Accepted Manuscript

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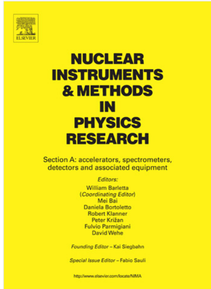

Nikola Marković, Per Roos, Xiaolin Hou, Guillaume Lutter, Sven Poul Nielsen

PII: S0168-9002(17)31175-0
DOI: https://doi.org/10.1016/j.nima.2017.10.086
Reference: NIMA 60232

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date : 26 July 2017
Revised date : 23 October 2017
Accepted date : 27 October 2017

Please cite this article as: N. Marković, P. Roos, X. Hou, G. Lutter, S.P. Nielsen, Calibration of HPGe-HPGe coincidence spectrometer through performing standardisation of ^{125}I activity by X-ray-gamma coincidence spectrometry using two HPGe detectors, *Nuclear Inst. and Methods in Physics Research, A* (2017), https://doi.org/10.1016/j.nima.2017.10.086

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

Nikola Marković*[1], Per Roos[1], Xiaolin Hou[1], Guillaume Lutter[2], Sven Poul Nielsen[1]

[1]Technical University of Denmark
Center for Nuclear Technologies, Frederiksborgvej 399, 4000 Roskilde, Denmark
[2]European Commission, Joint Research Centre, Directorate for nuclear safety and security, JRC-Geel, Retieseweg 111, 2440 Geel, Belgium

Abstract

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.

1. Introduction

The diversification of HPGe gamma coincidence systems [1–4] has been driven by the development of cheaper and easier to use digital acquisition systems. This raises questions relating to calibration routines for such systems. Coincidence HPGe detectors are very sensitive and require accurate and precise efficiency calibration. This is because the product of these efficiencies is used for activity determination ($\varepsilon_{det1} \times \varepsilon_{det2}$), and all associated errors and uncertainties contribute increasing the total uncertainty. Activity determination is either based on Monte Carlo (MC) calculations or reference sample. The first option is more versatile and does not require a dedicated calibration for each isotope to be measured; it does however generally introduce larger uncertainties. Full Energy Peak (FEP) efficiency calibration of a detector in low energy range is problematic because of true coincidence

*Corresponding author
E-mail address: nikmar@dtu.dk (N.Markovic)