Search for Asymmetric rotors in mass region A~100

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In the description of collective nuclear dynamics the mass coefficient plays as important role as the potential energy. However, much less is known about the mass coefficient in comparison with the numerous calculations of the potential energy. Frequently, it is assumed that the mass coefficient is a constant and in case of transitional nuclei, the same mass coefficient is used for description of the rotational motions of ground band and the γ-vibrations. However, in case of well deformed nuclei Jolos and Brentano has recently introduced different mass coefficients for the ground and γ-band [1]. Information about the mass coefficient can be extracted from the experimental data on excitation energies and electric quadrupole transition probabilities. The two Grodzins products $E(2_1^+)B(E2;2_1^+ \rightarrow 0_1^+)$ and $E(2_1^+)B(E2;2_2^+ \rightarrow 0_1^+)$ are inversely proportional to the corresponding mass coefficients.

Recently in mass region A~120-140 Xenon and Barium nuclei have been studied and the energy systematics have been drawn with excellent correlations in mass coefficient and rotation vibration interaction parameter with product of valance nucleons N_pN_n using three mass coefficients one each for yrast, odd and even γ-bands within the framework of general asymmetric rotor model [2]. Interestingly in the mass region A ~ 100 Ruthenium nuclei have been dealt using similar approach but only one mass coefficient was found sufficient to reproduce the striking correlations among various parameters [3]. The purpose of the present work is to study whether one mass coefficient ($B_\gamma = B_{rot}$) works well in describing the inter band transitions in other nuclei in mass region A ~ 100. We consider Mo, Ru and Pd nuclei and calculate the B(E2) values using asymmetric rotor model [4].

This is interesting that the calculated values of Davydov Rostovsky Model (DRM) [4] are close to experimental data and there is no need to assume $B_\gamma \neq B_{rot}$. However, there are two exceptions when the DR values are small and larger than experiment it they are divided by the factor calculated from the ratio P_{rot}/P_γ then the values are further reduced and become far away from experiment instead of coming closer. Thus the assumption of $B_{rot} \neq B_\gamma$ does not work at all. The nuclei, transitional one, possessing large asymmetry do not need to assume $B_{rot} \neq B_\gamma$ for describing inter band inter band transitions.

However, some values are very small in Pd nuclei. The values for $^{98-100}$Mo are very large and put these nuclei out of DRM range. $^{100-102}$Ru nuclei are truly asymmetric rotors.

Table 1

Nucleus	$B(E2;\frac{2^+_\gamma \to 0^+_g}{2^+_g \to 0^+_g})$			$B(E2;\frac{2^+_\gamma \to 2^+_g}{2^+_g \to 0^+_g})$	
	Exp	DR $B_\gamma = B_{rot}$	DR $B_\gamma \neq B_{rot}$	Exp.	DR $B_\gamma = B_{rot}$
^{98}Mo	0.047	12.5	-	2.9	115.2
^{100}Mo	0.028	262.5	-	0.98	1596
^{98}Ru	0.018	0.015	-	1.8	0.01
^{100}Ru	0.356	0.630	0.013	0.87	0.44
^{102}Ru	0.025	0.231	-	0.9	1.9
^{104}Ru	0.75	0.22	-	0.02	0.03
^{102}Pd	0.055	0.019	-	0.43	0.12
^{104}Pd	0.04	0.001	-	0.81	0.09
^{106}Pd	0.029	0.006	-	1.09	0.006
^{108}Pd	0.023	0.016	-	1.69	0.14
^{110}Pd	0.015	0.025	-	1.0	0.25

Table 2

Nucleus	$B(E2;3_\gamma \to \frac{2^+_g}{2^+_\gamma})$			$B(E2;3_\gamma \to \frac{4^+_g}{2^+_\gamma})$	
	Exp	DR $B_\gamma = B_{rot}$	DR $B_\gamma \neq B_{rot}$	Exp.	DR $B_\gamma = B_{rot}$
^{98}Ru	-	-	-	0.93	0.25
^{100}Ru	0.06	0.13	-	0.21	0.05
^{102}Ru	0.04	0.02	-	0.25	0.97
^{104}Ru	0.04	0.02	-	0.14	0.74
^{104}Pd	0.031	0.044	-	0.36	0.19
^{106}Pd	0.026	0.05	-	0.83	1.1
^{108}Pd	0.021	0.72	-	-	-
^{110}Pd	0.024	0.34	0.01	-	-

References:

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