



# **SiD IR & MDI**

## **Engineering Progress**

*Prelude to a Discussion of Integration with ILD*

*and Based on Marco Oriunno's Jan 2008 Talk at SiD CM*

Tom Markiewicz/SLAC

TILC'08 ACFA/GDE, Sendai, Japan

04 March 2008

A horizontal dotted line of yellow dots runs across the bottom of the slide.



## SiD IR & MDI Design Philosophy

SiD has traditionally tried to incorporate self-consistent IR/MDI design based on assumptions that detector would

- **Have solid endcap doors and be self-shielded**

We have assumed push-pull would require

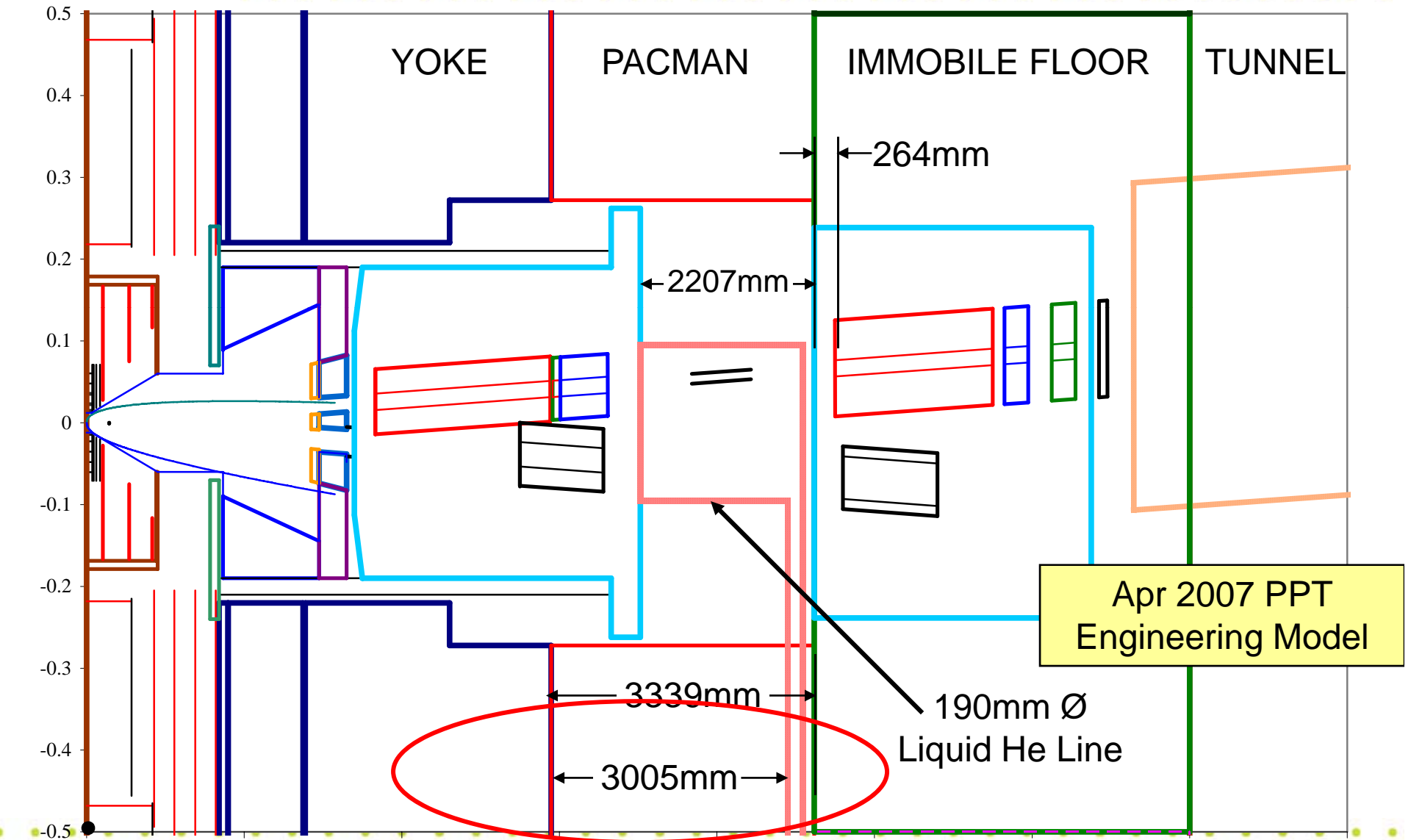
- **No connection of FCAL/Doublet support structure to a fixed point other than the detector**

We have tried to

- **Minimize diameter of the FCAL/Quad package**

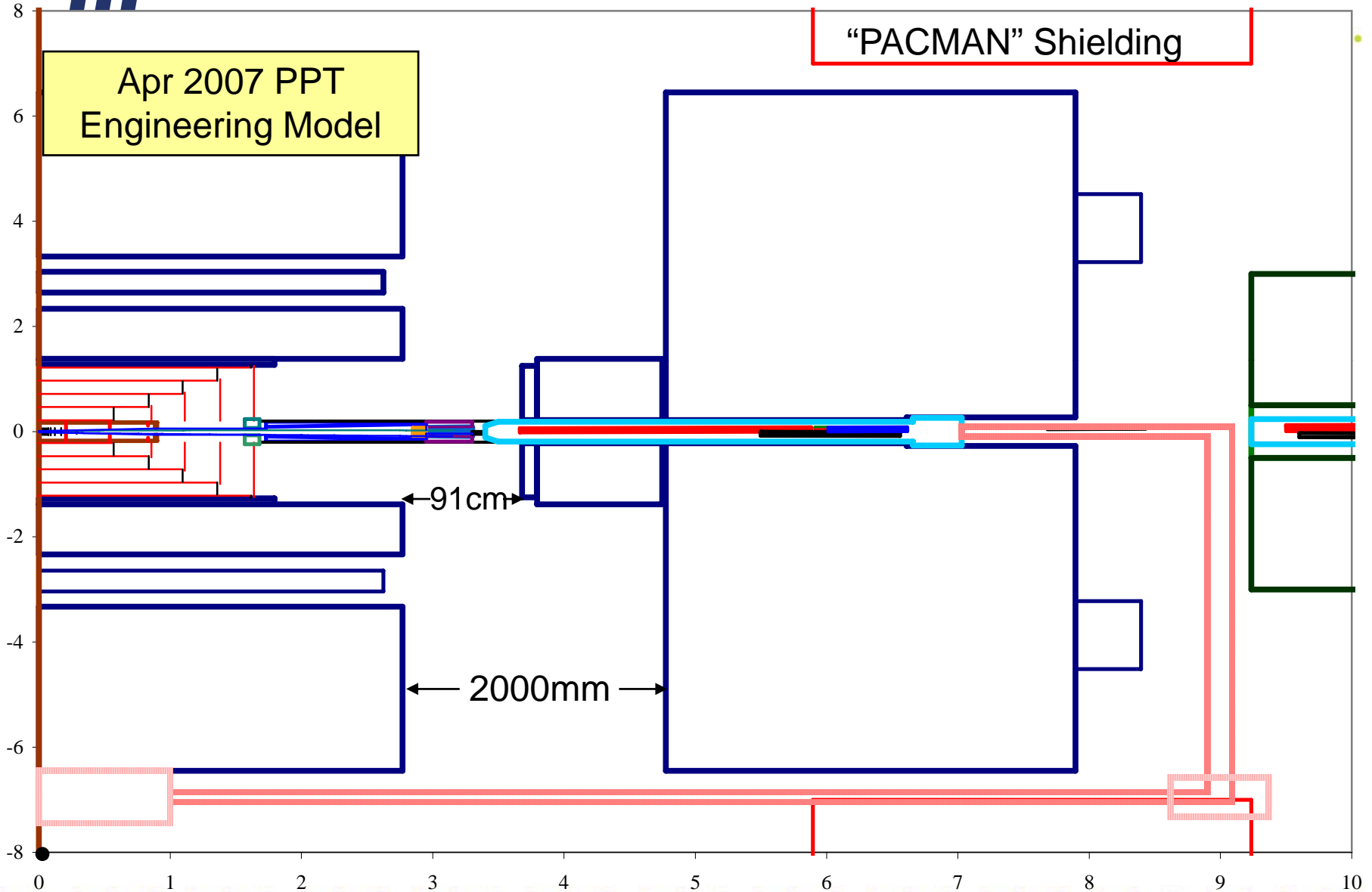


# SiD $r < 50\text{cm}$ , $L^* = 3.664\text{m}$ , $14\text{mrad}$ , Push-Pull, QF @ $9.5\text{m}$ , Door Closed



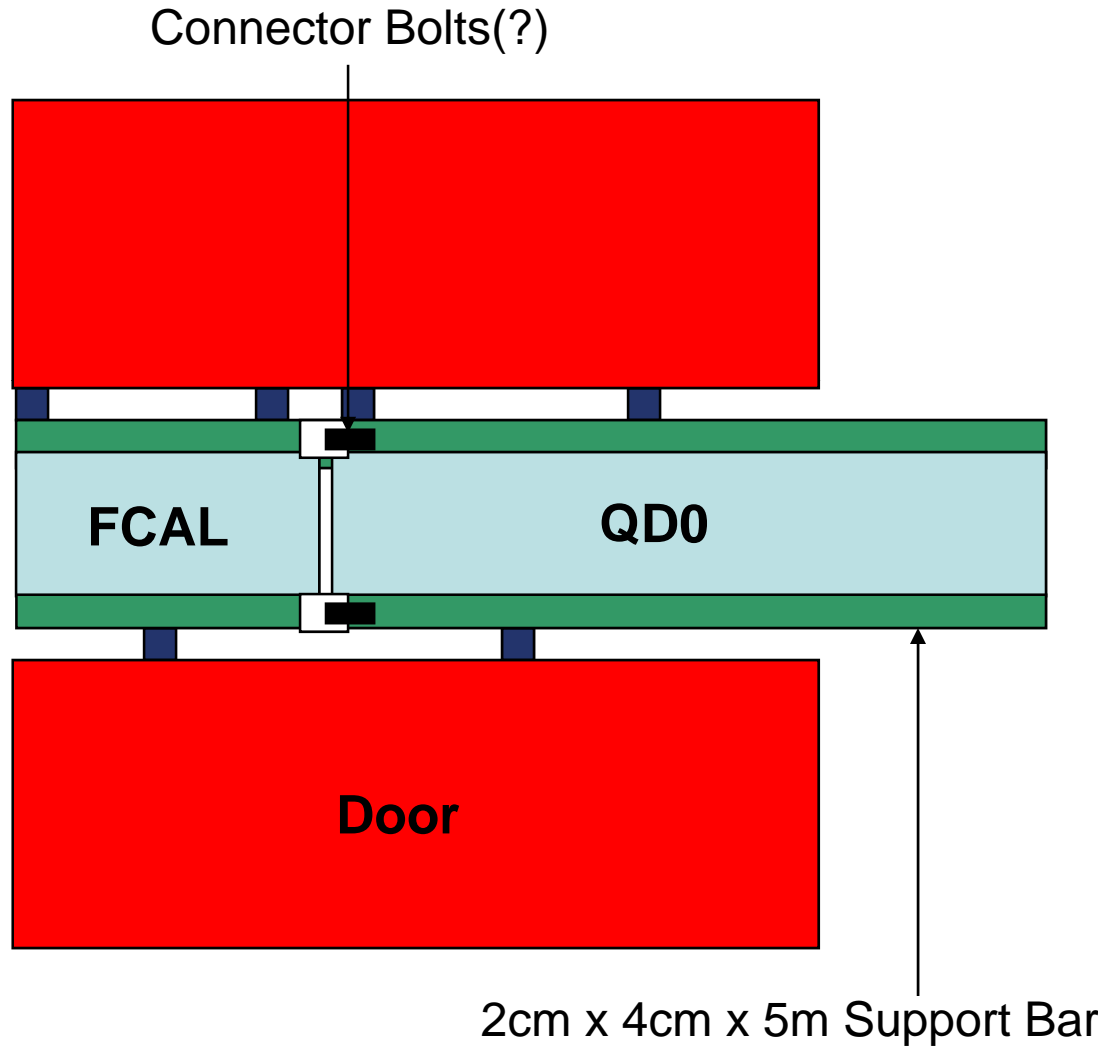


# Door Open, Permanent QD0 Liquid He Line

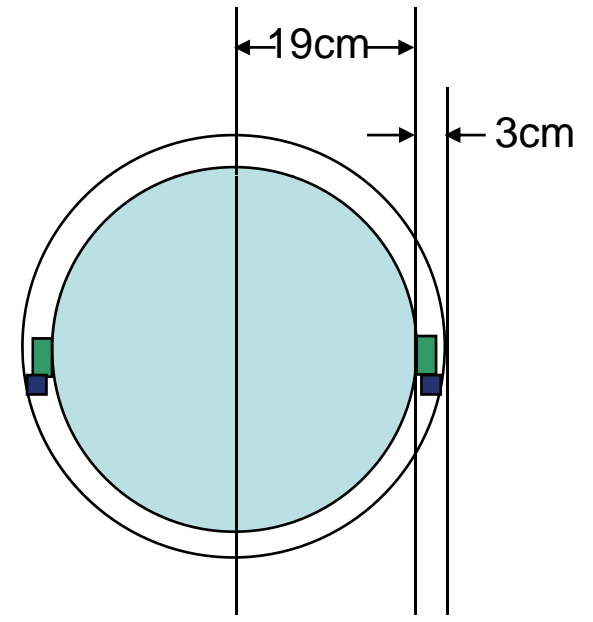




# FCAL/QD0 Supported with Door Closed



44cm Diameter Hole in Door



Apr 2007 PPT Engineering Model



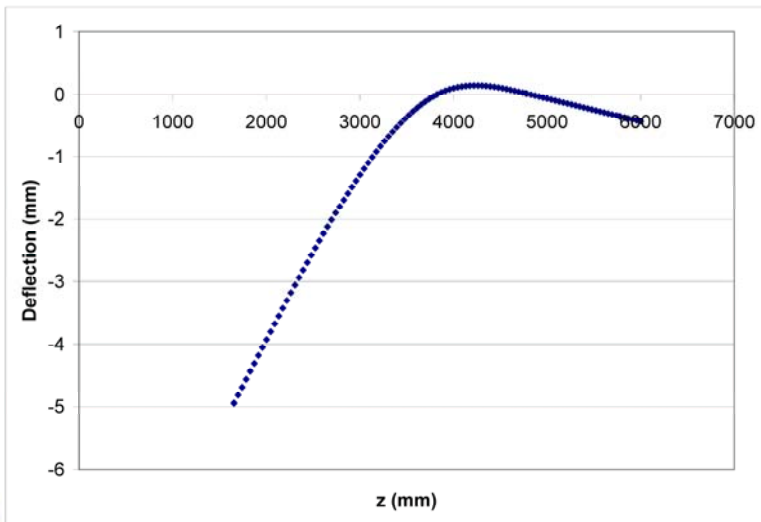
# Deflections of 2cm x 2cm Support Bars when Door Opens 2m

- Support points with rollers were assumed at front and rear of HCAL ( $Z = 3820, 4770$  mm).
- Forward calorimeters supported at their ends as dead weights
- QD0 weight ignored

4 - 20 mm x 20 mm bars

Deflection at front of Lumi-CAL = 4.9 mm

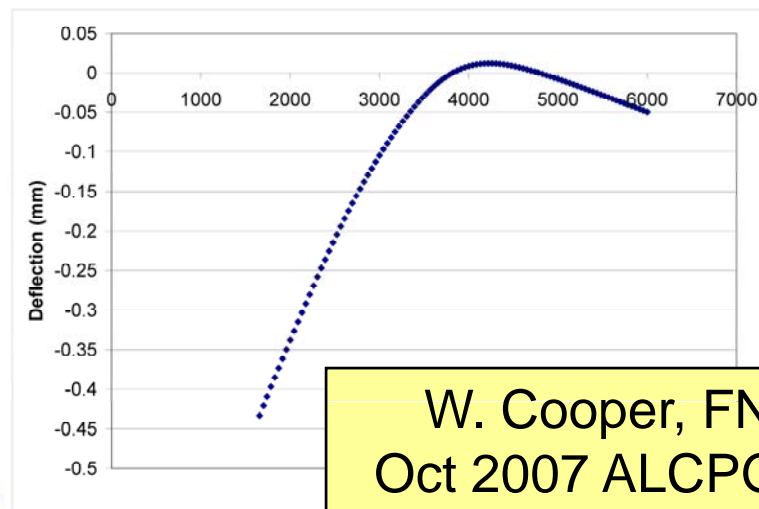
Stress in bars = 12.7 ksi



Stepped cylinders (3, 10, 20 mm walls)

Deflection at front of Lumi-CAL = 0.43 mm

Stress in cylinders = 1.0 ksi

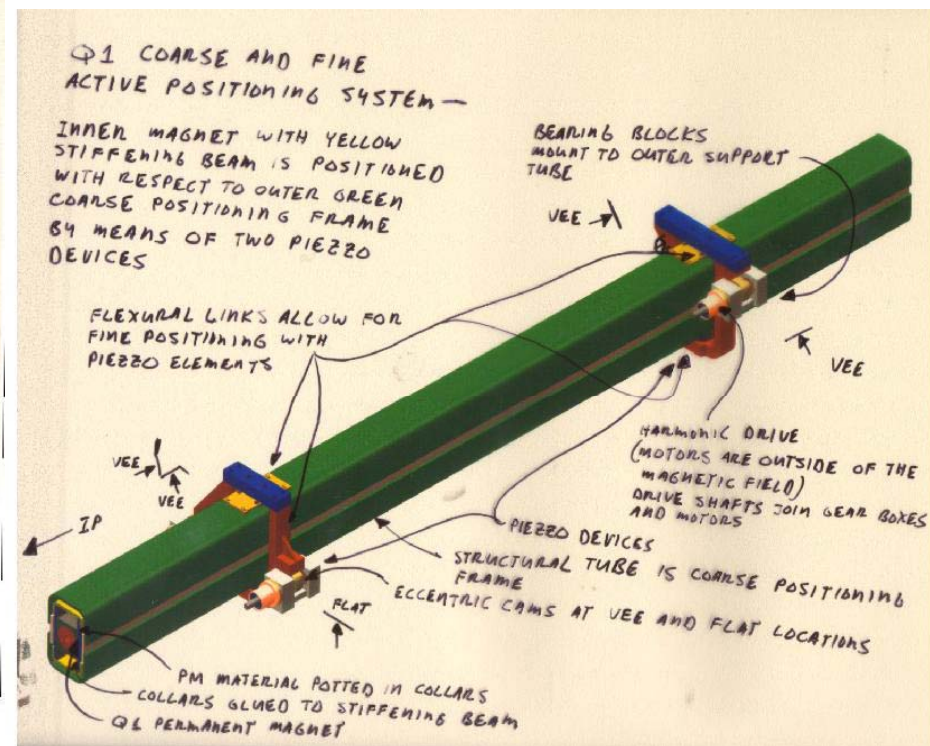
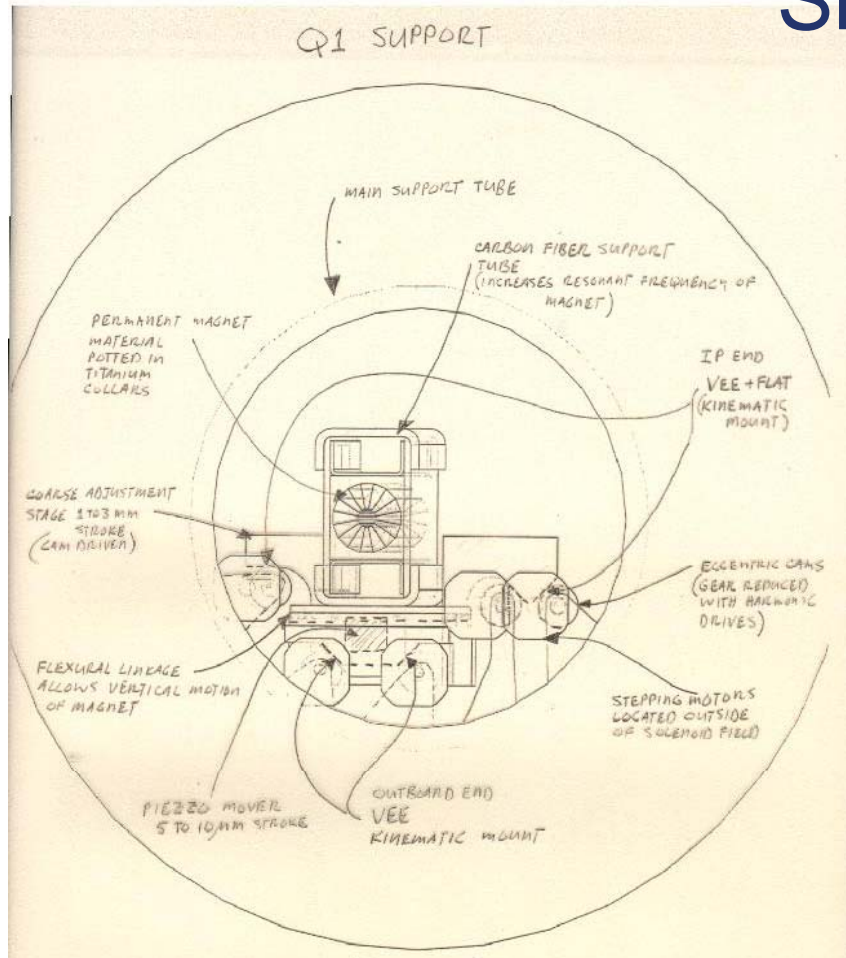


W. Cooper, FNAL  
Oct 2007 ALCPG Mtg



# QD0 Package Adjustment Mechanism Likely to Require Significant Radial Space

Knut Skarpaas 2000 Design of Integrated Coarse/Fine Cam/Piezo Mover System for a stiffened PM QD0

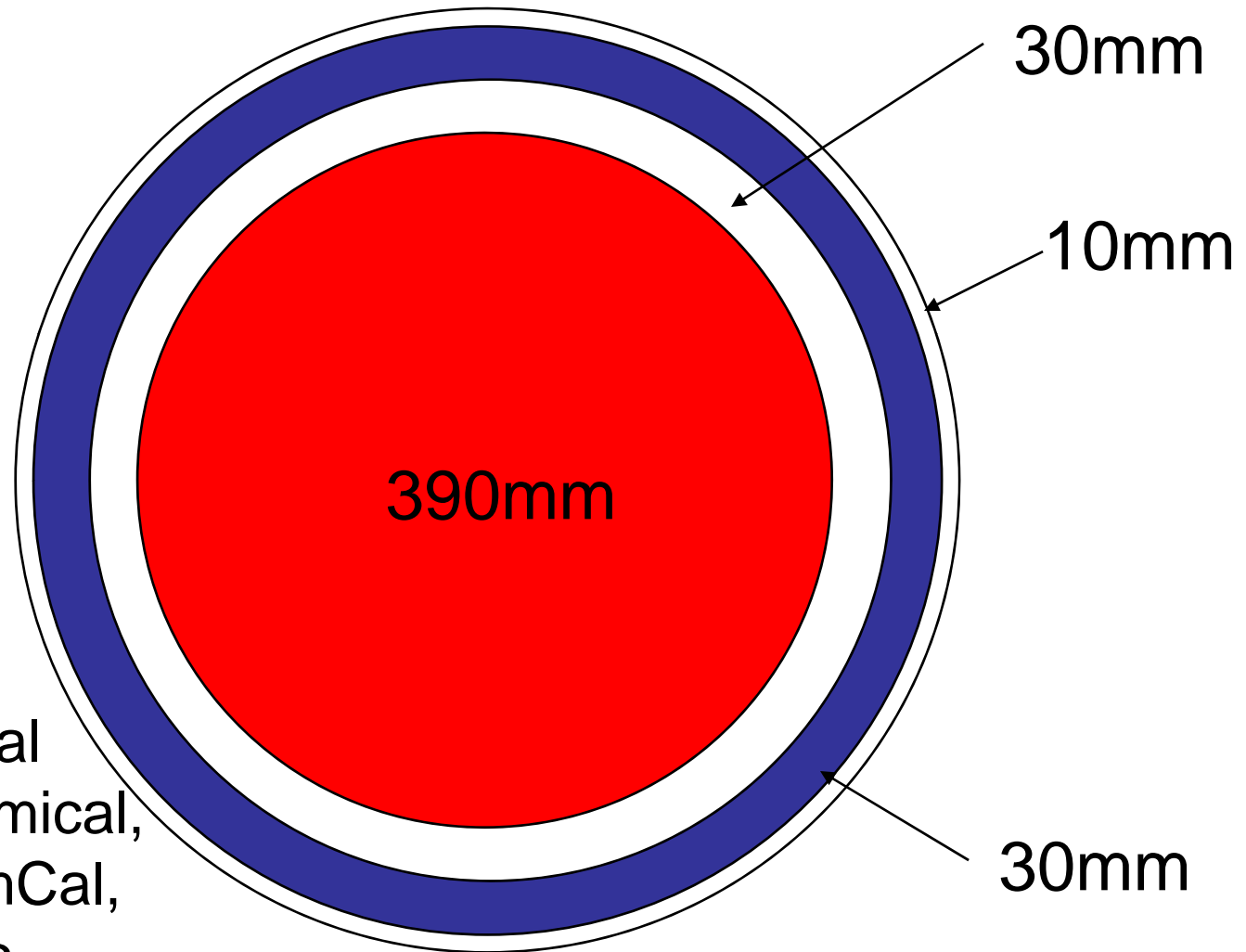


Not included in an IR Engineering Model since 2000



390mm QD0 + 2 x 30mm Support Tube Wall  
+ 2 x 30mm space for adjustment mechanism  
+ 2 x 10mm clearance = 530mm hole in door

TWM Proposal to  
SiD Oct 2007  
ALCPG to  
enlarge  
FCAL/QD0 radial  
space

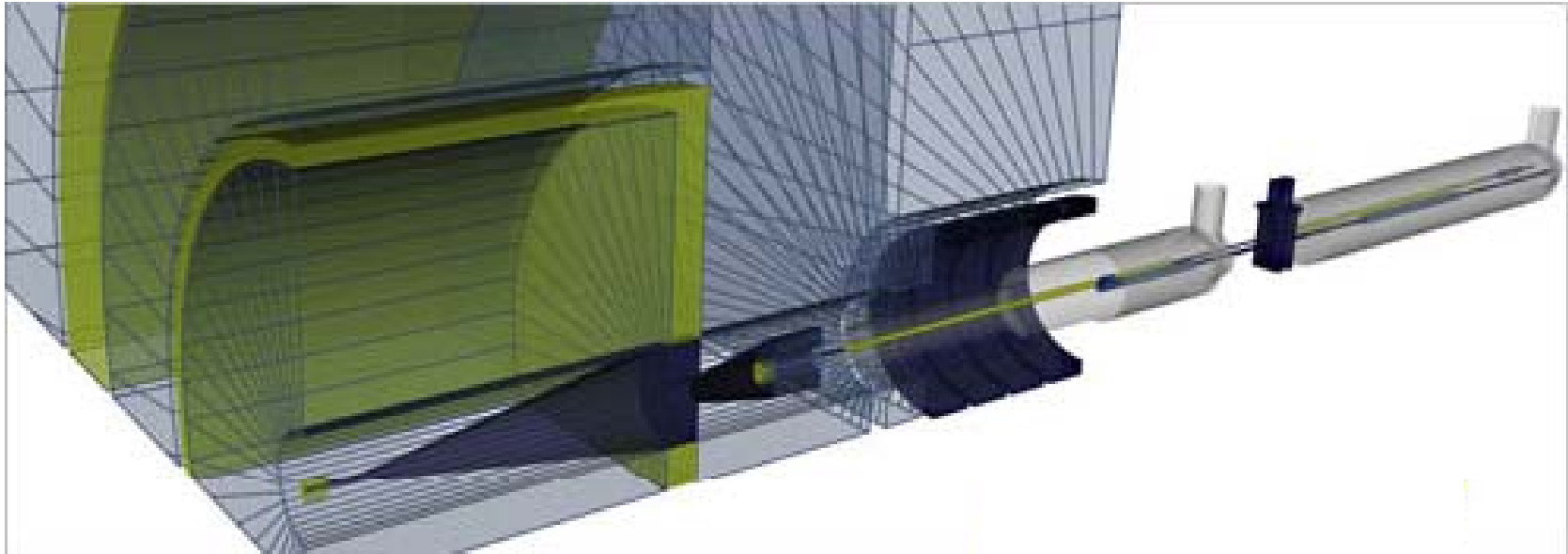


530mm total  
diameter of Lumical,  
FHCAL, BeamCal,  
Masks, etc.



# SiD Collaboration Meeting

January 28-30, 2008  
Stanford Linear Accelerator Center



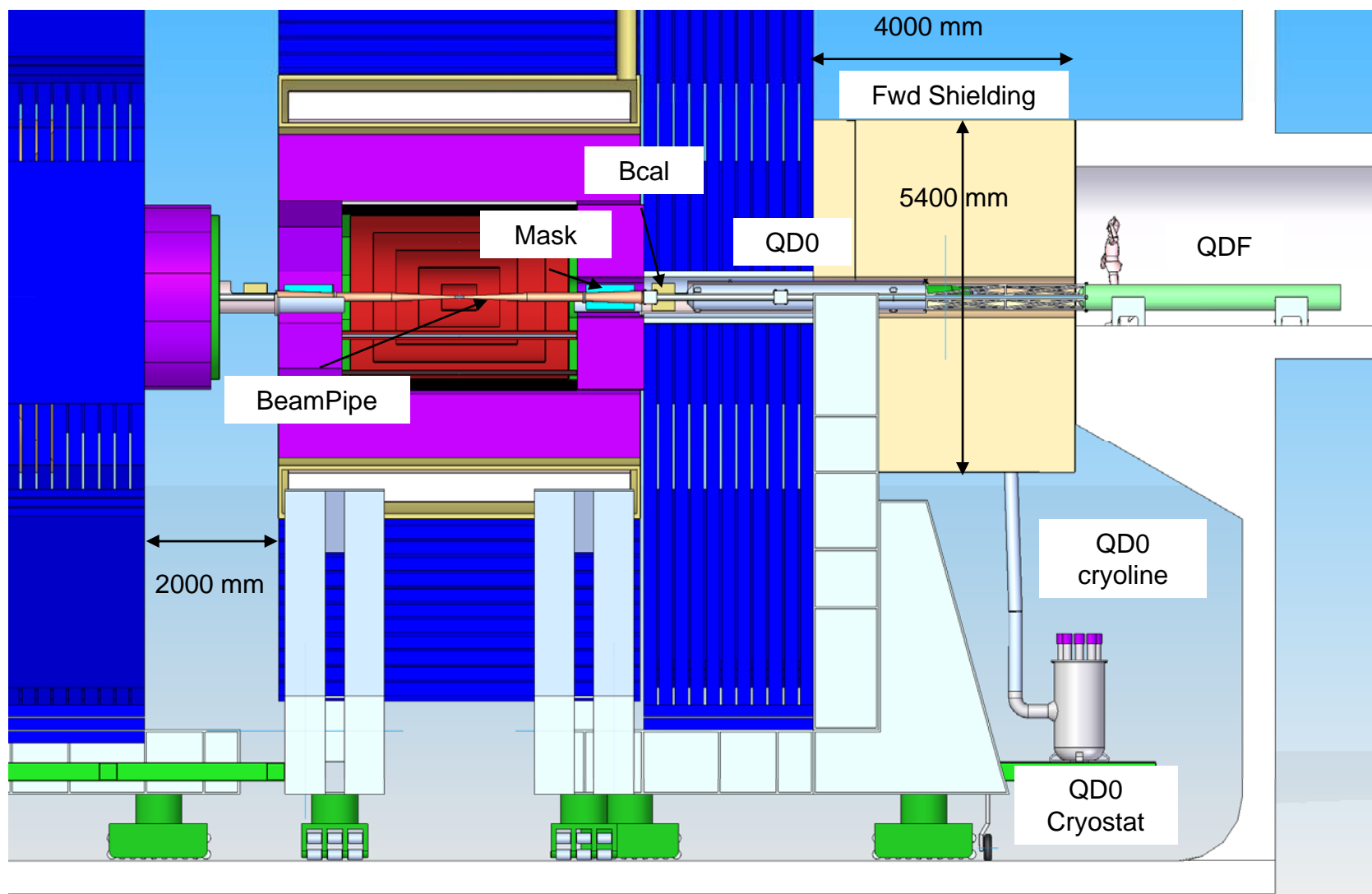
## Forward Region Engineering

Marco Oriunno, SLAC

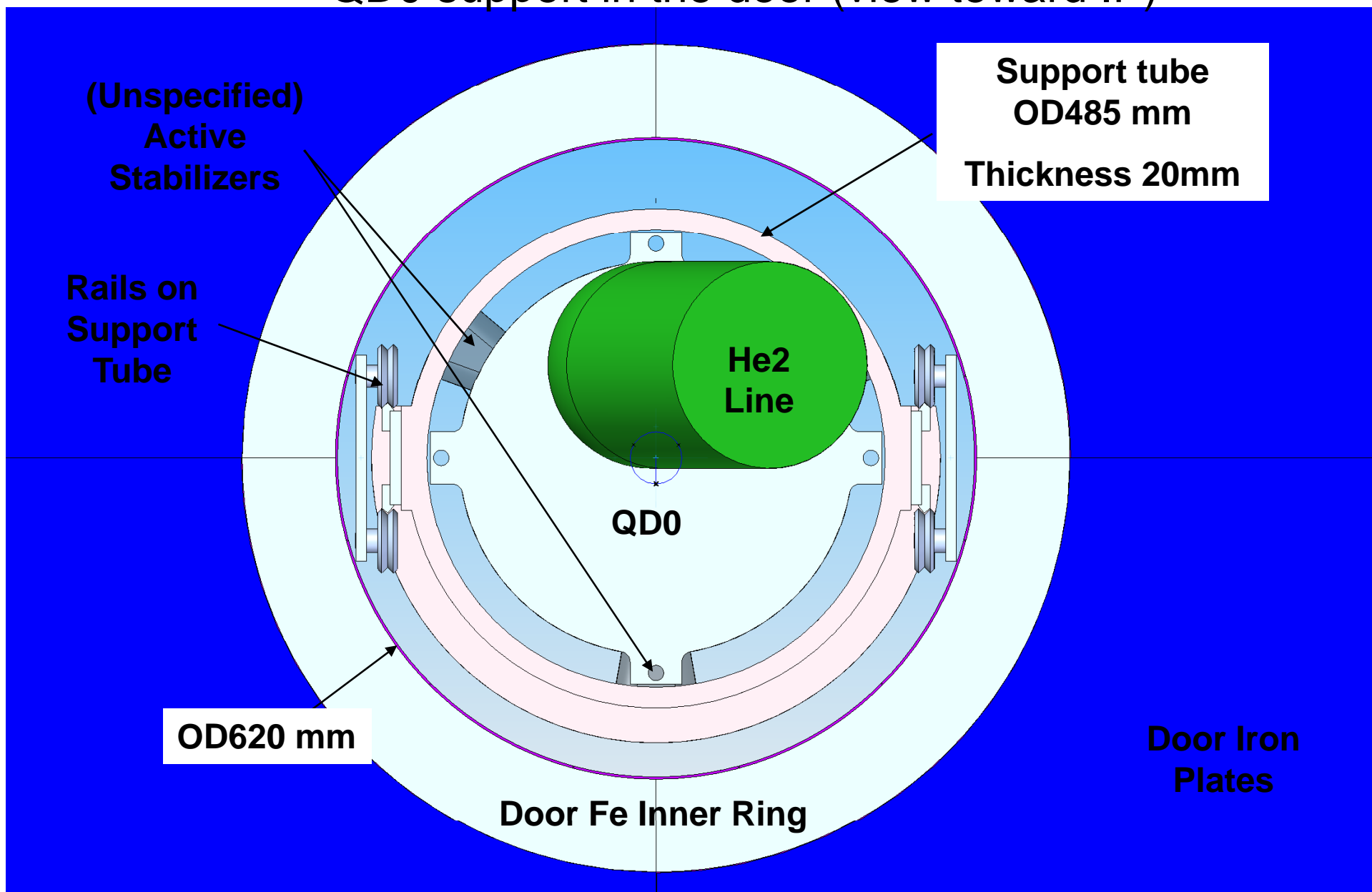


# Machine-Detector Interfaces

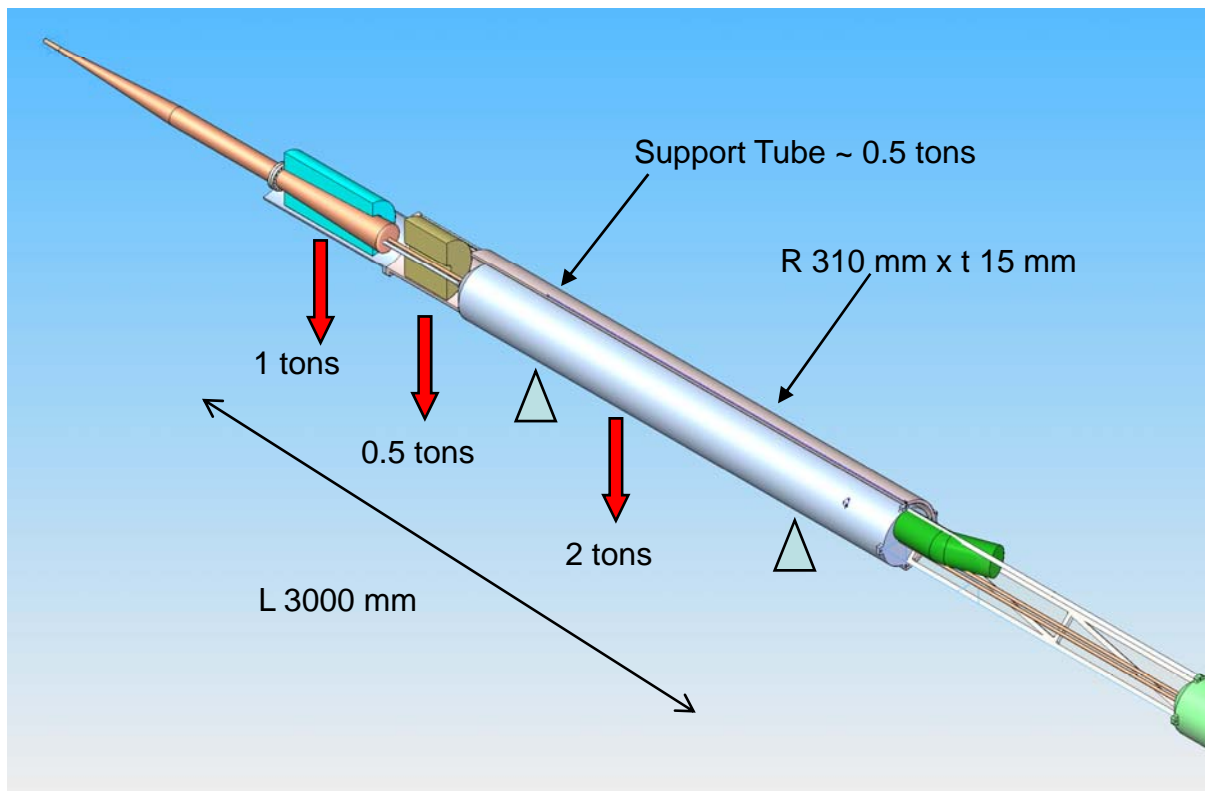
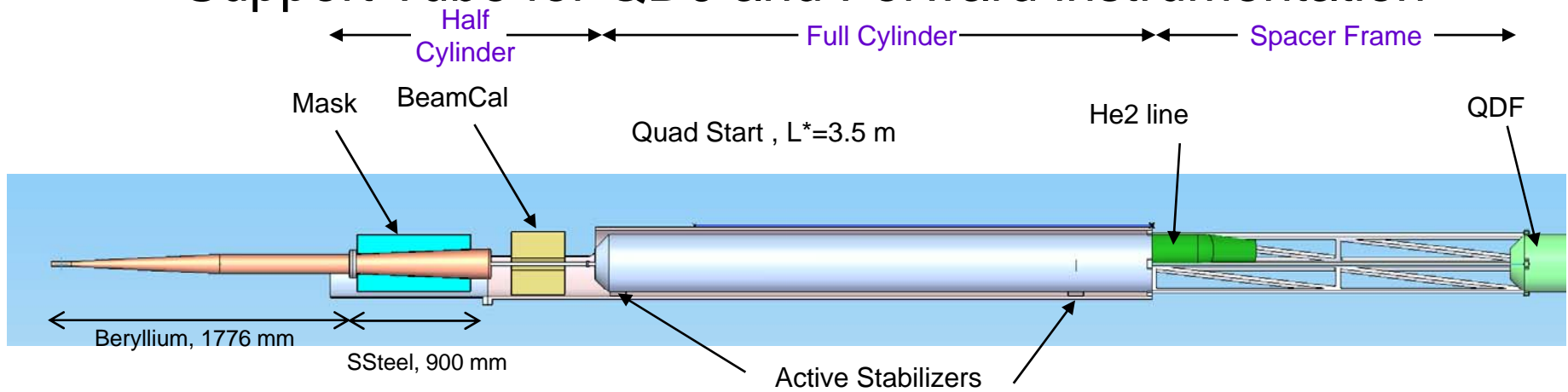
The first step is to translate the parameters in an engineering model, formulating technical solutions, clearances and components integration



# QD0 support in the door (view toward IP)



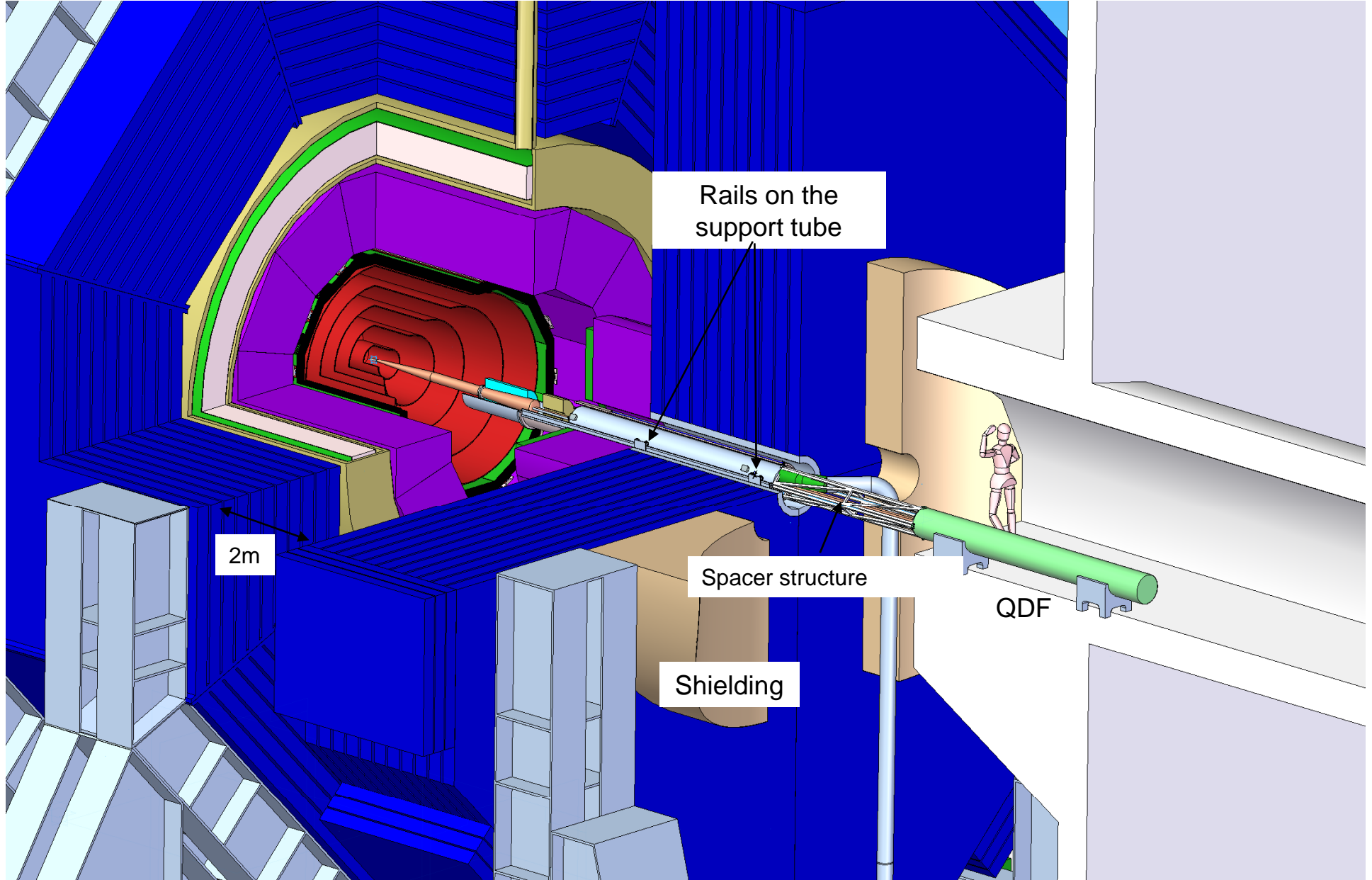
# Support Tube for QD0 and Forward instrumentation



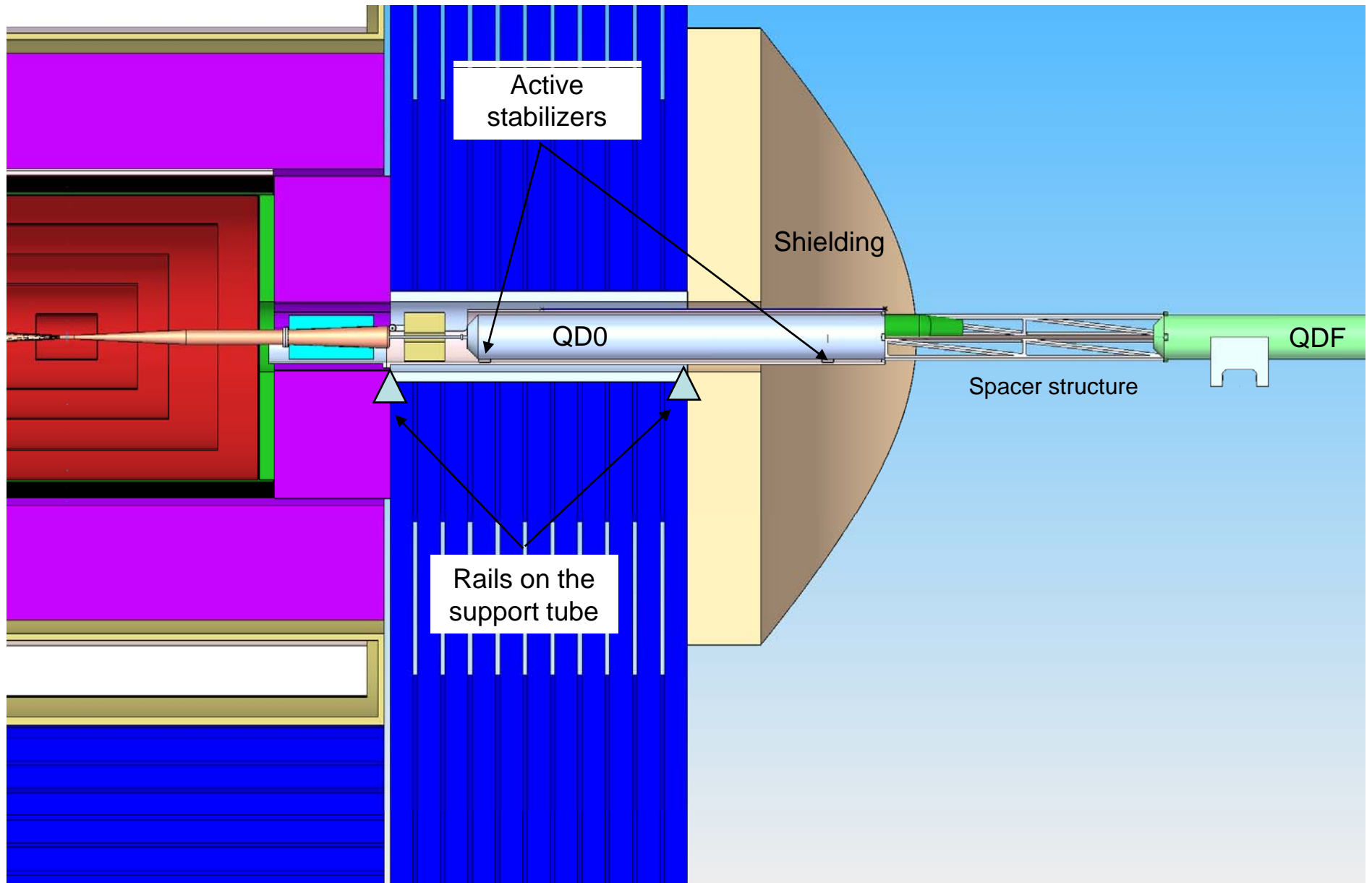
- The support tube provides an interface to the door to support QD0, the vacuum chamber, the beam instrumentation and the forward detectors

- An alternative option has sliding rails directly on the QD0 cryostat and the vacuum and detector instrumentation cantilevered from the front of QD0 with actuators directly on the door.

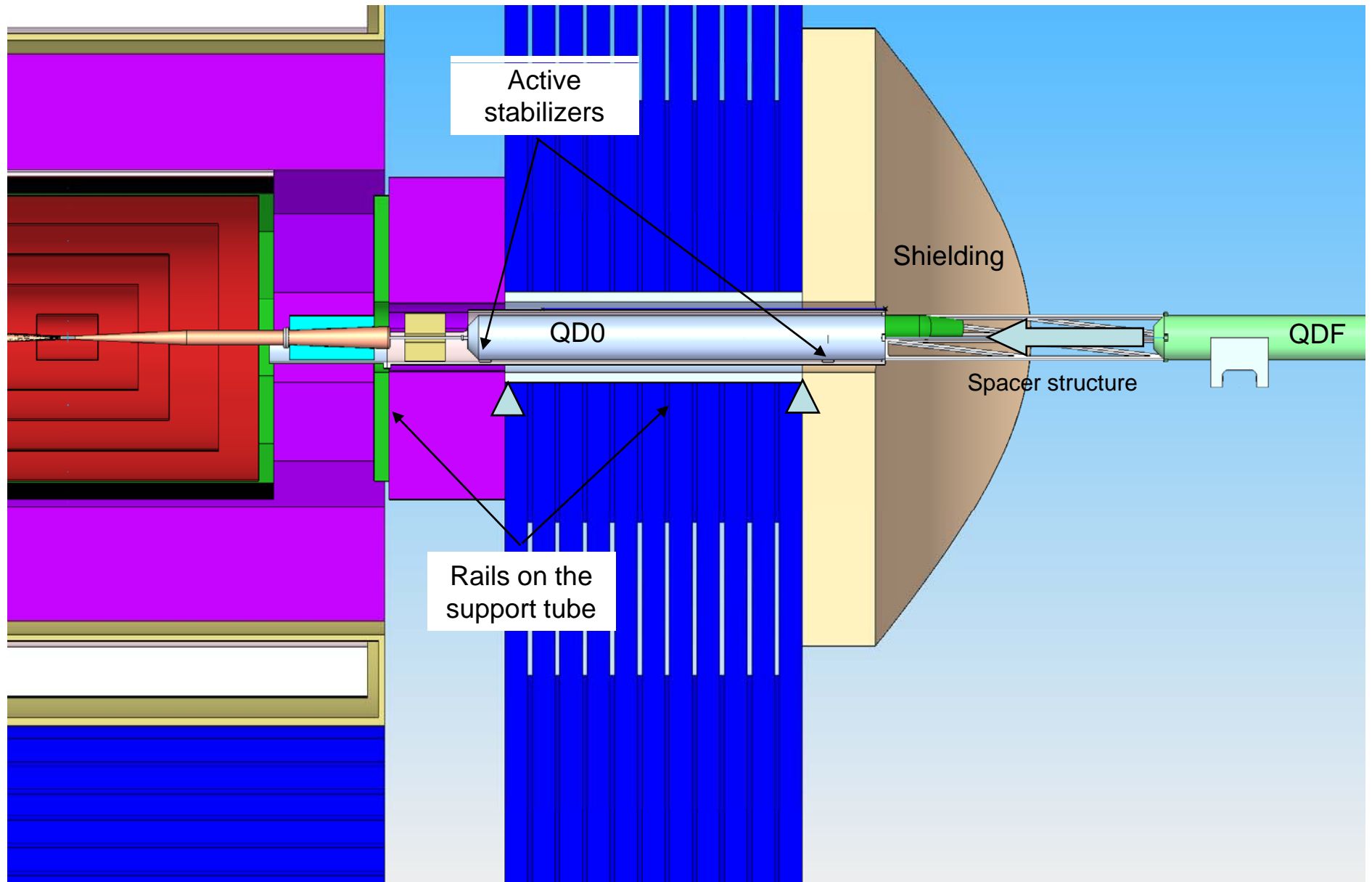
# 2m Door opening Procedure, on the beam



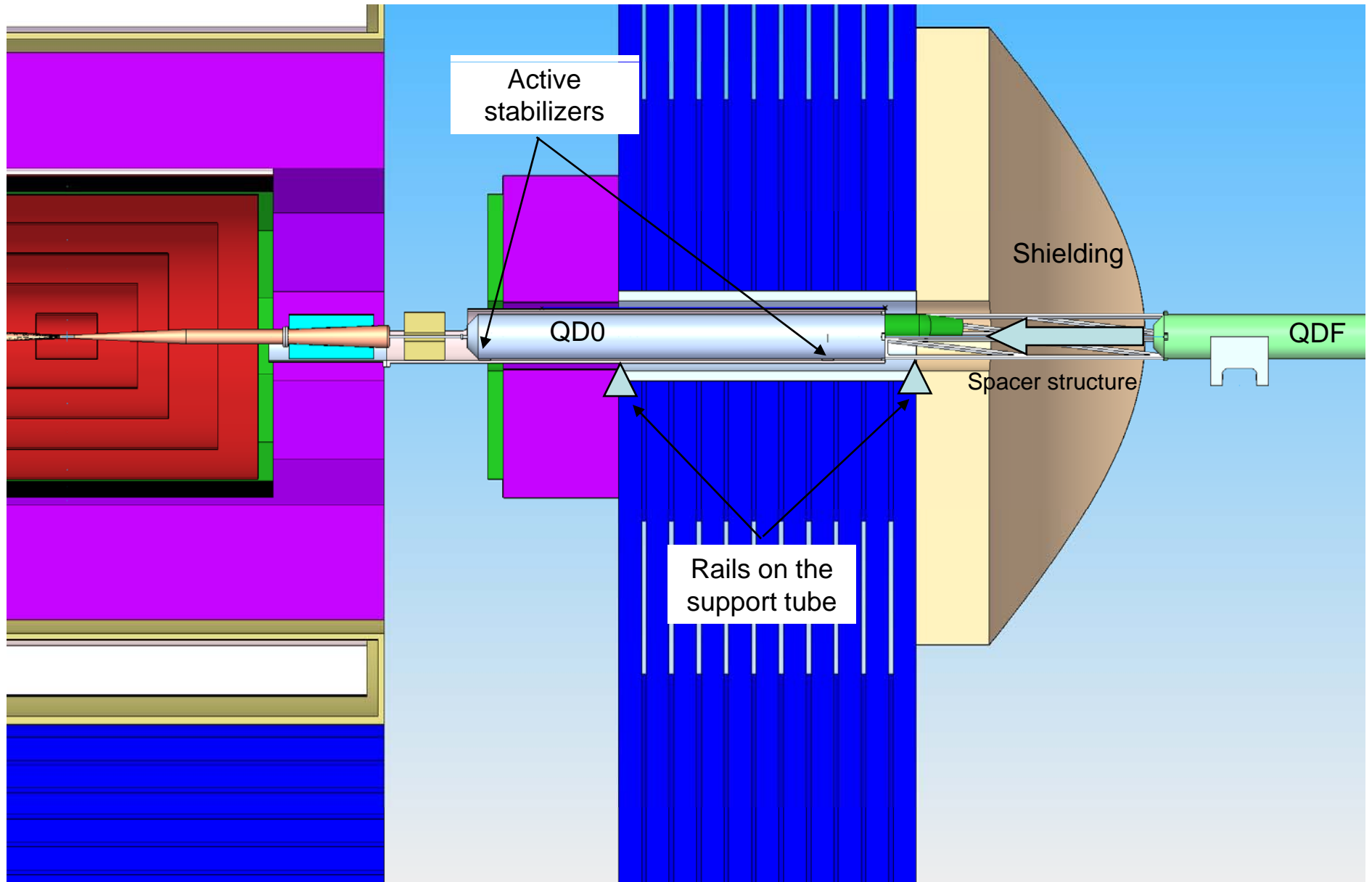
# 2m Door opening Procedure, on the beam I



## 2m Door opening Procedure, on the beam II



# 2m Door opening Procedure, on the beam III



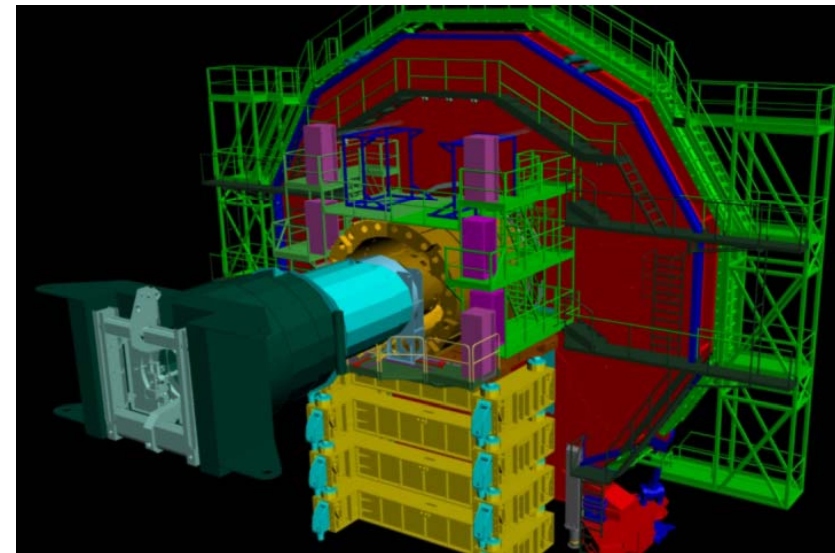
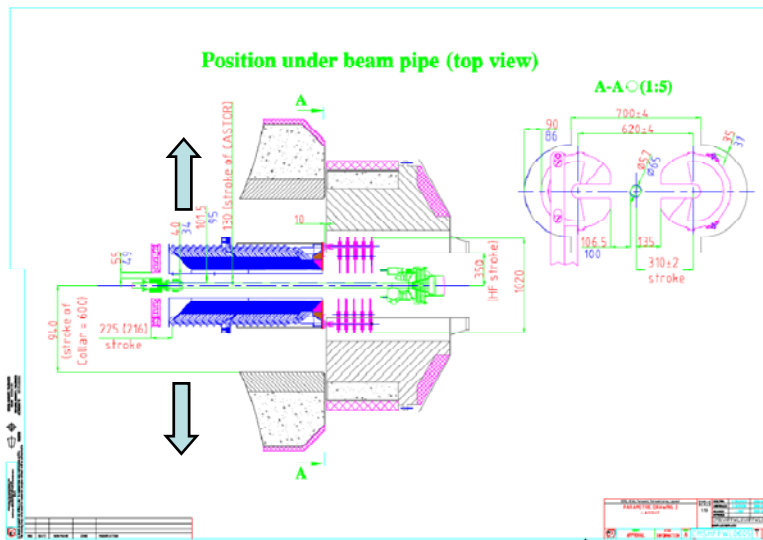
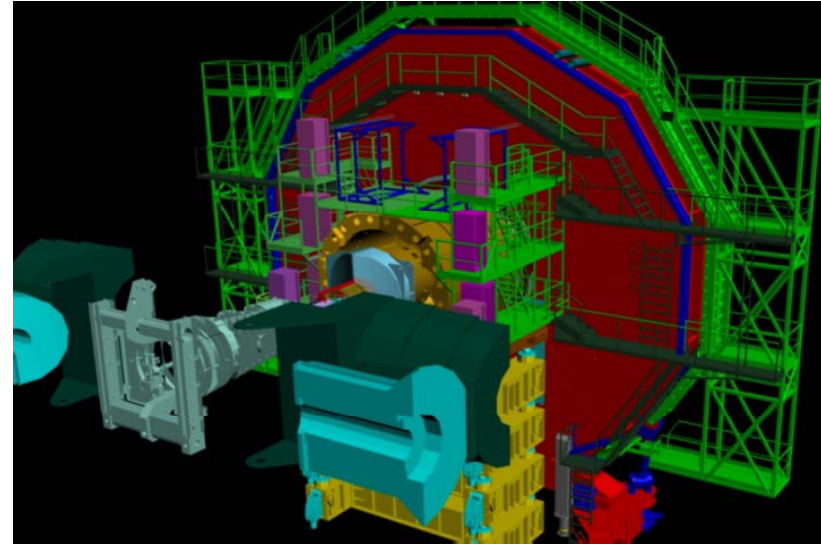


# Forward Shielding (Pacmen) I

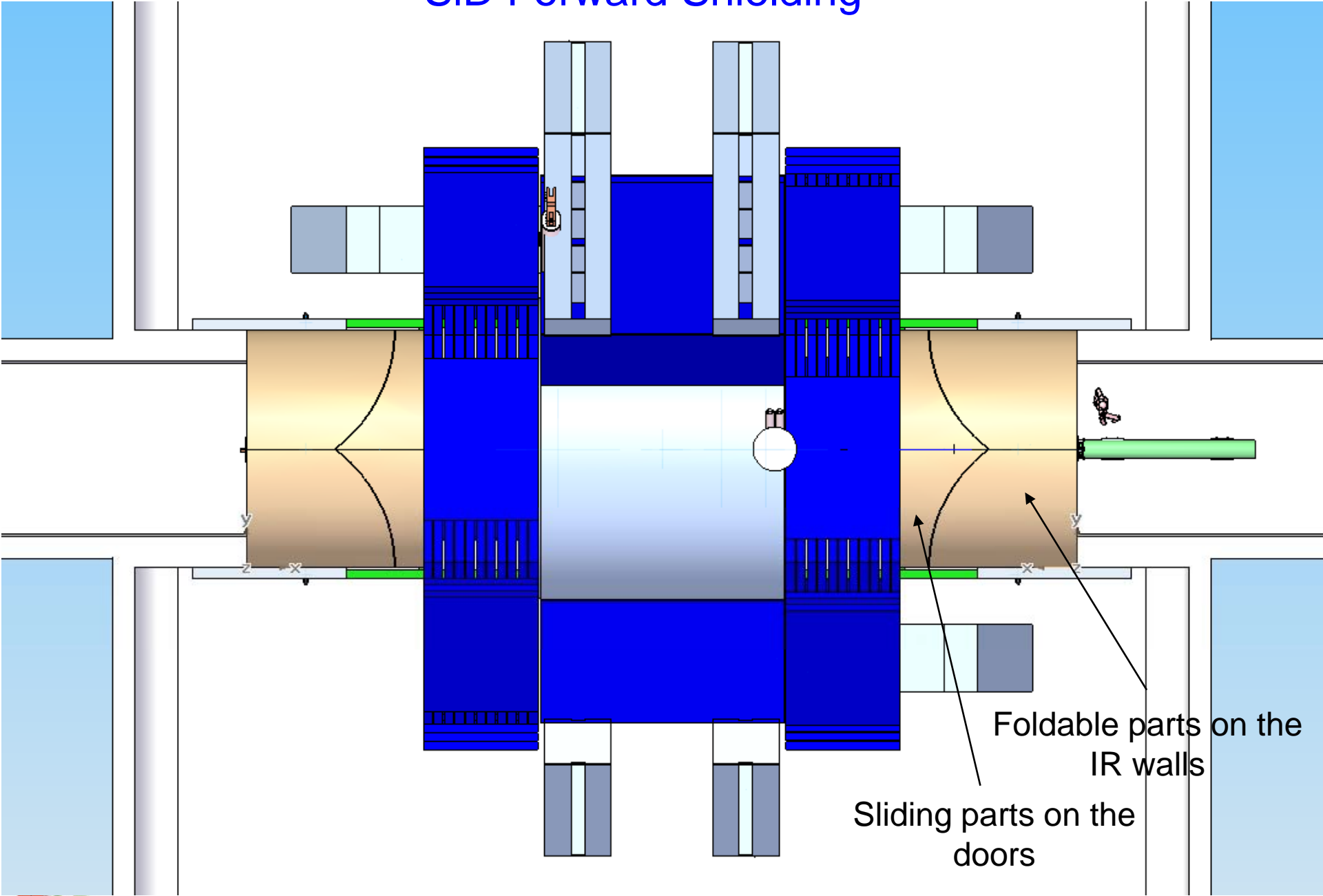
- Final dimensions will be dictated by the radiation background simulations (iron inner bore + borated concrete+ polyethylene)
- For safe and proper operation and alignment on the beam , it must include the mechanical tolerances of the closed experiment vs. the machine
- With the push-pull feature, it become must be partially or even totally integrated on the doors. Can we end up with two different Pacmen design for each push-pull experiments.
- Expected from the MDI group the definition of these interfaces.
- The He2 cryoconnection of QD0 must be integrated through the Pacmen
- Routing of other services like Vacuum, beam and detector instrumentation.

# Forward Shielding (Pacmen) II

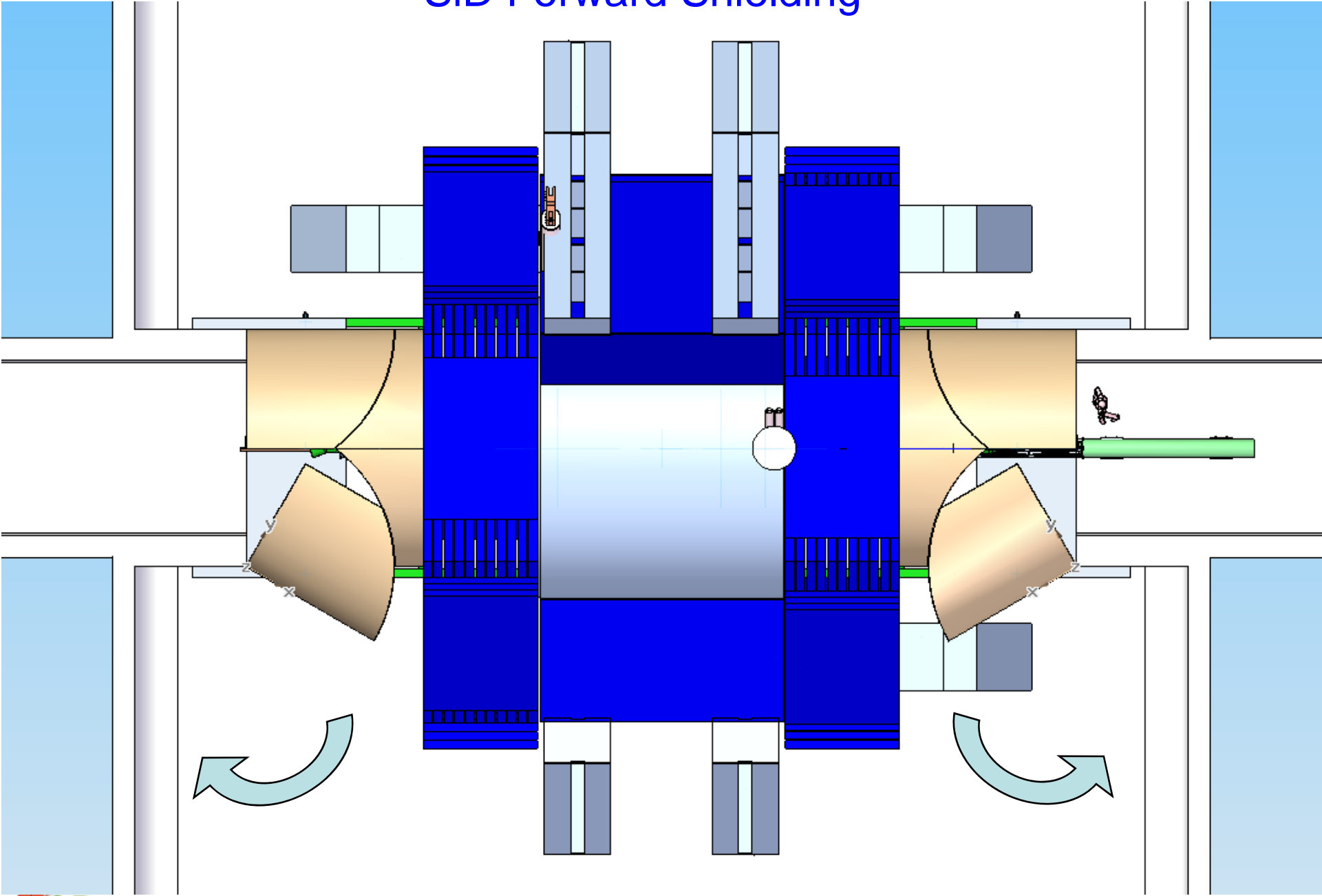
## SiD Design inspired by CMS Rotating Shielding



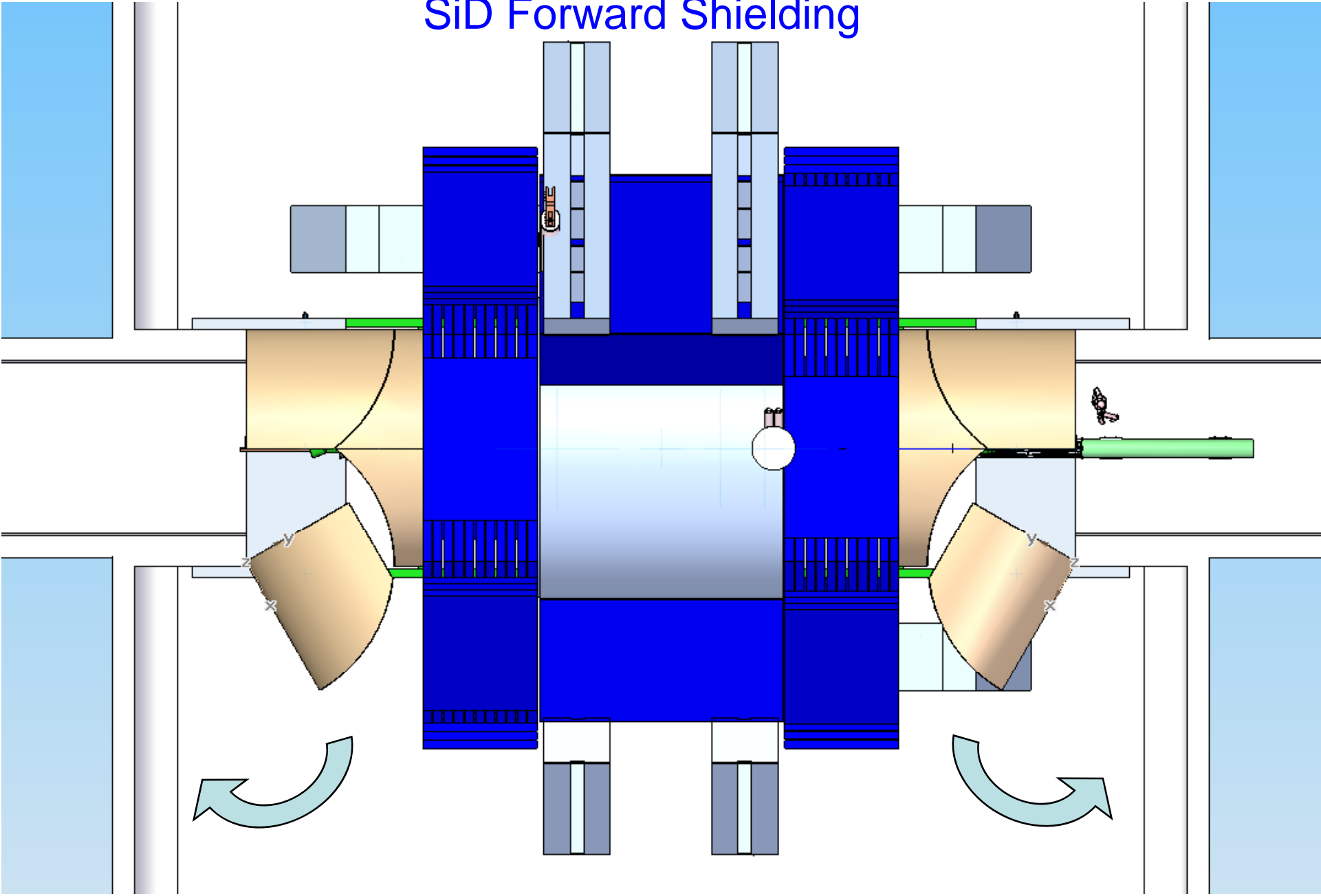
# SiD Forward Shielding



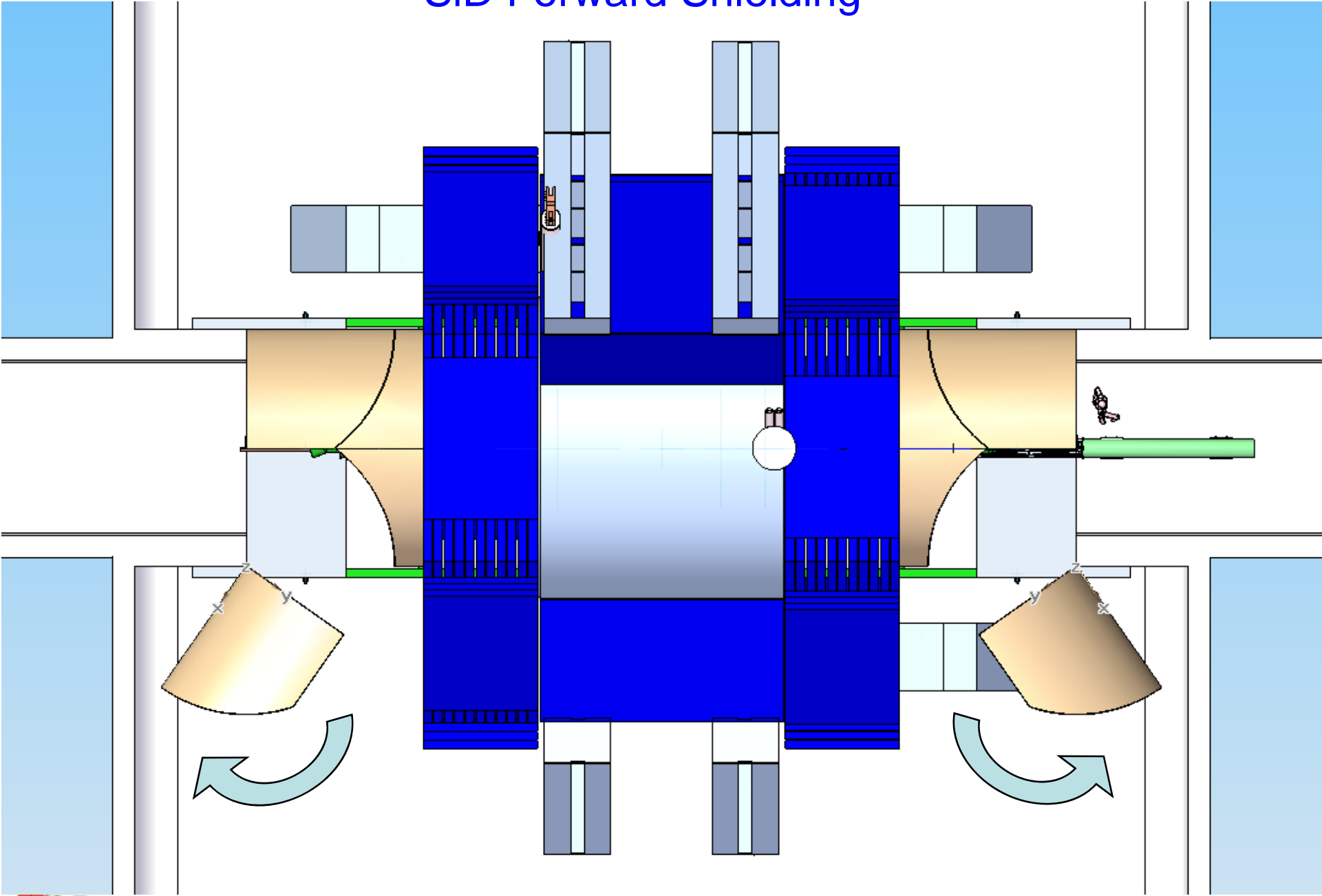
# SiD Forward Shielding



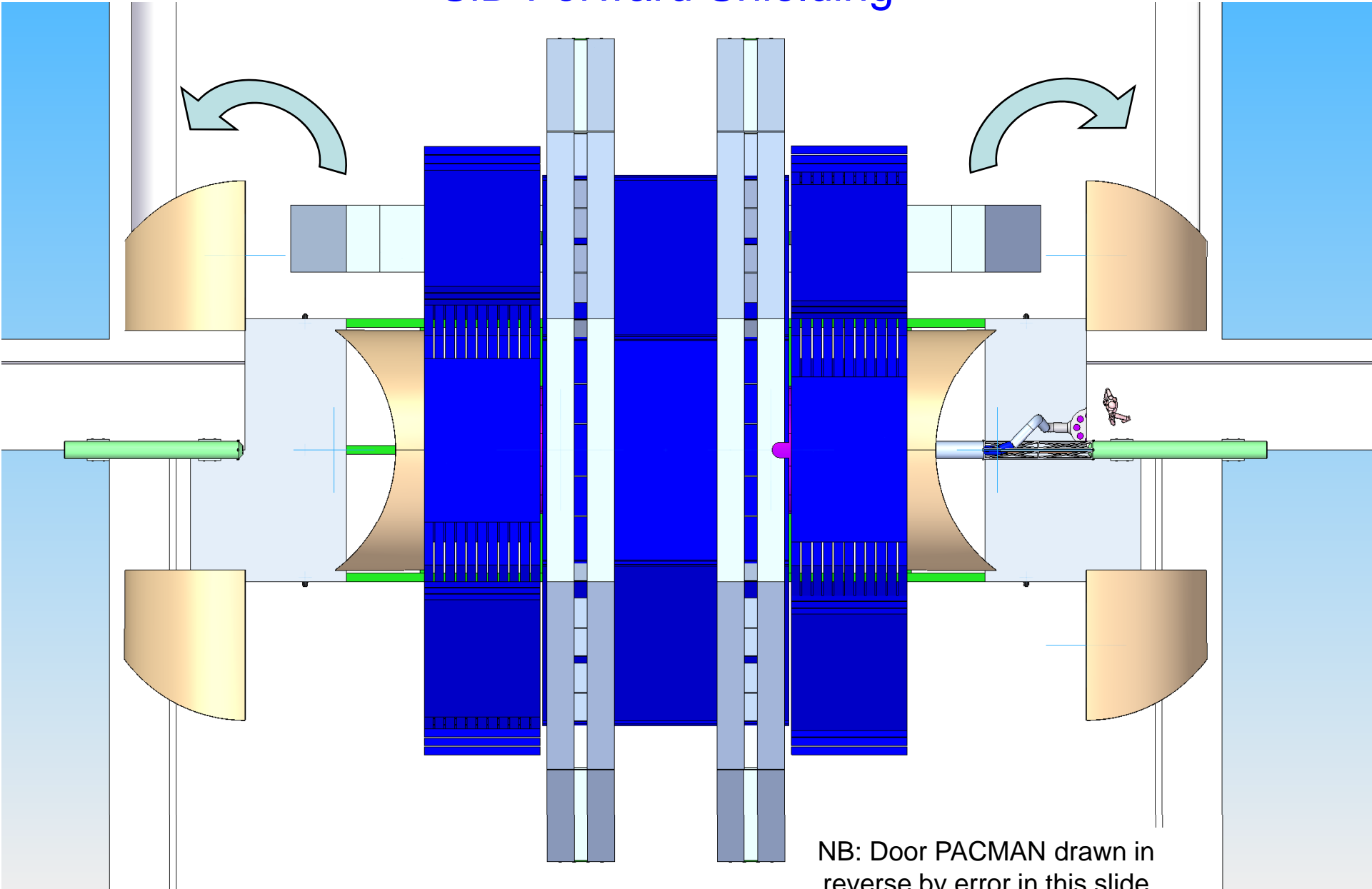
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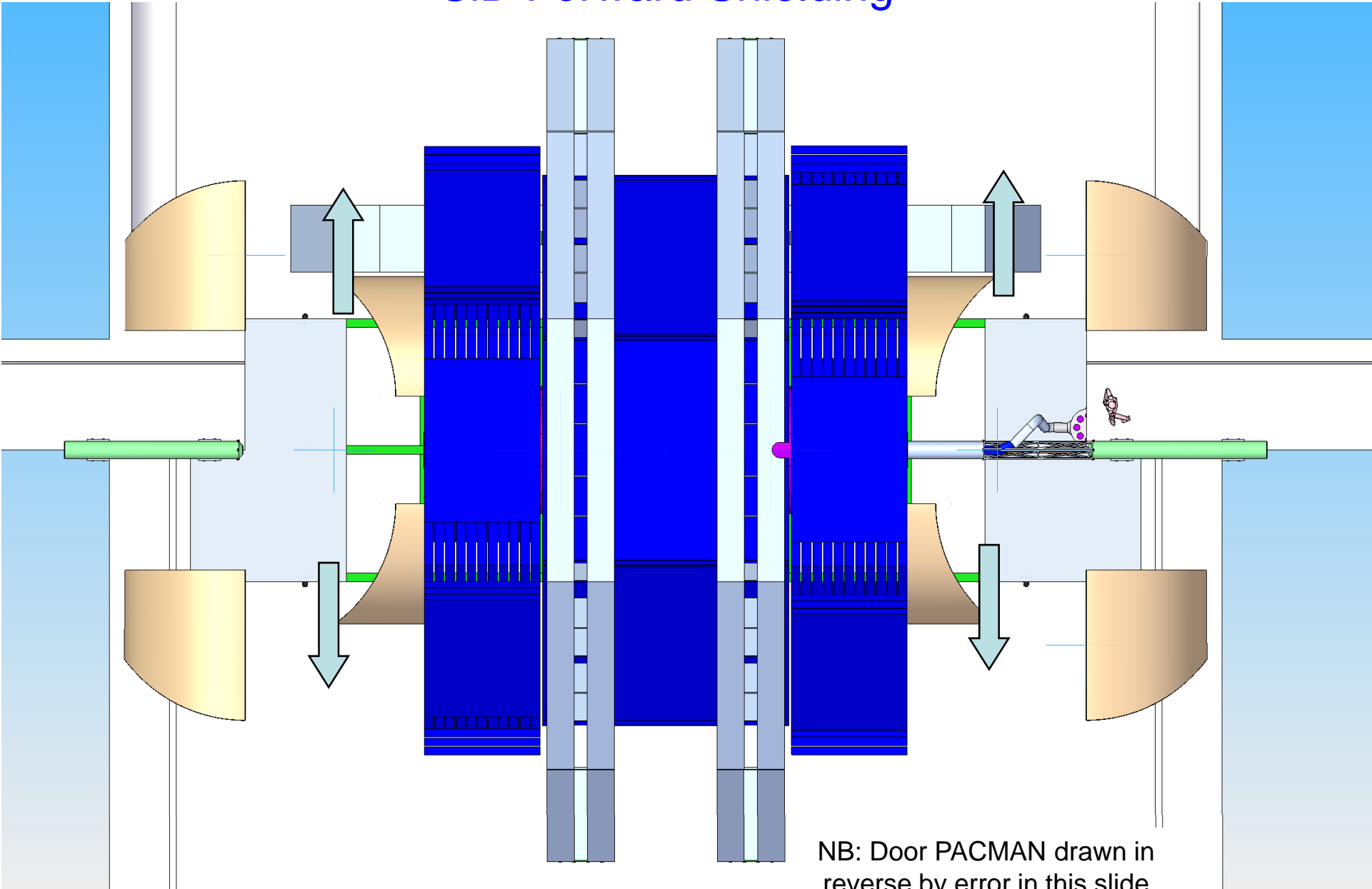


# SiD Forward Shielding



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

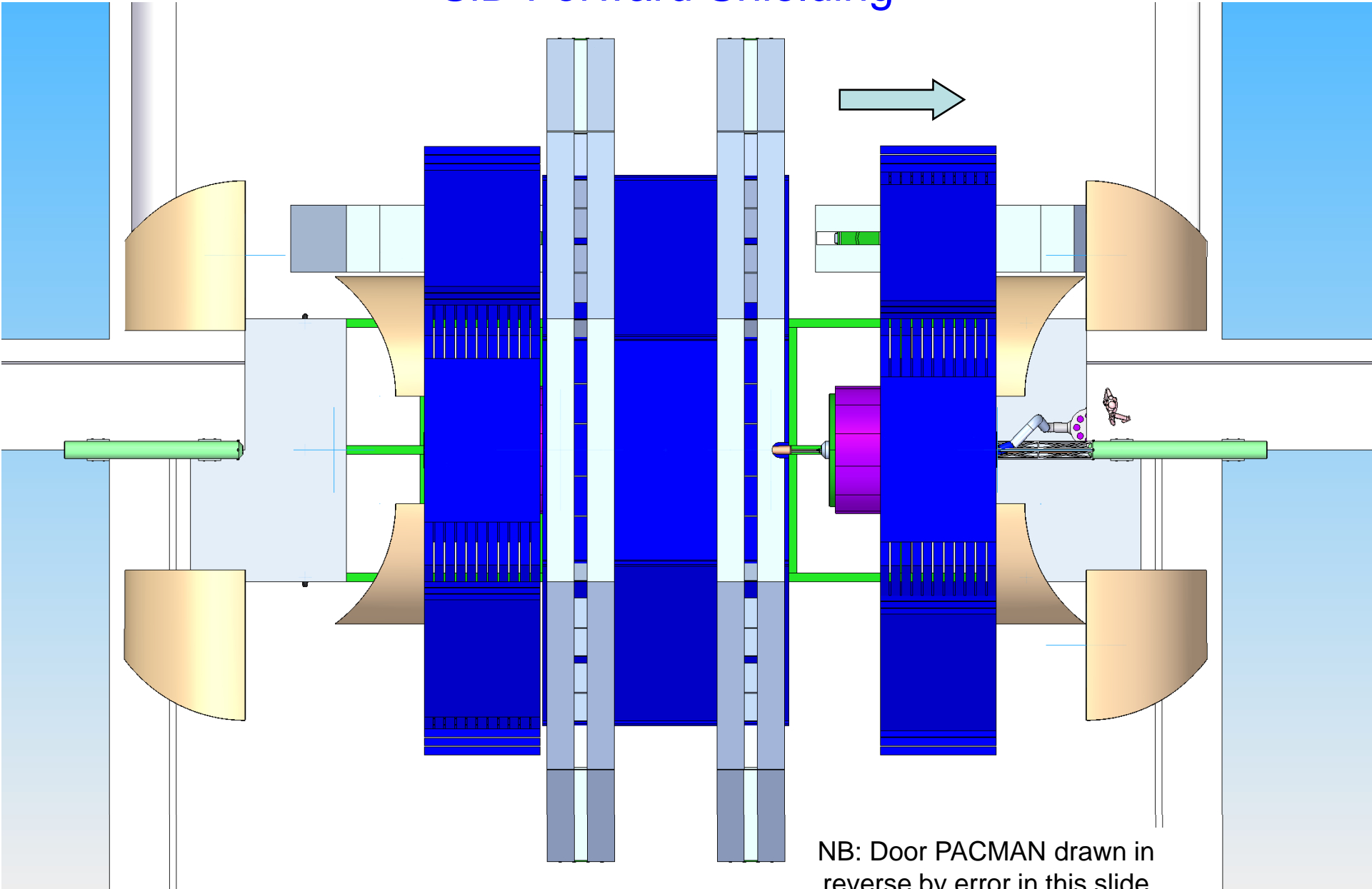
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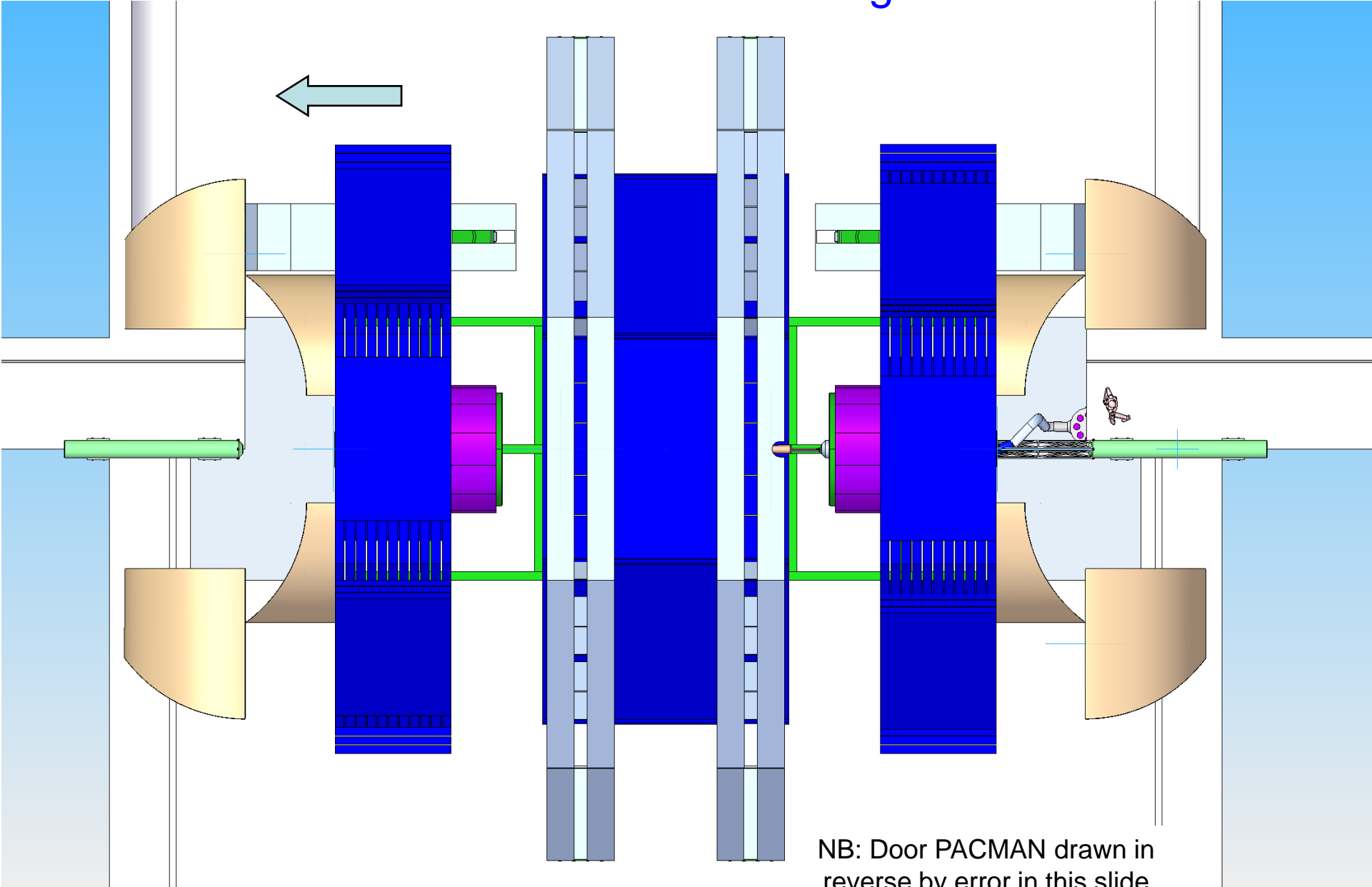
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# SiD Forward Shielding



# SiD Forward Shielding



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

# QD0 and He2 line design, B.Parker, IRENG07

**ilc** Design Constraints: Opening the detector for access and allowing for self shielding. **BROOKHAVEN NATIONAL LABORATORY Superconducting Magnet Division**

**Plan View**  
2 m movement  
Need a combination of stationary and removable shielding inserts?  
QD0 Cryostat  
QF1 Cryostat

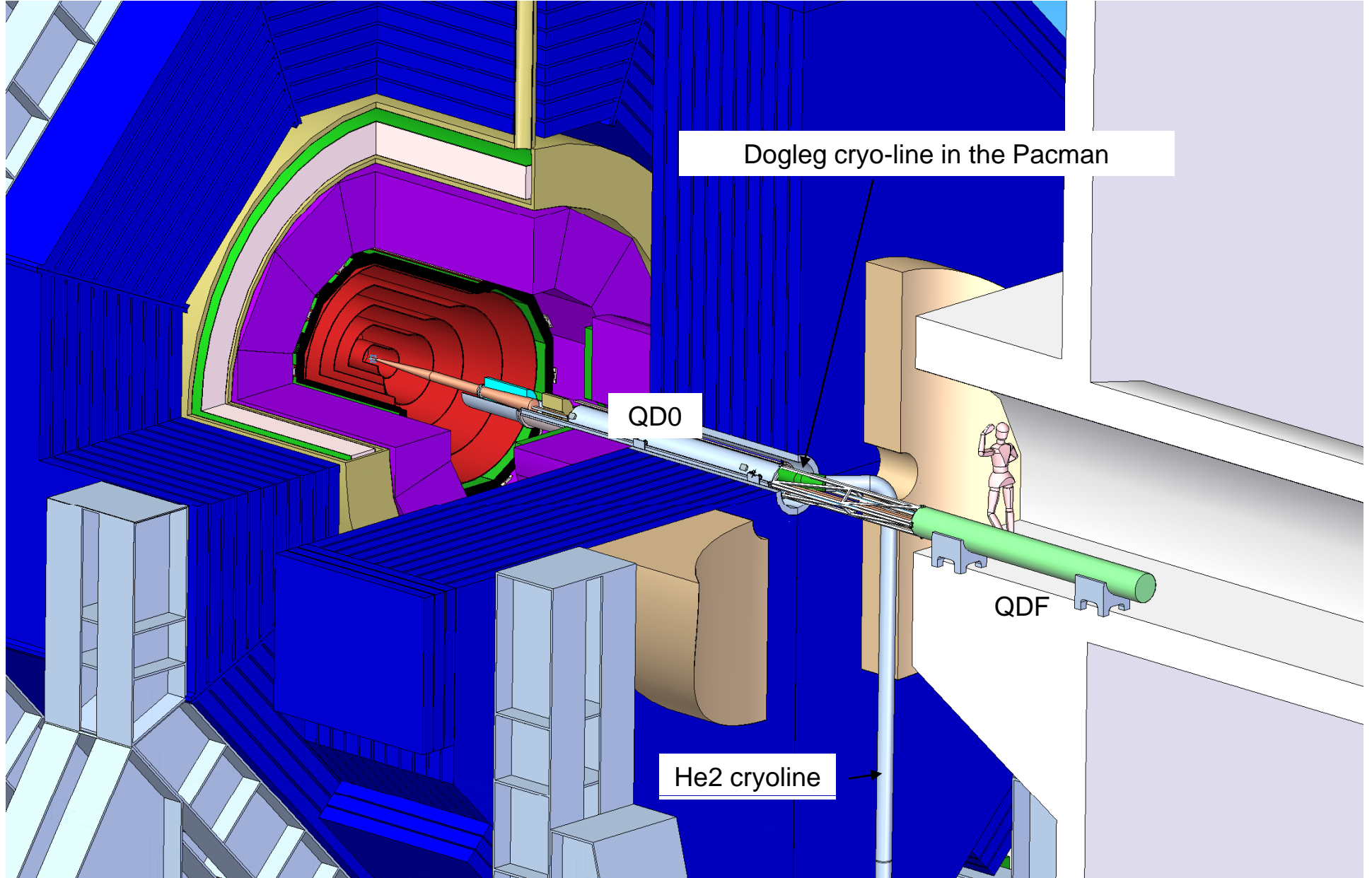
**End View**  
On later slide we see that loop to accommodate movement may need to be horizontal.  
Make the current lead, instrumentation, process gas, vacuum line, etc. connections outside to minimize penetration of pacman.

**QD0-Service Cryostat connection line has to permit 2 m opening by door but vertical section must not point directly to incoming/outgoing beamlines.**

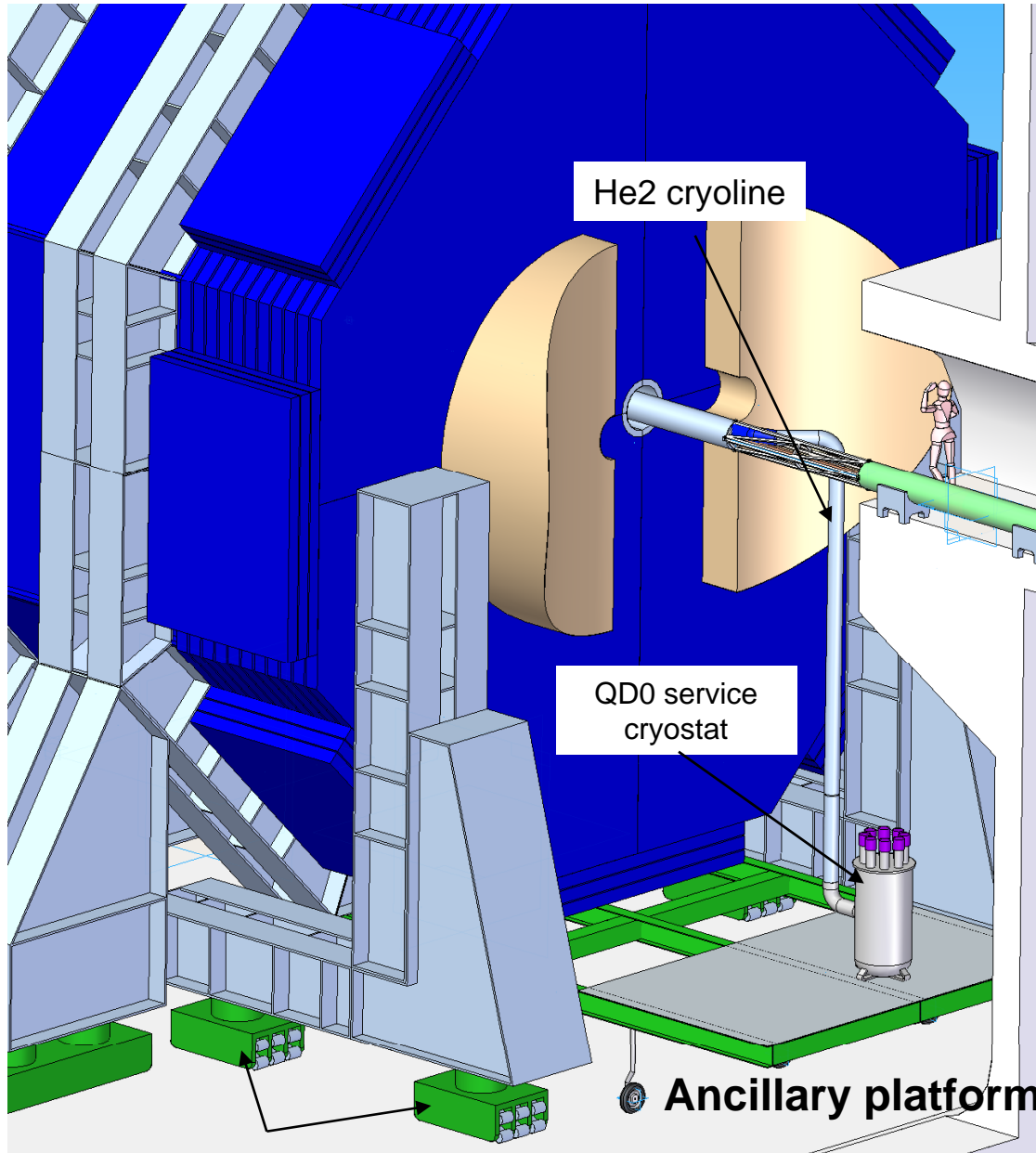
(Implicit assumption: mirror symmetric cryogenic layouts for the two experiments)

**8**

# Integration of the QD0 cryoline



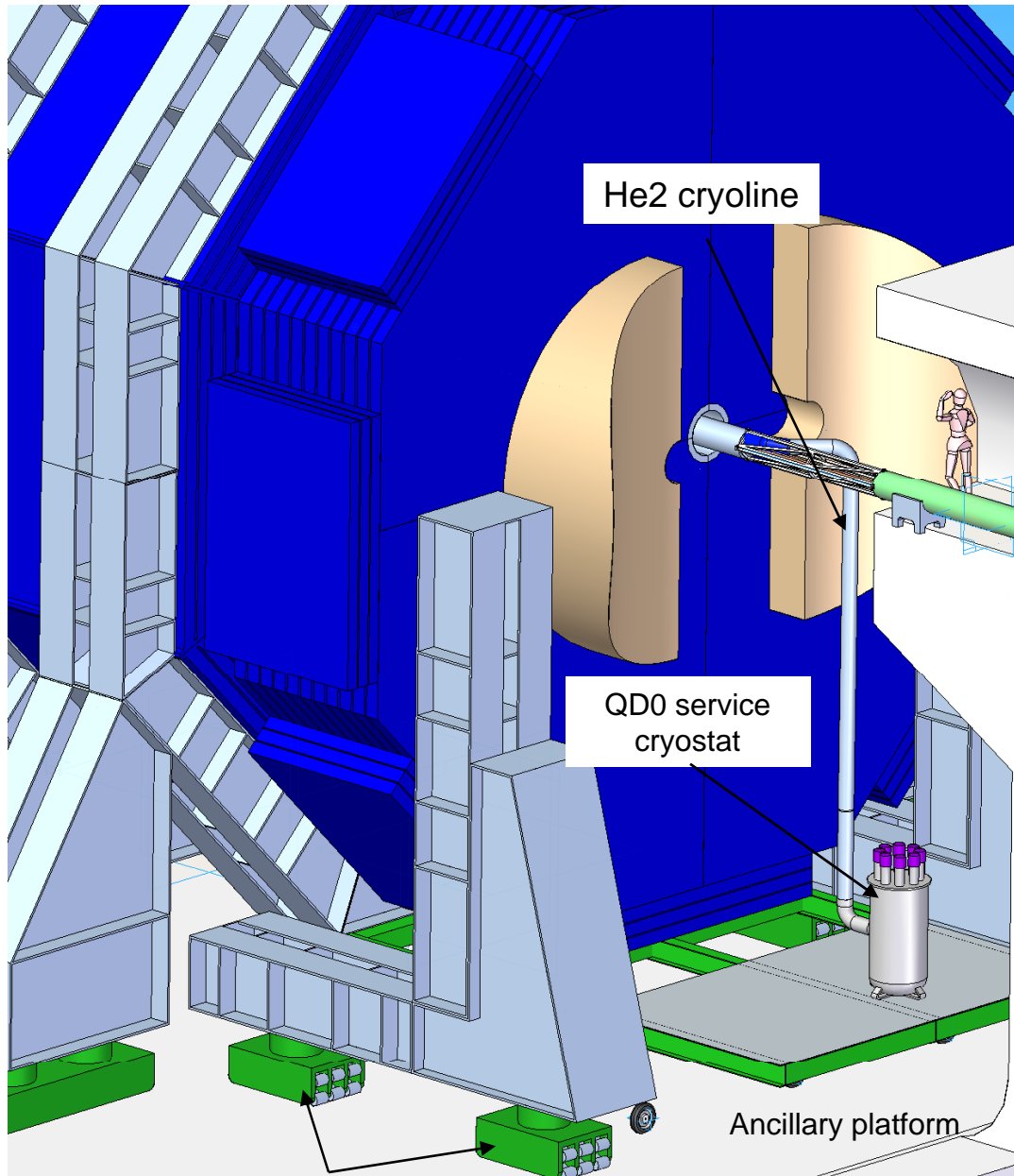
# Integration of the QD0 cryoline



## 2 m opening on the beam,

1. The QD0 service cryostat on ancillary platform, fixed to the SiD barrel infrastructure
2. He2 cryoline rigid 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.

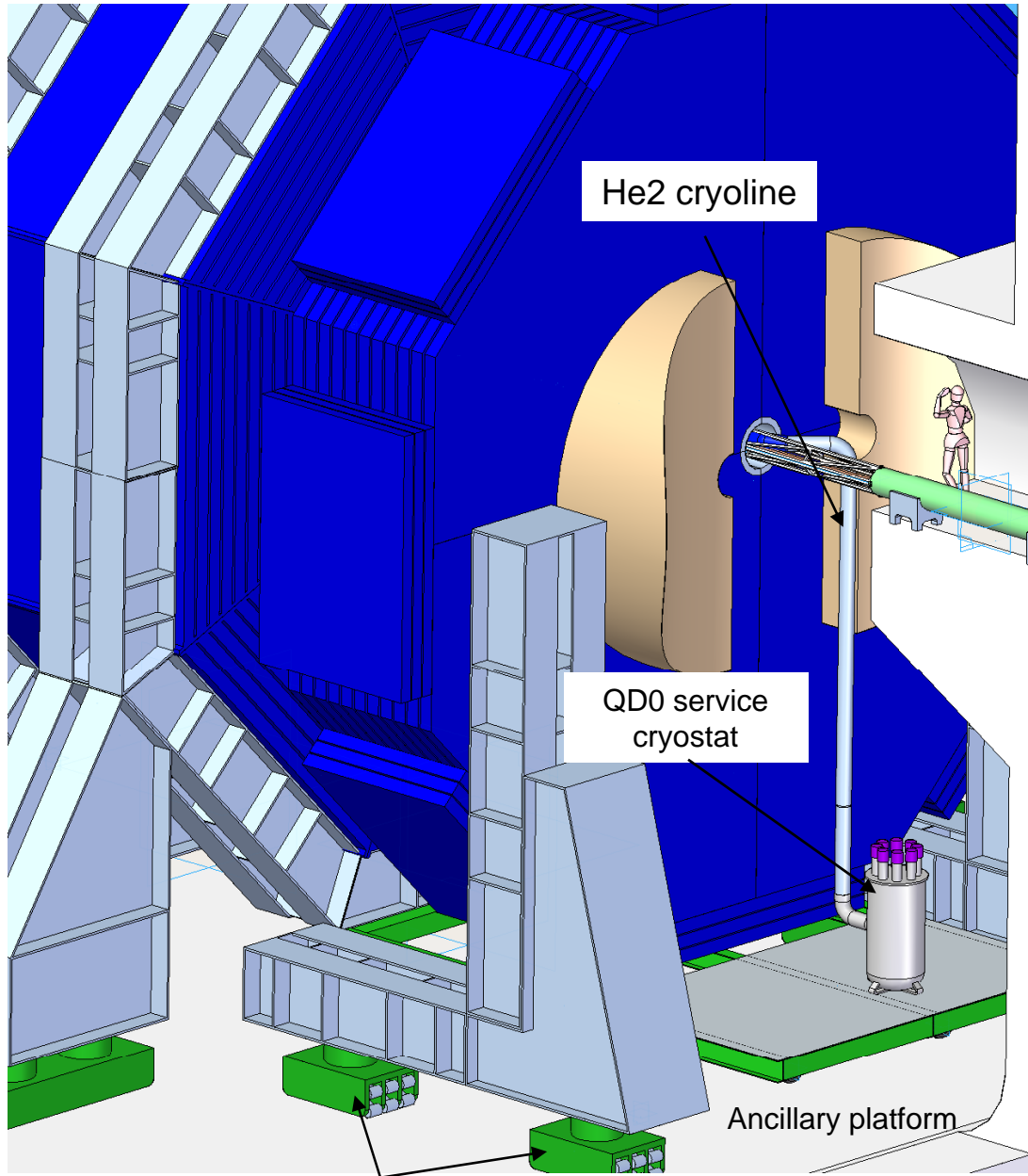
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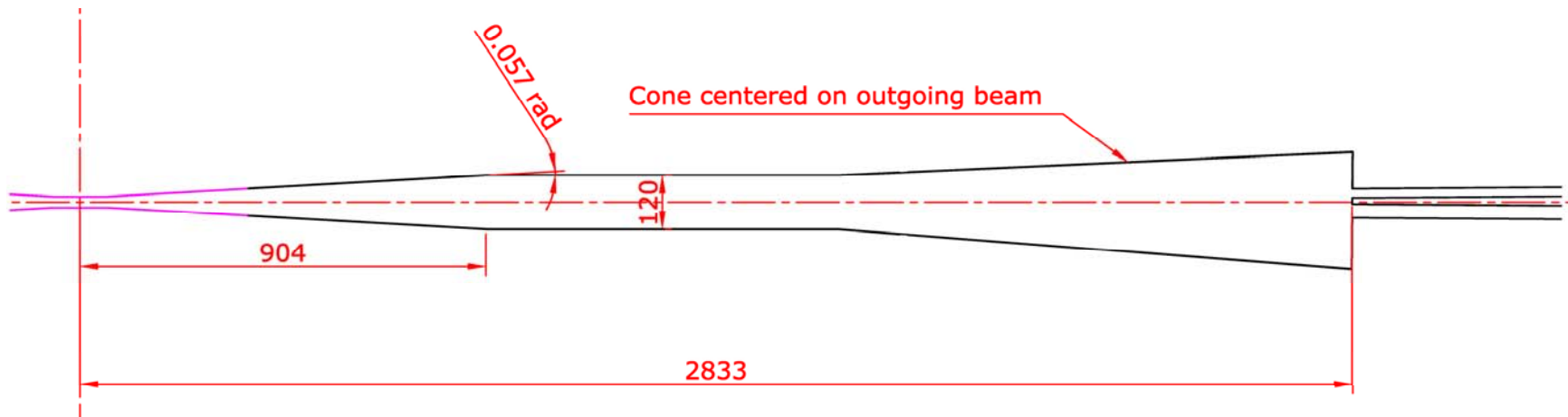
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# Beam Pipe Fabrication

- The October 2007 SiD design assumed stainless steel beyond  $Z = 759$  mm.
  - That allows more standard welding and fabrication techniques.
  - Beryllium to stainless transitions should be done by the fabricator of beryllium portions, but the stainless steel portions could be made by a different vendor.

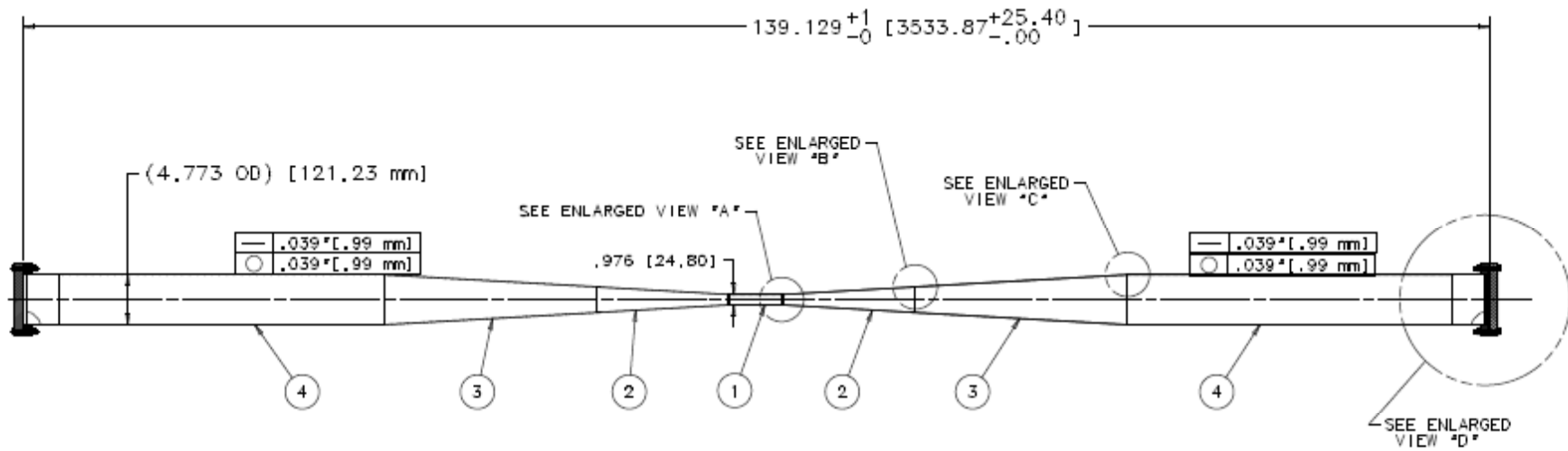
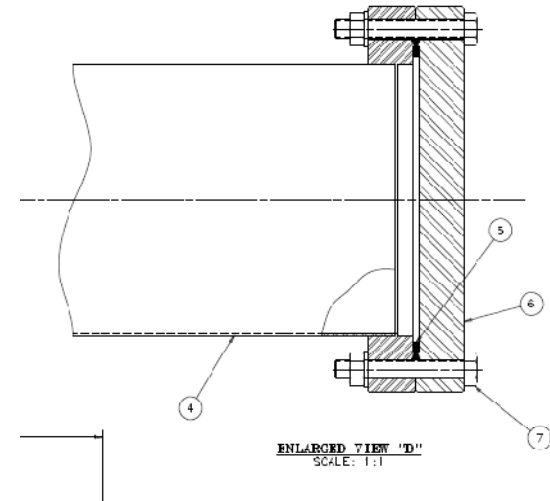






# Beam Pipe Fabrication

- Brush-Wellman visit: Be up to flange at LUMICAL
- CMS-like foldable ion pumps behind LUMICAL if needed
  - **Expected that MDI group relaxes vacuum spec at IP**



# Conclusions

While more detailed input needed, a forward region engineering design has been developed based on

- 620mm access hole in door
- 485mm OD, 20mm wall Stainless support tube, cut to a half cylinder in region of FCAL, with integrated rails supported off door slides and holding a still-to-be-defined motion adjustment system
- Spacer to QF0 to prevent longitudinal motion when door opens
- Doors supported by Hilman rollers
- Platform for QD0 cantilevered off barrel iron
- 4-part PACMAN shielding
  - One pair shield mounted permanently to QF support & rotatable
  - Second pair shields ride and slide on detector doors
- Beam pipe flanged at LUMICAL

Interface possibilities need discussion



# EXCEL pix of Marco's Design

