Yrast band structure of light $^{170\text{-}182}$Pt isotopes

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The neutron rich Pt isotopes with only 4 proton holes (two proton bosons) have been studied for long. For example, ^{196}Pt is cited as the best example of an O(6) nucleus [1]. Gupta et al. [2], in empirical studies of ground band energies of medium mass shape transitional nuclei, calculated the vibrational content of the low spin I=2 state in $^{182\text{-}196}$Pt isotopes and noted a phase transition at N=110 (A=188), with lighter isotopes showing significant deformation effects. The deformation for Pt is maximum at N=104, (A=182).

With the advance in nuclear reaction and detection technology, the level structure of lighter Pt isotopes is being pursued down to N=92. In a recent experiment [3], the level structure of $^{170\text{-}172}$Pt, the lightest ones, was studied using the Gammasphere detector array. The isotopes of interest were selected through recoil-decay tagging. The yrast band in ^{170}Pt is extended up to I=10 and in ^{172}Pt up to I=14, besides the non-yrast side bands. There is interest in these isotopes to study the effect of side bands on the yrast band, inducing the shape coexistence phenomenon.

To start with, we have studied the level structure of Pt isotopes N=92-104, by plotting the level energies against the spin I, to see the evolution of nuclear structure with N and to search for irregularity in the slope with varying spin I, if any. Further, we have calculated the kinetic Moment of inertia $J^{(1)}$ versus spin I.

Results:

In ^{174}Pt (N=96) the level energy increases with spin smoothly (Fig. 1). In lighter isotopes (N=92, 94) ^{170,172}Pt, it increases somewhat faster compared to ^{174}Pt, and in ^{170}Pt the slope changes at I=6-8. In $^{176\text{-}182}$Pt, the slope is less than in $^{170\text{-}174}$Pt and the curves for the four isotopes almost merge into each other, exhibiting their almost identical level structures at low spin. Also, the increase with spin is slower up to 8+ and sharper there after, signifying a shape transition from weakly deformed to prolate deformed [4, 5].

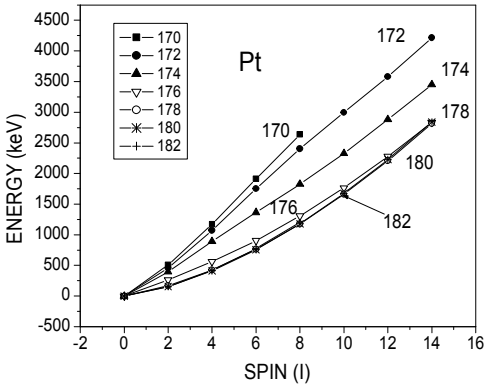

Fig.1. Variation of level energy versus spin for $^{170\text{-}182}$Pt.

Next we look at the kinetic MoI $J^{(1)}$ (Eq. 1) (Fig. 2 a and b).

$$J^{(1)} = (2\,I\text{-}1)/E_\gamma \qquad (1)$$

In ^{170}Pt, at I=6-8, there is an up-bend, indicating the band interaction. In ^{172}Pt the increase is relatively smooth and in ^{174}Pt there is a change in slope at I=8. In ^{176}Pt the slope changes at I=6. In $^{178\text{-}182}$Pt the kinetic MoI $J^{(1)}$ exhibits a change of slope at I=4. Next we look at the dynamic MoI $J^{(2)}=4/(E_{\gamma 2}-E_{\gamma 1})$.

The dynamical moments of inertia of $^{170\text{-}182}$Pt versus spin (fig. 3 a and b) shows a dip at 8^+ in $^{170\text{-}174}$Pt, maximum for ^{174}Pt, at which back bend is formed on plotting dynamic MoI versus $(\hbar\omega)^2$.

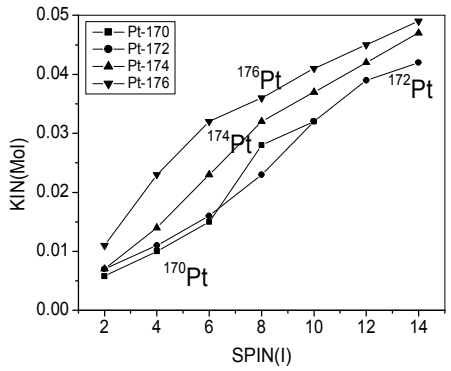

Fig. 2 (a) Variation of Kinematic moments of inertia versus spin for $^{170\text{-}176}$Pt.

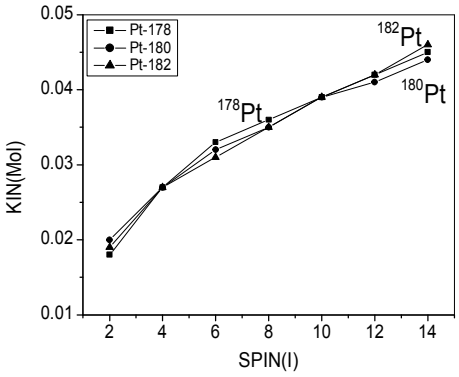

Fig. 2 (b). Variation of Kinematic moments of inertia versus spin for $^{178\text{-}182}$Pt.

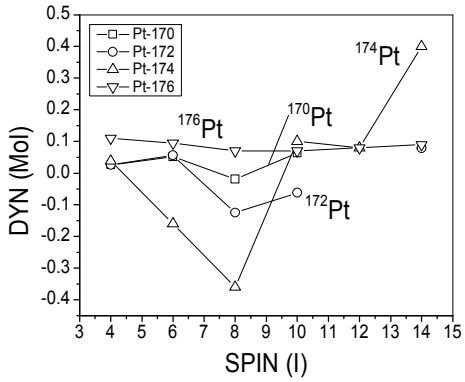

Fig. 3 (a).Variation of dynamical MoI versus spin.

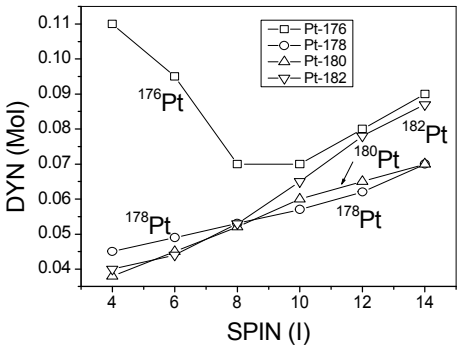

Fig. 3 (b).Variation of dynamical MoI versus spin

At I=8 interaction with deformed $K=0_2$ intruder band is predicted [3]. Thus through the study of level energies and kinetic moment of inertia, we get the information on the shape phase transition in these light Pt isotopes. The same is also reflected in the back bending plots of dynamic moment of inertia versus ω or ω^2 plots (to be presented).

Acknowledgement

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[+]Associated

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