RADIOACTIVITY

Radioactivity is exhibited by atoms that display a poor hold on the constituents that form their nuclei - protons and neutrons. Thanks to their instability, they occasionally shrug off a few particles here and there. The loss of particles transmutes the nuclei into different elements altogether!

STRONG NUCLEAR FORCE

How a group of protons stick together in such a tight space, despite having coulumbic repulsive force between them? This is where strong nuclear force comes into play. The strong force is the strongest fundamental force in the universe, but it only operates at the tiniest of scales. The strong force triumphs over the electromagnetic repulsive force and sticks protons and neutrons together. The energy required to hold them together is called binding energy.

EFFECT OF INCREASED NUCLEAR SIZE

However, isotopes exhibit some peculiar behaviour. A pair of isotopes contain the same number of protons, but a different number of neutrons, or vice versa. A consequence of this is an increase in nuclear size.

Furthermore, an increased size renders

the short-range strong force ineffective. At a scale just outside its range, the repulsive force kicks in. At that point, nuclei don't have enough energy to overcome it and hold their constituents together.

RELEASE OF EXCESS MASS

The inconsistency in mass incites instability in an isotope's nucleus. Atoms naturally covet stability, which in this case comes at the cost of releasing this excess mass.

EMISSION OF RADIOACTIVE ENERGY

Other than mass, nuclei also emits radioactive energy. The strong force gives in and the repulsive force launches a chunk of particles into its surrounding at very high speeds.

This process of emission is known as radioactivity and the atoms are said to undergo "decay".

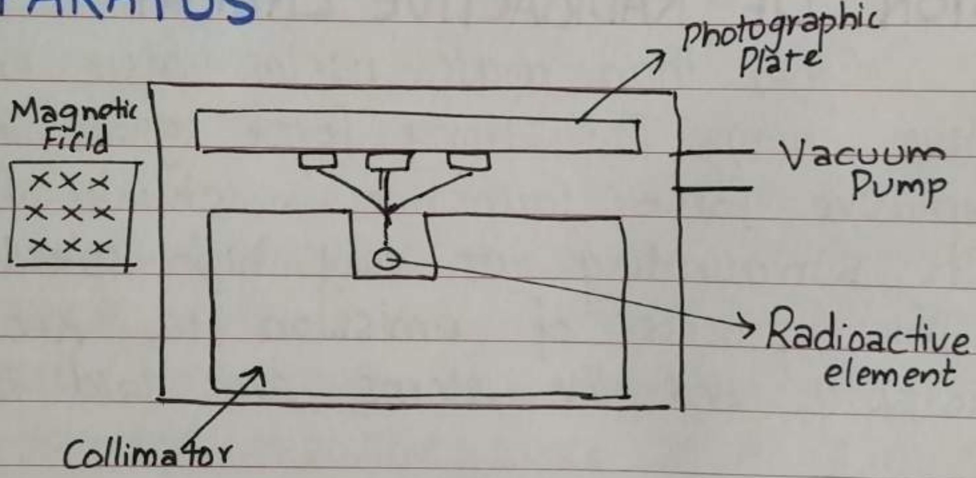
Date:

DISCOVERY OF RADIOACTIVITY

DISCOVERY OF BECQUEREL, 1896

In 1896, Becquerel was using naturally fluorescent minerals to study the properties of X-Rays, which had been discovered in 1895 by Roentgen. He observed that uranium emitted radiation without an external source of energy such as the sun. Becquerel had discovered radioactivity.

APPARATUS



OBSERVATIONS

Becquerel used an apparatus similar to that shown above that the radiations he discovered couldnot be X-Rays. X-Rays are neutral and cannot be bent in a magnetic field. The new radiation was bent by the magnetic field. So that the radiation must be charged and different than X-Rays. When different radioactive substances were put in the magnetic field, they deflected in different directions or not at all, showing that there were three classes of radioactivity: negative, positive and electrically neutral.

MARIE CURIE AND PIERRE CURIE

The term radioactivity was actually coined by Marie Curie, who together with her husband Pierre, began investigating the phenomenon recently discovered by Becquerel.

DISCOVERY OF POLONIUM AND RADIUM

The curies extracted Uranium from ore and to their surprise, found that ~~in~~ the leftover ore showed more activity than pure uranium. They concluded that the ore contained other radioactive elements. This led to the discovery of the elements polonium and radium

EXPERIMENT OF RUTHERFORD

Ernest Rutherford did many experiments studying the properties of radioactive decay.

Rutherford used an apparatus as shown in the previous figure. When the air from the chamber was removed, alpha source made a spot on the photographic plate. When the air was added, the spot disappeared. Thus, only a few cm of air was enough to stop the alpha radiation.

te:

OBSERVATIONS

After studying the properties of radioactive decay, he named them alpha, beta and gamma particles, and classified them by their ability to penetrate matter

ALPHA PARTICLES

Alpha particles carry more electric charge, are more massive, and move slowly compared to beta and gamma particles, they interact much more easily with matter.

BETA PARTICLES

Beta particles are much less massive and move faster, but are still electrically charged. A sheet of aluminium 1mm thick or several meters of air will stop these electrons or positrons.

GAMMA RAYS

As gamma rays carry no electric charge, they can penetrate large distances through materials before interacting several cm of lead or a meter of concrete is needed to stop most gamma rays.