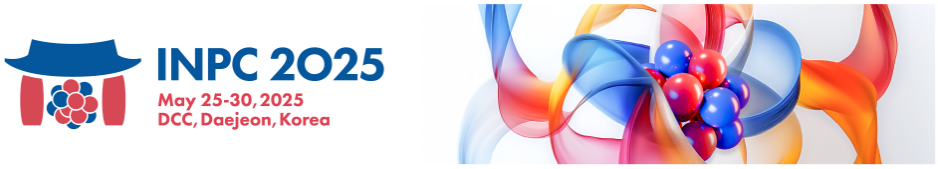

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Nuclear shell structure from ab initio perspectives

The shell structure and magic numbers are fundamental properties of atomic nuclei, which predict the existence of the island of stability for superheavy nuclei. On one hand, the occurrence of nuclear magic numbers can be theoretically explained by introducing a spin-orbit interaction between nucleons, leading to a breaking of the relevant spin symmetry. On the other hand, the observation of nearly degenerate pairs of orbitals in nucleon energy spectra, interpreted as pseudospin doublets, indicates the presence of pseudospin symmetry (PSS) in atomic nuclei. The origin of these symmetries has been extensively discussed at the mean-field level. In this work, based on the chiral two-nucleon-plus-three-nucleon interactions and the renormalization group, we investigate the behavior of nuclear spin and pseudospin symmetries–how they emerge or vanish naturally in the effective single-particle energy spectrum as the nuclear interaction evolves to a low-resolution scale.

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