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The Rotational, Translational and Galilean Invariant Model for Dipole States in QRPA

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In this review the QRPA approach with the rotational and translational invariant Hamiltonian with Galileo invariant pairing interaction has been carried out to describe magnetic and electric dipole excitations in deformed nuclei. Calculations show that the deformed nuclei demonstrates a very rich B(M1) strength structure and in some aspects nicely confirm the experimental data. It has been shown that the main part of 1+ states, observed at 2–4 MeV may be attributed to have a M1 character and may be interpreted as the main fragments of the scissors mode. The agreement between the calculated mean excitation energies as well as the summed B(M1) values of the scissors mode and the available experimental data is quite good. The calculations indicate the presence of a few prominent negative-parity $K\pi = 1-$ states in the 2–4 MeV energy interval. This suggests that the supposition of the experiment "all stronger $\Delta K = 1$ low-lying dipole excitations were of magnetic character" cannot be generalized. These results show the necessity of explicit parity measurements for the correct determination of the scissors mode strength in deformed nuclei.

Microscopic description of the giant dipole resonance (GDR) mode in ^{165}Ho

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The study of the giant dipole resonance (GDR), originating from the collective motion of neutrons against protons in the nucleus, provides basic insight into the isovector properties of the nuclear force and is quite helpful to understand the properties of the interaction between the nucleons. In this study, GDR mode in well-deformed ^{165}Ho has been investigated in the framework of the Translation and Galilean Invariant Quasiparticle Phonon Nuclear Model (TGI-QPNM). Excitation energies, reduced $B(E1)\uparrow$ probabilities and total photoabsorption cross sections have been calculated for ΔK=0 and ΔK=1 transitions. It has been found that the GDR spectrum in this nucleus is highly fragmented into several apparent peaks due to the quasiparticle⊗phonon interactions. The results of the total photoabsorption cross section are also in qualitative agreement with the experimental results.

Comparission of *E*1 Response of ^{154}Sm and ^{155}Sm in the Pygmy Dipole Resonance (PDR) Region

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The dipole response associated with the pygmy dipole resonance (PDR) in ^{154}Sm and ^{155}Sm has been studied. In the ^{154}Sm nucleus 1^- phonons with K=0 and K=1 branches have been calculated using the Translation and Galilean Invariant Quasiparticle Random Phase Approximation (TGI-QRPA). The structure of the more pronounced electric dipole (*E*1) peaks in PDR region in ^{154}Sm is composed of predominantly two-quasiproton or two-quasineutron states. The calculations in ^{155}Sm has been performed in the framework of the Translation and Galilean Invariant Quasiparticle Phonon Nuclear Model (TGI-QPNM) based on the TGI-QRPA 1^- phonons calculated for ^{154}Sm. When going from ^{154}Sm to neighbouring ^{155}Sm, the fragmentation of the *E*1 strength is dramatically enhanced. The results emphasize the role of the quasiparticle$\otimes$phonon interactions in enhancing the fragmentation of the strength in the PDR region in ^{155}Sm. Even though the strong fragmentation of the *E*1 strength obtained for ^{155}Sm, in 6-10 MeV energy region the summed *E*1 strength is comparable to that in ^{154}Sm. The results indicate that one quasiparticle behaves solely as a spectator in ^{155}Sm.