

A Two-Sided-Loop X-Ray Solar Coronal Jet and a Sudden Photospheric Magnetic-field Change, Both Driven by a Minifilament Eruption

Alphonse C. Sterling¹

Louise K. Harra^{2,3}

Ronald L. Moore^{4,1}

David A. Falconer^{4,1}

1. NASA/MSFC

2. PMOD/WRC

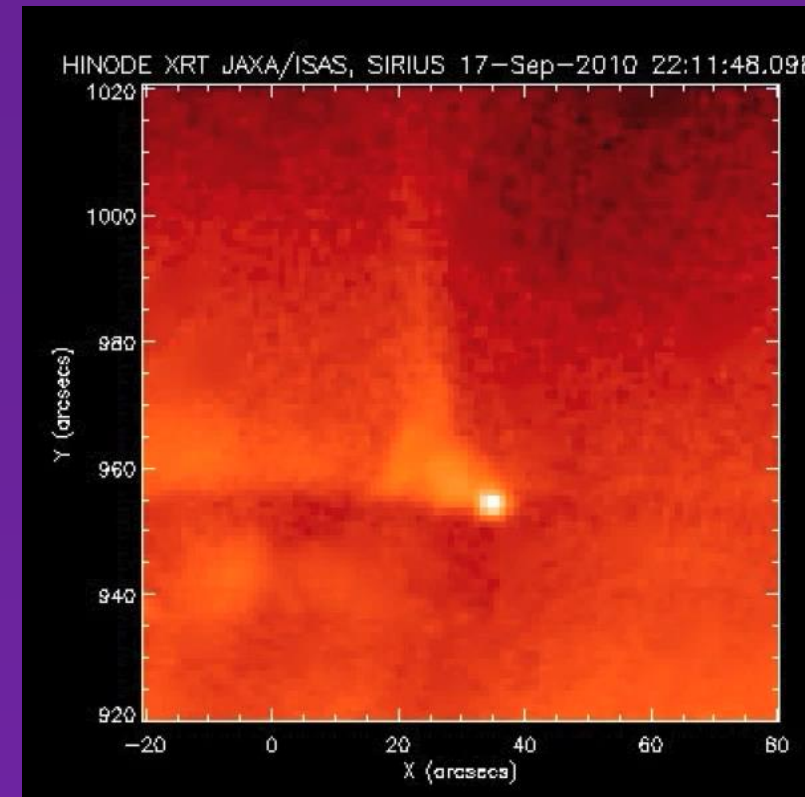
3. ETH-Zurich

4. University of Alabama Huntsville

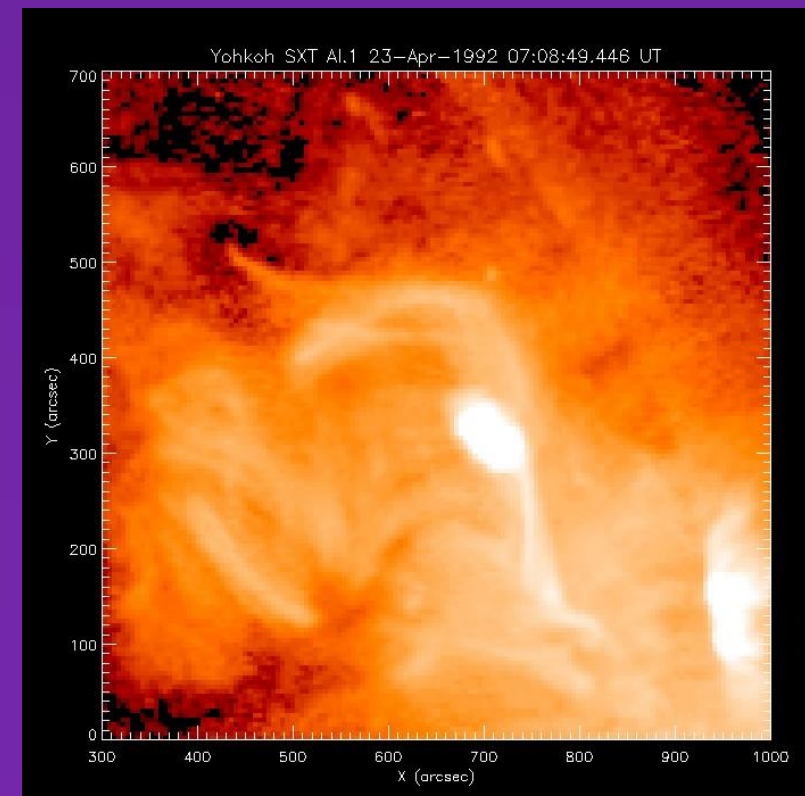
(Supported by NASA's HGI and NPP programs, and the MSFC/Hinode project.)

Yohkoh (X-rays) Identified two kinds of coronal jets

Single-spire jets



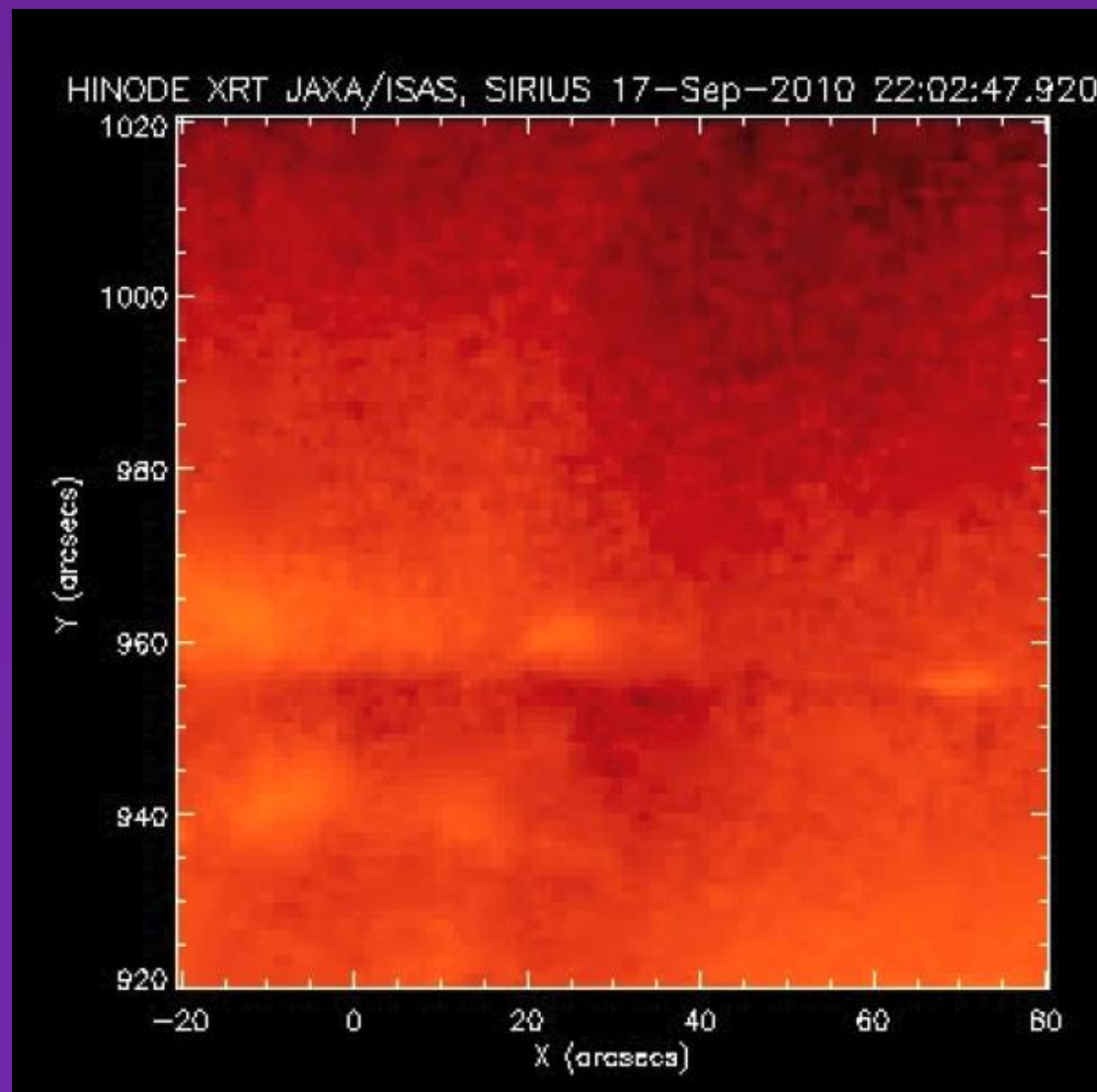
Two-sided Loop Jets



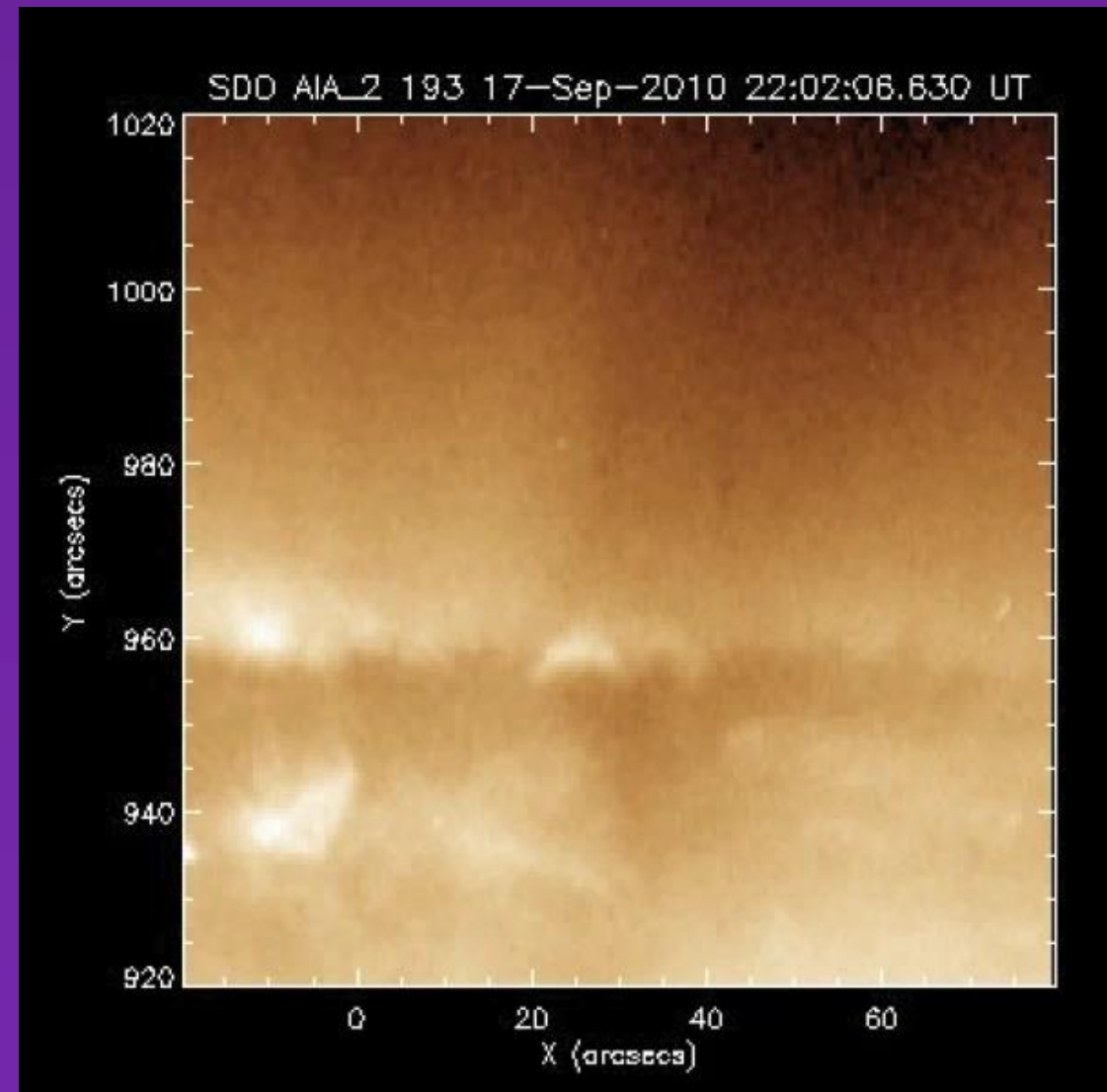
Single-Spire Jet

Recent studies indicate that many/most [single-spire] coronal Jets are small-scale versions of solar eruptions that produce flares and CMEs; a minifilament erupts to cause the jet.

Hinode/XRT



AIA 193

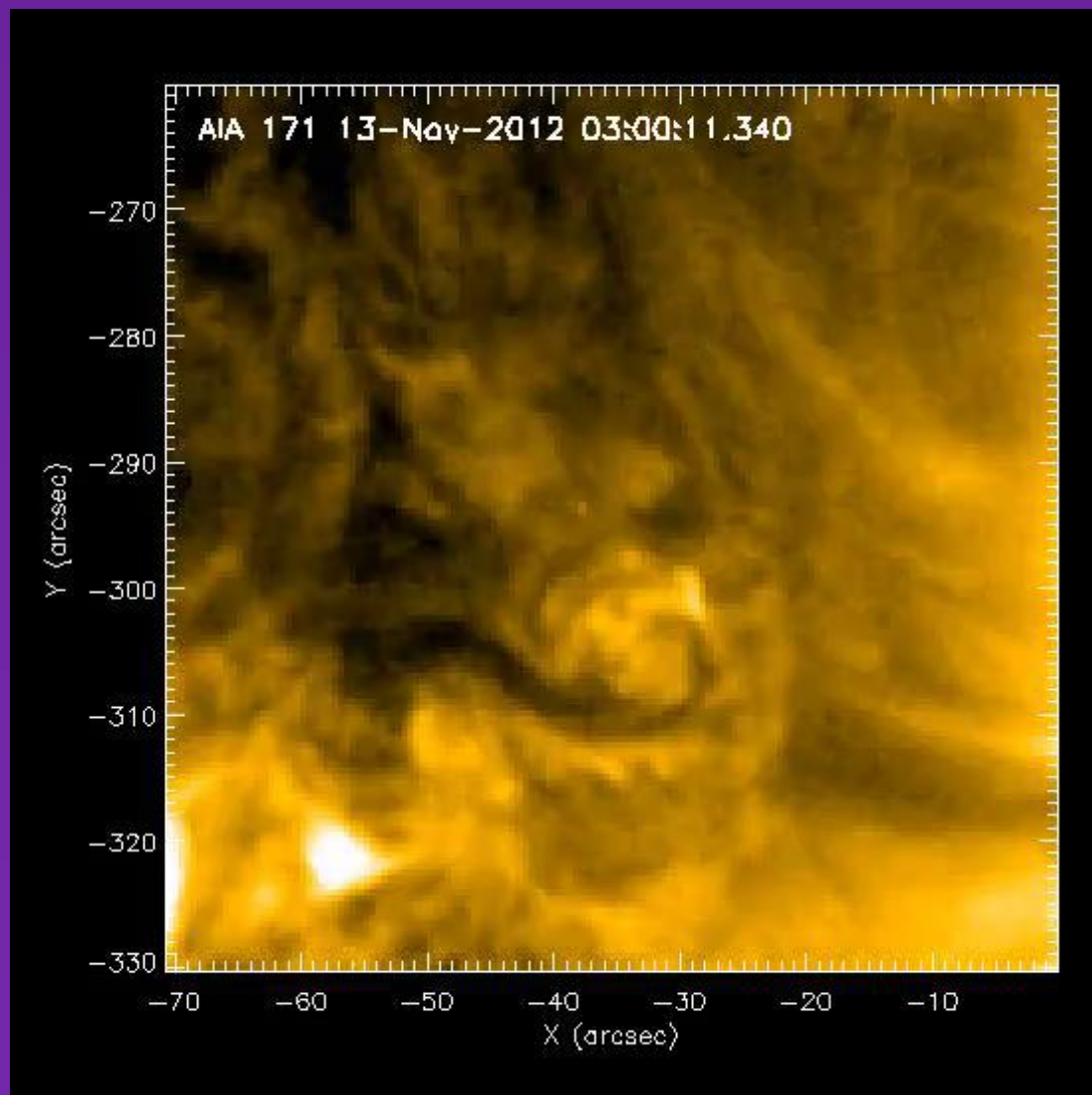


Sterling et al. (Nature, 2015)

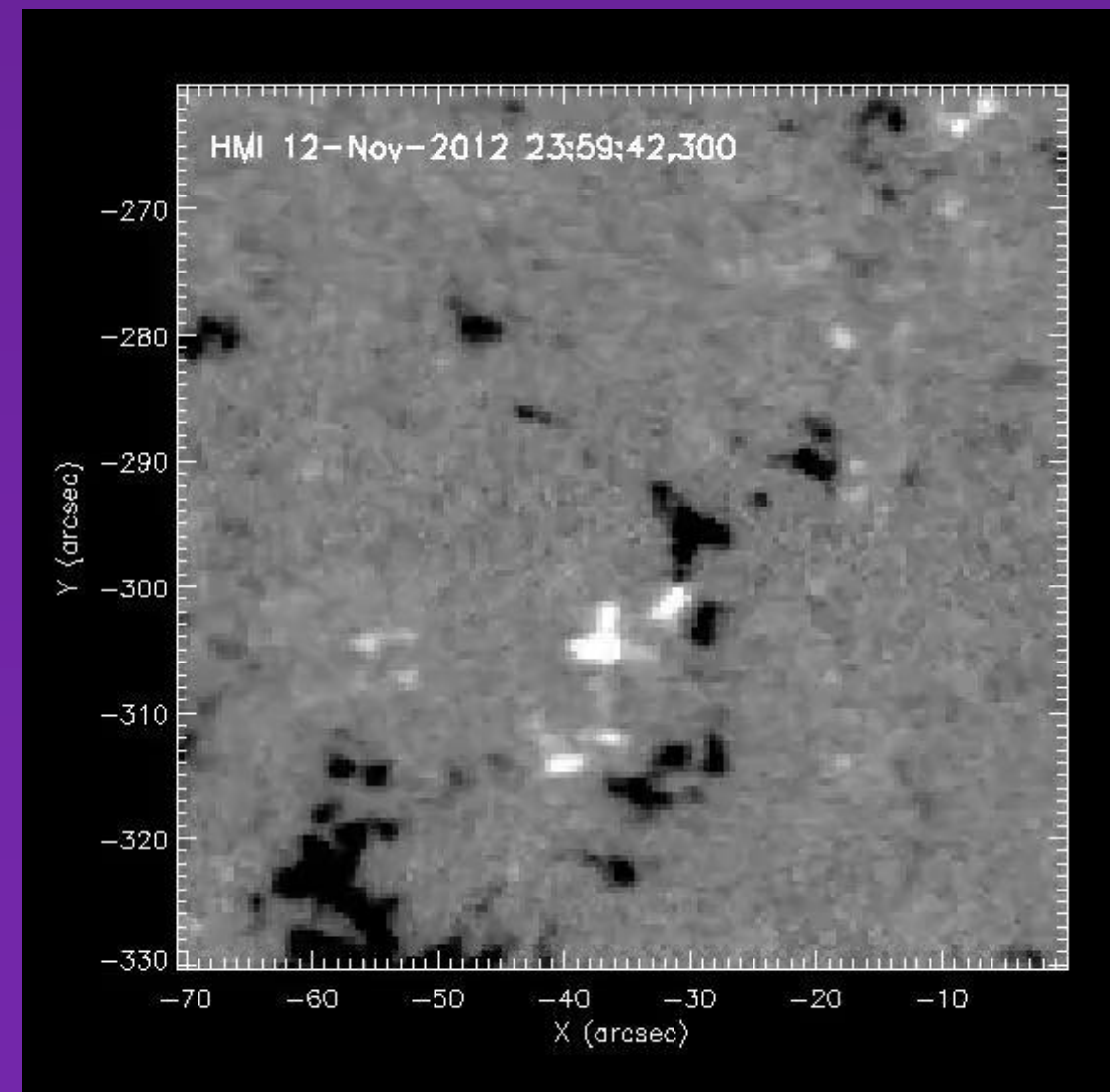
Single-Spire Jet

Recent studies also indicate that the minifilament is built and triggered to erupt by magnetic flux cancelation.

AIA 171



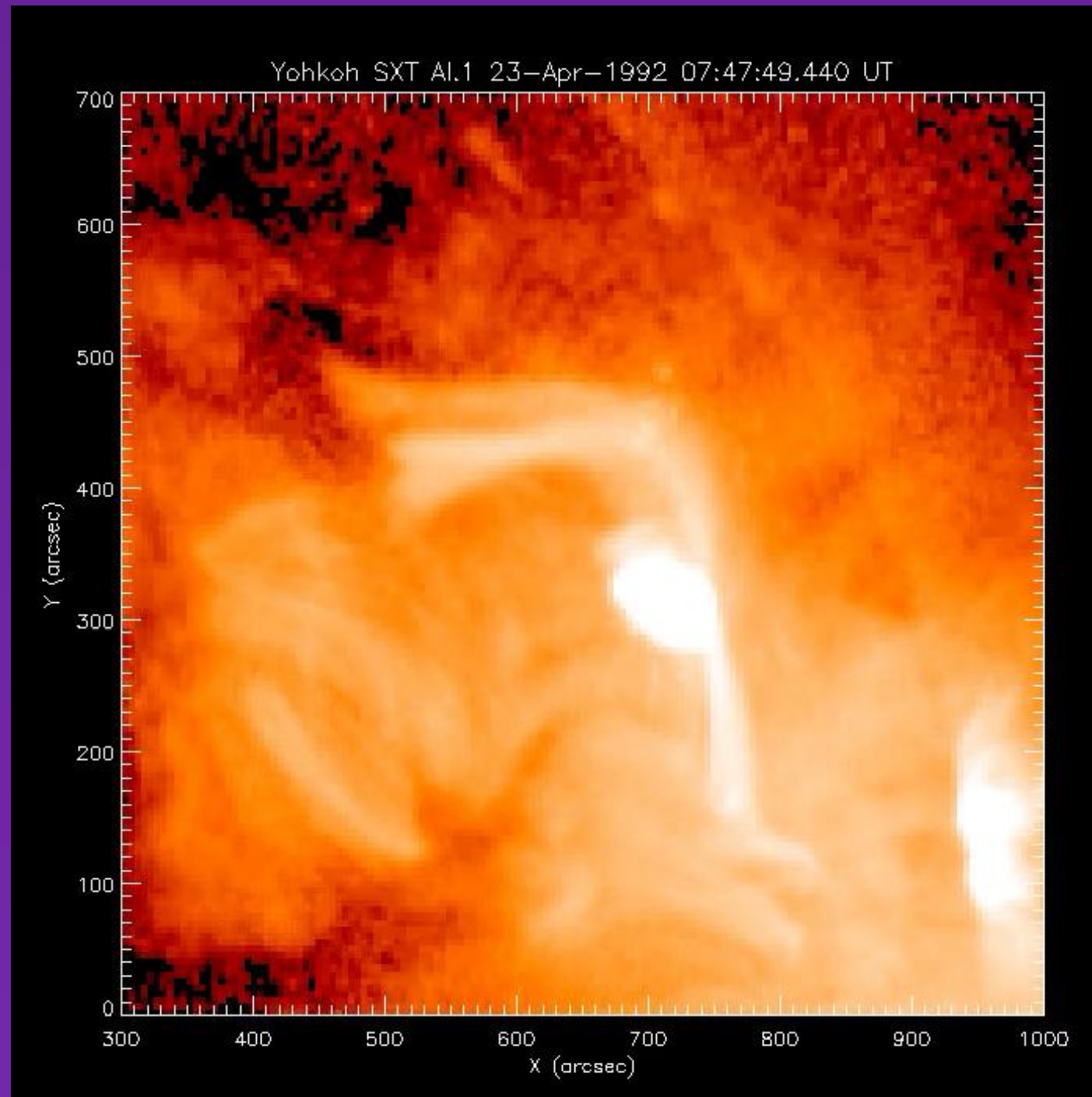
HMI



Panesar et al. (2016, ApJL)

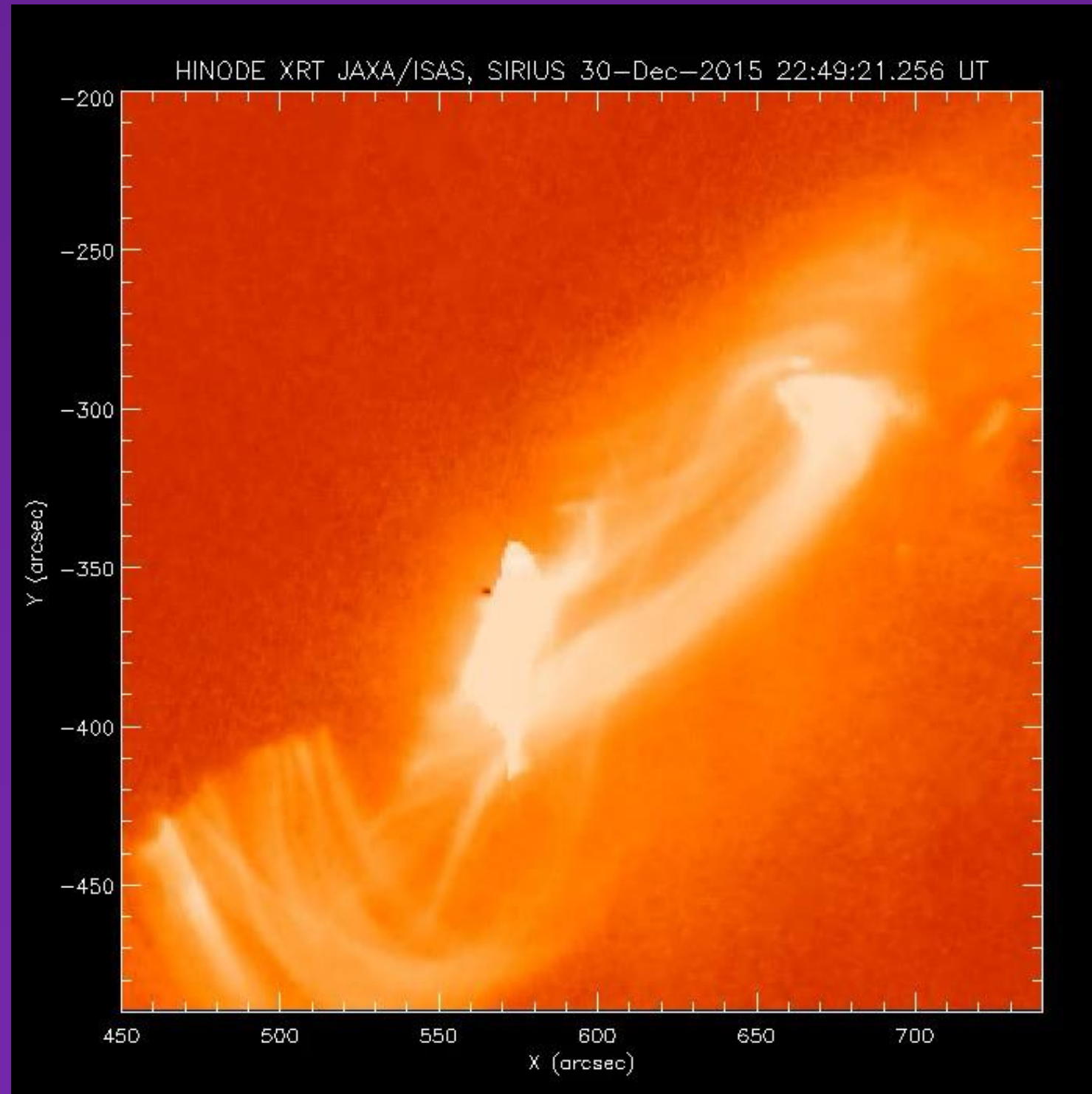
What about two-sided loop jets?

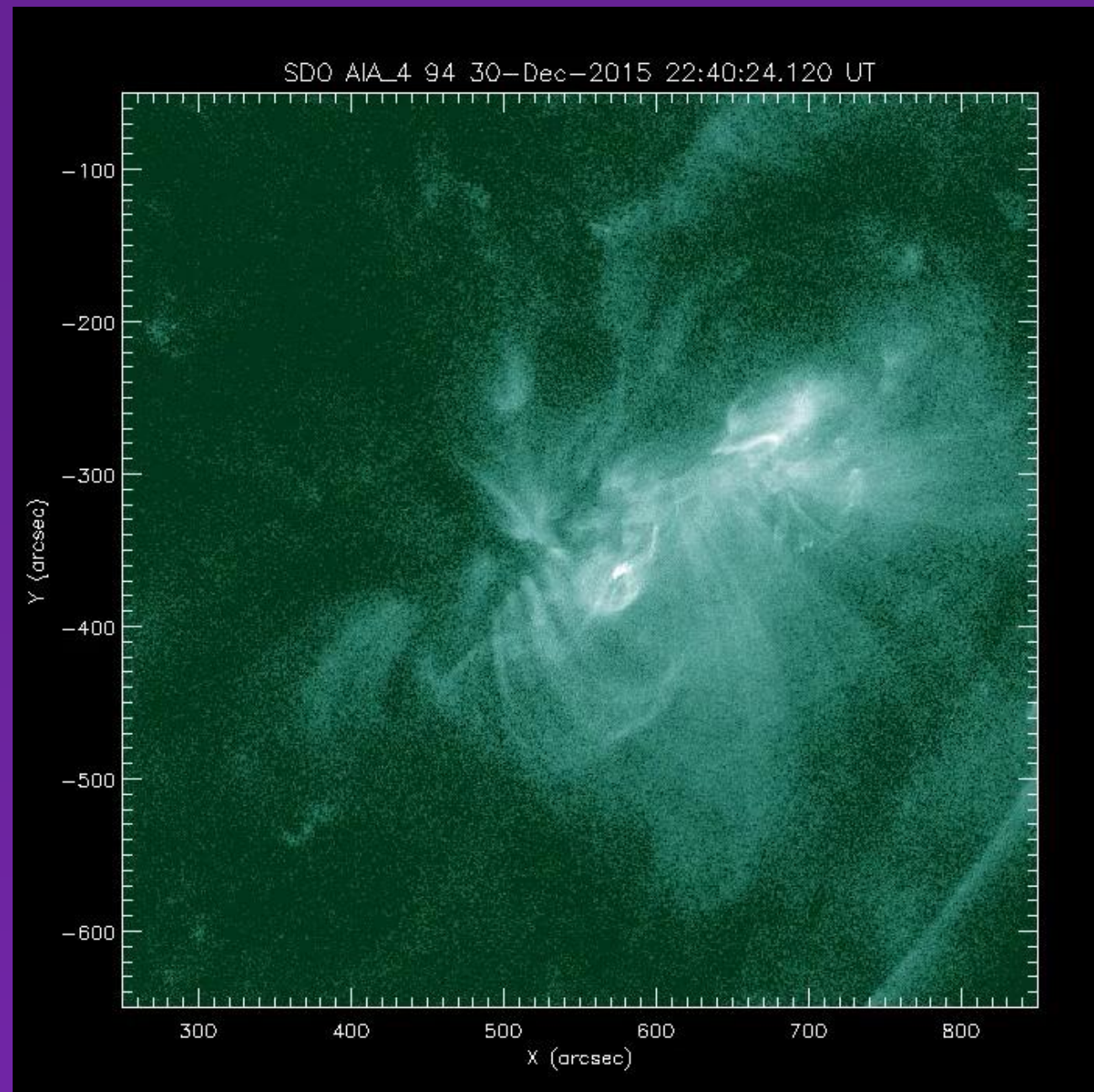
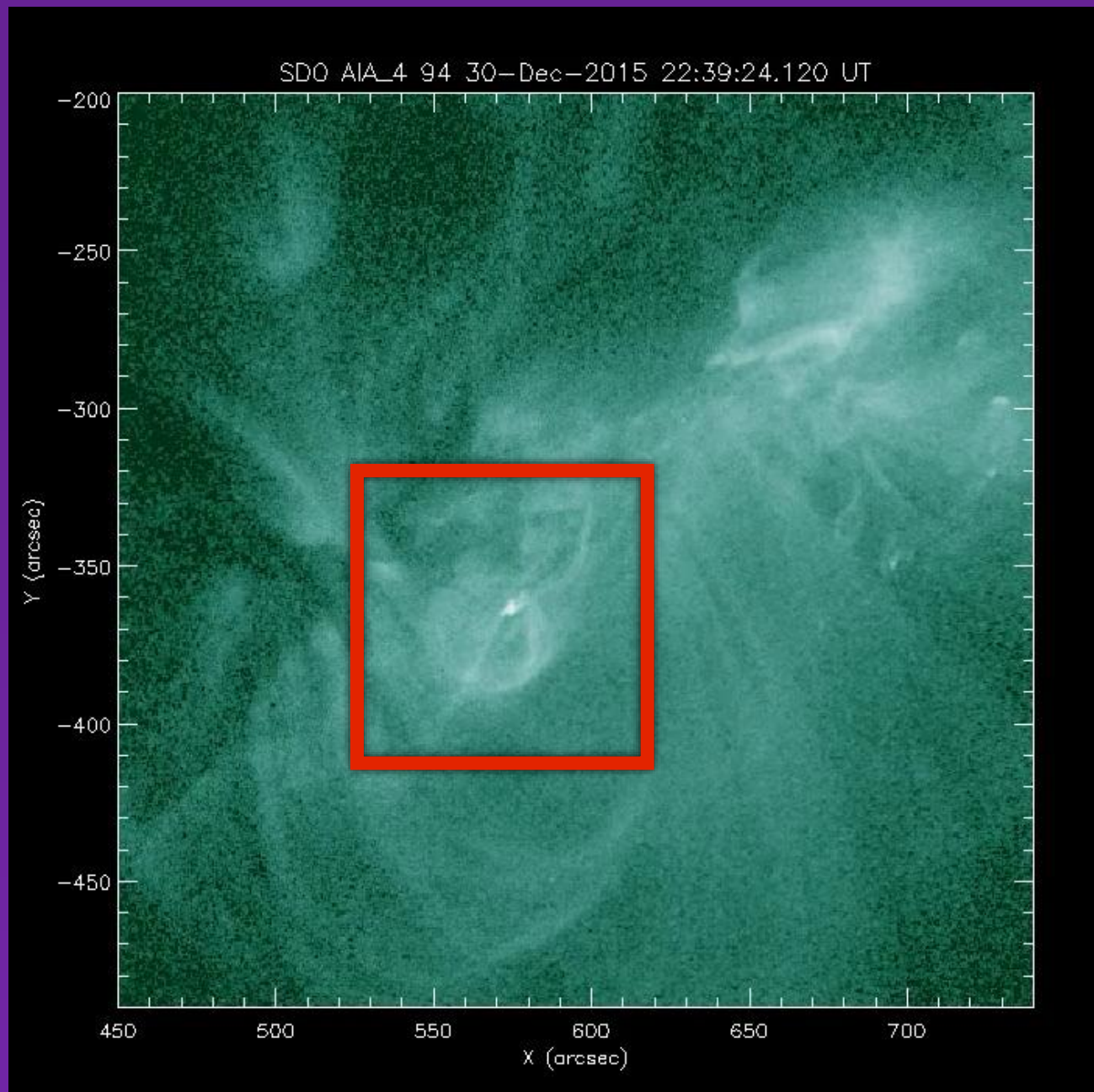
Yohkoh/SXT



Two-sided loop jet studied by Shibata et al. (1994)
(Pre SDO)

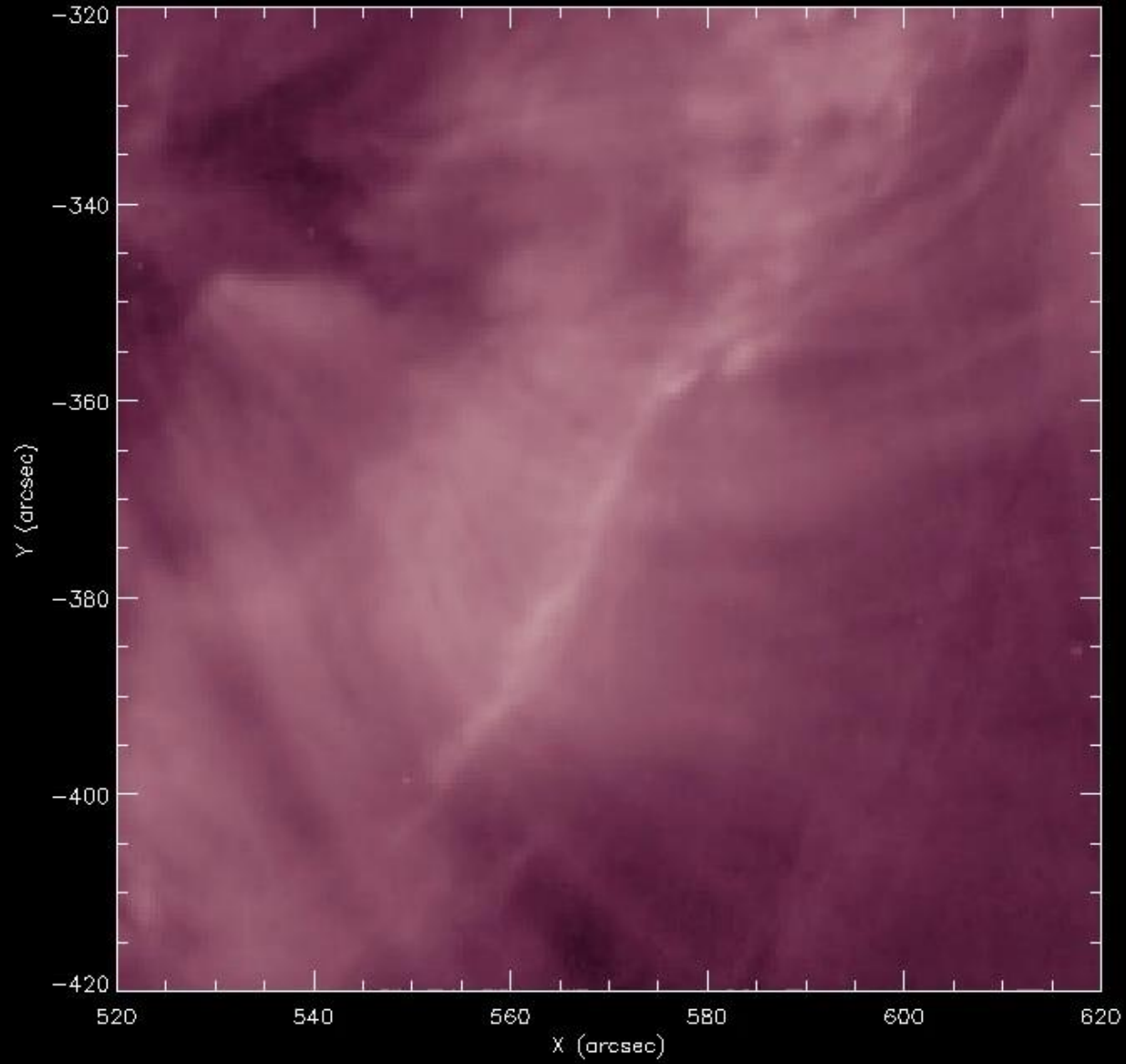
We observed a two-sided loop jet, using Hinode/XRT and EIS; and SDO/AIA and HMI





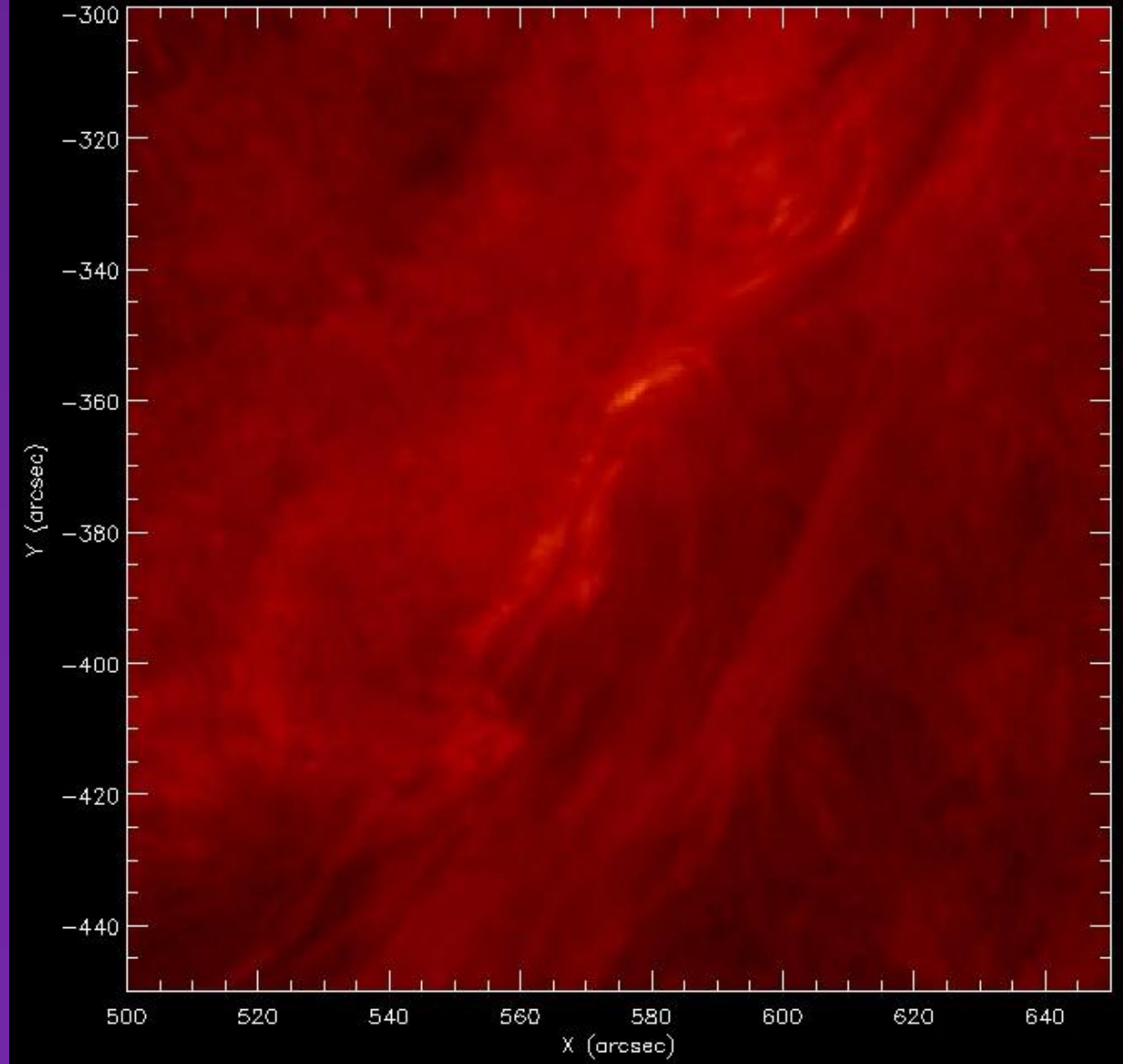
AIA 211

SDO AIA_2 211 30-Dec-2015 22:34:58.620 UT

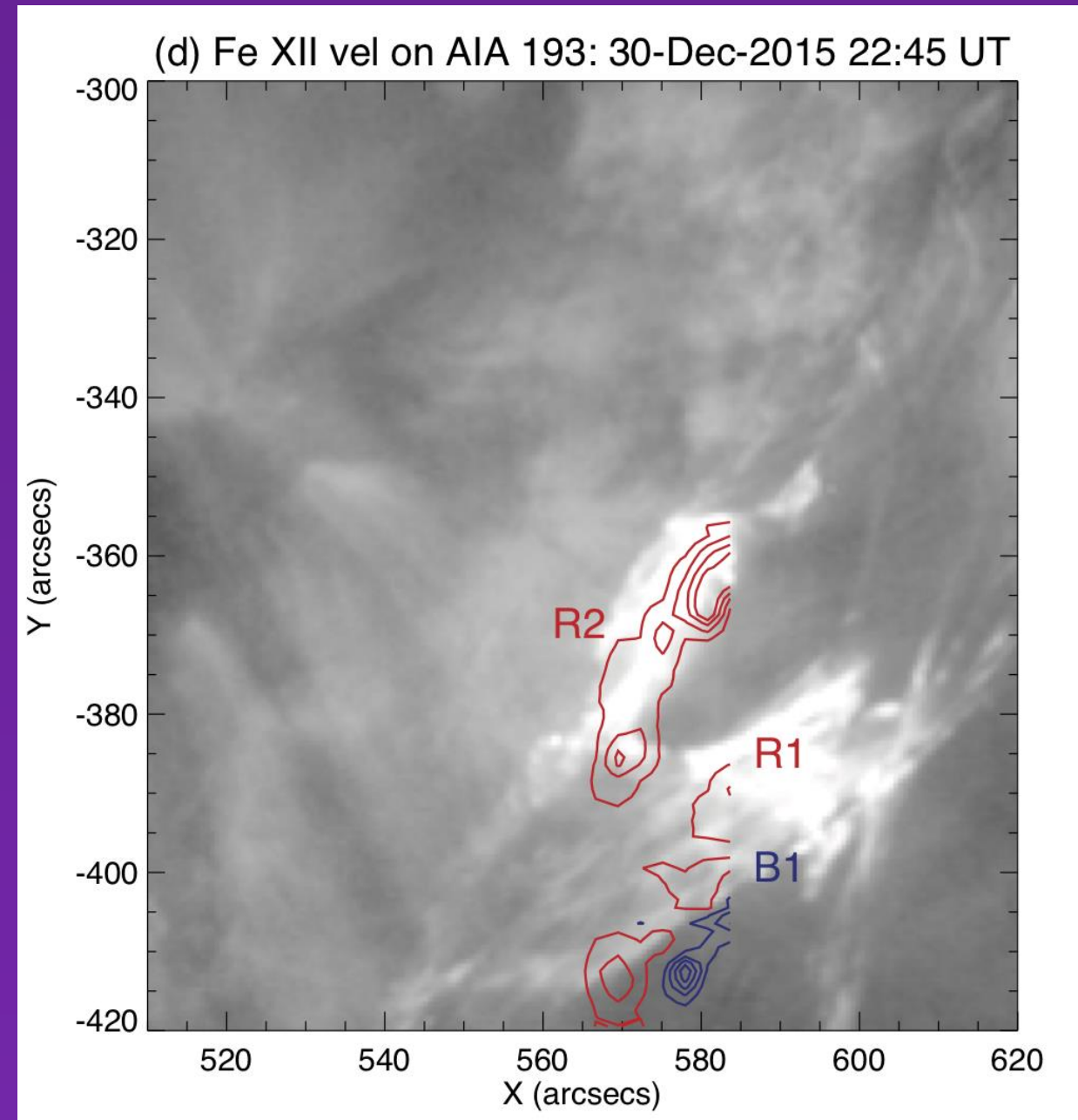
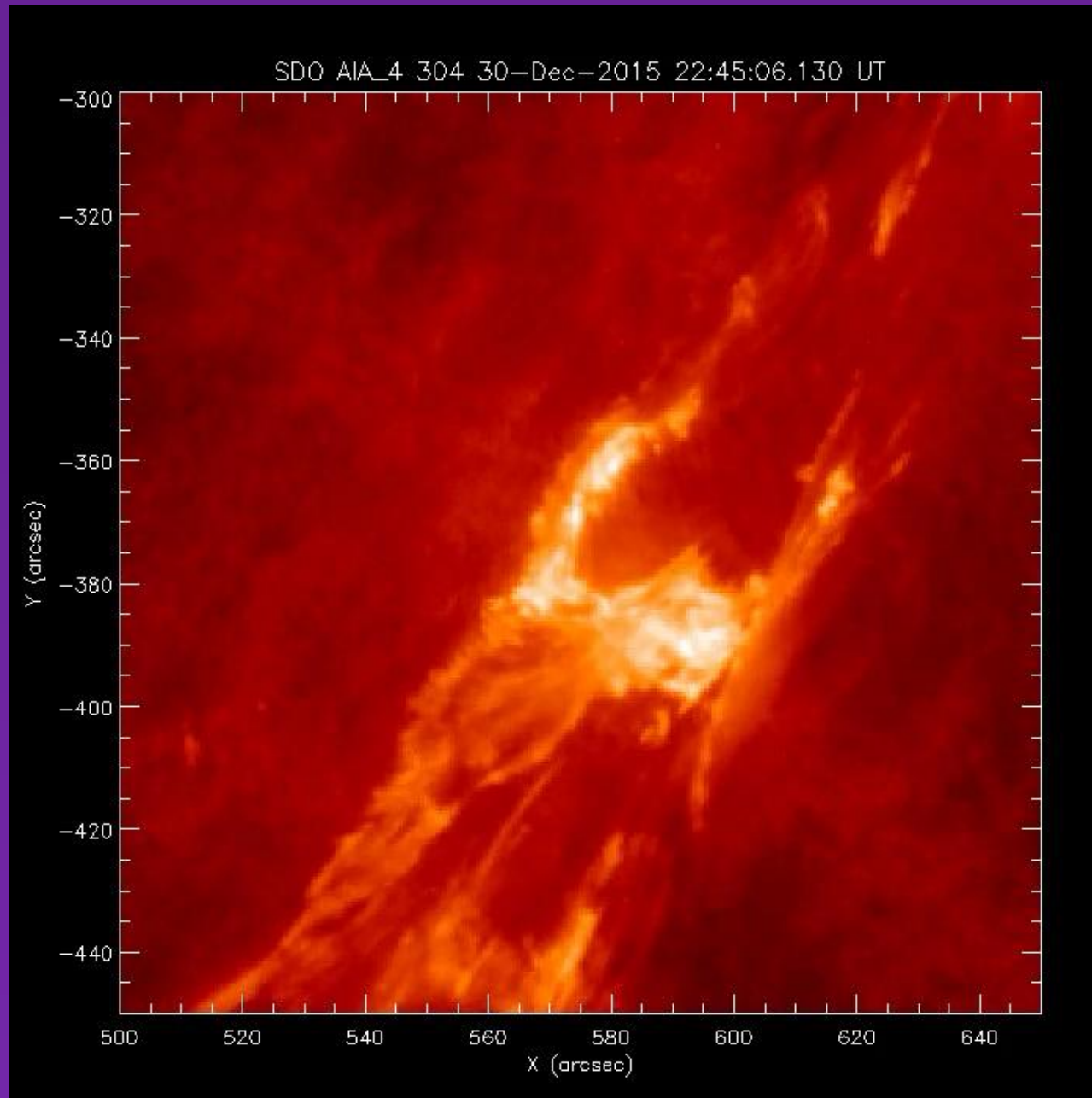


AIA 304

SDO AIA_4 304 30-Dec-2015 22:36:06.120 UT

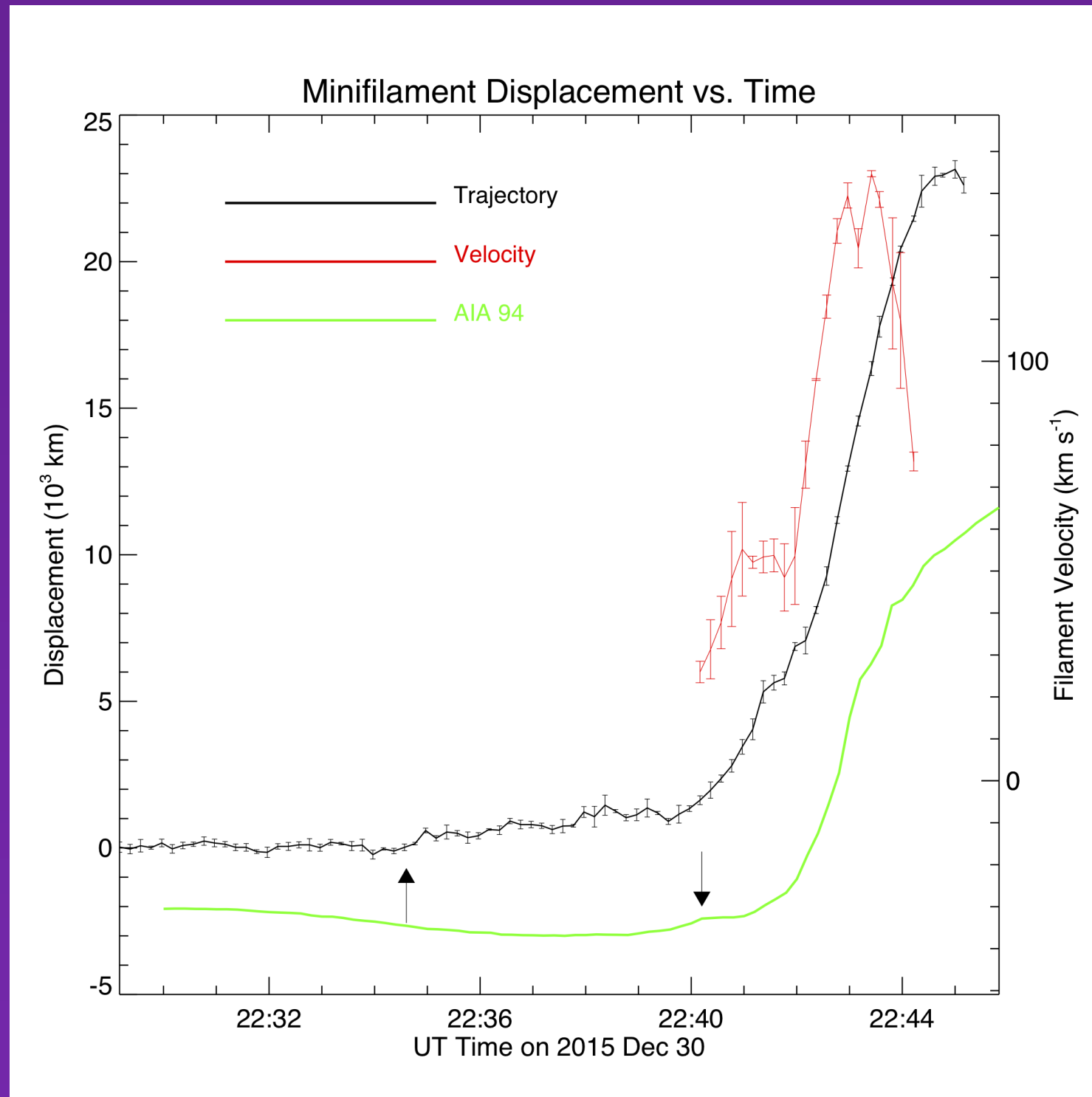


Dopper velocities from *Hinode*/EIS



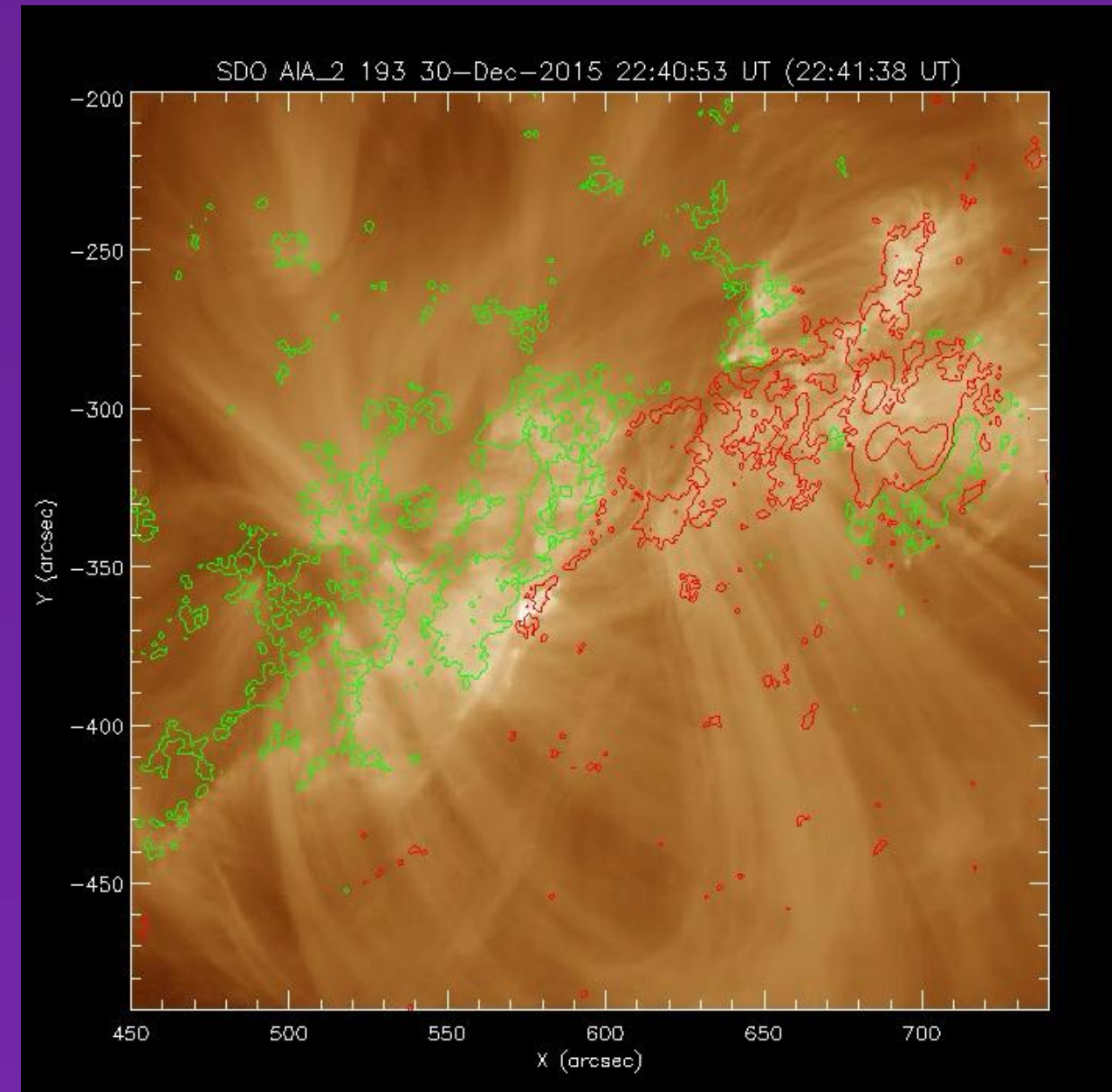
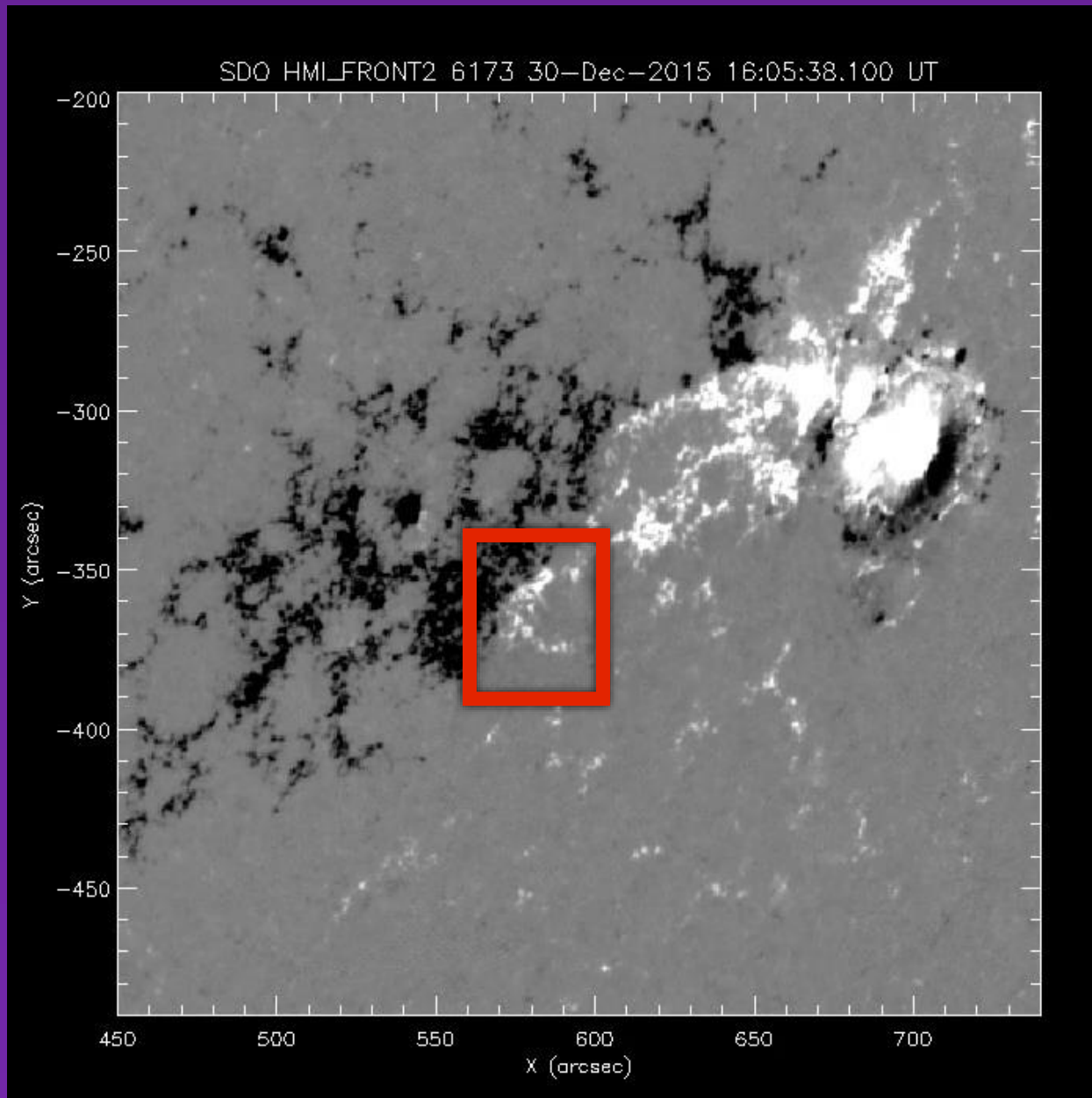
- R1 and B1: Either counter streaming or untwisting (e.g., Williams et al. 2009); ~ 40 km/s.
- R2: supra-arcade downflows (McKinzev, Savage; Warren); ~ 40 km/s.

Erupting minifilament trajectory and velocity

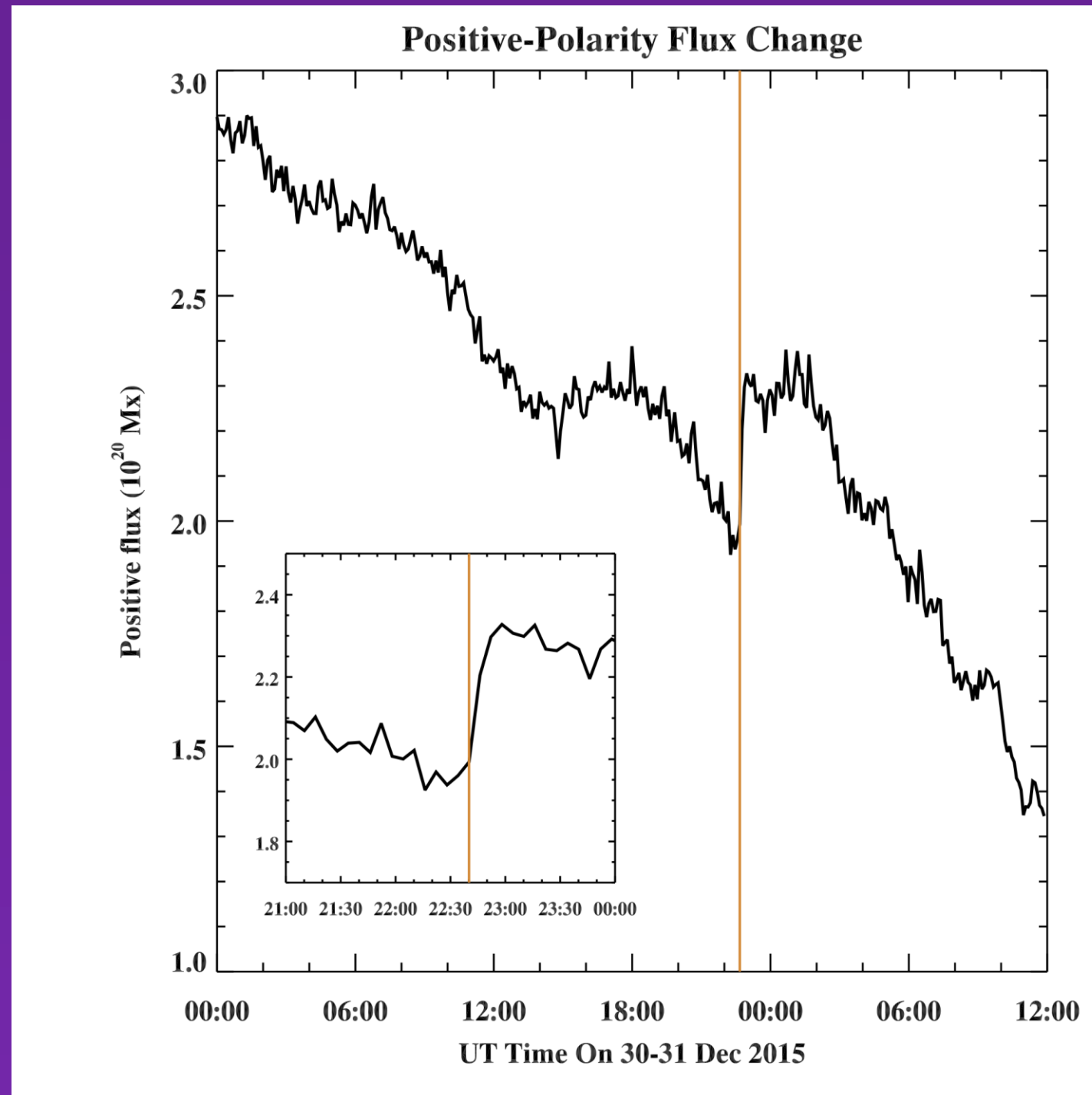


- Maximum upward-rising velocity, ~ 140 km/s
- "Altitude" (deprojected) of horizontal field: $\sim 30,000$ km.

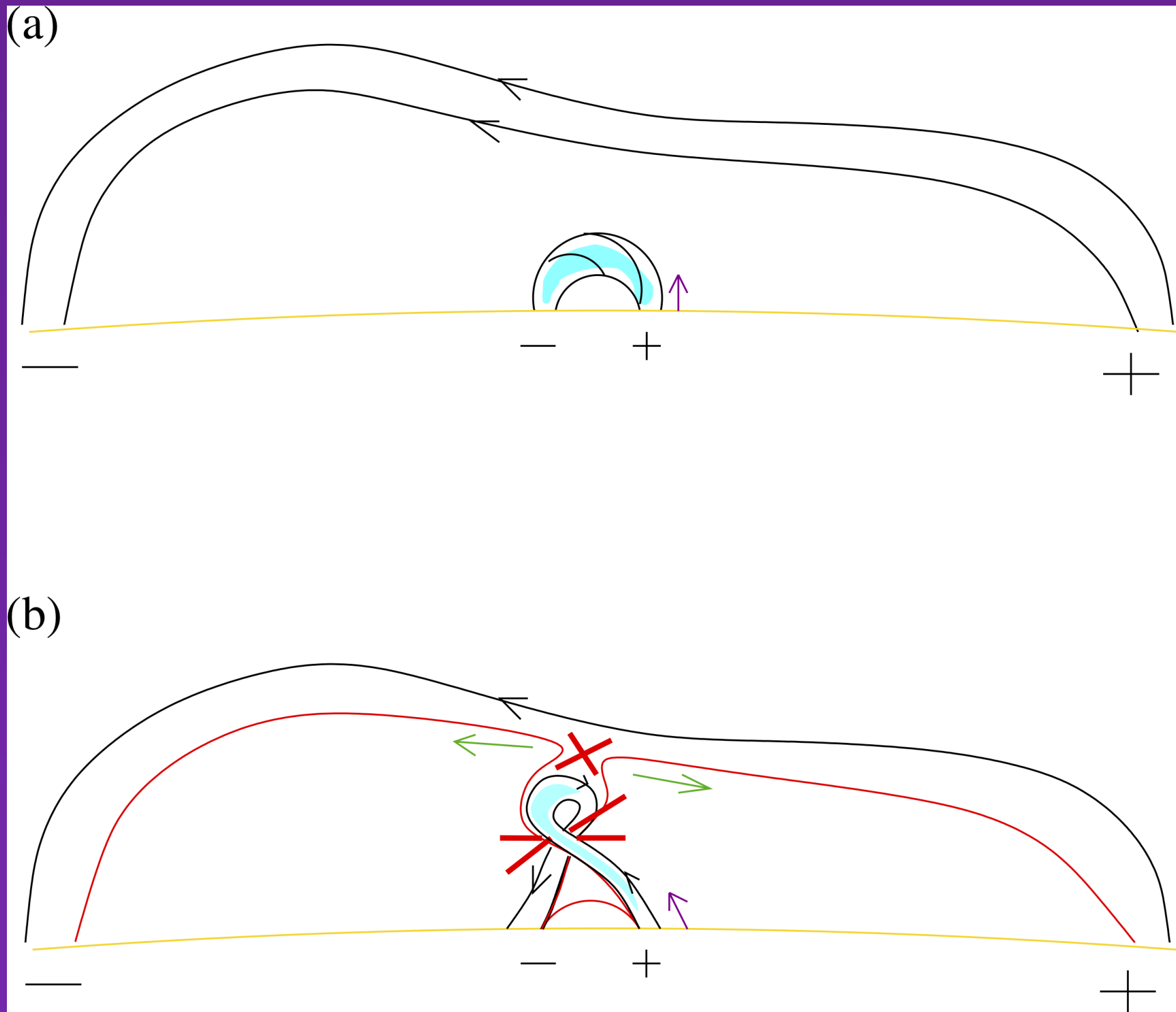
Magnetic field behavior (HMI)



Positive-polarity in box vs. time



Flux jumps up exactly at time of minifilament-eruption onset



Summary and Conclusions

- Observed a two-sided loop jet with Hinode and SDO.
 - Minifilament eruption leads to the jet.
 - “Miniflare” occurs at eruption site.
 - Flows along horizontal field (~ 40 km/s from EIS).
 - Eruption triggered by flux cancelation.
 - Flare-loop field “pointing” toward Earth.
- Just one event, but consistent with many single-spire jets:
***magnetic flux cancelation* \longrightarrow *minifilament eruption* \longrightarrow *jet*.**

(Details: Sterling, Harra, Moore, & Falconer 2019, ApJ)