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Microscopic shell-model calculations with realistic effective interactions

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We present a short overview of the realistic shell-model, in which the effective Hamiltonian is derived microscopically from free nuclear potentials within many-body perturbation theory. In particular, we give a sketch of our theoretical approach, namely the $\hat{Q}$ box-plus-folded diagram method, to determine the one- and two-body matrix elements of the effective interaction and show how three-body contributions, which account for Pauli principle violations in nuclei with more than two valence particles, can be included. A procedure to derive effective decay or transition operators within the same framework as the Hamiltonian is also outlined. Some selected results are presented by discussing energy spectra as well as electromagnetic and beta decay properties. First, we focus on neutron-rich nuclei around ^{132}Sn, which have been investigated by using as input the CD-Bonn nucleon-nucleon potential renormalized by the $V_{\mathrm{low-k}}$ approach. Then, we report on a study of Ca and Ti isotopic chains north-east of ^{48}Ca. In this study, calculations are carried out starting from a chiral potential with two- and three-body forces, with the aim to investigated the effects of genuine and effective chiral three-body forces on the monopole component of the shell-model effective Hamiltonian.

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