Medical physics

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In College of Pharmacy
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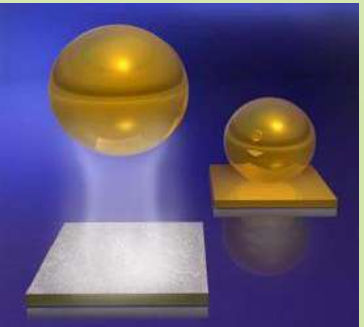
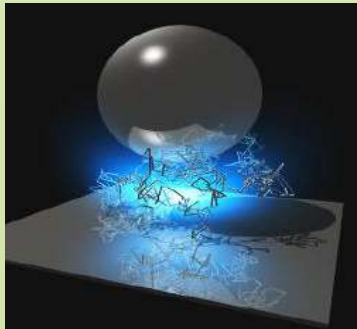




Physics of Diagnostic and Therapy

- The field of radiology has three major braches

❖Diagnostic radiology

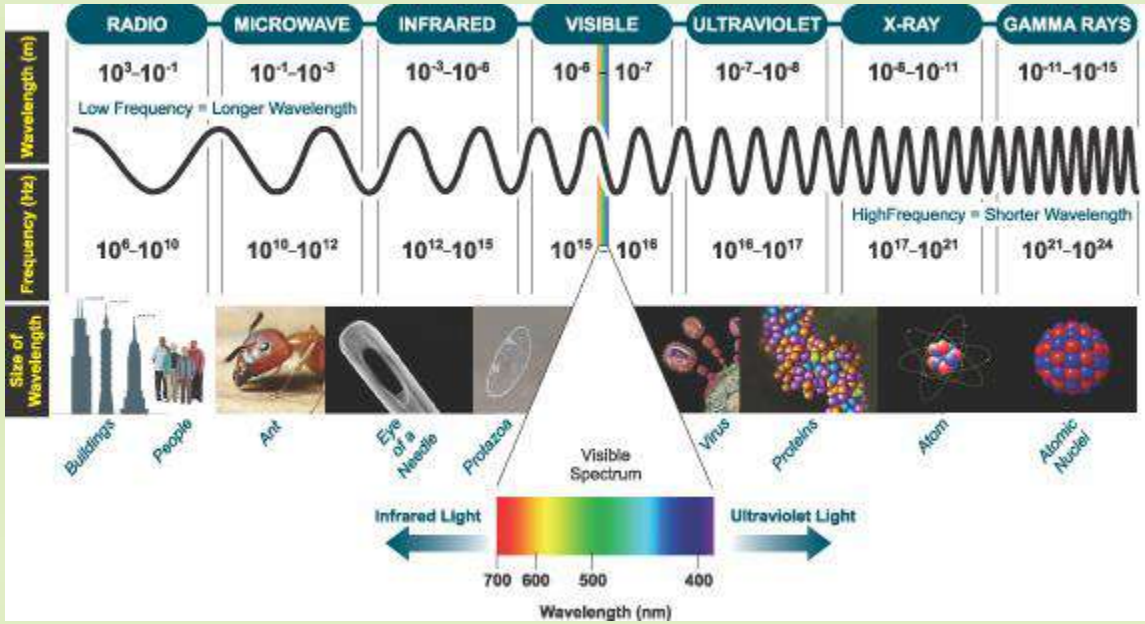
❖radiation therapy

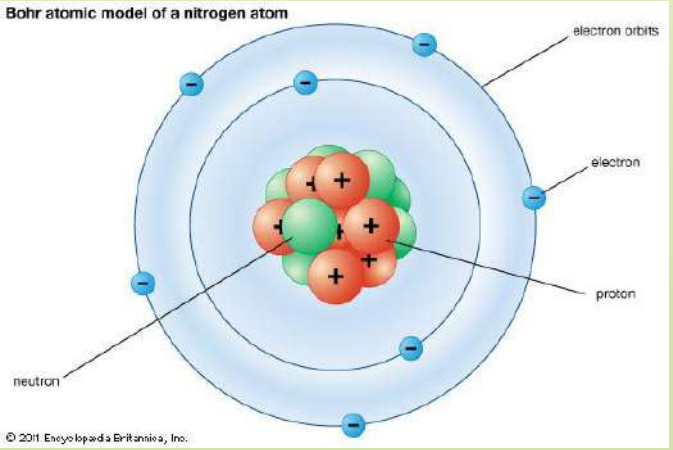
❖nuclear medicine

The nuclei of most naturally occurring atoms are stable. They do not change when left alone. There are, however, many unstable nuclei which undergo transformations accompanied by the emission of energetic radiation.

The atom

Radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium. This includes electro-magnetic radiation such as radio waves, visible light, and x-rays, particle radiation such as α, β, and neutron radiation

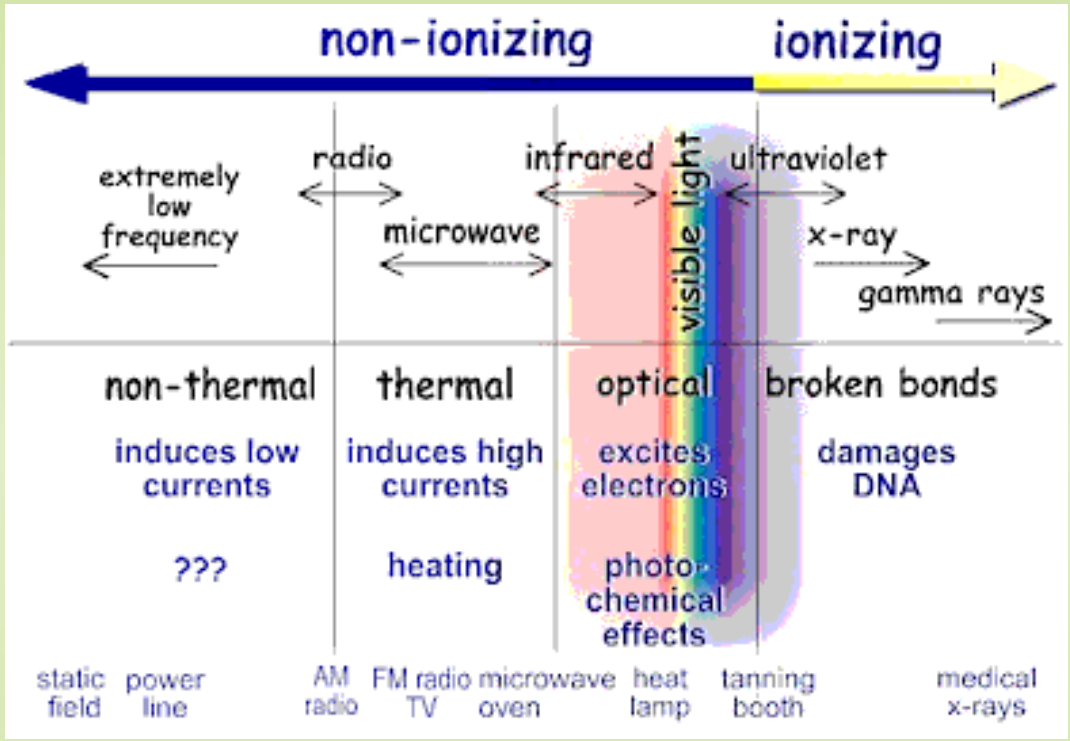




Type of radiation

- Non Ionizing radiation: has **less energy than ionizing radiation .it does not possess enough energy to produce ions**

- Ionizing Radiation: **It has so much energy if can knock electrons out of atoms, process known as Ionizing radiation**
- Alpha particles
- Beta Particales
- Gamma rays
- Nutrons



sources of radiation

➢ Natural sources

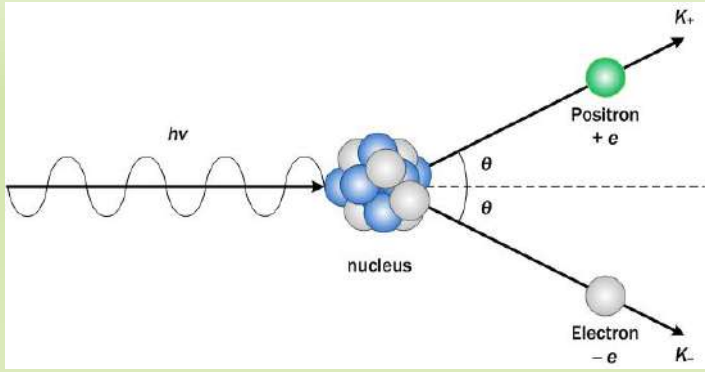
- Cosmic rays
- Terrestrial radiation
- Internal radiation (^{40}K , ^{14}C)

➢ Man-Made sources

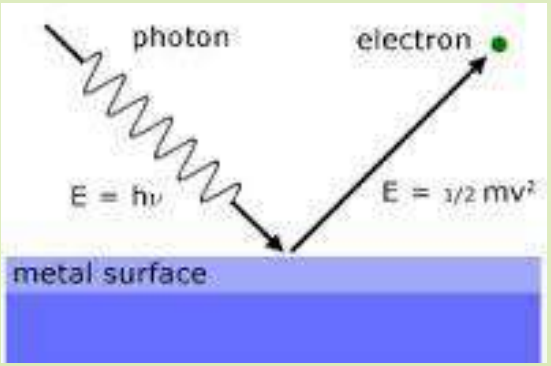
- Medical sources
- Industrial sources
- Nuclear Power
- Nuclear and radiation accidents

The phenomena

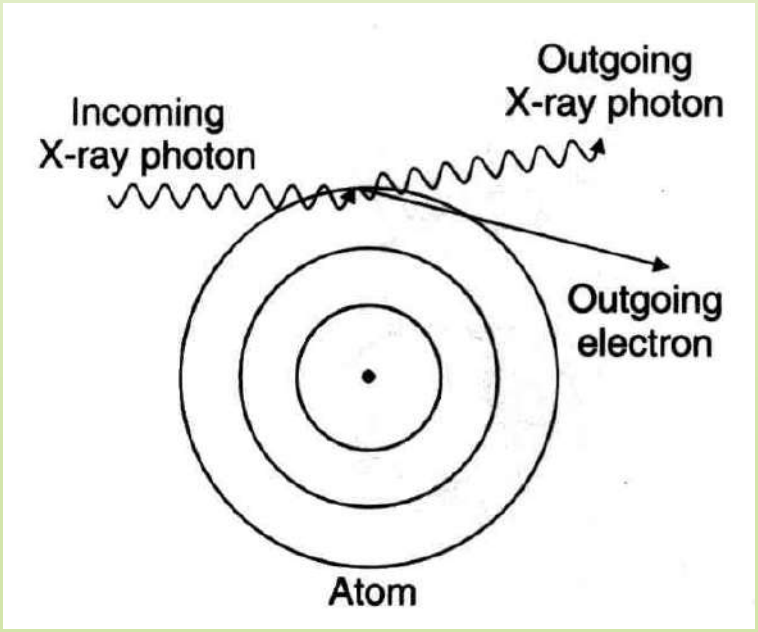
- pair production



- photoelectric effect

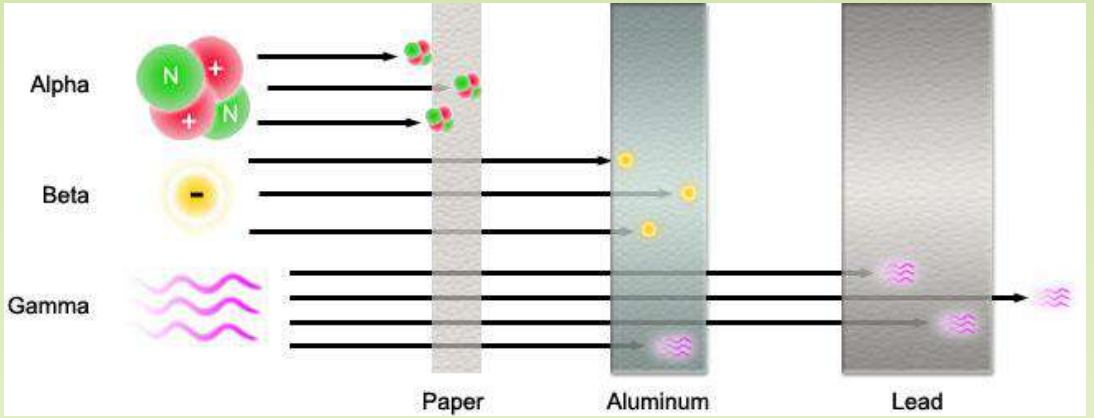


- compton effect



radioactive nuclei three categories

- **alpha (α) particles**, which are high-speed helium nuclei consisting of two protons and two neutrons Such as helium nucleus
- **beta (β) particles**, which are very high speed electrons emitted from the nuclei of decaying radioisotopes. Since these are electrons, they have a negative charge and a small mass; Beta particles may travel 2 or 3 meters through air
- **gamma (γ) rays**, which are highly energetic photons. It is electromagnetic radiation of the shortest wavelength and highest energy



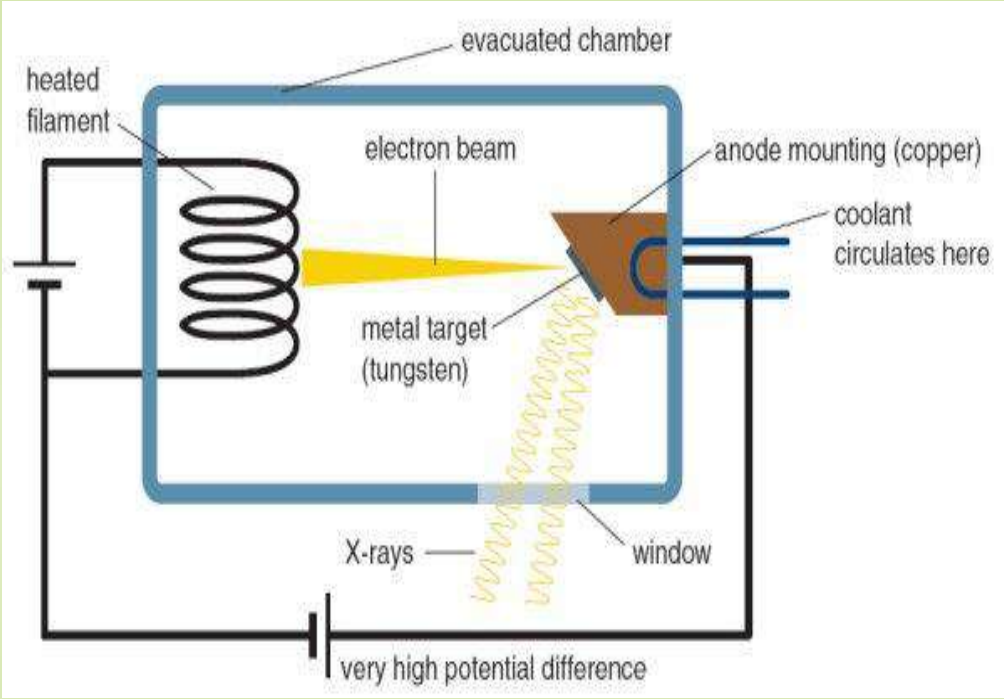
The x-ray

- X-rays are a form of ionizing electromagnetic radiation frequency and a very short wavelength.
- Their wavelengths range between 0.001 to 10 nm.
- When a patient has an X-ray, they are usually scanned at a frequency of approximately 7×10^{8} Hz because body tissues absorb this frequency the best

The x-ray

- The heated filament is positively charged and the tungsten target is negative.

- Electrons are emitted from the heated filament towards the tungsten target due to the very high potential difference between them.
- The tungsten target absorbs the electrons and releases some of the energy in the form of X-rays.

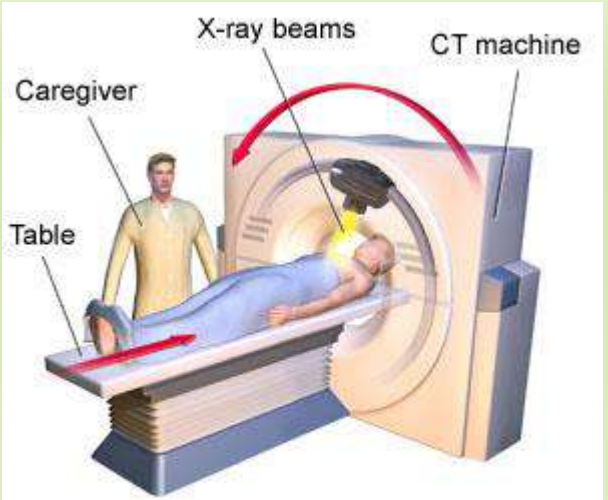


The X-RAY COMPUTERIZED TOMOGRAPHY

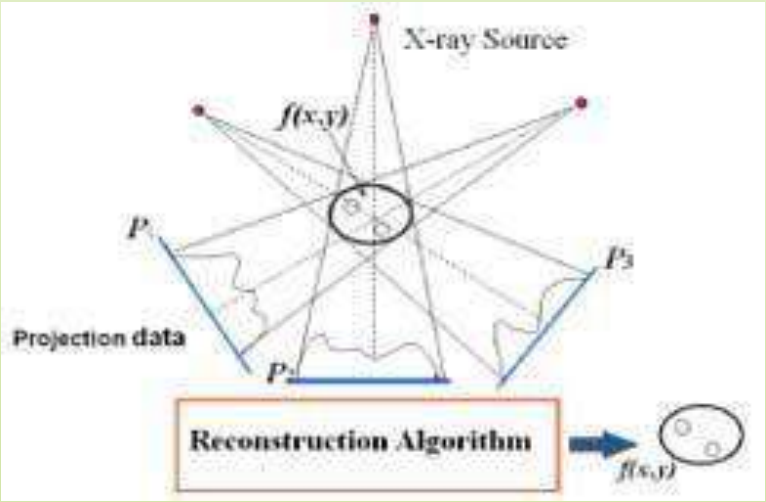
- The usual X-ray picture does not provide depth information. The image represents the total attenuation as the X-ray beam passes through the object in its path

- A thin beam of X-rays passes through the plane we want to visualize and is detected by a diametrically opposing detector

- The angle is then changed by a small amount (about 1◦) and the process is repeated full circle around the object. By rotation
- The CT scanner uses digital geometry processing to generate a 3-dimensional (3D) image of the inside of an object



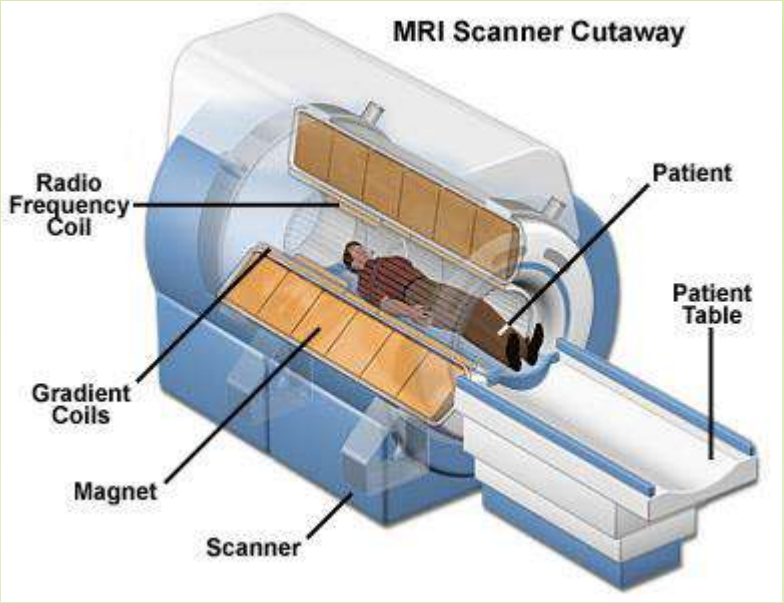
Computerized Axial Tomography Scan



MAGNETIC RESONANCE IMAGING

- X-rays, do not provide information about the internal structure of tissue
- CT scans may therefore, miss changes in tissue structure and pathological alteration
- *Magnetic resonance imaging* (*MRI*)

- When the body is placed in a strong magnetic field, such as an MRI scanner, the protons' axes all line up
- The radio wave frequency (RF) that causes the hydrogen nuclei to resonate is dependent on the element sought



When the radiofrequency source is switched off the magnetic vector returns to its resting state, and this causes a signal (also a radio wave) to be emitted

Unlike some other medical imaging techniques, MRI does not involve radioactivity or ionising radiation

The MR signal is sensitive to a broad range of influences, such as nuclear mobility, molecular structure, flow and diffusion. MRI is consequently a very flexible technique that provides measures of both structure and function.


Thank you