(NU3-1) Geiger Detector Characteristics

Aim of experiment

Determination of the characteristics for GM tube.

Apparatus

GM tube counting station consists of GM counter – radioactive source- source holder- stop watch- source cabinet made of thick lead.

Figure 1. A schematic diagram of Geiger counting system

Theory of experiment

The GM tube is one of a variety of radiation detectors that take advantage of the fact that charged particles lose energy in a gas by creating electron-ion pairs. In air for example, an alpha particle of energy 5-10 MeV will ionize from 50,000 to 100,000 molecules per cm of its path. The Geiger tube, *figure 2,* is simply a metal cylinder that is filled with some kind of inert gas; Ne, He, etc.. at certain pressure.

A thin mica window at one end of the cylinder allows the radiation to enter the counting region.

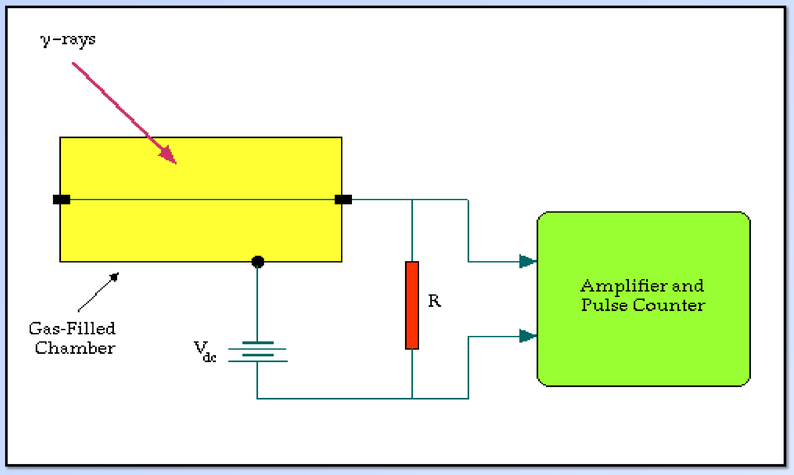

Figure 2. A Schematic diagram for radiation Gas detectors

The ion-pairs that are produced by the radiation are swept out and collected by an electric field that is maintained between a thin wire on the axis of the tube (anode) and the metal cylinder (cathode). The electric field between these two electrodes is high enough that the ions produced by the initial radiation are accelerated and produce secondary ions. This phenomenon is called an avalanche.

Figure 3 shows a typical voltage plateau curve for a GM tube. At low voltages, there is no output. As the voltage is increased, a few counts will be recorded at the "starting voltage", V_{th}.

As the voltage is further increased, the counting rate will change rapidly until the "knee" or threshold of the plateau is reached, V_1. From this point on, the counting rate is fairly constant for approximately 200 volts. This is called the plateau region. Shortly after the plateau region at V_2, the tube breaks down and goes into a continuous discharge.

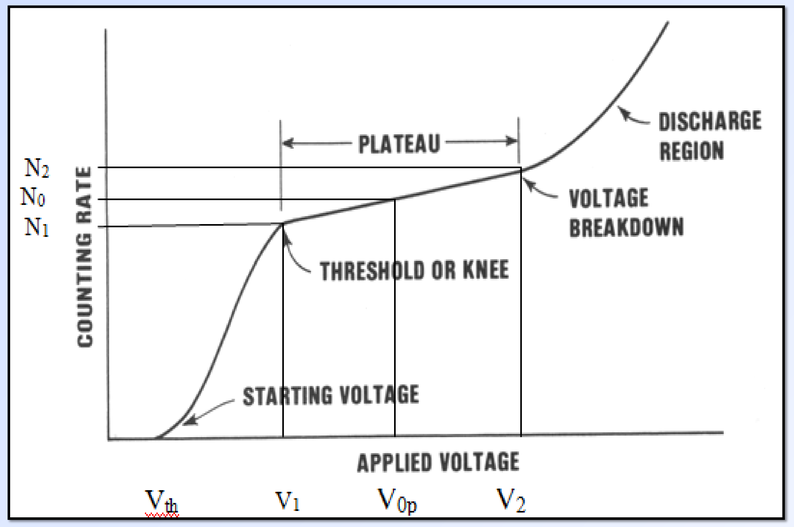

Figure 3. voltage plateau curve for a GM tube

Procedure

1. Set up the electronics as shown in *Figure 1.*
2. Switch on the power of the counting station, and leave to warm up for few minutes.
3. Place a radioactive source on a shelf of the GM stand at a suitable distance. Set the timer on "manual" so that the voltage on the tube can be slowly raised and the student can observe all of the features of *figure 1.*
4. Slowly raise the voltage until the starting voltage is reached. Record this value. Take the counting for at least 5 min.
5. Increase the voltage by 20 volts interval and record the corresponding reading each min, until a breakdown voltage is reached.
6. Record the obtained data in a table.
7. Do not forget to calculate the error in each reading.
8. Draw the relation between the applied voltage and the corresponding reading.
9. From the figure, obtain the characteristics of the GM tube.

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Results

N_{bg}=

V (volt)	N$\pm\sqrt{N}$ (min. $^{-1}$)

Starting voltage, V_{th} = *V.*

Geiger Plateau length= V_2-V_1= *V.*

Operating voltage V_{op}= (V_2 - V_1)/2 = *V.*

$$Percntage \quad slope\,\% = \frac{N_2 - N_1}{N_o(V_2 - V_1)} = \qquad V^{-1}$$

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