Title
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May 9, 1951

Berkeley, California

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Previous workers have observed portions of the diffraction patterns in elastic scattering of 14[1] and 90[2] Mev neutrons by nuclei. An experiment is now underway at this laboratory to investigate the elastic scattering of 340 Mev protons.

The DeBroglie wavelength of 340 Mev protons is appreciably less than nuclear radii, and because of this it is possible to observe a greater portion of the Fraunhofer diffraction pattern than has hitherto been observed.

The bombarding energy in this experiment is much larger than the coulomb barrier energies of the target nuclei. Rutherford scattering is therefore important only at very small angles. The use of protons makes possible selection of a very small energy interval, which could not be done in the neutron-nucleus experiments[1,2].

Incident protons are provided by the external beam of the 184-inch synchro-cyclotron, removed from the orbit by scattering into a magnetic deflecting channel[3]. Scattered protons are detected by a triple-coincidence, scintillation counter telescope placed 48 inches from a thin scatterer. The photomultiplier signals are clipped, amplified, and limited; then coincidences are made in a coincidence circuit of approximately 2×10^{-8} seconds resolving time. Elastically scattered protons are selected by inserting a copper absorber between the second and third phosphors of such thickness that only protons of energy greater than 330 Mev may be detected. The detection threshold for the Carbon and Aluminum curves was 315 Mev.

Diffraction patterns are shown in Figures 1 - 5 for the elements so far measured.

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1 Amaldi, Bacciarelli, Cacciapuoti, and Trabacchi, Nuovo Cimiento 3, 15-21, 203 (1946).
2 A. Bratenahl, S. Fernbach, R. H. Hildebrand, C. E. Leith, B. J. Moyer, Phys. Rev. 77, 597-605 (1950)
3 C. E. Leith, Phys. Rev. 78, 89 (1950).

The curves drawn for C, Cu and Pb are the predictions of the transparent nucleus theory[4] neglecting coulomb effects and using constants which fit the neutron results. The errors shown are the usual standard deviations based upon counting statistics. Further calibration is underway to detect any possible systematic errors.

The lack of sharp minima may be attributed to the finite angular resolution and to "smearing out" due to nuclear transparency[4]. It is noteworthy that, while the angular resolution is the same for all data shown, the smearing is greater in the lighter elements. The transparency effect is expected to be a smooth function of mass number.

Further experiments are contemplated with much improved angular resolution in order to look for any dissimilarities in the patterns from adjacent nuclei whose spins are know to differ appreciably.

This work performed under the auspices of the Atomic Energy Commission.

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[4] Fernbach, Serber, Taylor, Phys. Rev. 72, 1007 (1947).

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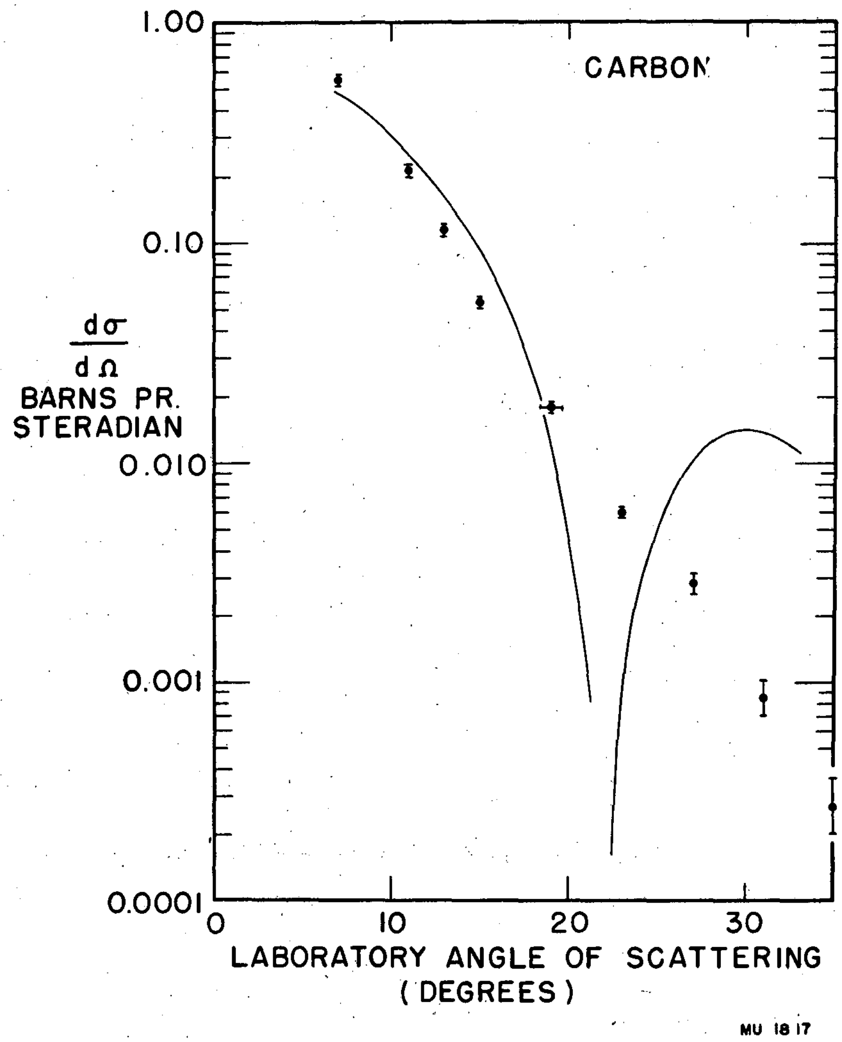
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0.10
0.010
0.001
0.0001
$\frac{d\sigma}{d\Omega}$
BARNS PR.
STERADIAN
0
10
20
30
LABORATORY ANGLE OF SCATTERING
(DEGREES)
MU 18 17

Fig. 1

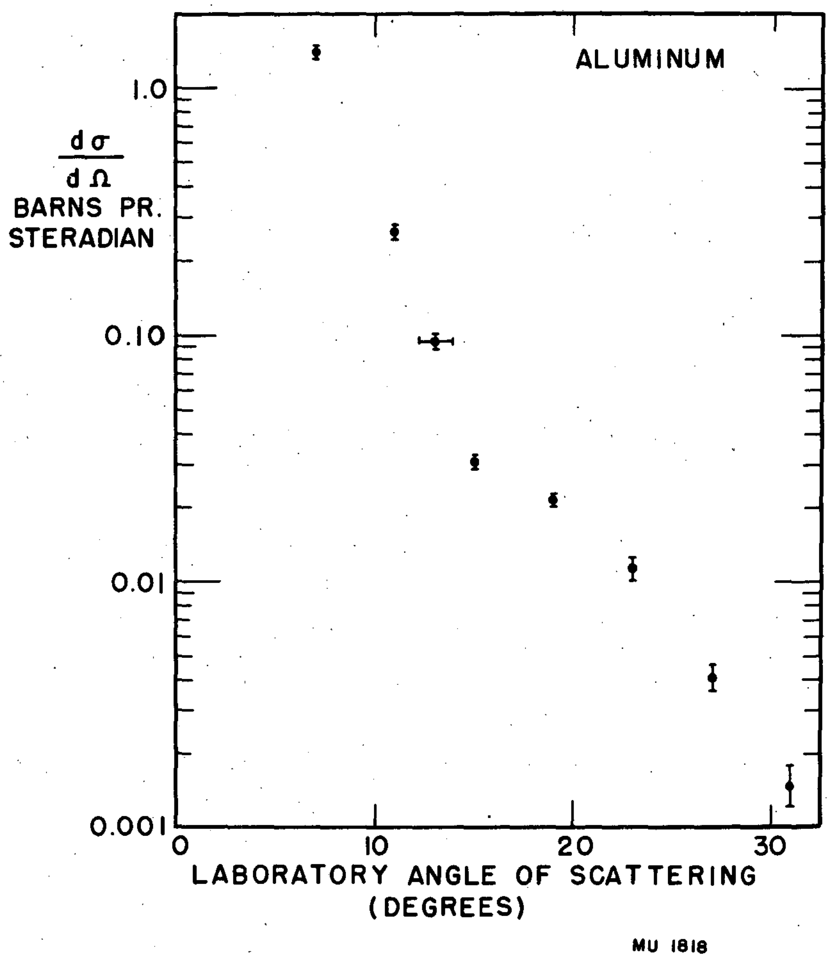
ALUMINUM
1.0
0.10
0.01
0.001
$\frac{d\sigma}{d\Omega}$
BARNS PR.
STERADIAN
0
10
20
30
LABORATORY ANGLE OF SCATTERING
(DEGREES)
MU 1818

Fig. 2

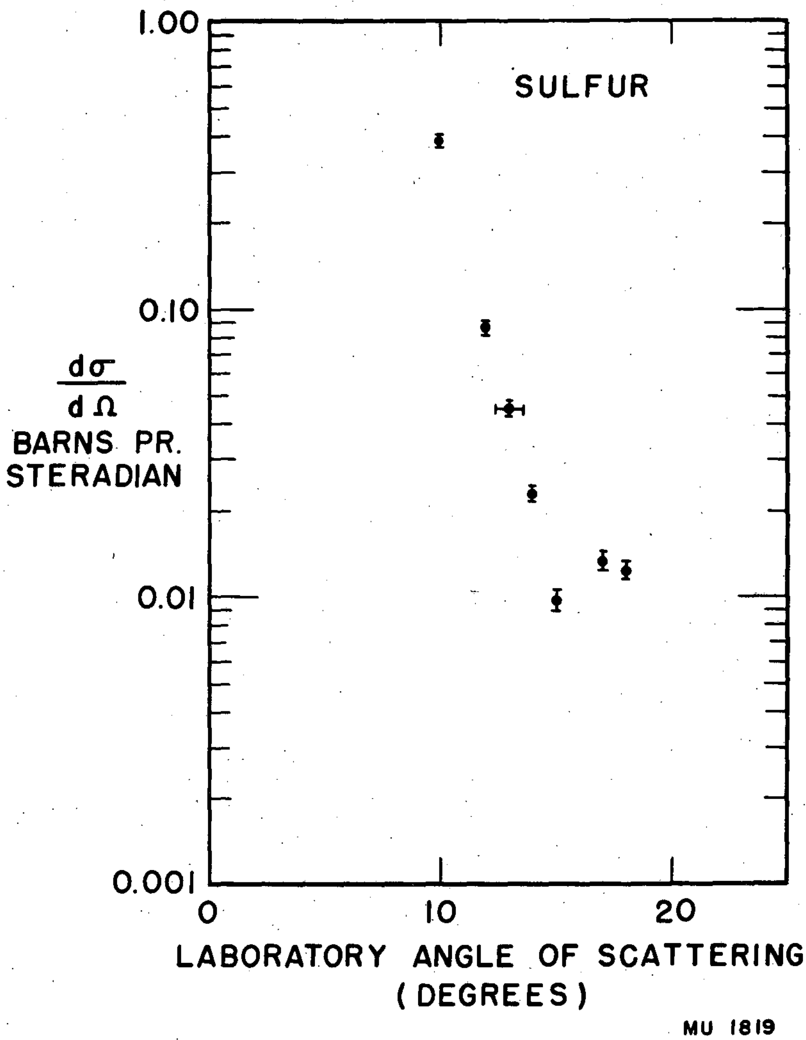
1.00
0.10
0.01
0.001
SULFUR
dσ / dΩ
BARNS PR.
STERADIAN
0
10
20
LABORATORY ANGLE OF SCATTERING
(DEGREES)
MU 1819

Fig. 3

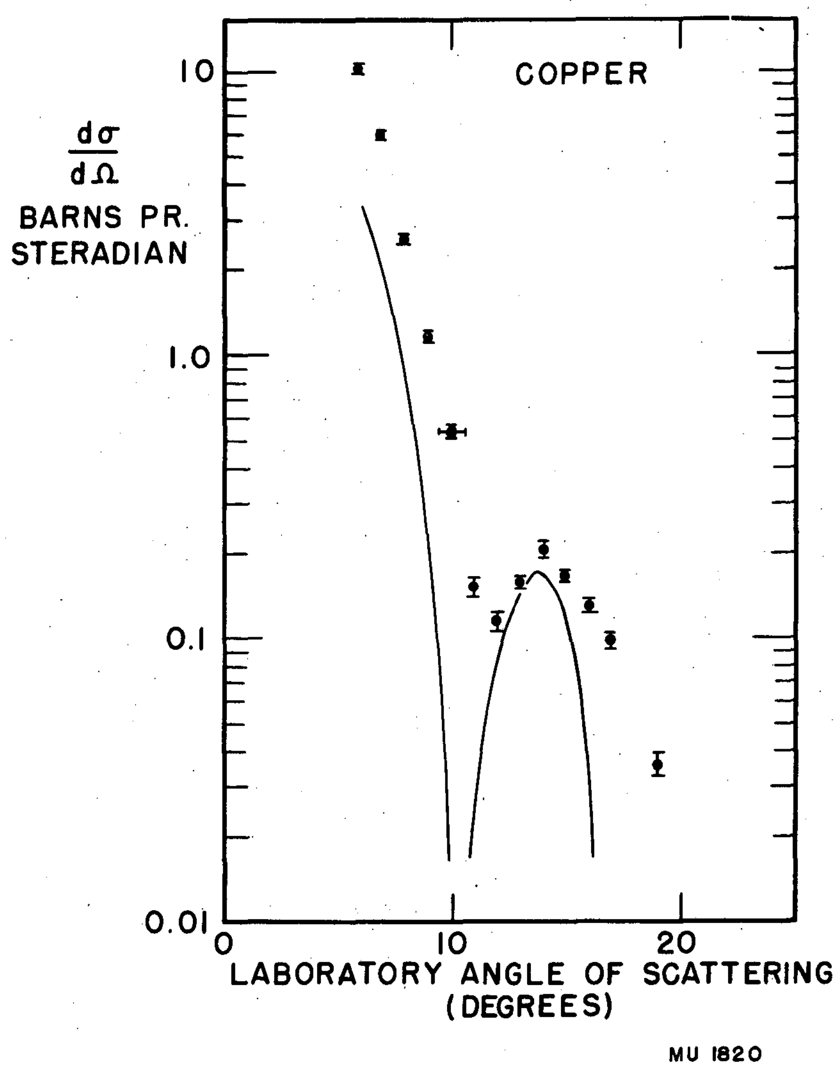
COPPER
$\frac{d\sigma}{d\Omega}$
BARNS PR.
STERADIAN
10
1.0
0.1
0.01
0
10
20
LABORATORY ANGLE OF SCATTERING
(DEGREES)
MU 1820

Fig. 4

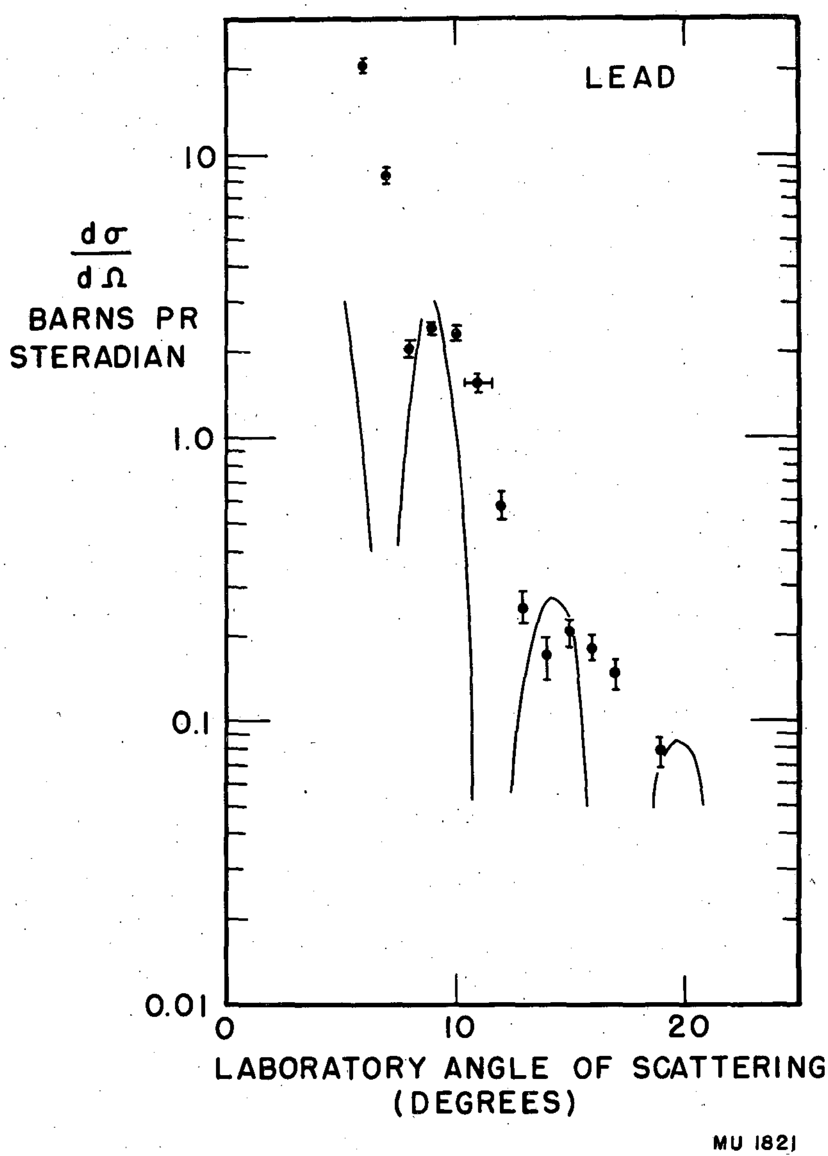
LEAD
10
1.0
0.1
0.01
dσ/dΩ
BARNS PR
STERADIAN
0
10
20
LABORATORY ANGLE OF SCATTERING
(DEGREES)
MU 1821

Fig. 5