Study of deformation systematics in some N=60 isotones

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Since an important discovery made by Cheifetz in 1970 about the occurrence of large deformation in the Zr isotopes around mass number A≈100, a considerable effort has gone in understanding the properties of this mass region. The experiments on the γ-ray spectroscopy, collinear laser spectroscopy, inelastic scattering of charged particles, coulomb excitation measurements, life-times measurements, etc. have provided a wealth of experimental data on the structure of nuclei in this mass region. It has been observed that neutron-rich isotopes with N≥60 and A≈100 are characterized by strong axial deformation. One of the major problems observed in this mass region is the occurrence of sudden and large onset of deformation in the neutron-rich nuclei of Sr, Zr and Mo with neutron number N≥60. This shape transition is observed to become very gradual in Ruthenium and Palladium isotopic mass chains. Thus for a complete analysis and to know as to what factors could be contributing towards the development of large deformations in the N=60 isotones in the mass region A≈100, we have applied a microscopic nuclear theory. It is with motivation, we have made an attempt to study some N=60 isotones like ^{98}Sr, ^{100}Zr, ^{102}Mo, ^{104}Ru and ^{106}Pd by employing the Variation-After-Projection (VAP) technique in conjunction with Hartree-Bogoliubov(HB) ansatz for the trial wave functions resulting from the pairing-plus-quadrupole-quadrupole (PQ) model of the two-body interactions operating in a valence space spanned by $3s_{1/2}$, $2p_{1/2}$, $2p_{3/2}$, $2d_{3/2}$, $2d_{5/2}$, $1f_{5/2}$, $1g_{7/2}$, $1g_{9/2}$ and $1h_{11/2}$ orbits for protons and neutrons outside the ^{56}Ni core.

The single particle energies (S.P.E.'S) that are employed here are (in MeV's) : $(3s_{1/2})$ = 9.90, $(2p_{1/2})$ =1.08, $(2p_{3/2})$ = 0.0, $(2d_{3/2})$ = 11.40, $(2d_{5/2})$ = 8.90, $(1f_{5/2})$ =0.78, $(1g_{7/2})$ =11.90, $(1g_{9/2})$ =3.50 and $(1h_{11/2})$ =12.90**.** The values for the strengths of the q.q interactions are the same as employed by Sharma et al. [1]. The strength for the pairing interaction was fixed through the approximate relation G = (18-21)/A.

Our calculations for these N=60 isotones have reproduced the observed yrast spectra (see figs. 1(a)-1(e)) with reasonably accepted discrepancy. We have also calculated the intrinsic quadrupole moments which give us an indication about the amount of deformation occurring in these isotones. Besides this, it turns out from our calculations that the observed development of deformation in the N=60 isotones in the mass region A≈100 depends sensitively on the simultaneous polarization of $2p_{1/2}$, $2p_{3/2}$ and $1f_{5/2}$ proton sub-shells.

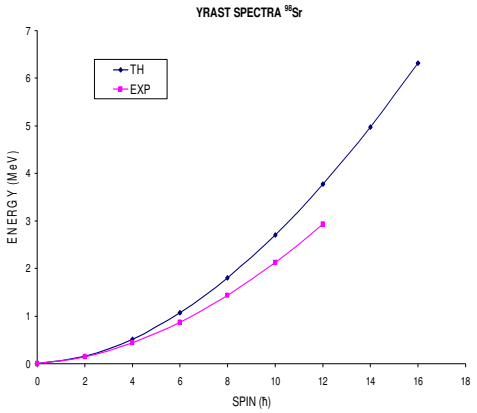

Fig.1(a)

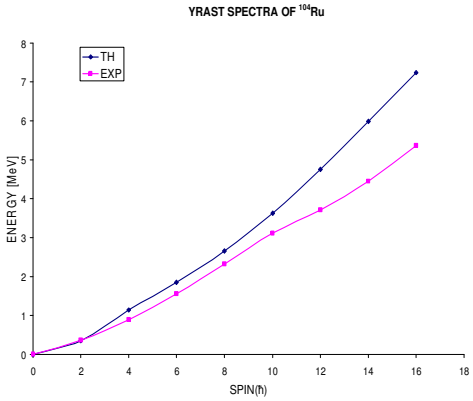

Fig.1(d)

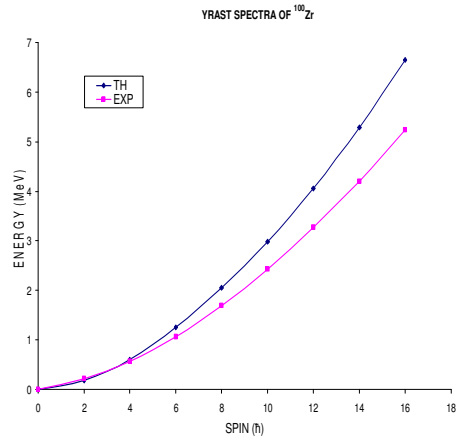

Fig.1(b)

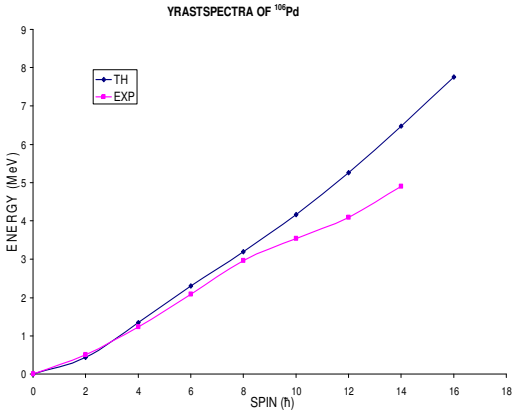

Fig.1(e)

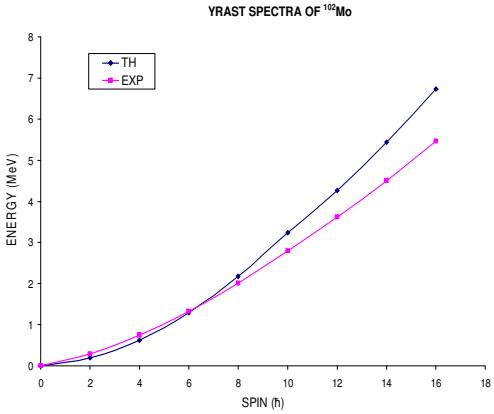

Fig.1(c)

Figures[1(a)-1(e)] Comparison of the experimental (Exp.) and theoretical (TH) yrast spectra in ^{98}Sr, ^{100}Zr, ^{102}Mo, ^{104}Ru and ^{106}Pd nuclei.

References

[1] S. K. Sharma, P. N. Tripathi and S.K.Khosa, Phys Rev.**C38** (1988) 2935.