

## Correlation of average scaling coefficient with asymmetric parameter and average power index with quadrupole deformation parameter

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### Introduction:

The nuclear structure of even-even nuclei in ground state band and other excited bands with non zero band head is collectively built [1]. The level energy in medium mass region deviates below the ideal rotor energy formula  $E_I = AI(I+1)$ . The ground band of medium mass nuclei are studied using various energy formulae e.g. Soft Rotor Formula [2], VMI etc. Gupta et al. [3] proposed the power law and studied the systematics of ground band. The level energy from Power Law is

$$E = aI^b \quad (1)$$

where, a and b are scaling coefficient and power index.

The power law parameters (average scaling coefficient and average power index) are obtained using spin up to I=12 in Eq. (1).

In RTR model the asymmetric parameter ( $\gamma$ ) is obtained using  $E(2_1)$  of ground band and  $E(2_2)$  of  $\gamma$ -band for medium mass region. The asymmetric parameter:

$$\gamma = (1/3) \sin^{-1} [(9/8) \{1 - ((R\gamma - 1)/(R\gamma + 1))^2\}]. \quad (2)$$

where,  $R_\gamma = E(2_2)/E(2_1)$ . The quadrupole deformation parameter ( $\beta$ ) is related with  $B(E2)$  values, energy (E) and atomic mass (A) of the nuclei as:

$$\beta = \left( \frac{4\pi}{3ZR_0^2} \right) \left[ \frac{B(E2)\uparrow}{e^2} \right]^{1/2} \quad (3)$$

and

$$\beta = (466 \pm 41) E^{-1/2} A^{-1} \quad (4)$$

where,  $R_0$  is  $1.2A^{1/3}$  fm,  $B(E2)\uparrow$  is in  $e^2 b^2$ , Z is atomic number, E is the energy of spin I=2 of

ground band and A is atomic mass. The  $\beta$  is taken from [4] and [5].

The correlation of average scaling coefficient, asymmetric parameter and average power index and deformation parameter versus N is studied quadrant -1.

### Systematics dependence of $a_{AV}$ and $\gamma$ with N

In quadrant-I ( $60 < Z < 66$ ,  $82 < N < 104$ ), as neutron number increases, the asymmetric parameter as well as scaling parameter decreases fast up to  $N=92$  and after  $N>92$ , both parameters remains uniform for Nd, Sm, Gd and Dy nuclei in Fig. 1.(a and b).

In quadrant II ( $66 < Z < 82$ ,  $82 < N < 104$ ), the asymmetric parameter as well as scaling parameter decreases as neutron number rises towards  $N=104$  Fig for Q-II,III,IV to be presented).. From  $N=102$  to  $N=104$  both parameters decrease slowly. In quadrant-III ( $60 < Z < 66$ ,  $104 < N < 126$ ), as neutron number increases, the W and Os nuclei shows a dip at  $N=108$  and for  $N>108$  both parameters rises, whereas the Pt nuclei shows separate fast increasing trend. In quadrant -IV  $N < 82$ , for  $N > 64$ , the scaling parameters as well as asymmetric parameters, both are increases as neutron number rises. Here Xe nuclei shows separate rising trend with both parameters (Figs. to be shown in poster).

### Systematics dependence of $b_{AV}$ and $\beta$ with N

In quadrant-I, the deformation parameter  $\beta$  and power index parameter  $b_{AV}$  sharply rises as N increases from 86 to 92. For  $N > 92$ , both parameters show uniform trend and saturates in fig. 2.1(a and b).

In quadrant-II, the Er and Yb nuclei show same trend for both parameters for  $N = 88-104$ . The  $\beta$  rises for Hf and W nuclei when N increases from 88 to 98 and decreases towards  $N = 100$  and again rises on increasing N. The

$b_{AV}$  rises for Er-Os nuclei when N increases from 88 to 104. The Pt has different behavior. In quadrant-III, the Pt nuclei shows same trend with both parameters whereas after  $N > 108$ , the W and Os nuclei shows same trend.

In quadrant-IV, the nuclei Ba, Ce, Nd and Sm shows same trend, whereas the Xe nuclei has a dip at  $Z = 66$  in power index parameter and a up in deformation parameter.

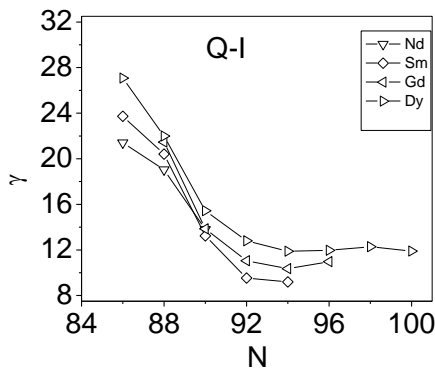


Fig.1 (a) The plot of  $\gamma$  vs. N in Q-I.

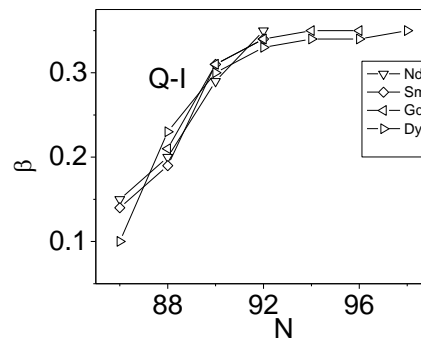


Fig. 2(a) The plot of  $\beta$  v N in Q-I.

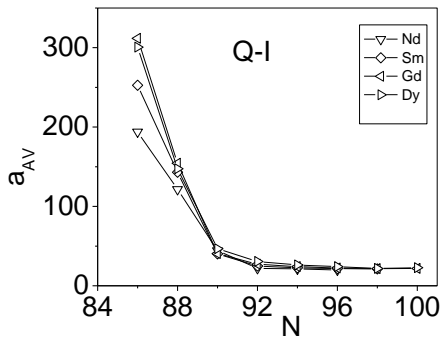


Fig. 1(b) The plot of  $a_{AV}$  vs. N in Q-I.

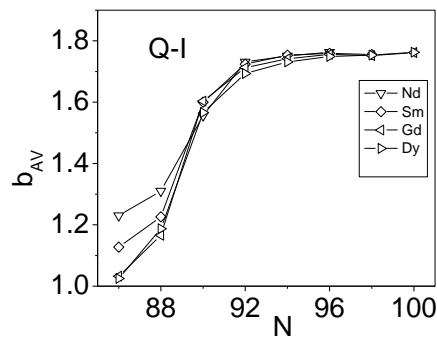


Fig. 2(b) The plot of  $b_{AV}$  vs. N in Q-I.

**Conclusion:** The average scaling coefficient with asymmetric parameter and

**References:**

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average power index with N show strong correlation in all four quadrants.

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