

OPERATING INSTRUCTIONS

Photoelectric Effect Module No. 32392

1. Introduction

The experiment using this equipment demonstrates the relationship between the kinetic energy of a photo-electron and the frequency of light which liberated that energy. A plot of light frequency versus maximum kinetic energy generates a straight line whose magnitude is Planck's constant, h , whose accepted value is 6.62×10^{34} joule/sec. The Photoelectric Effect Module also demonstrates that this released kinetic energy is independent of light intensity.

2. Description

The Photoelectric Effect Module consists of a photo tube mounted within a control box along with a rheostat. An exterior dial allows the experimenter to control the voltage potential across the tube. A 15cm cord is attached, terminating in a three-plug connector for the purpose of connection and grounding to an amplifier/power supply. Terminals are provided on the control box for meter connections. Exterior "jumpers" complete the circuit to the photo tube with the voltage supplied from the amplifier/power supply.

The filters provided with the Photoelectric Effect Module will transmit light from a tungsten lamp light source at these wavelengths: 600nm for red, 530nm for green, and 430nm for blue. If you use an arc lamp with discrete wavelengths, then the wavelengths specific to the lamp will be transmitted.

3. Setup

In addition to the Photoelectric Effect Module, the experiment requires the following equipment for its performance: a 85264 Universal Light Source, a 32386 Amplifier/Power Supply, and a 32381 Six-Range DC Meter or their equivalents. A loudspeaker or an oscilloscope may be substituted for the meter for a readout device.

This equipment should be set up as shown in Fig. 1 on the following page. Notice that the jumper leads on the Photoelectric Module are uncrossed. Because the leads are uncrossed, you can adjust the rheostat knob clockwise to vary the voltage from -2 volts to 0 volts. Additional accuracy in measuring the stopping voltage is provided by connecting a voltmeter (capable of measuring up to 2 volts) across the photo tube using the jumper lead terminals.

Though the 85264 Universal Light Source is recommended, you can use any strong incandescent light. Select the 0.1 volt scale of the 32381 Six-Range DC Meter, and carefully zero the meter by adjusting the DC offset of the 32386 Amplifier/Power Supply. Turn the gain of the amplifier up high, and adjust the DC offset very finely to obtain large voltage variations on the meter.

Figure 1

4. Operation

Align the light source to shine onto the photo tube through the opening in the photoelectric effect box. Place one of the filters over the opening and place a piece of black paper over the filter. Turn on the Amplifier/Power Supply and turn its gain control to about 100. Adjust the photoelectric effect rheostat fully clockwise to establish a zero volt potential across the tube, and zero the meter.

Remove the black paper so that the light shines on the photo tube through the filter. The meter will deflect in a positive direction. Adjust the rheostat counterclockwise slowly until the meter just reaches zero. Record the voltage. Repeat this procedure for the other two filters. If the amplifier drift makes finding the zero point difficult, use this alternative method: Repeatedly cover and uncover the filter with black paper while slowly increasing the stopping voltage. The zero point is reached when no change in meter deflection occurs while you are covering or uncovering the filter.

5. Analysis

If the stopping voltage measured is plotted against the reciprocal of the wavelength $F(1/\lambda)$, the slope of the line through the data points will be proportional to Planck's constant by the following:

$$E = hn = F(hc/\lambda)$$

or $eV = F(hc/\lambda)$

or $V = F(hc/e)\lambda^{-1}$

where $c = 2.998 \times 10^8$ m/sec

and $e = 1.602 \times 10^{-19}$ coul

6. Maintenance

The Photoelectric Effect Module needs no special maintenance. If you should experience any difficulty with a module, please contact Central Scientific Company, giving details of the problem. To ensure better service, please do not return any apparatus to Central Scientific Company until we have sent you authorization.

7. Accessories

<u>Description</u>	<u>Catalog No.</u>
Universal Light Source	85264
Amplifier/Power Supply	32386
Six-Range DC Meter	32381

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