DISCOVERY OF HIGH-SPIN LONG-LIVED K ISOMERS IN NEUTRON-RICH TANTALUM AND HAFNIUM ISOTOPES USING THE EXPERIMENTAL STORAGE RING (ESR) AT GSI

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A study of neutron-rich isotopes in the A~185 region of the nuclear chart has uncovered long-lived (>1 min) isomers in several isotopes of Hf and Ta. The region was accessed via the use of projectile fragmentation with the UNILAC-SIS facility at GSI. A 400 MeV/u ^{197}Au beam was incident on a ^{9}Be target and the subsequent fragments were passed through the fragment separator and injected into the experimental storage ring (ESR). With Schottky pick-ups coupled to the ESR it is possible to perform mass spectrometry on the injected particles with sensitivity down to single ions [1]. Evidence will be presented for isomers in ^{183,184,186}Hf and ^{186,187}Ta, with excitation energies in the range of 0.5-3.2 MeV. Prior to this experiment only one isomer had been reported in these nuclides, that being in ^{184}Hf [2]. We now confirm the existence of that isomer while also reporting a more energetic, longer-lived (>10 min) isomer in the same isotope. Continuous observation of a single ion of this second isomer was possible over a 25 min period, without its decay. The isomer's excitation energy matches well with the prediction of a high-spin, four-quasiparticle state at 2.5 MeV [3]. Details of this and the other observed isomers will be presented. Given their low production levels and long half-lives, it is unlikely that they could have been identified with any other technique.

Using the ESR it has been possible to gain access to a highly neutron-rich area where there is a predicted coexistence between well-deformed prolate and oblate shapes [4, 5]. This will have implications for the high-spin structure and isomer lifetimes, which can be addressed with the new data.

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