Phys 4910 Spectroscopy
Spectra of helium, neon, and xenon

Introduction

The objective of this assignment is to measure the wavelengths of the emission lines of the two noble gases helium, neon and xenon. Next week we shall use the known wavelengths of the strong lines to practice calibrating the spectra, and to find the wavelengths of all the other lines that you can find in the spectra.

Lamps

You will need three different lamps for this laboratory

1. The helium lamp that you used in the earlier experiment.
2. A lamp containing neon and sodium. (This is actually intended to be a sodium lamp, but lamps containing just a metal are unstable. A buffer gas is always introduced in order to get a stable discharge. Helium, neon, and argon are all in common use.)
3. A lamp containing xenon and rubidium. (This is actually intended to be a rubidium lamp, with xenon as the buffer gas.) Note: this lamp should be warmed up for at least twenty minutes before recording its spectrum. For this reason turn it on as you start, and let it warm up whilst you take the spectra of the other two gases.

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 procedure follows that in the lab exercise on March 12th. The known lines of helium or neon will be your calibration lines. All unidentified lines will need to have the wavelengths determined, and where possible their identification made.

Assignment

Record spectra for the following

1. Helium from 380 nm to 800 nm
2. ~~Neon from 380 nm to 800 nm~~
3. Neon from 580 nm to 700 nm
4. Xenon from 380 nm to 800 nm

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 3 to 5 strong lines in the spectrum. Try to pick lines which are easily identifiable. Picking one out of a closely spaced group of three or four good lead to problems next week. If you watch the current wavelength box in the Monochromator Control program it will tell you the *approximate* wavelength of the lines that you choose.

Report

There is no lab writeup for this week. However, print out and bring next week each of the three spectra (on separate sheets). Make each as large as possible. Normal letter size printer paper works fine, legal size would be better, but in either case make each plot fill the page[1] (near enough).

- Important: next week you will be measuring the spectra. To help, make each spectrum as fine as possible. I suggest going into the properties of the line, turning off the markers, and instead add the line (not the trendline) using as narrow a line width as you can.
- It might help to add borders to the plot to serve as a reference for your measurements. This is not critical, if you don't you can always use the edge of the paper.
- Remove any grid from the plot.

1 I find it useful to set the page properties to landscape rather than portrait.