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Development of a semi-empirical method to determine the efficiency of a gamma radiation detector for point sources

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The gamma spectrometry is the most popular technique for the determination and quantification of the radioactive nuclei present in a radioactive source. In order to obtain the quantification of the radioactive material it is necessary to determine the efficiency of the detector for the energies of the gamma photons emitted from the source.

In the present work we present the theoretical development and the first tests of a new method to calibrate the efficiency of a gamma radiation detector for point sources.

The method consists in the determination of the detector efficiency using a mono-energetic gamma source (such determination must be realized experimentally), which we will be named the reference energy. Using a mono-energetic source is the easiest way to do this. Then from this value we can extrapolate the efficiency to the complete energy range using the physics of first principles of gamma radiation detection theory. Therefore the proposed method corresponds to a semi-empirical method.

In the first work we show the application and the study for the validation of the method using one reference energy (661,65 keV). In this second work we will apply the method using three references energies along the gamma energy range of interest, due to that in the first work the agree between the obtained values by the proposed method and the expected values were worse while the energies were farther of the reference energy.

The reference energies will be: 59,54 keV, 661,65 keV and 1460,65 keV, which are associated to the ^{241}Am, ^{137}Cs and ^{40}K respectively. The second part of the method, the extrapolation from the reference energies to the gamma range, will be done over the energies emitted by ^{152}Eu. All simulations will be done using FLUKA code.

We expect to improve the results obtained by the extrapolation from one energy reference to the complete energy range, with this new proposal considering a set of reference energies and a local extrapolation from these.

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