

## International Committee for Radionuclide Metrology ICRM

### ICRM NEWSLETTER Issue 18

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Editorial Instructions to Contributors President's message Reports of the Working Group Coordinators

## **CONTRIBUTIONS**

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|   | United Kingdom  | • National Physical Laboratory, NPL, (SA1/SA2)<br>Teddington   |
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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;
- $\alpha$ -,  $\beta$  and  $\gamma$ -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 will be 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 issue, we have the following situation : Laboratories regard their normal Newsletter contribution as the fulfilment of SA1/SA2. In this case this is indicated on the contribution by "SA1/SA2". Or laboratories provide (additionally) the traditional SA1/SA2 reports which should not be longer than 2 pages. In the latter case it should be mentioned in the accompanying letter, that the SA1/SA2 contributions be intended for publication in the Newsletter.

As it was agreed at the ICRM General Meeting in Dublin 2003 the ICRM Newsletter will be included in the BNM-LNHB web site and distributed in hard copy, or CD-rom only in response for specific require.

• Contributions may be sent by E-mail as an attachment in MS Word or as plain text file.

### **INSTRUCTIONS TO CONTRIBUTORS**

This Newsletter is realised with no 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 (21cm x 29,7cm) format inside a box of 15,5cm x 20cm which should be situated 4,5cm from the upper and 3cm from the left margin. Please use font Times New Roman size 12. 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 completed as 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 "contribution.dot" file included on the pdf version of this issue.

| LABORATORY                          | Name of laboratory  |
|-------------------------------------|---|
| NAMES<br>through abbreviations (OR) | If more than one laboratory is involved, identify affiliation NL, LASL, etc.).<br>Visitors can also be identified with asterisks. |
| APPARATUS<br>ACTIVITY               | Choose one; the former for experiments and the latter for compilations, calculations, or theory.                                  |
| RESULTS                             | Use this for experimental results.  |
| PUBLICATIONS                        | Use Physical Review style. Include only published materials.  |
| IN PROGRESS                         | Use this for description of the current work.   |
| INFORMATION<br>SOURCE               | Use this for evaluations or compilations.   |
| IN PREPARATION                      | Use this to also indicate papers submitted for publication.   |
| OTHER RELATED<br>PUBLICATIONS       | Optional.   |
| ADDRESS<br>E-mail.                  | Mailing address. Give also telephone, telex, fax numbers and  |
| CONTACT                             | Single contact person.  |

#### **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.

There are 29 institutions now represented by delegates in the ICRM. 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 organizational guidelines and directions for the working programs are agreed upon. The following officers of ICRM are presently serving on the Executive Board

| President      | M.J. Woods <sup>1</sup>   |
|----------------|---------------------------|
| Vice-President | H. Janszen <sup>2</sup>   |
|                | Y. Hino <sup>3</sup>      |
|                | B.R.Simpson <sup>4</sup>  |
| Past-President | B.M. Coursey <sup>5</sup> |
| Secretary      | P. de Felice <sup>6</sup> |

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:

| Chairman | N Coursol <sup>7</sup> |
|----------|------------------------|
| Members  | M Sahagia8             |
|          | G Winkler9             |

ICRM activities are largely the responsibility of its working groups. Each group is guided by a co-ordinator who acts as a centre for ideas and communications and may organize conferences and workshops. There are now seven working groups with the following fields of interest:

- (1) Alpha-Particle Spectrometry E. Garcia-Torano<sup>10</sup>
- (2) Gamma-Ray and Beta-Particle Spectrometry J.M. Los Arcos<sup>10</sup>
- (3) Liquid Scintillation Techniques P. Cassette<sup>7</sup>
- (4) Low-Level Measurement Techniques S.M. Jerome<sup>1</sup>

- (5) Non-Neutron Nuclear Data A.L. Nichols<sup>11</sup>
- (6) Radionuclide Metrology Techniques J. Keightley<sup>1</sup>, M. Unterweger<sup>5</sup>
- (7) Life Sciences B. Zimmerman<sup>5</sup>

Plenary meetings of the ICRM are held biennially, and have developed into a successful instrument of communication among various specialists, thus encouraging international co-operation.

The 14<sup>th</sup> international conference on radionuclide metrology, 2003 took place on 2 –6 June, 2003 at the University College Dublin, Ireland. The local organisation was undertaken the Department of Experimental Physics, coordinated by Dr Peter Mitchell with a team of university staff. The proceedings of the ICRM2003 was published in Applied Radiation and Isotopes, volume 60, issues 2-4, 2004. The ICRM2003 Scientific Programme Committee and referees had the contribution of Yoshio Hino<sup>3</sup>, Nelcy Coursol<sup>7</sup>, Philippe Cassette<sup>7</sup>, Marie-Martine Bé<sup>7</sup>, Guy Ratel (BIPM); José M. Los Arcos<sup>10</sup>, Eduardo García-Toraño<sup>10</sup>, Bruce R.S. Simpson<sup>4</sup>, Pierino de Felice<sup>6</sup>, Alan Nichols<sup>11</sup>, Dietmar F.G. Reher<sup>12</sup>, John D. Keightley<sup>12</sup>, Goedele Sibbens<sup>12</sup>; Lisa R. Karam<sup>5</sup>, Michael Unterweger<sup>5</sup>, Brian E. Zimmerman<sup>5</sup>; Michael J. Woods<sup>5</sup>, Simon M. Jerome<sup>5</sup>; Herbert Janßen<sup>2</sup>, Heinrich Schrader<sup>2</sup>, Dirk Arnold<sup>2</sup>, Peter I. Mitchell<sup>13</sup> and Gerhard Winkler<sup>9</sup>.

The ICRM Low Level Radioactivity Measurement Techniques Working Group hold in Vienna, 13-17 October 2003, was organised under the auspices of ICRM, the Comprehensive Test Ban Treaty Organisation (CTBTO), the Austrian Research Centre Seibersdorf (ARCS), the Bundesamt fur Eich und Vermessungswesen (BEV) and the UK National Physical Laboratory (NPL).

Anyone wishing to participate in ICRM's activities or to receive further information is encouraged to contact one of the officers or Working Group chairs.

May 2004 Mike Woods

#### References

- 1. Centre for Ionizing Radiation Metrology, National Physical Laboratory (NPL), Queens Road, Teddington, Middlesex TWll 0LW, U.K.
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- 6. ENEA C.R. Casaccia, P.O. Box 2400, I-00100 Rome, Italy
- 7. CEA, DAMRI, Laboratoire National Henri Becquerel (LNHB-BNM), B.P. 52, F-91193 Gif-sur-Yvette Cedex, France.
- 8. National Institute of C&D for Physics and Nuclear Engineering (IFIN), P.O. Box MG-6, RO-76900 Bucharest, Romania

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- 13. University College Dublin, Department of Experimental Physics, Belfield, Stillorgan Road, Dublin 4, Ireland

#### **Report of the Liquid Scintillation Counting Working Group**

The Liquid Scintillation Counting Working Group was created in 1997 and its first meeting was held during the ICRM'99 conference in Prague. Further meetings were organized in Saclay in November 2000 and during ICRM symposiums: Braunchweig in 2001 and Dublin in 2003. The aim of this working group is to share information on the use of liquid scintillation counting techniques in the field of radionuclide metrology. This working group focuses on the CIEMAT/NIST and the TDCR methods but also on source preparation and new developments in LSC.

The following topics were discussed during the previous meetings:

- Ionisation quenching models and calculation of electron stopping power in the scintillator.
- Atomic and nuclear data needed: beta spectra shape factors, detailed X-ray and Auger K<sub>L</sub> and M lines, etc.
- Implementation of the CIEMAT/NIST method: CN2004 package and source \_ preparation.
- Implementation of the TDCR method: detection-efficiency calculation programs.
- Source stability studies: examples of <sup>188</sup>W/<sup>188</sup>Re and <sup>177</sup>Lu. Standardization of various nuclides: <sup>18</sup>F, <sup>11</sup>C, <sup>153</sup>Sm, <sup>226</sup>Ra, <sup>222</sup>Rn and <sup>177</sup>Lu.
- Need to standardize very long-lived radionuclides for the measurement of the half-life: <sup>235</sup>U, <sup>238</sup>U, <sup>40</sup>K, <sup>79</sup>Se, <sup>87</sup>Rb, <sup>147</sup>Sm, <sup>176</sup>Lu, <sup>187</sup>Rh, <sup>190</sup>Pt...

During the last working group meeting in Dublin, it was decided to organise a comparison of the calculated absorbed spectra for the interaction of the 835 keV photons of <sup>54</sup>Mn in a liquid scintillator. The aim of this action is to compare the calculation results obtained using various calculation tools, and to provide the metrology community with some information on the choice of these tools. The expected results of this exercise are the spectrum of the energy absorbed by the scintillator per emission of an 835 keV gamma ray and the integral of this spectrum, which is the probability of interaction of the 835 keV gamma ray within the LS cocktail. This action will begin in June 2004.

General information on LSC, TDCR and CIEMAT/NIST methods can be found in the LSC working group web page. Software to calculate detection efficiency can be downloaded and information is given on the composition of usual LSC cocktails The LSC working group web page is hosted by the BNM server and is accessible, via a hyperlink, from the main ICRM web page or through the BNM web site at the following address:

#### http://www.bnm.fr/bnm-lnhb/icrm.htm

. Participant contributions are welcome and must be sent to the co-ordinator.

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#### **Report of the ICRM Low-Level Techniques Working Group for 2003**

The main activity of the group since the last ICRM Newsletter has been the conference on Low-Level Radioactivity Measurement Techniques, held at the Parkhotel Schönbrunn, Vienna, Austria from October 13 to October 17, 2003. The conference was hosted



by BEV Wien (Mag. Robert Edelmaier) and ARC Seibersdorf (Dr Martina Schwaiger), Austria. There were 130 abstracts submitted to the to the scientific programme committee (Dr Dirk Arnold, PTB Braunschweig; Dr Kerry Burns, IAEA Seibersdorf; Dr Pierino De Felice, ENEA Casaccia; Mag Robert Edelmaier, BEV Wien; Prof Elis Holm, Lund University and Risø National Laboratory; Dr Mikael Hult, IRMM Geel; Dr Christian Hurtgen, SCK•CEN Mol; Dr Ken Inn, NIST Gaithersburg; Simon Jerome, NPL Teddington; Dr Matjaz Korun, Jožef Stefan Institute Ljubljana; Dr Françoise Nguyen Dinh, CEA Saclay; Dr Martina Schwaiger, ARC Seibersdorf; and Mike Woods, Ionising Radiation Metrology Consultants Teddington). Of the submitted abstracts, 92 were presented at the conference (51 Oral and 41 posters) over the 4½ days of the conference in these sessions;

Radiometrics (Calibration, Simulation, Statistics, Detectors, Ultra Low Level, Noble Gas) Non-radiometric measurement (Mass Spectrometry – ICP, High Resolution ICP, Thermal Ionisation, Accelerator Based Neutron Activation)

Radiochemical techniques (Fission Products, Actinides, Activation Products, Long Lived Radionuclides, Radon, Special Matrices)

Applications (NORM, TENR, Decommissioning, Bioassay, Safeguards, Remediation, Environmental Measurements, Monitoring Systems)

Quality (Reference Standards, Traceability, Quality Assurance, Intercomparisons)

The review process is now complete and the edited papers will be published in a special issue of Applied Radiation and Isotopes later in 2004. In addition to the scientific programme a commercial exhibition was also held during the week. Thanks are due to Martina and Robert for the work that they and their teams carried out to ensure the efficient organisation and running of the conference.

Future events may include:

Joint workshop with  $\alpha$ -particle Spectrometry Working group on Actinide Yield Tracers Joint meeting/workshop with CELLAR to present new developments and share experiences and techniques on Very Low Level  $\gamma$ -ray Spectrometry

Other items of interest that may be addressed by the LLTWG are

Nuclear Security – there may be a need to address the metrology connected with detecting illicit transport of nuclear materials, either 'small' fission devices or a 'dirty' bomb. Nuclear Skills – the continued loss of skills as experienced people retire and potential replacements put off by poor pay and prospects. It is expected that the ICRM as an organisation should work with the IAEA and others to preserve and increase nuclear knowledge.

Finally, I shall relinquish the post of LLTWG co-ordinator at the next main ICRM conference and a replacement is currently being sought.

Fre

Simon Jerome, NPL-UK, 31st March 2004

# 2003 Annual Report: Non-Neutron Nuclear Data Working Group (3NDWG)

- 1. As noted over previous years, the primary aim of the 3NDWG is to provide the worldwide scientific community with an appropriate environment for communications between specialists in the field of non-neutron nuclear data measurements and evaluations so that they can learn more about each others' work, liaise and combine forces to undertake research programmes of mutual interest, and organise multinational efforts to produce recommended sets of non-neutron nuclear data.
- 2. As over the previous 5 years, much of the work by members of 3NDWG has involved the Decay Data Evaluation Project (DDEP) and an IAEA Co-ordinated Research Project (CRP) "Update of X-ray and Gamma-ray Decay Data Standards for Detector Calibration and Other Applications". A significant fraction of the biennial 3NDWG meeting at ICRM2003, Dublin, was dedicated to the on-going work of the DDEP, including:
  - (a) report on status of DDEP (E. Browne-Moreno),
  - (b) webpage developments for DDEP (M.-M. Bé),
  - (c) on-going evaluations (V.P. Chechev),
  - (d)  ${}^{56}$ Co measurements (J.C. Hardy and R.G. Helmer).

Communications between decay-data evaluators continue to be encouraged through the Decay Data Evaluations Project (E. Browne: ebrowne@lbl.gov).

- 3. Three papers presented in the Nuclear Decay Data session of ICRM2003, Dublin, were dedicated to specific features of the IAEA-CRP (Update of X-ray and Gamma-ray Decay Data Standards for Detector Calibration and Other Applications). Five oral and ten poster presentations at ICRM2003 provided evidence of reasonably healthy work programmes in Brazil, Germany, France, Russian Federation, UK, USA, IAEA and IRMM. 3NDWG members continue to maintain a re-assuring profile under difficult financial circumstances.
- 4. Other points of note:
  - (i) request to re-measure half-lives of  $^{235}$ U and  $^{238}$ U;
  - (ii) need to resolve anomalies between recent and on-going half-life measurements (particularly all relevant work of national standards labs: NIST, NPL, PTB, LNHB);
  - (iii) new sets of internal conversion coefficients (Band et al., At. Data Nucl. Data Tables 81 (2002) 1);
  - (iv) request to evaluate <sup>237</sup>Np decay data;
  - (v) requests for better definition of  $\beta$ -decay shape factors.

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12 February 2004

#### **Report of the Life Sciences Working Group Coordinator's Report**

The most recent meeting of the Life Sciences Working Group (LSWG) was held on 4 June, 2003 in Dublin, Ireland as part of the 14<sup>th</sup> International Conference on Radionuclide Metrology and its Applications. It was preceded by 4 oral and 4 poster presentations presented during the Life Sciences session of the Conference, nearly all of which dealt with the subject of the development of secondary or transfer standards.

The first presentation of the Working Group meeting, given by M. Woods (NPL), summarized the status of the <sup>18</sup>F comparison carried out in 2001. All of the participants have reported their results and data analysis is nearly complete. A proposal has been made to the CCRI(II) to grant the comparison retroactive Key Comparison status. Assuming this is granted, the appropriate Draft A and B reports will be prepared and circulated. The results are expected to be published by the end of 2003. When available, they will be posted on the LSWG web site.

Most of the rest of meeting consisted of reports related to the <sup>90</sup>Y comparison conducted in 2002. The organizer of the comparison, B. Zimmerman (IAEA), reported that 4 laboratories (BNM-LNHB, NIST, NPL, and PTB) provided results, with one of the laboratories providing two independent values. Although the results are all in agreement within the measurement uncertainties, one of the labs, which had performed the measurements approximately 3 weeks after the others due to the intervening holidays, reported an unusually high value with a large associated uncertainty. This result has been tentatively attributed to uncertainties in the <sup>90</sup>Y half-life. On this topic, K. Kossert (PTB) presented preliminary data from recent PTB measurements of the <sup>90</sup>Y half-life that gave a much smaller uncertainty. Data were also presented showing differences in NPL chamber response due to differences in solution volume, as well as measurement differences between two of the participating laboratories in NPL chambers using the same volume.

As a preliminary exercise, the BNM-LNHB sent an ampoule to the BIPM for measurement in the SIR ionisation chamber. As reported by C. Michotte (BIPM), the measurement indicated very low detection efficiency for <sup>90</sup>Y, as well as a possible discrepancy between measured and calculated response. The main point, however, was that additional measurements will be necessary.

A series of short presentations was made by M. Woods describing some of the relevant projects on which NPL have been working as related to nuclear medicine. These included:

Establishing equivalence for activity standards for sort-lived radionuclides, Syringe factors for radionuclide calibrators,

Calibration factors for the new 10R Schott vials (replacing the P6 vial) in the NPL chamber, Investigation of accuracy of commercial calibrators in hospitals in the UK, and A EUROMET proposal for improving calibration factors in the NPL chamber.

A description of a new programme in radioactivity standardization, including the establishment of a secondary standard calibration network for radioactivity measurements in nuclear medicine, being implemented at the IAEA was then given by B. Zimmerman.

The following items were then taken up as new actions:

The pilot comparison of <sup>90</sup>Y and subsequent half-life measurements made by PTB indicated a need for a new review of the <sup>90</sup>Y half-life. The results of the half-life measurements have been submitted for publication and D. MacMahon (NPL) has conducted a new evaluation so that the new value can be used for the next comparison.

A CCRI(II) Key Comparison of <sup>90</sup>Y was conducted in October, 2003 and was administered by the IAEA and NIST. The participants were BNM-LNHB, NIST, PTB, CIEMAT, NMIJ, NPL, the BIPM, and CSIR-NML. The required Draft A B reports will be prepared in early 2004. In addition to the need for an evaluation of the <sup>90</sup>Y half-life, the level scheme for <sup>103</sup>Pd was also identified as a priority for the medical, as well as the metrological, community.

The need for evaluated data that included covariances was expressed, as well as the need for accurate shape factors for  $\beta$ -emitting nuclides.

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## ICRM

## CONTRIBUTIONS

| LABORATORIES                             | IAEA Nuclear Data Section, Vienna, Austria;<br>Serco Assurance, Winfrith Science Centre, Dorchester, UK   |
|--|---|
| NAMES                                    | A L Nichols (IAEA) and R J Perry (Serco Assurance)  |
| ACTIVITY                                 | Decay-data evaluations and preparation of databases   |
| RESULTS/<br>INFORMATION                  | Decay-data evaluations underway in 2004-05:<br>(a) evaluations for DDEP: <sup>97m</sup> Tc, <sup>109</sup> Pd, <sup>126</sup> Sb, <sup>127</sup> Sb, <sup>127</sup> Te<br>and <sup>127m</sup> Te;<br>(b) <sup>192</sup> Au, and <sup>226</sup> Ra decay chain;<br>(c) additional evaluations for JEFF-3.  |
| PUBLICATIONS                             | O Bersillon et al, "JEFF-3T: Decay Data and Fission Yield<br>Libraries", ND2001 Int. Conf. Nucl. Data for Science and<br>Technology, 7-12 Oct 2001, Tsukuba, Japan; also J. Nucl.<br>Sci. Technol., Supplement 2, Vol 1 (2002) pp 478-480.  |
| IN PROGRESS                              | Evaluation of decay data for DDEP.  |
| INFORMATION                              | Evaluations completed and databases assembled in 2003:<br><sup>81</sup> Se, <sup>81m</sup> Se, <sup>72</sup> Br, <sup>72m</sup> Br, <sup>94</sup> Sr, <sup>99</sup> Zr, <sup>110</sup> Rh, <sup>110m</sup> Rh, <sup>176</sup> W,<br><sup>180</sup> Os, <sup>196</sup> Os, <sup>192</sup> Ir, <sup>192m</sup> Ir, <sup>192n</sup> Ir, <sup>192m</sup> Au and <sup>202</sup> Pt; also <sup>228</sup> Th<br>decay chain re-evaluated.<br>Evaluations planned in future years for DDEP: <sup>106</sup> Rh,<br><sup>132</sup> Te, <sup>132</sup> I, <sup>144</sup> Pr and <sup>201</sup> Pb. Also possibility of additional<br>evaluations for JEFF-3. |
| IN PREPARATION                           | <sup>234m</sup> Pa decay data evaluation - data file in preparation.  |
| OTHER RELATED<br>PUBLICATIONS<br>ADDRESS | <ul> <li>M Herman and A L Nichols, Update of X- and Gamma-ray<br/>Decay Data Standards for Detector Calibration and Other<br/>Applications, INDC(NDS)-437, December 2002.</li> <li>A L Nichols, Decay Data: Review of Measurements,<br/>Evaluations and Compilations, Appl. Radiat. Isot., 55 (2001)<br/>23-70.</li> <li>A L Nichols, IAEA Co-ordinated Research Project: Update<br/>of X-ray and Gamma-ray Decay Data Standards for Detector<br/>Calibration and Other Applications, Appl. Radiat. Isot., 60<br/>(2004) 247-256.</li> <li>IAEA Nuclear Data Section,<br/>Department of Nuclear Sciences and Applications</li> </ul>              |
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Summary of the research programme related to radionuclide metrology for the years 2003 and 2004

at the "Institut für Isotopenforschung und Kernphysik" (IIK) of the University of Vienna, Austria

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[also to be regarded as contribution according to the ICRM standing actions SA1 and SA2]

The activities at the IIK concentrate on the improvement and development of atomic and nuclear measuring techniques and data handling procedures for interdisciplinary applied physics work with special emphasis on the detection of long-lived radionuclides, particularly in the very-low-level range. Nuclear-decay-counting techniques have been widely replaced by mass-spectrometric techniques with high selectivity and high sensitivity. Updated and more detailed information about research at IIK during the last four years is also be provided via the institute's internet home page given above.

Names: R. Andrejic, M. Auer, M. Berger, R. Drosg, H. Friedmann, H. Figl, E. Friedl, R. Golser, P. Hille, H. Humberger, J. Kühtreiber, W. Kutschera (director), J. Lukas, E. Pak, A. Pavlik, A. Priller, R. Schön, J. Schwarzenberg, P. Steier, B. Strohmaier, S. Tagesen, Ch. Vockenhuber, H. Vonach, A. Wallner, E. Wild, G. Winkler, St. Winkler

1. <u>The tandem-accelerator mass-spectrometry facility VERA</u> (Vienna Environmental Research Accelerator) and its use

Accelerator mass spectrometry (AMS) is a major field of research at the IIK. With AMS the radionuclides are measured by direct atom counting; selectivity is achieved employing energy-, momentum- and velocity-selecting devices (electrostatic, magnetic and time-of-flight/Wien filters) and using ion detectors for counting and final energy measurement. The interesting nuclides (with extremely small radioisotope-to-stable-isotope ratios in the 10<sup>-10</sup> to 10<sup>-15</sup> range) cannot be measured at natural levels through radioactive-decay counting, particularly for small samples in the milligram range, typically containing only 10<sup>5</sup> to 10<sup>8</sup> radionuclide atoms. Predominantly isotope ratios are measured relative to appropriate standards. The VERA facility is based on a 3-MV Pelletron tandem accelerator (from National Electrostatics Corporation in Wisconsin, USA). For details on the experimental equipment see http://www.univie.ac.at/Kernphysik/VERA/welcome.htm.

Through the recent upgrades of VERA it has been possible to measure ions from very heavy long-lived radionuclides such as <sup>129</sup>I ( $T_{1/2} \approx 1.6 \times 10^7$  a) [<sup>129</sup>I/<sup>127</sup>I ratios], <sup>210</sup>Pb ( $T_{1/2} \approx 22$  a), <sup>236</sup>U ( $T_{1/2} \approx 23 \times 10^6$  a) [marker for contamination by irradiated uranium, also daughter product of the decay of <sup>240</sup>Pu], <sup>244</sup>Pu ( $T_{1/2} \approx 81 \times 10^6$  a) [for research on e.g. interstellar medium grains], <sup>242</sup>Pu ( $T_{1/2} \approx 3.8 \times 10^5$  a) and <sup>182</sup>Hf [ $T_{1/2} \approx (9\pm 2) \times 10^6$  a] in natural samples.

In co-operation with GSI Darmstadt, University of Mainz, and Kurchatov Institute Moscow, ion detection with a *calorimetric cryodetector* was studied at a flight path for discrimination and energy spectroscopy of heavy ions showing improvement of the energy resolution up to two orders of magnitude better than with a surface-barrier detector.

- a) Study of the *stratosphere-troposphere exchange (STE)* via <sup>10</sup>Be/<sup>7</sup>Be isotope ratios: Stratosphere-troposphere exchange is one of the key factors controlling the budgets of ozone, water vapour and other substances in the troposphere and lower stratosphere. The two cosmogenic isotopes of Be, <sup>10</sup>Be (measured by AMS) and <sup>7</sup>Be (measured by decay counting), have very different half-lives; the combination of production rates, half-lives, and different residence times in the troposphere and stratosphere, results in <sup>10</sup>B/<sup>7</sup>Be isotope ratios that can be used as fingerprints leading to improved estimates of STE. Airfilter samples collected at high-alpine stations are employed.
- b) *Be- and Al-isotope ratios*( $\rightarrow$ <sup>26</sup>*Al*) in sediments for dating in geology, in particular <sup>10</sup>*Be* in loess samples from Luochuan, China [co-operation with the Chinese Academy of Sciences Xi'an]
- c) Effort to *reduce the large uncertainty* of the knowledge of the *half-life* of the neutron-rich isotope  ${}^{182}Hf$  [T<sub>1/2</sub>  $\approx$  (9±2)×10<sup>6</sup> a, measured 40 years ago]. The system  ${}^{182}Hf$   ${}^{182}W$  forms a geochronometer, which offers an excellent way to determine the time-scale for the early Solar System's accretion and the core formation of the planets. It can be used to study the early development of the Earth and the Moon through isotopic anomalies of its stable decay product  ${}^{182}W$ .  ${}^{182}Hf$  may also complement a few other radionuclides in the million-year half-life range to trace relatively recent stellar events with high neutron fluxes like nearby supernovas (inducing, e.g.,  ${}^{182}Hf$  from the double neutron capture in  ${}^{180}Hf$ ), e.g., by finding measurable traces of live  ${}^{182}Hf$  in suitable terrestrial archives.

#### 3. Conventional radionuclide instrumentation and evaluation

 $4\pi \ NaI(Tl) \ gamma \ well-type$  detector (12.7 x 12.7 cm) with software to calculate total efficiencies and check the consistency of chosen decay schemes; shielded high-purity *Ge* detector;  $3''x \ 3'' \ NaI(Tl)$  detectors;  $Si(Li) \ x$ -ray detector; sealed thin-window *Xe* proportional counter tube; surface-barrier detectors;  $4\pi$ -beta-ray counter;  $2\pi$ -beta-ray counter with anticoincidence shielding counter; two methane proportional counters with screening counters for dating using the conventional <sup>14</sup>C method; various types of ionisation chambers operated in current mode and a solid state detection system for measurements of radon and thoron and their daughters, an electrete measuring device for the same purpose; the universal spectra-analysis program "IRUK" [developed by H. Friedmann] for use on PCs (including peak search and macro programming).

#### 4. Other projects

a) Program to evaluate and check the reliability of the half-life values of some long-lived radionuclides("How well do we know our clocks") relevant to archaeochronology, geochronology and cosmochronology [compare, e.g., F. Begemann et al., Call for an improved set of decay constants for geochronological use, Geochim. Cosmochim. Acta <u>65</u> (2001) 111-121]. In addition, the basic question of the change of half-lives due to stellar environments or other extreme environmental conditions are to be discussed.

- b) A critical review of experimental data for the *half-lives of the uranium isotopes 238U and 235U* [R. Schön, G. Winkler, W. Kutschera], Proceedings of the 14th International Conference on Radionuclide Metrology and its Applications, ICRM 2003(Dublin)
- c) Austrian National Radon Project (ÖNRAP) [H. Friedmann]:

The aim of the project was to determine the radon exposure of the population in Austria as well as to classify areas according to their potential radon risk from the ground. The observed radon concentration does not reflect in all cases the radon risk from the ground because of different dwelling situations, house types, maintenance, and living conditions. The project was carried out by systematic indoor measurements in randomly selected houses using different types of detectors. A radon potential was derived from the results of these measurements and the information received from additional questionnaires. This radon potential was defined as an expected radon concentration in a standard situation and shall characterise the radon risk from the ground without the influence of different living situations. Expected lung-cancer mortalities were computed on basis of ICRP 65 estimates from mean radon exposure on county level and the results compared with actual lung-cancer mortality. For details of the investigation and a list of previous publications, see <u>http://www.univie.ac.at/Kernphysik/oenrap/onrap\_e.htm</u>; also available: "Radon information CD" (H. Friedmann).

- d) *Radiocarbon dating by means of AMS:* e.g., dating of glacier ice in the Alps on the millennium time scale using sub-mg samples [co-operation with the Institut fuer Umweltphysik of the University of Heidelberg, Germany]
- e) *Conventional radiocarbon dating* (up to about 40000 years B.P.): Interdisciplinary co-operation is continued.

#### 5. Work and co-operation on special reports and standard concepts, training tasks

Co-operation with the *Austrian Standards Institute* (OENORM) to achieve a uniform interpretation of low-level measurements and to harmonise measurement-uncertainty statements in radiation protection is continued:

- a) ÖNORM S 5250-2: "Counting statistics in radioactivity measurements Spectroscopic measurements" defines the requirements for the treatment of uncertainties in spectroscopic measurements, especially for low-level high-resolution spectroscopy. The decision limit and the lower limit of detection is introduced, procedures for single-peak evaluation and for the evaluation of several peaks produced by a specific radioisotope are treated. Criteria for deciding whether a measured quantity is below or above a (e.g. legally) set value are given. The practical handling of the given rules is demonstrated by examples. The program is to be extended to the certification of drinking water.
- b) OENORM S5280-1 and OENORM S5280-2: "Radon-measurement methods and their range of applications" and "Civil engineering precautionary measures in the case of buildings" (Austrian Standard for indoor radon measurements and for a certification of dwellings).

Students' training in the field of general experimental physics, quantum physics, atomic physics, nuclear physics, ion physics and radioactivity measurements is taken care of by the staff of the IIK.

#### 6. Participation in international organisations

- International Committee for Radionuclide Metrology (ICRM) [G. Winkler];
- Consultative Committee for Ionising Radiation (CCRI), Section II (Measurement of Radionuclides) at the BIPM, Sèvres, France [member: G. Winkler];
- Science and Technology Committee, EURATOM [delegate P. Hille];

April 2004

Gerhard Winkler

| LABORATORY   | European Commission - Joint Research Centre   |
|--------------|---|
|              | Institute for Reference Materials and Measurements (IRMM)   |
|              | JRC Reference Laboratory for Radionuclide Metrology   |
| NAMES        | T. Altzitzoglou, A. Bohnstedt, JG. Decaillon, R. Van<br>Ammel   |
| APPARATUS    | <ol> <li>HPGe detector systems (incl. low background<br/>detectors)</li> <li>Low and Ultra low level liquid scintillation<br/>spectrometers</li> <li>Facilities for radiochemical separations</li> <li>Various instruments for thin foil production and<br/>radioactive source preparation.</li> </ol>  |
| RESULTS      | <ol> <li>Standardisation of <sup>32</sup>P, <sup>192</sup>Ir, <sup>65</sup>Zn, <sup>241</sup>Am, <sup>54</sup>Mn<br/>(BIPM/CCRI(II) international comparisons).</li> <li>Standardisation of <sup>134</sup>Cs and <sup>137</sup>Cs (by LSC).</li> </ol>  |
| PUBLICATIONS | <ol> <li>L. Johansson, G. Sibbens, T. Altzitzoglou, B.<br/>Denecke and D.F.G. Reher "Six direct methods for<br/>standardisation of <sup>152</sup>Eu", Nuclear Instruments and<br/>Methods in Physics Research A508 (2003) 378-387.</li> <li>T. Altzitzoglou "Analysis of triple-label samples by<br/>Liquid Scintillation Spectrometry". Applied Radiation<br/>and Isotopes 60 (2004) 487-491.</li> <li>T. Altzitzoglou, G. Sibbens, M. Bickel, A. Bohnstedt,<br/>JG. Decaillon, C. Hill and L. Holmes "Characterisation<br/>of reference materials for radioactivity with assigned<br/>values traceable to the SI units". Contribution to the<br/>Conference on Low-level Radioactivity Measurement<br/>Techniques (October 13-17, 2003, Vienna, Austria), to be<br/>published.</li> </ol> |
| IN PROGRESS  | <ol> <li>Characterisation of the IAEA-152 (Milk powder) and<br/>IAEA-375 (Soil) RMs using radiochemical methods.</li> <li>Determination of photon emission probabilities of<br/><sup>65</sup>Zn (EUROMET project 721).</li> </ol>   |
| ADDRESS      | European Commission<br>Joint Research Centre<br>Institute for Reference Materials and Measurements (IRMM)<br>Retieseweg 111, B-2440 Geel, Belgium<br>Tel. +32 14 571266 - Fax +32 14 584273<br>E-mail : <u>timotheos.altzitzoglou@cec.eu.int</u>  |
| CONTACT      | Timos Altzitzoglou  |

| LABORATORY            | European Commission - Joint Research Centre   |
|-----------------------|---|
|                       | Institute for Reference Materials and Measurements (IRMM)   |
|                       | JRC Reference Laboratory for Radionuclide Metrology   |
| NAMES                 | S. Pommé, G. Sibbens, T. Altzitzoglou, R. Van Ammel, J. Keightley   |
| APPARATUS<br>ACTIVITY | $4\pi$ pressurised gas proportional counter<br>windowless $4\pi$ CsI(Tl)-sandwich spectrometer<br>two $\alpha$ -particle counters at defined solid angle<br>atmospheric $4\pi\beta$ – $\gamma$ coincidence counter<br>pressurised $4\pi\beta$ – $\gamma$ coincidence counter<br>$4\pi\gamma$ NaI well counter<br>two secondary standard ionisation chambers<br>two $4\pi$ liquid scintillation counters |
| RESULTS               | Standardisation of <sup>65</sup> Zn, <sup>192</sup> Ir, <sup>241</sup> Am and <sup>54</sup> Mn for CCRI key comparisons.  |
|                       | Standardisation of <sup>134</sup> Cs, <sup>137</sup> Cs for EC intercomparison <sup>137</sup> Cs in air filters.  |
|                       | Standardisation of <sup>232</sup> U, <sup>236</sup> Pu and <sup>229</sup> Th tracers for re-<br>certification of IAEA reference materials.  |
|                       | Activity measurement of <sup>233</sup> U in a <sup>233</sup> Pa source.   |
|                       | Half-life determination of <sup>65</sup> Zn.  |
| IN PROGRESS           | Standardisation of <sup>32</sup> P.   |
|                       | Intercomparison of DCC analysis algorithms with external partners.  |
| PUBLICATIONS          | L. Johansson, T. Altzitzoglou, G. Sibbens, S. Pommé, B. Denecke, Standardisation of <sup>238</sup> Pu using four different methods of measurements, Nucl. Instr. Meth. A505 (2003) 699-706.   |
|                       | S. Pommé, L. Johansson, G. Sibbens, B. Denecke<br>A practical algorithm for the solid angle calculation applied<br>in $\alpha$ -particle counting, Nucl. Instr. Meth. A505 (2003) 286-<br>289.  |
|                       | G. Sibbens, S. Pommé, L. Johansson, B. Denecke<br>Tailoring solid angle calculations to the actual radioactivity  |

|         | distribution of planar sources, Nucl. Instr. Meth. A505 (2003) 277-281.   |
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|         | R. Van Ammel, S. Pommé, G. Sibbens, Experimental verification of the half-life of <sup>65</sup> Zn, Appl. Rad. Isot., 60 (2004) 337-339.  |
|         | G. Sibbens, S. Pommé, T. Altzitzoglou, Standardisation of <sup>232</sup> U, <sup>236</sup> Pu and <sup>229</sup> Th solutions used as tracers for upgrading IAEA Reference Materials with assigned property values traceable to the International System of Units (SI), Internal Report IRMM, GER/RN/02/2003/03/25. |
|         | G. Sibbens, S. Pommé, T. Altzitzoglou, Standardisation of<br>low-activity actinide solutions by alpha-particle counting at a<br>defined solid angle, Appl. Rad. Isot., in press.  |
|         | S. Pommé, A full serial expansion of Ruby's solid angle<br>formula compared to Blachman's formula and a numerical<br>integration method, submitted to NIM A.  |
|         | S. Pommé, Serial expansion of Ruby's solid angle formula,<br>Internal Report IRMM, GE/IM/39/2003/11/23.   |
|         | G. Sibbens, Overview of source preparation techniques<br>applied to primary standardisation. Lecture notes for VERMI<br>Young Researchers Workshop, Paris 1-5 December 2003,<br>Internal Report IRMM, GE/IM/40/2003/11/24.  |
|         | S. Pommé, Defined Solid Angle counting techniques.<br>Lecture notes for VERMI Young Researchers Workshop,<br>Paris, 1-5 December 2003, Internal Report IRMM,<br>GE/IM/41/2003/11/30.  |
| ADDRESS | European Commission<br>Joint Research Centre<br>Institute for Reference Materials and Measurements (IRMM)<br>Retieseweg 111, B-2440 Geel, Belgium<br>Tel. +32 14 571 211 - Fax +32 14 584 273<br>E-mail: <u>stefaan.pomme@cec.eu.int</u>  |

CONTACT Dr. Dr. S. Pommé.

| LABORATORY            | European Commission - Joint Research Centre<br>Institute for Reference Materials and Measurements (IRMM)<br>JRC Reference Laboratory for Radionuclide Metrology   |
|-----------------------|---|
| NAMES                 | G. Sibbens, S. Pommé  |
| APPARATUS<br>ACTIVITY | Two high resolution semiconductor alpha-particle spectrometers  |
| RESULTS               | A novel off-line peak stabilisation method for alpha-particle spectrometry.   |
|                       | Study of the alpha-particle emission probabilities of <sup>240</sup> Pu.  |
|                       | High-resolution spectra and preliminary nuclear decay data for <sup>235</sup> U (EUROMET 591).  |
| IN PROGRESS           | Analysis of nuclear data of <sup>235</sup> U (EUROMET 591).   |
|                       | Migration of analysis code ALFA to Windows platform.  |
|                       | Development of spreadsheet application ALPHA for deconvolution of alpha-particle spectra.   |
|                       | EUROMET project no 749 on alpha-particle emission probabilities and energies in the decay of <sup>240</sup> Pu.   |
| PUBLICATIONS          | S. Pommé, G. Sibbens, Concept for an off-line gain stabilisation method, Appl. Rad. Isot. 60 (2004) 151-154.  |
|                       | G. Sibbens, S. Pommé, Study of alpha-particle emission probabilities and energies in the decay of <sup>240</sup> Pu, Appl. Rad. Isot. 60 (2004) 155-158.  |
|                       | S. Pommé, G. Sibbens, A new off-line gain stabilisation<br>method applied to alpha-particle spectrometry, Advanced<br>Mathematical and Computational Tools in Metrology, in press.  |
| ADDRESS               | European Commission<br>Joint Research Centre<br>Institute for Reference Materials and Measurements (IRMM)<br>Retieseweg 111, B-2440 Geel, Belgium<br>Tel. +32 14 571 211 - Fax +32 14 584 273<br>E-mail: goedele.sibbens@cec.eu.int |
| CONTACT               | G. Sibbens.   |

| LABORATORY   | European Commission - Joint Research Centre<br>Institute for Reference Materials and Measurements (IRMM)  |
|--------------|---|
|              | JRC Reference Laboratory for Radionuclide Metrology   |
| NAMES        | M. Hult, J. Gasparro, R. Vasselli   |
| APPARATUS    | Four underground gamma-ray HPGe-detectors   |
| RESULTS      | <sup>60</sup> Co activity in steel from Hiroshima to verify model calculations for survivor dosimetry   |
|              | <sup>210</sup> Pb distribution in human bones   |
|              | Radiation protection – dosimetry using neutron activation   |
|              | Radiopurity measurements  |
| IN PROGRESS  | Measurements of <sup>60</sup> Co in steel from Hiroshima  |
|              | Neutron dosimetry and plasma characterisation using activation of metal discs   |
|              | Measurements of NORMs in Biofood and fertilisers  |
|              | Intercomparison work  |
|              | Ultra-low background detector developments  |
| PUBLICATIONS | Hult, M., Gasparro, J., Johansson, L., Johnston, P.N. and<br>Vasselli, R. (2003). "Ultra Sensitive Measurements of γ-ray<br>Emitting Radionuclides using HPGe-detectors in the<br>Underground Laboratory HADES". Environmental<br>Radiochemical Analysis II, (2003) pp.375-382, Royal Society<br>of Chemistry, Cambridge, UK  |
|              | M. Hult, J. Gasparro, P.N. Johnston and M. Köhler<br>"Underground Measurements of Environmental Radioactivity<br>in Europe". Proceedings from: 1st International Symposium of<br>the Kanazawa University 21st-century COE Program<br>Environmental Monitoring and Prediction of Long- and Short-<br>Term Dynamics of Pan-Japan Sea Area:Construction of<br>Monitoring Network and Assessment of Human Effects,<br>Kanazawa, Japan, 2003, pp. 18-23. |
|              | Gasparro J, Hult M, Komura K, Vasselli R, Johnston PN,<br>Laubenstein M, Neumaier S, Arnold D, Reyss JL, Holmes L<br>and Van Britsom G. "Measurement of <sup>60</sup> Co in Spoons<br>Activated by Neutrons During the JCO Criticality Accident at<br>Tokai-mura in 1999". Journal of Environmental Radioactivity<br>73 (2004) 307-321.   |
|              | Hult M, Gasparro J, Shizuma, K, Vasselli R, Neumaier S and Arnold D, "Deep underground measurements of <sup>60</sup> Co in steel  |

|         | exposed to the atomic bomb in Hiroshima". <u>Accepted for</u> <u>publication</u> in Appl. Rad Isot.  |
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CONTACT

M. Hult

| LABORATORY   | SCK·CEN, Low Level Radioactivity Measurements<br>(SA1/SA2)   |
|--------------|--|
| NAMES        | C. Hurtgen, F. Verrezen.   |
| APPARATUS    | <ul> <li>ZnS alpha counters</li> <li>Proportional counters</li> <li>Liquid scintillation counters</li> <li>alpha spectrometers</li> </ul>  |
| ACHVIT       | Gross alpha and beta, <sup>3</sup> H, <sup>14</sup> C, <sup>89-90</sup> Sr, <sup>131</sup> I, <sup>210</sup> Po, <sup>226</sup> Ra and actinides 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. |
|              | Assay of <sup>14</sup> C, <sup>63</sup> Ni, <sup>99</sup> Tc, <sup>129</sup> I in low level waste  |
| RESULTS      | Extension to the QA system following ISO17025 of the procedure for radium determination by the emanation method  |
| PUBLICATIONS | Hurtgen, C. and C. Cossonnet (2003) "Work Package 3,<br>Uncertainty on bioassay measurements A survey of<br>European laboratories." BLG-935<br>Hurtgen, C. and C. Cossonnet (2003). "A survey of<br>uncertainty in bioassay measurements carried out within<br>the OMINEX project." Radiat. Prot. Dosim. 105(1-4): 375-<br>378.                    |
| IN PROGRESS  | Validation of the method for uranium determination by kinetic phosphorescence analysis.  |
| ADDRESS      | Low Level Radioactivity Measurements<br>SCK•CEN<br>Boeretang 200<br>B-2400 Mol Belgium<br>Telephone: (+32-14) 33 28 31<br>Telecopier: (+32-14) 32 10 56<br>E-mail: <u>churtgen@sckcen.be</u><br>Web:<br>http://www.sckcen.be/sckcen_en/activities/research/anpossi/a<br>n-possi.shtml  |
| CONTACT      | C. Hurtgen   |

| LABORATORY  | SCK.CEN, Nuclear Chemistry & Services (SA1/SA2)   |
|-------------|---|
| NAMES       | L. Vandevelde, M. Gysemans  |
| ACTIVITY    | • Destructive radiochemical analysis of spent fuels for the determination of burnup and for analysis of the fuel composition  |
|             | • Determination of the Pu and <sup>241</sup> Am 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                                |
|             | • Radiochemical analysis of reactor dosimeters and reactor materials.   |
| RESULTS     | • Validation of a HPGe-detector type GL0510R (Canberra) for an accurate determination of <sup>241</sup> Am in MOX solutions.  |
|             | • Validation of the algorithm used for calculation of the <sup>239</sup> Pu+ <sup>240</sup> Pu peak area in alpha-spectra originating from MOX solutions with high concentrations of <sup>241</sup> Am. |
|             | • Separation of <sup>93m</sup> Nb from highly activated reactor vessel materials for gamma-spectrometry measurement   |
| IN PROGRESS | • Comparison of radio-analytical techniques with ICP-MS for the analysis of the long-lived radionuclides such as <sup>99</sup> Tc, <sup>237</sup> Np and <sup>129</sup> I.                              |
|             | • Optimisation of the separation of <sup>147</sup> Pm from spent fuel solutions for LSC measurements.   |
| ADDRESS     | Nuclear Chemistry & Services  |
|             | SCK•CEN<br>Boeretang 200, B-2400 Mol, Belgium<br>Telephone : (+32-14) 33 32 07<br>Telecopier : (+32-14) 32 07 55<br>E-mail : mgyseman@sckcen.be   |
| CONTACT     | M. Gysemans.  |

| LABORATORY   | SCK·CEN, Safeguards and Nuclear Physics Measurements<br>(SA1/SA2)  |
|--------------|--|
| NAMES        | M. Bruggeman, J.L. Genicot, P. Vermaercke, P. Willeborts.  |
| APPARATUS    | <ul> <li>Low-level HPGe coaxial and planar detectors</li> <li>Particle detectors, X-ray detectors</li> <li>NaI(Tl) detectors (cylindrical and well-type)</li> <li>Shielded rooms</li> <li>4πβγ-coincidence, 4πγ-counting, 2πα-counting</li> <li>Neutron coincidence and multiplicity counting</li> <li>BR1 reactor and rabbit system for Neutron Activation Analysis</li> </ul>  |
| ACTIVITY     | 7 1141,515   |
|              | <ul> <li>α- and γ-spectrometry</li> <li>Preparation of Radioactive Standards</li> <li>Whole body and organ counting</li> <li>Neutron activation analysis with relative NAA and k<sub>0</sub> - method</li> <li>Non-destructive assay of nuclear wastes and special nuclear material (γ-spectrometry and neutron counting)</li> </ul>   |
| RESULTS      | <ul> <li>We studied the pros and the cons of spectra analysis with peak area method compared to the method with least squares fitting with standard spectra in WBC. The lower detection limits that are achieved with the latter method generally are underestimated if one considers the person specific variability of the background. If these are taken into account, comparable limits are obtained as with the peak area method.</li> <li>We co-organised the WGA (Working Group A) meeting of ENTRAP (European Network for Testing facilities of Radioactive waste Packages) together with JRC Ispra (Ispra, October 2003)</li> <li>We participated in the OMINEX project and training course on uncertainty estimation in in-vivo measurements.</li> <li>We investigated the bias in the k0 method for different reference materials. Accuracy better than 5% can generally not be achieved when applying only the k0 method. To correct for possible bias the co-irradiation of standards is required.</li> <li>Uncertainty Budgets for k0-NAA have been made up</li> <li>We participated in CCQM P34 – Mass fractions of the components of an Aluminium alloy – and in CCQM P 39 – Trace Elements in Tuna Fish.</li> </ul> |
| PUBLICATIONS | <ul> <li>Jean Louis Genicot, "Uncertainties on In Vivo<br/>Measurements. A survey of European Laboratories", BLG-<br/>943 - October 2003</li> <li>D. Franck, N. Borissov, L. de Carlan, N. Pierrat, J. L.</li> </ul>   |

|         | <ul> <li>Genicot and G. Etherington, "Application of Monte Carlo calculations to calibration of anthropomorphic phantoms used for activity assessment of actinides in lungs", Internal Dosimetry of Radionuclides. Radiation Protection Dosimetry Vol. 105, No. 1-4, pp. 403-408 (2003).</li> <li>J.L. Genicot, I. Geboers, A. Damen, D. Franck, L. de Carlan. "The reduction of limits of detection in in vivo counting of low energy photon emitters by optimizing the shape and size of detectors." ,Internal Dosimetry Vol. 105, No. 1-4, pp. 457-462 (2003).</li> </ul> |
|---------|--|
| ADDRESS | Safeguards and Nuclear Physics Measurements<br>SCK•CEN, GKD<br>Boeretang 200<br>B-2400 Mol Belgium<br>Telephone: (+32-14) 33 28 86<br>Telecopier: (+32-14) 32 10 56<br>E-mail: <u>mbruggem@sckcen.be</u>   |
| CONTACT | M. Bruggeman.  |

| LABORATORY               | Laboratório Nacional de Metrologia das Radiações Ionizantes<br>LNMRI/IRD/CNEN  |
|--------------------------|--|
| NAMES                    | A. Iwahara, C.J. da Silva, E.M.O. Bernardes, P.A.L. da Cruz, J. dos S. Loureiro, M.A.R.R. di Prinzio   |
| ACTIVITY                 | $4\pi\beta$ (PPC)- $\gamma$ (Ge) and $4\pi\beta$ (PC)- $\gamma$ (NaI(Tl)) coincidence systems, $4\pi\gamma$ ionization chambers, WALLAC liquid scintillation counter.  |
| RESULTS                  | <ol> <li>Standardization of <sup>231</sup>Am, <sup>65</sup>Zn and <sup>54</sup>Mn solutions.</li> <li>Traceability program with hospitals.</li> </ol>  |
| PUBLICATIONS             | J.A. dos Santos, A. Iwahara, A.E. de Oliveira, Mônica A.L. da<br>Silva, C.J. da Silva, L. Tauhata and R.T. Lopes, National<br>intercomparison program for radiopharmaceuticals activity<br>measurements, Appl. Radiat. Isot., 60 / 2,4 (2004) 523-527.<br>P.A.L. da Cruz, A. Iwahara, E.M.O. Bernardes and C.J. da<br>Silva, The absolute standardization of <sup>32</sup> P and <sup>204</sup> Tl at LNMRI, |
|                          | Appl. Radiat. Isot., 60 / 2,4 (2004) 415-418.  |
| IN PROGRESS              | Standardization of <sup>203</sup> Hg, <sup>67</sup> Ga and <sup>201</sup> Tl, Implementation of TDCR and MTR2 modules for absolute standardization.  |
| SOURCE IN<br>PREPARATION | Determination of disintegration rates and $\gamma$ -ray intensities of $^{65}$ Zn and $^{241}$ Am  |
| ADDRESS                  | Instituto de Radioproteção e Dosimetria, Av. Salvador Allende,<br>s/n, Recreio, CEP 22780-160, Rio de Janeiro, Brazil.Tel: ++55<br>21 3411 8179 Fax: ++55 21 2442 1605   |
| CONTACT                  | A.Iwahara  |
|                          | Email: iwahara@ird.gov.br  |

| LABORATORY   | Laboratório Nacional de Metrologia das Radiações Ionizantes<br>LNMRI/IRD/CNEN  |
|--------------|--|
| NAMES        | Antonio E. De Oliveira , C.J.Da Silva, E.M.O. Bernardes, J.U. Delgado, M.A.R.R. di Prinzio, R. Poledna.  |
| ACTIVITY     | X and γ-ray spectrometry   |
| RESULTS      | 1 - Half-life determination.   |
|              | 2 - Impurity study by gamma-ray spectrometry.  |
|              | 3- Determination of photon emission probabilities  |
| PUBLICATIONS | J. Morel, S. Sepman, M. Rasko, E. Terechtchenko and José U. Delgado. Precise determiantio of photon emission probabilities for the main X- and $\gamma$ -rays of <sup>226</sup> Ra in equilibrium with daughters. Appl. Radiat. Isot., 60 / 2,4 (2004) 341-346.        |
|              | Karla C. Souza, Mônica L. Da Silva, José Ubiratan Delgado,<br>Roberto Poledna, Ricardo T. Lopes and C. J. Da Silva.<br>Measurements of nuclear data parameters of <sup>201</sup> Tl by gamma-<br>ray spectrometry. Appl. Radiat. Isot., 60 / 2,4 (2004) 307-310.       |
|              | Mônica L. Da Silva, Maria C. M. De Almeida, Carlos J. Da<br>Silva and José Ubiratan Delgado. Use of the reference source<br>method to determine the half-lives of radionuclides of<br>importance in nuclear medicine. Appl. Radiat. Isot., 60 / 2,4<br>(2004) 301-305. |
| IN PROGRESS  | Measurements of nuclear data parameters in the standardization of $^{203}\mathrm{Hg},^{67}\mathrm{Ga}$ and $^{201}\mathrm{Tl}$   |
| ADDRESS      | Instituto de Radioproteção e Dosimetria, Av. Salvador Allende, s/n, Recreio, CEP 22780-160, Rio de Janeiro, Brazil.Tel: ++55 21 3411 8173 Fax: ++55 21 2442 1605   |
| CONTACT      | J. U. Delgado  |
|              | EmaiL : <u>delgado@ird.gov.br</u>  |

| LABORATORY   | Laboratório Nacional de Metrologia das Radiações Ionizantes<br>LNMRI/IRD/CNEN   |
|--------------|---|
| NAMES        | A.C.M. Ferreira, A.E. de Oliveira, A. F. Clain, L. Tauhata, M.E.C. Vianna, and M. J. C. S. de Bragança.   |
| ACTIVITY     | 1. Spike sources of beta, alpha and multi-gamma emitters in water matrix.   |
|              | 2. Samples of sediment and soils taken from Poços de Caldas region in Brazil.   |
| RESULTS      | 1- Quality control program of environmental laboratories  |
| PUBLICATIONS | M. J.C. S. Bragança, L. Tauhata, A. F. Clain, I. Moreira, The use of instrumental neutron activation and multivariate statistic analysis in differentiation of Brazilian phosphate ores, Appl. Radiat. Isot . In press. |
| IN PROGRESS  | Study of homogenity of soil samples from Poços de Caldas region.  |
| ADDRESS      | Instituto de Radioproteção e Dosimetria, Av. Salvador<br>Allende, s/n, Recreio, CEP 22780-160, Rio de Janeiro,<br>Brazil.Tel: ++55 21 3411 8154 Fax: ++55 21 2442 1605  |
| CONTACT      | L. Tauhata<br><u>tauhata@ird.gov.br</u>   |

| LABORATORY                    | Czech Metrology Institute  |
|-------------------------------|--|
| NAMES                         | Pavel Dryák, Jana Sochorová, Pavel Auerbach, Miroslav<br>Havelka, Petr Kovář   |
| APPARATUS<br>ACTIVITY         | $4\pi \alpha\beta\gamma$ coincidence system, liquid scintillation counter,<br>calibrated $4\pi$ ionization chamber and HPGe spectrometer<br>primary and secondary activity measurement methods<br>simulation of physical processes<br>activity standards production  |
| RESULTS                       | the last: very low deviation from the average of 23 laboratories in the key-comparison $^{152}$ Eu   |
| PUBLICATIONS                  | M.Havelka, P.Auerbach, Jana Sochorová,<br>Software coincident counting<br>Applied Radiation and Isotopes 56(2002)265-268<br>P.Dryák, P.Kovář, Jiří Šuráň,<br>Determination of corrections to the summations of photons<br>for measurement in Marinelli beakers<br>Applied Radiation and Isotopes 56(2002)111-116 |
| IN PROGRESS                   | <sup>241</sup> Am key-comparison , <sup>65</sup> Zn EUROMET project 721<br>standardization of the volume activity of <sup>41</sup> Ar  |
| INFORMATION                   | www.cmi.cz   |
| SOURCE IN<br>PREPARATION      | P. Dryák, P. Kovář, Testing of Properties of Digital<br>Modules Used in Gamma-Ray Spectrometry, ICRM2003<br>conference, Dublin 2003  |
| OTHER RELATED<br>PUBLICATIONS | V.Olšovcová, P.Dryák: Proc. of the Int. Symp. on Standards<br>and Codes of Practice in Medical Radiation Dosimetry,<br>Vienna 2002<br>Comparisons of activity measurements in nuclear medicine<br>with radionuclide calibrators in the Czech Republic  |
| ADDRESS                       | CMI-IIR, Radiova 1, 102 00 Prague 10<br>tel :+420266020497, fax :+420266020466<br>e-mail: <u>pdryak@cmi.cz</u>   |

CONTACT

Pavel Dryák

| LABORATORY  | BNM- Laboratoire National Henri Becquerel   |
|-------------|---|
| NAMES       | G. Moutard, I. Le Garrérès.   |
| ACTIVITY    | Organisation of national and international interlaboratory comparisons in the field of activity measurements.   |
|             | An opened intercomparison program is proposed every year by BNM-LNHB.   |
| APPARATUS   | Calibrated HPGe, NaI(Tl), Liquid scintillation counters,<br>Well-type ionisation chamber with standard electronics.   |
| RESULTS     | The program for 2003 was :<br>Activity measurement of <sup>239</sup> Pu solutions (about 40 Bq/g,<br>4 Bq/g and 4 Bq/kg);<br>Separation and activity measurement of <sup>3</sup> H and <sup>90</sup> Sr<br>(about 1 Bq/g each) in a solution simulating a radioactive<br>waste also containing <sup>137</sup> Cs and <sup>241</sup> Am (respectively<br>about 2 Bq/g and 0,2 Bq/g);<br>Measurement by gamma-ray spectrometry of the activity<br>concentration in solutions containing several<br>radionuclides (about 20 kBq/g, 1 Bq/g and 0,6 Bq/g). |
| IN PROGRESS | The proposed program for 2004 is:<br>Activity measurement of a solution of <sup>3</sup> H (about 40 kBq/g and 4 Bq/g);<br>Activity measurement of a solution containing a mixture of fission and activation products (about 20 kBq/g, 1 Bq/g and 0,6 Bq/g).   |
| ADDRESS     | DRT/DeTeCS/LNHB<br>CEA-Saclay<br>F-91191 Gif-sur-Yvette cedex, FRANCE<br>Tel. 33 1 69 08 43 75<br>Fax. 33 1 69 08 26 19<br>E-Mail : gerard.moutard@cea.fr   |
|             |   |
| CONTACT     | Gérard Moutard  |
| LABORATORY   | BNM-Laboratoire National Henri Becquerel  |
|--------------|---|
| NAMES        | M.N. Amiot, A.C. Bellanger, M.Moune, F. Rigoulay  |
| APPARATUS    | Calibrated $4\pi\gamma$ ionisation chamber  |
| ACTIVITY     | Well type NaI(Tl) scintillation detector  |
|              |   |
|              | Monte Carlo calculations for the determination of ionisation<br>chambers response to photons, positrons and electrons.  |
|              | Participating in international intercomparison of activity measurements organized by BIPM.  |
|              | Activimeters calibration  |
|              | Standardization of radioactive sources and solutions  |
|              | Half life measurements  |
| RESULTS      | Monte Carlo simulation of the Vinten 671 ionisation chamber for the calibration factors calculation for gamma emitters.   |
|              | Participation to the international intercomparison of <sup>18</sup> F   |
|              | Standardization of <sup>154</sup> Eu and <sup>134</sup> Cs  |
|              | Measurement of <sup>65</sup> Zn and <sup>88</sup> Y half life   |
| PUBLICATIONS | A. Lucas, M.N. Amiot, J. Morel. Determination of Half-life<br>and photon emission probabilities of <sup>65</sup> Zn.<br>Appl. Radiat. Isot. 58 (2003) p 607-610. (Technical note)       |
|              | A. de Vismes and M. N. Amiot Towards absolute activity<br>measurements by ionisation chambers using the<br>PENELOPE Monte-Carlo code, Appl. Radiat. Isot. 59, (4),<br>(2003), p 267-272 |
| IN PROGRESS  | Monte Carlo simulation of a Vinten chamber for electrons and of a medical chamber.  |
|              | Activimeters calibration.   |
| ADDRESS      | DRT/DeTeCS/LNHB<br>CEA-Saclay<br>F-91191 Gif sur Yvette Cedex, FRANCE<br>Tel : 33 1 69 08 36 89<br>Fax : 33 1 69 08 26 19   |
|              | E-mail : marie-noelle.amiot@cea.fr  |
| CONTACT      | Marie-Noëlle Amiot  |

| LABORATORY               | BNM-Laboratoire National Henri Becquerel  |
|--------------------------|---|
| NAMES                    | M.M. Bé, V. Chisté, C. Dulieu   |
| APPARATUS<br>ACTIVITY    | Evaluation of Radionuclide Decay Data   |
| RESULTS                  | - Evaluation of : <sup>32</sup> P, <sup>33</sup> P, <sup>204</sup> Tl, <sup>85</sup> Kr, <sup>226</sup> Ra and <sup>226</sup> Ra decay chain  |
|                          | - program to calculate, in details, all K and L X ray and K and L Auger electrons emissions following a disintegration  |
| PUBLICATIONS             | -M.M. Bé, V. Chisté, C. Dulieu, Le radium 226 et ses descendants. Tables et commentaires. Technical note LNHB, 04-04  |
|                          | -M.M. Bé, V. Chisté, C. Dulieu, Calcul détaillé des émissions de photons X et d'électrons Auger qui suivent la décroissance radioactive. Technical note LNHB, 04-06. Available on : <a href="http://www.bnm.fr/bnm-lnhb/Publications/2004.htm">http://www.bnm.fr/bnm-lnhb/Publications/2004.htm</a> |
|                          | -Base de donnees sur les radionucleides a vie longue<br>(RNVL),Rapport du groupe de travail CEA, version 2,<br>Rapport CEA-R-6026 (2003)  |
| IN PROGRESS              | A new volume of the "Table de radionuclides" with the related comments, A CD-Rom NUCLÉIDE   |
| SOURCE IN<br>PREPARATION | Lu-176  |
| ADDRESS                  | DRT/DeTeCS/LNHB<br>CEA-Saclay<br>F-91191 Gif sur Yvette Cedex, FRANCE<br>Tel : 33 1 69 08 46 41<br>Fax : 33 1 69 08 95 29<br>E-mail : mmbe@cea.fr   |

Marie-Martine Bé

| LABORATORY     | BNM-Laboratoire National Henri Becquerel   |
|----------------|--|
| NAMES          | B. Leprince, Ch. Bobin and J. de Sanoit  |
| ACTIVITY       | Radioactive sources preparation using a freeze-drying technique  |
| RESULTS        | With the use of a small scale commercial freeze-dryer, quantitative <sup>65</sup> Zn sources were prepared with an improvement of crystallization homogeneity. Better detection efficiencies to the electron emission were achieved. |
| IN PROGRESS    | In the course of the validation of the method, tests of others radionuclides (for instance: <sup>57</sup> Co, <sup>60</sup> Co, <sup>134</sup> Cs, <sup>154</sup> Eu, <sup>192</sup> Ir) are in progress.                            |
| IN PREPARATION | J. de Sanoit, B. Leprince, Ch Bobin and J. Bouchard.<br>Freeze-drying applied to radioactive source (Paper<br>accepted for publication in Applied Radiation and<br>Isotopes)   |
| ADDRESS        | DRT/DeTeCS/LNHB<br>CEA Saclay<br>F-91191 Gif sur Yvette Cedex<br>Tel: 33 1 69 08 29 64   |
|                | Fax: 33 1 69 08 26 19  |
|                | E-mail: <u>christophe.bobin@cea.fr</u>   |
| CONTACT        | Christophe Bobin   |

- BNM-Laboratoire National Henri Becquerel LABORATORY
- NAME T. Branger, M.G. Iroulart, I. Le Garrérès.
- **ACTIVITY** Radioactivity standard solutions preparation and characterization.
- **APPARATUS** Ionic Chromatography, Capillary Electrophoresis
- Characterization of liquid solutions for : RESULTS
  - Alkali metals and alkali earth metals : Na<sup>+</sup>, Cs<sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Sr<sup>2+</sup>, Ba<sup>2+</sup>, Ca<sup>2+</sup> Transition metals : Pb<sup>2+</sup>, Co<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ni<sup>2+</sup>, Fe<sup>2+</sup>, Fe<sup>3+</sup> Rare earth metals : Y<sup>3+</sup>, Eu<sup>3+</sup>, Er<sup>3+</sup>, Nd<sup>3+</sup>, Lu<sup>3+</sup>, Sm<sup>3+</sup>
  - \_
- **PUBLICATIONS** M.G. Iroulart : Radioactivity Standard solutions. Thermodynamic stability and phenomenon of sorption at the container-solution interface - ( proposed to BIPM for publication).
- IN PROGRESS Determination of technical conditions (buffer, pH, voltage, temperature) for the analyse of alkali metals, transition metals, rare earth metals with capillary electrophoresis. Validation of the two techniques (Ionic Chromatography and Capillary Electrophoresis) by intracomparison with standards.
- **ADDRESS** DRT/DeTeCS/LNHB **CEA Saclay** F-91191 Gif sur Yvette Cedex Tel. 33 1 69 08 85 67 Fax. 33 1 69 08 26 19 thierry.branger@cea.fr m-g.iroulart@cea.fr
- CONTACT T. Branger

| LABORATORY   | BNM- Laboratoire National Henri Becquerel  |
|--------------|--|
| NAMES        | J. Plagnard, C. Collin, M.C. Lépy  |
| ACTIVITY     | Gamma-ray spectrometry   |
|              |  |
| APPARATUS    | HPGe Detectors   |
| RESULTS      | Efficiency calibration of HPGe detectors within 0.5% for pont sources.   |
|              | Characterization of digital signal processor systems   |
| PUBLICATIONS | "Metrological characterization of the ADONIS system<br>used in gamma-ray spectrometry", J. Plagnard, J.Morel,<br>A.Tran Tuan, Applied Radiation and Isotopes |
| IN PROGRESS  | Tests of the ETNA code (efficiency transfer and coincidence summing corrections for gamma-ray spectrometry)  |
|              | Monte Carlo simulation of the detector for different source-detector geometries  |
|              | Study of <sup>93</sup> Nb <sup>m</sup> decay scheme  |
| ADDRESS      | DRT/DeTeCS/LNHB<br>CEA-Saclay<br>F-91191 Gif-sur-Yvette cedex, FRANCE<br>Tel : 33.1.69.08.24.48<br>Fax : 33.1.69.08.26.19                                    |
|              | E-mail : marie-christine.lepy@cea.fr   |
| CONTACT      | Marie-Christine Lépy   |

| LABORATORY            | Physikalisch-Technische Bundesanstalt, Braunschweig  |  |
|-----------------------|--|--|
| NAMES                 | H. Wershofen, D. Arnold<br>in co-operation with Mrs. J. Bieringer, Bundesamt für<br>Strahlenschutz, SW 3.5, Rosastraße 9, 79098 FREIBURG   |  |
| APPARATUS<br>ACTIVITY | Activity standard solution containing Mn-54, Co-60,<br>Ba-133, Cs-134, Ce-139, Am-241, Sr-90, spiked on real<br>dust-loaded aerosol filters taken from routine high-volume<br>environmental radioactivity monitoring at the participant's<br>sites; Some few Bq per spiked filter  |  |
| RESULTS               | In 2002 the inter-comparison was planned. After financing was claryfied in 2003, real aerosol loaded filters were sent by the participants from Germany, Austria and Switzerland to PTB for spiking and after that, were sent back to the participants for analysis and measurement. The results were submitted to BFS, Freiburg, in December. |  |
| PUBLICATIONS          | final report planned   |  |
| IN PROGRESS           | evaluation and compilation of results in March 2004  |  |
| ADDRESS               | Physikalisch-Technische Bundesanstalt<br>Department 6.1<br>Bundesallee 100, D-38116 Braunschweig, Germany  |  |
|                       | Telephone: +49-531-592-6331  |  |
|                       | Telefax: +49-531-592-6109  |  |
|                       | E-mail: <u>Herbert.Wershofen@ptb.de</u>  |  |
|                       |  |  |

Dr. Herbert Wershofen

CONTACT

| LABORATORY            | Physikalisch-Technische Bundesanstalt   |   |
|-----------------------|---|---|
| NAMES                 | A. Honig, A. Röttg  | ger, T. Reich, E.Gargioni, R. Dersch  |
| APPARATUS<br>ACTIVITY | Radon-222 and Radon-220 reference chamber of the PTB.<br>Production and measurement of radon reference<br>atmospheres and radon progeny reference atmospheres |   |
| RESULTS               | $c(^{222}$ Rn) from 1 kE $f_p$ from 0.01 to 0.9   | Bq m <sup>-3</sup> to 100 kBq m <sup>-3</sup> , F from 0.1 to 1.0,<br>, $c(^{220}$ Rn) from 1 kBq m <sup>-3</sup> to 10 kBq m <sup>-3</sup> |
| PUBLICATIONS          | E. Gargioni et. al.:<br>the measurements<br>NIM A 506, 166-1  | Development of a calibration facility for<br>of the thoron activity concentration.<br>72, 2003  |
| IN PROGRESS           | Euromet Project N   | lo 657  |
| ADDRESS               | Physikalisch-Technische Bundesanstalt<br>Department 6.1<br>Bundesallee 100, D-38116 Braunschweig, Germany   |   |
|                       | Telephone:<br>Telefax:<br>E-mail:   | +49-531-592-6103<br>+49-531-592-8525<br><u>Anja.Honig@ptb.de</u>  |
| CONTACT               | Anja Honig  |   |

| LABORATORY            | Physikalisch-Technische Bundesanstalt  |  |
|-----------------------|--|--|
| NAMES                 | A. Röttger, A. Hor   | nig, T. Reich  |
| APPARATUS<br>ACTIVITY | Aerosol spectrometry with nano differential mobility<br>analyser, simultaneous alpha gamma spectrometry for<br>radon progenies |  |
| RESULTS               | Aersol spectrometr   | ry from 2 nm to 1000 nm  |
| IN PROGRESS           | Reference atmosph<br>20 nm, new definit  | heres with aerosols of a diameter below tion of the quantity $f_p$     |
| ADDRESS               | Physikalisch-Technische Bundesanstalt<br>Department 6.1<br>Bundesallee 100, D-38116 Braunschweig, Germany                      |  |
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Annette Röttger

| LABORATORY               | Physikalisch-Te   | echnische Bundesanstalt  |  |
|--------------------------|---|--|--|
| NAMES                    | D. Arnold, S. N   | D. Arnold, S. Neumaier   |  |
| APPARATUS                | Two special sel<br>placed in the un<br>925 m in the AS<br>1.) 88% relative<br>2.) 95% relative  | Two special selected low background HPGe detectors,<br>placed in the underground laboratory UDO at a depth of<br>925 m in the ASSE salt mine.<br>1.) 88% relative efficiency extended range HPGe-detector<br>2.) 95% relative efficiency extended range HPGe-detector  |  |
| RESULTS                  | The shielding o<br>background cou<br>less than 10 d <sup>-1</sup>   | f the $2^{nd}$ detector has been optimised. The int rate for single photopeaks is in all cases and for most peaks less than 2 d <sup>-1</sup> .  |  |
| PUBLICATIONS             | S. Neumaier, R.<br>Untergrundlabo<br>ASSE II, PTB-I   | . Zwiener, J. Böhm (Edit.) Experimente im<br>ratorium UDO der PTB im Bergwerk<br>Dos-43 (2003), ISBN 3-89701-959-0.  |  |
| IN PROGRESS              | Plan to move th within the ASS  | e whole UDO laboratory to another place<br>E salt mine in 2004/2005.   |  |
| SOURCE IN<br>PREPARATION | <ul> <li>The following p<br/>of the ICRM-LI</li> <li>M. Köhler, M<br/>Reyss: Refer</li> <li>M. Hult, J. C<br/>D. Arnold, S<br/>of <sup>60</sup>Co in ste</li> <li>M. Laubenst<br/>Neumaier, G<br/>M. Schwaige<br/>measuremen</li> </ul> | <ul> <li>The following papers will be published in the proceedings of the ICRM-LLRMT conference 2003 in Vienna:</li> <li>M. Köhler, M. Hult, D. Arnold, M. Laubenstein, JL. Reyss: Reference measurements of <sup>60</sup>Co in steel.</li> <li>M. Hult, J. Gasparro, R. Vasselli, K. Shizuma, M. Hoshi, D. Arnold, S. Neumaier: Deep underground measurements of <sup>60</sup>Co in steel exposed to the atomic bomb in Hiroshima.</li> <li>M. Laubenstein, M. Hult, J. Gasparro, D. Arnold, S. Neumaier, G. Heusser, M. Köhler, P. Povinec, JL. Reyss, M. Schwaiger, P. Theodorsson: Underground measurements of radioactivity.</li> </ul> |  |
| ADDRESS                  | Physikalisch-Te<br>Department 6.1<br>Bundesallee 100<br>Telephone:<br>Telefax:<br>E-mail:   | echnische Bundesanstalt<br>0, D-38116 Braunschweig, Germany<br>+49-531-592-6120<br>+49-531-592-6109<br>Dirk.Arnold@ptb.de  |  |
| CONTACT                  | Dirk Arnold   |  |  |

| Physikalisch-Technische Bundesanstalt   |   |
|---|---|
| Heinrich Schrader   |   |
| Photon-photon (NaI) coincidence counting system with distance variation and efficiency extrapolation.   |   |
| - H. Schrader and K. F. Walz: <i>Standardization of</i> <sup>125</sup> <i>I by</i><br><i>photon-photon coincidence counting and efficiency</i><br><i>extrapolation</i> . Appl. Radiat. Isot. <b>38</b> (1987) 763 - 766 |   |
| - H. Schrader: S<br>with photon-ph<br>Appl. Radiat.   | Standardization of $^{129}I$ by a tracer method hoton coincidences from the decay of $^{125}I$ .<br>Isot. <b>41</b> (1990) 417 - 421  |
| Detector and instrument tests performed to upgrade the old equipment and data acquisition system in view of the <sup>125</sup> I international comparison (BIPM).   |   |
| Physikalisch-Technische Bundesanstalt<br>Department 6.1<br>Bundesallee 100, D-38116 Braunschweig, Germany   |   |
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|   | <ul> <li>Physikalisch-Tech</li> <li>Heinrich Schrader</li> <li>Photon-photon (N<br/>distance variation</li> <li>H. Schrader ar<br/><i>photon-photon</i><br/><i>extrapolation</i>.</li> <li>H. Schrader: S<br/><i>with photon-ph</i><br/>Appl. Radiat.</li> <li>Detector and instr<br/>equipment and dat<br/>international comp</li> <li>Physikalisch-Tech<br/>Department 6.1</li> <li>Bundesallee 100, Telephone:<br/>Telephone:<br/>Telefax:</li> <li>E-mail:</li> </ul> |

Heinrich Schrader

CONTACT

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|----------------------------------|--|--|
| NAMES                            | Karsten Kossert  |  |
| APPARATUS<br>ACTIVITY<br>RESULTS | <ul> <li>Liquid scintillation counter</li> <li>Activity measurements (e.g. international intercomparisions of <sup>65</sup>Zn, <sup>54</sup>Mn, <sup>90</sup>Y and <sup>241</sup>Am)</li> <li>Measurement of the half-life of <sup>90</sup>Y and <sup>87</sup>Rb</li> <li>Half-life of <sup>90</sup>Y and <sup>87</sup>Rb</li> </ul>                                     |  |
| PUBLICATIONS                     | <ul> <li>Kossert, K.: "LSC-Messungen zur Bestimmung der<br/>Halbwertszeit von <sup>87</sup>Rb". PTB-report Ra-43 (2003),<br/>ISBN 3-86509-006-0, 1-43</li> </ul>   |  |
|                                  | - Kossert, K.: Half-Life Measurement of "Rb by Liquid<br>Scintillation Counting. ARI 59 (2003) 377-382   |  |
| IN PROGRESS                      | <ul> <li>Measurement of the half-lives of the long-lived isotopes <sup>147</sup>Sm and <sup>176</sup>Lu</li> <li>Development of a new method for secondary activity standardizations by liquid scintillation counting.</li> <li><sup>65</sup>Zn EUROMET exercise 721</li> <li>Standardization of <sup>93</sup>Nb<sup>m</sup> and x-ray emission probabilities</li> </ul> |  |
| SOURCE IN<br>PREPARATION         | <ul> <li>Kossert, K.; Schrader, H.: Activity Standardization by<br/>Liquid Scintillation counting and Half-Life Measurement<br/>of <sup>90</sup>Y. ARI, in press</li> </ul>  |  |
| OTHER RELATED<br>PUBLICATIONS    | - Kossert, K.; Günther, E.: LSC Measurements of the Half-life of <sup>40</sup> K. ARI 60 (2004) 459-464  |  |
| ADDRESS                          | Physikalisch-Technische Bundesanstalt<br>Department 6.1<br>Bundesallee 100, D-38116 Braunschweig, Germany  |  |
|                                  | Telephone:       +49-531-592-6110         Telefax:       +49-531-592-6305         E-mail:       Karsten.Kossert@ptb.de   |  |
| CONTACT                          | Karsten Kossert  |  |

| LABORATORY  | National Office of Measures (OMH), Radiation Physics Section  |
|-------------|---|
| NAMES       | Gy. Hegyi, K. Rózsa, L. Szűcs, A. Zsinka  |
| APPARATUS   | $4\pi\alpha(\beta)(PC)-\gamma(NaI)$ and $4\pi\beta(PPC)-\gamma(NaI)$ coincidence and anti-<br>coincidence counting systems.<br>Calibrated $\gamma$ -ray spectrometer with HPGe semiconductor detector.<br>Calibrated and uncalibrated $4\pi\gamma$ ionization chambers.<br>Well type NaI(Tl) scintillation detector.  |
| ACTIVITY    | Preparation of radioactive sources for activity measurements.<br>Activity measurements by $4\pi\alpha(\beta)$ - $\gamma$ coincidence and anti-coinci-dence counting, calibrated $\gamma$ -ray spectrometer and $4\pi\gamma(IC)$ method.<br>Calibration and re-calibration of $4\pi\gamma$ ionization chambers.  |
| RESULTS     | Participation in the BIPM CCRI(II) K2. Key Comparison: Stand-<br>ardisation of a <sup>241</sup> Am solution by $4\pi\alpha$ - $\gamma$ coincidence counting.<br>Standardisation of a <sup>68</sup> Ge/ <sup>68</sup> Ga solution by calibrated $\gamma$ -ray spectro-<br>meter to provide a calibration factor for radionuclide calibrators<br>applied in Hungarian medical practice to <sup>18</sup> F activity used in positron<br>emission tomography. |
| IN PROGRESS | Participation in the Euromet project number 721: " <sup>65</sup> Zn-Determination of photon emission probabilities and other decay parameters." Participation in the BIPM CCRI(II) K2. Key Comparison of <sup>125</sup> I and <sup>85</sup> Kr radionuclides.   |
| ADDRESS     | National Office of Measures<br>H-1535 BUDAPEST, P. O. Box 919.<br>Hungary<br>Phone: (36-1) 458-5800<br>Fax: (36-1) 458-5937<br>E-mail: L.Szucs@omh.hu   |

CONTACT László Szűcs

| LABORATORY  | Bhabha Atomic Research Centre   |
|-------------|---|
| NAMES       | U.V. Phadnis, V. Sathian, G. Shobha   |
| APPARATUS   | 1. Manganese Sulphate Bath System.  |
|             | 2. Standard Thermal Neutron Assembly in Graphite  |
|             | 3. Precision Long Counter.  |
|             | 4. Multi-spheres for spectroscopy.  |
|             | 5. $4\pi$ polythene assembly.   |
|             | 6. Activation foils (Threshold detectors).  |
|             | 7. He-3 based thermal neutron fluence rate measuring system.  |
|             | 8. Neutron rem counter and flux meter.  |
|             | 9. Standard neutron sources.  |
|             | 10. Water moderator based thermal neutron jig.  |
| ACTIVITY    | 1. Standardization of radioactive neutron sources.  |
|             | 2. Standardization of fluence rate and dose rate.   |
|             | 3. Calibration of neutron monitors.   |
|             | 4. R&D work associated with neutron standards.  |
| RESULTS     | 1. Neutron sources were standardized for various users.   |
|             | 2. Neutron fluence rate and dose rate were standardized for various users.  |
|             | 3. Many neutron monitors were calibrated.   |
| IN PROGRESS | 1. Development of Neutron Spectrometer.   |
|             | 2. A thermal neutron source for high fluence rate $(>10^5 \text{ nv})$ is being prepared for the calibration of neutron monitors. |
| INFORMATION | 1. Fast neutron source yield and the thermal neutron fluence rate can be taken up for international intercomparison.              |
| ADDRESS     | Head, Radiation Standards Section, RSS Division, BARC, Mumbai 400085, India.  |
|             | Tel: +91 22 25595074 - Fax: +91 22 25505151   |
|             | e-mail: vvshaha@apsara.barc.ernet.in  |
| CONTACT     | V.V. Shaha  |

- LABORATORY Bhabha Atomic Research Centre
- NAMES R. Nathuram, Leena Joseph, Anuradha R., D.B. Kulkarni
- APPARATUS 1.  $4\pi \beta(PC) \gamma(NaI)$  coincidence system.
  - 2. Calibrated  $4\pi$  gamma ion chamber.
  - 3. HPGe detector assembly for gamma ray spectrometer.
- ACTIVITY 1. Participating in international intercomparison programmes of activity measurements organized by BIPM and APMP.
  - 2. Standardization of radioactive sources and solutions
  - 3. Organizing national intercomparison of activity measurements of <sup>131</sup>I among Nuclear Medicine Centres in India.
  - 4. Gamma ray spectrometry and activity measurements.
- RESULTS 1. Standardized Ir<sup>192</sup> under international intercomparison programme of BIPM deviated by 0.2% from the arithmetic mean value of all the participating laboratories.
  - 2. Conducted Eleventh National Intercomparison of activity measurements in Nuclear Medicine Centres.
  - 3. Standardized sources for users
- IN PROGRESS 1. Final results of Mn<sup>54</sup>, Am<sup>241</sup> under international intercomparison were communicated to BIPM
  - 2. Na<sup>22</sup> under SIR was standardized
- PUBLICATION 1. 'National Intercomparison of Iodine-131 Radioactivity Measurements in Nuclear Medicine Centres in India', Leena Joseph, Anuradha R., Nathuram R. and Shaha V.V. and Abani M.C., International Journal of Applied Radiation and Isotopes, 59(2003) 359-362.
  - 2. 'Standardization of Ir<sup>192</sup> for International Intercomparison', Anuradha R., Leena Joseph, D.B. Kulkarni, R. Nathuram, V.V. Shaha and D.N. Sharma, presented at NSRP-15, Mumbai, India
  - 3. 'Recalibration of 4π-gamma ion chamber for standardisation of radionuclides', Leena Joseph, Anuradha R., D.B. Kulkarni, R. Nathuram and V.V. Shaha, presented at NSRP-15, Mumbai
- ADDRESS Head, Radiation Standards Section, Radiation Safety Systems Division, BARC, Mumbai - 400 085, India Telephone: 25595074 Telefax: 0091(22) 25505151, 25519613 E-mail: <u>vvshaha@apsara.barc.ernet.in</u>
- CONTACT V.V. Shaha

| LABORATORY  | ENEA - Istituto Nazionale di Metrologia delle Radiazioni<br>Ionizzanti - Italy   |
|-------------|--|
| NAMES       | M. Capogni, P. De Felice   |
| APPARATUS   | NaI(Tl) well-type sum-peak coincidence counting equipment  |
| ACTIVITY    | Standardisation of I-125 for BIPM intercomparison  |
| IN PROGRESS | Investigation into theoretical problems identified with the standardisations of this radionuclide. Study of experimental aspects concerning source preparation and measurement procedures.                     |
| ADDRESS     | ENEA<br>Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti<br>Centro Ricerche Casaccia<br>P.O.Box 2400 - Roma (Italy)<br>Phone: +39 06 30483580<br>Fax: +39 06 30483558<br>defelice@casaccia.enea.it |

P. De Felice

| LABORATORY  | ENEA - Istituto Nazionale di Metrologia delle Radiazioni<br>Ionizzanti - Italy  |
|-------------|---|
| NAMES       | F. Cardellini, P. De Felice   |
| APPARATUS   | Radon Reference Measurement System and Radon chamber  |
| ACTIVITY    | Prosecution of calibration of passive and active radon<br>monitors in radon chamber. Comparison of radon<br>calibration facilities (Euromet Project No. 657)  |
| IN PROGRESS | A new radon chamber (about $30 \text{ m}^3$ ) is under construction<br>for the organisation of calibration and intercomparison<br>campaigns on radon measurements for the national<br>environmental radioactivity surveillance network. |
| ADDRESS     | ENEA<br>Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti<br>Centro Ricerche Casaccia<br>P.O.Box 2400 - Roma (Italy)<br>Phone: +39 06 30483580<br>Fax: +39 06 30483558<br>defelice@casaccia.enea.it                          |

CONTACT P. De Felice

| LABORATORY   | National Metrology Institute of Japan, National Institute of<br>Advanced Industrial Science and Technology (NMIJ/AIST)  |
|--------------|---|
| NAMES        | Yoshio HINO, Yasushi SATO   |
| APPARATUS    | $4\pi\beta(pc)-\gamma(NaI)$ and $4\pi\beta(ppc)-\gamma(Ge)$ coincidence systems,<br>Calibrated $4\pi\gamma$ ionisation chamber, HP-Ge and Si(Li) detectors,<br>Liquid scintillation system, Imaging analyser system, PIPS for<br>$\alpha$ counting and $2\pi$ multi wire chamber. |
| RESULTS      | 1. Participate the CCRI-II Key-comparisons of Mn-54, Y-90<br>and Am-241   |
|              | 2. Promoted the APMP regional Key-comparison of Ce-139<br>and sent several reference ampoule sources for calibration of<br>ionization chambers for the APMP project of "portability of<br>the calibration factors of ionisation chambers".  |
|              | 3. Established a new production method of area sources using<br>ink-jet printer, and adopted these sources for calibration of<br>the imaging analyzer system.   |
| PUBLICATIONS | Y. Sato and Y. Hino "The new production method of<br>standard surface sources" presented at ICRM 2003 in<br>Dublin, and to be published in Appl. Radiat. Isotopes   |
| IN PROGRESS  | 1. Continue the development of logarithmic scale surface<br>sources for low level activity measurement such as<br>evaluation of radioactive waste.  |
|              | <ol> <li>Continue the "portability of the calibration factors of<br/>ionisation chambers" with several ampoule sources from<br/>NMIJ.</li> </ol>  |
|              | 3. Test the possibility of remote calibration of ionization chambers using computer network system.   |
| ADDRESS      | Radioactivity and Neutron Standardization Section,<br>Quantum Radiation Division, AIST Tsukuba central-2<br>1-1-1 Umezono, Tsukuba, Ibaraki, 305-8568 JAPAN   |
|              | Tel.: (+81) 29 861 5667, Fax.: (+81) 29 861 5673  |
|              | E-mail : <u>y.hino@aist.go.jp</u>   |
|              | Web: <u>http://www.aist.go.jp</u>   |

Yoshio HINO

| LABORATORY   | Nagoya University  |
|--------------|--|
| NAMES        | H. Miyahara, K. Morita, K. Katoh   |
| APPARATUS    | $4\pi\beta(ppc)-\gamma(HPGe)$ and $4\pi\beta(pc)-\gamma(HPGe)$ coincidence apparatus<br>using a live-timed two-dimensional data-acquisition system, and $\gamma$ -<br>ray spectrometry system  |
| RESULTS      | 1. The emission probabilities for the 306 and 319 keV $\gamma$ -rays of <sup>105</sup> Rh were measured to be 0.0477(6) and 0.1699(20), respectively.<br>2. The emission probabilities for the 277 and 328 keV $\gamma$ -rays of <sup>149</sup> Eu were measured to be 0.0413(3) and 0.0475(3), respectively.  |
| PUBLICATIONS | <ol> <li>Production of <sup>147</sup>Eu for Gamma-ray Emission Probability<br/>Measurement, K. Katoh et al., J. Nucl. Sci. and Technol. 39 (2002)<br/>329.</li> <li>Emission Probability Measurement of 94.7 keV γ- rays for <sup>165</sup>Dy,<br/>H. Miyahara and K. Katoh, Nucl. Instr. and Meth. A516 (2004)<br/>104.</li> <li>Precise Measurement of the Emission Probability of the 543 keV<br/>γ ray of <sup>199</sup>Pt, H. Miyahara et al., to be published in Appl. Radiat.<br/>and Isot. (2004).</li> <li>Highly Precise Measurements of the Relative Gamma-ray<br/>Intensities for <sup>56</sup>Mn and <sup>72</sup>Ga, H. Miyahara et al., to be published in<br/>Appl. Radiat. and Isot. (2004).</li> </ol> |
| IN PROGRESS  | The $\gamma$ -ray emission probabilities of <sup>80</sup> Br and <sup>105</sup> Ru that are neutron-<br>rich nuclei are measuring.   |
| ADDRESS      | Department of Radiological Technology, School of Health<br>Sciences, Nagoya University, 1-1-20 Daikominami, Higashi-ku,<br>Nagoya, 461-8673 JAPAN<br>Telephone 81-52-719-1548, Facsimile 81-52-719-1506<br>E-mail <u>miyahara@met.nagoya-u.ac.jp</u>   |

CONTACT Hiroshi Miyahara

| LABORATORY               | IFIN-HH, Radionuclide Metrology Laboratory  |
|--------------------------|---|
| NAMES                    | Maria Sahagia, E.L.Grigorescu, A.C.Razdolescu   |
| APPARATUS<br>ACTIVITY    | $4\pi$ PC- $\gamma$ coincidence installation  |
| RESULTS                  | Standardization of: <sup>63</sup> Ni, <sup>241</sup> Am, <sup>137</sup> Cs, <sup>54</sup> Mn, <sup>192</sup> Ir, <sup>65</sup> Zn, <sup>152</sup> Eu  |
| PUBLICATIONS             | M.Sahagia,C.Ivan,,E.L.Grigorescu,M.Capogni,P.De<br>Felice,A.Fazio, Standardization of $^{65}$ Zn by the 4 $\pi$ PC- $\gamma$ efficiency extrapolation method, Appl.Radiat.Isot .60,2-4,(2004)423 - 427                            |
|                          | E.L.Grigorescu,C.D.Negut, A.Luca, A.C.Razdolescu,<br>M.Tanase,Standardization of <sup>68</sup> (Ge + Ga),<br>Appl.Radiat.Isot. 60,2-4,(2004)429 – 431   |
| IN PROGRESS              | Standardization of <sup>241</sup> Am, <sup>177</sup> Lu, <sup>125</sup> I, <sup>99m</sup> Tc  |
| INFORMATION              |   |
| SOURCE IN<br>PREPARATION | M.Sahagia,A.C.Razdolescu,C.Campeanu,E.L.Grigorescu,<br>A.Luca,C.Ivan,Preparation and standardization of a<br><sup>153</sup> SmCl <sub>3</sub> radiopharmaceutical solution,HIPAN02<br>Conference Proceedings, Ed.Romanian Academy |
|                          | E.L.Grigorescu,A.C.Razdolescu,M.Sahagia,A.Luca,C.Ivan<br>, D.Negut, Standardization of <sup>48</sup> V,HIPAN 02 Conference<br>Proceedings, Ed.Romanian Academy  |
| ADDRESS                  | IFIN-HH,str.Atomistilor 407, Com Magurele,jud.Ilfov,<br>POB MG6,76900, tel (4021)404 23 00/4517,<br>fax.(4021)4574432/4574440, e-mail:<br>msahagia@ifin.nipne.ro, msahagia@yahoo.com  |

Maria Sahagia

| LABORATORY                    | IFIN-HH, Radionuclide Metrology Laboratory and LNHB, France   |
|-------------------------------|---|
| NAMES                         | A. Luca, E.L. Grigorescu, C. Ivan, J. Morel, M.C. Lepy  |
| APPARATUS<br>ACTIVITY         | Gamma-ray spectrometer with HP Ge detector  |
| RESULTS                       | Study of background approximation methods for gamma-<br>ray spectra; determination of coincidence summing<br>corrections and efficiency calibrations for <sup>22</sup> Na, <sup>133</sup> Ba, <sup>134</sup> Cs,<br><sup>137</sup> Cs, <sup>152</sup> Eu, <sup>241</sup> Am; gamma-ray spectrometry measurements<br>of radiopharmaceuticals, standard sources and analysis of<br>other gamma-ray emitting samples |
| PUBLICATIONS                  |   |
|                               | A. Luca, J. Morel, Influence of the background approximation methods on the analysis of $\gamma$ -ray spectra, Appl. Radiat. Isot. 60, 2-4, (2004) 233-237  |
| IN PROGRESS                   | Standardization and photon emission probabilities of <sup>65</sup> Zn (Euromet Project 721); Coincidence summing corrections using ETNA and GESPECOR software   |
| INFORMATION                   |   |
| SOURCE IN<br>PREPARATION      | E.L. Grigorescu, P. De Felice, A.C. Razdolescu and A.<br>Luca, Low level gamma spectrometry using beta<br>coincidence and Compton suppression, Accepted at Appl.<br>Radiat. Isot.   |
| OTHER RELATED<br>PUBLICATIONS | A. Luca, M.N. Amiot, J. Morel, Determination of half-life<br>and photon emission probabilities of <sup>65</sup> Zn, Appl. Radiat.<br>Isot. 58, (2003) 607-610   |
| ADDRESS                       | IFIN-HH,str.Atomistilor 407, Com Magurele, jud. Ilfov,<br>POB MG6, 077125, tel (4021) 404 23 00/4517, fax.(4021)<br>4574432/4574440, e-mail: <u>aluca@ifin.nipne.ro</u>   |
| CONTACT                       | A. Luca   |

| LABORATORY                    | IFIN-HH, Radionuclide Metrology Laboratory,LNHB-<br>France, RC-Poland   |
|-------------------------------|---|
| NAMES                         | A.C.Razdolescu, Ph.Cassette, E.L.Grigorescu, R.Broda  |
| APPARATUS<br>ACTIVITY         | TDCR equipment  |
| RESULTS                       | Standardization of: <sup>63</sup> Ni, <sup>241</sup> Am, <sup>137</sup> Cs, <sup>3</sup> H  |
| PUBLICATIONS                  | A.C.Razdolescu, P.Cassette, Standardization of tritiated water and <sup>204</sup> Tl by TDCR liquid scintillation counting, Appl. Radiat.Isot.60,2-4, (2004)493 - 497   |
| IN PROGRESS                   | Standardization of <sup>241</sup> Am, <sup>3</sup> H, <sup>99m</sup> Tc   |
| OTHER RELATED<br>PUBLICATIONS | M.Sahagia, A.C.Razdolescu, E.L.Grigorescu, Checking of<br>the TDCR installation, by comparative measurements with<br>other methods,(in Romanian) Romanian Soc. for Radiation<br>Protection(SRRp) Conf. Proc., Sovata, Romania,<br>Sept.2003 |
| ADDRESS                       | IFIN-HH,str.Atomistilor 407, Com Magurele,jud.Ilfov,<br>POB MG6,76900, tel (4021)404 23 00/4517,<br>fax.(4021)4574432/4574440, e-mail: <u>crazdo@ifin.nipne.ro</u> ,<br><u>razdo@yahoo.com</u>  |
|                               |   |

A.C.Razdolescu

LABORATORY: Institutul National de C&D pentru Fizica si Inginerie Nucleara "Horia Hulubei" IFIN-HH NAMES: Maria Sahagia

## **ACTION SA1-PLANNED PROGRAM FOR 2004**

- 1. Participation to the BIPM key comparison: <sup>241</sup>Am (postponed from 2003)
- 2. Participation to the ICRM- Metrology Techniques WG comparison of <sup>3</sup>H
- 3. Participation to the EUROMET action 721, <sup>65</sup>Zn Determination of photon probability emissions and other decay parameters.
- 4. Legal metrological authorization of the LSC-TDCR installation
- 5. Standardization of <sup>99m</sup>Tc, <sup>125</sup>I, <sup>177</sup>Lu
- 6. Documentation regarding the obtaining of standard sources in Marinelli beakers
- 7. Cooperation with LNHB-France, in the following fields: <sup>222</sup>Rn measurements (IDRANAP action), and internal gas counting (Dr. Ph.Cassette); gamma-ray spectrometry (Dr. M.C.Lepy)
- 8. Delivery of radioactive standards, analyses of gamma emitting samples, metrological check of activity measurement equipment

# **ACTION SA2-REPORT FOR 2003**

- 1. Participation to the BIPM key comparisons of: <sup>54</sup>Mn, <sup>65</sup>Zn, <sup>192</sup>Ir
- 2. Standardization of <sup>63</sup>Ni, <sup>137</sup>Cs and <sup>1241</sup>Am by two comparative methods: TDCR and coincidences.
- 3. Participation, with 4 papers, to the ICRM 2003 Conference, Dublin, Ireland and 1 paper to the ICRM Conference, Low-level radioactivity measurement techniques, Vienna, Austria
- 4. Collaboration with LNHB-France: LSC-TDCR, Dr. Ph. Cassette; Internal gas counting, Dr. Ph.Cassette, Dr.J.Picolo; Gamma-ray spectrometry, Dr.J.Morel and
  - Dr.M.C.Lepy
    5. Work stage of Dr R.Broda, from R.C. Poland, in the LSC-TDCR measurements (IDRANAP action).
  - 6. Legal qualification for 4 kits of radioactive standard sources and solutions
  - 7. Delivery of radioactive standards, analyses of gamma-ray emitting samples, metrological check of medical dose calibrators

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CONTACT: Maria Sahagia

| LABORATORY:      | D.I. Mendeleyev Institute for Metrology (VNIIM)                      |
|------------------|--|
|                  | <u>www.vniim.ru</u>  |
| NAMES:           | M.A. Rasko, E.E. Terechtchenko A.V. Zanevsky                         |
|                  | S.S. Kozlovsky* (St. Petersburg Politechnical Institute)             |
| APPARATUS:       | The sandwich type large $4\pi\gamma$ NaI detector                    |
|                  | (small well in bottom crystal, two crystals 200*100 mm, entrance     |
|                  | window-0.5 mm Al)  |
| ACTIVITY:        | Standardization of radioactive solutions and sources.                |
|                  | Nuclear data analysis.   |
|                  | Improvement of measurement techniques.                               |
|                  | Preparation of sources.  |
|                  | Theoretical calculation of the counting efficiency per photon        |
|                  | by VC3D Monte-Carlo Code (developer – S.S. Kozlovsky).               |
| <b>RESULTS</b> : | 1. Theoretical calculation of the sensibility for nuclide            |
|                  | for $4\pi\gamma$ NaI detector by VC3D for cascade radionuclides:     |
|                  | $^{166}$ Ho, $^{152}$ Eu, $^{154}$ Eu, $^{134}$ Cs, $^{133}$ Ba etc. |
|                  | 2. Preliminary theoretical estimation of limiting accuracy of        |
|                  | activity measurement within $0.1-0.5$ % (k=2) for some               |
|                  | radionuclides with complex decay scheme.                             |
|                  | 1 5  |
| IN PROGRESS:     | 1. Preparation of sources with well-known activity for               |
|                  | calculating the experimental sensibility for nuclide and             |
|                  | correcting the   |
|                  | Monte – Carlo code.  |
|                  | 2. Participation in international comparisons.                       |
|                  | 3. Introduction of large $4\pi\gamma$ NaI detector in the Russian    |
|                  | Primary Activity Standard.   |
|                  |  |
| ADDRESS:         | VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia               |
|                  | Phone: (812) 323-96-12   |
|                  | Fax: (812) 113-01-14   |
|                  | E-mail: info2101@vniim.ru  |
|                  | <u></u>  |
| CONTACT:         | E.E. Terechtchenko   |

| LABORATORY:  | D.I. Mendeleyev Institute for Metrology (VNIIM)<br>www.vniim.ru   |
|--------------|---|
| NAMES:       | E.E. Terechtchenko, M.A. Rasko<br>S.S. Kozlovsky (St. Petersburg Polytechnic institute)   |
| APPARATUS:   | System of calibrated Ge(Li) and HPGe spectrometers.   |
| ACTIVITY:    | <ul> <li>Calibration of Ge(Li) detector (100 cm<sup>3</sup>) at 0,1,5,10,15,20 cm under the shield and 35,75,145,175 cm on the shield distances.</li> <li>Calibration of HP(Ge) detector (40 cm<sup>3</sup>) at 0,1,4,10,15,20,40,60,120,240 cm distances.</li> <li>Testing of cascade summation coefficient obtained by ENTA – program (developer – LNHB, M-C. Lepy at all.)</li> <li>Theoretical calculation of the counting efficiency for HPGe detector by VC3D Monte-Carlo Code (developer – S.S. Kozlovsky).</li> </ul> |
| RESULTS:     | <ol> <li>Calculation of single photo- and full- efficiency in the range 59-<br/>2754 keV for close distances using nuclides with double -<br/>cascade scheme (Co-60, Y-88, Na-24).</li> <li>Calculation of experimental cascade summation coefficient in<br/>the range 59-2754 keV.</li> <li>Calculation of empirical formulae for cascade summation<br/>coefficient as function of photo-efficiency for each line on this<br/>detector.</li> </ol>   |
| IN PROGRESS: | <ol> <li>Calculation of real photo- and full- efficiency and cascade<br/>summation coefficient in the range 14-59 keV with a help of<br/>Monte-Carlo method.</li> <li>Development of the VC3D Monte-Carlo Code.</li> </ol>  |
| ADDRESS:     | VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia<br>Phone: (812) 323-96-12<br>Fax: (812) 113-01-14<br>E-mail: <u>info2101@vniim.ru</u>  |
| CONTACT:     | E.E. Terechtchenko  |

| LABORATORY:  | D.I. Mendeleyev Institute for Metrology (VNIIM)<br>www.vniim.ru  |
|--------------|--|
| NAMES:       | E.E. Terechtchenko, M.A. Rasko   |
| APPARATUS:   | Calibrated HPGe and Si (Li) spectrometers.   |
| ACTIVITY:    | Calibration of planar HP (Ge) detector (20x10 cm) on 5-200 cm<br>distances and Si (Li) (8x4) on 2-8 cm distances.<br>Estimation and correction of detectors sizes using method Monte-<br>Carlo.  |
| RESULTS:     | <ul> <li>4. Calculation of photo-efficiency:<br/>HP(Ge) in the range 5.4-661 keV with 1-3% (k=2)<br/>Si(Li) in the range 5.4-136 keV with 2-4% (k=2)</li> <li>5. Creating set of photon flux reference sources with long-lived isotopes in the range 10<sup>4</sup> - 10<sup>9</sup> photon/s per 10<sup>-4</sup> str angle with an uncertainty of 1-3% (k=2) on the basis:<br/>Pm-145 (T<sub>1/2</sub>=17,7 y, E=37-72 keV),<br/>Am-241 (T<sub>1/2</sub>=432 y, E=11-59 keV),<br/>Pu-238 (T<sub>1/2</sub>=87.7 y, E=11-152 keV),<br/>Ra-226+descendans (T<sub>1/2</sub>=1600 y, E=186-609 keV).</li> <li>6. The analysis of fluorescent radiation caused by Gd-153 radiation (E=39,52-43,01 keV, 45,42-50,00 keV, 97,43 keV, 103,18 keV) on a matrix from a mix of stable isotopes Sm and Gd in medical sources. The contribution of stable Gd fluorescent radiation was 6-9 %, contribution fluorescent radiation of stable Sm being 1-7 % from the common radiation of source for different parties.</li> </ul> |
| IN PROGRESS: | <ol> <li>Correction of T<sub>1/2</sub>(Pm-145).</li> <li>Calibration of HPGe и Si(Li) in the range 4-10 keV.</li> </ol>  |
| ADDRESS:     | VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia<br>Phone: (812) 323-96-12<br>Fax: (812) 113-01-14<br>E-mail: <u>info2101@vniim.ru</u>   |
| CONTACT:     | E.E. Terechtchenko   |

| LABORATORY:  | D.I. Mendeleyev Institute for Metrology (VNIIM)<br>www.vniim.ru  |
|--------------|--|
| NAMES:       | T.E. Sazonova, A.V. Zanevsky, S.V. Sepman<br>M.A. Rasko, E.E. Terechtchenko,<br>I.A. Sokolova, A.E. Kochin,<br>I.A. Kharitonov, N.I. Karmalitsyn   |
| APPARATUS:   | $4\pi\beta(PC)-\gamma(NaI(Tl))$ and KX(0.1mm NaI(Tl))- $\gamma(NaI(Tl))$ -<br>coincidence counting systems,<br>$4\pi\beta(PC)$ -counting system,<br>calibrated gamma- and X-ray spectrometers. |
| RESULTS:     | Participation in the CCRI key comparisons of activity measurements of <sup>54</sup> Mn, <sup>65</sup> Zn, <sup>241</sup> Am  |
| IN PROGRESS: | Participation in the APMP comparisons of activity measurements of ${}^{51}$ Cr, ${}^{139}$ Ce<br>Participation in the CCRI key comparisons of activity measurements of ${}^{125}$ I            |
| ADDRESS      | VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia<br>Phone: (812) 323-96-12<br>Fax: (812) 113-01-14<br>E-mail: <u>info2101@vniim.ru</u>   |
| CONTACT:     | A.V. Zanevsky  |

| LABORATORY   | Institute of Occupational and Radiological Health  |
|--------------|--|
|              | "Dr Dragomir Karajović"  |
| NAMES        | G. Pantelić, I. Tanasković, Lj. Javorina,<br>M. Eremić Savković, V. Vuletić  |
| APPARATUS    | Low-background HP Ge detector;<br>Pop-top HP Ge detector;<br>NaI(Tl) detector  |
| ACTIVITY     | <ul> <li>Preparation, quality control and standardization of solutions of several radionuclides for gamma-ray spectrometry;</li> <li>Participation in international comparisons (EML New York, ALMERA Vienna);</li> <li>Routine measurements of radionuclides in environmental samples;</li> <li>Routine measurements and certifications of radioactive contamination in imported or exported foodstuffs;</li> <li><sup>222</sup>Rn measurements in homes and workplaces.</li> </ul> |
| RESULTS      | More then 400 samples from contaminated areas have been<br>measured for uranium. Contamination from depleted ura-<br>nium has been found in soil samples, lichens and mosses.  |
| PUBLICATIONS | 1. <i>G. Pantelić, M. Eremić Savković, I. Tanasković, V. Vuletić, Lj. Javorina.</i> Gammaspectrometric Determination of Depleted Uranium in Soil, Book of Abstracts, International Conference on Isotopic and Nuclear Analytical Techniques for Health and Environment, IAEA-CN-103, Vienna, 2003, 100   |
|              | 2. <i>G. Pantelić, M. Eremić Savković, V. Vuletić, I. Tanasković, Lj. Javorina.</i> Depleted Uranium in Soil in Serbia, Book of Abstracts, Fifth General Conference of the Balkan Physical Union BPU-5, Vrnjačka Banja 2529.08.03., Belgrade, 2003, 283  |
| ADDRESS      | Institute of Occupational and Radiological Health "Dr<br>Dragomir Karajović", Deligradska 29, 11000 Belgrade,<br>Serbia and Montenegro   |
|              | Tel: ++381-63-8470743<br>Fax: ++381-11-643-675   |
|              | E-mail: <u>dpantelic@ptt.yu</u>  |
| CONTACT      | Gordana Pantelić   |

## LABORATORY CSIR-National Metrology Laboratory

### NAMES Bruce Simpson, Freda Morris

Activities undertaken in 2003

• Participated in the international key comparisons of activity measurement of <sup>65</sup>Zn, <sup>192</sup>Ir, <sup>54</sup>Mn and <sup>241</sup>Am organised by the BIPM.

• Participated in the international key comparison of activity measurement of <sup>90</sup>Y organised by the IAEA. The TDCR efficiency calculation technique and a tracer method were used.

• Participated in the CCRI Section II meeting held at the BIPM.

• Presented three papers in poster form at the ICRM 2003 conference held in Dublin.

• As part of a comparison exercise at hospitals in South Africa, determined the activity of <sup>131</sup>I capsules that are administered orally to patients.

• Prepared a solution standard of <sup>131</sup>I for the medical physics department of a local hospital.

#### **Programme for 2004**

• Complete documentation in preparation for an ISO 17025 assessment in February for laboratory accreditation purposes.

• Measure <sup>90</sup>Y solution samples for ANSTO, Australia.

• Participate in an APMP regional key comparison of <sup>139</sup>Ce activity measurement.

• Participate in an APMP regional project to determine ionization chamber calibration factors for <sup>51</sup>Cr, <sup>57</sup>Co, <sup>134</sup>Cs and <sup>137</sup>Cs.

• Participate in the BIPM international key comparisons of activity measurements of <sup>32</sup>P and <sup>125</sup>I.

• Design and assemble a symmetrical three phototube LS detection system for activity measurement of non- $\gamma$ -emitting radionuclides.

• Provide radioactivity standards, sources and calibration services to the user community.

| PUBLICATIONS | B.R.S. Simpson and W.M. Morris, <i>The standardization of <sup>35</sup>P by the</i>                     |
|--------------|---|
|              | TDCR efficiency calculation technique. Appl. Radiat. Isot. 60   |
|              | (2004) 465.   |
|              | B.R.S. Simpson and W.M. Morris, <i>Direct activity determination of</i>                                 |
|              | <sup>54</sup> <i>Mn and</i> <sup>65</sup> <i>Zn by a non-extrapolation liquid scintillation method.</i> |
|              | Appl. Radiat. Isot. 60 (2004) 475.  |
|              | W.M. Morris and B.R.S. Simpson, <i>Preparation of solid water</i> -                                     |
|              | equivalent radioactive standards. Appl. Radiat. Isot. 60 (2004) 557.                                    |
| ADDRESS      | Radioactivity Standards Laboratory, CSIR-NML  |
|              | 15 Lower Hone Road Rosebank 7700  |

15 Lower Hope Road, Rosebank 7700 Cape Town, SOUTH AFRICA Tel./fax (office) 27 21 686 2759, Tel. (lab) 27 21 685 4325 Fax (reception) 27 21 686 6116 E-mail : <u>bsimpson@csir.co.za</u>

CONTACT B.R.S. Simpson

| LABORATORY   | IRA-METAS   |
|--------------|---|
| NAMES        | François Bochud<br>Youcef Nedjadi<br>Philippe Spring  |
| RESULTS      | Key comparison of Mn-54   |
| PUBLICATIONS | Triscone Gilles, Santos Manuel, Gostely Jean-Jacques,<br>Valley Jean-François, Bochud François O.; 'Absolute<br>activity measurement of radon gas at IRA-METAS';<br>metINFO 10; pp. 4-7 (2003). |
| IN PROGRESS  | Consolidation of absolute radon measurement.  |
| ADDRESS      | François Bochud, PhD<br>Institut universitaire de radiophysique appliquée<br>Grand-Pré 1<br>CH-1007 Lausanne<br>Switzerland   |
|              | http://www.hospvd.ch/public/instituts/ira/index.htm   |
|              | http://www.hospvd.ch/public/instituts/ira/grm/index.html  |
|              | Tel (direct): ++41-21-623-3450<br>Tel (secr): ++41-21-623-3434<br>Fax: ++41-21-623-3435   |
| CONTACT      | François Bochud   |
|              |   |

| LABORATORY  | NMi Van Swinden Laboratorium   |
|-------------|--|
| NAMES       | Wim de Vries   |
| APPARATUS   | 1. Ionisation chamber, with Keithley 617-based charge                        |
|             | measuring system, built into a lead castle                                   |
|             | 2. HPGe-detector with standard electronics, built into a                     |
|             | lead castle  |
|             | 3. Windowless large area flow proportional counter, built into a lead castle |
|             | 4. LSC measurement system for primary standard                               |
|             | 5. NaI(Tl)-detectors for the primary standard                                |
| IN PROGRESS | 1. Ongoing calibration of the HPGe-detector for                              |
|             | ampoules   |
|             | 2. Beta-measurement system for a coincidence standard                        |
|             | 3. Combine the LSC measurement system with the                               |
|             | NaI(Tl)-detectors  |
|             |  |
| ADDRESS     | NMi Van Swinden Laboratorium   |
|             | Dept. Radiation and Length   |
|             | PO Box 80 000  |
|             | 3508 TA UTRECHT, The Netherlands   |
|             | Tel.: +31 30 253 90 98, Fax.: +31 30 253 90 95                               |
|             | E-mail: WdeVries@NMi.nl  |
| CONTACT     | Wim de Vries   |

| LABORATORY            | National Physical Laboratory   |
|-----------------------|--|
| NAMES                 | Lena Johansson, Andy Stroak  |
| APPARATUS<br>ACTIVITY | $4\pi\beta$ (HPPC)- $\gamma$ and $4\pi\beta$ (LS)- $\gamma$ using Digital Coincidence Counting   |
| RESULTS               | Standardisation of Ru-103 for SIR submission to BIPM.<br>Result in agreement with the SIR entries from three other<br>laboratories.  |
|                       | Standardisation of Mn-54, Am-241 for BIPM comparison.  |
|                       |  |
| IN PROGRESS           | Standardisation of Cr-51   |
| ADDRESS               | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 (0)20 8943 8587<br>Fax: +44 (0)20 8943 8700<br>E-mail: lena johansson@npl.co.uk |

Lena Johansson

| LABORATORY            | National Physical Laboratory  |
|-----------------------|---|
| NAMES                 | Lena Johansson, Andy Stroak   |
| APPARATUS<br>ACTIVITY | $4\pi\beta(APPC)$ - $\gamma$ coincidence counting   |
| RESULTS               | Standardisation of Am-241, Y-90, Mn-54 for BIPM comparison completed.   |
|                       | F-18 for SIR submission completed.  |
|                       | Monte Carlo simulations of the complete detector set up performed for selected radionuclides.   |
| PUBLICATIONS          | L.C. Johansson, A.V. Harms, J.D. Keightley, A.K. Pearce, D.H. Woods, M.J. Woods, Primary standardisation of <sup>204</sup> Tl using the efficiency tracing method, Appl. Radiat. Isot. 60(2004) 347-351.                                |
| IN PROGRESS           | Standardisation of Cr-51  |
| ADDRESS               | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 (0)20 8943 8587<br>Fax: +44 (0)20 8943 8700<br>E-mail: <u>lena.johansson@npl.co.uk</u> |
| CONTACT               | Lena Johansson  |

| LABORATORY  | National Physical Laboratory   |
|-------------|--|
| NAMES       | Nigel Watkins, Sean Collins, Andy Pearce   |
| APPARATUS   | Sodium Iodide systems  |
| RESULTS     | Used for environmental measurements, typically dilution checks of samples.   |
| IN PROGRESS | Upgrading of signal conditioning electronics, and<br>calibration to enable an approximate assessment of the<br>source activity. An accurate activity measurement is very<br>difficult due to the high efficiency of the crystals, resulting<br>in sum peaks throughout the spectrum. |
| ADDRESS     | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington, Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8509, Fax: +44 20 8943 6161<br>E-mail: <u>nigel.watkins@npl.co.uk</u>   |

Nigel Watkins

| LABORATORY  | National Physical Laboratory  |
|-------------|---|
| NAMES       | Nigel Watkins, Michaela Baker, Kalyani Chari  |
| APPARATUS   | High pressure ionisation chambers   |
| RESULTS     | Secondary standardisation of customer sources, typically medical radionuclides for scanning and therapeutic purposes. |
| IN PROGRESS | Upgrading measurement hardware and software to ensure reliable operation for the foreseeable future.                  |
| ADDRESS     | Centre for Acoustics and Ionising Radiation   |
|             | National Physical Laboratory  |
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|             | United Kingdom  |
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|             | E-mail: nigel.watkins@npl.co.uk   |
|             |   |

Nigel Watkins

| National Physical Laboratory   |
|--|
| Nigel Watkins, John Sephton, Michaela Baker, Mike<br>Woods   |
| Upgrade of the hardware and software used to operate the high pressure ionisation chambers.  |
| The present system of nuclide activity measurement by<br>integrating current relies on hardware that uses obsolete<br>components, and software that runs under DOS. We intend<br>to rebuild the hardware using modern low-noise<br>components and off-the-shelf data acquisition modules,<br>and rewrite the software to run on a modern platform. An<br>automatic scheduling system and a robotic sample changer<br>will simplify use of the system and enable it to run<br>unattended, improving throughput of customer sources. |
| System expected to be ready end September 2004.  |
| Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington, Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8509, Fax: +44 20 8943 6161<br>E-mail: <u>nigel.watkins@npl.co.uk</u>   |
|  |

Nigel Watkins
| LABORATORY   | National Physical Laboratory  |
|--------------|---|
| NAMES        | Andrea Woodman, Julian Dean, Desmond MacMahon,<br>Hilary Phillips   |
| APPARATUS    | Internal Proportional Gas Counting Systems  |
| RESULTS      | The gas counters are routinely used to standardise customer gases and gases to be used in calibrating gas monitors such as <sup>3</sup> H and <sup>85</sup> Kr. |
| PUBLICATIONS |   |
| IN PROGRESS  | Following the recent move to new facilities both the brass<br>and stainless steel gas counting systems are undergoing<br>benchmarking measurements.             |
| ADDRESS      | Centre for Acoustics and Ionising Radiation   |
|              | National Physical Laboratory  |
|              | Queens Road   |
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|              | E-mail: andrea.woodman@npl.co.uk  |
|              |   |

Andrea Woodman

CONTACT

| LABORATORY               | National Physical Laboratory   |
|--------------------------|--|
| NAMES                    | Julian Dean, Desmond MacMahon  |
| APPARATUS                | A pulse ionisation chamber, a NaI(Tl) well crystal, a re-<br>entrant ionisation chamber, the Radon Standard Solution<br>Dispenser (RSSD) and two commercial liquid scintillation<br>counting systems are used. |
| RESULTS                  | The RSSD has been tested for long-term stability of its<br>radon emanation factor. The factor apparently varies with<br>ingrowth time and this problem needs to be resolved.                                   |
| IN PROGRESS              | Recommissioning of radon gas standard (using NaI(Tl)) and RSSD.  |
| SOURCE IN<br>PREPARATION | 'The Development of a <sup>222</sup> Rn Standard Solution Dispenser<br>at NPL' (presented at Conference on Low-level<br>Radioactivity Measurement Techniques, Vienna, 2003).                                   |
| ADDRESS                  | Centre for Acoustics and Ionising Radiation  |
|                          | National Physical Laboratory   |
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|                          | Middlesex  |
|                          | United Kingdom   |
|                          | TW11 0LW   |
|                          | Tel. +44 20 8943 6278  |
|                          | E-mail: julian.dean@npl.co.uk  |
|                          |  |

Julian Dean

CONTACT

| LABORATORY               | Radioactivity Metrology Group, Centre for Acoustics and<br>Ionising Radiation, National Physical Laboratory                          |
|--------------------------|--|
| NAMES                    | S. Collins, D. MacMahon, M. Woods, S. Woods*   |
| ACTIVITY                 | DECAY DATA EVALUATIONS   |
| RESULTS                  | IAEA CRP 'Update of X- and $\gamma$ -ray decay data standards for detector calibration and other applications':                      |
|                          | half-life evaluations for 64 radionuclides;  |
|                          | $\gamma$ -ray emission probabilities for <sup>56</sup> Co and <sup>94</sup> Nb.  |
|                          | Outside the IAEA-CRP: half-lives of <sup>3</sup> H, <sup>90</sup> Sr & <sup>90</sup> Y.  |
| PUBLICATIONS             | M.J. Woods, S.M. Collins, S.A. Woods*, 'Evaluation of half-life data' NPL Report CAIR 8, 2004.                                       |
| IN PROGRESS              | $\gamma$ -ray emission probabilities in <sup>103</sup> Ru and <sup>106</sup> Ru/Rh.  |
| SOURCE IN<br>PREPARATION | D. MacMahon, A. Pearce, P. Harris, 'Convergence of techniques for the evaluation of discrepant data'. Appl. Radiat. Isot. (in press) |
|                          | Abstracts submitted for presentation at the International<br>Conference "ND2004", Santa Fe, USA, Sept. 2004:                         |
|                          | D. MacMahon, C. Baglin, 'The evaluation of $\gamma$ -ray emission probabilities in the decay of <sup>56</sup> Co'.                   |
|                          | D. MacMahon, 'Half-life evaluations for ${}^{3}H$ , ${}^{90}Sr \& {}^{90}Y'$ .   |
| ADDRESS                  | Centre for Acoustics and Ionising Radiation, National<br>Physical Laboratory, Teddington, Middlesex, TW11 0LW,<br>United Kingdom.    |
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|                          | Fax: **44(0)20 8943 8700   |
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|                          |  |

CONTACT Desmond MacMahon

\* We very much regret to announce the death of our highly valued and esteemed colleague, Simon Woods, in October 2003

| LABORATORY               | National Institute of Standards and Technology   |
|--------------------------|--|
| NAMES                    | Peter Volkovitsky, Ron Collé   |
| APPARATUS                | Pressurized Ionization Chamber , LS detector, and HPGe detectors   |
| RESULTS                  | The series of 130 new Radium SRM4967A sources was prepared   |
| SOURCE IN<br>PREPARATION | "Preparation of a <sup>226</sup> Ra standard and determination of its<br>activity by different methods" was prepared for publication<br>in the Journal of Research of the National Institute of<br>Standards and Technology. |
| ADDRESS                  | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5527<br>Fax: +1-301-926-7416   |
|                          | peter.volkovitsky@nist.gov   |
|                          |  |

CONTACT

Peter Volkovitsky

| LABORATORY  | National Institute of Standards and Technology  |
|-------------|---|
| NAMES       | L. Pibida, L.R. Karam, J.M.R. Hutchinson  |
| APPARATUS   | Resonance Ionization Mass Spectrometry (RIMS)   |
| IN PROGRESS | In collaboration with Pacific Northwest National Laboratory (PNNL) and the University of Mainz, Germany, our RIMS system capabilities have been extended. Measurements of <sup>135</sup> Cs/ <sup>137</sup> Cs isotopic ratio in burn up samples were performed as well as investigations in extending the NIST system to study difference radioisotopes in environmental samples. Resonance Ionization Mass Spectrometry (RIMS) has been evaluated for measuring <sup>135</sup> Cs / <sup>137</sup> Cs isotopic ratios. Spectroscopic measurements of 6s $^{2}S_{1/2}(F = 4) \rightarrow 6p$ $^{2}P_{3/2}(F = 5)$ transition frequency shifts for <sup>135</sup> Cs and <sup>137</sup> Cs confirmed existing values and demonstrated that it is possible to perform such measurements on sub-picogram samples. Determination of the <sup>135</sup> Cs / <sup>137</sup> Cs ratio was performed using single-resonance excitation $6s$ $^{2}S_{1/2}(F = 4) \rightarrow 6p$ $^{2}P_{3/2}(F' = 5)$ with an extended cavity diode laser followed by photoionization with the 488 nm line of an argon ion laser. The NIST system was compared to a similar system at Pacific Northwest National Laboratory (PNNL). Optical selectivity of more than 2 orders of magnitude against stable <sup>133</sup> Cs was attained for <sup>135</sup> Cs and <sup>137</sup> Cs for both systems with an overall selectivity of 10 <sup>9</sup> for the PNNL system and 10 <sup>8</sup> for the NIST system. Overall efficiencies of $2 \times 10^{-6}$ and $5 \times 10^{-7}$ was measured for the PNNL and NIST systems respectively. Measurements to determine the chronological age of a nuclear burn-up sample have been performed using both RIMS systems at NIST. Atomization behavior of the graphite furnace and overall efficiency was measured for different sample preparations and an approximate value for the <sup>133</sup> Cs content in the sediment of $\approx 4 \times 10^{14}$ atoms/g was obtained. TIMS measurements were also performed on the same sample but barium isobaric interference prevented the extraction of information on radiocesium content. New ionization schemes were investigated showing that the $6s^{2}_{1/2}(F = 4) \rightarrow 8s^{2}S_{1/2}(F = 4)$ two-photon transition improves the overa |

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CONTACT

Leticia Pibida

| tional Institute of Standards and Technology   |
|--|
| n Inn, Iisa Outola, Svetlana Noor, Hiromu Kurosaki<br>diochemical techniques, alpha spectrometers, Ge detectors  |
| e NIST low-level radionuclide natural-matrix Standard<br>ference Material (SRM) program has issued certified<br>ssic activity standards for River Sediment, Human<br>ng, Human Liver, Rocky Flats Soil, Freshwater Lake<br>liment, Peruvian Soil, Ashed Bone and Ocean<br>liment, and is currently working on Seaweed, Shellfish<br>l Rocky Flats Soil - II. |
| ST<br>) Bureau Dr.<br>p 8462<br>ithersburg, MD 20899-8462 USA<br>one: +1-301-975-5541  |
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|  |

CONTACT

Kenneth Inn

| LABORATORY  | National Institute of Standards and Technology  |
|-------------|---|
| NAMES       | L. Lucas, J. Cessna   |
| APPARATUS   | LS counters   |
| IN PROGRESS | In order to establish a link between primary standards of gamma-emitters in the NMIs and the SIR, a Key Comparison of <sup>90</sup> Y is being completed. All measurements have been reported and the compilation is in progress. |
| ADDRESS     | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5539  |
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|             |   |

CONTACT

Jeffrey Cessna

| LABORATORY  | National Institute of Standards and Technology   |
|-------------|--|
| NAMES       | Peter Volkovitsky, Ron Collé   |
| APPARATUS   | Microcalorimetry   |
| IN PROGRESS | Some tests were performed with the NIST Isothermal Microcalorimeter CSC 4400. The instability of the baseline is the main factor which restricts the sensitivity and accuracy of the instrument. At present, the variations of the baseline (presumably due to the variations of the ambient temperature) are on the level of 1 $\mu$ W. It is expected that after the instrument is moved to the new room with stabilized temperature at the EML building in March 2004, we will be able to decrease the variation of the baseline $5 - 10$ times and thus to increase the sensitivity and the accuracy of the Isothermal Microcalorimeter. |

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CONTACT

Peter Volkovitsky

| LABORATORY     | -Institute for nuclear science "Vinča", Laboratory for nuclear and plasma physics, Group for Nuclear Instrument and Methods   |
|----------------|---|
| NAMES          | - D. Novković, A. Kandić, I. Vukanac, M. Đurašević, L. Nađđerđ, D. Jordanov   |
| APPARATUS      | <ul> <li>4πβ(2πα) gas flow PC</li> <li>NaI(Tl) detector</li> <li>HPGe detector</li> <li>ZnS(Ag) detector</li> <li>Si SBD for α-spectrometry</li> <li>plastic scintillation β detector</li> </ul>  |
| ACTIVITY       | <ul> <li>Investigation of non-exponential decay of <sup>198</sup>Au</li> <li>Measurements of goal foils activities</li> <li>Preparation and standardization of solutions of γ-radionuclides and α sources</li> <li>Participation in international comparisons (IAEA-385)</li> </ul> |
| PUBLICATIONS   | <ul> <li>D. Novković, A. Kandić, V. Ljubenov, I. Vukanac, Application of<br/>Neutron Activation Analysis Technique for Determination of Thermal<br/>Neutron Flux, V General Conference of the Balkan Physical Union,<br/>BPU 5, Vrnjačka Banja, 25. – 29. 08. 2003.</li> </ul>      |
|                | <ul> <li>I. Vukanac, D. Novković, A. Kandić, L. Nađđerđ, <i>Determination of the measurement uncertainity for NaI(Tl) detector</i>, (in Serbian) XXII Symposium of Yugoslav society for radiation, Petrovac na moru, 29. 09. – 01. 10. 2003.</li> </ul>                             |
| IN PREPARATION | - Dušan Novković and Aleksandar Kandić, <i>The determination of the thermal neutron flux density by the measurement of the activities ratio</i> <sup>199</sup> Au / <sup>198</sup> Au, Radiation Measurements, (in press)   |
| IN PROGRESS    | <ul> <li>β spectrometer with cooled Si-surface barrier detector</li> <li>preparation of monomolecular radioactive sources</li> </ul>  |
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