

Observation of Gas Discharge in Air
Carl Adams, Winter 2007

1. **Purpose:** Using a high voltage/ medium current source study electrical conduction through air at different pressures.
2. **Background:** Caro, McDonell, Spicer, *Modern Physics*, pp. 9-12
3. **Safety:** We are using a high voltage source that can produce **lethal** currents. We are also using voltages that are sufficiently high that things that normally don't conduct electricity (like air) can conduct electricity. The setup is not unsafe but does require some thought. A secondary precaution is related to the chance the glass tube may fracture. In any case **do not touch the tube unless the voltage is off, you have grounded it, and the pressure is at atmosphere**. Please ask for my assistance or Jim's assistance if you are unsure.
4. **Broad Procedure:**
 - (a) Before making any electrical connections familiarize yourself with the vacuum system and equipment. Set up a safety shield. Also try and keep the electrodes away from conductors to prevent accidental shock. Identify any spots where arcing might occur and try and reduce the potential difference between those points.
 - (b) Determine the resistance of the ballast resistor. Connect the voltage source, discharge tube, and ballast resistor in series. How does the ballast resistor work to steady the currents in the tube?
 - (c) Reduce pressure to below 10 Torr and get a current flowing. Reduce pressure while trying to adjust the voltage to keep the current constant. Try and follow the observations as seen on page 10. Take photographs.
 - (d) Once you are in the cathode ray region see if a magnet effects the glow.
 - (e) At high pressures see if the presence of a radioactive material helps "spark" the tube. This should be easiest to see for "small" voltage.
 - (f) Make measurements of the voltage versus pressure for a constant current. Plot your data and think about what you can do to improve your data set. Make more measurements if necessary.
 - (g) With a hand-held spectrograph observe the spectrum from the positive glow. Is it continuous or is it a line spectrum?
 - (h) Do you always see a glow when there is current? Are there sometimes currents without glow? Your answers depend on pressure.
 - (i) You usually use "hot" cathodes. How do any electrons get moving in this cold cathode setup? Are there other differences?