Whether ^{192}Os is a triaxially rigid nucleus?

A K. Varshney[1], M. Singh[2], Y. Singh[3], K. K. Gupta[4],

1. *Govt. College, Palampur, HP University, Shimla, (HP) INDIA.*
2. *Greater Noida Institute of Technology, Greater Noida, (UP) INDIA.*
3. Govt. College, Shahpur (HP), INDIA
4. *Govt. College, Dhaliara, (HP) INDIA.*

Many numbers of E2 transaction rates in ^{192}Os nucleus has recently been exhibited which have been compared with the calculations starting with the differential equation for β and γ variables, involving also the Euler angles, provided by the liquid drop model. The B (E2) values for ^{192}Os were calculated in three different formalism X (5), infinite square well potential (ISW), Davidson's potential (D) and compared with the corresponding experimental data in units of e^2b^2 [1]. We have calculated the hindrance/enhancing factor (F) in each of calculations for above three different formalisms. It is found that the factor exceeds by two in general in all of the formalisms presentation leaving aside the pure inter Yrast band transitions. In many cases F is more than a factor of four and in some cases it exceeds 20 and becomes 77.

In the present work we have employed the rigid triaxial rotor model (RTRM) of Davydov and Filippov for evaluating the known transition rates [2]. The RTRM considers the nucleus as a rigid rotor with rigid triaxial asymmetry as specified by γ and the fixed value of deformation parameter β. According to the classical aaproximation to the dynamics of the triaxial core, the nucleus prefers rotation about the axis with the largest moment of inertia in order to minimize the rotational energy. We have $|\beta A^{2/3}| < 4$ as a weak coupling classification in terms of core excitation states (and therefore these are vibrational nuclei) $|\beta A^{2/3}| > 7$ for well deformed nuclei and $4 < |\beta A^{2/3}| < 7$ more adequate for transitional nuclei. In ^{192}Os, the value of $\beta = 0.1667$ and A = 192 and thus the value of $|\beta A^{2/3}| = 5.55$. Therefore, ^{192}Os is suitable candidate to be considered by RTRM. We took another test for triaxialityon the basis of energy relation $\Delta E1 = E3_1^+ - [E2_1^+ - E2_2^+]$ for triaial nucleus given by Davydov et al [2] and for γ – soft nucleus $\Delta E2 = E3_1^+ - [2E2_1^+ + E4_1^+]$ given by wilets et al. [3]. The value of $\Delta E1$ for this nucleus is 3 KeV while the value of $\Delta E2$ is 301 KeV which is too large and further supports the employement of RTRM in calculating the E2 transaction rates.

The energies of $2_{1,2}^+$ states in RTRM is given by

$$E2^+_{1,2} = \frac{9[1-(-1)^{\sigma_{1,2}}\sqrt{1-\frac{8}{9}X}}{X} \quad (1)$$

where $\sigma_{1,2} = 0, 1$
and $X = \sin^2 3\gamma$
The reduced transition probabilities are given by –

$$B(E2; 2^+_{1,2} \to 0^+_1) = \frac{e^2 Q_0^2}{32\pi}\left[1(-1)^{\sigma_{1,2}}\frac{3-2X}{\sqrt{9-8X}}\right] \quad (2)$$

The energy ratio $R(\gamma) = E2_2^+/E2_1^+$ and $R_B(\gamma) = B(E2;\ 2_2^+ \to 2_1^+)/B(E2;\ 2_2^+ \to 0_1^+)$ depends only on γ and used to evaluate asymmetry parameter γ. The asymmetric parameter of this nucleus calculated from energy ratio and E2 transition ratio is 25^0 and 21^0 respectively.

The calculated values of known transition rates using RTRM are listed in table – I. The experimental values along with X (5), ISW and D formalism are also presented in the same table – I for the sake of comperision. The values which deviate by more than a factor of 2 are underlined.It surprises that RTRM values with $\gamma = 21^0$ describe all transitions except $6_2^+ \to 4_1^+$only.

As the electric quadrupole transition probabilities are sensitive to the asyemmetric parameter γ it appears that γ – band of 192Os nucleus is a result of rotation of triaxially rigid nucleus.

Table-I

The B (E2)s values in units of e^2b^2 are listed. The first columns headed by ISW and D formalism respectively are resluts with harmonic and in second column with anharmonic quadrupole transition operator.

Transition	Exp.*	Rigid Rotor		X(5)*	ISW*		D*	
		$\gamma = 25^0$	$\gamma = 21^0$					
$2_1^+ \to 0_1^+$	0.424	0.405	0.397	0.424	0.424	0.424	0.424	0.424
$4_1^+ \to 2_1^+$	0.497	0.579	0.581	0.678	0.678	0.656	0.726	0.673
$6_1^+ \to 4_1^+$	0.660	0.722	0.695	0.841	0.840	0.787	0.981	0.836
$8_1^+ \to 6_1^+$	0.754	0.801	0.780	0.966	0.964	0.879	1.230	0.966
$10_1^+ \to 8_1^+$	0.688	0.848	0.831	1.060	1.06	0.947	1.450	1.060
$2_2^+ \to 0_1^+$	0.037	0.018	0.027	0.012	0.009	0.037	0.009	0.037
$2_2^+ \to 2_1^+$	0.303	0.367	0.196	0.019	0.014	0.057	0.015	0.062
$4_1^+ \to 2_2^+$	0.014	0.016	0.0145	0.001	0.006	0.026	0.007	0.029
$4_2^+ \to 2_1^+$	0.002	0.0089	0.0019	0.008	0.006	0.026	0.007	0.028
$4_2^+ \to 4_1^+$	0.203	0.132	0.132	0.027	0.020	0.084	0.023	0.102
$6_1^+ \to 4_2^+$	0.012	0.0047	0.018	0.006	0.006	0.025	0.007	0.032
$6_2^+ \to 4_1^+$	0.0004	0.000	0.004	0.006	0.006	0.025	0.007	0.031
$6_2^+ \to 6_1^+$	0.171	0.055	0.066	0.023	0.023	0.100	0.029	0.138
$4_2^+ \to 2_2^+$	0.298	0.184	0.2000	0.269	0.275	0.274	0.302	0.288
$6_2^+ \to 4_2^+$	0.336	0.343	0.365	0.611	0.0610	0.590	0.730	0.643
$8_2^+ \to 6_2^+$	0.314	0.420	0.437	0.823	0.807	0.761	1.050	0.858

*The data have been taken from ref.1.

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