

Search for the origin of wobbling motion in the $A \approx 130$ region: The case of ^{131}Xe

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In-beam γ -ray spectroscopy of ^{131}Xe was carried out to study the structure of the intruder $\nu h_{11/2}$ band. Excited states were populated via an α -induced fusion-evaporation reaction at $E_\alpha = 38$ MeV. Inspection of $\gamma\gamma$ -coincidence data resulted in the identification of a new rotational sequence. Based on the systematics of excitation energy, assigned spin-parity, decay pattern, and the electromagnetic character of the interband $\Delta I = 1$ γ transitions, this sequence is proposed as the unfavored signature partner of the $\nu h_{11/2}$ band. The structure of this band is further illuminated in the light of the triaxial particle rotor model (TPRM). The possibility of wobbling excitation in $N = 77$ Xe-Ba-Ce isotones was explored in a systematic manner.

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I. INTRODUCTION

Rotational motion is a typical collective mode of excitation in atomic nuclei [1]. It originates to restore the rotational symmetry broken by nuclear deformation. The wave function of an axially symmetric (prolate or oblate) nucleus is invariant with respect to a rotation by an angle of 180° about an axis perpendicular to its symmetry axis (\mathcal{R}). The quantum number associated with the \mathcal{R} operator is known as the signature (α) [2]. The even and odd spin sequences of a rotational band in even- A nuclei correspond to $\alpha = 0, 1$, respectively. Likewise, the $I = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \dots$ and $I = \frac{3}{2}, \frac{7}{2}, \frac{11}{2}, \dots$ sequences

in an odd- A nucleus correspond to $\alpha = \pm 1/2$. The signature-dependent splitting in energy is known as signature splitting $S(I)$ and can readily be extracted from the experimentally deduced level energies. The magnitude of $S(I)$ has a distinct K dependence (K is the projection of total angular momentum on the symmetry axis) [3]. For instance, in an axially symmetric nucleus, a rotational band with a high- K (low- K) configuration is predicted to exhibit a small (large) signature splitting [4]. However, in triaxially deformed nuclei, the quantity K no longer remains conserved and hence the band structures in these nuclei have mixed configurations of wave functions with different K values. As a consequence, a rotational phenomenon like signature splitting is found to appear in a different way than expected [5]. Thus, the quantity $S(I)$ was proposed to quantify the degree of triaxiality in atomic nuclei [6].

The rotational motion of a triaxially deformed nucleus can be realized by observing a pair of chiral doublet bands or a wobbling band or a γ band [2,7–9]. A large number of experimental signatures in favor of triaxial nuclear shapes have been found in the $A \approx 130$ region, mainly due to the presence of the unique parity shape driving $h_{11/2}$ orbital. Among these, the occurrence of wobbling bands at low angular momentum in normal-deformed γ -soft nuclei has drawn a lot of attention in the recent past. The rotational properties, such as moments

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