DeTeCs/LNHB/05/274

LNE-LNHB progress report related to Radionuclide Metrology
April 2003 to March 2005 (by N. Coursol)

1 – Reform of the French metrological organisation

The French BNM (Bureau National de Métrologie) created in 1969, had, for management reasons, its status changed in 1994 to a Public Interest Group (GIP) with four National Metrology Laboratories and six Associated Laboratories.

Today, metrology is a key element in the advance of science, industry and society. In this context, many countries have heavily invested in the development of their metrological infrastructures, which are considered as an essential component of their national independence. In the same way, the exponential expansion of the coast of such development has led to the strengthening of international cooperation, particularly at the European level, to avoid unnecessary duplication.

France has been deeply involved in this effort to better organize its metrology. So, in 2004, the French Government has decided to reform the BNM organization and in January 2005, a joint decree from the Industry and Research Ministries has announced the dissolution of BNM and transfer to LNE the conduction of the French metrology. On this occasion, the LNE's name has been changed to **"Laboratoire national de métrologie et d'essais",** but keeping the acronym LNE.

As specified in the decree, the LNE as the National Metrology Institute, will ensure the monitoring of the French metrology through the support of a metrology committee made up of fourteen people, including seven scientific and industrial qualified persons that cover as far as possible the different fields of metrology, and seven representatives of bodies coming respectively from the LNE and the three other national laboratories, from CNRS and from the ministries of research and industry.

The LNHB has been confirmed as the National Laboratory for Ionisation radiation in charge of the units of gray and becquerel.

2 - Improvements in activity measurements

- Installation and validation of the new electronic modules (discriminator and dead-time) implemented in the 4πβ-γ coincidences device
- Testing of the 4πβ-γ coincidence counting device with a TDCR system (a 3-photomultiplier tubes LSC counter) in the β channel
- Development and implementation of a tritiated water reduction device, in collaboration with IFIN
- Studies for the characteristics of liquid scintillator cocktails in the frame of the CCRI(II) WG extension of SIR to alpha- and beta-particle emitters

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- Characterization of "SOLEX" a tunable monochromatic X-ray source (1 to 20 keV) for metrological studies in the 1 to 20 keV energy range (application to the measurement of attenuation coefficients)
- Characterization of a HPGe detector: application to the validation of coincidence summing correction
- Organisation of national and international interlaboratory comparisons in the field of activity measurements: an opened program is proposed every year by LNHB
- Monte Carlo calculation of calibration factors for gamma emitters of the Vinten 671 ionisation chamber for the medically-important radionuclides
- Characterization of digital signal processors
- Implementation of a ionic chromatograph column device for activity solution analysis (metals, lanthanides, alkalis and ions)
- Freeze-drying applied to radioactive source preparation (preliminary results obtained with ^{65}Zn)
- Development of a 4π–geometry detection bolometer prototype for radionuclide activity measurements
- Study of a magnetic bolometer for the X- and gamma-rays spectrometry
- High energy resolution alpha spectrometry using cryogenic detector (application to ^{239}Pu, ^{241}Am and ^{244}Cm)
- Quality control of liquid scintillation counters
- ISO 17025: accreditation of LNHB laboratory by the French Body COFRAC

2 – Radionuclide measurements

- Contributions to the SIR: ^{54}Mn, ^{57}Co, ^{67}Ga, ^{111}In, ^{124}Sb, ^{153}Sm, ^{134}Cs, ^{201}Tl
- 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 ^{3}H(gas), ^{133}Xe, ^{35}S, ^{55}Fe, ^{59}Fe, ^{56}Mn, ^{63}Ni, ^{88}Y, ^{188}Re+^{188}W, ^{188}Re and ^{222}Rn (by LSC) and other radionuclides needed by the user communities (eg ^{99}Tc^{m} and ^{99}Mo)

3 – Evaluation and measurement of nuclear decay data

- Determination of X- and γ-ray emission intensities in the decay of ^{153}Sm
- 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
- Gamma emission intensities determination in the decay of ^{65}Zn
- Contribution to improvement of the nuclear data concerning alpha decay of ^{235}U
- 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
- Measurement of half-life values for selected nuclides: ^{65}Zn and ^{88}Y

4 – International activities

- The laboratory staff has actively participated at the CCRI(II) working groups: Key Comparison, Uncertainty and Extension of the SIR
- Participations in the CCRI(II) key-comparisons of ^{32}P (first and second exercise), ^{54}Mn, ^{65}Zn, ^{90}Y , ^{125}I, ^{192}Ir and ^{241}Am solutions
- Submission of the result work on Thermodynamic Stability of Radioactivity Standard Solutions to be considered as a Monographie BIPM- vol. 1
- Monographie BIPM-5 vol. 1 and vol. 2: Decay Data (DDEP Evaluation works and comments available on the LNHB web page www.nucleide.org)
- EUROMET IR TCC : coordination of EUROMET IR actions and CMC submissions. Reviewed the activity CMCs submitted by the SIM, APMP and COOMET regions, on behalf of EUROMET
- Coordination of EUROMET IR project: ^{65}Zn decay data determination
- Participation in the IAEA Coordinated Research Program on "Updating of X- and γ-ray decay data standards for detector calibration
- Participation of the Scientifics Committees of ICRM03 and ICRM05 conferences
- Contribution with presentations to ICRM05
- Coordination of the ICRM Liquid Scintillation Counting Working Group
- Co-ordination of an international comparison of calculated spectra of 835 keV photons in a liquid scintillator
- Participation in the tri-lateral RMOS (APMP, COOMET and EUROMET) ^{134}Cs activity measurement

Others :

- Collaboration with RC-Swierk , NIST(USA), l'ANSTO (Australia) and CSIR-NML (South Africa) on Liquid Scintillation Counting Method
- Collaboration with IFIN on LS counting, gas measurement and on γ-ray spectrometry
- Collaboration with JINR/LNP, Dubna (Russia) on the database of electron emission
- Collaboration with VNIIM, LNMRI on activity measurement techniques and with the University of Sofia (Bulgaria) on gas measurement methods
- Collaboration with the University of Catane INFN (Italy) on α sources for PIXE
- Collaboration with BNL (USA), the KRI(Russia), the PTB and the CIEMAT on decay data evaluation
- Co-organisation of the European X-ray spectrometry conference in Paris, 2006

5 – Publications (2003 – 2004)

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E. Leblanc, Développements récents sur les détecteurs cryogéniques, applications à la mesure d'activité, à la spectrométrie de photons X et gamma, à la spectrométrie d'électrons et de particules alpha, Actes des Journées Techniques CETAMA, « les détecteurs et l'analyse », Radioprotection, Vol. 39, n°4, pp. 535-547 (2004)

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