Multiple shape coexistence in ^{100}Zr

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The region of neutron-rich nuclei around $N = 60$ has attracted much interest throughout the years for its unique features, such as the dramatic onset of deformation appearing in Zr and Sr nuclei precisely at $N = 60$. The sudden inversion of weakly and strongly deformed configurations at $N = 60$ was first proposed by Federman and Pittel within the shell model, invoking the interplay between spin-orbit partners $\pi g_{9/2}$ and $\nu g_{7/2}$ [1]. A more recent interpretation was given in terms of the tensor and central forces operating concurrently in what is known as type-II shell evolution, with Monte-Carlo shell-model calculations being able to quantify the sudden change in deformation, predicting, at the same time, a variety of configurations characterized by different intrinsic shapes appearing at low energy in ^{100}Zr [2]. A large set of experimental spectroscopic data related to the shape transition in the Zr isotopes was also satisfactorily reproduced in the framework of configuration mixing within the interacting boson model (IBM-CM) [3], invoking an intertwined quantum phase transition.

Our recent high-statistics β-decay study performed at the TRIUMF-ISAC facility with the GRIFFIN HPGe spectrometer resulted in an extension of the level scheme of ^{100}Zr. Notably, firm spin assignments were obtained for several low-lying 0^+ states and a candidate for a spin-2 level built on the 0^+_4 state was proposed. Moreover, lifetimes of several key levels were measured via a fast-timing approach, some of them for the first time. While these results support a general picture emerging from the MCSM calculations, i.e. that of multiple structures with different shapes being present in ^{100}Zr, they also point, for the first time, to certain deficiencies in the calculations, as well as important similarities in the structure of $N = 60$ ^{100}Zr and ^{98}Sr [4] nuclei.

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