

Lawrence Berkeley National Laboratory

Recent Work

Title

POLARIZATION OF NEUTRONS PRODUCED BY BOMBARDING TARGETS WITH 285 MeV
POLARIZED PROTONS

Permalink

<https://escholarship.org/uc/item/57q9v78g>

Authors

Bradner, Hugh
Donaldson, Robert.

Publication Date

1954-07-12

UNIVERSITY OF
CALIFORNIA

*Radiation
Laboratory*

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

Radiation Laboratory

UNCLASSIFIED

Contract No. W-7405-eng-48

POLARIZATION OF NEUTRONS PRODUCED BY BOMBARDING

TARGETS WITH 285 MEV POLARIZED PROTONS

Hugh Bradner and Robert Donaldson

July 12, 1954

Berkeley, California

POLARIZATION OF NEUTRONS PRODUCED BY BOMBARDING
TARGETS WITH 285 MEV POLARIZED PROTONS

Hugh Bradner and Robert Donaldson

Radiation Laboratory, Department of Physics,
University of California, Berkeley, California

July 12, 1954

Polarized neutrons have been produced by quasi-elastic scatter of polarized protons on the nucleons of carbon, beryllium, and lithium targets.

The polarized proton beam was obtained by scattering the cyclotron beam on an internal beryllium target, using the arrangement of Chamberlain et al¹. This resulting proton beam had a polarization of 65 ± 3 percent, a mean energy of 285 Mev, and a flux of approximately 10^5 protons per second in the "cave" outside the cyclotron shielding.

When targets were bombarded by these polarized protons, neutrons (and protons) were ejected by nucleon-nucleon collisions. The neutrons were counted in 180° center-of-mass coincidence with their recoil protons, and only recoil protons of greater than $0.7 E_0 \cos^2 \theta$ energy were accepted. Thus only quasi-elastic proton-neutron events were recorded. One telescope subtended a solid angle of approximately $1/200$ ster. but the other needed to subtend $1/10$ ster. to give good counting rates for some of the data.

The telescopes used for recording proton-neutron events could also be used for recording proton-proton events.

¹ O. Chamberlain, E. Segrè, R. Tripp, C. Wiegand, and T. Ypsilantis, Phys. Rev. 93, 1430 (1954).

Alignment of the apparatus was checked by measuring the asymmetry of double scattered protons as in the experiment of Chamberlain et al¹. Our data were found to agree within statistical errors with their results.

It can be shown² that a left-right asymmetry in the counting rate of neutrons can be related to the polarization P_p of the incident proton beam and the polarization P_n of the neutrons by the usual equation

$$e = (L-R)/(L+R) = P_p P_n,$$

where e is the asymmetry, and L and R are the neutron counting rates at equal scattering angles to the left and right. In the present experiment this gives $P_n = e/0.65$.

Figures 1 and 2 give the quasi-elastic asymmetry, e , for neutrons from carbon, beryllium, and lithium targets. For angles greater than 90° center-of-mass the neutrons were defined by the telescope with poor angular resolution.

It should be noted that the non-zero neutron polarization at 90° center-of-mass indicates⁴ the presence of both odd and even terms in the scattering analysis. A subsequent experiment by Chamberlain et al³ using a liquid deuterium target gives results in good agreement with our data on carbon.

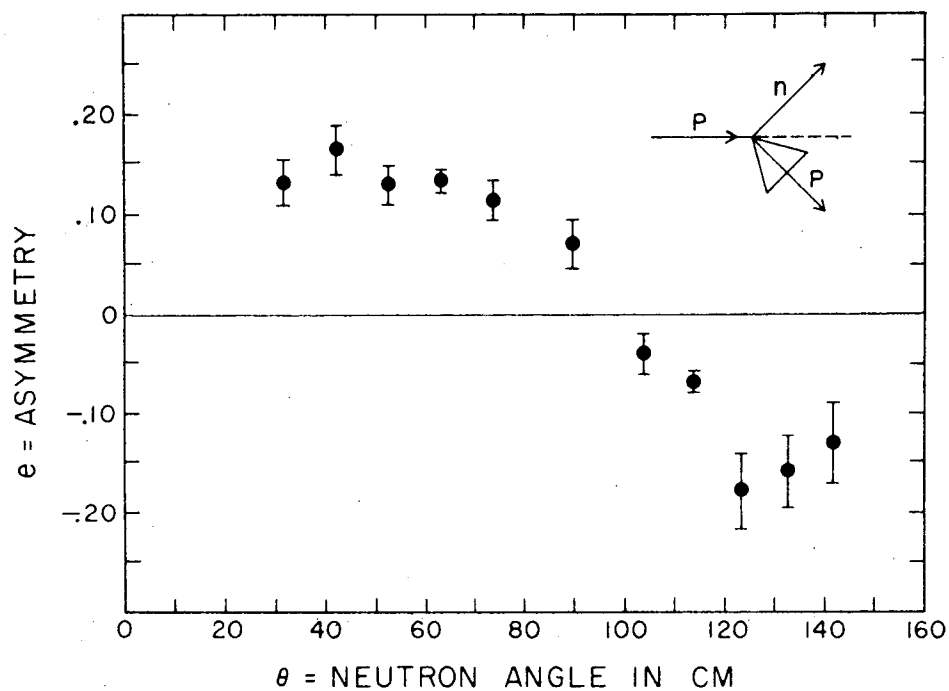
Figure 3 shows the asymmetry of quasi-elastic proton-proton scatters in carbon, obtained at the same time as the neutron data.

This work was done under the auspices of the Atomic Energy Commission.

² M. Ruderman, private communication.

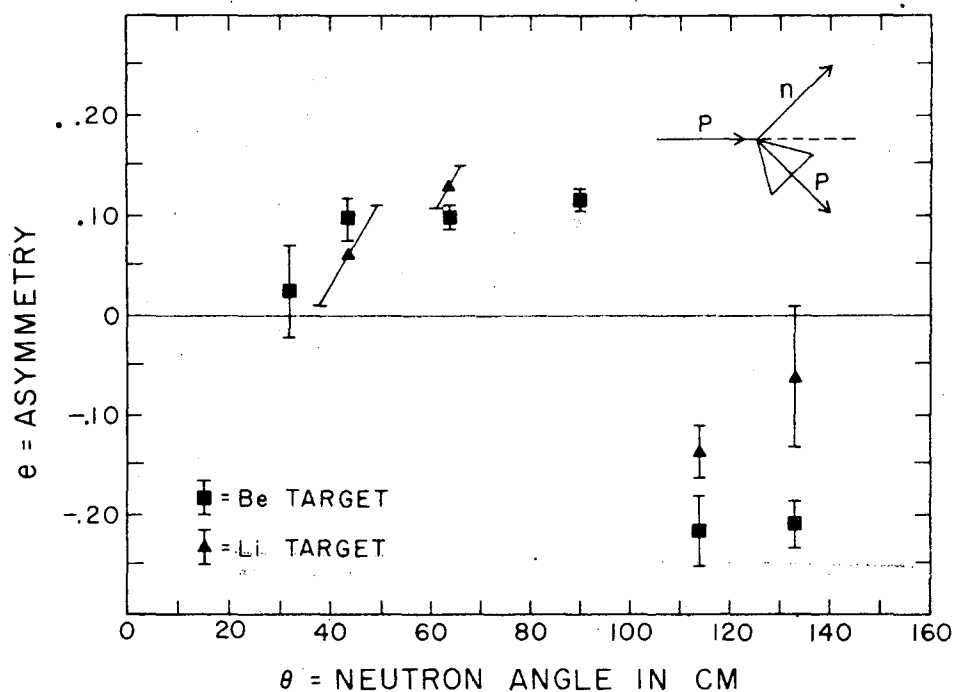
³ O. Chamberlain, R. Donaldson, E. Segrè, R. Tripp, C. Wiegand, and T. Ypsilantis, Phys. Rev., to be published.

⁴ Don R. Swanson, Phys. Rev. 84, 1086 (1951).



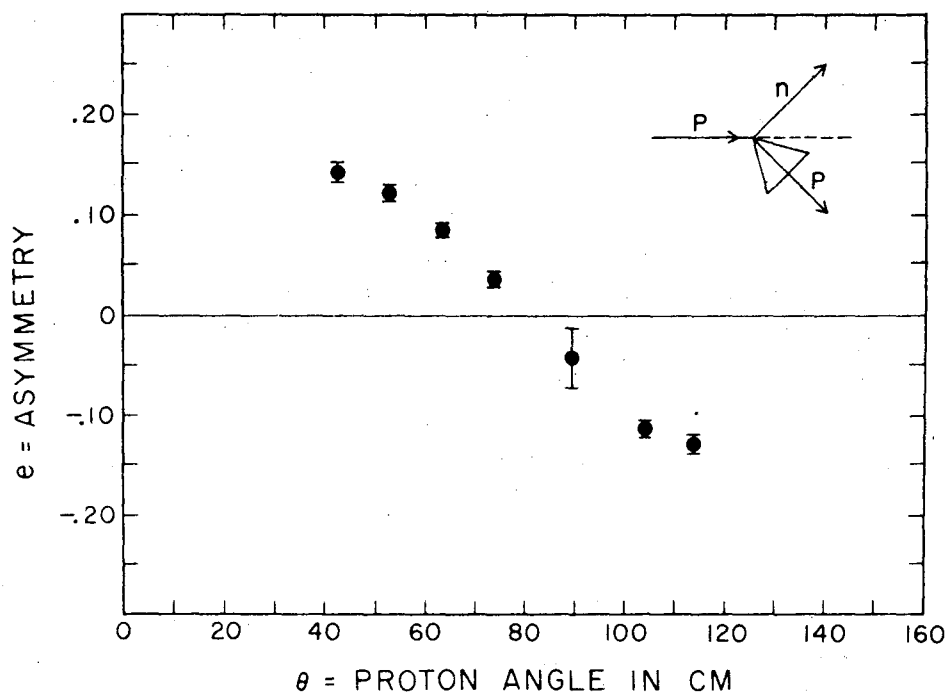
MU-7789

Fig. 1 Asymmetry e plotted as a function of the center-of-mass neutron angle for proton-neutron quasi-elastic scattering off carbon. The errors shown include only counting statistics.



MU-7788

Fig. 2 Asymmetry 3 plotted as a function of the center of mass neutron angle for proton-neutron quasi-elastic scattering off lithium and beryllium. The errors shown include only counting statistics.



MU-7787

Fig. 3 Asymmetry e plotted as a function of the center-of-mass proton angle for the proton-proton quasi-elastic scattering off carbon. The errors shown include only counting statistics.