

Successive Magnetic Reconnections Observed during Sympathetic Eruptions

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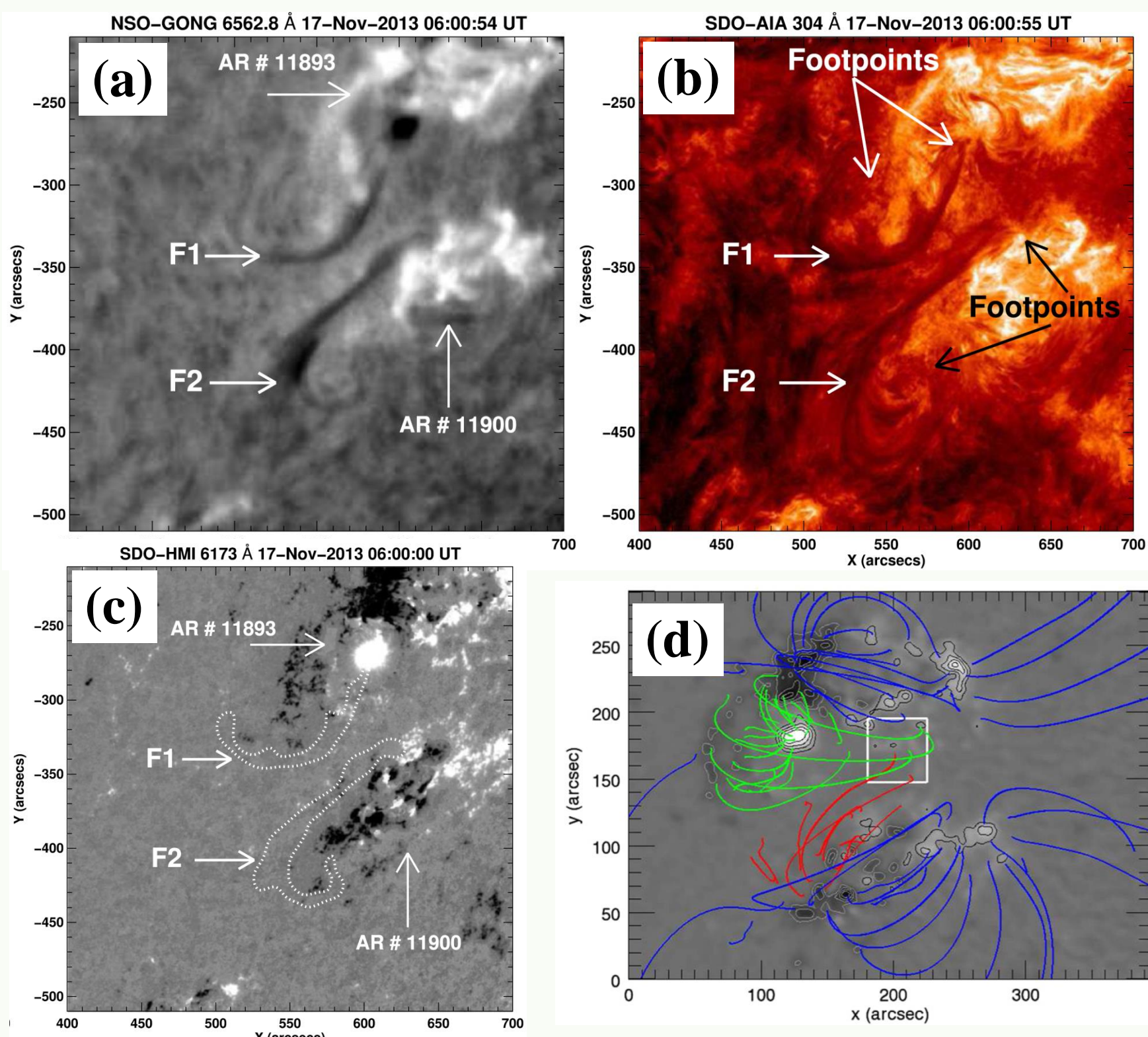
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SOLARNET IV MEETING

ABSTRACT

The nature of various plausible causal links between sympathetic events is still a controversial issue. In this work, we present multiwavelength observations of sympathetic eruptions, associated flares and coronal mass ejections occurring on 2013 November 17 in two close-by active regions NOAA 11893 and 11900. Two filaments i.e., F1 and F2 are observed in between the active regions. Successive magnetic reconnections, caused by different reasons (flux cancellation, shear and expansion) have been identified during the whole event. The first reconnection occurred via flux cancellation between the sheared arcades overlying a filament F2 creating a flux rope and leading to the first double ribbon solar flare. During this phase we also observed some partial eruption of overlying arcades and coronal loops. The second reconnection is believed to occur between the expanding flux rope of F2 and the overlying arcades of the filament F1. We suggest that this reconnection destabilized the equilibrium of filament F1, which further facilitated its eruption. The third stage of reconnection occurred in the wake of the erupting filament F1 between the legs of overlying arcades. This may create a flux rope and the second double ribbon flare. The fourth reconnection was between the expanding arcades of the erupting filament F1 and the nearby ambient field, which produced the bi-directional plasma flows towards both upward and downward. Observations and a nonlinear force-free field extrapolation confirm the possibility of reconnection and the casual link between the magnetic systems. The series of eruptions and flares, can thus be considered as a good example in which many of the formerly proposed theories accounting for sympathetic flares can be at work in a single event.

Morphology and Magnetic Properties of the Filaments

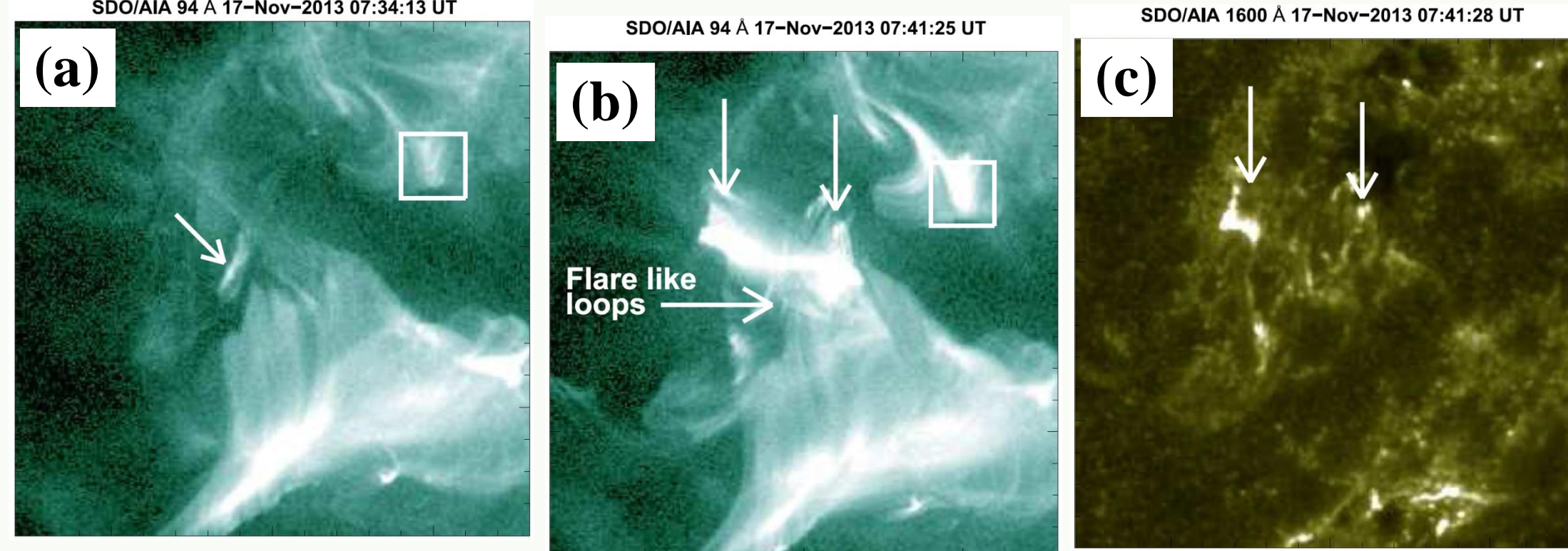


- * Filaments are located in the southern hemisphere.
- * Filament F2 is dextral, while F1 is sinistral.
- * Northern and southern footpoints are anchored in the positive and negative polarity regions.
- * The magnetic field between the two filaments mostly consists of positive polarity, while the other sides consist mostly of negative polarity.

Results:

1. Observations clearly show that the two successive eruptions and associated flares can be interpreted as sympathetic events.
2. The magnetic reconnection can be divided into four stages during these sympathetic events.

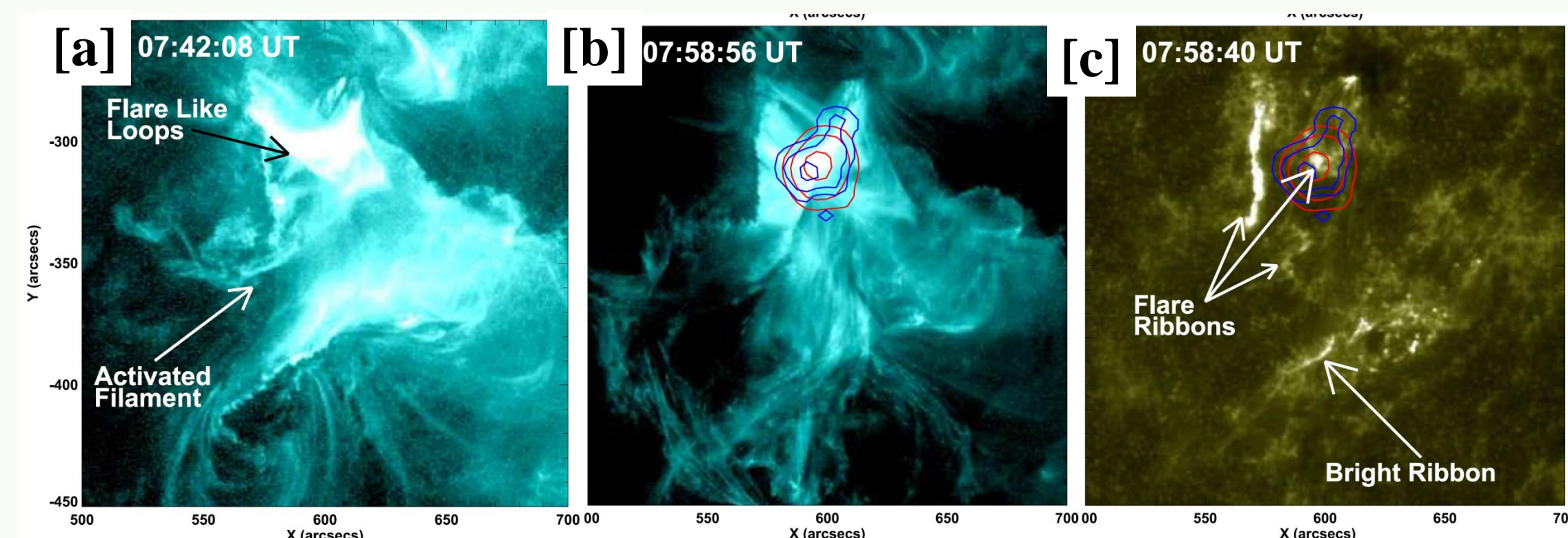
[ii]-Interaction between the Magnetic Field of the Two Filaments: Second Stage Reconnection



Result:

The second stage reconnection could be between the field lines of the expanding flux rope F2 and flux rope F1 as well as with its arcades. It activates F1 with heating signatures all along the flux rope and destabilizes it.

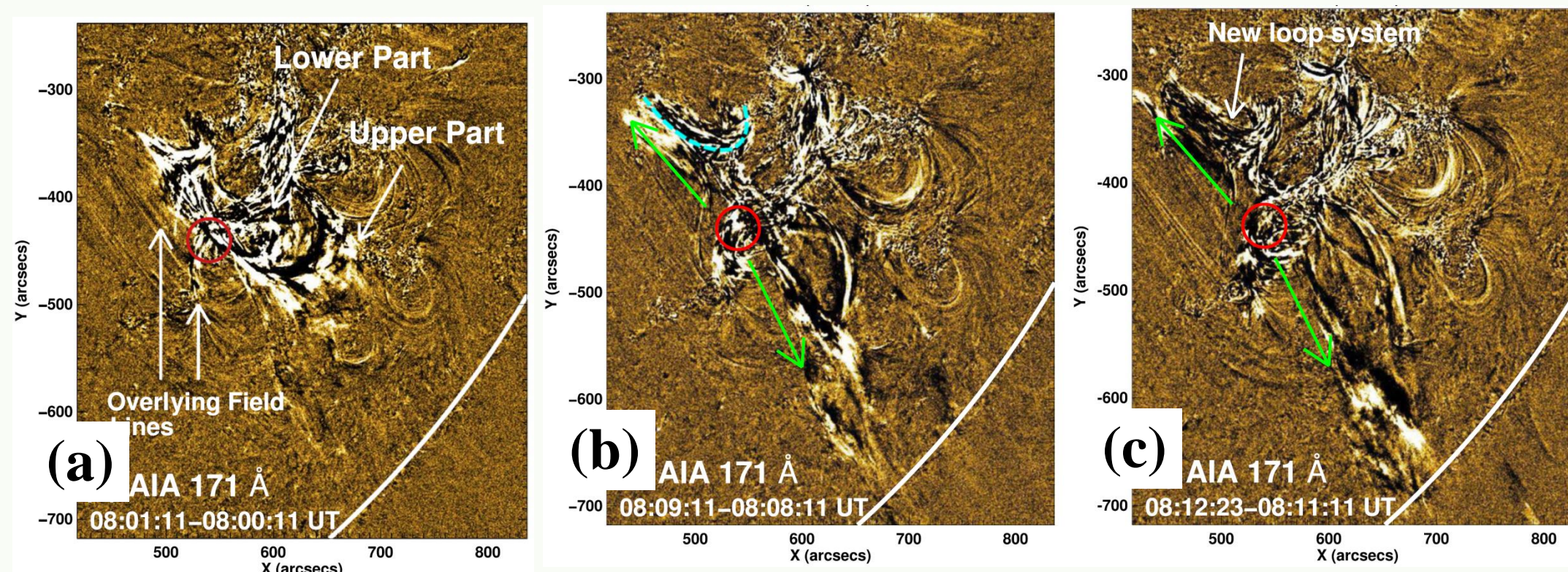
[iii]-Eruption of Filament F1 and the Associated Flare: Third Stage Reconnection



Result:

The third stage reconnection occurred at the wake of the erupting filament F1 between the legs of overlying arcades. This may trigger another two ribbon solar flare.

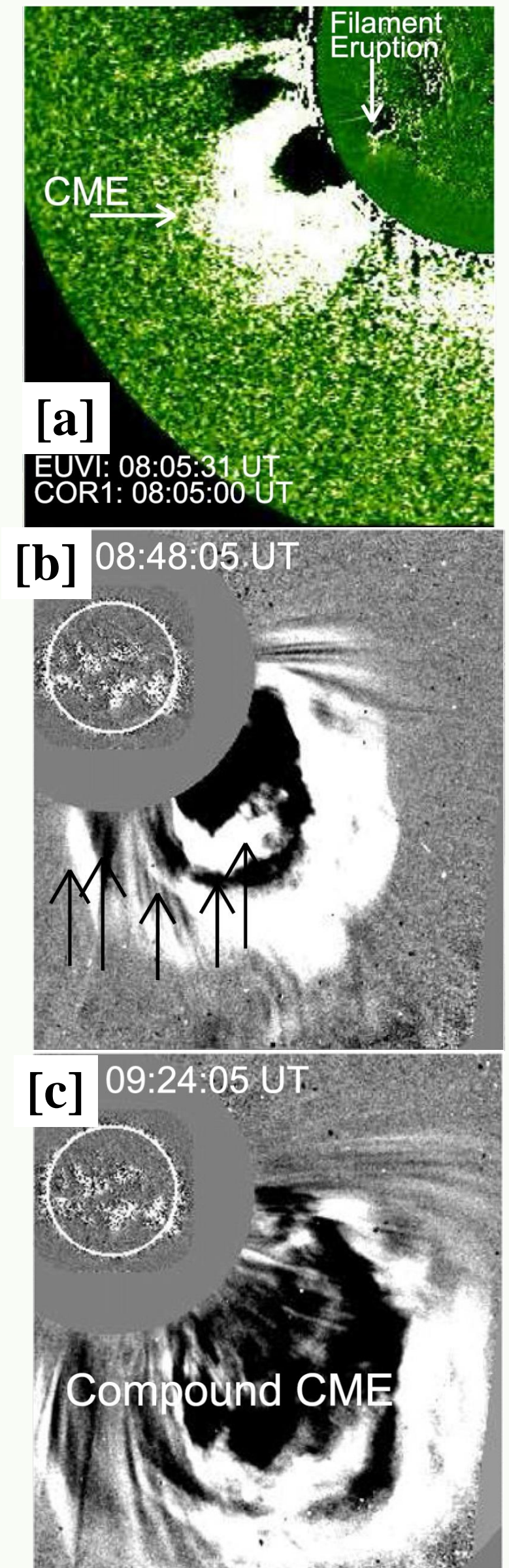
[iv]-Reconnection between the Erupting Filament F1 and the Ambient Field: Fourth Stage Reconnection



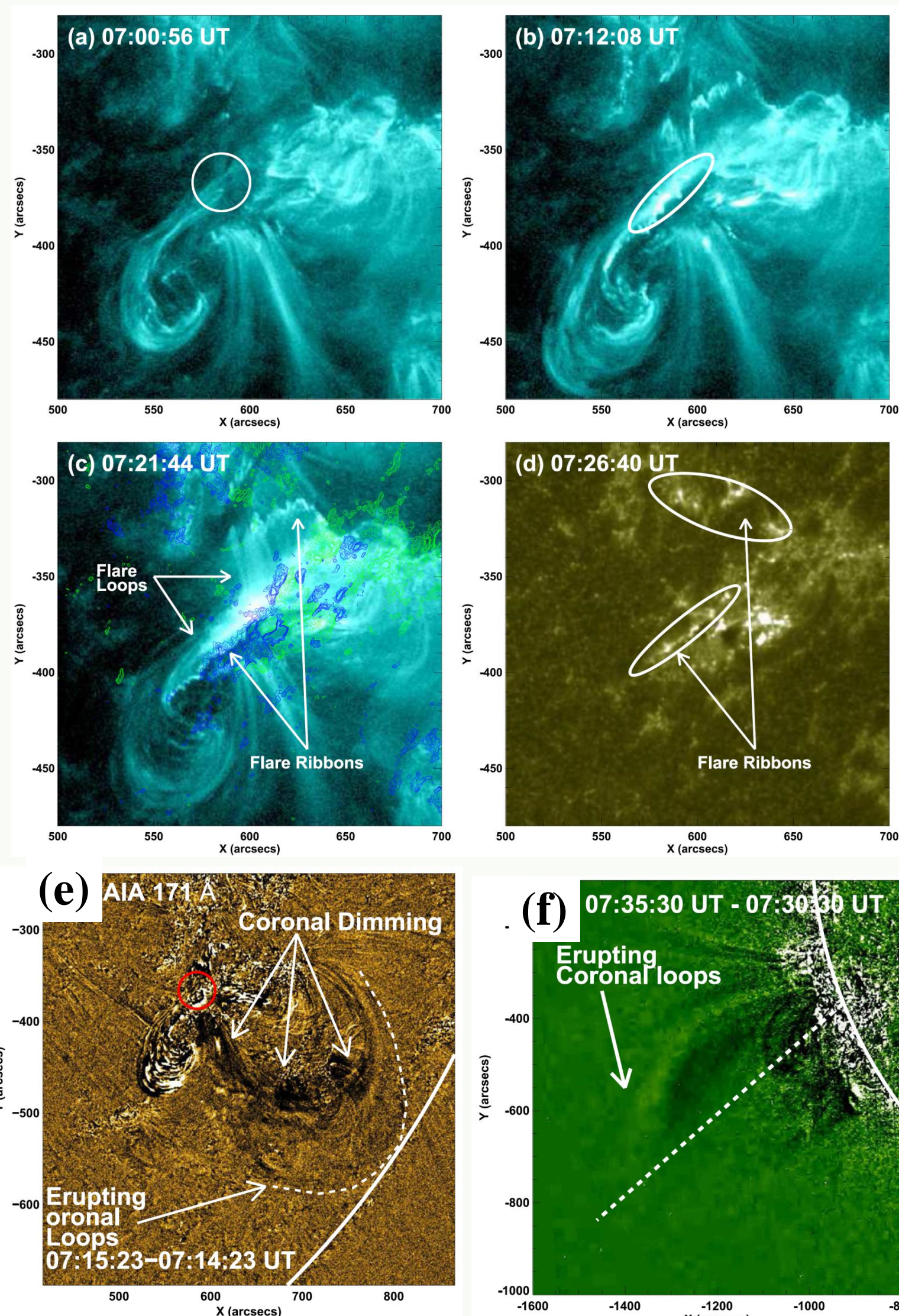
Result:

The fourth stage of reconnection occurred between the erupting arcades of filament F1 and the nearby surrounding ambient field.

Associated CMEs



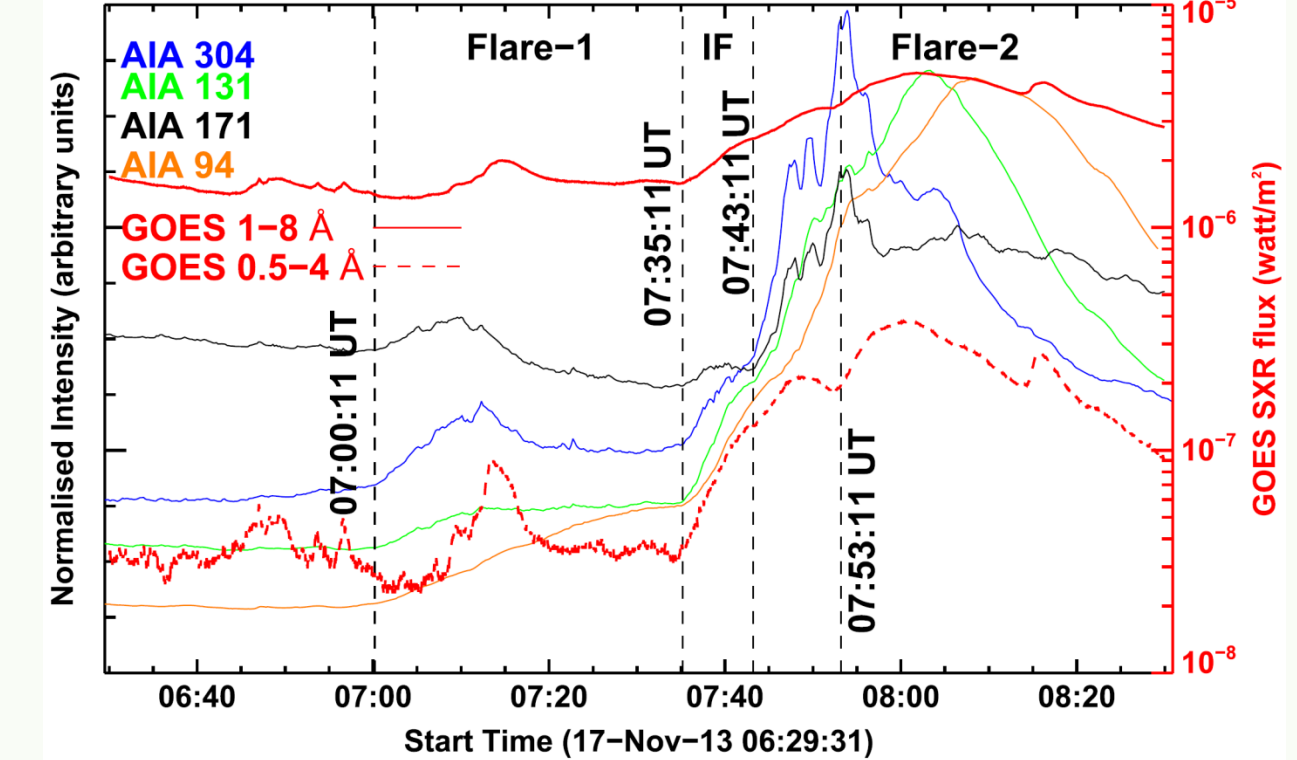
[i]-First Eruption and Associated Flare: First Stage Reconnection



Result:

The first stage of reconnection occurred as a flux cancellation between the legs of the sheared arcades of filament F2. This might trigger a two-ribbon solar flare, the eruption of the overlying coronal arcades, and coronal loops.

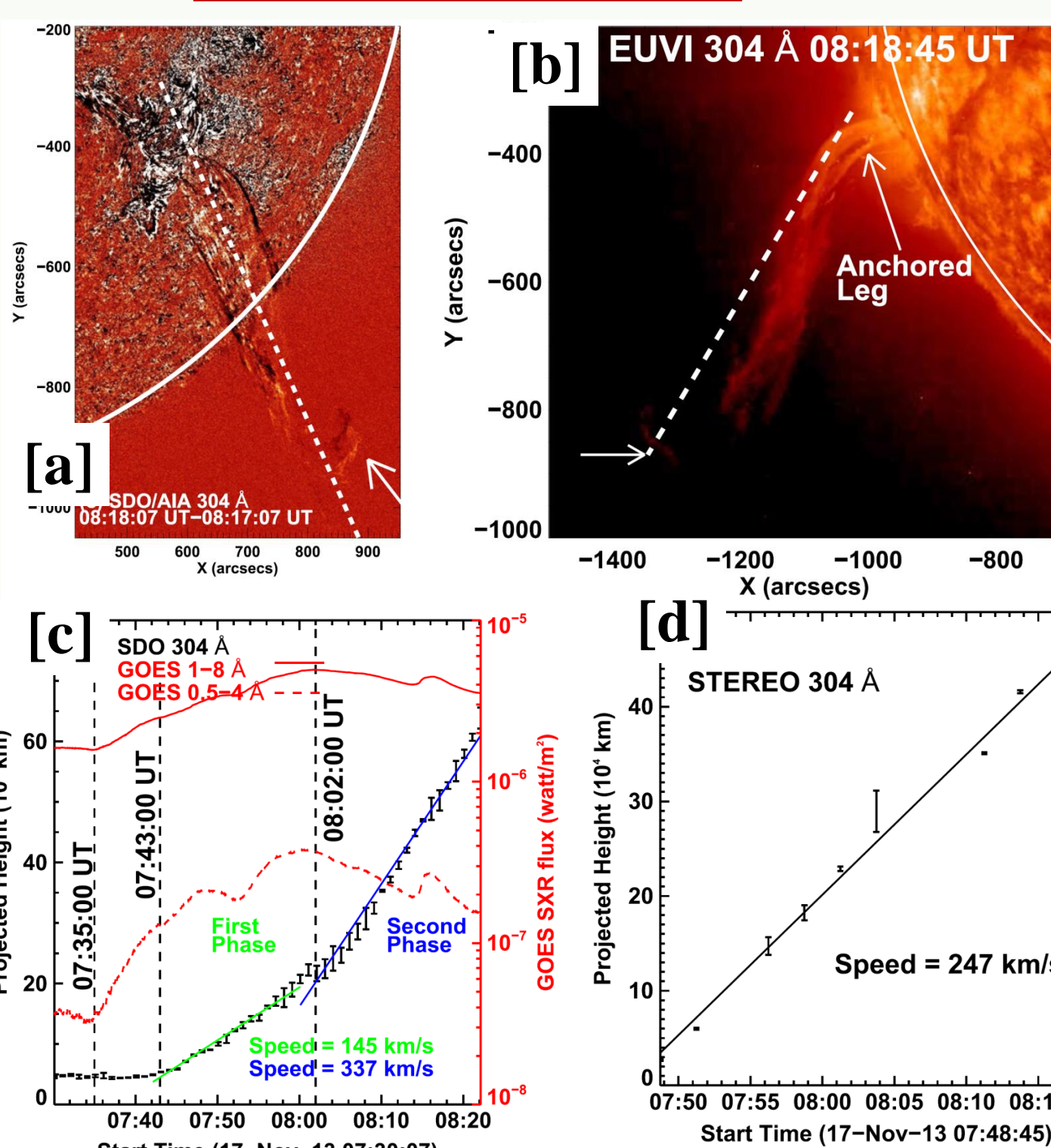
Intensity Profiles



Result:

We found three peaks corresponds to the first, second and third reconnection stages.

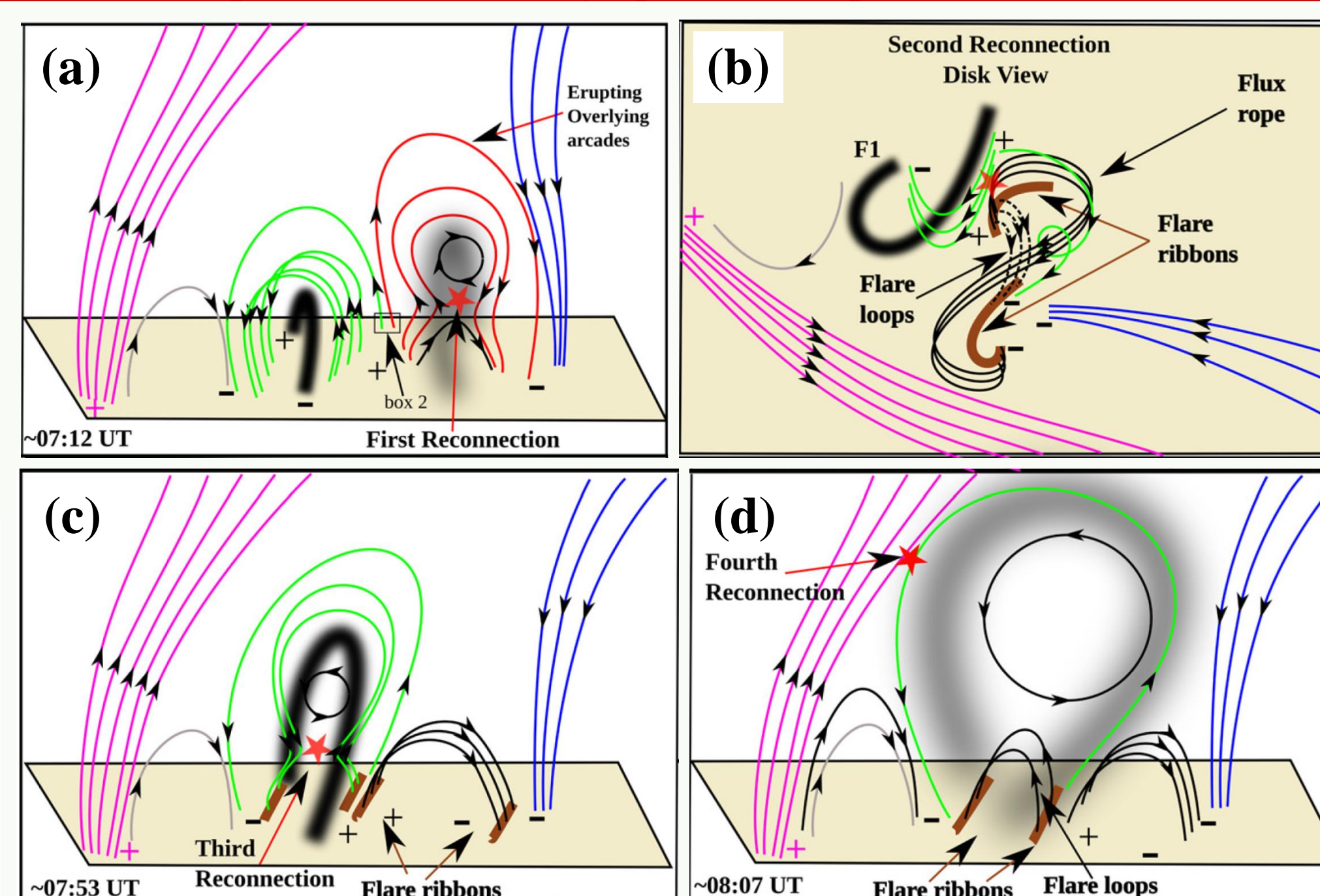
Kinematics of Filament F1



Result:

We believe that the acceleration phase and the asymmetric eruption of filament F1 are consequences of the fourth stage reconnection.

Schematic Representation of the Sympathetic Eruptions and Associated Flares



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