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.

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

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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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