

Properties of Alpha, Beta & Gamma rays.

GROUP-2

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INTRODUCTION

- In the year 1896, **Henry Becquerel** accidentally 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.

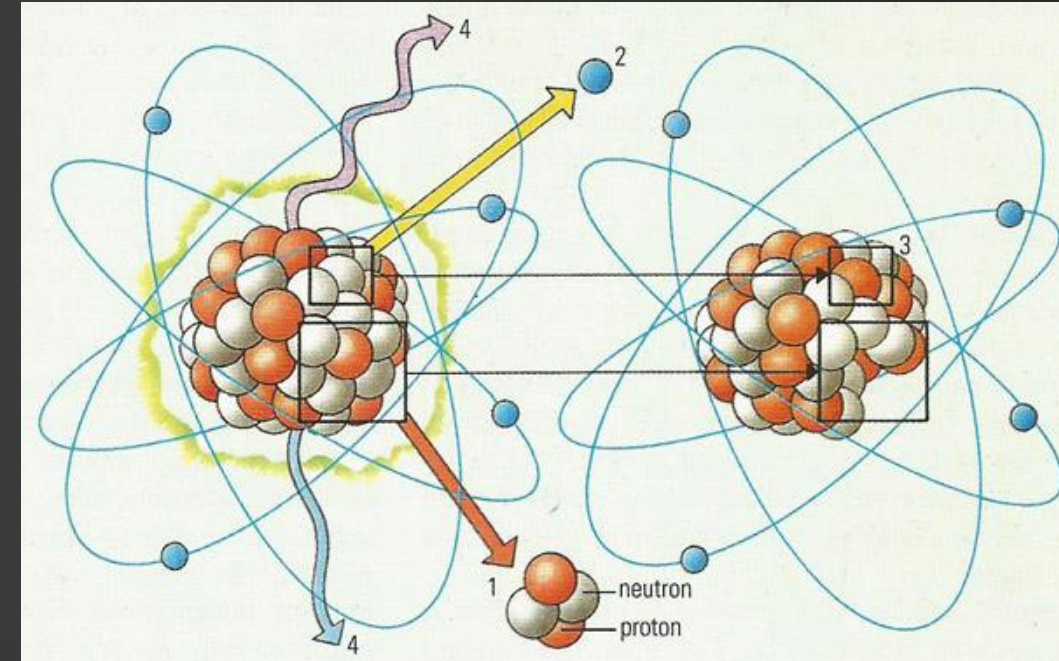
Decay- something that destroys gradually.



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.

RADIOACTIVE ELEMENTS																	
1 H Hydrogen 1.008	2 He Helium 4.003															3 Li Lithium 6.941	4 Be Beryllium 9.012
5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180											11 Na Sodium 22.990	12 Mg Magnesium 24.305
13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38
31 Ga Gallium 69.723	32 Ge Germanium 72.63	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.8	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.36	47 Ag Silver 107.87	48 Cd Cadmium 112.41
49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6	53 I Iodine 126.91	54 Xe Xenon 131.3	55 Cs Cesium 132.91	56 Ba Barium 137.33	57-71 La-Lu Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59
81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222	87 Fr Francium 223	88 Ra Radium 226	89-103 Ac-Lr Actinides	104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 266	107 Bh Bohrium 264	108 Hs Hassium 277	109 Mt Meitnerium 268	110 Ds Darmstadtium 271	111 Rg Roentgenium 272	112 Cn Copernicium 285
113 Nh Nihonium 284	114 Fl Flerovium 289	115 Mc Moscovium 288	116 Lv Livermorium 293	117 Ts Tennessine 289	118 Og Oganesson 294												
57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.05	71 Lu Lutetium 174.97			
89 Ac Actinium 227	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 252	100 Fm Fermium 257	101 Md Mendelevium 258	102 No Nobelium 259	103 Lr Lawrencium 260			

NUCLEAR RADIATIONS

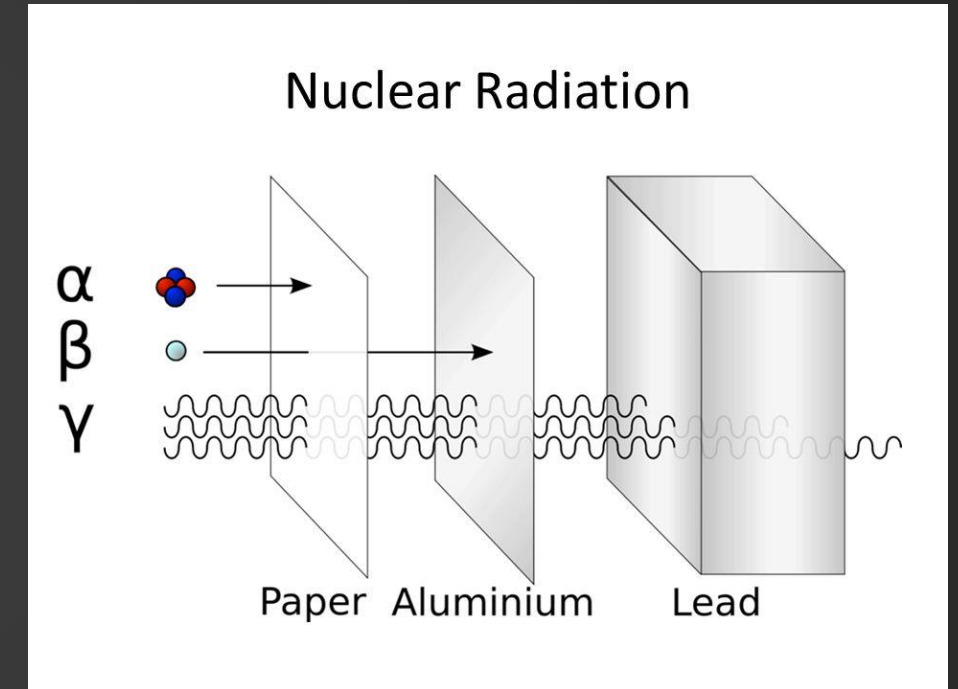
- In physics, radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium. **Rutherford** discovered α -radiations which are less penetrating and β -radiations which are more penetrating and later Villard discovered, γ -radiations which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



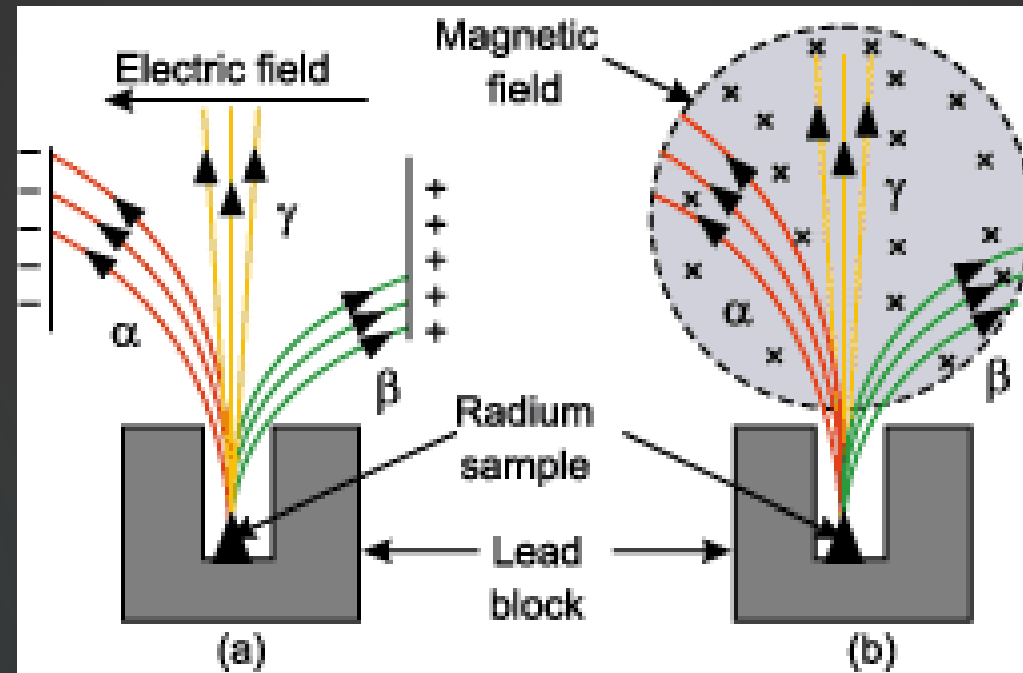


Fig. 1

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.

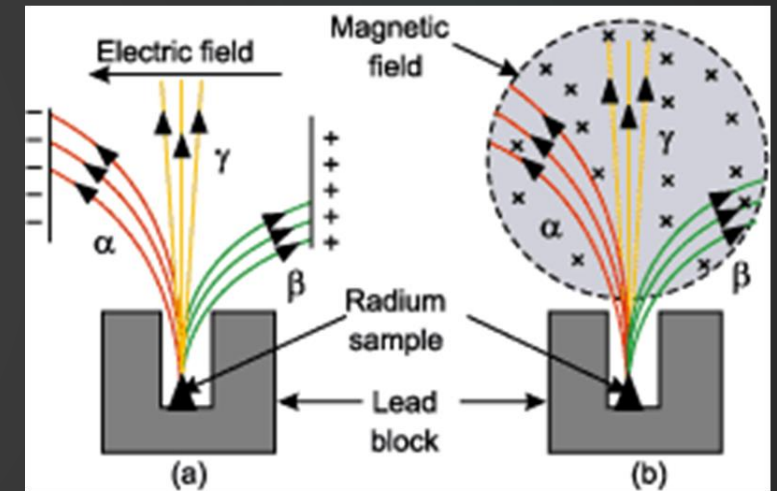


Fig. 1

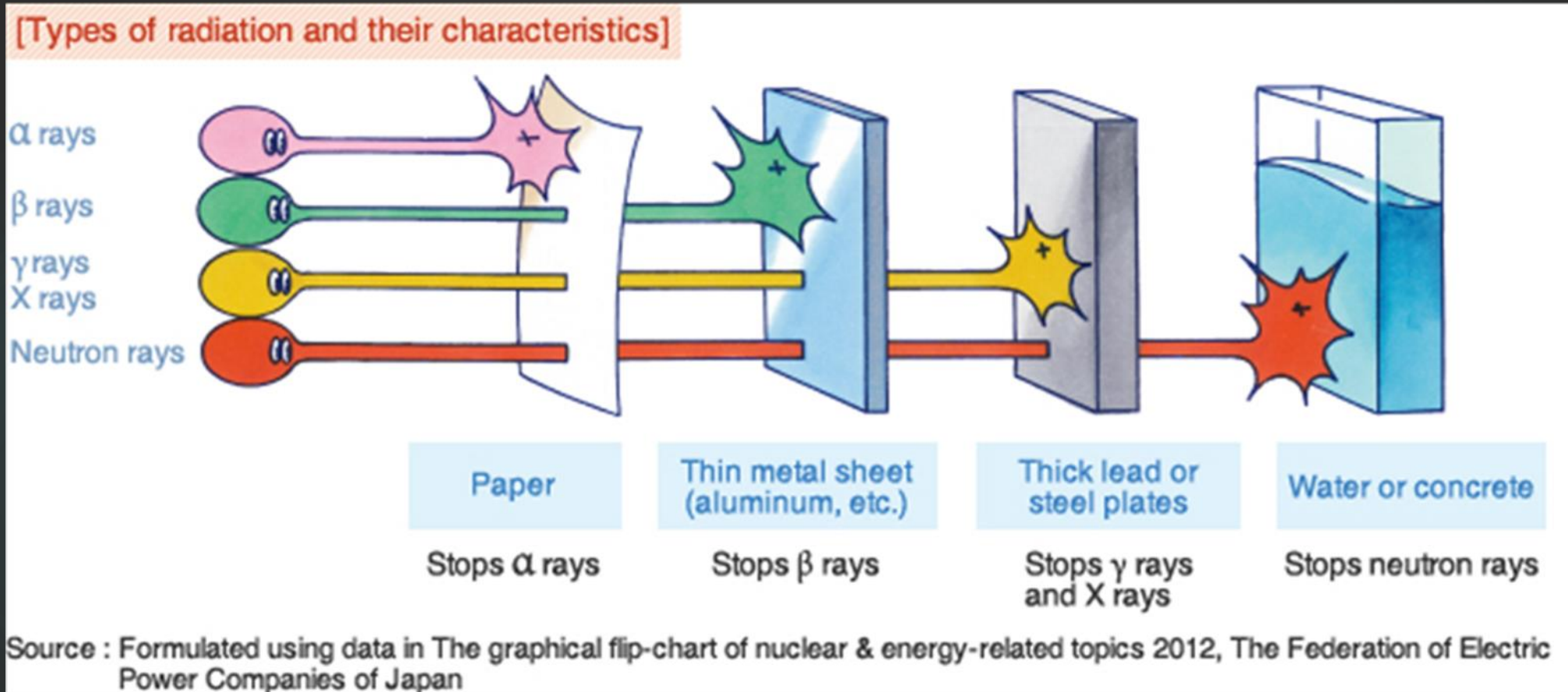
CHARACTERISTICS (*Properties*) of RADIOACTIVE ELEMENTS

- 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

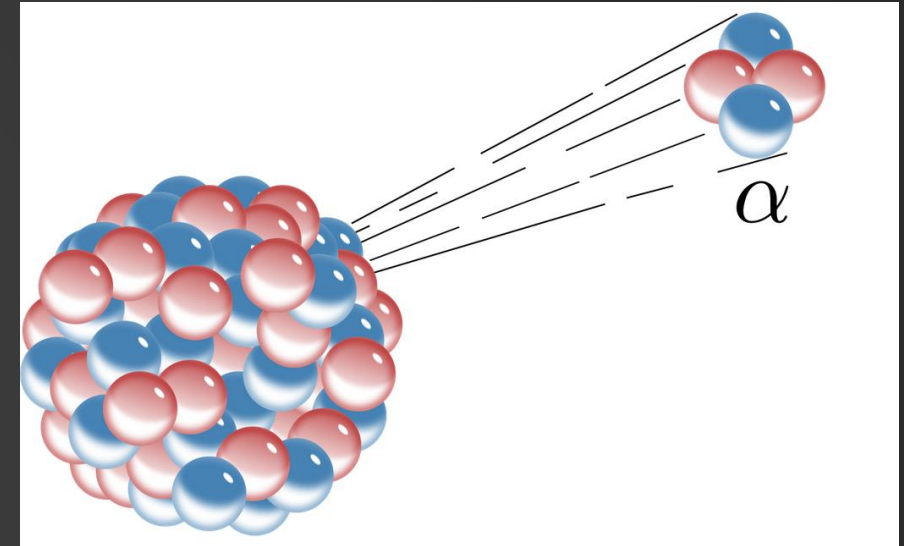
CHARACTERISTICS (*Properties*) of RADIOACTIVE ELEMENTS



PROPERTIES OF PARTICLES

■ PROPERTIES OF ALPHA (α) RAYS:

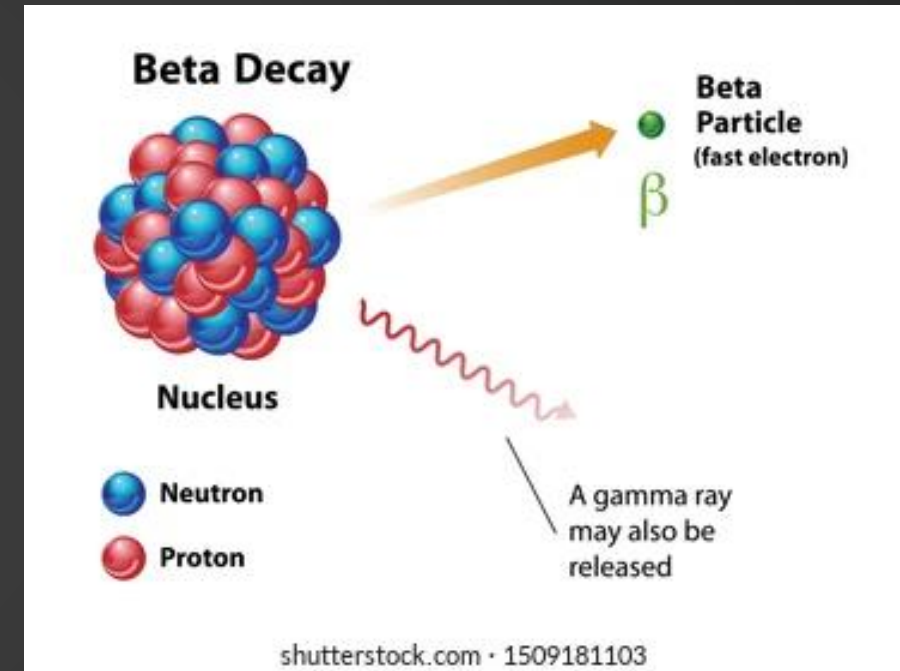
1. Alpha rays are the **positively** charged particles.
2. Alpha-particle is highly active and energetic helium atom that contains **two neutrons and protons**.
3. These particles have the **minimum penetration power** and **highest ionization power**. It is about **1/100 times of β -particles** and **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:

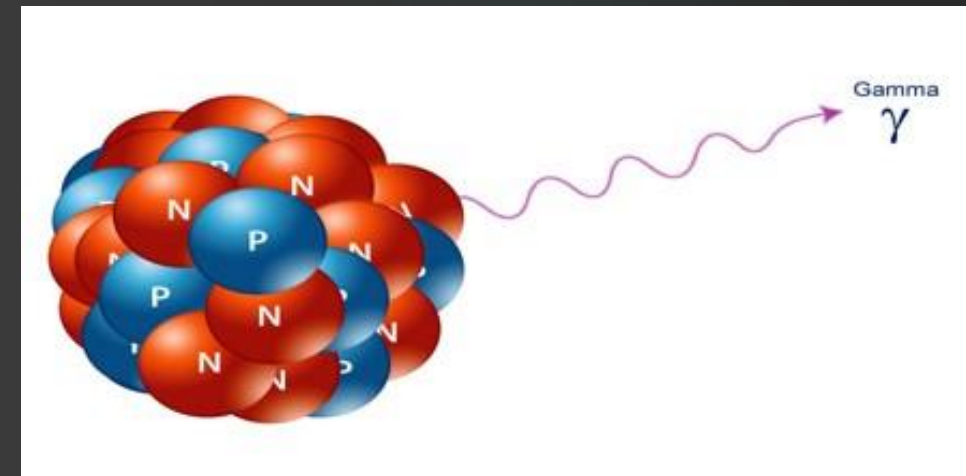
1. Beta particles are extremely energetic electrons that are liberated from the inner nucleus.
2. They bear negligible mass and carry the negative charge.
3. A neutron in the nucleus splits into a proton and an electron on the emission of a beta particle.
4. Hence, it is the electron that is emitted 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, $2\text{He } 4$ nucleus	Negatively charged particles (electrons).	Uncharged ? $\sim 0.01\text{a}$, electromagnetic radiation
Charge	$+2e$	$-e$	0
Mass	$6.6466 \times 10^{-27} \text{ kg}$	$9.109 \times 10^{-31} \text{ kg}$	0
Range	$\sim 10 \text{ cm}$ 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. ${}_{92}\text{U}^{236}$	By radioisotopes e.g. ${}_{29}\text{Co}^{68}$	Excited nuclei formed as a result of Gamma decay



THANK YOU.

MENTOR- MRS. DEEPA GUPTE