Giant Dipole Resonance Studies in A∼150 Mass Region

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Introduction

Giant Dipole Resonance (GDR), collective motion of neutrons against protons inside an excited nuclei, has been proven to be a unique tool to unravel the average shape of the vibrating, rotating excited nuclei [1]. The two main parameters which describe the GDR strength are the centroid energy (E_D) and the width (Γ_D). There have been several efforts to describe the evolution of E_D and Γ_D as a function of angular momentum (J) and temperature (T). Though E_D remains constant with J and T, the evolution of Γ_D with J and T still remains to be fully understood over a wide range of these variables. It has been observed experimentally that the width of GDR built on excited states is more than that built on ground state. Thermal Shape Fluctuation Model (*TSFM*) attributed the larger width to different shapes sampled by excited nuclei. Though this model is largely successful in explaining the GDR systematic in medium mass region, discrepancies has been reported in A ∼150 mass region [2]. With this motivation, GDR formed in the collision of ^{28}Si and ^{124}Sn with ^{28}Si beam of energies 149 MeV and 185 MeV was studied through gamma rays channel at Pelletron Linac Facility (PLF) at TIFR, Mumbai [3, 4]. It has been observed from these experiments that simultaneous inclusion of inhomogeneous and collisional damping could only explain the data. To investigate the same system at lower T, the same reaction is studied with at E_{lab}=130 MeV. The preliminary result of the GDR measurement in the ^{28}Si +^{124} Sn reaction leading to ^{152}Gd compound nuclei at an excitation energy ∼ 71 MeV, J_{max} ∼ 48$\hbar$ and $<$ J $>$ ∼ 26$\hbar$ is presented here.

Experimental Details

The experiment was carried out using ∼ 3 nA 135 MeV (130 MeV at the centre of the target) pulsed beam of ^{28}Si from PLF at Mumbai after using second stripper foil, bombarding an enriched, 2.0 mg/cm^2 thick ^{124}Sn target. High energy γ-rays were detected with an array of seven close-packed hexagonal BaF_2 detectors as described in experimental setup of ref. [4]. Periodic monitoring of energy calibrations was done using ^{137}Cs, ^{60}Co and Am-Be radioactive sources and drifts were found to be smaller than ± 2.0%. Fold, number of detectors producing simultaneous outputs (within 50 ns), was measured with multiplicity detector array consisting of 38 hexagonal BGO detectors configured in two equal close-packed groups placed above and below the target chamber. Selection of evaporation residue (ER) was not possible in this experiment employing Parallel Plate Avalanche Counter (PPAC) as described in ref. [4] because ER having lower energy in this experiment was not able to reach the PPAC. Data was taken for 0.1 PmC of incident beam particles with CAMAC based acquisition-cum-analysis software LAMPS [5]. 20 μg/cm^2 thick ^{12}C target was used for estimating the maximum fold contribution coming from Carbon impurity in the ^{124}Sn target. For in-beam background estimation data was taken with blank target and was found to be negligible.

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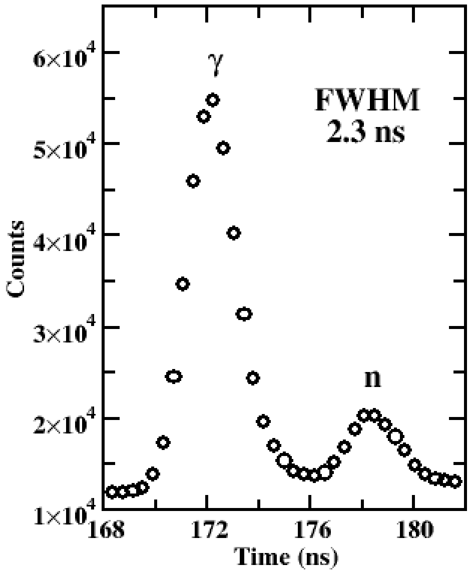

FIG. 1: Time of flight spectrum for central BaF_2 detector. Measured FWHM for γ-peak is 2.3 ns.

Data analysis and Results

The acquired data was analyzed in event-by-event mode with different filter conditions using LAMPS. From Carbon impurity, maximum fold observed is 4. The cosmic ray background reduction achieved with a plastic veto in 10-30 MeV energy window for the array is 94%. The lower fold data (less than 6) which also has contribution from Oxygen, Carbon impurities in target and from residual radioactivity has been excluded for extraction of GDR parameters from the data. Figure 1 shows a typical time of flight spectrum of the central BaF_2 detector where γ-rays and neutron were clearly separated. Typical FWHM of $\sim$ 2.3 ns was observed for γ-ray peak. High energy gamma ray spectra were generated from time prompt gated events after pile up rejection and chance correction. Figure 2 shows high energy spectra for different fold windows. The extraction of GDR parameters using Statistical Model Analysis from data is under process.

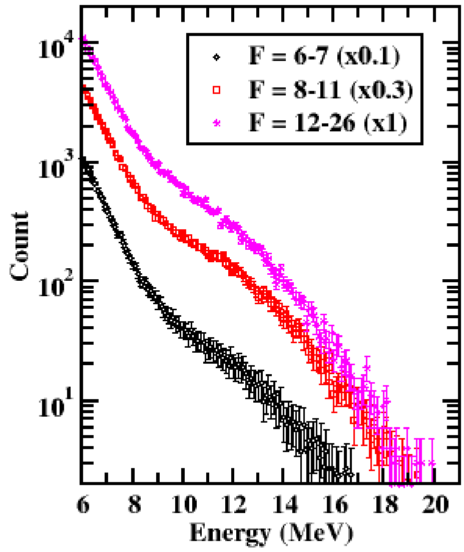

FIG. 2: High energy spectra for different fold windows.

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