* Dual Behaviour of Electromagnetic Radiations :-

Particle nature of light explains photoelectric effect and black body radiation. But it is not consists with the well known wave behaviour of light which account for the phenomenon of interference and diffraction.

Light possesses both particle and wave like properties. Thus light has dual nature i.e. it behaves as a wave and as a stream of particles.

A moving small particle like electron, proton etc. also show wave as well as particle nature. It is called dual nature of radiation.

Dual behaviour of matter :-

de Broglie suggested that moving small particles (like electron, proton, neutron, dust particle, a small ball etc.) have the properties of a wave.

The wave length (λ) of the moving particle may be calculated from the following expressions.

$$\boxed{\lambda = \frac{h}{mv}} \quad \text{or} \quad \boxed{\lambda = \frac{h}{P}}$$

Where,

m = mass of moving particles
v = velocity of moving particles
P = momentum of the particles.

This expression are applicable to photon also.

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A/c to planck's theory, the energy of a photon is given by —

$$E = h\nu \quad \text{——— (1)}$$

and A/c to Eienstein eqⁿ —

$$E = mc^2 \quad \text{——— (2)}$$

on compairing eqⁿ -(1) & eqⁿ - (2) we get.

$$h\nu = mc^2$$

or $$\frac{hc}{\lambda} = mc^2 \qquad \left(\nu = \frac{c}{\lambda}\right)$$

or $$\boxed{\lambda = \frac{h}{mc}} \quad \text{——— (3)}$$

where, c = velocity of radiation

m = mass of photon.

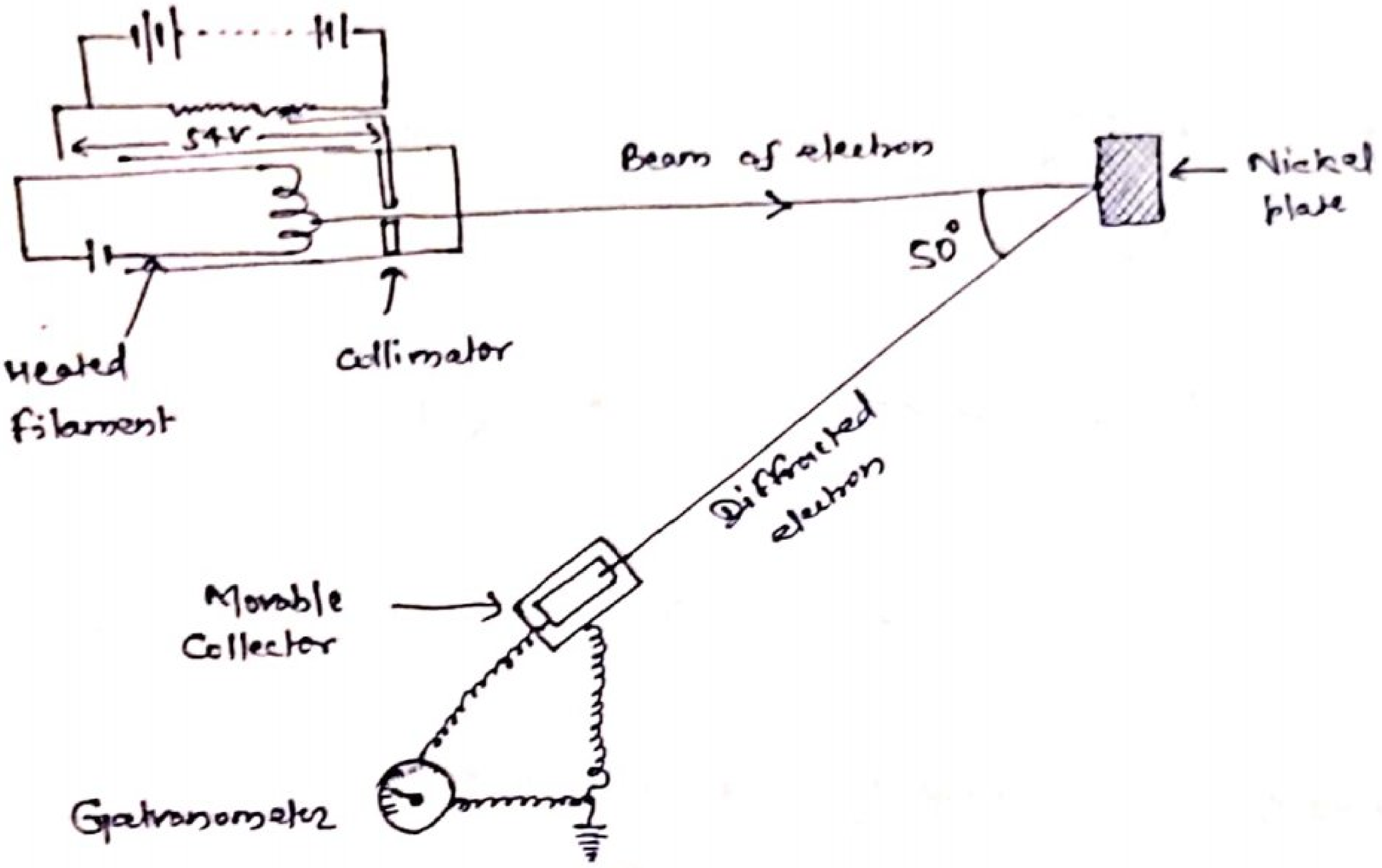
for small moving particles.

'c' is replaced by 'v'.

$$\boxed{\lambda = \frac{h}{mv} = \frac{h}{p}} \quad \text{—— (4)}$$

*. Experimental Verification of de-Broglies equation by Davission and Germer experiment :

The de-Broglies hypothesis regarding wave character of electron. In their experiment, electrons were emitted from a hot filament and were accelerated by a potential ranging between 40 & 68 volts before striking a nickel plate.



The impact of electrons resulted in the production of diffraction patterns which were similar to those of x-rays under similar conditions. Since, x-rays possess wave character, the experiment gave direct evidence for wave character of electron as well.

The intensities of electron waves scattered by the nickel plate at different angles were measured. The value of 'λ' of the electron wave, comes out to be 1.668 Å. This wave length also lies in the range of x-rays.

To apply the Bragg equation derived for x-rays diffraction, to electron diffraction as well —

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

Where,

n = whole no. = 1, 2, 3.... etc. of wave length 'λ' for a reflection of maximum intensity.

'd' is the distance between successive lattice ~~plate~~ plane of the crystal and 'θ' is the grazing angle of the waves. This provided an independent experimental method for determining wave length (λ) of electron waves. This experiment offered full support to de-Broglie's views.

—x—

from

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