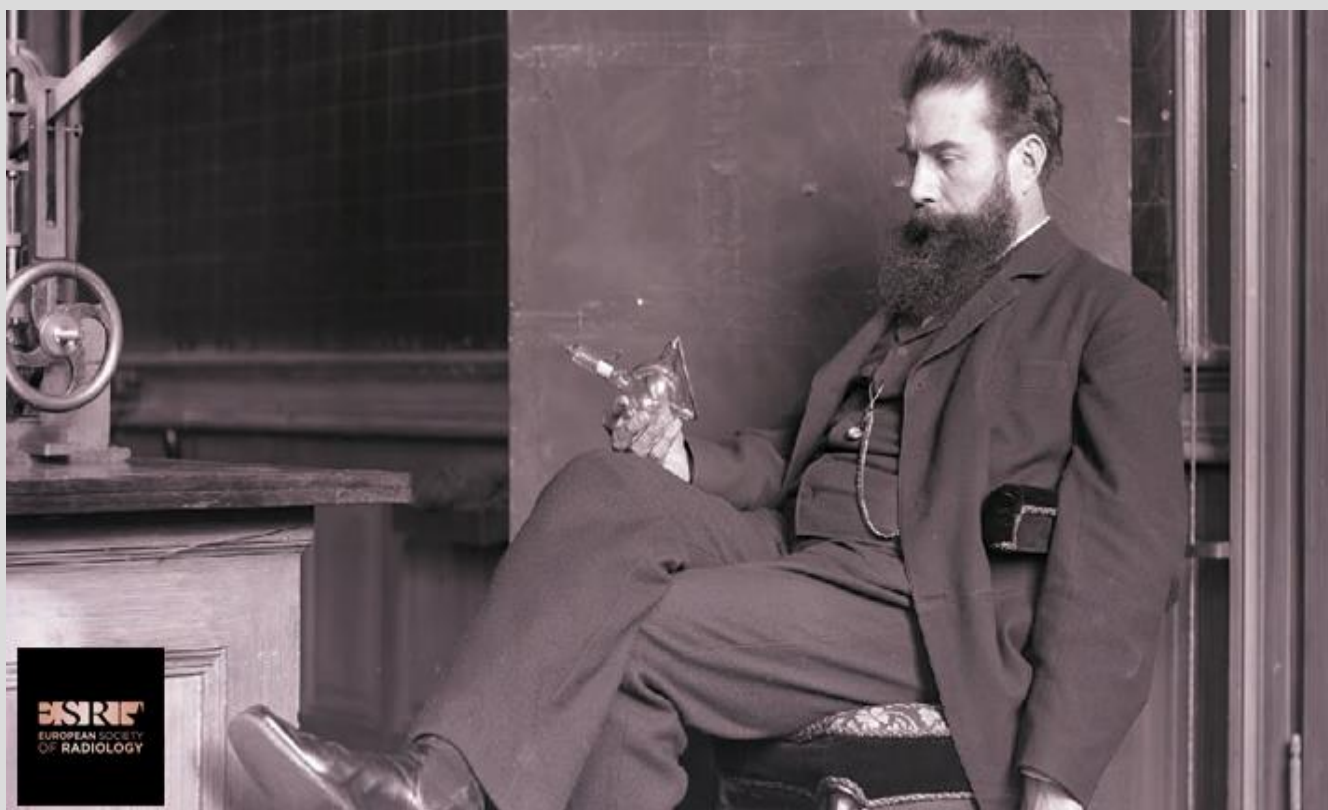


X-ray discovery:

In radiography and other technological and scientific fields, X-rays are often used. William Röntgen, a German physicist who received the Nobel Prize in Physics in 1901, made the discovery in 1895 at the University of Würzburg.

William Röntgen, the discoverer of X-rays, shone an electron beam into a glass tube with high electrical tension between its ends. This tube was deflated and electrons were released from the negative electrode to the positive electrode. This tube was surrounded by light colored paper to protect the user from the emitted electromagnetic field and a phosphorescent screen was placed at the end of it. When the electron beam hit the screen, it started to glow. When Richard Roentgen accidentally put his hand between the tube and the phosphor screen, he saw an image of the bones of his hand on the screen, and this was the first X-ray process.



Img (1): Wilhelm Conrad Röntgen was born on March 27, 1845

Application:

Radiography in medicine to detect teeth, bones and their fractures, locate solid objects such as fragments or lead in the body, as well as detect tumors in the body. Thanks to these rays, it has become possible to see bone fractures with high accuracy as these rays can penetrate soft objects such as the skin, but they cannot Passing through the bones, which leads to the appearance of the last image. One of the most important features of it is the lack of collateral damage.

Doctors also use these rays to treat and eliminate cancerous tumors. X-rays kill cancer cells and eliminate them, while healthy body cells regain their vitality after a short period and return healthy and sound.

In the field of security, X-rays are used to monitor passenger bags at airports for weapons or bombs.



Img (2): Application of X-ray

Concepts of radiation

Overview about x – rays:

X-rays are a type of electromagnetic (EM) radiation. X – rays are short wavelength, high frequency, which means high energy. When X – rays hit atoms this energy can be transferred, producing ionization of atoms. X-rays are having an energy in the general range of approximately 1 to several hundred kiloelectronvolts (keV). In medical x-ray imaging, the x-ray energy typically lies between 5 and 150 keV, with the energy adjusted to the anatomic thickness and the type of study being performed.

X-rays striking an object may either pass through unaffected or may undergo an interaction. These interactions usually involve either the photoelectric effect (where the x-ray is absorbed) or scattering (where the x-ray is deflected to the side with a loss of some energy). X-rays that have been scattered may undergo deflection through a small angle and still reach the image detector; in this case they reduce image contrast and thus degrade the image. This degradation can be reduced by the use of an air gap between the anatomy and the image receptor or by use of an antiscatter grid. Because of health effects, the doses in radiography are kept as low as possible.

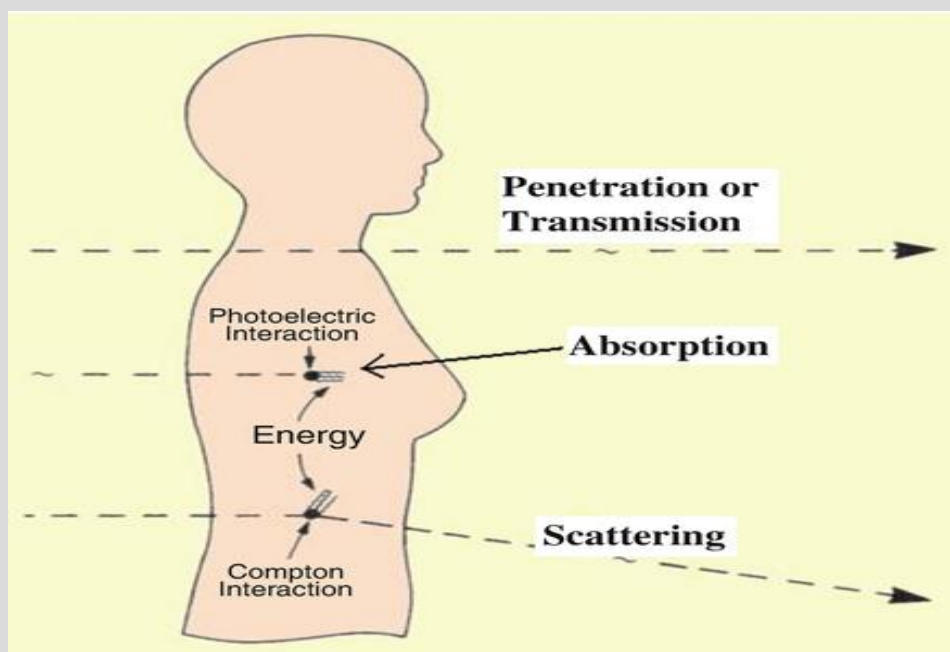


Fig (1): Interaction of Gamma Rays and X-Rays with Matter

X - Ray Production:

The x-rays are produced from electrons that have been accelerated in vacuum from the cathode to the anode. The electrons are emitted from a filament mounted within a groove in the cathode. Emission occurs when the filament is heated by passing a current through it. When the filament is hot enough, some electrons obtain a thermal energy sufficient to overcome the energy binding the electron to the metal of the filament. Once the electrons have “boiled off” from the filament, they are accelerated by a voltage difference applied from the cathode to the anode. This voltage is supplied by a generator.

After the electrons have been accelerated to the anode, they will be stopped in a short distance. Most of the electrons’ energy is converted into heating of the anode, but a small percentage is converted to x-rays by two main methods. One method of x- ray production relies on the fact that deceleration of a charged particle results in emission of .electromagnetic radiation, called bremsstrahlung radiation.

These x-rays will have a wide, continuous distribution of energies, with the maximum being the total energy the electron had when reaching the anode. The number of x-rays is relatively small at higher energies and increases for lower energies.

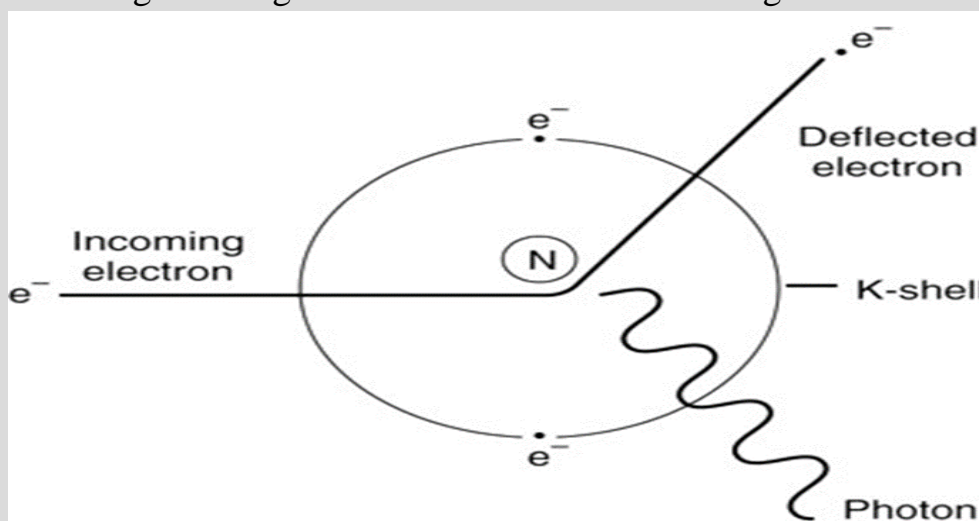


Fig (2): Photon energy emission process

A second method of x-ray production occurs when an accelerated electron strikes an atom in the anode and removes an inner electron from this atom. The vacant electron orbital will be filled by a neighboring electron, and an x-ray may be emitted whose energy matches the energy change of the electron. The result is production of large numbers of x-rays at a few discrete energies. Since the energy of these characteristic x-rays depends on the material on the surface of the anode, materials are chosen partially to produce x-rays with desired energies.

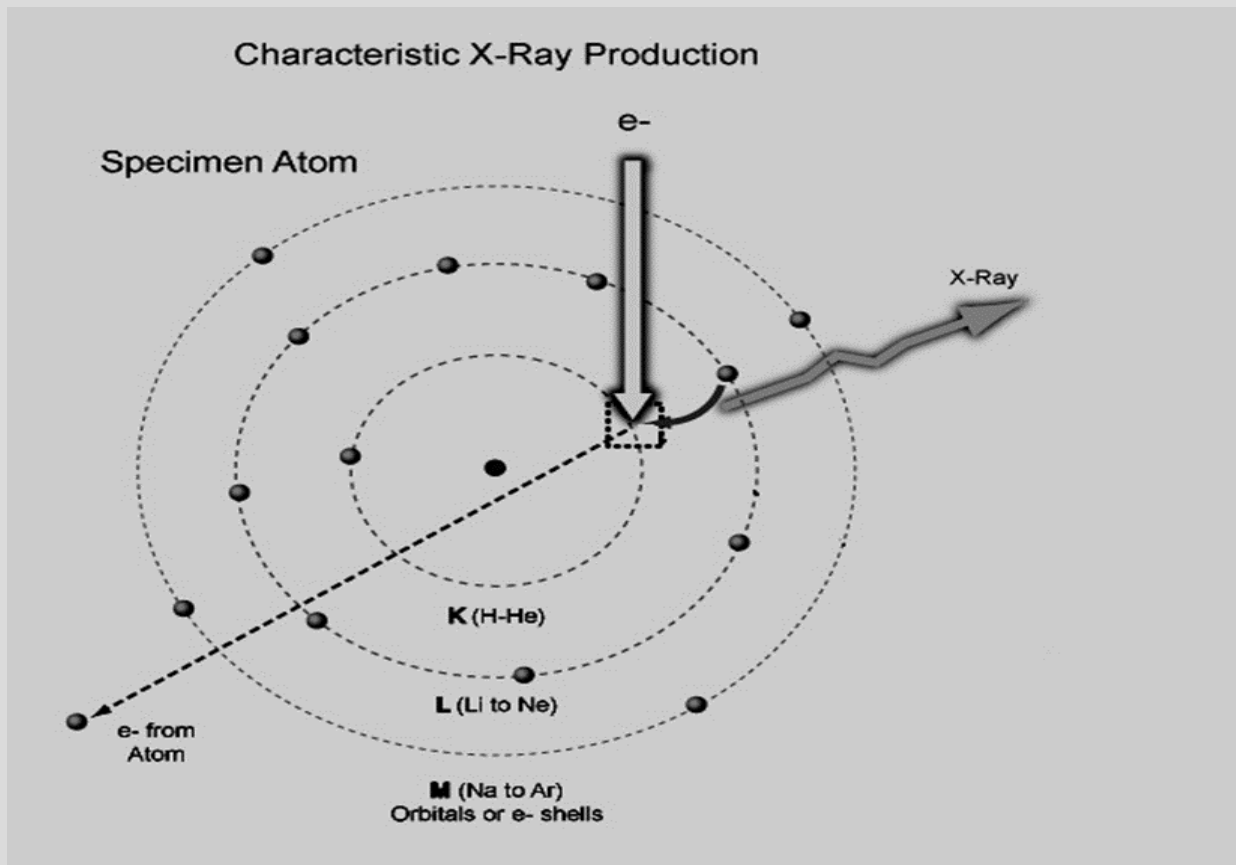


Fig (3): Electrons collide and produce photon energy