DeTeCs/LNHB

LNE-LNHB progress report related to Radionuclide Metrology
May 2005 to April 2007 - N. Coursol

1 – News

In 2005, the LNE-LNHB started a hard and costly work for better conforming national regulations related to the use and holding of radionuclides. This led to the beginning of rehabilitation works and removal of old radioactive sources and materials. This also led to a project for complete renovation of the building hosting the laboratory devoted to radionuclide metrology (built more than fifty years ago).

These important works have now begun and are planned to end not before December 2008. During that period, the work of the laboratory (source preparation and measurements) will be disturbed and this will result in delays for several studies.

2 - Improvements in activity measurements

Source preparation

- Application of the ionic chromatograph column device for ^{75}Se activity solution analysis
- Adaptation of electrophoreses capillary technique for the determination and quantification of o the element bismuth in solution
- Freeze-drying applied to radioactive source preparation (^{54}Mn and ^{51}Cr)
- Studies for the preparation of ^{55}Fe and ^{36}Cl sources adapted to activity measurements using bolometer detectors

Measurement methods

<u>4πβ-γ coincidence</u>

- Optimisation of the electronic threshold detection (on the unique electron) and polarity focalisation pilot of the 4πβ-γ coincidence device using the “BURLE 8850” photomultipliers
- 4π γ counting Calculation of efficiency coefficients for the 4π γ counting device using a updated PENELOPE and MCNP version 4C3 codes (NT LNHB 2006/50)

Liquid scintillation

- Development of a TDCR prototype liquid scintillation device using channeltrons photomultipliers in collaboration with IFIN
- Study of the feasibility of a virtual reference source by Compton effect in relation to the CCRI ESWG(II)

CEA-SACLAY, DETECS-LNHB, Bât.602, 91191 GIF-SUR-YVETTE CEDEX
TÉL. : 01 69 08 41 04 – FAX : 01 69 08 26 19

Photon spectrometry

- Link of the gamma-ray spectrometry devices to the LNHB/LMD standard time clock
- Determination of the thicknesses of constituent layers (Ni, Al, Ge dead layer) of a X-ray detector using the tunable source of monochromatic low-energy x rays "SOLEX"

Well-type ionisation chamber

- Monte Carlo calculation of calibration factors for gamma emitters of the "Normandy" ionisation chamber for important radionuclides of medical use

Cryogenic detectors

- Implementation of a bolometer temperature regulation in the cryogenic refrigerator (NT LNHB 06/59)
- Development of the cryogenic refrigerator in view to the implementation of magnetic calorimeters in it
- Development of magnetic calorimeters for X-ray metrology application

2 – Radionuclide measurements

- Contributions to the SIR: ^{51}Cr, ^{54}Mn, ^{67}Ga, ^{75}Se, ^{111}In, ^{124}Sb (pilot study), ^{134}Cs, ^{201}Tl
- Participations in the CCRI(II) key-comparisons of ^{55}Fe solution
- Pilot study of the ^{240}Pu alpha-particle emission probabilities using cryogenic detector (bolometer) in relation to the EUROMET project 749
- Study of Ionisation Chamber response to ^{85}Kr in relation with the pressure in the gas ampoule: comparison between the calculated results and the experimental ones
- Standardisation of ^{67}Ga by $4\pi(LS)\beta$-γ anticoincidences using extendable dead times
- ^{55}Fe solution standardisation by the $4\pi(LS)\beta$-γ coincidence using ^{54}Mn as tracer
- Application of the tracer method for the ^{14}C solution standardisation

3 – Evaluation and measurement of nuclear decay data

- Determination of XK - and 400 keV γ-ray emission intensities in the decay of ^{176}Lu
- Evaluation or updating decay data of ^{238}U, ^{79}Se, ^{203}Pb, ^{55}Fe, ^{60}Co, ^{226}Ra + daughters,
- Review of DDEP evaluation of ^{111}In, ^{206}Tl, ^{236}Np, ^{236}Np^{m}, ^{241}Pu
- Publication of the results of the EUROMET IR project 721 Activity measurements and gamma emission intensities determination in the decay of ^{65}Zn
- Contribution to improvement of the nuclear data concerning the alpha decay of ^{235}U
- Update of "Nucleide.org" web site to include two forums of discussion (one for decay data evaluators and one for gamma-ray spectrometry users)
- Implementation of the BIPM Monographie 5 "Table of Radionuclides" volume 3 at Nucleide.org

- Determination of the ^{67}Ga decay data by gamma-ray spectrometry and using the ICC from "Nucleide" (NT LNHB 2006-41)
- Measurement of half-life values for selected nuclides: ^{124}Sb, and long-lived ones: ^{79}Se, , ^{176} Lu in cooperation with LNE and CEA Cadarache (for mass spectrometry measurements)

4 – International activities

- The LNE-LNHB staff has actively participated at the CCRI(II) working groups: KCWG(II), BqWG(II), ESWG(II), TIWG(II) and UCWG(II)
- Determination of the 4π γ counting efficiency coefficients for the BIPM ampoules geometry using a updated PENELOPE code (NT LNHB 2006/48)
- Monographie BIPM-5 vol. 3 - Decay Data (comments available on the LNHB web page www.nucleide.org)
- Monographie BIPM-6: vol. 1 Thermodynamic Stability of Radioactivity Standard Solutions
- Coordination of EUROMET IR activity subfield
- Coordination of EUROMET IR project 907: Measurement of Sb-124 activity and determination of photon emission probabilities
- Participation at the EUROMET IR task group for the elaboration of IR proposal roadmaps in the frame of EMRP
- Edition of ICRM Newsletter issues: 19 (2005), 20 (2006) and 21(2007)
- Participation in the IAEA Coordinated Research Program on "Updating of X- and γ-ray decay data standards for detector calibration
- Contribution to the European database JEFF-3 (OCDE/IAEA)
- Organisation of and contribution to a DDEP Training Session in the field of evaluation of decay data (06/03/06 to 10/03/06) (NT LNHB 2006-28)
- Participation in the Scientific Committees of ICRM05 and ICRM07 conferences and contributions with presentations to ICRM07
- Coordination of the ICRM Working Groups: Liquid Scintillation Techniques and Gamma-ray and Beta-particle Spectrometry - Participation in and organisation of the ICRM Gamma-ray and Beta-particle Spectrometry workshop (comparison of Monte Carlo calculations results)

Others :

- Organisation of French inter laboratory proficiency tests - an opened program is proposed every year by the LNE-LNHB
- Participation in the French Commission d'ETAblissement des méthodes d'analyse (CETAMA) working groups GT14 "analyse des radionucléides dans les effluents et les déchets" and GT33 "chromatographie liquide"

- Participation in and organisation of the 12th European Conference X-ray Spectrometry "EXRS 2006" in Paris, 19-23 June
- Participation in the International Conference on Nuclear Data for Science and Technology "ND2007
- Collaboration with CIEMAT, IFIN-HH , IRA, NIST, NPL, ANSTO and CSIR-NML on Liquid Scintillation Counting Methods
- Collaboration with JINR/LNP, Dubna (Russia) on the electron emission decay data
- Collaboration with IRA and LNMRI on activity measurement techniques
- Collaboration with BNL (USA), KRI(Russia), PTB and CIEMAT on decay data evaluation

5 – Selected Publications

M.N. Amiot, M.N., Bouchard J., Bé M.M., J.B. Adamo, Half life determination of ^{88}Y and ^{89}Sr, Applied Radiation and Isotopes 62 (2005) 11-15

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*M.M. Bé***,** Activity measurements and determination of gamma – ray emission intensities in the decay of Zn-65, Applied Radiation Isotopes 64 (2006) 1396.

*MM. Bé, V. Chiste, C. Dulieu***,** Detailed calculation of K- an L- Auger electron emission intensities following radioactive disintegration, Applied Radiation Isotopes 64 (2006) 1435.

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P. Cassette, G.H. Ahn, T. Alzitzoglou, I. Aubineau-Lanièce, F. Bochud, E. Garcia Torano, A. Grau Carles, A. Grau Malonda, K. Kossert, K. B. Lee, J. P. Laedermann, W.M. van Wyngaardt, B. E. Zimmerman, Comparison of calculated spectra for the interaction of photons in a liquid scintillator. Example of ^{54}Mn 835 keV emission, Applied Radiation and Isotopes 64 (2006) 1471-1480

P. Cassette, P. Arenillas "Implementation of the TDCR liquid scintillation method at CNEA-LMR, Applied Radiation and Isotopes 64 (2006) 1500-1504

P. Cassette, I. Tartes, F. Maguet, J. Plagnard, M. C. Lépy and F. Jaubert, Measurement of photon absorption coefficients of liquid scintillators in the 5 to 12 keV energy range using a monochromatic X-ray source, LSC 2005, Advances in Liquid Scintillation Spectrometry. Radiocarbon (2006).

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M. C. Lépy, "Total efficiency calibration for coincidence summing corrections" (Ann Arbor), to be published in Nuclear Instruments and Methods.

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