

Possible observation of a high-spin K -isomer in ^{184}Hf via γ -ray spectroscopy

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The search for K -isomers in prolate deformed $A \sim 180$ nuclei has long been at the fore-front of nuclear structure research. While neutron-deficient hafnium ($Z = 72$) nuclei in this region are now well studied, much less is known concerning the neutron-rich isotopes. Recent mass measurement studies have found a $4\text{-}qp$ isomer in ^{184}Hf , four neutrons beyond the line of β -stability, which appears to β -decay [1], to a high spin state in ^{184}Ta . In the present work we report the possible observation of a high- K isomer in ^{184}Hf that γ -ray decays to the $K^\pi = 8^-$ band and would lie above the isomer identified in [1].

High-spin states in ^{184}Hf were populated using deep-inelastic and multi-nucleon transfer reactions induced on a neutron-rich ^{186}W target by a ^{136}Xe beam from the ATLAS facility at Argonne National Lab. Emitted γ -rays were detected by the Gammasphere array. The new weakly-populated isomer feeds a rotational band sequence that is in coincidence with hafnium x-rays, with corresponding yields from various targets suggesting a provisional assignment to ^{184}Hf . This band has properties that are consistent with those expected for the $K^\pi = 8^-$ band in ^{184}Hf . In addition, several known high- K isomeric states in $^{180,181,182}\text{Hf}$ are now found to have different life-times compared to the previous measurements [2]. Multi-quasiparticle calculations using the Lipkin-Nogami formalism and Nilsson single-particle energies have been used to support the configuration assignment of the new isomer in ^{184}Hf together with other states in neutron-rich hafnium nuclei.

[1] M. W. Reed *et al.*, Phys. Rev. Lett. **105**, 172501 (2010).

[2] R. D'Alarcao *et al.*, Phys. Rev. C **59**, R1227 (1999).