

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

BY S. SWARNAGOWRI AND M. K. RAMASWAMY, F.A.Sc.*

(Department of Physics, Karnatak University, Dharwar-3)

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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

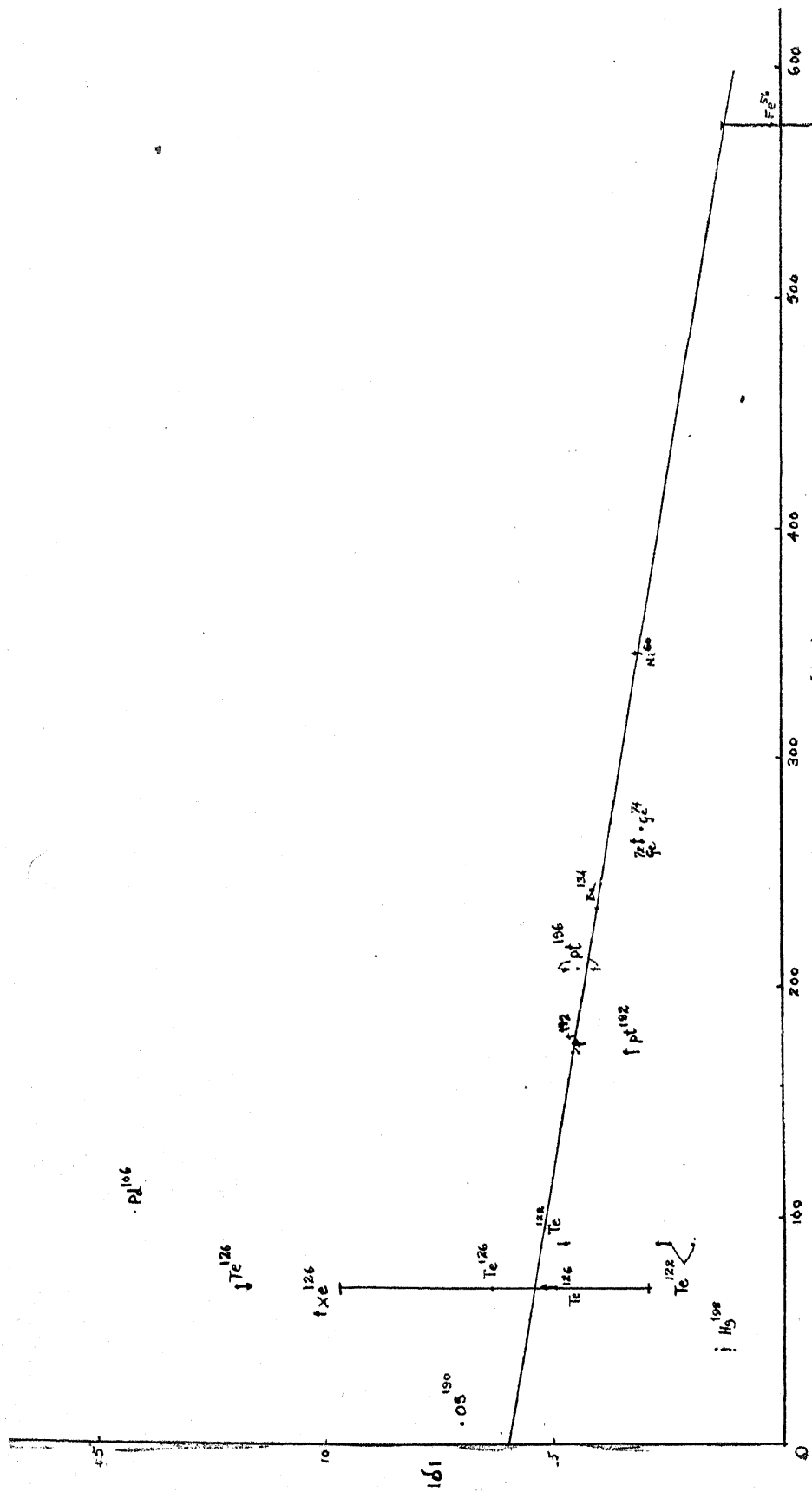
THE vibrational model for even-even nuclei in the medium-weight region predicts a low-lying one-phonon level with spin and parity 2^+ and a degenerate triplet of 0^+ , 2^+ , 4^+ for the two-phonon level. But in real nuclei this degeneracy is removed due to particle interaction and the two-phonon levels 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,

* Address after January 1, 1965: Visiting Associate Professor of Physics, Ohio State University, Columbus-10, Ohio (U.S.A.).



$E_{4+} - E_{2+}$ Splitting (keV)

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

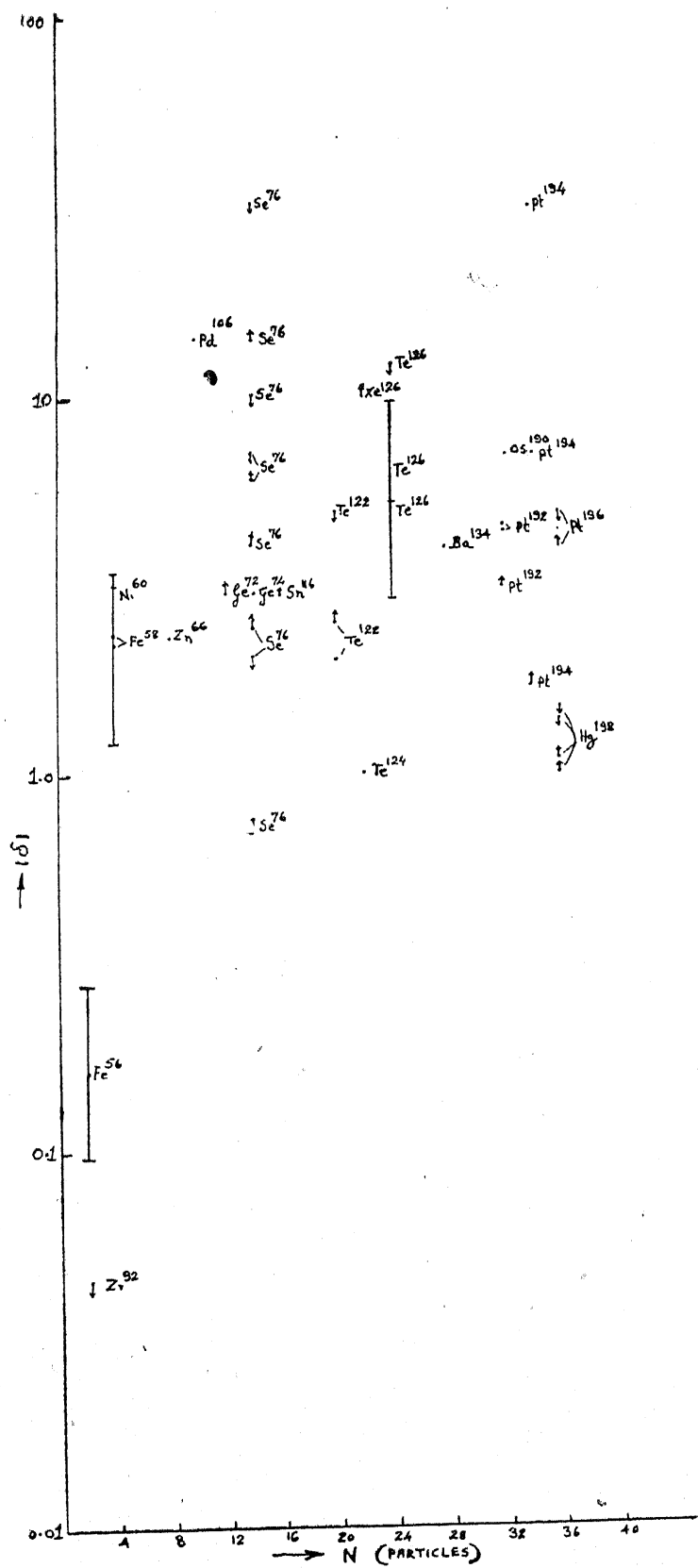


FIG. 2. Plot of $|\delta|$ values against the number of neutrons outside a major closed shell,

TABLE I

Nucleus	E_{2^+} in Kev.	E_{2^+} in Kev.	E_{4^+} in Kev.	$|E_{2^+} - E_{4^+}|$ in Kev.	Ref.	E_r in Kev.	$|\delta|$
${}_{26}\text{Fe}_{30}^{56}$	850	2600	2085	575	1	1510	0.16 ± 0.11
${}_{26}\text{Fe}_{32}^{58}$	810	1620	..	..	..	810	$\left\{ \begin{array}{l} 2.3 \pm 1.14 \\ 2.2 \end{array} \right.$
${}_{28}\text{Ni}_{32}^{60}$	1330	2180 2159	2505	346	1	850	> 3
${}_{30}\text{Zn}_{36}^{66}$	1040	1870	..	..	..	830	2.26
${}_{32}\text{Ge}_{40}^{72}$	840	1460 1465	1729	264	1	631	> 3
${}_{32}\text{Ge}_{42}^{74}$	598	1200	1470	270	1	602	3
${}_{34}\text{Se}_{42}^{78}$	550	1200	..	..	..	650	$\left\{ \begin{array}{l} 31.61 > \delta > 14.15 \\ 7 > \delta > 6 \\ 2 > \delta > 0.72 \\ > 2.39 \\ 10 > \delta > 4 \end{array} \right.$
${}_{40}\text{Zr}_{52}^{92}$	934	1820	..	..	..	886	$0.045 > \delta$
${}_{46}\text{Pd}_{60}^{106}$	513	1130 1127	1229	102	2	617	14.15
${}_{50}\text{Sn}_{66}^{116}$	1270	2090	..	..	..	820	> 3
${}_{52}\text{Te}_{70}^{122}$	560	1240 1257	1168	89	2	680	$\left. \begin{array}{l} 2 \\ 4.9 > \delta > 2.45 \end{array} \right\}$
${}_{52}\text{Te}_{72}^{124}$	603	1326	..	..	..	723	1
${}_{52}\text{Te}_{74}^{126}$	650	1400 1430	1360	70	2	750	$\left\{ \begin{array}{l} 11.92 > \delta > 4.9 \\ 6.33 \pm 3.39 \end{array} \right.$
${}_{54}\text{Xe}_{72}^{126}$	386	860 870	929	59	2	474	> 9.95
${}_{56}\text{Ba}_{78}^{134}$	605	1170 1167	1401	234	2	565	4
${}_{76}\text{Os}_{114}^{190}$	186	557	546	11	1	370	7
${}_{78}\text{Pt}_{114}^{192}$	316	613	785	172	2	297	$\left. \begin{array}{l} \approx 3.16 \\ 4.36 \\ 4.47 \end{array} \right\}$
${}_{78}\text{Pt}_{116}^{194}$	325	620	..	..	..	295	$\left. \begin{array}{l} 7 \\ 31.61 \\ 1.73 \end{array} \right\}$
${}_{78}\text{Pt}_{118}^{196}$	356	688 689	893	209	2	322	$\left. \begin{array}{l} \approx 4.36 \\ 4.9 > \delta > 4 \end{array} \right\}$
${}_{80}\text{Hg}_{118}^{198}$	411	1091 1090	1047	43	2	680	$\left\{ \begin{array}{l} 1.53 > \delta > 1 \\ \approx 1.23 \\ 1.36 > \delta > 1.11 \end{array} \right.$

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.