Proc. Sixth Int. Symp. Polar. Phenom. in Nucl. Phys., Osaka, 1985
J. Phys. Soc. Jpn. 55 (1986) Suppl. p. 710-711

1.79 Spin Flip Excitation of Light Nuclei by the (d,^{2}He) Reaction

T. Motobayashi, N. Matsuoka*, H. Sakai*, T. Saito*, K. Hosono*, A. Sakaguchi**, S. Shimoura**, A. Okihana+ and M. Ishihara++

Departmentof Physics, Rikkyo University Toshima, Tokyo, Japan
* Research Center for Nuclear Physics, Osaka University, Ibaraki, Osaka, Japan
**Department of Physics, Kyoto University, Kyoto, Japan
+ Kyoto University of Education, Kyoto, Japan
++Institute of Physical and Chemical Research, Wako, Saitama, Japan

The (d,^{2}He) reaction has a unique property of exciting strongly spin flip final nuclear states. This is because of the strong T=1 S=0 final state interaction of outgoing two protons in small relative energy (around 400keV). Other light ion induced charge exchange reactions which excite $T=T_0+1$ final states, such as (n,p) and (t,^{3}He) reactions, always contain considerable contribution from non spin-flip transitions. Therefore the (d,^{2}He) reaction has been expected to be a good probe for investigating the iso-vector spin-flip strength of nucleus, and some measurements have been performed on light nuclei[1,2]. However the results obtained up to now are not so promising because the angular distributions are somewhat monotonic irrespective to the transferred angular momentum l and there is no significant enhancement for l=0 transitions which is expected from the good kinematical matching.

The present experiment was performed with polarized deuterons to investigate the l-dependence of the spin dependent observables. Cross section and vector analyzing powere A_y of the (d,^{2}He) reaction were measured for targets of ^{12}C and ^{13}C by using vector polarized deuterons of 70 MeV incident energy provided from the RCNP cyclotron. Outgoing two protons were measured in coincidence by two sets of counter telescopes consisting of Si ΔE detectors and NaI E detectors. Coincidence events were recorded on a magnetic tape through the CAMAC data acquisition system. Contributions from accidental coincidence events were corrected for in off line analysis. Detection efficiency of ^{2}He was calculated with the help of the Watson-Migdal formula for final state interaction[3].

Typical energy spectra of (d,^{2}He) reaction on ^{13}C are shown in fig. 1. Peaks corresponding to the ground state transition and bumps with 4-7 MeV excitation energy are seen. For the ground state peak l=0 transition from $p_{3/2}$ to $p_{1/2}$ are the main component. On the other hand, the bump should correspond to the transitions from $p_{3/2}$ to $s_{1/2}$ or $d_{5/2}$ orbits, therefore transferred angular momentum l is not equal to 0. It should be noted that for the ^{12}C(d,^{2}He) reaction the peaks corresponding to the first and second excited states of the final ^{12}B nucleus cannot be resolved from that of the ground state transition. These contributions are estimated to be about 25-30% from the result of Stahel et al.[1] at E_d=55 MeV and our preliminary result with higher energy resolution obtained by using Si(Li) detectors as E-counters.

Angular distributions of differential cross section and vector analyzing power are shown in fig. 2. The cross sections for ^{12}C target are about twice of those for ^{13}C. This is consistent with a simple consideration assuming spin-flip direct charge exchange mechanism because the neutron orbit of final state is half occupied for the target ^{13}C while it is vacant for ^{12}C. It is clearly seen in fig. 1 and fig. 2 that l=0 transitions to the ground states of both ^{12}B and ^{13}B have large negative vector analyzing powers while A_y values for other transitions with finite l-values are about 0. This is very encouraging result in studying the l=0 spin-flip strength of nucleus. DWBA anasysis is in progress to understand this unique feature of the l=0 transitions.

References

1) D.P.Stahel, R. Jahn, G.J. Wozniak and J. Cerny, Phys Rev. **C20** (1979) 1680.
2) K.B. Beard, J. Kasagi, E. Kashy, B.H. Wildenthal, D.L. Friesel, H. Nann and R.E. Warner, Phys. Rev. **C26** (1982) 720.
3) K.M. Watson, Phys. Rev. **88** (1952) 1163.

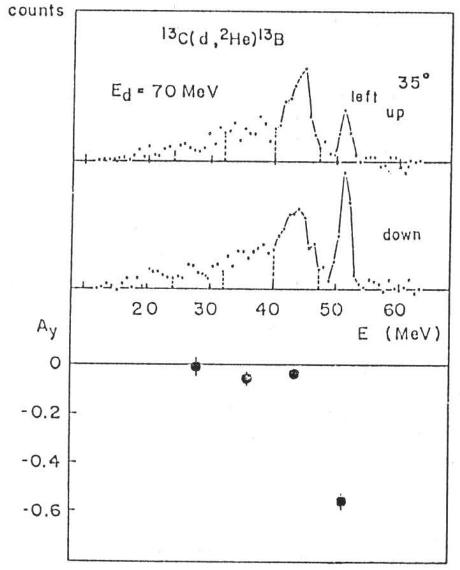

Fig. 1 Energy spectra and vector analyzing power of the $^{13}C(d,^{2}He)^{13}B$ reaction at 70 MeV.

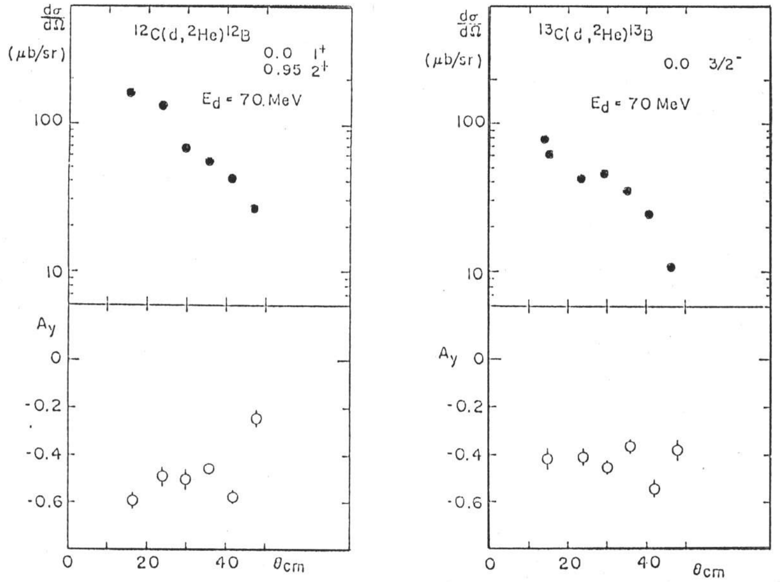

Fig. 2 Differential cross sections and vector analyzing powers of the ground state transitions of the reactions of $^{12}C(d,^{2}He)^{12}B$ and $^{12}C(d,^{2}He)^{13}B$. Note that for the ^{12}C target contribution from the first excited state of final ^{12}B nucleus is contained in the data.