# WELCOME

Virtual meeting of the ICRM Gamma Spectrometry Working Group
October 29-30, 2020 from 13:00 to 16:00 CET (12:00 to 15:00 UTC)

- Thanks to all participants

- Skype meeting
    - Please keep your microphone mute
    - Please keep your camera off
    - Use the chat to ask questions or to comment

- Special thanks to all presenters : please run your presentation on your computer; use the « present programs » option and select the appropriate window to display

MOTIVATION
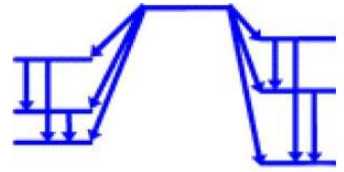
SHARE GENERAL INFORMATION

PREPARE NEW EXERCISE(S) OF INTEREST

FACILITATE EXCHANGES BETWEEN GAMMA SPECTROMETRISTS

Presentation of new studies : 7 speakers (small change of the agenda)

Discussion on topics of interest (*on request from participants*) with introductory presentations
Detection limits
Self- attenuation

Status of on-going action(s)
Benchmark for Monte Carlo simulation applied to coincidence summing corrective factors
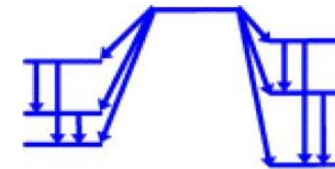
Suggestions for further actions (*your contribution is welcome!*)
Angular correlations, test spectra, exercise of activity measurement on low-energy emitting radionuclides (^{210}Pb), etc. ?
Ad-hoc meetings of a reduced number of participants on a dedicated topic ?

AGENDA – Thursday October 29th
(Time in CET – UTC +1)

ICRM GSWG

13:00 - 13:10   Welcome and workshop objectives (*Marie-Christine Lépy, LNHB*)

13:10 - 14:00   **Contributed talks**
     13:10 - 13:30   General presentation of angular correlations in gamma-ray spectrometry
                                (*Octavian Sima, University of Bucharest & IFIN-HH Bucharest*)
     13:30 - 13:45   New features of the peak fitting software COLEGRAM (*Yves Ménesguen, LNHB*)
     13:45 - 13:55   New features of the radionuclide decay database LARA (*Christophe Dulieu, LNHB*)

14:00 - 15:00   **Discussion on detection limits – Application of ISO 11929**   (Moderator: *Mikael Hult, EC-JRC*)
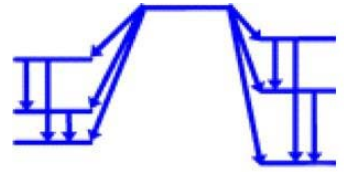   14:00 - 14:15   Introduction presentation *(Michel Bruggeman, SCK-CEN)*
     14:15 - 15:00   General discussion (*all participants*)

15:00 - 16: 00   **Implementation of density corrections**
     15:00 - 15:15   Cutshall transmission method of the self-attenuation correction determination - a
                                method outline and its Monte Carlo validation (*Pawel Jodlowsky, University Krakow*)
     15:15 - 16:00   Share experience of participants (*all participants*)

AGENDA – Friday October 30th (Time in CET – UTC +1)

ICRM GSWG

13:00 - 14:10   Benchmark on coincidence summing

    13:00 – 13:10   Introduction/ presentation of the on-going exercise (M.-C. Lépy)

    13:10 - 14:10   Presentation of results by code (5 minutes)

        13:10 - 13:15   EFFTRAN (*Tim Vidmar, SCK-CEN*)

        13:15 – 13-20   EGS (*Raphael Galea, NRC*)

        13:20 – 13:25   GESPECOR (*Octavian Sima*)

        13:25 - 13:30   GEANT (*Cheick Thiam, LNHB*)

        13:30 - 13:35   *PENELOPE (Iason Mitsios, NTUA)*

        13:35 - 13:40   MCNP (*Thien-Thanh Tran, VNUHCM-University of Science*)

    13:40 - 14:10   Summary and discussion – further step(s) (*all participants*)

14:10 – 14:20   Question about LARA - Short break (optional)

14:20 - 15:05   Contributed talks

    14:20 - 14:35   Modeling of inactive layers for p-type detectors (*Henrik Persson, Mirion technologies*)

    14:35 - 14:50   Self-evaluation of coincidence summing factor of radionuclides using MCNP-CP and PENNUC codes (*Thien-Thanh Tran*)

    14:50 - 15:05   Effect of the uncertainty of decay data parameters (*Octavian Sima*)

    15:05 - 15:20   New [166]Ho gamma emission intensities by high-energy-resolution and well-calibrated HPGe detector (*Marco Capogni, ENEA*)

15:20 - 16:00   Proposal of new actions - Discussion (all participants)
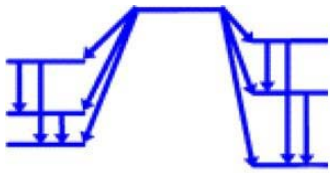
Web page : http://www.lnhb.fr/icrm_gs_wg/

ICRM GSWG

- Which information ?

- Update with
  - Training course presentations
  - WG meeting presentations and actions status

ICRM Gamma-Ray Spectrometry Working Group

The Gamma-Ray Spectrometry Working Group is devoted to the development of the metrological aspects of gamma-ray spectrometry and its applications. This includes, but is not restricted to: measurement techniques and equipment, determination of photon emission intensities, detector efficiency calibrations (including Monte Carlo methods), coincidence-summing corrections, uncertainties, correlations, new instrumentation, and X-ray spectrometry.

Meetings & Workshops

WG actions (Past & on-going)

Monte Carlo benchmarks

Past exercises & Publications

Events & Courses

Practical info & Useful links

ICRM Gamma-Ray Spectrometry Working Group

GAMMA-RAY SPECTROMETRY WORKING GROUP MEETINGS AND WORKSHOPS

Business meetings of the Gamma-Ray Spectrometry Working Group are regularly held during the ICRM conferences. The last one was held on May 28th, 2019 during ICRM2019 in Salamanca. The meeting report is attached here: ICRM_GSWG_Report_2019.pdf
The next one will take place during the ICRM 2021 conference.

These meetings give the opportunity to take stock of the on-going actions and to initiate new ones. Any member of the GSWG must feel free to propose and coordinate new projects at any time.

Intermediate workshop are organized, according to the needs of discussion about on-going actions. The last workshop was held on June 14th, 2018, in the headquarters of Laboratoire National de Métrologie et d'Essais in Paris.
The meeting report is attached here: ICRM_GSWG_Report_2018.pdf

An intermediate videoconference meeting will be held on 29-30 October between 13:00 and 16:00 (CET). Other WG meetings (Nuclear Decay Data, Beta Spectrometry and Radionuclide Measurement Techniques) will be held at the beginning of the same week. Further information will be provided in due time.

+ **List of 2018 workshop presentations**

+ **List of 2018 workshop courses**

ICRM GSWG
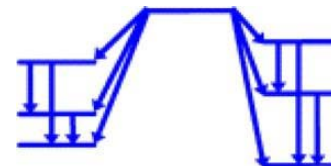
WORKING GROUP ACTIONS

Starting with the ICRM 2005 conference, the GSWG members participated in a series of exercises to compare codes as applied to detector calibration. The exercises addressed problems such as direct computation of efficiency, application of Monte Carlo codes to efficiency transfer, computation of coincidence summing corrections in various cases. The results of the most recent exercises (self-consistency of the methods applied for the evaluation of coincidence summing corrections and benchmark for Monte Carlo simulation) were presented during the ICRM 2019 conference in Salamanca.

ON-GOING ACTIONS

Simple exercise on self-consistency of the methods applied for the evaluation of coincidence summing corrections in the case of volume sources

Coordination: Octavian Sima

An action to test the internal self-consistency of the methods applied to evaluate coincidence-summing corrections for extended sources is proposed. While internal consistency does not guarantee the correctness of the method, if it is not satisfied, it points out that the method has some shortcomings and its validity has specific limitations. The proposed self-consistency test is based on exact relations that should be fulfilled in the case of specific ideal measurement configurations. More precisely, the results obtained using any computation method for one such configuration should be related by exact equations to the results given by the same method for other configurations. Thus, this test does not require experimental data (avoiding the problem of experimental uncertainties) or comparisons of a method with other methods (avoiding the debate concerning the selection of a particular reference method). Specifically, the participants in this exercise are asked to evaluate the coincidence-summing correction factors for several peaks of Co-60, Cs-134, Ba-133 and Eu-152 for one detector and 3 volume source geometries.

Further information is available here.

Action to facilitate the use of Monte Carlo simulation software

Coordination: Marie-Christine Lépy
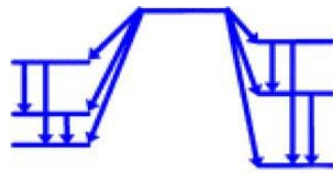
EVENTS & COURSES

Forthcoming events

- **ICRM LLRMT 2020**
  https://icrm2020.lngs.infn.it
  The Low-Level Radioactivity Measurement Techniques (LLRMT) 2020 Conference is a five-day topical meeting of the International Committee for Radionuclide Metrology (ICRM). INFN-LNGS is pleased to host the conference at the **Laboratori Nazionali del Gran Sasso, Assergi, Italy, April 20-24, 2020**.
  The ICRM working group for Low-Level Measurements Techniques (LLMT) examines techniques to enable the detection of ever lower amounts of radioactivity. This enables for example collecting smaller samples and realising new applications involving radionuclides. The working group focuses on metrology and the latest developments in a variety of areas, including measurement of environmental radioactivity, radionuclides in food and drinking water, reference materials characterisation, tracer studies and nuclear physics research. It is planned to publish the conference proceedings in a refereed scientific journal. The conference brings together 130-150 worldwide experts for presentations and discussion covering the techniques, applications and data in the field of low-level radioactivity measurement.

- **ISRD 2020**
  http://isrd17.reactordosimetry.org
  The **Seventeenth International Symposium on Reactor Dosimetry** (ISRD) will be held **May 10-15, 2020 in Lausanne, Switzerland**.
  This Symposium is held approximately every three years to provide a forum for the interchange of state-of-the-art techniques, databases and standards for radiation metrology. The Symposium will be of value to those involved in reactor dosimetry, including researchers, manufacturers and representatives from industry, utilities and regulatory agencies. The Symposium theme is dosimetry for the assessment of irradiated reactor materials and reactor experiments, featuring radiation metrology techniques, databases and standardization.

- **ALTECH 2020**
  https://www.european-mrs.com/altech-2020-analytical-techniques-precise-characterization-nano-materials-emrs
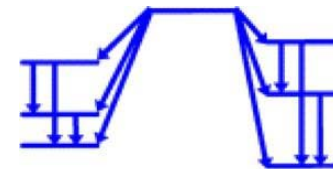
Uncertainties

- Uncertainties in gamma-ray spectrometry, M.-C. Lépy, A. Pearce and O. Sima, Metrologia 52 (2015) S123-S145

Bibliography by topics   Requires update …

The attached files include a non-exhaustive list of published articles in relation with the main topics.

Coincidence summing

- The attached file (Coincidence_summing_Biblio.pdf) gathers around 50 references sorted in the publication dates. They present either theoretical or practical methods, or experimental validations.
  This is only a list without any judgment about the quality of the quoted articles.

Monte Carlo methods applied to efficiency computation

- The attached file (Monte_Carlo_Efficiency_Biblio.pdf) gathers around 20 references sorted in the publication dates.
  This is only a raw list without any judgment about the quality of the quoted articles.

Training material

The hereafter attached PDF files are presentations that have been used for the purpose of training.

Efficiency
Self-attenuation   Should be updated with the presentations of the training workshop (June 2018)

ICRM GSWG

http://rma-symposium.engin.umich.edu
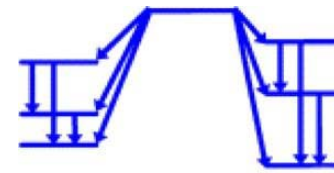
PRACTICAL INFORMATION

Basic bibliography

- **Practical Gamma-Ray Spectrometry, 2nd Edition**
  Author: Gordon Gilmore
  April 2008
  Publisher: Wiley
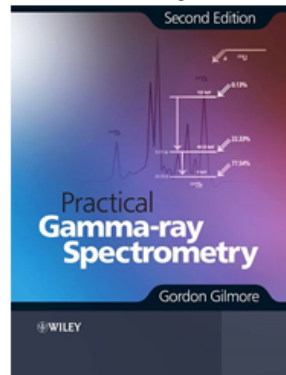
- **Radiation Detection and Measurements, 4th edition**
  Author: Glenn F. Knoll
  January 2000
  Publisher: John Wiley & Sons, Inc.

Gamma ray spectra

An on-line library of gamma ray spectra is maintained by Idaho National Laboratory – Gamma Spectrometry Center. « The INL's Gamma-ray Spectrum Catalogue is an attempt to compile spectra from various detector types and present these spectra with decay schemes and data tables based on the latest ENSDF data. It includes recently acquired Ge spectra and decay data as well as available spectra acquired for the original NaI(Tl) and Ge(Li) Catalogues. All information is documented by the spectra acquisition date and the ENSDF download date. (http://www4vip.inl.gov/gammaray/catalogs/ge/catalog_ge.shtml)

Software

Hereafter is included a list of software that can be useful for gamma-ray spectrometrists. This is given only for information purposes and citation does not mean that the working group recommends or supports these software. Any hyperlinks are only given for convenience and do not imply any support from the working group.

Efficiency transfer and self-attenuation corrections

- ANGLE: www.dlabac.com/angle
- EFFTRAN is an efficiency transfer code with the following characteristics:
  • Limited to HPGe detectors and cylindrical samples (including point sources)
  • Axial symmetry of the setup assumed, except for a possible shift (misalignment) of the detector crystal
  • Crystal rounding (bulletization) and an absorber can be modelled
  • The standard can be an extended source, not only a point one
  • User interface is an Excel workbook (with some VBA code)
  • Numerical integration is realised with the Monte Carlo method, statistical uncertainty of the results is 1%
  • Execution time is a few seconds

Any other information welcome !
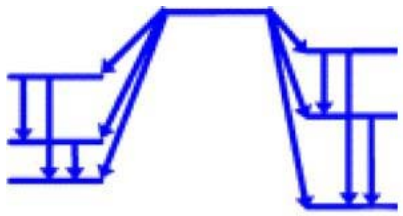
WELCOME

Virtual meeting of the ICRM Gamma Spectrometry Working Group
October 29-30, 2020 from 13:00 to 16:00 CET (12:00 to 15:00 UTC)

- Thank you all for your participation

- Special thanks to all speakers : please run your presentation on your computer; use the « present programs / desktop » option and select the appropriate window to display

- Apologies for any techical issues and changes in the agenda

- The presentations will be made available at the ICRM GSWG web page:
      http://www.lnhb.fr/icrm_gs_wg/

- « Laraweb » application at: http://www.lnhb.fr/donnees-nucleaires/module-lara/

With demo video (Nucleide-Lara.mp4) at: ftp://ftp.cea.fr/incoming/y2k01/DDEP_2020/

AGENDA – Friday October 30th (Time in CET – UTC +1)

ICRM GSWG

13:00 - 14:10   Benchmark on coincidence summing

    13:00 – 13:10   Introduction/ presentation of the on-going exercise (M.-C. Lépy)

    13:10 - 14:10   Presentation of results by code (5 minutes)

        13:10 - 13:15   EFFTRAN (*Tim Vidmar, SCK-CEN*)

        13:15 - 13-20   EGS *(Raphael Galea, NRC)*

        13:20 - 13:25   GESPECOR (*Octavian Sima*)

        13:25 - 13:30   GEANT (*Cheick Thiam, LNHB*)

        13:30 - 13:35   PENELOPE *(Iason Mitsios, NTUA)*

        13:35 - 13:40   MCNP (*Thien-Thanh Tran, VNUHCM-University of Science*)

    13:40 - 14:10   Summary and discussion – further step(s) (*all participants*)

14:10 – 14:20   Questions about LARA - Short break (optional)

14:20 - 15:05   Contributed talks

    14:20 - 14:35   Modeling of inactive layers for p-type detectors (*Henrik Persson, Mirion technologies*)

    14:35 - 14:50   Self-evaluation of coincidence summing factor of radionuclides using MCNP-CP and PENNUC codes (*Thien-Thanh Tran*)

    14:50 - 15:05   Effect of the uncertainty of decay data parameters (*Octavian Sima*)

    15:05 - 15:20   New [166]Ho gamma emission intensities by high-energy-resolution and well-calibrated HPGe detector (*Marco Capogni, ENEA*)

15:20 - 16:00   Proposal of new actions - Discussion (all participants)

FUTURE OF ICRM GAMMA SPECTROMETRY WORKING GROUP

ICRM GSWG
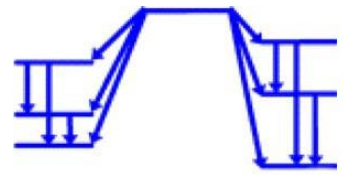
On-going action : coincidence summing corrections

Proposal of new actions/exercises :
- Reference spectra
- Angular correlations
- Self-attenuation
- Detection limits

Other suggestions:
Tests of efficiency fitting functions / associated uncertainties ?
Coincidence techniques
Efficiency for well-type detectors

Other topics to follow ?
Artificial intelligence (use of neural networks)
Experience on new portable detectors (electrically cooled ?)
DSP / dead time corrections (pulser?)
other suggestion ?
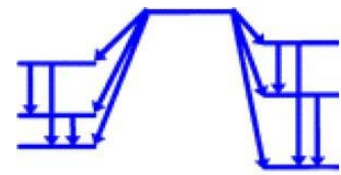
ICRM GSWG

Presentation by Samuele Cotta

Which goal ?

Peak analysis (net areas) ?
Efficiency calibration ?
Corrective factors ?
Training for new users ?

Link with IAEA ?
Monte Carlo simulation instead of experimental spectra ?

Interested partners for a dedicated study group (in conjunction with the low-level WG ?):

Rosella Rusconi, Samuele Cotta (ARPA), Pierino de Felice and colleagues (ENEA) (?), Stephen Long (ARPANSA), Marios Anagnostakis (NTUA), Marilia Savva (IPTA), Konstantinos Karfopoulos (EEAE), Niall Murphy (EPA), Raquel Ideota (EHU), Pawel Saganowski (POLATOM), others ?

SELF ATTENUATION IN THE LOW-ENERGY RANGE
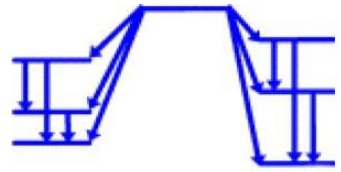
Several questions to prepare any intercomparison (survey ?)

Which radionuclide (chemistry issues ?)

Which geometry ?

Which material (resin, liquid, silica, ?)

What about mass attenuation coefficients (measurements, tabulated values ?) : 1st step ?

What to report ? Self attenuation or activity ?

Interested partners for a dedicated study group:
Marios Anagnostakis (NTUA), Anne de Vismes-Ott (IRSN), Marilia Savva, Theodora Vasilopoulou (IPTA), Konstantinos Karfopoulos (EEAE), Benoît Sabot (LNHB), Niall Murphy (EPA), Tran Thien Thanh (VNUHCM), Leen Verheyen (SCK-CEN), Pawel Jodlowski (U. Krakow), Raquel Idoeta (EHU), Virginia Peyres (CIEMAT), Pawel Saganowski (POLATOM),
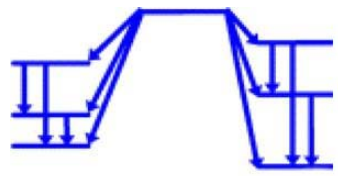
ICRM GSWG

Application of ISO 11929

      Provide simple explanation for users (see M. Bruggeman presentation)

      Test cases examples to compute the characteristic limits

      How to report results

      Excel spreadsheet for calculations ?

Interested partners for a dedicated study group :
      Michel Bruggeman, Aurelian Luca (IFIN), Mikael Hult (EC-JRC)?, Milton van Roy (NMISA)?, Anne de
      Vismes-Ott (IRSN), Pawel Saganowski (POLATOM), Stefan Roettger (PTB), Margarita Herranz (EHU),
      Tran Thien Thanh (VNUHCM), others ?
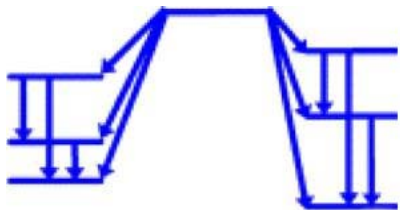
CONCLUSION

- Thank you all for your participation (> 70)
- Special thanks to all speakers

- Hope you will have find the meeting interesting/useful
  (new participants/ students)
- Apologies for any techical issues
- Following-up events (dedicated meetings)
- You are welcome to feed the web page

- The meeting report and presentations (with the updated « group photo ») will be made available at the ICRM GSWG web page: http://www.lnhb.fr/icrm_gs_wg/

Thank you for your attention
and active participation

See you in Bucharest !

ICRM GSWG