Beta-delayed proton spectrum from the $T_z = -2$ nucleus ^{64}Se at BigRIPS

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Spin-isospin excitations can be studied by β-decay and charge exchange reactions in mirror nuclei, shedding light on mirror symmetry. Hence we can compare our results on the β decay of proton-rich nuclei with the results of charge exchange experiments when appropriate targets for the mirror nuclei are available[1]. Accordingly we have performed experiments at GSI and GANIL to study $T_z = -1$[2] and $T_z = -2$[3,4] nuclei respectively where it became clear that the study of heavier, more exotic systems demands beam intensities available only at the RIKEN RIBF.

We have performed an experiment using the fragmentation of a 345-MeV/nucleon ^{78}Kr beam with a typical intensity of 200 pnA on a Be target. The fragments were separated in flight using the BigRIPS separator and implanted in three WAS3ABi double-sided Si strip detectors (60 mm × 40 mm × 1 mm, 60 horizontal and 40 vertical strips). The implantation setup was surrounded by the EUROBALL-RIKEN Cluster Array (EURICA). The experiment is described in detail in a previous report.[5]

Here we present the first experimental observation of the beta-delayed protons in the decay of the $T_z = -2$ ^{64}Se nucleus. The spectrum was constructed using time correlations between ^{64}Se implantations and all β signals within a single pixel, defined as the crossing of one X and one Y strip. Fig. 1 shows the β-delayed proton spectrum of ^{64}Se. The proton energies were obtained by fitting the previously known β-delayed proton response function in DSSSD detectors, detailed in Ref.[4], consisting of a Gaussian function plus an exponential tail. The WAS3ABi DSSSD detectors were calibrated using an external electron conversion in a ^{207}Bi source; thus proton energy shifts are expected. These energy shifts were compared and recalibrated using the ^{57}Zn and ^{61}Ge beta-delayed proton spectra obtained in this experiment and constructed in the same manner as the ^{64}Se beta-delayed proton spectrum. The ^{57}Zn and ^{61}Ge proton energies are taken from Ref.[6]. The uncertainties in the proton energies shown in Fig. 1 originate from the fit of the response function for each proton peak as well as the systematic shift of the proton energies compared with those reported in the literature.[6]

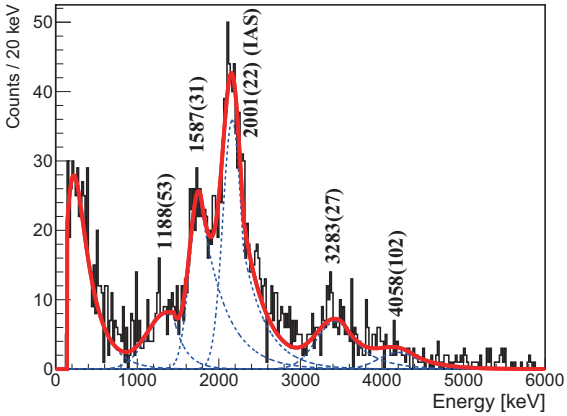

Fig. 1. β-delayed proton spectrum of ^{64}Se. The dashed blue lines represent the individual proton response functions. The numbers above the proton peaks indicate the proton energy after a shift correction has been applied (see text).

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