IN SEARCH OF NEW RELATIONSHIP IN N_pN_n SCHEME

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It is well understood now that the use of quantity N_pN_n as a variable to gauge the structure of a given nucleus, and to track the evolution of structure, is called the N_pN_n scheme. We stress here that the early schemes, as Mallman plots and the Grodzins rule, not only provided correlations of widespread data but pointed directly to underline physical properties [1]. In the first case, Mallman plots reveals that rotational energies depend linearly and quadratically on angular momentum. The Grodzins rule links the behavior of Eigen values and transition rate.

In recent years, effort have been made for minimizing the uncertainties in Grodzins Rule introducing asymmetry in the even symmetric nuclei of medium mass range and to provide new relationship on moment of inertia in N_pN_n scheme [2]. It has almost been established that the quadrupole deformation β in the nuclei increase with the increase of proton-neutron interaction strength N_pN_n till it optimizes at mid-shell and then start reducing onwards. Quite the contrary the asymmetric deformation γ decreases with the increase of N_pN_n and optimizes at mid-shell then it starts increasing with the increase of N_pN_n [3]. More sensitive quantity $\frac{\varepsilon}{\delta} = \beta_2/(N_p + N_n)$ has currently been discussed whose relationship with N_pN_n is excellently smooth in Ru isotopic chain [4]. It qualitatively matches with N_pN_n – γ systematic thus $\frac{\varepsilon}{\Delta}$ and γ, both have similar systematic in N_pN_n scheme in Ru nuclei. This new relationship need to be tested in broader way also and thus we present here Ru, Xe, Ba, and Hf isotopic chain covering medium and heavy mass of nuclear chart in N_pN_n scheme, where the above view point is clearly verified in wider sense(table 1 and fig. 1).

Table –1

Nucl.	N_pN_n	$\frac{\varepsilon}{\delta}\times10^{-3}$	γ(in deg.)
^{98}Ru	24	19.5	27
^{102}Ru	48	17.2	25.5
^{104}Ru	60	16.9	24.4
^{110}Ru	96(mid-shell)	13.5	24
^{112}Ru	84	15.3	26
^{114}Xe	40	15.8	24
^{116}Xe	48	15.2	24
^{120}Xe	64(mid-shell)	14.1	23.4
^{122}Xe	56	14.7	24
^{128}Xe	32	15.7	26.6
^{130}Xe	24	17.6	27.6
^{132}Xe	16	18.2	≈30
^{134}Xe	8	21.6	≈30
^{136}Xe	0(magic)	30.5	-
^{140}Xe	16	14.2	-
^{124}Ba	84	14.7	20.3
^{126}Ba	72	15.7	21.8
^{128}Ba	60	15.9	22.3
^{130}Ba	48	≤15.5	24.4
^{132}Ba	36	16.9	26.4
^{134}Ba	24	20.4	28.3
^{136}Ba	12	15.6	-
^{138}Ba	0(magic)	15.8	-
^{140}Ba	12	16.8	24.5
^{142}Ba	24	12.5	19.5
^{144}Ba	36	12.3	-
^{146}Ba	48	11.9	-
^{166}Hf	120	11.0	17
^{168}Hf	140	11.0	15
^{170}Hf	160	10.0	13
^{172}Hf	180	9.5	12.5
^{174}Hf	200	9.5	12.5
^{176}Hf	220(mid-shell)	9.2	10.7
^{178}Hf	200	9.4	11.2
^{180}Hf	180	9.8	11.2

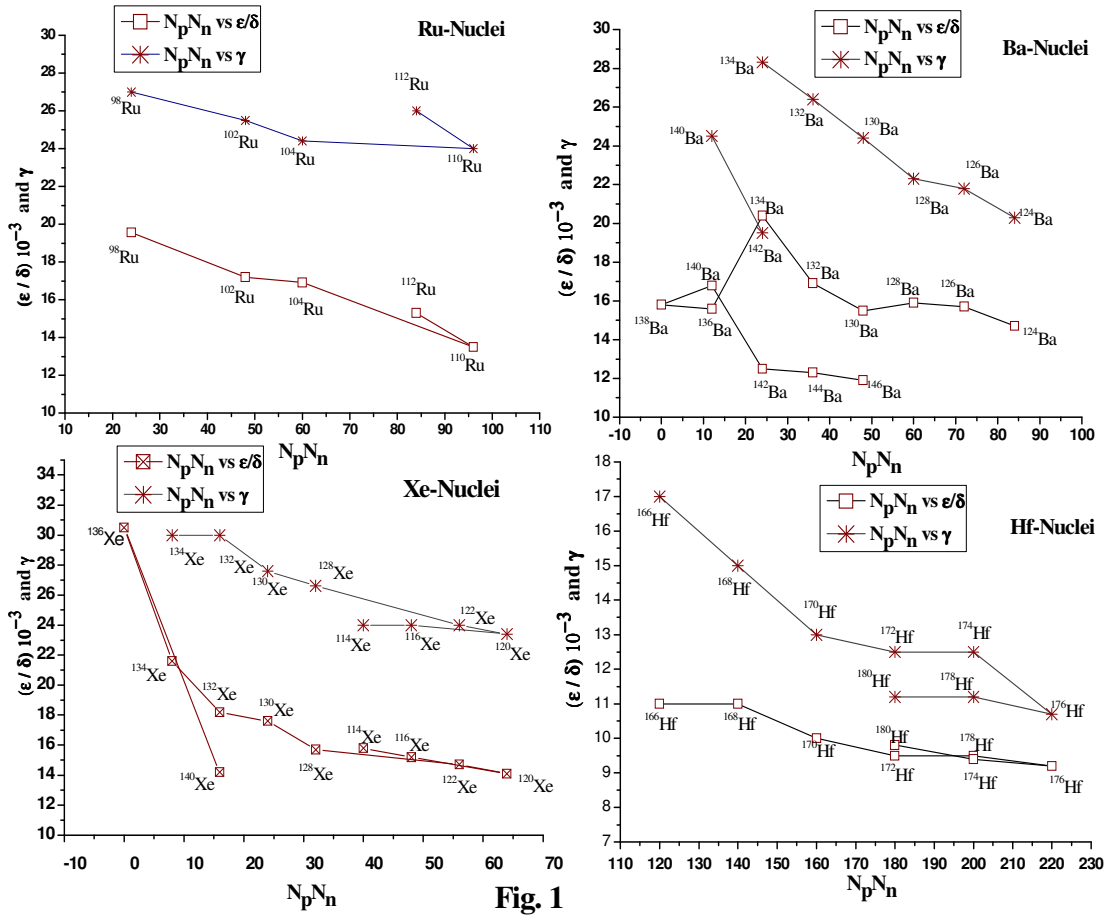

Fig. 1

The values of γ and $\frac{\varepsilon}{\Delta}$ in above nuclei get optimized at mid shell and also at magic N_pN_n. Both variables have similar qualitative trend in N_pN_n scheme which reflects from table 1 and the fig 1.. Such smooth relationships are useful for experimentalist and theoreticians both because of its predictive power and linear nature.

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