



# Temperature evolution of CMEs in two kinematic classes observed by SDO/AIA

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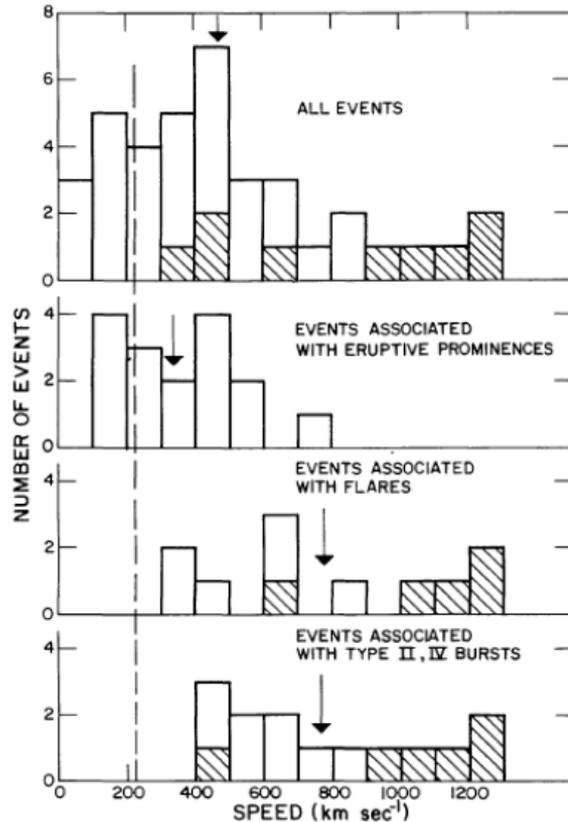
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<sup>2</sup>Space Research Center, Polish Academy of Sciences, Solar Physics  
Division, Poland

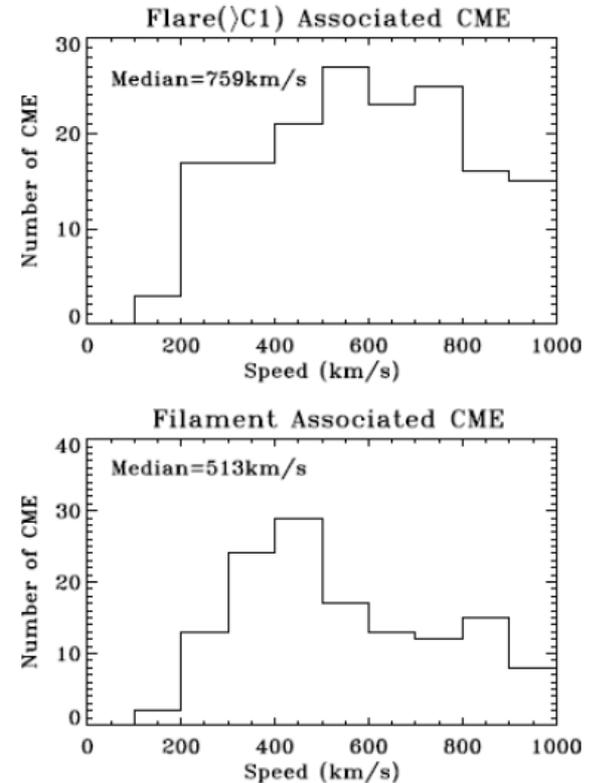
# Are there really two kinematical types of CMEs ?

Gosling et al., 1976, Solar Phys., 48, 398-397;

Moon et al., 2002, Astrophys. J., 581, 694-702;

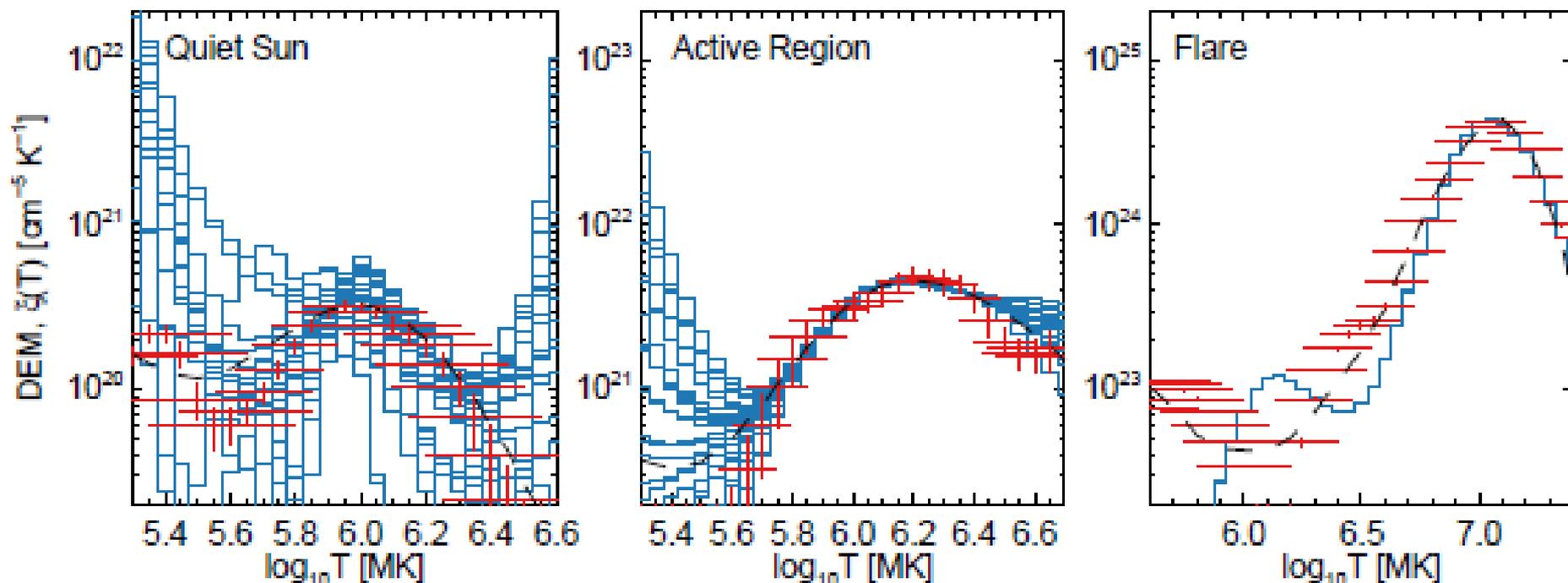


The number distribution of measured speeds of the leading edges of CME.



Histograms for the CME speeds corrected for the projection effect: flare (>C1)-associated CMEs (**upper panel**) and eruptive-filament-associated events (**lower panel**).

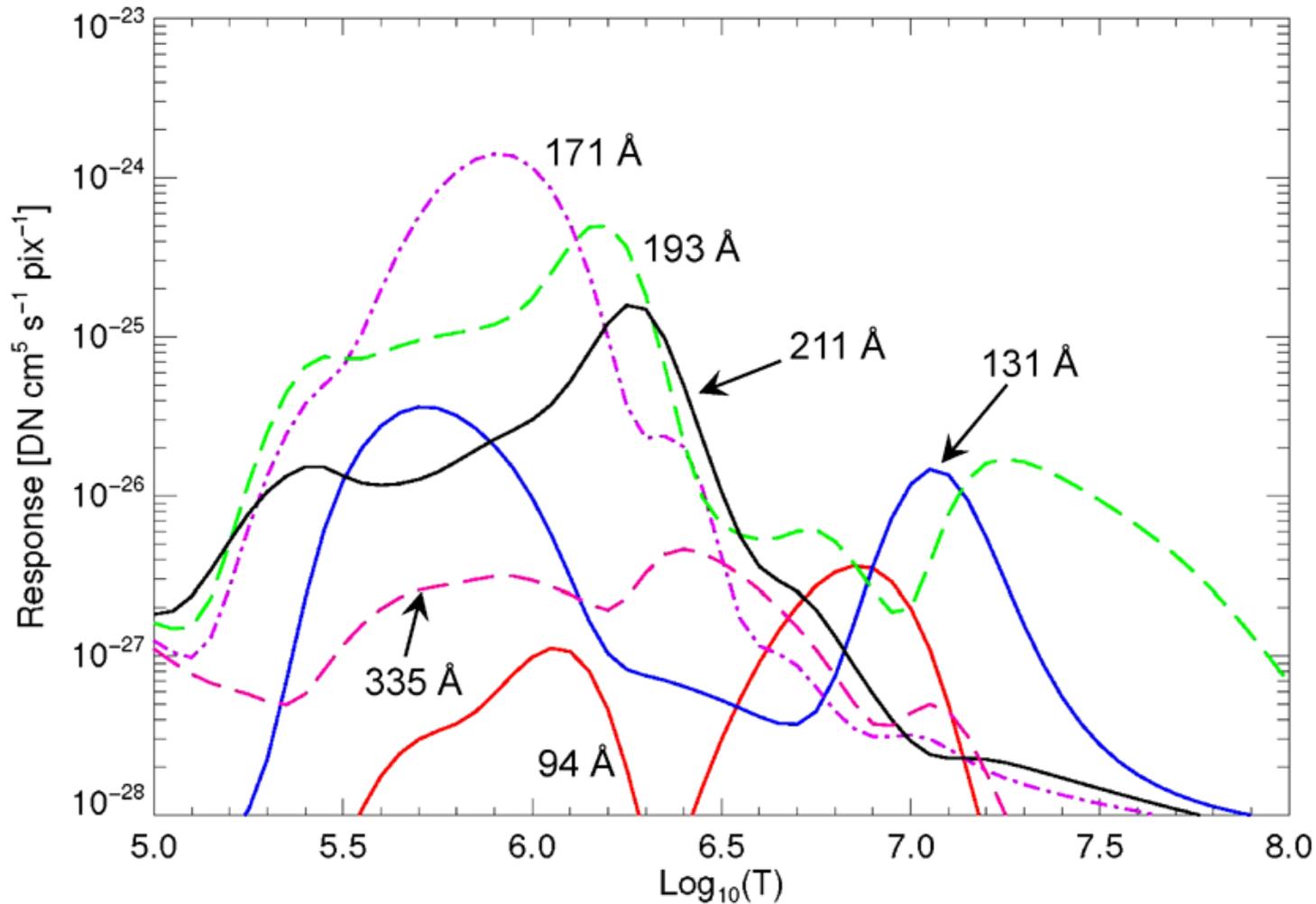
The **Regularized Inversion** method developed by Hannah and Kontar (2012), and **DEM forward-fitting method** (Weber et al. 2004; Golub et al. 2004) originally used for producing DEM profiles for *HINODE*/XRT images.



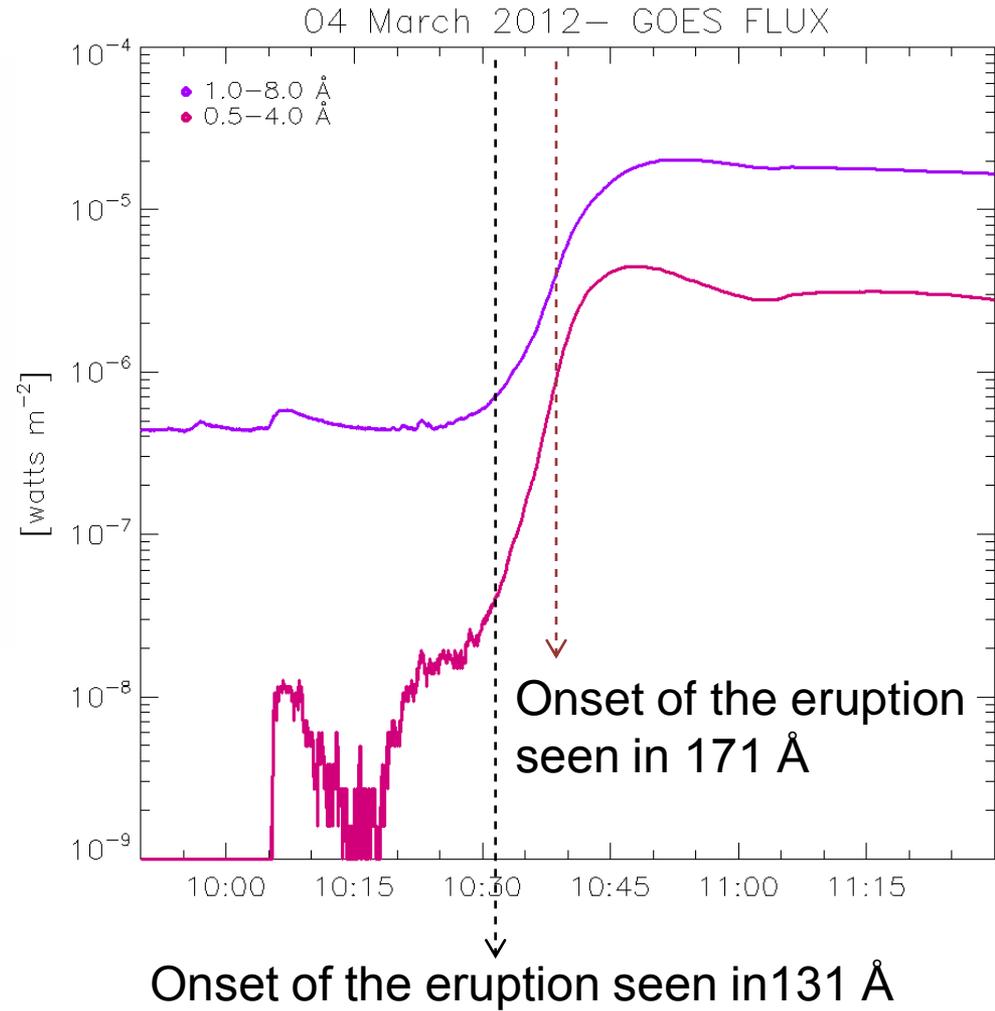
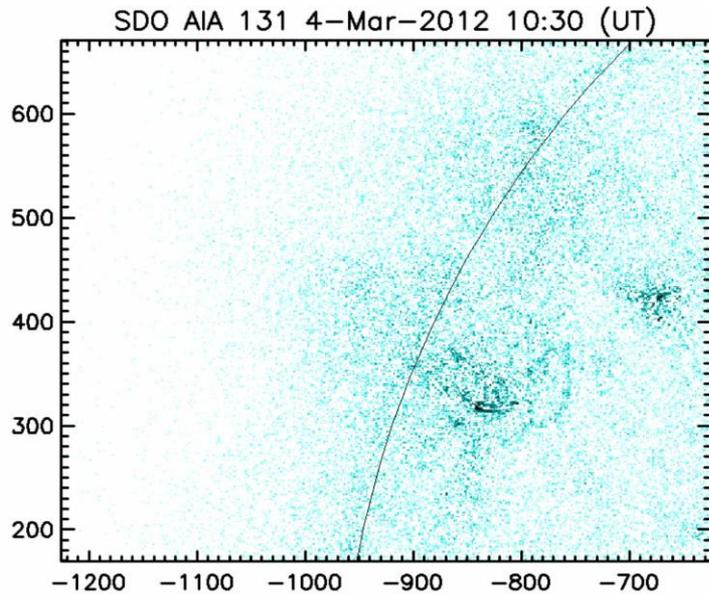
Hannah, I. G., & Kontar, E. P. **2012**, A&A, 539, A146

RI DEM (red error bars) and Hinode/XRT solution (blue histograms- 25 MC realisations) for simulated SDO/AIA data for CHANTI DEM models (from left to the right: quiet Sun, active region and M-CLASS flare)

AIA instrument temperature response curves for the six coronal passbands:  
131 Å, 94 Å, 335 Å, 211 Å, 193 Å, and 171 Å

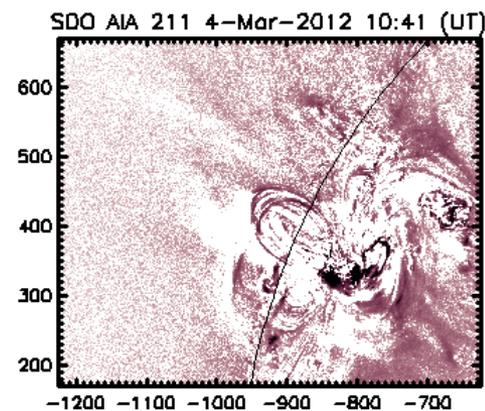
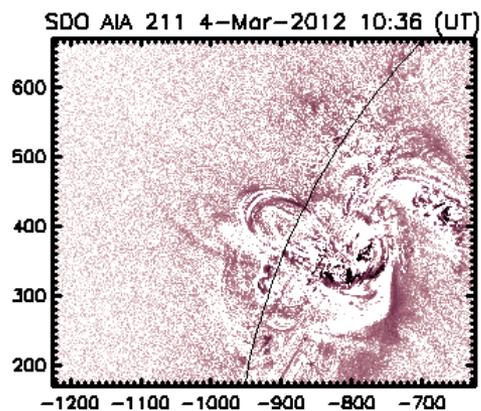
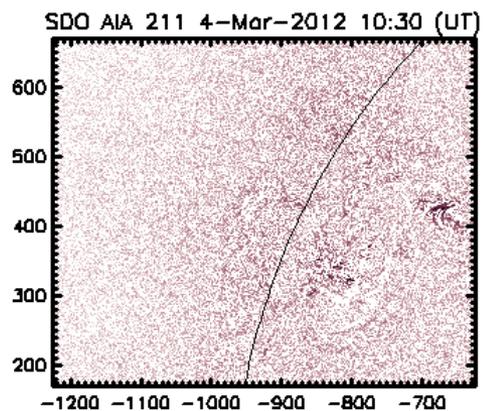
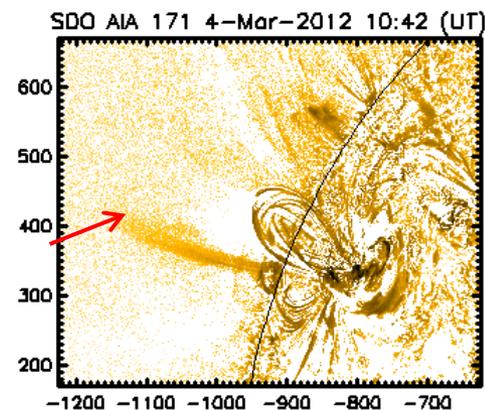
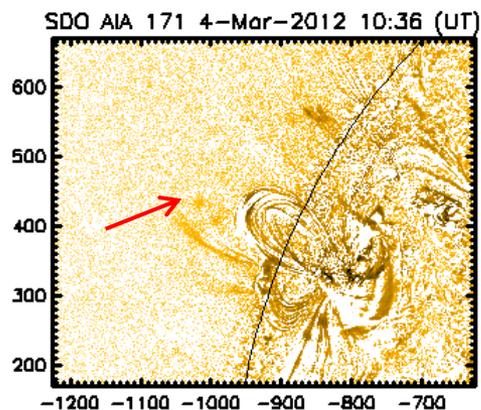
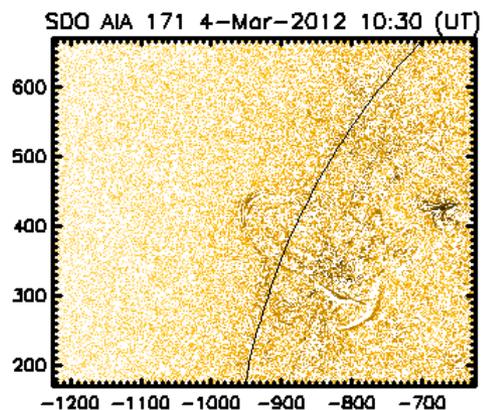
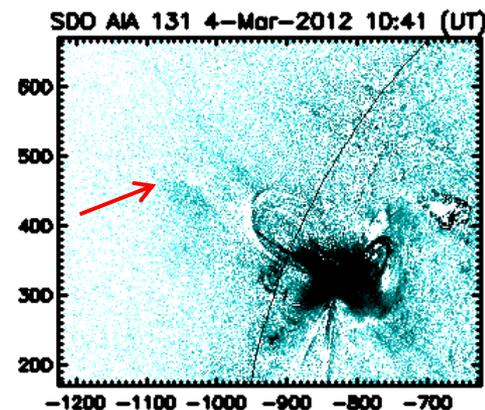
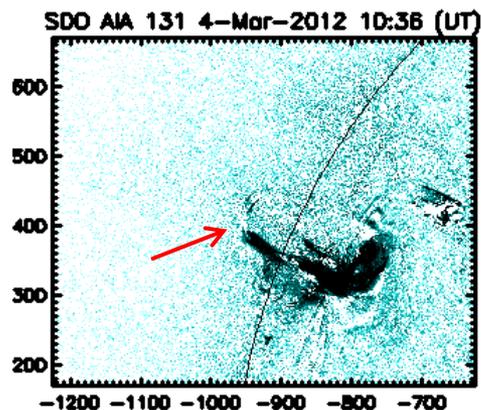
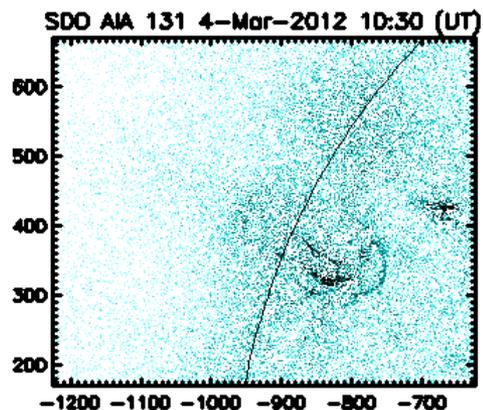


Lemen et al., Solar Phys, **2012**, 275:17–40

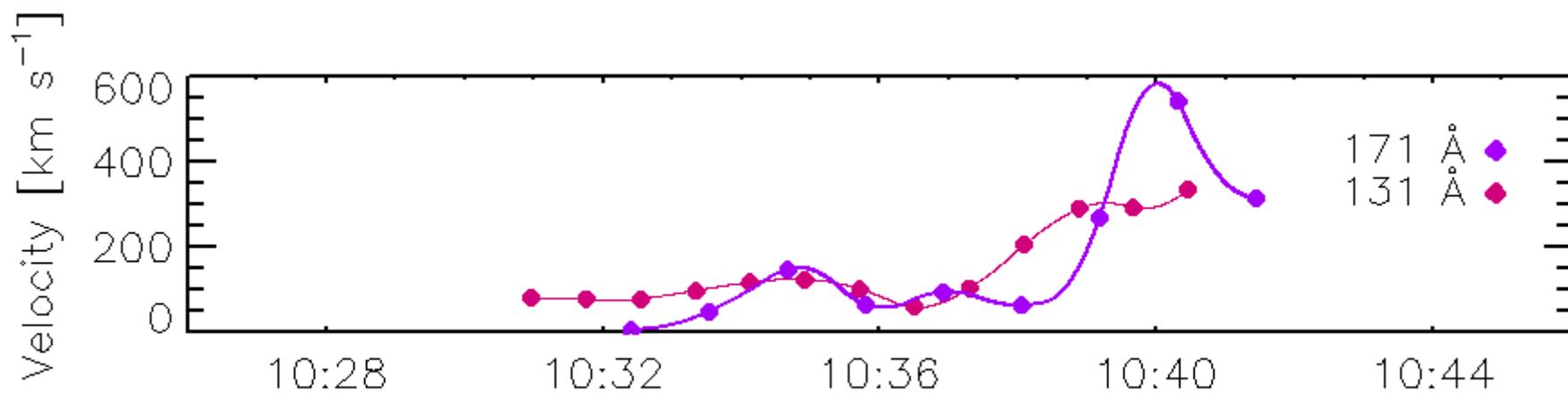
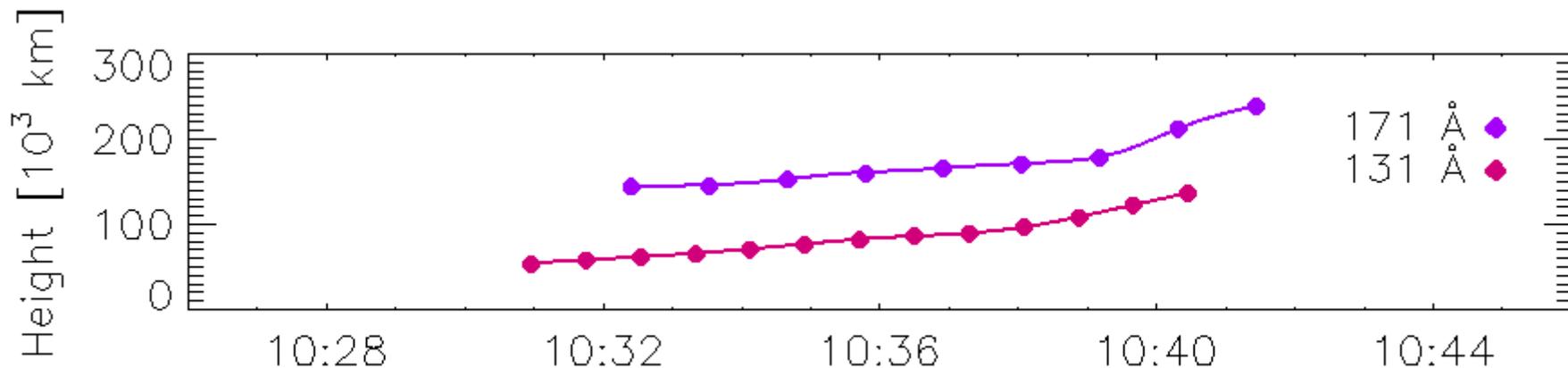


# 2012-March-04

AIA 131 Å (upper panel), 171 Å (middle panel) and 211 Å (bottom panel) base-difference images. Their base images are taken at 10:15 UT



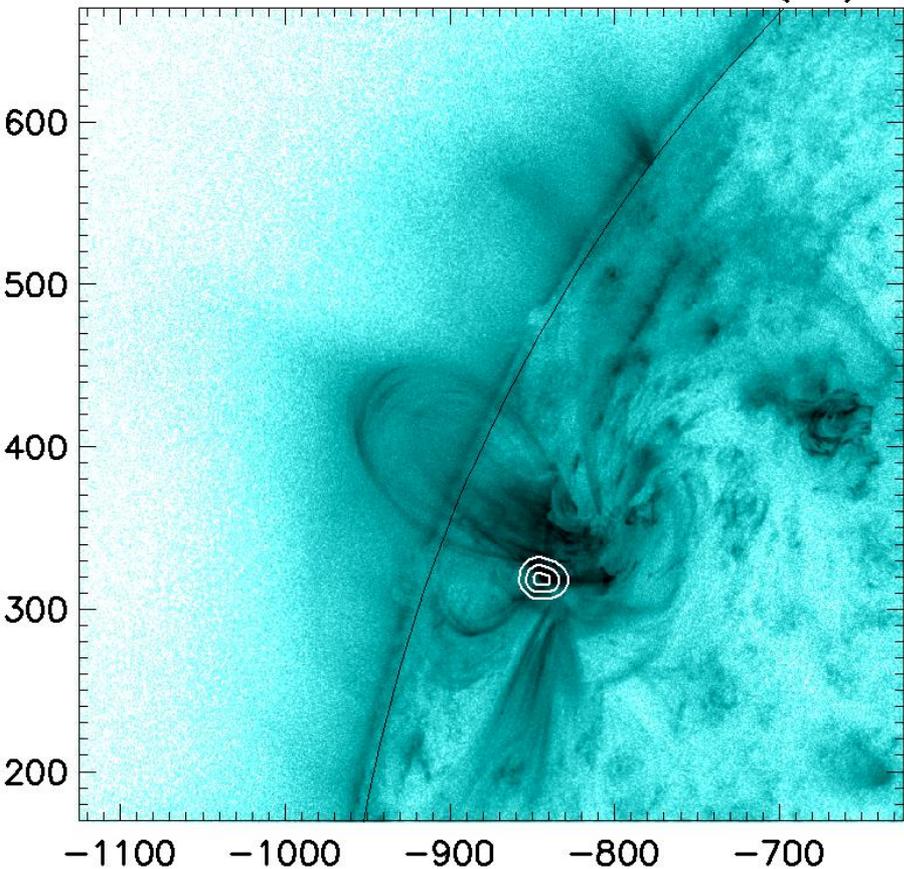
# 2012-March-04



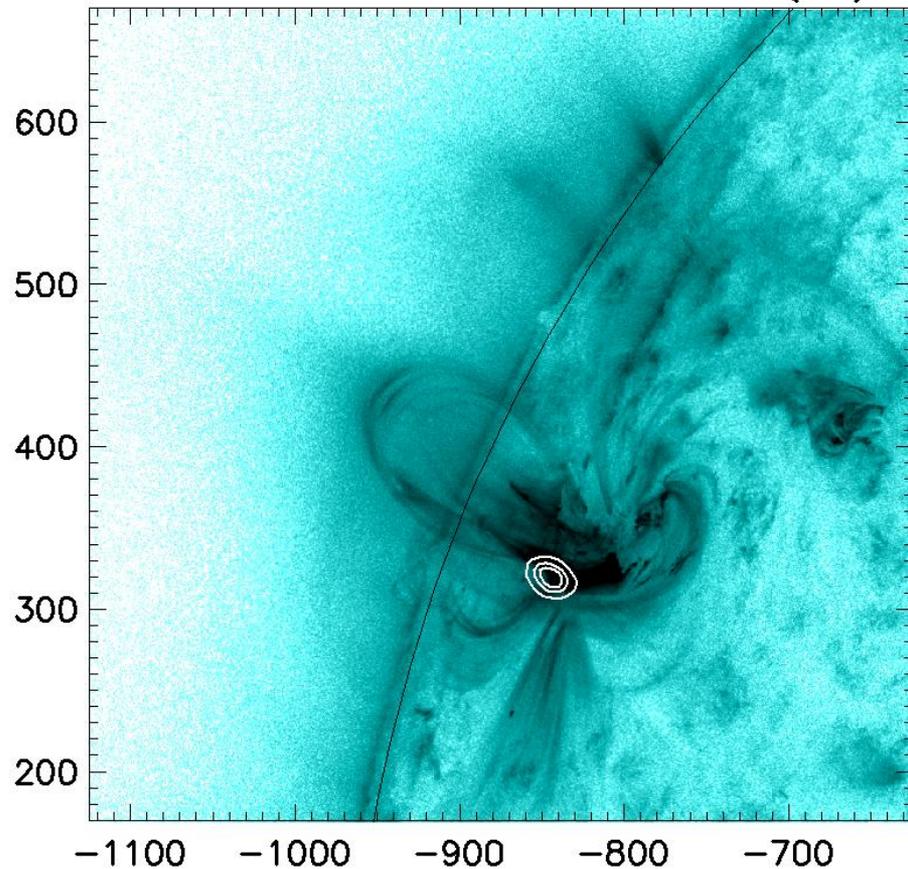
# 2012-March-04

RHESSI contours- 6-7 keV source. The results for the pre-eruptions and during the eruption, respectively.

SDO AIA 4-Mar-2012 10:29 (UT)



SDO AIA 4-Mar-2012 10:34 (UT)



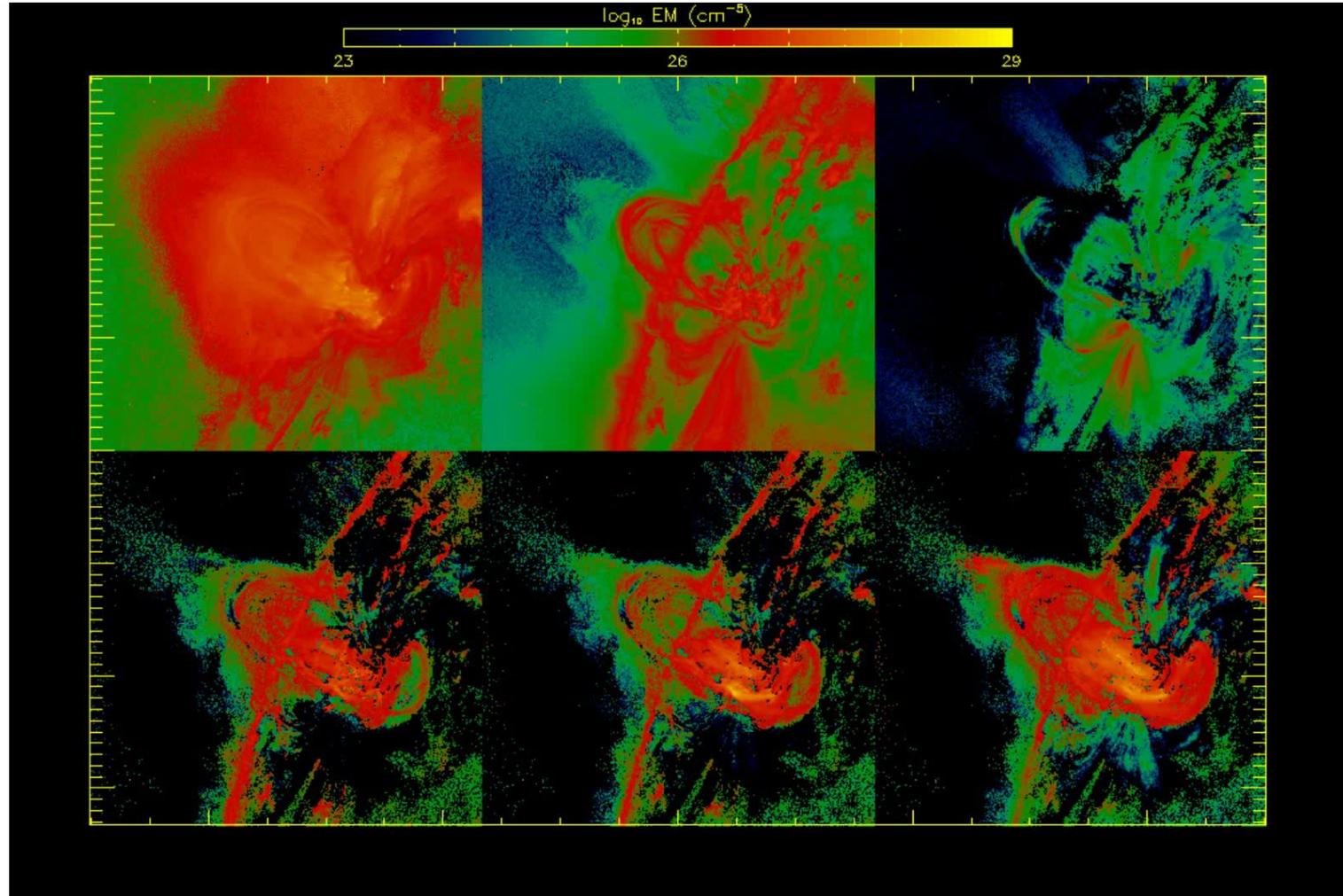
# 2012-March-04

Animation of DEM maps in six different temperature ranges and for various times

1.5K- 2.0 MK

1.0K- 1.5 MK

0.8K- 1.0 MK



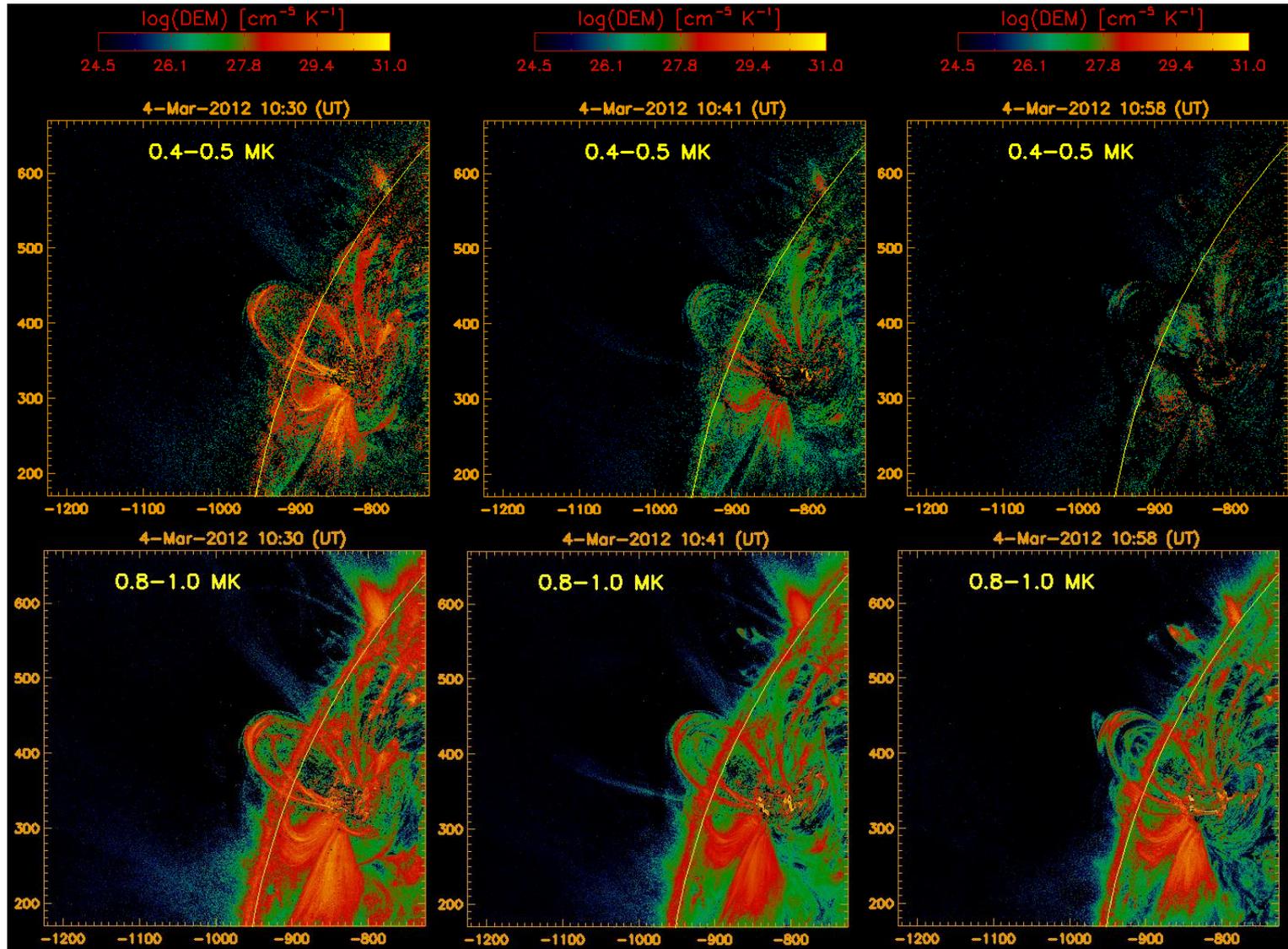
12.6K- 15.8 MK

8.0K- 10.0 MK

6.3K- 8.0 MK

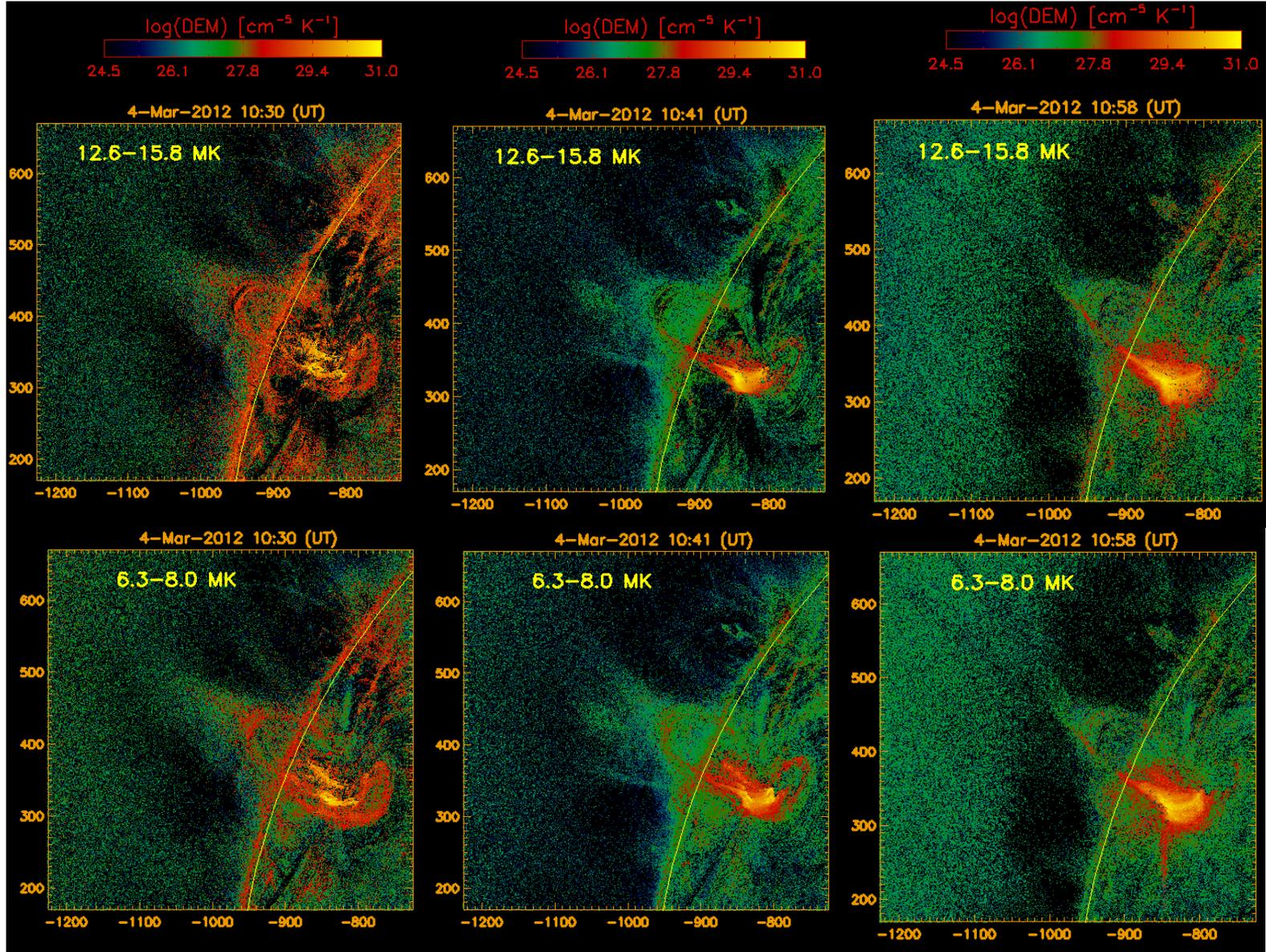
# 2012-March-04

DEM maps in different temperature ranges and for three various times.



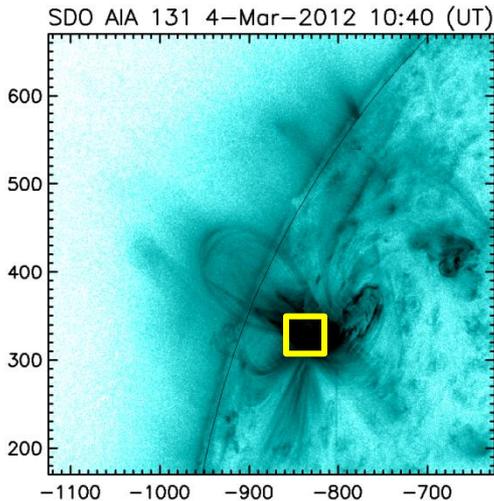
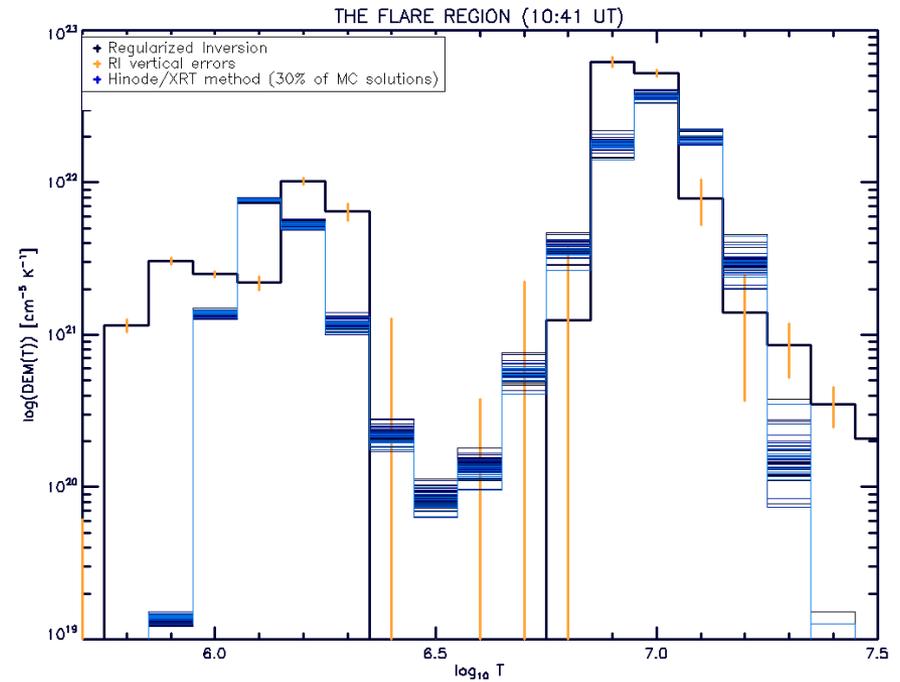
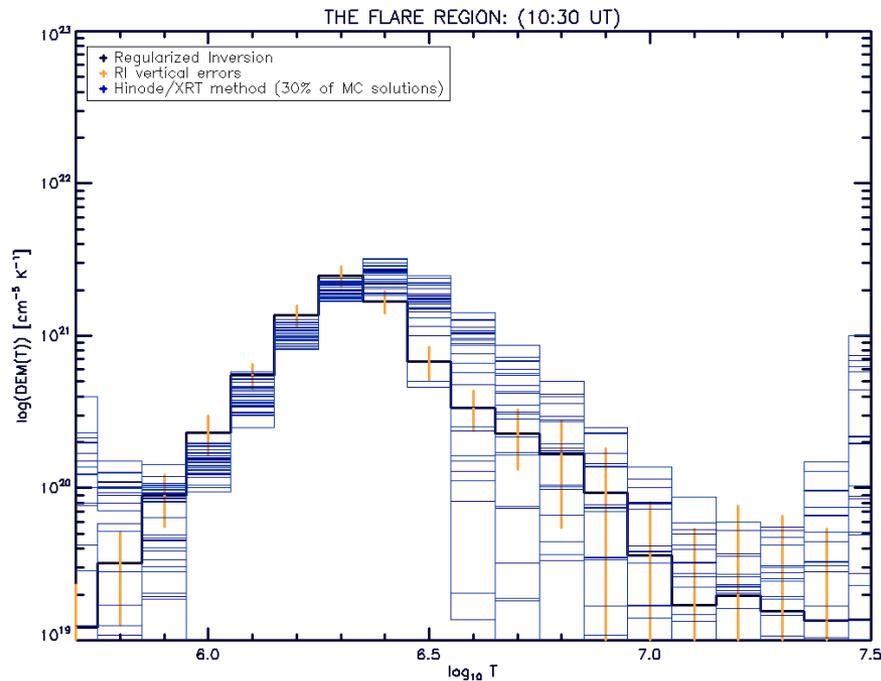
# 2012-March-04

DEM maps in different temperature ranges and for three various times.



# 2012-March-04

DEM curves of the selected regions (shown by the yellow box). Left and right panels display the results for the pre-eruptions and during the eruption, respectively.

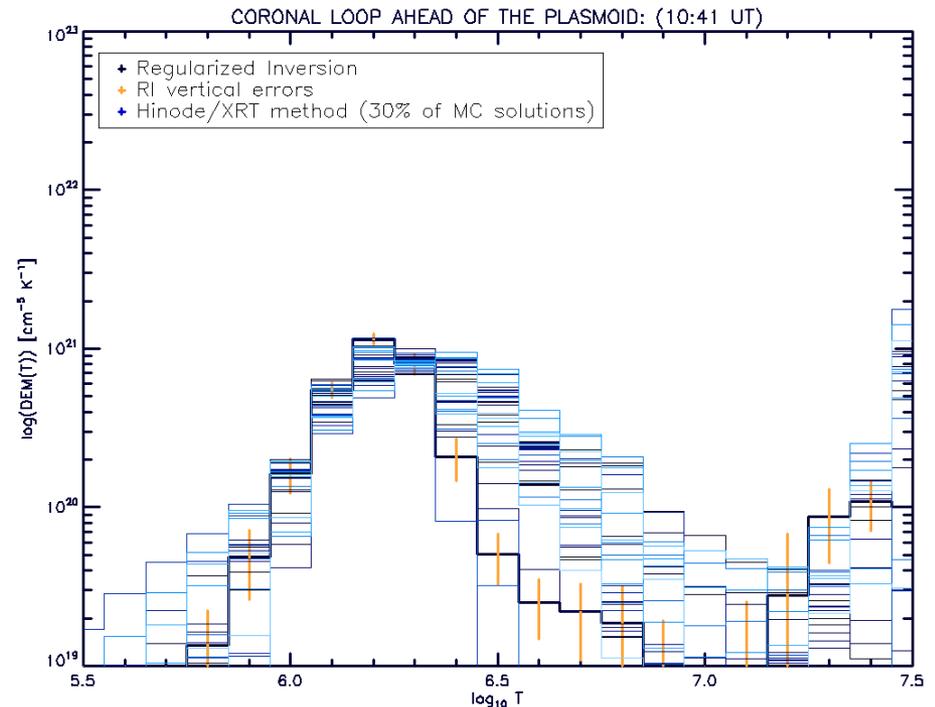
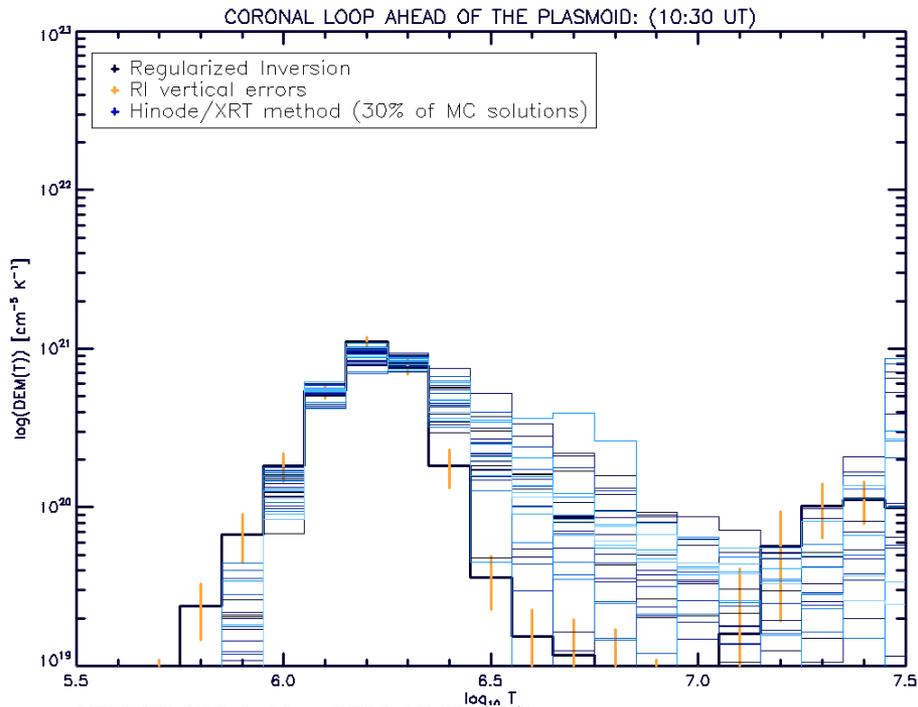


**Just before the eruption:** very high emission with broad profile (with peak at 2.0 MK).

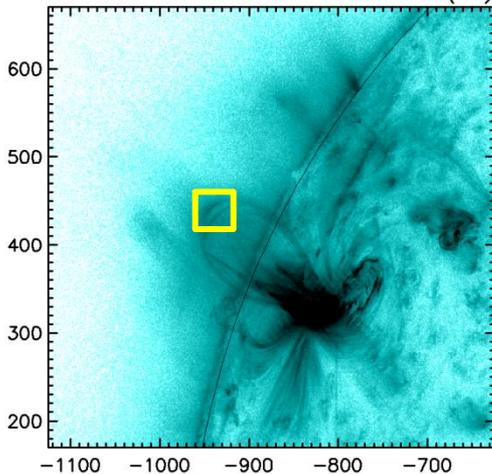
**During the eruption:** double peak, higher emission at higher temperatures (with peak at 10.0 MK)..

# 2012-March-04

DEM curves of the selected regions (shown by the yellow box). Left and right panels display the results for the pre-eruptions and during the eruption, respectively.



SDO AIA 131 4-Mar-2012 10:40 (UT)

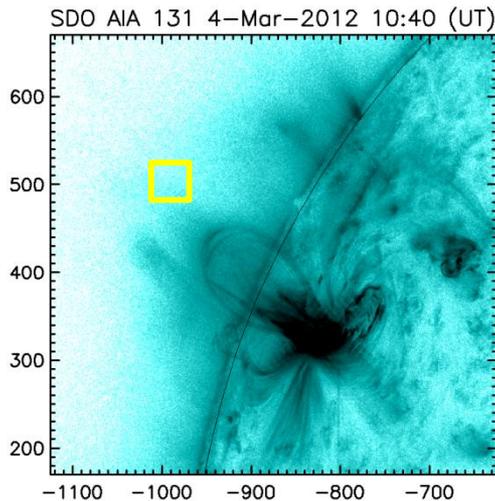
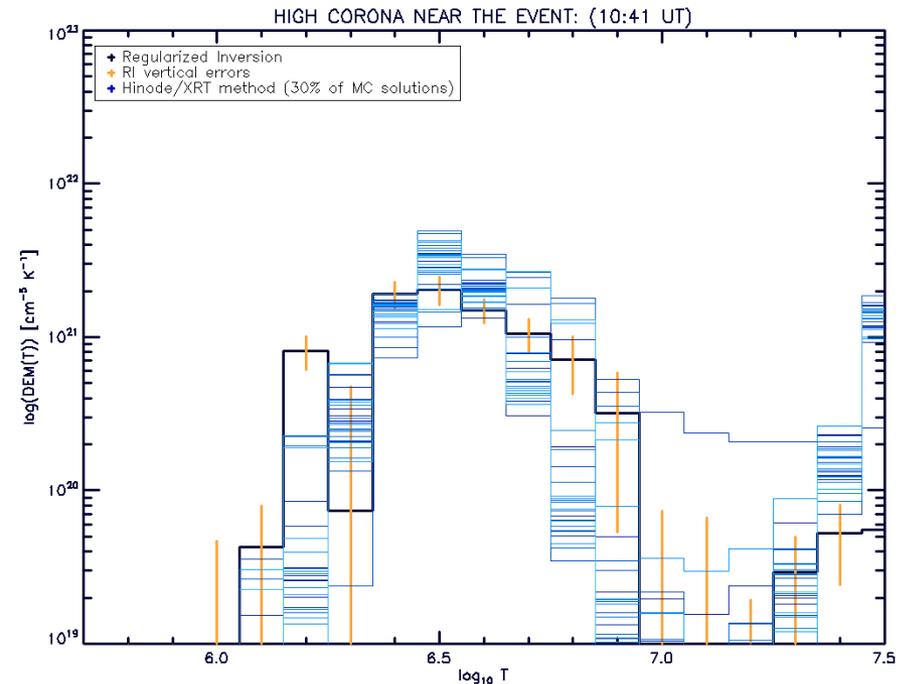
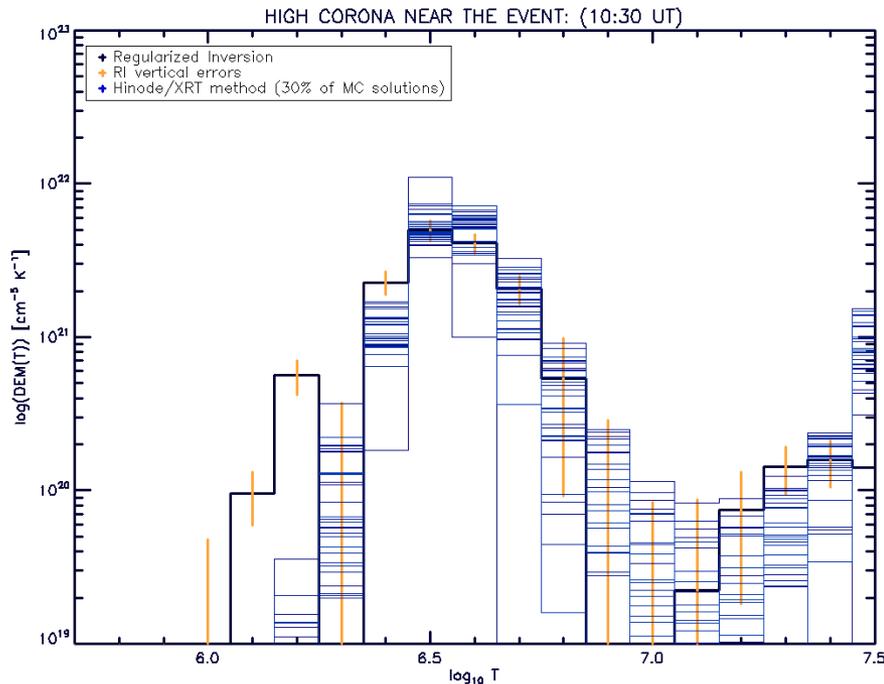


**Just before the eruption:** two components (clearly seen on RI profiles) the lower temperature is likely to be emission the background corona along the line-of-sight.

**During the eruption:** the identical profile to the onset of the eruption.

# 2012-March-04

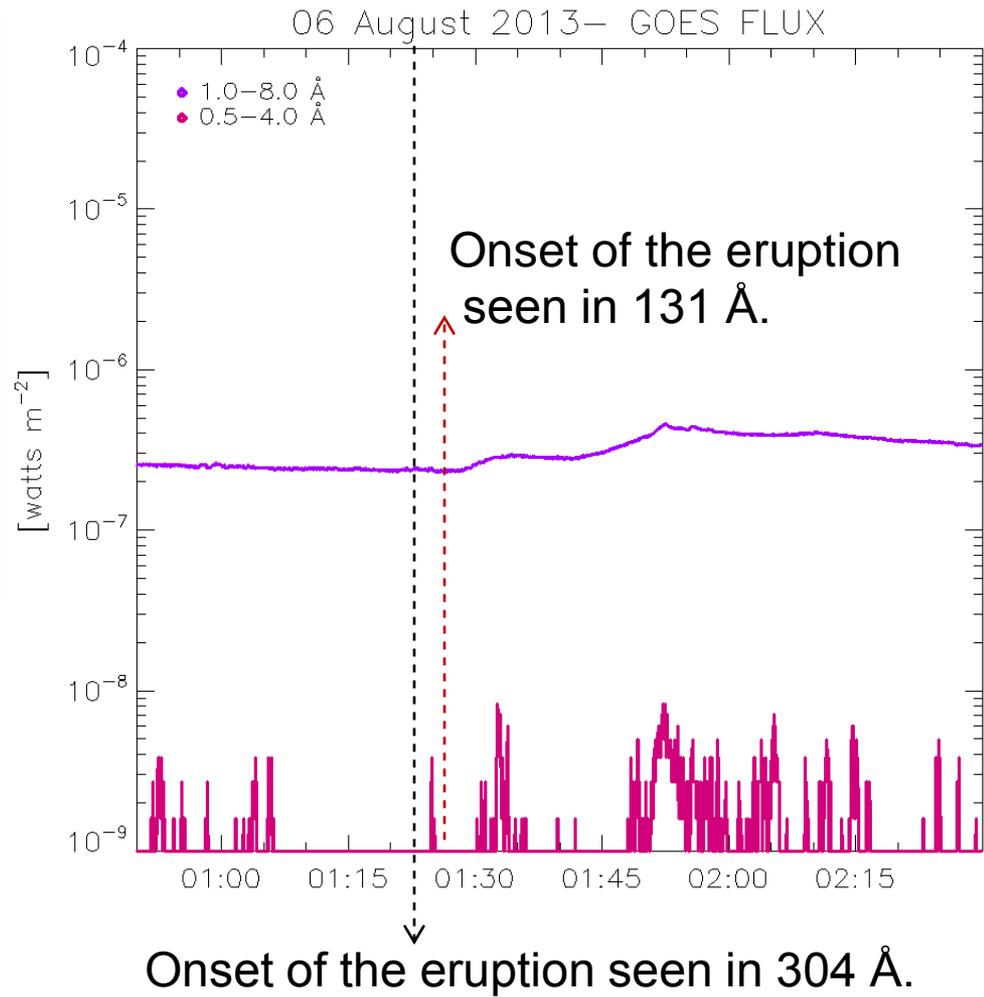
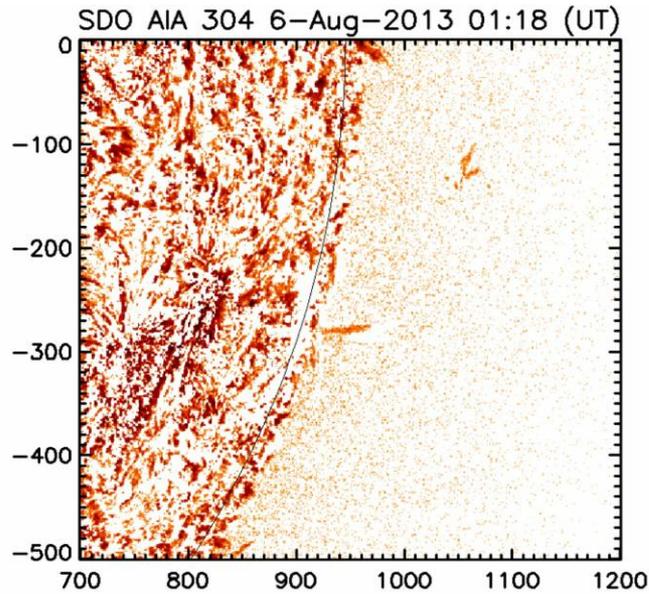
DEM curves of the selected regions (shown by the yellow box). Left and right panels display the results for the pre-eruptions and during the eruption, respectively.



**Just before the eruption:** two components (clearly seen on RI profiles). High emission can indicate the presence of coronal loops.

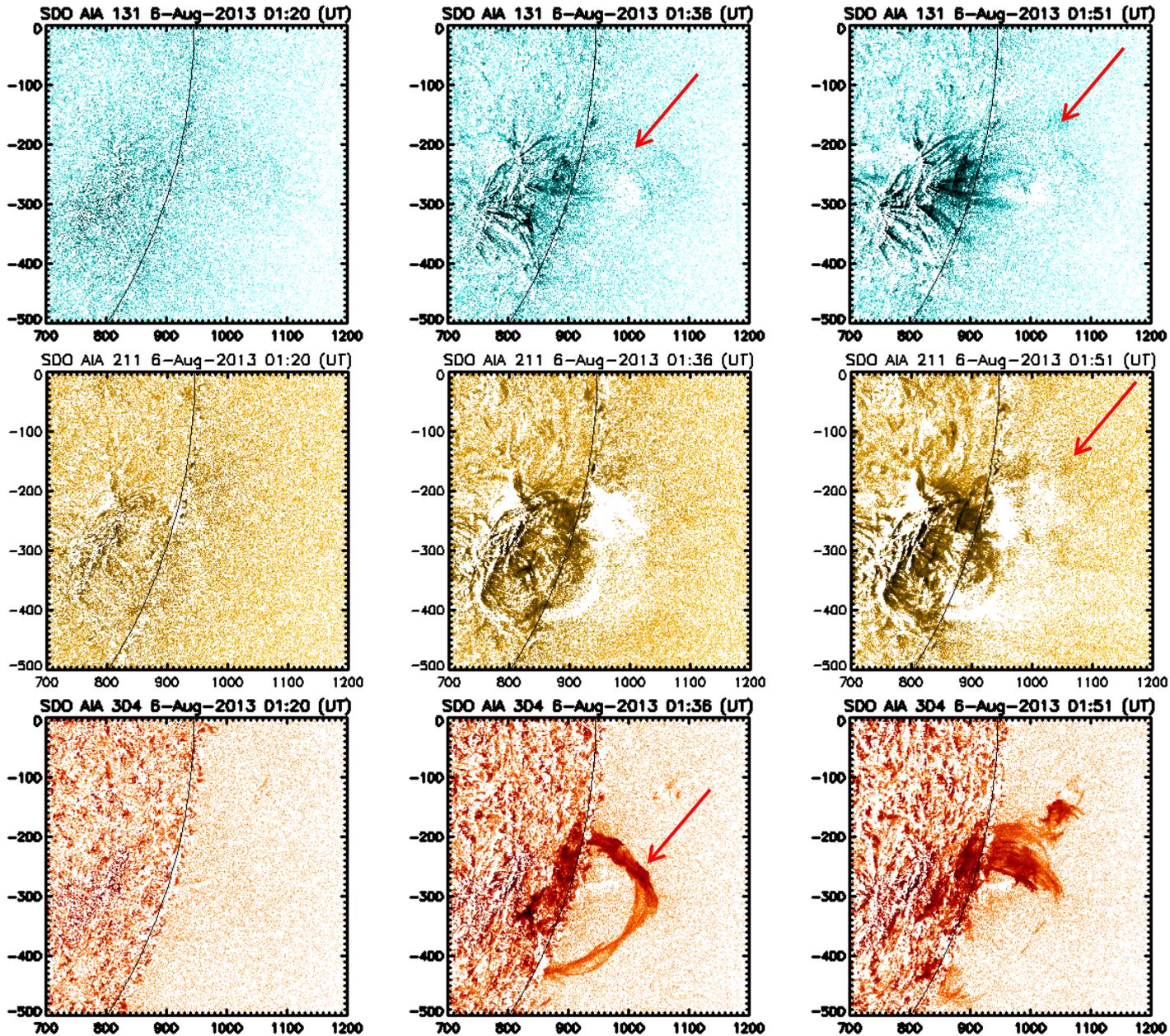
**During the eruption:** slightly lower emission than at the beginning of the eruption may indicate that loop moving out that region.

# 2013-August-06

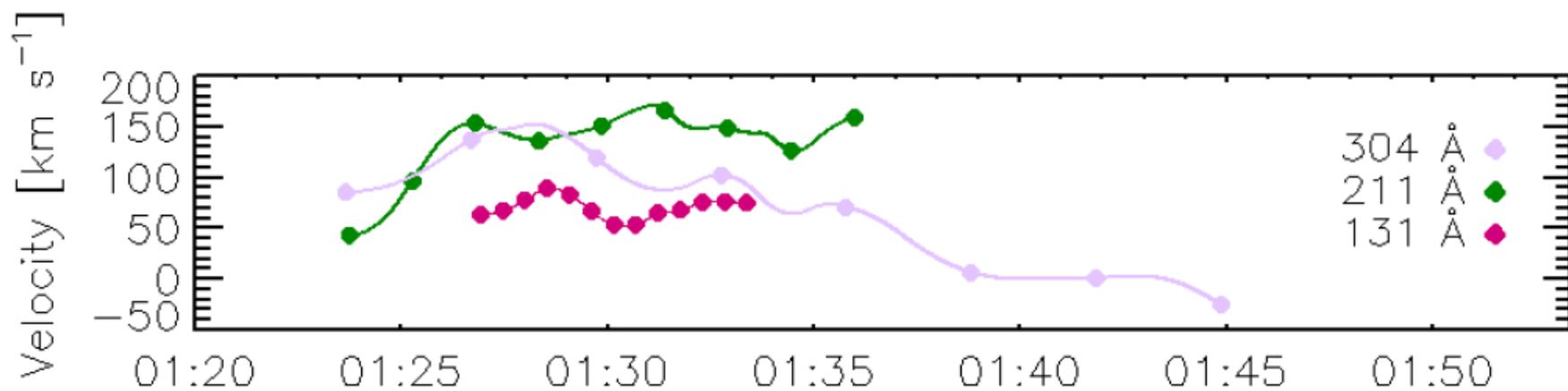
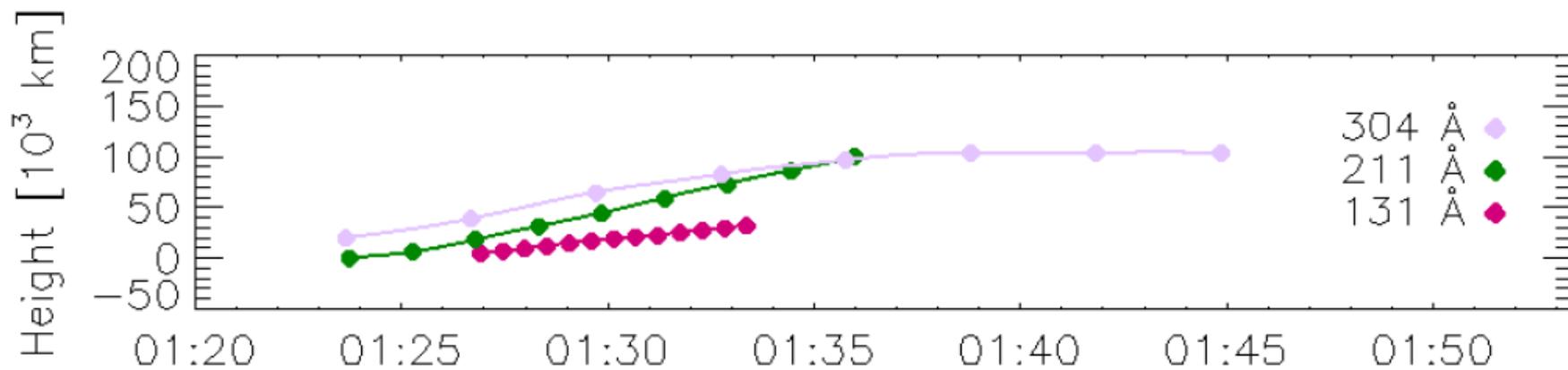


# 2013-August-06

131 Å (upper panel), AIA 171 Å (middle panels) and 304 Å (bottom panels) base-difference images. Their base images are taken at 01:15 UT.

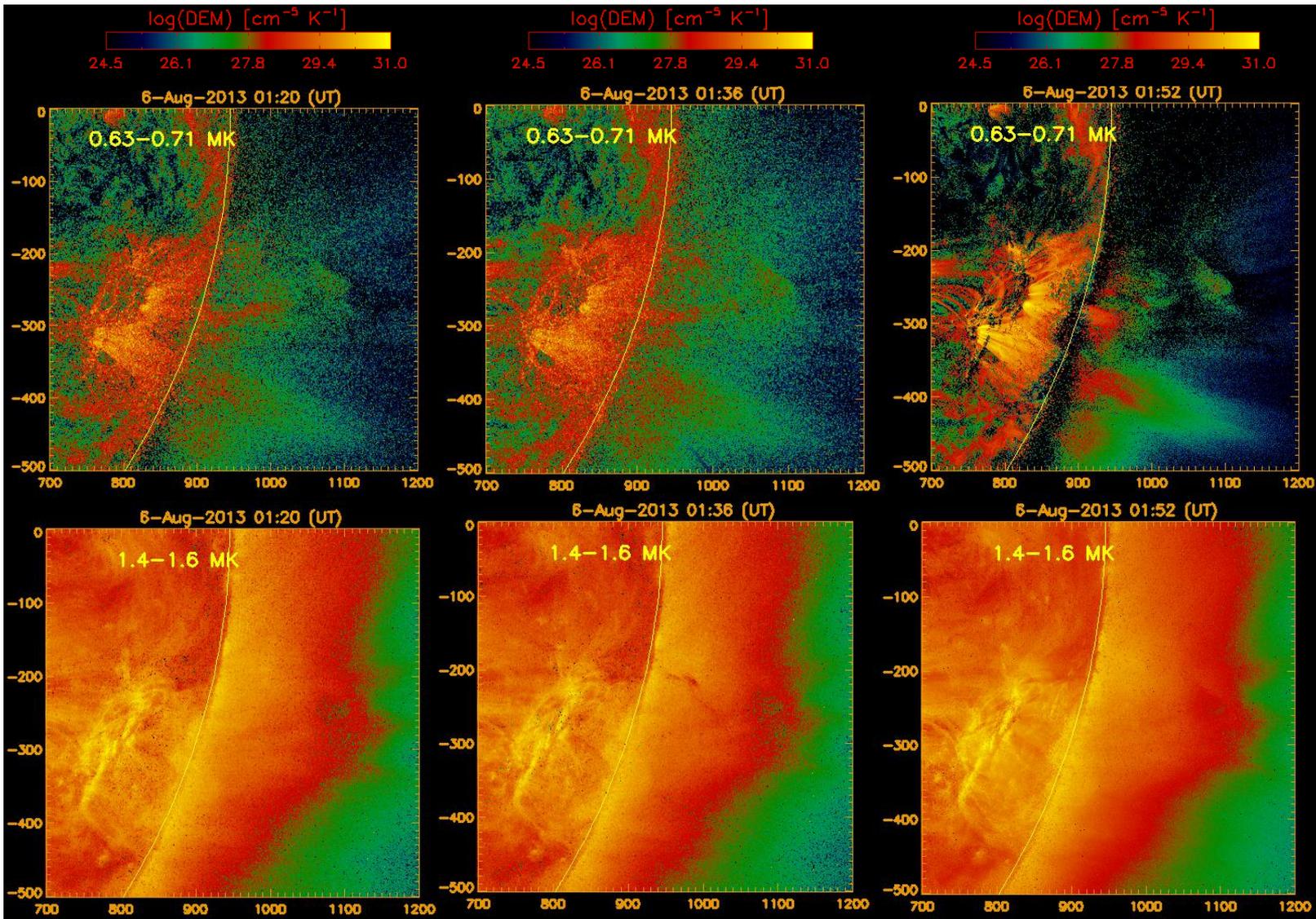


# 2013-August-06



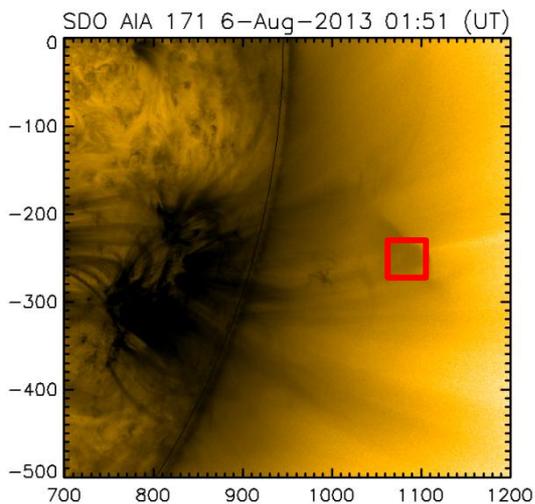
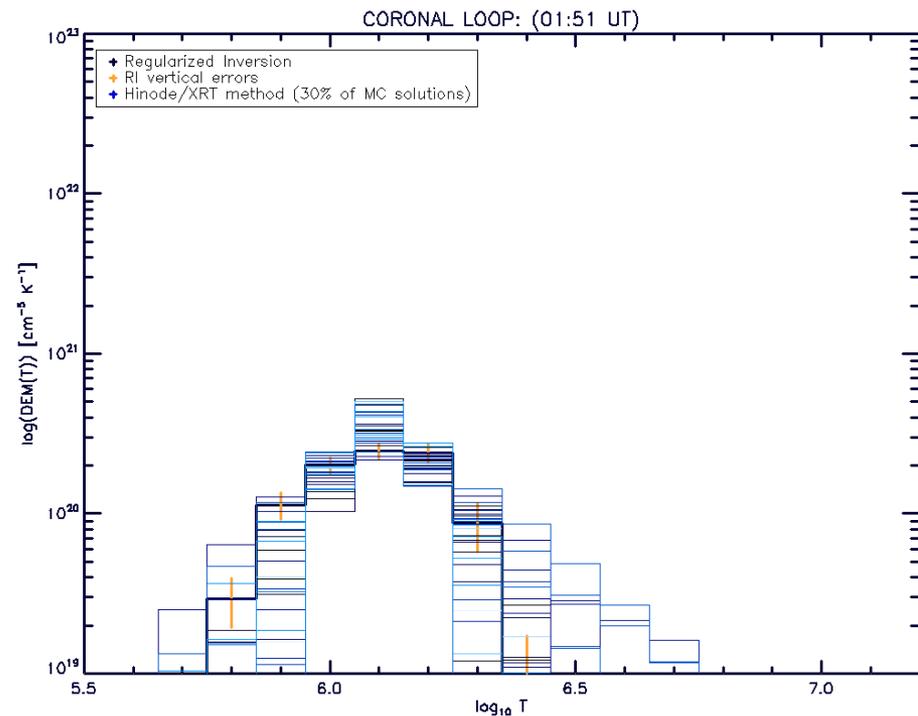
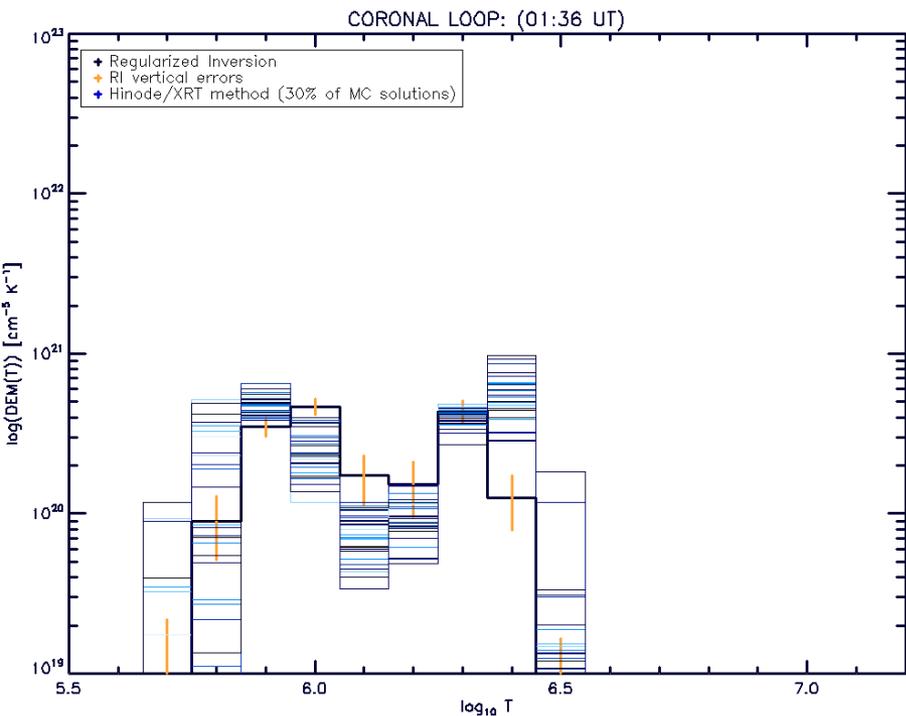
# 2013-August-06

DEM maps in different temperature ranges and for three various times.



# 2013-August-06

DEM curves of the selected regions (shown by the red box). The left and right panels display the results for the onset of the eruption and during the eruption, respectively.

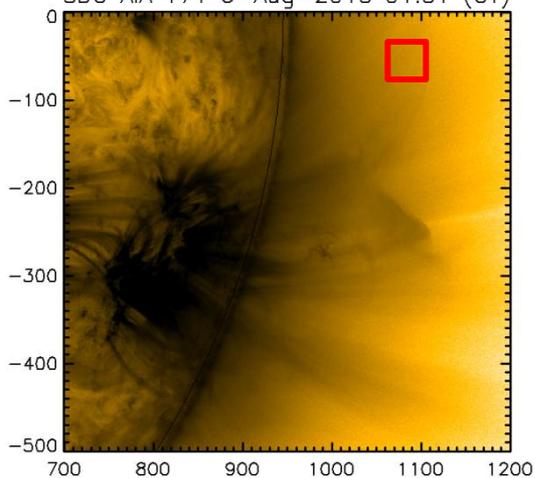
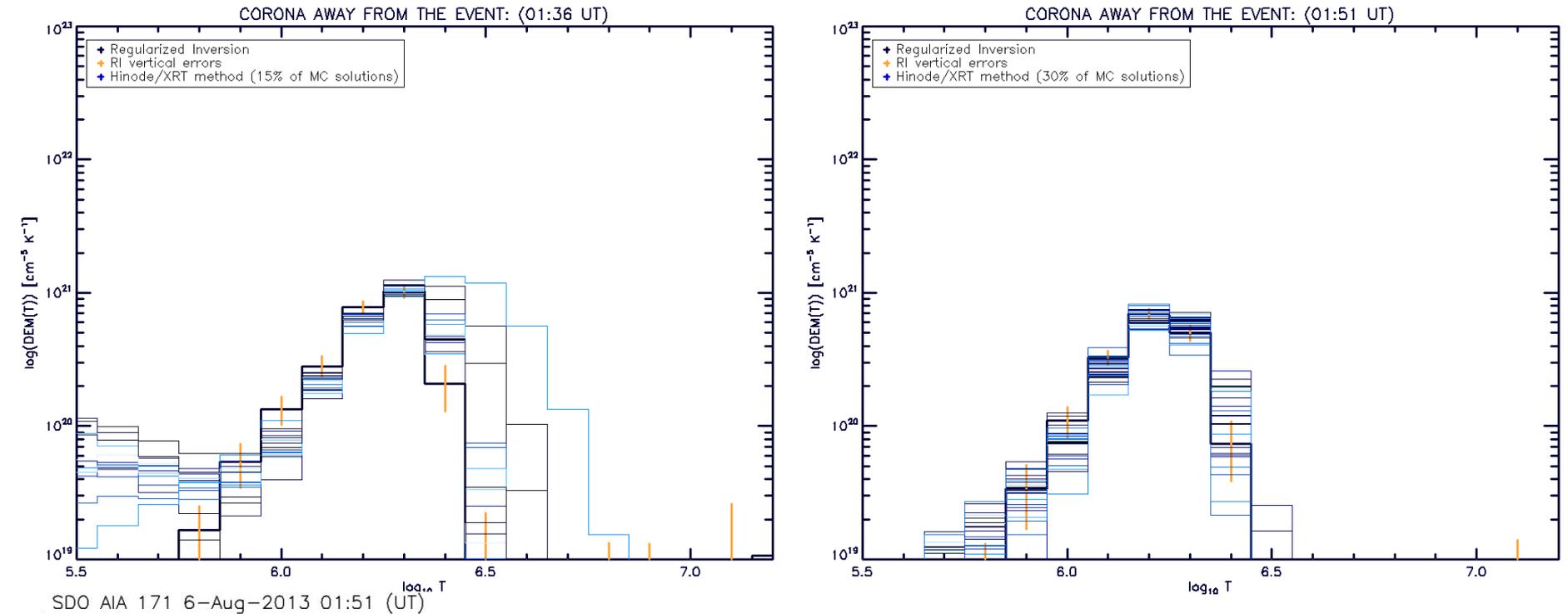


**The onset of the eruption:** low emission with two components

**During the eruption:** slightly lower emission with single peak.

# 2013-August-06

DEM curves of the selected regions (shown by the red box). The left and right panels display the results for the onset of the eruption and during the eruption, respectively.

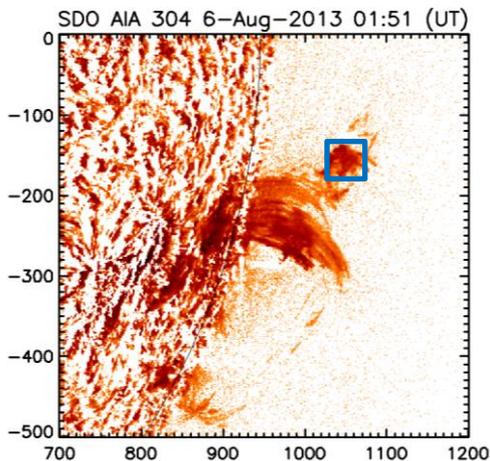
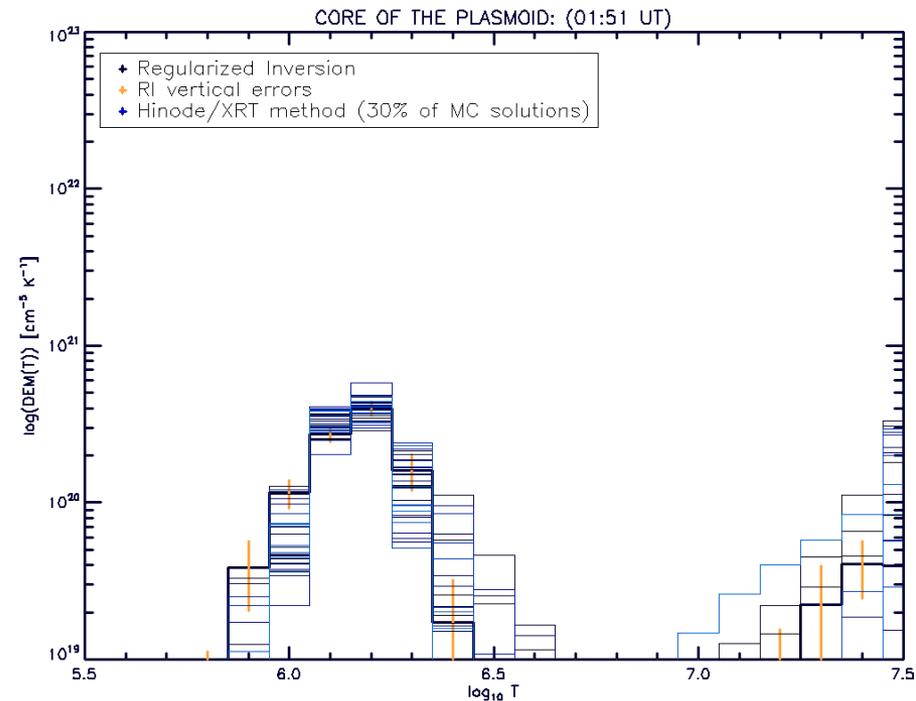
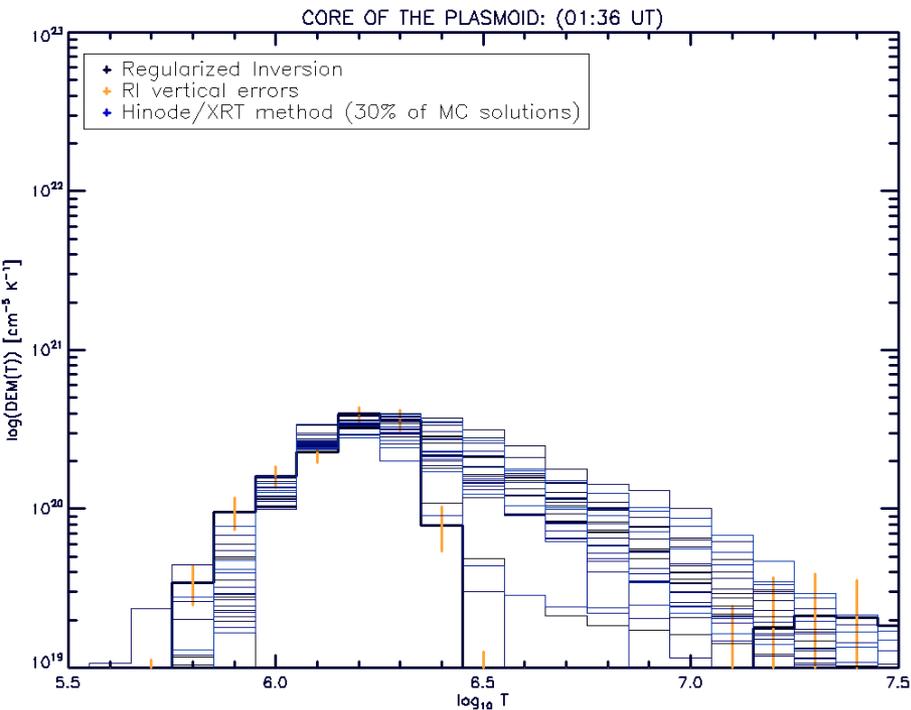


**The onset of the eruption:** single peak of emission with broad profile (1.0-3.0 MK).

**During the eruption:** consistent to the profile at the onset of the eruption.

# 2013-August-06

DEM curves of the selected regions (shown by the blue box). The left and right panels display the results for the onset of the eruption and during the eruption, respectively.

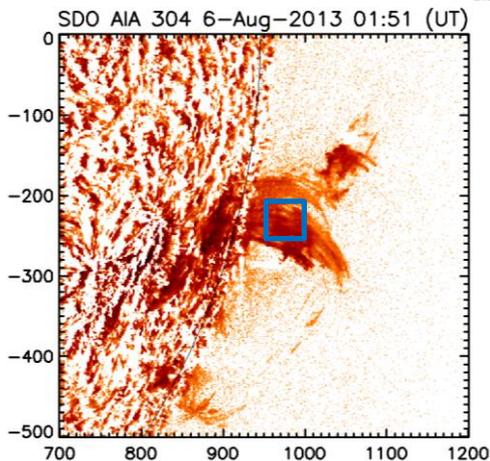
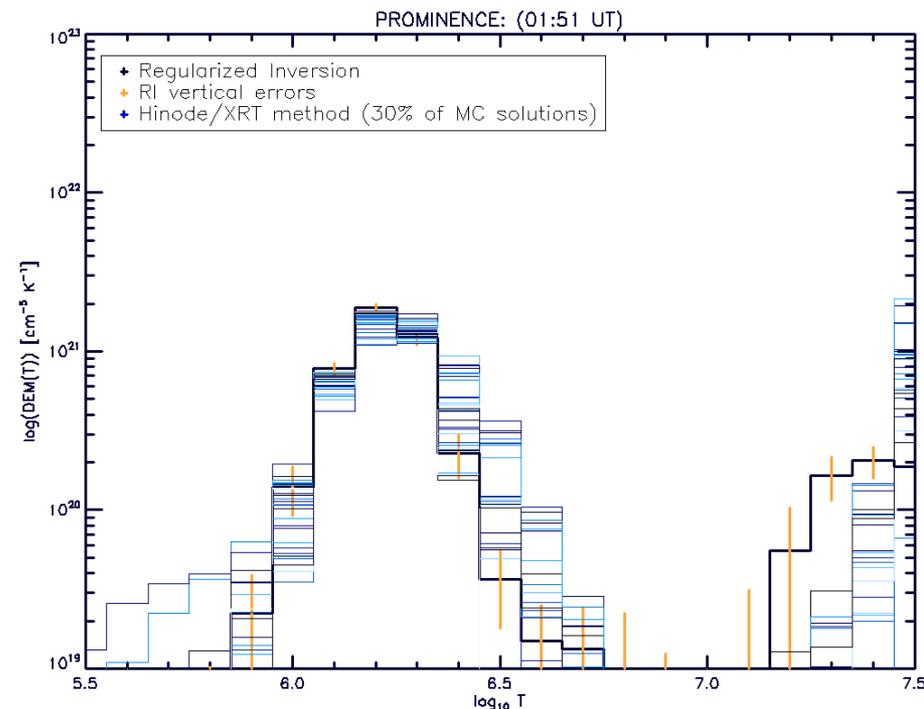
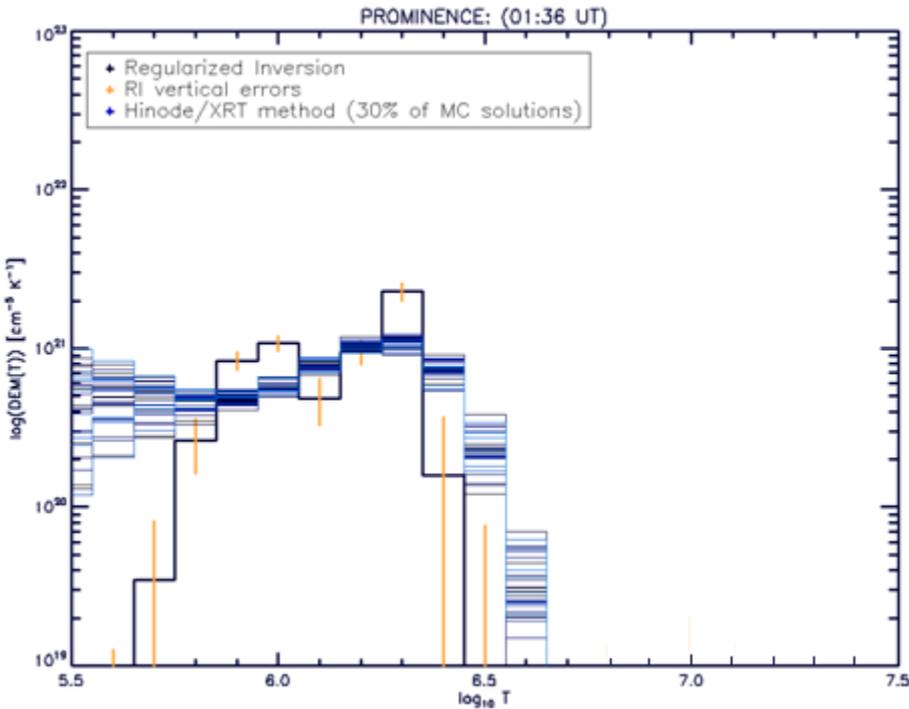


**The onset of the eruption:** low emission with very broad profile (0.6-12.0 MK). RI method gives very low double peak.

**During the eruption:** slightly higher emission and clear seen double peak of emission

# 2013-August-06

DEM curves of the selected regions (shown by the blue box). The left and right panels display the results for the onset of the eruption and during the eruption, respectively.

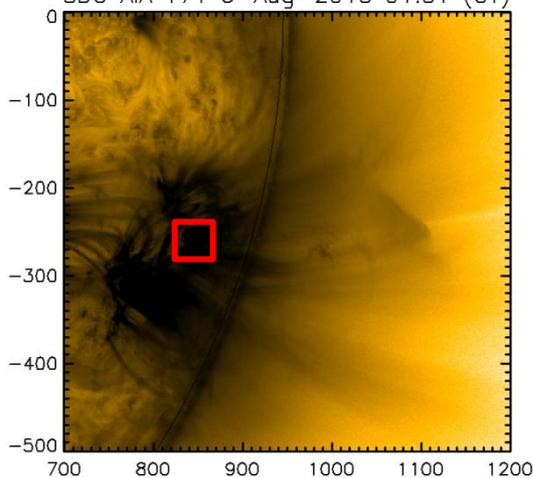
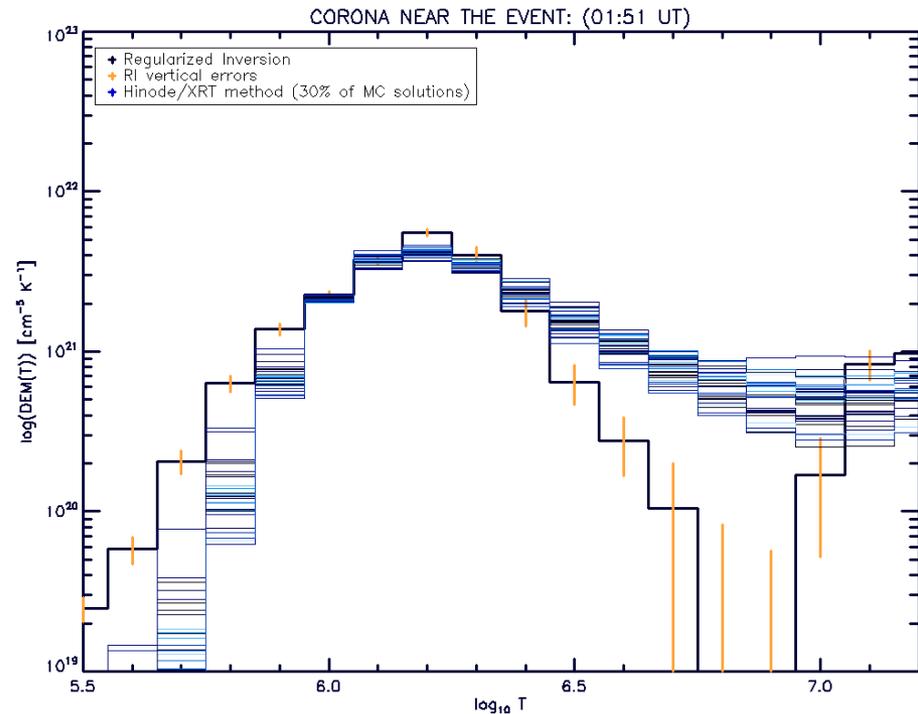
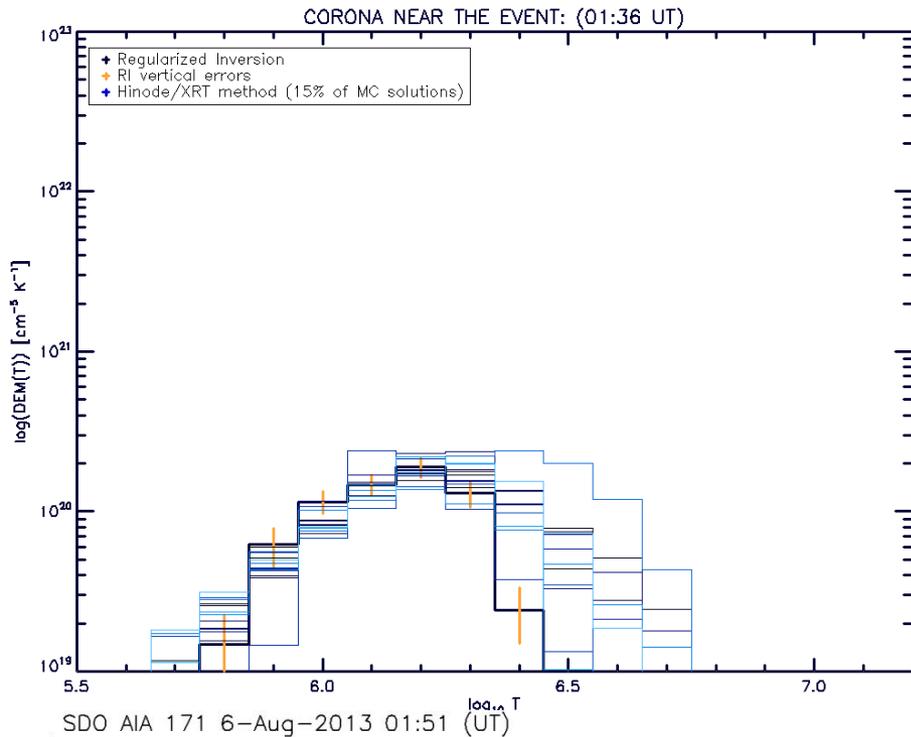


**The onset of the eruption:** high emission with broad profile (0.6-3.2 MK).

**During the eruption:** clear seen double peak of emission especially in RI profile .

# 2013-August-06

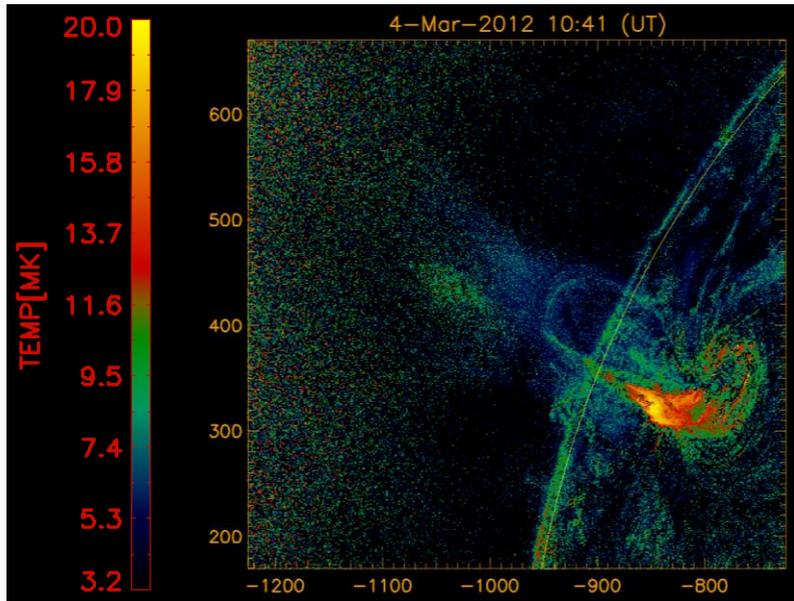
DEM curves of the selected regions (shown by the red box). The left and right panels display the results for the onset of the eruption and during the eruption, respectively.



**The onset of the eruption:** very low emission with (0.6-2.0 MK) with single peak

**During the eruption:** two order higher emission, for RI method clear seen double peak. Slightly lower emission peak for higher temperatures.

# CONCLUSIONS:



➤ We calculated DEMs profiles and created DEM maps using 2 methods: RI and HINODE/XRT method.

➤ For both events results show the multi-temperature nature of CMEs.

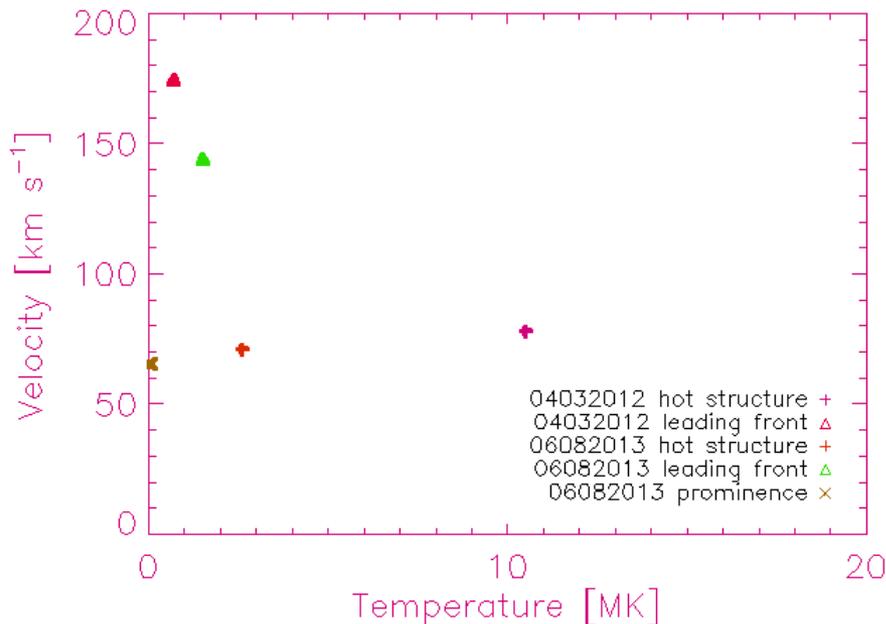
➤ Plasmoid core for the CME-FL event: 8.0-11.6 MK

➤ Structures seen in 171Å, 193Å, 211Å  
CME-FL: 0.8-1.5 MK  
CME-EP: 1.4-1.6 MK

➤ Region of HXR source: 12.6-20.0 MK

➤ Plasma observed in 171Å, 193Å, 211Å for both events move with faster speeds.

➤ For the CME-FL event onset of eruption of hot plasma occurred earlier, whereas for the CME-EP cold plasma start to rise first.





**THANK YOU FOR YOUR ATTENTION**