A Shell Model Description of Odd Z N=50 Isotones Above the ^{78}Ni

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It is of interest to understand the structural changes that occur in going from neutron rich side ^{78}Ni to proton rich side ^{100}Sn or vice versa. As N=50 is a well established shell closure, the low lying states of N=50 isotones should involve only proton excitation. The effective NN interaction is most easily studied in the nuclei in the neighborhood of doubly magic nuclei. The monopole part of the interaction is responsible for the changes in the effective SPE and its tensor term play a significant role. So it is interesting to study the energy spectrum of one family, proton or neutron in this model space, while the population of the other is varied.

In the present work odd proton nuclei between two doubly magic nuclei ^{78}Ni and ^{100}Sn with N=50, ^{81}Ga, ^{83}As, ^{85}Br, ^{87}Rb, ^{89}Y, ^{91}Nb, ^{93}Tc and ^{95}Rh nuclei have been studied and calculated value are compared with the available experimental data[1-4]. We have performed large scale shell model calculations using Nushell code [5] taking ^{78}Ni as a core and the valence space comprises of $\pi(0f_{5/2}, 1p_{3/2}, 1p_{1/2}, 0g_{9/2})$ for protons. The effective interaction have been used in this work is jj44b Hamiltonian[6] which was obtained from a fit to the experimental data of about 600 binding energies and excitation energies of nuclei with Z=28-30 and N=48-50.

The calculated energy levels of odd Z N=50 isotones for $31\leq Z \leq 45$ are shown in fig. 1-8 along with the experimental data. It is observed that the present calculation predict the ground state spins of ^{85}Br, ^{89}Y, ^{91}Nb, ^{93}Tc and ^{95}Rh correctly. Experimentally the ground state of ^{83}As is predicted as a $(3/2^-,5/2^-)$ doublet. In our calculation also $(3/2^-,5/2^-)$ difference is 0.09 MeV which is too small. However for ^{81}Ga and ^{87}Rb ground state is not reproduced correctly. The decreasing value of $9/2^+$ state are reproduced nearly well for all nuclei from ^{83}As to ^{89}Y and it finally becomes ground state for ^{91}Nb. $3/2^-$ state in ^{91}Nb have a very good agreement with experimental value but for ^{89}Y and ^{93}Tc it have some deviation. $5/2^-$ state has been reproduced nearly well for ^{93}Tc and ^{91}Nb but for other nuclei it is much deviated from the corresponding experimental value. $1/2^-$ state have a poor result for all nuclei. $7/2^-$ state shows a nearly good agreement for all nuclei with whatever experimental data is available. $9/2^-$ state is reproduced nearly well for ^{83}As, ^{85}Br and ^{91}Nb but for ^{81}Ga and ^{87}Rb corresponding energy of this state is much higher than the experimental values. Theoretically predicted levels which have not been observed experimentally as yet are to be confirmed. This interaction gives poor results for ^{81}Ga and ^{87}Rb while some of the predicted levels are close to corresponding experimental values in all other nuclei.

Our earlier large scale shell model calculation for even Z,N=50 isotones with jj44b interaction[7] had yielded very good agreement with the experimental result for 0^+, 2^+ and 4^+ states indicating suitability of model space and the interaction. However for odd Z, N=50 isotones the poor agreement with experimental results for most of states suggest the need for minor monopole correction in the interaction and more experimental data fitting in this region.

References:

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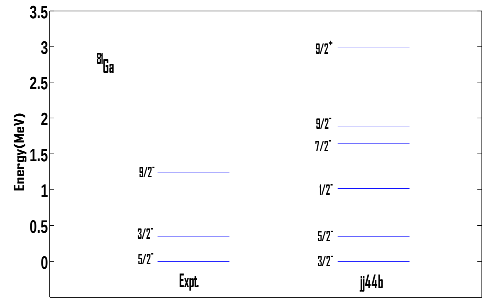


Fig.1

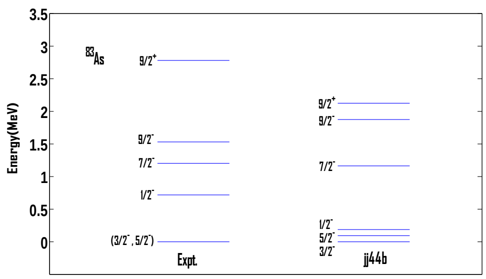


Fig.2

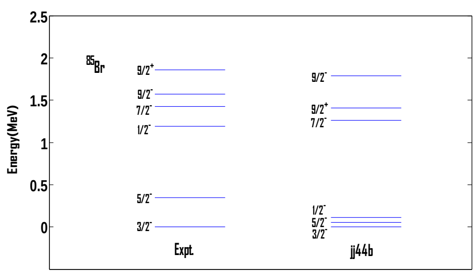
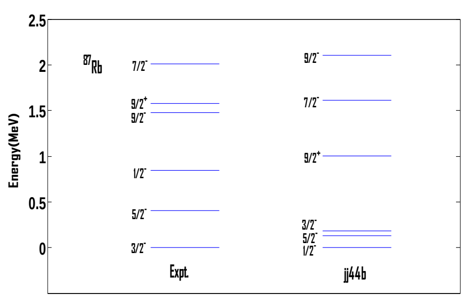


Fig.3



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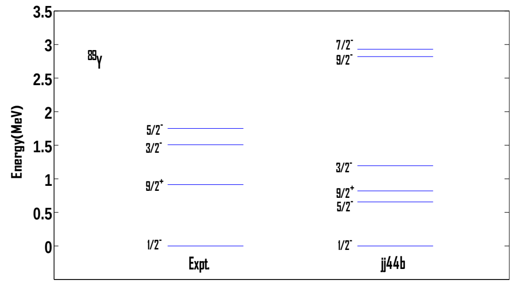

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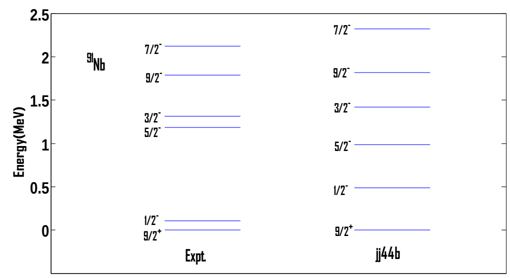

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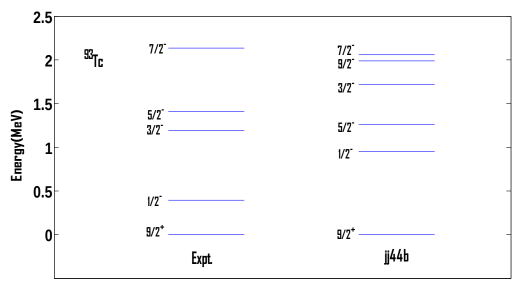

Fig.7

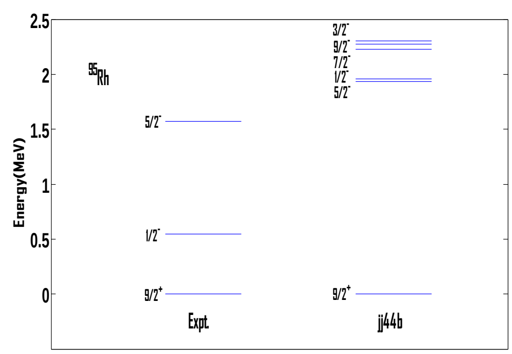

Fig.8