Contribution ID: **63** Type: **not specified**

Shape transition in neutron-rich A~190 nuclei via isomer decays in fragmentation reactions

Friday, July 26, 2024 11:20 AM (20 minutes)

The 180<A<190 Hf-Ta-W region near the valley of stability display robust axially symmetric prolate deformation and associated high-K isomerism. Mapping the evolution of shapes in approaching the Z=82 and N=126 shell closure from the very deformed rare-earth mid-shell region is of great interest for honing nuclear structure models, with a loss in axial symmetry and a transition from prolate to oblate shape expected. The very neutron-rich nuclei in this region are far less explored experimentally as they cannot be accessed via fusion-evaporation or transfer reactions, and long-standing predictions of shape transitions remain untested. Different theoretical models predict different shape evolution characteristics. Firm experimental evidence is needed to refine and tune the predictions on these exotic systems.

A fragmentation reaction was utilized for the first time to access these nuclei, using a newly developed 198Pt primary beam at NSCL incident on Ni and Be targets, populating isotopes in their isomeric states in the region of interest. These isotopes were implanted in a stack of Silicon detectors surrounded by the GRETINA array to detect delayed gamma rays correlated to their respective isomeric decay. Isotope identification was achieved with ΔE-B□-TKE-ToF information recorded on an event-by event basis for each implant. A range of isomers were populated in 72<Z<77 nuclei, with half-lives ranging from a few hundred ns to few hundred μs and many of them observed for the first time. These provide first spectroscopic data on high-spin excitations in this previously inaccessible region of the nuclear chart, with detailed level schemes deduced in some cases with the available □-□ statistics. The results of this experiment and analysis will be presented, with special emphasis on the detailed level structure of a N=116 nucleus, which provide a critical experimental test to model predictions in this very neutron-rich region of the nuclear chart.

This work is supported by the U.S. Department of Energy and the National Science Foundation.

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Session Classification: Decay Spectroscopy