Hard X-ray images at the flare on 1992 October 27

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Abstract

Hard X-ray images in the impulsive phase of the flare of 0145UT, 27 October 1992 are presented. The images show double source structure. One footpoint shows nonthermal spectrum, while the other shows thick target X-rays from super hot thermal electrons with 80 million degrees. This observation is consistent with the anomalous heat conduction model for the the loop flare.

Comment

Time profiles in four energy bands of the X-ray burst are shown in Figure 1. X-ray images in the three energy bands are shown in Figure 2, in which photon energy and the time of snap shot are indicated in each panel. The panel number of each X-ray map is identical with the numeral shown in the top panel of Figure 1 indicating the time range of snapshot of the X-ray map. The two peaks in the contour maps lie on the regions with opposite magnetic polarities. Consequently, the double source is probably foot points of a single coronal loop. The X-ray spectrum can be obtained from the brightnesses (counts/s/pixel) in the three energy bands. It is interesting that the average brightnesses on 3×3 pixels in each energy band in the lower source (B) at the Time (2) and (3) give a thick target spectrum from the electrons flowing into the chromosphere with quasi- thermal distribution, $T_e \simeq 8 \times 10^7$ K at the Time (3), otherwise power law spectral index for the X-ray photons is 3.6 between L and

M1 bands and 5.3 between M1 and M2 bands. The thermal electron number density is $2 \times 10^7 \mathrm{cm}^{-3}$ at the Time (3). On the other hand, the spectrum for the upper source (A) is nonthermal and seems to be a mixture of power law and thermal spectra. It becomes approximately power law at the Time (3) with the X-ray photon spectral index of 3.3, i.e., the index for electron energy is 4.8, and the electron number density above 15 Kev is $2.6 \times 10^7 \mathrm{cm}^{-3}$. This observation is consistent with the 'anomalous heat conduction model' presented by the simulation (Takakura, 1992) for the loop flares. These images are not compared with the radio contour maps yet, but the source (A) is probably much brighter than (B) in the radio maps.

References

Takakura, T. 1992, *Solar Phys.*, **142**, 327.

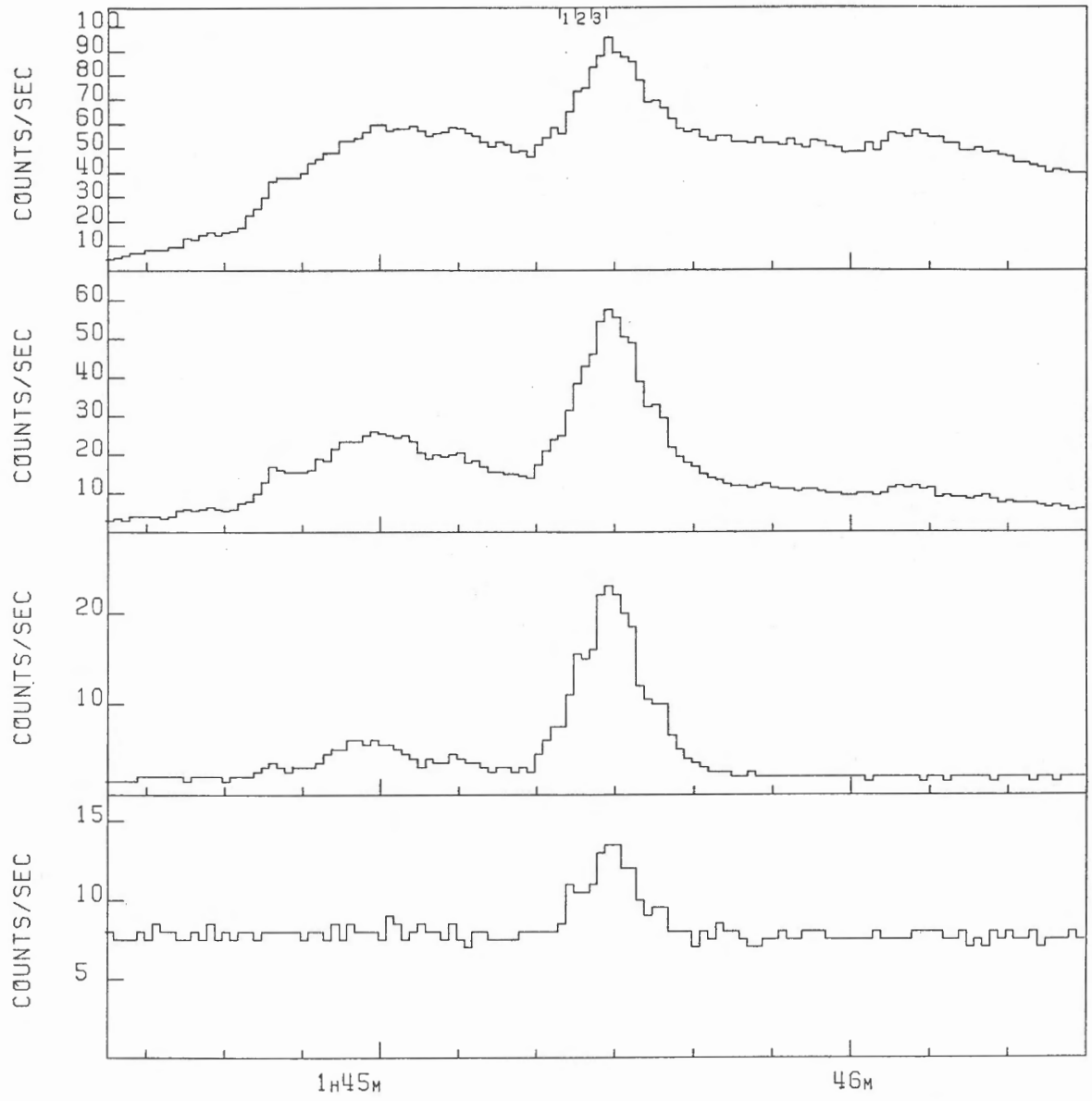

Fig.1. Time profiles of the X-ray burst on 1992 October 27 in four energy bands L, M1, M2, and H from top to bottom: L; 13.9-22.7 keV, M1; 22.7-32.7 keV, M2; 32.7-52.7 keV, H; 52.7-92.8 keV. Since the effective mean collecting area per each collimator is about 1 cm^2, the vertical scale is approximately X-ray flux ($c\,s^{-1}cm^{-2}$). The numerals marked on the curve in the top panel show the times of snapshots of X-ray maps shown in Figure 2.

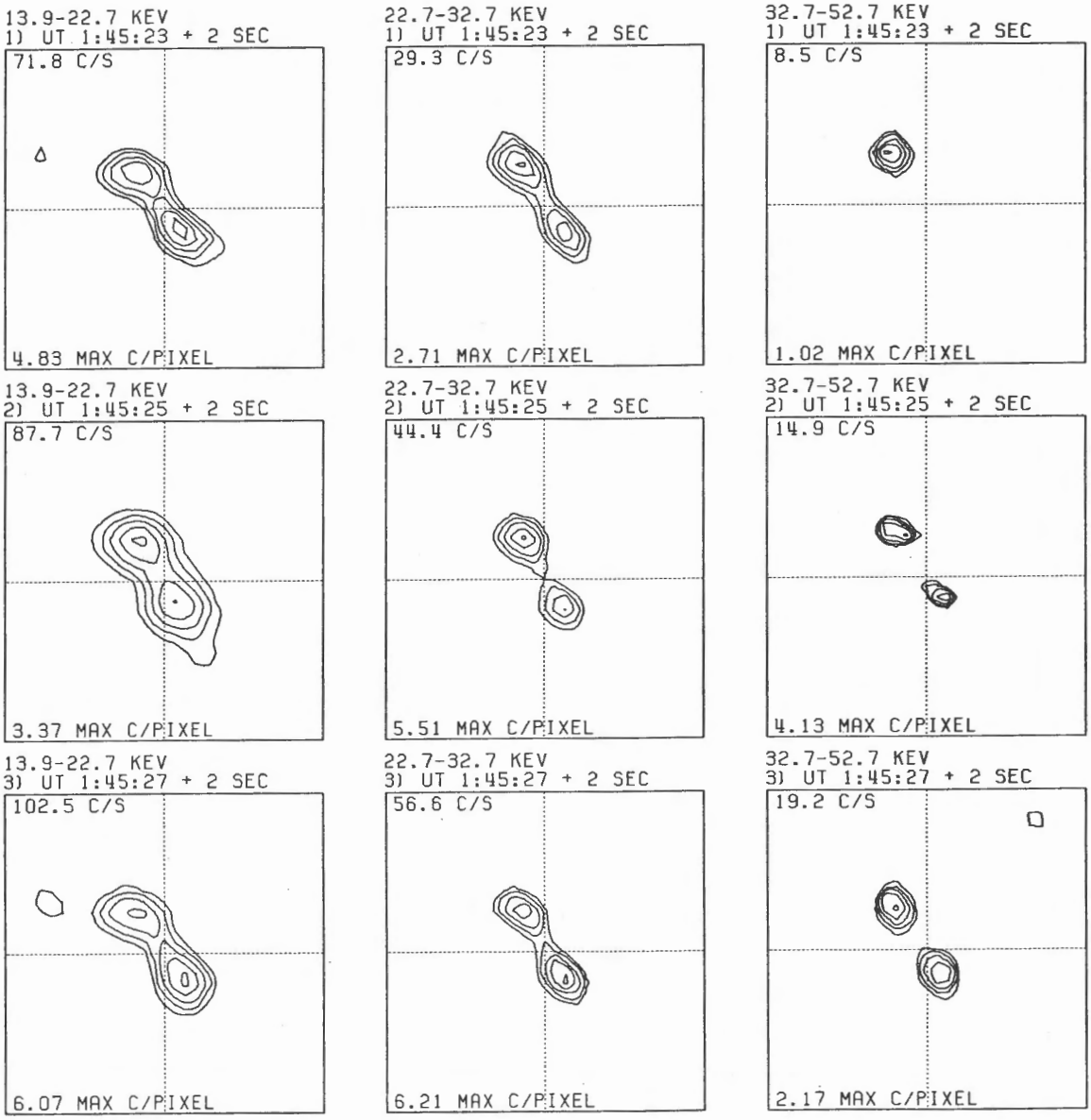

Fig.2. X-ray contour maps of the burst. The photon energy, the starting time and integration time of the map are shown in each panel. The panel number is identical with the numeral shown in Figure 1 indicating the time of the snapshot. The minimum contour level is 0.1 times the peak brightness in each map and the contour steps are logarithmic with $\sqrt{3}$ steps. The map size is 76.6 arcsec square. The map center is 4.663 arcmin west and 8.031 arcmin south from the solar center. The solar north is upward (y-axis) in the maps. In each panel, X-ray count/sec and count/pixel in the brightest pixel are shown.