Magnetic reconnection signatures in the solar atmosphere: results from multiwavelength observations

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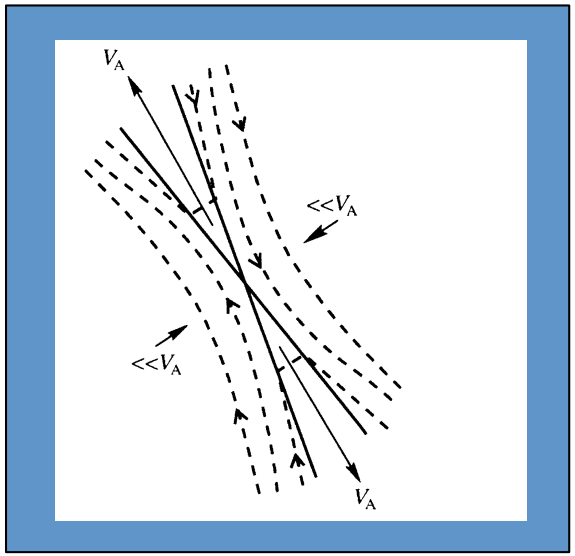
Jets and surges from reconnection sites



Oppositely directed field lines brought together to the reconnection site, from where plasma is ejected at the Alfvèn velocity v_A.

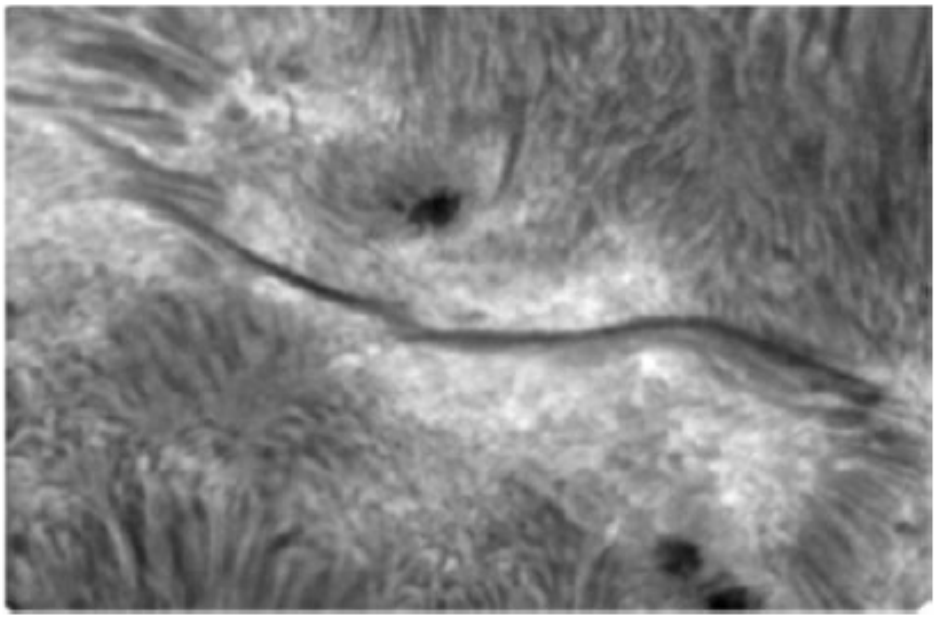
During magnetic reconnection, magnetic energy is converted into thermal energy and the increase of the plasma temperature can cause its emission in different wavelength ranges.

Observations show the presence of X-ray jets, as well as cooler Hα surges, characterized by a temperature of about 10^4 K.

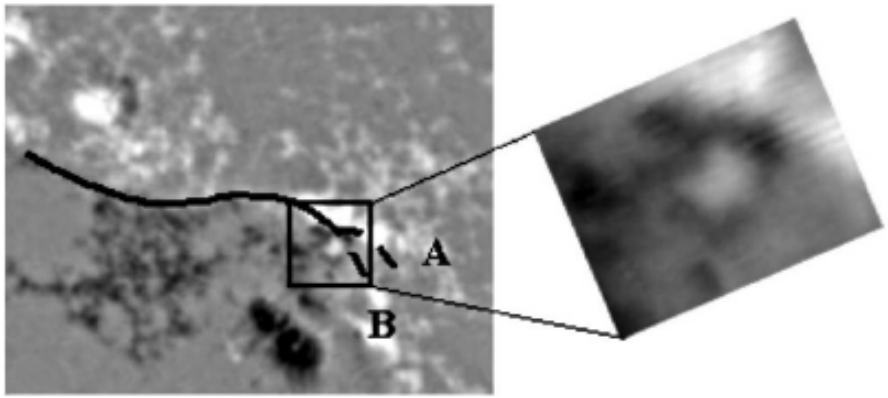
Surges are ejections of plasma with a filamentary structure, extending up to 10^5 km with speed of about 50 km s^{-1}

We describe some events observed by means of high resolution instruments, where the presence of **plasma jets** and in particular, of **chromospheric surges** has been singled out.

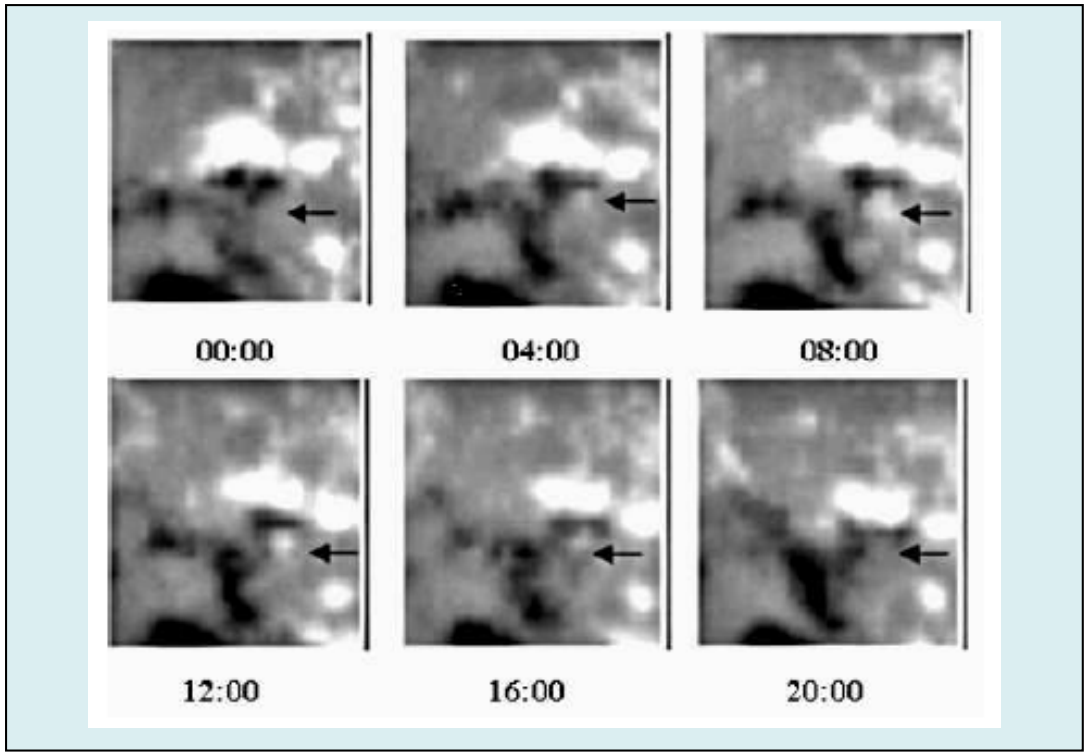
Bi-directional plasma flows during a filament eruption



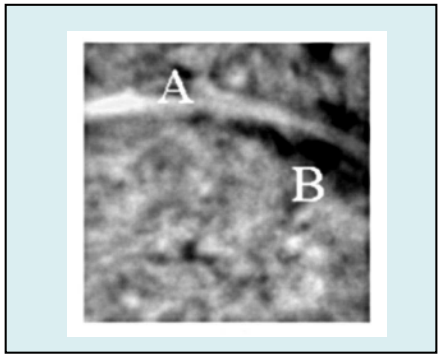
BBSO Hα image of a filament showing a bifurcate shape in AR 9445 (5 May 2001). The field of view (fov) is 140 x 105 Mm^2.



BBSO magnetogram of AR 9445. The insert shows an enlarged view of a CMF with a fov 20 x 16 Mm^2. A and B indicate the shape of the filament and the location of its threads.



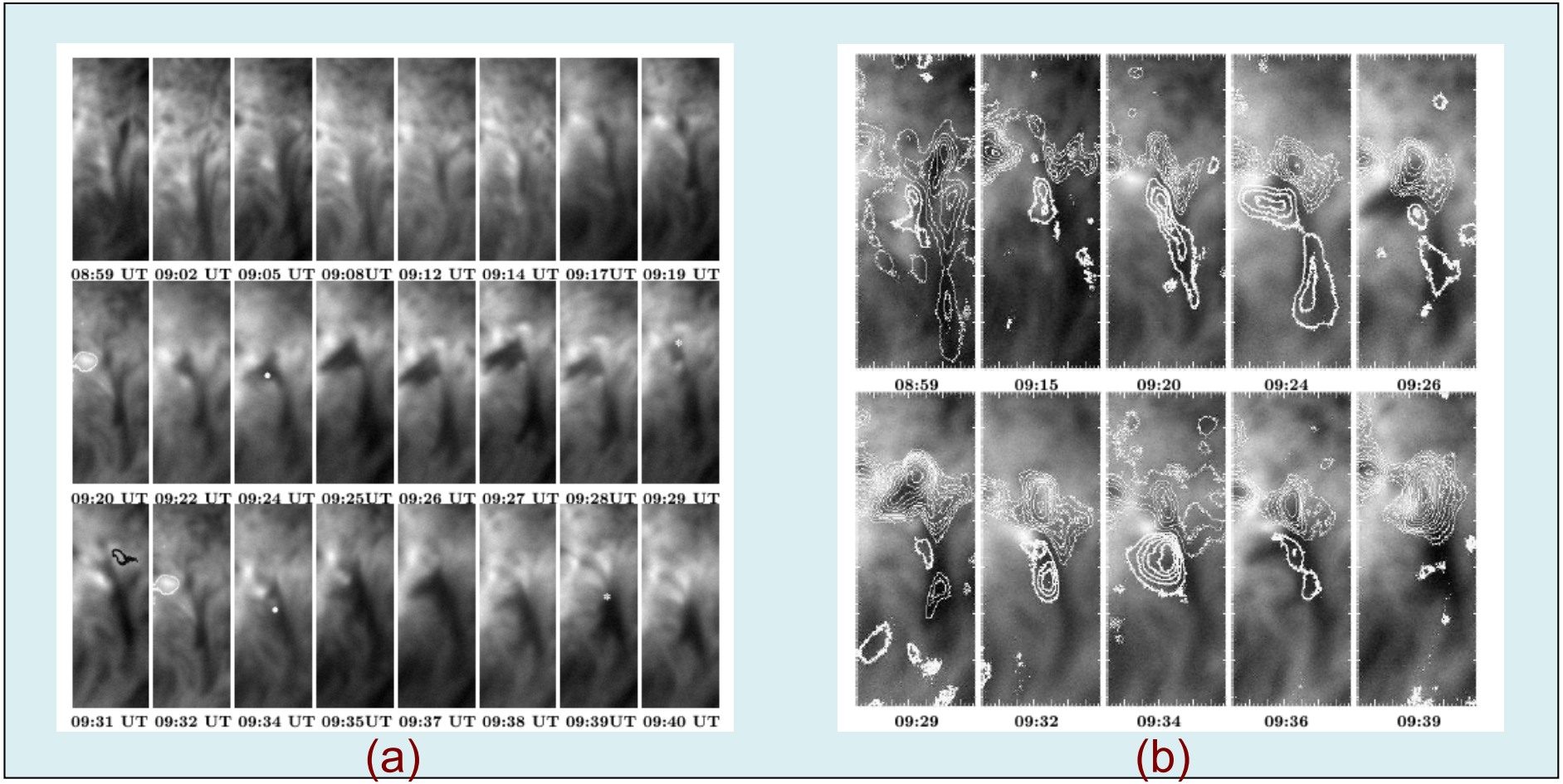
Sequence of MDI magnetograms. The arrows in each image indicate the location of a positive polarity knot of the magnetic field inside a more extended region of negative polarity.



Line-of-sight velocity map, obtained by subtracting a THEMIS blue-shifted image from a red-shifted one, at 17:13 UT.

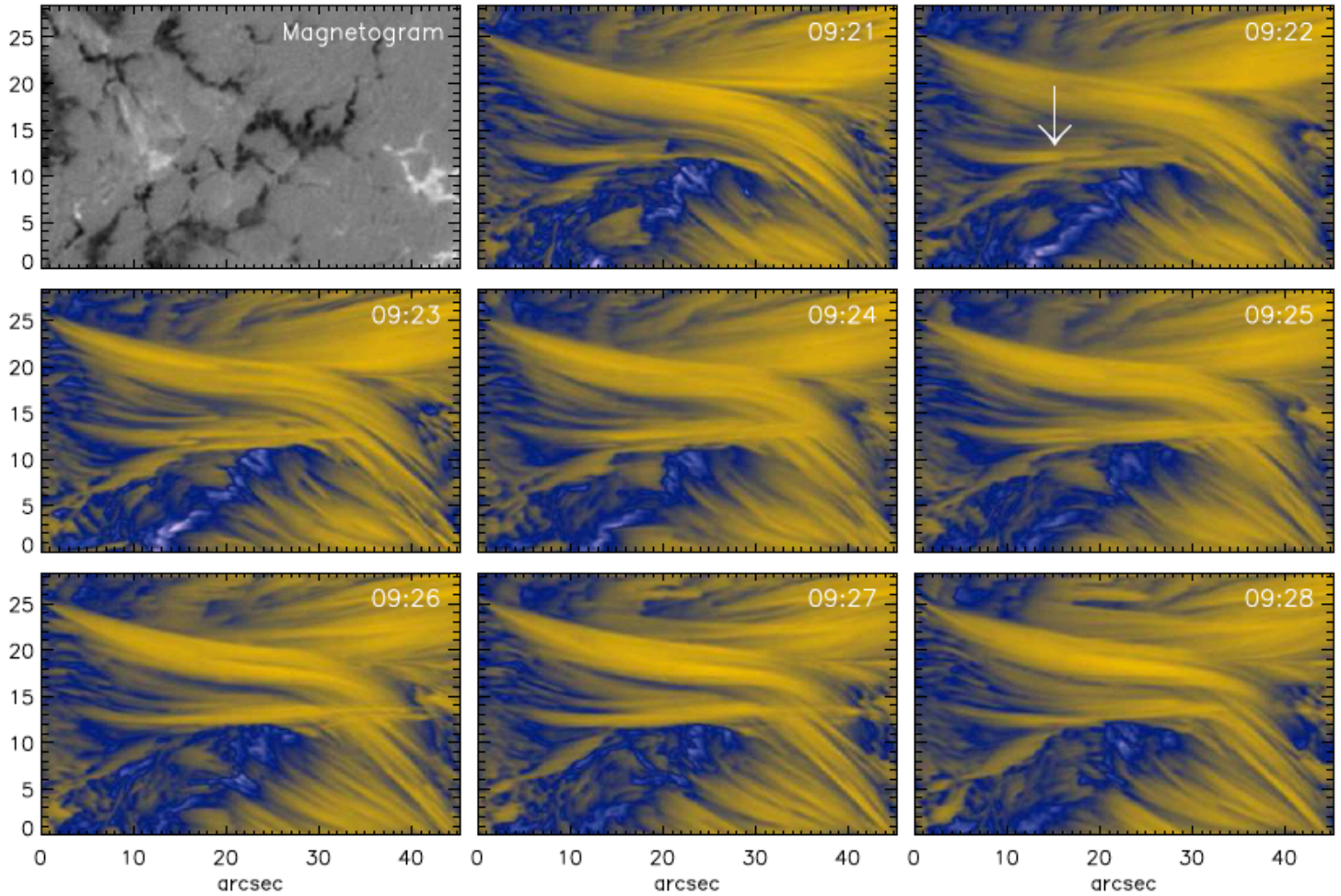
White (*black*) areas indicate regions where upward (downward) motions are present. The fov of each image is 24.5 × 24.5 Mm^2.

Surges in an active region filament

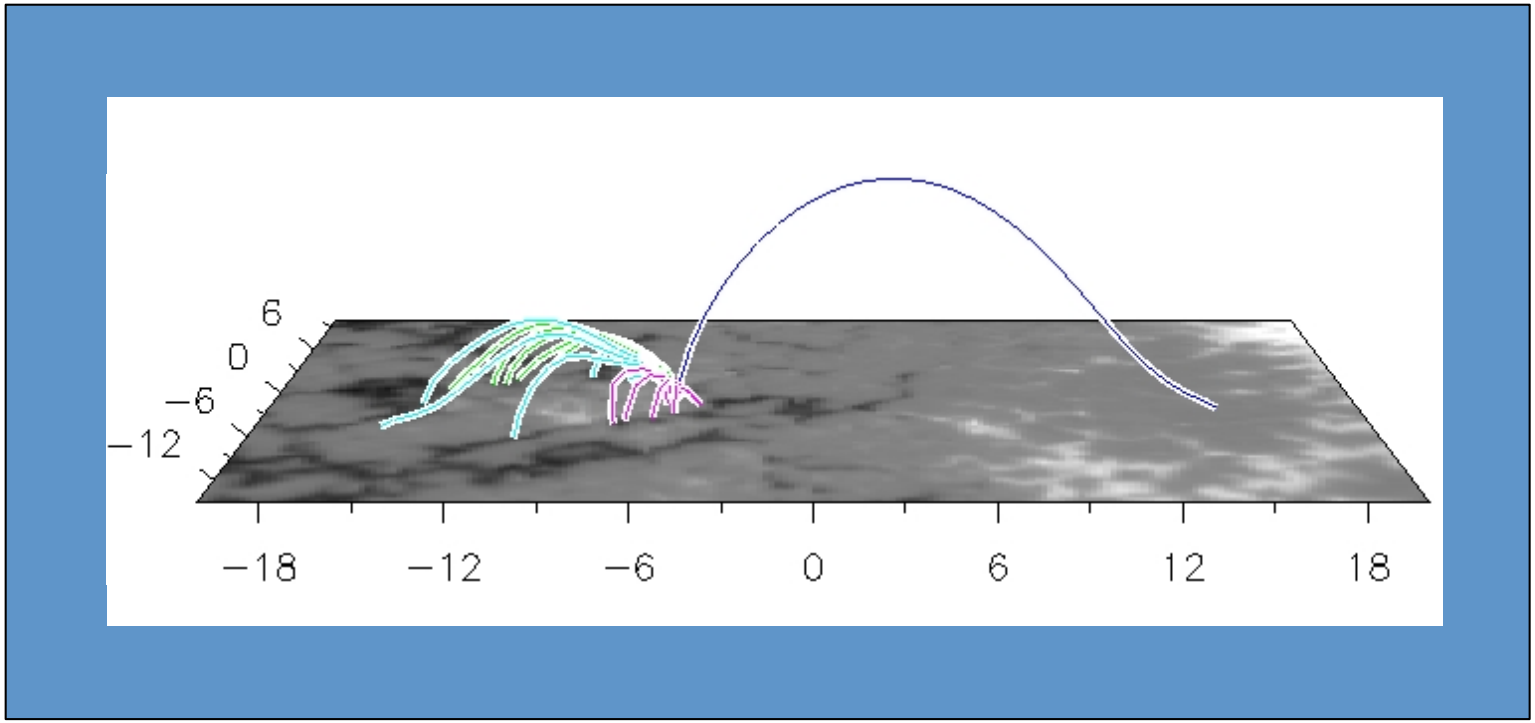


Successive chromospheric surges ejected in a filament observed by THEMIS, as a consequence of magnetic cancellation: (a) Evolution of the filament in the center of the Hα line during the time interval 8:59 – 9:40 UT; (b) velocity maps obtained using the Hα profile, plotted over the Hα images; thin (thick) contours indicate downward (upward) motions (the velocity contours are drawn every 3 km/s).

Chromospheric surge



Temporal sequence of Hα images acquired by SST during the onset of a surge. The first image reports the map of photospheric magnetic field, where white (black) areas indicate positive (negative) fields. The arrow indicates the cross-point of the surge.



Example of a series of potential field extrapolations carried out to obtain information on the coronal connectivity above the EFR.
We found an asymmetric 3D null point located above the EFR, just at the base of the chromosphere ($z \approx 400$ km). Around the null point there is a quadrupolar configuration, and a fan surface (*green and purple lines*) and a spine field line (*blue line*) originate from the null. The fan surface forms a dome and encloses the emerging positive polarity. The spine is East-West oriented and nearly cospatial with the Hα surge.

Conclusions

- High resolution observations of phenomena occurring in the solar atmosphere show the presence of jets and surges that can be associated to magnetic reconnection processes

- Important information can be deduced by the study of the topology of the magnetic field

- The emergence of new magnetic flux or cancellation phenomena play a key role in magnetic reconnection and in the jets or surges formation.