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Beta-delayed proton emission of the drip-line nucleus 73Rb

Nuclei near the neutron and proton drip lines play a key role in our understanding of astrophysics, weak-interaction physics, and nuclear structure. Weakly-bound or proton-unbound nuclei at the rp-process waiting points, such as the unbound Tz = −1/2 nucleus 73Rb, are critical for constraining calculations and observations of type I x-ray bursts. For instance, the rp process is greatly slowed near 72Kr (N = Z) due to its relatively long β-decay half-life and inhibited proton capture. This waiting point, however, may be bypassed by sequential 2p-capture through 73Rb - a reaction which is sensitive to the 73Rb proton separation energy [1]. The recent discovery of the relatively long-lived 72Rb nuclear "sandbank" highlights the interplay of the Coulomb interaction and structure effects that can arise at the proton drip line, particularly in the region of 73Rb [2]. To probe the extent by which 73Rb is proton unbound we have performed an implant-decay experiment designed to measure β-delayed protons from states in 73Rb fed through the decay of 73Sr (t1/2 ~ 30 ms). The experiment was carried out at NSCL where a newly available 92Mo primary beam was used to access neutron-deficient nuclei with Z>36 (krypton), producing 73Sr as well as other nearby neutron-deficient isotopes of interest. Short-lived nuclei were transported to the Beta-Counting Station (BCS) where they were identified and implanted in a silicon DSSD surrounded by the Segmented Germanium Array (SeGA). The secondary beam was purified with the RF Fragment Separator which reduced the total implantation rate to ~10 pps, thereby enabling the successful detection and correlation of β-delayed proton groups from 73Rb. Details of the experimental setup and new decay results, as well as the potential impact on the 72Kr rp-process waiting point will be presented.

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