Studies of the $N = 60$ shape transition; states in ^{98}Zr and ^{98}Sr populated via β-decay

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The evolution of ground-state shapes usually proceeds smoothly, however for Sr and Zr nuclei at $N = 60$ there is an abrupt shape transition. The dramatic onset of deformation in ^{100}Zr was recently well reproduced in state-of-the-art Monte Carlo Shell Model calculations [1,2], which also predict that the same deformed configuration may coexist at higher excitation energies in the lighter Zr isotopes. The $N = 58$ nucleus ^{98}Zr is of particular interest in this regard as it is a transitional nucleus which lies on the interface between both spherical and deformed phases for the ground state. Thus, a number of experimental and theoretical studies have been made in an attempt to elucidate the shape coexistence phenomena in ^{98}Zr [3,4,5,6]. They demonstrate differing degrees of success in the description of the ^{98}Zr nuclear structure, and the interpretation of the higher-lying shape coexisting bands is still uncertain. In particular, several discrepancies between theoretically calculated and experimentally deduced reduced transition probabilities were noted, highlighting the need for further investigations. Based on the above, a β-decay experiment was performed at the TRIUMF-ISAC facility. Beams of ^{98}Rb and ^{98}Sr were deposited onto a tape at the center of the 8π spectrometer with a beam deposition and tape movement cycles optimized fo the decay of ^{98}Y to ^{98}Zr. The high-quality and high-statistics of the data obtained with this setup allowed for the determination of branching ratios for very weak transitions important for assigning band structures. In particular, the key 155-keV $2_2^+ \rightarrow 0_3^+$ transition was observed, and its branching ratio measured, permitting the $B(E2)$ value to be determined. Additionally, γ-γ angular correlation measurements enabled the determination of both spin assignments and mixing ratios. As a result, firm spin assignments have been made for additional excited 0^+ and 2^+ states. The new results revealed the collective character of certain key transitions, supporting the multiple shape coexistence interpretation provided by the MCSM framework.

The γ-ray decays from levels in the $N = 60$ nucleus ^{98}Sr, populated by the decay of ^{98}Rb, was also observed with high intensity, enabling us to significantly expand the known decay scheme. From γ-γ angular correlations, the 0_3^+ state was firmly established, and candidates for the 2^+ and 4^+ band members assigned.

The observed structures in ^{98}Zr and ^{98}Sr will be discussed as they relate to the multiple shape coexistence scenario.

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