Competing decay modes from the 25/2− spin-gap isomer in 155Lu

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The decay properties of the neutron-deficient N=84 isotones are characterised by the presence of spin-gap isomers arising from the attractive monopole interaction between h11/2 protons and h9/2 neutrons, which perturbs the ordering of the single-particle orbitals. The resulting irregular spin sequences necessitate a large change in angular momentum, leading to hindered α-decaying isomeric states. Spin-gap isomers have been observed in the N=84 isotones 156Hf, 155Lu, 158W, and 160Os, that decay exclusively via α decay. Investigating the properties of these states provides vital information on nuclear structure near the limits of stability, where the ordering of single-particle orbitals is drastically changing.

Previous studies of 155Lu established the 25/2− isomer as decaying exclusively via hindered α decays with a half-life of 2.7 ms. Until now, a complete experimental characterization of this state has been constrained by the difficulty of identifying weak electromagnetic decay branches amidst the substantial background that precludes the identification of transitions when correlating γ rays on millisecond time scales.

The experiment was performed at the Accelerator Laboratory of the University of Jyväskylä. Nuclei were produced in the 102Pd(58Ni,3p2n)155Lu fusion-evaporation reaction. By exploiting the MARA recoil separator, the decay properties of 155Lu were studied via conversion-electron spectroscopy of the implanted nuclei. An electromagnetic branch depopulating the 25/2− isomeric state will be presented, and the experimental extraction of B(M3) and B(E4) strengths will be discussed alongside new α-decay fine-structure to non-yrast states in 151Tm. These results provide new spectroscopic insights into the decay dynamics of the most neutron-deficient lutetium isotopes.