been studied and compared with the experimental results. The M1 strength for ^{52}Cr has been calculated and compared with available results for (e,e′) and (p,p′) experiments. A comparison has been made with other $1f_{7/2}$ nuclei. This work is reported in Ref. 1.

1. D. Wang, et. al., The ^{52,54}Cr(p,n)^{52,54}Mn and ^{57,58}Fe(p,n)^{57,58}Co Reactions AT E_p = 120 MeV, Nucl. Phys. A **480**, 285 (1988).

GAMOW-TELLER MATRIX ELEMENTS AND THE (p,n) REACTION

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Nucleon charge exchange reactions, especially (p,n), have provided much information to enhance our understanding of nuclear structure and nuclear reactions. However, in spite of improved understanding, several features of existing data remain poorly understood. Two problems stand out in this respect – the missing Gamow-Teller strength, and fluctuation in the specific Gamow-Teller (GT) and Fermi (F) cross sections, that is, the cross sections per unit GT or F strength.

These problems, in a sense, represent only fine details, generally at the 20% discrepancy level and perhaps as bad as the 50% level in a few special cases. In fact, the (p,n) reaction has provided us with a very good overview of GT strength functions, clearly establishing the giant GT resonance as a general feature of nuclear structure. Furthermore, the (p,n) reaction is the only method presently known to provide quantitative, empirical information on transition matrix elements needed to estimate neutrino absorption cross sections for solar neutrino detectors.

The problem of specific cross sections is displayed in a recent published summary of our work[1]. Our present effort is aimed at attempting to understand the (p,n) cross sections with greater precision and to determine the limits to which the apparent proportionality between GT matrix elements and (p,n) cross sections can be exploited. In addition to the pure science aspect of this work there is an application. Bahcall[2] has pointed out that the uncertainty in inferring GT matrix elements from (p,n) cross sections now constitutes the major uncertainty in calculating neutrino absorption cross sections for proposed and existing solar neutrino detectors.

Our data base for calibrating (p,n) against beta decay is weakest for medium and heavy weight nuclei, where known GT matrix elements for transitions that are accessible to (p,n) are scarce, and cross sections for those transitions are small. The problem in making measurements for these nuclei is that we must measure cross sections for weak peaks on the tips of the wings of GT giant resonances where, in the normal method of cyclotron operation, the background from wraparound overwhelms the peak of interest. Since this background consists of real, low-energy, neutrons from (p,n) reactions in the target, there is no way to create an independent background run to use for subtraction. That leaves extrapolation of a smoothed background as the only way to subtract background.

Fortunately, the stripper loop solves the problem. It provides proton pulse separations greater than a microsecond, compared to about 30 or 120 ns separations in the more usual modes of operation. With the use of the stripper loop we have now succeeded in obtaining (p,n) spectra that are nearly free from background, and we are proceeding to apply the method to measuring weak GT transitions in medium and heavy nuclei.

Spin transfer measurements for mixed GT and F transitions contain important physics information[3]. Such measurements can be used to determine the relative GT and F contributions to the cross section without recourse to using beta decay ft values (that might not be available), and without the need to use a globally averaged parametrization of the relative weighting of the two types of transition in (p,n)[4]. In fact, comparison of the GT fractions deduced from spin transfer and those deduced from ft values and globally expected weightings might provide a needed clue to understanding the specific cross section problem. We expect to extend our measurements to the "simple" nuclei ^{17}O and ^{39}K this year.

Our detectors are now rebuilt, optimized for polarimetry in anticipation of a large-scale program to measure more general aspects of spin transfer. The proposed measurement will include the continuum region in the spectra, and, eventually, all othogonal spin orientations. In the course of the detector upgrade we found, somewhat to our surprise, that details of the light guide design have a measurable effect on position resolution. A design with parabolic reflecting surfaces yields better results than other designs tried. In actual operation the observed (not unfolded) FWHM is about 3% of the detector width. The geometric spread of the tracks in the data cuts is also close to that size, so the measurement does not directly determine the limiting resolution capability.

1. T.N. Taddeucci et al., Nucl. Phys. **A469**, 125 (1987).
2. J.N. Bahcall and R. K. Ulrich, Rev. Mod. Phys. (1988) to be published.
3. C.D. Goodman et al., Phys. Rev. Lett. **54**, 877, (1985).
4. T.N. Tadduecci et al., Phys. Rev. C **25**, 1094 (1982).

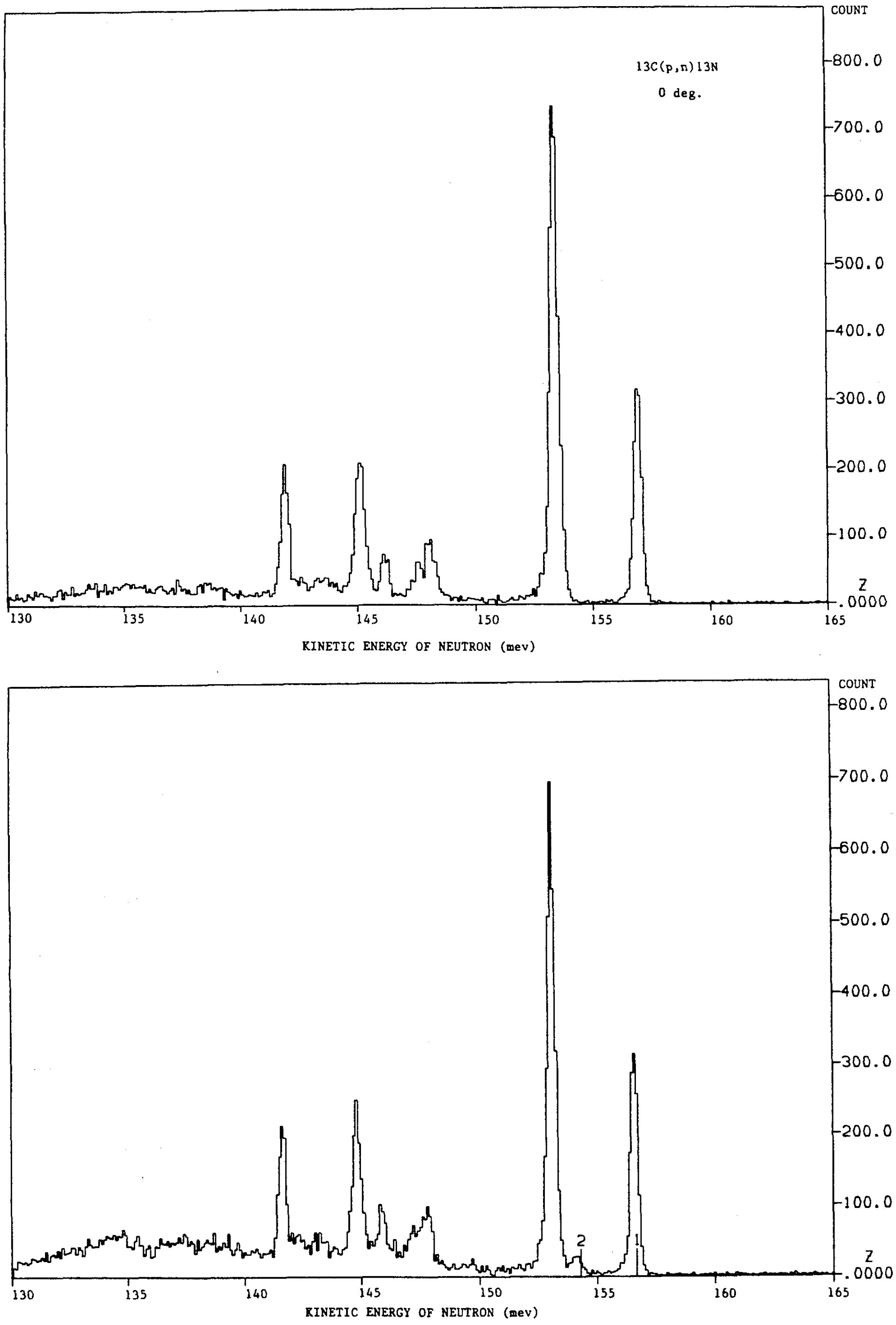

Figure 1. Neutron energy spectrum from $^{13}C(p,n)$. The upper spectrum is at 0° and the lower spectrum is at 5°. The small peak at neutron energy 154 MeV in the 5° spectrum is due to a $1/2^-$ to $1/2^+$ transition. In spectra obtained several years ago without the stripper loop, that peak was obscured by wrap-around background. The spectra shown here are taken with a low energy threshold on the neutron detectors and nothing has been subtracted.

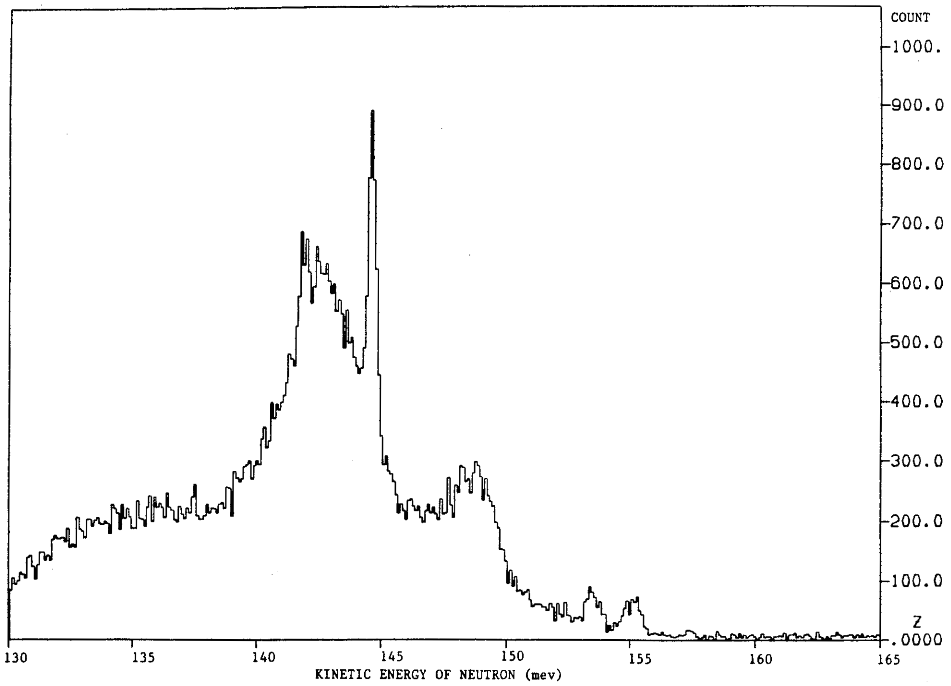

Figure 2. Neutron energy spectrum for ^{141}Pr(p,n) at 0°. The small peak at about 157 MeV is the ground-state transition whose inverse has been measured in beta decay. The spectrum was obtained with a beam current of 35 nA. The background at higher energy is due to cosmic rays that are not vetoed by a charged particle detector protecting most of the solid angle around the neutron detector. This background can be reduced to some extent by using higher threshold cuts in replay of the event mode data. The peak to background ratio can be improved linearly by increasing the beam current.