Experiment 2: The Relationship between Energy, Wavelength, and Frequency

According to the quantum model of light, the energy of light is directly proportional to its frequency. Thus, the higher the frequency, the more energy it has. With careful experimentation, the constant of proportionality, Planck's constant, can be determined.

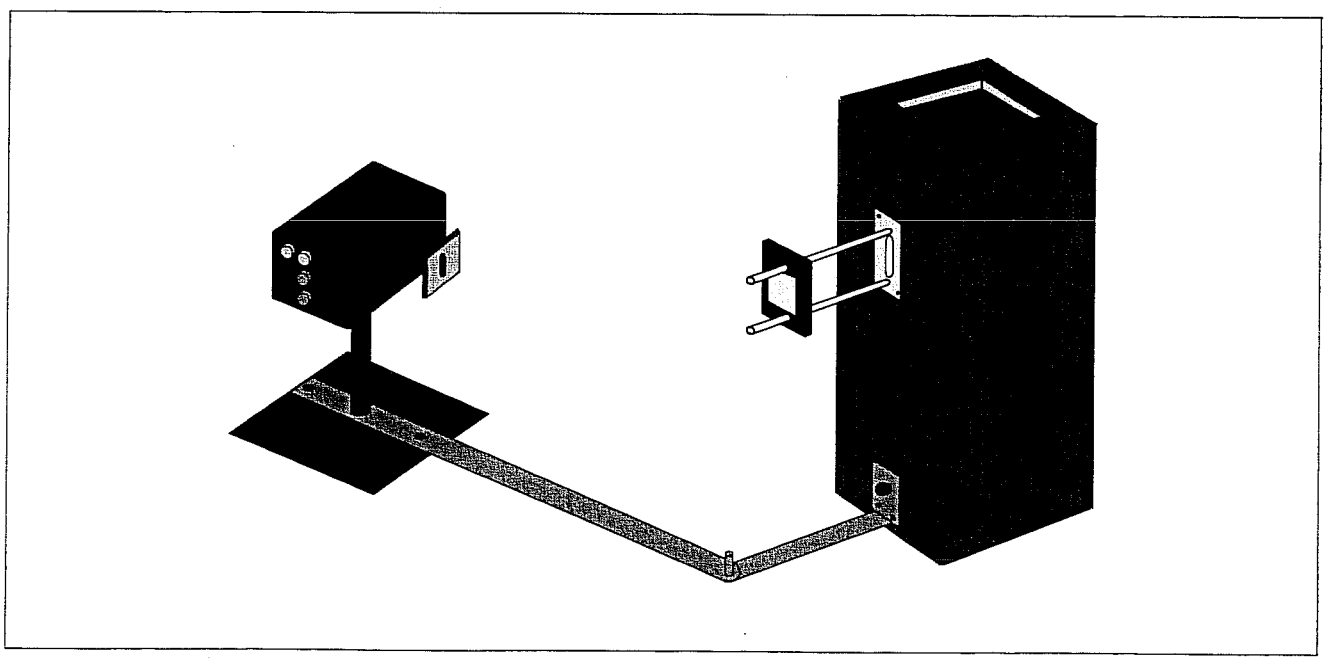
In this lab you will select different spectral lines from mercury and investigate the maximum energy of the photoelectrons as a function of the wavelength and frequency of the light.

Setup

Set up the equipment as shown in the diagram below. Focus the light from the Mercury Vapor Light Source onto the slot in the white reflective mask on the h/e Apparatus. Tilt the Light Shield of the Apparatus out of the way to reveal the white photodiode mask inside the Apparatus. Slide the Lens/Grating assembly forward and back on its support rods until you achieve the sharpest image of the aperture centered on the hole in the photodiode mask. Secure the Lens/Grating by tightening the thumbscrew.

Align the system by rotating the h/e Apparatus on its support base so that the same color light that falls on the opening of the light screen falls on the window in the photodiode mask with no overlap of color from other spectral bands. Return the Light Shield to its closed position.

Check the polarity of the leads from your digital voltmeter (DVM), and connect them to the OUTPUT terminals of the same polarity on the h/e Apparatus.



Experiment 2: Equipment Setup

Procedure

① You can see five colors in two orders of the mercury light spectrum. Adjust the h/e Apparatus carefully so that only one color from the first order (the brightest order) falls on the opening of the mask of the photodiode.

② For each color in the first order, measure the stopping potential with the DVM and record that measurement in the table below. Use the yellow and green colored filters on the Reflective Mask of the h/e Apparatus when you measure the yellow and green spectral lines.

③ Move to the second order and repeat the process. Record your results in the table below.

Analysis

Determine the wavelength and frequency of each spectral line. Plot a graph of the stopping potential vs. frequency.

Determine the slope and y-intercept. Interpret the results in terms of the *h/e* ratio and the W_o/e ratio. Calculate *h* and W_o.

In your discussion, report your values and discuss your results with an interpretation based on a quantum model for light.

First Order Color	Wavelength nm	Frequency x10^{14} Hz	Stopping Potential volts
Yellow			
Green			
Blue			
Violet			
Ultraviolet			
Second Order Color	**Wavelength nm**	**Frequency x10^{14} Hz**	**Stopping Potential volts**
Yellow			
Green			
Blue			
Violet			
Ultraviolet			