

Evidence of isomeric states in 183,184Ta

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The neutron-rich region around $A \sim 180-190$ is of particular interest for studying high-spin isomers and shape transitions. In this mass range, theory predicts a prolate-to-oblate shape transition, which may lead to prolate high-K isomers decaying to oblate low-K states. Experimentally, neutron richness and the refractory chemical properties of these elements, especially from Hf ($Z=72$) to Pt ($Z=78$), limit the experimental yields.

A recent experiment at the KEK Isotope Separation System (KISS) at RIKEN aimed to study neutron-rich hafnium isotopes produced via multi-nucleon transfer reactions. A ^{136}Xe beam at 7.2 MeV/nucleon was incident on a natural W target. The reaction products were captured in an argon gas cell, selectively ionised using two-step laser resonance ionisation, mass separated, and implanted on a moving Mylar tape at the decay station. A multi-segmented proportional gas counter was used for beta/conversion-electron detection together with Super HPGe Clover detectors for gamma-ray spectroscopy.

The experiment demonstrates successful production of neutron-rich $^{183,184}\text{Hf}^+$ ions and has yielded clear evidence of a new isomer in ^{183}Ta with $T_{1/2}=41(+6/-4) \mu\text{s}$, which is interpreted as the missing $\pi 1/2^+[411]$ state decaying to the known $\pi 5/2^+[402]$ level via a low-energy unobserved E2 transition. For $A=184$, our analysis suggests a low-lying isomer with $T_{1/2} \sim 10 \mu\text{s}$ in ^{184}Ta fed by the long-lived high-K isomer in ^{184}Hf with $T_{1/2} \sim 10 \text{ min}$. The presentation will summarise these results, discuss Nilsson-model systematics with ^{183}Ta and present IBM calculations for ^{184}Hf to benchmark structure evolution across this region.