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Outflows Big and Small: Observations of Solar Eruptions with a Range of Sizes and Energies

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Introduction

- Heliospheric Imagers at 1 AU provided crucial information on CME evolution beyond the corona, as well as regular outflows into the solar wind
- The next generation of heliospheric imagers (WISPR, SoloHI) can improve these observations due to a vastly improved spatial resolution
- Furthermore, these new instruments can provide information on smaller scale outflows in the solar wind that would have been difficult to resolve from 1 AU
  - Streamer Blobs – The pinching off of smaller flux ropes caused by reconnection at the tip of the helmet streamer
  - Streamer Blowouts – Typically Filaments/Flux Ropes erupting from within a helmet streamer. Not powerful enough to reorient the corona around them, instead getting channeled by the streamer into the open field along the plasma sheet
  - Psuedostreamer Eruptions – Essentially large scale jets that may or may not contain a filament and produce narrow, fan-like eruptions that quickly fade from observability

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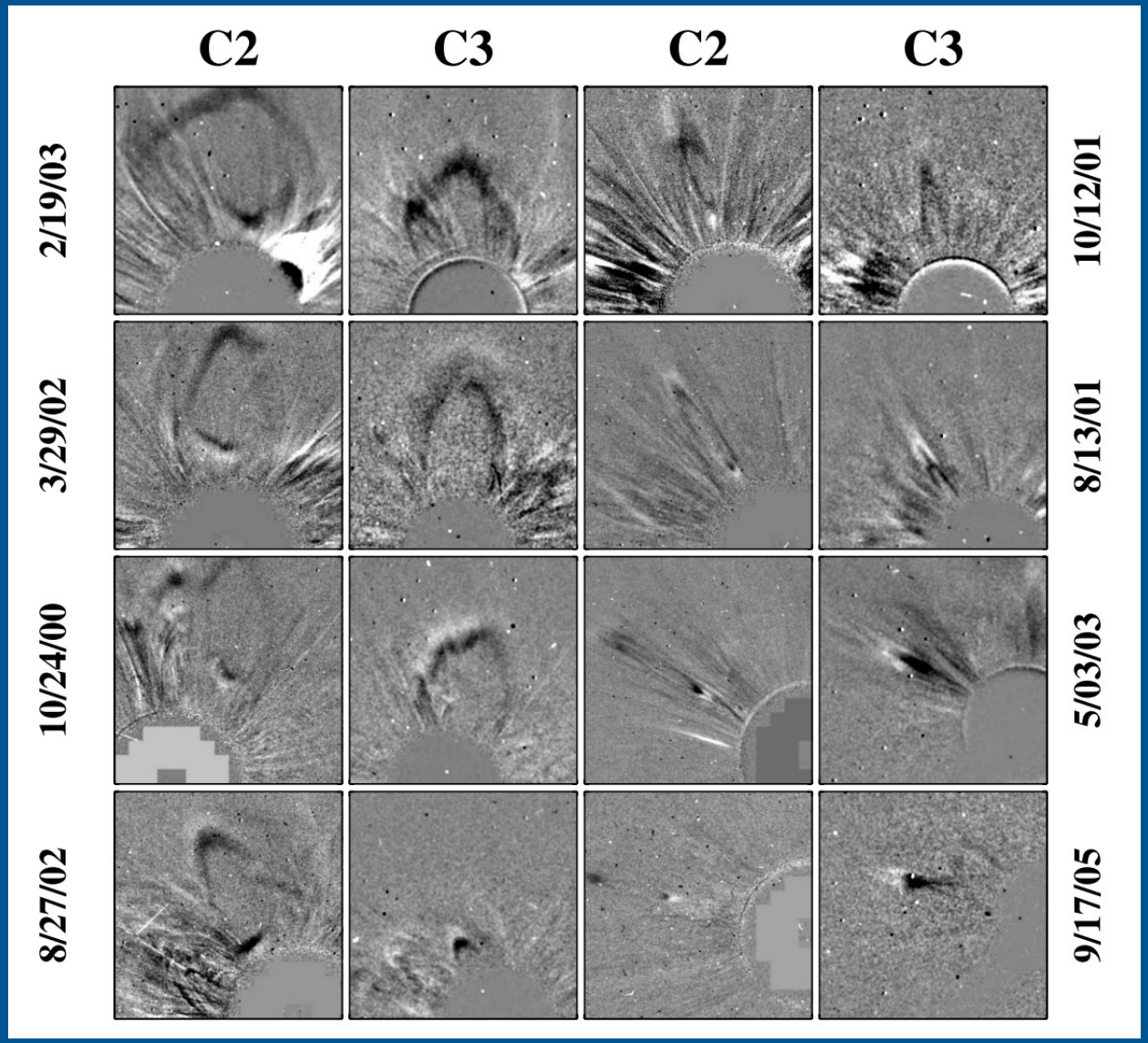
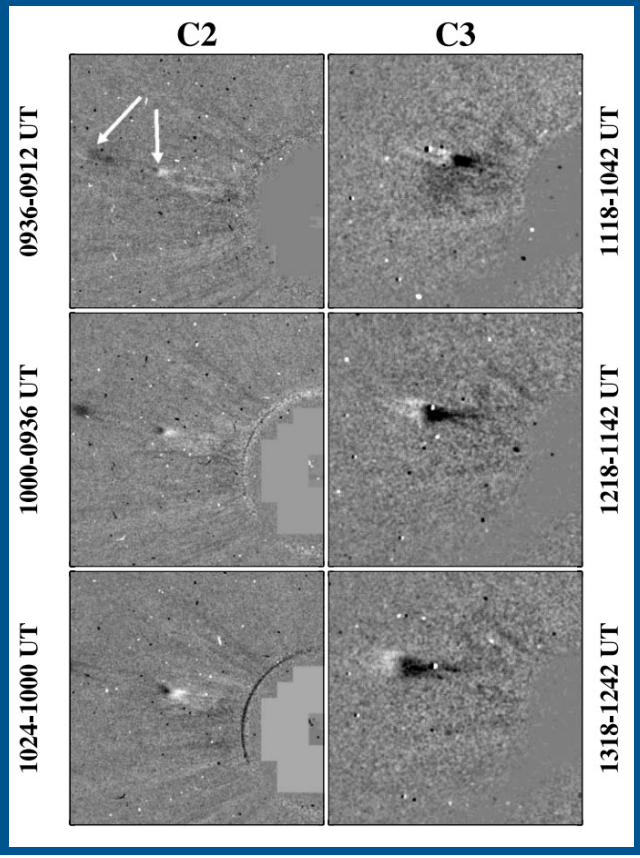
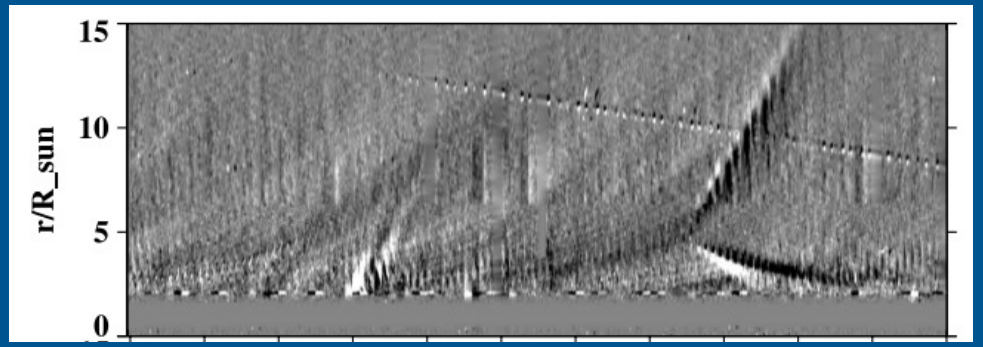
Streamer Blobs



Sheeley & Wang (2007)





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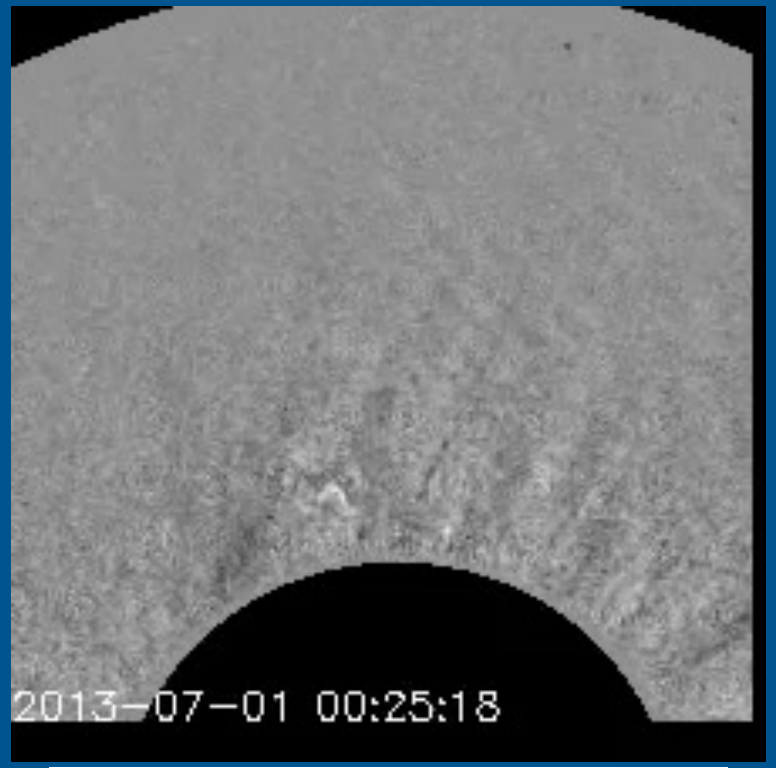
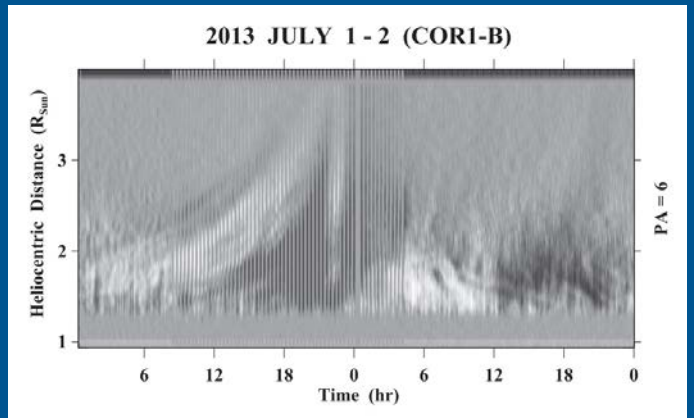
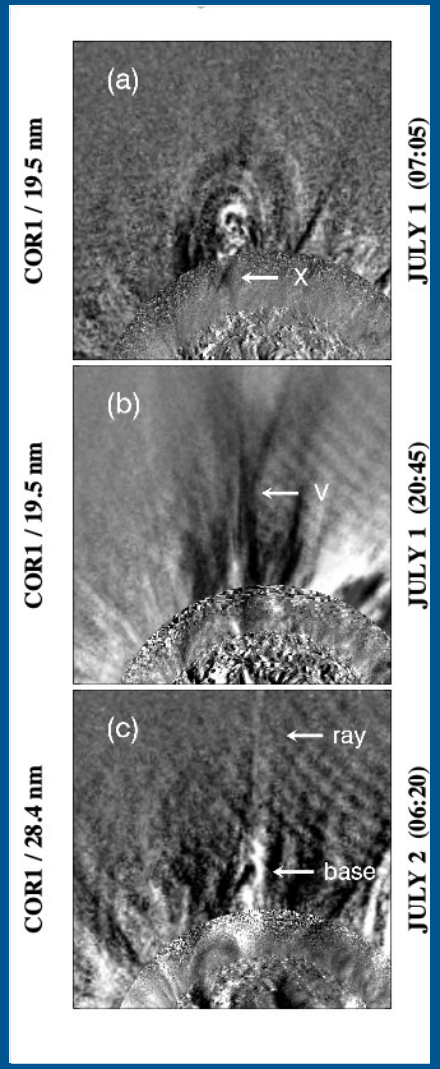
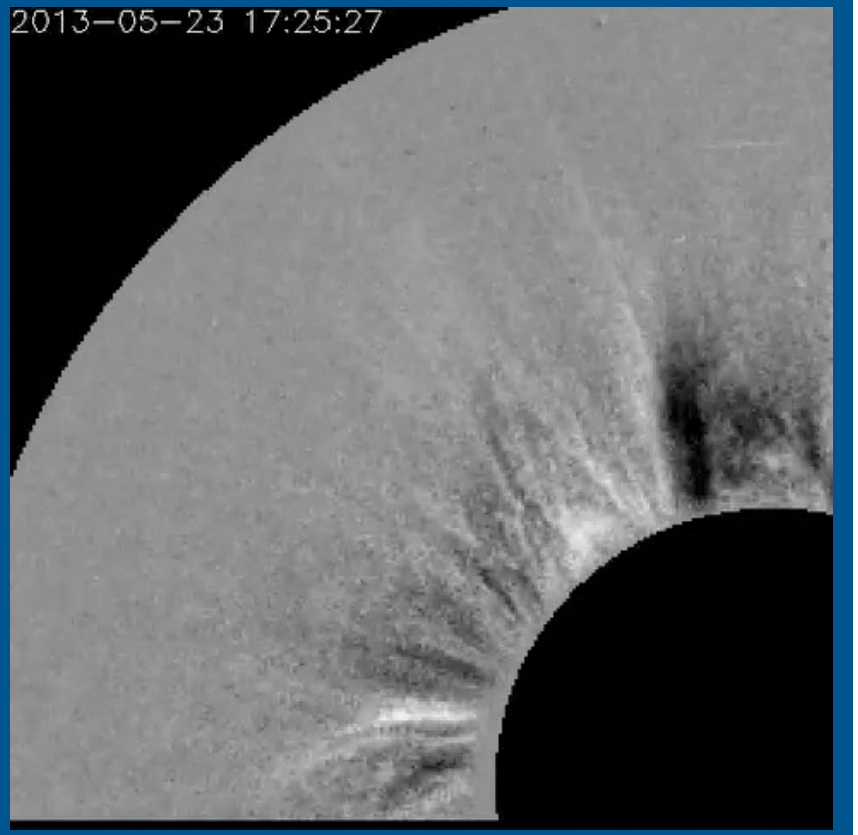
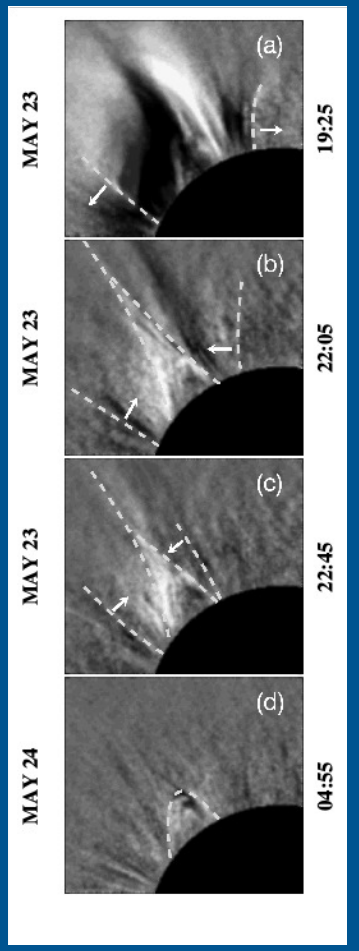
Streamer Blowout











Hess & Wang (2017)

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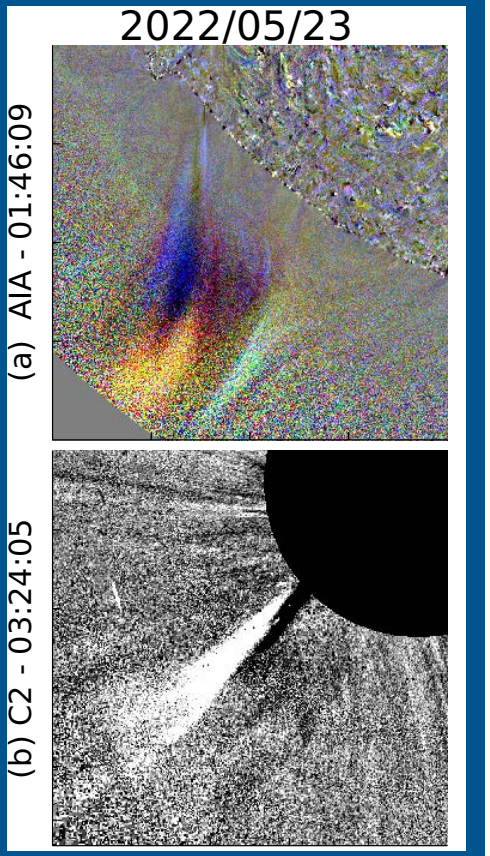
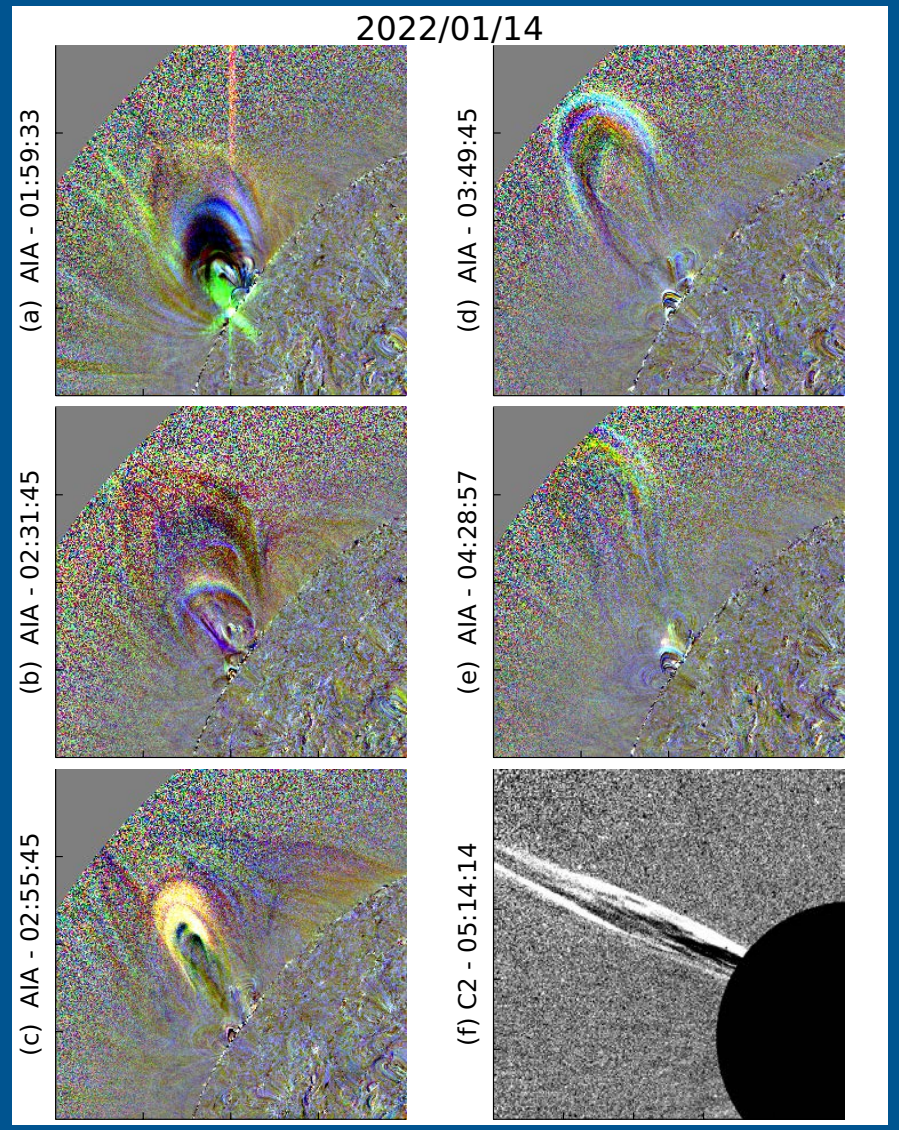
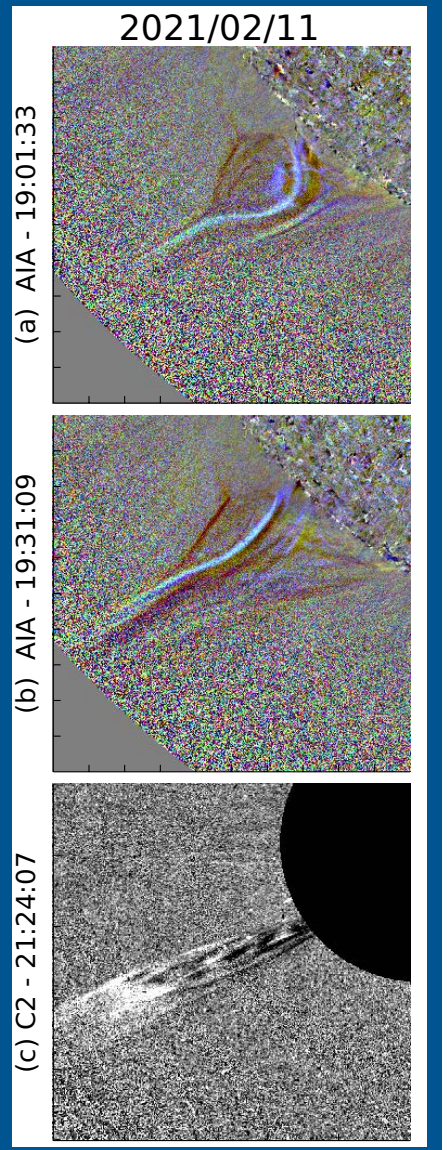
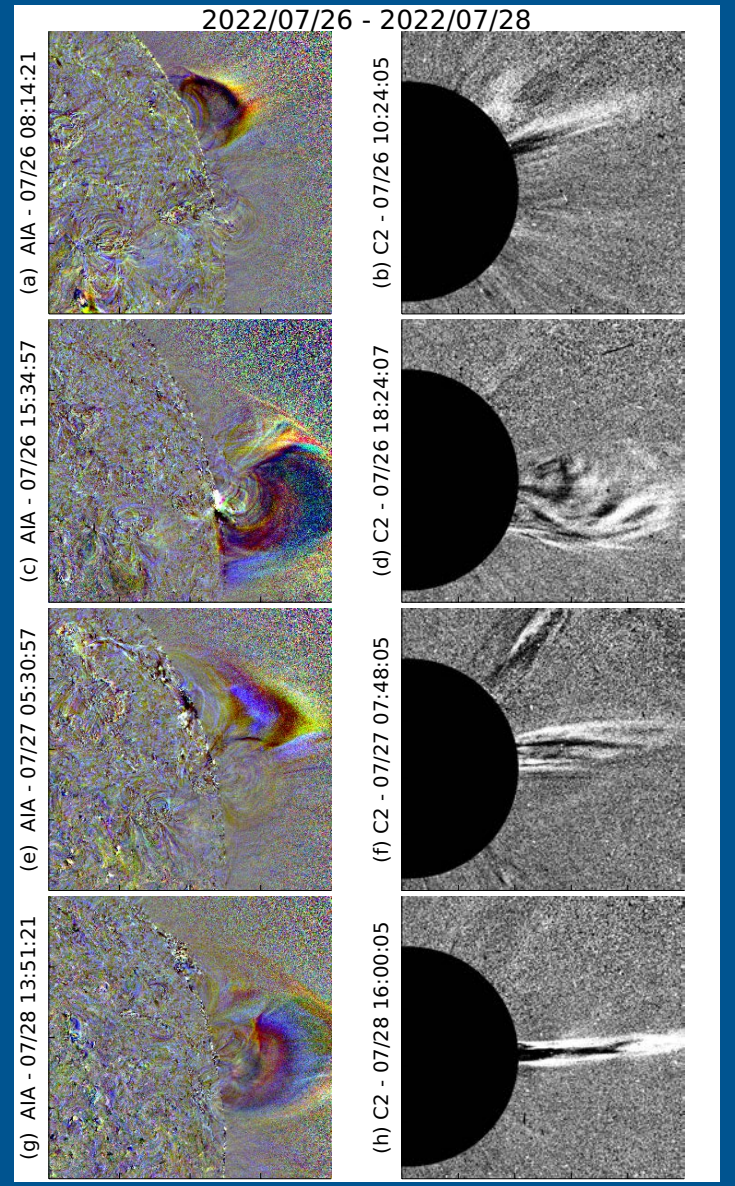
Psuedostreamer Eruptions









Wang & Hess (2023)

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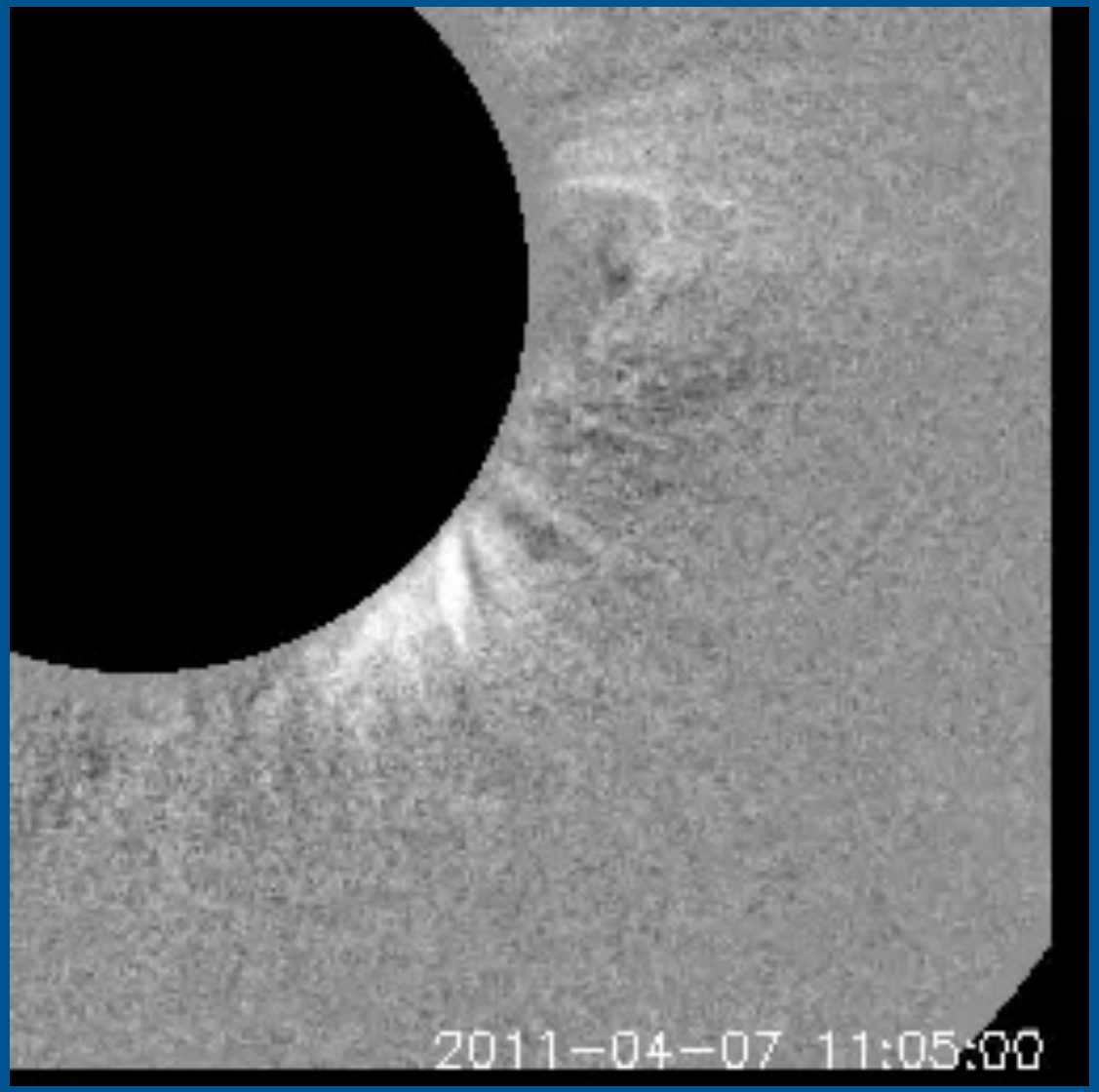
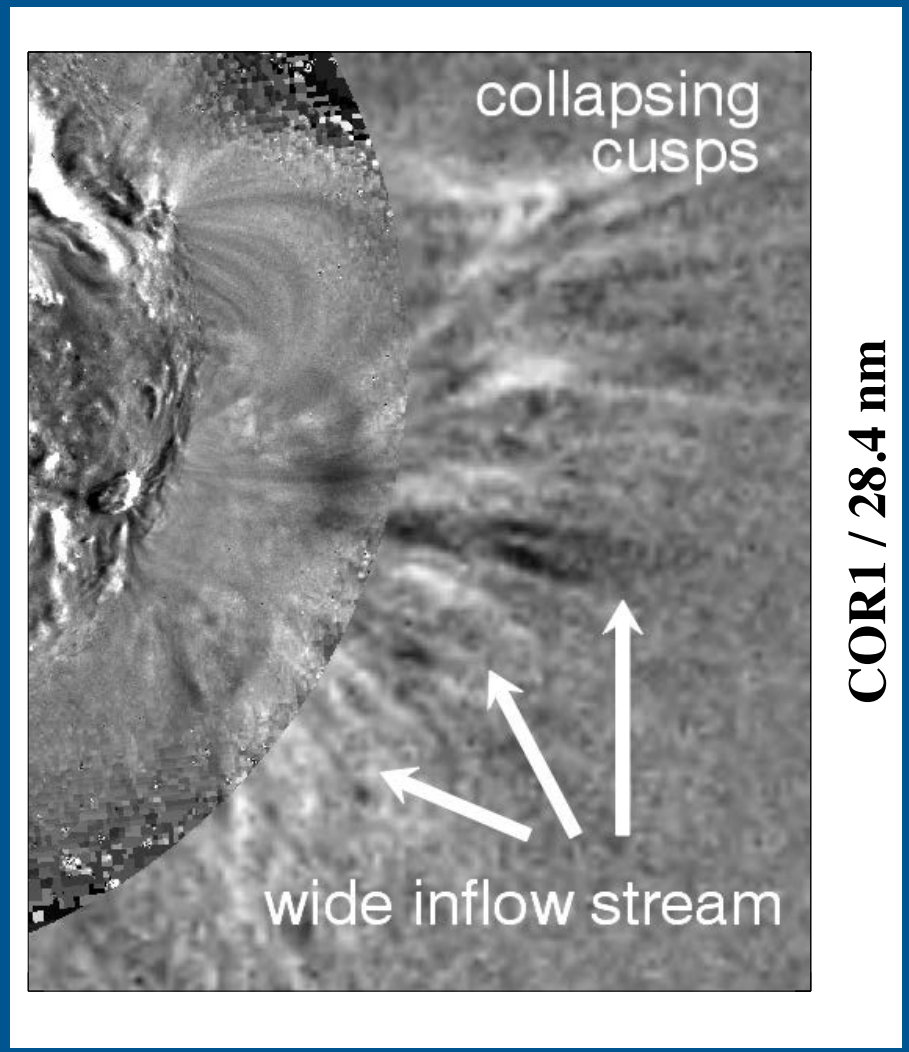
Importance of Perspective





Hess & Wang (2017)

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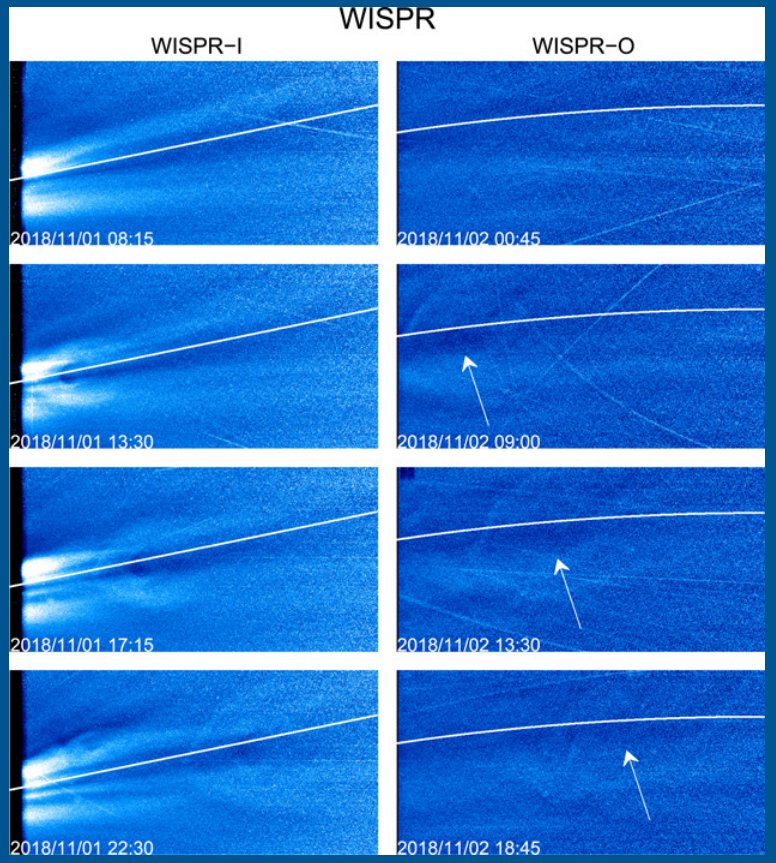
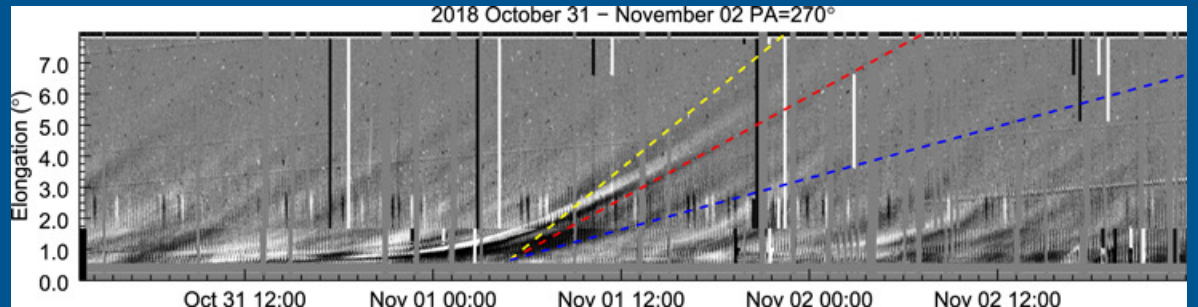
Apparent Flux Rope Structure

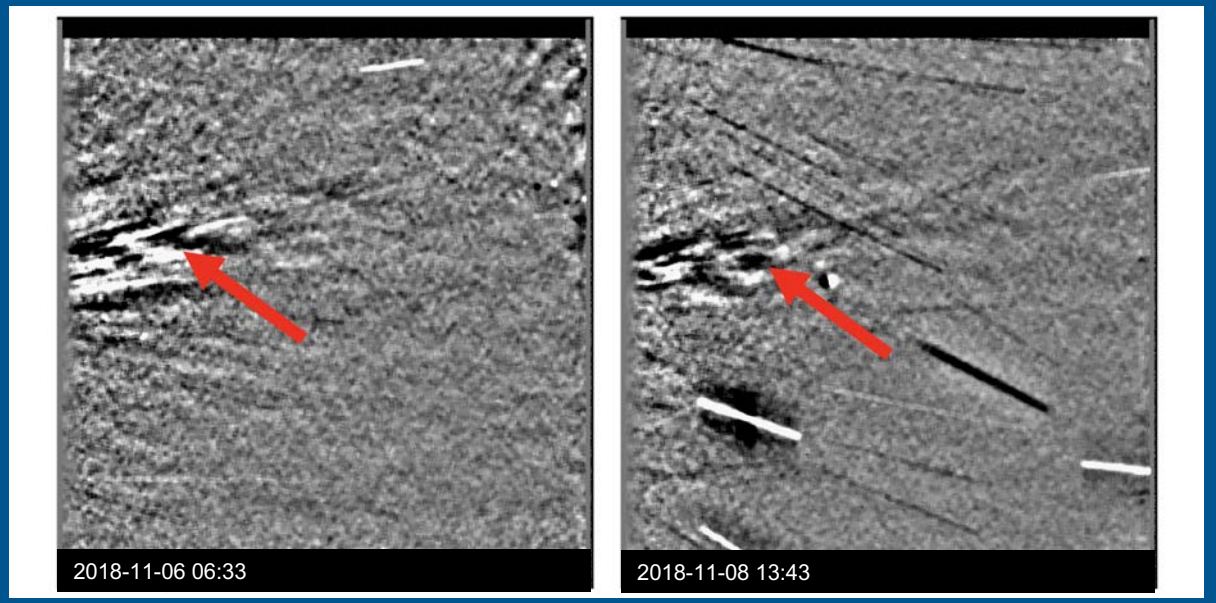


- Throughout every PSP encounter, flux rope like structures flowing from the streamer belt have been imaged with central cavities and trailing claw or 'v' structures

- These flux ropes range from small blobs slowly propagating in the solar wind to streamer blowout eruptions and, more recently, even larger CMEs

Hess et al 2020





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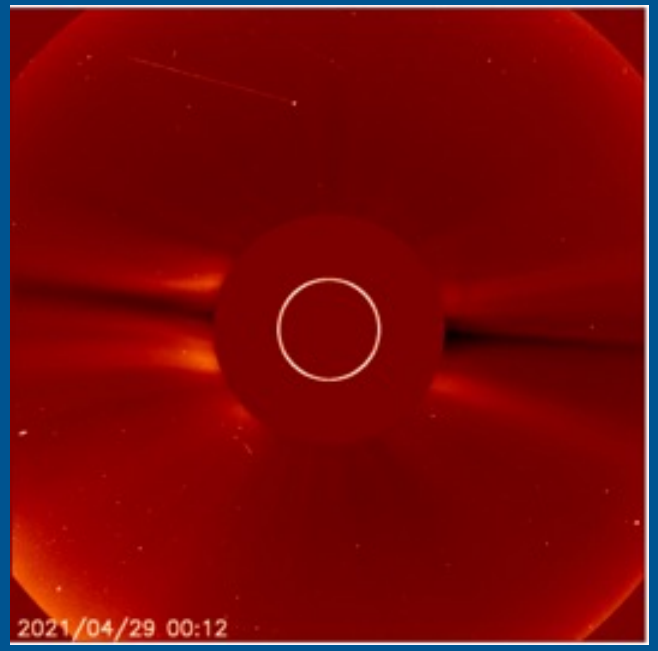
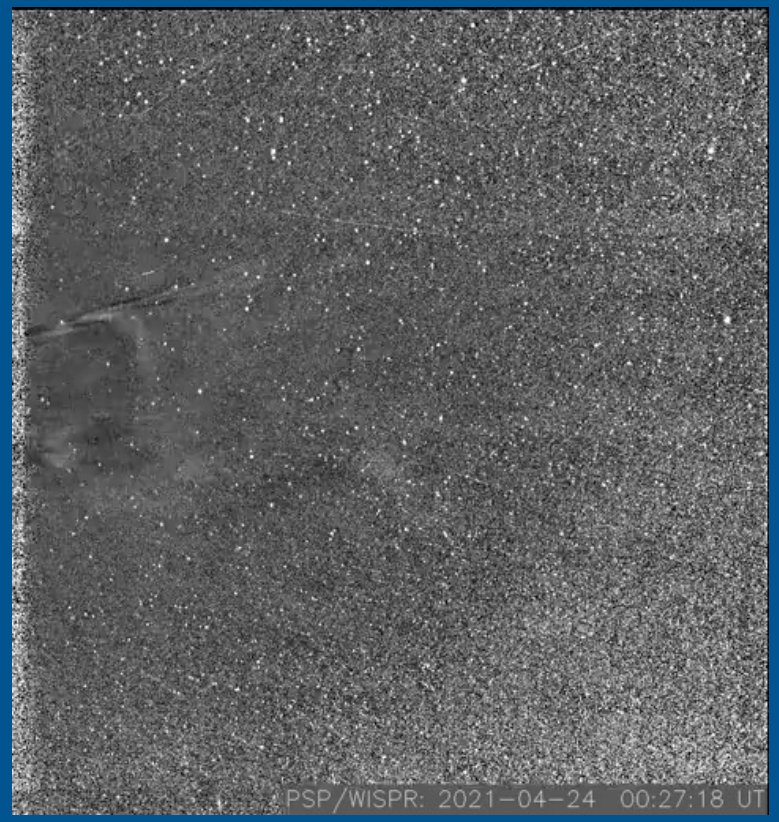
Viewing the Streamer Belt "Edge On" – E8

LASCO C2



WISPR-I 'LT'

WISPR-I 'LW'



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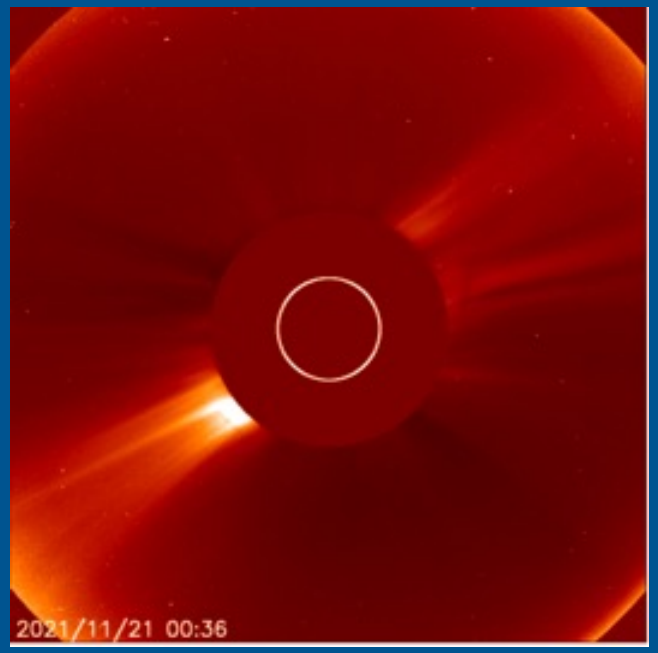
Viewing the Streamer Belt "Face On" – E10

LASCO C2



WISPR-I 'LT'

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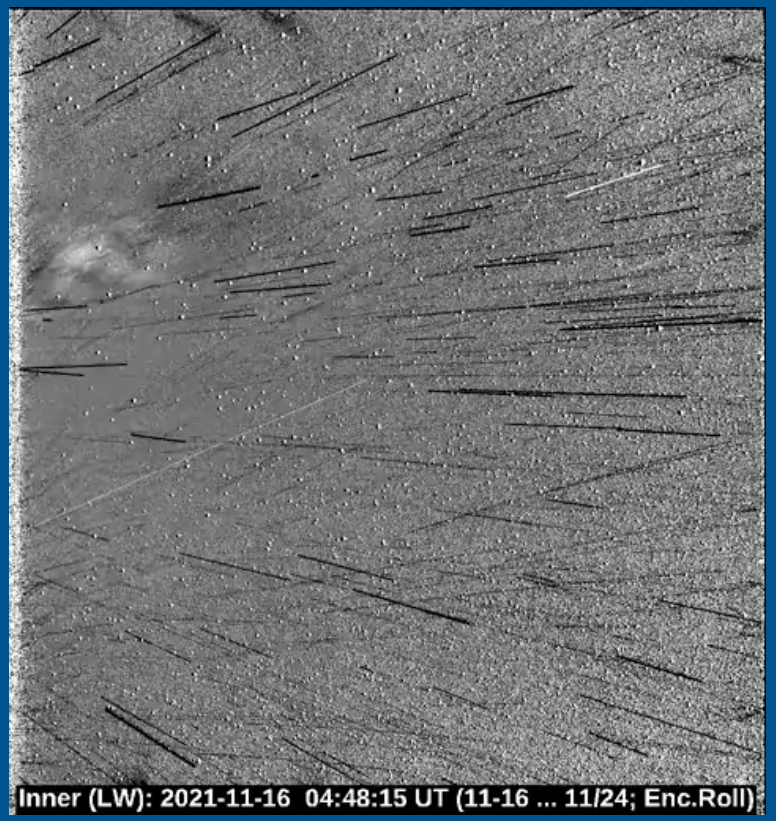

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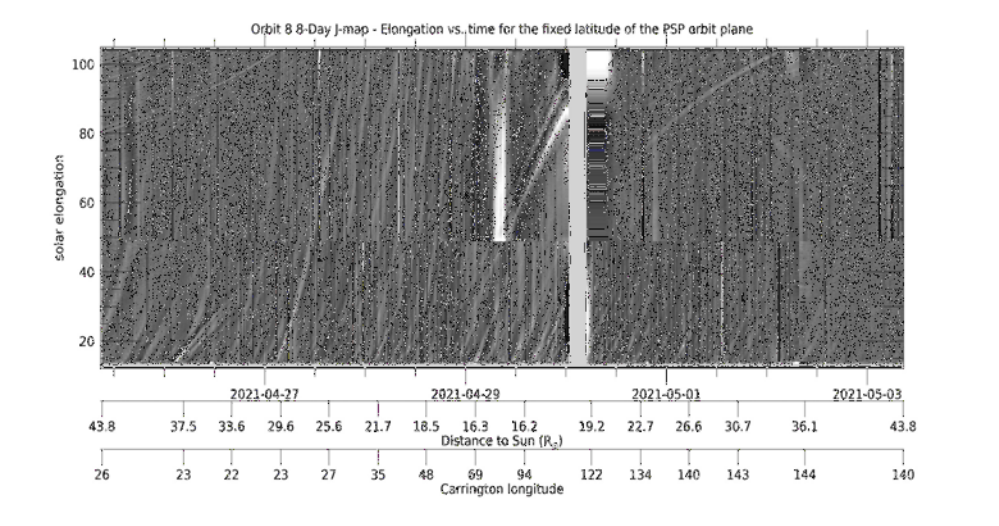
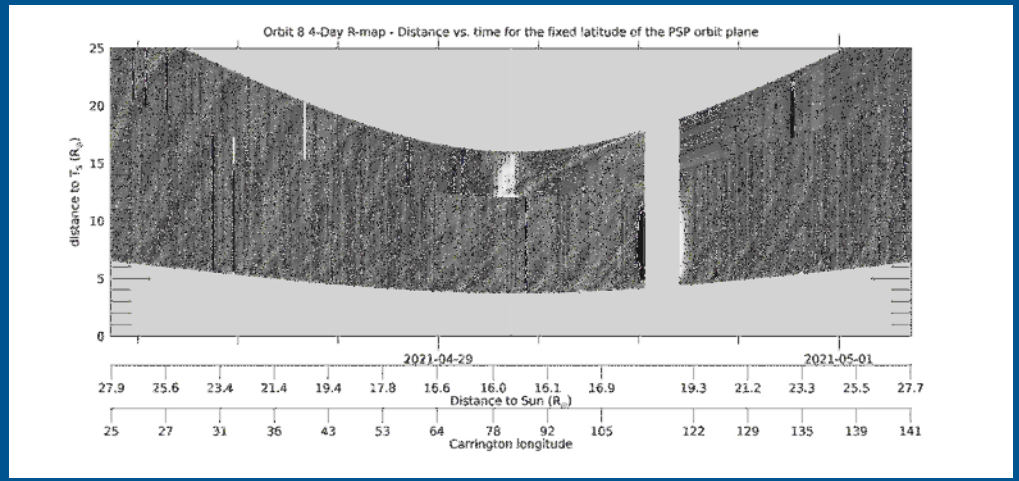
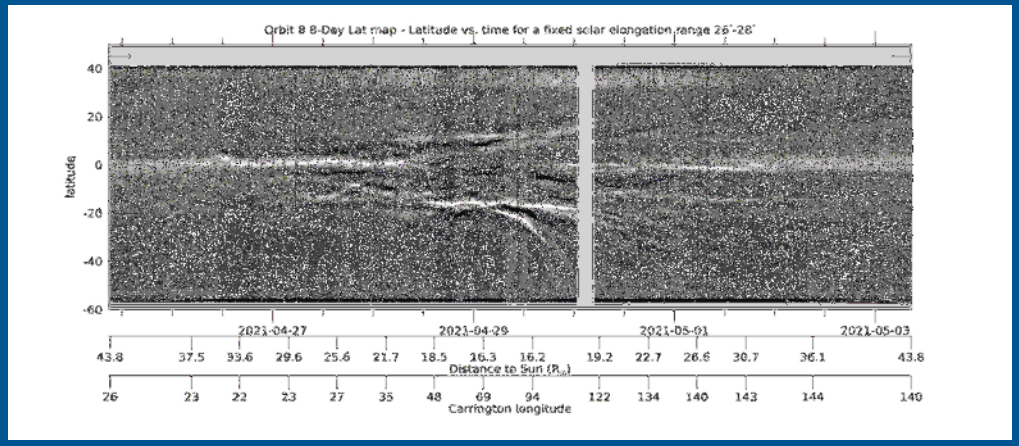
Encounter 8 Maps





Maps provided by NASA/JPL/CALTECH and available on WISPR encounter summary pages at wispr.nrl.navy.mil



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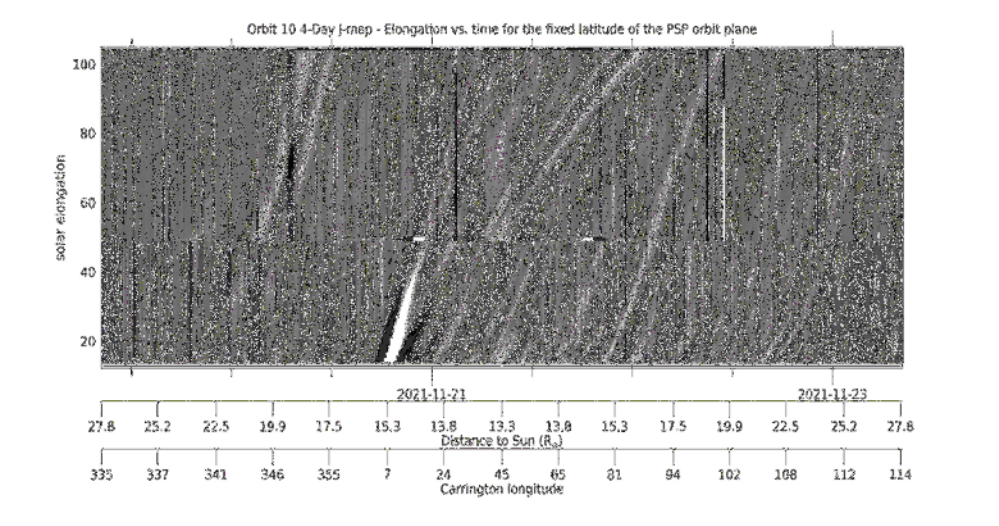
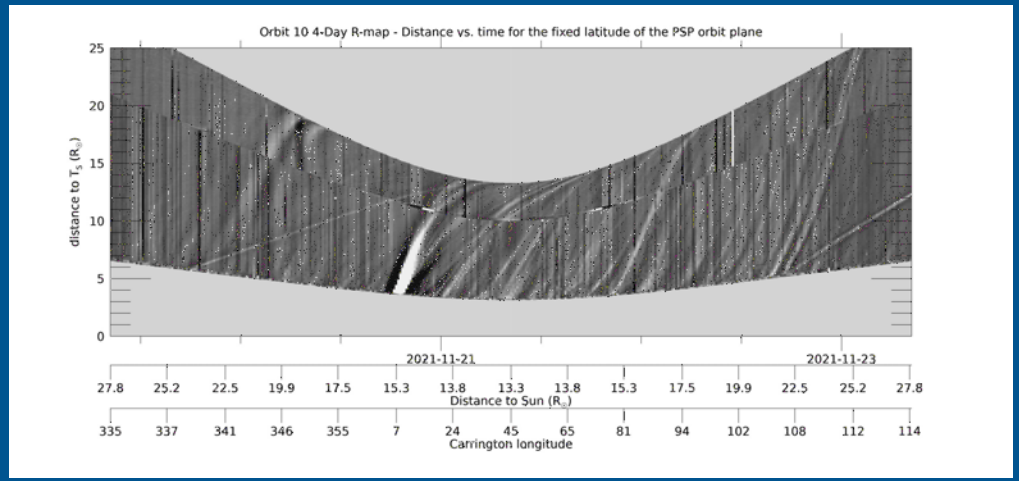
Encounter 10 Maps





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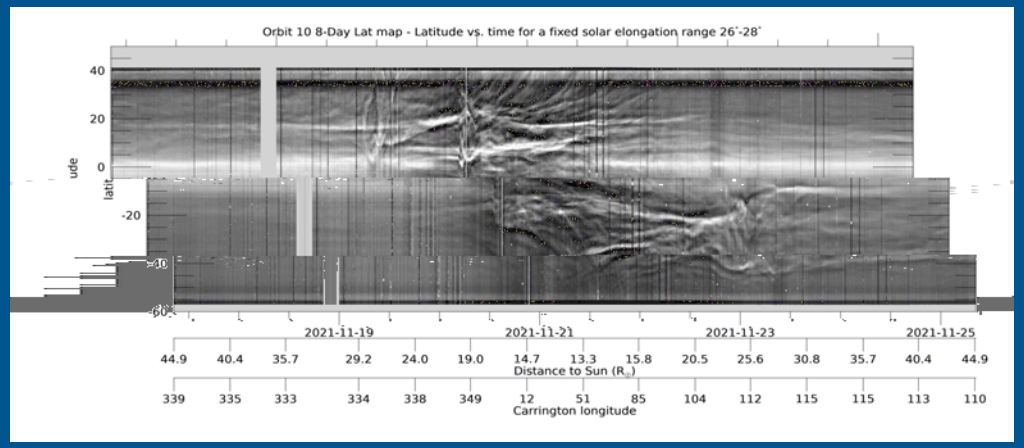

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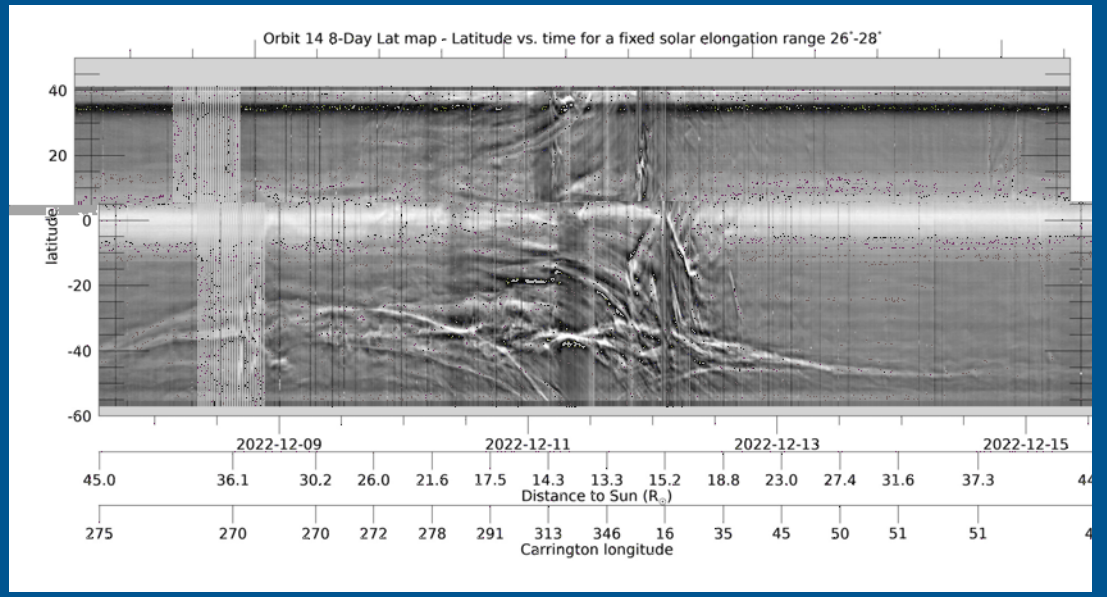
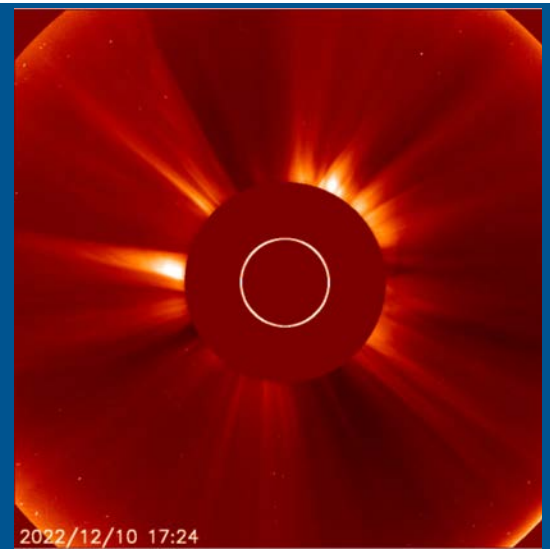
Encounter 14





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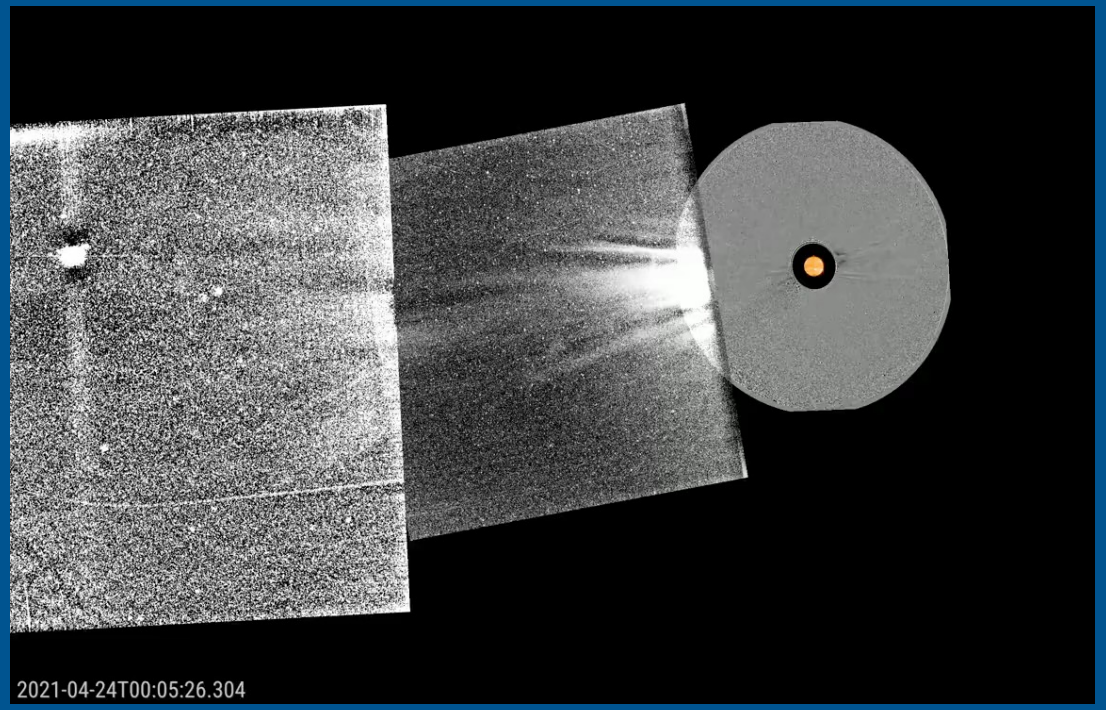
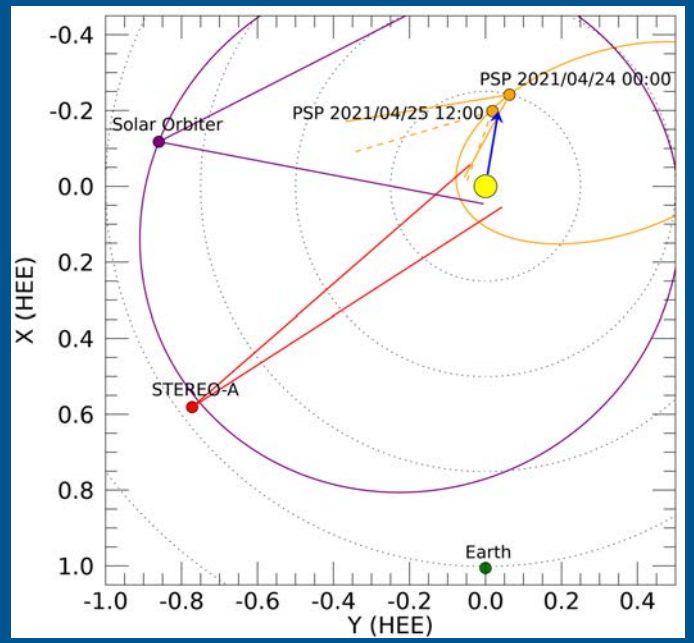
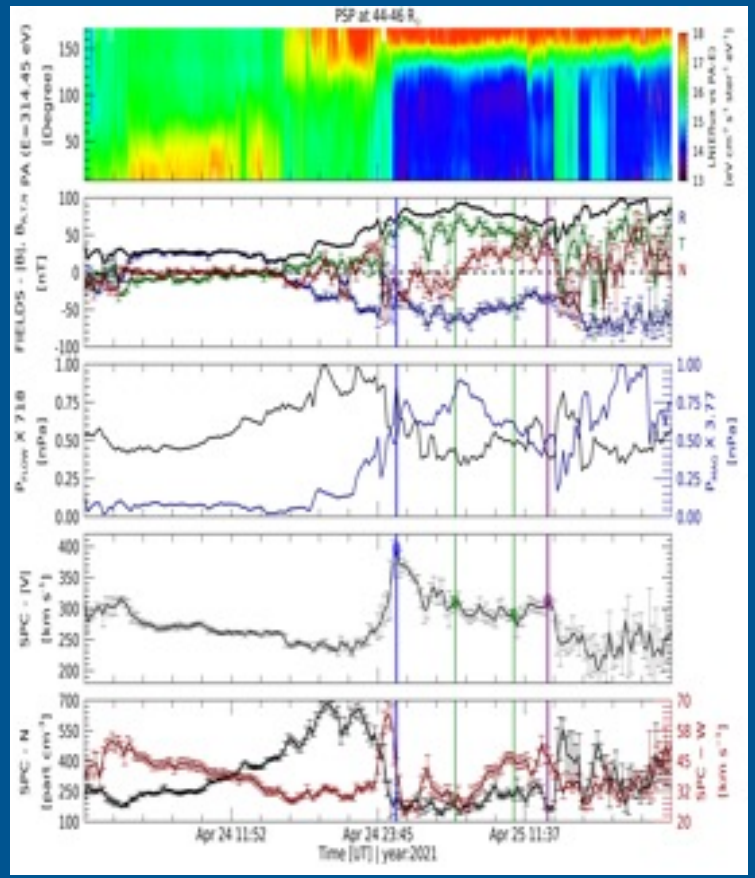
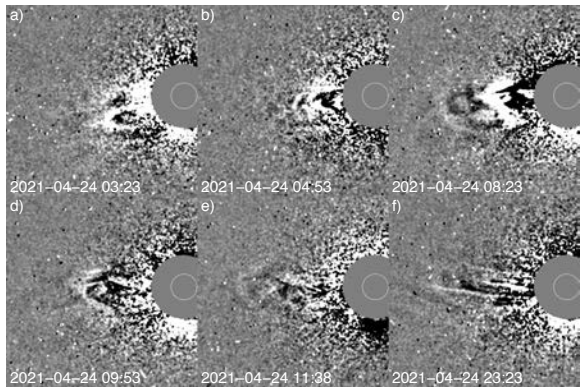
Linking Imaging of Blowout with In-situ data



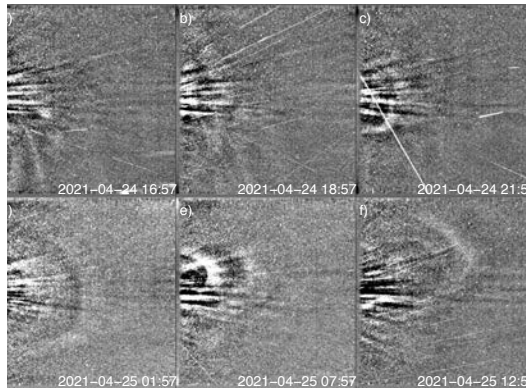




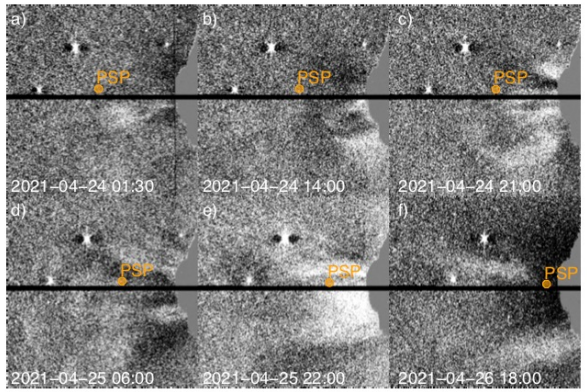
STEREO–A COR2



WISPR–I

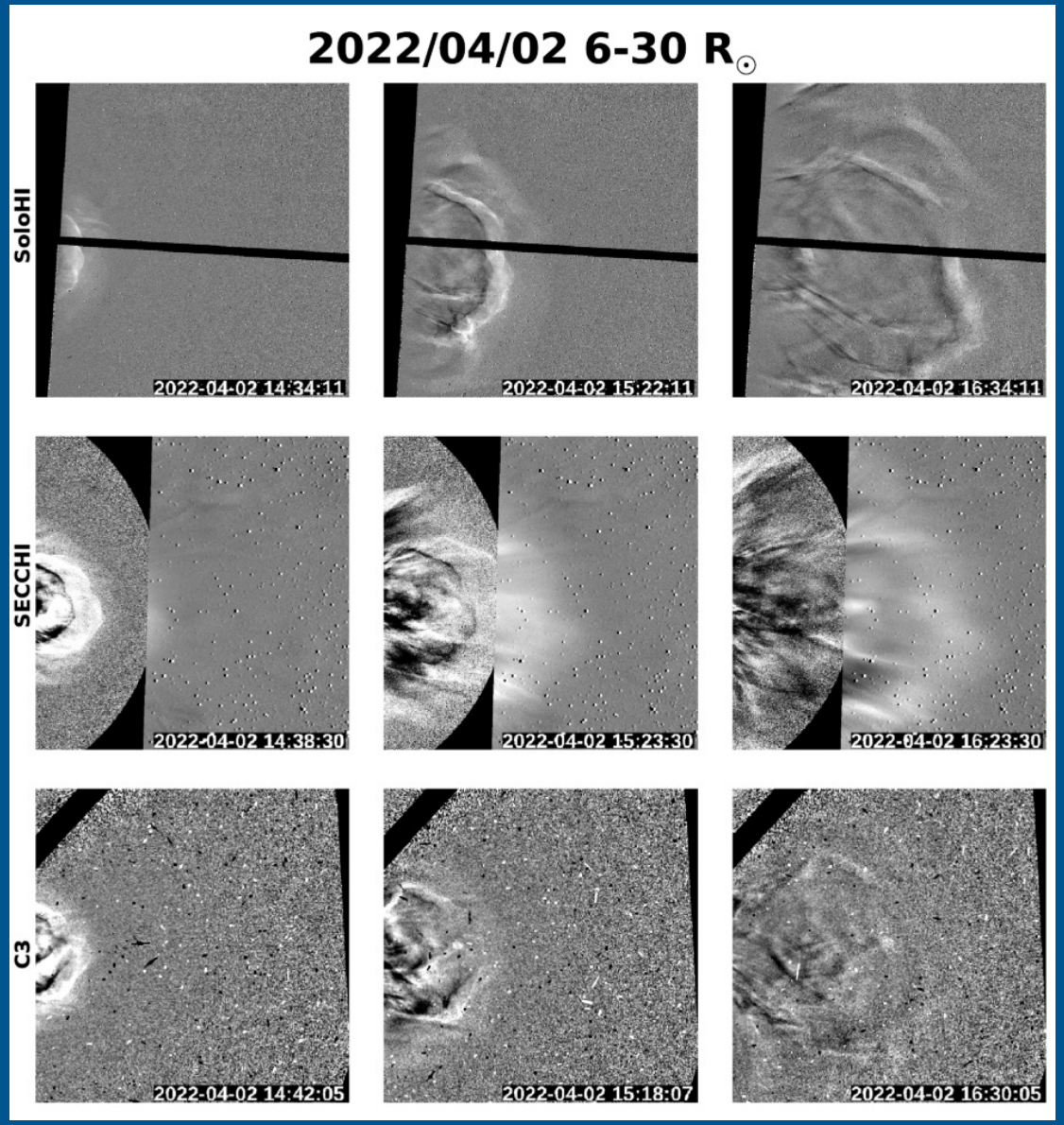


SoloHI

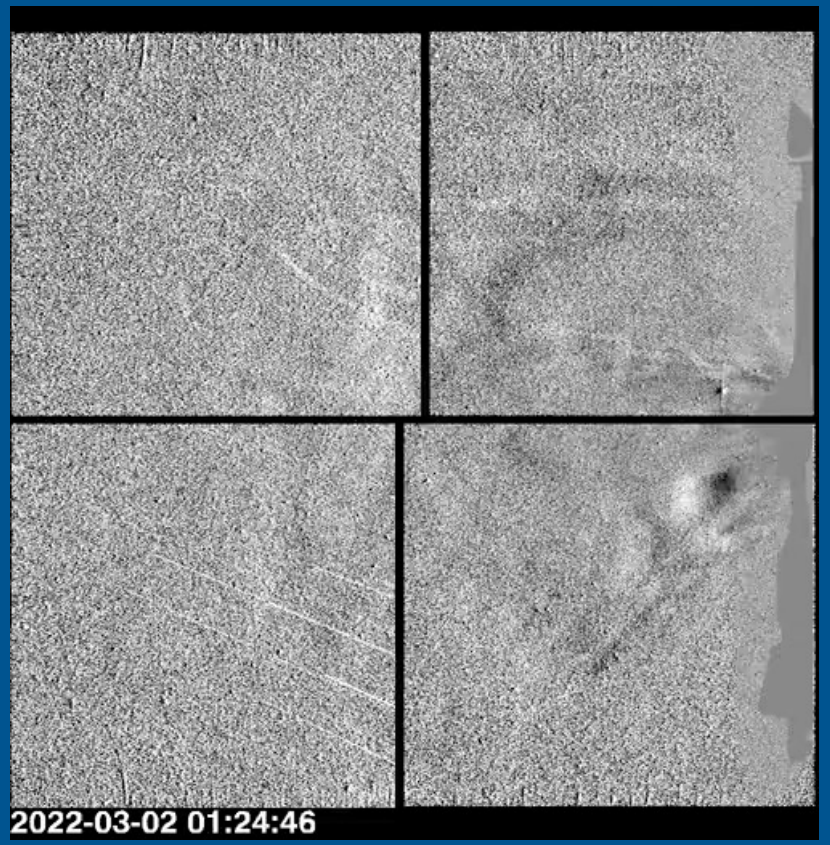


Niembro et al (2023)

SoloHI



- The Solar Orbiter Heliospheric Imager (SoloHI) provides quasi-stationary images combining the traditional coronagraph and HI fields of view



Hess et al 2023 (submitted)

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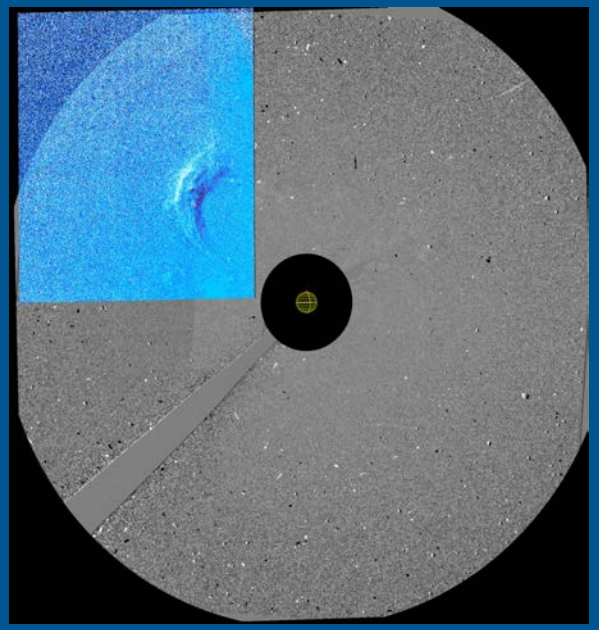
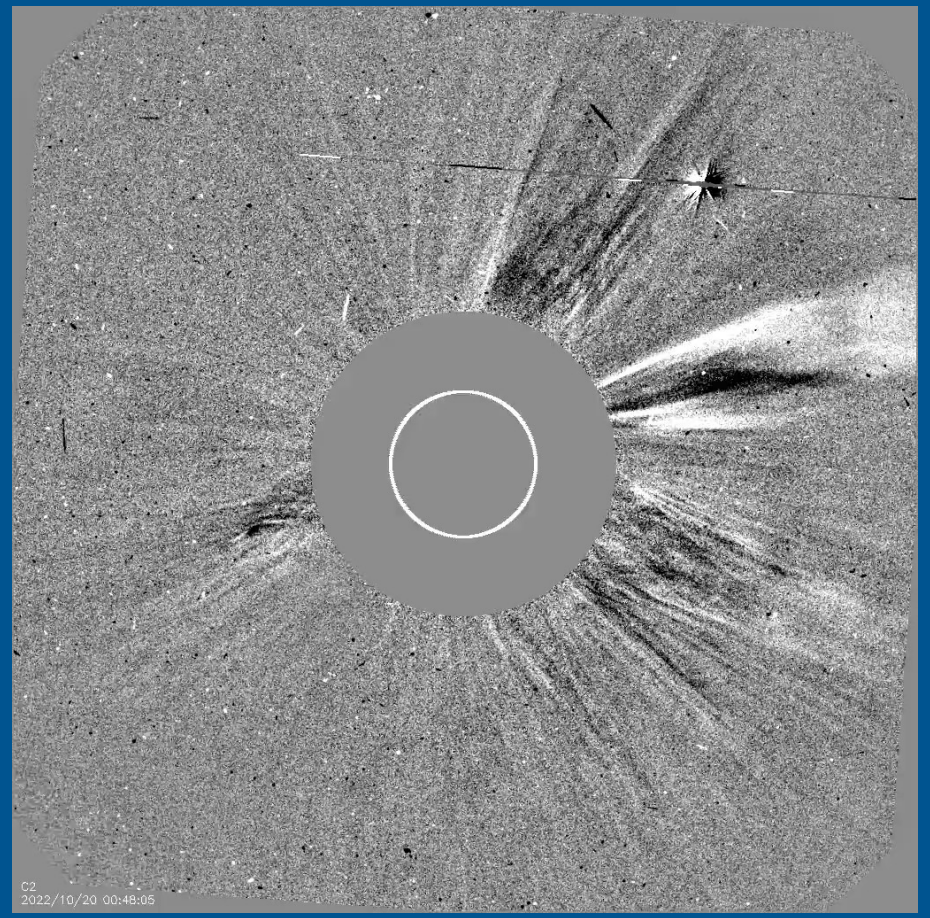
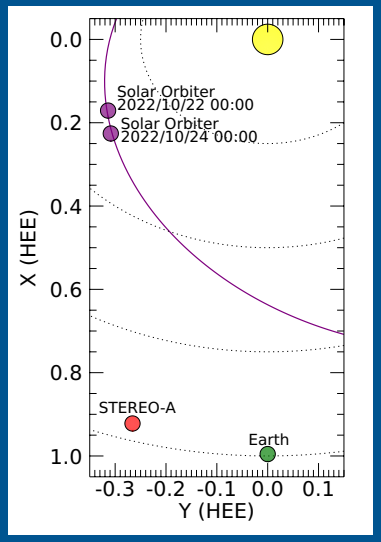
Expanding SoloHI Loops







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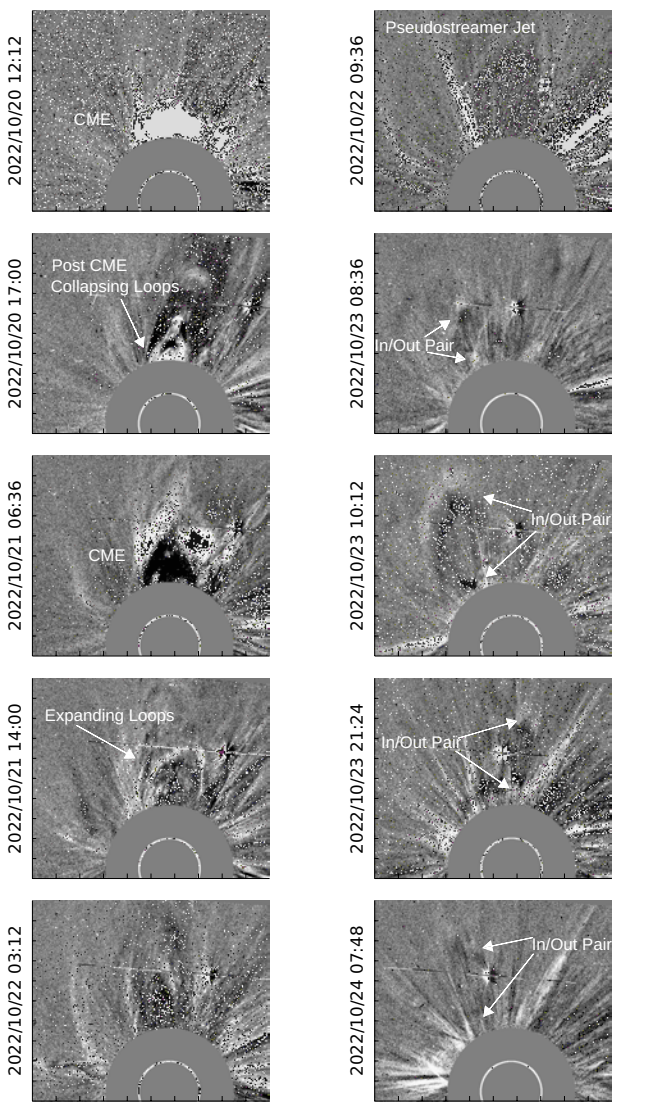
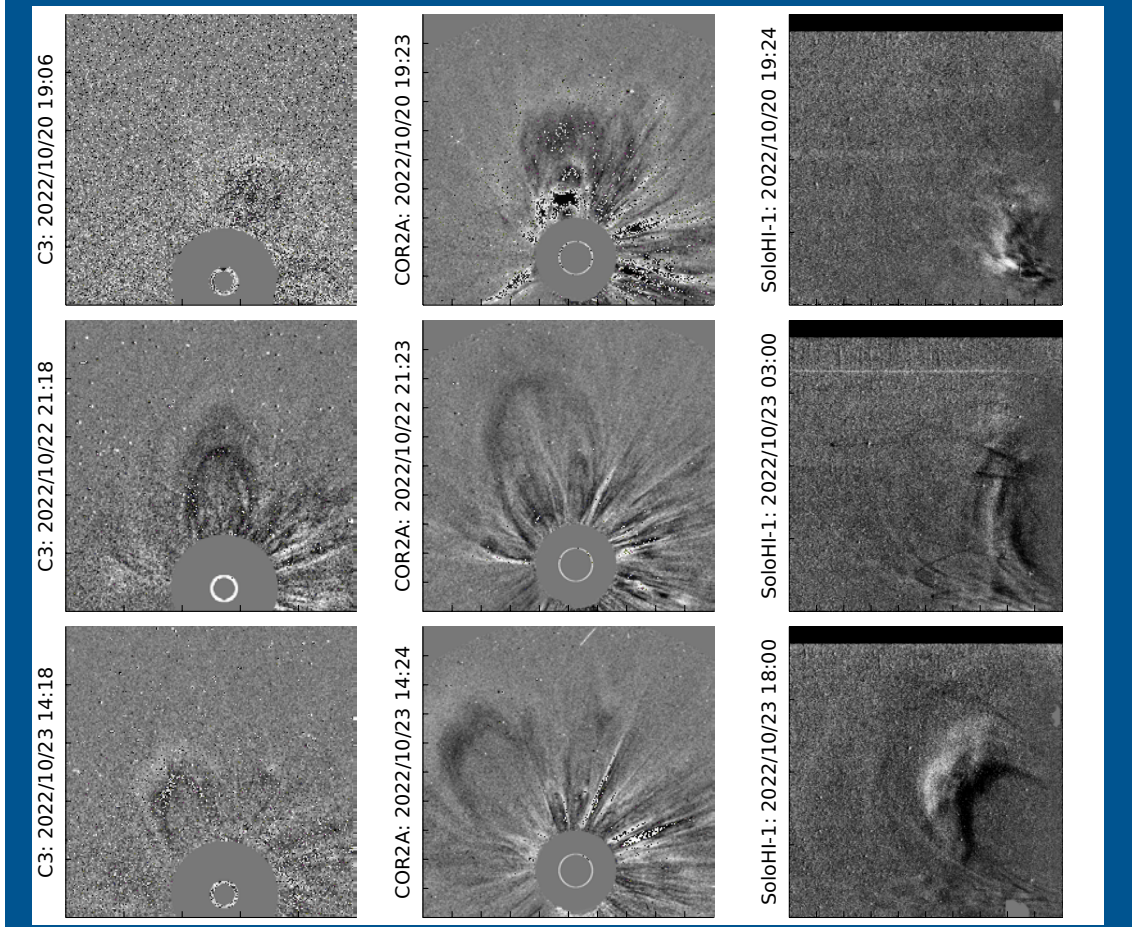
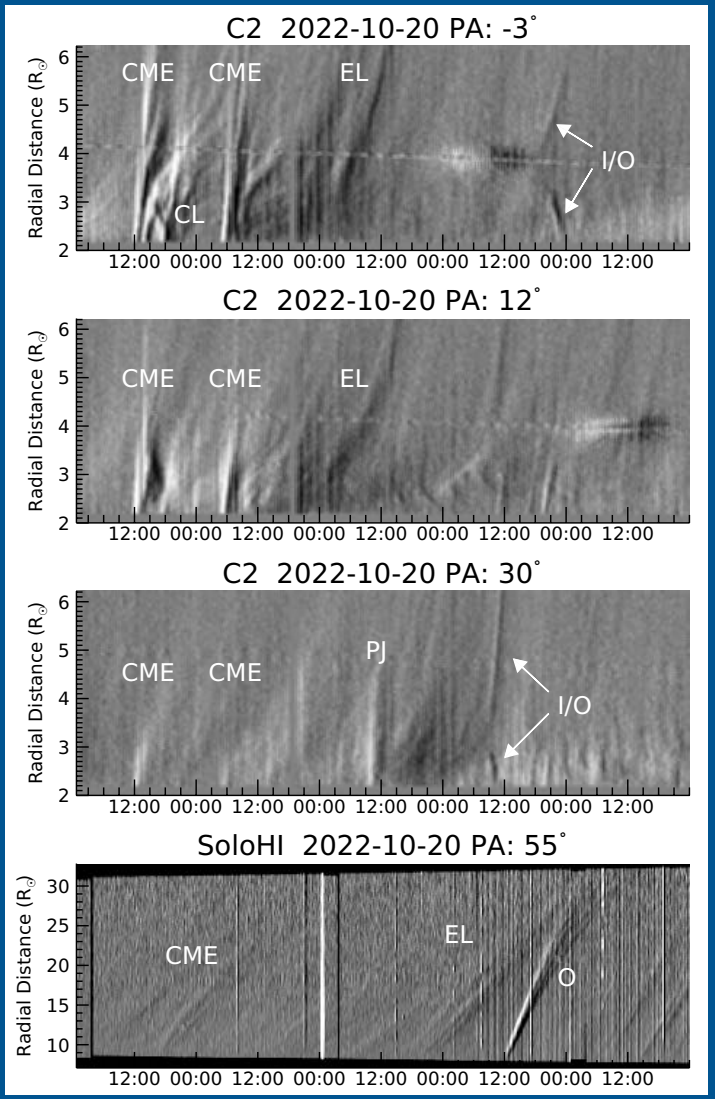
Comparing Observations







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Conclusions and Summary

- Our new generation of heliospheric imagers give us unprecedented views of erupting transients of all sizes in the solar wind
- The nature of the eruptions of each pass for PSP and Orbiter will be highly dependent on the inclination of the plasma sheet
- The small scale blobs and blowouts, while not being impactful from a space weather perspective, provide significant flux and structure to the solar wind
- The complexity of these observations also present new challenges in how we present and analyze the data, and new techniques will be needed