

**LDRD GTS Magnetic Model**  
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Abstract

A magnetic model of the LDRD GTS (lab directed research and development gun test stand) was developed at the request of Riad Suleiman. Locations were taken from drawing JL0038343 "magnetized beam LDRD assy" except for the first corrector, nominally at  $z=41.38$  cm, because it would have interfered with the adjacent solenoid. Its centerline was changed to  $z=40$  cm. The magnetic elements of the model are discussed individually in the next section. The following section shows fields in simulations with single elements energized. These will be compared to measurements.

**Magnetic elements**

The large LDRD coil was procured to a specification I wrote:

*One water cooled magnet coil*

*Inside diameter 30 cm, round to 0.2 cm*

*Outside diameter roundness: 0.5 cm*

*Flatness, each side, 0.3 cm*

*Eight double pancakes of 20 turns per pancake using Luvata 6092 or equivalent copper conductor, 9 mm square with 6 mm round hole for water cooling. 320 turns total. These may be soldered or bolted together as vendor prefers, see also potting options below. Vendor should propose input/output flags suitable for 500A.*

*Eight parallel water cooling circuits, one per double pancake, with 37° flare JIC tube fittings. All eight water connections shall be located on the coil outer diameter within a 15 degree region of the assembly. Vendor shall provide a cooling water specification (flow rate and pressure) for each water circuit assuming 400A current and water inlet temperature of 35C.*

*Coil cross-section shall be less than 16 cm Z by 20 cm R.*

*Vendor shall propose insulation system. Glass-epoxy with at least 110C capability preferred. Potting may be done as a "bag job". Tooling could also be built to pot four double pancakes as a coil half with four water circuits and two leads. Bolted jumper plate to electrically join the two halves shall be provided in this case. Or full depth tooling can be built.*

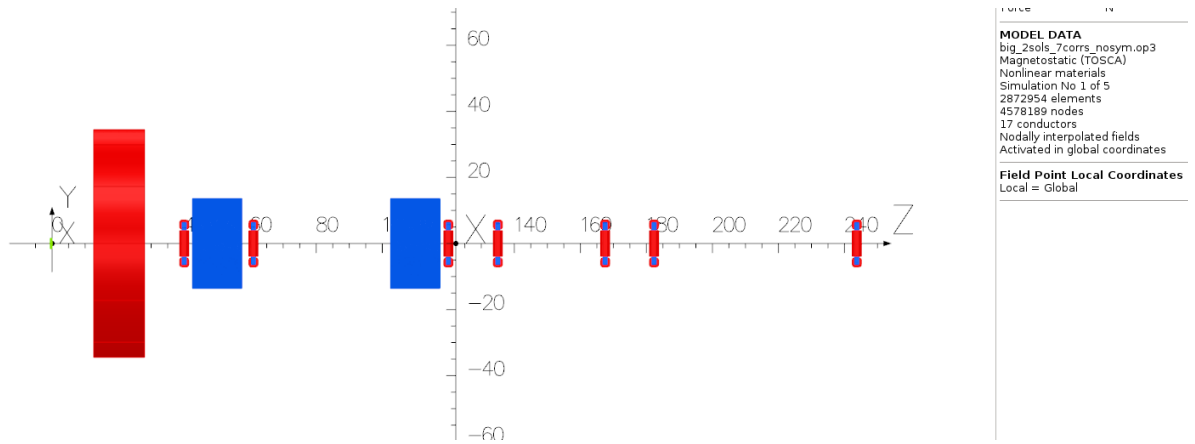
The two FEL-style focusing solenoids are documented only in JLab mechanical drawings and my Opera models.

The seven correctors were purchased from Radiabeam. <https://logbooks/entry/3485463> was written by Riad to retain relevant links.

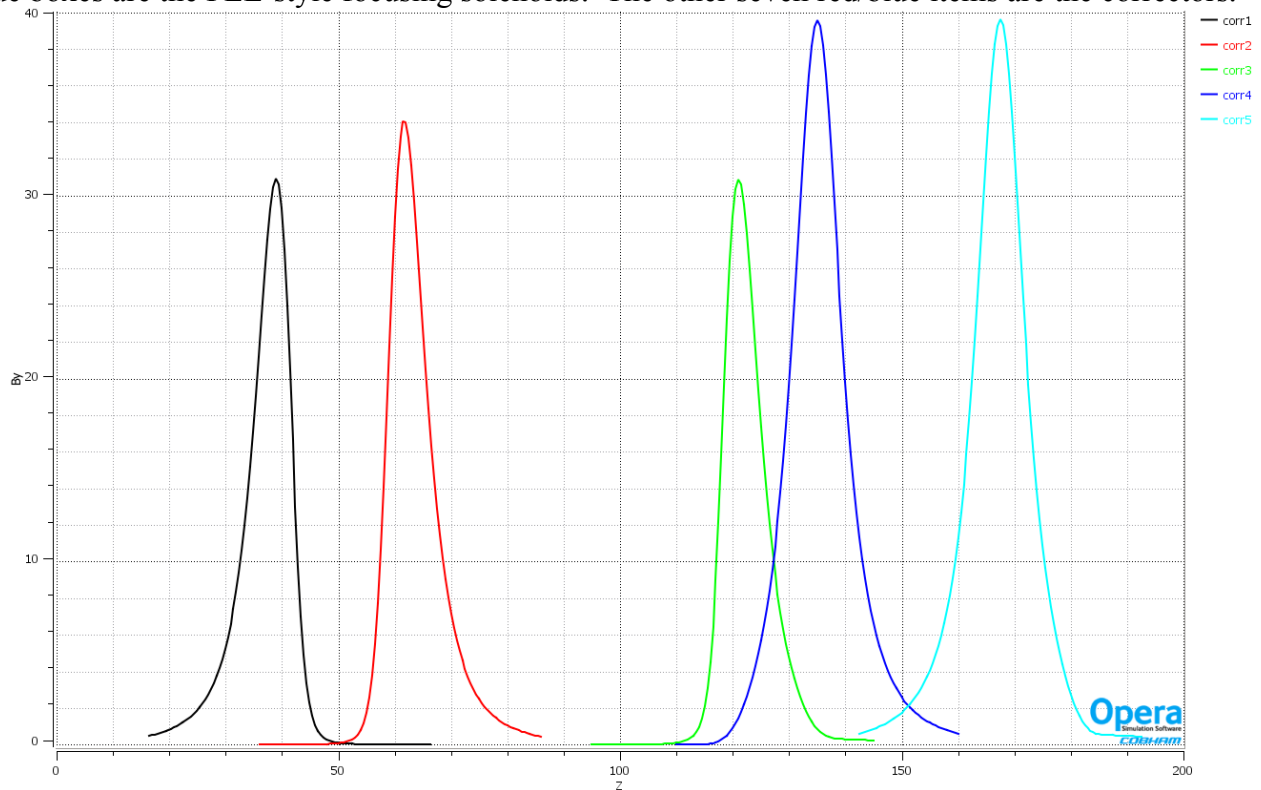
## Mechanical drawing

The portion of JL0038343 which has the Z locations is shown below.

## Opera model



**Figure 2.** Opera model. Cathode is at left, 0. Big red object is the LDRD coil defined above. The two blue boxes are the FEL-style focusing solenoids. The other seven red/blue items are the correctors.



**Figure 2.** By due to the first five correctors, all driven by the same current. The effect of the steel solenoid casings is obvious in the first three and even affects the fourth and fifth slightly.

simulation	By BdL at 477.75 AT per coil (G-cm)
separate model, corrector only	500
sim 1, corrector 1 energized	280
sim 2, corrector 2 energized	320
sim 3, corrector 3 energized	268
sim 4, corrector 4 energized	480
sim 5, corrector 5 energized	487

**Table 1.** BdL integrated over  $\pm 25$  cm from corrector center

Measurements with beam suggested that the correctors adjacent to the solenoid steel have about half the strength of those far away from it. The model supports these conclusions.  $B_y(z)$  shapes are distorted too.

Simulations with 100A, 200A and 400A in the big LDRD coil are still cranking away. All the small pieces of steel make it slow to converge. ETC 0800 Saturday. Plots of  $B_z(z)$  over [0,250] will be produced when all three are complete.