Systematic of triaxial moment of inertia in even nuclei of mass region A = 90 – 120

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The Ru – isotopes with Z > 50 lie in a region of structural change that has been a challenge to theoretical interpretations. The Zr and Sr – isotopes near A ~ 100 undergo the most rapid spherical deformed transition in heavy nuclei. The rate of change of structure with neutron number becomes more gradual with increasing proton number in Mo, Ru, Pd and Cd – nuclei. The Ru – isotopes show a smooth increase of collectivity with neutron (Table – I) which shows that the energy of the first excited state $(E2_1^+)$ drops smoothly, $B(E2;2_1^+ \to 0_1^+)_{exp}$ and $R_{4/2} = (E4_1^+/E2_1^+)$ increase as neutron number increases from 54 to 68. The values of parameter γ for neighbouring Mo and Pd – nuclei vary smoothly with mass number (A), decreasing for Mo – nuclei and increasing for Pd – nuclei.

The Ru-Chain of nuclei is Intermediate between these two having opposite trends for parameter γ and has an irregular behavior relative to parameter 'γ'. The Hamiltonian in Asymmetric rotor model of Davydov-Filippov [2] is written as

$$H = \frac{n^2}{Z}\sum_i I_i^2 / J_i \qquad (1)$$

Where, I_i is projection of the angular momentum on the intrinsic curves. The moment of Inertia of the model are given by the hydrodynamic relation

$$J_k = \frac{4}{3} J_0 Sn^2 (\gamma - \frac{2n}{3} K) \qquad (2)$$

Where, $J_0 = 4B\beta^2$ ……………………… (3)

Simple analytical expressions for the energy of two levels of the required symmetry are, for 1=2,
Defined by expression –

$$\varepsilon 2_{1,2}^+ = \frac{9 - (-1)^{\sigma_{1,2}} \sqrt{1 - \frac{8}{9}\sin^2(3\gamma)}}{Sin^2(3\gamma)} \qquad (4)$$

Where, $\sigma_{1,2} = 0,1$
The enrgy of a level with angular momentum I = 3 is given by –

$$\varepsilon(3) = \frac{18}{\sin^2 3\gamma} \qquad (5)$$

The moment of inertia parameter 'a' (= $\hbar^2/J_0$) is significant and therefore, is considered to be discussed in the present work since 'a' is directly related with deformation ($J_0 = 4B\beta^2$).
We consider the γ – band (anomalous rotational band in ARM) consist of two different energy sequences viz. odd spin energy and even spin energy as it essential at large asymmetry [3]. The moment of inertia parameters are different for these sequences and are evaluated as –

$$a_r = E 2_1^+ / \varepsilon 2_1^+ \qquad (6)$$

$$a_e = E 2_2^+ / \varepsilon 2_2^+ \qquad (7)$$

$$a_o = E 3_1^+ / \varepsilon 3_1^+ \qquad (8)$$

where, $E2_1^+, E2_2^+$ and $E3_1^+$ are experimental evergies of yrast energy band, even spin energy sequence and odd spin sequence of γ-band. $\varepsilon 2_1^+, \varepsilon 2_2^+$ & $\varepsilon 3_1^+$ are energy of band head of rest, even and odd spin sequence of γ – band given by equations (4) and (5). The value of a_r, a_e and a_o so calculated are listed along with

N_pN_n in table – I, Inferences, drawn from entries of table I are summarized as under:
The moment of inertia parameters $a = \hbar^2 / J_0$ are supposed to follow the trend of deformation parameter 'β' versus N_pN_n since the moment of Inertia depends on square of deformation 'β'. The trend of moment of Inertia 'a' is opposite to 'β'. In Mo chain, a_e and a_γ have minimum at midshell N=66 but a_e is minimum one step prior N=64. Ru nuclei given all of moment of inertia's minimum at one step forward i.e at N=68 and Pd chain also show all moment of inertia's minimum at one step forward such that at N = 68. The extensive study have been under taken for the first five in the transitional mass region A = 90 – 120.

The qualitative trend of 'a' versus N_pN_n are found similar in Ru and Pd isotopes. The present study points out a systematic difference in the rates of growth of collectivity [4] in different regions i. e particle – particle and hole - hole (P, P & P, H) that seems not to have been noted before in moment of inertia 'a'.

Table – I; The value of N_pN_n, a_γ, a_e and a_o

Nucleus	N_pN_n	a_γ	a_e	a_o
^{92}Mo	0	228	272.0	-
^{94}Mo	16	131	164.0	-
^{96}Mo	32	117	143.0	110
^{98}Mo	48	132	155.0	-
^{100}Mo	64	81	229.0	-
^{102}Mo	80	45	109.0	-
^{104}Mo	96	34	34.0	50
^{106}Mo	112	32	40.0	38
^{108}Mo	128	34	39.0	38
^{98}Ru	24	106	112.0	107
^{100}Ru	36	92	101.0	98
^{102}Ru	48	80	83.6	79
^{104}Ru	60	62	64.2	63
^{106}Ru	72	49	49.5	50
^{108}Ru	84	44	44.2	45
^{110}Ru	96	42	42.2	42
^{112}Ru	84	40	39.7	39
^{102}Pd	24	100	98.0	117
^{104}Pd	32	95	99.9	101
^{106}Pd	40	84	84.8	86
^{108}Pd	48	70	73.8	71
^{110}Pd	56	60	72.4	64
^{112}Pd	64	55	60.3	59
^{114}Pd	56	53	57.0	55
^{116}Pd	48	55	58.0	57

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