The 26Mg(3He,n) 28Si Reaction at 23.1, 45.5 and 64.6 MeV

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I. 3 The $^{26}Mg(^{3}He,n)^{28}Si$ Reaction at 23.1, 45.5 and 64.6 MeV

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Several experimental studies of the $^{26}Mg(^{3}He,n)^{28}Si$ reaction have been reported so far[1-3]. A study of the $^{26}Mg(^{16}O,^{14}C)^{28}Si$ reaction has also been reported[4]. These (^{3}He,n) experiments were performed at relatively low bombarding energies of 5.7-15 MeV, where an appreciable contribution of compound-nucleus process is expected.

We have made an experiment of the $^{26}Mg(^{3}He,n)^{28}Si$ reaction at bombarding energies of 23.1, 45.5 and 64.6 MeV. Two self-supporting metallic targets of ^{26}Mg isotopically enriched to 99.9 % were prepared; one 2.33 mg/cm^2 thick was used at 23.1 and 64.6 MeV bombarding energies, and the other 3.18 mg/cm^2 thick at 45.5 MeV. Neutrons from target were measured with a neutron time-of-flight spectrometer[5]. Neutron angular distributions were taken in an angular range of 0-55°. The neutron flight path was fixed at 24.6 m throughout the present measurements. Neutron detection efficiencies of the spectrometer have been determined experimentally for neutron energies up to 34 MeV[5], and extraporated by the aid of calculation with the code TOTEFF (MSU version)[6] for neutron energies above 34 MeV.

A typical neutron energy spectrum obtained in the present experiment is shown in fig. 1, where number of neutron counts per 50 keV is plotted against excitation energy in the residual nucleus ^{28}Si. Figs. 2 and 3 show the neutron angular distributions for transitions to the ground and 1.77-MeV first-excited states in ^{28}Si. At 64.6 MeV bombarding energy, we could not resolve two neutron groups for these transitions, and a composite angular distribution for them is shown in fig. 2.

Curves in figs. 2 and 3 are the results of a zero-range DWBA analysis performed with the code DWUCK4[7]. The curves are normalized to experimental points at forward angles. In this analysis, optical-model parameters taken from the work of Becchetti and Greenlees[8,9] were used, and bound-state parameters were chosen to be r_0 = 1.25 fm, a = 0.65 fm and λ = 25. Theoretical two-nucleon spectroscopic amplitudes based on the shell-model wave functions were taken from ref. 3). Enhancement factors from this analysis are listed in table 1.

One notes in figs. 2 and 3 that the experimental angular distributions, except the one for the transition to the 1.77-MeV 2^+ state at 45.5 MeV bombarding energy, are fairly well reproduced in shape by the DWBA calculation, at least at forward angles. One also notes that the enhancement factors listed in table 1 are not too far from unity, and are in moderate agreement with each other. It seems that the (^{3}He,n) reactions at a bombarding energy as high as 65 MeV are described reasonably by the conventional DWBA theory.

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Table 1. Enhancement factors for (^{3}He,n) transitions to the ground and 1.77-MeV first-excited states in ^{28}Si at 23.1, 45.5 and 64.6 MeV bombarding energies

	E(^{3}He)=23.1 MeV	45.5 MeV	64.6 MeV
ground state	1.8	1.7	3.0[a)]
1.77-MeV 2^+ state	2.0	1.8	3.0[a)]

[a)] The two neutron groups are unresolved.

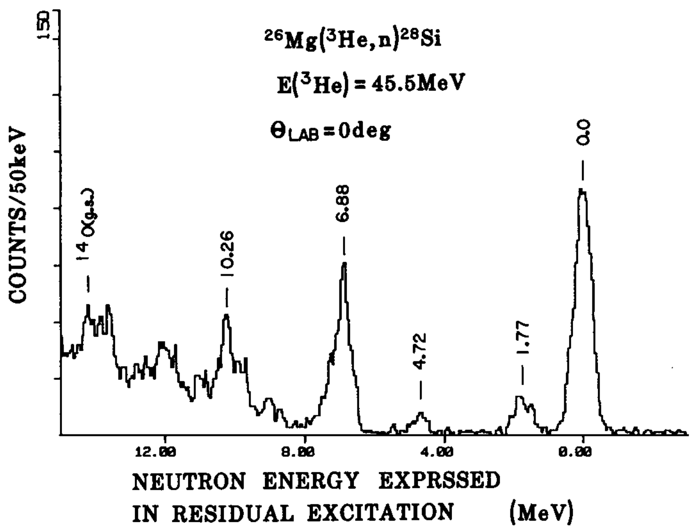

Fig. 1. A neutron energy spectrum for the $^{26}Mg(^{3}He,n)^{28}Si$ reaction at 45.5 MeV, which measured at 0° with a TOF spectrometer of 24.6 m flight path.

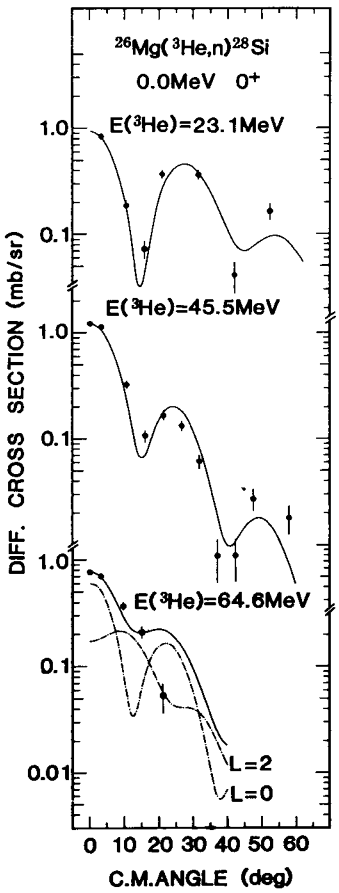

Fig. 2. Neutron angular distributions for the $(^{3}He,n)$ transition to the ground state in ^{28}Si. At 64.6 MeV bombarding energy, a composite angular distribution for the transitions to the ground and 1.77-MeV first-excited states in ^{28}Si is shown, since the two neutron groups was unresolved. Curves are the results of DWBA analysis.

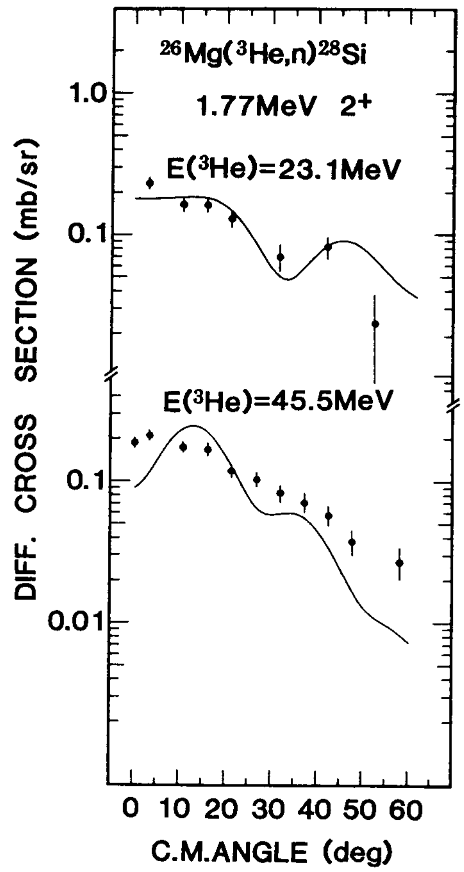

Fig. 3. Neutron angular distributions for the (^{3}He,n) transition to the 1.77-MeV 2^{+} first-excited state in ^{28}Si. Curves are the results of DWBA analysis.