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Department of Biomedical Engineering

Course Name: 19BME301 – Medical Physics

III Year : V Semester

Unit IV –PRINCIPLES OF RADIATION DETECTOR

Introduction

- The **Geiger counter** is an instrument used for measuring ionizing radiation

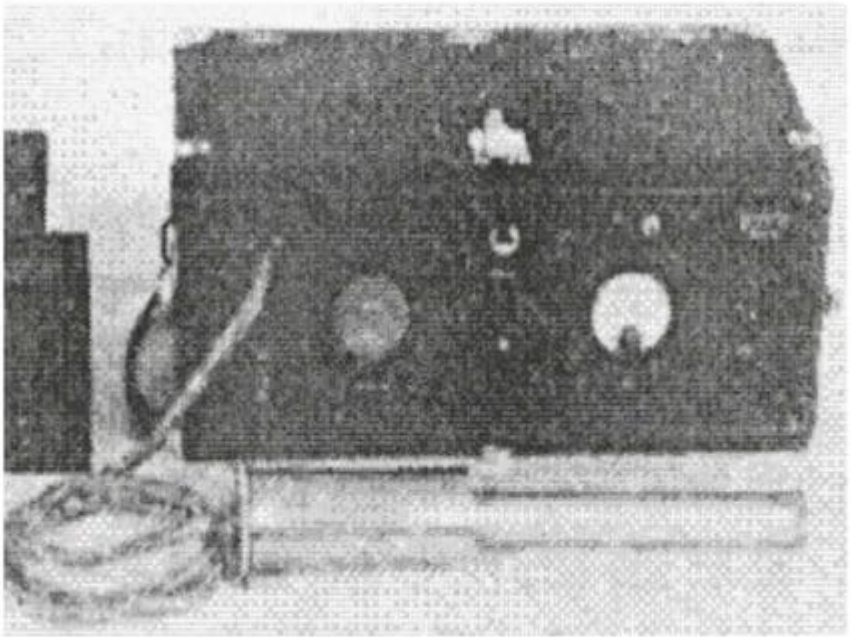
- It detects ionizing radiation such as alpha particles, beta particles and gamma rays using the ionization effect produced in a Geiger–Müller tube

- It is perhaps one of the world's best-known radiation detection instruments

History

- The original detection principle was discovered in 1908
- The development of the Geiger-Müller tube in 1928 that the Geiger-Müller counter became a practical instrument.
- It has been very popular due to its robust sensing element and relatively low cost.

Old GM Counter



GM Counter Using for Ukraine Military Purpose

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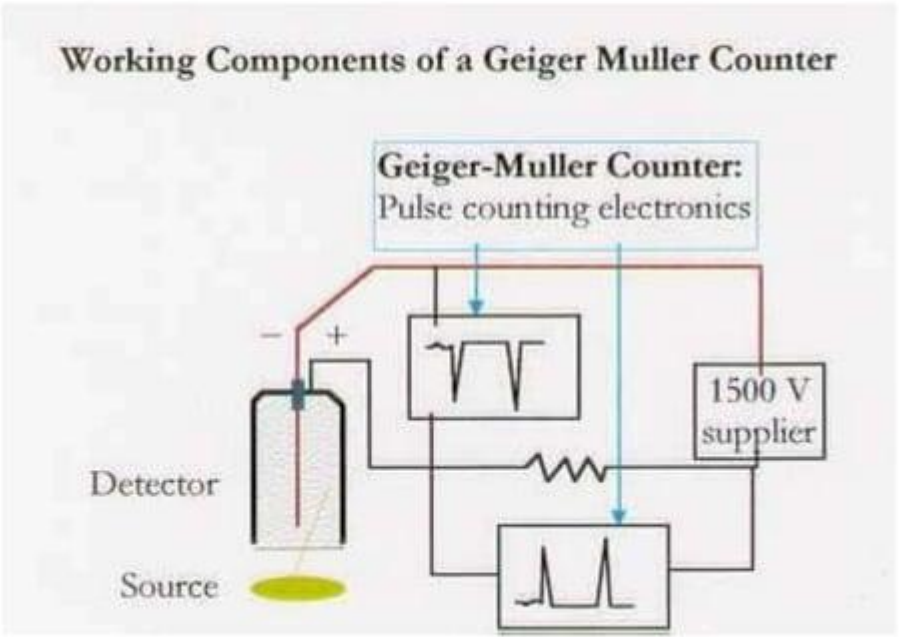
Operating Principle

- A Geiger counter consists of a Geiger-Müller tube, the sensing element which detects the radiation, and the processing electronics – Results in Display

- Geiger-Müller tube is filled with an inert gas such as helium, neon, or argon at low pressure, to which a high voltage is applied

- Tube briefly conducts electrical charge when a particle or photon of incident radiation makes the gas conductive by ionization

Operating Principle



Operating Principle

- The ionization is considerably amplified within the tube by the Townsend Discharge effect to produce an easily measured detection pulse
- This large pulse from the tube makes the G-M counter cheap to manufacture, as the subsequent electronics is greatly simplified.
- The electronics also generates the high voltage, typically 400–600 volts

Readout

2 Types

- Count per second
- Absorbed dose

Count per second

- The number of ionizing events displayed either as a count rate, commonly "counts per second“

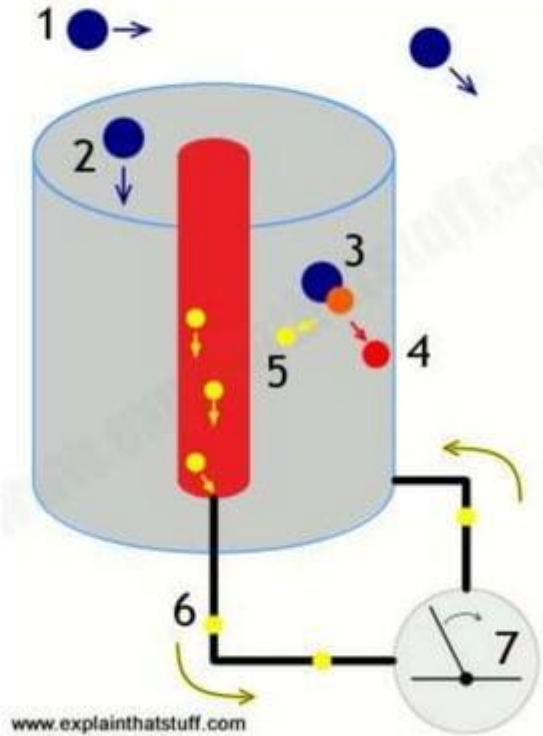
- The counts readout is normally used when alpha or beta particles are being detected

Absorbed dose

- More complex to achieve display of radiation dose rate, displayed in a unit such as the sievert

- Normally used for measuring gamma or X-ray dose rates

How it works?



How it works?

- Radiation (dark blue) is moving about randomly outside the detector tube.
- Some of the radiation enters the window (gray) at the end of the tube.
- When radiation (dark blue) crash with gas molecules in the tube (orange), it causes ionization: some of the gas molecules are turned into positive ions (red) and electrons (yellow).
- The positive ions are attracted to the outside of the tube (light blue).
- The electrons are attracted to a metal wire (red) running down the inside of the tube maintained at a high positive voltage.
- Many electrons travel down the wire making a burst of current in a circuit connected to it.
- The electrons make a meter needle deflect and, if a loudspeaker is connected, you can hear a loud click every time particles are detected.

Application

- For the detection of alpha and beta particles
- To detect radioactive rocks and minerals in the course of mineral prospecting or as a mineral collector
- To check for environmental levels of radioactivity
- For Fire and Police first responders to a analysis for making an initial determination of radiation risk.

Thank You