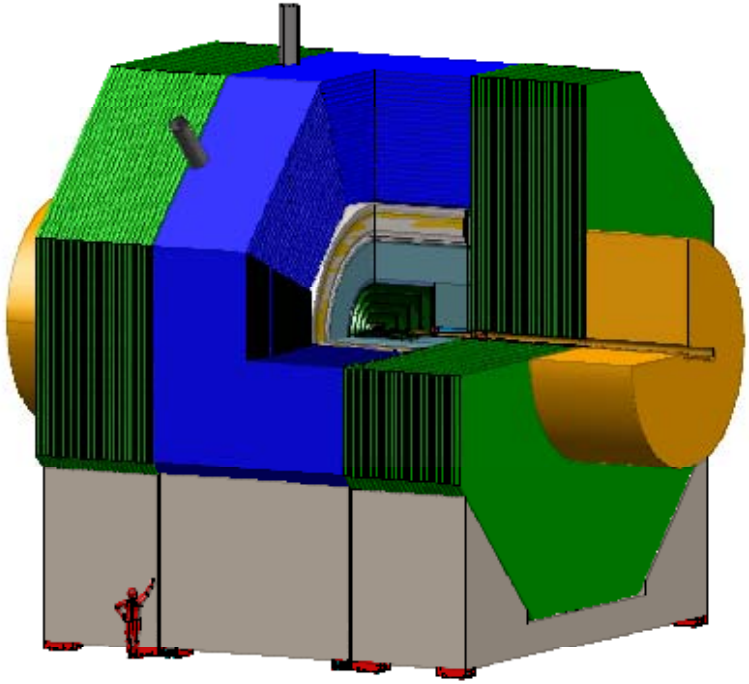
SiD
Engineering and Solenoid

Kurt Krempetz



SiD Engineering Group

Engineers

- ANL
  - Victor Guarino→Hcal
- FNAL
  - Bob Wands→FEA
  - Joe Howell
  - Kurt Krempetz→Integration
  - Walter Jaskierny→Solenoid Electrical
- PSL
  - Farshid Feyzi→Muon Steel
- SLAC
  - Jim Krebs→EndDoors
  - Marco Oriunno→Ecal
  - Wes Craddock→Solenoid
- RAL
  - Andy Nichols→Tracking

Physicists

Bill Cooper

Marty Breidenbach

Tom Markiewicz

Phil Burrows

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
- Document the design choices and the design
- Document and manage changes

Plans/Schedule-Now
Moving forward to LOI

10/07 to 2/08

- Identify liaison from each Sub-detector group to work closely with SiD Engineering group.
- Understand and refine the DOD SiD starting point.
- Define the sub-detector space and parameters(Global Parameters)
  - Sub-detector modules-weight/size/cables/utilities/dead space
  - Sub-detector assemblies-clearances/dead space
  - Sub-detector assembly supports
- Create Control Board/Committee
- Create engineering drawing/database

Moving Forward

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

Global Parameters

- DOD

Table 1 Key parameters of SiD starting point. (all dimension are given in cm.)

SiD BARREL	Technology	Inner radius	Outer radius	Z max
Vertex detector	Pixel	1.4	6.1	6.25
Tracker	Silicon strips	20.0	126.5	± 167.9
EM calorimeter	Silicon-W	127.0	140.0	±180.0
Hadron calorimeter	RPCs	141.0	250.0	± 277.2
Solenoid	5 Tesla	250.0	330.0	± 277.0
Muon chambers	RPCs	333.0	645.0	± 277.0

SiD FORWARD	Technology	Inner Z	Outer Z	Outer radius
Vertex detector	Pixel	71.9	172.0	71.0
Tracker	Silicon strips	26.7	165.4	126.5
EM calorimeter	Silicon-W	168.0	182.0	127.0
Hadron calorimeter	RPCs	182.0	277.0	140.7
Muon chambers	RPCs	277.5	589.5	645.0
LumCal	Silicon-W	170.0	183.0	19.0
GamCal				
BeamCal	Silicon-W	321.0	334.0	18.0

Global Parameters

Marty's Spreadsheet

Detector	Radius (m)		Axial (z) (m)	
	Min	Max	Min	Max
Vertex Detector	0.01	0.06	0.00	0.18
Central Tracking	0.20	1.25	0.00	1.67
Endcap Tracker	0.04	0.20	0.27	1.67
Barrel Ecal	1.27	1.40	0.00	1.82
Endcap Ecal	0.20	1.25	1.68	1.82
Barrel Hcal	1.42	2.37	0.00	2.78
Endcap Hcal	0.20	1.41	1.82	2.78
Coil	2.49	3.32	0.00	2.78
Barrel Iron	3.35	5.99	0.00	2.79
Endcap Iron	0.20	5.99	2.79	5.43

Inter-Detetcor Gaps	m
DR_GAP_Trkr_EMCal	0.015
DR_GAP_EMCal_Hcal	0.015
DR_GAP_Hcal_Cryostat	0.030
DR_Gap_Cryostat_Steel	0.030

Gap between Barrel and End cal

DR_Gap_BEcal_ECEcal=.02m

DR_Gap_BHcal_ECHcal=.01m

DZ_Gap_CT_ECEcal=.01m

DZ_Gap_BEcal_ECHcal=0

DZ_Gap ECEcal_ECHcal=0

DZ_Gap_BHcal_EndIron=.01m

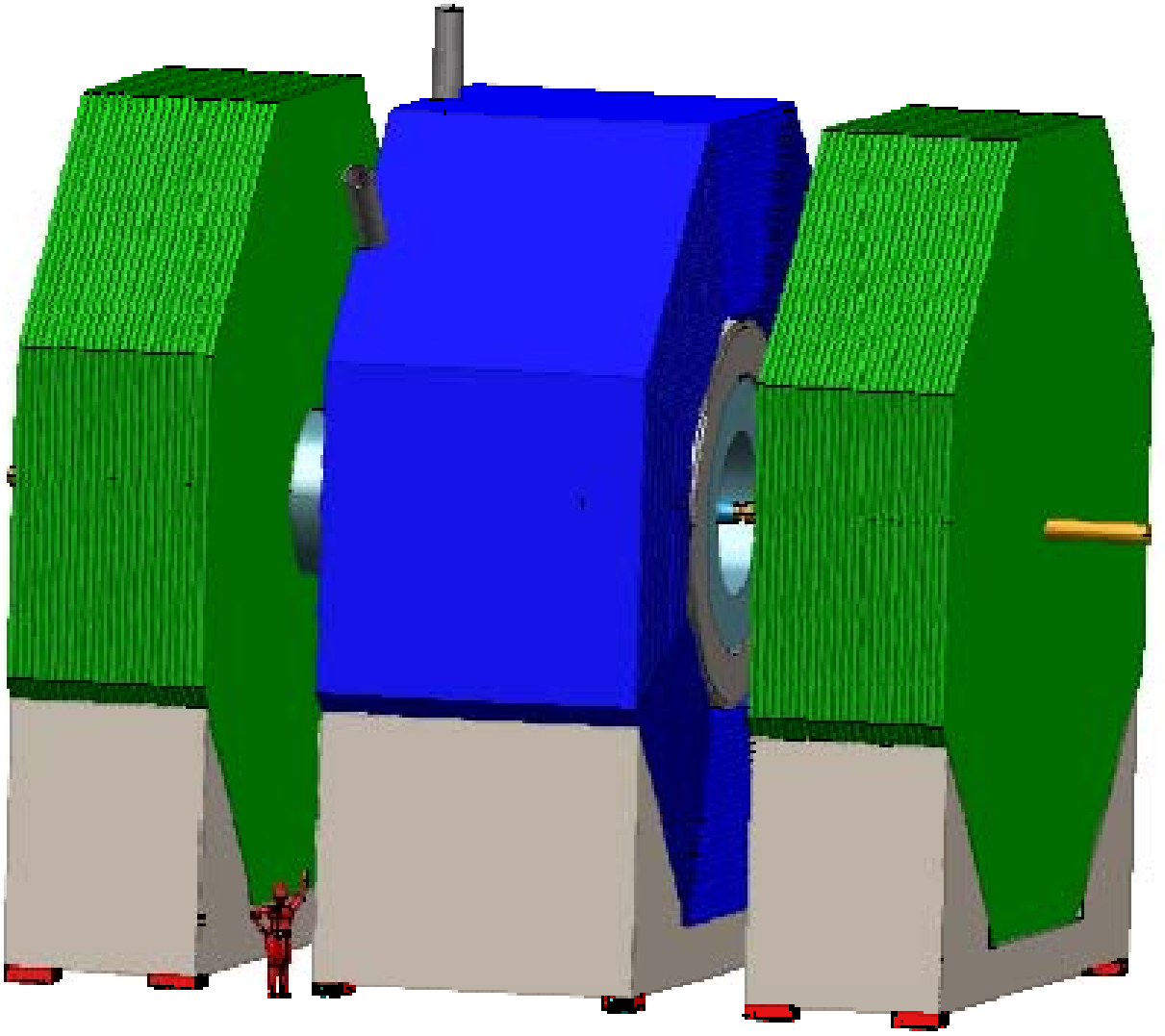
IR Engineering Meeting-SLAC Sept 17-21 Assembly Scenario

- 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

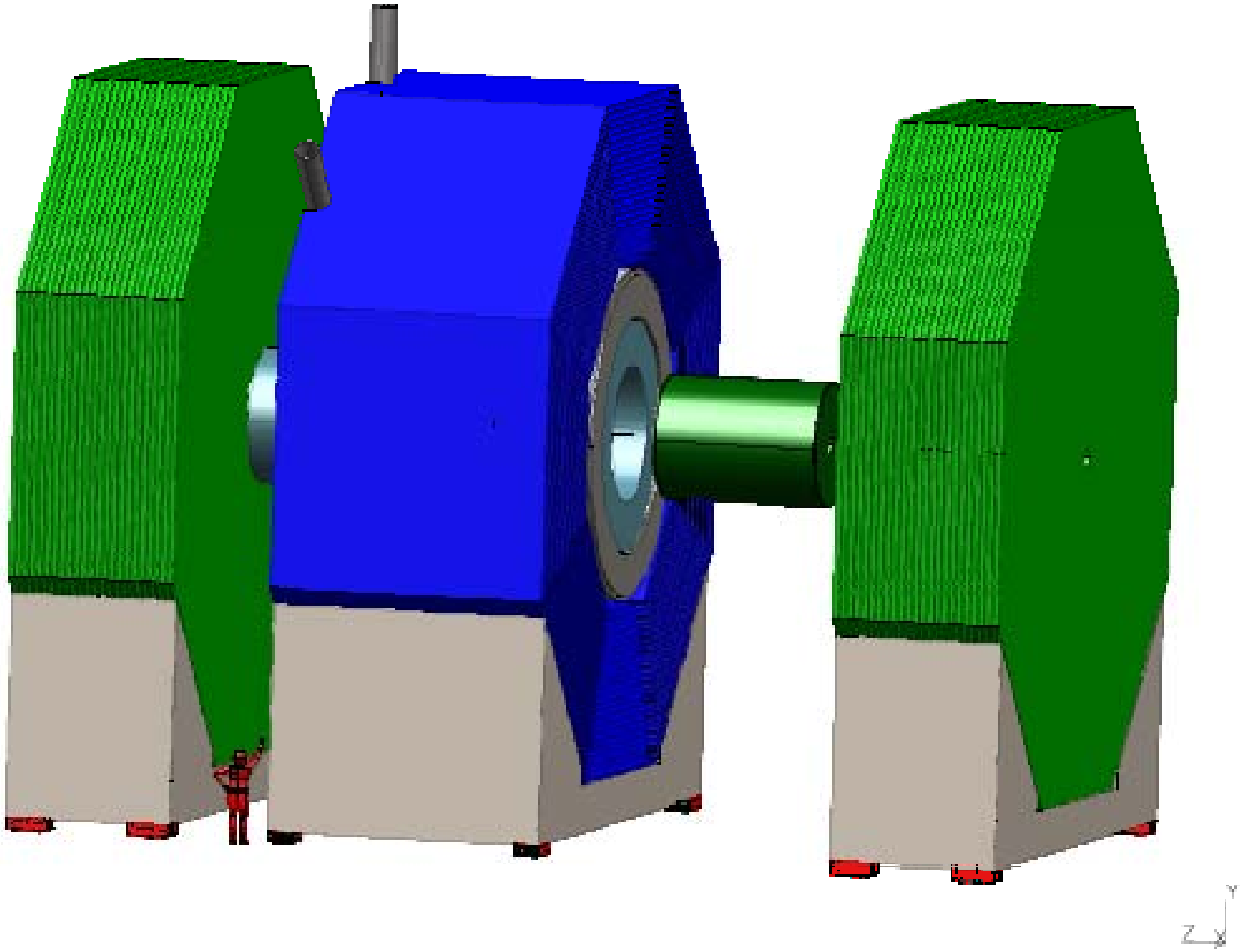
IR Engineering
Detector Opened 2 M



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



IR Engineering
Opening Procedures

- For Major Issues
  - Solenoid Repair
  - Absorber Plates Replacement
    - Under Shaft
      - Safety issues maybe a problem

IR Engineering
General Safety

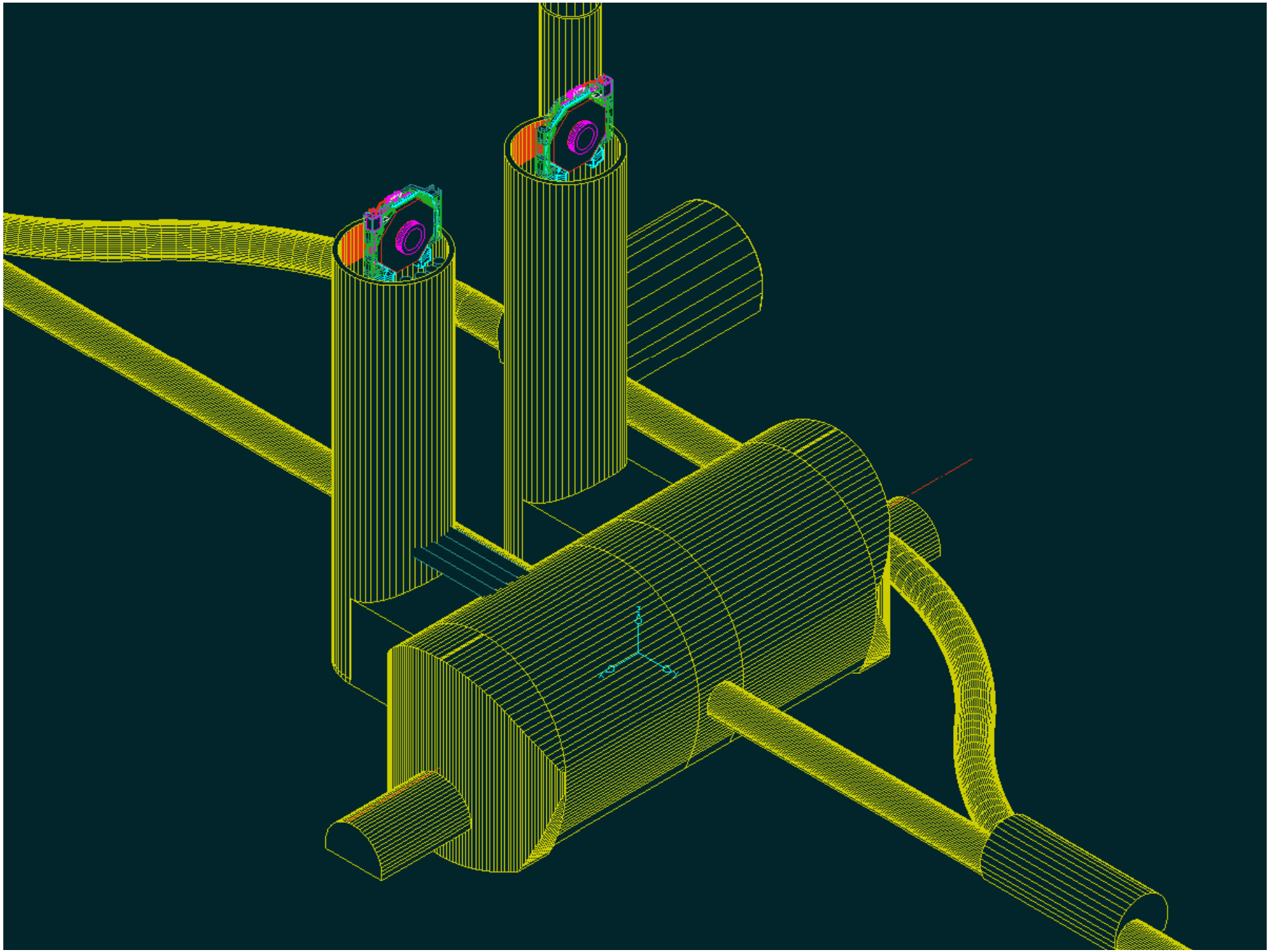
- Radiation
  - Self Shielding Detector
- Fire Safety
  - No Flammable Gases
  - Halogen-free Cables
  - Smoke Sensor in all sub detectors
- Seismic Safety
  - Looking for guidance; Site dependent
- ODH Issues
  - Looking for guidance

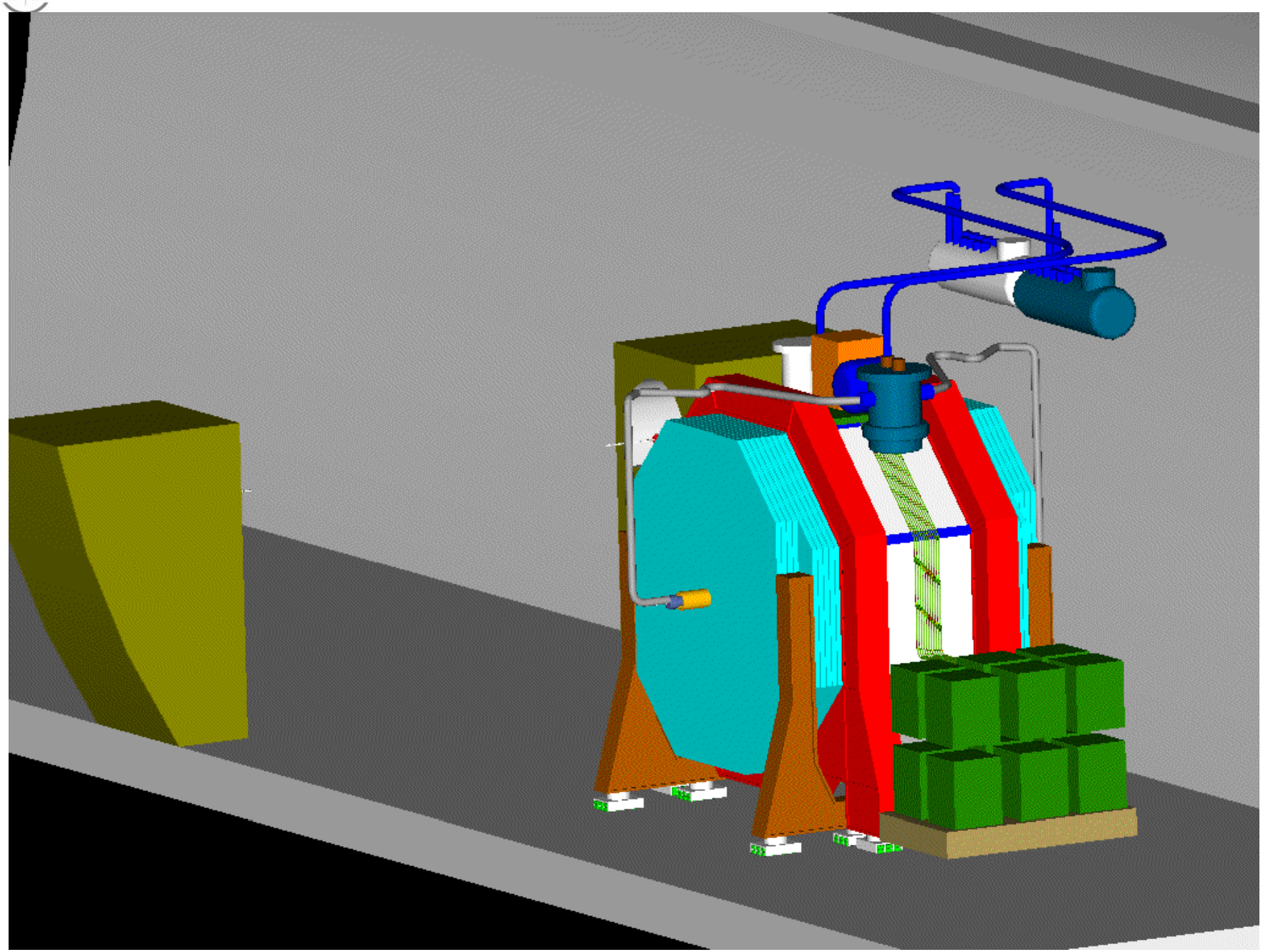
IR Engineering
Alignment Issues

- Positioning accuracy needed for detector after it was moved to IP in push-pull operation
  - 1 to 2mm
- Final/fine adjustment done by a positioning system; Frequency Scanning Intereferometer (FSI) approach is being considered.
  - Positions
    - Vertex Detector
    - Beam pipe
    - LumCal,GamCal and BeamCal
    - QDO

IR Engineering
Stability of IR Hall

- Settlement of Floor
  - <1-2 mm/Detector Exchange
- Temperature
  - 21 Degrees C
  - Plus or minus 1 Degrees C variation with time
  - Plus or minus 3 Degrees C at different hall locations
- Dewpoint
  - < 12 Degrees C or 56% relative humidity





IR Engineering Summary

- Most of the Detector Assembled at Surface
- Push-Pull Scenario
- 18m Diameter Shaft for each Detector
- Weight to be lower down shaft→TBD
- 2-100 ton cranes in IR Hall
- 23m crane travel in IR Hall
  - IR Hall width ~25m if one includes alcoves

IR Engineering
Baseline Global Design Decisions

- Moving Large pieces around Air Pads vs Hillman Rollers→Hillman Rollers
- Platform vs no-platform→ No platform
- Self-Shielding vs Shielding walls→Self Shielding
- Major Assembly above Ground vs Underground→Above Ground

Hcal Engineering Activity

- Define some engineering specifications
  - Barrel
    - IR=1420mm
    - OR=2370mm
    - Z=+-2780mm
    - Cables/Utilities come out at end of barrel
    - Barrel installed as one complete unit into Solenoid
    - Support of Hcal Barrel to Solenoid inner shell is at ~3 and ~9 o'clock positions along length
    - Hcal modules(not absorber plates) removal in IR garage position from barrel ends
    - Ecal and Silicon tracker weights are carried by Hcal.
  - EndCap
    - IR=200mm
    - OR=1410mm
    - Z=+-1820mm to 2780mm
    - Cables and Utilities come out radically (outer) from disk
    - Endcap is one unit which is support by cantilevering it from the End Iron
    - Endcap modules (not absorber plates) removal in IR garage position-radically

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

Hcal Questions

1. Max/Min Size of a Detector Module
   Width? Length? Height?
2. Shapes that modules can be formed into?
   Rectangles? Must they be flat, can edges be tapered?
3. Dead space between detector module edge and active area?
4. Clearance between detector module edge and next detector module edge?
5. Can the detector module support themselves?
6. Where can the detector module be support from?
7. Utilities needed in and out of the detector module?
   Gas? High voltage? Cooling? Power cables? Signal cables?
8. Where are the utilities coming out of the detector module, sides, ends, top, bottom?
9. How well must the detector module be held in the gap? Positioning x,y,z tolerances?
10. Detector modules have fiduals? Detectors get survey after installation?

–

SiD Solenoid Baseline

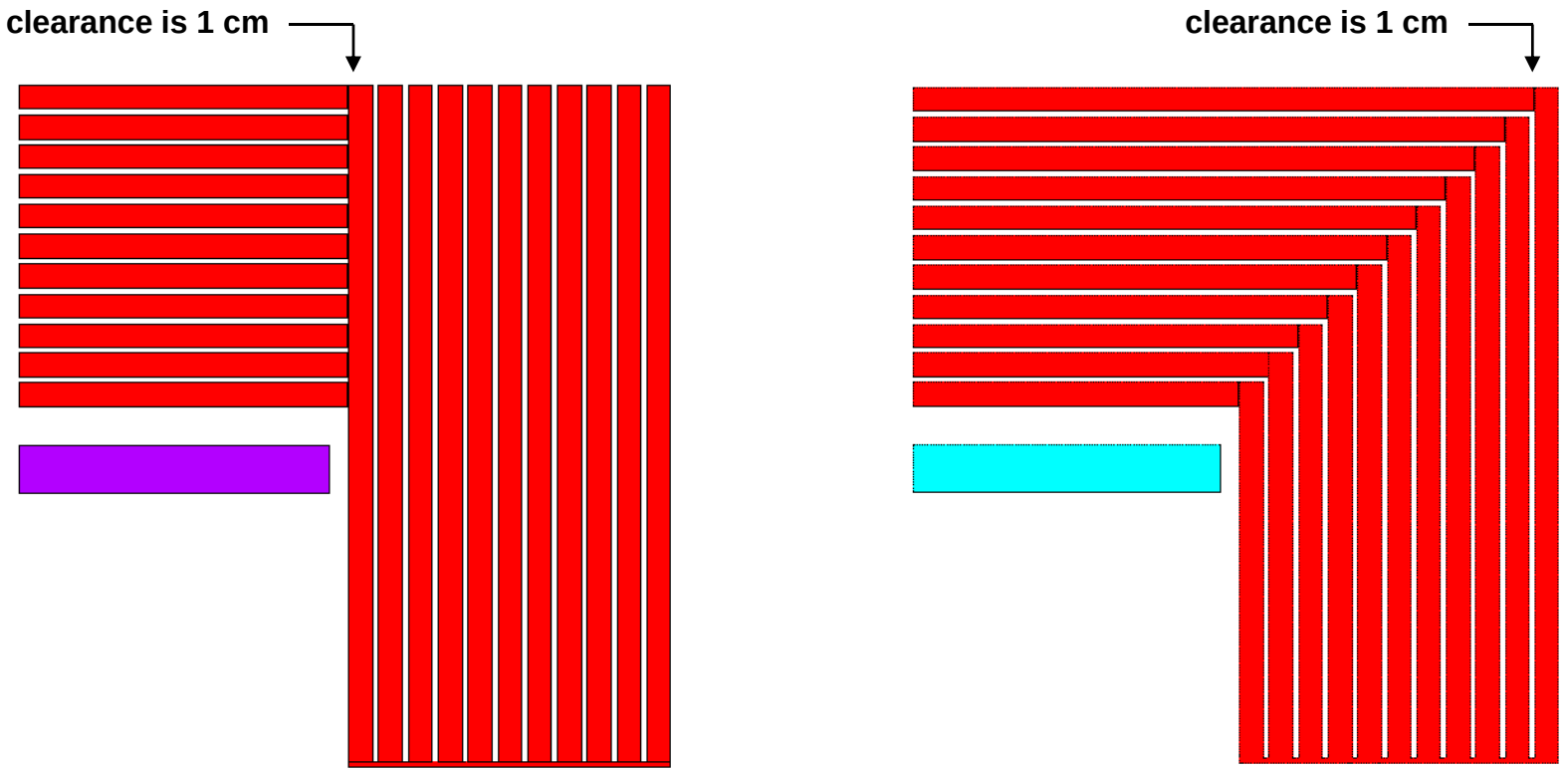
- 5 Tesla
- 5m diameter clear bore
- 5m Long
- 6 Layers
- Stored Energy 1.4 GJ
- Water Cooled Dump Resistor

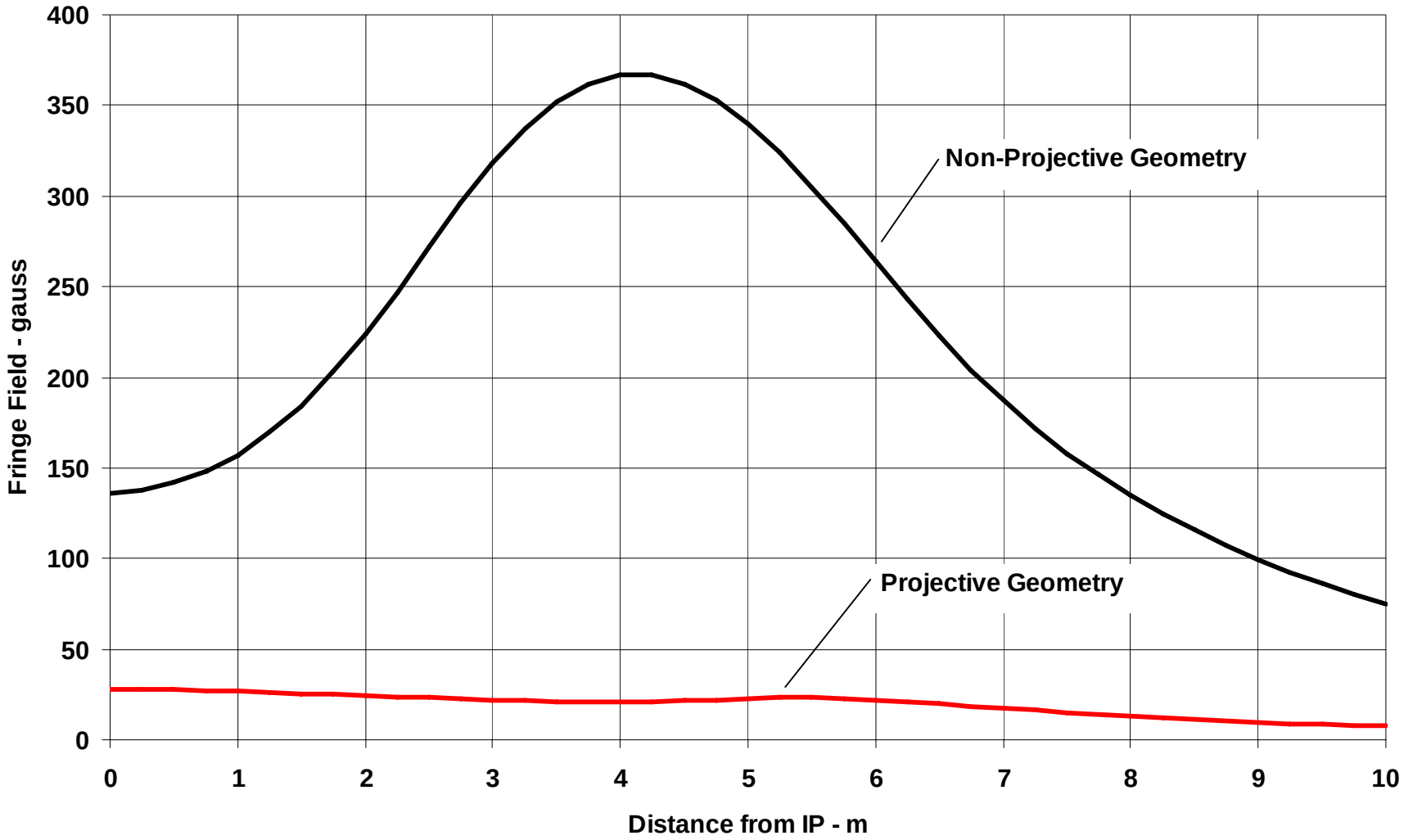
Flux Return

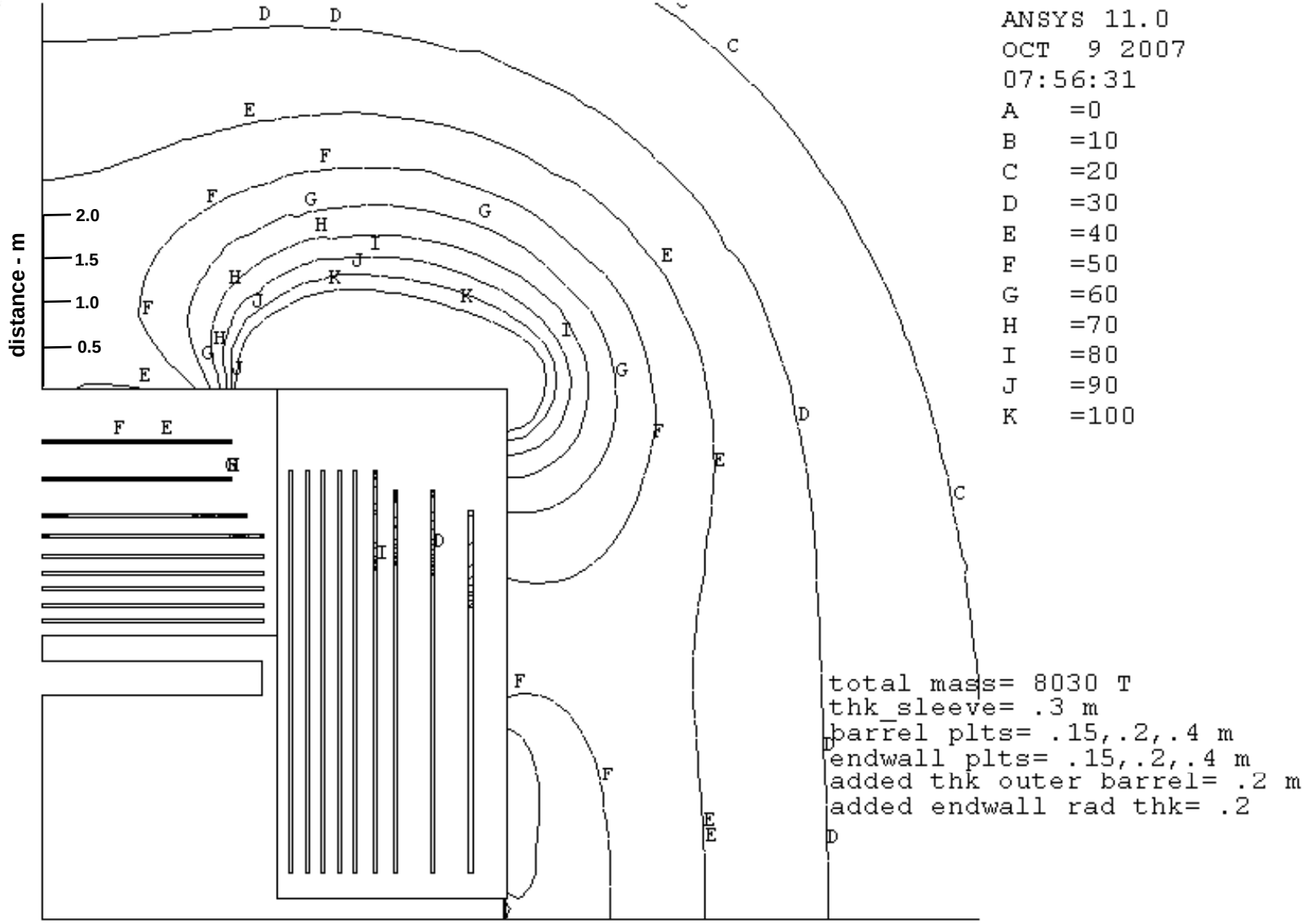
- Octagonal Barrel and Endcaps
- Fringe Field Issues outside the detector
  - <100 gauss
    - Thickness of plates, number of plates/gaps are being studied

The Two Iron Geometries

plates are 20 cm; gaps are 5 cm




Fringe Fields at R = 7.5 m (~1.5 m outside barrel)
Fringe Field - gauss
400
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
Distance from IP - m
Non-Projective Geometry
Projective Geometry



Increase thickness of outer barrel by 0.2 m, increase radial thickness of endwall corner by 0.2 m

Summary

- Lots of work ahead
- People are stepping forward …….

  but we need more!!!
- A great relationship between Engineers and Physicists is need so an excellent LOI can be developed.