## CHARGE EXCHANGE

# $D_{NN}(0°)$ AND $d\sigma/d\Omega(\theta)$ FOR THE $^{17,18}O(\vec{p},\vec{n})^{17,18}F$ REACTIONS AT $E_{\vec{p}}$ = 120 AND 186 MeV


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We have made $D_{NN}(0°)$ and $d\sigma/d\Omega(\theta)$ measurements on $^{17}O$ and $^{18}O$ gaseous targets at 120 and 185 MeV, respectively.

For the $^{17}O(\vec{p},\vec{n})^{17}F$(g.s.) transition, i.e., an odd-mass T = 1/2 mirror transition, both Gamow-Teller and Fermi amplitudes contribute to the cross section. The relative weighting of GT and F cross sections in 0° (p,n) spectra can be parameterized as a function of bombarding energy in the 50 – 200 MeV region as

$$\frac{\sigma_{\mathrm{GT}}/\mathrm{B(GT)}}{\sigma_{\mathrm{F}}/\mathrm{B(F)}} = \left(\frac{E_p}{E_o}\right)^2 \equiv R^2 \tag{1}$$

where $E_o$ = 55 MeV was empirically determined for even mass nuclei.[1] $D_{NN}$ measurements for the $^{17}O(\vec{p},\vec{n})^{17}F$(g.s.) were motivated due to the unexpected determination of $E_o$ = 45 MeV for odd-mass nuclei.[2] Transverse polarization-transfer measurements yield direct determinations of the relative weighting of the GT and F contributions. Therefore, $D_{NN}$ measurements will allow an independent check on the aforementioned empirical relationship.

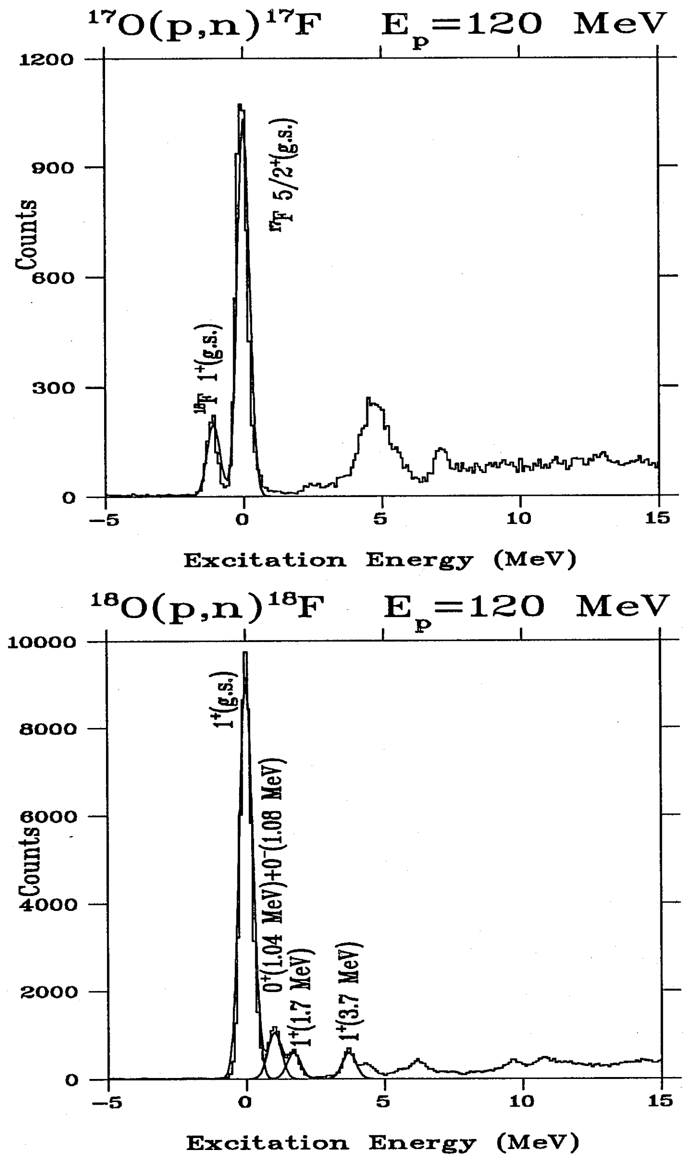


*Figure 1.* The 0° spectra for the $^{17,18}O(\vec{p},\vec{n})^{17,18}F$ reactions at $E_p = 120$ MeV are shown. The peak located to the left of the $^{17}O(\vec{p},\vec{n})^{17}F$(g.s.) is *contamination* from $^{18}O$. The $^{17}O(\vec{p},\vec{n})^{17}F$ (g.s.) peak also contains *contaminations* from low lying states from $^{18}O$(p,n).

We are interested in using $D_{NN}$ from the $^{18}O$(p,n) reaction to extract the cross section to the $0^-$ state at 1.08 MeV in $^{18}F$. The IAS cross section to the 1.04 MeV state may include some contribution from the $0^-$ state. Because these two states are only 40 keV apart, we cannot hope to differentiate them with our 500 keV energy resolution. However $D_{NN}$ is +1 for the IAS and –1 for the $0^-$ state. Thus we can use a $D_{NN}$ measurement to check the DWIA prediction of a 10% yield due to the $0^-$ state. Separation of these two states is of particular interest because it has a direct implication for determining the ratio of the interaction strengths $J_{\sigma\tau}/J_\tau$

$$\frac{\hat{\sigma}_{\rm GT}}{\hat{\sigma}_{\rm F}} = \frac{\sigma_{\rm GT}(\rm q=0)}{\sigma_{\rm F}(\rm q=0)}\frac{\rm B(F)}{\rm B(GT)} \equiv R^2 = \left(\frac{E_p}{55}\right)^2 \tag{2}$$

$$\hat{\sigma}_\alpha = K(E_p)N_\alpha^D|J_\alpha|^2 \quad \alpha = \rm GT, F \tag{3}$$

where $K(E_p)$ and $N_\alpha^D$ are the kinematic factor and the distortion factor, respectively.

The experiment was performed at the Neutron-Time-of-Flight (NTOF) facility using a pressurized gas cell filled with oxygen: $^{17}O_2$ is a mixture of ($^{16}$O, 17.7 atom%), ($^{17}$O, 76.1 atom%), and ($^{18}$O, 6.2 atom%); $^{18}O_2$ is 99% $^{18}$O with a trace of $^{16}$O. The gas cell was previously used in a $^4$He experiment at IUCF,[3] and consists of a welded stainless steel box with 25-$\mu$m thick Havar entrance and exit foils clamped between window frames that are also welded. At room temperature, 7 atm of pressure was easily contained in the cell, giving about 50 mg/cm$^2$ of oxygen target thickness. An energy resolution of about 500 keV was achieved. A sample of the excitation energy spectra obtained for the $^{17,18}$O$(\vec{p},\vec{n})^{17,18}$F reactions are shown in Fig. 1.

A *preliminary* $D_{NN}$ value of $-0.1464 \pm 0.0345 \pm 0.0320$ was obtained for the $^{17}$O$(\vec{p},\vec{n})^{17}$F(g.s.), where the errors include both statistical and systematic uncertainties. This value was obtained after subtracting the $^{18}$O background. Calculating the $E_o$ parameter associated with our preliminary data gives a value of 49.87. A more detailed analysis of the data is progressing, with the hope of reducing systematic errors.

Extraction of the $0^-$ (1.08 MeV) state of the $^{18}$O(p,n)$^{18}$F transition has begun. A *preliminary* $D_{NN}$ value of $0.7263 \pm 0.0261 \pm 0.0568$ has been obtained for the $0^-$ and $0^+$ states combined. This $D_{NN}$ value suggests that 13.7% of the combined cross section is due to the $^{18}$O(p,n)$^{18}$F($0^-$) transition. This compares well with DWIA predictions of 10%. Preliminary $D_{NN}$ values for higher excitation energy states have been obtained. A $D_{NN}$ value of $-0.2338 \pm 0.0389 \pm 0.0418$ has been calculated for the $^{18}$O(p,n)$^{18}$F($1^+$, 1.7 MeV) transition, and a $D_{NN}$ value of $-0.3937 \pm 0.0602 \pm 0.0444$ has been obtained for the $^{18}$O(p,n)$^{18}$F($1^+$, 3.7 MeV) transition. We are in the process of comparing these results with DWIA calculations. Further analysis is expected to reduce both the statistical and systematic errors.


1. T.N. Taddeucci, *et al.*, Nucl. Phys. **A469**, 125 (1987); T.N. Taddeucci, *et al.*, Phys. Rev. C **25**, 1094 (1981).
2. Y. Wang, *et al.*, IUCF Sci. and Tech. Rep. May 1988 - April 1989, p. 6.
3. C.M. Edwards, *et al.*, Bull. Am. Phys. Soc. **37**, 1298 (1992)