Multi-wavelength Study of a Solar Two-ribbon Flare

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Introduction:

- Solar eruptive phenomena (eruptive filaments, flares and CMEs) usually are accompanied by often-observed flare ribbons.
- Evolution of two-ribbon flares is morphologically characterized by separation of two ribbons in the chromosphere. Such separating motion is believed to provide a signature of the reconnection process occurring progressively higher up in the corona.
- Ribbon's behavior is important for probing the trigger mechanism of the eruption process. The separation velocity of the ribbons depends on the reconnection rate of magnetic field lines, indicating a close relationship between flare ribbon separation and energy release.

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Observations:

We presented a multi-wavelength analysis of a quiet-Sun two-ribbon flare that occurred on 18 Feb 2014.

We used observations provided by SDO/AIA in the 304 Å, 131 Å, 171 Å , 211 Å, 193Å and 94 Å passbands at 12s cadence, corresponding to different atmospheric heights and temperatures.

All the data were reduced with the standard procedures.

Line-of-sight magnetograms taken by the SDO/HMI with a 45 s cadence were used to determine the topology and evolution of the magnetic field. The HMI magnetograms and AIA images were co-aligned by using the AIA 1600 Å channel.

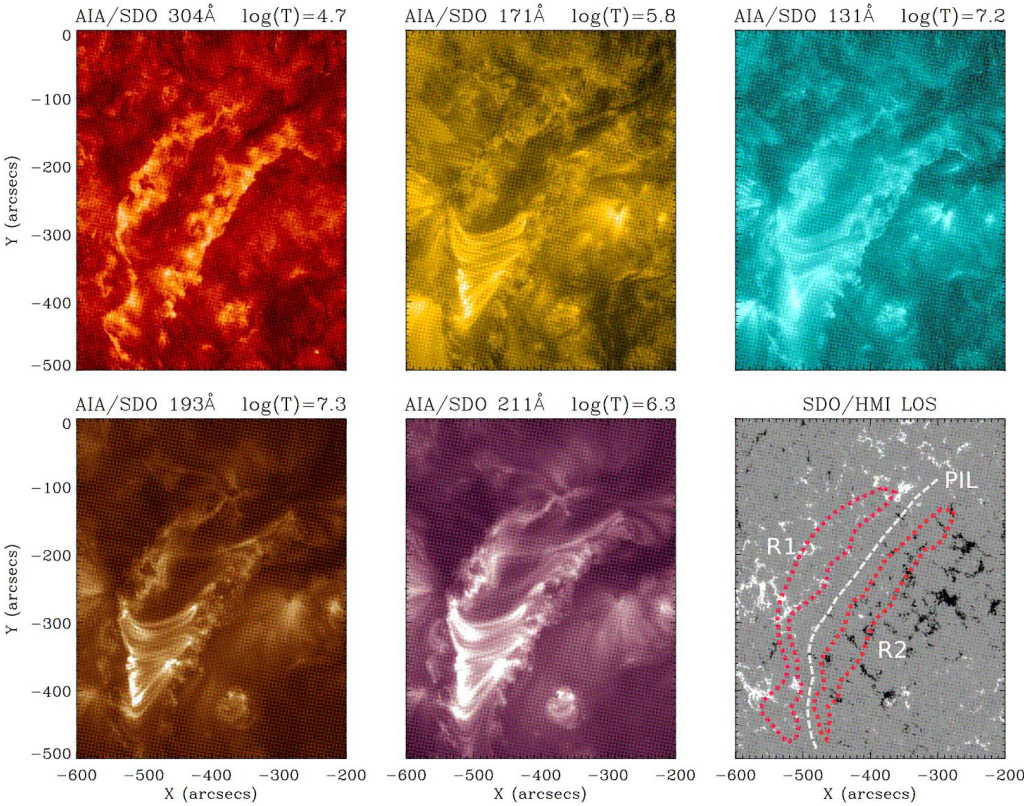

Fig. 1 Collection of multi-wavelength images illustrating the ribbon evolution in various AIA channels corresponding to different atmospheric layers.

For instance: 304 Å (He II; log T = 4.8) corresponds to the chromosphere and lower transition region; 94 Å (Fe XVIII ; log T = 6.8), together with 171 Å (Fe IX ; log T = 5.8) correspond to the upper transition region.

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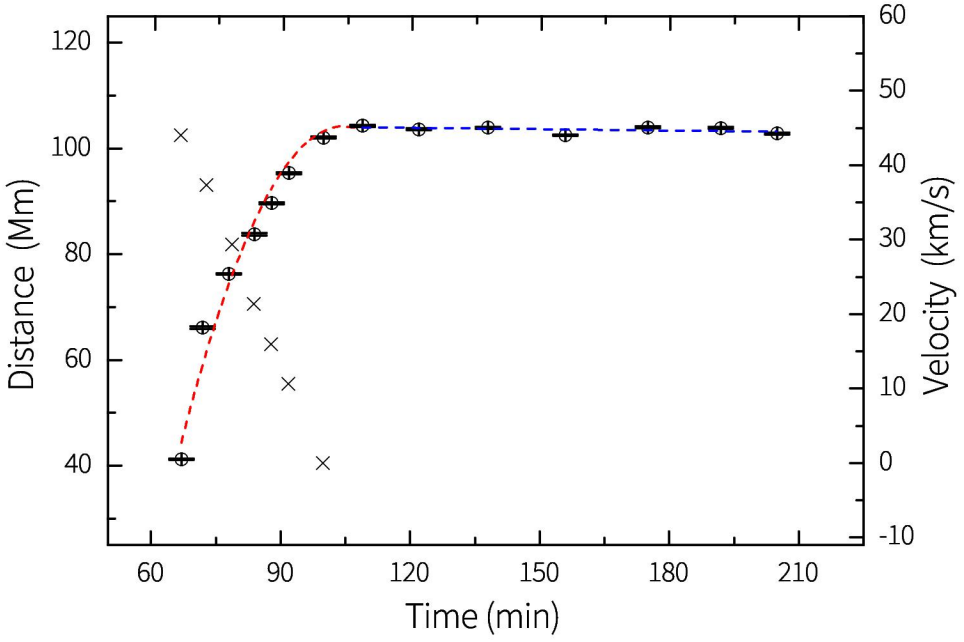
Kinematics:

We study the separation between the two ribbons seen in 131 Å channel as a function of time.



Time-slice diagram used for determination of ribbon separation:

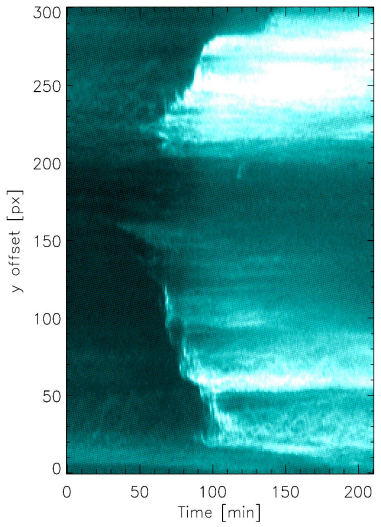


Fig.2. Time profiles of ribbon separation. The start time T(0) is 17-Feb-2014 23:59:56 UT.

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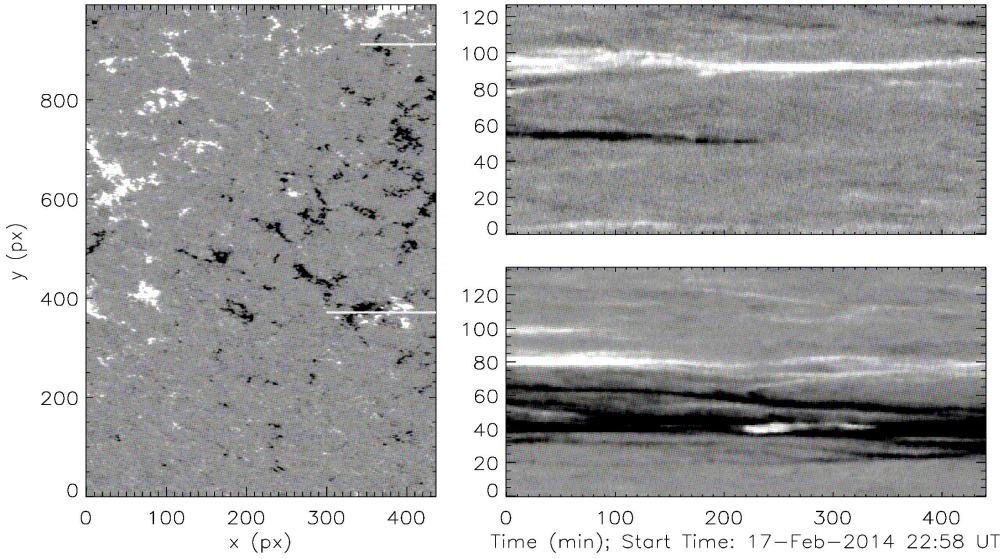
Results: magnetic flux

We look for regions of flux emergence/ cancelation in the photospheric LOS magnetic field using high resolution SDO/HMI magnetograms. ***Left:*** the HMI magnetogram in the flaring region. We test the two place, marked with white lines. ***Right:*** time-slice showing the magnetic field evolution.



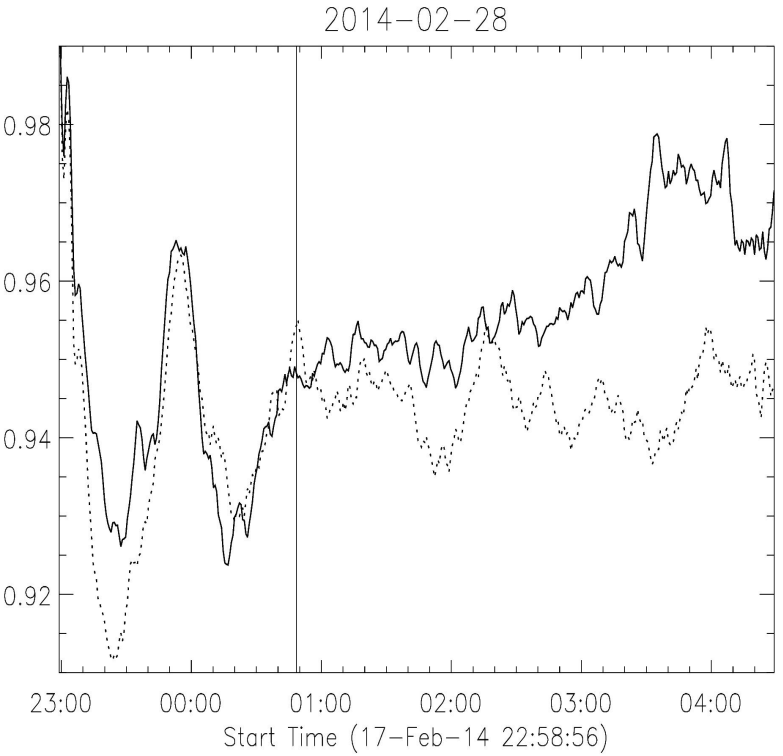


Fig. 3. Time profiles of positive and negative fluxes (normalized) within the region covering the entire flaring area:

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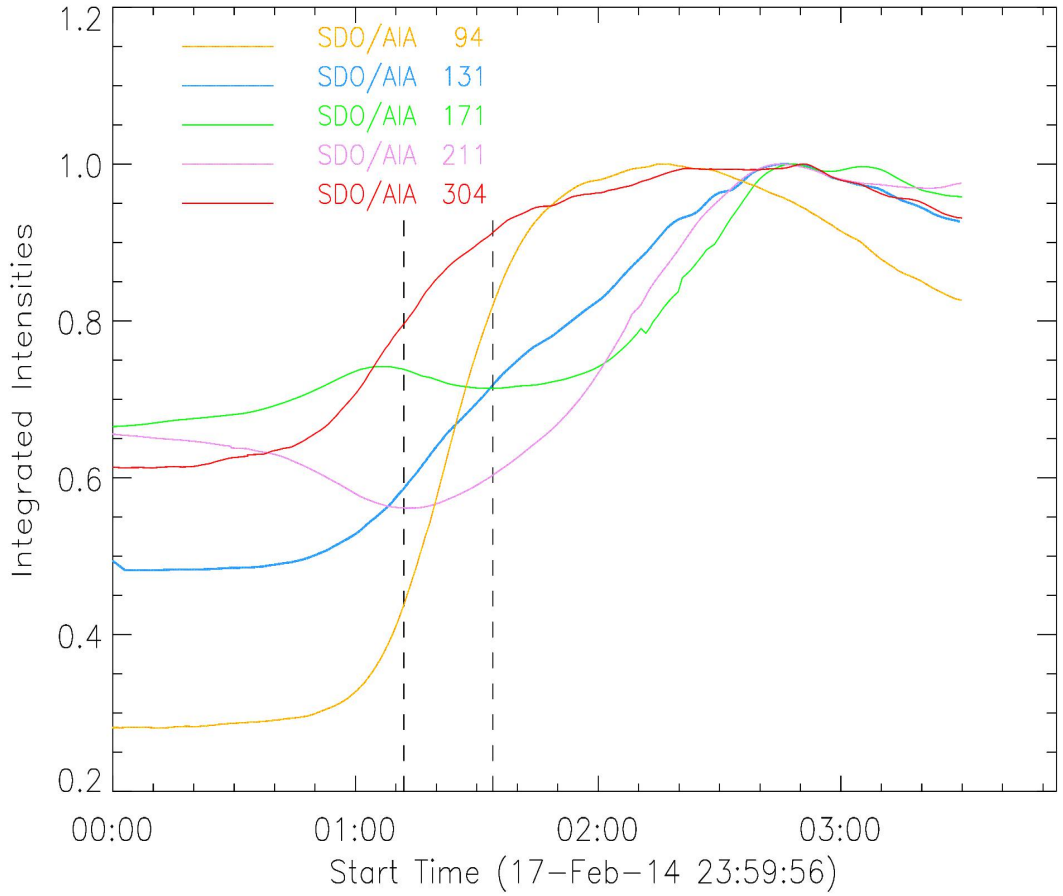

Fig.4. The light curves of the flare in different wavelengths. The vertical dashed lines outline the impulsive phase of the flare as inferred from GOES soft X-rays.

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Summary:

- The ribbon kinematics consisted of a fast stage of rapid split at a decreasing velocity from
- 45 km/s to 0.5 km/s in the first 35 minutes and a stage without a separation motion, lasting for about 2 hr.
- A flux emergence can be observed at 02:38 UT close to the southward ribbon (marked with R2 in Fig.1), after the flare impulsive phase.
- Prior to the flare onset the behavior of the two magnetic fluxes was similar.
- After 00:49 UT, just before the impulsive flare phase, the positive flux (solid line) increased, when the negative one (dotted line) decreased. This suggests an indirect evidence of magnetic reconnection.

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