FERMI AND GAMOW-TELLER TRANSITIONS OBSERVED IN $^{12,13,14}$C($^3$He,$t$)$^{12,13,14}$N CHARGE EXCHANGE AT $E(^3$He) = 200 MeV

K. Ashktorab, F. Becchetti, J. Jänecke, and D. Roberts
University of Michigan, Ann Arbor, Michigan 48109

G.P.A. Berg, C. Foster and E. Stephenson
Indiana University Cyclotron Facility, Bloomington, IN 47408

M. N. Harakeh
Natuurkundig Laboratorium, Vrije Universiteit, Amsterdam, The Netherlands

S. van der Werf
Kernfysisch Versneller Instituut, Groningen, The Netherlands

The techniques established for performing measurements at $\theta = 0^\circ$ with the K600 magnetic spectrometer have been used to determine ($^3$He,$t$) cross sections for several low-excited states in $^{12}$N,$^{13}$N,$^{14}$N. Fig. 1 displays a spectrum for $^{14}$C($^3$He,$t$)$^{14}$N. The transitions to the $0^+$, $T=1$ (2.313 MeV) and $1^+$, $T=0$ (3.948 MeV) states represent pure Fermi and Gamow-Teller transitions, respectively.

Cross sections at $\theta = 0^\circ$ are used extensively in ($p$,n) charge exchange to extract the ratio of spinflip to non-spinflip strength.\textsuperscript{1} Using this procedure and our earlier data,\textsuperscript{2} taken at $E(^3$He) = 200 MeV for the transitions to the $1/2^-$ (g.s.) and $3/2^-$ (3.511 MeV) states in $^{13}$N, led to a ratio of spinflip to non-spinflip strength of about unity. Furthermore, it was shown from data for isobaric analog states from $A=30$ to 208 that the non-spinflip strength $V_\tau$ decreases for bombarding energies from 75 MeV to 200 MeV by a factor 0.6 in agreement with ($p$,n) data.

\textbf{Figure 1.} Triton energy spectrum from $^{14}$C($^3$He,$t$)$^{14}$N for the angular range = 0° to 1° for transitions to the low-excited $0^+$ and $1^+$ states in $^{14}$N.
However, it is known\textsuperscript{3} from results obtained at lower \(^3\text{He}\) bombarding energies that 0° cross sections are not sufficient to determine spinflip strength because of the presence of the tensor interaction \(V_{T\tau}\) in addition to the spinflip interaction \(V_{\sigma\tau}\). It was, therefore, decided to measure complete angular distributions for several low-excited states with targets of \(^{12,13,14}\text{C}\). Some of the preliminary results are displayed in Fig. 2. The non-spinflip Fermi transitions to the \(1/2^-\) (g.s.) state in \(^{13}\text{N}\) and the \(0^+\) (2.313 MeV) state in \(^{14}\text{N}\) show a more diffractive behavior at small angles compared to the spinflip Gamow-Teller transitions to the \(1^+\) (g.s.) state in \(^{12}\text{N}\), the \(3/2^-\) (3.511 MeV) state in \(^{13}\text{N}\), and the \(1^+\) (3.948 MeV) state in \(^{14}\text{N}\). It should be noted, though, that the transition to the \(1/2^-\) (g.s.) state in \(^{13}\text{N}\) contains weak spinflip admixtures.

The theoretical interpretation of the data has not been completed. It will follow the earlier one-step DWBA analysis\textsuperscript{3} performed for 65/90 MeV data. Microscopic wave functions will again be used, and the effective \(^3\text{He}-\text{nucleon}\) interaction will be parameterized with potentials of Yukawa shape and strengths \(V_\tau\), \(V_{\sigma\tau}\) and \(V_{T\tau}\). It is expected that the tensor interaction will play a major role, and a comparison with the \((p,n)\) charge-exchange reaction will become possible.


\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Angular distributions for Fermi (left) and Gamow-Teller (middle and right) transitions to low-excited states in \(^{12,13,14}\text{N}\). The lines are drawn to guide the eye.}
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