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Surprising Decay Properties of the New SHE Isotope ^{255}Db

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Isotopes of SuperHeavy Elements (SHE) boast extraordinary numbers of protons and neutrons and push the boundaries of the nuclear chart and our understanding of nuclear structure. Typically, SHE isotopes follow one of two primary decay paths: emission of an α particle or Spontaneous Fission (SF). A more robust understanding of the mechanism for SF in the SHE region is of great interest.

Experiments conducted at Lawrence Berkeley National Laboratory's 88-inch cyclotron facility aimed to produce and study the decay of the previously unobserved isotope ^{255}Db. This isotope was produced in the ^{206}Pb(^{51}V,2n)^{255}Db reaction, separated from unreacted beam material and reaction byproducts with the Berkeley Gas-filled Separator (BGS), and then implanted into a double-sided silicon-strip detector at the BGS focal plane. Decay properties of ^{255}Db were determined from the analysis of Evaporation Residue (EVR)-Fission and EVR-α-α correlations. The properties of this new isotope of dubnium are intriguing as they differ dramatically from those of its isotopic neighbors. ^{255}Db was found to decay primarily by Spontaneous Fission (SF) with a small α-decay branch, where the average half-life of the observed decays was $t_{1/2}$ = $2.6^{+0.4}_{-0.3}$ ms. Theoretical calculations were performed using the Wentzel-Kramers-Brillouin (WKB) approximation, with parameters calculated within a self-consistent microscopic approach, to see if these unique properties could be reproduced. A SF half-life estimate is obtained that closely matches the measured value, while simultaneously pointing out the sensitivities that need to be further constrained in future work.

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