Hyperon Effects on Nuclear Structure within Skyrme-Hartree-Fock method

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Content

The deformed Skyrme-Hartree-Fock (SHF) approach, including its beyond-mean-field extension and localization function analysis, provides comprehensive insights into how the Λ hyperon influences deformation, excitations, and single-particle properties of hypernuclei. The inherent robustness of cluster structures dictates the stability of hypernuclei against enhanced hyperon-nucleon (YN) interactions. ^{20}Ne, characterized by a robust prolate $\alpha-{}^{12}C-\alpha$ cluster, maintains its deformation in $^{28}_{\Lambda}$Ne even with strengthened YN forces. Beyond-mean-field SHF calculations for the Ne isotopic chain ($^{20\text{-}34}$Ne) successfully predict low-lying spectra (J≤6) and E2 transition rates, confirming shape coexistence involving ground-state rotational bands and β vibrational bands in ^{20,22,24}Ne. Crucially, the Λ hyperon is found to fundamentally alter collective excitation modes. The Λ single-particle spectra exhibit remarkable spin symmetry across light to heavy hypernuclei, attributed to the intrinsically small Λ-nucleon spin-orbit force. This symmetry manifests as a consistent linear relationship between the reduced spin-orbit splitting ΔEs.o.. Notably, in light p-shell hypernuclei (e.g., Λ-hyperisotopes of carbon and N=6 hyperisotones, A ≤ 15), a novel phenomenon emerges: the interplay between deformation and weak binding can produce deformed halo structures in Λ 1p states, challenging the conventional association of halo solely with spherical shapes.

Reference

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