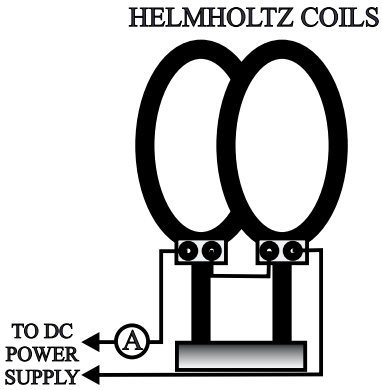
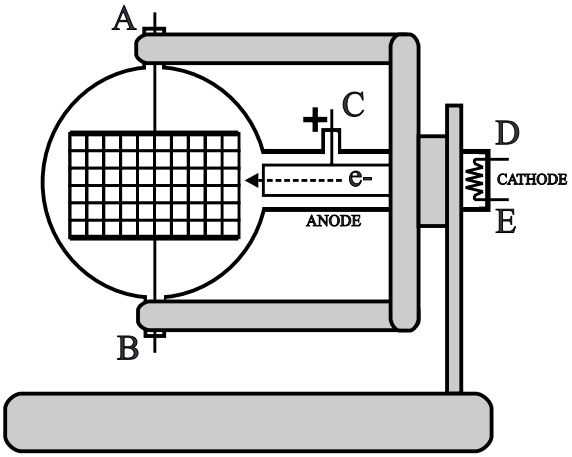
Goal - The goal of this lab is to measure the effect of a uniform magnetic field on a moving beam of charged particles and to show that the magnetic force on a moving charged particle is given by $F_m = qv \times B$.

Procedure -



1. Place the two Helmholtz coils into their respective holes in the base of the deflection tube stand.
2. Connect the two coils together in series with each other and with an ammeter and then connect this circuit to the DC power supply built into the lab table.
3. Adjust the current in the circuit until the reading on the ammeter is 0.2 - 0.3 Amperes. The exact current in this circuit is not critical, just be sure to record the value whatever it is for purposes of reproducibility.
4. Using the Hall Effect device measure the average magnetic field strength B between the two coils by varying the position in the central region between the coils. Make several measurements, record and determine an average value for the magnetic field strength that corresponds to a current of 0.2- 0.3 Amperes [or as determined before] and determine the direction of the magnetic field using the magnetic field probe. Record the current flowing through the coils and the corresponding magnetic field strength.
5. Turn off the power supply and then remove the Helmholtz coils from the stand. Carefully, insert the deflection tube into the stand and secure with the sliding clamps. [A replacement tube costs $500+.]
6. Connect up the electrostatic deflection tube as shown to the right.
   a. Connect terminals D and E of the deflection tube to the 6.3 Volts power supply.
   b. Connect terminal D to the negative terminal of the high voltage supply and connect terminal C to the positive terminal of the high voltage supply. [Terminals A and B will not be used in this procedure.]



7. Carefully, reinsert the Helmholtz coils into the deflection tube stand, turn on the current to the coils and readjust the current to the coils to 0.2 - 0.3 Amperes as before.
8. Gradually, turn up the high voltage to the deflection tube to approximately 4000 Volts.
9. Record several pairs of intersection points (x,y) of the curved path on the deflection grid.
10. Calculate the radius of curvature R of the electron beam based on the above pairs of intersection points and determine the average radius of the path followed by the electrons.
11. Based on the applied accelerating potential, calculate the velocity of the electrons passing through the hole in the anode as they move into the magnetic field.
12. From the above information, calculate the centripetal force acting on the moving beam of electrons.
13. Use $F_m = q\ v \times B$ to determine the magnetic force acting on the beam of electrons and compare this to the centripetal force calculated above. [Why should these two be the same?]
14. Verify the cross product nature of the magnetic force by using the right hand rule. [Be sure to **support** this with a **carefully labeled diagram**.]

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