Quantum physics

Home Assigment - 2

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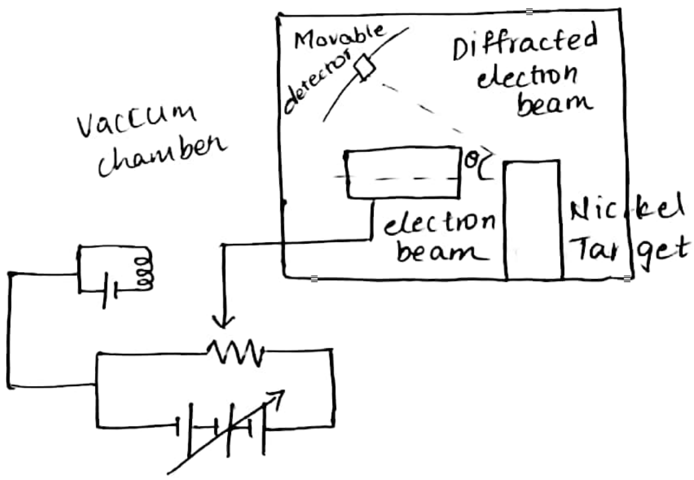
1. Davisson and Germer Experiment

The experimental setup for the davisson and germer experiment is enclosed within a vaccum chamber Thus the deflection and scattering of electrons by the medium are prevented



Construction:-

Thus the deflection and scattering of electrons by the medium are prevented. The main parts of the setup.

Electron gun:-

An electron gun is a tungsten filament that emits electrons via thermionic emission i.e it emits electrons when heated to a particular temperature.

Electrostatic particle accelerator :-

Two opposite plates (+ve & -ve) are used to accelerate the electrons at a known potential.

collimator : The accelerator is enclosed within a cylinder that has a narrow passage for the electrons along its axis. It's function is to render a narrow and straight beam of electrons ready for acceleration.

Target :-

The target is nikhil crystal. The electron beam is filled normally on the nickel crystal. The crystal is placed such that it can be rotated about a fixed axis.

Detector :-

A detector is used to capture the scattered electrons from the Ni crystal

Justification :-

In the Davisson and Germer experiment, waves are used in the place of electrons. These electrons formed a diffraction pattern. The dual nature of matter thus justified.

$$\lambda = h/p = h/\sqrt{2ME}$$

$$= h/\sqrt{2mev} \quad —①$$

where m - mass of electron

e - change of electron

h - planck's Constant

$$n\lambda = 2d\sin(90^\circ - \theta/2) \quad —②$$

2. <u>photoelectric</u> effect : The emission of electrons from a metal surface when illuminated by light (or) any other radiation of suitable wavelength.

→ other It was first observed by HeinRich in 1887.

<u>work function</u> : Minimum amount of energy needed to eject an electron from an atom in metal.

$$E_f = hf$$
$$E_f = k_{max} + \phi \qquad \boxed{\phi_0 = hv_0}$$
$$k_{max} = hf - \phi$$

<u>Threshold frequency</u> (f_0) :

Frequency of light that carries photons with the amount of energy equal to the work function of a metal, will eject an electron with zero kinetic energy.

Threshold frequency is defined as the minimum frequency of incident light which can cause photo electric emission, i.e., This frequency is just able to eject electrons without giving additional energy.

<u>Cutoff Wavelength</u> : For photoelectric effect to occur, the energy of photo must be greater than the work function, $\phi = hc\lambda$

As the wavelength of the incident light decreases but it is lower than the cut-off wave length. the maximum kinetic energy of the photo electrons increases.

3. We know that,

kinetic energy max = e charge $\times$ stopping potentia

$= 1.6 \times 10^{-19} \times 3V$

kinetic Energy KE $= 1.6 \times 10^{-19} \times 3V$

De-Broglie's Justification :-

De-Broglie realised that if you use the wavelength associated with the electron, and assume that an integral number of wavelengths must fit in the circumference of an orbit.

De-Broglie's Hypothesis :-

The concept that matter behave like a wave was proposed by Lious de Broglie in 1924

→ In 1924, de-broglie suggested that similar to light dual nature "every moving matter has a associated wave". The wave associated with the moving particle is known as matter wave (or) de-Broglie wave.