Boson structure of 1s0d and 1p0f-shell nuclei

Edward Kwaśniewicz[1], Edyta Hetmaniok[1]
[1]Institute of Mathematics, Silesian Technical University, Gliwice, Poland.

Description of the nuclear structure in the framework of the Interacting Boson Model (IBM) usually consists in expanding the boson space by the *s*, *d* and *g* bosons. But, for majority cases this set of bosons is too small for the reproduction of basic features of the low-lying spectra of collective nuclei. Therefore, recently many attempts have been made to reproduce results obtained in large shell model (SM) spaces in the boson spaces of correspondingly large dimensions, but expanded in terms of set of bosons as small as possible.

We report a method which immediately indicates the bosons dominating in low-lying states of selected *1s0d*- and *1p0f*- shell nuclei. Namely, by constructing and diagonalizing the boson image of the SM Hamiltonian [1] in the space expanded in terms of all bosons corresponding to the collective pairs expanding the complete SM space in a given major *1s0d*- or *1p0f*- shell, we obtain the boson representation of the SM eigenfunctions for selected *1s0d*- or *1p0f*- shell nuclei. These eigenfunctions are employed to find boson's population in examined nuclear states and implicitly to select a small set of bosons to expand the reduced boson space sufficient to reproduce the SM spectra.

As an example we present in Figures 1 and 2 the boson's population in the low-lying T=0 states of A=20 and A=60 nuclei, respectively. In the case of A=60 nucleus we assume that valence nucleons occupy the $1p_{3/2}$, $1p_{1/2}$ and $0f_{5/2}$ subshells of the major *1p0f* shell while the $0f_{7/2}$ subshell is closed. Due to this assumption one can compare of the bosons population in selected nuclei from *1s0d* and *1p0f* major shells. The energy spectra of the T=0 states of A=20 and A=60 nuclei calculated in the reduced boson spaces expanded by the *ss'dd'gg'* and *ss'dd'd''fg* bosons, respectively, well reproduce the low-lying SM energy spectra.

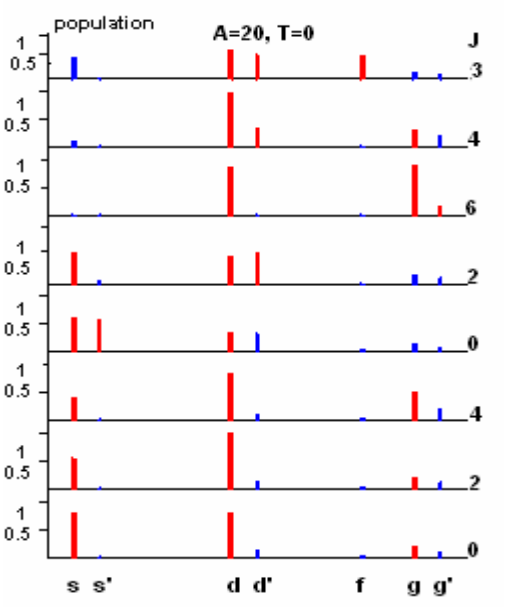

Figure1 (see text)

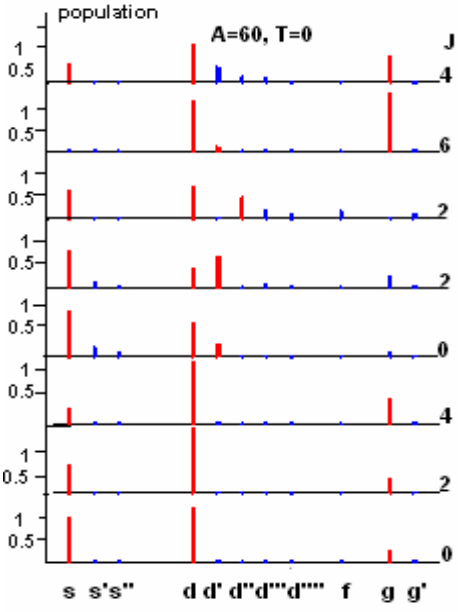

Figure 2 (see text)

[1] M.Sambataro, Phys.Rev.**C 52**, 3378 (1995).