Standalone Stray Field Mapping Units for Hall A's CLEO Solenoid

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This note presents the development of a standalone unit that will be used to map the stray magnetic fields of the CLEO solenoid.

During the planned lower current (100 A) test of the CLEO solenoid in the High Bay of the Test Lab facility, the possibility of magnetizing the steel in the structure (rebar in flooring, crane girders, and support beams) around the solenoid was raised as an issue because of the proximity of the solenoid to the Superconducting Radio Frequency lab. To measure the field at several locations during the ramping of the solenoid, a sensor assembly was designed, tested, and fabricated.

To quickly have a device up and running, pre-assembled components were used where possible—the main board is an Adafruit ESP32-S3 TFT Feather (Arduino-based microcontroller) that contains an ESP32-S3 Dual Core 240MHz Tensilica processor, a 1.14" TFT display in µT, along with connectors for a LiPoly battery and STEMMA QT sensors. The main sensor in the device is based on an ST Microelectronics LIS2MDL magnetometer (with a range of ±50 G) on a breakout board, also with a STEMMA QT connector, allowing the sensor to be directly connected to the main board with no additional fabrication. Aside from the display itself, data will be saved to a microSD card, also via a breakout board, Fig. 1.

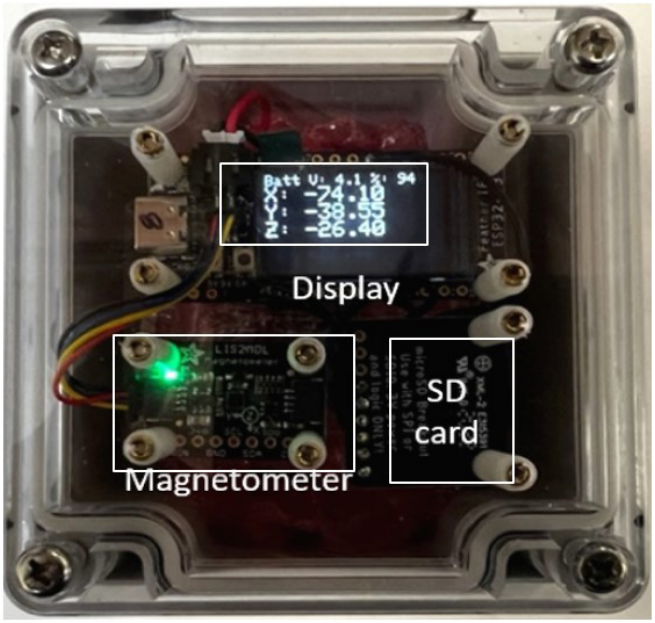

FIG. 1. Completed mapping unit. Display shows *x*,**y**, and z components of the magnetic field in µT.

Initially, most of the development time was spent trying to optimize the code such that the microcontroller would stay in the lower power states as much as possible to preserve battery life to provide the longest runtime possible between recharges. Later, the decision was made that the low current test would not be for more than 24 hours, a period for which the battery would provide power without using the power saving measures.

The deployed code to the Arduino that measures the *x*, *y*, and *z* components of the magnetic field, displays it on a screen, and saves data to an SD card has been developed and tested.

To conclude, eight units have been assembled and tested.