New Microscopic Derivation of the Interacting Boson Model and its Applications to Exotic Nuclei*

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We propose a new approach to microscopic derivation of the Interacting Boson Model (IBM) Hamiltonian for general cases, starting from the mean-field model, *e.g.*, the one with Skyrme-type interactions [1]. The multi-fermion dynamics of the surface deformations and the effects of the nuclear force are simulated in terms of bosons. By comparing Potential Energy Surface (PES) of the mean-field model with that of the IBM, the parameters of the IBM Hamiltonian can be obtained as functions of N and Z.
Using this method, levels and wave functions of the excited states are computed precisely: Various situations of three dynamical symmetries and quantum shape/phase transitions, including the recently proposed critical-point symmetries [2,3], can be reproduced quite nicely. Moreover, intriguing spectroscopic properties, *e.g.*, unexpectedly large region of the E(5) symmetry, are predicted for experimentally unknown exotic nuclei such as W-Os isotopes with $A \gtrsim 200$.
As another application, we will present the results of the systematic calculations for $Z \lesssim 50$ nuclei such as Ru isotopes. These results contain the predicted energy levels for unexplored territory.
Finally, we would like to discuss the uniqueness of the derived IBM parameters with the aid of the wavelet analysis, taking Sm and Ba isotopes as examples.

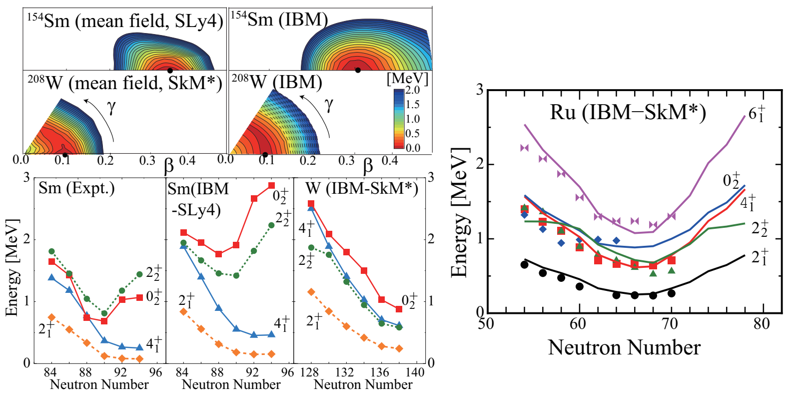

FIG. 1: (Upper left) Comparisons of PES's for ^{154}Sm and ^{208}W. (Lower left) Experimental and calculated spectra for Sm isotopes and predicted ones for exotic W isotopes. (Right panel) Low-lying spectra for Ru isotopes, where dots and solid lines stand for experimental and calculated results, respectively.

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