Direct one-neutron decay of the isoscalar giant dipole resonance in medium-heavy spherical nuclei: A semi-microscopic approach description

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Direct one-nucleon decay of giant resonances (GRs) is the subject of permanent (but not-too-intensive) experimental and theoretical studies. They allow one to get information on GR structure and decay mechanisms. Decay probabilities are usually deduced from a common analysis of cross sections of direct inclusive and "decay" reactions. In Ref. [1], direct one-neutron decay of Isoscalar Giant Dipole Resonance (ISGDR) in ^{90}Zr, ^{116}Sn, and ^{208}Pb have been studied via the (α, α')- and $(\alpha, \alpha' n)$-reactions. To some extent, this study has been stimulated by predictions made in Ref. [2] for partial branching ratios b_μ of direct one-neutron ISGDR decay accompanied by population of neutron-hole states μ^{-1} in product nuclei. A simple extension of standard and nonstandard continuum-RPA versions to taking phenomenologically the spreading effect into account has been exploited in Ref. [2].

In the present work, we have employed the semi-microscopic Particle-Hole Dispersive Optical Model (PHDOM)-based approach (see, e.g., Ref. [3] and references therein) to estimate the branching ratios for direct one-nucleon decay of an arbitrary GR. Unique abilities of the PHDOM where conditioned by a joint description of the main relaxation processes of high-energy p-h configurations associated with a given giant resonance. Two processes, Landau damping and coupling the mentioned configurations to the single-particle continuum, were described microscopically in terms of Landau-Migdal p-h interaction and a phenomenological mean field, partially consistent with this interaction. Another mode, the coupling to many quasiparticle states (the spreading effect) was 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. We, have first, specified the approach of Ref. [2], employing for evaluation of b_μ values the semi-microscopic PHDOM, see Ref. [3], and, secondly, use the alternative definition for b_μ employed in Ref. [1]. These points allowed us to reduce markedly the difference between theoretical and experimental b values related to direct one-neutron decay of ISGDR in the above-mentioned nuclei. The experimental values $b = \sum_\mu b_\mu$ (the sum is taken over a few valence neutron-hole states) of Ref. [1] were found to be essentially less than the respective values obtained in the calculations.

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