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Studies of Shape Coexistence in the Sr-Ru isotopes

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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, and very low-lying 0+2 states are observed [1,2]. The dramatic onset of deformation in 100Zr was recently well reproduced in state-of-the-art Monte Carlo Shell Model calculations [3,4], which also predict that the same deformed configuration may coexist at higher excitation energies in the lighter Zr isotopes. In the Mo isotopes, shape coexistence has been firmly established in 96,98,100Mo through detailed Coulomb excitation studies [5–7], and low-lying 0+2 states exist here as well, but the evolution of the ground state shape is smoother than for Zr and Sr. Proceeding to higher Z, the structure of states in the Ru isotopes evolves more smoothly than those of Mo. This change in evolution of the structures in this region, with drastically different shapes in the Sr and Zr isotopes that appear to generally mix weakly, vs. the Mo and Ru isotopes where they are more similar and appear to mix strongly, presents an ideal topic of study to understand the development of collectivity.
In an effort to elucidate the nature of excited states in the Sr−Ru isotopes near N = 60, we have performed an extensive series of measurements which include β decay, neutron capture, Coulomb excitation, and transfer reactions. As some examples of our results, from our β-decay studies populating the N = 60 nuclei 98Sr and 100Zr, we have identified the 0+3 bands and provided a measure of the collectivity in the 0+2 band of 100Zr. Combining β-decay and the (p,t) transfer reaction, the structures of excited states of 98Ru were reinterpreted into rotational bands [8]. Our study of the 99Ru(nth,γ) reaction leads to a dramatic revision of the collectivity of the 0+3 band, while the Coulomb excitation of 102Ru has established the collectivity of the 0+2 band for the first time [9].
These highlights will be outlined and placed into the context of the emerging systematics of collectivity in the region.

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