Calculations of Physical Constants for Spherical Ion Chambers in ^{60}Co and ^{137}Cs gamma radiation using EGS4 Monte Carlo Simulation Code

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ABSTRACT

The EGS4 Monte Carlo simulation system is used to obtain two physical constants, which are essential components for the measurement of air kerma rate, a fundamental unit in radiation dosimetry. For the measurement of air kerma rate in gamma radiation, a graphite ion chamber is a good apparatus and these constants represent mass energy absorption coefficient ratio and stopping power ratio between air and graphite and are symbolically written $\left(\frac{\mu_{en}}{\rho}\right)_G^{air}$ and $\left(\frac{S_c}{\rho}\right)_{air}^G$, respectively. An unfolding code to obtain a real spectrum from the spectrum measured by an HPGe detector was developed and applied to the spherical type ion chamber. Here, the real spectrum is the photon energy absorption spectrum that arrives at the front surface of the detecting unit after it's emitted from the source. The energy spectra emitted from the dummy source inside the irradiator of ^{60}Co and ^{137}Cs were measured at a point on the central axis of the beam 1 m away from the source, respectively. Dummy source is a radioisotope with activity of order of 10^7 Bq, small enough for HPGe detector to able to measure its energy spectrum. From the real spectrum, the constants for the three different spherical ion chambers were calculated and compared with other results. As a result, $\left(\frac{\mu_{en}}{\rho}\right)_G^{air}$ = 1.0045, $\left(\frac{S_c}{\rho}\right)_{air}^G$ = 1.0008 ~ 1.0009 for ^{60}Co and $\left(\frac{\mu_{en}}{\rho}\right)_G^{air}$ = 1.0058, $\left(\frac{S_c}{\rho}\right)_{air}^G$ = 1.0093 ~ 1.0094 for ^{137}Cs. The feasibility of EGS4 Monte Carlo simulation has been investigated and the result will be reported in other place.[1]

[1] K. J Chun, S. H. Hah, H. M. Kim and G. H. Yoo, "Development of Technology for Unfolding Radiation Energy Spectra using EGS4 Monte Carlo Code", on preparation