Thin coronal jets and plasmoid-mediated reconnection: Insights from Solar Orbiter and Bifrost simulations

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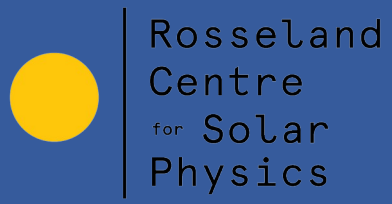

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Introduction

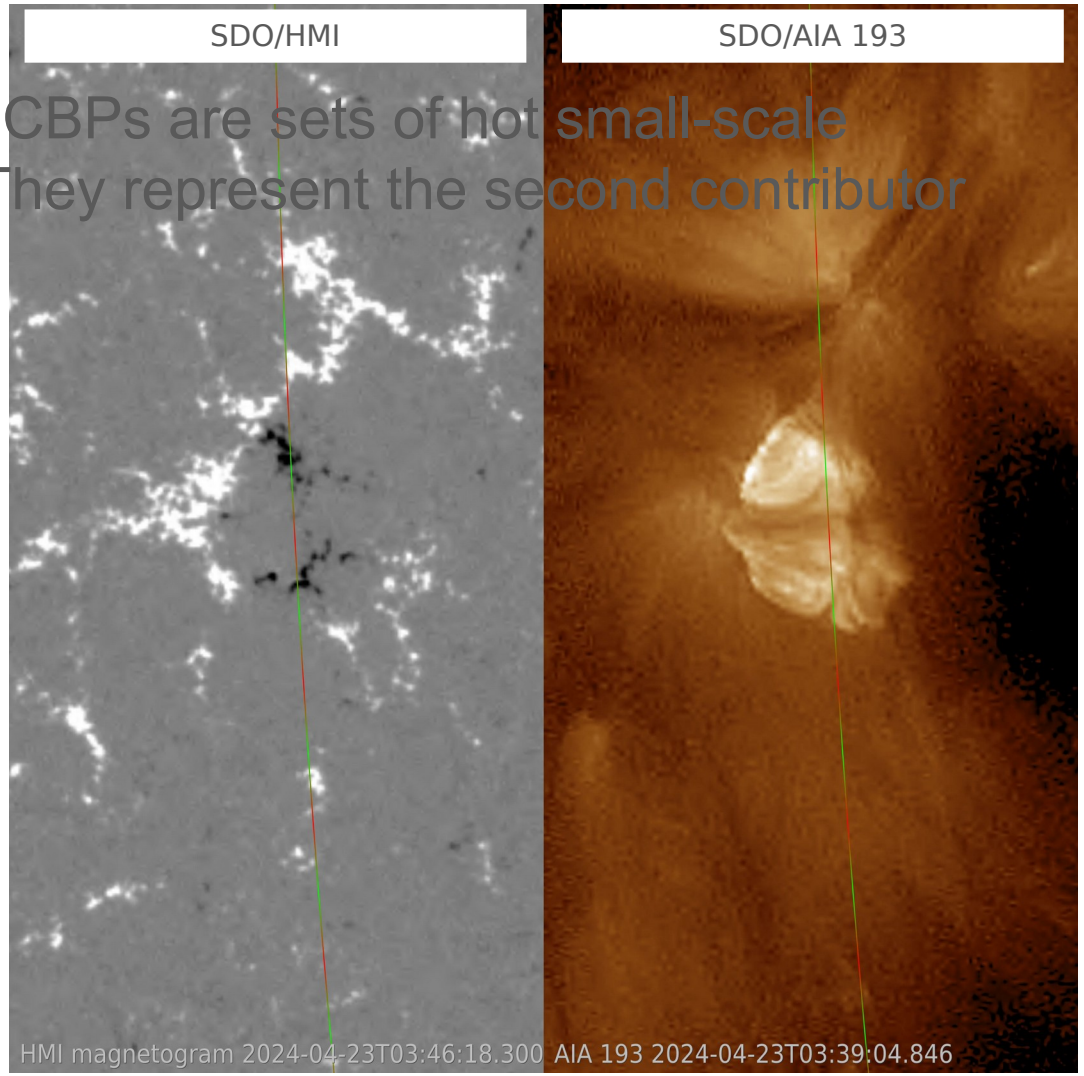
Coronal Bright Points (CBPs) CBPs are sets of hot small-scale loopswith enhanced EUV and X-ray emission. They represent the second contributor to high-energy radiation over the solar disk.

e.g., Ugarte-Urra et al 2004, Chitta et al. 2013, Gao et al.) 2022, Mondal et al. 2024, Petrova et al. 2024, Kraus et al. (2023, 2025, among many others

Size	Lifetime
4—43 Mm	hrs—days

(Madjarska et al. 2019, Kraus et al. 2023, 2025)

(Mondal et al. 2023)



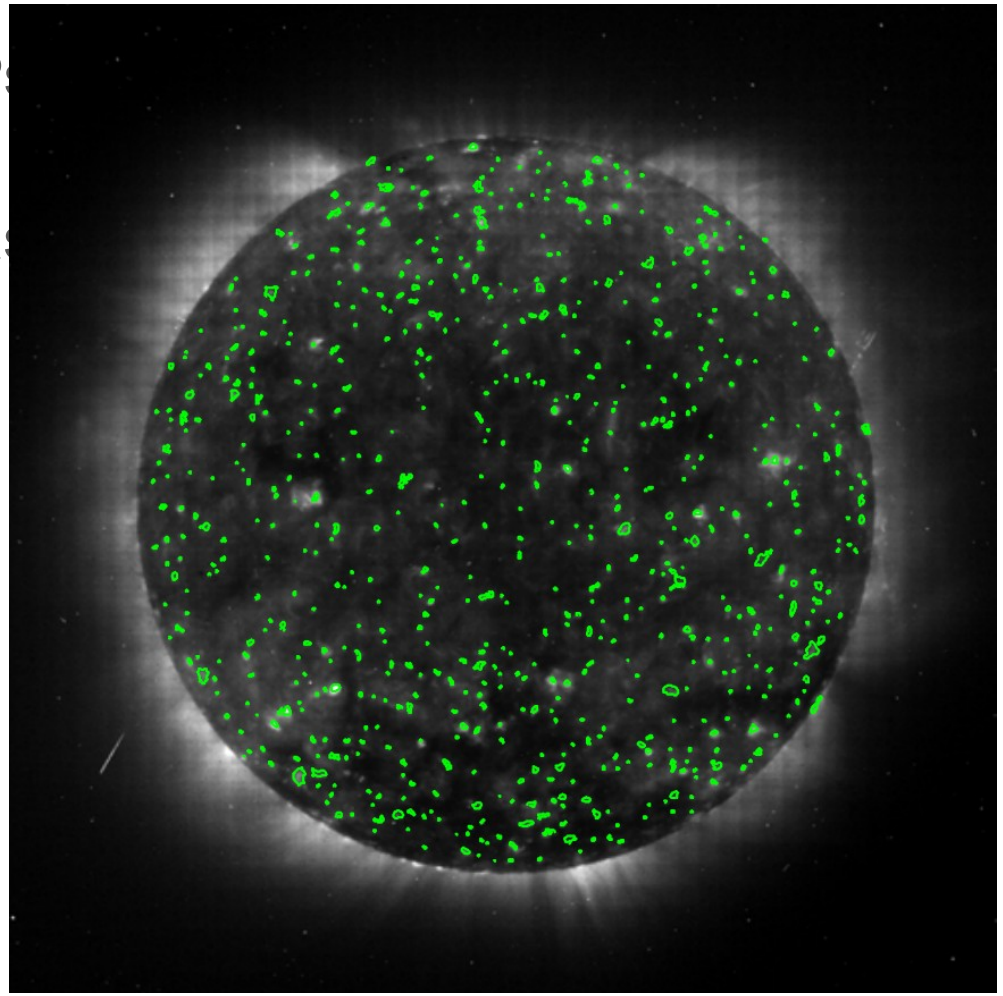
SDO images. Jhelioviewer

Introduction

Coronal Bright Points (CBPs) CBP
Sun,regardless of the solar cycle activity.

Daily average number of CBPs in the EUV 193 Å pa
~570, with a range from 427 to 790.

e.g., Golub et al. 1977; McIntosh et al. 2014a,b; Alipour & Safari)
(et al. 2015, Madjarska et al. 2019

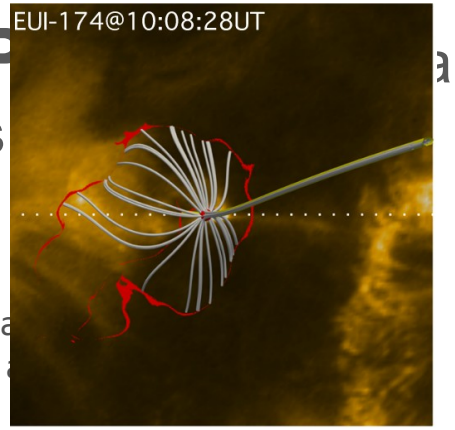


Alipour & Safari et al. (2015)

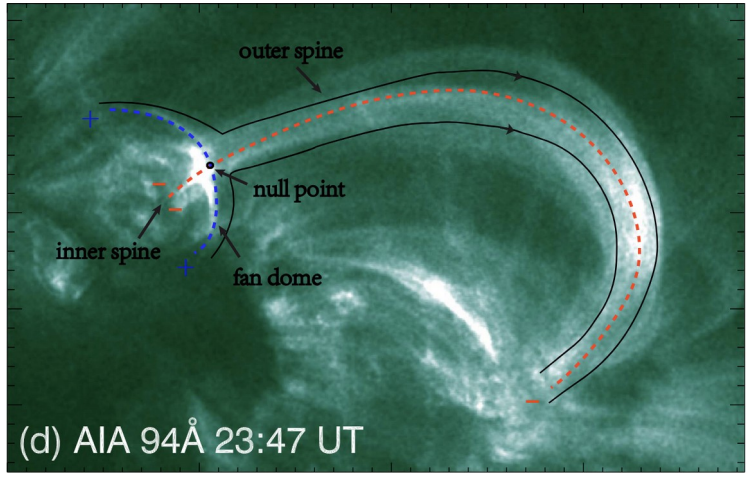
Introduction

Coronal Bright Points (CBP
ally show a fan-spine
topologywith a null point at coronal heights

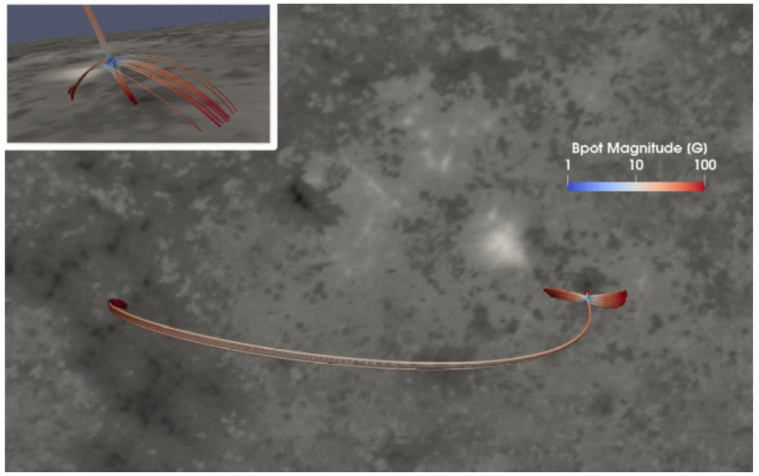
e.g., Zhang et al. 2012; Mou et al. 2016; Li et al. 2017, Galsgaard et a
(2020, Madjarska et al. 2021; Cheng et al. 2023, Petrova et al. 2024,



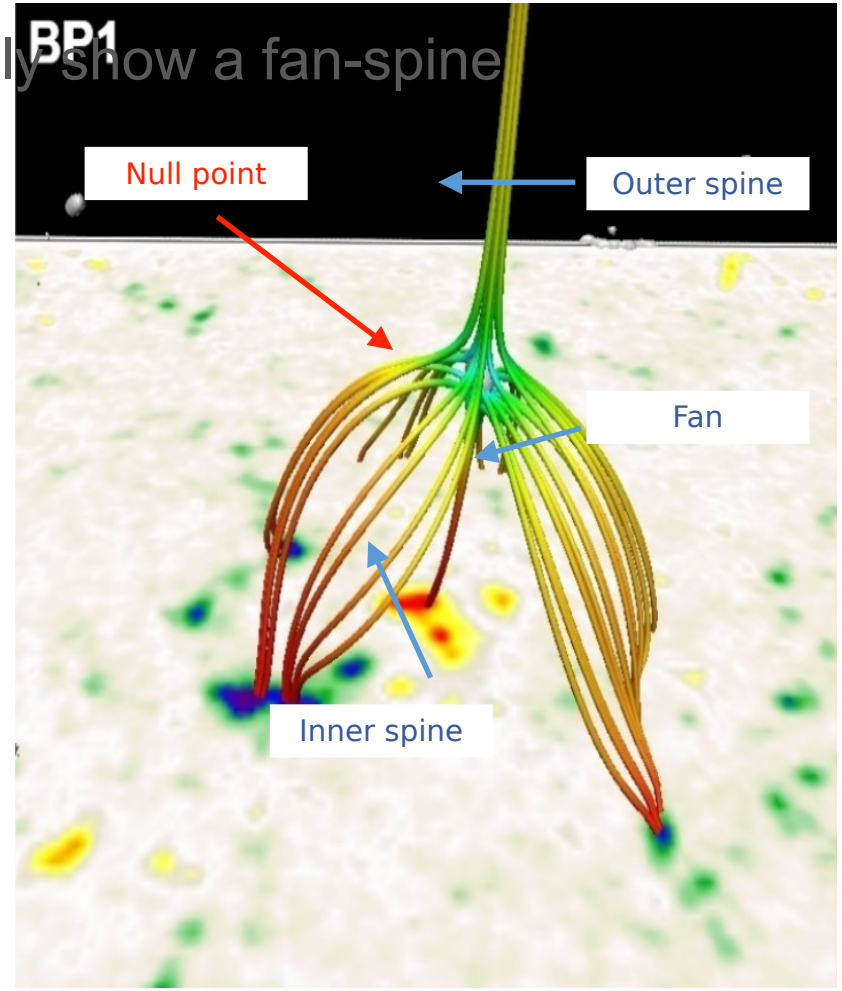
Chen et al. (2023)



Li et al. (2017)



Petrova et al. (2024)

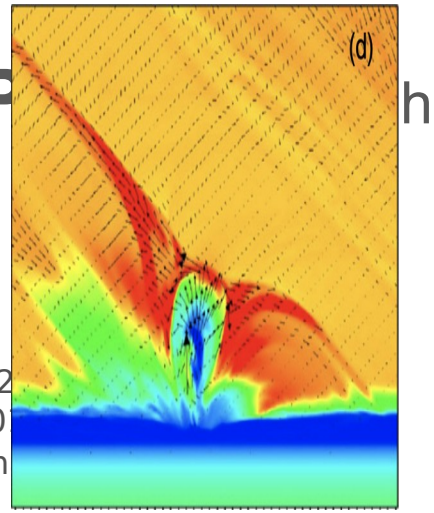


Galsgaard et al. (2017)

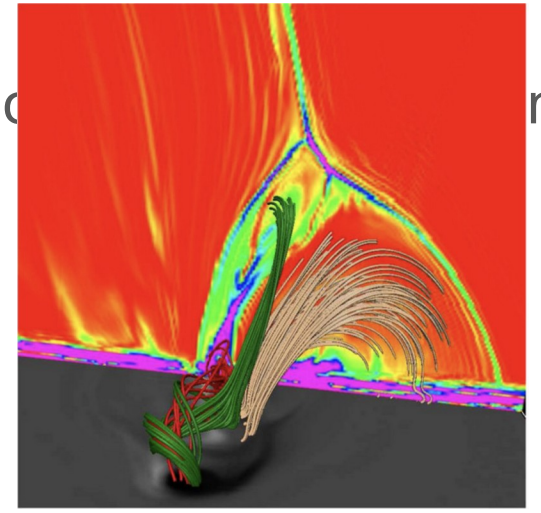
Introduction

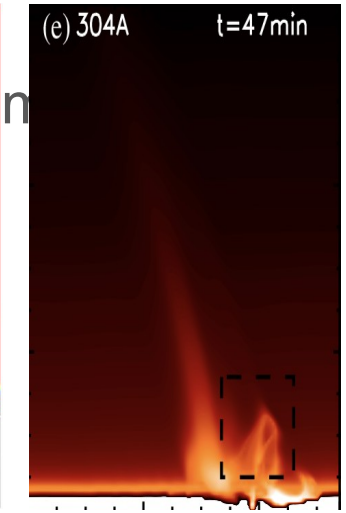
Coronal Bright Points (CBP
scale filament eruptions.

e.g., Archontis & Hood 2013, Moreno-Insertis et al. 2013, Fang et al. 2
Sterling et al. 2015; Panesar et al. 2017, Shen et al. 2017, Li et al. 20
(Kumar et al. 2019; Madjarska et al. 2022, Teng et al. 2024, among m



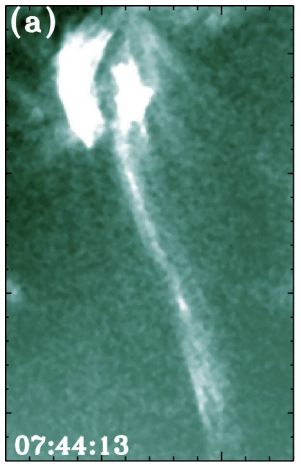
Archontis & Hood et al. (2013)


Moreno-Insertis & Galsgaard et al. (2013)

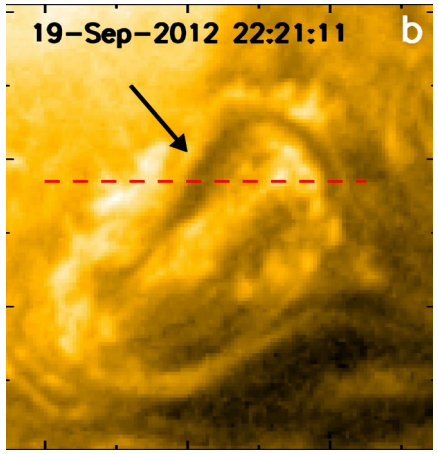


Fang et al. (2014)

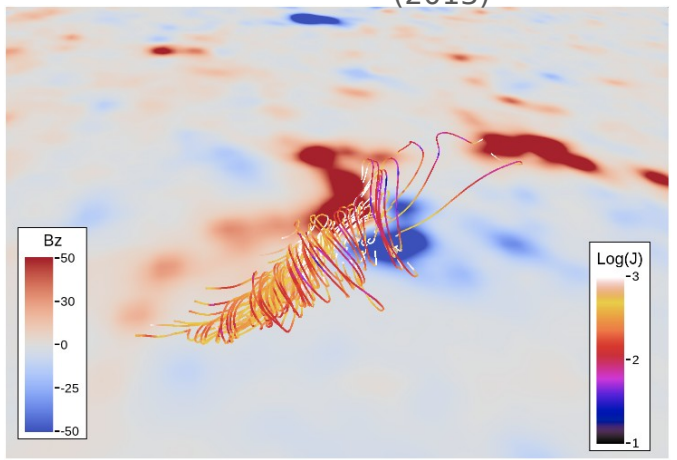

Hong et al. (2014)



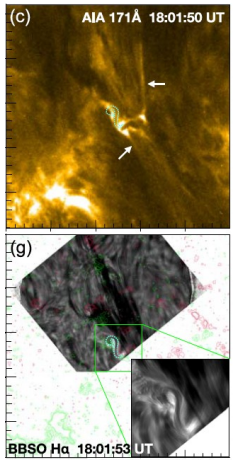
Shen et al. (2017)



Panesar et al. (2017)



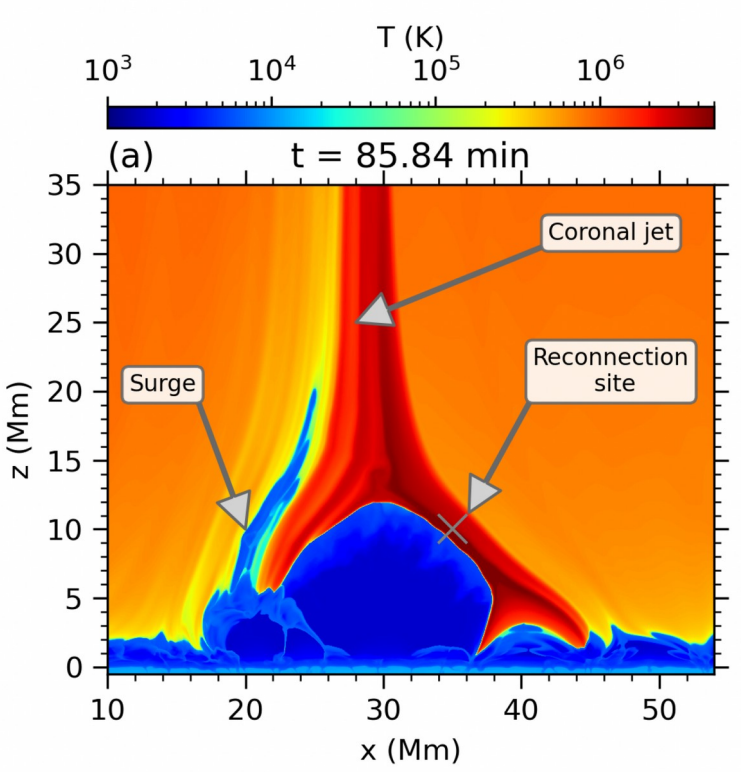
Madjarska et al. (2022)



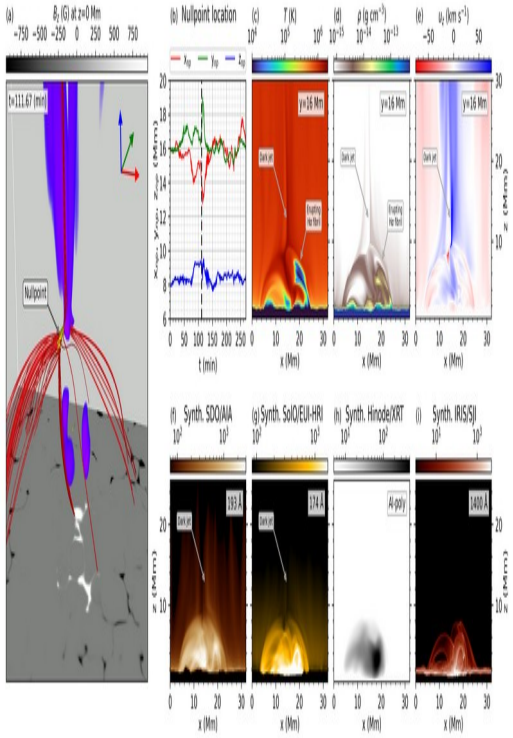
Teng et al. (2024)

Our aim

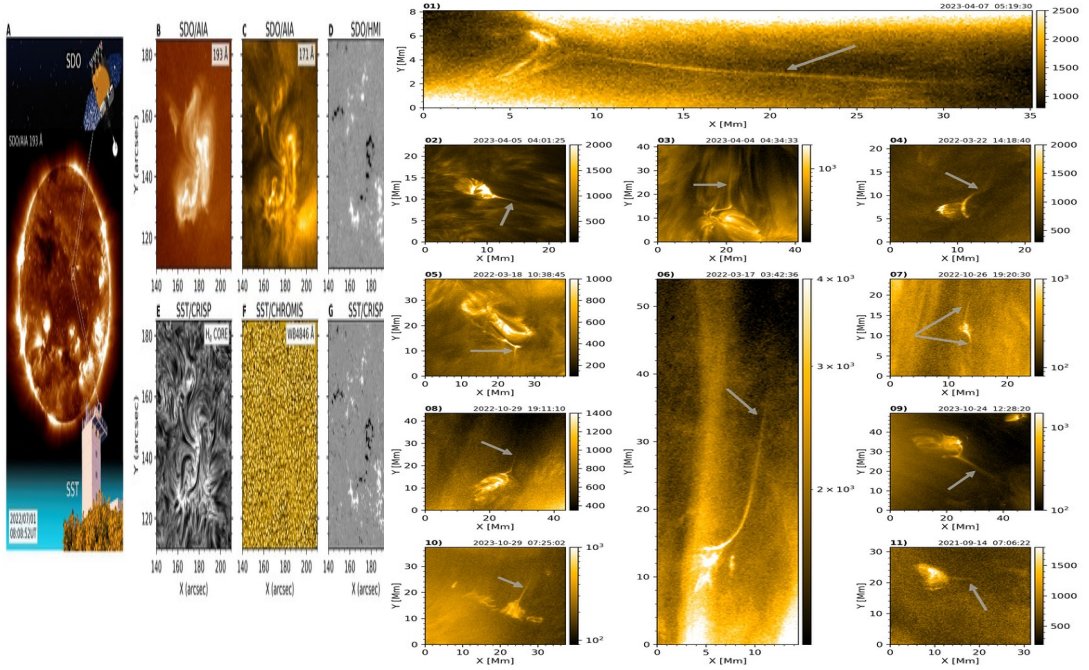
Deciphering Coronal Bright Points (CBPs) We employ a combined approach using both numerical experiments and observations



Nóbrega-Siverio & Moreno-Insertis) (2022



(Nóbrega-Siverio et. al 2023)

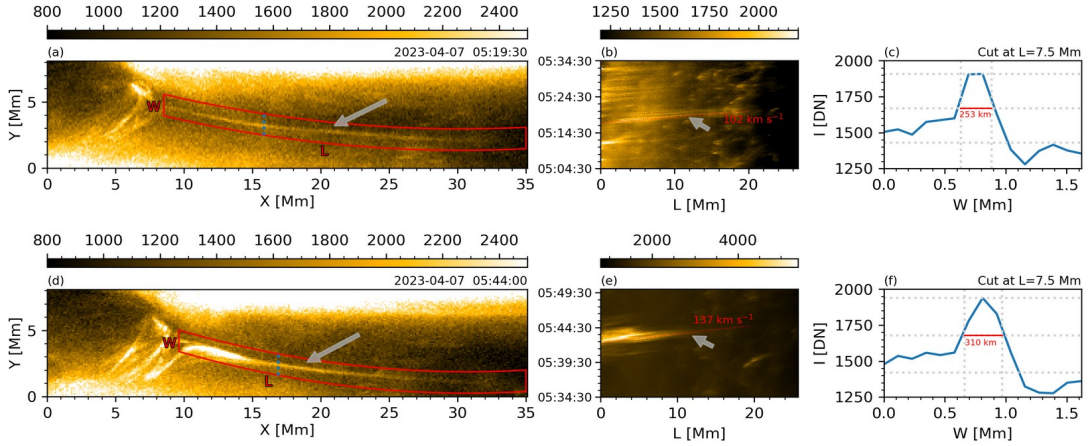


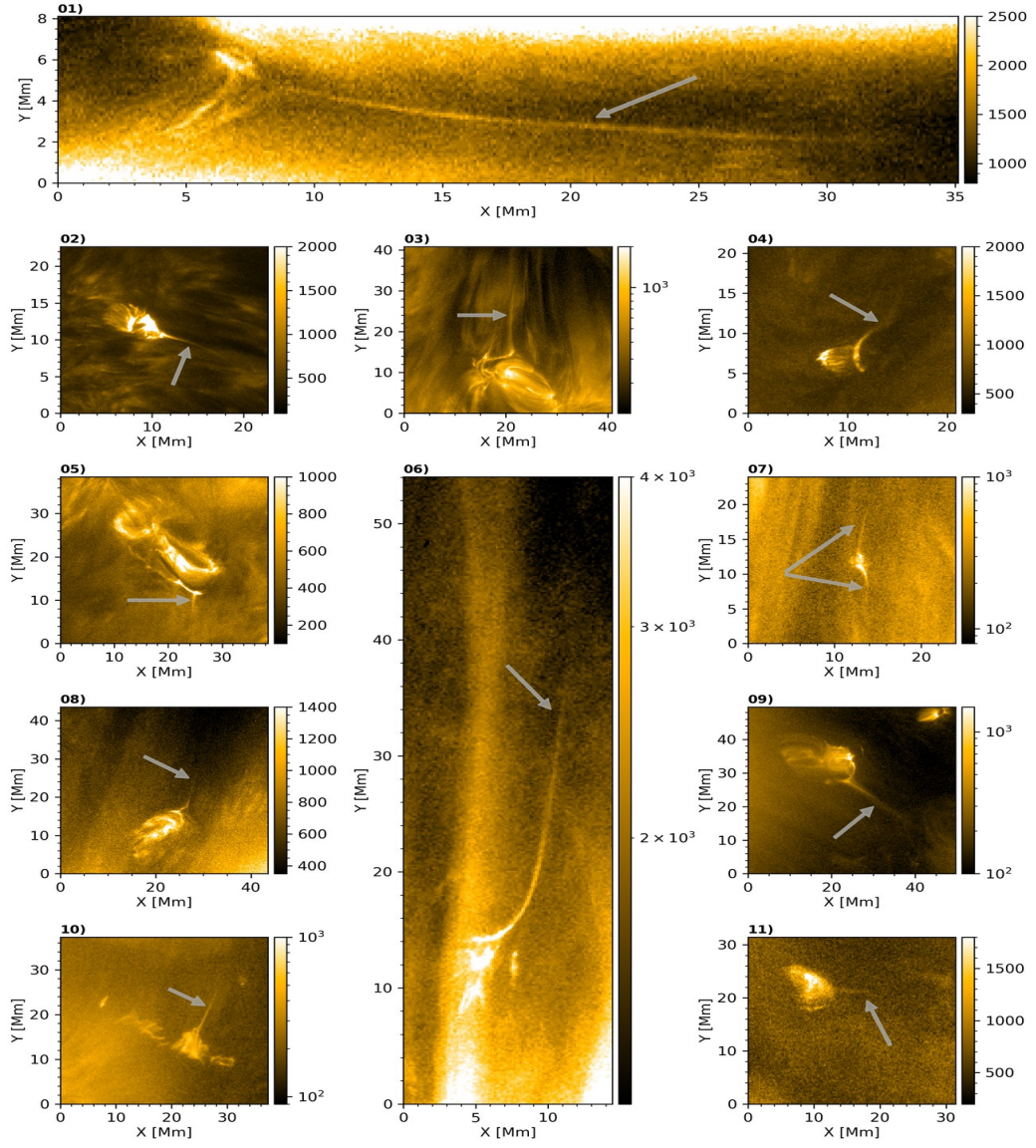
(Nóbrega-Siverio et. al 2025)

Thin coronal jets and plasmoid-mediated reconnection: Insights from Solar Orbiter and Bifrost simulations

Thin coronal jets

Solar Orbiter HRI$_{EUV}$ 174 We have an
CBPs.The pixel size of these observations goes
km!Cadence can be as fast as 3 seconds!



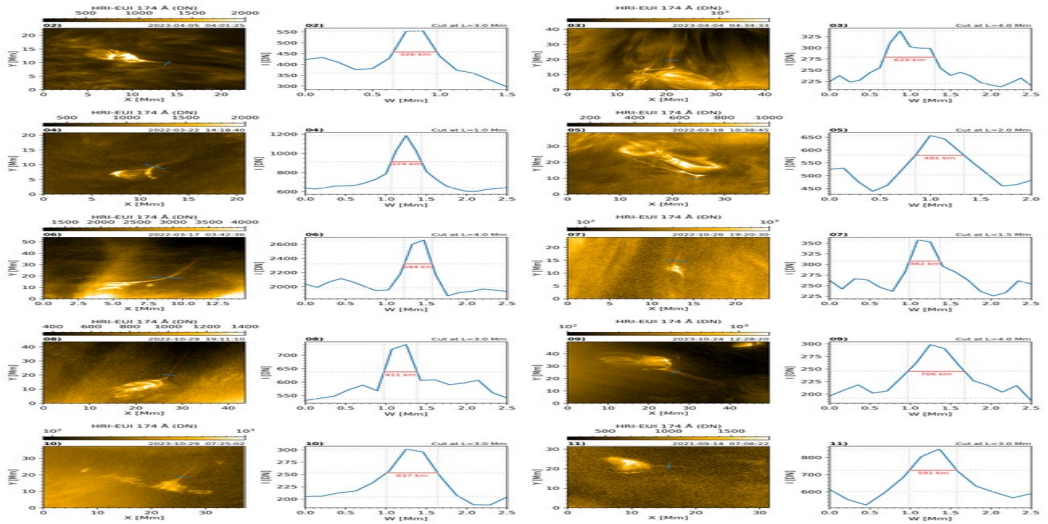


Thin coronal jets

Statistics Thin coronal jets originating from CBPs from 253 km to 706 km.

These jets are 30–85% brighter than their surrounding Mm while maintaining their narrow form.

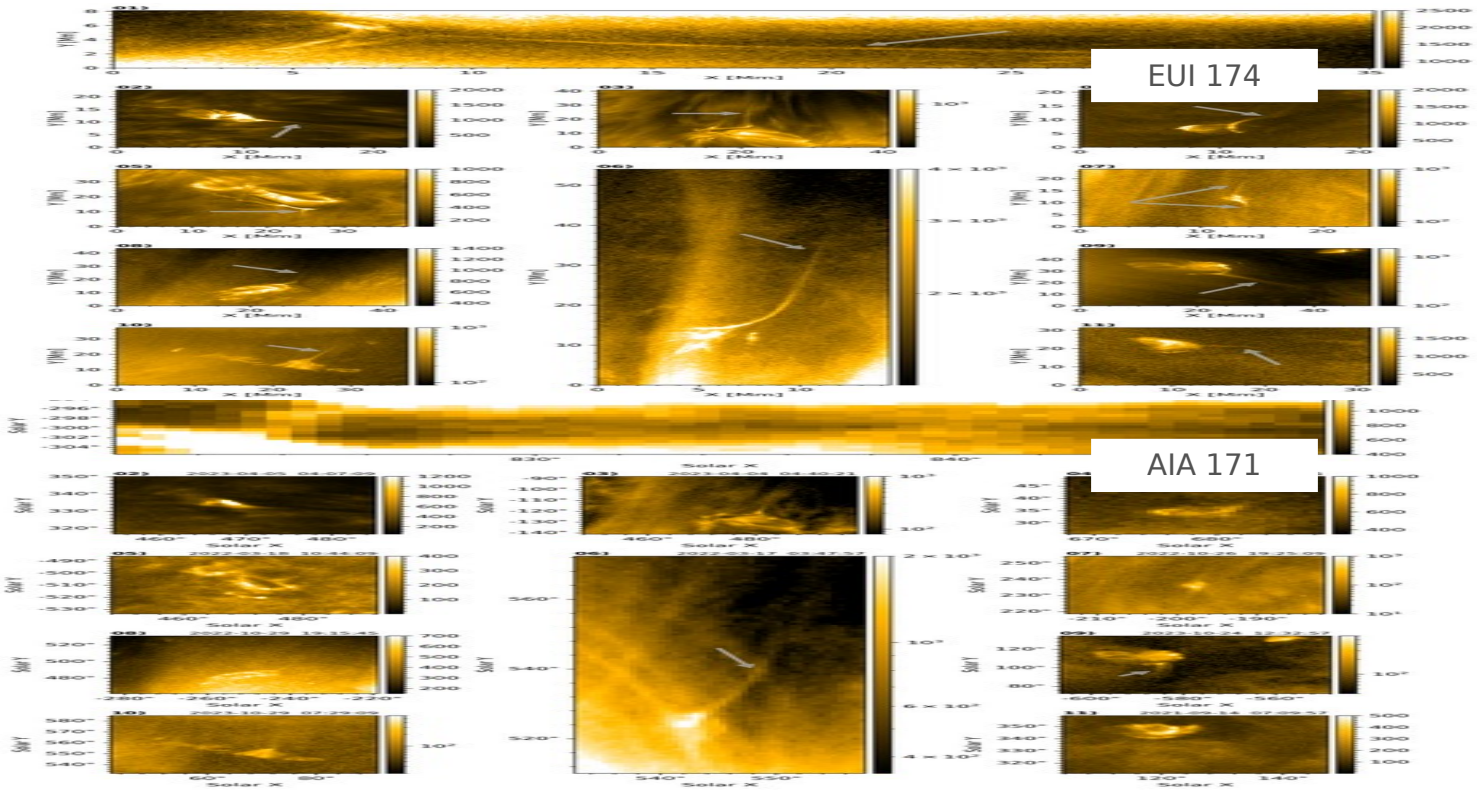
Bézier curve

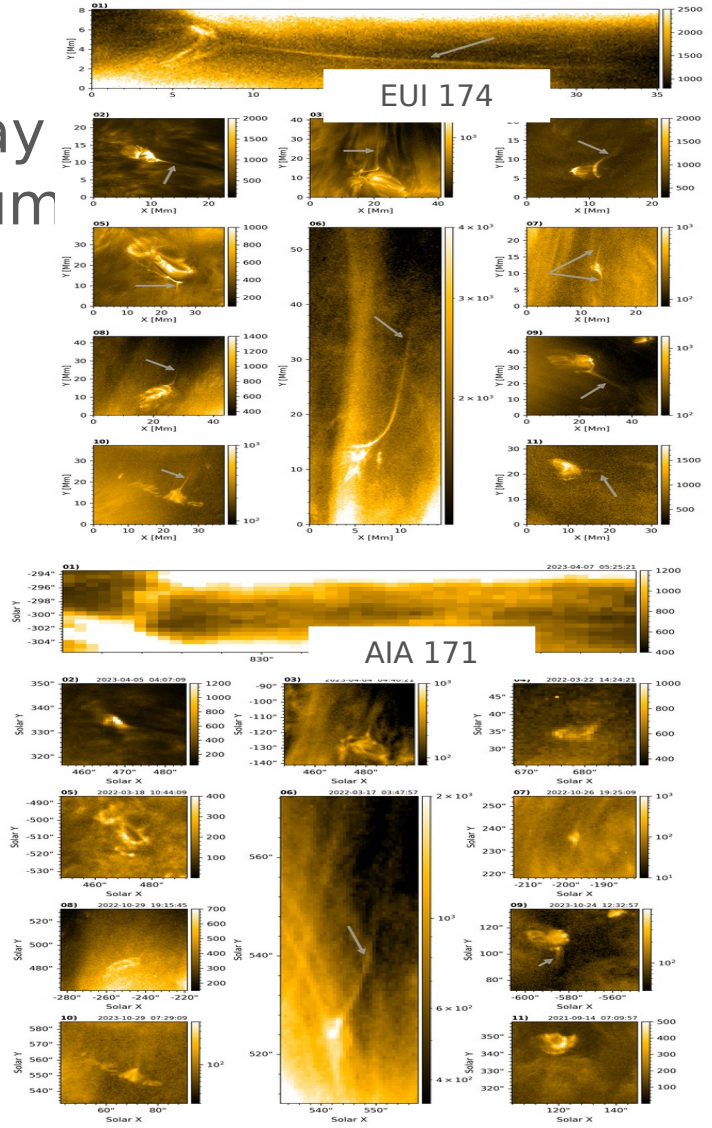


Case	L_{jet} (Mm)	w_{jet} (km)
01	22.1	253
	21.7	310
02	9.1	326
03	15.4	629
04	4.1	374
05	10.0	481
06	21.8	344
07	5.5	382
08	19.5	411
09	16.1	706
10	7.5	637
11	6.7	591

Thin coronal jets

Why are these jets important? CBPs may
jets that cannot be resolved with previous EUV instrum





Thin coronal jets

Continuous jetting activity from the models Magnetic reconnection is bursty, leading to multiple jets.Magnetic reconnection is also oscillatory, similar to reports from observations.

(e.g., Zhang et al. 2014, Hong et al. 2025)

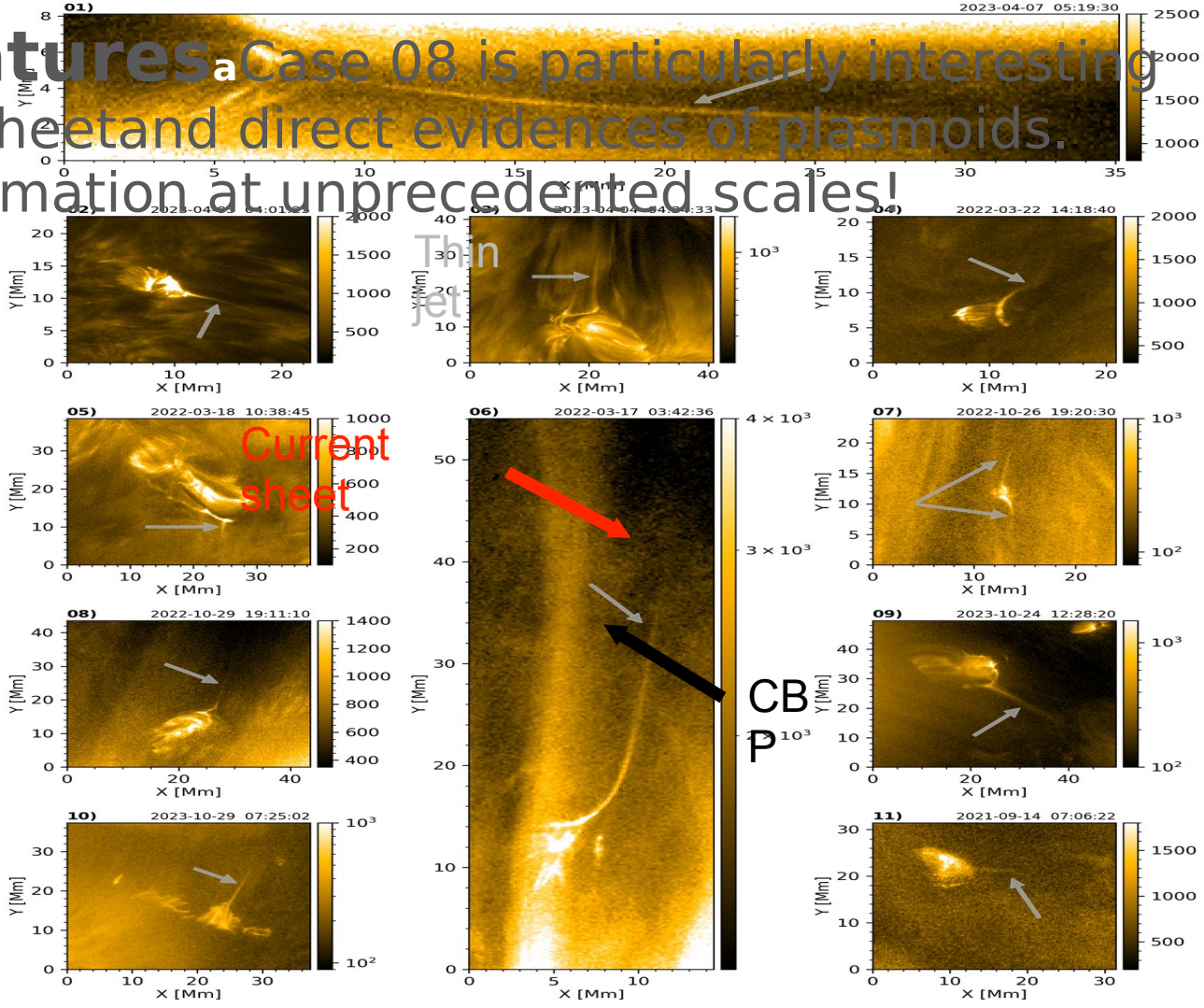
Nóbrega-Siverio & Moreno-Insertis)
(2022

Plasmoid-mediated reconnection

Direct observational signatures

because we can discern the current sheetand direct evidences of plasmoids.

HRI_{EUV} allows us to study plasmoid formation at unprecedented scales!



Introduction

SOLAR ORBITER HRI_{EUV} 174 OBSERVATIONS

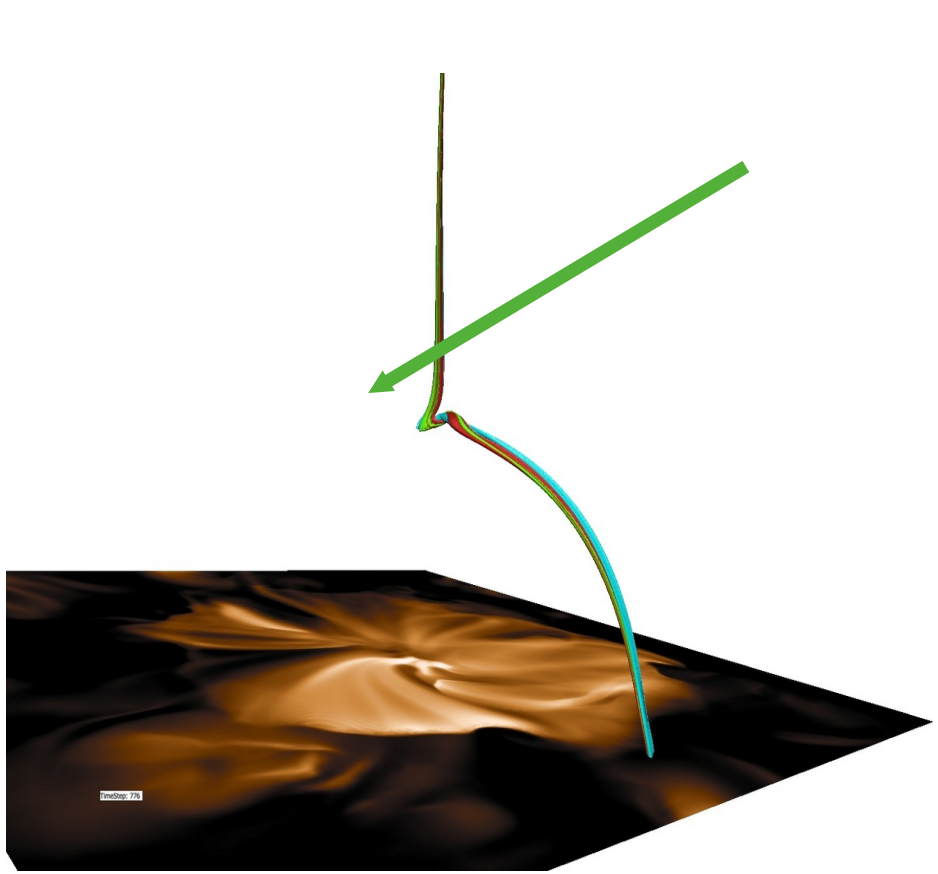
Plasmoids in CBPs We detected the smallestplasmoid in EUV (so far). Size: ~332 km.The simulations can reproduce signatures similar to those observed.

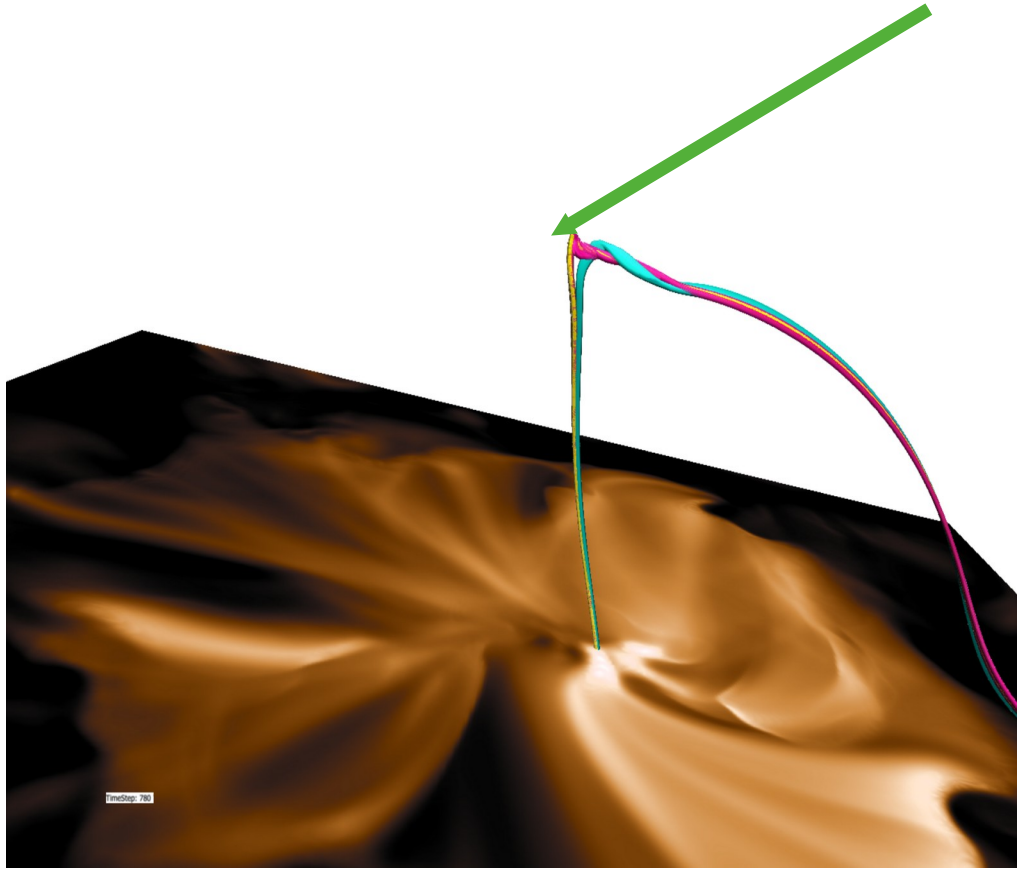
(Nóbrega-Siverio et. al 2025)

2D BIFROST SIMULATIONS DEGRADED TO HRI_{EUV} RESOLUTION

Plasmoid-mediated reconnection

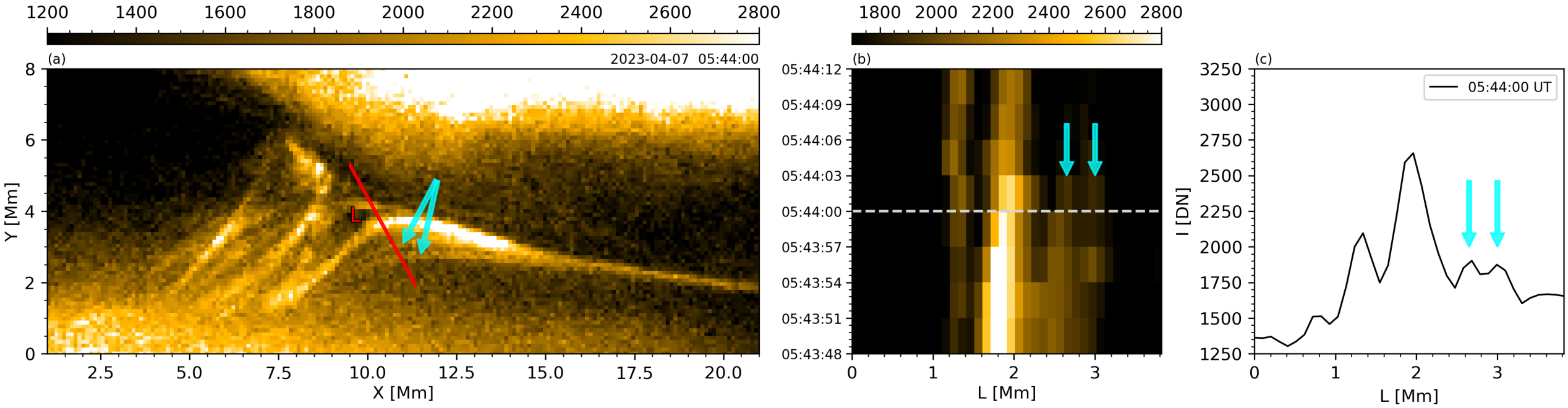
Insights from simulations Our 3D CBP model also shows plasmoid formation.





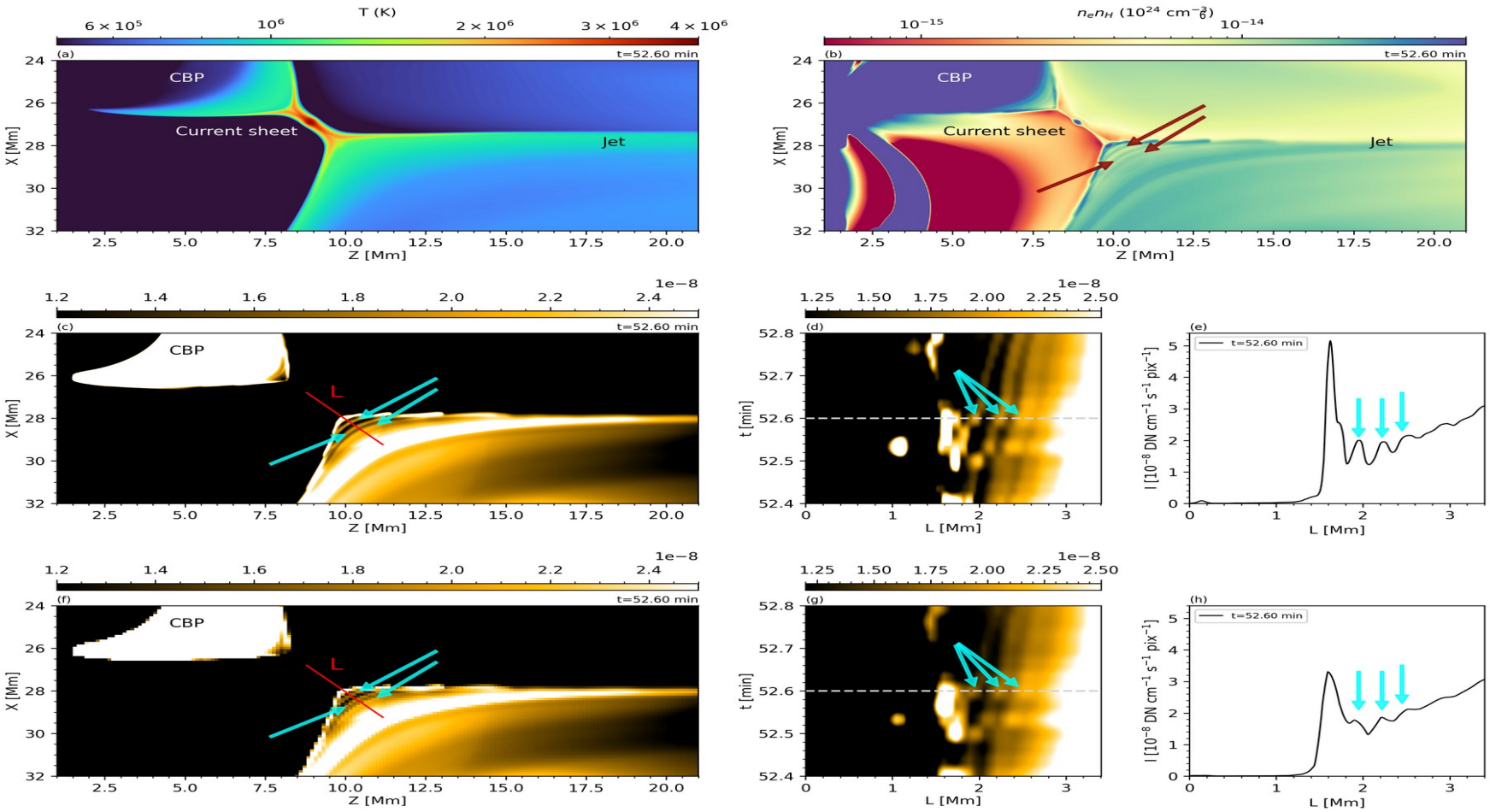
Plasmoid-mediated reconnection

Indirect observational signatures We infer plasmoid ejections through the intermittent boomerang-like pattern that appears in the outflow region.



Plasmoid-mediated reconnection

Insights from simulations Hot plasmoids ~3MK,produce an intermittentboomeran site.



Original pixel size: 16 km

Plasmoid-mediated reconnection

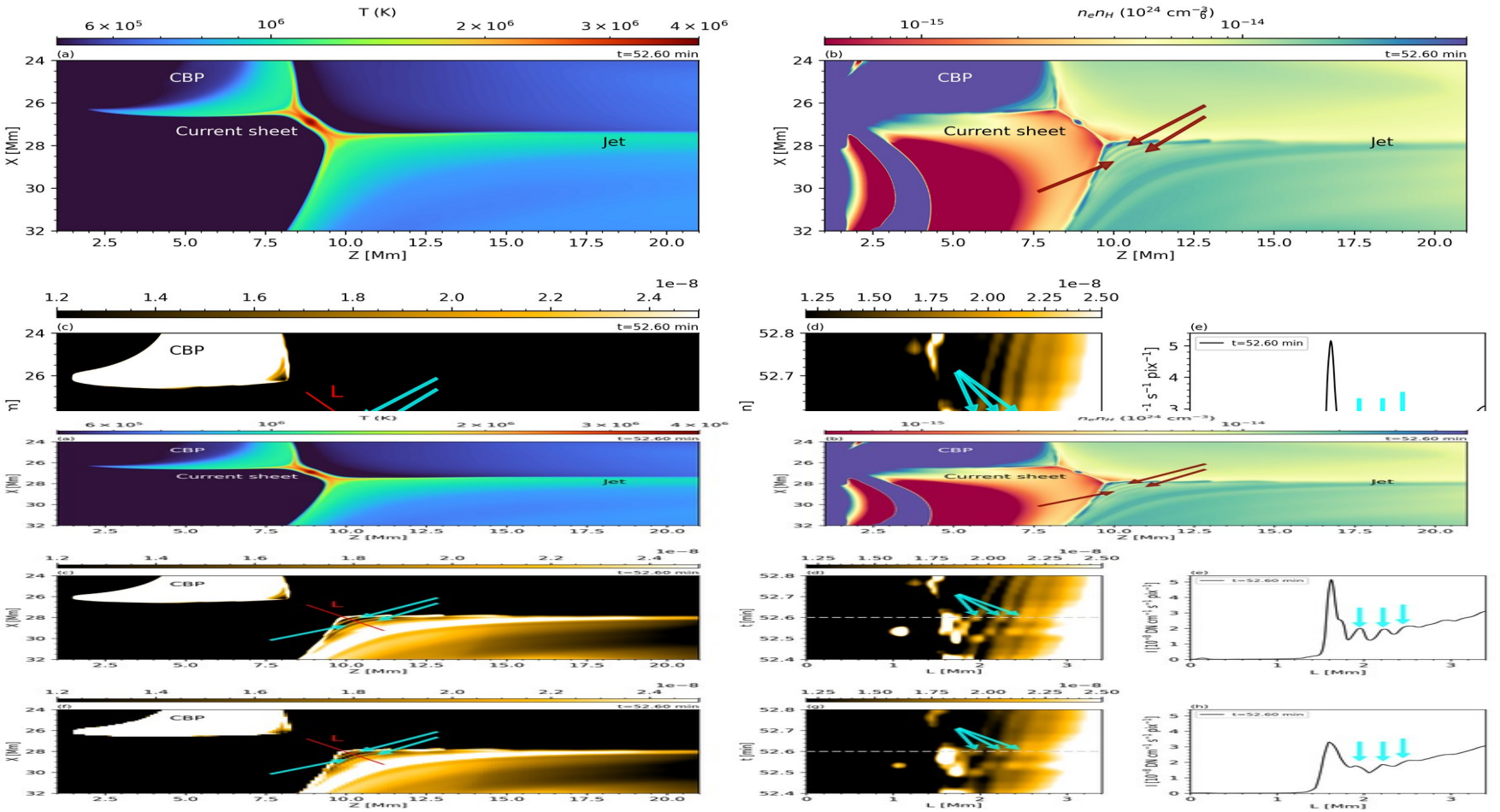
Insights from simulations Hot plasmoids ~3.4k,produce an intermittentboomerang-like patternafter being ejected fromthe reconnection site.

Original pixel size: 16 km

Plasmoid-mediated reconnection

Insights from simulations Hot plasmoids ~3MK,produce an intermittentboomeran site.

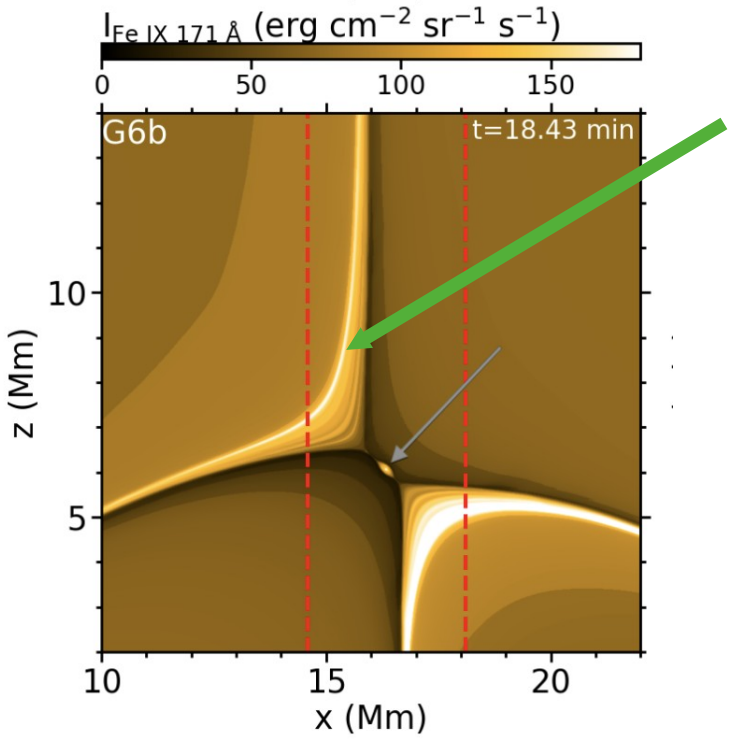
EUI pixel size: 160 km



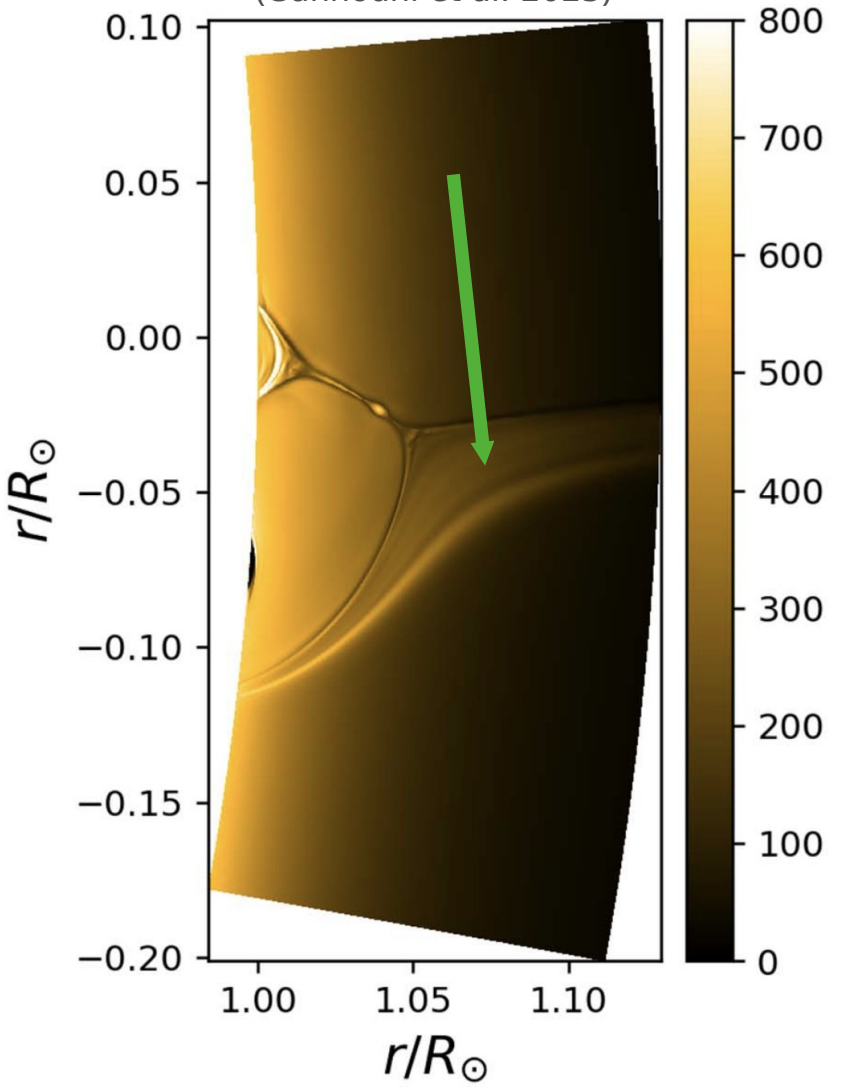
Plasmoid-mediated reconnection

Insights from simulations These patterns
MHD simulations.

(Færder et al. 2024)

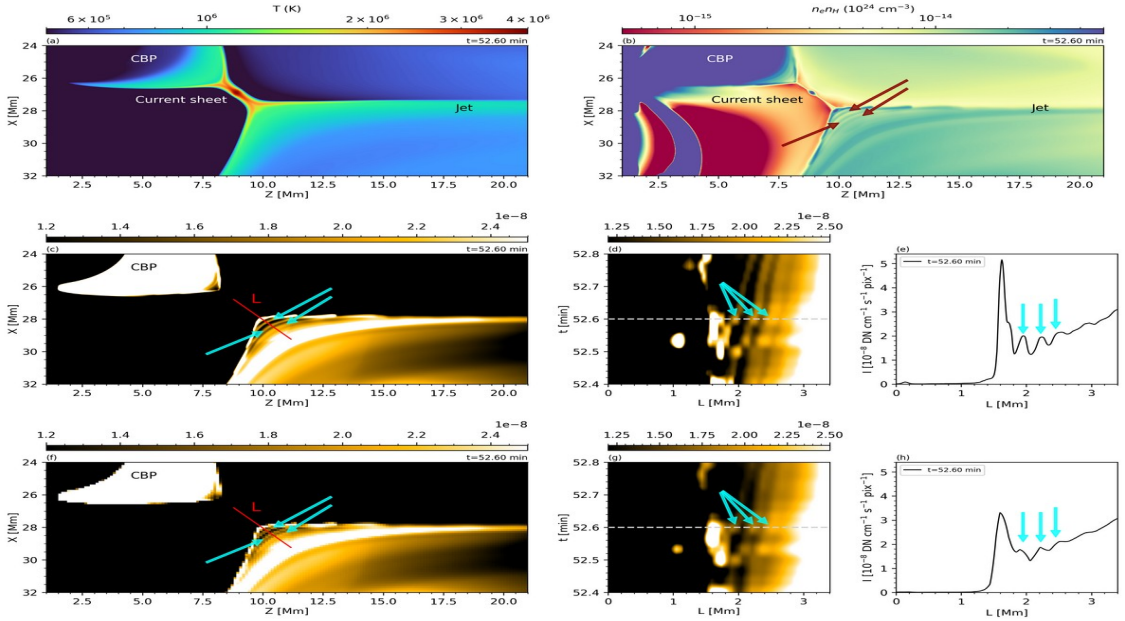


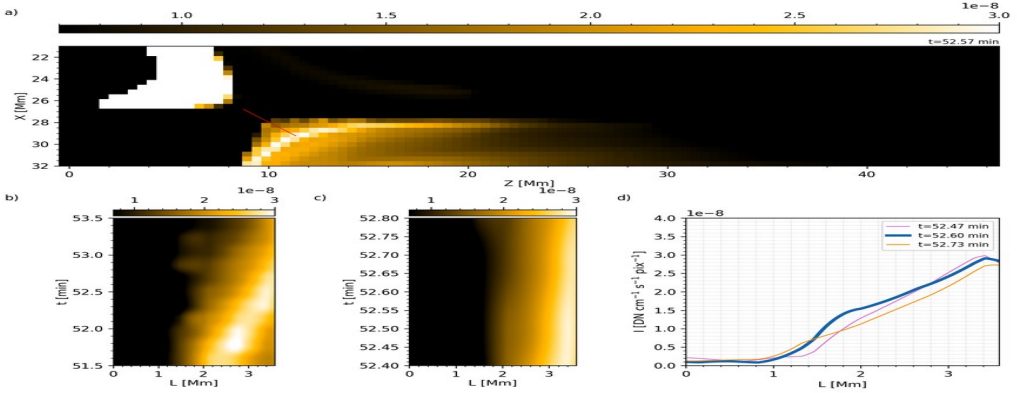
(Gannouni et al. 2023)



Plasmoid-mediated reconnection

Insights from simulations These patterns cannot be resolver with previous EUV instruments.





Conclusions

Take away messagesCBPs may show continuous jets that cannot be resolved with previous EUV instruments.The observed plasmoid is the smallest plasmoid reported in EUV (so far).Direct and indirect plasmoid signatures are supported by comparisons with the synthetic HRI_{EUV} emission from Bifrost simulations.