β decay of ^{140}Sb : level scheme of ^{140}Te†

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We report the first observation of the level structure of ^{140}Te through the β-delayed γ-ray spectroscopy of ^{140}Sb. The structure of Te with $N > 82$, two protons beyond $Z = 50$, is expected to provide a wealth of information on the shell evolution in extreme proton-neutron imbalanced environments. Besides, the present work provides valuable inputs for modelling the nucleosynthesis since the ^{140}Sb decay process is one of important paths along the rapid neutron capture process.
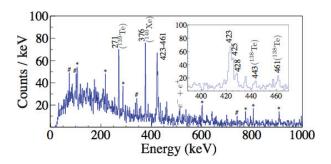

Fig. 1. Singles γ-ray spectrum associated with the β decay of ^{140}Sb obtained in 2000 ms time interval after ions are implanted on the active target. The inset is a zoomed spectrum in representing the 380 to 470 keV region. Peaks with an asterisk are room- and beam-induced backgrounds from random coincidence with β events. Peaks with a # mark represent unassigned γ rays after decays of Te nuclides.

The parent ^{140}Sb nuclides were produced by the in-flight fission of a 345 MeV per nucleon ^{238}U beam on a ^{9}Be target and selected by the first stage of the BigRIPS separator. During the beam time, a total of 7.8×10^3 ions for ^{140}Sb were collected among about 10^7 total ions. Emitted γ rays, following the β decay of ^{140}Sb were collected by EURICA, the HPGe array, surrounding the active double-side stripped Si stopper array WAS3ABi[1]. Figure 1 shows the β-delayed γ-ray spectrum of ^{140}Sb. The broad peaks around 425 keV are composed of triple photo-peak as shown in the inset of Fig. 1; 423, 425, and 428 keV. On the basis of the γγ coincidence data and γ-ray intensities in the singles spectrum, we propose that the 423- and 425-keV peaks should be assigned as γ-ray transitions in ^{140}Te.

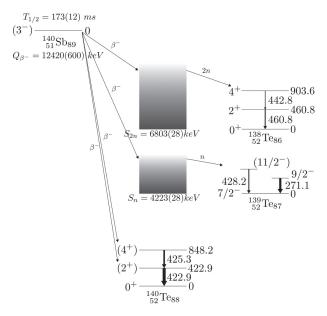Fig. 2. The β-decay scheme of ^{140}Sb deduced from the present work. The thicknesses of each transition represent the relative intensities to the 423 keV transition.

As shown in Fig. 2, we successfully identified β-decay scheme, β-delayed one-neutron emission, and β-delayed two-neutron emission channels from the decay of ^{140}Sb.

Reference
1) P.-A. Söderström et al. Nucl. Instrum. Methods Phys. Res. B **317**, 649 (2013).