Projected mean-fields for isotope shifts

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The systematics of nuclear shapes and sizes in the neutron-rich region around A$\sim$100 is of long-standing interest due to several characteristic features that have been observed from optical measurements across isotopic chains. Experimental data on mean-square charge radii across the Zirconium isotopes show a sharp increase at N=60, creating a discontinuity in an otherwise steadily increasing charge radius as one approaches the neutron drip-line[1]. This is thought to be due to a shape change, which is characteristic of the features of nuclei in this region.

Theoretical predictions of the ground state deformation and charge radii for these nuclei vary in their ability to model the discontinuity. To explain these discrepancies it may be necessary to use beyond mean-field techniques such as angular momentum and particle number projection within the framework of mean-field models, since the discontinuity occurs in a region of softness with respect to shape fluctuations.

The systematics of nuclear charge radii are studied within the framework of axially-deformed Skyrme Hartree-Fock + BCS calculations[2]. In this prescription, the trial wavefunction used in the variational procedure is not an eigenstate of the particle number operator. Particle number projection after variation is performed with respect to the HF mean-field states following the Fomenko formalism[3]. Expressions for the projected values of the energy and radius are obtained, which will be applied to the A$\sim$100 region.

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