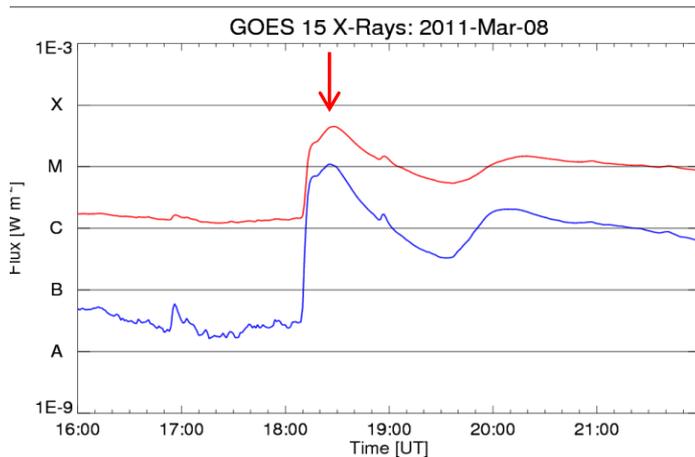


# A 3-Dimensional View of the Filament Eruption and Coronal Mass Ejection Associated with the 2011 March 8 Solar Flare

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# Analysis of March 8<sup>th</sup> 2011 Flare



In the AR- 11165 (2011-03-08).  
Filament eruption + jets.  
A probable Filament eruption +  
collision with coronal loop  
generated loop expansion and  
several hour later a CME was  
observed.

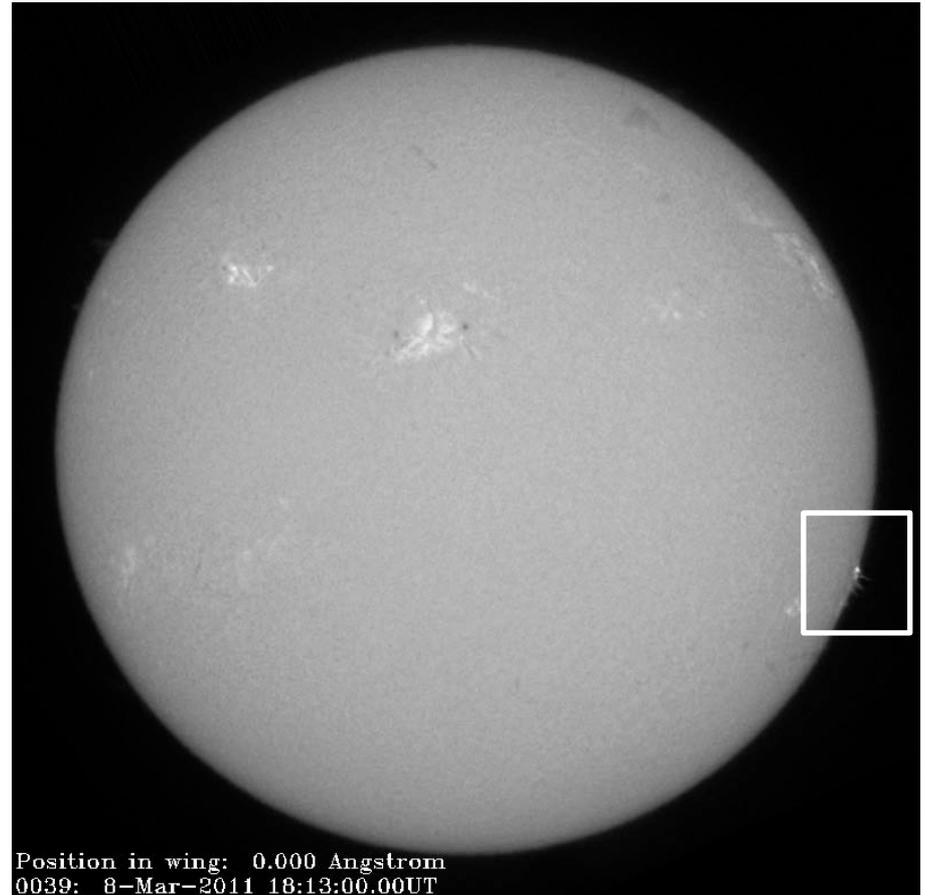
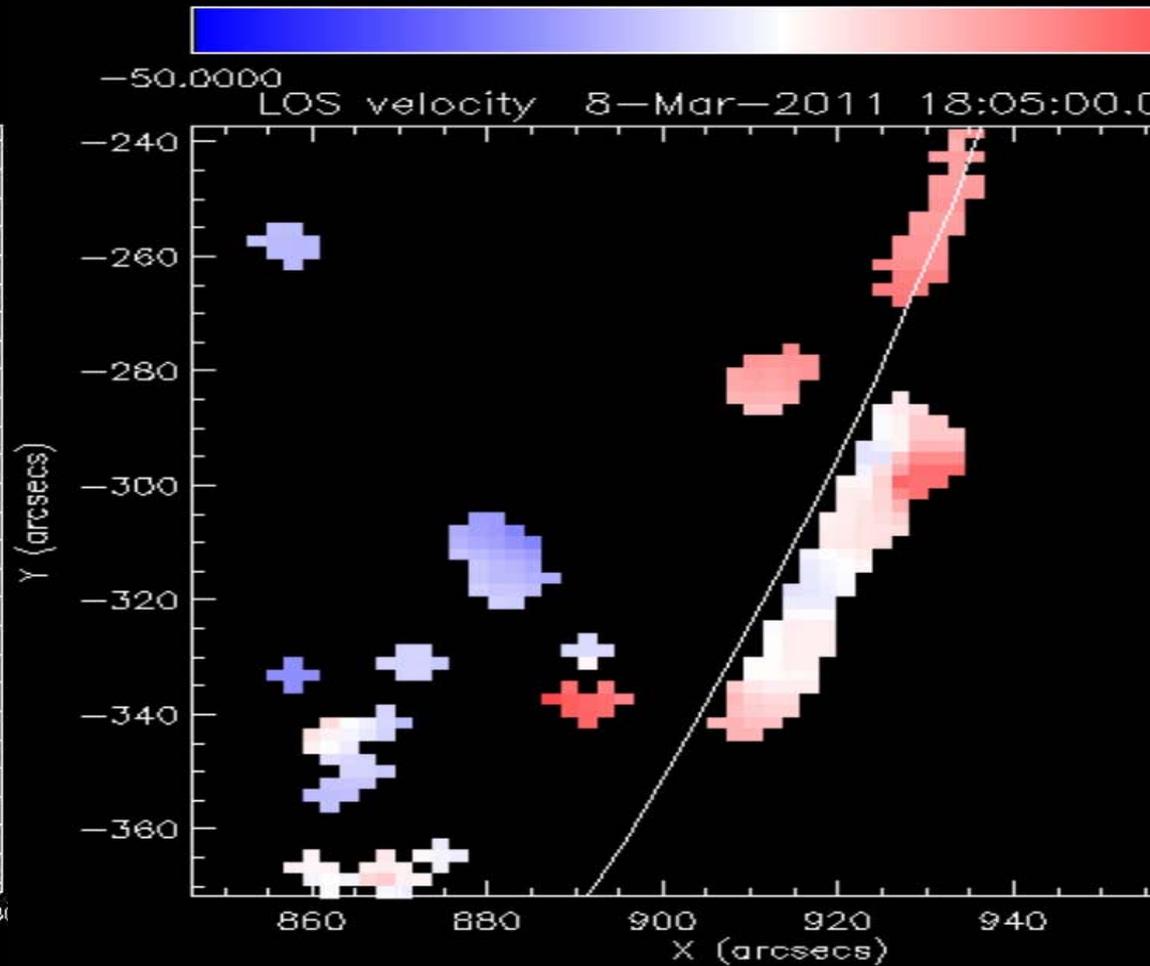
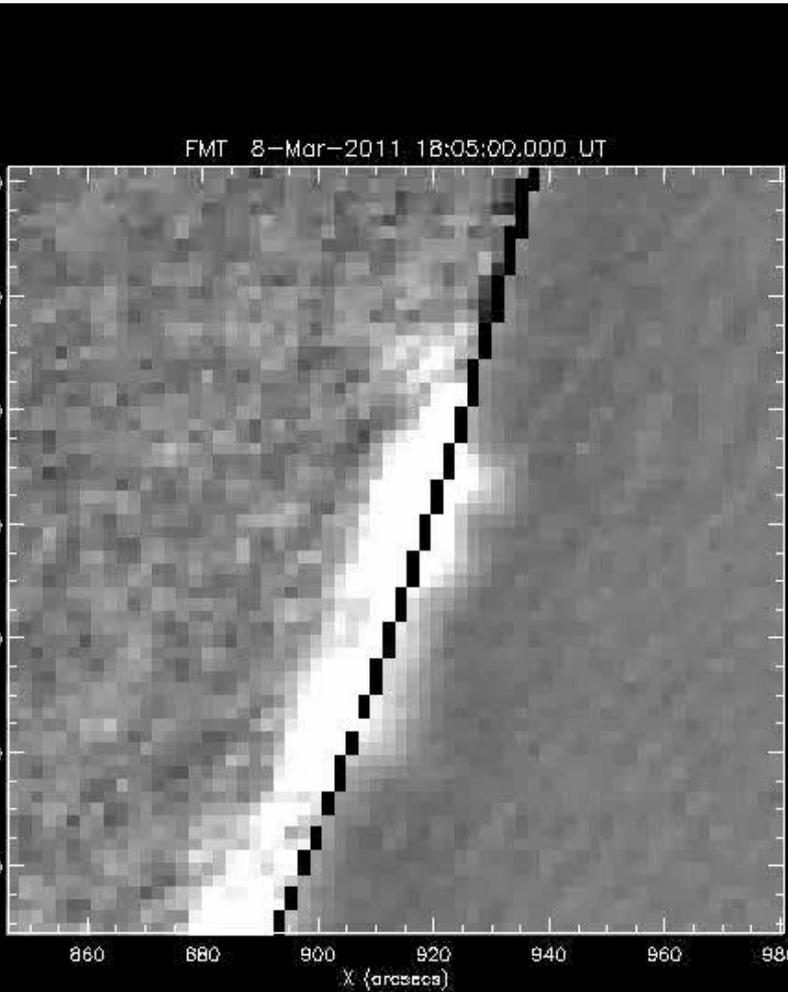


Image of the solar chromosphere obtained with the  
FMT and position of NOAA 11165 (S17-W88)  
(Flare Start:18:08, Peak: 18:28)

# Filament Eruption & its Line-of-sight velocity

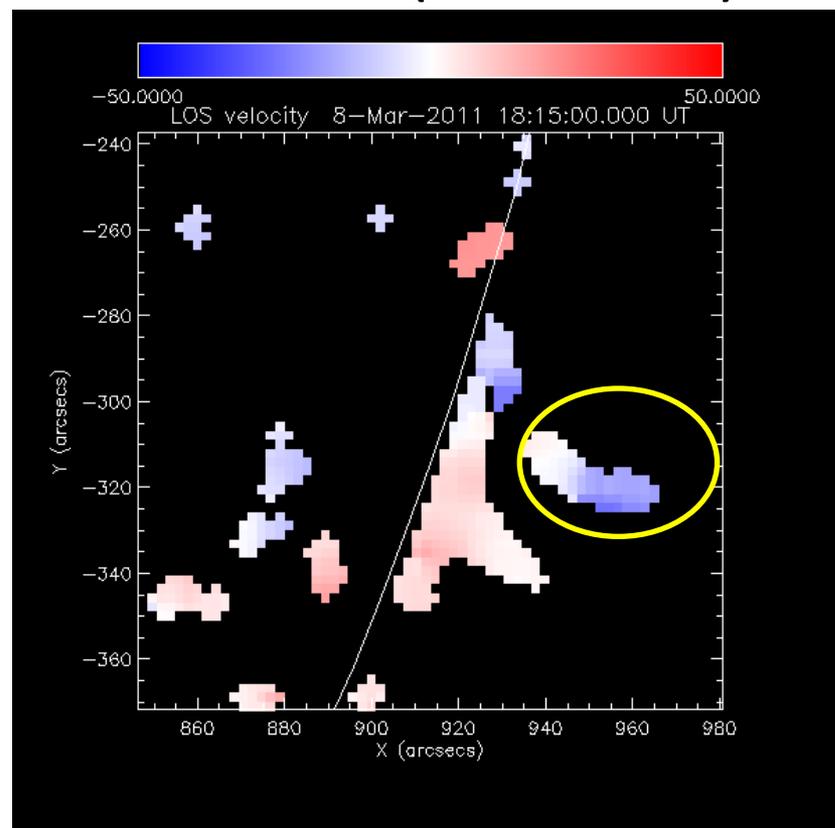
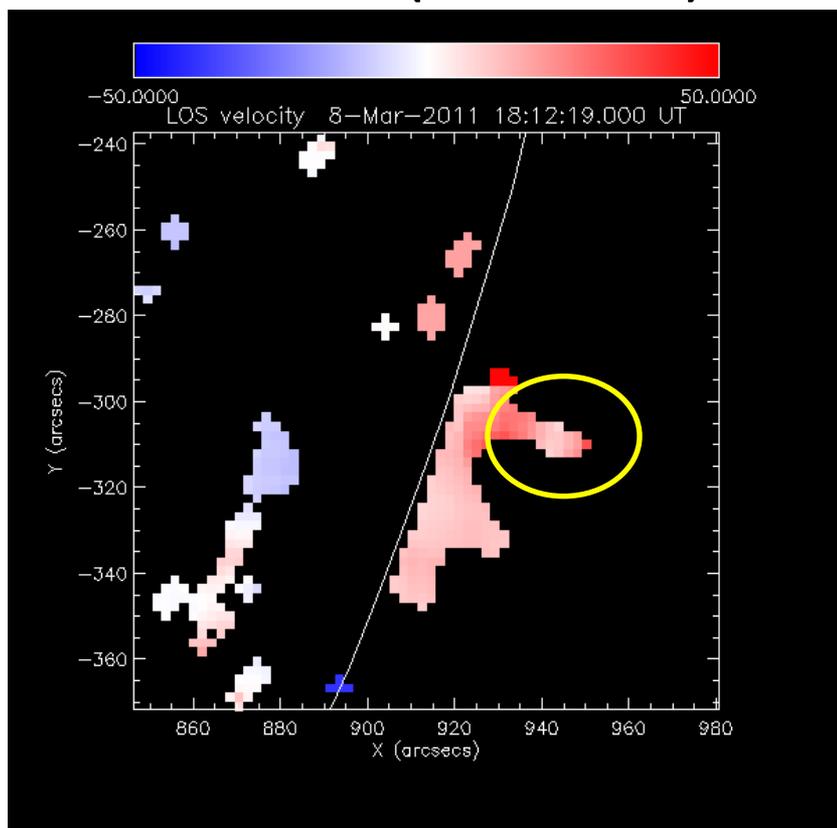


# Time evolution of line-of-sight velocity

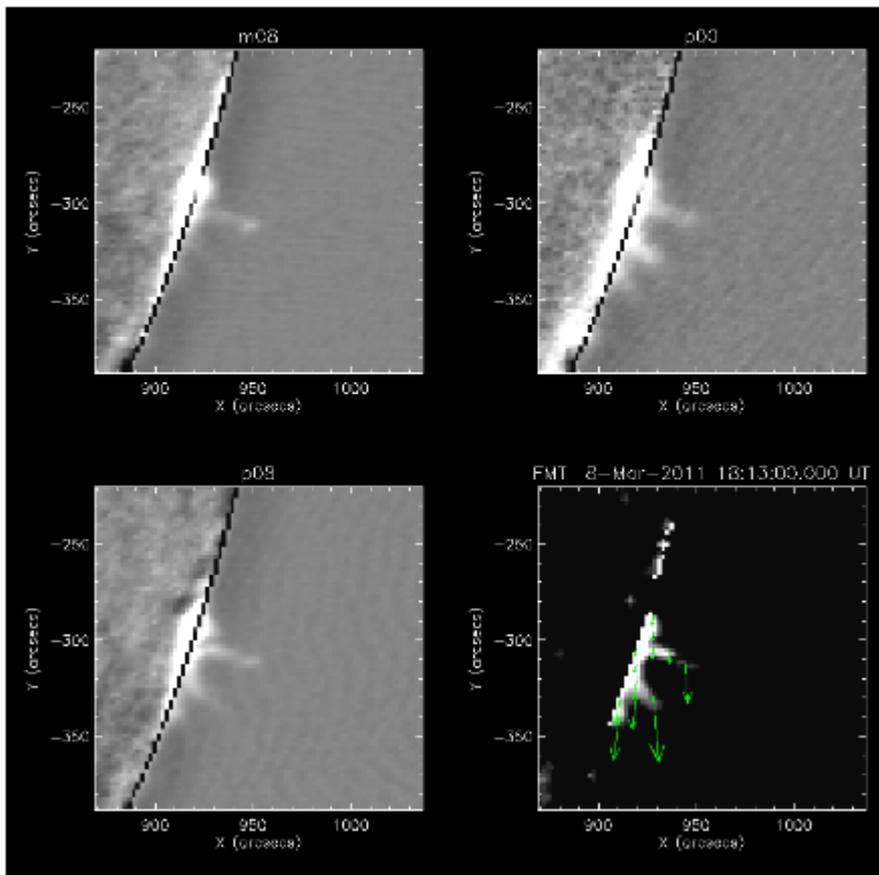
- The direction of the H $\alpha$  filament changed at  $\sim 18:13$ UT

18:12:19UT (red-shift)

18:15:00UT (blue-shift)

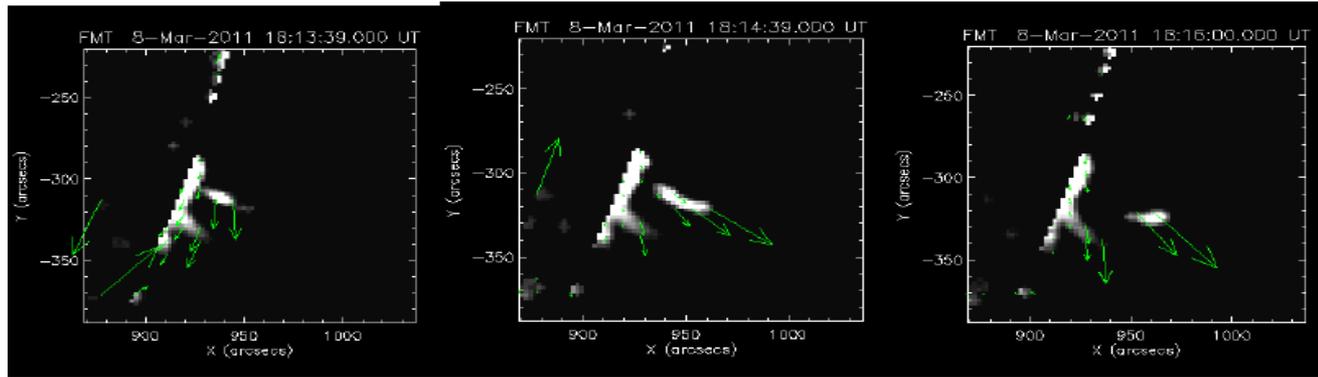


# Tangential velocity of the filament eruption

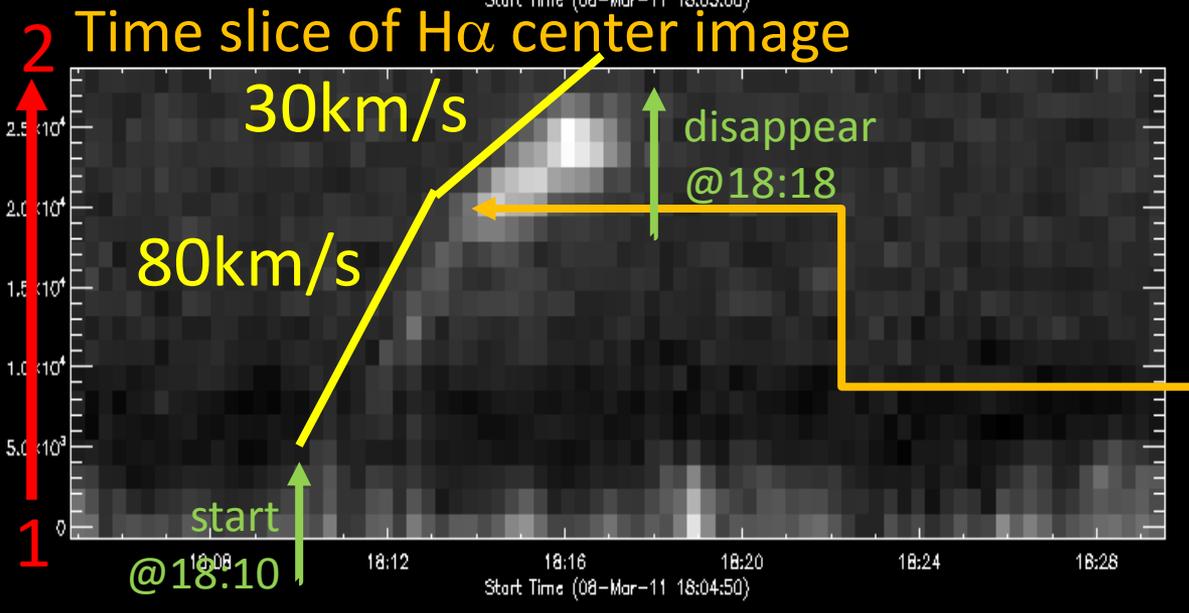
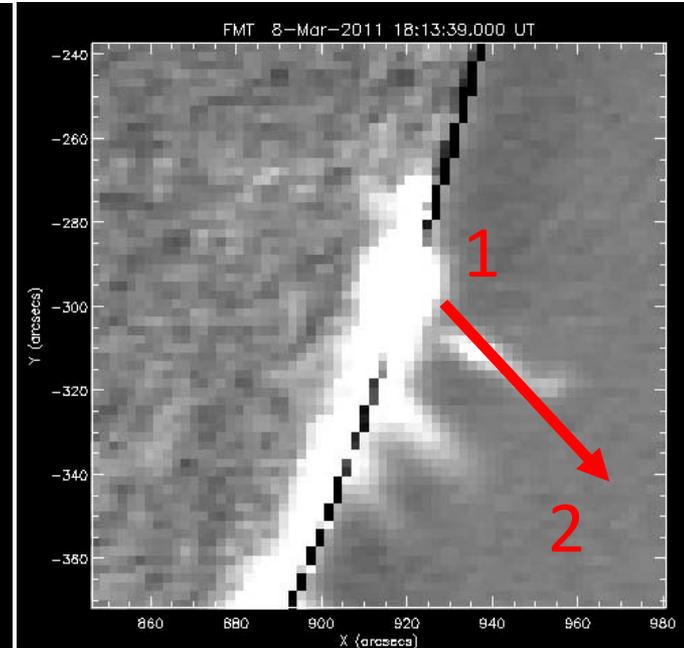
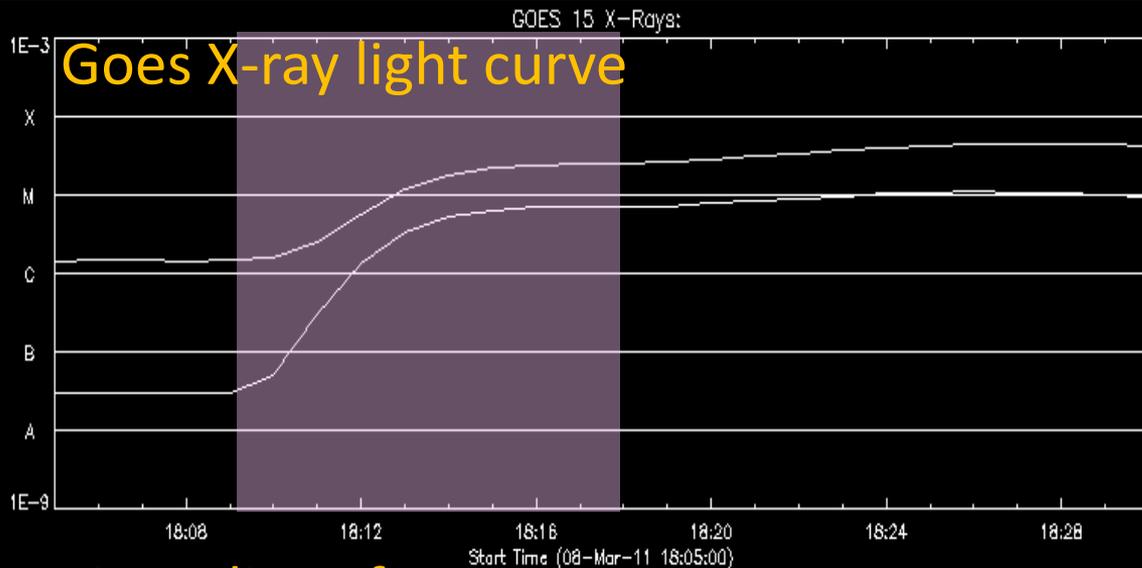


The figure on the top left corresponds to the wavelength H-alpha - 0.8A, top right H- alpha center, lower left corner H-alpha + 0.8A, bottom right corner velocity vectors.

Tangential velocity calculated dates green on the filament eruption representing vectors speed



# Time evolution of tangential velocity

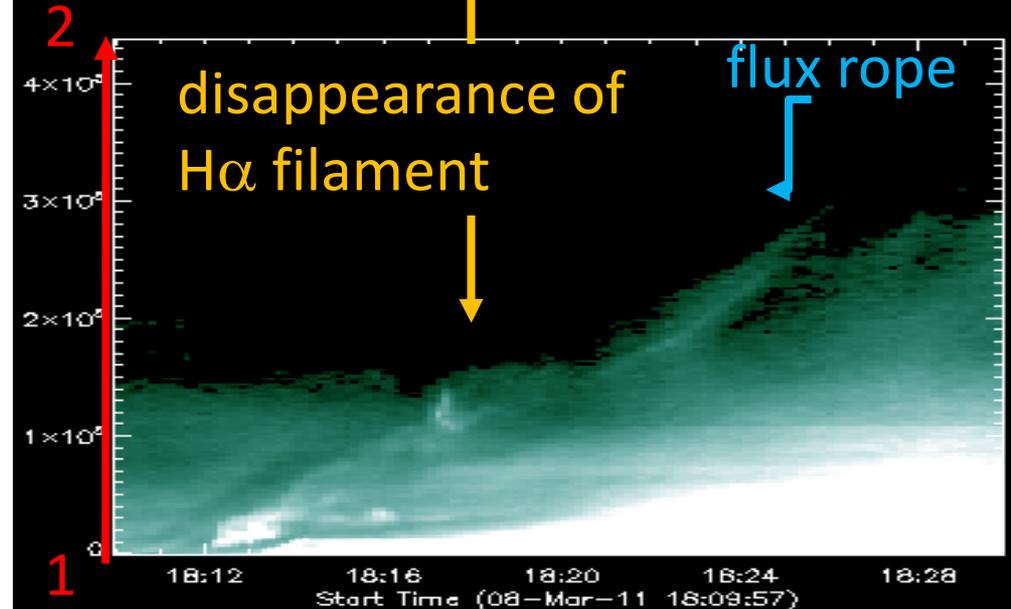
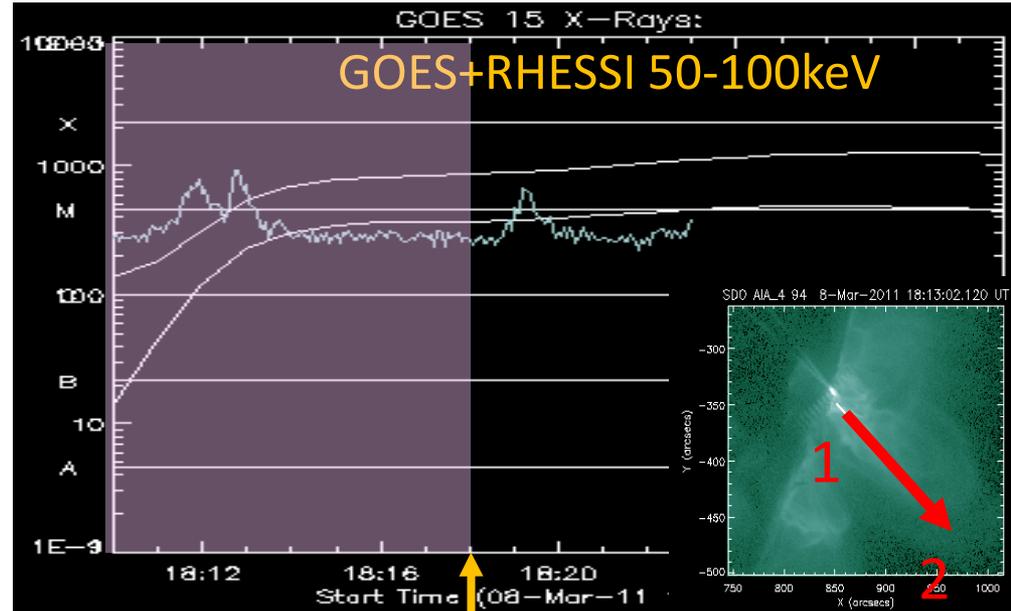
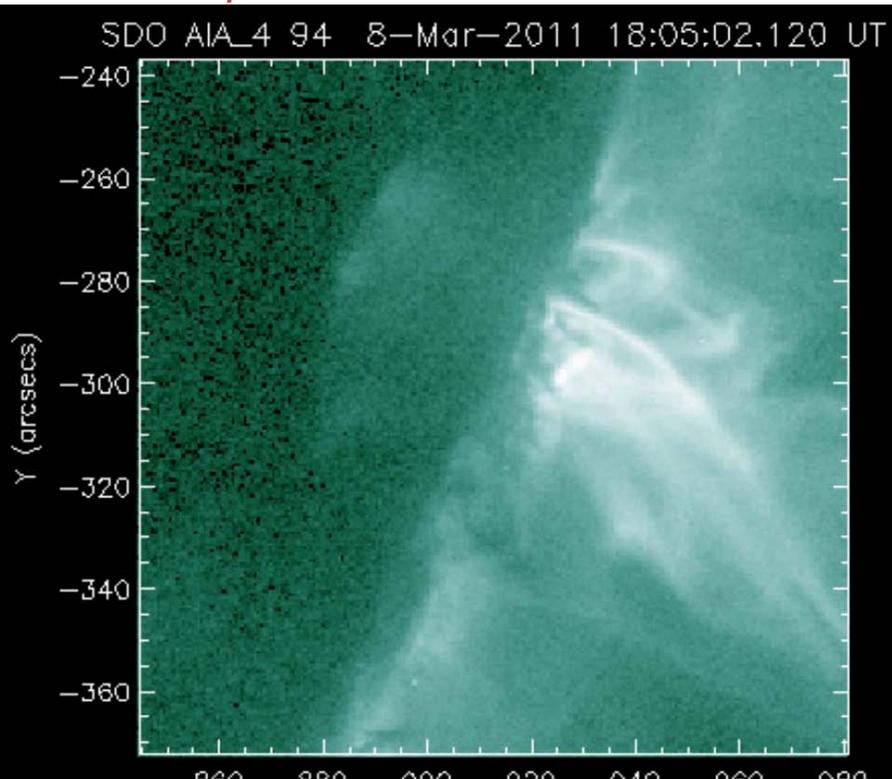


- The tangential velocity also changed (was decelerated) at 18:13UT

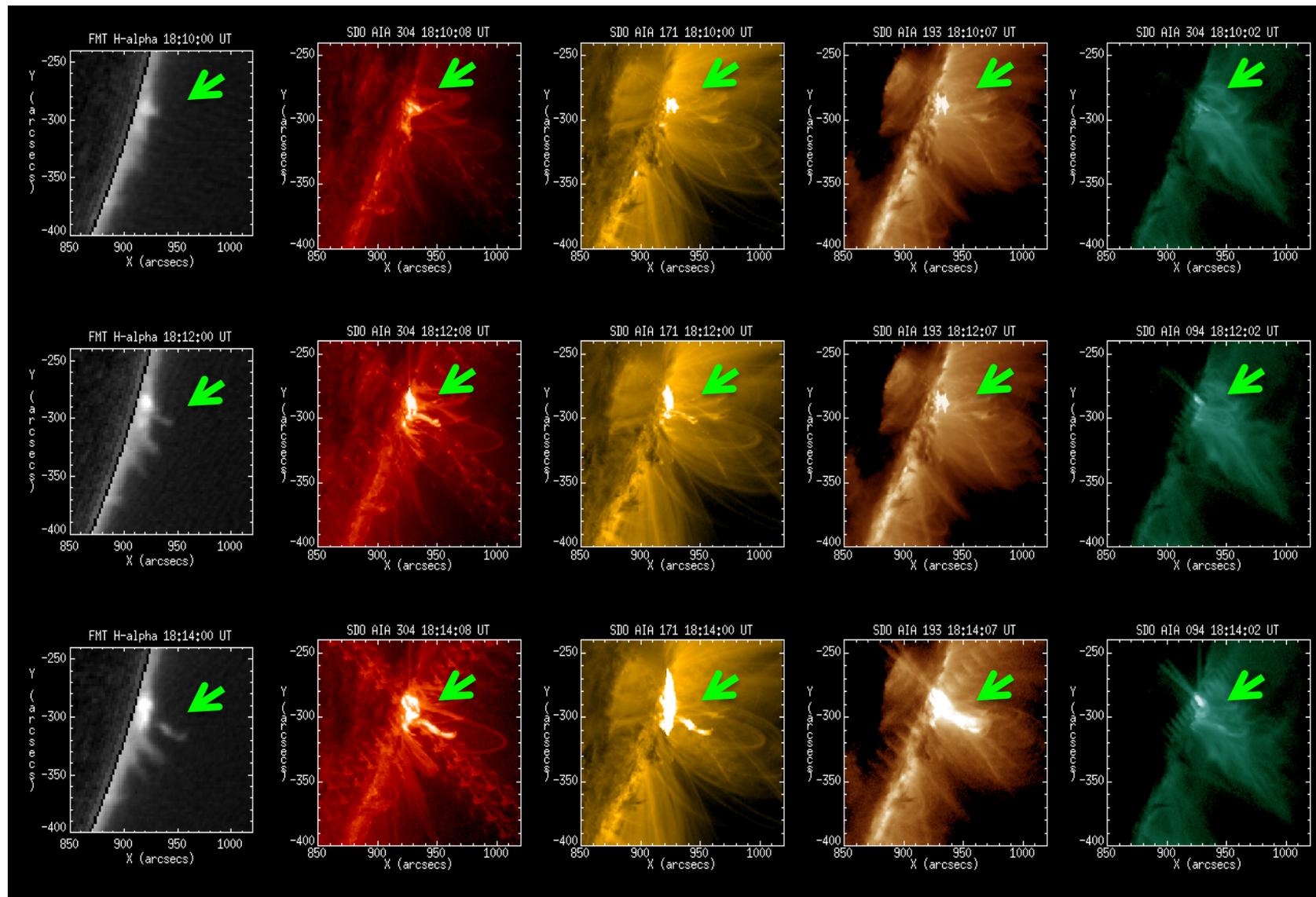
# Flux Rope Expansion in the Corona

- After deceleration, another energy release occurred and a flux rope was ejected

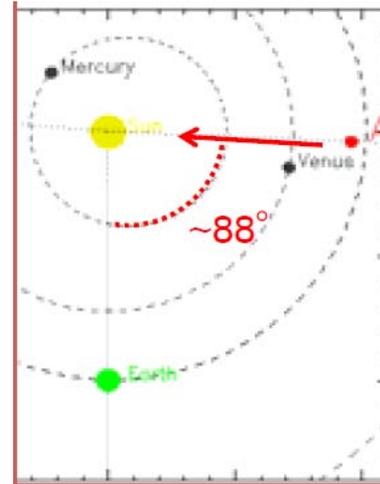
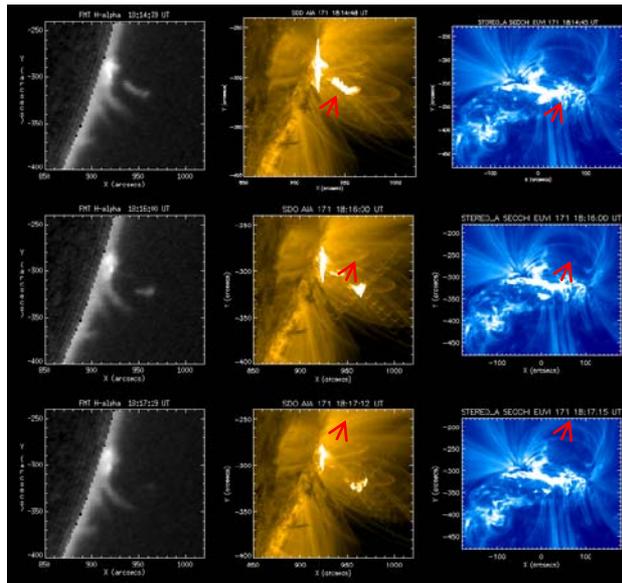
SDO/AIA 94A



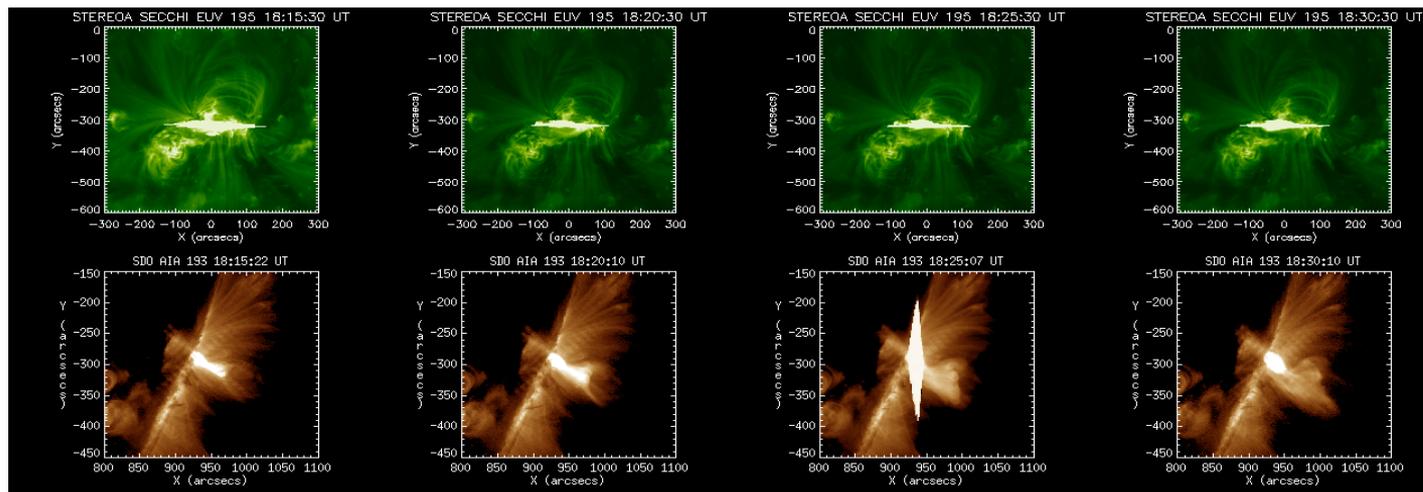
# Temporal Evolution of Filament Eruption in Multi-wavelength Images



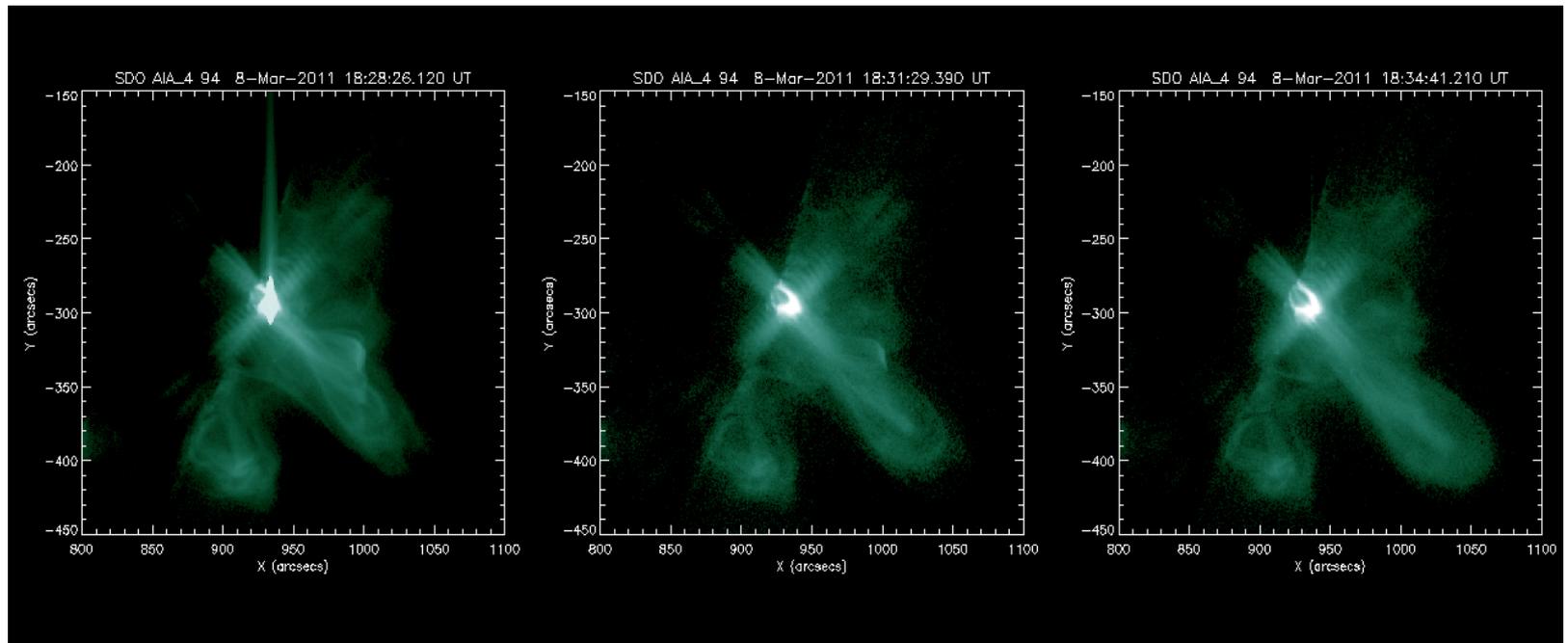
# Another evidence of change of the direction of the eruption



Multi-wavelength observation of the filament eruption. In the top view (right column) taken by STEREO-A/EUVI we can confirm the change of the direction of eruption.

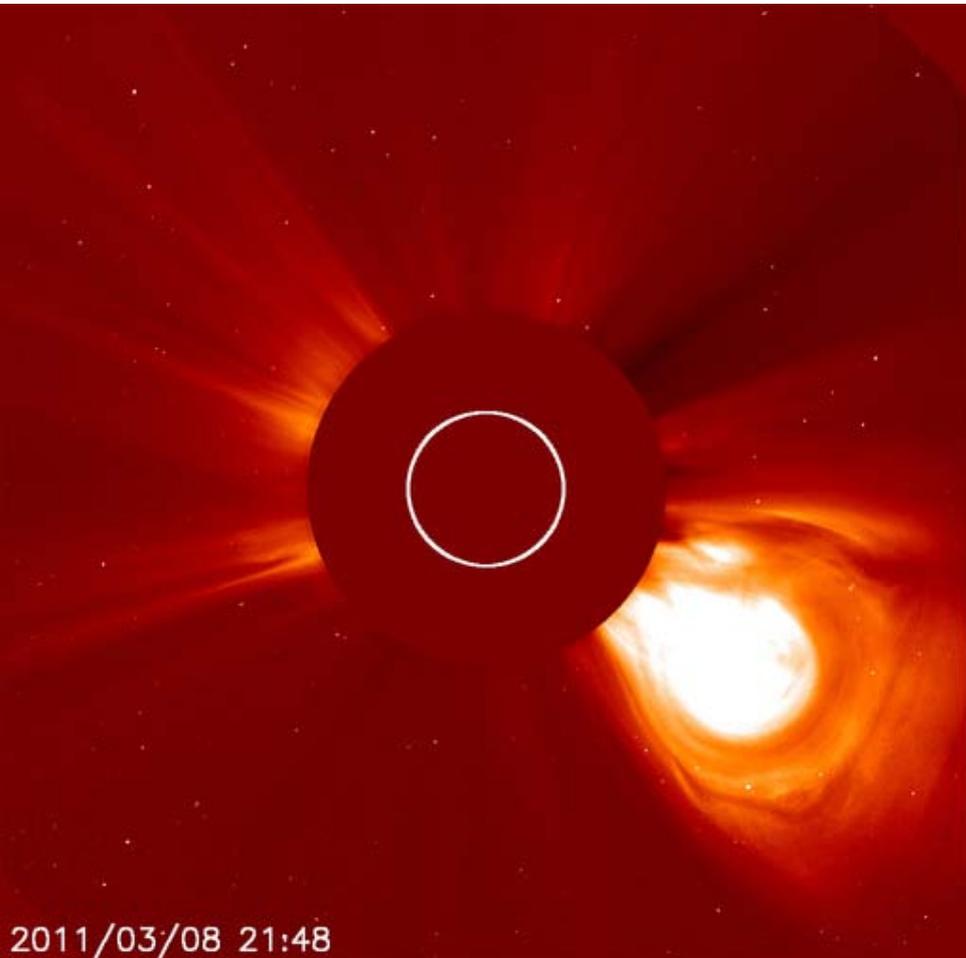


# Flux rope eruption after that

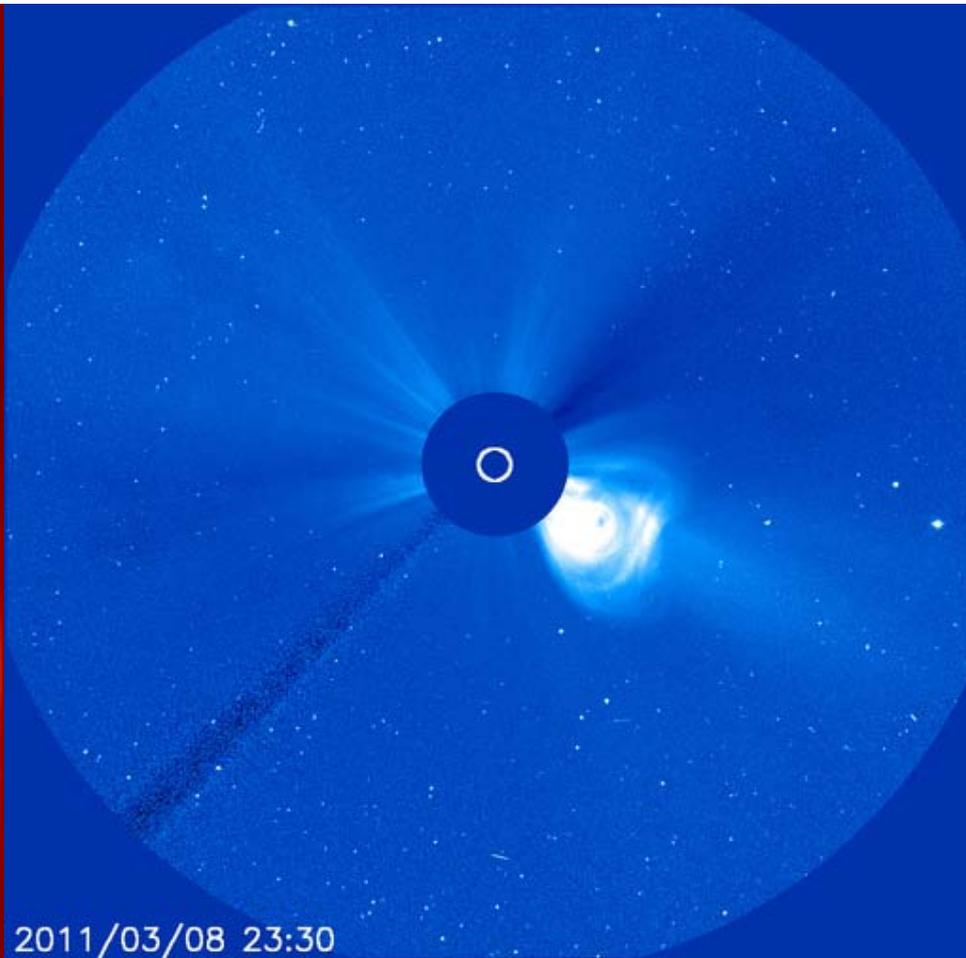


# CME

3 hours later



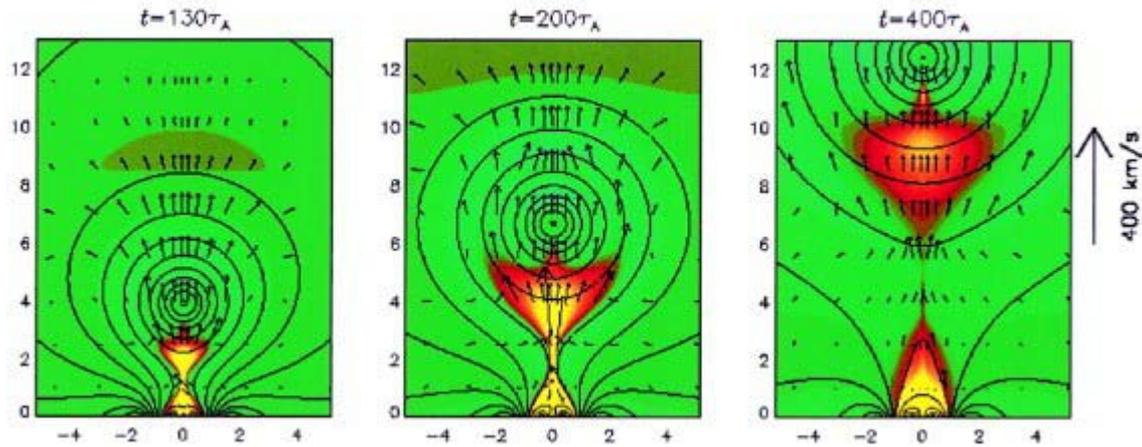
5 hours later



# CME Models

## Simple standard model

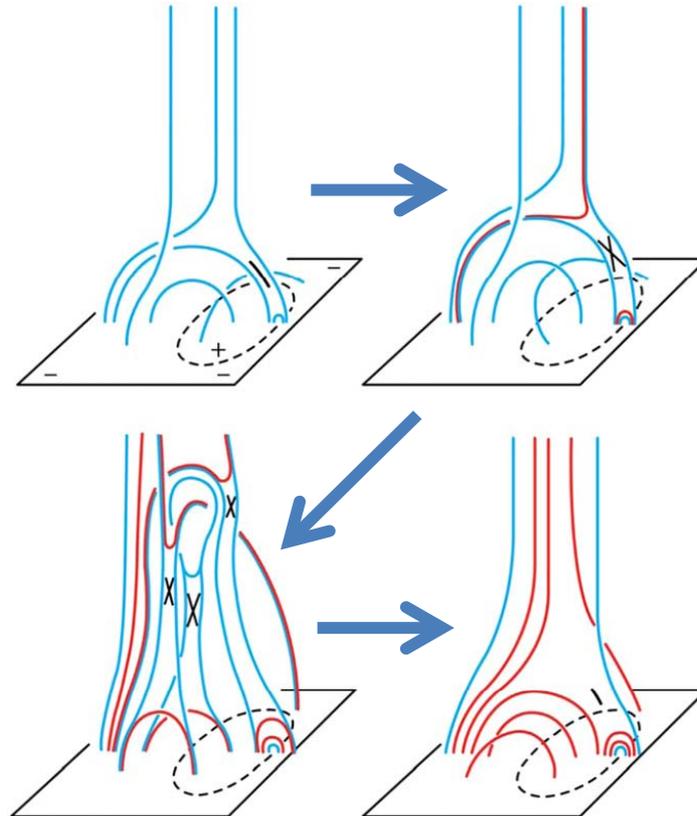
For example:  
Chen & Shibata, 2000, ApJ



## Blowout-jet model

For example:  
Moore et al. 2010, ApJ

Multi-phased magnetic  
reconnection and  
slower evolution



# Conclusion

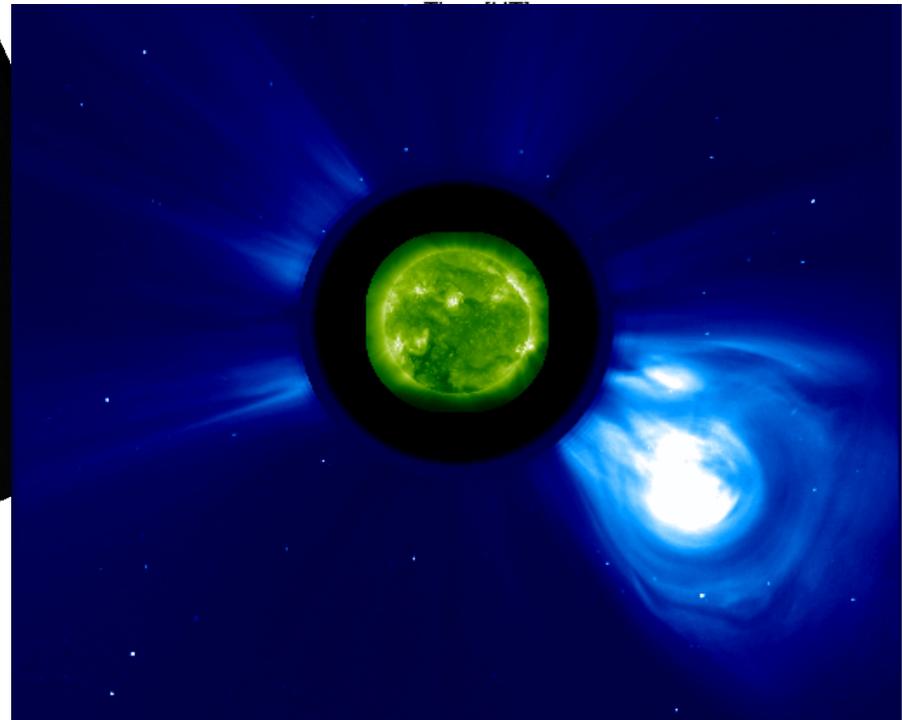
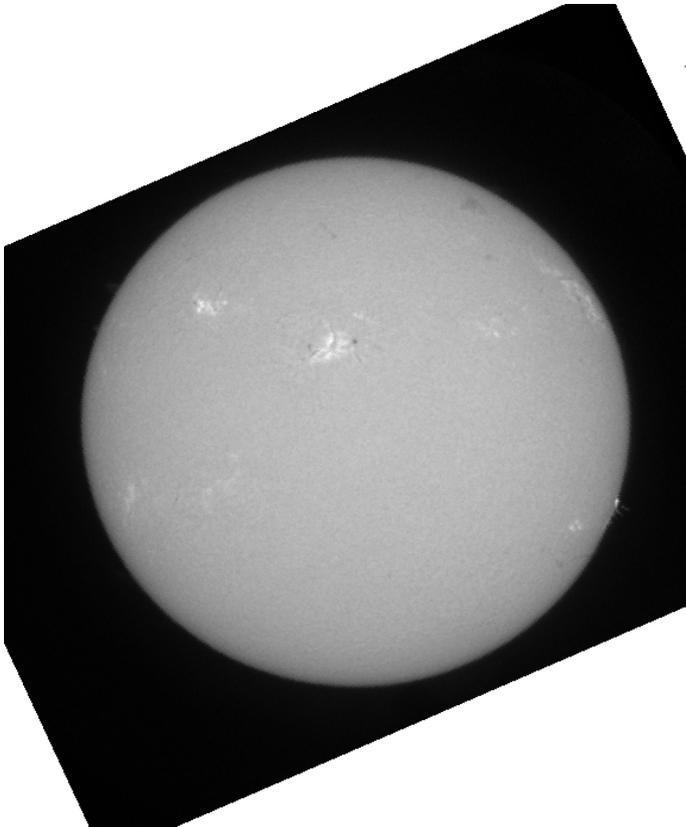
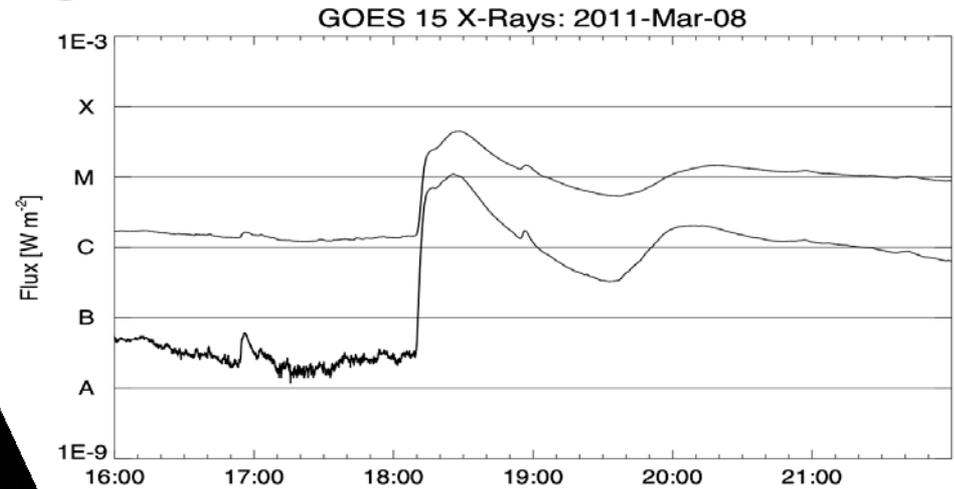
- Erupted filament three-dimensionally changed its direction and velocity by collision with the overlying coronal magnetic field.
- GOES X-ray curve reach maximum after erupted filament disappear
- After the collision of erupted filament with the coronal magnetic field, some coronal loops began to expand and they grew a clear CME.
- This process can not be explained by simple standard CME model (for example, Chen & Shibata 2000).

# Acknowledgment

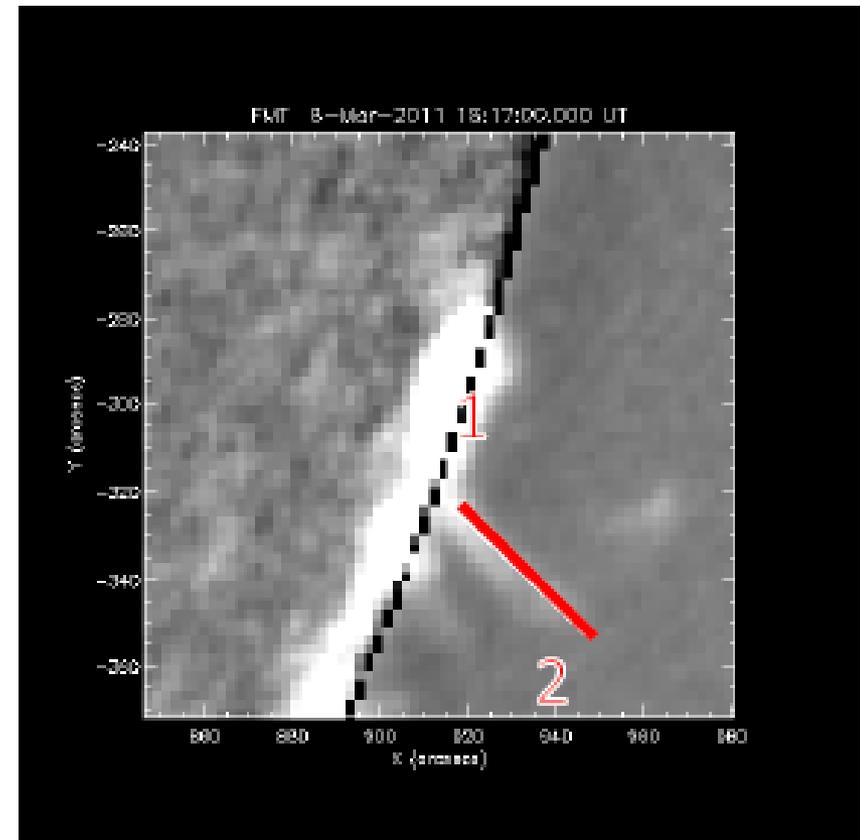
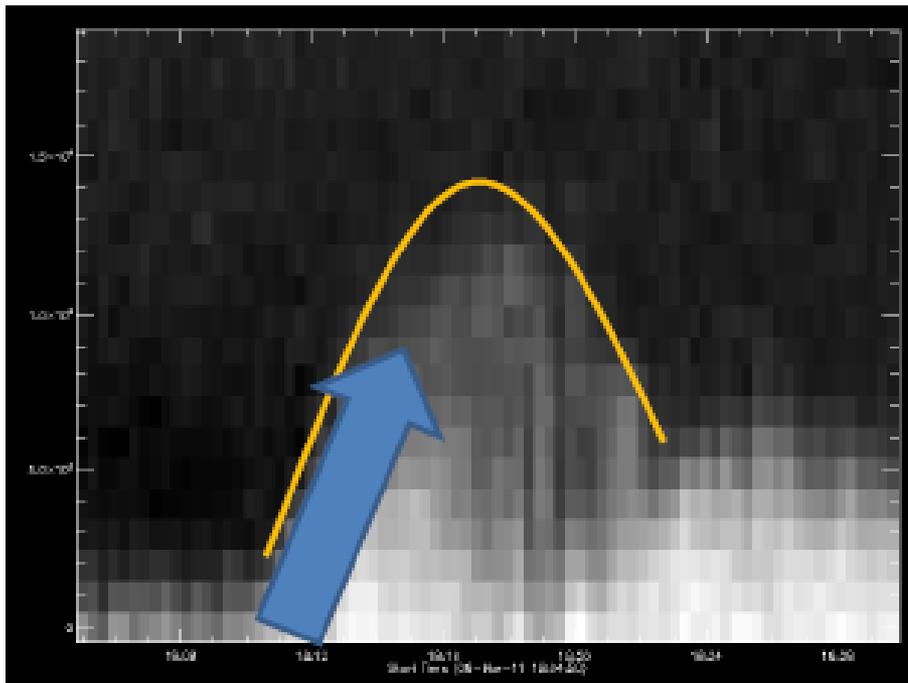
International Scientific Organizer Committee of ISWI2012  
Local Organizer Committee of ISWI-2012

# (2) 3D View of the Filament Eruption and CME

- 2011-Mar-08 18:08UT~
- GOES M4.4
- NOAA 11165



# Jet velocity



Initial velocity  $\sim 80\text{km/s}$   
After that, ballistic motion