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Letter

Coexistence of low-K oblate and high-K prolate $g_{9/2}$ proton-hole bands in ^{115}Sb

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ABSTRACT

A positive parity sequence of $\Delta I = 2$ γ transitions has been identified above $I^{\pi} = 9/2^{+}$ state ($E_x = 2019$ keV) in ^{115}Sb through in-beam γ ray spectroscopic technique. Rotational features of this sequence are found similar to a low-K decoupled band. Observation of this newly identified low-K decoupled band, along with the earlier reported strongly coupled high-K band in this nucleus, provides the first experimental evidence for prolate-oblate shape coexistence associated with $g_{9/2}$ proton-hole configuration around $Z = 50$ shell closure. Experimental results are reproduced reasonably well in the frameworks of the projected shell model and the total Routhian surface calculations.

As a many-body quantal system, atomic nuclei are excellent laboratories for testing various quantum mechanical phenomena. The shape coexistence in the realm of atomic nuclei has long been a topic of interest as its exploration across the Segrè chart can provide insight into the underlying nucleonic shell structures. The phenomenon of nuclear shape coexistence was started with the observation of the deformed $I^{\pi} = 0^{+}_{2}$ state in the doubly magic ^{16}O nucleus along with the spherical $I^{\pi} = 0^{+}_{1}$ ground state [1–3]. Thereafter, such coexistence of spherical and deformed shapes were also identified near different shell closures across the nuclear landscape [4–6]. The best evidence to date for a coexistence of the states corresponding to prolate, oblate and spherical shapes at low excitation energy was found in ^{186}Pb [7].

The nuclei in $A \approx 110 - 120$ region mainly exhibit weak deformation at lower angular momentum with the observation of non-collective single-particle excitations. Of special interest in this region of the Segrè chart, lying close to the $Z = 50$ shell closure, is the observation of rotational bands associated with the shape-driving high-j orbitals. Most of these deformed rotational bands have elongated cigar-like prolate deformation. The particle-hole excitations across the $Z = 50$ closed shell play a dominant role to develop the deformation in these nuclei. Consequently, coexistence of the collective and non-collective structures was reported in several even-even, odd-A and odd-odd nuclei in this mass region [8–18]. In addition, shape transition from collective prolate to non-collective oblate over a range of angular momentum and excita-

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