Abstract

In the present thesis, shape evolution with excitation energy and spin is explored in ^{123}Xe, ^{122,124}Cs, and ^{122}Ba using γ-spectroscopy and lifetime measurements. The excited states of ^{123}Xe and ^{124}Cs were populated in heavy-ion fusion evaporation experiments via the ^{80}Se(^{48}Ca,5n)^{123}Xe and ^{64}Ni(^{64}Ni,$p3n$)^{124}Cs reactions, respectively, where the γ-γ coincidence events were recorded with the Gammasphere spectrometer. The Indian National Gamma Array (INGA) was used for spectroscopy of ^{122}Cs and ^{122}Ba populated in the ^{94}Mo(^{32}S,3$pn/2p2n$)^{122}Cs/^{122}Ba reaction. The previously known level schemes of these nuclei have been significantly extended and several new bands and interband transitions have been observed. The configurations to the bands have been discussed in the framework of the cranked Nilsson-Strutinsky (CNS) and cranked Nilsson-Strutinsky-Bogoliubov (CNSB) formalisms and the calculated results have been compared with those from experiments.

The present studies in the ^{123}Xe and ^{124}Cs nuclei have concluded that the bands in low- and medium- spin regions are built from excitation of neutrons within the $N = 50 - 82$ shell, where shape change from triaxial at lower spin to prolate at medium/higher spin is suggested. Moreover, non-collective maximally-aligned states have been observed in both the nuclei around $I \sim 30 - 36\ \hbar$ which are based on valence nucleon distribution in the ($d_{3/2}\ s_{1/2}$) and $h_{11/2}$ orbitals outside the ^{114}Sn core.

In the very-high spin regions of ^{123}Xe, rotational bands (extending up to $I \sim 60\ \hbar$) have been observed due to a larger deformation ($\varepsilon_2 \sim 0.3$) of the nucleus. Calculations indicate that the bands are built on two proton excitations across the $Z = 50$ shell gap, coupled to neutron excitations across the $N = 82$ shell closure.

Significant extension of all the previously-known bands in ^{124}Cs have led to the observation of band crossing in both the chiral bands for the first time. By comparing the results with calculations, it is suggested that the crossings arise due to a change in nuclear shape, and not because of the alignment of a pair of $h_{11/2}$ neutrons, as was previously suggested.

Lifetime measurements in ^{122}Cs and ^{122}Ba have been carried out using the Doppler Shift Attenuation Method (DSAM). The staggering in the $B(M1)/B(E2)$ and $B(E2)$ values in the positive-parity yrast band of ^{122}Cs indicate chiral configuration of the band, as observed in other odd-odd Cs isotopes. In ^{122}Ba, the deformation parameters show a decreasing trend with spin indicating loss of collectivity at higher spin. Moreover, the enhanced $B(E1)$ rates measured for the interband dipole transitions are comparable to those observed in other Ba isotopes. This indicates the presence of octupole correlations in ^{122}Ba.

Keywords: Nuclear reactions: ^{80}Se(^{48}Ca,5n)^{123}Xe, $E = 207$ MeV; ^{64}Ni(^{64}Ni,$p3n$)^{124}Cs, $E = 265$ MeV; ^{94}Mo(^{32}S,3$pn/2p2n$)^{122}Cs/^{122}Ba, $E = 150$ MeV; Gammasphere; INGA; γ-γ coincidences; angular distribution ratios; cranked Nilsson-Strutinsky (CNS) model; lifetime measurements; Doppler Shift Attenuation Method (DSAM); LINESHAPE code.