SEARCH FOR COLLECTIVE AND NON-COLLECTIVE BAND STRUCTURES IN ^{123}Xe

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Introduction

The nuclei in the mass region A $\simeq$125 lie between the spherical Sn nuclei(Z=50) and strongly deformed Ce nuclei(Z=58) and are therefore, transitional with respect to their shapes at low and high angular momenta. In this mass region, there exists a unique parity intruder orbital $h_{11/2}$ which is accessible to both the protons and neutrons. These $h_{11/2}$ nucleons have opposite deformation driving effects; neutrons drive the nucleus towards the oblate shape whereas the protons favour the prolate shape. Thus, the outcome of this interplay makes this region very interesting to study shape evolutions from lower to higher spins as the nucleus can have a prolate, an oblate or a triaxial shape depending on the alignment of the $h_{11/2}$ nucleons[1].

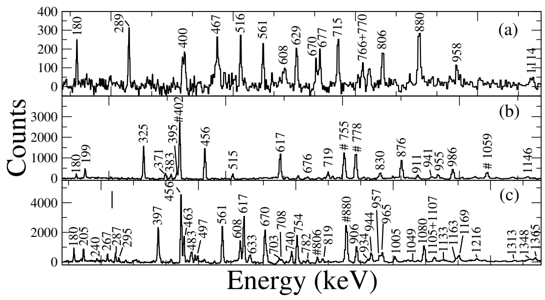

FIG. 1: Summed triple-gated spectra of the newly observed γ-transitions. "#" denotes multiple transitions having the same energy. (a) Double gates on a list (516-, 629-, 715- keV) of Band 15 and single gate on 770 keV. (b) Single gate on a list (456-, 617-, 754-, 876- keV) from band 8 and double gates on 986- and 1181 keV energies. (c) Triple gates on a list (180-, 806-, 880-, 1169- keV) from bands 12 and 13.

Experimental Details

The high spin states of ^{123}Xe were populated in the reaction ^{80}Se(^{48}Ca, 5n)^{123}Xe. A heavy-ion fusion evaporation experiment was carried out at the ATLAS accelerator at Argonne national Laboratory, USA where a ^{48}Ca beam of energy 207 MeV and 4 pnA current was bombarded on a target comprising a 0.6 mg/cm^2 ^{80}Se layer with a 0.3 mg/cm^2

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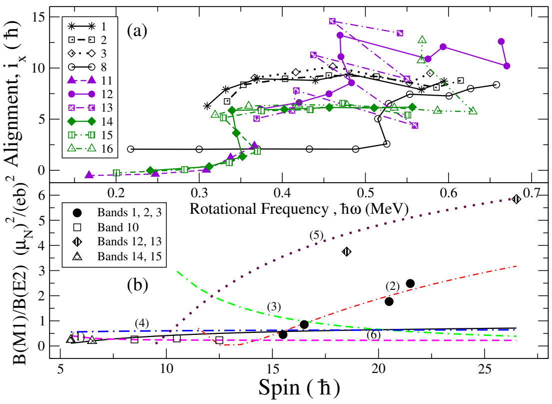

FIG. 2: (a) Alignment i_x as a function of rotational frequency for a few bands in ^{123}Xe. (b) B(M1)/B(E2) ratios as a function of spin for similar bands. The configurations used from geometrical model calculations[4] are given below.
(1) $\nu h_{11/2}$, (2) $\nu(h_{11/2})^3$, (3) $\nu h_{11/2} \otimes \pi(h_{11/2})^2$, (4) $\nu d_{3/2}s_{1/2}$, (5) $\nu d_{3/2}s_{1/2} \otimes \nu(h_{11/2})^2$, (6) $\nu(g_{7/2}d_{5/2})^{-1}$

Au backing. The γ-ray coincidence data was recorded with the Gammasphere spectrometer consisting of 101 Compton-suppressed Ge detectors which recorded a total of 2.7×10^9 events with a Ge-detector coincidence fold $\geqslant$ 5 over a period of 10 days. The RADWARE software package [2] has been used for offline analysis.

Results and Discussions

In the earlier work by Schmidt, *et al* [3], the bands of ^{123}Xe were observed upto a maximum tentative spin of $53/2^+\hbar$. In the present work, the level scheme of ^{123}Xe has been confirmed, extended and enriched with the addition of new structures; three new bands have been observed. Spins have been assigned based on angular distribution ratios and interband transitions. Fig.[1] illustrates triple-gated spectra showing some of the newly observed band energies.

The alignment plots for some of the bands are given in Fig.[2(a)]. Band 8, the yrast band, has an alignment gain of $5\hbar$, and has been interpreted to have a $\nu(h_{11/2})^3$ configuration[3]. At around $27/2^-\hbar$ spin, bands 1 and 2 become more populous and have an alignment gain of 7-8$\hbar$ with respect to the yrast band. From the B(M1)/B(E2) vs spin plot [refer Fig.[2(b)]], this may be due to the alignment of a pair of $h_{11/2}$ neutrons although similar bands observed in ^{125}Xe [5] have been reported to have a pair of $h_{11/2}$ proton alignment. Band 10 coincides with the $\nu h_{11/2}$ configuration curve and can be the signature partner of the yrast band. Bands 12 and 13 have a complicated decay pattern to other positive and negative parity states and thus, may have a very different configuration from the other observed bands. From Fig.[2(a)], an alignment gain of $\sim 6\hbar$ can be noted in the 450-500 keV region, and a tentative configuration of $\nu d_{3/2}s_{1/2} \otimes \nu(h_{11/2})^2$ has been assigned to the band from Fig.2(b). Bands 14, 15 and 16, having a similar nature in Fig.[2(a)], have been assigned a $\nu(g_{7/2}d_{5/2})^{-1}$ configuration based on Fig.[2(b)]. Cranked Nilsson-Strutinsky (CNS) calculations are also being done to confirm the configuration assignments.

Acknowledgments

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