LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the eighteenth of the preceding month, for the second issue, the third of the month. Because of the late closing dates for the section no proof can be shown to authors. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Communications should not in general exceed 600 words in length.

The Scattering of Neutrons by Deuterons

The angular distribution of 328 tracks of recoil deuterons has been studied. These tracks have been selected from one thousand tracks measured on 3000 photographs, which were taken with the aid of an expansion chamber. The chamber was filled with 54.3 percent deuterium, 37 percent argon, 6 percent nitrogen, and 2.7 percent heavy water vapor; this mixture was bombarded with neutrons of 2.6 Mev energy from the deuteron-deuteron reaction. The criterion for selecting the above tracks was established by using: (1) the calculated stopping power of the gas mixture, (2) the pressure variation within which tracks can form, (3) the energy-range relationship for deuterons,[1] and (4) the energy variation in the neutrons caused by (a) loss of energy of the incident deuteron beam in the thick heavy-ice target and (b) the angular aperture of the detector. To these selected tracks have been applied the necessary azimuthal, area, and random track corrections, in a manner similar to that used in the study of the scattering of neutrons by protons.[2]

The results are given in Table I and Fig. 1.

TABLE I. *Observations on the distribution and angle of the recoil deuterons bombarded with neutrons. $\Delta\phi$ is the scattering angle interval. N is the number of tracks observed in each $\Delta\phi$. C is the total correction factor. N_c is the number of tracks, corrected. $N_c/(\Delta\omega\cdot\Delta\phi)$ is the number of tracks per unit solid angle per unit $\Delta\phi$. $\%/(\Delta\omega\cdot\Delta\phi)$ is the relative number of tracks per unit solid angle per unit $\Delta\phi$.*

$\Delta\phi$	N	C	N_c	$N_c/(\Delta\omega\cdot\Delta\phi)$	$\%/(\Delta\omega\cdot\Delta\phi)$
0–9	17	3.2	55	7050	25
10–19	31	3.3	102	4600	16
20–29	38	3.5	132	3310	12
30–39	47	2.4	114	2280	8
40–49	53	3.0	158	2525	9
50–59	69	3.6	247	3470	12
60–69	54	5.2	281	3560	13
70–79	18	6.7	121	1447	5

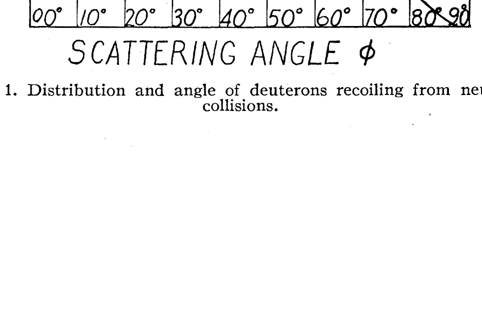

FIG. 1. Distribution and angle of deuterons recoiling from neutron collisions.

Although these results are based on a small number of tracks (328), the data indicate that there is present a marked deviation from spherically symmetrical scattering in the center of mass system. More data are needed before the precise shape and size of the peak in the curve (cf. Fig. 1) at scattering angle $\phi=60°$ can be determined.

The marked departure from S scattering in this experiment can possibly be explained in three ways. Massey and Mohr,[3] assuming a rectangular potential hole of radius 4×10^{-13} cm and one of 6×10^{-13} cm, obtained curves which are not far different in shape from our curve, except at small angles. Their calculations include 1 Mev and 6.25 Mev neutrons and take into account P scattering. It seems likely that the choice of a different potential hole with further regard for the structure of H^3 [4] might allow agreement with this experiment. A second possibility,[5] to account for the marked difference from S scattering and the scattering predicted by Massey and Mohr at the small angles (0°–20°), would be to include the effect of a polarization of the deuteron by the incident neutron. A third possibility is to include higher orders of partial waves in the description of the scattered neutron wave.

From the stopping power of the gas in the chamber, the range-energy relation, and the maximum track length extrapolated in the usual way in the scattering angle intervals 0°–10°, 0°–20°, 0°–30°, the range of a recoil deuteron at 0° scattering angle has been calculated. This has been used to determine the disintegration energy Q for the reaction

$$_1D^2+{}_1D^2\rightarrow{}_2He^3+{}_0n'+Q$$

and leads to a value of $Q=3.40\pm0.10$ Mev. This value, because it is based on deuteron recoil atoms, is an independent check on the value recently given by Bonner,[6] and agrees very well.

A more complete description of this experiment will be ready for publication shortly.

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[2] P. Gerald Kruger, W. E. Shoupp, and F. W. Stallmann, Phys. Rev. **52**, 678 (1937).
[3] H. W. S. Massey and C. B. O. Mohr, Proc. Roy. Soc. **148A**, 206 (1935).
[4] L. I. Schiff, "Scattering of Neutrons by Deuterons," Phys. Rev. **52**, 149 (1937).
[5] This idea was suggested by Dr. J. H. Bartlett, Jr.
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