

## High-K multi-quasiparticle states and anomalous $\gamma$ -ray decays in $^{184}\text{W}^*$

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Traditional heavy-ion fusion reactions with stable beams and targets cannot be used to populate high-spin states in the stable and neutron-rich nuclei of the  $A=180$  region where some of the best examples of high-K isomers based on multi-quasiparticle intrinsic states are known. This has motivated extensive efforts to use more exotic techniques such as relativistic fragmentation [1] and deep-inelastic / multi-nucleon transfer reactions [2].

Using a deep-inelastic reaction, Wheldon et al [3] have identified a  $T_{1/2}=188\text{ns}$  isomer in the stable nucleus  $^{184}\text{W}$ , and observed its decay towards the  $\gamma$ -vibrational and ground state rotational bands through a series of excited states with unknown spin and parity. We have clarified and significantly extended the level scheme in an experiment which used a pulsed beam of 820 MeV  $^{136}\text{Xe}$  ions from the ATLAS accelerator at Argonne National Laboratory, incident on a gold-backed,  $5\text{ mg/cm}^2$   $^{185}\text{Re}$  target. The gamma-rays from the products of deep-inelastic and multi-nucleon transfer reactions, including the 1p transfer channel leading to  $^{184}\text{W}$ , were observed with Gammasphere.

The lifetime of the isomer has been remeasured and the complex decay through previously unknown multi-quasiparticle and gamma-vibrational states has been characterised. Time-correlated spectroscopy across the isomer has resulted in the discovery of higher-lying excited states which appear to be mostly of a multi-quasiparticle nature with very little development of rotational structure. A number of short-lived isomers (lifetimes of a few ns) have also been observed, including an isomer which exhibits anomalously fast gamma-ray decays that can be explained through a chance degeneracy between the isomeric state and a level in the  $\gamma$ -vibrational band.

The new experimental results for  $^{184}\text{W}$  will be presented and the observed spectrum of intrinsic states will be compared with the results of multi-quasiparticle calculations. The deduced interaction between a K-isomer state and a  $\gamma$ -vibrational state will be discussed in the context of chance degeneracies in the  $A=180$  region between multi-quasiparticle intrinsic states [4,5].

[1] M. Caamano et al., *Eur. Phys. J. A* **23**, 201 (2005).

[2] G.D. Dracoulis et al., *Phys. Lett. B* **635**, 200 (2006).

[3] C. Wheldon et al., *Eur. Phys. J. A* **20**, 365 (2004).

[4] G.D. Dracoulis, *Nucl. Phys. A* **752**, 213c (2005), INPC proceeding.

[5] G.D. Dracoulis, *AIP Conf. Proc.* **819**, 3 (2006), CGS Conference Proceeding.

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