Shape-coexistence study of even-even nuclei

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Abstract

In recent years, the development of radioactive nuclear beams (RNB) and state-of-the-art detector arrays has allowed the experimental studies of nuclei close to the proton and neutron drip lines. The new experimental data obtained from these experiments provide a challenge to theoretical models. These nuclei reveal many interesting phenomena on nuclear structure physics and provide testing ground for nuclear theoretical models, which should explain the systematics of various properties over long chain of isotopes.

Atomic nuclei exhibit a variety of shapes, varying from spherical to superdeformed quadrupole and higher-order multipole deformations. Nuclei between closed shells generally exhibit a deformation in their ground states. The possible shape that the nucleus may adopt results depends on the intrisic shell structure. There have been many attempts to use various theoretical methods, e.g, the shell model self-consistent mean-field models as well as the interacting boson model to determine the nuclear properties. The self-consistent mean-field calculations have used both purely phenomenological and more fundamental interaction for the two-body force and have examined a large class of different questions ranging from the exact charge density to quadrupole moments of deformed nuclei. Most of these mean-field approaches use the symmetry un-projected Hartree-Fock-Bogoliubov approach.

In the present work, we have developed a symmetry projected mean-field model based on the shell model interaction and as a first application of this new development we have evaluated potential energy surfaces for a range of N=Z nuclei from Z=10 to 36. The results obtained shall be discussed and interpreted in terms of occupation of the shell model states.