STATUS OF AN INVESTIGATION OF THE ^{3}He WAVE FUNCTION BY QUASI-FREE SCATTERING

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Data acquisition for CE-25 was completed in the Spring of 1993 and the apparatus removed from the A-section shortly thereafter. Over the last year considerable effort has gone into data analysis and some of the preliminary results will be shown here. Detailed descriptions of the polarized ^{3}He target,[1,2] the detectors[3] and techniques[4,5] can be found in the given references and will be not be included in the following discussion. Papers about the techniques[6] and results[7] are in preparation.

The motivation for our measurements is an investigation of the ground state spin structure of the ^{3}He nucleus. This nucleus has the advantage that exact non-relativistic calculations using the Faddeev technique are available. These calculations indicate that the ground state of ^{3}He consists primarily of an S-state with the proton spins anti-aligned such that the neutron accounts for $\sim$ 90% of the polarization of the ^{3}He nucleus. The remainder of the wave function is dominated by the D-state and the mixed-symmetry S'-state. Recent measurements of the asymmetries in quasi-free knockout from polarized ^{3}He at TRIUMF[8,9] with incident proton energies of 220 and 290 MeV indicate considerable disagreement with plane wave impulse approximation (PWIA) calculations. CE-25 has explored a much wider range of kinematics by using large acceptance detectors and by covering a broader energy range, having taken measurements at 200, 300 and 415 MeV. As will be demonstrated below, this has allowed us to find regions where PWIA appears

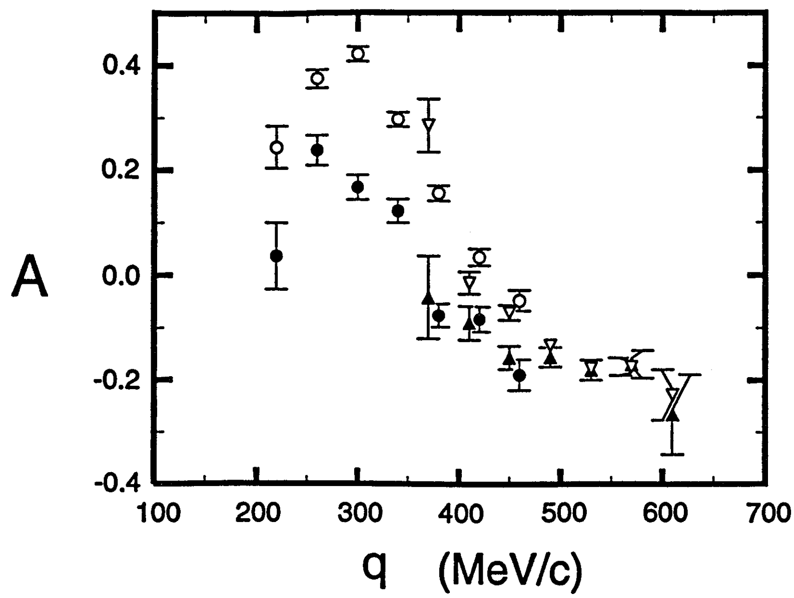

Figure 1. The target (filled symbols) and beam (open symbols) analyzing powers, A_t and A_b, respectively, for ^{3}He(p,pn) at $|p_m| < 100$ MeV/c as a function of $|\mathbf{q}|$. Data where the proton scattered to the right (left) detector and neutrons to the left (right) detector are indicated by circular (triangular) symbols.

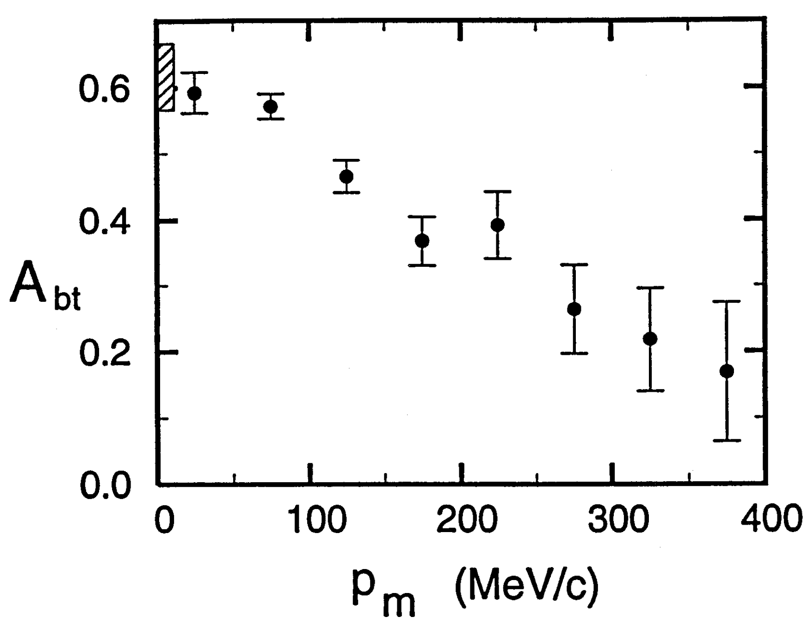

Figure 2. The spin correlation, A_{bt}, versus p_m for ^{3}He(p,pn) for $|\mathbf{q}|$ >500 MeV/c. The error bars reflect only the statistical errors. The shaded box in the panel at $p_m = 0$ indicates the range of PWIA predictions allowed by various phase shift solutions for the free observables.

to be valid and to verify that polarized ^{3}He can be used as an effective polarized neutron target in the proper kinematic regimes.

A wide range of reaction channels was detected in the apparatus, but for the purpose of testing the spin-dependent momentum distributions of the nucleons in polarized ^{3}He, the ^{3}He(p,pN) reaction is of primary interest. In PWIA one assumes that the incoming proton elastically scatters from a moving target nucleon and that the proton and struck nucleon escape the nucleus without further interactions. In this model the measured spin observables are given by the product of the free scattering spin observables and the polarization of the nucleons in ^{3}He. Since the free scattering spin observables are known, the polarization of the nucleons in ^{3}He can be extracted.

We present the ^{3}He(p,pn) spin observables versus the momentum transfer $\mathbf{q}$ and a kinematic variable known as the missing momentum, p_m. The missing momentum is the momentum carried away by the undetetected recoils calculated from the difference between the initial momentum of a beam particle and the total momentum of the two outgoing nucleons. In PWIA, p_m is identified with the initial momentum of the struck nucleon in the nucleus. Neutrons with p_m <100 MeV/c are expected from Faddeev calculations to have very close to 100% of the polarization of the ^{3}He nucleus. In Fig. 1 we show ^{3}He(p,pn) beam (A_b) and target (A_t) analyzing powers at a beam energy of 200 MeV versus the momentum transfer ($|\mathbf{q}|$) for p_m <100 MeV/c. If the corrections to the PWIA picture are small, ^{3}He should act as a good polarized neutron target and one would expect A_b to equal A_t. This is what is seen above $|\mathbf{q}|$ ~480 MeV/c. At lower $|\mathbf{q}|$, for example 370 MeV/c corresponding to the TRIUMF 220 MeV data, we see the same suppression of A_t with respect to A_b reported previously.[8,9] This can also be checked in the spin correlation data. Here one expects the low p_m data to agree with the free scattering value. In Fig. 2 we show ^{3}He(p,pn) spin correlation data, again at a beam energy of 200 MeV, versus p_m for $|\mathbf{q}|$ >500 MeV/c. At p_m=0 a shaded box is shown which represents the range of PWIA predictions for a number of phase shift solutions obtained from Arndt's SAID program. These values were generated from Monte-Carlo calculations which included the detector acceptance and momentum resolutions. Again the agreement is quite good.

Analysis of the 200 MeV data is nearly complete and our focus is now shifting to the completion of the other energies and reaction channels.

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