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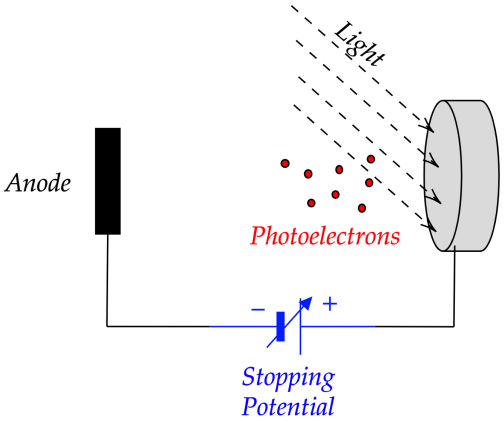
Modern Physics Laboratory (FIZ 313EL) - [Pre-Report]

Photoelectric Effect Experiment

Theory



The photoelectric effect is defined as the emission of electrons when electromagnetic radiation, such as light, hits a material. Each packet carries energy $h\nu$ that is proportional to the frequency, ν, of the corresponding electromagnetic wave.

The kinetic energy of each electron ejected from the metal surface is calculated as:

$$K.E._{electron} = h\nu - \Phi_{work}$$

In this equation, h is the Planck constant, Φ_{work} is the work function, and ν is the frequency of the incident light quanta.

The photoelectric effect influenced the development of the wave–particle duality concept and led to the key breakthroughs in understanding the quantum nature of light and electrons.

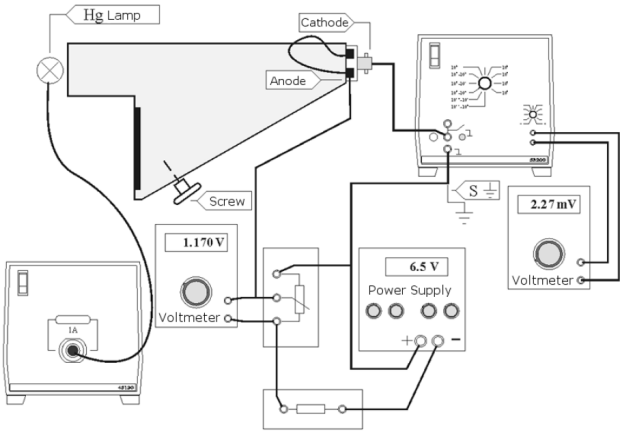
Aim of the Experiment

The aim of this experiment is to investigate the light behaves like a particle with the help of the photoelectric effect. Obtaining the Planck's constant using the formulation in the photoelectric effect is also an aim of this experiment.

Performing the Experiment

During the experiment, the following steps are done respectively:

1. First, we set the experimental setup as in the diagram[1] on the right. Then we turn on the mercury lamp.
2. After adjusting the maximum voltage in the potentiometer to 3.5 V, we turn on the current/voltage amplifier and the other voltmeter.
3. Using the screw, the region where the spectrum will hit the photocell is determined and the corresponding current is read from the voltmeter in terms of voltage.
4. Stopping voltage is increased until the photoelectric current vanish.
5. Then the same process is done for different colors.
6. Finally, a frequency-stopping potential graph is obtained with the help of a computer.



The Results of the Experiment

- The higher the frequency, the more the kinetic energy of the photoelectrons increases.
- With increasing light frequency, the rate of electron emission, which is proportional to the measured electric current, increases.
- As the frequency of light increases, the electric current remains constant.

[1] Istanbul Technical University Physics Engineering Department (2012). Modern Physics Laboratory [Course notes]. Retrieved from `https://ninova.itu.edu.tr`