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^{233}U fission yields measurements in the heavy mass region

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Nuclear energy production can rely on the availability of two fuel cycles in nature : Uranium-Plutonium (U-Pu) and Thorium-^{233}U (Th-U). Nowadays, the nuclear industry is only based on the U-Pu fuel cycle. The inventory of nuclear waste is composed of the ultimate waste as fission products and minor actinides. The Th-U fuel cycle presents the characteristics to produce less minor actinides than the present U-Pu one, but the radiotoxicity of the Th-U cycle spent fuel is greater than U-Pu during the first 50 years [1].

Over the last ten years, a vast campaign of measurements has been initiated to bring the precision of data for neutron induced reactions of the key nuclei (^{232}Th, ^{233}Pa and ^{233}U) to the level of those of the U-Pu cycle. In complement with reaction cross section data, new measurements of the fission yields are needed for burn-up reactor calculations.

For innovative U/Th reactors, nuclear charge and mass distributions of the fission products are strongly needed for two reasons:

- The first one concerns the nature of fission products. Some products called neutron poisons have a large neutron capture cross section. These fission products limit the breeder character of the new system. Because of the smaller fraction of delayed neutron emission (6.64 10^{-3} for ^{233}U(n_{th},f) versus 1.65 10^{-2} for ^{235}U(n_{th},f) [2]), the determination of neutron poison yields is essential for innovative nuclear reactor fuel studies. The main poisons are ^{135}Xe and various lanthanide isotopes (^{149}Sm, ^{151}Sm, etc.) [3,4].

- The second point concerns the spent fuel residual heat and radiotoxicity. Charge and mass distributions are needed to compute the residual power of the reactor after shutdown, for the fuel cycle management and the characteristics of long-term nuclear waste repositories (eg :^{137}Cs, ^{90}Sr).

New measurements of charge and mass distributions of the fission products have been achieved at the Lohengrin spectrometer of the Institute Laue-Langevin (ILL) during fall 2010 to complete the experimental data of ^{233}U(n,f) that exist mainly for light fission fragments. That is why we performed measurements of mass and isotopic yields with a special focus on the heavy fission fragment part. Mass yields were measured by ion counting with an ionization chamber after separation by the Lohengrin spectrometer. Isotopic yields were derived from gamma spectrometry of mass-separated beams using the ILL clover Ge detectors. We will present the results of these fission yield measurements along with details on the experimental set-up and the chosen analysis method.

Références

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Je souhaite concourir au prix « présentation orale » et je déclare être un chercheur non-permanent ayant soutenu la thèse après le 31 Juillet 2009.