In Beam test of a transient magnetic field based g factor setup

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Introduction

Magnetic Moments or g factors[1,2] provide substantial information on the microscopic structure of the nuclei. Since the g factor is very different in sign and magnitude for neutrons and protons, therefore they can serve as a good indicator as to which nucleon contributes most to the wave function of that state.

There are different techniques available for measuring g factors depending on the lifetime of the state involved. Using transient field technique we can measure the g factor of nuclei having a lifetime of the order of several hundreds of femto seconds.

To measure the g factor of such low lifetime states we have designed and fabricated a setup [3] based on the Transient Field Technique Measurement.

Experimental Details

The experiment was carried out in the GDA beamline at Inter University accelerator centre (IUAC). ^{16}O beam at 56MeV, accelerated from 15UD pelletron was used as the projectile to perform Coulomb excitation reaction. The beam current was limited to 1pna to prevent the burning of the target. A ferromagnetic host with a thick copper backing was used as the target for the experiment. The target consisted of 6.12mg/cm^2 layer of ^{nat}Gd stuck to a thick copper backing of thickness 4.98mg/cm^2 using a thin layer of indium [4]. The motivation for using Gd as the ferromagnetic host came from the fact that it shows better magnetization properties with respect to iron. Since the curie temperature of Gd is 293K the target was also cooled down to -20degrees during the experiment. The targets were prepared at the target lab of IUAC.

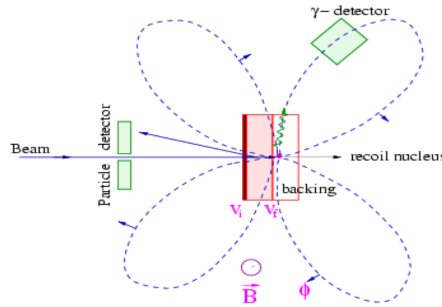

Fig. 1 The schematic diagram showing the arrangement of the gamma detectors and particle detectors with respect to the beam direction.

The de-exciting gamma rays were detected in a pair of germanium detectors and NaI(Tl) detectors. These detectors were placed symmetrically (in the forward and backward hemisphere) with respect to the beam direction at angle 45 degree, at a distance of 13.6 cm from the target in the reaction plane. The back scattered ^{16}O ions were detected in a pair of solar cells (10mm by 10mm size) of thickness 300um. The particle detectors were placed at a distance of 36mm from the target and covered a angular range from 145 to 155 degrees. The opening angle of the particle detectors was 12.2 degrees. The back scattered ^{16}O ions covered a energy range from 34MeV to 37MeV in that detection range. The excited Gd ions got stopped within the target layer. The data was recorded in a 8K ADC attached to a CAMAC crate. The trigger was generated by taking the OR of all the particle and gamma detectors.

Since the beam direction and spot size are crucial for the experiment, three different points of reference were taken for proper beam alignment. A 2mm collimator was placed just behind the target chamber. Along with that the target current was monitored and also a faraday cup was placed at the end of the beam line.

Results

The analysis has been performed using ROOT and Go4 software program. The particle gamma coincidence was set up in the software. The back scattered beam-like ions detected in the particle detectors were used to gate the gamma rays.

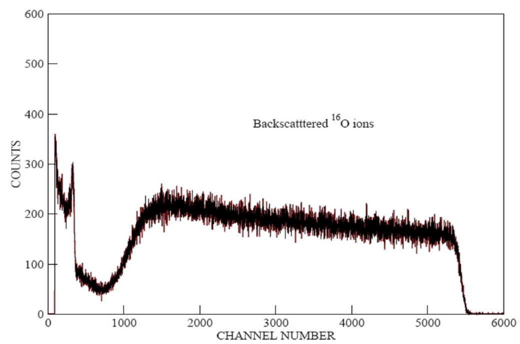

Fig. 1 The figure shows the energy spectrum of the backscattered ^{16}O ions detected in the particle detector.

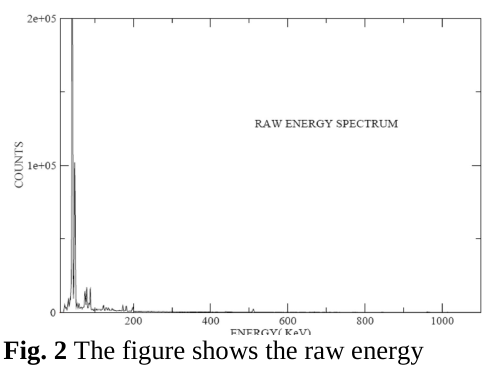

Fig. 2 The figure shows the raw energy spectrum of gamma rays populated during the run.

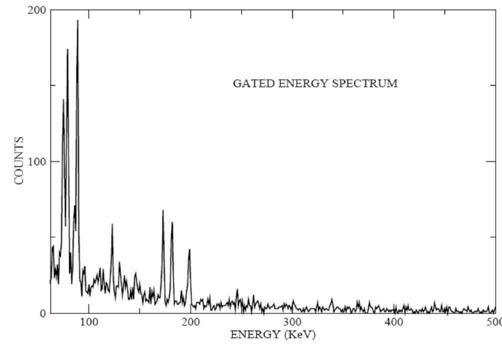

Fig. 3 Gated energy spectrum of one of the germanium detectors.

The gated energy spectrum is shown in Fig3. The first 2^+ state for ^{154,156,158,160}Gd was clearly observed .

Summary

We have developed a setup to measure the g factor of a nuclei using transient field technique. Coulomb excitation reaction was performed using ^{16}O beam . The particle gamma angular distribution was measured. Further analysis is in progress.

Acknowledgments

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