Phys 4910 Spectroscopy
Spectra of hydrogen, helium, and neon

Introduction

The objective of this assignment is

1. to be able to use the spectrometer to measure the wavelengths of the emission lines of hydrogen and two of the noble; gases helium and neon.
2. To identify the stronger lines in the spectra.
3. To detail observed lines which could not be identified.

Next week we shall use the known wavelengths of the strong lines to practice accurately calibrating the spectra, and to find the wavelengths of all the other lines that you can find in the spectra.

Spectra

When trying to measure wavelengths accurately it is always risky to rely on equipment calibration, unless you have calibrated it yourself and are sure of its accuracy. However, when the lines are not tabulated the instrument calibration is simply not good enough to determine unknown wavelengths. In that case a preferred method is to calibrate an unknown spectrum against a known spectrum, whose lines are recorded *at the same time*. The lines you identify this week will be used to calibrate spectra next week.

Assignment

Record spectra for all three lamps using the wavelength range 300 nm to 900 nm (approximately the spectral range for the photomultiplier. Set the Photomultiplier voltage to about 500V, the electrometer sensitivity to 10^{-6} A fsd, and the slit width to about 50 μ (a reading of 5 on the micrometer). You might have to adjust the position of the discharge tube on front of the entrance slit to get a good strong signal. To adjust the lamp position you should be able to get a signal if you set the monochromator to

- 656.34 nm (H lamp)
- 587.64 nm (He lamp)
- 633.51 nm (Ne lamp)

Once you have a signal try moving the lamp from side to side in order to maximize the signal before running your scan.

Aim for 10 to 15 minutes for each spectrum, with as many data points as possible (staying under the 10,000 point limit). Also for the helium spectrum only take two spectra, one that keeps the strong lines on scale, and one which has a PMT voltage 150 to 200 V higher (to hopefully show up the weaker lines in the spectrum).

As you take the spectra make a note of the positions of the strong lines in the spectrum. Try to pick lines which are easily identifiable. (In the case of neon there are some many in the red portion that you will probably not be able to identify all of them, 8 to 10 will suffice.) As each line is reached (a large signal on the data taking program or on the dial of the electrometer) note as

accurately as you can its channel number (on the data taking program) and the current wavelength box in the Monochromator Control program, which tells you the *approximate* wavelength of the lines that you choose. That will allow you layer to assign wavelengths correctly on your print out.

Report

Since this is not an experiment there is no formal report this week. I would like you to turn in the following for each lamp

- A diagram of the spectrum. (If you input your data into Excel it will make the plot for you.) On the diagram number the lines that you identified.
- A table of the lines you identified with
  - the identification number from your diagram
  - the *approximate* wavelength that you read off the computer as it was scanning.
  - the *actual* wavelength of the line from the data table. See the table at http://physics.csustan.edu/Ian/Spectroscopy/LectureNotes/VisibleLines.htm. Note that in this table the wavelengths are measured in Angstroms. Your approximate wavelength should allow you to identify which wavelength from the table goes with which line on your diagram. The difference between the approximate wavelength and the actual wavelength won't be zero, but it shouldn't be very large either.
- A list of the lines which you didn't identify.