Detecting Changes in the Earth’s Magnetic Field

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What is the goal of this study? The purpose of this project was to study the changes in the Earth’s magnetic field due to solar activity. A magnetometer was built using two neodymium magnets and mirrors suspended from a thin nylon thread. A change in the Earth’s magnetic field causes a slight rotation in the magnets which was then detected by a laser light reflected off the mirror.

**Experimental Setup**

The Earth’s magnetic field is impacted by variations in the sun’s sunspot activity and solar flares. We are in a peak of sunspot activity (see above.) The magnetic field of the Earth has an average value of ~50 μ Tesla. Sunspot activity can change that value by ~50 n Tesla. This is 1/1000 of the Earth’s field strength and requires a very sensitive instrument to detect this very small change in magnetic field.

![Artists view of a sunspot impacting the Earth’s magnetic field.](image1.png)

The torque of the thread is counterbalanced by the torque of the Earth’s magnetic field on the very strong, small magnets. Small field changes will cause small changes in the equilibrium position of the magnets. These angular changes are amplified by the long optical path from the mirror on the magnets to the detector.

Shown at top left is data collected during the experiment over a two day period. Below it is the data collected by the United States Geological Survey. This data was taken in Corbin, Virginia, as it is the closest geographic location to Dayton. The two data sets correspond very well.

**References**

*United States Geological Survey Geomagnetism Program (geomag.usgs.gov)*