**β-NMR measurement in coincidence with β-delayed γ rays of ⁴¹S**

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We aim to measure the magnetic moment of the ground-state ⁴¹S, by combining the technique to produce spin-polarized RI beams and the method of β-ray-detected nuclear magnetic resonance (β-NMR). In the previous experiment, the spin polarization realized in the ⁴¹S beam was pulsed with durations regarding time of flight (TOF) and energy loss (ΔE). The spin polarization in ⁴¹S was produced by the RI beam of ⁴³CaS stopper were detected using plastic scintillator at F2 and F3, and ΔE was measured using a pair of coils. The spin reversal was detected through the spin-parity ⁴¹S, where ΔE is the product of the asymmetry parameter A for the β-ray emission and the degree of polarization P of ⁴¹S. The small ΔE value may be attributed to a cancellation of A when various β-decay branches are mixed. Indeed, the decay scheme of ⁴¹S has not been established other than the observation of several β-delayed γ rays. In order to avoid a possible cancellation of the A parameter, we have attempted to perform the β-NMR measurement in coincidence with the β-delayed γ rays, along with the normal β-NMR measurement.

The experiment was carried out at the RIPS at RIKEN Nishina Center. The beam production of ⁴¹S and experimental setup are common to the normal β-NMR measurement. The β-delayed γ rays emitted from ⁴¹S in the CaS crystal located at the center of poles of the dipole magnet were detected with two Ge detectors set at a distance of 20 cm from the crystal. Each Ge detector has a relative efficiency of 35%. The data acquisition system was triggered by a γ-hit event defined by a logical OR of signals from the Ge detectors.

In this experiment, we have observed 3 β-delayed γ rays of ⁴¹S with large yields, with energies of 131, 554 and 761 keV, as shown in Fig. 1 (a), (b) and (c), respectively. To confirm the origin of these γ rays, the half lives associated with these γ rays were deduced from the decay curve spectra synchronized with the beam pulsing: 2.9 s for beam-on and 2.9 s for beam-off. Figure 2 shows the decay-curve spectra for the 131-keV γ ray in the beam-off period. The decay-curve was fitted to an exponential function on a constant background, and then, the half life was preliminarily determined to be 1.99(5) s, which is in good agreement with the previous value, and the origin was confirmed to be ⁴¹S. Further analysis to obtain the NMR spectra in coincidence with these γ rays is in progress.

Fig. 1. β-delayed γ rays of ⁴¹S with energy of (a) 131 keV, (b) 554 keV and (c) 761 keV.

Fig. 2. Decay-curve spectrum for 131-keV γ ray. The half life was preliminarily determined to be 1.99(5) s.

References