β-NMR measurement in coincidence with β-delayed γ rays of ^{41}S

Y. Ichikawa,[*1] Y. Ohtomo,[*1,*2] Y. Ishibashi,[*1,*3] T. Suzuki,[*2] T. Sato,[*2] K. Imamura,[*1,*4] T. Fujita,[*5] T. Furukawa,[*6] K. Asahi,[*2] T. Egami,[*7] C. Funayama,[*2] M. Hayasaka,[*8] C. Hirao,[*2] S. Kojima,[*2] T. Komine,[*2] M. Matsumoto,[*8] Y. Sakamoto,[*2] A. Takamine,[*9] D. Tominaga,[*7] H. Yamazaki,[*1] and H. Ueno[*1]

We aim to measure the magnetic moment of the ground-state ^{41}S, by combining the technique to produce spin-polarized RI beams[1] and the method of β-ray-detected nuclear magnetic resonance (β-NMR). In the previous experiment, the spin polarization realized in the ^{41}S beams implanted in a CaS crystal was measured to be $AP = -0.14(4)\%$[2] using the adiabatic field rotation (AFR) device[3]. Since the AP value is the product of the asymmetry parameter A for the β-ray emission and the degree of polarization P of ^{41}S, the small AP value may be attributed to a cancellation of A when various β-decay branches are mixed. Indeed, the decay scheme of ^{41}S has not been established other than the observation of several β-delayed γ rays[4]. 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[5].

The experiment was carried out at the RIPS at RIBF. The beam production of ^{41}S and experimental setup are common to the normal β-NMR measurement[5]. The β-delayed γ rays emitted from ^{41}S 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 was system 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 ^{41}S with large yields, with energies of 131, 554 and 761, 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[4], and the origin was confirmed to be ^{41}S. Further analysis to obtain the NMR spectra in coincidence with these γ rays is in progress.

*1 RIKEN Nishina Center
*2 Department of Physics, Tokyo Institute of Technology
*3 Department of Physics, University of Tsukuba
*4 Department of Physics, Meiji University
*5 Department of Physics, Osaka University
*6 Department of Physics, Tokyo Metropolitan University
*7 Department of Physics, Hosei University
*8 Department of Physics, Tokyo Gakugei University
*9 Department of Physics, Aoyama Gakuin University

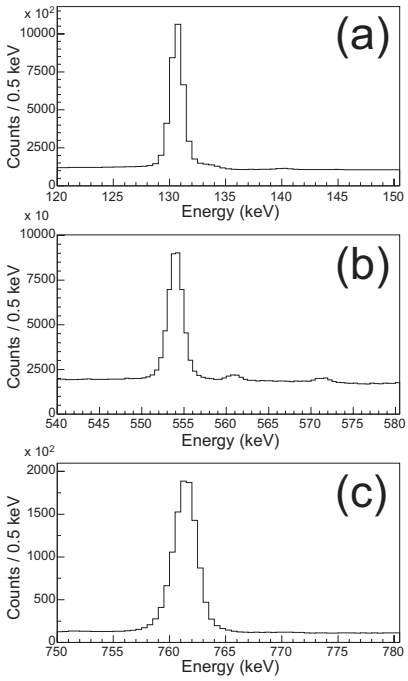

Fig. 1. β-delayed γ rays of ^{41}S with energy of (a) 131 keV, (b) 554 keV and (c) 761 keV.

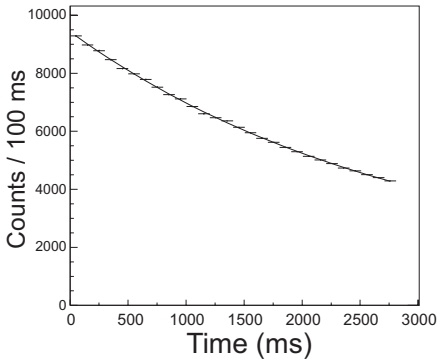

Fig. 2. Decay-curve spectrum for 131-keV γ ray. The half life was preliminarily determined to be 1.99(5) s.

References

1) K. Asahi et al.: Phys. Lett. B **251**, 488 (1990).
2) H. Shirai et al.: RIKEN Accel. Prog. Rep. **47**, 39 (2014).
3) Y. Ishibashi et al.: Nucl. Instrum. Meth. B **317**, 714 (2013).
4) J. A. Winger et al.: AIP Conf. Proc. **455**, 606 (1998).
5) Y. Ichikawa et al.: RIKEN Accel. Prog. Rep. **48** (in this report).