Study of the nucleus ^{25}Mg

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Introduction

Transfer reactions can be used as a good tool to extract spectroscopic informations about the structure of nuclei. Transfer reactions like (p, d), (d, p), (d, t), (d, ^{3}He) and (d, α) had been frequently used to extract structure information of nuclei for several decades. One of the characteristic property of such reactions is that the recoil nucleus may be left in any of its excited states and structure information of these states can be easily extracted using these reactions as a tool. The experimentally extracted spectroscopic information can be compared with those predicted theoretically using different nuclear models for the same. At high bombarding energy of the particle, direct reaction is the main process and the angular distributions of ejectiles which correspond to the states of the recoil nucleus can be very well explained by the distorted wave Born approximation (DWBA) calculations. The reactions (d, α) can be a good choice to extract important structure information of nuclei as well as can be used to understand pairing correlation among bound nucleons. The structure of the nucleus ^{25}Mg has been studied using (d, α) reaction as well as several other reaction probes Ref. [1, 2]. Here, we report our experimental measurement on ^{27}Al(d, α)^{25}Mg reaction at 25 MeV to study the structure of the nucleus ^{25}Mg using one deuteron (which is a bound system of 1n and 1p) pick-up reaction. The results of the present study will also be compared with previous results for the same.

1. Experimental Details

The experiment was performed at Variable Energy Cyclotron Centre, Kolkata using deuteron beam of energy 25 MeV on a self - supporting ^{27}Al target (thickness$\sim$90 μg/cm^2). The experimental details have been given in Ref. [3]. A typical excitation energy spectrum of ^{25}Mg populated in the present study of the reaction ^{27}Al(d, α)^{25}Mg is shown in Fig.1.

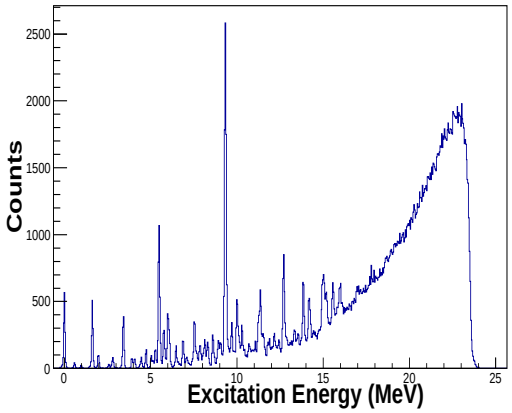

FIG. 1: Excitation energy spectrum of ^{25}Mg at θ_{lab} = 28° produced from the reaction ^{27}Al(d,α)^{25}Mg.

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2. Results

Local, zero range distorted wave Born approximation (DWBA) calculations have been performed using the computer code DWUCK4 [4]. The optical model potential (OMP) parameters for the entrance channel has been taken from our previous study [3] which were extracted using the ECIS94 optical model search code [5]. The OMP parameters for the exit channel (α + ^{25}Mg) were borrowed from Ref. [1].

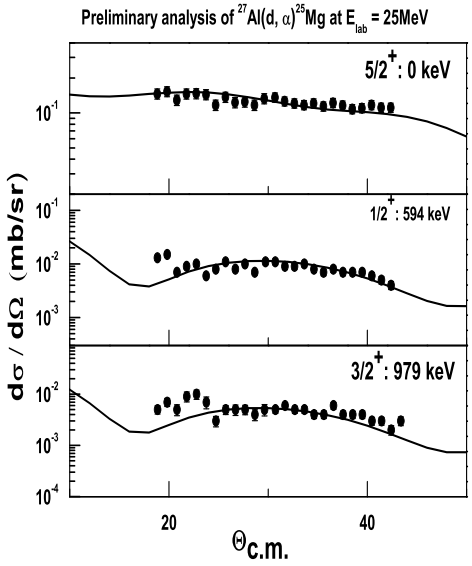

FIG. 2: Fitted angular distributions of differential cross-sections of the states of ^{25}Mg. The preliminary assigned levels of the states are shown inside the figure.

The preliminary extracted experimental angular distributions of the ground, 594 and 979 keV states of ^{25}Mg are shown in Fig. 2 by solid points. The experimentally extracted angular distributions of these states were fitted with the theoretically predicted cross sections (shown by solid lines in Fig. 2) using zero range distorted wave Born approximation using computer code DWUCK4. As we know that in direct rection several angular momentum transfer (l) values can be possible for states of target having high angular momentum (J) values. At present, the ground state of the nucleus ^{25}Mg has been fitted with l = *4* transfer while other two excited states have been fitted with l =*0* transfer. In this work, the experimental angular distributions will be analysed using both zero and finite range distorted wave Born approximation calculations with all other possible l values to get the reliable structure information about the states of ^{25}Mg. The results of the present work will also be compared with those obtained earlier for the same. Apart from these calculations, we can extract interesting physics about these nuclei by performing coupled channel calclations. Further analysis is in progress and the detailed results will be presented during the conference.

3. Acknowledgement

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