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Optimization of gamma-ray spectrometry by Monte-Carlo simulation

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The low-level radioanalysis laboratory is performing part of its measurements of environmental samples using high-resolution gamma spectrometry. These samples are of various types: water, soils, plants, biologicals, aerosols. They are held in different containers for liquids and solids (from few milliliters to 500 milliliters), centering devices are used for aerosol filters.
The laboratory is developing numerical Monte-Carlo models of its pool of HPGe detectors (ranging from small 60 cm3 planar detectors to large coaxial ones with a volume larger than 250 cm3). The objectives are multiple, for some geometries radioactive calibration standards are no longer available and the simulation makes it possible to generate efficiency curves for which correction factors (self-absorption and coincidence) are derived from these models. First, a presentation of the development and validation of a numerical model and its uncertainties will be presented. Then, three examples of applications will be shown. The first is the simulation of the efficiency curve for a sample of aerosols filter, with the aim to obtain a numerical model with uncertainties lower than 10% (k=2) for energies > 60 keV and 15% (k=2) for lower energies. The second example will be on the study of equivalent heights necessary for the assessment of the self-absorption coefficients according to the formalism of ISO 18589-3 standard. Finally, a study on the variation of summation correction factors as a function of the sample composition will reopen the debate on this complex but essential subject.

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