# E/M DETERMINATION (Rev Spring 2011)

IN THIS EXPERIMENT YOU WILL DETERMINE THE RATIO OF E/M FOR AN ELECTRON USING THE LORENTZ FORCE DUE TO A MAGNETIC FIELD. SEE THEORY SECTION OF MANUAL FOR EQUATIONS.

**MAKE SURE YOU KNOW WHAT TO DO BEFORE TURNING ON DEVICE. IT SHOULD NOT BE OPERATED FOR MORE THAN 1 HOUR AT A TIME.**

**Preliminary Setup**

In order to determine the effect of the Earth’s magnetic field on the result, use a compass to align the case with the left side of the top aligned with the Earth’s magnetic field. **When all data has been collected for this orientation, the case will be rotated 180 degrees and experiment repeated.**

**PROCEDURE**

1. Before turning on check switch positions. Both direction controls should be off. Set accelerating voltage and magnetizing current to zero. Set deflecting voltage to 50v. The built in current meter has been disconnected. Connect digital current meter at the back of the cabinet. Use 10 or 20 Amp scale depending on meter. Also connect digital voltmeter in back.
2. **Turn on the power and wait 5 minutes**. You should see a glow. Read the hints on reducing error page while waiting.
3. **The tube needs to be rotated so 90 degrees mark is opposite red pointer. Get lab administrator (currently Dr. Maddox) to do this when you are ready. The apparatus was damaged**.
4. When warmup complete slowly increase the accelerating voltage until you see a beam. This should occur by 100v. Increase the accelerating voltage to 150 v. Set the magnetizing current direction switch to clockwise. Increase the magnetizing current until you get a circle. **You may need to make some fine adjustment of the tube angle so you have a circle not a spiral.**
5. **You may need to apply a deflection voltage (controls on left side of base) to get the right end of the beam level with the left end. The tube is physically tilted. You may want to fold a piece of paper and put under right side of tube base to level tube and hold in place**.
6. Measure the diameter of the circle. Record diameter, voltage and current.
7. Repeat measurements for other accelerating voltages and different magnetizing currents until you have ten sets of data.
8. Before turning off, set switches as in step 1. Turn off power. Repeat experiment after rotating case 180 degrees. It may be necessary to wait until next period to repeat the experiment to avoid overheating apparatus.
9. **When finished with experiment set switches as in step 1. Turn off power. Have Dr. Maddox turn tube base back to zero degrees and tighten screw so base will not turn easily.**

ANALYSIS

1. For use in the formulae, you need radius in meters. Compute e/m values. Compute average value of e/m for each orientation and standard deviation. To partially compensate for effect of Earth’s magnetic field compute average of the two averages for the different orientations. Compute % error compared to value in texts.
2. To estimate how much the Earth’s magnetic field can affect the value of e/m, rewrite eq. 8 in terms of B instead of I. Pick your value of e/m that is closest to average and get value of B. Get new value of e/m if you add value of Earth’s field to B. Repeat subtracting Earth’s field. Use Google to find local value of field.