Projected shell model study of yrast bands of some odd mass N=61 isotones

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With the advent of new experimental tools the level scheme of N=61 nuclei have been extended to higher spins [1-4]. For example, for ^{101}Zr and ^{103}Mo [1] the ground state bands have been extended from spins $23/2^+$ to $39/2^+$ and $31/2^+$ to $39/2^+$, respectively. The signature splitting has been observed in ^{101}Zr and ^{103}Mo isotopes. Particle rotor model [5,6] has been employed to study the signature splitting phenomenon in these nuclei. To interpret the latest experimental data and to study the structure of yrast bands in some N=61 isotones, projected shell model (PSM) approach has been employed.

The Hamiltonian [7] employed in the present work is

$$H = H_0 - \tfrac{1}{2}\chi\sum_{\mu} Q^{+}_{\mu} Q_{\mu} - G_M P^{+} P - G_Q \sum_{\mu} P^{+}_{\mu} P_{\mu}$$

where H_0 is the spherical single-particle Hamiltonian. The second term in the Hamiltonian is the quadrupole-quadrupole interaction and the last two terms the monopole and quadrupole pairing interaction, respectively. The strength of the quadrupole force χ is adjusted such that the known quadrupole deformation parameter ε_2 is obtained. This condition results from the mean field approximation of quadrupole-quadrupole interaction of the Hamiltonian in above equation. The monopole pairing force constant G are adjusted to give known energy gaps. The strength parameter G_Q for quadrupole pairing is assumed to be proportional to G_M.

In the present piece of work, the yrast energies and transition energies of yrast bands of ^{101}Zr, ^{103}Mo, ^{105}Ru and ^{107}Pd have been obtained. In Fig.1, the transition energies are presented for ^{101}Zr, ^{103}Mo, ^{105}Ru and ^{107}Pd, respectively. For ^{101}Zr and ^{103}Mo there are [E(I)-E(I-1)] transitions in the experimental data and the available experimental data shows staggering in the yrast band . It can be seen that energy staggering in the yrast bands for ^{101}Zr and ^{103}Mo are reproduced qualitatively by PSM calculations. In case of ^{105}Ru and ^{107}Pd experimental data shows E2 transitions in the yrast bands and so energy staggering is absent in these nuclei. In case of ^{105}Ru and ^{107}Pd, the theoretical [E(I)-E(I-2)] transition energies are compared with the experimental data in Fig.1. In case of ^{105}Ru, the increasing trend of [E(I)-E(I-2)] displayed in fig.1 is reproduced by theoretical results. In case of ^{107}Pd, the transition energy versus spin graph reproduces the experimental transition energies up to spin 10.5ħ. For the higher spins the deviation from the experimental data is more.

References

[1] H. Hua et al., Phys. Rev. **C 69** (2004) 014317.

[2] H. Hua et al., Phys. Rev. **C 65** (2002) 064325.

[3] J.K. Hwang et al., J.Phys.**G24** (1998) L9.

[4] K.R. Pohl et al., Phys. Rev. **C53** (1996)2682.

[5] J. Mayer et al., Nucl. Phys. **A249** (1975)141.

[6] S.E. Larsson et al., Nucl. Phys. **A307** (1978) 149.

[7] K. Hara and Y. Sun, Int. J. Mod. Phys. **E 4** (1995) 637.

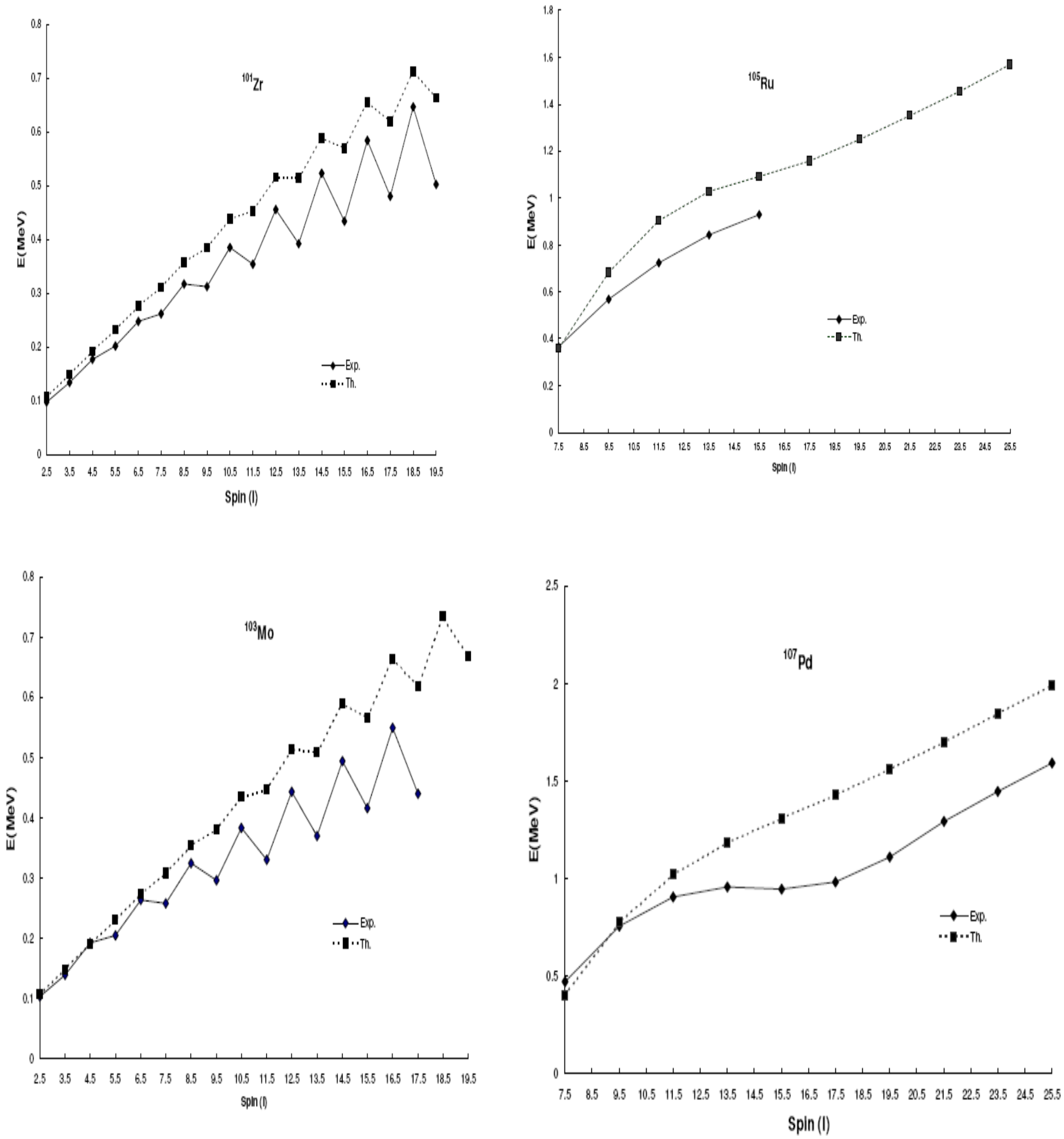

Fig. 1 Comparison of the calculated transition energies with experimental data for some N=61 isotones.