

# The roll of EUV observations in space weather capabilities: insights from the first statistical study of prominence eruptions observed with SolO/EUI/FSI

B.D. Dorsch<sup>1,2</sup>, D.C. Talpeanu<sup>1</sup>, L. Rodriguez<sup>1</sup>, E. D’Huys<sup>1</sup>, M. Mierla<sup>1,3</sup>,  
D. Shukhobodskaia<sup>1</sup>, M. West<sup>4</sup>, D. Berghmans<sup>1</sup>, C. Verbeeck<sup>1</sup>



KU LEUVEN

Large-Scale  
Structures  
Originating  
from the Sun

LASSOS

Meeting June 8th, 2026.

<sup>1</sup> Solar-Terrestrial Centre of Excellence - SIDC, Royal Observatory of Belgium, Brussels, Belgium.

([Brenda.dorsch@observatory.be](mailto:Brenda.dorsch@observatory.be))

<sup>2</sup> KU Leuven, Centre for mathematical Plasma Astrophysics Celestijnenlaan 200B, Leuven.

<sup>3</sup> Institute of Geodynamics of the Romanian Academy, Bucharest, Romania.

<sup>4</sup> European Space Agency European Space Research and Technology Centre, Keplerlaan 1, 2201 AZ, Netherlands.

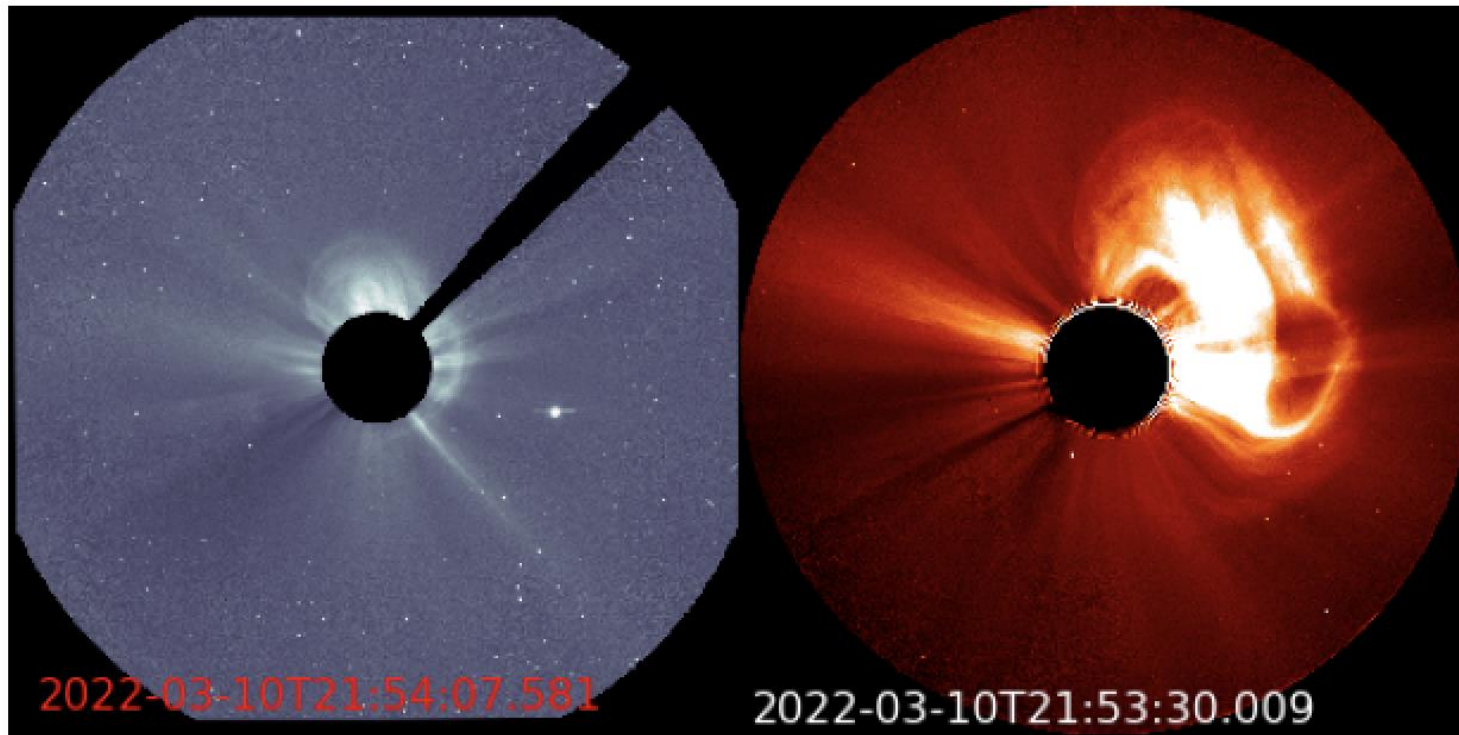


# EUV observations for Space Weather

# EUV observations for CME modelling

---

## *CME modelling*



Coronagraph images  
provide valuable  
information

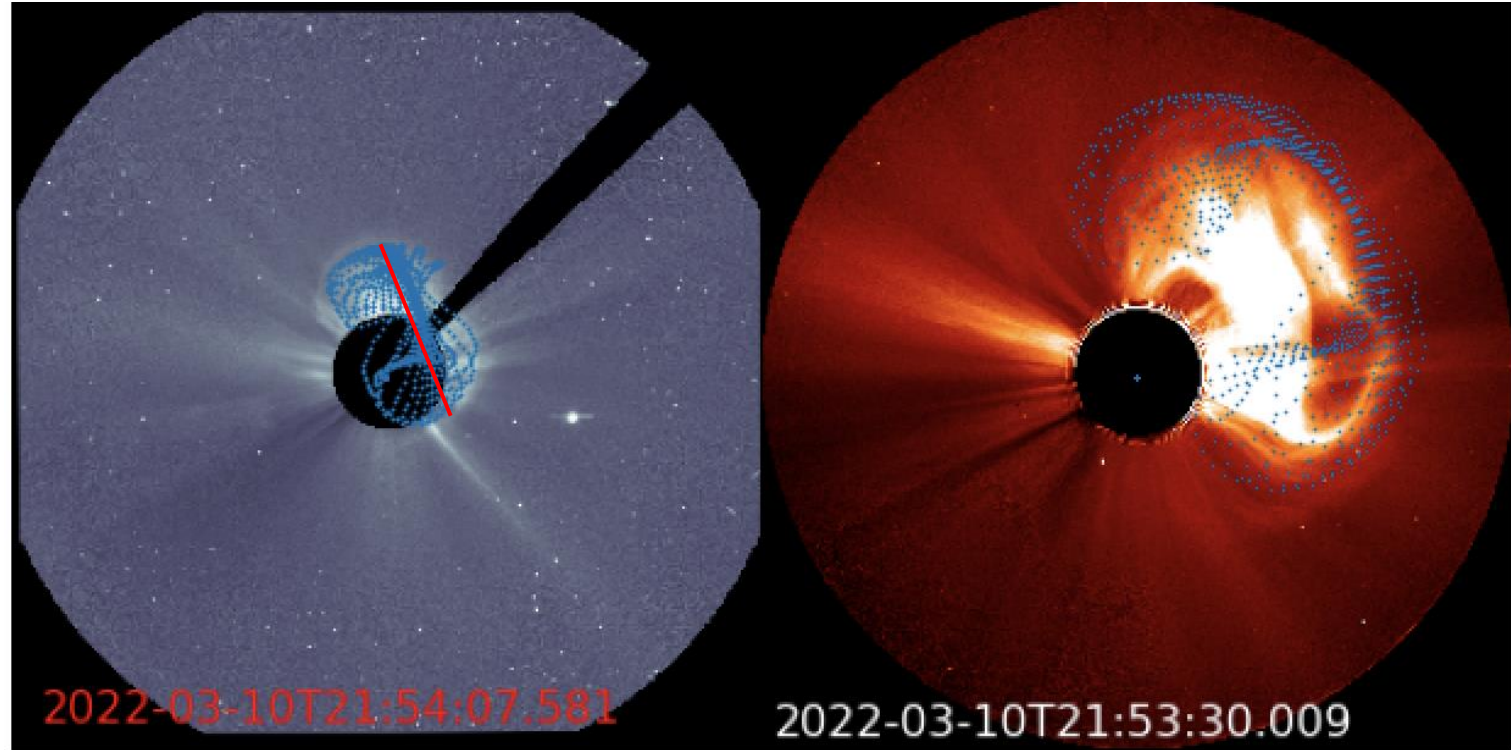
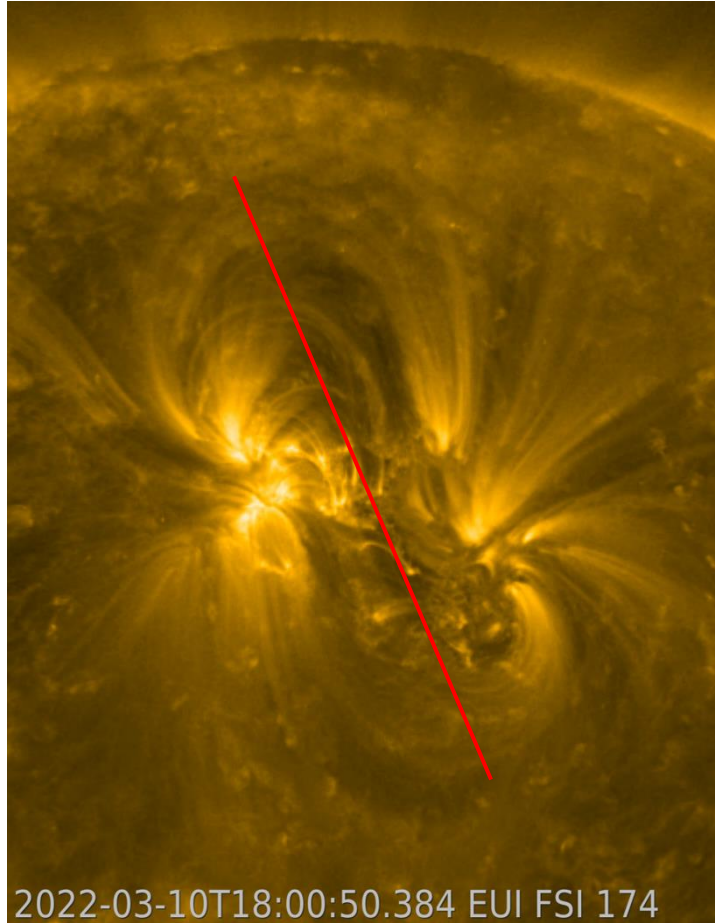
but...

CME source region?

CME magnetic field characteristics?

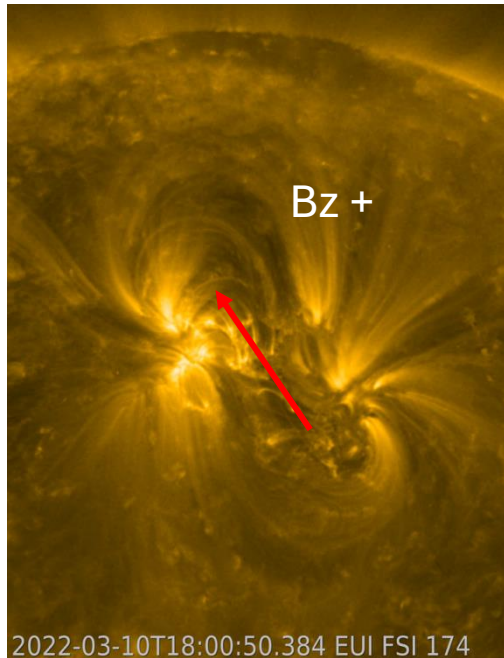
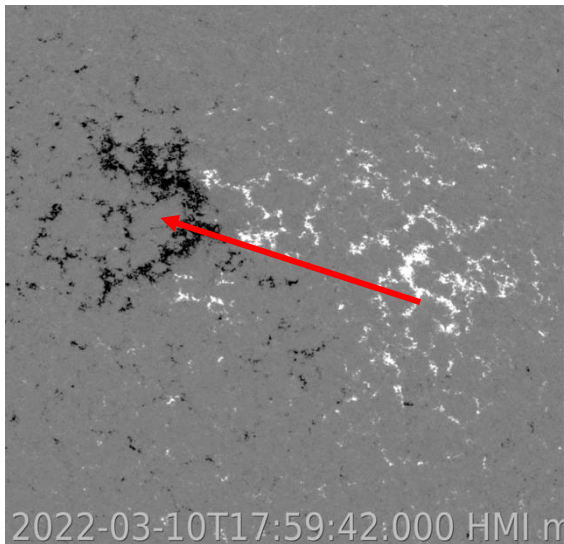
# EUV observations for CME modelling

---

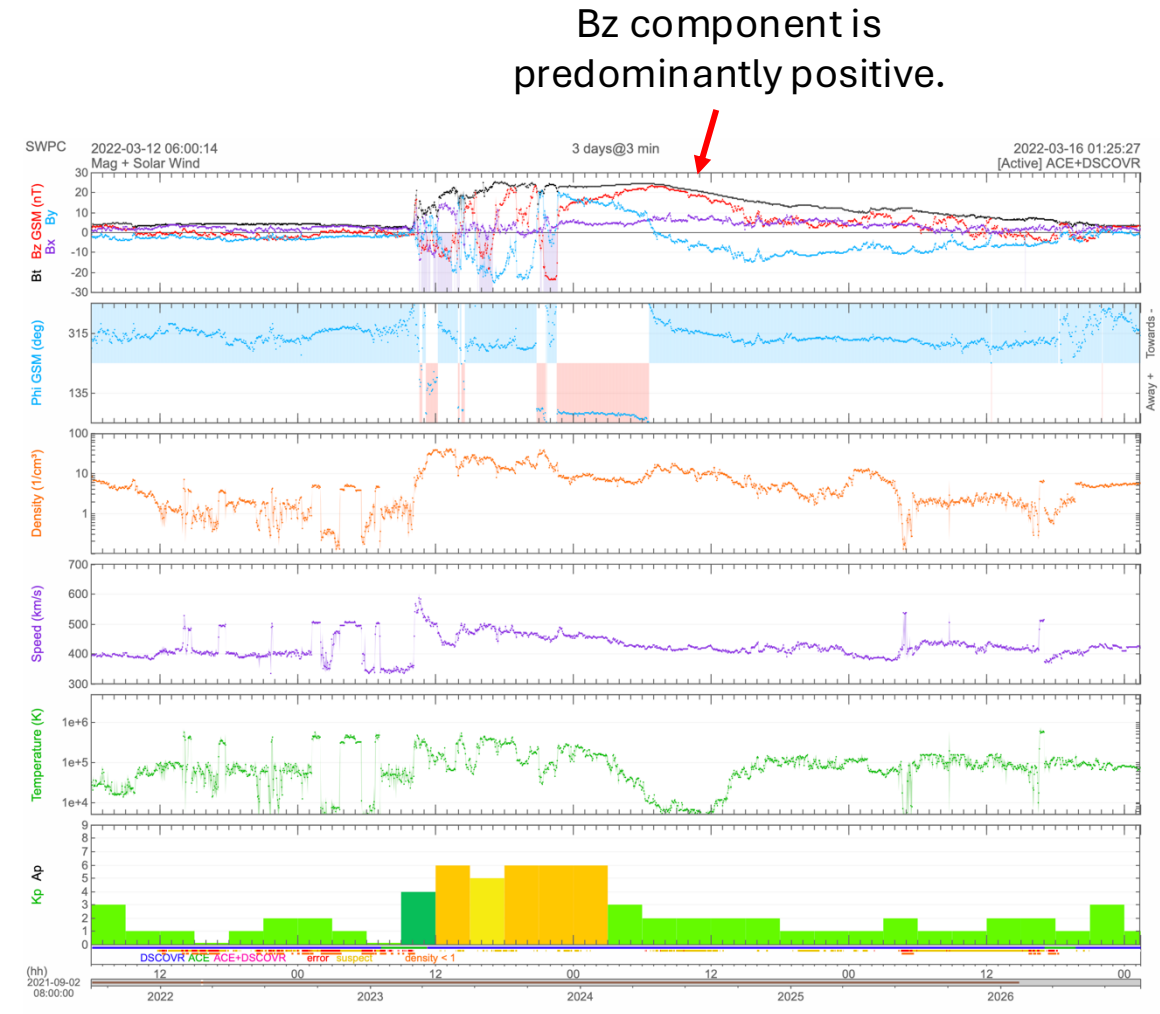


More accurate CME 3D reconstruction for propagation direction and speed.

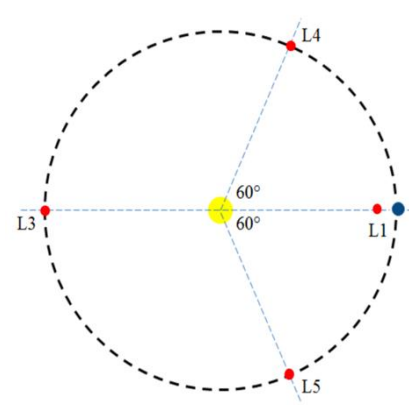
# EUV observations for CME modelling



Understanding of magnetic field orientation is important to assess the ICME impact at Earth.

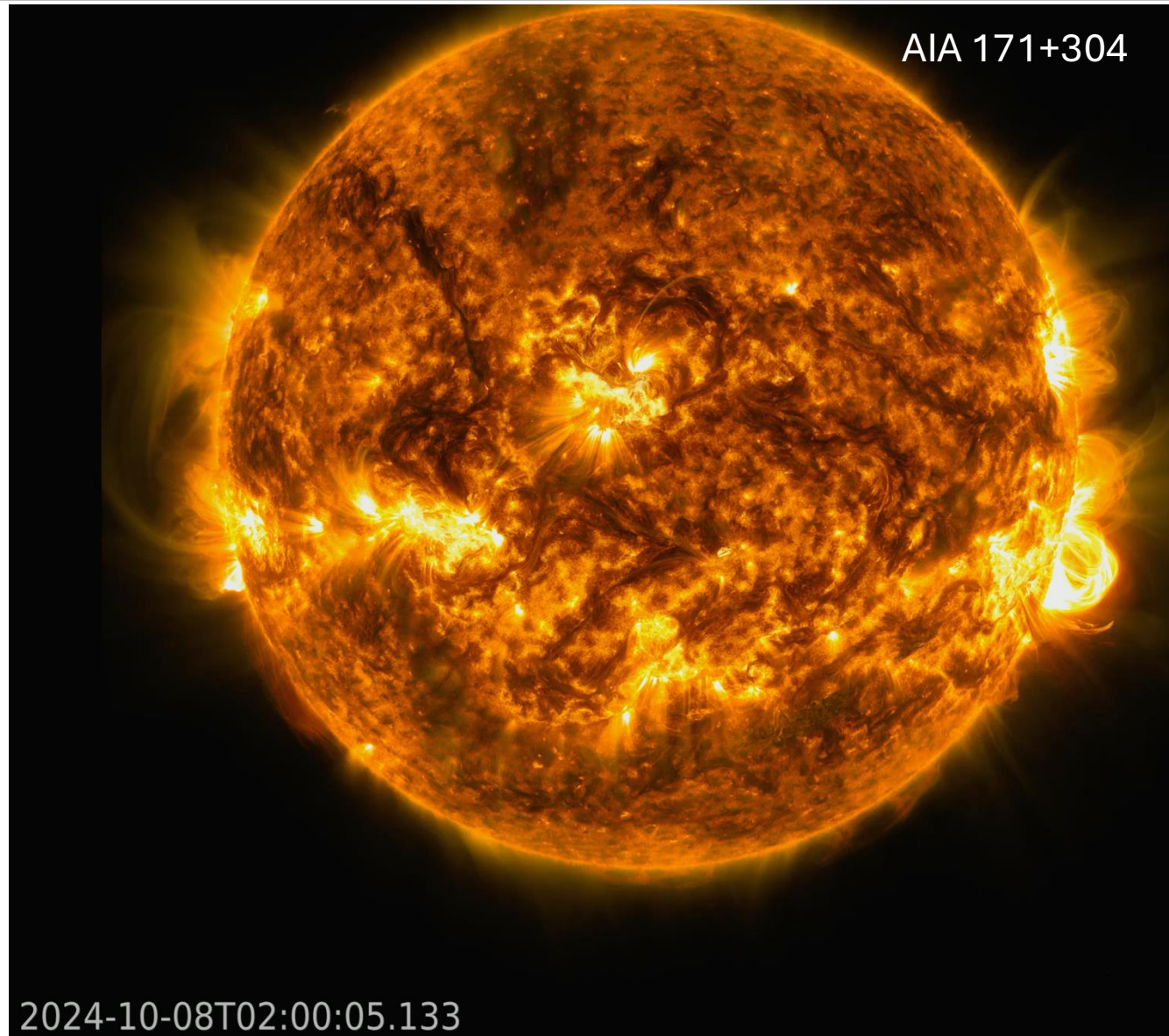


# EUV from L5 perspective



Case: CME eruptions  
directed towards Earth.

**L1** observations are important  
for diagnostic but front  
viewpoint does not allow to  
follow evolution of eruptions  
in the low corona.



# EUV from L5 perspective

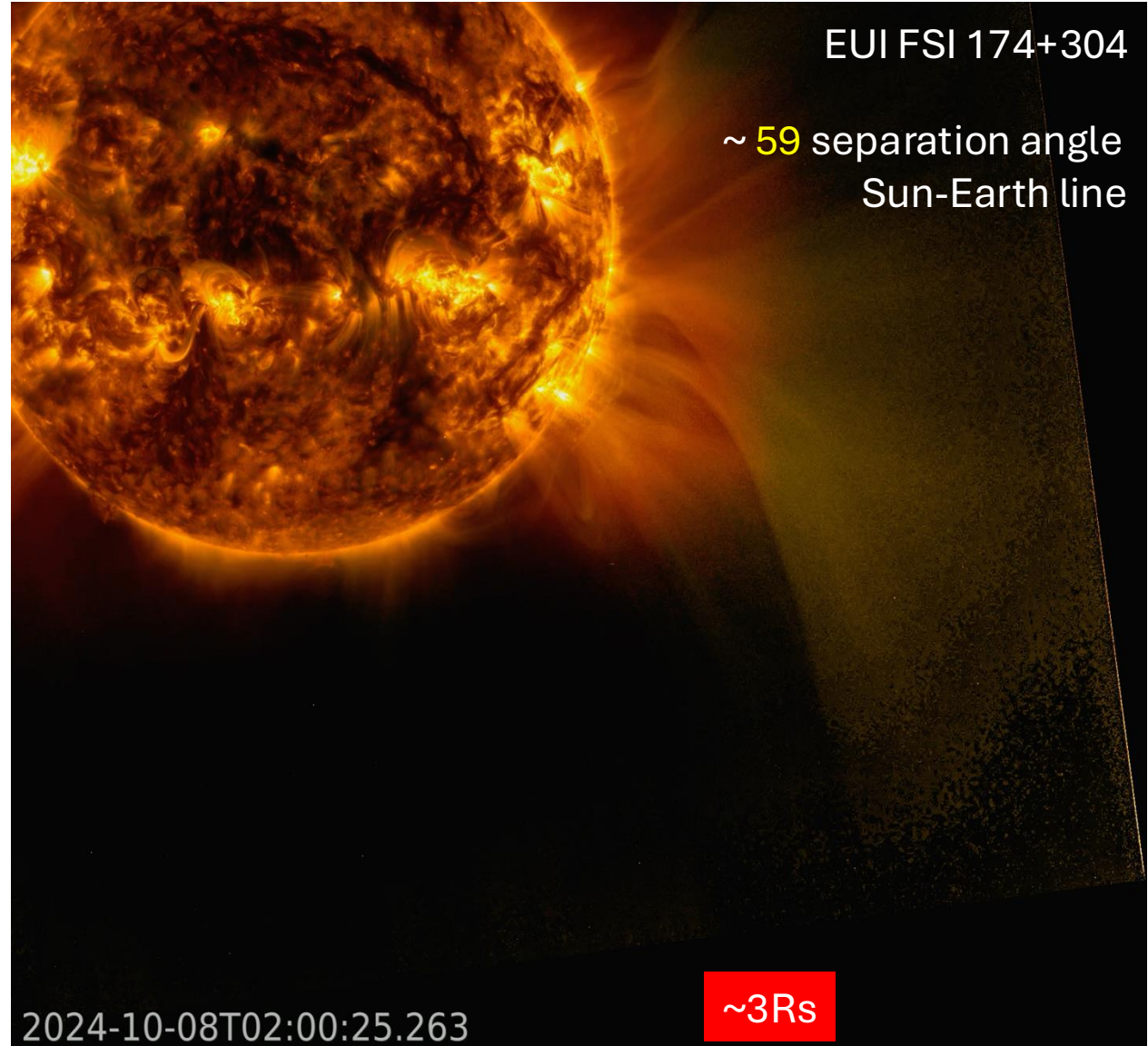
Loop-like shaped prominence material remains unchanged till  $\sim 1.8 R_s$  then it started to twist.

Magnetic field orientation changes.

Magnetized CME models.

Advancement for Space Weather forecasting.

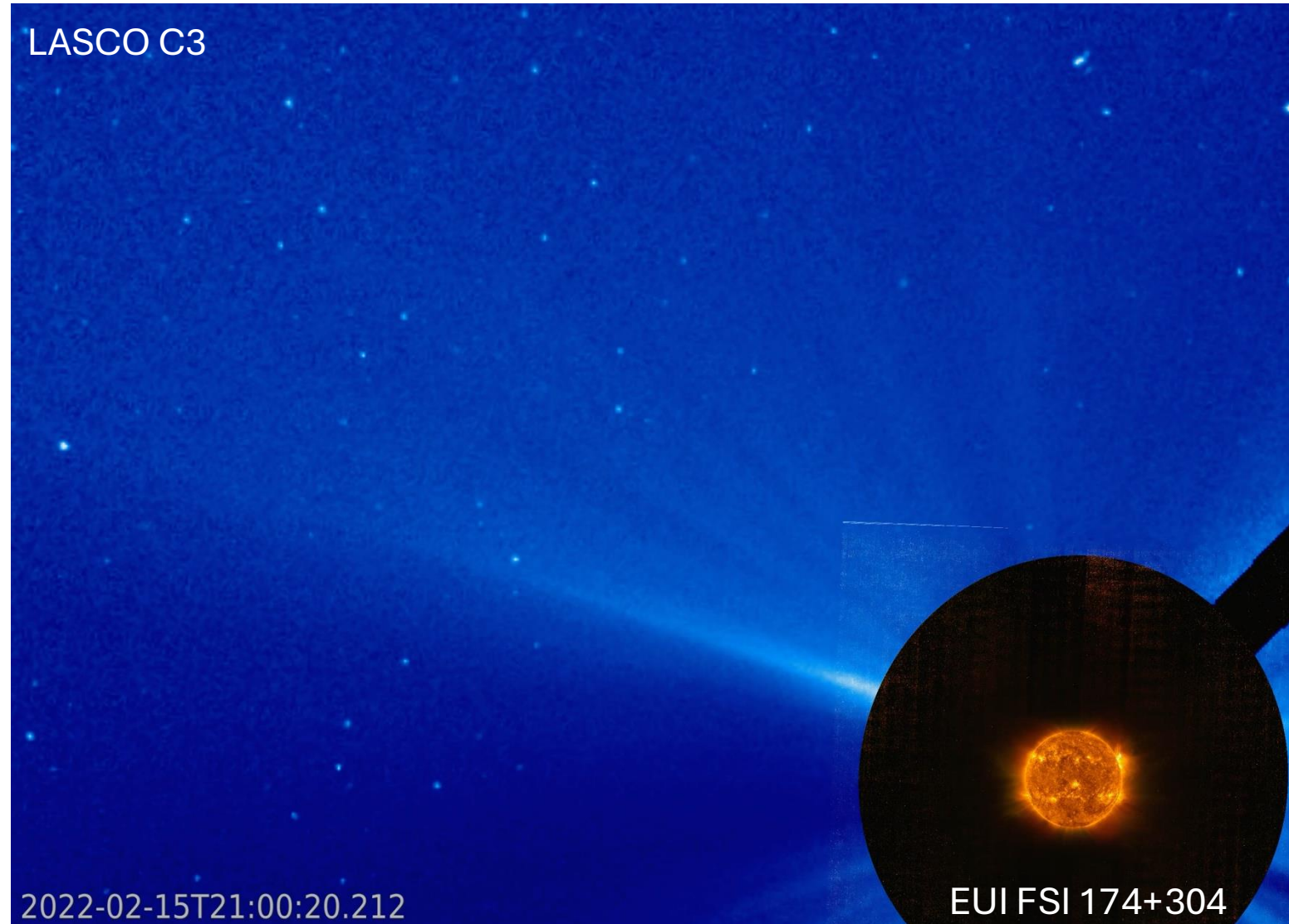
Understanding magnetic field properties is key!



# EUV observations of extended corona

---

Connecting  
structures  
observed in  
**EUV** with  
**white light**  
imaging.

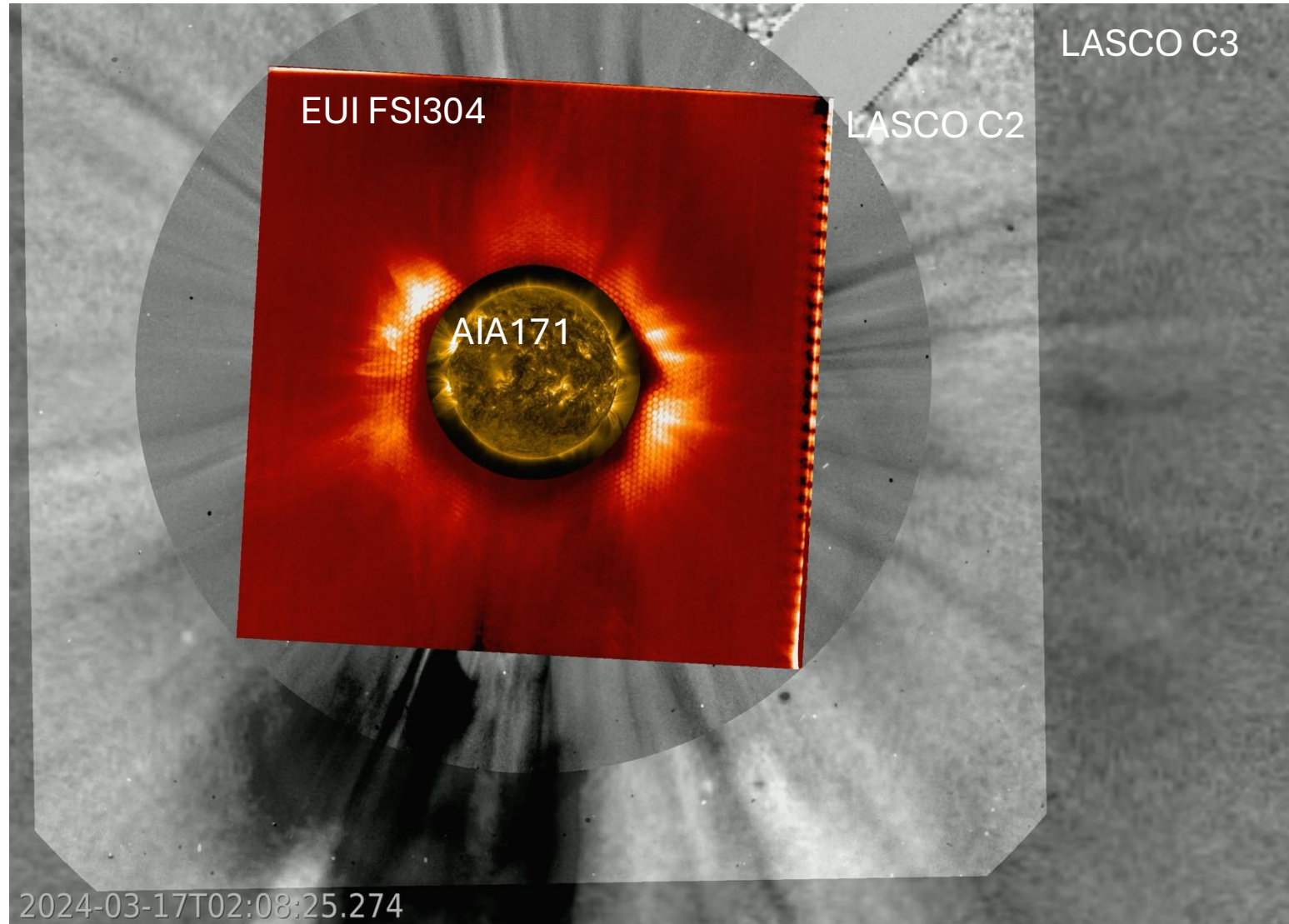


# EUV observations of extended corona

## **EUI/FSI**

EUV observations with  
“coronagraph mode”.

Better definition of solar  
structures on the edges of  
the FOV.

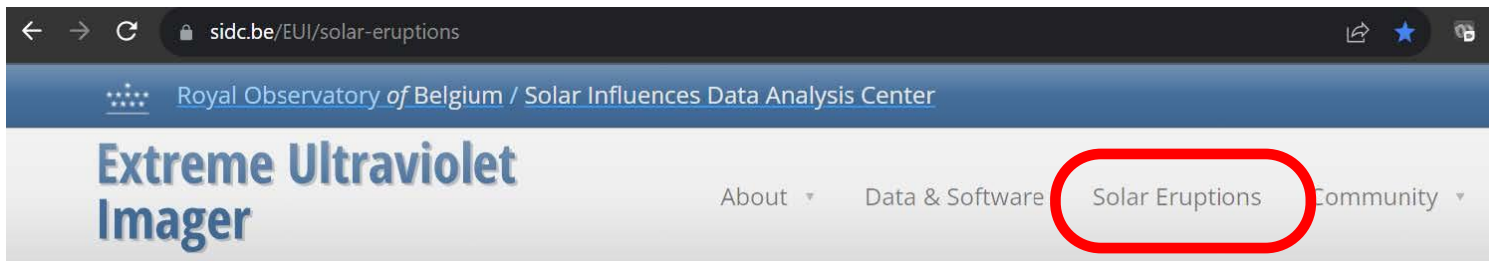




Insight from the first statistical study of  
prominence eruptions observed with  
**SoLO/EUI/FSI**

# Starting point: EUV eruption list

<https://www.sidc.be/EUI/solar-eruptions>



sidc.be/EUI/solar-eruptions

Royal Observatory of Belgium / Solar Influences Data Analysis Center

Extreme Ultraviolet Imager

About Data & Software **Solar Eruptions** Community

## Solar Eruptions

Onset Time	Instrument	Principal Angle	Description of Event
<a href="#">2020-05-30 00:40:00 UTC</a>	FSI 174	South-East	first CME observed by FSI
<a href="#">2020-06-17 14:00:00 UTC</a>	FSI 174	South-East	Small eruption
<a href="#">2020-06-19 17:00:00 UTC</a>	FSI 304	East	Small prominence eruption
<a href="#">2020-11-17 03:00:00 UTC</a>	FSI 174	North-West	Nice eruption
<a href="#">2020-11-18 21:00:00 UTC</a>	FSI 174	South-West	Nice eruption
<a href="#">2020-11-19 02:30:00 UTC</a>	FSI 174	South-West	Eruption
<a href="#">2020-11-20 16:00:00 UTC</a>	FSI 174	South-West	Small eruption
<a href="#">2021-01-16 20:45:00 UTC</a>	FSI 174	South-West	Small eruption

Event selection criteria:

- Events seen off-limb in EUI/FSI **304 Å**.
- Years: 2021, 2022.
- Set of investigated events: **229 prominences**.

# Measurements

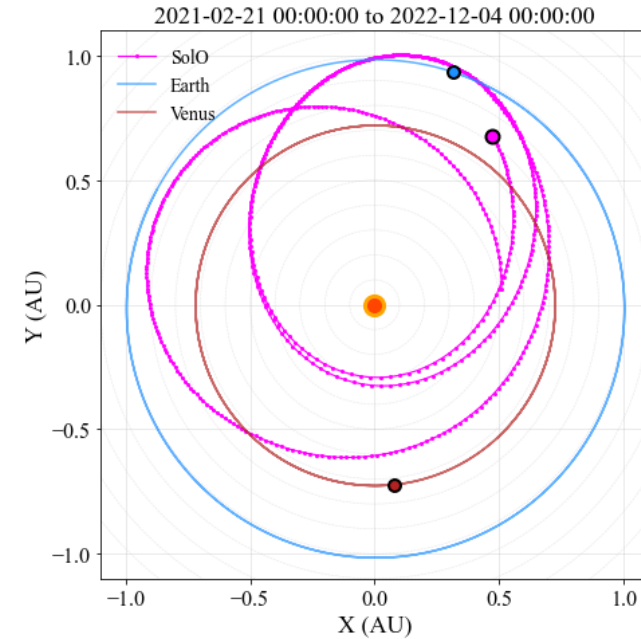
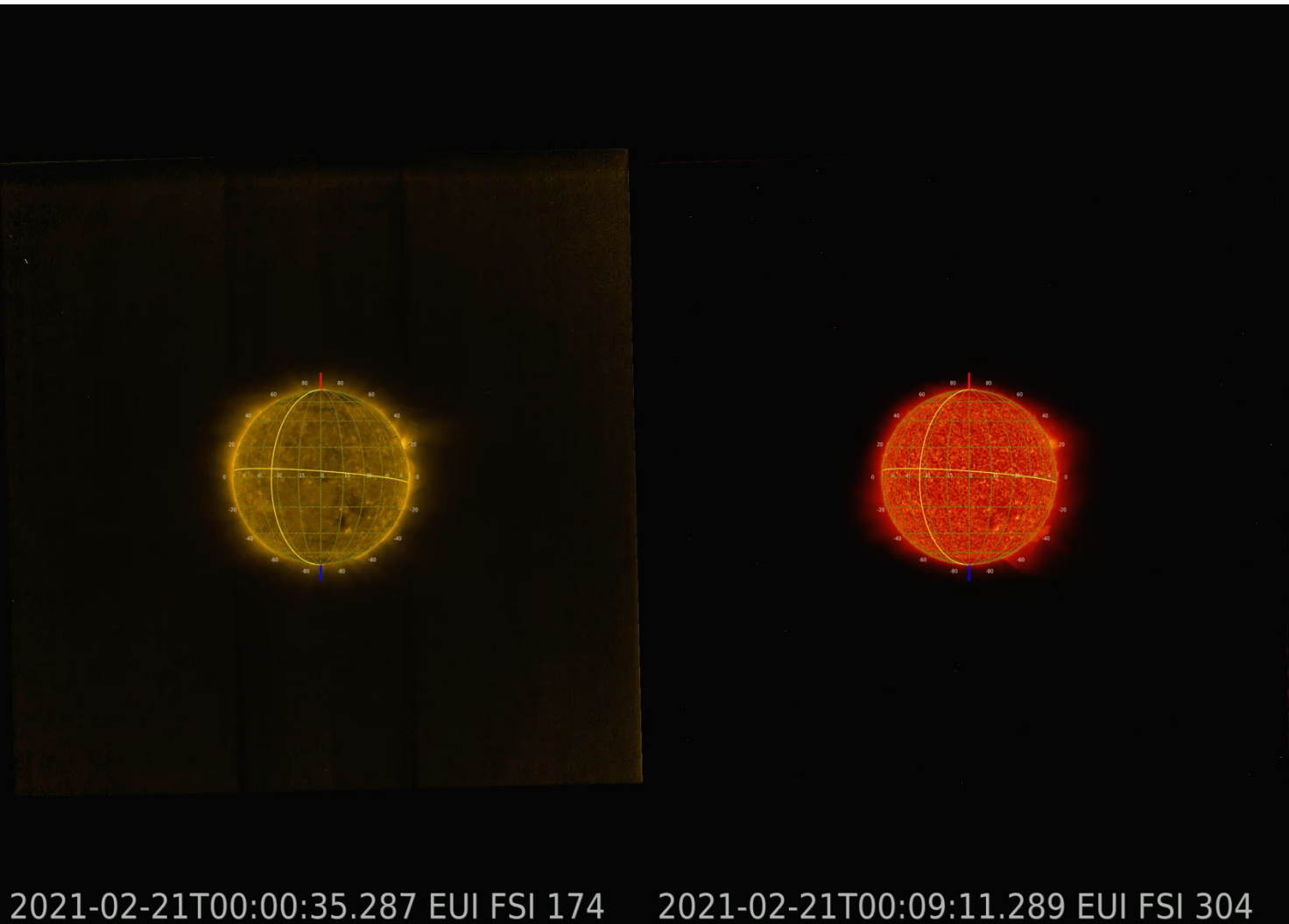
	FSI 174 (Y/N/ND) ND = No Data	FSI 304 (Y/N/ND) ) ND = No Data	Compass_point from disk center (N,S,E,W)	Description of eruption, PE = prominence eruption	Time of Maximum height measurement	Reviewer 1 (BD, DS, DT, ED, LR, MM, MW)	maximum height of leading bright feature [Rs]	PA at maximum height of leading bright feature [deg]	PA leaving Limb [deg]	Reviewer 2 (BD, DS, DT, ED, LR, MM, MW)	maximum height of leading bright feature [Rs]	PA at maximum height of leading bright feature [deg]	PA leaving Limb [deg]	Reviewer 3 (BD, DS, DT, ED, LR, MM, MW)	maximum height of leading bright feature [Rs]	PA at maximum height of leading bright feature [deg]	PA leaving Limb [deg]
2021-02-21 2:00:00	Y	Y	North-West	Narrow PE, later detached from the Sun	2021-02-21 10:24:11	MM	1.56	294	316	MW	1.56	290	310	BD	1.57	295	316
2021-03-21 16:00:00	Y	Y	North-West	PE, from narrow to cloud(rain)-like. Downflows also observed.	2021-03-21 21:02:44	MM	1.56	298	310	MW	1.5	295	310	BD	1.56	298	310
2021-03-21 20:00:00	Y	Y	South-West	PE, narrow attached to the Sun, it detached later. Twisted. Downflow?	2021-03-22 01:32:44	MM	2.26	238	235	MW	2.3	240	236	BD	2.3	239	235
2021-04-22 21:00:00	Y	Y	North-West	Big PE, moving along a loop-like structure	2021-04-23 01:47:44	MM	1.66	269	310	MW	1.68	270	310	BD	1.69	272	310
2021-04-23 22:00:00	Y	Y	South-East	PE, starts as a loop and then one leg detaches and erupts	2021-04-24 0:32:44	MM	1.62	112	136	MW	1.63	110	135	BD	1.64	112	135
2021-04-24 4:00:00	Y	Y	South-East	PE, far in the FOV, twisted and then elongated structure	2021-04-24 7:25:14	MM	2.69	111	118	MW	2.69	230	115	BD	2.71	111	116
2021-04-25 8:00:00	Y	Y	South-West	PE, elongated, parallel with the limb	2021-04-25 12:32:44	MM	1.3	231	231	MW	1.3	230	230	BD	1.38	227	230
2021-04-25 10:10:00	Y	Y	East	PE, detached at one leg. A small one just before this one.	2021-04-25 13:25:14	MM	1.7	70	81	MW	1.7	80	80	BD	1.74	69	85
2021-09-04 17:30:00	Y	Y	South-East	PE, loop-like, one leg detaching later on	2021-09-04 18:41:44	MM	1.33	150	142	MW	1.35	151	150	BD	1.38	150	143

Avg Max height [Rs]	Avg PA at max height [deg]	Avg PA leaving limb	Approx deflectio n (Deg, use with care)	Obvious deflectio n (Y/N)	Reach edge of FOV of image? Y/N	Nearby Feature (AR, EqCH)	Nearby Fan/Stream er (Y/N)	Nearby Polar CH (Y/N)	Post flare loops (Y/N)	Associated flare/bright ening (Y/N)	Dimming (Y/N)	Wave 304 (Y/N)	Wave 174 (Y/N)	Case study (Y/N)	Approx Velocity (km/s, use with care)
1.563333333	293.00	314	21.00	Y	N	-	Y	Y	N	N	Y	N	N	N/Y	10.65554858
1.54	297.00	310	13.00	N	N	AR	N	Y	N	N	N	N	N	N/Y	16.85245541
2.286666667	239.00	235.3333	-3.67	Y	N	-	N	Y	N	N	N	N	N	N/Y	41.35263474
1.676666667	270.33	310	39.67	Y	N	-	Y	Y	N	N	N	N	Y	23.23835728	
1.63	111.33	135.3333	24.00	Y	N	-	N	N	N	N	N	N	N	N/Y	40.23581405
2.696666667	110.67	116.3333	5.67	N	N	-	N	N	N	N	N	N	N	N/Y	90.2063505
1.326666667	229.33	230.3333	1.00	N	N	AR	Y	Y	Y	N	N	N	N	N	9.636519188

- BD: Brenda Dorsch
- DS: Daria Shukhobodskaja
- DT: Dana Talpeanu
- ED: Elke D'Huys
- LR: Luciano Rodriguez
- MM: Marilena Mierla
- MW: Matt West



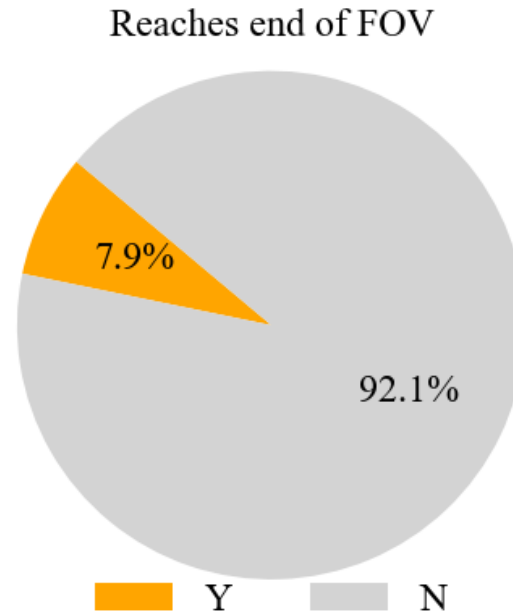
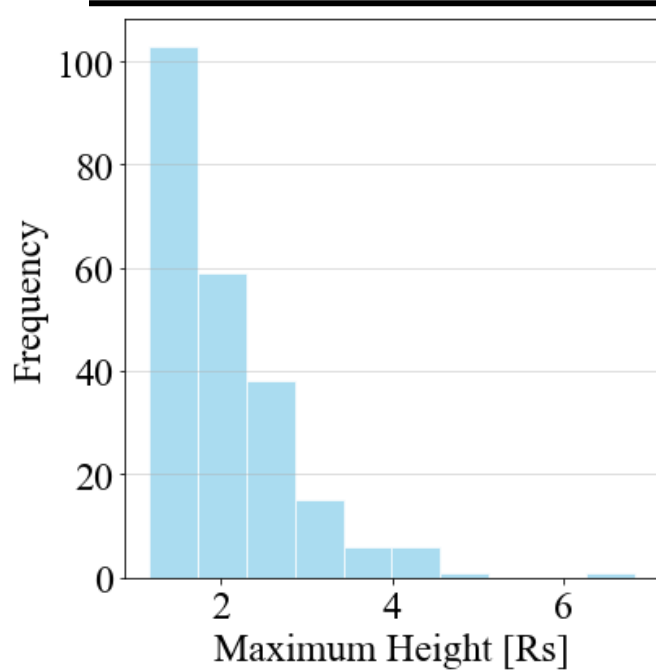
# Changing FOV of FSI



→ With changing FOV, spatial resolution also varies.

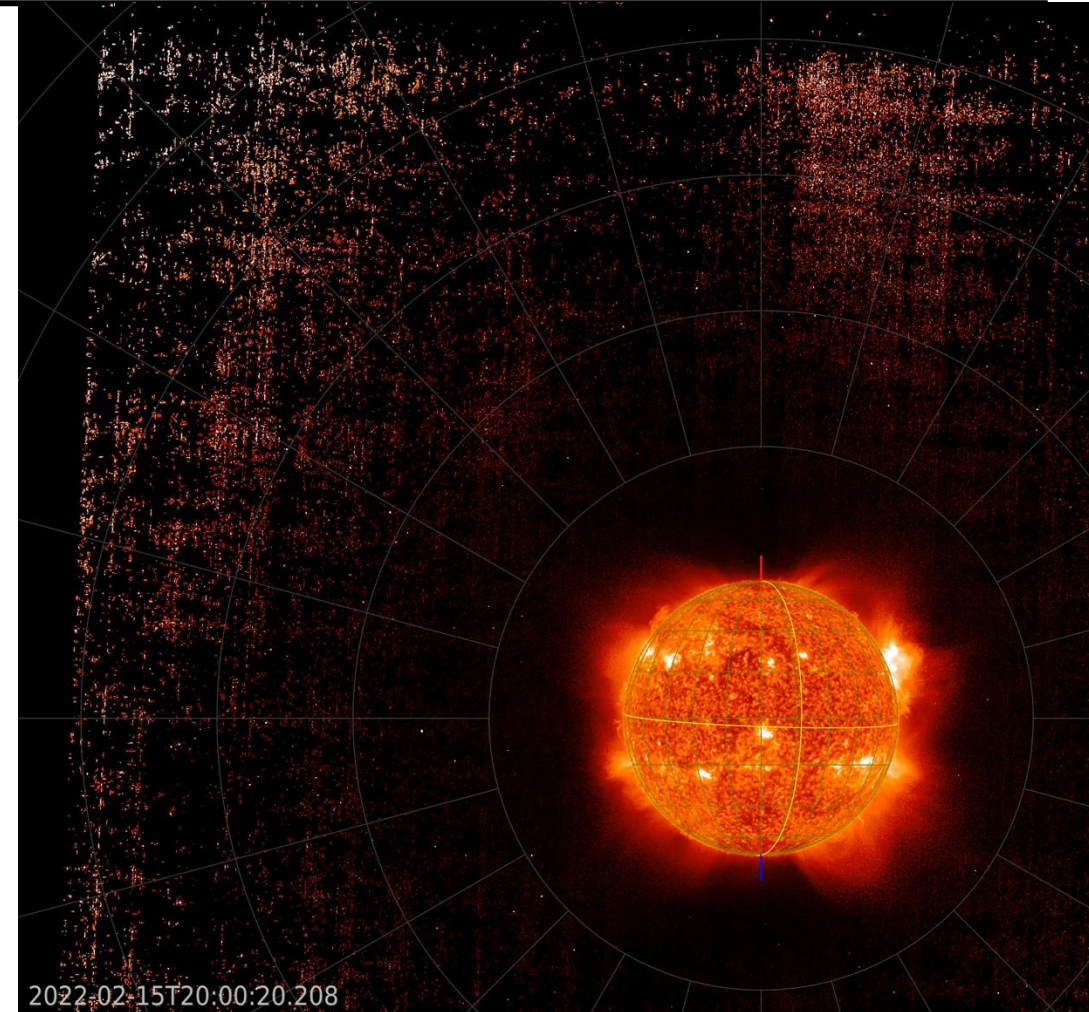
+ The cadence of FSI is not constant. Dataset presents events with cadence of 2, 5, 7.5, 10, 15, & 30 minutes.

# Statistical results – Maximum height



**18 events reached FOV.**  
 - 7 during perihelion, FOV of FSI at is smallest.  
 - 11 within 10% tail of distribution.

Percentile	Max. height ( $R_{\odot}$ )	Count
Q1	$\leq 1.61$	67
Median	$\leq 1.80$	115
O3	$< 2.38$	172
90%	$\leq 3.14$	206



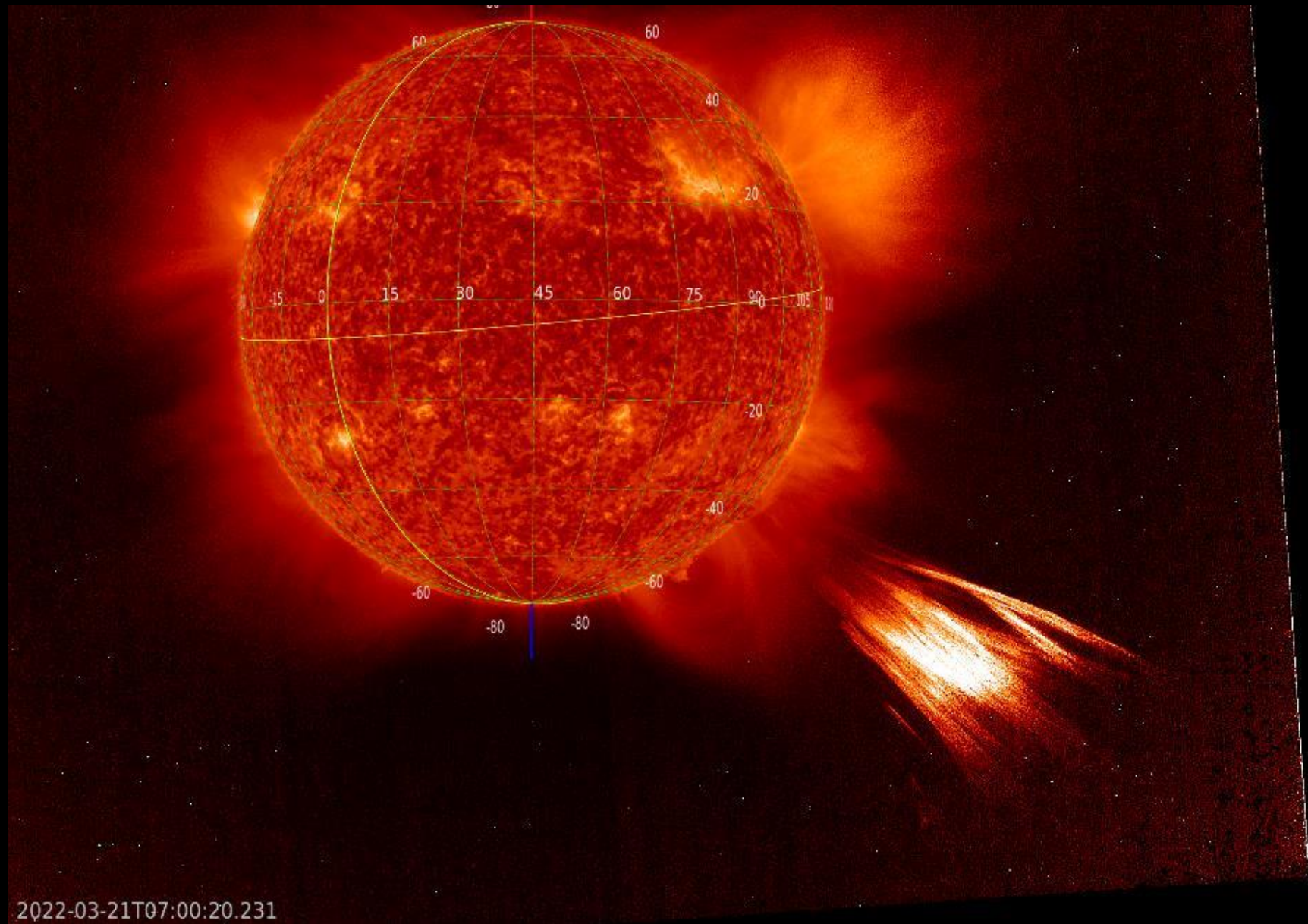
Furthest measured eruption:  
 2022-02-16 01:44:20 UT,  $6.82 R_{\odot}$

See Mierla+2022.

# Various morphologies observed

Fan-like

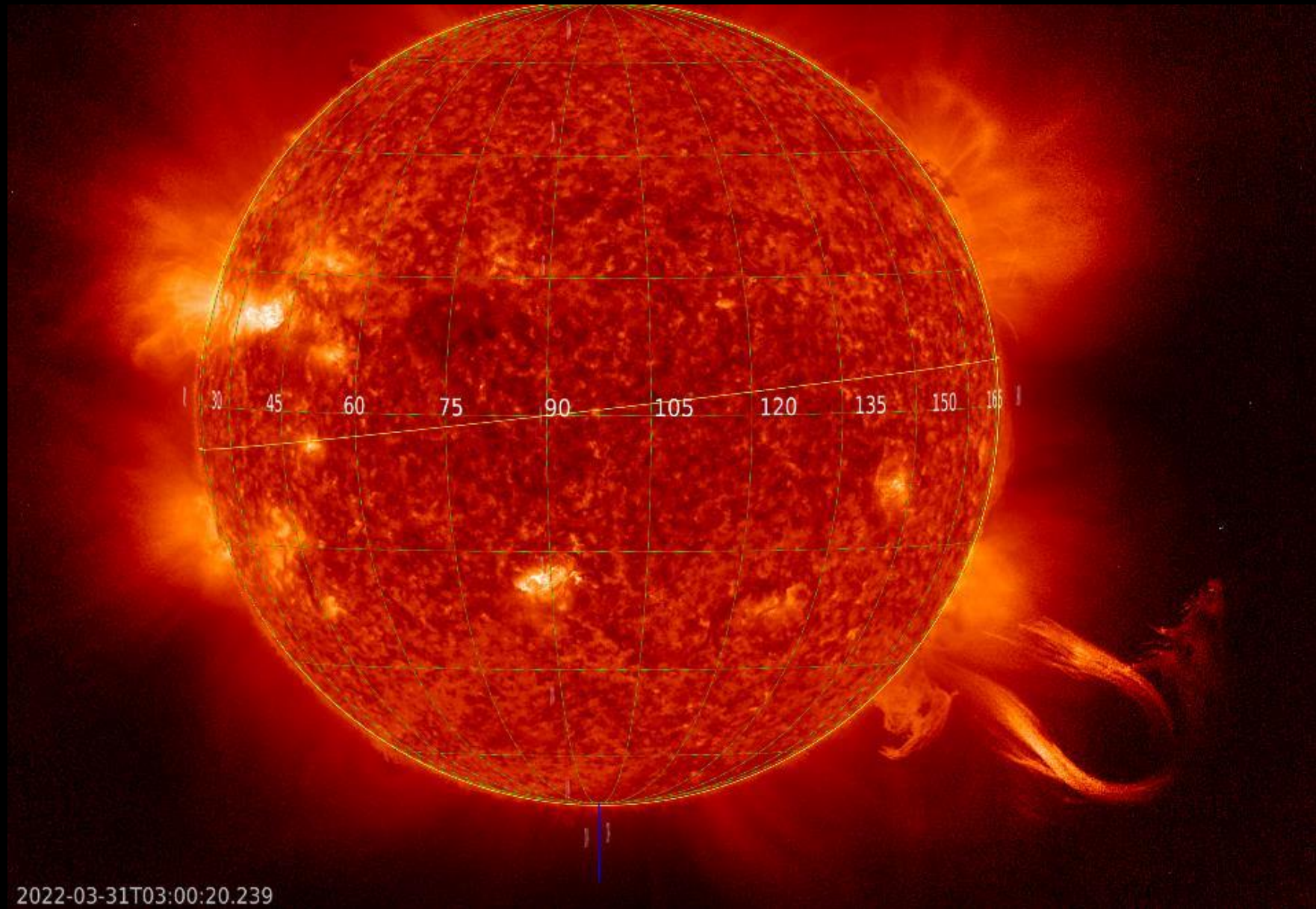
20.1% of  
the events.



# Various morphologies observed

Loop-like

50.2% of  
the events.

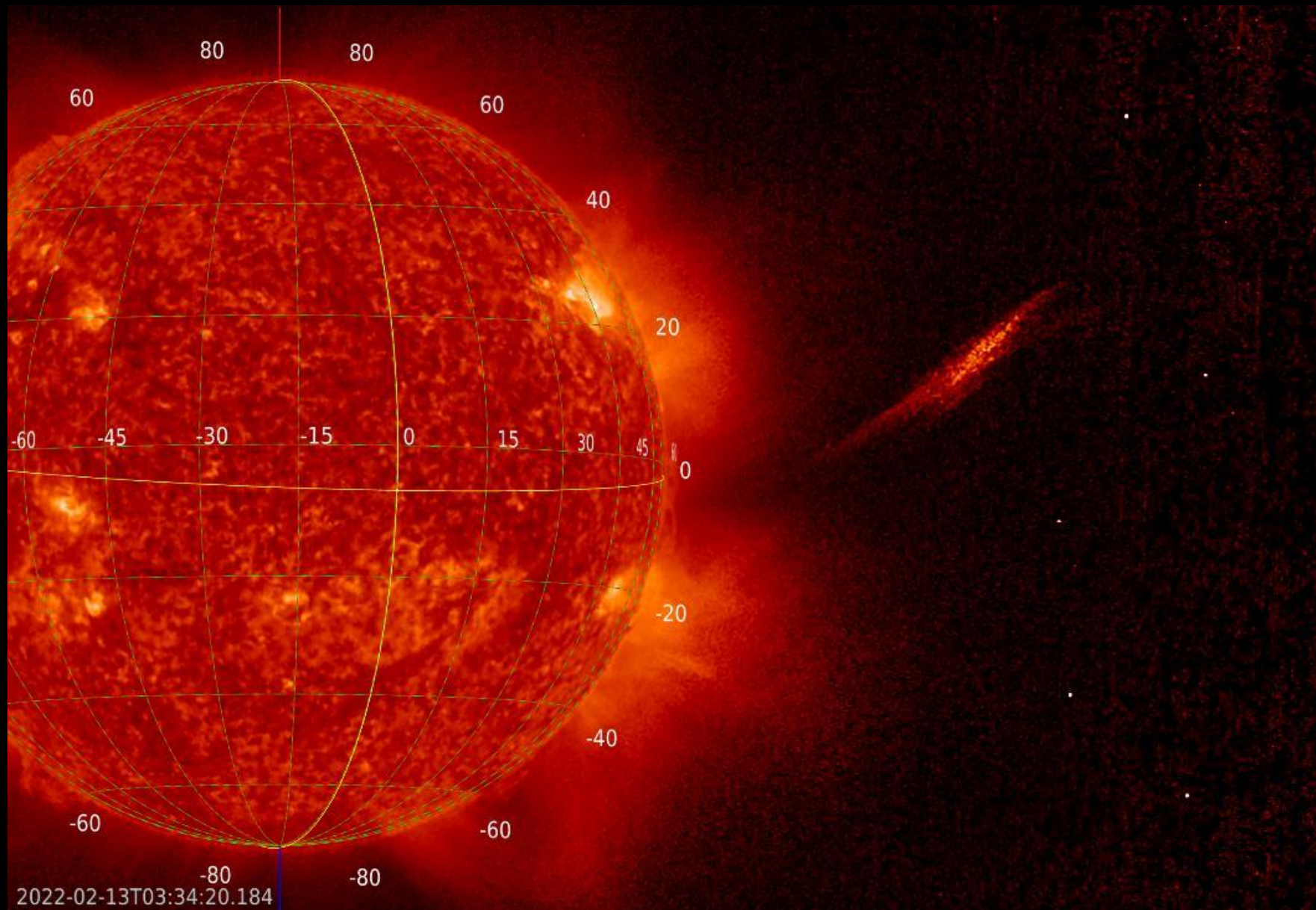


2022-03-31T03:00:20.239

# Various morphologies observed

Jet-like

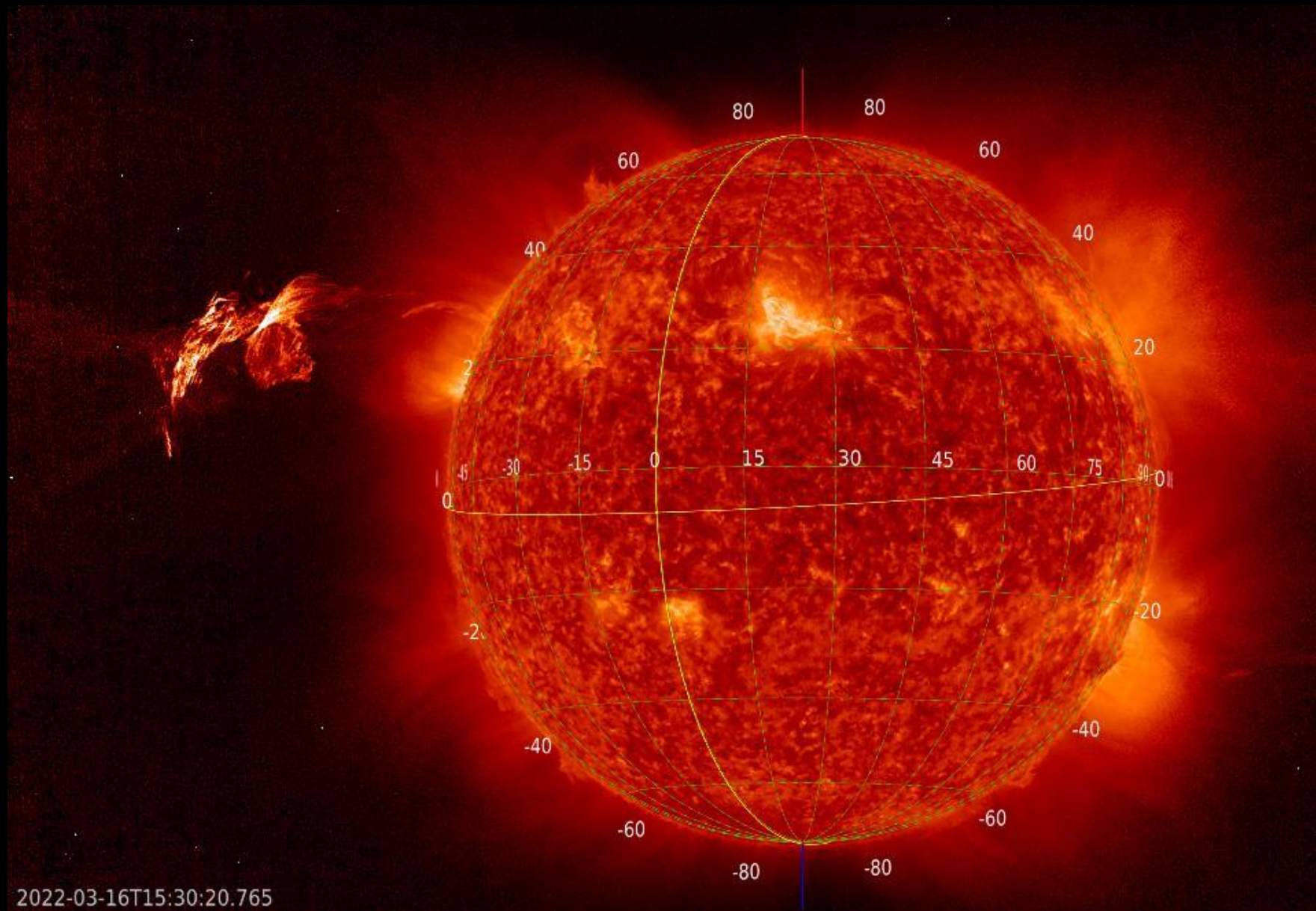
25.3% of  
the events.



# Various morphologies observed

Twisted

29.3% of  
the events.

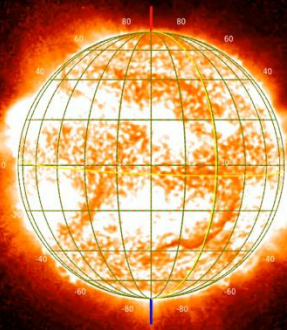


# Changing morphology

E.g.

Loop-like → Fan-like

24% of the  
events.



2022-07-23T16:00:25.215

Loop structure is observed followed by a fan structure that corresponds to the legs of the prominence eruption.

Fan-like may reflect only part of a larger (loop?) structure, with the remaining portion obscured by projection effects.

	<b>Loop-like</b>	<b>Fan-like</b>	<b>Jet-like</b>	<b>Twisted</b>
<b>Loop-like</b>	50.2%	5.2%	0.9%	14%
<b>Fan-like</b>	5.2%	20.1%	0.4%	4.8%
<b>Jet-like</b>	0.9%	0.4%	25.3%	0.9%
<b>Twisted</b>	14%	4.8%	0.9%	29.3%

We primarily observe first a loop structure that after undergoes twisting/untwisting motions.

Conversion of twist into writhe from the built-up of helicity prior to the eruption.

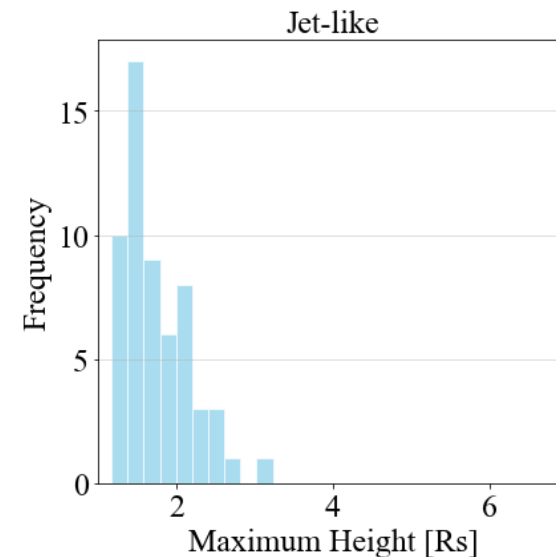
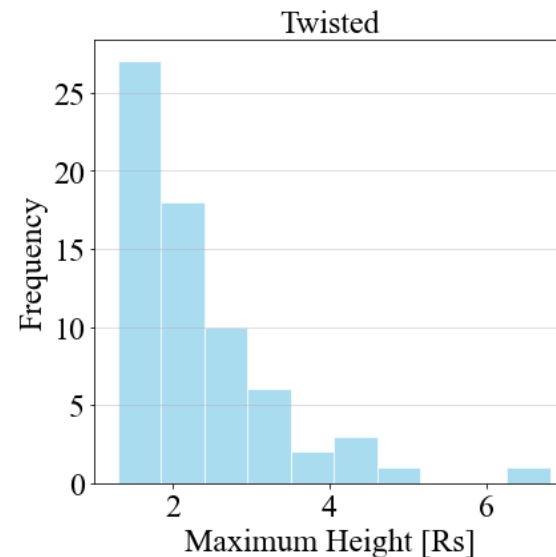
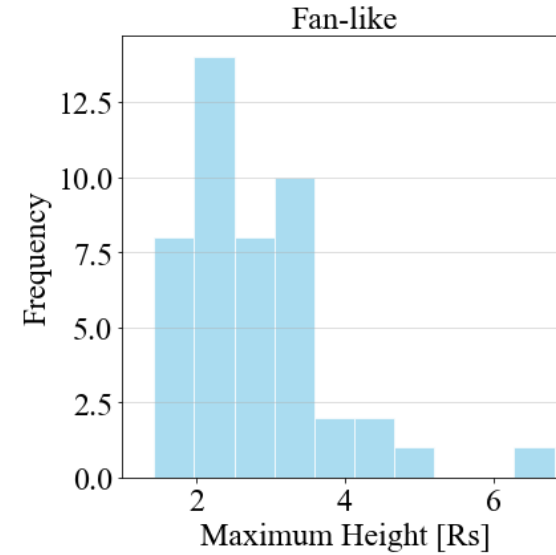
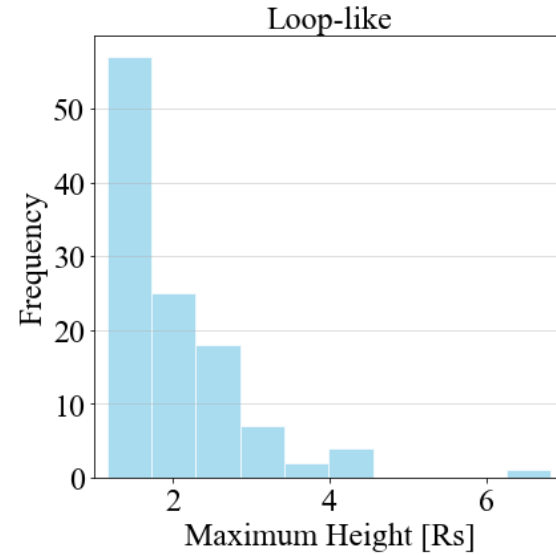
!!!  
Low cadence & spatial resolution.



Challenge to characterise the eruptions.

# Statistical results – Maximum height

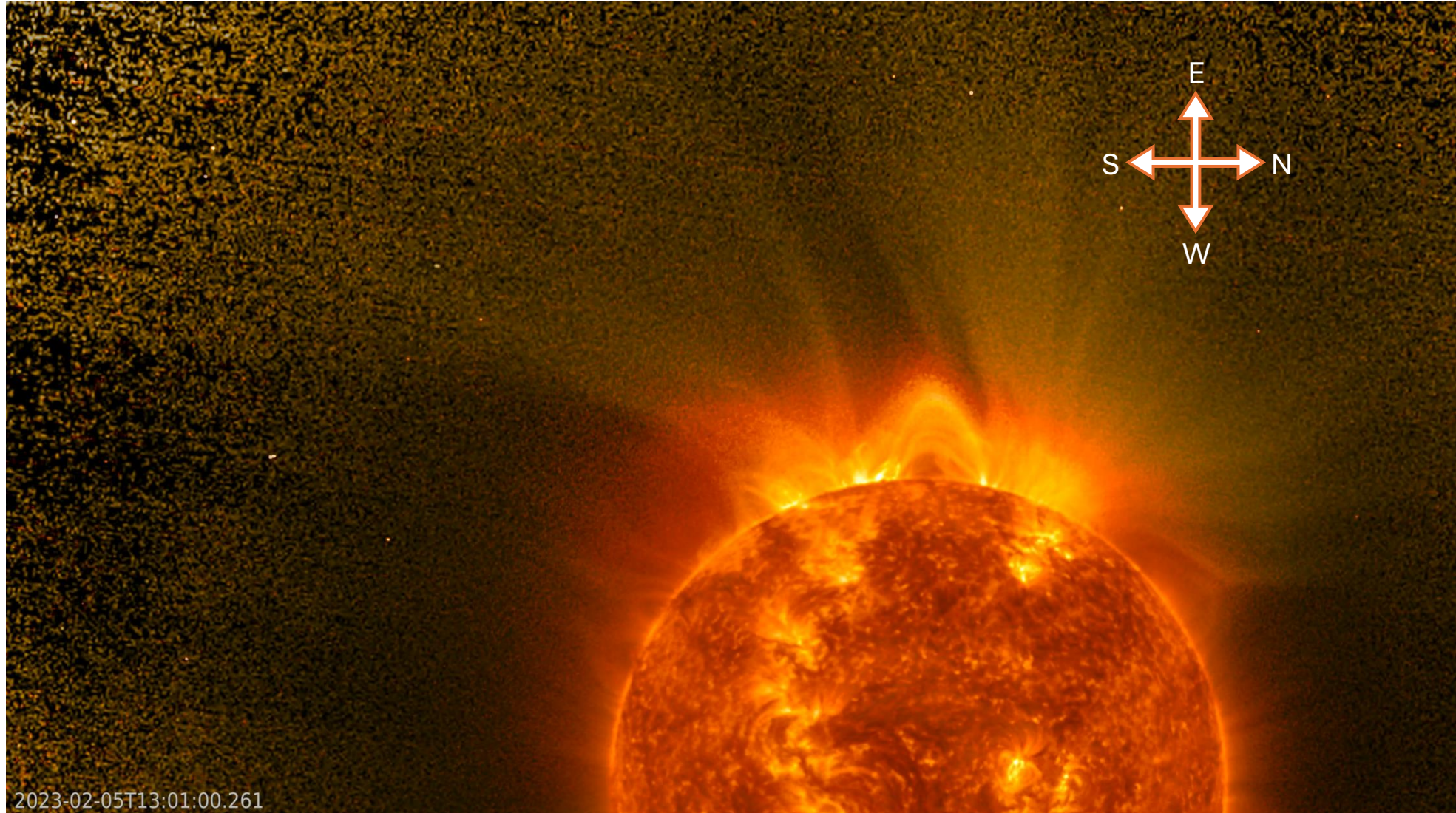
Similar distributions. This is coherent in the context of twisted eruptions being strongly related to loop-like eruptions under deformation processes.



Distribution shows a different behaviour. Events more sparced towards higher maximum heights.

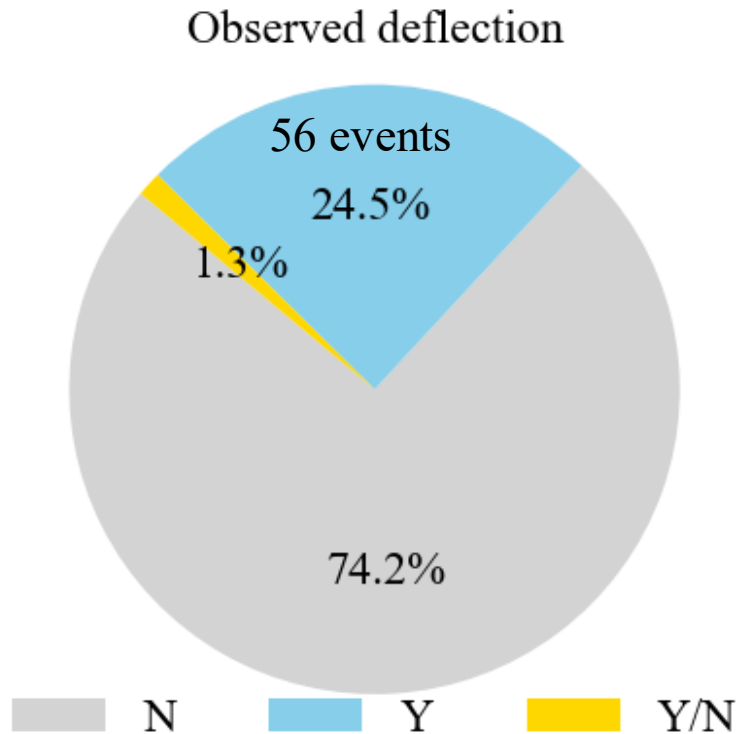
Reach lower heights compared to eruptions associated with other morphologies ( $2 < R_s$ ).

# Deflections

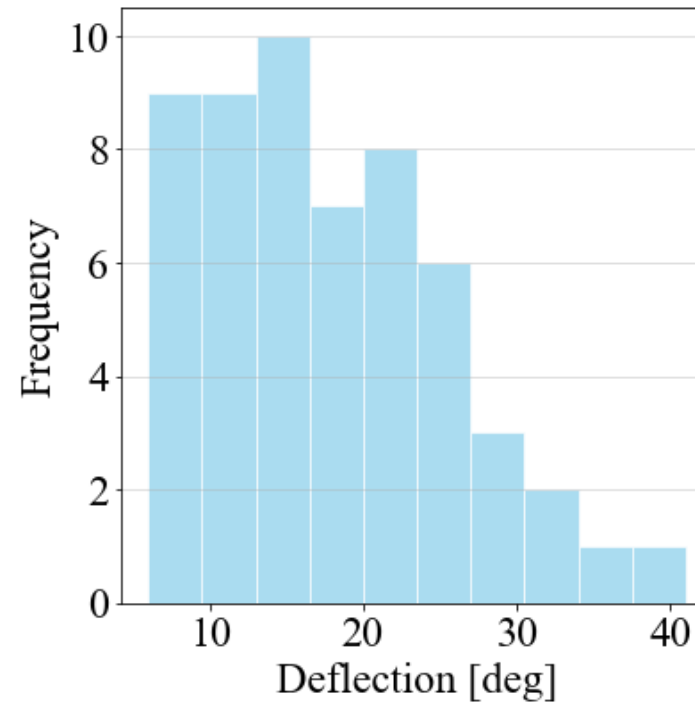


2023-02-05T13:01:00.261

# Deflections



Tracking of the same feature of the prominence as far as possible with the maximum available cadence.



75% of events showed deviation between 6° to 23°.

# Kinematics – selection criteria

	FSI 174 (Y/N/ND) ND = No Data	FSI 304 (Y/N/ND) ND = No Data	Compass_point from disk center (N,S,E,W)	Description of eruption, PE = prominence eruption	Time of Maximum height measurement	Reviewer 1 (BD, DS, DT, ED, LR, MM, MW)	maximum height of leading bright feature [Rs]	PA at maximum height of leading bright feature [deg]	PA leaving Limb [deg]	Reviewer 2 (BD, DS, DT, ED, LR, MM, MW)	maximum height of leading bright feature [Rs]	PA at maximum height of leading bright feature [deg]	PA leaving Limb [deg]	Reviewer 3 (BD, DS, DT, ED, LR, MM, MW)	maximum height of leading bright feature [Rs]	PA at maximum height of leading bright feature [deg]	PA leaving Limb [deg]
2021-02-21 2:00:00	Y	Y	North-West	Narrow PE, later detached from the Sun	2021-02-21 10:24:11	MM	1.56	294	316	MW	1.56	290	310	BD	1.57	295	316
2021-03-21 16:00:00	Y	Y	North-West	PE, from narrow to cloud(rain)-like. Downflows also observed.	2021-03-21 21:02:44	MM	1.56	298	310	MW	1.5	295	310	BD	1.56	298	310
2021-03-21 20:00:00	Y	Y	South-West	PE, narrow attached to the Sun, it detached later. Twisted. Downflow?	2021-03-22 01:32:44	MM	2.26	238	235	MW	2.3	240	236	BD	2.3	239	235
2021-04-22 21:00:00	Y	Y	North-West	Big PE, moving along a loop-like structure	2021-04-23 01:47:44	MM	1.66	269	310	MW	1.68	270	310	BD	1.69	272	310
2021-04-23 22:00:00	Y	Y					1.62	112	136	MW	1.63	110	135	BD	1.64	112	135
2021-04-24 4:00:00	Y	Y					2.69	111		MW	2.69		115	BD	2.71	111	116
2021-04-25 8:00:00	Y	Y					1.3	231				230	80	BD	1.38	227	230
2021-04-25 10:10:00	Y	Y					1.7	70					80	BD	1.74	69	85
2021-09-04 17:30:00	Y	Y					1.33	150				151	150	BD	1.38	150	143

Avg Max height [Rs]	Avg PA at max height [deg]	Avg PA leaving limb [deg]	Wave 304 (Y/N)	Wave 174 (Y/N)	Speed (km/s, use with care)										
1.563333333	293.00	314	21.00	Y	N	-	Y	Y	N	N	Y	N	N	N/Y	10.65554858
1.54	297.00	310	13.00	N	N	AR	N	Y	N	N	N	N	N	N/Y	16.85245541
2.286666667	239.00	235.3333	-3.67	Y	N	-	N	Y	N	N	N	N	N	N/Y	41.35263474
1.676666667	270.33	310	39.67	Y	N	-	Y	Y	N	N	N	N	Y	Y	23.23835728
1.63	111.33	135.3333	24.00	Y	N	-	N	N	N	N	N	N	N	N/Y	40.23581405
2.696666667	110.67	116.3333	5.67	N	N	-	N	N	N	N	N	N	N	N/Y	90.2063505
1.326666667	229.33	230.3333	1.00	N	N	AR	Y	Y	Y	N	N	N	N	N	9.636519188

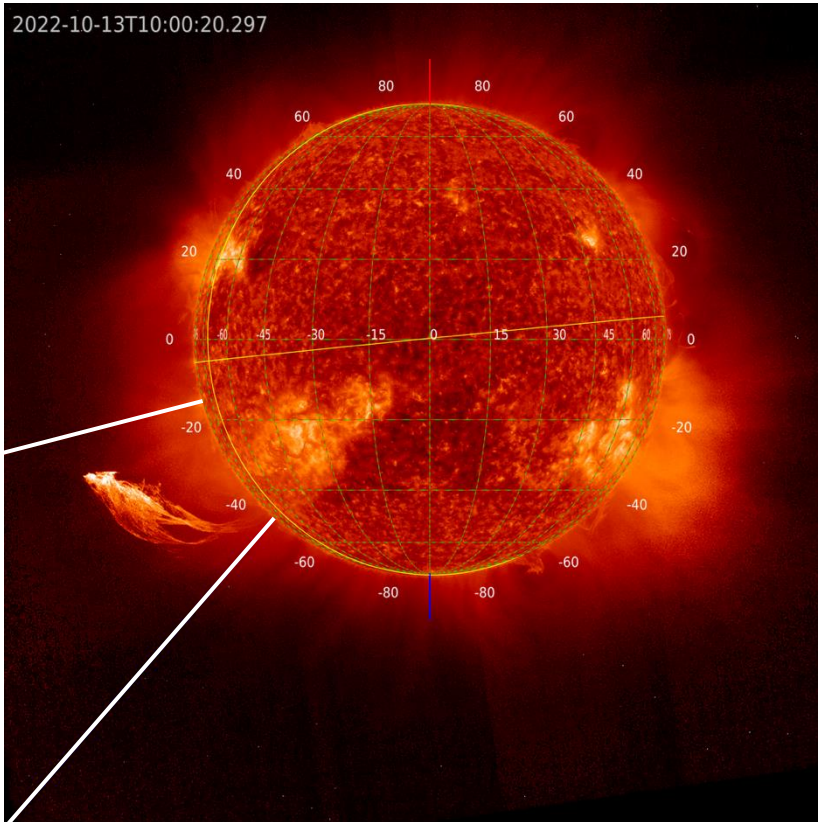
Maximum observed height  $\geq 2 R_{\odot}$   
 &  
 Observed in more than a few  
 frames.

66  
 events.

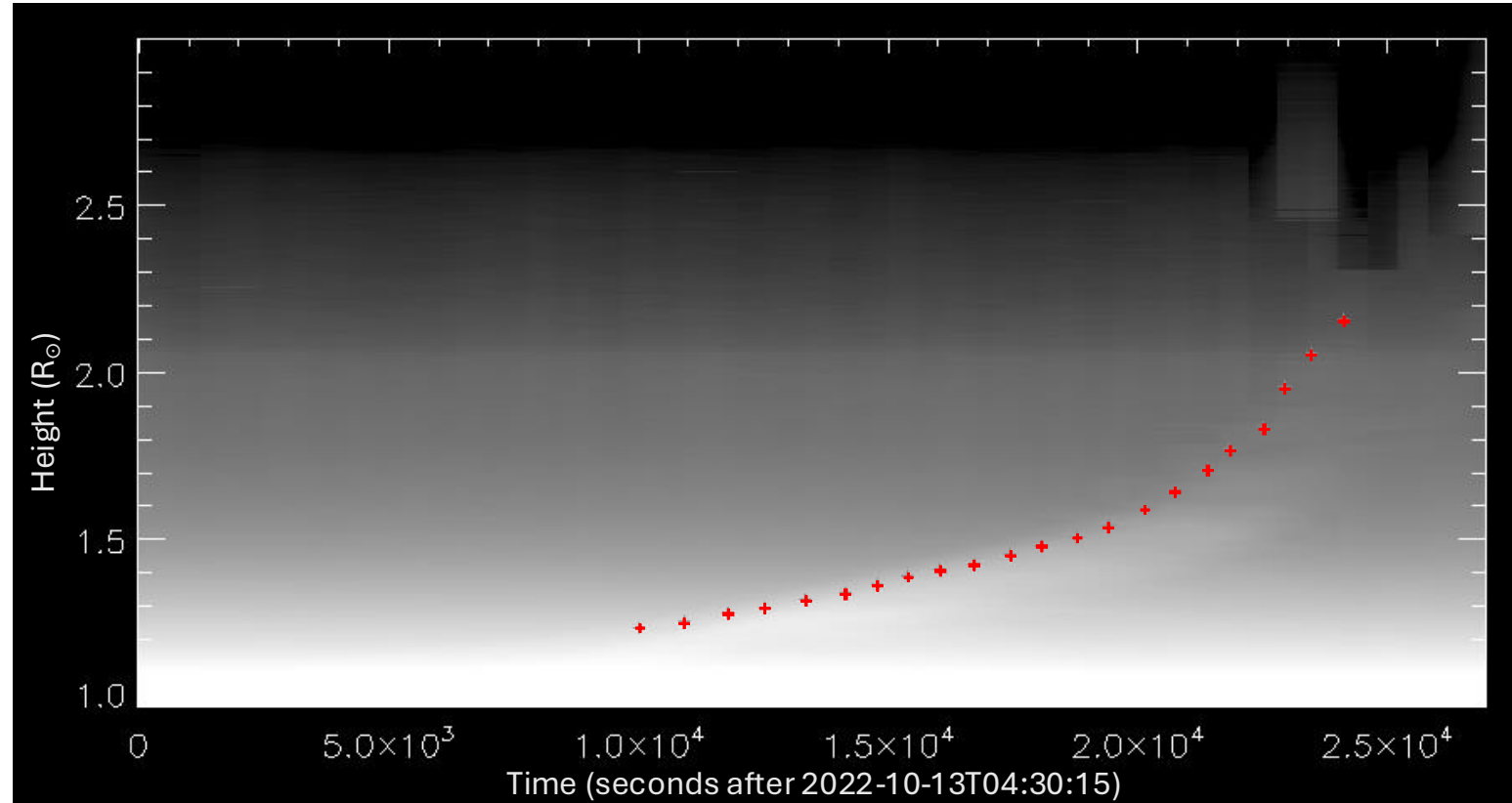
- BD: Brenda Dorsch
- DS: Daria Shukhobodskaja
- DT: Dana Talpeanu
- ED: Elke D'Huys
- LR: Luciano Rodriguez
- MM: Marilena Mierla
- MW: Matt West

# Kinematics – Height-time plots

- Method: each eruption front is measured independently by 3 people 5 times.
- Software used: IDL/SolarSoft.



Example of an analysed eruption;  
start time: 2022-10-13 04:30:00 UTC.



Averaged intensity over the selected cone.

# Kinematics – Fitting h-t measurements

We initially considered:

→ Linear fit

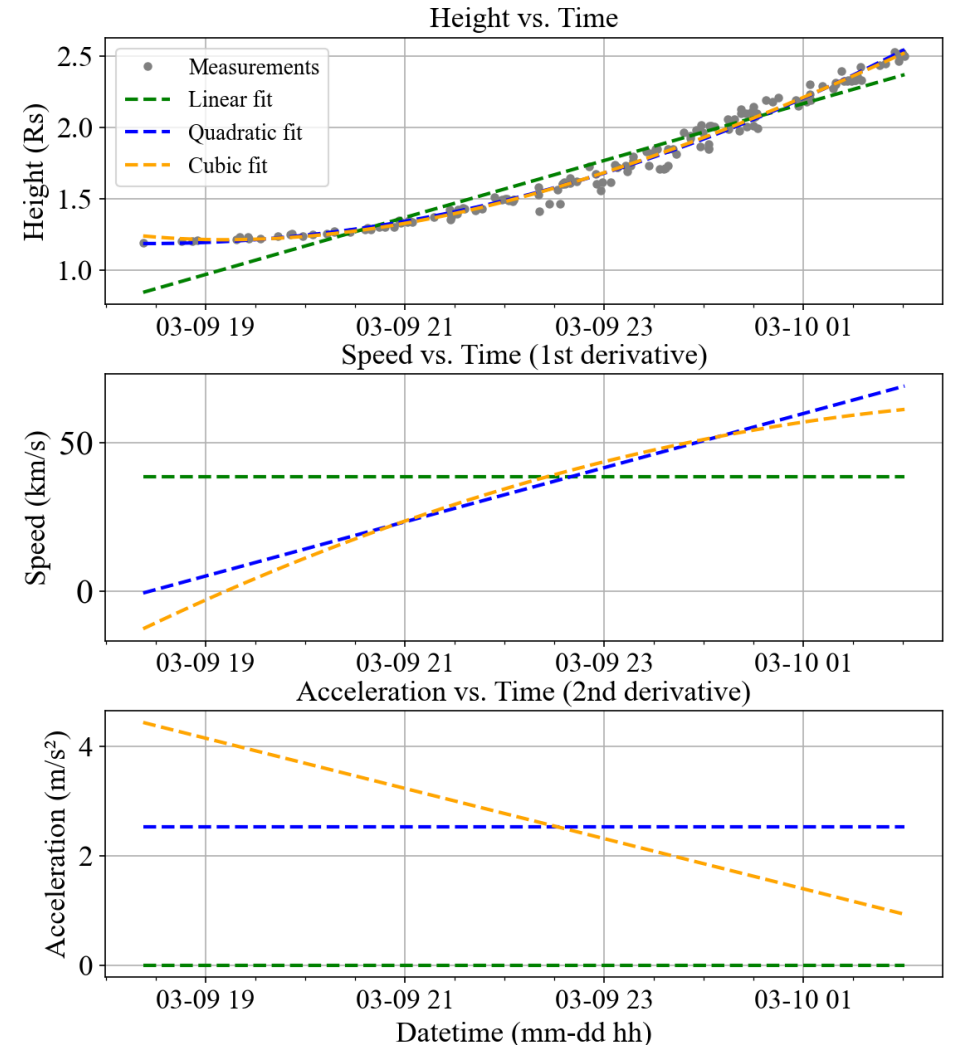
→ Quadratic fit

→ Cubic fit

Linear fit under-represents in most cases.

Cubic (quadratic) fit produced negative speeds in about 20% (3%) of the events.

Quadratic fit provides more accurate description.



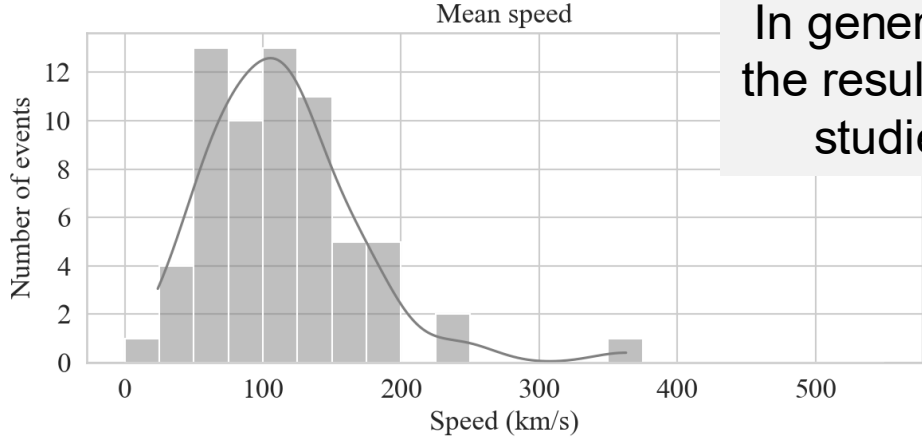
Different phases...

- 1-slow rise (linear) phase,
- 2-sudden acceleration phase,
- 3-propagation (linear) phase.

→ Higher data cadence.

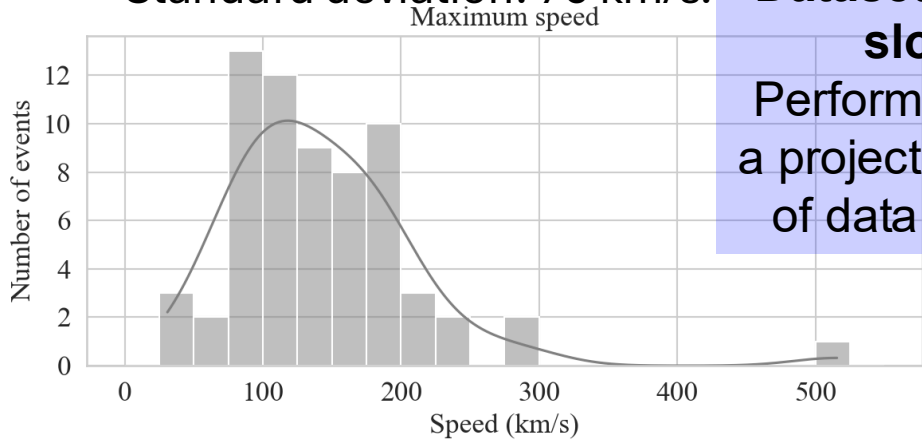
# Kinematics – Quadratic fit results

Average speed: 119 km/s.  
Standard deviation: 59 km/s.

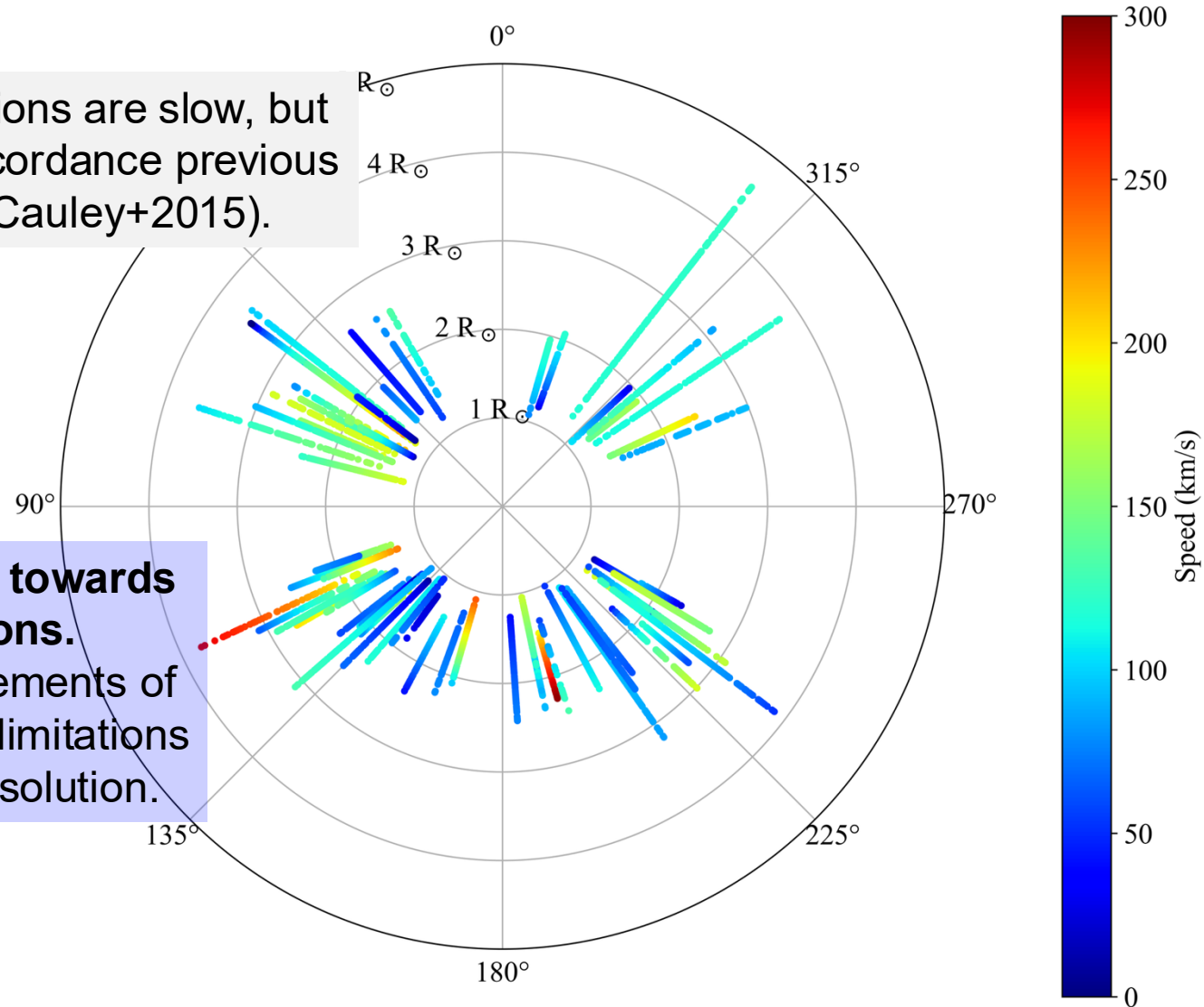


In general the eruptions are slow, but the results are in accordance previous studies (e.g., McCauley+2015).

Average speed: 149 km/s.  
Standard deviation: 76 km/s.



**Dataset is biased towards slower eruptions.**  
Performing measurements of a projected speed + limitations of data temporal resolution.





Take home messages

EUV data are important for both research and operations & L5 point provides valuable perspective for space weather.

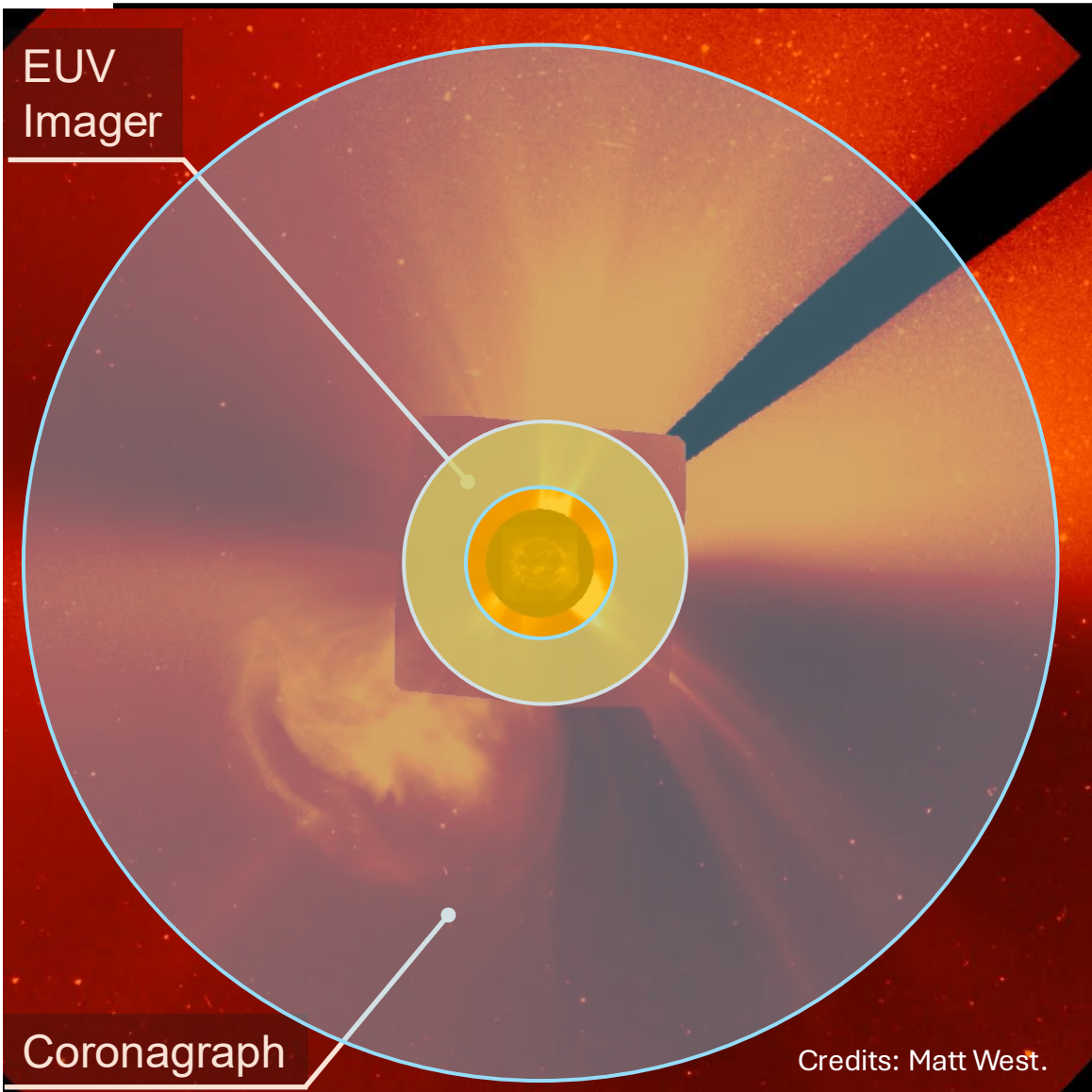
90% of prominence eruptions showed a projected maximum height, observed with FSI 304 Å, below 3.14 Rs.

We defined 4 different morphology categories: loop-like, fan-like, jet-like, & twisted. Different morphologies describe different parts/phase of same prominence eruption?

Around 25% of prominence eruptions showed deflection, primarily between 6° - 23°.

We applied a quadratic fit to describe the kinematics of 66 events. In general eruptions are slow. We notice the dataset is biased towards slow events.

# What comes: From EUI to JEDI



## SWOC - (Space Weather Operational Coronal Imager)

3 channels: 133, 195, 304 Å.

4 min cadence.

Full solar disk and extended corona out to **3.2 Rs.**

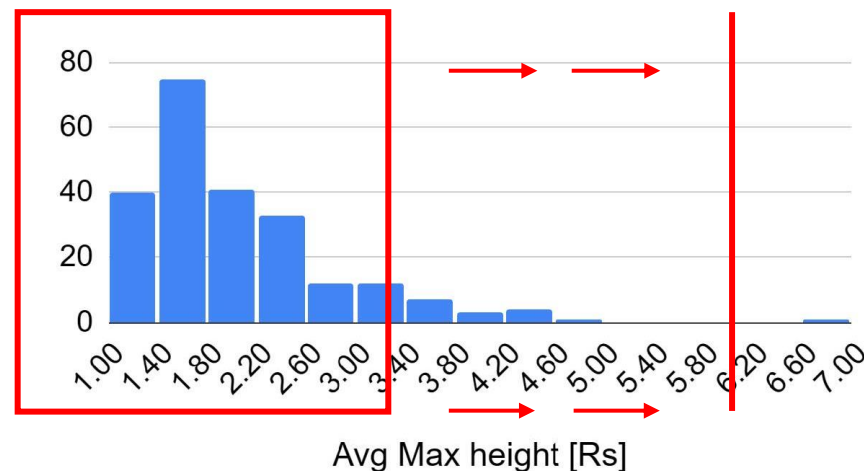
## EWOC - (Enhanced Wide-angle Observations of the Corona)

2 channels: 171, 304 Å.

8 min cadence.

Full solar disk & Occulted coronal images out to **6 Rs.**

Occulter 10x greater throughput than EUI/FSI.





Thank you!