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Isomers and enhanced stability of the heaviest elements

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Deformed, axially-symmetric nuclei in the trans-fermium region are known to exhibit high-K isomerism, because of the presence of high-Ω orbitals near both the proton and neutron Fermi surfaces. The properties of such isomers provide important information on the single-particle structures and on the role played by the pairing, and residual nucleon-nucleon interactions in the region. It is also believed that the existence of high-K states at relatively low excitation energies could lead to an enhanced stability of the super-heavy elements. However, the knowledge is very limited owing to the paucity of experimental data.

A number of experiments in Fm, No and Rf nuclei near the N=152 sub-shell closure, aimed at the discovery of isomeric states and elucidation of their properties, were carried out at Argonne using the Fragment Mass Analyzer.
Recently, a digital data acquisition system was deployed, which allowed comprehensive pulse-shape analysis of the recoil-decay pile-up events to be performed and identification of implant and decay events separated by decay times as short as hundreds of nanoseconds. Furthermore, this novel approach resulted in a much lower $\sim$50-keV threshold for conversion-electron events, associated with decays of isomeric states within the first 6 μs following implantation, independent from the energy threshold set in the digitizer firmware.
Data from those experiments will be presented and the results will be discussed in comparison with predictions from multi-quasiparticle blocking calculations that include empirical estimates for the configuration-dependent residual interactions.

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