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# Investigating shape transition in neutron-rich Zr isotopes

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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 very sudden onset of deformation appearing in several isotopes, precisely at N = 60. Studies of this phenomenon are of great importance in our understanding of shape evolution and shape coexistence [1]. 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 $\nu g_{7/2}$ [2]. 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 [3]. 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) [4], invoking an intertwined quantum phase transition.

Experimentally, E0 transitions between low-lying $0^+$ states in even-even nuclei are a sensitive probe to shape coexistence and shape mixing, being directly related to the charge radius of the nucleus. On the other hand, certain conclusions can already be reached on the basis of level energies, as well as relative and absolute E2 transition strengths obtained via $\gamma$-ray spectroscopy following $\beta$-decay.

A new device for conversion electron spectroscopy, COeCO (COnversion electron Chasing at Orsay) [5], has recently been built at the ALTO ISOL facility in Orsay, France, and used in a $\beta$-decay experiment with $^{98}$Rb and $^{100}$Rb beams, revealing new insights into shape coexistence in Zr isotopes [6] and opening up new perspectives for conversion electron studies in neutron-rich nuclei at ALTO. A complementary $\beta$-decay study at the TRIUMF-ISAC facility with the GRIFFIN HPGe spectrometer and the PACES Si(Li) array resulted in an extension of the level scheme of $^{100}$Zr, including, notably, obtaining firm spin assignments for several low-lying $0^+$ states, and proposing a candidate for spin-2 level built on the $0^+_4$ state [7].

Selected results of these two measurements will be presented, which support a general picture emerging from the MCSM calculations, *i.e.* that of multiple structures with different shapes being present in $^{100}$Zr. However, 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 nuclei [8].

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