$\alpha, \beta \rightarrow$ particle
$\gamma \rightarrow$ Radiation (Gamma)

Ch-7 [Quantum Mechanics]

N·M
C·M
S·M
Q·M

Atomic size
$\sim 10^{-10}$ m

Inadequacy of classical mechanics [imp]

① ~~Stability of atoms or~~

↳ Classical physical deal with macroscopic phenomena. most of the effect with which classical theory is concerned are directly observable or can be made obserable with simple instrument.

↳ The phenomena which occur in a very small scale (atomic) scale can be explained by quantum mechanics.

Some inadequacy of classical mechanics are as follows! –

① Classical mechanics couldnot explain the stability of the atom or molecules.

② Classical mechanics couldnot explain the enormous range of electrical conductivity of solid materials.

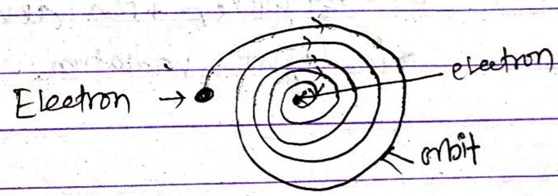
③ Classical mechanics could not explain the observed spectrum of black body radiation.

④ It couldn't explain the specific heat capacity of solid at low Temperature.

⑤ It couldn't explain the origin discrete spectra of ~~spectrum~~ atoms.

⑥ It couldnot explain the several phenomena like, photoelectric effect, compten effect, Raman spectra, Charge particle at high temperature, emission of α, β particles and γ radiat-~~ion~~ etc.

⑦ ↳



[Fig. collapse of electron]

Dual Nature of radiation

↳ The phenomenon like interference, diffraction & polarization can be explained on the basis of classical ~~consider~~ theory (~~where~~ consideration) where light behave as a wave nature. On the other hand, some phenomenon like photoelectric effect, compton effect, emission of high energy charged particle (α, β, γ etc) can be explained on the basis of Quantum mechanics where light behaves as a particle nature. From above both cases we conclude that light as wave as well as particles nature (Dual ~~nature~~) nature of radiation.

↳ De-Broglie's theory was developed on the basis of dual character of light radiation.

De-Broglie's Theory:

The moving wave of particle is called de-Broglie wave or matter wave. Wave length associated with moving wave is called de-Broglie wavelength.

Let m be the mass of moving particles with velocity v.

Then de-Broglie's wave length λ is given by

$$\boxed{\lambda = \frac{h}{mv} = \frac{h}{p}}$$ — where p = mv

$2\pi\sqrt{\frac{k}{m} - \left(\frac{b}{2m}\right)^2}$

me period

of

velocity of light, c — Wave nature
velocity of light — V — particle nature

but Cyclotron has $c \propto v$ → is a particle

$c > v$ always

Derivation

According to the Einstein's mass-energy relation

$E = mc^2$ — (1) where m = mass of photon

c = velocity of light

According to the planck's theory,

$E = hf$ — (2) where h = planck's constant $= 6.62 \times 10^{-34}$ Js

Energy of both cases have same. Thus, from eqn (1) and (2) we get,

$mc^2 = hf$ — (3)

We know that $c = f \times \lambda$

$f = \frac{c}{\lambda}$ — (4)

Using (4) & (3)

$mc^2 = h\frac{c}{\lambda}$

or $\boxed{\lambda = \frac{hc}{mc^2} = \frac{h}{mc} = \frac{h}{mv} = \frac{h}{p}}$ — (5)

↳ Due to Dual nature