Calibration of HPGe–HPGe coincidence spectrometer through performing standardisation of $^{125}$I activity by X-ray-gamma coincidence spectrometry using two HPGe detectors

An X-ray-gamma coincidence measurement method for efficiency calibration of a HPGe–HPGe system, using the methodology for activity standardisation of $^{125}$I, has been developed. By taking one list-mode time-stamped measurement of the $^{125}$I source, six spectra were generated in post-processing: total spectra, coincidence spectra and energy gated coincidence spectra for each of the two detectors. The method provides enough observables for source activity to be determined without a prior knowledge of the detector efficiencies. In addition, once the source is calibrated in this way the same spectra can also be used to perform efficiency calibration of the individual detectors in the low energy range. This new methodology for source activity determination is an alternative to the already established X-ray-(X-ray, gamma) coincidence counting method; with two NaI(Tl) detectors and the sum-peak method using a single HPGe detector. When compared to the coincidence counting method using two NaI(Tl) detectors, the newly developed method displays improved energy resolution of HPGe detectors combined with measurement of only full peak areas, without the need for total efficiency determination. This enables activity determination even in presence of other gamma emitters in the sample. Standard coincidence counting with NaI(Tl) detectors provides lower uncertainties. The method has been used for calibration of a coincidence HPGe spectrometer in the low energy range of $^{125}$I and fine adjustments of a Monte Carlo model of the coincidence system.
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