Letters to the Editor

PROMPT publication of brief reports of important discoveries in physics may be secured by addressing them to this department. The closing date for this department is the third of the month. Because of the late closing date 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 Polarization of Electrons

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RECENTLY experiments have been performed to determine electron polarization as predicted by the Mott theory on scattering.[1] The present experiment was carried out to test the previous results with apparatus redesigned to reduce to a minimum any spurious asymmetries in the experimental method. This was accomplished, principally, by using Geiger counters in a coincidence arrangement.

Electrons accelerated to an energy of 400 kev by a Van de Graaff electrostatic generator were used throughout the experiment so that a comparison with previous results would be possible.[1] The accelerating potential was stabilized to within ± 0.5 percent. The same assembly for double scattering as constructed for the previous experiment was used, with the exception that ground conical joints with centered apertures replaced the aluminum exit windows. Into these joints were accurately fitted metal cylindrical units, each with a thin, vacuum-tight, aluminum window. Each cylinder contained two Geiger counters mounted parallel to each other and to the entrance window. Both units were evacuated and filled with a gas mixture of argon and alcohol. The counter cathodes were of oxidized aluminum with thin entrance and exit windows large enough to include the solid angle defining the electron beam. Two advantages of the above arrangement are evident. First, the coincidence counter units may be interchanged precisely with respect to the exit windows; secondly, the whole top foil assembly may be rotated as one unit without disturbing the existing geometry.

Two separate twofold coincidence circuits operated two scaling and recording circuits. The counter-circuit resolving time was much better than required for successful operation. Background counts from twofold coincidences were almost negligible with the beam on. Backgrounds were taken by interchanging the top foil and holder with an identical blank holder. The lower foil holder contained a gold foil interchangeable with an aluminum foil. Adequate shielding was obtained by enclosing the whole rotating top assembly in a circular lead box; additional shields were placed along the accelerating tube, around the Faraday cage, and over defining apertures.

Gold foils were prepared by evaporation, and the thickness was calculated by utilizing the inverse square law, those used in this experiment being 3.8×10^{-5} cm thick. This would give a calculated ω of 5° on Wentzel's criterion. The aluminum foil was 7.6×10^{-3} cm in thickness and was commercially prepared.

The ratios of the number of electrons scattered into the two resulting beams were obtained with all the orientations necessary to determine the reflection-transmission ratios of gold and aluminum, the counter-geometrical asymmetry, and the percent polarization of the electrons in transmission. Table I lists a few of the more important corrected ratios. The letters *A* and *B* refer to the two coincidence counter assemblies, and the orientations are as listed in reference 1, Fig. 4.

The counter-geometry asymmetry was 1 percent. Note that no separation of the asymmetry into that due to the counter or geometry alone was made.

The apparent asymmetry due to polarization for gold is 6.8 percent, a result in agreement with that of Shull, Chase, and Myers,[1] while the apparent asymmetry for aluminum is -2.1 percent.

The reflection-transmission ratio[2] for gold foils, as well as that obtained by using an aluminum bottom foil in transmission, was 1.49. The complete results of this experiment will be published at an early date.

TABLE I. Ratio of electrons scattered into the two beams.

Orientation of foils, and counter units	Ratio
II Gold upper and lower foil	1.41
IV Gold upper and lower foil	1.58
V Gold upper and lower foil	1.56
V Aluminum lower foil	1.46
VIII Aluminum lower foil	1.51

[1] Shull, Chase, and Myers, Phys. Rev. 63, 29 (1943), and references therein.
[2] For a discussion of the importance of these ratios, see paper by Goertzel and Cox, Phys. Rev. 63, 37 (1943).

The Cepheid Theory of the Origin of the Solar System

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THE regular features of the solar system are well known and various theories have been proposed to explain them. However, these have been found to be inadequate on the general grounds of angular momentum and of energy, e.g., Jeans and Jeffreys' tidal theory has been criticized by Russell, and Lyttleton's "enticement" theory criticized by Luyten and Hill. The author, while considering the large adiabatic pulsations of the Cepheid variable, was led to an entirely different theory of the origin of the solar system, based on the instability of radial oscillations of a variable star. The square of the amplitude has been neglected in most investigations on oscillating stars, which are restricted to the consideration of small oscillations. The author has found that the oscillations are no longer stable when terms of the order of the square of the amplitude are retained. He has considered in detail the star models: (1) A star of uniform density; and (2) a star in which the density varies as a power of the distance from the center, except in a small central homogeneous core.

In the author's Cepheid theory of the origin of the solar system,[1] a star of about nine times the sun's mass is supposed to pass so near a Cepheid variable of about the same mass as to make, by its tidal influence, the oscillations of the Cepheid unstable. Matter of the sun's mass is ejected from the Cepheid together with a ribbon initially connecting the two. The planets of the solar system would be formed out of the portion of the ribbon attached to the sun's mass. The solar system would have to take about two-fifths of the energy of the parent Cepheid in order to escape from the latter. It has also been shown that the visiting star will have sufficient angular momentum to impart the necessary amount to the planets. The parent Cepheid too, on this theory, will have a planetary system of its own. A less number of assumptions is made in the theory than in any other existing theory, and the probability of existence of other planetary systems is definitely increased.

On the lines of the author, instability of radial oscillations of even small amplitude has been found for stellar models in which the laws of density are (1) $\rho=a-br$, (2) $\rho=a-br^2$, and (3) $\rho=k/r^n$, except in a small, homogeneous core. The analysis suggests that for the stability of radial oscillations the distribution of density in the star must be more or less uniform. The investigations of Chandrasekhar and Kopal on the central condensation in Cepheids lend support to this view.

[1] A. C. Banerji, Proc. Nat. Inst. Sci. India **8**, 173–197 (1942).

Scattering of Protons by Magnesium Nuclei

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IN earlier reports[1,2] angular distribution and energy measurements on 6.9-Mev protons scattered by magnesium nuclei were presented along with a description of the emulsion track camera with which exposures were made. Further analyses of runs, referred to in the above papers as numbers III and IV,[3] have yielded the following additional results:

(*a*) The intensity distribution of scattered protons as a function of scattering angle ϕ has been measured for a series of 26 emulsion plates exposed during run No. IV at angles extending from $\phi=20\pm0.5°$ to $\phi=170\pm0.5°$, inclusive. Exposure factors for each plate were determined by passing the unscattered portion of the primary proton beam into a Faraday chamber with attached condenser arranged to discharge on attaining a critical potential difference. Exposure was then measured in terms of the number of condenser discharges occurring during a run, and was adjusted for different angles so that the number of emulsion tracks per plate was approximately constant.

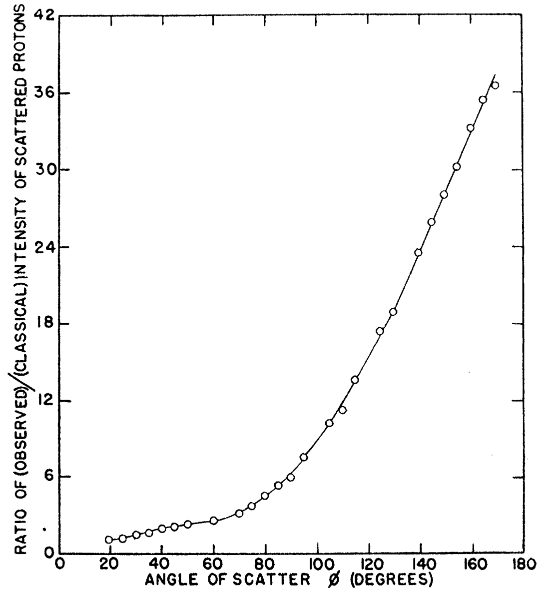

FIG. 1. Ratio of (observed/classical) intensities of 6.9-Mev protons scattered by magnesium. Scattered protons of all ranges were counted.

From knowledge of the exposure factor and the number of tracks scattered for each angle, relative intensities of scatter as a function of ϕ were obtained. The ratio of observed intensities to values calculated from Rutherford's classical formula for inverse square law scattering is plotted against ϕ in Fig. 1. Plates measured contained an average of 1700 tracks each while check number counts agreed to within 0.8 percent. Pronounced deviations from inverse square scattering are evident at angles greater[4] than 20°.

(*b*) Relative intensities of the four proton groups reported earlier[2] have been estimated for a few plates (Table I). The symbols E, I_1, I_2, I_3, are again used to identify the elastic and inelastic scatter proton groups of energies 5.94, 4.62, 3.25, and 2.04 Mev, respectively. Probable accuracy of the results of Table I was limited by the necessity of estimating the intensities of peaks E and I_1 relative to I_2 and I_3 from two separate runs normalized to the same exposure. Omission of values of I_2 and I_3 at certain angles merely indicates that their intensities were not measurable to the order of accuracy indicated, not that they were absent.

(*c*) Evidence of the existence of a fifth group I_1' of

TABLE I. Relative intensities N_E, N_{I_1}, N_{I_2}, N_{I_3} of proton groups E, I_1, I_2, I_3, respectively, as functions of scattering angle ϕ.

$\phi=$	25°	45°	70°	95°	130°	160°	Est. error
N_E	6,100	1,100	327	144	198	308	5%
N_{I_1}	0	140	268	292	159	211	5%
N_{I_2}	0	480	25	46	—	126	15%
N_{I_3}	—	180	42	54	—	74	15%