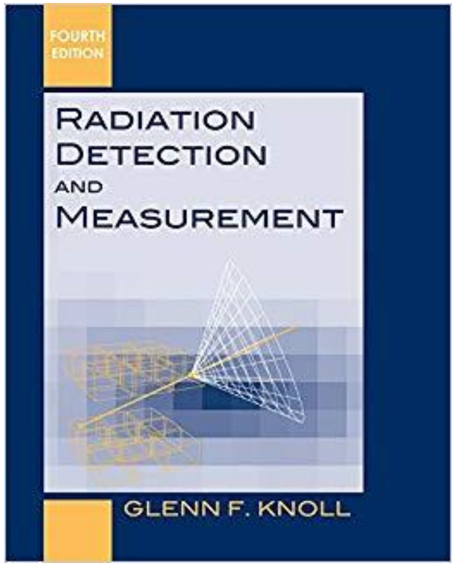
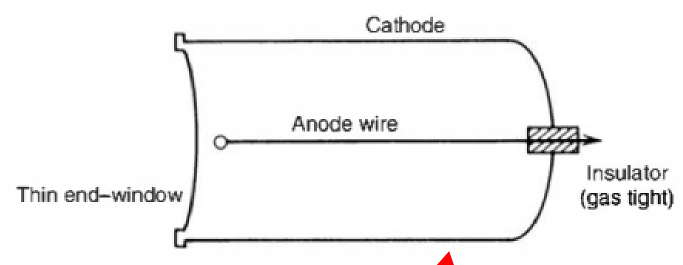
Instrument Presentation

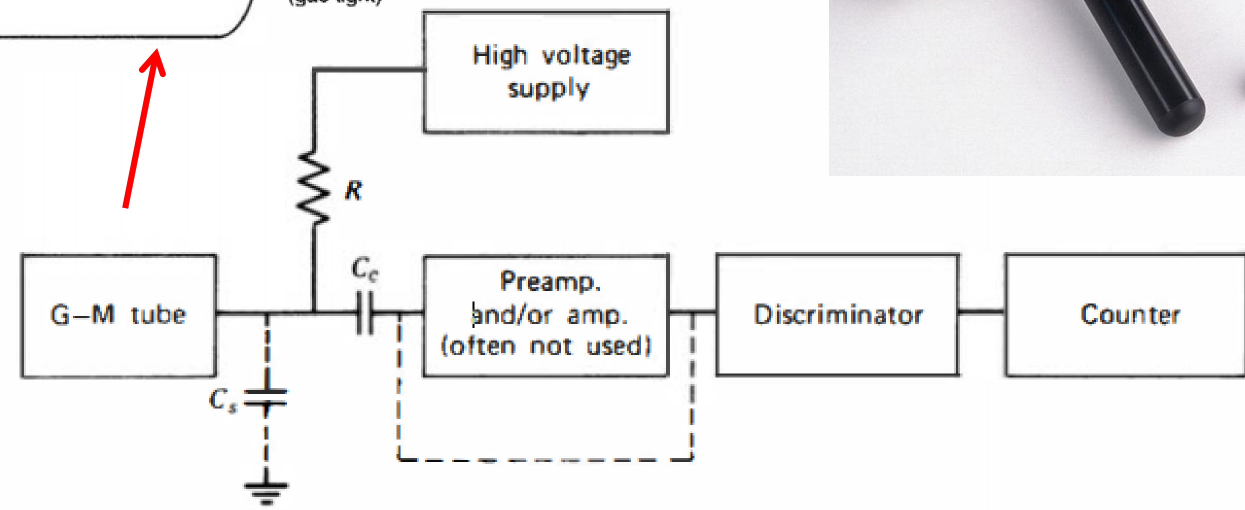
Geiger Muller Counter



Vishal

- ❑Developed by Hans Geiger and Walther Müller in Germany, **Geiger Muller Counter** is to detect and measure ionizing radiation.
- ❑Hans Geiger developed Geiger counter in 1908 while working under Ernst Rutherford
- ❑It was not until 1928 that Geiger and Walther Müller (a PhD student of Geiger) developed the sealed Geiger–Müller tube which used basic ionization principles previously used experimentally.

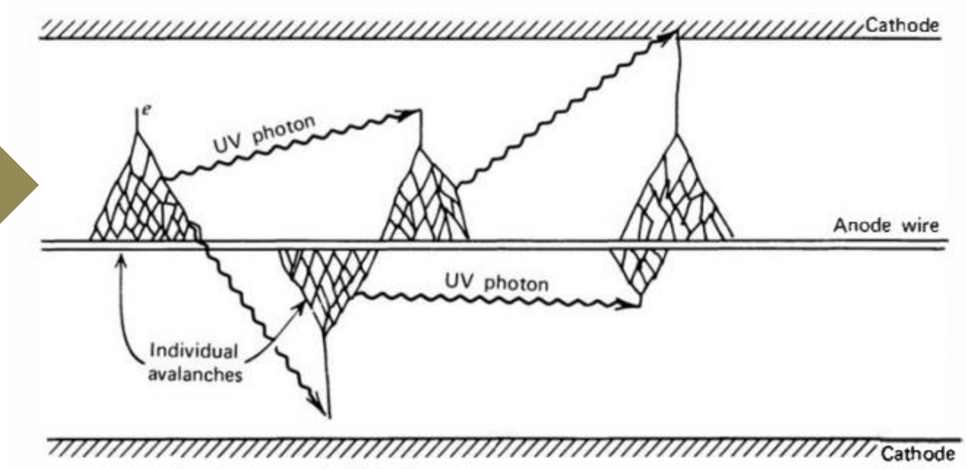




becomes rapidly divergent and, in principle, an exponentially growing number of avalanches could be created within a very short time. Once this *Geiger discharge* reaches a certain size, however, collective effects of all the individual avalanches come into play and ultimately terminate the chain reaction. Because this limiting point is always reached after about the same number of avalanches have been created, *all pulses from a Geiger tube are of the same amplitude regardless of the number of original ion pairs that initiated the process*. A Geiger tube can therefore function only as a simple counter of radiation-induced events and cannot be applied in direct radiation spectroscopy because all information on the amount of energy deposited by the incident radiation is lost.

A typical pulse from a Geiger tube represents an unusually large amount of collected charge, about 10^9–10^{10} ion pairs being formed in the discharge. Therefore, the output pulse amplitude is also large (typically of the order of volts). This high-level signal allows considera-

The Townsend discharge or Townsend avalanche name after John Sealy Townsend, who discovered the fundamental ionisation mechanism by his work circa 1897 at the Cavendish Laboratory, Cambridge.



the entire anode wire, regardless of the position at which the primary initiating event occurred.

The process that leads to the termination of a Geiger discharge has as its origin the positive ions that are created along with each electron in an avalanche. The mobility of these positive ions is much less than that of the free electrons, and they remain essentially motionless during the time necessary to collect all the free electrons from the multiplying region. When the concentration of these positive ions is sufficiently high, their presence begins to reduce the magnitude of the electric field in the vicinity of the anode wire. Because the ions represent a positive space charge, the region between the ions and the positive anode will have an electric field below that predicted by Eq. (6.3) in the absence of the space charge. Because further gas multiplication requires that an electric field above some minimum value be maintained, the buildup of positive ion space charge eventually terminates the Geiger discharge. Another way to picture the termination mechanism is to recognize that the buildup of the dense cloud of positive ions has the same effect as temporarily increasing the anode wire diameter. The electric field at the outer surface of the cloud then drops to below the critical value for further avalanche formation.

For a fixed applied voltage to the tube, the point at which the Geiger discharge is terminated will always be the same, in the sense that a given density of positive ions will be needed to reduce the electric field below the minimum value required for further multiplication. Thus, each Geiger discharge is terminated after developing about the same total charge, regardless of the number of original ion pairs created by the incident radiation. All output pulses are therefore about the same size, and their amplitude can provide no information about the properties of the incident radiation.

As the high voltage is raised in a Geiger tube, the magnitude of the Geiger discharge

Hans Geiger

Hans Wilhelm Geiger (1928)

Born	30 September 1882 Neustadt an der Haardt, Palatinate, German Empire
Died	24 September 1945 (aged 62) Potsdam, Germany
Nationality	German
Known for	Geiger counter Geiger–Marsden experiment Geiger–Müller tube Geiger–Nuttall law Atomic nucleus
Awards	Hughes Medal (1929) Duddell Medal and Prize (1937)
	Scientific career
Fields	Physics and sciences
Institutions	University of Erlangen University of Manchester
Influences	Ernest Rutherford John Mitchell Nuttall

Thank you