

**Massachusetts Institute of Technology
Physics Department**

8.01X

Fall 2001

PROBLEM FOR EXPERIMENT FM: Magnetic Force Law

Handed out: October 3. Due: October 12 at 5 pm in 4-339B.

Lab hours: No lab the week of Oct 1-Oct 4, Tuesday Oct 9 7:30-9 pm, Wednesday Oct 10 7:30-9 pm, Thursday Oct 11 3-5 pm.

Problem 1: Experiment FM (40 points)

- a. Measure the width of your magnets.
- b. Measure the center-to-center distance between the magnets as a function of the force pressing the magnets together. (See Experiment FM for details).
- c. Tabulate the data, with two columns labeled Force (in N), and Center-to-Center Distance, S_c (in mm).
- d. Make two plots of the data, one on linear paper and the other on log-log paper with center-to-center distance S_c (in mm), along the horizontal axis and Force (in N) along the vertical axis.
- e. **Analysis:** On the log-log paper try to fit a straight line between the data points to match your best-fit curve. If you cannot match one straight line, you may be able to find two different regions where there are straight-line fits. This means that the force between these magnets can be described by different inverse powers at different distances.

Calculate the slope of the $\log F$ vs. $\log S_c$ best-fit straight lines. This gives the approximate power law for the force between the magnets for different ranges of center-to-center separation distance. You may use a program to find the best-fit straight line. If you want to calculate the slope note that if the force is a power law

$$F = a(S_c)^b,$$

where a is a constant and b is the power exponent, then

$$\log F = \log(a(S_c)^b) = \log(a) + \log((S_c)^b) = \log(a) + b \log(S_c).$$

The slope of the $\log F$ vs. $\log S_c$ graph is the power exponent b , and the intercept is the constant

- a. On the log-log graph paper choose two points that lie on your best-fit straight line.

- f. Try to explain your results. Why should the power law vary when the magnets are very close together or further apart?