

SiD for ILC

17-19 September 2008
Boulder, Colorado

Lol Planning : Engineering and Global Issues

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The logo for the International Linear Collider (ILC), consisting of the letters "ilc" in a bold, blue, sans-serif font, with a horizontal dotted line passing through the middle of the letters.

IDAG questions

IDAG wishes the proponents of the 3 LOI's to address the following points in their LOI document:

(1) Sensitivity of different detector components to machine background as characterized in the MDI panel.

(2) Calibration and alignment schemes.

✓ **(3) Status of an engineering model describing the support structures and the dead zones in the detector simulation**

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

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

(6) A short statement about the energy coverage, identifying the deterioration of the performances when going to energies higher than 500 GeV and the considered possible detector upgrades.

(7) How was the detector optimized: for example the identification of the major parameters which drive the total detector cost and its sensitivity to variations of these parameters.

1. The Engineering Model for the Lol

The present engineering model is described by a set of parameters that enable the integration of the sub-systems.

The parameters are very close with the geometrical description of the simulation: the beam pipe shape slightly different ;4.5 lambda HCAL proposed very recently-> integration inside solenoid need to be set.

Some optimization features are implemented in the mechanical design but not in the simulation, like the non projectivity of cracks.

At this stage of SiD it is not possible to say much more on cable and piping

A minimum amount for internal services routing is taking in account and the dead material is compatible with the simulation model.

An estimation and integration of other ancillaries like magnet chimneys and embedded Pacmen has been included.

See the Kurt's talk for more details on the mechanical design of the sub-detectors

2.The Engineering Model for the Lol

Fruitful work last Tuesday at the Pre-engineering meeting: we have a shared view of the engineering concepts and on the issues still to be solved.

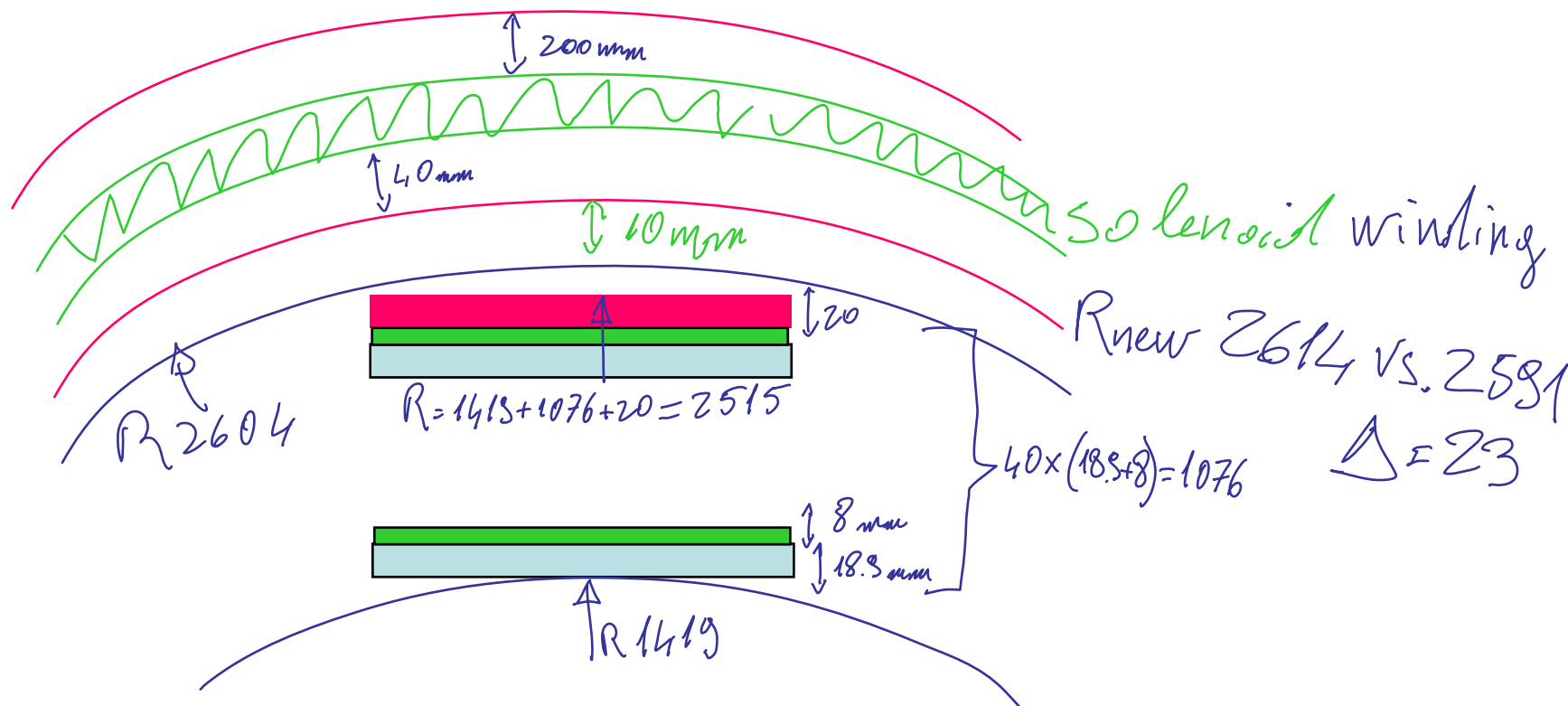
Example of integration issues addressed on these days:

- ✓ Tracker and Door have now the same radius $R=206\text{mm}$ which enable a QD0 movement system and a coherent maintenance scheme for the Tracker/Vertex. Solved
- ✓ To accommodate a 4.5 lambda HCAL with steel absorbers, the vacuum tank inner radius need to be increased to accommodate the mechanical support and the clearances

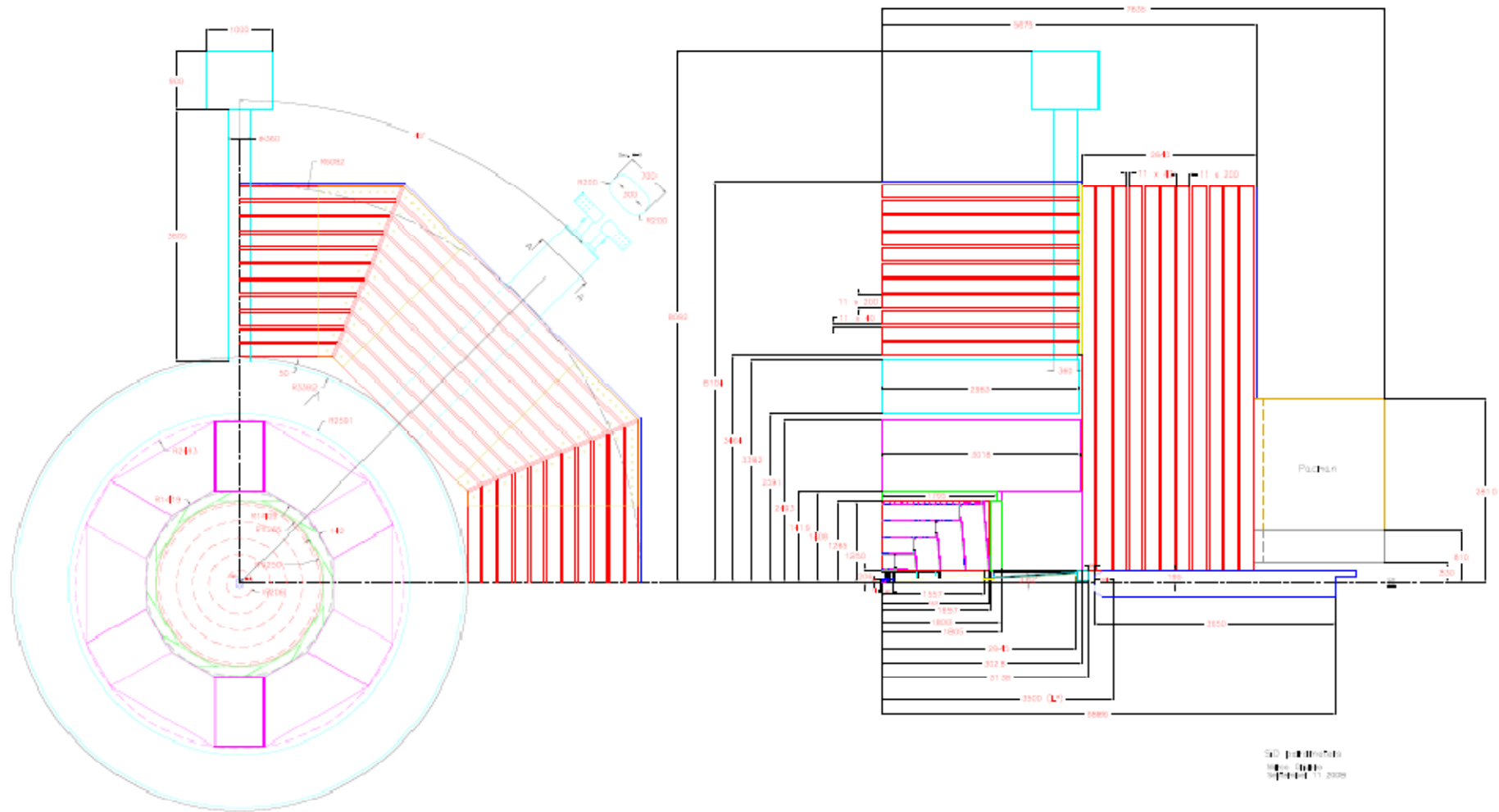
The 4.5 λ Affair

With aggressive but still realistic mechanical assumptions, the magnet inner radius would be increased of 23 mm. This can be shared partially moving the inner vacuum tank shell close to the winding, partially pushing the cold mass radius ~ 1 cm ? The iron barrel stays the same.

That provide a realistic design and a coherent Lol



Parameters Drawing for Lol



Push-Pull and Machine Detectors Interface

We have a clear strategy of the Push-pull for SiD, which has been spelt out in the Marty's talk.

Sharing the same beam with other detectors implies the agreement on a set of rules as part of the Machine Detectors Interface.

Major debates on the platform and the surfaces vs. underground assembly.

Submitting the Lol, the detector concepts are not yet requested to converge on single solutions.

Upon initiative of the ILC/BDS group, an Interface Document has been presented at EPAC08 conference: while it provide a fair list of requirements it has the limit of baselining some technical solutions for the push-pull and the MDI

With the start up of IDAG at ECFA08 conference, the detector concepts have agreed to make a step back and work together on a MDI Functional Requirements document which define the list of constraints without forcing technical solutions at this stage.

The Functional Requirements document is in preparation by T.Markiewicz, see his talk at the ECFA08 plenary, with an exhaustive list

The interface document or EPAC08 Paper to be Improved by Warsaw then Chicago LCWS

CHALLENGES AND CONCEPTS FOR DESIGN OF AN INTERACTION REGION WITH PUSH-PULL ARRANGEMENT OF DETECTORS – AN INTERFACE DOCUMENT*

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Abstract

Two experimental detectors working in a push-pull mode has been considered for the Interaction Region of the International Linear Collider [1]. The push-pull mode of operation sets specific requirements and challenges for many systems of detector and machine, in particular for the IR magnets, for the cryogenics system, for alignment system, for beamline shielding, for detector design and overall integration, and so on. These challenges and the identified conceptual solutions discussed in the paper intend to form a draft of the Interface Document which will be developed further in the nearest future. The authors of the present paper include the organizers and conveners of working groups of the workshop on engineering design of interaction region IRENG07 [2], the leaders of the IR Integration within Global Design Effort Beam Delivery System, and will also include representatives from each detector concept submitting the Letters Of Intent.

INTRODUCTION

The process of finding an acceptable technical solution for Interaction Region involves searching a balance between complex and often contradictory requirements coming from machine or detector. An Interface Document was thought as a way to keep track of the achieved agreements and assumption and also as the way to highlight existing contradictions and focus the efforts for their resolution. The latter imposes the present interface Document to be an evolving entity. The first attempt of creation of the Interface Document was undertaken at the IRENG07 workshop. The paper presented represents the next draft, which will be further developed as an integral part of LOI preparation.

FUNCTIONAL REQUIREMENTS

In this section, the minimal functional requirements, to which all detector concepts are bound, are summarized. These requirements are closely related to fundamental properties of design and less dependent on site location and similar specifics. In contrast, the next section will describe more detailed specification and outline the present working models and likely technical solutions.

The list of minimal functional requirement starts with the need to have two detectors in a single collider hall, able to work in turns, in push-pull mode.

The speed of push-pull operation is the first defining assumption. We set as the goal that hardware design should allow the moving operation, reconnections and possible rearrangements of shielding to be performed in a few days, or less than a week.

The range of detector sizes considered in the design include detectors with half size of 6-7 meters, performing optimally if the IP to start of QD0 quadrupole (L^* parameter) would be in the range of 3.5-4.5 meters (different L^* is allowed for different detectors), while the distance from IP to the second quadrupole QF1 is 9.5 meters, which drives many parameters of the design, including the hall width.

The off-beamline detector is shifted in transverse direction to a garage position, located 15m from the IP. The radiation and magnetic environment, suitable for people access to the off-beamline detector during beam collision, are to be guaranteed by the beamline detector using their chosen solution.

The IR and detector design is to satisfy the beam parameters defined in the RDR [1] including nominal, Low N, Large Y and Low P parameter sets.

INTERFACE SPECIFICATIONS

The superconducting final doublets, consisting from QD0 and QF1 quadrupoles (and associated sextupoles SD0 and SF1) are grouped into two independent cryostats, with QD0 cryostat penetrating almost entirely into the detector. The QD0 cryostat is specific for the detector design and moves together with detector during push-pull operation, while the QF1 cryostat is common and rests in the tunnel.

Radiation shielding is essential with two detectors occupying the same Interaction Region hall. Detector should either be self-shielded or need to assume responsibility for additional local fixed or movable shielding (walls) to provide area accessible for people near the second detector when the first is running with beam. The radiation criteria to be satisfied are for normal operation and for accident case. In the normal operation, the dose anywhere near non-operational second detector

*Work supported in part by US DOE contract DE-AC02-76-SF00515.

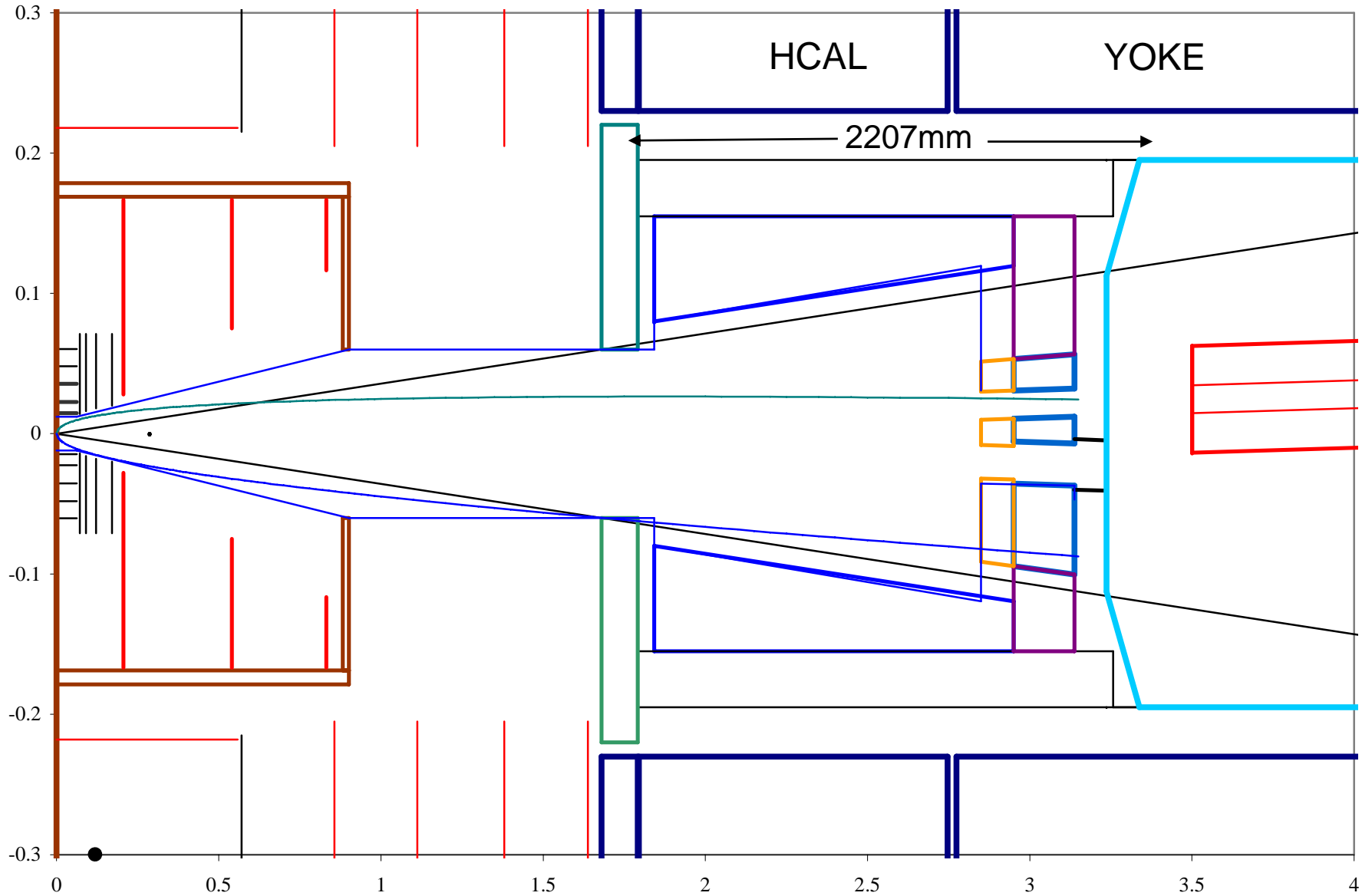
List of functional requirements

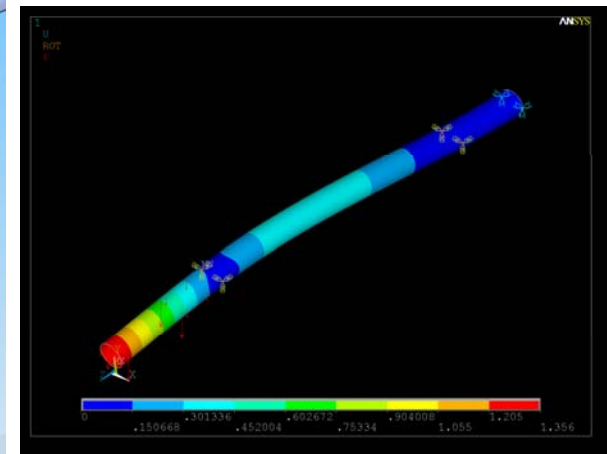
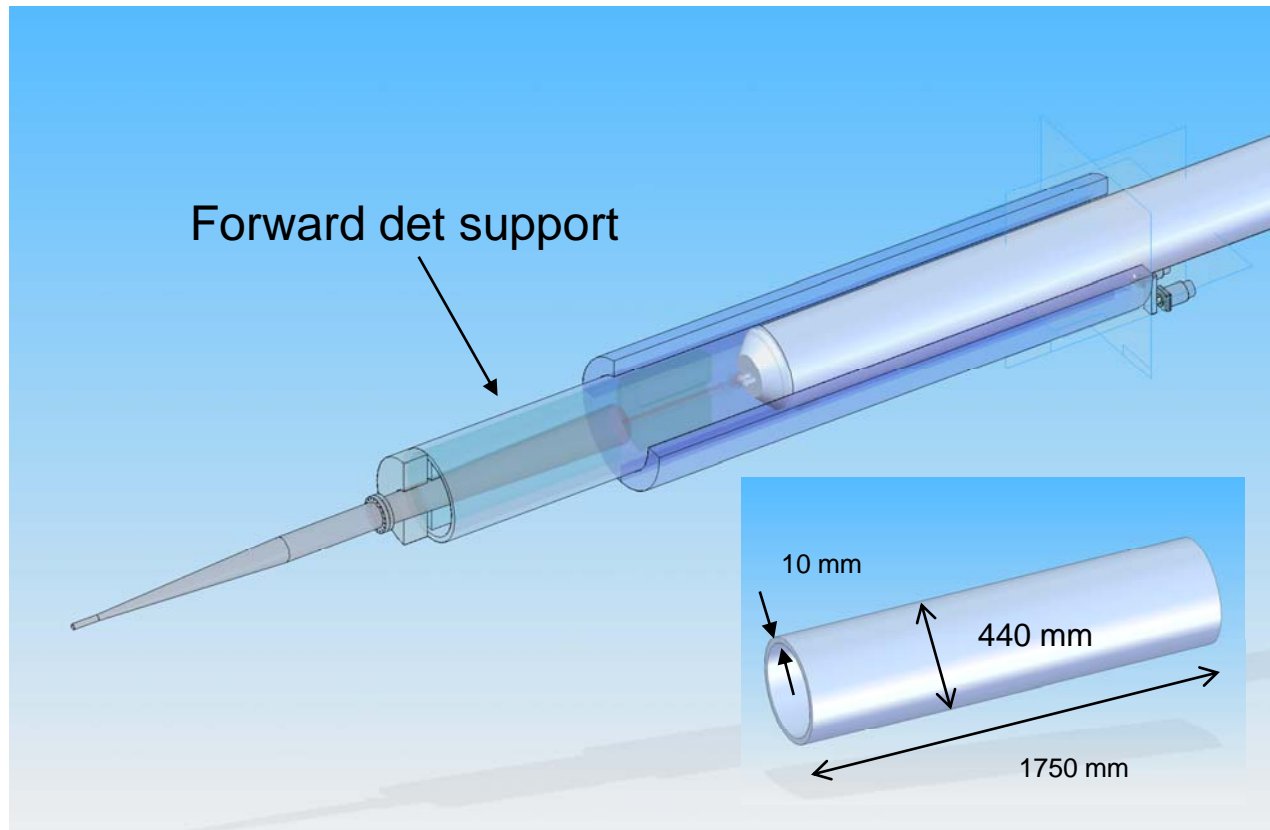
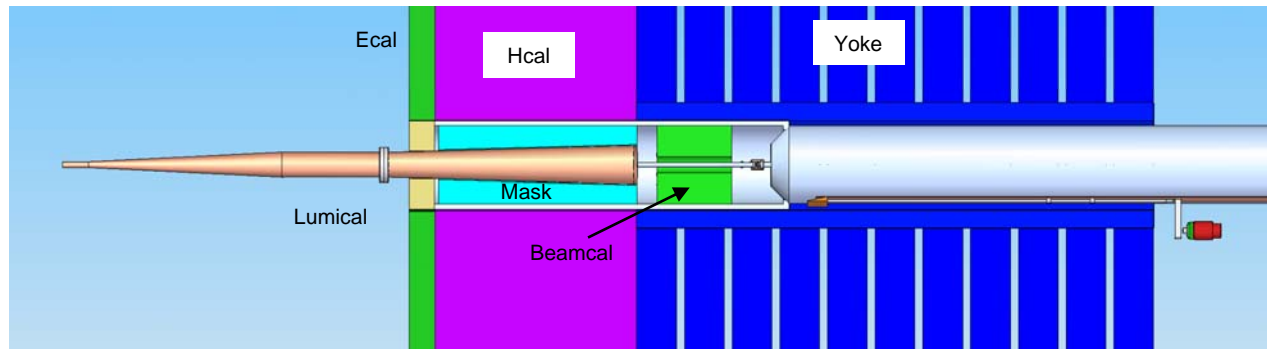
1. Two detectors in a single collider hall, able to work in turns, in push-pull mode.
2. The hardware design should allow the moving operation, reconnections and possible rearrangements of shielding to be performed in a few days, or less than a week.
3. The IP to start of QD0 quadrupole (L^* parameter) would be in the range of 3.5-4.5 meters (different L^* is allowed for different detectors), while the distance from IP to the second quadrupole QF1 is 9.5 meters.
4. The range of detector sizes considered in the design include detectors with half size of 6-7 meters, performing optimally
5. The off-beamline detector is shifted in transverse direction to a garage position, located 15m from the IP.
6. The radiation and magnetic environment, suitable for people access to the off-beamline detector during beam collision, are to be guaranteed by the beam line detector using their chosen solution.
7. The IR and detector design is to satisfy the beam parameters defined in the RDR [1] including nominal, Low N, Large Y and Low P parameter sets.

SiD specific features MDI related

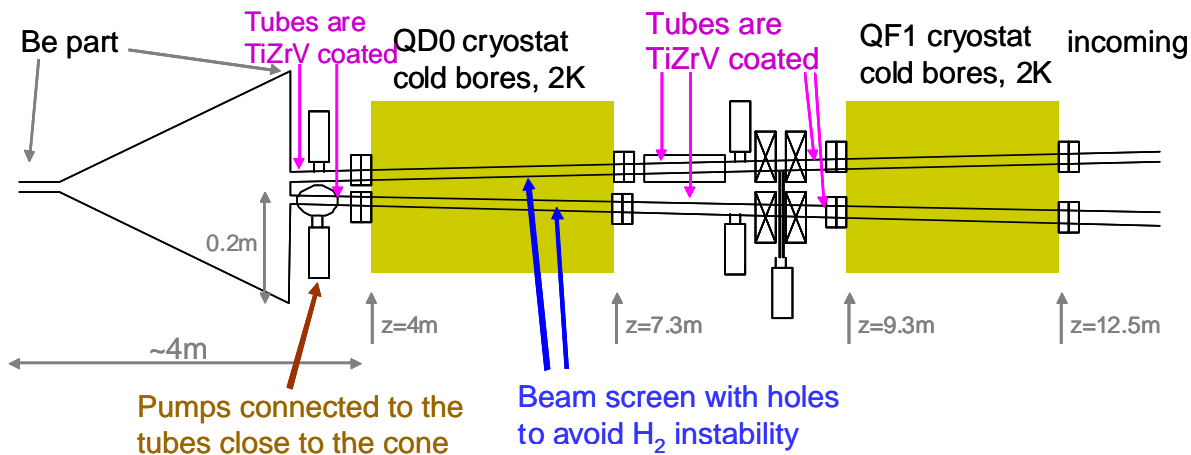
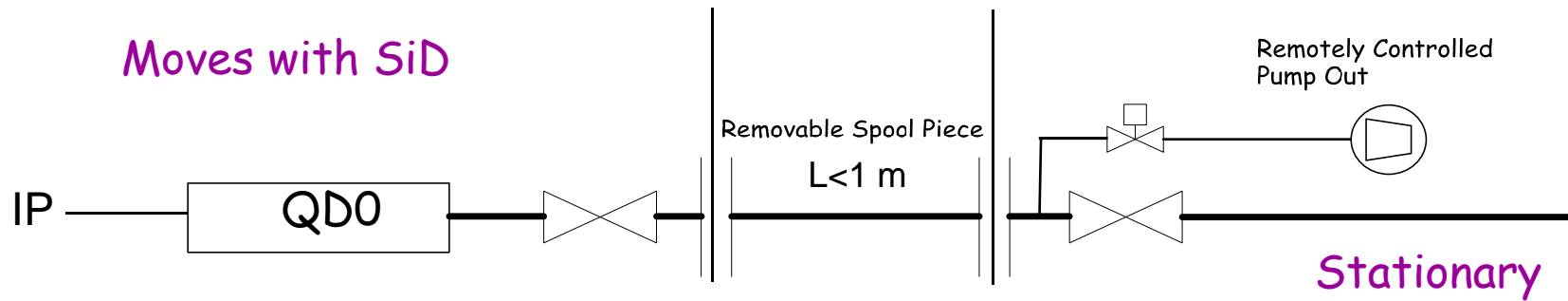
- Engineering in the Forward Region
- QD0 supports
- Pacmen Shielding
- Experimental Vacuum Chamber
- Push pull without platform
- Detector Assembly, surface vs. underground

SiD $r < 50\text{cm}$, $L^* = 3.664\text{m}$, 14mrad ,
Push-Pull, QF@9.5m, Door Closed





Max vertical deformation 1.3 mm



IRENG07 Workshop

Present vacuum requirements :

$P < 1nT$ in the BDS

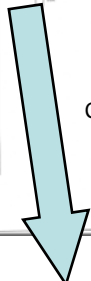
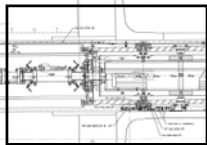
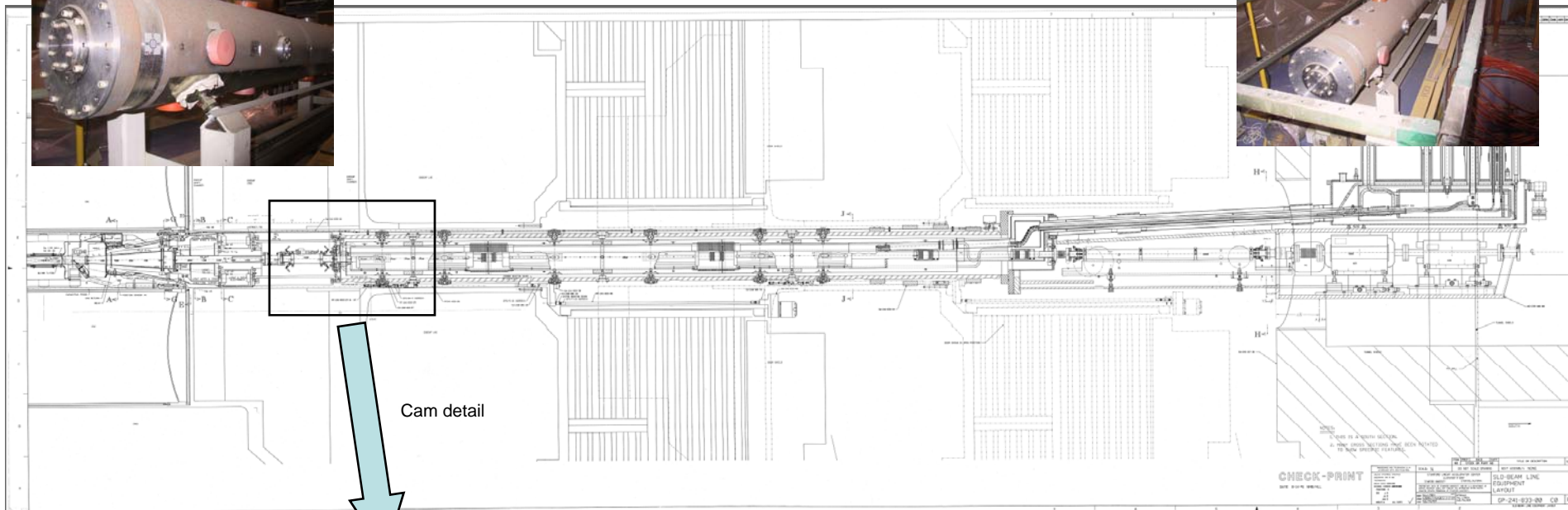
$P < 100nT$ in the experimental region

- We may rely on the cryopumping from QD0
- We do not need extra pumps
- We do not need periodic bake out *in situ*.

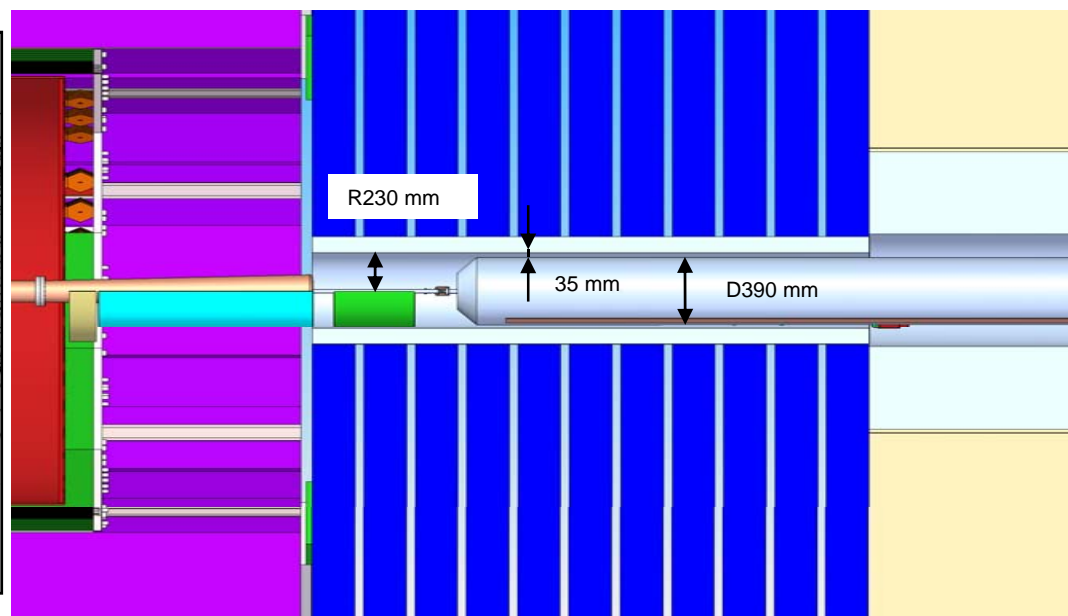
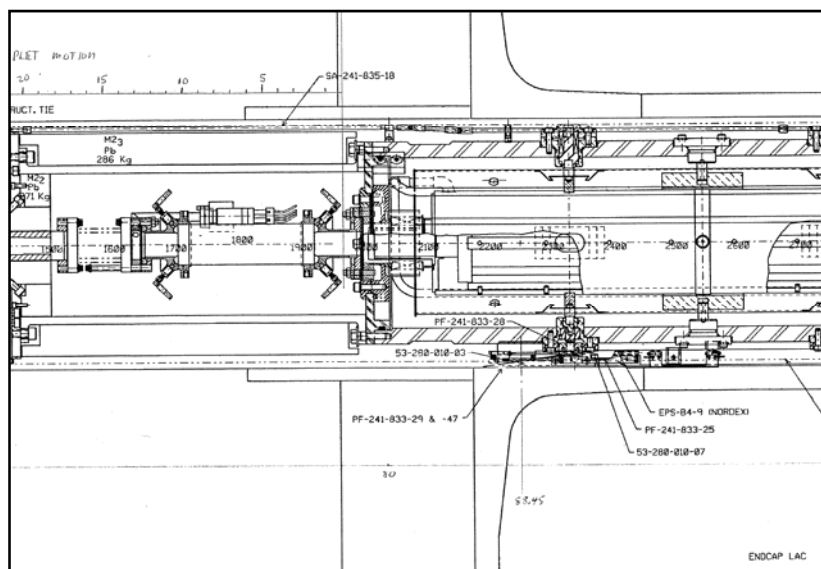
Open point :

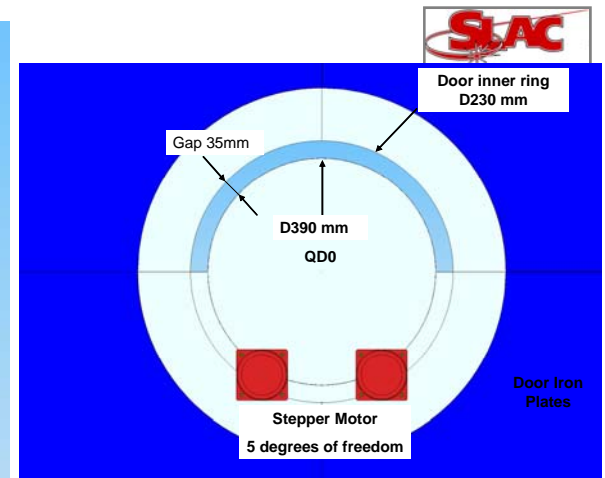
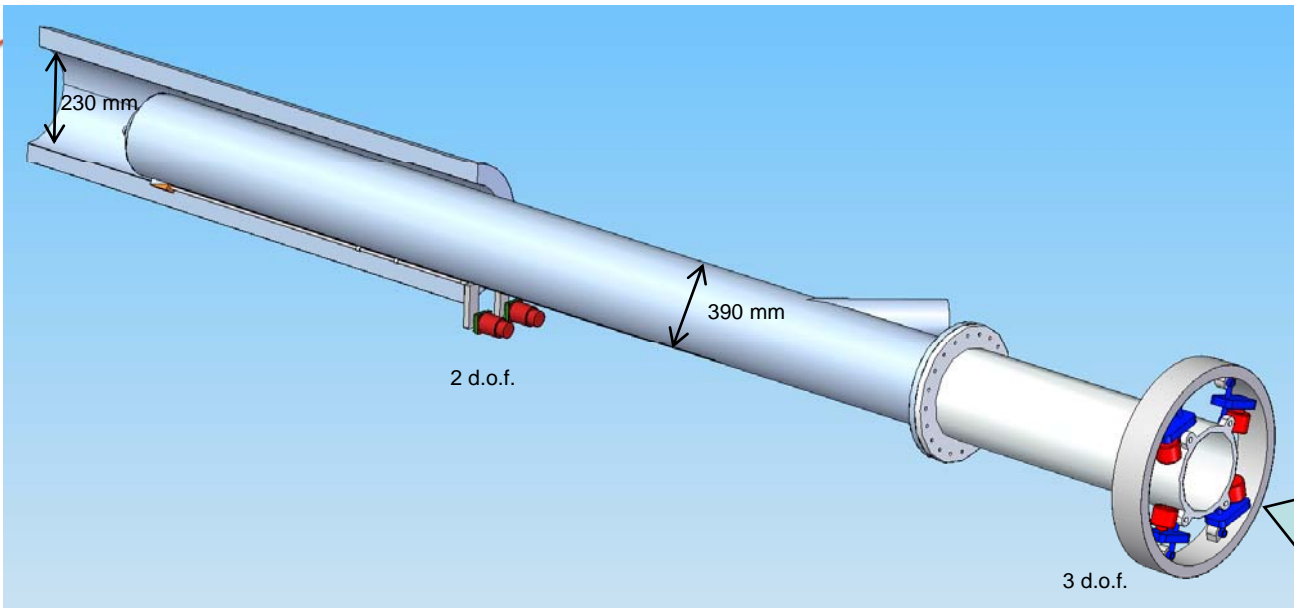
- The beam instrumentation required
- Shut-off valves

QD0 integration and movement as in SLD

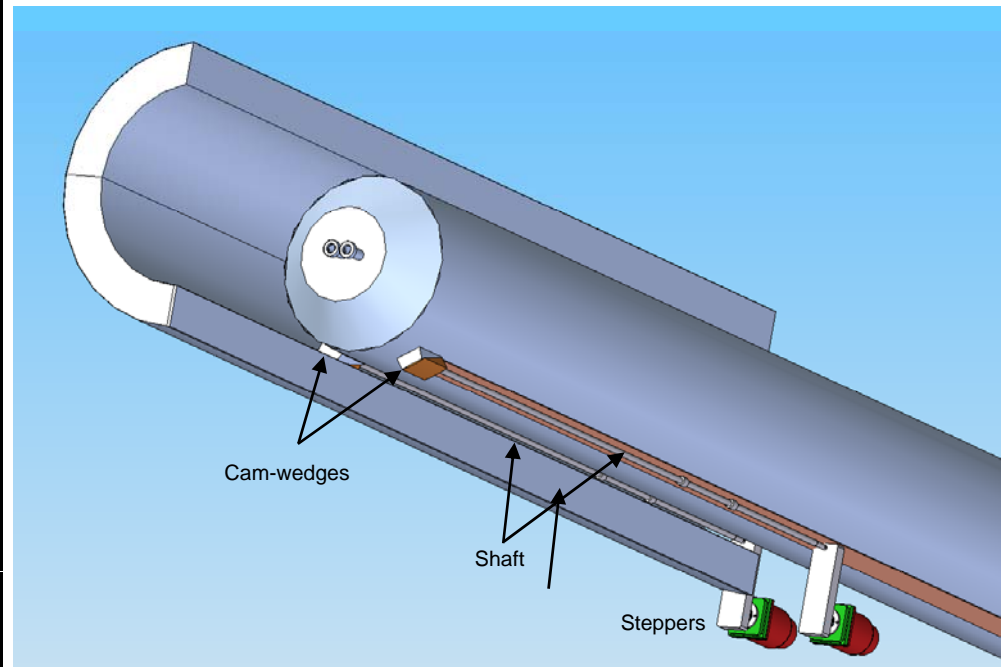
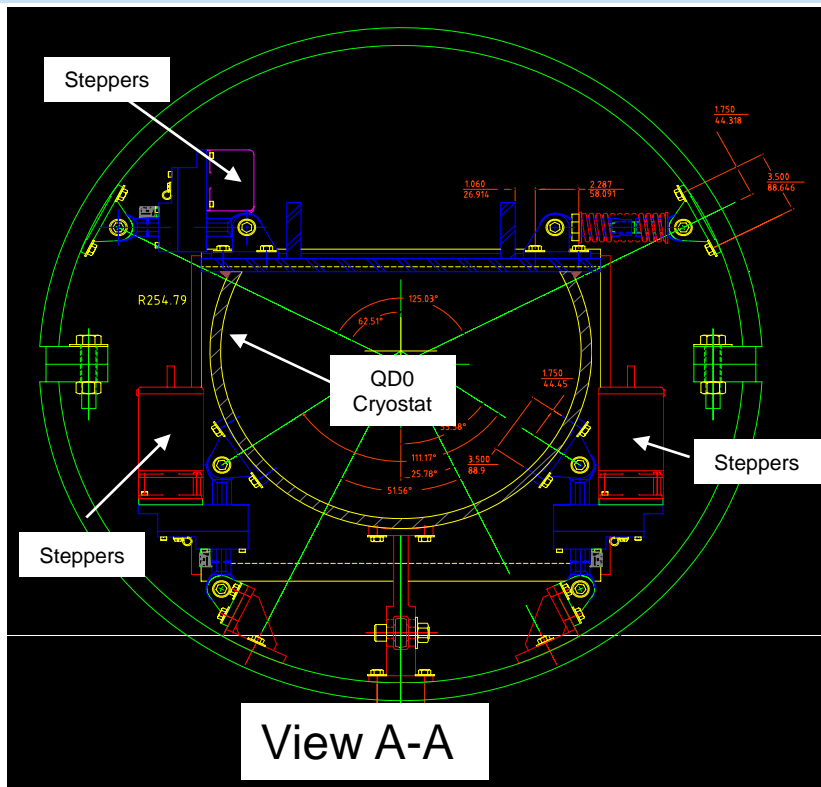


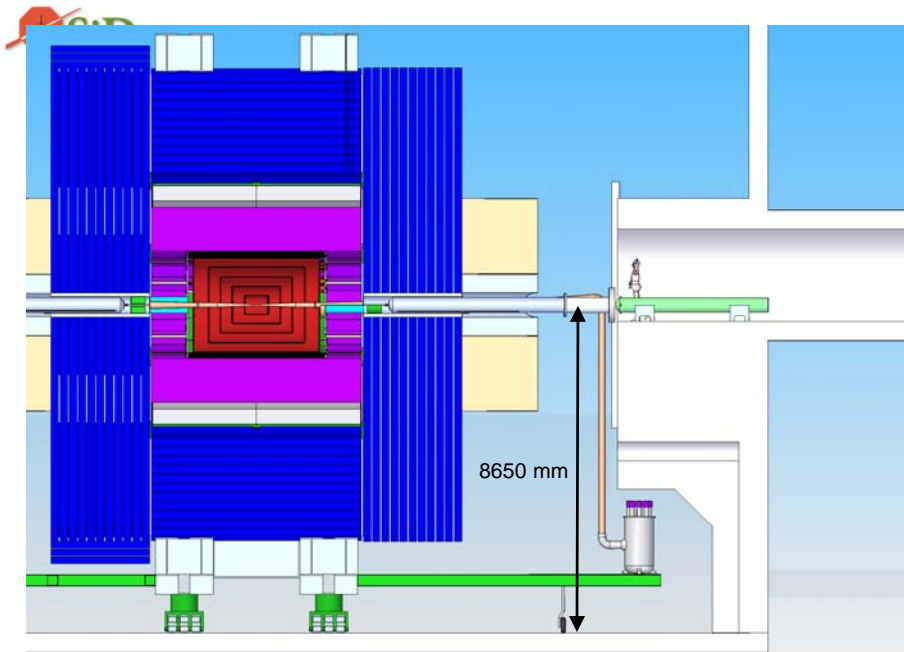
Cam detail



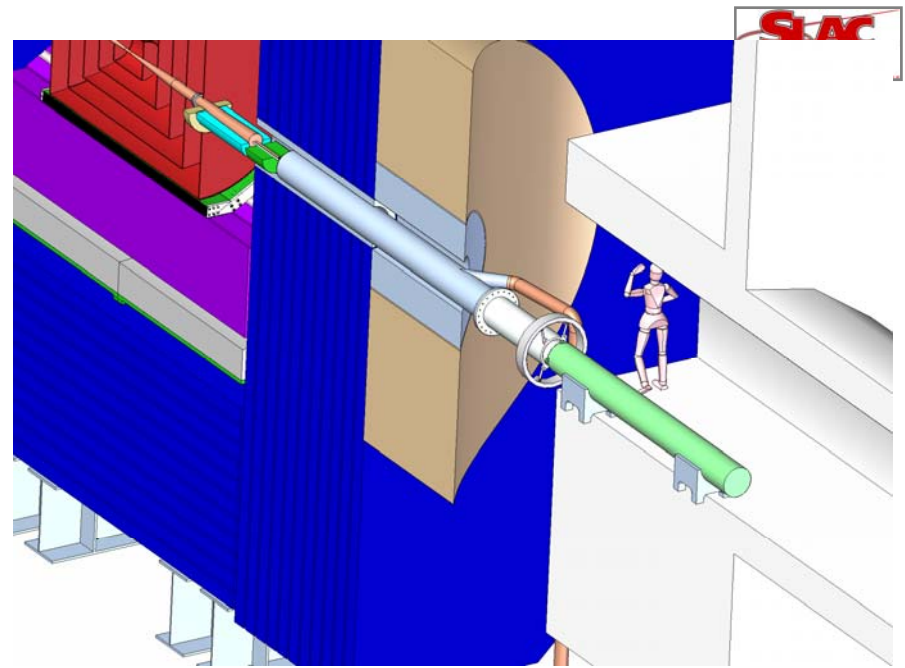


View A-A

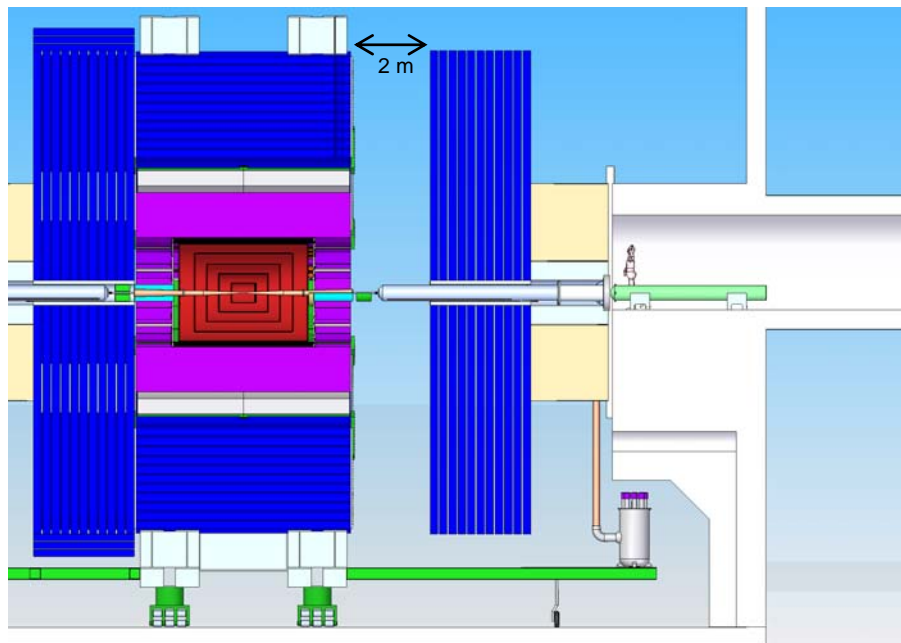




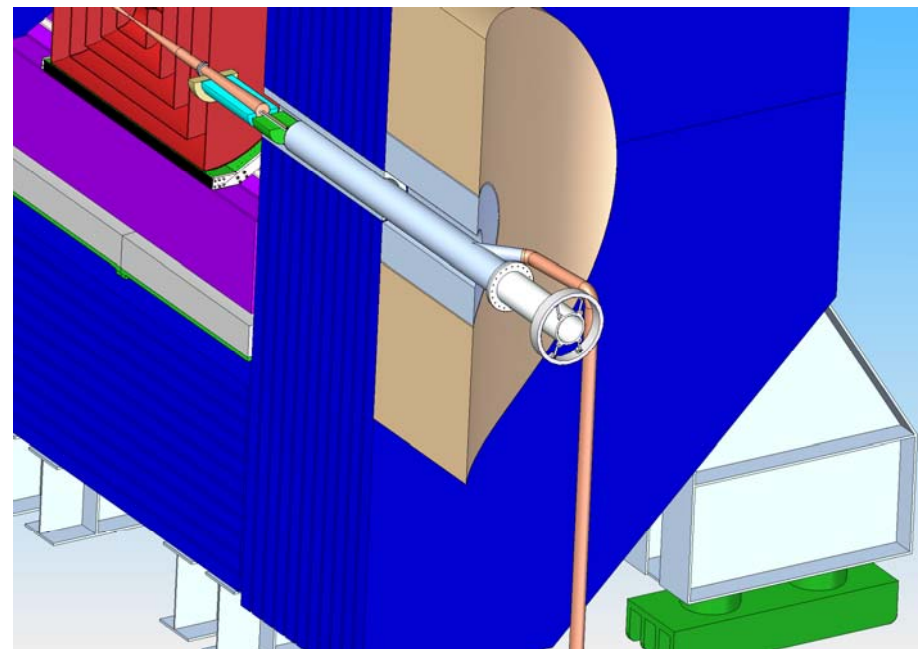
Close Position



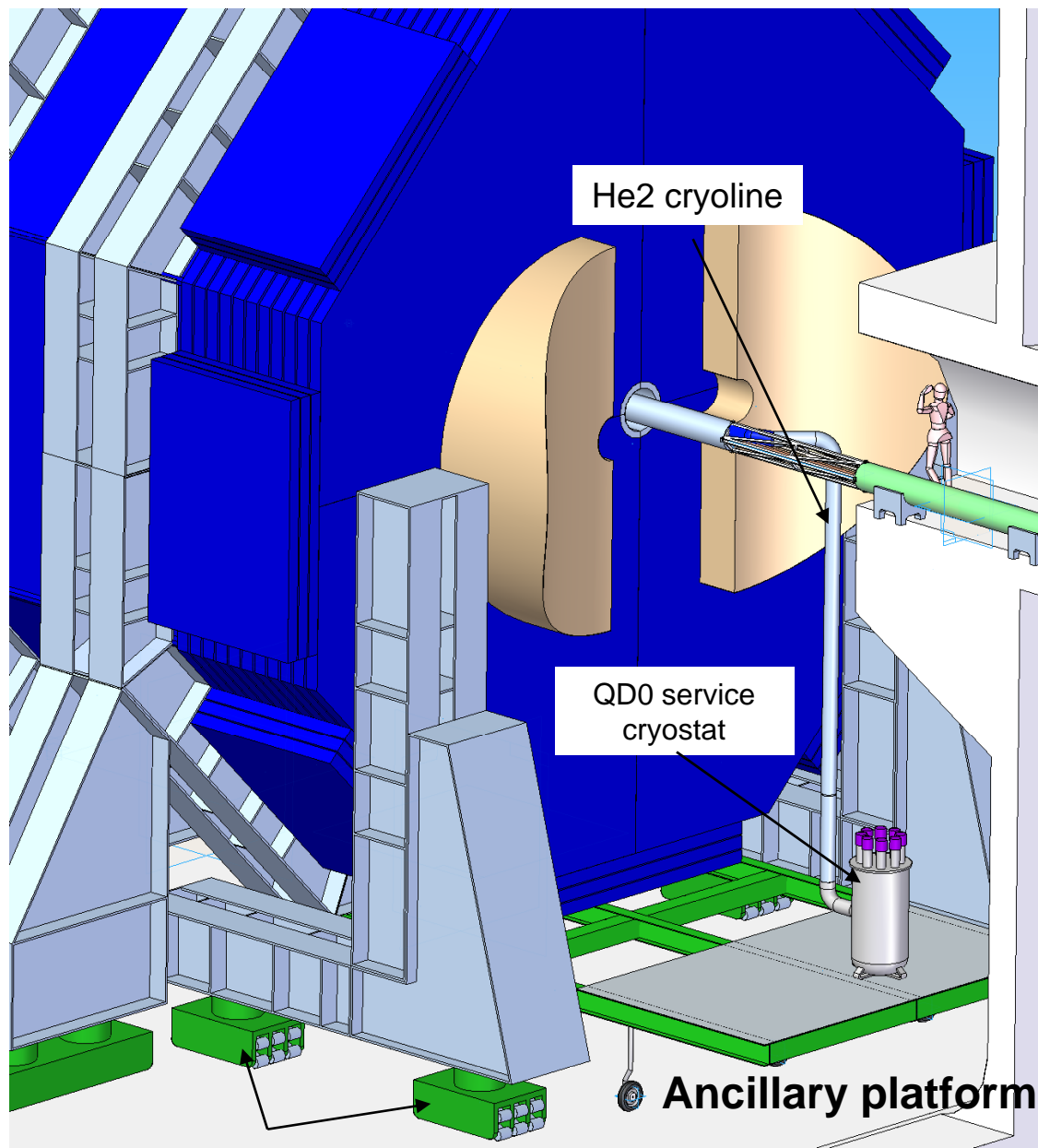
Close Position on the beam



2 m Open Position



Close Position off the beam



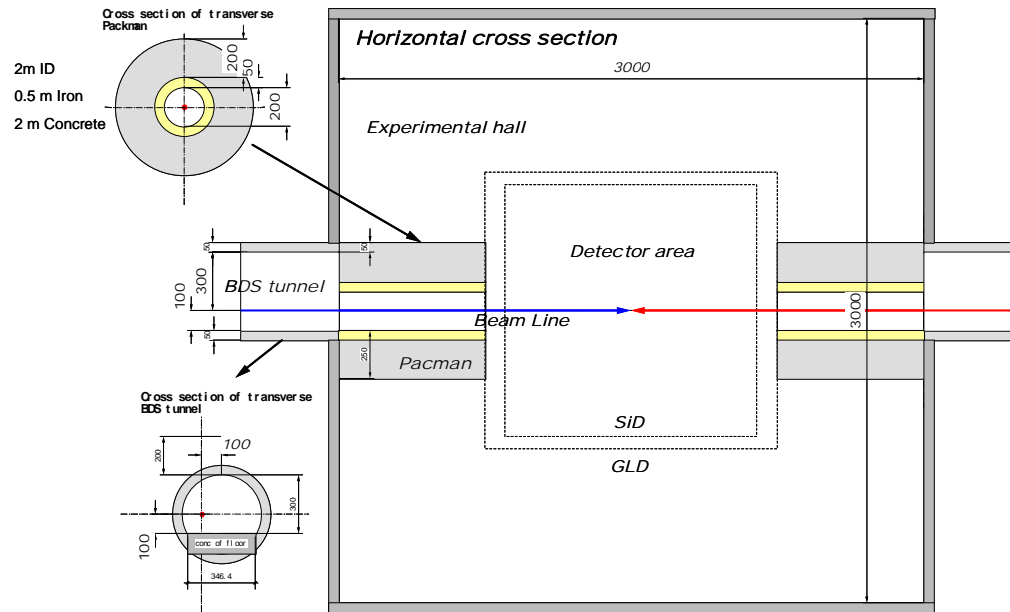
2 m opening on the beam,

1. The QD0 service cryostat on ancillary platform, fixed to the SiD barrel infrastructure
2. He2 cryoline rigidly connected to QD0 through the Pacman
3. No relative movement between QD0 and He2 line when door opens.
4. The ancillary platform allows the QD0 cryogenics to travel with detector during push-pull
5. Additional space for racks, controls et al.

Hilman Rollers

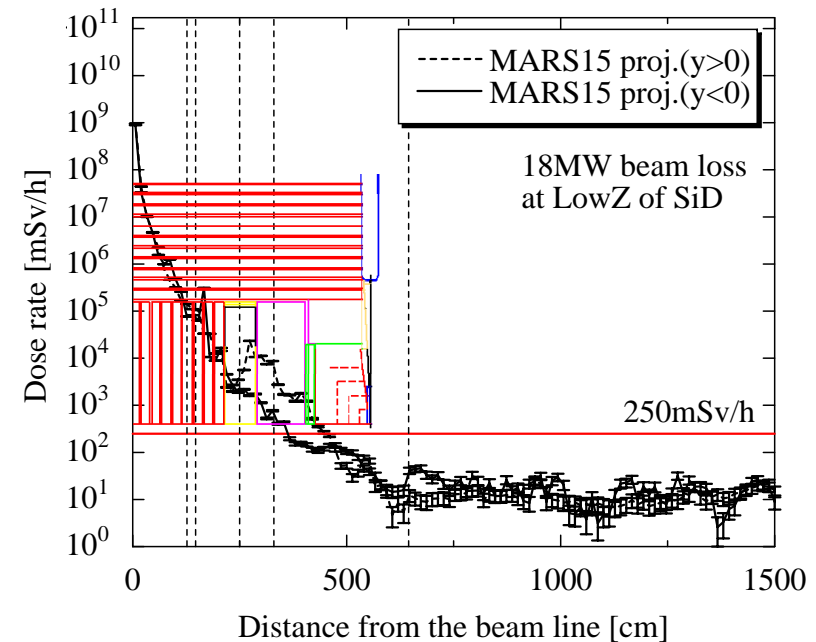
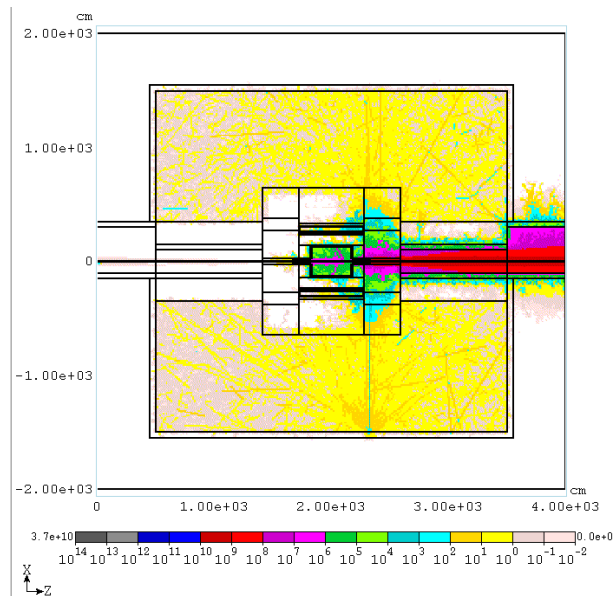
Pacman Radiation Physics requirements

From T.Sanami, IRENG'07



Keywords :

- Self-Shielding Detector
- Adjusting pacman to reduce dose below 250mSv/hr

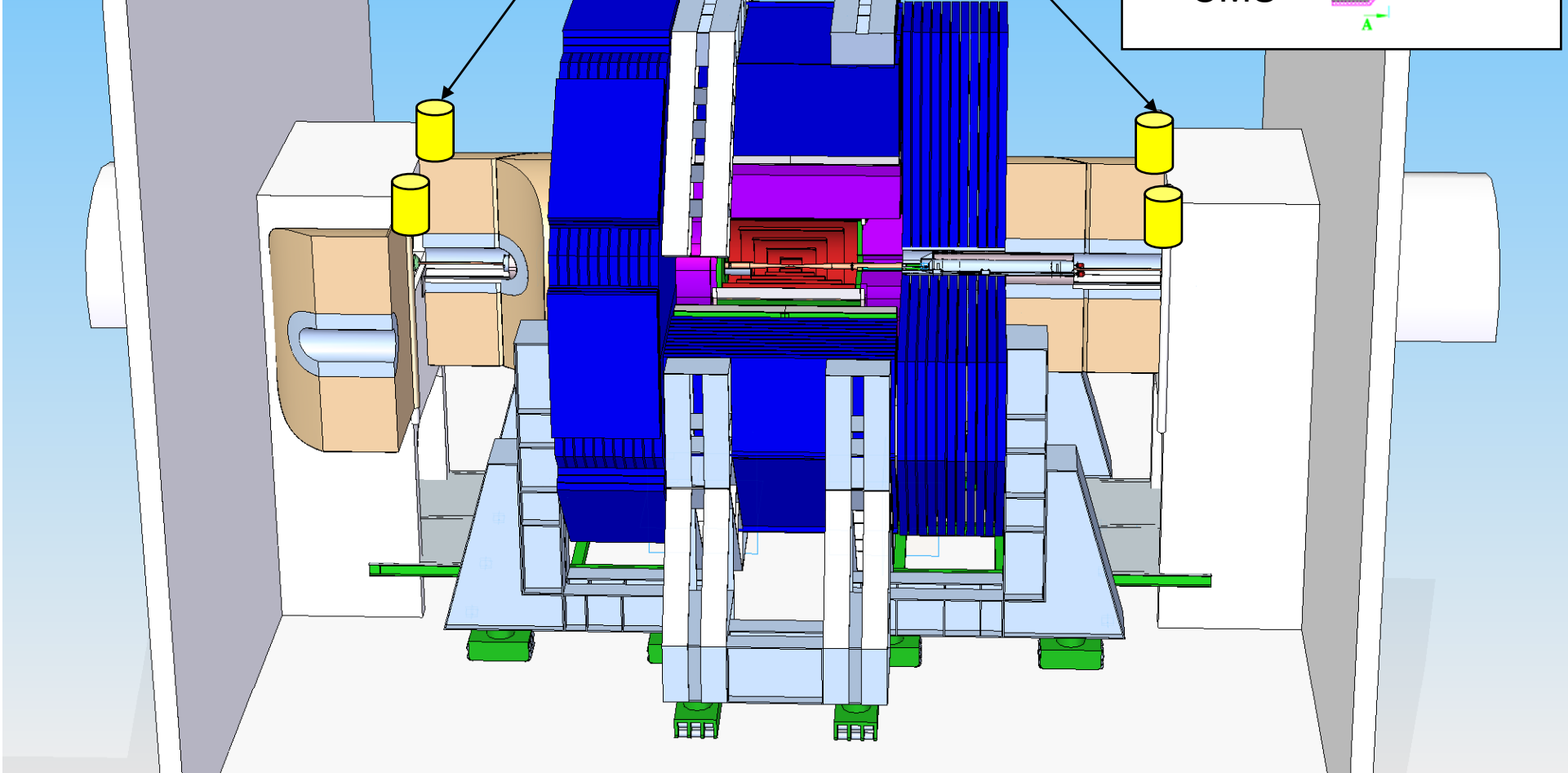
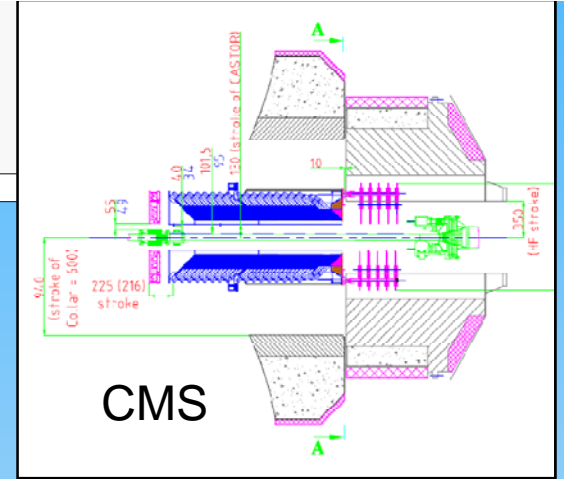


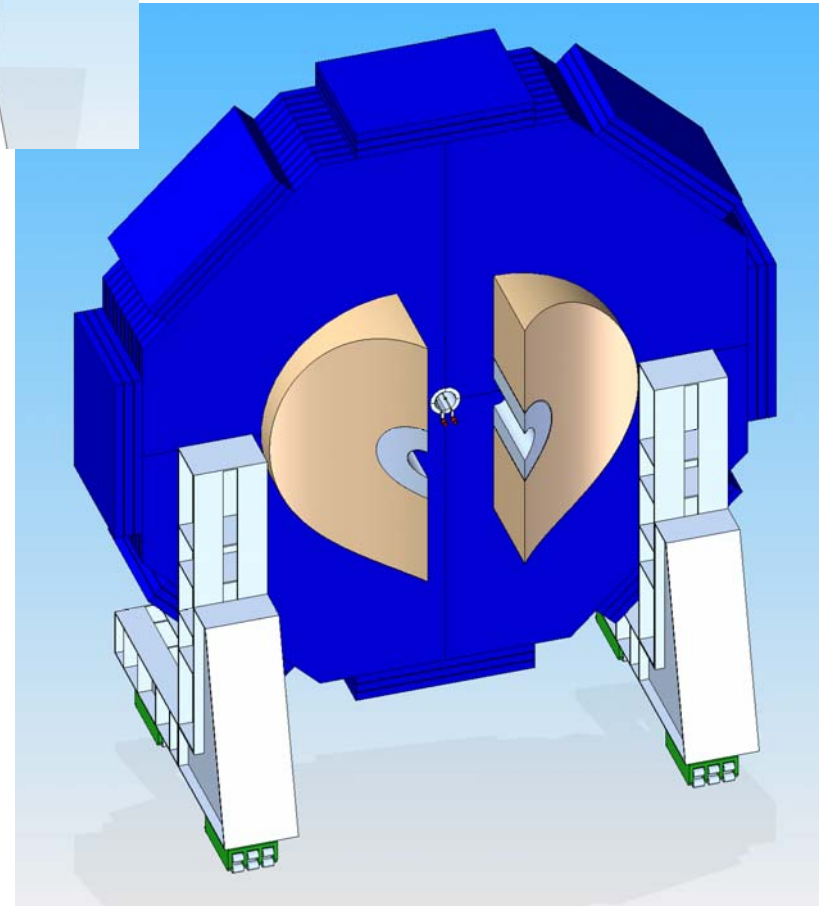
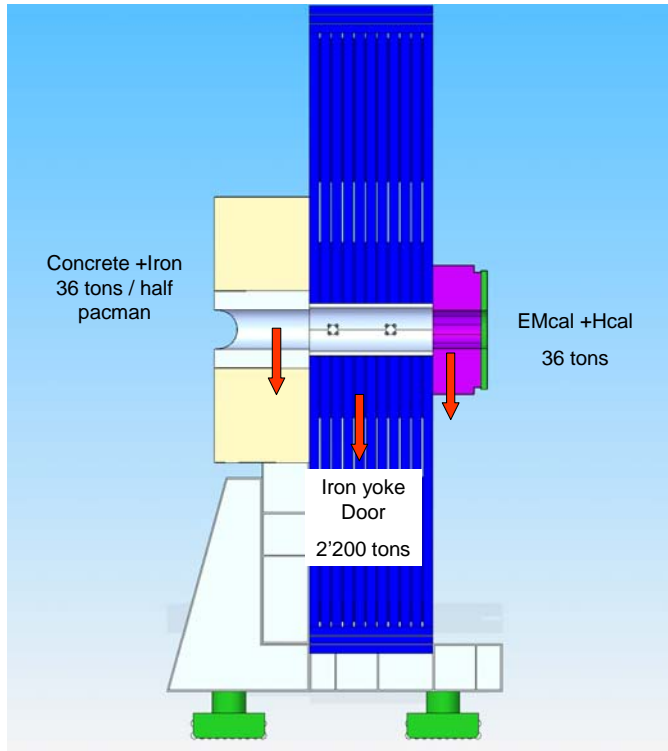
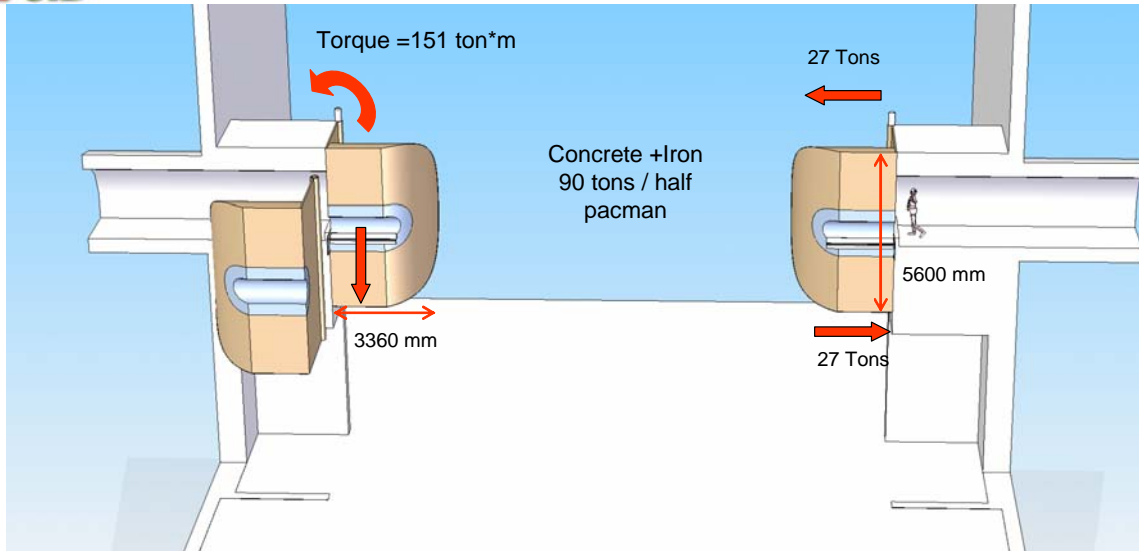


CMS

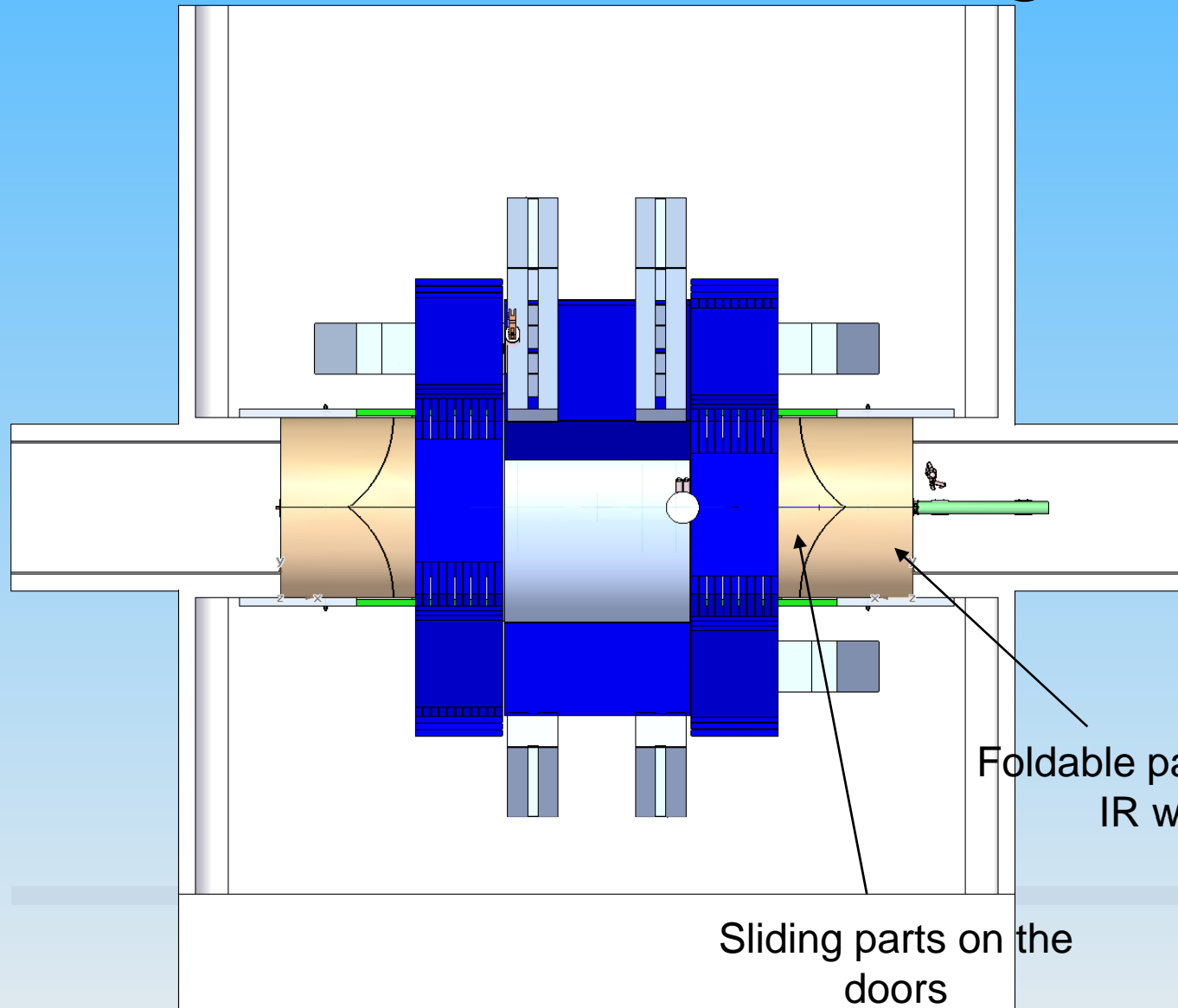
Rotating Pacmen

Electrical motor, low friction hinges





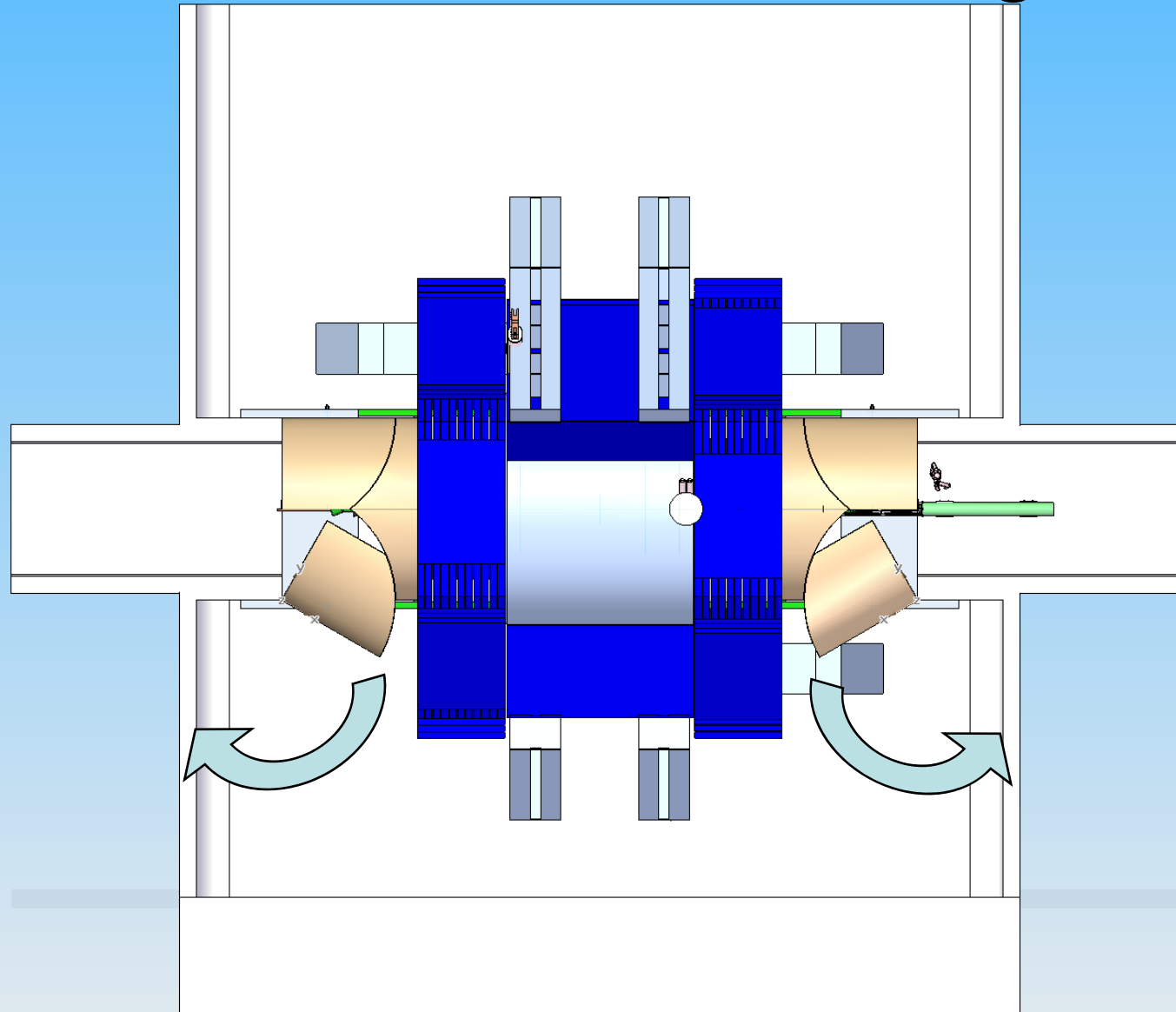
SiD Forward Shielding



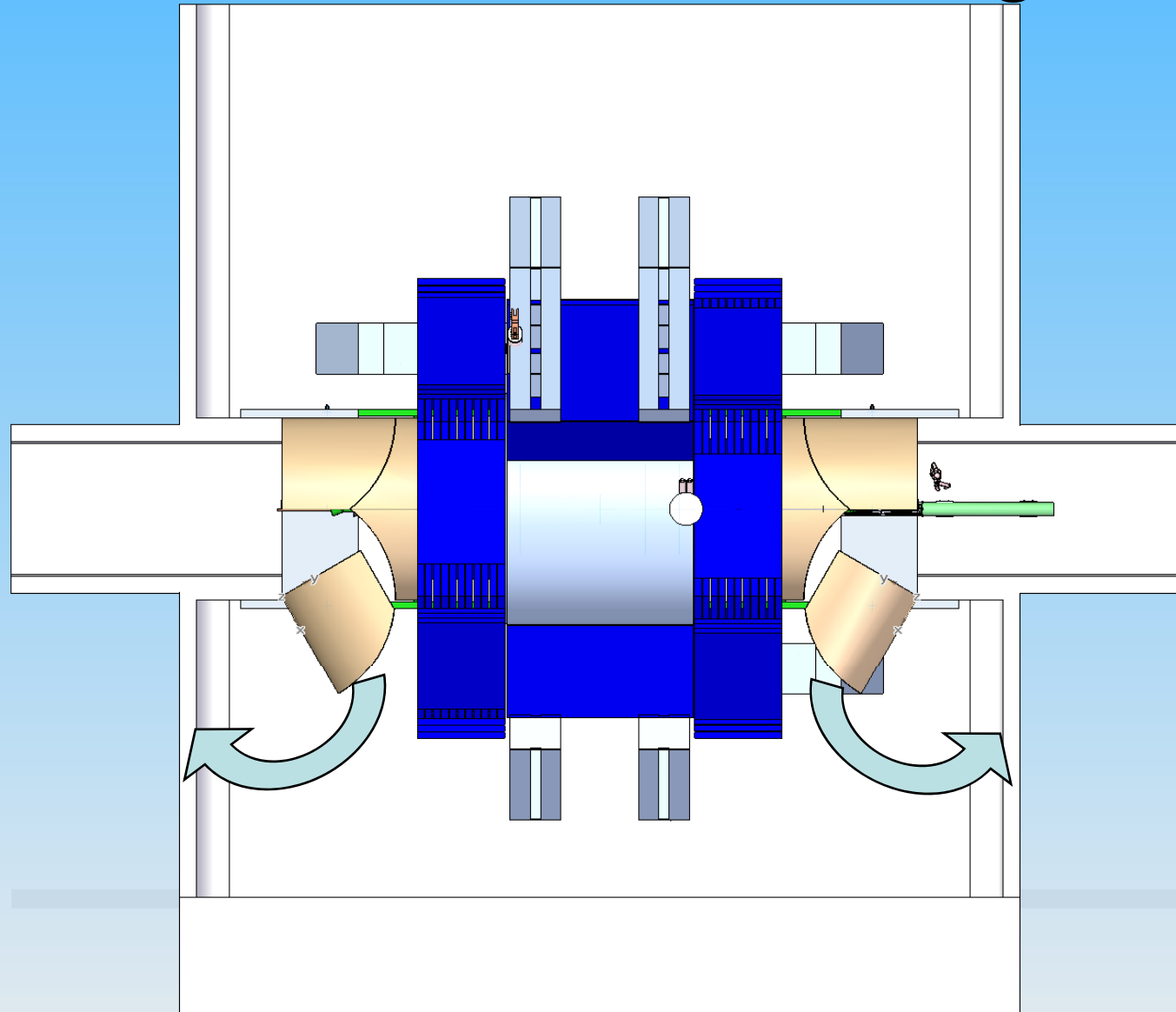
Foldable parts on the IR walls

Sliding parts on the doors

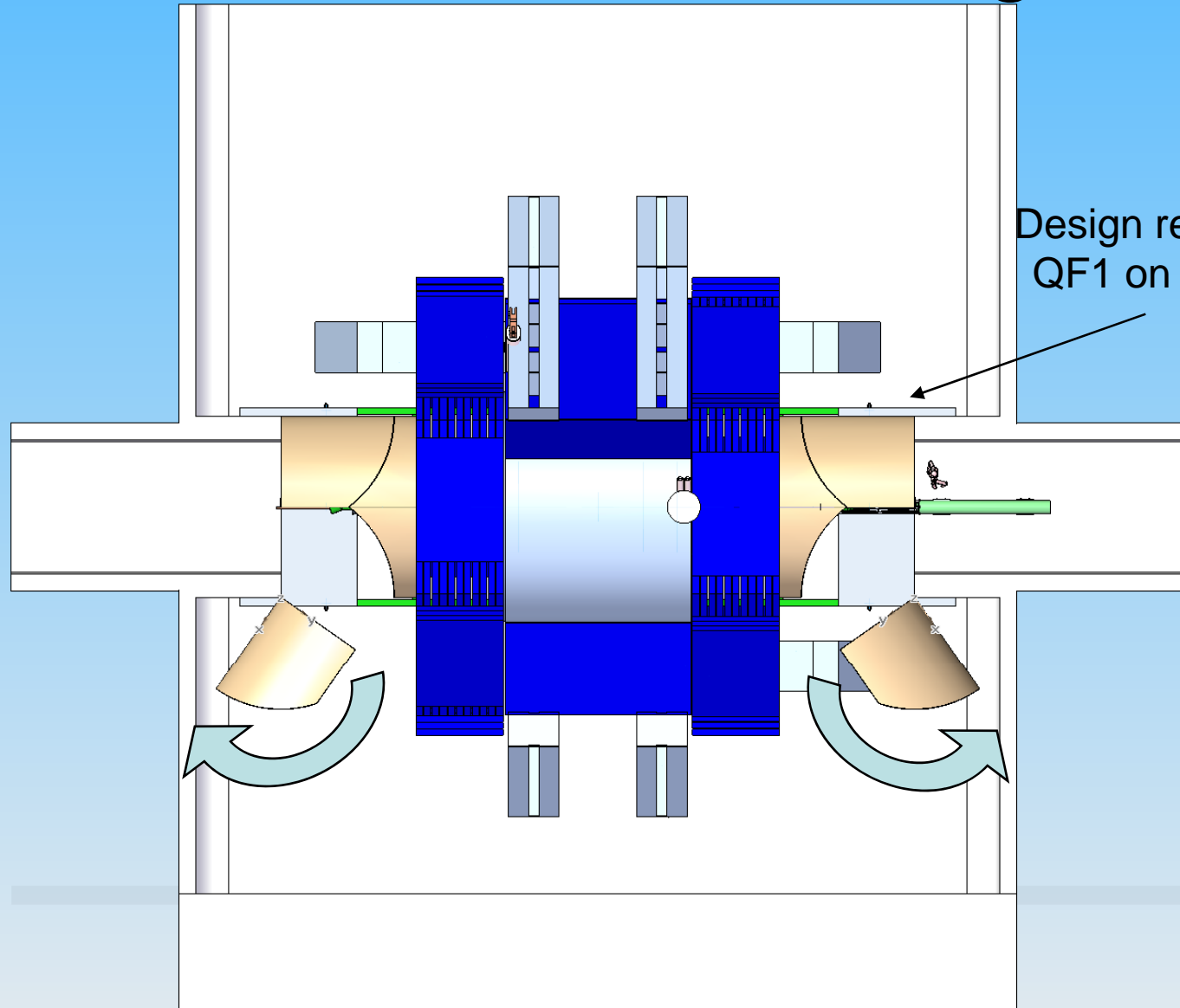
SiD Forward Shielding



SiD Forward Shielding

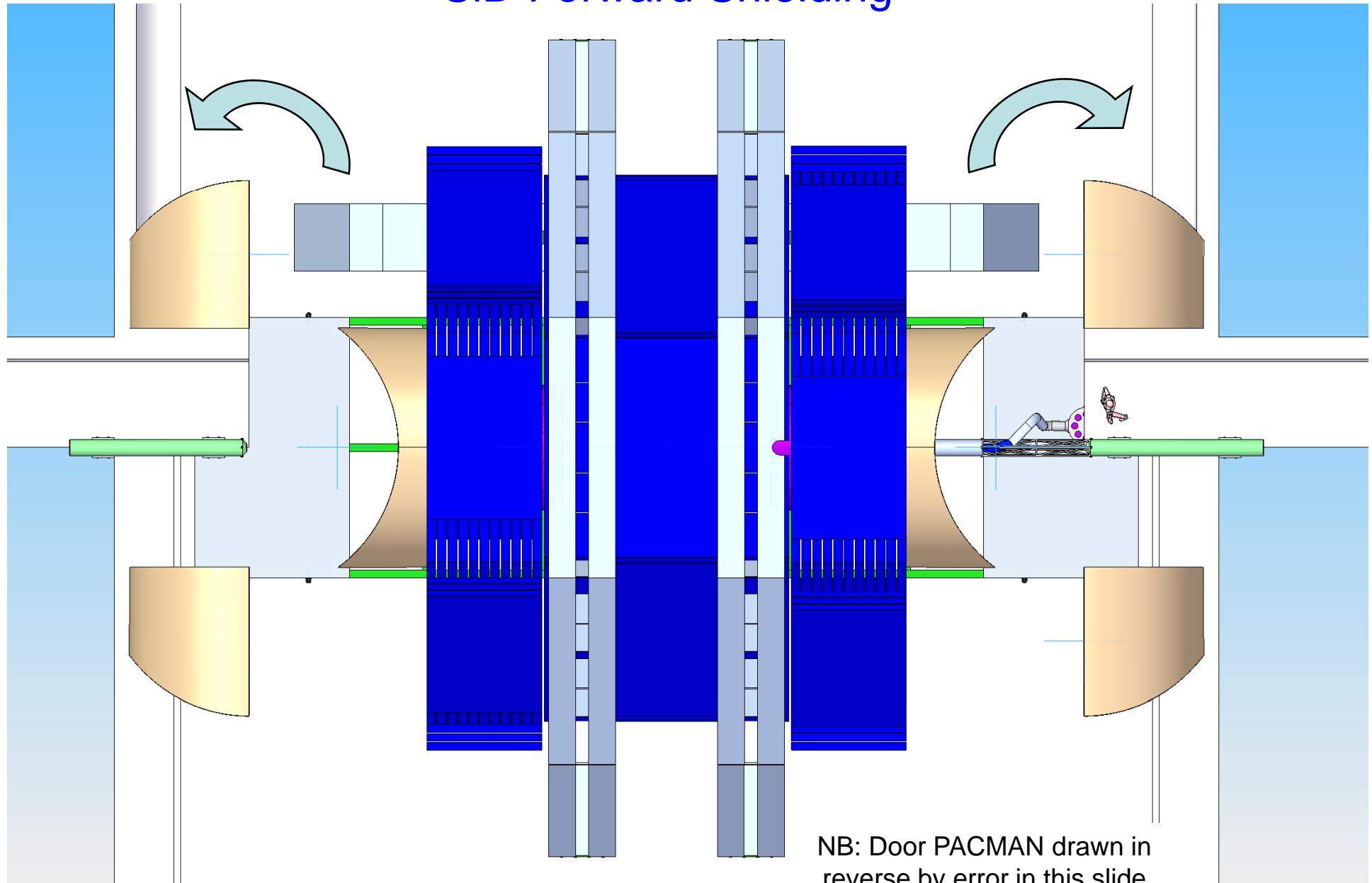


SiD Forward Shielding



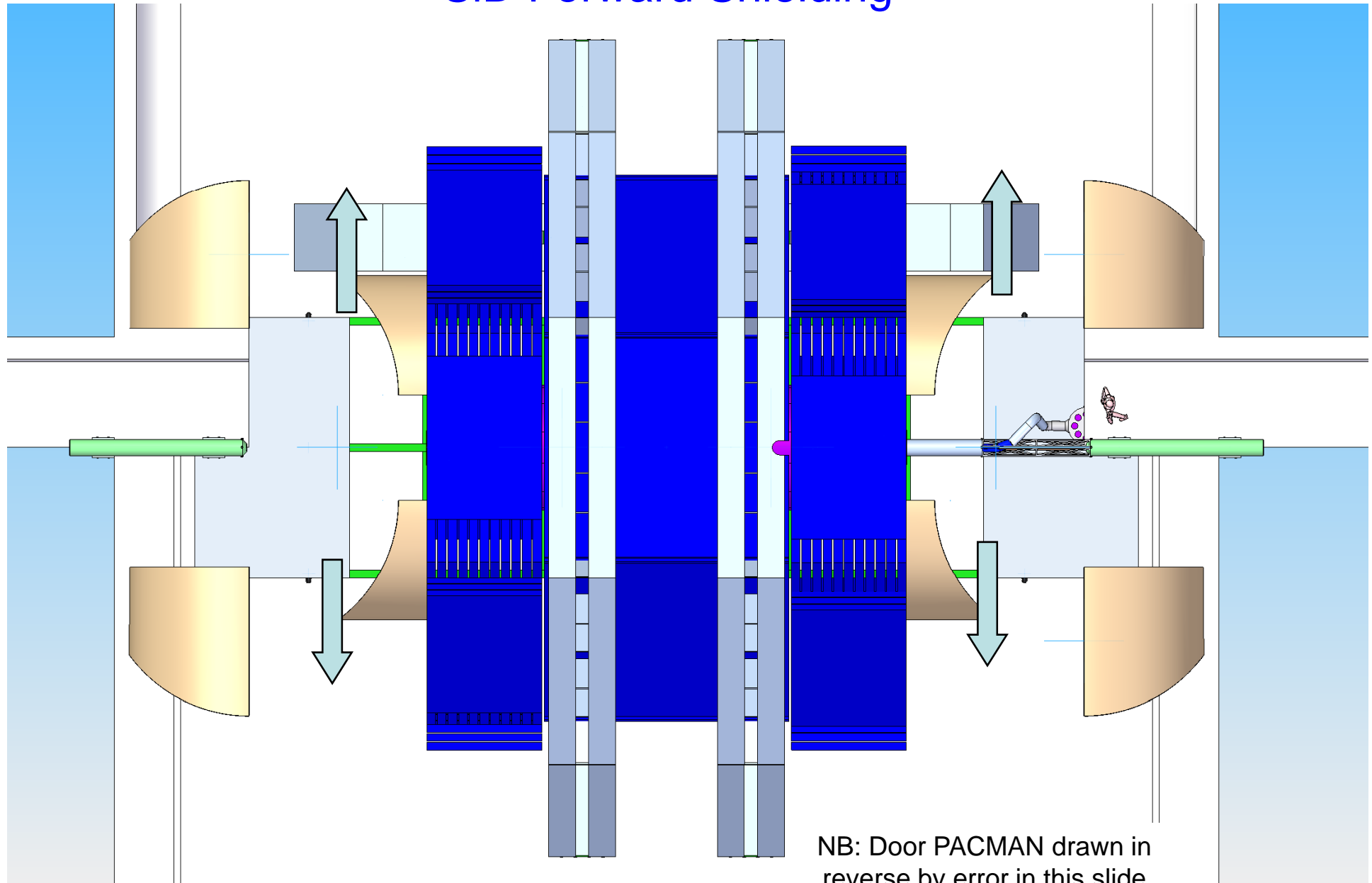
Design requires
QF1 on a pier

SiD Forward Shielding



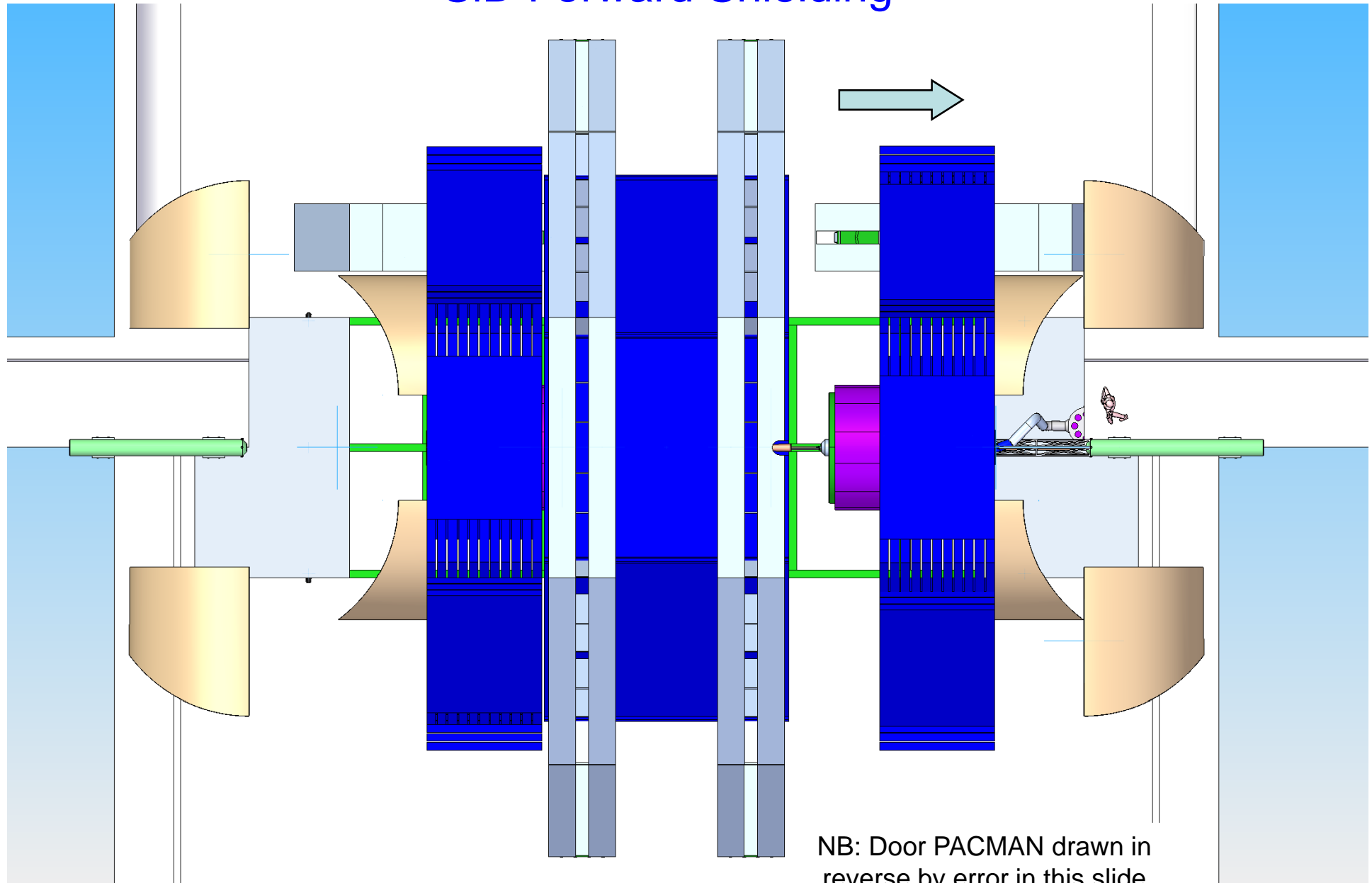
NB: Door PACMAN drawn in reverse by error in this slide

SiD Forward Shielding

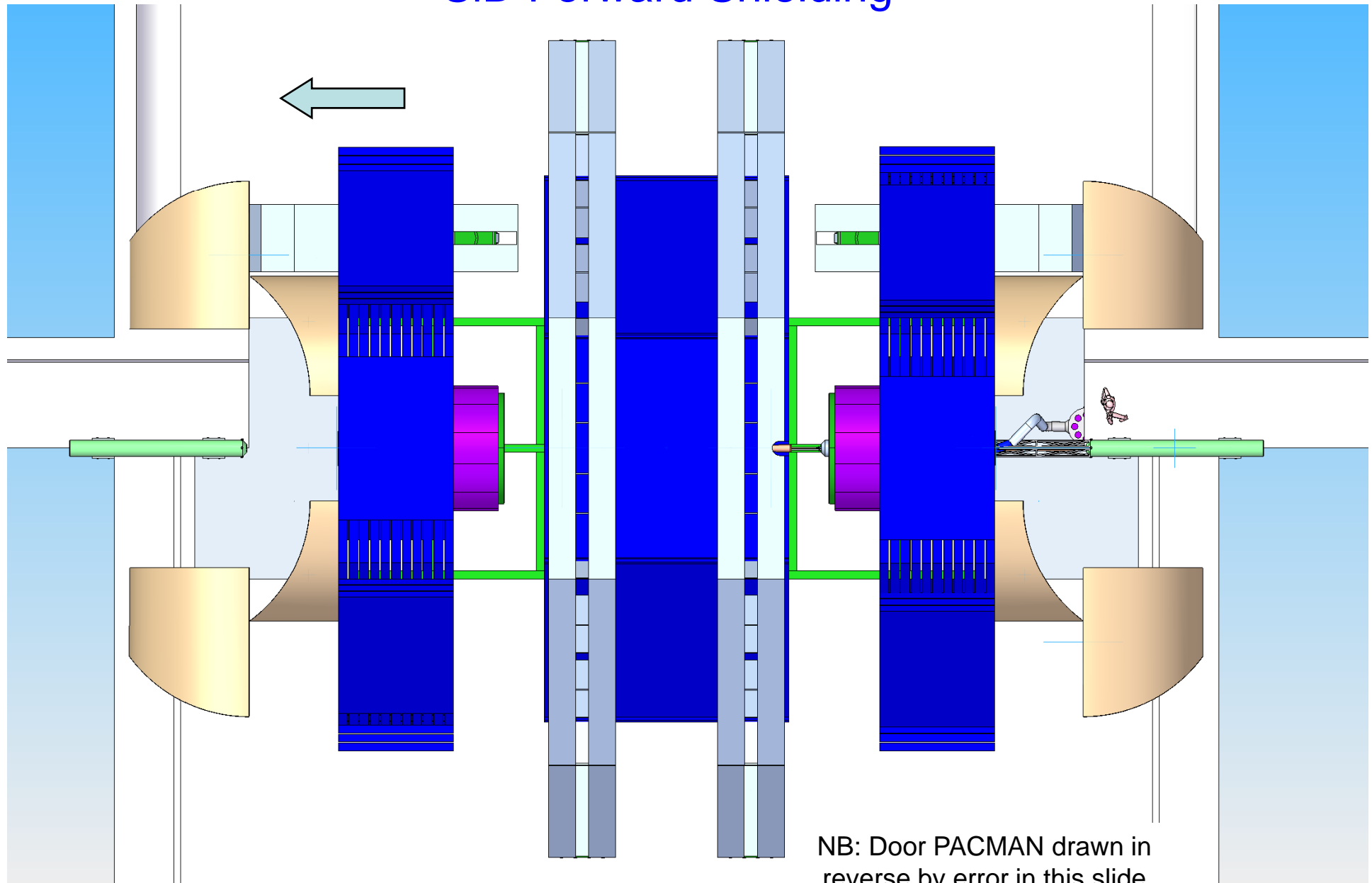


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SiD Forward Shielding



SiD Forward Shielding

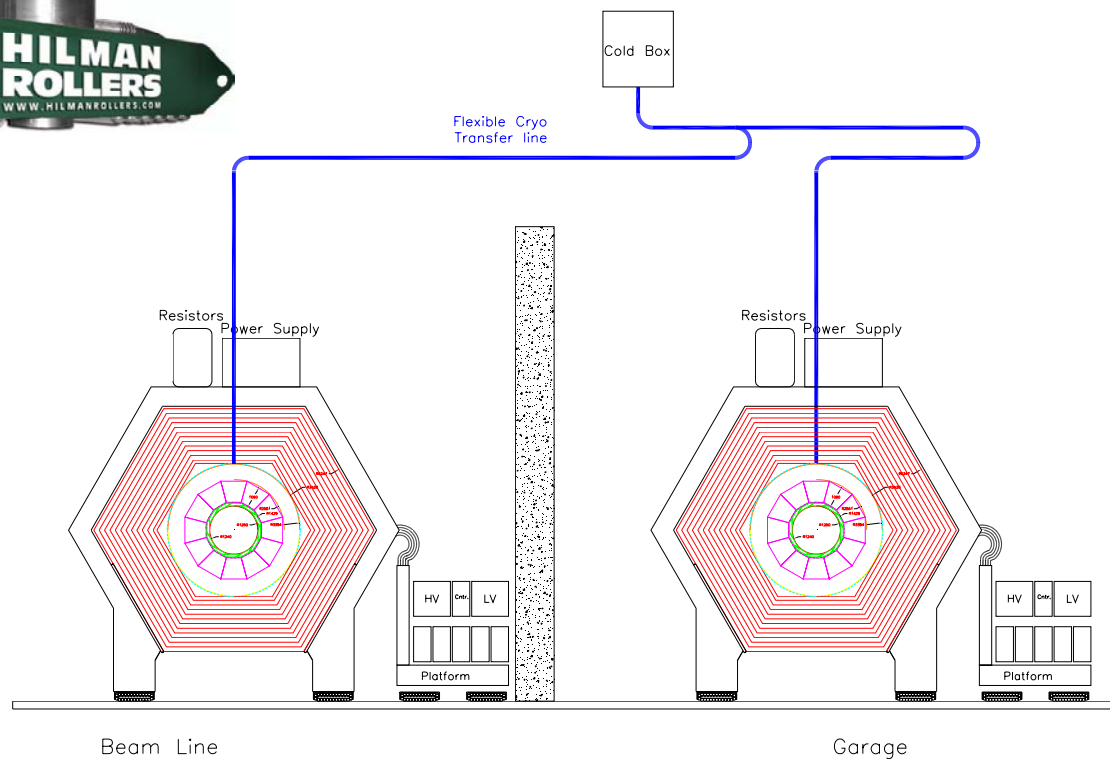
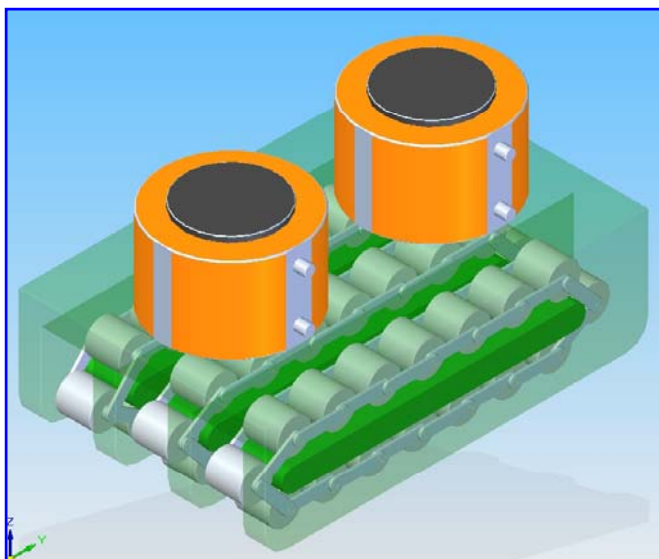


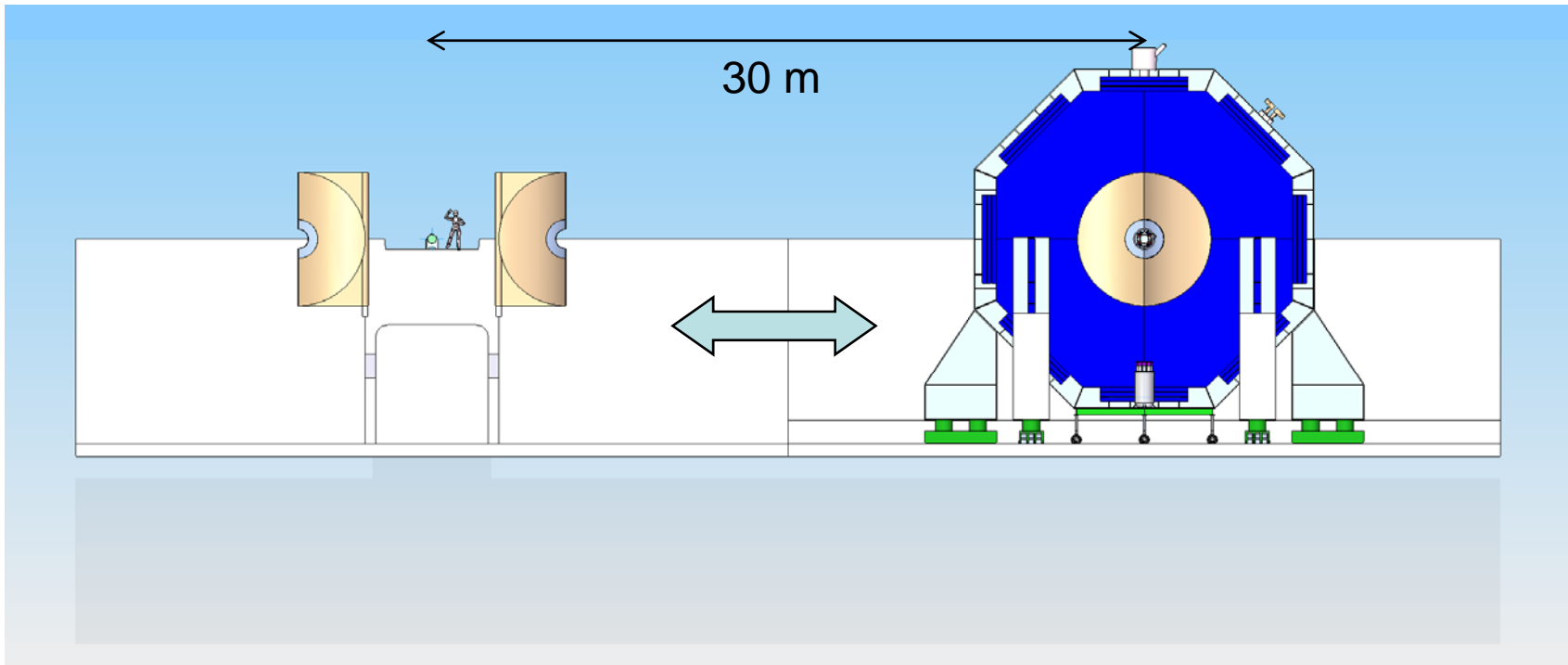
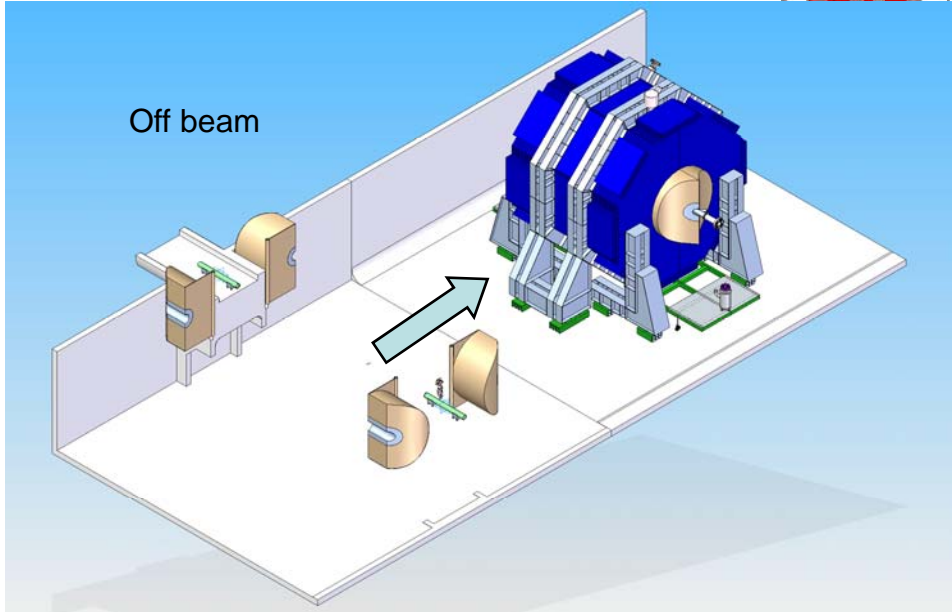
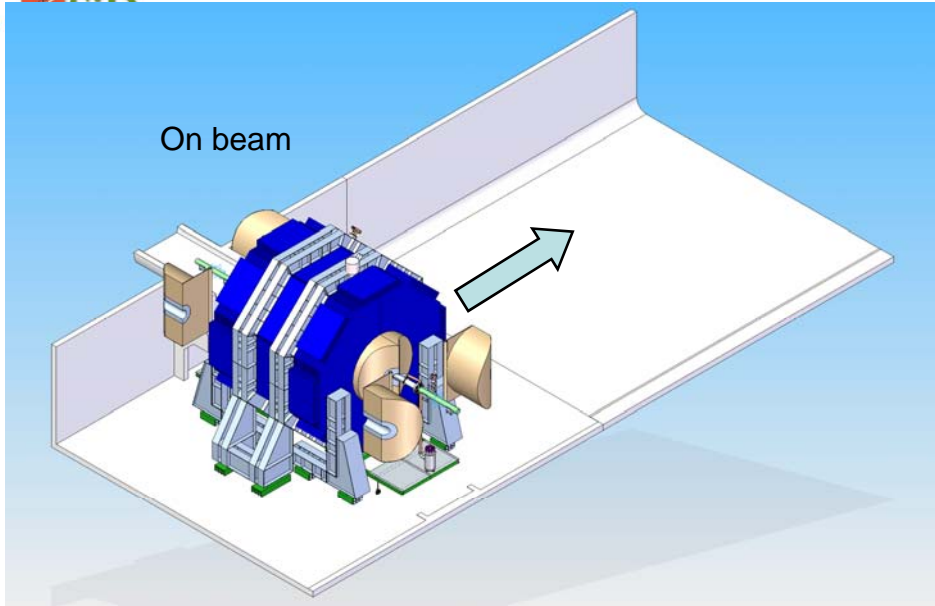
NB: Door PACMAN drawn in reverse by error in this slide

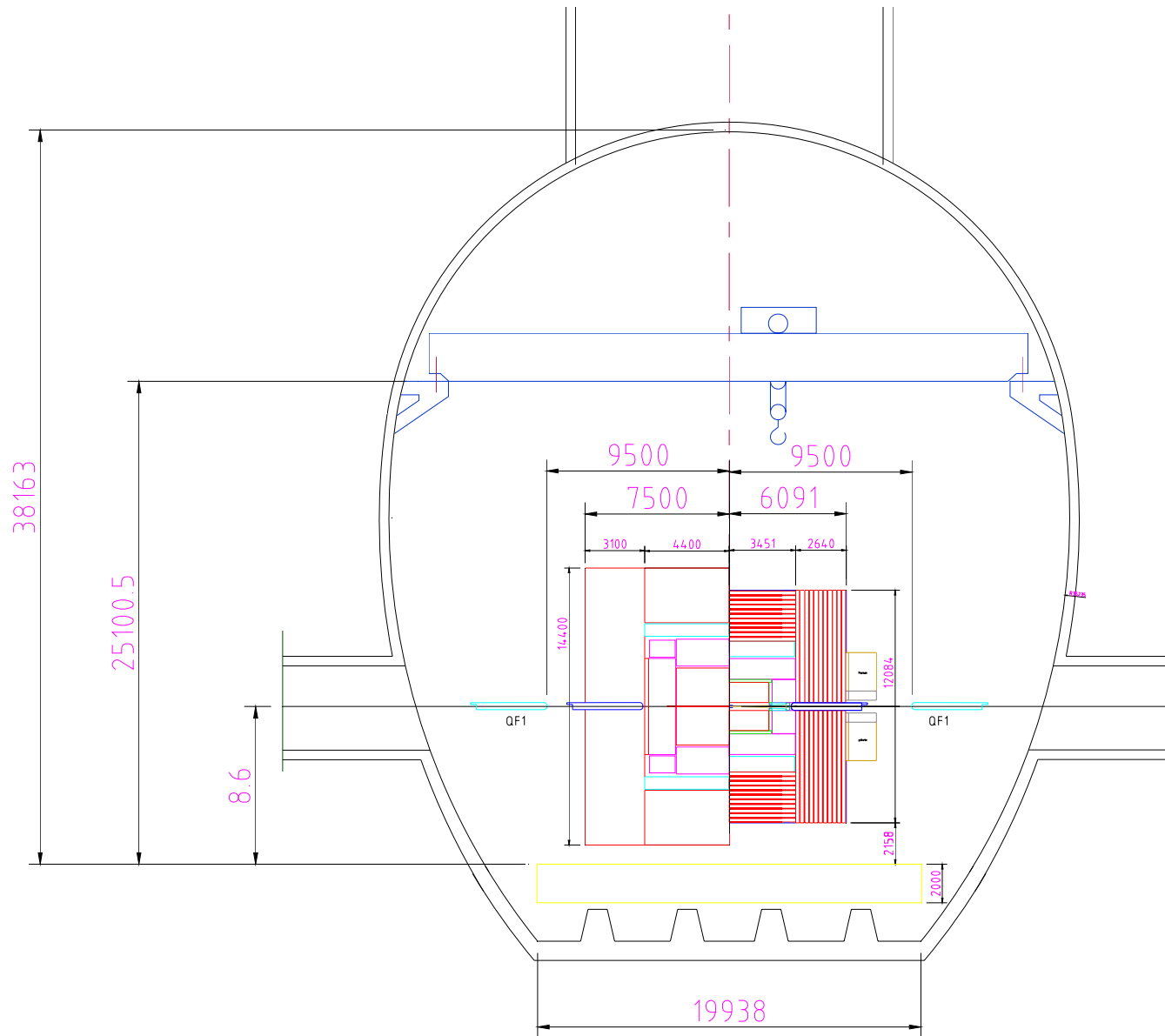
1. Push-Pull and doors opening with Hilman Rollers
2. Racks and ancillaries on SiD or on a side platforms (location driven by the the fringe field)
3. Cold Box off detector (in the hall)
4. Flexible cryogenic transfer line (100mm OD) Solenoid-Cold box
5. He compressors remote

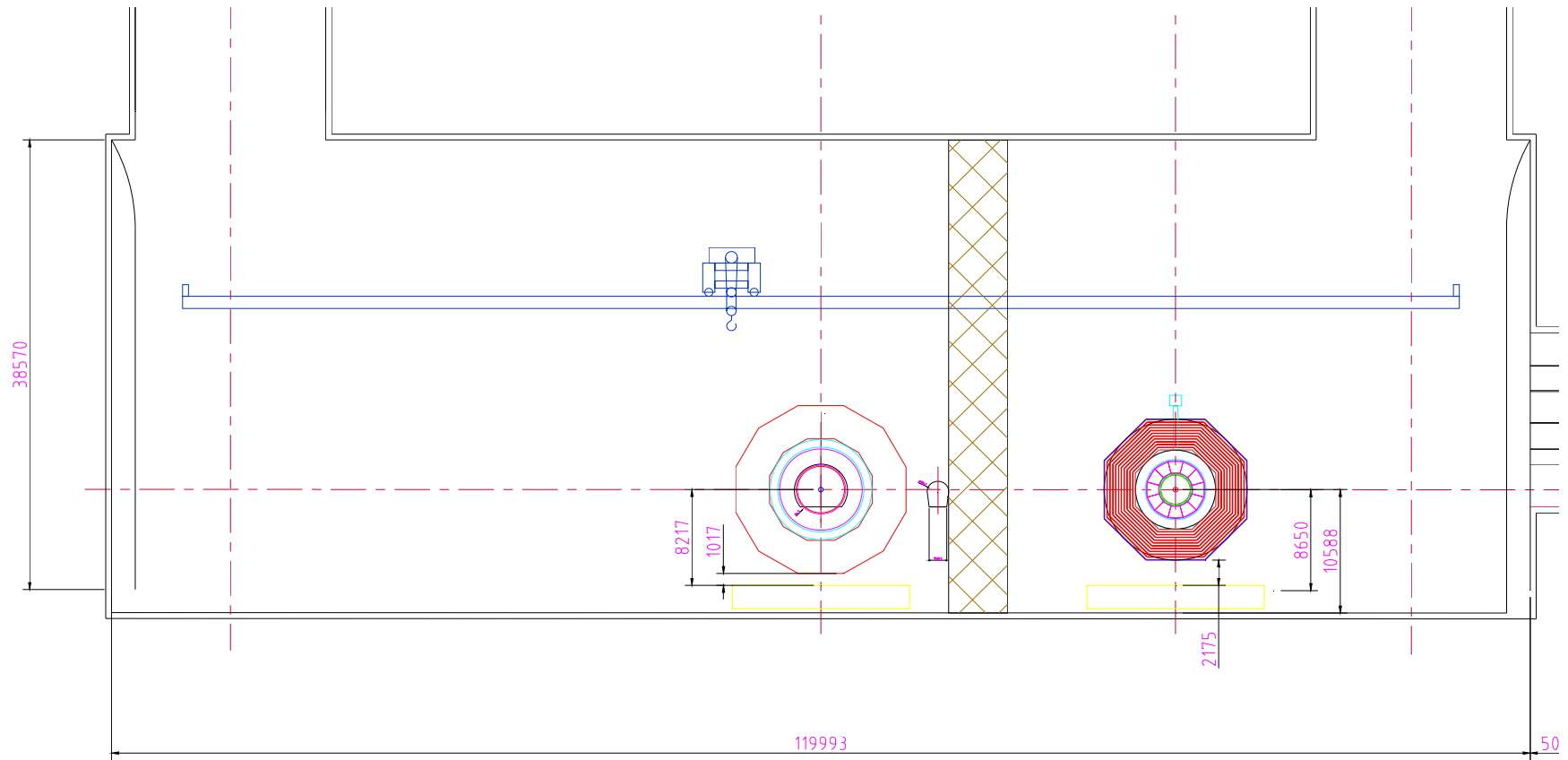


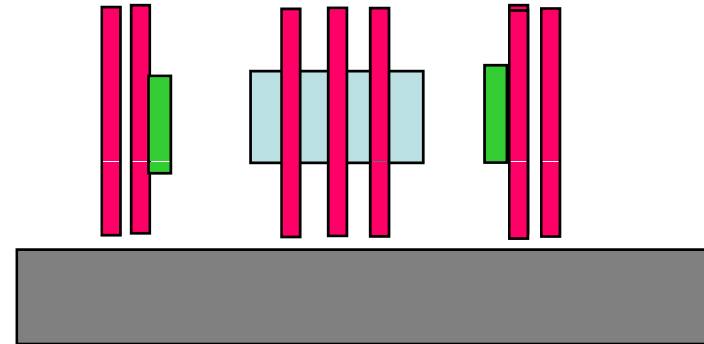
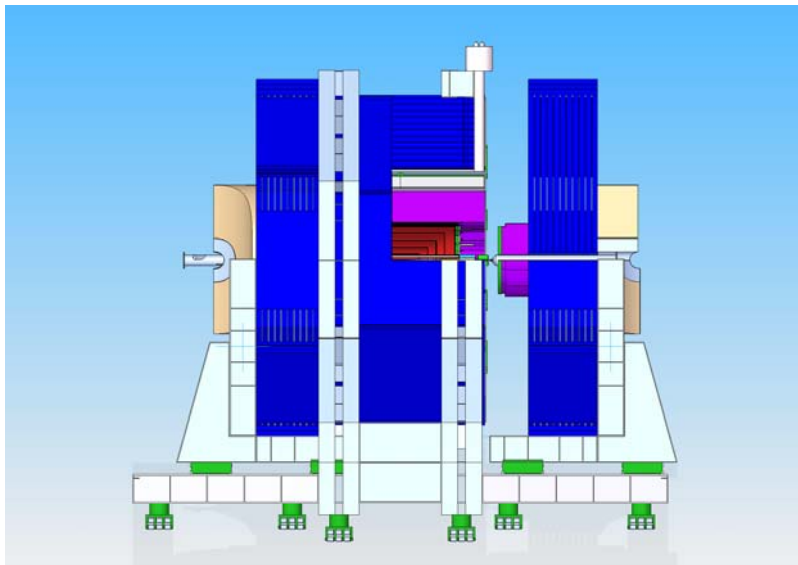
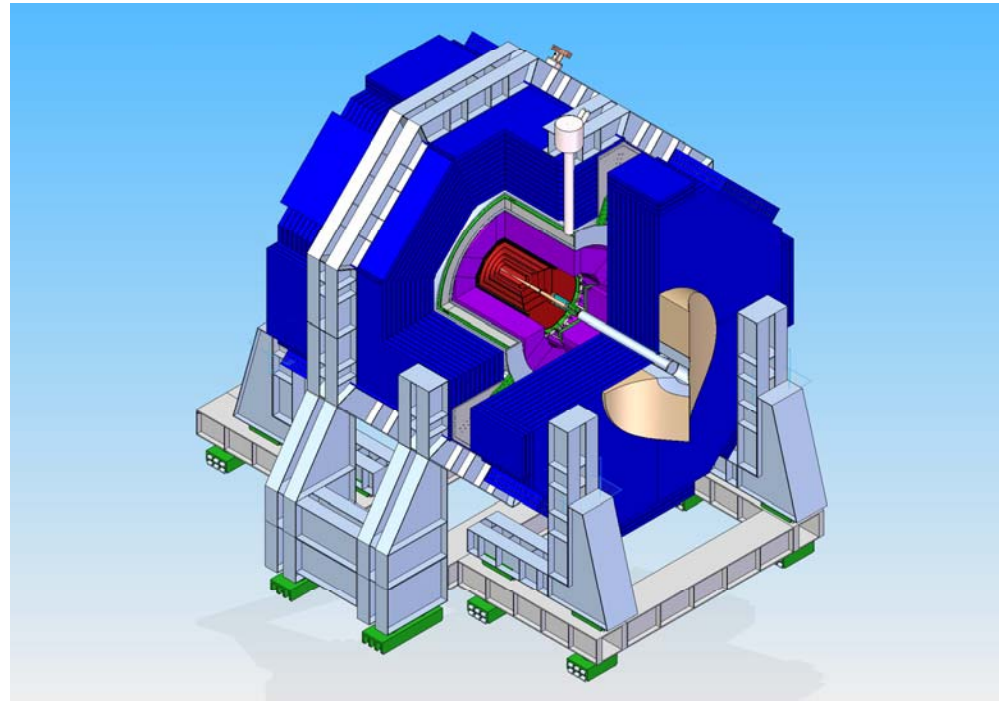
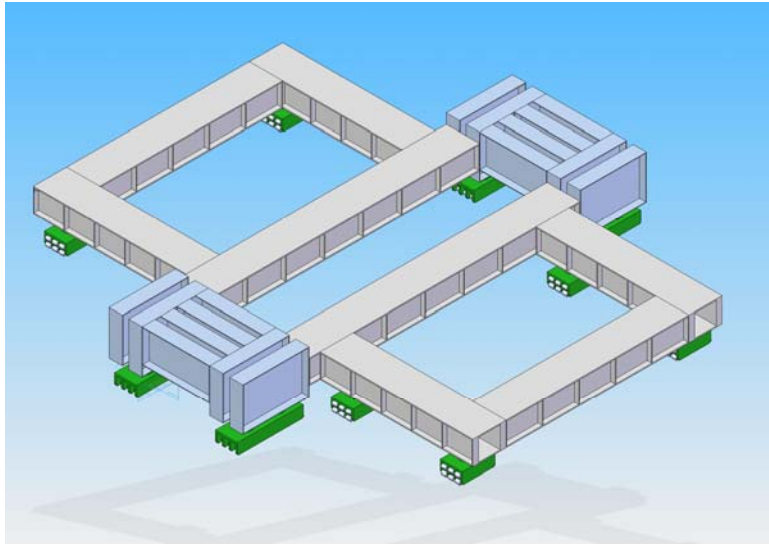
3.5 kton capacity
recently manufactured



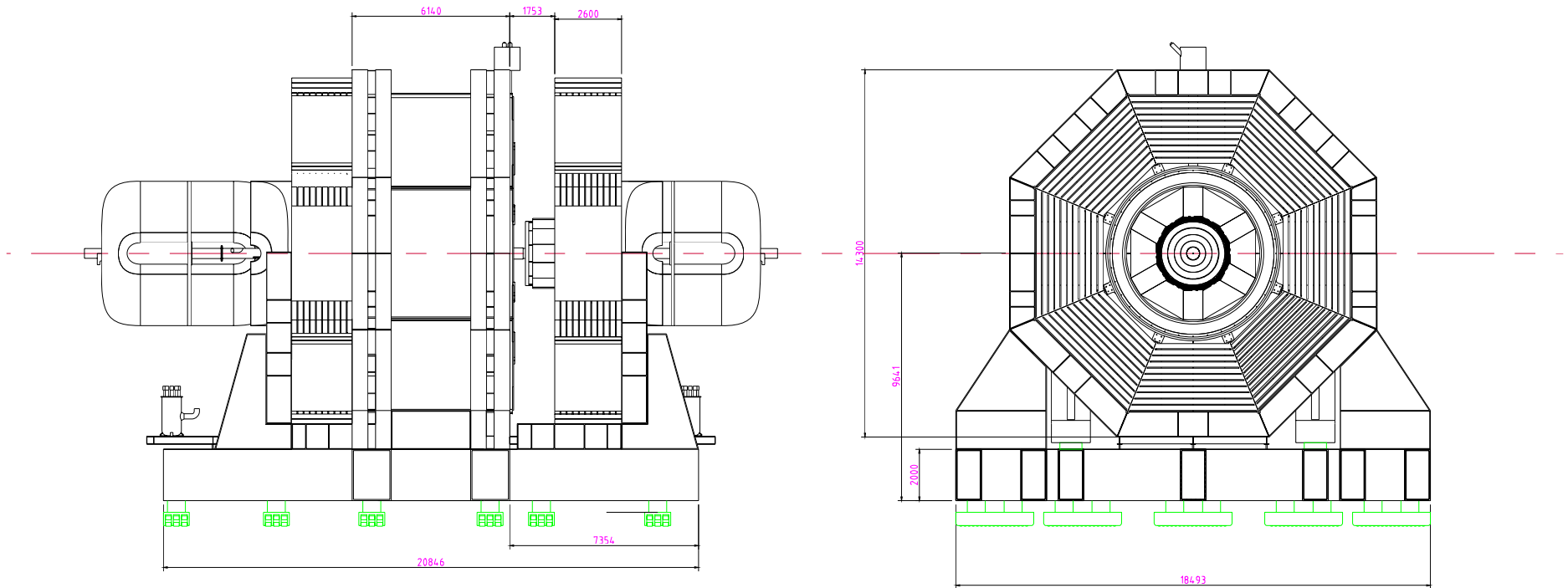


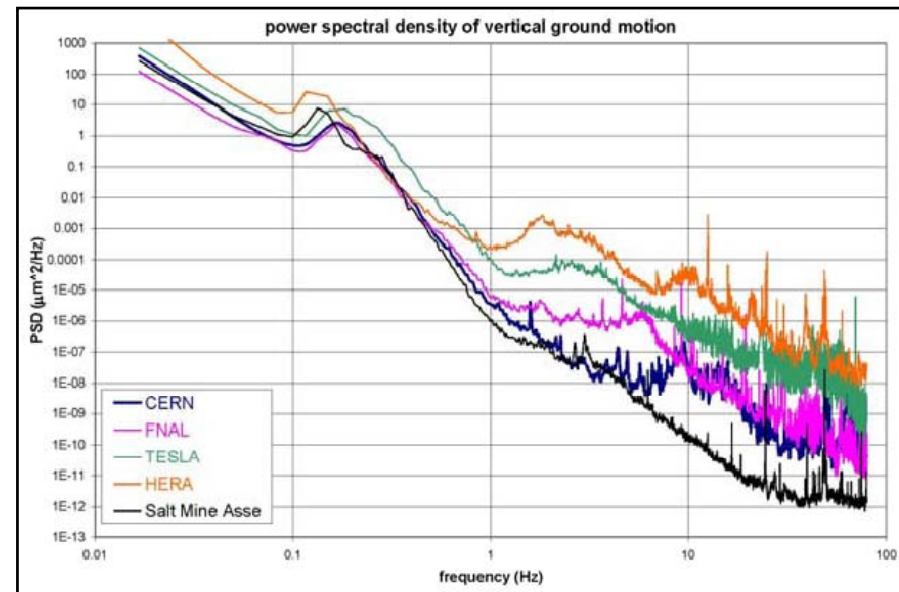
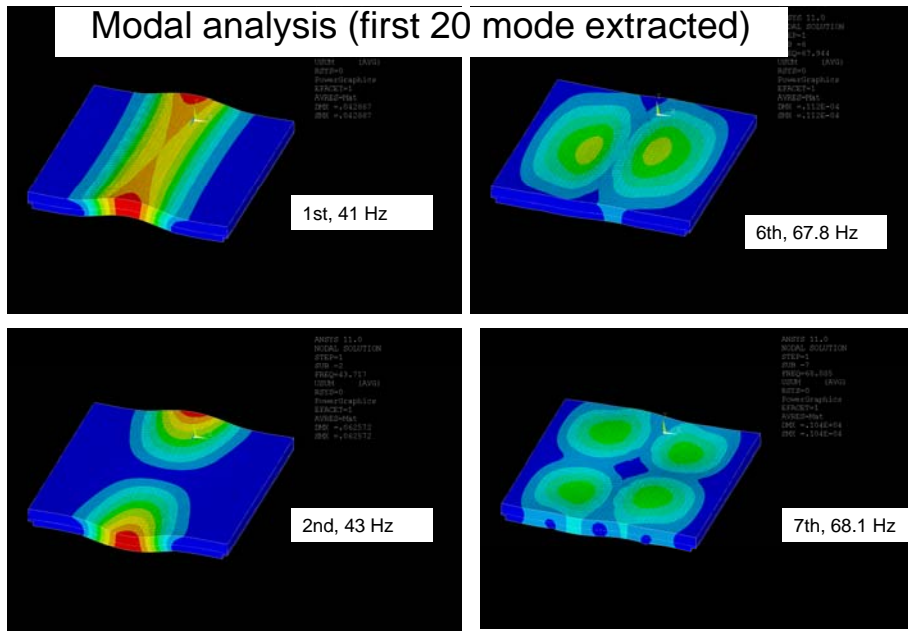
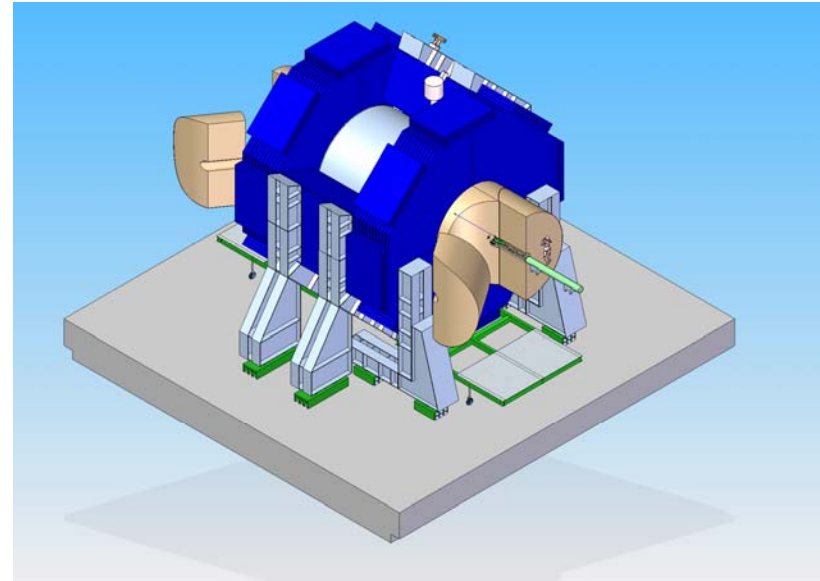
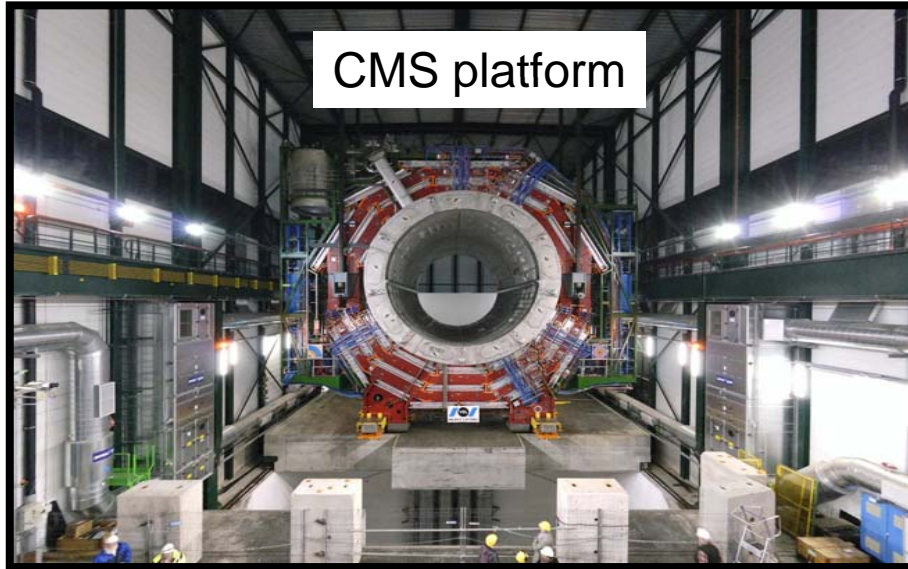






Zee sliced layout (ILD)



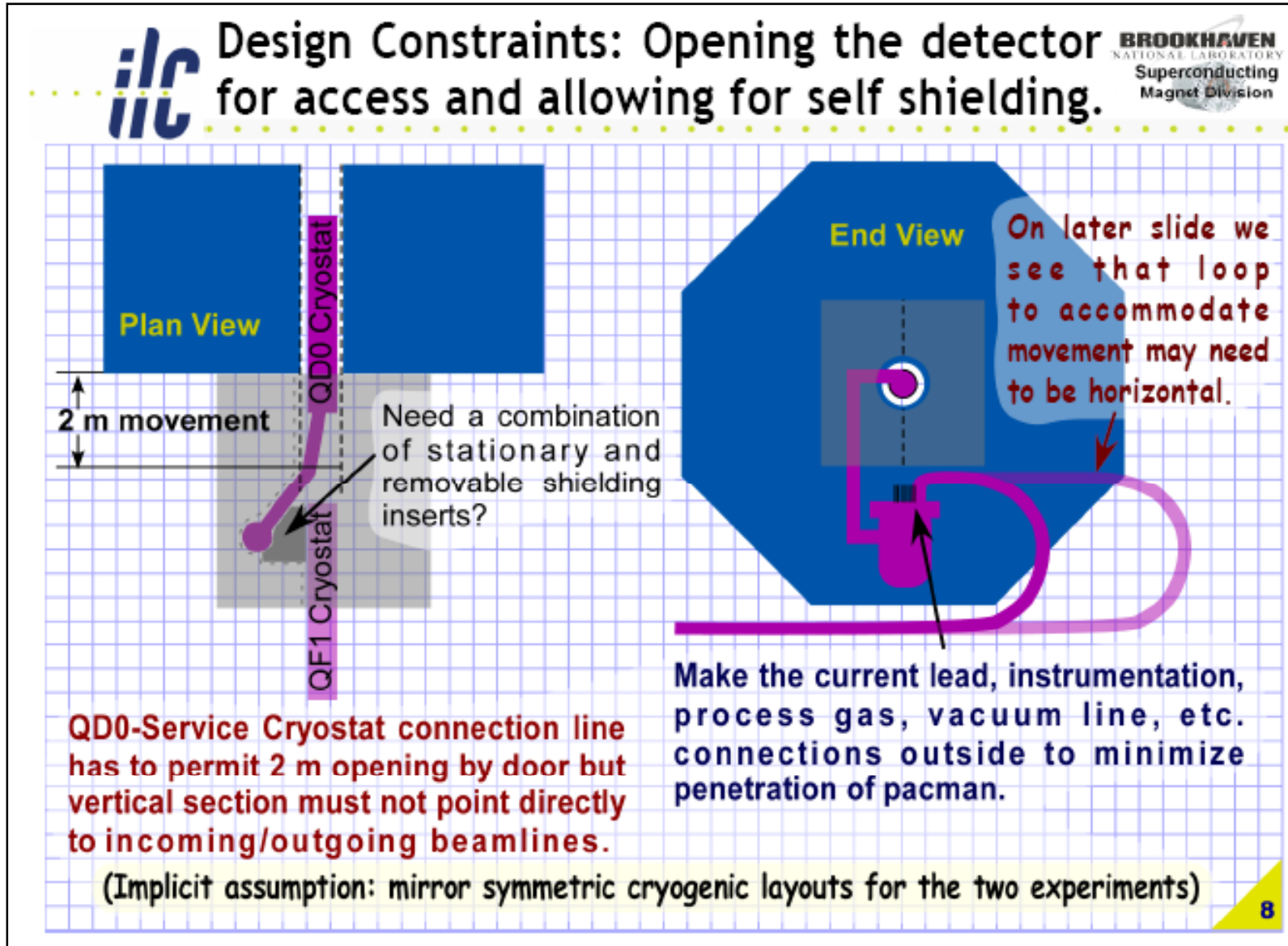


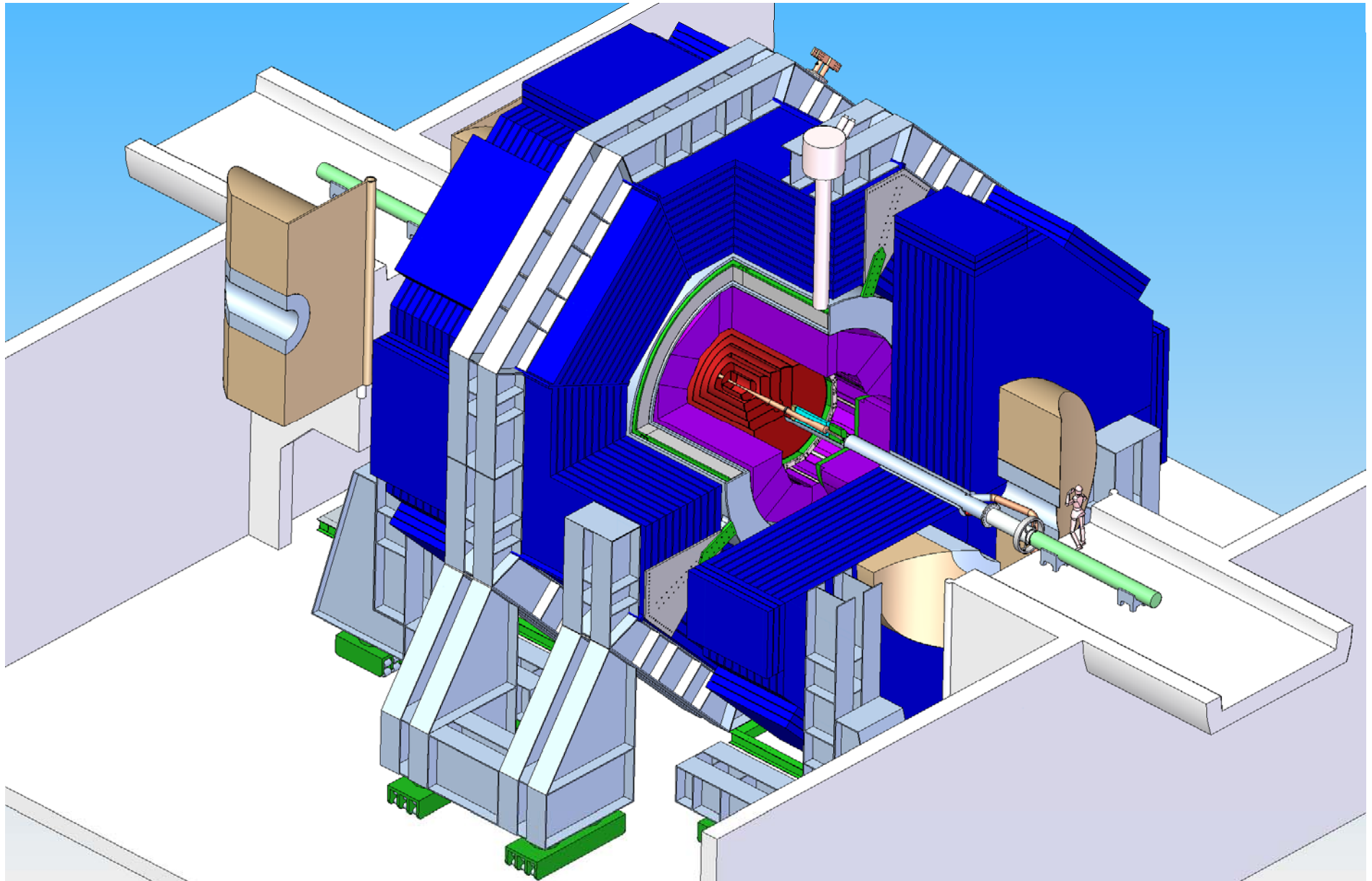
Conclusion

- We provide answers to the engineering issues on the IDAG list
- From Black December on we have worked even harder to delivery a self consistent engineering model.
- In future, the expected progress on the detector modules design would allow terrific improvements of the integration, assembly and maintenance schemes.
- We participate actively to the ongoing design of the MDI issues: functional requirements document in preparation; progress expected for LCWS08 in Chigago



Bonus Material





Time Estimate

