The erosion of $N = 28$ shell gap has been suggested from several spectroscopic experimental data. In particular, the $^{43}\text{S}$ nucleus is of considerable interest because shape coexistence is expected to occur, which is key to understanding the evolution of shell gaps far from stability. The isomeric state of $^{43}\text{S}$ at 320 keV is suggested to have a shape close to spherical with a spin-parity of $7/2^{-}$, but both the spin-parity and deformed parameter of the ground state have not been determined directly. To investigate the mechanics leading to such an anomalous nuclear structure, we aim to measure the ground-state nuclear moment of $^{41,43}\text{S}$. First, $\mu$ of $^{41}\text{S}$ was measured using the $\beta$-ray detected nuclear magnetic resonance ($\beta$-NMR) method combined with a technique to produce spin-polarized RI beams.

The experiment was carried out at the RIPS facility at RIBF. The RI beam of $^{41}\text{S}$ was produced by the fragmentation of a primary beam of $^{48}\text{Ca}$ at an energy of $E = 63$ MeV/nucleon on a primary target of $^{9}\text{Be}$ with a thickness of 0.52 mm. The typical intensity of the $^{48}\text{Ca}$ beam at the target was 200 pmA. To realize the spin polarization in $^{41}\text{S}$, an emission angle of $\theta_F > 1^\circ$ and a momentum window of $p_F = p_0 \times (1.015 \pm 0.025)$ were selected, where $p_0$ represents the central momentum of the fragment $^{41}\text{S}$. Under this condition, the particle identification of the secondary beam was performed on an event-by-event basis with information regarding time of flight (TOF) and energy loss ($\Delta E$) as shown in Fig. 1. The beam was pulsed with durations of beam-on and beam-off periods of 2.9 s and 2.9 s, respectively. The $^{41}\text{S}$ beam was then transported to the final focal plane and implanted into a stopper crystal of CaS with which $AP = -0.14\%$ was observed previously, where $A$ and $P$ denote the asymmetry parameter for the $\beta$-ray emission and the degree of polarization of $^{41}\text{S}$, respectively. The CaS stopper was mounted between the poles of a dipole magnet that produces an external magnetic field of $B_0 = 0.5$ T. $\beta$ rays emitted from the stopper were detected using plastic scintillator telescopes located above and below the stopper. An oscillating radio-frequency field $B_1$ was applied perpendicular to $B_0$ using a pair of coils. The frequency of $B_1$ was swept over a certain region, and spin reversal occurred when the region included the Larmor frequency. The spin reversal was detected through the change of the up/down ratio $R$ of the $\beta$-ray counts at the two telescopes. Because the range within which the $g$-factor of $^{41}\text{S}$ is predicted theoretically is quite wide, a fast switching system for changing the tank-circuit frequency was used. In this experiment, the $g$-factor search was conducted in the region where $0.2 < g < 0.8$. The results of the NMR measurements are under analysis.

References