LETTERS TO THE EDITORS

SPACE SCIENCE

Interpretation of Cosmic Noise Measurements at 3·8 Mc./s. from Satellite 1960 η1

THE results of measurements of cosmic noise at 3·8 Mc./s. from the satellite 1960 η1 have been reported by Molozzi, Franklin and Tyas[1]. A puzzling feature was the variation in field-strength at different locations. These results have now been analysed, on the assumptions that variations in signal strength are due to three causes: (*a*) the variation of radiation resistance of the antenna due to the ionosphere surrounding of the satellite; (*b*) the restriction in angular aperture of the satellite antennæ due to the ionosphere; and (*c*) the variation of cosmic noise power over the sky. The results indicate that these are the most important factors affecting the cosmic radio signals.

The variation of cosmic noise across the sky can be removed from the field-strength data by plotting noise-field contours along the orbit, using one of the sky maps such as that computed by Steiger and Warwick at 18 Mc./s. (ref. 2). The field-strengths can then be normalized to a standard value of the cosmic-noise field. In this communication the field-strength is normalized with respect to a region of the sky remote from the centre of the Galaxy, where the variation was small and the sky temperature low. Variation in antenna gain over the region is neglected.

The remaining variation in cosmic-noise levels is predominantly due to the effect of the ionosphere, neglecting for the moment the effect of the restriction in angular aperture. It can be shown that the radiation resistance of loop antennæ, such as those used in the experiment, varies as $\varepsilon^{3/2}$, ε being the dielectric constant of the medium. Therefore, as the antenna is immersed in ionosphere of increasing electron density, the resistance due to radiation will decrease, and hence the cosmic-noise power output from the receiver will also decrease.

The largest values of the electric field-strength are assumed to be representative of the noise field outside of the ionosphere, where the dielectric constant is unity. It follows that the ratio of the noise field-strength measured in the ionosphere to that outside the ionosphere, is proportional to $\varepsilon^{3/4}$, when absorption in the upper F region of the ionosphere is assumed to be negligible.

Since several modes, particularly the ordinary and extraordinary modes, can be propagated independently in the ionosphere, each one can contribute to the total noise-power at the satellite. The assumption was made that the energy was evenly divided between the two components above the ionosphere, that their signals added incoherently at the satellite and that the gyro-frequency was of the order of 1·4 Mc./s. at an altitude of 800 km.

Based on the hypotheses in the preceding two paragraphs, first estimates of the values of the dielectric constant and the electron density at the satellite were computed for each of the 22 observations reported by Molozzi *et al.* Since the largest values of the field-strength were observed over Woomera, these values were taken to represent the field-strength outside the ionosphere.

In order to arrive at more precise values of ε, it is necessary to allow for the angular aperture θ of the antenna, by a method of successive approximations. In the limiting case, $\sin\theta = \sqrt{\varepsilon}$.

Using the first value of ε calculated above, the angular aperture can be determined, and a more precise value computed for the noise-field received at the satellite, averaged over the region of the sky being viewed. Following the same procedure as before, a second approximation of the dielectric constant can be arrived at. The procedure can then be repeated and mean values of the electron density found by this means for the North American telemetry stations, Ottawa, Blossom Point and Fort Myers.

Date	Local time (approx.)	Mean height of satellite	Electron density
June 24–26, 1960	2200 hr.	870 km.	$9·2 \times 10^4$ per c.c.
June 27, 1960	2200 hr.	855 km.	$10·4 \times 10^4$ per c.c.
June 24–26, 1960	1400 hr.	1,050 km.	$7·5 \times 10^4$ per c.c.

The difference in electron density between the measurements on June 24–26 and June 27, at the same local time, is approximately 10 per cent. Since a magnetic storm began with a sudden commencement at 0146 G.M.T. on June 27, it is surmised that the increase is due to the effects of the magnetic storm. The observations on June 27 were all made within 6 hr. of the beginning of the storm, during the initial positive phase of the variation of magnetic field.

The sky brightness temperature T computed from the results obtained over Woomera was found to be $8·1 \times 10^6$ °K. in the vicinity of R.A. 5·5 hr., Dec. $-30°$, the region used for normalization of the values of field-strength.

A more detailed report will be given elsewhere.

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[1] Molozzi, A. R., Franklin, C. A., and Tyas, J. P. I., *Nature*, **190**, 616 (1961).

[2] Steiger, W. R., and Warwick, J. W., *J. Geophys. Res.*, **66**, 57 (1961).

ASTROPHYSICS

Apparent Recession of Nebulæ and the Nature of Radio Stars

IN a recent communication[1m], a brief summary was given of the quantitative evidence in favour of the whirl theory of light and matter, according to which the whole physical universe is the manifestation of Maxwell's electromagnetic waves, wherein the fundamental particles of matter are represented as integral solutions of Maxwell's equations *in vacuo*, in cylindrical co-ordinates, extended from a low limit of the variable parameter of the integrant solution to infinity (the 'compound whirl'), while the photons are represented by the same kind of solution but with a