Fermilab

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# EIC RCS Dipole Magnet

## ( Coils air cooling )

Vladimir Kashikhin

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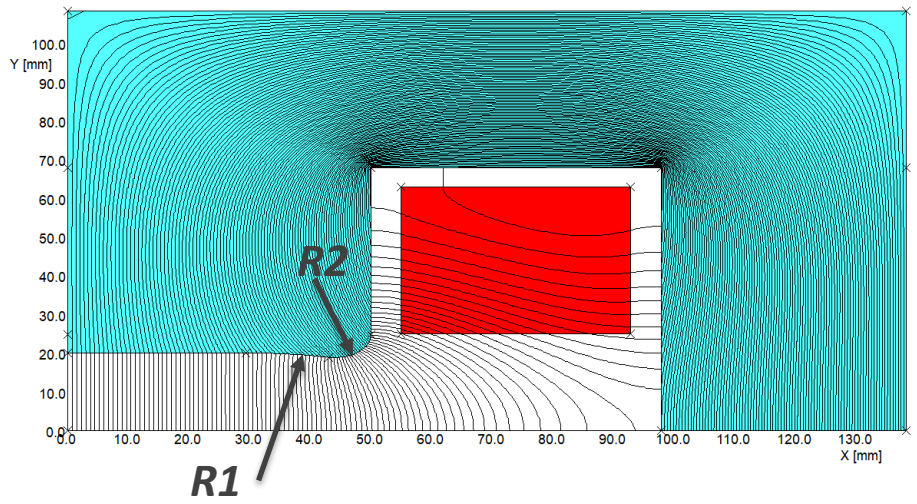
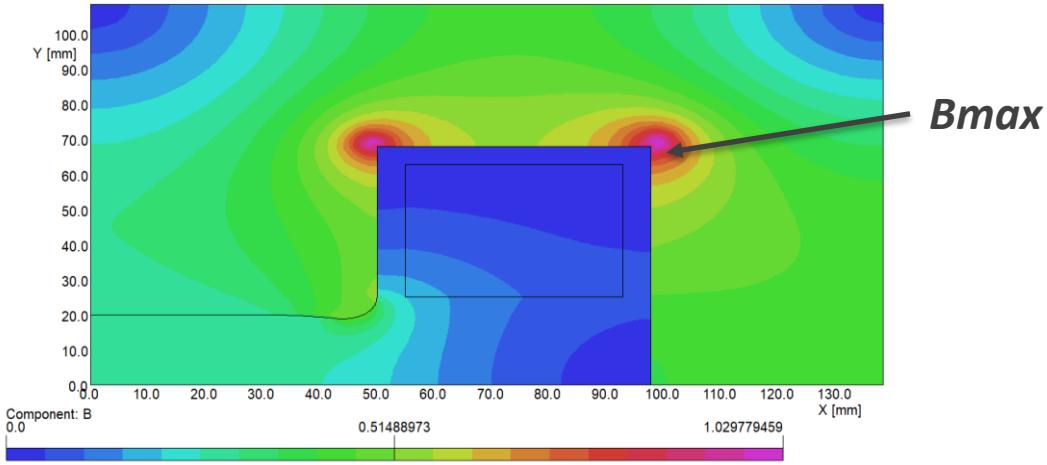
# RCS Dipole 2D Simulation



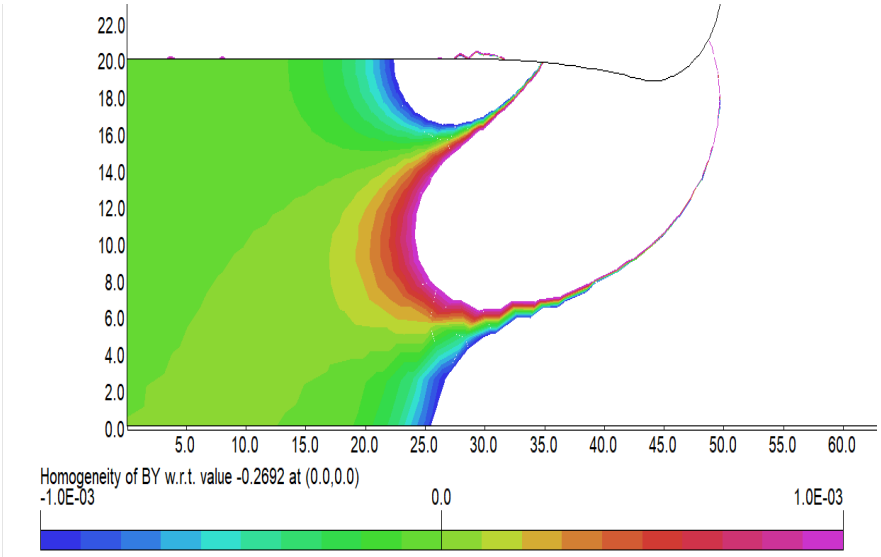



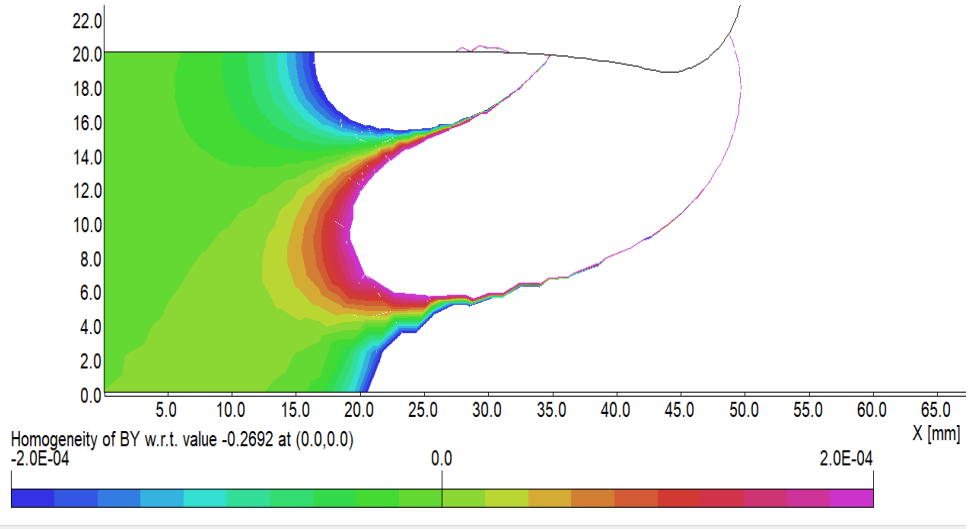

Coil ampere-turns 4100 A.
Center field 0.25523 T.
Iron peak field Bmax=1.03 T.
Pole profile optimized to obtain the best field homogeneity in the magnet gap by variations:

- Pole width, pole shim height, and radiuses R1, R2.

Besides the pole contour is smooth and has uninterrupted dy/dx derivative to eliminate high order harmonics.

# RCS Dipole 2D Field Homogeneity

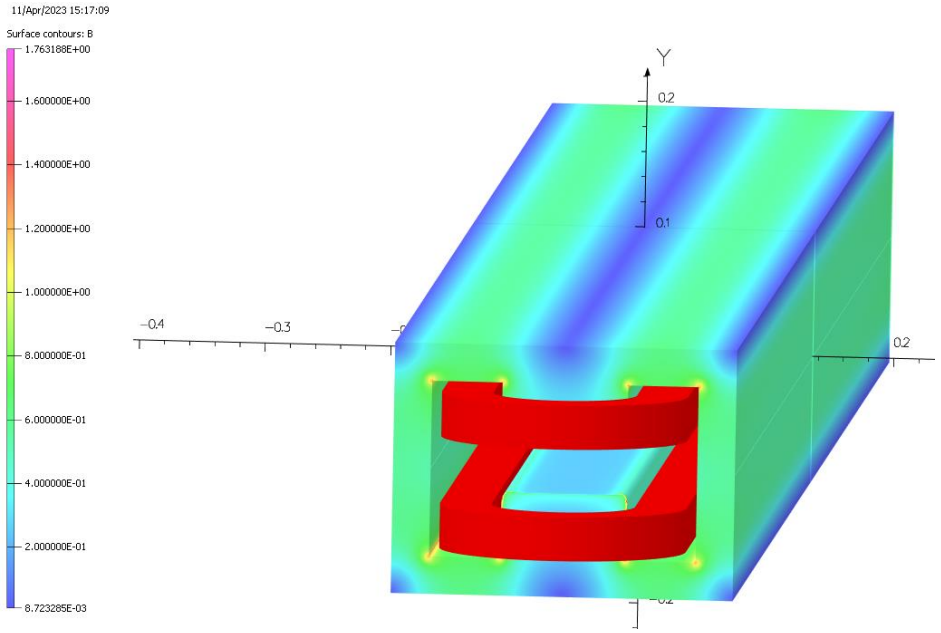


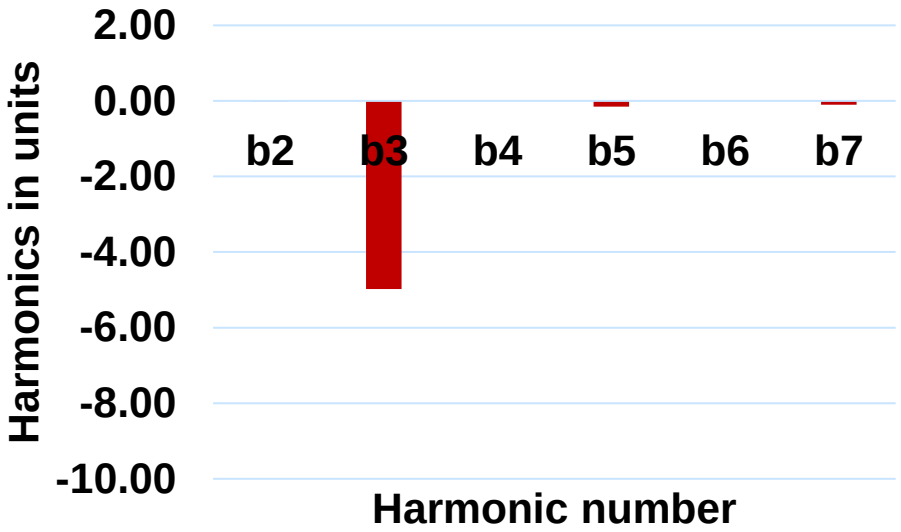




Field homogeneity area +/- 0.1%.

Field homogeneity area +/- 0.02%.

# RCS Dipole 3D Field




Iron core flux density.
Bmax=1.4 T (in corners).

Integrated field harmonics in units (10^-4).
Integrated field 0.491 T-m.

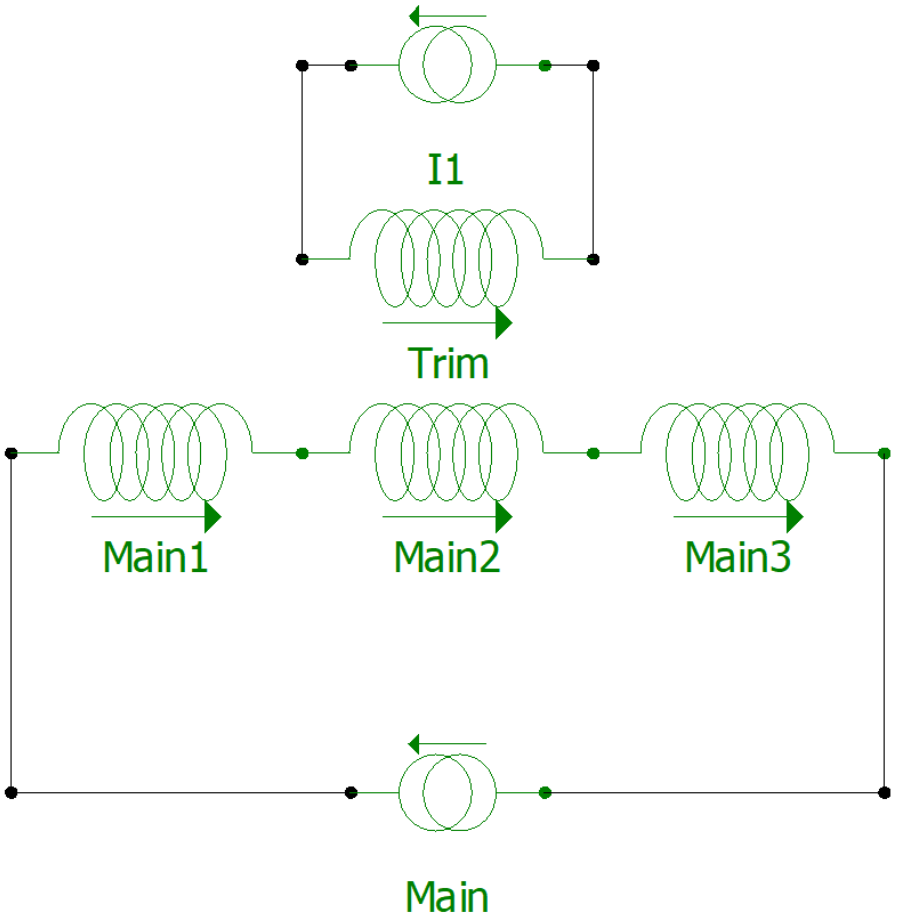
# RCS Dipole Specification

| Parameter | Unit | Value |
|---|---|---|
| Number of magnets (3 magnets/dipole module) | | 1152 |
| Magnetic length | m | 1.148 |
| Gap | mm | 40 |
| Gap minimum field at 0.4 GeV | T | 0.0191 |
| Gap maximum field at 18 GeV | T | 0.2852 |
| Field quality at Rref=20 mm | % | 0.1 |
| Current ramp time | s | 0.1 |
| Current pulses repetition rate | Hz | 1.0 |
| Field maximum integrated strength/magnet | T-m | 0.327 |
| 3 magnets integrated strength | T-m | 0.982 |
| Magnet cooling | | Air |

# RCS Dipole Parameters

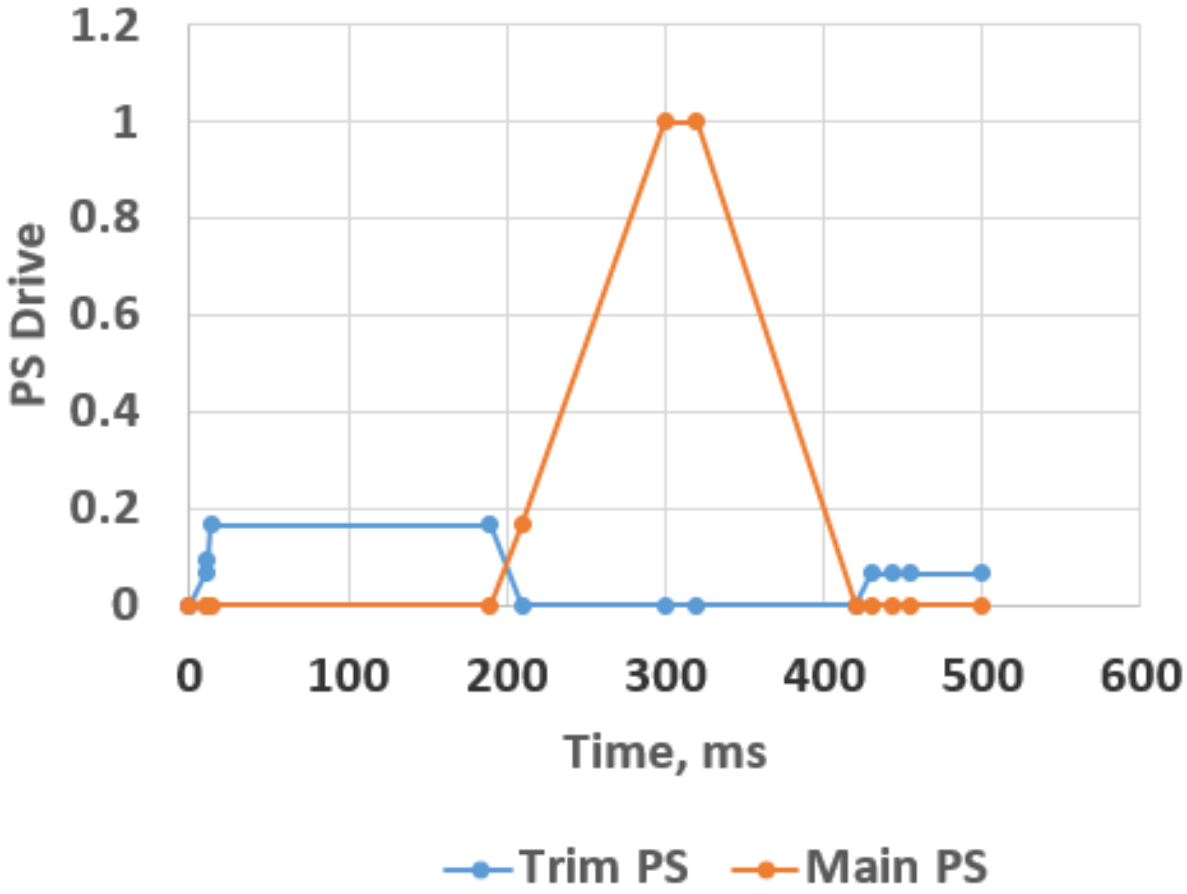
| Parameter | Unit | Main coils | Trim coils |
|---|---|---|---|
| Coil copper conductor | mm | 20 x 35 | 10 x 35 |
| Number of turns/pole | | 2 | 2 |
| Number of dipole cores | | 3 | 1 |
| Number of racetrack | | 2 | 2 |
| Magnet resistance | mOhm | 0.914 | 0.32 |
| Peak gap field | T | 0.2856 (18 GeV) | 0.06 (1.26 GeV) |
| Peak current | A | 2275 | 955 |
| Peak DC voltage | V | 2.08 | 0.3 |
| Average power losses main/trim | W | 383 | 230 |

# RCS Dipole Circuit Diagram



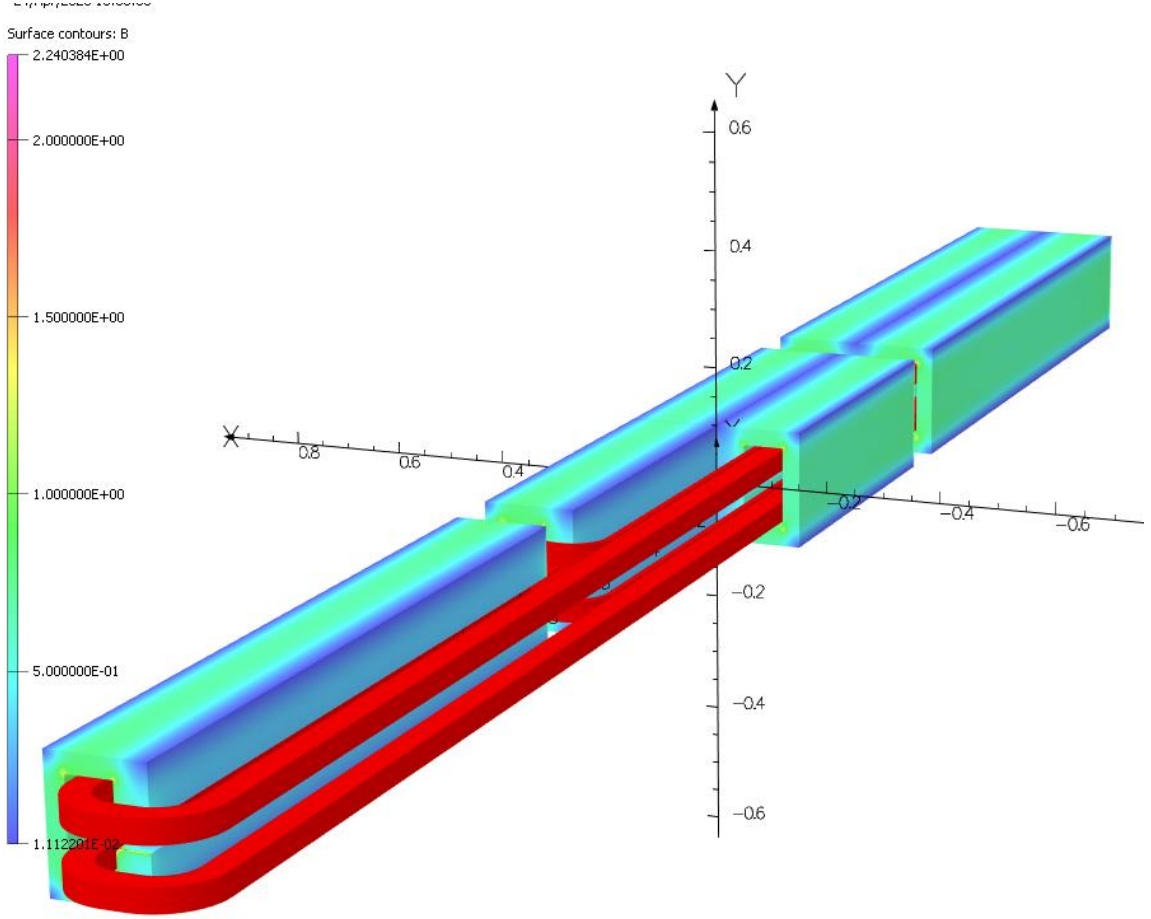

Two power supplies: Main and Trim working independently.

# RCS Dipole Drive Functions



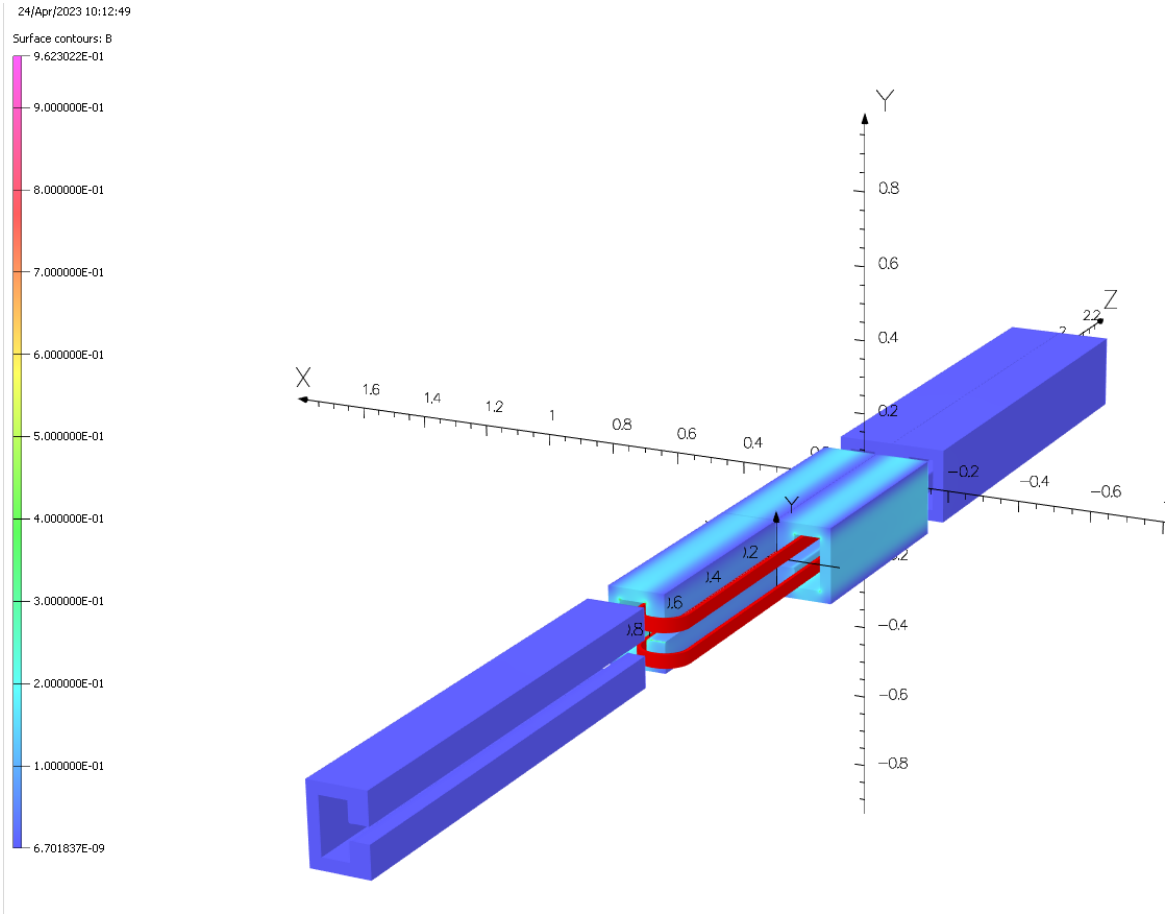

Normalized for Bmax=0.28516 T, peak current 2275 A.

# RCS Dipole 3D Model View (Main mode)



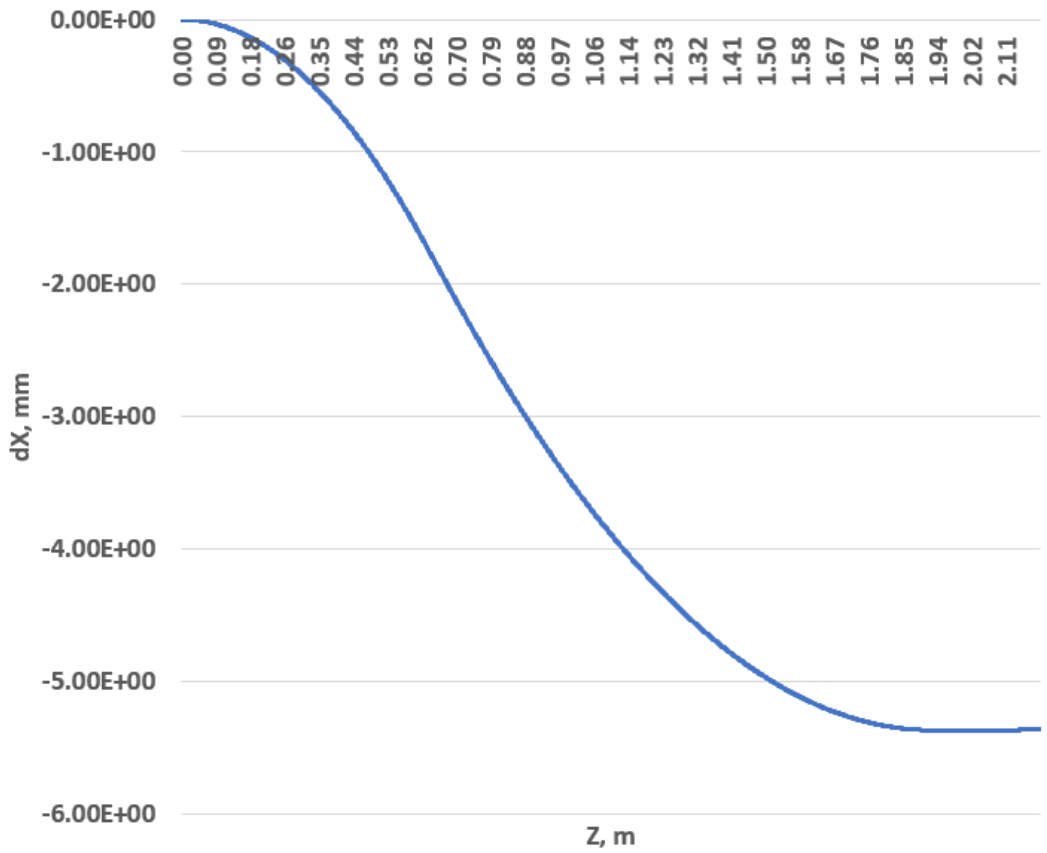

Only main coil powered at current 2275 A.

# RCS Dipole 3D Model View (Trim mode)




Only trim coil powered at current 955 A.

# RCS Dipole Electron Beam Tracks




The difference 5.36 mm (maximum) between tracks for 0.4 GeV and 18 GeV electron beams.

# RCS Dipole Cross-Section