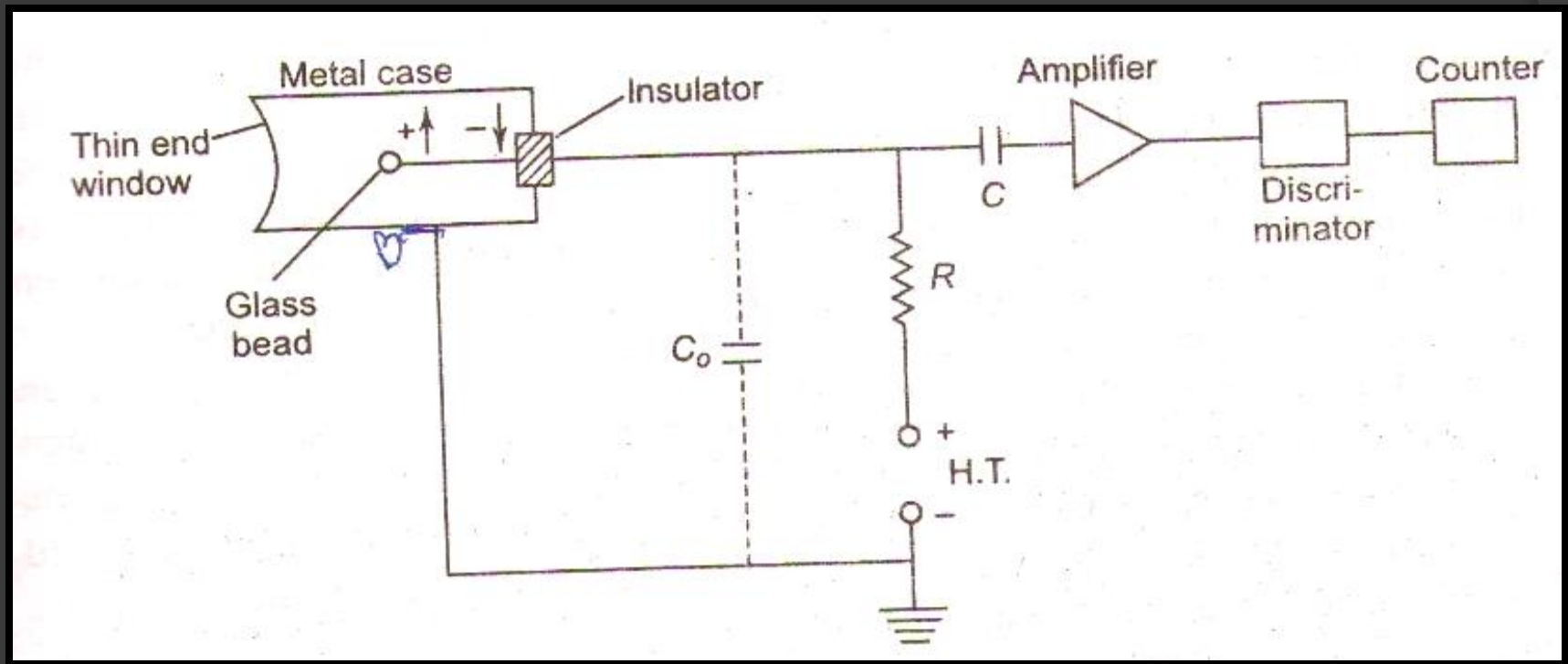


GM COUNTER

PRINCIPLE: charged particles ionize the gas through which they pass ,the electrons so produced during ionization get accelerated under high potential and further produce ionization.

CONSTRUCTION AND WORKING



Construction of GM counter

1. **Cylinder(B):** It is a sealed glass tube of radius 2-3 cm enclosing a co-axial metal cylinder serving as a cathode.
2. **Thin metal wire:** It is stretched along the axis of cylinder and serves as anode. The free end of anode is covered with **glass bead** to avoid corona discharge building up at sharp points.
3. **Thin window** made of mica or other materials provided for counting less penetrating radiation like α or β rays.
1. **Inert gas** like, argon is filled in glass tube with vapors of some volatile compound like ethyl alcohol (quenching vapor) in ratio 10:1 is added to it. In some counters neon gas mixed with traces of halogen (e.g. Bromine as a quenching vapor) is used.

The gases must be free from electro negative impurities such as(CO_2 , O_2)which will tend to form negative ions and initiate secondary avalanche.

WORKING:

1). Because of cylindrical geometry electric field $X \propto 1/r$ SO field is very high near surface of central wire .Avalanche created due to this high field by a single original electron can now start second avalanche at some other point in GM tube. It gives rise to Geiger Discharge

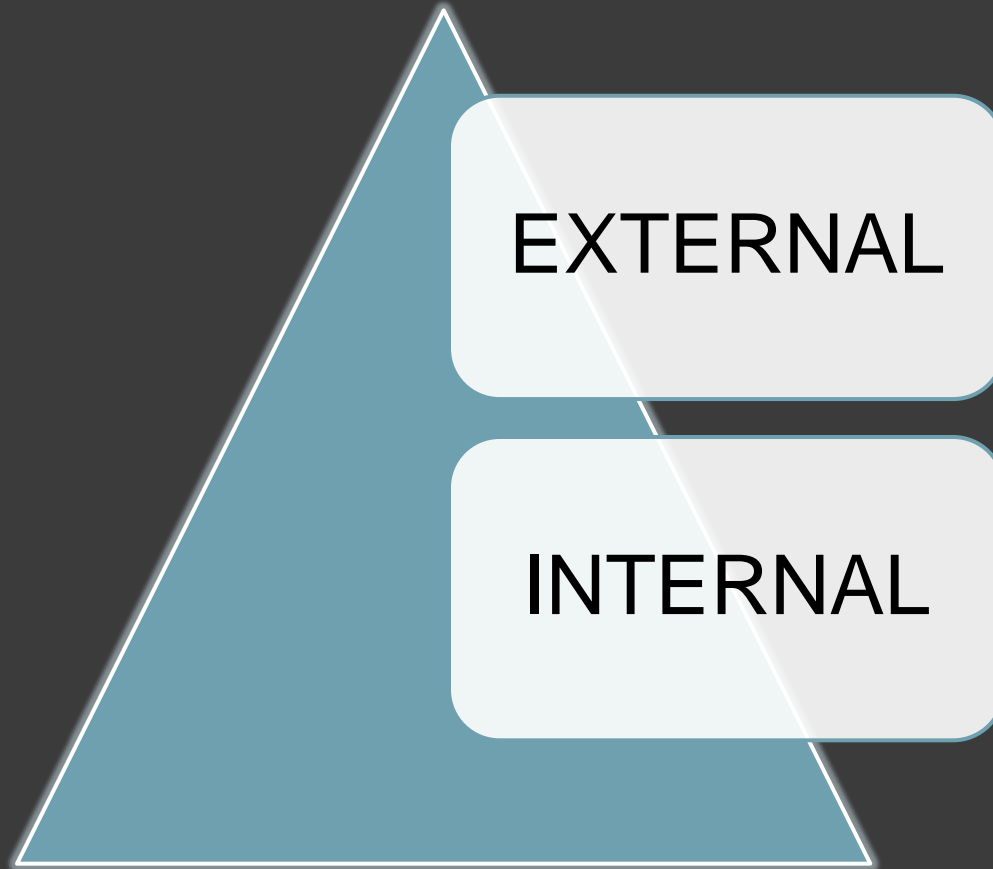
2) The second avalanche is created due to emission of photons during de-excitation of gas molecules with in first avalanche .These photons on reaching cathode emits photo electrons. which initiate second avalanche and so on.

3) Electrons are quickly collected by anode wire .Positive ions being heavy, remains in vicinity of central wire and reduce the field near central wire .This stops the process of Geiger Discharge.

4) Positive ions slowly move towards cathode and reach cathode in time 10^{-4} sec where they capture electrons and produce UV-photons.

If the energy so liberated exceeds work function an electron from cathode is ejected which then initiates another Geiger Discharge. These Geiger Discharges produced at intervals of nearly 10^{-4} sec must be quenched.

QUENCHING

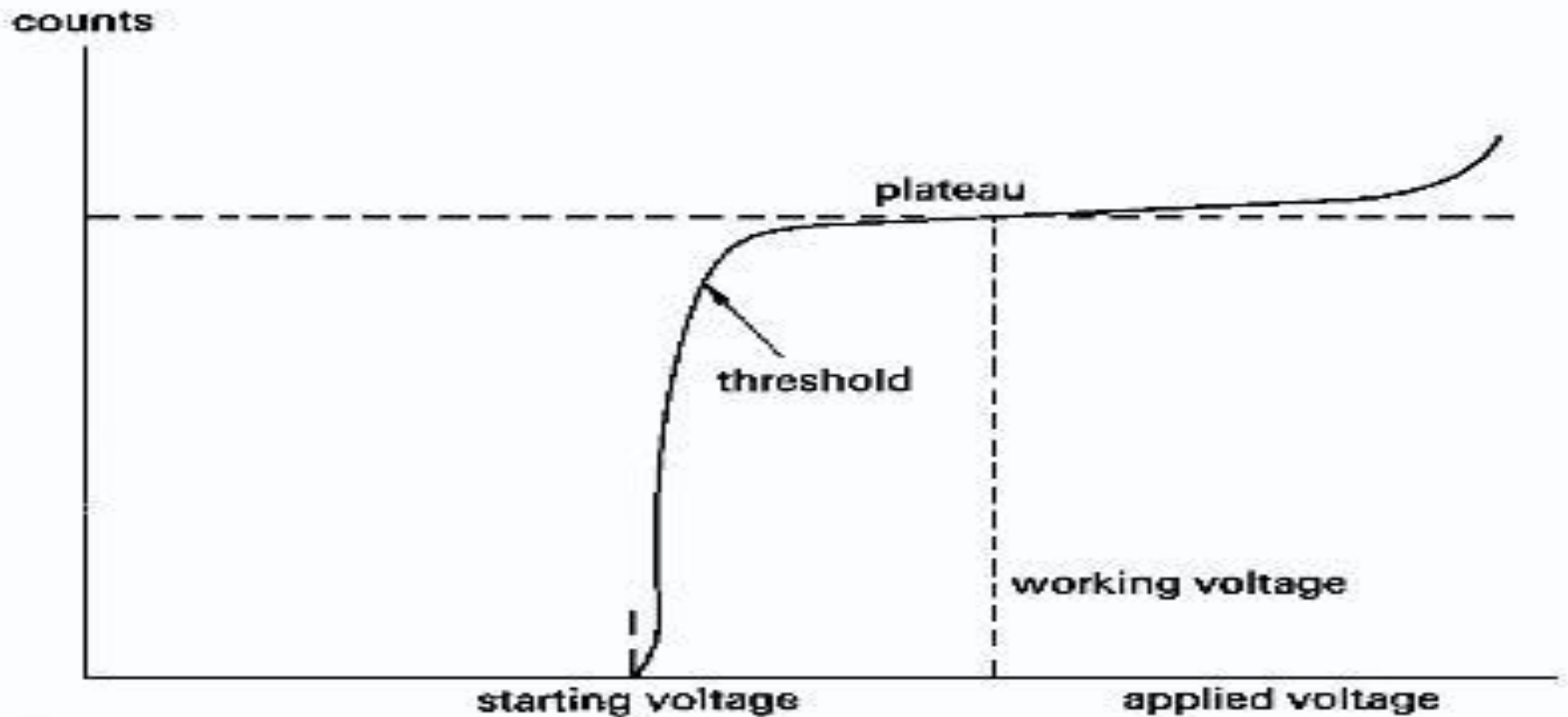


QUENCHING: Elimination of positive sheath around central wire is called quenching.

EXTERNAL QUENCHING: IS achieved by using external load resistance in series with tube.

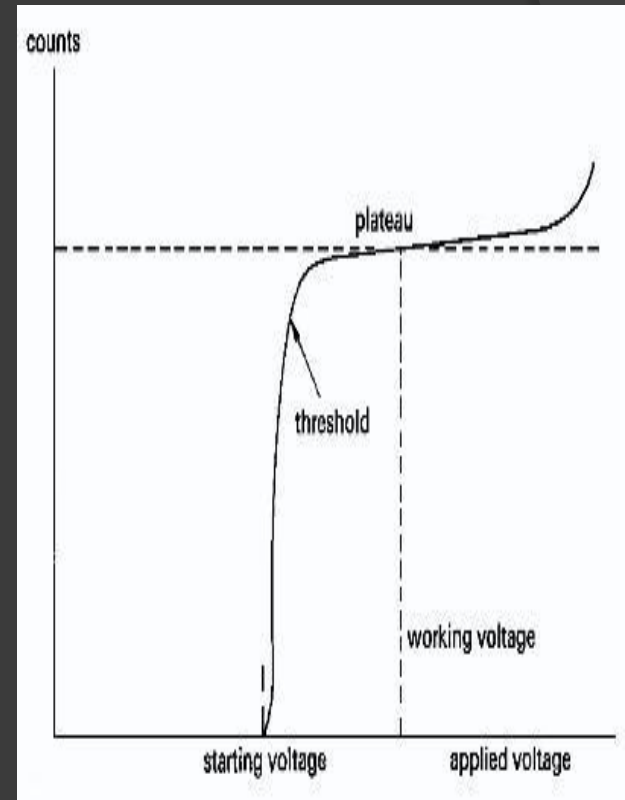
INTERNAL QUENCHING: IS achieved using gases either poly atomic or halogen .

COUNTER CHARACTERISTICS

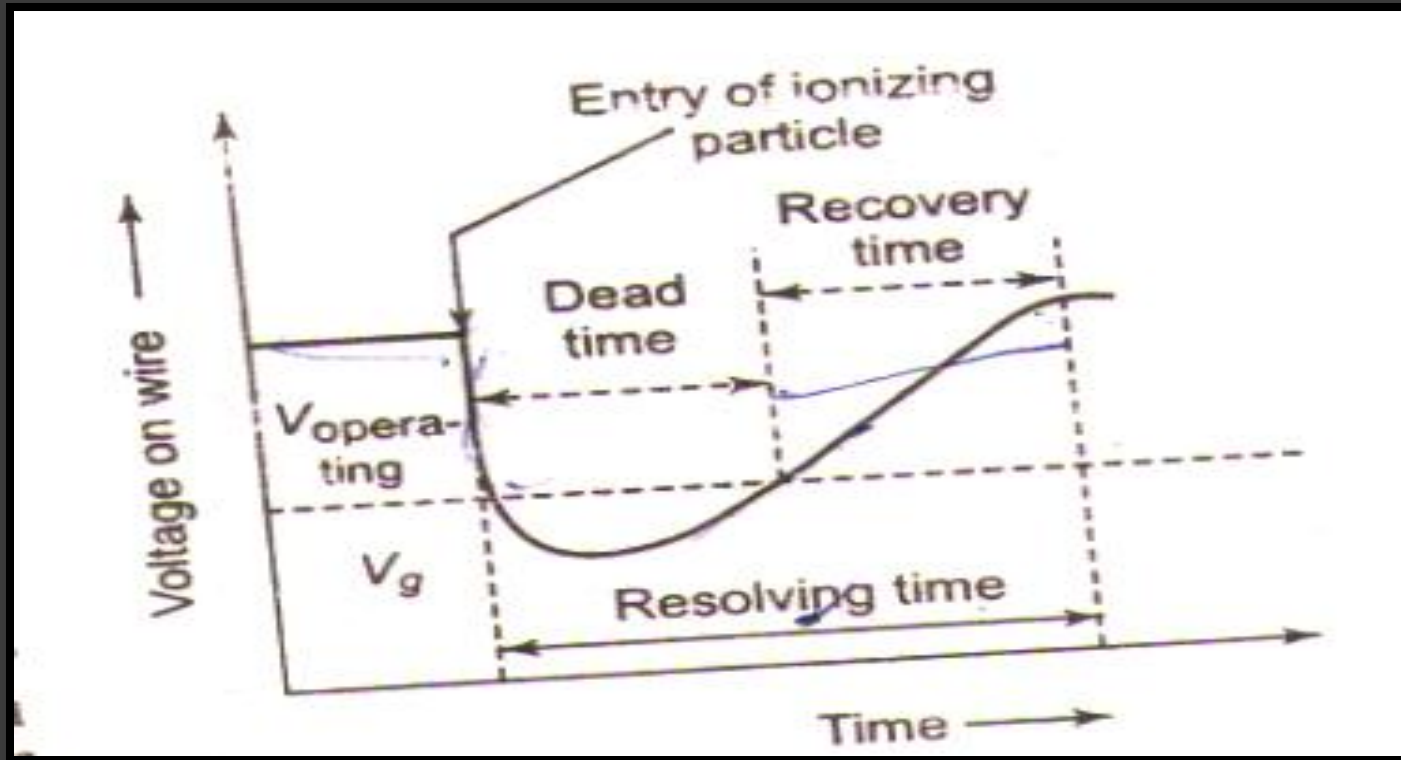


Characteristics of gm counter

- The rate of counting is recorded as function of voltage . A graph between voltage and rate of counting is called **characteristic curve of counter**
- When voltage is low counter operates in **ionization chamber** region where there is no gas amplification. The voltage pulse will be small and no counts will be recorded
- unless the voltage exceeds v_s the **threshold voltage** .
- As voltage increases over v_s counting rate increases as gas amplification sets in and output pulse size increases. This is region of **proportional counter** where more and more low energetic particles are counted until point C is reached . From this point onwards counting rate become constant. The flat region CD is called **plateau of counter**.

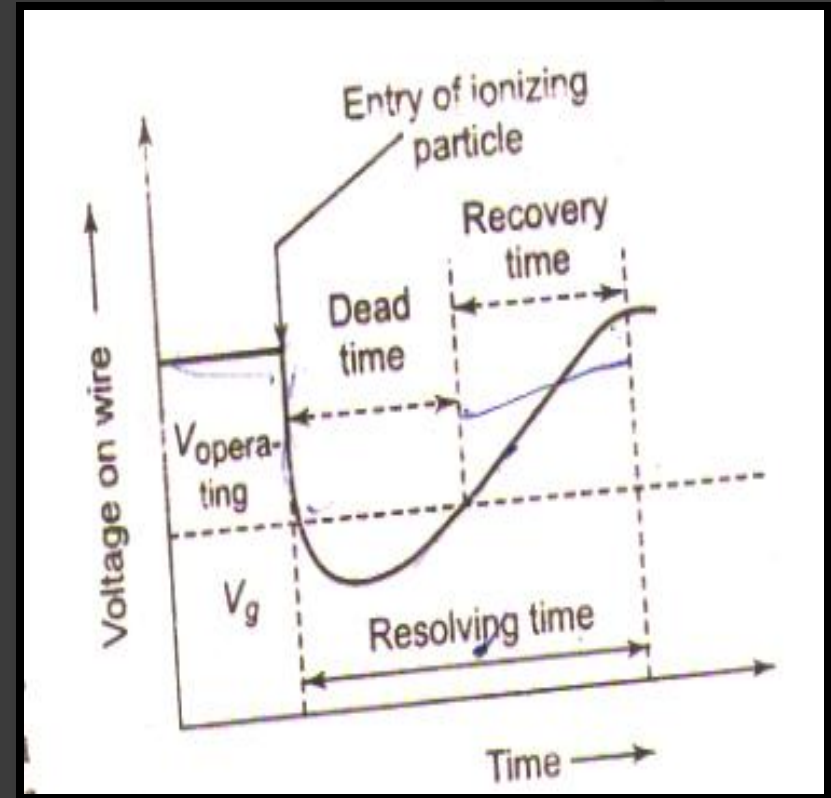


DEAD TIME OF GM COUNTER



Dead time: It is the time during which the counter is completely insensitive .

Recovery time: It is the time after which the original pulse level is restored.



Efficiency of counting

The ratio of the number of counts observed per unit time to the number of ionizing particle which pass through the counter during that time (N) is called efficiency of counting.

$$\eta = n/N$$

ADVANTAGES

- 1.very useful for detecting nuclear particles like alpha ,beta,photons and charged particles.
- 2.very sensitive even for production of single ion pair.
- 3.pulse height is independent of nature and energy of incident particle or radiation.
- 4.height of pulse is almost constant over a wide range of applied voltage .

DISADVANTAGES:

1. These detectors have low efficiency of counting gamma rays.

2. These detectors lack information of detected particles.

3. Detector can not detect uncharged particle like neutrons.

4. Gm tube has limited life because of quenching gases.

THANKS