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An Approach for Detection Efficiency Determination of High Purity Germanium Detector Using Cesium-137

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Abstract : Estimation of a radiation detector's efficiency plays a significant role in calculating the activity of radioactive samples. Detector efficiency is measured using sources that emit a variety of energies from low to high-energy photons along the energy spectrum. Some photon energies are hard to find in lab settings either because check sources are hard to obtain or the sources have short half-lives. This work aims to develop a method to determine the efficiency of a High Purity Germanium Detector (HPGe) based on the 662 keV gamma ray photon emitted from Cs-137. Cesium-137 is readily available in most labs with radiation detection and health physics applications and has a long half-life of ~30 years. Several photon efficiencies were calculated using the MCNP5 simulation code. The simulated efficiency of the 662 keV photon was used as a base to calculate other photon efficiencies in a point source and a Marinelli Beaker form. In the Marinelli Beaker filled with water case, the efficiency of the 59 keV low energy photons from Am-241 was estimated with a 9% error compared to the MCNP5 simulated efficiency. The 1.17 and 1.33 MeV high energy photons emitted by Co-60 had errors of 4% and 5%, respectively. The estimated errors are considered acceptable in calculating the activity of unknown samples as they fall within the 95% confidence level.

Keywords : MCNP5, MonteCarlo simulations, efficiency calculation, absolute efficiency, activity estimation, Cs-137
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