Systematic dependence of B(E2)↑on N_pN_n

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Introduction

The study of the variation of collective nuclear structure with (a) neutron number N, proton number Z, (b) total boson number N_B (=N_p+ N_n, where N_p and N_n are the valence proton and neutron numbers respectively), and (c) the product N_pN_n, provide a deep understanding of collective nuclear interactions involved.

Earlier, Casten [1] studied the variation of the energy ratio R_4 and the $E(2_1^+)$ with the total boson number N_B and the N_pN_n product for A =100-200. Gupta et al [2] presented a systematic dependence of the γ–g B(E2) ratios on the N_pN_n product in different parts of the major shell space Z=50 – 82 , N < 82 and N = 82 – 126 and demonstrated that the interband B(E2) ratios were smooth functions of N_pN_n. The above studies were related to the N_pN_n in even-even nuclei. The systematic dependence of B(E2, $0_1^+ \rightarrow 2_1^+$) on N_pN_n quadrant wise was not studied earlier. This may provide a new insight. The recent data of the transition probability B(E2, $0_1^+ \rightarrow 2_1^+$) have been taken from the website of nndc [3] and Atomic Data & Nuclear Data Tables [4].

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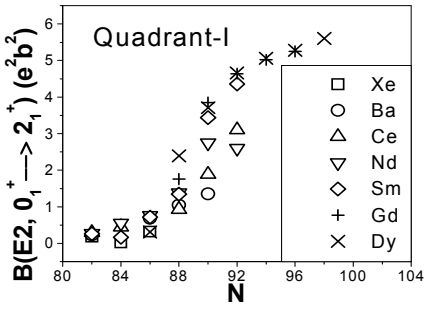

Fig.1. Plot of B(E2, $0_1^+ \rightarrow 2_1^+$) with N in quadrant-I.

Results and Discussion

In quadrant-I, the B(E2, $0_1^+ \rightarrow 2_1^+$) versus N data for Xe-Dy lie on a smooth curve (Fig. 1). At N=88-90, there is sharp phase transition. B(E2)↑ saturates for N>92. At N=88, 90, 92, value rises with increasing Z. The plot of B(E2)↑ versus N_pN_n (figure 2) provides a smooth dependence on N_pN_n with somewhat lesser spread, but the sharp phase change is less evident.

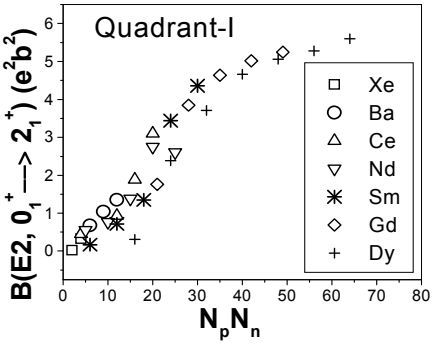

Fig. 2. Plot of B(E2, $0_1^+ \rightarrow 2_1^+$) values with N_pN_n in quadrant-I.

The B(E2)↑ for Dy-W (Z=66-74, N<104) in Quadrant–II (Fig. 3), rise with N, but each Z has it own smooth curve, for higher Z being lower. If one plots the same data versus N_pN_n a smooth single curve (with some spread) is obtained (Fig. 4). This is similar to the F-spin multiplets observed in Quadrant-2 earlier.

The B(E2, $0_1^+ \rightarrow 2_1^+$) for Yb-Pt (N> 104) in quadrant-3) (Fig. 5) plotted versus N yield a different pattern, values falling with increasing N. Each Z has it own slope. The same data on a plot versus N_pN_n (figure 6) yields a smooth rising curve.

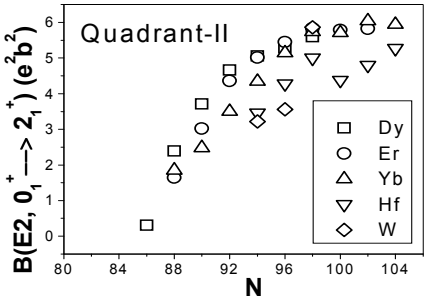

Fig. 3. The plot of B(E2, $0_1^+ \rightarrow 2_1^+$) values with N in quadrant-II.

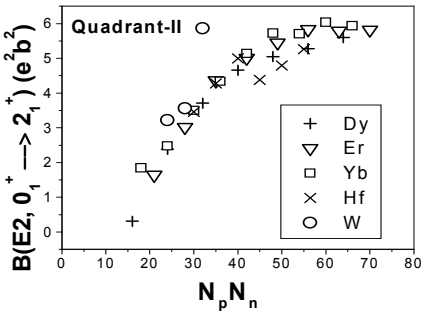

Fig.4. The plot of B(E2, $0_1^+ \rightarrow 2_1^+$) values with N_pN_n in quadrant-II**.**

In all three regions (Q I-III), B(E2, $0_1^+ \rightarrow 2_1^+$) values have a systematic dependence on N_pN_n. but having different patterns.

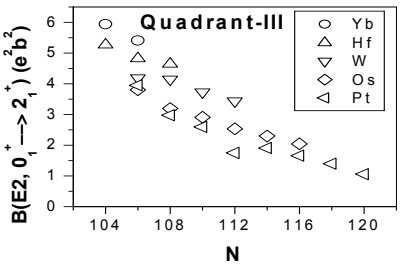

Fig.5. The plot of B(E2, $0_1^+ \rightarrow 2_1^+$) values with N in quadrant-III.

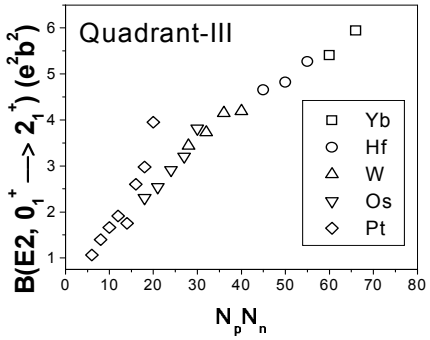

Fig. 6. The plot of B(E2, $0_1^+ \rightarrow 2_1^+$) values with N_pN_n in quadrant-III**.**

References

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