Search for γ-band in ^{114}Te

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Introduction

Large number of collective and non-collective states have been observed at lower excitation energies owing to different nuclear shapes across the mass region. For deformed nuclei the nuclear shapes have traditionally been described in terms of β and γ parameters leading to β- and γ- vibrational bands, respectively. The most common low-lying collective vibrational band structure, known as gamma-band is extensively reported for different nuclei over decades [1]. Different gamma transitions are observed in nuclei having potentials of different γ-dependencies(triaxial parameter). The shapes of nuclei can be inferred by distinguishing such potentials empirically.

For Tellurium, there exist two protons outside the Sn core(Z=50) in $1g_{7/2}$ orbitals. The energy ratio, $4_1^+/2_1^+$ for ^{114}Te is found to be very close to 2, indicating it to be a vibrational type of excitation. However, the transition rates [B(E2)] show a soft triaxial nature for ^{120,122,124}Te [2]. Moreover, energy staggering in the odd-even spin states can also be evaluated to have the structural information regarding γ-band [3]. Therefore, an in-beam γ-ray spectroscopy of ^{114}Te has been carried out in order to study the γ-vibrational band in this nucleus.

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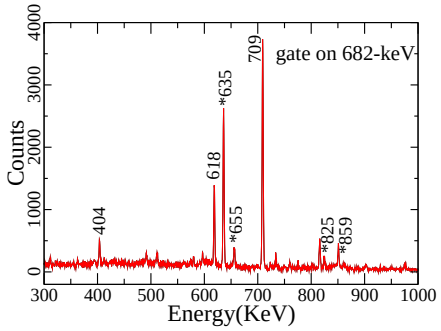

FIG. 1: Single gated spectrum of ^{114}Te, gated by 682-keV. The asterisk(*) marked transitions are the newly found gamma transitions.

Experimental Aspects

The excited states of ^{114}Te was populated using fusion-evaporation reaction ^{112}Sn(α,2n)^{114}Te. Self supportig ^{112}Sn foils of effective thickness of 4.5 mg/cm^2 were used for the experiment. The α beam of 37-MeV, supplied from K-130 cyclotron at VECC(kolkata), was used and the de-excited γ-rays were detected using INGA set-up comprising of seven compton suppressed HPGe clover detectors at three different angles(40°, 90° and 125°) and one LEPS(Low Energy Photon Spectrometer) detector. The acquired listmode data was processed using the IUCPIX [4] package, developed at UGC-DAE CSR, Kolkata Centre, and analysed using RADWARE [7].

Results and Discussions

The low-lying partial level scheme of ^{114}Te has been investigated using coincidence relationship and is also confirmed by measuring the corresponding relative intensities, DCO ratios and plarization assymetries of relevant gamma transitions. A typical gated spectrum is shown in fig. 1. Most of the transitions are found to be E2 in nature except a few connecting interband ones. The mixing ratios as calculated using theoritical code ANGCOR [5] show higher values for such several trasitions. The width of the sub-state population(σ/J) required for the mixing ratio calculation is found to be 0.37.

Excitation energy and projection of total angular momentum on the symmetry axis (I_x) are plotted with spin for different bands observed in the present experiment (Band I(g.s.), Band II and Band III(build on 2_2^+ state)) (fig. 2). Both the plots have shown similar characteristics for all the three bands indicating a γ-vibrational band. The odd-even energy staggering [S(I)] plotted as a function of spin[I] also shows a similar pattern when compared with the γ-vibrational band of ^{118}Xe (fig. 3) with minimum at even spin indicating the band structure observed in ^{114}Te is of γ-vibrational in nature. However, the absolute values of staggering are small in the present case compared to ^{118}Xe [3]. The calculated value of $E_s/E(2_1^+)$ is -0.13 which indicates a γ-soft nature for the nucleus [6]. Detailed data analysis and to be able to firmly identify the mode of vibrational excitation in the ^{114}Te, theoretical model calculations are in progress.

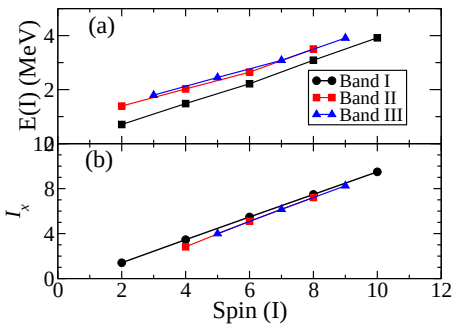

FIG. 2: (a) The experimental excitation energies of the levels with spin values , (b)Projection of angular momentum on the symmetry axis (I_x) plotted with spin (I) for the quadrupole band structures in ^{114}Te.

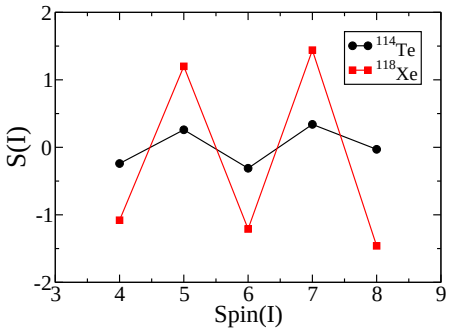

FIG. 3: Calculated odd-even energy staggering S(I) plotted against spin (I) for ^{114}Te. Values for ^{118}Xe are taken from literature.

Acknowledgments

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