

**CIPM-CCRI(II), 14 May – 16 May 2013 Meeting, Presentation**

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Radionuclide Metrology Laboratory – Report: June 2011 – May 2013**

Maria Sahagia

**1. Official Status of the Laboratory:**

IFIN-HH, Radionuclide Metrology Laboratory (RML), is a designed participant in CIPM-MRA in the field of ionizing radiations, member of the CIPM-CCRI (II); it is also associated member of EURAMET, Technical Committee for Ionizing Radiations (IR-TC).

During 2012, the Commission of National Standards evaluated the Laboratory, as documentation and on site, and proposed to attest IFIN-HH as owner of the National Activity Standard.

**2. Infrastructure, equipment:**

**2.1 Infrastructure**

Situated in the Radioisotopes and Radiation Metrology Department (DRMR) building, RML disposes of 6 rooms for: preparation of sources, balances, measurement rooms and of the Radon standard.

**2.2 Basic equipment**

- **Installations for absolute (direct) standardization:**

- (i)  $4\pi$ PC- $\gamma$  coincidence system
- (ii) Two variants of LSC-TDCR system, based on 3 PMTs and respectively 6 CPMs
- (iii) Photon-photon coincidence system

- **Installations for relative (indirect) standardization:**

- (i) Two large area, multiwire window and windowless proportional counters
- (i) X and gamma-ray spectrometry system with Si(Li) and high efficiency HPGe; during 2012 the Si(Li) system was completed with a dedicated spectra analysis system
- (ii) CENTRONIC IG12/20A system operated with a Keithley E6517A Electrometer.

**3. Personnel:**

The staff members are: 3 PhD (Maria Sahagia, Aurelian Luca and Constantin Ivan serving also as the technical director of IFIN-HH); Andrei Antohe and Beatris Luminita Neacsu presented their theses in September 2012; a new PhD Student, Razvan Mihai Ioan, joined the laboratory; 1 Technician (Constantin Teodorescu).

Dr. Doru Stanga is a member of the Reactor Decommissioning Department, but deploys research in the field of Radionuclide Metrology, too.

**4. Main research areas:**

**4.1 Absolute standardization:**

- Standardization of  $^{68}\text{Ga}$ ,  $^{18}\text{F}$ ,  $^{67}\text{Cu}$  (during 2013),  $^{124}\text{I}$  (2014) within the frame of the National Project: PN-II-ID-PCE-2011-3-0070 „Absolute standardization and study of the decay parameters of the positron emitters for PET systems. Metrological traceability assurance.”

- Standardization of  $^{177}\text{Lu}$  and  $^{186}\text{Re}$  (2013-2014) within the frame of the JRDP C2-05/01.03.2012, “Creation of national standards for some emerging pharmaceutical radionuclides to ensure the radioprotection of patients and medical staffs”, IFIN-HH/LMR (Romania) – CEA/LIST/LNHB (France)

#### 4.3 Relative measurements:

##### Gamma –ray spectrometry:

The HPGe system was used in the Measurement of  $^{137}\text{Cs}$  and  $^{40}\text{K}$  Activity Concentrations in KRIS Rice Powder Reference Material: supplementary comparison CCRI(II)-S9, and other gamma-ray sources calibration

##### Ionization chamber CENTRONIC IG12/20A:

New calibrations factors were determined for  $^{18}\text{F}$ :

#### 4.4 Participation at Nuclear Decay Data Projects

- Evaluation of nuclear decay data (IAEA CRP F42006, DDEP) for  $^{113}\text{Sn}$   
 - Measurement of photon emission intensities for  $^{68}\text{Ga}$  and for  $^{177}\text{Lu}$ ,  $^{186}\text{Re}$ ,  $^{82}\text{Sr}$ - $^{82}\text{Rb}$  (2013-2015, in co-operation with CEA/LNHB, France)

#### 4.5 New National project.

Realization of a Radon Chamber – Calibration Stand for the Equipment Used in the Measurement of Radon and Daughter Products Concentration in Air. CARSTEAM, Contract no. 141/2012 (2013 – 2015)

## 5. International affiliation and international activities

### 5.1 Affiliations

IFIN-HH is a member of ICRM, CIPM-CCRI(II), DDEP and associated member of EURAMET

### 5.2 Participation at International Comparisons

CCRI(II)-K2.Tc-99/ 2012. Results reported

CCRI(II)-S9 “Supplementary Comparison on  $^{137}\text{Cs}$  and  $^{40}\text{K}$  Activity Concentrations in KRIS Rice Powder Reference”/(2011-2012). Results reported

CCRI(II)-S10.LASCE ”Large area sources comparison exercise”/(2012-2013). Results reported

BIPM.RI(II)-K4[Tc-99m TI], planned, 2013

### 5.3 EURAMET-EMRP, A169 participation:

- **JRP – Contract: Metrology for new generation nuclear power plants. Metrofission, number ENG08.** Coordinator – Dr. Lena Johansson, NPL-UK. 2010-2013

IFIN-HH responsible: Dr. Aurelian Luca, participation in WP8; a Workshop is planned in June 2013, during the ICRM2013 Conference. Andrei Antohe was awarded an EURAMET Mobility Grant (EMR) at ENEA, Italy, 2011-2012

- **JRP IND04 – Ionizing radiation Metrology for Metallurgical Industry. MetroMETAL,** Coordinator: Dr. Eduardo Garcia Torano, CIEMAT – Spain, 2012-2014.

IFIN-HH responsible: Dr. Maria Sahagia, participation in WP2, WP3 and WP5.

### 5.4 Bilateral collaboration:

- The collaboration accord with LNHB-France, renewed in 2010, is under operation. The Joint Research & Development Project, C2-05/01.03.2012, is part of this accord.

### 5.5 Calibration and Measurement Capabilities (CMC) and the Quality System

- A number of new 3 CMCs, for mono-nuclide solutions were submitted in 2010 and are still under the RMOs analysis.

- The Quality System of the IFIN- Ionizing Radiations Metrology Laboratory, according to the EN ISO/IEC 17025:2005, was reported and reconfirmed annually by the EURAMET TC-Q, as a basis for CMCs coverage.
- A short description of the Radionuclide Metrology Laboratory activities during the period 2011-2012 was presented at the Ionizing Radiation (TC-IR) Contact Person Meeting, Bucharest-Magurele, Romania, 25-th – 26-th October 2012

## **6. National accreditation:**

### **6.1 Designations**

The RML is designed as a calibration laboratory for the Romanian units operating in the nuclear field, through the Notification of the National Nuclear Authority (CNCAN).

### **6.2 Accreditation by the national body, RENAR.**

The laboratory obtained in 2009 the RENAR accreditation, according to EN ISO/IEC17025:2005, for two types of operations:

- Calibration laboratory, Certificate no. LE013/22.07.2009
- Testing laboratory, measurement of the low level activities by gamma-ray spectrometry, Certificate no. LI804/22.07.2009
- During 2012 the Laboratory was evaluated by RENAR in order to extend the accreditation for the calibration of measurement equipment at the users' site and applied for the reaccreditation (RENAR evaluation during the period 13-15 March 2013).

## **7. Radioactive standards and metrology services**

### **7.1 Radioactive standards delivery**

Standard sources and solutions were prepared and delivered to various users. The most significant users were the Laboratories belonging to the food chain (animal products) survey, accredited, or in process of accreditation.

### **7.2 Calibration services and high precision measurements**

- A significant number of standard sources, produced by our laboratory, or imported from abroad, were standardized and certified for various users, including the Cernavoda Nuclear Power Plant.
- Hospitals' radioisotope calibrators were calibrated with standard solutions of the radionuclides I-131, Tc-99m and the PET radionuclides Ga-68 and F-18.
- HPGe and NaI(Tl) spectrometers, gross alpha and beta activity measurement instruments, liquid scintillation counters, alpha particle spectrometers, were calibrated at the users' site

## **8. Publications**

**The 2011-2013 published papers, such as presented on the Data Base of the CIPM-CCRI(II)**

### **a). Articles published in International Journals, Thomson Reuters (ISI), Philadelphia, USA, Quoted**

1. M.Sahagia, A.Antohe, A.Luca, A.C.Waetjen, C.Ivan. *The Support Offered by the Romanian Primary Activity Standard Laboratory to the Nuclear Medicine Field.*

Rom J.Phys. Vol. 58, 1-2 (2013) in press

2.A.Luca, M.-C. Lépy. *Measurements of relative photon emission intensities and nuclear decay data evaluation of Sn-113.* Appl. Radiat Isot. 70, 9(2012)1881-1885

3. U. Wätjen, T. Altzitzoglou, A. Ceccatelli, H. Dikmen, H. Emteborg, L. Ferreux, C. Frechou, J. La Rosa, A. Luca, Y. Moreno, P. Oropesa, S. Pierre, M. Schmiedel, Y. Spasova, Z. Szántó, L. Szücs, H. Wershofen, Ü. Yücel. *Results of an international comparison for the determination of radionuclide activity in bilberry material*, Appl. Radiat. Isot. 70, 9 (2012)1843-1849
4. A.Stochioiu, M Sahagia, I.Tudor. *Area dosimetry in the Praid-salt mine*. Radiation Protection Dosimetry, 151,1 (2012)129-134
5. A.Luca, M.Sahagia, A.Antohe. *Measurement of Cu-64 and Ga-68 half-lives and gamma-rays emission intensities*. Appl. Radiat. Isotopes 70, 9(2012)1876-1880
6. A.Stochioiu, A.Luca, M.Sahagia, R.M.Margineanu, I.Tudor *Quality assurance for measurements of the radioactivity in the area of the "Horia Hulubei" National Institute for Physics and Nuclear Engineering, IFIN-HH* Journal of Environmental Radioactivity 112(2012) 4-7
7. B.E.Zimmerman, T.Altzizoglou, A.Antohe,A.Arinc, E.Bakhshandeiari, D.E.Bergeron, L.Bignell, C.Bobin, M.Capogni, J.T.Cessna, M.L.Cozzella, C.J.da Silva, P.de Felice, M.S.Dias, T.Dziel, A.Fazio, R.Fitzgerald, A.Iwahara, F.Jaubert, L.Johansson, J.Keightley, M.F.Koskinas, K.Kossert, J.Lubbe, A.Luca, L.Mo, O.Nahle,O.Ott, J.Paepen, S.Pomme, M.Sahagia, B.R.S. Simpson, F.F.V.Silva, R.van Ammel, M.J.van Staden, W.M.van Wyngaardt, I.M.Yamazaki. *Results of an international comparison for the activity measurement of Lu-177*.Appl. Radiat. Isot. 70, 9(2012)1825-1830
8. M. Sahagia, A. Luca, A. Antohe, C. Ivan.*Standardization of  $^{64}\text{Cu}$  and  $^{68}\text{Ga}$  by the  $4\pi\text{PC-}\gamma$  coincidence method and calibration of the ionization chamber*. Appl. Radiat. Isotopes 70, 9 (2012)2025-2030
9. M.-M. Bé, P. Cassette, M.C. Lépy, M.-N. Amiot, K. Kossert, O.J. Nähle, O. Ott, C. Wanke, P. Dryak, G. Ratel, M. Sahagia, A. Luca, A. Antohe, L. Johansson, J. Keightley, A. Pearce. *Standardization, decay data measurement and evaluation of  $^{64}\text{Cu}$* .Appl. Radiat. Isotopes 70, 9 (2012)1894-1899
10. D. Stanga. *Numerical modeling of large-area beta sources constructed from anodized-aluminum foils*. Applied Radiation and Isotopes, Vol. 70, 9 (2012) 1955-1958
11. D. Stanga, D. Gurau. *A new approach in gamma-ray scanning of rotating drums containing radioactive waste*, App. Radiat Isot. Vol.70,9 (2012) 2149-2153
- 12.A.Luca, B.Neacsu, A.Antohe, M.Sahagia. *Calibration of the high and low resolution Gamma-ray spectrometers*. Romanian Reports in Physics 64,4(2012)968-972
13. M.A. Kellett, M.-M. Be, V. Chechev, X. Huang, F.G. Kondev, A. Luca, G. Mukherjee, A.L. Nichols, A. Pearce . *New IAEA actinide decay data library*. Journal of the Korean Physical Society, 59 (23), pp. 1455-1460, 2011.
- 15 M.Sahagia, A.Antohe, A.Luca, C.Ivan. *Results of proficiency tests on the measurement of volume radioactive sources from the mixture  $^{134}\text{Cs}$  and  $^{137}\text{Cs}$* . Rom. Rep in Phys., 63, Supplement (2011) 1195-1204
16. M.Sahagia, A.Luca, A.C.Watjen, A.Antohe, C.Ivan, D.Stanga, C.Varlam, I.Faurescu, L.Toro, M.Noditi, P.Casette. *Results obtained in measurements of Rn-222 with the Romanian standard system*. Rom. Journ. Phys. 56,5-6 (2011) 682-691
17. A.Stochioiu, S.Bercea, M.Sahagia, C.Ivan, I.Tudor, A.Celarel.*The measurement of the natural radiation background in a salt mine*. Rom. Journ. Phys. 56,5-6 (2011)757-761

18. M. Sahagia, A. Luca, A. C. Wätjen, A. Antohe, C. Ivan, C. Varlam, I. Faurescu, P. Cassette. *Establishment of the  $^{222}\text{Rn}$  traceability chain with the Romanian Standard System*. Nuclear Instruments and Methods A 631 (2011) 73-79
19. D. Stanga, F.J. Maringer, E. Ionescu. *A new method for determining the efficiency of large-area beta sources constructed from anodized aluminum foils*. Appl. Radiat. Isotopes 69 (2011) 227–230.

#### **Other Romanian Journals**

1. M. Sahagia, A. Luca, A. Antohe, C. Ivan. *Role of the Radionuclide Metrology Laboratory from IFIN-HH in the assurance of the international equivalence and national traceability for activity unit standard*. Metrologie, Vol.LVII no.4/2011, ISSN 1220-546, Journal of the Romanian Bureau of Legal Metrology
2. M. Sahagia, A. Luca, A. Antohe, C. Ivan. *Role of the radionuclide metrology in quality assurance of the environmental physics measurements*. Journal of Science and Arts, nr.2, 2011. ISSN 1844-9581; eISSN 2068-3049
3. A. Antohe, B. Neacsu, A. Stochioiu, A. Luca, M. Sahagia. *Methods for the realization of radioactive standards and environmental radioactivity measurement*. Journal of Science and Arts, no.2, 2011, ISSN 1844-9581; eISSN 2068-3049

#### **b) Papers presented at International Conferences, Workshops**

##### **-International Conference on Nuclear Data for Science and Technology, ND2013, New York, USA, March 4-8, 2013**

1. A. Luca. *Nuclear Decay Data Evaluations at IFIN-HH, Romania*

##### **- 19-th International Conference on Radionuclide Metrology and its Applications, ICRM2013, Antwerp, June 17-21, 2013, Belgium, accepted papers**

1. M. Sahagia, R. Ioan, A. Luca, A. Antohe, C. Ivan, B. Neacsu, C. Ghioca. *Standardization of  $^{18}\text{F}$  and its use for the Romanian PET metrological traceability chain assurance*.
2. M. Sahagia, A. Antohe, R. Ioan, A. Luca, C. Ivan. *Standardization of Tc-99 by two methods and participation at the CCRI(II)-K2, Tc-99 comparison*.
3. A. Antohe, M. Capogni, F. Cardellini. *Radon in water activity measurements by new ENEA fixed TDCR system*.
4. D. Stanga. *A simple method for determining the activity of large-area beta sources constructed from anodized aluminum foils*.

##### **- TRACE Workshop on Development of New Radiotracers for PET Imaging and Targeted Radiotherapy. 03-05 April 2013, Magurele, Romania**

1. M. Sahagia, A. Luca, R. Ioan, A. Antohe, C. Ivan, B. Neacsu. *Metrological traceability assurance in production and use of radiopharmaceuticals for PET imaging and targeted radiotherapy*

##### **- 4-rd International Proficiency Testing Conference, PTConf.2013, Brasov, Romania, September 18-20, 2013. Transmitted abstracts:**

1. M. Sahagia, A. Luca, R.M. Mărgineanu, E. Garcia Toraño, V. Peyrés, M. Mejuto, T. Crespo. *Comparison of analysis methods for the characterisation of radioactive content of the metallurgical slag used within the EURAMET-EMRP JRP IND04 MetroMetal*
2. A. Luca, B. Neacsu. *Activity concentration measurements of a rice powder reference material*.

##### **- First East European Radon Symposium (FERAS 2012) Cluj-Napoca, Romania, September 2-5, 2012**

1. M.Sahagia, A.Luca, A.Antohe, C.Ivan, R.Ioan, B.Neacsu

*Realization of the metrological traceability chain of radon-222* . INVITED LECTURE

- **2-nd European Nuclear Physics Conference (EUNPC2012) Bucharest, Romania, September 17-21, 2012. OVERVIEW PAPERS**

1. E.L.Grigorescu, M.Sahagia, A.C.Waetjen, C.Ivan, A.Luca, A.Antohe. *Contribution of the radionuclide Metrology Laboratory to the improvement of methods for absolute standardization.*

2. A. Luca, L. Johansson, P. De Felice, S. Pommé, E. Garcia-Toraño, M. Loidl. *The European Metrology Research Programme JRP ENG08 – MetroFission project and its expected impact in nuclear data improvement*

- **1-st World Congress on Ga-68 and Peptide Receptor Radiopharmaceuticals BAD BERKA, GERMANY, 23-26 JUNE, 2011**

1. Th. Ebenham, Z. Szucs, C.Cimpeanu, D.Dudu, L.Craciun, A.Luca, M.Sahagia, J.R.Zeevaart. *PRODUCTION OF 68GE FROM NATURAL ZINC BY CYCLOTRON.*

Abstract published in WORLD JOURNAL OF NUCLEAR MEDICINE, VOL. 10. ISSUE 1, JUNE 2011

- **3-rd International Proficiency Testing Conference, Iasi, Romania, September 28-30, 2011**

1. A.Luca, M. Sahagia, A. Antohe, C. Şulea, R. Berenştain. *Recent participations of the Radionuclide Metrology Laboratory from IFIN-HH to proficiency tests and interlaboratory comparisons.* pp. 120-127, Ed. Universităţii “Lucian Blaga” din Sibiu, ISSN 2066-737X

### c) International Reports

1. C. Michotte, G. Ratel, S. Courte, R. Fitzgerald and M. Sahagia. *Activity measurements of the radionuclide  $^{57}\text{Co}$  for the NIST, USA and the IFIN-HH, Romania in the ongoing comparison BIPM.RI(II)-K1.Co-57.* Metrologia 49(2012) (Technical supplement 06005)

2. M.-M. Be, V. Chiste, C. Dulieu, X. Mougeot, V. Chechev, N. Kuzmenko, F. Kondev, A. Luca, M. Galan, A.L. Nichols, A. Arinc, A. Pearce, X. Huang, B. Wang. **Table of Radionuclides (vol. 6 - A=22 to 242) Monographie BIPM-5**, Ed. Bureau International des Poids et Mesures, Pavillon de Breteuil, F-92310 Sèvres, France, 2011, pp. 73-78, ISBN-13 978-92-822-2242-3

### d. Chapters in books

1. Maria Sahagia. *Chapter 6 “Role of the Radionuclide Metrology in Nuclear Medicine” pp 137 – 164, of the Book: “12 Chapters on Nuclear Medicine”* December 2011, Publisher InTech, Croatia, ISBN 978-953-307-802-1.

2. A.Antohe, M.Sahagia, A.Luca, Ph. Cassette, C.Ivan. *Influence of detection efficiency on the measurement of radon by liquid scintillation counting.* RADIOCARBON, Special Volume (2011), pp.189 – 197. Proc of the 2010 International Liquid Scintillation Conference, Paris, France, September 6-10 LSC2010 Advances in Liquid Scintillation Spectrometry . The Univ. of Arizona, Tucson, Arizona, USA. ISBN 978-0-9638314-7-7

### e. PhD Theses

1. Andrei Antohe. *Contributions at the elaboration of the absolute and relative methods for the standardization of radon and realization of radon standards.*

Bucharest University, September 2012, supervisor, Dr. Maria Sahagia

**2.** Beatris-Luminita Savu (Neacsu). *Contributions at the implementation of the gamma-ray spectrometry for applications in nuclear medicine and in radionuclide metrology.*  
Bucharest University, September 2012, supervisor, Dr. Maria Sahagia