Contribution ID: **192** Type: **Oral report**

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

Friday 24 September 2021 16:10 (25 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 ^{118,120,122,124}Sn [9] and give prediction for ^{132}Sn [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 ^{132}Sn. We give prediction for the excitation energy of the lowest two-phonon state around $E_x = 8$ 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 authors: SEVERYUKHIN, Alexey (JINR); ARSENYEV, Nikolay (Joint Institute for Nuclear Research)

Presenter: ARSENYEV, Nikolay (Joint Institute for Nuclear Research)

Session Classification: Section 1. Experimental and theoretical studies of the properties of atomic nuclei

Track Classification: Section 1. Experimental and theoretical studies of the properties of atomic nuclei.