

MPD Magnet designs

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NDWS

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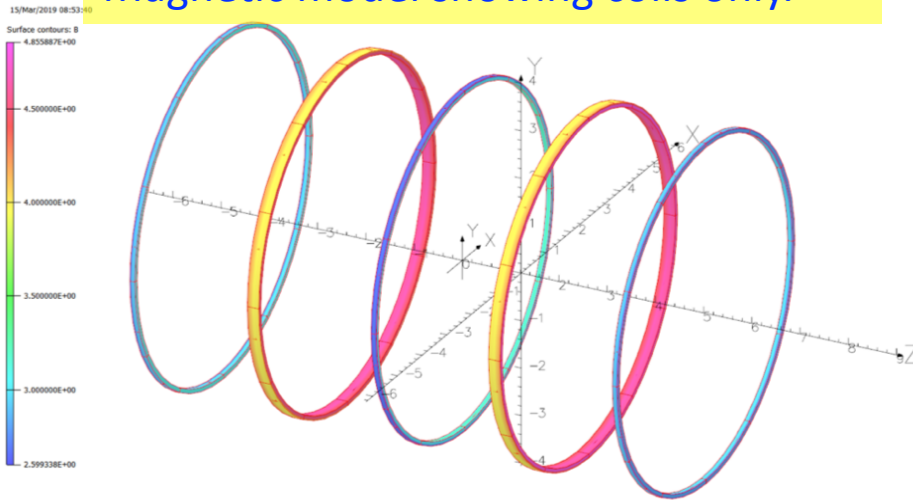
Magnet comments

- 22. 1-30 29 It's not clear to me how the magnet distinguishes pions and muons of the same momentum?
 - Correct. Need ECAL plus (possibly) μ tagger. Future optimization study
- 32. 1-38: Electromagnet vs. superconducting magnet? Same arguments in terms of cost/running cost against electromagnet are applicable for the 3DST magnet. Also background coming from the iron. Since we continue to hear noise about the KLOE magnet being used, you may want to comment on the need to reduce the magnet's mass.

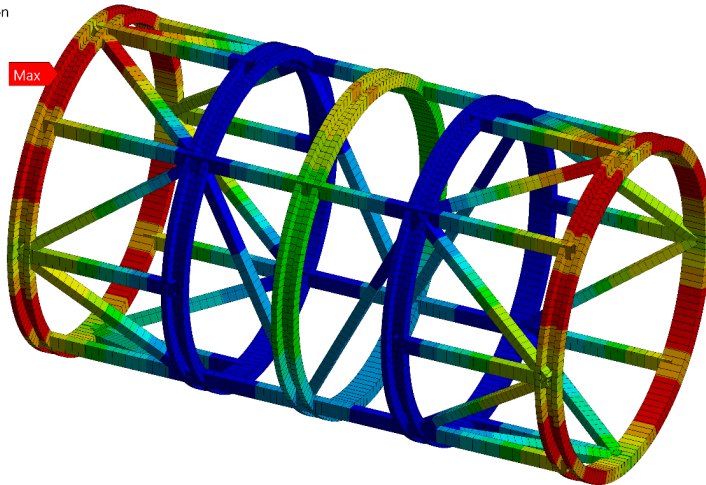
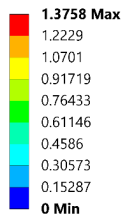


Magnet design: 3-coil Helmholtz with bucking coils

Magnetic model showing coils only.



Type: Total Deformation
Unit: mm
Time: 1
3/7/2019 2:24 PM

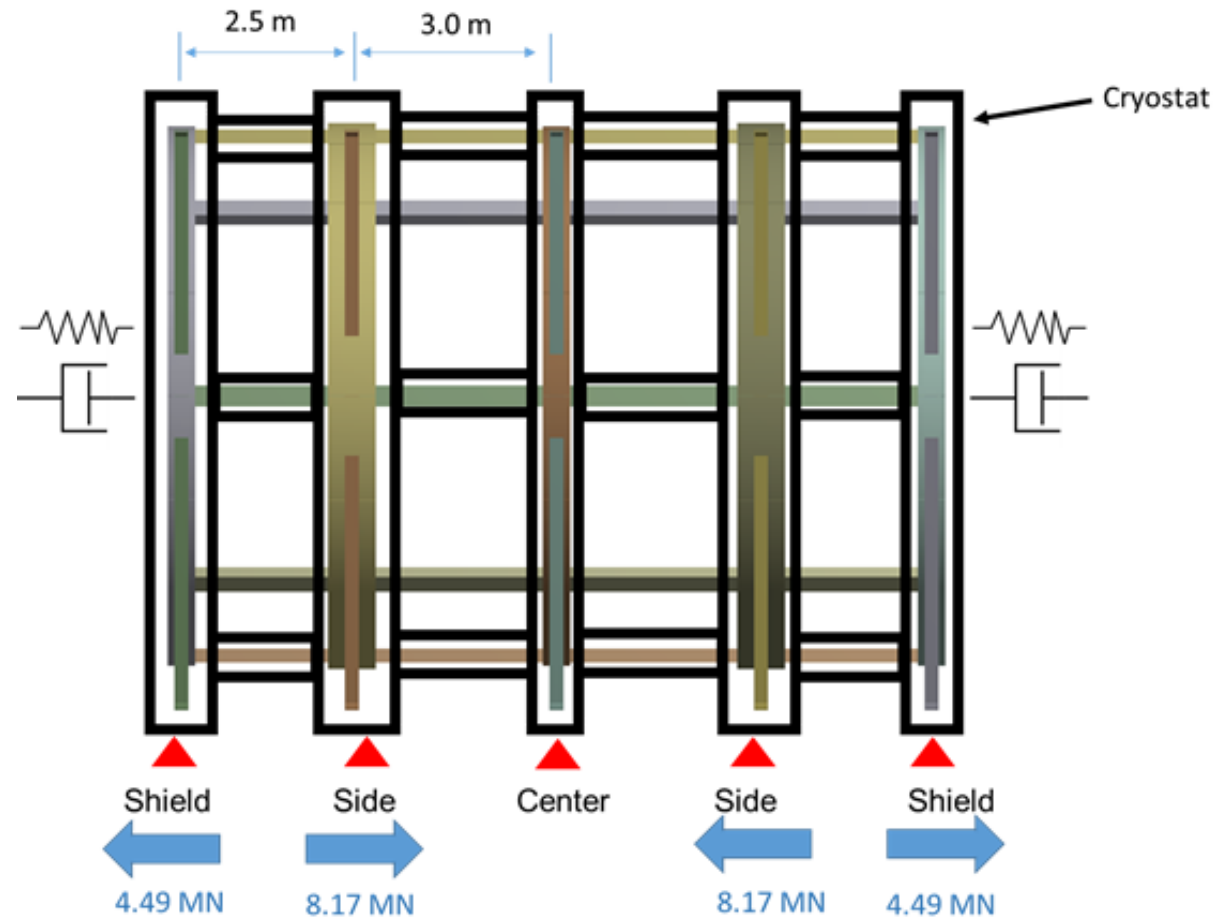


- Central field = 0.5T
- Side coils at 2.5 m, shielding coils placed at 5 m from the magnet center in Z.
- All coils have the same inner radius 3.5 m and outer radius 3.59 m.
- Center and shielding coils are identical.
- INFN looking into SC dipole design
- Our BARC colleagues have looked at NC design optimization
 - Still very high power– 4MW

Mechanical support structure analysis

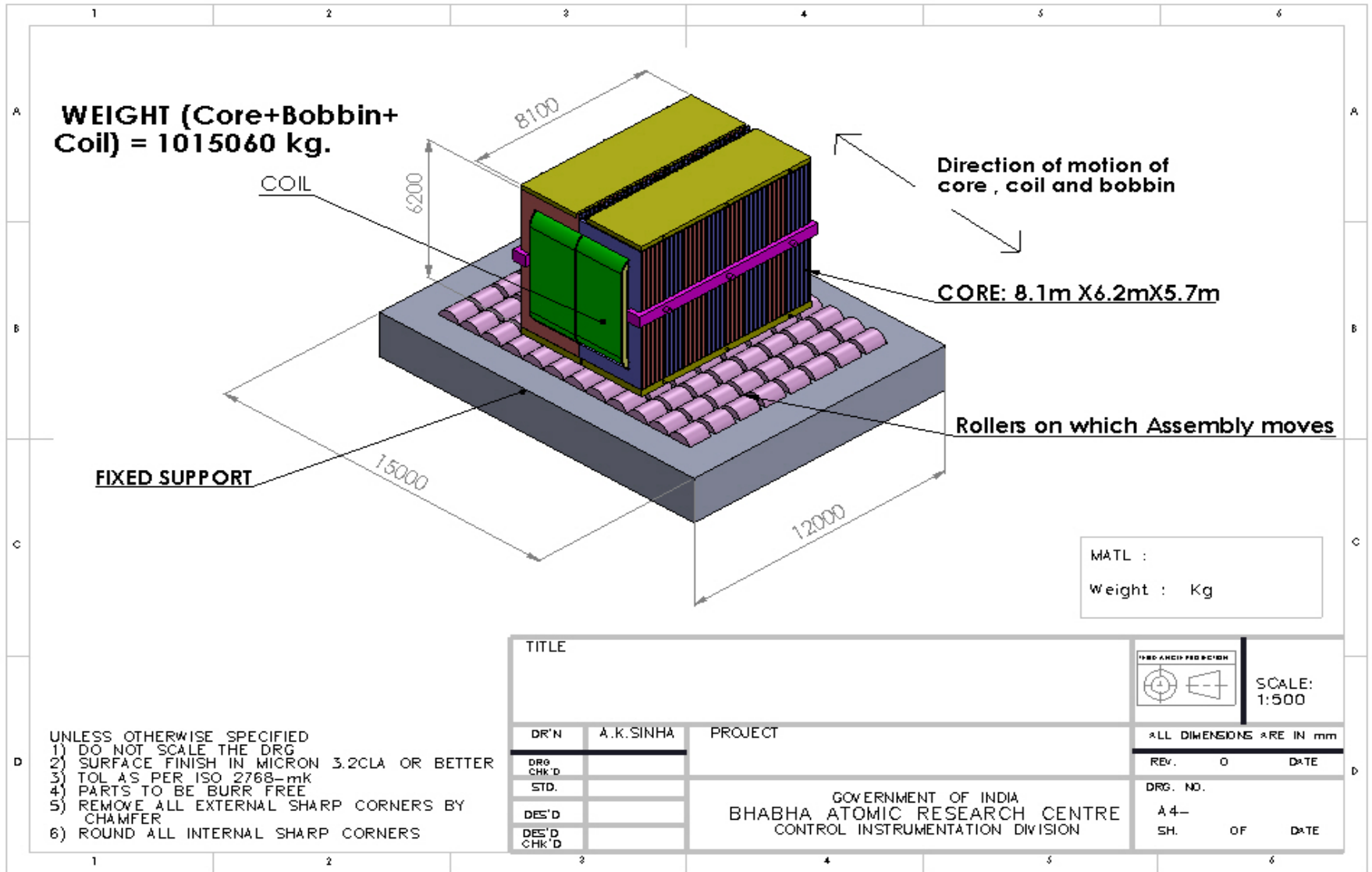


SC Magnet design evolution



NC magnet design studies



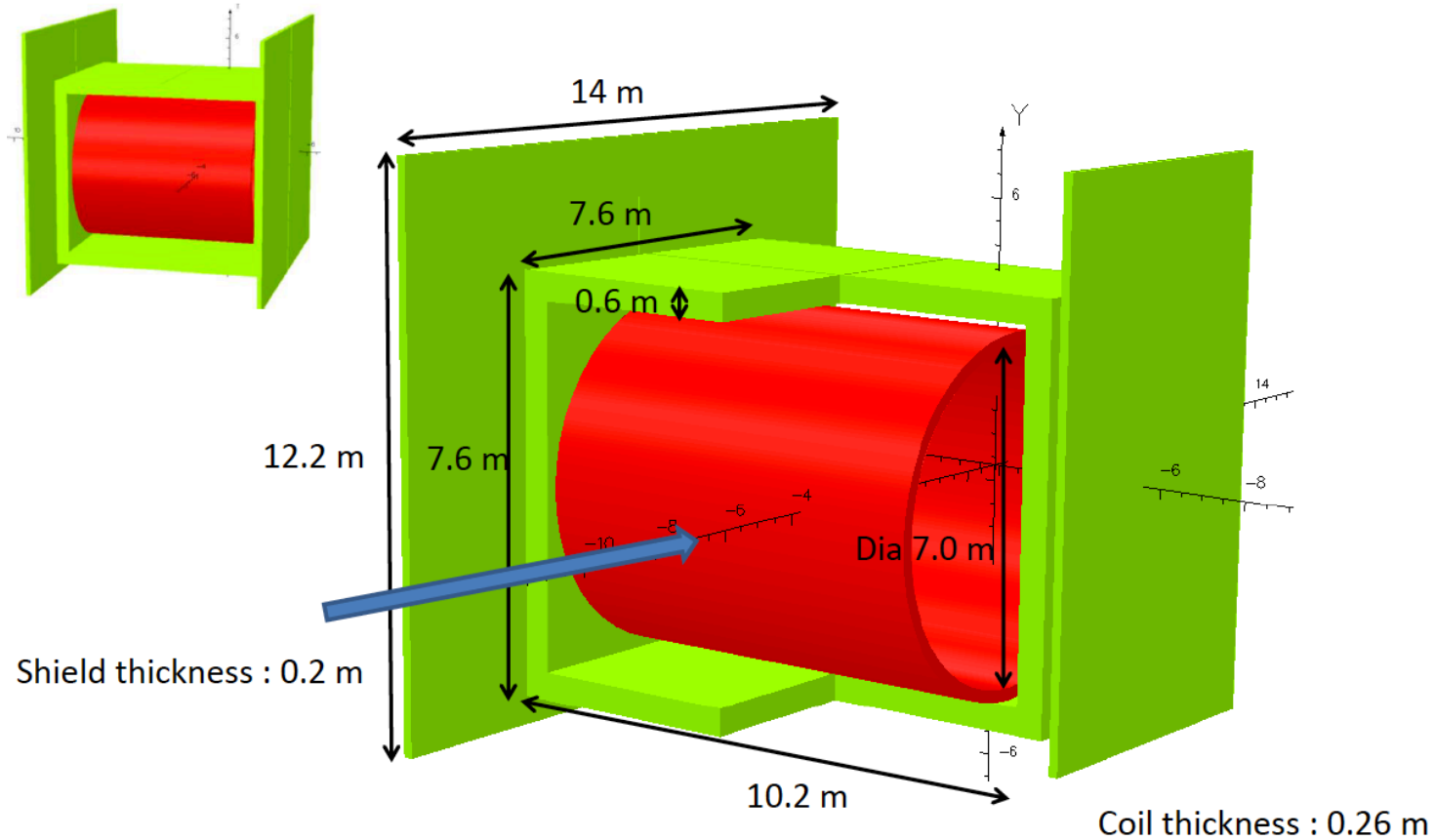


<i>Particulars</i>	<i>Units</i>	<i>Value</i>
<i>Single hydraulic circuit (Turns, length)</i>	<i>meter</i>	<i>16,480</i>
<i>Total number of hydraulic circuits in parallel</i>	<i>-</i>	<i>86</i>
<i>Power Loss per hydraulic circuit</i>	<i>kW</i>	<i>28.25</i>
<i>Cooling Flow rate</i>	<i>LPM</i>	<i>8.968</i>
<i>Pressure drop in single hydraulic circuit</i>	<i>bar</i>	<i>8.58</i>
<i>Water velocity</i>	<i>m/s</i>	<i>1.15</i>
<i>Temperature difference between inlet and outlet header for single hydraulic circuit</i>	<i>°K</i>	<i>45</i>
<i>Cooling Surface area</i>	<i>m²</i>	<i>19.59</i>
<i>Reynolds Number</i>	<i>-</i>	<i>21900</i>
<i>Prandtl number</i>	<i>-</i>	<i>4.536</i>
<i>Nusselt Number</i>	<i>-</i>	<i>112.93</i>
<i>Heat Flux</i>	<i>kW/m²</i>	<i>1.44</i>
<i>Temperature difference between Copper surface and Bulk water temperature</i>	<i>°K</i>	<i>0.26</i>
<i>Bulk water temperature (taken ref inlet water temperature as 20)</i>	<i>°C</i>	<i>42.5</i>
<i>Heat Transfer Coefficient</i>	<i>W/m²°K</i>	<i>3438</i>





Magnet Geometry (3/4 view)



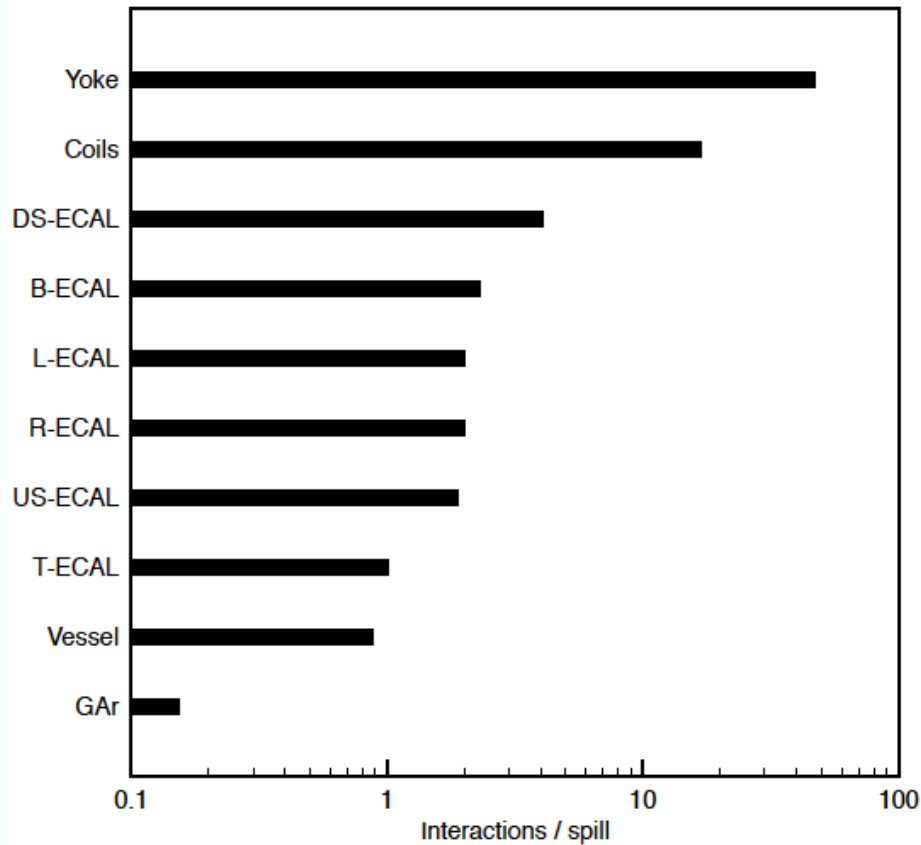
NC magnet design update:

SN	Parameter	Value (Copper)	Value (Copper Modified)	Unit
1.	Coils Type	Double Pancake	Double Pancake	-
2.	Number of Double pancakes	52 10 turns per pan cake	52 6 turns per pan cake	-
3.	Copper Coil Thickness	0.500	0.260	-
4.	Conductor Dimensions	80 X 80 Hole dia : 36	80 X 80 Hole dia : 36	mm
5.	MMF	4,600,000	3,660,000	At
6.	Current density	1.65	2.18	A/mm sq
7.	Power dissipation per pancake	57.5	63	kW
8.	Total Power dissipation	3	3.28	MW
9.	Chilling power consumption	1	1.10	MW
10.	Pumping motor power consumption (gross estimate)	0.25	0.20	MW
11.	Water velocity	2.5	2.5	m/s
12.	Total pressure drop	5	4	bar
13.	Water temperature rise	5.38	5.71	C
14.	Weight per pancake coil	11	6.7	MT
- 15.	Magnet Coil OD	8	7.52	Meter
16.	Total power dissipation	~4.25	~4.5	MW

~\$1.5M/yr operating costs



Backgrounds



800t Fe
SC design: 100t AL