19.10: Instruments for Radiation Detection

Because radiation is harmful to humans and other organisms, it is very important that we be able to detect it and measure how much is present. Such measurements are complicated by two factors. First, we cannot see, hear, smell, taste, or touch radiation, and so special instruments are required to measure it. Second, different types of radiation are more dangerous than others, and corrections must be made for the relative harm done by α particles as opposed to, say, γ rays.

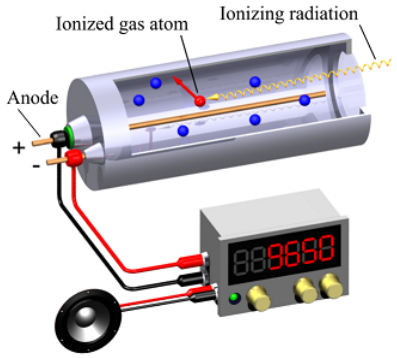

Figure 19.10.1: Schematic of a Geiger-Müller counter using an "end window" tube for low penetration radiation. A loudspeaker is also used for indication. (CC-BY-SA-3.0 Svjo-2 vai Wikipedia).

Perhaps the most common instrument for measuring radiation levels is the **Geiger-Müller counter** (the same Geiger who worked with Rutherford to discover the atomic nucleus). A schematic diagram of a Geiger-Müller counter is shown in Figure 19.10.1. A metal tube containing Ar gas is sealed at one end with a thin glass or plastic window and contains a central wire well insulated from it. A potential difference of about 1000 V is applied between the central wire and the tube. Any incoming α, β or γ ray will ionize some of the Ar atoms. These Ar^+ ions are quickly accelerated to a high velocity by the large potential difference, high enough for them in turn to start ionizing further Ar atoms. Thus, for every ray that enters the tube, a large number of ions is formed and a pulse of electrical current is produced. This pulse is amplified and allowed to drive a digital electronic counter which operates on a principle similar to that of a digital watch. The number of particles passing through the tube in a given time can thus be found. Alternatively, the tube can be made to operate a meter indicating the *rate* at which radiation is passing into the Geiger-Müller tube.

Another type of detector, much used for γ rays, is the **scintillation counter**. When a γ ray penetrates a special crystal or solution, it produces a momentary flash of light (called a scintillation) which is detected by a photoelectric cell. Again the output can be amplified and fed into a counter or a meter. A third kind of detector is used to monitor how much exposure laboratory workers have been subjected to in the course of their work. This is simply a strip of photographic film. The degree to which this film is darkened is a measure of the total quantity of radiation to which the worker has been subjected.