Preliminary results from new measurement of the 4^+ to 2^+ γ-decay in ^{8}Be

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Introduction

The radiative decay branch of the 4^+ resonance in ^{8}Be had been measured [1] to be ~ 10^{-7} within ±30%. This measurement could not discriminate between two theoretical models, viz., the α-cluster [2] and the *ab initio* [3] models used to calculate this quantity since the results of the calculations differ by only ~15%. Much of the large error in the measurement was due to systematic effects. The present measurement included several improvements aimed at reducing the error to ±10%. We report here the preliminary results from this experiment.

Experimental details

The experiment was performed at the Pelletron Linac Facility at Mumbai. ^{4}He beams at four energies between 19 and 29 MeV were used to bombard helium gas, at a pressure of 600 torr, in a target chamber [4]. An array of 38 BGO detectors was used to detect the γ-rays from the radiative α-capture to the 2^+ resonance at 3 MeV in ^{8}Be. The α-particles depopulating the 2^+ resonance were detected in a 500 μm thick annular, double sided silicon strip detector (SiSD) with an active zone of 96 mm OD and 48 mm ID. The SiSD with 32 θ rings in two halves and 16 ϕ sectors was placed at 0° with respect to the beam. The 4.44 MeV γ-ray background due to beam interactions with the Kapton windows was reduced using heavymet shield. The event trigger was generated from a triple coincidence of logic signals from the two halves of the SiSD and the BGO array. The energy and time information from each of the Si strips and BGO detectors was recorded in an event by event mode in a CAMAC based data acquisition system. The energy calibrations were done using alpha particles scattered from mylar and carbon targets.

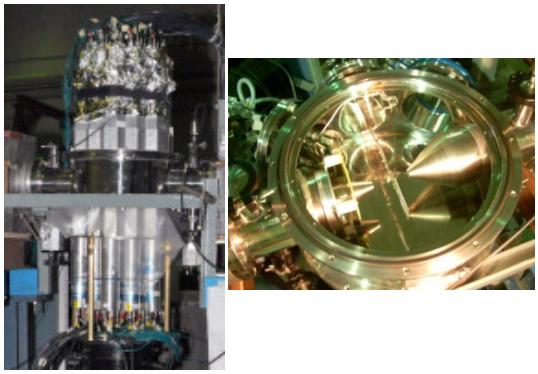

Fig. 1 Experimental set up showing the BGO detectors (left) and gas target chamber with SiSD and heavymet shield (right).

Results

We present preliminary results from an analysis of the data at two beam energies viz. E_α = 22.5

MeV (~30% of data) and 29 MeV. The former beam energy (on resonance) populates the 4^+ resonance at 11 MeV in ^{8}Be. At 29 MeV the radiative capture cross section is expected to be lower by an order of magnitude [2].

Scatter plots of the summed energies of the two α-particles in opposite halves of the SiSD vs. the summed BGO energy are shown in Figs. 2 and 3 for the two beam energies. At E_α=22.5 MeV, the radiative capture events, in the region around E_γ ~8 MeV and $E_{\alpha1}+E_{\alpha2}$ ~13 MeV, are well separated from the background events. The background events arise from (a) ^{14}N(α,2αγ) and ^{16}O(α,2αγ) reactions due to air contamination in the target gas and (b) random coincidences between γ-rays and elastically scattered α-particles. At E_α = 29 MeV the yield in the corresponding region (E_γ ~11 MeV and $E_{\alpha1}+E_{\alpha2}$ ~16 MeV) is significantly lower. The estimated on-resonance cross section is consistent with our earlier measurement.

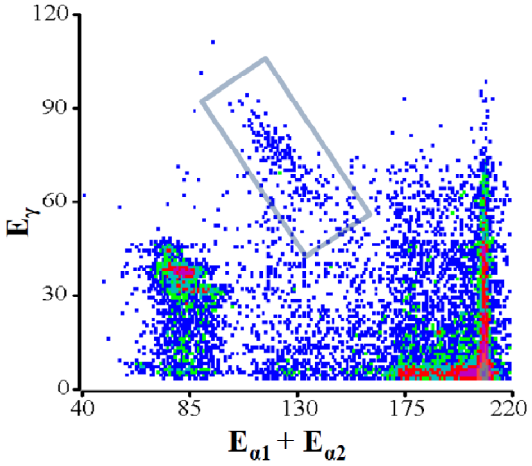

Fig. 2 Two dimensional plot of sum energy of α-particles detected in the SiSD vs sum energy of γ-rays detected in the BGO array (100keV/ch for both) at E_α = 22.5 MeV for an integrated beam charge of ~175 μC. The box indicates the region of interest (see text).

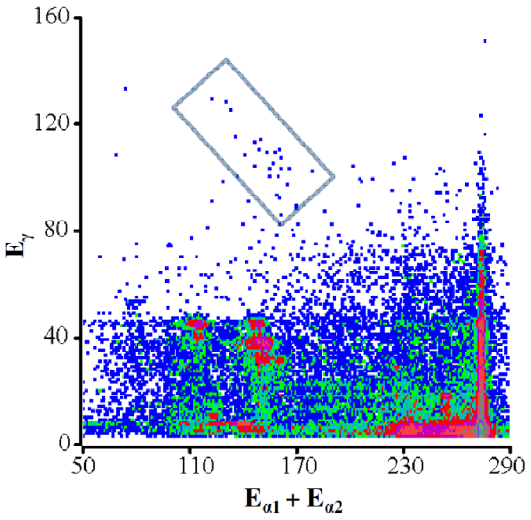

Fig. 3 Same as Fig. 2 for E_α = 29 MeV and beam charge of ~ 107 μC.

A more detailed analysis of the data, including those at the other two beam energies, will be presented.

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