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Nuclear shape dynamics at different energy scales

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Abstract

We show that the complex shape deformations which govern the collective dynamics of atomic nuclei in the typical energy scale from several tens of keV to several mega electron volts may also appear of crucial importance in the manifestation of nuclear structure effects on the border of the atomic energy scale. We demonstrate within a model of collective quadrupole-octupole and single-particle motion that the same mechanism which governs the quasi parity-doublet structure of the spectra in odd-mass nuclei [1] can also be responsible for the formation of extremely low-energy excited states as the 7.8 eV isomer in ^{229}Th [2]. We show under various model conditions that the collective shape degrees of freedom and their fine interplay with the single-particle motion play a sustainable role both in the formation and the radiative decay of such a state. The study suggests that similar or other kinds of specific excitations may also exist in nuclei with the manifestation of complex-shape and single-particle dynamics.

References

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[2] N. Minkov and A. Pálffy, “Reduced Transition Probabilities for the Gamma-decay of the 7.8 eV Isomer in ^{229}Th”, Phys. Rev. Lett. **118**, 212501 (2017).