



Superconducting Magnet for DUNE near detector

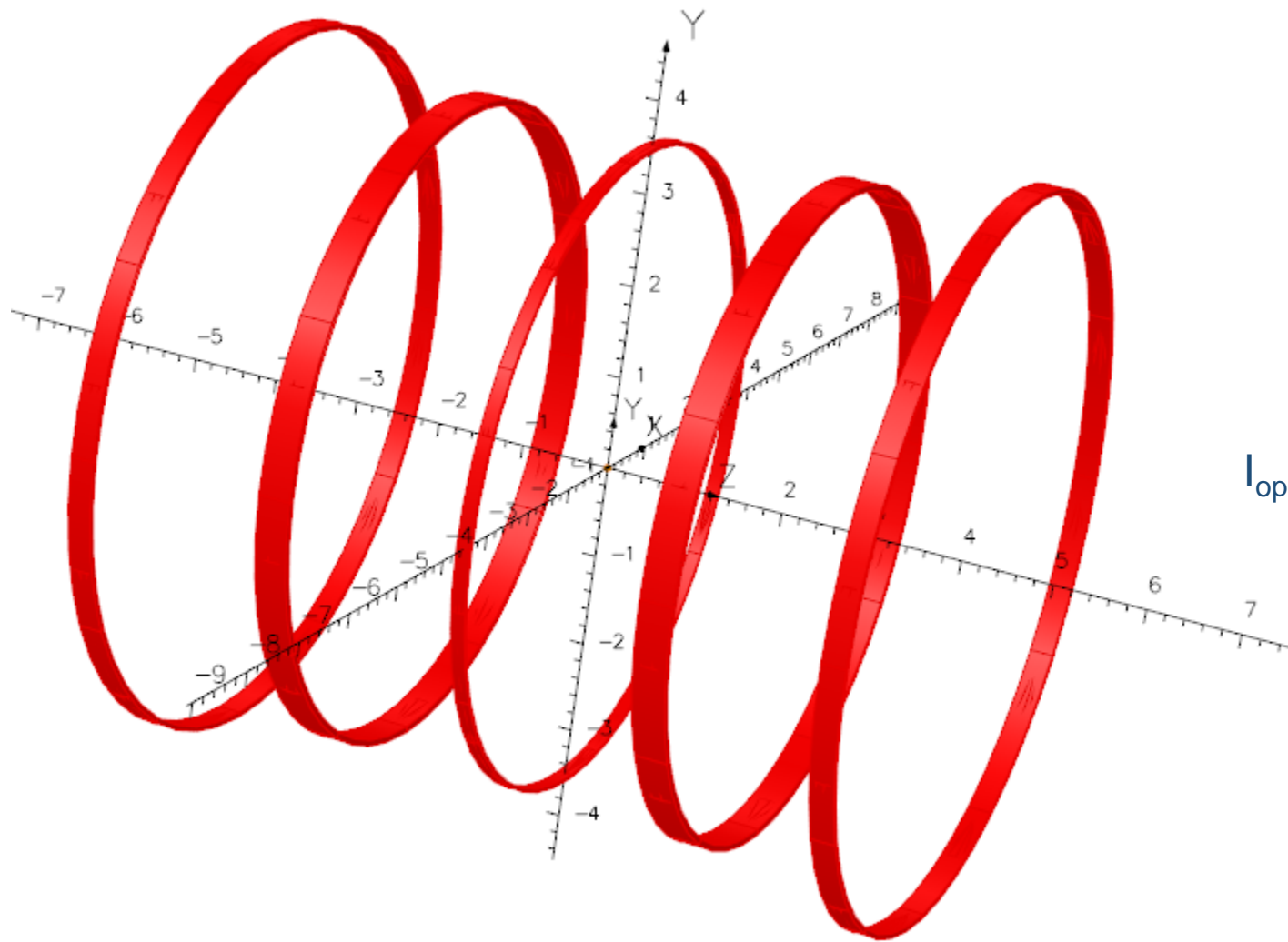
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Electromagnetic Application & Instrumentation Division
Bhabha Atomic Research Centre
Dune Near Detector Magnet Meeting
Date:11-01-2019

Magnet Design

Requirement (Meeting dated 30.11.2018)

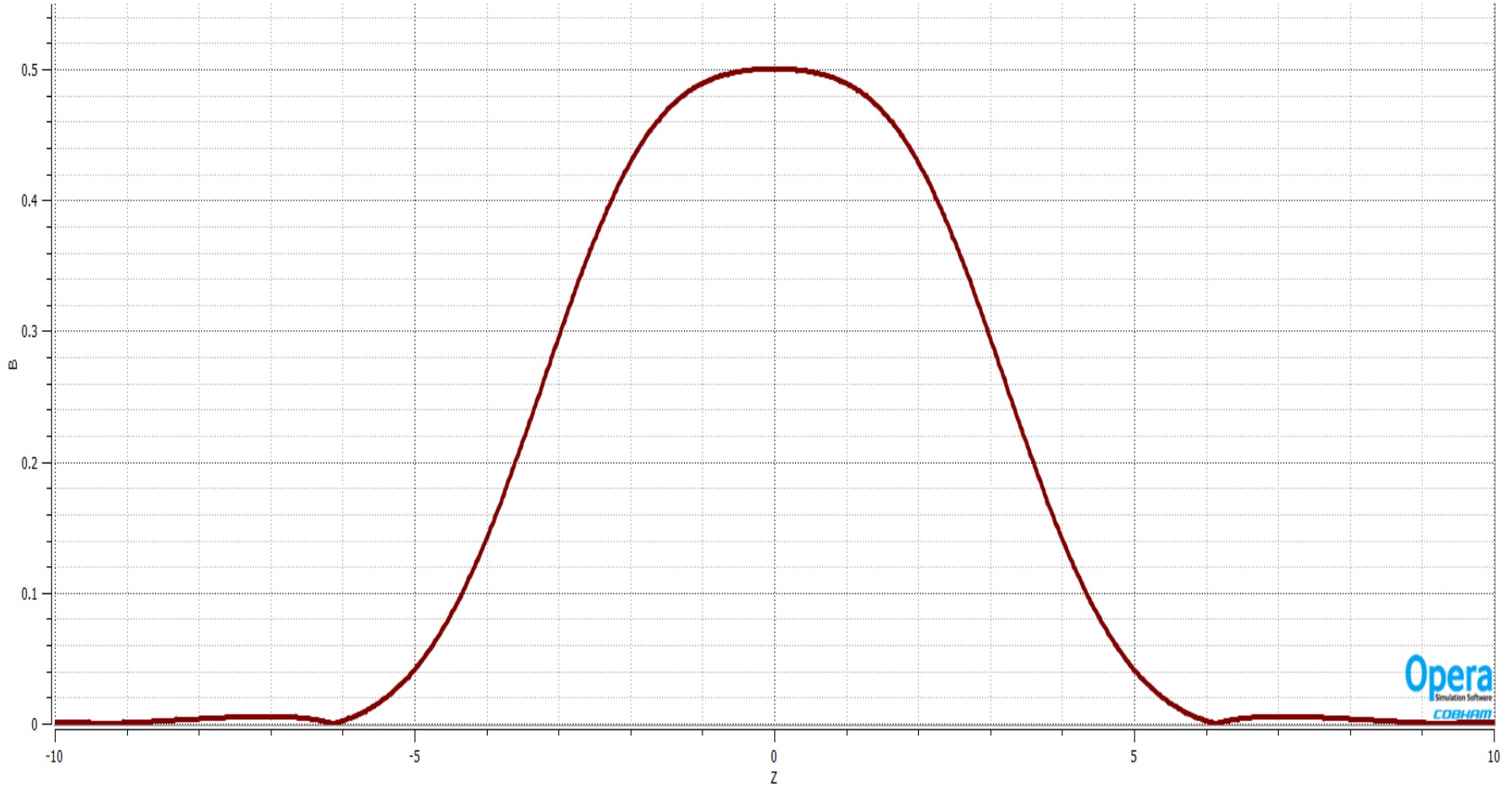
- Central Magnetic Field : $B(0,0,0) = 0.5\text{T}$
- Fringe Field : $B(6,0,0) < 50 \text{ Gauss (5mT)}$
- Uniformity : $> \pm 20\%$ in a DSV of 5.2 m dia

Detector Magnet Coil Configuration



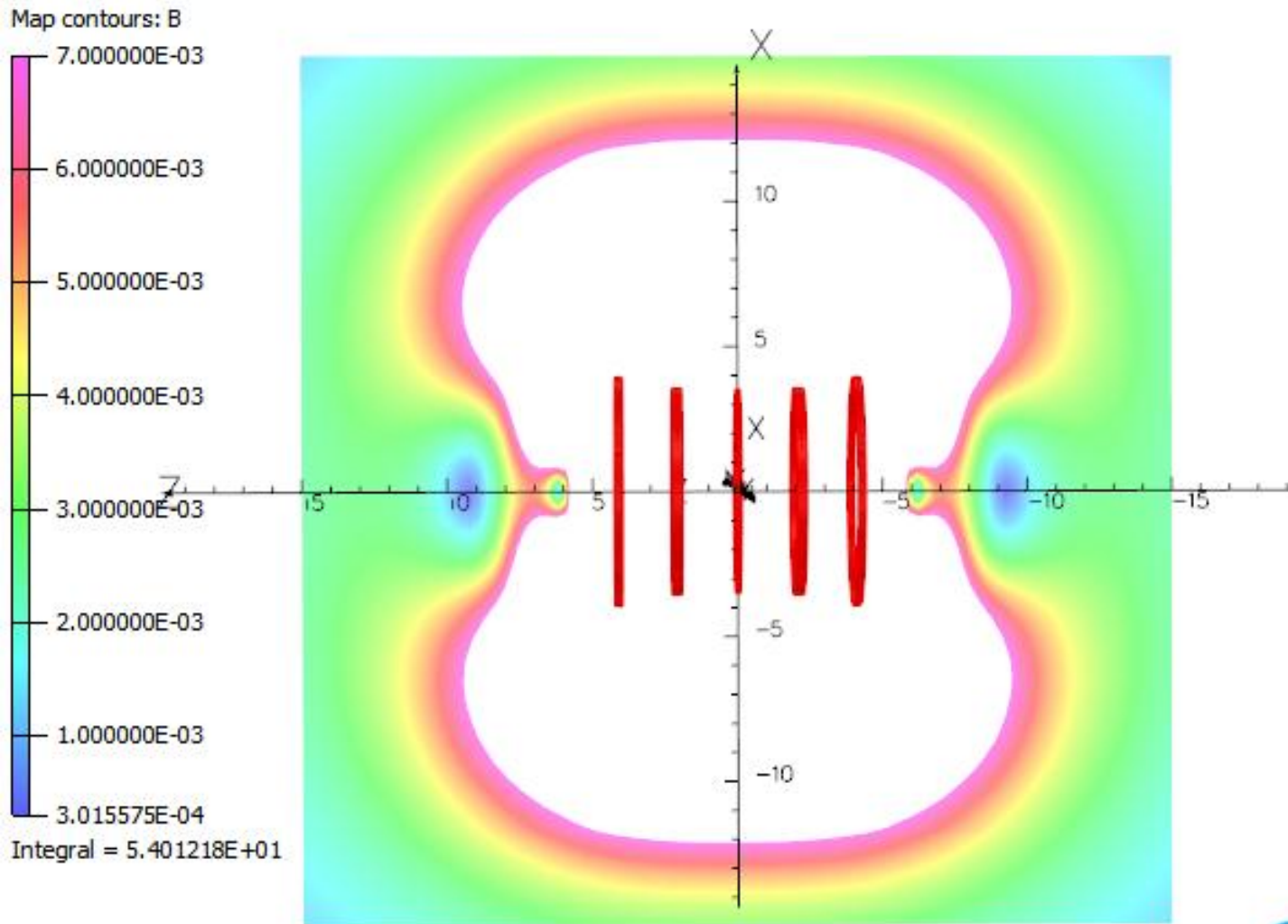
Detector Magnet Coil Configuration-01

Magnetic Field Plot

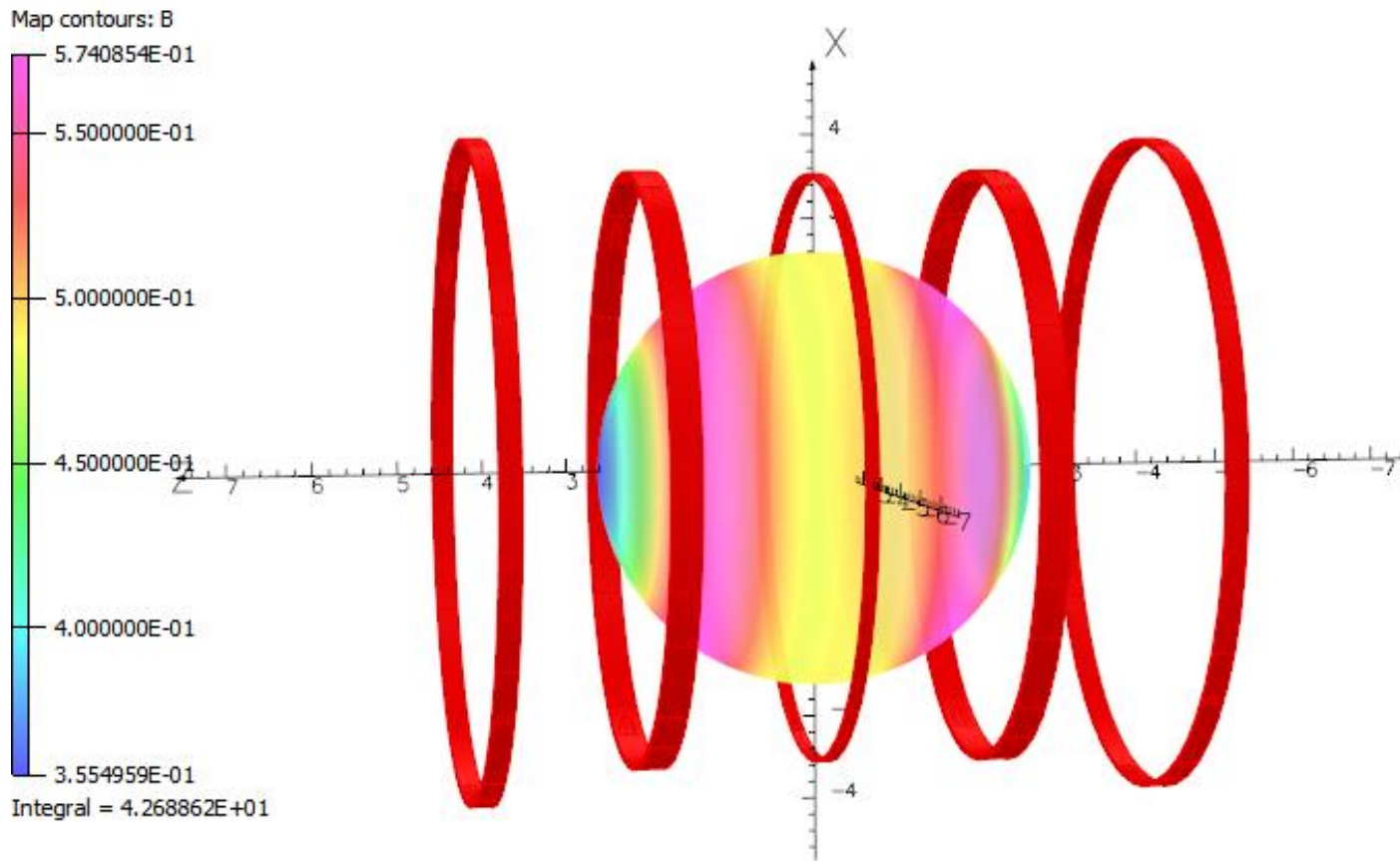


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Stray Magnetic Field Configuration-01



Field Uniformity Configuration-01

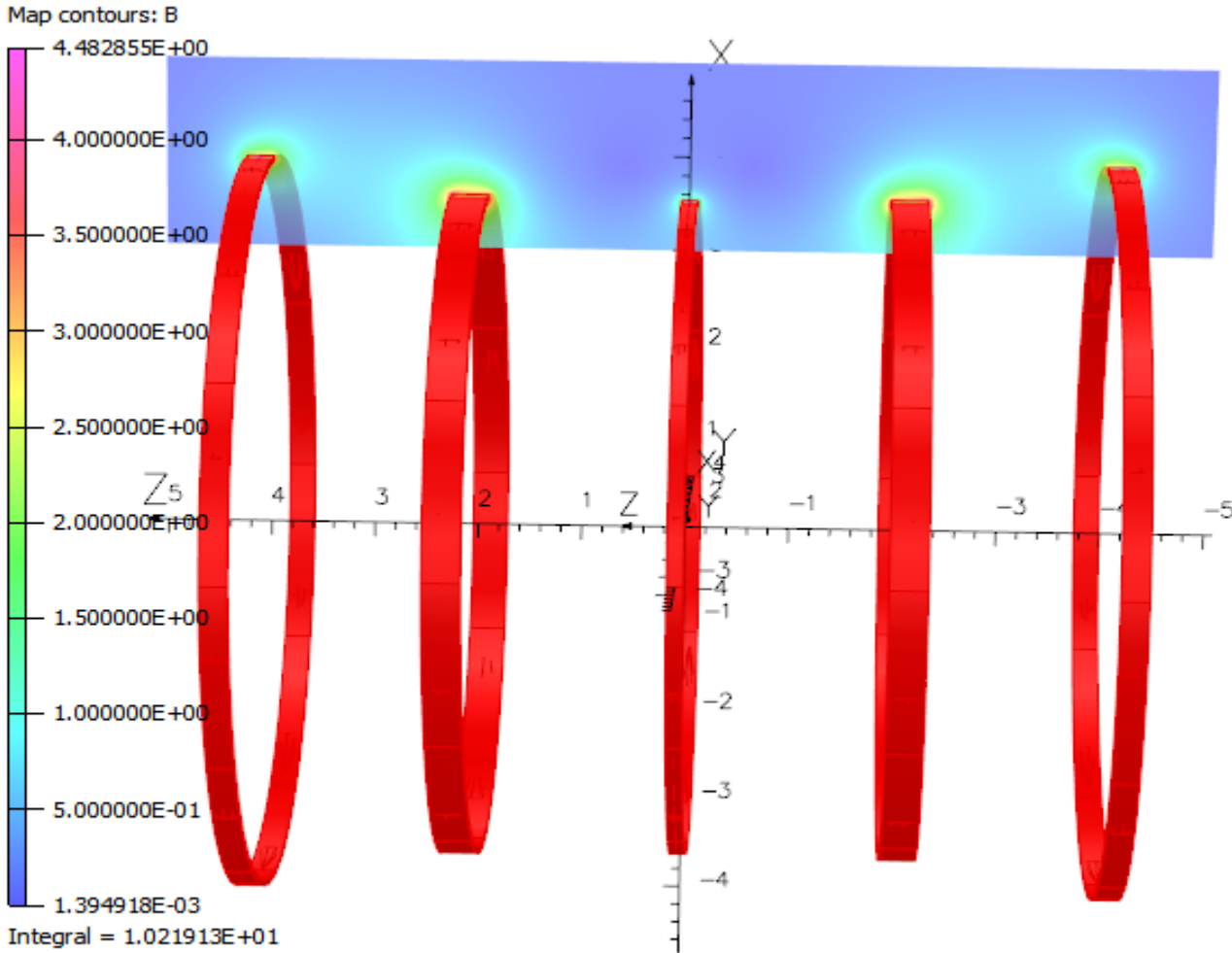


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$$B(0,0,0)=0.5 \text{ T}$$

$$B_{\text{uniformity}}= 29\%$$

Magnetic Design Configuration-01



$$B_{\text{peak}} = 4.5 \text{ T}$$

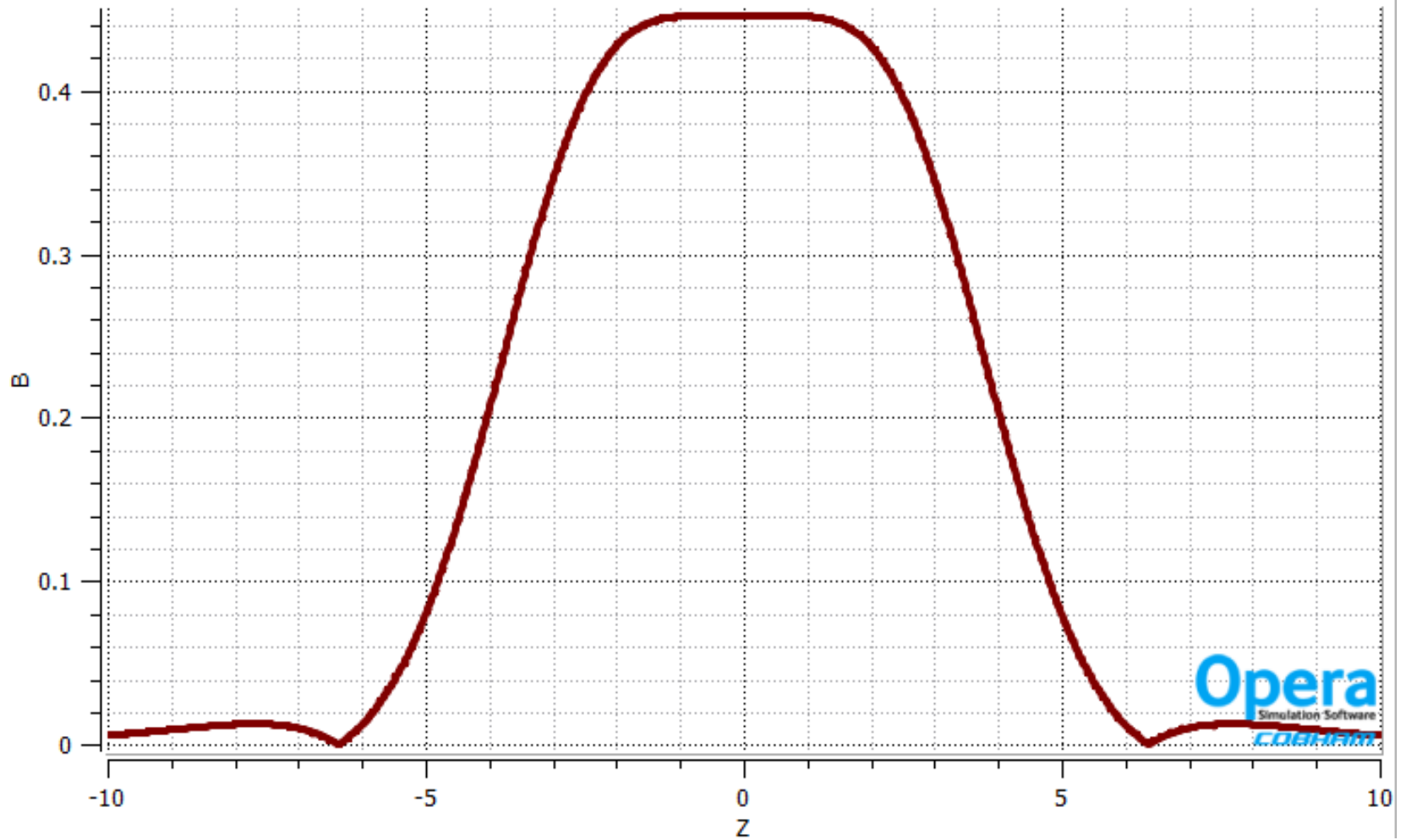
$$\text{Stored Energy} = 118 \text{ MJ}$$

Forces on the Coil
Main Coil : $F_z = -1.4 \text{ N}$
Side Coils : $F_z = 3.62 \text{ N}$
Bucking Coils : $F_z = -8.18 \text{ N}$

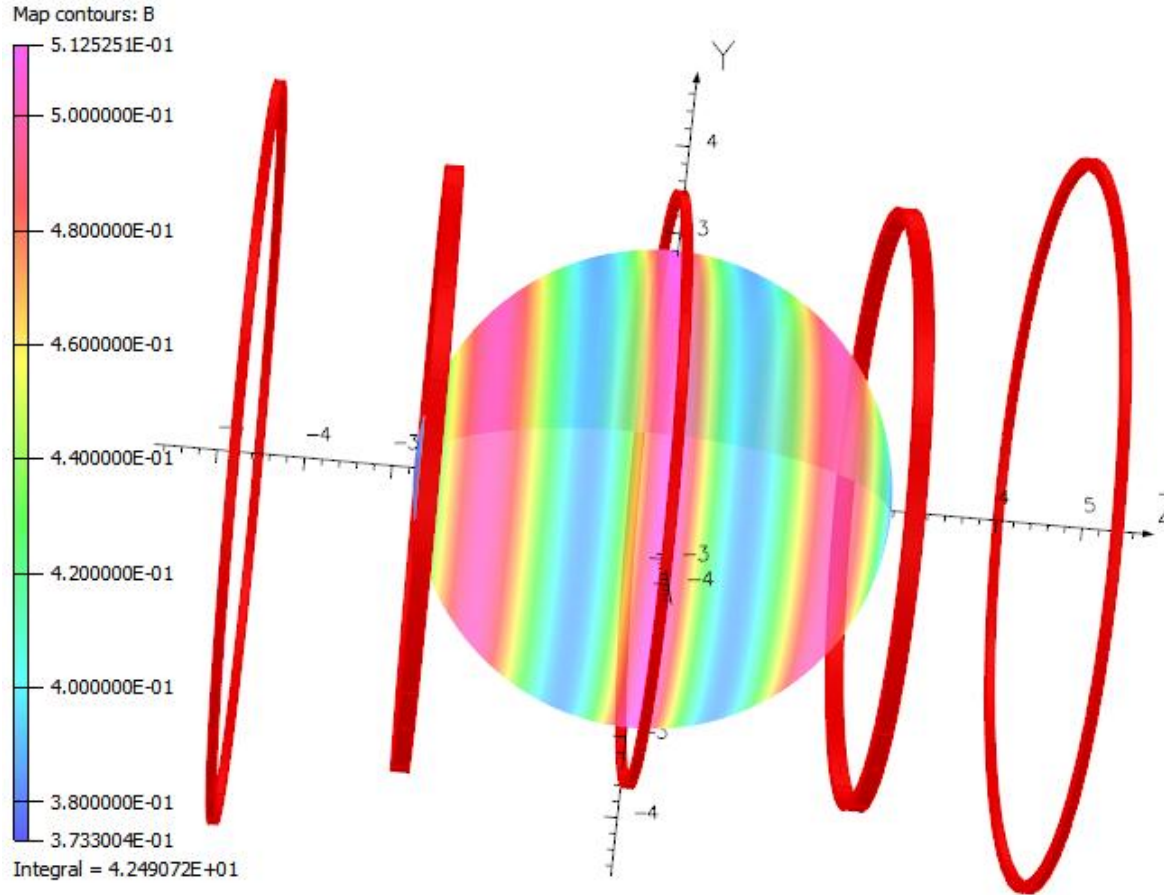
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Detector Magnet Configuration-02

Magnetic Field Plot



Field Uniformity Configuration-02

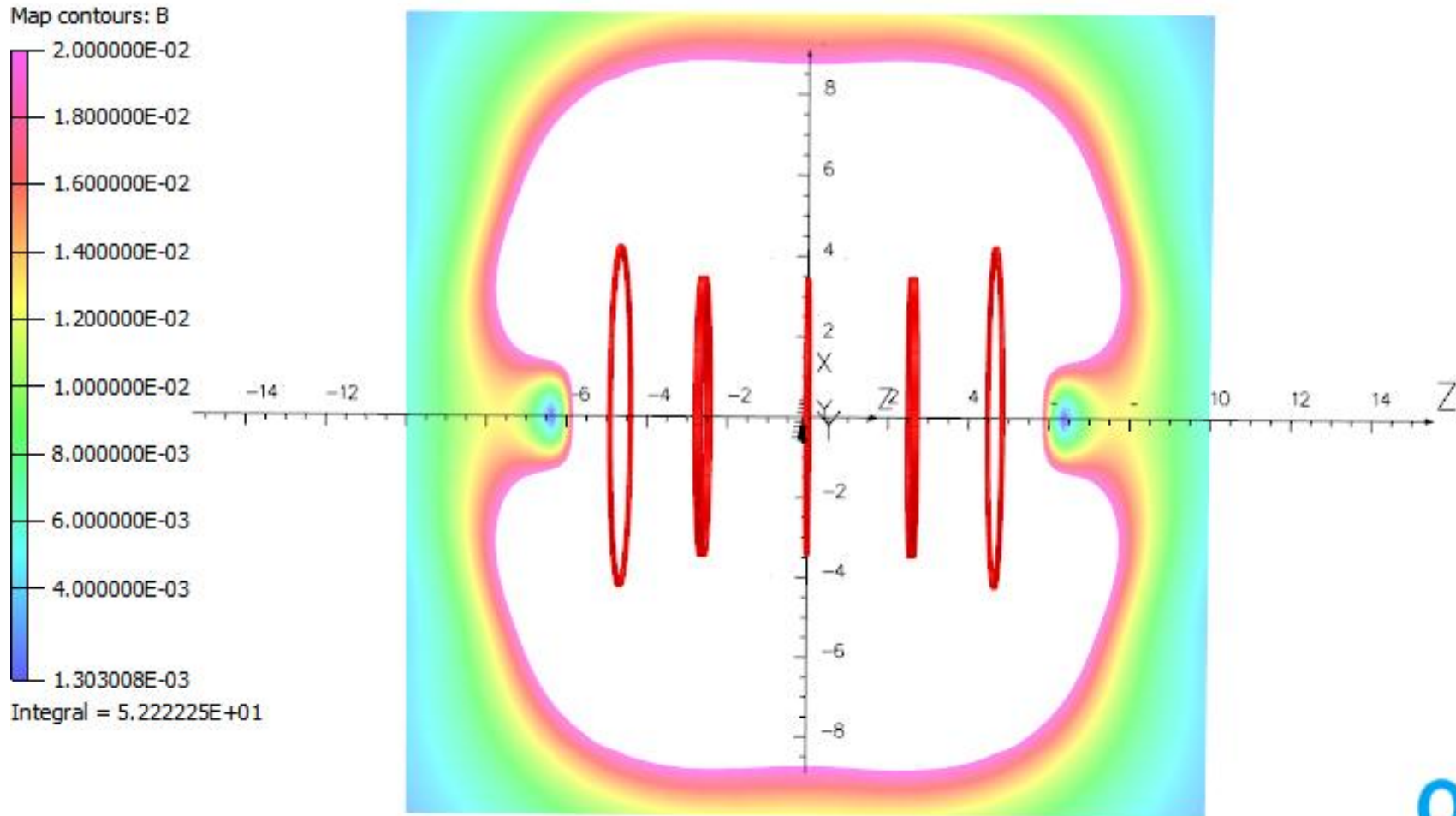


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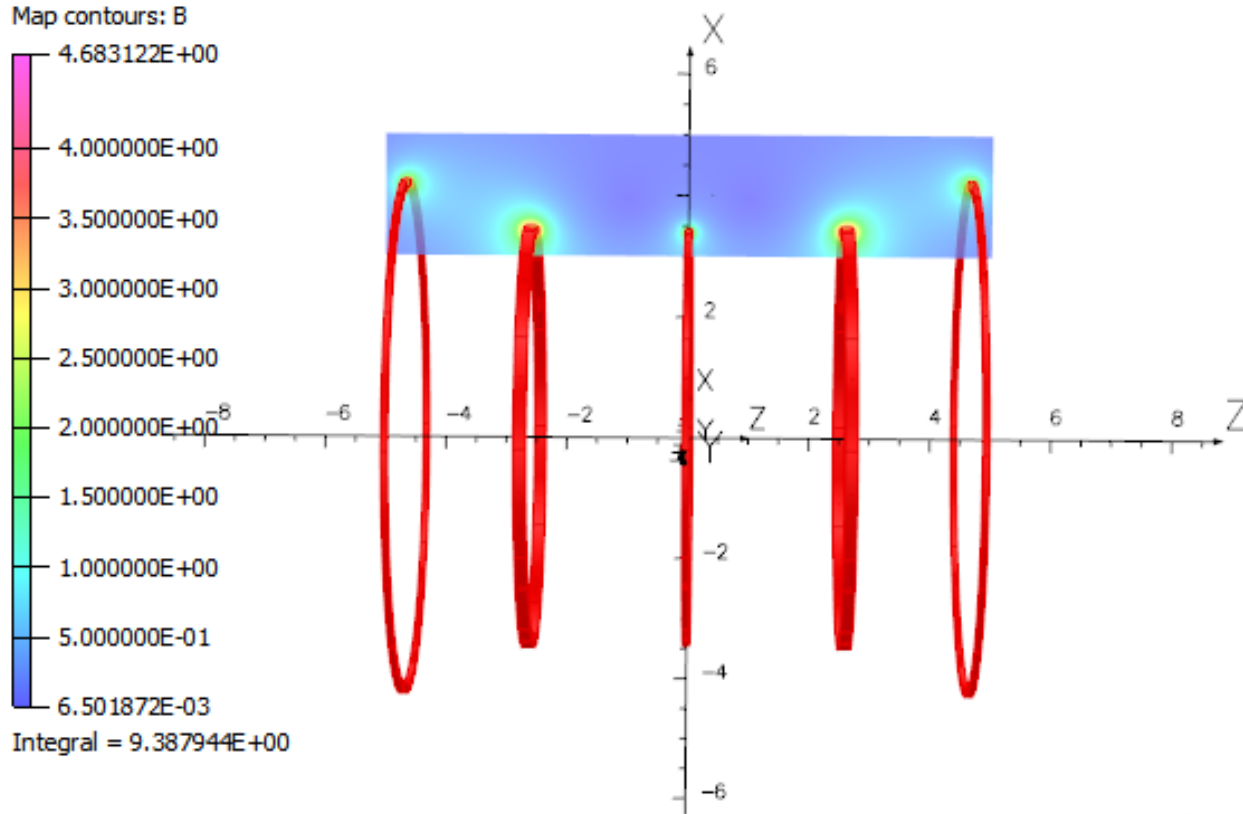
$$B(0,0,0)=0.45 \text{ T}$$

$$B_{\text{uniformity}}= 17\%$$

Stray Magnetic Field Configuration-02



Magnetic Design Configuration-02



$B_{\text{peak}} = 4.7 \text{ T}$

Stored Energy = 112 MJ

Forces on the Coil
Main Coil : $F_z = 0.32 \text{ N}$
Side Coils: $F_z = 2.97 \text{ N}$
Bucking Coils : $F_z = -0.98 \text{ N}$

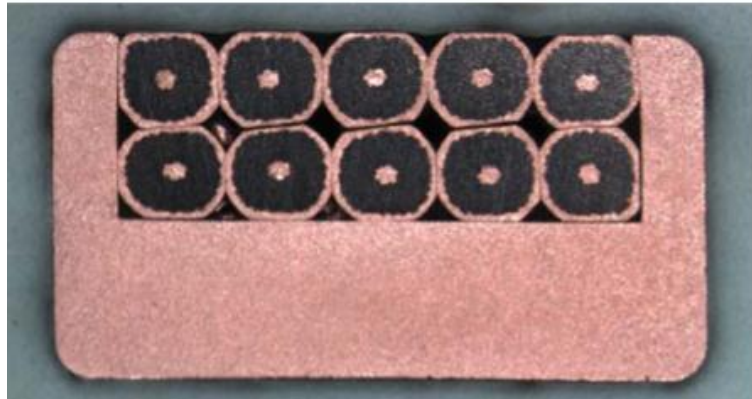


Magnetic Design status

Present Status : Optimization of coil

- Constraints :
 - $B(0,0,0) \approx 0.5T$
 - Max ($B(10,0,0)$ to $B(6,0,0)$) $\sim \leq 50$ Gauss (5mT)
- Objective function:
 - Maximize uniformity in the DSV of 5.2 m

Conductor Selection



RIC Conductor used in
11.75Tesla Iseult MRI Magnet

Detailed discussion with Luvata in progress
Piece Length : 1.6 Km
Lead Time : 9 Months

Conductor Type	Cable in channel
Bare Dimension (mm)	9.18 x 4.88
No of SC strands in cable	7
No of filaments in each strand	480
Cu/SC of SC Strand	1.23
Filament Diameter	37 microns
Filament twist	50 mm
Overall Cu/SC	10
I _c (5T, 4.2K)	> 10,000A
RRR	> 100
0.2% Yield Strength	> 200 MPa

Thank you