SiD Engineering:
Iron and Solenoid Design

Kurt Krempetz

SiD Engineering Group Participates

Meet via Webex every other Wednesday morning 8:00 PST

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

ILC Document Server

- **Web Address: http://ilcdoc.linearcollider.org/**

Currently in SiD Engineering:

2 Documents on Hcal Geometry

1 Document on Global Parameters

1 Document on BeamCal

Contributions to the LOI

- Global Parameters
- Supplied Engineering consultation to sub-detector groups
- Magnet section
  - Solenoid
  - Return Iron
- MDI, Push-Pull and other IR Hall Issues
  - Marco will give a separate talk
- Cost Estimate
  - Marty will give a separate talk

Solenoid System

- 5 T superconducting solenoid
- Power supply, pressurized water cooled dump resistor and dump switch that moves with the detector
- Helium Refrigerator supplying 4.5K LHe to the Solenoid and a pair of 2 K cold boxes for the superconducting focusing quadruples.
- Superconducting Detector Integrated “anti” Dipole (DID)

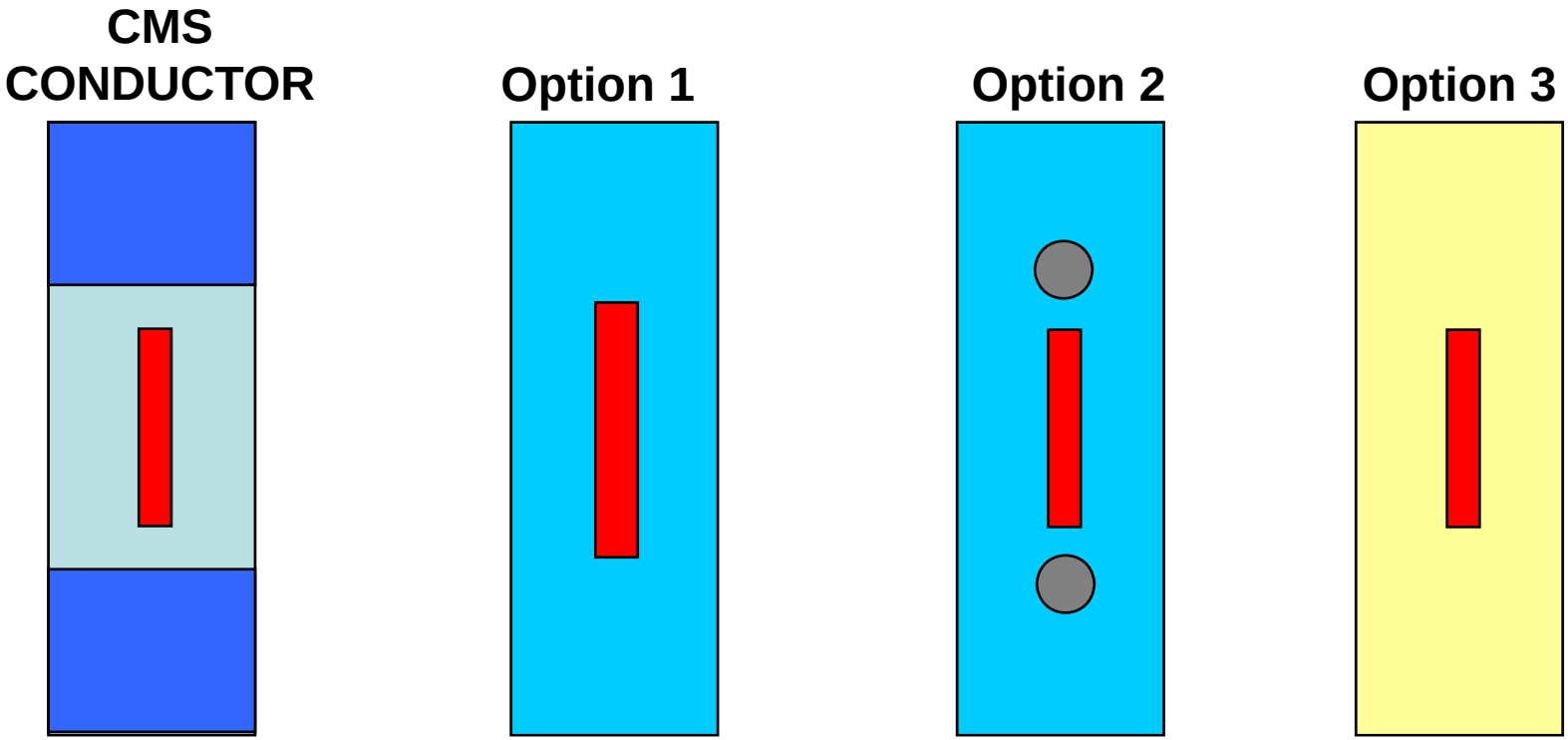
SiD- CMS Comparison

	SiD	CMS	UNITS
Central Field	5.0	4.0	T
Stored Energy	1.56	2.69	GJ
Stored Energy Per Unit Cold Mass	12	11.6	kJ/kg
Operating Current	17.75	19.2	kA
Inductance	9.9	14.2	H
Fast Discharge Voltage to Ground	300	300	V
Number of Layers	6	4	
Total Number of Turns	1457	2168	
Peak Field on Superconductor	5.75	4.6	T
Number of CMS superconductor strands	40	32	
Total Mass of Solenoid	125	220	Metric ton
Rmin Cryostat	2.591	2.97	m
Rmin Coil	2.731	3.18	m
Rmax Cryostat	3.392	3.78	m
Rmax Coil	3.112	3.49	m
Zmax Cryostat	±3.033	±6.5	m
Zmax Coil	±2.793	±6.2	m
Operating Temperature	4.5	4.5	K
Cooling Method	Forced flow	Thermo siphon	

CONDUCTOR REPLACEMENT MOTIVATION

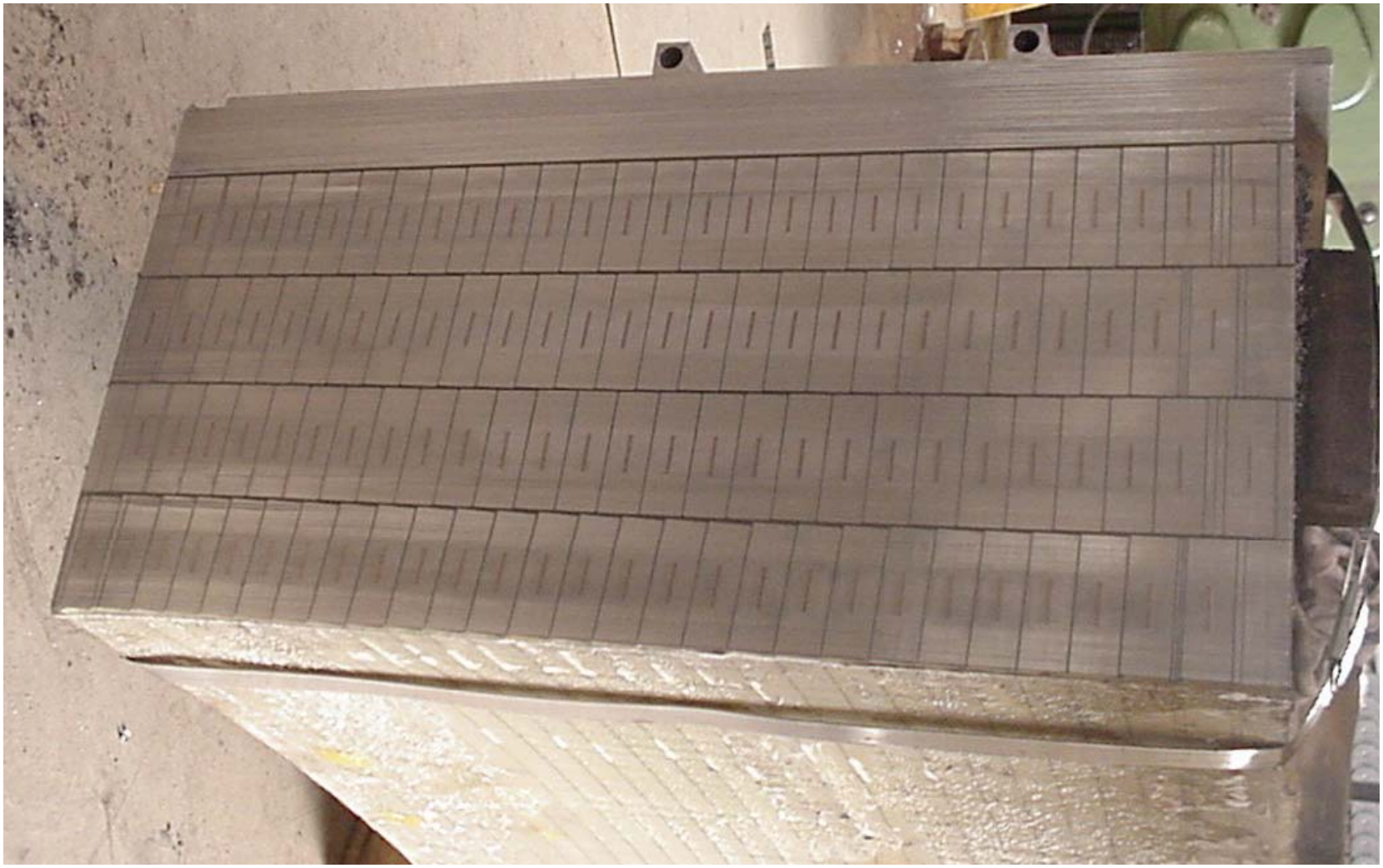
- The CMS conductor requires difficult on site ebeam welding
- There is great incentive to produce a cheaper/ “easier” conductor
- The replacement conductor should be also easier to wind
- An advanced design could be used in other projects such as high field MRI magnets

SiD CONDUCTOR OPTIONS

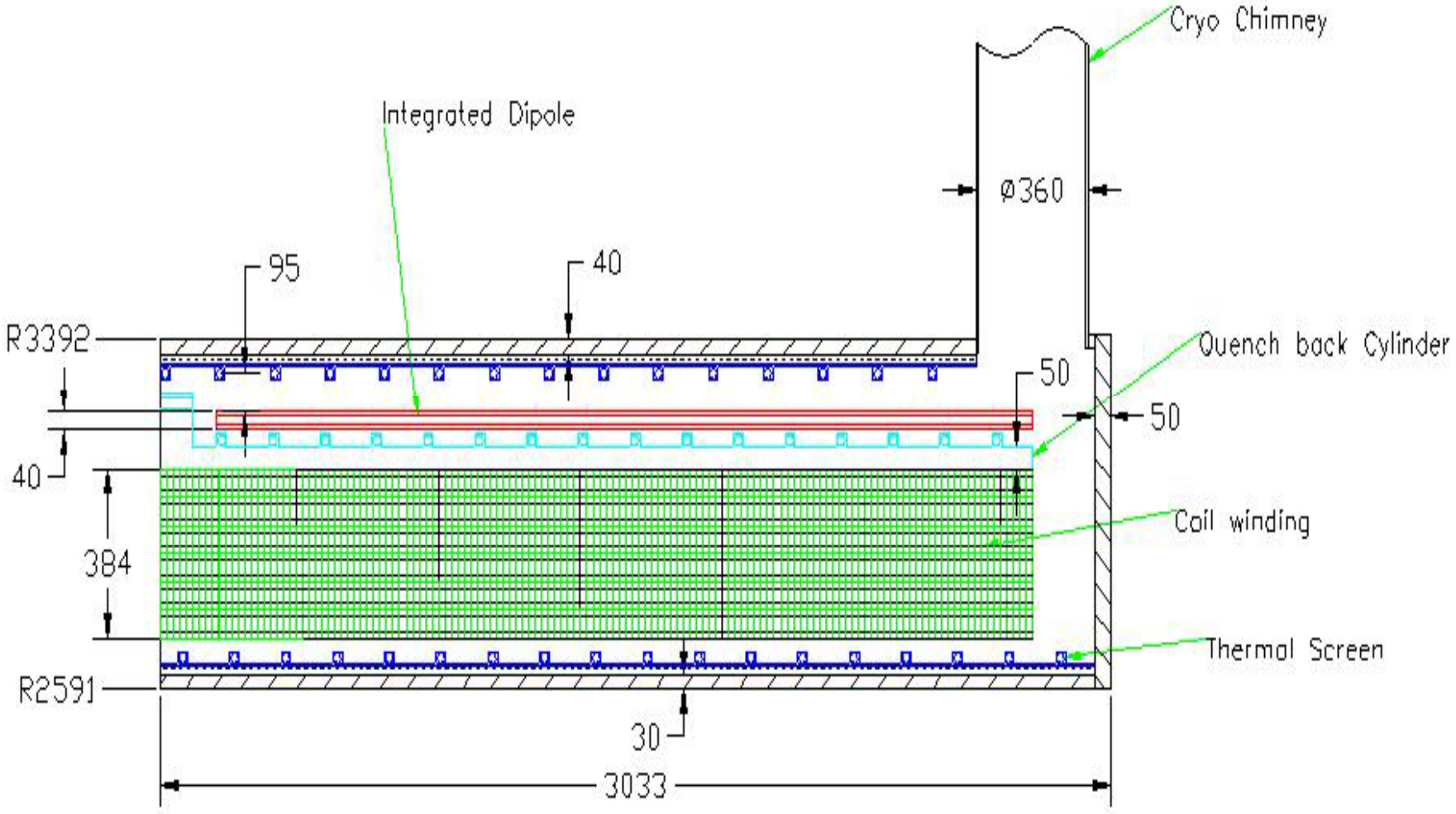


Ultra High Purity Al
6082 T6 Al
Superconducting Cable
Al – 0.1 % Ni
Stainless steel cable
Aluminum/matrix composite

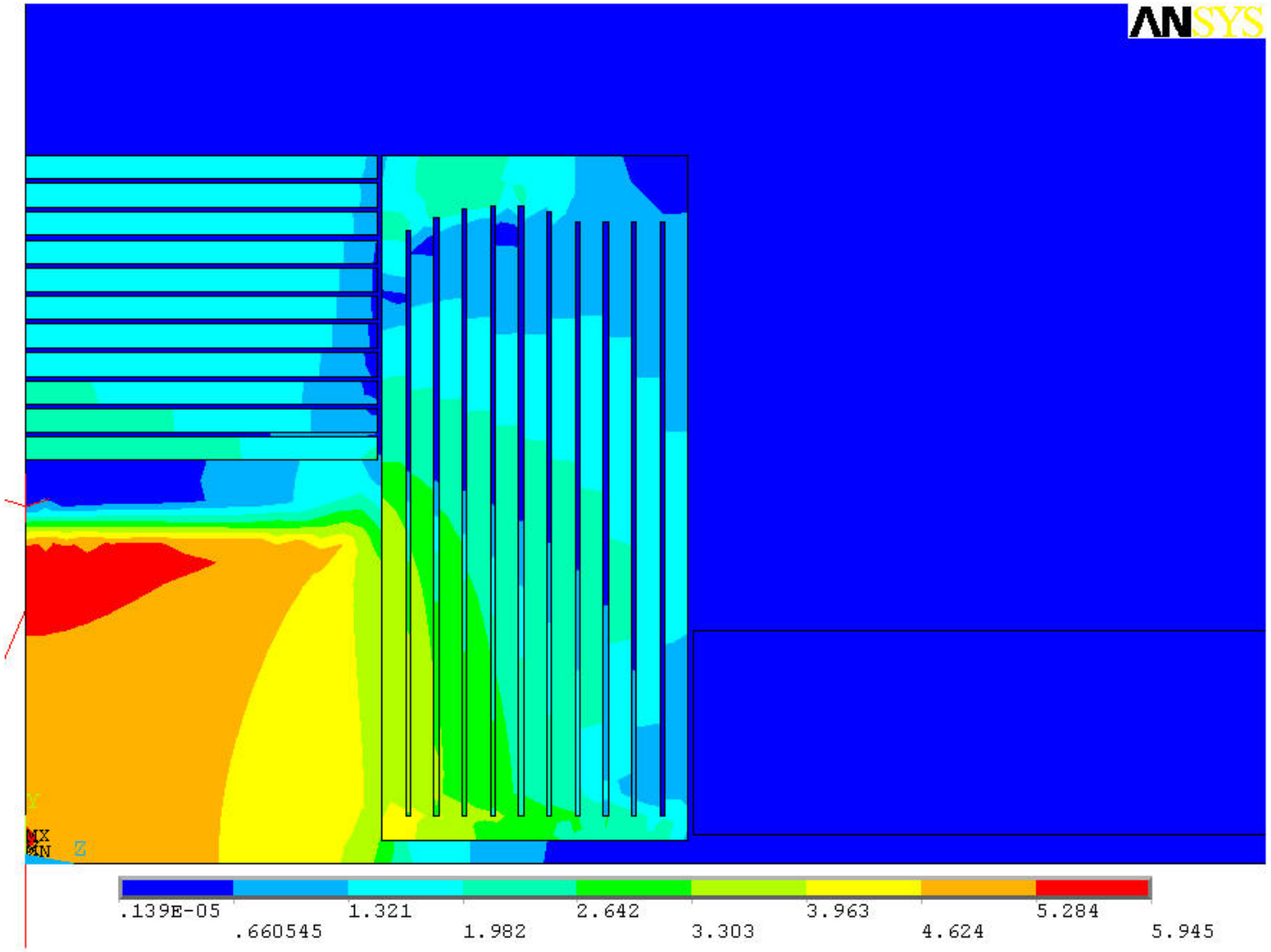
CMS Winding Pack



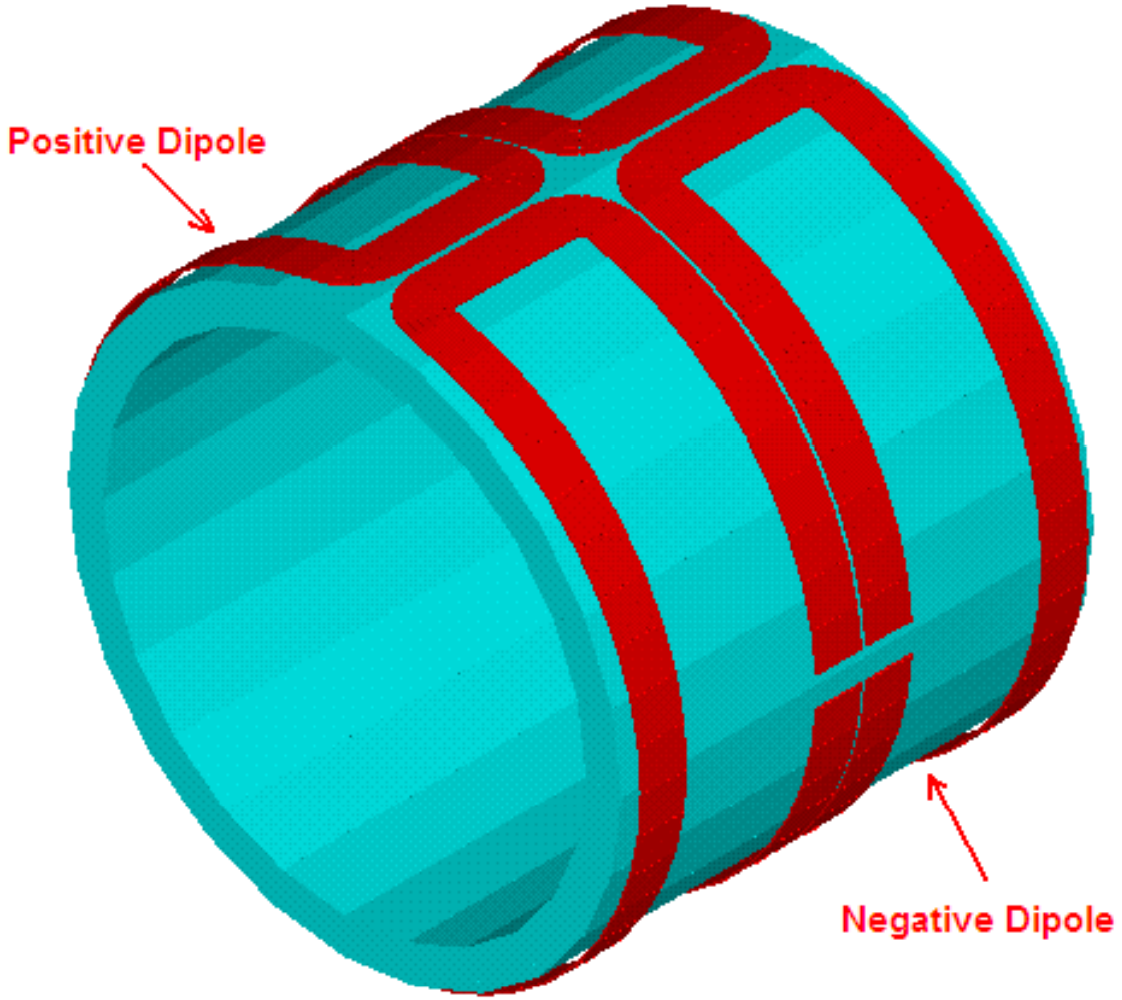
Solenoid Cryostat



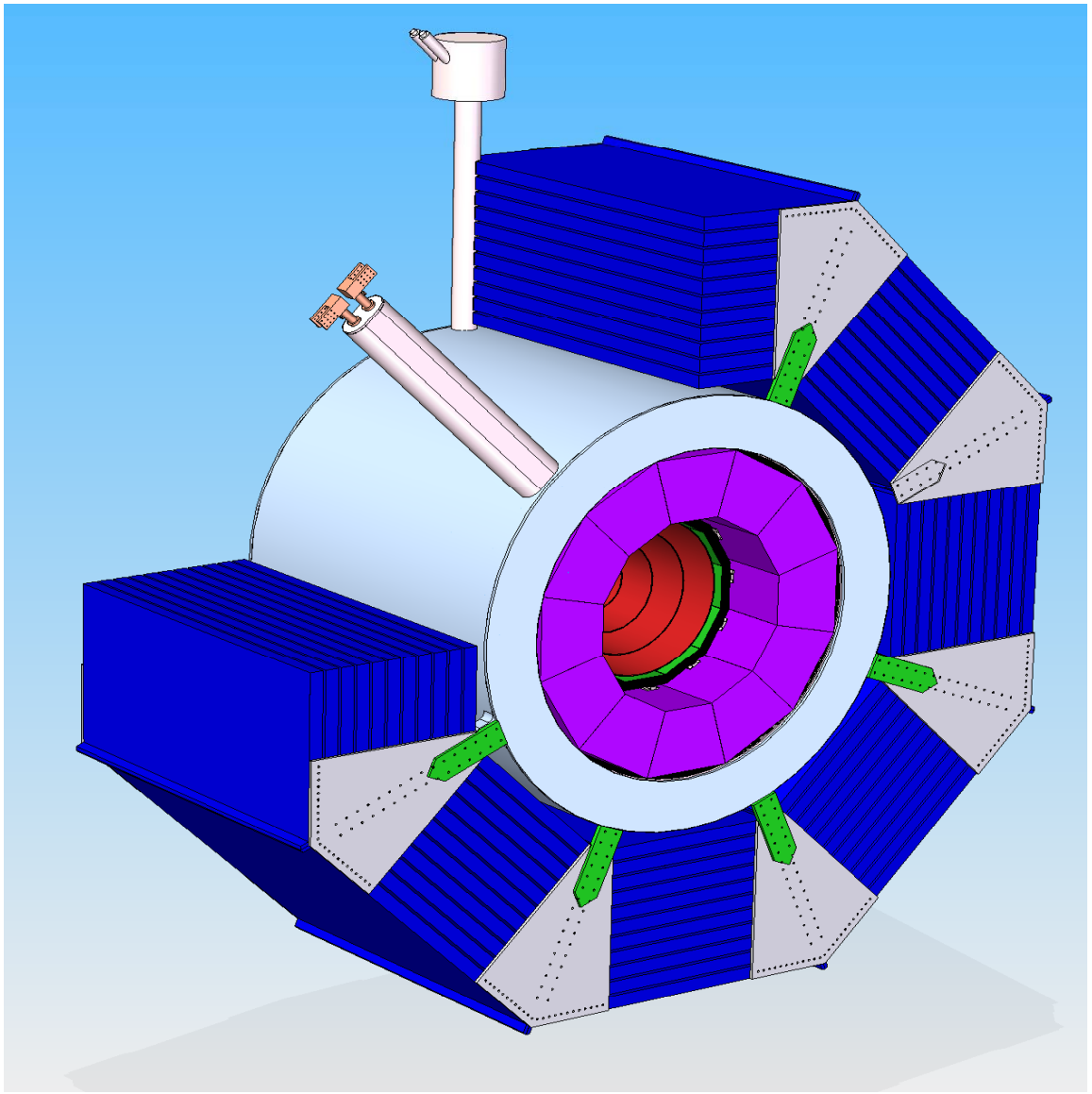
Solenoid Central Field



Anti Solenoid-DID



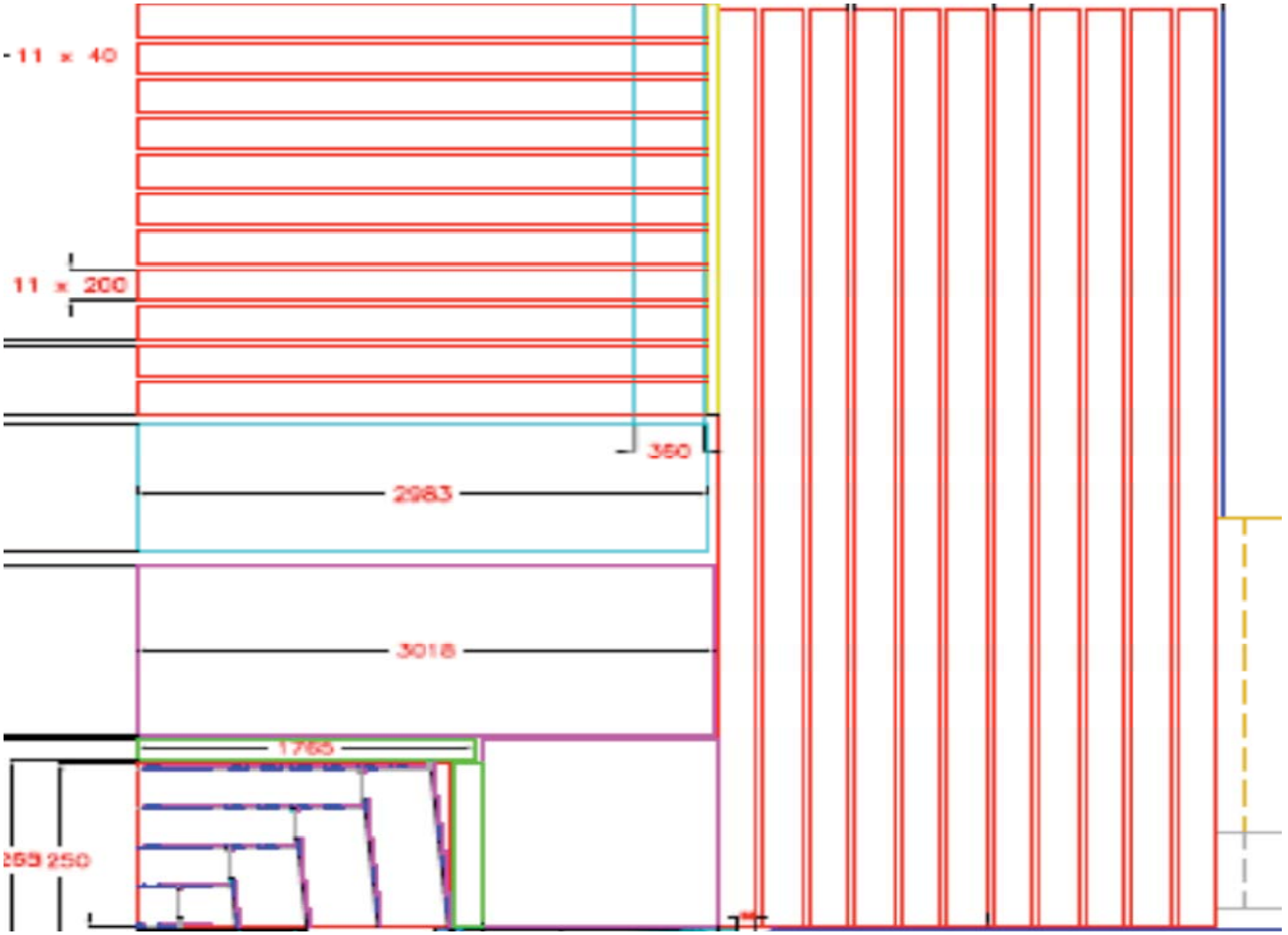
Solenoid/ Barrel Iron



Iron Return Flux

- 11 Plates
  - 200 mm Thick
- Gaps
  - 40 mm
- Total Weight
  - ~8000 tonnes
    - 7000 tonnes of Plates
    - 1000 tonnes of support Structure

Iron Return Flux



Moving Forward

- What is next???-After the LOI
  - Stretched Detector
  - More detailed designs of Subsystems
    - Ecal End Caps
    - Hcal End Caps
    - Muon End Walls
    - Detector Moving System
    - Detector Alignment System
  - Continue Conductor Studies
    - Start of a Solenoid/Return Iron Specification