# Study of ($^4$He,t) reaction on $^{27}$Al target at 50 MeV

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Study of single-nucleon transfer reactions gives valuable information on nuclear structure. The spectroscopic factors deduced experimentally can be directly compared with the predictions from nuclear models. The $\alpha$ + $^{27}$Al reaction had been studied at 65 and 80 MeV and the spectroscopic factors for ($\alpha$, $^3$He) and ($\alpha$,t) reaction channels had been deduced [1,2]. Here we report our measurement on 1p transfer channel at 50 MeV for $\alpha$ + $^{27}$Al reaction.

The experiment was performed using $\alpha$-beam of energy 50 MeV at VECC, Kolkata. The self-supporting target of $^{27}$Al (225 µg/cm$^2$) was used in the experiment. Particle Identification was done with two detector telescope setup made from $\Delta$E- E- 2CsI(Tl) details are given in Ref. [3]. Well separated ridges corresponding to different particles as well as excited states are clearly seen in E - CsI scatter plot (Fig. 1). The solid angle subtended by each strip is ~ 5 msr.

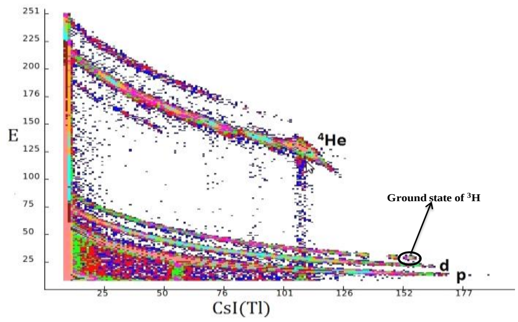


**Fig.1** Typical two dimensional spectrum obtained from E Vs. CsI(Tl) at 47°.

Angular distributions of elastic and transferred particles have been measured in the angular range 13$^0$ - 160$^0$ .

Preliminary analysis of elastic scattering of alpha particles from $^{27}$Al target had already been reported[3]. The elastic scattering angular distribution has been shown in Fig. 2

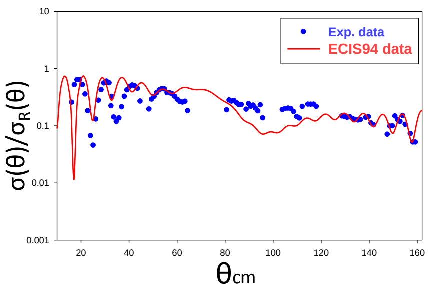


**Fig. 2** $\sigma(\Theta)/\sigma_R$ Vs $\Theta_{cm}$ for elastic scattering at $E_\alpha$=50MeV

The optical model analysis was carried out with the parametric Woods-Saxon forms for both the real and imaginary potentials [3]. The search code ECIS94 [4] has been used to perform optical model calculations to obtain the parameters of the best fit potential. The best fit parameters are given in Table 1. The fit is shown in Fig.2 by solid line.

**Table:1.** Potential parameters for the $\alpha$+$^{27}$Al reaction at 50 MeV.

| Reaction | $\alpha$ + $^{27}$Al | $^3$H+ $^{28}$Si |
|---|---|---|
| $V_0$ | 203.52 | 110.06 |
| $R_0$ | 1.288 | 1.150 |
| $A_0$ | 0.749 | 0.781 |
| $W_v$ | 26.76 | 21.30 |
| $R_v$ | 1.100 | 1.270 |
| $A_v$ | 0.732 | 0.800 |
| $W_s$ | 8.480 | |
| $R_s$ | 1.420 | |
| $a_s$ | 0.600 | |

The measured angular distribution of ground state of tritium for the reaction $^{27}Al(\alpha,t)^{28}Si$ at 50 MeV has been shown in Fig.3 by solid points. The ground state angular distribution for tritium has been fitted with finite-range distorted wave Born approximation calculation using DWUCK5 code [5] and shown by solid curve in Fig. 3. The distorted waves in the entrance and exit channels have been generated using the optical model potentials.

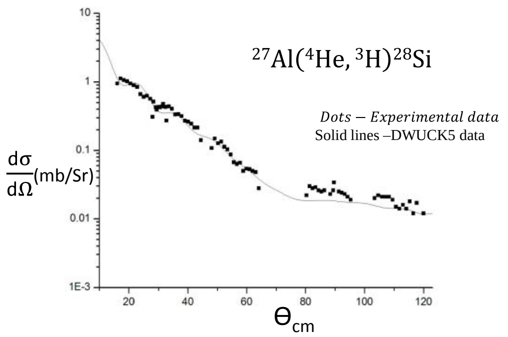


**Fig.** 3 σ vs $\Theta_{cm}$ for tritium at $E_\alpha$=50MeV.

The optical model parameters for exit channel are given in Table 1 [6].

The spectroscopic strength **G** was extracted for each of the observed transitions using the relation $[d\sigma/d\Omega]_{expt}$ = $\mathbf{G}g[d\sigma/d\Omega]_{DW5}$, where $[d\sigma/d\Omega]_{expt}$ is the experimentally measured differential cross-section, $[d\sigma/d\Omega]_{DW5}$ is the differential cross-section predicted by computer code DWUCK5 and *g* is the light-particle spectroscopic strength. The spectroscopic strength **G** is written as

$$\mathbf{G} = \frac{2J_f + 1}{2J_i + 1} C^2 S,$$

where $C^2$ is the isospin Clebsch-Gordon coefficient and *S* is the spectroscopic factor.

In this analysis, the spectroscopic factor for the ground state of $^{28}Si$ has been estimated. The bound state potential parameters are $r$ = 1.25 fm and $a$ = 0.65 fm**.**

The spectroscopic strength **G** for the ground state ($0^+$) of $^{28}Si$ is found to be 0.61. The analysis is in progress.

## References

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