I. 1. Search for Gamow-Teller Strengths in $^{14}$O via the ($p,n$) Reaction

Okamura H., Terakawa A., Suzuki H., Sugimoto N., Shinozaki H., and Hasegawa T.

CYRIC, Tohoku University

The old and well-known feature of the mass $A=14$ system is the anomalous hindrance of the transition between the ground state of $^{14}$N ($J^p=1^+, T=0$) and the ground states of $^{14}$O and $^{14}$C ($J^p=0^+, T=1$). Although the quantum numbers involved would permit a Gamow-Teller decay, the log($\text{ft}$) values are as large as 9.0 and 7.3 for $^{14}$C and $^{14}$O, respectively, allowing the widely used $^{14}$C dating in archaeological studies. A number of theoretical works have been made, but it is interesting to note that none of the widely used empirical effective $p$- or $psd$-shell model interactions can explain this famous suppression. Recently it was suggested that the suppression can be explained if a tensor component of the residual interaction is considered in a large model space$^1)$. It was also suggested that the main part of the Gamow-Teller strength should be found at higher excitation energies, which, however, has not been established due to the lack of experimental data. Aiming at pursuing this problem, the $^{14}$N($p,n$)$^{14}$O reaction has been measured at $E_p=70$ MeV and $\theta_n=0^\circ$−$60^\circ$ with small contaminants by using a gas target. $^{14}$N gas was contained in a cell having 6-$\mu$m thick Havar windows at a pressure of 1 atm. The target thickness was 5 cm, which gives an energy loss comparable to other sources of energy spread. Owing to the newly installed beam buncher, the intensity of 20−90 nA was obtained after beam pulse selection by 1/8. A typical excitation energy spectrum is shown in Fig. 1. The $l=0$ Gamow-Teller strength will be extracted from the angular dependence of the spectra by using the multipole-decomposition analysis.

References

Figure 1. Typical excitation energy spectrum of the $^{14}\text{N}(p,n)^{14}\text{O}$ reaction at $E_p=70\text{ MeV}$ and $\theta_n=0^\circ$, after subtracting the background from the gas-cell window.