Structure of ^{192}Pt nucleus and staggering in γ-band

M Singh[1], Pradeep Kumar[1], Rajesh Kumar[2], K K Gupta[3] and D K Gupta[4]

1. *Greater Noida Institute of Technology, Greater Noida (UP), India.*
2. *Noida Institute of Engineering & Technology, Greater Noida (UP), India.*
3. *Govt. College, Dhaliara (HP University), Shimla, (H.P.) India.*
4. *SSLD Varshney Engineering College, Aligarh (UP), India*

The transitional nuclei are either γ– rigid or γ – soft, is an active issue in nuclear structure physics. However, several systematic studies have shown that transitional nuclei exhibit clear triaxial features [1 – 2]. A new phase in the field began with the studies of the phase transitions by means of different classical limits of Hamiltonian belonging to Lie – Algebra [3]. It is worth mentioning here the two important models viz. Y (5) and Z (5) [4-5] which are associated with the transition between the axial and triaxial shapes and between prolate and oblate shapes respectively. Similar to Z(5) model, another model called Z (4)having an exact solution for $\gamma = 30^0$ and infinite square well potential was used [6].

Recently, analytical solution for Davydov – Chaban Hamiltonian with sextic potential with $\gamma = 30^0$ have been proposed for the shape variables β and called as Z (4) sextic which is an γ rigid solution [7]. In past rigid triaxial rotor model (RTRM) of Davydov and Filippov [8] have been used which is especially meant for the transitional nuclei.

One criterion to distinguish between γ –rigid and γ – soft nuclei are the quantities $\nabla E_1 = E3_1^+ - (E2_1^+ + E2_2^+) \approx 0$ and $\nabla E_2 = E3_1^+ - (2E2_1^+ + E4_1^+) \approx 0$ based on the relation of rigid triaxial rotor model and γ – soft model of Wilets and Jean [9]. For ^{192}Pt the $\nabla E_1 = 7.9$ KeV and $\nabla E_2 = 496.5$ KeVwhich supports the γ – rigid nature of the nucleus. Therefore, in present work, we have employed the RTRM to explain the Yrast band and γ – band in ^{192}Pt nucleus normalizing with the Lipas like relation –

$E_{fit} = \frac{E_{RTRM}}{1+\propto . E_{RTRM}}$ where, α is Lipas parameter.

We have calculated the asymmetric parameter by three different methods for this particular nucleus ^{192}Pt. One γ value has been evaluated from usual energy ratio R (=$E2_2^+/E2_1^+$) which is 37.2^0 and as alternate method from the energy ratio R (= $E2_2^+/En_1^+$) where the En_1^+ belongs to any level of Yrast band nearest to $E2_2^+$ not necessarily $E2_1^+$. It comes out to be 32.8^0. It has been kept in mind that the repulsion among even spin level of γ band and Yrast band causes asymmetry and it can best be estimated when repulsion is strongest. Another value of $\gamma = 31.6^0$ which has been evaluated using B (E2) values for ^{192}Pt.

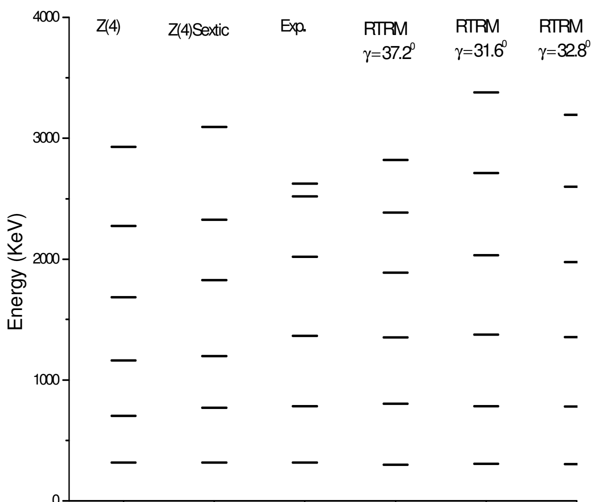

Fig. 1. Energy levels of ground band in ^{192}Pt nucleus

For these three values of γ, we have calculated RTRM energies for ground state and γ – band which are shown in Fig 1 and Fig 2 respectively along with the experiment, Z(4) and Z(4)Sextic. As seen from fig 1 and 2 the ground state and γ – band energies are very close to the experimental for γ = 32.8^0 calculated by the ratio R (= $E2_2^+/En_1^+$) where the En_1^+ belongs to any level of Yrast band nearest to $E2_2^+$.

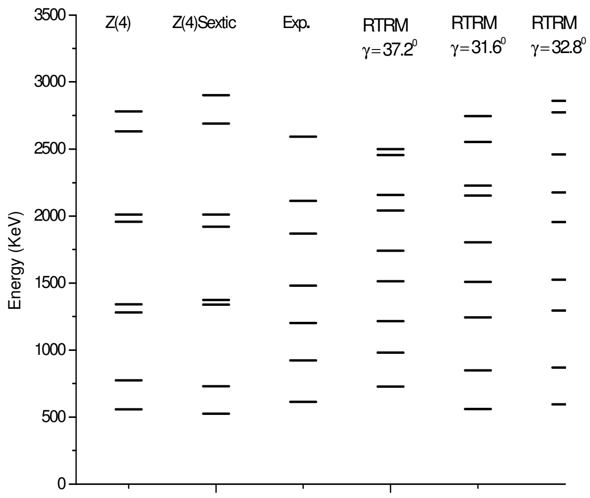

Fig. 2. Energy levels of gamma band for ^{192}Pt

Further, staggering indices have been calculated for γ – band using relation –

$$S(J) = \frac{(E4_2^+ - E3_1^+) - (E3_1^+ - E2_2^+)}{E2_1^+}$$

The staggering indices have been plotted for ^{192}Pt and shown in fig 3. It is clear from fig. 3 that the RTRM (γ = 32.8^0) values match with the experiment except S (4) and S (5). However, staggering for z(4) and Z(4)$_{\text{sextic}}$ do not match with the experiment in sign and magnitude. The values of S (4) and S (5) in experiment are very small in magnitude which reflects that the nucleus is axial rotor at low spin and at higher spin it becomes more rigid.

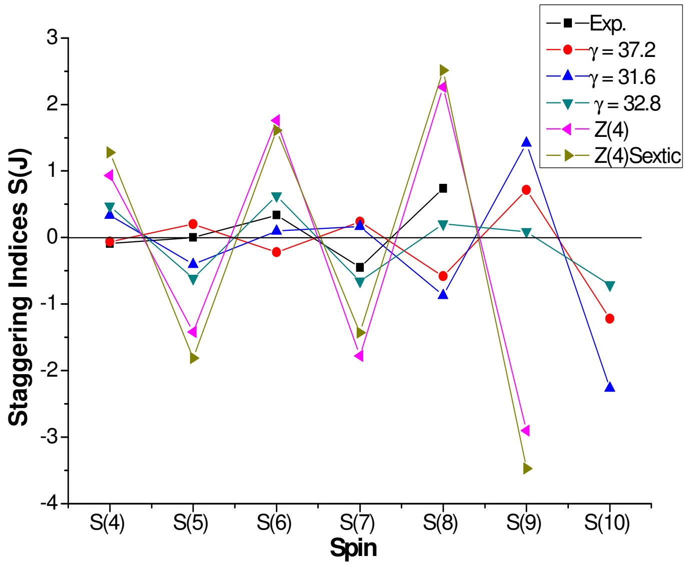

Fig 3

References:

1. J. Yan, O. Vogel et al; Phys. Rev. C **48** 1046 (2008).
2. O. Vogel et al; Phys. Rev. C **53** 1660 (1996).
3. R. Gilmore and D. H. Feng; Phys Lett B **76** (1978).
4. F. Ichello; Phys rev. Lett **91** 132502 (2008).
5. D. Bonatsos et al; Phys Lett B 588 172 (2004).
6. D. Bonatsos et al; Phys Lett B 632 238 (2006).
7. P. Buganu and R. Budaca; Phys rev. C 91 014306 (2015).
8. A. S. Davydov and G. F. Filippov; Nucl. Phys **8** 237 (1958).
9. J. Wilets and M. Jean; Phys Rev. **102** 788 (1956).

Acknowledgement:

One of the authors namely M. Singh is thankful to the Chairman and Director GNIOT, Gr. Noida, for their kind co-operation and providing working facilities.