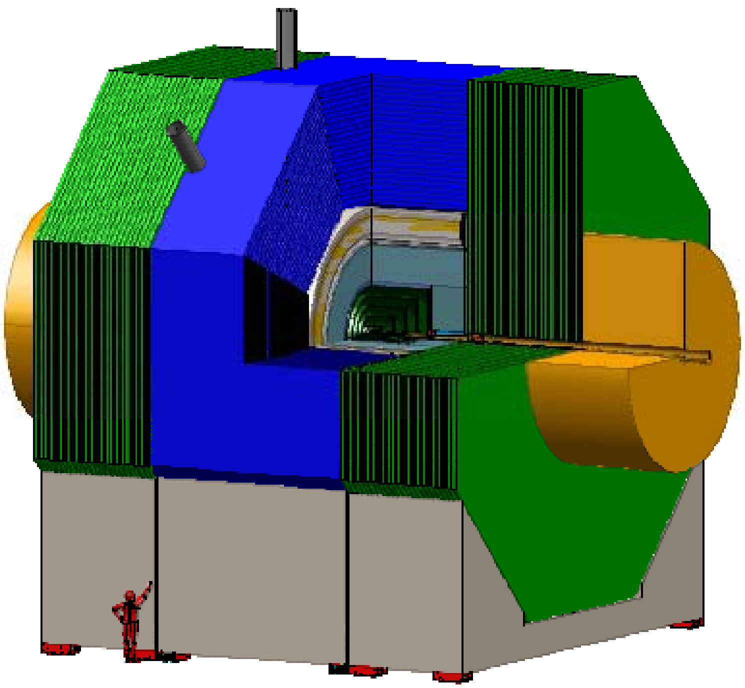
SiD Engineering Status Report

Kurt Krempetz



Outline of Talk

I) Introduction/History of the SiD Engineering Group.

II) Discuss Progress and Work since the Workshop at SLAC on 1/29/08.

III) Discuss Specific Engineering Issue in regards to Simulation Studies.

SiD Engineering Group Participants

Engineers	Physicists
– ANL	
• Victor Guarino→Hcal	
– FNAL	
• Bob Wands→FEA	Bill Cooper
• Joe Howell→FNAL Test Beam	
• Kurt Krempetz→Integration	
• Walter Jaskierny→Solenoid Electrical	
– LAPP	
• Claude Girard	Yannis Karyotakis
• Franck Cadoux	
• Nicolas Geffroy→Hcal	
– PSL	
• Farshid Feyzi→Muon Steel	
– SLAC	
• Jim Krebs→EndDoors	Marty Breidenbach
• Marco Oriunno→Ecal	Tom Markiewicz
• Wes Craddock→Solenoid	
– RAL	
• Andy Nichols→Tracking	Phil Burrows
– U of Texas, Arlington	
•	Andy White

Subsystem Liaisons to the Engineering Group

- Vertex→ Bill Cooper
- Silicon Tracker→ Tim Nelson
- Ecal→Marty Breidenbach
- Hcal→Andy White
- Muons→Henry Band
- Forward→Bill Morse
- MDI→Tom Markiewicz

SiD Engineering Group-History

- Formed in the summer '07
- Meet via Webex on Wednesdays @10:00 (US Central Time Zone) ~ every other week
- If interested send me mail (Krempetz@fnal.gov) to get on meeting notice list.
- Meetings/Workshops
  - IR Workshop - Sept '07
  - ALCPG – Oct '07
  - SLAC SiD Workshop – Jan '08

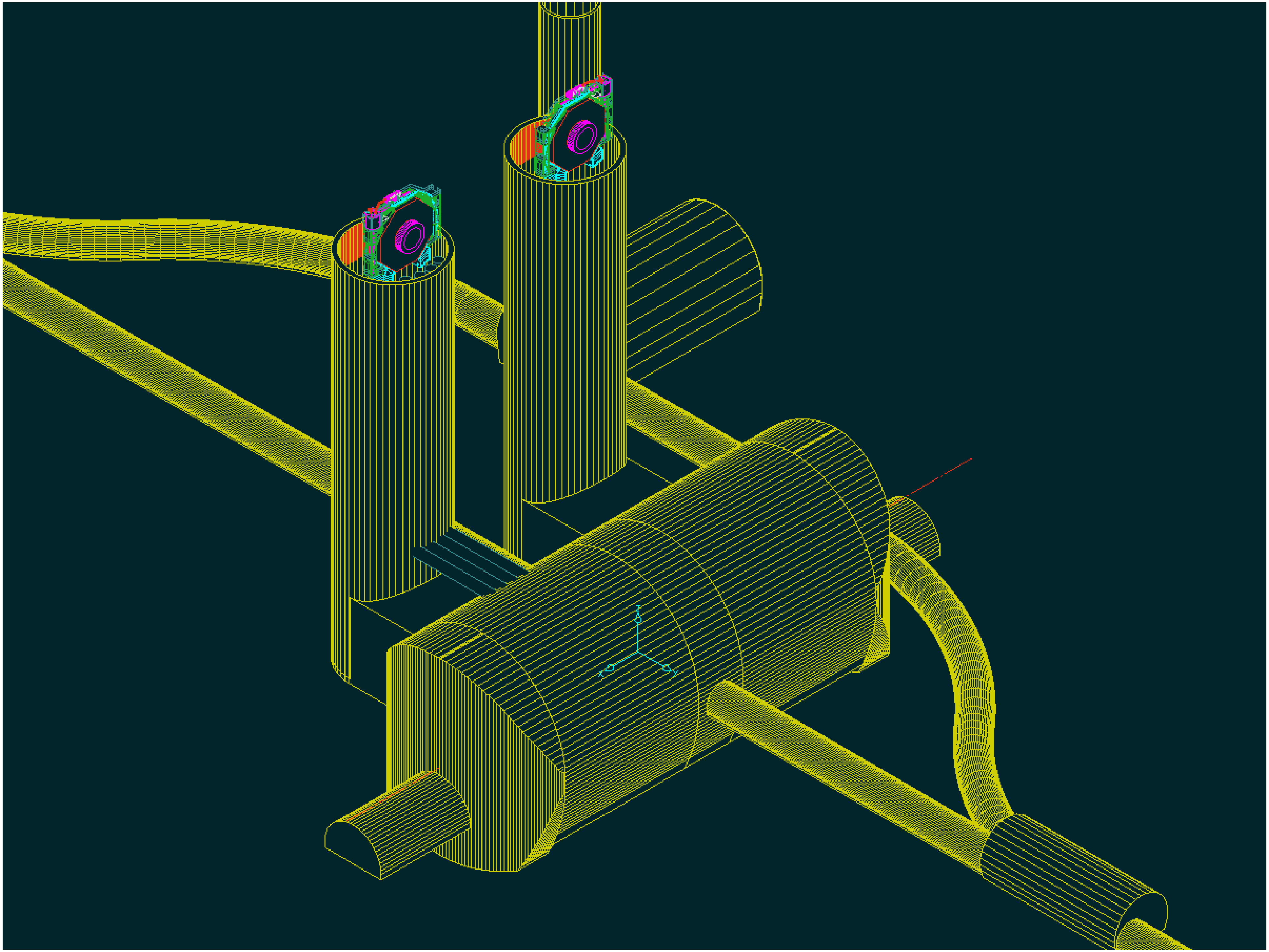
SiD Engineering Group Function/Purpose

- Realism into the Detector
    - Supports
    - Tolerances
    - Fabrication Limitations
    - Cost Estimates
    - Safety Issues
- Help integrate the detector sub-system into an overall Detector
    - Define Clearances
        - Assembly
        - Cables and utilities
- Help with the design of different Detector Sub-systems
- Document the design choices and the design
- Document and manage changes

IR Engineering
General Safety

- Radiation
  - Self Shielding Detector
- Fire Safety
  - No Flammable Gases
  - Halogen-free Cables
  - Smoke Sensor in all sub detectors
- Seismic Safety

  Site dependent
- ODH Issues
- Magnet Fringe Fields



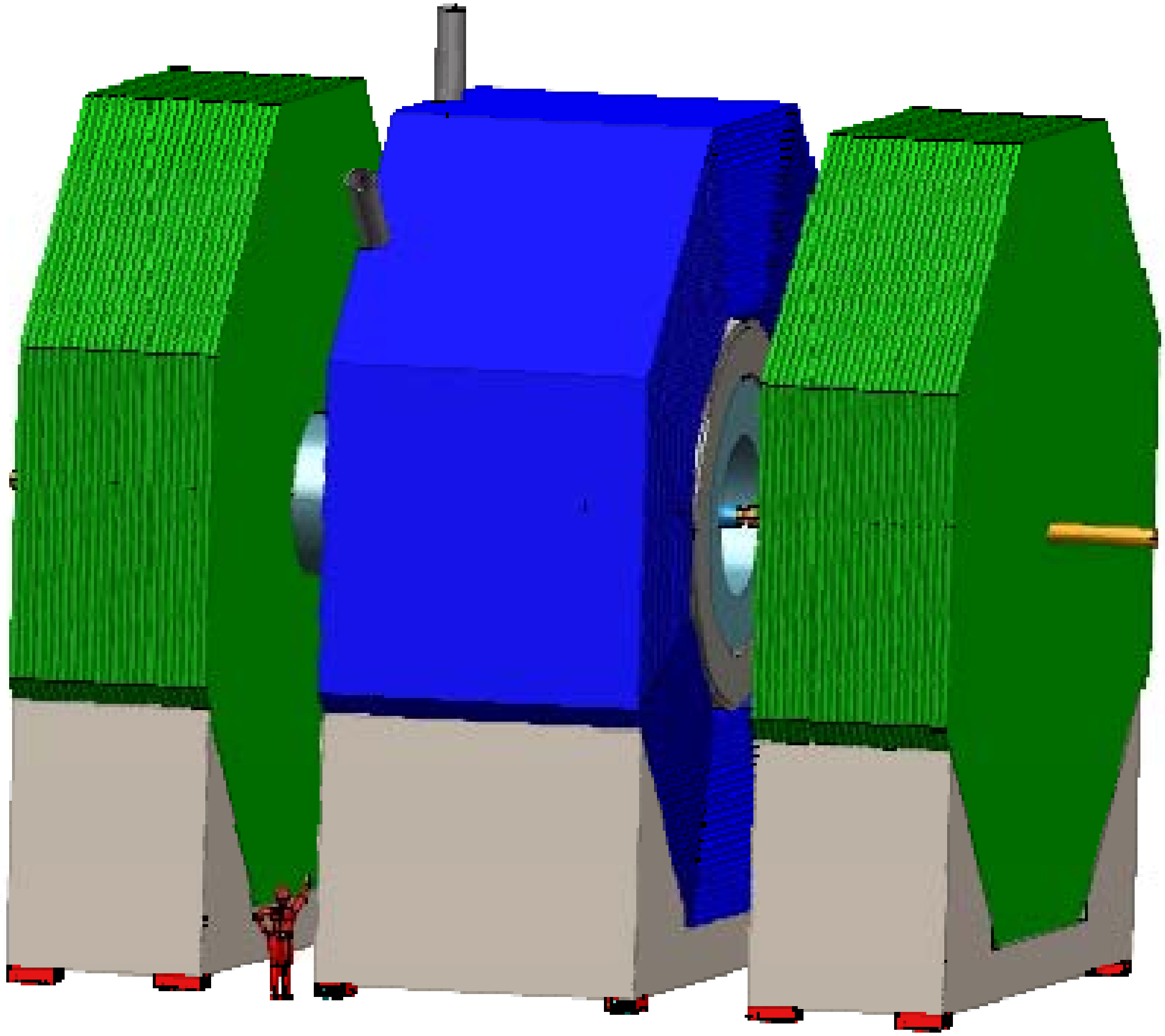
IR Engineering Meeting
Baseline Assembly Scenario

- Solenoid tested to full field on surface
- Other Sub-systems are also constructed and tested on surface.
- Defines a surface building
  - Roughly 24mX24mX24m
  - 500 tonnes crane (smaller hoists should also be available)

IR Engineering
Opening Procedures

- on beamline
  - Need to access Electronics→ End caps open 2m
    - Roughly 16m total
  - Small Crane system (~5tons)
  - Time Duration → 20hrs
    - Power down magnet-4hrs
    - Open End Caps- 4hrs
    - Perform work- 4hrs
    - Close End Caps- 4hrs
    - Power up magnet- 4hrs

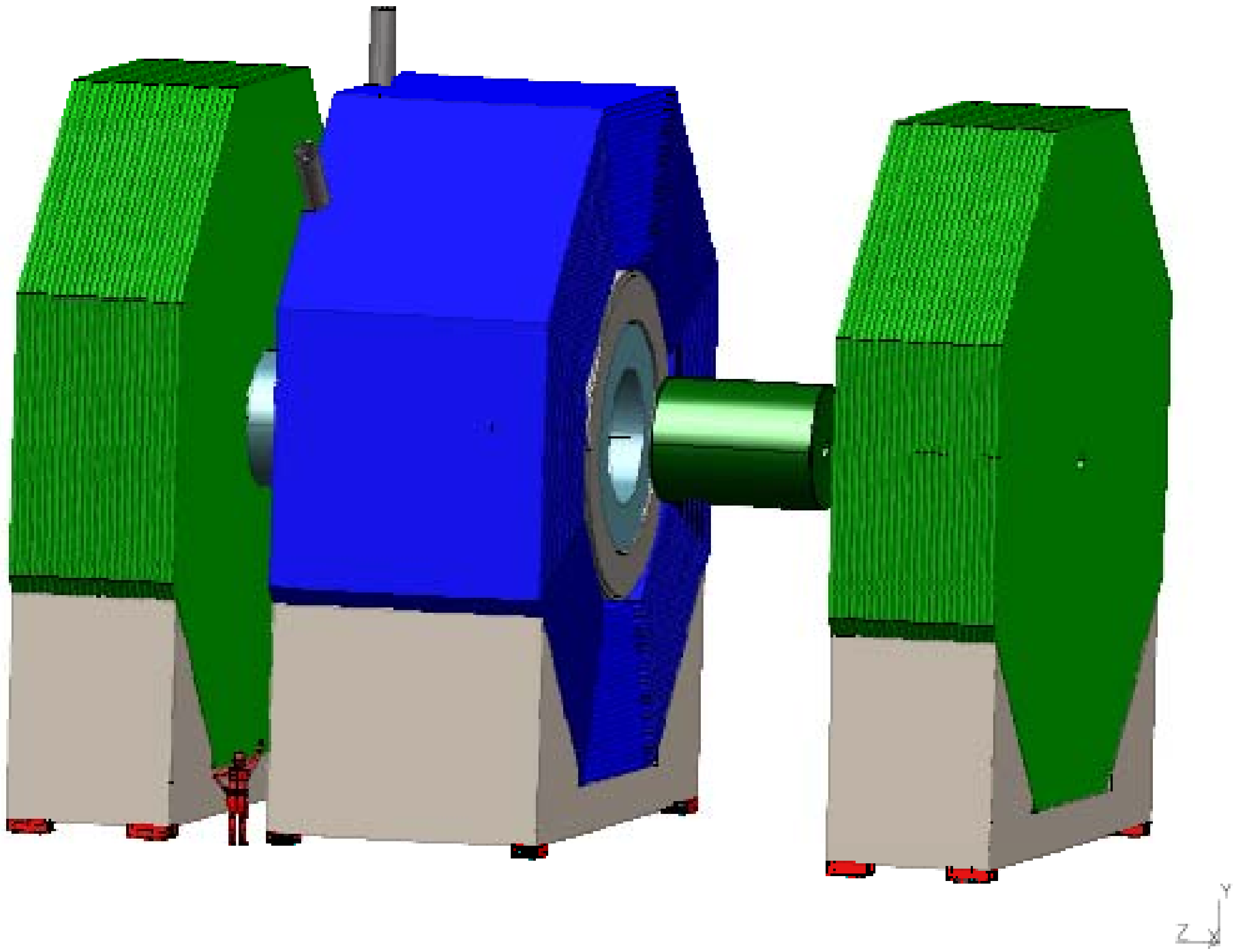
IR Engineering
Detector Opened 2 M



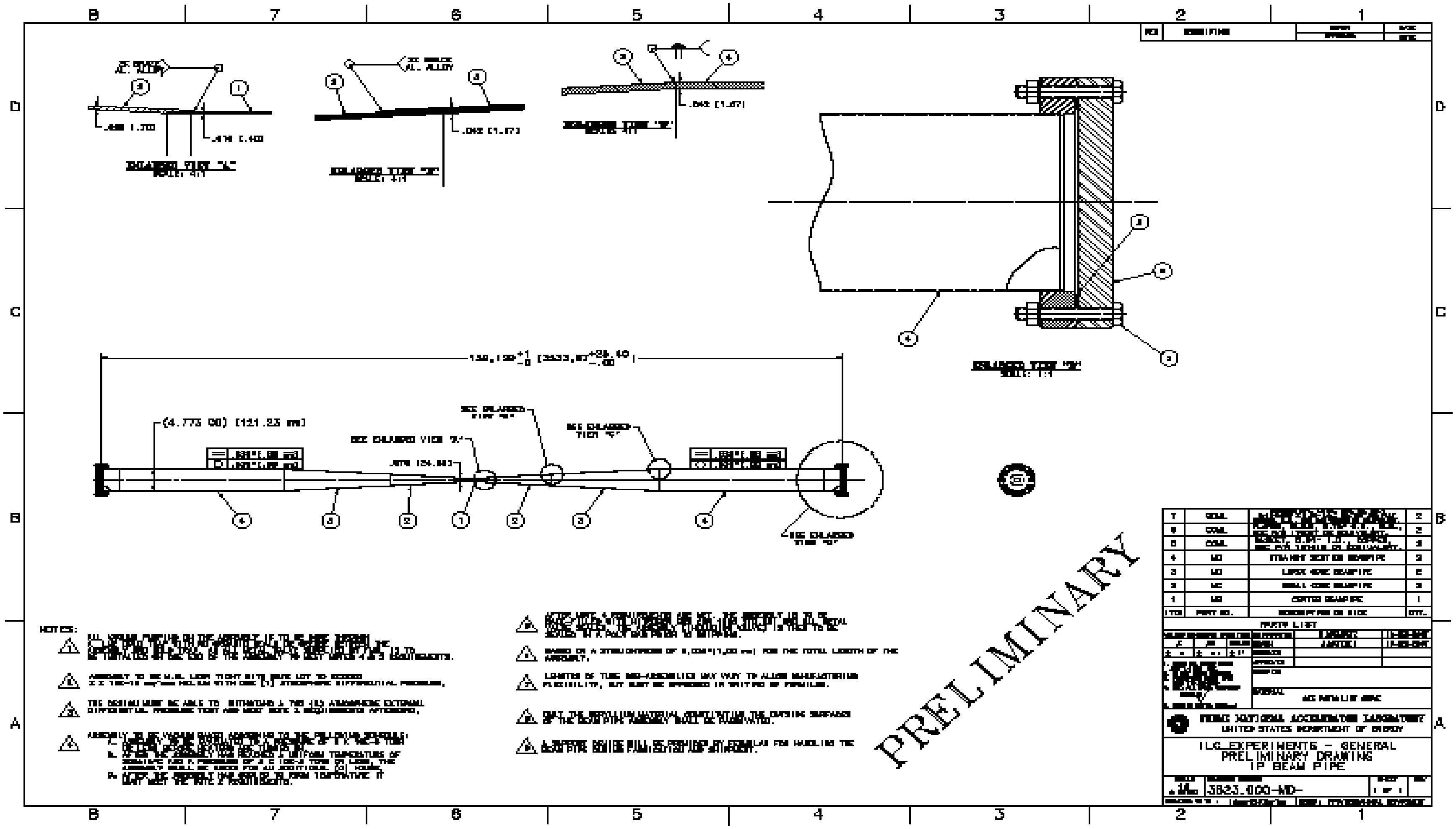
IR Engineering Opening Procedures

- off beamline
  - Detector Motion→ End caps open 2m
    - Frequently for Electronics maintenance
  - Detector Motion→ End caps open 3m
    - Possible every 6 months for Vertex and Tracker maintenance
    - Possible every few years for Vertex Detector replacement
    - Time Duration for Opening or Closing→ about 1 week
  - Detector Motion→ End caps open 6m
    - Possible every 5 years for Upgrades
      - Tracker Detector System
      - ECal Silicon Detectors
      - HCal RPC's
      - Muon RPC's
  - Crane System for above scenarios (~25 tons plus another smaller hoist)

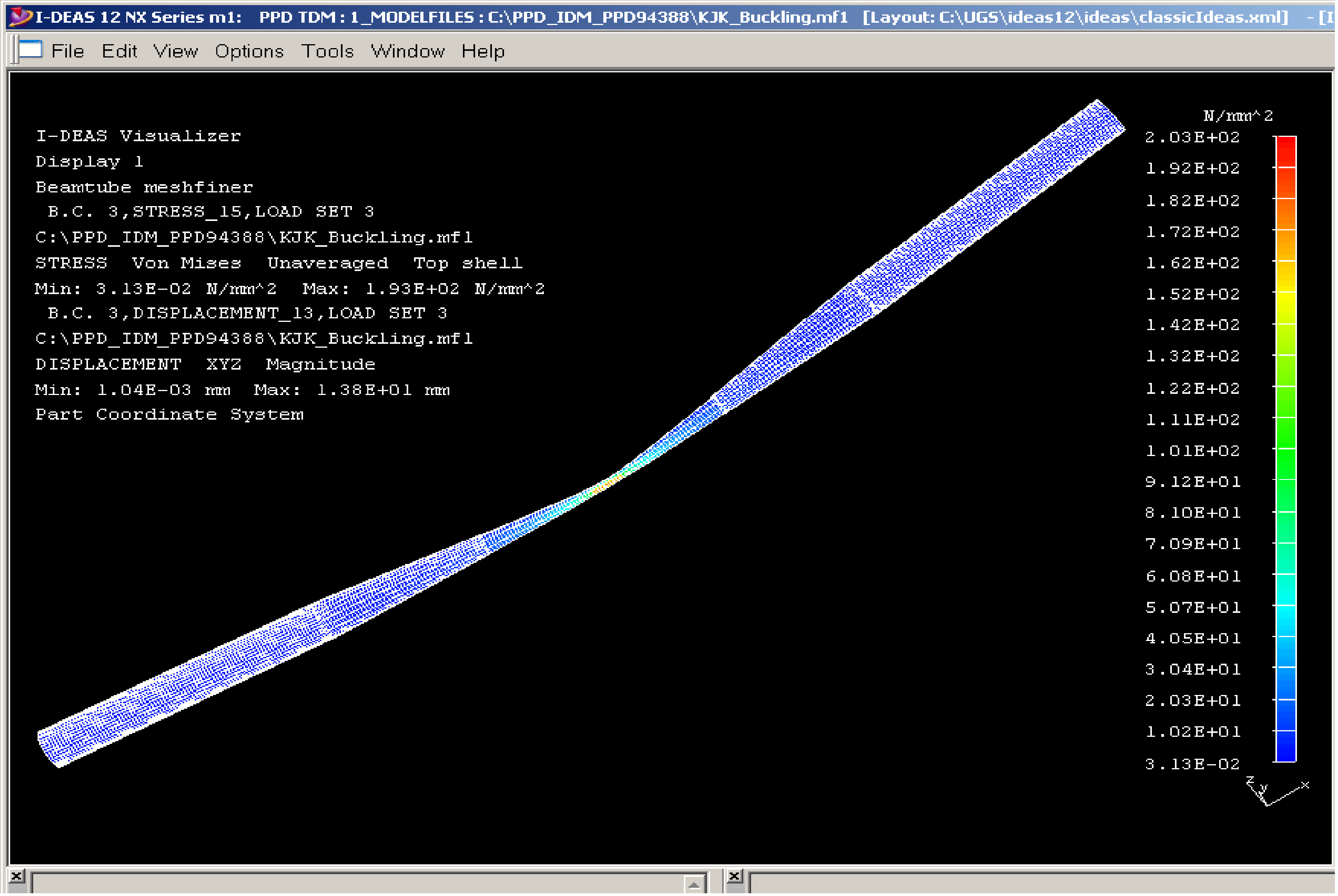
IR Engineering
Detector Opened 6M



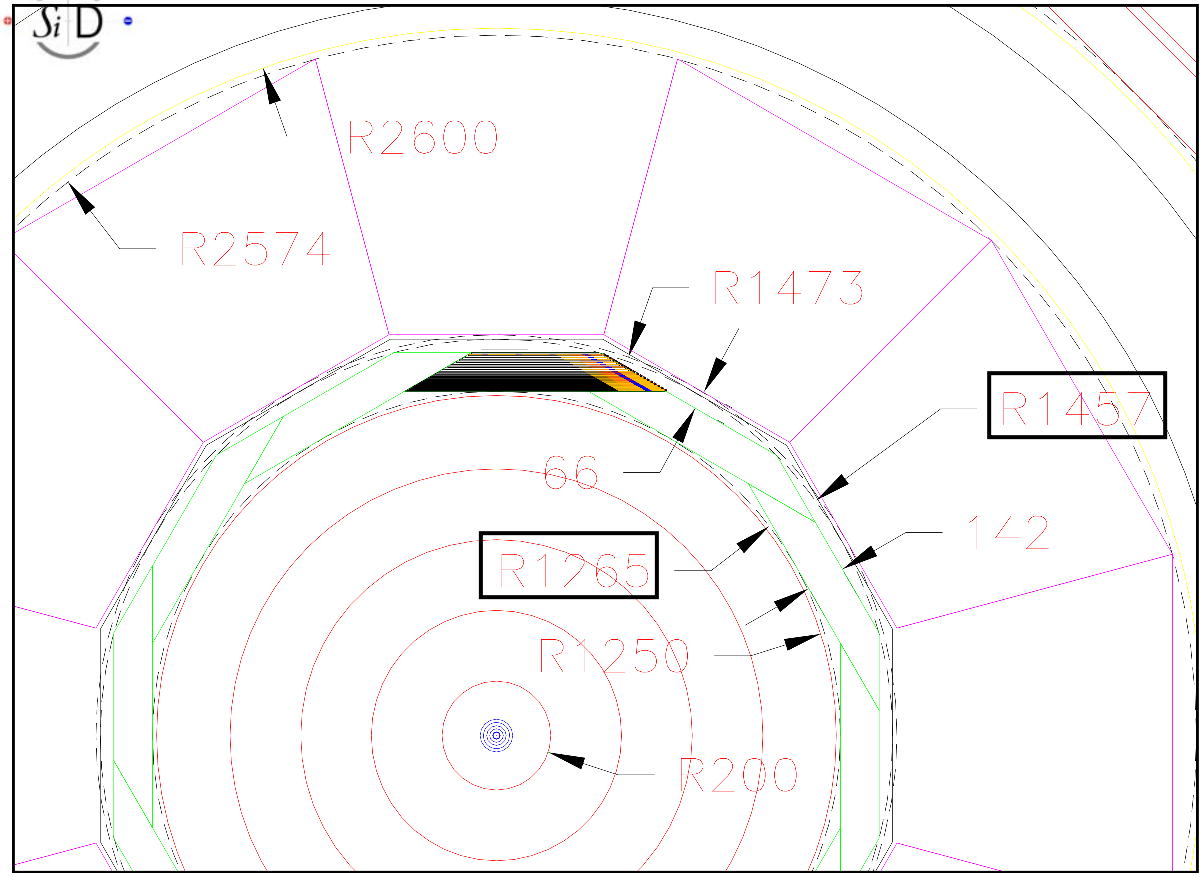
Beam Tube From LumiCal to LumiCal-Cooper/Krempetz-Fermilab



Beam Tube Deflections-with Vertex Detector



Parameters Si/W ECAL barrel



Physics requirement

Radial envelope: 1265 mm to 1473 mm

12 wedges over 2π

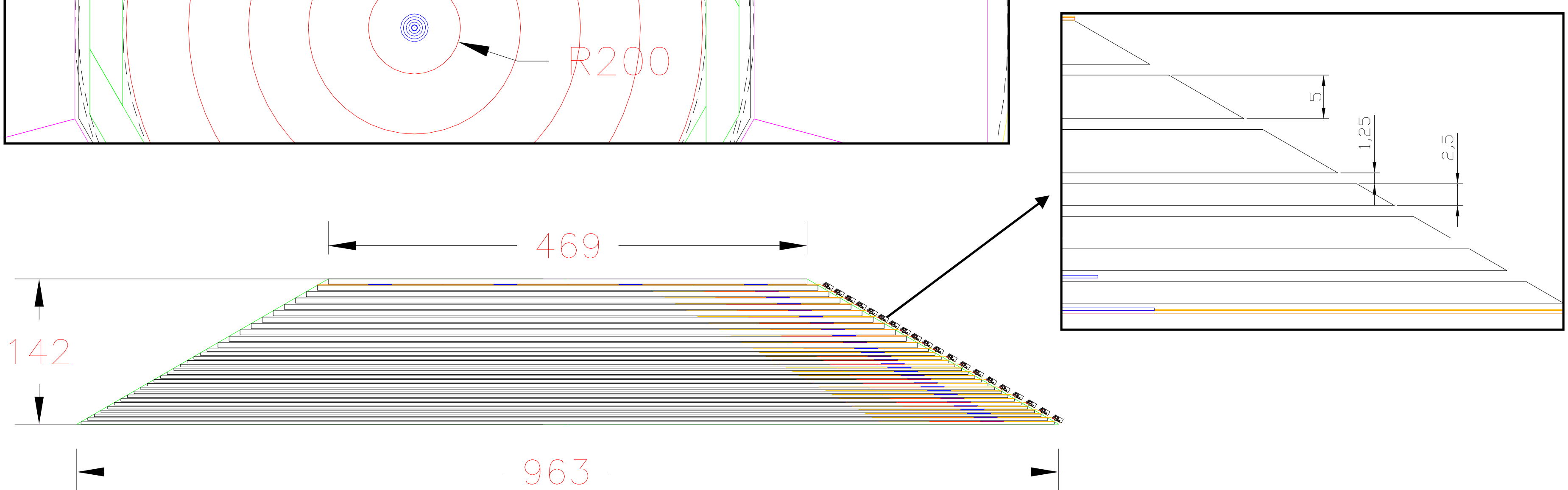
20 tungsten layers of 2.5 mm

10 tungsten layers of 5 mm

Instrumented gap 1.25 mm. i.e. shortest Moliere radius

Z length: 3600 mm

Wedge mass 4900 Kg



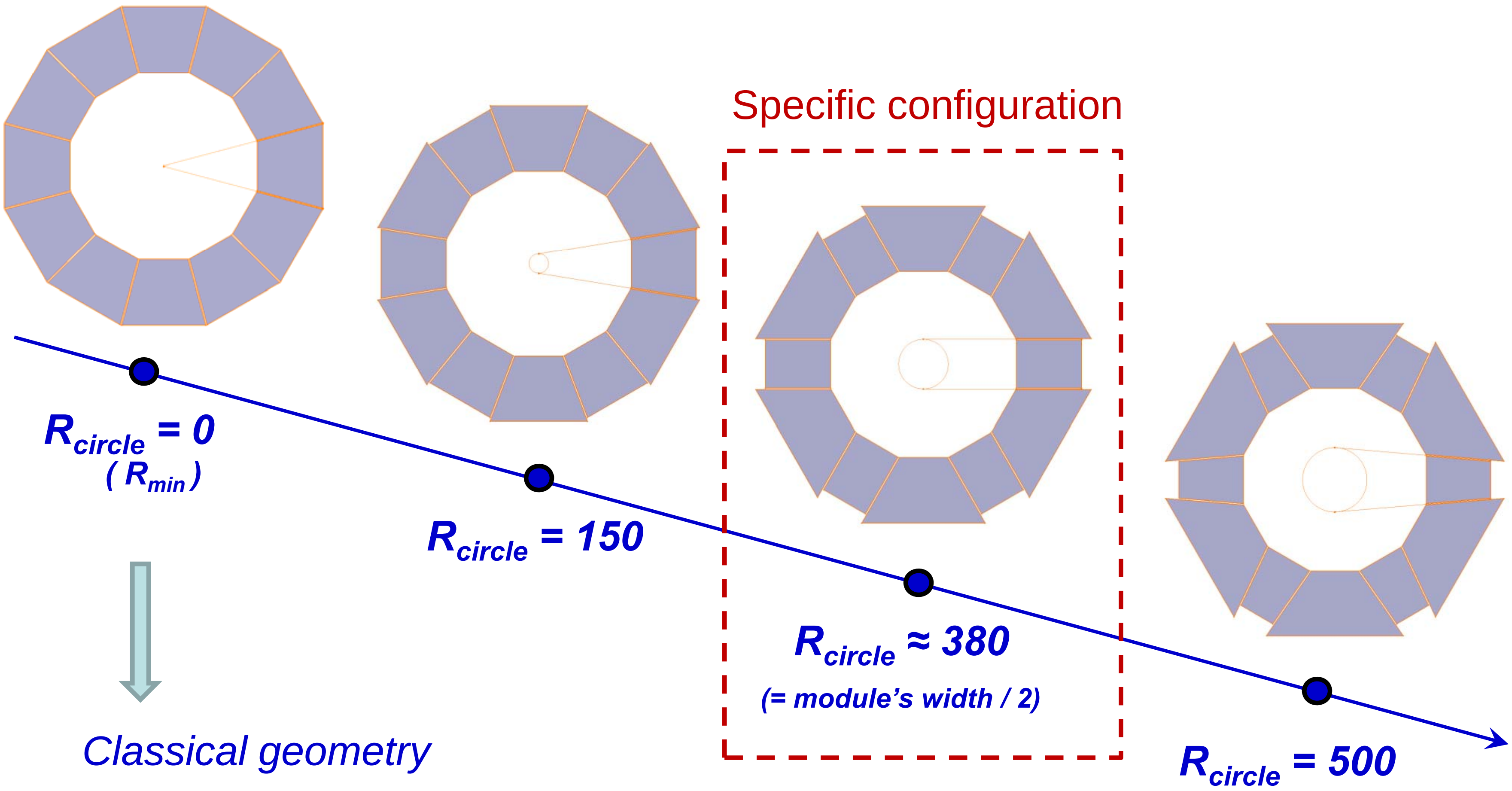
Hcal Absorber Plates

- Try to design one common absorber plate configuration
  - Plate thickness-20mm
  - Gap thickness-8mm
  - No point cracks to IP, minimize all cracks/dead space
  - Detector modules are removable from gap
  - Absorber Material might change

Study of a new Hcal geometry…

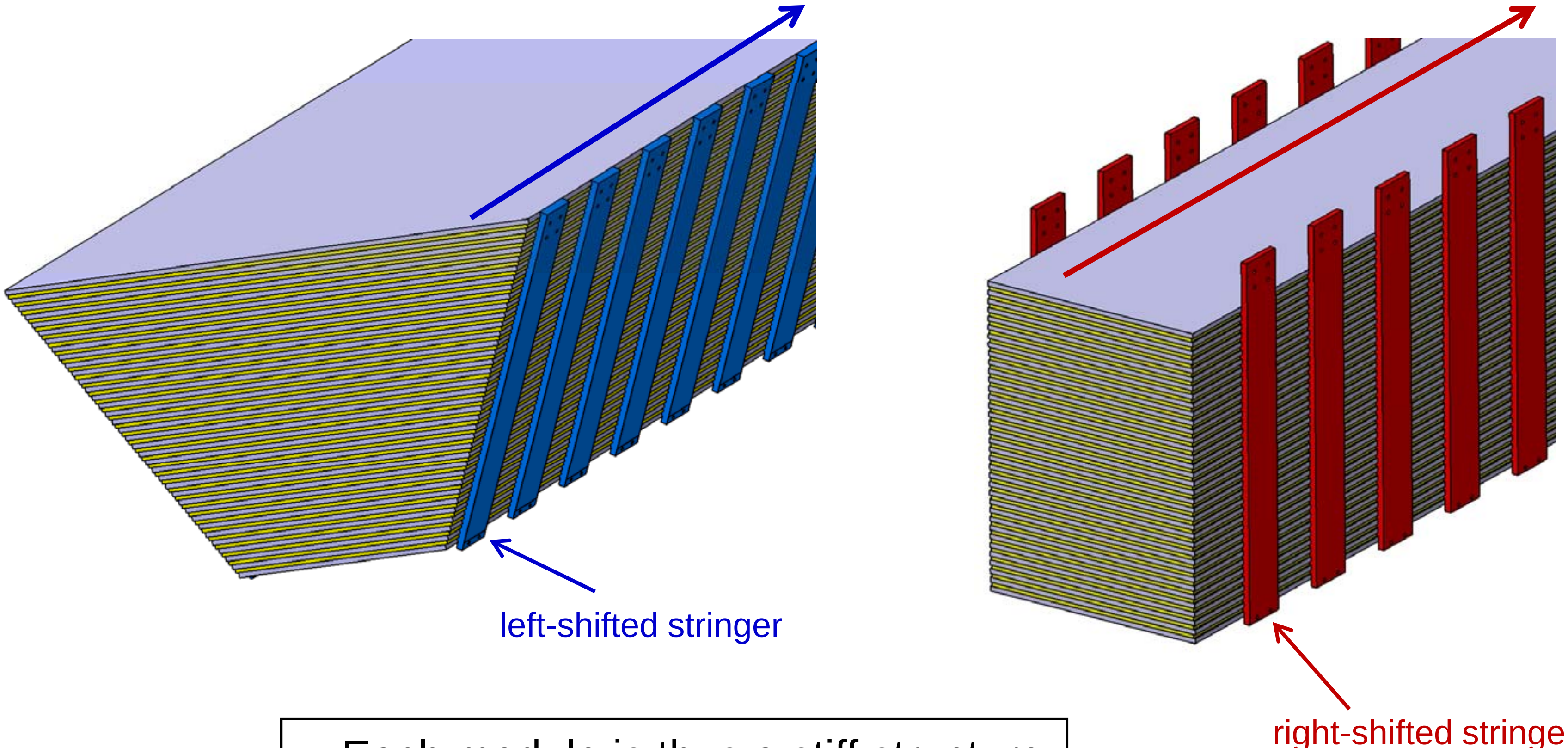
- 2^{nd} version -

Examples of tilt level as a function of the tangent circle radius



Proposal of Hcal assembly

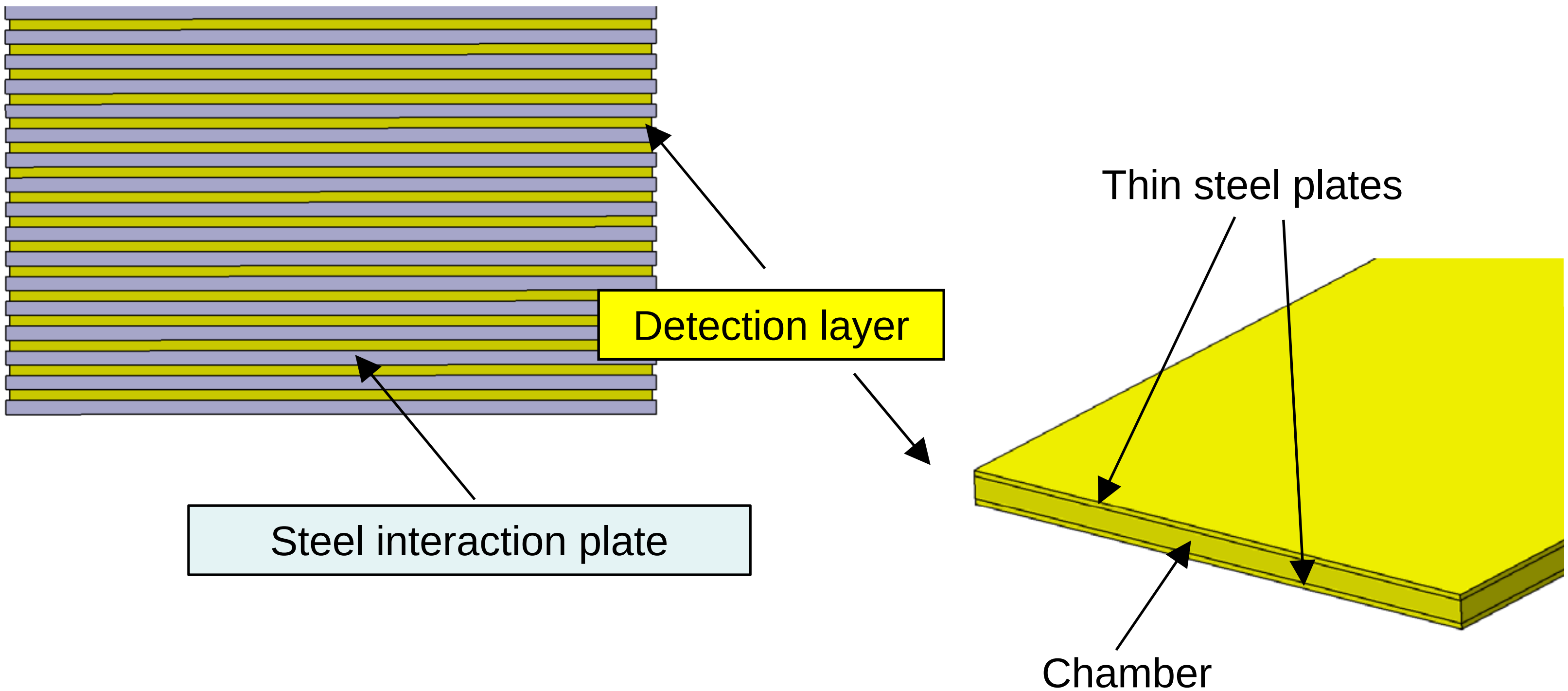
Several stringers are welded along the module



➡ Each module is thus a stiff structure in which chambers can be inserted

Proposal of Hcal assembly

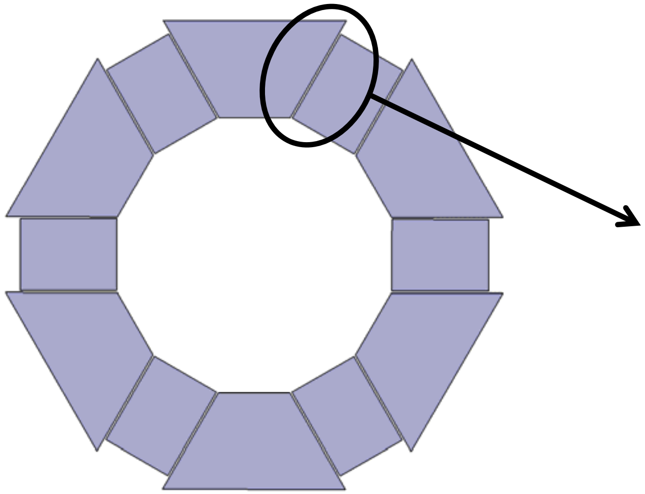
Detail of a detection layer

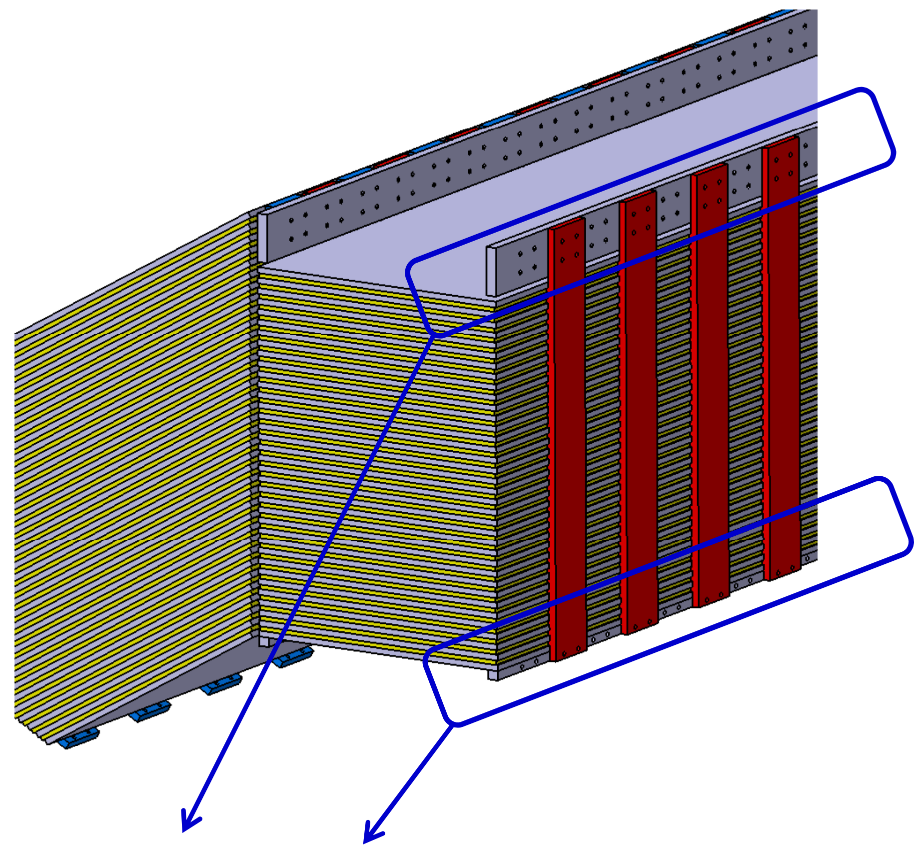


A detection layer ("sandwich part") consists in a chamber rigidified with two thin steel plates.

➡ **Protection and stiffness !**

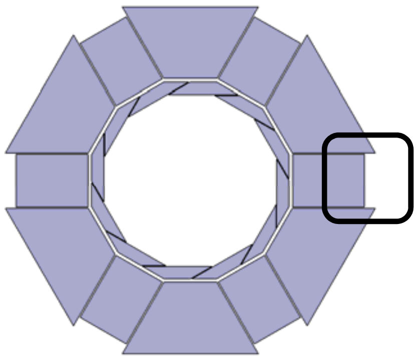
Proposal of Hcal assembly



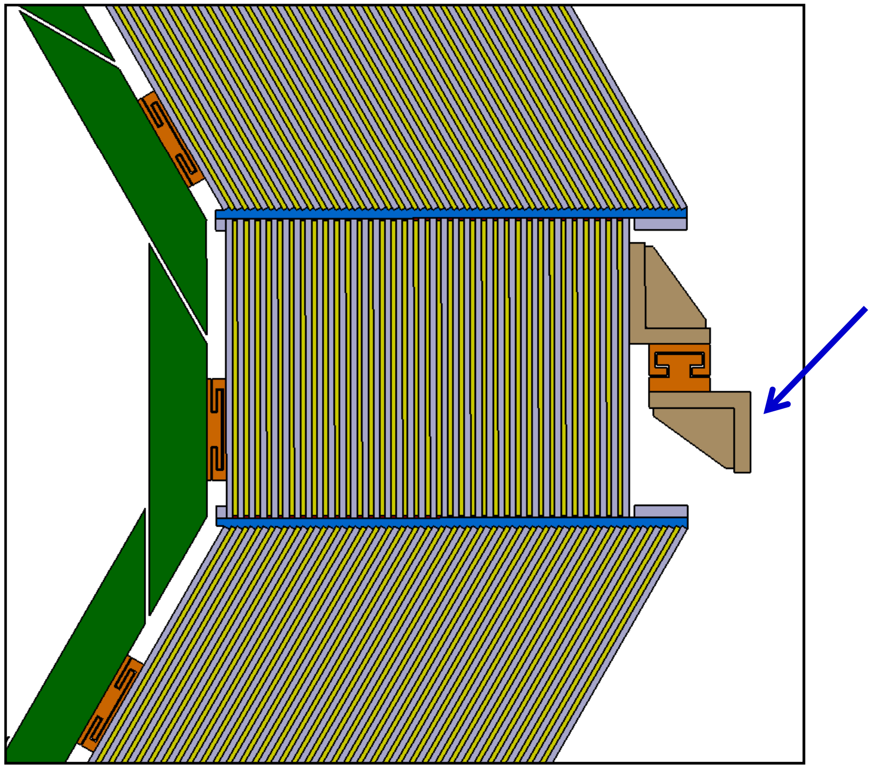


Inter-modules fixation: 2 small plates are screwed on blue and red stringers.

Proposal of Hcal assembly



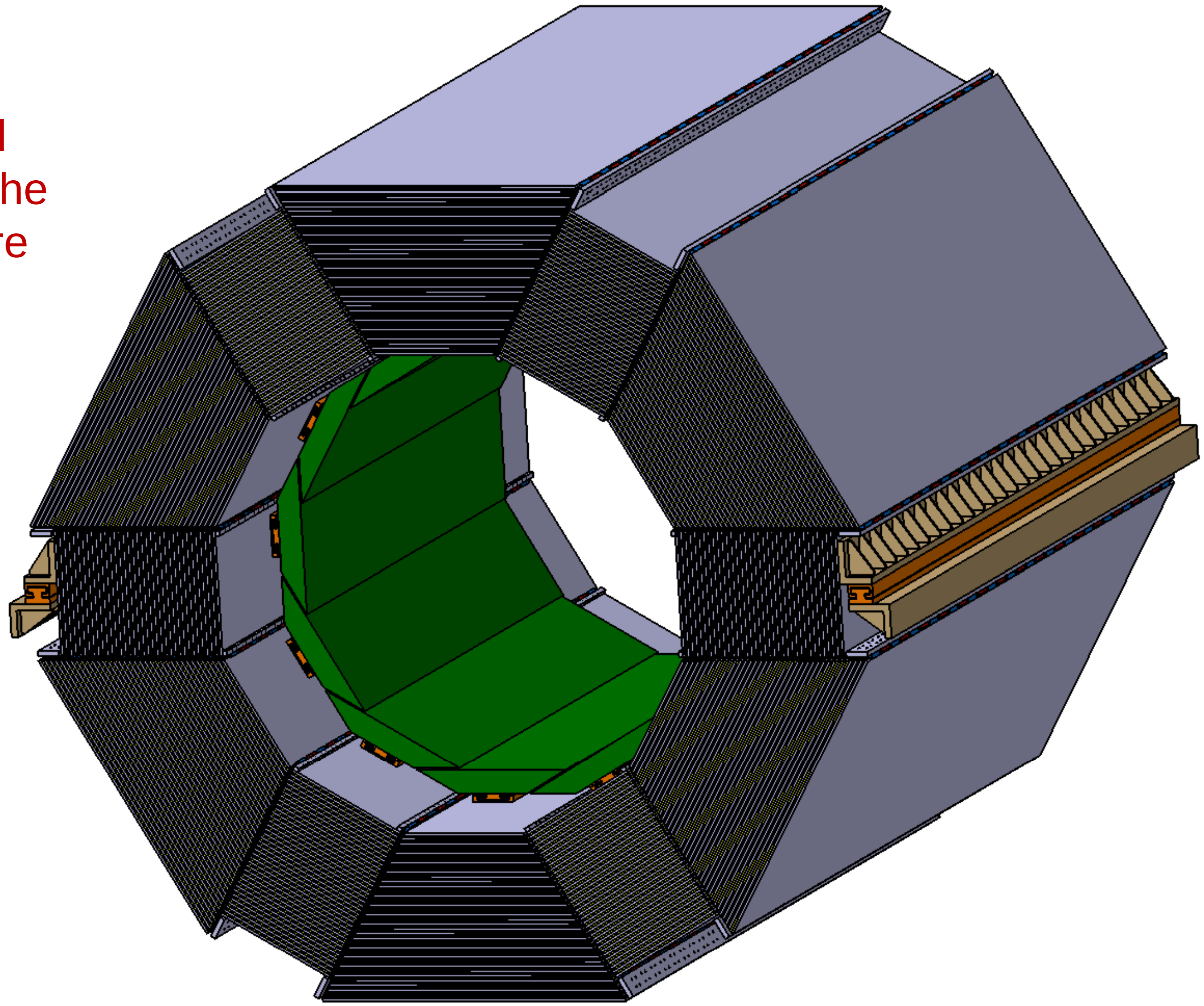
3h & 9h fixation



The whole system (Hcal & Ecal) slides inside the magnet thanks to rails.

Proposal of Hcal assembly

Global view of the structure



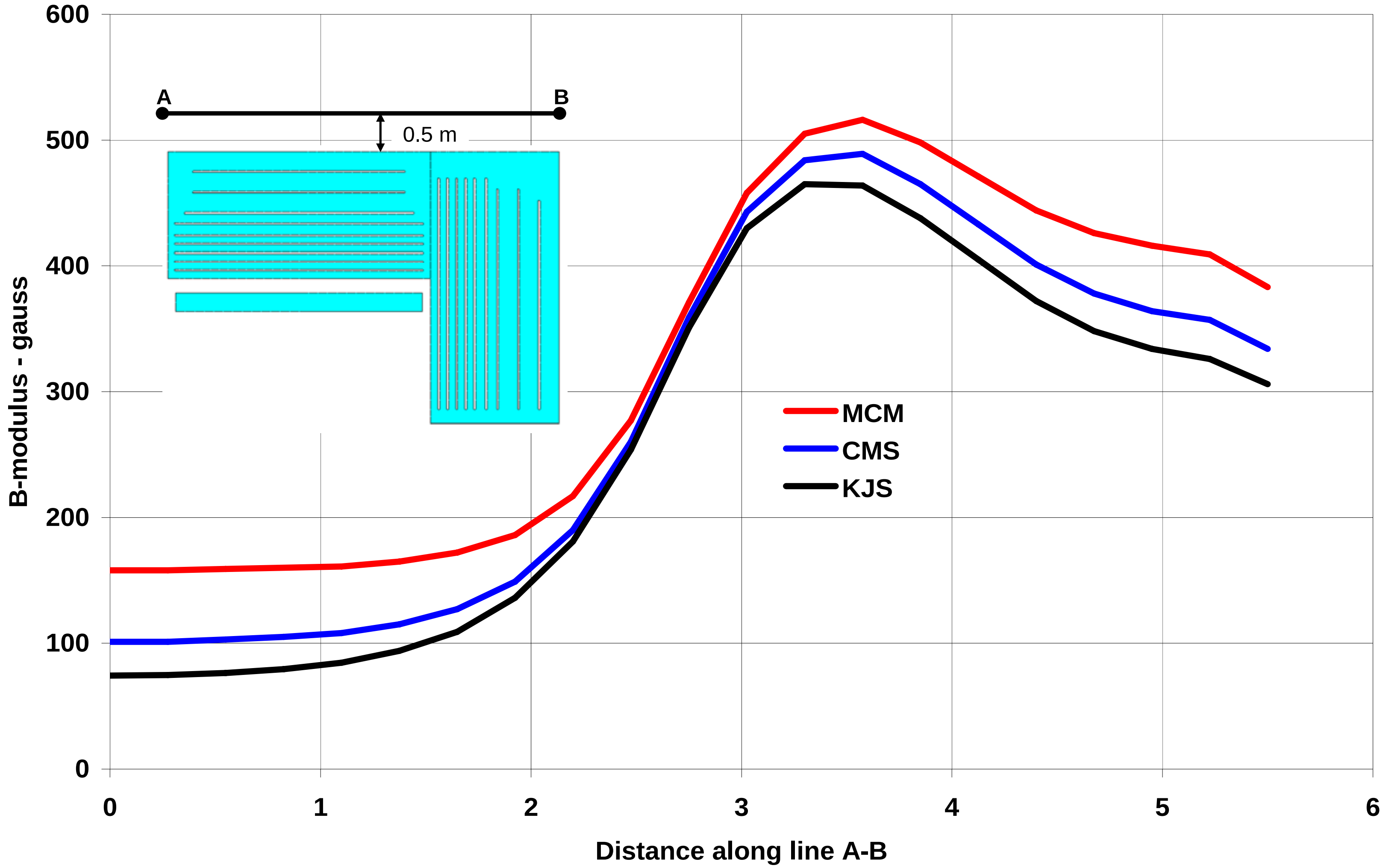
SiD Solenoid Baseline

- 5 Tesla
- 5m diameter clear bore
- 5m Long
- 6 Layers
- Stored Energy 1.4 GJ
- Water Cooled Dump Resistor

Flux Return

- Octagonal Barrel and Endcaps
- Fringe Field Issues outside the detector
  - <100 gauss

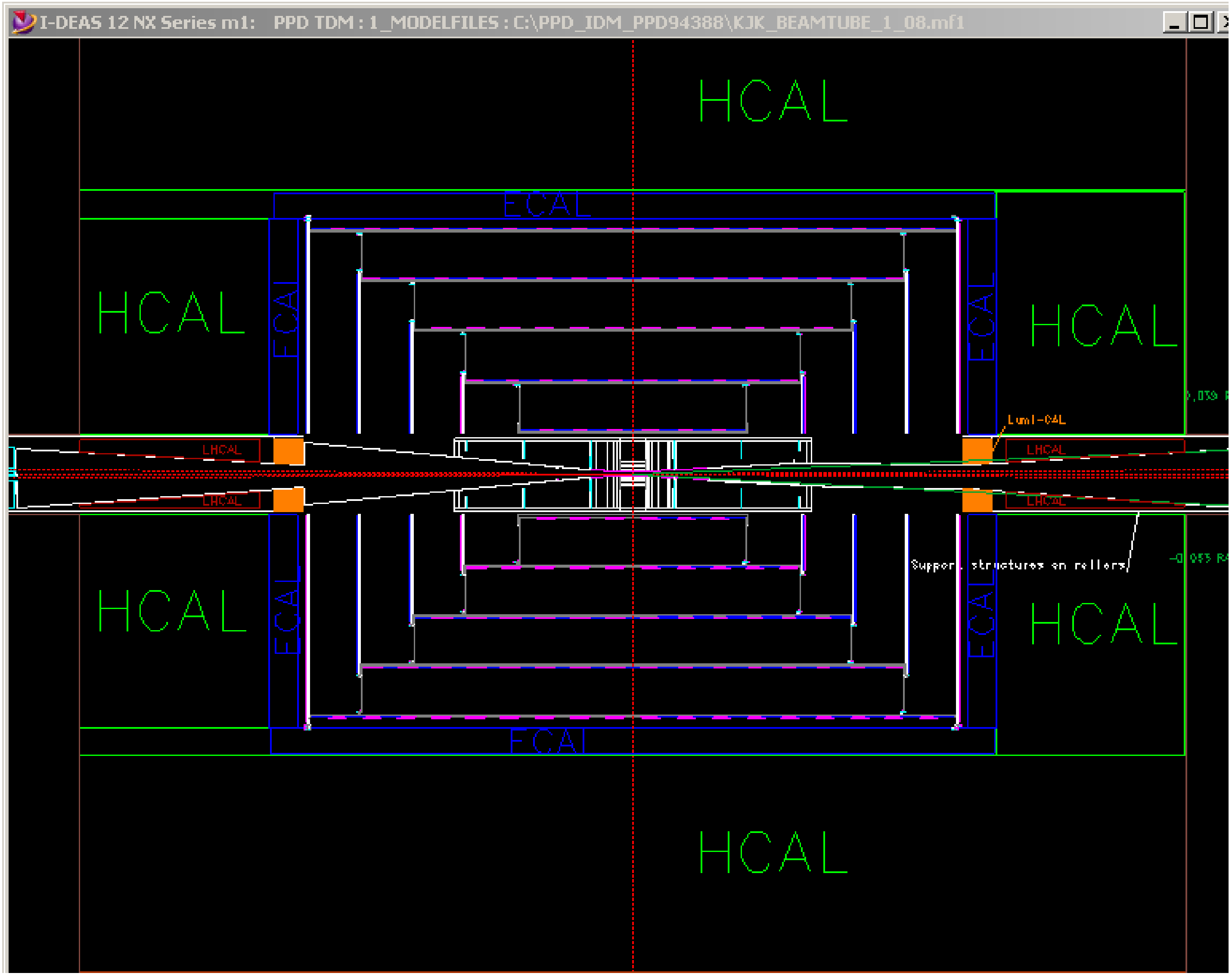
Fringe Fields - Comparison of Results for Three Curves



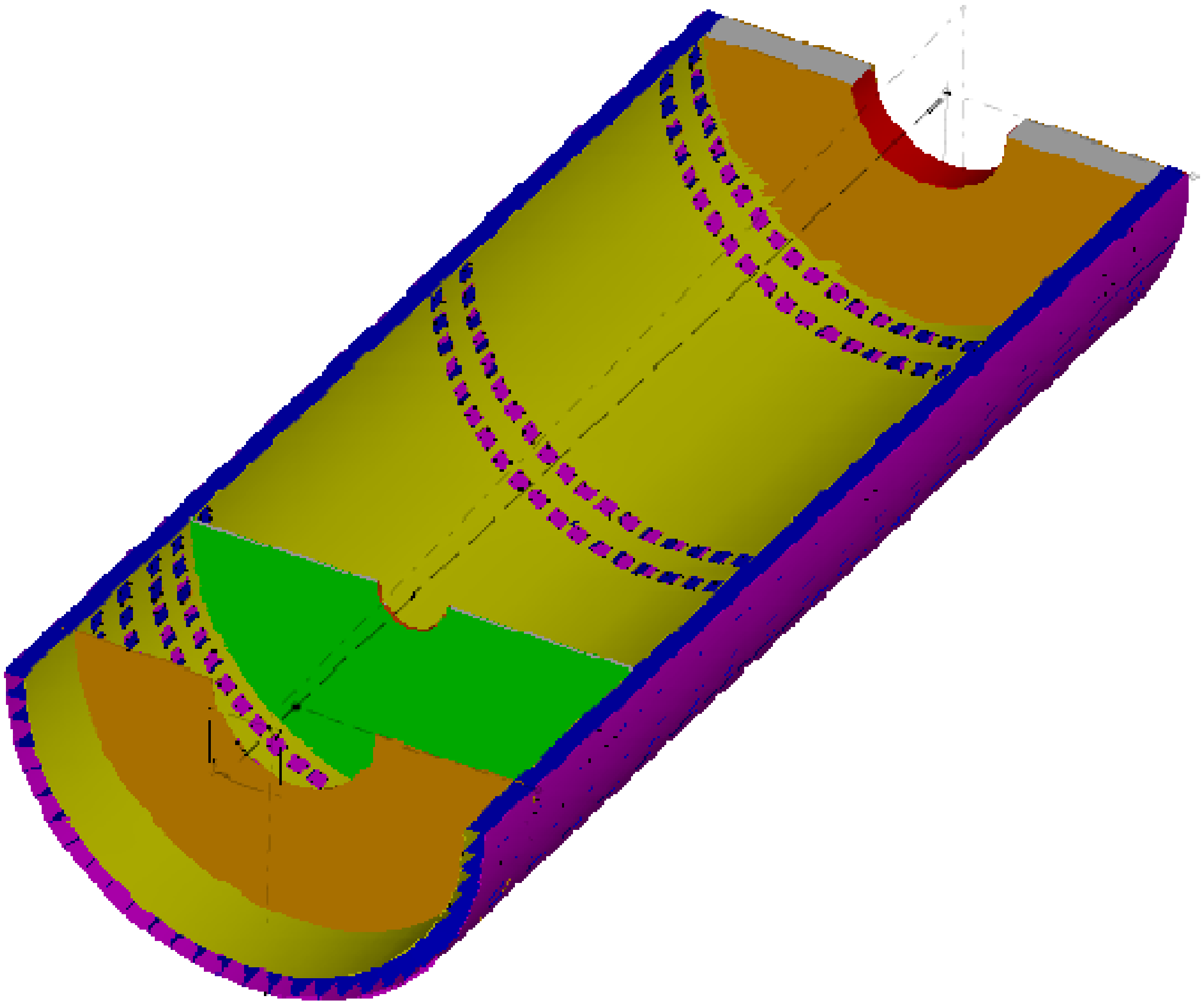
Recent Work

- Beam tube Studies
- Vertex Detector Mechanics
- Ecal
- Hcal
- Iron Barrel
- End Wall/Endcap
- Magnetic Field Calculations with a Bucking coil
- MDI Issues

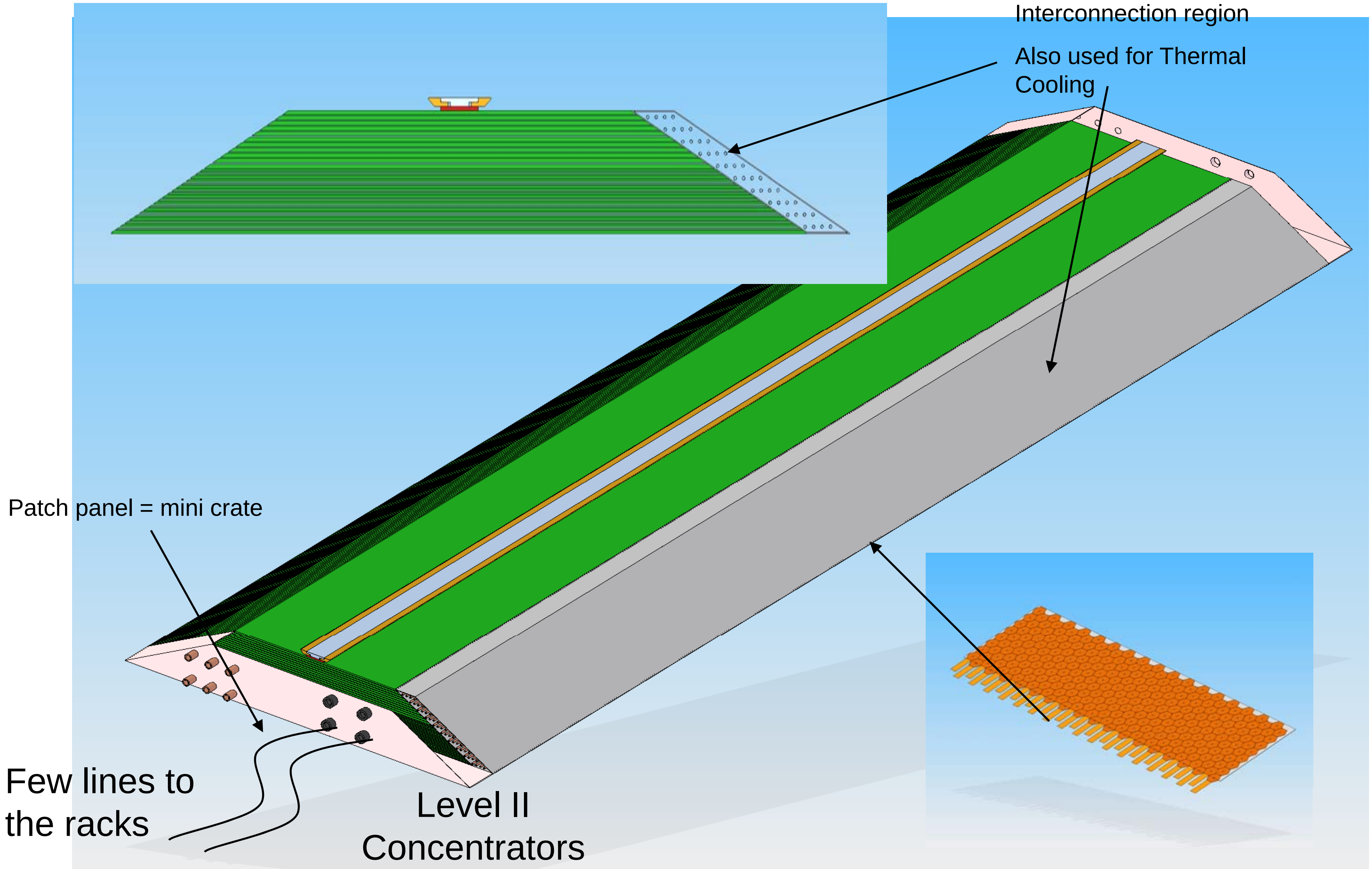
Other Beam Tube Proposals
HCal Configurations



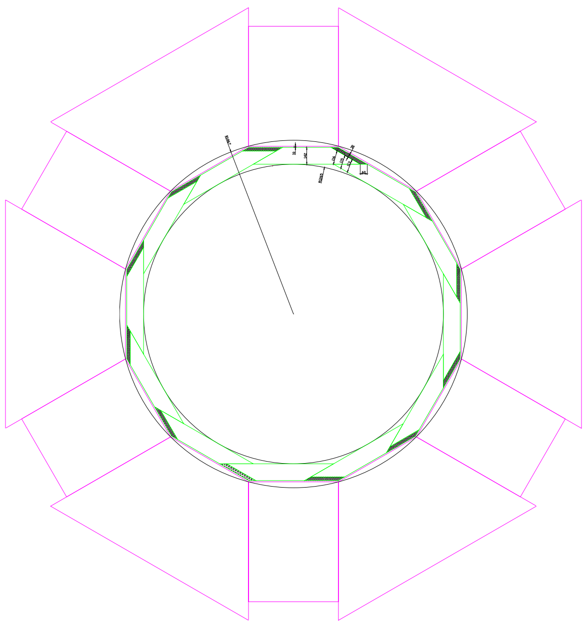
Vertex Detector/Beam Tube Support Exoskeleton



Ecal


Interconnection region
Also used for Thermal Cooling
Patch panel = mini crate
Few lines to the racks
Level II Concentrators

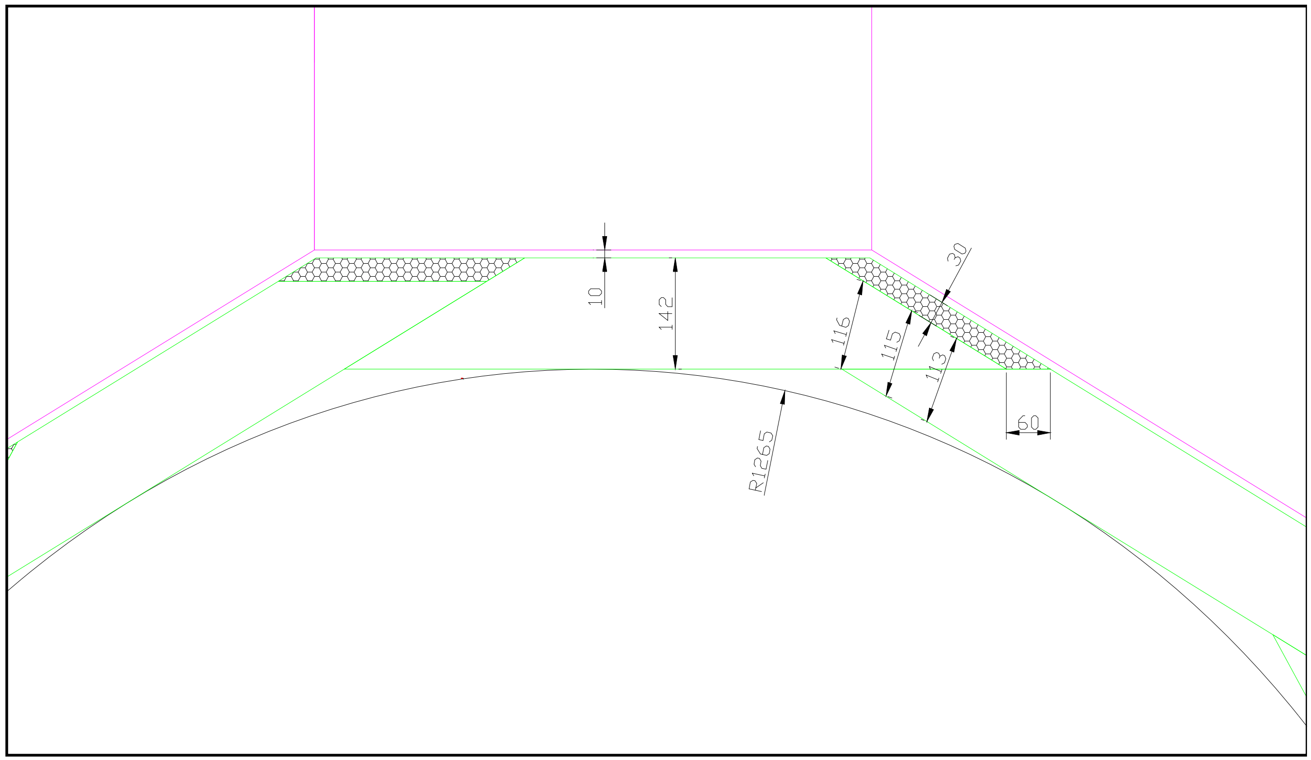
Optimization of the EMcal-Hcal interface, Option 1:



10mm gap (20 max allowed for physics)

60mm interconnection region integrated in the EMcal wedge envelope

20% of local loss of radiation length



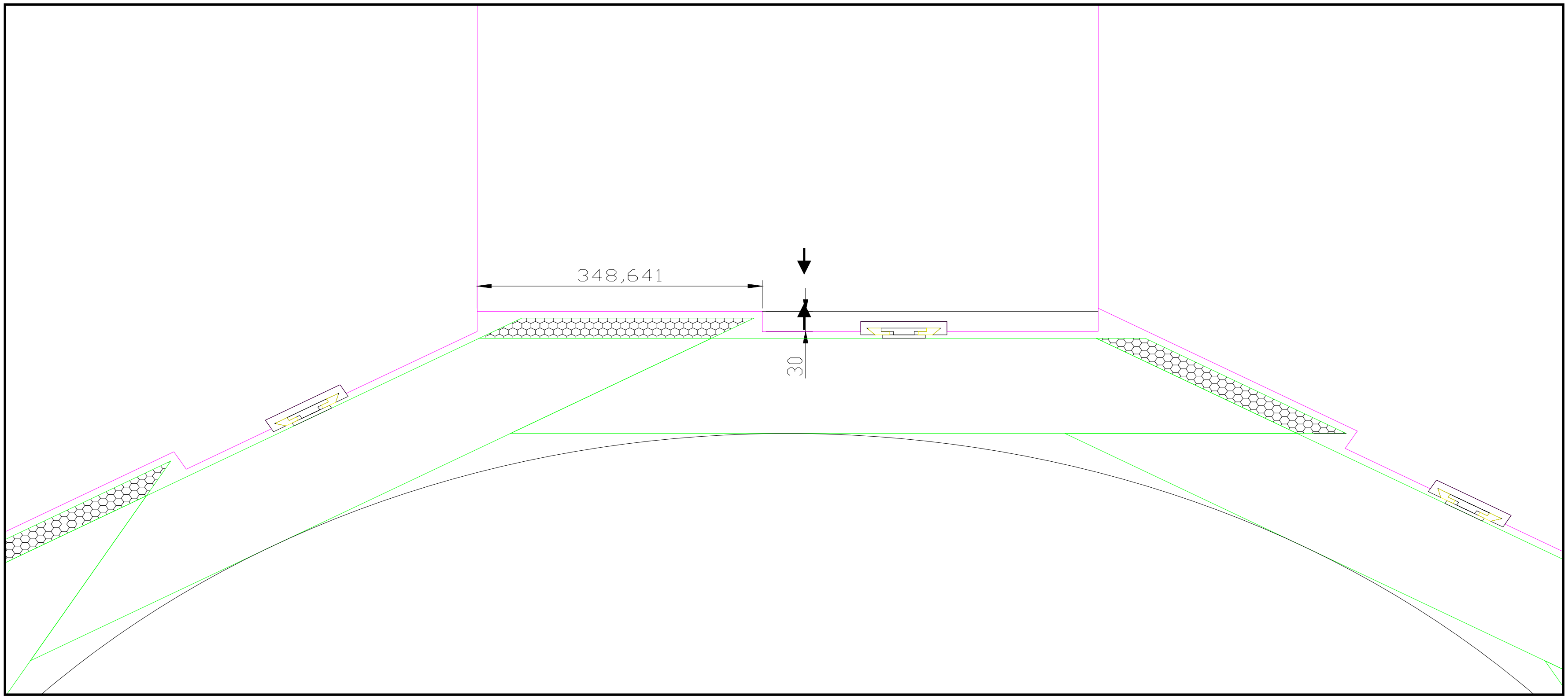
Optimization of the EMcal-Hcal interface, Option 2:

10mm gap (20 max allowed for physics)

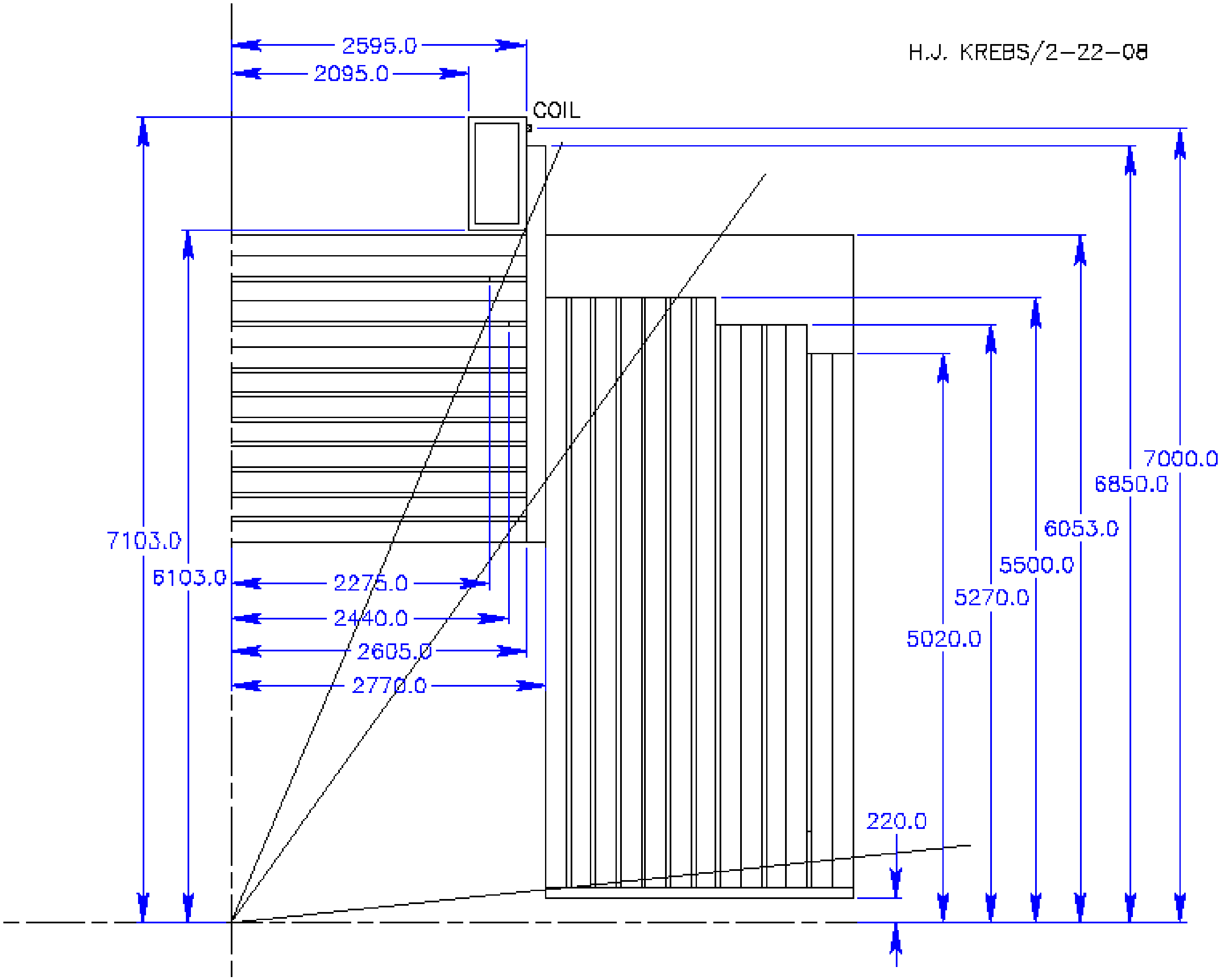
60mm interconnection region outside the EMcal wedge envelope

Notches on the first Hcal plate: absorbers

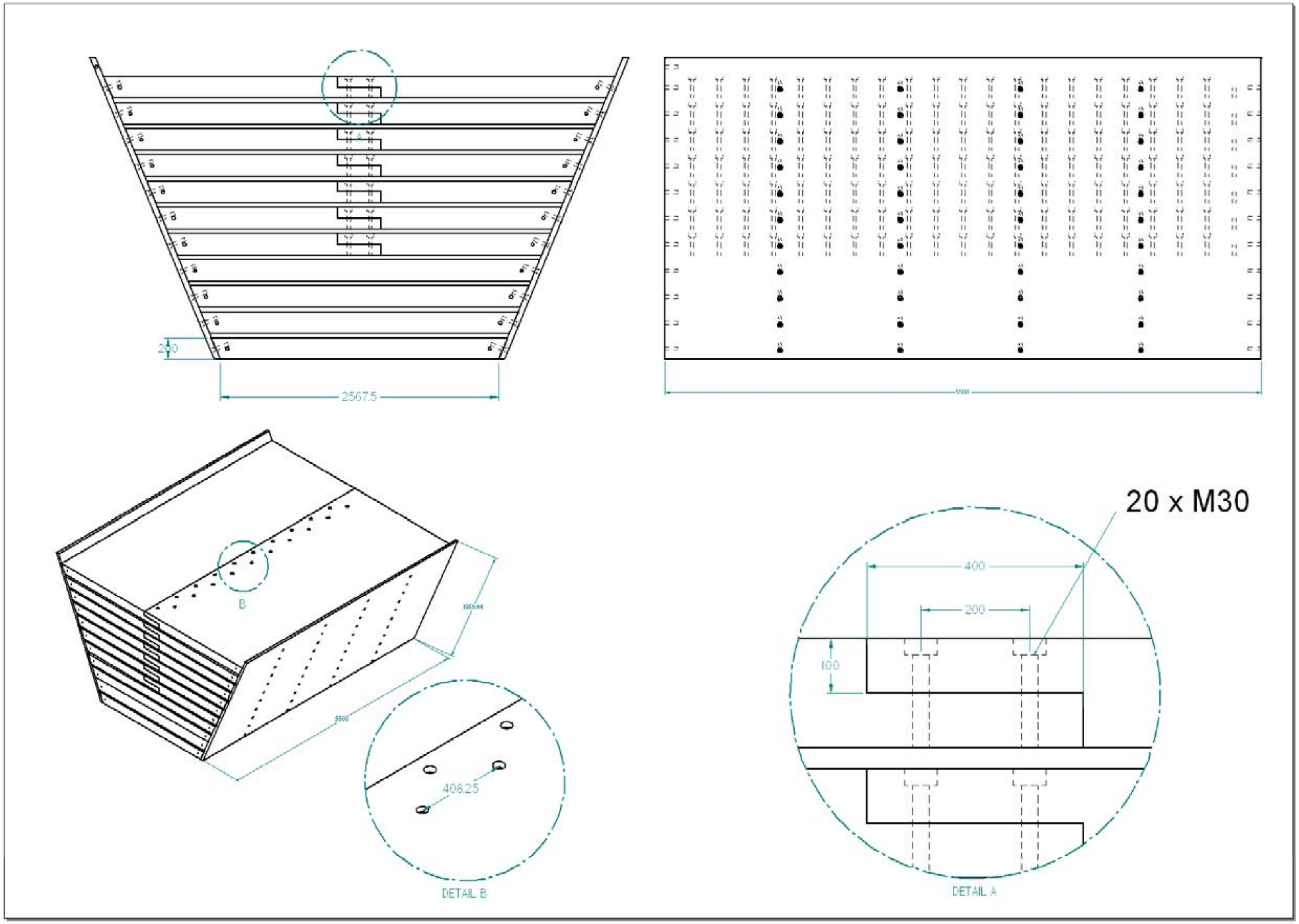
no local loss of radiation length vs some loss of interaction length



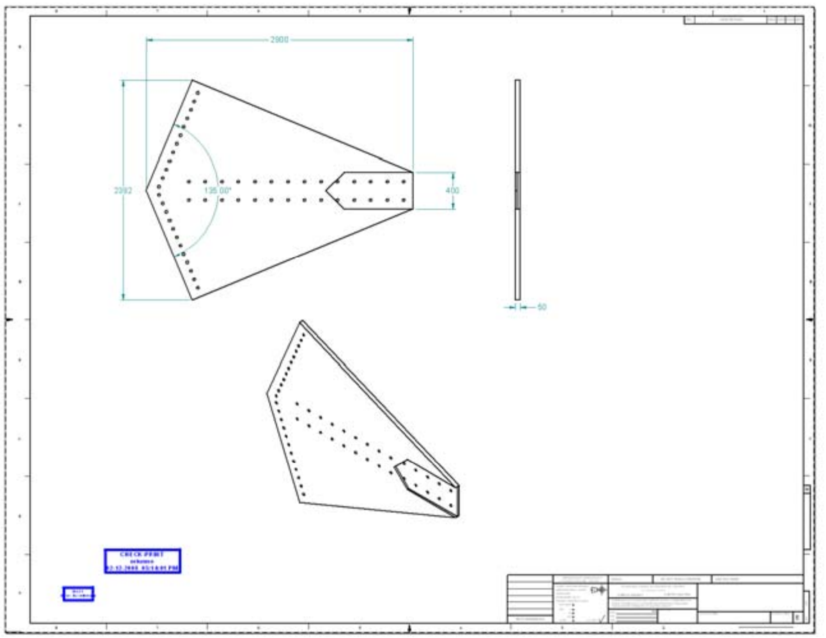
Proposed Return Flux End Layout

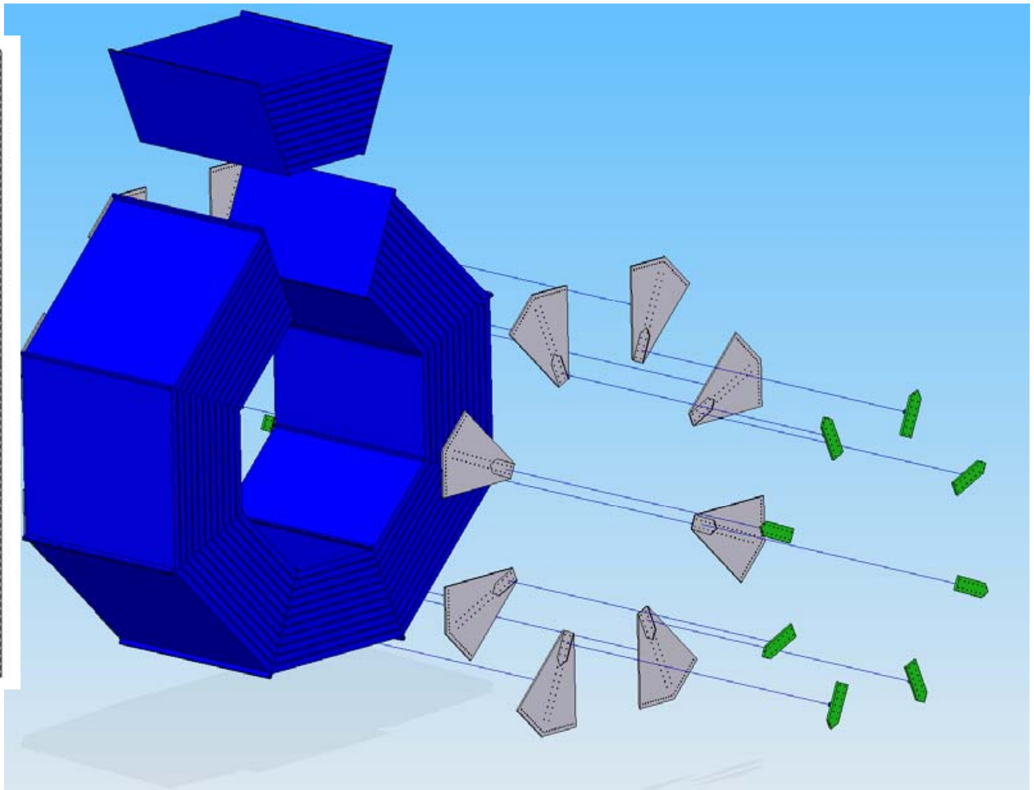


Return Flux Barrel Modules



Barrel Iron Assembly

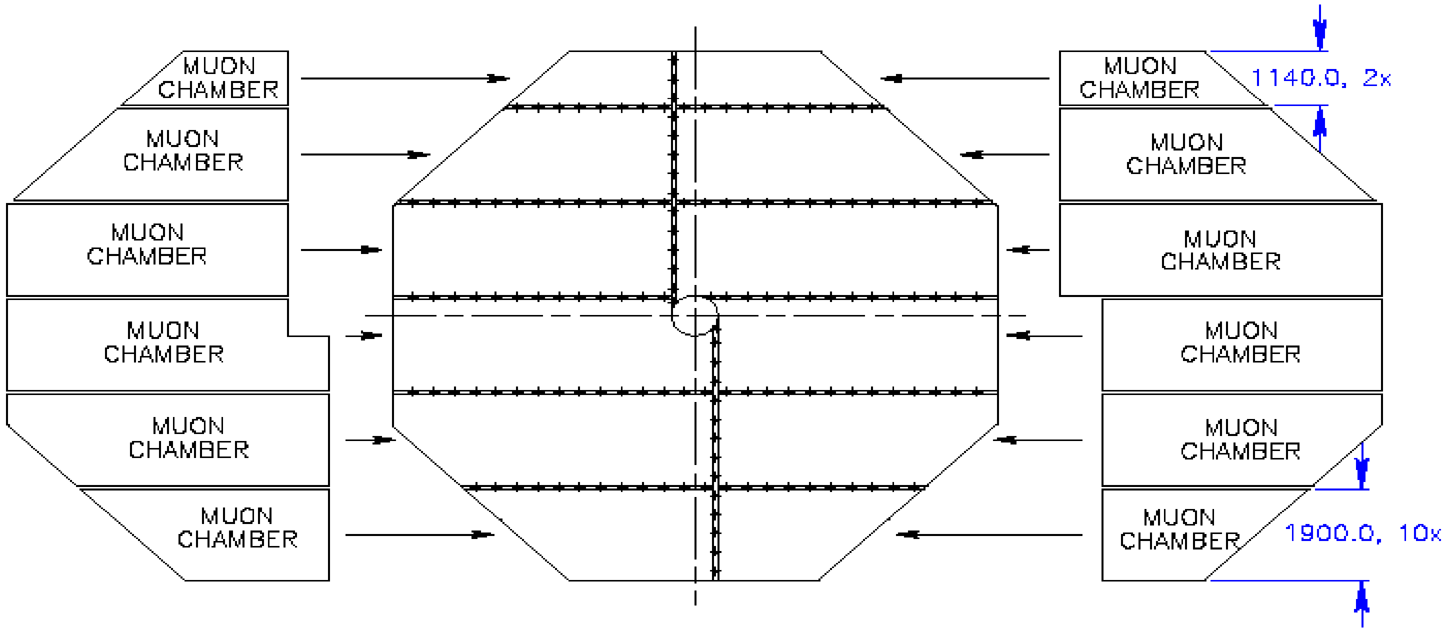




Modified End Wall End Cap Design

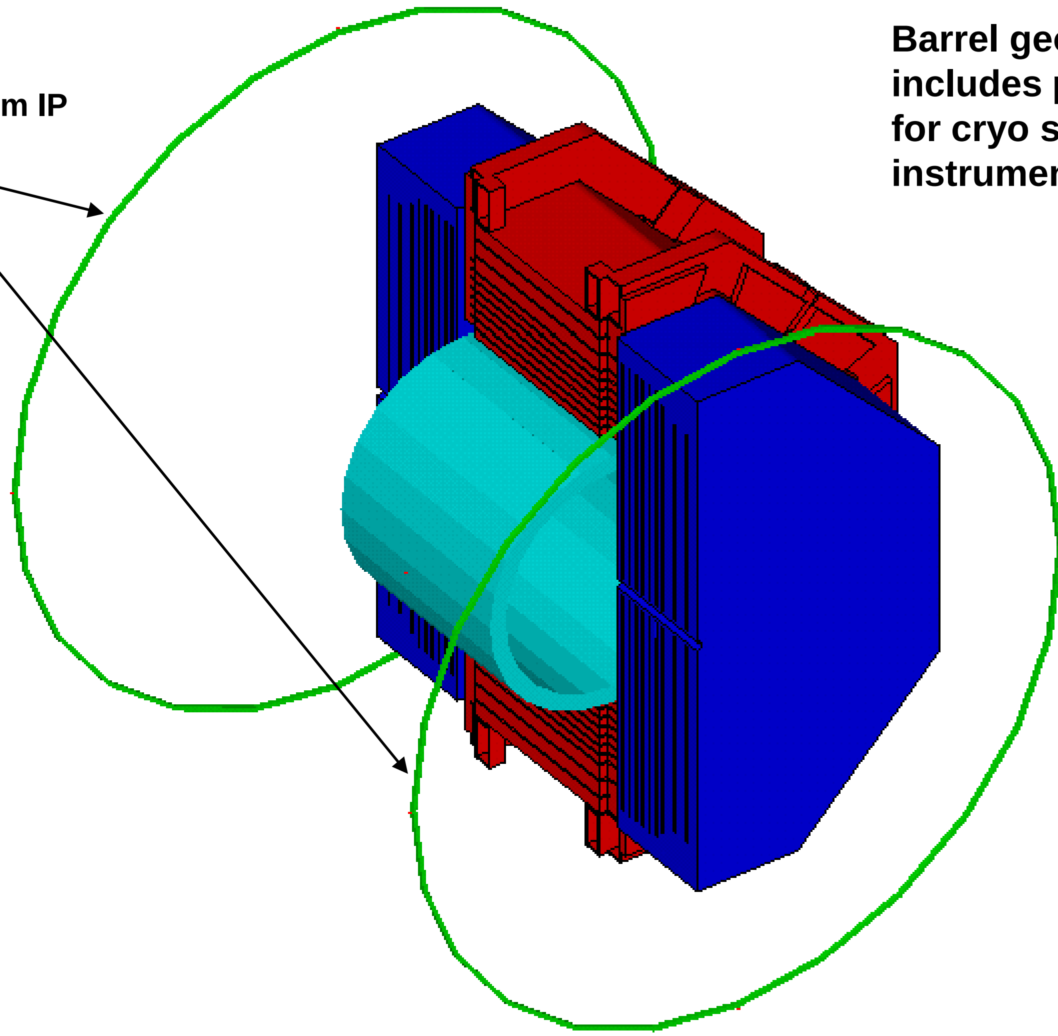
- Uses continuous cast steel plates rolled to 180mm thickness
- 40mm gaps for muon identification chambers
- Plate-to-plate spacers are staggered for better muon identification coverage
- Welded and bolted construction
- 100mm thick inner support cylinder

Muon Chamber Installation Replacement



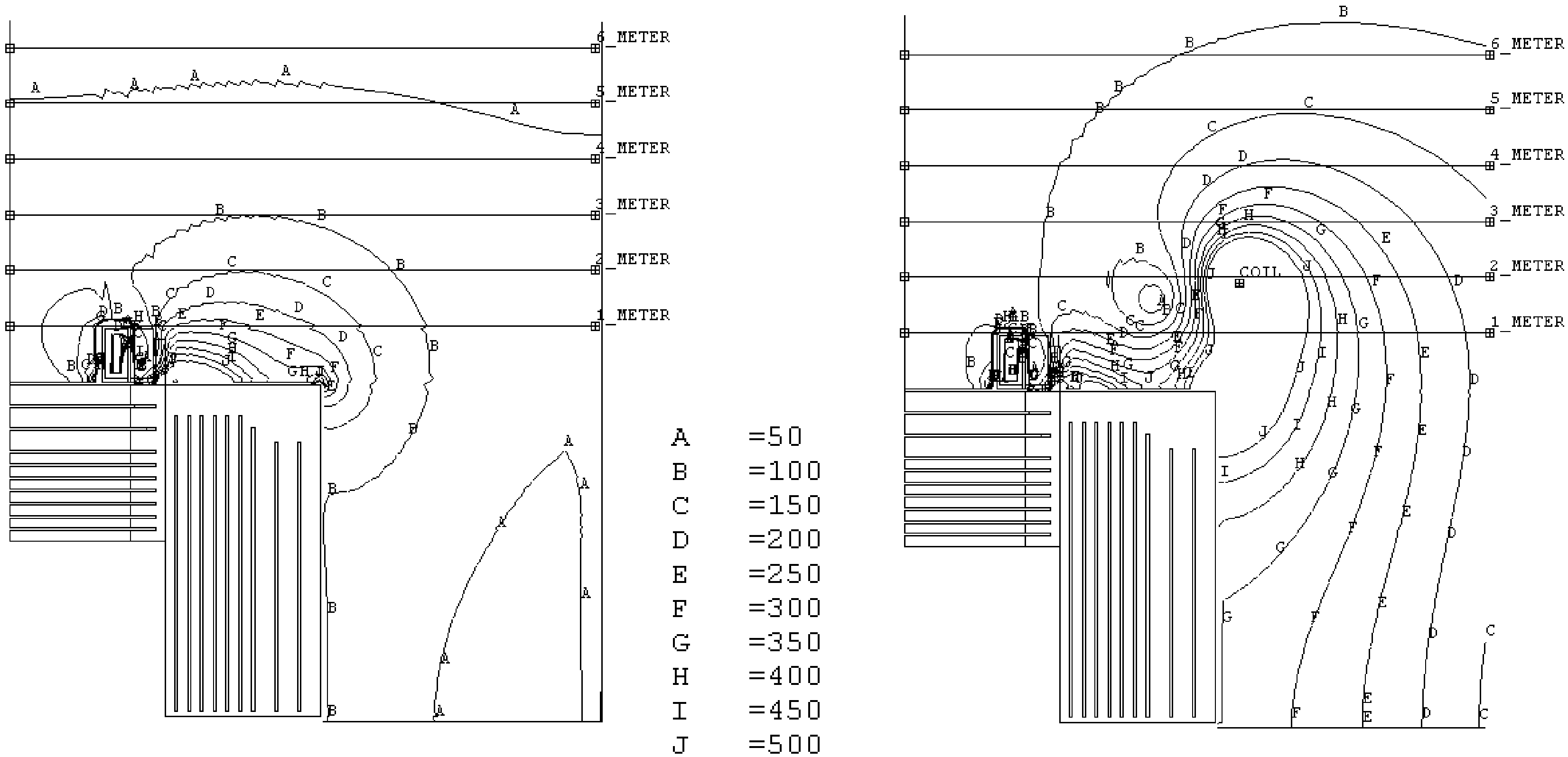
Using Bucking Coils to Reduce Fringe Field Outside of SiD Barrel

radius = 8 m
z-location = 7 m from IP
NI = 2e5 A-t

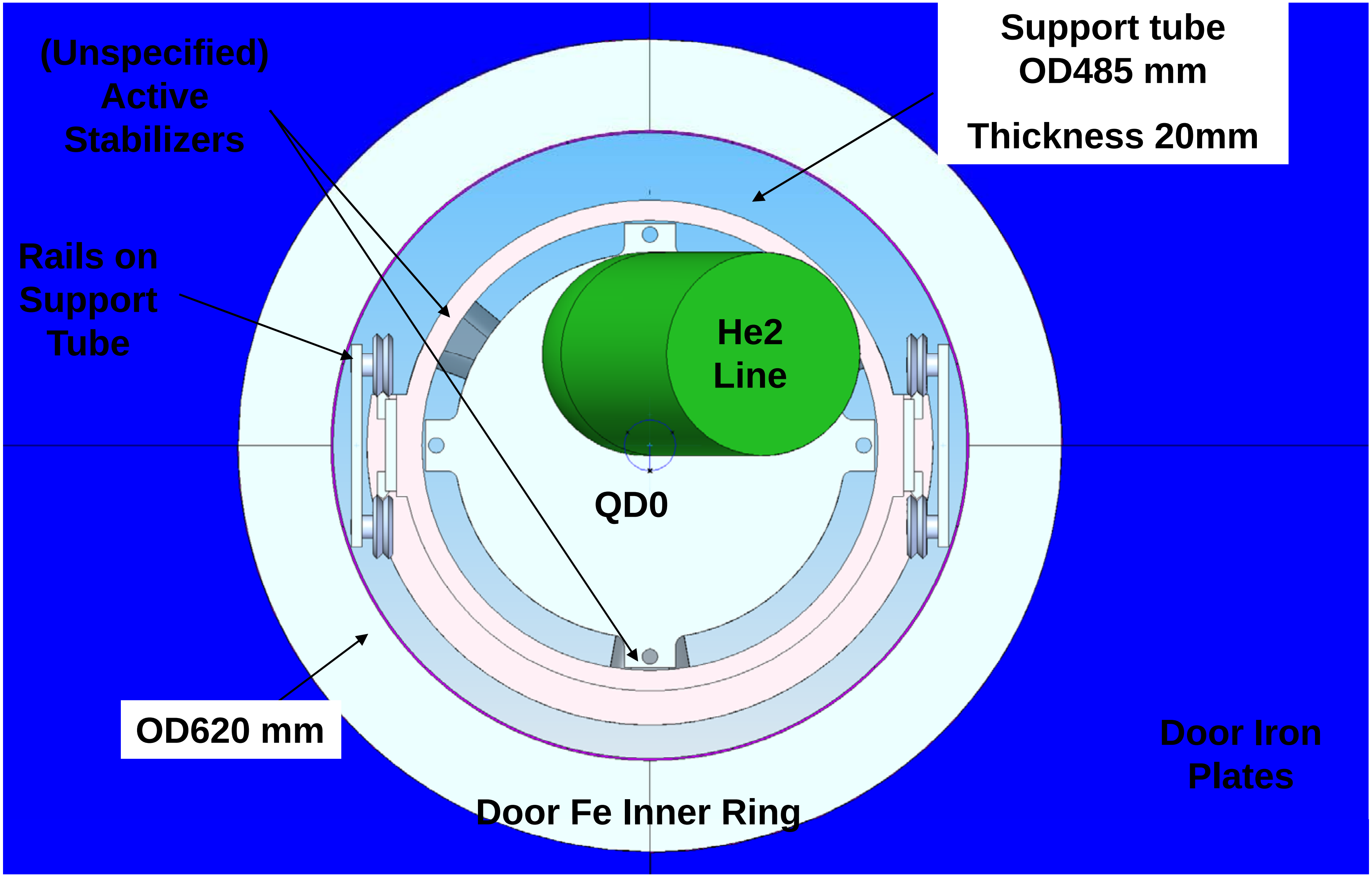


Barrel geometry includes penetrations for cryo services and instrumentation

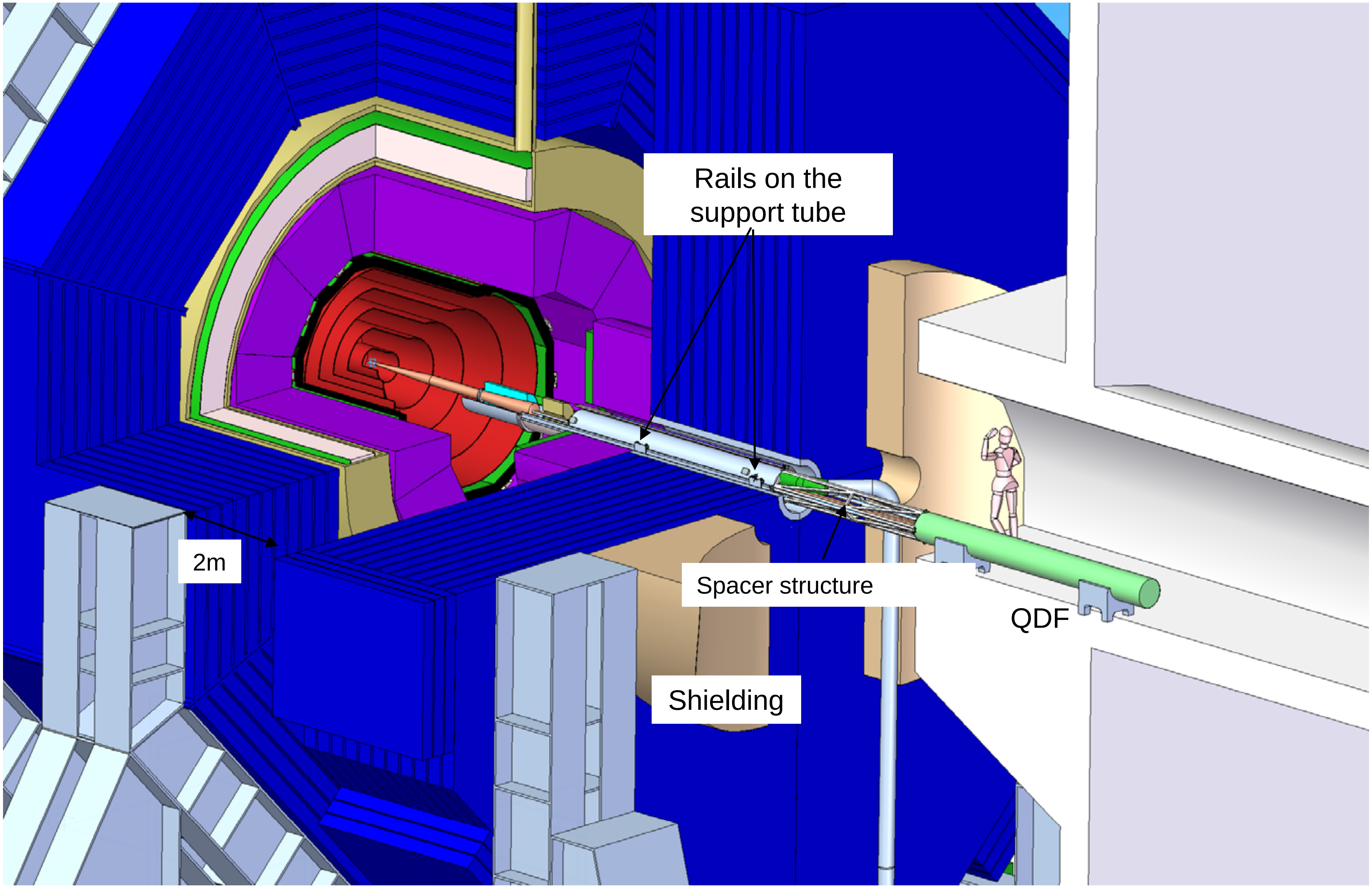
Contours of Constant B-modulus – Carbon Steel Support Beam, with and without Bucking Coil



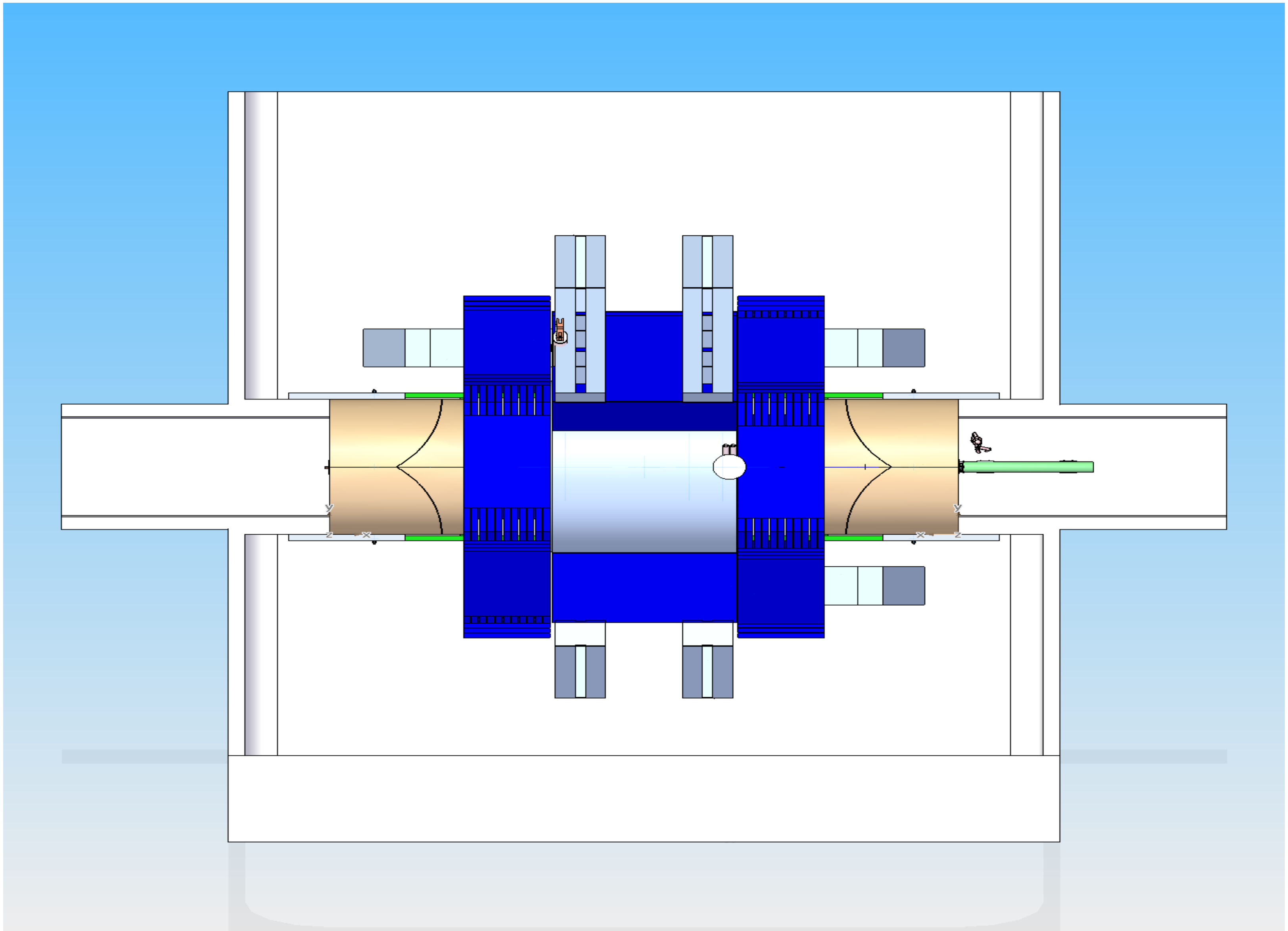
QD0 support in the door (view toward IP)



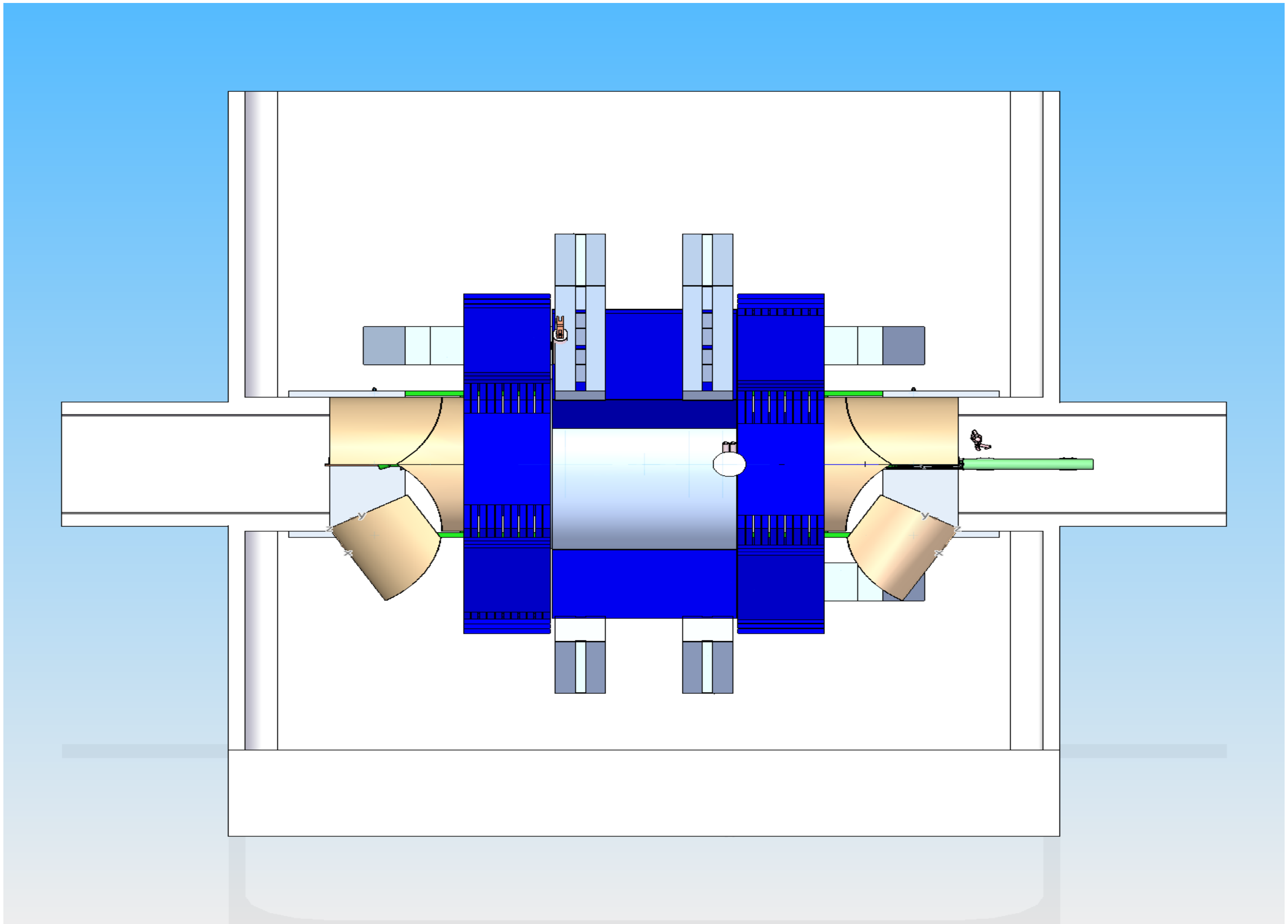
2m Door opening Procedure, on the beam



Proposed Pacman Configuration



Proposed Pacman Configuration-Opening



Specific Engineering Issues in regard to Simulation Studies

1) HCal- Overall Detector Thickness; Crack configurations Proposals; Number of Detector Gaps needed
2) Si Tracker- Moving Barrel #1 Radius out to allow for QD0 Support Proposal
3) Vertex/Forward Detectors-Different Beam Tube Configurations
4) ECal-Overall Detector Thickness needed; Varying Absorber Plate Thickness; Number of Detector Gaps needed
5) Solenoid-DID magnet required
6) Muon System-Overall Detector Thickness; Varying Absorber Plate Thickness; Number of Detector Gaps needed

Global Parameters

Detector	Radius (m)		Axial (z) (m)		
	Min	Max	Min	Max	
Vertex Detector	0.0140	0.0600	0.0000	0.1800	
Central Tracking	0.2060	1.2500	0.0000	1.6067	
Endcap Tracker	0.2060	0.4920	0.8499	1.3744	
Barrel Ecal	1.2650	1.4088	0.0000	1.7854	
Endcap Ecal	0.2060	1.2650	1.6467	1.7854	
Barrel Hcal	1.4188	2.3708	0.0000	2.7374	
Endcap Hcal	0.2060	1.4088	1.7904	2.7374	
Coil	2.4644	3.2654	0.0000	2.7374	
Barrel Iron	3.2754	5.9154	0.0000	2.7374	
Endcap Iron	0.2060	5.9154	2.7524	5.3924	
Inter-Detetcor Gaps	m				
DR_GAP_Trkr_EMCal	0.0150				
DR_GAP_EMCal_Hcal	0.0100				
DR_GAP_Hcal_Cryostat	0.0936				
DR_Gap_Cryostat_Steel	0.0100				
DR_Gap_Becal_ECEcal	0.0000				
DR_Gap_BHcal_ECHcal	0.0100				
DZ_Gap_CT_ECEcal	0.2723				
DZ_Gap_BEcal_ECHcal	0.0050				
DZ_Gap_ECEcal_ECHcal	0.0050				
DZ_Gap_BHcal_EndIron	0.0150				
Note gap requirements:	If subdetectors only get inserted once-->10mm gap				
	If subdetectors only move during opening/closing-->15m				
	No cables/pipes included.				