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Abstract Title: Counting time measurement and statistics in gamma spectrometry: the balance

Nuclear counting statistics at high count rate are assessed on a γ -ray spectrometer set-up. Our typical gamma spectrometry system consists of a High Purity Germanium (HPGe) detector, liquid nitrogen cooling system, preamplifier, detector bias supply, linear amplifier, analog-to-digital converter (ADC), multichannel storage of the spectrum, and data readout devices. Although the system is powerful enough for background measurements, it is important, nowadays, to have a great statistical in short time measurement: which is a challenge for scientists. The purpose of this study was to determine the average time for gamma spectrometry measurement. To detect Uranium, Thorium and their respective daughters and Potassium series with a relative related error less than 1%, it was found that it is necessary to count during a minimum of 24 Hours (86,400 s). This result is in accordance to the literature with planar geometry detector. These results conduct us to make the following three guidelines for selecting the detector best suited for an application:

1. The more detector material available (germanium semi-conductor), the higher the full-energy peak efficiency.
2. The smaller the distance between the detector and the source material, the higher the full-energy peak efficiency.
3. While better resolution gives a better MDA, the resolution contributes only as the square root to the MDA value, whereas the MDA is proportional to the full-energy peak efficiency.

This idea came to us by comparing the spectra of measuring radioactivity lasts for 12 hours in the day that does not fully covered the night spectra for the same sample. The conclusion after several investigations became clearer: to remove all effects of radiation from outside (earth, sun and universe) our system, it is necessary to measure the background for 24, 48 or 72 hours. In the same way, the samples have to be measures for 24, 48 or 72 hours to be safe to be purified the measurement (equality of day and night measurement). It is also possible to not use the background of the winter in summer. Depend to the energy of radionuclide we seek, it is clear that the most important steps of a gamma spectrometry measurement are the preparation of the sample and the calibration of the detector.

