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Investigation of Nuclear Structure Near N = 126

The study of excited nuclear states near shell closures serves as a vital framework for advancing our understanding of nuclear structure. While neutron-rich nuclei around magic numbers far from the line of stability, such as N = 82, have been extensively explored using conventional production methods like fission and fragmentation, the region near the doubly magic nucleus 208Pb along the N=126 shell closure remains less explored. Most studies have focused on nuclei above 208Pb, while experimental data for neutron-rich nuclei south of 208Pb are limited and presently are restricted to decay studies [1]. This has resulted in a "blank spot" in the nuclear chart, where some of the basic properties, such as first-excited states, remain largely unknown for nuclei far from stability.

Recent advancements in multi-nucleon transfer reactions between heavy nuclei, such as those involving the 136Xe beam, have successfully accessed some of these unexplored regions [2, 3]. In the present work, to investigate the nuclear structure near N=126, a multi-nucleon transfer experiment was performed using a 198Pt target bombarded by a 136Xe beam at 7 MeV/nucleon. The decaying gamma rays were detected using the state-of-the-art AGATA and EXOGAM arrays, while particle identification was carried out with the VAMOS++ spectrometer at the GANIL facility [4].

The goal of this experiment was to measure the excited states of neutron-rich nuclei near the N=126 shell closure and to gain insight into their shell structure. For instance, in the Os and Re isotopes beyond the deformed neutron subshell gap, variations in deformation with neutron number affect the single-particle structure, leading to the emergence of multi-quasiparticle isomers along the yrast lines of axially symmetric, well-deformed nuclei [5]. These nuclei exhibit deviations from axial symmetry and the interactions between the multi-quasiparticles with increasing neutron number drive structural transitions from prolate to triaxial and ultimately to oblate shapes [6]. Prior to this study, little experimental data existed on the high-spin structure above the isomeric states in isotopes with A>186. This work explores the high-spin structure of some of these isotopic chains, measures the lifetimes of isomers, and examines the evolution of deformation as a function of neutron numbers. It can provide insights into the nuclear structure of the N=126 region, filling gaps in experimental knowledge and improving our understanding of this under-explored area.

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