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Decay Spectroscopy of High-K Isomers in Deformed Neutron-rich 180<A<190 Nuclei via Fragmentation of ^{198}Pt

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Long-lived K-isomers at high angular momenta in very neutron-rich deformed Hf (Z=72) nuclei have been predicted for decades, but their spectroscopy has remained elusive as they are difficult to populate. Not only are these nuclei interesting from a nuclear structure perspective, but they also border the r-process pathway, and thus their β-decays are of considerable relevance for our understanding of heavy-element nucleosynthesis. Standard reaction mechanisms, such as fusion-evaporation, deep-inelastic and transfer, have led to slow and incremental progress in pushing the spectroscopic frontier by barely two or three neutrons beyond the heaviest stable isotope.

To break this stalemate and make significant inroads into neutron-rich territory, a new reaction mechanism was needed. An experiment was conducted at the NSCL to study neutron-rich nuclides in the Hf-Ta-W region, through the fragmentation of a newly developed ^{198}Pt primary beam incident at 86 MeV/u on Be and Ni targets. Additional motivation for the experiment was to observe new isotopes, as well as compare angular momenta imparted to the fragments with different primary targets. The products were momentum-analyzed with the A1900 separator and implanted into a stack of Si detectors, consisting of two 140-μm ΔE detectors, a 500-μm single-sided strip detector with 16 horizontal strips for momentum sensitivity, a 1000-μm implant detector for total energy, and backed with a 500-μm veto detector. This allowed for full event-by-event particle identification (A, Z, Q) using measured ΔE-Bρ-TKE-ToF parameters. The Si stack was surrounded by the GRETINA γ-ray tracking array, which provided efficient detection of γ-ray cascades following isomer decays. Data were acquired in three different central-momentum settings for the very-neutron-rich ^{186}Hf, ^{189}Hf and ^{192}Hf isotopes, with a number of neighboring isotopes populated in the process at each setting. Prior spectroscopic information of ^{190}W, populated strongly in the ^{186}Hf (and ^{189}Hf) settings, was used to benchmark and calibrate the particle identification landscape.

Decay spectroscopy of new and previously-observed multi-quasiparticle isomers in deformed neutron-rich Hf, Ta and W nuclei, with half-live measurements ranging from a few hundred nanoseconds to a few hundred microseconds, will be presented and discussed.

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