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Solar eruptions observed by *SDO* and *STEREO*

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ABSTRACT

We investigate the early phase of evolution of a few examples of CMEs associated with solar flares and/or filament eruptions. The aim of this work is to determine kinematical properties and important structural components of these solar eruptions. We analyzed multi-thermal observations of eruptive plasmoids associated with CMEs and/or flares using the data recorded by the Atmospheric Imaging Assembly (AIA) on board the *Solar Dynamics Observatory (SDO).* In addition, we also use data taken by Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) on board the *Solar Terrestrial RElations Observatory (STEREO).* An important findings are that in every of four examples eruptions we observed a EUV channel structures in the images of high temperature passbands of the AIA, three of them are seen before the impulsive acceleration phase of the eruption.

INTRODUCTION

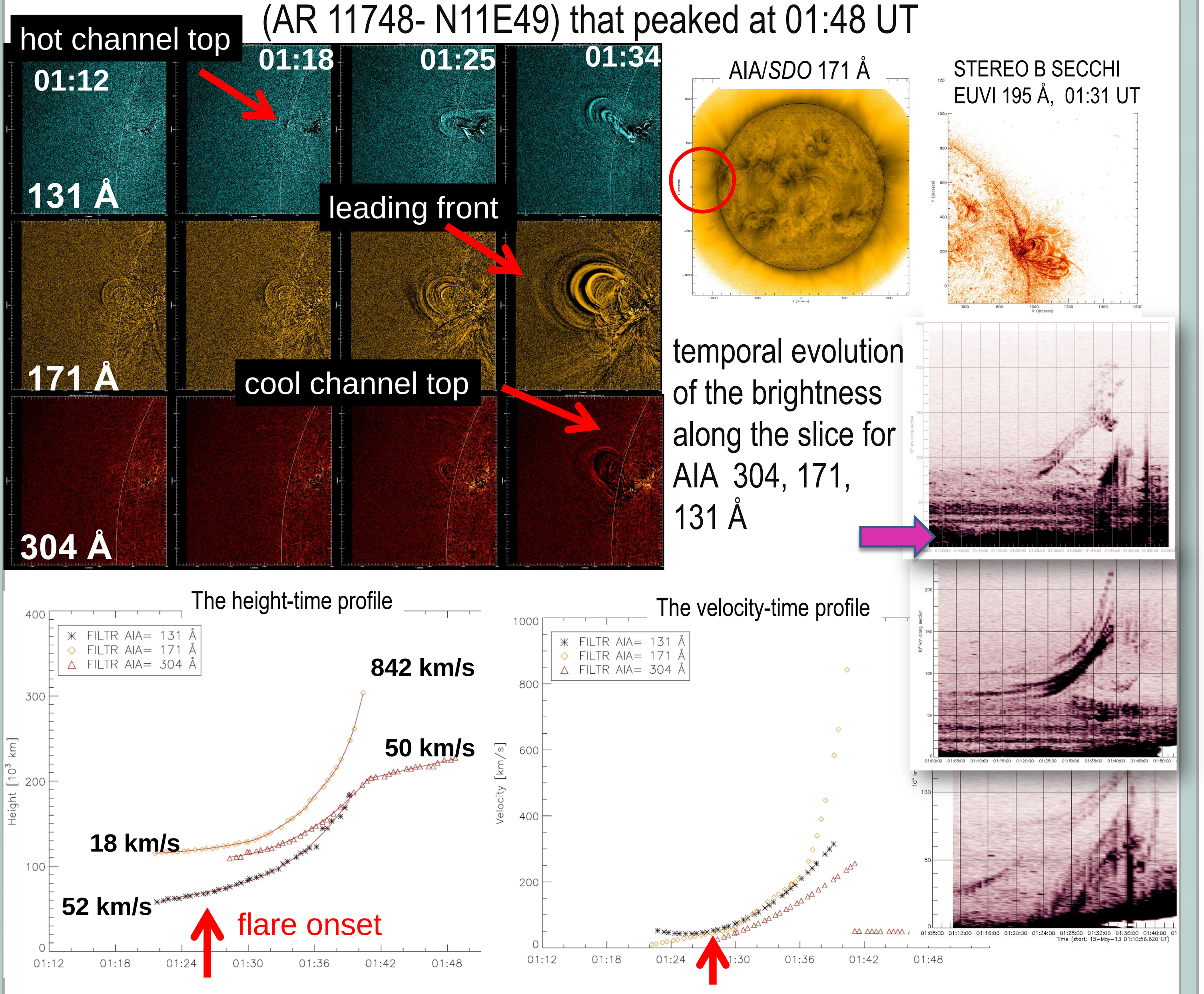
Key issue in understanding physical mechanism, that drives this eruptive phenomena is study the relationship between CMEs and their associated flares. Zhang et al. (2001) studied the kinematics of flare-associated CMEs and proposed a three phases evolutionary scenario a slow initiation phase, an impulsive acceleration phase, and a propagation phase. These three kinematic phases are closely related to the three phases of the associated flare: the pre-flare phase, flare rise phase, and decay phase,respectively (Vrsnak et al. 2007, Cheng et al. 2010b). Temmer et al. (2008, 2010) also studied temporal correlation between CMEs and flares, and they found that the CME acceleration profile and the flares HXR flux are coincide very well. These results may suggest common physical mechanism that is responsible for the formation of these phenomena. A typical CME has a velocity of several hundred kilometer per second, while the fastest one is over 3000 km s^{-1} (Yashiro et al. 2004)

OBSERVATIONS

Recently, AIA observations reveal that CMEs consist of a multi-temperature structure. Hot signature of CME seems to be the twisted flux rope (Cheng et al. 2012). In order to study the structural components of CME, we used mainly data from AIA on board *SDO.* High spatial (1.2'') and temporal resolution (12 s), and large field of view gives us the great opportunity to study the evolution of eruptive events. We also identified three of the four of our examples of solar eruptions on images taken by *STEREO A* and *B* SECCHI/EUVI that provide the images with spatial resolutions (3.2 '' for 195 Å) and time cadence (5 min for 195 Å). Below we present preliminary results of our analysis of four examples of CMEs, which have been divided into criterion of correlation with other solar eruptive phenomena: associated with flares (left) and associated with prominences (right). Analysis of the kinematical properties was also made which provides us the opportunity for verifying the existing models for solar eruptions.

15 May 2013-

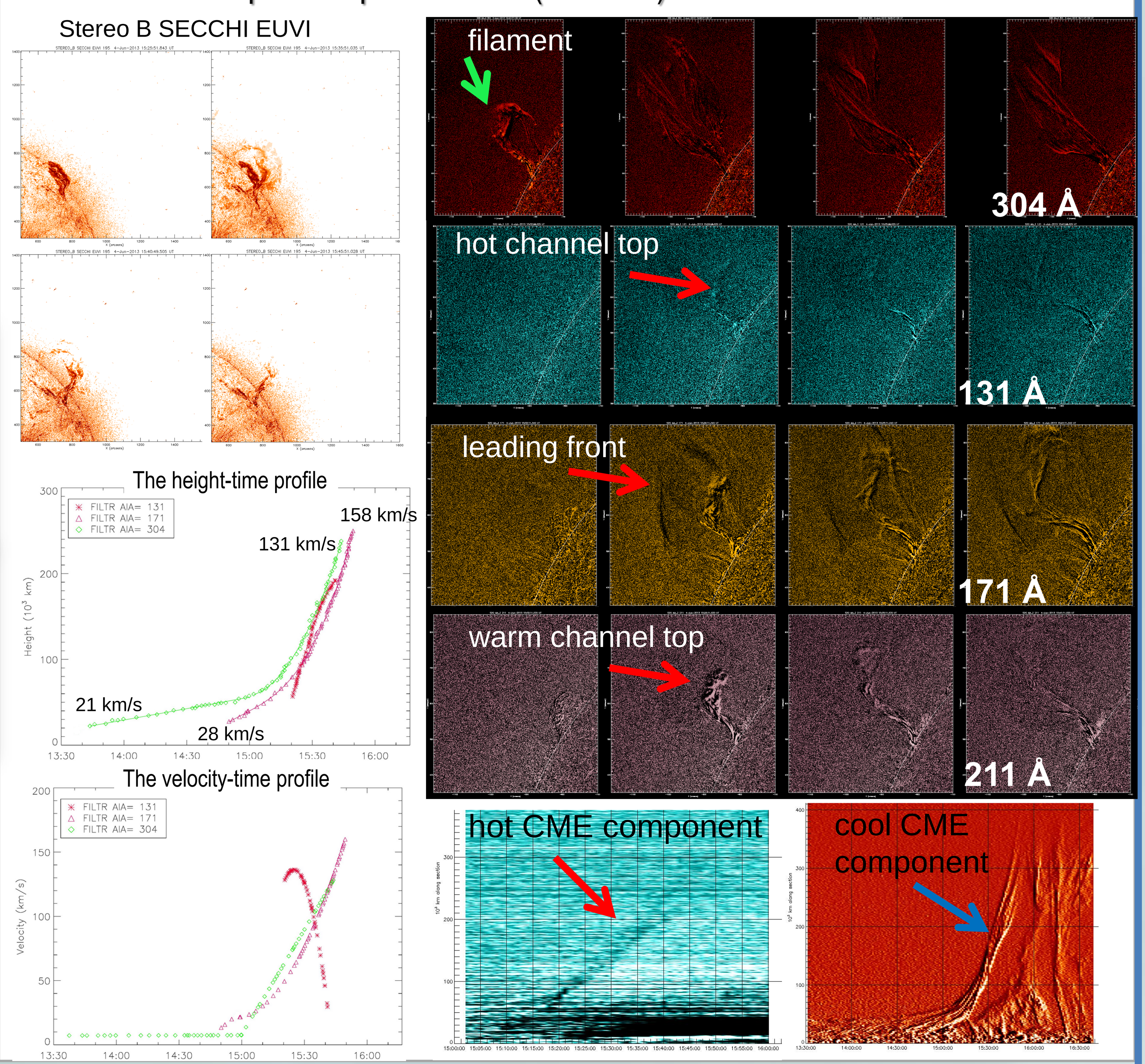
an expanding system of loops associated with CME, and **X1.2 flare** (AR 11748- N11E49) that peaked at 01:48 UT



Temporal evolution of height and speed of three well-defined structures for 131 Å, 171 Å, and 304 Å obtained from AIA

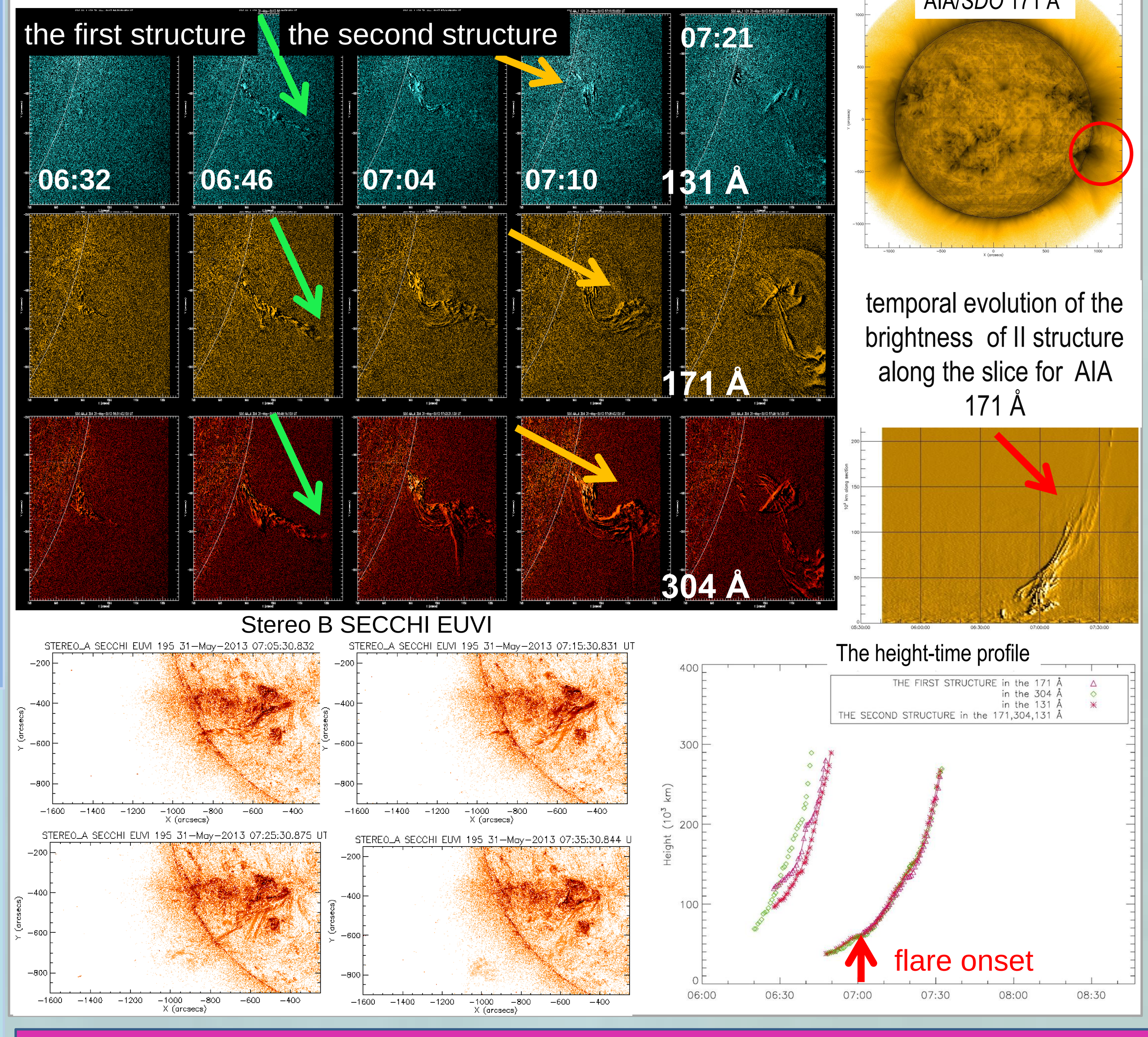
04 June 2013-

eruption of prominence (N39E92) associated with CME



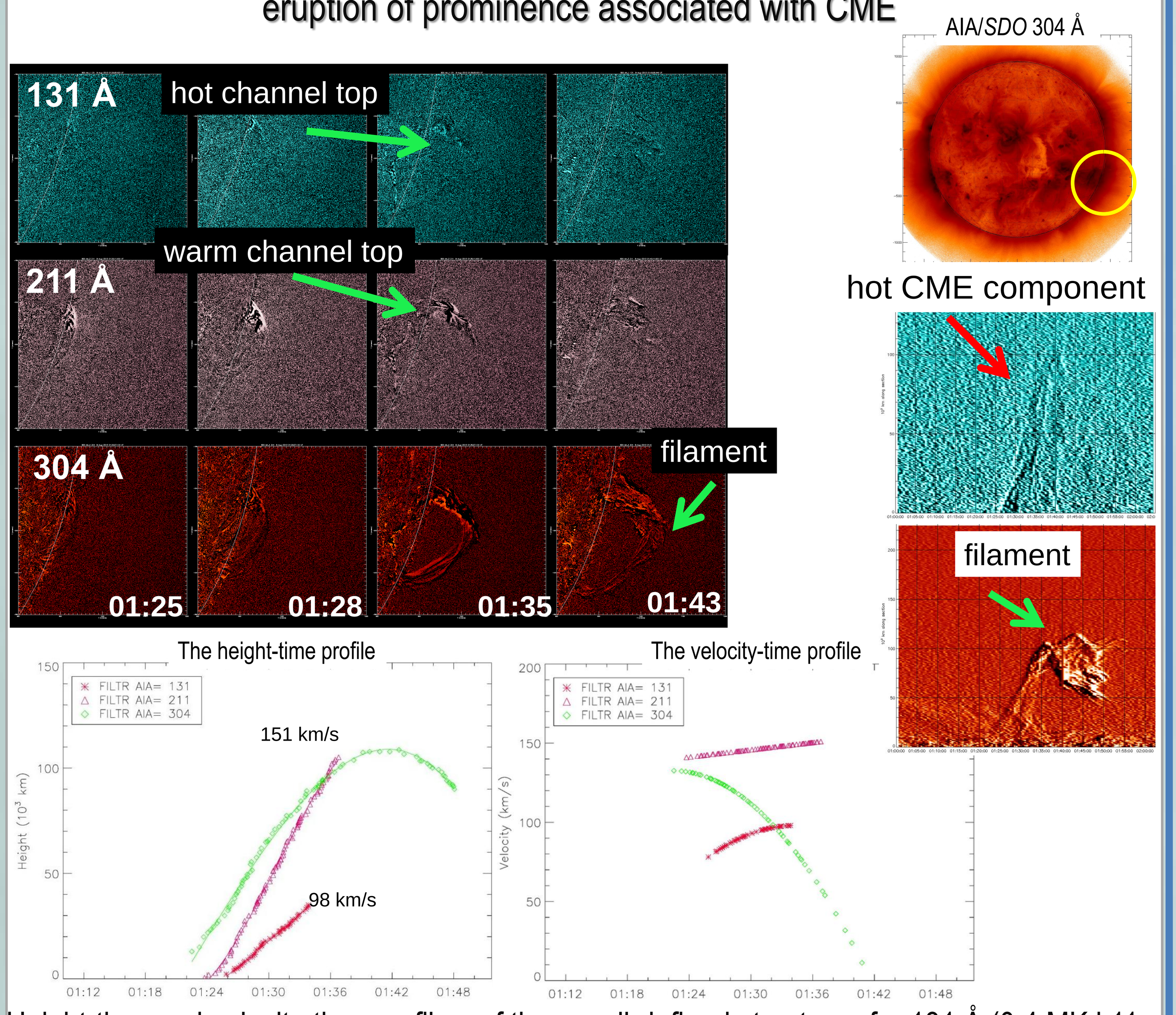
31 May 2013-

a C1.2 flare associated with plasmoid eruption (AR 11754) and a CME



06 August 2013-

eruption of prominence associated with CME



Height-time and velocity-time profiles of three well-defined structures for 131 Å (0.4 MK i 11 MK), 171 Å (0.6 MK), and 304 Å (0.05 MK) obtained from AIA

Results and conclusions

In order to better understanding nature of CME we investigated possible relationships between the solar surface phenomena such as filament eruption, and flares. We observed that **CMEs associated with flares in the low corona have two phases of kinematical evolution**: slow rise and an impulsive acceleration. Estimated time of **onset impulsive acceleration phase of these two examples coincides with start of associated flare** (Cheng et al. 2013b). We have also shown that **in all examples of eruptions we can distinguish hot structures** seen in the high temperature passbands of the AIA, **three of them are seen before the impulsive acceleration phase of the eruption**. **For CME associated with flares we obtained higher speeds** than for CME correlated with prominences (mean values: 232 km s^{-1} and 128 km s^{-1}, respectively). **For CME-flares pairs** we observed that **front of eruption** (seen in 171 Å) **moves with the highest speeds** (20-842 km s^{-1} with mean value 302 km s^{-1}). We also notice that in the case of CME associated with prominences we can observed partial failed eruption.