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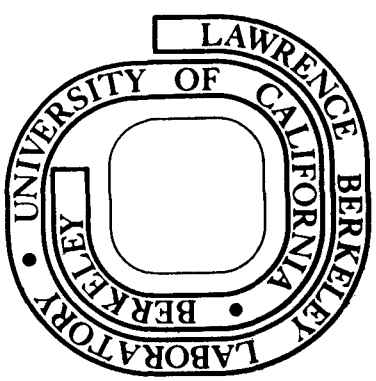

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THE VECTOR ANALYZING POWER IN ELASTIC DEUTERON-DEUTERON SCATTERING BETWEEN 20 AND 40 MeV*

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The subject of d-d elastic scattering has not received very much attention in the past. The cross sections are quite smooth functions of energy in the region up to 20 MeV where there are the most data available. However, the complexity of the spin structure and the low threshold for inelastic processes has made any meaningful phase-shift analysis impossible because of the large number of parameters involved even with the restrictive assumption of channel-spin conservation[1]. A resonating-group calculation[2] has obtained good agreement with the cross-section data between 5 and 20 MeV, but the use of a purely central nucleon-nucleon potential precludes the prediction of any spin-polarization observables.

From an experimental point of view, the polarization experiments in elastic d-d scattering have raised a qualitative question. Previous measurements of the vector analyzing power iT_{11} in $\vec{d}$-d scattering have been made at several energies below 12 MeV.[1,3] and at 21.4 MeV[4]. Non-zero but very small values of iT_{11} were obtained, reaching a maximum value of about 0.04 at 21.4 MeV. These values are almost an order of magnitude smaller than the nucleon and deuteron vector analyzing powers found in other elastic processes involving few nucleon systems, e.g. $\vec{p}$ + ^{2}H, ^{3}He, ^{4}He and $\vec{d}$ + ^{3}He, ^{4}He. Since sizable contributions of S, P, and D-waves were required to fit the d-d data[1,2], the rather insignificant polarization effects could not be explained as a consequence of a predominance of S-wave scattering. Thus, its reason remained unexplained.

We have extended the measurements of vector analyzing powers in $\vec{d}$-d scattering to 40 MeV to examine whether or not its anomalously small value persists at these higher energies. Also, another determination near 20 MeV was desired, since the older measurement at 21.4 MeV was rather uncertain because of lack of knowledge of the beam polarization. We used the axially injected vector-polarized deuteron beam from the Berkeley 88-Inch Cyclotron. Left-right asymmetry data were taken simultaneously at two angles separated by 20°, using pairs of ΔE-E silicon detector telescopes. A polarimeter, consisting of a gas target and a pair of ΔE-E counter telescopes, was placed downstream of the main scattering chamber and provided continuous monitoring of the beam polarization. The analyzer used was ^{4}He, whose vector analyzing power in $\vec{d}$-^{4}He elastic scattering has been measured in detail[5]. The differential cross section for vector-polarized deuterons is given by

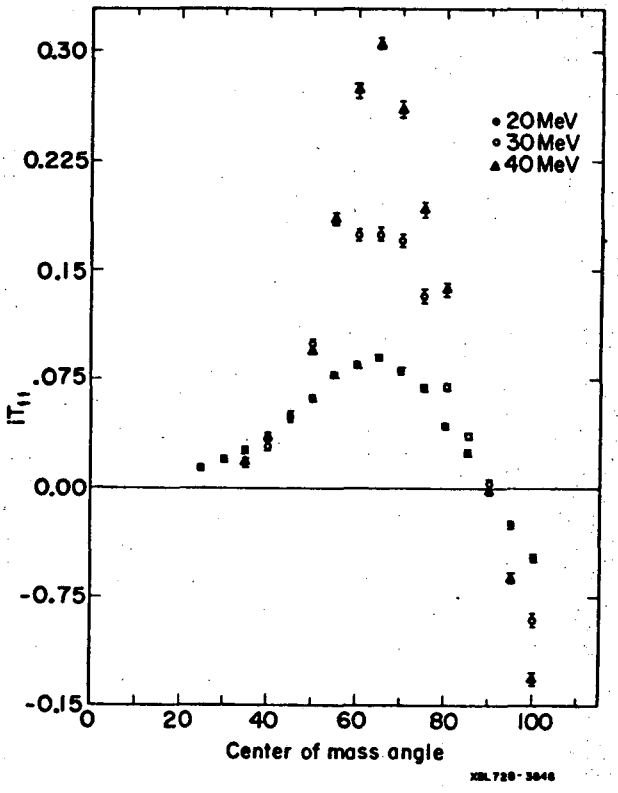
$$\sigma(\theta) = \sigma_o(\theta)\ [1 + 2\ (it_{11})\ (iT_{11})], \qquad (1)$$

where $\sigma_o(\theta)$ is the differential cross-section for unpolarized deuterons and it_{11} is the beam polarization. A left-right asymmetry measurement gives

$$\varepsilon(\theta) = 2\ (it_{11})\ (iT_{11}), \qquad (2)$$

and the simultaneous determination of the beam polarization yields the vector analyzing powers iT_{11}. Figure 1 shows our data at $E_{\vec{d}}$ = 20, 30,

and 40 MeV; the particle symmetry requires that $iT_{11}(\theta) = - iT_{11}(\pi-\theta)$. Our 20-MeV values are a factor of two larger than the previous results at 21.4 MeV, and clearly the vector analyzing powers increase rapidly with increasing energy. These values, when compared with the analyzing powers in $\vec{d}$-p elastic-scattering measured at comparable center-of-mass energies[6], can no longer be considered anomalously small.



References

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1) G. R. Plattner and L. G. Keller, Phys. Letters 30B, (1969) 327; P. D. Lien, Nucl. Phys. A178 (1972) 375; H. O. Meyer and P. Schiemenz, Nucl. Phys. A197 (1972) 259.

2) F. S. Chwieroth, Y. C. Tang, and D. R. Thompson, Nucl. Phys. A189 (1972) 1.

3) W. Grüebler, V. König, R. Risler, P. A. Schmelzbach, R. E. White, and P. Marmier, Nucl. Phys. A193 (1972) 149.

4) J. Arvieux, J. Goudergues, B. Mayer, and A. Papineau, Phys. Letters 22 (1966) 610.

5) H. E. Conzett, W. Dahme, Ch. Leemann, J. A. Macdonald and J. P. Meulders, Fourth Polarization Symp.

6) J. S. C. McKee, H. E. Conzett, R. M. Larimer and Ch. Leemann, Phys. Rev. Lett. 29 (1972) 1613.

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