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VECTOR ANALYZING POWER IN THE ^{3}He($\vec{d}$, ^{3}He)np REACTION

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VECTOR ANALYZING POWER IN THE $^3He(\vec{d},{}^3He)np$ REACTION*

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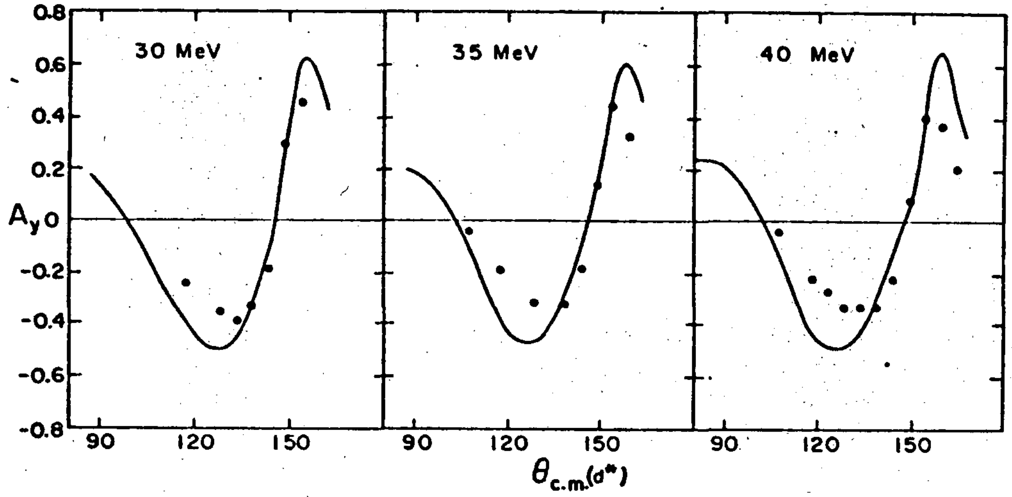
During the past decade, substantial investigations of polarization effects have been made in the three-nucleon system[1]. The polarization in nucleon-deuteron elastic scattering has received the principal attention of both the experimental and theoretical effort, while the study of such effects in the breakup reaction has received very little attention. The exact three-body calculations using the Faddeev equations have shown a remarkably good agreement with the proton and deuteron analyzing powers in p-d elastic scattering[1]. However, in the breakup channel the theoretical calculations[2] have been restricted to the use of nucleon-nucleon S-wave forces and, therefore, cannot predict any polarizations. Until recently experimental measurements of polarization effects in the breakup reaction had yielded values which were very small or consistent with zero[3]. The first evidence of significant polarizations was seen by Rad et al.[4,5] in their measurements of the vector analyzing power A_y for the transition to the np final state interaction (FSI) region. The $^1H(\vec{d},p)np$ and $^2H(\vec{p},p)np$ reactions, studied at the same center-of-mass energy, showed not only significant values of the vector analyzing powers, but also a definite similarity of its angular distribution with that of the elastic channel.

Since the spin structure of the deuteron breakup on ^3He and ^1H is the same, the nondynamical properties of the two reactions are identical. Thus, it is of interest to look for similar polarization effects in the $^3He(\vec{d},{}^3He)d^*$ reaction, where d* denotes final-state np pairs with low relative energy E_{np}, in both singlet and triplet states. We report here measurements of the vector analyzing power A_y in this reaction at E_d = 30, 35, and 40 MeV for E_{np} <2.0 MeV. Our results are shown in fig. 1. The statistical errors are smaller than the symbols. For comparison, the analyzing powers in $\vec{d}$-^3He elastic scattering at the same energies are shown as the smooth curves. It is seen that A_y in the $^3He(\vec{d},{}^3He)d^*$ reaction reaches substantial values and follows that of the elastic channel at d* production angles beyond 90° c.m. The peak values near $\theta_{cm} = 135°$ and 155° are quite constant in magnitude and position over the 10 MeV energy interval studied. In a comparison of our results with the previous measurements[4], near $\theta_{cm} = 135°$ the ratio A_y (elastic)/A_y (d*) is ≈ 3 in the $^3He(\vec{d}, d^*)\,{}^3He$ and $^1H(\vec{d}, d^*)\,{}^1H$ reactions respectively, and the ratio is ≈ 1.4 and ≈ 1.9, respectively, near $\theta_{cm} = 155°$. We are presently involved in a comparison of these data with DWBA calculations of $A_y(\theta)$ in transitions which produce both the $^1S_0$ and $^3S_1$ final state d*.



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