Proc. Sixth Int. Symp. Polar. Phenom. in Nucl. Phys., Osaka, 1985
J. Phys. Soc. Jpn. 55 (1986) Suppl. p. 644-645

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Studies of the ($\vec{p}$,^{3}He) Reaction on 0^+ sd Shell Nuclei at 89.6 MeV*

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Differential cross-section and analysing power angular distributions over the range 6° to 35° (lab.) have been taken for the ^{24}Mg(p,^{3}He)^{22}Na and ^{28}Si($\vec{p}$,^{3}He)^{26}Al reaction for final states up to 4 MeV in excitation.

The experiment was performed with polarised protons of 89.6 MeV extracted from the IUCF main stage cyclotron. Reaction products were analysed using a ODDM spectrometer which afforded a resolution of less than 60 keV.

It appears that like the ($\vec{d}$,α) work[1] at 80 MeV, there is a strong population of states which are formed by coupling the spins of the two particles to the maximum permissible J, see figure 1. Additionally, the analysing power signature of the $(d_{5/2})^2_{5^+}$ states in both ^{22}Na and ^{26}Al is very similar to that of the $(f_{7/2})^2_{7^+}$ states formed via ($\vec{d}$,α) on fp shell nuclei.

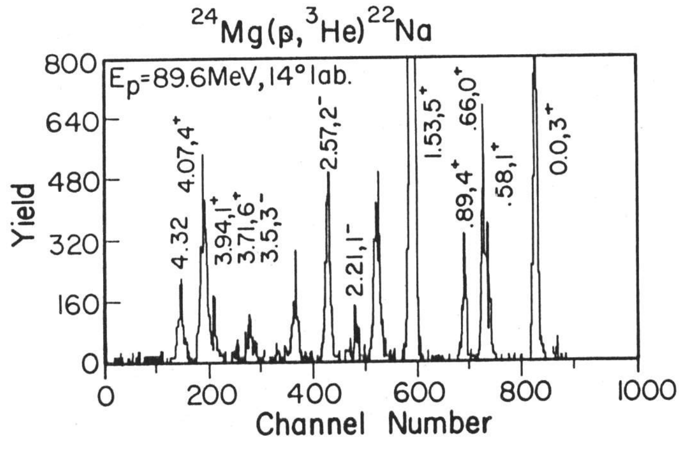

Figure 1: Energy spectrum for the ^{24}Mg(p,^{3}He)^{22}Na reaction at 14° lab.

The analysing power angular distributions for any one final state spin and parity in both of the reactions are very similar. This apparent J dependence follows for all states with spin of 0^+ to 6^+ and 1^- to 3^-. The differential cross-section angular distributions are indicative of the transferred L value.

Preliminary analyses of the data using zero range DWBA calculations indicated very strong sensitivity to the choice of the exit channel distorted waves. Many works exist which cover proton elastic scattering; however, the converse is true for ^{3}He elastic scattering at these energies. Therefore, in order to constrain the optical model parameterisation as much as possible, data for the elastic scattering of ^{3}He on ^{24}Mg and ^{22}Al were taken at 78.6MeV. This energy is similar to that of the exiting ^3He's in the $(p,{}^3He)$ reaction.

Using this new parameterisation, DWBA calculations were carried out for all the states for which angular distributions were extracted. Considerations as to the geometry of the bound state potential, binding energy prescription, non locality and finite range effects were made. For the positive parity states a zero range microscopic DWBA formalism was used employing the spectroscopic amplitudes from Chung and Wildenthal[2)]. The agreement with the data was very good apart from the magnitude of the differential cross section. Such a discrepancy might be construed as evidence for two step processes. Negative parity states which are intruder states in the shell model calculations of Chung and Wildenthal were analysed using a cluster model for the transferred np pair. Again, the reproduction of the data is satisfactory apart from the magnitude of the predicted differential cross section.

REFERENCES

*Supported in part by the National Science Foundation

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