

PHYS 1402
General Physics II
EXPERIMENT 10

THE PHOTOELECTRIC EFFECT

I. OBJECTIVE

The objective of this experiment is to study the photoelectric effect. This will be done by shining light of various frequencies (colors) on a photodiode and measuring the stopping potential of the emitted electrons. The kinetic energy of the emitted electrons is proportional to the stopping potential. It will be calculated ($K = qV_{\text{stopping}}$) and compared with the prediction of the theory.

II. APPARATUS

Pasco h/e apparatus and accessories, digital voltmeter, connection wires.

III. EXPERIMENTAL PROCEDURE

1. Assemble the apparatus as shown in figure (1) and tighten all brackets.

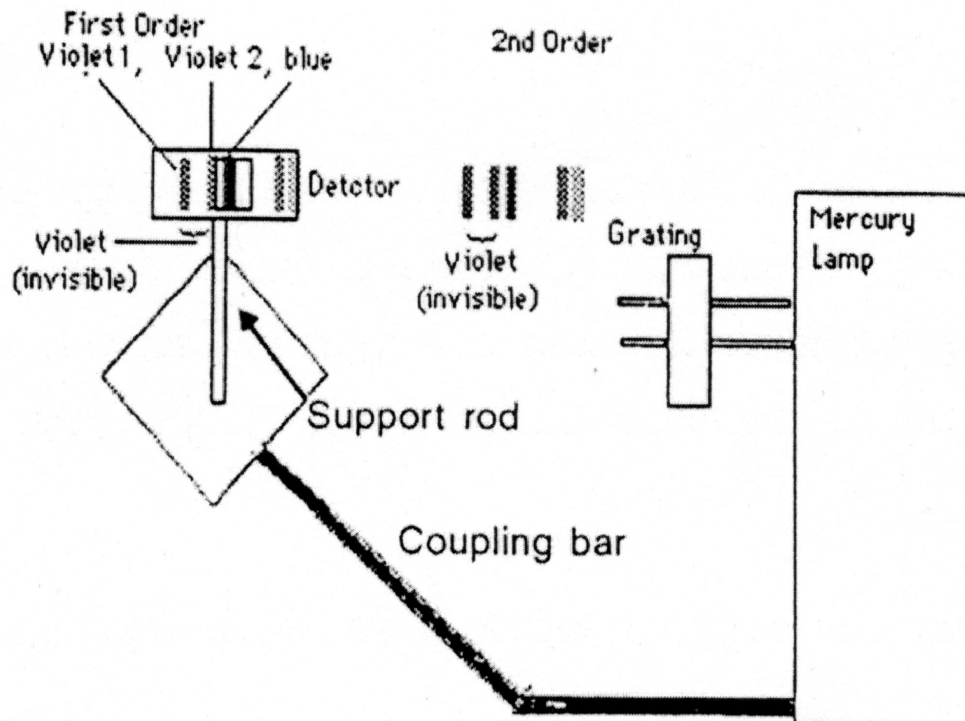


Figure 1: Pasco h/e apparatus

2. Turn on the lamp and let it warm up for 5 minutes.
3. Rotate the detector with the coupling bar to the side with the brightest pattern on the screen.
4. Slide the grating on its frame to get the sharpest image.
5. Open the light shield (cylinder behind the screen) on the detector and center one color on the screen. Rotate the detector so the same color passes through both the inner and outer slits and tighten the thumbscrew on the support rod under the detector.
6. Connect the voltmeter to the red and black terminals on the detector. Turn on the detector. Press the zero button and record the voltage for each color after the voltage reading stabilizes. For the yellow and green colors, use the corresponding filters.

IV. ANALYSIS

1. For each color, calculate the frequency from the equation $f = c/\lambda$.
2. Calculate the kinetic energy of the ejected electrons from the equation $K = qV_{\text{stopping}}$.
3. Plot the kinetic energy on the vertical axis and the frequency on the horizontal axis. Draw the best straight line fit for the data.
4. Calculate the slope of the straight line. What are the units of this slope? Recall that the kinetic energy of the photoelectrons is related to the frequency of the incident light by the equation $K = hf - W_0$. This equation should help you figure out the significance of the slope.
5. Find the percent difference between the slope you found above and Planck's constant $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$

$$\text{PercentDiff} = \frac{|\text{slope} - h|}{h} \times 100.$$

6. Write a short conclusion summarizing your results. In your conclusion, comment on the accuracy of this experiment. What are the two most important sources of error in this experiment?

Experiment (10) Data Table				
Color	Wavelength λ (nm)	Frequency f (Hz)	Stopping Voltage V (Volts)	Kinetic Energy $K = qV$ (J)
Yellow	578			
Green	546			
Blue	436			
Violet	405			
Ultraviolet	365			