BNM BUREAU NATIONAL DE MÉTROLOGIE

COMMISSARIAT À L'ÉNERGIE ATOMIQUE

LABORATOIRE NATIONAL
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Review of the activities at the BNM-LNHB related to Radionuclide Metrology (June 2001 to March 2003)

By N. Coursol

1 – Improvements in activity measurements

- Development of MTR2: a discriminator and dead-time module used in counting systems e.g. on $4\pi\beta$-γ coincidences (pulse mixing method)
- Implementation of a TDCR system (a 3-photomultiplier tubes LSC counter) in the β channel of the $4\pi\beta$-γ coincidence counting device
- Study of the effect of the ionisation quenching factor kB on the calculated detection efficiency using the TDCR method, for electron-capture radionuclides (it is small) and for low-energy beta nuclides (can be important)
- MAC3 : an electronic module for the processing of pulses delivered by a three photomultiplier liquid scintillation counting system
- Implementation of "SOLEX" a tunable monochromatic X-ray source (1-20) keV for low-energy X-ray spectrometry and counting
- Efficiency and peak shape calibration of semiconductor detectors using synchrotron radiation: study of the response function of low-energy X-ray spectra obtained with an HPGe detector
- Development and experimental tests in order to validate the "ETNA" code (Efficiency Transfer for Nuclide Activity measurements and coincidence summing corrections)
- Portability of the calibration factors of 4π-ionisation chambers using the stochastic code "Penelope" : study of the influence of the geometry and components (on-going)
- Calibration of a 4π-ionisation chamber for the standardisation of nuclides of medical interest (ongoing)
- Characterization of digital signal processors
- Implementation of a ionic chromatograph column device for activity solution analysis
- Feasibility study of activity standardization with a 4π counting bolometer, see reference list please (on-going)
- Implementation of ISO 17025: accreditation by the French Body COFRAC

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2 – Radionuclide measurements

- Submissions to the SIR: ^{18}F, ^{85}Kr, ^{90}Y and $^{110}Ag^{m}$
- Standardisation of: ^{18}F, ^{14}C, ^{32}P, ^{35}S, ^{51}Cr, ^{54}Mn, ^{60}Co, ^{65}Zn, ^{89}Sr, ^{90}Y , $^{99}Tc^{m}$, ^{103}Pa, $^{110}Ag^{m}$, ^{133}Xe, ^{134}Cs, ^{169}Er, ^{152}Eu, ^{154}Eu, ^{192}Ir, ^{204}Tl and ^{241}Am solutions

3 – Evaluation and measurement of nuclear decay data

- Determination of the γ-ray emission probabilities for ^{65}Zn and ^{154}Eu decay
- Evaluation or updating decay data of ^{123}I, ^{131}I, ^{15}O, ^{13}N, ^{11}C, ^{18}F, ^{32}P, $^{123}Te^{m}$, ^{33}P, ^{204}Tl
- Development of a program in order to transfer the data from NUCLÉIDE to ENSDF
- Development of a program in order to calculate the detailed K- and L-X-ray and L-Auger emission energies and intensities following the radiation disintegration
- Preparation of an updated version of NUCLÉIDE_2000 on CD-Rom (on going)
- Preparation of a database of experimental data from beta spectra and electrons emissions (Auger or Internal Conversion) for selected radionuclides (ongoing)
- Measurement of half-life values for selected nuclides: ^{65}Zn, ^{88}Y, ^{89}Sr and ^{125}I

4 – International activities

BIPM :

- Member of CCRI, section II
- Member of the CCRI(II) International Equivalence-WG
- Member of the CCRI(II) WG extension of the SIR to β emitters
- Member of the CCRI(II) uncertainty WG
- Participation on the CCRI(II) intercomparison of ^{32}P, ^{65}Zn, ^{204}Tl, ^{192}Ir and ^{241}Am activity measurements

EA :

- Member of the WG “Ionizing radiation and radioactivity”
- Member of Committee 2 “Calibration and testing activities”

ESARDA :

- Synthesis and report of the international “Pu-2000” exercise
- Publication of a U- and Pu-spectra data library (see http://www.bnm.fr/bnm-lnhb)

- Member of the WG "Non-Destructive Assay"

EUROMET :

- TC-Chairperson on the field of Ionising Radiation; coordination of convenors and WGs actions on the process of setting up and reviewing of CMCs
- Participation on project n° 591 (^{235}U decay data)
- French Technical Contact Person on the field of Ionising radiation
- Coordination of proposed projects: ^{85}Kr (gas) activity standardisation and ^{65}Zn decay data determination

IAEA :

- Membership of the Coordinated Research Program on "Updating of X- and γ-ray decay data standards for detector calibration
- Active participation on Decay Data Evaluation Project (DDEP). Evaluation works and comments available on the LNHB web pages : http://www.bnm.fr/bnm-lnhb/NucData.ftm . At present decay data of 66 nuclides of large interest are available on the site
- Re-certification of two reference materials for the determination of their low level radionuclides with assigned property values traceable to the SI

ICRM :

- Co-ordination of the Liquid Scintillation Counting Working Group
- Attended the Executive Board meetings held in Dublin, Ireland in 2002
- Chairman of the Nominating Committee
- Member of the Scientifics Committees of ICRM'01 (Braunschweig, Germany) and ICRM'03 (Dublin, Ireland)
- Coordination of the project: ^{85}Kr ionisation chamber efficiency response using simulation codes

Others :

- Collaboration with RC-Swierk on Liquid Scintillation Counting Method
- Collaboration with NIST on the ^{103}Pd LSC standardisation
- Collaboration with IFIN on LS counting, gas measurement and on γ-ray spectrometry
- Collaboration with PTB on the "Table of Radionuclides"
- Collaboration with BNL (USA), the KRI(Russia), the PTB and the CIEMAT on decay data evaluation

- Collaboration with JINR/LNP, Dubna (Russia) on the database of electron emission
- Collaboration with VNIIM on activity measurement techniques
- Collaboration with LNMRI on activity measurement techniques
- Collaboration with the University of Sofia (Bulgary) on gas measurement methods
- Collaboration with the University of Catane INFN (Italy) on α sources for PIXE
- Organisation of the French "Journées de spectrométrie gamma et X" at Saclay the 15-17 October 2002 (200 participants)

5 – Publications (2001 – 2003)

*M.N. Amiot, J. Bouchard, MM. Bé, J.B. Adamo***,** Half live determination for ^{88}Y et ^{89}Sr, to be published in Appl. Rad. Isot..

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P. Cassette, J. Bouchard: The design of a TDCR counter, Conf. Radiation Measurements and Applications (Ann Arbor - Detroit – USA, 21-23-05-2003), to be published in Nucl. Instr. Meth.

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B.E. Zimmerman, R. Collé, J.T. Cessna , R. Broda and P. Cassette, Application of the Triple-to-Double Coincidence Ratio Method at NIST for absolute standardization of Radionuclides by liquid scintillation counting. ACS meeting, Orlando, Florida. In press

P. Cassette, E. L. Grigorescu, A. C. Razdolescu, Obtaining tritiated water standards using triple to double coincidence ratio (TDCR) method, IDRANAP conference, September 2002, Neptun (Roumanie), in press

*P. Cassette, J.L. Picolo, D. Stanga***,** Standardization of gazeous tritium comparison between different coincidence measurement methods, IDRANAP conference, September 2002, Neptun (Roumanie), in press

P. Cassette, M. M. Bé, F. Jaubert. Evaluation of uncertainties in radionuclide metrology using liquid scintillation counting methods, IDRANAP conference, September 2002, Neptun (Roumanie), in press.

R. Broda, K. Maletka, T. Terlikowska, P. Cassette, Study of the influence of the LS-cocktail composition for the standardisation of radionuclides using the TDCR model., Appl. Rad. Isot., 56 (2002) 285-289

A.C. Razdolescu, M. Sahagia, P. Cassette, E. L. Grigorescu, A. Luca, C. Ivan, Standardisation of ^{89}Sr, Appl. Rad. Isot., 56 (2002) 461-465

V.M. Gorozhankin, N. Coursol, E.A. Yakushev, TS. Vylov, C. Briançon, New features of the IC(4) code and comparison of internal conversion coefficient calculations, Appl. Rad. Isot., 56 (2002) 189-197

*F. Dayras***,** Analysis of ^{239}Pu, ^{244}Cm and ^{243}Am alpha spectra using unfolding code Colegram without prior use of a nuclear data library, Nucl. Instr. and Meth. A 490, 2002, 492-504

N. Chauvin, F. Dayras, D. Le Du and R. Meunier,'SIDONIE : an electromagnetic isotope separator for preparation of high purity thin targets', to be published in Nucl. Instr. and Meth.

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J. Morel, DeLynn Clark, Esarda NDA-WG Members, Influence of nuclear data on uranium enrichment results obtained by XKα spectral region analysis, Appl.Rad.Isot., 56 (2002) 85-91

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*J. Plagnard, Ahn Tran Tuan et J. Morel***,** Caractérisation métrologique du système ADONIS de traitement numérique du signal en spectrométrie gamma, Journées de spectrométrie gamma et X, to be published in Bulletin du BNM

V. Tsoupko-Sitnikov, J.L. Picolo, M. Carrier, S. Peulon, G. Moutard, Nouvelle méthode de fabrication de sources de grande surface pour l'étalonnage des moniteurs de contamination alpha et bêta, ICRM 2001, Appl. Rad. Isot., 56 (2002) 21-29

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*G. Pappalardo, J. de Sanoit, L. Pappalardo, F. P. Romano, S. Garraffo et C. Marchetta***,** Le système portable PIXE-α développé conjointement au DIMRI et à l'INFN. Quelques applications récentes dans le domaine de l'archéologie, Journées de spectrométrie gamma et X, to be published (Bulletin du BNM)

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