High spin spectroscopy of ^{134}Cs

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Introduction

For the nuclei with neutron number N < 82 in mass region A = 130, both the proton and the neutron Fermi level lie in the 50 – 82 sub shell space. These nuclei show a rich variety of structural phenomena [1 - 4]. Apart from spherical structure, bands based on prolate and oblate deformation, the magnetic rotational bands and chiral bands have been observed in this region. For the odd-odd nuclei in this region, the odd proton occupies the high-J, low-Ω orbital whereas, the odd neutron, lies in the upper part of the sub shell space and occupies the high-J high-Ω orbital. These two orbitals have different shape driving effect. For the N = 79 isotones in this region, the odd-proton normally lies in the positive parity $g_{7/2}$ or $d_{5/2}$ orbitals and the odd-neutron lies in the positive parity $d_{3/2}$ or negative parity $h_{11/2}$ orbital. However, at moderate excitation energies, the $h_{11/2}$ unique parity orbital becomes accessible to the odd-protons as well for the heavier isotones particularly with small deformation. It is interesting to study the positive parity excited states arising out of this $\pi h_{112} \otimes \nu h_{11/2}$ configurations in the odd-odd nuclei.

Bands built on this configuration have been identified in the N = 79 isotones of Z > 55 nuclei i.e ^{136}La, ^{138}Pr, ^{140}Pm, ^{142}Eu [5 – 8] etc. The effect of different shape driving orbitals of protons and neutrons are manifested in prolate and oblate shapes respectively in these nuclei [9]. We have studied the high spin spectroscopy of ^{134}Cs to extend the systematic of these isotones in the neutron rich regime towards the Z = 50 spherical shell closure. The low lying states of ^{134}Cs have been studied, previously, mostly by (n,γ) reactions [10]. The only level scheme of ^{134}Cs in heavy ion reaction has been obtained by T. Koike et al [11] with 6 HPGe detectors. However, the spin and parity assignment could not be done.

Experimental Details

Excited states of ^{134}Cs have been populated via the fusion-evaporation reactions ^{130}Te(^{7}Li, 3n) at 30 MeV and ^{130}Te(^{11}B,α3n) at 52 MeV at the 14-UD BARC-TIFR Pelletron at Mumbai, India. γ–γ data were taken using 7 (8 for the 2nd expt) Compton-suppressed clover HPGe detectors. A 14-element NaI(Tl) multiplicity filter was also used, in the 1st expt., to select multiplicity fold of 2 over and above the γ–γ fold in the clover detectors. The data were sorted into a 2D γ-γ matrix and analyzed by using the program RADWARE [12]. Angle dependent matrix was created for the DCO analysis to assign J^{π} of the excited states.

Results and Discussion

The preliminary level scheme of ^{134}Cs established from the present work is shown in Fig.1. The new γ rays (22 of them) have greatly extended the present level scheme of ^{134}Cs compared to the previous work [11]. The spin and parity assignments, shown in Fig.1, are tentative ones. The detailed analysis of the DCO matrix is in progress.

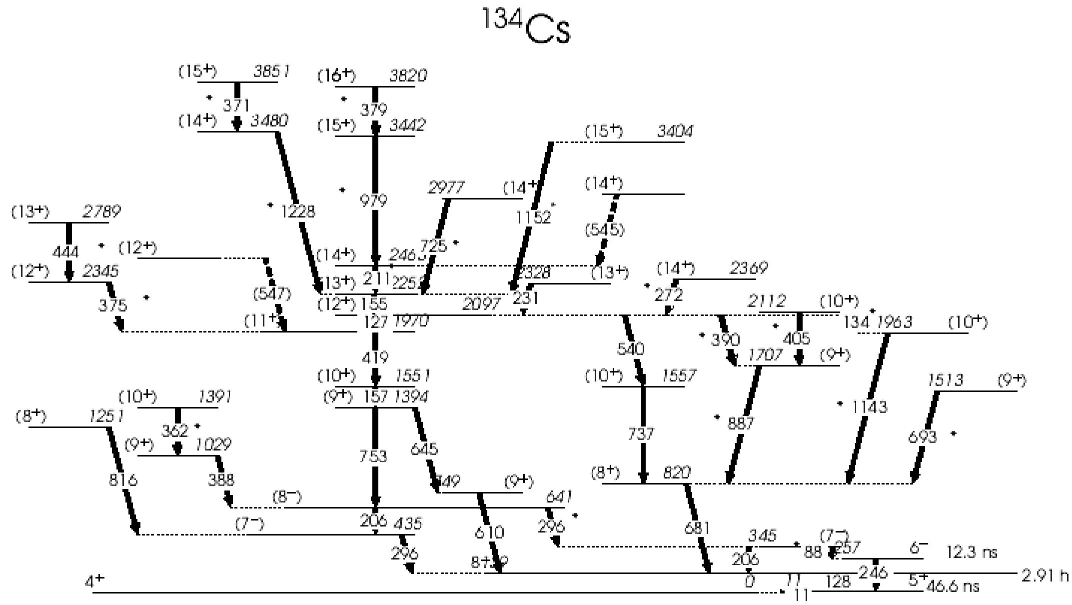

Fig. 1 Preliminary level scheme of ^{134}Cs obtained from this work. The * indicates the new γ-rays.

The excitation energies of the 9^+, 10^+ and 11^+ states of the $\pi h_{11/2} \otimes \nu h_{11/2}$ configuration of the N = 79 isotones are plotted in Fig 2. With the increase in Z the proton Fermi level increases and the $\pi h_{11/2}$ becomes accessible at lower energy and hence the excitation energy of the above configuration decreases. The increase in the excitation energy for the ^{134}Cs (shown by dotted line) shows that the effect of Z = 50 gap started dominating.

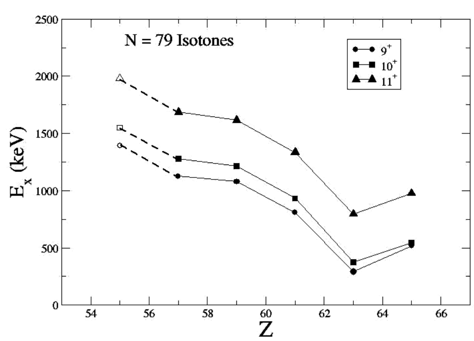

Fig. 2 Systematic of excitation energy of $\pi h_{11/2} \otimes \nu h_{11/2}$ configuration of N = 79 isotones.

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