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CONSTRUCTION OF IONISATION CHAMBER TO DETECT ALPHA AND BETA PARTICLES

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Ionising radiation cannot be observed directly with the naked eye. Therefore, there are various types of detectors available to detect them. An ionisation chamber is the simplest form among the gaseous detectors that can be constructed using inexpensive and readily available materials. The main objective of this research was to build an ionising chamber that can be used in the laboratory to detect alpha and beta particles separately—the design comprised of two components, so-called the detector segment and the measuring segment. The detector segment was constructed using an outer cylinder (anode) and an inner rod (cathode) made of aluminium. Two Teflon insulators were used to separate the electrodes at one end, and the other was kept open. Air at atmospheric pressure was used as the ionisation medium, and an external voltage was applied between the two electrodes. The measuring segment is comprised of a preamplifier and a current/voltage meter. A differential amplifier with four Darlington transistors was used along with an ARDUINO Uno microcontroller board and a voltage sensor to amplify and measure the output voltages from the detector segment. The ARDUINO board was connected to a computer interfaced program to obtain the real-time plot for quantitative analysis. Americium-241 (Am-241), Cesium-137 (Cs-137), and Strontium-90 (Sr-90) radiation sources were used to determine the ionisation region that the ionisation chamber operates and to identify alpha and beta particles by measuring their relevant output voltages over the same period. The ionisation region of the constructed chamber was found to be above the input voltage of 18 V. Background radiation was identified in the form of small fluctuations in the output voltage. The detection of beta particles was done using the radiation sources Cs-137 and Sr-90 where, Cs-137 is both a beta and gamma emitter, while Sr-90 is a pure beta emitter. The obtained output voltage due to the Cs-137 source increased very slightly (~0.05 V), while no significant increase was observed for Sr-90 with respect to the background radiation. This was mainly due to the low activity of Sr-90 compared to Cs-137 sources available at the laboratory. The detection of alpha particles was carried out by using the strong alpha emitter, Am-241. Output voltage due to this source had a significant increase of ~1.00 V compared to the background radiation. This is due to the high ionisation capability of alpha particles compared to beta particles. Hence, the study implies that the output voltage pulses from the constructed ionisation chamber can qualitatively identify alpha and beta particles.

Keywords: Alpha particle, Beta particle, Cosmic radiation, Ionisation chamber