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Giant resonances studied with quasiparticle vibration coupling approach

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Giant monopole and dipole resonances are important modes of nuclear collective vibrations, which provide direct constraints on nuclear Equation of State (EoS), such as nuclear incompressibility and symmetry energy. However, “Why is the EoS for tin so soft?” is a longstanding question, which prevents us from determining the nuclear incompressibility accurately. To solve this puzzle, a fully self-consistent quasiparticle random phase approximation (QRPA) plus quasiparticle-vibration coupling (QPVC) approach based on Skyrme-Hartree-Fock-Bogoliubov is developed. We show that the many-body correlations introduced by QPVC, which shift the ISGMR energy in Sn isotopes by about 0.4 MeV more than the energy in 208Pb, play a crucial role in providing a unified description of the ISGMR in Sn and Pb isotopes. The best description of the experimental strength functions is given by SV-K226 and KDE0, which are characterized by incompressibility values of 226 MeV and 229 MeV, respectively, at mean field level. For the dipole case, the unified description of light and heavy nuclei is also examined at QRPA and QPVC level. It is shown that it is possible to give good descriptions of centroid energies for Ca, Sn and Pb already at QRPA level, and the inclusion of QPVC effect further improves the description of widths as well as the evolution trend of dipole polarizability.

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