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Final results of the ^{239}Pu neutron capture and fission cross-section measurements at n_TOF

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Improving the accuracy of the neutron capture and fission cross sections of ^{239}Pu is listed as a High Priority Request by the Nuclear Energy Agency (NEA/OECD), due to their central importance for nuclear applications and reactor technology. To address this, a dedicated experimental campaign was carried out at n_TOF, the CERN time-of-flight facility, where ^{239}Pu was measured for the first time. The experiment employed ten high-purity ^{239}Pu samples (total mass less than 10 mg) produced at JRC-Geel and SCK CEN and placed in a custom ionization chamber capable of operating under the high α-decay background of ^{239}Pu. The fission tagging technique, based on the use of fission fragment detectors in coincidence with the n_TOF Total Absorption Calorimeter, enabled a precise determination of the capture cross section by suppressing the dominant fission background. Additionally, a 100 mg ^{239}Pu sample was used to extend the capture measurement up to 10 keV.

This contribution to the XVII CPAN Days will present the final results of the campaign. The complete data analysis, including the procurement of the resonance parameters using the SAMMY code, provides high-precision cross sections for both capture and fission reactions. Particular emphasis will be placed on the ^{239}Pu(n,γ) results, presented here for the first time, including detailed resonance analysis and a direct comparison with evaluated nuclear data libraries and previous experimental datasets. The outcomes confirm the reliability of the n_TOF measurements and provide improved constraints for nuclear data evaluations, contributing directly to the NEA High Priority Request List.

Abstract

Improving the accuracy of the neutron capture and fission cross sections of 239Pu is listed as a High Priority Request by the Nuclear Energy Agency (NEA/OECD), due to their central importance for nuclear applications and reactor technology. To address this, a dedicated experimental campaign was carried out at n_TOF, the CERN time-of-flight facility, where 239Pu was measured for the first time. The experiment employed ten high-purity 239Pu samples (total mass less than 10 mg) produced at JRC-Geel and SCK CEN and placed in a custom ionization chamber capable of operating under the high α-decay background of 239Pu. The fission tagging technique, based on the use of fission fragment detectors in coincidence with the n_TOF Total Absorption Calorimeter, enabled a precise determination of the capture cross section by suppressing the dominant fission background. Additionally, a 100 mg 239Pu sample was used to extend the capture measurement up to 10 keV. This contribution to the XVII CPAN Days will present the final results of the campaign. The complete data analysis, including the procurement of the resonance parameters using the SAMMY code, provides high-precision cross sections for both capture and fission reactions. Particular emphasis will be placed on the 239Pu(n,γ) results, presented here for the first time, including detailed resonance analysis and a direct comparison with evaluated nuclear data libraries and previous experimental datasets. The outcomes confirm the reliability of the n_TOF measurements and provide improved constraints for nuclear data evaluations, contributing directly to the NEA High Priority Request List.

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