Towards Nonlinear QRPA Description of States of Multiphonon Origin

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We develop a new approach to describe nuclear states of multiphonon origin, motivated by the necessity to describe better nuclear transition of neutrinoless double beta decay. This approach is based on extension of QRPA using the nonlinear phonon operator. Our ultimate goal is to describe all the mother (A, Z), intermediate $(A, Z + 1)$ and daughter nuclear $(A, Z + 2)$ excited states by a single QRPA system. Before that, we develop a nonlinear QRPA or a simplistic model in order to gain better insight. The model is equivalent to the harmonic oscillator, thus exactly solvable. We shall present a novel method to obtain the exact solution by means of a QRPA equation with nonlinear phonon operator formulated separately for every individual excited state.