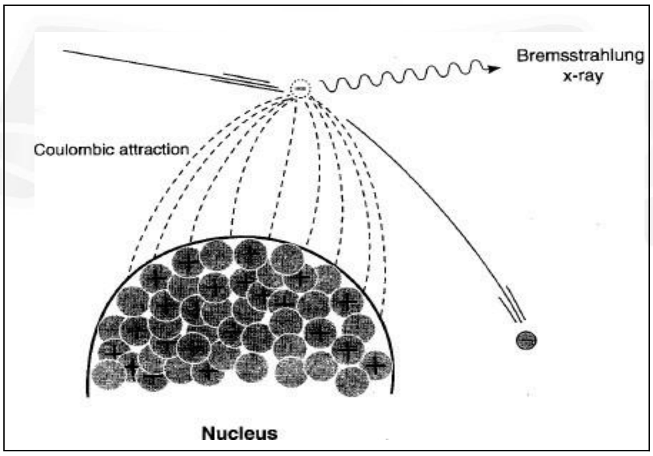
UNIT III

INTERACTION OF RADIATION WITH MATTER LIPID

3.2 Bremsstrahlung

- When energetic charged particles, particularly electrons, pass through matter and come close to the nucleus of the atom, they lose energy as a result of deceleration in the Coulomb field of atomic nuclei.
- The loss in energy appears as an x-ray that is called **bremsstrahlung** (German for ―braking‖ or ―slowing down‖ radiation).
- These bremsstrahlung radiations are commonly used in radiographic procedures and are generated by striking a tungsten target with a highly accelerated electron beam.
- Bremsstrahlung production increases with the kinetic energy of the particle and the atomic number (*Z*) of the absorber.
- For example, a 10-MeV electron loses about 50% of its energy by bremsstrahlung, whereas a 90-MeV electron loses almost 90% of its energy by this process.
- The bremsstrahlung production is proportional to Z^2 of the absorber atom. Therefore, bremsstrahlung is unimportant in lighter metals such as air, aluminum, and so forth, whereas it is very significant in heavy metals such as lead and tungsten.



- High-energy β^--particles from radionuclides such as ^{32}P can produce bremsstrahlung in heavy metals such as lead and tungsten.
- For this reason, these radionuclides are stored in low-*Z* materials such as plastic

containers rather than in lead containers.

- Bremsstrahlung is inversely proportional to the mass of the charged particles and therefore is insignificant for heavy particles, namely α-particles and protons, because the probability of penetrating close to the nuclei is relatively low due to their heavier masses.

Annihilation

- When energetic β^+-particles pass through an absorber, they lose energy via interaction with orbital electrons of the atoms of the absorber.
- When the β^+-particle comes to almost rest after losing all energy, it combines with an orbital electron of the absorber atom and produces two 511-keV annihilation radiations that are emitted in opposite directions (180°).
- These annihilation radiations are the basis of positron emission tomography (PET) in which two photons are detected in coincidence.