

## Abstract

The present thesis delves into the hindered isomeric states and shape evolution in  $A \sim 90$  regions. Specially, the thesis demonstrates experimental observation of isomeric states and evolution of collectivity in  $^{92-93}\text{Nb}$  while carrying out comparisons with already published results from neighboring  $A \sim 90$  nuclei. The  $^{92}\text{Nb}$  was populated using the reaction  $^{80}\text{Se}(^{18}\text{O}, p5n)^{92}\text{Nb}$  at a beam energy of 99 MeV. The  $\gamma$ - $\gamma$  coincidences were measured using Indian National Gamma Array (INGA). The previously reported isomeric state at  $11^-$  was revisited, and the half-life was measured to be 103.6(32) ns. It is the first time when the half-life of the newly observed  $9^-$  isomer in  $^{92}\text{Nb}$  was measured and reported to be 35.8(23) ns. Thus, a new  $9^-$  isomer has been identified in the odd-odd nucleus. The transition probability  $B(E2)$  has been determined for the isomeric states. The effect of effective nucleonic charges was explored, and the results endorse the proposals given in the earlier literature. The isomeric structure has been interpreted as a four-quasiparticle excitation, consisting of three protons and one neutron, using large-scale shell model calculations. However, low-spin isomers are yet to be reported in the neighboring nucleus  $^{93}\text{Nb}$ . Though a high-spin isomeric state was already reported in the earlier literature. With the motivation to search for isomeric state the  $^{93}\text{Nb}$  was populated through  $^{80}\text{Se}(^{18}\text{O}, p4n)^{93}\text{Nb}$  reaction with a beam energy of 99 MeV. Though the present study could not confirm the presence of any isomeric state at low-spin states as well as the reported probable isomeric state within the scope of the level scheme concerned in the present study beyond  $I = 37/2\hbar$ . However, the present work could unfold the collective properties of the nucleus at high spin. The INGA spectrometer was used to investigate high-spin states in odd  $A$   $^{93}\text{Nb}$ . Our data analysis revealed the spectral features of the nuclear states of interest. The previously reported decay scheme was verified. Spin and parity were confirmed for the tentative assignments, whereas new assignments were done to the new levels. Fourteen

new side-feeding transitions were placed. Doppler Shift Attenuation Method (DSAM) was used to measure the lifetimes of multiple levels in the dipole and quadrupole bands. The measured  $B(M1)$  values across the dipole band indicate the enhanced magnetic nature of the constituting transitions, however, the constancy of the transition probabilities highlights the absence of a probable magnetic rotation band in the nucleus. Comparisons between the experimental characteristics and cranked Nilsson-Strutinsky (CNS) calculations for the observed quadrupole bands and dipole bands indicate that these bands have been formed on the triaxial deformed shape of  $^{93}\text{Nb}$ . In addition, several single-particle high-energy  $\gamma$  transitions originating due to core-excitations, were observed to feed the yrast band. Motivated by the evolution of the collective properties in  $^{93}\text{Nb}$ , the medium and high-spin states in  $^{92}\text{Nb}$  were also probed using the same reaction as mentioned above. The  $\gamma$ - $\gamma$  coincidences were measured using INGA spectrometer. The previously reported decay scheme was verified. Some major modifications have been made to the level scheme in terms of the placement of transitions and the bands. Twenty-nine new transitions were placed along with a newly observed band. DSAM measurements were also performed for the dipolar band, and almost constant  $B(M1)$  values were extracted, similar to that of  $^{93}\text{Nb}$ . The cranked Nilsson Strutinsky (CNS) model calculations have been performed for experimentally observed bands. The calculations suggest that the nucleus represents a triaxial shape with small deformation.

**Keywords :** Nuclear reactions  $^{80}\text{Se}(^{18}\text{O}, p5n/p4n)^{92-93}\text{Nb}$ ,  $E = 99$  MeV; INGA array; measured  $\gamma$ - $\gamma$  coincidences;  $E_\gamma$ ;  $I_\gamma$ ; ADO, linear polarization asymmetry; spin and parity; DSAM measurements; isomers; cranked Nilsson Strutinsky (CNS) model calculations; Shell model calculations.