Study of Quasibands in ^{150}Sm using IBM

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Introduction

The interacting boson model-1 (IBM-1) of Arima and Iachello [1] has been successful in describing the collective nuclear properties in the medium mass nuclei. Earlier systematic studies of $^{146-154}$Sm have been performed using interacting boson model [2] and Dynamic Pairing-Plus-Quadrupole (DPPQ) Model [3,4,5]. Very recently Diab [6] presented electrical monopole transition structure of ^{150}Sm isotope. Simpson et al.[7] successfully interpreted the isomers of ^{156,158}Sm using Quasiparticle Rotor Model. Sharma and Kumar [8] presented a fresh analysis of g- , β-, and γ- bands upto higher spins in ^{150}Sm using IBM. This search is now extended to calculate B(E2) values for (g -> g), (β -> g) , (β -> β), (γ -> g) and (γ -> β) transitions using IBM and compare with experimental data.

The Interacting Boson Model

The phenomenological interacting boson model-1 (IBM-1) initially introduced by Arima and Iachello[1] has been rather successful in describing the collective properties of several medium and heavy mass nuclei. In the first approximation, only pair with angular momentum L=0 (called s – boson) are considered. The model has associated with it an inherent group structure, which allows for the introduction of limiting symmetries called SU(5), SU(3) AND O(6).

The multi-pole form of the interacting boson model-1 (IBM-1) Hamiltonian is given by

$$H=\varepsilon\hat{n}_d+a_0\left(\hat{P}^+.\hat{P}\right)+a_1\left(\hat{L}.\hat{L}\right)+a_2\left(\hat{Q}.\hat{Q}\right)$$
$$+a_3\left(\hat{T}_3.\hat{T}_3\right)+a_4\left(\hat{T}_4.\hat{T}_4\right)$$

Result and Discussion

The absolute B(E2) values are presented in table 1, where the experimental data [9,11] is compared with the present calculation and other previous work [5,9,11,12,13] . The B(E2) values are available for 15 transitions. In the present calculation the B(E2) values for (g -> g) transition increases with spin I^+. The same feature is also observed by Yen et al.[14], however, in the experiment B(E2) values increases with spin upto 4^+ and decreases when spin increases from 8^+ to 10^+. For (β -> g) , (β -> β), (γ -> g) and (γ -> β) transitions the theoretical values lie very close to the experimental data.

In the effective IBM-1 calculation [13] the B(E2; 2g -> 0g) value is 8 times smaller than observed value, for (2β -> 0g) transition it gives 135 times larger value than observed and for (2γ -> 2g) transition the calculated value is 20 times smaller than experiment, but in present calculation all these three B(E2) values lie very closed to the observed values. Yen et al,[14] used the effective IBM calculation and included the Z = 64 proton sub-shell effect for N< 90 region. They[12] used two sets of calculation i. e. MI and MII, in MI the proton boson were counted from Z=50 closed shell, however, jn MII set the Z = 64 subshell was included and obtained better results from MII [12].

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Table 1. Absolute B(E2 ; I i – I f) values (in e^2 b^2 unit) for ^{150}Sm.

I i -> I f	Expt.	Present work	DPPQ		BEM	IBM[f]		IBM[g]
	b		d	e	c	MI	MII	
2g->0g	0.264(12)[a]	0.269	0.41	0.186	0.275	0.355	0.318	0.034
4g->2g	0.49(4)	0.5339	0.73	0.186	0.51	0.708	0.566	0.54
6g->4g		0.7465						
8g->6g	0.435[c]	0.8738				0.934	0.609	
10g->8g	0.447[c]	0.9076				0.700	0.512	
4g->2β	0.0106[c]	0.1201			0.139	0.08	0.05	0.006
0β->2g	0.218(26) 0.26(3)[c]	0.686	0.47	0.43	0.42			
2β->0g	0.004(2)[c]	0.0146	0.008	0.0074	0.02	0.09	0.021	0.54
2β->2g	0.27(15) 0.043(20)[c]	0266	0.12	0.108	0.181	0.14	0.11	
2β ->4g	0.55(30) 0.17(10)[c]	0.216	0.10	0.10	0.077			
4β ->2g		0.013		0.0004	0.007			
4β ->4g		0.127		0.063	0.105			
2β ->0 β	0.56(31)	0.23	033					
2γ ->0g	0.009(4) 0.009(2)[c]	0.004		0.015	0.02	0.0001	0.004	0.001
2γ ->2g	0.29(11) 0.039(14)[c]	0.082	0.029	0.027	0.024	0.005	0.08	0.002
2γ->4g	0.028(13) 0.019(10)[c]	0.129	0.059	0.054	0.087	0.036	0.025	
2γ->0β	0.034(16)	0.1297	0.097					
2γ->2β	0.4(3)	0.3323	0.55					
4γ->2g		0.0042		0.009	0.022			
4γ->4g		0.0677		0.035	0.032			

[a] Reference [9] [b] Reference [10] [c] Reference [11] [d] Reference [4]
[e] Reference [5] [f] Reference [12] [g] Reference [13]

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