Rotational structure and K-isomerism in neutron-rich tantalum nuclei populated via deep-inelastic reactions.

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The neutron-rich region of nuclei centred around A=180 is inaccessible to conventional fusion-evaporation reactions and recent efforts to access them have been focussed on using more exotic techniques such as deep-inelastic [1] and relativistic fragmentation [2] reactions. Nuclei in this region are generally prolate deformed with axial symmetry and exhibit metastable states known as K-isomers [3,4]. In these nuclei, the single-particle energy levels depend on the component of the nucleon's angular momentum (Ω) along the nuclear symmetry axis. These components sum to give a quantum number, $K= \Sigma_i \Omega_i$, that is nominally conserved. Metastable states can form when the only possible decay is via transitions whose multipole order λ is less than the K change, thus violating the selection rule, $\lambda \geq \Delta K$.

The present γ-ray spectroscopy experiment used the Gammasphere array at Argonne National laboratory. A beam of 840 MeV ^{136}Xe ions from the ATLAS accelerator was incident on a thick ^{186}W target resulting in population of a range of neutron-rich nuclei via deep inelastic reactions. The experimental measurements involved a variety of macroscopic beam-pulsing conditions ranging from microseconds to seconds and γ-γ coincidence techniques to enable identification of isomers with a range of lifetimes.

This presentation will focus on an exploration of the structure of possible K-isomers in neutron-rich tantalum isotopes. The data analysis is in progress and the interim results will be presented. These will include a partial level scheme for ^{183}Ta and a new 75 ns isomer feeding the known 900 ns isomeric state [5]. The reaction used is expected to populate tantalum nuclei from A=182 to A=187; note that the heaviest stable tantalum isotope is ^{181}Ta and little or no information is available for γ-rays in tantalum nuclei heavier than ^{183}Ta except for ^{185}Ta [6,7]. Some of the partial level schemes believed to belong to these heavy nuclei but yet unassigned, will also be presented.

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