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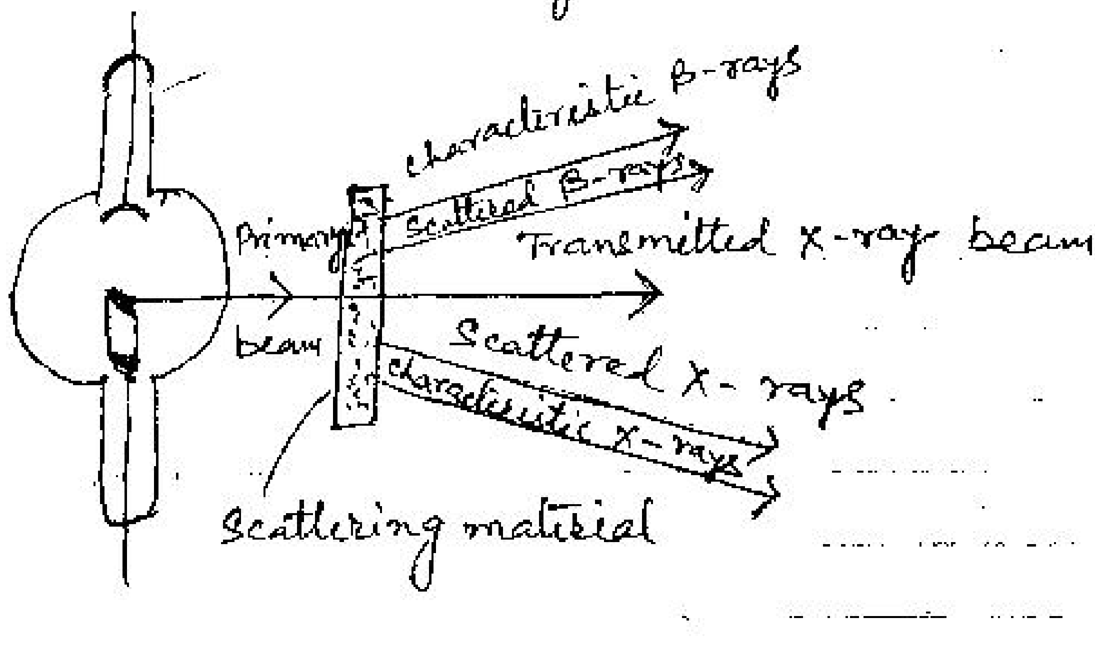
D-3(H) Paper V

Scattering of X-rays

When a beam of x-rays from the anticathode of an x-ray tube is made to fall upon a plate of a certain element, a part of the primary beam gets transmitted through the plate whereas the remaining gets converted into heat or other types of radiations. These other types of radiations excited by the primary beam on its interaction with the material of the plate are together called secondary radiations. The secondary radiations are found to consists of (a) scattered x-rays; (b) characteristic x-rays; (c) Scattered β-rays (d) characteristic β-rays.



(a) Scattered x-rays :- These are assumed to be the primary rays with their direction changed on interaction with the plate. They have the same penetrating power and their character is independent of the nature of the scattering material.

(b) characteristic x-rays: They are characteristic of the nature of the material of the plate and are independent of the hardness of the primary rays.

(c) & (d) Scattered and characteristic β-ray:
They consists of ejected electrons moving with higher velocities and are produced by the process of photoelectric emission. They are independent of the nature of the scattering material but depend upon the hardness of the primary x-rays.

The electromagnetic theory was applied to the scattering of x-rays by J. J Thomson with the following assumptions

The electrons in the scatterer are free or weakly bound and are distributed in such a random fashion that no definite phase relation exists between the rays scattered by the different electrons,

~~Secondaly~~ Secondly, when the incident

X-rays fall upon the free electrons of the scatterer, these electrons will be accelerated.

Now, according to electrodynamics, an accelerated charge must radiate energy. Consequently, the electrons radiate energy due to forced oscillations under the action of the primary beam. Since these forced oscillations are of the same frequency as the incident wave, the secondary scattered waves produced by the oscillations must ~~to~~ also be of the same frequency. This means that the scattered radiations will have the same wave length as the incident one (Coherent Scattering).

Thirdly, the intensity of radiation which is, by definition, the energy per unit are of the wave surface, is directly propor-tional to the square of the electric vector.

Thomson with these initial conditions and by a simple application of electrodynamics obtained expressions for the intensity and energy of the scattered beam.