

Contribution ID: 157



Type: Oral

Microscopic description of isoscalar giant monopole resonance: The case of 132Sn

Friday, 24 September 2021 12:20 (20 minutes)

The study of nuclear giant resonances has long been a subject of extensive theoretical and experimental research. The multipole response of nuclei far from the beta-stability line and the possible occurrence of exotic modes of excitation present a growing field of research. In particular, the study of the isoscalar giant monopole resonances (ISGMR) in neutron-rich nuclei is presently an important problem not only from the nuclear structure point of view [1] but also because of the special role they play in many astrophysical processes such as prompt supernova explosions [2] and the interiors of neutron stars [3]. One of the successful tools for describing the ISGMR is the quasiparticle random phase approximation (QRPA) with the self-consistent mean-field derived from Skyrme energy density functionals (EDF) [4]. Due to the anharmonicity of the vibrations there is a coupling between one-phonon and more complex states [5]. The main difficulty is that the complexity of calculations beyond standard QRPA increases rapidly with the size of the configuration space, and one has to work within limited spaces. Using a finite rank separable approximation for the residual particle-hole interaction derived from the Skyrme forces one can overcome this numerical problem [6-8].

In the present report, we study the effects of phonon-phonon coupling on the monopole strength distributions of neutron-rich tin isotopes. Using the same set of the EDF parameters, we describe available experimental data for 118,120,122,124Sn [9] and give prediction for 132Sn [10]. The effects of the phonon-phonon coupling leads to a redistribution of the main monopole strength to lower energy states and also to higher energy tail. We analyze thoroughly the properties of the low-energy 0+ spectrum of two-phonon excitations of 132Sn. We give prediction for the excitation energy of the lowest two-phonon state around Ex=8 MeV in comparison to 11.5 MeV in the case of the lowest 0+ state within the random phase approximation.

This work was partly supported by the Heisenberg-Landau (Germany-BLTP JINR) program and the National Research Foundation of South Africa (Grant No.129603).

- 1. J.P. Blaizot, Phys. Rep. 64, 171 (1980).
- 2. H.A. Bethe, Rev. Mod. Phys. 62, 801 (1990).
- 3. N.K. Glendenning, Phys. Rev. Lett. 57, 1120 (1986).
- 4. N. Paar, D. Vretenar, E. Khan, G. Colò, Rep. Prog. Phys. 70, 691 (2007).
- 5. V.G. Soloviev, Theory of Atomic Nuclei: Quasiparticles and Phonons, Bristol/Philadelphia (1992).
- 6. N.V. Giai, Ch. Stoyanov, V.V. Voronov, Phys. Rev. C 57, 1204 (1998).
- 7. A.P. Severyukhin, V.V. Voronov, N.V. Giai, Phys. Rev. C 77, 024322 (2008).
- 8. A.P. Severyukhin, V.V. Voronov, N.V. Giai, Eur. Phys. J. A. 22, 397 (2004).
- 9. T. Li, U. Garg, Y. Liu et al., Phys. Rev. C 81, 034309 (2010).
- 10. N.N. Arsenyev, A.P. Severyukhin, Universe 7, 145 (2021).

Primary author: ARSENYEV, Nikolay (Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research)

Presenter: ARSENYEV, Nikolay (Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research)

Session Classification: Session 12

Track Classification: Nuclear Structure, Reactions and Dynamics