Transition probabilities of nuclear states in ^{129}Cs

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Introduction

The intricate nature of nuclei – with many complex structures – poses a challenge in nuclear spectroscopy. Nuclei exhibit many interesting phenomena, *e.g.* chirality, K-isomerism and signature inversion; they arise because of multiple probable configurations of valence protons and neutrons. Researchers use phenomenological models (*e.g.* particle plus triaxial rotor) to describe various phenomena. The odd proton nuclei in the mass region (A) ~130 have stable triaxial deformation [1].

Sihotra *et al.* [2] have studied high spin states of ^{129}Cs extensively and established many bands. Recently Wang *et al.* [3] have further investigated ^{129}Cs and deduced short lifetimes using Doppler shift attenuation method (DSAM). In the present study, we intend to measure lifetimes accurately using DSAM.

Experimental details

The high spin states of ^{129}Cs were populated using the heavy-ion fusion evaporation reaction ^{124}Sn(^{11}B, 6n)^{129}Cs at beam energy 70 MeV. The experiment was performed using Pelletron accelerator facility at Tata Institute of Fundamental Research (TIFR), Mumbai, India. An isotropically enriched, self-supported ^{124}Sn target of thickness 2.2 mg/cm^2 was used. The γ-rays were measured by Indian National Gamma Array (INGA), consisting of 21 Compton suppressed clover HPGe detectors. The detectors were placed at 23º, 40º, 65º, 90º, 115º, 140º and 157º with respect to the beam direction. Double-γ and triple-γ coincidence data were collected.

Data analysis and results

When moving nuclei emit γ-rays, Doppler broadened peaks appear in the γ-spectrum; the shape of the peak (called lineshape) depends on the angle of the detector with respect to the direction of moving nuclei. We constructed three E_γ-E_γ matrices depending on the detector angles: all *vs.* forward (23º), all *vs.* 90º, and all *vs.* backward (157º, 140º). Different energy gates were set on these matrices to observe lineshapes. For instance, when gated on 182.2 keV (Fig. 1), the projected spectrum shows clean lineshape at 459.4 keV (Fig. 2). We observed many new lineshapes at γ-energies: 419.9, 606.1 and 448.0 keV; in addition to those previously reported by Wang *et al.* [3]. We plan to deduce life times by fitting the lineshapes, and the results will be presented in the symposium.

We would like to point out the similarity and difference between our experiment and that reported by Wang *et al.* [3] – both used the same reaction with slightly different beam energies. While we used self-supporting target (2.2 mg/cm^2), they used target (7.06 mg/cm^2) with backing (6.7 mg/cm^2). Since the life time results depend sensitively on the slowing down of recoils, it will be interesting to compare the two results.

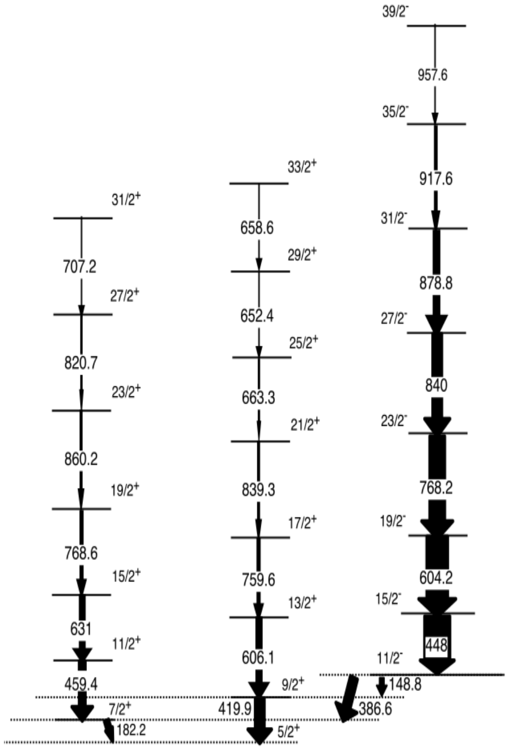

FIG. 1: Partial decay scheme of ^{129}Cs [2].

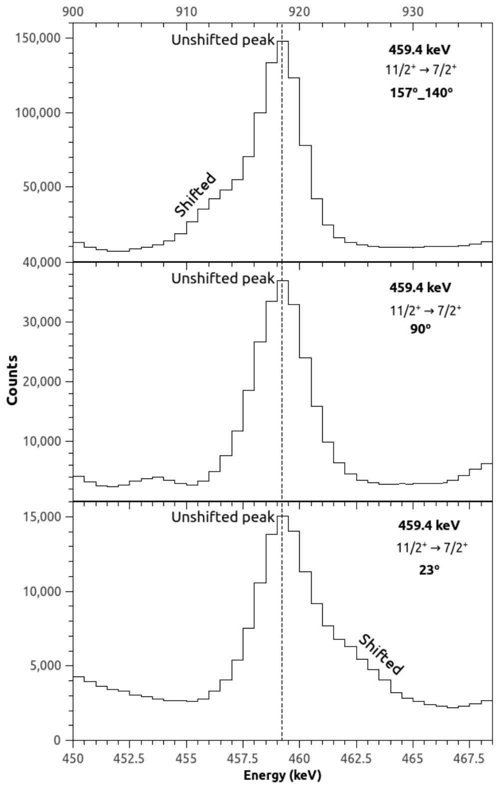

FIG. 2: Spectra of 459.4 keV transition with lineshape.

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