Quasiparticle structure of some odd mass Palladium isotopes

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Introduction

In the A~100 mass region, collective quasi-rotational structures were observed to high spins associated with the $d_{5/2}$, $g_{7/2}$ and $h_{11/2}$ neutron orbitals [1,2]. Also, neutron-deficient nuclei in the A ~ 100 region are susceptible to dramatic shape changes with the addition or removal of a small number of nucleons [3]. Further, the rotational alignments of $g_{9/2}$ protons and $h_{11/2}$ neutrons in this mass region have different deformation driving effects on the core [4]. The alignment of the $h_{11/2}$ neutron pair would drive the core towards prolate deformation but the alignment of the $g_{9/2}$ proton pair favors oblate deformation. All these phenomena make this region very interesting and nuclei in this region are good source to study nuclear structure properties. In the present work, an attempt is made to study the above mentioned phenomenon by calculating the nuclear structure properties of some nuclei in A~100 Mass region by applying Projected Shell Model (PSM) [5].

Hence, in that direction, PSM calculations have been carried out on odd-mass ^{101,103,105}Pd isotopes and various nuclear structure properties like Yrast spectra, Band-diagrams, Back-bending etc have been calculated compared with the experimentally available data.

Details of input parameters used in present work

The Hamiltonian [4] used in this work is

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

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 neutrons and ''+'' for protons. Values of G_1 and G_2 are taken as 20.00 and 14.00 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= 0.172, for ^{101,103}Pd and 0.194 for ^{105}Pd. The configuration space used in calculations consists of the three major harmonic oscillator shells, and in the present case, harmonic shells, N = 3, 4, 5 (2, 3, 4) for neutrons (protons) are taken.

Results and Discussion

In the present work, negative-parity yrast spectra of ^{101,103,105}Pd isotopes have been obtained through the process of diagonalization of the Hamiltonian in the deformed basis. The calculated results are then compared with the corresponding available experimental data [6-8] and the comparison is shown in Figs. 1(a)-1(c). From these Figures, one can conclude that the calculated yrast spectra are in good agreement with the observed ones Through PSM calculation, we have been able to obtain the yrast states upto $59/2^-$ whereas experimental data are available up to a maximum spin value of $43/2^-$, $51/2^-$ and $43/2^-$ for ^{101}Pd, ^{103}Pd and ^{105}Pd respectively. Moreover, the present PSM calculations have reproduced successfully the experimental band head spin $11/2^-$ for negative parity band of $^{101\text{-}105}$Pd. To conclude, the available experimental yrast levels as well as band head spins in $^{101\text{-}105}$Pd have been reproduced very well by the present PSM calculations. The band diagram for ^{101}Pd is

shown in Fig. 2(a). From Fig.2(a), it is clear that at lower spins the yrast spectra is formed by 1-qp bands whereas the at higher spins 3-qp bands contributes towards the formation of yrast spectra.

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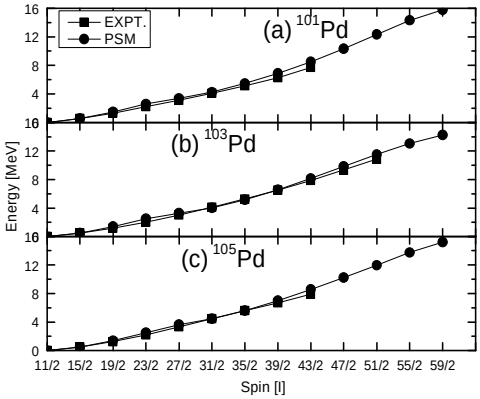

Fig. 1(a-c) Yrast spectra for ^{101,103,105}Pd isotopes.[Experimental data taken from Ref. 6-8]

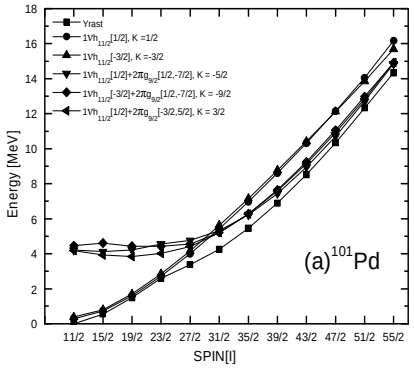

Fig. 2(a) Band diagram for ^{101}Pd

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