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MEASUREMENT OF THE VECTOR ANALYZING POWER NEAR THE VALUE $A_y=1.00$ IN d-He ELASTIC SCATTERING

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THE VALUE $A_y \approx 1.0$ IN $d\text{-}^4\text{He}$ ELASTIC SCATTERING

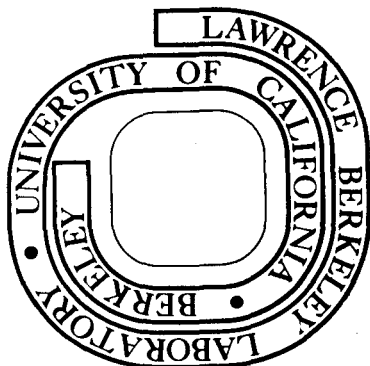
H. E. Conzett, F. Seiler, F. N. Rad,
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MEASUREMENT OF THE VECTOR ANALYZING POWER NEAR THE
VALUE $A_y \approx 1.0$ IN $d\text{-}^4\text{He}$ ELASTIC SCATTERING*

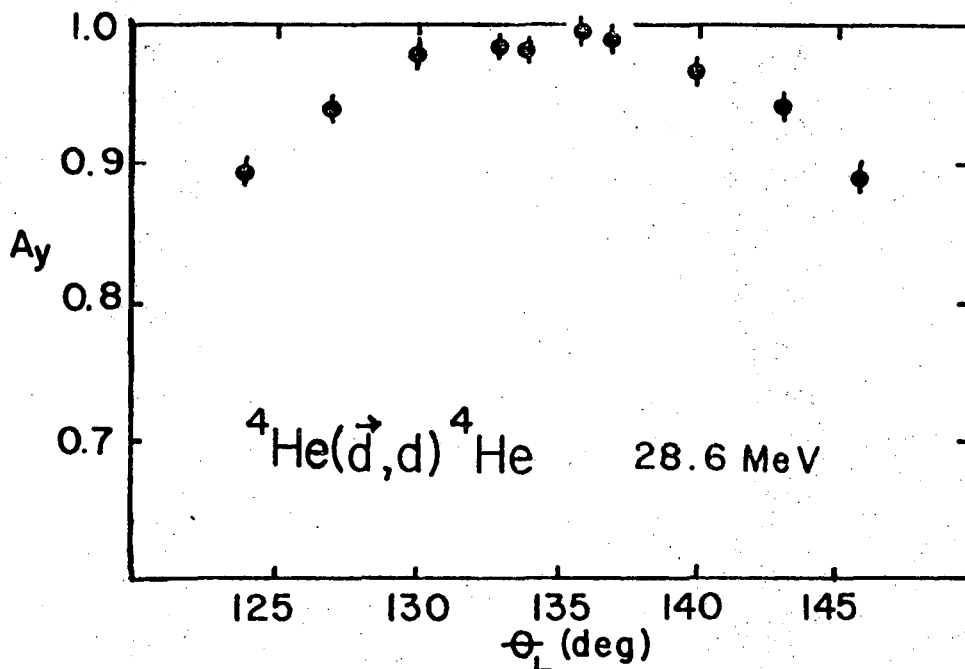
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Points in energy and angle (E, θ) at which a component of the analyzing power for spin-polarization reaches its theoretical maximum are of particular interest and importance. Experimentally, they provide valuable absolute calibrations. Theoretically, there exist at such points important conditions on, or relations among, the M-matrix amplitudes. As a consequence, other polarization observables are determined, and in reactions with particularly simple spin structure it is possible that all such observables are determined.

The simplest case is that with the spin structure $\frac{1}{2} + 0 \rightarrow \frac{1}{2} + 0$, for which it has been shown that points for which $A_y(E, \theta) = \pm 1$ do exist in $N\text{-}^4\text{He}$ and $^3\text{He}\text{-}^4\text{He}$ elastic scattering¹⁾. The resulting condition on the two M-matrix amplitudes f and g is that $g = \pm i f$, and the other polarization observable, the spin rotation angle, is determined. Similar investigations in $d\text{-}^4\text{He}$ elastic scattering ($1 + 0 \rightarrow 1 + 0$) have led to identification of points for which the tensor analyzing-power component $A_{yy} = 1$ (ref. 2). The corresponding linear relations among the M-matrix elements at points $A_{yy} = 1$ and $A_y = \pm 1$ have been given^{2,3)}, and it was shown²⁾ that $A_{yy} = 1$ is a necessary condition for the existence of a point of $A_y = \pm 1$. This latter result has now been proved to be valid more generally; that is, it is valid for all reactions with the spin structure $1 + a \rightarrow b + c$, where a , b , and c are arbitrary spins⁴⁾. Relations among, and determinations of, the other polarization observables have also been given for several reactions⁵⁾.

Since a point of $A_y = \pm 1$ for spin 1 is so unique and restrictive, and *a priori* perhaps so unlikely, the location and identification of such a point would be of considerable value. The best candidate for such a point was suggested in the measurements of $A(\theta)$ in $d\text{-}^4\text{He}$ elastic scattering between 15 and 45 MeV⁶⁾. There, values of $A(\theta_L = 135^\circ) \geq 0.97$ were found near 25 and 30 MeV. Therefore, we have examined this energy region to determine the maximum value of $A_y(E, \theta)$. The experimental details and the calibration procedures are described elsewhere⁶⁾. We find that A_y reaches its maximum value near 28.6 MeV, and we show in fig. 1 our preliminary results for $A_y(28.6 \text{ MeV}, \theta_L)$. Although finite geometry corrections and polynomial fits to all our data in this energy and angular region must be made before the maximum value of A_y is determined, it is clear from fig. 1 that A_y does indeed reach a value very close to unity near $\theta_L = 135^\circ$ at 28.6 MeV.

We have also measured $A_{yy}(E, \theta)$ over the same regions, using the $^4\text{He}(\vec{d}, d)^4\text{He}$ A_{yy} data of ref. 3 at 17 MeV for the determination of the tensor polarization of our beam. Again, our preliminary result is that A_{yy} reaches a maximum value approaching unity near 26.8 MeV and $\theta_L = 135^\circ$, as would be required to fulfill the necessary condition that $A_{yy} = 1$ at a point for which $A_y = 1$.



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References

- * Work performed under the auspices of the U.S. Energy Research and Development Administration.
- + On leave of absence from the University of Basel, Switzerland.
- † National Research Council of Canada Postdoctoral Fellow.
- 1) G. R. Plattner and A. D. Bacher, Phys. Lett. 36B (1971) 211.
- 2) W. Grüebler et al., Nucl. Phys. A242 (1975) 285.
- 3) G. G. Ohlsen et al., Phys. Rev. C 8 (1973) 1262.
- 4) F. Seiler, F. N. Rad and H. E. Conzett, Fourth Polarization Symp.
- 5) F. Seiler, Fourth Polarization Symp.; F. Seiler, H. E. Conzett, F. N. Rad and R. Roy, *ibid.*; F. Seiler, R. Roy, H. E. Conzett and F. N. Rad, *ibid.*; F. Seiler, F. N. Rad, H. E. Conzett and R. Roy, *ibid.*
- 6) H. E. Conzett et al., Fourth Polarization Symp.

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