Investigating octupole correlations in Xe nuclei with mass A < 120

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Nuclei with mass A <120 are perfectly placed to study the shape-driving properties of different quasiparticle configurations. For these nuclei, the Fermi surface for the protons lies close to the low-Ω $h_{11/2}$ orbitals which drives the nucleus towards prolate shape, while the neutron fermi surface lies near the mid-Ω $h_{11/2}$ orbitals which induces an oblate deformation [1]. Due to the conflicting deformation driving properties, the nuclei observe prolate, oblate or triaxial shape in this mass region. Also, the presence of octupole driving $h_{11/2}$ and $d_{5/2}$ orbitals near the Fermi surface make them suitable to exhibit octupole correlation. In this mass region, octupole correlations have been reported earlier in several isotopes of Xe-Cs-Ba having N < 70 [5–7]. In previous high spin gamma ray spectroscopy measurements in ^{118}Xe nuclei though the octupole correlations have been reported in Refs. [8–10] but in almost all the cases a precise data on parity assignments, was missing. For example, in Ref. [10], though the issue of octupole collectivity has been discussed in relation to the observed inter-band transitions, 1022 keV ($7^- \rightarrow 6^+$), 846 keV ($9^- \rightarrow 8^+$), 726 keV ($11^- \rightarrow 10^+$) and 924 keV ($8^- \rightarrow 8^+$), however, the quoted B(E1) values have errors in the range from 4% to 28%. In the present work, the excited states in ^{118}Xe nucleus were reinvestigated with the aim: 1) to update the level scheme with inclusion of more γ transition in the non-yrast bands (if any), 2) to fix the missing parities with polarisation measurements and 3) to provide a more precise data on the octupole collectivity (transition). We have also performed the triaxial projected shell model (TPSM) calculations to investigate the observed band structures further.

High spin states in ^{118}Xe have been populated via ^{93}Nb (^{28}Si, xpyn) ^{118}Xe fusion-evaporation reaction at a beam energy of 115 MeV provided by the 15 UD pelletron accelerator facility at the Inter University Accelerator Center, New Delhi. In the experiment, several new γ-transitions have been found and are placed appropriately in the level scheme. Theoretical study using the triaxial projected shell model (TPSM) approach suggests that the first band-crossing is due to the alignment of two neutrons, and a parallel band tracking the yrast configuration is the γ-band built on the two-quasiparticle state. Enhanced E1 transition rates have been obtained between opposite parity bands, involving $\nu h_{11/2}$ and $\nu d_{5/2}$ orbitals having $\Delta j = \Delta l = 3$, indicates the presence of octupole correlation in this nucleus. More details of the analysis and the physics outcomes will be discussed during the presentation.

References :

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