# $^{24}Mg(\alpha,^{12}C)^{16}O$ at $E_\alpha$=90 MeV*

F. D. Becchetti, J. Jänecke and H. Song
University of Michigan, Ann Arbor, Mi. 48109

G. Kekelis
Williams College, Williamstown, Ma. 01267

ABSTRACT

The reaction $^{24}Mg(\alpha,^{12}C)^{16}O$ has been studied at $E_\alpha$=90 MeV and exhibits characteristics suggestive of a direct-type reaction, either $^{8}Be$ transfer or successive α-transfer.

Reactions such as $(\alpha,^{12}C)$ are potentially useful as a means of reaching nuclei far from the line of stability. Information on the exact mechanism of such reactions would be extremely valuable. Such reactions, if shown to be direct, could yield information on cluster overlaps in nuclei. Recent models utilizing SU3 theory[1] predict large overlaps among certain s-d shell nuclei, e.g. $^{28}Si \to {}^{16}O + {}^{12}C$, $^{32}S \to {}^{12}C + {}^{20}Ne$, $^{12}C \to \alpha + {}^{8}Be$.

We have begun an investigation of such cluster transfer reactions. The $(\alpha,^{12}C)$ reaction on $^{24}Mg$ has been studied at LBL ($E_\alpha$=90 MeV), and appears to populate states in $^{16}O$ in a selective manner rather than a statistical one [viz $\sigma \propto (2J+1)$] as observed for the inverse reaction $(^{12}C,\alpha)$ at low bombarding energies.[2] Instead the $0^+$ g.s. and low-lying $3^-$ levels are favored (fig. 1). The spectrum, in fact, resembles that for $^{20}Ne(d,^{6}Li)^{16}O$, i.e. single α-pickup, suggesting a strong correlation between the two types of reactions. The population of the $0^+$ g.s. and $3^-$ (6.1 MeV) levels may be favored compared to the $2^+$ (6.9 MeV) and $4^+$ (10.3 MeV) levels since $^{24}Mg$ in a simple α-cluster model would have a large overlap with the former but <u>not</u> the latter (fig. 2). Furthermore, the $0^+$ g.s. angular distributions exhibit oscillations and forward-backward asymmetry characteristic of a direct-type reaction. The general features of the angular distributions are reproduced surprisingly well by simple DWBA calculations naively assuming a direct $^{8}Be$ transfer mechanism (fig. 3). The successive α-transfer $(\alpha,^{8}Be)(^{8}Be,^{12}C)$ cannot be excluded however and is likely also important. The results suggest that specific bombarding energies and angles may be preferable in optimizing the cross sections for such reactions. The experiment is being extended to other sd-shell nuclei.

REFERENCES

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1. K. T. Hecht (private communication).
2. M. L. Halbert <u>et al</u>., Phys. Rev. 162 (1967) 919.

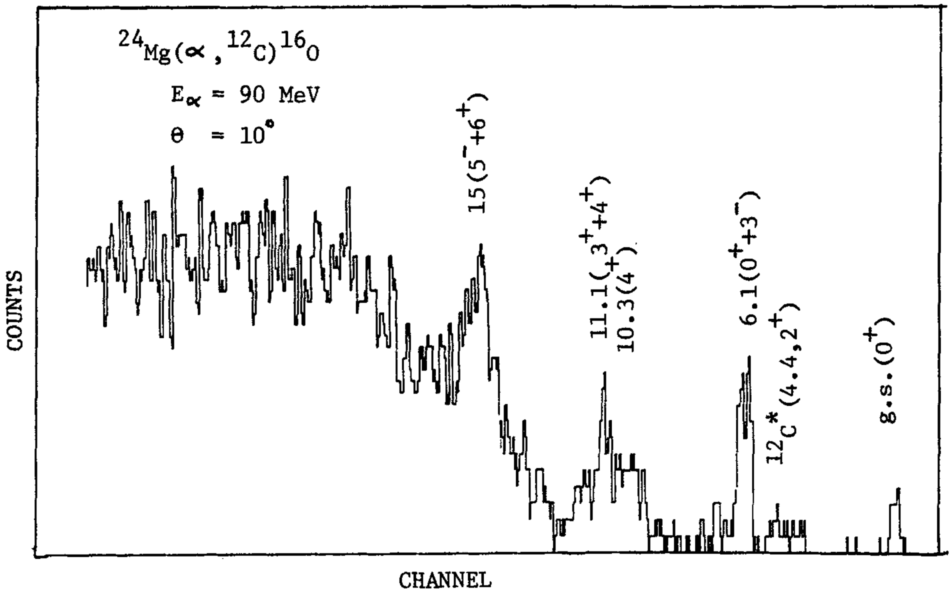


Fig. 1 $^{24}Mg(\alpha,{}^{12}C)^{16}$ spectrum

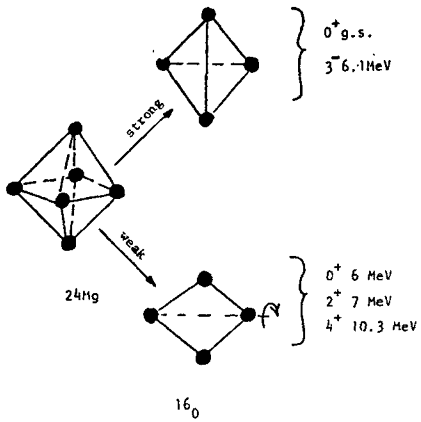


Fig. 2 $^{24}Mg \rightarrow {}^{8}Be + {}^{16}O$

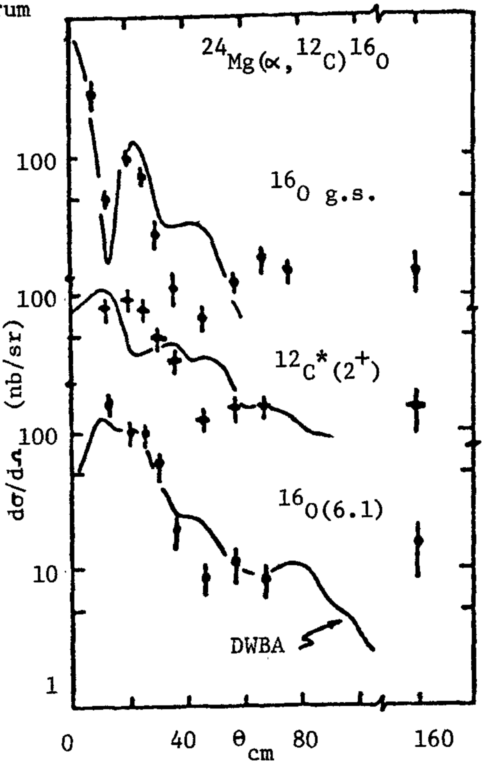


Fig. 3