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First full β-strength measurement with DTAS across N=126 at FAIR PHASE-0

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(On behalf of S505-DESPEC experiment collaboration)

Our understanding of the production of the heavy elements in the Universe is still incomplete. In particular the contribution of the rapid neutron capture (r-) process to the observed stellar abundances around mass number A~195 (the 3rd r-process peak), which is linked to the effect of N=126 shell closure in the production path. Given the lack of nuclear data, astrophysical abundance calculations must rely on theoretical predictions, for the important parameters T1/ 2 (half-life) and Pn (neutron emission probability). Both parameters are extracted from theoretical beta-strength distributions, which depend on nuclear structure. However, large discrepancies exist among different theoretical models [Mor14,Cab16]. Our aim is to discern between models by comparing with measured beta-strengths. For this we will use Total Absorption Gamma-ray Spectroscopy (TAGS) which is the most effective method for obtaining beta-strength distributions across the entire decay energy window [Rub05].

With this purpose, an experiment was performed at the GSI/FAIR facility in June 2022. During the experiment, the decay of Au and Pt isotopes with N=125-27 were measured. These isotopes were produced by high-energy nuclear reactions using a beam of Pb on a Be target and selected and identified using the FRagment Separator (FRS) [Win08]. Ion implants and decay electrons were measured with the Advanced Implantation and Decay Array (AIDA) [Hal23], while isomeric and β-delayed γ-ray cascades were measured with the Decay Total Absorption Spectrometer (DTAS) [Gua18], both developed within the NUSTAR/DESPEC collaboration.

We succeeded in performing clean implanted-ion identification, minimizing the contamination of ionic charge states and reactions in the FRS. We obtained for each isotope beta-gated TAGS decay spectra by combining the information from the three systems. We did a preliminary analysis of half-life and beta intensity distribution. We will discuss the status of the analysis and the work remaining.

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Abstract

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