Observations of nanojets in multi-structures and from different drivers: from KHI-driven reconnection in a blowout jet to coronal rain loops

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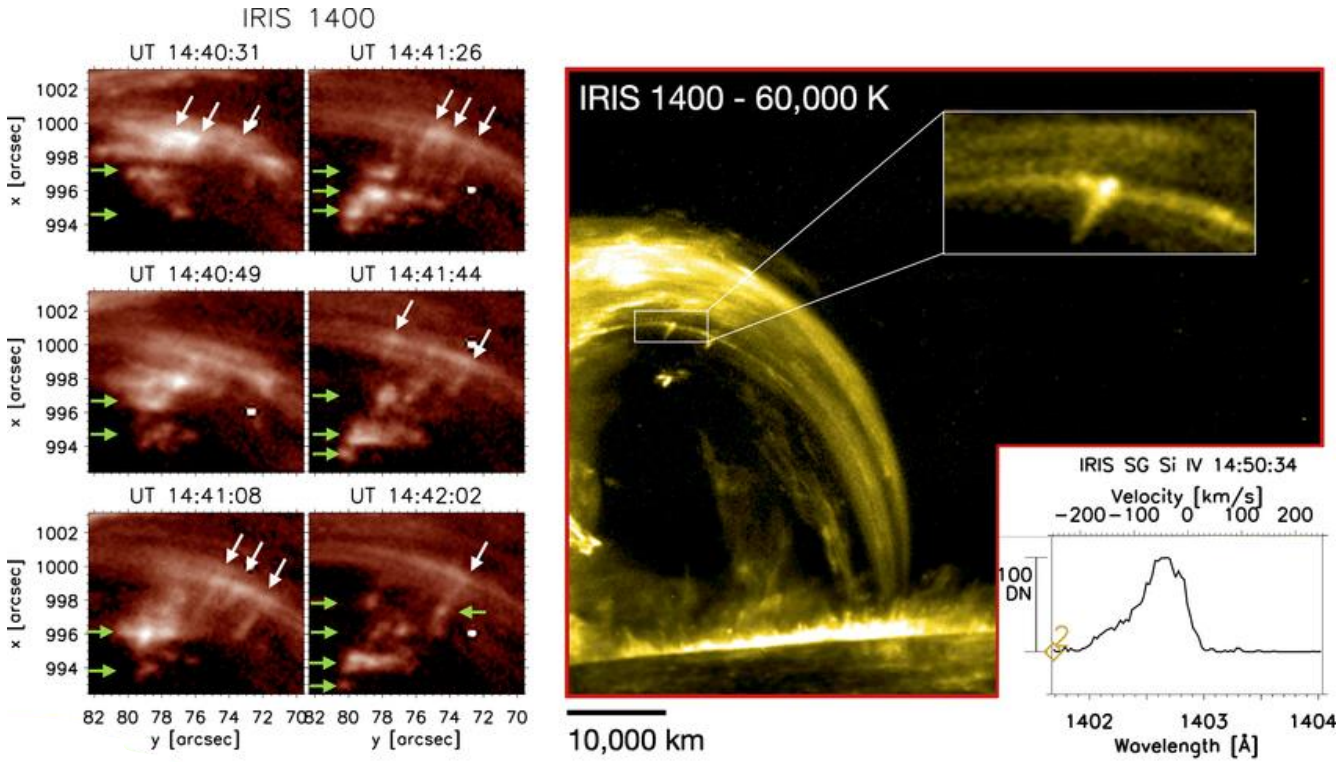
Background: Reconnection Nanojets in the solar corona (Antolin et al. 2021, see poster talk)

- Nanojets are small scale and short lived perpendicular bursts.
- Formation due to the misalignments of field lines.
- The nanojet's driver in this observation is from a nearby prominence becoming unstable.



Antolin et al. (2021)

Videos of the figures are also available and included in the powerpoint version.

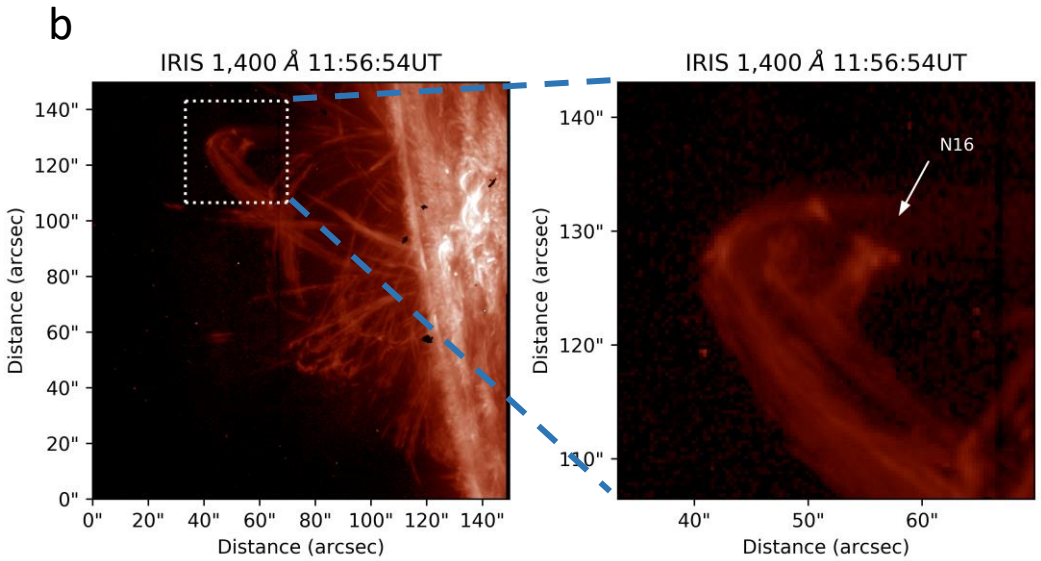
Nanojet Observations

In this work: Observations from IRIS and AIA, a blowout jet and loops with coronal rain.

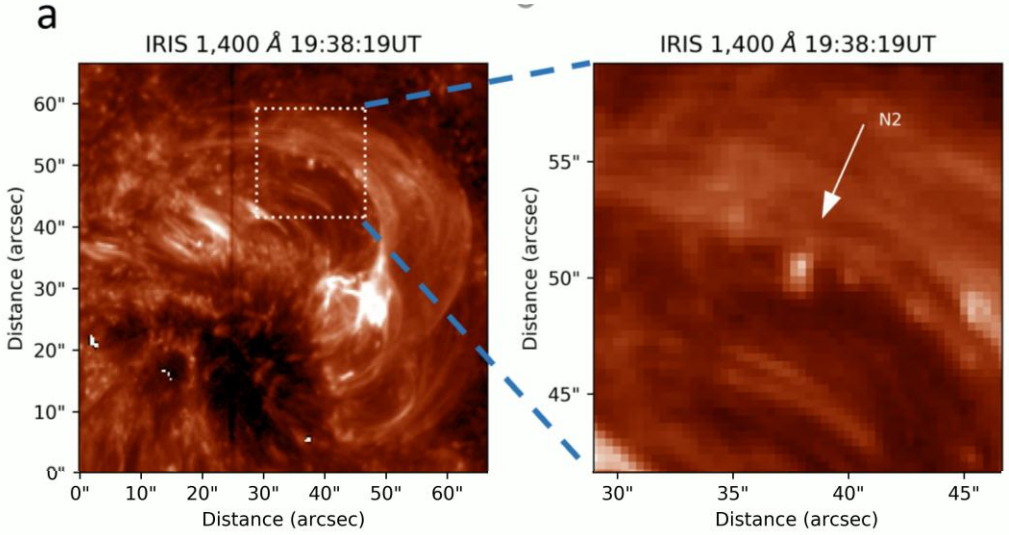
Nanojet signatures:

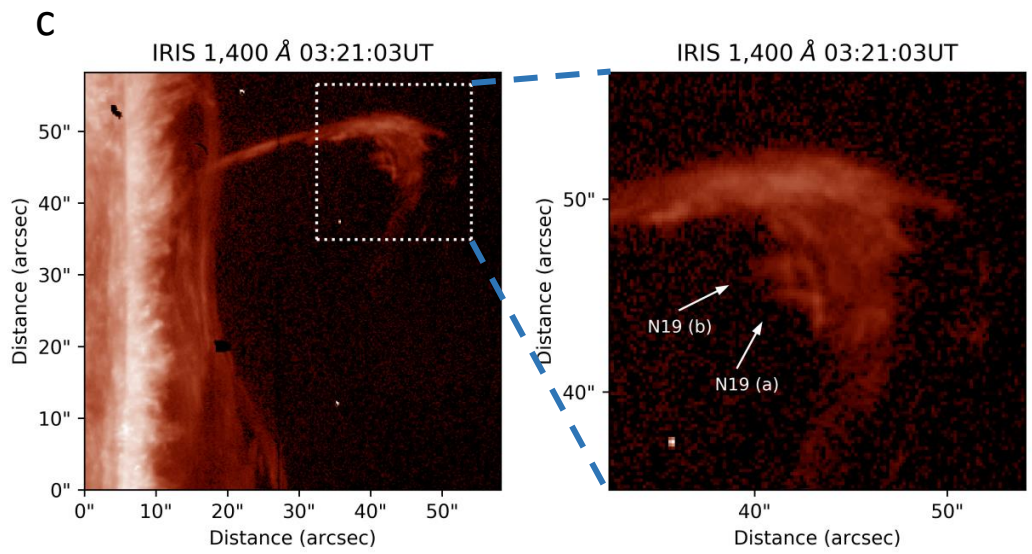
- Small bursts ejected perpendicular to the field with velocities of ~100 km/s
- Mostly seen in the structure's edges
- Found in curved regions (e.g., apex of the loop)

Loops with coronal rain (b & c)



Blowout jet (a)





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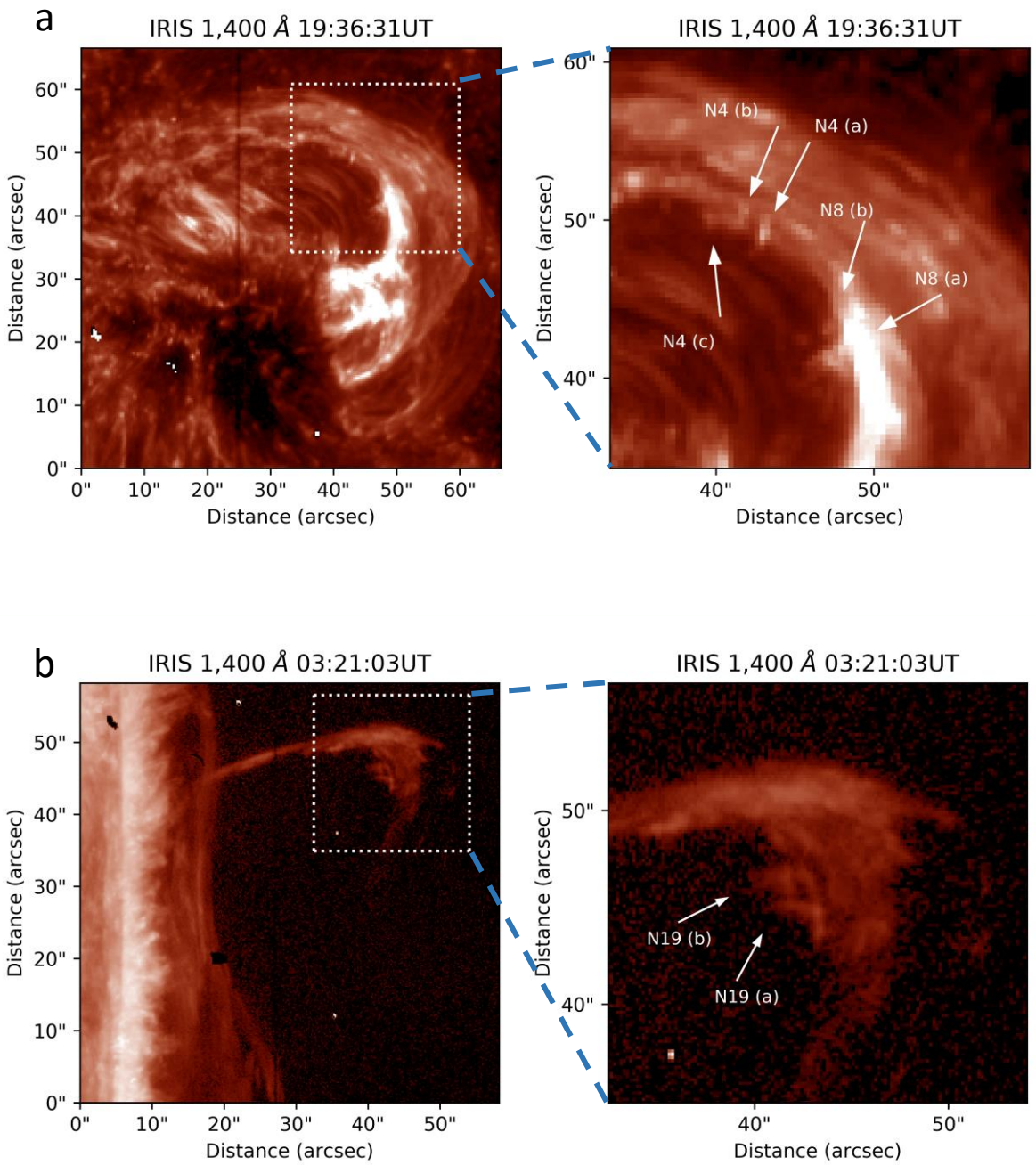
Cluster Nanojets

Nanojets occur as individual events and in clusters.

- Cluster nanojets: Multiple nanojets that occur neighbouring each other.
- Occur less than 1500 km apart at similar times (less than ~ 10 s apart from one another).

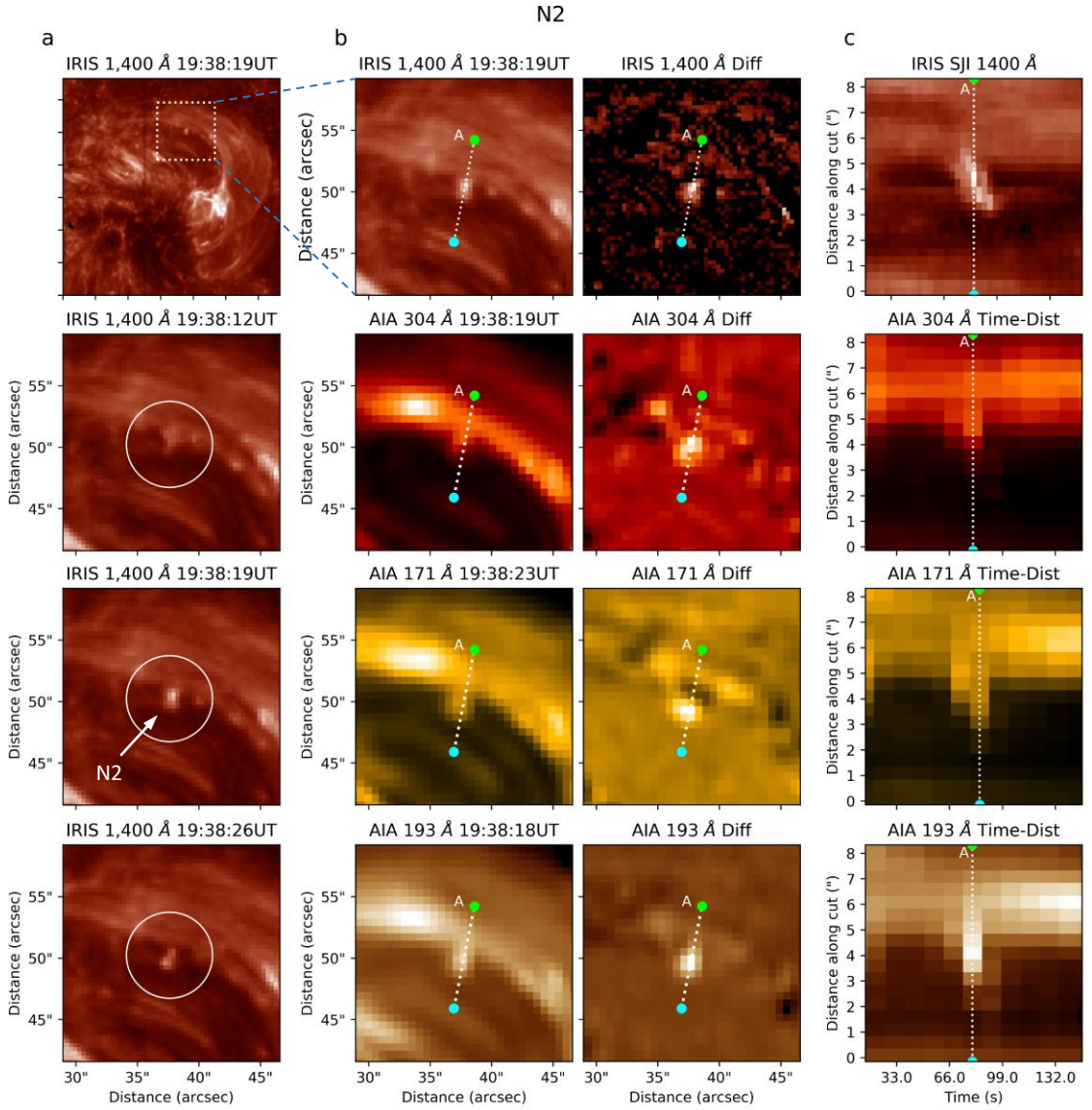
Left: Cluster nanojets linked to the blowout jet (a), showing cluster N4 containing 3 nanojets and N8 containing 2 nanojets. (b) shows cluster N19 with 2 nanojets in the loop-like structure.



Nanojet linked to the blowout jet: Different channels

- Nanojets seen in IRIS and AIA observations.
- Clear signatures often found in IRIS 1330 Å, 1400 Å, 2796 Å, and AIA 304 Å.
- Fainter signatures in all other AIA channels except for 1700 Å where no signatures are found.
- This may indicate that nanojets are multithermal.

Left figure: An example of a nanojet where the signatures are seen in different channels.

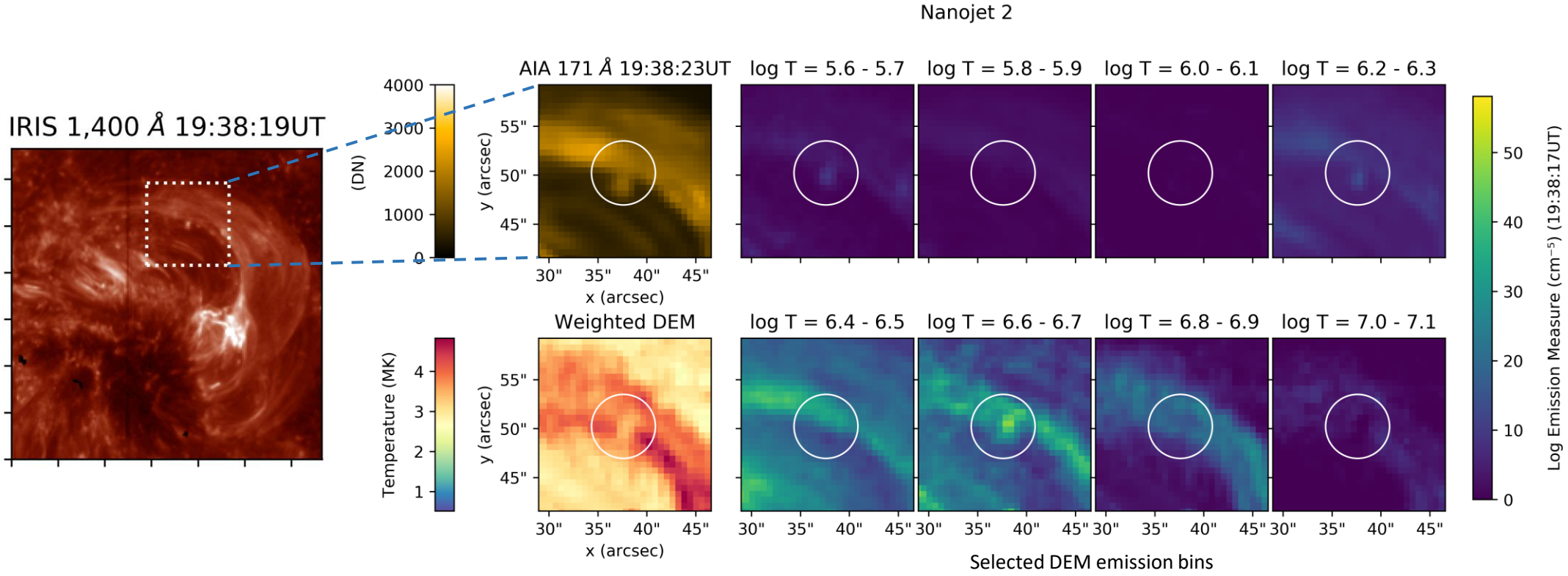


Above: Snapshots of a nanojet found in the blowout jet from IRIS and AIA. Column (a) shows the time evolution of the nanojet, with the first image (top) showing the location of the nanojet in the blowout jet. The two columns (b) shows snapshots of the nanojet when it is most visible in IRIS and AIA (left column) and its time differece (right column). Column (c) shows the time-distance diagram of the slice taken in the images from column (b).

Temperature and Number Density

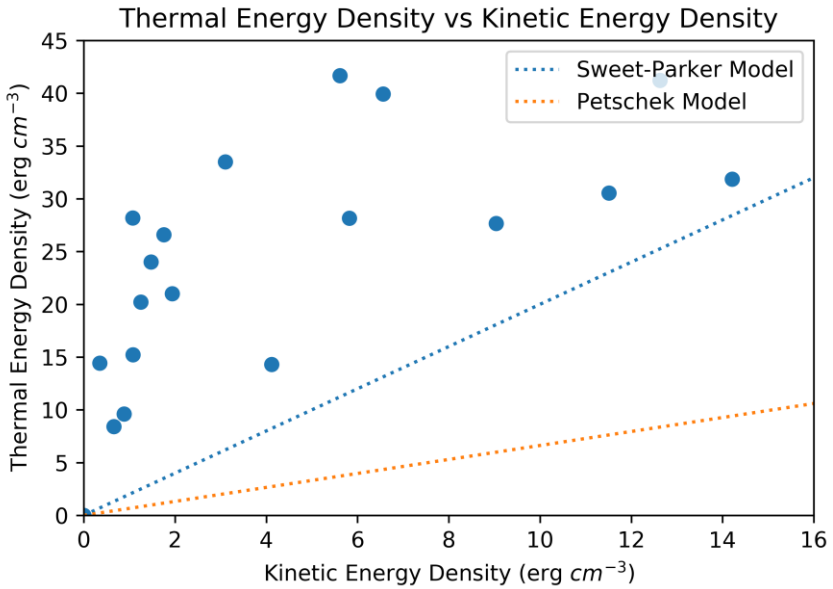
Using Differential Emission Measure (DEM) Analysis (Cheung et al. 2015), basis pursuit method

- Emission seen in the temperature bins 5.5, 5.6, 6.2, and 6.6
- Mean nanojet temperature: 3.3 MK
- Mean nanojet number density: 1.64 x 10^{10} cm^{-3}

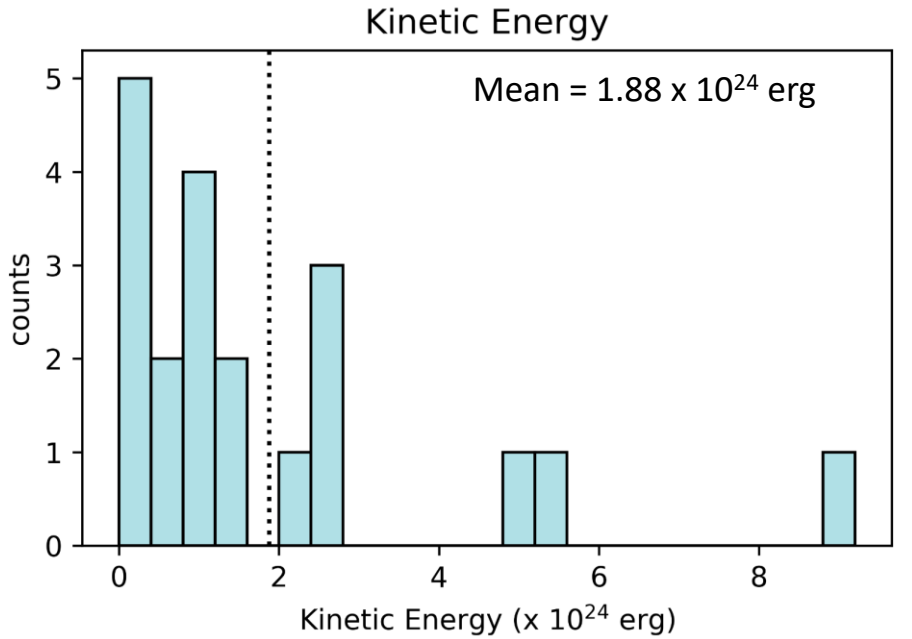


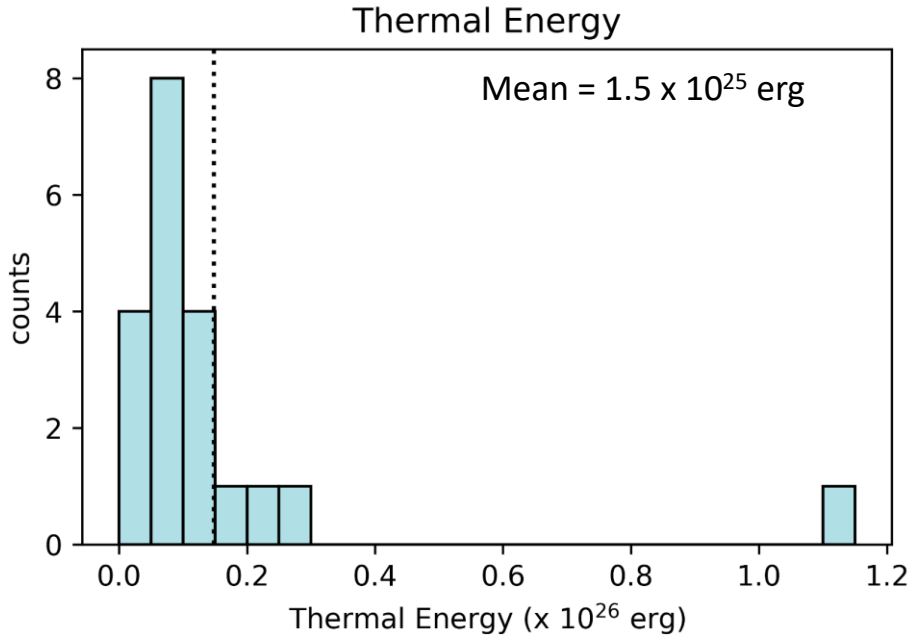
Kinetic and Thermal Energies

- Using values from the DEM analysis to calculate the kinetic and thermal energies
- Average length: 1816 km, average width: 621 km
- Timescales: < 30s



Above: Distribution of kinetic and thermal energy densities of the nanojets compared to the Sweet-Parker and Petschek Model. We were only able to obtain the projected velocity values for the energy calculations, which does not include the doppler velocity component. If we have included the doppler velocity component, then it is likely that we have a larger value for the velocity which may shift the distribution closer to the two models.

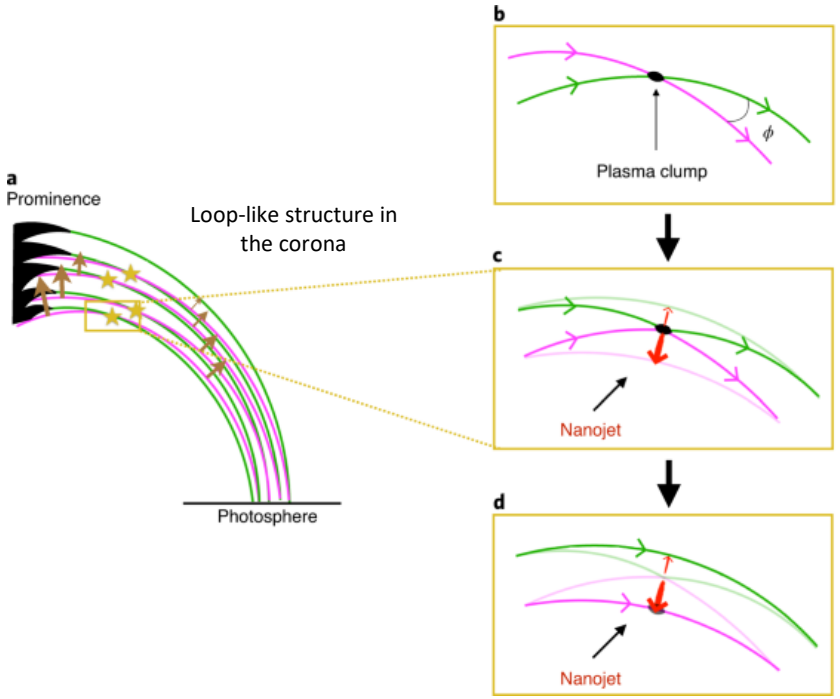




Discussions and Conclusion

- Our findings align with Antolin et al. (2021).
- Nanojets may be a product of episodic small-scale reconnections from small field misalignments.
- Blowout jet: KHI observed in structure (Li et al. 2018). Nanojets -> a result of the field twisting and braiding from the KHI vortices.
- Other similar small-scale bursts reported by Testa et al. (2013, 2014), or minijets by Chen et al. (2020), possibly related to nanojets.

<u>Still unknown:</u> How common nanojets are, the role of other instabilities, and the role of partial ionisation.



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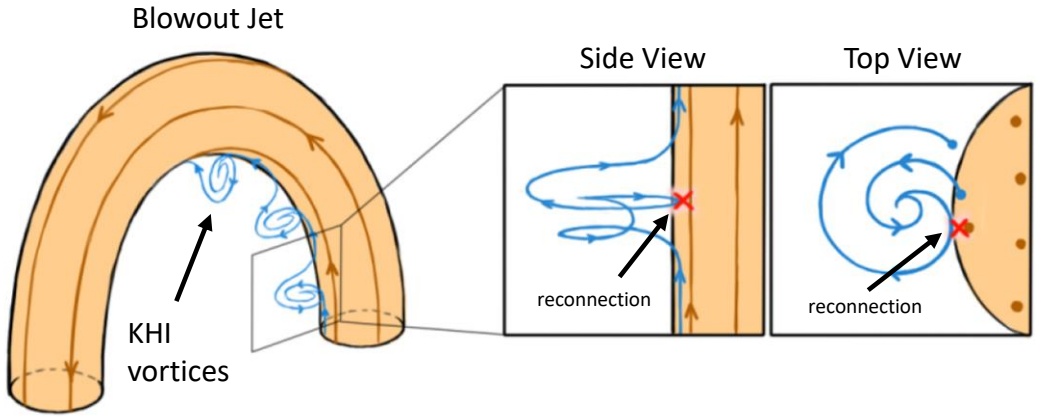

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