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ABSTRACT:

Solar microwave maps at 8 mm performed at the Metsähovi Radio research Station in the period 1978-1982 revealed some radiation sources located up to 50 000 km outside the optical Sun. Here we describe two characteristic events which were associated with large flares occurring close to the Solar limb.

INTRODUCTION

Solar microwave maps measured at the Metsähovi Radio Research Station have revealed several radiation sources on the limb of the Sun. A 14 meter radio telescope has been used with receivers working at 22 GHz and 37 GHz (Urpo, 1975, 1982). In normal conditions the size of the Sun at microwaves closely corresponds to the size of the optical Sun or the photosphere, and the sources of the microwave radiation are located at the height of 2000 to 4000 km above Hvar Obs. Bull. 9(1985) 1, 25-32
the photosphere. However in some occasions, the measured radio map revealed a radiation source which was located outside the optical limb of the Sun.

THE EVENT OF SEPTEMBER 8, 1980

The microwave limb source at 22 GHz is shown in Figure 1a. The position of the source was $S 10^\circ W$, the height 25 000 km and the brightness temperature was 2300 K above

Fig. 1 a. Solar map at 22 GHz on September 8, 1980 performed from 07 54-08 12 UT. Contours on the map are 250 K.
the estimated quiet Sun level. A large active region was at the west limb (Hale No. 17089, Mt Wilson No. 21700, modified Zürich class EKO). see Figure 1 b. An importance 2B, M9 two ribbon flare occurred at the position S 09° W 68° (beg. 05 22 UT, max. 05 24 UT, end 07 13 UT). A Sudden Ionospheric Disturbance (SID) of importance 3, was also registered and was attributed to the 05 22 UT flare (Solar Geophysical Data. 1980, No. 435, Part I).

Fig. 1 b. Drawing of the photosphere on September 6, 1980. Note the large spot group on the southern hemisphere approaching the west limb.
THE EVENT OF MAY 10, 1981

The limb source is shown in Figure 2 a. The position of the source was N 12 E, its height at the time of measurement was 60 000 km above the photosphere and the brightness temperature was 5500 K above the quiet Sun's level.

Fig. 2 a. Solar map at 37 GHz on May 10, 1981 performed from 13 31 - 13 58 UT. Contours on the map are 150 K.
A large, developed active region Hale No. 17644, Mt Wilson No 22278, modified Zürich class HSX) appeared at the east limb of the Sun. (Figure 2 b). According to Solar Geophysical Data (1981, No. 443, Part I) a SID of importance 3+ (with no known flare on the disc) started at 12 03 UT.

Fig. 2 b. Drawing of the photosphere on May 11, 1981. Note the large active region appearing at the eastern limb.
peaked at 12 55 UT and ended at 14 50 UT. Also a corresponding GOES class M3 soft X-ray event has been reported. At Wroclaw Observatory a large limb flare has been observed at the position N 08 E from 12 29 UT to 13 00 UT and from 12 44 UT to 14 29 UT a large and beautiful system of post flare H-alpha loops was observed occupying the limb region from N 03 E to N 13 E, Figure 2 c.

Fig. 2 c. The post flare loop system LPL (1) observed at 13 49 UT at Wroclaw Observatory.
DISCUSSION

In this two cases - and in most of the other observed cases (under study and to be published elsewhere) the microwave limb sources appeared after large flares situated close to the Solar limb. The duration of the limb sources was from one to several hours. We suggest that these sources are connected to loop systems which form at successively higher altitudes in the corona, similar to the behaviour of H-alpha post flare loops (Bruzek, 1969; Svestka, 1976) and the X-ray loops (Pallavicini et al., 1975; Rust and Webb, 1977).

Ascending motions of microwave sources were also reported by Kosugi et al. (1983). Out of 15 events of Post Burst Increases at 17 GHz, where the source distance from the center of the Sun ś disk was larger than 7 arc minutes measured with the Nobeyama interferometer, 12 sources showed gradual ascension with a velocity of some 10 km s⁻¹.

It has been speculated that the observed microwave PBI sources at 17 GHz after cooling become visible as the H-alpha loops. The low spatial resolution at microwaves however does not allow to prove or disprove this hypothesis.

REFERENCES


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SAŽETAK

Mikrovalne karte Sunca dobivene na valnoj dužini od 8 mm u Radioistraživačkoj postaji Metsähovi u periodu 1978. - 1982. godine pokazuju desetak izvora radio zračenja koji se nalaze na visinama i do 50 000 km iznad fotosfere. Ovdje opisujemo dva karakteristična izvora povezana s velikim bljeskovima koji su se odvijali blizu ruba Sunca.