Production of High Temperature Plasmas During the Early Phases of a C9.7 Flare. II. Bi-Directional Flows Suggestive of Reconnection in a Preflare Brightening Region

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The 2007 June 6 16:55 flare was well observed with high time-cadence sparse raster scans by the EUV Imaging Spectrometer (EIS) on board the Hinode spacecraft. The observation covers an active region area of 240″×240″ with the 1″ slit in about 160 seconds [1].

A preflare brightening to this flare, which started ~9 minutes prior to flare-ribbon onset, looks like two small loops apparently having a cusp-shape structure about 40″–50″ west of the main flaring loops. This interaction shows dyanamic behavior in velocity during the early phases of the flare: The HeII line at 256.32 Å shows the existence of a bi-directional flow along the Earth-Sun line of sight of about −70 and +100 km s^{-1}. On the other hand, the FeXVI line at 262.98 Å formed at higher coronal temperatures shows only a slight increase in intensity at the location of these loops, and the FeXXIII line at 263.76 Å barely appears. Electron density at the site derived from the intensity ratios of the FeXIV line pair at 264.78 Å and 274.20 Å is lower than the average of $10^{9.3}$ cm^{-3} in other parts of the active-region outskirts.

The FeIX images taken on Stereo-A/B reveal that two tiny loops may merge at first around 17:14:24 UT, and move south- or southwest-wards. A bright point located at the junction of the loops seen in the images taken at 17:19:24 UT may be considered as a candidate location where magnetic reconnection took place, triggered by the preceding interaction of these two loops. The S-E side loop exhibits more dynamic plasma motions via this energy deposition.

From these observations, the preflare-brightening region may be heated via magnetic reconnection taking place as a result of loop-loop interaction [2].

A similar type of transient phenomena is explosive events constantly occurring in the quiet-sun network, which are thought to be a manifestation of magnetic reconnection [3]. These phenomena appear as bi-directional jets in transition-region (TR) lines. Although the characteristics of flows in the event studied here are observed to be similar to those of TR explosive events, this event is associated to the occurrence of a major flare (C9.7), and plasmas are produced around the region heated more than 10 MK. The length of brightening loops are much larger than those of explosive events, and the locations of up- and down-flows in the TR are better spatially-resolved in these interacting coronal loops.

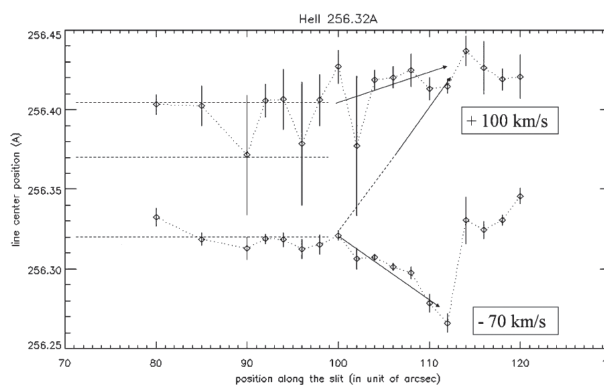

Figure 2: Line-center wavelengths of the two components in the HeII line window. Bars indicate the ranges of fitting errors. Horizontal dotted lines indicated the wavelengths of HeII λ256.32, SiX λ256.37, and FeX/XII λ256.405.

References

[1] Watanabe, T., Hara, H., Sterling, A. C., Harra, L. K.: 2010, *ApJ*, **719**, 213.
[2] Watanabe, T., Hara, H., Sterling, A. C., Harra, L. K.: 2012, *Sol. Phys.*, **281**, 87.
[3] Innes, D. E., Inhester, B., Axford, W. I., Willhelm, K.: 1997, *Nature*, **386**, 811.

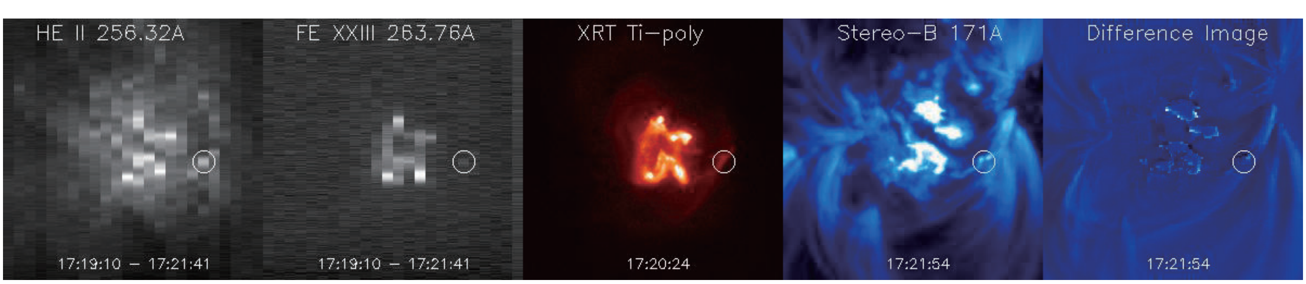

Figure 1: Coalignment among the EIS (HeII and FeXXIII), XRT (Ti-Poly), and EUVI-171 Å on STEREOB, and its difference of image to that of STEREO-A (top panels).