Stimulation of Paramagnetic Absorption by a Constant Field

IN previous researches¹ it has been found that paramagnetic absorption at frequencies of about 2×10^7 may decrease considerably under the simultaneous application of a constant magnetic field. We have now observed that, on the contrary, paramagnetic absorption may be strongly stimulated by a comparatively large constant field applied parallel to an alternating field of comparatively low frequency. The accuracy of our observations did not allow us to detect the dissipation of heat in iron alum at a frequency of 3.7×10^6 and a temperature of 77° K. in the absence of a constant field. But under the influence of such a field a strong absorption appeared which attained a maximum at 1,000 oersteds and decreased in still larger fields. The maximum shifts to larger fields for higher temperatures and lower frequencies.

These results are in agreement with our recent observations² on paramagnetic dispersion in the same region of frequencies and temperatures, which had already indicated that the absorption region shifted enormously (from about 10^6 to 10^8) under the influence of a strong parallel field. Further, the conclusion³ that the phenomena at a fixed temperature and field cannot be described by one single relaxation time is corroborated by these results.

Details will be published in *Physica*.

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¹ Gorter, C. J., *Physica*, 3, 503 (1936); 3, 1006 (1936).

² Gorter, C. J., and Brons, F., *Physica*, 4, 579 (1937). Brons, F., and Gorter, C. J., *Physica*, 5, 60 (1938).

³ Kronig, R. de L., *Physica*, in the press.

A Wireless Interferometer

IN a recent communication in *NATURE*¹, the use of a pair of spaced frame aerials for locating the position of the scattering clouds in the *E* layer of the ionosphere was described. The system, an example of which is shown in the accompanying illustration, has another function, which is also of importance in the investigation of scattering, namely, the determination of the spread in direction of the scattered rays.

In the presence of a single ray, the E.M.F.'s in the two aerials are definitely related in phase and amplitude, and so it is possible by varying these quantities in the central circuit completely to balance the output of the system. When, however, there are many rays of random direction and phase forming a spread pencil or cone of independent rays, the setting for any one ray differs from that of the others, and all the rays cannot be balanced simultaneously. It is no longer possible to obtain a complete balance since the E.M.F.'s in the two aerials are not exactly correlated. There is a certain random diversity effect which increases as the frames are spaced farther apart. It

is possible to calculate the degree of correlation between the E.M.F.'s in the two aerials when it is assumed that the E.M.F. arises from rays of random phase and direction within a cone of angular aperture φ_0 , the distribution being

$$Ae^{-\varphi^2/\varphi_0^2}$$

The correlation coefficient r is then approximately

$$r = 1 - \left(\frac{2\pi d}{\lambda} \frac{\varphi_0}{2} \right)^2, \text{ so long as } \left(\frac{2\pi d}{\lambda} \frac{\varphi_0}{2} \right) \ll 1.$$

Photo]

[Marconi's Wireless Telegraph Co. Ltd.

With such a correlation coefficient, it is also possible to calculate the ratio of the residual E.M.F. at the best obtainable balance to the E.M.F. of one aerial alone.

This ratio is

$$\frac{u}{v} = \frac{2\pi d}{\lambda} \frac{\varphi_0}{\sqrt{2}}$$

and becomes unity, that is, there is no effective balance at all, when $\pi d \varphi_0 / \lambda = 1/\sqrt{2}$.

It will be observed that except for a numerical factor of the order of unity depending on the distribution function of intensity within the pencil of rays, this is exactly the Michelson interferometer formula relating the angular diameter φ_0 of a pencil of rays to the observed mirror spacing d at which the contrast ratio in the fringes disappears. Thus the pair of spaced frames constitutes a wireless Michelson interferometer, the frames taking the place of the mirrors and the ratio u/v corresponding to the fringe intensity ratio.

In the radio technique, the spacing is left constant but the contrast ratio measured. In the astronomical technique, the distance d is varied until the contrast ratio is unity. The same quantity, namely, the angular spread, is, however, measured in both cases.

Observations have been made during the past year to measure the angular spread of the rays reflected from the ionosphere.

Two salient facts emerge: The first is, that whereas for local ground signals balances, that is u/v ratios, of $1/1,000$ or less can be obtained, it is very rare for a reflected signal from the ionosphere to give a better balance than about $1/30$, with 20-m. frame spacing, and the balance is usually of the order of $1/10$, giving a spread of the order of 1° or 2° . The second is that the behaviour of the short scattered echoes (from heights of 100 km.) is in complete contrast with