Signature partners pairs in triaxial superdeformed bands of ^{164}Lu isotopes

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Introduction

A mass region (160) containing N∼94 and Z∼72 is of special interest in the field of nuclear structure physics. Potential energy surface calculations (PES) confirms the existence of exotic shapes with prolate deformation in the A∼160 mass region. Thus, the PES calculations allocates a remarkable probability of investigating superdeformed (SD) shapes with prominent triaxiality. Experimentally, Petersen and Schmitz [1, 2] found such case in $^{163,165}Lu$ with a large quadrupole moment values ($\varepsilon_2 \approx 0.4$, $\gamma \sim +18°$). In the A∼160 mass region, the triaxiality is associated with the movement of the high-j single quasiparticle outside the SD core. The introduction of the wobbling mode provides the confirmation of triaxiality in the SD spectroscopy. At deformation $\varepsilon_2 \approx 0.4$ and $\gamma \sim 20°$, a gap around N=94 proves to be important for the evolution of triaxial superdeformed shapes (TSD) in the A∼160 mass region. The TSD bands and their decayed strength in ^{164}Lu was studied by Tormanen et al. [3]. Gammasphere spectrometer was used by Bringel et al. [4] to investigate the eight TSD bands in ^{164}Lu. The band head spin of triaxial SD bands in Lu isotopes was determined by Sharma et al. [5].

In this present paper, we have calculated the band head moment of inertia ($\Im_0$) for triaxial SD bands in ^{164}Lu isotopes. Here, we have considered only ^{164}Lu(1,2,3)triaxial SD bands and neglected ^{164}Lu(4,5,6,7,8)triaxial SD bands as there corresponding band head spins are not known. To do this work we have employed the nuclear softness formula.

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Formalism

Nuclear softness formula

Nuclear softness formula was formalised by Gupta [6]. The energy levels of ground state bands in even-even nuclei have been taken into the account. Identical formulation was given for transitional and well deformed nuclei called as soft rotor formula [7]. The transition energies for the SD bands can be expressed as

$$E_\gamma = \frac{\hbar^2}{2\Im_0} \times \left[\frac{I(I+1)}{1+\sigma I} - \frac{(I-2)(I-1)}{1+\sigma(I-2)} \right]. \quad (1)$$

where $\Im_0$ and σ are the model parameter, which can be found by the fitting procedures.

TABLE I: Parameters obtained from least square fitting for triaxial SD bands of ^{164}Lu isotopes by using Nuclear softness formula.

TSD BANDS	$E_\gamma(I \to I-2)$	$\Im_0$
$^{164}Lu(1)$	374	89.7
$^{164}Lu(2)$	354	89.4
$^{164}Lu(3)$	536	73.9

Results and Discussion

Signature partner SD bands are the one which have same values of band head moment of inertia ($\Im_0$). Following this definition we have applied the nuclear softness formula to calculate the band head moment of inertia ($\Im_0$) for triaxial SD bands in ^{164}Lu. The data has been taken from the tables of SD bands given by Singh et al.[8] and from Ref. [9]. It is noticed from Table I that the obtained band head moment of inertia ($\Im_0$) of triaxial

SD band in $^{164}Lu(1)$ is same as that of triaxial SD band in $^{164}Lu(2)$. Hence, triaxial SD band in $^{164}Lu(1)$ and $^{164}Lu(2)$ are the signature partner bands.

Conclusion

In this present work, it is very well noticed that the identical value of band head moment of inertia ($\Im_0$) of triaxial SD bands in $^{164}Lu(1)$ and $^{164}Lu(2)$ obtained by the nuclear softness formula verified the experimentally observed signature partner bands.

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