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

S. Chakraborty,[1,*] S. Bhattacharyya,[1,2,†] R. Banik,[3] Soumik Bhattacharya,[1,‡] G. Mukherjee,[1,2] C. Bhattacharya,[1,2] S. Biswas,[4,§] S. Rajbanshi,[5] Shabir Dar,[1,2] S. Nandi,[1,2,∥] Sajad Ali,[6] S. Chatterjee,[7] S. Das,[7] S. Das Gupta,[8] S. S. Ghugre,[7] A. Goswami,[9,2,¶] A. Lemasson,[4] Debasish Mondal,[1] S. Mukhopadhyay,[1,2] A. Navin,[4] H. Pai,[10] Surajit Pal,[1] Deepak Pandit,[1,2] R. Raut,[7] Prithwijita Ray,[11] M. Rejmund,[4] and S. Samanta[7,#]

[1]*Variable Energy Cyclotron Centre, Kolkata 700064, India*
[2]*Homi Bhabha National Institute, Mumbai 400094, India*
[3]*Institute of Engineering and Management, Kolkata 700091, India*
[4]*Grand Accélérateur National d'Ions Lourds (GANIL), CEA/DRF-CNRS/IN2P3, BP 55027, F-14076 Caen Cedex 5, France*
[5]*Department of Physics, Presidency University, Kolkata 700073, India*
[6]*Department of Physics, Government General Degree College at Pedong, Kalimpong 734311, India*
[7]*UGC-DAE Consortium for Scientific Research, Kolkata Centre, Kolkata 700098, India*
[8]*Department of Physics, Victoria Institution (College), Kolkata 700009, India*
[9]*Saha Institute of Nuclear Physics, Kolkata 700064, India*
[10]*Extreme Light Infrastructure - Nuclear Physics (ELI-NP), IFIN-HH, Bucharest-Magurele 077126, Romania*
[11]*Department of Physics, Acharya Brojendra Nath Seal College, Coochbehar 736101, India*

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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 $I = \frac{1}{2}, \frac{5}{2}, \frac{9}{2}, \dots$ 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

*saikat.c@vecc.gov.in
†sarmi@vecc.gov.in
‡Present address: Department of Physics, Florida State University, Tallahassee, Florida 32306, USA.
§Present address: Neutron and Muon Division, Paul Scherrer Institute, Forschungsstrasse 111, 5232 PSI-Villigen, Switzerland.
∥Present address: Physics Division, Argonne National Laboratory, Argonne, Illinois 60439, USA.
¶Deceased.
#Present address: Department of Physics, University of Genova, Via Dodecaneso 33, 16146 Genova, Italy.

