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Uncertainties in Monte Carlo calculated correction factors for true coincidence summations (TCS)

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Content

Measurements of radionuclides are important in many areas, like environmental monitoring, treaty verification, process control in nuclear power plants and in the aftermath of a nuclear or radiological incident. Measurements of gamma emitting radionuclides can be done using e.g. high resolution gamma ray spectrometry. Calibrations in gamma ray spectrometry is often done using a mixed radionuclide solution. However, this empirical calibration approach will, for close geometries, result in a biased calibration (at least in some energy regions) due to coincidence summation (e.g. gamma-gamma coincidences and gamma-X coincidences). Moreover, measurement results may also be biased for radionuclides emitting gamma rays in coincidence as well as for radionuclides emitting gamma- and X-rays in coincidence. This systematic effect should, at least when significant, be corrected and the uncertainty in the correction should be quantified. The aim of this work was to estimate the uncertainties in Monte Carlo calculated correction factors for true coincidence summing (TCS), *ktcs*. Based on a detector model and a sample geometry, different parameters were changed in order to obtain a distribution in the *ktcs*, from which the standard uncertainty could be evaluated. First, a sensitivity analysis was done in order to exclude parameters, which do not significantly influence *ktcs*. After that a Monte Carlo approach using the data sampling scheme Latin Hyper Cube Sampling (LHS) was used. LHS was used since it reduces the number of calculations needed for the estimation of the mean value as well as for the standard uncertainty. The *ktcs* calculations were done with the Virtual Gamma Spectroscopy Laboratory (VGSL) software developed at the CTBTO. In this work TCS-factors and their uncertainties were calculated for 134Cs and then compared to empirical data. It was shown that the uncertainty in the calculated correction factor for the primary gamma ray was below 0.5%, which means it will not contribute significantly to the combined measurement uncertainty in an activity determination for e.g. environmental monitoring.

About the Presenter

Dr. Johan Kastlander has a PhD in experimental nuclear physics. Currently employed as senior scientist at the Swedish Defence Research Agency (FOI).

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