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Pygmy and giant dipole resonances in ^{48,50}Ca and ^{68,70}Ni

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The structure of exotic neutron-rich nuclei is one of the main science drivers in contemporary nuclear physics research. An attention has been devoted to effects of varying the ratio between the proton Z and neutron N numbers on different nuclear structure characteristics of nuclei deviated from their valley of β-stability. One of the phenomena associated with the change in N/Z ratios is the pygmy dipole resonance (PDR) [1]. One of the successful tools for describing the PDR is the quasiparticle random phase approximation (QRPA) with the self-consistent mean-field derived from Skyrme energy density functionals (EDF) [2]. Such an approach can describe the properties of the low-lying states reasonably well by using existing Skyrme interactions. Due to the anharmonicity of the vibrations there is a coupling between one-phonon and more complex states [3]. 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 [4-6].

In the present report, we analyze the effects of phonon-phonon coupling (PPC) on the $E1$ strength distributions of neutron-rich calcium and nickel isotopes. Using the same set of the EDF parameters we describe available experimental data for ^{48}Ca, ^{68}Ni and give prediction for ^{50}Ca, ^{70}Ni. The inclusion of the PPC results in the formation of low energy 1^- states of ^{48}Ca. There is an impact of the PPC effect on low-energy $E1$ strength of ^{48}Ca [7]. The effect of the low-energy $E1$ strength on the electric dipole polarizability is discussed. We predict a strong increase of the summed $E1$ strength below 10 MeV (12 MeV), with increasing neutron number from ^{48}Ca (^{68}Ni) till ^{50}Ca (^{70}Ni) [8].

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