β-NMR measurement in coincidence with β-delayed γ rays of ^{39}S

L. C. Tao,[*1,*2] Y. Ichikawa,[*1] H. Ueno,[*1] Y. Ishibashi,[*1,*3] A. Takamine,[*1] A. Gladkov,[*1,*4] T. Fujita,[*1,*6] K. Asahi,[*7] T. Egami,[*8] C. Funayama,[*7] K. Imamura,[*1,*5] T. Kawaguchi,[*8] S. Kojima,[*7] T. Nishizaka,[*8] T. Sato,[*7] D. Tominaga,[*8] and H. Yamazaki[*1]

We aim to measure the ground-state magnetic moment of neutron-rich S isotopes. The β-NMR measurement of ^{39}S was carried out before ^{41}S and ^{43}S, in order to check the AP value that was produced through fragmentation reaction and was kept in a CaS stopper[1]. The β-decay of ^{39}S was reported but spin parities of the produced ^{39}Cl excited states have not been fixed other than the two excited states whose energies respectively are 396 keV and 1697 keV[2]. β-γ spectroscopy with polarized beams was carried out to establish a complete decay scheme including fixed spin parities, which is required for an accurate evaluation of AP value.

This experiment was carried out at the RIPS of RIBF in December 2015. A beam of ^{39}S was obtained from the fragmentation of ^{48}Ca projectiles at $E = 63$ MeV/nucleon on a ^{9}Be target with a thickness of 0.5 mm. The intensity of ^{48}Ca beam on the Be target was typically 200 pnA. The isotope separation of ^{39}S was performed with RIPS where an emission angle of $\theta_{\mathrm{F}} > 2.0°$ and a momentum window of $p_{\mathrm{F}} = p_0 \times (1.02 \pm 0.02)$ were selected in order to produce spin polarization in ^{39}S. Here, p_0 represents the central momentum of fragment ^{39}S.

The ^{39}S beam was then transported to the final focal plane and implanted into a 0.5-mm-thick CaS stopper in the β-NMR apparatus. The β-NMR apparatus consists of a collimator, a CaS crystal stopper, a dipole magnet, a radio frequency Helmholtz coil and scintillator telescopes located above and below the stopper. The CaS stopper was mounted between the poles of the dipole magnet. The experimental setup for NMR measurement was same as described in Ref[1]. The β-delayed gamma rays of ^{39}S that stopped in the CaS crystal were detected using two high purity Ge detectors that were diagonally placed at a distance of 30 cm from the stopper. Fig. 1 shows the photograph of the experimental setup around the stopper. The data acquisition system was triggered by a gamma-hit event defined by a logical OR of signals from the Ge detectors.

In this experiment, we also observed six gamma-ray peaks with energies of 396 keV, 485 keV, 874 keV, 904 keV, 1300 keV and 1697 keV, which had been observed in the previous experiment[2]. As an example, the energy spectrum of 396 keV is shown in Fig. 2. The further analysis to obtain the polarization effect in coincidence with the β rays is in progress.

Fig. 1. Photograph of experimental setup. The top part of one Ge detector is seen on the right side of the figure, and the other detector is located behind the dipole magnet. Two sets of plastic scintillators are inserted between the poles of the magnet.

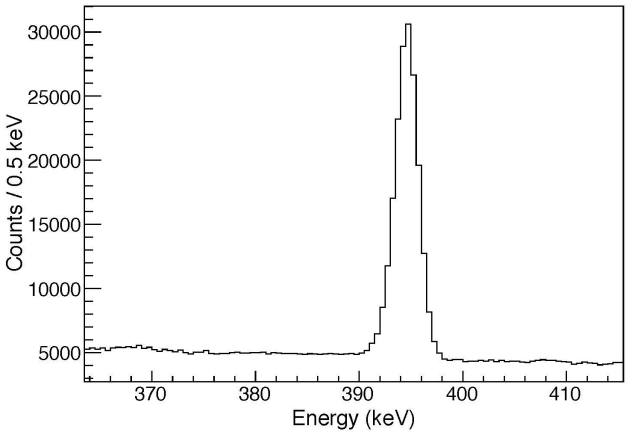

Fig. 2. γ ray spectrum with the energy of 396 keV.

*1 RIKEN Nishina Center
*2 School of Physics and State Key Laboratory of Nuclear Physics and Technology, Peking University
*3 Department of Physics, University of Tsukuba
*4 Department of Physics, Kyungpook National University
*5 Department of Physics, Meiji University
*6 Department of Physics, Osaka University
*7 Department of Physics, Tokyo Institute of Technology
*8 Department of Physics, Hosei University

References

1) Y. Ishibashi et al., RIKEN Accel. Prog. Rep. **49** (in this report).
2) J. C. Hill, R. F. Petry, K. H. Wang: Phys. Rev. C **21**, 384 (1980).