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Nucleon effective mass and the ground-state properties

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Theoretical and experimental investigations of neutron-rich nuclei represent one of the most fascinating and abundant sources of new information about nuclear structure. The varied properties of atomic nuclei impose significant requirements on theoretical approaches. One of the most effective microscopic methods for investigating ground-state properties is the Hartree-Fock (HF) approach, which utilizes a self-consistent mean-field based on the Skyrme energy density functional (EDF) [2]. The HF calculations with the Skyrme interactions provide a rather satisfactory description of the radii, binding energy, and single-particle (s.p.) energy of magic nuclei. However, the calculated density of the s.p. states near the Fermi level is less than what has been observed experimentally.

The s.p. states around the Fermi surface are known to be strongly affected by the dynamical particle-hole correlations [3], which modify the level density. These effects can be implemented in the Skyrme EDF by including the isoscalar correction term. The correction term enhances the nucleon effective mass and increases the density of states [3, 4]. However, such modification of the EDF leads to a decline in the accuracy of the binding energy description. In this work, we readjust the parameters of the Skyrme interaction and isoscalar correction term in order to reach more accurate description of binding energies and density of the s.p. states near the Fermi level [5]. As an illustration, we study impact of surface peaked effective mass on the ground-state properties of magic nuclei ^{16}O, ^{40,48}Ca, ^{56,78}Ni, ^{132}Sn и ^{208}Pb.

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