

SIMULTANEOUSLY OBSERVATIONAL STUDY OF FILTERGRAMS, VELOCITY AND VECTOR MAGNETIC FIELDS FOR A SOLAR FLARE ON 7 Oct. 1987

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Abstract In this paper are described the simultaneously observational results of filtergrams, Dopplergrams and vector magnetograms for a solar flare in the active region NOAA/USAF 4862 on 7 Oct. 1987 with the solar telescope-magnetograph of Beijing Astronomical Observatory. From the analyses of these data, some conclusions were obtained.

1. Observational Data In 0050-0110 UT on 7 Oct. 1987 a small solar flare, with its maximum at 0055 UT and an apparent area of 27×10^{-6} solar disk, occurred in the active region NOAA/USAF 4862 (N33, E16) (Solar-Geophysical Data, 1987). The high-quality chromospheric filtergrams and Dopplergrams (in H_{β}) as well as the photospheric filtergrams, longitudinal and transverse magnetograms (in Fe I 5324) were obtained simultaneously with the solar telescope-magnetograph of Beijing Astronomical Observatory around the flare period (Table 1).

Table 1. Observations around flare period

UT	Observation	Wave Length
0031	Photospheric filtergram	Fe I 5324
0035	Photospheric longitudinal magnetogram (B_{\parallel})	Fe I 5324
0055	Chromospheric filtergram	H_{β}
0058	Chromospheric Dopplergram	H_{β}
0114	Photospheric longitudinal magnetogram (B_{\parallel})	Fe I 5324
0124	Photospheric transverse magnetogram (B_{\perp})	Fe I 5324

The 35 cm telescope is equipped with a tunable birefringent filter of 0.12Å (H_{β}) and 0.15Å (Fe I 5324) bandwidths. (The Cooperative Development Group, 1985; Ai and Hu, 1986). A 4cm solar image is formed on the focal plane where is installed a detector of CCD with 500×582 pixels, which corresponds to a view field of $4' \times 5.3'$. Thus the spatial resolution of the solar image on the display screen is $0.5''$. Because each measurement on the magnetograms was taken from the average of measurements in 3×3 pixels, the spatial resolution of magnetograms became $1.5''$. The temporal resolution of filtergrams is $1/12.5$ second, while that of the Dopplergrams and magnetograms are 40 seconds (255 superposition). The sensibilities of measurements for B_{\parallel} and B_{\perp} are 20-30 gauss and 150 gauss respectively, whereas that of Dopplergrams is 40m/sec.

In Fig.1 are shown the filtergrams in Fe I 5324 and H_{β} , H_{β} Dopplergrams and B_{\parallel} magnetograms for the NOAA/USAF 4862 around the flare period. Also in Fig.2 and Fig.3 are shown the B_{\parallel} and vector magnetograms with contours.

2. Analyses and Conclusions Since that the H_{β} emission of solar flares is far weaker than H_{α} emission and it mainly concentrate in solar kernels, so that the morphology of the flare in Fig. 1b is probably more similar to the H_{α} flare kernels. Usually these kernels are most likely developed from the original bright points in flares (Lin and Gaizauskas, 1987).

From the comparisons of Fig. 1b with 1c, Fig.2 and Fig.3, one can see that this flare consists of five kernels and only kernel B is located near the magnetic neutral line, others are situated much far from that (A in positive polarity; C, D and E in negative polarity). However all kernels are located in those regions where the transverse field B_{\perp} are quite strong, implying that they are likely located

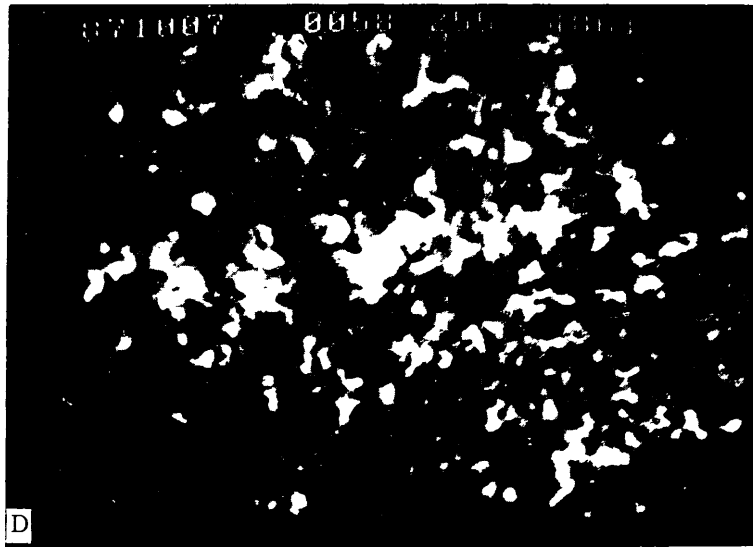
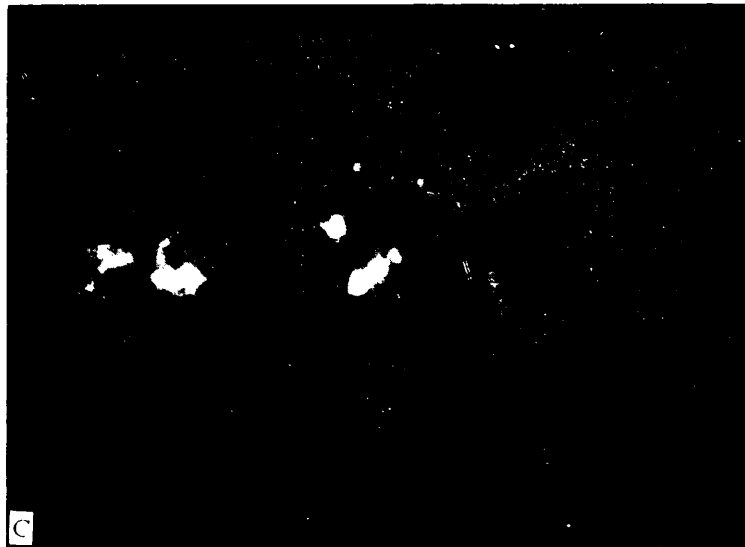
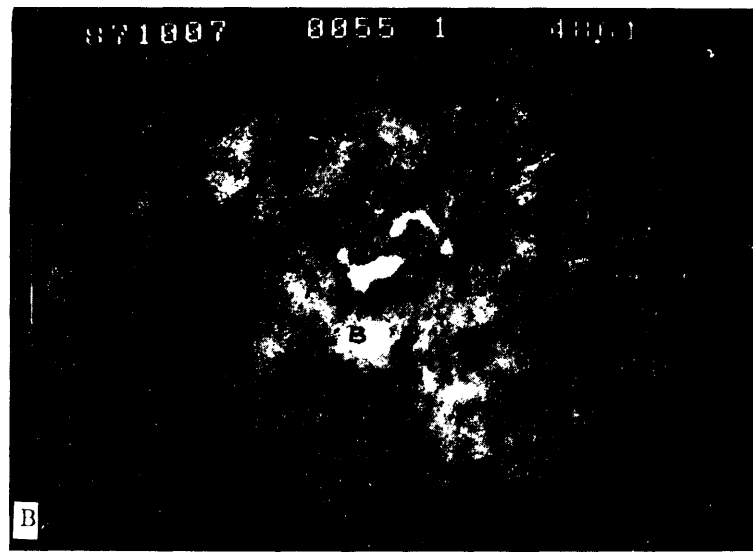
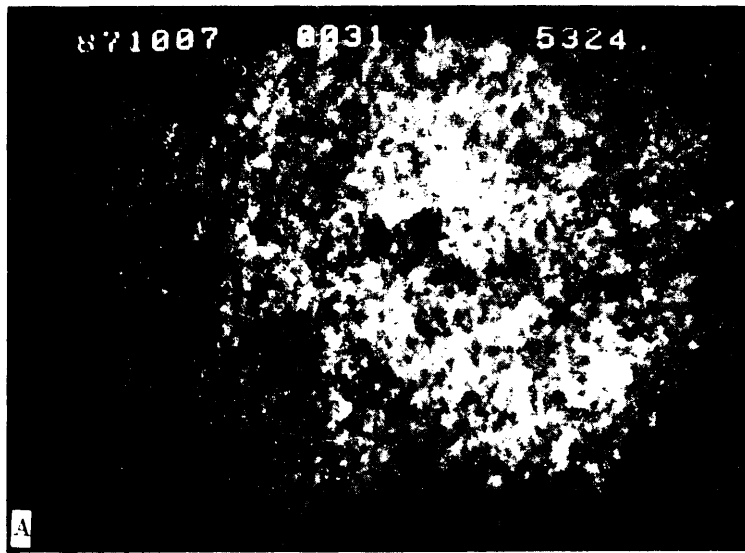


Fig. 1 Filtergrams, Dopplergram and B_v magnetogram of NOAA/USAF 4852 on 7 Oct. 1987. (All frames correspond to a view field of $4' \times 5.3'$). (a) Fe I 5324 filtergram (0031 UT). (b) H_α filtergram at flare maximum (0055 UT). (c) B_v magnetogram (0055 UT). Bright and dark regions represent positive and negative polarities respectively. (d) H_α Dopplergram (0058 UT). Bright and dark regions depict receding and approaching line-of-sight velocity respectively.

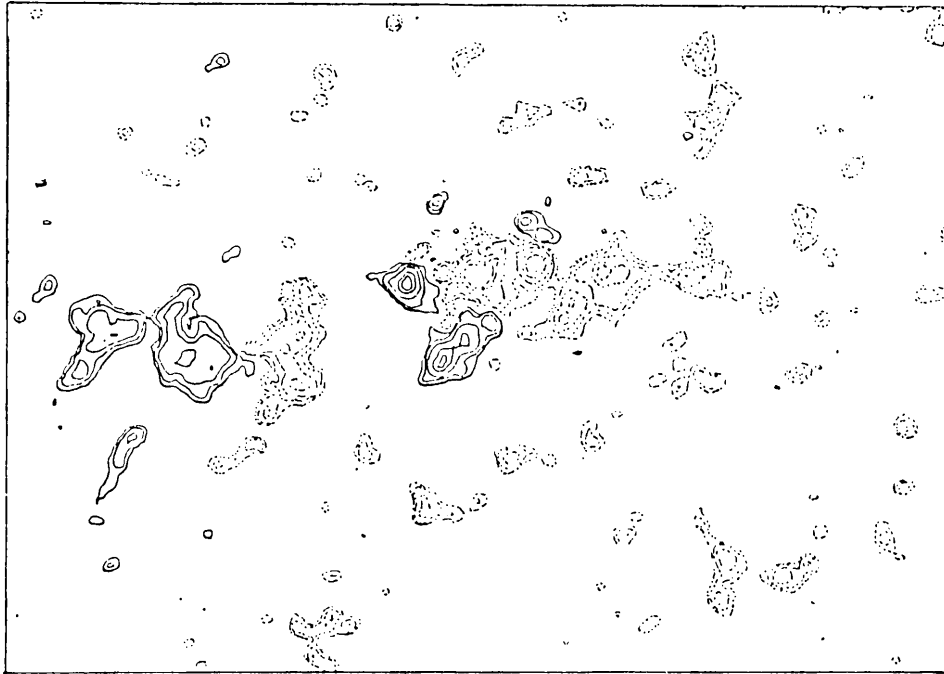


Fig. 2 The B_{\parallel} magnetogram with contours for NOAA/USAF 4862 on 7 Oct. 1987 (0035 UT). Solid and dotted contours indicate positive and negative polarities respectively. The contour levels are ± 20 , ± 10 , ± 80 , ± 160 , ± 320 , ± 640 , ± 1280 , ± 1600 gauss. The area shown is 270×190 arc sec^2 .



Fig. 3 The B_{\parallel} and B_{\perp} magnetogram with contours and line segments for NOAA/USAF 4862 on 7 Oct. 1987. Contours depict B_{\parallel} (0114 UT). The length and direction of line segments represent the magnitude and orientation of B_{\perp} (0124 UT). The area shown is 118×78 arc sec^2 . Bold contours indicate H_{β} emission.

in the regions with strong shear and hence maximum longitudinal electric current densities. These results are consistent with those in Lin and Gaizauskas (1987), Hagyard et al. (1984), and Hagyard et al. (1985). The comparison of Fig. 1b with Fig. 1d indicates that all the positions of five kernels correspond to the bright regions in Fig. 1d, showing that the kernels possess line-of-sight velocities down to the solar surface. Further study are needed to determine whether this result support the theories which consider optical flares are caused by the accelerated particles from corona down to chromosphere.

Finally, comparison of two $B_{||}$ magnetograms at 0035 UT (preflare) and 0114 UT (postflare) shows that no remarkable difference could be found between them, and therefore it demonstrates once more that no substantial change occurred in longitudinal magnetic fields between onset and end of the flare.

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