Abstract

The present thesis explores the evolution of shape changes in the ^{120}Te, ^{122}Te and ^{124}Xe nuclei with excitation energy and angular momentum using γ-spectroscopy. The nucleus ^{120}Te has been populated through heavy-ion fusion reaction, ^{80}Se(^{48}Ca, α4n)^{120}Te with Gammasphere. The study of ^{122}Te involved two experiments, one using ^{116}Cd(^{11}B, p4n)^{122}Te with Indian National Gamma Array (INGA) and the other using ^{82}Se(^{48}Ca, α4n)^{122}Te with Gammasphere. Heavy-ion fusion reaction involving ^{80}Se target and ^{48}Ca as projectile was used to populate high-spin states in ^{124}Xe. The previously known level schemes were extended to considerable higher spins using γ-ray coincidence measurements.

Non-collective maximally-aligned and anti-aligned oblate states were observed in ^{120}Te and ^{122}Te around $I \sim 20\hbar$. The experimental results were discussed in the theoretical framework of pairing independent cranked Nilsson Strutinsky (CNS) model calculations. The calculated and observed results were found to be in agreement. These states were explained with distribution of valence nucleons in $(g_{7/2}, d_{5/2})$, $(d_{3/2}, s_{1/2})$ and $h_{11/2}$ orbitals outside the ^{114}Sn core.

Furthermore, several high-spin rotational bands have been observed in all the three nuclei. The existence of these bands is an indication of development of collectivity beyond termination. The transitions connecting the bands and low-medium spin states in level scheme were not observed. The spins and excitation energies of the bands were chosen in accordance with those of the connected bands in neighboring nuclei and from their relative intensities respectively. The configurations were assigned for the bands corresponding to the lowest band structures calculated using CNS model. Interestingly, high-spin bands in ^{120}Te and ^{122}Te involve proton excitations across $Z = 50$ shell gap coupled to neutron excitations within $N = 50$-82 valence space. Similar results were observed for ^{124}Xe except for a few configurations where neutron excitations across $N = 82$ shell gap was found to be energetically favorable.

Keywords: Nuclear reactions ^{80,82}Se(^{48}Ca, α4n)^{120,122}Te, E = 205, 207 MeV; ^{116}Cd(^{11}B, p4n)^{122}Te, E = 65 MeV; ^{80}Se(^{48}Ca, 4n)^{124}Xe, E = 207 MeV; Gammasphere array; INGA array; measured γ-γ coincidences; E_γ; I_γ; angular distribution ratios; linear polarization; spin and parity; cranked Nilsson Strutinsky (CNS) calculations.