PROTON SINGLE-PARTICLE STATES IN THE HEAVIEST ACTINIDE NUCLEI*

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Although many superheavy elements have been discovered recently, there is still controversy regarding their proton shell structure. Hence, it is important to experimentally delineate the energies of single-particle levels in nuclei that are at the boundary of the island of these superheavy elements. The heaviest odd-proton nuclide available in the largest quantity is the α decaying $^{253}_{99}$Es ($T_{1/2}$=20.47 d) isotope. We have studied the level structure of its daughter nucleus $^{249}_{97}$Bk by measuring the γ-ray spectra of a highly enriched ^{253}Es sample that was obtained from a ^{253}Cf source material produced in the High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory. Because of the chemical and isotopic purity of the source, we were able to identify, with a single HpGe detector, many weakly populated states that decay by γ rays with intensities as low as 1.0×10^{-6}% per ^{253}Es α decay. In addition, we used the Gammasphere spectrometer at Argonne National Laboratory to measure γ-γ coincidences in order to determine the decay pattern of high-lying structures. The high efficiency and resolving power of Gammasphere allowed us to identify many weak γ rays that were initially buried under the background of the singles spectrum. Information on low spin states of ^{249}Bk was also obtained from γ-ray spectroscopic study following β-decay of ^{249}Cm at Lawrence Livermore National laboratory. The ^{249}Cm sample was produced by neutron irradiation of ^{248}Cm. Using the results of the present study and the data available from the previous ^{248}Cm(α,t) investigation, a number of single-particle and vibrational states have been identified in ^{249}Bk, including: $7/2^+[633]$, 0.0 keV; $3/2^-[521]$, 8.78 keV; $1/2^+[400]$, 377.55 keV; $5/2^+[642]$, 389.17 keV; $1/2^-[530]$, 569.19 keV; $9/2^+[624]$, 1040.2 keV; $\{7/2^+[633]\otimes0^-\}7/2^-$, 932.2 keV; and a $K^\pi=1/2^-$ band, 643.0 keV. A comparison of the level structure of ^{249}Bk with those of neighboring ^{247}Bk and ^{251}Es will be discussed.

* This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under contract No. W-31-109-ENG-38 (ANL) and W-7405-ENG-48 (LLNL), and Department of Energy, Office of Basic Energy Sciences, under contract No. DE-AC05-00OR22725. The authors are also indebted, for the use of ^{253}Es samples, to the Office of Basic Energy Sciences, U. S. Department of Energy, through the transplutonium element production facilities at Oak Ridge National Laboratory.