β-delayed one and two neutron emission probabilities south-east of ^{132}Sn and the odd-even distribution of the r-process abundances†

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The nucleosynthesis of elements around the second r-process abundance peak has attracted considerable interest recently, with metal-poor star observations of elemental and isotopic abundances[1,2] providing important clues on the sensitivity of the peak to the r-process environments. To connect such observations to the astrophysical models and ultimately derive the r-process conditions, knowledge of the nuclear properties of the second r-process peak radioactive progenitors is essential.

After r-process freezeout, final r-process abundances of the second peak originate from a network of competing reactions including the neutron capture, photodisintegration, fission contribution and β-delayed neutron emission. The latter has been the main focus of our experiment carried out within the BRIKEN project[3] at RIBF, where β-delayed one and two neutron emission probabilities (P_{1n} and P_{2n}) of neutron-rich nuclei south-east of ^{132}Sn have been measured. The systematic of the measured P_{1n} and P_{2n} values, shown in Fig. 1, highlighted the nuclear shell effects around doubly-magic ^{132}Sn. Our results also provided important benchmarks for the recent macroscopic-microscopic and self-consistent global model, including the statistical treatment of neutron and γ emission.[4,5] Direct impacts of the measured P_{1n} and P_{2n} on the odd-even staggering of the final r-process abundance around the second r-process peak were demonstrated. The observed odd-mass isotopic fractions of Ba in metal-poor stars[2] were found to be better reproduced by using our data.

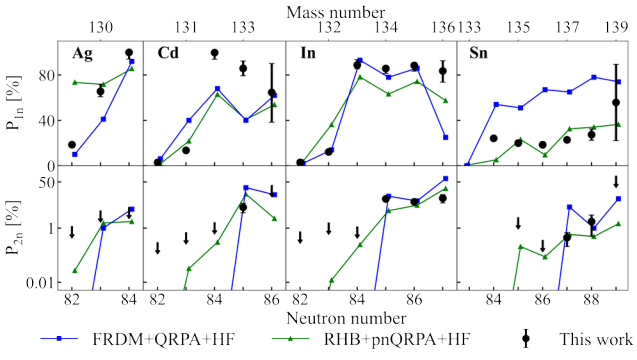

Fig. 1. Systematics of measured P_{1n} (top panels) and P_{2n} compared with theoretical calculations.[4,5]

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