Projected shell model study of the yrast bands of some odd-mass N=63 isotones.

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Neutron–rich nuclei in the A≈100 mass region have been the subject of many experimental studies because these nuclei exhibit a competition between spherical and deformed shapes. Light neutron-rich odd neutron N=63 isotones with A≈100 can be cited as one such example which are of current interest in high spin nuclear structure physics because of being well deformed with quadrupole deformation of β_2 = 0.26-0.38 [1] for some N=63 isotones (^{103}Zr, ^{105}Mo and ^{107}Ru). Due to availability of very large γ-ray detector arrays, the level schemes of these isotones have been extended to high spins. A wealth of data exist on collective and quasiparticle excitations in these isotones and these isotones also exhibit multiple extended rotational bands.

Recently, the yrast band in ^{103}Zr[2] has been extended to spin $23/2^-$ based on the band head $5/2^-$ whereas the yrast bands in ^{105}Mo[3] and ^{107}Ru[4] have been extended respectively to the spins $35/2^-$ and $25/2^-$ based on the same band head $5/2^-$.

The purpose of the present work is to interpret the yrast bands of above mentioned N=63 isotones in some microscopic theory. In recent years, the projected shell model (PSM)[5] has become quite successful in explaining broad range of properties of deformed nuclei in various regions of nuclear Periodic Table. The most striking aspect of this quantum mechanical model is its ability to describe the finer details of high spin spectroscopy data with simple physical interpretations.

In the present work Projected Shell Model (PSM) has been employed to study the structure of yrast bands in N=63 isotones (^{103}Zr, ^{105}Mo and ^{107}Ru).

The Hamiltonian[5] employed in the present work is

$$H = H_o - \frac{1}{2}\chi \sum_\mu Q_\mu^+ Q_\mu - G_M P^+ P - G_Q \sum_\mu P_\mu^+ P_\mu$$

where H_o is spherical single particle Hamiltonian. The second term in the Hamiltonian is the Quadrupole-quadrupole interaction and the last term the monopole and quadrupole pairing interaction, respectively.

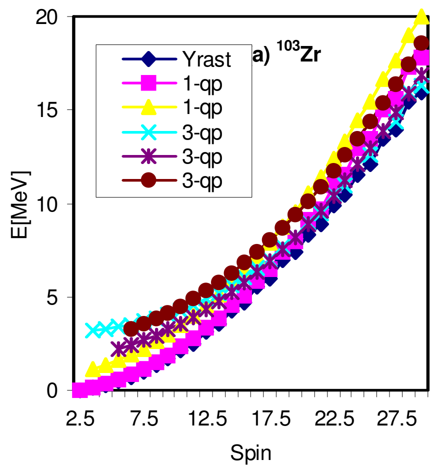
The strength of the quadrupole force χ is adjusted such that the known quadrupole deformation parameter ε_2 is obtained by the usual Hartree+BCS self-consistent procedure. The monopole pairing strength G_M is taken as

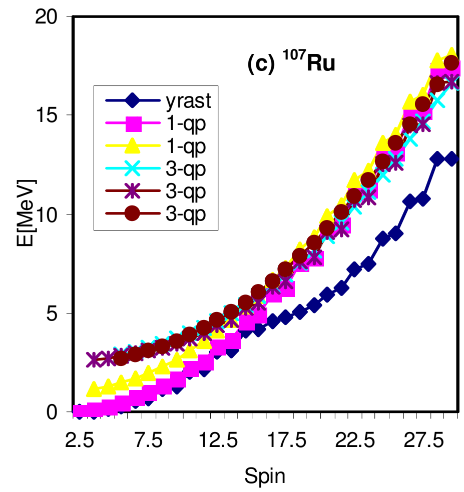
$$G_M^n = \left[20.25 - 16.20\frac{N-Z}{A}\right]A^{-1}$$

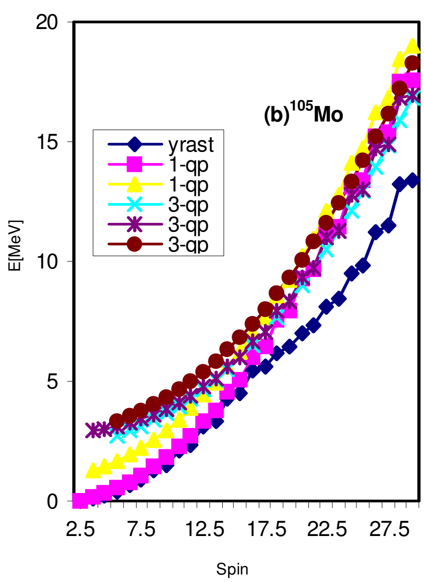
$$G_M^p = 20.25A^{-1}$$

The projected shell model calculations carried out for ^{103}Zr, ^{105}Mo and ^{107}Ru isotones show satisfactory agreement with observed yrast spectra. The calculations also reproduce the band head spin of these isotones, which turns out to be $5/2^-$.

In Figs.1(a)-1(c), we have presented the results on band diagram of the ^{103}Zr, ^{105}Mo and ^{107}Ru isotones. From the results of band diagrams, it is established that the low lying yrast states in these isotones arise from a single band whereas the higher angular momentum states could be thought to be arising from a superposition of bands which indicates the possibility of co-existing of shapes.







Figs.[1(a)-1(c)] Band diagrams of ^{103}Zr, ^{105}Mo and ^{107}Ru isotones.

References

[1] S.Goriely, F.Tondeur and J.Pearson, At.Data and Nucl.Data Tables,Vol.**77**, No.2(2001) 329.
[2] W.Urban et al.,Phys.Rev.**C79** (2009) 067301.
[3] H.Hua et al.,Phys.Rev.**C69** (2004) 014317.
[4] S.J.Zhu et al., Phys.Rev.**C65** (2001) 014307.
[5] K.Hara and Y.Sun,Int.J.Mod.Phys. **E4** (1995) 637.