Tracking Transition Region Network Jets to Coronal Structures

August 12, 2015

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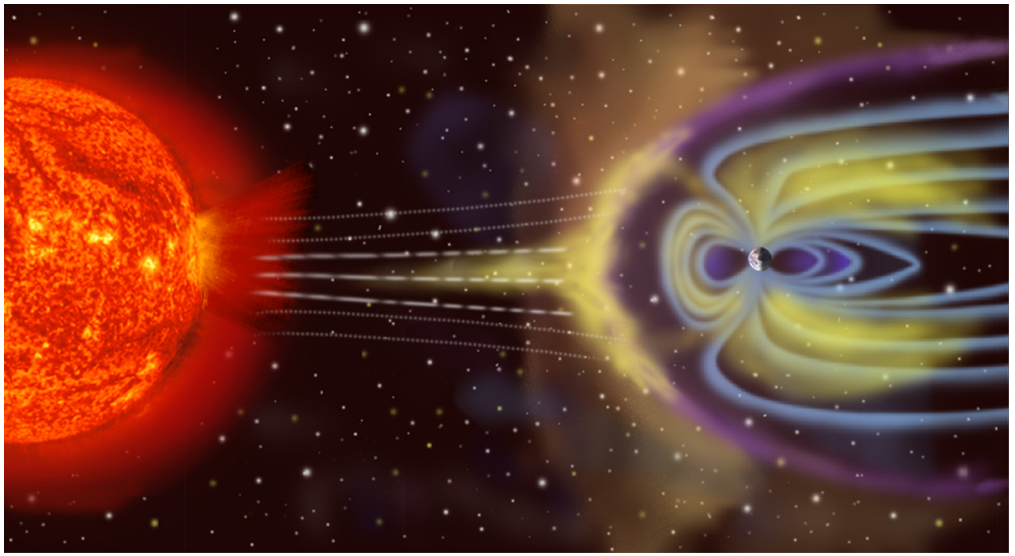
Outline

- Introduction
- Deriving parameters of the transition region network jets
- Tracking network jets to coronal structures
- Summary

Solar Wind

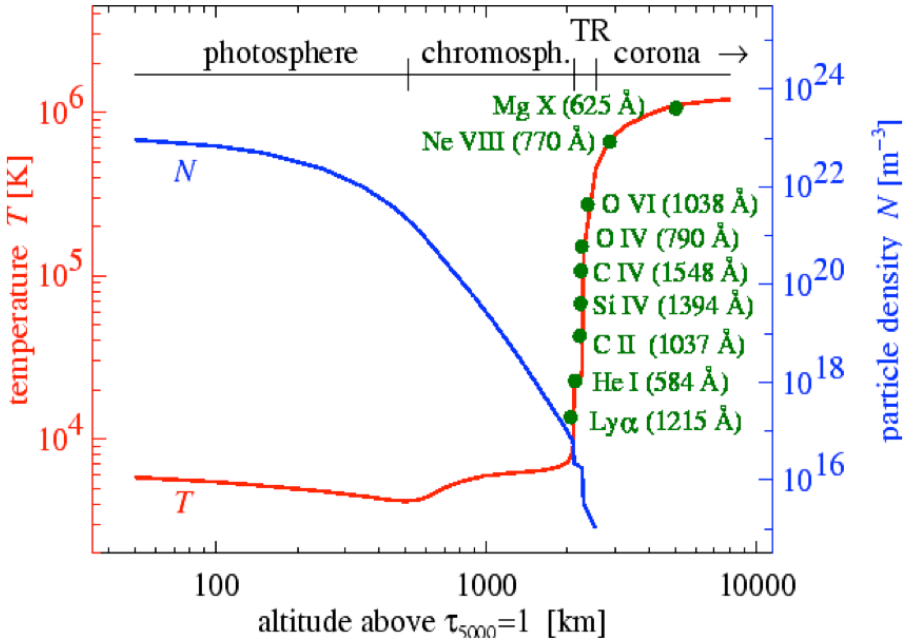
- Continuous stream of ionized particles emitted into interplanetary space
- Origin and acceleration mechanism are poorly understood



https://upload.wikimedia.org/wikipedia/commons/f/f3/Magnetosphere_rendition.jpg

Transition Region (TR)

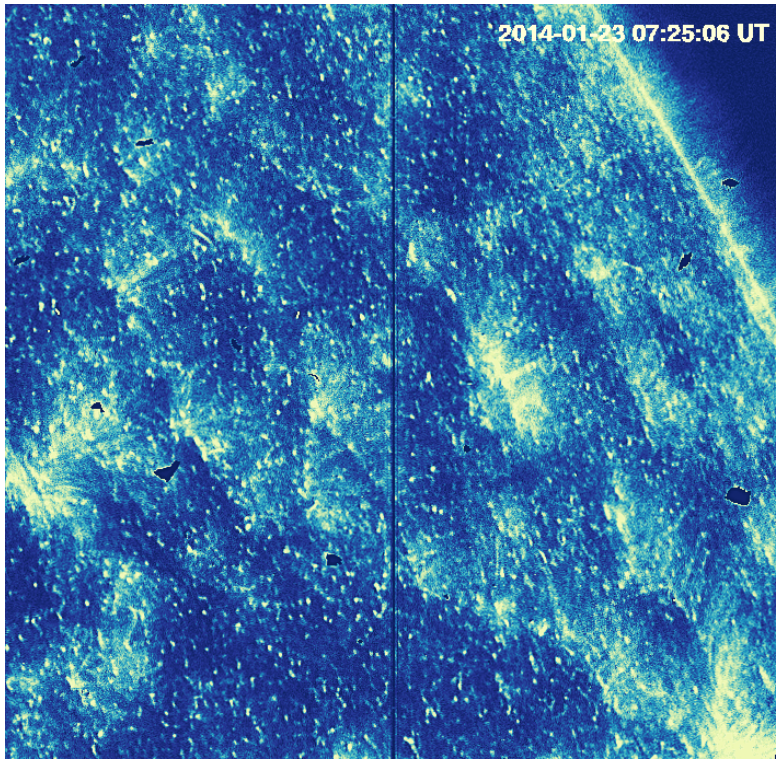
- Interface between the chromosphere and corona
- Dominated by network like emission and magnetic field structures
- Network lanes in the transition region of coronal holes have been suggested to be the origin site of the fast solar wind (Hassler et al. 1999, Science; Tu et al. 2005, Science)



Peter, 2004, Reviews in Modern Astronomy
Vernazza et al. 1981, ApJS

Transition Region Network Jets

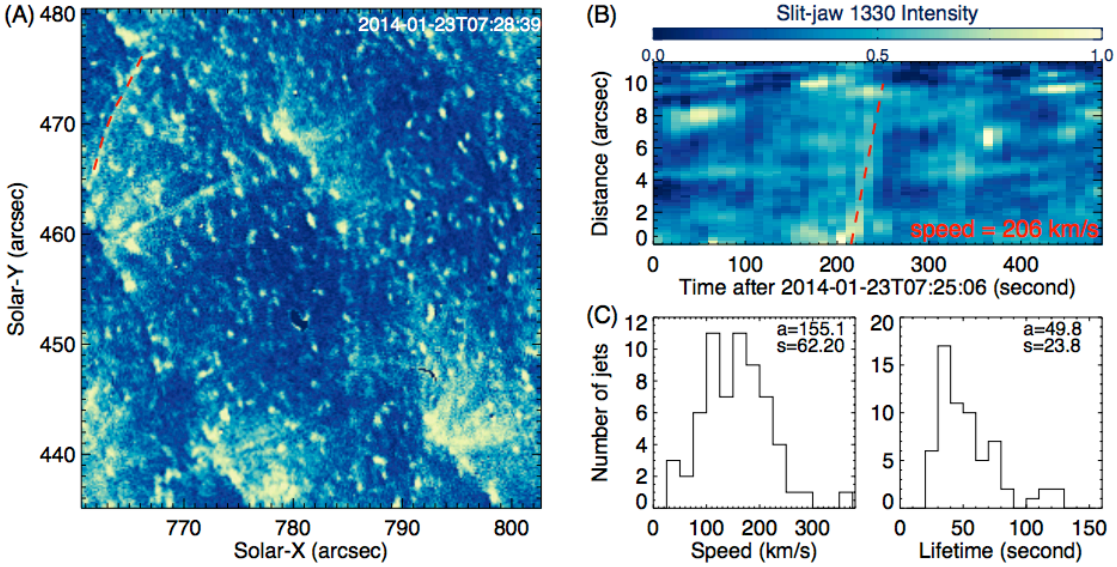
- Observations by the Interface Region Imaging Spectrograph (IRIS) reveal prevalent, intermittent, and small-scale jets from the network lanes (Tian et al. 2014, Science)
- These network jets may play a key role in supplying the mass and energy to the corona and solar wind



Tian, DeLuca, Cranmer, et al. 2014, Science, 346, 1255711

Transition Region Network Jets

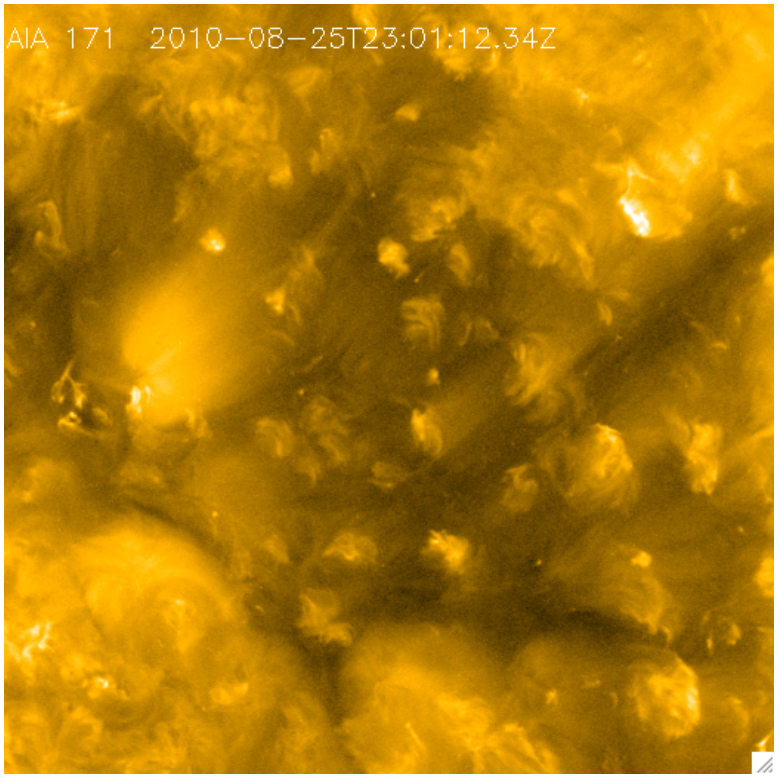
- Reach at least ~10^5 Kelvin
- Apparent speed 80-250 km·s^{-1}
- Lifetime 20-80 s
- Likely dominated by mass flows



Tian, DeLuca, Cranmer, et al. 2014, Science, 346, 1255711

Propagating Disturbances (PDs) along Plume-like Structures

- Discovered in 1997 by the EIT and UVCS instruments onboard SOHO satellite (Ofman et al. 1997; DeForest & Gurman 1998)
- Speed 70 – 180 km·s^{-1}
- Debate on the nature of PDs
  - Upward propagating slow magneto-acoustic waves (Ofman et al. 1999, Krishna Prasad et al. 2011, Gupta et al. 2012, Uritsky et al. 2013, et al.)
  - Mass flows (McIntosh et al. 2010, Tian et al. 2011, Pucci et al. 2014, et al.)



Tian et al. 2011, ApJ. 736, 130

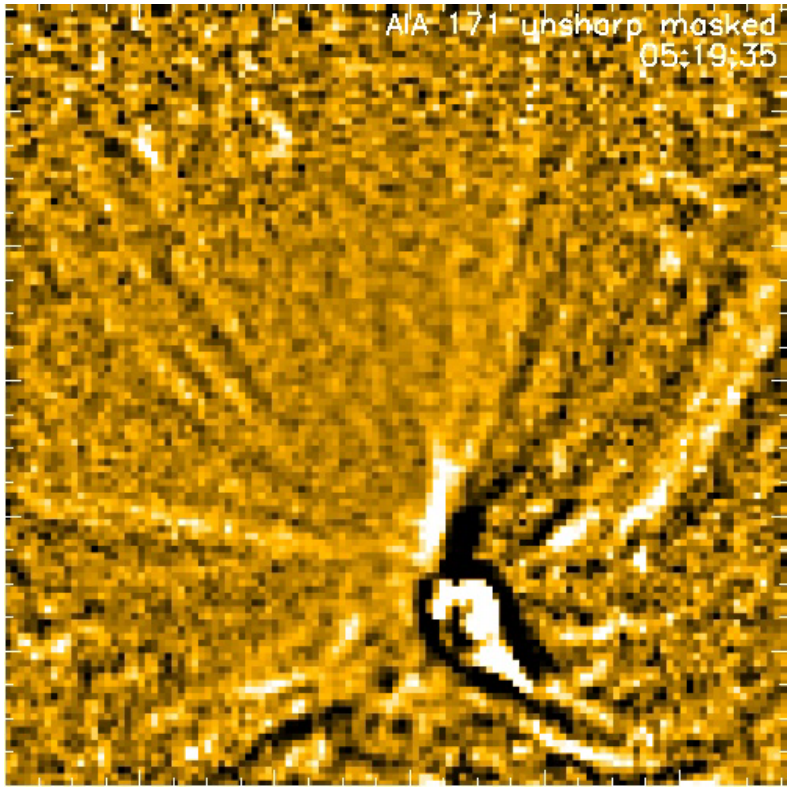
Goals

1. Identify possible connections between network jets and PDs

2. Determine if these network jets play an important role in providing heated mass to the corona and solar wind

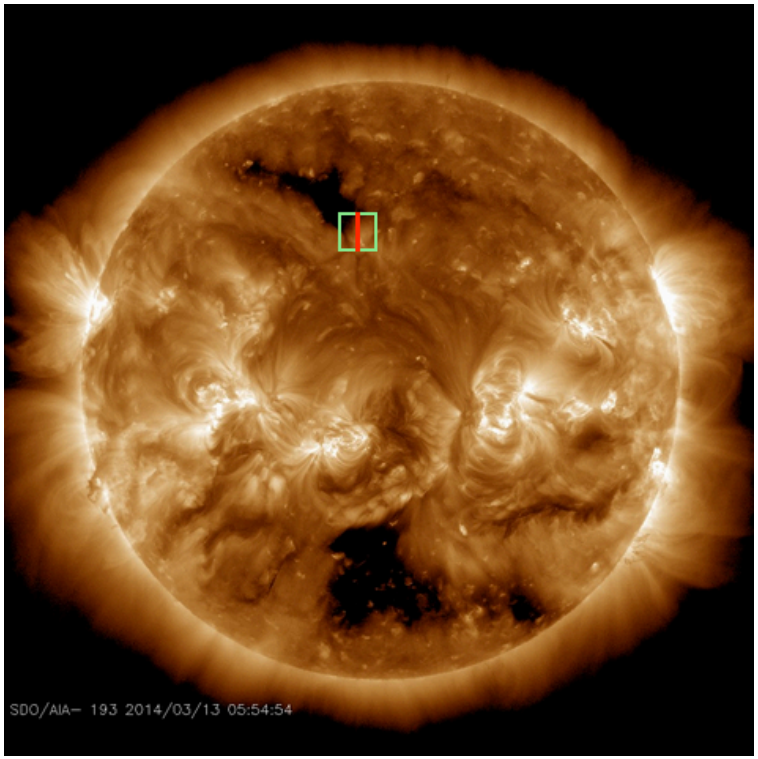
Atmospheric Imaging Assembly (AIA) Observation

- AIA provides full-disk imaging of the solar atmosphere
- Target: PDs along a Coronal Hole Plume
- AIA 171 Å samples
  (1) Coronal emission
  (2) TR emission
- PDs may be features with coronal or TR temperatures



IRIS Observation

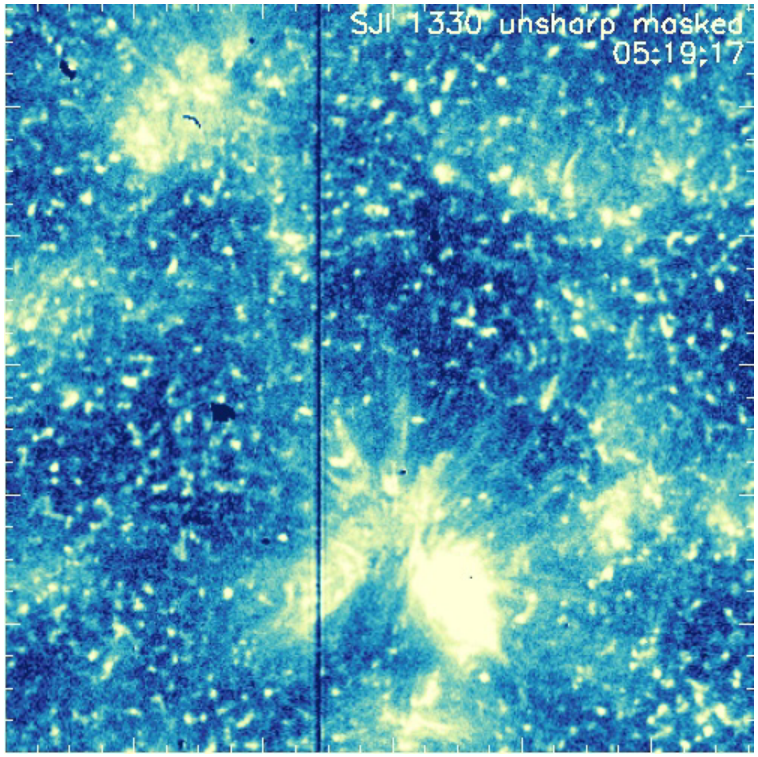
- IRIS provides imaging and spectroscopic observations of chromosphere and TR
- High-resolution imaging of a coronal hole at 1330 Å
- Unsharp masked images showing the network at the base of the plume



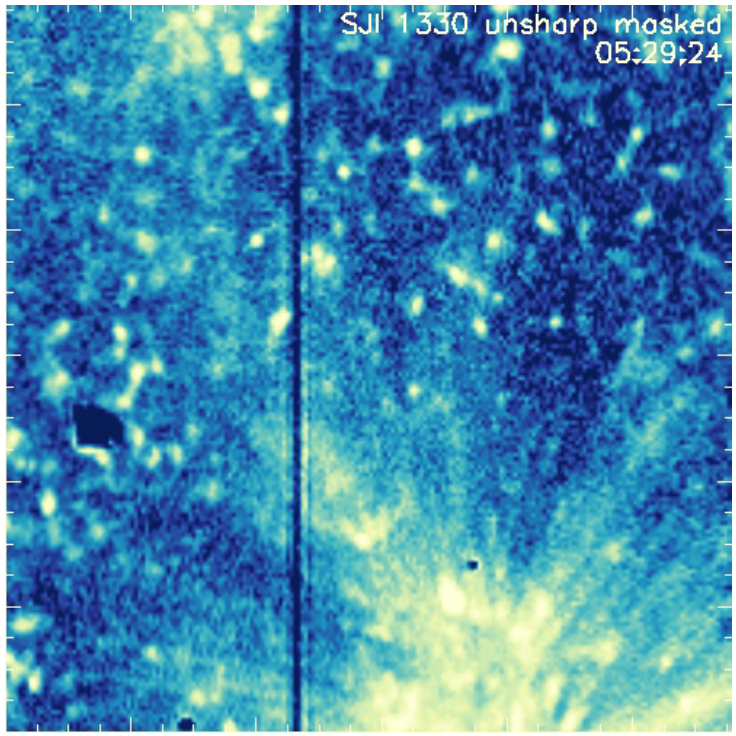
http://iris.lmsal.com/search/

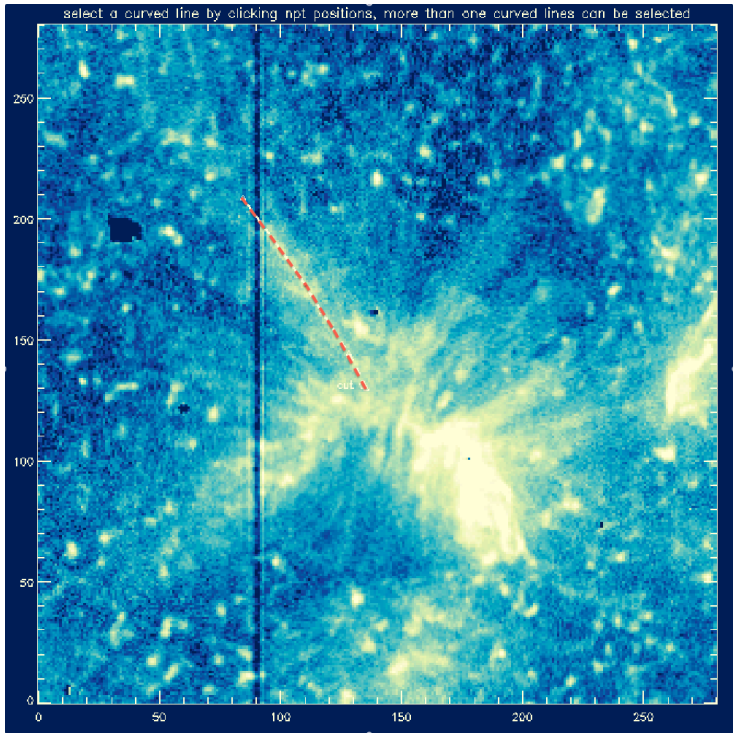
IRIS Observation

- Sit-and-stare observation
- Only use slit-jaw images (SJI) in this project
- Observation date: March 3, 2014
- Field of view: 119”×119”
- Cadence: 5s

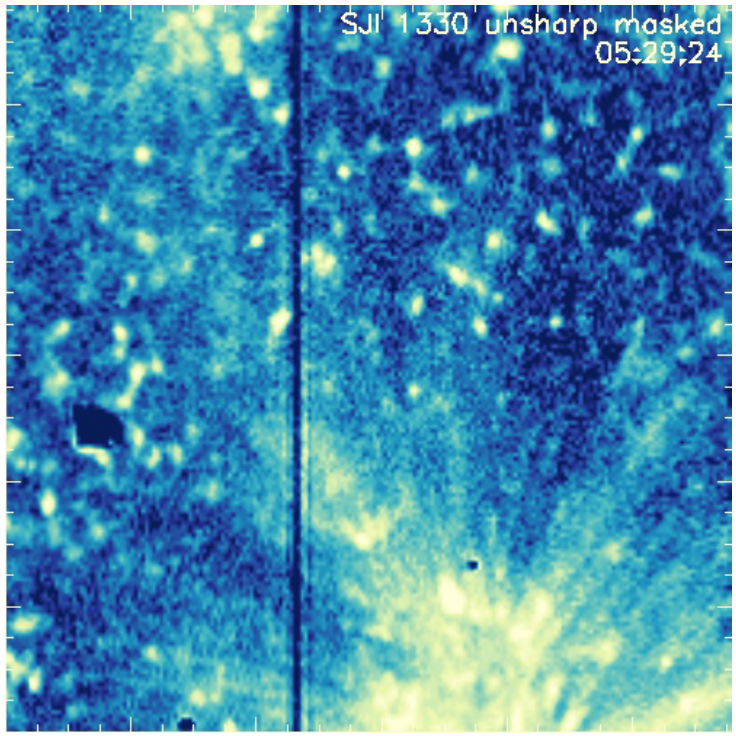


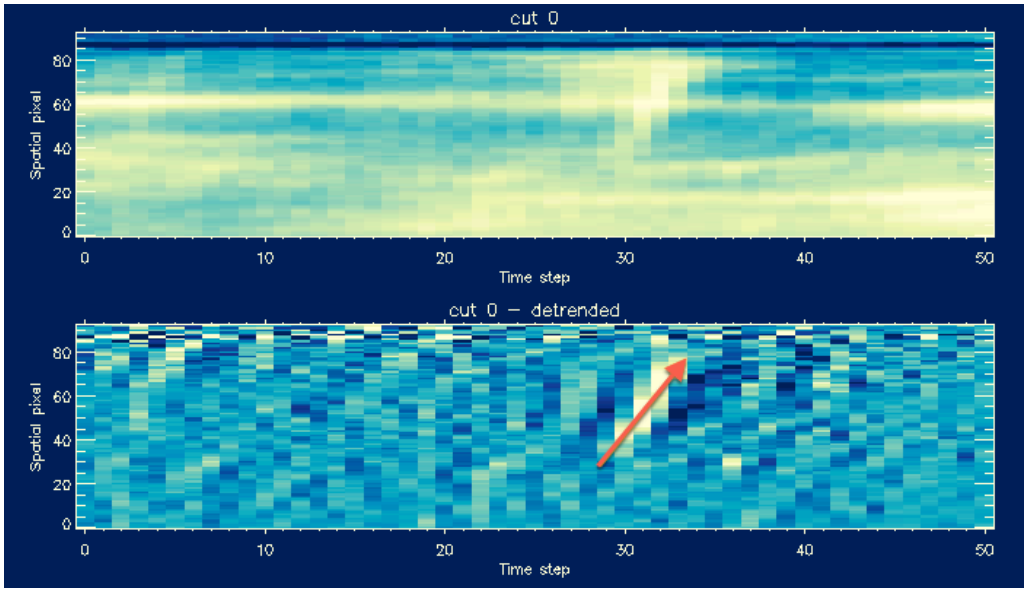
Tracking Network Jets



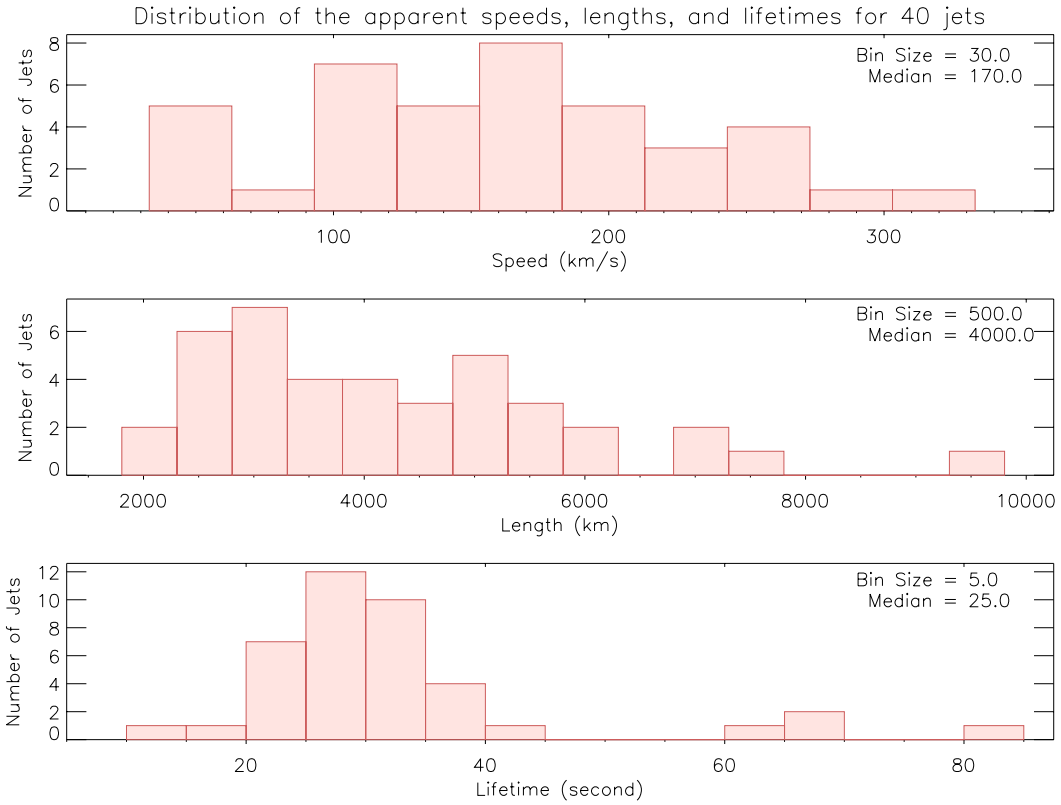


Tracking Network Jets



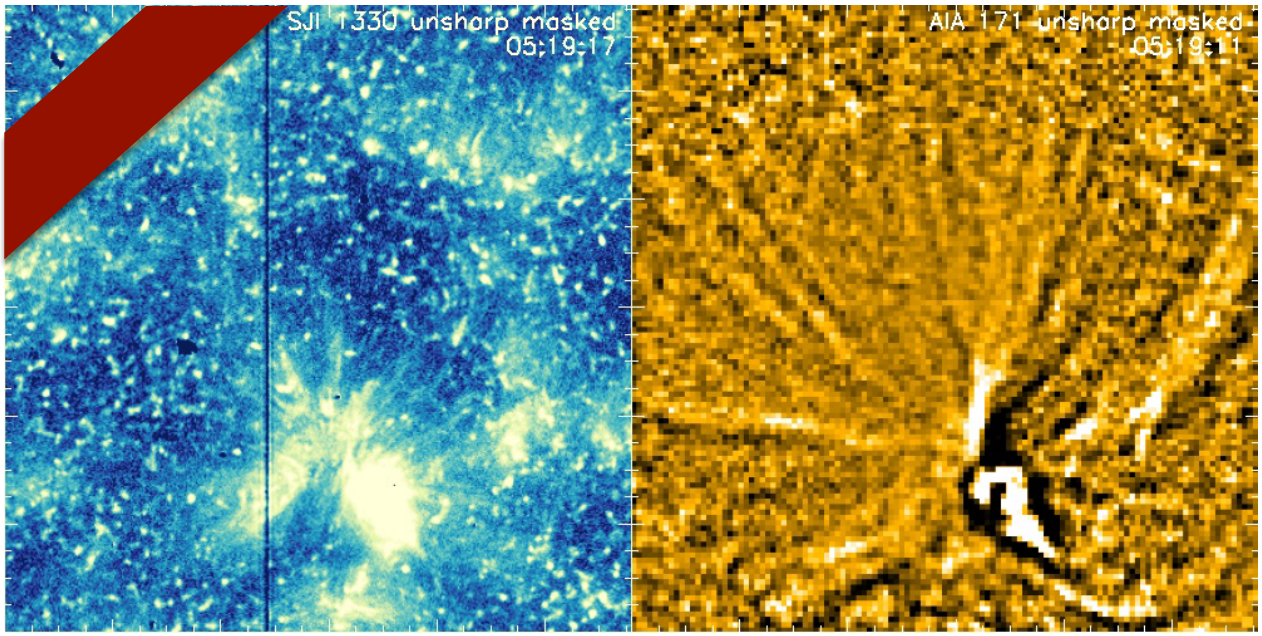


Histograms of Jet Parameters



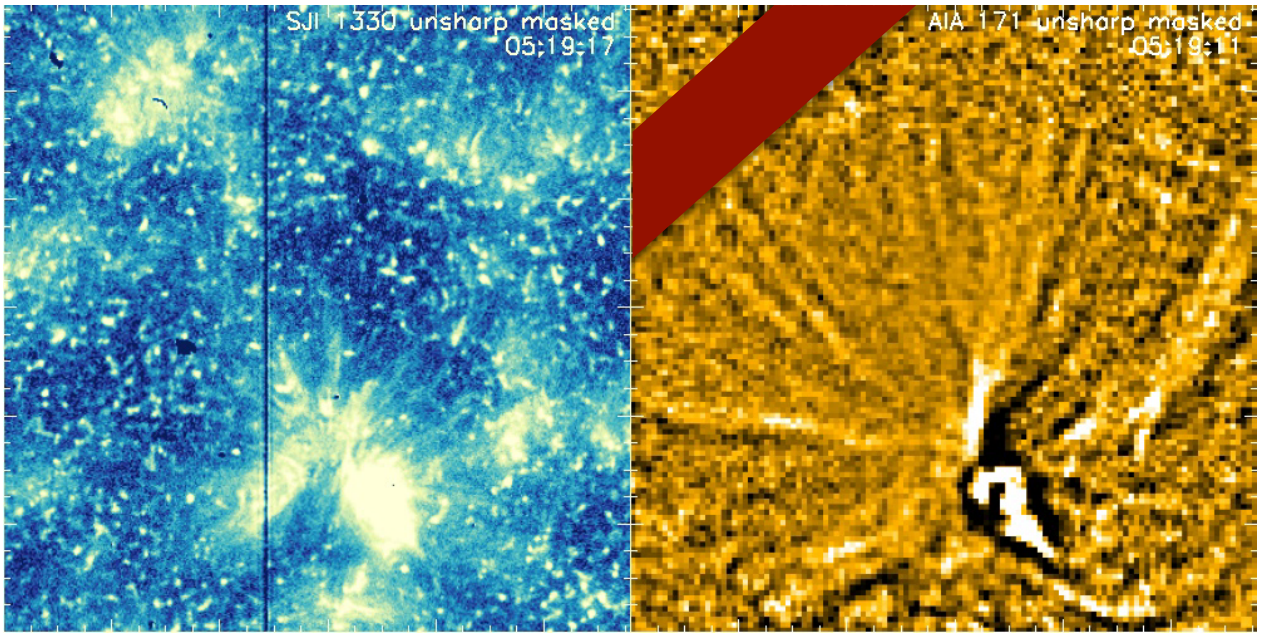
Searching for a Connection

- IRIS network jets are most likely dominated by TR mass flows (Tian et al. 2014; Pereira et al. 2014; Rouppe van der Voort et al. 2015)

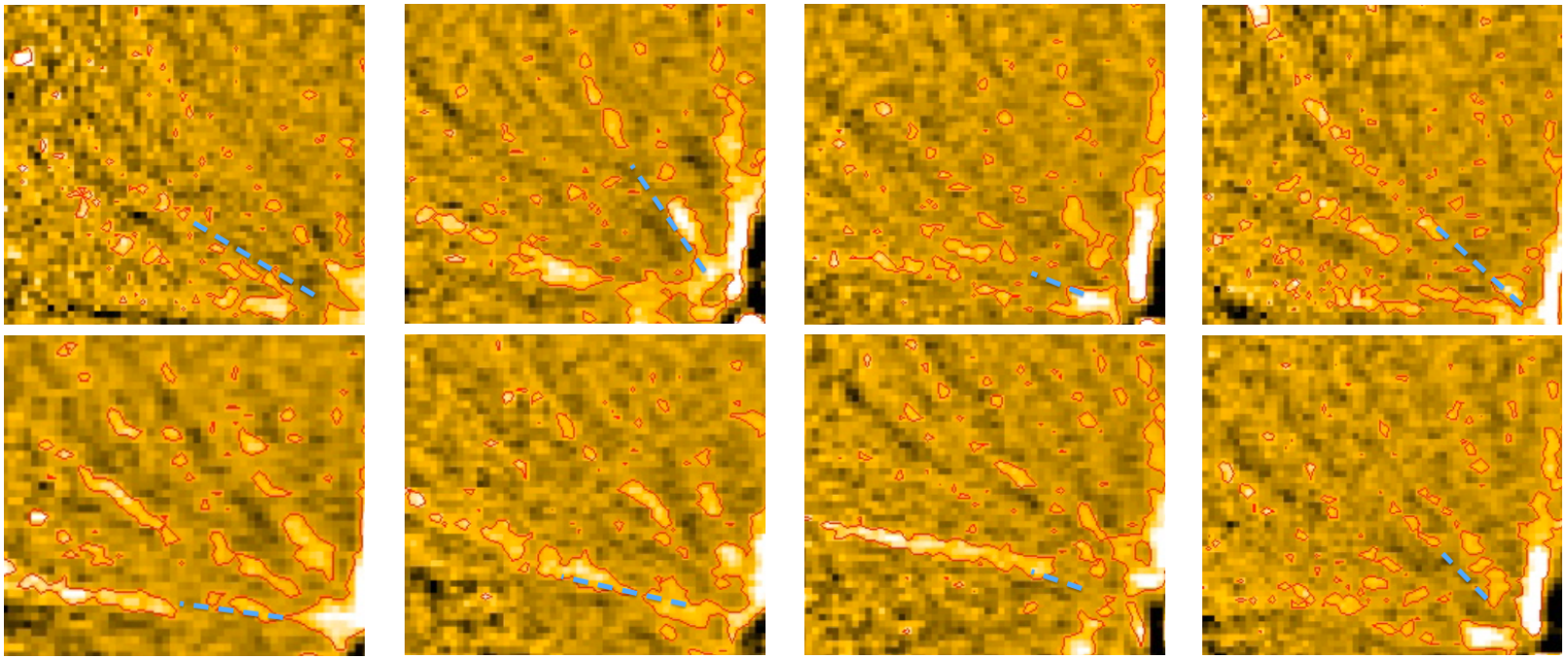


Searching for a Connection

- AIA PDs could be:
  - TR mass flows
  - Coronal mass flows
  - Slow magneto-acoustic waves propagating in the corona



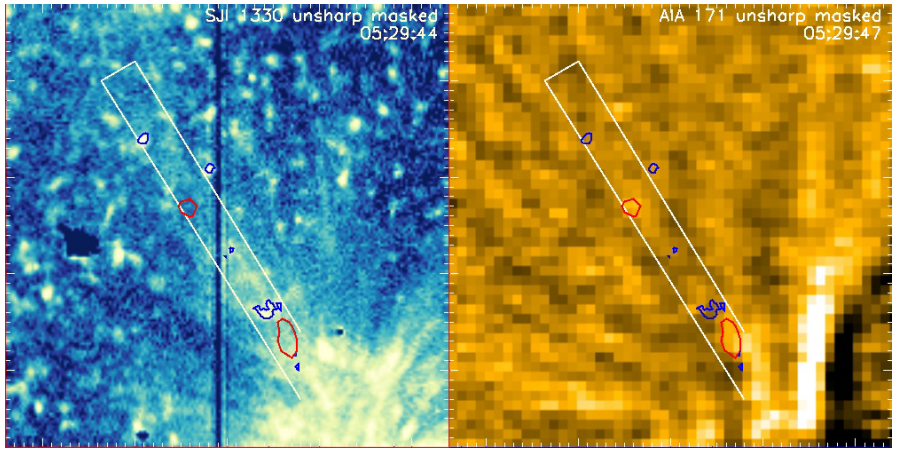
Spatial Correlation



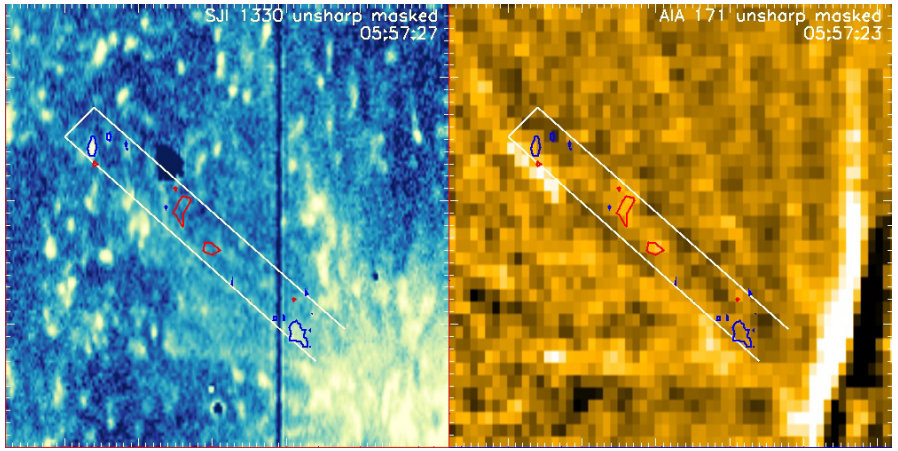
Network jets and PDs usually propagate in the same directions, suggesting that they are likely propagating along the same magnetic structures

Continuation

Example 1:



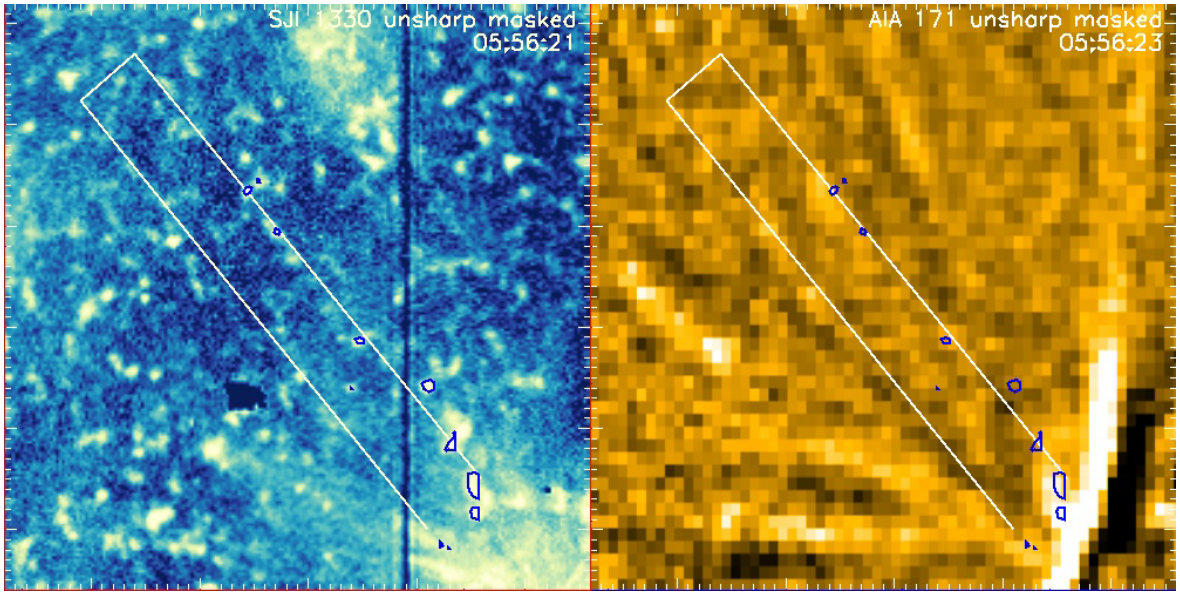
Example 2:



Majority of the IRIS 1330 Å network jets are continued with AIA 171 Å PDs

- Excludes PDs as TR mass flows
- Inconclusive if PDs are coronal mass flows or slow magneto-acoustic waves

Absence of a Network Jet



Some strong AIA 171 Å PDs do not show any jet signature in IRIS 1330 Å: Jets too weak to be observed with IRIS?

Summary and Future Work

- We found a clear connection between TR network jets and coronal PDs
- Supports the idea that network jets may play an important role in the mass and energy budget of the hot corona/solar wind
- This connection suggests that the PDs are either continuations of TR mass flows or waves triggered by TR mass flows
- Solar Orbiter will reveal more insight: Doppler shift of coronal lines measured by SPICE will tell us
  - (1) if PDs are mass flows or waves
  - (2) if all network jets are heated to coronal temperatures

Acknowledgements

- I'd like to thank my mentors Hui Tian and Chad Madsen for taking me on for the summer
- Kathy Reeves, Henry (Trae) Winter, and all the other REU organizers
- The other REU interns for being stellar
- This work was supported by the NSF-REU Solar Physics Program at SAO, grant number AGS 1263241; NASA grant NNX15AF48G; and by the IRIS contract 8100002705 from Lockheed-Martin to SAO

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- Tu et al. 2005, Science, 308, 1109447
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Doppler shifts

- Dopplergram of Ne VIII 770Å in a quiet Sun region (Tian et al. 2009).