ATM - Atomic Physics

Signature Sheet

Student's Name _____ Partner's Name _____

Pre-Lab Discussion Questions

It is your responsibility to discuss this lab with an instructor before your first day of your scheduled lab period. This signed sheet must be included as the first page of your report. Without it you will lose grade points. You should be prepared to discuss at least the following before you come to lab:

1. Draw an energy level diagram for hydrogen. Show the transitions that produce the Balmer series. What is the formula that gives the wavelengths of these lines for the simple Bohr hydrogen atom? How does the derivation of the energy levels in the Bohr model differ from the quantum mechanical methods?

2. Write the following atomic state's abbreviation in "full spectroscopic notation" (the notation for states written in the n,l,j,m_j basis, described in the first instructional video). This **article** provides a good overview of the notation, in case you need a refresher. A hydrogen atom is in the n=3, l=2 state. Note that there are 2 possible values for J.

3. Draw an energy level diagram for helium. Show the transitions that produce the red and yellow lines. Note the differences in the structure and splitting between the energy levels for hydrogen and helium.

4. Draw an energy level diagram illustrating the Zeeman effect for the red line of helium. When a 1 Tesla magnetic field is applied to helium, what happens to the energy levels and transitions that produce the red line of helium?

5. What gives a spectral line a non-zero width? Estimate the line width for the first Balmer series. Assume that the pressure inside the tube is 5 torr and the temperature 600K, and that the lifetimes of the states are about 10 ns.

6. Draw a sketch of the diffraction grating spectrometer showing the placement of the optical elements and the path and focusing of a light beam as it goes from the source through the spectrometer and to the film or photomultiplier. Explain how the grating works. Calculate a representative value for the resolving power of the grating.

7. Is the photomultiplier output current proportional to the number of incident photons, independent of wavelength? If not, how does the output depend on wavelength?

8. Draw a sketch of the Fabry-Perot interferometer showing the placement of the optical elements and the path of a light beam as it goes from the source through the interferometer and through the telescope. Calculate the resolving power of the interferometer. Why is it necessary to use the interferometer instead of the grating for observing the Zeeman Effect?

Staff Signature _____ Date _____

Completed before the first day of lab? (Circle one) Yes / No

Mid-Lab Discussion Questions

1. On day 3 of this lab, you should have successfully produced a plot of the Balmer-series lines, and made an estimate of the Rydberg constant. Show them to an instructor and ask for a signature.

Staff Signature _____ Date _____

Completed by day 3 of lab? (Circle one) Yes / No

1. On day 5 of this lab, you should have successfully observed the Zeeman splitting of the helium lines and estimated a value for the Bohr magneton. Demonstrate this to an instructor and ask for a signature.

Staff Signature _____ Date _____

Completed by day 5 of lab? (Circle one) Yes / No

Checkpoint Signatures

1. Preparation

   Staff Signature _____

2. Peak Finding

   Staff Signature _____

3. Additional Questions

   Staff Signature _____

4. Zeeman Picture

Staff Signature _____

5. Zeeman Splitting

Staff Signature _____