BOSON EFFECTIVE INTERACTION AND CONFIGURATION MIXING FOR THREE-BOSON NUCLEI IN sdgIBM1

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In the Interacting Boson Model (IBM), the boson interaction parameters are treated as adjustable and determined by the experimental data. In general, the number of djustable parameters rapidly increases along with increase of the freedom degree of bosons. It is quite difficult to diagonalize the general IBM Hamiltonian matrix with huge number of free parameters. In this paper, we use the interacting boson model with boson effective interaction and configuration mixing to study the nuclear spectra. This approach has a few free paremeters only.

The phenomenological effective interaction is the surface delta interaction

$$V_{12}^{BSDI} = -g\delta(r_1-r_2)\delta(r_1-R_0)\delta(\Omega_{12}),$$

here g is the interaction strength. The two-boson interaction matrix element calculated by the V_{12}^{BSDI} is

$$\langle l_1 l_2 L | V_{12}^{BSDI} | l_3 l_4 L \rangle = G(2L+1)^{-1}[(2l_1+1)(2l_2+1)(2l_3+1)(2l_4+1)]^{1/2} \cdot \langle l_1 0 l_2 0 | L 0 \rangle \langle l_3 0 l_4 0 | L 0 \rangle.$$

Where G is the product of the radial matrix element multiplied by $-g$, and it is independent of L. We assume that G is a constant in a nucleus.

There are 10 configurations and 70 independent states for the three-boson nucleus in the sdgIBM1. If we take the energy of the state $s^3(L=0)$ as zero, then there are three adjustable parameters only, namely G, $\Delta\varepsilon_d = \varepsilon_s - \varepsilon_d$ and $\Delta\varepsilon_g = \varepsilon_s - \varepsilon_d$. We calculate 31 and 28 energy levels of nuclei ^{46}Ti and ^{54}Cr, and the rms deviations between experiment and theory (σ) are 158 and 208 keV respectively. We have calculated 9 and 8 energy levels for these two nuclei in sdIBM1, and the σ values are 229 and 271 keV respectively[1]. Obviously, addition of g boson considerably improves agreement between theory and experiment.

We also calculate B(E2) values between states in ground band and between states of different bands($\beta \rightarrow g$ and $\gamma \rightarrow g$). The sdg bosons scheme satisfactorily explain more experimental data than that sd bosons scheme. It is further shown that the g boson plays important role and this approach is successful.

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Reference

1) Zhang Qingying, Chen Xiaolin and Feng Mang, High Ener. Phys. and Nucl. Phys. **18** (1994) 353.