KARNATAKA RADIOLOGY EDUCATION PROGRAM

INTERACTION OF X RAY AND MATTER

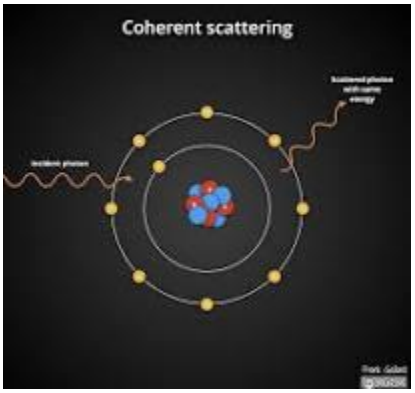
Properties of X rays:

Travel in straight line,
Undergo reflection: follow laws of reflection,
Undergo refraction: follow laws of refraction,
Ionize the gas/ medium through which they pass,

INTERACTIONS Three fates
-Transmitted, (If we consider X ray beam it is attenuated by matter)
-Absorbed,
-Reflected: Scattered: adds noise to system.

INTERACTIONS
1.COHERENT SCATTERING
2.PHOTOELECTRIC EFFECT (Characteristic radiation)
3.COMPTON SCATTERING (General radiation)
4.PAIR PRODUCTION
5.PHOTODISINTEGRATION

COHERENT SCATTERING



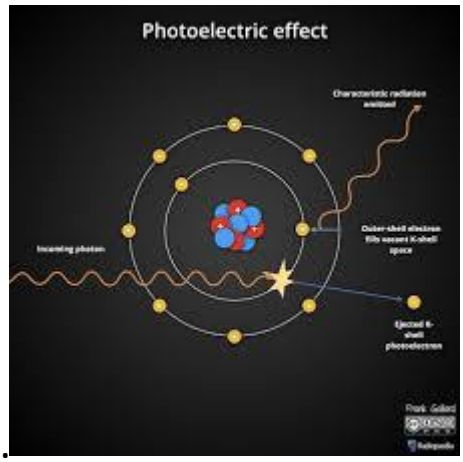
5% of all interactions.
Radiation undergoes change in direction without a change in wavelength.
2 Types

1.Thomson Scattering-involves single electron of the atom
2.Rayleigh Scattering- involves all electrons of the atom
Significance : Not so important in practical radiology.

Produces scattered radiation, Contributes in formation to film fog

PHOTOELECTRIC EFFECT

phenomenon in which electrically charged particles are released from or within a material when it absorbs electromagnetic radiation. The effect is often defined as the ejection of electrons from a metal plate when light falls on it.



CHARACTERISTIC RADIATION

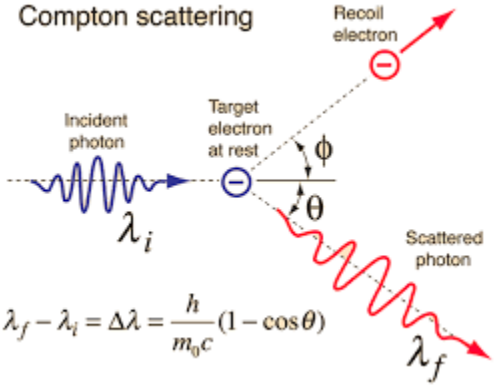
One electron from outer orbit jumps into K- shell / inner orbit of atom (that has high potential energy.)

Energy is given up by the electron before entering inner orbit which is particular / characteristic for that atom / element - characteristic radiation.

In an X-ray tube a high speed electron ejects the bound electron while

In a photoelectric reaction an X-ray photon ejects the bound electron.

Compton scattering



is a partial absorption reaction that involves moderate-energy x-rays. As photon energy increases with a higher number of peak kilovolts, the x-ray gives up some of its energy as it strikes an outer shell electron in an absorbing medium

PAIR PRODUCTION

High energy photon strikes with nucleus and produces 2 particles
-Positron and Electron.
Do not occur in diagnostic radiology range which uses photons of keV.
THIS Interaction doesn't occur if photon energy less than 1.02 MeV.

PHOTODISINTEGRATION

Part of nucleus is ejected by high energy photon. Not useful in diagnostic radiology which uses 10 to 150 keV.
Doesn't take place with photons <7MeV energy.
Ejected portion may be proton, neutron, an alpha particle.

FACTORS AFFECTING SCATTER RADIATION:

Kilovoltage :
Scatter radiation is maximum with high kVp techniques.
Less important as we can't compromise kVp.
Only variable we can control.
Field Size :
Most important . Scatter radiation increases with increase in field size, then gradually tapers off until finally it reaches plateau or saturation point.
Part Thickness : Reaches saturation with increase in part thickness.

Some authors (Yochum says use grid to decrease scatter radiation if skeletal part thickness is > 10 cm.) Collimation, filter decrease scatter radiation.
Air gap technique, grid decrease scatter reaching film.

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REF : Christensen's Physics of Diagnostic Radiology,Radiopedia.
Christensen's physics of diagnostic radiology
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