180D Magnet Experiment

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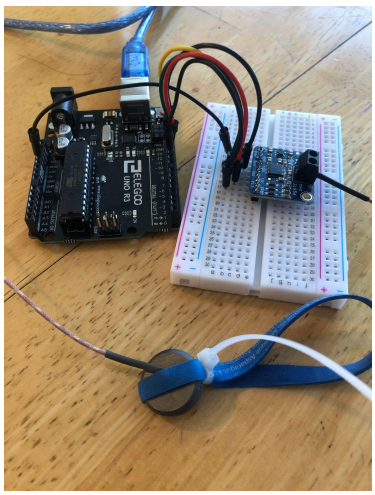
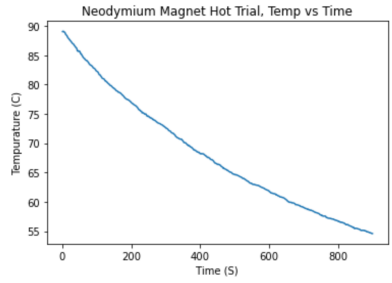
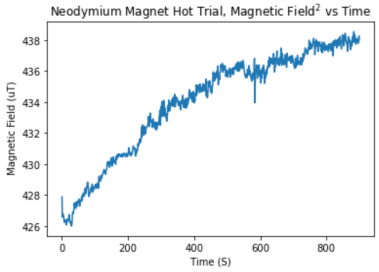
- **Pictures Of Set Up**

In my kit I received the ADAFRUIT 31856 chip and followed the accompanying wiring schematic and code given by their online walk through. I used coolTerm to record the serial monitor data from the thermocouple, and the PhyPhox magnetometer application to record the changes in the magnetic field. To keep my data consistent I cleared my workspace of all materials and tried to keep my laptop, cup, and phone in the same positions for all trials. We started by calibrating the magnetometer by rotating the phone around a few times. Once it was calibrated to high accuracy, I ran 10 minute timed trials for the neodymium and ferrite magnets in both hot and cold conditions with my phone placed next to the cup. The thermocouple was attached to both types of magnets using a rubber band and zip tie. Another key element was to try and reduce any movement in the magnet during the trials by placing it flat on the bottom of the cup and not suspended by the thermocouple wire.

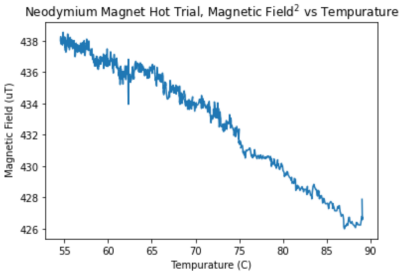


- **Data Plots**

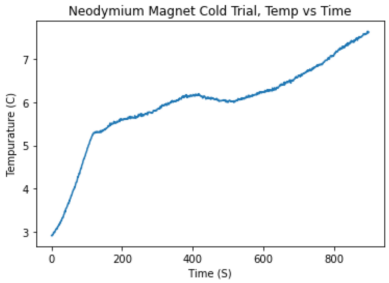


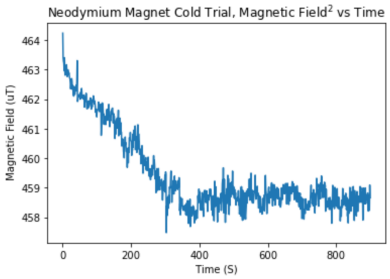


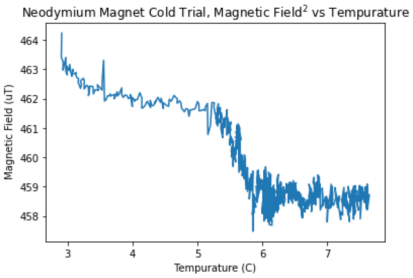
array([-3.46555179e-01, 4.57615786e+02])



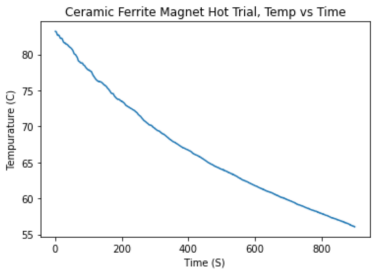
array([-1.17474865, 466.44617784])

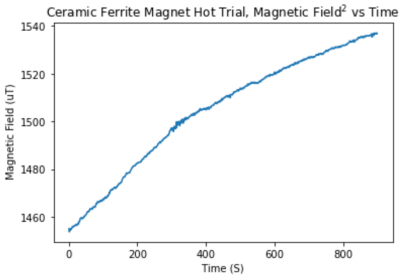


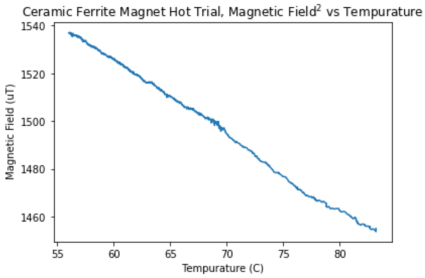




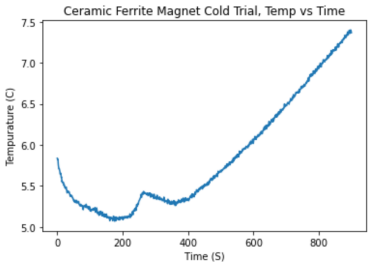
array([-3.18314008, 1716.78463496])

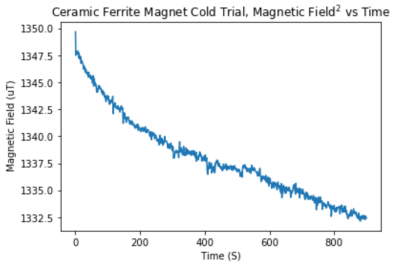


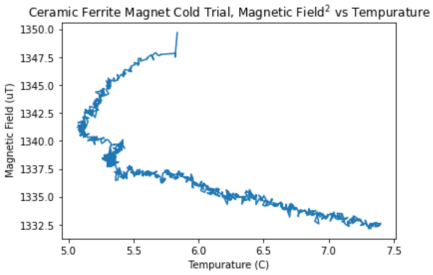




array([-4.42768947, 1363.86663657])







- **Calculating the linear fit**

To calculate my lines of regression I used the python function pyplot, which returns the slope and intercept. Mathematically this is done by finding the average of a said variable, calculating the difference between accompanying points, and then squaring the differences and adding them up. We then do this for the other set of variables upon which we are comparing, and then

combine these squares of differences together. By comparing these combined differences to their average we find our slope and intercept.

- **Calculating Curie Point and Comparison**

By using the given formulas I was able to find my curie temperature for each of my runs.

Neodymium Hot Trial Curie Point	1326.40 C
Neodymium Cold Trail Curie Point	396.93 C
Neodymium Average Curie Point	861.66 C
Ferrite Hot Trial Curie Point	539.35 C
Ferrite Cold Trial Curie Point	307.88 C
Ferrite Average Curie Point	423.61 C

The average accepted value for a ferrite magnet is somewhere between 300-450 degrees celsius, which is in agreement with our experimental data. Neodymium magnets are expected to have a lower currie temp around the range of 250 degrees celsius. This is not in agreement with my data unless maybe this magnet is a different type than when I expected. I am not too sure why this discrepancy occurred because the data seems clean, especially for my hot trial. In some of my other trials I suspect the magnet might have moved and thrown off my readings giving that obscure “S” curve or sudden change seen in my cold trials.

- **Temperature vs Magnetization Relationship**

Magnets should have increased magnetic field in colder temperatures and decreased field as the temperature increases, i.e they are inversely related. This occurs because the added heat gives energy to electrons and ruins the neat aligned structure of spins. This is supported by the data above, since as the hot water bath cooled the magnets had a stronger field, while in the cold bath the magnetic field was the strongest in the beginning, and decreased as the water warmed to room temperature.