Properties of Alpha, Beta & Gamma rays.

GROUP-2

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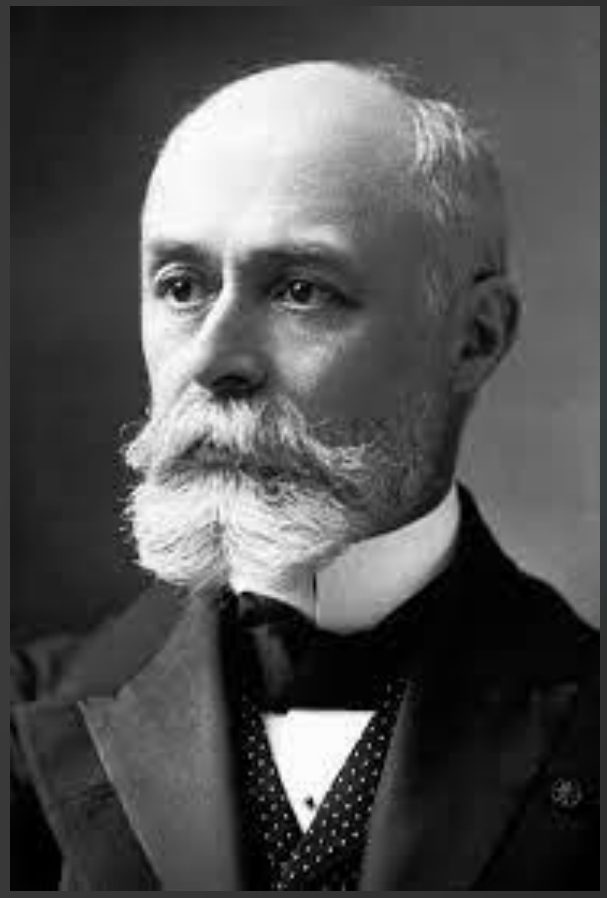
Contents

INTRODUCTION

- In the year 1896, Henry Becquerel accidently discovered that uranium salts spontaneously emit a penetrating radiation that can be registered on a photographic plate. Further studies made it clear that this radiation was something new and not X-ray radiation: he had discovered a new phenomenon, radioactivity.
- Radioactivity is known as radioactive decay or nuclear decay.

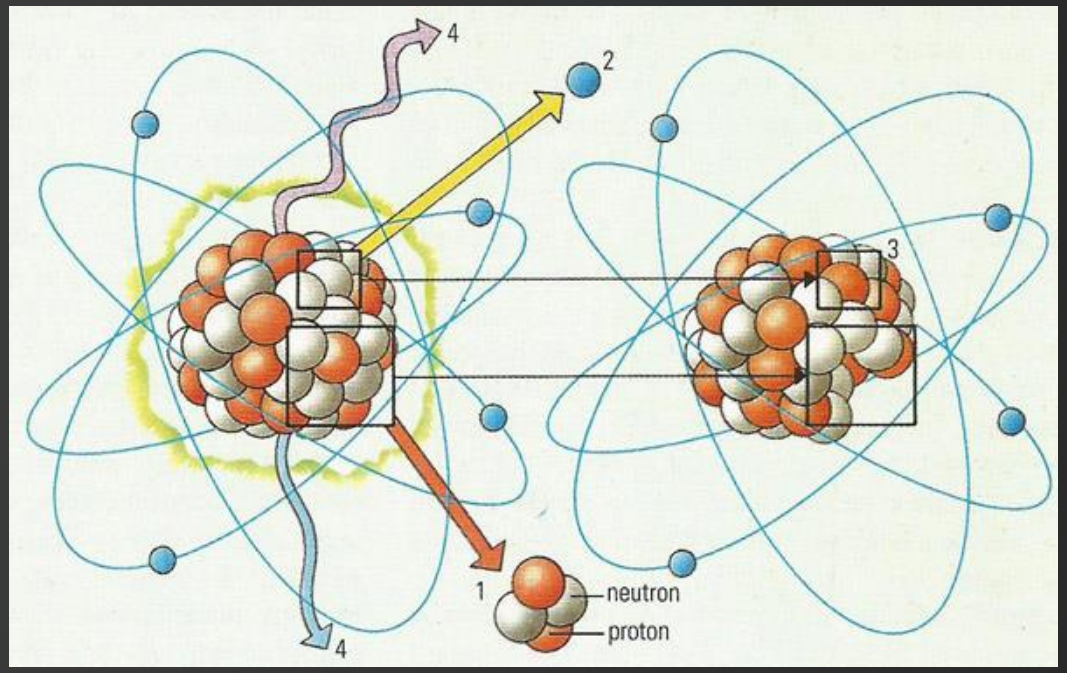
Decay- something that destroys gradually.



1852-1908

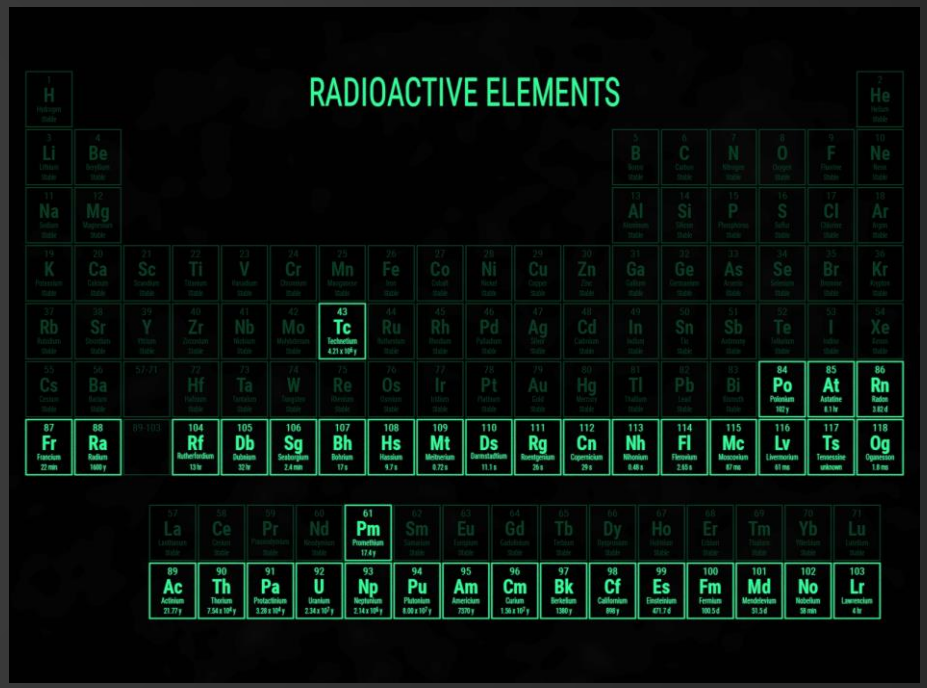
INTRODUCTION

- *Radioactivity is the process of spontaneous emission of radiations from radioactive substance. The substance which emit the radiations are known as radioactive substances.*
- Radioactivity refers to the particles which are emitted from nuclei due to nuclear instability. In radioactive process, particles or electromagnetic radiations are emitted from the nucleus.
- Thus radioactivity is the process by which unstable atomic nucleus losses energy by emitting radiations, such as an alpha (α), beta (β) and gamma (γ) radiations. Radioactivity is the random process and it is not possible to predict when certain atom will decay.



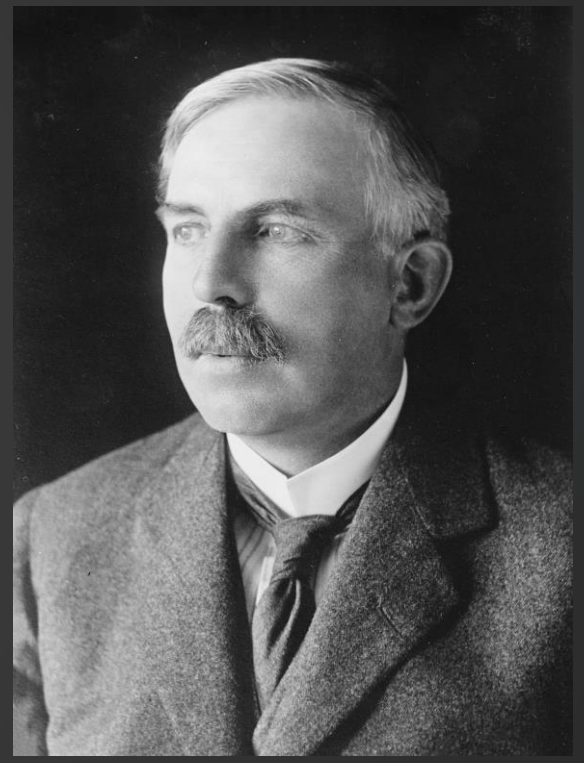
INTRODUCTION

- Radioactivity is also defined as spontaneous emission of particles or radiations due to decay of a certain nuclides by adjustment or their internal structure.
- Radioactivity can be natural or artificial. In natural radioactivity the substance already posses radioactivity in natural state. In artificial radioactivity, the radioactivity is induced by irradiation.
- Radioactive substances are those which emit the radiations. Examples of radioactivity substances are: Uranium, radium, polonium, radon, thorium, ionium, actinium, etc. Thus all naturally occurring elements whose atomic numbers are greater than 82 are radioactive and radioactivity is the property of an atom of the element concerned in a compound because these radiations are not affected by physical and chemical changes.



NUCLEAR RADIATIONS

- In physics, radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium. Rutherford discovered α-radiations which are less penetrating and β-radiations which are more penetrating and later Villard discovered, γ-radiations which are still more penetrating.



1791-1867

NUCLEAR RADIATIONS

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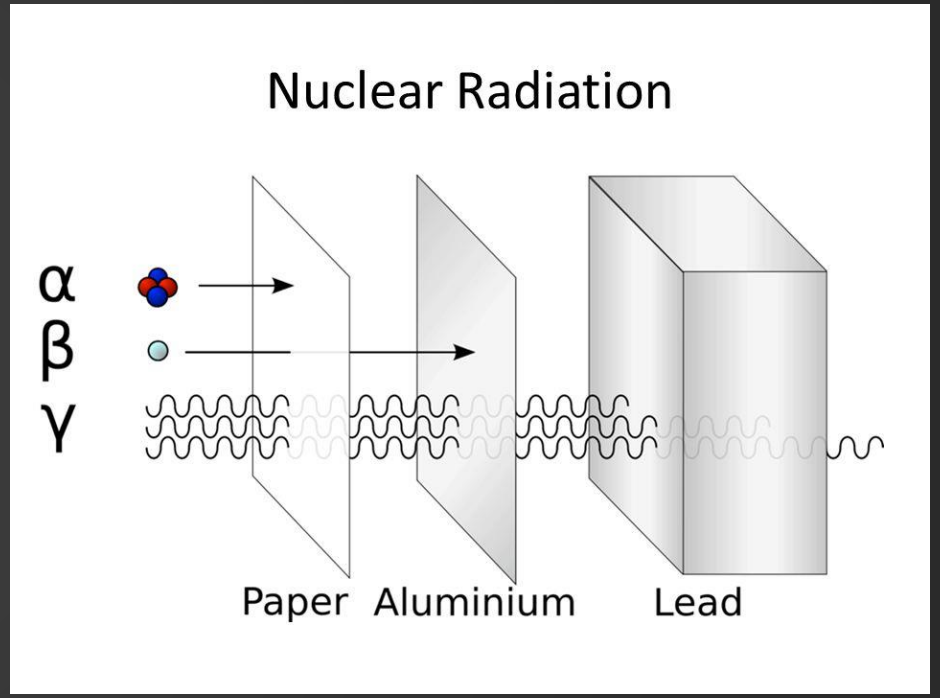
- When a radioactive substance say radium is placed in a cavity made of lead. Lead is preferred because it absorbs three types of radiations. Now this radium is a lead placed in 1) electric field and 2) magnetic radiations as shown in *fig. 1*



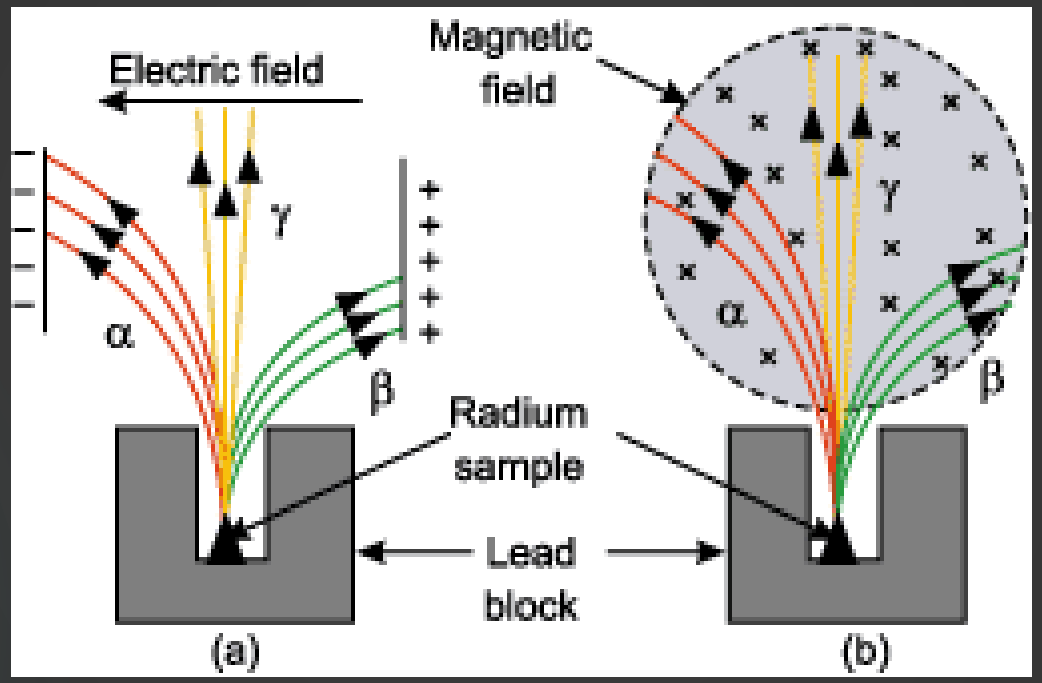

Electric field
Magnetic field
γ
α
β
Radium sample
Lead block
(a)
(b)

Fig. 1

NUCLEAR RADIATIONS

- When these radiations are placed in electric field as shown in *fig.1*, a) some radiations which get deflected towards negative plate of electric field are positively charged particles called as α particles, b) the radiations which are not deflected towards positive plate are negatively charged β particles and the radiations which are not deflected are γ rays (*particles*).
- α-particles are doubly ionized helium atoms, i.e. helium nucleus, β-particles are electrons and γ-rays are photons having higher frequency (energy), i.e. higher penetration power than X-rays.

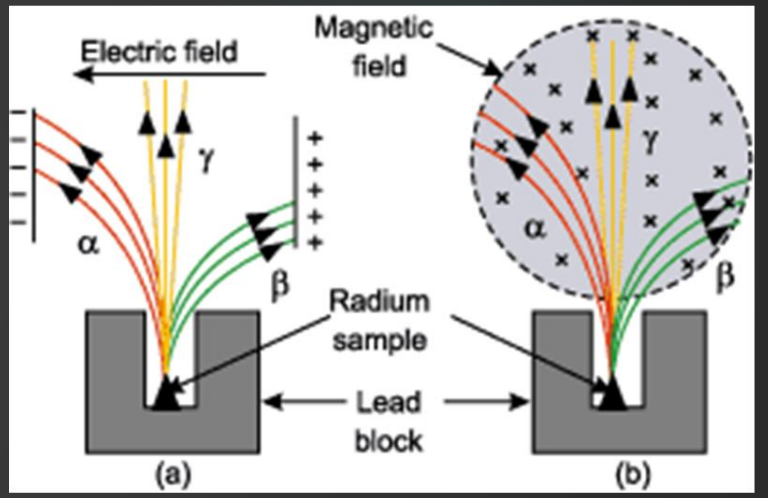


Fig. 1

CHARACTERISTICS (*Properties*) of RADIOACTIVE ELEMENTS

- General (common) properties of radioactive radiations are as follows:

A. The radiations α, β and γ are highly penetrating, affect photographic plate, ionize gases, generate heat, produce scintillations on fluorescent screen, produce chemical changes, etc.

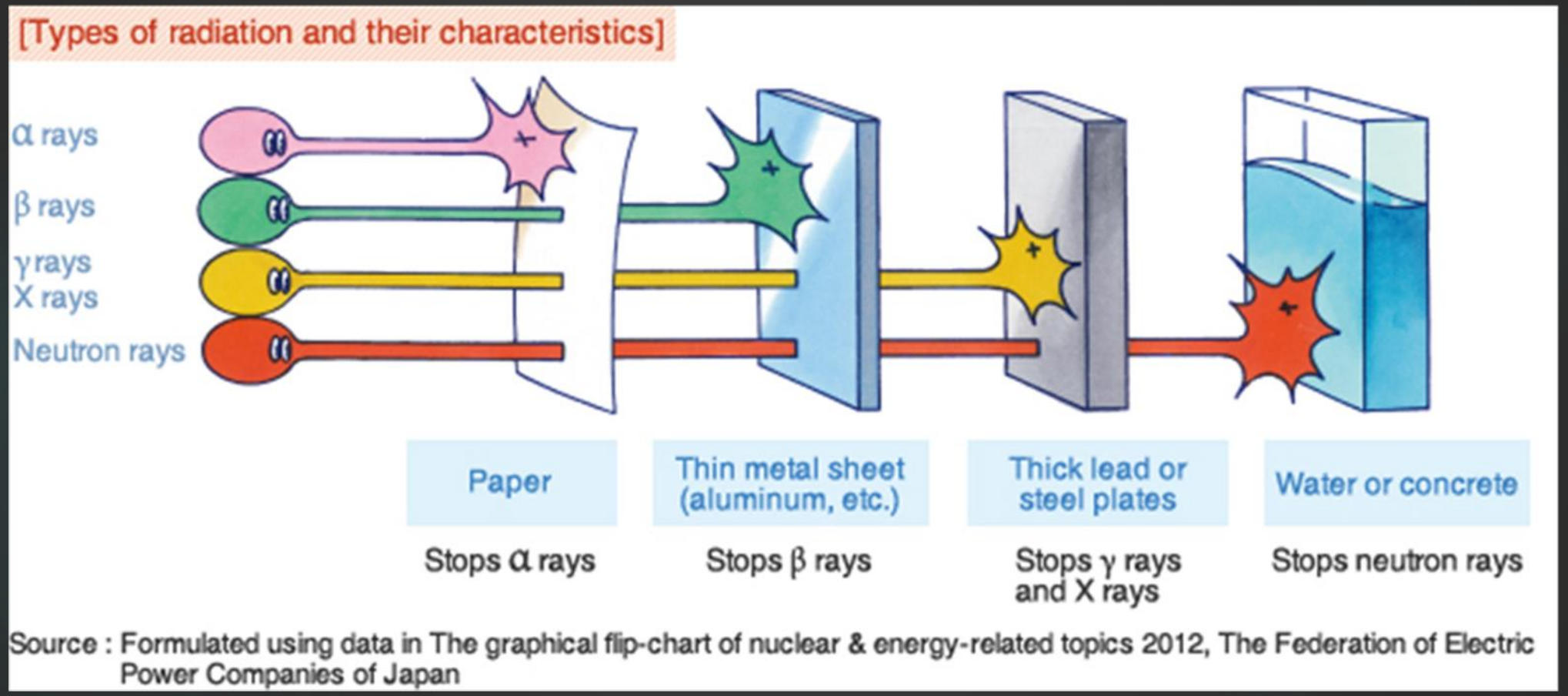
B. When radioactive element radiates radiations then it gets converted into new element which is also a radioactive element. This change is irreversible.

C. The emission of radiations is spontaneous.

D. This emission of radiation from radioactive element is a *prolonged process* i.e. takes longer time.

not instantaneous

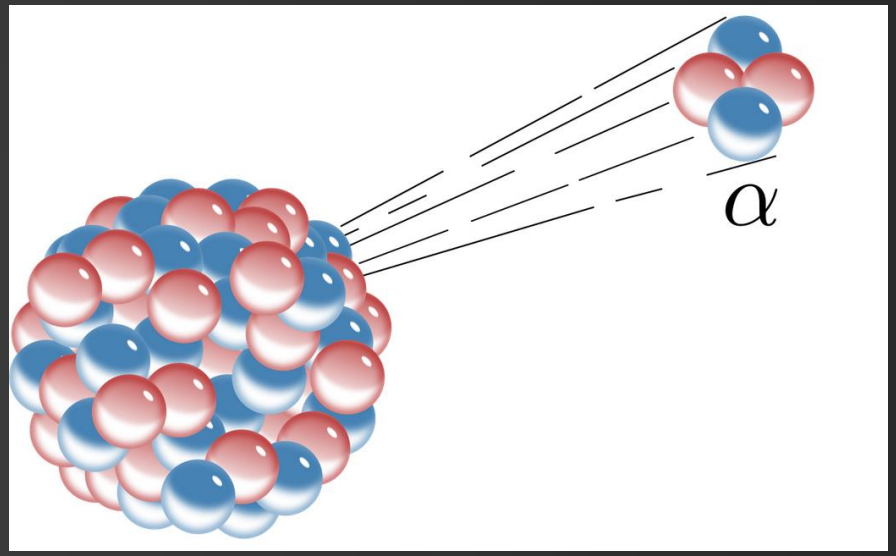
CHARACTERISTICS (*Properties*) of RADIOACTIVE ELEMENTS



PROPERTIES OF PARTICLES

- PROPERTIES OF ALPHA (α) RAYS:

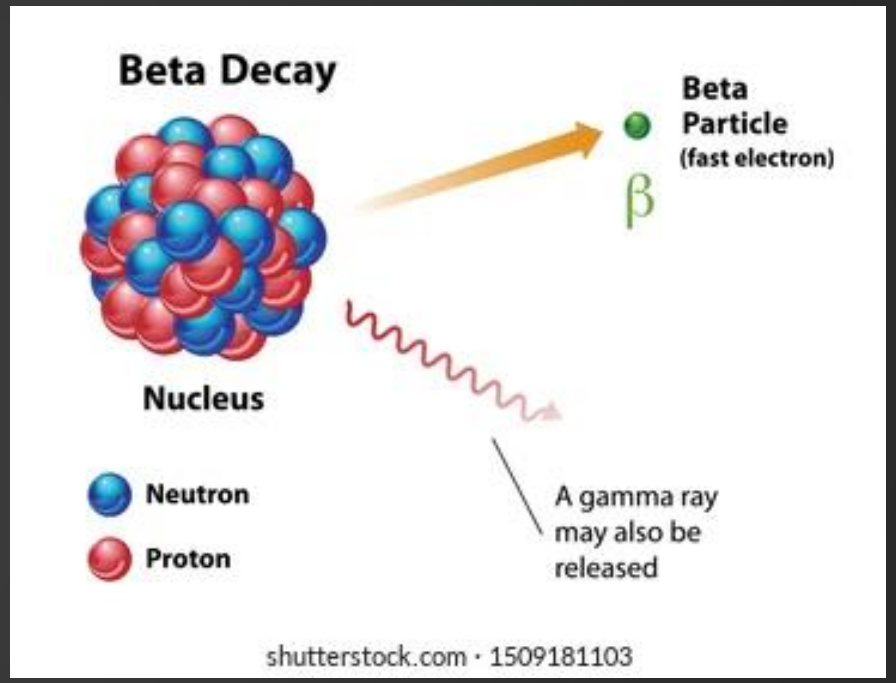
1. Alpha rays are the positively charged particles.
2. Alpha-particle is highly active and energetic helium atom that contains two neutrons and protons.
3. These particles have the minimum penetration power and highest ionization power. It is about 1/100 times of β-particles and 1/10,000 times that of γ-particles.
4. They produce ionization gases and heating effect which can burn a human body.
5. The range of α-particles in air varies from 2.70 cm in the case of uranium and 8.62 cm in the case of thorium.
6. α-particles get scattered when they pass through sheets of aluminium, mica and gold foil, etc.



PROPERTIES OF PARTICLES

- PROPERTIES OF BETA (β) RAYS:

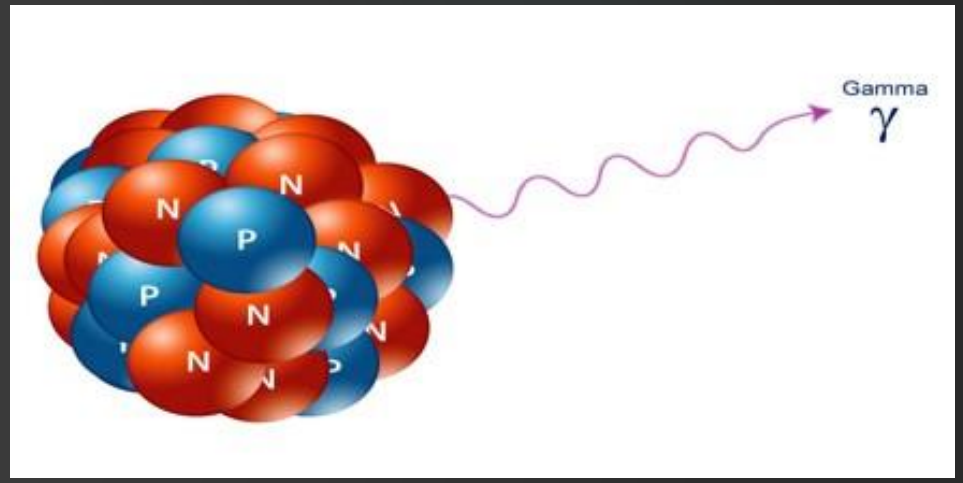
1. Beta particles are extremely energetic electrons that are liberated from the inner nucleus.
2. They bear negligible mass and carry the negative charge.
3. A neutron in the nucleus splits into a proton and an electron on the emission of a beta particle.
4. Hence, it is the electron that is emitted by the nucleus at a rapid pace.
5. Beta particles have a higher penetration power when compared to alpha particles and can travel through the skin with ease.
6. Beta particles can be dangerous and any contact with the body must be avoided, though their ionization power is low i.e. 1/100 times of those of α-particles.



PROPERTIES OF PARTICLES

- PROPERTIES OF GAMMA (γ) RAYS:

1. *The waves arising from the high-frequency end of the electromagnetic spectrum that has no mass are known as gamma rays*.
2. They hold the highest power of penetration.
3. They are the most penetrating but least ionizing and very difficult to resist them from entering the body.
4. The Gamma rays carry a large amount of energy and can also travel via thick concrete and thin lead.
5. They produce small heating effect.
6. They are diffracted by crystals.
7. When γ-rays are incident on matter then β-rays are ejected from matter. γ-rays show the phenomenon of *pair production*.



The below table describes the characteristics of alpha, beta and gamma radiations and compares the masses and charges of the three rays.

Property	α ray	β ray	γ ray
Nature	Positive charged particles, 2He 4 nucleus	Negatively charged particles (electrons).	Uncharged ? ~0.01a, electromagnetic radiation
Charge	+2e	−e	0
Mass	6.6466×10^{-27} kg	9.109×10^{-31} kg	0
Range	~10 cm in air, can be stopped by 1mm of Aluminium	Upto a few m in air, can be stopped by a thin layer of Aluminium	Several m in air, can be stopped by a thick layer of Lead
Natural Sources	By natural radioisotopes e.g.$_{92}U^{236}$	By radioisotopes e.g.$_{29}Co^{68}$	Excited nuclei formed as a result of Gamma decay

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THANK YOU.

MENTOR- MRS. DEEPA GUPTE