

Abstract

The present thesis is devoted to the study of nuclear structure in the $A \sim 120$ region. The nuclei in this mass region are soft with respect to deformation changes at low and medium spin and are sensitive to polarization effects from excited nucleons. The proton Fermi surface in these nuclei lies in the lower part of the $h_{11/2}$ orbitals, which favors prolate shape. On the other hand, neutrons occupy medium- to high- orbitals of the $h_{11/2}$ subshell, which tries to drive the shape towards oblate. Therefore, shape changes, including triaxiality, can be induced by the excitation of nucleons into the $h_{11/2}$ deformation-driving orbitals. The unique signatures of triaxiality are the presence of time-reversal chirality, wobbling dynamics, and the existence of γ -band.

This thesis explores the evolution of shape changes in the ^{125}Xe , ^{114}Te , and ^{119}I nuclei via the reactions $^{82}\text{Se}(^{48}\text{Ca}, 5n)^{125}\text{Xe}$, $^{112}\text{Sn}(^4\text{He}, 2n)^{114}\text{Te}$, and $^{109}\text{Ag}(^{13}\text{C}, 3n)^{119}\text{I}$ by using γ -spectroscopy.

In odd-mass ^{125}Xe , neutron orbitals form the yrast band with large signature splitting and yrare band with comparatively low signature splitting. Also, the signature splitting is inverted in yrare band with respect to the yrast bands. In recent years, this type of structure has attracted more attention because, after precise analysis, they are found to exhibit wobbling motion. With this motivation, negative-parity bands based on the $\nu h_{11/2}$ configuration in ^{125}Xe have been revisited. The directional correlation ratios and angular distribution measurements were used to determine the $E2$ admixtures of the interconnecting $\Delta I = 1$ transition. Evidence for first and second phonon wobbling excitations in this nucleus has been established based on large $E2\%$. The increasing nature of wobbling energy with respect to spin indicates the presence of longitudinal wobbling motion in this nucleus. The observed wobbling energy was compared with the recently published results obtained within the framework of Triaxial projected shell-model (TPSM) calculations.

The level structure of ^{114}Te has been revisited, and 35 new γ -transitions are observed by using the γ - γ coincidence method. The spin and parity of these transitions are confirmed by using R_{DCO} and polarization measurements. The Te isotopes are known to exhibit collective vibrational features appearing on top of non-collective excitations. Several collective and non-collective states around medium spin, which were predicted by Paul *et.al.* and Grinberg *et.al.* are explored within the relevant theoretical model (Shell model and Ultimate Cranking model). Furthermore, Te isotopes have both proton and neutron numbers close to the octupole magic number (56), making them an ideal candidate for studying such a phenomenon. The presence of octupole correlation in this nucleus is verified through the presence of several enhanced $E1$ transitions. To understand the microscopic structure, the covariant density functional theory (CDFT) was used by using PC-PK1 coupling, which shows the octupole soft nature of this nucleus.

Iodine nuclei ($Z = 53$) lie in a transitional region between the vibration-like Te ($Z = 52$) and the deformed rotor Xe ($Z = 54$). Although the one signature of triaxiality *i.e.*, chirality has been reported in a few iodine isotopes; no experimental signature of wobbling has been observed till date. With this aim, the negative parity states of this nucleus based on $\pi h_{11/2}$ orbitals have been revisited. In order to confirm the wobbling motion in this nucleus, the $E2$ fractions of the interconnecting transitions decayed from the previously reported unfavored signature partner band to yrast band are measured. Observation of a large $E2\%$ indicates the presence of wobbling motion in ^{119}I . A pair of chiral doublet negative-parity bands was also observed. The observed variation of excitation energies, staggering parameter, and $B(M1)/B(E2)$ with respect to spin show a similar type of behavior in both bands, which are the signature of the chiral partner's band.

Keywords: Nuclear reactions, $^{82}\text{Se}(^{48}\text{Ca}, 5n)^{125}\text{Xe}$, $E = 205$ MeV; $^{112}\text{Sn}(^2\text{He}, 2n)^{114}\text{Te}$, and $E = 37$ MeV; $^{109}\text{Ag}(^{13}\text{C}, 3n)^{119}\text{I}$, $E = 54$ MeV; γ - γ coincidences, E_γ , R_{DCO} , polarization asymmetry; wobbling dynamics, octupole correlation, chirality, Shell model calculation, Ultimate Cranking model, CDFT, TPSM.