

HIGH-SPIN STATES IN  $^{124}\text{Ba}^*$ 

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(Received November 30, 2004)

High-spin states in  $^{124}\text{Ba}$  were populated using the  $^{64}\text{Ni}(^{64}\text{Ni},4n)^{124}\text{Ba}$  reaction at beam energies of 255 and 261 MeV. Gamma-ray coincidences were measured using the EUROBALL detector array. The charged-particle detector array DIAMANT provided channel selection. The previously known rotational bands are extended to higher spins. Five new bands are observed, one of them extends up to the spin  $40\hbar$  region.

PACS numbers: 27.60.+j, 21.10.Re, 23.20.Lv

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\* Presented at the XXXIX Zakopane School of Physics — International Symposium “Atomic Nuclei at Extreme Values of Temperature, Spin and Isospin”, Zakopane, Poland, August 31–September 5, 2004.

## 1. Introduction

The nuclei around mass number  $A \simeq 130$  are very well suited to study the interplay between single-particle and collective excitation modes. The transitional nuclei with a few nucleons outside a closed-shell core are soft with respect to  $\gamma$ -deformation [1–3] and shape driving effects of nucleons in different orbitals can be investigated. In particular, protons and neutrons in  $h_{11/2}$  intruder orbitals compete in polarising the nuclear core which leads to a co-existence of different shapes [4, 5]. Recent investigations have also revealed terminating bands, *e.g.* in  $^{122}\text{Xe}$  [6] and  $^{123}\text{Cs}$  [7]. The aim of this work is to search for these phenomena as well as to test the cranked shell model (CSM) at high spins.

## 2. Experimental methods and results

The reaction  $^{64}\text{Ni}(^{64}\text{Ni},4n)^{124}\text{Ba}$  was used to populate high-spin states in  $^{124}\text{Ba}$ . The beam with energies of 255 and 261 MeV was provided by the Vivitron Tandem accelerator at IReS, Strasbourg. The target consisted of a self supporting foil of  $\simeq 500 \mu\text{g}/\text{cm}^2$  thickness. The  $\gamma$ -ray coincidences were detected by the EUROBALL-IV spectrometer array [8]. A total of  $12 \times 10^9$  Compton suppressed coincidence events was recorded. In addition, the charged-particle detector array DIAMANT [9] was mounted inside the target chamber. For the present analysis it was used to suppress the charged-particle reaction channels.

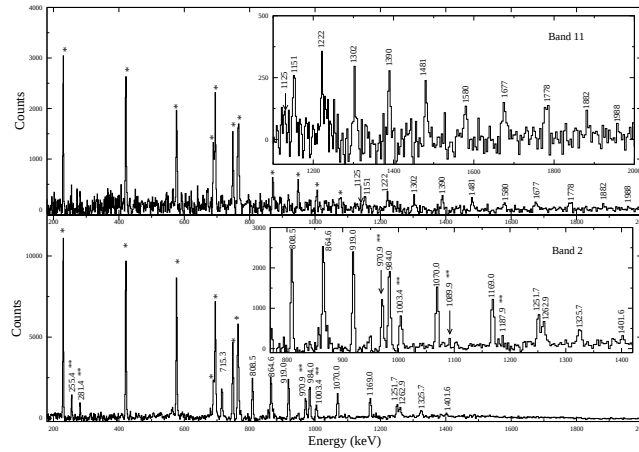


Fig. 1. Summed triple gated  $\gamma$ -ray coincidence spectra of band 11 (upper panel) and of band 2 (lower panel) in  $^{124}\text{Ba}$ . The peaks marked by a single asterisk belong to band 1 (yrast band) and those marked by two asterisks (lower panel) are decay-out transitions from band 2 to band 1.

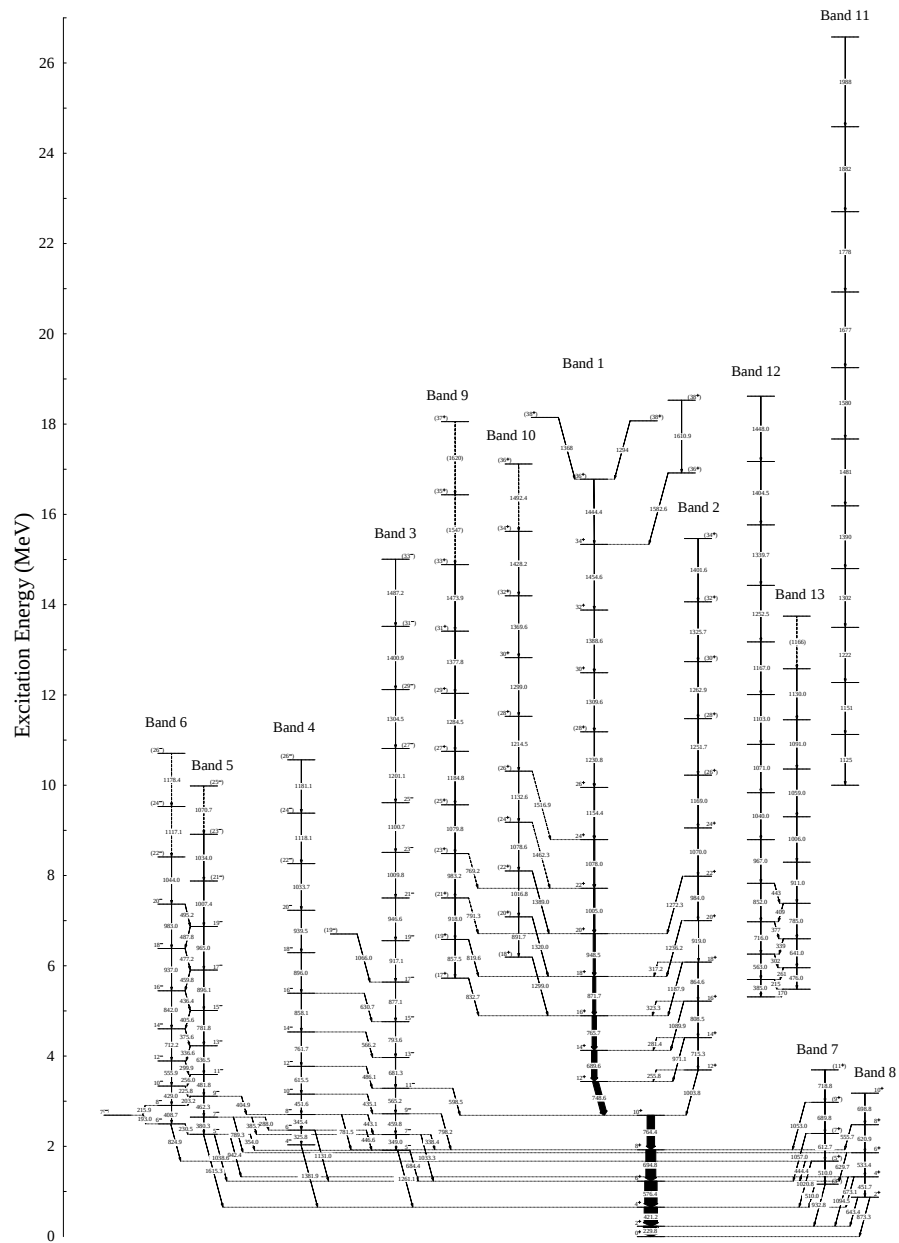


Fig. 2. Partial level scheme of  $^{124}\text{Ba}$  deduced from this work. The low-spin part of bands 1-8 is taken from [11]. Transition intensities are not completely determined.

The  $\gamma$ -ray coincidence events were sorted into three- and four-dimensional arrays, cubes and hypercubes, respectively and were analysed using the RADWARE program package [10]. The previously observed structures [11] were extended to higher spins. Five new rotational bands (bands 9–13) were observed for the first time in this work, two of them (bands 9 and 10) could be connected to the yrast band. Fig. 1 shows examples of the coincidence spectra and in Fig. 2 the partial level scheme for  $^{124}\text{Ba}$  deduced from this work is presented. The unconnected band 11 feeds into the yrast band around spin  $22\hbar$  and is therefore expected to extend up to about spin  $48\hbar$ . The yrast band shows an irregular structure above spin  $34\hbar$ , which is a typical fingerprint of band termination. However, theoretical calculations are needed for a detailed interpretation of the observed structures.

This work was supported by the German BMBF (06 BN 907) and DFG (Hu 325/10), by the Polish State Committee for Scientific Research (KBN) Grant No. 2 P03B 11822 and by the Hungarian Research Foundation (OTKA T38404).

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