A Shell Model Study of Even Nuclei Between ^{78}Ni and ^{100}Sn

K. Maurya* and I. Mehrotra
Nuclear Physics Group, Department of Physics, University of Allahabad-211002, Allahabad, India
*email: kamleshmaurya23@gmail.com

It is of interest to study the persistance of the magic character of the nucleons of one family, proton or neutron, while the population of the other is varied. The shell model orbitals for neutrons in nuclei with Z=28 and N=28-50 are the same as those for protons in nuclei with N=50 and Z=28-50. ^{78}Ni and ^{100}Sn are two doubly magic nuclei with Z=28,50 and N=50. It is of interest to understand changes that occur in the spectra in going from neutron rich side ^{78}Ni to proton rich side ^{100}Sn or vice versa. In the present work even proton number nuclei between these two doubly magic nuclei with N=50, i.e. Zn, Ge, Se, Kr, Sr, Zr, Mo, Ru, and Pd, have been studied. Recently experimental data has been made available on the energy levels of N=50 isotones in the mass region A=80-96[1-3].

In the present work we have performed large scale shell model calculations using Nushell code [4] for N=50 isotones with Z=30-46. In our calculations ^{78}Ni is chosen as the inert core and the valence space comprises of $\pi(0f_{5/2}, 1p_{3/2}, 1p_{1/2}, 0g_{9/2})$ for protons. The calculations have been performed with jj44b Hamiltonian[5] 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 aim of this work is to study the low lying spectra of even nuclei between neutron rich side N=50 isotones to proton rich side N=50 isotones for Z=30-46.

The results of our calculations for different isotones are shown in Fig.1-9 along with experimental levels for comparison.
1. In all nuclei 0^+ is predicted as ground state.
2. 2^+ state is well reproduced as first excited state. In going from Z=30 to Z=46 this separation increases till a maximum is reached at Z=40 and then it showsa decline. A large separation between 0^+ and 2^+ state is an indication of shell closure at Z=40.
3. E(4^+) is also well reproduced for all the nuclei .
4. E(6^+) is lower than the experimental levels and is maximum for Kr in our work while it is maximum for Sr in experimental data.
5. E(8^+) is decreased from Z=30 to 46 but reproduced very well for ^{86}Kr, ^{88}Sr, ^{92}Mo and ^{96}Ru.

The results of our analysis shows that in the cosen configuration space jj44b interaction gives very good agreement with the experimental data for 0^+ ,2^+ and 4^+ state.

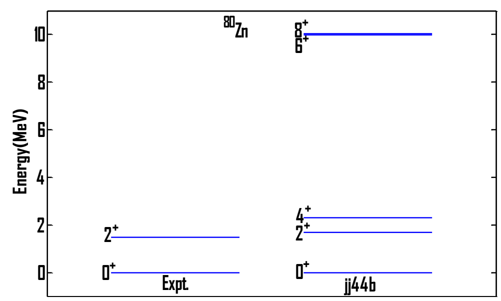

Fig.1

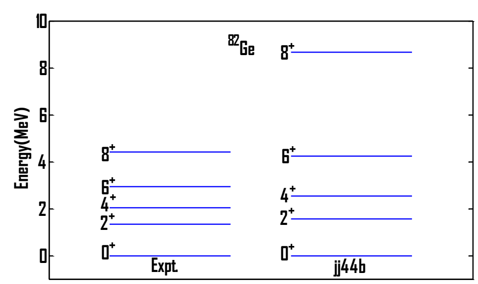

Fig.2

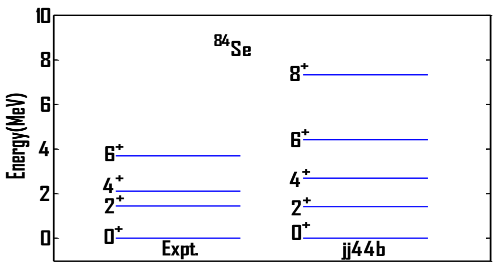

Fig.3

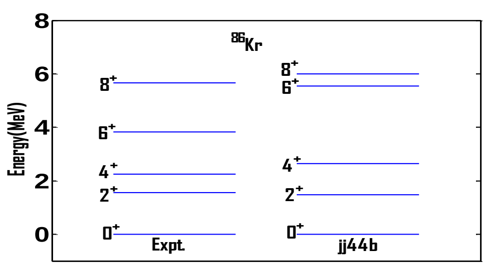

Fig.4

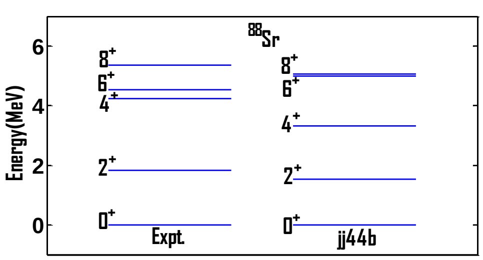

Fig.5

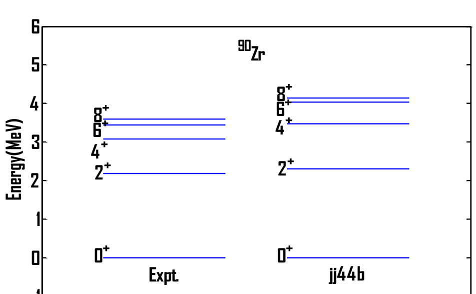

Fig.6

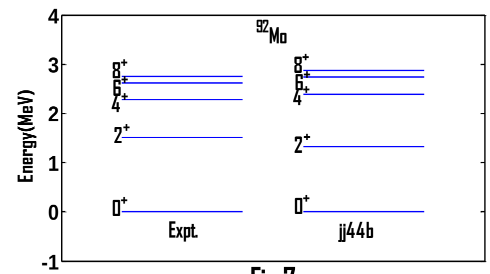

Fig.7

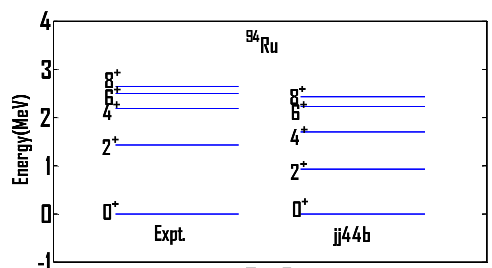

Fig.8

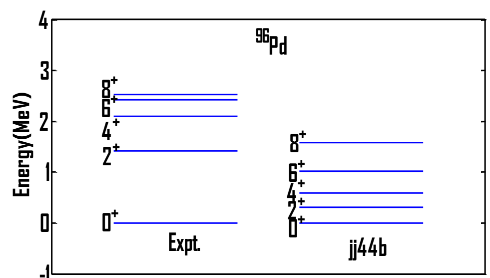

Fig.9

References:

[1] D. Verney *et. al*. **Phys. Rev. C 76**, 054312(2007)

[2] M. Gorska *et al*. **Phys. Rev. Lett. 79**, No. 13(1997)

[3] ***www.nndc.bnl.gov***

[4] NuShell @ MSU B. A. Brown and W. D. M. Rae (unpublished)

[5] Lisetskiy and Brown (unpublished)