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 twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Diffuse Scattering of X-Rays from Piezoelectrically Oscillating Quartz

Using a photographic method, Fox and Fraser[1] have recently found that when a crystal is piezoelectrically oscillating the increased intensity of the Laue spots is accompanied by an increased intensity of the undeviated beam penetrating the crystal. Obviously it is of interest to determine whether piezoelectric oscillations affect the intensity of the diffusely scattered x-rays. We used an unetched "Y cut" quartz plate of thickness 0.105 cm and the ionization chamber technique described by Jauncey and Claus.[2] A typical result is shown in Fig. 1. This curve is corrected for scattering from the aluminum electrodes placed in contact with the quartz plate. The ratio of "oscillating" to "not oscillating" reaches its maximum value of 2.0 at the center of each component of the double Laue spot. The curve shows evidence of the doubleness of the spot. Beyond the Laue spot on either side where there is only diffuse scattering the ratio drops to 1.00 ± 0.01, indicating no change in the diffuse scattering. Numerous readings showed that the S values for quartz are changed, if at all, by no more than one percent. This lack of effect of piezoelectric oscillations on the diffuse scattering supports the view that the effect on the Laue spots is due to a change in the extinction coefficient, since the value of this coefficient has no effect on the diffusely scattered x-rays.

Our ionization chamber method showed no change in the intensity of the undeviated beam penetrating the crystal greater than one percent. This is at variance with the increased area and blackness of the central spot as reported by Fox and Fraser.

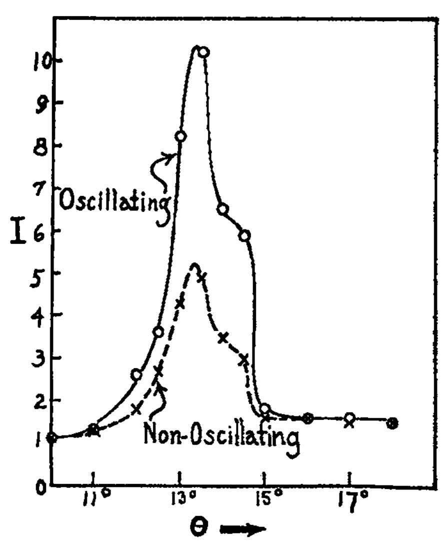

FIG. 1. Curve for the ionization chamber set at a scattering angle of 30°. θ is the angle between the normal to the crystal plate and the primary beam. The flat portions of the curve are due to diffuse scattering.

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July 30, 1935.

[1] Fox and Fraser, Phys. Rev. **47**, 899 (1935).
[2] Jauncey and Claus, Phys. Rev. **46**, 941 (1934).

The Velocity of Light Within a Massive Enclosure

D. C. Miller explains in his report,[1] that the difference between his results and those of other experimenters in the field[2] may be due to entrapping of the ether in the heavily enclosed apparatus of the other investigators, while his own apparatus is quite open to the outside atmosphere. If this explanation be correct, it should be possible to detect a differential light velocity between a light beam in a heavily walled tube with stopped ends held in the direction of the earth's velocity and a light beam just outside and parallel to the tube.

An apparatus was therefore constructed in which an unpolarized beam of white light was divided by means of a half-silvered mirror into two beams of approximately equal intensities. One beam, entered transversely a heavy walled steel tube with lead plugged ends through a small hole near one end, was reflected by means of a fully silvered mirror a distance of 89.4 centimeters along the axis of the tube, then encountered another fully silvered mirror which reflected the beam out through a small lateral hole near the other end of the tube. Outside the second hole was another fully silvered mirror which projected the beam parallel to the tube toward the originally encountered half-silvered mirror through which a portion of the half-beam passed a second time, but now at right angles to its original direction. The second of the original half-beams traversed the same path indicated above but in the opposite direction from the half-beam first considered. Since the two half-beams partly reunited after passing through the half-silvered mirror for the second time, a pattern of interference fringes was seen in the field of the half-silvered mirror. If any differential velocity existed between the light inside the tube and that outside, the position of the interference pattern should depend on this differential velocity. The velocity difference should yield an apparent path difference of $2VD/C$, where V is the difference in the ether drifts outside and inside the tube, C

is the velocity of light in air, and D is the length of the light path along the axis of the tube.

In my apparatus D has a value of 89.4 cm, and a shift in the position of the interference pattern of 1/10 of a fringe can be detected. It should then be possible to detect a difference in an ether drift between the inside of the tube and the outside of 1 km/sec.

On September 1, 1934, the apparatus was set up on the top of a high hill about two miles south of Moscow, and many observations were made in all azimuths during the daylight hours of September 1, 2 and 3. No shift of the interference fringes was observed, although conditions were very favorable, and a shift of 1/10 fringe would easily have been seen.

I conclude that Professor Miller's explanation of the difference between his results and those of the other investigators is not correct.

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July 27, 1935.

[1] D. C. Miller, Rev. Mod. Phys. 5, 203–242 (1935).
[2] R. J. Kennedy, Astrophys. J. 68, 367 (1928); A. Piccard and E. Stabel, Comptes rendus 183, 420 (1926); Naturwiss. 16, 25 (1928); A. A. Michelson, F. G. Pease and F. Pearson, J. Opt. Soc. Am. 18, 181 (1929); G. Joos, Ann. d. Physik (5) 7, 385 (1930).

Heavy Particles from Lead

During an investigation of cosmic-ray showers with a large cloud chamber,[1] one photograph was obtained showing a dense track originating in a lead plate supported in the center of the chamber. The particle traveled a distance equivalent to a path of 10 cm in air at which point it passed out of the illuminated region. This event in conjunction with the recent ionization chamber results of Clay[2] led us to investigate the phenomenon more fully. An estimate from Clay's data indicates that if such particles exist, they should be expected in the ratio of one heavy particle to every 100 to 200 penetrating electrons. In the ordinary operation of the cloud chamber the time interval during which the chamber is sensitive is approximately a tenth of a second. A calculation, based on our knowledge of the frequency of occurrence of cosmic-ray electrons, shows that, on the average, one penetrating electron through the lead (area 280 cm^2) should be observed on a photograph taken at random. If we assume that both upper and lower surfaces of the lead are effective, we should expect one heavy track in 75 photographs. In order to increase the probability of observing these particles we adjusted the apparatus so that the sweeping field was removed about 0.3 sec. before the expansion. With this adjustment three of 38 photographs showed heavy particles. They had air equivalent ranges as follows: 9 cm ending in the illuminated space, 12.9 cm passing out of the lighted field, 12.6 cm ending in the gas. The latter is reproduced in Fig. 1. In the 38 photographs three short range heavy tracks (presumably alpha-particles) were observed leaving the lead. Thus it seems impossible to ascribe the long range particles to any ordinary radioactive contamination because of the relatively small number of shorter tracks observed. The heavy particle observed on the shower photograph was definitely not coincident in time with the cosmic-ray shower.

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[1] E. C. Stevenson and J. C. Street, Phys. Rev. (this issue).
[2] J. Clay, Physica 2, 111 (1935).

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FIG. 1. The heavy particle emerging from the lower side of the lead plate is quite evidently old, occurring one or two tenths second before the expansion.