Quantum fluctuations in low–lying collective states of deformed nuclei

Yang Sun[1] and Fang-Qi Chen[1]

[1] *Department of Physics, Shanghai Jiao Tong University, Shanghai 200240, China*

The appearance of low–energy collective motion is a widespread phenomenon in quantum systems. To describe fluctuations about deformation equilibrium, especially to understand the nature of excited 0^+ states in deformed nuclei, we improve nuclear many–body wave functions by superimposing angular-momentum and particle–number projected states constructed with different quadrupole deformation and pairing gap parameters as two–dimensional generator co–ordinates. Using these as trial wave functions, we solve the Hill–Wheeler Equation and analyze obtained weight functions with help of the Gaussian overlap approximation.

We take deformed rare–earth nuclei as examples and quantitatively compare the calculated low–lying 0^+ bands and associated electric monopole transition rates with experimental data. The analysis of the obtained results for the excited 0^+ states indicates clear features of quantum oscillation, with large fluctuations in deformation found for soft nuclei and strong anharmonicities in oscillation for rigidly–deformed nuclei. We try to identify physical quantities that may help for understanding competitions between shape and pairing fluctuations.

Work supported by the National Natural Science Foundation of China (No. 11135005 and 11075103) and by the 973 Program of China (No. 2013CB834401).