# Experiment 1: The Wave Model of light vs. the Quantum Model

According to the photon theory of light, the maximum kinetic energy, $KE_{max}$, of photoelectrons depends only on the frequency of the incident light, and is independent of the intensity. Thus the higher the frequency of the light, the greater its energy.

In contrast, the classical wave model of light predicted that $KE_{max}$ would depend on light intensity. In other words, the brighter the light, the greater its energy.

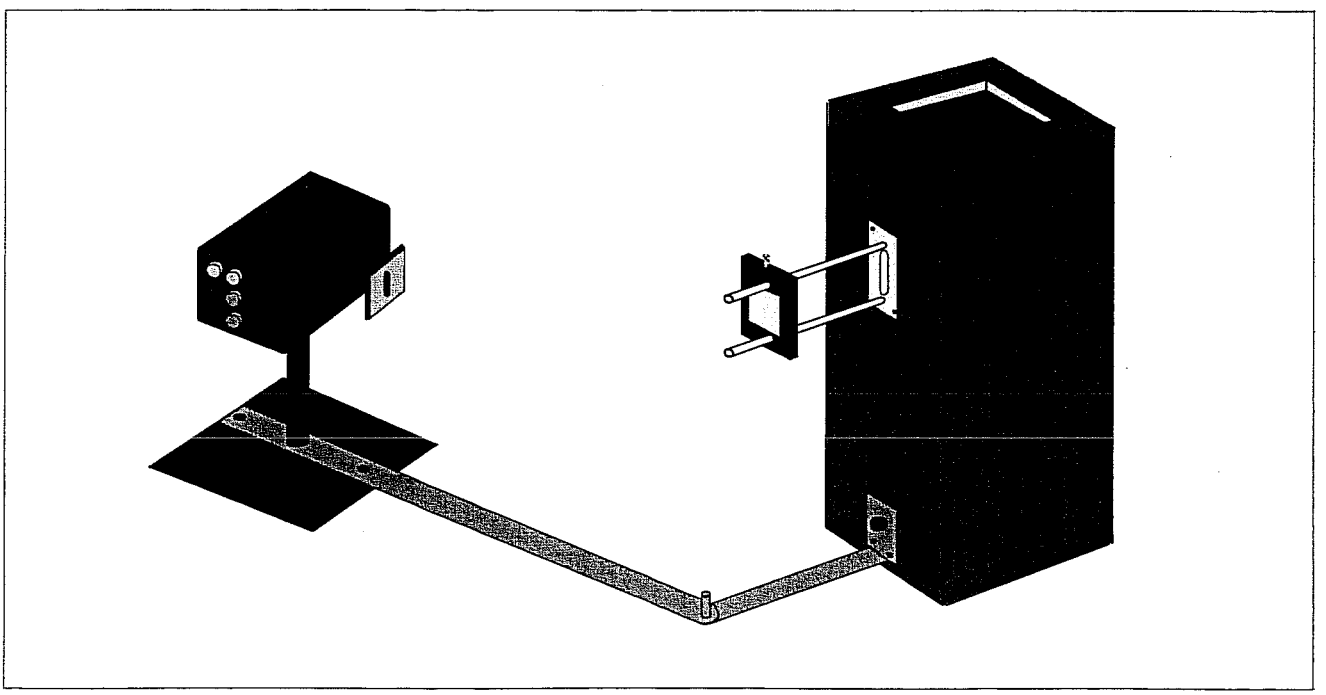
This lab investigates both of these assertions. Part A selects two spectral lines from a mercury light source and investigates the maximum energy of the photoelectrons as a function of the intensity. Part B selects different spectral lines and investigates the maximum energy of the photoelectrons as a function of the 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 lines. 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 1: Equipment Setup**

## Procedure

## Part A

① Adjust the h/e Apparatus so that only one of the spectral colors falls upon the opening of the mask of the photodiode. If you select the green or yellow spectral line, place the corresponding colored filter over the White Reflective Mask on the h/e Apparatus

② Place the Variable Transmission Filter in front of the White Reflective Mask (and over the colored filter, if one is used) so that the light passes through the section marked 100% and reaches the photodiode. Record the DVM voltage reading in the table below.

Press the instrument discharge button, release it, and observe approximately how much time is required to return to the recorded voltage.

③ Move the Variable Transmission Filter so that the next section is directly in front of the incoming light. Record the new DVM reading, and approximate time to recharge after the discharge button has been pressed and released.

④ Repeat Step 3 until you have tested all five sections of the filter.

⑤ Repeat the procedure using a second color from the spectrum.

| Color #1 _____ (name) | %Transmission | Stopping Potential | Approx. Charge Time |
|---|---|---|---|
| | 100 | | |
| | 80 | | |
| | 60 | | |
| | 40 | | |
| | 20 | | |
| **Color #2** _____ (name) | **%Transmission** | **Stopping Potential** | **Approx. Charge Time** |
| | 100 | | |
| | 80 | | |
| | 60 | | |
| | 40 | | |
| | 20 | | |