Magnetic Reconnection in SUVI Observations
(September 10, 2017 X8 Solar Flare)

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Shrinking Loops

Reeves et al. (2018)

When the field line is first reconnected, as shown in Figure 1 (left), the field line is connected to the X-point and has a cusp shape at the top. As time progresses, the loop disconnects from the X-point and relaxes to a more potential configuration, taking on a more rounded shape, as shown in Figure 1 (right). During this process, the footpoints of the loop are line-tied in the chromosphere, so that the footpoint ends of the loop do not move.

In this paper, we use two methods to study the apparent shrinking motion of the flare loops observed by the XRT. The first method was developed by Forbes & Acton (1996), and it determines the percentage of shrinkage of the postflare loops by comparing the altitudes of loop tops at different times. This method provides only an average value of how much a field line shrinks as it "moves" through the visible flare loop structure. In the second method, we extract a strip of the XRT image that intersects the flare loops and plot the changes in intensity in this strip as a function of time. This procedure provides a much more stringent test of shrinkage models if individual field lines can be identified and tracked within the flare loop system. At any given time, each field line will undergo a different rate of shrinkage depending on its position relative to the cusp point at the lower tip of the current sheet. Following several fields lines, therefore, provides a measure of shrinkage as a function of time and space rather than just a single average value.

Figure 2 shows a C2.1 flare observed on 2006 December 17. The images in the top row show the flare at two different times, and they have been edge-enhanced using the Sobel filter. The panel in the bottom left shows contours from each of these images overlaid. The crosses on the contours show the points used to calculate the altitude of the shrinking loops, as described below. There is some distortion in the inner edge of the contour at Fig. 1.—Field lines change from a cusp shape immediately following reconnection (left) to a more rounded shape at a later time (right) (figure reproduced courtesy of ASP Conf. Ser. from Forbes 1997).

Fig. 2.—Images from a C2.1 flare observed on 2006 December 17. The top panels show images from the flare at two different times, processed using a Sobel filter to bring out the edges. The bottom left panel shows contours from the top panels overlaid. The GOES light curve for this event is shown in the bottom right panel. Vertical bars mark the locations of the images on the GOES plot.

SHRINKAGE IN FLARES OBSERVED BY XRT 869

Reeves et al. (2018)
Flare Model Trajectories

Forbes et al. (2018)
Steps taken to study this structure

• Image Alignment
• Noise Gating
• Processing
  • Scaling, normalization, interpolation
  • Dynamic enhancement
• Determine path of current sheet
• Identify flow locations and measure velocities
• Measure height of current sheet
Steps taken to study this structure

• Image Alignment
• Noise Gating
• Processing
  • Scaling, normalization, interpolation
  • Dynamic enhancement
• Determine path of current sheet
• Identify flow locations and measure velocities
• Measure height of current sheet
Noise-Gating Example

2017-09-10 17:57:54 UT (1s Exposure)
Steps taken to study this structure

• Image Alignment
• Noise Gating
• Processing
  • Scaling, normalization, interpolation
  • Dynamic enhancement
• Determine path of current sheet
• Identify flow locations and measure velocities
• Measure height of current sheet
Extracting Data Along Current Sheet
Steps taken to study this structure

• Image Alignment
• Noise Gating
• Processing
  • Scaling, normalization, interpolation
  • Dynamic enhancement
• Determine path of current sheet
• Identify flow locations and measure velocities
• Measure height of current sheet
Outflows
Eruption
Outflow-Downflow Pairs

Location of Structures

Distance Along Sheet (Pixels)

15:17:54
23:29:55

Eruption
Outflows

Time
Project Goals:

• Observe and measure outflows along current sheet in the lower and middle corona

• Compare the trajectories of these flows with those predicted in Forbes et al (2018)

• Observe shrinking loops

• Measure reconnection rate

• Utilize DEM analysis for temperature estimates
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