NAME – PIYUSH AGRAWAL

BRANCH → IT

SUBJECT → PHYSICS

"UNIT-1"

QUANTUM MECHANICS

Date: 28/03/23
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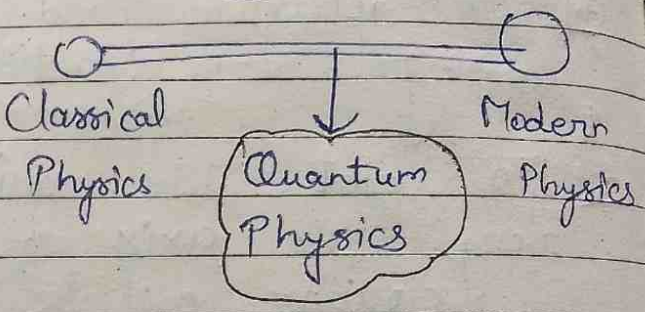
★ Quatum Mechanics,-

14 Dec. 1900 quatum mechanics has discovered :

Black-Body Radiation → Nobel Prize



★ Quantum Mechanics,-

It is the branch of physics : which explain about the motion of microscopic particles like electron, proton etc. It was introduced by Max planck in 1990.

★ Classical Mechanics,-

It is the branch of physics, which explains the motion of macroscopic objects. It was introduced by Issac Newton.

★ Application of Quantum ~~Mech.~~ Physics,-

- Computer System Network
- Mob. phones, transistor, Laser, microscope etc.
- Digital Camera, LED.
- Telecommunications
- Nuclear power plants

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Date - 28/03/23
H.W → Definition photon.
Write a short note of Max planck.
Properties of photons.

★ Photon -

A particle representing a quantum of light and made up of electromagnetic waves. They have no mass and no charge. A photon carry energy proportional to the radiation frequency.

$$E = h\nu$$

▸ Examples - Radio waves, microwaves, infrared, UV-light etc.

★ Properties of photon -

(1) The energy of photon given as

$$E = h\nu$$

Here, ν = frequency, h = planck's constant
E = Energy of photon

(2) We know that speed of light ($c = 3 \times 10^8$). Therefore the speed of photon is also equal to $c = 3 \times 10^8$ m/s.

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(3) The rest-mass of photon is zero.
(4) Photons are stable particles.
(5) They do not have any electric change.

★ Max-planck,-

Max-planck is a german physician who introduced to quantum physics. He got nobel prize in 1918. Max-planck was born on 28 april in 1858. He work on 2nd law of thermodynamic.

After using plank theory he analysis results come different in every experiment then he give a new theory is called max-planck quantum theory, which mean he give relation b/w energy of photon & frequency of radiation.

$$E = h\nu \quad (1)$$

h = planck's constant = 6.62×10^{-34} J s

ν = frequency of radiation

We know that =>

$$\nu = \frac{C}{\lambda} \quad (2)$$

C → Speed of light
λ → Wavelength of radiation

$$E = \frac{hC}{\lambda} \quad (3)$$

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★ Planck's Quantum hypothesis :-

* In 1900, plank reported his discovery of a formula that accurately described the shape of a blackbody spectrum for all wavelength & temperature.

* When a blackbody is heated, it emits thermal radiations of different wavelength & frequency. To explain these radiations. Max planck put forward a theory known as planck quantum theory.

• According to plank's quantum theory -

(1) Substances radiate (or) absorb energy discontinuously in the form of small packets (or) bundles of energy.

(2) The smallest packet of energy is called quantum/ quanta. In case of light the quanta is known as photon.

(3) The energy of quanta is directly proportional to the frequency of quanta radiation.

Energy of Photon $\propto$ frequency of radiation

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★ Mass & Momentum of a photon :-

- Rest mass (m_p) of photon is zero. If photon is in rest then it's mass is zero.
- When photon is in motion, then its mass is known as Kinetic mass and let it is denoted by (m).

Then according to einsteins mass energy eq,n -

$$E = mc^2 \quad \text{---(4)}$$

From eq. (4) & (1), we get -

$$mc^2 = h\nu \Rightarrow \boxed{mc^2 = \frac{hc}{\lambda}} \quad \text{---(5)}$$

Mass of photon is given by -

$$m = \frac{h\nu}{c^2} = \frac{h}{c^2} \cdot \frac{c}{\lambda} = \frac{h}{c\lambda} \Rightarrow \boxed{m = \frac{h}{c\lambda}} \quad \text{---(6)}$$

We know that, momentum (p) = mass × Velocity

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

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

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★ Properties of photon :-

(1) They have zero mass & rest energy.
(2) They have no electric charge (neutral).
(3) They only exist as a moving particles.
(4) They are stable.
(5) They can destroyed & Created by many natural process (like radiation, absorption, or immetiated or emission).

(6) When in empty space. They travel at the speed of light (in vacuum).

★ Wave particle duality of radiation :-

(1) Wave :-
A wave nothing but spreading of disturbance in a medium. The characteristics / properties of wave are -

(i) Amplitude (ii) Time Period (iii) frequency (iv) Wave length
(v) Phase (vi) Intensity.

(2) Phase :- A particle is a point in space which has mass & occupies space (or) Region. The Charac. properties of a particles.

(1) Mass (2) Velocity (3) Momentum (4) Energy.

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Date

Gauthi

Radiation (Light)

Wave
(Visible / Infrared / ultra violet / X-rays)
(λ or frequency)
↓ shows
Interference / Diffraction
↓ when
(Two waves at the same position at the same time)
↓
The radiations behaves like wave)

Particle
(Photon / quanta)
$E = h\nu$ $(p = h\frac{\nu}{c})$
↓ shows
Blackbody Radiation, Photoelectric effect.
↓ when
(The Radient energy in its interaction with matter in the form of photon
↓ conclusion
(The radiations behaves like particles like particle)

(waveparticle dulity)
1924 Lewies de. Broglie.