Coordinator's Report
Beta-Particle Spectrometry WG

Background

The Beta Particle Spectrometry Working Group is devoted to the development of the metrological aspects of beta spectrometry and its applications. This includes:

- Theory. Beta ($\beta^{\pm}$) and electron capture (ε) transitions; Theoretical shape factors and influence of the nuclear current; Atomic effects.
- Experiments. Instrumentations used for beta spectrometry; Techniques that need beta information; Confidence on experimental shape factors; Data analysis and unfolding methods.
- Simulations. Confidence on the physical processes: low energies, radioactive decays, atomic rearrangements; Comparison of the results of different codes.
- Evaluations. Confidence and uncertainties on experimental shape factors; Procedure for establishing recommended shape factors; Mean energies, log *ft* values, database.

Interested communities in radionuclide metrology are: nuclear decay data, liquid scintillation counting, ionising chambers, 4π β-γ counting.

Recent and on-going activities

- A dedicated website was created in 2016 and can be found at the following address: http://www.lnhb.fr/icrm_bs_wg/. This first version will change in accordance with the activities of the Working Group.
- Theory. *i*) Development of improved calculations of electron capture decays. *ii*) Inclusion of the nuclear structure in beta decay calculation is on-going. *iii*) Released of the first version of the BetaShape code, now available for the community here: http://www.lnhb.fr/activites-recherche-developpement/logiciels-traitement-spectres/
- Simulation. A decay module for Geant4 is in development at LNHB, in the same spirit as the PenNuc module developed by CIEMAT with support from LNHB, but with improvements such as a coupling with the BetaShape code.
- Measurements. Beta spectra of ^{14}C, ^{36}Cl, ^{99}Tc and ^{151}Sm should be measured at LNHB and PTB with metallic magnetic calorimeters. A PhD student started her thesis at LNHB in July 2017 and will carry out new measurements with silicon detectors.
- Evaluations. The BetaShape program is now the reference code for future DDEP evaluations. A database of published experimental shape factors, as comprehensive as possible, is being developed and will be made available on the Working Group website.

Related projects

- European metrology project (EURAMET, EMPIR programme) MetroBeta 15SIB10, 2016-2019. Website: http://metrobeta-empir.eu/. Partners are from Czech Republic, France, Germany, Netherlands, Poland and Switzerland.

  Summary. The MetroBeta project is taking both theoretical and experimental approaches to improving the knowledge of beta spectra. On the theoretical side, existing knowledge of the calculation of nuclear wave functions is being used to take into

account the nuclear structure effect on these spectra. On the experimental side, beta spectrometry with MMCs is being developed, as well as solid scintillators containing the beta emitters in the structure of the scintillator crystal. Comparison of the newly calculated and measured spectra will validate the quality of the spectra.

- European metrology project (EURAMET, EMPIR programme) MetroMMC 17FUN02, 2018-2021. Partners are from France, Germany, Netherlands, Poland and Switzerland.

  Summary. The main objective of the MetroMMC project is to improve the knowledge of electron capture decay and subsequent atomic relaxation processes. New theoretical calculation techniques and extensive experiments using MMCs will be developed to determine important decay data which are relevant for primary activity standardisations in radionuclide metrology, in cancer therapy on the DNA level, and when studying the early history of the solar system. The experimental parts will be complemented with a new approach based on microwave coupled resonators.

Recent and future meetings

- A WG meeting took place at NPL together with a Nuclear Decay Data Working Group meeting (September 21, 2016) and a DDEP meeting (September 19-20, 2016).
- A WG meeting took place in Buenos Aires during the last ICRM conference (May 15-19, 2017).
- The next WG meeting will take place at the NIST Institute (September 10-14, 2018) alongside a DDEP workshop and two other ICRM WG meetings (Nuclear Decay Data and Radionuclide Metrology Techniques).

On behalf of the Beta-Particle Spectrometry Working Group,

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