

# Beta Spectrometry Working Group *Report*

- Meeting at NPL in September 2016 together with the DDEP meeting and the Nuclear Decay Data ICRM Working Group.
  - Frédéric Juget (University Hospital of Lausanne, IRA, Switzerland) presented the current status of his beta spectrometer. Developments are ongoing in order to improve the accuracy of the measured beta spectra.
  - Presentation of Alejandro Sonzogni (NNDC, Brookhaven National Laboratory, USA) during the DDEP meeting. Discussions about the difficulties of analyzing published shape factors.
- Meeting at Buenos Aires during the ICRM 2017 conference.
  - As coordinator, Mark A. Kellett presented the MetroBeta project.
  - Interesting discussions on theory with J.C. Hardy (Texas A&M) and Y. Nadjadi (IRA).
- Next meeting will take place at NIST in 2018 together with the DDEP meeting and the Nuclear Decay Data ICRM Working Group.

<http://www.nucleide.org/BSWG.htm>

### International Committee for Radionuclide Metrology (I.C.R.M.) Beta Particle Spectrometry Working Group

The Beta Particle Spectrometry Working Group is devoted to the development of the metrological aspects of beta spectrometry and its applications. This includes, but is not restricted to:

- Theory
  - Beta ( $\beta^\pm$ ) and electron capture ( $\epsilon$ ) 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: Geant4, Penelope, etc.
- Evaluations and dissemination
  - Confidence and uncertainties on experimental shape factors
  - Evaluation procedure for establishing recommended experimental shape factors
  - Mean energies, log  $ft$  values, database

Interested communities in radionuclide metrology are: nuclear decay data, liquid scintillation counting, ionizing chambers, 4 $\pi$   $\beta$ - $\gamma$  counting.

Any experimental shape factor found in the literature can be sent to the coordinator who will keep up-to-date a dedicated database.

Any other suggested topic is welcome. If you want to participate to this working group, please E-mail your contribution to the coordinator: [xavier.mougeot@cea.fr](mailto:xavier.mougeot@cea.fr)

### Projects

EMPIR Project MetroBeta "Radionuclide beta spectra metrology" (2016 - 2019)

This project proposes both theoretical and experimental approaches to improve the knowledge of beta spectra. On the theoretical side, the existing knowledge of the calculation of nuclear wave functions will be used to account for the nuclear structure effect on these spectra. On the experimental side, the development of beta spectrometry with metallic magnetic calorimeters, a class of cryogenic detectors operating at very low temperature, and solid scintillators containing the beta emitters in the structure of the scintillator crystal are addressed. These detectors have the potential to measure the shapes of beta spectra with unprecedented precision and, in particular in the case of metallic magnetic calorimeters, low systematic errors. Comparison of the newly calculated and measured spectra, as well as the application of several complementary detection techniques, will validate the quality of the spectra.

Coordinator: Mark A. Kellett ([mark.kellett@cea.fr](mailto:mark.kellett@cea.fr))

Website: <http://metrobeta-empir.eu/>

### Meetings

MetroMRT Workshop - Paris, France, 21st-22nd May 2014 Website: <https://projects.npl.co.uk/metro/>

- ✓ Summary of interest
- ✓ Related projects and meetings
- ✓ Software
- ✓ Working Group reports
- ✓ Scientific publications

Update on [http://physics.nist.gov/ICRM/working\\_groups.html](http://physics.nist.gov/ICRM/working_groups.html)

## Beta ( $\beta^\pm$ ) transitions

First release of the BetaShape program. Improved calculations of  $\beta$  emission properties (mean energies,  $\log ft$  values) compared to the LogFT program. Beta and neutrino spectra are provided. A database of experimental shape factors is included.

→ **Officially adopted by DDEP for future evaluations**

## Electron capture ( $\varepsilon$ ) transitions

Not included in BetaShape yet. Improved calculations were presented at ICRM 2017. Implementation in BetaShape is expected by the end of the year.

## Influence of the nuclear current

The calculation of the nuclear matrix elements involved in  $\beta$  decays is being studied in the context of the EMPIR MetroBeta project.

- Collaboration with nuclear theorists in Strasbourg.
- Should allow the calculation of  $\beta$  and  $\varepsilon$  transitions of any nature.

The EMPIR MetroBeta project has been written, defended and is now funded (2016-2019). It is a good example of close collaboration between 3 NMIs (CMI, LNHB, PTB) on beta spectrometry.

## Scheduled

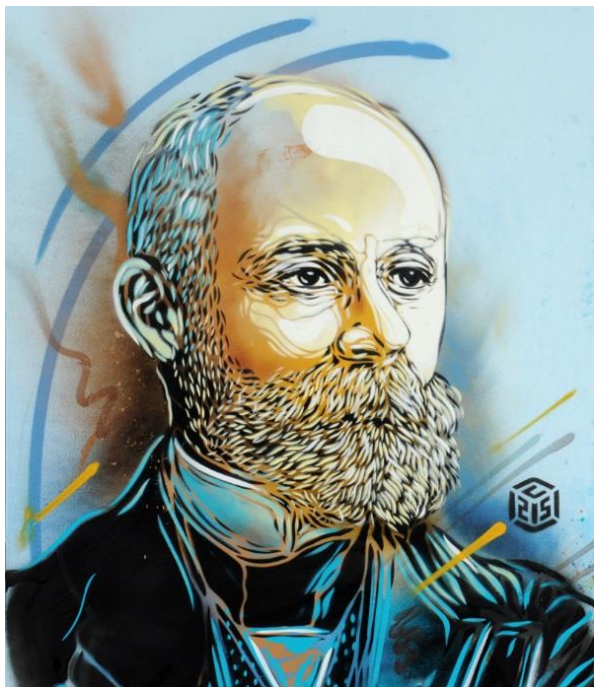
- PTB Braunschweig is developing a beta spectrometry system based on metallic magnetic calorimetry (MMC).
- CMI is developing a device for beta spectrometry based on silicon detectors. A new detection system will also be developed by a PhD student (2017-2020) at LNHB.
- Measurements will be done at PTB and LNHB with MMCs:  $^{14}\text{C}$ ,  $^{36}\text{Cl}$ ,  $^{99}\text{Tc}$ ,  $^{151}\text{Sm}$ .
- A decay module for Penelope was developed (PenNuc) by E. García-Toraño. A similar Geant4 module exists but is known to be deficient. C. Thiam and a Master student are implementing a new one at LNHB using DDEP data.

- A database of published experimental shape factors, as comprehensive as possible, is recommended. This database can be held at the Working Group website. Measurements of single transition as well as cumulative beta spectra following a decay should be considered.
- The needs of the metrological community and of the medical care sector for dosimetry calculations were mentioned. The simplest solution is recommended: ASCII files of beta spectra should be associated with each DDEP evaluation and made available online on the DDEP website.





# Thank you for being involved!



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