LETTERS TO THE EDITOR

RADIO ASTRONOMY

Radiation from Jupiter at 178 Mc/s

A NUMBER of observations have been made of the decimeter radio emission from Jupiter at frequencies between 3 cm and 70 cm.

Although there is some evidence that the emission at a given frequency shows some variation with time, the results, when corrected to the same distance for the planet, provide a fairly well defined spectral law (see, for example, the review article by Roberts[1]).

The origin of the emission has been attributed to radiation by relativistic electrons trapped in the Jovian magnetic field in a manner analogous to the terrestrial Van Allen belt[2]. If this interpretation is correct a more accurate determination of the spectral distribution of the non-thermal component, especially at the lower frequencies, is of considerable interest in connexion with the energy spectrum of the trapped particles.

Observations at a frequency of 178 Mc/s have, therefore, been made at the Mullard Radio Astronomy Observatory using the large east–west interferometer[3]. At a frequency as low as this, the expected flux density is small and there is some difficulty in distinguishing between the radiation from Jupiter and the radiation from the numerous radio sources having a comparable flux density. Consequently, it is necessary to develop an observing procedure whereby the records obtained on one day are subtracted from those taken on another day when the position of Jupiter has altered by more than the beam width of the instrument; in this way it becomes possible to detect a source very much weaker than could normally be distinguished if there were no relative motion.

Observations were made both with a fan-beam system and with an interferometer having a separation of 469λ between its elements; a comparison of the two records then enables limits to be set on the angular diameter of the source[4]. The observations were made over the period June 22–July 1, 1963, and the method of subtracting the records was used on both fan beam and interferometric systems to provide a series of ten independent determinations of the apparent flux density of Jupiter on each system.

The mean values derived were:

(*a*) Flux density using fan beam, $3{\cdot}3 \pm 0{\cdot}45 \times 10^{-26}$ W m^{-2}(c/s)$^{-1}$

(*b*) Flux density on interferometer, $3{\cdot}8 \pm 0{\cdot}4 \times 10^{-26}$ W m^{-2}(c/s)$^{-1}$

The day-to-day variations in the measured flux density were close to the values expected from the combined effects of noise and small variations in the phase of the interference pattern caused by ionospheric irregularities; these phase variations lead to a small residual component when subtracting the records from different days.

It can therefore be concluded that over the period of observation the flux density of Jupiter did not vary by more than 20 per cent. Furthermore, since, over this period, the day-to-day variations in electron content of the ionosphere are sufficient to cause variations in the Faraday rotation of more than 45°, the results indicate that at 178 Mc/s any polarized component of the emission is less than 20 per cent.

A comparison of the fan beam and interferometric observations allows an upper limit of 1·5 min arc to be set to the source diameter, on the assumption of a Gaussian strip distribution. With a circular source of this angular diameter the surface brightness would correspond to a brightness temperature $T_s > 1{\cdot}7 \times 10^4$ °K; if the source were the same size as the optical disk $T_s = 8{\cdot}6 \times 10^4$ °K.

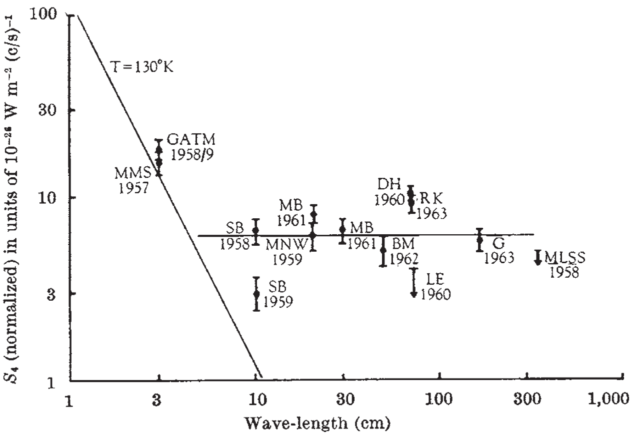

Fig. 1. Flux density of Jupiter corrected to a standard distance of 4·04 A.U. *GATM* 1958/59, see ref. 5; *MMS* 1958, ref. 6; *SB* 1958 and *SB* 1959, ref. 7; *MB* 1961, ref. 8; *MNW* 1959, ref. 9; *BM* 1962, ref. 10; *RK* 1963, ref. 11; *DH* 1960, ref. 12; *LE* 1960, ref. 13; *MLSS* 1958, ref. 14. '*G*1963' refers to the present observations.

The flux densities derived from these and a number of other observations have been corrected to a distance to the planet of 4·04 A.U. and are shown in Fig. 1.

The observed spectrum has been fitted in the figure by the adoption of a thermal contribution corresponding to a temperature of 130° K, as suggested by Roberts[1], and of a non-thermal component which has a spectral index, α, of 0, and for which S equals 6×10^{-26} W m^{-2} (c/s)$^{-1}$.

Although the points show considerable scatter, part of which may be due to temporal variation in the source, the new observations suggest that the spectral index is less than the figure of 0·3 given by Roberts[1].

I would like to thank Dr. P. F. Scott for assistance with the observations.

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GEOPHYSICS

Magnetotelluric and Very Low Frequency Signatures from Small High-Altitude Nuclear Explosions

THIS communication presents a preliminary account of the magnetotelluric and very low frequency signatures associated with the U.S. high-altitude nuclear detonations of October 20 (0830 : 00 G.M.T.), October 26 (0959 : 49 G.M.T.), November 1 (1210 : 06 G.M.T.), and November 4