On isoscalar dipole and second monopole giant resonances

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Previous theoretical studies of isoscalar monopole and dipole giant resonances in medium-heavy mass spherical nuclei [1,2] are extended to describe (i) partial and total direct-nucleon-decay branching ratios for the isoscalar giant dipole resonance (ISGDR) in a number of single- and double-closed-shell nuclei; (ii) main properties of the second isoscalar giant monopole resonance (ISGMR2) in the same nuclei. We are motivated by current experimental studies of direct nucleon decays of the ISGDR [3], and also by an interest to properties of highly-excited (and, therefore, strongly coupled to single-particle continuum) giant resonances, which are overtones of the respective low-energy GRs. As in Refs. [1,2], we use a continuum-RPA-based partially self-consistent approach. The spreading effect is phenomenologically taken into account by the replacement $\omega \to \omega + \frac{i}{2}I$ in the continuum-RPA equations (ω is the excitation energy, I is a proper smearing parameter). Model parameters used in calculations are taken the same, as in Ref. [2].

We evaluate the partial and total direct-nucleon-decay branching ratios for the ISGDR in ^{90}Zr, ^{116}Sn, ^{144}Sm, and ^{208}Pb. In some cases we use in calculations the experimental spectroscopic factors of the one-hole states populated after decay. We studied stability of the calculated branching ratios to variations of the smearing-parameter radial dependence under the condition that the total width of the resonance is kept fixed.

Following to Ref. [2], we undertake also a systematic study of the main properties (strength function, transition density, direct-nucleon-decay branching ratios) of the ISGMR2 in the above-listed nuclei. A rather large calculated direct-proton-decay branching ratios make it reasonable to search this resonance in $(\alpha, \alpha' p)$-type coincident experiments.

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[2] M.L. Gorelik and M.H. Urin, arXive: nucl-th/0209094;
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[3] U. Garg, M. Fuijiwara, and M.H. Harakeh, private communications.