Giant dipole resonance in compund nucleus ^{144}Sm

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1. Introduction

Study of giant dipole resonance (GDR) in hot nuclei continues to be a topic of interest in nuclear structure as the GDR γ line shape is a useful tool to study nuclear shapes at high excitation energies [1, 2]. High energy GDR gamma rays measured in coincidence with a multiplicity filter provide nuclear shapes at different angular momentum. At Inter-University Accelerator Centre (IUAC), we have performed an experiment to study the GDR observables in compund nucleus ^{144}Sm at high excitation energy. We present the initial results of the experiment in this paper.

2. Experimental details

The experiment was performed using the 15UD Pelletron accelerator facility at the IUAC, New Delhi. A self supporting target of ^{116}Cd, with more than 98.3 % enrichment, was rolled to a thickness $\sim$ 1.6 mg/cm^2 at IUAC target laboratory. ^{28}Si DC beam of 140 MeV was used for formation of ^{144}Sm compund nucleus at the excitation energy of 78 MeV. This excitation energy is after taking consideration of dE/dx energy loss in target. The high energy γ-rays were detected using the High Energy Gamma Ray Spectrometer (HiGRaSp) [3]. The spectrometer consists of a 25.4 cm x 30.5 cm cylinder of NaI(Tl) detector with plastic detectors surrounding it for cosmic background rejection. The detector system was positioned at 80 cm from target position at an angle of 135° w.r.t. beam axis. The response function of detector was generated experimentally using ^{137}Cs (.662 MeV), ^{60}Co (1.173 & 1.332 MeV) and Am-Be (4.438 MeV) sources. The response functions for other energies were simulated using monte-carlo simulation package GEANT4 [4]. A multiplicity filter detector array, sum-spin spectrometer, was used to measure low-energy γ-rays multiplicity, in coincidence with high energy γ-rays from HiGRaSp. The complete multiplicity filter consists of 32 NaI(Tl) detectors and covers a solid angle of nearly 4π sr [5]. For the present experiment only 27 detectors were used and it had a solid angle coverage of 82% of 4π sr. The target was positioned at the geometrical center of the 4π array. To eliminate the chance of beam hitting the target frame, a collimator was placed in beam line at a distance of $\sim$40 cm before target center. The γ-rays and neutrons originating from collimator were shielded by heavy Lead and Borated polythene bricks for γ and neutron, respectively. A time-of-flight (TOF) TAC signal, with the start signal given by the large NaI(Tl) detector and stop by sum-spin spectrometer, was used in order to distinguish γ-rays from neutrons. The pile-up (PU) rejection for the NaI(Tl) detector was obtained using zero-cross over method. A plastic anti-compton shield (ACS) signal was generated using start from plastic detectors and stop from large NaI(Tl) detector. An Energy scalar with 4 MeV threshold was used to collect γ-rays from 4 MeV and above. A master strobe generated by AND of PU, TOF and Energy scaler was used to start data acqusition.

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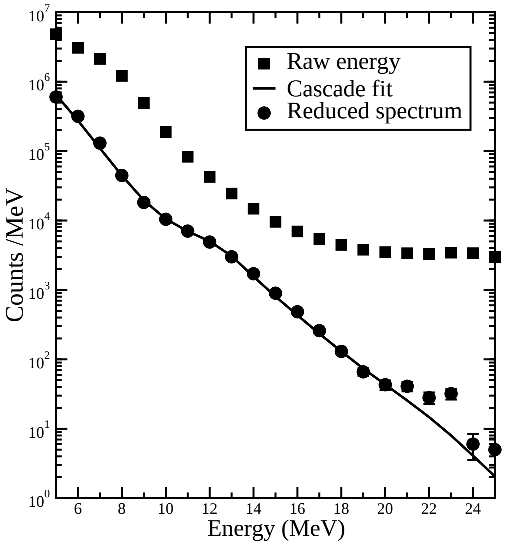

FIG. 1: Experimental $\gamma-$ray spectra for fold 6 and above. See text for details.

3. Data reduction and Results

The raw energy signal taken from HiGRaSp was gated with gamma peak in TOF spectrum and good events' peak in PU spectrum. The resulting spectrum was gated in anti-coincidence with ACS. The data was further gated with different fold windows to get the final spectra. The cosmic background was recorded for the same time and with same settings as in the experiment. Raw γ-ray energy and the reduced spectrum with fold 6 and above is shown in fig 1. A close fit of the spectrum using statistical model code CASCADE [6] is also shown. The TOF spectrum showing the gamma and neutron discrimination is given in fig 2. Detailed calculations for the system are in progress.

4. Acknowledgement

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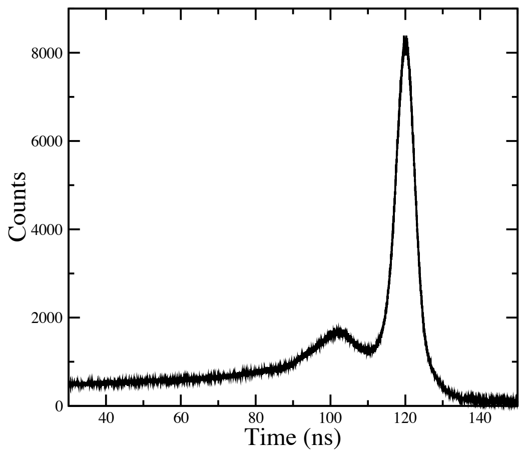

FIG. 2: A typical Time of flight (TOF) spectra showing γ and neutron discrimination

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