General Physics

Radiology Techniques Department

1st Class

Al-Mustaqbal University college

*Lecture : **Radioactivity** and **Particles***

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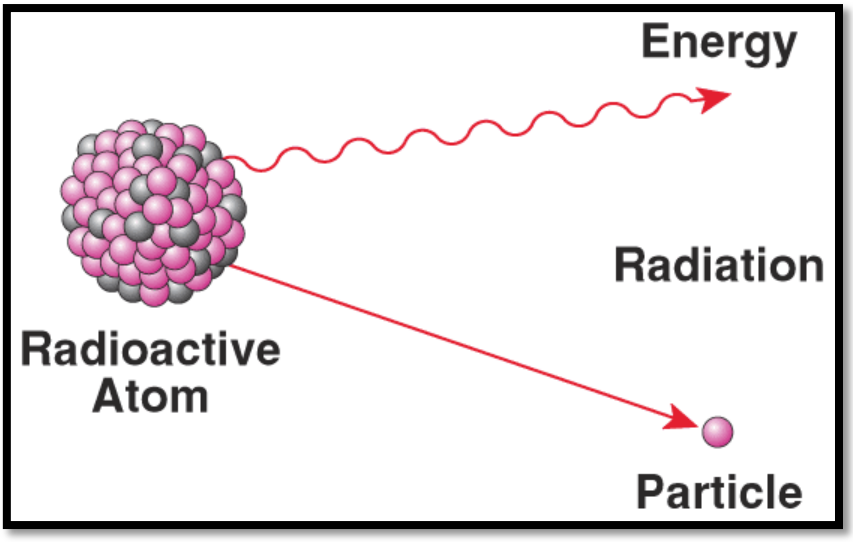
Radioactivity: The act of spontaneously emitting particles and/or radiation from unstable atomic nuclei or as the result of a nuclear reaction.

Ionizing Radiation. Although not all radiation is harmful, ionizing radiation (or radiation that alters chemical bonds and produces ions) often comes to mind when the topic is discussed. To understand ionization, it is important to review the basic composition of an atom. An atom consists of a central nucleus that contains comparatively larger particles known as protons and neutrons. These particles are orbited by smaller particles known as electrons. Their relative masses are displayed in the sidebar. One way to think of an atom is to visualize a miniature solar system where the sun represents the nucleus and the orbiting planets represent electrons. In a normal situation or in the case of a neutral atom, the number of electrons orbiting a nucleus equals the number of protons in the nucleus

When an atom or molecule gains or loses electrons, it becomes an ion. Ions can be either positively or negatively charged. A positively charged ion (i.e., cation) results from the removal of one or more electrons, while a negatively charged ion (i.e., anion) results from gaining extra electrons.

Radiation that has enough energy to remove or knock out electrons from atoms, and thus create positively charged ions is known as ionizing radiation. Many types of ionizing radiation exist, but the most well - known include alpha, beta and gamma radiation. These basic types of ionizing radiation are also emitted during the process of radioactive decay, which is described below.



The ionizing radiation produced from alpha, beta, or gamma decay can be especially harmful because it can change the chemical makeup of many things, including the

chemistry of the human body and other living organisms. X-rays and CT scans are good examples of ionizing radiation. If possible, it is good to avoid any unnecessary exposure to ionizing radiation.

Alpha, Beta, and Gamma Radiation. Although there are several forms of ionizing radiation (i.e., when the energy produced is strong enough to knock electrons out of molecules and create ions or free radicals, we will concentrate on just three. These three types of radiation - alpha, beta, and gamma - result from the decay of radioactive isotopes. An alpha particle, beta particle, or gamma ray is emitted during radioactive decay.

1-Alpha radiation is the emission of helium nuclei that have two protons and two neutrons. The nuclei have two positive charges. Atoms with radioactive nuclei that have too many protons and neutrons often emit alpha radiation. They transform into another chemical element with a lighter nucleus. For example, uranium-238 is alpha radioactive and transforms into thorium-238.

$$^{238}_{92}\mathrm{U} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{234}_{90}\mathrm{Th}$$

2-Beta radioactivity

A-Beta Negative radioactivity (β^-)

Beta minus radiation consists of negatively charged electrons. Certain atoms with nuclei that have too high a number of neutrons emit beta minus radiation. One of the neutrons within the nucleus disintegrates into a proton plus an electron. The electron is ejected, so the atom is transformed into a different chemical element. For example, thorium-234 is beta minus radioactive and changes into protactinium-234.

$$^{234}_{90}\mathrm{Th} \rightarrow {}^{0}_{-1}\mathrm{e} + {}^{234}_{91}\mathrm{Pa}$$

B-Beta Poistive radioactivity (β^+)

Beta plus radiation consists of positrons (particles with the same mass as electrons but positively charged). Some atoms with nuclei too heavily loaded with protons emit beta plus radiation. One of the protons within the nucleus disintegrates into a neutron plus a positron. The positron is ejected, so the atom is transformed into a different chemical element. For example, iodine-122 is beta plus radioactive and transforms into tellurium-122. Note that for both types of beta disintegration, the nucleus keeps the same number of nucleons (and therefore the same mass number).

3-Gamma radiation

is an electromagnetic wave, just like visible light or x-rays but with more energy .This type of radiation often follows alpha or beta disintegration. After emission of the alpha or beta particle, the nucleus is still excited because its protons and neutrons are not yet in equilibrium. The excess energy is then rapidly released through the emission of gamma radiation. This is gamma radioactivity. For example, cobalt-60 transforms by beta disintegration into nickel-60, which reaches a stable state by emitting gamma radiation.

$$^{238}_{92}\mathrm{U} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{234}_{90}\mathrm{Th} + 2{}^{0}_{0}\gamma$$