Study of one neutron pick-up reaction ^{27}Al(d,t)

Vishal Srivastava[1],* C. Bhattacharya[1], T.K. Rana[1], S. Manna[1], S. Kundu[1], S. Bhattacharya[1], K. Banerjee[1], P. Roy[1], R. Pandey[1], G. Mukherjee[1], T.K. Ghosh[1], J.K. Meena[1], T. Roy[1], A. Chaudhuri[1], M. Sinha[1], A. Saha[1], Md. A. Asgar[1], A. Dey †, Subinit Roy[2], and Md. Moin Shaikh[2]
[1] *Variable Energy Cyclotron Centre,1/AF, Bidhan Nagar, Kolkata 700064, India*
[2] *Saha Institute of Nuclear Physics,1/AF, Bidhan Nagar, Kolkata 700064, India and*
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Introduction

Transfer reaction provides a powerful tool to study the structure of nuclei. The spectroscopic factors deduced experimentally can be directly compared with the predictions from nuclear models. The specific aspects for the study of structure of any nucleus are excitation energies, spin, and parity assignments, branching ratios, spectroscopic factors and life times. Many excited states of ^{26}Al had been studied using one nucleon pick-up reactions [1], [2], [3]. Here we report our measurement on d + ^{27}Al reaction at 25 MeV to study the structure of ^{26}Al using one neutron pick-up reaction.

1. Experimental Details

The experiment was performed at VECC, Kolkata using deuteron beam of energy 25 MeV on a self - supporting target ^{27}Al (90 μg/cm^2). Particle identification was done using a three - element telescope, consisting of a single - sided 55 μm thick Si (ΔE) strip detector, followed by a double - sided 1030 μm Si (E) strip detector backed by two CsI(Tl) detectors (each of thickness 6 cm). A 6 mm horizontal slit was placed in front of the telescope. Well separated ridges corresponding to different particles p, d, t, ^{3}He and ^{4}He are clearly seen in ΔE- E scatter plot (Fig.1) measured at an angle 37°. Typical excitation energy spectrum for ^{26}Al populated via the reaction channel ^{27}Al(d,t) is shown in Fig.2.

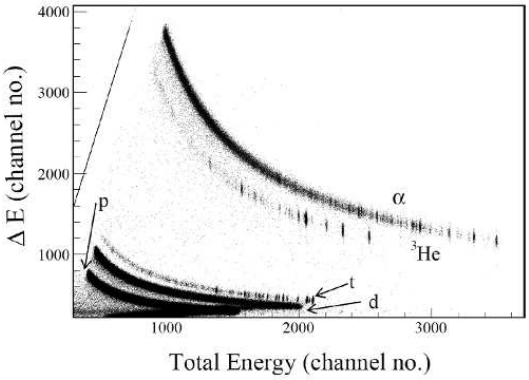

FIG. 1: Two dimensional ΔE - (E + ΔE) plot obtained at θ_{lab} = 37°.

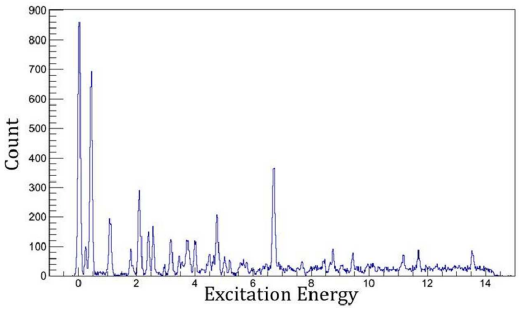

FIG. 2: Excitation energy spectrum of ^{26}Al at θ_{lab} = 37° produced from the reaction ^{27}Al(d,t) .

2. Results

The angular distribution for the elastically scattered deuteron from ^{27}Al target is shown

*Electronic address: vishalphy@vecc.gov.in

in Fig.3 by filled circles and has been fitted using the optical model search code ECIS94 [4] by solid lines. The depth of the real and imaginary potentials were varried for getting minimum χ^2 and the extracted values of the optical model parameters are given in Table 1. The triton optical model parameters were obtained from the relation for global fit parameters given by Perey and Perey [5].

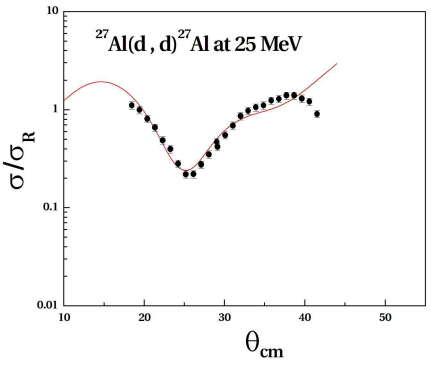

FIG. 3: Angular distribution for elastic scattering of deuteron at E_{lab} = 25 MeV .

TABLE I: The best fit potential parameters used in DWBA for the reaction ^{27}Al(d,t).

parameters	[a)] d+^{27}Al	[b)] t+^{26}Al	*B.S.Potential*
V_R(MeV)	89.209	161.91	V [c)]
R_R(fm)	1.061	1.20	1.25
a_R(fm)	0.701	0.72	0.65
W (MeV)		39.99	
W_D(MeV)	2.250		
R_I(fm)	1.360	1.40	
a_I(fm)	0.850	0.840	
V_{ls}(MeV)	9	2.5	
r_{ls}(fm)	1.061	1.20	
a_{ls}(fm)	0.801	0.72	
R_c (fm)	1.25	1.30	

[a)] Present data,
[b)] Perey and Perey and
[c)] Adjusted to give the required separation energy for the transferred particle.

In this work we are extracting spectroscopic factors for different excited states of ^{26}Al for

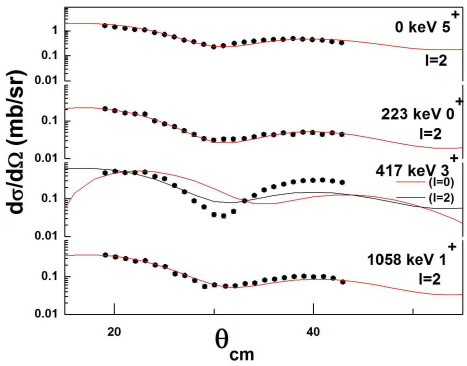

FIG. 4: Angular distributions of differential cross-sections for 0, 223, 417 and 1058 keV states of ^{26}Al.

sd-shell. The angular distributions for ground, 223, 417 and 1058 keV states of ^{26}Al are shown in Fig.4 by filled circles and these have been fitted with theoretical predictions from finite range distorted wave born approximation using computer code DWUCK5 [6] by solid lines. The values of the transferred angular momentum (l-value) for different excited states are shown with their respective plots in Fig.4. The spectroscopic factor values will be extracted and will be compared with previously done one nucleon pick-up reactions. Further analysis is in progress.

References

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