Study of intermediate excited states above the I=10^+ isomer in the ^{136}Ba nucleus

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Introduction

Nuclei having the proton number (Z) in the range of 50-64 and neutron number(N) in the vicinity of N=82 shell closure exhibit an interplay of single-particle and low quadrupole collectivity. Fermi surface of the these nuclei occupies the proton $d_{5/2}$, $g_{7/2}$ and $h_{11/2}$ orbitals and neutron $g_{7/2}$, $d_{3/2}$, $s_{1/2}$ and $h_{11/2}$ orbitals. Mostly, the multi-nucleon transfer reactions were used to excite the state above the $I^\pi = 10^+$ in even-even nuclei and interpreted systematic shell-model calculations. The spin and parity of these states was assigned from the angular correlation studies. In present work, we report on the extension of intermediate states above $I^\pi = 10^+$ and spin and parity measurement based on DCO and polarization asymmetry measurement.The shell-model calculations have been performed for both the positive and negative parities for the same observed state to understand the experimental structure.

Experimental Detail

The excited states of the ^{136}Ba nucleus were populated through the ^{130}Te(^{9}Be,3nγ) reaction at 36 MeV beam energy. The ^{9}Be beam was delivered by the Pelletron accelerator at Inter- University Accelerator Centre(IUAC), New Delhi, India and the ^{130}Te target of 1.2 mg/cm^2 thickness was used with 4.2 mg/cm^2 gold backing. The de-exciting gamma-ray were detected by Indian National Gamma Array (INGA) spectrometer [2].

Results and Discussion

In Fig. 1, we have presented the level scheme resulted from present study. The spin and parity of the level were assigned on the basis of both DCO ratios and polarization asymmetry measurements [3, 4]. In present study, one of the sequence placed above the 4921 keV level is extended up to $I^\pi = (18^-)$ compared to the

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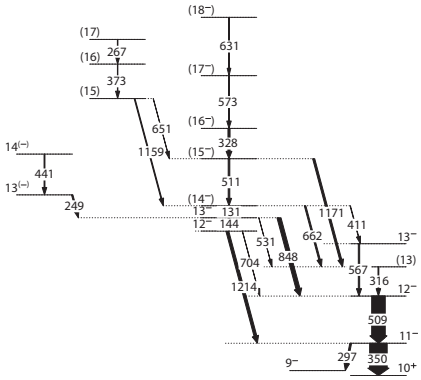

FIG. 1: Partial level scheme of the ^{136}Ba nucleus obtained in the present work.

sequence as reported in the ref [1] and also previously known prompt γ-rays of 267- and 373 keV were placed at the 6995- and 6768 keV levels, respectively. The 350 keV γ-ray transition has dipole character based on the measure value of DCO ratio with positive polarization asymmetry, and hence has E1 character. Thus, it confirmed the positive parity of the 3707 keV level. The 509-, 567-, 662- and 328 keV γ-ray transition placed above the 3707 keV have confirmed M1 character. The M1 character of 509- and 567 keV transitions established the negative parity of 4217 and 4784 level which was tentative assigned as negative parity state[1]. Further, the placement of 662 keV and 316 keV γ-ray transitions is interchanged as the 1171 keV γ-ray transition is seen in coincidences of the 328- , 350- , 362-, 509 keV γ-ray transition, not in 144- and 1215 keV transitions. This leads to placement of 511 keV and 328 keV. We also have extended this sequence with addition of 573 and 631 KeV transition above the 5195 level. The observation of new 1159 keV γ-ray which is not found in gate of 328 keV γ-ray transition help us to place previously known prompt 267-and 373 keV γ-ray transitions. As the polarization value of 848- and 1215 keV γ-ray transitions suggest these γ-ray transitions are (M1) or (M1/E2) in nature rather than electrical nature which also contradict the positive parity configuration for this sequence [1]. In In Fig. 2, the results of shell model calculations using SN100PN interaction in 50-82 model space for both positive and negative parity are compared with experimental results. Further, the shell-model calculations are in progress to have a better understanding of the wave function.

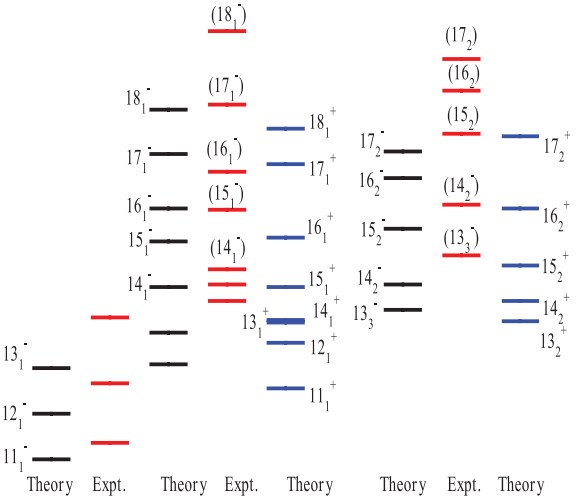

FIG. 2: The shell model results for the high-spin states above $I^{\pi} = 10^{+}$ in ^{136}Ba in comparison with experimental results. Shell model results are shown for both the positive and negative parity states.

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