DECAMETRIC RADIO BURSTS ASSOCIATED WITH CORONAL LOOP STRUCTURES

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The soft x-ray (2-54 Å) pictures obtained by the S-054 experiment aboard SKYLAB provide an excellent opportunity to study the association of x-ray loop structures with radio bursts. We report here on the properties of meter-decameter wavelength radio bursts which appear to be associated with two different types of loop structures:

a) Relatively short lived small scale loops, which are observed to link magnetic fields of opposite polarity, called x-ray bright points (XBPs); and

b) Longer lived loop systems which appear to connect opposite magnetic polarities of an active region and active region complexes as well.

a) Meter-decameter Bursts Associated With XBP Flares.

A fraction of the XBP's exhibit sudden, substantial increases in surface brightness which in larger regions would be termed flaring (Golub et al. 1974). It has been suggested that such events constitute the simplest manifestations of the flare process. It is, therefore, of interest to investigate if there are instabilities in the corona, as manifested for example by type III bursts, produced by streaming electrons generated by the flare process.

To study the association of type III bursts with flaring XBP's we selected two time intervals during which the level of flare and radio activity were low, in order to minimize chance coincidences. These intervals extended from 17 June to 14 August 1973 and from 10 to 19 September 1973. Brief periods, when large flares occurred or storm activity was present were omitted.

The overlapping radio and soft x-ray observations covered a total of 430 hours. During this time 29 XBP flares were detected. Faint type III bursts were associated with 4 of these events. As the main criterion for the association we required that the type III bursts and the XBP flares occur within one minute of each other. We note that the exposure time of the soft x-ray photographs used by us was 64 s. The temporal resolution of the radio observations was 1 second. The spatial resolution

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of the x-ray photographs was of the order of a few arc seconds, two orders of magnitude higher than that of the radio observations. Therefore, we used the radio positions only to eliminate those type IIIs which coincided in time with a flaring XBP, but occurred at distant locations. Only one such burst was found in our sample.

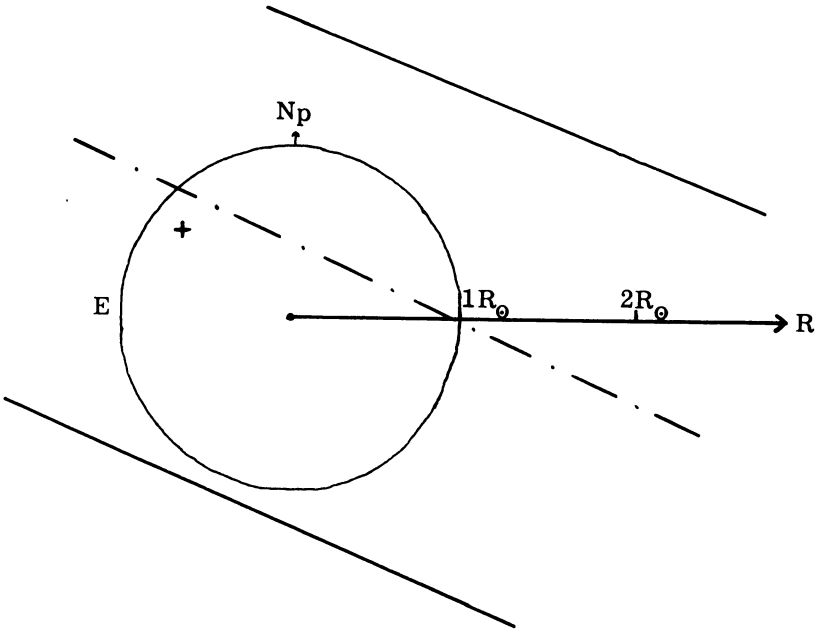

Figure 1. Shows the 30 MHz position of the burst associated with an XBP flare which occurred at $22^h\ 29^m$ UT on 12 July 1973. The position of the flaring XBP on the disk is indicated by the cross. The full lines indicate the extent of the type III burst source, the dotted line its centroid. Only N-S positions were available for this burst. No Hα flare was reported to occur during the 10 hour period centered on the event and the type III burst was the only one in five days of observations, centered on the date of the event. We feel certain that two of the other three associations found by us are genuine. In the third case the type III burst may have been associated with a small Hα flare which occurred a few minutes after the x-ray event. All type III bursts observed in association with the flaring XBPs were weak. Unfortunately, no flux density is available for any of the bursts. The simple detection of the type III bursts from the flaring XBPs is interesting, however, because it identifies them with the basic flare process where plasma radiation take place. A full description of this study will be published by Kundu et al. (Ap. J. Letters 1980).

b) Association Of Type III Storms With Large Scale Loop Systems

We studied the decameter wavelength radio emissions associated with long lasting loop systems, connecting active regions through the corona. Indirect evidence has suggested that decametric storms are associated

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with such large scale loop systems (Gergely and Kundu, 1975, Gergely and Erickson, 1975). We used the synoptic x-ray maps prepared by the AS&E group for Carrington rotations 1601 to 1608 for this purpose.

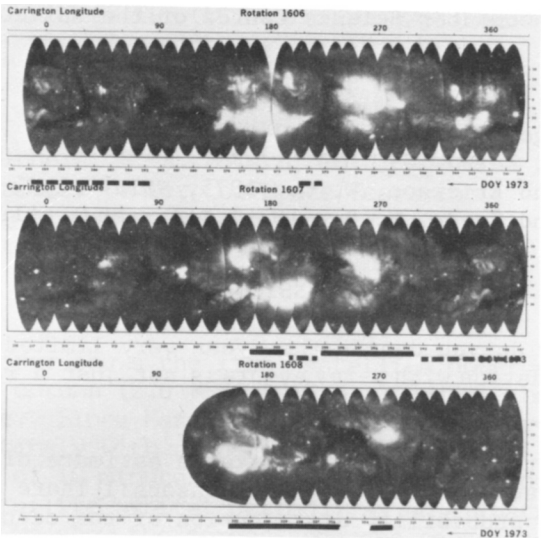

Figure 2. Shows the synoptic x-ray maps prepared by the AS&E group, for Carrington rotations 1606, 1607, and 1608. The full lines under the map indicate the presence of decametric storms on the disk; the dashed lines indicate periods for which no radio data were available. Inspection of the data lead us to make the following general conclusions:

1) Decametric storms are without exception associated with large scale x-ray loop systems.

2) Not every large scale loop system observed in x-rays is associated with a decameter storm. For example, the loops near Carrington longitude 360° during rotation 1605 and 1606, which later disappeared, were not associated with storms.

3) Occasionally a storm is associated with a loop system during one rotation, disappears during the next rotation, and then reappears. For example, the storm associated with the large loop system which extends from longitude 90° to 180° on the disk is one such case.

4) Decametric storms do not seem to be confined to any given phase of the evolution of the loop system.

It appears therefore that the presence of active region loop complexes on the disk is a necessary, but not sufficient condition for a decametric storm to occur. Some other conditions, possibly related to the geometry of the magnetic field must play an important role. The details of this study will be published elsewhere.

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Gergely, T. E. and Kundu, M. R.: 1975, *Solar Phys.* 41, 163.

DISCUSSION

Stone: How do you decide that your very limited sample of weak type III's correlation with x-ray events is not just a random occurrence of type III?

Gergely: It is difficult to make an estimate of the probability of chance occurrences because of two reasons: 1) There is not enough data to establish the probability distribution of the occurrence of XBP flares in time. 2) The average occurrence of type III's is not constant, but varies greatly from week to week, month to month, or as a function of the solar cycle.

However when one observes only one type III burst in five days, as is the case for the type III observed on July 12, 1973; and this burst occurs within one minute of the XBP flare I believe that the probability of a chance coincidence is small indeed.