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Ionizing Rays its Sources and Medical Applications

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Abstract:

Ionizing radiation of the medium through which it passes is high-energy radiation that works to ionize the medium through which it passes due to the beam's collision with atoms. The medium leads to the expulsion of some electrons Atoms and the formation of ions in the middle. Of these rays are elementary particles Such as electrons, protons, neutrons, and alpha rays Which is the nucleus of a helium atom. It also exists among electromagnetic rays Types characterized by high energy, above several eV (such as X-rays and gamma rays). It causes ionization of the medium through which it passes, such as gases, liquids, solids, and the bodies of living organisms. Therefore, ionizing radiation is harmful to health if its quantity exceeds certain limits. This makes it necessary not to go overboard with X-ray medical examination.

1-The atom and the nucleus

An element is made up of similar, very small units called atoms. The elements differ depending on their atoms. The atom of the element is composed of a small central body known as the nucleus, around which a number of electrons revolve The mass of the atom is concentrated in the small nucleus -13 , which has a radius of about 10(cm). The electron It is a very small body whose mass at rest is 9.11 x coulomb.The proton proton meaning that it is approximately 1,839 times A small body with a rest mass of 1 gm, than 1.675 times the electron and carries an electrical charge exactly equal to the charge of the electron, but positive. It is a neutral body (i.e. it does not carry an electrical charge) and its rest mass is approximately equal to the mass of the proton. The neutron is often considered to be a union of a proton and an electron, as the free neutron (i.e. outside the nucleus) lives on average (15.2) A minute then it spontaneously disintegrates into a proton and an electron. Although solid matter appears solid, it is in fact considered a vacuum, but the ability of the human eye and modern optical magnification is unable to distinguish this vacuum. To understand this fact, we will assume for the sake of argument that there is a device capable of enlarging the atom by ten million times. Then the diameter of the nucleus, which carries all The mass of the atom is approximately about 1 cm. That is, the size of an average round grape seed, while the closest orbit to the nucleus is the K orbital (which accommodates only two electrons) at a distance of tens of kilometers from the nucleus, and the farthest orbit, which is the seventh orbit, is hundreds or even thousands of kilometers from the nucleus. Thus, the atom is similar in its structure to a group. The solar system, where the sun occupies the center of the system and the nine planets affiliated with it revolve in orbits with a radius of the smallest, which is the orbit of Mercury (approximately 58 million km). With this method of analogy, the atom can be understood. As a real vacuum, Figure (1-1) formally shows a layout of a number of atoms, where the nucleus contains both protons and neutrons and the electrons rotate in external orbits, noting that the aspect ratios shown in the figure do not represent the realistic ratios.

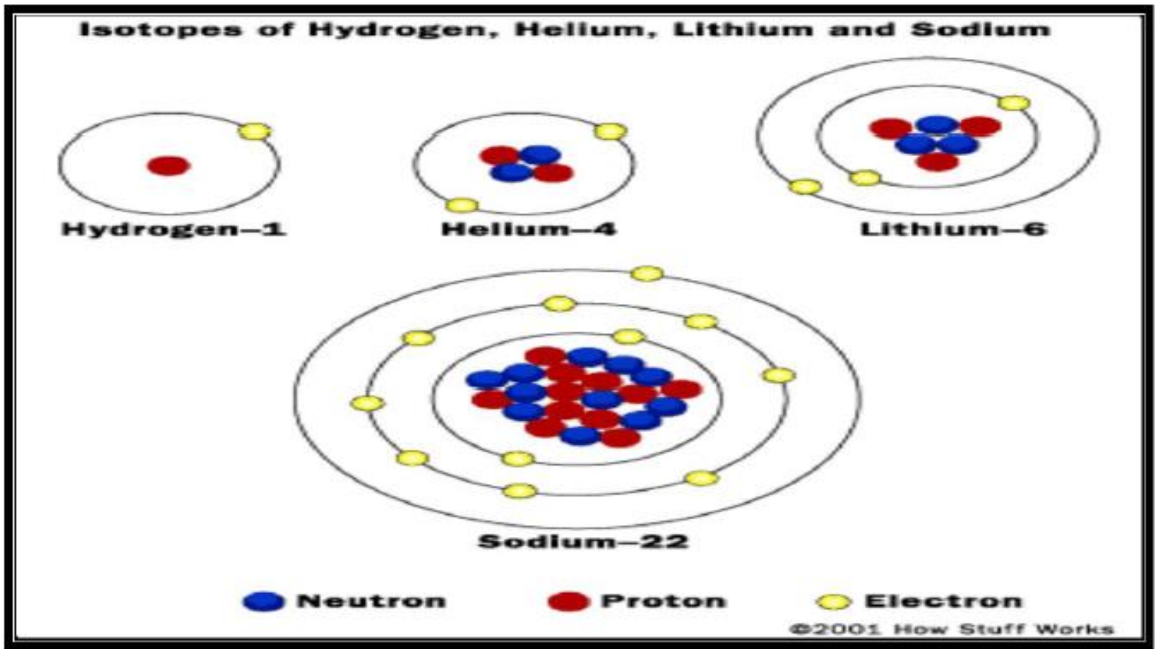

Figure (1) shows the atomic structure of a number of atoms (helium, hydrogen, sodium, lithium)

An electrically neutral atom, where the number of positive protons in the nucleus is equal to the number of negative electrons rotating around it, and the electrons rotate in orbits. Different orbits around the nucleus, and each orbit accommodates a certain number of electrons, so the orbit closest to the nucleus, known as the (k) orbit, accommodates two electrons, while the second, third orbit, known as the (M) orbit, accommodates eight. Known as the orbital (L) for eight and ten electrons, the fourth, known as the orbital (N) for thirty-two electrons, and so on. The mass number is The mass number of the atom is the sum of the numbers of protons and neutrons in the nucleus. This by the letter A. number shows the approximate mass of the atom. It is an integer and is symbolized.The atomic number atomic number: It is the number of protons in a particular atom, and it is symbolized by the symbol (Z). Elemental atoms are usually symbolized by the first letter of their Latin name (or two letters, sometimes the first is large and the mass number in thAend second is small). Then the atomic number is written on the left side, the bottom side on the top side. That is, it is symbolized by For example, the hydrogen atom is represented by the symbol H, since its atomic number = 1. As for the helium atom, it is symbolized by the symbol He, since its atomic number = 2 and its mass number = 4, as the helium nucleus (alpha particle) consists of two protons and two neutrons. Likewise, the uranium atom is symbolized by the symbol U, since its atomic number is 92 Its mass is 238, as the uranium nucleus contains 92 protons and 146 neutrons. Isotopes. The nucleus of a single element contains the same number of protons, but it can contain different numbers of neutrons. This means that the atomic number of a single element does not change, while its mass number changes. In this case, it is said that the element, for example hydrogen, has three isotopes:

one has several isotope 1-Hydrogen H, its nucleus consists of one proton and does not contain neutrons (1 = Z, 1 = A), and one electron revolves around the nucleus.(2)-Deuterium H, its nucleus consists of a proton and a neutron (Z = 1 2 = A) and one electron revolves around the nucleus. (3)Tritom H. Its nucleus consists of a proton and two neutrons (1=Z, 3=A) and one electron revolves around the nucleus. In general, each element has a number of isotopes that may sometimes reach more than fifty isotopes . And per element. Some of the nuclei of these other R isotopes are capable of disintegration. Therefore, these latter nuclei are radioactive and emit radiation in the form of alpha or beta particles or gamma radiation.The element exists in nature in the form of a mixture of some of its isotopes. There it does not exist, but it can be produced industrially using reactors or accelerators in general, in nature and nuclear. It is worth noting that isotopes of a single element are united in all their chemical properties, but are separated in ways, so isotopes cannot be separated from each other by chemical or other methods. They are generated between these. The nucleus of the atom contains a certain number of positively charged protons. The distance between the protons. The repulsive electrostatic forces are inversely proportional to the square. Since the distances between the protons in the nucleus are very small, it is one of the protons. It is expected that the repulsive forces will be so great that the nucleus must disintegrate quickly. Since the nucleus does not disintegrate into its components of protons, this means that there are forces. These attractive forces are what is known as other attractions, stronger than the aforementioned repulsive forces, and nuclear forces, and they affect the protons among themselves and the neutrons among themselves as long as this is the case between them. Both protons and neutrons, some, and the has been proven 10-13 2× particles are at a small distance from each other (less than a cm). It that the nuclear forces between protons and neutrons or protons between each other are from a nuclear perspective (and not from or neutrons between e.ach other are equivalent in charge) Both the proton and the neutron can be considered as a single particle called a nucleon. These nuclear forces lead to the bonding of the components of the nucleus, including protons and neutrons, and their disintegration. As a result of the bonding of these components of the nucleus, the actual mass of the nucleus is less than the sum of the masses of the nucleons that make up it, and this is the difference Between the actual mass of the nucleus and the masses of its components, it is equivalent to the bonding mass of the nucleus. By multiplying this difference in mass (10-) by the square of the speed of light, it is called the mass deficiency. It is possible to easily determine the energy that binds the nucleus, which is: B = ((NMn + ZMp) - M) C2 Where M is the actual mass of the nucleus , (Mp) and (Mn) the masses of the proton and neutron respectively, Z, N the number of protons and neutrons respectively, c the speed of light in a vacuum. When expressing the mass difference (m)ÿin atomic mass units (f. K. y (And converting this difference into energy, it is easy to determine the bonding energy B of the nucleus in megaelectron volts (m). A.F) from the following relationship: B = ÿm ×931 (Mev) The average bonding energy of one nucleon, F, is the bonding energy of nucleus B divided by the number of nucleons. The cohesion of the nucleus increases whenever the bonding energy of the nucleon is large, and its cohesion decreases whenever this value is small. The most closely connected nuclei are the nuclei with a medium atomic number, and the least connected are the nuclei with a very small or very large atomic number. Radioactivity Many isotopes, whether natural or artificial (i.e. prepared using the activity of accelerators or nuclear reactors), are characterized by a property known as radioactivity. Radioactivity is when the isotope nucleus spontaneously disintegrates (decays) into a smaller nucleus (or a nucleus with a lower energy value) with the release of the maternal nucleus It is the original radioactive nucleus that disintegrates, such as uranium-237 or polonium-218.The nascent nucleus It is the nucleus resulting from the disintegration, such as the nuclei of thorium-234 and lead-213, and for alpha decay to occur for a particular isotope, the mass of the nucleus of this parent isotope (MP) must be greater than the sum of the alpha (Mÿ) , meaning the condition must be met by the masses of both the daughter (Md) and the body. Mp -- (Md + Mÿ) > 0 Therefore, it is noted that this condition is met for many isotopes heavier than lead. It is noted that most of the isotopes heavier than lead are radioactive in relation to emitting alpha particles. Energy of alpha particles:The energy of alpha particles emitted by the same isotope is equal and approximately equal in magnitude { Mp -- (Md + Mÿ) } C2 Therefore, alpha particles are considered an isotope fingerprint. By measuring the energy of alpha particles, its radioactive isotope can be determined.Alpha particles: It is the nucleus of the helium-4 atom, consisting of two protons and two neutrons. It is therefore a positively charged particle, with a charge twice that of a proton. Therefore, its path can be controlled using electric or magnetic fields, and it can also be accelerated (i.e. accelerated) using nuclear accelerators to high energy values. These heavy And charged nuclear particles belong to beta decay. In order for the nucleus of a particular isotope to be stable, the ratio between the number of neutrons and the number of protons in This nucleus is a certain ratio (Z/N). This ratio ranges between 1 for light isotopes and increases until it reaches 1.6 for heavy isotopes. For example, it is noted that the nucleus of the carbon isotope is 12. 12 (6) C is stable, as the ratio of neutrons to protons is 1=6/6=Z/N. As for the nucleus of the carbon 14 isotope, it is an unstable nucleus. This nucleus is one of the light nuclei. Note that the nucleus of the cesium isotope becomes 1.33=6. /8=Z/N as well 133 is stable because the ratio becomes 1.42 = 55/78, while the cesium 137 nucleus is unstable because the ratio becomes 1.49 = 55/82.

Electronic dissociation (negative beta dissociation): If the ratio of neutrons to protons exceeds the value specified from the stability curve for the isotope with a certain mass number, this means that the nucleus is trying to reach a state of stability by transforming a neutron (or more) inside the nucleus known as the antineutrino v . That is, the process of electron disintegration. It is the transformation of a neutron inside the nucleus into a proton and the release of an electron (beta particle) and an antineutrino. This disintegration is represented by the following equation (10). This type of disintegration occurs in hundreds of unstable (radioactive) isotopes, where the nucleus of a new element is formed as a result of increasing the number of protons in the nascent nucleus by one proton. For example, when the nucleus of carbon 14 disintegrates, the nucleus of a new element is formed, which is nitrogen 14, as a result of the transformation of one of the neutrons in the nucleus into A proton, and both the beta particle and the antineutrino are released externally from the nucleus. This disintegration is represented by the following equation.

146Cÿ 147N + e- + v-

Cobalt-60 is also considered a radioactive isotope of beta particles, and it transforms into nickel-60 when the proportion of neutrons and protons is low. The nucleus can transform in another way. Where the mother nucleus captures one of the atomic electrons from the orbits close to it, then one of the protons of the nucleus, and this proton turns into a neutron. This electron combines with without any of the beta particles being released outside the nucleus, but the neutrino is released. The electronic household is represented by the following equation:{^{60}27Coÿ ^{60}28Ni + e- + v }It should be noted that nuclei subject to positronic dissociation can experience electron capture. Beta particles: Beta particles are divided into two types: negative beta particles (electrons) and positive beta particles (positrons), but they have a positive charge. Since these particles are charged, their path can be controlled using electric or magnetic fields, and they can be accelerated to high energies. Beta particles belong to the class of p, articles Lightly charged.Neutrino: It does not carry any charge and is a particle with a rest mass approximately equal to zero Beta particle energy: The basic condition for any type of beta decay to occur is that the mass of the parent nucleus be greater than the total mass of the parent nucleus, and the sum of the resulting masses is the energy that both the beta particle and the neutrino (or antineutrino) are released, and this energy is distributed between each Of a beta particle and a neutrino (or antineutrino) in a random manner. To begin with, the energy of beta particles emitted by the same isotope takes different values From zero, but it does not exceed the value of the total energy resulting from disintegration, so measuring the energy of beta particles does not indicate the identity of the source that emits it. Gamma radiation: In most cases, the daughter nuclei resulting from alpha decay or beta decay are in an excited state. This means that the energy of the nucleus is higher than its energy in the stable (ground) state. The nucleus cannot live in this excited state for long, but it soon moves to The state is less exciting or to the (ground) state, It gets rid of excess energy by emitting electromagnetic radiation known as stable nuclei. Stable nuclei can also be excited in various ways, such as nuclear reactions and gamma radiation. For example, these excited nuclei return to their ground state after their emission Excess energy in the form of gamma radiation. Gamma rays are photons (electromagnetic waves) like light photons, but their frequency is very high (that is, they have very high energy) compared to light radiation, which does not carry any charge. Since these radiations are not physical and electrical bodies, their path cannot be controlled or accelerated using fields. Electric or magnetic. There are many sources of gamma radiation, for example: Cobalt 60 and cesium 137 are sources of gamma radiation, as these isotopes disintegrate first through negative beta dissociation, thus forming the isotopes of nickel 60 and barium 137, respectively, in excited states, which results in the release of gamma radiation when these latter isotopes transform from the excited state to the ground state. The nickel-60 nucleus moves from the excited state to the less excited state with the lowest excitation energy, which is 1.332 MeV. As a result, gamma radiation is emitted, carrying the energy difference between the two states (1.332 = 0 - 1.332) Then the nickel nucleus moves from this last excited state to the stable (ground) state, and another gamma photon is released carrying the energy difference between ÿ (as a result of the transition of the two states (1.332). In general, the energyof the released photon is (E (to the less excited state with energy (Ef)i) the nucleus from the excited state with energy (E). Eÿ = Ei – Ef There are radioactive isotopes that emit gamma photons directly, without alpha or beta dissociation occurring, and one of these isotopes is the technetium 99 isotope, where the isotope results from the disintegration of the molybdenum 99 isotope through beta dissociation, and technetium 99 is formed in the excited state, to. Therefore, it is considered semi-stable, as the half-life of this state is 6 hours. Technetium-99 is a radioactive isotope of gamma photons. This isotope has multiple muses for narrowing arteries, clots, and blockagesIt is widely used in diagnosing a number of diseases and others, by injecting it into the patient and tracking the flow of the isotope in the blood vessels and various organs of the patient. **Gamma photons:** It should be noted that each radioactive isotope emits photons with a single energy or with specific values. As shown in the previous two examples, cesium 137 emits gamma photons witha single energy. AF, while cobalt 6 emits gamma photons with M One of 0.662 two energies, with two enetrhgeypmheotaosnusremenFts (-1.332 and 1.173) m. Therefore, the energies of emitted from a specific isotope facilitate the direct identification of this isotope. isotope is a fingerprint of Therefore, it is said that gamma radiation emanating from an that isotope. **Neutrons and their sources:** Neutrons, as we know, are neutral particles of charge. Therefore, it is not affected by fields, as there are no electrical or magnetic radioactive isotopes in nature. In general, however, it is possible to produce an artificial isotope used as a source of neutrons, which is neutrons, and the isotope californium 252, of which one microgram emits about 2 million neutrons per second. The energy of the neutrons released from them ranges between (1.1 - 7) M A. There are several other sources of neutrons. The most important of which are: Source Be – Ra The source of radium is beryllium: It is a mixture of both radium 226 and beryllium 9. Radium 226 is active with the beryllium 9 nucleus, creating radioactive alpha and emitting alpha particles. When a nuclear reaction particle collides, it results in the formation of a carbon nucleus and one neutron is released. Several grams of beryllium can be obtained, and when mixing one gram of radium with 7 a neutron source of varying energies, it gives about (10) neutrons per second. The . neutrons released from it range from about (1-10) m.

However, this type of neutron source is no longer in circulation because radium 226 and polonium 214 emit large quantities of gamma radiation through its nascent nuclides, such as lead 214. This source has now been replaced by sources of americium 241 and beryllium 9. B- The source of americium is beryllium -9Be-241-Am the number This source is prepared by grinding a specific amount of the isotope americium 241 with a limited number of grams of crushed beryllium 9.

Americium emits alpha particles that react from beryllium nuclei and emit neutrons with the same equation as before.

Americium 241 is distinguished over radium 226 in that it emits only a small amount of...This source gives the same gamma radiation with a small energy of 59.5 kF, the neutron yield of the radium-beryllium source, and a range of neutron energies that covers the F. M same range from 1 to about 10. The source of photoneutrons: In this type of neutron source, a gamma radiation source is used instead of an alpha particle source. When a gamma photon falls on the beryllium nucleus, this results in the formation of two alpha particles and the release of one neutron. In order for the reaction to occur, the energy of the gamma photon must not be less than 1.67 MeV. Therefore, a sodium 24 source can be used, which emits gamma radiation with an energy of 2.67 MeV. . By placing sodium 24 with beryllium 9, it is possible to obtain a neutron source that is distinguished from previous sources in that the neutron energy takes a single value instead of the continuous energy spectrum from previous sources.Charged particle accelerators: Neutrons with a specific energy can be obtained by bombarding some light nuclei with charged objects such as protons or deuterons, accelerating them to a specific energy.

21H +31 H ÿÿ ÿÿHe + 10n + 17.6 MeV

Among these interactions are:

12H+ 12H ÿÿ ÿÿHe +10 n + 3.29 MeV

The use of which has spread, especially in various industrial applications, where deuterons are accelerated to an energy of 150 kiloelectron volts and are bombarded with a target made of tritium (the third isotope of hydrogen). Neutrons are released, and it is possible to obtain 11 (a neutron per second with a constant energy, which is a number of neutrons up to To about 10 A F of this generator m $^{14.1}$ reactors Nuclear E - Nuclear reactors Nuclear reactors are considered the largest sources of neutrons ever, as they can produce 19 13 (up to) 10 neutrons. The neutron flux density inside the reactor ranges between (10 Then Seconds.cm2). Neutrons inside the reactors are produced by the fission of uranium nuclei. When a uranium nucleus splits, two smaller nuclei are formed, and a limited number of eutrons are released as a result of this fission. When these released neutrons collide with other uranium nuclei, they can lead to their fission and the release of another number of neutrons. Thus, what is known as a chain reaction occurs , where one nucleus begins to fission, leading to the release of a certain number of neutrons, let this number be two, and these two neutrons lead to the fission of two new nuclei, so the number of neutrons becomes four, which in turn leads to the fission of four nuclei. New, the number increases Neutrons range to eight. Thus, until the number of neutrons reaches a certain limit, it must not exceed it, otherwise the reactor will explode.

2-Applied uses of radiation and radioisotopes

Application of radiation and radioactive isotopes With the development of nuclear physics, the fields of applied uses of radiation beams expanded. And radioactive isotopes. These uses included various fields such as agriculture and industry. Medicine and mining. The areas of use of radiation and radioactive isotopes have also expanded to include several other aspects, such as crime detection, studying the environment, determining the ages of antiquities, and others. This chapter presents some of these uses, especially in the field of agriculture and industry and medicine.

2-2 Uses of radiation and radioactive isotopes in medicine

In recent years, there has been a great development in the use of radiation and radioactive sources in medicine, whether in the field of diagnosis or treatment. Various types are used for these purposes Gamma rays, neutrons, and heavy ions. Radioactive isotopes are also used, such as Cobalt 60, radioactive iodine, tekenium, and others. Also, the use of nuclear methods became widespread Such as neutron activation analysis and others in performing many accurate medical tests. For the purpose of proper diagnosis of the disease. To clarify the scope of the use of radiation In medical aspects, some of these areas can be reviewed as In recent years, many vaccines have been produced to protect animals from many deadly diseases. The effect of radiation on vaccines is reduced The time of the parasitic stage of the specific type of vaccine, without reducing the ability of this vaccine to generate immunity in sick animals. Also, a method has recently been developed that shows promising results Taiba Dhanna produces a vaccine against malaria. This method consists of irradiating the mosquitoes carrying the disease with a certain dose of radiation, and then allowing these irradiated mosquitoes to Some volunteers transmit the microbe to them, but it is in a weak state and unable to reproduce, so immunity is generated in the volunteer. However, it should be noted that this method does not It still needs more research to resolve it. Radiation and radioisotopes are used to treat some diseases. For example, radioactive iodine ablation is used to treat some cancerous tumors in the glands that cannot be removed. Or that grows repeatedly after surgery. The treatment process in this case is to drink An amount of water containing a certain dose of radioactive iodine. Radioactive iodine or radioactive neutrons, and heavy ions are phosphorus are also used to treat leukemia. Likewise, gamma radiation, used to treat some cancerous diseases, or to stop their growth. These radiations are also used in the post- cancer surgery stage. Products Use irradiation, prices, and basis for sterilizing many instruments Medical equipment that is difficult to sterilize with steam or heat, or that may be affected as a result of its sterilization by gases, high temperatures, or chemicals. For this purpose, gamma radiation emanating from a cobalt-60 source or from linear accelerators is used. Sterilization using radiation has several advantages compared to sterilization using traditional methods. Neutron activation analysis is one of the most accurate methods for determining environmental pollution with many substances. Toxic substances such as mercury and others, where the presence of such substances can be detected, no matter how small their percentage. Likewise, archaeologists use nuclear methods to determine the ages of discovered antiquities and for the general dating process, by measuring the radioactivity emitted by carbon-14 that is formed during the life of the object. Nuclear methods are also used to detect crimes. For example For example, neutron activation analysis is used to match paint residue left on With the painting of the car that may have been involved in the accident and whose driver lost the car as a result of a hit-and- run accident. There are many other uses for beams, such as searching for sources Groundwater, determining its flow, the direction of its flow, and the speed of this flow, as well as in There are many other areas that this booklet does not have room to list.

2-Ionizing Of Biological Effects-1-3 Biological Effects Of Harmful Radiation Radiation

Energy is transferred from ionizing radiation to the body of a living organism and leads to the ionization of atoms. Cells. Heavy charged particles and beta particles ionize cell atoms directly when Passing through it. The energy of gamma rays or X-rays is transferred to the electrons in the atoms of the cell, and these electrons perform ionization. As for the energy of neutrons The protons are then transferred to the hydrogen atoms through elastic collision, and then these protons ionize the cell atoms. Also, it is possible to absorb neutrons (especially thermal ones), which then leads to the formation of radioactive isotopes inside the body, and the radiations released from these isotopes lead to the ionization of cell atoms. Whether the ionizing radiations are Issuing from a source located outside the body or from contamination of the body from within with radioactive materials, this will not lead to the following biological effects in the body, which may appear later and later during the period. Clinical Symptoms sis Symptoms in the form of The time required for its appearance depends on the amount of absorbed radiation and the rate of its absorption. The biological effects of ionizing radiation on living organisms are divided into two types: A - Intrinsic effects: It has previously been shown that alpha particles emitted from all natural sources are absorbed in a thin M layer of air (the thickness does not exceed 4 cm). By studying the properties of beta particles, it becomes clear that to make an adequate shield for the sources of these particles, light solid materials must be used, that is, those characterized by small atomic numbers Z, since the use of materials with large atomic numbers produces km Large amounts of highly penetrating and dangerous X-ray photons. The energy ratio of the transformed f particles is as follows X-rays a of these particles (in the unit Emax is determined in terms of both the maximum energy the atomic number Z of the reactant is given by the following relationship:f = 0.035 Z Emax % Although beta particles are characterized by a continuous energy spectrum, the range of these particles the mass in a substance can be calculated, easily, in terms of the maximum energy of this spectrum Particles Emax is in mV. The mass range and R (in g/cm2) for beta particles are determined from the source of these particles with a maximum energy of Emax , in terms of both the linear range R (i.e. the sufficient linear thickness off this... Particles (cm) and the density of the substance p. in (g/cm) with the following relationship: This leads to the two exponential relationships not being valid for attenuation or decreasing The average effective dose, to calculate the thickness of the armor, as they will give thicknesses less than Necessary to prevent intended sources. For this reason, it must be taken The accumulation factor is taken into account when calculating shield thicknesses for gamma rays and X-rays. This is done by entering this factor into the attenuation or absorption equation. Therefore, the formula that must be followed to calculate the correct thickness of the shield is the following relationship: Activity Radiological imaging of the radioactive source. Increasing the radioactive activity of the source requires increasing its thickness. Shield to reduce the dose outside it to the required amount. With Neutrons with energies of several megaelectron volts need about 18 collisions with protons (hydrogen nuclei) until they completely lose their energy and are transformed into neutrons. Thermal power 0.025 electron volt. As for light materials rich in hydrogen, Such as paraffin wax, plastic, water, etc., the thickness required to temper the Fast neutrons and converting them into thermal neutrons ranges between about 20-25. Poison. Therefore, such thicknesses are sufficient to absorb the energy of fast neutrons I hope not. One of the most important principles of shielding neutron sources is to dampen the fast neutrons emitted from these sources or from thermal and ventricular neutron generators. These thermal and ventricular neutrons are then absorbed by a material with a high capacitance coefficient. There is a large (absorption) of these neutrons, and then a layer of high-quality material is placed Atomic number (heavy), such as lead, absorption of instantaneous gamma photons emitted as a result of neutron capture of thermal or slow neutrons. There are some elements, such as edmium, boron, and others, which are characterized by a very large cross-section to absorb thermal or ventricular neutrons. Therefore, the source or neutron generator is not yet surrounded by a layer of sufficient thickness (-20 25 cm) of a substance with a low atomic number, such as wax, water, etc., this is surrounded by The moderator consists of a thin layer of cadmium metal, about 1 mm thick, which absorbs the majority of the thermal neutrons. And the absorption of gamma photons emitted by captivity Neutron in cadmium, this cadmium is surrounded by another layer of high-number material. Atomic like lead. Thus, the ideal shield for fast neutrons consists of three successive layers of different materials, with different thicknesses: about (20-25 cm) of wax, plastic, or mm of cadmium, which is then surrounded by a layer of water, surrounded by a slice about 1 mm thick of lead or any other material with a high atomic number. Likewise, a shield for sources or generators of fast neutrons can be made from a single layer of a material with a low atomic number, no Wax, plastic or water. This is due to the ability of the absorbed hydrogen nuclei Thermal neutrons, and the formation of the unsaturated isotope of deuterium (hydrogen isotope). The only requirement is to make a suitable shield from a light material without the use of cadmium. What about the bullets? The thickness of the light material must be sufficient to absorb the vast majority of cooled (i.e. thermal) neutrons. Examples of these neutron shields include howitzers. Hemispherical neutron, which is made of wax, and a neutron source or generator is placed in its center. For such a shield, the wax or water poison must be made of wax or water, depending on the neutron yield of the source. About -40 120 In the event of accidents related to neutron sources, a person can use any Light natural materials present and available in the environment, to create a suitable shield for neutron sources, including bags of water or sand, or even pieces of wood.

Conclusion:

These are very high-energy radiations that, during their passage through the physical environment, cause the expulsion of electrons from the atoms of the substance and turn them into ions. For this reason, they are very harmful to human health if they exceed their limit. This is why it is preferable not to neglect medical examinations through X-rays. Examples of ionizing rays are X-rays and gamma rays. Gamma rays are considered more dangerous than Other examples of Ionizing radiation: charged particles such as alpha particles (helium atom nuclei) and beta particles. Therefore, workers in this field are given medical care and very high protection from radiation to maintain their health. The permeability of these types differs from each other, as electromagnetic waves have a very high ability to penetrate in comparison. With the ability to penetrate the radiation of alpha and beta particles, as electromagnetic waves consist of photons of very high energy, while alpha and beta particles consist of electrons, beta can be stopped by a piece of paper whose energy is lower compared to the energy of photons, as alpha is thick paper or a thin strip of aluminum, while gamma rays have It has a high ability to penetrate objects, and it requires several centimeters of lead or several meters of water to stop it to reduce its danger. Through this information about radiation, its types, and the difference in its danger from one type to another, it is possible to give a simplified idea of how to prevent its danger. The influencing factors can be divided into three factors that differ in importance: exposure time, distance, Protective shields) Radiation is used in many fields, the most important of which is the medical field, where it is used in treating tumors, but with high energy, as it works to break up cancer cells and works to stop their growth. Radiation doses have limits, meaning that each type of cancer has an appropriate dose, so that it does not exceed its limits and negatively affect the body. Patient health. It is also used through low-level

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