JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN VOL. 34, SUPPLEMENT, 1973
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR MOMENTS AND NUCLEAR STRUCTURE, 1972

III–2

Spin-Isospin Distribution in Mirror Pair

R. LEONARDI

Istituto di Fisica dell'Università, Bologna, Italy

To obtain the S-I distribution in nuclear m.m., M1 transitions and β-decay of isodoublets, the properties of the operator $\sum_i j_i\tau_i$ (no matrix elements connecting different j-j coupling configurations) may be usefully utilized.[1)]

Defining:

$$\begin{aligned}&\langle \text{even-}N|\sum f_i\tau_{i3}|\text{even-}N\rangle \\ &\quad = -\langle \text{odd-}N|\sum f_i\tau_{i3}|\text{odd-}N\rangle \\ &\quad = (-)^N\langle\sum f_i\tau_{i3}\rangle,\end{aligned}$$

$\delta = (-)^N\langle\sum \sigma_i\tau_{i3}\rangle - \langle\sum\sigma_i\rangle$ and

$\mu_{p(n)}$ = m.m. of odd-$Z(N)$ nucleus

one obtains:

$$2.29(-)^N\langle\sum\sigma_i\tau_{i3}\rangle = \mu_p - \frac{1}{2}[J + (-)^N\langle\sum j_i\tau_{i3}\rangle] + 0.19\,\delta \qquad (1)$$

$$1.9(-)^N\langle\sum\sigma_i\tau_{i3}\rangle = -\mu_n + \frac{1}{2}[J - (-)^N\langle\sum j_i\tau_{i3}\rangle] - 0.19\,\delta \qquad (2)$$

In the seniortity scheme one has[2)]

$$(-)^N\langle\sum j_i\tau_{i3}\rangle = j\Big[1 - \frac{N}{3(j+1)}\Big],$$

for pair in which the odd Z nucleus has $Z = N+1$ and

$$(-)^N\langle\sum j_i\tau_{i3}\rangle = j\Big[1 - \frac{2j+1-N}{3(j+1)}\Big],$$

for pair in which the odd Z nucleus has $Z = N-1$. These two relations permit to extract the S-I term when *only one* magnetic moment is measured, allowing the comparison with β-decay in this case also. In fact δ is of order of 1 in the most unfavourable case. (Incidentally, combining (1) and (2) one obtains:

$$\Big[\frac{\mu_p - J}{\mu_n}\Big] = -1.20 + \frac{1}{10\mu_n}[\{J - (-)^N\langle\sum j_i\tau_{i3}\rangle\} - 4.2\delta].$$

where both a $S \neq 0$ and/or a total angular momentum $J \neq 0$ of the even nucleons group work in deviating the first member from -1.20).

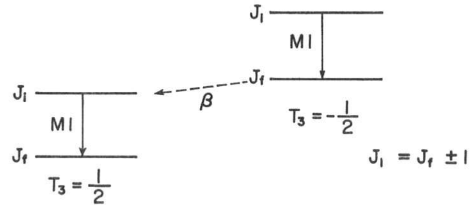

Fig. 1

Similar formulas may be obtained for the spin distribution:

$$2.29\,\langle\sum\sigma_i\rangle = \mu_p - \frac{1}{2}[J + (-)^N\langle\sum j_i\tau_{i3}\rangle] - 2.1\delta$$

$$1.9\,\langle\sum\sigma_i\rangle = -\mu_n + \frac{1}{2}[J - (-)^N\langle\sum j_i\tau_{i3}\rangle] - 2.1\delta$$

however they critically depends on δ.

Finally one can analyze $\langle f|\sum\sigma_i\tau_i|i\rangle$ extracted from $\Delta T = 0$ β and γ ray decay of mirror pair.[3)] The diagram of the levels utilized for this analysis is illustrated in Fig. 1.

One has:

$$\frac{a}{ft_{G-T}} = |\langle f|\sum\sigma_i\tau_i^{\pm}|i\rangle|^2 \qquad (3)$$

and:

$$\Lambda(M1) \simeq b[\langle f|\sum\sigma_i\tau_{i3}|i\rangle + 0.24\langle f|\sum j_i\tau_{i3}|i\rangle]^2 \qquad (4)$$

where the disregarded isoscalar contributions are expected to be small. The second term is different from 0 only for the 'reorientation' part of the transition (diagonal in the j-j configuration) and enhances or inhibits Λ following the relative phase of the two m.e.. Data on these processes are interesting not only for a direct comparison of (3) and (4, in both mirror) but also for a complementary comparison with the diagonal terms (1, 2).

From the existing data on A = 25, 29, 31, 33, 35, for example, the $|\langle\frac{3}{2}|\sum\sigma\tau|\frac{5}{2}\rangle|$ and $|\langle\frac{1}{2}|\sum\sigma\tau|\frac{3}{2}\rangle|$ exhibits a behaviour rather complementary of $|\langle\frac{3}{2}|\sum\sigma\tau|\frac{3}{2}\rangle|$ as deduced from m.m. analysis (increase with A, reach a maximum at $A = 33$ and again decrease).

A detailed systematics of these m.e. is in progress.

References

1) This property has been considered by R. Leonardi and M. Rosa-Clot: Nuovo Cimento Letters **1** (1969) 329.
2) I. Talmi: in *Proc. Intern. Conf. on Hyperfine Interactions as Detected by Nuclear Radiations. Rehovt and Jerusalem, Israel, 1970*, ed. Gordon and Breach.
3) A careful analysis along this line has been independently carried out by K. Sugimoto and I. Tanihata, presented at this conference III–1.