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Subject: Magnetic field correction in the Electromagnetic Undulator	Name: Robert A. Bosch	
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<p>The correction of magnetic field errors with trim coils was studied for the SRC electromagnetic undulator using the POISSON code.¹ In Fig. 1, we show one quadrant of an end-on view of the undulator and trim coils; the undulator extends indefinitely into and out of the paper in the two-dimensional POISSON model. We consider a trim coil with ½ cm x ½ cm cross section in a feasible location adjacent to the undulator yoke. The location of the trim coil relative to the undulator axis is: 5 cm < x < 5.5 cm, 8.8 cm < y < 9.3 cm. The yoke (0 < x < 5 cm, 6.9 cm < y < 9.9 cm) was modeled as 1010 steel while the polepieces (0 < x < 5 cm, 1.2 cm < y < 6.9 cm) were modeled as 1010 steel with a stacking factor of 0.4404. The stacking factor is the ratio of the axial extent of a polepiece to one-half of the undulator period (2.4 cm / 5.45 cm = 0.4404).</p> <p>To estimate the vertical magnetic field error from the Earth's magnetic field, POISSON was used to model the undulator inside a large window-frame magnet producing a vertical magnetic field of 0.3 G far from the undulator. The undulator steel concentrated the field to a vertical magnetic field of 0.715 G on the undulator axis, an enhancement of 2.4 times.</p> <p>The correction of a vertical magnetic field error such as that expected from the Earth's field was modeled by choosing boundary conditions such that the magnetic field is parallel to the x = 0 plane and normal to the y = 0 plane. The magnetic field was also considered parallel to the problem boundaries at x = 200 cm and y = 200 cm. A trim coil current of 10 A produces a field of 0.914 G on the undulator axis. The associated vertical calibration is: $dB_y/dI = 9.1 \times 10^{-2}$ Gauss/Amp-turn.</p> <p>The correction of a horizontal magnetic field error was modeled by choosing boundary conditions such that the magnetic field is normal to the x = 0 plane and parallel to the y = 0 plane. A trim coil current of 100 A produces a field of 0.031 G on the undulator axis. The associated horizontal calibration is: $dB_x/dI = 3.1 \times 10^{-4}$ Gauss/Amp-turn. Because the polepieces and yoke tend to short out horizontal magnetic fields, the horizontal calibration value is much smaller than the vertical calibration value.</p> <p>The correction of a skewquad field error was modeled by choosing boundary conditions such that the magnetic field is parallel to both the x = 0 plane and the y = 0 plane. A trim coil current of 1000 A produces zero field on the undulator axis, and $B_x = 0.040$ G at (x,y) = (0.2 cm, 0). The field gradient is thus 0.20 G/cm, and the associated calibration is: $d(\partial B_x/\partial x)/dI = 2.0 \times 10^{-4}$ Gauss/cm-Amp-turn.</p> <p>¹ "POISSON/SUPERFISH Reference Manual," LA-UR-87-126 (1987), Los Alamos Accelerator Code Group, Los Alamos National Laboratory, Los Alamos, NM 87545.</p>		

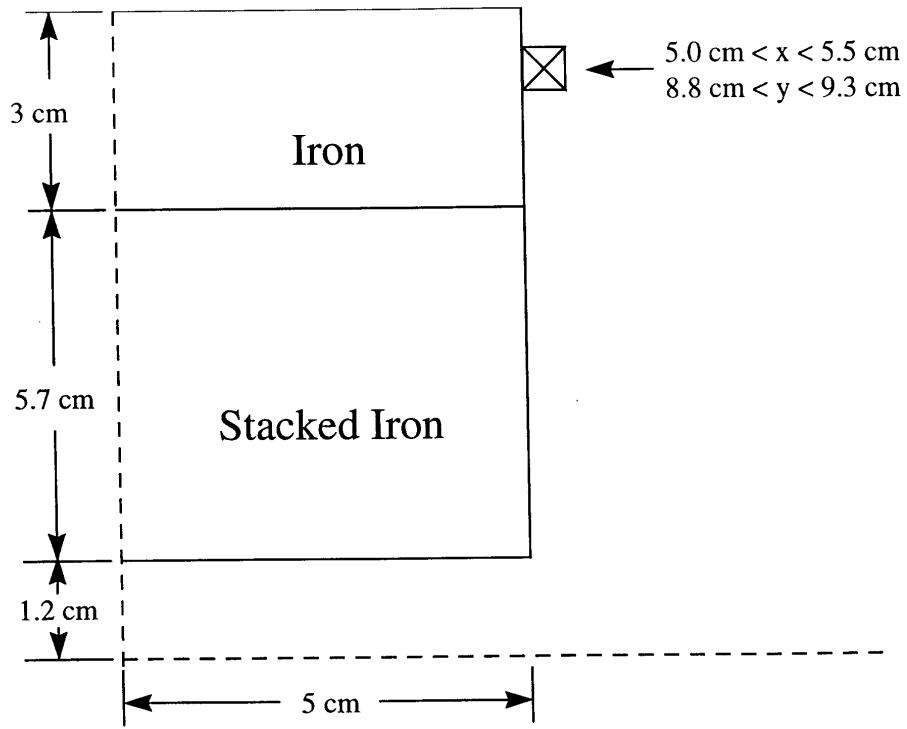


Figure 1. The upper right quadrant of an end-on view of the Electromagnetic Undulator is shown. Also shown is the trim coil location which was modeled.