Origins of Quantum Theory:

→ The review of the main physical ideas and their experimental facts that defined Classical physics and led to the birth of Quantum M.

Classical Physics:

divided — two broad categories:

- Physic of matter.
- Physics of radiation

→ treated separately

Physic of matter. → Classical M. — deals.

Physics of radiation → Classical electro-dynamics.

→ Matter is described in terms of particles and radiations are treated in terms of waves.

→ Classical or Newtonian mechanic
↓ describe
Matters — as particle
↓ study
dynamics

→ Maxwell Theory of electromagnetism.
↓ describe
Nature of radiation.
↓ interms of
electromagnetic waves.

→ Interaction b/w matter and radiation — Explained by Lorentz force or by Thermodynamics

Failures of Classical Mechanics:

up to end of 19th Century, classical Mechanics works well.

→ Two main drawbacks:

1). Einstein theory of relativity: 1905

→. Newtonian M- failed - at very high speed phenomena, when a body moves with a speed comparable to that of light.

$$E = mc^2.$$

this fact is called relativistic domain

2). Classical Mechanics — work well at macroscopic level: Such as. Astronomical objects: spacecraft, planes, stars, and galaxies.

→ Also describe the behaviour of solids, liquids and gases.

→ But fails at microscopic level: Such as to describe the atomic structure of atoms and molecules and how light interact with them.

→ Hence, need new ideas to explain these phenomena.

Particle Aspect of Radiations:

Departure from Classical Physics

a). Planck's Energy Density Distribution:

Quantization of Energy:

→. Hypothesis of exchange of energy b/w radiations and matter.

" The exchange of energy b/w radiation and matter must be discrete".

→ Classical Assumption: This exchange is continuous.

→. Planck's - formula.

$$E = \hbar\omega.$$

$$P = \hbar K.$$

Known as. Planck-Einstein relations which relate the particle characteristics (E, P) with those of waves (ω, K).

i) black body radiations:

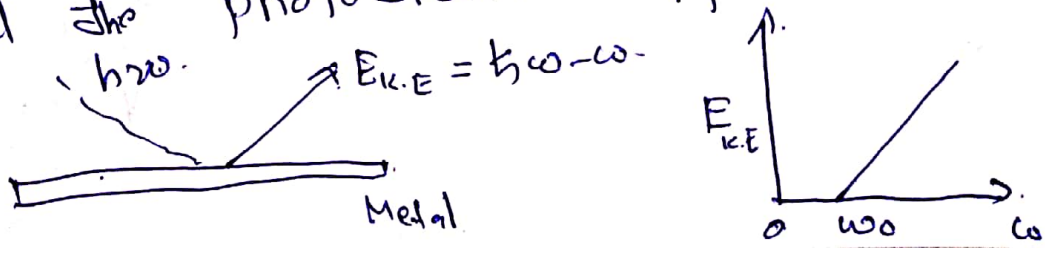
Spectrum — continus.

↓

But was discrete

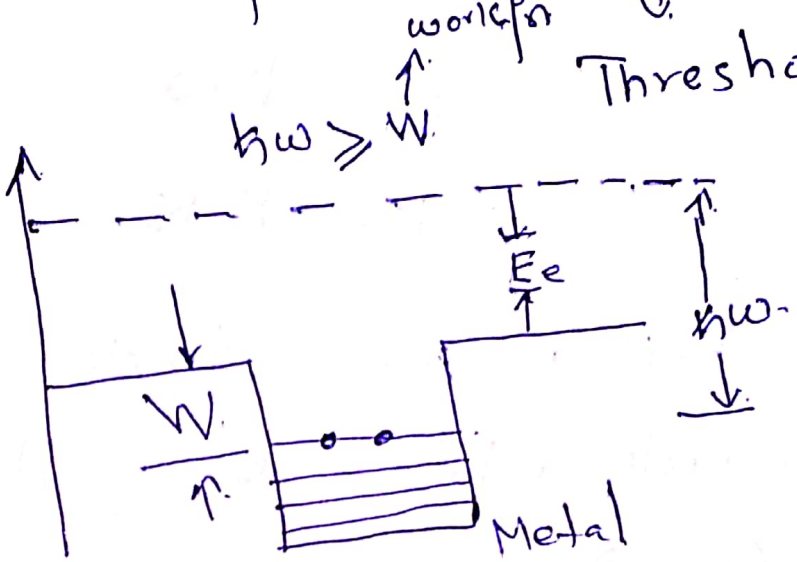
b) Photoelectric Effect:

"The ejection of $\bar{e}$ from a metal surface by light is called the photoelectric effect."



→ Classical assumption: $\bar{e}$ emission depends on the intensity of incident radiation.

→ Q. M. — depends on the frequency



c) Compton Effect:

→ Particle aspect of radiation is clearly demonstrated in Compton effect in which photon as a particle collides with an electron.