Flares in the Region NOAA7270 Observed with the Nobeyama Radioheliograph

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Abstract

The Nobeyama Radioheliograph observed the flare-productive active region NOAA7270 appeared in September 1992 and caught many flares. The advantages of the Radioheliograph observations enables us to study some interesting features. Some of them, successive flarings and the radio and hard X-ray spectra are briefly reviewed here.

1. Introduction

The active region NOAA7270 appeared in September 1992 is one of the most flare-productive active region for the Nobeyama Radioheliograph, which started the regular observation in June 1992. The radio flares in this region are generally rather gradual, besides the radio flares in the region NOAA7260 and 7321, which were discussed in the meeting are generally impulsive. Since the characteristics of the radio flares strongly depend on magnetic field configurations, the difference in the flare characteristics suggests the difference in the magnetic field configurations related to the flare occurrence.

On September 5-6, several magnetic bipoles rapidly emerged at once and the magnetic features in the region became very complicated one. Magnetograms obtained with the Flare Telescope at Mitaka on these days are shown in Figure 1. Many flares occurred due to the rapid development of the region. The Nobeyama Radioheliograph observed nine M-class flares and numerous C-class flares in the region NOAA7270 in September 5-9.

Since the general features of this region in soft X-rays, hard X-rays, and Hα are described in other papers appeared in these proceedings, we present interesting features in the radio images of the flares in this paper to encourage future collaborations. In Section 2, successive flarings are described. In Section 3, relations between time profiles of flares in radio frequencies and those in hard X-rays are described.

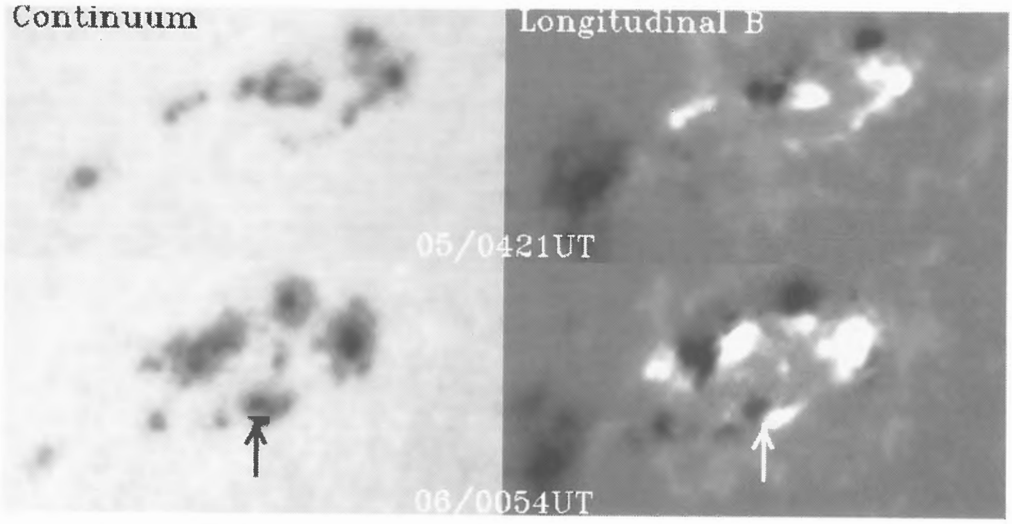

Fig. 1 Continuum images and magnetograms of longitudinal fields of NOAA7270 on September 5 and 6 obtained with the Flare Telescope at Mitaka. White stands for positive polarities, and black stands for negative polarities in the magnetograms.

2. Successive Flarings

On September 6, the flare activity was especially high. Sometimes several flares, which were related to each other, occurred successively in short times. In Figures 2 and 3, two examples of the successive flarings are shown.

In the flares during 00-01^{h}UT shown in Figure 2, the sources 1, 2, and 3 were brightened successively. The source 3 consists of two bright points; they are double footpoints of a flare loop.

In the flares during 02-03^{h}UT in Figure 3, the source 1 was impulsively brightened and reached the maximum first. Before the brightening of the source 1, the source 2 started the gradual brightening and it reached a maximum at 0208UT. After the source 2 reached the maximum, the sources 3 and 4 were brightened gradually. The source 3 reached the maximum at 0226UT. The source 4 shows two footpoints first, and then the loop which connect the footpoints was appeared and it decayed gradually.

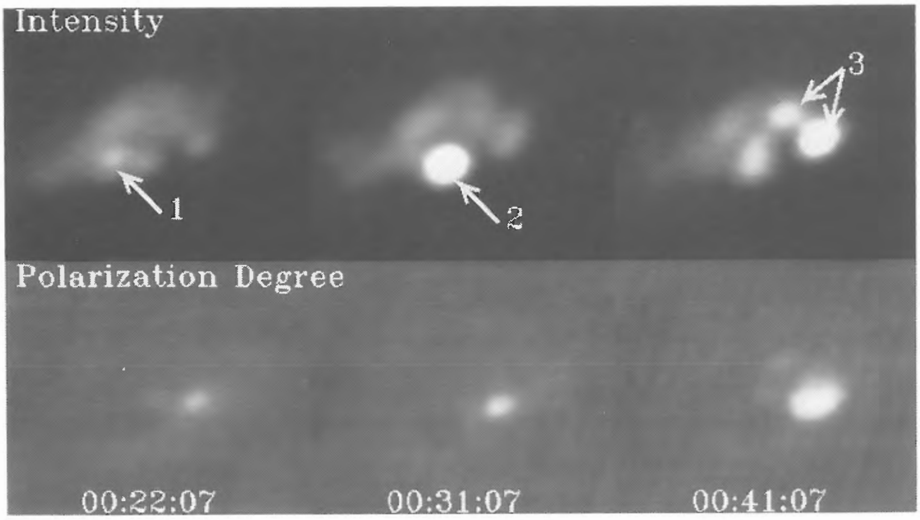

Fig. 2 Successive flarings during 00-01^{h}UT on 1992 September 6 observed with the Nobeyama Radioheliograph.

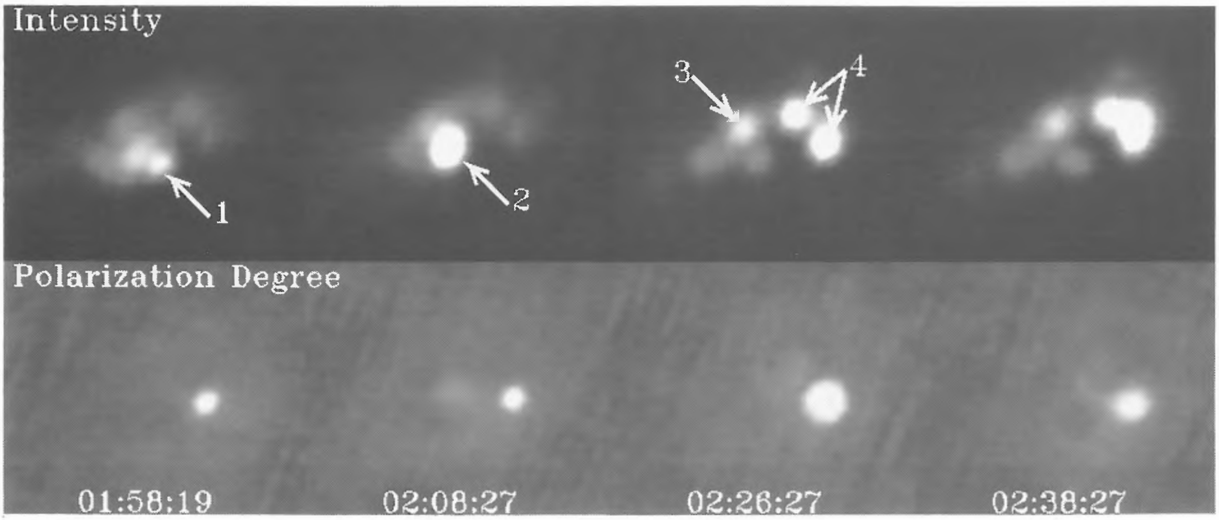

Fig. 3 Successive flarings during 02-03^{h}UT.

The positions of the sources of these successive flarings are shown is Figure 4. In both flares the first brightened points are around the same region. Consulting the magnetograms in Figure 1, we can find that the newest emerging flux, which is directed by arrows in Figure 1, corresponds the first brightened points.

This active region consists of several magnetic bipoles and it shows very complicated structure. Magnetic free energy should be stored in various places. In particular the magnetic fields at the newest bipole are probably most stressed. Therefore the first manifestation of the flares tends to occur at the newest bipole, and due to the abrupt magnetic field change by the first flare, the other flares occurred successively. This is the scenario of the successive flarings.

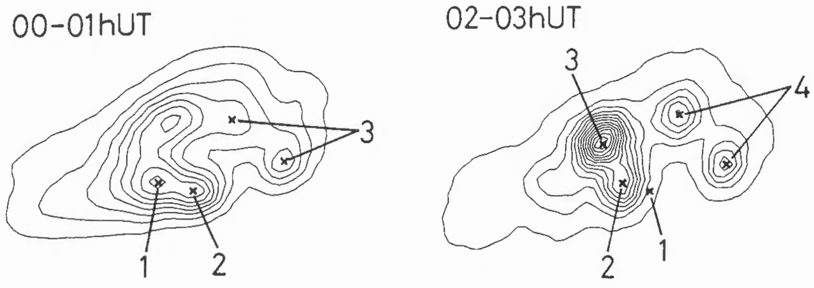

Fig. 4 Flare sites of the successive flarings on the contours of the radio maps.

Radio images generally show footpoint brightenings at the early phase of flares. In particular the Radioheliograph can catch smaller flares because of its high sensitivity. Therefore the observations of such successive flarings with the Radioheliograph show how the flare triggerings propagate from a bipole to another bipole.

3. Relation between hard X-rays and 17GHz

In general hard X-ray time profiles of flares are similar to those at 17 GHz. For example, time profiles of an M2.4 flare at 0519UT (GOES) on September 6 at 17GHz and in hard X-rays observed with the *Yohkoh* HXT shown in Figure 5 are very similar to each other. Even small fluctuations are seen in both time profiles. Therefore such fluctuations shows actual fluctuations in electron accelerations.

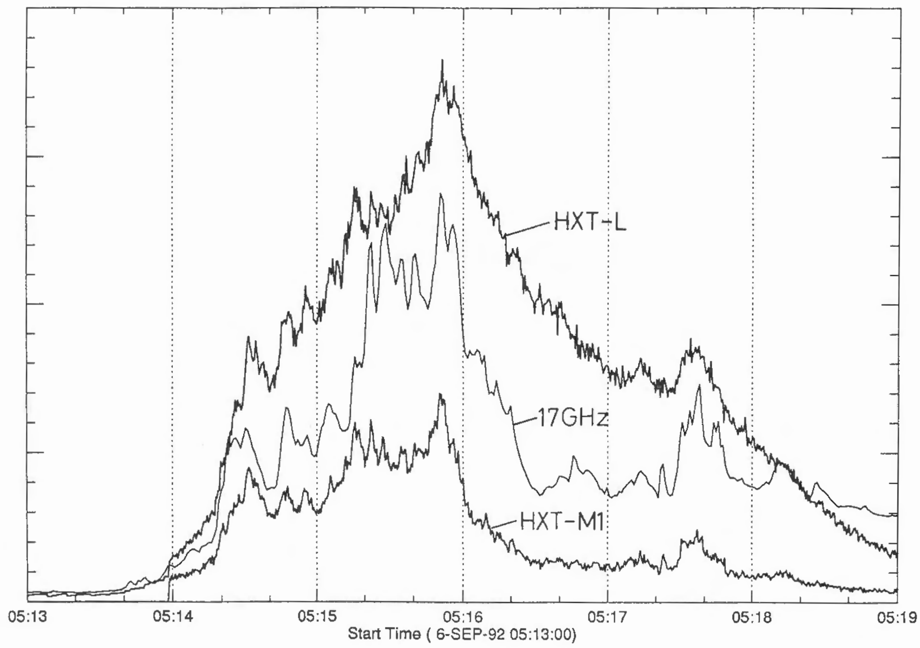

Fig. 5 The time profiles in the M1-channel of the HXT and at 17GHz(correlation) of the flare at 0519UT (GOES) on September 6, 1992. The correlation at 17GHz is averages of Fourier components in higher spatial-frequency region. It is a good index of flare activities. The scale in ordinate is arbitrary.

However, the flares during 02-03^{h}UT shown in Figure 3 are not the case. Time profiles of this period in various frequencies are shown in Figure 6. The brightening of the source 1 in Figure 3 at 0158UT, which was not so intense at 17 GHz, was the strongest one among the brightenings during 02-03^{h}UT in hard X-rays. However, the peak at 0158UT is clearly seen at lower frequencies. Other brightenings during 02-03^{h}UT, which were strong at 17GHz, show only weak hard X-ray radiation. The facts that the turn-over frequency of the 0158UT peak is low and that no polarization was observed at this peak suggest low magnetic-field strength at the source. The peak at 0208UT and the gradual brightening from 0220UT have higher turn-over frequencies than the 0158UT peak. Such differences in the relation between radio and hard X-rays imply the differences in the magnetic fields of the sites of flares. Therefore we can obtain information on magnetic field of the flare sites from the radio observations.

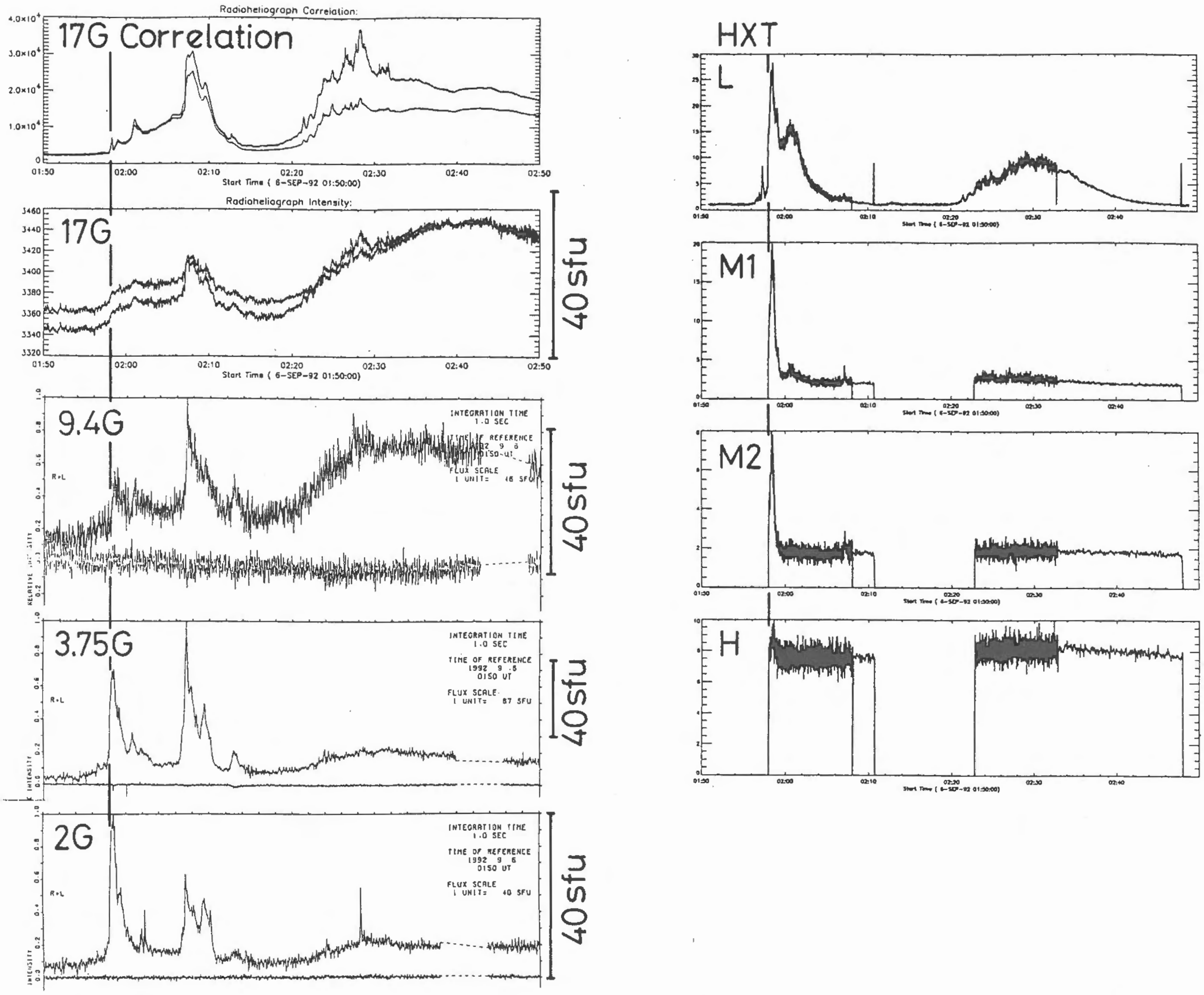

Fig. 6 Time profiles at 17 GHz (the Nobeyama Radioheliograph), 9.4 GHz, 3.75 GHz, and 2 GHz (Toyokawa data) in radio frequencies and those in the L, M1, M2, and H channels of the HXT during 0150UT-0250UT. The vertical lines show 01:58:00UT.

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