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

III–10 The g-Factors of High Spin Isomeric States in ^{114}Sn and ^{118}Sn

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The g-factor of an isomeric state in ^{114}Sn has been measured by the time-differential-PAC method. A 22–MeV pulsed α beam from the Tandem accelerator was used for the production of the isomeric state by the ^{112}Cd(α, 2n)^{114}Sn reaction. The isomeric state was found by Yamazaki and Ewan[1] to have a half life of longer than 300 nsec. In the present experiment it is determined to be $t_{1/2} = 726 \pm 25$ nsec.

For the g-factor measurement, a molten Cd target was used to preserve the nuclear alignment following the nuclear reaction. Shown in Fig. 1 are the spin-rotation patterns of the 628-keV(M1), 889-keV(E2) and 274-keV transitions. The patterns show that the angular distribution of the 274-keV has a positive A_2 value and that it most probably is an E2 transition. The g-factor determined from the patterns is; g(uncorrected) $= -0.0812 \pm 0.0025$. No correction was made for the Knight shift ($\sim -0.8\%$) and the diamagnetism ($\sim 0.6\%$), but uncertainty of 1% was added to obtain the value;

$$g(^{114}\text{Sn}; \text{corrected}) = -0.081 \pm 0.003.$$

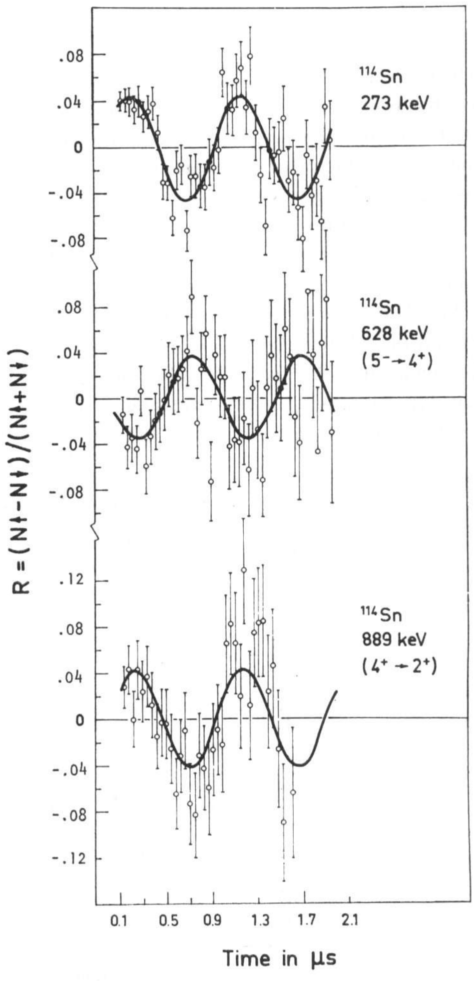

Fig. 1. Spin-rotation patterns of the 3091-keV state in ^{114}Sn.

In Fig. 2 the proposed level scheme is shown based on the present results. The levels up to the 2817-keV 5^- state have been assigned by Yamazaki and Ewan.[1] Careful studies of the 274-keV transition revealed that no prompt component was present, and therefore the isomeric state must be the state at 3091 keV. It is reasonable to expect that the isomeric state is a two-quasiparticle state with high spin. The small negative g-factor obtained indicates that the isomer has negative parity and consists of the two quasiparticles of neutron with $l_1 + 1/2$ and $l_2 - 1/2$. This fact set a limit for various possible configurations. Furthermore, the $(h_{11/2}, s_{1/2})_{5-}$, and the $(g_{9/2}, d_{5/2})_{6+}$ configurations can be dropped because neither the transition to the 4^+ nor to the 3^- state was observed. Hence the most probable configuration of the state is $(h_{11/2}, d_{3/2})_{7-}$. This state is expected to appear as a low-lying state in this nucleus.

The long lifetime for the 274-keV E2 transition is quite reasonable, since a large hindrance of E2 transitions due to the pairing effect has been reported for similar cases in ^{118}Sn and ^{120}Sn. The systematic appearance of the 7^- states in ^{114}Sn, ^{118}Sn and ^{120}Sn is very consistent with the theoretical prediction by Arvieu,[2] though the 7^- state in ^{116}Sn does not fit into the systematics.

Since a natural Cd target was used, γ-rays from ^{118}Sn following the isomeric transition were also observed, and the g-factor of the 7^- state in ^{118}Sn

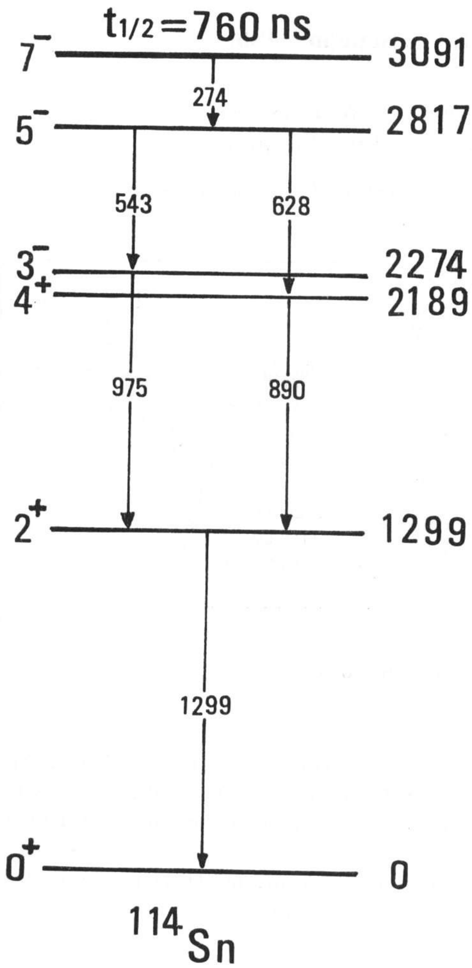

Fig. 2. Level scheme of ^{114}Sn.

was determined simultaneously;

$$g(^{118}\mathrm{Sn}, 7^-) = -0.099 \pm 0.011.$$

According to the theoretical work by Arvieu,[2] the configurations of the 7^- states are very pure;

$$|^{114}\mathrm{Sn}, 7^-\rangle = 0.9949|\mathrm{h}_{11/2}, \mathrm{d}_{3/2}\rangle + \cdots,$$
$$|^{118}\mathrm{Sn}, 7^-\rangle = 0.9999|\mathrm{h}_{11/2}, \mathrm{d}_{3/2}\rangle + \cdots.$$

The g-factor of the state with a configuration like present, where the $J = l_1 + l_2$ state is composed of two particles with $l_1 + 1/2$ and $l_2 - 1/2$, is sensitive to the effective orbital g-factor, since the spin parts of the g-factor are nearly cancelled. The present g-factor is given as; $g(7^-(\mathrm{h}_{11/2}, \mathrm{d}_{3/2})) = g_l + 1/7 \times 5(g_s - g_l)$. The second term can be estimated by use of the configuration-mixing model. The ambiguity in calculating g_s is reduced by the factor of 35. The effective orbital g-factor of the neutron deduced from the present result is

$$\delta g_l(\mathrm{n}) = g_l^{\mathrm{eff}}(\mathrm{neutron}) = -0.03 \pm 0.03.$$

The $\delta g_l(\mathrm{n})$ obtained is significantly smaller than the $\delta g_l(\mathrm{p})$. Similar situation is observed in the Pb region.[3] The values $\delta g_l(\mathrm{n})/\delta g_l(\mathrm{p})$ from the analyses of experimental data appear somewhat in disagreement with those expected as the mesonic effect. This may indicate that the origins of the anomaly are not only the mesonic effect but also some other effects such as the higher order effects in core polarization.

References

1) T. Yamazaki and G. T. Ewan: Nuclear Phys. **A134** (1969) 81.
2) R. Arvieu: Ann. de Phys. **8** (1963) 407.
3) K. Nakai, B. Herskind, I. Bergström, J. Blomqvist, A. Filevich, K.-G. Rensfelt, J. Sztarkier and S. Nagamiya, presented at this conference III-16.