SOME REMARKS ON THE E_2–M_1 MIXING RATIOS OF $2' \rightarrow 2$ TRANSITIONS IN EVEN-EVEN NUCLEI

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ABSTRACT

Experimental values of E_2–M_1 mixing ratios of $2'^+ \rightarrow 2^+$ transitions in even-even nuclei are found to decrease with increasing splitting of $2'^+$ and 4^+ levels.

1. INTRODUCTION

THE vibrational model for even-even nuclei in the medium-weight region predicts a low-lying one-phonon level with spin and parity 2^+ and a degenerate triplet of 0^+, 2^+, 4^+ for the two-phonon level. But in real nuclei this degeneracy is removed due to particle interaction and the two-phonon levels have unique spins and parities. The transition from the degenerate second excited state to the first excited 2^+ state which is pure E_2 in the pure vibrational model actually turns out to be an admixture of E_2 and M_1 transitions when the non-degenerate levels are considered due to particle interaction.

It follows then that the larger the number of particles outside of a closed shell core (which we may regard as representing a pure vibrational situation), the larger the splitting of the 0, 2, 4 triplet and the greater the mixing between M_1 and E_2. In this paper we have looked for these correlations. Specifically, we have studied the (M_1–E_2) mixing ratio (δ) as a function of (*a*) the number of neutrons outside a major closed shell and (*b*) the $2'^+$-4^+ level splitting.

2. ANALYSIS OF DATA

Table I represents our attempt in this direction. The first column lists the nuclei. The next three columns give the energy of the 2^+, $2'^+$ and 4^+ levels in Kev. The fifth column represents the splitting of $2'^+$ and 4^+ levels,

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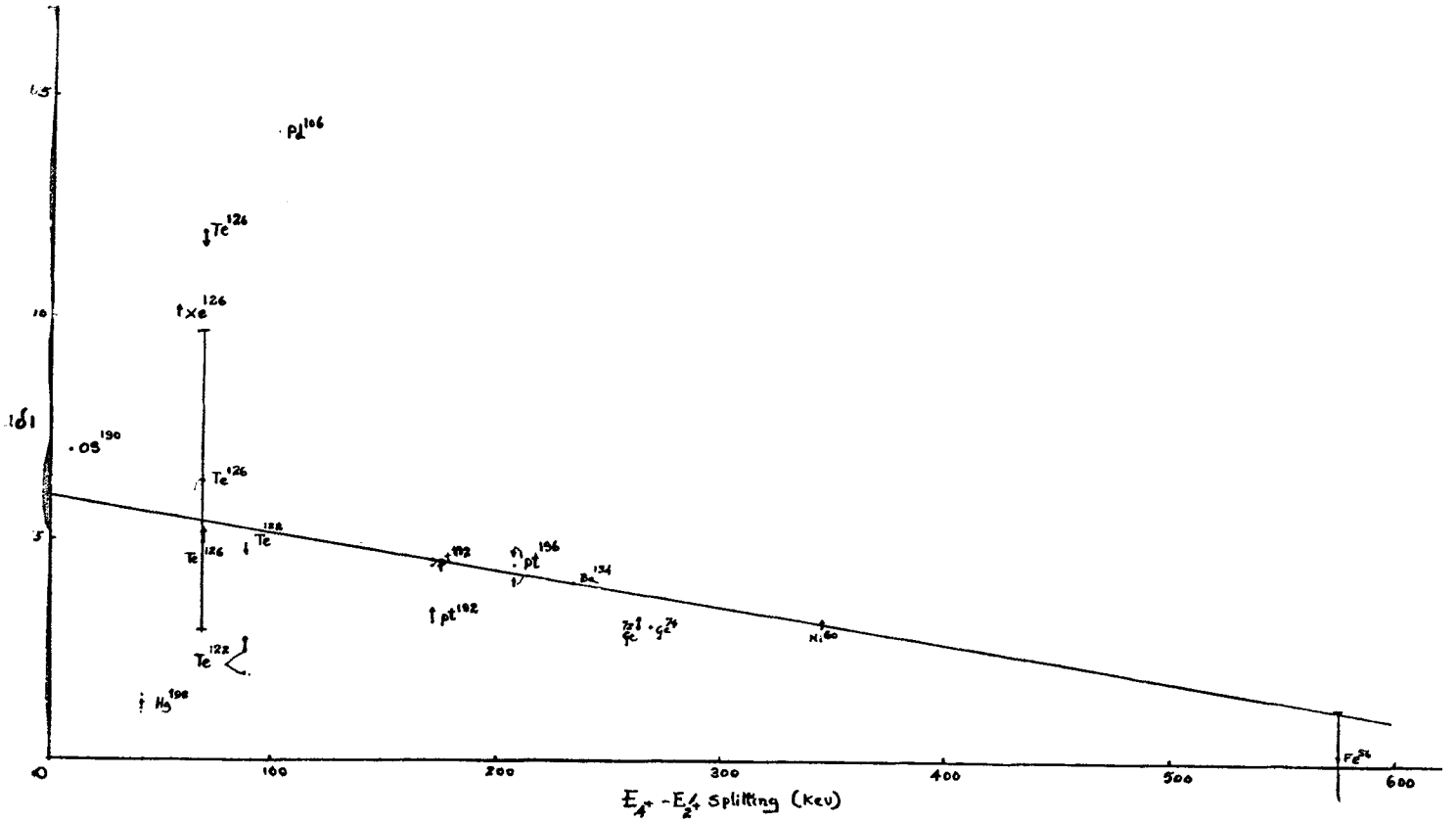

FIG. 1. Plot of $|\delta|$ values against $E_{4+} - E_{2'+}$ splitting.

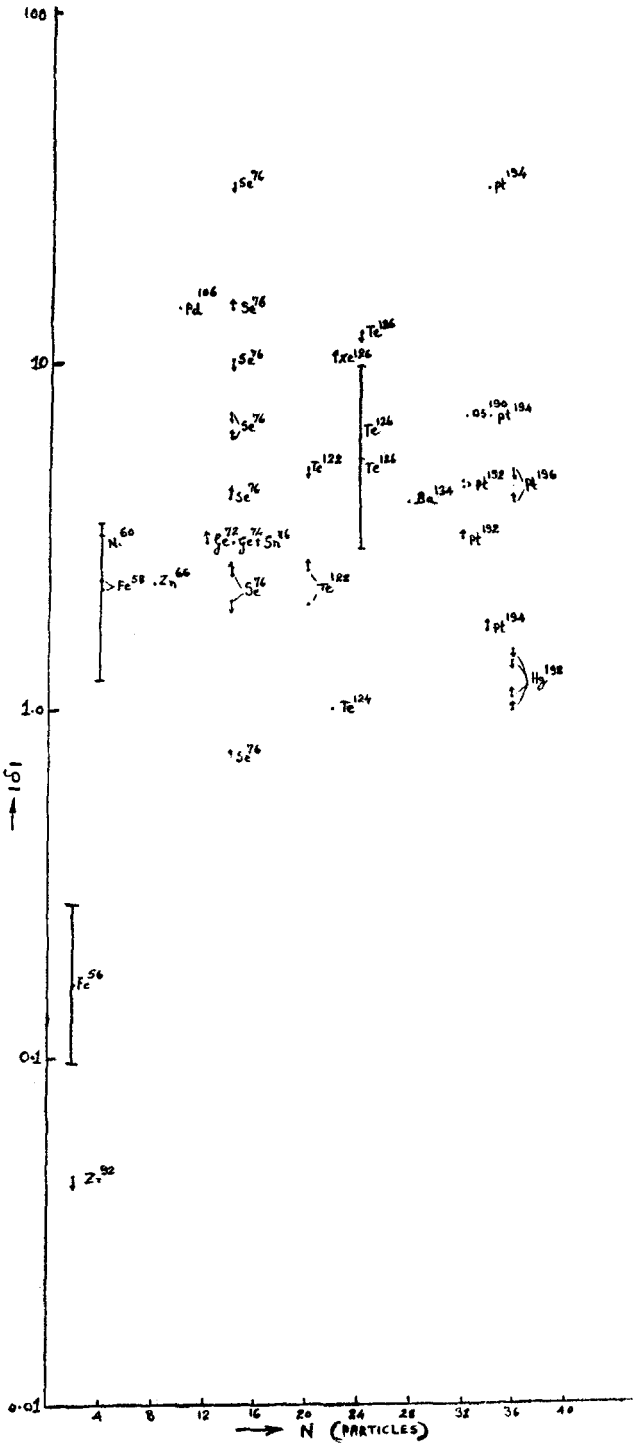

FIG. 2. Plot of $|\delta|$ values against the number of neutrons outside a major closed shell.

TABLE I

Nucleus	E_{2+} in Kev.	$E_2'_+$ in Kev.	E_{4+} in Kev.	$\lvert E_2'_+ - E_{4+}\rvert$ in Kev.	Ref.	E_r in Kev.	$\lvert\delta\rvert$
$_{26}Fe^{56}_{30}$	850	2660	2085	575	1	1510	$0{\cdot}16 \pm 0{\cdot}11$
$_{26}Fe^{58}_{32}$	810	1620	..	..	..	810	$2{\cdot}3 \pm 1{\cdot}14$ $2{\cdot}2$
$_{28}Ni^{60}_{32}$	1330	2180 2159	2505	346	1	850	>3
$_{30}Zn^{66}_{36}$	1040	1870	..	..	..	830	$2{\cdot}26$
$_{32}Ge^{72}_{40}$	840	1460 1465	1729	264	1	631	>3
$_{32}Ge^{74}_{42}$	598	1200	1470	270	1	602	3
$_{34}Se^{76}_{42}$	550	1200	..	..	..	650	$31{\cdot}61 > \delta > 14{\cdot}15$ $7 > \delta > 6$ $2 > \delta > 0{\cdot}72$ $>2{\cdot}39$ $10 > \delta > 4$
$_{40}Zr^{92}_{52}$	934	1820	..	..	..	886	$0{\cdot}045 > \delta$
$_{46}Pd^{106}_{60}$	513	1130 1127	1229	102	2	617	$14{\cdot}15$
$_{50}Sn^{116}_{66}$	1270	2090	..	..	..	820	>3
$_{52}Te^{122}_{70}$	560	1240 1257	1168	89	2	680	2 $4{\cdot}9 > \delta > 2{\cdot}45$
$_{52}Te^{124}_{72}$	603	1326	..	..	..	723	1
$_{52}Te^{126}_{74}$	650	1400 1430	1360	70	2	750	$11{\cdot}92 > \delta > 4{\cdot}9$ $6{\cdot}33 \pm 3{\cdot}39$
$_{54}Xe^{126}_{72}$	386	860 870	929	59	2	474	$>9{\cdot}95$
$_{56}Ba^{134}_{78}$	605	1170 1167	1401	234	2	565	4
$_{76}Os^{190}_{114}$	186	557	546	11	1	370	7
$_{78}Pt^{192}_{114}$	316	613	785	172	2	297	$\geqq 3{\cdot}16$ $4{\cdot}36$ $4{\cdot}47$
$_{78}Pt^{194}_{116}$	325	620	..	..	..	295	7 $31{\cdot}61$ $\geqq 1{\cdot}73$
$_{78}Pt^{196}_{118}$	356	688 689	893	209	2	322	$\approx 4{\cdot}36$ $4{\cdot}9 > \delta > 4$
$_{80}Hg^{198}_{118}$	411	1091 1090	1047	43	2	680	$1{\cdot}83 > \delta > 1$ $\approx 1{\cdot}23$ $1{\cdot}36 > \delta > 1{\cdot}11$

1. Landolt-Bornstein, *Energy Levels of Nuclei A = 5 to A = 257*, Vol. I, Springer-Verlag (Berlin, 1961). 1.

2. Sakai, M., Yamazaki, T. and Ejiri, H., *Phys. Letters*, 1964, **12**, 29,

and the corresponding references are given in the sixth column. The transition energy of $2'^+ \rightarrow 2^+$ transitions is given in the seventh column. The last column gives the experimental values of $|\delta|$ taken from Grechukhin.[1] We have omitted the sign of δ values and considered only the magnitude for the time being.

In Fig. 1 we have plotted the $|\delta|$ values of $2'^+ \rightarrow 2^+$ transitions against the splitting of $2'^+$ and 4^+ states. Figure 2 represents the plot of $|\delta|$ values against the number of neutrons outside of a major closed shell.

In plotting the $|\delta|$ values, wherever there are more than one measurement for the same transition, we have plotted all the values. If the maximum and minimum values of $|\delta|$ are given, they are indicated by arrows in Figs. 1 and 2.

3. Conclusions

From a study of Fig. 1 we conclude that $|\delta|$ decreases with the increase in splitting of $2'^+$ and 4^+ levels which is in agreement with the theoretical prediction.

No definite trend can be observed in the variation of δ with the number of neutrons outside of a major closed shell.

Reference

1. Grechukhin, D. P. .. *Nucl. Phys.*, 1963, **40**, 422.