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Nuclear Collective Vibrations studied by beyond mean-field approach

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Nuclear collective vibration provides deep insight in understanding the origin of heavy elements in the universe as well as the nuclear equation of state (EoS). For example, the Gamow-Teller transitions determine the beta-decay half-lives as important inputs for the nucleosynthesis study, while the giant monopole resonance (GMR) provides direct constraints on nuclear incompressibility, a key parameter of nuclear EoS. The quasiparticle random phase approximation model is the most commonly used microscopic model to study the collective vibration of atomic nuclei. However, due to the lack of higher-order many-body correlations beyond the mean field, the resonance width cannot be given, and serious problems are encountered when describing beta-decay lifetime and GMR energies. In this talk, I will introduce how to solve the above problems by developing a quasiparticle random phase approximation + quasiparticle vibration coupling model which considers higher-order many-body correlations. Furthermore, facing to various modes of nuclear collective vibrations, the photonuclear reaction is limited to the study of nuclear dipole excitations. I will discuss new possibilities to excite different modes of nuclear collective vibrations with vortex photons.

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