Study on the β decay of ^{39}S

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We performed β-decay spectroscopy on the neutron-rich nucleus ^{39}S. The neutron-odd S isotopes with neutron numbers larger than 20 have negative-parity ground states, which decay into highly excited states with negative-parity in the Cl isotopes via allowed transitions. The investigations on the level structure of ^{39}Cl including both spin parities are necessary for understanding the nuclear structure in this mass region.

The experiment was carried out with the fragment separator RIPS in December 2015 together with the β-NMR measurement of ^{39}S[2]. A secondary beam of ^{39}S was obtained from the projectile fragmentation reaction of a ^{48}Ca projectile at an energy of 63 A MeV on a ^{9}Be target with a thickness of 0.5 mm. The beam was pulsed with the duration of the beam-on and off periods, 16 s and 16 s, respectively. The ^{39}S beam was implanted into a 0.5-mm-thick CaS stopper which was tilted at an angle of 45 degrees with respect to the beam axis. Two plastic scintillators with thicknesses of 0.5 mm and 1 mm were placed upstream and downstream of the stopper, respectively, in order to count the beam particles implanted into the stopper. The β-delayed γ rays of ^{39}S were detected using two high-purity Ge detectors that were diagonally placed at distances of 30 cm from the stopper.

In this measurement, three γ rays with energies of 1210.3(2) keV, 2571.9(4) keV and 3377.4(5) keV were newly identified to originate from ^{39}S, because their half-lives, 11.6(5) s, 11.5(5) s and 11.2(6) s, respectively, are in a good agreement with the known half-life of ^{39}S, 11.5(5) s[1]. As a result of the γ-γ coincidence analysis, the 1210-keV γ ray was found to have significant coincidence with the 485-keV one, as shown in Fig. 1. This γ ray was assigned to be a de-excitation from a new level at 2995 keV, as shown in Fig. 2. The 2572-keV γ ray was assigned to decay to the ground state directly because its energy is consistent with the known level energy[1]. On the other hand, the 3377-keV γ ray has not been assigned to the decay scheme, although its source is confirmed to be ^{39}S. The deduction of the branching ratio and the log ft values reflecting the new assignments are in progress.

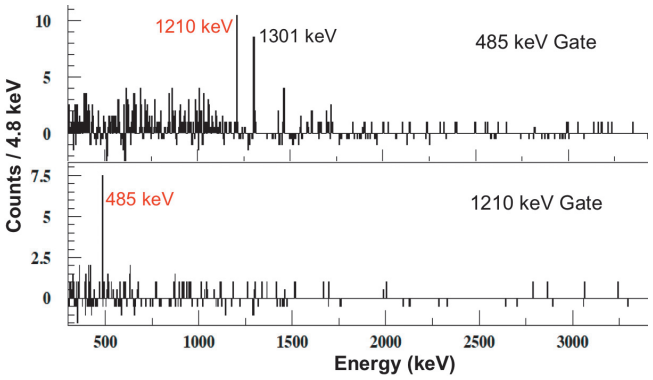

Fig. 1. γ-γ coincidence between the 1210-keV γ ray and the 485-keV γ ray.

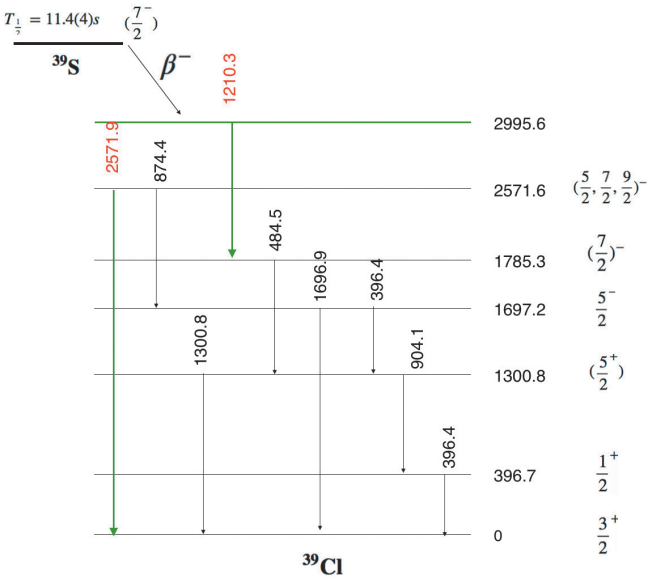

Fig. 2. β decay scheme of ^{39}S. Two γ rays of 1210 keV and 2571 keV newly identified in this work are assigned. Spin-parity values are taken from the compilation[3].

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