Massachusetts Institute of Technology
Physics Department

8.01X **Fall 2002**

PROBLEM FOR EXPERIMENT MF: Magnetic Force Law

Posted: Sept 27. Due: October 11 at 4 pm

Problem 1: Experiment FM

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?