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Fine structure of the isoscalar giant monopole resonance in spherical nuclei

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A comprehensive analysis of the isoscalar giant monopole resonance (ISGMR) has long been a subject of extensive theoretical and experimental studies [1,2]. The ISGMR properties are presently an important problem not only from the nuclear structure point of view [2,3] but also because of the special role they play in many astrophysical processes such as prompt supernova explosions [4] and the interiors of neutron stars [5]. The random phase approximation (RPA) with the Skyrme-type energy-density functional (EDF) is the most widely used theoretical model for describing the ISGMR [2,3]. The study of the monopole strength distribution in the region of giant resonance involves taking into account a coupling between the simple particle-hole excitations and more complicated configurations [3,6].

In the present report, we discuss the effects of the coupling between one-, and two-phonon terms in the wave functions on the fine structure of the ISGMR in spherical nuclei. The effects of the phonon-phonon coupling (PPC) [7] lead to a redistribution of the main monopole strength to lower energy states and into higher energy tail [8,9]. In particular, the PPC predictions of the fine structure of the ISGMR in 58Ni, 90Zr, 120Sn, and 208Pb are in good agreement with the fine structure which is extracted from experimental data analysis [8].

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