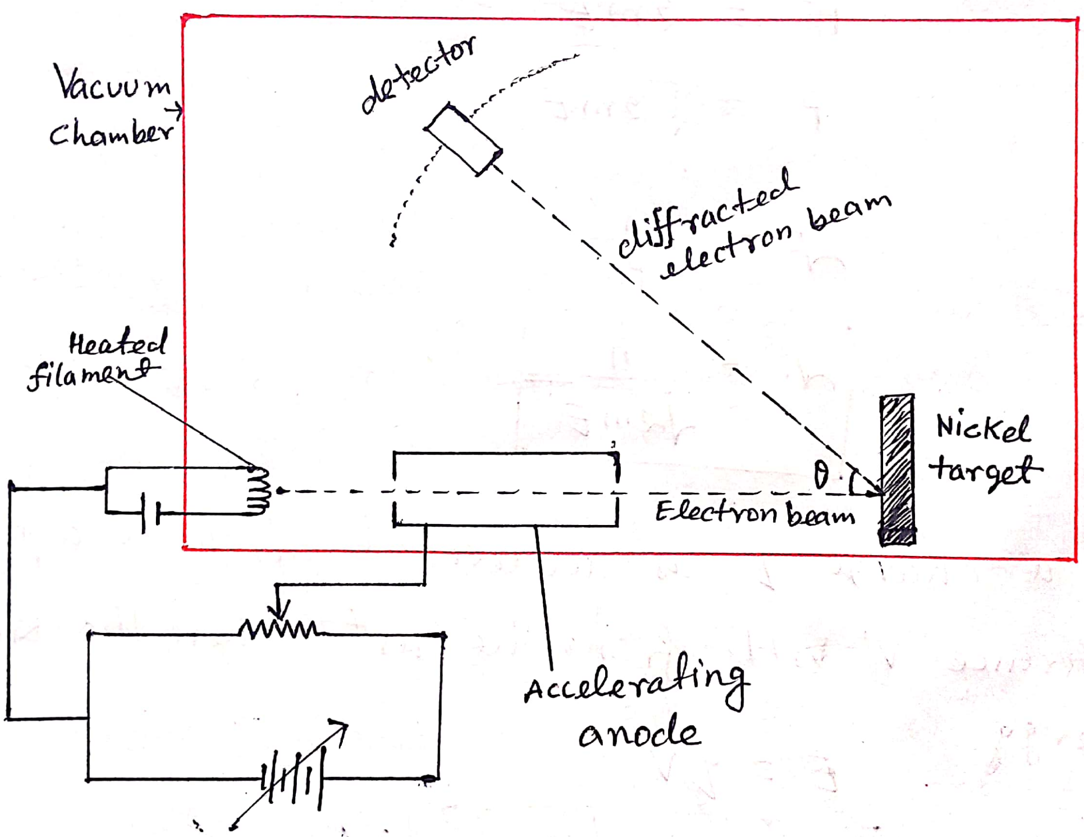
Davisson and Germer Experiment :->

In 1927 Davisson and Germer proved that fast moving electron show diffraction effect (wave nature) and calculate the wavelength of electron wave.

This experiment confirmed the de-Broglie hypothesis which demonstrated the wave nature of the electron when the electrons scattered from a crystal plane then they exhibit diffraction pattern.



In this apparatus the energy of electrons in the primary beam can be varied with the angle at which they are incident upon the nickel crystal target.

The crystal and the detector was kept on a rotating Plane.

The experiment was conducted in a vacuum chamber to avoid collisions of the electrons with other atoms on their way.

The electron gun was a heated tungstem filament. The thermally excited electrons were accelerated through an electric potential difference, giving them a certain amount of Kinetic energy, towards the nickel crystal.

To measure the number of electrons that were sattered at a different angle a faraday cup electron detector was used. The number of reflected electrons varied as the angle ~~to~~ between the detector and the incident electron beam varied.

When the angle between the incident beam and the scattered beam become 50° the detector shows maximum number of electron scattering.

The maximum number of reflected electrons in the detector indicate that electron are being diffracted. In such cases applying Bragg's law,

$$\boxed{2d \sin\theta = n\lambda}$$

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$2d \sin\theta = n\lambda$

$\theta \rightarrow$ Glancing angle $\Rightarrow \theta = 65^\circ$

$d = 0.91\ \text{Å}$ for nickel

$n = 1$ 1^{st} order.

$2 \times 0.91 \times \sin 65^\circ = \lambda$

$\lambda = 1.82 \times 0.9063$

$$\boxed{\lambda = 1.65\ \text{Å}}$$

$\lambda = 1.65\ \text{Å}$ is the experimental value of wavelength associated with an electron.

Again the wavelength associated with an electron moving under the potential difference of 54 volt is calculated using de-Broglie hypothesis.

$E = 54\ eV$

$E = 54 \times 1.6 \times 10^{-19}\ J$

$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}$

$\lambda = \frac{6.6 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times 54 \times 1.6 \times 10^{-19}}}$

$$\boxed{\lambda = 1.66\ \text{Å}}$$

The wavelength of matter wave is very close to the wavelength measured for electron applying Bragg's law.