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

\[ H = H_0 - \frac{1}{2} \sum_\mu \left[ \chi Q_{\mu}^2 - G_P P_{\mu}^2 - G_Q \sum_\mu P_{\mu}^2 \right] \]

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 $\chi$ is adjusted such that the known quadrupole deformation parameter $E_2$ 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 $^{105}$Ru and $^{107}$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 10.5h. For the higher spins the deviation from the experimental data is more.

References

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