

Thank you for your purchase of the Planck's Constant Apparatus
The instrument is a delicate equipment, its ruggedness will allow many years of use if proper operating techniques are developed

The unit provides a simple demonstration of the Photo-electric effect and a way to produce a reasonable values for Planck's Constant.

Experiment Background :

The photoemissive cell mounted in the unit is a Caesium-Antimony cell having a spectral response between 185 to 650 nanometers, and is ideal for use with visible and near UV light. A suitable instrument to measure small current in the order of nano ampere is required. Suggested instrument will be EDU-LAB Picoammeter , catalogue number 614-008, this picoammeter provides a input short button, which is good for use with the Planck's constant unit.

The Planck's constant apparatus comes with a UHF-UHF lead for direct connection between picoammeter and the Planck's constant apparatus.

As photons are absorbed by the atoms of the cathode material , electrons are emitted with a maximum kinetic energy which is proportional to the frequency of the incident photons. The current through the tube can be reduced by a reverse variable "stopping" voltage, provided by the internal PP3 9V battery together with a 50K ohm, 10turns potentiometer / potential-divider. The stopping voltage is displayed on the front panel by LCD display.

The Planck's constant apparatus comes with a few 35mm slides containing acetate filters. The filters can be placed over the cell window on the front panel so that photons of frequencies within a reasonably narrow range are incident on the cathode.

With visible light from ordinary room lighting, the set of 6 color filters gives reasonable result for the experiment, no extra light source is required.

The filter set comes with their spectral response curve, students are required to judge for the appropriate frequency of the light passed through the filter and the reciprocals of frequencies gives the corresponding wavelengths.

Planck's constant experiment

Experiment set up :

Set the picoammeter to 100nA range

With both the pico-ammeter and Planck's constant unit switched on, arrange them side by side and lying on a bench.

- Use the UHF to UHF connection lead to connect the two equipments together
- Adjust the stopping potential to zero
- While pressing the short button on the top for the picoammeter ,also press once the zero button. This will tare the picoammeter reading to absolute zero reading.
- Place an acetate filter of your choice over the cell window
- Now release the short button on the top of the picoammeter, the picoammeter then records the current generated from the photoemissive cell
- Now slowly turn up the stopping voltage until the picoammeter reading reduces to zero.
- Now record the stopping voltage for this particular colour filter.
- Replace the acetate filter with another colour (frequency) and readjust the stopping voltage for zero picoammeter reading
- Now record the stopping voltage for this particular colour filter.
- Repeat the above 2 steps for other colour filters

Typical result.

Filter Colour	Suggested wavelength	Stopping Potential (V)
Primary red	600nm	0.13
Primary Green	540nm	0.38
Yellow	530nm	0.42
Magenta	500nm	0.70
Primary Blue	450nm	0.71V

$$E_{\max} = eV$$

$$E_{\max} = hf - W_0$$

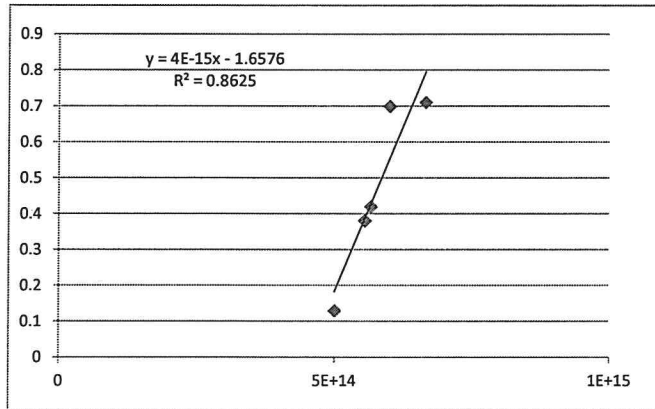
$$V = hc/e \cdot 1/\lambda - \text{constant}$$

A plot of V against $1/\lambda$ gives a straight line with gradient hc/e

Speed of light charge on an electron
 299792458 1.60E-19

Lowest Wavelength	Frequency (Hz)	V/V	
600 nm	4.99654E+14	0.13	Primary Red
540 nm	5.55171E+14	0.38	Primary Green
530 nm	5.65646E+14	0.42	Yellow
500 nm	5.99585E+14	0.7	Magenta
450 nm	6.66205E+14	0.71	Primary Blue

Planck constant = slope x charge on an electron
 =6.41E-34



Karoo Close Bexwell Business Park
 Bexwell, Norfolk ZPE 38 9GA , United Kingdom.

Phone : 44(0)1366-385-777

Fax : 44(0) 1366-386-535

Email : sales@edu-lab.co.uk

Website : <http://www.edu-lab.co.uk>

Product Code : 261-008
 Planck's Constant Unit
 Version 1.0, March,2011