Microscopic insight of ^{155}Tb nucleus using projected shell model

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Introduction

In the mass range A ~160 of rare-earth region much work has been done over the last two decades on the odd-Z, odd-A nuclei. This area has proven to be fascinating due to the variety of structures resulting from the active proton orbitals and the softness of the nuclei with respect to deformation. A large number of high-spin phenomena has been investigated, for example, signature splitting and signature inversion [1,2], shape changes due to g deformation [3,4], the persistence of proton pairing correlations at high spin [5], and band termination [6]. However, these studies have been limited to nuclei with $Z \geq 67$ largely because only beams of mass $A \leq 11$ may be used to obtain a significant cross section for the lighter nuclei. The promethium (Z=61) [7–11] and europium (Z=63) [12–17] nuclei have attracted much attention recently due to the possibility of octupole correlations in these nuclei. The nuclei with N=90 also shows very interesting nuclear structure behavior. As the $N <$ 88 nuclei are weakly deformed as a result of the N=82 shell gap, the $N > 92$ isotopes behave as well-deformed quantum rotors [18]. The intermediate deformations of the $N = 90$ isotones permit these nuclei to be especially susceptible to shape driving forces by various competing processes.

In present paper we have studied the ^{155}Tb nucleus using the microscopic frame work of calculations known as projected shell model, which is the natural extension of the S(U3) shell model. Where the Nilsson + BCS scheme is used for the basis selection and the projection of these deformed basis onto good angular momentum is done numerically. The PSM has been developed as a shell model truncation scheme which is implemented in a deformed single-particle basis [19].The Hamiltonian employed in the present calculation is

$$H=H_o-\frac{1}{2}\chi\sum_{\mu}Q^{+}_{\mu}Q_{\mu}-GP^{+}P-G_{Q}\sum_{\mu}P^{+}_{\mu}P_{\mu} \qquad (1)$$

where H_0 is the spherical single-particle Hamiltonian which contains a proper spin-orbit force. The second term in Eq. (1) is the quadrupole-quadrupole (QQ) interaction and χ represents its strength, which is determined by the self-consistent relation between the input quadrupole deformation ε_2 and the one resulting from the HFB procedure [19]. The last two terms are the monopole and quadrupole pairing interactions, respectively.The strengths of the monopole pairing interactions are given by

$$G_M=(G_1 \mp G_2\frac{N-Z}{A})\frac{1}{A}, \qquad (2)$$

and that for the quadrupole pairing interaction is related to the monopole pairing by

$$G_Q=\gamma\, G_M \qquad (3)$$

The Hamiltonian (1) is diagonalized in the shell model space spanned by $\hat{P}^{I}_{MK}\left|\varphi_{k}\right\rangle$ where the $\hat{P}^{I}_{MK}$ is the angular-momentum-projection operator and $\left|\varphi_{k}\right\rangle$ the multi-qp states of eq. (1).

The nuclear structure properties yrast spectrum , transition spectra are given in this abstract and rest of the nuclear structure properties like band diagrams, back bending etc. will be discussed in the paper to be presented at the conference.

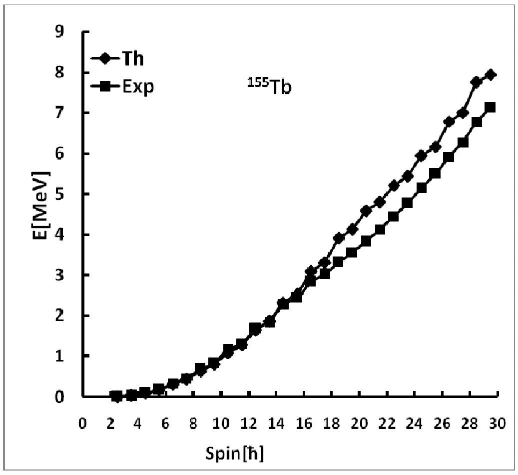

Fig. 2 Yrast spectra of ^{155}Tb.

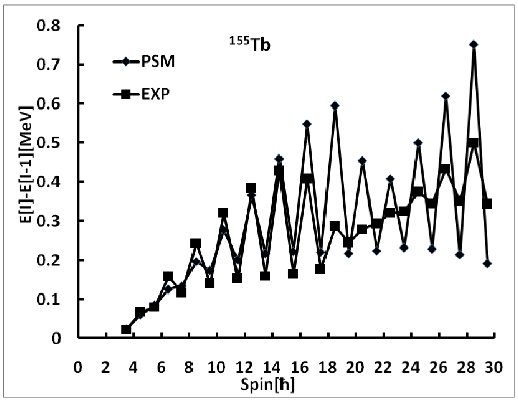

Fig. 2 Transition energy versus spin in ^{155}Tb

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