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Properties of Isoscalar Giant Multipole Resonances in medium-heavy closed-shell nuclei: a semimicroscopic description

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The particle-hole (p-h) dispersive optical model (PHDOM) developed recently [1] is adopted and implemented for describing main properties of Isoscalar Giant Multipole Resonances (ISGMPR) up to L=3 in medium-heavy closed-shell nuclei. The overtones of monopole and quadrupole isoscalar giant multipole resonances are also studied. Being considered in a large excitation-energy interval, the main properties include the following energy-averaged quantities: the strength function related to an appropriate probing operator; the projected (i.e., related to the mentioned operator) one-body transition density; partial probabilities of direct one-nucleon decay. Unique abilities of PHDOM are conditioned by a joint description of the main relaxation modes of high-energy p-h configurations associated with a given giant resonance. Two modes (Landau damping and coupling of mentioned configurations to the single-particle continuum) are described microscopically in terms of Landau-Migdal p-h interaction and a phenomenological partially selfconsistent mean field. Another mode, coupling to manyquasiparticle states (the spreading effect), is described phenomenologically in terms of the imaginary part of the properly parameterized energy-averaged p-h self-energy term. The imaginary part determines the real one via a microscopically-based dispersive relationship. Using previous studies of the isoscalar giant monopole resonance in 208Pb [2, 3] as a base, we specify and markedly extend the above-outlined PHDOM description of mentioned giant resonances in closed-shell nuclei 40,48Ca, 90Zr, 132Sn, 208Pb. The model parameters related to a mean field and p-h interaction are taken from independent data accounting for the isospin symmetry and translation invariance of the model Hamiltonian. Parameters of the strength of self-energy term imaginary part are adjusted to reproduce in PHDOM-based calculations of ISGMPR total width (full width at half maximum (FWHM)) in each nucleus under consideration. The calculation results are compared with available experimental data. Some of results are compared with those obtained in microscopic Hartree-Fock calculations [4]. These comparisons confirm the statement that PHDOM is a powerful tool for describing ISGMPR in medium-heavy closed-shell nuclei. Extension of the model on taking nucleon pairing into account in open-shell spherical nuclei is in order.
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