Magic Eggs: Magnetism at Any Level of Sophistication

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Can a child's toy intrigue a specialist in orthogonal function decomposition?

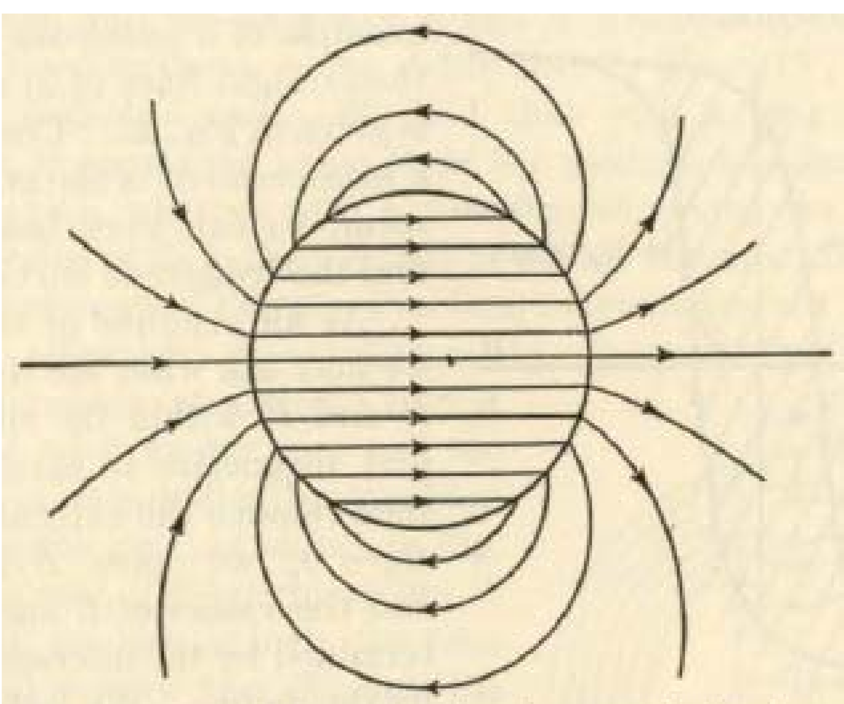
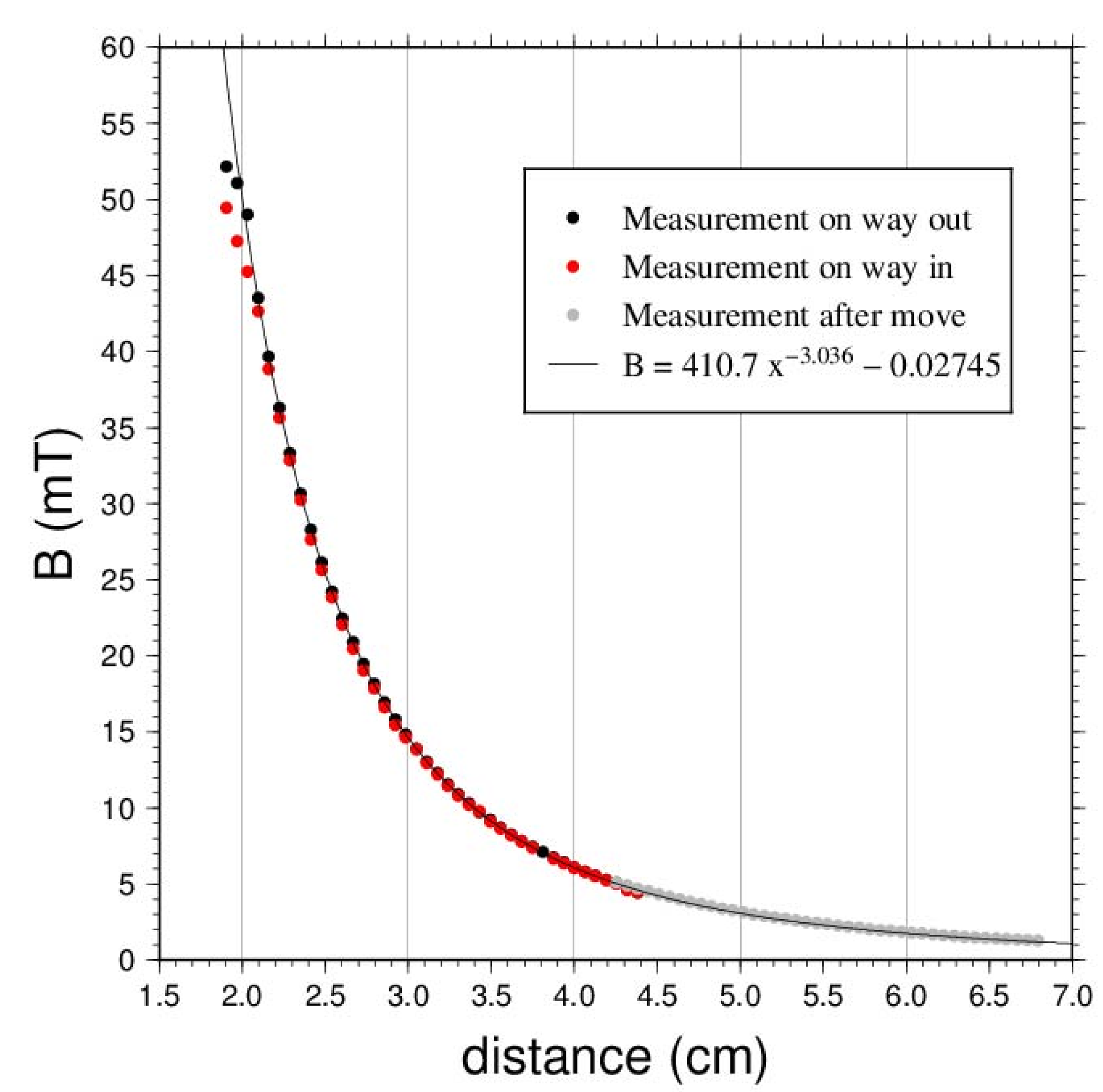


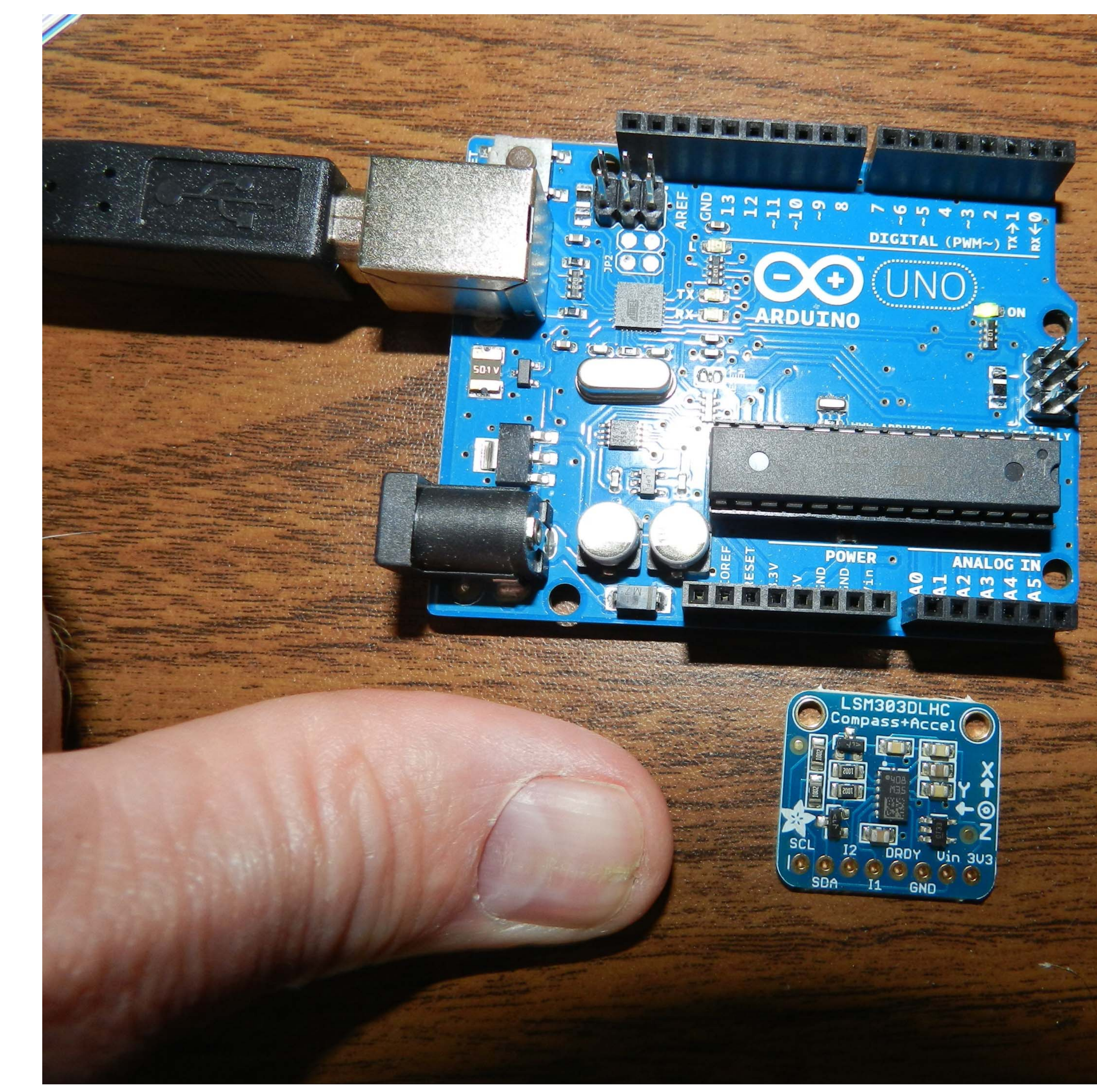
FIG. 21.—Lines of force of uniformly magnetized sphere.

A uniformly magnetized sphere produces an ideal dipole external magnetic field (left; Slater and Frank *Electromagnetism*, 1947). Toy spherical magnets (right) approximate this ideal field.

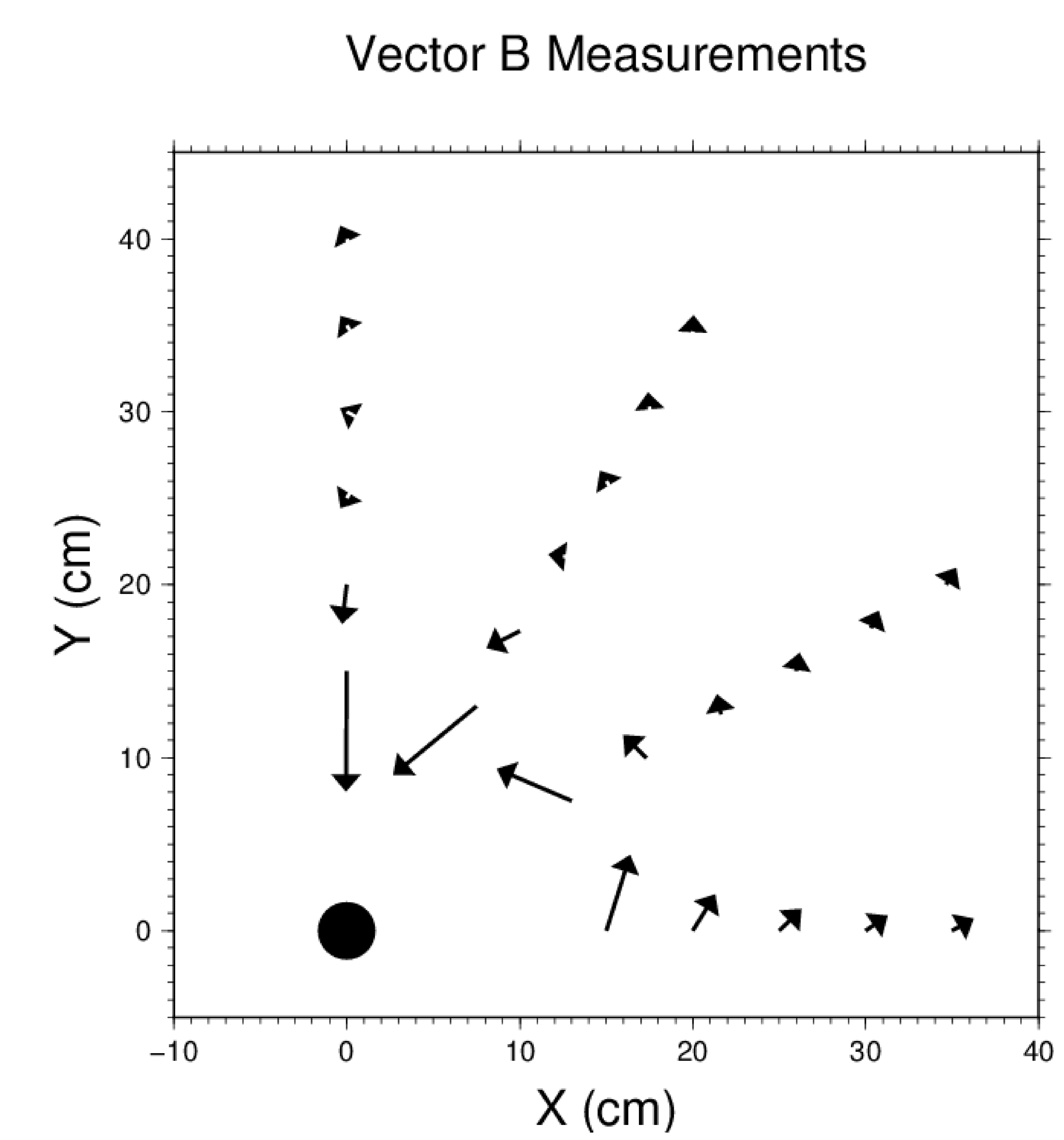
Simple apparatus consisting of a multimeter, voltage regulator and magnetic chip (Connors, *The Physics Teacher*, 2002), with the magnet mounted on an easy-to-build nonmagnetic carriage (below), allows determining that the ideal dipole -3 power law dependence on distance applies well for a spherical magnet (left center).



Recently, 3-d magnetic chips became available (right). For $15 one gets magnetic *and* acceleration sensing, using a $50 Arduino to connect to a PC. With this the 2-d or 3-d structure of magnetic fields can be easily investigated.



The preliminary try is a bit crude, but basic aspects of the field of the magnet are readily apparent (right). This result was obtained with a few minutes of measurement, with more time spent on rotating the data. It helps see **B** as a *field*.



Conclusions: with simple apparatus, a stunning result can be illustrated quantitatively. A bit more sophistication gets 3-d.