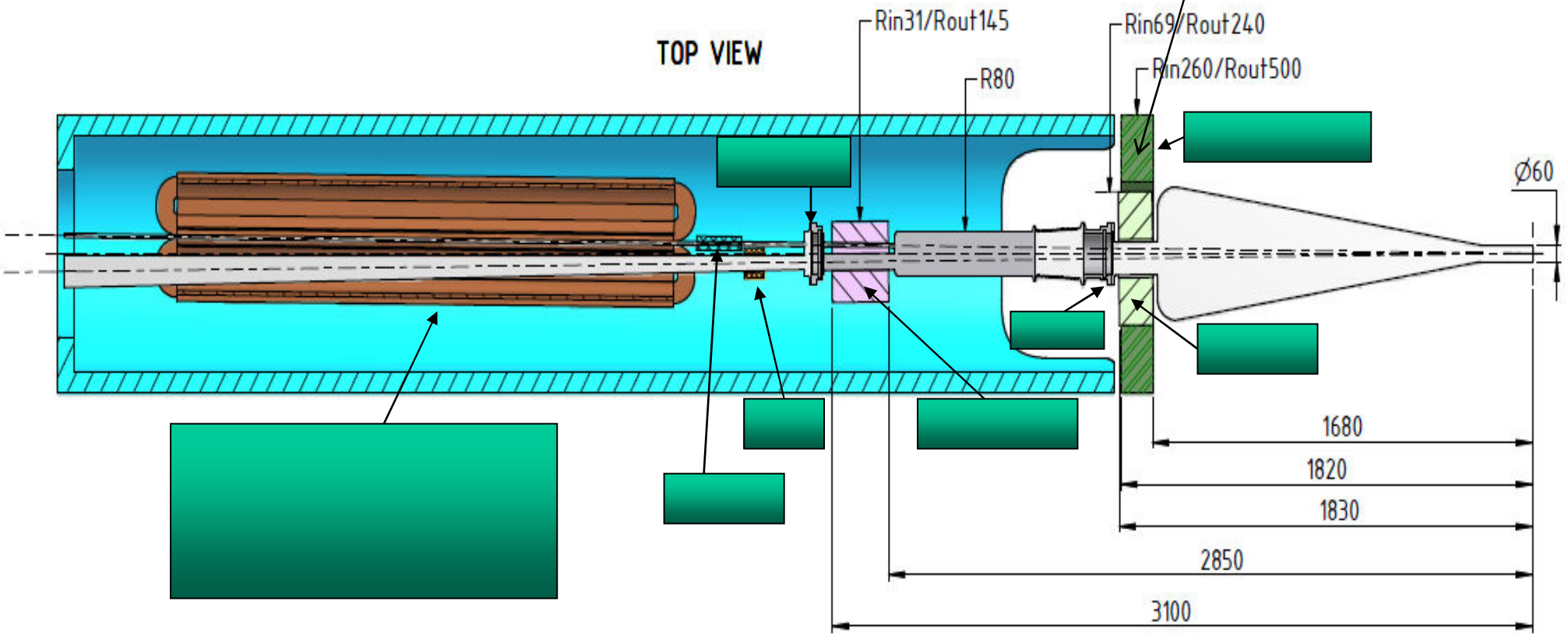
Baseline Detector Parameters for 5 T ('SiD')

massive endcap, no endcap coils



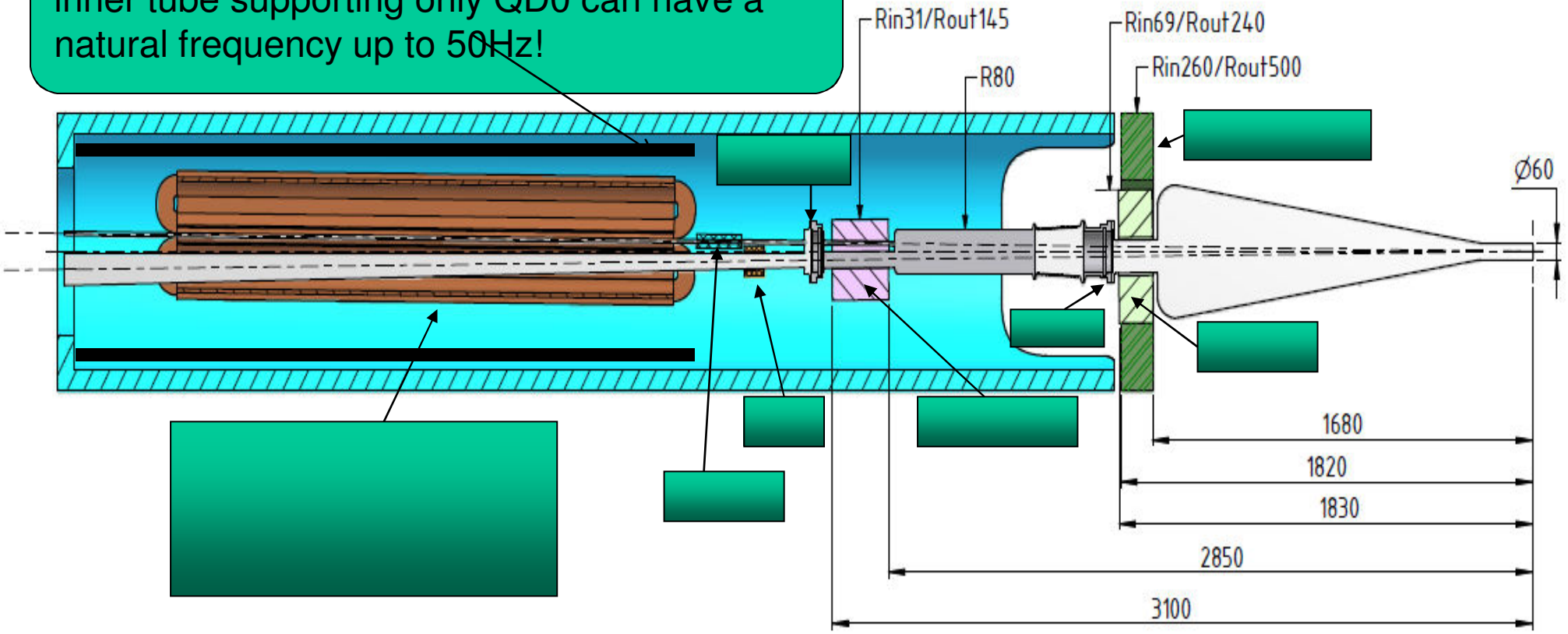
Single support tube details (SiD-ish)

This mass at the end of a long tube, precludes to obtain a high natural frequency. It saturates around 20 to 30Hz

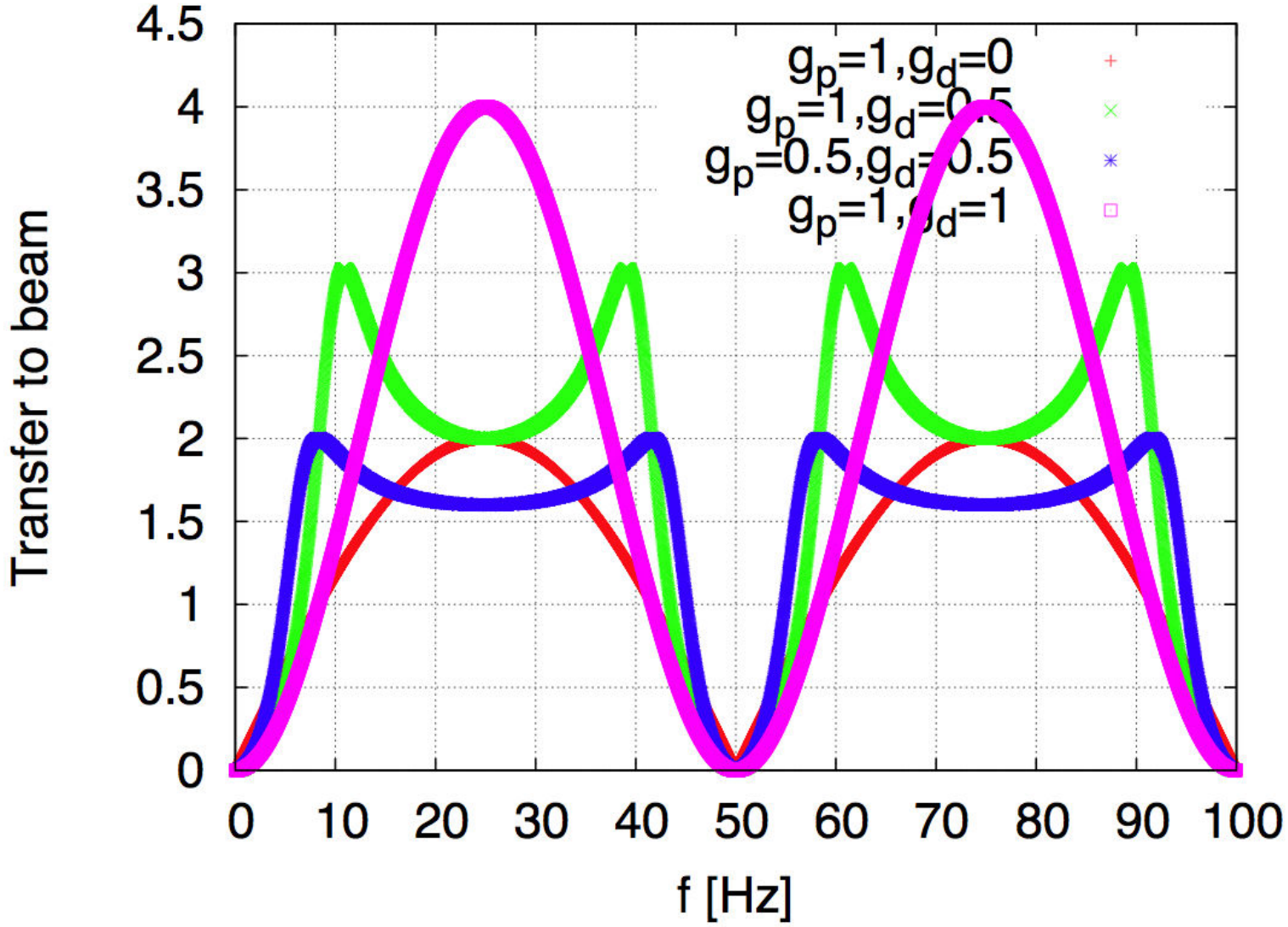


Double support tube details (SiD-ish)

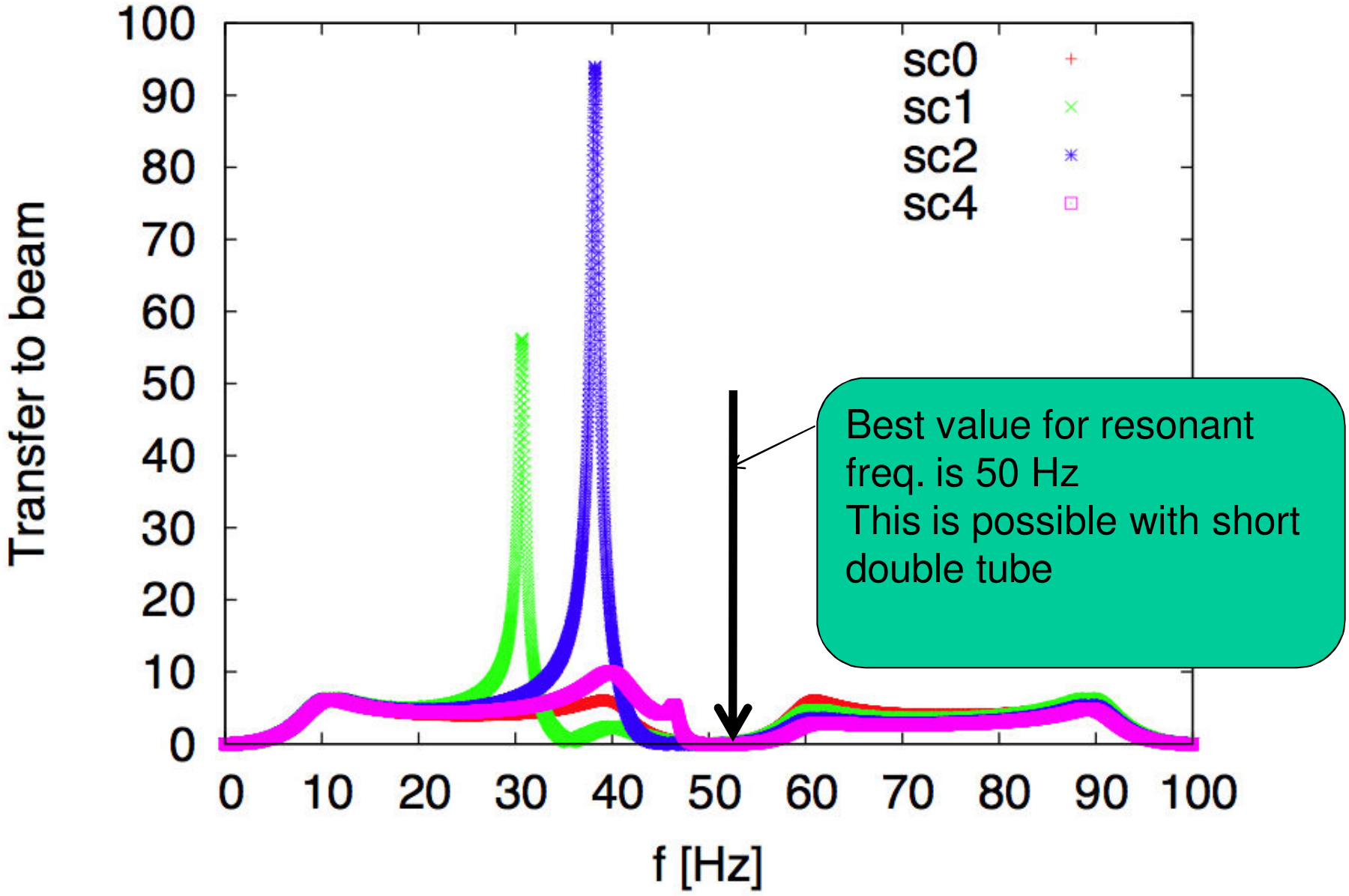
As pointed out by Yamaoka-san this short inner tube supporting only QD0 can have a natural frequency up to 50Hz!



Convolution of Transfer Functions Without Cantilever (D. Schulte)

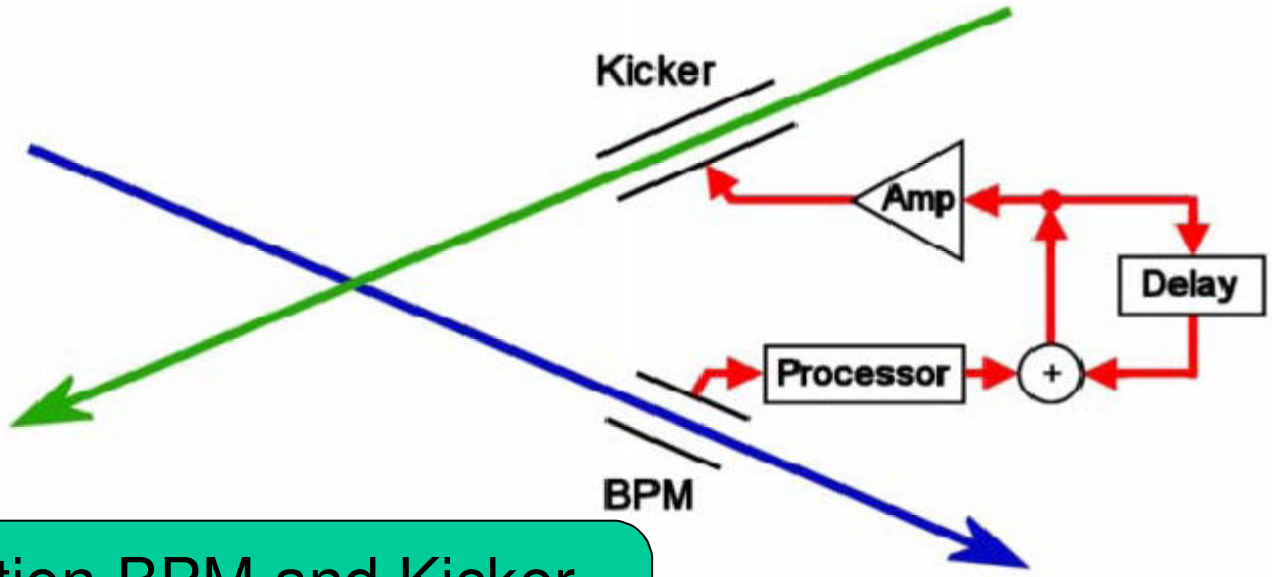


Inclusion of Cantilever Support



IP intra-train feedback system - concept

- **Last line of defence against relative beam misalignment**
- **BPM measures vertical position of outgoing beam**
- **Fast kicker correct vertical position of beam incoming to IR**

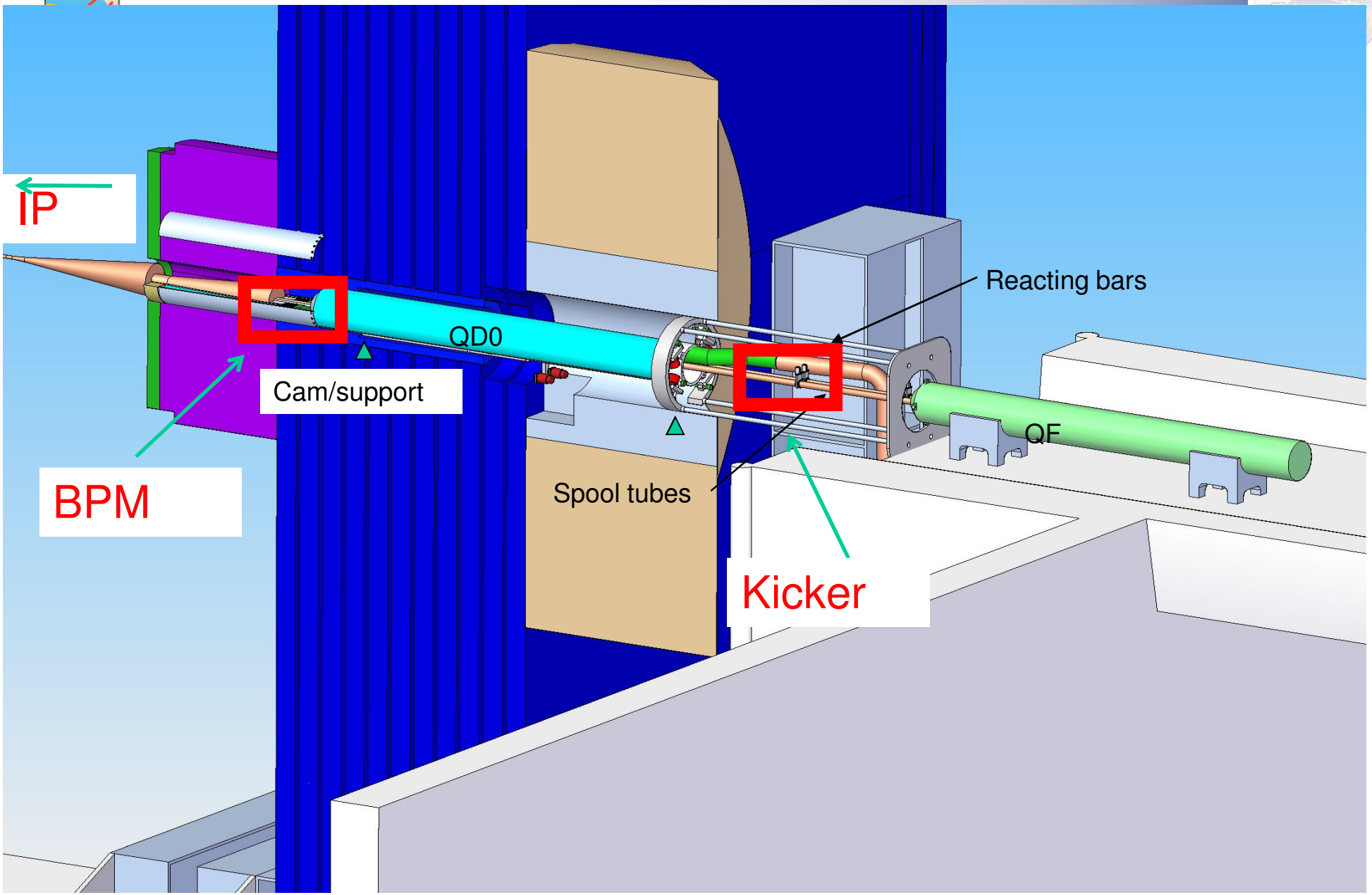


For timing consideration BPM and Kicker must be both in front of QD0 (for CLIC)

FONT – Feedback On Nanosecond Timescales

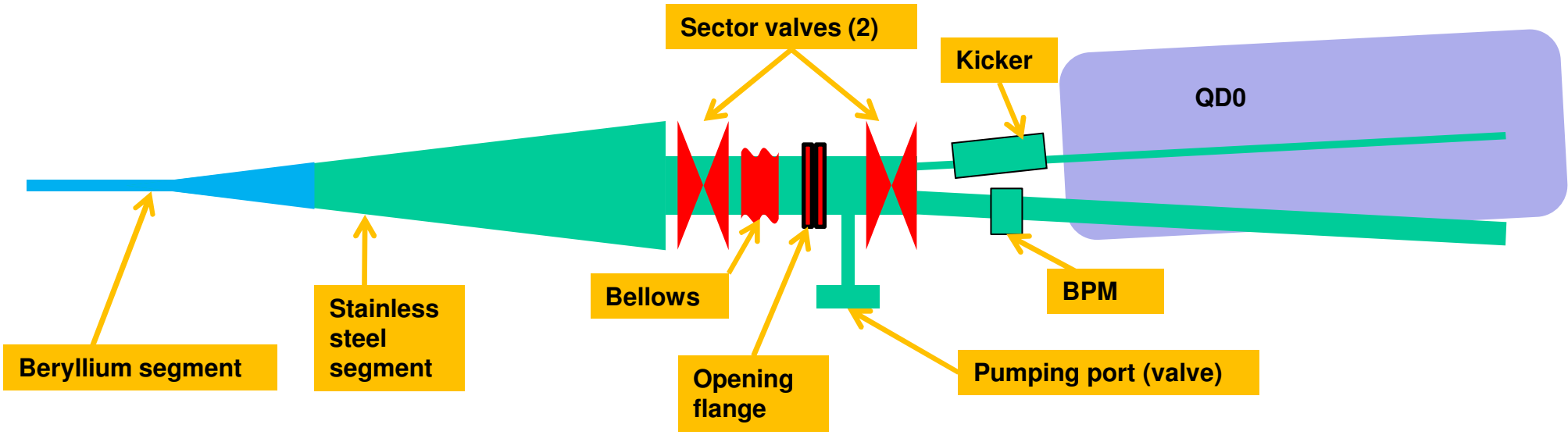
(JAI/Oxford, Valencia, CERN, DESY, KEK, SLAC)

Final Doublet Region (SiD for illustration) - Oriunno



Opening 2 m on the beam

Vacuum Equipment on beamline (first draft)

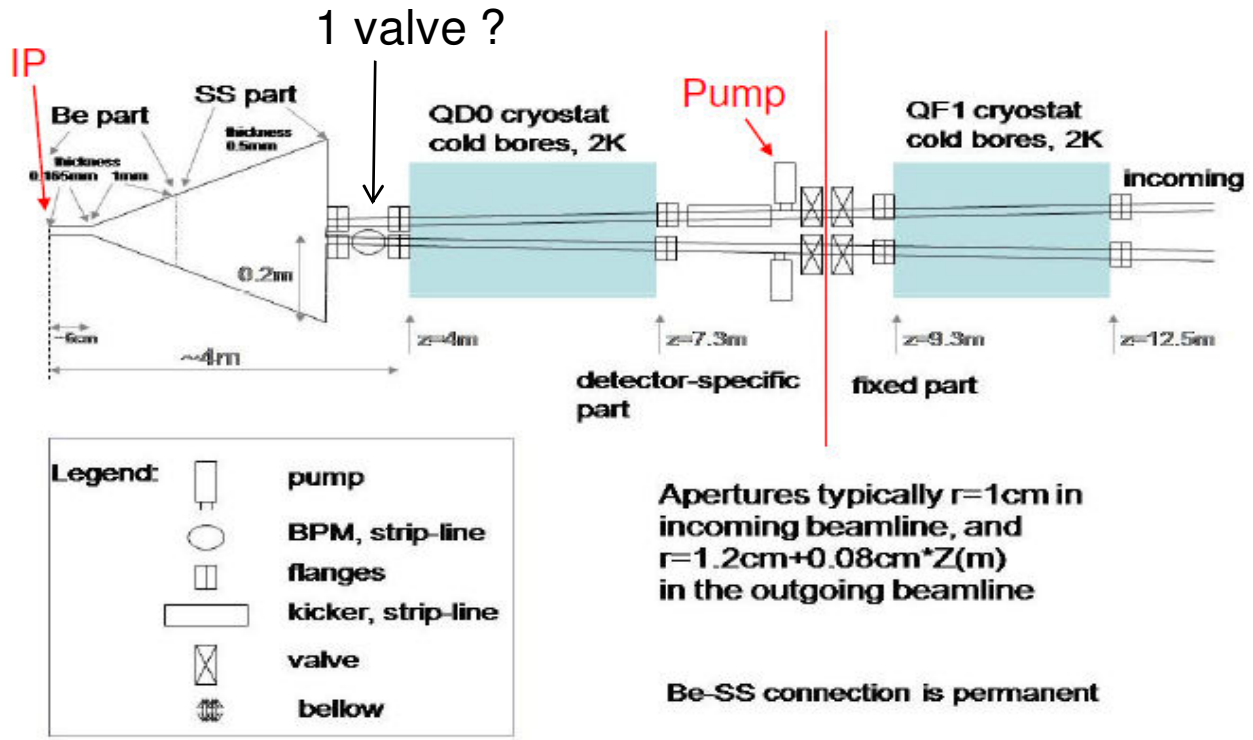


- Features
  - 2 valves for push-pull
    - Minimise re-start pumping times
    - Consistant with H.Gerwig talk to MDI in Dec '09
  - Pumping port to rough-out the connected sector
- Not shown
  - Pumps
    - NEG coatings in experiment and / or QD0?
  - Vacuum instrumentation
    - Would need some gauges for control and interlock

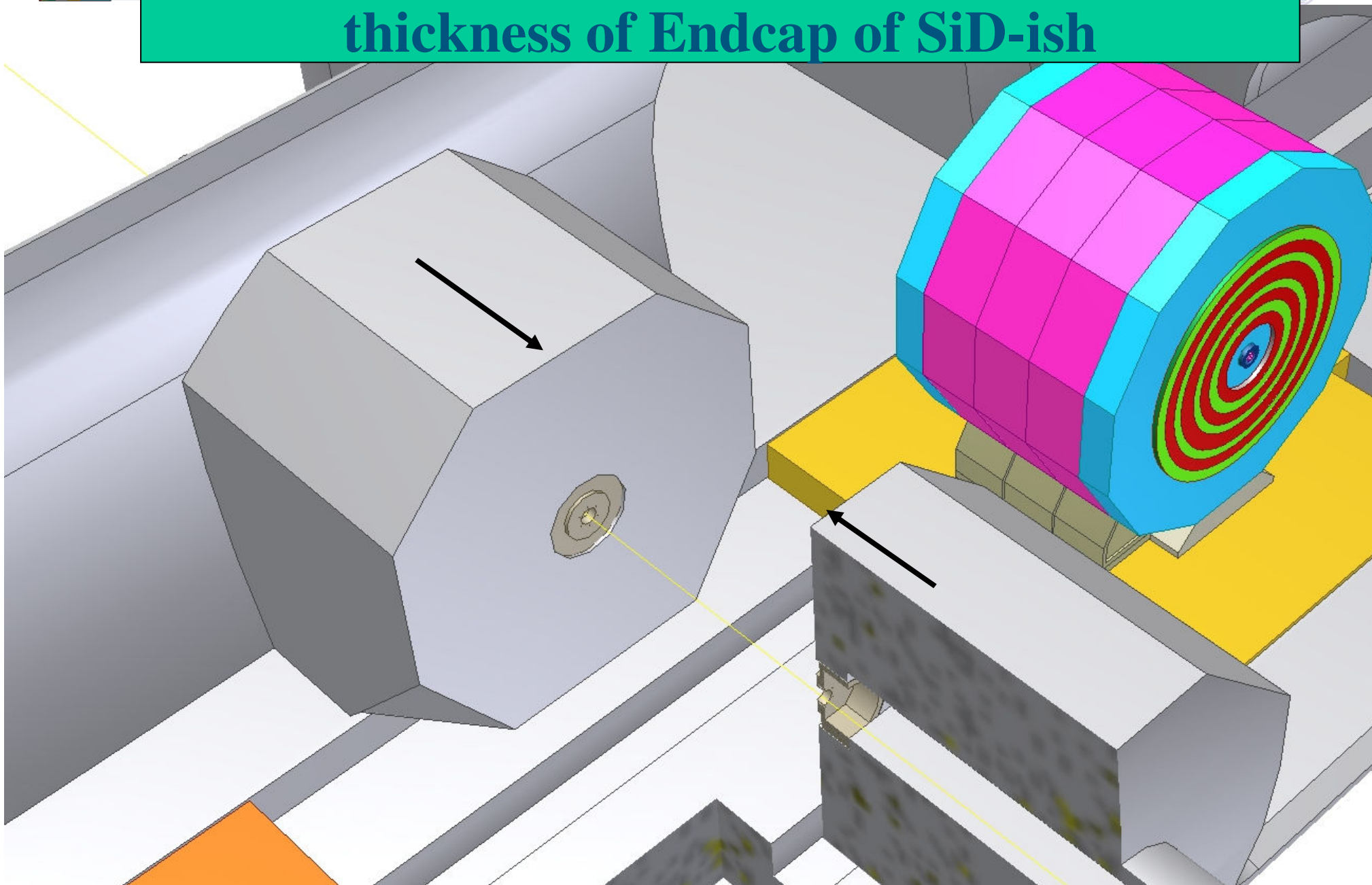
There are clear differences wrt ILC

IP Vacuum

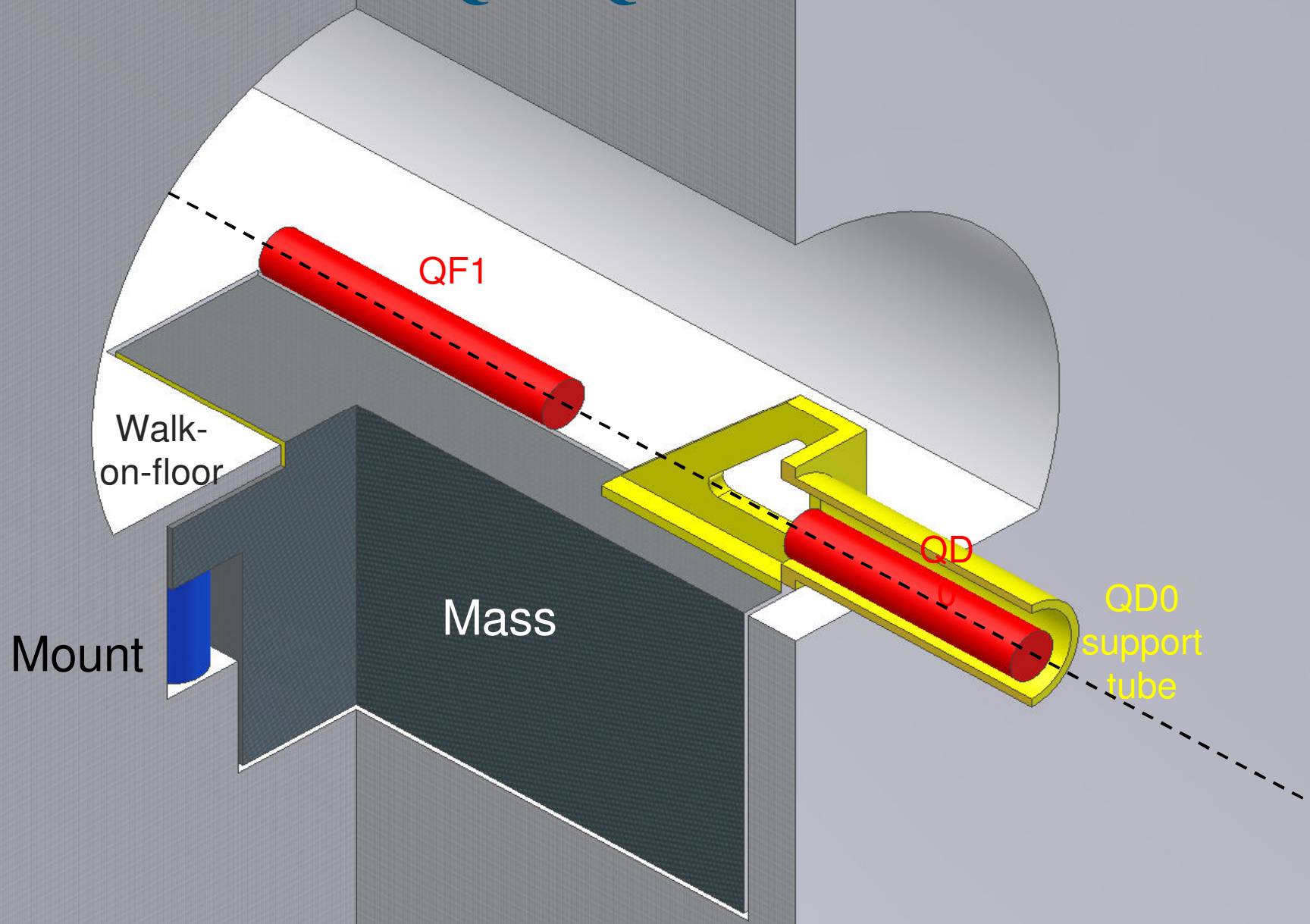
- 0-th draft of IR region (A. Seryi)



Proposal of H. Gerwig to reduce thickness of Endcap of SiD-ish

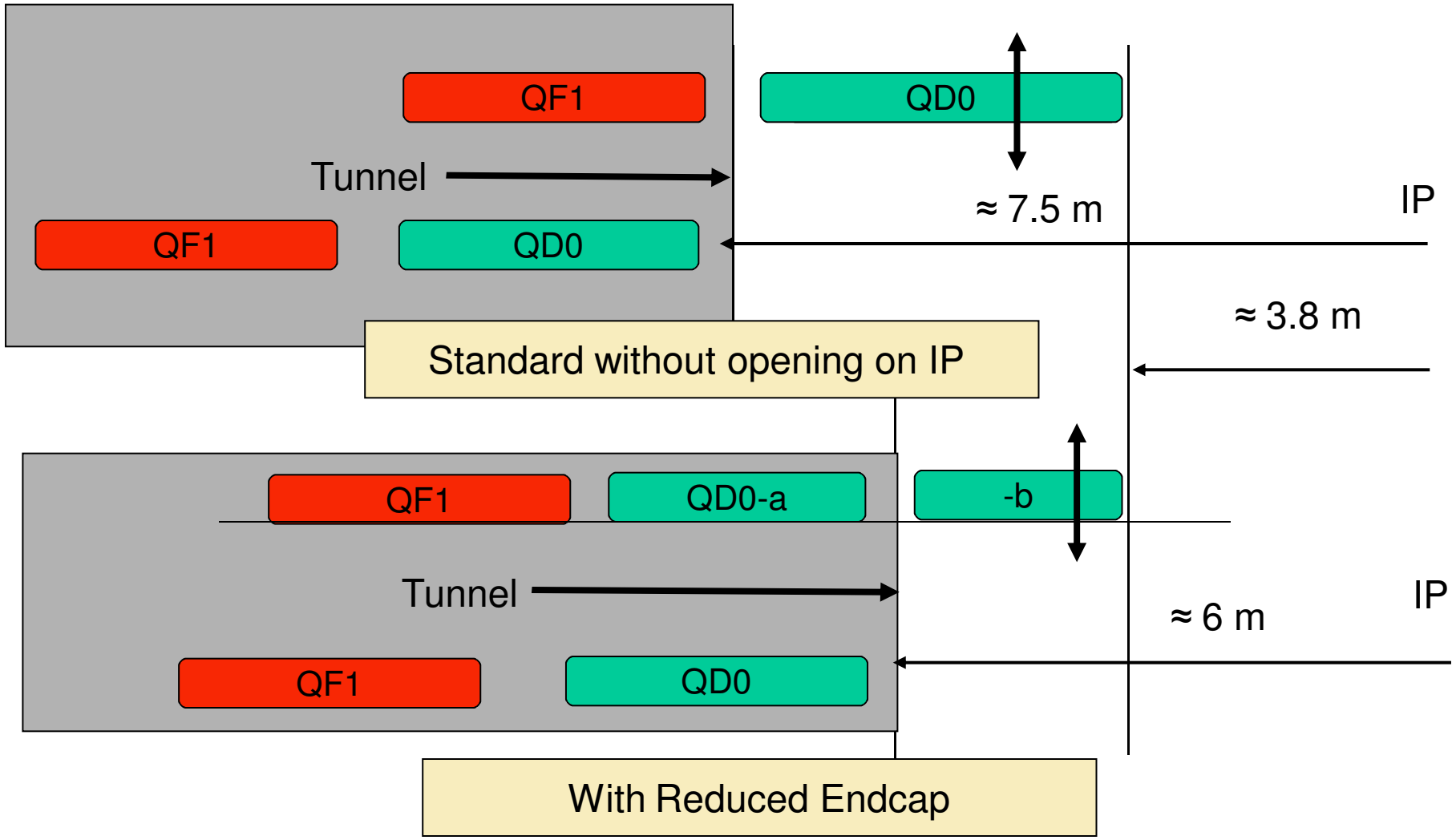


Additional possible stable foundations for QD0/QF1

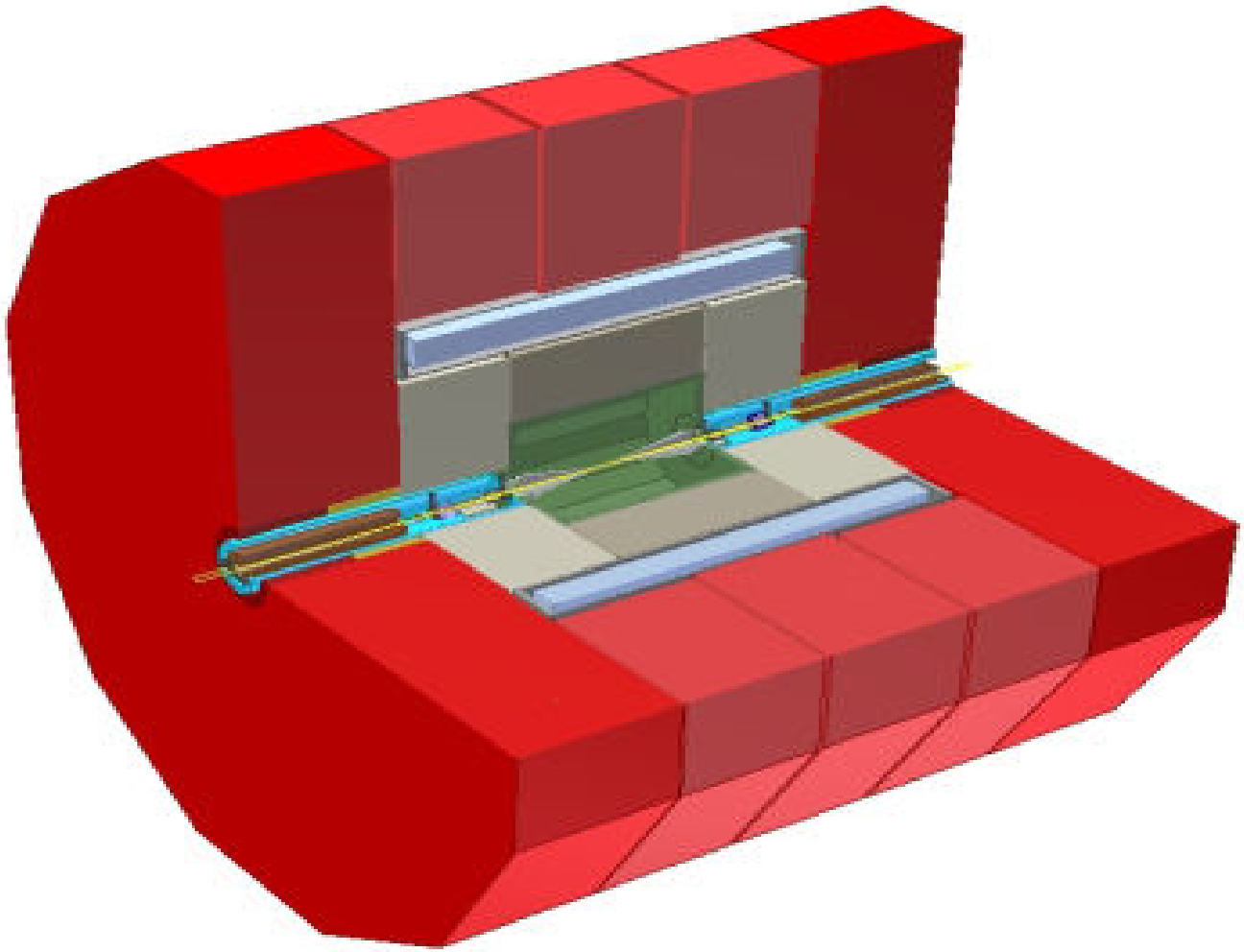


*Conceptual design

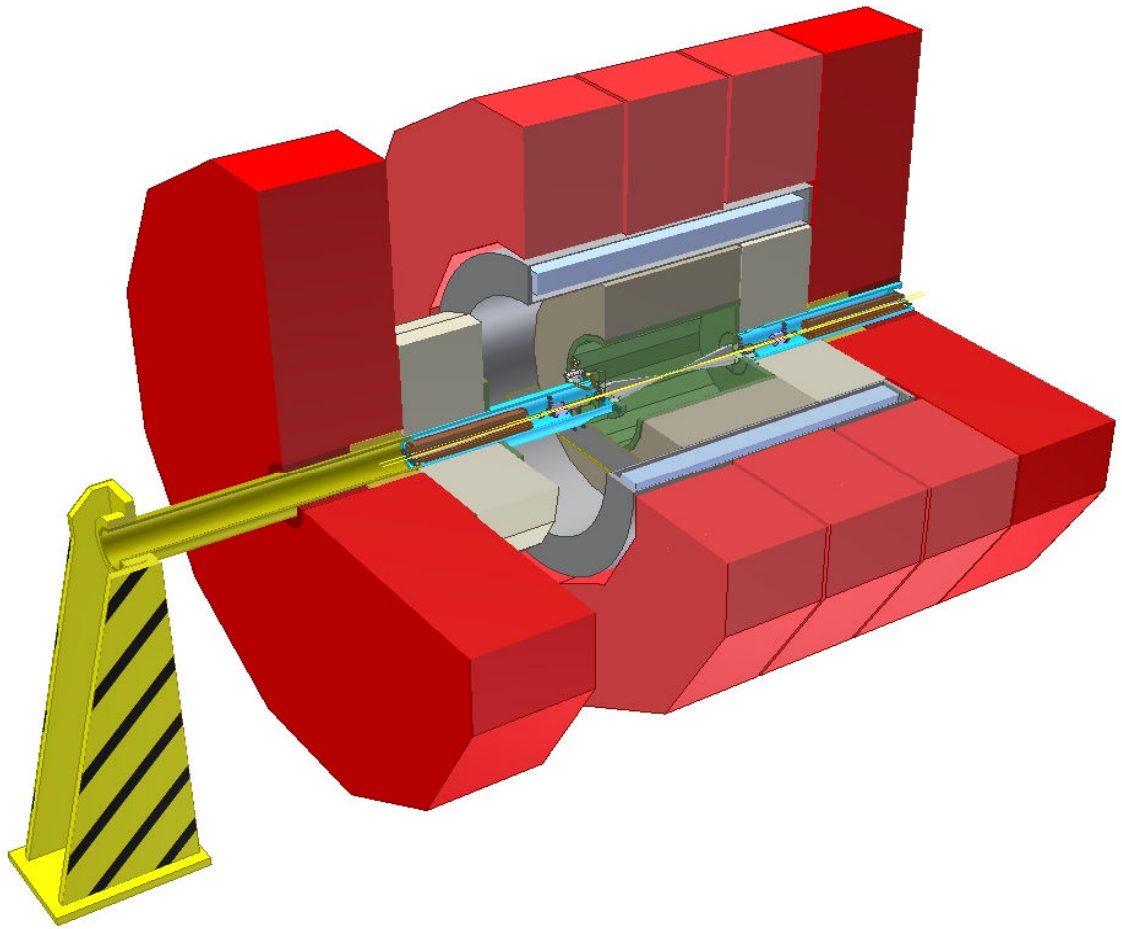
Possible configurations of last FF



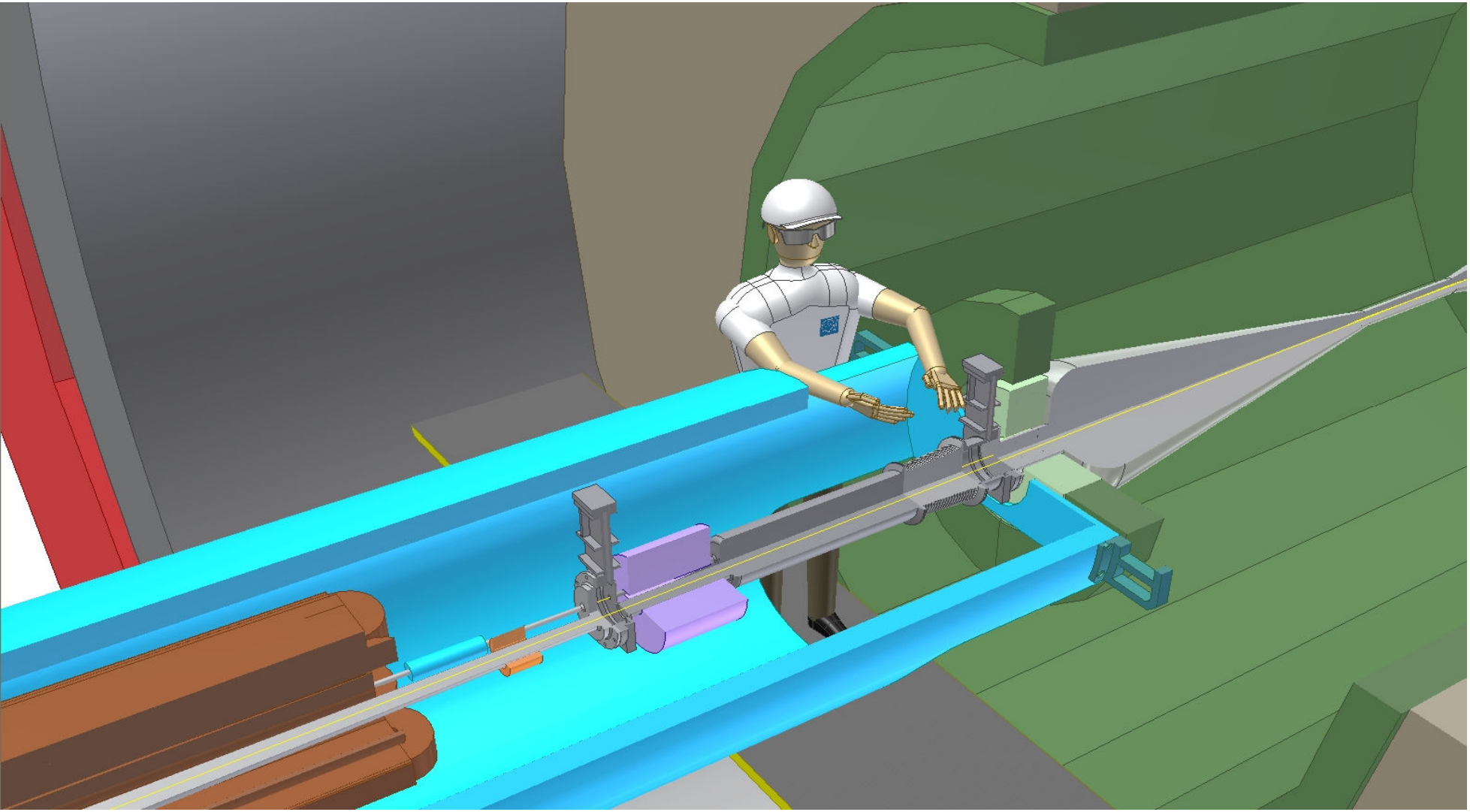
Closed Detector -> garage position



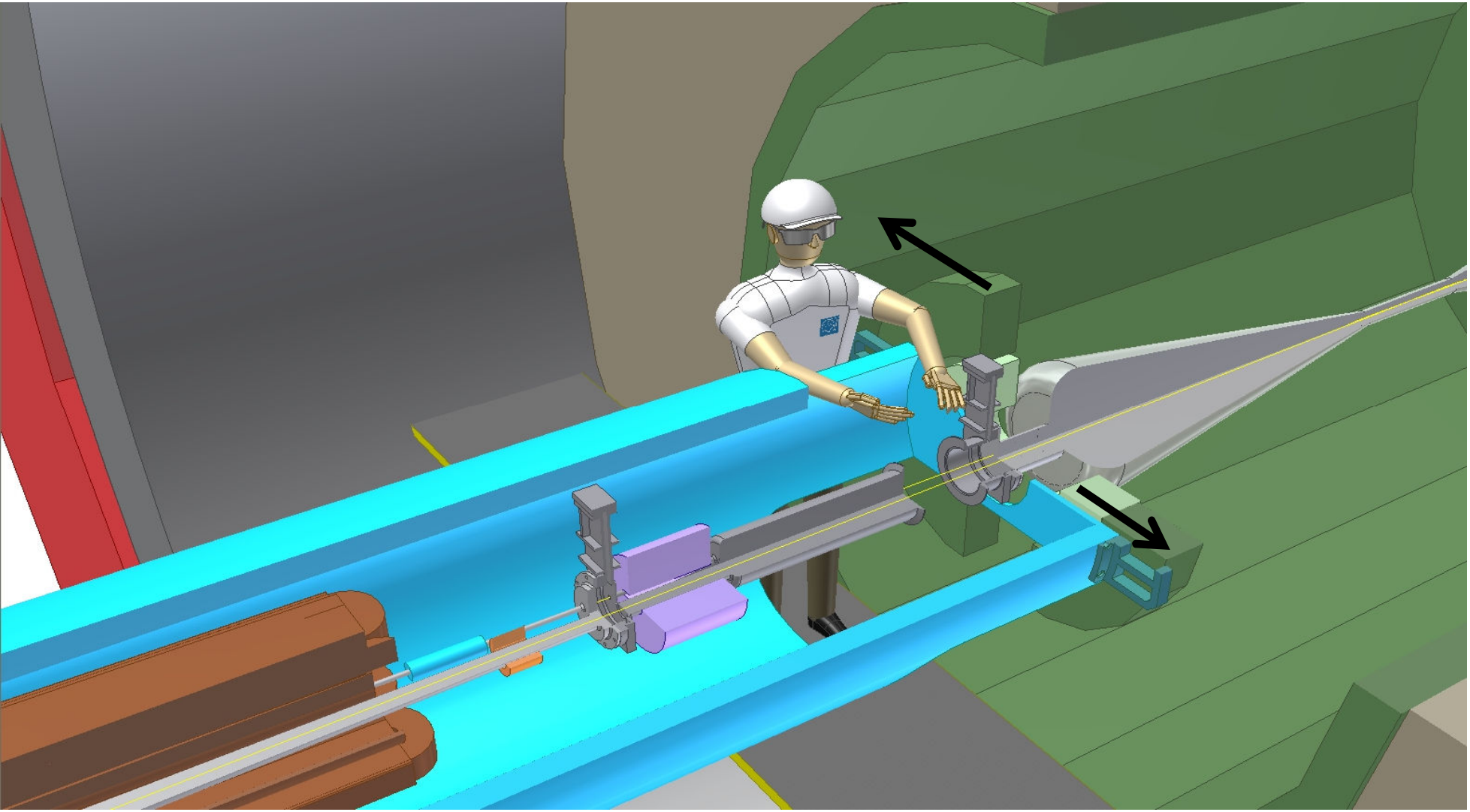
Step 2, Extraction tool, support tube does NOT move



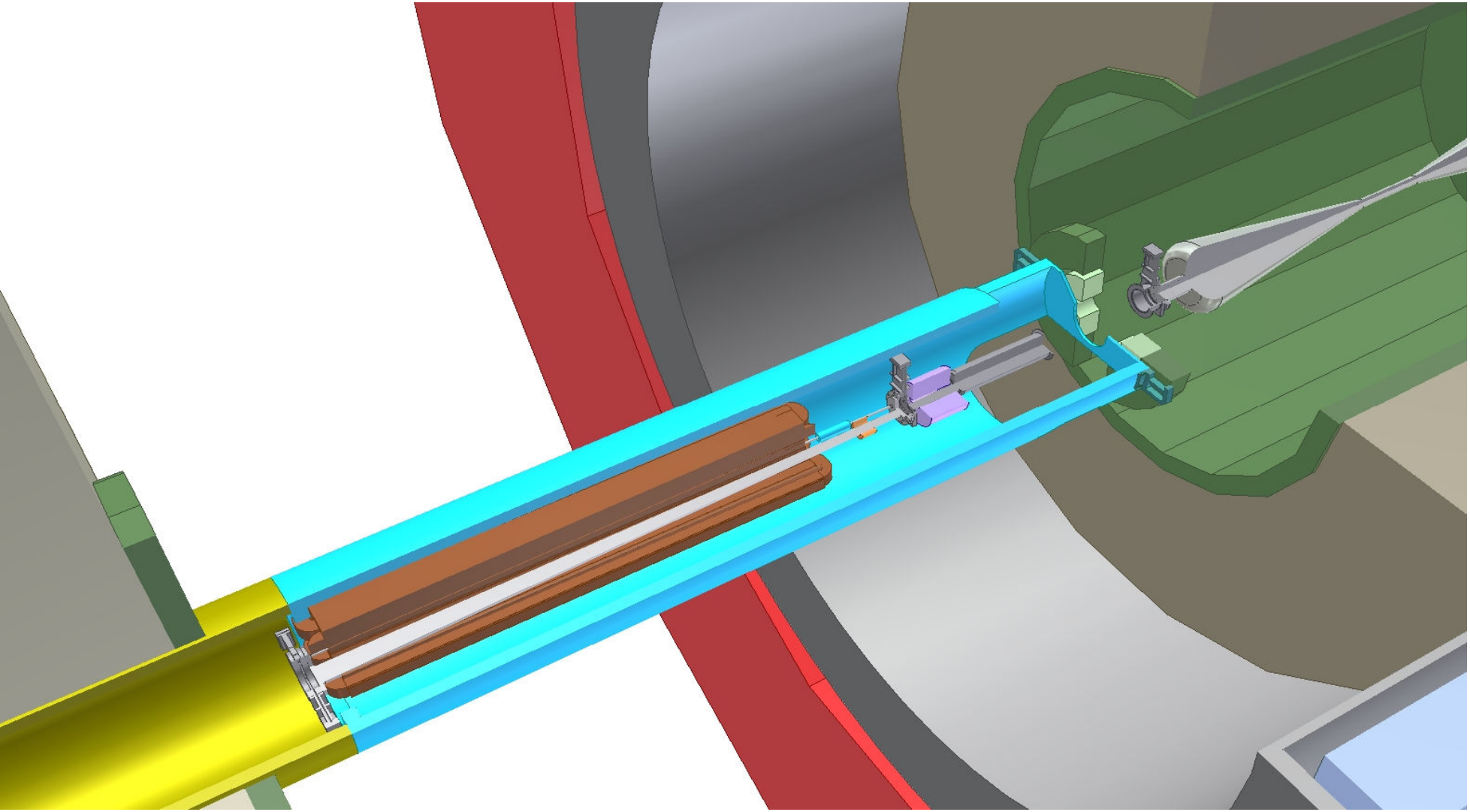
Step 3, Access to vacuum valve(s)



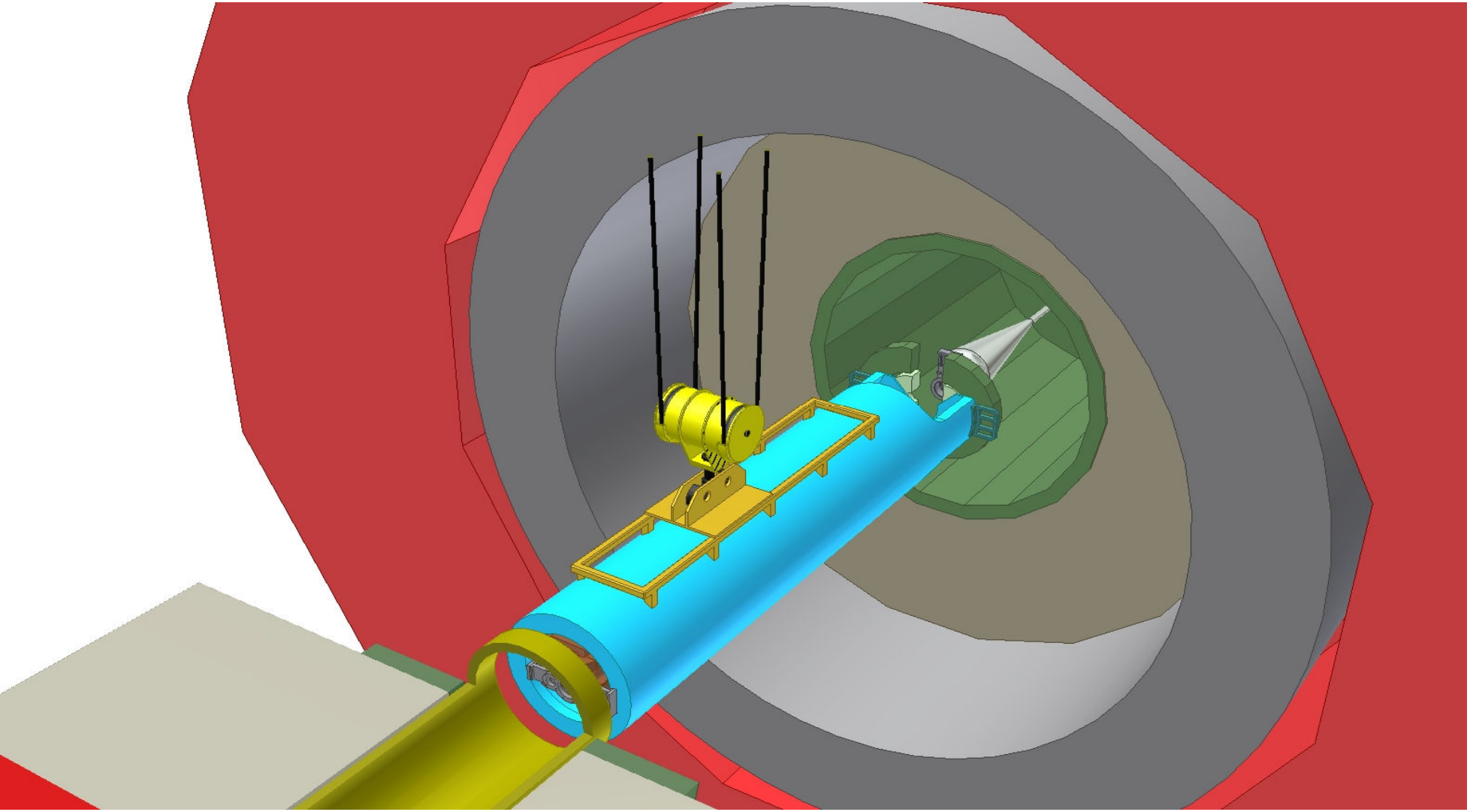
Step 4, disconnect and open Lumical to clear valve attached toTracker



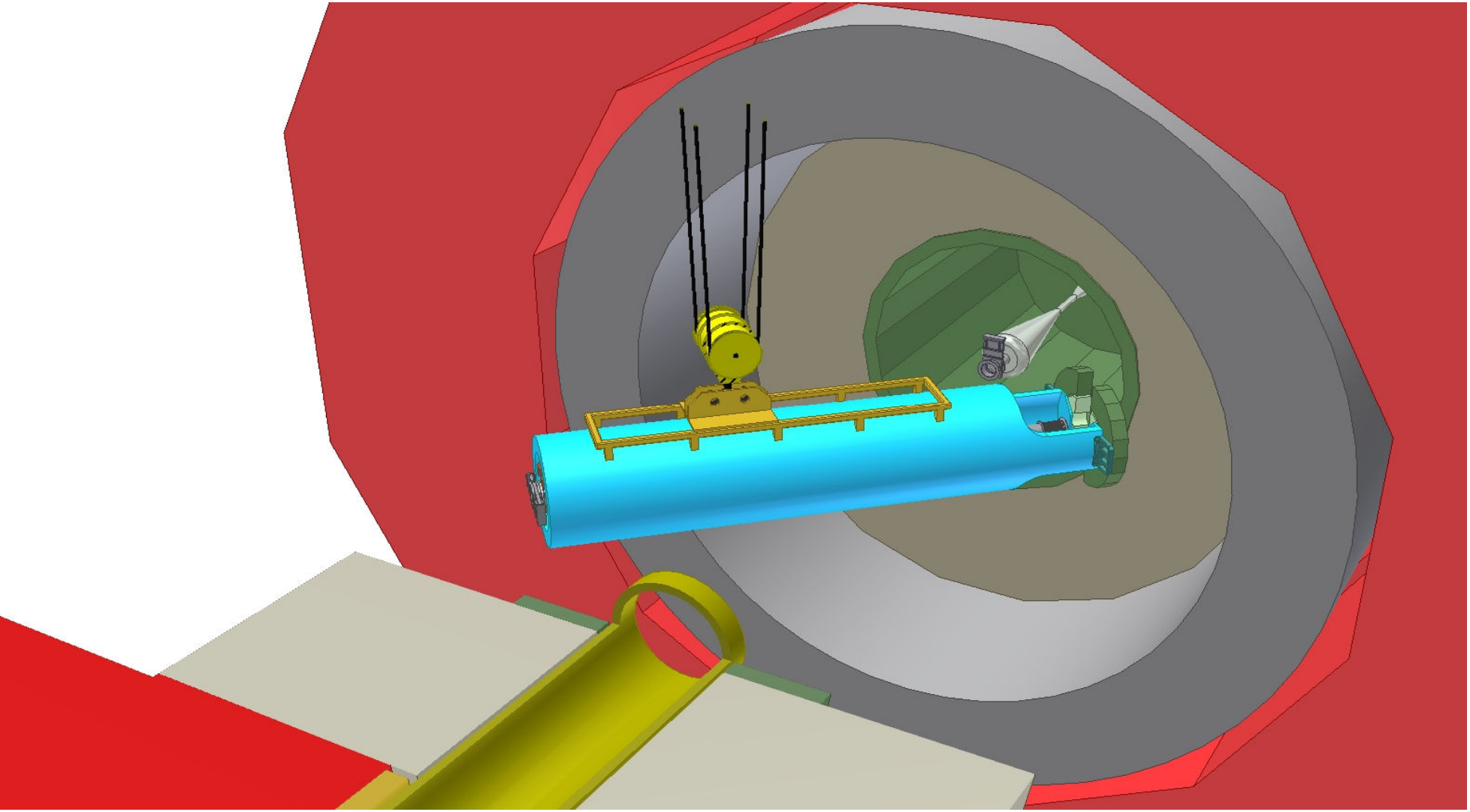
Step 5, back Endcap & prepare removal of ST



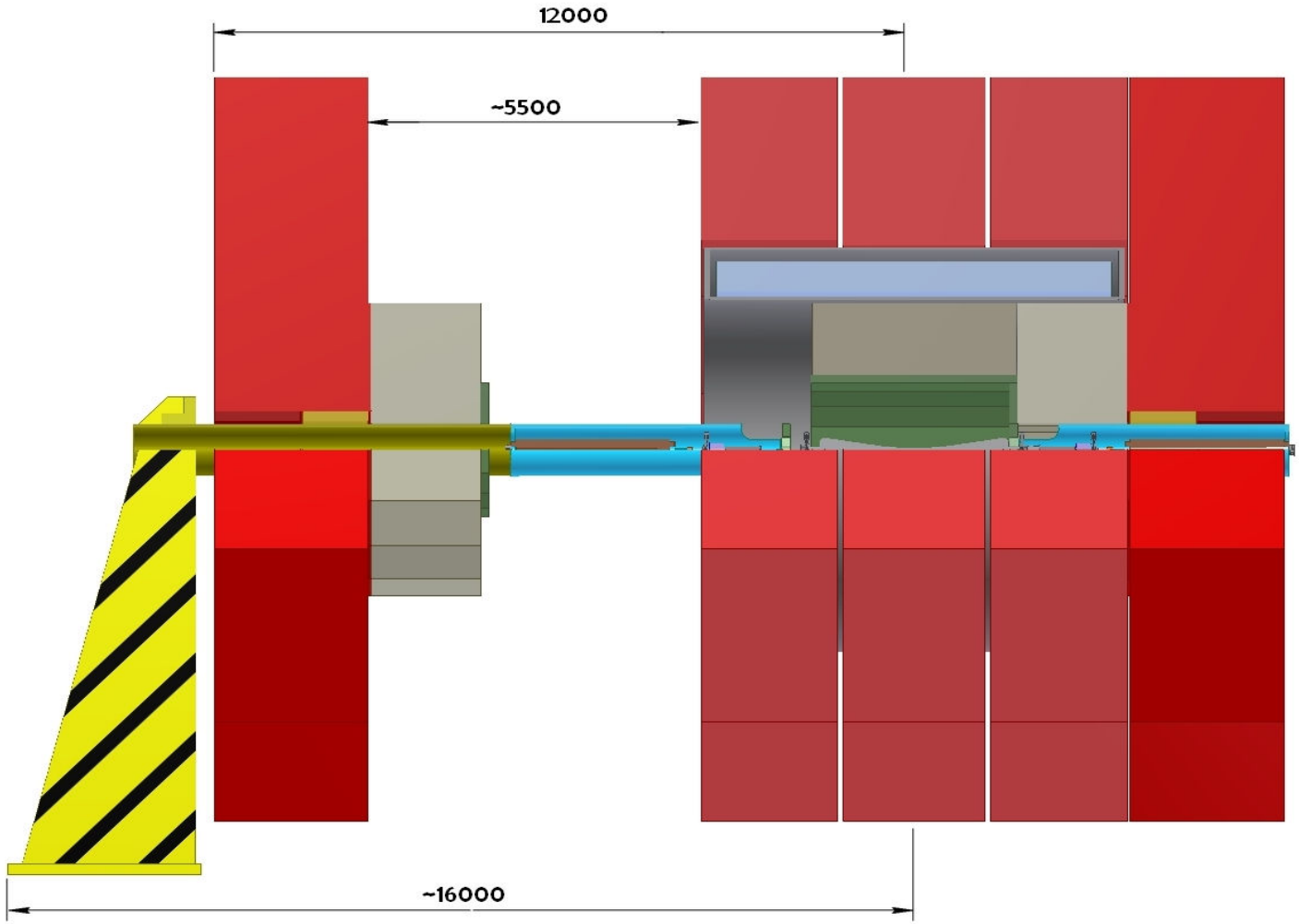
Step 6, Load transfer &disconnect Support Tube from extension tool



Step 7, Full Access, work can start



Distances Detector open



Conclusion & next steps-I

- An engineering parameter drawing for the CLIC_SiD exists with a L* of 3800 mm
- A parameter drawing is being created for the CLID_ILD with a L* around 4600 mm
- Opening on IP is abandoned and QD0 is cantilevered from tunnel

Conclusion & next steps-II

- As explained this morning, endcap coils may be introduced to reduce the length of the experiment and thus improve the QD0 stability, but then the QD0 magnet must be split in two parts, one being inside the tunnel
- The support tube may be a 2 in 1 type (a separate tube for QD0) to try to adjust the natural frequency of the ensemble to 50Hz and satisfy the QD0 stability requirement
- Kicker and BPM must be in front of QD0.
- Full vacuum sectorisation if built-in from the beginning.

Conclusion & next steps-III

- **All these proposals are still to be fully validated, in particular check their compatibility with the physics requirements in the forward region.**