β-decay γ-ray spectroscopy of ^{140}Te : level structure of ^{140}I beyond $N = 82$

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The region beyond the doubly-magic nucleus ^{132}Sn is currently the subject of great experimental and theoretical interest in view of the shell structure evolution and rapid neutron capture processes. An accurate measurement of the β-decay of neutron-rich nuclei is crucial for the determination of the r-process path. We report the first observation of excited states of ^{140}I by the β-delayed γ-ray spectrosocopy of ^{140}Te.

The ^{140}Te nuclide was produced by the in-flight fission with a 345 MeV per nucleon ^{238}U primary beam on a ^{9}Be target by means of the BigRIPS separator. A total of 1.8×10^{6} ions of ^{140}Te was implanted during the beam time among about 10^{7} total implanted ions. After beams were implanted on the active double-side stripped silicon detector array, WAS3ABi, γ-rays following after the β-decay were detected by Euroball RIKEN HPGe Cluster Array(EURICA) surrounding WAS3ABi.[1,2)]

Total 40 γ-rays were assigned as internal transitions of ^{140}I. The level scheme of ^{140}I as shown in Fig. 1 has been built based on $\gamma\gamma$ coincidence matrices and the β-delayed γ-ray singles spectrum. The β-decay half-life of the parent ^{140}Te was obtained to be 350(5) ms by the 341-, 739-, 875-keV transitions.

Spin parity assignments of the established levels were made on the basis of the logft value argument. For instance, those with logft values of near 6 to 7, applying to the region of the first forbidden β strengths,

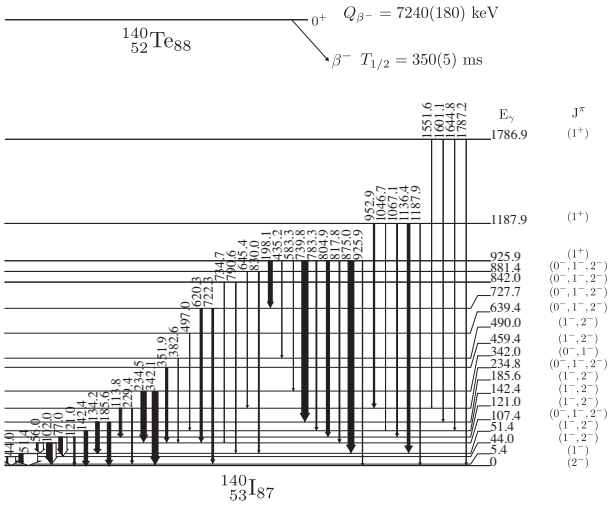

Fig. 1. The level scheme of ^{140}I. The thickness of each transition represents the relative intensity to the 44 keV transition.

are possibly 0, 1, and 2. We note that the spin-parity of the ground state should be assigned as (2^-) according to our analysis of the β-decay to ^{140}Xe. The 5.4-keV level is likely to be a (1^-) state based on the shell model calculations. Additionally, levels with a direct transition to the ground state are assigned as (1^-) or (2^-) by assuming that all transitions are M1.

The level at 926 keV is assigned as an 1^+ state with an argument based on the log ft value, 4.89. This 1^+ state is strongly related to the Gamow-Teller(G-T) transition. In this region, the only allowed β-decay transitions, G-T transitions, involves the decay of an $h_{9/2}$ neutron to an $h_{11/2}$ proton. Such a decay from an even-even nucleus gives rise to a $[\nu h_{9/2}\pi h_{11/2}]1^+$ state in the odd-odd daughter nucleus.

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