

Lawrence Berkeley National Laboratory

Recent Work

Title

POLARIZATION IN p-He4 SCATTERING BETWEEN 27 AND 63 MeV

Permalink

<https://escholarship.org/uc/item/7h8470f4>

Authors

Boschitz, E.T.

Chabre, M.

Conzett, H.E.

et al.

Publication Date

1965-08-01

University of California
Ernest O. Lawrence
Radiation Laboratory

POLARIZATION IN $p\text{-He}^4$ SCATTERING BETWEEN 27 AND 63 MeV

TWO-WEEK LOAN COPY

*This is a Library Circulating Copy
which may be borrowed for two weeks.
For a personal retention copy, call
Tech. Info. Division, Ext. 5545*

Berkeley, California

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory
Berkeley, California

AEC Contract No. W-7405-eng-48

POLARIZATION IN $p\text{-He}^4$ SCATTERING BETWEEN 27 AND 63 MeV

E. T. Boschitz, M. Chabre, H. E. Conzett, E. Shield, and R. J. Slobodrian

August 1965

Paper presented at International Conference on Polarization Phenomena of
Nucleons, Kernforschungszentrum Karlsruhe, September 6-10, 1965.

POLARIZATION IN p-He⁴ SCATTERING BETWEEN 27 AND 63 MeV*E. T. Boschitz[†], M. Chabre[‡], H. E. Conzett, E. Shield, and R. J. SlobodrianLawrence Radiation Laboratory
University of California
Berkeley, California

Using the polarized-proton facility at the Berkeley 88-inch cyclotron, we have measured the asymmetries in the elastic scattering of polarized protons from ⁴He at energies of 26.8, 34.2, 44.1, 54.8, and 63.3 MeV. These energies were selected so that experimental results would then be available at approximately 5-MeV intervals over the region 10 to 63 MeV, the latter being the maximum energy available at this facility. With the beam polarization P_{\perp} known from experimental results, we then determined from the measured asymmetries $\epsilon(E, \theta)$ the polarizations $P(E, \theta) = \epsilon(E, \theta)/P_{\perp}$. A phase-shift analysis of these and other data available throughout this energy range has been started, and we report here preliminary results of this analysis.

Figure 1 shows our data along with those from the Rutherford Laboratory at 29, 40, and 48 MeV¹⁾ and 21-MeV data from Berkeley²⁾. The polarizations calculated from the phase-shift solutions are also shown. Available or interpolated differential cross-section data^{3,4)} were included in the analysis at all energies, although such data at 66 MeV were limited to c.m. angles forward of 60°. The 55-MeV polarization results show a continuation of the trend established with the lower energy data, and they are in substantial disagreement with the polarization calculated by Kanada and Horikawa⁵⁾ from phase shifts derived from analysis of 55-MeV differential cross section data⁴⁾. Their calculated $P(\theta)$ has three maxima, of values approximately +0.37, -0.77, and +0.93 near c.m. angles of 50, 95, and 125 degrees, respectively.

Figure 2 shows our preliminary phase-shift results. We use the notation $\eta_{\ell}^{\pm} \exp(2i\delta_{\ell}^{\pm})$ for the (complex) amplitude of the outgoing ℓ^{th} partial

wave, so that η_l^+ (η_l^-) and δ_l^+ (δ_l^-), the absorption parameter and nuclear phase shift for the $j = l + 1/2$ ($j = l - 1/2$) state, are real. The smooth curves show the general energy dependence of the δ_l^\pm , although the actual preliminary values show some scatter about these curves. Until further more complete searches are made, we do not ascribe physical significance to the slightly oscillatory behavior of δ_1^- and δ_2^- near and above 40 MeV. As is seen in the table listing the values of η_l^\pm , there are accompanying variations in these parameters in the same energy region. This behavior is not to be expected because all possible reaction thresholds occur at lower energies, and so a smoother behavior would be more plausible.

The arrows at 22.9 and 35.2 MeV in Fig. 2 mark the threshold for the first reaction channel, going to $d+^3\text{He}$, and the energy at which all channels are open, the last being the $3p+2n$ five-body channel. In this energy interval the absorption appears to be strongest in the $l = 2$ ($j = 5/2$) partial wave, with appreciable absorption also taking place in the $l = 1$ ($j = 1/2$) and $l = 3$ ($j = 7/2$) waves. We see no evidence of threshold effects, but data more closely spaced in energy would be required in order to study such questions.

We are grateful to A. W. Stetz for providing the computer program for phase-shift analysis and to W. F. Tivol for his considerable efforts in debugging and running the program.

FOOTNOTES AND REFERENCES

* This work was performed under the auspices of the U. S. Atomic Energy Commission.

† On leave from NASA Lewis Research Center, Cleveland, Ohio.

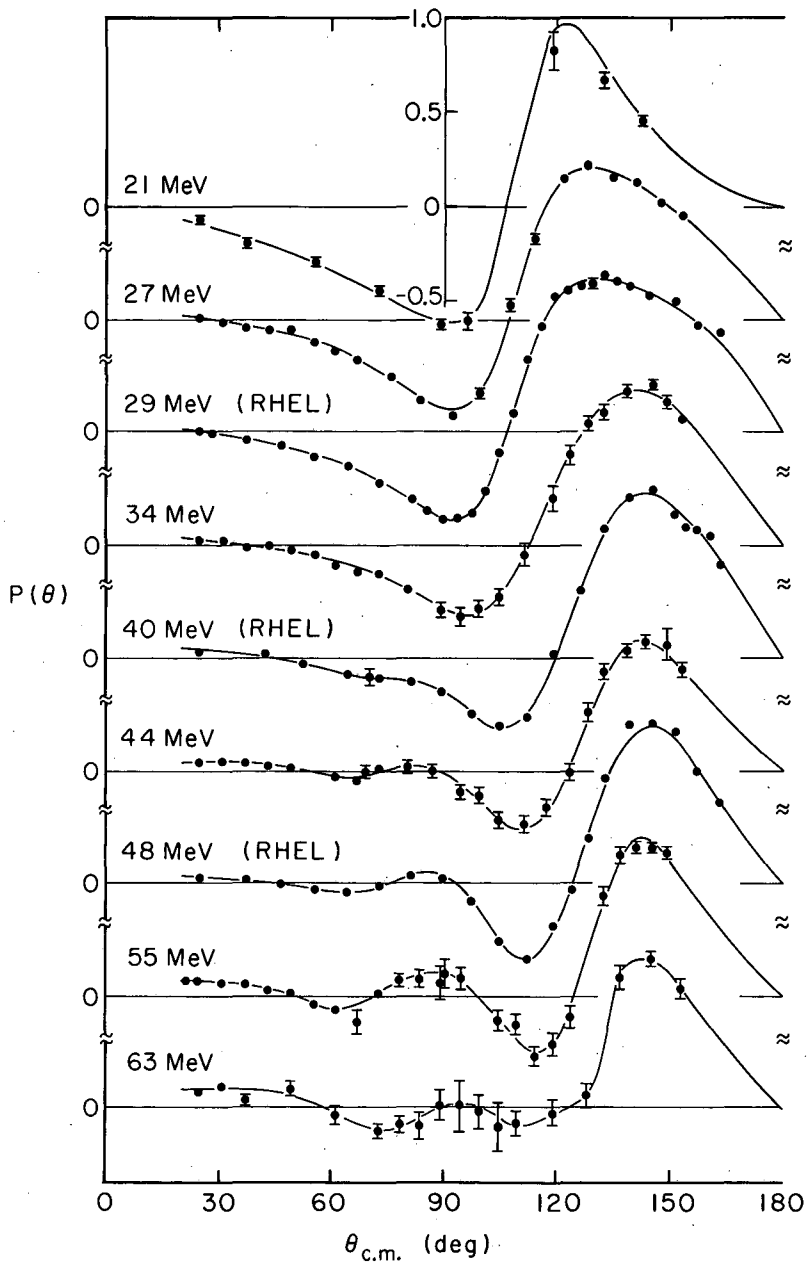
‡ NATO fellow on leave from CNRS, Institut Fourier, Grenoble, France.

1. M. K. Craddock, R. C. Hanna, L. P. Robertson and B. W. Davies, Phys. Letters 5, 335 (1963); P. L. A. Progress Report, NIRL/R/60, 44, 1963.
2. H. E. Conzett, G. Igo, and A. Nir, private communication.
3. P. W. Allison, Thesis, University of Colorado, 1964;
S. M. Bunch, H. H. Forster, and C. C. Kim, Nucl. Phys. 53, 241 (1964);
M. K. Brussel and J. Williams, Phys. Rev. 89, 422 (1953);
B. W. Davies, M. K. Craddock, R. C. Hanna, L. P. Robertson and R. E. Shamu, P. L. A. Progress Report, NIRL/R/81, 69, 1964;
A. M. Cormock, J. N. Palmieri, N. F. Ramsey and Richard Wilson, Phys. Rev. 115, 599 (1959).
4. S. Hayakawa, N. Horikawa, R. Kajikawa, K. Kikuchi, H. Kobayakawa, K. Matsuda, S. Nagata and Y. Sumi, J. Phys. Soc. Japan 19, 2004 (1964).
5. H. Kanada and N. Horikawa, Nagoya University, Physics Department Report T-5, March 1965.

FIGURE CAPTIONS

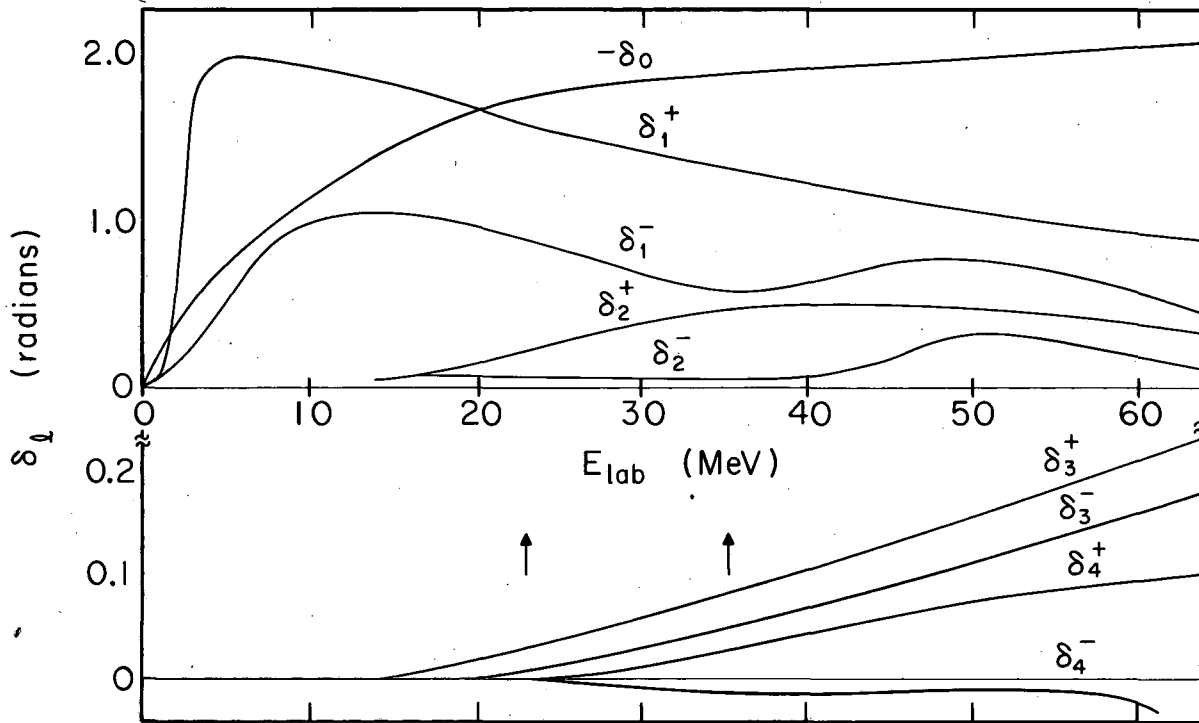
Fig. 1. Polarization $P(\theta)$ in p - ^4He elastic scattering. The dots are the experimental data (references in text). The curves represent values calculated in this analysis.

Fig. 2. Phase-shift parameters from preliminary analysis of the data. The symbols are defined in the text.



MUB-7490

Fig. 1



	E (MeV)	27	30	34	40	44	48	55	63
Absorption parameters	η_0	1.00	1.00	1.00	0.92	0.99	0.94	1.00	0.96
	η_1^+	1.00	0.99	1.00	0.99	0.77	0.95	0.75	0.97
	η_1^-	0.92	0.94	0.97	0.90	0.84	0.92	0.84	0.81
	η_2^+	0.91	0.85	0.82	0.77	0.85	0.97	1.00	0.88
	η_2^-	1.00	1.00	1.00	0.80	0.78	0.85	0.86	0.92
	η_3^+	0.98	0.94	0.72	0.84	0.71	0.71	0.77	0.78
	η_3^-	1.00	1.00	0.97	0.92	0.83	0.92	0.85	0.67
	η_4^+	0.93	0.96	1.00	0.96	0.99	0.99	0.99	0.99
	η_4^-	1.00	0.98	0.98	1.00	0.89	0.93	0.98	0.98

MUB-7491

Fig. 2

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

- A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
- B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

[The page contains extremely faint and illegible text, likely bleed-through from the reverse side of the document.]

