Dual Nature of electromagnetic radiation

According to classical physics, a particle is characterized by an energy E and a momentum $\vec{P}$.

A wave is characterized by amplitude and a wave vector $\vec{k}$ $(\vec{k} = 2\pi/\lambda)$, that specifies the direction of propagation of wave.

Particles and wave exhibit entirely different behavior.

These rigid concepts of classical physics fail to explain a number of microscopic phenomenon such as blackbody radiation, photoelectric effect & compton effect.

These phenomenon could only be explained ~~using~~ by abandoning the rigid concepts of CM and introducing a new concept : the particle aspect of radiation.

Radiation consists of small packets of energy called quanta. The packets/quanta can be treated as particles. Thus EM radiation exhibits both wave and particle like behaviour & is termed as dual nature of EM radiation.

Q) Major experimental evidence for particle aspect of radiation are -

(1) Photo electric effect- (PEE)

" " " provides a direct confirmation for the energy quantization of light.

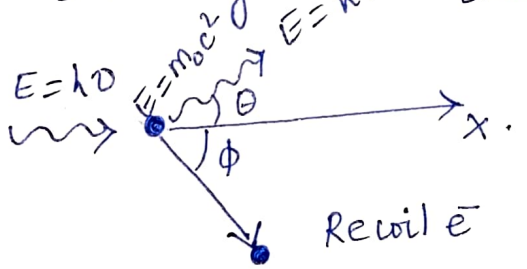
1887 : Hertz discovered PEE.

1902 : Lenard proposed if $\nu_{incident} < \nu_0$ no e^- is emitted.

If $\nu_{inc} > \nu_0$ then e^-s are emitted.

ν_0 being threshold frequency of metal.

(2) Compton Scattering



(3) Pair Production

$\gamma \longrightarrow e^- + e^-$