Theoretical study of band structure of ^{115}In nucleus

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Introduction

The A~100 nuclei are equipped with rich information about the kind of deformation occurring in these nuclei. Nuclei near A~100 mass region are situated in a transitional region in between spherical and deformed nuclei and are characterized by a good amount of quadrupole deformation. The nuclides with 40≤ Z≤ 50 and N ≥ 50 are of great interest because of the several shape transitions occurring in near A~100 mass region. Different types of deformations (e.g. prolate, oblate, triaxial) can coexist in the same nucleus in accordance with the due to interplay between orbitals. Thus, the nuclei near A~100 mass region are good candidates to study the influence of orbitals on the deformation. In the present work, the axial PSM has been systematically applied to the ^{115}In nucleus to study the effect of interplay between $1g_{9/2}$ proton and $1h_{11/2}$ neutron orbitals on the structure of ^{115}In nucleus.

Outline of the Framework

In this work we have used the following Hamiltonian [1]

$$\hat{H} = \hat{H}_o - \frac{\chi}{2}\sum_{\mu}\hat{Q}^{\dagger}_{\mu}\hat{Q}_{\mu} - G_M\hat{P}^{\dagger}\hat{P} - G_Q\sum_{\mu}\hat{P}^{\dagger}_{\mu}\hat{P}_{\mu}$$

Where, H_o is spherical single particle Hamiltonian. The second term is the quadrupole-quadrupole interaction and the last two terms are the monopole and quadrupole pairing interactions, respectively. The monopole pairing strength G_M is given by

$$G_M = (G_1 \mp G_2\frac{N-Z}{A})\frac{1}{A}(MeV)$$

with ''+'' for protons and ''-'' for neutrons. Values of G_1 and G_2 are taken as 22.50 and 12.12, respectively. The quadrupole pairing strength G_Q is assumed to be proportional to G_M and the proportionality constant is fixed to be 0.16. In the present calculations, we use ε_2= 0.20 for ^{115}In. The configuration space used in calculations consists of the three major shells for each kind of nucleon: N=2, 3 and 4, for protons and N= 3, 4 and 5 for neutrons.

Results and Discussions

Some nuclear structure properties such as band structure, yrast spectra and back-bending for ^{115}In nucleus has been calculated and compared with the available experimental data [2]. The calculated data for various nuclear structure properties are found to be in good agreement with the corresponding experimental data.

From the results of the calculations, it is found that:

- PSM calculations have successfully reproduced the experimental yrast states.
- Bands structure for ^{115}In isotopes has been obtained from the PSM calculations and is shown in the form of band diagram. This diagram predicts multi quasi-particle structure for ^{115}In nucleus.
- Back-bending in Moment of inertia and rotational alignment for ^{115}In are also studied in this work.

The detail presentation of results for ^{115}In would be made during the conference.

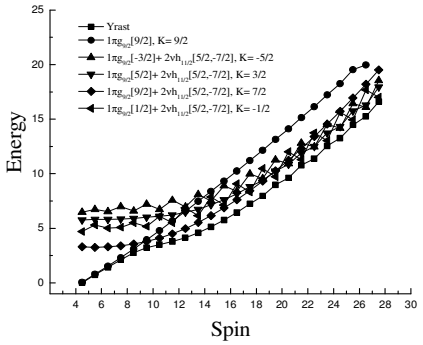

Fig. 1 Band diagram for ^{115}In.

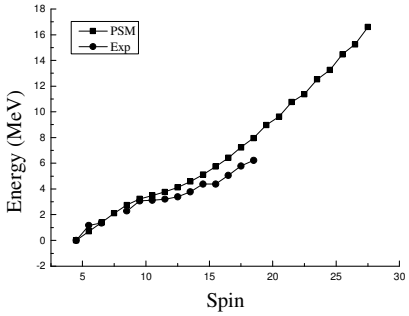

Fig. 2 Comparison of experimental observed and theoretically calculated yrast spectra for ^{115}In.

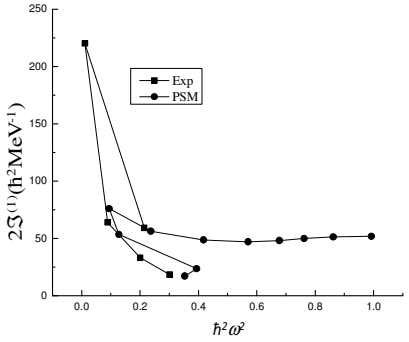

Fig. 3 Comparison of experimental and PSM results for twice the kinetic moment of inertia $[2\Im^{(1)}(\hbar^2 MeV^{-1})]$ plotted as a function of angular frequency squared $(\hbar^2\omega^2)$ for ^{115}In.

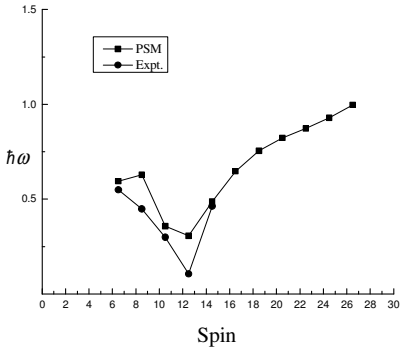

Fig. 4 Plot of rotational frequency $(\hbar\omega)$ versus spin depicting rotational alignment in ^{115}In.

References

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