Study of backbending in superdeformed bands of ^{36}Ar through two parameter formula

Honey Sharma* and H. M. Mittal
Department of Physics,
Dr. B. R. Ambedkar National Institute of Technology,
Jalandhar, Punjab, India

Introduction

In contrast to fission isomers in actinides the occurrence of superdeformation (SD) was now recognized in different A∼60, 80, 130, 150, 190 mass regions. The high spin phenomenon of SD bands are described by the kinematic ($J^{(1)}$) and dynamic ($J^{(2)}$) moment of inertia. The $J^{(1)}$ completely rely upon spin, whereas $J^{(2)}$ does not. The systematic study of kinematic ($J^{(1)}$) and dynamic ($J^{(2)}$) moment of inertia of SD bands with N_pN_n scheme was studied by Sharma et al. [1]. The correlation between spin and valence nucleon helps to study the phenomenon like backbending at high spin [2]. In the phenomenon of backbending as the spin increase, the nucleons goes in the distinct orbits. Recently, the backbending of SD bands in $^{36,40}Ar$ in the framework of particle conserving method was studied by Xu and Xiao [3]. In the present work an attempt is made to study the behavior of the backbending phenomena in ^{36}Ar SD nuclei using two-parameter formula(nuclear softness formula). The plots of the calculated data of $J^{(1)}$ versus $\hbar\omega$ for the above mentioned SD nuclei is given in Fig. 1, where the experimental data are also presented.

Formalism

Nuclear softness formula

Nuclear softness formula was formalised by Gupta [4]. 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 [5]. 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.

The kinematic moment of inertia $J^{(1)}$ is defined as

$$J^{(1)}(I-1)/\hbar^2 = \frac{2I-1}{E_\gamma(I)} \quad (2)$$

The experimentally observed rotational frequency ($\hbar\omega$) for SD bands are generally detected from the observed E_γ transition energies between two consecutive transitions of the corresponding SD bands.

$$\hbar\omega = \frac{E_\gamma(I) + E_\gamma(I+2)}{4} \quad (3)$$

Results and Discussion

In Fig.1 the experimental data show a clear evidence of backbending phenomenon due to simultaneous arrangement of neutron and protons ($1d_{5/2}[202]_{5/2}$ pairs and $1f_{7/2}[321]_{3/2}$) [3] in the presented ^{36}Ar SD nuclei at around $\hbar\omega$=1.5 MeV. It is clear from the same figure that the predictions of experiment and other calculated formula such as nuclear softness formula describe ^{36}Ar SD nuclei very well. Furthermore, the predictions of the calculated result obtained by nuclear softness formula reproduce backbending phenomena very well.

*Electronic address: `honeyshrma777@gmail.com`

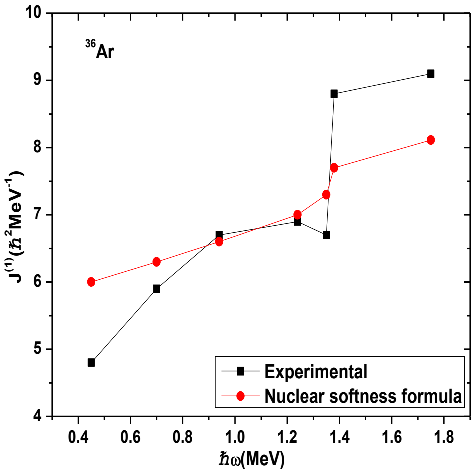

FIG. 1: Calculated and experimental kinematic moment of inertia $J^{(1)}$ vs $\hbar\omega$ for ^{36}Ar SD nuclei.

Conclusion

The present work suggests that the calculated result of nuclear softness formula give a accurate description of the backbending in ^{36}Ar SD nuclei.

References

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