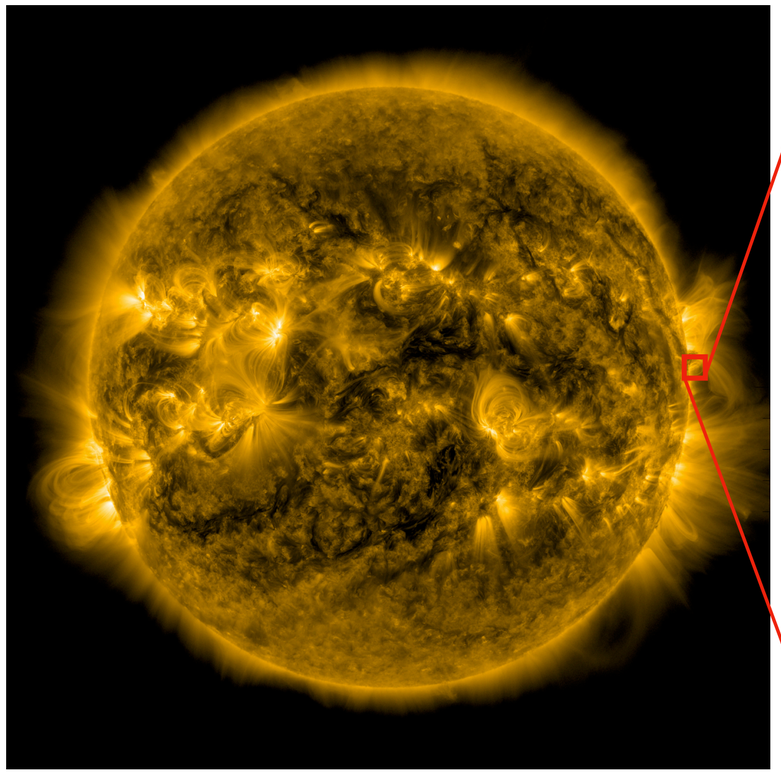
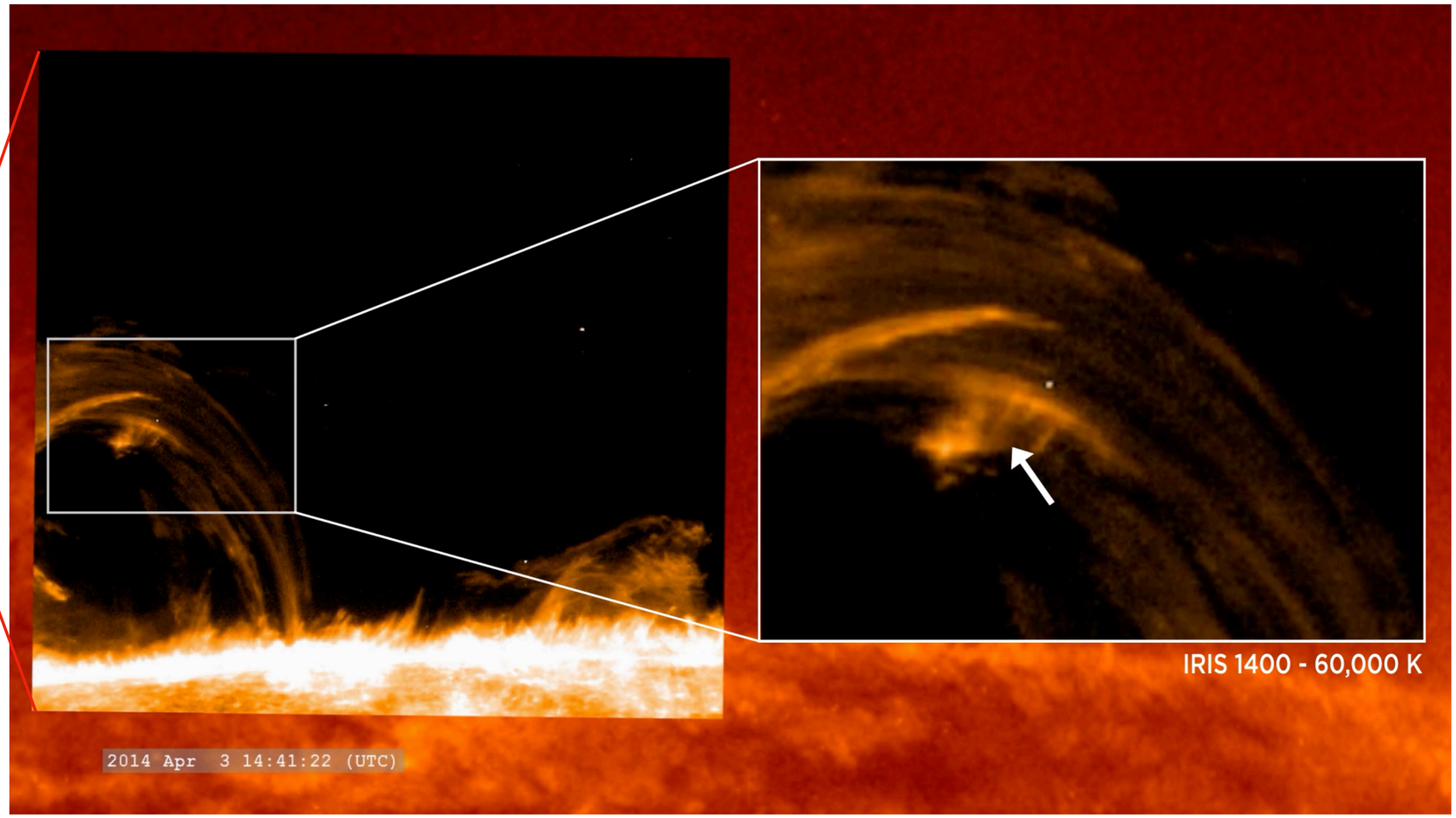
Nanojets of Coronal Heating

Patrick Antolin

P. Antolin[1], P. Pagano[2,5], P. Testa[3], A. Petralia[4], F. Reale[4,5], *Nature Astronomy (2021)*



Movie of event, courtesy of NASA visualisation studio



10,000 km

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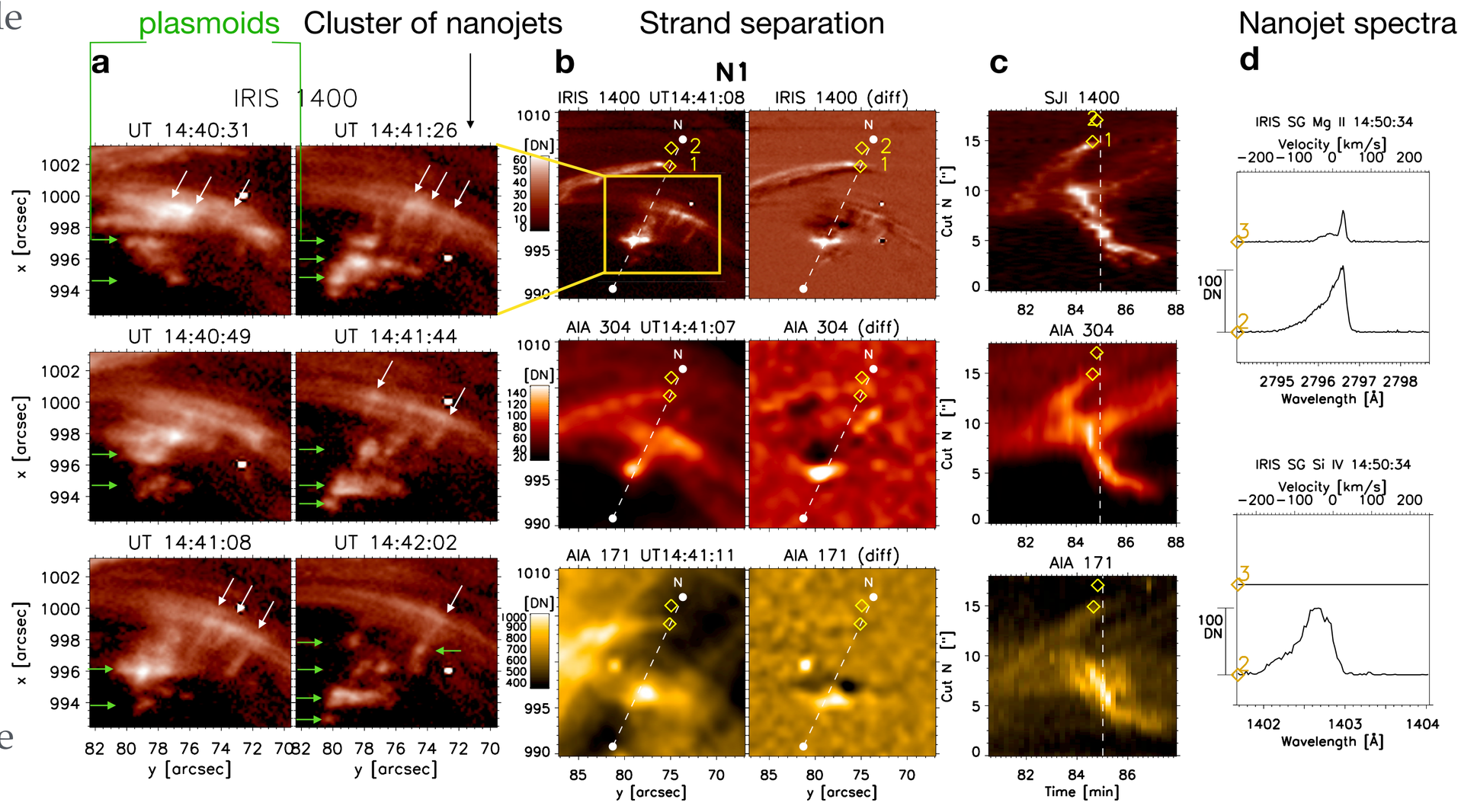
[4]INAF - Palermo, Italy; [5]Università di Palermo, Italy

Nanojet properties

Local response

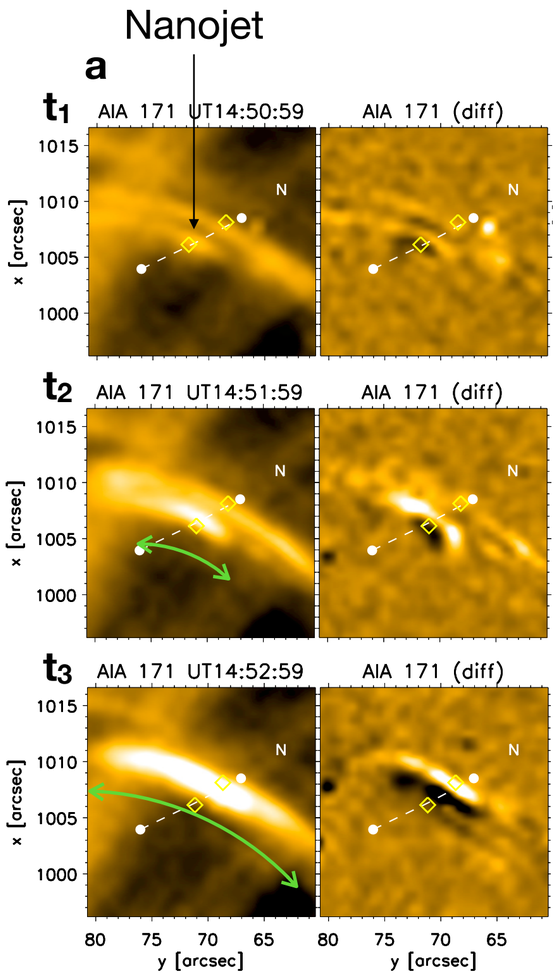
- Intensity bursts on the nanoflare energy scale $\sim< 10^{25}$ erg
- Jet-like features transverse / oblique to global magnetic field
- Very short lived (<10 s - 15 s)
- v ~ 100–200 km/s (POS or LOS)
- 1000—2000 km in length
- ~500 km in width
- Single or clustered occurrence; countable nature: ~150 events
- Plasmoids for largest
- Uni-directional



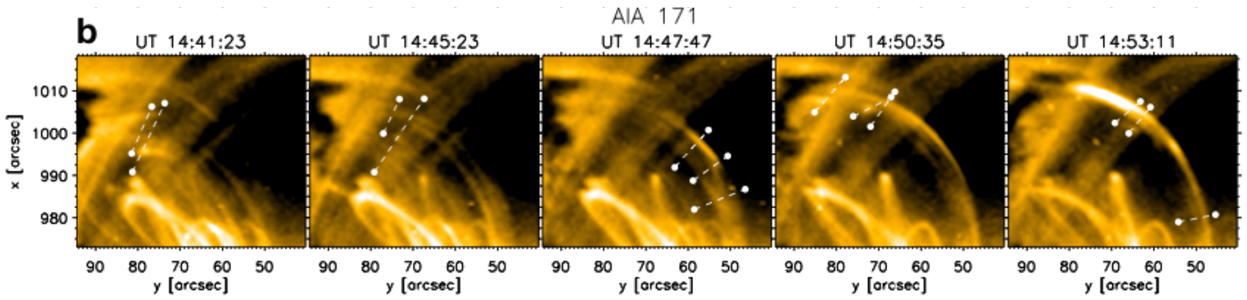
Nanojet properties

Global response

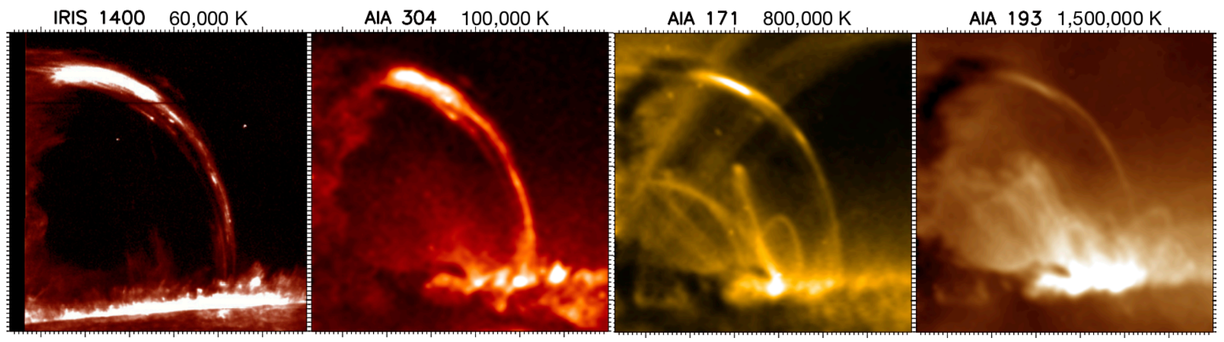
- Transverse displacement of rain strands
- Nanojets spread along & across the loop, number increase with time
- Nanojets precede formation of coronal strands
- Loop heating to coronal temperatures (~<5 MK)
- Complex rotational motions, reduction of braiding



Strand formation



Heating



Reconnection Nanojets in the Solar Corona

3D MHD numerical modelling with PLUTO

- Nanojets match with component **magnetic reconnection:** transverse advection of field lines accelerated by magnetic tension

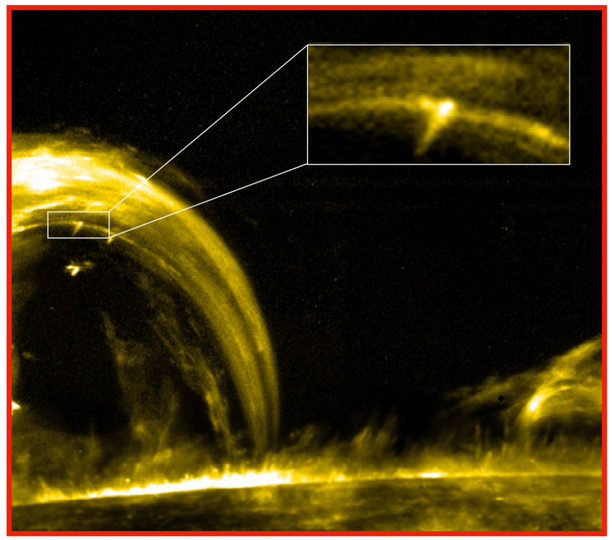
Discussion

- Unidirectional nature (no clear bidirectional jet) <-> effect of curvature & braiding (*Pagano et al., submitted*)
- Global response suggestive of MHD avalanche
- Driver: prominence loss of stability; we conjecture largely independent of reconnection driver (*Sukarmadji et al, submitted*, see talk)
- Rain role: catalyst for reconnection since partially ionised; high resolution tracer of coronal dynamics

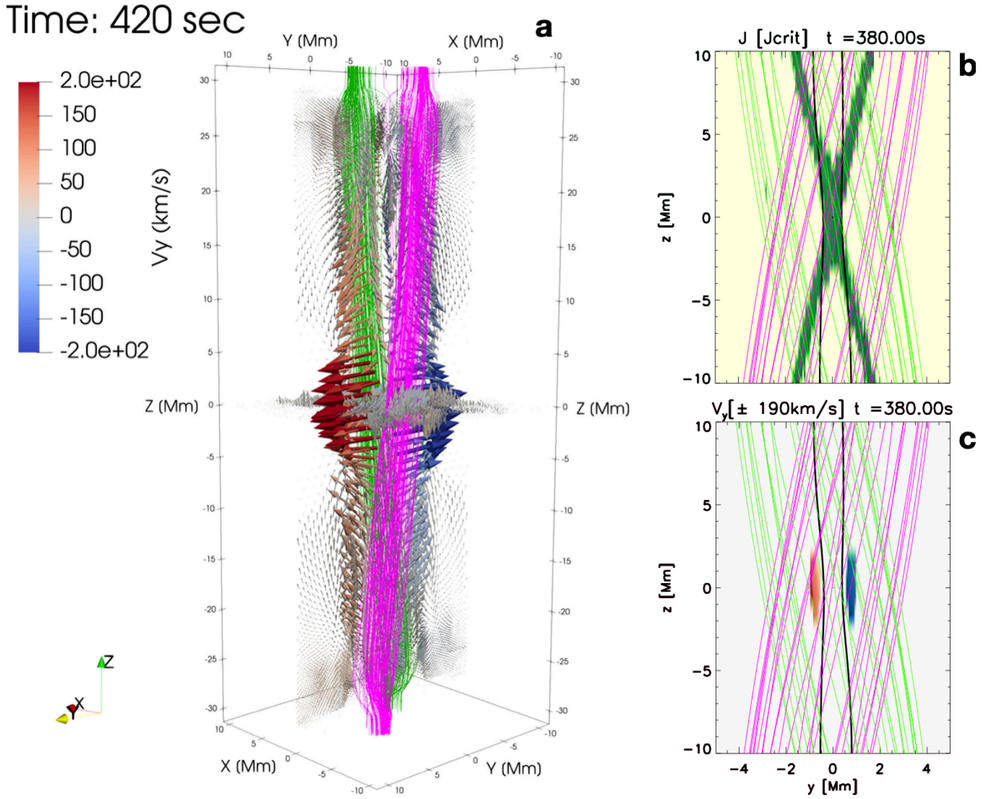
➡ Nanojets: direct observational signature of reconnection-driven nanoflare

Behind the scenes: https://go.nature.com/2FT48ka

Antolin et al. Nature Astronomy (2021)



3D MHD numerical simulation with PLUTO



Sketch