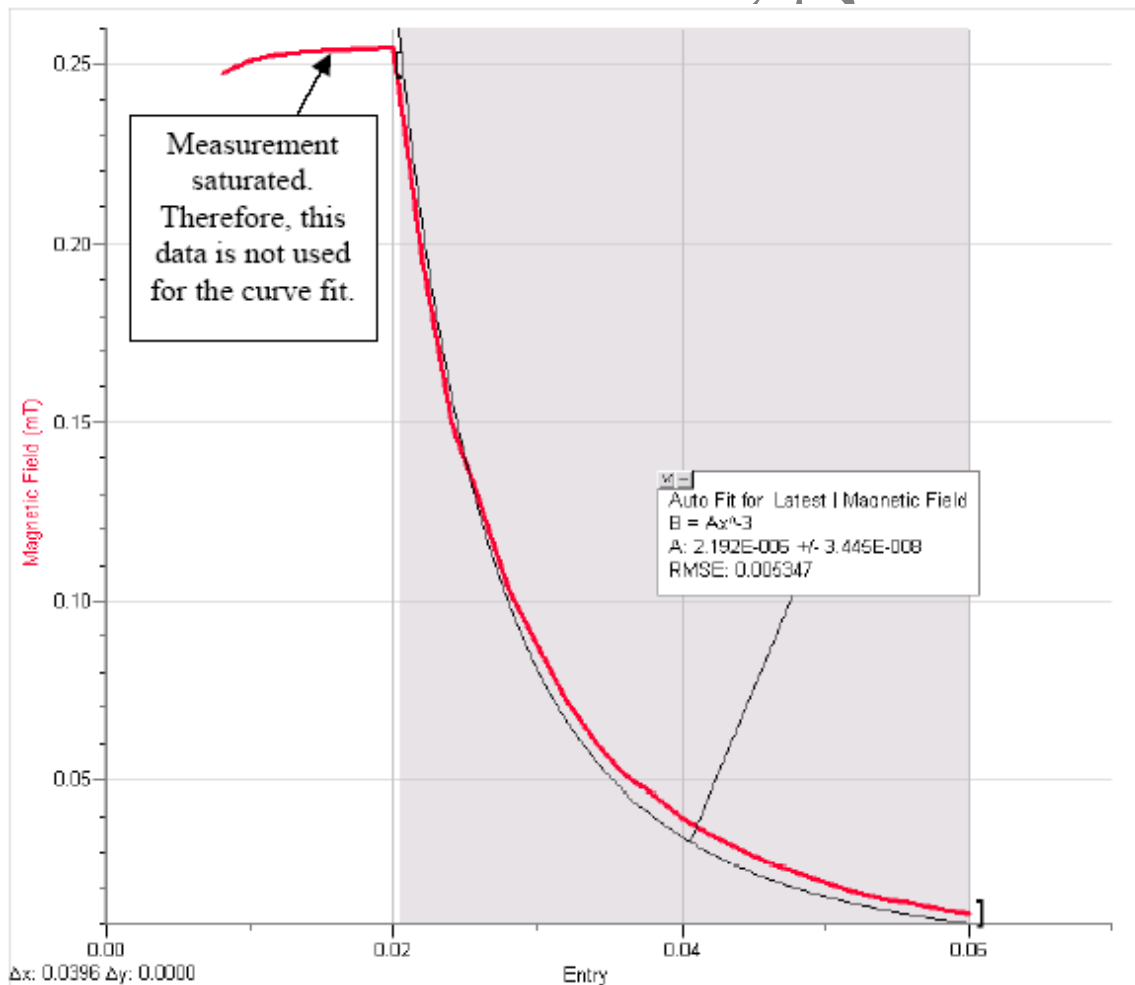


Magnetism I Pre-lab Questions

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- The graph below is the measurement of the axial magnetic field of a pair of magnets verse distance from the magnetic pair.



- Would you say that this graph is inverse cubic? Therefore, does it reproduce the magnetic field of an ideal dipole?

$$y = (2.192 \times 10^{-6} \text{ Tm}) \frac{1}{x^3}$$

The equation of the best fit line given in the graph is inverse cubic. The root mean square error was 0.005347, meaning we had a regression of $R^2 = 0.994653$. This is obviously an excellent fit for the inverse cubic trendline. Hence, the measurement of magnetic field strength versus distance appears to fall off in a nearly inverse cubic fashion.

- Using what you have learned in lecture and this manual about the magnetic field of an ideal dipole find the magnetic moment (μ) of this material. The equation of the magnetic field of an ideal dipole is:

$$B_{axis} = \left(\frac{\mu_o 2\mu}{4\pi} \right) \frac{1}{x^3}$$

Combine this with the results of the curve fit to find μ .

Relating the correlation coefficient to the field expression for a magnetic dipole, we see that:

$$\left(\frac{\mu_o 2\mu}{4\pi} \right) \frac{1}{x^3} = \left(2.192 \times 10^{-6} \frac{\text{kgm}^3}{\text{As}^2} \right) \frac{1}{x^3}$$

(Watch your units! Be sure you know whether you are using mT or T and cm or m. Also notice that the $1/x$'s cancel out.)

$$\frac{\mu_o 2\mu}{4\pi} = 2.192 \times 10^{-6} \frac{\text{kgm}^3}{\text{As}^2}$$

Using your value of the correlation coefficient we can thus solve for “mu”(μ) to determine the magnetic dipole moment of the magnet.

$$\mu = \left(\frac{4\pi}{2\mu_o} \right) 2.192 \times 10^{-6} \frac{\text{kgm}^3}{\text{As}^2}$$

$$\mu = \left(\frac{4\pi}{2 \left(4\pi \times 10^{-7} \frac{\text{kgm}}{\text{A}^2 \text{s}^2} \right)} \right) 2.192 \times 10^{-6} \frac{\text{kgm}^3}{\text{As}^2}$$

$$\boxed{\mu = 10.96 \text{ Am}^2}$$