Exp. P-1   Determining Planck's constant *h* with the photoelectric effect

References:

1. Melissinos, "Experiments in Modern Physics", **1st ed. (!)** (p.18-27); see library

Objectives:

To determine Planck's constant *h*.

Equipment:

Photoelectric Apparatus:

Phototube, mercury lamp, spectral filters or spectrometer, DC power supply, voltmeter, and Keithley picoammeter (sensitive! Handle with care).

Basic Instructions:

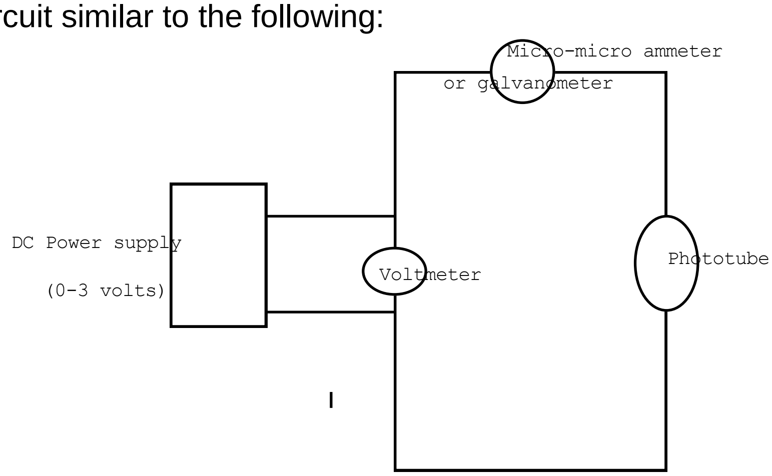
Determining Planck's constant from photoelectric effect

If ultraviolet radiation strikes a metallic surface, electrons will be emitted. The kinetic energy of the emitted electron, K_e, is given by $h\upsilon$-W where h is the Planck's constant, υ is the frequency of the electromagnetic radiation, and W is the work function of the metal. The electron can be stopped by a stopping potential V, i.e. eV= $h\upsilon$-W. Thus h can be determined from the measurement of V for various frequencies υ.

General experimental procedures:

For the **actual** experimental procedure, please follow the long write-up!

1. Connect a circuit similar to the following:



(Original 1/14/04, R.S.Jin, revised 1/15/07 and 1/20/10 M. Hohlmann)

2. Using the unfiltered Hg lamp, adjust the location of the lamp with respect to the phototube to obtain maximum reading of current. The illumination of the room should be such that no stray light is incident on the phototube. You may need a slit to aim the light beam onto the cathode.

3. With the unfiltered Hg light incident on the cathode, change the retarding voltage from zero and upwards in steps of 0.1 volts and record the current reading for each voltage. This should be done until the reverse current is saturated or becomes constant. The stopping potential can be determined from a plot of the current vs. voltage where the current changes from a constant value and starts to rise. The unfiltered Hg lamp provides the data for a cut-off frequency of 4047 A.

You may want to make several runs to obtain an average value of the stopping potential.

4. Repeat the above step with different filters placed between the Hg lamp and the phototube or with different light frequencies selected with a spectrometer. Be careful that the filter is not overheated and keep the burning time of the Hg lamp to a minimum.

5. Plot the stopping potential versus frequency to obtain Planck’s constant and the work function W of the photocathode.

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