ENERGY DEPENDENCE IN $^{16}O(d,{}^{6}Li)^{12}C$ REACTION

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ABSTRACT

The reaction $^{16}O(d,{}^{6}Li)^{12}C$ has been studied at incident deuteron energies of 50, 65 and 80 MeV to study energy dependence of spectroscopic factors for the transitions to ground state (0^+), 4.439 MeV state (2^+) and 14.08 MeV state (4^+). The angular distributions have been fitted using zero range DWBA calculations. The results indicate that the relative spectroscopic factors for the transitions involved are constant and do not depend on incident energy but are influenced by the choice of bound state parameters describing alpha + ^{12}C systems.

Using the JULIC, we have studied the $^{16}O(d,{}^{6}Li)^{12}C$ reaction at incident energies of 50, 65 and 80 MeV. The ^{6}Li particles were analysed by four conventional ΔE-E counter telescopes. The Nickel oxide target used in the present experiment at 50 and 65 MeV is prepared by surface oxidation of a thin nickel foil. The 80 MeV data was taken using a gas target. The absolute cross section for the 80 MeV data was determined as usual for gas targets. By normalizing a spectrum at 80 MeV obtained with gas target to the one obtained with nickel oxide at 80 MeV, the absolute cross section at 50 and 65 MeV were determined. Transitions to ground state (0^+), 4.439 MeV state (2^+) and 14.08 MeV state (4^+) were investigated in the present study. The angular distributions for transitions leading to the ground and 4.439 MeV state are shown in fig. (1).

The solid lines are zero range DWUCK calculations. The deuteron optical model potentials are due to Cooper et al.[1] fitting deuteron elastic scattering on ^{16}O at E_d = 63.2 MeV. For ^{6}Li particles, we have used the potentials due to Chua et al.[2] fitting elastic scattering at 60.6 MeV. The uncertainty in the choice of the optical model potential is minimum for the 65 MeV data. We have retained the same optical model parameter sets to fit our 50 and 80 MeV data. The bound state potential is calculated to fit the alpha + ^{12}C binding energy in a Woods-Saxon well of radius $R = 1.15A^{1/3}$ fm and diffuseness a = 0.65 fm. The alpha-spectroscopic factors for 0^+, 2^+ and 4^+ transitions are listed in Table I.

The present zero range DWBA analysis shows the relative spectroscopic factors are independent of the incident deuteron energy, and for the bound state radius used is in rather good agreement with the shell model predictions of Kurath[3]. However, changing the bound state radius from $R = 0.85\ A^{1/3}$ fm to $R = 2.15\ A^{1/3}$ fm, changes the ratio $|S(2^+)/S(0^+)|$ by about a factor of 1.5 and the ratio $|S(4^+)/S(0^+)|$ by about a factor of 5. Further finite range DWBA analysis are in progress to study the sensitivity of the relative spectorscopic factors to the bound state radius more realistically.

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It may be noted that the $^{16}O(^{6}Li,d)^{20}Ne$ reaction had been studied at 20 and 32 MeV, and an energy dependence of the relative spectroscopic factors had been reported[4].

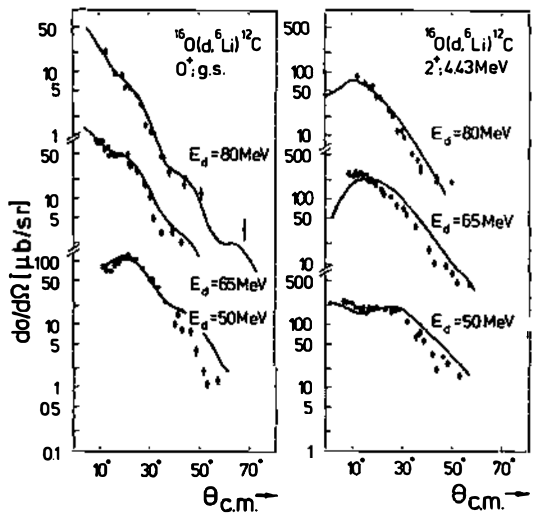

Fig. 1: Angular distributions for transitions to 0^+ and 2^+ in ^{12}C in the reaction $^{16}O(d,^{6}Li)^{12}C$ at incident deuteron energies of 80, 65 and 50 MeV. The solid lines are zero range DWBA calculations.

TABLE 1

Alpha spectroscopic factors normalized to the ground state transition. The bound state parameters are $R = 1.15A^{1/3}$ fm and a = 0.65 fm.

Transition	E_d=50 MeV	E_d=65 MeV	E_d=80 MeV	Theory[3]
0^+(0.0 MeV)	1	1	1	1
2^+(4.439 MeV)	4.81	5.18	4.84	5.54
4^+(14.08 MeV)	7.49	7.01	7.71	10.15

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