

International Committee for Radionuclide Metrology Editor : Mark A. Kellett



International Committee for Radionuclide Metrology ICRM

ICRM NEWSLETTER Issue 31

Foreword

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September 2018

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Editorial

This newsletter was established in response to a recommendation of the International Committee for Radionuclide Metrology made during its General Meeting in Grenoble 1985. It is meant to serve as a medium for informal exchange of information between workers active in the field of Radionuclide Metrology.

The scope of the Radionuclide Metrology Newsletter is to describe briefly current activities in the following topics:

- foil and source preparation;
- α -, β and γ -ray spectrometry including spectrum evaluation;
- improvement and development of radionuclide measurement techniques;
- measurement and evaluation of radionuclide data;
- low-level radioactivity measurement techniques;
- life-sciences;
- quality assurance and traceability.

In order to ensure that the Newsletter is as comprehensive and informative as possible, contributions are sought from all laboratories known to be engaged in measurements and data evaluation techniques relevant to Radionuclide Metrology. All previous contributors will be informed concerning the deadline for the next issue. New contributing Radionuclide Metrology laboratories are welcome. Please contact the editor.

Any comments on this issue or suggestions for improvement are welcome.

At the ICRM General Meeting in Paris 1995, it was decided that the ICRM Newsletter would also allow for the distribution of Progress/Planning Reports SA1 and SA2. From the experience of this and previous issues, many laboratories regard their normal Newsletter contribution as a fulfilment of SA1/SA2 and provide no further information.

Laboratories who do wish to provide these SA1/SA2 reports (which should not be longer than 2 pages) should mention in the letter/email accompanying their contribution(s) that the SA1/SA2 contributions are intended for publication in the Newsletter. Any such reports are presented prior to the normal Newsletter contributions for each laboratory and shown as such in the Table of Contents.

For economic reasons, at the ICRM General Meeting in Dublin 2003, it was agreed that the ICRM Newsletter would be available for download from the LNE–LNHB website at (<u>http://www.lnhb.fr/conferences-publications/icrm-newsletter/</u>) and only distributed in hard copy or CD-ROM to those having requested this.

Contributions may be sent by email as an attachment in MS Word (see below) to the Editor.

Instructions to Contributors

This Newsletter is produced with no major alterations by the editor. To ensure readability and avoid unnecessary work by the editor, it is suggested that:

- Contributions should be typed on plain white A4 paper (21 cm x 29.7 cm) format inside a box of 15.5 cm x 20 cm which should be situated 4.5 cm from the upper and 3 cm from the left margin. Please use font Times New Roman size 11. The format indicated below should be followed.
- Contributions should contain **no** page number, date, signature, or any correspondence references typed on this sheet. Correspondence to the editor must be on a separate sheet.
- Contributions should be in English and carefully proofread by the authors.
- References to publications or reprints should be provided in the style required by the Physical Review.
- Complete mailing address and the name of a person who can be contacted for additional information by those desiring it should be given at the end.
- Please use the "ICRM_NL_form_2017.dotx" template (shown below) to help ensure your contribution meets the above specifications.
- Please note that only files in MS Word format will be accepted.

Contri	bution	Format
	Junion	I UI IIIuv

LABORATORY	Name of laboratory, Country
NAMES	If more than one laboratory is involved identify affiliation through abbreviations (ORNL, LASL, etc.).
	Visitors can also be identified with asterisks.
APPARATUS/ ACTIVITY	Please choose one: APPARARTUS for experiments or ACTIVITY for compilations, calculations or theory.
KEYWORDS	<i>(Delete/insert as appropriate)</i> Alpha spectrometry, beta spectrometry, calorimetry, (anti) coincidence method, cryogenic detector, data evaluation, data measurement, defined solid angle (ASD) measurement, environmental control, Euromet, gamma-ray spectrometry, gas proportional counter, ionisation chamber, life sciences, liquid scintillation, low-level, NaI well-type counter, neutron measurement, radioactive gas, radiochemistry, simulation code, SIR, source preparation, traceability, X-ray spectrometry, radionuclide by name (e.g. ⁵⁵ Fe or Fe-55)
RESULTS	Use this for experimental results.
PUBLICATIONS	Use Physical Review style. Include only published material.
IN PROGRESS	Use this for description of the current work.
INFORMATION SOURCE	Use this for evaluations or compilations.
IN PREPARATION	Use this to also indicate papers submitted for publication.
OTHER RELATED PUBLICATIONS	Optional.
ADDRESS	Mailing address. Give also telephone, fax numbers and E-mail address.
CONTACT	Single contact person.

Additional items

You may also add information below. All items given here will be brought together in a specific chapter at the beginning of the Newsletter.

Announcements: (*Only information of interest to the Radionuclide Metrology Community, e.g. conferences, workshops, theses in progress, etc.*)

Proposals: (Search for PhD or post-doc students, collaboration proposals, etc.)

General Information on ICRM

ICRM Newsletter 2017

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President's Message

The International Committee for Radionuclide Metrology (ICRM) is an association of radionuclide metrology laboratories whose membership is composed of delegates of these laboratories together with other scientists (associate members) actively engaged in the study and applications of radioactivity. It explicitly aims at being an international forum for the dissemination of information on techniques, applications and data in the field of radionuclide metrology. This discipline provides a range of tools for tackling a wide variety of problems in numerous other fields, for both basic research and industrial applications.

ICRM was founded at Paris in 1974 as a "club" of a few nuclear metrology laboratories and grew rapidly to a worldwide association with at present 47 institutions represented by delegates. The ICRM has no membership fee and no paid secretariat or other staff. Its overall direction is determined by the delegates in General Meetings, which convene usually every two years, where organisational guidelines and directions for the working programmes are agreed upon. The following officers of ICRM are presently serving on the Executive Board:

President	Eduardo García-Toraño ¹	e.garciatorano@ciemat.es
Vice-President	Mikael Hult ²	mikael.hult@ec.europa.eu
	John Keightley ³	john.keightley@npl.co.uk,
	Akira Yunoki ⁴	a.yunoki@aist.go.jp
Past-President	Dirk Arnold ⁵	dirk.arnold@ptb.de
Secretary	Franz Josef Maringer ⁶	franz-josef.maringer@bev.gv.at

The Executive Board relies heavily on the Nominating Committee which has the objective of ensuring the continuity of purpose and vigour of ICRM. It does this by soliciting from the membership, and by itself proposing, the names of eligible candidates to fill vacancies about to occur on the Executive Board and the Nominating Committee. The current membership of this committee is:

Chairperson	Simon Jerome ³	simon.jerome@npl.co.uk
Members	Pierino de Felice ⁷	pierino.defelice@enea.it
	Octavian Sima ⁸	octavian.sima@partner.kit.edu

Plenary meetings of the ICRM are held biennially and have developed into a successful instrument of communication among various specialists, truly encouraging international co-operation. The most recent one was at the 21^{st} International Conference on Radionuclide Metrology and its Applications (ICRM 2017), which took place on 15 - 19 May 2017 in Buenos Aires, Argentina, hosted by the Argentinian Comisión Nacional de Energía Atómica (CNEA).

Our appreciation and thanks go to all who contributed to this very successful meeting. In particular we recognise the great contributions made by Pablo Arenillas and his Local Organising Committee, especially Christian Balpardo, Amanda Iglicki, Darío Rodrígues and Eliana Depaoli. Many thanks are

also addressed to the Scientific Programme Committee, the referees and session chairmen and the authors of oral and poster presentations.

ICRM activities are largely the responsibility of its working groups. Each group is guided by a coordinator who acts as a centre for ideas and communications and may organise conferences and workshops. Currently eight working groups are featuring with the following fields of interest:

(1) Radionuclide Metrology Techniques (RMT)	
John Keightley ⁴	john.keightley@npl.co.uk,
Mike Unterweger ⁹	michael.unterweger@nist.gov
Sub-groups:	
- Digital Coincidence Counting	
Christophe Bobin ¹⁰	christophe.bobin@cea.fr
- Internal Gas Counting	
Mike Unterweger ⁹	michael.unterweger@nist.gov
- Large Area Sources	
Pierino De Felice ⁵	pierino.defelice@enea.it
(2) Life Sciences (LS)	
Jeffrey T. Cessna ⁹	jeffrey.cessna@nist.gov
(3) Alpha-Particle Spectrometry (AS)	
Stefaan Pommé ²	stefaan.pomme@ec.europa.eu
(4) Gamma-Ray Spectrometry (GS)	
Marie-Christine Lény ¹⁰	marie-christine lenv@cea fr
	<u>indre ennstnenepy e cedin</u>
(5) Liquid Scintillation Counting (LSC)	
Karsten Kossert ²	<u>karsten.kossert@ptb.de</u>
(6) Low-Level Measurement Techniques (LL)	
Mikael Hult ²	mikael.hult@ec.europa.eu
Sub-group:	
- 04 near decision threshold	
Matiaz Korun ¹¹	matiaz korun@ijs si
	<u>inagaz.korun@ijs.si</u>
(7) Beta-Particle Spectrometry (BS)	
Xavier Mougeot ¹⁰	<u>xavier.mougeot@cea.fr</u>
(8) Nuclear Decay Data (NDD)	
Mark Kellett ¹⁰	mark.kellett@cea.fr

We thank all the above co-ordinators.

The next 22^{nd} International Conference ICRM 2019 will be held on 27 - 31 May 2019 in Salamanca, Spain, hosted by the Universidad de Salamanca. The contact persons of the local organising committee are Dr. Begoña Quintana (<u>quintana@usal.es</u>) and Dr. Juan Carlos Lozano (<u>jll390@gugu.usal.es</u>). The conference will include oral and poster presentations and business meetings of the ICRM Working Groups, in plenary format.

In addition to these plenary meetings at the ICRM conference, each WG may have specific meetings in the form of international conferences or more restricted workshops. The most recent one was the ICRM-LLRMT 2016 Conference, organised on September 2016 by the Low-Level WG in Seattle (WA, USA) and hosted by the Pacific Northwest National Laboratory. Conference Proceedings have been published in Applied Radiation and Isotopes 126 (2017).

Two WGs will hold meetings at VNIMM in St. Petersburg, Russia, this year. The LSC WG will meet on 4-5 June 2018 and the Life Sciences WG on 7-8 June 2018. The Gamma-ray Spectrometry WG will meet in Paris on 14 June. Finally, three WGs, Beta Spectrometry, Nuclear Decay Data and Radionuclide Metrology Techniques, are planning a meeting 10-14 September 2018 at NIST, USA, in collaboration with the Decay Data Evaluation Project (DDEP). All relevant information is available from WG coordinators.

All ICRM meetings are announced on the ICRM home page <u>http://physics.nist.gov/icrm</u> or in this Newsletter. Anyone wishing to participate in these ICRM activities or to receive further information is encouraged to contact one of the officers or Working Group co-ordinators, and also to visit the ICRM home page.

We express our heartfelt thanks to Dr. Mark A. Kellett¹⁰ for compiling and Christophe Dulieu¹⁰ for uploading this ICRM Newsletter, and also to Dr. Lisa Karam⁹ for maintaining our ICRM home page.

February 2018

Eduardo García-Toraño President of ICRM

Affiliations

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- 4. National Metrology Institute of Japan (NMI), National Institute of Advanced Industrial Science and Technology, Tsukuba Central 2, 1-1-q, Umezono, Tsukuba, Ibaraki, 305-8568, Japan.
- 5. Physikalisch-Technische Bundesanstalt (PTB), Bundesallee 100, D-38116 Braunschweig, Germany.
- 6. Bundesamt für Eich- und Vermessungswesen (BEV), Arltgasse 35, A-1160 Wien, Austria.
- 7. Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA), C.R. Casaccia, P.O. Box 2400, I-00100 Rome, Italy.
- 8. Faculty of Physics, University of Bucharest, 425 Atomistilor Str., Bucharest-Magurele, P.O. Box MG-11, RO-077125, Romania.
- 9. National Institute of Standards and Technology (NIST), Gaithersburg, Maryland, 20899-8462, U.S.A.
- 10. Laboratoire National Henri Becquerel (LNHB), F-91191 Gif-sur-Yvette Cedex, France.
- 11. Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia

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Letter to Mrs Ursula Schönfeld

Madrid, Spain, 29 January 2018

Dear Mrs. Schönfeld and family,

We have been made aware of the very sad news that our dear colleague Eckart Schönfeld passed away. For many years, he has been an active participant in the activities of our association, the International Committee for Radionuclide Metrology (ICRM).

All ICRM members recognize the significant contributions that Eckart made to the field of radionuclide metrology over the years, in particular in nuclear data studies.

On behalf of the ICRM Executive Board and all ICRM members, we express our sympathy to you and your family.

Sincerely yours,

Eduardo García-Toraño (ICRM President) Franz-Josef Maringer (ICRM Secretary)



Summary of Executive Board meeting of April 2016

Geel, 6 May 2016 Ref: UW/ICRM Sec/2016/03

Dear ICRM delegate and associate members,

On behalf of the ICRM Executive Board, I would like to give you a summary of our most recent Executive Board meeting, held on 12 and 13 April 2016 at CNEA-CAE in Buenos Aires-Ezeiza, Argentina. The meeting was attended by Dirk Arnold (President), Pierino de Felice (Past-President), Eduardo García-Toraño, Franz Josef Maringer (Vice-Presidents) and Uwe Wätjen (Secretary). Tae Soon Park (Vice-President) and Guy Ratel (Chair of the Nominating Committee, invited as observer) were excused. Pablo Arenillas and (temporarily) Amanda Iglicki and Juan Carlos Furnari attended the meeting as members of the ICRM 2017 local organising committee.

The meeting was scheduled to, mainly,

- > Prepare the next ICRM 2017 Conference in Buenos Aires:
 - As communicated earlier, the conference will take place 15 19 May 2017. The Argentinian National Commission of Atomic Energy – Ezeiza Atomic Center (CNEA-CAE) will be hosting the conference. Pablo Arenillas is the Scientific Secretary and Chair of the local organising committee.
 - The Local Organising Coimmittee (LOC) comprises Pablo, Juan Carlos Furnari, Amanda Iglicki, Christian Balpardo, Gabriela Cerutti; Daniela Guevara and Melania Kikuchi (CNEA public relations department); Silvia Chinen (WEBsite support).
 - The conference itself will take place 15 18 May 2017, on 19 May there will be the ICRM General Meeting and, alternatively, opportunity for laboratory visits at the Ezeiza Atomic Center.
 - Only a few days before this EB meeting, the Legislature (city parliament) reconsidered its offer to host the conference. Therefore, the Regente Palace Hotel in the centre of Buenos Aires was now chosen as venue. Nevertheless, the local organisers are still exploring alternative venues.
 - The LOC will recommend a number of hotels in different price categories, all within walking distance from the definite venue.
 - Social activities: Get-together on Sunday, 14 May 2017, together with the registration. Cocktail reception on Monday evening, and Conference Dinner incl. a short Tango show on Wednesday.
 - Early registration fees will be around 450 EUR.
 - The abstract review procedure introduced with the ICRM 2015 conference allowing for an in-depth abstract evaluation in subgroups of the Scientific Committee will be applied again. Members of the Scientific Committee were proposed.
 - Deadline for the submission of abstracts was fixed at 16 September 2016.
 - The Scientific Committee will meet in Rome 2-3 November 2016. Acceptance (or rejection) letters for presentations at ICRM 2017 will be sent to authors during November.

- It is intended to publish the conference proceedings as a special issue of Applied Radiation and Isotopes.
- All necessary details will be communicated in a first conference announcement and call for papers before the end of this month.

> Discuss future symposia of ICRM Working Groups:

As communicated earlier:

- The Low-Level Measurement Techniques WG will hold its 7th ICRM-LLRMT conference in Seattle (WA, USA) from 26-30 September 2016, hosted by the Pacific Northwest National Laboratory (PNNL).
- The newly formed Nuclear Decay Data WG, together with the Beta Spectrometry and Radionuclide Metrology Techniques WGs of ICRM and the Decay Data Evaluation Project (DDEP), will hold a joint workshop and ICRM WG meetings 19-22 September 2016 at NPL, Teddington, UK.
- The Liquid Scintillation Counting WG and the Life Sciences WG will organise their **interim meetings** at ENEA, Casaccia, Italy from 7 to 11 November 2016.

> Membership:

After invitation by the last General Meeting to join ICRM, the Rector of the National Technical University of Athens, Greece, accepted the membership for the NTUA and appointed Marios Anagnostakis as delegate to ICRM.

Likewise, the Director of the International Monitoring Systems Division of the Comprehensive Nuclear-Test-Ban Treaty Organization, Vienna, accepted membership for the CTBTO and nominated Ms. Naoko Nakashima as delegate to ICRM.

> ICRM Newsletter, publications and WEB site:

– The ICRM Newsletter 30 was published online in April 2016, the EB is grateful to Mark Kellett for taking care of the editorship:

http://www.nucleide.org/Publications/icrm_newsletter.htm

[See new website: http://www.lnhb.fr/conferences-publications/icrm-newsletter/ Ed.]

- The ARI special issue of the ICRM 2015 Proceedings was published already in March 2016 in printed form and dispatched by Elsevier to the conference participants: Applied Radiation and Isotopes Vol. 109, March 2016.

- The ICRM WEB site still needs to be updated.

Uwe Wätjen (ICRM Secretary)



Summary of Executive Board meeting of November 2016

Geel, February 2018

Dear ICRM members,

I apologize that I did not write and circulate this summary in due time (end of 2016/early 2017) as I had usually done during the past four years with other meetings. For transparency reasons and documentation, I would still like to present this summary of the Executive Board (EB) meeting, held on 4 November 2016 at ENEA headquarters in Rome, Italy, as a contribution to the Newsletter.

The meeting was attended by Dirk Arnold (President), Pierino de Felice (Past-President), Franz Josef Maringer, Tae Soon Park, John Keightley (Vice-Presidents) and Uwe Wätjen (Secretary). Pablo Arenillas (Scientific Secretary of ICRM 2017), Guy Ratel (Chair of the Nominating Committee) and Eduardo García-Toraño were invited as observers.

The meeting was scheduled to, mainly,

- > Support the preparation of the next ICRM 2017 Conference in Buenos Aires:
 - Pablo Arenillas, Scientific Secretary of ICRM 2017, reported about the status of preparation.
 - The conference would take place 15 18 May 2017, the ICRM General Meeting on 19 May.
 - Venue would be the Hotel Panamericano on Av. Carlos Pellegrini 551, across from the Obelisco and Teatro Colón in the very centre of Buenos Aires.
 - Hotel booking: a list of hotels with negotiated prices would be made available.
 - Registration fees were targeted to be between 450 € (before 28 February 2017), 520 € afterwards and 570 € on-site, the WEBpage would give all details once fixed. All other registration information was given on the WEB as well such as social activities in the evenings of Sunday through Wednesday, the accompanying person's fee (110 €) and optional tour costs.
 - At the level of these fees, a considerable deficit was envisaged to be covered by the hosting institution CNEA and additional sponsoring companies and institutions.
 - CNEA also considered to provide an instantaneous interpretation service in order to attract more Latin-American participants.
 - During the two days preceding this EB meeting, the Scientific Committee (SC) had met to make a selection from the 149 submitted abstracts for oral and poster presentations (132 abstracts accepted, 17 rejected) as well as for papers to be published in the proceedings. Elsevier's change in proceedings policy encompassing a reduction of the number of papers in a conference special issue, communicated to the Scientific Committee only during the meeting, required a new approach by the ICRM

SC to the conference proceedings. After intensive discussions, of the 132 abstracts admitted as conference contributions, 115 were accepted to be reviewed for *Appl. Radiat. Isot.*; 11 contributions were accepted for review as paper in the new online *ICRM Technical Series on Radionuclide Metrology*, and 6 poster contributions remained without a paper. Two post-deadline abstracts were accepted later as poster without paper.

- All abstract authors were informed of the decision of the SC on their abstract as soon as possible. The manuscript deadline was set only after the proceedings details had been clarified with ARI.
- The EB discussed the abstract evaluation procedure, which is relying more on subgroups of the Scientific Committee with the proper expertise for a better in-depth abstract evaluation, and which was applied for the second time with this conference. Some necessary refinements were identified (improvement of the abstract template, clearer instructions on the timeliness) which will be used for the next conference (ICRM 2019).

> Discuss symposia of ICRM Working Groups:

- The 7th ICRM-LLRMT conference was organised by the LLMT WG from 26 to 30 September 2016 in Seattle (WA, USA), hosted by the Pacific Northwest National Laboratory (PNNL). It drew 120 participants, interesting contributions were given i.a. by PNNL and CTBTO. Gas counting at PNNL would possibly be compared in the future with measurements at LNHB and NPL.
- In the week of 19 September 2016, the ICRM RMT, BPS and NDD WGs and the Decay Data Evaluation Project (DDEP) met in a series of meetings at NPL, discussing issues of their fields and also of common interest.
- In the week following the SC and EB meetings, the Liquid Scintillation Counting WG and the Life Sciences WG were going to organise their interim meetings at ENEA with more than 20 participants (7 11 November 2016).

> Publications:

ICRM Secretary Uwe Wätjen was going to request an ISSN number for the new periodical *ICRM Technical Series on Radionuclide Metrology*, which will contain part of the proceedings of future conferences starting with ICRM 2017.

Future ICRM conferences (2019 and later):

With the recent offer of University of Salamanca to host ICRM 2019, presented on their behalf by Eduardo García-Toraño in this EB meeting, there were at the time (together with TAEK, Turkey and BATAN, Indonesia) three candidates to host ICRM 2019.

Uwe Wätjen (ICRM Secretary at the time of the meeting)



Summary of the 2017 ICRM General Meeting

Geel, 8 September 2017 Ref: UW/ICRM Sec/2017/04

Dear ICRM delegate and associate members,

Before getting to the summary of the ICRM 2017 General Meeting (GM), held at Buenos Aires, Argentina, on 19 May 2017, I would like to give you a short **overview of ICRM activities planned for the coming 12 months** or so.

Several ICRM interim working group meetings in the course of this and the next year will give ample opportunity to discuss in an informal atmosphere technical details of specific sub-fields of radionuclide metrology. Therefore, ICRM member institutions are strongly encouraged to give young researchers the possibility to participate. Consecutive meetings of the Liquid Scintillation Counting and Life Sciences working groups are being planned at VNIIM in St. Petersburg, Russia in the first full week of June 2018. A combined workshop of the Nuclear Decay Data, Beta-Spectrometry and RMT working groups together with a DDEP (Decay Data Evaluation Project) meeting is planned for 2018, probably at NIST. Within the LLMT working group, a subgroup led by Matjaž Korun is performing an action addressing the uncertainty of locating gamma-ray peaks of large statistical uncertainties using computerized peak-evaluation procedures. The Gamma-Ray Spectrometry WG proposes an interim meeting to be held in Paris (in the week before or after the St. Petersburg meeting) to discuss two actions concerned with the evaluation of detection efficiency and of coincidence summing and other required corrections and the application of corresponding calculation codes. The LLMT working group started planning its next ICRM-LLRMT 2020 conference to be hosted by the Laboratori Nazionali del Gran Sasso (INFN-LNGS) in Assergi close to L'Aquila, Italy. Details of all mentioned and other additional activities will be announced in due time by the WG coordinators and in the ICRM Newsletter. You can also contact the WG coordinators for further information (addresses are found on the ICRM website, http://physics.nist.gov/ICRM/).

The ICRM 2019 conference will be held at the University of Salamanca, Spain, 27 to 31 May 2019.

Summary of the ICRM 2017 General Meeting:

Introduction: The 25th General Meeting of the International Committee for Radionuclide Metrology (ICRM) was held on Friday, 19 May 2017, at the Hotel Panamericano, Buenos Aires, Argentina. This was the conclusion of a week of successful meetings hosted by the Comisión Nacional de Energía Atómic (CNEA). The meetings consisted of the four day 21st International Conference on Radionuclide Metrology and its Applications (ICRM 2017) combined with business meetings of the ICRM Working Groups held after the relevant scientific sessions. About 167 participants from 32 countries worldwide attended the conference. The technical conference was followed by an ICRM Executive Board Meeting and the General Meeting.

- The General Meeting was **attended** by 31 Delegate Members incl. their temporary representatives, which is the largest participation so far.
 - New ICRM members since GM 2015:
 - CTBTO, International Org., delegate Ms. Naoko Nakashima
 - NTUA, Greece, delegate Marios Anagnostakis

ICRM had 45 institutional members at the time of this 25th GM 2017.

- New delegates:
 - CNEA Argentina, delegate Pablo Arenillas (replaces Juan Carlos Furnari)
 - IAEA, International Org., delegate Iolanda Osváth (excused, replaces A. Ceccatelli)
 - IFIN-HH Romania, delegate Aurelian Luca (replaces Maria Sahagia)
 - VNIIM Russia, delegate Ilya Alekseev (replaces Nikolay Karmalitsyn)
- Proxies at this GM:
 - ANSTO Australia, Mark Reinhard represented by Freda van Wyngaardt
 - NIM China, Yuandi Yang (retired) represented by Juncheng Liang
 - IAEA, International Org., Iolanda Osváth represented by Arvic Harms
 - RC POLATOM Poland, Ryszard Broda represented by Zbigniew Tymiński
 - VINCA Serbia, Ivana Vukanac represented by Aleksandar Kandic
 - NMISA South Africa, Martin van Staden represented by Milton van Rooy
 - NIST USA, Michael Unterweger represented by Brian Zimmerman
- The meeting started with **Opening remarks** from the ICRM President Dirk Arnold, who welcomed the new delegates, the participating members and guests. He thanked the Scientific Secretary of the ICRM 2017 conference Pablo Arenillas and his conference team for the effective and very successful conference organisation.
- Then the **President** gave his **Report for the 2015 2017** period considering the following points:
 - Proceedings of the ICRM 2015 conference in Vienna were published incl. 120 papers (Appl. Radiat. Isot. 109, March 2016).
 - WG conference and meetings (more information below with the WG reports):
 - The 7th ICRM-Low-Level Radioactivity Measurement Techniques conference took place Sept. 26-30, 2016 in Seattle hosted by PNNL.
 - A joint workshop of the Beta Spectrometry, the Nuclear Decay Data and the RMT working groups (in conjunction with a DDEP meeting) was organized at NPL in September 2016.
 - Both the LSC WG and the Life Sciences WG held meetings in November 2016 at ENEA.
 - Officers and nominations:
 - Eduardo García-Toraño's 2nd term in office as Vice-President ended on 30 Sept. 2016. The Nominating Committee proposed four candidates. In a secret mailed ballot, John Keightley was elected as Vice President for the term October 2016 until September 2018.
 - The terms in office of all other Executive Board members were to end in September 2017; elections were taking place at this GM (see below).

- Executive Board meetings: Since the last GM 2015, two EB meetings were held: April 2016 in Buenos Aires and November 2016 in Rome. Main topics: preparation of the ICRM 2017 conference, issues with the publication of the proceedings of ICRM 2017, working group business. A summary of the April 2016 meeting was sent to all ICRM members.
- Relations with Liaison Organisations:
 - EURAMET: ICRM Letters of support for EMRP projects were sent.
 - BIPM: At the CCRI(II) meeting of June 2017, ICRM will have an official observer status for the first time.
- Scientific committee meeting in November 2016 in Rome for the preparation of the ICRM 2017 conference programme:
 - 149 abstracts submitted
 - 132 abstracts accepted, 17 rejected
 - accepted as 38 oral and 94 poster presentations
 - Elsevier's change in proceedings policy, communicated only during the SC meeting, required a new approach by the ICRM SC to the conference proceedings: of the 132 abstracts accepted as conference contributions, 78 were accepted to be reviewed for *Appl. Radiat. Isot.* as full papers and 37 as technical notes; 11 contributions were accepted for review as paper in the new online *ICRM Technical Series on Radionuclide Metrology*, and 6 contributions without a paper
 - 2 post-deadline abstracts were accepted later as poster without paper
- Preliminary conference statistics for ICRM 2017 were given by Pablo Arenillas:
 - 167 participants (incl. 8 scientific staff of the organizing CNEA) from 31 countries and 4 international organizations, plus 15 registered company exhibitors
 - 36 oral presentations (incl. 2 invited) and 86 posters actually seen at the conference
 - 105 manuscripts were submitted to be reviewed for the proceedings in ARI and 5 manuscripts in the ICRM Technical Series
 - The certificate for the Best Poster of ICRM 2017 was awarded to Juncheng Liang and co-workers, NIM China, for the poster "Development of the absolute standardization apparatus for radon-222 activity".
- Each Working Group Coordinator gave a report of activities carried out in his group:
 - Alpha-particle spectrometry (S. Pommé): JRC, CIEMAT and LNHB (within an EMRP project) presented direct measurements of the α -emission probabilities of the 3 main peaks in ²²⁶Ra decay with results perfectly in agreement with DDEP values based on the gamma balance, and solving a discrepancy in literature. JRC and STUK applied new spectral deconvolution software to conversion electron spec. and derived emission probabilities of Pu isotopes agreeing well with theoretical values (BrIcc database). LNHB presented Q-spectrometry with a metallic magnetic calorimeter (MMC) as an alternative to α and conversion electron spectrometry for the analysis of nuclear materials. Methods developed in the APS WG show impact on the user community, such as improved fitting of α -peaks from Rn with plastic scintillators. The Metrologia special issue paper on uncertainties in α -spectrometry has been downloaded > 3000 times in 2 years hopefully contributing to a better understanding of uncertainties in various APS applications. Future actions would be developed around ²³³U emission probabilities, the decay characteristics of ²³¹Pa, and CIEMAT would continue its work for a time-of-flight system aiming at an energy resolution around 2 keV.

- Beta-particle spectrometry (X. Mougeot): A written report of the activities of this WG had been distributed to all ICRM members earlier in April of this year. During the WG meeting of this week in Buenos Aires, interesting theory discussions were held with J.C. Hardy (Texas A&M) and Y. Nedjadi (IRA). In the frame of the EMPIR MetroBeta project (coordinator M. Kellett), funded from 2016 to 2019, PTB is developing a MMC-based beta-spectrom. system, CMI a beta-spec. system based on Si detectors, and another new system will be developed at LNHB. Measurements of ¹⁴C, ³⁶Cl, ⁹⁹Tc, and ¹⁵¹Sm with MMCs are scheduled at PTB and LNHB. A decay module for Penelope was developed by E. García-Toraño. A similar Geant4 module, known to be deficient, will be improved at LNHB using DDEP data. The WG website is available at <u>http://www.lnhb.fr/icrm_bs_wg/</u>. The next meeting would take place at NIST in 2018 together with the DDEP meeting and the NDD WG.
- Gamma-ray spectrometry (O. Sima): Although two actions proposed in 2015 to refine the evaluation of coincidence summing correction factors and to evaluate efficiency transfer factors for the analysis of steel samples could not be performed as planned, several improvements in the codes for coincidence summing corrections and efficiency transfer, including more friendly procedures to deal with decay data and the estimation of uncertainty, were published by members of the GS WG. Continued efforts of members towards more refined calculation of uncertainty and problems such as inhomogeneous sources resulted in contributions to the ICRM-LLRMT 2016 Conference or to this week's ICRM 2017. At the WG meeting in Buenos Aires, two actions were proposed: an internal consistency test of codes for coincidence summing corrections, and an action to facilitate the evaluation of efficiency and correction factors by generalist users, for example in monitoring laboratories. An interim WG meeting on these two actions was proposed to be held in Paris in 2018 (a week before or after the LS-LSC WG meetings in St. Petersburg), possibly combined with a training course on gamma-ray spectrometry.
- Life sciences (J. Cessna): A written report of the activities of this WG had been distributed to all ICRM members earlier in April of this year, focusing on the combined LS and LSC interim meeting of Nov. 2016 at ENEA with 24 participants. During the WG meeting in Buenos Aires, presentations and discussions focused on the collection and sharing of IC response curves, MetroMRT results with dosimetry plans, ANSTO measurements of ⁶⁸Ga, SIRTI results for ¹⁸F and ⁶⁴Cu from NIST, and problems with on-site measurements of ⁹⁰Y using portable TDCR. For the planned ¹²⁴I comparison, a pilot laboratory is still being searched. The WG website is available at http://physics.nist.gov/ICRM/working_groups.html#LS. The next meeting would take place at VNIIM in St. Petersburg, Russia together with the LSC WG. Early travel planning is necessary for successfully obtaining the necessary visa (application at least 3 months before the event).
- Liquid scintillation counting (K. Kossert): Also the LSC WG report about activities of 2016 was distributed prior to the conference. Since the combined interim meeting of Nov. 2016 at ENEA with 20 participants, members of the LSC WG participated actively in the LSC 2017 conference in Copenhagen i.a. with three invited lectures and further contributions. The CCRI(II) S12 Comparison of the activity calculation for the same set of TDCR data for ³H is being piloted by Philippe Cassette (LNHB). The next interim meeting, again combined with the Life sciences WG, would be hosted by VNIIM in St. Petersburg, see above.

 Low-level measurement techniques (M. Hult): The 7th ICRM-Low-Level Radioactivity Measurement Techniques conference took place Sept. 26-30, 2016 in Seattle hosted by Pacific Northwest National Laboratory. 123 participants from 20 countries attended. Beyond the regular programme, three special sessions on the 'metrology of NORM', 'monitoring networks' and 'metrology&citizens initiatives' were held. Proceedings would be published in May or June 2017 in ARI.

At the WG meeting in Buenos Aires, several presentations were discussed such as about ISO 11929 on decision thresholds/detection limits and on drinking water control. A new action addressing the uncertainty of locating weak gamma-ray peaks was proposed by Matjaž Korun. The CELLAR collaboration of European low-level (underground) laboratories would have its next meeting in Oct./Nov. 2017 in Bucharest with participation of ICRM members. Preparations for the next low-level conference have started; ICRM-LLRMT 2020 would be hosted by the Laboratori Nazionali del Gran Sasso (INFN-LNGS), Italy.

- Nuclear Decay Data (M. Kellett): Newly created at the GM 2015 with the aim to reignite interest in measuring and evaluating nuclear decay data and promote collaboration, the WG had its first meeting at NPL in Sept. 2016 alongside a DDEP workshop and the BS and RMT WGs with about 20 participants. It successfully brought together DDEP members with the RMT community. At the NDD WG meeting during ICRM 2017, several laboratories gave brief reports of their decay data measurements. It was reported that Ra-226 gamma-ray measurements indicate problems in decay data of daughters. Brian Zimmerman, NIST, who completed an evaluation presented in the conference, reported as new evaluator about his experience. Next to Brian, and following a request at ICRM 2015, two more new DDEP evaluators had come forward: Herbert Janssen, retired from PTB; Haoran Liu, NIM. An interim meeting of the WG is planned for 2018 probably at NIST alongside a DDEP workshop and the BS and RMT WGs.
- Radionuclide metrology techniques (J. Keightley): At the RMT WG session in conjunction with the NDD, BS and DDEP meetings in Sept. 2016, issues with the traceability for wide area reference sources according to ISO, the development of a data format for digital data acquisition, and problems with coincidence counting of electron capture radionuclides were discussed. Whereas the final report of the wide area source comparison CCRI(II)-S10 would be completed in 2017, a proposal for a new CCRI(II) SC for beta/gamma emitting wide area reference sources would be made. In addition, this week's WG meeting discussed to set up a task force to assist laboratories in implementing the IEC 63047 list mode data standard. Another new action aims at a survey of NMIs' status in gas counting and the potential support to CTBTO with traceability for gas standards, also at very low levels, with new comparison exercises. Han Jubong of KRISS presented their segmented HPGe detector system. NMIs interested in Gd-153 can still join in a bi-lateral comparison of NPL and NIST. Next meeting would be the joint workshop with the NDD and BS WGs and the Decay Data Evaluation Project (DDEP) as proposed at NIST in 2018.
- All WG coordinators explicitly expressed their thanks to the reviewers for their quality work in refereeing ICRM 2017 conference papers.
- Confirmation of existing WGs and new WG coordinators
 - Unanimously, the GM confirmed the continuation of all 8 existing WGs.
 - Octavian Sima resigned as GS WG coordinator and was thanked for his work during six years. He suggested to be followed up by Marie-Christine Lépy, acclaimed by the GM.

• The other WG coordinators were willing to continue with their tasks, confirmed by the GM. John Keightley intends to resign as WG coordinator at the next ICRM conference in 2019, a replacement is sought.

• Election of officers

- Except for one Vice President position, that of John Keightley, NPL, who was elected by mailed ballot in Sept. 2016 for his term in office until 30th Sept. 2018, all other positions on the Executive Board would become vacant on 30th Sept. 2017. The complete Nominating Committee would need replacement by 30th Sept. as well.
- The present Nominating Committee, after receiving several names of candidates for the vacant positions, proposed at least two names for each of the EB positions and one for the three Nominating Committee members.
- Election results Executive Board:
 President: Eduardo García-To

President:	Eduardo García-Toraño, CIEMAT, Spain
Vice-President:	Mikael Hult, JRC Geel, Belgium
Vice-President:	Akira Yunoki, AIST/NMIJ, Japan
Secretary:	Franz Josef Maringer, BEV, Austria

- *Dirk Arnold*, PTB, Germany, remained member of the Executive Board as immediate Past President.
- Election results Nominating Committee: *Pierino De Felice*, ENEA, Italy *Simon Jerome*, NPL, UK *Octavian Sima*, University of Bucharest, Romania
- The General Meeting decided that term in office for all newly elected officers would start on 1 October 2017, ending on 30 September 2019.
- On behalf of the present ICRM Executive Board, the Secretary thanked all ICRM members who were willing to stand for election including those who were, according to the bylaws, not eligible for election.
- Three offers to host the ICRM 2019 Conference and next General Meeting were presented, Begoña Quintana for University of Salamanca, Spain, to host the conference on the university campus in the centre of Salamanca, and Marie-Christine Lépy for LNE-LNHB to host the conference in Paris. Since the delegate of TAEK was not able to participate in the GM, the ICRM Secretary Uwe Wätjen presented the TAEK offer to host the conference in Ankara. The Univ. of Salamanca estimated registration fees of about 400 € (at 150 participants) and proposed end of May or end of June as conference date. The GM voted to organise the 22nd ICRM conference (ICRM 2019) in Salamanca. In the EB meeting directly after the GM, held together with the organiser and the newly elected members, it was decided that ICRM 2019 would take place from 27 to 31 May 2019.
- ICRM and other future meetings were outlined:
 - As mentioned above, the 8th Low-Level Radioactivity Measurement Techniques Conference (**ICRM-LLRMT 2020**) is being planned to be held at LNGS close to L'Aquila, Italy.
 - Information on interim WG meetings planned during 2018 are given in the very beginning of this circular letter, and also in the WG reports above.

- **Organisational membership:** The Executive Board proposed to invite two new institutions for membership, the University of Salamanca (USAL) and the Pacific Northwest National Laboratory (PNNL). The proposals were accepted unanimously by the GM.
- Associate membership: Maria Sahagia, IFIN-HH, Romania, was elected as associate member in recognition of her special contributions to ICRM and to the science of radionuclide metrology during the many years of her professional career.

• Newsletter

No ICRM Newsletter was published so far in 2017. Since all relevant information, that could be published in the Newsletter, was presented at this conference and GM, the GM decided that no Newsletter would be needed during 2017. For the future, a biennial publication frequency should be envisaged, with a Newsletter being published in the years without an ICRM general conference. Until the next GM only the Newsletter for 2018 should be published, and the GM 2019 would be asked to agree on a corresponding change of the bylaws.

- **Proceedings:** In view of the recent difficulties encountered with Elsevier on the publication of the proceedings in ARI, briefly touched upon in the President's report, it would be necessary to clarify details of the next conference proceedings before the call for papers. It was mentioned that Elsevier as well as Springer are aiming at smaller proceedings volumes with higher quality papers in order to improve their impact factor. The Executive Board would have to discuss this issue in the preparation of ICRM 2019, keeping in mind the interests of conference participants and authors. *Note added at time of writing:* Any suggestion or opinion from ICRM members in this matter would be very welcome, if possible by the end of October 2017. Email addresses see above in the letter head.
- **ICRM website:** Lisa Karam asked the WG coordinators to generate more visibility for interim WG meetings by announcing and reporting more events on the ICRM website.
- The President **closed the General Meeting** thanking the attending ICRM members for their participation and looking forward to the next ICRM conference and General Meeting 2019 in Salamanca. Being his last General Meeting as President, he thanked the GM members, the Executive Board and in particular the Secretary for their support during the past 4 years.

The **Executive Board** had met on 18 May 2017 in the evening to prepare the General Meeting and convened again for a second short meeting directly after the GM, in order to mainly discuss with Begoña Quintana, the representative of University of Salamanca, and the newly elected EB members the next steps in preparation of the ICRM 2019 conference and to plan the necessary meetings: EB meeting in Salamanca in November 2017, the date of the Scientific Committee meeting was not fixed yet. Since all relevant items were described above in the summary of the General Meeting, a separate summary of the Executive Board meeting of 18/19 May 2017 will not be prepared.

Uwe Wätjen (ICRM Secretary)



Summary of Executive Board Meeting 7 – 9 Nov. 2017

February 2018

Dear ICRM Delegate and Associate Members,

The Executive Board met in Salamanca, Spain, 7 - 9 November 2017. The main tasks of the meeting were to hand over the ICRM business to the new Executive Board and Nominating Committee and to start the preparation of the 22^{nd} International Conference ICRM 2019 to be held 27 - 31 May 2019 in Salamanca, Spain, hosted by the Universidad de Salamanca.

Short summary of main topics discussed, and decisions taken at the Executive Board Meeting:

- Handover of business from previous to new President, Secretary and Nominating Committee Members \rightarrow see also President's Message (this newsletter)
 - Vice-President designated as acting President (bylaws Art. 8.7): John Keightley
- Starting the preparation of the next ICRM conference, Salamanca, Spain, 27 31 May 2019 → see also *President's Message (this newsletter)*
 - Schedule: First announcement: March 2018; Abstract deadline: Sept 2018; Programme Committee (Working Group Coordinators, and other Coordinating Referees / Session Chairs, Executive Board, Conference Scientific Secretary) Meeting, CIEMAT, Madrid: 23 24 Oct 2018; notification of authors: Dec 2018; deadline manuscripts: March 2019; deadline final manuscripts: Sept 2019
 - Publication: Applied Radiation and Isotopes and ICRM Technical Series
 - Logistics: train from Madrid or bus from Madrid airport, then taxi or walk; info about metro/train/bus connection from the airport to Salamanca will be provided; Ryanair to Valladolid airport is possible as well
 - \circ > 10 hotels 2* to 5* and university residence available (within about 10 min walk)
 - Next ICRM General Meeting: 31 May 2019
- Future ICRM Working Group meetings and symposia
 - WGs LSC & LS: St. Petersburg, June 2018
 - WGs RMT, BS, NDD (+ DDEP): NIST, Sept 2018
 - WG GS: Paris, June 2018
 - Next ICRM LLRMT Conference: Gran Sasso Underground Laboratory (LNGS), Italy, 2020
- Membership
 - Status November 2017: 47 Delegate Members, 37 Associate members, 8 Liaison Organisations
- ICRM publications and website
 - <u>https://physics.nist.gov/ICRM/</u> regularly updated by Lisa Karam, NIST
 - First issue of ICRM Technical Series on Radionuclide Metrology (ISSN 2522-4328) published (download from ICRM website available)
 - ICRM 2017 proceedings edited by Pablo Arenillas, Dirk Arnold, Uwe Wätjen published online: Appl Rad Isot, Volume 134, Pages 1-482 (April 2018)
- Next ICRM Executive Board Meeting: 24 25 October 2018, CIEMAT, Madrid.

Please keep me informed about all changes in membership details and contact information in order that I can keep the ICRM membership database up-to-date. This is particularly important for sending correctly all ICRM information, e.g. circular letters to ICRM Members and Liaison Organisations.

With my best regards, Franz Josef Maringer, ICRM Secretary Announcements

In Memoriam

Valerii Pavlovich Chechev

26.04.1939 - 05.03.2018

Dr.Sc. Director Radionuclide Nuclear Data Center, V. G. Khlopin Radium Institute, St Petersburg, Russia Leading Specialist on Nuclear Spectroscopy

All his scientific activities were developed at the Radium Institute where V.P. Chechev started as a young assistant researcher, later became the Head of the Laboratory of Nuclear Spectroscopy and subsequently the Head of the Radionuclide Nuclear Data Centre. His scientific interests were focused on nuclear physics and astrophysics. Some of his astrophysics-related work on nuclear fusion and the evolution of the Universe are well known and acknowledged by the community.

Chechev was one of the pioneers who created a new scientific discipline - nuclear data evaluation. He developed several evaluation and verification methods, which are still broadly used.

Under his direction several Russian radionuclidic standards have been developed.

V.P. Chechev was highly regarded among the international nuclear data community, in particular for his collaboration with the IAEA and DDEP.

Vladimir Pronyaev, Roberto Capote

Eckart Schönfeld

I have the sad news to inform the members of the Physikalisch-Technische Bundesanstalt that the former employee

Dr. rer. nat. Eckart Schönfeld

died on 28 December 2017 at the age of 80.

Dr. Schönfeld studied physics at the Humboldt University Berlin. After completing his studies in 1964, he worked until 1980 as a research assistant in the activity department of the Office for Standardization, Metrology and Product Testing (ASMW) of the GDR. From 1981 to 1988 he worked at the VEB NARVA Berlin. During this time he received his doctorate at the TU Dresden with the degree of Dr. rer. nat. in 1983. In 1988 Dr. Schönfeld returned to the ASMW as a leading scientific assistant in the field of activity of the ASMW. In October 1990 he joined PTB as a scientific employee and in 1994 took over the management of the radionuclide analysis project, which was renamed Laboratorium Umweltradioaktivität in 1995. From 1997 until his retirement in 2001, he headed the Laboratory Activity Unit.

Dr. Schönfeld was an internationally recognized expert in the field of radionuclide metrology. His scientific work focused on the development of activity measurement methods and the measurement and evaluation of radionuclide data. He made significant contributions to the international "Decay Data Evaluation Project (DDEP)". Furthermore, he was fascinated by theoretical work on an alternative description of the fine structure constant, which he continued after leaving PTB.

Dr. Schönfeld also maintained contact with the PTB and his former colleagues in retirement. In sadness, we bid farewell to Eckart Schönfeld. We would especially like to express our sympathy to his wife and his relatives.

For the Personnel Council The President, Physikalisch-Technische Bundesanstalt

Meetings

Beta Spectrometry, Nuclear Decay Data and Radionuclide Measurement Techniques Working Group Meetings

A week of meetings took place between 10-14 September 2018 at the NIST in Gaithersburg, USA in collaboration with the Decay Data Evaluation Project (DDEP).

The Beta Spectrometry, Nuclear Decay Data and Radionuclide Measurement Techniques Working Groups all held consecutive meetings. A halfday workshop on the EMPIR funded project "Radionuclide beta spectra metrology (MetroBeta)" also took place during the week along with an ancillary meeting organised by the BIPM on "**New current measurement technologies**". There was also time allocated for a tour of the NIST laboratories during the week.

For further details, contact one of the WG coordinators: Mark A. Kellett (<u>mark.kellett@cea.fr</u>), Xavier Mougeot (<u>xavier.mougeot@cea.fr</u>), John Keightley (<u>john.keightley@npl.co.uk</u>) or Steven Judge of the BIPM (<u>steven.judge@bipm.org</u>).

Life Sciences and Liquid Scintillation Counting Working Group Meetings

A meeting of the **Life Sciences Working Group (LSWG) took place between 7-8 June 2018** at the VNIIM in St. Petersburg, Russia. This meeting was planned in coordination with a meeting of the **Liquid Scintillation Counting Working Group on 4-5 June**. There was opportunity for a tour of the laboratories at the VNIIM on 6 June. For further details, contact the coordinator of the LSWG, Jeffrey Cessna (jeffrey.cessna@nist.gov).

Gamma Spectrometry Working Group Meeting

A Working Group Meeting and Gamma spectrometry training course was organised from 12-15 June 2017 at the LNE, Paris, France.

For further details, contact the coordinator of the GSWG, Marie-Christine Lépy (<u>marie-christine.lepy@cea.fr</u>).

Reports from the Working Group Coordinators

Coordinator's Report Radionuclide Metrology Techniques WG

No report available.

Coordinator's Report Life Sciences WG

The purpose of the Life Sciences Working Group is to provide a forum for ICRM members to address radionuclide metrology issues as they relate to the life sciences. Issues may include, but are not limited to: development of methodologies to calibrate short-lived radionuclides of interest in nuclear medicine, measurement of decay properties (half-lives, decay energies and probabilities, etc.) of radionuclides used in nuclear medicine and biological research, and development of measurement methodologies for transferring National Measurement Standards to the clinic and research laboratory. The Working Group will facilitate finding solutions to these problems through workshops, publications, electronic communications (i.e., email), and collaborative work.

The most recent meeting of the Life Sciences Working Group (LSWG) was held during the ICRM congress in, Buenos Aires, Argentina on 15 May 2017. The agenda of the meeting is presented here. Those interested in a topic of discussion are invited to contact the presenter or the coordinator.

- Introduction/Last WG meeting (J. Cessna, Coordinator, NIST)
- Comparison of Monte Carlo IC Models (B. Zimmerman, NIST)
- MRTDosimetry (A. Robinson, NPL)
- Measurement of Ga-68 in Australian Nuclear Medicine departments and the proPSMA clinical trial (F. van Wyngaardt, ANSTO)
- Recent SIRTI exercise at NIST: F-18 and Cu-64 (D. Bergeron, NIST)
- Problems in on-site IC Calibration for Y-90 using a portable TDCR (M. Capogni, ENEA)

Status of action items:

- Interview 124 <u>I Comparison (proposed)</u>: The possibility of a comparison, through the LS-WG, was discussed at the Rome interim WG meeting. A pilot is needed. NIST, IFIN-HH, ENEA, NPL, and PTB (if there is no I-125) expressed interest in participation. This will provide an opportunity for more half-life determinations.
- ²²⁷Th Comparison (proposed): The future need for a comparison of this radionuclide was discussed at the Rome interim WG meeting. Bayer AS expressed a willingness to support this comparison. The comparison would, presumably, follow a ²²³Ra comparison.
- <u>Coordination of efforts for new radionuclides (new)</u>: Contact the LS-WG coordinator to transmit requests to other WG members regarding coordination of efforts for new or uncommon radionuclides. There is the opportunity to coordinate with CIEAMT and NPL on the standardization of ⁸⁹Zr.
- <u>Metrology for short-lived radionuclides? (new)</u>: Motivation or justification papers for the need of metrology in the case of short-lived radionuclides is requested. Send any information to the LS-WG coordinator. The possibility of a workshop to bring together stakeholders and produce a position paper was discussed.
- Coordinated collection of Ionization Chamber response curves (proposed): This action was introduced by Brian Zimmerman at the ICRM meeting in 2017. The effort would build upon data collected for radionuclide calibrators by metrology institutes. Curve generation would follow an updated SOLVER method. NIST, IRA, CEA, NPL, PTB, ANSTO, and NRC have expressed interest. A protocol for collection will be generated. The collection will aid in the prediction of new calibration factors, especially in complicated parent-daughter situations, such as ²²⁷Th.
- ⁶⁸Ge/⁶⁸Ga comparison (complete): The comparison, CCRI(II)-K2.Ge-68, is complete. Results were presented at ICRM 2017 and published in Applied Radiation and Isotopes. https://doi.org/10.1016/j.apradiso.2017.10.052
- Formation of an informal subcommittee to investigate simulation of beta emitter response in <u>RC (ongoing/on hold)</u>: A detailed study of the influence of various quantities on Monte-Carlo

modelling was presented by NRC-Canada at the Rome interim WG meeting. Prior plans for a comparison using a simple geometry have been put on hold. This action has been replaced with the coordinated collection exercise mention above.

- Emphasize importance of measuring nuclear data for nuclear medicine radionuclides (ongoing): Working group members wish to emphasize the importance of measuring nuclear data for nuclear medicine radionuclides.
- Collecting activity calibrator factors for medical radionuclides in different ionization chambers (ongoing): The database is updated as needed and is available from the coordinator. An offer has been made by NPL to host the database on their website. Discussions ensued regarding the best form to present information, spreadsheet or database. Appropriate disclaimers are need for the data. A link from the working group homepage will be provided if this can be established. Many NPL-type chamber calibration figures did not contain reference to publication. This will be remedied with the publication of updated calibration figures in the proceedings of ICRM 2017.
- <u>Sharing of software for automation of radionuclide calibrators (ongoing)</u>: Individuals who have developed freely available software for this purpose are requested to provide that software to the coordinator, for distribution to the LSWG.
- <u>Comparison of ⁹⁰Y with portable TDCR</u>: This comparison was proposed in support of the MetroMRT joint research project of the European Metrology Research Programme. The eventual goal would be direct measurement of ⁹⁰Y microspheres. An update is needed for this project.
- <u>Compile a list of comparisons in nuclear medicine (ongoing)</u>: The proposed list would serve as a basis for future reviews of similar comparisons. A bibliography has been created in support of investigations into radionuclide calibrators. This bibliography is available from the coordinator. Please forward publications to the coordinator for inclusion in the list.
- <u>Create repository for information on dissolution of microspheres (ongoing)</u>: This action would support MetroMRT. Please submit methods and experience to the coordinator. The experiences of LNHB and NPL were presented at the recent WG interim meeting and have now been published. ENEA is also working in this area and will report their results in the future.
- Questionaire what radionuclide calibrators/ionization chambers are used in your institute to support nuclear medicine? (ongoing): To support interaction between laboratories information is requested regarding what models of radionuclide calibrators or ionization chambers are used in support of nuclear medicine at your institute. Information has still only been provided by ENEA-INMRI. Please provide information to the coordinator for distribution to working group members.
- Support for measurements of impurities in nuclear medicine radionuclides (ongoing): Members have been requested to provide support or suggest methods for the measurement of impurities in nuclear medicine products. This is of importance when new production methods can introduce different impurities than previously seen for established radionuclides, such as ⁹⁹Mo and ^{99m}Tc. Two papers that touch on this topic are accepted in the Radionuclide Metrology in the Life Sciences session at the ICRM 2017 congress.
- <u>Comparison of activity of a ²²³Ra solution (ongoing)</u>: A comparison under the auspices of CCRI(II), has been planned, to be piloted by NPL. NPL is soliciting participants and comments on the proposed protocol.

The next meeting of the LSWG is planned be held at the VNIIM in St. Petersburg, Russia on 7-8 June 2018. Topics of discussion being considered include the current action items. Those laboratories having any work they wish to present or action items to propose are requested to contact the coordinator by 30 March 2018.

The LSWG web page may be found here: <u>http://physics.nist.gov/ICRM/working_groups.html#LS</u>

J.T. Cessna, Coordinator

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Coordinator's Report Alpha Spectrometry WG

The alpha-particle spectrometry working group convened on 16 May 2017 at the ICRM-2017 conference in Buenos Aires (Arg).

In the frame of an EMRP (MetroNORM) the JRC, CIEMAT and LNHB have presented direct measurements of the alpha emission probabilities of the three main peaks in the decay of ²²⁶Ra. The results were in perfect agreement with DDEP values derived from the gamma balance, and solved a discrepancy between two direct measurements by alpha spectrometry in the literature.

The measurement campaign was performed over a period of 1 year, at different solid angles in the percent level. On a technical level, it required software for gain shift and a magnet system against detection of conversion electrons. These facilities were missing at LNHB and the JRC will help to give access to these tools.

There is feedback from the user community that demonstrates the methods developed in the alpha spectrometry working group have impact on applications in the field. A recent paper on advances in spectral deconvolution of alpha peaks has triggered several metrologists in various fields. In the working group meeting, Krasimir Mitev presented new work in which the fit of an alpha peak from radon measured with a plastic scintillator could be fitted using the convolution of a Gaussian with two left-handed and two right-handed exponential functions. This progress is a recent achievement.

Work performed at JRC and STUK has demonstrated that the new spectral deconvolution software can also be applied for internal conversion spectrometry. The spectra of Pu isotopes were analysed and the derived emission probabilities agreed well with theoretical values from the BrIcc database.

LNHB presented Q-spectrometry with a metallic magnetic calorimeter, which is an alternative to alpha and conversion electron spectrometry for the analysis of isotopic composition of nuclear materials.

The user community has also found its way to the special issue on uncertainty in Metrologia. The paper on typical uncertainties in alpha spectrometry has been downloaded more than 3000 times and 2 years after publications still realises on average 8 downloads per day. One may hope that this contributes to a better estimate of the uncertainties involved with alpha spectrometry in various applications.

As for future actions, improvement of the ²³³U emission probabilities in its complex spectrum is identified as a remaining problem. NPL shall lead a project in which the decay characteristics of ²³¹Pa will be investigated, among which the very first direct measurements of the alpha emission probabilities are included. CIEMAT presented a preliminary design of a time-of-flight detector which could improve the energy resolution to a level of 2 keV. This would allow direct measurements of the energy of alpha emissions, as well as facilitate deconvolution of interfering peaks.

Stefaan Pommé Buenos Aires, 19 May 2017

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Coordinator's Report Gamma Spectrometry WG

Gamma-ray spectrometry community comprises a large number of members, with a wide range of interests and expertise. The ICRM Gamma-Ray Spectrometry Working Group (GS WG) represents a frame for active collaboration between the ICRM members for the development of experimental and computational techniques relevant to gamma-spectrometry. It also promotes collaboration in view of disseminating knowledge in the field and provides the opportunity for testing the analytical capability of various laboratories.

The last meeting of the GSWG was held in Buenos Aires during the ICRM 2017 conference. On this occasion Dr. Marie-Christine Lépy (LNHB) proposed an action intended to facilitate the application of generalist Monte Carlo simulation codes (PENELOPE, GEANT4, MCNP, etc) in gamma-ray spectrometry. Specifically, detector and geometry models to be used as input in simulations should be prepared for selected cases. The structure of the files should allow an easy modification by the user in order to adjust the input data for the particular problem of interest. Dr. Octavian Sima (Univ. of Bucharest) proposed an action intended to test the self-consistency of the methods to evaluate the coincidence-summing corrections. The progress in the development of the two actions will be discussed during an intermediate GSWG meeting organized by Dr. Marie-Christine Lépy in Paris (June 14, 2018). The meeting will be preceded by a specialized school in gamma ray spectrometry, organized by Dr. Lépy (June 12-13, 2018).

Members of the GSWG actively participated in disseminating actions such as training courses, workshops, and also served in quality of referees for the papers presented in ICRM conferences. At the general meeting of ICRM, Dr. Sima, who served 6 years as a coordinator of the GSWG, withdraw from this position. Dr. Marie-Christine Lépy was unanimously elected for this position.

On behalf of the Gamma-Ray Spectrometry Working Group,

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and

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Coordinator's Report Liquid Scintillation Counting WG

Scope of the WG

The purpose of the Liquid Scintillation Counting Working Group is to provide a forum for ICRM members to address issues related to liquid scintillation and Čerenkov counting. In particular the CIEMAT/NIST efficiency tracing and the Triple-to-Double-Coincidence Ratio (TDCR) method play major roles in Radionuclide Metrology. In the past decade, many new developments were presented by ICRM researchers, e.g. new counter systems, new electronics for signal treatment and data acquisitions, investigations of existing models and extensions of calculation procedures. The methods are used for activity standardization of a growing number of radionuclides.

Working Group meeting at ENEA 17-18 November 2016

An interim meeting of the LSC Working Group was organized at ENEA in Rome from 7th to 8th November 2016. The purpose of the LSC Working Group interim meetings is to discuss issues that typically cannot be addressed at the general ICRM meetings due to time limitations. The interim meeting shall also provide an opportunity for members of the LSC-WG to present results of works in progress or recently completed projects, as well as to discuss and plan future LSC-WG activities.

The following topics were presented at the meeting in November 2016:

Models and applications

- NIST standardization of ⁶⁴Cu (Denis Bergeron)
- Calibration of ⁴¹Ca solution by efficiency tracing method with ⁵⁵Fe (Philippe Cassette)
- Activity determination of ¹³⁴Cs (Karsten Kossert)
- Standardization of ²²Na by the CIEMAT/NIST method (Liu Hoaran)
- The importance of beta spectra for LSC (Karsten Kossert)
- Comparison of the analysis of the same set of TDCR data for ³H (Philippe Cassette)
- Ionization quenching parameter *kB* values used in the LSC technique (Ryszard Broda)
- ¹³¹I and ¹⁴C standardization (Marco Capogni)
- Calibration of ¹⁴⁷Nd by the TDCR method (Philippe Cassette)
- Update on micelles (Denis Bergeron)
- On the micelle effect in LSC (Youcef Nedjadi)

Hardware

- New developments of LS-techniques in radionuclide metrology (Tatiana Shilnikova)
- Experience with new Hitachi Aloka LSC-8000 counter (Brian Zimmerman)
- A new TDCR-γ counter for measurements of PET isotopes (Karsten Kossert)
- Current status of the TDCR system with gamma detector and the FPGA digital board at POLATOM (Tomasz Ziemek)
- New fast digital $4\pi\beta$ - $4\pi\gamma$ coincidence counting at IRA-METAS (Teresa Durán)

Each talk was followed by very comprehensive and detailed discussions and the participants found it beneficial to have more time for that than during the general conference.



Participants of LSC WG meeting at ENEA in November 2016

The event has been combined with a laboratory tour of the ENEA laboratories in Casaccia (9 November) and an interim meeting of the ICRM Life Sciences Working Group (10-11 November). Thus, the organization was similar as in four previous successful meetings held at LNE in 2007, NPL in 2008, PTB in 2012 and NPL in 2014.

Since such events are good training opportunities, NMIs are encouraged to give young researchers the possibility to participate.

Working Group meeting at the main ICRM conference from 15th to 19th of May, 2017 in Buenos Aires, Argentina

Several LSC-related papers were presented during the ICRM 2017 conference. In addition, some topics were discussed within the scope of a short WG meeting in Buenos Aires. The meeting comprised the following contributions:

- On the reverse micelle effect in LSC (Youcef Nedjadi)
- Producing a mini-TDCR with a 3D-printer (Philippe Cassette)
- A new nano-TDCR system (Krasimir Mitev)

The talks were followed by a general discussion.

Forthcoming meetings

Next interim meeting of the LSC-WG is scheduled for 2018 (first full week of June 2018; combined with ICRM Life Sciences WG meeting) in St. Petersburg, Russia.

On behalf of the LSC Working Group

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Coordinator's Report Low Level Measurement Techniques WG (ICRM-LLMT WG)

General comments on low-level measurements

The measurement of low levels of radioactivity in a wide variety of matrices has been of interest to the scientific community since the beginning of the 'nuclear age'. Libby's carbon-14 dating measurements in the late 1940s are seen as the starting point for low-level radioactivity measurements. Since then, techniques have been developed to enable the detection of ever-lower activities and activity concentrations of radioactivity for new applications. However, the challenges of performing quantitative analysis increase drastically as the activity goes down and approaches the detection limits of a measurement system. Therefore, the ICRM has an important role in stimulating science and industry to discuss and exchange metrologically sound techniques to ensure quality of low-level measurements to support cross-disciplinary research and policy programs. Examples of domains that benefit from metrology at low-levels include for example astroparticle physics and radioecology. From the European perspective we see that two recent Council regulations (The basic Safety Standards and the Euratom-Drinking Water Directive) have resulted in more focus given to techniques to measure radioactivity in the environment and to do so correctly also at low levels.

The ICRM-LLRMT'16 Conference

The main event for this working group in a recent year was the 7th ICRM-Low-Level Radioactivity Measurement Techniques conference, which was excellently hosted by PNNL (Pacific Northwest National Laboratories) at the Motif hotel in Seattle (WA, USA) September 26-30, 2016. This was the first time this conference was on the American continent and only the second time ever outside Europe. ICRM is a world-wide organisation and it is therefore important that the conferences reflect this. As expected, there was a greater than average share of participants from the Pacific region (Western USA and East Asia). The conference drew 123 participants from over 20 countries worldwide. A total of 121 papers were selected for presentation at the conference including 60 oral presentations and 61 posters. Again, a contract was set-up with Elsevier for arranging proceedings in Applied Radiation and Isotopes. The Managing Guest Editor, Craig Aahlseth (PNNL) did a fantastic job in collaborating with Elsevier in preparing Elsevier's new online submission system EVISE for the conference.

The conference welcomes were provided by the ICRM President, Dr. Dirk Arnold (PTB) and the PNNL Associate Laboratory Director for the National Security Directorate, Tony Peurrung. Dr. Mikael Hult provided the Scientific Encouragement and Dr. Craig Aalseth, Managing Guest Editor for the ARI special issue, opened the conference.

Similarly to previous conferences, there were sessions on radiochemical techniques, non-radiometric techniques (of measuring radionuclides), radioactive noble gases, applications, and quality. In addition, there were three special sessions:

(i) NORM (Naturally Occurring Radioactive Materials) – A recent European Council Directive (the new Basic Safety Standards) has triggered work in the field of NORM, as such materials will soon be regulated in EU Member States. There are several European research actions focusing on NORM, which triggered a special session on this topic.

(ii) Monitoring networks – Worldwide, there is a tremendous increase in monitoring of radioactivity, for example: Verification of the comprehensive nuclear-test-ban treaty, establishing baselines for environmental radioactivity before constructing new nuclear facilities, radioprotection of the population, emergency preparedness etc. New techniques are developed and metrological aspects of the results from these radiological networks needs to be addressed.

(iii) Metrology and citizen initiatives – Citizens will in the coming years be increasingly involved in measuring radioactivity and collecting samples for radioactivity measurements. This development follows both from the advancement of small handheld radioactivity monitors and public data sharing, and has increased awareness of radiological issues. Furthermore, many researchers can benefit from the support that the general public can provide in research projects studying radioactivity in the

environment. At this session many aspects were discussed, ranging from uploading your own measurement to the internet to downloading professionally acquired data from the internet for private analyses. Can we trust and make scientific use of new gadgets that private citizens can connect to their mobile phones?

There were many interesting scientific presentations from which one can distinguish some trends. The number of measurements performed in underground laboratories increased. The big underground laboratories are making more room available for radioactivity measurements and several smaller laboratories (generally at shallow depth) have started up since previous conferences. There were several presentations from the Sanford Underground Research Facility in South Dakota which started recently in the former Homestake gold mine that closed in 2001 (famous as the site of Raymond Davis Jr's solar neutrino measurements). The general understanding of the community as to which materials are of sufficient radiopurity to be used in underground measurements is improving, but the availability of such materials is not always improving as industries may close production lines of materials important for science.

Many radioactive noble gases are of great interest to study as they can travel long distances without chemically interacting with the environment. By detecting them one can unravel stories about such discrepant events as nuclear explosions and age-dating of ground-water; many presentations focused on finding ways of removing natural radon-gas from different types of instrumentation to reduce background.

It is becoming evident that there are many synergies to exploit by making use of mass spectrometric techniques combined with radioactivity measurements. Not only can long half-lives be measured but it also enables better quantification of all radionuclides in a given matrix.

An interesting trend, which this conference encouraged, is technology transfer: from science to industry, from fundamental physics to applied physics, from applied physics to other fields of science. There were presentations exploring these connections and their impacts, for example the importance of ultra-pure materials.

The previous conference (in 2012) held a special Fukushima-session. Also at this conference there were several papers related to radioactivity from Fukushima. Some papers presented the possibility of using radionuclides from Fukushima as tracers for ocean currents and other natural processes and others focused on the great advancements made in establishing a high number of new laboratories in Japan that measure radioactivity. Quality control measures and fast development of reference materials have been key aspects.

The previous conference also held a special session on certified (radioactive) reference materials. The need for such materials have increased further as several older materials either decayed, supplies were exhausted, or passed their shelf-life. The conclusion from 2012, that more (particularly organic) certified reference materials need to be developed, was a conclusion from ICRM-LLRMT'16 as well. One can also add that as increasing number of laboratories have a quality system, there is an increased need for proficiency tests and in particular for low-levels of radioactivity. This fact was also acknowledged by the ICRM'17 scientific committee, who stimulated quality related topic to be discussed at the low-level measurement techniques WG at ICRM'17 in Buenos Aires.

The prize for Best Poster(s) at ICRM-LLRMT'16 was awarded to the following three papers (in no particular order):

"Uncertainties in Monte-Carlo-calculated correction factors for true coincidence summations" by Kastlander, de Geer, Jonsson and Ramebäck from FOI in Sweden.

"Application of an artificial neural network for evaluation of activity concentration exemption limits in NORM industry" by Wiedner, de Peyrés, Crespo, Mejuto, García-Toraño and Maringer from BEV (Austria) and CIEMAT (Spain).

"GAMMA3: latest improvements and coincidence measurements" by Cagniant, Delaune, Douysset and Gross from CEA/DAM/DIF in France.

My appreciation and sincere thank you goes out to all that contributed to the successful meeting, in particular to authors of the papers, the conference organizing committee, Associate Guest Editors (=coordinating referees), session chairs and to the members of the Scientific Committee for giving input to the programme and for both selecting and refereeing the papers.

The low-level radioactivity measurement techniques session at the ICRM'17 conference included 3 oral presentations and 7 poster presentations covering topics of e.g. air/water-monitoring, underground measurements and radiochemistry. The Working group session included in addition to general information, presentations on drinking water control, how to interpret the newest ISO standard on detect limits (ISO11929-2010).

Matjas Korun (Institute Josef Stefan, Ljubljana, Slovenia) launched in 2016 an exercise devoted to systematic influences analysis of peaks in gamma-ray spectra with poor counting statistics. The work attracted the participation of 10 institutes using 6 different types of spectrum analysis software. The results were presented at the Quality Session of ICRM'17.

The ICRM-LLRMT'20 Conference

Preparations for the 2020 ICRM-LLRMT have already begun as the proposal by INFN-LNGS to host the conference at Gran Sasso in Italy was approved by the executive board at their meeting in 2017. The final decision on the date is not yet taken.

Other actions

The network CELLAR (Collaboration of European low-level underground laboratories) commenced at the ICRM-LLRMT'99 conference and has been in close contact with ICRM-LLMT WG since then. In 2015 a meeting was organised by IAEA in Monaco and the most recent meeting was held in November 2017 in Bucharest organised by IFIN-HH and Romulus Margineanu. In addition to a very full day of presentations from European underground laboratories, the meeting held a visit to the underground laboratory mBq located in the Unirea salt-mine outside the city Ploiesti north of Bucharest.

The next working group meeting is scheduled to take place during the ICRM conference in Salamanca, May, 2019.

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The ICRM-LLRMT'16 participants at the room of the Motif hotel, Seattle



The ICRM-LLRMT'16 website

Coordinator's Report Beta-Particle Spectrometry WG

Background

The Beta Particle Spectrometry Working Group is devoted to the development of the metrological aspects of beta spectrometry and its applications. This includes:

- <u>Theory</u>. Beta (β^{\pm}) and electron capture (ϵ) transitions; Theoretical shape factors and influence of the nuclear current; Atomic effects.
- <u>Experiments</u>. Instrumentations used for beta spectrometry; Techniques that need beta information; Confidence on experimental shape factors; Data analysis and unfolding methods.
- <u>Simulations</u>. Confidence on the physical processes: low energies, radioactive decays, atomic rearrangements; Comparison of the results of different codes.
- <u>Evaluations</u>. Confidence and uncertainties on experimental shape factors; Procedure for establishing recommended shape factors; Mean energies, log *ft* values, database.

Interested communities in radionuclide metrology are: nuclear decay data, liquid scintillation counting, ionising chambers, $4\pi \beta$ - γ counting.

Recent and on-going activities

- A dedicated website was created in 2016 and can be found at the following address: <u>http://www.lnhb.fr/icrm_bs_wg/</u>. This first version will change in accordance with the activities of the Working Group.
- <u>Theory</u>. *i*) Development of improved calculations of electron capture decays. *ii*) Inclusion of the nuclear structure in beta decay calculation is on-going. *iii*) Released of the first version of the BetaShape code, now available for the community here: <u>http://www.lnhb.fr/rd-activities/spectrum-processing-software/</u>
- <u>Simulation</u>. A decay module for Geant4 is in development at LNHB, in the same spirit as the PenNuc module developed by CIEMAT with support from LNHB, but with improvements such as a coupling with the BetaShape code.
- <u>Measurements</u>. Beta spectra of ¹⁴C, ³⁶Cl, ⁹⁹Tc and ¹⁵¹Sm should be measured at LNHB and PTB with metallic magnetic calorimeters. A PhD student started her thesis at LNHB in July 2017 and will carry out new measurements with silicon detectors.
- <u>Evaluations</u>. The BetaShape program is now the reference code for future DDEP evaluations. A database of published experimental shape factors, as comprehensive as possible, is being developed and will be made available on the Working Group website.

Related projects

• European metrology project (EURAMET, EMPIR programme) MetroBeta 15SIB10, 2016-2019. Website: <u>http://metrobeta-empir.eu/</u>. Partners are from Czech Republic, France, Germany, Netherlands, Poland and Switzerland.

<u>Summary</u>. The MetroBeta project is taking both theoretical and experimental approaches to improving the knowledge of beta spectra. On the theoretical side, existing knowledge of the calculation of nuclear wave functions is being used to take into account the nuclear structure effect on these spectra. On the experimental side, beta spectrometry with MMCs is being developed, as well as solid scintillators containing the beta emitters in the structure of the scintillator crystal. Comparison of the newly calculated and measured spectra will validate the

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quality of the spectra.

• European metrology project (EURAMET, EMPIR programme) MetroMMC 17FUN02, 2018-2021. Partners are from France, Germany, Netherlands, Poland and Switzerland.

<u>Summary</u>. The main objective of the MetroMMC project is to improve the knowledge of electron capture decay and subsequent atomic relaxation processes. New theoretical calculation techniques and extensive experiments using MMCs will be developed to determine important decay data which are relevant for primary activity standardisations in radionuclide metrology, in cancer therapy on the DNA level, and when studying the early history of the solar system. The experimental parts will be complemented with a new approach based on microwave coupled resonators.

Recent and future meetings

- A WG meeting took place at NPL together with a Nuclear Decay Data Working Group meeting (September 21, 2016) and a DDEP meeting (September 19-20, 2016).
- A WG meeting took place in Buenos Aires during the last ICRM conference (May 15-19, 2017).
- The next WG meeting will take place at the NIST Institute (September 10-14, 2018) alongside a DDEP workshop and two other ICRM WG meetings (Nuclear Decay Data and Radionuclide Metrology Techniques).

On behalf of the Beta-Particle Spectrometry Working Group,

Xavier Mougeot (coordinator)

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Coordinator's Report Nuclear Decay Data WG

Background

The "Nuclear Decay Data" Working Group aims to:

- Create a link between evaluators in the Decay Data Evaluation Project (DDEP) and the measurement community within NMIs, in order to improve the understanding of the evaluation needs within NMIs;
- Encourage NMIs to undertake decay data measurements as part of their normal standardisation work, which it is felt can be achieved with limited extra effort;
- Communicate current/future measurements within NMIs to the DDEP in order to better coordinate future evaluations;
- Ensure that new measurement needs identified during the evaluation process are communicated to the measurement community;
- Interest/recruit new DDEP evaluators at ICRM events.

In particular, the evaluations undertaken by the DDEP are critically reliant on the availability of absolute emission probability measurements, which solely NMIs, with their ability to make absolute activity measurements, are in a position to provide.

Inaugural Working Group Meeting, 21 September 2016, NPL, UK

The first meeting was attended by fifteen or so participants. Presentations and discussions included the early feedback of a new DDEP evaluator, recent nuclear data measurements and future possibilities. Although it was a fairly limited attendance, the opportunity for discussion within such a forum was welcomed.

ICRM Conference Session, 18 May 2017, Buenos Aires, Argentina

During the 21st International Conference on Radionuclide Metrology, a Working Group Session was organised. Presentations from a number of NMIs and other institutes active in measuring nuclear data were made, which included CIEMAT, PTB, NPL, NIST, LNE-LNHB, TAMU and JRC-Geel, who gave an overview of their recent and future measurements. A second presentation from NIST concentrated on the experience gained from the completion of a nuclear data evaluation for DDEP.

Forthcoming

The second meeting for this Working Group will be held during the week of nuclear data related meetings to be held at NIST during the week ($10^{th} - 14^{th}$ September 2018). The week will include a DDEP workshop, various ICRM Working Group meetings (Nuclear Decay Data, Beta Spectrometry and Radionuclide Measurement Techniques). The final schedule will be released shortly.

On behalf of the Nuclear Decay Data Working Group,

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Tel.: +33 1 69 08 27 76 E-mail: <u>mark.kellett@cea.fr</u> Contributions

LABORATORY	Comisión Nacional de Energía Atómica (CNEA), Argentina
NAMES	G. L. CERUTTI, E. CIRELLO, R. AMOR
ACTIVITY	Measurement of natural and artificial radionuclides in environmental samples and others
KEYWORDS	Gross alpha determination, gross beta determination, liquid scintillation, radiochemistry, gamma spectrometry, environmental activity.
RESULTS	Participation in IAEA-ALMERA comparisons
	Gross alpha and gross beta determination in samples of milk powder, maize, soybean meal, wheat and fish by liquid scintillation technic
	Radiochemistry separation and ⁹⁰ Sr determination in samples of milk powder, maize, soybean meal, wheat, cheese, fish and meat.
	Analysis of environmental samples by high resolution gamma spectrometry
	Routine measurements and certifications of non radioactive contamination in exported foodstuffs by high resolution gamma spectrometry
PUBLICATIONS	
IN PROGRESS	Monte Carlo simulation of efficiency curves for large gamma sources of environmental matrices
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
ADDRESS	Comisión Nacional de Energía Atómica, Centro Atómico Ezeiza, Presbítero Juan González y Aragón N°15 (B1802AYA) Ezeiza, Buenos Aires ARGENTINA
	Tel./FAX.: +54 11 4125 8683
	E-mail: <u>cerutti@cae.cnea.gov.ar</u>
CONTACT	G. L. CERUTTI

LABORATORY	Comisión Nacional de Energía Atómica (CNEA), Argentina
NAMES	G.L. CERUTTI; M. P. ROSSI; M. C. FERRARI
ACTIVITY	 Preparation, quality control, standardisation and issue of radioactive sources Development of radioactive standards in different matrixes. Monte Carlo simulations applied to efficiency calibration curves in GeHP detectors
KEYWORDS	Radioactive standards, Monte Carlo
RESULTS	 Preparation and calibration of radioactive sources in different matrixes. Maintenance of the accreditation by ISO17025 in "Preparation and calibration of radioactive standards" by the Argentinean Accreditation Body (OAA). Development of radioactive standards in special geometries Monte Carlo simulation of one GeHP detector and its efficiency curves for a volume gamma sources
PUBLICATIONS	
IN PROGRESS	Monte Carlo simulation of efficiency curves for different large gamma sources of environmental matrices
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
ADDRESS	Comisión Nacional de Energía Atómica, Centro Atómico Ezeiza, Presbítero Juan González y Aragón N°15 (B1802AYA) Ezeiza, Buenos Aires ARGENTINA Tel./FAX.: +54 11 4125 8683 E-mail: <u>cerutti@cae.cnea.gov.ar</u>
CONTACT	G. L. CERUTTI

LABORATORY	Comisión Nacional de Energía Atómica (CNEA), Argentina	
NAMES	C.C. GUARDO, S.BERTOLA, M. LOBO	
ACTIVITY	 Routine metrological assessment of radionuclide activimeters used in Nuclear Medicine. Preparation, quality control and standardisation of standard sources for Nuclear Medicine. Organisation of comparisons for activity measurements among Nuclear Medicine Centres in Argentina. Organisation and participation in 21st International Conference on Radionuclide Metrology and its Applications, in Buenos Aires in May 2017. 	
KEYWORDS	Ionisation chamber, life scineces, activimeters	
RESULTS	 Assessment of 86 Nuclear Medicine Centre calibrators for ¹⁸F, ³²P, ⁶⁷Ga, ⁹⁰Y, ⁹⁹mTc, ⁹⁹Mo, ¹¹¹In, ¹³¹I, ¹⁵³Sm.¹⁷⁷Lu, ²²³Ra Maintenance of the accreditation of "Activimeters calibration" by the Argentinean Accreditation Body, by ISO 17025. 	
PUBLICATIONS	Poster presentation "Results of a regional measurement comparison exercise for I-131 and Y-90 using radionuclide calibrators. Oropesa, P.; Arenillas, P.; De Oliveira, E. A.; Oyarzun, C.H.; García, L.; Guardo, C.; Iwahara, A.; da Cruz, P. A. L.; da Silva, C. J.; Moreno, Y. in 21st International Conference on Radionuclide Metrology and its applications, in Buenos Aires in May 2017.	
IN PROGRESS		
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CONTACT	C.C. GUARDO	

LABORATORY	Comisión Nacional de Energía Atómica (CNEA), Argentina	
NAMES	P. Arenillas, C. Balpardo, S. Consorti, R. Llovera, E. Depaoli, M. Rossi, L. Paredes	
ACTIVITY	 Absolute activity measurements. Participation in international comparisons. Accelerator Mass Spectrometry (AMS). Measurements with 4πγ system. 	
KEYWORDS	Alpha spectrometry, beta spectrometry, digital coincidence method, TDCR, data evaluation, data measurement, defined solid angle (ASD), gas proportional counter, ionisation chamber, liquid scintillation, NaI(Tl) well-type counter, simulation code, SIR, accelerator, AMS, C14, digital $4\pi\gamma$ system.	
RESULTS	 Continue with the digitization of TDCR system. ¹⁴C measurements in archeological samples by AMS technique. Implementation of a new digital 4πγ system with a NaI(Tl) well-type detector. 	
PUBLICATIONS	M. Rossi, C. Balpardo, P. Arenillas, G. Cerutti, M.C. Ferrari. A new digital $4\pi\gamma$ system with a NaI well-type detector at LMR-CNEA. Appl. Radiat. Isot. (2018)	
IN PROGRESS	 Radiocarbon dating by AMS. ¹⁰Be and ¹²⁹I measurements at the accelerator facility. New TDCR system based on hybrid PMT. Implementation of a new 4 channel ULS-TAR module for TDCR system. Development of a new gas proportional counter. 	
ADDRESS	Comisión Nacional de Energía Atómica, Centro Atómico Ezeiza, Av. del Libertador 8250 (C.P. 1429), Buenos Aires ARGENTINA Tel.: +54 11 4125 8595 E-mail: <u>balpardo@cae.cnea.gov.ar</u>	
CONTACT	C. Balpardo	

LABORATORY	Radionuclide Metrology Laboratory, Australian Nuclear Science and Technology Organisation (ANSTO), Australia
NAMES	Mark Reinhard, Freda van Wyngaardt, Michael Smith, Tim Jackson, Bonnie Howe, Siobhan Tobin, Samantha Lee, Jayden Ilter, Adam Sarbutt
ACTIVITY	Primary standards development, maintenance and calibration of secondary standard ionisation chamber, gamma-ray spectrometry
KEYWORDS	Coincidence method, Liquid scintillation counting, TDCR efficiency calculation, CIEMAT/NIST efficiency tracing, gas-proportional counter, high pressure proportional counter, ionisation chamber, gamma-ray spectrometry, source preparation, Tc-99m, Cu-64, F-18
RESULTS	CCRI(II)-S12 (Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated-water source measured using the LSC-TDCR method)
PUBLICATIONS	S. Pommé, et al. Evidence against solar influence on nuclear decay constants. Phys. Lett. B 761 (2016) 281-286.
	S. Pommé, et al. On decay constants and orbital distance to the sun – part I: alpha decay. Metrologia 54 (2017) 1-18.
	S. Pommé, et al. On decay constants and orbital distance to the sun – part II: beta minus decay. Metrologia 54 (2017) 19-35.
	S. Pommé, et al. On decay constants and orbital distance to the sun – part III: beta plus and electron capture decay. Metrologia 54 (2017) 36-50.
	W.M. van Wyngaardt, M.L. Smith, T.W. Jackson, B. Howe, S.M. Tobin, M.I. Reinhard. Development of the Australian Standard for Germanium-68 by two Liquid Scintillation Counting methods. Appl. Radiat. Isot. 134 (2018) 79-84.
	J.T. Cessna, et al. Results of an International Comparison of Activity Measurements of ⁶⁸ Ge. Appl. Radiat. Isot. 134 (2018) 385-390.
	P. Cassette, et al. Results of the CCRI(II)-S12.H-3 supplementary comparison: Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated-water source measured using the LSC-TDCR method. Appl. Radiat. Isot. 134 (2018) 257-262.
IN PROGRESS	F-18, Tc-99m and Cu-64 standardised by $4\pi(LS)-\gamma$ coincidence method for BIPM.RI(II)-K4 SIRTI comparison
	Implementation and testing of a 4π (HPPC) β - $4\pi\gamma$ coincidence system
	Development and testing of digital data acquisition and coincidence counting system based on CAEN digitisers for $4\pi\beta$ - γ coincidence counting
INFORMATION	http://www.ansto.gov.au/BusinessServices/ActivityStandardsLaboratory/inde x.htm
SOURCE IN PREPARATION	

OTHER RELATED PUBLICATIONS	Bonnie Howe, "Dissemination of standards for F-18 FDG", presented at the 47 th Annual Scientific Meeting of the Australian and New Zealand Society for Nuclear Medicine (ANZSNM), 2017, Australia Freda van Wyngaardt, "Development of an internationally traceable standard for Ge-68/Ga-68", 47 th ANZSNM Annual Scientific Meeting, 2017, Australia
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CONTACT	Freda van Wyngaardt

LABORATORY	Radionuclide Metrology Laboaratory, Australian Nuclear Science and Technology Organisation (ANSTO), Australia
NAMES	Mark Reinhard, Bonnie Howe, Freda van Wyngaardt, Tim Jackson, Michael Smith, Samantha Lee, Siobhan Tobin, Jayden Ilter
ACTIVITY	Client services
KEYWORDS	Am-241, Cr-51, Cu-64, F-18, Ga-67, Ga-68, Ge-68/Ga-68, I-123, I-131, Lu-177, Mo-99, P-32, Sm-153, Sr-90, Tc-99m, Y-90
RESULTS	Australian Nuclear Medicine Traceability Program (ANMTP) offered on-site certification for measurement of Tc-99m, I-131 and Ga-67 to 26 dose calibrators at 13 Nuclear Medicine facilities during 2016
	ANMTP offered on-site certification for measurement of Tc-99m, I-131 capsules and Ga-68 using Ge-68/Ga-68 solution to 28 dose calibrators at 16 Nuclear Medicine facilities during 2017
	Australian Industry Becquerel Traceability Program (AIBTP) provided measurement traceability to the Radiopharmaceutical industry for Mo-99, I-131, I-123, Cr-51, Sm-153, Lu-177
	AIBTP-PET provided measurement traceability for F-18 to 4 Cyclotrons
	Australian Certified Reference Materials (ACRMs) of Tc-99m, I-131, Lu-177 and Y-90 were prepared for users from Australia and New Zealand
PUBLICATIONS	D.L. Bailey, M.S. Hofman, N.J. Forwood, G.J. O'Keefe, A.M. Scott, W.M. van Wyngaardt, B. Howe, O. Kovacev, R.J. Francis. Accuracy of dose calibrators for Gallium-68 PET imaging: unexpected findings in a multi-centre clinical pre-trial assessment. Journal of Nuclear Medicine
	http://jnm.snmjournals.org/content/early/2018/01/10/jnumed.117.202861
IN PROGRESS	Collaboration with Clarity Pharmaceuticals to provide measurement traceability for a clinical study using Cu-64 SARTATE
INFORMATION	http://www.ansto.gov.au/BusinessServices/ActivityStandardsLaboratory/inde x.htm
SOURCE IN PREPARATION	The impact of source geometry on radionuclide dose calibrator activity measurements. B Howe, et al.
	International measurement traceability for Australia's primary standards for Tc- 99m, F-18 and Cu-64. W van Wyngaardt, et al.
OTHER RELATED PUBLICATIONS	
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CONTACT	Bonnie Howe

LABORATORY	Bundesamt für Eich- und Vermessungswesen (BEV), Referat Ionisierende
	Radioactivity
NAMES	Scientists:
	Franz Josef MARINGER (Section Head)
	Robert BRETTNER-MESSLER
	Hannah WIEDNER
	Technician:
	Patrick LOBNER, Alfred MATZEK
ACTIVITY	Development and operation of primary and secondary radionuclide metrology standards:
	• Multi-wire proportional chamber for large area sources
	• $4\pi\gamma$ ionisation chambers
	• HP-Ge detectors for gamma-ray spectrometry
	Radon ionisation chamber
	Operation of legal metrology:
	• Type approval of medical activity meter, surface contamination monitors, hand-foot monitors, clearance monitors
	• Verification of medical activity meter, surface contamination monitors, hand-foot monitors, clearance monitors
	Calibration services for activity measurement instruments
	Research and development:
	• EMPIR 15HLT06 MRTDosimetry Metrology for clinical implementation of dosimetry in molecular radiotherapy
	• EMPIR 16ENV10 MetroRADON Metrology for radon monitoring (JRP co-ordination)
	Participation in international comparisons:
	• SIR BIPM-RI(II)-K1.I-131 (Measurements)
	• SIR BIPM-RI(II)-K1.Y-88 (Measurements)
	• CCRI(II)-S10: Measurement of source emission rate for the calibration of surface contamination monitors (Draft A)
	Applications:
	Coordination of intercomparison exercises
	Quality management services for ionising radiation laboratories (ISO/IEC 17025)
	Low-level radionuclide metrology
	Gamma-ray spectrometry
	Radon and thoron instruments calibration
	Radiation protection
	Radioecology
	Radionuclides in environmental research
	Monte Carlo Simulations

KEYWORDS	National Metrology Institute, radionuclide metrology, low-level radioactivity measurement techniques environmental control, EURAMET, EMPIR, gamma-ray spectrometry, gas proportional counter, ionisation chamber, low-level, radioactive gas, simulation code, SIR, source preparation, traceability, radionuclide metrology
RESULTS	 BIPM-RI(II)-K2.Ba-133 BIPM-RI(II)-K1.Co-57 Calibration and verification of contamination monitors Calibration of thyroid monitors NORM intercomparison exercise
PUBLICATIONS	Franz Josef Maringer, Andreas Baumgartner, Francesco Cardellini, Philippe Cassette, Teresa Crespo, Julian Dean, Hannah Wiedner, Jiři Hůlka, Mikael Hult, Simon Jerome, Franz Kabrt, Petr Kovář, Cyrus Larijani, Guillaume Lutter, Maria Marouli, Alexander Mauring, Monika Mazánová, Bogusław Michalik, Nathalie Michielsen, Virginia Peyres, Sylvie Pierre, Roy Pöllänen, Stefaan Pommé, Mário Reis, Michael Stietka, László Szücs, Branko Vodenik. Advancements in NORM metrology – Results and impact of the European joint research project MetroNORM. Appl Rad Isot 126(2017) 273-278
	H. Wiedner, K. Lotter, P. Karner, H. Friedmann, F.J. Maringer. Radon in drinking water: Comparison and evaluation of two ionization chamber activity measurement methods. Appl Rad Isot (2017) doi: 10.1016/j.apradiso.2017.06.031
	H. Wiedner, J. Riedl, F.J. Maringer, A. Baumgartner, M. Stietka, F. Kabrt. Production and characterization of a traceable NORM material and its use in proficiency testing of gamma-ray spectrometry laboratories. Appl Rad Isot (2017) doi:10.1016/j.apradiso.2017.09.025
	Andreas Baumgartner, Michael Stietka, Franz Kabrt, Hannah Wiedner, Franz Josef Maringer. Study of particular problems appearing in NORM samples and recommendations for best practice gamma-ray spectrometry. Appl Rad Isot 126(2017) 289-292
	F. Kabrt, A. Baumgartner, M. Stietka, H. Friedmann, V. Gruber, W. Ringer and F. J. Maringer. A comparison of radon indoor measurements with interpolated radon soil gas values using the inverse weighting method on measured results. Rad Prot Dos (2017), pp. 1-7 doi:10.1093/rpd/ncx141
	M. Stietka, A. Baumgartner, F. Kabrt and F.J. Maringer. Measurement strategies for radon in indoor air of waterworks – a review. Radioprotection 2017, 52(2), 101-107
	H. Moser, F.J. Maringer. A quick technique to improve the geometry characterisation of aged HPGe detectors for MC code efficiency calculation. App Rad Iso109(2016) 532-534
	C. Larijani, A.K. Pearce, P.H. Regan, B.C. Russell, S.M. Jerome, M.T. Crespo, P. de Felice, G. Lutter, F. Maringer, M. Mazánová. Reference materials produced for a European metrological research project focussing on measurements of NORM. Appl Rad Isot 126(2017) 279-284
	Maringer F.J. et al. EMRP JRP ENV57 MetroNORM – Metrology for processing materials with high natural radioactivity. 21st Int. Conference on radionuclide metrology and its applications ICRM 2017. 15-18 May 2017, Buenos Aires

	Wiedner H., Maringer F.J. Interlaboratory comparison of a new norm reference material obtained from treatment of drinking water. 21st Int. Conference on radionuclide metrology and its applications ICRM 2017. 15-18 May 2017, Buenos Aires
	Wiedner, H.; Lotter, K.; Maringer, F. J.; Friedmann, H. Radon in drinking water: review and evaluation of activity measurement methods. 21st Int. Conference on radionuclide metrology and its applications ICRM 2017. 15-18 May 2017, Buenos Aires
	F.J. Maringer et al.: Radiation protection for NORM industries - Results of the European joint research project 'Metrology for processing materials with high natural radioactivity (MetroNORM)'. 14th Congress of the International Radiation Protection Association (IRPA 14), Cape Town, South Africa, 9-13 May 2016.
	Hannah Wiedner, Virginia Peyres, Teresa Crespo, Marcos Mejuto, Eduardo García-Toraño, Franz Josef Maringer. Application of an Artificial Neural Network for evaluation of activity concentration exemption limits in NORM industry by gamma-ray spectrometry. 14th Congress of the International Radiation Protection Association (IRPA 14), Cape Town, South Africa, 9-13 May 2016.
	Hannah Wiedner, Virginia Peyres, Teresa Crespo, Marcos Mejuto, Eduardo García-Toraño, Franz Josef Maringer. Application of an Artificial Neural Network for evaluation of activity concentration exemption limits in NORM industry. ICRM LLRMT'16, Seattle, USA, 26-30 September 2016.
	Maringer F.J. Emerging social, scientific and legislative triggers for the application and development of LLRMT resolving NORM issues (invited talk). ICRM LLRMT'16, Seattle, USA, 26-30 September 2016.
	Maringer F.J. et al. Advancements in NORM metrology - Results and impact of the European joint research project MetroNORM. ICRM LLRMT'16, Seattle, USA, 26-30 September 2016.
	Maringer F.J. et al. Study of particular problems appearing in NORM samples and recommendations for best practice gamma-ray spectrometry. ICRM LLRMT'16, Seattle, USA, 26-30 September 2016.
IN PROGRESS	Co-operations in research, applications and university courses:
	• IAEA – Radioactive Waste Management, NORM, Radon
	• IRPA (Internat. Radiation Protection Association) – radiation protection
	• ISO / CEN – Natural radioactivity of building materials
	 COST – TU1301, NORM for Building materials network (NORM4BUILDING)
	• BOKU (University of Natural Resources and Life Science Vienna) – radioecology, natural radiation environment
	• TU Wien (Technical University of Vienna) – radiation physics, radionuclide metrology, radiation protection, dosimetry
	• AIT (Austrian Institute of Technology) – environmental isotopes
	• SEIB (Seibersdorf Laboratories GmbH) – radiation protection
	ÖVS (Austrian Radiation Protection Association) – radiation protection
	• ASI (Austrian Standards Institute) – Low-level radioactivity measurements working group

INFORMATION	82 CMCs for radioactivity measurement calibration services
SOURCE IN PREPARATION	Planned radionuclide comparisons in BIPM SIR / CCRI(II).K1: Tl-201, Lu-177, Pb-210
OTHER RELATED PUBLICATIONS	Franz Josef Maringer, Claudia Ackerl, Andreas Baumgartner, Christopher Burger-Scheidlin, Maria Kocadag, Johannes H. Sterba, Michael Stietka, Jan Matthew Welch. Long-term environmental radioactive contamination of Europe due to the Chernobyl accident - Results of the Joint Danube Survey 2013. Appl Rad Isot 126 (2017) 100-105
	F. Kabrt, A. Baumgartner, M. Stietka and F.J. Maringer. Introduction and testing of a simplified method for the evaluation of the radon emanation. Rad Prot Dos (2017), pp. 1-5 doi:10.1093/rpd/ncx151
	M Kocadag, V Exler, C Burger-Scheidlin, A Baumgartner, M Stietka, C Landstetter, M Korner, FJ Maringer. Environmental radioactivity study of Austrian and Bavarian forest ecosystems: Long-term behaviour of contamination of soil, vegetation and wild boar and its radioecological coherences. Appl Rad Iso 126 (2017) 106-111
	F Kabrt, A Baumgartner, FJ Maringer. A Study of parameters relevant for a better prediction of the radon potential. Appl Rad Iso 109 (2016) 444-448.
	H. Friedmann, A. Baumgartner, M. Bernreiter, J. Graeser, V. Gruber, F. Kabrt, H. Kaineder, F.J. Maringer, W. Ringer, C. Seidel, G. Wurm. Indoor radon, geogenic radon surrogates and geology - Investigations on their correlation. Env Rad 166 (2017) 382-389.
	H. Friedmann, A. Baumgartner, V. Gruber, H. Kaineder, F.J. Maringer, W. Ringer, C. Seidel. The uncertainty in the radon hazard classification of areas as a function of the number of measurements. Journal of Environmental Radioactivity. Env Rad 173 (2017) 6-10
	Franz Kabrt, Harry Friedmann, Wolfgang Ringer, Franz Josef Maringer. Correlations of Radon Measurements in Soil Gas and Indoor for Improving the Prediction of an Area's Radon Potential. 14th Congress of the International Radiation Protection Association (IRPA 14), Cape Town, South Africa, 9-13 May 2016.
	Maringer F.J et al. Long-term environmental radioactive contamination of Europe due to the Chernobyl accident - Results of the ICPDR Joint Danube Survey 2013 radioactivity measurements. ICRM LLRMT'16, Seattle, USA, 26- 30 September 2016.
	Kocadag M., Maringer F.J, et al. Environmental radioactivity study of forest ecosystems: long-term behaviour of contamination of wild boar and its radioecological coherences. ICRM LLRMT'16, Seattle, USA, 26-30 September 2016.
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RadioNuclide Metrology Team of the JRC-Geel, SA1/SA2 2016-2019 Progress Report and Work Plan (information for ICDM members)

(information for ICRM members)

The European Commission's Joint Research Centre was restructured in 2016. The former institute IRMM doesn't exist as such. The Geel-site (formerly IRMM) now has the name "JRC-Geel". The work of the JRC is divided in Directorates that each covers several sites. The work of the RadioNuclide (RN) metrology Team of JRC-Geel resides in the Directorate G for Nuclear safety and Security. The Dir-G Director is Maria Betti. The programme at the *JRC-Geel* site in the field of radionuclide metrology in the years 2016-2017 was on maintaining and developing the primary and secondary standards for activity measurements in support of the SIR and to support member state laboratories monitoring radioactivity by producing reference materials and conducting proficiency tests. Furthermore, the external access programme called EUFRAT has been quite extensive and resulted in 22 science application projects many of which carried out in the underground laboratory HADES. The new JRC-wide external access scheme is available at https://ec.europa.eu/jrc/en/research-facility/open-access

Scientists	Function
Mikael Hult	Head of RadioNuclide Metrology Team
Stefaan Pommé	Head of Primary Standardisation and Decay data
Maria Marouli	Alpha spectrometry, Standardisation, Decay data
Viktor Jobbagy	Environmental radioactivity, radiochemistry
Kasia Sobiech-Matura	Environmental radioactivity, radiochemistry
Guillaume Lutter	Gamma spectrometry, low-level measurements
Technicians	
Raf van Ammel	Source preparation/radiochemistry, secondary activity
Jan Paepen	Documentary Standards (IEC, ISO,.), electronics
Gerd Marissens	Gamma-ray spectrometry, low-level measurements
Petya Malo	Logistics for Proficiency Tests, Quality System
Heiko Stroh	Decay data, low-level, gamma-ray spectrometry

The *JRC-Geel* staff of the RN-Team in 2017 were:

Two key persons left the team early in 2017. Dr. Timos Altzitzoglou, a leading expert in liquid scintillation counting, radiochemistry and many other radiometric techniques left with retirement after more than 30 years at CBNM/IRMM/JRC-Geel. Dr. Faidra Tzika left for a permanent position at DG ENER in Luxembourg. We miss their outstanding contributions but wish them all the best with their new "functions".

The main specific activities carried out by the RN-Team at JRC-Geel are summarised below.

Activity line	JRC-Geel	JRC-Geel
	Radionuclide Metrology 2016- 2017 Progress report	Radionuclide Metrology 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Development of ICE spectrometry Test of exponential decay law vs solar influence Improved decay data for ²³⁵U, ²²⁷Ac, ²²⁶Ra, ²⁰⁹Po 	 Standardisation and alpha spectrometry of ²³¹Pa Improve half-lives of various nuclides Standardisation of medical nuclides
International comparisons	 Suppl. Comp. H-3 by TDCR Participant on the NPL 2017 environmental radioactivity PT Participant in the 2017 Almera ILC. 	• Participant on the NPL 2018 environmental radioactivity PT
Standardization of measurement methods	 Uncertainty propagation in nuclear dating Characterization of environmental radioactive reference materials from IAEA, TEAK, IRMM/JRC-Geel/Nemo/EMRP/EMPIR 	• Characterization of environmental radioactive reference materials from JRC- Geel and external collaboration partners
European proficiency tests	 MetroERM proficiency test of I-131, Cs-134, Cs-137 in air-filters Gross-alpha/beta in drinking water 	 I-131, Cs-134, Cs-137, K-40 in maize (both emergency and routine reporting) Radon in water (pilot-PT and full scale PT) Validation of method for measuring radioactivity in feed for a new CEN- standard (hay, maize, oil)
Membership in international and national organisations	 ICRM committee membership BIPM/CCRI(II), EURAMET TC IR IEC, ISO liaison CEN/CENELEC 	 ICRM committee membership BIPM/CCRI(II), EURAMET TC IR IEC, ISO liaison CEN/CENELEC

Activity line	JRC-Geel Radionuclide Metrology 2016- 2017 Progress report	<i>JRC-Geel</i> Radionuclide Metrology 2018-2019 Work plan
Management and Organisation	 European Projects: MetroPreparedness, MetroDecom II, Insider MetroERM, MetroDecom, MetroRadon Running or involved in 13 JRC Work packages. 	 European Projects: <i>MetroPreparedness,</i> <i>MetroDecom II, Insider,</i> <i>MetroRadon</i> Running 4 JRC Work Packages: PRIMER, SELMER, HUMOR, STANDER
Teaching activity	 MOOCS videos on radioactivity and atomic model Metrology for MEDECIS 	 Courses in support of JCPOA Courses in support of other Commission services (ENER)
Quality system	• Accreditation for ISO17025 and 17043	• A complete reorganisation of the quality system and accreditations due to the reorganisation of JRC.

LABORATORY	European Commission - Joint Research Centre, Institute for Reference Materials and Measurements (IRMM), Radionuclide Metrology Sector
NAMES	Mikael Hult, Gerd Marissens, Heiko Stroh, Guillaume Lutter, Kasia Sobiech- Matura, Faidra Tzika (until march 2017), Timos Altzitzoglou (until March 2017)
ACTIVITY	Ultra Low-level and Low-level gamma-ray spectrometry
KEYWORDS	gamma-ray spectrometry, muon shield, underground laboratory, low-level, ultra low-level, neutron measurement, simulation code, EGSnrc, environmental radioactivity, tracer studies
RESULTS	* Measurements in support EMRP projects MetroNORM, MetroERM and MetroDecom. Like e.g. determination of activity distribution inside metal reference standards. Characterisation and certification of reference materials.
	* Establishing the underground lab HADES as an open access facility via the JRC external access programme "EUFRAT" <u>https://ec.europa.eu/jrc/en/research-facility/open-access/calls/relevance/2017-1-RD-EUFRAT-HADES</u> with new projects/results like: (i) tracer studies of hydrothermal plumes in the Pacific to study uptake of CO2 by oceans (ii) Study of uptake of radiocaesium in different parts of rice plants (iii) Pulse-shape characterisation of a SAGe-well detector (iv) Study of the most long-lived isomeric state, 180mTa, a new improved lower bound for the half-life. (v) radiocaesium as tracer of ocean currents in Pacific sea water collected by Woods Hole Oceanographic Institute.
	* Support to the GERDA double beta decay experiment with detector testing and radiopurity measurements
	* Support to characterisation of JRC-Geel/IRMM reference materials for environmental radioactivity (proficiency tests materials, method testing materials and certified reference materials)
	* Support to characterisation of "external" reference materials (IAEA, TAEK, EMRP, EMPIR, Nemo)
	* Activation technique combined with deconvolution for obtaining neutron cross-section curves
PUBLICATIONS	 M. Hult, H. Stroh, G. Marissens, F. Tzika, G. Lutter, J. Šurán, P. Kovar, L. Skala, J. Sud, Distribution of radionuclides in an iron calibration standard for a free release measurement facility, Applied Radiation and Isotopes, 109 (2016) 96–100.
	 M. Agostini, M. Hult, G. Lutter, and GERDA collaboration, Search of Neutrinoless Double Beta Decay with the GERDA Experiment, Nuclear and Particle Physics Proceedings 273 – 275 (2016) 1876-1882.
	 P.P. Povinec, M.K. Pham, J. Busto, C. Cerna, D. Degering, Y. Hamajima, K. Holy, M. Hult, M. Jeskovsky, M. Koehler, A. Kovacik, M. Laubenstein, P. Loaiza, F. Memedov, Ch. Marquet, J. Mott, M. Muellerova, F. Perrot, F. Piquemal, JL. Reyss, R. Saakyan, H. Simgen, B. Soule, J. Stanicek, I. Sykora, I. Stekl, Reference material for natural radionuclides in glass designed for underground experiments, J Radioanal Nucl Chem (2016) 307:619-626.

4. K. Sobiech-Matura, B. Máté, T. Altzitzoglou, Spiked environmental matrix for use as a reference material for gamma-ray spectrometry: Production and homogeneity test, Applied Radiation and Isotopes 109 (2016) 126-128.
 B. Máté, K. Sobiech-Matura, T. Altzitzoglou, Evaluation of the 2014 EC measurement comparison on ¹³⁷Cs in air filters, Applied Radiation and Isotopes 109 (2016) 36-40.
6. T. Altzitzoglou, A. Bohnstedt, Characterisation of the IAEA-375 soil reference material for radioactivity, Applied Radiation and Isotopes 109 (2016) 118-121.
 M. Aoyama, Y. Hamajima, M. Hult, M. Uematsu, E. Oka, D. Tsumune, Y. Kumamoto, ¹³⁴Cs and ¹³⁷Cs in the North Pacific Ocean derived from the March 2011 TEPCO Fukushima Dai-ichi Nuclear Power Plant accident, Japan. Part one: surface pathway and vertical distributions, J Oceanogr (2016) 72:53–65.
 S. Vanderheyden, R. Van Ammel, K. Sobiech-Matura, K. Vanreppelen, S. Schreurs, W. Schroeyers, J. Yperman, R. Carleer, Adsorption of cesium on different types of activated carbon, J Radioanal Nucl Chem, 2016.
 M. Aoyama, M. Hult, Y. Hamajima, G. Lutter, G. Marissens, H. Stroh, F. Tzika, Tracing radioactivity from Fukushima in the Northern Pacific Ocean, Applied Radiation and Isotopes 109 (2016) 435-440.
10. F. Tzika, O. Burda, M. Hult, D. Arnold, B. Caro Marroyo, et al, ⁶⁰ Co in cast steel matrix: A European interlaboratory comparison for the characterisation of new activity standards for calibration of gamma-ray specrometers in metallurgy, ARI 114 (2016) 167-172.
 B. Lehnert, E. Andreotti, D. Degering, M. Hult, M. Laubenstein, T. Wester and K. Zuber, Double beta decays into excited states in ¹¹⁰Pd and ¹⁰²Pd, J. Phys. G: Nucl. Part. Phys. 43 (2016) 115201.
 N. Jovančević, L. Daraban, H. Stroh, S. Oberstedt, M. Hult, C. Bonaldi, W. Geerts, FJ. Hambsch, G. Lutter, G. Marissens, and M. Vidali, The neutron cross-section functions for the reactions ¹⁸⁷Re(n, α)¹⁸⁴Ta, ¹⁸⁷Re(n, 2n)¹⁸⁶Re and ¹⁸⁵Re(n, 2n)¹⁸⁴Re in the energy range 13.08–19.5MeV, Eur. Phys. J. A (2016) 52: 148.
 M.K. Pham, P. van Beek, F.P. Carvalho, E. Chamizo, D. Degering, C. Engeler, C. Gascó, R. Gurriaran, O. Hanley, A.V. Harms, J. Herrmann, M. Hult, Y. Ikeuchi, C. Ilchmann, G. Kanisch, G. Kis-Benedek, M. Kloster, M. Laubenstein, M. Llaurado, J.L. Mas, M. Nakano, S.P. Nielsen, I. Osvath, P.P. Povinec, U. Rieth, J. Schikowski, P.A. Smedley, M. Suplinska, I. Sýkora, S. Tarjan, B. Varga, E. Vasileva, T. Zalewska, W. Zhou, Certified reference materials for radionuclides in Bikini Atoll sediment (IAEA-410) and Pacific Ocean sediment (IAEA-412), ARI 109 (2016) 101-104.
 T. Vidmar, A. Camp, S. Hurtado, H. Jäderström, J. Kastlander, M-C. Lépy, G. Lutter, H. Ramebäck, O. Sima, A. Vargas, Equivalence of computer codes for calculation of coincidence summing correction factors – Part II, Appl. Rad. Isot. 109 (2016) 482-486.
 K. Sobiech-Matura, B. Maté, T. Altzitzoglou, Radioactivity monitoring in foodstuff and drinking water – An overview of performance of EU laboratories based on interlaboratory comparisons, Food Control 72B (2017) 225-231.
16. T. Croymans, W. Schroeyers, P. Krivenko, O. Kovalchuk, A. Pasko, M. Hult, G. Marissens, G. Lutter, S. Schreurs, Radiological characterization

and evaluation of high volume bauxite residue alkali activated concretes, Journal of Environmental Radioactivity 168 (2017) 21-29.
17. Tom Croymans, Indy Vandael Schreurs, Mikael Hult, Gerd Marissens, Guillaume Lutter, Heiko Stroh, Sonja Schreurs, Wouter Schroeyers, Variation of natural radionuclides in non-ferrous fayalite slags during a one- month production period, Journal of Environmental Radioactivity 172 (2017) 63-73.
 B. Lehnert, M. Hult, G. Lutter, K. Zuber, Search for the decay of nature's rarest isotope 180mTa, Physical Review C 95, 044306 (2017).
19. GERDA Collaboration, Background-free search for neutrinoless double beta decay of 76Ge with Gerda, Nature, vol. 544 (2017).
 GERDA Collaboration, First results of GERDA Phase II and consistency with background models, IOP Conf. Series: Journal of Physics: Conf. Series 798 (2017).
21. G. Lutter, I. Vandael Schreurs, T. Croymans, W. Schroeyers, S. Schreurs, M. Hult, G. Marissens, H. Stroh, F. Tzika, A low-energy set-up for gamma- ray spectrometry of NORM tailored to the needs of a secondary smelting facility, Applied Radiation and Isotopes 126 (2017) 296-299.
22. F. Tzika, M. Hult, A. Fenyvesi, I. Bandac, D. Degering, A. Ianni, M. Laubenstein, A. De Vismes-Ott, G. Marissens, H. Stroh, S. Son, Hong Suk Young; Kim Jun Young; Kim Junghee; Cheon Munseung; Jo Jungmin, M. Braun, J. Nemeth, S. Zoletnik; G. Bonheure, Coordinated underground measurements of gamma-ray emitting radionuclides for plasma physics research, Applied Radiation and Isotopes 126 (2017) 121- 126.
23. C. Larijanai, A.K. Pearce, P.H. Regan, B.c. Russell, S.M. Jerome, M.T. Crespo, P. de Felice, G. Lutter, F. Maringer, M. Mazánová, Reference materials produced for a European metrological research project focussing on measurements of NORM, Applied Radiation and Isotopes 126 (2017) 279-284.
24. GERDA Collaboration, Limits on uranium and thorium bulk content in Gerda Phase I detectors, Astroparticle Physics 91 (2017) 15-21.
25. P. Krivenko, O. Kovalchuk, A. Pasko, T. Croymans, M. Hult, G. Lutter, N. Vandevenne, S. Schreurs, W. Schroeyers, Development of alkali activated cements and concrete mixture design with high volumes of red mud, Construction and Building Materials 151 (2017) 819-826.
26. GERDA Collaboration, Study of the GERDA Phase II background spectrum, Journal of Physics: Conf. Series 888 (2017).
27. GERDA Collaboration, First results from GERDA Phase II, Journal of Physics: Conf. Series 888 (2017).
28. N. Jovančević, L. Daraban, H. Stroh, S. Oberstedt, M. Hult, C. Bonaldi, W. Geerts, FJ. Hambsch, G. Lutter, G. Marissens, F. Tzika and M. Vidali, The cross section functions for neutron induced reactions with rhenium in the energy range 13.0 -19.5 MeV, EPJ Web of Conferences 146, 11025 (2017),
29. E. Yeltepe, N. K. Şahin, N. Aslan, M. Hult, G. Özçayan, H. Wershofen, Ü. Yücel, A review of the TAEA proficiency test on natural and anthropogenic radionuclides activities in black tea, ARI in Press (ICRM'17)

	30. A. Domula, M. Hult, Y. Kermaïdic, G. Marissens, B. Schwingenheuer, T. Wester, K. Zuber, Pulse shape discrimination performance of Inverted Coaxial Ge detectors, NIM A accepted for publications
IN PROGRESS	* Characterisation of reference materials for their radioactive components
	* Measurements in support of the EMRP projects MetroDecom II and MetroRadon.
	* Measurements rare nuclear decays.
	* Characterisaton of NORM materials for usage in geopolymers
	* Measurement of neutron cross sections and neutron fluence using novel techniques
	* Support to external access projects aiming at; developing fusion plasma monitors, tracer studies for dating corals, ice-core samples from Greenland, baseline of radioactivity in Antarctica, etc.
INFORMATION	https://ec.europa.eu/jrc/en/research-facility/hades-underground-laboratory https://ec.europa.eu/jrc/en/research-facility/open-access/calls/relevance/2017- <u>1-RD-EUFRAT-HADES</u> https://www.youtube.com/watch?v=leyeHub_788
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	E-mail: <u>mikael.hult@ec.europa.eu</u>
CONTACT	Mikael Hult

LABORATORY	European Commission - Joint Research Centre, Institute for Reference Materials and Measurements (IRMM), Radionuclide Metrology Sector
NAMES	S. Pommé, M. Marouli, R. Van Ammel, J. Paepen, H. Stroh, T. Altzitzoglou (until March 2017)
ACTIVITY	Primary standardisation of activity and measurement of nuclear decay data
KEYWORDS	Alpha-particle spectrometry, coincidence counting, $4\pi CsI(Tl)$ -sandwich spectrometer, defined solid angle (alpha-particle and X-ray) counting, gamma- ray spectrometry, gas proportional counting (atmospheric, pressurised), ionisation chamber, liquid scintillation counting, NaI well-type counters, X-ray spectrometry, conversion electron spectrometry, simulation code, SIR, source preparation (quantitative drop deposition, IRMM source drying device, vacuum evaporation and electrodeposition), traceability, data evaluation, data measurement, statistics and uncertainty evaluation, Euramet projects, life sciences, norms and standards
RESULTS	* Overview paper of the 'state-of-the-problem' in radionuclide metrology referring to the special issue on uncertainty
	* Set-up for internal conversion electron (ICE) spectrometry with a silicon detector
	* Deconvolution of ICE spectra and determination of ICE emission probabilities for plutonium isotopes
	* Improve half-life of ²⁰⁹ Po and answer to critique
	* Derivation of fundamental equations for nuclear dating and uncertainty propagation, applied to ¹⁴⁰ Ba- ¹⁴⁰ La and ²²⁷ Th- ²²³ Ra chronometers
	* Evidence against solar influence on nuclear decay constants: study of annual and monthly oscillations
	* Direct measurement of alpha emission probabilities in the decay of ²²⁶ Ra
	* Measurement of absolute $\gamma\text{-ray}$ emission probabilities in the decay of ^{235}U and ^{227}Ac
	* Intercomparison of ^{99m} Tc, ¹⁸ F, and ¹¹¹ In activity measurements with radionuclide calibrators in Belgian hospitals
	* Training for students in the MEDICIS program and metrologists in the frame of the JCPOA
	* MOOCS lecture videos on radioactive decay in the frame of GENTLE, on the Elearning platform of Delft University
	* MetroRWM: half-life of ¹²⁹ I
	* MetroDECOM: provision of radioactive standards
	* Supplementary comparison on ³ H activity determination by TDCR
	* Improvement of international standards in the field of nuclear security through liaison JRC-IEC/SC45B
	* Phase II of illicit trafficking radiation detection assessment programme
	* Acceptance of the proposal for a new international standard for list-mode data used in nuclear instrumentation
	* Standardisation and alpha spectrometry of ²³¹ Pa

PUBLICATIONS	S. Pommé, When the model doesn't cover reality: examples from radionuclide metrology, Metrologia 53 (2016) S55-S64.
	S. Pommé, J. Paepen, K. Peräjärvi, J. Turunen, R. Pöllänen, Conversion electron spectrometry of Pu isotopes with a silicon drift detector, Applied Radiation and Isotopes 109 (2016) 183-188.
	T. Altzitzoglou, A. Rozkov, Standardisation of the ¹²⁹ I, ¹⁵¹ Sm and ^{166m} Ho activity concentration using the CIEMAT/NIST efficiency tracing method, Applied Radiation and Isotopes 109 (2016) 281-285.
	S. Pommé, L. Benedik, On the ²⁰⁹ Po half-life error and its confirmation: an answer to the critique, J. Radioanal. Nucl. Chem. 309 (2016) 931-940.
	S. Pommé, S. M. Collins, A. Harms, S. M. Jerome, Fundamental uncertainty equations for nuclear dating applied to the ¹⁴⁰ Ba- ¹⁴⁰ La and ²²⁷ Th- ²²³ Ra chronometers, J. Env. Radioact. 162-163 (2016) 358-370.
	S. Pommé, et al., Evidence against solar influence on nuclear decay constants, Phys. Lett. B 761 (2016) 281-286
	S. Pommé, et al., On decay constants and orbital distance to the sun – part I: alpha decay, Metrologia 54 (2017) 1-18
	S. Pommé, et al., On decay constants and orbital distance to the sun – part I: alpha decay, Metrologia 54 (2017) 19-35
	S. Pommé, et al., On decay constants and orbital distance to the sun – part I: alpha decay, Metrologia 54 (2017) 36-50
	M. Marouli, S. Pommé, R. Van Ammel, E. García-Toraño, T. Crespo, S. Pierre, Direct measurement of alpha emission probabilities in the decay of ²²⁶ Ra, Appl. Rad. Isot. 125 (2017) 196-202.
	Franz Josef Maringer et al., Advancements in NORM metrology - Results and impact of the European joint research project MetroNORM, Applied Radiation and Isotopes 126 (2017) 273-278.
	M.C. Lépy, S. Pierre, R. Van Ammel, M. Marouli, Photon emission intensities in the decay of U-235, Applied Radiation and Isotopes 126 (2017) 150-153.
	S. Pommé, K. Kossert, O. Nähle, On the claim of modulations in ³⁶ Cl beta decay and their association with solar rotation, Solar Physics 292 (2017) 162 (pp. 8).
	J. Suran, P. Kovar, J. Smoldasova, J. Solc, L. Skala, D. Arnold, S. Jerome, P. de Felice, B. Pedersen, T. Bogucarska, F. Tzika, R. van Ammel, New high- throughput measurement systems for radioactive wastes segregation and free release, Applied Radiation and Isotopes 130 (2017) 252-259.
	M. Marouli, G. Lutter, S. Pommé, R. Van Ammel, M. Hult, S. Richter, R. Eykens, V. Peyrés, E. García-Toraño, P. Dryák, M. Mazánová, P. Carconi, Measurement of absolute γ -ray emission probabilities in the decay of ²³⁵ U, Appl. Rad. Isot. 132 (2018) 72-78.
	S. Pommé, G. Lutter, M. Marouli, K. Kossert, O. Nähle, On the claim of modulations in radon decay and their association with solar rotation, Astroparticle Physics 97 (2018) 38-45.
	A.H. Tkaczyk, H. Saare, C. Ipbüker, F. Schulte, P. Mastinu, J. Paepen, B. Pedersen, P. Schillebeeckx, G. Varasano, Characterization of EJ-200 plastic scintillators as active background shield for cosmogenic radiation, Nuclear Instr. and Methods in Physics Research, A 882 (2018) 96-104.

	S Dommé H Stroh T Altzitzoglou I Deenen D Van Ammel K Kossert O
	Nähle, J. D. Keightley, K. M. Ferreira, L. Verheyen, M. Bruggeman, Is decay constant?, Appl. Rad. Isot. 134 (2018) 6-12.
	S. Pommé, M. Marouli, J. Paepen, N. Marković, R. Pöllänen, Deconvolution of ^{238,239,240} Pu conversion electron spectra measured with a silicon drift detector, Appl. Rad. Isot. 134 (2018) 233-239.
	Raf Van Ammel, Katarzyna Sobiech-Matura, Uwe Wätjen, Tom Vercammen, Pieter Castelein, Roel Wuyts, Johan Paul, Qualification of a precision pattern dispenser, Appl. Rad. Isot. 134 (2018) 117-121.
	Jiri Suran, et al., Metrology for decommissioning nuclear facilities: partial outcomes of joint research project within the European Metrology Research Program, Appl. Rad. Isot. 134 (2018) 351-357.
	Philippe Cassette, Timotheos Altzitzoglou, Andrei Antohe, Mario Rossi, Arzu Arinc, Marco Capogni, Raphael Galea, Arunas Gudelis, Karsten Kossert, K.B. Lee, Juncheng Liang, Youcef Nedjadi, Pilar Oropesa Verdecia, Tanya Shilnikova, Winifred van Wyngaardt, Tomasz Ziemek, Brian Zimmerman, Results of the CCRI(II)-S12.H-3 supplementary comparison: Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated-water source measured using the LSC-TDCR method, Appl. Rad. Isot. 134 (2018) 257-262.
	C. Saldarriaga Vargas, S. Rodriguez Pérez, K. Baete, S. Pommé, J. Paepen, R. Van Ammel, L. Struelens, Intercomparison of ^{99m} Tc, ¹⁸ F, and ¹¹¹ In activity measurements with radionuclide calibrators in Belgian hospitals, Physica Medica 45 (2018) 134-142.
IN PROGRESS	Half-life measurements of ²³⁵ U, ²³⁸ U, ⁵⁵ Fe, ²² Na, ¹³⁴ Cs, ²⁴³ Am, ²³¹ Pa
	Decay data evaluation using the Power-Moderated Mean
	Calibration of ionisation chambers for parent-daughter decay
	Reply to a rebuttal advocating solar influences on decay
INFORMATION	https://ec.europa.eu/jrc/en/research-topic/nuclear-reference-data-materials- and-measurements?search
SOURCE IN	The half-life of ¹²⁹ I
PREPARATION	Linearity test of an ionisation chamber through 99mTc half-life measurements
	Gamma-ray emission probabilities in the decay of ²²⁷ Ac
OTHER RELATED PUBLICATIONS	https://online-learning.tudelft.nl/courses/understanding-nuclear-energy/
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	Tel. +32 14 571 289 Fax +32 14 584 273
	E-mail: stefaan.pomme@ec.europa.eu
CONTACT	Stefaan Pommé

SCK•CEN, Low-Level Radioactivity Measurements (LRM), Belgium, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The laboratories of the LRM services group are devoted to routine radioactivity analyses and elemental concentration analyses with neutron activation analysis. Striving to high quality measurements and services for our customers we are investing continuously in the quality assurance of our services and in supporting research to apply the best techniques in terms of accuracy, throughput and cost.

Our laboratories provide services to the Federal Agency of Nuclear Control (FANC) who is coordinating the radiological surveillance program of the Belgian territory and to the Federal Agency for the Safety of the Food Chain (FAVV) and to many external parties. Our services consist in the sampling, sample preparation and radiological analysis of food and environmental samples. Our laboratories also have a long history in bio-assay e.g. the radioactivity analysis of excretion samples (urine and faeces).

Scientist	Function	
Bruggeman Michel	Head LRM	
Verrezen Freddy	Technical Group Manager	
Vasile Mirela	R&D Task Manager	
Sneyers Liesel	Technical Group Manager and Lab Head (Neutron activation analysis)	
Dupuis Edmond	Lab Head (gross alpha/beta counting & Ra-226/Rn-222 analysis	
Smits Katrien	Lab Head (preliminary sample preparation)	
Verheyen Leen	Lab Head (Gamma-ray Spectrometry)	
Jacobs Karin	Lab Head (Alpha-spectrometry)	
Loots Hilde	Lab Head (Liquid Scintillation Counting)	
Verstrepen Diana	Lab Head (^{89/90} Sr and I counting)	
Lab Technicians		
Cools Sandy	Bio-assay sample preparations	
Vicky Theunis	Sampling and preliminary sample preparations	
Bouwens Benny	Sampling and preliminary sample preparations	
Avci Huliye	Sampling and preliminary sample preparations	
Steven Goris	Liquid Scintillation Counting	
Tessens Els	Gross alpha and beta counting	
Van Baelen Willeke	Gross alpha and beta counting	
Jansen Linde	Gross alpha and beta counting	
Vanuytven Mieke	Alpha spectrometry	
Anke Hooyberghs	Gamma-ray spectrometry	
Verbist Myriam	Alpha spectrometry	
Goelen Sofie	Sampling and preliminary sample preparations	
Activity line	SCK•CEN, Low-Level Radioactivity Measurements 2016- 2017 Progress report	SCK•CEN, Low-Level Radioactivity Measurements 2018-2019 Work plan
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Development of primary standards, Improvement of measuring methods and instrumentation	 Ra-228 analyses based on RadDISK Determination of 'difficult to measure' radionuclides 	 Validation of low energy gamma-ray emitters in solid samples using transmission based matrix characterization with a modified EFFTRAN version; alpha/beta global measurements using LSC Validation of fast Sr-90/Sr-89 analysis; Separation methods using membrane technology (Tc, Sr, Pb) Determination of Fe-55 Determination of Ca-41 Determination of 'difficult to measure' radionuclides
International comparisons	 ALMERA (IAEA) NPL IRSN PROCORAD BfS 	 ALMERA (IAEA) NPL IRSN PROCORAD BfS
Standardization of measurement methods		
national QA programmes and services		
Membership in international and national organisations	 ICRM (member) ALMERA (IAEA) k₀ users group 	 ICRM (member) ALMERA (IAEA) k₀ users group
Management and Organisation	 Partner in the execution of the Belgian Radiological Surveillance program Bio-assay analysis of nuclear industry 	 Partner in the execution of the Belgian Radiological Surveillance program Bio-assay analysis of nuclear industry
Teaching activity	 Teaching in the framework of SCK•CEN's Academy Practical exercises in the framework of BNEN (Belgian Nuclear higher Education Network) Lecturing at EC-organized gamma-spec courses 	 Teaching in the framework of SCK•CEN's Academy Practical exercises in the framework of BNEN (Belgian Nuclear higher Education Network) Lecturing at EC-organized gamma-spec courses
Quality system	 Management of Quality System ISO 17025 Installation of a central sample management system (C-LIMS) 	Continuous Improvement of Quality SystemLicensing ISO14001

The main specific activities carried out by SCK•CEN, LRM in this field are summarised below.

LABORATORY	SCK•CEN, Low-Level Radioactivity Measurements (LRM), Belgium SCK CEN, Policy Support*
NAMES	M. Bruggeman, F. Verrezen, M. Vasile, P. Vermaercke, T. Vidmar*, A. Borella*, L. Sneyers, L. Verheyen, K. Smits
ACTIVITY	Gross alpha and beta, ³ H, ¹⁴ C, ⁸⁹⁻⁹⁰ Sr, ¹³¹ I, ²¹⁰ Po, ²²⁶ Ra, actinides and gamma activity measurements in environmental samples
	Assay of actinides (Th, U, Pu, Am) in biological samples (urine, faeces) and environmental samples (water, sediment, soil) by alpha spectrometry and by KPA for U.
	Gamma-spectrometry, in-situ gamma-ray spectrometry
	Preparation of Radioactive Standards,
	Neutron activation analysis with relative NAA and k_0 – method
	Determination of the Pu isotopic composition with medium resolution gamma ray detectors
KEYWORDS	Alpha spectrometry, measurement, environmental control, gas proportional counter, liquid scintillation, low-level, radiochemistry, coincidence counting, gamma-ray spectrometry, ionisation chamber, low-level, NaI well counter, neutron measurement, simulation code, source preparation, X-ray spectrometry, in-situ gamma-ray spectrometry, Cadmium Zinc Telluride detectors, CZT detectors, Inspector 1000, measurement, gamma-ray spectrometry, Safeguards, Plutonium, isotopic composition, CZT, LaBr.
RESULTS	
PUBLICATIONS	Ramebeck, H., Jonsson, S., Allard, S., Ekberg, C., Vidmar, T., Bruggeman, M. 2015. Laboratory exercise on systematic effects in gamma-ray spectrometry. Journal of Radioanalytical and Nuclear Chemistry 303 (3) 0236-5731.
	Jonsson, S., Vidmar, T., Ramebeck, H., Bruggeman, M. 2015. Implementation of calculation codes in gamma spectrometry. Journal of Radioanalytical and Nuclear Chemistry 303 (3) 1727-1736.
	H. Ramebäck, P. Lagerkvist, S. Holmgren, S. Jonsson, B. Sandström, A. Tovedal, A. Vesterlund, T. Vidmar, J. Kastlander, On the accuracy of gamma spectrometric isotope ratio measurements of uranium, In Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 815 (2016) 57-61, ISSN 0168-9002, https://doi.org/10.1016/j.nima.2016.01.056
	T. Vidmar, A. Camp, S. Hurtado, H Jäderström, J. Kastlander, M-C. Lépy, G. Lutter, H. Ramebäck, O. Sima, A. Vargas, Equivalence of computer codes for calculation of coincidence summing correction factors – Part II, In Applied Radiation and Isotopes 109 (2016) 482-486, ISSN 0969-8043, https://doi.org/10.1016/j.apradiso.2015.11.071
	Jelena Krneta Nikolic, Milica Rajacic, Dragana Todorovic, Tim Vidmar, The first experimental test of the MEFFTRAN software on HPGe detector calibration for environmental samples, In Journal of Environmental Radioactivity 165 (2016) 191-196, ISSN 0265-931X, <u>https://doi.org/10.1016/j.jenvrad.2016.10.002</u>

 Alexander Mauring, Tim Vidmar, Torbjörn Gäfvert, Jon Drefvelin, Aldo Fazio, InSiCal – A tool for calculating calibration factors and activity concentrations in in situ gamma spectrometry, In Journal of Environmental Radioactivity, 2017, ISSN 0265-931X, <u>https://doi.org/10.1016/j.jenvrad.2017.10.011</u> V. Jobbagy, J. Meresova, E. Dupuis, P. Kwakman, T. Altzitzoglou, A. 	
V. Jobbagy, J. Meresova, E. Dupuis, P. Kwakman, T. Altzitzoglou, A.	
Rozkov, M. Hult, H. Emteborg, U. Watjen, "Results of a European interlaboratory comparison on gross alpha/beta activity determination in drinking water". Journal of Radioanalytical and Nuclear Chemistry, October 2015, 306 (1) 325-331	
C. Li, P. Battisti, P. Berard, A. Cazoulat, A. Cuellar, R. Cruz-Suarez, X. Dai, I. Giardina, D. Hammond, C. Hernandez, S. Kiser, R. Ko, S. Kramer- Tremblay, Y. Lecompte, E. Navarro, C. Navas, B. Sadi, I. Sierra, F. Verrezen, M.A. Lopez. EURADOS intercomparison on emergency radiobioassay, Radiat Prot Dosimetry. 2014 Dec 27. pii: ncu366.	
T. Bacquart, L. Sneyers, T.P.J. Linsinger, P. Vermaercke, "Comparison of k0 NAA analysis results of four different reference materials using six various materials for comparator factor calculation" [accepted for publication in Journal of Radioanalytical and Nuclear Chemistry.]	
M. Bruggeman, L. Verheyen, T. Vidmar, B. Liu, "Assessing sample attenuation parameters for use in low-energy efficiency transfer in gamma-ray spectrometry", Applied Radiation and Isotopes 109 (2016) 547-550.	
M. Vasile, H. Loots, K. Jacobs, L. Verheyen, L. Sneyers, F. Verrezen, M. Bruggeman, "Determination of 210Pb, 210Po, 226Ra, 228Ra and uranium isotopes in drinking water in order to comply with the requirements of the EU Drinking Water Directive", Applied Radiation and Isotopes 109 (2016) 465–469.	
Fons-Castells, J., Vasile, M., Loots, H., Bruggeman, M., Llauradó, M. & Verrezen, F. 2016. On the direct measurement of ²²⁶ Ra and ²²⁸ Ra using 3M Empore TM RAD disk by liquid scintillation spectrometry. Journal of Radioanalytical and Nuclear Chemistry 309 , 1123-1131.	
Vasile, M., Bruggeman, M., Van Meensel, S., Bos, S., Laenen, B. Characterisation of the natural radioactivity of the first deep geothermal doublet in Flanders, Belgium, Applied Radiation and Isotopes 126 (2017) 300-303.	
M. Vasile, K. Jacobs, M. Bruggeman, K. Van Hoecke, A. Dobney, F. Verrezen. 2018. ON THE SEQUENTIAL SEPARATION AND QUANTIFICATION OF 237NP, 241AM, THORIUM, PLUTONIUM, AND URANIUM ISOTOPES IN ENVIRONMENTAL AND URINE SAMPLES. Applied Radiation and Isotopes 134 , 455-460.	
F. Verrezen, M. Vasile, H. Loots, M. Bruggeman. 2017. METHOD VALIDATION AND VERIFICATION IN LIQUID SCINTILLATION COUNTING USING THE LONG-TERM UNCERTAINTY METHOD (LTUM) ON TWO DECADES OF PROFICIENCY TEST DATA. Journal of Radioanalytical and Nuclear Chemistry, DOI <u>https://dx.doi.org/10.1007/s10967-017-5436-2</u>	
M. Bruggeman, S.M. Collins, L. Done, M. Đurašević, M.A. Duch, A. Gudelis, M. Hyža, A. Jevremović, A. Kandić, M. Korun, S. Ilie, J.M. Lee, K.B. Lee, A. Luca, R.M. Margineanu, A. Pantelica, I. Serrano, B. Šešlak, L.C. Tugulan, L. Verheyen, B. Vodenik, I. Vukanac, Z. Zeng, B. Zorko. 2018. Systematic influences on the areas of peaks in gamma-ray spectra that have a large statistical uncertainty, Applied Radiation and Isotopes 134 , 51-55.	

IN PROGRESS	Pb-210 analysis in dense materials with gamma-ray spectrometry using transmission for matrix characterisation; selection of appropriate source, use of EFFTRAN to compute the correction factors.
	(General method for matrix characterization using un-collimated transmission measurements and EFFTRAN calculations.)
	Development of 'on-site' measurement methods for assay of alpha - emitting radionuclides
	Development of measurement methods in field using LSC
	Development of methods for determination od 'difficult to measure' radionuclides (94Nb, 41Ca, 55Fe, 63Ni, 59Ni, 79Se, 36Cl, 151Sm, 89/90Sr, 99Tc)
	PhD topic on medium resolution gamma ray spectroscopy for Pu and U isotopic composition analysis started in 2015, research is ongoing.
ADDRESS	Low Level Radioactivity Measurements SCK•CEN Boeretang 200 B-2400 Mol Belgium Tel.: +32 14 33 28 86 E-mail: mbruggem@sckcen.be
	website: <u>https://go.app.sckcen.be/LKM</u>
CONTACT	Michel Bruggeman, Freddy Verrezen

SCK•CEN, Radiochemical Analyses and Processes (RCA), Belgium, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The Radiochemical Analysis expert group (RCA) at SCK•CEN is a multidisciplinary laboratory dedicated to being a centre of excellence in radiochemistry and in the destructive chemical and radiochemical analysis of samples and materials originating from the nuclear fuel cycle and from nuclear research.

Scientist	Function
Cardinaels Thomas	Head RCA
Adriaensen Lesley	Group leader (alpha and gamma spectrometry; sample preparation)
Dobney Andrew	Group leader (Thermal ionisation mass spectrometry; ICP- MS)
Peter Van Bree	Lab Head (ICP-MS)
Lab Technicians	
Ooms Magda	Sample preparation, alpha and gamma spectrometry
Van Rompaey Karolien	Sample preparation, ICP-MS analyses
Verheyen Els	TIMS analyses
Gelens Luc	TIMS analyses, ICP-MS analyses
Lycke Patrick	Sample preparation, ICP-MS analyses
Campsteyn Arnaud	LSC analyses

The main specific activities carried out by SCK•CEN, RCA in this field are summarised below.

Activity line	SCK•CEN, Radiochemical Analyses and Processes 2016-2017 Progress report	SCK•CEN, Radiochemical Analyses and Processes 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	• Combustion of graphite for the analysis of volatile radionuclides	 Optimisation of analyses of radioactive samples with HR-ICP-MS Optimisation of the measurement methodology of Ni-63 and Cl-36 with LSC Optimisation of Labsocs software for different geometries
International comparisons	 CETAMA IRMM IAEA safeguards analytical laboratory 	 CETAMA IRMM IAEA safeguards analytical laboratory
Standardization of measurement methods		
National QA programmes and services	Analyses for BR2 reactor	Analyses for BR2 reactor
Membership in international and national organisations	 ICRM (member) EGADSNF (expert group on assay data for spent nuclear fuel - member) 	 ICRM (member) EGADSNF (expert group on assay data for spent nuclear fuel - member)
Management and Organization		

Activity line	SCK•CEN, Radiochemical Analyses and Processes 2016-2017 Progress report	SCK•CEN, Radiochemical Analyses and Processes 2018-2019 Work plan
Teaching activity	 Teaching in the framework of SCK•CEN's Academy Teaching in the framework of BNEN (Belgian Nuclear higher Education Network) 	 Teaching in the framework of SCK•CEN's Academy Teaching in the framework of BNEN (Belgian Nuclear higher Education Network)
Quality system	 Continuous Improvement of Quality System Management of Quality System ISO 17025 	Continuous Improvement of Quality SystemManagement of Quality System ISO 17025

LABORATORY	SCK•CEN, Radiochemical Analyses and Processes (RCA), Belgium
NAMES	T. Cardinaels, L. Adriaensen, A. Dobney
ACTIVITY	Destructive radiochemical analysis of spent fuels for the determination of burn-up and for spent fuel characterization programs
	Determination of Pu concentration in MOX fuels (accredited according to ISO17025).
	Radiochemical analysis of long-lived and radiotoxic nuclides in various types of radioactive waste such as resins, evaporator concentrates, filters, incinerator ashes
	Study of separation chemistry of actinides and specific radionuclides
	Radiochemical analysis of reactor dosimeters and irradiated reactor materials.
KEYWORDS	Alpha spectrometry, beta spectrometry, gamma-ray spectrometry, low-level, Nal well-type counter, radiochemistry, source preparation
RESULTS	Burn-up determination for the REGAL and CMP program.
	Combustion of graphite for the analysis of volatile radionuclides I-129, Cl-36, C-14 and H-3
PUBLICATIONS	K. Van Hoecke, J. Bussé, M. Gysemans, L. Adriaensen, A. Dobney, T. Cardinaels. Isolation of lanthanides fron spent nuclear fuel by means of HPIC prior to mass spectrometric analysis, Journal of Radioanalytical and Nuclear Chemistry, 2017, 314(3), 1727-1739.
SOURCE IN PREPARATION	Dissolution, separation and analysis of ³⁶ Cl in radioactive concrete or metal samples
	Microwave and high pressure dissolution of different types of waste materials
ADDRESS	Radio-Chemical Analysis SCK•CEN Boeretang 200, B-2400 Mol, Belgium Tel.: +32 14 33 32 26 Fax: +32 14 32 07 55
	E-mail: <u>ladriaen@sckcen.be</u>
CONTACT	L. Adriaensen, A. Dobney

(information for ICRM members)

The programmes at the National Laboratory for Ionizing Radiation Metrology of Institute of Radiation Protection and Dosimetry (LNMRI/IRD) in the field of Radionuclide Metrology in the period of 2016-2019 were and will be focused in primary standardization and also in the maintenance of the national radiaoctivity standards. We also have three programmes for guarantee the traceability in national level with hospital, radiopharmaceutical producer and low level activity measurements.

Researchers	Function
Akira Iwahara	Primary Radionuclide activity standardization by coindence
	counting, Secondary Radionuclide activity standardization
Maura Julia Bragança	Reference Material and radiochemistry
Antônio E. De	Traceability of activity measurements programme with hospitals
Oliveira	
Carlos J. Da Silva	Primary Radionuclide activity standardization by anticoindence
	counting, Secondary Radionuclide activity standardization and
	Deputy Head of LNMRI Services
Alfredo Lopes F.	Primary Radionuclide activity standardsization and gamma
Filho	spectrometry
Jamir S. Loureiro	Liquid scintillation counting – CIEMAT/NIST and TDCR
Karla Cristina Patrão	Head of Metrology Division
Estela M. de Oliveira	Reference Material and radiochemistry
Paulo A. L. da Cruz	Liquid scintillation counting –CIEMAT/NIST and TDCR
Andre Quadros	Data Aquisition System
Roberto Poledna	Gamma spectrometry
Technicians	
Ronaldo L. da Silva	Secundary Radionuclide activity standards gamma spectrometry
Regio S. Gomes	Data Aquitiom System
Eduardo Vieira de	Sources preparation
Veras	
Otavio L. Trindade	Secundary Radionuclide activity standardization
Johnny de A. Rangel	Sources preparation

The LNMRI-IRD Radionuclide Metrology staff in 2017 is the following:

Activity	IRD-LNMRI	IRD-LNMRI
	Radionuclide Metrology	Radionuclide Metrology
	2016-2017 Progress Report	2018-2019 Work plan
National QA	Calibration service	Calibration service
programmes and	Preparation of radionuclide standards	Preparation of radionuclide
Services	(liquid solutions, point sources and	standards (liquid solutions, point
	spiked reference materials) for	sources and spiked reference
	external users.	materials) for external users.
International	Y-90 (ARCAL), Eu-152	Cs-137
comparisons and		
SIR submission		
Primary	Zn-65, Y-90, I-125, Eu-152, Ra-223	Eu-152, , Cs-137, I-125, Y-90
standardization		
Membership in	ICRM, BIPM/CCRI(II)	ICRM, BIPM/CCRI(II)
international and	SBM (Brazilian Metrology Society)	SBM (Brazilian Metrology
national		Society)
organisations		
Teaching activity	Invited lectures	Invited lectures
	Master and doctor degree courses	Master and doctor degree
		courses
Quality system	Maintenance the quality system	Maintenance the quality system
	based on ISO/IEC 17025	based on ISO/IEC 17025

	I
LABORATORY	Laboratório Nacional de Metrologia das Radiações Ionizantes (LNMRI/IRD), Brazil, Instituto de Radioproteção e Dosimetria, Comissão Nacional de Energia Nuclear - CNEN
NAMES	A. Iwahara, C. J. da Silva, A. E. de Oliveira, Eduardo V.de Veras, P. A. L. da Cruz, J. dos S. Loureiro, J. U. Delgado, R. Poledna, L. Tauhata, Johnny Rangel, Regio dos S. Gomes
ACTIVITY	1- Participation in international comparisons
	2- Absolute activity measurements
	3- Sources supply to users
	4- Quality assurance program for activity measurements in nuclear medicine
KEYWORDS	(anti) coincidence method, data evaluation, data measurement, SIM, gamma- ray spectrometry, gas proportional counter, ionisation chamber, life sciences, liquid scintillation, low-level, NaI well-type counter, radiochemistry, SIR, source preparation, traceability, X-ray spectrometry.
RESULTS	1- Primary standardization of 65Zn,90Y,125I, 152Eu, 223Ra solutions;
	2-Comparative performance of $4\pi\beta$ (LSC)-NaI(Tl) anticoincidence, $4\pi\beta$ (LSC)-(NaI(Tl) coincidence systems and CIEMAT/NIST Methods.
PUBLICATIONS	1- De Oliveira A.E., Iwahara, A., Da Cruz P.L.; Da Silva, C.J., De Araujo E.B., Mengatti J., Da Silva R.L., Trindade O.L., Rapid and accurate assesement of activity in Brazilian hospital and clinics. Will be published in Applied Radiation and Isotopes.
	2- Da Silva, C.J., Rezende, E.A., Poledna, R., Tauhata, L., Iwahara, A., Lopes, R.T., Standardization of Ru/Rh-106 by live-timed anticoincidence counting and gamma emission determination. Applied Radiation and Isotopes 122 (2017) 37.
	3- Da Silva, C.J, Da Cruz, Paulo A.L., Iwahara A., De Oliveira A.E., Loureiro, J. S., Tauhata, L.; Da Silva R.L, Poledna R., Lopes, R.T., ⁶⁸ (Ge + Ga) Activity Standardization by $4\pi\beta$ LS- γ (NaI(Tl)) anticoincidence counting. Will be published in Applied Radiation and Isotopes.
	4- Da Silva, C.J.; Da Cruz, Paulo A. L.; Iwahara A.; Loureiro J. Dos S.; Gomes, R. Dos Santos; Araujo M.T.F.; Poledna, R.; Da Silva R. L.; Laranjeira, A. da S., ¹³⁴ Cs activity standardization by $4\pi\beta$ LS- γ (NaI(Tl)) live- timed anticoincidence counting and submission to International Reference System. Will be published in Applied Radiation and Isotopes.
	5- Oliveira, A.E.; Iwahara, A.; Silva, C. J.; Da Cruz, P.A. L.; Poledna, R.; da Silva, R. L.; Laranjeira, A.S.; Delgado, J.U.; Tauhata, L.; Loureiro, J. S.; Toledo, J.S.; Braghirolli, B.C.; Andrade, A.M.S.; Silva, E.A.L.; Hernandes, J.L.; Valente, H.O.K.; Valente, Dalle E.S.; Almeida, H.M.; Silva, V.M.; Fragoso, T.G.; Oliveira, M.C.F.; Nascimento, M.L.; Oliveira, E.S.S.; Herrerias, E.M.; Souza, R.; <i>et al.</i> ; Traceability from governmental producers of radiopharmaceuticals in measuring ¹⁸ F in Brazil. Applied Radiation and Isotopes 109 (2016) 236-241.
	6- Da Cruz, P A L; Da Silva, C.J.; Iwahara, A.; Loureiro, J S; De Oliveira, A E; Tauhata, L; Lopes, R T; TDCR and CIEMAT/NIST Liquid Scintillation Methods applied to the Radionuclide Metrology. Journal of Physics. Conference Series (Print), v. 733, p. 012099, 2016.

IN PROGRESS	Primary activity measurements of ²²³ Ra, ¹²⁵ I Standardization of ¹³⁷ Cs
ADDRESS	Instituto de Radioproteção e Dosimetria, Av. Salvador Allende, s/n, Recreio, CEP 22783-127, Rio de Janeiro, Brazil
	Tel.: +55 21 2173 2874/2875 Fax: +55 21 2442 1605
	E-mail: <u>carlos@ird.gov.br</u>
CONTACT	Carlos José da Silva

LABORATORY	Laboratório Nacional de Metrologia das Radiações Ionizantes (LNMRI/IRD), Brazil, Instituto de Radioproteção e Dosimetria, Comissão Nacional de Energia Nuclear - CNEN
NAMES	J.U. Delgado, R. Poledna, Ronaldo L. da Silva, Miriam T.F. de Araújo, Octavio L. Trindade
ACTIVITY	 Half-life determination. Impurities study by gamma-ray spectrometry. Determination of photon emission probabilities
KEYWORDS	Data evaluation, data measurement, SIM, gamma-ray spectrometry, life sciences, NaI well-type counter, SIR, traceability, X-ray spectrometry
RESULTS	1- ²²³ Ra. 2- Impurities study of ⁹⁰ Y, ¹²⁵ I, ²²³ Ra.
PUBLICATIONS	1- Correia, A. R.; Iwahara, A.; Da Cruz, Paulo A. L.; Da Silva, C.J.; Tauhata, Luiz; Poledna, R.; da Silva R. L.; Queiroz Filho, P. P. Q.; Lopes, R. T Evaluation of the efficiency curve of a Cadmium Telluride detector for low- energy photon spectrometry. Applied Radiation and Isotopes 116 , p. 157, 2016.
	2- Araujo, M. T. F.; Poledna, R.; Delgado, J.U.; da Silva R. L.; Iwahara, A.; Da Silva, C.J.; Tauhata, Luiz; de Oliveira, A. E.; Almeida, M. C. M.; Lopes, R. T. Absolute standardization of the impurity ¹²¹ Te associated to the production of the radiopharmaceutical I-123. Applied Radiation and Isotopes 109 , p. 389, 2016.
	3- De Almeida M.C.M.; Da Silva R.L.; Delgado J. U.; Poledna, R.; Determination of impurities in ¹²⁴ I samples by high resolution gamma spectrometry. Applied Radiation and Isotopes 109 , p. 261-263, 2016.
	4- Filho Ferreira. A. L.; da Silva L.R; Da Cruz, Paulo A. L.; Da Silva, C.J.; Poledna R.; Araujo, M.T.F.; Arcanjo C.F.; Delgado J. U.; Lopes, R. T.; Application of the sum peak method to activity standardization of ¹⁵² Eu sources in LNMRI (Br). Will be published in Applied Radiation and Isotopes.
	5- De Paula, E.B.; De araujo, M.T.F.; Poledna R.; Delgado J. U.; Leira A. da S.; Development of a methodology for the analysis of radionuclide impurities in radiopharmaceuticals by gamma-ray spectrometry. Brazilian Journal of Radiation Sciences V5 , .p.300, 2017.
IN PROGRESS	1- Application of sum peak method to reference sources for radionuclide metrological calibrations to research in nuclear programmes.
	2- Study for application coincidence $X-\gamma$ method for radionuclide metrological calibrations.
ADDRESS	Instituto de Radioproteção e Dosimetria, Av. Salvador Allende, s/n, Recreio, CEP 22783-127, Rio de Janeiro, Brazil
	Tel.: +55 21 2173 2874/2875 Fax: ++55 21 2442 1605
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CONTACT	Ronaldo L. Da Silva

LABORATORY	Laboratório Nacional de Metrologia das Radiações Ionizantes (LNMRI/IRD), Brazil, Instituto de Radioproteção e Dosimetria – IRD, Comissão Nacional de Energia Nuclear - CNEN
NAMES	A. C. M. Ferreira, A. E. de Oliveira , A. F. Clain, L. Tauhata, M. E. C. Vianna, Maura J. C. S. Bragança and E. M. de Oliveira
ACTIVITY	 Preparation of the spiked sources of beta, alpha and multi-gamma emitters in water matrix Quality assurance program for low level activity measurements
KEYWORDS	SIM, gamma-ray spectrometry, low-level, radiochemistry, spike source preparation, traceability low level activity
RESULTS	Performance of 28 laboratories for low-level measurements.
PUBLICATIONS	De Souza S. Poliana, Produção de amostras de vegetação contendo radionuclídeos emissores gama para participar de programas interlaboratoriais. IRD Master Degree Thesis – 2016
IN PROGRESS	Spike in grass matrix
ADDRESS	Instituto de Radioproteção e Dosimetria, Av. Salvador Allende, s/n, Recreio, CEP 22783-127, Rio de Janeiro, Brazil Tel.: +55 21 2173 2874/2875 Fax: +55 21 2442 1605 E-mail : <u>estela@ird.gov.br</u>
CONTACT	Estela M. de Oliveira

National Research Council of Canada (NRC), Canada, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The programs at the National Research Council (NRC) of Canada Radionuclide Laboratory consist of the development, maintenance and dissemination of activity standards, through primary and secondary standard methods. Canadian stakeholders from the medical physics, radiation protection and nuclear forensic communities in both private and public sectors have requested and received certified reference materials and services in the form of proficiency testing and calibration services from NRC. NRC has also partnered with the private and public sector in various research projects.

The NRC Radionuclide Metrology staff in 2017 consisted of:

Scientists	Function	
Pat Saull	Head (of laboratory or group)	
R. Galea	Primary/Secondary Radionuclide activity standards, Liquid scintillation	
	counting, Gamma spectrometry, Alpha spectrometry, Source	
	preparation/radiochemistry	
John Paul Archambault	Neutron standards	
Technicians		
Islam El Gamal	Secondary activity standards	
Kim Moore	Source preparation/radiochemistry	

The main specific activities carried out at the NRC Radionuclide Laboratory in this field are summarised below.

Activity line	NRC Radionuclide Metrology 2016-2017 Progress report	NRC Radionuclide Metrology 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Hosted the SIRTI and performed a comparison of ¹¹C, ¹⁸F, ⁶⁴Cu and ^{99m}Tc. Primary standardization of ¹²⁵I by coincidence counting, LSC and sumpeak counting methods. 	 Collaboration with NRC chemical metrology on the production of Uranium Ore Concentrate CRMs. Production of a ⁹⁹Ru free ⁹⁹Tc CRM. Revival of Neutron emission rate primary standard and provision of ⁵⁶Mn primary standardization.
International comparisons	 CCRI(II)-²³¹Pa. Trilateral (NIST, NPL, LLNL(USA)) ²³¹Pa and ²³³Pa. 	 CCRI(II)-³H. Bilateral ¹²⁵I. New submissions to SIR
Standardization of measurement methods	 Improving the γ-spectroscopy capability. Dedicated 3D-printed source holders manufactured in-house. 	• Improvement of α - β separation in LSC.
National QA programmes and services	 Preparation of radioactive independent test samples (liquid solutions, point sources, paper filters and spiked matrices) for external users. Radionuclide calibrator calibration service. Provision of CRMs to the Canadian Nuclear Forensics Lab network. 	 Radionuclide calibrator calibration service. Organization of external independent tests. Custom CRM preparation Maintain national inventory for the Canadian Nuclear Forensics Lab network.

Activity line	NRC	NRC
	Radionuclide Metrology 2016-2017 Progress report	Radionuclide Metrology 2018-2019 Work plan
Membership in international and national	 ICRM, BIPM/CCRI(II), SIM, ISO/TC85/WG2, ISO/TC85/WG22 NRC adopted Chair position for SIM- NUCC 	• ICRM, BIPM/CCRI(II), SIM, ISO/TC85/WG2, ISO/TC85/WG22
Management	MWG6.	•
Teaching activity	Undergraduate Coop students	Undergraduate Coop studentsPhD student in radionuclide metrology
Quality system	Internal peer reviewExternal peer review 2017.	• Presentation of first CMCs in radioactivity for NRC to SIM-QSTF in spring 2018.

LABORATORY	National Research Council of Canada (NRC), Canada	
NAMES	Raphael Galea (Research Officer), Kim Moore and Islam El Gamal (Technicians)	
ACTIVITY	Primary and secondary standardization of radioactivity.	
KEYWORDS	Alpha spectrometry, beta spectrometry, (anti) coincidence method, SIM, gamma- ray spectrometry, gas proportional counter, ionisation chamber, life sciences, liquid scintillation, NaI well-type counter, neutron measurement, radiochemistry, simulation code, SIR, source preparation, traceability.	
RESULTS	Hosted the SIRTI and performed comparisons of C-11, F-18, Cu-64 and Tc- 99m	
	Participation in a CCRI(II) comparison of Pa-231.	
	Participation in a trilateral comparison of Pa-231 and Pa-233.	
	Performed accuracy check service for radionuclide calibrators in Manitoba and Nova Scotia.	
	Performed independent testing of radioactivity measurement service for external clients.	
	Participation in the Canadian Nuclear Forensics Laboratory Network and supply of reference material to participating laboratories.	
PUBLICATIONS	R.Townson, F.Tessier and R.Galer, "EGSnrc calculation of activity calibration factors for the Vinten ionization chamber", Appl.Radiat. Isot. 134 (2018) 100-104.	
	P.Cassette et. al., "Results of the CCRI(II)-S12.H-3 supplementary comparison: Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated-water source measured using the LSC-TDCR method", Appl.Radiat. Isot. 134 (2018) 257-262.	
	S. Pomme et. al., "On decay constants and orbital distance to the Sun - Part I: Alpha decay", Metrologia 54 (2017) 1-18.	
	S. Pomme et. al., "On decay constants and orbital distance to the Sun - Part II: Beta minus decay", Metrologia 54 (2017) 19-35.	
	S. Pomme et. al., "On decay constants and orbital distance to the Sun - Part III: Beta plus and electron capture decay", Metrologia 54 (2017) 36-50.	
	C. Michotte et. al., "Update of the BIPM comparison BIPM.RI(II)-K1.Co-60 of activity measurements of the radionuclide 60 Co to include the 2011 result of the CNEA (Argentina), the 2012 results of the BARC (India) and the NRC (Canada), and the 2014 result of the NIM (China)", Metrologia 54 (2017) 06002-06002.	
	S. Pomme et. al., "Evidence against solar influence on nuclear decay constants", Phys.Lett. B761 (2016) 281-286.	
	Y. Gao, et. al., "On-line UV photochemical generation of volatile copper species and its analytical application", Microchemical Journal 124 (2016) 344-349.	
IN PROGRESS	H-3, Mn-56 and I-125 standardization.	
	Uranium radiochronometry.	
	Monte Carlo methods in radionuclide metrology.	

INFORMATION	http://www.nrc-cnrc.gc.ca
SOURCE IN PREPARATION	Publications on production of Pa-233 and comparisons of Pa-231 and Pa-233 are pending.
ADDRESS	NRC/MSS/IRS 1200 Montreal Road Building M-35 Ottawa, ON K1A0R6 Canada E-mail: <u>raphael.galea@nrc-cnrc.gc.ca</u>
CONTACT	Raphael Galea

National Institute of Metrology (NIM), China, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The programme at the National Institute of Metrology, China, in the field of radionuclide metrology in the years 2016-2017 was on maintaining and developing the primary and secondary national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

The National Institute of Metrology, China, staff in 2017 were:

Scientists	Function	
Juncheng LIANG	Head of NIM-RM	
Haoran LIU, Ming ZHANG, Juncheng LIANG	Primary/secondary radionuclide activity standards, Environmental studies, Liquid scinitillation counting, Gamma spectrometry, Alpha spectrometry, Radon standards	
Fuyou FAN	Source preparation and radiochemistry	
Technicians		
Qing ZHAO, Zhijie YANG,	Primary/secondary radionuclide activity standards, Source preparation and radiochemistry,	
Xiangzhuang MA	Radon standards	

The main specific activities carried out at National Institute of Metrology, China, in this field are summarised below.

Activity line	National Institute of Metrology, China, 2016-2017 Progress report	National Institute of Metrology, China, 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Development of new primary standards: <i>Rn-222</i> Development of new primary standard of Kr-85, Xe-133 and H-3 Improvement of national reference system for γ ray emitting nuclides Improvement of large-area multi-wire proportional counting system for 2π alpha and beta emission measurement 	 Development of new primary standards: <i>C-11, Ra-223</i> Development of low-background secondary standard for γ-ray emitting nuclides Improvement of radon decay products measuring method Development of portable TDCR system
International comparisons	 CCRI.(II)-Ge-68 CCRI(II)-S12.H-3 CCRI(II)-K2.Pa-231 Bilateral: Ra-222, Between NIM and LNHB 	 CCRI(II).H-3, Piloted by LNHB CCRI(II) SC of Cs-134 and Cs-137 in wheat flour, piloted by NMIJ Pilot a supplementary comparison on surface emission rate for widen sources

Activity line	National Institute of Metrology, China, 2016-2017 Progress report	National Institute of Metrology, China, 2018-2019 Work plan
Standardization of measurement methods	 Standardization of reference materials ICRM WG comparisons Other measurements and investigations 	 New detection methods New use of digital electronics or detectors Development of new systems for nuclear medicine nuclides
National QA programmes and services	 Preparation of radioactive standards (liquid solutions, point sources, reference materials) for external users. Proficiency Tests of multi-gamma nuclides in matrix including ash, soil and water for environmental protection measurement Proficiency Tests of H-3 and multi- gamma nuclides in water for China General Nuclear Power Group (CGN) 	 Calibration services Organisation of Proficiency Tests
Membership in international and national organisations	ICRM committee membershipBIPM/CCRI(II), IAEA, APMP	 ICRM committee membership BIPM/CCRI(II), IAEA, IEC, APMP,ISO,
Teaching activity	Lecture courses given for external users.Invited lectures in national-wide meetings	Lecture courses givenInvited lectures
Quality system	Management of Quality SystemImprovements of quality control methods.Developments	Management of Quality SystemImprovementsDevelopments

LABORATORY	National Institute of Metrology (NIM), China
NAMES	Ming ZHANG, Zhijie YANG, Juncheng LIANG
ACTIVITY	Development of a new large area multi-wire proportional counter for surface emission rate measurement of widen sources;
	Establishment of primary standard for activity concentration measurement of noble gas using differential inter gas proportional counter
KEYWORDS	gas proportional counter, surface emission rate , length compensated method for noble gas measurement
RESULTS	An alpha/beta emission rate counting system which comprises of a large-area windowless multi-wire proportional counter has been developed, aiming at realizing the absolute measurement of emission rate for alpha and beta widen sources. Performance of the detector, including high-voltage plateaus and uniformity were measured. Measured emission rates for large-area Am-241 and Sr-90/Y-90 sources when compared with certificated values showed difference within 1.0%, and good agreements achieved.
PUBLICATIONS	Jun Wei Zhang, Ming Zhang, Min Li Duan et al. The large-area multi-wire proportional counting system for 2π alpha and beta emission measurement at the NIM China. Applied Radiation and Isotopes, proceedings of ICRM2017.
IN PROGRESS	Regarding the establishment of primary standard for noble gas measurement, triple gas proportional counters, electronics circuit, dilution volume for gases mixture, related pipework have been available, and assembled preliminarily. Pipework for gas sample preparation, volume determination and first trial measurement for Kr-85 is in progress.
OTHER RELATED PUBLICATIONS	Ming Zhang, Shunhe Yao, Juncheng Liang et al. Standardization of the radionuclides Co-60 and Fe-59 by digital $4\pi\beta(PC)-\gamma(Nal)$ coincidence counting. Applied Radiation and Isotopes, proceedings of ICRM2015.
ADDRESS	National Institute of Metrology, China No.18, Bei San Huan Dong Lu, Chao yang Dist, Beijing, P. R. China, 100029 E-mail: <u>zhming@nim.ac.cn</u>
CONTACT	Ming ZHANG

LABORATORY	National Institute of Metrology (NIM), China
NAMES	Haoran LIU, Juncheng LIANG, Fuyou FAN
ACTIVITY	Liquid Scintillation Counting
KEYWORDS	LSC, TDCR, Monte Carlo simulation, Pa-231
RESULTS	Improvement of Monte Carlo geometry model of TDCR counter in cooperation with Philippe CASSETTE. The new approach set up a more detailed description of the TDCR counter, including optical chamber, PMTs.
	branching were applied to describe the Pa-231 decay chain. The contributions of Pa-231 and all 8 generations of unstable daughters were taken into account in the calculation.
IN PROGRESS	Development of portable TDCR system.
OTHER RELATED PUBLICATIONS	K. Mitev, P. Cassette, V. Jordanov, H. R. Liu, Ch. Dutsov. Design and performance of a miniature TDCR counting system. Journal of Radioanalytical and Nuclear Chemistry. 2017 :1-7
ADDRESS	National Institute of Metrology, China No.18, Bei San Huan Dong Lu, Chao yang Dist, Beijing, P. R. China, 100029 E-mail: <u>liuhr@nim.ac.cn</u>
CONTACT	Haoran LIU

LABORATORY	National Institute of Metrology (NIM), China
NAMES	Juncheng LIANG, Zhijie YANG, Liyuan WANG, Zexi LI, Ming Zhang, Haoran Liu, Daqing Yuan
ACTIVITY	In order to meet the tractability requirements of radon radioactivity, an apparatus based on the defined solid angle method has been established in NIM, China. Two home-made vacuum sealed radium-226 sources with radioactivity of 500 kBq and 3 MBq are used to provide high purity radon gas to minimize the impact from gas impurities. The distance of source to diaphragm and the radius of diaphragm are precisely measured. The diameters of the condensed radon sources are evaluated by the cyclone storage phosphor equipment with the auto radiography method, the temperature on the cold finger can be adjusted from 30 K to 80 K, and typically at 35 K, the diameter of radon source is 3.138(98) mm. The defined solid angle is calculated depending on precisely measured geometrical dimensions by several algorithms including Monte Carlo simulation and the results are equivalent in uncertainty. Alpha particle's scattering behavior in the measuring chamber has also been simulated by geant4 Code and the result shows a total scattering alpha particle ratio up to 0.23% at the edge of diaphragm. Finally, a typical combined standard uncertainty of 0.24% is evaluated for radon activity primary measurement in NIM's apparatus.
KEYWORDS	Activity of radon-222, absolute measurement
RESULTS	The result of the activity measurement is mainly concerned with geometry factor and the statistics of counts, also depends on the upper limit of energy to determine Rn-222 peak area and the scattering ratio etc. Considering the real measuring condition, the repeatability of measurement is used to replace the uncertainty contribution from the statistics of counts.Typical uncertainty budget for a primary measurement using the solid angle method in NIM is given in table 2. Finally, a typical combined standard uncertainty of 0.24% is evaluated for NIM's absolute measuring system.
PUBLICATIONS	Liang J, Yang Z, Wang L, et al. Development of the absolute standardization apparatus for radon-222 activity. Applied Radiation and Isotopes, proceedings of ICRM2017
IN PROGRESS	Secondary standard of radon concentration; Activity measurement of radon decay products; International comparison of activity concerning radon and it's decay products.
ADDRESS	National Institute of Metrology, China No.18, Bei San Huan Dong Lu, Chao yang Dist, Beijing, P. R. China, 100029 E-mail: <u>liangjc@nim.ac.cn</u>
CONTACT	Juncheng LIANG

LABORATORY	National Institute of Metrology (NIM), China
NAMES	Fuyou Fan, Juncheng Liang, Haoran Liu, Ming Zhang, Qing Zhao, Zhijie Yang
ACTIVITY	U(VI) Sorption Behaviors on Several Functionalized Nano Materials
KEYWORDS	environmental control, radiochemistry, source preparation
RESULTS	Four kinds of functionalized nanomaterials were prepared and their physical and chemical properties were characterized. The U(VI) adsorption behaviors on these materials were studied. The effects of pH, adsorbent concentration, ionic strength, coexisting ions and temperature on U(VI) adsorption on functionalized nanomaterials were investigated. The adsorption isotherms were fitted by Langmuir and Freundlich model. The adsorption mechanisms of U(VI) on functionalized nanomaterials were discussed by spectroscopy technique. The results obtained in this paper can provide a basis for the purification of uranium contaminated water and technical support for the sustainable development of nuclear energy and nuclear environment protection.
PUBLICATIONS	Fuyou Fan, Duoqiang Pan, Hanyu Wu, Tianjiao Zhang, and Wangsuo Wu. Succinamic Acid Grafted Nanosilica for the Preconcentration of U(VI) from Aqueous Solution. Industrial & Engineering Chemistry Research 2017, 56(8), 2221-2228
IN PROGRESS	Preparation of polonium standard reference materials
INFORMATION	Succinamic acid functionalized nano-silica (SA@SiO ₂) was synthesized, characterized and tested for hexavalent uranium preconcentration from contaminated aqueous solutions. The succinamic acid grafted nano-silica exhibited improved uranium preconcentration capacity in comparison with that of raw nano-silica. The effects of environmental conditions such as pH, ionic strength, solid-liquid ratio, foreign ions and temperature on uranium(VI) preconcentration performance were investigated by batch technique in detail, and the related mechanism was discussed with aid of XPS technique. Results showed that uranium(VI) preconcentration by SA@SiO ₂ was strongly dependent on pH while less so on ionic strength, the preconcentration was mainly dominated by inner-sphere surface complexation. The co-existing cations had no effects while anions influenced U(VI) preconcentration significantly. The preconcentration of U(VI) is favorable at lower temperature, the maximum preconcentration capacity was 44.5 mg/g at pH = 4.0 ± 0.1 and T = 298 K. Thermodynamic parameters indicated that the preconcentration process was exothermic and spontaneous. Accordingly, the SA@SiO ₂ is a potential and suitable candidate for the preconcentration of U(VI) from considerable volume of wastewater.
ADDRESS	National Institute of Metrology, China No.18, Bei San Huan Dong Lu, Chao yang Dist, Beijing, P. R. China, 100029 E-mail: fanfy@nim.ac.cn
CONTACT	Fuyou Fan

LABORATORY	National Institute of Metrology (NIM), China	
NAMES	Juncheng LIANG,Haoran LIU,Ming ZHANG, Fuyuo FAN, Qing ZHAO, Zhijie YANG	
ACTIVITY	Organization of national interlaboratory comparison in the field of activity measurements.	
KEYWORDS	Environmental radioactivity control, gamma-ray spectrometry, Liquid scintillation counters	
RESULTS	In 2017, the comparison protocal was drafted and 16 laboratories expressed their interests to participant this comparison.	
	Tritum sample with 9 Bq/g of H-3 and multi-gamma nuclides including Co-57, Cd-109,Cs-137,Co-60 and Am-241 (respectively 3Bq/g) were prepared for this comparison.	
	Standardization of the sample by LSC method and gamma-ray spectrometry method.	
	The participants reported their results to NIM about a month after they received the samples.	
IN PROGRESS	The draft A report of this comparison.	
	The comparison results will be further summarized and analyzed. After that the final report will be prepared.	
ADDRESS	National Institute of Metrology, China No.18, Bei San Huan Dong Lu, Chao yang Dist, Beijing, P. R. China, 100029 E-mail: <u>liangjc@nim.ac.cn</u>	
CONTACT	Juncheng LIANG	

Ruđer Bošković Institute (RBI), Laboratory for Low-level Radioactivities, Croatia, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The programme at the RBI-LNA in the field of radionuclide metrology in the years 2016-2017 was on measuring H-3 activity in precipitation, surface and ground waters, measuring C-14 activity in various samples, and improvement of measurement techniques for radiocarbon (benzene synthesis and direct absorption of CO₂, LSC technique; preparation of graphite targets for AMS ¹⁴C measurement) and tritium measurement (electrolytic enrichment and LSC measurement, direct measurement) by taking part in various Intercomparison studies and proficiency tests, as well as to develop quality management system in the laboratory.

The RBI-LNA staff in 2017 were:

Scientists	Function
Ines Krajcar Bronić	Head of laboratory; data evaluation; management of monitoring program, C-14 method of biogenic component determination in liquid fuels
Jadranka Barešić	Environmental studies – lake sediment and tufa, karst water; Sample preparation (benzene synthesis, CO ₂ absorption, H-3 enrichment), deputy head
Andreja Sironić	Environmental studies – karst waters, plants and carbon cycle; AMS sample preparation
Ivanka Lovrenčić Mikelić	Quality Manager of the Laboratory Quality manager of the RBI Gamma spectrometry
Matea Krmpotić	PhD student
Technicians	
Anita Rajtarić	Sample preparation, benzene synthesis, absorption of CO ₂ , electrolytic enrichment
	Secondary activity standards
Assistant	
Damir Borković	Graphite preparation for AMS, running of LSC Quantulus, maintaining data base and web page, quality control, quality manager deputy

The main specific activities, relevant to ICRM and carried out at RBI-LNA are summarised below.

Activity line	RBI-LNA, Radionuclide	RBI-LNA, Radionuclide
	Metrology, 2016-2017 Progress	Metrology, 2018-2019 Work plan
	report	
Improvement of measurement techniques for C- 14 and H-3	 preparation of graphite targets for AMS C-14 measurement from various types of samples developed pre-treatment procedures for parchment and mortar samples developed method for OBT measurement 	 Increased capacity of the preparation of graphite targets for AMS C-14 measurement Development of pre-treatment techniques for new types of samples for AMS-¹⁴C dating
comparisons	 Pronciency test EKA – KAD108 H-S activity, direct measurement OBT (organically bound tritium) in grass samples Bilateral: <i>biogenic component in liquid fuels</i> – with the Department of Physics, Univ. Novi Sad, Serbia Bilateral: <i>H-3 and C-14 activities in water samples</i>, with University of Veszprem, Hungary 	 IAEA TRIC2018 OBT inter-laboratory exercise on environmental samples - Fifth exercise: measuring OBT in fish tissue biogenic component in liquid fuels – organized by Gliwice group (Poland)
Standardization of measurement methods	 A new evaluation technique for determination of the biogenic fraction in liquids by the direct ¹⁴C method in LSC has been tested and validated OBT method – improvements implemented 	 AMS preparation of dark-coloured and/or viscose samples Validation of OBT method Improvements in pre-treatment of mortar samples for C-14 dating
National QA programmes and services	 Preparation of radioactive standards (liquid solutions, point sources, reference materials) for external users. 	 Calibration services Organisation of Proficiency Tests
Membership in international and national organisations	 ICRM committee membership Croatian Radiation Protection Association (CRPA) membership, president (IKB) International Radiation Physics Society (IRPS, vice-president (IKB) Croatian Quality Society, Croatian Quality Managers Society ESIR membership 	 continue with various societies membership join IAEA ALMERA network (Analytical Laboratories for the Measurement of Environmental Radioactivity)
Management and Organisation	 IAEA CRO/7/001: Isotope investigation of the groundwater-surface water interaction at the well field Kosnica in the area of the city of Zagreb, 2016-2017 organization of 11th Symposium of Croatian Radiation Protection Association 	 European Projects: H2020 TWINNING – <i>ISOTWIN</i> – proposed, under evaluation organization of 12^h Symposium of Croatian Radiation Protection Association

Activity line	RBI-LNA, Radionuclide Metrology, 2016-2017 Progress report	RBI-LNA, Radionuclide Metrology, 2018-2019 Work plan
Teaching activity	 Lecture courses given: ILM – Quality management according to ISO 17025, course for RBI staff Invited lecture: I. Krajcar Bronić: Environmental levels of H-3 and C-14 in Croatia, ENVIRA conference, Vilnius 2017 2 fellowships from Bulgaria, within IAEA CRO/7/001 project 	Lecture courses givenInvited lectures
Quality system	 Improvements of Quality management system Developments toward better quality system 	 preparation of necessary documents and forms application for accreditation of the C-14 method – different measurement techniques, and H-3 measurements

LABORATORY	Ruđer Bošković Institute (RBI), Laboratory for Low-level Radioactivities, Croatia
NAMES	Researchers: Jadranka Barešić, Nada Horvatinčić (only 2016, then retired), Ines Krajcar Bronić, Ivanka Lovrenčić Mikelić (since March 1, 2016), Matea Krmpotić (since March 1, 2016), Martina Rožmarić (since March 1, 2016, on leave at IAEA Monaco), Andreja Sironić
	Assistant: Damir Borković; Technician: Anita Rajtarić
ACTIVITY	Improvement of measurement techniques for radiocarbon (benzene synthesis and direct absorption of CO ₂ , LSC technique; preparation of graphite targets for AMS ¹⁴ C measurement) and tritium measurement (electrolytic enrichment and LSC measurement, direct measurement)
	Development of a simple method for determination of biogenic fraction in liquid fuels by direct measurement using LSC Quantulus
	Radiocarbon dating of archaeological, geological and paleontological samples, geochronology, dating of cultural heritage and art objects
	Tritium activity measurements of natural waters (precipitation, surface and ground waters) and modelling
	Use of stable (H-2, C-13, O-18) and natural radioactive isotopes (H-3, C-14) in hydrogeological, paleoclimatological, environmental and ecological studies
	Physico-chemical and isotopic study of processes in karst environment, particularly in carbonate sediments, and water-sediment interaction
	Carbon isotopes (C-13, C-14) in carbon cycle studies
	 C-14 monitoring in biological samples around nuclear power plant (npp), C-14 monitoring in atmospheric CO₂ around the npp and in the clean areas, C-14 monitoring in npp waste water, C-14 monitoring in river water and biota
	Participation in IAEA/WMO project: "Global Network of Isotopes in Precipitation (GNIP) and Isotope Hydrology Information System (<u>ISOHIS</u>)". Data for stations Zagreb and Ljubljana since 1976
	Project "Reconstruction of the Quaternary environment in Croatia using isotope methods" continued, reports for the second and third year accepted
KEYWORDS	data evaluation, data measurement, environmental monitoring, liquid scintillation, low-level, LSC, accelerator mass spectrometry, AMS, dating, radionuclides C-14, H-3, stable isotopes H-2, C-13, O-18
RESULTS	C-14 dating of various types of samples was performed. For large samples, containing >2 g of carbon, the liquid scintillation measuring techniques were used. Small samples, containing <1 g of carbon, were prepared as graphites and measured by AMS technique. Altogether in 2016 and 2017, 178 samples were measured by the LSC technique after benzene synthesis, 194 samples after CO_2 absorption, and 422 samples by the AMS.
	H-3 monitoring in precipitation and in the Sava River continued, as well as monitoring of tritium in air moisture of the laboratory where some materials used in test fusion reactor are tested. Tritium activity concentration was determined in 165 samples after electrolytic enrichment, and in 122 samples without enrichment.
	C-14 monitoring in atmospheric CO_2 and recent plants has been continued. In 2016 regular exchange of fuel elements in nuclear power plant was performed

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	In autumn and expected slightly higher ¹⁴ C activities were observed in atmospheric CO ₂ collected close to the ventilation output for short period during and immediately after the refueling. ¹⁴ C activity of biological samples neither in 2016 nor in 2017 was not affected by the autumn releases of gaseous effluents.
	Study of carbon cycle was extended to emersed and submerged plants in karst river, and preliminary comparison of ¹³ C and ¹⁴ C content revealed some interesting results, publication is in preparation.
	The comprehensive multi-proxy study of lake sediments from two karst lakes of different sizes, Lake Prošće (0.68 km ²) and Lake Kaluđerovac (0.02 km ²), the Plitvice Lakes system, Croatia, involved mineralogical, chemical (C/N and TOC) and carbon isotope analyses ($a^{14}C$ and $\delta^{13}C$ of carbonate and organic fractions) of 6 sediment cores. The analyses showed that the response of the lake sediment to the environmental conditions does not depend particularly on the size of the lake, but the surrounding environmental conditions could have great influence on the sediment composition. If one wants to study regional and long-term paleoclimatic records in lake sediments, the chosen sampling location should be far from local-scale influences. Sediment locations closer to the shore and influenced by local water inputs (feeding streams) that may occasionally bring terrigenic material to the lake are more appropriate for the determination of local short-term paleoenvironmental events.
	C-14 dating of the three historically important documents/objects related to the period of the reign of the Ottoman Empire in SE Europe, kept in the museum collection of the Franciscan Monastery in Fojnica, Bosnia and Herzegovina, enabled to evaluate the originality of the objects and some later interventions in both documents were identified.
	Statistical analysis of 30-years long record of various physico-chemical data from the karst area of the Plitvice Lakes, Croatia, showed the air temperature increase of 0.6°C/decade, which followed global trends, as well as some trend in chemical composition of spring and lake waters.
DUDUCATIONS	Books and chapters in books
FUBLICATIONS	Seltzer, S., Fernandez-Varea, J., Andreo, P., Bergstrom, P., Burns, D., Krajcar Bronić, I., Ross, C. & Salvat, F. (2016) Key data for ionizing-radiation dosimetry: Measurement standards and applications, ICRU Report 90. Bethesda, USA, Oxford University Press.
	Radolić, V., Poje Sovilj, M. & Krajcar Bronić, I. (eds.) (2017) Proceedings of the 11 th symposium of the Croatian Radiation Protection Association. Zagreb, HDZZ/CRPA. (<u>https://www.bib.irb.hr/869869</u> or <u>http://www.hdzz.hr/simpoziji/</u>).
	Lovrenčić Mikelić, I. (2016) Kako akreditirati laboratorij prema normi HRN EN ISO/IEC 17025: praktične upute za početnike. U: Jakovčić, M. (ur.) Akreditacija i ocjenjivanje sukladnosti. Zagreb, Hrvatsko mjeriteljsko društvo, str. 139-148.
	Papers in journals
	Krmpotić, M., Rožmarić, M. & Benedik, L. (2017) Evaluation of several electrolyte mixture-cathode material combinations in electrodeposition of americium radioisotopes for alpha-spectrometric measurements. Applied radiation and isotopes, 128, 158-164. doi:10.1016/j.apradiso.2017.07.005.
	Horvatinčić, N., Sironić, A., Barešić, J. & Kozjak, I. (2017) Radiocarbon dating of Ahdname, mantel and armorial from the Fojnica Franciscian monastery. Radiocarbon, 59 (5), 1359-1368. doi:10.1017/RDC.2017.40.

 Horvatincić, N., Sironić, A., Baresić, J., Sondi, I., Krajčar Bronić, I. & Borković, D. (2017) Mineralogical, organic and isotopic composition as palaeoenvironmental records in the lake sediments of two lakes, the Plitvice Lakes, Croatia. Accepted for publication Quaternary international. http://dx.doi.org/10.1016/j.quaint.2017.01.022 http://dx.doi.org/10.1016/j.quaint.2017.01.022 https://www.sciencedirect.com/science/article/pii/S1040618216309776 https://www.sciencedirect.com/science/article/pii/S1040618216309776 https://www.sciencedirect.com/science/article/pii/S1040618216309776 https://www.sciencedirect.com/science/article/pii/S1040618216309776 https://www.sciencedirect.com/science/article/pii/S1040618216309776 https://science/article/pii/S1040618216309776 https://science/article/pii/S1040618216309776 https://science/article/pii/S1040618216309776
Lovrenčić Mikelić, I., Oreščanin, V. & Škaro, K. (2017) Variation of sedimentation rate in the semi- enclosed bay determined by Cs-137 distribution in sediment (Kaštela Bay, Croatia). Journal of environmental radioactivity, 166 (1), 112-125. doi:10.1016/j.jenvrad.2016.03.027.
Krajcar Bronić, I., Barešić, J., Horvatinčić, N. & Sironić, A. (2017) Determination of biogenic component in liquid fuels by the 14C direct LSC method by using quenching properties of modern liquids for calibration. Radiation physics and chemistry, 137, 248-253. doi:10.1016/j.radphyschem.2016.01.041.
Lovrenčić Mikelić, I. (2017) Akreditacija i sustav upravljanja prema normi HRN EN ISO/IEC 17025 na Institutu Ruđer Bošković. Svijet po mjeri: Časopis za mjeriteljstvo, normizaciju, akreditaciju i ocjenjivanje sukladnosti, 4, 39-43.
Lovrenčić Mikelić, I. (2017) Što akreditacija - nije?. Svijet po mjeri: Časopis za mjeriteljstvo, normizaciju, akreditaciju i ocjenjivanje sukladnosti, 3, 31-35.
Lovrenčić Mikelić, I. (2017) Kako upravljati nesukladnim i popravnim radnjama?. Svijet po mjeri: Časopis za mjeriteljstvo, normizaciju, akreditaciju i ocjenjivanje sukladnosti 2, 27-30.
Publications in proceedings
Barešić, J., Nikolov, J., Todorović, N., Krajcar Bronić, I., Stojković, I., Tenjović, B., Krmpotić, M., Tomić, M. & Marić, D. (2017) COMPARISON OF METHODS FOR DETERMINATION OF BIOGENIC FRACTION IN LIQUID FUELS. U: Stanković Petrović, J. & Pantelić, G. (ur.) Zbornik radova - XXIX Simpozijum DZZSCG. Beograd, DZZSCG, str. 529-536.
Krajcar Bronić, I., Breznik, B. & Zorko, B. (2017) HOW TO ESTIMATE THE EFFECTIVE DOSE DUE TO INGESTION OF ¹⁴ C. U: Stanković Petrović, J. & Pantelić, G. (ur.) Zbornik radova - XXIX Simpozijum DZZSCG, Srebrno jezero. Beograd, DZZSCG, str. 143-151.
Nikolov, J., Krajcar Bronić, I., Stojković, I., Todorović, N., Barešić, J., Krmpotić, M. & Tomić, M. (2017) COMPARISON OF TWO DIFFERENT METHODS FOR DETERMINATION OF BIOGENIC FRACTION IN LIQUID FUELS. In: Radolić, V., Poje Sovilj, M. & Krajcar Bronić, I. (eds.) Proceedings of the 11 th symposium of the Croatian Radiation Protection Association. Zagreb, HDZZ/CRPA. 206-211.
Krajcar Bronić, I., Breznik, B., Volčanšek, A., Barešić, J., Borković, D., Sironić, A., Horvatinčić, N., Obelić, B. & Lovrenčić Mikelić, I. (2017) ¹⁴ C ACTIVITY IN THE ATMOSPHERE AND BIOLOGICAL SAMPLES IN THE VICINITY OF THE KRŠKO NUCLEAR POWER PLANT – 10 YEARS OF EXPERIENCE. In Radolić, V., Poje Sovilj, M. & Krajcar Bronić, I. (eds.) Proceedings of the 11 th symposium of the Croatian Radiation Protection Association. Zagreb, HDZZ/CRPA. 231-237.

	Barešić, J. & Kraicar Bronić, I. (2017) Stop 4 · Plitvice Lakes National Park. In
	Marković, T., Martinjak, J. & Pomper, N. (eds) ⁴⁴ th Annual Congress of the IAH "Groundwater Heritage and Sustainability" Dubrovnik (Ombla), Blue and Red Lakes (Imotski), Gacka River, Plitvička Lakes, Zagreb, Ljubljana : excursion guidebook. Zagreb, Croatian Geological Survey, str. 30-36.
	Krajcar Bronić, I. (2017) ETHICS IN RADIATION PROTECTION. In: Radolić, V., Poje Sovilj, M. & Krajcar Bronić, I. (eds.) Proceedings of the 11 th symposium of the Croatian Radiation Protection Association. Zagreb, HDZZ/CRPA. 9-14.
IN PROGRESS	Continuous improvement of preparation and measurement techniques
	Continuous monitoring of H-3 and C-14 in environment, study of water and carbon natural cycles, anthropogenic influence on carbon cycle
	Optimization of fast and robust method of determination of biogenic fraction in liquid fuels and oils, Intercomparison with other laboratories
	Study of processes in karst by applying stable and radioactive isotopes, study of speleothem formation and their application in paleoclimatic studies
	The main scientific project "Reconstruction of the Quaternary environment in Croatia using isotope methods" (responsible investigator: N. Horvatinčić and since 2017 I. Krajcar Bronić) - Since the Dinaric karst is the region where various carbonate sediments (speleothems, tufa, lake sediment, algal rims) can be found, the research under this project is aimed towards integrating knowledge obtained by studies of individual types of deposits from the same area, searching for new conclusions on the reconstruction of the Quaternary environment and climate.
	Regional project IAEA CRO/7/001: Isotope investigation of the groundwater- surface water interaction at the well field Kosnica in the area of the city of Zagreb, 2016-2017 – the analysis of obtained isotope and chemical data is being performed.
	Improvement of Quality Management System in progress, various forms and documents have been prepared and implemented in the laboratory work.
INFORMATION	http://www.irb.hr/eng/Research/Divisions/Division-of-Experimental- Physics/Laboratory-for-Low-level-Radioactivities
	http://www.irb.hr/Istrazivanja/Zavodi/Zavod-za-eksperimentalnu- fiziku/Laboratorij-za-mjerenje-niskih-radioaktivnosti/HRZZ-IP-11-2013- 1623-Reconstruction-of-the-Quaternary-environment-in-Croatia-using- isotope-methods-REQUENCRIM
SOURCE IN PREPARATION	
OTHER RELATED	https://www.bib.irb.hr/pretraga/?q=Krajcar- Broni%C4%87%2C+Ines+%28112976%29&by=author
FUDLICATIONS	https://www.bib.irb.hr/pretraga/?q=Bare%C5%A1i%C4%87%2C+Jadranka+ %28237472%29&by=author
	https://www.bib.irb.hr/pretraga/?q=Lovren%C4%8Di%C4%87+Mikeli%C4%
	<u>https://www.bib.irb.hr/pretraga/?q=Sironi%C4%87%2C+Andreja+%2826834</u> <u>2%29&by=author</u>
MEMBERSHIP IN INTERNATIONAL	Ines Krajcar Bronić is the president of CRPA – Croatian Radiation Protection Association (2013 – 2017 and 2017 – 2021) and the vice-president for eastern and Central Europe of IRPS – International Radiation Physics Society (2012 –

AND NATIONAL ORGANISATIONS	2015, second term 2015 – 2017), member of European Society for Isotope Research – ESIR, Croatian Physical Society, Croatian Humboldtianner Club
	Jadranka Baresic – member of CRPA, ESIR, Croatian Chemical Society, INQUA – Croatian National INQUA Committee
	Andreja Sironić – member of CRPA, ESIR, Croatian Chemical Society, INQUA – Croatian National INQUA Committee
	Ivanka Lovrenčić Mikelić – member of CRPA, of a technical committee of the Croatian Standards Institute (HZN/TO Z2: Assessment of conformity and accreditation), Croatian Quality Society, Croatian Quality Managers Society - member of the Management board, Croatian Geological Society.
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CONTACT	Ines Krajcar Bronić

Czech Metrology Institute (CMI), Radionuclide Metrology, Czech Republic, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The programme at the CMI in the field of radionuclide metrology in the years 2015-2017 was on maintaining and developing the primary national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

The CMI staff in 2017 were:

Scientists	Function
Petr Kovář	Head of Primary standards group
Jana Sochorová	Primary activity standards
Pavel Dryák	Gamma spectrometry
Pavel Auerbach	Electronics specialist
Miroslav Havelka	Liquid scintillation counting, Radon in water standard

The main specific activities carried out at CMI in this field are summarised below.

Activity line	CMI Radionuclide Metrology	CMI Radionuclide Metrology
	2016-2017 Progress report	2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Development of new primary standards: Ho-166 Activity standardization of Pb-210 by 4πα liquid scintillation counting New 4π(LS)-γ coincidence system (TDCRG) with FPGA based digital platform Emission of 6.13 MeV photons from Am-241 (α,n) C-13 sources measurement Characterisation of the new HPGe detector with MC method Yield Measurement of γ- and X-rays in Ra-226 and Pb-210 	 Revision of primary standards: Sn-113, Cd-109 4π(LS)-γ coincidence system - comparison of different ways of efficiency changes for extrapolation measurement Measurement of ⁹⁰Y decay parameters Development of new method for measurement of emanation power of Rn-220 source
International comparisons	• BIPM (Ho-166)	• SIR (Am-241)
National QA programmes and services	• Preparation of radioactive standards (liquid solutions, point sources, reference materials) for external users.	• Preparation of radioactive standards (liquid solutions, point sources, reference materials) for external users.
Membership in international and national organisations	• ICRM, BIPM/CCRI(II), EURAMET	• ICRM, BIPM/CCRI(II), EURAMET

Activity line	CMI Padionuclida Matralogy	CMI Radionuclida Matrology
Activity line	CMI Kaulonuchue Mietrology	CMI Kaulohuchue Metrology
	2016-2017 Progress report	2018-2019 Work plan
Management	• 15SIB10, Radionuclide beta spectra	• 15SIB10, Radionuclide beta spectra
and	metrology', WP leadership	metrology', WP leadership
Organisation	• 15HLT06, Metrology for clinical	 15HLT06, Metrology for clinical
	implementation of dosimetry in	implementation of dosimetry in
	molecular radiotherapy''	molecular radiotherapy''
	 16ENV09 MetroDecomII, In situ 	 16ENV09 MetroDecomII, In situ
	metrology for decommissioning	metrology for decommissioning
	nuclear facilities, WP leadership	nuclear facilities, WP leadership
	• 16ENV04 Metrology for mobile	 16ENV04 Metrology for mobile
	detection of ionising radiation in the	detection of ionising radiation in the
	aftermath of a nuclear or radiological	aftermath of a nuclear or radiological
	incident, WP leadership	incident, WP leadership
	• 16ENV10 MetroRADON, Metrology	 16ENV10 MetroRADON , Metrology
	for radon monitoring, WP leadership	for radon monitoring, WP leadership
Teaching	Cooperation with Faculty of Nuclear	• Cooperation with Faculty of Nuclear
activity	Sciences and Physical Engineering,	Sciences and Physical Engineering,
	Prague	Prague
Quality system	Maintaining of Quality Management	Maintaining of Quality Management
	System according to ISO17025	System according to ISO17025
	• On site peer review 1109/2017 SMÚ-ČMI	

LABORATORY	Czech Metrology Institute (CMI), Radionuclide Metrology, Czech Republic
NAMES	Petr Kovář, Jana Sochorová, Pavel Dryýk, Pavel Auerbach, Miroslav Havelka
ACTIVITY	Maintaining of the National Standard of Activity of Radionuclides in Czech Republic Maintaining and improving of the management system according to ISO 17025 Production of standard solutions and sources Development of new measurement methods for activity standardisation Nuclear decay data evaluation
KEYWORDS	Alpha spectrometry, beta spectrometry, coincidence method, data evaluation, data measurement, environmental control, Euromet, gamma-ray spectrometry, gas proportional counter, ionisation chamber, life sciences, liquid scintillation, low-level, 4π NaI counter, neutron measurement, radioactive gas, radiochemistry, simulation code, SIR, source preparation, traceability, X-ray spectrometry
RESULTS	The new 4π (LS)- γ coincidence system (TDCRG) with FPGA based digital platform was validated in 2017.
	Activity standardization of Pb-210 by $4\pi\alpha$ liquid scintillation counting
	Emission of 6.13 MeV photons from Am-241 (α ,n) C-13 sources measurement
	Characterisation of the new HPGe detector with MC method
	Yield Measurement of γ - and X- Rays in Ra-226 and Pb-210
PUBLICATIONS	Havelka, M., 2018. Activity standardisation of 210 Pb by $4\pi\alpha$ liquid scintillation counting method. Appl. Radiat. Isot.134, 122-125
	Šuráň, J. et al., 2018. Metrology for decommissioning nuclear facilities: Partial outcomes of joint research project within the European Metrology Research Program. Appl. Radiat. Isot.134, 351-357
	Mazánová, M., Dryák, P., Havelka, M., 2018. Emission probability measurement of γ - and X- rays in Ra-226 and Pb-210 decay. Appl. Radiat. Isot.134, 429-432
	Šolc, J., Kovář, P., 2018. Subtraction of natural radiation contribution from gamma-ray spectra measured by HPGe detector. Appl. Radiat. Isot.134, 167-171
IN PROGRESS	Measurement of ⁹⁰ Y decay parameters
	Development of new method for measurement of emanation power of Rn-220 source
	Revision of methods of activity determination, development of measurement methods based on $4\pi(LS)$ - γ coincidence system
INFORMATION	$4\pi\beta$ - γ coincidence system with gas flow proportional counter
	$4\pi\beta$,X- γ coincidence system with pressurized proportional counter
	4π (LS)- γ coincidence system
	TDCR system
	4π windowless NaI(Tl) detector

	X and γ ray spectrometry systems MC based efficiency calculation for spectrometry detectors	
	Radon in water standard	
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CONTACT	Petr Kovář	
LNE – Laboratoire National Henri Becquerel (LNHB), France, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The programme at the Laboratoire National Henri Becquerel (LNE-LNHB) in the field of radionuclide metrology in the years 2015-2017 was on maintaining and developing the primary and secondary national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

Scientists	Function
L. de Carlan	Head of LNE-LNHB
T. Branger	Head of radioactivity metrology laboratory
C. Bobin, C. Thiam	Primary activity standards
V. Chisté	Secondary activity standards
L. Ferreux, B. Sabot	Environmental studies, low-level measurements
P. Cassette	Liquid scintillation counting
MC. Lépy	Gamma spectrometry
S. Pierre, M. Loidl	Alpha spectrometry
S. Pierre	Radon standards
C. Thiam, P. Cassette	Neutron standards
V. Lourenço, M. Corbel	Source preparation/radiochemistry
M. Rodrigues	Proportional gas counters
X. Mougeot	Beta spectrometry and theory, Data evaluation
M.A. Kellett	Data evaluation
C. Dulieu	Data dissemination, web development
Technicians	
L. Brondeau, F.Rigoulay (ret.),	Secondary activity standards
M. Cardot-Martin	
S. Morelli, I. Le Garrérès (ret.),	Source preparation/radiochemistry
D. Lacour	

The LNE-LNHB staff in 2016-2017 were:

The main specific activities carried out at LNE-LNHB in this field are summarised below:

Activity line	LNE-LNHB	LNE-LNHB
	Radionuclide Metrology 2016 -	Radionuclide Metrology 2018 -
	2017 Progress report	2019 Work plan
Development of	• Development of new primary	• Development of new primary
primary	standards: At-211	standards: At-211
standards,	• Interface for digital counting systems	• Interface for digital counting systems
Improvement of	• Nuclear Data measurements: <i>Nd-147</i>	• Nuclear Data measurements: <i>Nd-147</i>
measuring	• Participation in EMPIR Projects :	• Participation in EMPIR Projects :
methods and	MetroNORM	MetroNORM
instrumentation	ThinErgy	ThinErgy
	MetroDecom	MetroDecom
	• MetroERM	• MetroERM
	• 3DMetChemIT	• 3DMetChemIT
	DigitalSTD	DigitalSTD
	• MetroBeta	• MetroBeta
	• MRTDosimetry	MRTDosimetry

Activity line	LNE-LNHB	LNE-LNHB
· ·	Radionuclide Metrology 2016 -	Radionuclide Metrology 2018 -
	2017 Progress report	2019 Work plan
International	• BIPM (Y-88)	
comparisons	• CCRI(II) comparison on Ra-223	
	CCRI(II) comparison on Rn-222	
Standardization	Portable TDCR system	
of measurement	Accurate self-absorption correction	
methods	in gamma-ray spectrometry	
	• New use of digital electronics or	
	detectors	
National QA	• Preparation of radioactive standards	• Preparation of radioactive standards
programmes	(liquid solutions, point sources) for	(liquid solutions, point sources) for
and services	external users.	external users.
	Calibration services for external	• Calibration services for external users
	users	 Organisation of Proficiency Tests
	• Calibration of the activity in	for activity measurements
	samples used for comparisons	• Calibration of the activity in
	Organisation of 8 Proficiency Tests	samples used for comparisons
	for activity measurements	
Membership in	ICRM committee membership	• ICRM committee membership
international and	• BIPM/CCRI(II), BIPM/CCRI(III),	• BIPM/CCRI(II), BIPM/CCRI(III),
national	EURAMET TC-IR, IAEA, ISO	EURAMET TC-IR, IAEA, ISO
organisations	• BNEN/AFNOR, COFRAC,	• BNEN/AFNOR, COFRAC,
	CETAMA, LARD, SFRP	CETAMA, LARD, SFRP
	• DDEP, JEFF	• DDEP, JEFF
Management	European Projects:	
and	• MetroNORM (4 WPs)	
Organisation	• ThinErgy (4 WPs)	
	• MetroDecom (3 WPs)	
	• MetroERM	
	• 3DMetChemii (3 WPS)	
	• DigitalS I D	
	• MetroBeta (project leader, 5 WPs,	
	MDTD asim stray (4 WDs, WD1	
	• WIK I Dosilleury (4 WPS, WP1	
Teaching	• Lecture courses given	• Lecture courses given
activity	Invited lectures	 Invited lectures
Quality system	Improvements of Ouglity System	
Zumity System	according to ISO 17025:2005	

LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	C. Dulieu, M.A. Kellett, X. Mougeot
ACTIVITY	Evaluation and Dissemination of Radionuclide Decay Data
KEYWORDS	Data evaluation, ⁸² Rb, ⁸² Sr, ⁹⁰ Y, ¹⁵¹ Sm, ¹⁶⁹ Er, ¹⁷⁷ Lu, ²³⁰ U decay chain, DDEP
RESULTS	Coordination of the Decay Data Evaluation Project (DDEP) and review of evaluations
	Evaluation of decay data: ⁸² Rb, ⁸² Sr, ⁹⁰ Y, ¹⁵¹ Sm, ¹⁶⁹ Er, ¹⁷⁷ Lu, ²³⁰ U decay chain
	New website and decay data evaluation distribution page: http://www.lnhb.fr/nuclear-data/nuclear-data-table/
	Continual improvements to the α/γ spectrometry website (Laraweb), and new address: <u>http://www.lnhb.fr/nuclear-data/module-lara/</u>
PUBLICATIONS	"Monographie BIPM-5 – Table of Radionuclides, Volume 8 (2016)", Marie- Martine Bé, Vanessa Chisté, Christophe Dulieu, Mark A. Kellett, Xavier Mougeot, Valery Chechev, Xiaolong Huang, Baosong Wang, Aurelian Luca, Alan L. Nichols, CEA/LNE-LNHB, 91191 Gif-sur-Yvette, France and BIPM, Pavillon de Breteuil, 92312 Sèvres, France.
IN PROGRESS	Evaluation of: ^{177m} Lu, ¹⁸⁶ Re, ²³⁰ U decay chain (²²² Ra, ²¹⁸ Rn, ²¹⁴ Po, ²¹⁰ Pb)
INFORMATION	Coordination of EMPIR project MetroBeta (Radionuclide beta spectra metrology) and WP1 leader
	Participation in WP1 of EMPIR project MRTDosimetry
OTHER RELATED PUBLICATIONS	"Mini Table de radionucléides – Mini Table of Radionuclides 2015", EDP Sciences, ISBN: 978-2-7598-1186-1
	For further information, see: <u>http://www.lnhb.fr/conferences-publications/lnhb-publications/</u> or <u>http://laboutique.edpsciences.fr/produit/781/9782759811861/Mini%20Table%2</u>
	Ode%20radionucleides%202015
	CD Rom NUCLÉIDE, Editor EDP Sciences, ISBN 978 2 7598 0077 3
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LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	X. Mougeot
ACTIVITY	Beta Spectrometry
KEYWORDS	Beta spectrometry, Calculation of beta and electron capture decays.
RESULTS	1. In order to assess the reliability of the theoretical estimates for electron capture decays, the modelling of the LogFT and EC-capture programs, commonly used in current decay data evaluations, was studied in detail. An improved modelling was then set out and implemented for the calculation of allowed and forbidden unique transitions, on the basis of relativistic atomic wave functions determined in previous work. The atomic overlap and exchange effects are corrected using Bahcall's and Vatai's approaches. Shake-up, shake-off and inner hole effects are approximately corrected. Relative capture probabilities and their ratios, including capture-to-positron ratios, have been found to be in good agreement with a selection of precise measurements. The decay scheme of ⁴⁰ K was updated using this modelling.
	2. The new code BetaShape has been developed in order to improve the nuclear data related to beta decays. An analytical model was considered, except for the relativistic electron wave functions, for ensuring fast calculations. Output quantities are mean energies, log <i>ft</i> values and beta and neutrino spectra for single and multiple transitions. The uncertainties from the input parameters, read from an ENSDF file, are propagated. A database of experimental shape factors is included. A comparison over the entire ENSDF database with the standard code currently used in nuclear data evaluations shows consistent results for the vast majority of the transitions and highlights the improvements that can be expected with the use of BetaShape.
PUBLICATIONS	1. X. Mougeot, <i>Improved calculations of electron capture transitions for decay data and radionuclide metrology</i> , Applied Radiation and Isotopes 134, 225-232 (2018).
	2. X. Mougeot, <i>BetaShape: A new code for improved analytical calculations of beta spectra</i> , EPJ Web of Conferences 146, 12015 (2017).
IN PROGRESS	1. Inclusion of the nuclear structure in beta decay calculations within the EMPIR project MetroBeta (2016-2019).
	2. High-precision calculations of electron capture decays and atomic parameters within the EMPIR project MetroMMC (2018-2021).
INFORMATION	 The first version of the BetaShape program is available on the LNHB website. A. Singh started her PhD thesis on beta spectrometry in July 2017, for three years. A 4π apparatus based on silicon detectors is being developed.
OTHER RELATED PUBLICATIONS	1. K. Kossert, J. Marganiec-Gałązka, X. Mougeot, O.J. Nähle, Activity determination of ⁶⁰ Co and the importance of its beta spectrum, Applied Radiation and Isotopes 134, 212-218 (2018).
	2. L. Hayen, N. Severijns, K. Bodek, D. Rozpedzik, X. Mougeot, <i>High precision analytical description of the allowed</i> β <i>spectrum shape</i> , Review of Modern Physics (accepted, in press) (2017), arXiv:1709.07530v2.

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LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	C. Bobin, C. Thiam, B. Chauvenet
ACTIVITY	Primary measurements: $4\pi\beta-\gamma$ counting, $4\pi\gamma$ counting, TDCR. Development of digital instrumentation (primary measurements, radionuclide identification). Development of a Geant4 modeling for TDCR and $4\pi(LS)\beta-\gamma$ counting using liquid scintillation and Cerenkov.
KEYWORDS	(anti) coincidence method, life sciences, liquid scintillation, NaI well-type counter, simulation code, Cherenkov, digital instrumentation
RESULTS	
PUBLICATIONS	Bobin C., et al., 2017. A radionuclide calibrator based on Cherenkov counting for activity measurements of high-energy pure β -emitters. Appl. Radiat. Isot. 119, 60-65.
	Chauvenet B., et al., 2017. A general dead-time correction method based on live-time stamping. Application to the measurement of short-lived radionuclides. Appl. Radiat. Isot. 130, 238-244.
	Thiam C., et al., 2017. Adaptation of PTB's analytical modelling for TDCR– Cherenkov activity measurements at LNHB. J. Radioanal. Nucl. Chem. 314, 591–597.
	Bobin C., et al., 2018. Standardization of ${}^{68}\text{Ge}/{}^{68}\text{Ga}$ using the $4\pi\beta-\gamma$ coincidence method based on Cherenkov counting. Appl. Radiat. Isot. 134, 252-256.
IN PROGRESS	Participation to European projects (MRTDosimetry, DigitalStandard); standardization of ¹⁶⁶ Ho. New design of a radionuclide calibrator based on Cherenkov counting.
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CONTACT	Christophe Bobin

LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	Sylvie Pierre, Benoît Sabot, Philippe Cassette
ACTIVITY	Radon and thoron calibration
KEYWORDS	²²⁰ Rn, ²²² Rn, PIPS detectors
RESULTS	²²² Rn activity standard and ²²⁰ Rn standard
PUBLICATIONS	Applied Radiation and Isotopes 109 (2016) 205-209: A new thoron reference atmosphere measurement system. B.Sabot ¹ , S.Pierre ¹ , P. Cassette ¹ , N. Michielsen ² , S.Bondiguel ² ¹ LNHB, ² Institut de Radioprotection et de Sûreté Nucléaire (IRSN) PSN-RES, SCA, LPMA
	Conference ICRM 2017, under publication: Bias in the measurement of radon gas using ionization chambers: application to SIR, S. Pierre, B. Sabot, P. Cassette, J. Liang, S. Courte, L. Ferreux, G. Ratel.
IN PROGRESS	A new loop device for the thoron circulation
SOURCE IN PREPARATION	Development of a ²²⁰ Rn and ²²² Rn emanation sources
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CONTACT	Benoît Sabot

LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	Valérie Lourenço, Didier Lacour, Sophie Morelli, Margot Corbel
ACTIVITY	Source preparation for all measurement techniques. Teaching activities on source preparation. Radiochemical separations or dissolution.
	Organisation of national and international proficiency tests in the field of activity measurements (from low-level to high-level activity measurements), <u>http://www.lnhb.fr/services-en/interlaboratory-tests/</u>
	Development of reference materials representative of environmental radioactivity or dismantling samples either by spiking or by characterized sampling.
	The group is involved in EMPIR/H2020 Projects (MetroDECOM2, MetroRadon, MRT Dosimetry, MetroBeta, Insider).
KEYWORDS	Source preparation, radiochemistry, proficiency tests
RESULTS	Radiochemical separations (¹⁰³ Pd/ ^{103m} Rh ; ¹⁴⁴ Ce/ ¹⁴⁴ Pr)
PUBLICATIONS	"Weighing uncertainties in quantitative source preparation for radionuclide metrology", Metrologia, Volume 52(3), S18-S29, 2015, V. Lourenço and C. Bobin
IN PROGRESS	Development of radioactive resin test sources with known activities (¹³³ Ba, ⁶⁸ Ge/ ⁶⁸ Ga, ¹⁷⁷ Lu, ⁹⁰ Y), Radon emanation sources, spiked filters, surface sources
INFORMATION	The proficiency tests programme is available at http://www.lnhb.fr/services-en/interlaboratory-tests/
SOURCE IN PREPARATION	See "in progress" section
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CONTACT	Valérie Lourenço

LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	Sylvie Pierre, Martin Loidl
ACTIVITY	Activity calibration and spectroscopy of alpha radionuclides
KEYWORDS	Defined solid angle, PIPS detector
RESULTS	A chamber with a new define solid angle (DSA 4) with a better uncertainty
PUBLICATIONS	
IN PROGRESS	An alpha chamber equipped with magnet
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	Applied Radiation and Isotopes 126 (2017) 66-72: Residual radioactivity of treated green diamonds, Philippe Cassette, Franck Notari, Marie-Christine Lépy, Candice Caplan, Sylvie Pierre, Thomas Hainschwang, Emmanuel Fritsch
	Applied Radiation and Isotopes 125 (2017) 196-202: Direct measurement of alpha emission probabilities in the decay of ²²⁶ Ra M. Marouli, S. Pommé, □, R. Van Ammel, E. García-Toraño, T. Crespo, S. Pierre
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LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	Laurine Brondeau, Sylvie Pierre, Benoît Sabot, Marie-Christine Lépy
ACTIVITY	Gamma-ray and X-ray spectrometry
KEYWORDS	Gamma-ray spectrometry, simulation code, X-ray spectrometry
RESULTS	Measurement of photon emission intensities in the decay of ²³¹ Pa and ¹⁴⁷ Nd
PUBLICATIONS	Consistency of photon emission intensities for efficiency calibration of gamma- ray spectrometers in the energy range from 20 keV to 80 keV, <i>MC. Lépy, L.</i> <i>Brondeau, Y. Ménesguen, S. Pierre, J. Riffaud,</i> Applied Radiation and Isotopes, 134 (2018) 131-136.
	Measurement of Absolute K X-Rays Emission Intensities in the Decay of ^{103m} Rh, J. Riffaud, P. Cassette, D. Lacour, V. Lourenço, I. Tartès, M.A. Kellett, M. Corbel, MC. Lépy, C. Domergue, C. Destouches, H. Carcreff, O. Vigneau, Applied Radiation and Isotopes, 134 (2018) 399-405.
IN PROGRESS	Calibration of HPGe detector in the low-energy range – Application to measurement of ⁹³ Nb and ^{103m} Rh activity for reactor dosimetry
INFORMATION	
SOURCE IN PREPARATION	Measurement of photon emission intensities: ²²⁶ Ra, ^{103m} Rh, ¹⁰³ Pd
OTHER RELATED PUBLICATIONS	Measurement of K fluorescence yields of niobium and rhodium using monochromatic radiation, J. Riffaud, MC. Lépy, Y. Ménesguen, A. Novikova, X-Ray Spectrometry, 46 (2017) 341–346.
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LABORATORY	LNE – Laboratoire National Henri Becquerel (LNHB), France
NAMES	Yves Ménesguen, Marie-Christine Lépy
ACTIVITY	X-ray Spectrometry
KEYWORDS	X-ray Spectrometry, Atomic data
RESULTS	Measurement of linear attenuation coefficients and fluorescence yields of several materials
	Development of a grazing incidence X-ray fluorescence goniometer for reference-free X-ray analysis
PUBLICATIONS	Measurement of K fluorescence yields of niobium and rhodium using monochromatic radiation, <i>J. Riffaud</i> , <i>MC. Lépy</i> , <i>Y. Ménesguen</i> , <i>A. Novikova</i> , X-Ray Spectrometry, 2017, 46, 341–346
	Experimental determination of the X-ray atomic fundamental parameters of nickel, <i>Y. Ménesguen et al.</i> , Metrologia, 2018, 55, 56-66
IN PROGRESS	Update of the COLEGRAM peak processing software
	Quantification of material traces by X-ray fluorescence
INFORMATION	Silicon Drift and Si(Li) Detectors
	Tunable monochromatic X-ray source (0.6-28 keV) (SOLEX)
	X-ray tube (20-88 keV)
	Synchrotron beam line (0.05-35 keV) (SOLEIL)
SOURCE IN PREPARATION	Measurement of mass attenuation coefficients, fluorescence yields
OTHER RELATED PUBLICATIONS	CASTOR, a new instrument for combined XRR-GIXRF analysis at SOLEIL, Y. Ménesguen, B. Boyer, A. Novikova, J. Lubeck, J. Weser, B. Beckhoff, D. Grötzsch, B. Kanngießer, H. Rotella, E. Nolot and MC. Lépy, X-Ray Spectrometry, 2017, 46, 303–308
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LABORATORY	Physikalisch-Technische Bundesanstalt (PTB), Germany
NAMES	Karsten Kossert, Ole Nähle, Lina Bockhorn, Marcell Takács. et al.
ACTIVITY	R&D in liquid scintillation counting; activity determination by means of ionization chambers; measurement of nuclear decay data
KEYWORDS	Decay data measurement; ionisation chambers; life sciences; liquid scintillation; several comparisons, metallic magnetic calorimeters (MMCs)
RESULTS	Activity standardization and determination of decay data for various radionuclides
PUBLICATIONS	Kossert, K., Bokeloh, K., Ehlers, M., Nähle, O., Scheibe, O., Schwarz, U., Thieme, K.: Comparison of ⁹⁰ Y activity measurements in nuclear medicine in Germany, Applied Radiation and Isotopes 109 (2016) 247-249.
	Kossert, K.: Half-life measurement of ²¹² Pb by means of a liquid scintillator- based ²²⁰ Rn trap, Applied Radiation and Isotopes 125 (2017) 15-17.
	Kossert, K., Marganiec-Galazka, J., Nähle, O.J.: Primary activity determination of ¹³⁴ Cs. Journal of Radioanalytical and Nuclear Chemistry 314 (2017) 545-553.
	Marganiec-Gałązka, J., Nähle, O.J., Kossert, K.: Activity determination of ⁸⁸ Y by means of $4\pi\beta(LS)$ - γ coincidence counting. Journal of Radioanalytical and Nuclear Chemistry 314 (2017) 599-604.
	Pommé, S., Kossert, K., Nähle, O.J.: On the claim of modulations in ³⁶ Cl beta decay and their association with solar rotation. Solar Physics (2017) 292:162 (8 pages).
	Pommé, S., Lutter, G., Marouli, M., Kossert, K., Nähle, O.: On the claim of modulations in radon decay and their association with solar rotation. Astroparticle Physics 97 (2018) 38-45.
IN PROGRESS	Construction of an enhanced TDCR counter to measure short-lived isotopes (e.g. for PET) on site, development and test of a $4\pi(LS)\beta$ - γ coincidence system
	Construction of a cryogenic metallic magnetic calorimeter to measure beta emission spectra with distinguished energy resolution (EMPIR project MetroBETA)
	Restarting measurement facilities for large-area source calibrations according to ISO 8769 (expected start of service for customers: 2019)
INFORMATION	Works are done with many collaborators; Information about activity standards and calibration services:
	https://www.ptb.de/cms/en/ptb/fachabteilungen/abt6/fb-61/611-unit-of-activity.html
SOURCE IN PREPARATION	Marganiec-Gałązka, J, Nähle, O.J., Kossert, K.: Activity determination of 68 Ge/ 68 Ga by means of $4\pi(\check{C})\beta$ - γ coincidence counting, Applied Radiation and Isotopes, in press.
	Kossert, K., Marganiec-Gałązka, J., Mougeot, X., Nähle, O.J.: Activity determination of ⁶⁰ Co and the importance of its beta spectrum, Applied Radiation and Isotopes, in press.

	Nähle, O., Activity determination of 67 Ga using $4\pi\beta-\gamma$ coincidence counting, Applied Radiation and Isotopes, in press.
	Pommé, S., et al.: Is decay constant? Applied Radiation and Isotopes, in press.
	Cassette, Ph. <i>et al.</i> : Results of the CCRI(II)-S12.H-3 supplementary comparison: Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated-water source measured using the LSC-TDCR method. Applied Radiation and Isotopes, in press.
	Cessna, J.T., <i>et al.</i> , Results of an International Comparison of Activity Measurements of ⁶⁸ Ge. Applied Radiation and Isotopes, in press.
	Loidl, M., Beyer, J., Bockhorn, L., Enss, C., Györi, D, Kempf, S., Kossert, K., Mariam, R., Nähle, O., Paulsen, M., Rodrigues, M., Schmidt, M.: MetroBeta: Beta Spectrometry with Metallic Magnetic Calorimeters in the Framework of the European Program of Ionizing Radiation Metrology. Proceedings of the 17 th International Workshop on Low Temperature Detectors in Journal of Low Temperature Physics, in preparation.
	Determination of the half-life and activity of ²²⁷ Th, in preparation.
	Determination and validation of beta spectra, in preparation.
OTHER RELATED PUBLICATIONS	<i>Pommé, S., et al.</i> : Evidence against solar influence on nuclear decay constants. In: Physics Letters B 761 (2016) 281-286. + 3 further articles in Metrologia
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LABORATORY	Physikalisch-Technische Bundesanstalt (PTB), Germany
NAMES	Janine Noordmann, Herbert Wershofen
ACTIVITY	Radionuclide determination in environmental reference materials with multicollector inductively coupled plasma mass spectrometry (MC-ICP-MS)
KEYWORDS	<i>Traceability of isotope ratios, environmental matrices, radiochemistry, rapid determination, reference materials, ²³⁵U, ²³⁸U, ²³⁹Pu, ²⁴⁰Pu, multicollector inductively coupled plasma mass spectrometry (MC-ICP-MS)</i>
RESULTS	
CONFERENCE PRESENTATION	
IN PROGRESS	The lab is currently being rebuilt with special ambient requirements and measurements will start in May of 2018.
INFORMATION	Establishment of SI traceable isotope ratio measurements of uranium and plutonium is planned to implement a much faster method with a much lower relative expanded uncertainty compared to alpha spectrometry measurements.
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	J. Vogl, B. Brandt, J. Noordmann, O. Rienitz, D. Malinovskiy, Characterization of a series of absolute isotope reference materials for magnesium: ab initio calibration of the mass spectrometers, and determination of isotopic compositions and relative atomic weights, Journal of Analytical Atomic Spectrometry, 31 (2016) 1440-1458
	B. Brandt, J. Vogl, J. Noordmann, A. Kaltenbach, O. Rienitz, Preparation and characterization of primary magnesium mixtures for the ab initio calibration of absolute magnesium isotope ratio measurements, Journal of Analytical Atomic Spectrometry, 31 (2016) 179–196
	J. Noordmann, S. Weyer, C. Montoya-Pino, O. Dellwig, N. Neubert, S. Eckert, M. Paetzel, M. E. Böttcher, Uranium and molybdenum isotope systematics in modern euxinic basins: Case studies from the central Baltic Sea and the Kyllaren fjord (Norway), Chemical Geology, 396 (2015) 182-195
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CONTACT	Janine Noordmann

LABORATORY	Physikalisch-Technische Bundesanstalt (PTB), Germany
NAMES	Daniel Zapata-García; Herbert Wershofen
ACTIVITY	Rapid radiochemistry for the determination of alpha and beta particle emitting radionuclides
KEYWORDS	Radiochemistry, Emergency preparedness, Environmental monitoring, Decommissioning, EMPIR
RESULTS	
PUBLICATIONS	
IN PROGRESS	Development of fast radiochemical procedures for the simultaneous separation of alpha and beta particle emitting radionuclides in different matrices.
	The work is being carried out in the framework of two EMPIR projects and focuses in two areas of capital interest nowadays:
	 Preparedness: implementation of validated procedures to achieve fast results in the analysis of environmental samples for environmental monitoring and radiological emergency preparedness. MetroDecom2: setting up of analytical strategies for samples which are of interest in the decommissioning nuclear facilities, such as concrete or steel.
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	D. Zapata-García, H. Wershofen; <i>Development of radiochemical analysis</i> strategies for decommissioning activities. Appl. Radiat. Isotopes 126 (2017) 204–207
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LABORATORY	Bhabha Atomic Research Centre (BARC), India
NAMES	Leena Joseph, Anuradha Ravindra, D.B. Kulkarni
ACTIVITY	 Absolute activity measurements Participation in international intercomparison programmes Audit programme of activity measurements in nuclear medicine centres Calibration of radionuclide calibrators and sources Dissemination of various radioactive standards to users
KEYWORDS	coincidence method, gas proportional counter, ionisation chamber, liquid scintillation, source preparation, traceability, Re-188, Ni-63, Sr-90/Y-90
RESULTS	 Standardisation of Re-188 used as radiopharmaceutical in nuclear medicine. National audit of I-131 activity measurements for hospitals and nuclear medicine centres in the country. Calibration of dose calibrators. Standardised radioactive solution of Sr-90/Y-90 by CIEMAT/NIST method Standardised Ni-63 radioactive solution for bilateral intercomparison of activity measurements with NMIJ, Japan.
PUBLICATIONS	 Anuradha Ravindra, D.B. Kulkarni, Leena Joseph, M.S. Kulkarni, D.A.R. Babu, A primary standard for the measurement of alpha and beta particle surface emission rate from large area reference sources. Applied Radiation and Isotopes 107 (2016) 87-91 D.B. Kulkarni, Leena Joseph, R. Anuradha, M.S. Kulkarni, B.S. Tomar, Standardization of ⁶⁸Ge-⁶⁸Ga using 4πβ(LS)-γ coincidence counting system for activity measurement, Applied Radiation and Isotopes, Volume 123, May 2017, Pages 6-10 D.B. Kulkarni, R. Anuradha, Leena Joseph, M.S. Kulkarni, B.S. Tomar, Performance demonstration of 4πβ(LS)-γ coincidence counting system for standardization of radionuclides with complex decay scheme. Applied Radiation and Isotopes 108 (2016) 24–29
IN PROGRESS	 Primary and secondary standardisation of radioisotopes used in Nuclear Medicine Design, fabrication and testing of coincidence analyser board. Dissemination of radioactivity standards to hospitals, industry and DAE units Design and fabrication of a new plastic scintillator based coincidence system
ADDRESS	Dr M S Kulkarni, Head, Radiation Standards Section, RSSD BARC, Mumbai - 400 085, INDIA Email: <u>kmukund@barc.gov.in</u> or <u>leena@barc.gov.in</u>
CONTACT	Leena Joseph

The programmes at the Italian National Institute of Ionising Radiation Metrology belonging to ENEA (ENEA-INMRI) in the field of radionuclide metrology in the years 2016-2017 was, as in the past, on maintaining and developing the national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

Scientists	Function
P. De Felice	ENEA-INMRI Head
M. Capogni	Primary radionuclide activity standards
G. Cotellessa	Nuclear tracks laboratory
P. Carconi	Secondary beta-emitting radionuclide activity standards
A. Petrucci	Secondary gamma-emitting radionuclide activity standards
F. Cardellini	Radioactive gas (radon and thoron) primary and secondary standards
M. D'Arienzo ⁺	High Dosimetry primary standards
L. Quintieri [*]	Neutron primary and secondary standards
Technicians	
A. Fazio	Secondary gamma-emitting radionuclide activity standards

The ENEA-INMRI Radionuclide Metrology staff in 2018 is the following:

(*) Involved in radionuclide metrology only for aspects common with dosimetry metrology (*) Involved in radionuclide metrology only for aspects common with neutron metrology

The main specific activities carried out at ENEA-INMRI in this field are summarised below. Highlights are marked in bold with corresponding details reported in separate sheets.

Activity line	ENEA-INMRI Radionuclide Metrology 2016-2017 Progress report	ENEA-INMRI Radionuclide Metrology 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Development of new primary standards (I-131, C-14, Y-90, Rn-220, Rn-222) Generation of Aerosol atmosphere in radon chamber Cherenkov TDCR counting and Y-90 standardisation Participation in EMRP/EMPIR Projects: MetroNORM MetroDECOM MetroERM DIGITALSTD MetroMRT Participation in TAWARA project funded by EC FP7 "security" theme 	 Development of new primary standards (H-3, Fe-55, Ho-166, Mn-56) Participation in EMRP/EMPIR Projects: DIGITALSTD_14SIP07 Metrological characterization of a Cu-64 solution produced at ENEA by 14 MeV neutrons from D-T fusion reactions Update of Rn-222 in water standard Update of Rn-222 gas standard in glass vial Participation in LSC, LS and γ-ray spectrometry ICRM WGs
International comparisons	• EURAMET.RI(II)-K2.I-131	 BIPM (Y-90, Large Area Sources) SIR (Co-60, Rn-222, Cs-134)

	 CCRI(II)-S12 supplementary comparison on H-3 activity measurements by LSC TDCR method Bilateral comparison ENEA-POLATOM on C-14 activity measurements ESIR (Ni-63) SIR (I-131) 	 ESIR (H-3) EURAMET.RI(II)-K2.Ho-166 comparison within MRTDosimetry project Trilateral ENEA-POLATOM-VNIIM on Fe-55 activity measurements
Standardization of measurement methods	 Nuclear track detection methods Methods for radioactivity measurements in tap waters 	 New detectors for Medical Imaging Metrology for PET and SPECT system Monte Carlo code development for gamma ray spectrometry laboratory
National QA programmes and services	 Preparation of radioactive standards (liquid solutions, point sources, paper filters and spiked reference materials) for external users Organisation of Proficiency Tests for national laboratories: radioactivity surveillance network, radon measurement laboratories, nuclear medicine departments Collaboration with IAEA (Lectures and guideline development) 	 Provision of Calibration service Collaboration with the National Accreditation Body (ACCREDIA) for development of Secondary Calibration Laboratories for surface contamination
Membership in international and national organisations	• ICRM, BIPM-CGPM, BIPM/CCRI(II), EA, EURAMET, IEC/TC45, ISO/TC85, UNI- CEI (National Standardisation Organisation)	• ICRM, BIPM-CGPM, BIPM/CCRI(II), BIPM/CCRI(III), EA, EURAMET, IEC/TC45, ISO/TC85, UNI-CEI (National Standardisation Organisation)
Management and Organization	 European Projects: MetroDECOM (Impact) Completion of reactivation of measuring systems after laboratory restructuration 	 Submission of new CMCs Upgrading of measuring systems
Teaching activity	Invited lectures	Invited lectures
Quality system	 Management of Quality System Quality System Peer Review, in the frame of EURAMET Project n.1123 	 Improvement of Quality System Development of working standards for influence quantities (temperature, rel. humidity, mass, volume,) Review of Calibration Certificates

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy
NAMES	M. Capogni, P. De Felice, P. Carconi, A. Fazio
APPARATUS	Liquid Scintillation counting systems Gamma-ray spectrometry system Radiochemistry laboratory
ACTIVITY	Participation of the ENEA to the BIPM ESIR for ³ H
RESULTS	Measurements on going
IN PROGRESS	Absolute activity measurements by liquid scintillation counting techniques (TDCR method). Impurity check by analytical procedure and γ -ray spectrometry.
PUBLICATIONS	
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY Tel.: +39 06 3048 6628 Fax: +39 06 3048 4650 E-mail: marco.capogni@enea.it Tel.: +39 06 3048 3580 Fax: +39 06 3048 3558 E-mail: pierino.defelice@enea.it
CONTACT	M. Capogni, P. De Felice

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy
NAMES	M. Capogni, L. Quintieri, A. Fazio, P. De Felice, P. Carconi
APPARATUS	$4\pi\beta$ -γ coincidence system based on TDCR detector in the beta channel Gamma-ray spectrometry system
ACTIVITY	Metrological characterization of a Cu-64 liquid solution obtained by solid raw material activated by 14 MeV neutrons produced by fusion D-T reactions at ENEA FNG facility
RESULTS	Activity in collaboration with other Technical Units of ENEA started
IN PROGRESS	Activity measurements by beta(TDCR)-gamma coincidence method.
	Quantitative energy-spectrum analysis and impurities identification by high-energy resolution γ -ray spectrometry.
PUBLICATIONS	
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY
	Tel.: +39 06 3048 6628 Fax: +39 06 3048 4650 E-mail: <u>marco.capogni@enea.it</u>
	Phone: +39 06 3048 3437 Fax: +39 06 3048 3558 E-mail: <u>lina.quintieri@enea.it</u>
CONTACT	M. Capogni, L. Quintieri

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy
NAMES	M. Capogni, F. Cardellini, P. De Felice, A. Fazio
APPARATUS	4πβ[TDCR-Cherenkov]–γ[NaI(Tl)], Gamma-ray spectrometry.
ACTIVITY	Upgrading of the Rn-222 in water standard by applying the absolute technique of $4\pi\beta$ [TDCR-Cherenkov]– γ [NaI(Tl)] with efficiency extrapolation.
RESULTS	Activity on going
IN PROGRESS	A set of measurements was carried out by 20 mL glass vial filled with radon-in-water. Data were acquired by Desktop CAEN DT5720 Digitizer linked to the TDCR and NaI(Tl) 2''x2'' detectors working in coincidence.
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY Tel.: +39 06 3048 6628 Fax: +39 06 3048 4650 E-mail: marco.capogni@enea.it Tel.: +39 06 3048 3084 Fax: +39 06 3048 4650 E-mail: francesco.cardellini@enea.it
CONTACT	M. Capogni, F. Cardellini

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy
NAMES	M. Capogni, P. De Felice, A. Fazio, P. Carconi
APPARATUS	$4\pi\beta$ (TDCR)– γ , Gamma-ray spectrometry.
ACTIVITY	Development of a new primary standard of Ho-166 and calibration of the ENEA-INMRI secondary standards for activity measurements.
RESULTS	Measurements on-going within the EURAMET.RI(II)-K2.Ho- 166 project.
IN PROGRESS	A glass vial Ho-166 filled, provided by CMI, was measured by the ENEA-INMRI IC IG-11.
PUBLICATION	
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY
	Tel.: +39 06 3048 6628 Fax: +39 06 3048 4650 E-mail: marco.capogni@enea.it Tel.: +39 06 3048 3580 Fax: +39 06 3048 3558 E-mail: pierino.defelice@enea.it
CONTACT	M. Capogni, P. De Felice

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy
NAMES	G. Cotellessa, M. Capogni
APPARATUS	CR-39 solid state nuclear tracks detectors
ACTIVITY	Upgrading on alpha particle detection by CR-39 detectors
RESULTS	Activity in progress.
IN PROGRESS	Automatization of the CR-39 track reading analysis for α -particle detection. Contact with potential end-users for applying the method to the autoradiography technique in hot-spot determination of the tracks of alpha particles emitted by Plutonium.
PUBLICATION	a) A patent for the new analysis technique was recorded by the Italian Ministry of Economic Development.
	b) Zorri, V., Remetti, R., Capogni, M., Cotellessa, G., Falcone, R., 2017. <i>Feasibility study on the application of solid state</i> <i>detectors for fast survey of residual alpha contamination in</i> <i>decommissioning activities</i> . Radiation Measurements 107, 111- 114.
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY
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CONTACT	G. Cotellessa, M. Capogni

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy
NAMES	M. Capogni, M. D'Arienzo
APPARATUS	TDCR counting system and Quantitative Imaging systems for nuclear medicine applications.
ACTIVITY	Application of the TDCR technique to the metrology of high- energy beta emitting radionuclides for activity measurements on site and quantification of the activity by imaging techniques
RESULTS	Y-90 on-site activity determination by the ENEA TDCR portable system (Hidex 300SL and portable TDCR systems). Applications to PET and SPECT systems of interest of Italian scientific Institutions operating in the nuclear medicine field.
IN PROGRESS	Work in progress within the EMRP MetroMRT project
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY
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CONTACT	M. Capogni, M. D'Arienzo

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy	
NAMES	L. Quintieri, M. Capogni, P. De Felice, A. Fazio, F. Cardellini, P. Carconi, A. Petrucci	
APPARATUS	ENEA-INMRI sphere of Manganese bath; $4\pi\beta$ - γ coincidence method.	
ACTIVITY	Developing of the new Mn-56 activity primary standard by $4\pi\beta$ - γ coincidence method and calibration of the manganese bath standard	
RESULTS	Activity in progress	
IN PROGRESS	Preliminary phase of the measurements completed	
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY	
	Tel.: +39 06 3048 3437 Fax: +39 06 3048 3558 E-mail: <u>lina.quintieri@enea.it</u>	
	Tel.: +39 06 3048 6628 Fax: +39 06 3048 4650 E-mail: <u>marco.capogni@enea.it</u>	
	Tel.: +39 06 3048 3580 Fax: +39 06 3048 3558 E-mail: <u>pierino.defelice@enea.it</u>	
CONTACT	L. Quintieri, M. Capogni, P. De Felice	

LABORATORY	ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (INMRI), Italy	
NAMES	M. Capogni, P. De Felice	
APPARATUS	ENEA-INMRI activity primary systems.	
ACTIVITY	Upgrading of the ENEA-INMRI activity primary systems by using digitalization techniques for data acquisition and analysis	
RESULTS	Work in progress within the EMPIR DIGITALSTD_14SIP07 project	
IN PROGRESS	Upgrading in progress	
ADDRESS	ENEA Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti Centro Ricerche Casaccia P.O.Box 2400, Roma ITALY Tel.: +39 06 3048 6628 Fax: +39 06 3048 4650 E-mail: marco.capogni@enea.it Tel.: +39 06 3048 3580 Fax: +39 06 3048 3558 E-mail: pierino.defelice@enea.it	
CONTACT	Marco Capogni, P. De Felice	

National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology (NMIJ/AIST), Japan, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The programme at the NMIJ in the field of radionuclide metrology in the years 2015-2017 was on maintaining and developing the primary and secondary national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

The NMIJ staff in 2017 were:

Scientists	Function	
Akira Yunoki	Calibrations of activity by using the following apparatus;	
Yasushi Sato	$4\pi\beta$ -γ coincidence counter, $4\pi\gamma$ ionisation chamber, HP-Ge,	
Yasuhiro Unno	S1 detectors, Liquid scintillation counter, IDCR, Nal(11) well-type counter, 2π multi-wire proportional counter,	
Rio Furukawa	Length-compensated internal gas counting system.	
Technicians		
Aki Naganuma	Secondary activity standards	

The main specific activities carried out at NMIJ in this field are summarised below.

Activity line	NMIJ Radionuclide Metrology 2016-2017 Progress report	NMIJ Radionuclide Metrology 2018-2019
Development of primary standards, Improvement of measuring methods and instrumentation	 Launched a calibration service of surface emission rate of large area source whose size was 10 cm * 15 cm. Launched a calibration service of activity measurement of ²²³Ra solution. 	 Work plan Continue to develop a proportional counter for the primary standard of ²²²Rn. Continue to develop a reference material of ¹³⁴Cs and ¹³⁷Cs in wheat flour.
International comparisons	• Prepared samples for CCRI(II)-S13.	 CCRI(II)-S13. CCRI(II) (Xe-133), SIRTI (F-18)
Standardization of measurement methods	•	•
National QA programmes and services	 Calibrated emission rate of large area source of Cl-36 for assessment of calibration institutes. Organised a proficiency test of activity measurement of ¹³⁴Cs and ¹³⁷Cs in rice grain. 	• Calibrate standard instruments of registered calibration institutes in Japan.
Membership in international and national organisations	 ICRM committee membership BIPM/CCRI(II) IEC/TC45 	 ICRM committee membership BIPM/CCRI(II) IEC/TC45
Management and Organisation		•

Activity line	NMIJ Radionuclide Metrology 2016-2017 Progress report	NMIJ Radionuclide Metrology 2018-2019 Work plan
Teaching activity	• Introduction of activity measurement and uncertainty evaluation to personnel of Fukushima prefecture.	• Introduction of activity measurement and uncertainty evaluation to personnel of Fukushima prefecture.
Quality system	Maintain.	• Peer review.

LABORATORY	National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology (NMIJ/AIST), Japan
NAMES	Akira YUNOKI, Yasushi SATO, Yasuhiro UNNO, Rio FURUKAWA and Aki NAGANUMA
ACTIVITY	Calibrations of activity by using the following apparatus; $4\pi\beta$ - γ coincidence counter, $4\pi\gamma$ ionisation chamber, HP-Ge and Si detectors, Liquid scintillation counter, TDCR, NaI(Tl) well-type counter, 2π multi-wire proportional counter, Length-compensated internal gas counting system.
KEYWORDS	Alpha spectrometry, beta spectrometry, coincidence method, data evaluation, data measurement, defined solid angle measurement, gamma-ray spectrometry, gas proportional counter, ionisation chamber, liquid scintillation, low-level, NaI(Tl) well-type counter, neutron measurement, radioactive gas, simulation code, SIR, source preparation, traceability, X-ray spectrometry.
RESULTS	NMIJ launched calibration service of surface emission rate of large area source whose size was 10 cm * 15 cm.
PUBLICATIONS	Y. Sato, "Establishment of the Primary Activity Standard of 223Ra in Japan", RADIOISOTOPES (in Japanese), Vol 66, No. 7.
	Y. Unno, T. Sanami, S. Sasaki, M. Hagiwara, A. Yunoki, "Evaluation of absolute measurement using a 4π plastic scintillator for the $4\pi\beta-\gamma$ coincidence counting method",
	http://dx.doi.org/10.1016/j.apradiso.2017.10.029.
IN PROGRESS	NMIJ is developing a proportional counter for standardization of ²²² Rn.
	NMIJ is improving its TDCR system to achieve smaller uncertainties.
INFORMATION	
SOURCE IN PREPARATION	Reference material of wheat flour containing ¹³⁴ Cs and ¹³⁷ Cs for CCRI(II) supplementary comparison (CCRI(II)-S13).
OTHER RELATED PUBLICATIONS	R. Furukawa, Y. Unno, T. Miura, A. Yunoki, M. Hachinohe, S. Hamamatsu, H. Itadzu, M. Mizui, "Proficiency testing with uncertainty evaluation for measuring activities per unit mass of ¹³⁴ Cs and ¹³⁷ Cs in brown rice in Japan", Applied Radiation and Isotopes 126 (2017) 249–251.
	Y. Unno, R. Furukawa, A. Yunoki, "Simulation of a well-type HPGe detector for samples both in the hole and on top of the endcap", Applied Radiation and Isotopes 126 (2017) 154–157.
ADDRESS	Radioactivity and Neutron Standards Group, Research Institute for Measurement and Analytical Instrumentation, National Metrology Institute of Japan, Central2, 1-1-1 Umezono Tsukuba, Ibaraki 305-8568, JAPAN
	E-mail: <u>a.yunoki@aist.go.jp</u>
CONTACT	Akira Yunoki

National Centre for Nuclear Research Radioisotope Centre (POLATOM), Poland, SA1/SA2 Laboratory of Radioactivity Standards 2016-2019 Progress Report and Work Plan (information for ICRM members)

The programme at the Laboratory of Radioactivity Standards RC POLATOM in the field of radionuclide metrology in the years 2016-2017 was focused on maintaining and developing the national standard for activity measurements and on the more general activities in the field of standardization and quality assurance in radioactivity measurements.

Scientists	Function
T. Dziel	Laboratory Manager, primary and secondary standards
A. Listkowska	Quality Manager, source preparation and radiochemistry
R. Broda	primary radionuclides activity standards
D. Cacko	electronics specialist
A. Jęczmieniowski	electronics specialist
E. Lech	source preparation and radiochemistry
M. Nowicka	source preparation and radiochemistry
P. Saganowski	secondary radionuclide activity standards
Z. Tymiński	secondary radionuclide activity standards
T. Ziemek	primary radionuclides activity standards
Technicians	
E. Kołakowska	secondary radionuclide activity standards

The Laboratory of Radioactivity Standards RC POLATOM staff in 2017 were:

The main specific activities carried out at RC POLATOM in this field are summarized below.

Activity line	RC POLATOM	RC POLATOM
	Radionuclide Metrology 2016-2017 Progress report	Radionuclide Metrology 2018-2019 Work plan
Improvement of measuring methods and instrumentation	• Development of a proposal for the extension of the International Reference System to beta emitters (ESIR) organization	• New measuring systems with ionization chambers (stationery and portable) as secondary standards for radionuclides used in nuclear medicine.
	 Development of the proposal of the ESIR³H exercise as a test of the ESIR system. Comparative studies of the scintillator and measuring system influence on quenching curves in LSC. Characterization of new HPGe detector with MC method 	 Modernization of equipment based on modular electronics. Comparative studies of the RC POLATOM and PTB coincidence modules. Exchange of experiences concerning data analysis and models. Joint projects and comparisons Ionization quenching model in the LS- counter efficiency calculation.
International comparisons	• SIRTI: ¹⁸ F, ⁶⁴ Cu, ^{99m} Tc	 BIPM: ³H SIR: radionuclides to be specified ENEA-INMRI, VNIIM: ⁵⁵Fe

Activity line	RC POLATOM	RC POLATOM
	Radionuclide Metrology 2016-2017 Progress report	Radionuclide Metrology 2018-2019 Work plan
Standardization of measurement methods	5	
National QA programs and services	• Preparation of radioactive standards (solutions, point sources, volume sources) for external users.	• Preparation of radioactive standards (solutions, point sources, volume sources) for external users.
	• Calibration of dose (radionuclide) calibrators.	• Calibration of dose (radionuclide) calibrators.
	• Organization of proficiency tests for measurements of emission rate from surface sources.	• Organization of proficiency tests for activity measurements of diagnostic and therapeutic radionuclides in nuclear medicine departments in Polish hospitals.
		• Organization of proficiency tests for measurements of emission rate from surface sources.
Membership in international and national organizations	• ICRM, BIPM/CCRI(II), EURAMET, Polish Physical Society, Committee for Metrology and Scientific Instrumentation of the Polish Academy of Science, Scientific Council of the National Centre for Nuclear Research, Metrology Council of the Central Office of Measures	• ICRM, BIPM/CCRI(II), EURAMET, Polish Physical Society, Committee for Metrology and Scientific Instrumentation of the Polish Academy of Science, Scientific Council of the National Centre for Nuclear Research, Metrology Council of the Central Office of Measures
International cooperation	• Scientific visits related to construction of new absolute measurements systems and development of new primary standards.	• Scientific visit at SMU (Slovakia) related to construction of a new TDCRG measuring system.
		• Scientific visit at PTB (Germany) related to LSC and systematic comparison of coincidence modules
		• Improvement of the collaboration between RC POLATOM and PTB in the field of radionuclide metrology.
		• Scientific cooperation with VNIIM (Russia) and ENEA-INMRI (Italy).
		• Participation in EMPIR projects.
Teaching activity	• Lectures on quality assurance in activity measurements of radiopharmaceuticals.	• Lectures on quality assurance in activity measurements of radiopharmaceuticals.
	• Training course for dose (radionuclide) calibrators' users.	• Training course for dose (radionuclide) calibrators' users.
Quality system	• Maintaining of Quality Management System according to ISO 17025:2005.	• Improvement of Quality Management System according to ISO 17025:2005.
	• Audits from Polish Centre for Accreditation (2016 and 2017)	• Audits from Polish Centre for Accreditation (2018 and 2019).

LABORATORY	National Centre for Nuclear Research Radioisotope Centre (POLATOM), Poland
NAMES	Ryszard Broda, Daniel Cacko, Tomasz Dziel, Adam Jęczmieniowski, Ewa Kołakowska, Edyta Lech, Anna Listkowska, Marlena Nowicka, Paweł Saganowski, Zbigniew Tymiński, Tomasz Ziemek
ACTIVITY	 Ryszard Broda, Daniel Cacko, Tomasz Dzlei, Adam Jęczmenłowski, Ewa Kołakowska, Edyta Lech, Anna Listkowska, Marlena Nowicka, Paweł Saganowski, Zbigniew Tymiński, Tomasz Ziemek Maintaining of the National Standard of Radionuclides Activity in Poland. Maintaining and improving of management system according to ISO 17025. Services for domestic and international customers: Calibration/production of standard solutions and sources Calibration/production of standard solutions and sources Calibration of dose calibrators Participation in conferences and scientific meetings: Meeting of the ICRM Liquid Scintillation Counting Working Group, Rome, Italy, 07-08.11.2016 R. Broda, T. Ziemek, A. Listkowska. Values of the ionization quenching parameter kB used in the LSC technique T. Ziemek, A. Jęczmieniowski, R. Broda, A. Listkowska, E. Lech. Current status of the TDCR system with gamma detector and the FPGA digital board at POLATOM VII Congress of Metrology, Lublin - Nałęczów, Poland, 28.06-01.07.2016 R. Broda, T. Dziel, A. Listkowska, T. Ziemek. Realisation of radionuclides activity unit using the liquid scintillation counting (LSC) VII National Conference for Radiochemistry and Nuclear Chemistry, Lublin, Poland, 20.04. 2016 Z. Tymiński, T. Dziel, A. Listkowska, R. Broda, E. Kołakowska, P. Saganowski, E. Lech, D. Cacko, A. Jęczmieniowski, T. Ziemek, M. Nowicka, J. Wojnarowicz, R. Sosnowiec, K. Tymińska. Standards with non-conventional geometries for radionuclides activity measurements in the defention of the defention of the defention of radionuclides activity measurements
	 CCRI(II) Key Comparison Working Group meeting, Sèvres, France, 20-21.11.2017 R. Broda, G. Ratel, T. Ziemek. An analysis of the ESIR exercise performed at BIPM. A tentative proposal for the ESIR system organization. ICRM-2017, International Conference on Radionuclide Metrology, Buenos Aires, Argentina, 05-15-18.05.2017 T. Ziemek, M. Capogni, G. Ratel, R. Broda, T. Dziel, A. Fazio, A. Listkowska. Comparison of I-131 activity measurements at the NCBJ RC POLATOM and the ENEA-INMRI linked to the BIPM SIR system Z. Tymiński, P. Saganowski, E. Kołakowska, A. Listkowska, T. Ziemek, E. Lech, D. Cacko, A. Jęczmieniowski, R. Broda, T. Dziel. Impurities in Tc-99m radiopharmaceutical solution obtained from Mo-100 in cyclotron A. Listkowska, E. Lech, P. Saganowski, Z. Tymiński, D. Cacko, T. Ziemek, E. Kołakowska, R. Broda, A. Jęczmieniowski, T. Dziel. The method of production and quality control of volume multigamma sources with different matrices International Conference on Advances in Liquid Scintillation Spectrometry, Copenhagen, Denmark, 01-05.05.2017 T. Ziemek, M. Capogni, R. Broda, P. De Felice, T. Dziel, A. Listkowska. Bilateral comparison of C-14 activity measurements at the NCBL RC POL ATOM and the ENFA-INMRI

	 T. Ziemek, A. Jęczmieniowski, R. Broda, E. Lech, A. Listkowska. An influence of the TDCR system settings on the radionuclides standardization 	
	 CCRI(II) Key Comparison Working Group meeting, Sèvres, France, 21- 22.11.2017 	
	- R. Broda , G. Ratel, T. Ziemek . An analysis of the ESIR exercise	
	 performed at BIPM R. Broda, T. Ziemek. A tentative proposal for the ESIR system 	
	organization	
	Participation in international projects:	
	• BIPM SIRTI – international comparison of activity measurements of the ¹⁸ F (BIPM.RI(II)- K4.F-18), ⁶⁴ Cu (BIPM.RI(II)- K4.Cu-64) and ^{99m} Tc solution (BIPM.RI(II)- K4.Tc-99m).	
	Agreement No. DE/34/2017 between NCBJ RC POLATOM (Poland) and	
	SMU (Slovakia): "Construction of the new TDCRG measuring system for SMU"	
KEYWORDS	alpha spectrometry, beta spectrometry, (anti) coincidence method, TDCR	
	method, EURAMET, gamma-ray spectrometry, ionisation chamber, liquid	
	scintillation, NaI well-type counter, proportional counter, radiochemistry,	
	simulation code, SIR, source preparation, traceability, A-ray spectrometry	
RESULTS	• Finished validation of a new $4\pi(LS)$ - γ coincidence and anticoincidence	
	system (1DKG) with a 1DCR detector in LS-channel and NaI(11) – in γ - channel with a FPGA-based digital platform	
	 Development of new types of volume sources with different matrices. 	
PUBLICATIONS	 Broda R., Dziel T., Listkowska A., Ziemek T., Realisation of 	
	radionuclides activity unit using the liquid scintillation counting (LSC). <i>Informatyka, Automatyka, Pomiary w gospodarce i ochronie środowiska</i> , 3, (2016) 28-31.	
	• Dziel T., Listkowska A., Tymiński Z. Standardisation and half-life measurements of ¹¹¹ In Appl. Radiat. Isot. 109 (2016) 345-348	
	Driel T. Tymiński Z. Scheryk V. Walacka Marur A. Badionyalidia	
	\bullet DZIEL I., EVITIIISKI Z., SODCZYK N., WATECKA-IVIAZUL A. KAUTOHUCHUIC	
	• Dzier T., Tymnski Z., Sobczyk K., Walecka-Mazur A. Kadionuchuc purity tests in ¹⁸ F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346.	
	 Dziel T., Tyliniski Z., Sobczyk K., Walęcka-Mazul A. Kadiohuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres 	
	 Dziel T., Tymnski Z., Sobczyk K., Walęcka-Mazul A. Kadiohuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for 	
	 Dziel T., Tymnski Z., Sobczyk K., Walęcka-Mazur A. Kadiohuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629–635 	
	 Dziel T., Tymniski Z., Sobczyk K., Walęcka-Mazur A. Kadionuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629–635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., 	
	 Dziel T., Tymniski Z., Sobczyk K., Walęcka-Mazul A. Kadiohuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629– 635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną 	
	 Dziel T., Tymniski Z., Sobczyk K., Walęcka-Mazul A. Kadiondelidic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629–635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. 	
	 Dziel T., Tymniski Z., Sobczyk K., Walęcka-Mazul A. Kadiohuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629– 635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A. Farrowy L. Corrán Torrão F., Javornik A. Klamola S., Luca a, Mosor 	
	 Dziel T., Tymniski Z., Sobczyk K., Walęcka-Mazul A. Kadiohuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629– 635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A., Ferreux L., García-Toraño E., Javornik A., Klemola S., Luca a., Moser H., Nečemer M., Pevrés V., Reis M., Silva L., Šolc J., Svec A., Tymiński 	
	 Dziel T., Tymniski Z., Sobczyk K., Walęcka-Mazul A. Kadiohuchdic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629– 635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A., Ferreux L., García-Toraño E., Javornik A., Klemola S., Luca a., Moser H., Nečemer M., Peyrés V., Reis M., Silva L., Šolc J., Svec A., Tymiński Z., Vodenik B., Wätjen U. ⁶⁰Co in cast steel matrix: A European 	
	 Dziel T., Tymniski Z., Sobczyk K., Walęcka-Mazul A. Radiohuendic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629–635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A., Ferreux L., García-Toraño E., Javornik A., Klemola S., Luca a., Moser H., Nečemer M., Peyrés V., Reis M., Silva L., Šolc J., Svec A., Tymiński Z., Vodenik B., Wätjen U. ⁶⁰Co in cast steel matrix: A European interlaboratory comparison for the characterization of new activity 	
	 Dziel T., Tyminski Z., Sobczyk K., Wałęcka-Mazul A. Kadiolidendic purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Lada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629– 635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A., Ferreux L., García-Toraño E., Javornik A., Klemola S., Luca a., Moser H., Nečemer M., Peyrés V., Reis M., Silva L., Šolc J., Svec A., Tymiński Z., Vodenik B., Wätjen U. ⁶⁰Co in cast steel matrix: A European interlaboratory comparison for the characterization of new activity standards for calibration of gamma-ray spectrometers in metallurgy. <i>Appl.</i> <i>Padiat. Isot.</i> 114, (2016) 167, 172 	
	 Dziel T., Tyminski Z., Sobczyk K., Walęcka-Mazur A. Kathohuchule purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629–635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A., Ferreux L., García-Toraño E., Javornik A., Klemola S., Luca a., Moser H., Nečemer M., Peyrés V., Reis M., Silva L., Šolc J., Svec A., Tymiński Z., Vodenik B., Wätjen U. ⁶⁰Co in cast steel matrix: A European interlaboratory comparison for the characterization of new activity standards for calibration of gamma-ray spectrometers in metallurgy. <i>Appl. Radiat. Isot</i>, 114, (2016) 167-172. Tzika F., Hult M., Stroh H., Marissens G. Arnold D. Burda O. Suran J. 	
	 Dziel T., Tyminski Z., Sobczyk K., Walęcka-Mazur A. Kadionuchule purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629–635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A., Ferreux L., García-Toraño E., Javornik A., Klemola S., Luca a., Moser H., Nečemer M., Peyrés V., Reis M., Silva L., Šolc J., Svec A., Tymiński Z., Vodenik B., Wätjen U. ⁶⁰Co in cast steel matrix: A European interlaboratory comparison for the characterization of new activity standards for calibration of gamma-ray spectrometers in metallurgy. <i>Appl. Radiat. Isot</i>, 114, (2016) 167-172. Tzika F., Hult M., Stroh H., Marissens G., Arnold D., Burda O., Suran J., Listkowska A., Tymiński Z. A new large-volume metal reference standard 	
	 Dziel T., Tyminski Z., Sobczyk K., Wałęcka-Mazur A. Kadobuchule purity tests in ¹⁸F radiopharmaceuticals production. <i>Appl. Radiat. Isot.</i> 109, (2016) 342-346. Łada W., Iller E., Wawszczak D., Konior M., Dziel T. ⁹⁰Y microspheres prepared by sol-gel method, promising medical material for radioembolization of liver malignancies. <i>Mat. Sci. Eng.</i> C, 67, (2016) 629– 635 Tymiński Z., Dziel T., Saganowski P., Kołakowska E., Listkowska A., Tymińska K., Żołądek P., Olech A. Pomiary ⁶⁰Co w obiektach z żelazną matrycą. <i>Acta Soc. Metheor. Polon.</i> 7, (2016) 144-150. Tzika F., Burda O., Hult M., Arnold D., Caro Marroyo B., Dryák P., Fazio A., Ferreux L., García-Toraño E., Javornik A., Klemola S., Luca a., Moser H., Nečemer M., Peyrés V., Reis M., Silva L., Šolc J., Svec A., Tymiński Z., Vodenik B., Wätjen U. ⁶⁰Co in cast steel matrix: A European interlaboratory comparison for the characterization of new activity standards for calibration of gamma-ray spectrometers in metallurgy. <i>Appl. Radiat. Isot</i>, 114, (2016) 167-172. Tzika F., Hult M., Stroh H., Marissens G., Arnold D., Burda O., Suran J., Listkowska A., Tymiński Z. A new large-volume metal reference standard for radioactive waste measurement. <i>Radiat. Protect. Dosim</i>, Vol. 168, No. 	

	 Ziemek T., Jęczmieniowski A., Cacko D., Broda R., Lech E. A new 4π(LS)-γ coincidence counter at NCBJ RC POLATOM with TDCR detector in the beta channel. <i>Appl. Radiat. Isot</i>, 109, (2016) 290-295. T. Ziemek, M. Capogni, R. Broda, P. De Felice, T. Dziel, A. Jęczmieniowski, E. Lech, A. Listkowska, Z. Tyminski. Bilateral comparison of C-14 activity measurements at the NCBJ RC POLATOM and the ENEA-INMRI. <i>J. Radioanal. Nucl. Chem.</i> 314 (2017) 721-725 T. Ziemek, M. Capogni, G. Ratel, R. Broda, T. Dziel, A. Fazio, A. Listkowska. Comparison of I-131 activity measurements at the NCBJ RC POLATOM and the ENEA-INMRI linked to the BIPM SIR system. <i>Appl. Radiat. Isot.</i>, 134, (2018) 380-384 A. Listkowska, E. Lech, P. Saganowski, Z. Tymiński, T. Dziel, D. Cacko, T. Ziemek, E. Kołakowska, R. Broda. Preparation method and quality control of multigamma volume sources with different matrices. <i>Appl. Radiat. Isot.</i>, 134, (2018) 126-130 Z. Tymiński, P. Saganowski, E. Kołakowska, A. Listkowska, T. Ziemek, E. Lech, D. Cacko, A. Jęczmieniowski, R. Broda, T. Dziel. Impurities in Tc-99m radiopharmaceutical solution obtained from Mo-100 in cyclotron. <i>Appl. Radiat. Isot.</i>, 134, (2018) 85-88 J.T. Cessna,, T. Dziel, A. Listkowska, Z. Tymiński, et al. Results of an International Comparison of Activity Measurements of ⁶⁸Ge. <i>Appl. Radiat. Isot.</i>, 134, (2018) 385-390 M. Wiśniewski, T. Tymiński,, et al. Results of the CCRI(II)-S12.H-3 supplementary comparison: Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated water source measured using the LSC-TDCR method <i>Annl Radiat Isot.</i> 134 (2018) 257-262
IN PROGRESS	 Comparative studies of the RC POLATOM and PTB coincidence modules.
	 Ionization quenching model in the LS-counter efficiency calculation.
INFORMATION	 4π(LS)-γ coincidence and anticoincidence system 4π(LS)-γ coincidence system (TDCRG) with TDCR detector in beta channel TDCR system X-γ coincidence system multiwire windowless proportional counter Wallac 1411 liquid scintillation counter Tri-Carb 2910 TR liquid scintillation counter X- and γ-ray spectrometry systems with HPGe detectors ionization chamber systems Capintec CRC-15β dose calibrator MAD2000 dose rate meter scintillation counters with NaI(TI) detectors
ADDRESS	National Centre for Nuclear Research Radioisotope Centre POLATOM Andrzeja Soltana 7 05-400 Otwock Poland Tel.: +48 22 273 1940 FAX: +48 22 718 0350 E-mail: tomasz.dziel@polatom.pl
CONTACT	Tomasz Dziel

IFIN-HH, Radionuclide Metrology Laboratory, Romania, SA1/SA2 2016-2019 Progress Report and Work Plan

(information for ICRM members)

The programme at the IFIN-HH, RML in the field of radionuclide metrology in the years 2016-2017 was on maintaining and developing the primary and secondary national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

The IFIN-HH, Radionuclide Metrology Laboratory staff in 2017 were:

Scientists	Function
Aurelian Luca, PhD	RML Head: Primary and secondary activity standards; Radon; Gamma spectrometry; Nuclear decay data.
Andrei Antohe, PhD	RML Deputy Head. Primary (LSC) and secondary standards; sources preparation
Mihail-Razvan Ioan, PhD	Primary (Coincidence) and Secondary activity standards;
	Alpha and Gamma spectrometry
Constantin Ivan, PhD	Primary (Electronics) activity standards
Doru Stanga, PhD*	Primary (Large area) and secondary activity standards
Maria Sahagia, PhD**	Primary and secondary activity standards; Radon standards
Technicians	
Constantin Teodorescu	Source preparation/radiochemistry; Radon standards

*) Member of the Reactor Decommissioning Department (DDR)

**) Retired, part time employee

The main specific activities carried out at IFIN-HH, Radionuclide Metrology Laboratory in this field are summarised below.

Activity line	IFIN-HH, Radionuclide	IFIN-HH, Radionuclide
	Metrology Laboratory 2016-2017 Progress report	Metrology Laboratory 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Development of new primary standards: ⁶⁷Cu Evaluation of nuclear decay data for radionuclides: ^{52,52m}Mn and ²³⁰U Developments of the Radon chamber: finalization of construction, adjusting Start of the: EURAMET EMPIR 16ENV10 <i>MetroRADON</i> project 	 Development of new primary standards: ²²³Ra (with LNE-LNHB); ⁸⁹Zr, within the project C5-09/2016 Evaluation of nuclear decay data for radionuclides: ²³⁰U and ²²⁶Th, ²²³Ra Development of the Radon chamber: calibration and validation European Projects: 16ENV10 MetroRADON: WP1, WP5, WP6
International comparisons	• CCRI(II)-S12.H-3 supplementary comparison: Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated-water source measured using the LSC-TDCR method	 CCRI(II)-S13 Cs-134 and Cs-137 in wheat flour (organizer NMIJ-AIST, Japan) EURAMET (Rn-222, low activity; radon chamber calibration) within the MetroRADON project

Activity line	IFIN-HH Radionuclide	IFIN-HH Radionuclide
	Metrology Laboratory 2016-2017	Metrology Laboratory 2018-2019
	Progress report	Work plan
Standardization of measurement methods	 Organisation of Proficiency Tests: H-3 standard solutions distributed to IFIN-HH laboratories measuring tritium samples by LSC Construction of a new optical chamber for the LSC-TDCR system 	 Construction of a new 4π(LSC)- γ coincidence system, using the new optical chamber, three Burle PMs and a NaI(Tl) crystal Finalization of an alpha spectrometry system
National QA programmes and services	 Preparation of radioactive standards (liquid solutions, point, surface and volume sources) Calibration of radioactive sources Calibration of activity measurement installations, like: gross alpha-beta activity counters, liquid scintillation counters, gamma-ray spectrometers [HPGe and NaI(Tl)], radionuclide calibrators 	 Preparation of radioactive standards (liquid solutions, point, surface and volume sources) Calibration of radioactive sources Calibration of activity measurement installations, like: gross alpha-beta activity counters, liquid scintillation counters, gamma-ray spectrometers [HPGe and NaI(Tl)], radionuclide calibrators
Membership in	• ICRM committee membership, reviewer	ICRM committee membership
international	for papers at ICRM2017 Conference	• BIPM/CCRI(II) member.
and national	• BIPM/CCRI(II) member, report	
organisations	presented in 2017	
Management	International Projects:	International Projects:
and Organisation	 Bilateral IFA (Romania) - CEA (France) accord, 2015–2020, contract C5-09/2016. IAEA Research Contract 17442/2012 (2012-2017) EURAMET-EMPIR: Energy and Environment.: 16ENV10, Metrology for radon monitoring, 2017-2020 	 EURAMET-EMPIR: Energy and Environment.: 16ENV10, Metrology for radon monitoring, 2017-2020 Bilateral IFA (Romania) - CEA (France) accord, 2015–2020, contract C5-09/2016 (2016 – 2019). EURAMET-EMPIR, Metrology for Health. PRTMetroHiLET: Metrology for high linear energy transfer radiation delivery in molecular radiotherapy. 2018 Health call
Activity line	IFIN-HH, Radionuclide	IFIN-HH, Radionuclide
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	Metrology Laboratory 2016-2017	Metrology Laboratory 2018-2019
	Progress report	Work plan
Teaching activity	 2 PhD theses : Done Laurentiu on γ-ray spectrometry, presented at the Bucharest University Tuca Carmen on Activity and Dose measurement and evaluation in the decommissioning of the Nuclear Reactor of IFIN-HH, presented at the Bucharest University 2 PhD students supervision Lectures for specialists in nuclear techniques applications - Centre for Specialization in Nuclear Field (CPSDN), IFIN-HH A lecture at the National Workshop on Nuclear Security Measures for Major Public Events, 10-13 July 2017, Bucharest, Romania (with participation of IAEA and DoE, USA) 	 1 PhD thesis (Vocheci Florin) on γ-ray spectrometry applied in detection of radioactive dispersing devices (RDD), to be presented at the Bucharest University 1 PhD student supervision, in cooperation at the Polytechnical University of Bucharest Lectures for specialists in nuclear techniques applications- Centre for Specialization in Nuclear Field (CPSDN), IFIN-HH A lecture for young specialists in the European ELI network (Romania, Hungary, Czech Republic)
Quality system	Reaccreditation of the RML by the RENAR, Romanian accreditation body	• Annual survey for maintaining of the accreditation

LABORATORY	IFIN-HH, Radionuclide Metrology Laboratory, Romania	
NAMES	Aurelian Luca, Mihail-Razvan Ioan	
ACTIVITY	Nuclear decay data evaluation	
KEYWORDS	Data evaluation, data measurement, radionuclides: ${}^{52}Fe$, ${}^{52}Mn$, ${}^{52m}Mn$, ${}^{230}U$, ${}^{226}Th$, ${}^{223}Ra$, ${}^{177}Lu$, ${}^{186}Re$, ${}^{124}I$	
RESULTS	Participation in the IAEA CRP F41029: Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production (2012-2017): nuclear decay data evaluations of ⁵² Fe, ⁵² Mn, ^{52m} Mn, ²³⁰ U, ²²⁶ Th;	
	Determination of nuclear decay data for ¹⁷⁷ Lu, ¹⁸⁶ Re, ¹²⁴ I.	
PUBLICATIONS	Decay Data Evaluation Project: Evaluation of ⁵² Fe nuclear decay data. A. Luca, Appl. Radiat. Isot. 109 (2016) 169-171;	
	<i>Experimental determination of some nuclear decay data in the decays of Lu- 177, Re-186 and I-124.</i> A. Luca, M. Sahagia, MR. Ioan, A. Antohe, B.L. Savu, Appl. Radiat. Isot. 109 (2016) 145-150;	
	<i>Decay Data Evaluation Project: Evaluation of</i> ⁵² <i>Mn and</i> ^{52m} <i>Mn nuclear decay data.</i> A. Luca, EPJ Web of Conferences 146 (2017) 08003.	
IN PROGRESS	DDEP evaluations of ²³⁰ U, ²²⁶ Th and participation to the joint research project IFA Romania – CEA France no. C5-09/2016: Metrology research for the standardization of some pharmaceutical and public health interest radionuclides, to ensure radioprotection in hospitals, homes and working places (evaluation of ²²³ Ra)	
INFORMATION		
SOURCE IN PREPARATION	 ²³⁰U nuclear decay data evaluation. A. Luca, MR. Ioan, Appl. Radiat. Isot. 134 (2018) 426-428 	
OTHER RELATED PUBLICATIONS	Monographie BIPM-5: Table of Radionuclides (Vol. 8 – A = 41 to 198), M M. Bé et al., edited by BIPM, France, 2016, ISBN-13 978-92-822-2264-5	
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	Tel.: +4021 4046163 FAX: +4021 4574440 or +4021 4574945 E-mail: <u>aluca@nipne.ro</u>	
CONTACT	Aurelian Luca	

LABORATORY	IFIN-HH, Radionuclide Metrology Laboratory, Romania	
NAMES	Aurelian Luca, Mihail-Razvan Ioan, Andrei Antohe, Doru Stanga, Simona Ilie	
ACTIVITY	 -Measurements of activity for ⁶⁷Cu. -Repairment, testing and calibration of the HPGe detector. -Radioactivity analysis for various samples. -SR EN ISO/CEI 17025:2005 RENAR Accreditation, Certificate: LI 804/2017 	
KEYWORDS	Data measurement, gamma-ray spectrometry, ¹⁷⁷ Lu, ¹⁸⁶ Re, ¹²⁴ I, ⁶⁷ Cu	
RESULTS	Determination of nuclear decay data for ¹⁷⁷ Lu, ¹⁸⁶ Re, ¹²⁴ I;	
	Participation to the ICRM Low-level Measurement Techniques Working Group exercise on analysis of gamma-ray spectra with poor counting statistics (2016) and the IAEA exercise ConvEx-3 (2017)	
PUBLICATIONS	Experimental determination of some nuclear decay data in the decays of Lu- 177, Re-186 and I-124. A. Luca, M. Sahagia, MR. Ioan, A. Antohe, B.L. Savu, Appl. Radiat. Isot. 109 (2016) 145-150;	
	Uncertainty Assessment in the Free Release Measurement by Gamma Spectrometry of Rotating Waste Drums. D. Stanga, O. Sima, D. Gurau, Appl. Radiat. Isot. 109 (2016) 526-531	
IN PROGRESS	Measurements of ⁸⁹ Zr and ²²³ Ra (in cooperation with CEA/LNE-LNHB)	
	Participation to the comparison CCRI(II)-S13 and the ICRM GSWG exercises	
INFORMATION	http://www.nipne.ro/facilities/laboratories/lmri.php	
SOURCE IN PREPARATION	Systematic influences on the areas of peaks in gamma-ray spectra that have a large statistical uncertainty. M. Bruggeman et al., Appl. Radiat. Isot. 134 (2018) 51-55;	
	Determination of the neutron activation profile of core drill samples by gamma- ray spectrometry. D. Gurau, S. Boden, O. Sima, D. Stanga, Appl. Radiat. Isot. 134 (2018) 194-199;	
	Standardization of ⁶⁷ Cu and calibration of the ionization chamber. Impurities and decay scheme problems. M. Sahagia, A. Luca, MR. Ioan, A. Antohe, C. Ivan, Appl. Radiat. Isot. 134 (2018) 297-301	
OTHER RELATED PUBLICATIONS	⁶⁰ Co in Cast Steel Matrix: a European Interlaboratory Comparison for the Characterisation of New Activity Standards for Calibration of Gamma-ray Spectrometers in Metallurgy, F. Tzika et al., Appl. Rad. Isot. 114 (2016) 167-172	
ADDRESS	IFIN-HH, PO Box MG-6, RO-077125 30 Reactorului Str., Magurele, Jud. Ilfov, Romania	
	Tel.: +4021 4046163 FAX: +4021 4574440 or +4021 4574945 E-mail: <u>aluca@nipne.ro</u>	
CONTACT	Aurelian Luca	

LABORATORY	IFIN-HH, Radionuclide Metrology Laboratory, Romania	
NAMES	A. Antohe, M. Sahagia, C. Ivan, MR. Ioan, Ph. Cassette	
ACTIVITY	Measurement of ³ H, ¹⁴ C and ²⁴¹ Am	
KEYWORDS	Liquid scintillation, ³ H, ¹⁴ C, ²⁴¹ Am	
RESULTS	- Pilot laboratory in the frame of a interlaboratory comparison from IFIN-HH, regarding the determination of the activity of tritiated – water using different types of commercial LS counters.	
	- Implementing a new optical chamber, custom made.	
	- Measurements of ³ H, ¹⁴ C and ²⁴¹ Am standard sources	
	- Calibration of commercial LS Counters	
	- SR EN ISO/CEI 17025:2005 RENAR Accreditation, Certificate: LE 013/2017	
PUBLICATIONS	Measurement of liquid scintillation sources of Pb-210 obtained from Rn-222 decay. A. Antohe, M. Sahagia, A. Luca, MR. Ioan, C. Ivan, Appl. Radiat. Isot. 109 (2016) 286-289	
IN PROGRESS	Interlaboratory comparison of methods for the determination of the activity of tritiated – water, paper for publication, Andrei Antohe, Mihail-Razvan Ioan, Maria Sahagia, Aurelian Luca	
INFORMATION		
SOURCE IN PREPARATION	Philippe Cassette et al., <i>Comparison of methods for the calculation of the activity</i> <i>and standard uncertainty of a tritiated-water source measured using the LSC-</i> <i>TDCR method (CCRI(II)-S12)</i> , Applied Radiation and Isotopes, vol. 134 (2018) 257-262; A Antobe M Sahagia Ph Cassette A Luca M-R Joan	
	A. Antone, M. Sanagia, Th. Cassette, A. Luca, MK. Ioan	
	<i>international comparisons</i> , paper sent to be published in Romanian Reports in Physics	
OTHER RELATED PUBLICATIONS		
ADDRESS	IFIN-HH, PO Box MG-6, RO-077125 30 Reactorului Str., Magurele, Jud. Ilfov, Romania	
	Tel.: +4021 4046163 FAX: +4021 4574440 or +4021 4574432 E-mail: <u>antohe@nipne.ro</u>	
CONTACT	Andrei Antohe, Maria Sahagia, Constantin Ivan	

LABORATORY	IFIN-HH, Radionuclide Metrology Laboratory, Romania	
NAMES	M. Sahagia, M.R. Ioan, A. Antohe, A. Luca	
ACTIVITY	- Reaccreditation of the method by RENAR (Romanian Accreditation Association- National Accreditation Body), according to ISO 17025 Standard, Certificate LE 013 / 2017.	
	- Calibration of radioiosotope calibrators of end users with ¹³¹ I, ^{99m} Tc, ¹⁸ F standard solutions.	
	- Calibration of various radioactive sources for external users	
KEYWORDS	Ionisation chamber, Reaccreditation, Radionuclides: 131 I, 99m Tc, 18 F, 68 (Ge+Ga)	
RESULTS	 Calibration of the ionization chamber for different radionuclides Calibration Certificates issued to end users 	
PUBLICATIONS	Radon gas activity measurements in the frame of an international comparison. A. Luca, M. Sahagia, A. Antohe, MR. Ioan, L. Serbina, C. Ivan, J. Radioanal. Nucl. Ch. 311(2) (2017) 1075-1079.	
	Standardisation of a ⁶⁸ (Ge+Ga) solution within the CCRI(II)-K2.Ge-68 key comparison. M. Sahagia, A. Luca, A. Antohe, MR. Ioan, C. Cimpeanu, C. Barna, C. Ivan, J. Radioanal. Nucl. Ch. 311(2) (2017) 983-990.	
	Study of the influence of radionuclide impurities in radionuclide metrology. M. Sahagia, A. Luca, A. Antohe, MR. Ioan, Radiation & Applications in Phys, Chem, Biol, Med Sci, Eng and Env Sci (rad-journal.org) 2 (2), 142 – 144 (2017), doi: 10.21175/RadJ.2017.02.030, ISSN 2466-4294.	
	The most recent participations in key and supplementary comparisons, the technical support for declaration and maintaining of Calibration and Measurement Capabilities (CMCs). M. Sahagia, A. Luca, A. Antohe, MR. Ioan, Proceedings of the 6 th International Proficiency Testing Conference, 2017, 166-172 (<u>http://www.pt-conf.org/index.php/conference-proceeding/</u>)	
IN PROGRESS	Calibration of the Ionization chamber using ⁸⁹ Zr; Calibration of various radioactive sources for external users	
SOURCE IN PREPARATION	Standardization of ⁶⁷ Cu and calibration of the ionization chamber. Impurities and decay scheme problems. M. Sahagia, A. Luca, MR. Ioan, A. Antohe, C. Ivan, Appl. Radiat. Isot. 134 (2018) 297-301	
OTHER RELATED PUBLICATIONS		
ADDRESS	IFIN-HH, PO Box MG-6, RO-077125 30 Reactorului Str., Magurele, Jud. Ilfov, Romania Tel.: +4021 4046163	
	FAX: +4021 4574440 or +4021 4574945 E-mail: <u>msahagia@nipne.ro</u>	
CONTACT	Maria Sahagia, Mihail Razvan Ioan, Andrei Antohe	

LABORATORY	IFIN-HH, Radionuclide Metrology Laboratory, Romania	
NAMES	Maria Sahagia, Mihail Razvan Ioan, Andrei Antohe, Doru Stanga	
ACTIVITY	Measurement of activity of ⁶⁷ Cu ;	
	RENAR Reaccreditation, Certificate: LE 013/2017	
KEYWORDS	<i>Coincidence method, Gas proportional counter, Surface beta contamination,</i> ⁶⁷ Cu, ¹²⁴ I, ⁶⁸ (Ge+Ga), ⁸⁹ Zr	
RESULTS	Measurement of ⁶⁷ Cu, ¹²⁴ I and ⁶⁸ (Ge+Ga) activity using the coincidence method in the efficiency extrapolation variant. Evaluation of the influence of the decay scheme parameters and of impurities in activity measurement. Measurements of surface beta contamination	
PUBLICATIONS	Measurement of I-124. M. Sahagia, MR. Ioan, A. Antohe, A. Luca, C. Ivan, Appl. Radiat. Isot. 109 (2016) 349-353	
	Standardisation of a ⁶⁸ (Ge+Ga) solution within the CCRI(II)-K2.Ge-68 key comparison. M. Sahagia, A. Luca, A. Antohe, MR. Ioan, C. Cimpeanu, C. Barna, C. Ivan, J. Radioanal. Nucl. Chem. 311 (2017) 983-990	
	A new approach in evaluating the surface beta contamination using the direct method of measurement. D. Stanga, P. De Felice, M. Capogni, Appl. Radiat. Isot. 129 (2017) 135-141	
IN PROGRESS	Standardization of ⁸⁹ Zr by the coincidence method	
INFORMATION	http://www.nipne.ro/facilities/laboratories/lmre.php	
SOURCE IN PREPARATION	 - Results of an International Comparison of Activity Measurements of ⁶⁸Ge. J.T. Cessna, R. Fitzgerald, B.E. Zimmerman, L. Laureano-Pérez, D.E. Bergeron, F. van Wyngaardt, M. Smith, T. Jackson, B. Howe, C.J. da Silva, A. Iwahara, P.A.L. da Cruz, M. Zhang, H. Liu, J. Liang, C. Fréchou, C. Bobin, P. Cassette, K. Kossert, O. Nähle, J. Marganiec-Gałązka, L. Joseph, A. Ravindra, D.N. Kulkarni, A. Yunoki, Y. Sato, K.B. Lee, J.M. Lee, Agung, T. Dziel, A. Listkowska, Z. Tymiński, M. Sahagia, A. Antohe, MR. Ioan, A. Luca, M. Krivosek, J. Ometakova, A. Javornik, M. Zalesakova, E. García-Toraño Martinez, M. Roteta, M. Mejuto, Y. Nedjadi, F. Juget, MC. Yuan, C.Y. Yeh, E. Yeltepe, A. Dirican, J. Keightley, A. Pearce, Appl. Radiat. Isot. 134 (2018) 385-390; 	
	- Standardization of "Cu and calibration of the ionization chamber. Impurities and decay scheme problems. M. Sahagia, A. Luca, MR. Ioan, A. Antohe, C. Ivan, Appl. Radiat. Isot. 134 (2018) 297-301;	
	- Efficiency transfer method applied to surface beta contamination measurements, D. Stanga, P. De Felice, M. Capogni, Appl. Radiat. Isot. 134 (2018) 370-375;	
	 The Romanian system of activity standards for the radiopharmaceuticals used in Positron Emission Tomography; influence of the decay scheme on the standardization method. M. Sahagia, A. Luca, A. Antohe, MR. Ioan. Accepted at the Sixth International Conference on Radiations and Applications in Various Fields of Research (RAD 2018), Ohrid, Macedonia (FYROM), 18- 22 June, 2018 	

OTHER RELATED PUBLICATIONS	Study of the influence of radionuclide impurities in radionuclide metrology. M. Sahagia, A. Luca, A. Antohe, MR. Ioan, Radiation & Applications in Phys., Chem., Biol., Med. Sci., Eng. and Env. Sci. 2, 2 (2017) 142-144. DOI: 10.21175/RadJ.2017.02.030
ADDRESS	IFIN-HH, PO Box MG-6, RO-077125 30 Reactorului Str., Magurele, Jud. Ilfov, Romania Tel.: +4021 4046163 FAX: +4021 4574440 or +4021 4574945 E-mail: <u>msahagia@nipne.ro</u>
CONTACT	Mihail-Razvan Ioan, Maria Sahagia

Announcements:

-Workshop organized by CEA/LNE-LNHB, France and IFIN-HH, within the frame of the Joint Research Project IFA-CEA no. C5-09/2016 (contact: <u>aluca@nipne.ro</u>, <u>thierry.branger@cea.fr</u>)

LABORATORY	Physics Department, University of Bucharest, Romania	
NAMES	Octavian SIMA	
ACTIVITY	Simulation of gamma-ray spectrometry measurements for complex samples; simulation of ²²² Rn decay products measurements by active methods; implementation of the Monte Carlo approach to evaluation of uncertainties according to GUM Supplement 1	
KEYWORDS	Gamma-ray spectrometry, Monte Carlo simulation, data evaluation, data measurement	
RESULTS	Improvement of Monte Carlo simulation for complex samples. Inclusion of intrinsic inhomogeneity for bulk sample assessment by gamma-ray spectrometry.	
	Development of a Monte Carlo code for the simulation of the processes involved in the measurement of the ²²² Rn decay products by active measurements.	
	Evaluation of the uncertainties of the computed values of parameters of interest (efficiency, correction factors) by propagation of distributions.	
PUBLICATIONS	T. Vidmar et al., Equivalence of computer codes for calculation of coincidence summing correction factors – Part II, APPL. RADIAT. ISOT. 109 (2016) 482-486	
	O. Sima, MC. Lépy, Application of GUM Supplement 1 to uncertainty of Monte Carlo computed efficiency in gamma-ray spectrometry, APPL. RADIAT. ISOT. 109 (2016) 493-499	
	D. Stanga, O. Sima, D. Gurau, Uncertainty assessment in the free release measurement by gamma spectrometry of rotating waste drums, APPL. RADIAT. ISOT. 109 (2016) 526-531	
	O. Sima, A. Luca, M. Sahagia, Monte Carlo simulation of air sampling methods for the measurement of radon decay products, APPL. RADIAT. ISOT. 126 (2017) 4-8	
	O. Sima, Efficiency computation for gamma-ray spectrometry assessment of samples with intrinsic inhomogeneity, APPL. RADIAT. ISOT. 126 (2017) 146-149	
IN PROGRESS	Preparation of an action of the GSWG to test the self-consistency of the methods applied for the computation of the coincidence-summing corrections for volume samples	
INFORMATION	Coordinator of the GSWG up to May 2017	
SOURCE IN PREPARATION	Evaluation of self-attenuation effects for the measurement of ²¹⁰ Pb (in press) Evaluation of quality of homogeneity approximation in gamma-ray spectrometry of bulk sample (in press)	

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CONTACT	Octavian SIMA

Slovak Institute of Metrology, Department of Ionizing Radiation (SMU), Laboratory of Radionuclide Activity, Slovakia, SA1/SA2 2016-2019 Progress Report and Work Plan (information for ICRM members)

The role of the Department of Ionizing Radiation is to maintain and develop the National standard of radionuclide activity No. 017/99 and other dosimetric national standards and their international comparison, the development of new methods and measurement techniques as well as to implement the quality management system according to ISO 17025:2005.

Scientists	Function	
Jarmila Ometáková	Head of Department of Ionizing Radiation, Quality manager, Radon	
	standards, Source preparation/radiochemistry	
Matej Krivošík	Primary activity standards, Liquid scintillation counting techniques	
Andrej Javorník	Secondary activity standards, Gamma-ray spectrometry, α/β area sources,	
	Ionization chambers, Surface activity, Metrological services	
Michaela Zálešáková	Liquid scintillation counting, Source preparation/radiochemistry,	
	Metrological services	
Pavol Blahušiak	Radon standards, Dosimetry of neutrons	
Anton Švec (part time)	Secondary activity standards, Gamma-ray spectrometry, α/β area sources,	
	Ionization chambers	
Norman Durný	Dosimetry of gamma rays	
Stanislav Sandtner	Dosimetry of RTG rays	

The Department of Ionizing Radiation staff in 2017 were:

The main specific activities carried out at SMU in this field are summarised below:

Activity line	IJS, LMR and LSC	IJS, LMR and LSC
	2016-2018 Progress report	2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Development of the primary standard of radionuclide activity based on liquid scintillation counting technique using triple-to- double coincidence ratio method (LSC-TDCR) in cooperation with Radioisotope centre POLATOM – contract, technical documentation preparation 	 Development of the primary standard of radionuclide activity based on liquid scintillation counting technique using triple-to- double coincidence ratio method (LSC-TDCR) in cooperation with Radioisotope centre POLATOM – construction, setting-up in laboratory, measurements
International comparisons	• No comparison	 DUNAMET D65 F-18 comparison using well type ionizing chamber DUNAMET D63 Kr-85 secondary comparison using semiconductor or scintillation detector CCRI(II)-S13 Cs-134 and Cs-137 in wheat flour EURAMET Reg. No. 1437 comparison of the radionuclide calibrators (F-18, Ga-67, Tc-99m, In-111, I-123, I-125, I-131, Cs-137 and Tl-201)

Activity line	LIS. LMR and LSC	LIS. LMR and LSC
	2016-2018 Progress report	2018-2019 Work plan
Standardization of measurement methods	 The secondary standard of Rn-222 in air – development and finalization of construction of the radon chamber, construction of components, The use of autoradiography to measurement of radioactivity 	 The secondary standard of Rn-222 in air – development and finalization of construction of the radon chamber, construction of components, The use of autoradiography to measurement of radioactivity Separation techniques for Ra-226
National QA programmes and services	 Calibration of radioactive sources and calibration of all parts of the National standard No. 017/99 (gamma-ray spectrometer, ionizing chambers, large area α/β measurement system) Legal metrology (calibrations and verifications) Type tests Preparation of radioactive standards (liquid solutions) for external users. Application of LSC techniques 	 Calibration of radioactive sources and calibration of all parts of the National standard No. 017/99 (gamma-ray spectrometer, ionizing chambers, large area α/β measurement system) Legal metrology (calibrations and verifications) Type tests Preparation of radioactive standards (liquid solutions) for external users. Application of LSC techniques Rn-222 in air and water measurements
Membership in international and national organisations	 ICRM BIPM/CCRI(II) EURAMET TC-IR COOMET TC 1.9 DUNAMET - 	 ICRM BIPM/CCRI(II) EURAMET TC-IR COOMET TC 1.9 DUNAMET -
Management and Organization		
Teaching activity	Lecture courses givenInvited lectures	Lecture courses givenInvited lectures
Quality system	 Maintaining of Quality Management System according to ISO 17025:2005 External Peer Review from CMI, Czech Republic Internal audit 	 Improvement of Quality Management System according to ISO 17025:2017 Internal audit

LABORATORY	Slovak Institute of Metrology, Department of Ionizing Radiation (SMU), Laboratory of Radionuclide Activity, Slovakia
NAMES	M. Krivošík, J. Ometáková, A. Javorník, M. Zálešáková, P. Blahušiak, N. Durný, S. Sandtner and A. Švec
ACTIVITY	Approved project from the Slovak Research and Development Agency to build a primary standard based on TDCR-G and the secondary standard of Rn- 222 in air.
KEYWORDS	Large area alpha/beta activity measurements, gamma ray spectrometry, well type ionisation chamber (radionuclide calibrator), liquid scintillation counting, Rn-222, traceability
RESULTS	The new radon chamber was built and secondary standard of Rn-222 based on AlphaGuard was bought. All needed electronics for LSC TDCR-G measurement system was bought and the framework of the system is under construction.
PUBLICATIONS	-
IN PROGRESS	Ong. comparisons: CCRI(II)-K2.Ge-68, CCRI(II)-S9 and CCRI(II)-S10 Building of a primary standard based on LSC TDCR-G.
	The radon chamber with the secondary standard were put into operation for testing
INFORMATION	-
SOURCE IN PREPARATION	-
ADDRESS	Slovak Institute of Metrology (SMU) Karloveská 63 842 55 Bratislava Slovak Republic Tel.: +421 2 602 94 208 E-mail: <u>krivosik@smu.gov.sk</u>
CONTACT	M. Krivošík

Proposals:

SMU would like to participate in the key comparisons of pure beta emitters (C-14, H-3, Sr-90) using LSC TDCR method.

SMU would like to participate in the comparisons of large area alpha/beta sources for activity measurements (Am-241, C-14, Pm-147, Co-60, Cs-137, 36-Cl, Tl-204, 90-Sr/Y). SMU would like to participate in the comparison of radon monitors (AlphaGuard).

Jožef Stefan Institute, Laboratory for Radioactivity Measurements (LMR), Laboratory for Liquid Scintillation Spectrometry (LSC), Slovenia, SA1/SA2 2016-2019 Progress Report and Work Plan (information for ICRM members)

The programmes at the Jožef Stefan Institute, Laboratory for Radioactivity Measurements and Laboratory for Liquid Scintillation Spectrometry in the field of radionuclide metrology in the years 2015–2017 were and will be focused, as in the past, on maintaining and developing gamma-ray spectrometry method and liquid scintillation spectrometry, participation in characterisation and preparation of reference material (i.e. intercomparison samples) and quality-assurance in radioactivity measurements.

The Jožef Stefan Institute, Laboratory for Radioactivity Measurements (LMR) and Laboratory for Liquid Scintillation Spectrometry (LSC) staff in 2017 was the following:

Scientists	Function
Branko Vodenik	Head of Laboratory for Radioactivity Measurements until
	November 2017, gamma-ray spectrometrist
Toni Petrovič	Head of Laboratory for Radioactivity Measurements from
	November 2017, gamma-ray spectrometrist
Jasmina Kožar Logar	Head of Laboratory for Liquid Scintillation Spectrometry, liquid
	scintillation spectrometrist, C-14, total α/β and H-3
Denis Glavič-Cindro	Quality manager and gamma-ray spectrometrist
Benjamin Zorko	Gamma-ray spectrometrist
Marijan Nečemer	Gamma-ray spectrometrist (radiochemist)
Boštjan Črnič	Gamma-ray spectrometrist
Matjaž Korun	Consultant (retired)
Romana Krištof	Head of the group for sampling and sample preparation in the
	frame of Laboratory for Radioactivity Measurements,
	Liquid scintillation spectrometrist, C-14, total α/β and H-3
Technicians	
Diana Marguč	Sample preparation for liquid scintillation
Drago Brodnik	Sampling, equipment maintenance
Sandi Gobec	Sampling
Petra Osterman	Sampling and sample preparation

The main specific activities carried out at IJS (LMR and LSC) in this field are summarised below

Activity line	IJS, LMR and LSC	IJS, LMR and LSC
	2016-2017 Progress report	2018-2019 Work plan
Improvement of measuring methods and instrumentation	 Traceability in gamma-ray spectrometry and liquid scintillation spectrometry Interpretation of measurement results near the detection limit and decision threshold in gamma-ray and liquid scintillation spectrometry Validation of a method for a radon tight sample preparation for gamma- ray spectrometry Determination and interpretation of tritium, total alpha / beta activity and members of the uranium and thorium decay in ground-water samples using gamma-ray spectrometry Development of activity measurements of barrels on the basis of self- 	 Traceability in gamma-ray and liquid scintillation spectrometry Implementation of methods for quantitative interpretation of gamma-ray spectrometric measurement results near the natural limit (zero activity) Improvement of the robustness of gamma-ray spectrometric measurements of water samples Development of generalized method for determination of H-3 in water samples by electrolytic enrichment Improvement of the sensitivity of total alpha / beta ray spectrometric measuremetric measurements of water samples Accreditation of C-14 in different samples

Activity line	IJS, LMR and LSC	IJS, LMR and LSC
	2016-2017 Progress report	2018-2019 Work plan
	 attenuation of gamma-rays (theoretical part) Validation of the method for activity measurements of inhomogeneously distributed radioactive material in barrels on the basis of self-attenuation of gamma-rays Development and optimization of direct method for determination of biocomponents in fuels Development and construction of a complex portable aerosol sampling device with an on-line capability for monitoring of airborne radioactivity Validation and on-site testing of a complex portable aerosol sampling device with an on-line capability for monitoring of airborne radioactivity Implementation of the method for determination of the method for determination of oBT (sample preparation, development and introduction of the new equipment) 	 Optimisation and further development of the method for determination of OBT (sample preparation, development and introduction of the new equipment) Technical development of detector systems that will be mounted on UAV and will be used for localisation of radiation hot-spots in contaminated areas Further development and upgrade of the transportable air-sampling system for in- field use with real time gamma spectrometry, including calibration, validation and operation of such systems
International comparisons	 Participation in supplementary comparison on measurement of the activity concentration of Cs-137 and K-40 in rice material CCRI(II)-S9 ETRIT intercomparison on H-3 in water, IARMA (2016, 2017) EGROSS intercomparisons on the determination of gross alpha and beta in water, IARMA (2016, 2017) ERAD intercomparisons on determination of radionuclides in water and solid samples, IARMA (2016, 2017) Interlaboratory comparison on gamma- ray radionuclides and gross alpha/beta activity measurement in water, soil sediments, vegetation (IAEA ALMERA 2016 and 2017) MRI, Radionuclides in raw milk 2016, 2017 JRC Geel, EC proficiency test on I- 131, Cs-134 and Cs-137 in maize powder, 2017 EMRP ENV MetroERM, interlaboratory comparisons of aerosol filter (IRMM, 2016) EC GCL FAM - Round Robin 2016 C- 14 determination of bio-component in diesel in accordance with DIN 51637:2014 (2015) International group for OBT, 4th exercise (2017), dehydrated grass 	 NPL Environmental Radioactivity Proficiency Test Exercise 2018 (GL and solid sample) PROCORAD intercomparison; different radionuclides in urine (gamma ray emitters, H-3, total alpha / beta, C-14) (2018 or 2019) Interlaboratory comparison on gamma- ray radionuclides in different samples, total alpha / beta and tritium in water samples (IAEA ALMERA 2018 and 2019) ETRIT, EGROSS, ERAD intercomparisons, IARMA, 2018, 2019 Participation in other suitable interlaboratory comparisons EC GCL FAM - Round Robin C-14, determination of bio-component in different types of fuels / other organic liquid, 2018 or / and 2019 CNL Canada (OBT), 5th exercise

Activity line	IJS, LMR and LSC 2016-2017 Progress report	IJS, LMR and LSC 2018-2019 Work plan
Standardization of measurement methods	 Characterization of spruce needles for ALMERA IAEA (2016) Homogeneity tests of water samples IARMA, UK (2016) Homogeneity tests of water and soil samples IARMA, UK (2017) 	 Characterization of samples for ALMERA IAEA and IARMA, UK (2018, 2019) Development of a new Digital Signal Analyzer for gamma ray spectrometry Preparation steps for standardization of the direct LSC method for determination of biocomponents in fuels
National QA programmes and services	 Collaboration with IAEA (characterisation of different reference materials) Collaboration with IARMA UK (characterisation and preparation of different reference materials) 	 Collaboration with IAEA (characterisation of other reference materials) Collaboration with IARMA UK (preparation of reference materials in different types of water and their characterization)
Membership in international and national organisations	 ICRM EURAMET TC-IR EURADOS CONCERT SIST/TC UGA (National Standardisation Organisation) ALMERA (IAEA) MODARIA (IAEA) International group for OBT 	 ICRM EURAMET TC-IR EURADOS CONCERT SIST/TC UGA (National Standardisation Organisation) ALMERA (IAEA) MODARIA (IAEA) NERIS International group for OBT
Management and Organization	 European Project (EMRP 2013): MetroERM Europen Project (EMPIR 2016) Preparedness 	 Europen Project (EMPIR 2016) Preparedness European Projects - EMPIR Call 2019 Environment
Teaching activity	 Lectures for national users given at IJS Invited lectures (IAEA) Mentorship on BSc, MSc, PhD thesis Hosting of foreign academic stuff on their sabbatical year 	 Lectures for national users given at IJS Invited lectures Mentorship on BSc, MSc, PhD thesis International fellows on trainings
Quality system	- Management of Quality System	 Improvement of Quality System

LABORATORY	Jožef Stefan Institute, Laboratory for Radioactivity Measurements (LMR), Laboratory for Liquid Scintillation Spectrometry (LSC), Slovenia
NAMES	Denis Glavič-Cindro, Branko Vodenik, Toni Petrovič, Jasmina Kožar Logar, Benjamin Zorko, Marijan Nečemer, Boštjan Črnič, Matjaž Korun, Romana Krištof, Drago Brodnik, Sandi Gobec, Petra Osterman, Diana Marguč
ACTIVITY	Laboratory for Radioactivity Measurements develops gamma-ray spectrometry measurement methods with the emphasis on the metrological point of view and performs routine measurements of the samples belonging to the regular environmental monitoring programs
KEYWORDS	gamma-ray spectrometry, beta spectrometry, liquid scintillation spectrometry, X-ray spectrometry, EURAMET, environmental control, data evaluation, data measurement, low level, traceability
RESULTS	-
PUBLICATIONS	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>Calculation of decision thresholds for radionuclides identified in gamma-ray spectra by post-processing peak analysis results</i> . Nuclear Instruments and methods in Physics research. Section A, accelerators, spectrometers, detectors and associated equipment, 813 (2016) 102–110
	GLAVIČ-CINDRO, Denis, KORUN, Matjaž, NEČEMER, Marijan, VODENIK, Branko, ZORKO, Benjamin. <i>Evaluation of comparison and</i> <i>proficiency test results of gamma ray spectrometry at Jožef Stefan Institute</i> <i>from 1986 to 2014</i> . Applied Radiation and Isotopes, 109 (2016) 54–60
	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>Calculation of the decision threshold in gamma-ray spectrometry using sum peaks</i> . Applied Radiation and Isotopes, 109 (2016) 522–525
	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>Measurement function for the activities of multi-gamma-ray emitters in gamma-ray spectrometric measurements</i> . Applied Radiation and Isotopes, 109 (2016) 518–521
	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. Calculation of best estimates for measurements of radioactive substances when the presence of the analyte is not assured. Accreditation and quality assurance, 21 (2016) 191–195
	GLAVIČ-CINDRO, Denis, KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>On the definition of the decision threshold as stated in the standard ISO 11929</i> . Accreditation and quality assurance, 21 (2016) 433–435
	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>Calculation of the correlation coefficients between the numbers of counts (peak areas and backgrounds) obtained from gamma-ray spectra</i> . Applied Radiation and Isotopes, 118 (2016) 1–6
	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>Reliability of the peak-analysis results in gamma-ray spectrometry for high relative peak-area uncertainties</i> . Applied Radiation and Isotopes 105 (2016) 60–65
	ZORKO, Benjamin, KORUN, Matjaž, MORA CANADAS, Juan Carlos, NICOULAUD-GOUIN, Valerie, CHYLY, Pavol, BLIXT BUHR, Anna Maria, LAGER, Charlotte, AQUILONIUS, Karin, KRAJEWSKI, Pawel. Systematic influences of gamma-ray spectrometry data near the decision threshold for

	<i>radioactivity measurements in the environment.</i> Journal of Environmental Radioactivity, vol. 158/159 (2016) 119–128
	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. An alternative approach to the decision threshold. Applied Radiation and Isotopes, 134 (2016) 56–58
	GLAVIČ-CINDRO, Denis, KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>Calculation of the detection limits by explicit expressions</i> . Applied Radiation and Isotopes, 126 (2017) 267–269
	KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin. <i>Determination of the measurement threshold in gamma-ray spectrometry</i> . Applied Radiation and Isotopes 121 (2017) 126–130
	GLAVIČ-CINDRO, Denis, BRODNIK, Drago, PETROVIČ, Toni, VENCELJ, Matjaž, PONIKVAR, Dušan, BELL, Steven James, KEIGHTLEY, Lynsey, WOODS, Selina. <i>Compact radioactive aerosol monitoring device for early</i> <i>warning networks</i> . Applied radiation and isotopes 126 (2017) 219–224
	SHAKHASHIRO, Abdulghani, DOHERTY, Paul, KOŽAR LOGAR, Jasmina, VODENIK, Branko, VERHEYEN, Leen, TAGGART, Mark. <i>New certified reference materials and proficiency test for environmental radioactivity measurements</i> . Accreditation and quality assurance. 21 (2017) 351–360
	KRIŠTOF, Romana, KOŽAR LOGAR, Jasmina. <i>Direct LSC method for determination of bio-origin by C-14 measurement</i> . Journal of radioanalytical and nuclear chemistry, 314 (2017) 715–719
	BRUGGEMAN, M., KORUN, Matjaž, VODENIK, Branko, ZORKO, Benjamin, et al. <i>Systematic influences on the areas of peaks in gamma-ray</i> <i>spectra that have a large statistical uncertainty</i> . Applied Radiation and Isotopes, 134 (2018) 51–55
	GLAVIČ-CINDRO, Denis. Comparison of intercomparison results of gamma ray spectrometry of spiked and real samples. Applied Radiation and Isotopes, 134 (2018) 59–63
	GLAVIČ-CINDRO, Denis, BRODNIK, Drago, CARDELLINI, Francesco, DE FELICE, Pierino, PONIKVAR, Dušan, VENCELJ, Matjaž, PETROVIČ, Toni. Evaluation of the radon interference on the performance of the portable monitoring air pump for radioactive aerosols (MARE). Applied Radiation and Isotopes, 134 (2018) 439–445
	KRIŠTOF, Romana, KOŠENINA, Suzana, ZORKO, Benjamin, KOŽAR LOGAR, Jasmina. <i>Tritium in organic matter around Krško Nuclear Power</i> <i>Plant</i> . Journal of radioanalytical and nuclear chemistry, ISSN 0236-5731, [in press] 2017, 5 p.
IN PROGRESS	Participation in the European Projects: MetroERM (EMRP 2013) and Preparedness (EMPIR 2016)
	Project MetroERM finished in 2016.
	MetroERM (EMRP Call 2013 Environment) project is aimed at the metrologically sound measurement of fundamental radiological quantities like ambient dose equivalent rate, radioactivity concentrations in air and ground contamination levels in real-time. IJS is engaged at WP2, WP3, WP4 and WP5.
	PREPAREDNESS (EMPIR Call 2016 Environment), the overall objective of this project is the establishment of a metrological basis to support adequate protective measures in the aftermath of nuclear and radiological emergencies. JSI is engaged in development of unmanned aerial detection

	systems installed on drones for the remote measurement of dose rates and radioactivity concentrations and in development of transportable air-sampling systems. IJS is engaged at WP1, WP2, WP4 and WP5.
	Continuation of work on calculation of decision thresholds and detection limits in gamma-ray spectrometry, and reporting of measurement results.
	Evaluation and optimisation of electrolytic enrichment, statistical methods of measurement results, estimation of seasonal variation of radon on spectrometer background, optimisation of measurement conditions in LSC counter, influence of temperature on LSC measurements, testing of new approach of raw spectral data evaluation on LSC.
INFORMATION	-
SOURCE IN PREPARATION	KORUN, Matjaž, PETROVIČ, Toni, VODENIK, Branko, ZORKO, Benjamin, Calculation of decision thresholds and detection limits in the case of overlapping peaks occurring in gamma-ray spectra, working title
	KRAJCAR-BRONIĆ Ines, BAREŠIĆ Jadranka, HROVATINČIĆ Nada, KRIŠTOF Romana, KOŽAR LOGAR Jasmina, New techniques of determination of biogenic fraction in liquid fuels by the C-14 method
	KRIŠTOF Romana, KOŽAR LOGAR Jasmina, New approach to general calibration curves for all types of biocomponents in diesel, working title
	KRIŠTOF Romana, BAEZA JIMENEZ Ramiro, KOŽAR LOGAR Jasmina OTERO Cristina, <i>Acid-catalysed biodiesel preparation and characterization of</i> <i>biodiesels from various feedstocks</i> , working title
	VODOPIVEC Tina, KOŽAR LOGAR Jasmina, Total Activity of alpha / beta emitters in drinking waters: validation and optimization of the method, working title
	KRIŠTOF Romana, KOŽAR LOGAR Jasmina, VARLAM Carmen, WAGNER Irina, Intercomparison of samples and methods for determination of biocomponents in fuels by LSC, working title
OTHER RELATED PUBLICATIONS	-
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LABORATORY	National Metrology Institute of South Africa (NMISA), Radioactivity Standards Laboratory, South Africa
NAMES	M.J. van Staden, J. Lubbe, M.W. van Rooy
ACTIVITY	On-going project: Upgrade and verification of the NMISA Primary Measurement Data Acquisition System from analogue to digital coincidence counting.
	A simulation of the Tc-99m rate vs. efficiency curve (from 4π (LS)e- γ measurements) was undertaken to predict the best functional form. The simulation involved estimation of the detection efficiency of the 140.51 keV γ -ray with the liquid scintillator via two simple methods. The simulation and results form part of a paper on the standardization of Tc-99m.
	Measurement data from the primary standardization of F-18 via $4\pi(LS)\beta-\gamma$ coincidence counting were analyzed via a non-extrapolation method and showed good agreement with the extrapolation result. The results will form part of a paper on the standardization of F-18.
	NMISA participated in the IAEA-TEL-2016-03 worldwide open proficiency test on the determination of anthropogenic and natural radionuclides in water and biota.
	The laboratory's historic C-14 TDCR results (from 1992 to 2014) were submitted to Stefaan Pommé to analyze for an Earth-Sun distance correlation.
	A primary standardisation (TDCR) was conducted during July/August 2016 on a H-3 stock solution.
	 NMISA provided radioactivity measurement services to the user community in South Africa. These services included: calibration checks on various dose calibrators and ionisation chambers at production facilities and nuclear medicine departments; standardization of various radionuclides (liquids) & I-131 therapy capsules (used by production facilities and nuclear medicine departments for calibration of dose calibrators) and the supply of various standards (H-3, I-131 & mixed radionuclides) to the National Nuclear Regulator for low-level gamma-ray spectrometry and LSC measurements. NMISA participated in the IAEA-TEL-2017-03 worldwide open proficiency test on the determination of anthropogenic and natural radionuclides in water, milk powder and Ca-carbonate of natural origin. NMISA participated in a round robin low level measurement study (determination of K-40 and Cs-137 in soil) with the National Nuclear Regulator (NNR) during 2017.
	NMISA participated in key comparison BIPM.RI(II)-K1.Ho-166m and submitted a 3.6ml flame-sealed ampoule of Ho-166m solution to the SIR (BIPM). The ampoule was shipped to France (BIPM) during September 2017.
	NMISA participated in key comparison BIPM.RI(II)-K1.I-131 and submitted a 3.6ml flame-sealed ampoule of I-131 solution to the SIR (BIPM). The ampoule was shipped to France (BIPM) during September 2017.
KEYWORDS	environmental, low-level measurements, gamma-ray spectrometry, ionisation chamber, IAEA, liquid scintillation, National Nuclear Regulator (NNR), SIR, source preparation, traceability, SIRTI, Co-57, Tc-99m, F-18, Fe-59, Ho-166m, I-131, H-3, Ba-133.
RESULTS	Draft B report was received with results on APMP RI(II)-K2 Fe-59 Comparison NMISA received results on the IAEA-TEL-2016-03 PT scheme. All NMISA results were within 6% of the reference values.

	Draft B report was circulated and approved on our 2015 SIRTI comparison results for Tc-99m and F-18.
	Received Draft A report with results for BIPM.RI(II)-K1.Co-57 comparison.
	NMISA received the Daft A report on the BIPM.RI(II)-K1.Ho-166m key comparison and the results showed excellent agreement with the latest key comparison reference value (KCRV).
	NMISA received the Daft A report on the BIPM.RI(II)-K1.I-131 key comparison and the results showed excellent agreement with the latest key comparison reference value (KCRV).
	NMISA received a report on the IAEA TEL 2017-03 low level PT scheme we participated in. (determination of anthropogenic and natural radionuclides in water, milk powder and Ca-carbonate of natural origin). All NMISA reported results were deemed acceptable by IAEA.
PUBLICATIONS	M. van Rooy, B. Simpson, J. Lubbe, M. van Staden, <i>Hands-on radionuclide activity meter (dose calibrator) training at NMISA (Abstract P5).</i> Physica Medica 32 (2016) 162.
	J. Lubbe, M. van Rooy, M. van Staden, B. Simpson, International comparisons of Activity Measurements of Tc-99m and F-18 (Abstract O29). Physica Medica 32 (2016) 150.
	M.W. van Rooy, M.J. van Staden, J. Lubbe, B.R.S. Simpson, Activity of Fe-59 by 4π beta-gamma counting using liquid scintillation in the beta channel. Appl. Radiat. Isot. 109 (2016) 276-280
	M.W. van Rooy, M.J. van Staden B.R.S.Simpson, J.Lubbe, Absolute standardizations of ^{99m}Tc and ^{57}Co by 4π electron-gamma liquid scintillation coincidence counting for SIRTI and SIR comparisons. Appl Radiat Isot. (2017).
	C. Michotte, M. Nonis, M.W. van Rooy, M.J. van Staden, J. Lubbe, Activity Measurements of the radionuclides ¹⁸ F and ^{99m} Tc for the NMISA, South Africa in the ongoing comparisons BIPM.RI(II)-K4.F-18 and BIMP.RI(II)-K4.Tc-99m. Metrologia 54 (2017) Tech. Suppl. 06001.
IN PROGRESS	Method development and validation of LSC low-level measurements of environmental samples with PerkinElmer Tri-Carb 3180 TR/SL. Method development of low-level measurements with a HPGe detector. Both projects are part of the collaboration with the National Nuclear Regulator.
INFORMATION	All personnel in the radioactivity section were registered with SACNASP (South African Council for Natural Scientific Professions); two as Professional Natural Scientists & one as a Certified Natural Scientist.
	A new hybrid cryostat for the second HPGe detector was installed.
	Dr Milton van Rooy and Joline Lubbe attended the SAIP 2016 Conference in Cape Town where Milton presented a talk on the primary liquid scintillation radioactivity measurement capabilities of NMISA. Joline presented a talk on the secondary standard instrumentation used at NMISA for radioactivity measurements.
	Joline Lubbe and Dr Milton van Rooy attended the SAAPMB 2016 Congress in Cape Town and Joline presented a talk on "International comparisons of activity measurements of Tc-99m and F-18". Dr Milton van Rooy presented a poster on "Hands-on dose calibrator training at NMISA".
	Our planned SIR submissions to the BIPM were not possible during 2016 because of the import restrictions of radioactive sources into France.

	Dr Milton van Rooy represented NMISA at APMP 2016 in Vietnam.
	The Radioactivity Standards Section received the "Team Excellence award" at the NMISA annual awards function in 2016.
	Dr Milton van Rooy represented NMISA at ICRM 2017: He presented an oral paper titled: "Absolute standardizations of ^{99m} Tc via $4\pi(LS)e-\gamma$ and ⁵⁷ Co via $4\pi(LS)(e,X)-\gamma$ coincidence counting." Highlights in this paper includes the preparation done at NMISA for the SIRTI and SIR comparisons of ^{99m} Tc and ⁵⁷ Co, respectively. This was also the first technical report on the standardization of ^{99m} Tc via liquid scintillation coincidence counting.
	Joline Lubbe attended IRCM2017 and presented a poster titled: "Utilising normalized manufacturer's calibration factors for an ionization chamber with depleted gas".
	The NMISA Radioactivity Standards section underwent a successful SANAS surveillance assessment (ISO 17025) on 16 March 2017. No findings or corrective actions were raised.
	Dr Milton van Rooy attended the CCRI(II) meetings in Paris in June 2017.
	Milton van Rooy presented a poster at the SAIP conference in July 2017 on "NMISA radioactivity services for industry".
	The Radioactivity Standards section attended the NMISA 70/10 Conference in Pretoria (South Africa) in August 2017 and presented 3x technical posters; "Secondary radioactivity calibration & measurement capabilities for life sciences." ; "A history of successful international comparisons of radioactivity measurements at NMISA" ; "Low-level radioactivity measurement capabilities at NMISA"
	Dr Milton van Rooy attended the IAEA training course on gamma-spec and alpha- spec method validation and quality assurance from 6-10 Nov 2017 in Tanzania, hosted by Tanzania Atomic Energy Commission.
	Joline Lubbe attended the SANAS Lead Assessor Training Course in September 2017.
	Joline Lubbe attended the SAAPMB 2017 Congress in September 2017 and gave an oral presentation on NMISA's secondary radioactivity CMCs for nuclear medicine applications.
	At the NMISA 2017 annual awards Joline Lubbe won the NMISA Quality award and Dr Milton van Rooy won the award for outstanding contribution towards Development, Maintenance, and Dissemination of the National Measurement Standards.
SOURCE IN PREPARATION	Standardization of Ba-133 stock solution; Standardization of H-3 for a CCRI(II) Key Comparison
OTHER RELATED PUBLICATIONS	S. Pommé et al, <i>Evidence against solar influence on nuclear decay constants</i> . Phys Lett B 761 (2016) 281-286.
	S. Pommé et al, On decay constants and orbital distance to the Sun-Part I: alpha decay. Metrologia 54 (2017) 1-18.
	S. Pommé et al, On decay constants and orbital distance to the Sun-Part II: beta minus decay. Metrologia 54 (2017) 19-35.
	S. Pommé et al, On decay constants and orbital distance to the Sun-Part II: beta plus and electron capture decay. Metrologia 54 (2017) 36-50.

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Laboratorio de Metrología de Radiaciones Ionizantes (CIEMAT), Spain, SA1/SA2 2016-19 Progress Report and Work Plan (information for ICRM members)

The Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT) holds the Ionizing Radiations Metrology Laboratory (LMRI) which is the Spanish National Standards Laboratory for ionizing radiations, according to Royal Decree 533/1996, and Designated Institute by the Spanish Centre of Metrology (CEM) in this field. The LMRI maintains the national standards of Activity of radionuclides. The LMRI-CIEMAT experience traces back to the 60's.

The CIEMAT staff in 2017 were:

Scientists	Function	
Eduardo García-Toraño	Head (of laboratory or group), Nuclear medicine, LSC	
Miguel Roteta	Primary activity standards	
Virginia Peyrés	Secondary activity standards, gamma spectrometry	
Marcos Mejuto	Environmental studies	
Nuria Navarro	Liquid scintillation counting	
Teresa Crespo	Alpha spectrometry, source preparation/radiochemistry	
Víctor Hernández	PhD student, X-ray measurements	
Technicians		
Daniel Muñoz	Secondary activity standards	
Oscar Oller	Source preparation/radiochemistry	

The main specific activities carried out at CIEMAT in this field are summarised below.

Activity line	Radionuclide Metrology 2016-2017 Progress report	Radionuclide Metrology 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Setup of the absolute X-ray counter standards: <i>list of radionuclides</i> Developments: LSC-NaI(Tl) coincidence system developed and tested. TDCR Prototype optimized, new HIDEX system in operation Measurement of nuclear data (Pα ²²⁶Ra, Pγ ²³⁵U, ^{166m}Ho), ²⁴³Am studies European Projects: MetroNorm-Completed, Metrodecom2- In progress 	 Setup of the absolute X-ray counter Standards. Measurement of some X-ray data. Developments:X-Ray spectrometry with low-energy Ge detector. European Projects: MetroDecom2 Measurement of nuclear data (Pα, ²³¹Pa, Pγ ^{234m}Pa). TDCR digital acquisition.
International comparisons	 CCRI(II)-K2.Ge-68 Completed Ionex Resin, Pb-210 (JRP EMRP IND57 MetroNorm) Completed BIPM CCRI(II)-Pa-231. In progress 	 BIPM CCRI(II)-H.3 SIR (Tc- 99m) BIPM CCRI(II)-Pa-231 CCRI(II)-S13 (Supplementary comparison of activity measurement of ¹³⁴Cs and ¹³⁷Cs in wheat flour) CCRI(II) Cd-109

Activity line	Radionuclide Metrology	Radionuclide Metrology
	2016-2017 Progress report	2018-2019 Work plan
National QA programmes and services	 Development of an interface for Nuclide-oriented simulation for PENELOPE (PENNUC) Neural network for NORM analysis by gamma-ray spectrometry Characterization of materials within the MetroNORM project 	 Characterization of Zircon sand (alpha and gamma measurements) GRWG comparisons: self-consistency of the methods applied for the evaluation of coincidence-summing corrections in the case of volume sources (Octavian Sima) LLWG action regarding the measurements of the probability for location of peaks in gamma-ray spectra, as a function of the relative uncertainty of the peak area (Matjaz Korun)
Membership in international and national organisations	 Preparation of radioactive standards for external users, solid and liquid, alpha-, beta- and gamma-emitters. Reference mixed standards (liquid) for NPP's and cocktails of gamma emitters for other clients. Calibration of surface contamination monitors Calibration of activimeters (mainly for the nuclides^{99m}Tc, ¹³¹I and ¹⁸F) 	 Preparation of radioactive standards for external users, solid and liquid, alpha-, beta- and gamma-emitters. Reference mixed standards (liquid) for NPP's and cocktails of gamma emitters for other clients. Calibration of surface contamination monitors Calibration of activimeters (mainly for nuclides^{99m}Tc, ¹³¹I and ¹⁸F)
Management and Organization	ICRM Vice-presidencyBIPM/CCRI(II)	ICRM presidencyBIPM/CCRI(II)
Teaching activity	European Projects: Participation in MetroNorm, MetroDecom2.	European Projects: MetroDecom2
Quality system	 Master and other courses at IEE (Institute for Energy Studies) at CIEMAT. IAEA TC RLA6074-4, Curso Regional de Capacitación sobre Metrología Aplicada a la Preparación y Uso de Radiofármacos, CNEA, Argentina 	• Master and other courses at IEE (Institute for Energy Studies) at CIEMAT.

LABORATORY	Laboratorio de Metrología de Radiaciones Ionizantes (CIEMAT), Spain	
NAMES	Eduardo García-Toraño, Virginia Peyrés, Miguel Roteta, Teresa Crespo, Nuria Navarro, Víctor Hernández	
ACTIVITY	Standardization of alpha-beta and gamma emitting nuclides. European projects and SIR contributions	
KEYWORDS	Coincidence method, gamma-ray spectrometry, ionisation chamber, liquid scintillation, NaI well-type counter, source preparation	
RESULTS	Setup of a new coincidence system (LSC-gamma) completed. Participation in a CCRI(II) comparison	
	Source preparation (CCRI (II) Pa-231 comparison, X-ray counter)	
	A HIDEX TDCR counter has been incorporated to the LSC laboratory	
	Concept design of a time-of-flight system completed	
	PENNUC interface for nuclide-oriented simulation with PENELOPE (+Univ. Barcelona, LNHB)	
PUBLICATIONS	García-Toraño E., 2017. Concept design of a time-of-flight spectrometer for t measurement of the energy of alpha particles. Applied Radiation and Isotopes <u>http://dx.doi.org/10.1016/j.apradiso.2017.07.037</u> .	
	García-Toraño, E ; Peyrés, V ; Bé, MM ; Dulieu, C ; Lépy, MC ; Salvat, F, 2017. Simulation of decay processes and radiation transport times in radioactivity measurements. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 396, 43-49.	
IN PROGRESS	CCRI (II) comparison of Pa-231	
	CCRI (II) comparison of H-3	
	CCRI (II) comparison of ¹⁰⁹ Cd (announced)	
	MetroDecomII European project started in 2017. (Metrology for decommissioning nuclear facilities)	
	Set-up and measurements with the absolute X-ray counter for low-energy X-rays	
	CCRI(II)-S13 (Supplementary comparison of activity measurement of 134 Cs and 137 Cs in wheat flour)	
	GRWG comparisons: self-consistency of the methods applied for the evaluation of coincidence-summing corrections in the case of volume sources (Octavian Sima)	
	LLWG action regarding the measurements of the probability for location of peaks in gamma-ray spectra, as a function of the relative uncertainty of the peak area (Matjaz Korun)	

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LABORATORY	Laboratorio de Metrología de Radiaciones Ionizantes (CIEMAT), Spain
NAMES	Eduardo García-Toraño, Virginia Peyrés, Miguel Roteta, Teresa Crespo, Nuria Navarro
ACTIVITY	Standardization and Nuclear data Measurements of PET Radionuclides
KEYWORDS	Nuclear data, PET nuclides, coincidence method, gamma-ray spectrometry, ionisation chamber, life sciences, liquid scintillation, NaI well-type counter
RESULTS	Standardization and measurement of the half-life of Zr-89; Standardization of Ge/Ga 68 in the frame of CCRI(II)-K2.Ge-68 by TDCR and Coincidence measurements.
PUBLICATIONS	E. García-Toraño, V. Peyrés, M. Roteta, M. Mejuto, A. Sánchez-Cabezudo, E. Romero, 2017., Standardisation and half-life of ⁸⁹ Zr, Applied Radiation and Isotopes,, <u>https://doi.org/10.1016/j.apradiso.2017.10.033</u> .
	J.T. Cessna, et al., 2017. Results of an international comparison of activity measurements of ⁶⁸ Ge,Applied Radiation and Isotopes, <u>https://doi.org/10.1016/j.apradiso.2017.10.052</u>
IN PROGRESS	Determination of calibration factor for activimeters
	Measurements of other emerging PET nuclides
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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LABORATORY	Laboratorio de Metrología de Radiaciones Ionizantes (CIEMAT), Spain
NAMES	Eduardo García-Toraño, Virginia Peyrés, Miguel Roteta, Ana Isabel Sánchez- Cabezudo, Teresa Crespo, Nuria Navarro
ACTIVITY	Nuclear data Measurements
KEYWORDS	Nuclear data, alpha-particle spectrometry, gamma-ray spectrometry, ionisation chamber, liquid scintillation, NaI well-type counter, semiconductor detectors, source preparation
RESULTS	Measurement of the alpha-particle emission probabilities of ²²⁶ Ra
	Gamma-ray emission intensities of ^{166m} Ho, ²³⁵ U and ²¹⁰ Pb.
	Studies in the decay of ²⁴³ Am
PUBLICATIONS	Peyrés, V.; García-Toraño, E., 2017, Determination of the absolute photon emission intensities of some gamma rays of 166mHo. Applied radiation and isotopes. DOI: 10.1016/j.apradiso.2017.06.035
IN PROGRESS	Alpha-particle emission probabilities of Pa-231, gamma-ray intensities of ^{234m} Pa
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	B. Caro Marroyo, A. Martín Sánchez, M. Jurado Vargas, E. García-Toraño, M. Roteta, 2017., Study of the 243Am decay, Applied Radiation and Isotopes, https://doi.org/10.1016/j.apradiso.2017.10.039.
	+ See MetroNORM description
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LABORATORY	Laboratorio de Metrología de Radiaciones Ionizantes (CIEMAT), Spain
NAMES	Teresa Crespo, Virginia Peyrés, Miguel Roteta, Marcos Mejuto, Anabel Sánchez-Cabezudo, Nuria Navarro, Eduardo García-Toraño, Daniel Muñoz
ACTIVITY	Standardization of alpha-, beta- and gamma-emitting sources for external clients
	Calibration of surface contamination monitors. Calibration of Activimeters (Radionuclide Calibrators)
KEYWORDS	Alpha spectrometry, beta spectrometry, coincidence method, data measurement, gamma-ray spectrometry, gas proportional counter, ionisation chamber, liquid scintillation, low-level, NaI well-type counter, radiochemistry, source preparation
RESULTS	Liquid and solid reference sources for environmental laboratories; interlaboratory comparisons; calibration certificates for equipment. More than 130 technical services completed.
PUBLICATIONS	
IN PROGRESS	Reference sources for external clients
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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	Nuria Navarro (LSC, reference sources),
	Eduardo García-Toraño (Nuclear Medicine, LSC)

LABORATORY	Laboratorio de Metrología de Radiaciones Ionizantes (CIEMAT), Spain	
NAMES	Virginia Peyrés, Teresa Crespo, Eduardo García-Toraño, Marcos Mejuto	
ACTIVITY	Participation in the EMRP project "JRP IND57 MetroNORM: Metrology for processing materials with high natural radioactivity"	
KEYWORDS	Gamma-ray spectrometry; alpha-particle spectrometry; nuclear data measurement; reference materials; radiochemistry; source preparation	
RESULTS	Radioactive characterization of different NORM matrices by gamma-ray spectrometry and radiochemistry and alpha-particle spectrometry.	
	New set of ²²⁶ Ra alpha-particle emission intensities in cooperation with JRC, LNHB)	
	New set of ²³⁵ U gamma-ray emission intensities (Int'l cooperation)	
	Ionex Resin, Pb-210 (JRP EMRP IND57 MetroNorm) comparison completed	
PUBLICATIONS	Maringer, FJ et al., 2017. Advancements in NORM metrology - Results and impact of the European joint research project MetroNORM. Applied Radiation and Isotopes, 126, 273-278.	
	Wiedner, H; Peyres, V; Crespo, T; Mejuto, M; Garcia-Torano, E; Maringer, FJ, 2017. Application of an artificial neural network for evaluation of activity concentration exemption limits in NORM industry. Applied Radiation and Isotopes 126, 289-292.	
	M. Marouli , S. Pommé , R. Van Ammel , E. García-Toraño , T. Crespo , S. Pierre, 2017. Direct measurement of alpha emission probabilities in the decay of ²²⁶ Ra. Applied Radiation and Isotopes 125, Pages 196-202.	
	Peyres, V; Crespo, T; Mejuto, M; Garcia-Torano, E, 2017. Measurement of NORM samples with CeBr ₃ detectors. Applied Radiation and Isotopes, 126, 307-310.	
	M. Marouli et al., 2018. Measurement of absolute γ -ray emission probabilities in the decay of ²³⁵ U,Applied Radiation and Isotopes, Volume 132	
	C. Larijani, A.K. Pearce, P.H. Regan, B.C. Russell, S.M. Jerome, M.T. Crespo, P. de Felice, G. Lutter, F. Maringer, M. Mazánová, 2017. Reference materials produced for a European metrological research project focusing on measurement of NORM. Applied Radiation and Isotopes 126, 279-284.	
IN PROGRESS	Characterization of zircon sand used in foundries and ceramic industries	
ADDRESS	Laboratorio de Metrología de Radiaciones Ionizantes, Avenida Complutense 40, 28040 Madrid, SPAIN	
	Tel.: +34 91 346 6225, E-mail: virginia.peyres@ciemat.es	
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	Tel.: +34 91 346 6553, E-mail: teresa.crespo@ciemat.es	
	Tel.: + 34 91 346 6244 E-mail: marcos.mejuto@ciemat.es	
CONTACT	Virginia Peyrés	

Institut de Radiophysique (IRA), Switzerland, SA1/SA2 2016-2019 Progress Report and Work Plan (information for ICRM members)

The programme at the Institut de Radiophysique (*IRA*) in the field of radionuclide metrology in the years 2015-2017 was on maintaining and developing the primary and secondary national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

The (IRA) staff in 2017 were:

Scientists	Function	
Claude Bailat	Head of radiometrology	
Youcef Nedjadi	Primary and secondary activity standards	
Frédéric Juget	Primary and secondary activity standards	
Teresa Durán	Primary and secondary activity standards	
Technicians		
Manuel Santos	Mechanical design and manufacturing	
Damien Bühlmann	Electronic and computing engineering	

The main specific activities carried out at IRA in this field are summarised below.

Activity line	IRA Radionuclide Metrology 2016-2017 Progress report	IRA Radionuclide Metrology 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	• New use of digital electronics or detector	 New use of digital electronics or detectors Metrobeta Horizon 2020 projects
International comparisons	 CCRI(II)-K2.Ge-68 CCRI(II) H-3 CCRI(II) comparison on Rn-222 Bilateral: IRA-LNHB (Rn-222) 	 CCRI(II) H-3 Trilateral: IRA-LNHB-NIM (Rn-222) Preparation of Ho-166m
Standardization of measurement methods	 Plastic scintillation validation TDCR: study of micelle's effects 	 New use of digital electronics or detectors Half-life measurement of Si-32

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Activity line	IRA	IRA
-	Radionuclide Metrology	Radionuclide Metrology
	2016-2017 Progress report	2018-2010 Work plan
	2010-2017 1 Togress Teport	
National QA	• Preparation of radioactive	Preparation of radioactive
programmes	standards (liquid solutions,	standards (liquid solutions,
and services	reference materials) for external	reference materials) for external
	ligarg	
	• Calibration services	• Calibration services
	• Calibration of activity samples used	Calibration of activity samples
	for comparison	used for comparison
	1	L
Manalana la tar		
Membership in	• ICRM committee membership	• ICRM committee membership
international	• BIPM/CCRI(II), IAEA, IEC,	• BIPM/CCRI(II), IAEA, IEC, ISO,
and national	ISO	
organisations		
Management	• European Projects:	Furopean Projects:
and	Matra Data (2 WDa WD2	• Matrobate (2 WDg WD2
	• MetroBeta (2 WPS, WP3	• Metrobeta (2 WPS, WPS
Organisation	leader)	leader)
		Horizon 2020 projects
Teaching		
activity		
Quality system		
Quanty system		

LABORATORY	Institut de Radiophysique (IRA), Switzerland	
NAMES	Claude Bailat, Frédéric Juget, Youcef Nedjadi, Maria Teresa Duràn	
ACTIVITY	Source preparation, coincidence method, NaI well counter, liquid and solid scintillation, gamma-ray spectrometry, ionization chamber, beta spectrometry, Monte Carlo simulation, Radon measurement, digitalization, proportional counter	
KEYWORDS	Beta spectrometry, (anti) coincidence method, cryogenic detector, data evaluation, data measurement, defined solid angle (ASD) measurement, environmental control, gamma-ray spectrometry, ionisation chamber, life sciences, liquid scintillation, low-level, NaI well-type counter, neutron measurement, radioactive gas, radiochemistry, simulation code, SIR, source preparation, traceability, solid sample reference	
RESULTS	Ge/Ga-68 and Rn-222 international comparison	
PUBLICATIONS	Frederic Juget, Youcef Nedjadi, Thierry Buchillier, François Bochud, Claude Bailat, <i>Determination of ¹³⁷Cs half-life with an ionization chamber</i> , Appl. Radiat. Isot. 118 (2016) 215-220	
	M. Teresa Durán, Youcef Nedjadi, Frederic Juget, François Bochud, Claude Bailat, <i>Fast digital</i> $4\pi\beta$ - $4\pi\gamma$ <i>coincidence counting with offline analysis at IRA</i> , Appl. Radiat. Isot. Available online 21 September 2017	
	Frederic Juget, Youcef Nedjadi, Thierry Buchillier, M. Teresa Durán, François Bochud, Christian Klotter, Claude Bailat, <i>A portable precision ionization</i> <i>chamber: The transfer ionization reference chamber</i> , Appl. Radiat. Isot. Available online 12 October 2017	
	J.T. Cessna et al., Result of an international comparison of activity measurement of ^{68}Ge , available online 7 November 2017	
IN PROGRESS	Study of liquid scintillation method	
	Building a new reference ionization chamber	
	Digitalization of the data acquisition and processing system	
	Rn-222 comparison and development of a new gas container	
	Further development of solid sample	
	Purification of Ho-166m solution	
	MetroBeta project	
INFORMATION	http://www.chuv.ch/ira	
OTHER RELATED PUBLICATIONS	C. Bailat, Jean-Pascal Laedermann, Sébastien Baechler, Laurent Desorgher, Abbas Aroua, François O. Bochud Dose Assessment Following an Overexposure of a Worker at a Swiss Nuclear Power Plant, J. Radiol. Prot. 37 (2017) 812–825.	
	Ruslan Cusnir, Maud Jaccard, Claude Bailat, Marcus Christl, Philipp Steinmann, Max Haldimann, François Bochud, Pascal Froidevaux, Probing the kinetic parameters of Pu-NOM interactions in freshwaters using the DGT technique, Environ. Sci. Technol., 2016, 50 (10), pp 5103–5110.	

	François Bochud, Jean-Pascal Laedermann, Sebastien Baechler, Claude Bailat, Converting specific activity into ambient dose equivalent: updated coefficients for in situ gamma spectrometry, RPD 2016, pp 1-8.	
	Pascal Froidevaux, François Bochud, Sébastien Baechler, Vincent Castella, Marc Augsburger, Claude Bailat, Katarzyna Michaud, Marietta Straub, Marco Pecchia, Theo M. Jenk, Tanya Uldin, Patrice Mangin, 210Po poisoning as possible cause of death: forensic investigations and toxicological analysis of the remains of Yasser Arafat, Forensic Science International, Volume 259, February 2016, Pages 1-9	
	M. Jaccard, K. Petersson, T. Buchillier, JF Germond, MT Durán, MC Vozenin, J. Bourhis, FO Bochud, C. Bailat, High dose-per-pulse electron beam dosimetry: Usability and dose-rate independence of EBT3 Gafchromic films, Med Phys. 2017 Feb;44(2):725-735.	
ADDRESS	Institut de Radiophysique Grand-Pré 1 CH-1007 Lausanne Switzerland	
	Tel.: +41 21 6233434 FAX: +41 21 6233435 E-mail: <u>claude.bailat@chuv.ch</u>	
CONTACT	Claude Bailat	

National Radiation Standard Laboratory, Institute of Nuclear Energy Research (NRSL/INER), Taiwan, SA1/SA2 2016-2019 Progress Report and Work Plan (information for ICRM members)

(information for ICRM members)

The programme at the National Radiation Standard Laboratory (NRSL/INER) in the field of radionuclide metrology in the years 2016-2019 was on maintaining and developing the primary and secondary national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

The NRSL/INER radionuclide metrology staff in 2017 were:

Scientists	Function
Ming-Chen Yuan	Head of laboratory, Primary activity standards,
Chien-Yung Yeh	Secondary activity standards, Liquid scintillation, Source preparation
Wei-Han Chu	Neutron standards, Gamma spectrometry

The main specific activities carried out at NRSL/INER in this field are summarised below.

nuclide Metrology 2017 Progress report velopment of new primary ndards: <i>Tc-99m, Mn-54</i>	 Radionuclide Metrology 2018-2019 Work plan Development of new primary standards: Cr-51, Ce-141
velopment of new primary ndards: <i>Tc-99m, Mn-54</i>	Development of new primary standards: <i>Cr-51, Ce-141</i>
	•
B-γ coincidence counting EMAT/NIST method CR er-comparisons with the tificated sources issued by er NMI RM WG comparisons MP/TCRI WG comparisons er-comparisons between different asurement methods	 4πβ-γ coincidence counting CIEMAT/NIST method TDCR Inter-comparisons with the certificated sources issued by other NMI ICRM WG comparisons APMP/TCRI WG comparisons Inter-comparisons between different measurement methods
paration of radioactive standards uid solutions, reference materials) external users. ibration services	 Preparation of radioactive standards (liquid solutions, reference materials) for external users. Calibration services Organisation of Profisional Tests
	MP/TCRI WG comparisons er-comparisons between different asurement methods paration of radioactive standards uid solutions, reference materials) external users. ibration services canisation of Proficiency Tests

Activity line	NRSL/INER Radionuclide Metrology 2016-2017 Progress report	NRSL/INER Radionuclide Metrology 2018-2019 Work plan
Membership in international and national organisations	ICRM committee membershipAPMP/TCRI	ICRM committee membershipAPMP/TCRI
Management and Organisation	•	•
Teaching activity	•	•
Quality system	Management of Quality System based on ISO 17025	Management of Quality System based on ISO 17025
LABORATORY	National Radiation Standard Laboratory, Institute of Nuclear Energy Research (NRSL/INER), Taiwan	
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NAMES	Ming-Chen Yuan, Chin-Hsien Yeh, We-Han Chu	
ACTIVITY	Standardization of Mn-54	
	Handled proficiency testing programs of survey meters in Taiwan.	
KEYWORDS	coincidence circuit, absolute counting method, Mn-54, accreditation	
RESULTS	Mn-54 was standardized by $4\pi\beta - \gamma$ coincidence counting method, and the measurement uncertainty was less than 0.5%. In-house comparison with PTB (Germany), it showed a well agreement.	
	Six laboratories participated in this proficiency testing program and this program will be finished in 2018.	
PUBLICATIONS	Ming-Chen Yuan, Yi-Chun Lin, Wei-Han Chu and Chin-Hsien Yeh, Standardization of ¹⁰⁹ Cd by three methods, ICRM 2017, May 15-19, 2017. Buenos Aires, Argentina.	
	Chin-Hsien Yeh, Ming-Chen Yuan, Impact Evaluations of Activity Measurement Results for Clearance Operations, ICRM 2017, May 15-19, 2017. Buenos Aires, Argentina.	
IN PROGRESS	Cr-51 Standardization	
	Handled proficiency testing programs of survey meters, environmental radioactivity analysis and low-intermediate level radioactivity analysis	
OTHER RELATED PUBLICATIONS		
ADDRESS	Heath Physics Division, Institute of Nuclear Energy Research, No.1000, Wuuhua Rd., Jiaan Village, Longtan Township, Taoyuan County, 325, Taiwan E-mail: <u>mcyuan@iner.gov.tw</u>	
CONTACT	Ming-Chen Yuan	

TAEK-SANAEM, Radiation Metrology Laboratories, Turkey, SA1/SA2 2016-2019 Progress Report and Work Plan (information for ICRM members)

The programmes at the Turkish Atomic Energy Authority Sarayköy Nuclear Research and Training Center Ionising Radiation Metrology Division (TAEK SANAEM-RMB) in the field of radionuclide metrology in the years 2016-2019 were and will be focused, as in the past, on maintaining and developing the national standards for activity measurements and on the more general activities in the field of standardisation and quality-assurance in radioactivity measurements.

Scientists	Function
Ü. Yücel	TAEK-SANAEM Radiation Metrology Division Head
E. Yeltepe	Radionuclide standardization by gamma spectrometry
N. K. Şahin	Radionuclide standardization by gamma spectrometry
N. Aslan	Radionuclide standardization by liquid scintillation
G. Özçayan	Radionuclide standardization by liquid scintillation
A. Dirican	Radionuclide standardization by alpha spectrometry

The TAEK-SANAEM Radionuclide Metrology staff in 2017 were:

The main specific activities carried out at TAEK-SANAEM in this field are summarised below.

Activity line	TAEK-SANAEM Radionuclide Metrology 2016-2017 Progress report	TAEK-SANAEM Radionuclide Metrology 2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	Optimization of alpha particle counting system at defined solid angle, Validation of TDCR method	Setting up, software development and validation of 4π - β - γ digital coincidence counting system
International comparisons	Key Comparison CCRI(II)-K2.Ge-68	SIR (Ba-133, Co-60, Cs-137, Ge-68, Eu-152) BIPM CCRI(II)-S13 (Supplementary comparison - Cs-134 and Cs-137 in wheat flour
Standardization of measurement methods	Standardization with ionization chamber Standardization with HPGe detectors Standardization with CIEMAT-NIST method Standardization with TDCR method	Standardization with the ionization chamber Standardization with HPGe detectors Standardization with CIEMAT-NIST method Standardization with TDCR method Standardization with 4π - γ counting system Standardization with 4π - β - γ -counting system
National QA programmes and services	Collaboration with IAEA (ALMERA Network proficiency tests) Organization of proficiency tests on national and international scale	Preparation of radioactive standard reference materials for external users, Preparation of standard point sources for calibration

Activity line	TAEK-SANAEM Radionuclide Metrology 2016-2017 Progress report	TAEK-SANAEM Radionuclide Metrology 2018-2019 Work plan
	Preparation of radioactive standard reference materials	Calibration of radionuclide calibrators with a reference ionization chamber, Organization of proficiency tests on national and international scale
Membership in international and national organisations	IAEA ALMERA Membership EURAMET TC IR ICRM committee membership	IAEA ALMERA Membership ICRM committee membership EURAMET TC IR, BIPM CCRI(II)
Teaching activity	EMRP ENV57 "Metrology for radiological early warning networks in Europe" WP2 Airborne radioactivity monitoring Networks	Participation in EMPIR projects
Quality system	Training course for a private company in Turkey on liquid scintillation counting	Workshops for national laboratories Invited lectures

LABORATORY	TAEK-SANAEM, Radiation Metrology Laboratories, Turkey
NAMES	Ü. Yücel, E. Yeltepe, N.K. Şahin, N. Aslan, G. Özçayan, A. Dirican
ACTIVITY	Organization of proficiency tests on national and international scale Organization of workshop for national laboratories Liquid scintillation counting Gamma-ray spectrometry Alpha particle counting and alpha spectrometry Preparation of reference materials
KEYWORDS	Alpha spectrometry, gamma-ray spectrometry, Compton suppression system, liquid scintillation counting, TDCR, CIEMAT/NIST, low-level counting, radiochemistry, proficiency test, traceability, reference material
RESULTS	¹⁴² Pr and ¹⁷⁰ Tm activity concentrations were standardized with CIEMAT/NIST efficiency tracing method, gamma spectrometry and a calibrated ionization chamber. A defined solid angle alpha spectrometric system with accurate dimensions was
	designed and installed for primary standardisation. The design and construction of alpha source preparation systems were completed. Validation and uncertainty budget studies were completed
	Efficiency calibration, verification and validation of secondary standard radionuclide calibrator was completed and ready for use as radioactivity standardization method. Activity concentrations of Ba-133, Co-60, Cs-137, Ge-68 and Eu-152 standard solutions prepared from the PTB standards in our own ampoules were determined and transferred into BIPM ampoules. They were sent BIPM for measurement and be used as CMC claims for these radionuclides.
	TAEK participated in the Key Comparison CCRI(II)-K2.Ge-68 organized by BIPM and NIST/USA as pilot laboratory. Ge-68 measurements by ionization chamber have been submitted to NIST. Evaluation by NIST was completed. TAEK's result fell within 1% of the proposed comparison reference value.
	The results of the second proficiency test of Radiation Metrology Division, "TAEK-RMB-2015-01 Proficiency test on the determination of Cs-137, K-40 and Sr-90 activity levels in processed black tea" was evaluated and PT Evaluation Report was shared with the participants.
	Test samples used for TAEK-RMB-2015-01 Proficiency Test was certified as TAEK-RM-1 black tea powder reference material.
	3-year EMRP Project ENV57 "Metrology for radiological early warning networks in Europe" was completed in 31 May 2017. In the scope of WP2 "Airborne radioactivity monitoring Networks", studies on the "development of rapid extraction methods for alpha and beta-particle emitting radionuclides in air dust" and "minimum detectable activity (MDA) of ²⁴¹ Am in air filters with a Compton suppression spectrometer and related counting statistics" were completed and reported.
	Methods for the determination of the radionuclide impurities in ^{99m} Tc eluate (sodium pertechnetate solution) used in the medical diagnosis and therapy, especially the long-lived radionuclides were developed.

	SANAEM secondary standard dosimetry laboratory was established. Calibration services are expected to start to by the end of 2018.
PUBLICATIONS	E. Yeltepe, N.K. Şahin, N. Aslan, M. Hult, G. Özçayan, H. Wershofen, Ü. Yücel, "A review of the TAEA proficiency test on natural and anthropogenic radionuclides activities in black tea", <i>Applied Radiation and Isotopes</i> , 134 (2018), 40-44.
	E. Yeltepe, H. Yücel "Standardization of ¹⁴² Pr activity concentration", <i>Applied Radiation and Isotopes</i> , 134 (2018) 263–268
	J.T. Cessna, R. Fitzgerald, B.E. Zimmerman, L. Laureano-Pérez, E. Yeltepe, A. Dirican et al "Results of an international comparison of activity measurements of ⁶⁸ Ge", <i>Applied Radiation and Isotopes</i> , 134 (2018), 385-390
	Andrej Rožkov, Viktor Jobbágy, Gulten Özçayan, "Optimization of the liquid scintillation counting technique for the European interlaboratory comparison on gross α/β activity concentrations in water", <i>J Radioanal Nucl Chem</i> , (2017) 314:773–780.
	N. Aslan, G. Özçayan, "Isolation and measurement of strontium-90 activity in soil sample using Cherenkov counting and liquid scintillation spectrometry", <i>Fresenius Environmental Bullet Fresenius</i> , 26 (6), pp 3856-3862 (2017).
	N. Aslan, E. Yeltepe, Ü. Yücel, N. Kaya, A. Kurt, G. Gündoğdu "Determination of ⁹⁰ Sr, ¹⁴ C, ⁴⁰ K, ¹³⁴ Cs, and ¹³⁷ Cs Activities in the Total Diet Around Potential Nuclear Power Plant Sites in Turkey", <i>Journal of Scientific and Engineering Research</i> , 2016, 3(3):482-489
	D. Zapata-Garcia, H. Wershofen, M. Seferinoğlu, A. Dirican, N. Aslan, G. Özçayan, Ü. Yücel "Assessment And Comparison of Methods For The Fast Analysis of Alpha And Beta Emitters in Air Filters", <i>poster</i> , NRC9- IX. International Conference On Nuclear And Radiochemistry, 25 Ağustos-2 Eylül 2016, Helsinki-Finland.
	E. Yeltepe, K. Kossert, A. Dirican, O. Nähle, C. Niedergesäß, N. K. Şahin "Calibration and efficiency curve of SANAEM ionization chamber for activity measurements" <i>Applied Radiation and Isotopes</i> , 109 (2016), 70-73
	A. Dirican, M. Şahin "Comparison of acid leaching and fusion techniques to determine uranium in soil samples by alpha spectrometry" <i>Applied Radiation and Isotopes</i> , 109 (2016), 189-192
	N.K. Şahin, E. Yeltepe, Ü. Yücel "A review of the nationwide proficiency test on natural radioactivity measurements by gamma spectrometry" <i>Applied</i> <i>Radiation and Isotopes</i> , 109 (2016), 49-53
IN PROGRESS	Standardization with the ionization chamber
	Standardization with HPGe detectors
	Standardization with CIEMAT-NIST method
	Standardization with TDCR method
	Standardization with 4-pi-gamma counting system
	Standardization with defined solid angle alpha spectrometer
	Setting up and validation of a 4π - β - γ coincidence counting system
	Organisation of a proficiency test on determination of natural and anthropogenic radioactivity concentrations in thermal water

	Preparation and dispatch of PT samples, evaluation of the results and preparation of PT Evaluation Report
	Preparation of radioactive standards for external users
	Preparation of radioactive standard point sources
	Organisation of a workshop on radioactivity measurements, measurement uncertainty and evaluation of results of TAEK-RMB- 2015-01 Proficiency test on the determination of Cs-137, K-40 and Sr- 90 activity levels in processed black tea
	Calibration of radionuclide calibrators with a reference ionization chamber
INFORMATION	-
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
ADDRESS	Sarayköy Nuclear Research and Training Center Saray Mah. Atom Cad. No. 27 Kazan 06983 Ankara TURKEY E-mail: <u>ulku.yucel@taek.gov.tr</u>
CONTACT	Ü. Yücel

LABORATORY	TAEK-SANAEM, Radioactivity and Analytical Measurement Laboratories, Turkey
NAMES	S. Yüksek, D. Erçin, N. Kaya, A. Kurt, M. Şahin, M. Özgür, H. Dikmen, Y. Ö. Özkök, Y. Ağuş, M. Kaplan, A.T. Bakioğlu, S. Özvatan, A. Zararsız, Y. Kalaycı, R. Kırmaz, N.B. Öztaş, E. Çantay, Ö. Kantoğlu, E. Ergun, Y. Mert, O. Oktar
ACTIVITY	Gross Alpha/Beta counting technique with proportional counters are used in the analysis of gross alpha beta activity in drinking water, natural mineral water, hot springs, sea water, air filtration and other environmental samples and analysis of Pb-210 activity in water samples.
	³ H measurements in water, ⁹⁰ Sr measurements in water, food and environmental samples by Liquid Scintillation Spectrometry (LSC).
	²³⁴ U, ²³⁸ U, ²¹⁰ Po and ²²⁶ Ra measurements in environmental samples by alpha spectrometry.
	Gamma activity measurements in food and environmental samples. Radiocarbon dating of archaeological and geological samples (¹⁴ C dating method).
	Elemental analysis of soil, liquid, powder, bulk form samples by using different types of XRF spectrometer
	Analysis of uranium and thorium isotopes by HR-ICP-MS Participation in international/national comparisons
KEYWORDS	Alpha spectrometry, beta spectrometry, gamma-ray spectrometry, gas proportional counter, liquid scintillation, low-level, radiochemistry, simulation code, source preparation, traceability, X-ray spectrometry
RESULTS	EPA 900.0 Standard Method "Gross Alpha and Gross Beta in Drinking Water".
	ASTM D 4107-08 "Standard Test Method for Tritium in Drinking Water".
	"Determination of Radium Isotopes by BaSO ₄ Coprecipitation for the Preparation of Alpha Spectrometric Sources" method for ²²⁶ Ra radioisotope in water samples.
	Eichrom ACW02 Coded "Uranium in Water" method for ²³⁴ U, ²³⁸ U radioisotopes in water samples.
	ASTM E-181 Standard test method for measurement of the activities of gamma- ray emitting ¹³⁴ Cs and ¹³⁷ Cs radionuclides in foodstuffs and ⁴⁰ K, ¹³⁷ Cs, ²²⁶ Ra and ²³² Th radionuclides in building materials and soil samples with high purity Germanium detectors.
	Experiment Instruction of Na, Mg, Al, Si, K, Ca, Ti, Mn, Fe, P, Sc, V, Cr, Co, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Pb, La, Th And U Elements Analysis By WDXRF Spectrometry Experiment methods
	The methods mentioned above were accredited by TURKAK (Turkish Accreditation Agency) on May 2009 and revised on June 2017 according to ISO 17025
PUBLICATIONS	N. Aslan, E. Yeltepe, Ü. Yücel, N. Kaya, A. Kurt, G. Gündoğdu, "Determination of ⁹⁰ Sr, ¹⁴ C, ⁴⁰ K, ¹³⁴ Cs, and ¹³⁷ Cs Activities in the Total Diet Around Potential Nuclear Power Plant Sites in Turkey", <i>Journal of Scientific and Engineering Research</i> , (2016), 3(3):482-489

	Y. Ağuş, "Effect of the Radon Background Fluctuation on the Low Activity Measurement of the ²¹⁴ Pb, ²¹⁴ Bi and ²²⁶ Ra", <i>Süleyman Demirel University</i> <i>Journal of Natural and Applied Sciences</i> , (2017), Vol 21, Iss 2, 345-349
	Y. Ağuş, "Radioactivity concentrations of the milk and dairy products", Balikesir University Inst. Sci. Technol., (2017), 19(2), 169-176.
	M. Şahin, A. Dirican, N. K. Şahin, "Radiochemical separation and determination of radium-228 in bottled mineral waters by low level gamma spectrometry and its committed effective dose", <i>Environmental Earth Sciences</i> (2017) 76:795
	M. Şahin, M. E. Korkmaz, O. Agar, A. Dirican, "A study of gross alpha and beta measurements for thermal springs in Central Anatolia, Turkey", <i>Environmental Earth Sciences</i> (2017) 76:121
	M. Uygun-Sarıbay, E. Ergun, Y. Kalaycı, T. Köseoğlu, "The secondary structure of proteins in liquid, frozen, and dried egg-white samples: Effect of gamma irradiation treatment", <i>International Journal of Food Properties</i> , (2017), Vol 20, Iss. 2
	Ö. Kantoğlu, E. Ergun, D. Ozmen, H. B.D. Halkman, "A biological survey on the Ottoman Archive papers and determination of the D10 value", <i>Radiation Physics and Chemistry</i> , (2018 Online : 2017), Vol 144
	Ö. Kantoğlu, "Decoloration and Mineralization of Aqueous Solution of Cationic (Basic) Dye Astrazon Black FDL By Using Gamma Rays", <i>Radiochimica Acta</i> , (2017), 105 (3), 241.
IN PROGRESS	The study of investigating of Po-210 and Pb-210 radioactivity level in tobacco products grown in Turkey and calculating of radiation dose exposure.
	The study of the preparation, characterization of conductive polymer-doped composites and use it in some radioactive ions adsorption.
	Validating a procedure for routine measurement of ²¹⁰ Pb in water by LSS and Gross alpha and beta counting,
	Validating a procedure for routine measurement of ²²⁸ Ra in water by Gamma Spectrometry and Gross alpha and beta counting,
	Validating a procedure for routine measurement of ¹³⁷ Cs in water by LSS and Gross alpha and beta counting,
	Validating a procedure for routine measurement of ²¹⁰ Po in tobacco by alpha spectrometry
	Calibration of in-situ gamma spectrometry
	Analysis of Pu isotopes by HR-ICP-MS
SOURCE IN PREPARATION	
ADDRESS	Sarayköy Nuclear Research and Training Center Saray Mah. Atom Cad. No. 27 Kazan 06983 Ankara TURKEY
	E-mail: abdullah.dirican@taek.gov.tr
CONTACT	Abdullah.Dirican

LABORATORY	National Physical Laboratory (NPL), UK
NAMES	Sean Collins, Giuseppe Lorusso, Rob Shearman, Patrick Regan, John Keightley, Andrew Fenwick, Kelly Ferreira, Andrew Robinson, Andy Pearce, Arzu Arinc, Paris Aitken-Smith
ACTIVITY	Nuclear Data
KEYWORDS	Nuclear data, gamma-ray, half-life, nuclear structure, evaluations
RESULTS	Measurement of the absolute gamma-ray and/or positron emission intensities from ²²⁷ Th, ¹⁵³ Gd, ¹⁵⁵ Tb, ⁹⁰ Y, ⁶⁸ Ga and ²³¹ Pa.
	Measurement of the half-lives of ¹⁰⁹ Cd, ¹¹¹ Ag, ²¹⁹ Rn, ¹⁵⁵ Tb, ⁶⁸ Ga, ¹⁶⁶ Ho and ²³¹ Pa.
	Development of a multi-LaBr3 fast timing coincidence gamma-ray spectrometer for nuclear decay and structure studies.
PUBLICATIONS	Collins, S. M., Harm, A. V., Regan, P. H., 2016. Half-life determination of the ground state decay of ¹¹¹ Ag. Appl. Radiat. Isot 108 , 143-147
	Lorusso, G., <i>et al.</i> , 2016. Development of the NPL gamma-ray spectrometer NANA for traceable nuclear decay and structure studies. Appl. Radiat. Isot. 109 , 507-511.
	Fenwick, A. J., Ferreira, K. M., Collins, S. M., 2016. Measurement of the ¹⁰⁹ Cd half-life. Appl. Radiat. Isot. 109 , 151-153.
	Aitken-Smith, P. M., Collins, S. M., 2016. Measurement of the ²¹¹ Pb half-life using recoil atoms from ²¹⁹ Rn decay. Appl. Radiat. Isot. 110 , 59-63.
	MM. Bé, V. Chisté, C. Dulieu, M.A. Kellett, X. Mougeot, A. Arinc, V.P. Chechev, N.K. Kuzmenko, T. Kibédi, A. Luca, A.L. Nichols, 2016. Table of Radionuclides, BIPM Monographie N°5, Vol. 8, Bureau International des Poids et Mesures, Sèvres, France.
	Pommé, S., <i>et al.</i> , 2016. Evidence against solar influence on nuclear decay constants. Phys Lett. B 761 , 281-286.
	Shearman, R., <i>et al.</i> , 2017. Absolute intensities of the gamma-ray emissions originating from the electron capture decay of ¹⁵³ Gd. EPJ Conf. 146 , 10008. DOI: 10.1051/epjconf/201714610008.
	Ferreira, K. M., Collins, S. M., Fenwick, A. J., 2017. Half-life measurement of the medical radioisotope ¹⁷⁷ Lu produced from the ¹⁷⁶ Yb(n,γ) reaction. EPJ Conf. 146 , 08002. DOI: 10.1051/epjconf/201714608002.
	Lorusso, G., <i>et al.</i> , 2017. Measuring radioactive half-lives via statistical sampling in practice. EPL 120, 22001. DOI: 10.1209/0295-5075/120/22001.
	Susuki, H., <i>et al.</i> , 2017. Discovery of ⁷² Rb: A nuclear sandbank beyond the proton drip-line. Phys. Rev. Lett. 192503-1-6. DOI:10.1103/PhysRevLett.119.192503
	Kondev, F. G., et al., 2018. Nuclear Data Sheets for A=217, Nuclear Data Sheets 147, 382-458. DOI: 10.1016/j.nds.2018.01.002.
IN PROGRESS	The potential radioimmunotherapeutic α -emitter ²²⁷ Th – part I: Standardisation via primary liquid scintillation techniques and decay progeny ingrowth measurements. Collins, S. M., <i>et al.</i> , 2018.
	The potential radioimmunotherapeutic α -emitter ²²⁷ Th – part II: Absolute γ -ray emission intensities from the excited levels of ²²³ Ra. Collins, S. M. <i>et al.</i> , 2018.

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Terbium-155: Primary standardisation and precision measurements of the gamma-ray emission intensities and radioactive decay constant. Collins, S. M., <i>et al.</i> , 2018.	
Positron branching ratio of ⁹⁰ Y. Lorusso, G., et al., 2018.	
Evaluation of ³⁸ K. Lorusso, G., 2018.	

	Evaluation of ³⁸ K. Lorusso, G., 2018.
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CONTACT	Sean Collins

LABORATORY	National Physical Laboratory (NPL), UK	
NAMES	Ben Russell	
ACTIVITY	Inductively coupled plasma mass spectrometry (ICP-MS)	
KEYWORDS	Data evaluation, data measurement, low-level, radiochemistry, Sm-151, Pa-231, Zr-93, Sr-90, Np-237	
RESULTS	 Measurement of: Sm-151 in spiked graphite samples Sr-90 in soils, sediments and cements Np-237 in effluent samples from a nuclear reprocessing facility Ra-226 in various water samples Actinides in concrete Stable element composition has been measured for multiple samples matrices prior to deciding on radiochemical separation techniques required, including the matrices above.	
	Stable or long-lived tracers have also been used to test the effectiveness of separation prior to active testing for short-lived radionuclides relevant to nuclear medicine, such as Tb/Ce separation.	
PUBLICATIONS	 Atomic spectrometry update: review of advances in the analysis of metals, chemical and materials. S.Carter, A.Fisher, B.Gibson, J.Marshall, B.Russell, I.Whiteside. J. Anal. Atom. Spectrom. 2017, 32, 2068-2117 Interference-free determination of sub ng kg⁻¹ levels of long-lived ⁹³Zr in the presence of high concentrations (μg kg⁻¹) of ⁹³Mo and ⁹³Nb using ICP-MS/MS. P.Petrov, B.Russell, D.N.Douglas, H.Goenaga-Infante. Anal. Bioanal Chem 2017, 410(3), 1029-1037 	
	 Isolation and purification of protactinium-231. S.Jerome, S.M.Collins, S.Happel, P.Ivanov, B.Russell. Appl. Radiat. Isotope. 2017, In Presss, corrected proof Evaluation of the separation and purification of ²²⁷Th from its decay progeny by anion exchange and extraction chromatography. P.Ivanov, S.M.Collins, E.M.van Es, M.Garcia-Miranda, S.M.Jerome, B.C.Russell. Appl. Radiat. Isotope. 2017, 124, 100-105 	
	 Plasma source mass spectrometry for radioactive waste characterisation in support of nuclear decommissioning: a review. I.W.Croudace, B.C.Russell, P.E.Warwick, J. Anal. Atom. Spectrom. 2017, 32, 494-526 Metrology for decommissioning nuclear facilities: Partial outcomes of joint research project within the European Metrology Research Program. J.Suran, P.Kovar, J.Smoldasova, J.Solc, R.Van Ammel, M.Garcia Miranda, B.Russell, D.Arnold, D.Zapata-García, S.Boden, B.Rogiers, J.Sand, K.Peräjärvi, P.Holm, B.Hay, G.Failleau, S.Plumeri, Y.L.Beck, T.Grisa 	
	Rapid Analysis of Radium-226 in Water Samples by ICP-QQQ. B.Russell, E.M. van Es, G.Woods, D.Read, Agilent Application Note, <u>https://www.agilent.com/cs/library/applications/8800_ICP-MS_5991-8324EN_radium_analysis.pdf</u>	

IN PROGRESS	Procedures are being developed and validated for measurement of Sr-90 and Np-237 by ICP-MS, with the ultimate aim to develop new measurement services for the nuclear industry.	
	The first measurement of Sm-151 by tandem ICP-MS/MS has been achieved in standards and spiked graphite samples as part of a European Metrology Research Project (Metrology for Decommissioning). The manuscript for this work has just been accepted for publication	
	Characterisation of concrete for stable element and long-lived radionuclide concentrations as part of Proficiency Test Exercise and Horizon 2020 (Insider) projects	
	Development of procedures for measurement of Ni-59 and Ni-63 in steel, and Ca-41 in concrete	
INFORMATION	The Nuclear Metrology Group at NPL has a tandem inductively coupled plasma mass spectrometer (Agilent 8800 ICP-MS/MS), consisting of a collision-reaction cell positioned between two quadrupole mass filters. This configuration reduces the reliance on offline chemical separation prior to measurement by offering online instrumental separation of the radionuclide of interest from interferences.	
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CONTACT	Ben Russell	

Announcements:

- 1) Upcoming conferences: Invited presentation at Agilent (instrument manufacturer) user group meeting (March 2018), Radiobioassay and Radiochemical Measurement Conference (RRMC) workshop (May 2018), World Conference on Chromatography (September 2018)
- Current PhD thesis topics in progress: Joint funded NPL/University of Southampton PhD (3rd year) investigating the capabilities of tandem ICP-MS/MS for nuclear decommissioning Joint-funded NPL/University of Surrey PhD (1st year) for developing of radiological characterisation techniques and reference materials
- Masters placement students: University of Surrey MPhys (10 months, ending December 2017)- development and characterisation for 3D printed materials for phantoms in nuclear medicine

University of Birmingham (3 months, ending September 2017)- development of procedures for measurement of Ni-59 and Ni-63 for nuclear decommissioning

LABORATORY	National Physical Laboratory (NPL), UK	
NAMES	Steven Bell	
ACTIVITY	Absolute gas counting	
KEYWORDS	Beta spectrometry, Euromet, gamma-ray spectrometry, gas proportional counter, radioactive gas	
RESULTS	Standardisation of low-level ¹⁴ CH ₄ and ¹⁴ CO ₂ for EMRP projects Biogas and MetroDecom.	
	Standardisation of ¹¹ CO ₂ .	
PUBLICATIONS		
IN PROGRESS	Development of flow-through radioactive gas monitor calibration system. Inter-comparison of Xe-133.	
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CONTACT	Steven Bell	

LABORATORY	National Physical Laboratory (NPL), UK	
NAMES	Arzu Arinc, Julian Dean, Andy Pearce	
ACTIVITY	Liquid scintillation counting	
KEYWORDS	Liquid scintillation, CIEMAT/NIST, TDCR	
RESULTS	Standard solutions prepared of ¹⁴ C (as glucose), ³⁵ S, ⁹⁰ Y, ¹²⁹ I, ¹⁴⁷ Pm, ²⁰⁸ Po, ²¹⁰ Po, ²³¹ Pa, ²³² U, ²³³ U, ²³⁶ Pu, ²³⁷ Np, ²³⁹ Pu, ²⁴² Pu. Radioanalytical measurements of ⁹⁹ Tc, ¹⁴⁷ Sm and ²²⁷ Ac by LSC	
	Acquisition of Hidex 300 SL liquid scintillation counter	
PUBLICATIONS	Results of the CCRI(II)-S12.H-3 supplementary comparison: Comparison of methods for the calculation of the activity and standard uncertainty of a tritiated-water source measured using the LSC-TDCR method", Philippe Cassette, Timotheos Altzitzoglou, Andrei Antohe, Mario Rossi, Arzu Arinc, Marco Capogni, Raphael Galea, Arunas Gudelis, Karsten Kossert, K.B. Lee, Juncheng Liang, Youcef Nedjadi, Pilar Oropesa Verdecia, Tanya Shilnikova, Winifred van Wyngaardt, Tomasz Ziemek, Brian Zimmerman, Applied Radiation and Isotopes (2017). "Standardisation of ⁹⁰ Y and determination of calibration factors for ⁹⁰ Y microspheres (resin) for the NPL secondary ionisation chamber and a Capintec CRC-25R", K.M. Ferreira, A.J. Fenwick, A. Arinc, L.C. Johansson, Applied Radiation and Isotopes 109, 226-230 (2016).	
IN PROGRESS	Standardisation of ¹⁵² Eu and ²²⁷ Th by efficiency tracing techniques Development of software for analysis of TDCR measurement data Validation of the Hidex counter	
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LABORATORY	National Physical Laboratory (NPL), UK	
NAMES	Arzu Arinc, John Keightley	
ACTIVITY	Primary standardisation of alpha emitters	
KEYWORDS	Defined solid angle (DSA) alpha counting, primary standardisation	
RESULTS	Standardisations of ²³¹ Pa, ²³⁶ Pu	
PUBLICATIONS	"Defined solid angle alpha counting at NPL", A. Arinc, M.J. Parfitt, J.D. Keightley, A. Wilson, Applied Radiation and Isotopes 109, 198-204 (2016).	
IN PROGRESS	Purchase of an autoradiography system	
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CONTACT	Arzu Arinc	

LABORATORY	National Physical Laboratory (NPL), UK		
NAMES	Andrew Fenwick, Kelley Ferreira, Andrew Robinson, Jill Wevrett, Ana Denis-Bacelar, Sean Collins, John Keightley		
ACTIVITY	Nuclear Medicine Metrology (Life Sciences)		
KEYWORDS	Data measurement, ionisation chamber, life sciences, SPECT/PET/CT		
RESULTS	Determination of calibration factors for medical radionuclides (see Ionisation Chamber report from NPL)		
	Measurement of Half-lives and gamma emission probabilities for medically relevant radionuclides (see Nuclear Data report from NPL)		
PUBLICATIONS	Kelley M. Ferreira, et al., ¹²³ I intercomparison exercises: Assessment of measurement capabilities in UK hospitals, Applied Radiation and Isotopes, Volume 134, 2018, Pages 108-111, ISSN 0969-8043, <u>https://doi.org/10.1016/j.apradiso.2017.11.015</u> .		
	A.J. Fenwick , et al., Quantitative imaging, dosimetry and metrology; Where do National Metrology Institutes fit in? Applied Radiation and Isotopes, Volume 134, 2018, Pages 74-78, ISSN 0969-8043, https://doi.org/10.1016/j.apradiso.2017.11.014 .		
	Maxime Chauvin Ana M. Denis-Bacelar Andrew P. Robinson et al., Abstract ID: 155 OpenDose: A collaborative effort to produce reference dosimetric data with Monte Carlo simulation software, Physica Medica,Volume 42, supplement 1, 2017, Pages 32-33, ISSN 1120-1797, https://doi.org/10.1016/j.ejmp.2017.09.081.		
	Wevrett, Jill , et al., (2017) Development of a calibration protocol for quantitative imaging for molecular radiotherapy dosimetry Radiation Physics and Chemistry, 140. pp. 355-360.		
	Denis-Bacelar AM , Chittenden SJ, McCready VR, Divoli A, Dearnaley DP, O'Sullivan JM, et al. Bone lesion absorbed dose profiles in patients with metastatic prostate cancer treated with molecular radiotherapy. Br J Radiol 2018; 91: 20170795.		
	Denis-Bacelar, A.M ., Chittenden, S.J., Dearnaley, D.P. et al. Eur J Nucl Med Mol Imaging (2018) 45: 515. https://doi.org/10.1007/s00259-017-3902-2		
IN PROGRESS	Primary standardisation of ⁸⁹ Zr and determination of calibration factors for the NPL secondary standard ionisation chambers; Fenwick AJ et al., 2016		
	Measurement of absolute gamma emission probabilities for ⁸⁹ Zr; Fenwick AJ, et al., 2016		
	Measurement of the half-life of ⁸⁹ Zr; Fenwick AJ, et al., 2016		
	Inter-comparison of quantitative SPECT/CT imaging of lutetium-177 (177Lu) in European hospitals Jill Lynda Wevrett; Andrew Fenwick; et al., (EJNMMI Physics)		
	Clinical quantitative PET/CT imaging of ⁸⁹ Zr and development of calibration protocol; Fenwick AJ, et al., 2016		
	A heterogeneous 3D printed mouse phantom for pre-clinical imaging and radiotherapy dosimetry quality assurance, A Robinson et al (2018)		
	First clinical SPECT imaging of 155Tb: towards a theranostic isotope quartet, A Robinson et al (2018)		

INFORMATION	Installation of SPECT-CT-PET system (three modalities in single scanner) in December 2017.		
	A new rapid phantom prototyping laboratory focused on the use of 3D printing for phantom production and tissue equivalent material development.		
	Currently have 5 PhD students working on:		
	"Traceability of Patient Dose in Molecular Radiotherapy" (part-time)		
	"Metrology for nanoparticles used in nuclear medicine therapy and diagnostics"		
	"Establishing the traceability of novel theranostic isotopes: from production to imaging"		
	"The purification of Lanthanide Isotopes and their binding to novel materials for pharmaceutical applications"		
	"Quantitative Imaging of I-131"		
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Announcements:

Nuclear Medicine Metrology meeting, including sections relating to quantitative SPECT and PET imaging to be held at NPL on July 12/13th 2018.

LABORATORY	National Physical Laboratory (NPL), UK	
NAMES	Andrew Fenwick, Kelley Ferreira, Sean Collins, John Keightley, Giuseppe Lorusso	
ACTIVITY	Ionisation Chambers	
KEYWORDS	Data measurement, ionisation chamber, life sciences, Ge/Ga-68, Ho-166, Th-227, Ra-223, Tb-155, Zr-89	
RESULTS	New Calibration factors and geometry assessments performed for Ge/Ga-68, Ho-166, Th-227, Ra-223, Tb-155, Zr-89. Factors for Vinten 671 master system (parent of the Vinten/NE ISOCAL IV, NPL-CRC, and Fidelis Ionisation chambers)	
PUBLICATIONS	Kelley M. Ferreira , et al., ¹²³ I intercomparison exercises: Assessment of measurement capabilities in UK hospitals, Applied Radiation and Isotopes, Volume 134, 2018, Pages 108-111, ISSN 0969-8043, <u>https://doi.org/10.1016/j.apradiso.2017.11.015</u> .	
IN PROGRESS	Ho-166 Primary standardisation and nuclear data measurement Th-227 Primary standardisation and nuclear data measurement Zr-89 Primary standardisation and nuclear data measurement Tb-155 Primary standardisation and nuclear data measurement Upgrade to electronic current measurement system (ongoing)	
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Announcements:

Nuclear Medicine Metrology meeting, including Radionuclide Calibrator user forum to be held at NPL on July 12/13th 2018.

Radionuclide Calibrator e-Learning course now available on the NPL website. Aimed at trainee physicists in nuclear medicine departments, but good background for anybody using these commercial ionisation chamber systems.

Update to the NPL Good Practice Guide #93 (Protocol for establishing and maintaining the calibration of Medical radionuclide calibrators and their quality control) planned for 2018/19

LABORATORY	National Physical Laboratory (NPL), UK	
NAMES	John Keightley, Sean Collins, Andy Pearce, Andrew Fenwick, Rob Shearman	
ACTIVITY	Primary measurements: 4π(LS)-γ coincidence counting, 4π(APPC)-γ coincidence counting, 4π(HPPC)-γ coincidence counting	
KEYWORDS	Coincidence method, gas proportional counter, liquid scintillation, traceability	
RESULTS	Primary standards of: Ra-223, Th-227, Ge/Ga-68, Pa-233, Pa-231, Tb-155, Mn-54, Cs-134, Gd-153	
PUBLICATIONS	 Coincidence method, gas proportional counter, liquid scintillation, traceability Primary standards of: Ra-223, Th-227, Ge/Ga-68, Pa-233, Pa-231, Tb-155, Mn-54, Cs-134, Gd-153 "Absolute intensities of the γ -ray emissions originating from the electron capture decay of ¹³⁵Gd". R. Shearman, S.M. Collins, J.D. Keightley, A.K. Pearce, and J. Garnier. <i>EPJ Web of Conferences. 146, 10008 (2017) DOI: 10.1051/epiconf/201714610008</i> "Investigation of γ-γ coincidence counting using the National Nuclear Array (NANA) as a primary standard", S.M. Collins, R. Shearman, J.D. Keightley, P.H. Regan. <i>Applied Radiation and Isotopes, Volume 134, April 2018, Pages 290-296</i> "Results of an International Comparison of Activity Measurements of ⁶⁸Ge", J.T. Cessna et al, <i>Applied Radiation and Isotopes, Volume 134, April 2018, Pages 385-390</i> "Activity measurements of the radionuclides ¹⁸F and ⁶⁴Cu for the NIST, USA in the ongoing comparisons BIPM.RI(II)-K4.F-18 and BIPM.RI(II)-K4.Cu-64". C. Michotte et al, Metrologia 54 (2017) 06011 "Comparison of ¹⁸F activity measurements at the VNIIM, NPL and the ENEA-INMRI using the SIRTI of the BIPM". C. Michotte, et al. Applied Radiation and Isotopes, Volume 109, March 2016, Pages 17-23. "Development of the NPL gamma-ray spectrometer NANA for traceable muclear decay and structure studies". G. Lorusso, R. Shearman, P.H. Regan, S.M. Judge, S. Bell, S.M. Collins, C. Larijani, P. Iwanov, S.M. Jerome, J.D. Keightley, S. Lalkovski, A.K. Pearce, Zs Podolyak. Applied Radiation and Isotopes, Volume 99, 2015, Pages 46-53. "Standardisation of ²²³Ra by liquid scintillation counting techniques and comparison with secondary measurements". Keightley, J., Pearce, A., Fernwick, A., Collins, S., Ferreira, K. and Johansson, L. Applied Radiation and Isotopes (2015), Volume 95, Pages 114-121. "Precise measurement of the absolute gamma emissions of ²²³Ra and its decay progeny in	
IN PROGRESS	Ra-224, Zr-89	
SOURCE IN PREPARATION	Ra-224	

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National Institute of Standards and Technology (NIST), USA, SA1/SA2 2017 Progress Report and 2018 Plan (information for ICRM members)

The programs at the National Institute of Standards and Technology (NIST), Physical Measurement Laboratory, Radiation Physics Division, Radioactivity Group in the field of Radionuclide Metrology and its applications are focused on the development of primary and secondary activity standards; dissemination of those standards through Standard Reference Materials, Calibration Services, and Measurement Assurance Programs; development of instrumentation; and Quality Assurance.

Scientists	Function		
B. Zimmerman	Acting Leader, Radioactivity Group; Primary and Secondary activity		
	standards, standards for Nuclear Medicine		
D. Bergeron	Primary and Secondary activity standards, standards for Nuclear		
	Medicine		
J. Cessna	Primary and Secondary activity standards, Calibrations, standards for		
	Nuclear Medicine		
R. Collé	Primary Radionuclide activity standards, Standard Reference Materials		
R. Essex	Homeland Security Reference Standards		
R. Fitzgerald	Primary radioactivity standards		
L. King	Primary and Secondary activity standards, Calibrations		
J. LaRosa	Environmental Radioactivity standards		
L. Laureano-Pérez	Primary Radionuclide activity standards, Standard Reference Materials		
K. Lavelle	Homeland Security standards		
L. Lucas	Primary and Secondary Radionuclide activity standards, Homeland		
	Security		
J. Mann	Environmental Radioactivity standards, mass spectrometry		
M. McCord	Measurements for Homeland Security		
S. Nour	Environmental Radioactivity standards		
L. Pibida	Secondary activity standards, Homeland Security, gamma-ray		
	spectrometry		
M. Tyra	Environmental radioactivity standards, mass spectrometry		
M. Unterweger	Primary and Secondary activity standards		
Associates			
R. Hutchinson	Primary Radionuclide activity standards		
K. Neal	Measurement Assurance Program		
W. Regits	Measurement Assurance Program		
Technicians			
J. Stann	Shipping		
Secretary			
L. Chase			

The NIST Radioactivity Group staff at the end of 2017 was the following:

Activity line	NIST	NIST
	Radionuclide Metrology	Radionuclide Metrology
	2016-2017 Progress report	2018-2019 Work plan
Development of primary standards, Improvement of measuring methods and instrumentation	 Development of new primary standards: I-124, Pa-231, Pa- 233, Pu-238, nat. U, Pu-242 Ongoing standards for nuclear forensics 	 Development of new primary standards: Ra-224, Cu-67, Mn- 54, Ba-133 Surrogate Urban Debris Reference Material Ongoing standards for nuclear medicine imaging (e.g., phantoms)
International	• SIRTI (F-18, Cu-64)	• CCRI(II) (Ra-223)
Comparisons	• CCRI(II)-S12-H3	
	• CCRI(II)-K2.Ge-68 Draft A	
Nuclear Data	• Half-life: Th-229, Cu-64, Ge-68	• Half-life: I-124, Pa-231, Ra-224
	• P-gamma: Cu-64, Ge-68	• P-gamma: I-124, Pa-233, Ra-224
	• DDEP Evaluations: I-124	• DDEP Evaluations: Tb-155
Standardization of measurement methods	 Installation and commissioning of mass spectrometry system 	 SI traceable current measurements for ionization chambers Restart gas counting standards
National QA programmes and services Membership in	 NIST Radioactivity Measurement Assurance Program (NRMAP) for the Radiopharmaceutical and Power Plant Industries NIST Radiochemistry Intercomparison Program (NRIP) Radiological Traceability Program (RTP) Calibration services ICRM, BIPM/CCRI(II), SIM A NSUM42 	 NIST Radioactivity Measurement Assurance Program (NRMAP) for the Radiopharmaceutical and Power Plant Industries NIST Radiochemistry Intercomparison Program (NRIP) Radiological Traceability Program (RTP) Calibration services ICRM, BIPM/CCRI(II), SIM, ANSI N42
International and national	SIM, ANSI N42	ANSI N42

The main specific activities carried out at NIST in this field are discussed below.

The following is a summary of completed and in-progress Standard Reference Materials.

Nuclide	Completion Date
131 I	yearly January
⁹⁹ Mo	yearly February
⁶⁷ Ga	yearly April
^{99m} Tc	yearly May
²⁰¹ Tl	yearly August
111 In	yearly June
¹³³ Xe	yearly September
⁹⁰ Y	yearly October
^{125}I	yearly December
²³⁸ Pu	August 2016
Natural Uranium	June 2017
²⁴² Pu	2018

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	R. Fitzgerald, D. E. Bergeron
ACTIVITY	Anticoincidence measurements (LS-NaI) for primary standards
KEYWORDS	anti-coincidence, ¹²⁴ I, ²³³ Pa
RESULTS	primary standards for ¹²⁴ I, ²³³ Pa
PUBLICATIONS	Fitzgerald, R., Monte Carlo based approach to the LS-NaI $4\pi\beta - \gamma$ anticoincidence extrapolation and uncertainty, Applied Radiation and Isotopes 109 (2016) 308-313
	Bergeron, D.E., Fitzgerald, R., Monte Carlo modelling of live-timed anticoincidence counting (LTAC) for ⁶⁴ Cu, Applied Radiation and Isotopes, http://dx.doi.org/10.1016/j.apradiso.2017.09.032.
IN PROGRESS	¹²⁴ I analysis; ²³³ Pa manuscript and MARC presentation; ⁵⁴ Mn and ¹³³ Ba planning
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	R. Fitzgerald, L. Pibida
ACTIVITY	Cross sections for nuclear fusion diagnostics, using sum-peak counting to calibrate detectors and Monte Carlo modelling to transfer calibration to experimental arrangement.
KEYWORDS	Nuclear fusion, Monte Carlo
RESULTS	Calibration of NaI coincidence detectors for normalizing absolute ${}^{12}C(n,2n){}^{11}C$ cross section experiment, used as diagnostic for nuclear fusion research.
PUBLICATIONS	Yuly, M. et al., ¹² C(n,2n) ¹¹ C cross section from threshold to 26.5 MeV, Physical Review C 97, 024613 (2018).
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technology (NIST) USA
	Turional institute of Standards and Teenhology (1451), COA
NAMES	D. E. Bergeron, J. T. Cessna, R. Fitzgerald
ACTIVITY	SI traceable current measurements for ionization chambers
KEYWORDS	Ionization chambers
RESULTS	
PUBLICATIONS	
IN PROGRESS	Collaboration with NIST Quantum Measurement Division to develop ion chamber electrometer calibration source and procedure, and incorporate into procedure for secondary standardization of radionuclides
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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CONTACT	Dr. Denis E. Bergeron

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	B. E. Zimmerman, D. E. Bergeron, J. T. Cessna, R. Fitzgerald, R. M. Essex, J. L. Mann, and L. Pibida
ACTIVITY	Experimental Nuclear Data
KEYWORDS	Nuclear data, half-lives, gamma-ray emission probabilities
RESULTS	Measurements of half-lives, gamma-ray emission probabilities
PUBLICATIONS	 Pibida, L., Zimmerman, B., Bergeron, D.E., Fitzgerald, R., Cessna, J.T, King, L. Determination of photon emission probability for the main gamma ray and half-life measurements of ⁶⁴Cu. Applied Radiation and Isotopes, 129, 6 (2017). D.E. Bergeron, J.T. Cessna, and B.E. Zimmerman. Two determinations of the ⁶⁸Ge half-life. Applied Radiation and Isotopes, https://doi.org/10.1016/j.apradiso.2017.10.038.
IN PROGRESS	Manuscript and MARC presentation on ²²⁹ Th half-life collaboration; Analysis of ²³³ Pa P γ 's. Analysis of ²³¹ Pa half-life, for possible half-life determination in collaboration with other NMI's and with mass spectrometry laboratories. Analysis of ¹²⁴ I half-life data
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	B. E. Zimmerman
ACTIVITY	Nuclear Data Evaluation for I-124
KEYWORDS	Nuclear data, half-lives, gamma-ray emission probabilities, positron emission probabilities, electron capture probabilities
RESULTS	DDEP evaluation for decay data of I-124
PUBLICATIONS	B. E. Zimmerman, "Decay data for the positron emission tomography imaging radionuclide ¹²⁴ I: A DDEP evaluation", Appl. Radiat. Isot., <i>in press</i> (2017). https://doi.org/10.1016/j.apradiso.2017.10.051.
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	R. Collé, L. Laureano-Perez, J. L. Mann, R. M. Essex, R. Fitzgerald
ACTIVITY	Activity Measurements for Th-229 Half-life determination.
KEYWORDS	Th-229, half-life, massic activity, liquid scintillation counting, isotope dilution alpha spectrometry
RESULTS	The Th-229 massic activity was measured for a reference material with a previously determined Th-229 molality. These measurements were made by direct comparison with SRM 4328C using $4\pi\alpha\beta$ liquid scintillation counting, NaI counting, and standard addition liquid scintillation counting. The ²²⁹ Th massic activity was confirmed by isotope dilution alpha spectrometry measurements. A publication providing the ²²⁹ Th half-life calculated from these measurements is forthcoming.
PUBLICATIONS	
IN PROGRESS	"New determination of the ²²⁹ Th half-life" manuscript drafted yet to be submitted.
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	R. M. Essex, J. L. Mann, R. W. Williams, W. S. Kinman, A. Hubert, M. E. Bennett, and G. Alkiviadias, Appl. Rad Iso. http://dx.doi.org/10.1016/j.apradiso.2017.07.050 (2017)
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CONTACT	Richard Essex

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	J. T. Cessna, L. Laureano-Perez, R. Collé, B. E. Zimmerman, D. E. Bergeron, J. La Rosa, S. Nour, R. Fitzgerald
ACTIVITY	CCRI(II)-K2.Ge-68
KEYWORDS	Key comparison, Ge-68
RESULTS	A key comparison of the ⁶⁸ Ge activity concentration of a ⁶⁸ Ge/ ⁶⁸ Ga solution has been successfully carried out with NIST as the pilot laboratory. Samples were distributed to 18 participants. Results were received from 17 participants. A Comparison Reference Value (CRV) of 621.7(11) kBq·g ⁻¹ was proposed, based on 14 values. Two results were identified as outliers. One result was not from primary methods. Both outlying results were from liquid- scintillation based methods. Results based on solid sources show these sources can be successfully produced, if necessary precautions are taken. Coincidence and anticoincidence results utilizing Cherenkov detection in the beta channels have been utilized in an international comparison for the first time, with success. Draft A has been agreed by participants and submitted to the Key Comparison Working Group.
PUBLICATIONS	Zimmerman, B.E., Bergeron, D.E., Fitzgerald, R., Cessna, J.T., 2016. Long- term stability of carrier- added Ge-68 standardized solutions. Appl. Radiat. Isot. 109, 214–216. https://doi.org/10.1016/j.apradiso.2015.11.078 Cessna, J.T., et al. 2017. Results of an international comparison of activity
	measurements of ⁶⁸ Ge. Appl. Radiat. Isot. (<i>in press</i>) https://doi.org/10.1016/j.apradiso.2017.10.052
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	SRM 4927g
OTHER RELATED PUBLICATIONS	
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CONTACT	Jeffrey T. Cessna

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	A new primary radioactivity standardization of ²³⁸ Pu
KEYWORDS	Liquid scintillation, gamma-ray spectrometry, HPGe, Pu-238, SRM
RESULTS	A new primary radioactivity standardization of ²³⁸ Pu was performed. This standardization was performed to support new ²³⁸ Pu transfer standard that was developed and which will be disseminated by the National Institute of Standards and Technology (NIST) as Standard Reference Material SRM 4323c. Plutonium-238 is a very powerful alpha emitter and does not emit significant amounts of other, more penetrating radiation. This makes the plutonium-238 isotope suitable for usage in radioisotope thermoelectric generators (RTGs) and radioisotope heater units, its main application. RTG technology was first developed to provide radioisotope thermoelectric generator power for cardiac pacemakers. In addition, plutonium-238 is the material of choice to help produce electrical power for more than two-dozen U.S. space missions that have been enabled by radioisotope power systems. In many cases, the heat from this radioisotope has also been used to keep spacecraft electronics and other components warm enough to be able to operate effectively in the frigid environments often found in deep space and on planetary surfaces like Mars. The certified massic activity of SRM 4323c was obtained from the $4\pi\alpha\beta$ liquid scintillation based standardization. NIST confirmatory standardizations of the ²³⁸ Pu massic activity for SRM 4323c were performed by and by high-resolution HPGe gamma-ray spectrometry (γ -spec) with a comparison difference of -0.13% and 3.8%, respectively. The uncertainty in the (γ -spec measurement was 6.5% ($k = 1$).
PUBLICATIONS	SRM 4323c Certificate, NIST 2016
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	SRM 4323c
OTHER RELATED PUBLICATIONS	
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CONTACT	L. Laureano-Pérez

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	Long-term Radiochemical Stability of Polonium Solutions and an Upper Limit on the ²⁰⁹ Po Half-Life
KEYWORDS	Half-life, liquid scintillation spectrometry, polonium chemistry
RESULTS	A rigorous investigation of the stability of polonium solutions has been underway for several years. Polonium solutions at trace concentrations, under various alkaline, neutral, or weakly acidic conditions are known to be unstable: being readily hydrolyzed, chemically deposited, or volatilized; exhibiting "radiocolloidal" behavior; and undergoing "plate-out" or adsorption onto glass surfaces. Stored polonium solutions, such as those needed for SRMs, are generally considered by NIST to be stable in the acid range of 0.1 to 1.0 normality, but scant data existed on any possible long-term effects, particularly for very dilute, carrier- free, aged solutions. The work present was based on careful radionuclidic assays of solutions of ²⁰⁹ Po having massic concentrations of less than 10 ¹² atoms of Po per gram of solution that have been stored in flame-sealed ampoules for ages ranging from less than 2 years to over 24 years. Measurements were made for the soluble and readily removable ²⁰⁹ Po activity as well as for any insoluble residual activity adhering to the glass surfaces. It was found that the solutions were stable for periods of nearly 25 years with deposition losses that were negligible within the low- level measurement uncertainties and less than few tenths of a percent in worst cases. The findings validate the previously determined ²⁰⁹ Po half-life, that is now based on 36 distinct data sets of decay measurements by NIST of stored ²⁰⁹ Po solution during seven periods in 1993, 1994, 2005, 2013, 2015, and 2016. The LS-based measurement methodology is "absolute" in the sense of not requiring use of identical LS cocktail compositions or the use of the same LS counter. The new assay results extend the ²⁰⁹ Po decay curve to a period of 24 years, or about 20 % of the ²⁰⁹ Po half-life.
PUBLICATIONS	R. Collé, et al. J. Res. NIST 100, 1 (1995);
	 R. Collé, L. Laureano-Perez, I. Outola, Appl. Radiat.Isot. 65, 728 (2007); R. Collé, R. Fitzgerald, L. Laureano-Perez, J. Phys G 41:105103, doi 10.1088/0954-3899/41/10/105103 (2014); R. Collé, A.M. Collé, J. Radioanal. Chem. doi 10.1007/s109-015-4307-y (2015); R. Collé, R. Fitzgerald, L. Laureano-Perez, J. Res. NIST 120, 138 (2015).
IN PROGRESS	R. Collé, R. Fitzgerald, L. Laureano-Perez, "Long-term Radiochemical Stability of Polonium Solutions and an Upper Limit on the ²⁰⁹ Po Half-Life", to be published.
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CONTACT	R. Collé

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	Extend the SIR to β emitters
KEYWORDS	Liquid scintillation, low-level, SIR, source preparation
RESULTS	Lizbeth was on detail at BIPM for approximately six months to test the feasibility and performance of both the UCE and AA in an exercise for the extension of the SIR as an external expert in measurement and sample preparation in the field of LS counting. She reinforced the current skills and task force available at the BIPM. She prepared LS samples for both UCE and AA methods from about 15 ampoules received from 8 laboratories with the test nuclides ⁶³ Ni, ³ H, ¹⁴ C and ⁵⁵ Fe, in three scintillators and two volumes. The sources will be used for establishing the LS cross-efficiency curves for those nuclides, using ³ H as tracers, using three commercial counters (Beckman, Quantulus, Packard) and the BIPM-designed Triple-to-Double Coincidence Ratio (TDCR). All the measurements of the sources have been completed and a report is being prepared to present at the ESWG (II) during their semiannual meeting in November in which the final decision on the exercise was taken. Preliminary results show an instability on some of the sources according to the preparation and a similar (high) uncertainty on both methods. This exercise was done in an effort to propose to the CCRI(II) the appropriate method to be chosen to extend the existing SIR to β emitters, which allowed NIST to play a major role in establishing which method will be used. This experience improved the knowledge base for the entire Radioactivity Group on LS and international radionuclide metrology with implications for health care, homeland security and environmental.
PUBLICATIONS	
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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CONTACT	L. Laureano-Pérez

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	Natural Uranium Solution Standard
KEYWORDS	Isotope dilution α spectrometry, gamma-ray spectrometry, HPGe liquid scintillation, NaI well-type counter, Natural Uranium
RESULTS	A new natural uranium solution standard has been produced and will be disseminated by the National Institute of Standards and Technology (NIST) as Standard Reference Material 4321d. The standard is certified for the massic activities of 234 U, 235 U, and 238 U in solution, and it is based on isotopic mass data for the metallic Certified Reference Material (CRM) 112-A (originally issued as SRM 960) that was obtained from the U.S. Department of Energy, New Brunswick Laboratory. The metallic CRM was chemically cleaned, dissolved, and gravimetrically diluted to prepare a master solution, which was quantitatively dispensed into 5 mL aliquots that were contained within flame-sealed glass ampoules for each SRM unit. Homogeneity among SRM units, verifying solution homogeneity, was substantiated by photonic-emission integral counting with a NaI(Tl) well counter. Confirmatory measurements were performed by liquid scintillation counting for the total massic activities. The standards will be disseminated with the following specifications: Radionuclides: Natural uranium (mixture of 234 U, 235 U, and 238 U) Reference time: 1200 h EST, 15 March 2017 Massic activities of the solution: 234 U: 220.16 Bq g ⁻¹ ; 234 U: 0.52 %; 235 U: 0.31 %; 238 U: 0.25 %
PUBLICATIONS	Collé R, Laureano-Pérez L, Nour S, La Rosa JJ, Zimmerman BE, Pibida L, Bergeron DE (2017) Natural Uranium Radioactivity Solution Standard: SRM 4321d. <i>J Res Natl Inst</i> <i>Stan</i> 122:44. https://doi.org/10.6028/jres.122.044;
	SRM 4321d Certificate, NIST 2017
SOURCE IN PREPARATION	SRM 4321d
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CONTACT	R. Collé

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	L. Laureano-Perez, R. Collé
ACTIVITY	SRM 4334j: Pu-242 Radioactive Standard
KEYWORDS	Alpha spectrometry, gamma-ray spectrometry, HPGe, liquid scintillation, Pu- 242, SRM
RESULTS	Plutonium-242 is a very powerful alpha emitter and does not emit significant amounts of other, more penetrating radiation. It is the number one tracer for the monitoring of chemical processes involving plutonium and it is mainly used in the calibration of instruments. However, lately it has been suggested as a choice in explosive tests. The plutonium-242 isotope in explosives tests would allow a full-scale nuclear weapon mockup to be detonated without resulting in any nuclear yield, an experiment that would allow detailed hydrodynamical study of the early stages of the implosion of a nuclear weapon. A new primary radioactivity standardization of ²⁴² Pu was performed. This standardization was used to support SRM 4334i which is currently out of stock. ²⁴² Pu is our best seller SRM with average sales of 46 units/year. Approximately 400 SRM ampoules were prepared for dissemination. Measurements by liquid scintillation counting indicates an agreement with previous SRM batches (i.e. 4334i) to ± 0.12 %. A complete standardization based on $4\pi\alpha\beta$ LS counting was completed and certification is underway.
PUBLICATIONS	
IN PROGRESS	Certification
INFORMATION	
SOURCE IN PREPARATION	SRM 4334j
OTHER RELATED PUBLICATIONS	
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CONTACT	L. Laureano-Pérez

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	R. Collé, L. Laureano-Perez, R. Fitzgerald
ACTIVITY	$4\pi\alpha\beta$ LS standardization of ²³¹ Pa
KEYWORDS	Liquid scintillation, 231Pa
RESULTS	A radionuclidic assay of a ²³¹ Pa solution by $4\pi\alpha\beta$ LS counting, with efficiency tracing for the beta-emitting in-growth daughters has been completed. This is a difficult metrological case given that the long-lived ²³¹ Pa (32 760 a) is the parent of decay chain having ten shorter-lived daughters that grow in with decay. Preliminary investigations revealed that several of the daughter radionuclides are unsupported and were not completely removed during the chemical purification of the solution, which makes the ingrowth and efficiency corrections exceedingly complex. This work is part of an informal measurement comparison between NRC (Canada) and NPL (UK). The standardized solution is intended to be a DHS / DNDO nuclear forensic certified reference material needed for ²³¹ Pa / ²³⁵ U radiochronometry. The massic activity standardization will be linked to isotope-dilution mass spectrometric molality measurements.
PUBLICATIONS	
IN PROGRESS	
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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CONTACT	R. Collé

LABORATORY	National Institute of Standards and Technology (NIST), USA
NAMES	J. Mann, M. Tyra, K. Lavelle
ACTIVITY	Surrogate Urban Debris Reference Material
KEYWORDS	Mass spectrometry, uranium-235, microXRF, INAA, reference material
RESULTS	Currently, no well documented measurement traceable post nuclear detonation reference materials (RMs) exist to support post-detonation nuclear forensics sample analysis. Nuclear detonation RMs allow for analytical method development, measurement performance assessment, and serve as quality control materials to achieve metrological traceability and measurement accuracy. Furthermore, these RMs insure confidence in data quality that provide legal defensibility for forensic results, attribution and response. As a part of NIST's mission addressing critical national needs, including "improving the accuracy of forensics measurements and ensuring the reliability of protective technologies and materials, in ways that foster homeland security and effective law enforcement," the delivery of a well-characterized Uranium (U) doped urban surrogate glass RMs that mimic the rubble collected after a nuclear detonation event will enable the user community to not only validate their nuclear forensic and attribution abilities but also establish measurement accuracy and traceability.
PUBLICATIONS	
IN PROGRESS	Assessment of elemental homogeneity by microXRF and INAA of the material is underway. We have completed all the INAA measurements for both surrogate materials and data analysis is underway. microXRF analysis of the blank (natural U doped material) surrogate is complete and data analysis is in progress. Our next steps are to perform the microXRF analysis of the U-235 doped material to complete the elemental homogeneity analysis.
INFORMATION	
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	
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CONTACT	Jacqueline Mann
LABORATORY	National Institute of Standards and Technology (NIST), USA
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NAMES	L. King, M. Unterweger, R. Fitzgerald
ACTIVITY	2π alpha and beta measurements
KEYWORDS	2π , alpha, beta, emission rate, activity, MCA
RESULTS	Calibrations, correction factors for MCA live-time inaccuracies at high count rates, new method of data handling for sources or certain geometries
PUBLICATIONS	
IN PROGRESS	Testing of new MCA, acquiring a set of beta standards
INFORMATION	To ensure the counter(s) is operating correctly, beta-emitting sources that are submitted for calibration are measured with a Sr-90 standard (0.1958 MeV), H-3 being the only exception. The sources received have a wide range of energies; 0.0057 MeV to 0.6259 MeV.
	Identifying, obtaining, and measuring a set of beta-emitting standards with multiple energies would better represent the sources received for calibration. Once obtained these standards will be measured to determine a voltage plateau for each and then added to the measurements when calibrations are performed.
SOURCE IN PREPARATION	
OTHER RELATED PUBLICATIONS	King L., Fitzgerald R., Tosh R.E., "Large area alpha sources with a lip: Integral counting and spectral distortions."
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CONTACT	Lynne King

Announcements: Planning workshop at NIST in coordination with BIPM during the week of September 13th, to coincide with ICRM working groups and the DDEP working group meeting.

End of Contributions