

# Photon emission intensities in the decay of U-235

Wednesday, 28 September 2016 10:01 (0:01)

## Content

Uranium-235 is the parent of one of the natural radioactive decay series and appears in the background of any spectrometer and is also classed as a NORM (Naturally Occurring Radioactive Material). Recommended photon emissions probabilities of  $^{235}\text{U}$  are based on the intensity of the 185.7-keV gamma-ray which is used to normalize relative measurements. In the evaluation performed in 2008 [1], only six independent measurements of the absolute emission intensity of the 185.7-keV gamma-ray were available, leading to the recommended value of 57.1 (3) %. In the frame of the European Metrology Research Project (EMRP) IND57 "MetroNORM" (Metrology for processing materials with high natural radioactivity), new measurements of the photon emission intensities in the decay of U-235 were conducted in order to improve the knowledge of the decay scheme. This is first based on the measurement of the reference 185.7-keV gamma-ray which overlaps with the 186.2 keV gamma-ray from  $^{226}\text{Ra}$  decay. Sources were prepared by EC-JRC IRMM, by deposition of a U-235 solution on glass plates. Standardization was carried out by alpha counting in a defined solid angle geometry. The reference activity was obtained with 0.7% relative combined uncertainty. Gamma spectrometry was performed using two high-purity germanium (HPGe) detectors: one for the low-energy range, and one for the high one, at different source-to-detector distances. Accurate efficiency calibration of the spectrometers was obtained with point sources, and the resulting relative combined uncertainty varies from 0.5–2%, depending on the energy range. Corrections for source geometry and coincidence summing effects were applied. The reference peak intensity was obtained with 1% relative combined uncertainty. The processing of the X-ray region included K and L lines: accurate deconvolution of the respective regions of interest was performed using COLEGRAM [2] to derive individual intensities, taking into account the natural line width of the X-rays. On the whole, about 60 gamma-rays in the decay scheme of U-235 and daughters were identified and quantified. These are presented and compared with the available recommended data.

[1] Bé, M.-M., Chisté, V., Dulieu, C., Mougeot, X., Browne, E., Chechev, V., Kuzmenko, N., Kondev, F. G., Luca, A., Galan, M., Arinc, A., Huang, X., Nichols, A., Table of Radionuclides, Monographie BIPM-5, vol.5, ISBN 13 978-92-822-2234- (Vol. 5) and 13 978-92-822-2235-5 (CD-Rom), CEA/LNE-LNHB, 91191 Gif-sur-Yvette, France and BIPM, Pavillon de Breteuil, 92312 Sèvres, France. /<http://www.nucleide.org> [2] Ruellan H., Lépy, M.-C., Etcheverry, M., Plagnard, J., Morel, J. (1996) A new spectra processing code applied to the analysis of  $^{235}\text{U}$  and  $^{238}\text{U}$  in the 60 to 200 keV energy range, Nuclear Instruments and methods in Physics Research A 369, 651-656.

## About the Presenter

Current position: Research director at CEA (French Alternative Energies and Atomic Energy Commission)- In charge of gamma- and X-ray spectrometry in the Laboratoire National Henri Becquerel (laboratory of the French metrology institute)

**Primary author(s) :** Dr. LEPY, Marie-Christine (CEA/LNHB)

**Co-author(s) :** Dr. PIERRE, Sylvie (CEA/LNHB)

**Presenter(s) :** Dr. LEPY, Marie-Christine (CEA/LNHB)

**Session Classification :** Radiometrics

**Track Classification :** Radiometrics