Measuring the ratio h/e with a photoelectric effect tube and a mercury vapor lamp

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We performed an experiment to get a qualitative understanding of the photoelectric effect and to measuring the ratio h/e, where h is Planck's constant and e is the fundamental charge of the electron. The experimental setup consists of a photoelectric effect tube placed at the exit slit of a monochromator device equipped with a voltage divider box. At the input slit of the monochromator, a mercury vapor lamp provided the required light source, whose wavelength of interest is adjusted by a crank device. For each wavelength set with the monochromator crank, the output photo-current was measured as a function of the accelerating potential applied with the voltage divider box. Moreover, the value of the stopping potential was derived. With this data, the linearity between the stopping potential and the frequency of light was proved, just as expected by the photoelectric effect framework. Under this background, we determined the ratio of h/e to be $(3.9 \pm 0.3) \times 10^{-15}\ V \cdot s$. Furthermore, we experimentally proved that the intensity of light does not have an impact on the kinetic energy of the photo-electrons emitted.

I. FAVORITE EQUATION

My favorite math-physics equation is the Sturm-Liouville equation[1]. I like it because under certain boundary conditions its solutions form a complete set of orthogonal basis in a functional space in where the weight function w(x) can be easily determined from the original form of the equation.

$$\frac{d}{dx}\left[p(x)\frac{dy}{dx}\right] + q(x)y + \lambda w(x)y = 0 \tag{1}$$

In physics, this equation represents the foundation from the set of models we use in different fields such as in Electricity and Magnetism, where the Legendre and Bessel functions take relevance, being those solutions of the Sturm-Lioville problem expressed in equation 1.

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[1] K. T. Tang, Tech. Rep. (2007).