Electronic Waves and Thibaud's 'Particles'

An inadvertent omission from my earlier communication[1] of the universal constant ($-e/c$), which should multiply the right of equation (5), and, therefore, both sides of equations (11) and (12), involves that the predicted rate of energy loss by electronic wave radiation is now some 14·4 times as large. Writing $v_r = v \cos \theta$, the corrected formula (12) now reads

$$(-ec)\ \frac{\overline{A}_r}{r} = \frac{e^4}{2mc^2} \cdot \frac{v \cos \theta}{r^3} \cdot \psi\psi^* \doteqdot$$

$$(3{\cdot}24)10^{-31}\ \frac{v \cos \theta}{r^3} \cdot \psi\psi^* \quad . \quad . \quad . \quad (12a)$$

The radiation is now seen to depend on an even power of the charge, and so can be of negative sign only for values of θ which make $\cos \theta$ negative. An element of an electron beam is seen to radiate nothing in its equatorial plane, a maximum in the forward direction, and a negative maximum in the backward direction.

This fact, coupled with the smallness of the numeric in (12a), suggests the conclusion that electrons accompanied by the assumed spherical electronic waves (of low and substantially uniform group velocity) would not lose observable energy in transit. Indeed, integration of (12a) over all possible values of θ gives zero for a cylindrical beam, neglecting complications due to the effects of beam-forming or beam-receiving electrodes. For an expanding beam a small net rate of loss, and for a converging beam a small net rate of absorption of energy are predicted; but for electrons and all heavier particles the effect is negligible, frequently even when the restriction to nearly uniform motion is waived.

If, however, extremely light particles should come in for consideration, these conclusions might well be reversed in respect of such particles. In this connexion we must give careful attention to the beautiful researches of Jean Thibaud[2], in which he seems to establish the mass of the neutrino at $10^{-11}\ m_0$, where m_0 is the rest mass of an electron. In addition, the neutrino is, according to Thibaud, endowed with a charge, small compared with that of an electron. The term 'electrino' is suggested to cover the particle; but since Thibaud finds both positive and negative neutrinos, we should obviously need 'positrinos' as well. From the preliminary values quoted, it would appear that the radiation-rate divided by the kinetic energy of Thibaud's particles may be up to ten thousand times the corresponding ratio for electrons. For such particles moving in a non-uniform electric field, it is conceivable that this brings the radiation loss to an observable order of magnitude.

At all events, Thibaud[2] finds his particles are liable to gain or lose energy when traversing zones of intense gradient: ". . . the particle appears to suffer appreciable loss of energy per unit length of path—loss due doubtless to a radiation which is no longer negligible as for an electron".

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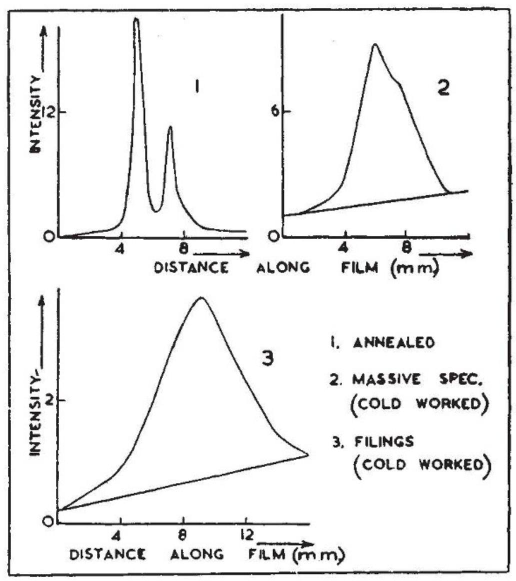
[1] *Nature*, **160**, 160 (1947).
[2] *C.R. Acad. Sci. Paris*, **224**, 739 (1947) (*et aliunde*).

X-Ray Diffraction Rings from Deformed Solid Metal and Metal Powders

The changes in crystalline texture of metals subjected to plastic deformation can be studied by following the increase in diffusion of the X-ray reflexions from the atomic planes. The correct procedure should be always to obtain the reflexions direct from the metal in the normal solid state. But for convenience much work has been based on the circular camera technique, where the test specimen has to be in the form of powder. The metal has been reduced to powder by filing, and measurements made of the breadth and intensity of the X-ray reflexions from the filings. These values have been compared with the breadth and intensity of the reflexions after the filings have been annealed and the effect of deformation thereby removed. The difference has been taken to represent the effect of the cold plastic deformation produced by the action of filing. Then it has been assumed that the same differences would exist between the annealed and plastically deformed state in the solid metal; also that the theoretical conclusions would be applicable directly to interpretation of the structural changes produced by plastic deformation of the solid metal.

We have considered it worth while examining these assumptions by experiment. The results are interesting and may serve to direct attention to a factor which does not appear to have been recognized in previous work.



We have compared the diffraction rings from solid metal, in the form of flat tensile specimens of iron, with the diffraction rings of filings taken from the same specimens. The tensile specimens were plastically deformed by stretching to increasing extents in order that a measurement might be made of the characteristic maximum diffraction broadening which, it has been shown, is reached after progressive deformation, and which has a specific value for a particular metal[1]. This maximum line-broadening was then compared with the breadth of the diffraction rings from the filings. For this purpose the filings were formed into a flat layer of powder, so that they might be examined by X-rays under exactly the same conditions as the flat tensile specimens.