THE MOST INTENSE BURST OF SOLAR RADIO EMISSION OBSERVED ON FEBRUARY 23, 1956

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Summary-

A violent outburst of solar radio emission was observed on February 23, 1956. A perfect record of the intensity was successfully obtained by 3750 and 9400 Mc/s radiometers, together with a drift curve taken by an 8-element interferometer at 4000 Mc/s. The maximum intensity was 225 and 141 times as large as that of the quiet-sun radiation for 3750 and 9400 Mc/s radio flux density, respectively. The position of the radio source at 4000 Mc/s slightly moved during the burst. The most probable E-W width of the radio source during the burst is 3 minutes of arc, which corresponds to the maximum effective temperature of about 5×10^8 °K.

A very intense outburst of solar radio emission was observed at 3750 and 9400 Mc/s on February 23, 1956. This is the most intense of all outbursts observed here at 3750 Mc/s since November 1951. It probably exceeds the burst on April 15, 1947, observed at Ottawa station at a wavelength of 10.7 cm. Fortunately, test observations were being made at 9400 Mc/s since November 1955, and peak intensities at both frequencies were successfully recorded with the aid of an automatic level-changer (maximum attenuation 21 db).

Tracings of the burst have been made and are shown in Fig. 1. Numerical values are given as follows;

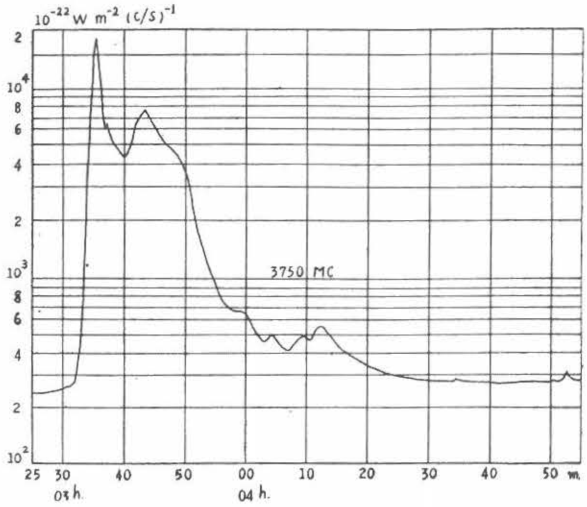
Freq. in Mc/s	Starting Time (20%) in U.T.	Duration (20%—20%)	Max. Intensity (x)	Time of Max.	Daily Values(x)
3750	03h 34m 00s	15m 30s	1.80×10^4	03h 35m 25s	244
9400	03h 33m 40s	15m 00s	3.14×10^4	03h 41m 50s	349

(x)— in 10^{-22} WM^{-2} $(c/s)^{-1}$

In addition to the above intensity measurements at two frequencies, the observation with an 8-element interferometer at 4000 Mc/s was carried out. However, overall records of burst were not obtained because the interferometer had no automatic level-changer. Moreover, as the time required for one scanning of the solar disk is about 2.7 minutes, the rapid change of the source could not be observed. The E-W distribution of radio emissive regions before the burst (around local noon or 0304 U.T.) is shown in Fig. 2, together with sun-spot data observed at the Tokyo Astronomical Observatory. The burst occurred in the westmost emissive region (16' W). The drift-curves in the middle and near the end of the burst (around 0342 and 0410) are shown in Fig. 3; Dotted lines are the drift-curves before the burst.

The differnce between the drift-curves before and in the middle of the burst is attributed to the emission from the source of the burst. If the corrections for the variation of the source intensity are applied to

(a) 3,750 MC



(b) 9,400 MC

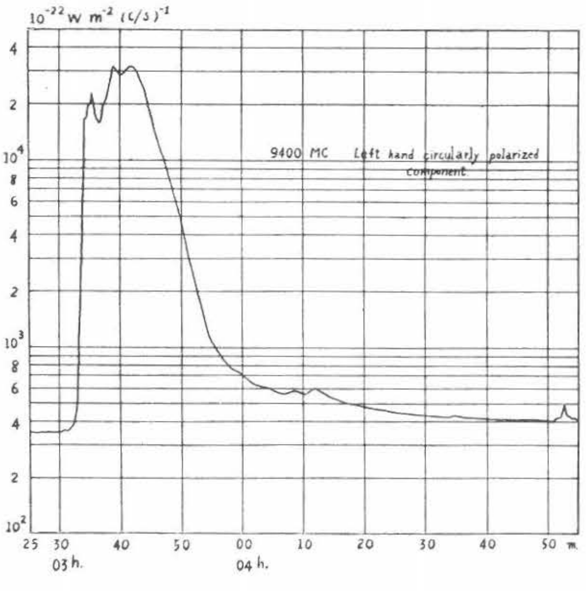


Fig. 1. Intensity variations of burst.

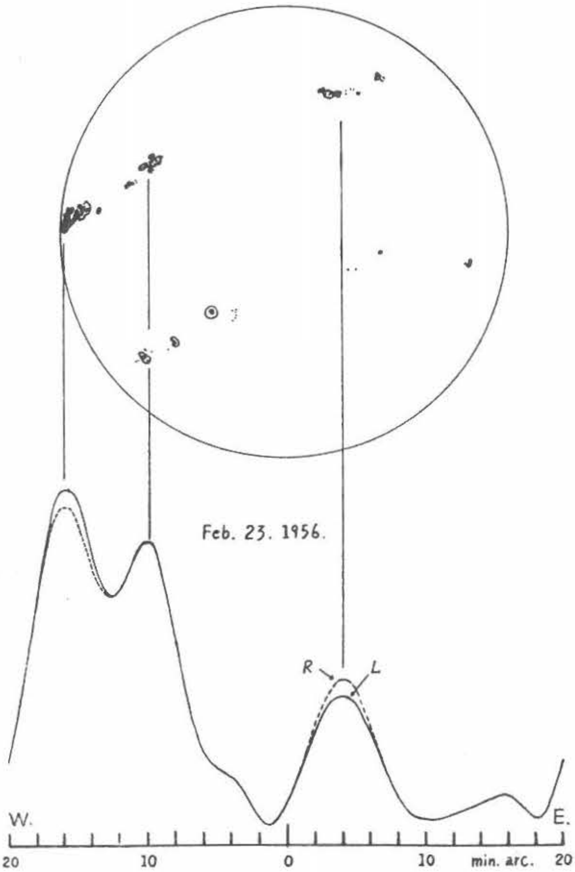


Fig. 2. E-W distribution of the radio emissive regions at local noon.

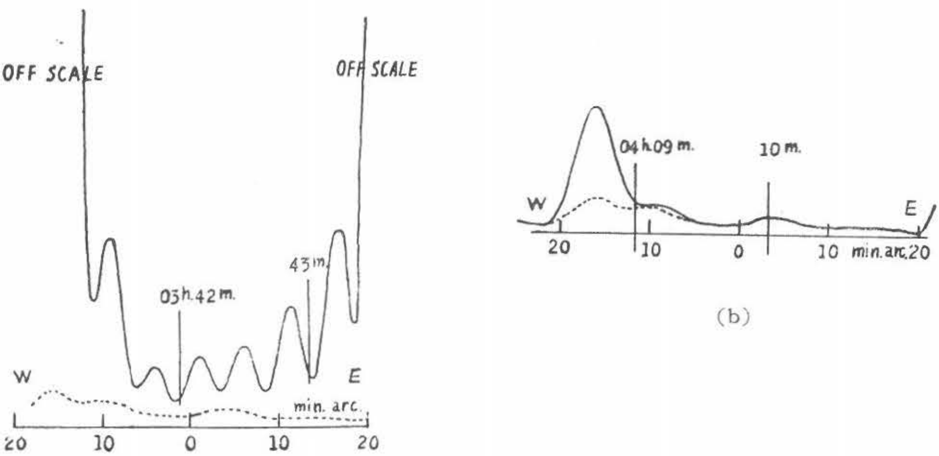


Fig. 3. Drift-curves during the burst.
Dotted lines are the drift-curves before the burst.

this excess by referring to the record at 3750 Mc/s, the position of the source willbe found. The mean position thus obtained from three examples around 03h 42m was 16.6' W and that from several examples around 04h 10m was 16.2' W. It seems that the source slightly moved towards the west.

It is also quite important to estimate the E-W width of the source because it determines the effective temperature of the source. In the case of Fig. 3 (b), the width can be estimated from the half-power width of the peak which is separated from the daily level. The result is about 3' which corresponds to the width towards the end of the intense burst. Under the circumstances shown in Fig. 3 (a), on the other hand, the above method cannot be applied, so that the width was estimated by studying the ripple due to side-lobes of the directive pattern. It is clear that the wider the width of the source the smaller the ripple becomes. Accordingly, a theoretical curve was sought which best fits the observed one by assuming various widths of the radio source. At this time, the peak value was estimated by referring to the record obtained at 3750 Mc/s. As the correction of the drift curve is imperfect owing to a probable difference of flux variation between 3750 and 4000 Mc/s, we failed to find a theoretical curve which perfectly fits the obsered one. Hewever, it is certain that the width of the radio source lies between 2 and 4 minutes of arc. It means that the width scarcely changed at least in the latter half of the burst. Calculating from the result, the maximum temperature of the radio source can be estimated at $3\text{-}12 \times 10^8$ °K.

The associated flare was observed at the Tokyo Astronomical Observatory. The time of the maximum of the flare was 03h 42m and was coincident with the maximum of the burst at 9400 Mc/s, but the maximum of 3750 Mc/s burst occurred 6.5 minutes before the maximum of the flare. The position of the radio source was in good agreement with that of the flare.

Reference

(1) M. Notsuki, T. Hatanaka and W. Unno: Publ. A.S. Japan, 8, 1, p. 52 (1956).