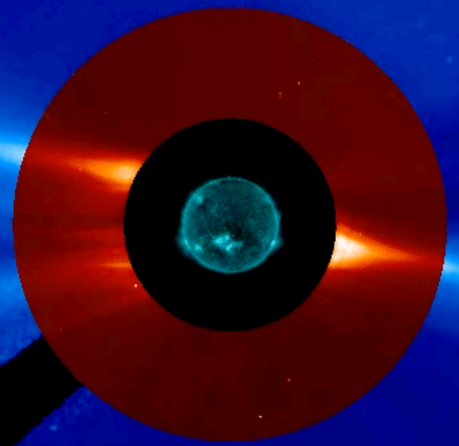
Dynamic evolution of a solar flare current sheet

workings of the central engine



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Max Planck Institute for Solar System Research

in collaboration with

Eric Priest (St Andrews Uni.) and Xin Cheng (Nanjing Uni.)

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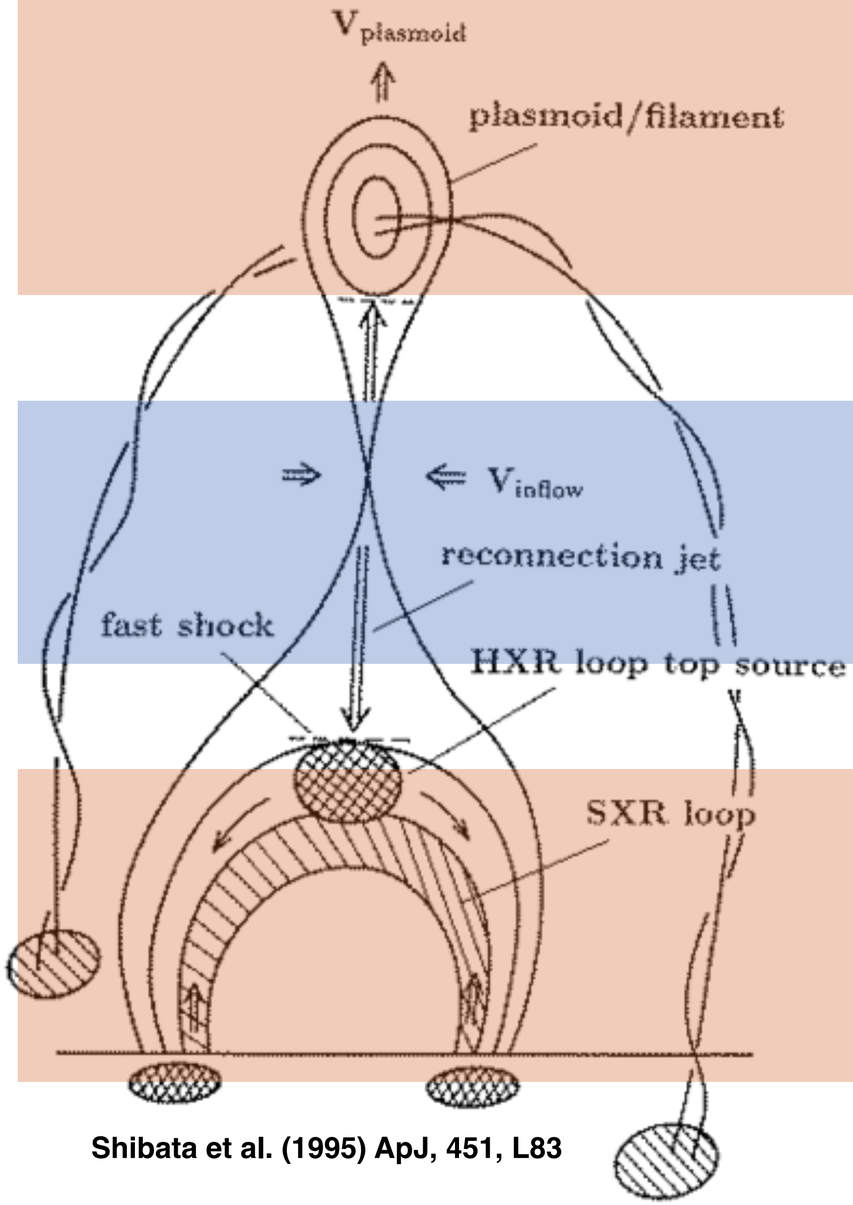
(Standard) solar flare structure



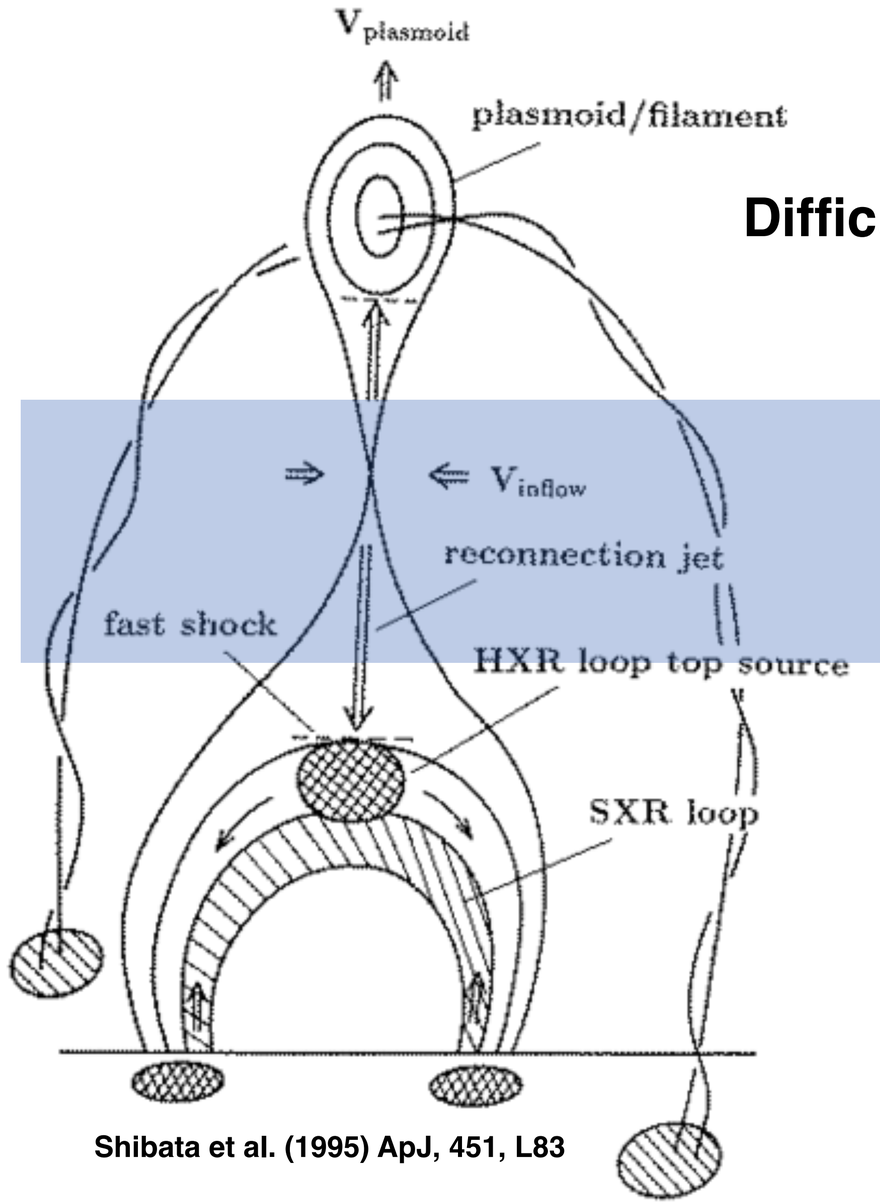
Shibata et al. (1995) ApJ, 451, L83

flux rope (often) escapes as a CME into the heliosphere

current sheet - reconnection engine
(magnetic energy is converted to other forms)

flare arcade anchored to the Sun
(soft X-rays, EUV)

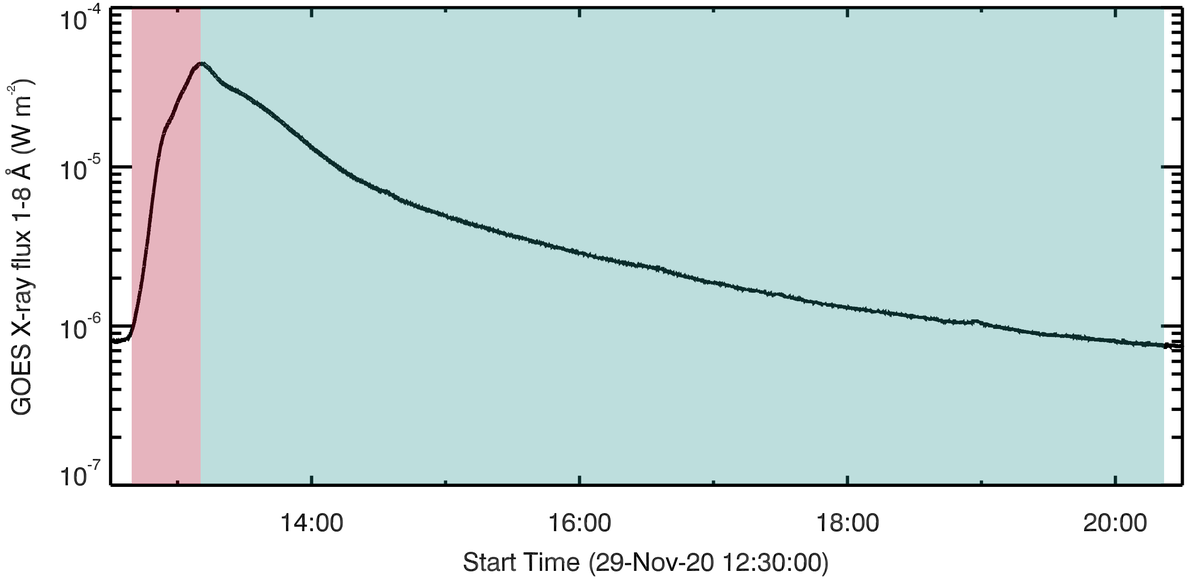
(Standard) solar flare structure



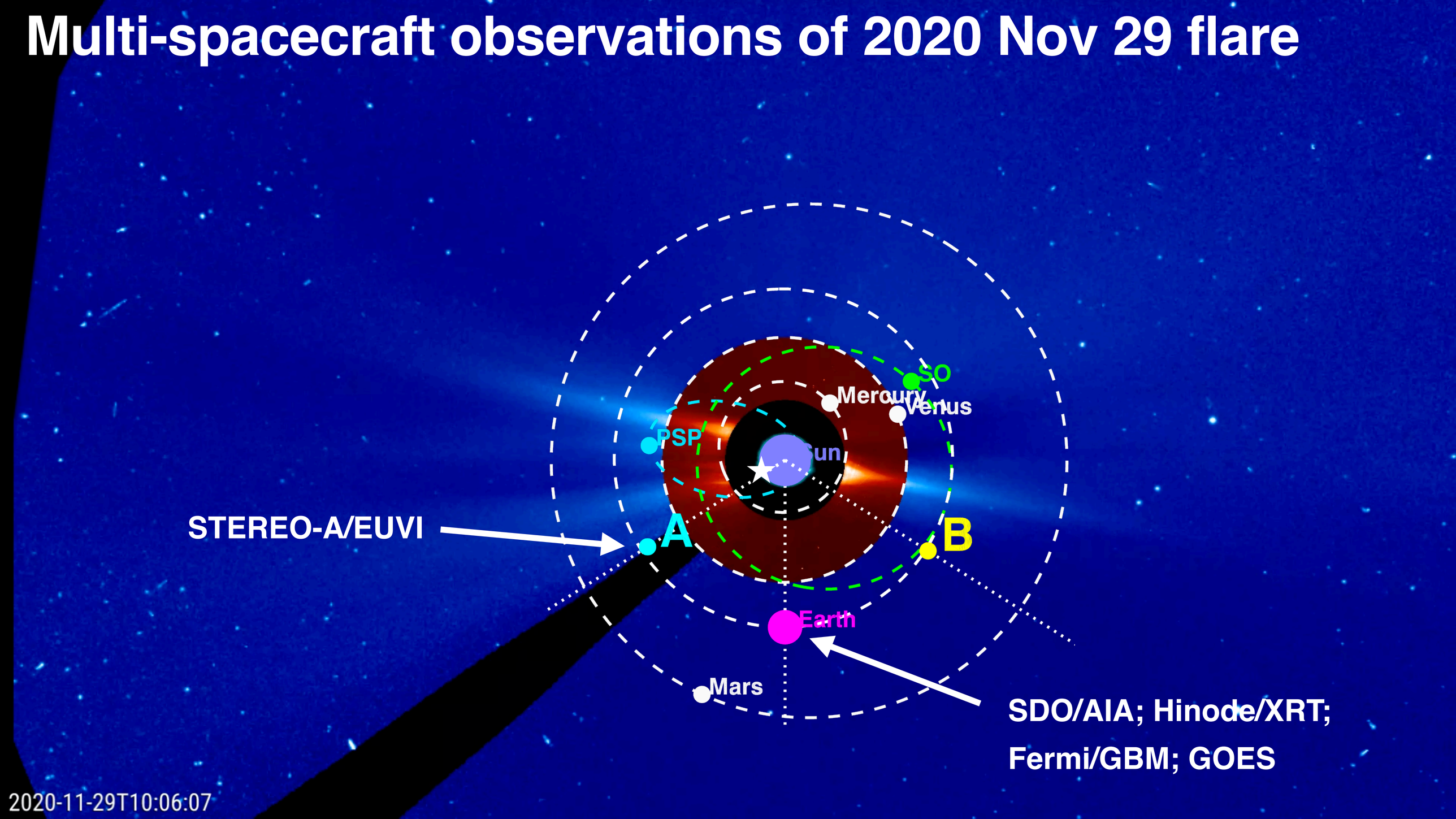
Shibata et al. (1995) ApJ, 451, L83

Difficult to catch the formation and evolution of current sheet during the explosive rise phase of the flare

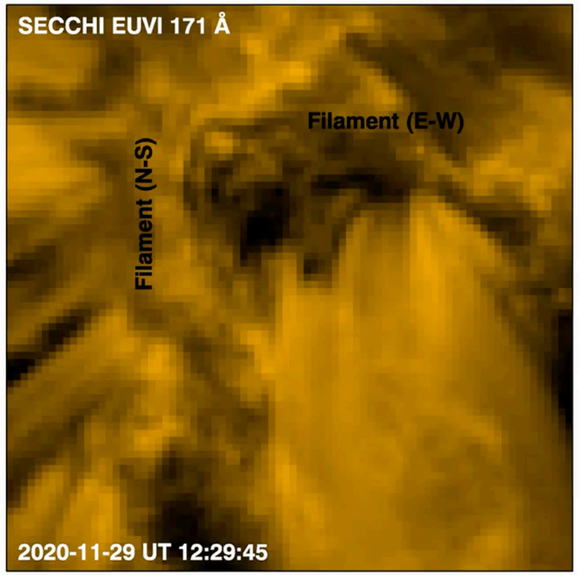
current sheet - reconnection engine (magnetic energy is converted to other forms)

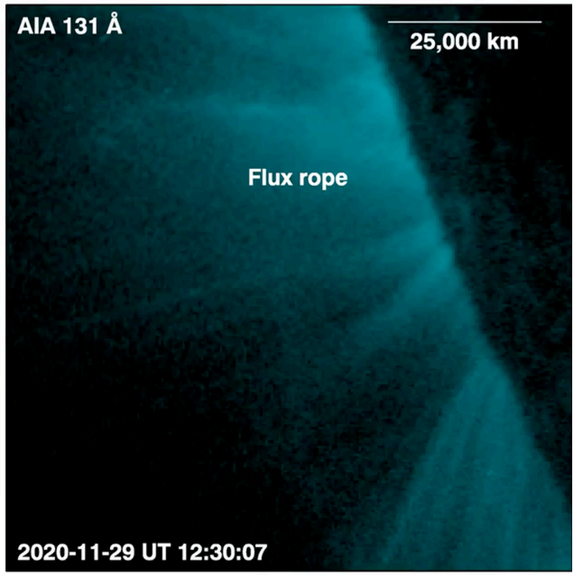


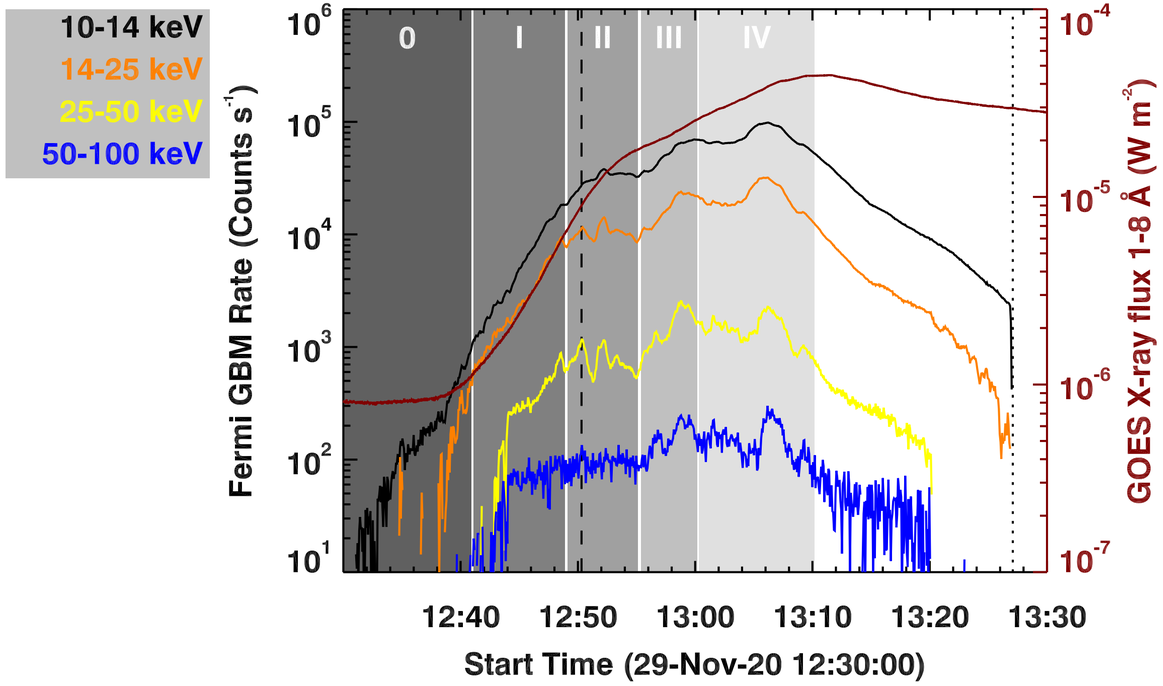
Multi-spacecraft observations of 2020 Nov 29 flare

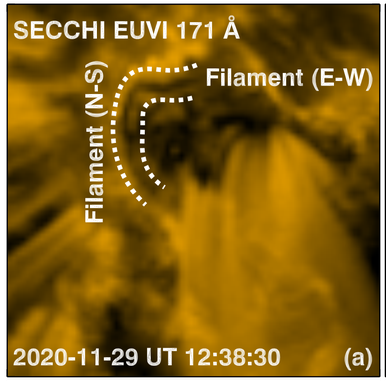


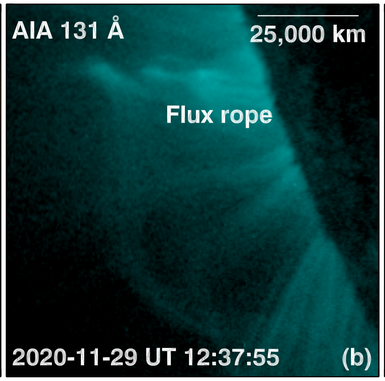
Multi-spacecraft observations of the flare

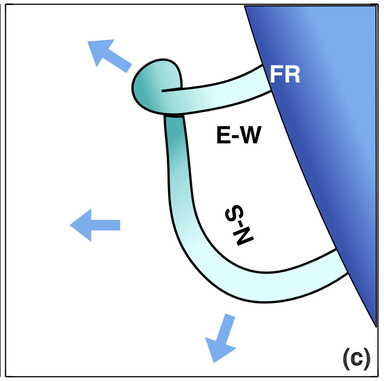


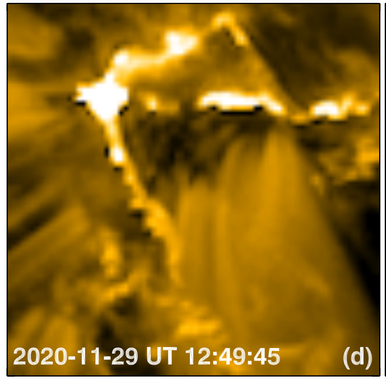


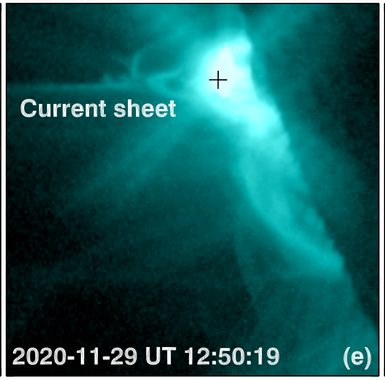


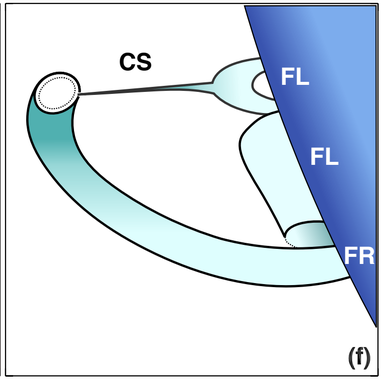


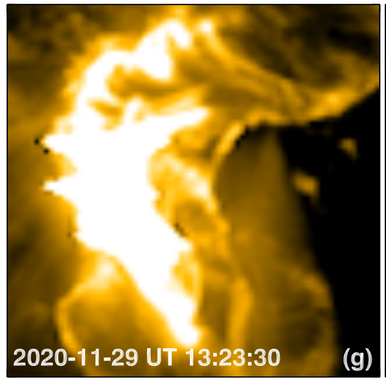


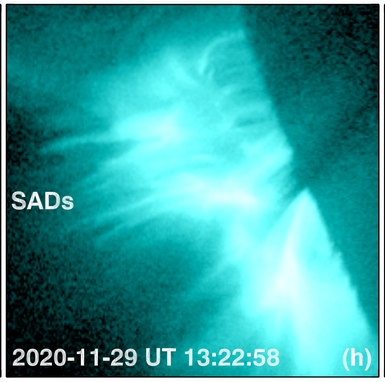


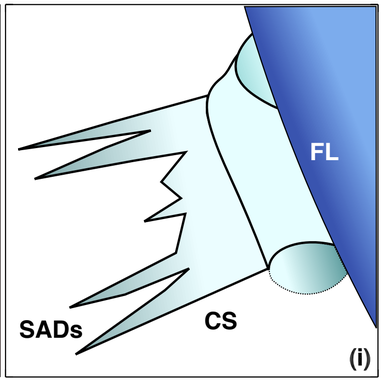






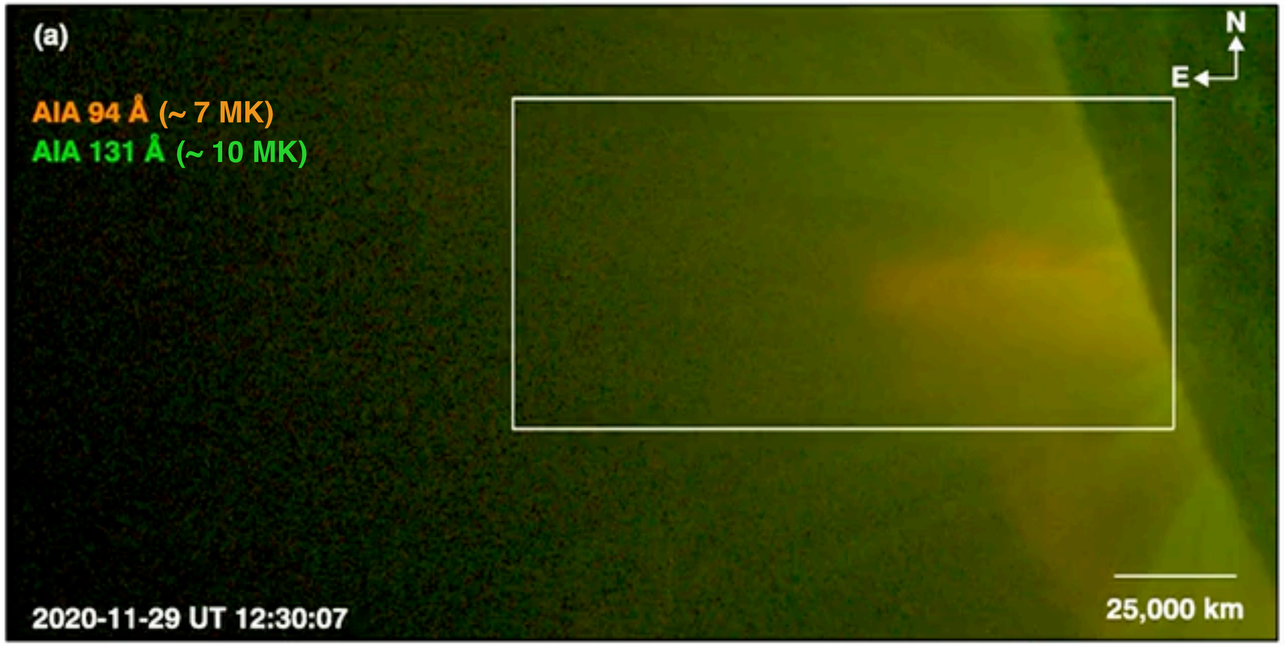


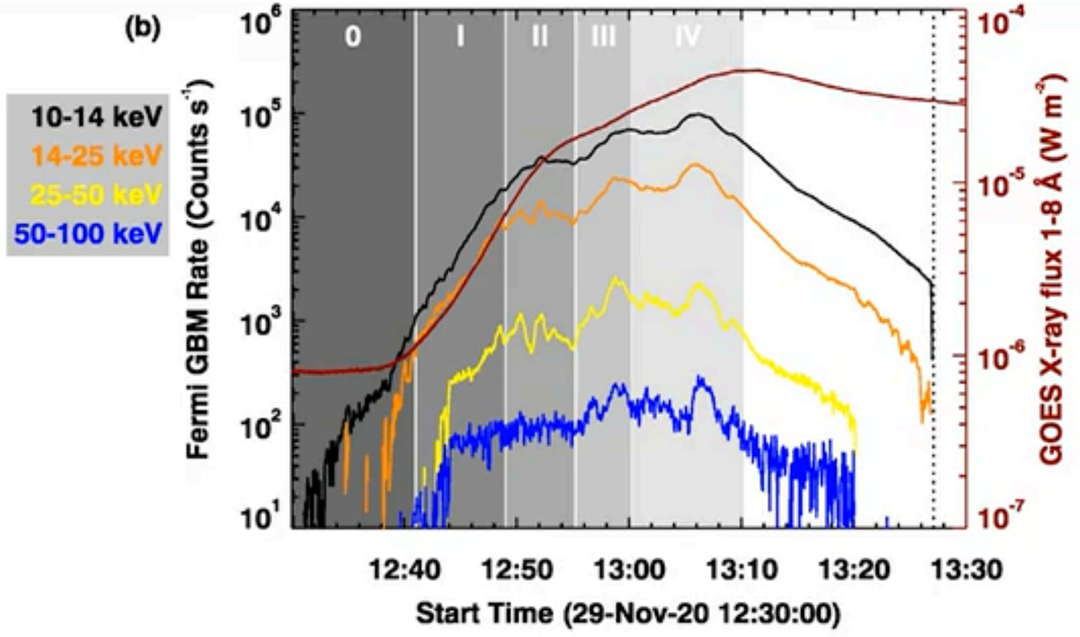


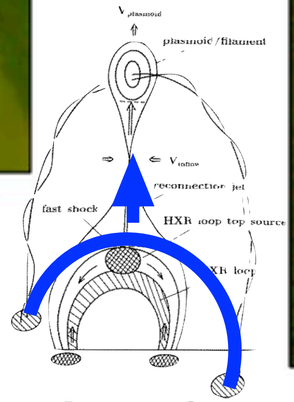


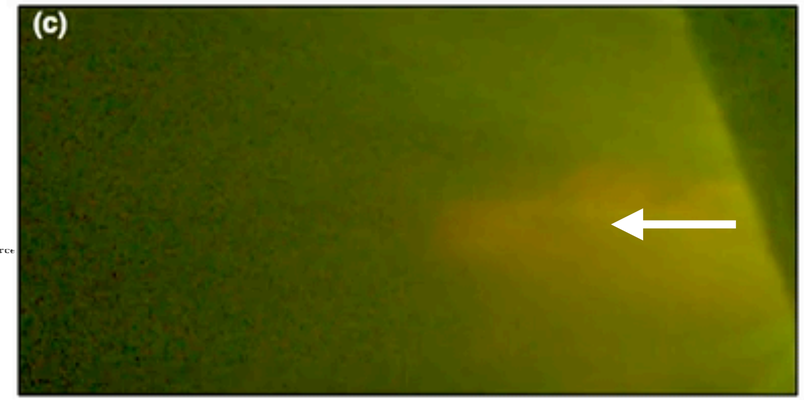
Dynamic evolution of the current sheet

Preflare



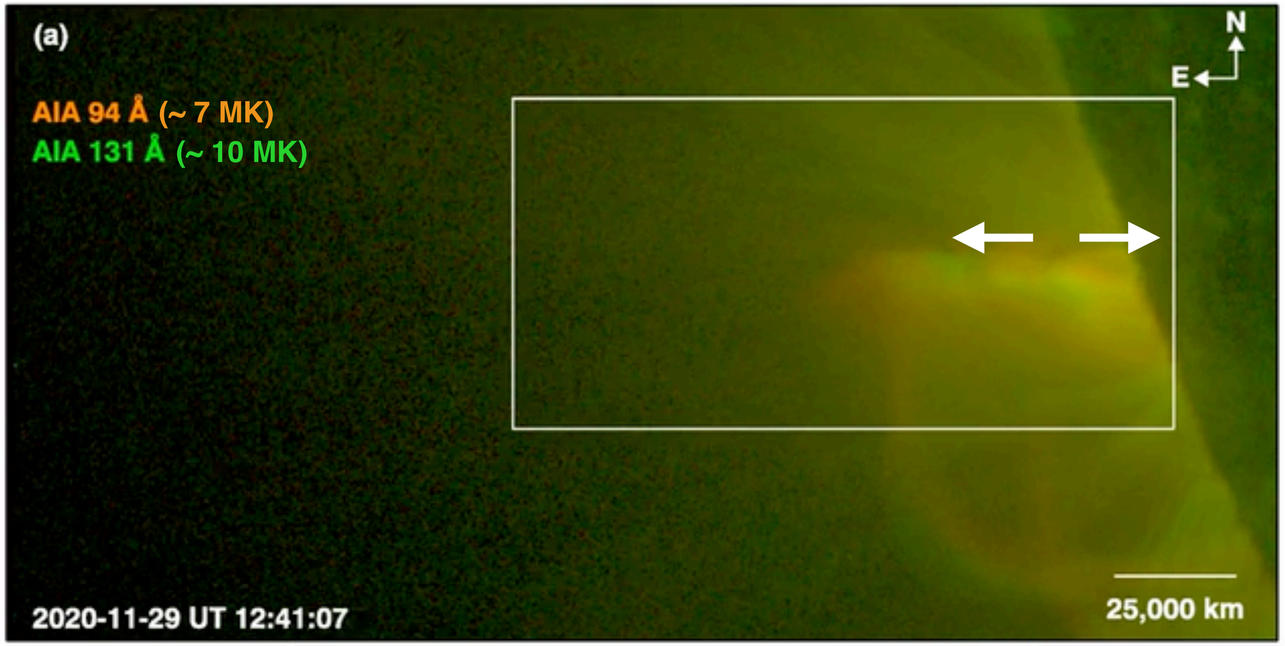


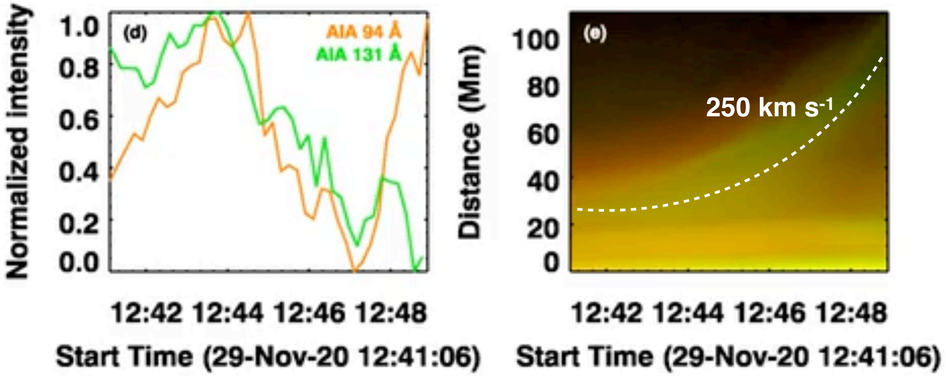


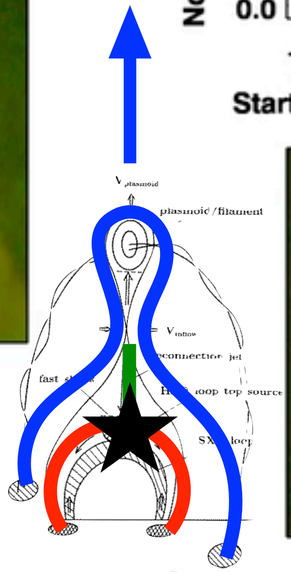


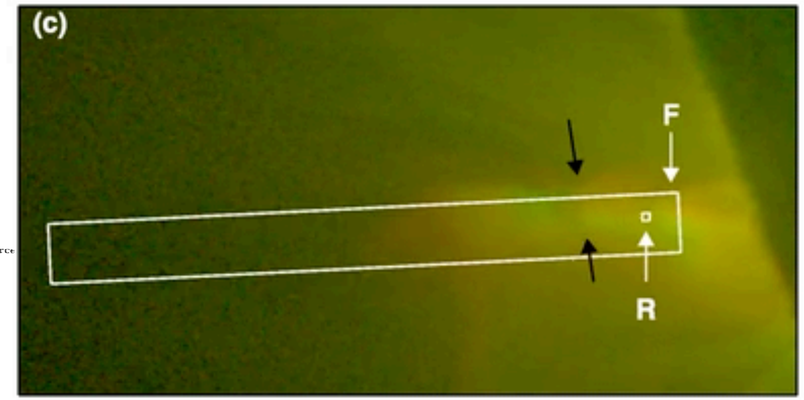
- Slow rise of hot flux rope

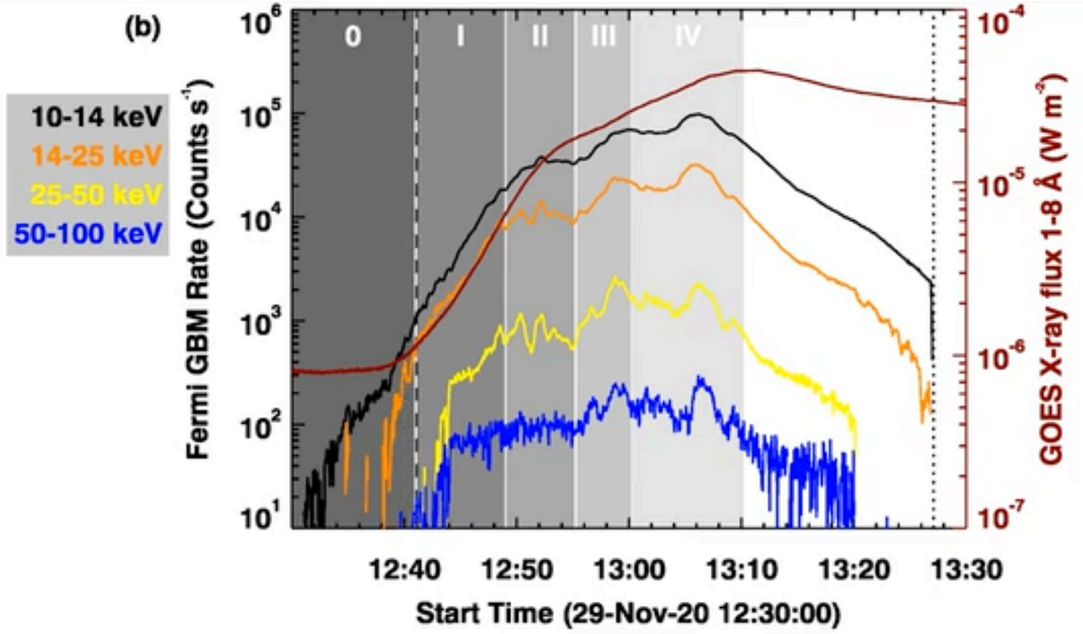
Formation of current sheet





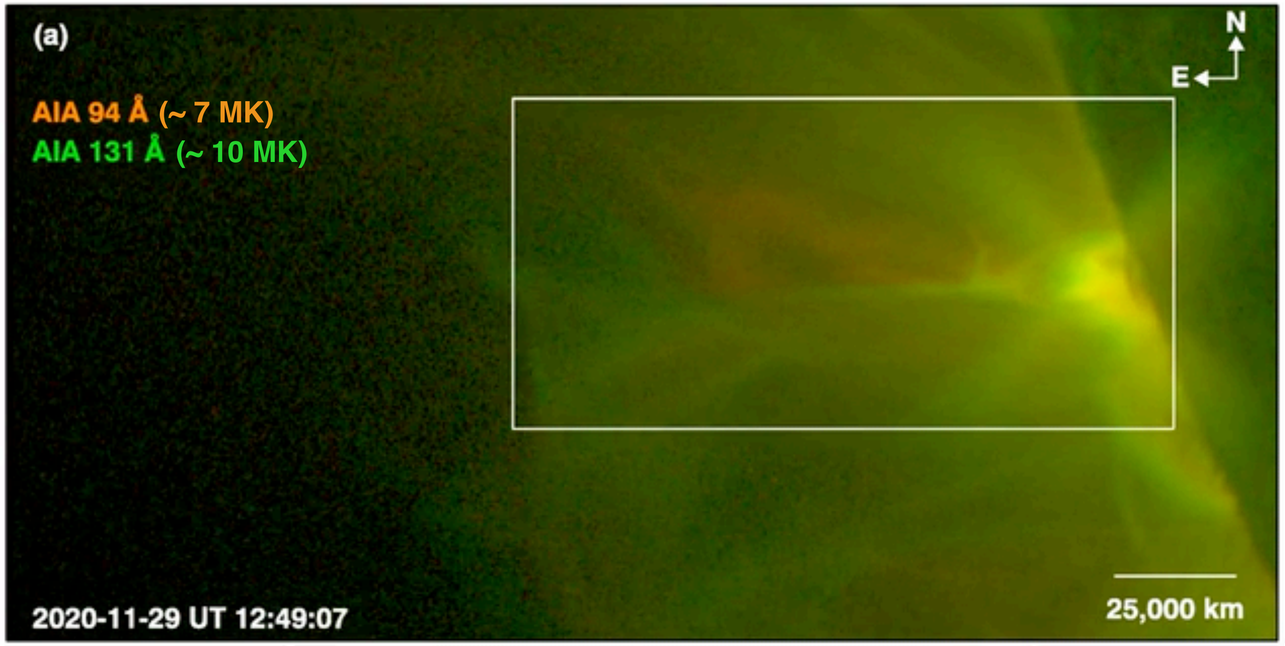


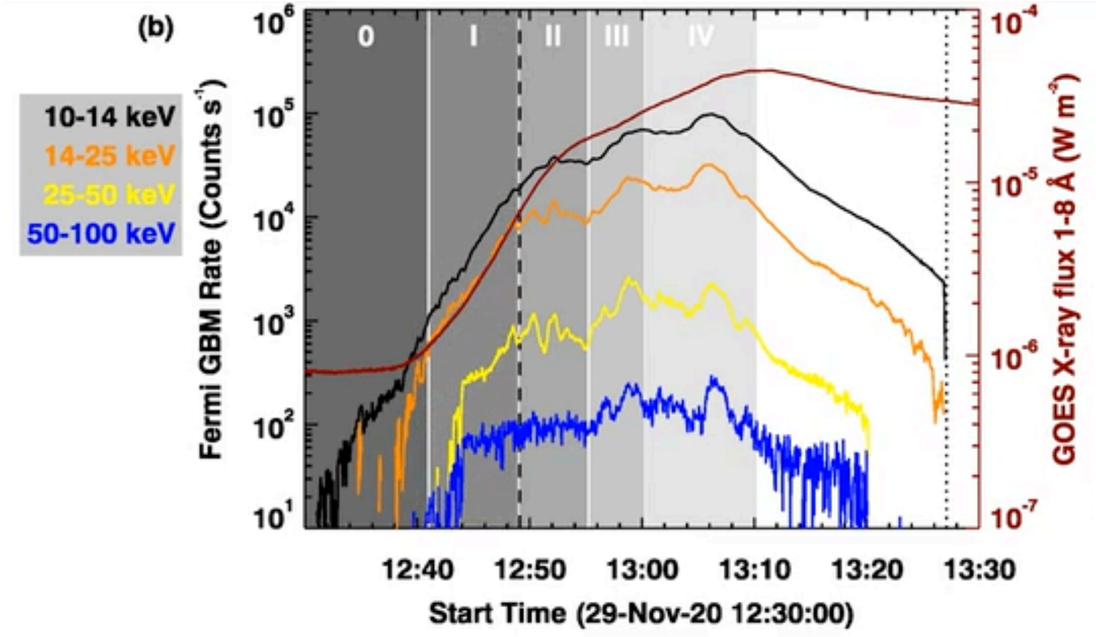


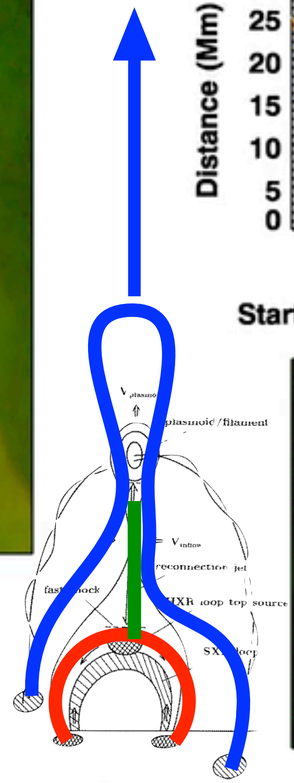


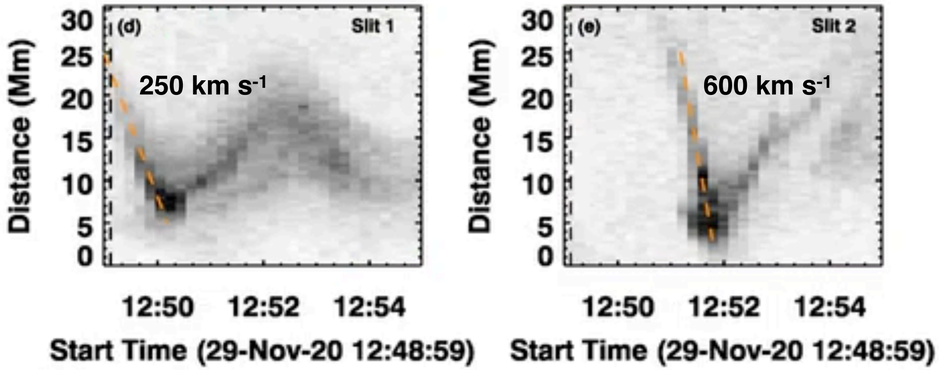
- Reconnection at the top of arcade
- Increase in hard X-ray count rate
- Accelerated expansion of flux rope
- Formation of current sheet

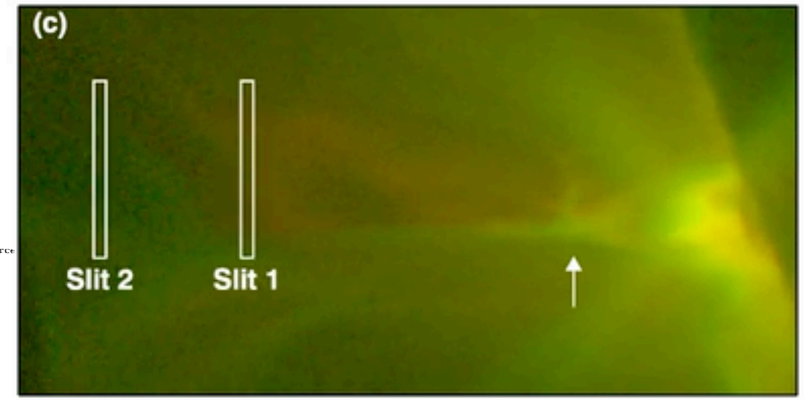
Quasi-stable evolution



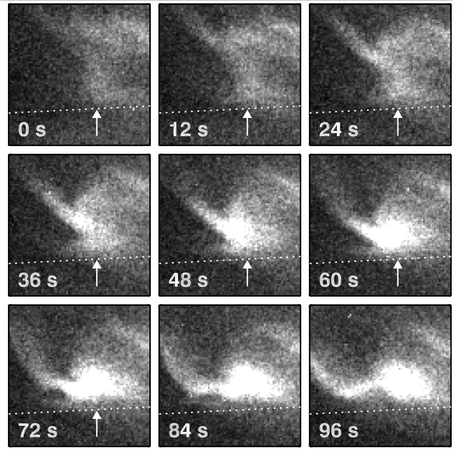




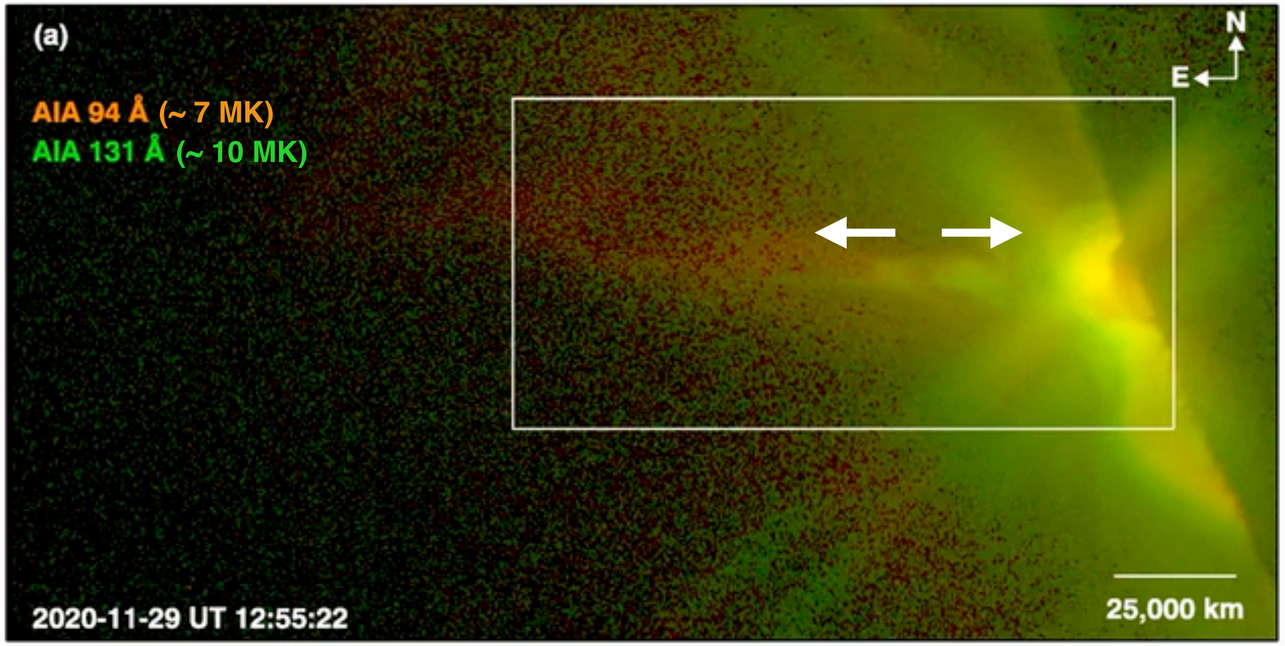


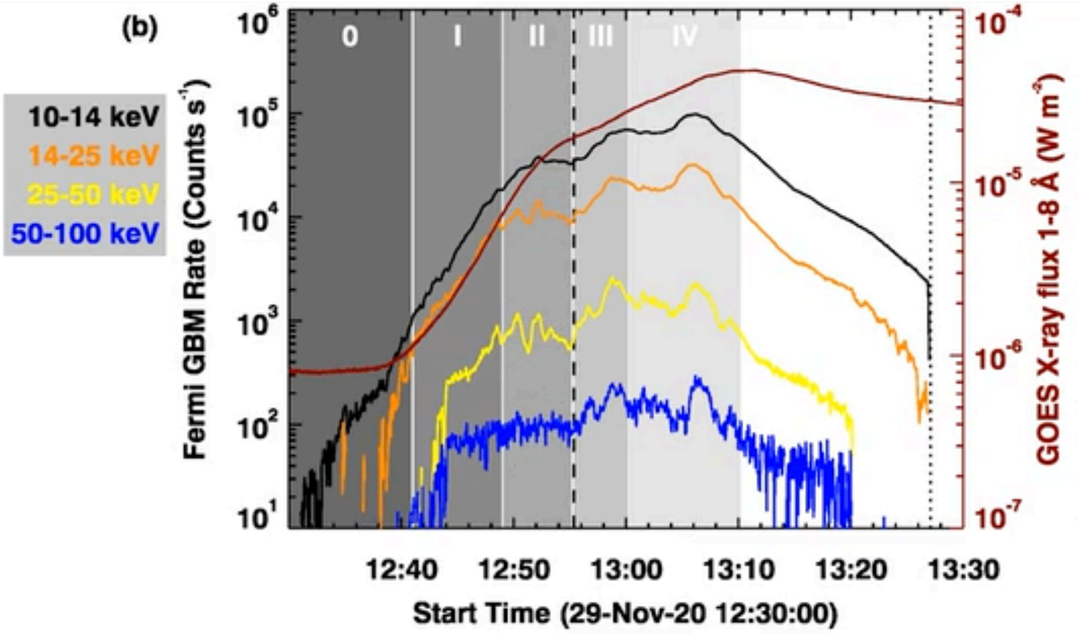


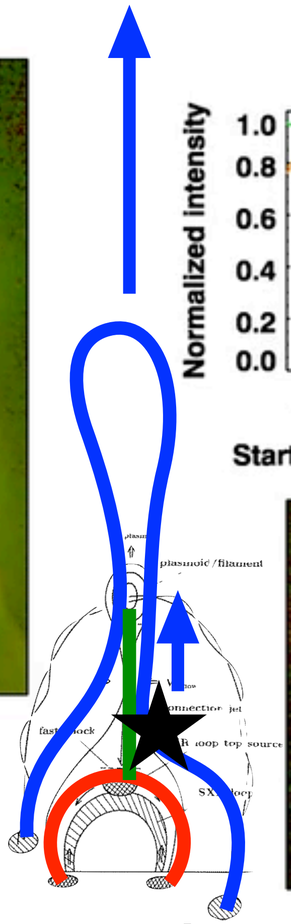
- External perturbations
- Hard X-ray bursts

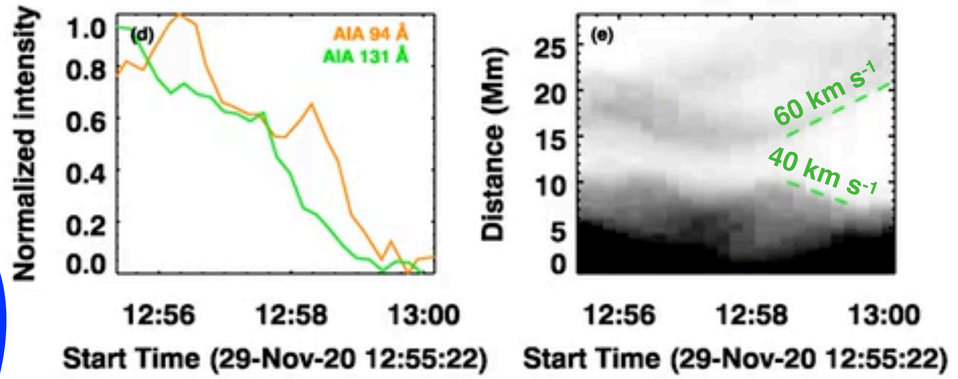


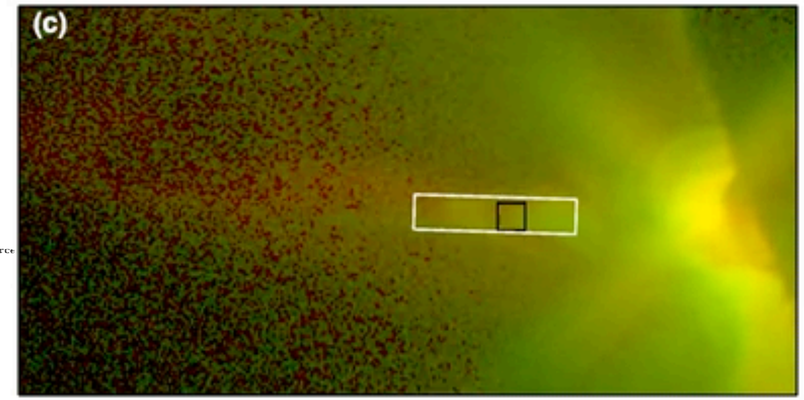
Onset of current sheet disruption





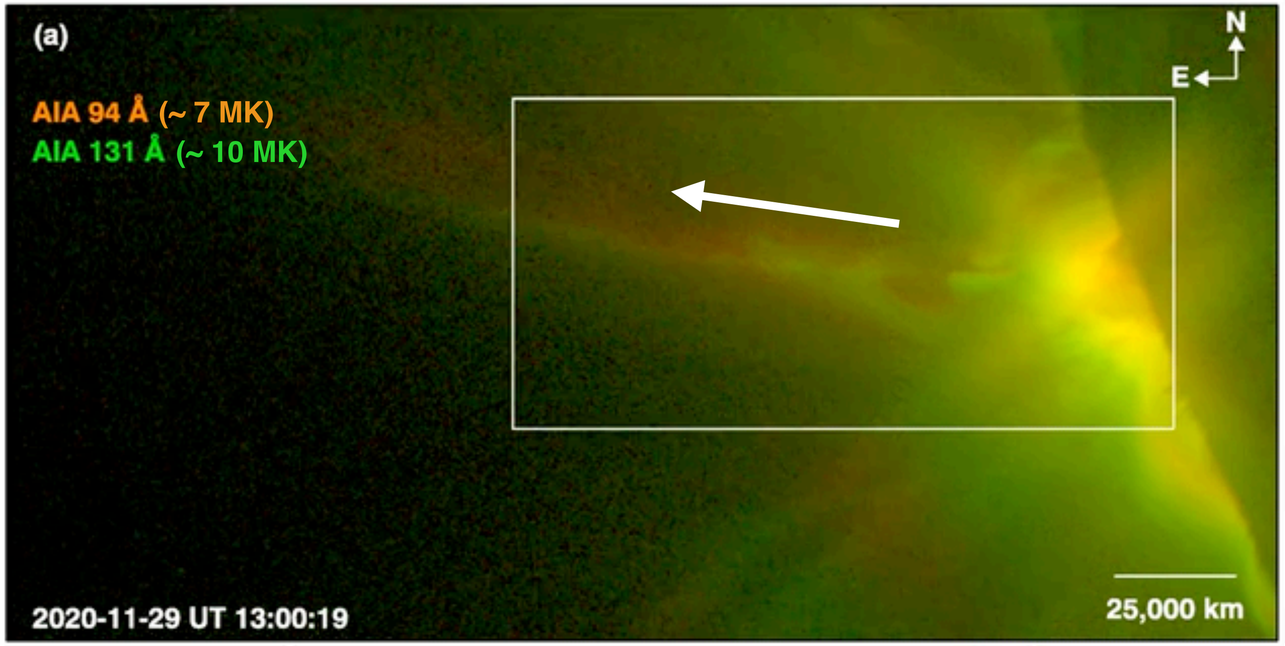


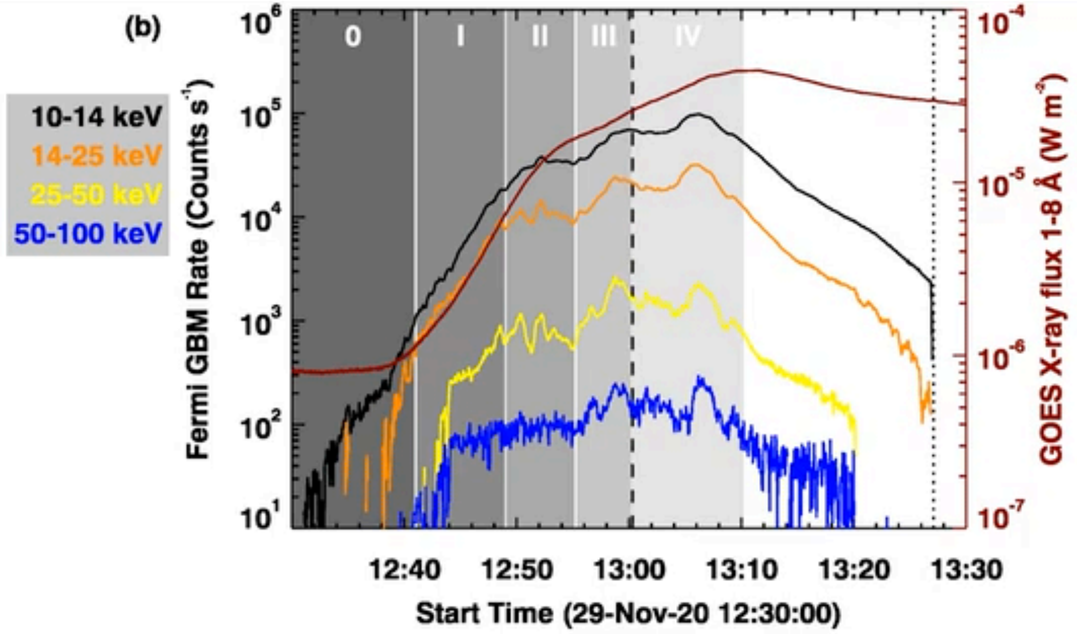


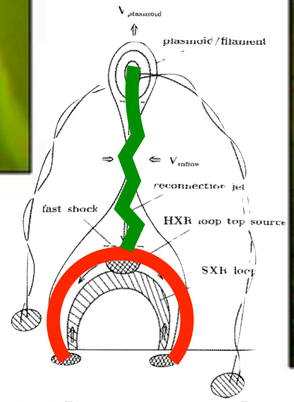


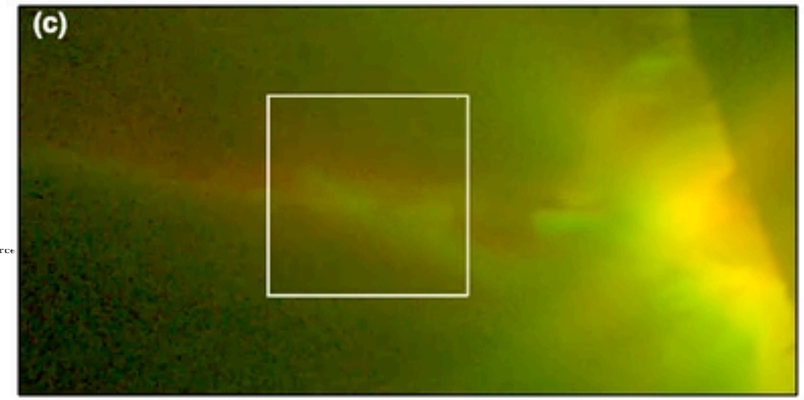
- Disconnection of flux rope

Disruption of current sheet



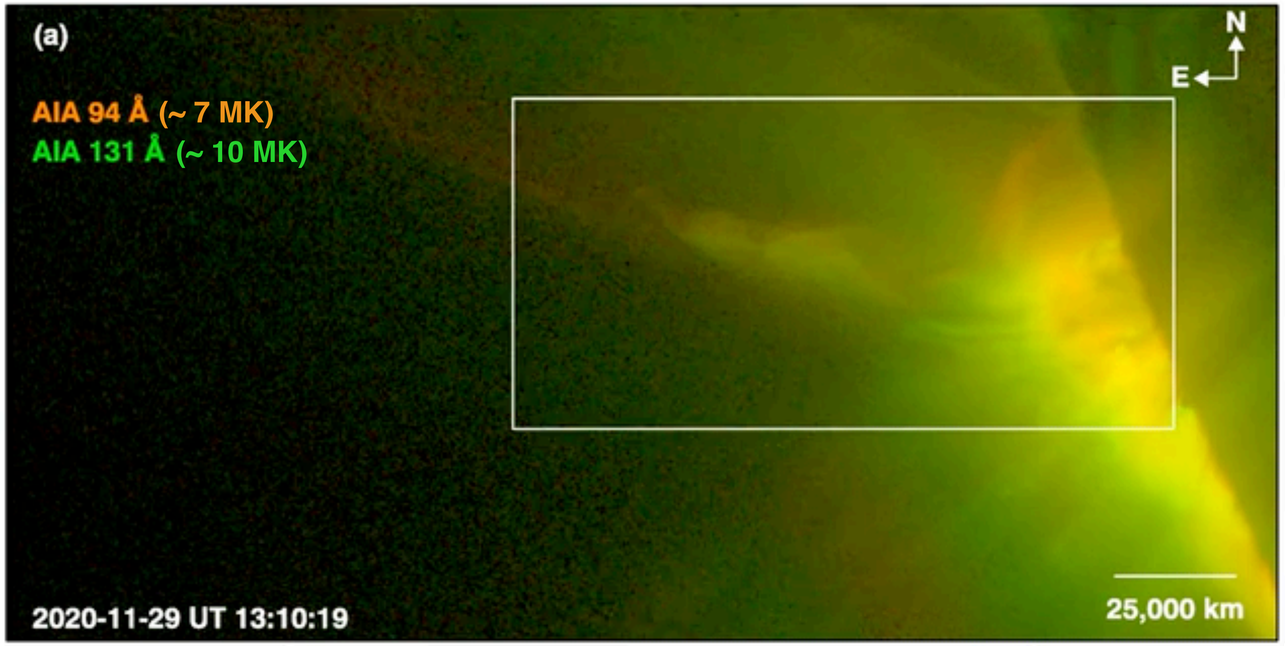


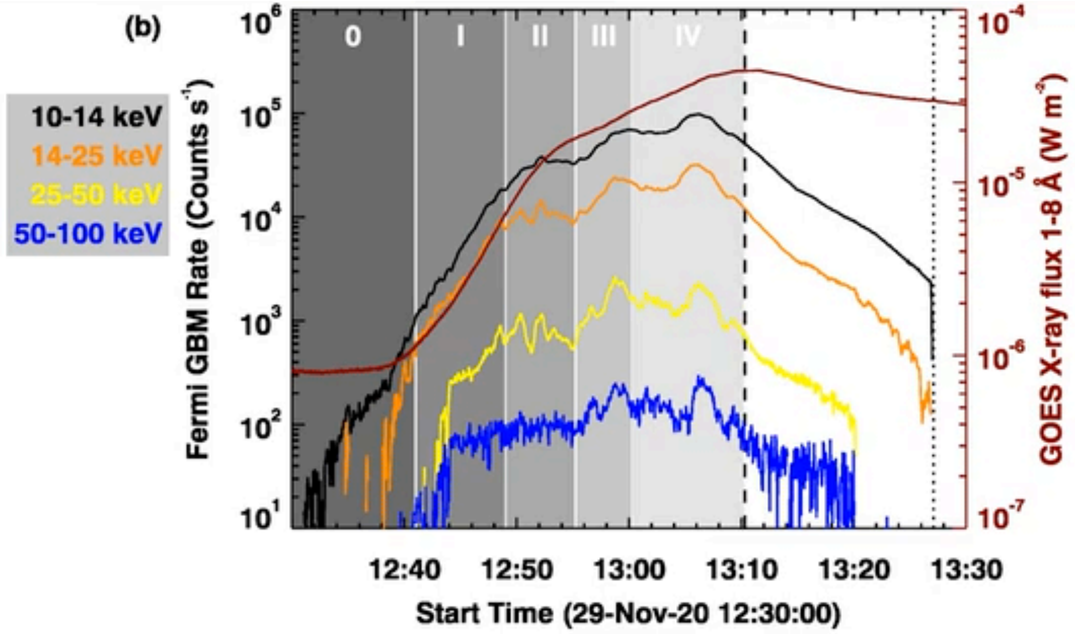


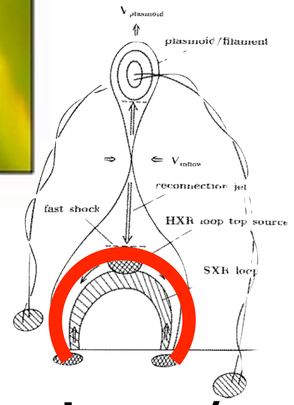


- Swirl-like eddies
- End of impulsive rise phase of the flare

Main phase of the flare



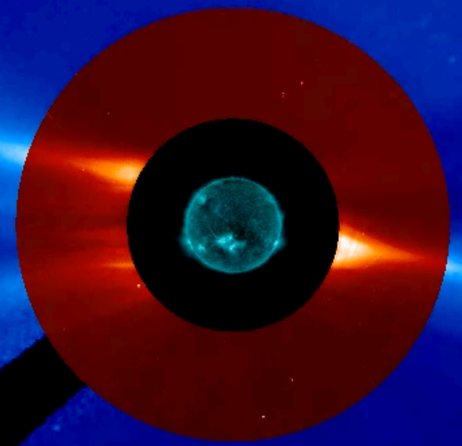




- Slow decay / main phase of the flare

Summary

- We observed multiphase evolution of a solar flare current sheet
- Current sheet modulated by external perturbations and swirl-like eddies
- Phases closely associated with hard X-ray bursts (but no spatial information)



Chitta et al. (2021) ApJ, 911, 133

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