表には、各研究者の名前が記載されています。研究者の名前は、左側の欄に記載されています。右側の欄には、各研究者の所属組織が記載されています。
I. 2. Half-life and Magnetic Moment of the First Excited State in $^{132}$I

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The recent progresses in the shell model calculations¹) enable the detailed discussions on the nuclear structure in the region around $^{132}$Sn. In this region, there has been a long time confusion on the half-life measurements of the first excited state in $^{132}$I. Several groups performed the lifetime measurements, but the reported values range from 1 ns to 7 ns²-⁴. Therefore, the magnetic moment of this state reported by Singh⁵) should not be treated as reliable because they used time-integral perturbed angular correlation (TIPAC) method, where the Larmor frequency was determined as the rotation angle of the nuclear alignment during the lifetime of this state.

On the other hand, iodine, which is one of the elements in the halogen family, plays important roles in the materials with high conductivity. $^{132}$I is expected to be a good probe nucleus in the halogen family as far as the half-life of $T_{1/2}=7.14$ ns reported by Yousfi⁶), which is suitable for perturbed angular correlation (TDPAC) measurements, is true.

Based on these points of view, we report the determination of the half-life and the magnetic moment of this state⁶).

The first excited state in $^{132}$I was populated by the β-decay of $^{132}$Te ($T_{1/2} = 3.204$ d) obtained as a radioactive beam of $A = 132$ from the RFIGISOL (Radio Frequency Ion Guide Isotope Separator On-Line system) at Tohoku University⁷,⁸). This is the first successful extraction of a radioactive beam in the region around $^{132}$Sn by RFIGISOL. The radioactive beam, of which intensity is 500~1000 atoms/s in terms of $^{132}$Te, is implanted into either aluminum or nickel foil for off-line measurements. The contaminations in the sample were attenuated by cooling the sample down for a few hours. After this cool-down, implanted foil was cut into several pieces, and we used only selected pieces in which $^{132}$Te
was dominantly implanted.

The half-life of the first excited state in $^{132}$I was determined to be $T_{1/2} = 1.120 \pm 0.015$ ns by observing the cascade of 228.2 and 49.7 keV with a pair of BaF$_2$ detectors. A sufficient time-resolution of this system was confirmed by the prompt gamma rays. The obtained time spectra are shown in Fig. 1.

TDPAC measurements were performed for the first excited state of $^{132}$I implanted into Ni. A strong hyperfine field of $B_{hf} = +(26.5 \pm 0.5)$ T at the iodine site in nickel was applied and an external field of 0.3 T was applied to produce the alignment of this hyperfine field. We have developed a so-called cage type magnet for suppressing the effect of the fringing field towards the low-energy detection by BaF$_2$ detectors. Three BaF$_2$ detectors were placed form $\pm 135^\circ$ in a plane perpendicular to the external magnetic field, then the time dependence of the asymmetry is given as follows:

$$R_{\pm}(t) = \frac{N_+(t, \pm 135) - N_+(t, 135)}{N_+(t, \pm 135) + N_+(t, 135)}$$

$$= \frac{3}{4} A_{2\eta} \sin(2\omega_l t),$$

$$\omega_l = -\frac{\mu B}{I \hbar},$$

where $N_+(t, \alpha)$ is the number of coincidences between the two $\gamma$ rays at 0 and $\alpha$ degrees, and the subscript $\pm$ in Eq. (1) stands for the direction of the external magnetic field. $\mu$ and $I$ are the magnetic moment and the spin of this state, respectively, and $B$ is the magnetic field at the nucleus. A typical TDPAC spectrum is shown in Fig. 2. The magnetic moment for this state was determined to be $\mu = +(2.06 \pm 0.18) \mu_B$.

The present magnetic moment result is consistent with the magnetic moment for $(\pi g_7/2)(\nu \delta_3 2)^{-1}$ $(\mu = +2.40 \mu_B)$ which is calculated by using a simple $jj$-coupling model and the empirical g-factor of neighboring nuclei. The present results are consistent with the half-life value obtained by Gorodetskzy et al. and the magnetic moment value obtained by Singh et al. Then, the transition probability, $B(M1)$ deduced from the present half-life value is 1/50 of Weisskopf unit, and may indicate a large M1 retardation for this state.

This is the first successful extraction of a radioactive beam in the region around $^{132}$Sn from the RF-IGISOL at Tohoku University. We will extend the magnetic moment measurements in this region with radioactive beams produced by the RF-IGISOL.
References


Figure 1. (a) Time spectrum of the 228.2- to 49.7-keV cascade. A single exponential curve with a constant term was applied as a fitting function to the data. (b) Time spectrum taken with the gates shifted slightly above to miss the 228.2- to 49.7-keV cascade. A Gaussian function with a constant term as the fitting function was applied to the data.
Figure 2. TDPAC spectrum of $^{127}$I in nickel. We performed two runs of the TDPAC measurements by inverting the direction of the external magnetic field along with the sample. Then, one obtain the enhanced asymmetry change by subtraction as $R_+(t) - R_-(t) = 2R_0(t) = \frac{3}{2} A_0 \sin(\omega_0 t)$. 