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Beta-decay study of the shape coexistence in 98Zr

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Anomalies in the systematics of nuclear properties challenge our understanding of the underlying nuclear structure. One such anomaly emerges in the Zr isotopic chain as a dramatic ground- state shape change, abruptly shifting from spherical into a deformed one at N=60. Only a few state-of-the-art theoretical models have successfully reproduced this deformation onset in 100Zr and helped to establish the shape coexistence in lighter Zr isotopes [1, 2]. Of particular interest is 98Zr, a transitional nucleus lying on the interface between spherical and deformed phases. Exten- sive experimental and theoretical research efforts have been made to study the shape coexistence phenomena in this isotope [3,4,5]. Although they provide an over-all understanding of 98Zr's nu- clear structure, uncertainties remain in interpreting its higher-lying bands. Specifically, two recent studies utilizing Monte Carlo Shell Model (MCSM) [6] and Interacting Boson Model with configuration mixing (IBM-CM) [7] calculations have presented conflicting interpretations. The MCSM predicts multiple shape coexistence with deformed band structures, whereas the IBM-CM favours a multiphonon-like structures with configuration mixing.

To address these uncertainties, a β-decay experiment was conducted at TRIUMF-ISAC facility utilizing the 8π spectrometer with β-particle detectors. The high-quality and high-statistics data obtained enabled the determination of branching ratios for weak transitions, which are crucial for assigning band structures. In particular, the key 155-keV 2+2 ⟶ 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, the 0+, 2+, and I = 1 natures for multiple newly observed and previously known (but not firmly assigned) states have been established. The new results revealed the collective character of certain key transitions, supporting the multiple shape coexistence interpretation provided by the MCSM framework. These results will be presented and discussed in relation to both MCSM and IBM-CM calculations.

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