Decay Spectroscopy at the Radioactive Isotope Beam Factory (RIBF) at RIKEN

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Question on the robustness of N = 82 shell closure and seniority conservation of g9/2 shell in south 132Sn region

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Over the past few decades, research have revealed that some nuclear magic numbers can shift or disappear in regions where significant imbalance between the number of protons and neutrons exist. It remains an open question whether such a change can occur for N = 82 in south 132Sn region. If the shell gap is reduced, it becomes easier for particles to be excited across the shell. which drives the nuclear system toward a more collective behavior. As a result, excitation energies and transition probabilities may deviate from what is expected based on the seniority scheme. Whether seniority is conserved in the ⊠ g9/2 shell for the N = 82 isotones is another open question worth investigation. So far, 8+ isomeric states have been identified in 130Cd (A. Jungclaus et al., PRL 99, 132501 (2007)) and 128Pd (H. Watanabe et al., PRL 111, 152501 (2013)). The identification of those seniority isomers has revealed the robustness of the N = 82 shell closure for Z = 48 and Z = 46. Still the question arises how the g9/2 shell evolves for larger proton to neutron unbalance and, in general if seniority is conserved. Partial conservation of seniority for the g9/2 shell has been suggested for Z = 82 and N = 50 shell closures (J. Valiente Dobon et al., PLB 816 136183 (2021), B. Das et al., Phys. Rev. Research 6 L022038 (2024)) and linked to the phase of Berry. To find out if far below 132Sn an erosion of N = 82 shell closure takes place, and whether the partial conservation remains, we need to study lighter isotones. With the recent upgrades of beam intensities at RIKEN, and the higher performances of the planned new gamma detector array, those systems are becoming accessible to nuclear structure studies. We propose therefore to focus our research on nuclei in the south 132Sn region, such as 126Ru, 124Mo, 129Ag, 127Rh, 124Ru, 130Pd, and 132Cd etc. Spectroscopic studies of these nuclei could provide a deep understanding of the complicated many-body fermionic system in a very exotic nuclear region.

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