

Spectroscopy Using the Diffraction Grating

PURPOSE:

To use a spectrometer and diffraction grating to determine the wavelengths of spectral lines emitted by hydrogen.

PROCEDURE:

1. Focus the spectrometer telescope for parallel light as follows. Point the telescope at a distant object, like across the room (the farther the better). Then make the cross-hair clear by moving the outermost eyepiece assembly while looking at the distant object. After that, obtain a clear image of a distant object by moving the secondary (inner) eyepiece assembly. The cross-hair should stay clear. Do not change the telescope adjustments hereafter unless you repeat the entire procedure.
2. Become familiar with all of the adjusting screws so that you can use them effectively in a rather dark room. The only screws that you must not move are those that adjust the vertical alignment of the scope and collimator. They are located on the underside of the scope and collimator.
3. Familiarize yourself with the vernier scale. There are two scales on opposite sides of the instrument but you will only be using one during any experiment. A magnifying glass will be available to help you read the fine scales.
4. Line up the telescope and collimator and focus the collimator using the hydrogen light as the source. Make the slit vertical and sharply focused. Focusing is done by sliding the slit assembly in or out of the collimator. This assembly can also be rotated to produce a vertical slit. Do not change the collimator focusing after this unless it is absolutely necessary. IMPORTANT--Make sure that you put the source where it looks brightest when viewed through the scope by simply moving it sideways relative to the collimator and bringing it as close to the collimator as possible. Finally, record the angular position of the scope in this "in line" configuration to the nearest minute of angle using one of the vernier scales. This is your initial angle A_0
5. Place a diffraction grating on the spectrometer table at right angles to the collimator and with the grating at the center of the circular spectrometer table. Use the scope to observe and record the angular positions of the three prominent hydrogen lines in first order on one side of the "in line" position. Then swing the scope to the other side of the "in line" position and repeat the procedure determining another set of angles. Always use the same vernier scale that you used in step #4. Call the angles on the right A_R and the angles on the left A_L for each color.
6. From this data, calculate the first order diffraction angles (theta) for each of the three hydrogen lines on each side. Where $\theta_R = |A_0 - A_R|$ and $\theta_L = |A_0 - A_L|$. Then average the left and right side thetas to obtain on average value of theta for each hydrogen line. Finally, calculate the wavelengths of these hydrogen lines, in nanometers. Where:

$$\lambda = d \cdot \sin(\theta_{\text{Average}})$$

7. Compare them to the accepted values given below by calculating a percent error.

Color	Wavelength (nm)
Purple	434
Aqua (blue-green)	486
Red	656

8. The grating's number of lines/mm N is **530**. You should be able to determine the separation d using the fact that $N = 1/d$
9. **Remember** : 1 degree equals 60 minutes
10. Follow the link in the main page to download the **data file**. Upload this word document to Canvas as your report.