

# Flares on September 6, 1992

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## Abstract

We present some preliminary results of our observational study of typical eruptive flares in NOAA7270 on September 6, 1992. (1) Magnetic shear and flux emergence are strongly related to flare production. (2) Observed flares showed a common temporal relation between cool plasma dynamics seen in  $H\alpha$  and coronal energy releases seen in YOHKOH data.

## 1. Introduction

NOAA7270 produced many M or C class flares on Sep 5-7, 1992. The region grew its area rapidly during this period, and formed  $\delta$  type magnetic configurations at 4 parts of the region on Sep 6. All the flares were observed to be related to these  $\delta$  type magnetic configurations. Here we report the results of  $H\alpha$  optical observation of the eruptive flares on Sep 6, at the DST of Hida. We will also discuss the results of cross-comparative analyses of YOHKOH observations of the flares, especially on the spatial and temporal relations of  $H\alpha$  mass explosion, SXT brightenings and HXT bursts.

## 2. Evolutional Characteristics of NOAA7270

As can be seen in figure 1, NOAA7270 evolved rapidly from Sep 5 through Sep 7. On Sep 5, there appeared an EFR at the northern part of the preceding spot ( EFR A ). The axis of the EFR was directed nearly along the N-S direction. On Sep 6, the axis of the region rotated in counter-clockwise direction. And the distance between opposite polarities grew rapidly. As a result of these motions of rotation and separation, a highly sheared magnetic structure was formed on Sep 6. M-class flares occurred at this site of the region repeatedly.

The emergence of another EFR ( EFR B ) was essential to the evolution and the activity of NOAA7270. The EFR B appeared at the central part of NOAA7270, pushing the pre-existing magnetic structures aside on Sep 5-6. The specific character of the EFR was its way of emergence. The magnetic structure was highly sheared since the beginning of the emergence.  $H\alpha$  features in the region were nearly parallel to the magnetic neutral line. This site was also active for producing M-class flares on Sep 6.

### 3. Flares

On Sep 6, following four M-class flares were observed (figure 2):

(1) M1.0/1N flare ( 0156-0225 UT ) : Threads or low-lying filament were observed on a magnetic neutral line. Part of the filament was highly excited and a bright loop in  $H\alpha$  was observed to expand with a velocity of 200 km/sec at the explosive phase. Following the initial expansion, an arcade system of  $H\alpha$  plasma, possibly situated underneath the covering neutral filament, started to expand. One or two minutes after the first  $H\alpha$  explosion, a hard X-ray burst started. In SXT images, two bright kernels, situated in opposite magnetic polarity regions, were observed.

(2) M1.1/SF flare ( 0232-0251 UT ) : Surrounding the leading spot, there was a system of superpenumbral filaments in highly sheared form. Parts of the filaments which emanated radially outwards from the leading spot, were gathered to a following spot, forming a twisted bundle of loops in  $H\alpha$ . After about half an hour of internal motions in the twisted bundle, the flare started. The flare itself was of a slow type. Soft X-ray flux increased and then decreased gradually. No hard X-ray bursts were detected in this flare.

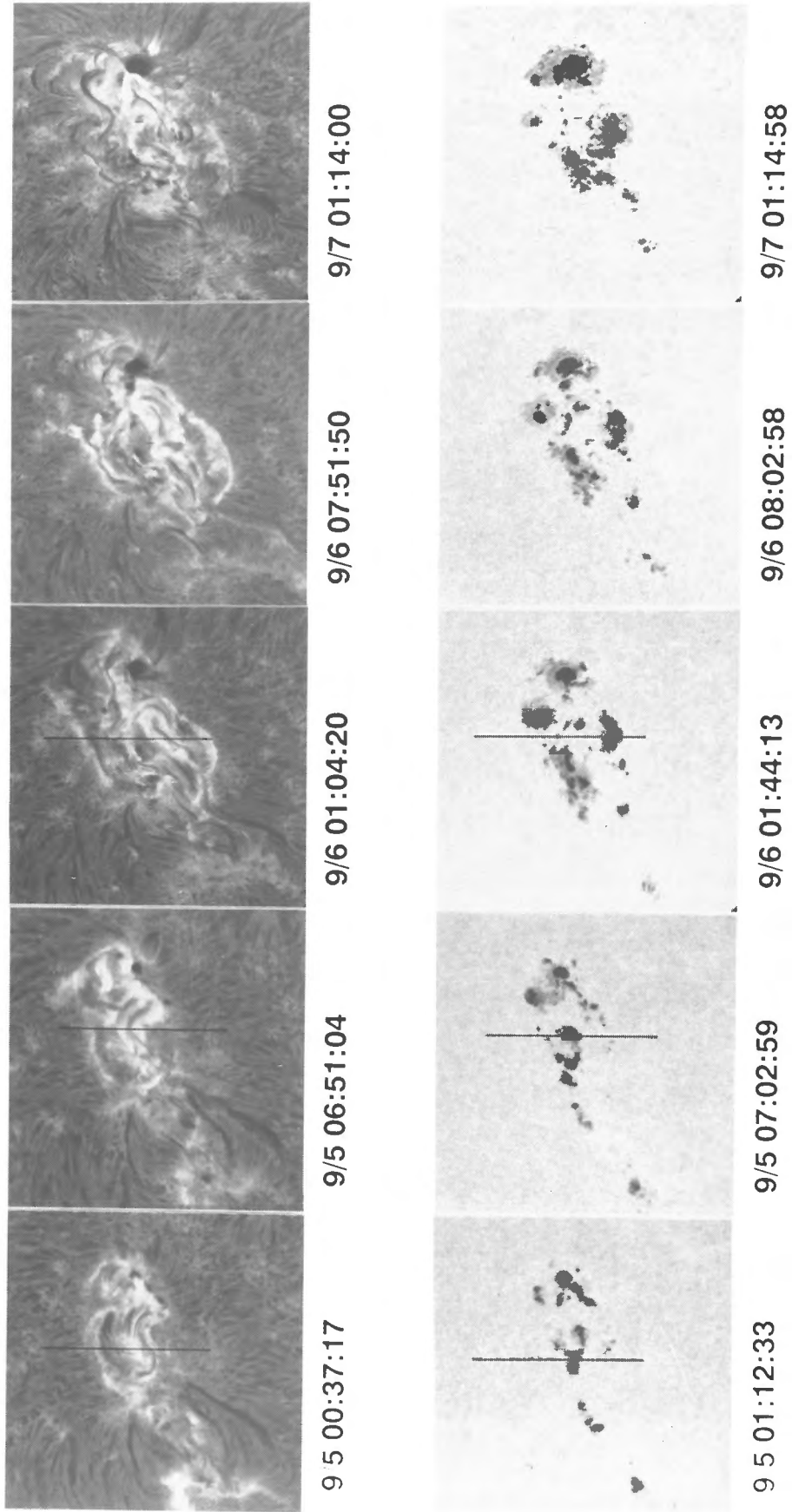
(3) M2.4/2N flare ( B0515-0614 UT ) : The flare occurred at the same part as the flare (2) with a similar  $H\alpha$  morphology, but was different from (2) in some respects. The flare firstly brightened at both sides of the neutral filament in  $H\alpha$ . In SXT images of YOHKOH, there appeared a bright loop, parallel to the magnetic neutral line, connecting two-ribbons of  $H\alpha$  bright patches. A filament eruption occurred at the explosive phase. Then there appeared another pair of  $H\alpha$  bright ribbons adjacent to the initial ribbons. A faint loop or a cusped loop in soft-X rays was observed, related to the second two-ribbons. A hard-X ray burst was also observed 1-2 min after the explosive phase.

(4) M1.3/1F flare ( B0657-0818 UT ) : The flare occurred at the same part as the flare (1) and showed a very similar behavior as the flare (1), though there were some differences in the explosive filament morphology.

### 4. Discussion

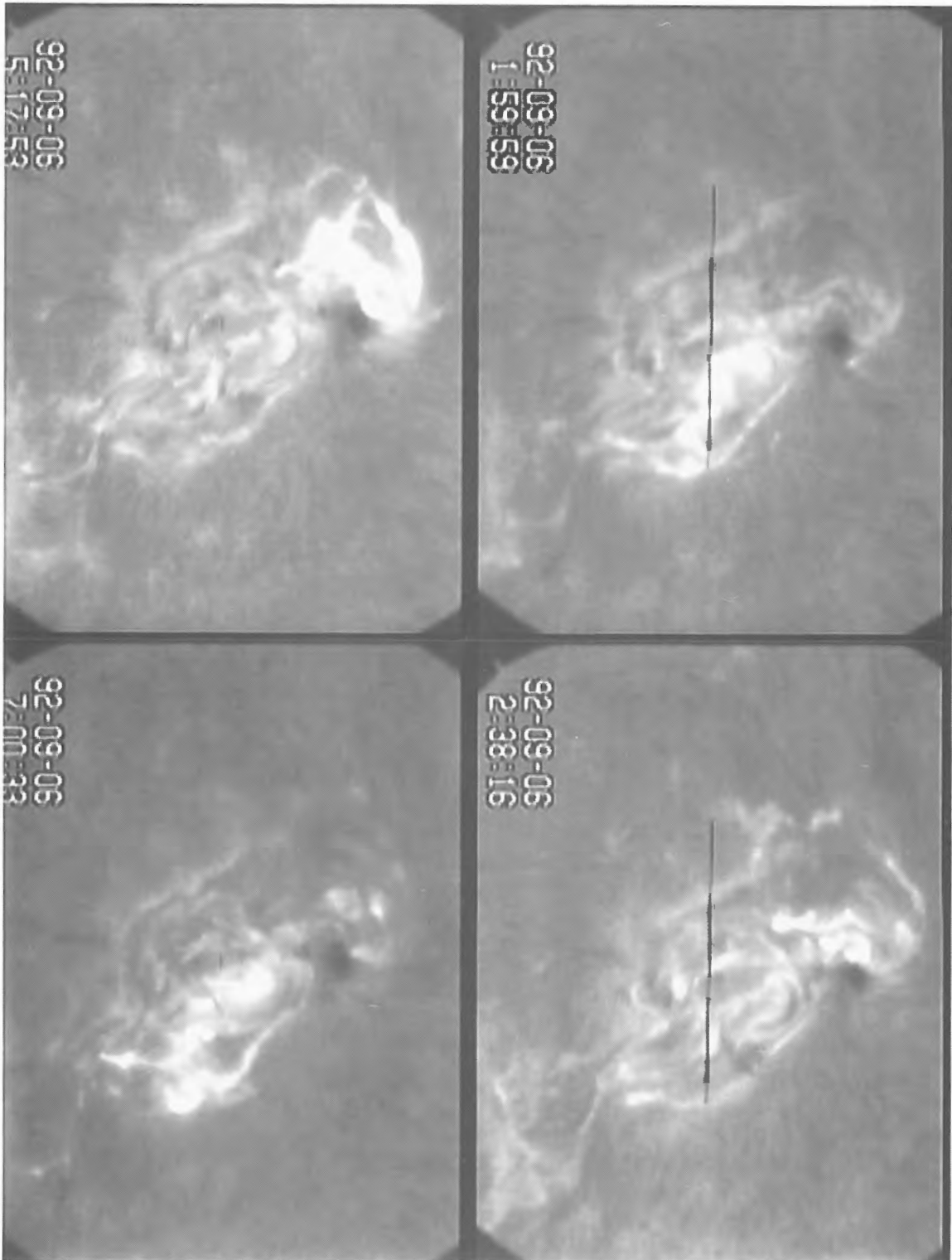
As was stated above, the characteristics of initial time evolutions of M1.0/1N flare ( 0156-0225 UT ), M2.4/2N flare ( B0515-0614 UT ) and M1.3/1F flare ( B0657-0818 UT ) were very similar to each other (figure 3). After the pre-heating stages of 5 to 10 min, there came explosive phases associated with  $H\alpha$  filament eruptions (  $v \simeq 200$  km/s ). Then about 1 to 2 min later, hard X-ray bursts started. We think that the observed temporal evolution is typical of erupting flares. Nearly simultaneous occurrence of  $H\alpha$  bursts of brightening, of filament explosions, and of soft-X ray bursts is a very interesting fact. It may indicate that sites of initial energy release of flares are not in high corona, but in lower layers, i.e., in the chromosphere or in the lowest layer of corona. From a quick look of  $H\alpha$  and SXT images in pre-heating and explosive stages of the observed flares, the initial energy releases of the flares occurred at very compact regions in the neighbourhood of neutral lines. This may also support the idea of energy releases in lower layers at initial phases of eruptive flares. Results of our detailed analyses will be published in another paper.

**NOAA7270  
SEP 5-7, 1992**



**Fig. 1. Temporal evolution of NOAA7270. Upper row : H $\alpha$  images. Lower row : Continuum images. North is to the top. East is to the left.**

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Fig. 2.  $H\alpha$  line center images of the four flares observed in NOAA7270 on September 6, 1992.

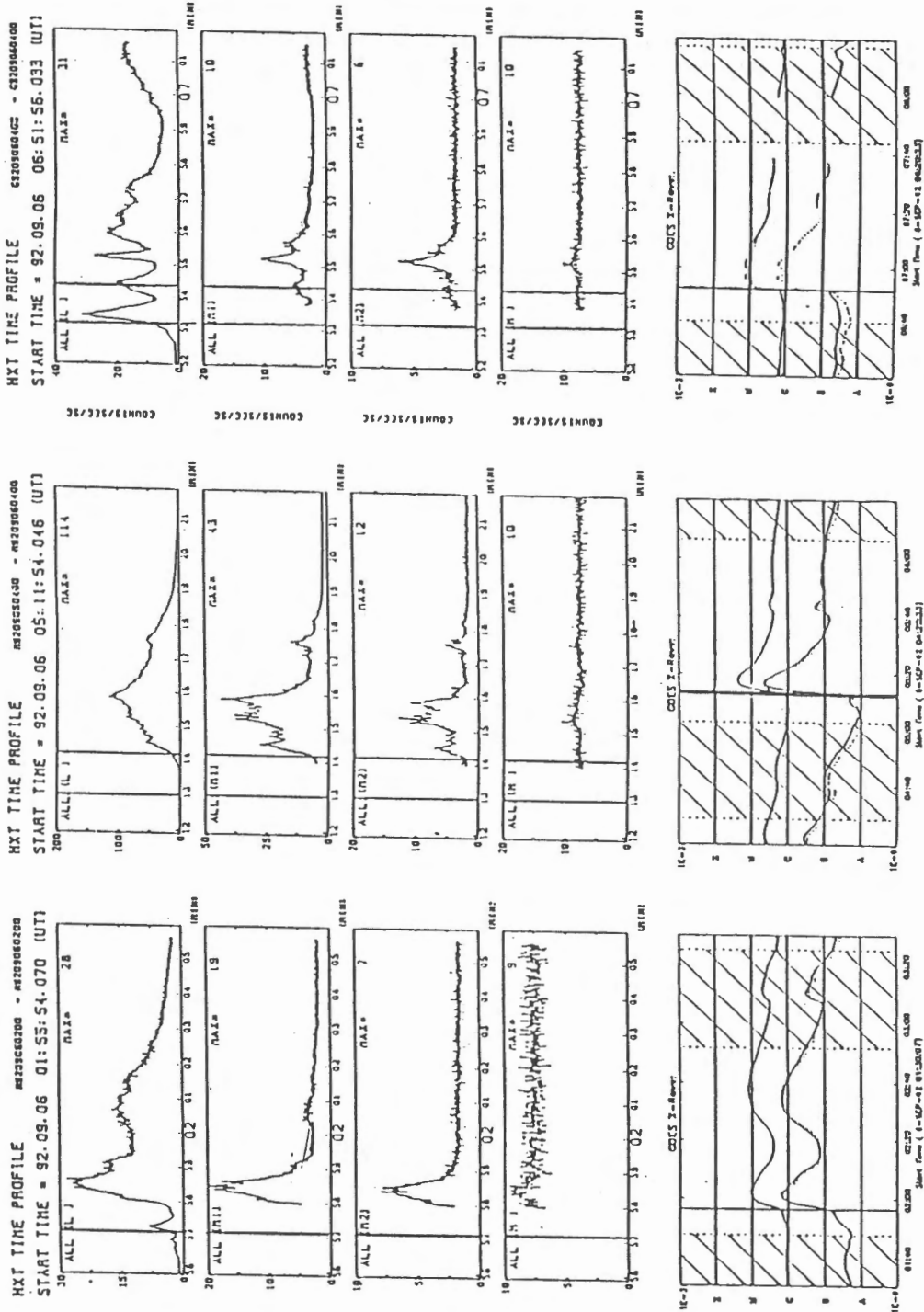


Fig. 3. Temporal evolution of the M-class flares observed. Top panels show time profiles in four channels of HXT of YOHKOH. Lower panels are GOES plots. Vertical bars in each panel indicate the start-times of H $\alpha$  explosions.