High spin structure of ^{133}Cs

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Introduction

The nuclei in the mass $A \sim 130$ region below N = 82 shell closure are soft to gamma-deformation, and exhibit many interesting phenomena at low and medium spin regions [1–3]. For these nuclei, the proton Fermi surface lies low within the $h_{11/2}$ orbitals driving the nucleus to prolate shape, while the neutron Fermi surface lies near middle of the $h_{11/2}$ orbitals favoring an oblate shape [4]. Due to the opposite types of quadrupole deformations for the proton and neutron mass distributions these nuclei develop γ instability and provide an opportunity to investigate evolution of collectivity and the competing nuclear shapes with increasing spin and as a function of positions of neutron and proton Fermi surfaces in the unique-parity $h_{11/2}$ intruder orbital. Triaxial rotor plus particle model has been used to explain the negative parity states in the ^{125,127,129}Cs isotopes [5]. The odd-even nuclei provide a possibility to study different types of coupling of the valence proton with the even-even core and its excitations. Presence of nearby $h_{11/2}$, $g_{7/2}$, and $d_{5/2}$ proton orbitals usually gives rise to different one quasi-particle band structures and further rearrangements of neutrons and protons add richness to the structure. High spin states of ^{133}Cs have been reported by Garg *et al.,* [6] using the ^{130}Te(^{6}Li,3n) reaction. The motivation of the present work is to investigate the structure of the transitional nucleus ^{133}Cs, which is at the boundary of deformed and spherical Cs isotopes, at moderate and high spin.

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Experimental Details

The experiment was performed using the ^{7}Li beam at energies E_{lab} = 30 MeV, from the 14UD BARC-TIFR Pelletron accelerator, Mumbai. The target used was ^{130}Te of thickness $\approx$ 700 $\mu g/cm^2$ with Au backing. Seven Compton suppressed clover detectors, kept in the horizontal plane, were used along with 14 element NaI(Tl) multiplicity filter for the present experiment. The master trigger for collecting gamma-gamma coincidence data was generated with the condition that at least two Clover detectors and two NaI(Tl) detectors fired in coincidence. The collected coincidence data were sorted into two-dimensional matrix. From the gamma-gamma coincidence data, the intensity, directional correlation of oriented states (DCO) ratio and polarization measurements of different transitions are extracted and used for placement of the new transitions in the level scheme of ^{133}Cs.

Results and Discussion

The present level scheme of ^{133}Cs, shown in Fig. 1 is built on the ground state with $I^{\pi} = 7/2^{+}$ with around 30 new transitions added to the previously established level

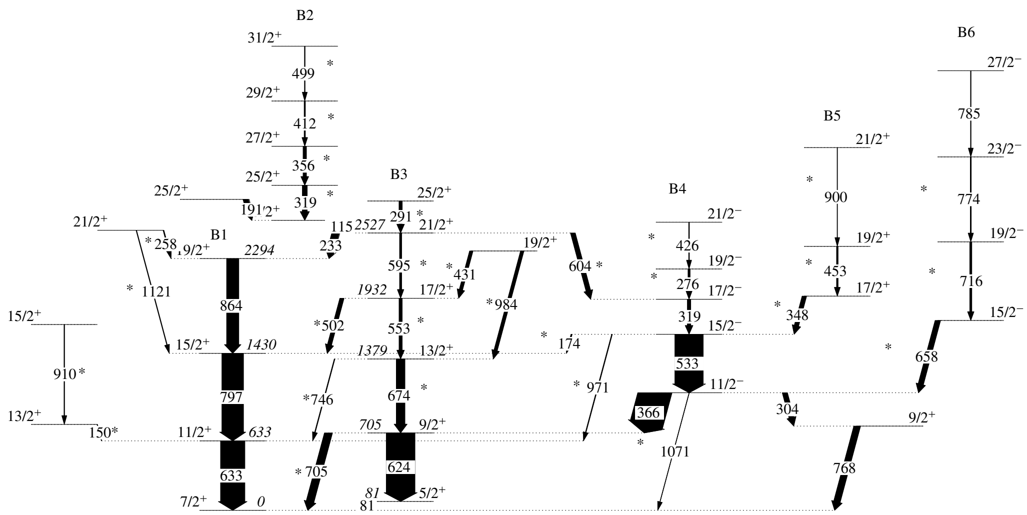

FIG. 1: The partial level scheme of ^{133}Cs developed in the present work.

scheme. The previously observed band structures have been confirmed in the present work. The decay scheme contains about 6 bands labeled by B1 - B6. The B1, B3 and B6 bands shown in Fig. 1, have the collective character with the $\Delta I = 2$ transitions. These B1, B3 and B6 bands have features similar to that of B6, B5 and B10 bands of ^{131}Cs nucleus, respectively, and they could be assigned to have the $\pi g_{7/2}$, $\pi d_{5/2}$ and $\pi h_{11/2}$ configurations. A regular dipole band B2 with band head energy of 2642 keV has been established in the present work. The excitation energy and the decay pattern of this band B2 are similar to that of positive parity 3-quasi-particle bands in lighter odd-Cs isotopes [7, 8]. Titled axis cranking calculations and projected Hartree-Fock calculations are in progress to understand the structure of the various bands and to probe the evolution of deformation for the Cs isotopes.

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