Finding the earth's magnetic field by twisting magnets*

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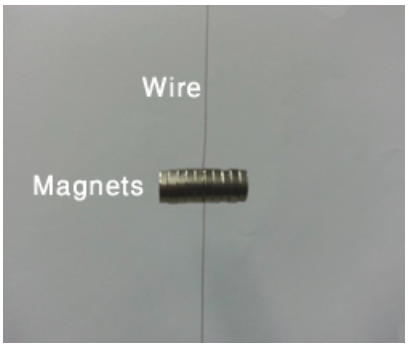
The objective of this experiment is to use the oscillation of magnets in order to determine the earth's magnetic field B. When we suspend magnets vertically pressing upon a wire, allow these to align in the north-south direction, and then slightly nudge these magnets, they will start oscillating in a horizontal plane. In fact, the magnets twist due to the torque exerted by the earths magnetic field.



In this task, you will proceed by symmetrically suspending an equal numbers of identical magnets in space around a wire pressed between them. See the figure above. You would need to measure the average height h, radius R and mass m of magnets and the time period T of oscillations for a given number of magnets. Finally, the period of oscillations depends on the number of magnets N suspended through the relation:

$$T = 2\pi\sqrt{\frac{m}{\mu_1 B}}\sqrt{\frac{1}{12}h^2N^2 + \frac{1}{4}R^2} \tag{1}$$

The magnetic moment of an individual magnet that is provided to you, μ_1 has been independently measured at (0.736 ± 0.005) Am^2. Use your measurements to estimate the earth's magnetic field. You will be evaluated on the basis of choosing suitable variables to tabulate and plot, curve fitting and determining uncertainties. It would be interesting to see the logical progression of your experimental scheme. Good luck!

References

[1] M. Connors and F. Al-Shamali, Phys. Teach. **45**, 440 (2007).