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. 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

Emission of Neutrons from Chlorine and Argon Under Alpha-Particle Bombardment

In some recent experiments in this laboratory[1] it was established that A^{40} does not emit protons when bombarded by Th C′ alpha-particles. It seemed likely that if the emission of protons is energetically not favored, the emission of neutrons might, for the same reasons, be favorable. Accordingly we set up an ionization chamber filled with boron trifluoride,[2] surrounded by paraffin and connected to a linear amplifier as a neutron detector. We placed a Th C′ source (average strength 1.5 mc) at the center of a flask which could be evacuated or filled with argon and found that on admitting argon the counts rose from 2 per minute to 20 per minute, corresponding to 18 per minute due to argon. This is to be compared with roughly 6 per minute from nitrogen under the same circumstances, so that the yield of neutrons is considerable.

A rough excitation curve showed that the neutrons were emitted for alpha-particle ranges greater than 5.6 ± 0.5 cm, the yield becoming proportional to the thickness of argon traversed at 6.9 ± 0.5 cm. These figures mean that Ra C′ alpha-particles should have sufficient energy to cause the reaction to take place. We therefore mixed 50 mc radon with argon and attempted to observe hydrogen recoils in a hydrogen-filled proportional counter. We found that the number of counts rose from 20 per hour to 60 per hour when the argon plus radon was brought near. Only deflections well above the gamma-ray background were recorded. No recoils were observed from a paraffin layer when 6.5 cm absorption had to be traversed although a very small yield could not have been detected. The great majority of the neutrons, however, must have energies between 0 and 1.5 Mev.

A similar experiment with chlorine gave an increase of five per minute per millicurie with the BF_3 detector. The kicks began when the alpha-particle range exceeded 5.3 ±0.5 cm, the yield becoming proportional to thickness at 7.2 ± 0.5 cm.

We suggest that the following reactions take place.

$$A^{40}+He^4\rightarrow Ca^{43}+n^1,$$
$$Cl^{37}+He^4\rightarrow K^{40}+n^1.$$

The excitation curves suggest that unless a series of closely spaced resonance levels are present the nuclear radii of Cl^{37} and A^{40} are 6.1×10^{-13} cm and 7.3×10^{-13} cm. Both values should be regarded as provisional, but it is interesting to note that the value for A^{40} agrees with Bethe's revised radius for the radioactive elements[3] while that for Cl^{37} is rather low. It is also possible to deduce from the excitation curves that the mass of Ca^{43} and K^{40} (the radioactive isotope of potassium) cannot exceed 42.9768 and 39.9788, with Aston's value for the mass of A^{40} and Bainbridge's value for Cl^{37}.

We wish to express our thanks to Professor A. F. Kovarik for his interest and encouragement.

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[1] E. Pollard and C. J. Brasefield, Phys. Rev. **51**, 8 (1937).
[2] Obtainable in tanks from the Harshaw Chemical Company, New York City.
[3] H. Bethe, Phys. Rev. **50**, 977 (1936).

The Scattering of Electrons by Atomic Nuclei

The failure of a recent experiment[1] to confirm the prediction made by Mott[2] from the Dirac equations of an asymmetry in the intensity of an electron beam twice scattered by atomic nuclei increases the interest in the experimental tests of the equation for single scattering derived by Mott in the same calculation. In most such experiments little attempt has been made to exclude from the scattered beam as measured those electrons (ignored in the theory) which lose energy in being scattered.

We describe an experiment in which scattered electrons were counted only if they retained nearly all their initial energy. Electrons from a filament at about 1600 volts below ground potential were accelerated into a steel chamber where they were scattered by a thin gold foil. The chamber was at high potential throughout except for the region inside a smaller movable chamber, which received scattered electrons through a double diaphragm. The movable chamber contained the collecting electrode behind a grid at ground potential. Between the double diaphragm and this grid the scattered beam was thus strongly retarded and no electron which lost as much as 1600 ev is being scattered could reach the collecting electrode. As observation proved, the retarding field gave an additional advantage by eliminating electrons scattered by other parts than the foil, and all kinds of secondary electrons. This freedom from background made it possible to measure the intensity of scattering over the small angular aperture of 0.00194 rad^2 even at large angles of scattering.

The potential employed in the following observations was 80 kv. The thickness of the gold foil was 5.94×10^{-6} cm, as reckoned from its transparency to sodium light and confirmed by weighing. Scattering was observed only at oblique incidence, the electrons passing through the foil. The angle of scattering was 90°. Under these conditions