EVOLUTION OF AN ACTIVE REGION AND FLARE PRODUCTIVITY

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Abstract

We have studied the evolution of an active region (AR 7515) in terms of flare productivity. This region appears at the east limb on May 23, 1993 and then continues its onward march across the disk. We follow its evolution until June 2. This region produces many small flares. We study the topology, both magnetic and structural of the neighboring regions as observed at 17 GHz by the Nobeyama Radio Heliograph (NRH) and the Yohkoh/SXT to find their effects on the flare-producing AR. We investigate the spatial structure of the flaring region from 17 GHz and SXT maps during various times of the impulsive and decay phase, to understand the difference in the flaring region spatial structure during the preflare, impulsive and decay phases. In general, the maps made during these phases show several loops. We try to relate these flaring loops with the preflare active region structure.

1. Ten Days in the Life of an Active Region

We have collected a large amount of data on the evolution of an active region NOAA 7515 and have observed over 30 flares at 17 GHz originating from the same AR over the period May 23 to June 2, 1993 using the Nobeyama Radioheliograph. We have studied the behavior of the active region in relation to flare productivity. In this paper we show only one day's data, namely May 28, 1993, and then summarize some general conclusions. These conclusions are based primarily on the Nobeyama data.

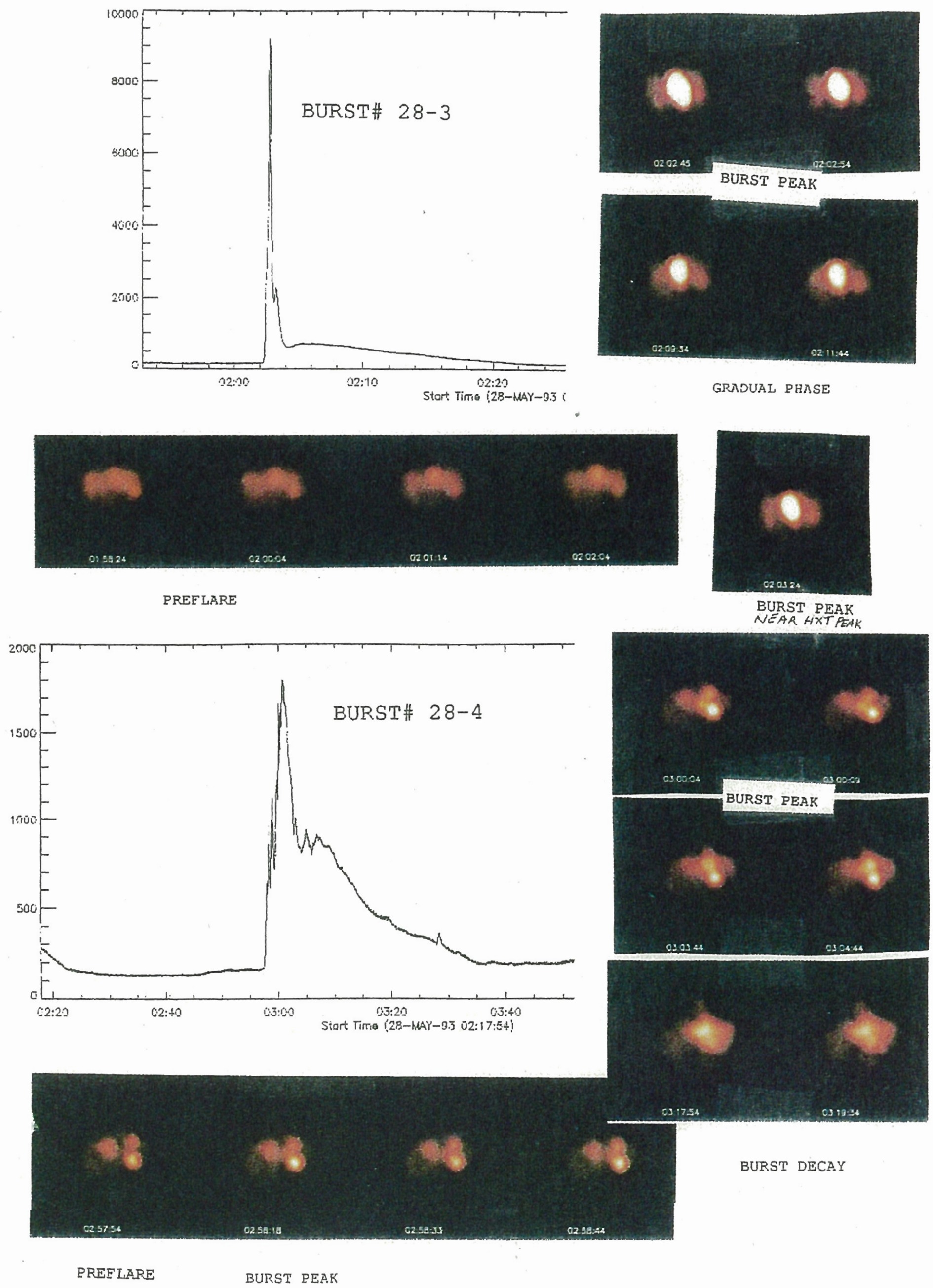

Fig. 1. Snapshot images (field of view about 5'x 5') at 17 GHz at various phases – preflare, burst peak, burst decay and gradual phases of two flares observed on May 28, 1993.

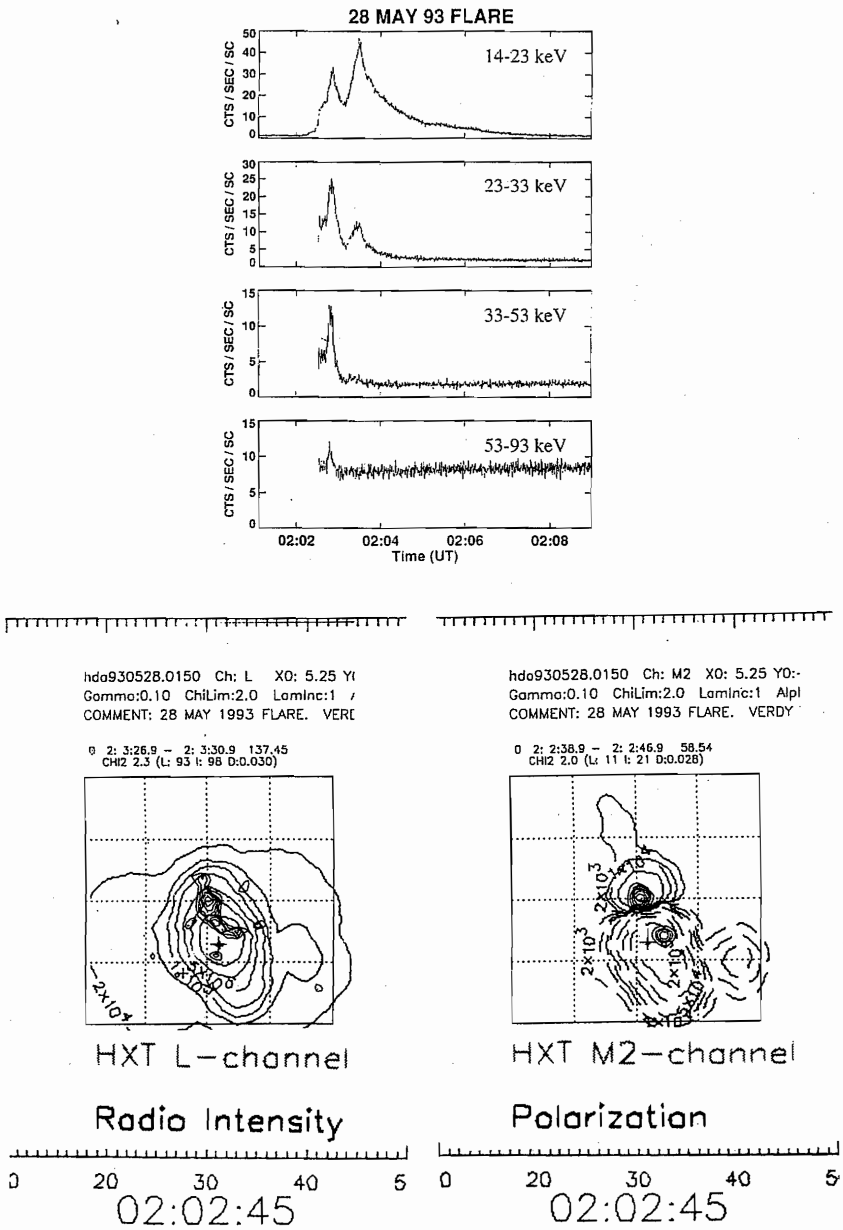

Fig. 2. (Top) Yohkoh/HXT intensity versus time curves in various energy channels for the burst #28-3 shown in Fig. 1. (Bottom) 17 GHz intensity (left) and polarization (right) contours superposed on Yohkoh/HXT maps (red contours) for the burst #28-3. Field of view is about 5' x 5'.

2. Summary and Conclusions

The time profiles of the bursts shown are correlated amplitude of the 350 longest baselines of the array versus time. Nominal spatial resolution of the array is 10" arc. In practice, resolution achieved is more like 15" arc. Field of view of each image is about 5' x 5'. Polarization data are available but not shown. The following conclusions are primarily based upon Nobeyama Radioheliograph data at 17 GHz and Yohkoh/HXT data (Figs. 1 and 2).

1) Frequently a flare starts with the appearance of a new region or a loop which interacts with a pre-existing loop; this interaction acts as a flare trigger.

2) There appear to exist multiple sets of interacting loops in the same active region. Different bursts on the same day and originating from the active region seem to come from different sets of interacting loops.

3) Sometimes two or more sets of interacting loops can activate at the same time, giving rise to different peaks in the same burst. In the decay phase of some bursts, there may appear a new or reactivated region/loop which becomes the source of new burst emission.

4) A simple spiky burst in general originates from a narrow region and by implication from a compact set of interacting loops.

5) We have compared radioheliograph images of one burst (burst #28-3) with HXT images. At the peak of burst #28-3, HXT images in M2 channel show two sources which correspond to two opposite polarities of 17 GHz source. Hard X-rays of lower energy (L channel) seem to fill the entire loop. Peak brightness temperature for burst #28-3 is 5×10^6 K. Peak degree of polarization for burst #28-3 is 40%.

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