POLARIZATION TRANSFER D_{NN} MEASUREMENTS AT NON-ZERO ANGLES ON ^{39}K AND ^{19}F

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The purpose of experiment 339 is to investigate more generally the importance of the tensor force in (p,n) reactions by measuring polarization transfer as a function of scattering angle for selected cases that might also have relevance to the GT/F (Gamow-Teller/Fermi) cross section ratio. We started with targets ^{39}K and ^{19}F, both are odd-mass nuclei for which the GT strengths in the mixed GT and F mirror ground state transitions are known from beta decay. Also a polarization transfer measurement at zero degrees on these two nuclei has been successfully carried out in experiment 296.[1] The results[1,2] of the experiment 296 and 320 indicate that the GT/F cross section ratios are higher for odd-mass nuclei compared to those extracted from previous studies,[3] most of which were for even mass-nuclei. The cause of this difference is not understood. However, the possibility that this effect might be related to a contribution from the tensor force is being considered. The quantity D_{NN} is directly related GT/F ratio and sensitive to the contribution of the tensor force at non-zero degree angles. The results of DWIA calculations for these selected cases indicate that tensor force might play an important role in polarization transfer $D_{NN}(\theta)$ at angles in the range of 5° to 15°.

This experiment has progressed through two phases. In the first phase, using split beam (from CE-18) at $E_p = 186$ MeV, we tested our neutron spin rotating system along with our neutron polarimeter. The spin rotation is accomplished with a superconducting solenoid in the neutron flight path. The neutron polarimeter was placed at 71 m from the target along the zero degree flight path. The reversible superconducting solenoid has a sufficient field integral to rotate the neutron spin either +90° or −90°. This rotation is used to measure and cancel out false asymmetries that might be caused by geometrical misalignments, and unbalanced detection efficiencies for left and right scattering. Since the neutron spin itself is rotated the correction can be made properly even in the presence of a steep angular dependence of the cross section.

The polarimeter is constructed of 12 scintillation detectors, each $10 \times 15 \times 100$ cm^3. These are used in two planes, each with six detectors, and a charged particle paddle between the planes, to distinguish between n-p scattering events with the proton going forward and the neutron going forward.

We have constructed rotatable frames so that the detectors can be used either horizontally or vertically to optimize the figure-of-merit of the polarimeter. The point is that the position resolution along the length of the detector is about three centimeters, but the width of the bars is 15 centimeters, so there is an advantage to orienting the good resolution in the direction of the scattering asymmetry.

In the split beam run we used a ^{6}Li target, for which the ground state transition in the (p,n) reaction is a pure GT transition with $D_{NN}(0°) = -1/3$. We have previously measured $D_{NN}(0°)$ for that transition calibrated against the Fermi transition in ^{14}C(p,n) and found it to be suitable as a secondary standard. With cuts that might not be perfectly optimized but are good enough for the test, we found with horizontal detectors an effective analyzing power of the polarimeter of $A_E = 0.30 \pm 0.02$ for detecting up-down polarized neutrons and $A_E = 0.22 \pm 0.03$ for detecting sideways polarized neutrons. Thus, there seems to be an advantage to orienting the detectors in the appropriate direction.

In the second phase of the experiment where we were the primary user, we measured $D_{NN}(\theta)$ for ^{39}K, and ^{19}F at Lab. angles 0.0°, 5.0°, 9.0°, and 13.1° at E_p=160 MeV. The target ^{6}Li again was used to calibrate our neutron polarimeter. The BL2 low energy proton polarimeter, and the BL5 in-beam CD_2 high energy proton polarimeter were used to monitor the polarization of the proton beam. The calibration of the BL5 polarimeter carried out recently will help us to determine the polarization of proton beam with greater precision. The replay of data for this experiment 339 is still in progress, and is expected to be finished at end of this year.

1. W. Huang, Ph. D. dissertation, 1991.
2. Y.Wang, *et al.*, "Weak Interaction Matrix Elements and (p,n) Cross Sections," IUCF Scientific and Technical Report, 1991.
3. T. N. Taddeucci, *et al.*, Nucl. Phys. **A496**, 125 (1987).