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Medium spin states in the ^{87}Se isotope produced in neutron induced fission of ^{233}U and ^{235}U targets

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The area of the nuclear chart lying northeast of the doubly magic nucleus ^{78}Ni represents a key benchmark for shell-model-based theoretical descriptions. Although closed-shell nuclei in this region have been extensively investigated for decades, the double-magic character of ^{78}Ni was only recently confirmed experimentally by Taniuchi et al. [1]. Their results also revealed a weakening of the $N = 50$ and $Z = 28$ shell closures beyond ^{78}Ni , driven by the appearance of deformed configurations, in agreement with modern large-scale shell-model calculations [2]. These observations underscore the importance of further experimental studies in the vicinity of ^{78}Ni .

In this context, the selenium isotopic chain, located six protons away from the closed shell, displays clear signatures of shape coexistence. In particular, the tentative identification of a 3^{+} state in ^{86}Se [3] points to the emergence of collectivity. The present work investigates neutron-rich selenium isotopes northeast of ^{78}Ni , with special emphasis on ^{87}Se , for which spectroscopic information has so far been very limited, with only three known gamma-ray transitions [4].

The $^{86,87,88}\text{Se}$ isotopes were populated through thermal-neutron-induced fission of ^{233}U and ^{235}U targets at the Institut Laue-Langevin. In ^{87}Se a level scheme extending up to 3.5 MeV in excitation energy was constructed from high-fold gamma-ray coincidence data recorded with the high-efficiency HPGe array FIPPS [5]. Using cross-coincidence analysis, seven previously unobserved gamma-ray transitions were identified and their relative intensities determined. Spin assignments for low-lying states were inferred from gamma-ray angular-correlation measurements. The observation of an E3 transition connecting the $(11/2^{-})$ and $(5/2^{+})$ states suggests enhanced octupole correlations and motivates systematic searches for similar E3 excitations in neighboring even-mass selenium isotopes.

In addition, our analysis, validated the presence of an emerging collective band in ^{86}Se , until now observed only in β -decay [3] and confirmed 589-keV gamma ray as deexciting the first 2^{+} state in ^{88}Se . These findings and validations in $^{86,88}\text{Se}$ isotopes contribute to more vivid picture of evolution of a collectivity along even-even Se isotopic chain.

References:

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Type of contribution

Regular Abstract

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