

## Analysis of the Field Mapping Data of the CLEO Magnet

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This note presents the analysis of the data from each of the eight field mapping units that were deployed in the test lab during low current testing of the CLEO magnet, which has been refurbished for the Solenoidal Large Intensity Device (SoLID).

The hardware and software details of the field mapping units are given in reference [1]. Figure 1 shows the approximate unit placement. Units 1, 2, 3, 5, and 6 were placed at ground level, on top of the steel cable access covers, which remained in place during the test. Units 7 and 8 were placed approximately level with the bore of the magnet (2 m above ground level). The field lines in Fig. 1 are at the bore height of the magnet. The striped area indicates the walkway on the floor and the grey rectangles the cable conduits under the steel cover in the floor.

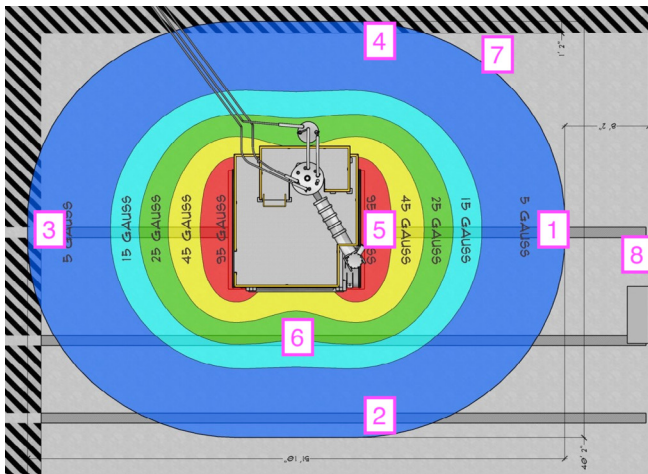


FIG. 1. Approximate placement of field mapping units.

In analyzing the data, the first step was to rotate all the units to have a common coordinate system as they were not placed with the same orientation, some due to being mounted on a vertical surface others because the display would be in a direction that was easy to read. After all the data were rotated to have a common coordinate system, the data were trimmed to only contain the time around when the current was applied to the magnet. Trimming the acquisition time resulted in approximately 2.5 hours' worth of data recorded at 1 Hz. The first and last minute of the trimmed data were averaged to calculate the baseline, which were subtracted from each subsequent measurement. Figure 2 shows the individual  $X$ ,  $Y$ , and  $Z$  components of each unit.

The components were then combined to calculate the magnitude of the magnetic field. Figure 3 shows the resulting field magnitude from each unit and Table I lists some overall statistics.



FIG. 2.  $X$  (blue),  $Y$  (orange), and  $Z$  (green) components of each of the field mapping units.

Unit	Max field [ $\mu\text{T}$ ]	Average field start [ $\mu\text{T}$ ]	Average field end [ $\mu\text{T}$ ]
1	190.7	0.2	23.0
2	181.2	0.3	11.2
3	428.3	0.2	13.3
4	292.3	0.3	22.0
5	4698.9	0.2	46.2
6	462.3	0.2	45.8
7	1620.9	0.2	14.6
8	106.0	0.2	4.4

TABLE I. Summary of calculated data.

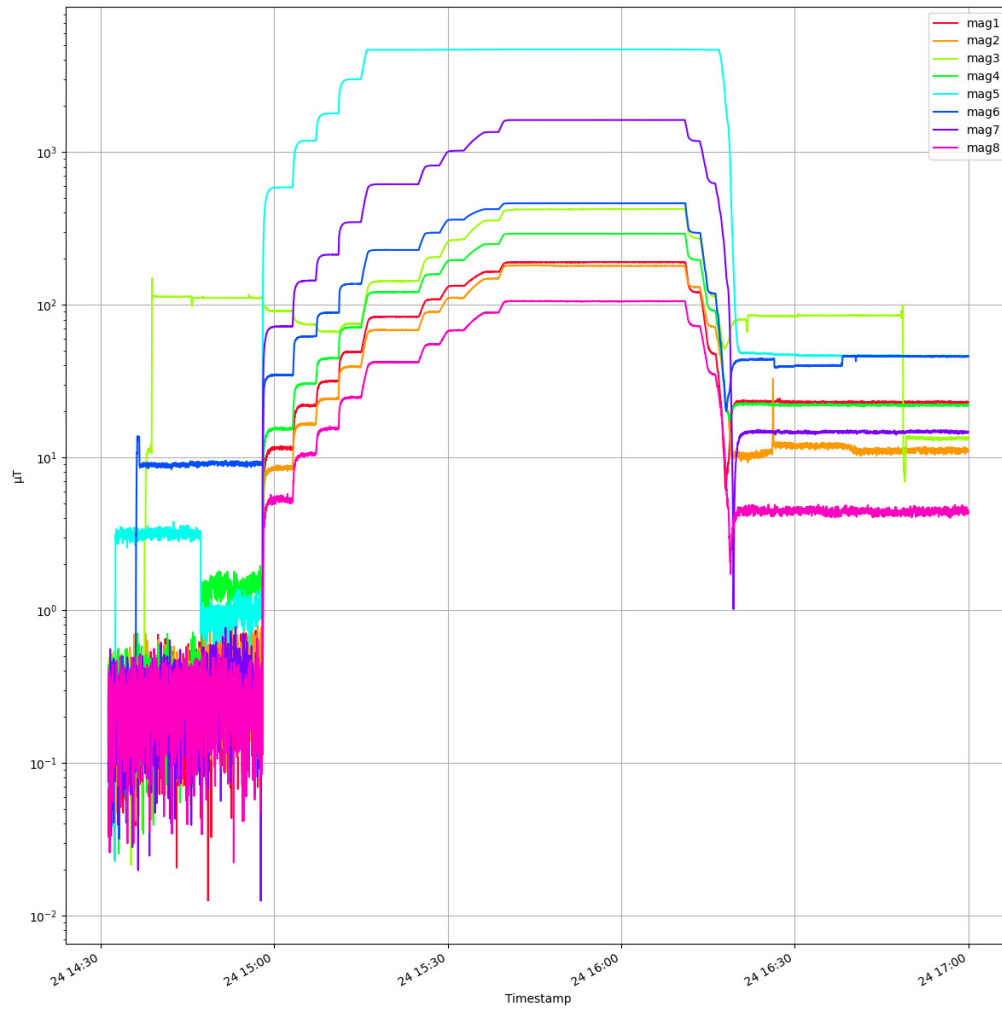


FIG. 3. Field magnitude with a log scale on the Y-axis.

To conclude, analysis of the data acquired by the field mapping units shows that any stray field remaining after powering the solenoid is at the level of the earth's magnetic field (25–65  $\mu\text{T}$ ) and should not be significant enough to affect any sensitive tests performed in the test lab.

[1] B. Eng, et al., *Standalone Stray Field Mapping Units for Hall A's CLEO Solenoid*, DSG-Note 2023-07, 2023.