Eur. Phys. J A 2, 21–23 (1998)

THE EUROPEAN
PHYSICAL JOURNAL A

Short note

High Spin Structure in ^{123}Xe

A. Schmidt[1], I. Schneider[1], H. Meise[1], I. Wiedenhöver[1], O. Stuch[1], K. Jessen[1], D. Weisshaar[1], C. Schumacher[1], P. von Brentano[1], G. Sletten[2], B. Herskind[2], M. Bergström[2], J. Wrzesinski[3]

[1] Institut für Kernphysik der Universität zu Köln, Zülpicher Str. 77, D-50937 Köln, Germany
[2] Niels-Bohr-Institute, Tandem Accelerator Laboratory, Risø, DK-4000 Roskilde, Denmark
[3] Institute of Nuclear Research, Kraków, Poland

Received: 11 December 1997
Communicated by P. Armbruster

Abstract. Excited states of the nucleus ^{123}Xe have been investigated with the fusion–evaporation-reaction ^{110}Pd(^{18}O,5n)^{123}Xe at 86 MeV beam energy, using the compton-suppressed NORDBALL-multidetector-system at the Niels-Bohr-Institute in Risø, Denmark. The level scheme of ^{123}Xe was extended up to a level of tentative $53/2^+\hbar$. Four excited bands of 3-quasiparticle-character were observed. Analyzing the directional correlation information, we could assign spin- and parity-values to all observed bands in ^{123}Xe. The observed band structures fit well into systematics of the neighboring nuclei ^{125}Xe and ^{127}Xe.

PACS. 21.10.Re Collective levels – 27.60+j $90 \leq A \leq 149$

The Xenon, Barium and Cerium nuclei with masses around A ≈ 130 exhibit collective excitations with a deformation parameter of $\beta \approx 0.2$. At the same time, they are soft with respect to the γ-deformation parameter. The appearance of triaxial shapes is attributed to the opposite deformation driving forces of protons and neutrons [1]. A recent systematic investigation of odd-mass nuclei around A ≈ 130 with the cranked shell model showed that the core can be polarized towards different triaxial shapes, depending on the quasiparticle structure [2]. The identification of the observed high-spin structures with the theoretically predicted ones depends crucially on the parity assignments.

For the nucleus ^{123}Xe only low-spin states were known [3]. To investigate the high-spin states of ^{123}Xe we performed an experiment at the NORDBALL-spectrometer in Risø. The high-spin states of ^{123}Xe and ^{124}Xe were populated with the fusion–evaporation-reaction ^{110}Pd (^{18}O, 4,5n)^{124,123}Xe at 86 MeV beam energy. The target consisted of a foil of Palladium enriched to 97.7% in ^{110}Pd (1 mg/cm^2 on 3 mg/cm^2 Tantalum). The $\gamma\gamma$-coincidences were measured with the NORDBALL-spectrometer at the FN TANDEM facility in Risø. The 10^9 coincidence events were sorted into coincidence matrices employing the sum-energy and multiplicity information of the 60-segment BaF_2-calorimeter in order to separate the 4n- and 5n-reaction channels.

The high spin level scheme of ^{123}Xe is shown in Fig. 1. In the analysis of the coincidence spectra, 91 new transitions were placed into the level scheme, establishing 53 new levels. The level scheme of [3,4] could be confirmed except for the placement of a 891 keV transition above the $23/2^-\hbar$ level in [4], which in our coincidence data is replaced by a 876.3 keV transition, in agreement with [3]. We observed the negative parity Yrast band (E) up to a level of tentative spin $51/2^-\hbar$. This band shows a backbending at a rotational frequency $\hbar\omega \approx 0.5$ MeV, analogous to its neighbors ^{127}Xe and ^{125}Xe [5,6]. In [6] this crossing was assigned a $(\nu h_{11/2})^3$ - configuration. A second negative parity structure (H2), could be observed up to the same tentative spin. The tentative spin and parity assignment to this band is based on the relatively strong population of this band and the observation of the 1819 keV stretched E2-transition to band (E).

One very interesting 3-qp-structure is band (Z), which also exists in ^{127}Xe and ^{125}Xe [5,6]. The band is the only one observed with a strong-coupling sequence. It shows a very complicated decay pattern to the lower positive and negative parity states. This indicates that the Z-band has a significantly different structure than the other bands. The spin and parity of this band could be established unambiguously from the analysis of the $\gamma\gamma$-DCO-information with methods analogous to those described in [7]. The absolute spin values could be assigned from the DCO pattern of a $\Delta I = 1$ cascade, namely of the 205-275-267-1128 keV γ-rays. Other spin assignments than $25/2^+\hbar$ ($\chi^2 \leq 1.5$) for the bandhead are excluded with values of $\chi^2 \geq 8$. It should be noted that the correlation pattern of $\Delta I = 1$ sequences show unique patterns, whereas stretched E2-sequences usually can also be fit-

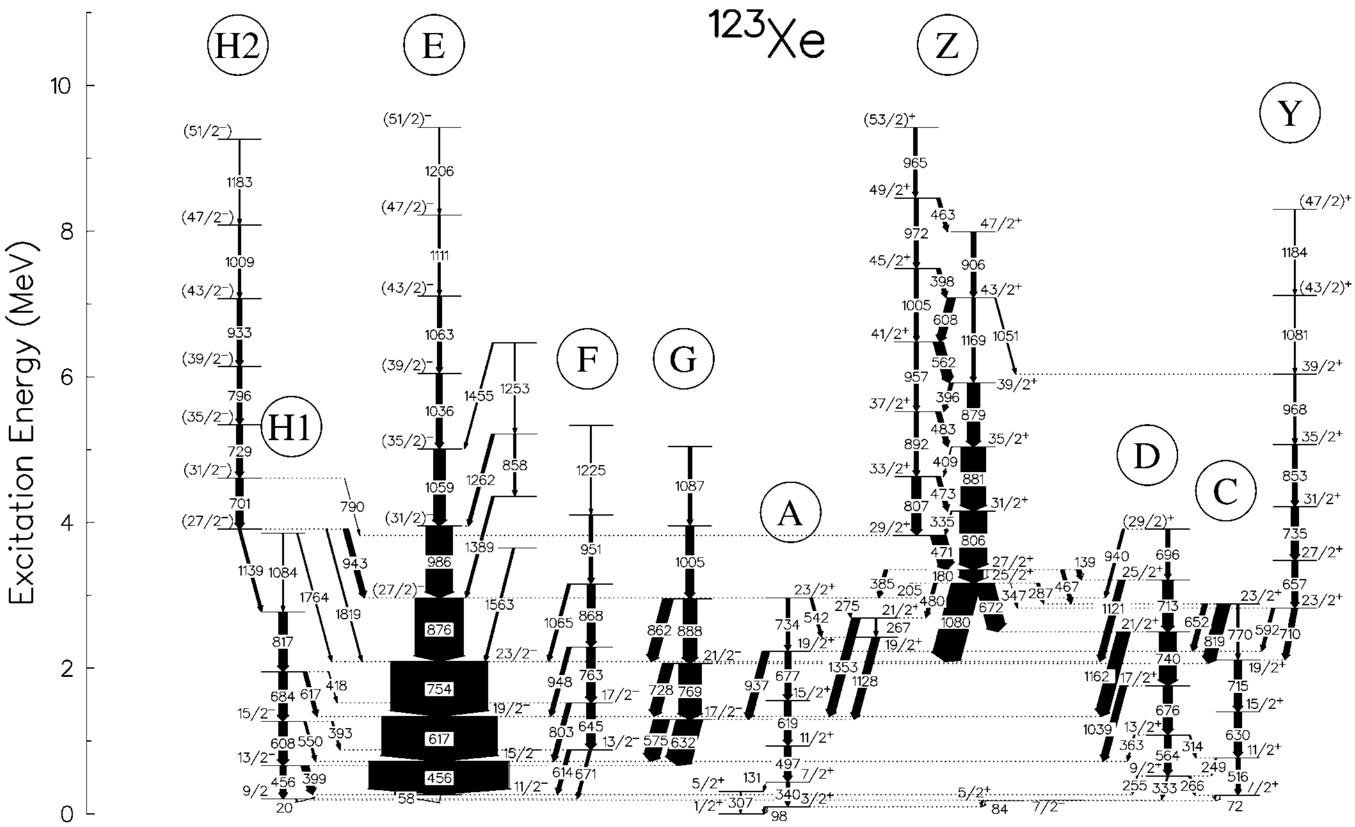

Fig. 1. High spin level scheme of the nucleus ^{123}Xe. The band labels are chosen in analogy to ^{125}Xe and ^{127}Xe [6]

ted with $\Delta I = 0$ sequences, which makes unambiguous spin assignments in pure E2-cascades very difficult. The spins in band (Z) could also be established unambiguously up to spin $49/2^{+}\hbar$. The positive parity of band (Z) is a consequence of this spin assignment, since the 385 keV transition can only be of E2-character and we can assume a $(h_{11/2})^2(g_{7/2})$ - configuration. The spin values of band (Z) also determine the spin and parity values of band (Y), because with the observation of the 1051 keV, only a sequence of stretched E2-transitions remains possible.

In Fig. 2 the $\gamma\gamma$-correlation intensity pattern of the transitions of 608 keV and 562 keV in band (Z) is shown. The experimental data fit well into the theoretically calculated $\Delta I = 1$ - cascade, excluding unambiguously a $\Delta I = 2$ and a $\Delta I = 0$ transition hypothesis.

We thank Drs. A. Dewald, A. Gelberg and J. Eberth for discussion. Many thanks to the Danish Natural Science Research Council for supporting the Tandem-Accelerator-Laboratory in Risø. This work was supported by DFG under contract Br 799/8-1.

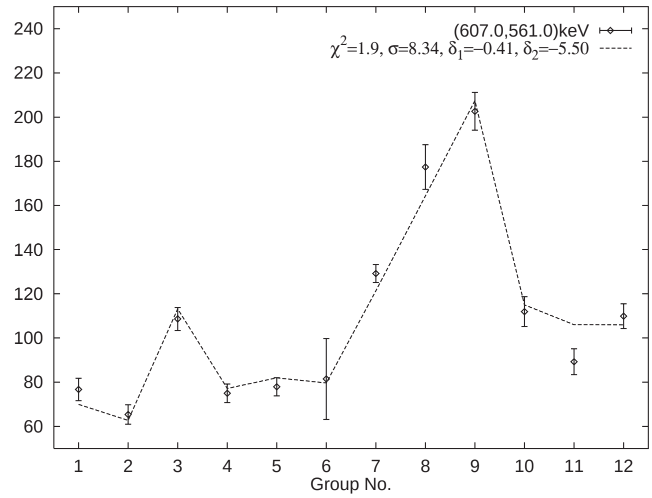

Fig. 2. Example for a $\gamma\gamma$-correlation intensity pattern of the transitions 608 keV and 562 keV in band (Z). Groups 3,4,5 and 10,11,12 are asymmetric [7]

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