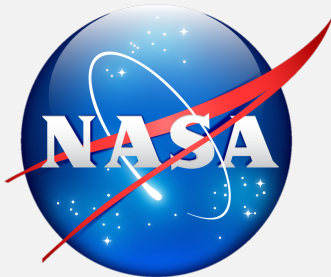


# Origin of Pre-Coronal-Jet Minifilaments: Flux Cancellation

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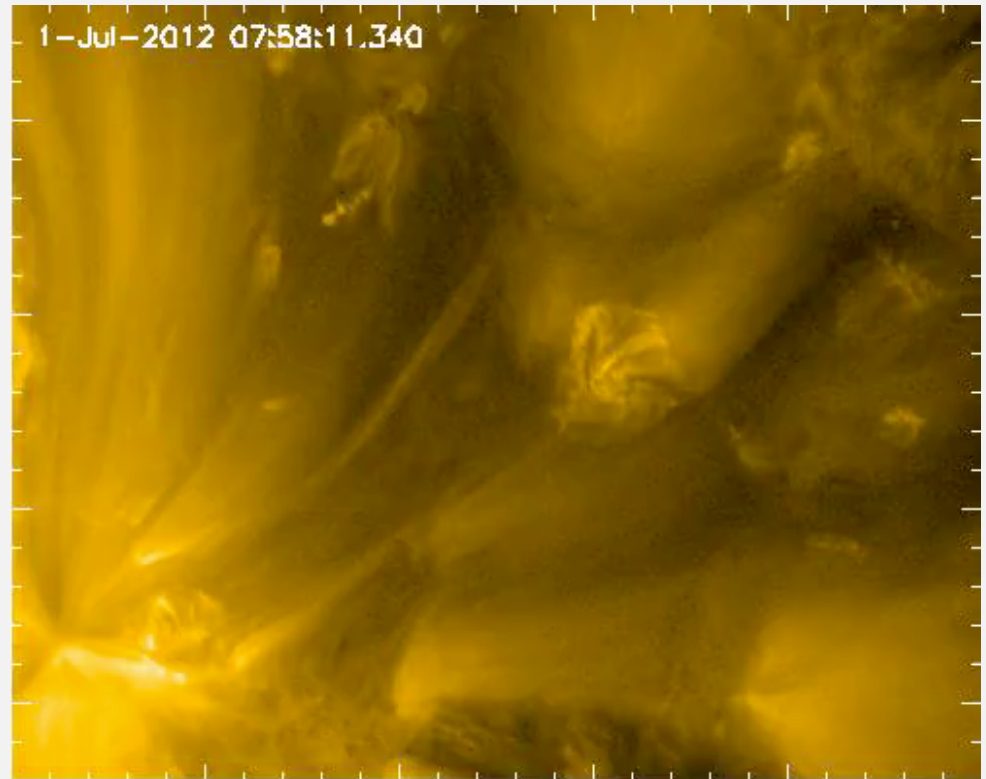
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## Background

- Coronal jets are frequent magnetically channeled narrow eruptions.
- All coronal jets observed in EUV and X-ray images show a bright spire with a base brightening, also known as jet bright point (JBP).
- Recent studies of jets show that coronal jets are driven by small-scale filament eruptions (e.g. *Hong et al. 2011*, *Shen et al. 2012*, *Adams et al. 2014*, *Sterling et al. 2015*).
- We recently investigated the triggering mechanism of ten ondisk quiet-region coronal jet eruptions and found that magnetic flux cancellation at the neutral line of *minifilaments* is the main cause of quiet-region jet eruptions (*Panesar et al. 2016*).
- **What leads to the formation of these pre-jet minifilaments?**

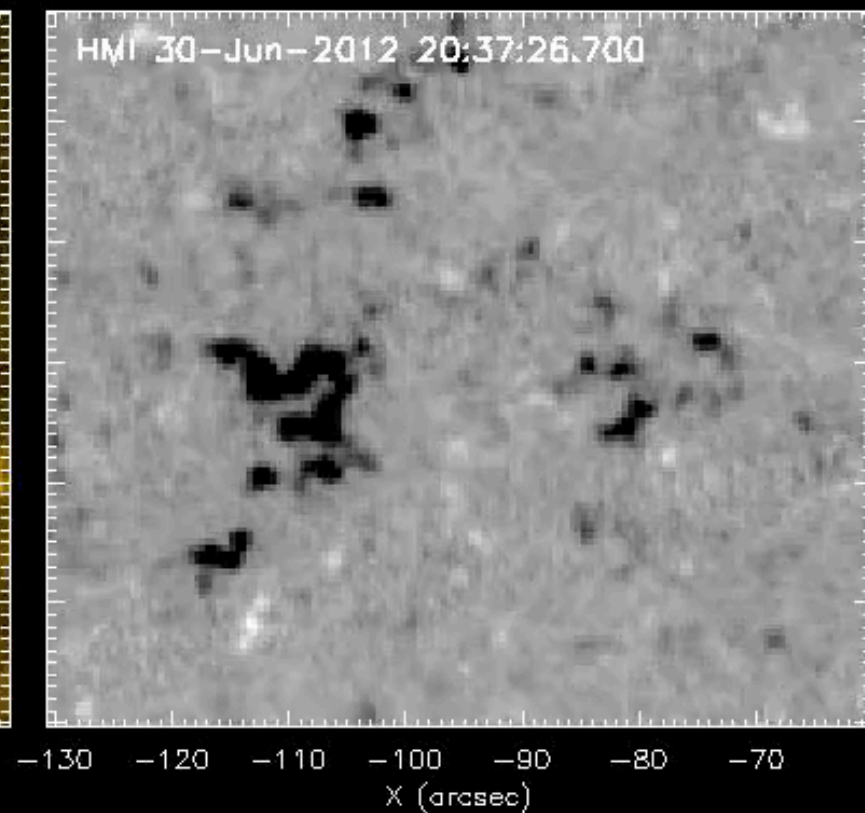
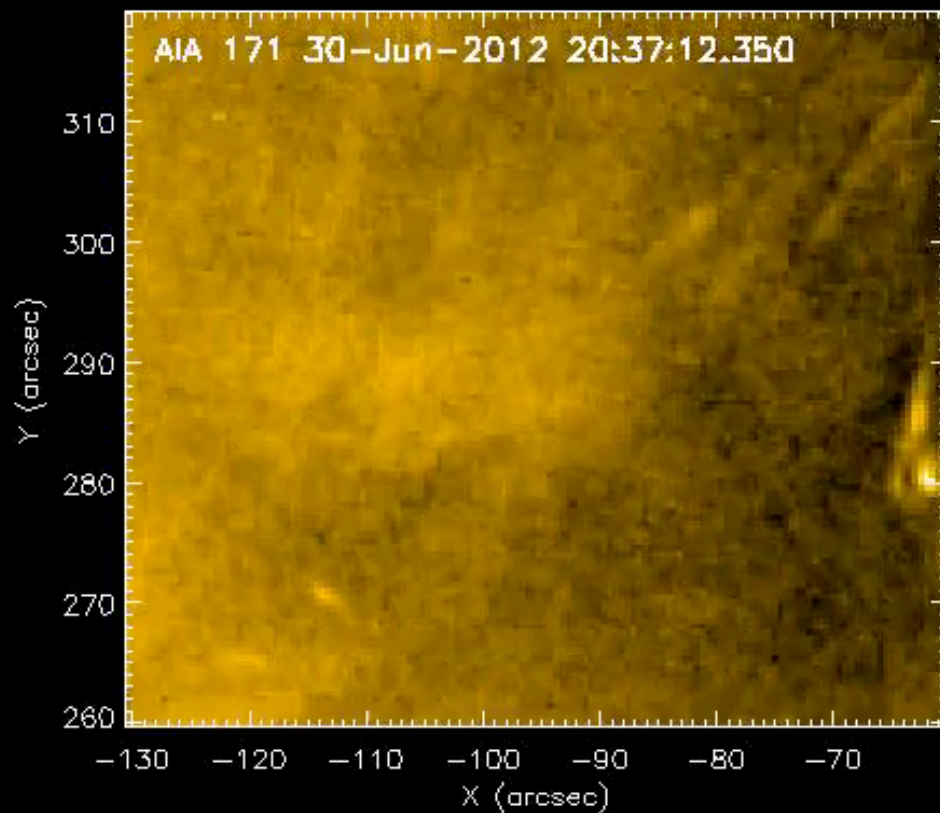


- We investigate the magnetic field evolution that leads to pre-jet minifilament formation

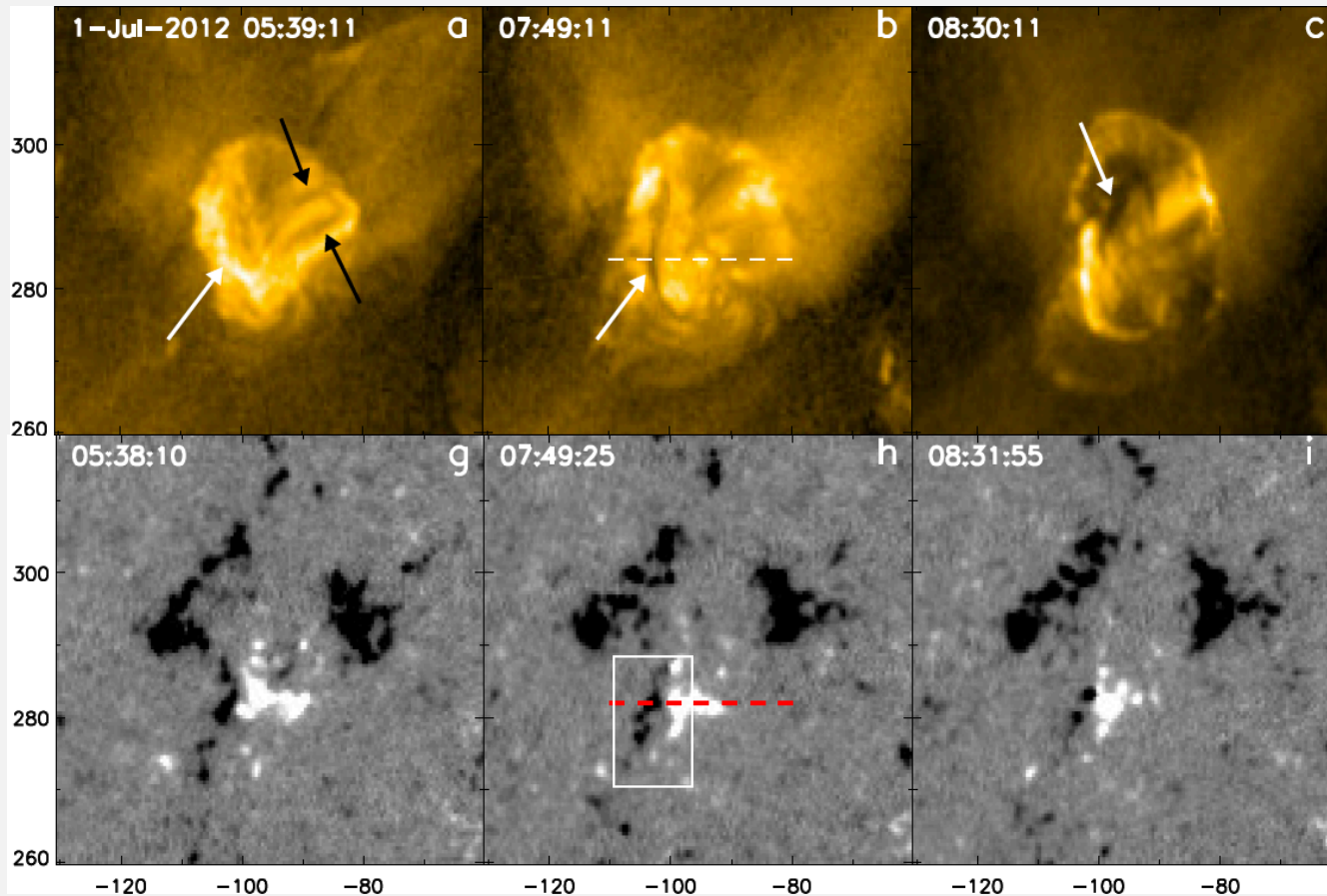
Measured parameters for the observed quiet-region pre-jet minifilaments:

Event No.	Minifil. formation <sup>a</sup> time (UT)	Minifil. eruption <sup>b</sup> time (UT)	Location <sup>c</sup> helio. cord.	Duration of <sup>c</sup> minifil. (hrs)	Width of <sup>d</sup> minifil. (km)	No. of <sup>e</sup> Jets	$\Phi$ values <sup>f</sup> $10^{19}$ Mx	% of $\Phi^g$ reduction
J1	2012 Mar 21 22:46	2012 Mar 22 04:46	S09, E29	6	2000±500	1	1.6	20 ± 6.8
J2	2012 Jul 01 05:58	2012 Jul 01 08:29	N12, E02	2.5	1500±200	1	1.9 <sup>h</sup>	20 ± 7.3
J3	2012 Jul 07 — <sup>i</sup>	2012 Jul 07 21:31	S15, E12	—	2200±200	1	—	—
J4	2012 Aug 04 05:14	2012 Aug 05 01:58 <sup>j</sup> , 2012 Aug 05 02:20	N07, E30	21	2500±500	2	5.8	14 ± 4.6
J5	2012 Aug 10 19:43	2012 Aug 10 23:03	S31, E11	3.2	1500±200	1	0.9	27 ± 6.1
J6	2012 Sept 19 17:15	2012 Sept 20 22:52	S34, E11	34	2500±500	2	3.0	9 ± 5.3
J7	2012 Sept 21 00:51	2012 Sept 21 03:33	S34, E08	3.5	2500±500	1	1.7	38 ± 2.6
J8	2012 Sept 21 23:55	2012 Sept 22 01:25	N01, E20	1.5	1500±500	1	0.9	38 ± 5.5
J9	2012 Nov 11 02:56	2012 Nov 11 13:08, 2012 Nov 12 17:06, 2012 Nov 12 21:34, 2012 Nov 13 04:20	S23, E01	49.5	2500±500	4	— <sup>k</sup>	—
J10	2012 Dec 13 08:06	2012 Dec 13 10:11, 2012 Dec 13 10:36	S01, W01	2.5	1600±200	2	1.2	7.0 ± 8.3

## Minifilament Formation (J2)

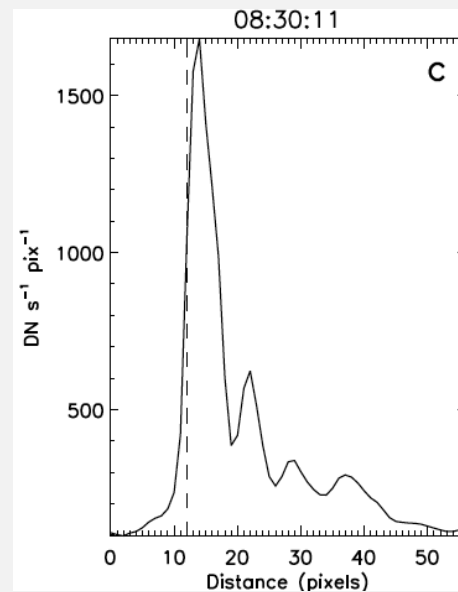
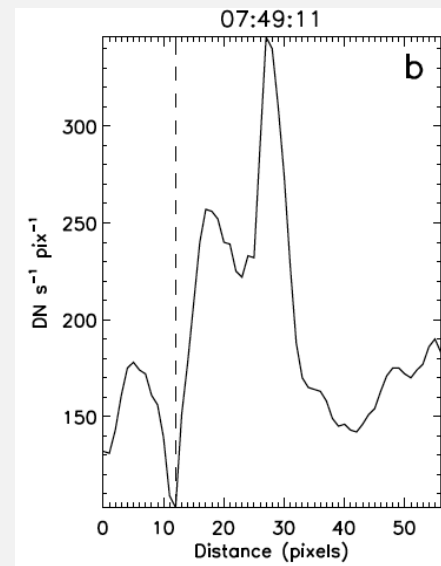
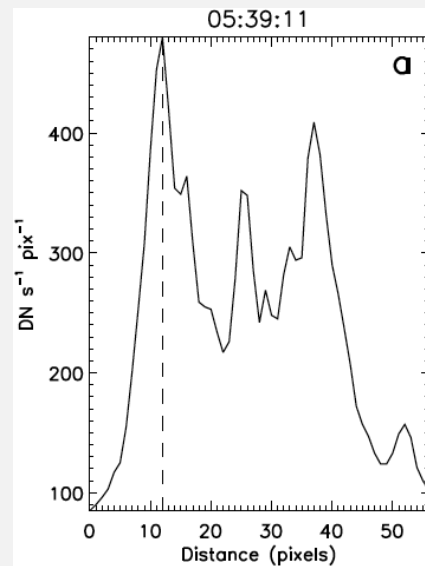
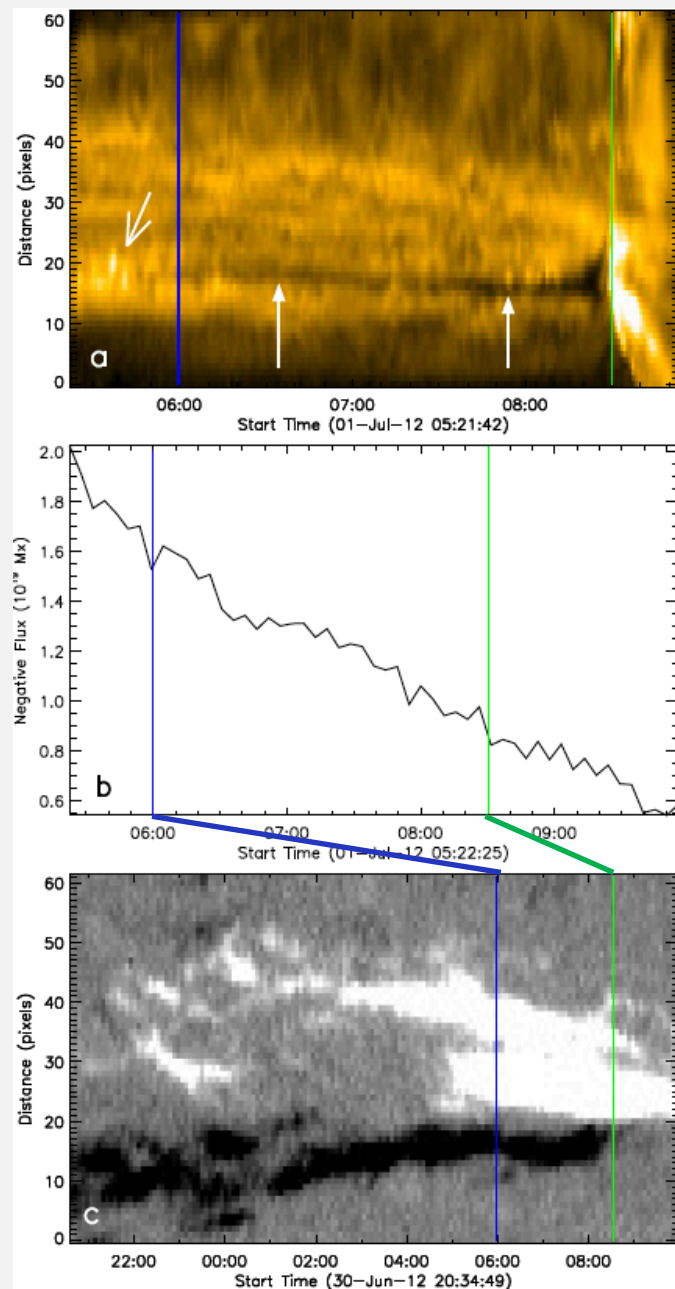


## Minifilament Formation (J2)



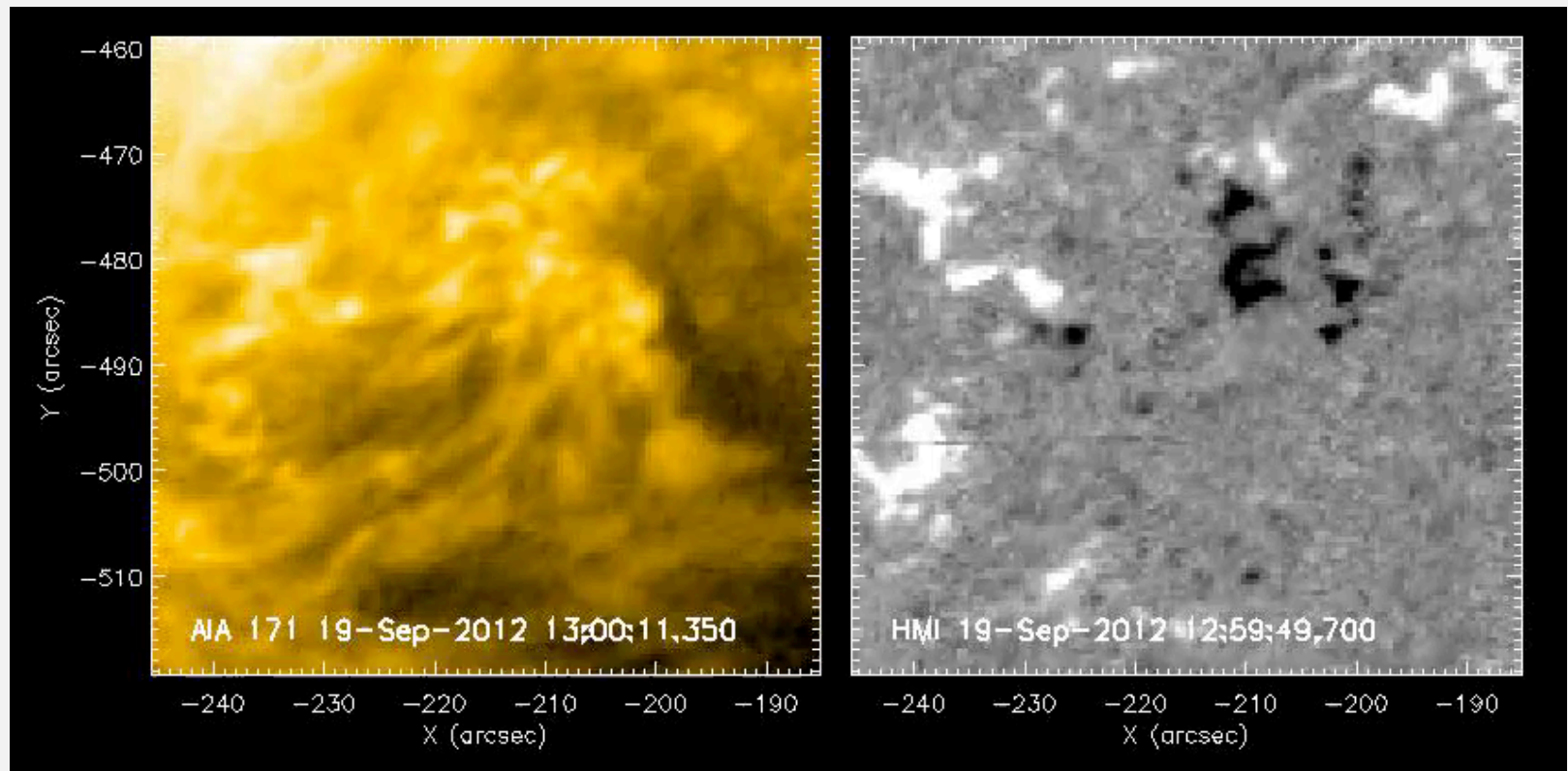
- Duration of minifilament  $\sim 2.5$  hours.
- Brightenings appear at the location where the minifilament subsequently forms.

# Minifilament Formation and Flux Cancellation





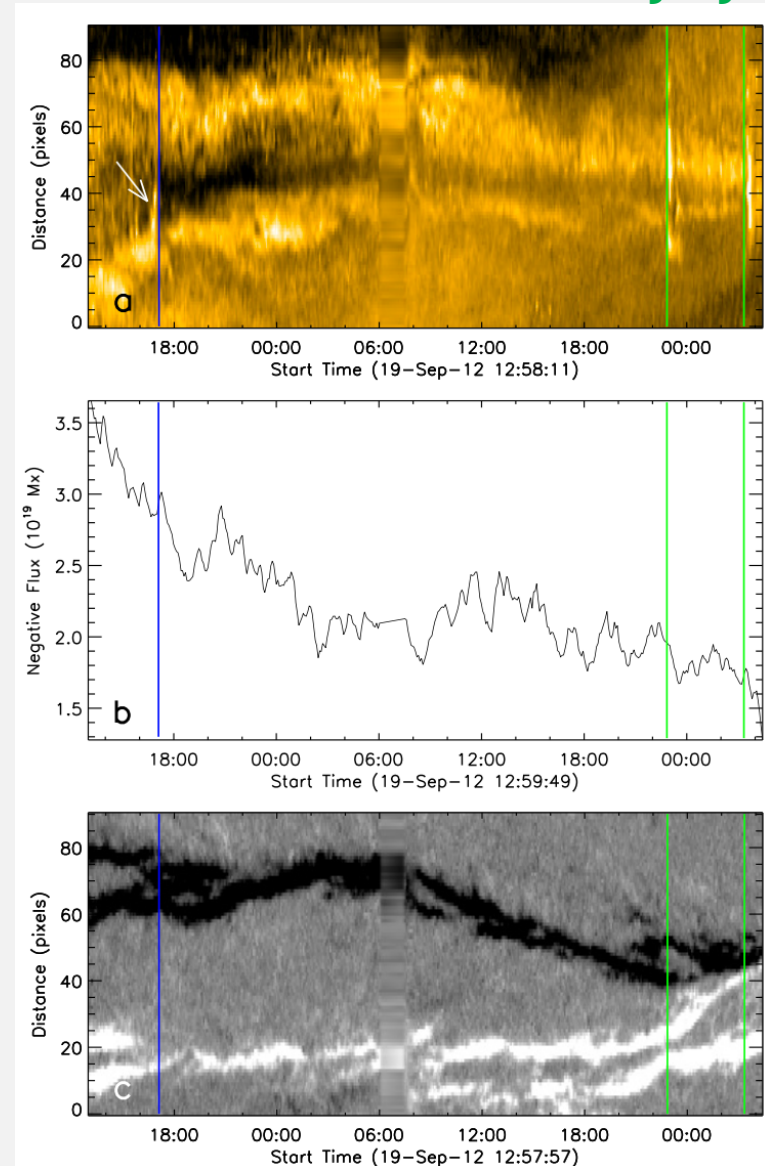
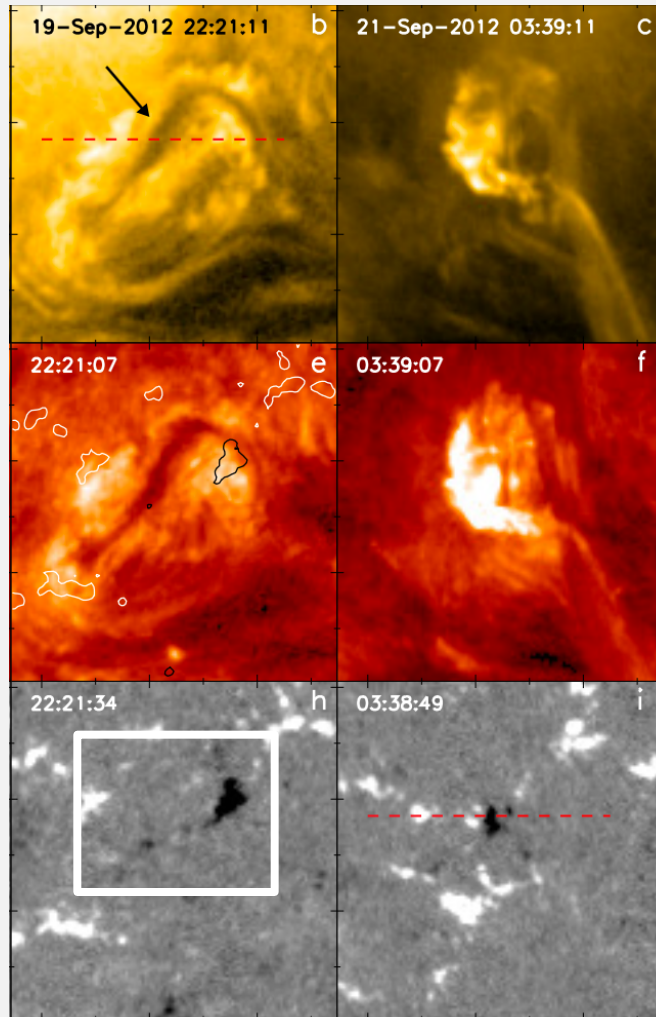
## Homologous Jet Eruptions (J6 and J7)



- We also observe more than a single jet from the same neutral line. A minifilament erupts and drives a jet, reforms/reappears at the same location, and then again erupts, driving the next jet.
- This process occurs as flux cancelation is ongoing and continues until all the minority-polarity flux vanishes. Eventually, the neutral line disappears, no more minifilaments and homologous jets are produced.

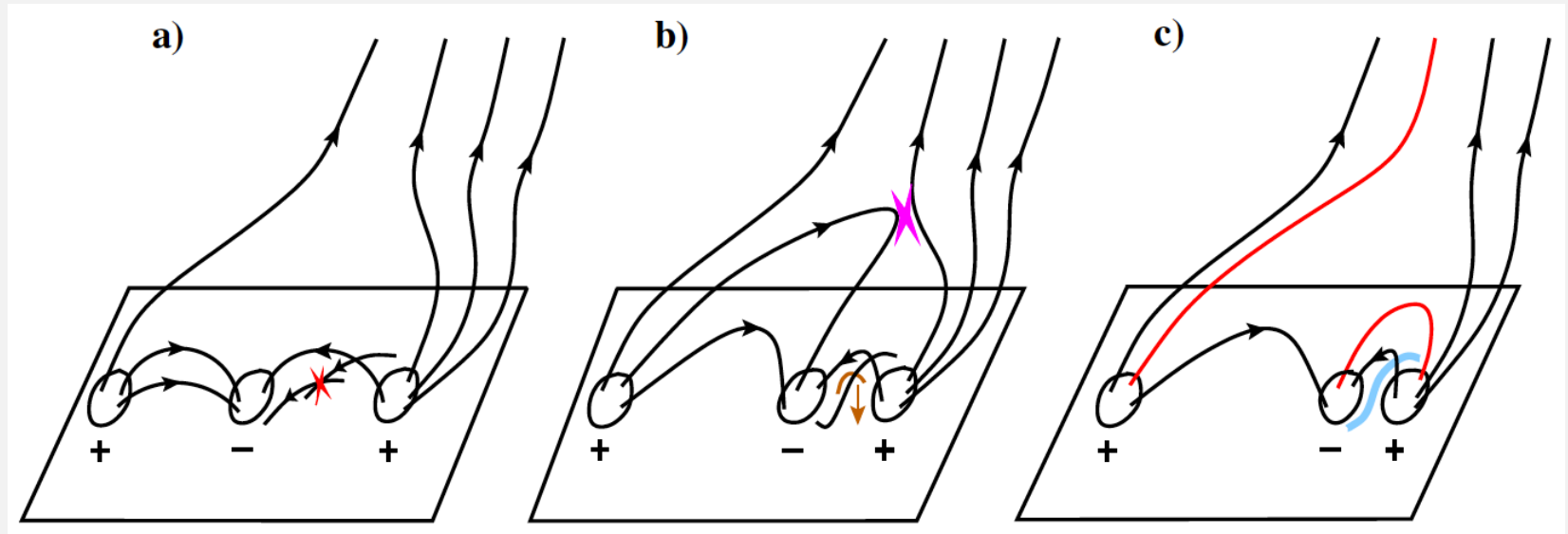
# Homologous Jet Eruptions (J6 and J7)

J6 J7





## Schematic Illustration of Observations



- Continuous flux cancelation between a minority-polarity flux clump and a majority-polarity flux clump builds a highly sheared minifilament field, leading to the formation of a minifilament.
- These results are consistent with the models for the formation of the field of typical solar filaments (*van Ballegooijen & Martens 1989; Martens & Zwaan 2001*).

## Summary

- We examined in detail the formation mechanism of ten random on-disk quiet-region pre-jet minifilaments.
- We found that flux cancelation is the key agent responsible for building a highly sheared minifilament field, leading to the formation of minifilaments. Sometimes continuous flux cancelation results in homologous eruptions.
- Persistent flux cancelation at the neutral line finally destabilizes the field holding the minifilament, and that field then erupts to make a coronal jet.
- Our observations supports that quiet region flux cancelation results in both the formation of the pre-jet minifilament and its jet-driving eruption.