Radioactivity

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1 A Short History

DEFINITION

Radioactivity.

The spontaneous breaking up of certain unstable nuclei, accompanied by the emission of radiation.

- It can be said that the purpouse or radiation is to make an atom more stable.
- Radioactivity was first discovered by a French physicist called Henri Becquerel in 1896.
- A substance that gives off rays is said to be radioactive.
- Uranium was the first radioactive substance discovered.

1.1 Marie Curie

- Pierre and Married Currie, 1898.
- Investigated the radioactivity of uranium salts.
- Isolated radioactive isotopes.
- Discovered Polonium and Radium.
- Discovered Alpha, Beta and Gamma radiation.

DEFINITION

Radioisotope.

A radioactive isotope

2 Radioactivity

- Radiation is emitted in three forms:
  - Alpha particles (α)
  - Beta particles (β)
  - Gamma particles (γ)

2.1 Alpha Particles (α)

- Consist of two protons and two neutrons, stuck together.
- Same as nucleus of a Helium atom.
- Therefore alpha particles can be represented as ^4_2He.

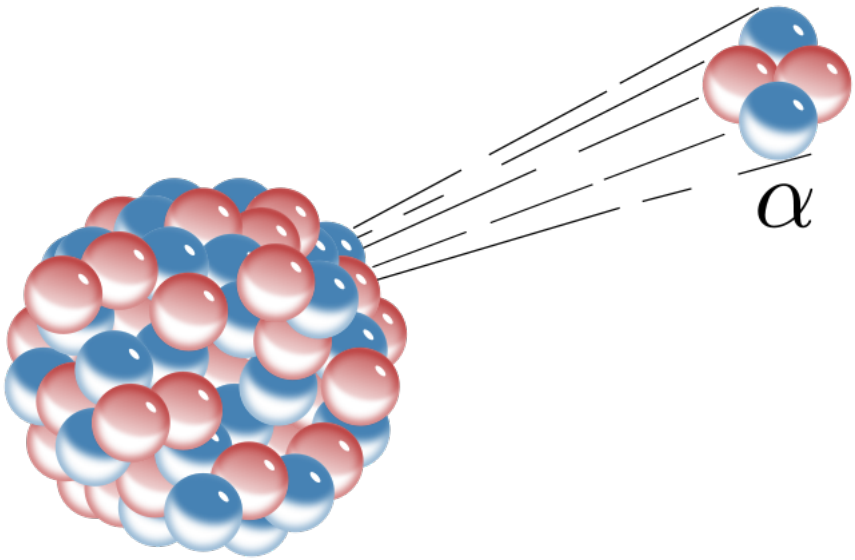

Figure 1: Diagram of Alpha Radiation

- Emitted out of an unstable nucleus of a radioactive element as it becomes more stable.
- Example: Smoke detectors contain Americum-241 which is a source of radioactive alpha particles.

2.2 Beta Particles (β)

- Just an electron.
- A beta particle is formed when an unstable neutron is changed into a proton and an electron, the electron is then emitted.
- Carbon-14 emits beta particles.

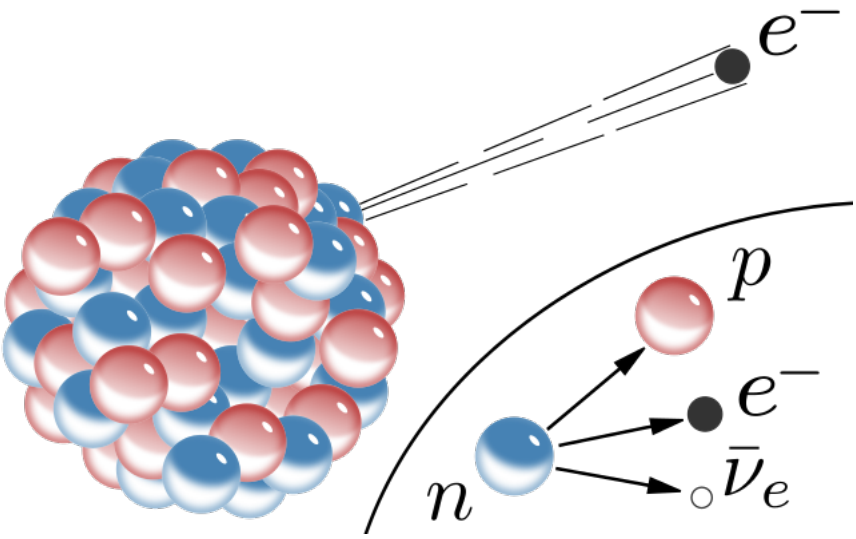

Figure 2: Diagram of Beta Radiation

2.3 Gamma Radiation (γ)

- Gamma radiation is a form of energy similar of X-Rays.
- Therefore it doesn't contain particles.
- An unstable nucleus emits gamma radiation to lose surplus energy.

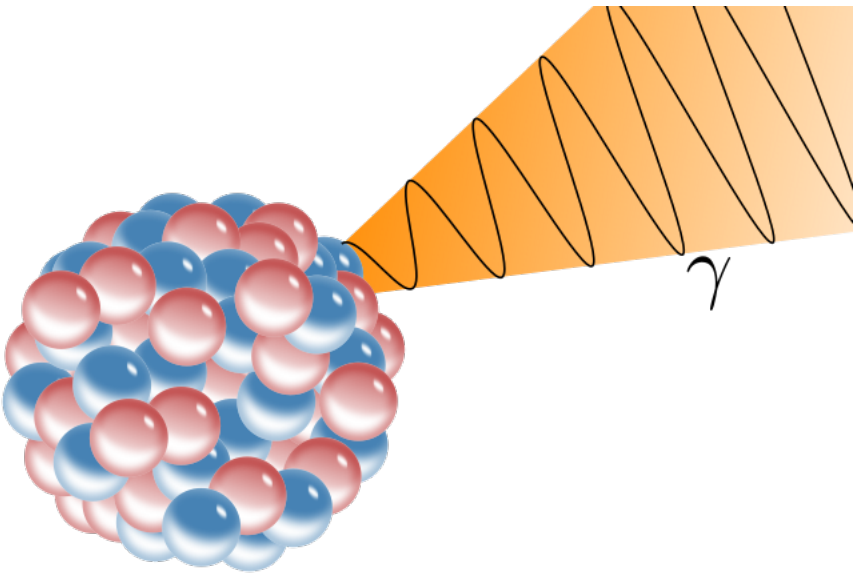

Figure 3: Diagram of Gamma Radiation

- If it is absorbed in large quantities into the body it can alter chemicals in our bodies and cause cancer.
- It can also be used to kill cancer cells by focusing the gamma rays on specific areas of the body.

- Cobalt-60 gives off gamma rays.

2.4 Penetrating Ability of Radioactive Particles

Radiation	Stopped By
Alpha (α)	Paper
Beta (β)	5mm Aluminum
Gamma (γ)	Thick Lead

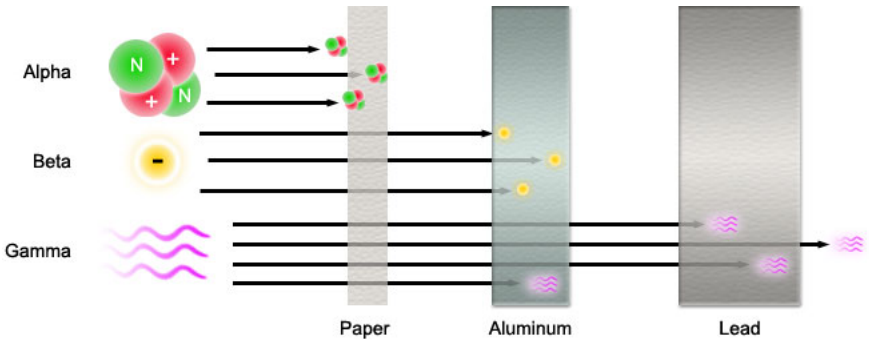

Figure 4: Diagram of Radioactive particles penitrating materials

3 Decay

3.1 Alpha Decay

$${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$$

Z - atomic number and A is atomic mass.

3.2 Beta Decay

$${}^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}\beta$$

4 Nuclear Reactions vs. Chemical Reactions

Chemical Reaction	Nuclear Reaction
Involves electrons rather than nucleus.	Changes take place in nucleus and electrons not involved.
No new element is formed.	A new element is formed.
No release of nuclear radiation.	Nuclear radiation is released.
Chemical bonds broken and formed.	No chemical bond breaking or bond formation involved.

5 Half Life

DEFINITION

Half Life.

The time taken for half of the nuclei in any given sample to decay.

- This occurs at different rates and different rates and different times for each elements.
- It is not a fixed process and not fully understood by scientists.