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High precision 209Bi(n,γ) cross section measurement at n_TOF EAR2.

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The development of innovative future nuclear reactors and the enhancement of operational safety rely heavily on the precision of nuclear data, particularly in minimizing the uncertainties associated with microscopic neutron-induced cross sections. MYRRHA is an experimental Accelerator Driven System that uses a lead-bismuth mixture as a coolant system. The radiological burden associated with the use of this type of coolant for fast nuclear systems is mainly due to the production of 210Po from 209Bi(n,γ) reactions. There are significant discrepancies in the existing evaluations of 209Bi(n,γ) reactions, particularly concerning the feeding into the metastable state. Therefore, accurate prediction of the 210Po inventory in lead-bismuth cooled nuclear systems requires precise knowledge of both reaction channels and their branching ratios.

From an astrophysical perspective, this reaction also plays a crucial role in the s-process and for U/Th cosmic clocks.

The most recent 209Bi(n,γ) Time-of-Flight (ToF) measurement was performed at the CERN n_TOF EAR1 facility by C. Domingo and colleagues in 2006, using the state-of-the-art low neutron sensitivity C6D6 detectors. However, the target accuracy could not be reached due to a significant in-beam γ-ray background and insufficient luminosity of EAR1. This limitation has been significantly improved with the renewed high luminosity EAR2. Recently, in combination with the high sensitivity sTED array detection setup, EAR2 has demonstrated its potential for challenging (n,γ) such as 94Nb and 79Se cross section measurements in a broad neutron energy range.

The current 209Bi(n,γ) experiment at n_TOF EAR2 aims to achieve an accuracy of 5-10% in the Resolved Resonance Region, covering neutron energies from thermal levels up to 35 keV, and an accuracy of less than 15% in the neutron energy range from 35 to 100 keV. At the time of the conference, a comprehensive overview of the ongoing experiment at the CERN n_TOF facility will be presented, along with the initial experimental results from the current measurement campaign.

Abstract

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