ON THE MIXING RATIOS (M_1-E_2) IN SOME EVEN-EVEN NUCLEI

THE vibrational-spherical model of Goldhaber and Weneser[1] which had considerable success in correlating the properties of even-even nuclei, such as energy-ratios, etc., does not make any quantitative predictions concerning these properties. The Davydov and Filippov[2] model based on the assumption that the energy levels of even-even nuclei away from deformed region can be represented as rotational levels of an asymmetric rotor, on the other hand, makes quantitative predictions regarding the specific properties of even-even nuclei. One such parameter is the mixing ratio in 2′→ 2 transition.

Another model which makes quantitative prediction concerning the mixing ratio is the single particle model.

In this note we have carried out a comparison between the predictions of the S-P model and the D-F model regarding the M_1-E_2 mixing ratio.

The mixing ratio of 2′→ 2 transition of 2′ → 2 → 0 spin sequence of even nuclei can be defined as

$$\delta^2 = \frac{T\ (E_2)}{T\ (M_1)} \cdot$$

The expressions for the mixing ratio in the two models considered are given as:

$$\delta^2_{DF} = \frac{0 \cdot 21 k^2}{80} \left(\frac{eZR_0{}^2}{\mu_0 g R}\right)^2 \quad \text{—— D-F Model}^2$$

and

$$\delta^2_{SP} = 2 \cdot 642 \times 10^{-6}\, E_\gamma{}^2 A^{4/3} \quad \text{—— S-P Model.}^2$$

In the present analysis the values of the experimentally determined mixing ratio have been collected for the even-even nuclei which are characterised by 2′ → 2 → 0 spin sequence. All the data collected from the various publications are presented in Table I. Columns 1 and 2 represent the various even-even nuclei and the energy of γ-transition for the cascade 2′ → 2. Columns 3, 4 and 5 indicate the mixing ratios obtained from single particle model, Davydov and Filippov model and the experimentally determined value represented by δ^2_{exp}.

TABLE I

1	2	3	4	5	6	7	8
Nucleus	Energy (Kev)	δ^2_{SP}	δ^2_{DF}	$\delta^2_{\text{exp.}}$	$\frac{(5)}{(3)}$	$\frac{(5)}{(4)}$	Reference
$_{26}Fe^{56}_{30}$	1812	0·01858	37·59	0·0225	1·211	0·0005987	*a*
$_{26}Fe^{58}_{32}$	857	0·0004356	8·812	5·383	12360·0	0·6108	*a*
$_{34}Se^{76}_{42}$	659	0·0003693	12·77	13·77	37290·0	1·078	*a*
$_{40}Zr^{92}_{52}$	900	0·000719	43·14	0·000022	0·03091	0·0000005	*a*
$_{44}Ru^{102}_{52}$	693	0·000514	29·79	> 225	> 437700·0	> 7·553	*b*
$_{48}Cd^{114}_{66}$	1·263	0·002329	162·0	0·01124	4·823	0·0000693	*d*
$_{50}Sn^{116}_{66}$	818	0·000999	74·80	12·26	12280·0	0·1639	*a*
$_{52}Te^{122}_{70}$	693	0·0007668	62·05	10·30	13430·0	0·1660	*a*
$_{52}Te^{124}_{72}$	723	0·0008537	69·07	1·0	1171·0	0·01448	*a*
$_{52}Te^{126}_{74}$	750	0·0009164	64·06	77·4	84450·0	1·208	*a*
$_{54}Xe^{126}_{72}$	480	0·000088	33·55	> 25	> 284100	> 0·7452	*c*
$_{54}Xe^{128}_{74}$	540	0·000496	43·17	41·0	82660·0	0·9497	*c*
$_{76}Cs^{192}_{116}$	283·35	0·0002347	42·77	42·25	1800000·0	0·9879	*d*
$_{78}Pt^{194}_{116}$	293	0·0002547	46·36	846·8	3325000·0	18·27	*a*
$_{78}Pt^{196}_{118}$	331·3	0·0003302	60·10	29·48	89280·0	0·4793	*d*
$_{80}Hg^{198}_{118}$	625·7	0·01392	266·7	0·9717	698·1	0·003643	*d*
$_{80}Hg^{200}_{120}$	579·4	0 001037	198·6	0·05	48·22	0·0002518	*d*

(*a*) Malik, S. S., Potnis, V. R. and Mandeville, C. E., *Nucl. Phys.*, 1959, **11**, 691.
(*b*) McGowan, F. K. and Stelson, P. H., *Phys. Rev.*, 1961, **123**, 2131.
(*c*) Asplund, I., Strömberg, L. G. and Wiedling, T., *Arkiv för Fysik*, 1960, **18**, 65.
(*d*) Van Patter, D. M., *Nucl. Phys.*, 1959, **14**, 42.

δ^2_{DF} and $\delta^2_{exp.}$ respectively. Columns 6 and 7 represent the ratios $\frac{\delta^2_{exp.}}{\delta^2_{SP}}$ and $\frac{\delta^2_{exp.}}{\delta^2_{DF}}$ respectively.

The last column gives the reference for the various nuclei.

Conclusions.—(1) The cases

$${}_{26}Fe^{56}_{30},\ {}_{40}Zr^{92}_{52},\ {}_{48}Cd^{114}_{66} \text{ and } {}_{80}Hg^{200}_{120}$$

agree better with the single particle estimate than the D-F model estimate.

Note the absence of any correlation with shell closure. For instance, ${}_{50}Sn^{116}_{66}$ does not agree with S-P-estimates.

(2) The cases

$${}_{34}Se^{72}_{42},\ {}_{54}Xe^{126}_{72},\ {}_{54}Xe^{128}_{74} \text{ and } {}_{76}Os^{192}_{116}$$

agree better with the D-F-prediction than the S-P-estimate.

(3) Trends in deviations:

(*a*) The deviations from S-P- are mostly in one direction, namely δ^2_{SP} is larger than $\delta^2_{exp.}$

(*b*) The deviations from D-F are both ways but mostly such that $\delta^2_{DF} < \delta^2_{exp.}$ This would perhaps indicate that a combination of the two models in some way might reproduce the observed δ^2 values.

(4) From this analysis it appears that there is no strong reason to prefer D-F model, which makes the rather unphysical assumption of nuclei not possessing axial symmetry, over the conventional models.

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1. Scharff-Goldhaber, G. and Weneser, J., *Phys. Rev.*, 1955, **98**, 212.
2. Davydov, A. S. and Filippov, G. F., *Nucl. Phys.*, 1958, **8**, 237.
3. See for instance: S. A. Moszkowski in *Beta and Gamma-ray Spectroscopy*, Edited by K. Siegbahn, North Holland Publishing Co., 1955.