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SOHO OBSERVATIONS OF OSCILLATORY MOTIONS IN AN ERUPTIVE FILAMENT: INTENSITY AND VELOCITY VARIATIONS

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Abstract. The variations in intensity and velocity inside an eruptive filament, observed on May 30, 2003 with CDS and EIT on-board SOHO, are analysed in the transition region He I line and the coronal Mg X line. Vertical oscillating motions of the filament with damped velocity oscillations before its disappearance are revealed. The link between theses oscillations, the flaring regions nearby and the filament eruption is investigated.

Keywords: sun: filaments, prominences, sun: oscillations, sun: atmosphere, sun: cme

1 Introduction

In the context of the initiation of coronal mass ejections and the problem of mass loss related to the physics of coronal neutral sheets and streamers, occurring above lines of solar disc magnetic polarity reversal, we focus our analysis on a single event which occurred at the west limb, on May 30, 2003. We examine the dynamical behaviour of the filament region where reconnection and dissipation of magnetic energy in the turbulent plasma are occurring. The link between the observed oscillatory motions and the eruption occurrence is investigated in detail, using CDS/SOHO measurements, EIT/SOHO images, Hα filtergrams with emphasize on synoptic data describing homologous flares.

2 Observations

Fig. 1 shows the general context of the event, in Hα and in He II. The successive Hα filtergrams taken around the time of the analyzed eruption, show the position of the CDS slit (the black vertical line) used to perform the intensity and the velocity analysis in EUV (He I and Mg X lines). Note the arrow at 9:55 showing a relative short brightening under the filament at the time when a burst was observed in both the He I and the Mg X lines using the CDS/SOHO observations. The EIT/SOHO sequence (He II at 30.4 nm) at 12 minute cadence is used to examine the dynamics of the filament channel several hours before and during the eruption (see Fig. 1, on the right).

The filament is analysed from time series of spectra using a transition region line (He I at 58.43 nm) and a coronal line (Mg X at 60.98 nm), with a 25 s cadence.

In He I line, a strong blue-shifted (Fig. 2) pulse is detected simultaneously with the eruption around 10:00 UT, as shown by the signal in intensity and velocity in both lines on Fig. 3. The oscillations in velocity last roughly one hour and are quickly damped (see Bocchialini et al., 2011). The oscillatory content was investigated using a wavelet analysis and was compared to different models (Bocchialini et al., 2011). Oscillations are clearly observed, in intensity and velocity in the He I line (Fig. 4) and the Mg X line (Fig. 5), with similar periods from a few minutes up to a few tens of minutes, co-temporal with the eruption. In the following, we consider these observations in the light of a more global view of solar activity phenomena.

3 Suggested interpretation

The global context suggests a possible link between several events occurring almost simultaneously as seen in Hα (Fig. 6). Several regions flared and/or erupted quasi-simultaneously; such phenomenon was called "sympathetic

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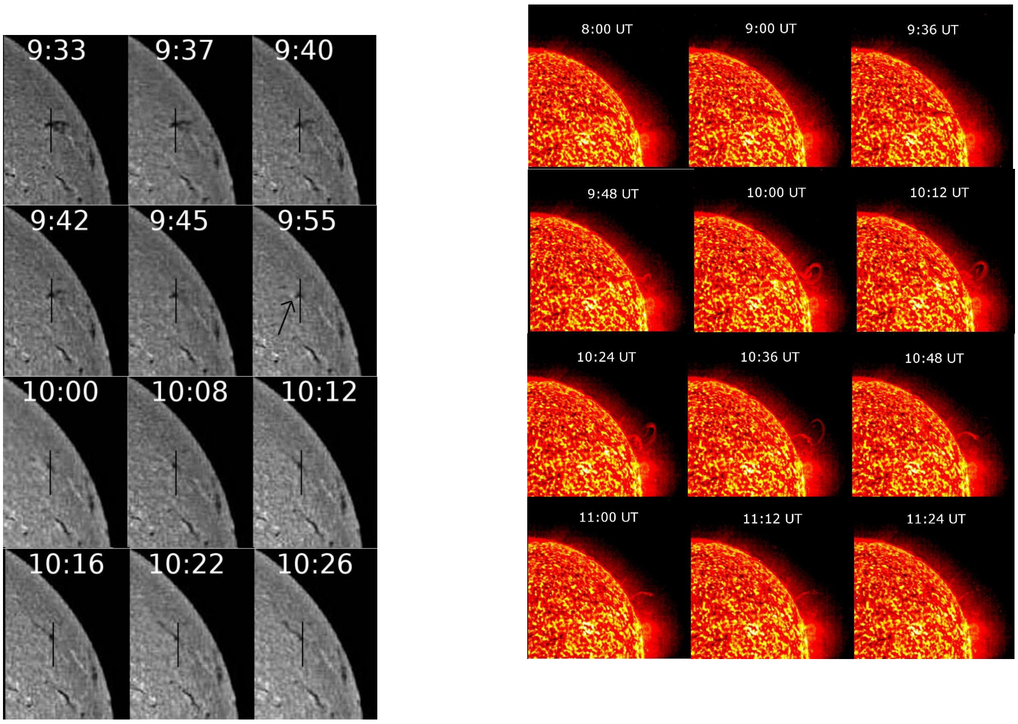

Fig. 1. Left: Successive Hα filtergrams taken around the time of the analyzed eruption. **Right:** Successive partial images from the EIT observations to show the context of the filament eruption.

flares" (Schrijver and Title, 2011 and references inside) or homologous flares in the former literature. The link could be supported by the large scale coronal magnetic field as evidenced by the result of the PFSS (Potential Field Source Surface) computed from the underlying measured field. The magnetogram obtained from MDI/SOHO one day before was used, together with a SS (source surface) at 1.4 solar radius. Note the coronal magnetic "channel", extended in the radial direction, with open field lines near the location of the studied filament eruption red lines on the Fig. 6 on the right).

4 Conclusions

The link between oscillations in a filament and its eruption was investigated. Oscillations are clearly observed, in intensity and velocity in the He I and Mg X lines, with similar periods from a few minutes up to 80 minutes, with a main range from 20 to 30 minutes, simultaneously with the eruption of the filament. The filament exhibits vertical oscillating motions, and the evidence of damped velocity is provided, before its disappearance. The "sympathetic" flares occurring in regions magnetically connected to the observed filament, could be the cause of the oscillations detected, but this scenario is now under investigations (paper in progress).
More details concerning the oscillatory behaviour are given in Bocchialini et al. (2011).

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References

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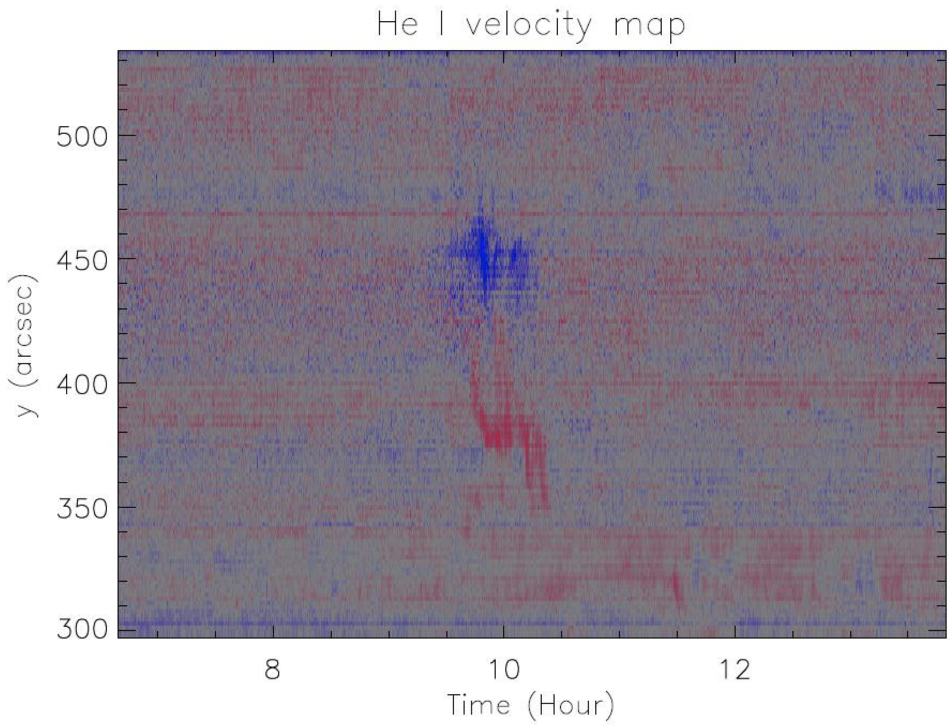

Fig. 2. He I velocity map, as a function of time and along the CDS slit. The filament is located between y = 409 and 459 arcsec.

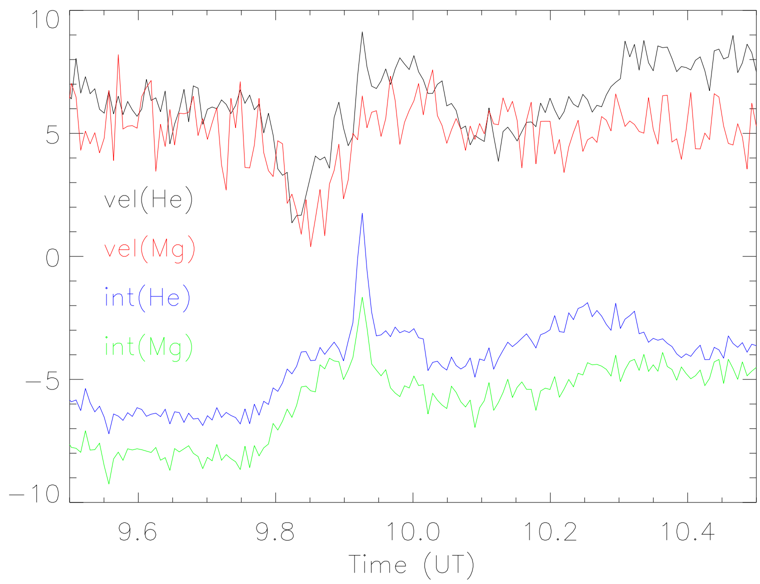

Fig. 3. Velocities and intensities observed during the eruption of the filament between 9:00 UT and 11:00 UT in both the emission lines of He I and Mg X from the CDS observations

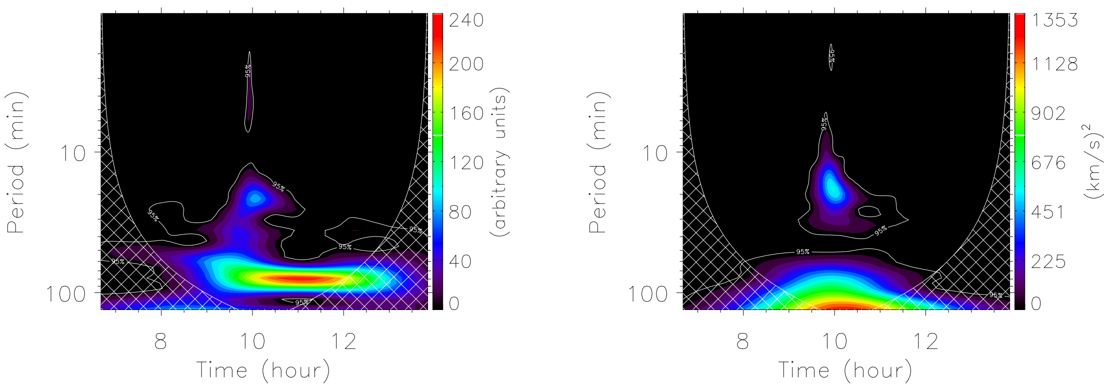

Fig. 4. Wavelet analysis performed in He I using intensities (left) and velocities (right) observed inside the erupting filament during the whole interval of CDS observations. Significant power is within the 95% confidence level contour and outside the hatched cone of influence.

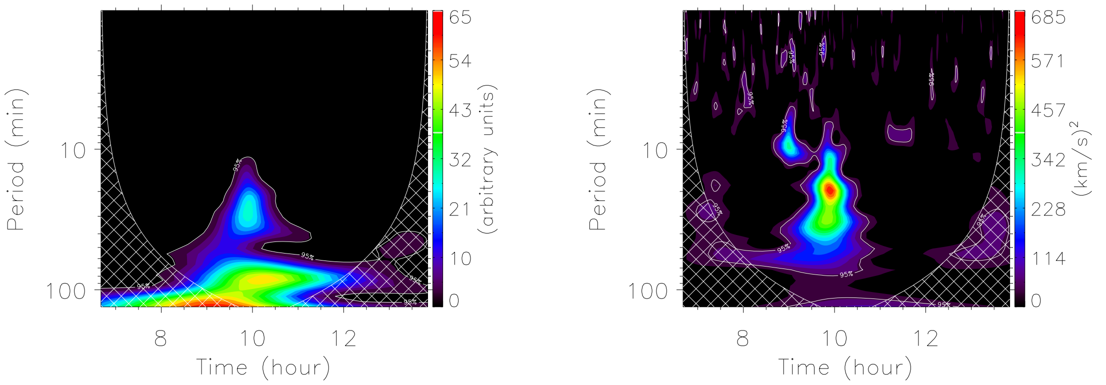

Fig. 5. Wavelet analysis performed in Mg X using intensities (left) and velocities (right) observed inside the erupting filament during the whole interval of CDS observations. Significant power is within the 95% confidence level contour and outside the hatched cone of influence.

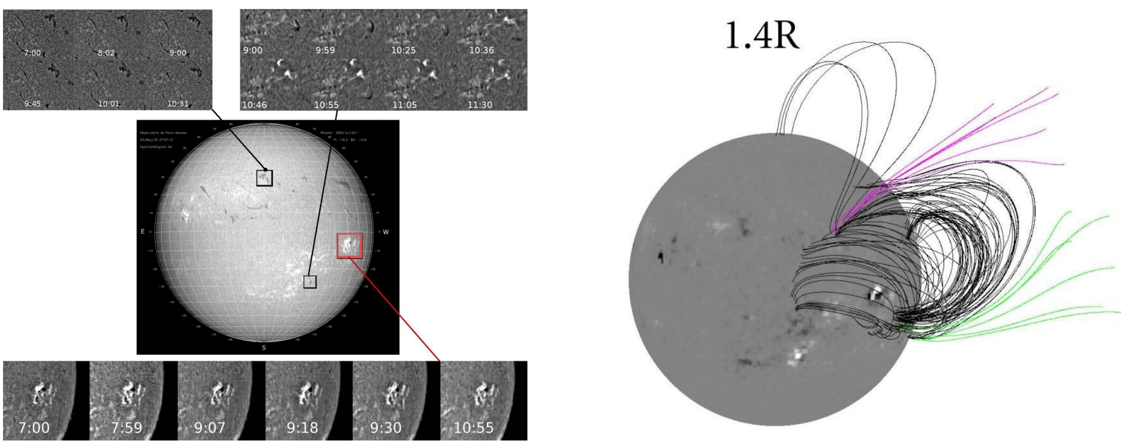

Fig. 6. Left: The global context suggesting a possible link between several events occurring almost simultaneously as seen in Hα. **Right:** Extrapolated magnetic field lines using the PFSS approximation. From E. Tavabi et al.