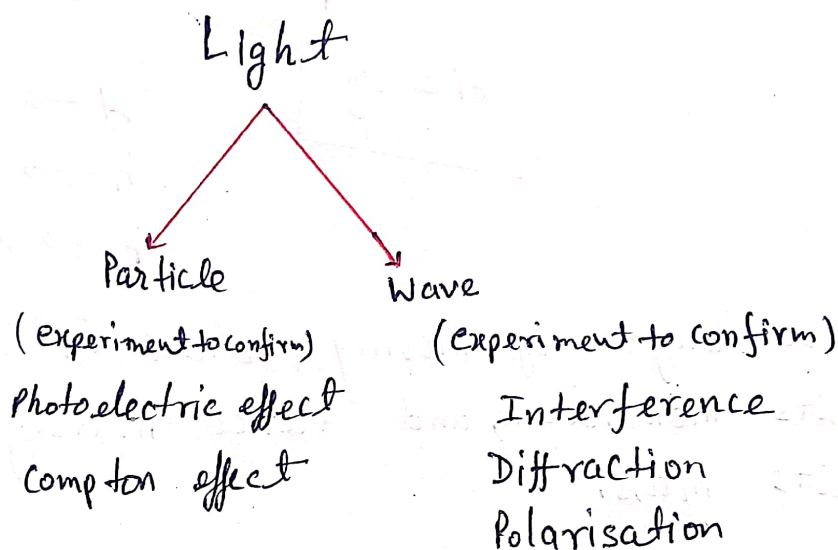


de-Broglie Hypothesis $\Rightarrow$ According to the de-Broglie every object which possess mass and velocity behaves both as particle and as wave.
or light have dual nature that is particle ^{nature} as well as wave nature.



de-Broglie Equation: $\Rightarrow$

According to the Planck's Quantum theory energy of the photon is given by

$$E = h\nu \quad \text{--- (1)}$$

According to the Einstein's mass energy relation

$$E = mc^2 \quad \text{--- (2)}$$

from equation (1) and (2)

$$h\nu = mc^2$$

$$\nu = \frac{c}{\lambda}$$

$$\frac{hc}{\lambda} = mc^2$$

$$\frac{h}{\lambda} = mc$$

$$\boxed{\lambda = \frac{h}{mc}} \Rightarrow \lambda = \frac{h}{\text{mass} \times \text{velocity}}$$

for particle (matter-wave)

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

$$\boxed{\lambda = \frac{h}{p}}$$

$\lambda \rightarrow$ wave length
 $h \rightarrow$ Planck's constant
 $p \rightarrow$ momentum.

The wavelength of moving particle is inversely proportional to its momentum, and hence inversely proportional to its mass.

Comparison: Let us consider a ball of mass $m = 100\text{g}$ and $v = 100\text{ m/sec}$, $h = 6.626 \times 10^{-34} \text{ J sec}$.

Then $\lambda = \frac{h}{mv}$

$$\lambda = \frac{6.626 \times 10^{-34}}{100 \times 10^{-3} \times 100}$$

$$\boxed{\lambda = 6.626 \times 10^{-35} \text{ m}}$$

the wavelength is very small we can not measure this wavelength.

Let us consider an electron whose mass is $m = 9.1 \times 10^{-31}$ and $v = 100\text{ m/sec}$.

$$\lambda = \frac{6.626 \times 10^{-34}}{9.1 \times 10^{-31} \times 100}$$

$$\boxed{\lambda = 7.3 \times 10^{-6} \text{ m}}$$

which is measurable,

Therefore matter have dual nature.

de-Broglie wavelength in terms of kinetic energy.

consider a particle of mass 'm' moving with velocity v .

Now kinetic energy of the particle is given as.

$$E = \frac{1}{2} m v^2$$

$$E = \frac{m^2 v^2}{2m}$$

$$E = \frac{p^2}{2m} \quad (\because p = mv)$$

$$p^2 = 2mE$$

$$p = \sqrt{2mE}$$

$$\lambda = \frac{h}{p}$$

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

If a charge 'q' is accelerated through a potential difference 'V' volt from the rest then the kinetic energy

$$E = qV$$

$$\lambda = \frac{h}{\sqrt{2mqV}}$$

This is the wavelength of an accelerated charge particle.