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β-decay half-life as an indicator of shape-phase transition in neutron-rich Zr isotopes

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β-decay half-life is sensitive to the shell structure near the Fermi levels. Nuclear deformation thus impacts the β-decay properties.
A first-order shape-phase transition in neutron-rich Zr isotopes is predicted by some models. We investigate the β-decay half-lives of neutron-rich nuclei around ^{110}Zr, where the shape-phase transition is predicted to occur, to see if the β-decay half-life can be an indicator of the shape changes.
To do that, the proton-neutron quasiparticle random-phase approximation (RPA) is adopted to calculate the Gamow-Teller transitions. In addition, we apply the quasiparticle phonon-vibrational coupling (PVC) to consider the phonon couplings. Then, we found that the spherical and oblate configurations give similar half-lives but shorter ones than the prolate configuration at the RPA level. The PVC effect further reduces the half-lives in general, but the effect is smaller for the deformed configuration than that for the spherical one. As a result, it makes the shape change from the oblate configuration to the spherical configuration visible. Therefore, a sudden shortening of β-decay half-lives is always found at the nuclear shape changes.

Reference:
K. Yoshida, Y. Niu, and F. Minato, Phys. Rev. C 108 (2023), 034305.

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