MULTIPLE OCTUPOLE BANDS AND SHAPE CHANGE IN ^{221}TH*

W. Reviol[1], D. G. Sarantites[1], J. B. Snyder[1], O. L. Pechenaya[1], M. P. Carpenter[2], C. J. Chiara[2], R. V. F. Janssens[2], T. Lauritsen[2], D. Seweryniak[2], S. Zhu[2], K. Hauschild[3], A. Lopez-Martens[3], and D. J. Hartley[4]

[1]*Washington University, St. Louis, MO 63130, USA*
[2]*Argonne National Laboratory, Argonne, IL 60439, USA*
[3]*CSNSM, IN2P3-CNRS, F-91405, Orsay Campus, France*
[4]*US Naval Academy, Annapolis, MD 21402, USA*

Alternating-parity level structures connected by strong E1 transitions represent one of the experimental signatures for an octupole-deformed nuclear shape. Such bands have been found, particularly around ^{224}Th and ^{146}Ba [1]. A study of ^{221}Th seems interesting for two reasons. First, there is a marked difference from the structure of ^{219,223}Th [2,3]. In the latter nuclei, pairs of nearly degenerate spin-parity states I^+ and I^- (parity doublets) are found that give rise to two bands, whereas in ^{221}Th only one band is reported [3]. Hence, delineation of the non-yrast structure of ^{221}Th is desirable. Second, the concentration of decay intensity in one band, like in an even-even nucleus, predestines ^{221}Th as a case for studying the feeding of octupole bands. Indeed, for ^{222}Th an octupole to reflection-symmetric shape transition has been predicted at high spin (e.g. Fig. 39 of Ref. [1]). The experimental study of ^{222}Th [4] remained somewhat inconclusive with respect to this issue, and a study of ^{221}Th is complementary.

The nucleus has been studied using the ^{207}Pb(^{18}O,4n) ^{221}Th, E_{lab} = 96 MeV fusion-evaporation reaction and the Gammasphere + HERCULES detector combination. HERCULES helps to separate the γ rays of the evaporation residues from those of the dominant fission products. Based on selected γ-ray coincidence data, the previously reported level scheme [3] has been improved as follows: *(i)* The yrast octupole band has been corrected at medium spin (I^π = 31/2$^+$, 33/2$^-$) and extended up to I^π = 39/2$^+$ and 37/2$^-$. Here, the alternating-parity level structure appears to be cut off, but the level scheme extends farther. The placement of a higher lying transition establishes a spin of 43/2. *(ii)* The non-yrast structure of ^{221}Th includes another octupole band. The band has similar B(E1)/B(E2) ratios as the yrast band ($3 \cdot 10^{-6}$ fm^{-2} on average), but is elevated by 400 keV relative to the latter.

The discussion of ^{221}Th will focus on two aspects: *(i)* The rotational frequency reached at the highest spins ($\hbar\omega$ = 0.26 MeV) concurs with the critical frequency for the predicted shape transition in ^{222}Th. *(ii)* The absence of parity doublets in ^{221}Th is related to the low K value of the ground-state configuration.

References

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