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 $4\pi\beta-\gamma$ coincidences (pulse mixing method)
- Implementation of a TDCCR system (a 3-photomultiplier tubes LSC counter) in the $\beta$ channel of the $4\pi\beta-\gamma$ coincidence counting device
- Study of the effect of the ionisation quenching factor $k_B$ on the calculated detection efficiency using the TDCCR 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 $4\pi$-ionisation chambers using the stochastic code "Penelope" : study of the influence of the geometry and components (on-going)
- Calibration of a $4\pi$-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 $4\pi$ counting bolometer, see reference list please (on-going)
- Implementation of ISO 17025: accreditation by the French Body COFRAC
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 $\gamma$-ray emission probabilities for $^{65}$Zn and $^{154}$Eu decay
- Evaluation or updating decay data of $^{123}$I, $^{131}$I, $^{15}$O, $^{11}$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 (ongoing)
- 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 $\beta$ 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 \(\gamma\)-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](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 Scientists 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 \(\gamma\)-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 $\alpha$ sources for PIXE
- Organisation of the French “Journées de spectrométrie gamma et X” at Saclay the 15-17 October 2002 (200 participants)


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