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Harvesting Radioisotopes from an Aqueous Target at a Projectile Fragmentation Facility

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A remotely-operated liquid water target system for harvesting radioisotopes at the National Superconducting Cyclotron Laboratory (NSCL) was designed and constructed as the initial step in proof-of-principle experiments to harvest useful radioisotopes from the Facility for Rare Isotope Beams (FRIB). FRIB will be a new national user facility for nuclear science to be completed in 2020 at which radioisotopes can be collected synergistically from the water in cooling-loops for the primary fragmentation target. To develop the radiochemical expertise required to harvest long-lived radioisotopes of interest in this environment, the water target system was constructed and has been successfully used to collect beams of 24Na and 67Cu ions produced at the NSCL. Initial experiments included collection of an analyzed 24Na test beam and collection and extraction of 67Cu, a radioisotope with medical applications, from both an analyzed and an unanalyzed beam. The last test run, where 67Cu was delivered as a 2.6% unanalyzed beam, contained a cocktail of contaminant beam particles that had to be radiochemically separated from the isotope of interest. The collected radioisotopes were characterized using low-background gamma spectroscopy at both Hope College and Washington University. Analysis of the extraction technique indicated 95% and 74% of the delivered copper isotope from the analyzed and unanalyzed beam, respectively, was successfully removed from the water. The 67Cu was subsequently utilized for labeling antibodies and biological evaluation.

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