ICRM GSWG

March 17, 2023

Action report of the ICRM Gamma Spectrometry Working Group

One of the objectives of the GSWG is to disseminate knowledge to end-users through various exercises that provide practical information that is regularly posted on a dedicated web page. Since the last ICRM general meeting, on-going action on Monte Carlo simulation continued and, following discussion during ICRM 2019 in Salamanca, two new exercises started: one on the calculation of detection limits (lead : Milton Van Roy) and one on the calculation of self-attenuation corrections in the low-energy range.

The contact between the participants was maintained (the information is distributed to an e-mail list of 180 people), in particular through an intermediate meeting, which was held in late 2020.

More information is available at http://www.lnhb.fr/icrm_gs_wg/.

Intermediate meeting

This first “virtual meeting” of the ICRM "Gamma Spectrometry" working group was held on October 29-30, 2020 and brought together more than 70 on-line participants.

The meeting was divided into two 3-hour sessions (from 13:00 to 16:00 CET) to allow colleagues from outside Europe to actively participate.

The agenda of meeting included seven contributed talks, status on the on-going action (Benchmark for Monte Carlo simulation applied to coincidence summing corrective factors) and time dedicated to topics of interest (calculation of detection limits according to ISO11929 and self-attenuation in the low-energy range).

The last part of the meeting took the form of a general discussion in order to identify several topics of interest for future studies/exercises, and identify potential contributors. These topics are:

1. Angular correlations in coincidence summing,
2. Reference spectra
3. Self-attenuation
4. Detection limits

Thanks to the kind authorization of speakers, most of the presentations are made available on the ICRM/GSWG website: http://www.lnhb.fr/icrm_gs_wg/

Benchmark for Monte Carlo simulation – Part I: Efficiency - Part II: Coincidence summing corrective factors

This action was launched to provide a benchmark for several Monte Carlo (MC) software used in gamma-ray spectrometry, for selected detector-source cases. The examples are based on simple geometries, two types of germanium detectors and four kinds of sources, to mimic eight typical measurement conditions.

The first part of the exercise was dedicated to the calculation of detection efficiency (full energy peak efficiency and total efficiency). Eleven participants provided nineteen sets of results using four Monte Carlo generalist codes (EGSnrc, GEANT4, MCNP-CP and PENELOPE). The summary of the results was presented during the ICRM2019 conference and has been published (Lépy et al., 2020). A full report including the exhaustive series of results and comparisons obtained during the study has also been published as an LNHB internal report and should be also recorded as an ICRM special issue.

The second part of the exercise concerns the calculation of coincidence summing corrective factors, for the same geometrical conditions. Four radionuclides (^{22}Na, ^{60}Co, ^{133}Ba, and ^{134}Cs) are considered. Fifteen laboratories participate in the exercise and provided 23 sets of data, using 6 different codes (EFFTRAN, EGSnrc, GEANT4, GESPEOR, MCNP-CP and PENELOPE). The first results were presented during the October 2020 intermediate GSWG meeting. Several dedicated meetings were held to specifically discuss about this exercise. Fruitful exchanges between the meeting participants induced complementary calculations with harmonized simulation conditions to clarify the results for complex spectra and better understand the reasons for some discrepancies. Most of the data have been improved and the case of the beta-plus emitter (^{22}Na) is still under study.

The final goal of the exercise is to make “training sets” available for new users. For each code, a specific information form, the input files and the results are available in the archives. This material for the first part of the exercise (efficiencies) is already available on the ICRM/GSWG website. The same information will be prepared and distributed for the coincidence part in the next few months.

Detection limits / ISO 11929

This exercise was launched during the intermediate meeting. Several participants wished to clarify the application of ISO 11929, in order to provide simple explanation and guidelines for users when they need to report detection limits or decision thresholds.

The action is lead by Milton VAN ROOY (NIMSA) and the kick-off meeting was held on January 29, 2021. Test spectra prepared by Margarita HERRANTZ and Raquel IDOETA (Universidad del País Vasco) have been distributed to the participants who discussed in several meetings. Seven institutes participated in 3 rounds of comparisons for the manual calculation and software calculation of ISO 11929 detection limits and decision thresholds. The goal of the action has been achieved and

the results will be presented during ICRM 2023. A follow up meeting will not be required. The action is now closed.

Self-attenuation in the low-energy range

The principle of an exercise dedicated to the calculation of self-attenuation corrective factors in the low energy range was initially discussed during ICRM 2019 in Salamanca. It started

Thirteen laboratories agreed to carry out measurements with matrices containing ^{210}Pb and ^{137}Cs, and to compare their approaches to the determination of self-attenuation correction factors in order to draft practical recommendations for users. With this aim, the Laboratoire National Henri Becquerel (LNHB) prepared sets of three samples (reference, sample A and sample B), each packed in cylindrical containers, with known activities of ^{210}Pb and ^{137}Cs, according to the preparation procedure using standard solutions. Four similar batches of samples were distributed on September 2022 and circulated between the participating laboratories. The “reference” sample, filled with resin, was meant to be considered as a standard source by the participants and could be used for the efficiency calibration of the detectors. The goal of the exercise was to determine the activity of the two radionuclides included in the samples A and B, with unknown matrices. This required the participants to establish the self-attenuation correction factors between the calibration and the unknown samples. Inactive matrices were also provided and could be used to experimentally determine the attenuation coefficients of the three samples, for calculating self-absorption. The results of this initial step appear rather dispersed, as presented in a poster in the ICRM2023 conference. Analysis of the different experimental approaches and further investigations are underway.

ICRM GSWG web page (http://www.lnhb.fr/icrm_gs_wg/)

The ICRM GSWG web page is regularly updated with information on the recent activities of the group, report of the working meetings, as well as practical recommendations. Information on decision-threshold and detection-limit calculator has been included, as well as the full report on the first part of the Monte Carlo exercise.

On behalf of the Gamma Spectrometry Working Group

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