EXP.NO. (8)

Radiation Detection

The aim Of experiment:-

-To distinguish among alpha, beta and gamma radiation
-To verify inverse square relationship between the distance and the intensity

Apparatus:-

The radiation detector (Geiger- Muller counter (GM)) is a simple device which is used using for measuring radioactivity. It consists of a metal tube called cathode, containing inert gas at low pressure and a wire along its central axis called anode. One of the end tube usually has a very thin window made of some low-atomic mass material, such as mica or beryllium, through which radiation can easily enter as shown in Figure 1. When the ionizing radiation enters to the GM tube. It is ionizing the inner gas and producing ions and free electrons. The flow of charge causes a pulse current and this current amplified and detected by external counter. Radioactive sources are (Ɣ-source Co-60) and (Cs-137), α source (Am-241), β- sources (Ti-204) and Sr-90). Also, the sheets of aluminum and lead used in this experiment

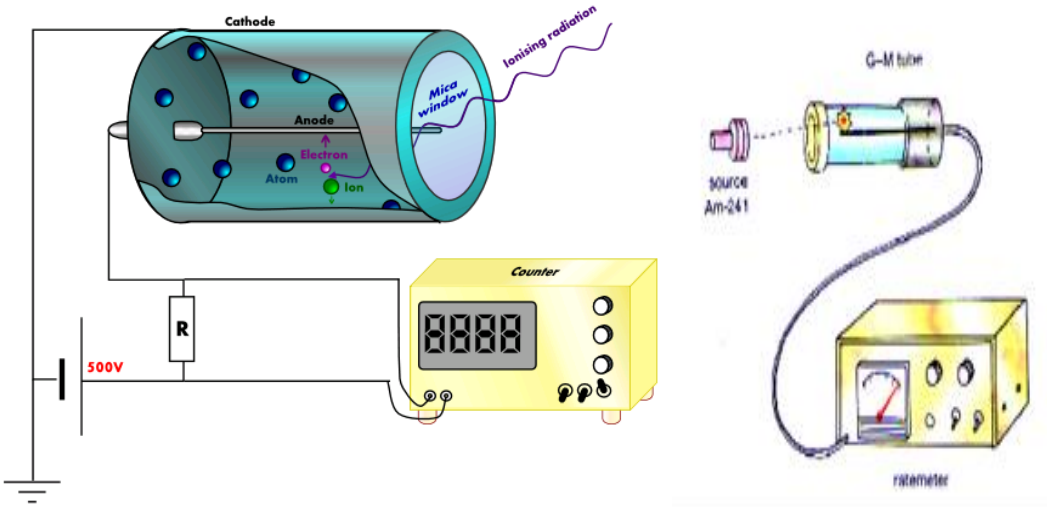


Figure 1: The description of Geiger- Muller counter device

Theory:-

Alpha α, Beta β particles and Gamma ɣ rays are nuclear radiation emitted by radionuclide. Each kind of these radiations has certain characteristics which depend on mass, charge and wave or particle nature as explain in Table 1 .The penetrating power of these rays varies widely among them and is found to be a way of distinguishing among them based on their absorption in matter. Radioactive materials emit radiation uniformly in all directions and its obeys to the inverse law as shown in Figure 2.

Table 1: Explain the Characteristics of α,β and ɣ rays

Radiations	Composition	Mass	Charge	Penetrating Power	Ionizing Power
Alpha (α)	2 protons + 2 neutrons	Approx. 4 amu (6.6×10^{-24}g)	$+2^{*}(3.2 \times 10^{-19}$c)	2 to 7 cm in air	Very large
Beta (β)	Electron	About 1.1837 of hydrogen atom (9.1×10^{-28}g)	$-1^{*}(1.6 \times 10^{-19}$ C)	Several meters in air	Less than 1/100 that of the particle
Gamma (γ)	Electron magnetic	Zero	Zero	Very high	Very Low

Inverse square law in general it's a physical law can applied to many sources such as electrical field, light, sound and radiation. The radiation intensity proportional to the square of distance from the source of that physical quantity as follow the equation 1.

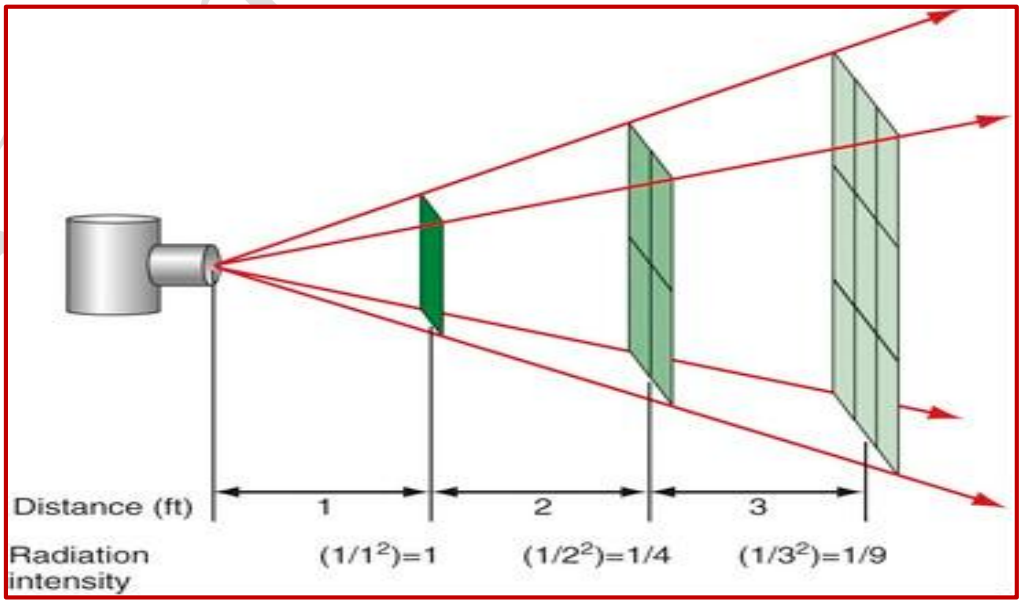
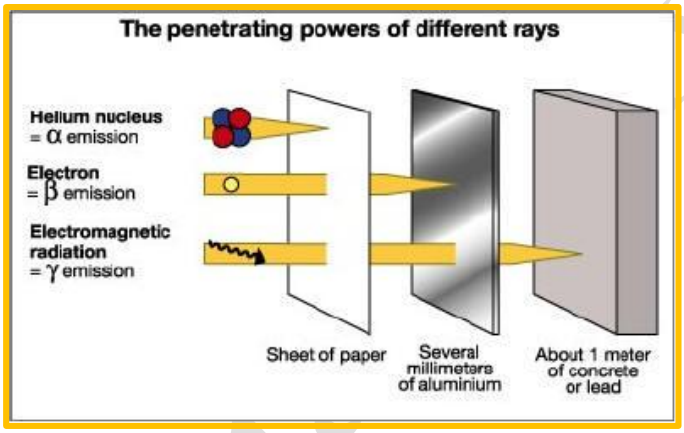


Figure 2 : The radiation emit from radioactive materials

Methodology:-

1- Distinguish among alpha, beta and gamma radiation

- Take one radioactive source and set it on the holder.
- Set GM-tube in front of the source.
- Set up the source at fixed distance (10 cm) from GM-tube.
- Turn on the counter.
- Place sheet of paper between the source and the GM-tube, regard the counter if not stop use thin sheet of aluminum and regard the counter if not stop then use sheet of lead. As shown in Figure 3.
- Explain the results**.**



Figuer3: Sheet of paper, aluminum and lead

2- Verify inverse square relationship between the distance and the intensity

- Determine the background count by measuring number of particles entering the tube without source. Background radiation comes from cosmic ray, natural radioactive material in rocks, soil and in bricks of building.
- Take radioactive source e.g. beta source and set it on the holder.
- set GM-tube in front of the source.
- Place the source at distance (1 cm) away from the tube.
- Turn on the counter set the counting time at 60sec.
- Record the count rate.
- Repeat step 6 with distance 2, 3,4,….,10 .
- Tabulate the results as shown below.

Distance cm (d)	Square distant (d^2)	Intensity count/sec	Background count/sec	Actual intensity intensity-background

★ Plot the graph between square distance and actual intensity.
★ Discuss the results.

Medical application:-

Alpha particles:-

1-To treat various form of cancer by inserting tiny amount of α –particles into cancerous mass, such as brain tumor, pancreatic, ovarian and melanoma cancers.
2- α-particles are used for treating bone cancers.
3-Treating leukemia: which may involve bone marrow transplant by kill the defective bone marrow by lethal dose of radiation before being replaced with healthy bone marrow.

Beta particles:-

1-To treat thyroid disorder by using Iodine 131.
2-Treating eye disease.
3-Treating skin cancer.

Gamma rays:-

1-Gamma photons are used in treating cancer by irradiating cells that need to be kill.
2-It is used in diagnoses by using radioisotopes emitter ɣ rays off sufficient energy to escape from the body and it have short half-life to decay away soon after imaging is completed.
3-It is used in sterilizing medical products such as syringes, gloves, clothing and instruments.