Interacting boson model from microscopic theory

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Atomic nucleus is a highly quantal many-body system that displays a distinct geometrical shape. The shape reflects deformation of nuclear surface arising from collective motion of many nucleons. Understanding the collective nuclear structure from a microscopic theory has been a theme of major interest in nuclear physics.

Energy density functional (EDF) approach provides complete and universal description of nuclear ground-state properties, and can be a good starting point for collective dynamics. The interacting boson model (IBM) is also successful in reproducing low-lying structure of medium-heavy nuclei. The model itself should, however, have a certain microscopic foundation, which has been investigated for the past decades. More recently, a general way of deriving the Hamiltonian of IBM has been presented [1]. By mapping the self-consistent mean-field energy surface with a given EDF onto the relevant IBM Hamiltonian, low-lying collective spectra and transition rates are calculated.

I will present some outcomes of the recent microscopic study of IBM: justification of the model for rotational nuclei [2], robust regularity of non-axial nuclei [3], quantum phase transitions, and predictions on exotic nuclei.

[1] K. Nomura, N. Shimizu, and T. Otsuka, Phys. Rev. Lett. **101**, 142501 (2008).
[2] K. Nomura, T. Otsuka, N. Shimizu, and L. Guo, Phys. Rev. C **83**, 041302(R) (2011).
[3] K. Nomura, N. Shimizu, D. Vretenar, T. Nikšić, and T. Otsuka, Phys. Rev. Lett. **108**, 132501 (2012).