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Cross-section measurement of ^{146}Nd(n,γ) at CERN n_TOF and CNA HiSPANoS

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Accurate neutron-capture cross sections are essential for modelling the slow neutron capture process, which governs the synthesis of roughly half of the elements heavier than 56Fe and determines their isotopic ratios. In particular, the case of 146Nd is of astrophysical interest due to the lack of capture data in the resolved resonance region below 5 keV (RRR) \1, the persistent disagreement between experimental measurements in the unresolved resonance region above 5 keV (URR) [2,3], and discrepancies between reference data and isotopic ratios inferred from presolar stardust grains [4,5,6].

To address these challenges, a multi-facility campaign has been undertaken combining neutron time-of-flight (TOF) and activation techniques. At CERN's n_TOF facility, high-resolution TOF measurements have been performed in the EAR2 station \[7] to study the RRR up to 5 keV \[8], while activation experiments are pursued both at the new CERN's NEAR station [9, 10] and at CNA's HiSPANoS neutron source in Seville \[11]. HiSPANoS is a well-characterised facility uniquely suited to provide a quasi-stellar neutron spectrum at kT=25 keV via the 7Li(p,n) reaction \[12], enabling a direct and complementary determination of Maxwellian-Averaged Cross Section (MACS) at the stellar temperature of reference for the main s-process nucleosynthesis.

This contribution will present the current status of the data analysis from the CNA HiSPANoS campaign, with first results on the 146Nd(n,γ) activation leading to 147Nd (T1/2 ≈ 11 d). These data provide an essential benchmark for the URR, where previous measurements are inconsistent, and are key to resolving the discrepancies between experimental nuclear data and astrophysical observations.

By combining international large-scale infrastructures such as CERN n_TOF with national facilities like CNA, this work highlights the strategic role of HiSPANoS in complementing global efforts to produce high-precision nuclear data for astrophysics.

(1) H. Tellier, CEA-N-1459 (1971)
(2) Z.Y. Bao et al., Atomic Data Nucl. Data Tables 76, 70 (2000)
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(8) J. Lerendegui-Marco et al., INTC-P-671 (2023)
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(11) M.A. Millán-Callado et al., Radiation Physics and Chemistry 217 (2024)
(12) P. Pérez-Maroto, C. Guerrero, B. Fernández, A. Casanovas-Hoste, M.E. Stamati, Physics Letters B 862, 139360 (2025)

Abstract

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