# SOOP Coordinators Feedback meeting (LTP17)

Part 2: SOOP presentations

Miho Janvier

17/02/2024

# Composition vs Height

SOOP coordinators: Alessandra Giunta, Tim Grundy

# R_SMALL_HRES_LCAD_Composition-vs-Height

SOOP coordinators: Giunta A., Grundy T.

## Goal

To map the composition as a function of height in the solar atmosphere and through the limb, to distinguish between fast and slow wind.

Two flavours:

- on disk composition measurements along the different layers of the solar atmosphere
- measurements of composition at limb (this run)

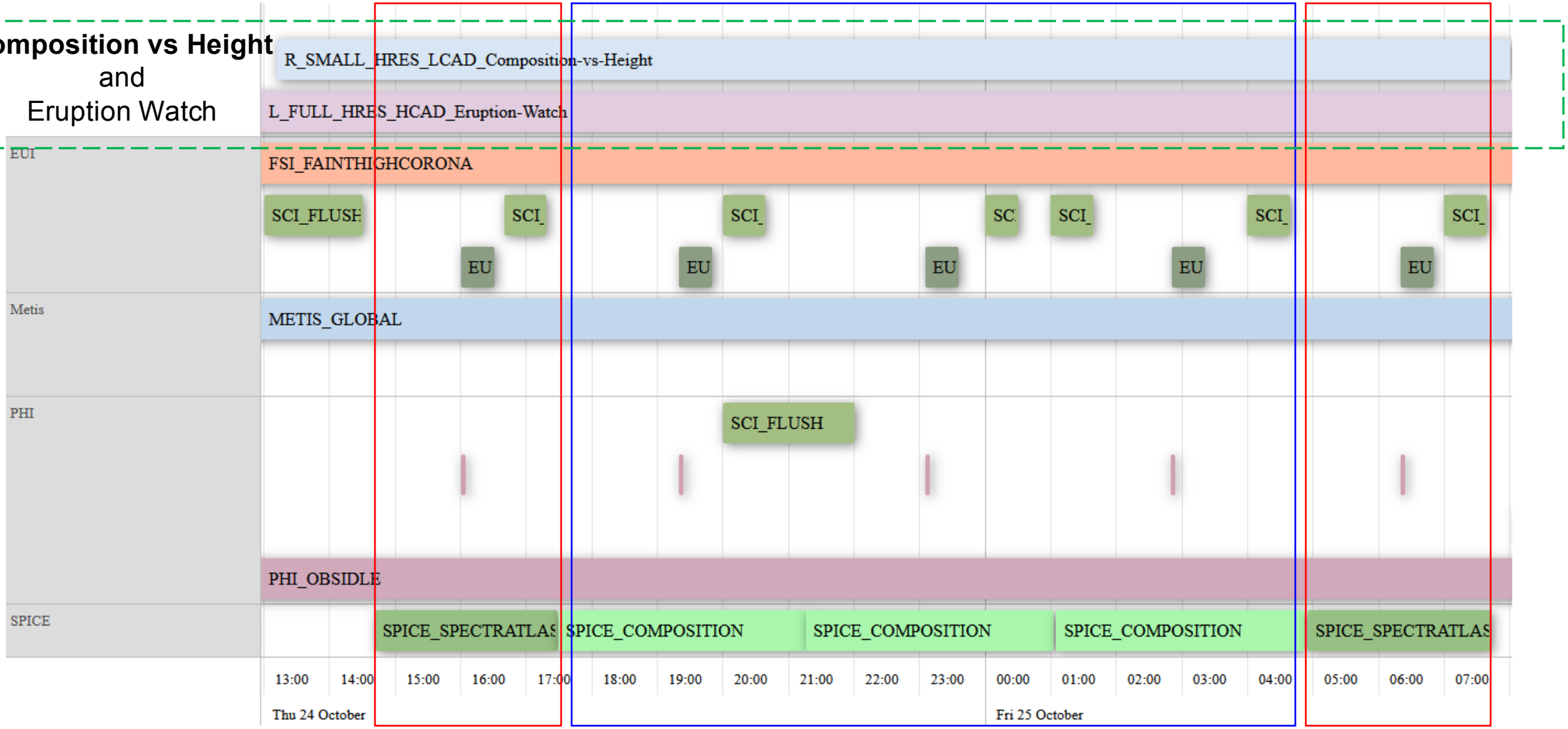
## Runs

Previous run:
LTP13, RSW12, 1 November 2023 (20h) at 0.56 AU, limb pointing (east)
LTP15, RSW13, 18 March 2024 (~19h) at 0.46 AU, disk centre

Current run:
LTP17, RSW18, 24-25 October 2024 (~19h) at 0.56 AU, west limb

# Planned Observations

**Composition vs Height**
and
Eruption Watch



# Instruments involved and status of observations

## Solar Orbiter instruments

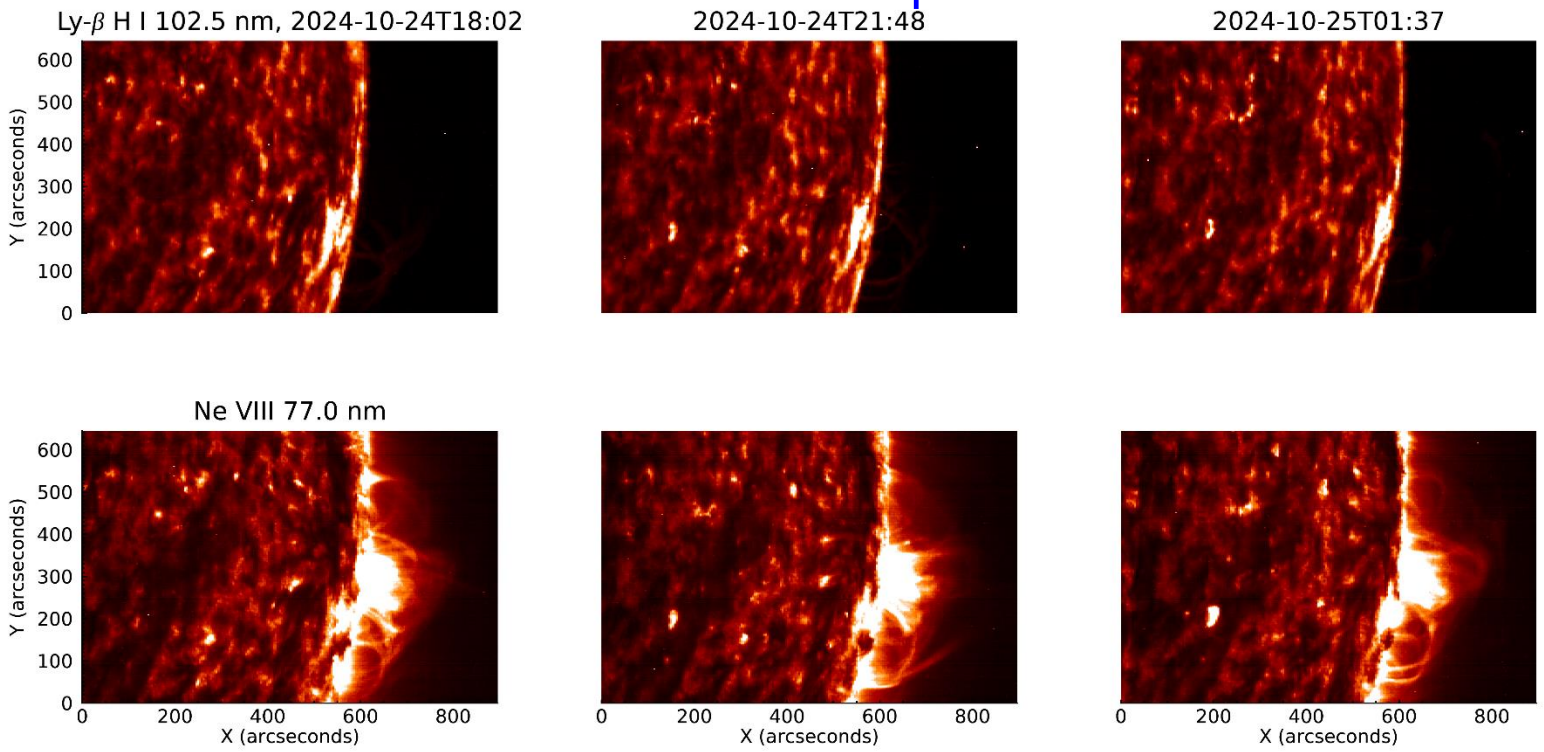
| Instruments | Observations | Status |
|---|---|---|
| SPICE (lead) | 2 runs of Spectral Atlas and 3 runs of Composition with 2 tests:<br>Test 1: O III 70.4nm, Mg IX 70.6nm, N IV 76.5nm, Ne VIII 77.0nm, Mg VIII 77.2nm, Ne VIII78.0nm, Mg VIII 78.2nm, S V 78.6nm, O IV 78.7nm, C III 97.7nm, H I 102.5nm, O VI 103.2nm<br>Test 2: O III 70.4nm, Mg IX 70.6nm, O II 71.8nm, S IV 75.0nm, N IV 76.5nm, Ne VIII77.0nm, S V 78.6nm, O IV 78.7nm, C III 97.7nm, H I 102.5nm, O VI 103.2nm, C II 103.6nm, O VI 103.7nm | Successful |
| EUI | 35 HRI 174 images (7 for each SPICE raster) and 54 FSI Occulter 174 images | Successful |
| PHI | 5 HRT datasets (1 for each SPICE raster) with a cadence of 3h30min | Successful |
| Metis | VL (4×4 binning) and UV (2×2 binning) observations with 5min candence | Successful |

## Support from external observatories

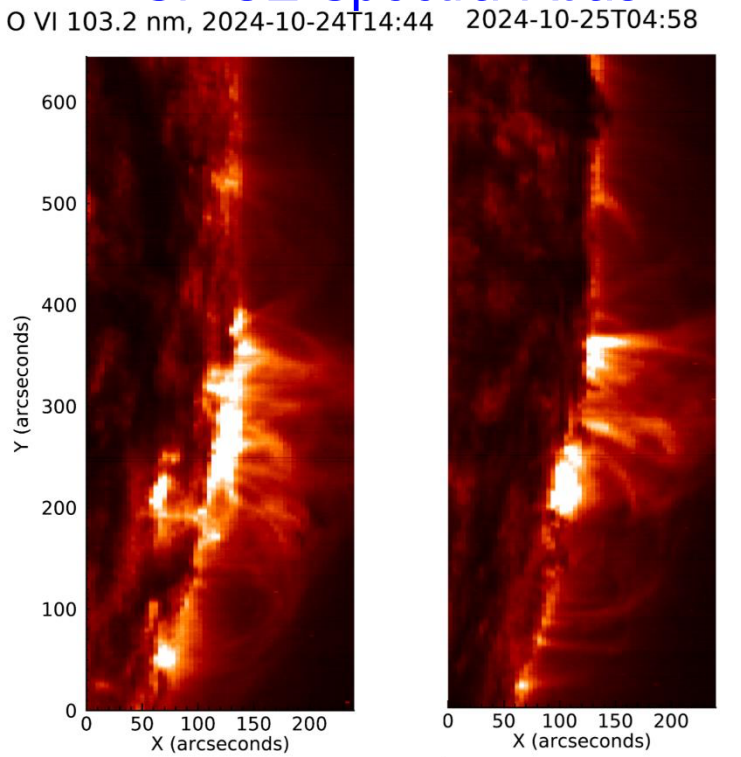
- Standard support from IRIS
- Support from Hinode/EIS through the HOP491

# SPICE observations and EUI HRI 174

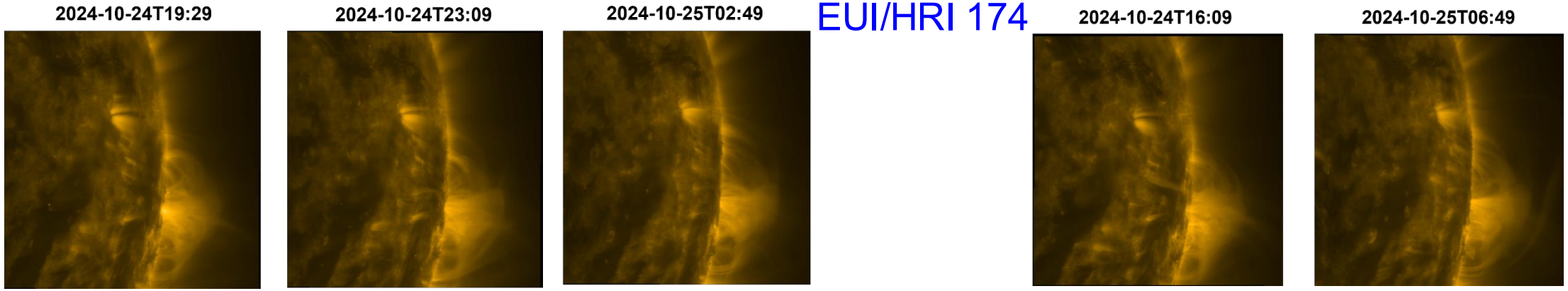
## SPICE Composition




## SPICE Spectral Atlas



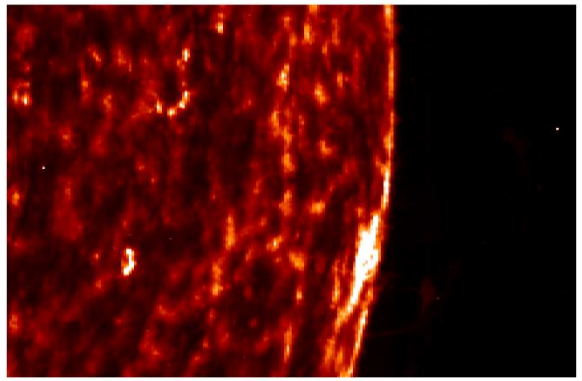

## EUI/HRI 174



# Combined images: SPICE composition, EUI, PHI and Metis

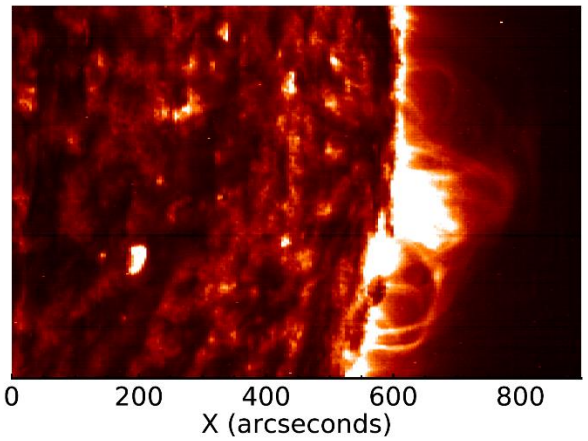
## SPICE Composition

2024-10-25T01:37

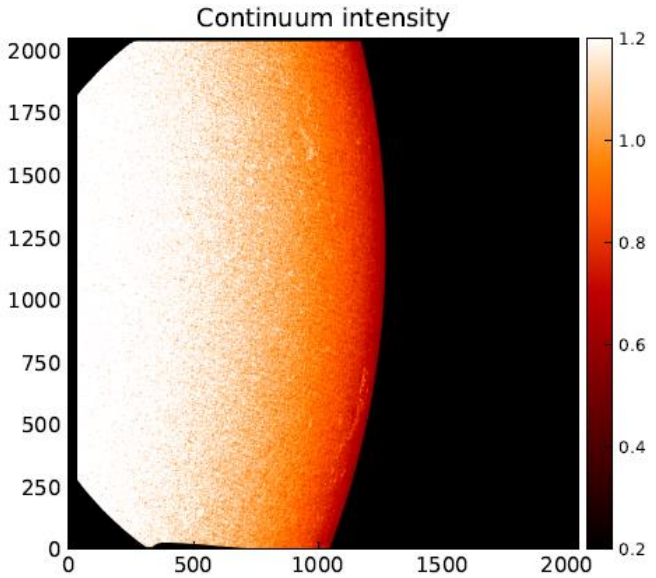


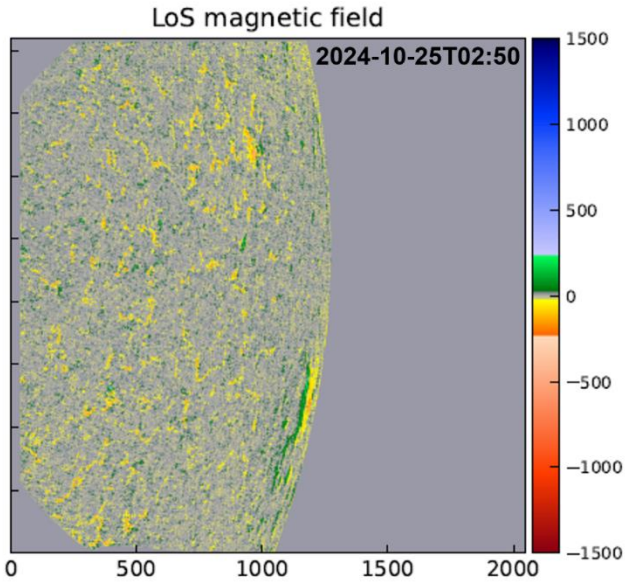
**Ly-β H I 102.5 nm**

**Ne VIII 77.0 nm**

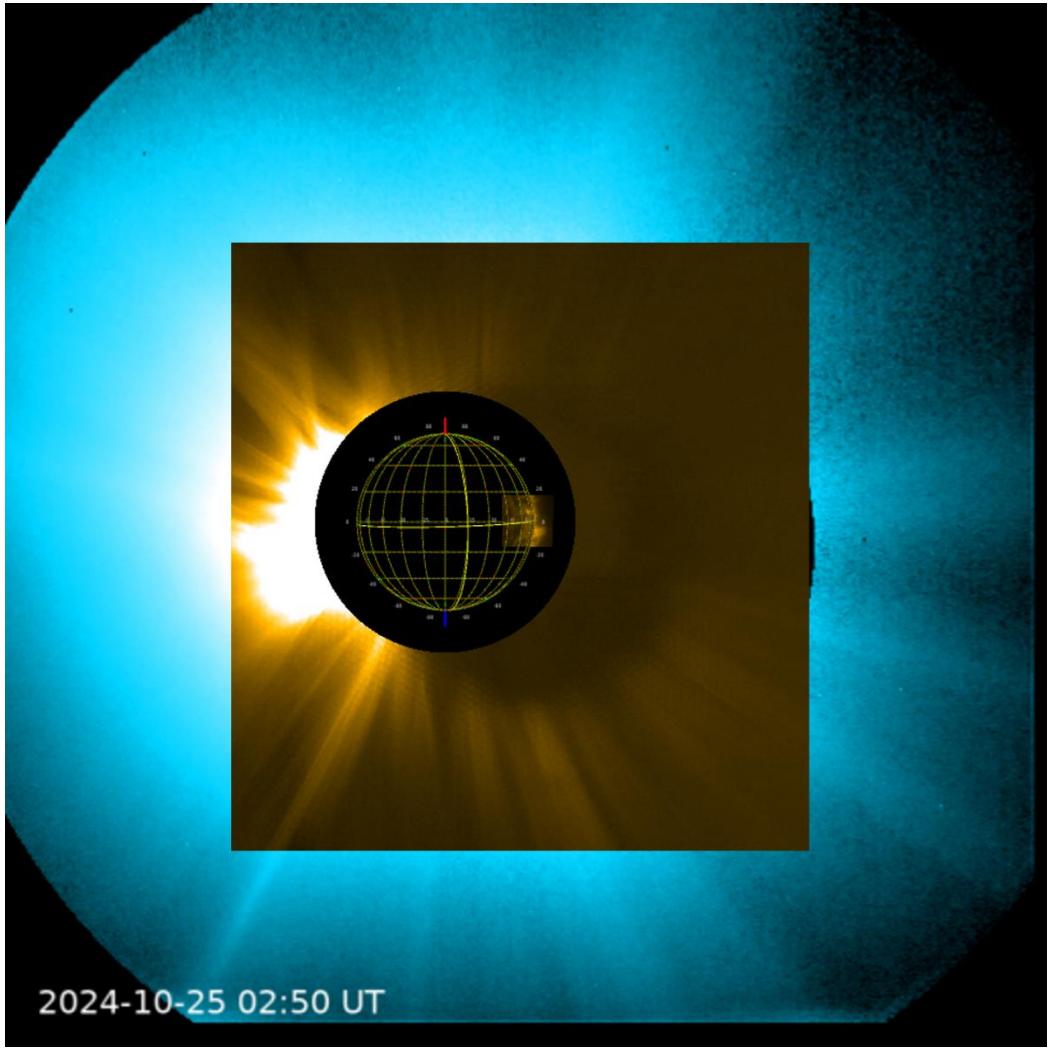



## PHI HRT



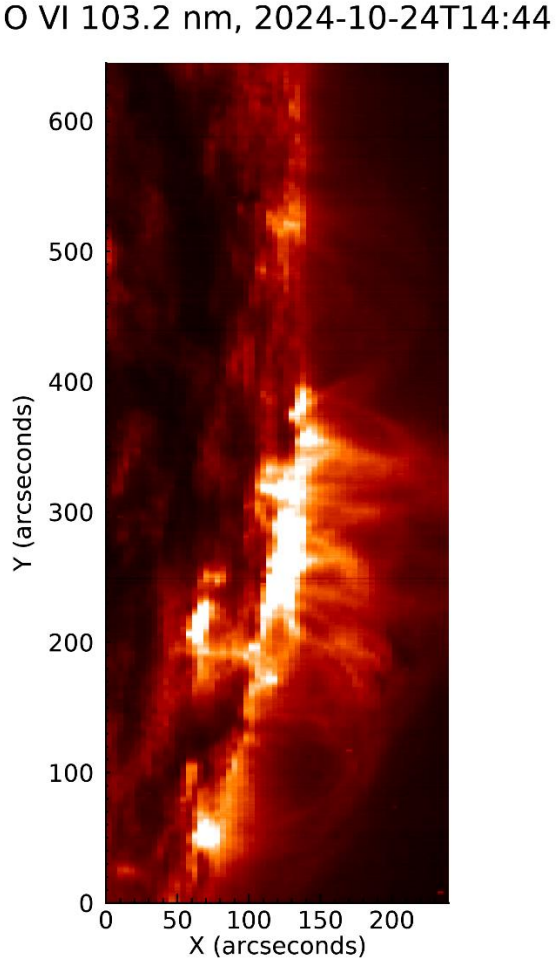




## Metis UV + EUI FSI Occulter 174 + HRI 174

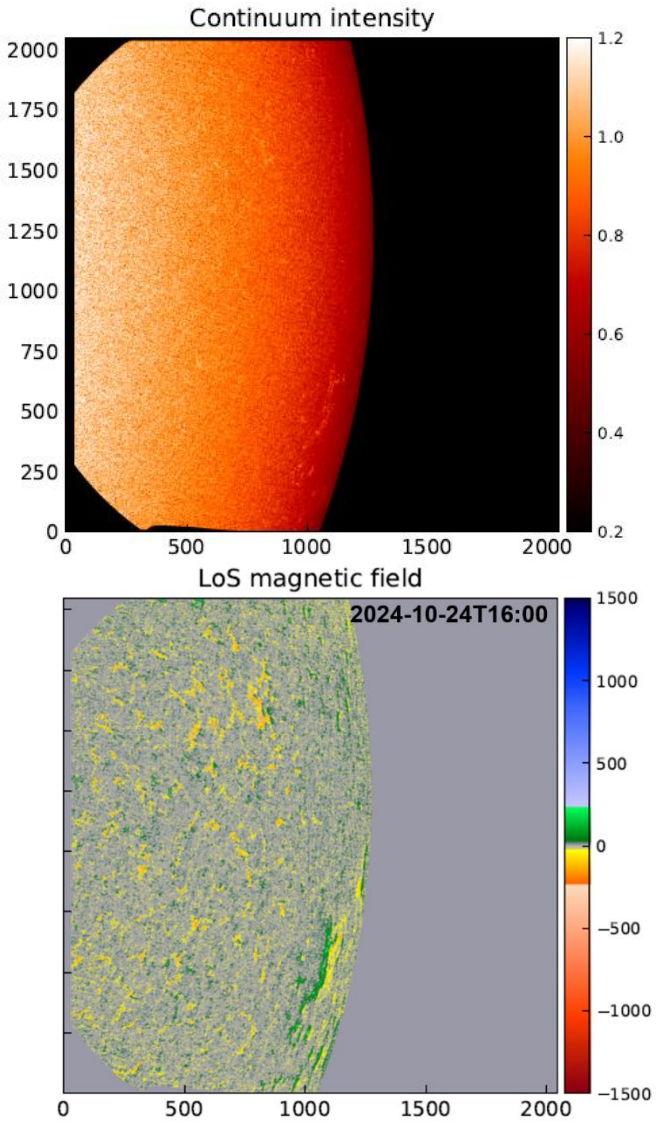


# Combined images: SPICE spectral atlas, EUI, PHI and Metis

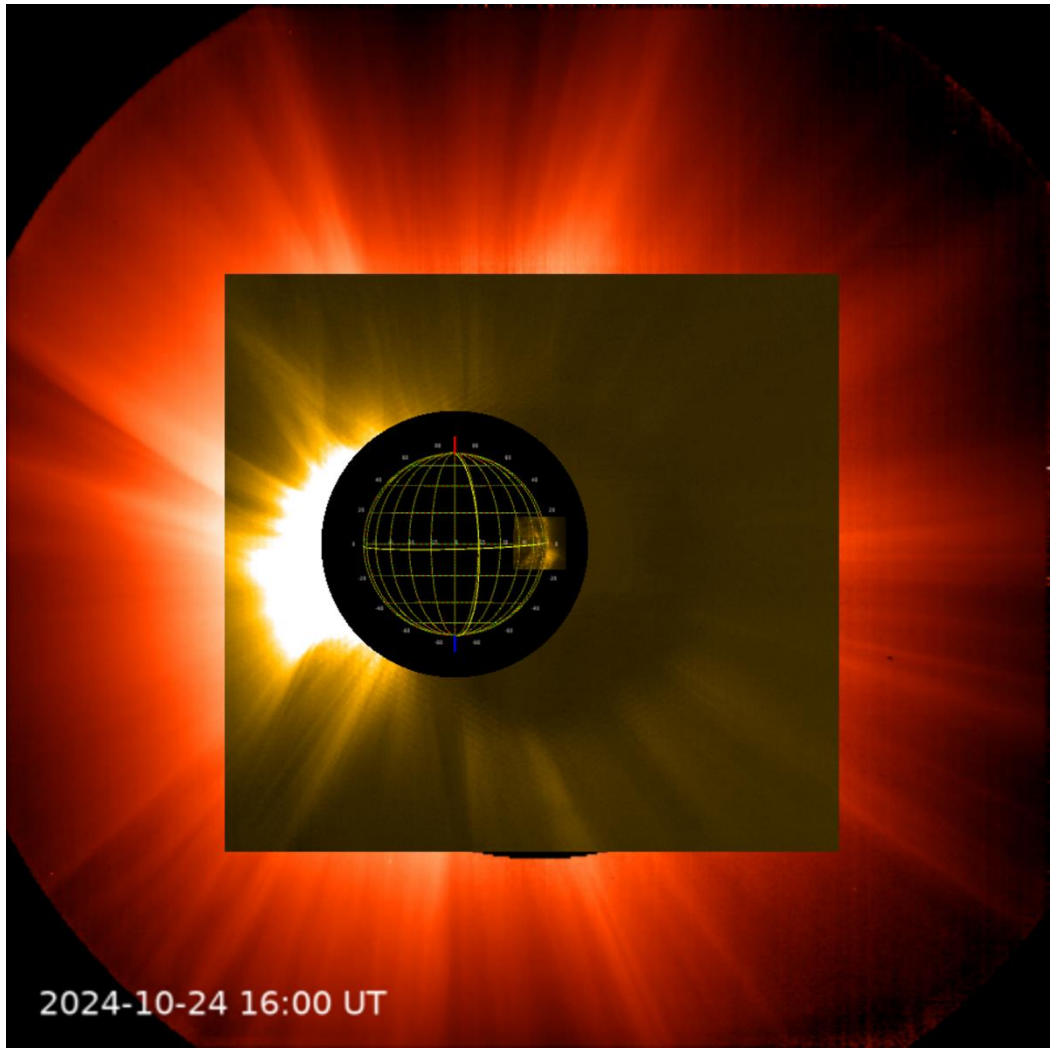
## SPICE Spectral Atlas




## PHI HRT




## Metis VL + EUI FSI Occulter 174 + HRI 174



# Summary and work to do

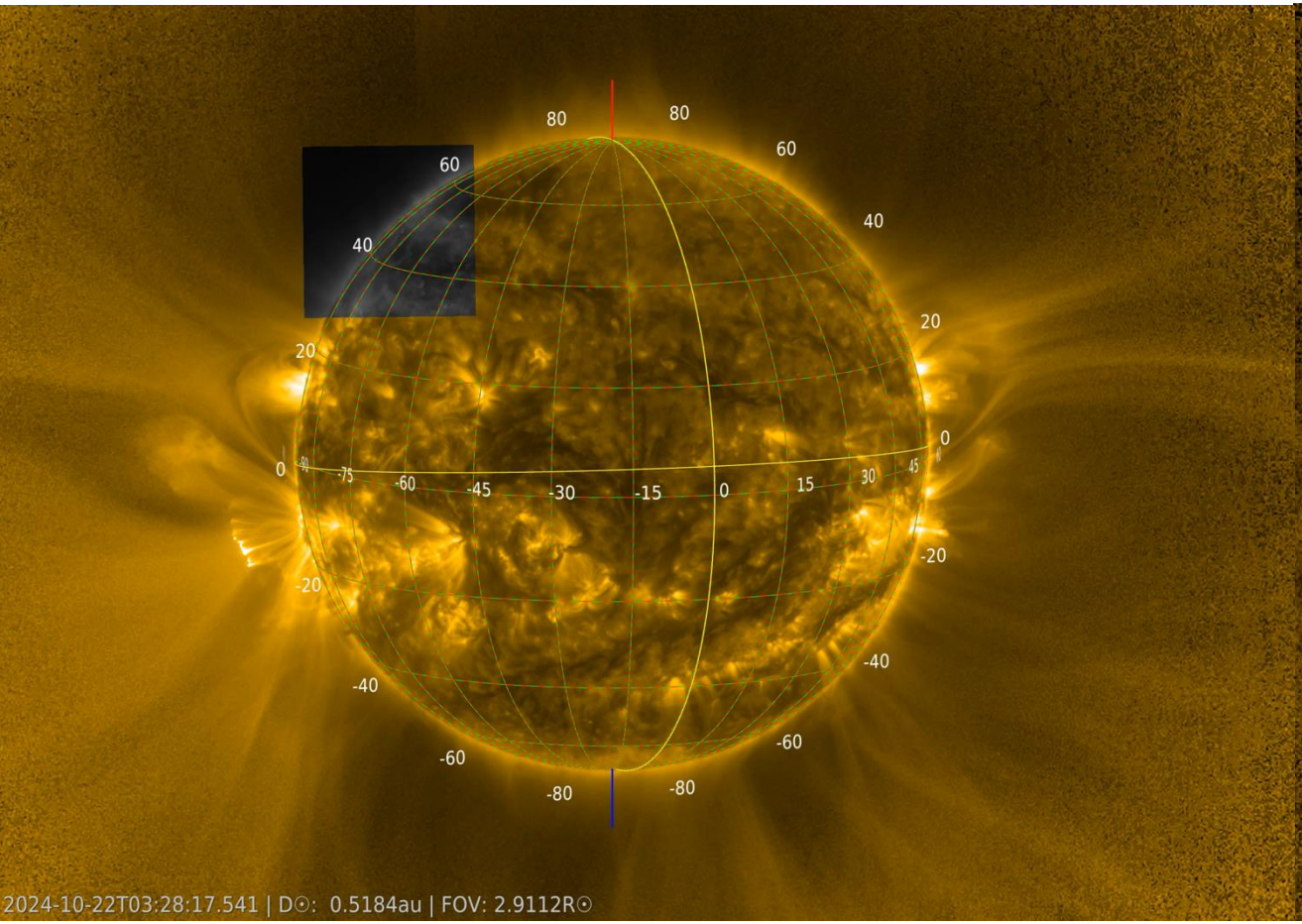
- The 2 flavours  of Composition versus Height SOOP have now run, twice for the limb version and once for the disk centre version, and they were overall successful:
    - First attempts as a test to tidy up all the requirements from all instruments.
    - Second attempts as official runs using lesson learned from the tests, in particular concentrating on a more appropriate support from the other RS instruments on Solar Orbiter.
- The SPICE studies, designed for both flavours, are appropriate for the purpose of deriving the composition along the layers of the solar atmosphere (disk centre flavour) and through the limb (limb flavour).
- The set-up for the other supporting instruments is also appropriate, e.g. the use of EUI Occulter and Metis VL and UV channel observations are crucial for the limb flavour, in addition to the magnetic field information given by PHI HRT close to the limb.
- Support from external observatories worked well for disk centre flavour, while the analysis and checks is still ongoing for the limb flavour.
- The second run of the disk centre flavour is planned for 13 March 2025 still in coordination with Hinode/EIS and IRIS.

# Full Disk Mosaic

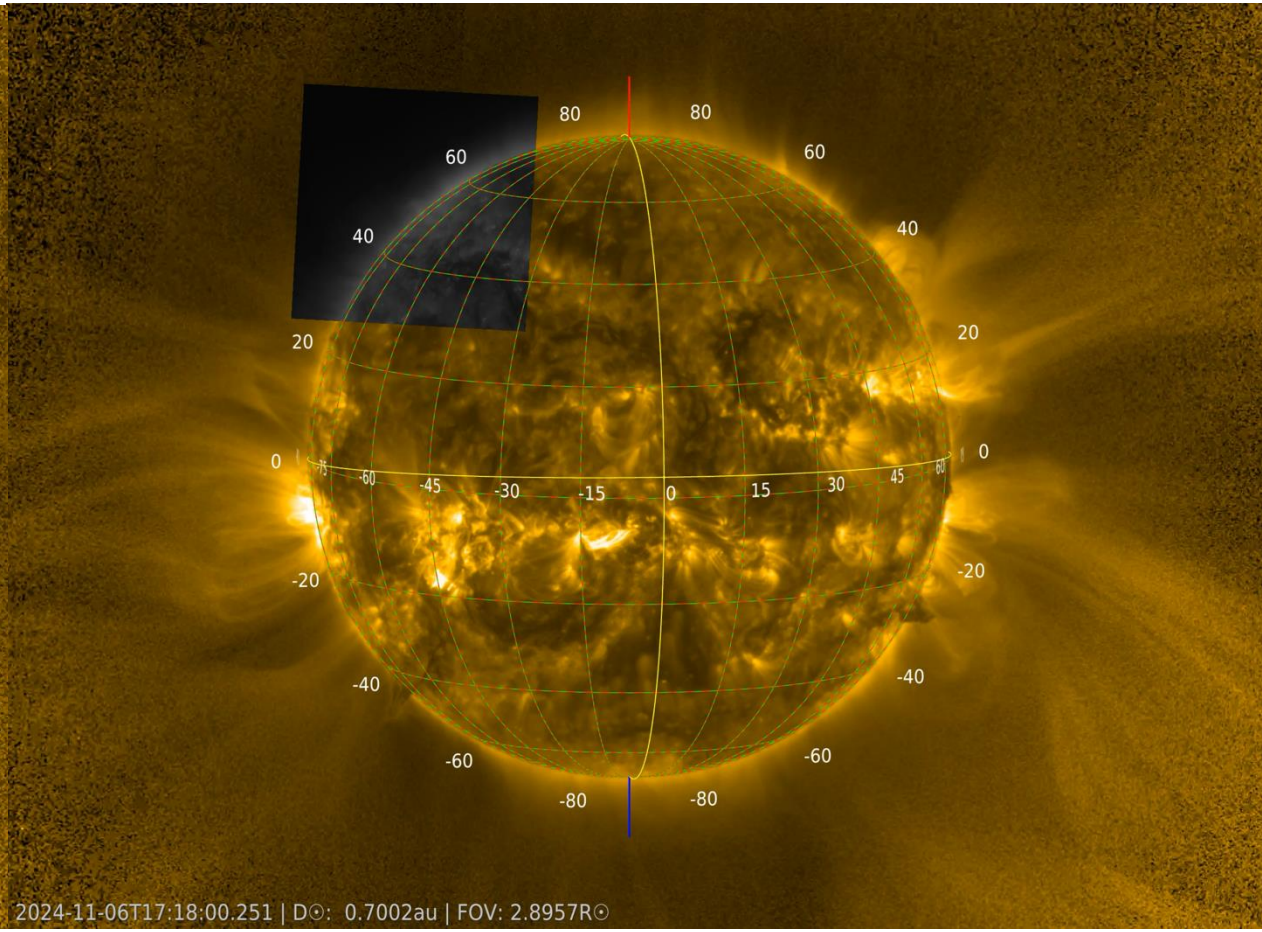
SOOP coordinators: Alessandra Giunta, David Berghmans

# Full Disk Mosaic

## 2024-10-22
## dwell time 6 min, @0.52 au

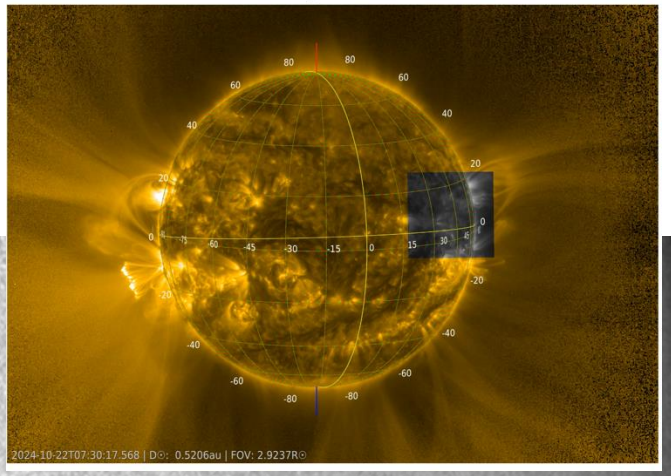



## 2024-11-06
## dwell time 22 min, @0.70 au



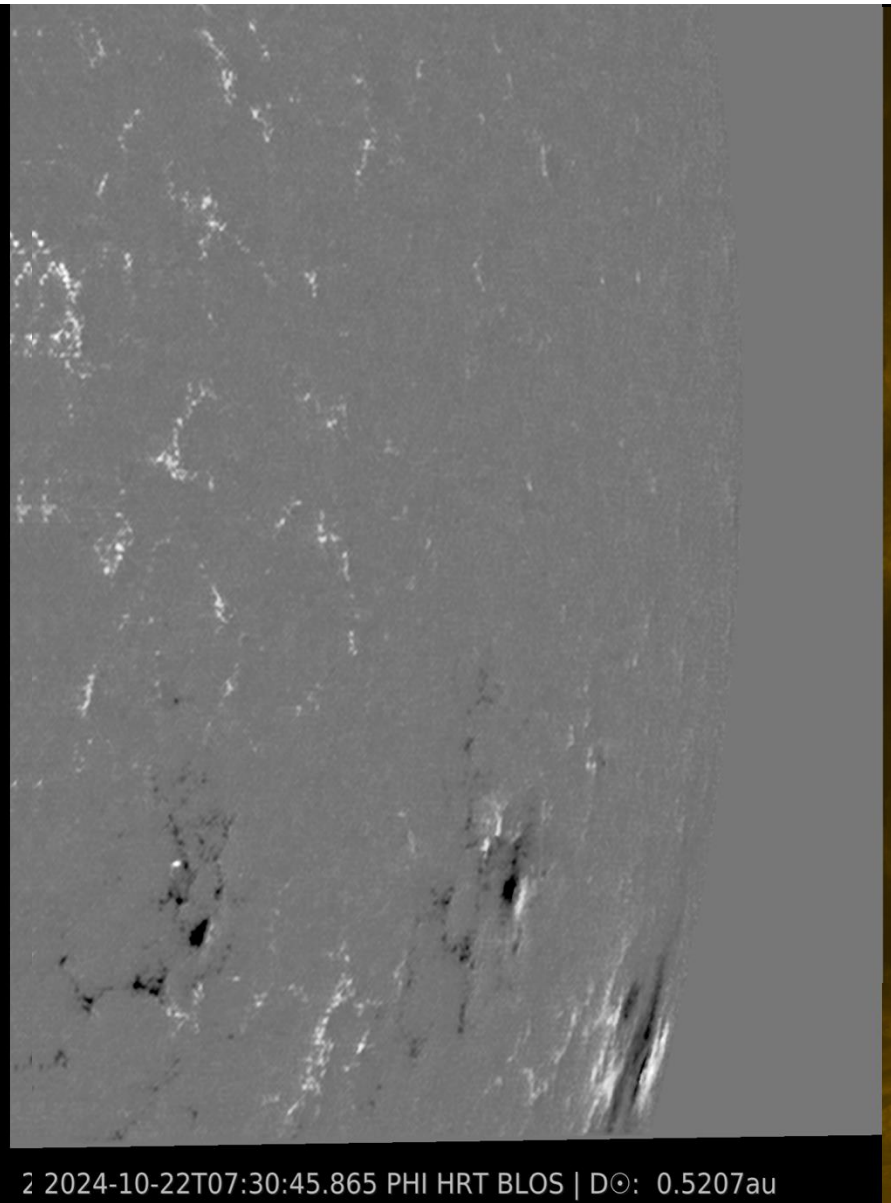

All data (EUI, PHI, SPICE) acquired successfully.
No detailed processing yet.

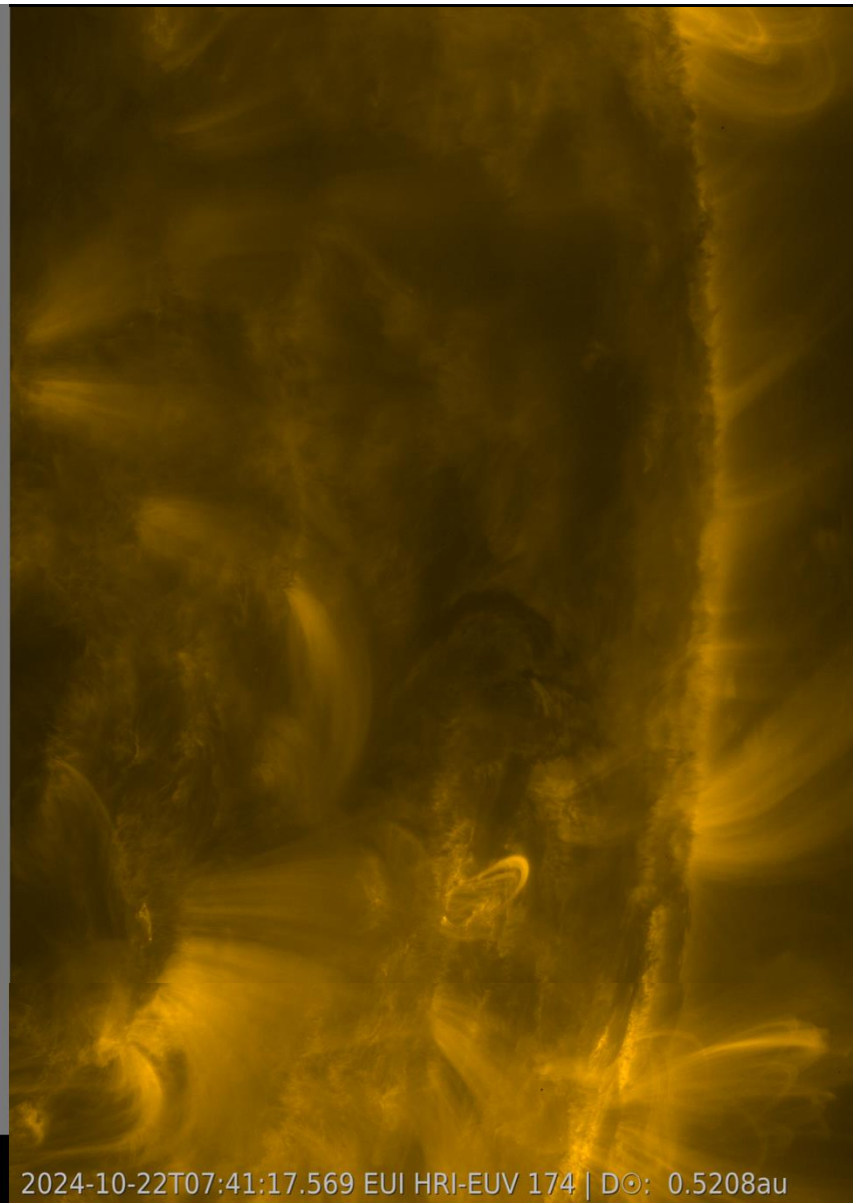
# 2024-10-22
# dwell time 6 min, @0.52 au









# 2024-11-6/7, dwell time 22 min, duration 11h 20m

## Goal

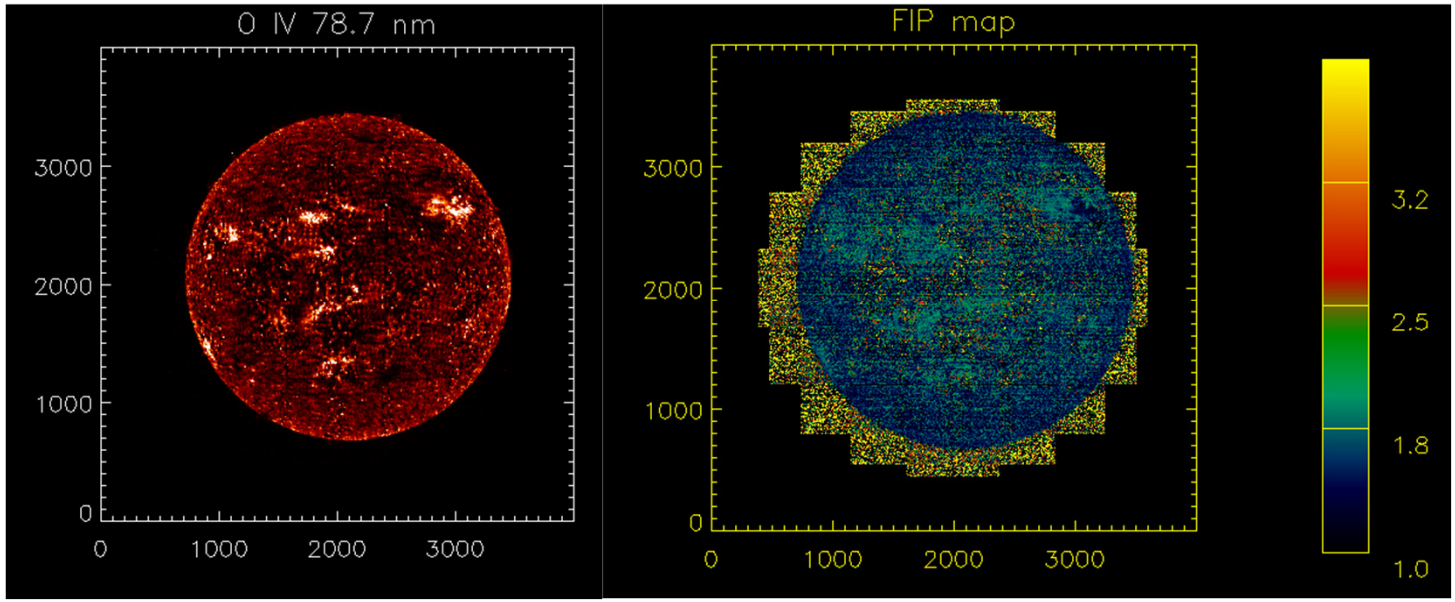
Full Disk Mosaic using the SPICE 6″ narrow slit to build up the full Sun in several monochromatic images and make up a global composition map.

It is designed to run at solar distance of 0.7AU. This adds the benefit of joint observations with Metis and allows a thorough view of the spectroscopic features of the full disk, in addition to the preliminary tracking off limb into the heliosphere.

## Previous runs with 22 min dwell and preliminary results

- LTP13, out of RSWs, 13 November 2023 (11h20m) at 0.7 AU

- **LTP14, out of RSWs, 26 February 2024 (11h20m) at 0.71 AU** ⇨



# 2024-11-6/7, dwell time 22 min, duration 11h 20m

## Current run: LTP17, out of RSWs, 6-7 November 2024 (11h20m) at 0.70 AU

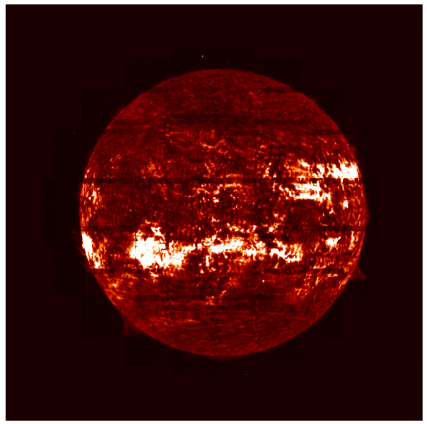
Main instruments involved and status of observations

| Instruments | Observations | Status |
|---|---|---|
| SPICE | 25 rasters, one for each pointing to make up a full disk mosaic. Spectral lines : O III 70.3 nm, Mg IX 70.6 nm, N IV 76.5 nm, Ne VIII 77.0 nm, S V 78.6 nm, O IV 78.7 nm, C III 97.7 nm, Ly-β 102.5 nm, O VI 103.2 nm. | Successful |
| EUI | 28 HRIEUV images, 2 FSI 304 and 2 FSI 174 for each of 25 pointings. | Successful |
| PHI | 25 HRT datasets. | Successful |
| Metis | 224 images in VL and UV, Synoptic observations with 12 min cadence and 4×4 binning for both channels. | Successful |

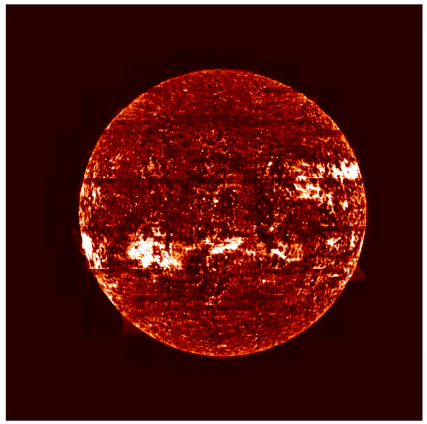
# 2024-11-6/7, dwell time 22 min, duration 11h 20m

## SPICE full Sun monochromatic images as a function of temperature

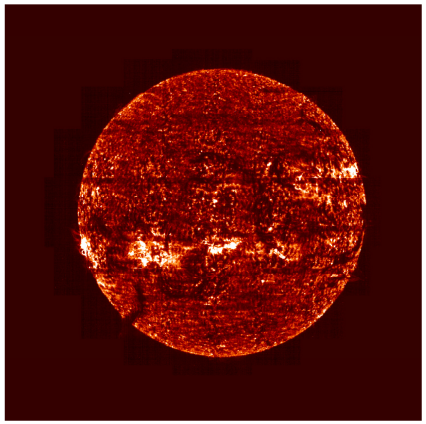
H I 102.5 nm, $\log(T_e/K)=4.0$



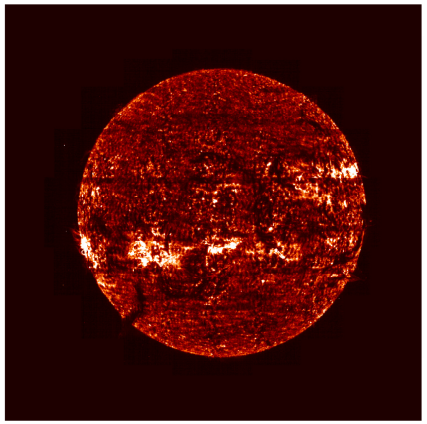
C III 97.7 nm, $\log(T_e/K)=4.8$



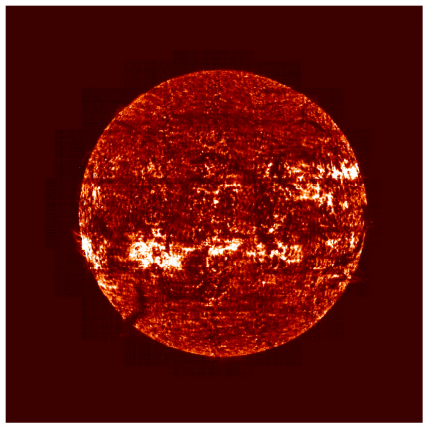
N IV 76.5 nm, $\log(T_e/K)=5.1$



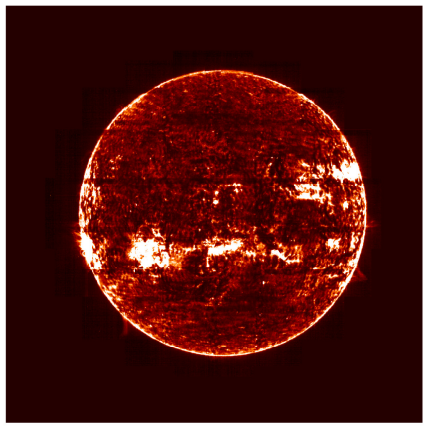
O IV 78.7 nm, $\log(T_e/K)=5.2$



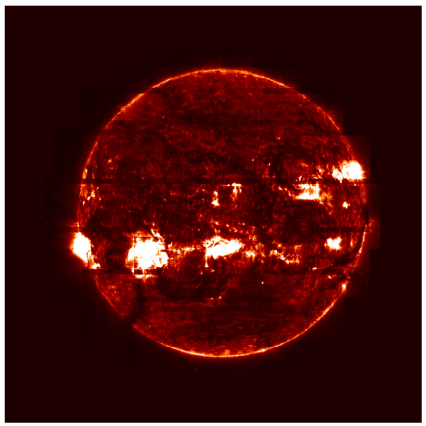
S V 78.6 nm, $\log(T_e/K)=5.2$



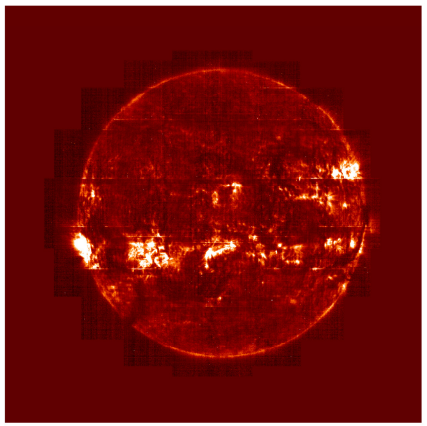
O VI 103.2 nm, $\log(T_e/K)=5.4$



Ne VIII 77.0 nm, $\log(T_e/K)=5.8$



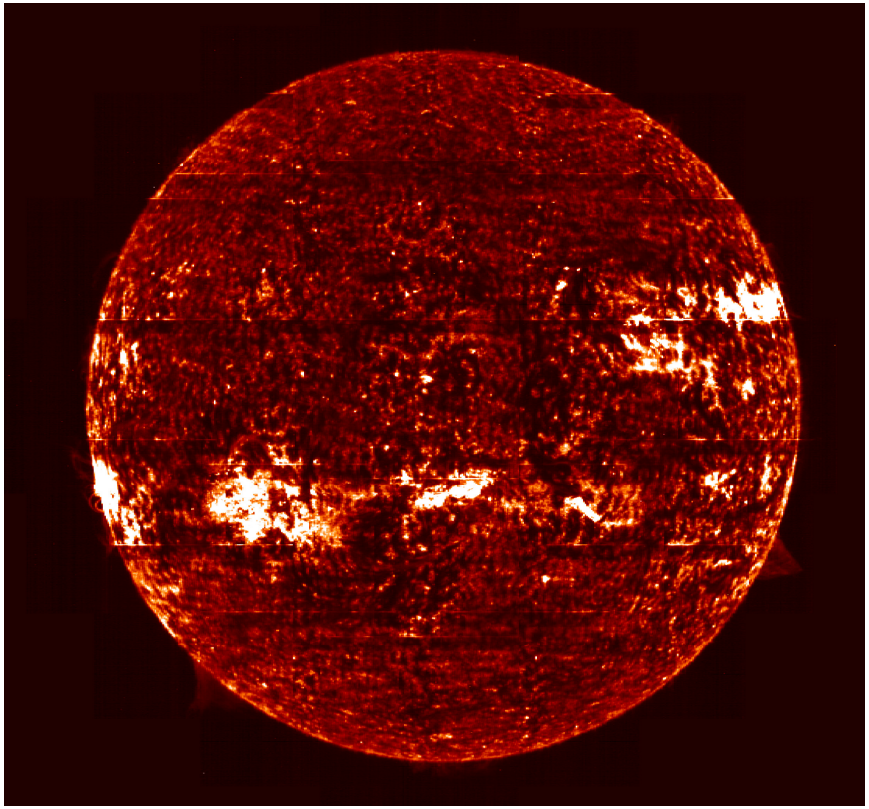
Mg IX 70.6 nm, $\log(T_e/K)=5.9$



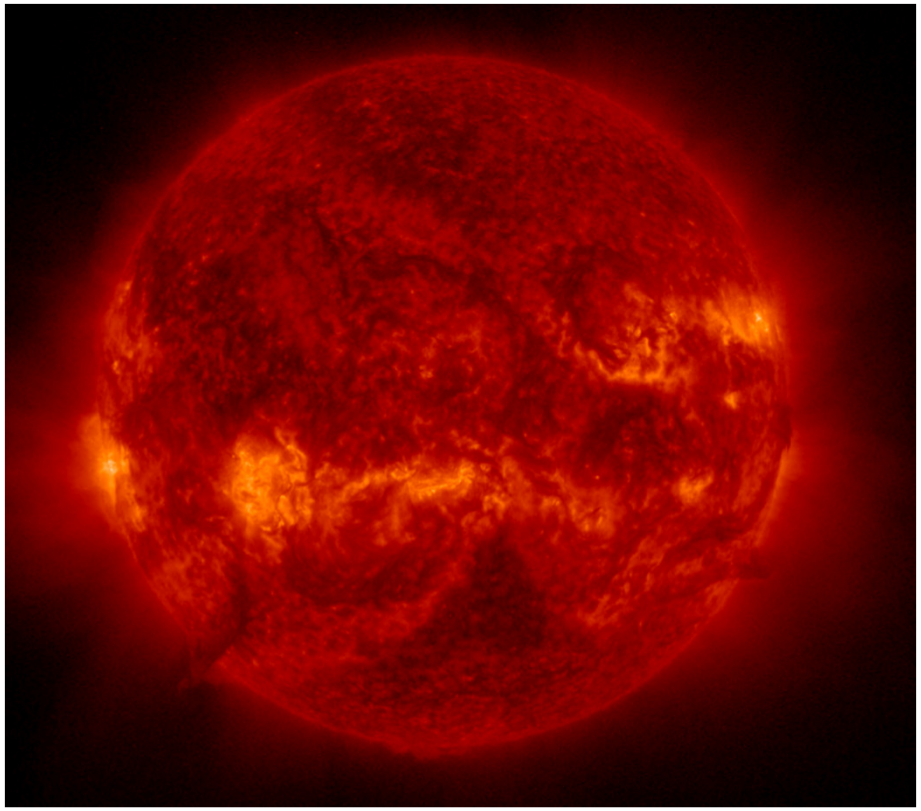
# 2024-11-6/7, dwell time 22 min, duration 11h 20m

SPICE C III 97.7 nm and EUI FSI 304

**SPICE C III 97.7 nm**



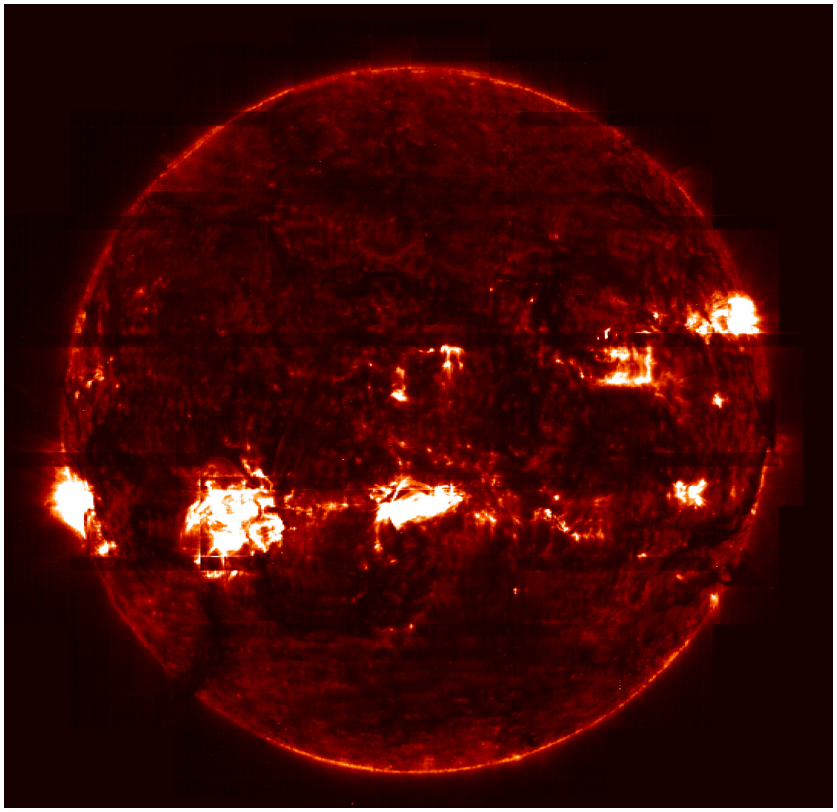
**EUI FSI 304  2024-11-06T22:41**



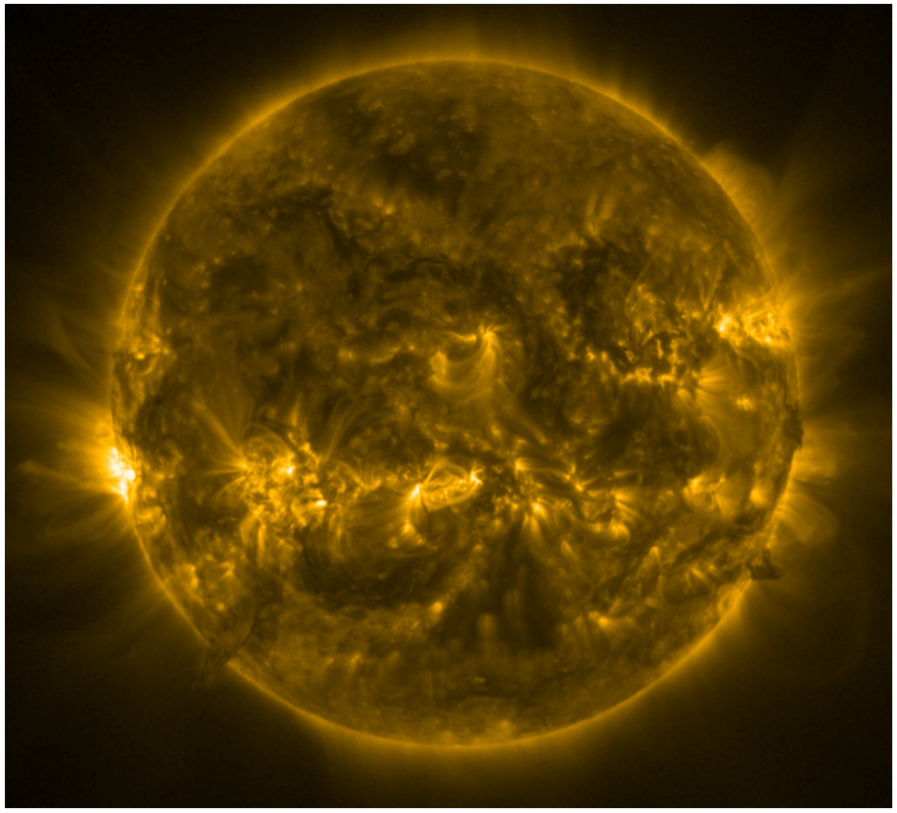
# 2024-11-6/7, dwell time 22 min, duration 11h 20m

SPICE C III 77.0 nm and EUI FSI 174

**SPICE Ne VIII 77.0 nm**



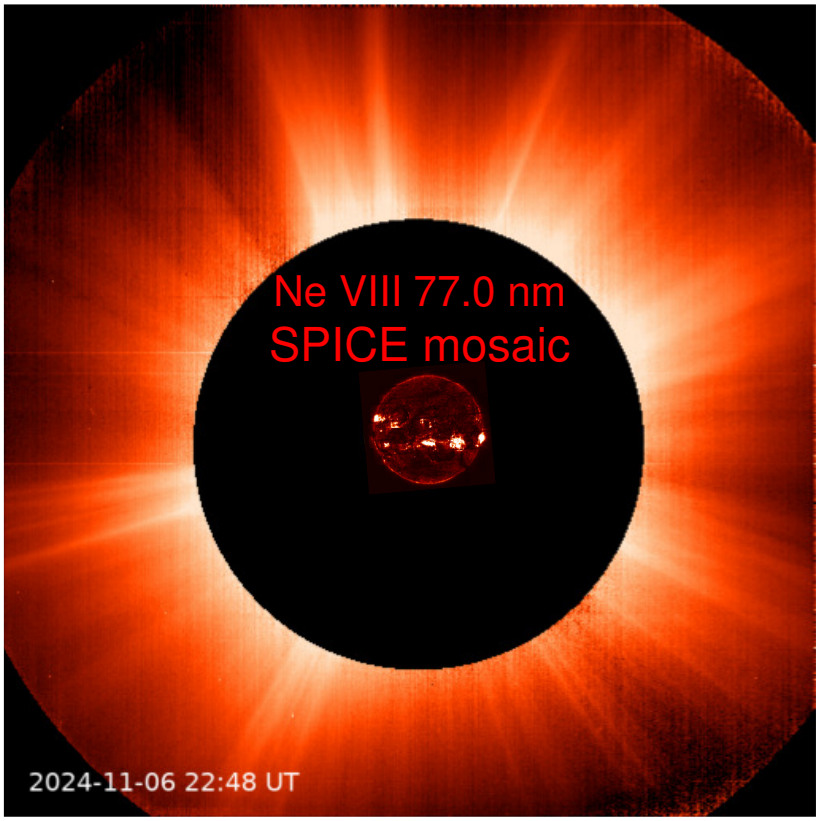
**EUI FSI 174 2024-11-06T22:42**



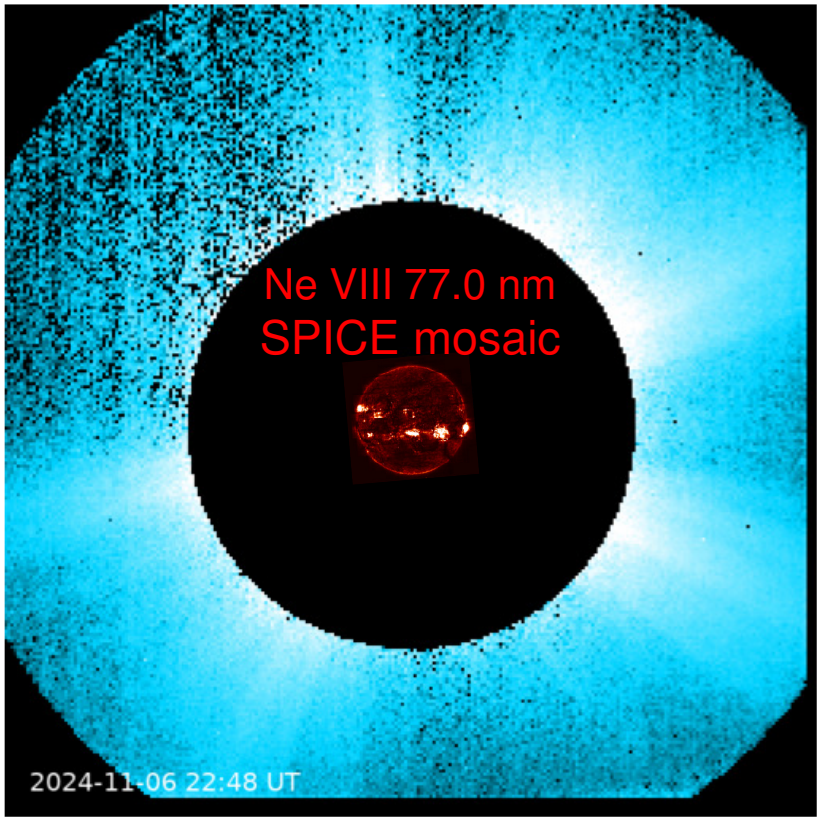
# 2024-11-6/7, dwell time 22 min, duration 11h 20m

Combined images with Metis and SPICE

Metis VL



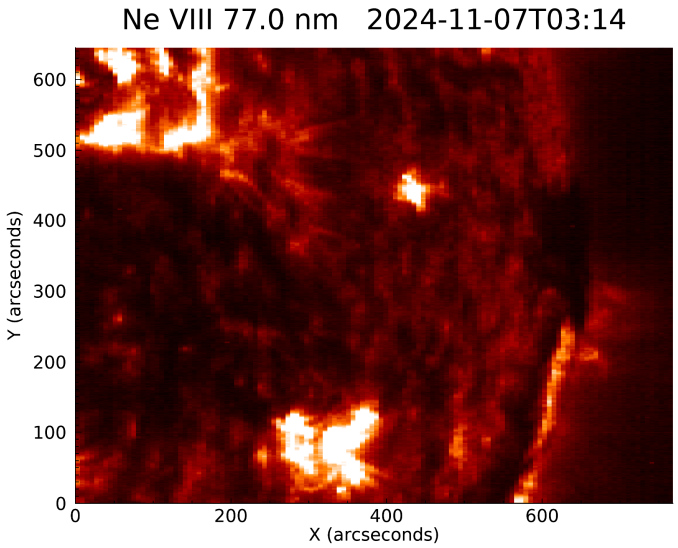

Metis UV



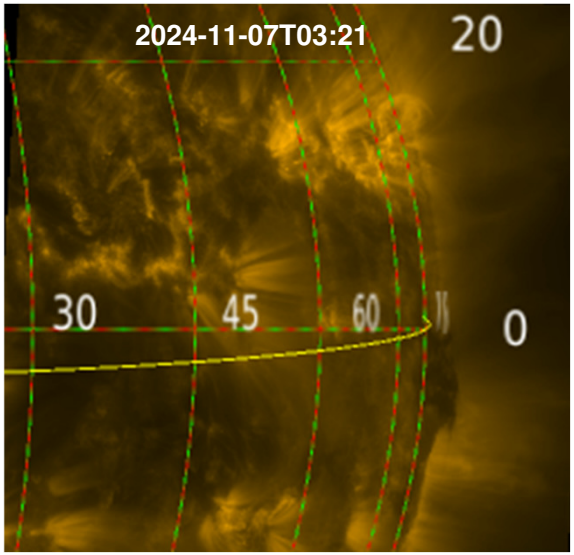
# 2024-11-6/7, dwell time 22 min, duration 11h 20m

West Limb dwell with high-resolution telescopes

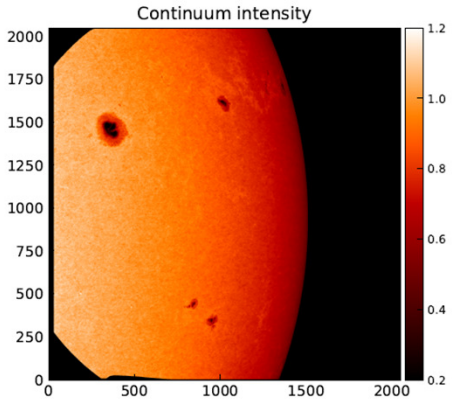
SPICE

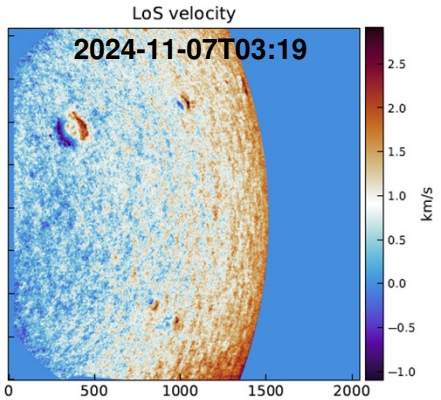


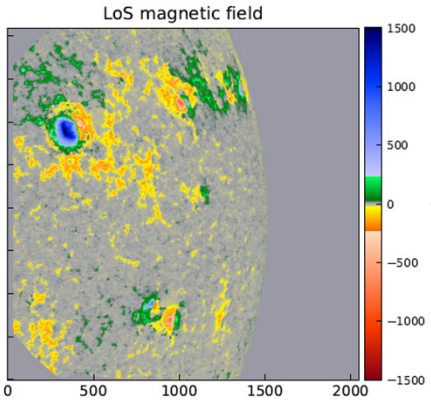

EUI HRI 174




PHI HRT



# 2024-11-6/7, dwell time 22 min, duration 11h 20m

## Lesson learned and way forward

- This run of 22 min full disk mosaic was overall successful: all instruments acquired the data as planned and the analysis is ongoing.
- Until now 3 runs of the full disk mosaic with 22 min dwell have been planned and executed.
- Each run helped to plan the next one

  For example:

  - PHI/HRT planned for the second run in addition to the other instrument observations.
  - Metis UV channel observations planned for the third run in addition to VL.
- A fourth run has been planned for 10-11 May 2025 and this will include a very comprehensive set of observations: SPICE as for the previous runs, EUI HRI and FSI Occulter, PHI HRT and Metis VL and UV for each dwell.
- The May 2025 run will look for the first time to the North Pole and will give the chance to create the first composition map of the full Sun including one of the pole and with a full coverage from the solar surface into the heliosphere, thanks to the FOV of EUI Occulter and Metis.

# Earth Quadrature, Target 2 = Filament

SOOP coordinators: Susanna Parenti, Terry Kucera

# SOOPR_BOTH_HRES_HCAD_Filaments

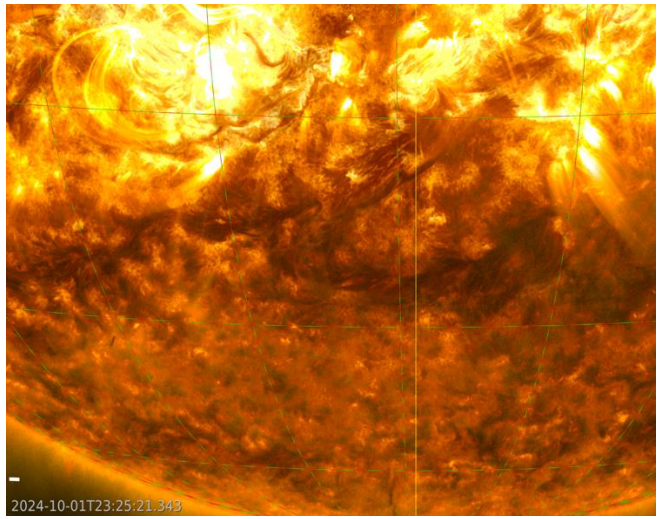
## 1-2 October 2024, 23h->5h
## Quadrature with Earth; Solo at the limb (0.29 AU)

SOOP coordinators: S. Parenti[1], T. Kucera[2]

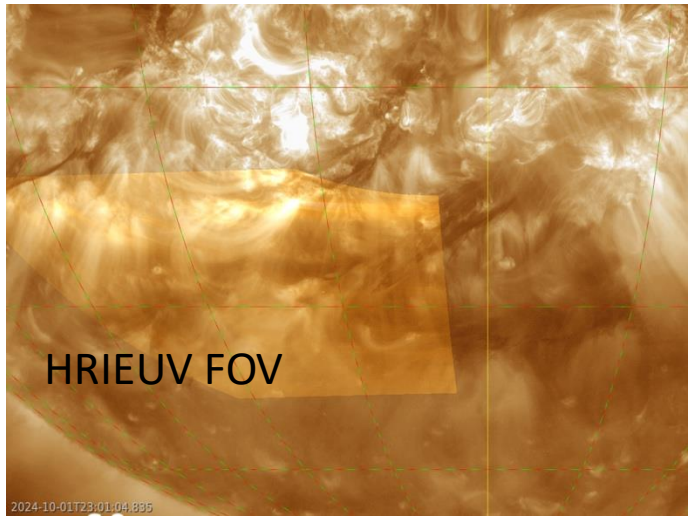
1. Institut d'Astrophysique Spatiale, Fr
2. GSFC, US

# Earth view: Hinode, DKIST

**Target**: complex U shaped filament with a brunch extending to East.
The east side is low in the atmosphere, the west side has probably 2 branches, one of which higher in the atmosphere.

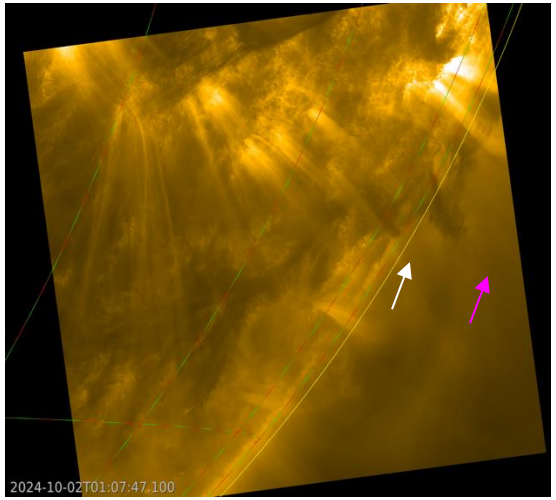



AIA



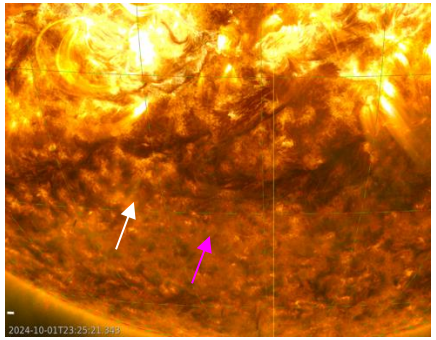

First DKIST test on filament. Data taken few hours before starting the SOOP

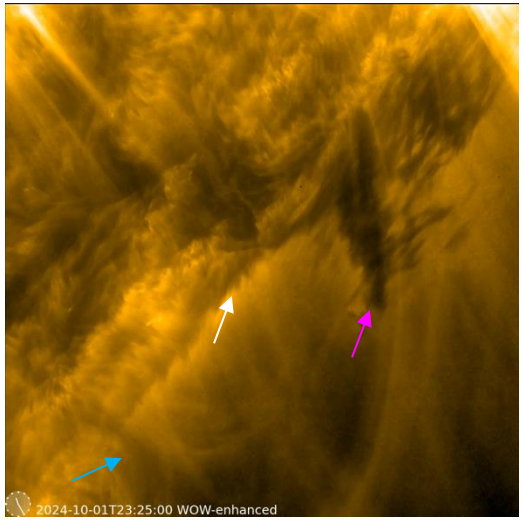
-> Better coordination for LTP21

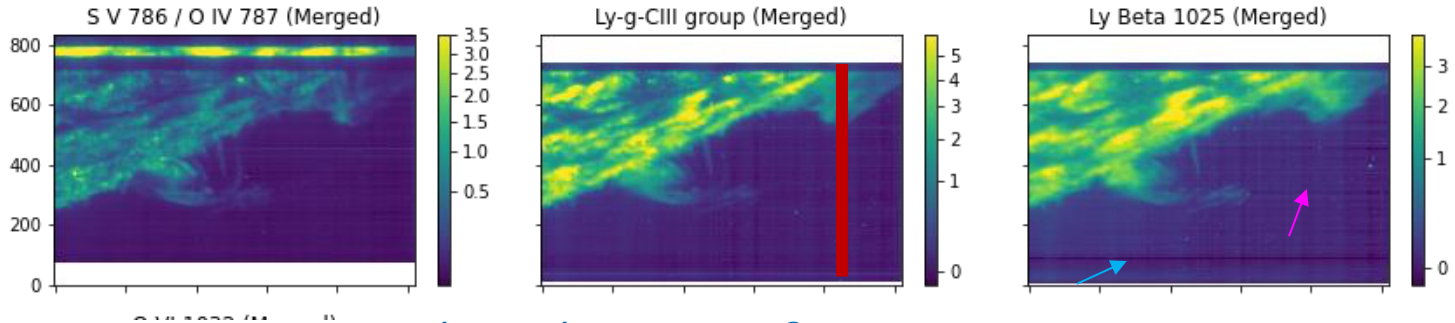



HRIEUV 5s cadence
FSI 304 3m cadence

AIA

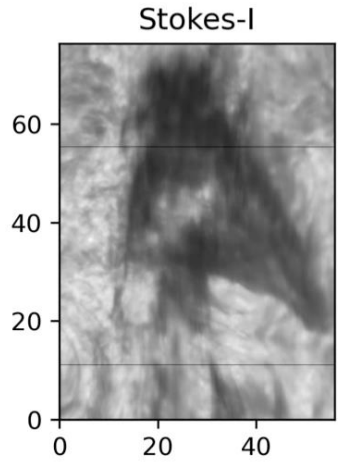




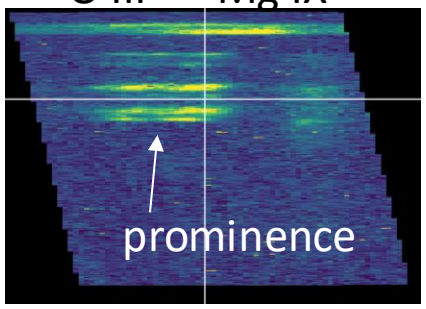

SPICE: large deep raster & 3steps DYN

SoLO pointing a bit too far south




DKIST ViSP

O III - Mg IX




λ

# Summary

- The SOOP run 3 times in quadrature with Earth
  - LTP13: good target, eruption in SPICE only
  - LTP15: missed target
  - LTP17: at perihelion, the pointing was a bit too far south, no cotemporal DKIST observations.
- LTP21 -> Earth alignment, limb pointing
  - Better coordination with DKIST: time slot important.
  - For a good target: time slot to be the closer possible to the VSPT_UPDATE

# EUI Fast Cadence

SOOP coordinators: Daye Lim, Krzysztof Barczynski

# R_SMALL_HRES_HCAD_RS-BURST

**SOOP coordinators: Daye Lim & Krzysztof Barczynski**

**Science Goal**

- to study coronal waves with a very short period from the perspective of coronal heating and coronal seismology
- to investigate the origin of the upflow region for a possible slow solar wind source region

**Target**

the border of active region

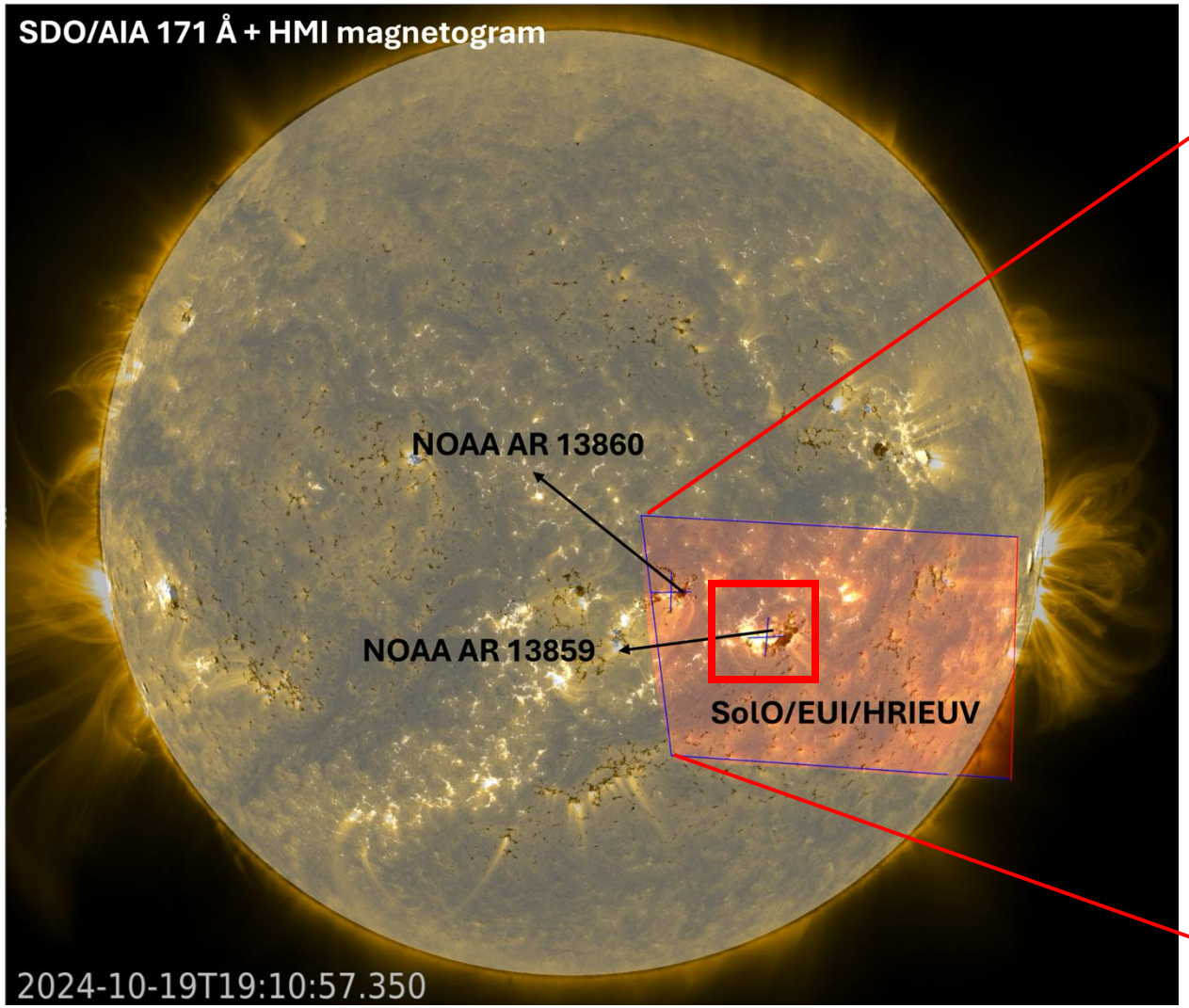
**Run**

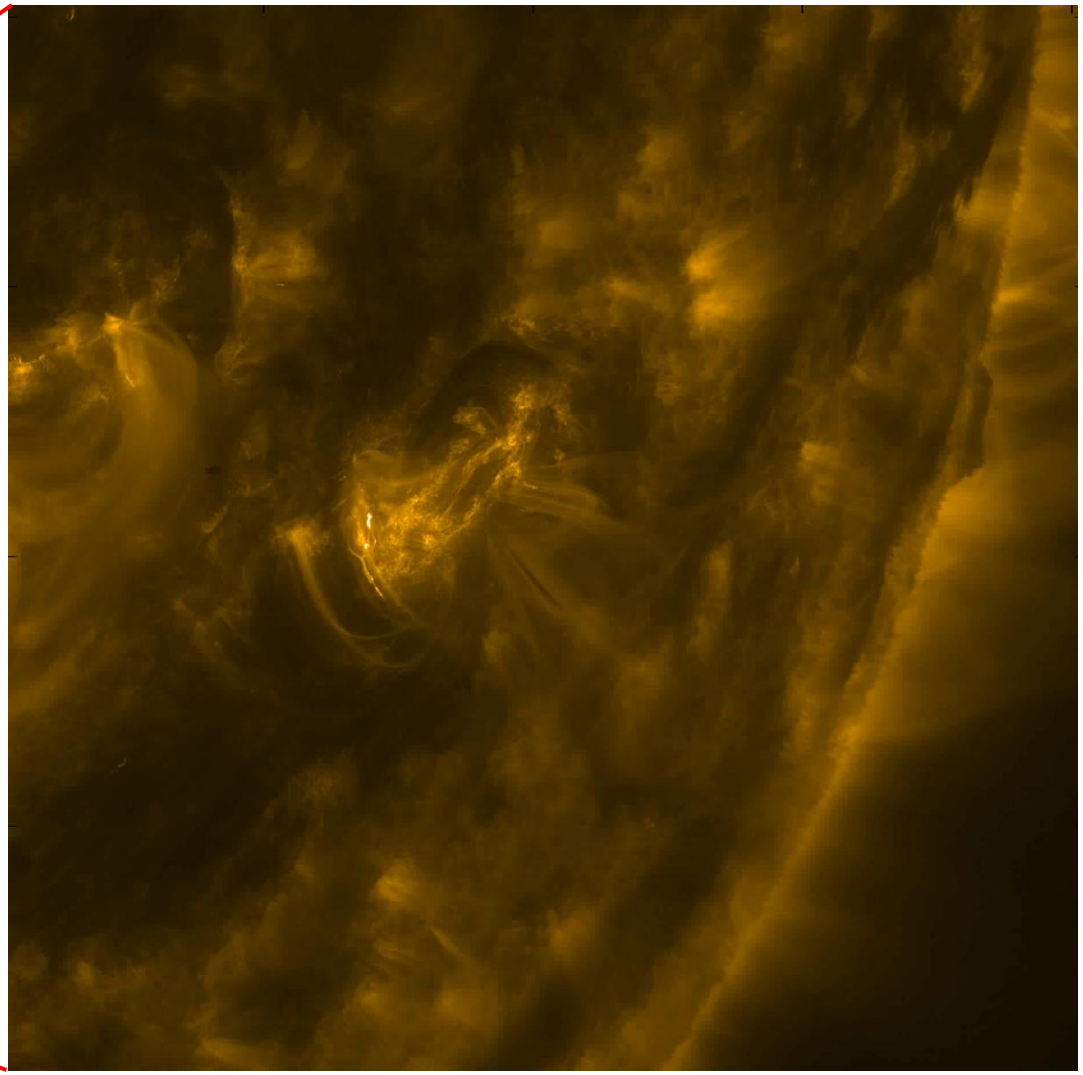
LTP17, RSW18, 19 October 2024 19:00 – 19:30 at 0.487 au

# Coordinated Observations and Data Availability

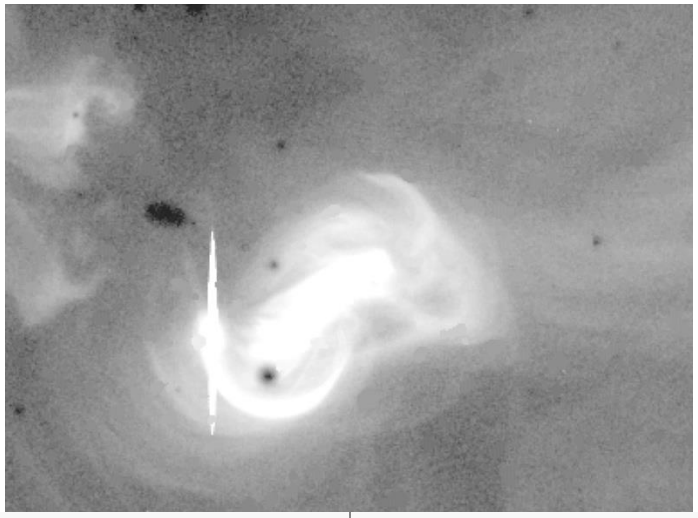
| Instrument | | Plan | Availability |
|---|---|---|---|
| Solar Orbiter | EUI | 19:00 – 19:30<br>**HRIEUVOPN 1 sec cad**<br>(0.659 s exp) | Successfully observed<br>Available in JHv |
| | SPICE | 19:00 – 19:40<br>Slot mode (1.8 s exp) | Successfully observed<br>Available |
| | PHI | 19:00 – 20:00<br>HRT 1 min cad | Successfully observed<br>Not available yet |
| External | DKIST | 19:00 – 20:30<br>ViSP, VBI, DL-NIRSP | Not observed<br>due to bad weather |
| | IRIS | 18:41 – 19:59<br>Raster & SJI | Successfully observed<br>Available |
| | Hinode | 18:45 – 21:56<br>EIS & SOT | Successfully observed<br>Available |

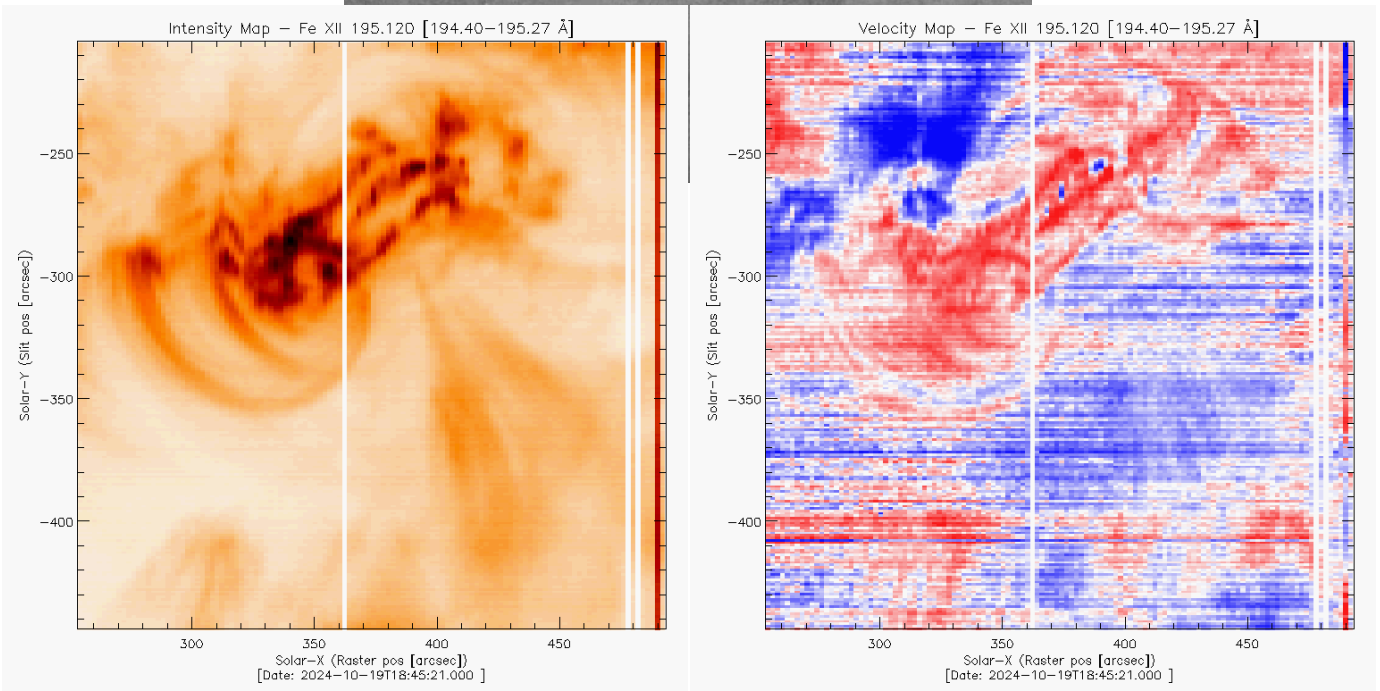
# Observation Preview



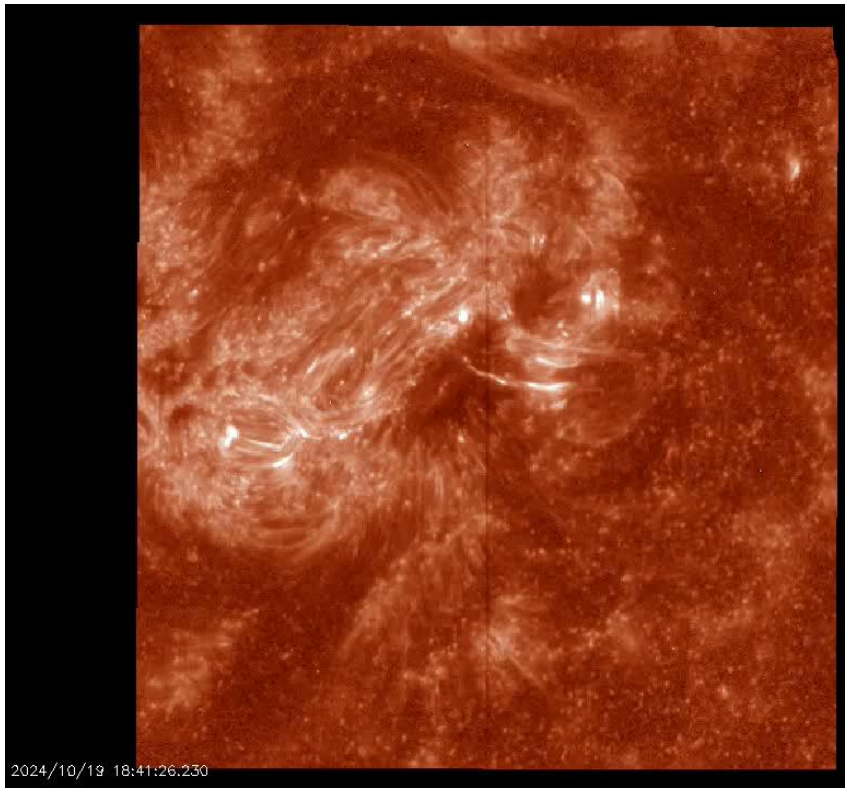



# Observation Preview






Hinode




IRIS

# Sunspot oscillations + AR Heating

SOOP coordinator: Andrzej Fludra

# Active Region Heating

## A. Fludra & the RAL team

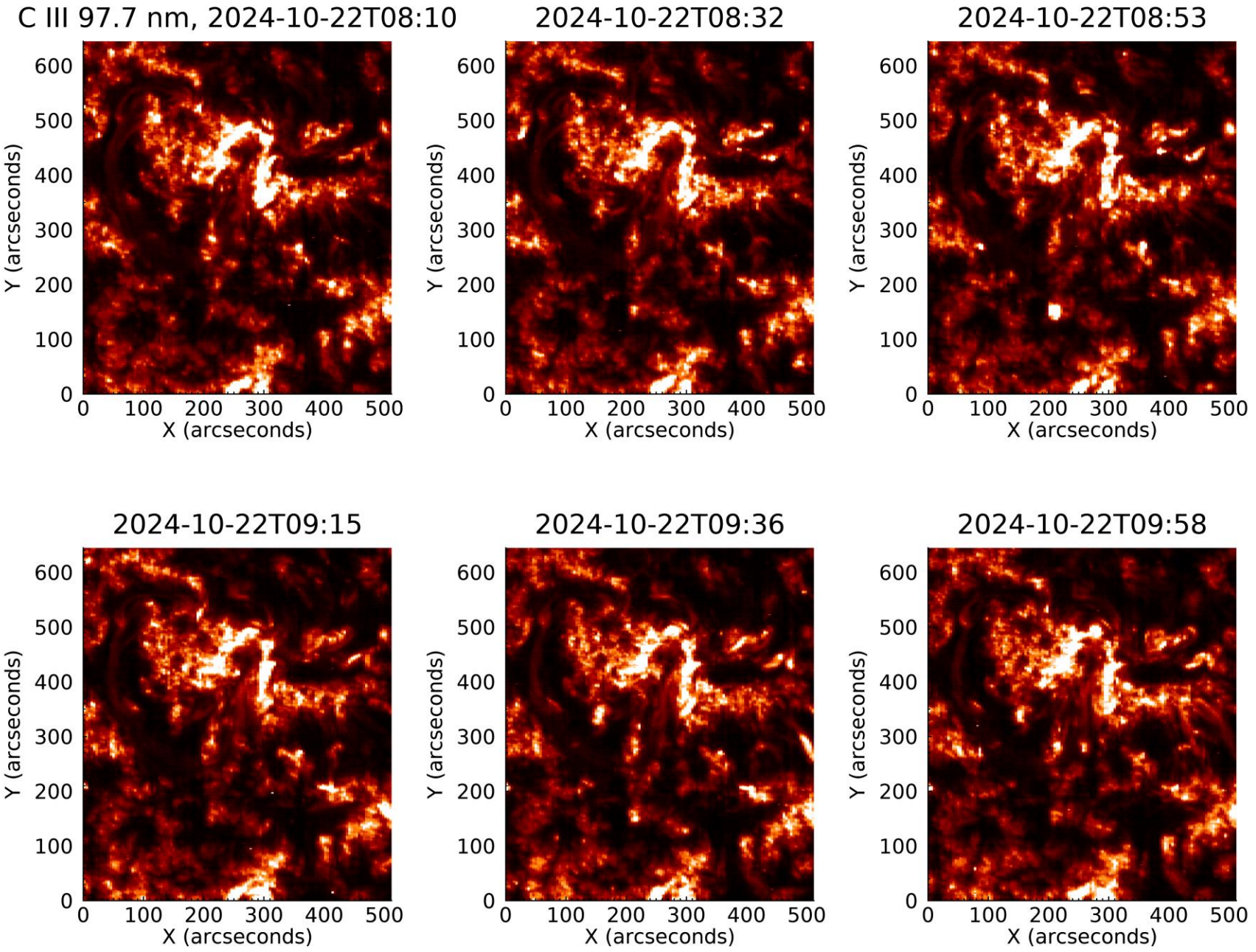
SOOP previously executed in LTP09 (Oct 2022) and LTP13.
For LTP17, one active region followed for 3 consecutive days from 22 to 24 Oct 2024, 5 hours/day = 11 rasters

Carrington coordinates 261, -10 for all three days – AR13867

6 rasters in the C III line on 22 October. →

EUI High-Res data exist – see later slide

EUI FSI not available 22-26 October (EUI in the occulter mode).



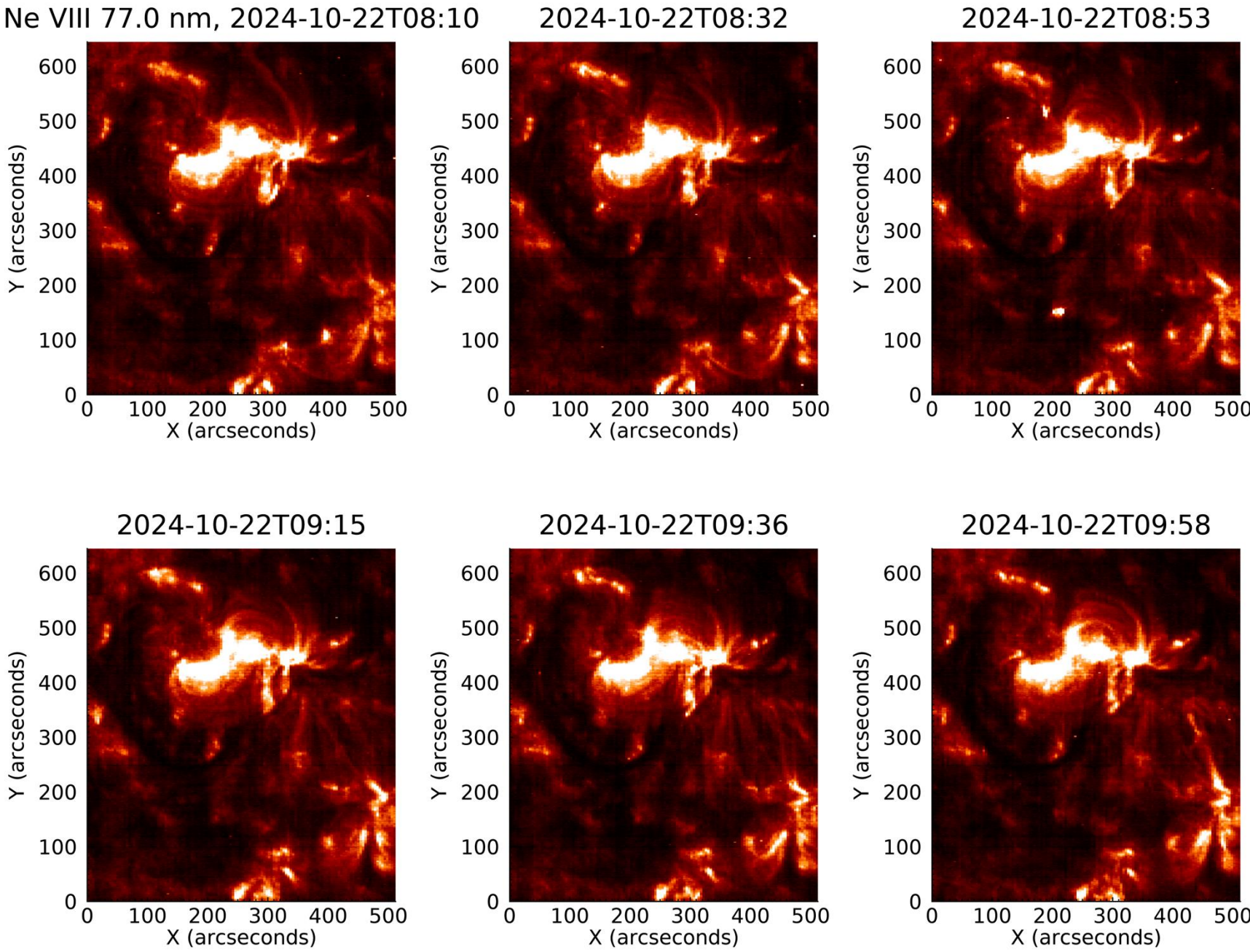
# Active Region Heating

## A. Fludra & the RAL team

6 rasters in the Ne VIII line on 22 October. →

11 such rasters available each day, on 3 days.

C III, Ne VIII, O VI. Other weaker lines available.



# Active Region Heating

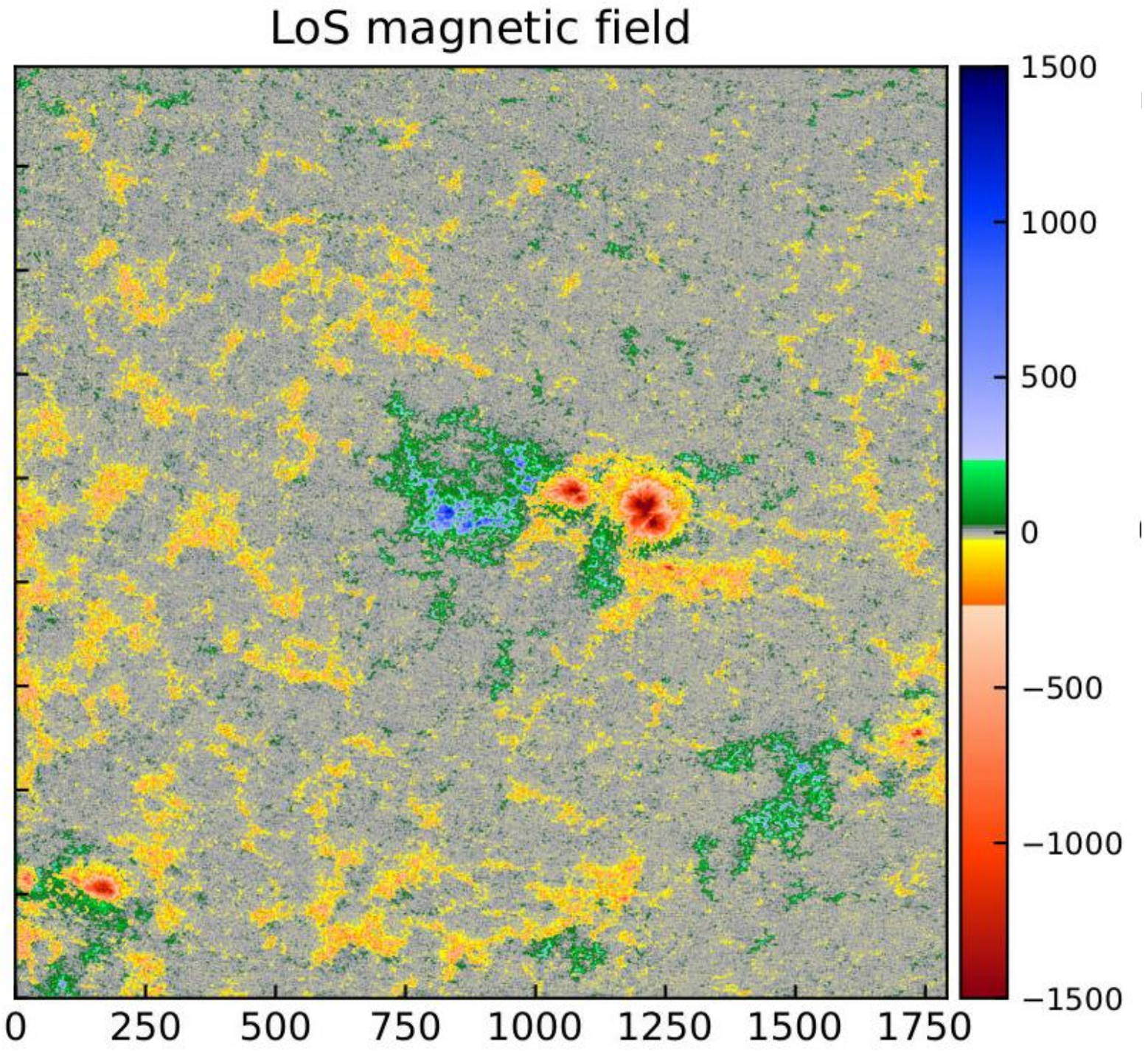
## A. Fludra & the RAL team

PHI high-resolution field of view →

The angular resolution of HRT is 0.5", which at the distance of SO on 24 Oct 2024, corresponds to a pixel size on the Sun at disk center of 197km. The size of the dataset is 1792x1792 pixels.

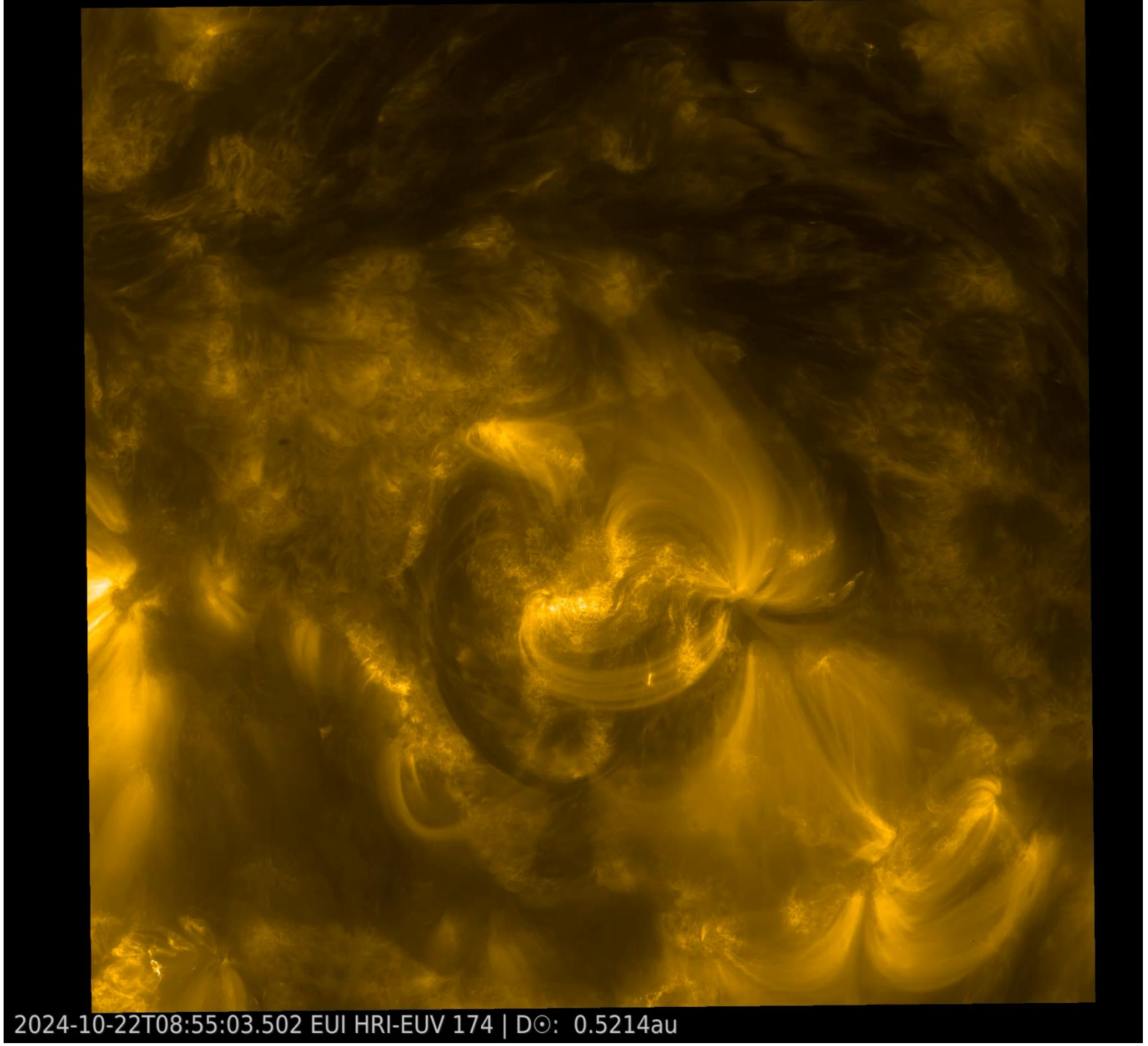
**PHI acquired 6 data sets for each of the AR_Heating SOOP's instances, at 10 minutes cadence over one hour, starting at 8:55 each day.**
Preliminary data processing…

There are FDT too (not during the soop, but before or after, on the same dates). These are released and can be found in the SOAR database.



# AR Heating – EUI HRI

**On each of these 3 days EUI made 360 regular HRI images and 360 short exposure images.**
Movies made by David Berghmans available at: https://sidc.be/EUI/data/movie/SOOPs/



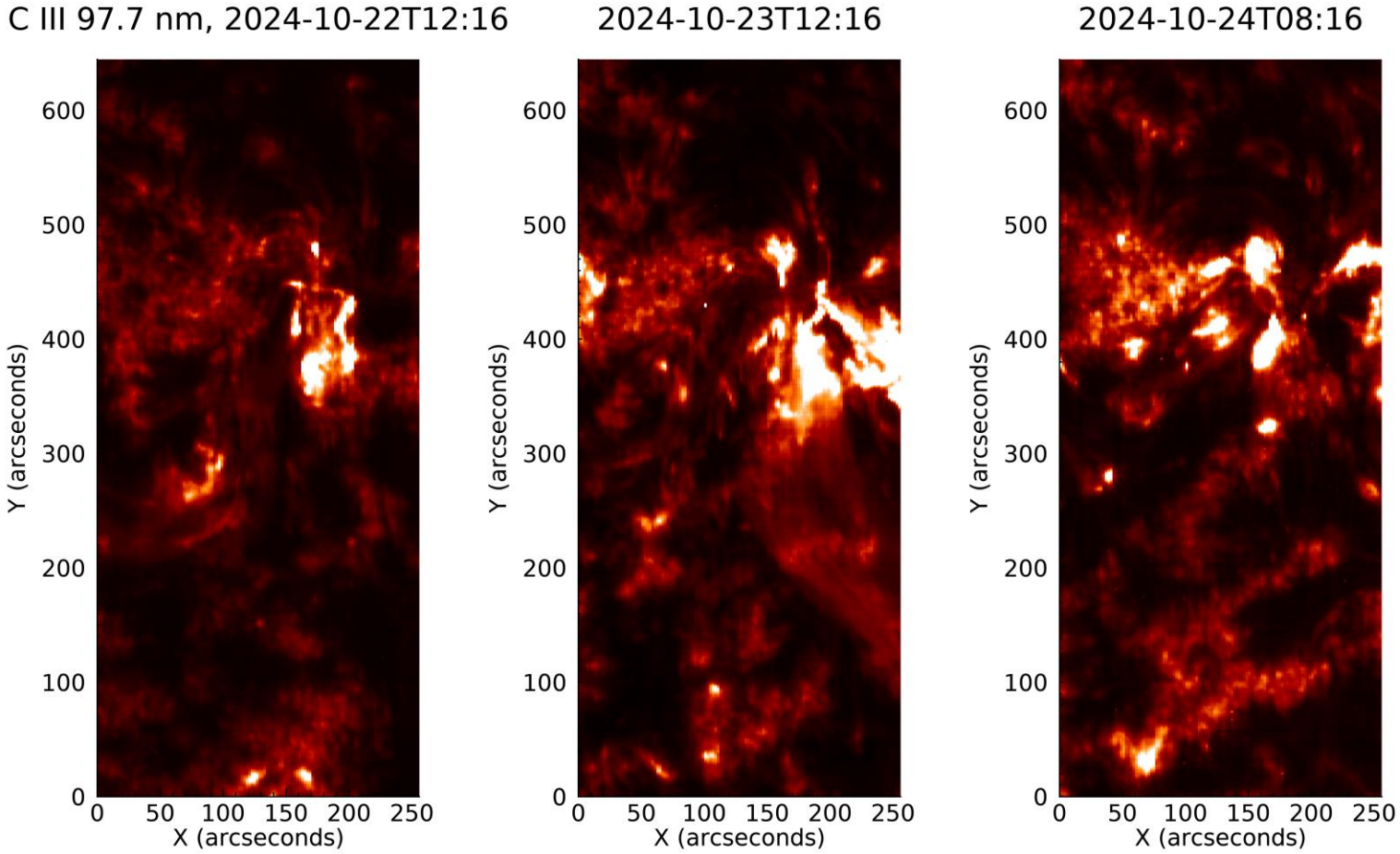
# AR Heating

SPICE used two studies:

Main raster, 22min cadence, 4” slit, 10s exposures – 11 repeats

Supporting narrow raster, 2” slit, 20s exposures, one repeat

Targets all visible from SDO and other earth-based assets, but no specific coordination



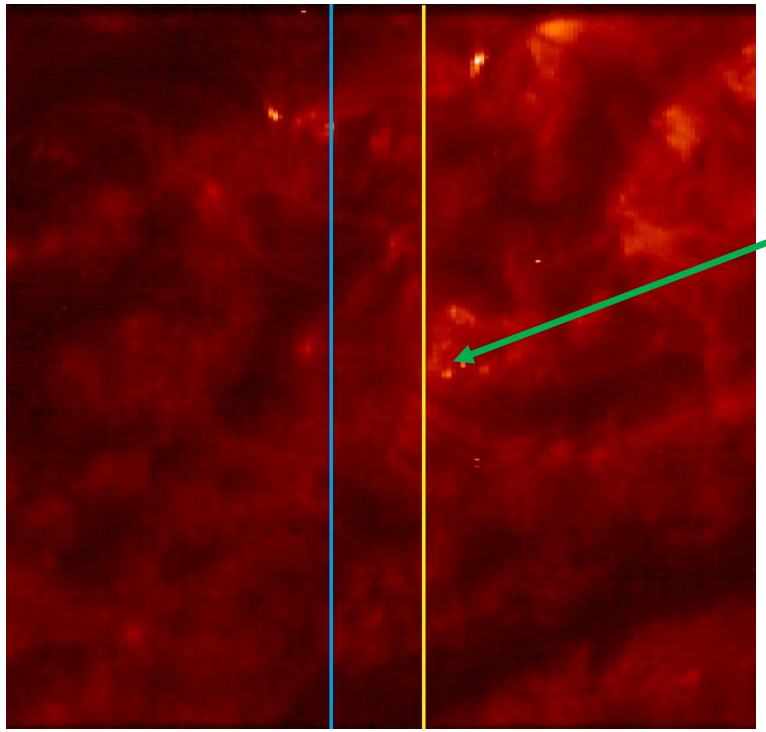

Supporting raster, 2” slit

# Sunspot Oscillations - 24 October 2024 (with precursor images 20th October)

**Sunspot Oscillations - 4th run of SOOP** **A. Fludra, T. Grundy, S. Sidher, A. Giunta**

Target: active regions AR13867, with a good-size sunspot, near the central meridian.
Instruments: SPICE, PHI, EUI, SDO AIA & HMI, Duration: 8 hours per sunspot.
SPICE Observation: sit & stare series - 7 hours 10 min, 4" slit, 10 s exp, + initial/final context rasters

**Main problem**: how to get the SPICE slit correctly aligned with the sunspot?
**Answer:** Move the S/C at 10" per hour across the target. Requires achieving alignment of < 30".

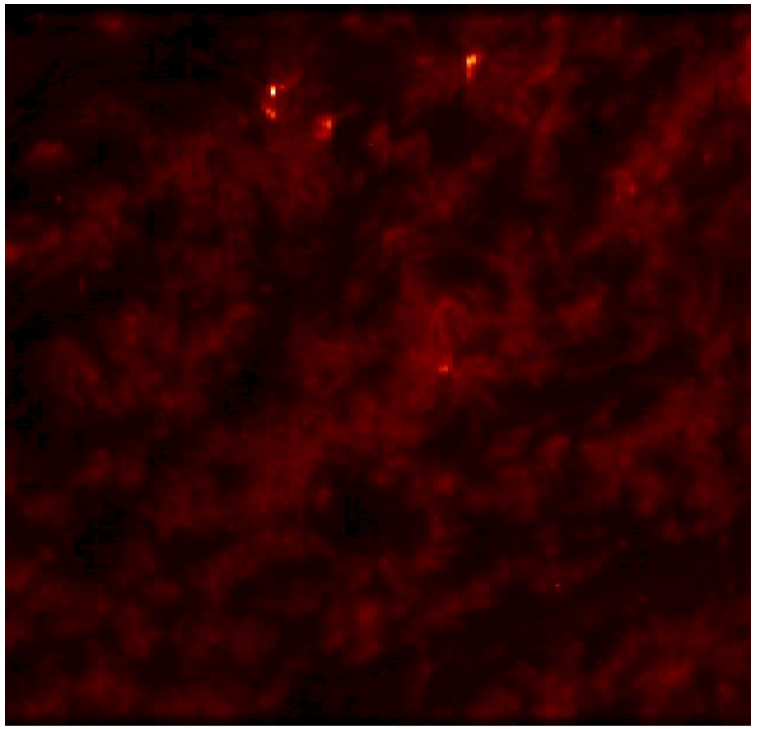


Low Latency Images from 20th October

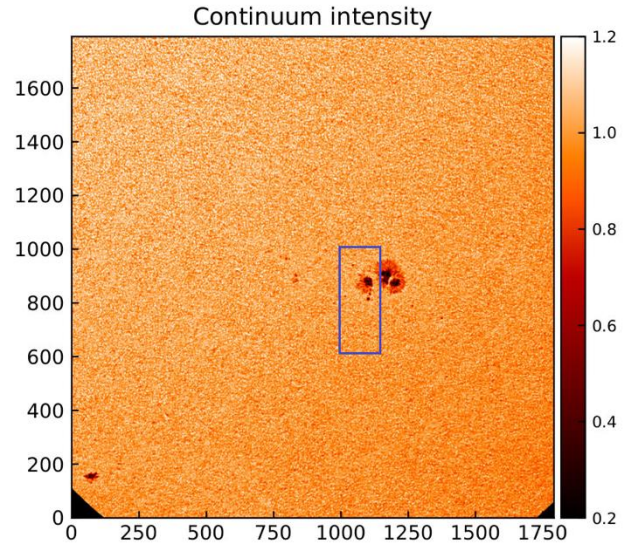
SPICE Ne VIII image (left)
SPICE C III (right)

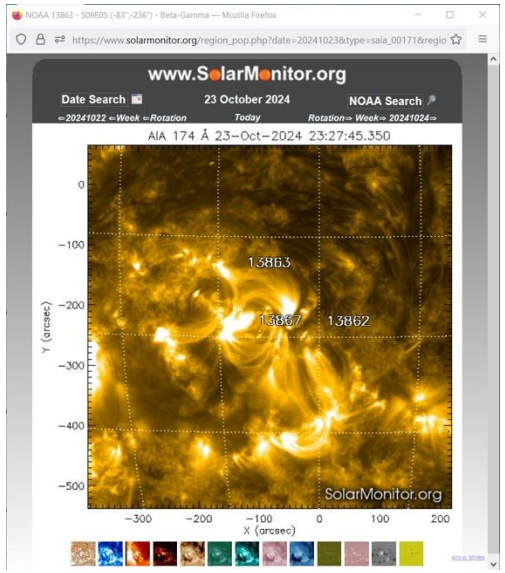
Located expected target at 88" from the SPICE boresight

This is similar to the March 2024 result (80"), but the solar distance is greater (0.54 vs 0.39AU)

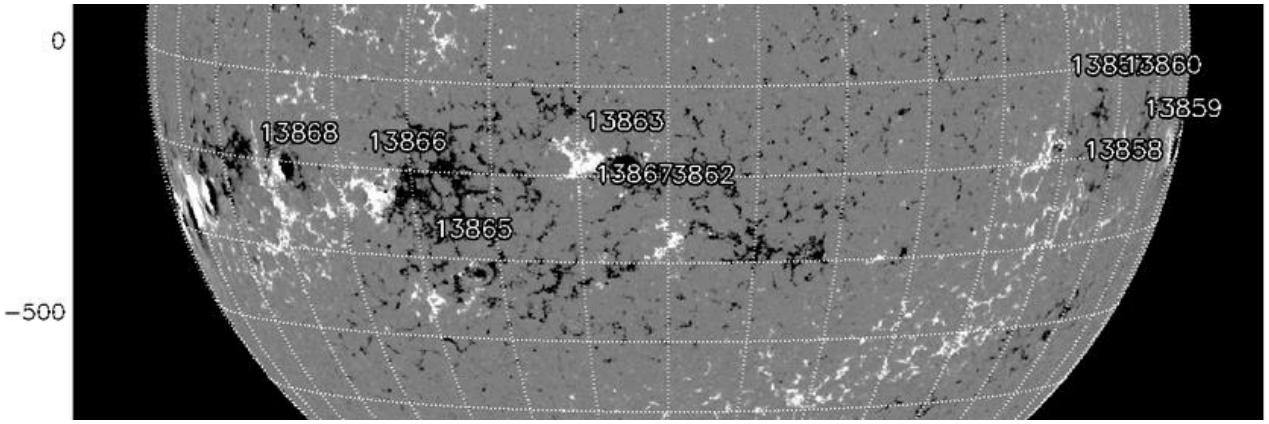


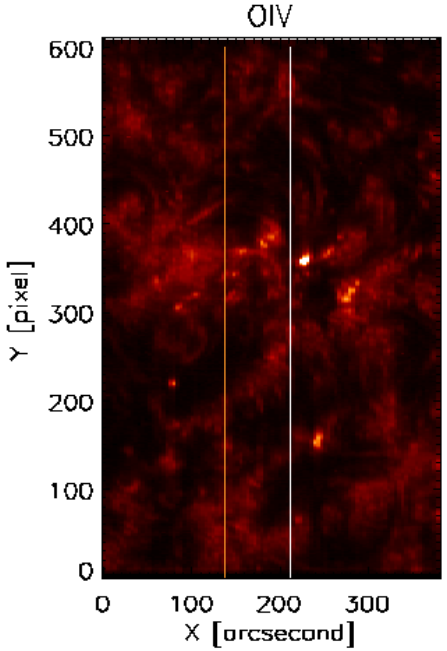
# Sunspot Oscillations 24 Oct 2024

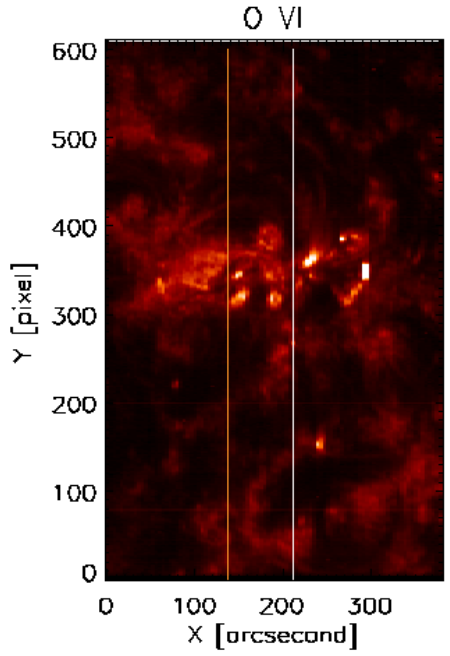


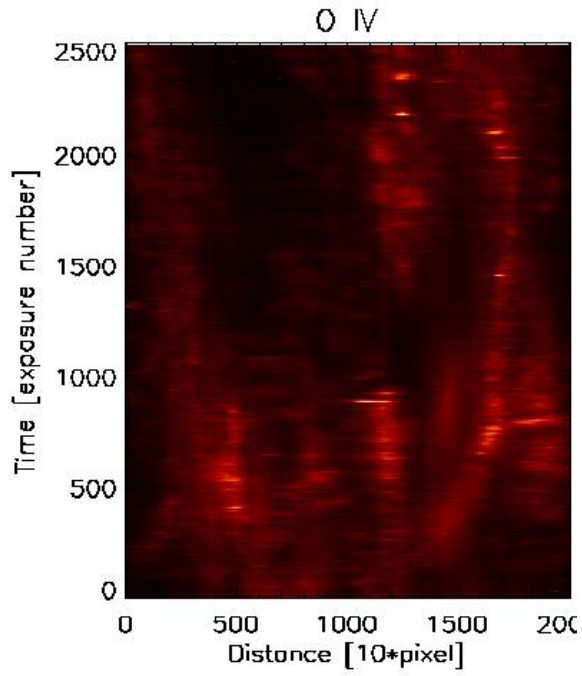




HMI, 23 Oct 2024, 21:58

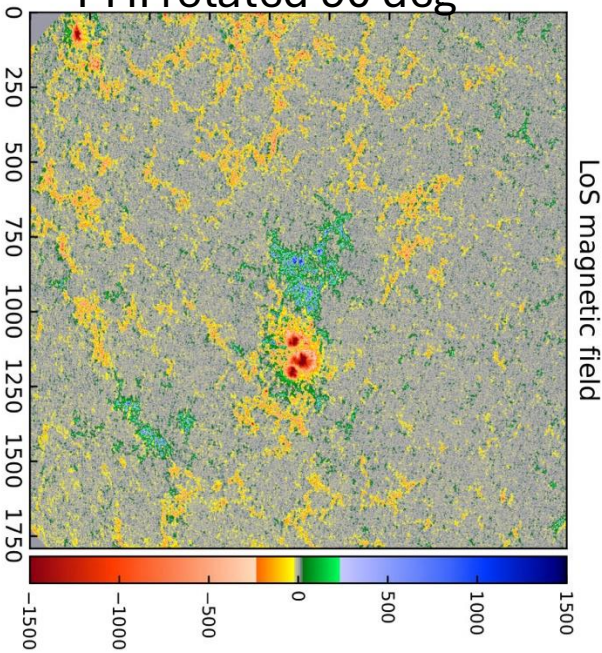



PHI rotated 90 deg



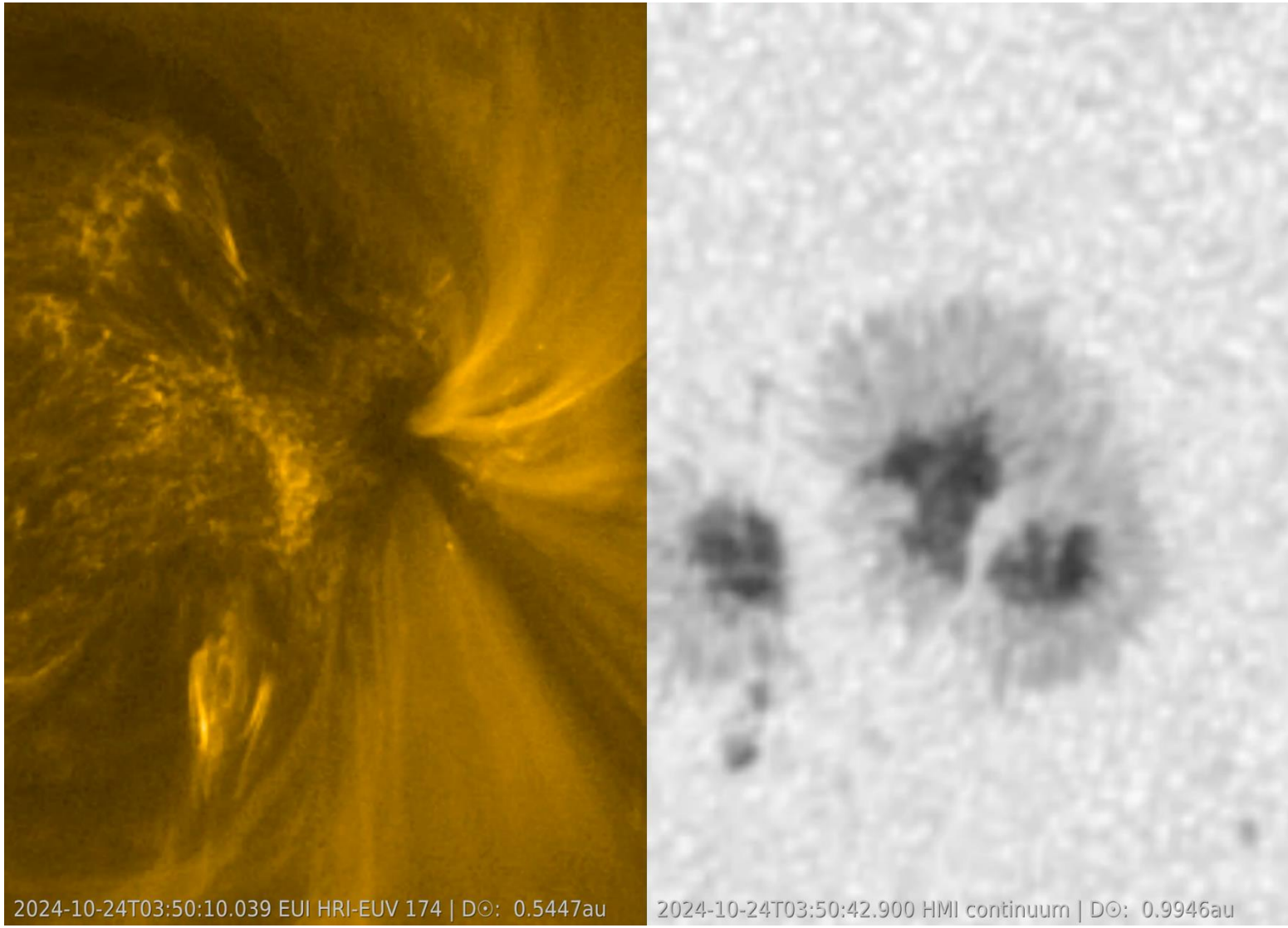
# Sunspot Oscillations – EUI HRI & PHI HRT

20241024 ~04:20

MDI

**EUI ran for 1 hour at 3s cadence (*big* dataset of 1200 HRIEUV images) between 03:50 and 04:50.** Seeing the usual p-mode leakage from the sunspot.

**PHI acquired 10 HRT datasets, from 03:50 to 04:44 at 6 minutes cadence**.



# Sunspot Oscillations – 24 October 2024

## Summary:


LTP17 data are available for full analysis

Target was selected 3 days before the SOOP in LTP17

Pointing adjustment similar to previous case, when SPICE boresight was 80” to the left of the S/C boresight at 0.39AU (Mar ‘24), with 8” added for the increased solar distance of 0.54AU in this measurement. We compensated for this by moving the SPICE mirror 88” to the right.

Pointing selection – used PHI LL full disk magnetogram.

Position of SPICE slit relative to the sunspot needs to be confirmed.

Oscillations seen in SPICE O IV and O VI lines in features outside sunspot – interesting, strange patterns, ~10 min and ~90 s periods present. EUI see 3 min periods in one of the sunspots.

Data analysis will continue.

Coffee break

Back at 15:45 CET

# CH Boundary Expansion

SOOP coordinators: Roberto Susino


# L_BOTH_HRES_LCAD_CH-Boundary-Expansion

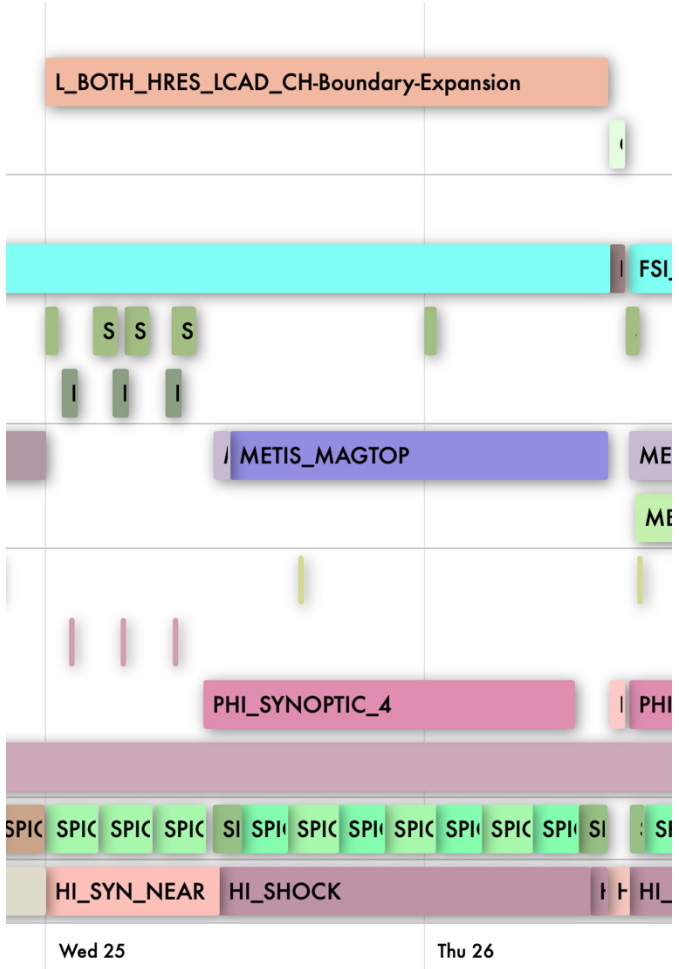
R. Susino & the Metis Team

LTP17 SOOP Feedback Meeting – 17/02/2025

# L_BOTH_HRES_LCAD_CH-Boundary-Expansion

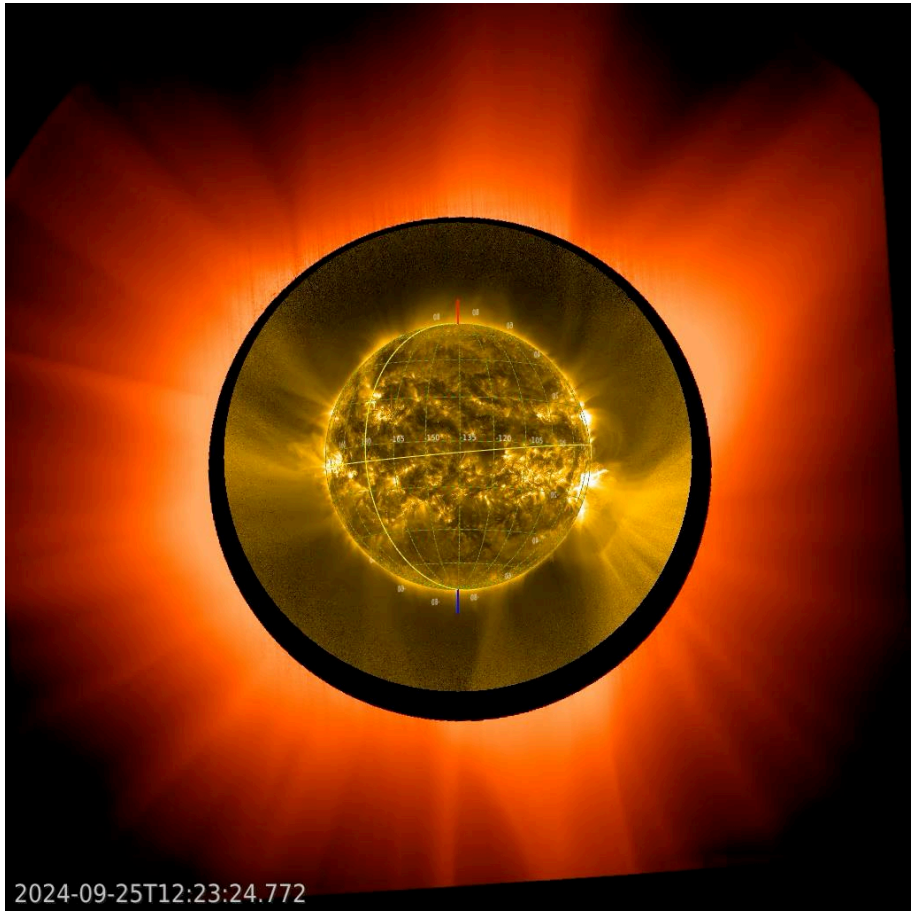
- Science goal: *How is slow solar wind originating from the over-expanded edges of coronal holes?*
- Participating SolO instruments: Metis (lead), SPICE, PHI, EUI, SoloHI
- External support: IRIS standard coordination

- LTP17 run on 25-26/09/2024:
  - Metis: FLUCTS-HR_TBF (1h, cad. 1-20 s) + MAGTOP (~ 24 h, cad. 20 m)
    - *data available, validation in progress*
  - SPICE: three scans at the West limb (~ 9 h) + composition & dynamics studies at disk centre (~ 24 h)
    - *data available*
  - PHI: three HRT observations during off-pointings + FDT synoptic mode (cad. 6 h)
    - *data available, processing of HRT observation in progress*
  - EUI: FSI synoptic mode (cad. 10 min)
    - *data available*
  - SoloHI: synoptic mode (cad. 12 m)

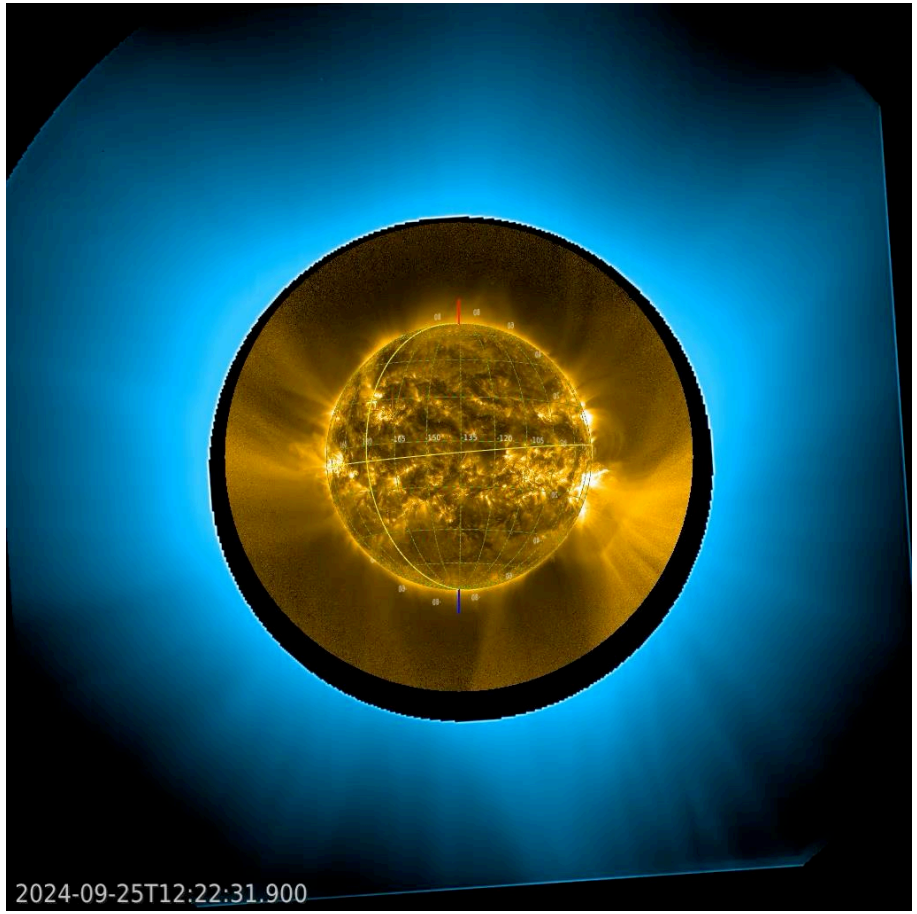


# Metis observations

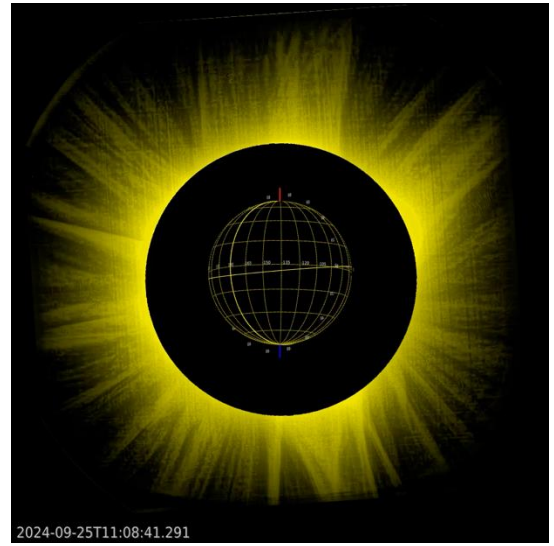
**Metis VL pB**



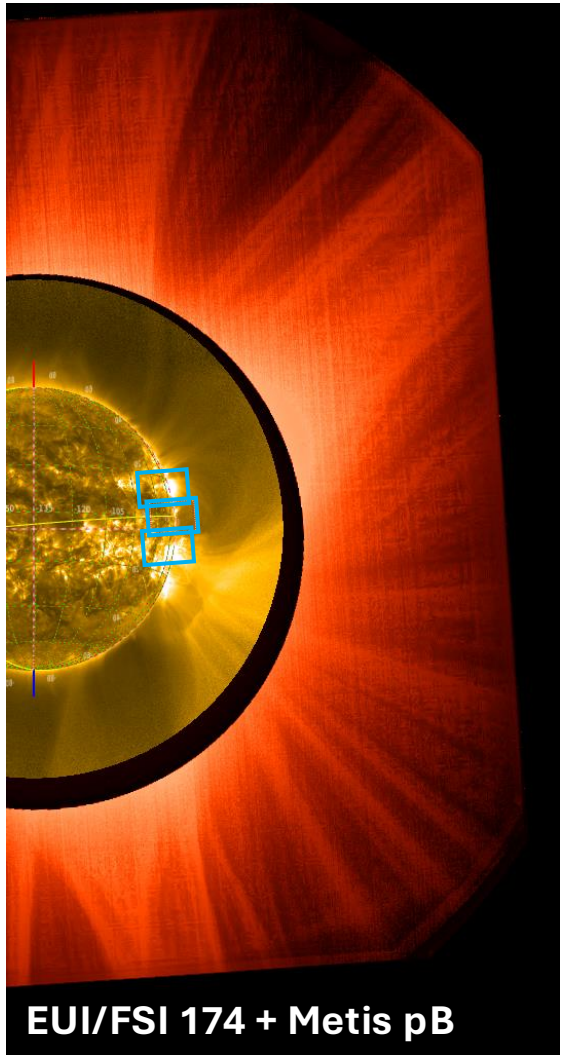

**Metis UV**



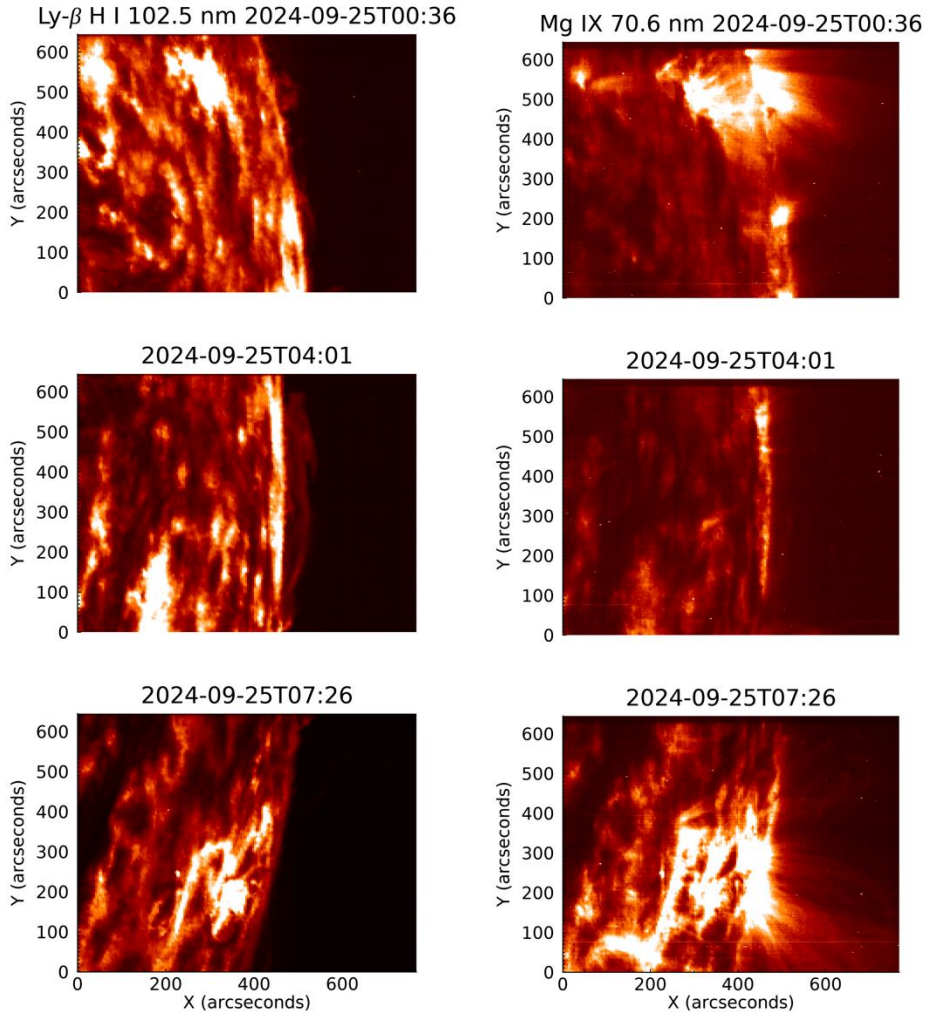

**High-cadence VL tB**



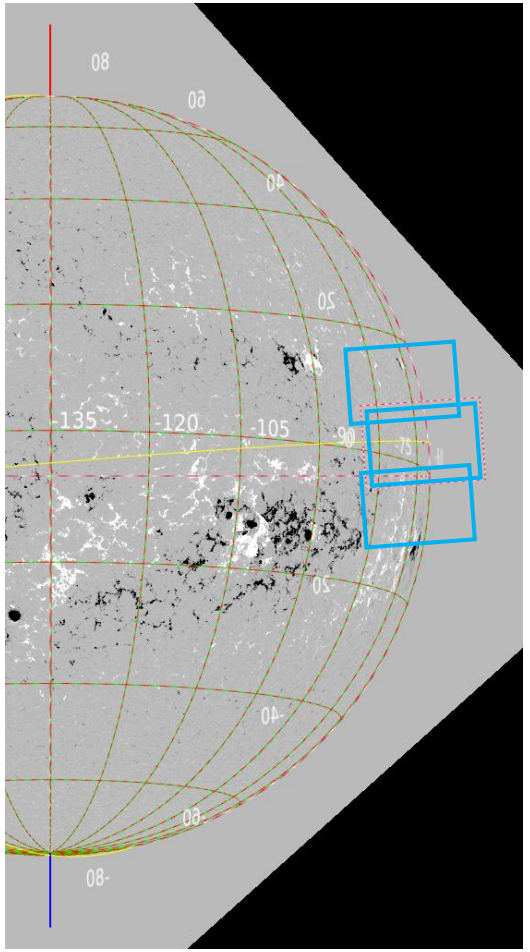
# SPICE/EUI/PHI support observations




**SPICE H I Lyman-β & Mg IX 70.6 nm**




**PHI/FDT $B_{los}$**




R. Susino & the Metis Team

# Density Fluctuations

SOOP coordinator: Vincenzo Andretta

LTP17 SOOP Coordinators feedback Meeting
17 February 2025

# SOOP:
# R_FULL_HRES_HCAD_Density-Fluctuations

V. Andretta
INAF – National Institute for Astrophysics
Capodimonte Astronomical Observatory, Naples (Italy)

# Overview of the SOOP

Goal: Study of density fluctuations in the extended corona as a function of the outflow velocity of the solar wind while evolving in the heliosphere.

Lead instrument: Metis

Principal participating instruments: SoloHI, EUI/FSI

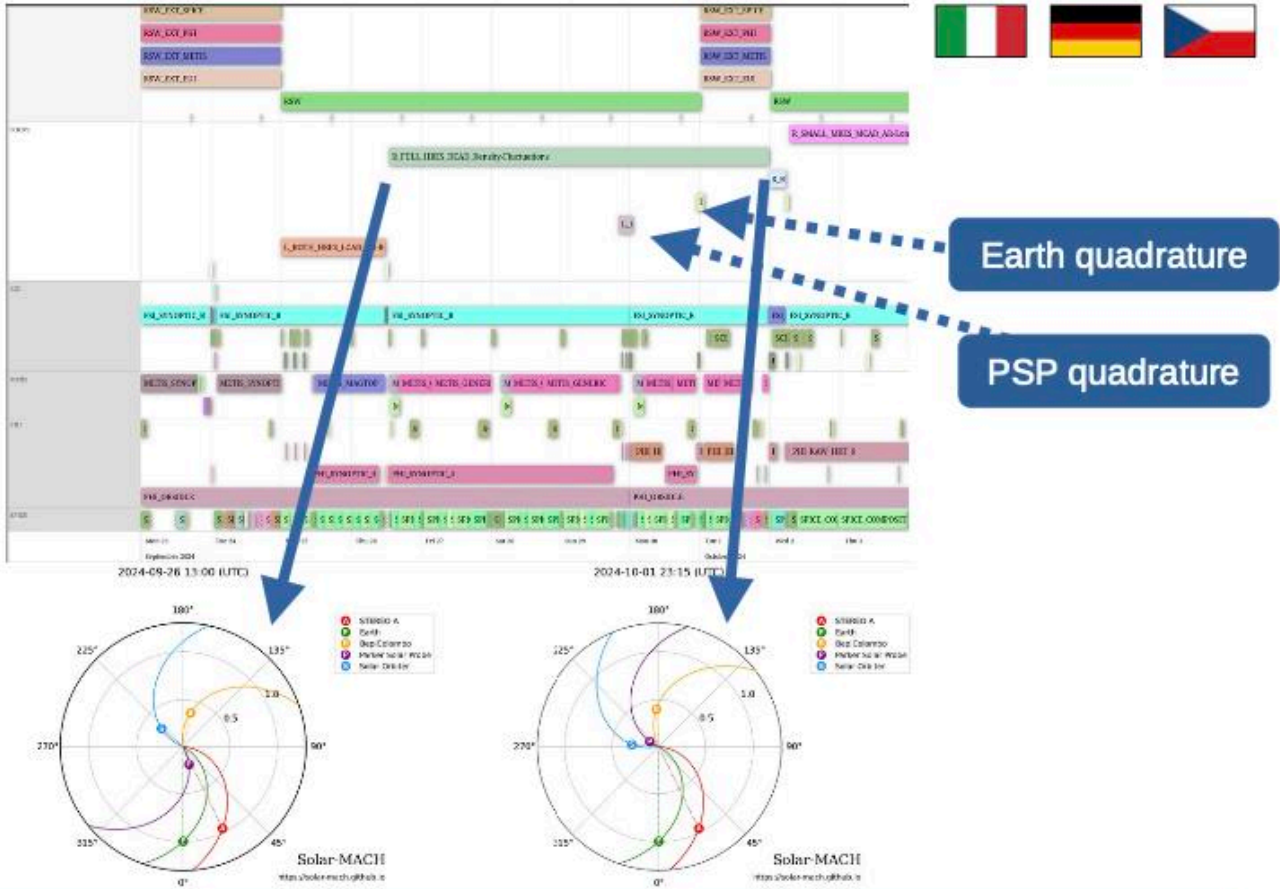
Supporting instruments: PHI, SPICE, STIX, all in-situ instruments

Dates run: 2024-09-26T13:00:00 – 2024-10-01T23:15:00 (total: 5 1/2 days):

Distance from Sun: 0.31 – 0.29 au

Notes:

- Longest run in the last threee orbits: 24 h in LTP13 and 3 ½ h in LTP15. Covers PSP orbit from quadrature to radial alignment (see PSP Quadrature SOOP).
- Earth quadrature SOOP on 30 September.



# Summary of Metis observations

Metis observations:

- VL Fixed polarization, cadence: 1 s, duration 2 min each run:

  2024-09-26T13:07:31, 2024-09-28T03:10:01, 2024-09-30T01:45:30

- VL Total brightness, blocks of 3h 13m @ 20 s + 10h 15m @60 s

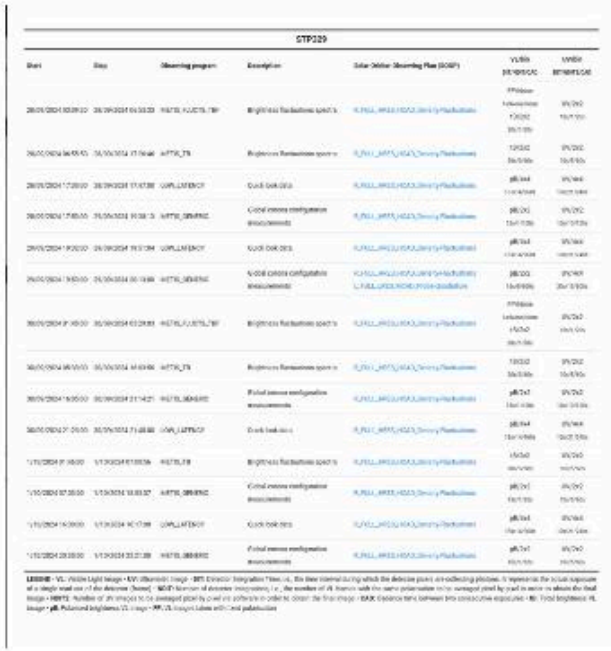
  2024-09-26T13:37:31, 2024-09-28T03:40:01, 2024-09-30T02:15:30

  in addition: a 4 h block @ 60 s on 2024-10-01

- VL Polarized brightness, blocks @60 s (4 pol. x 15 s)

  2024-09-27T03:55:01 (25 h 40 m), 2024-09-30T16:05:00 (4 h 10 m), 2024-10-01T07:03:00 (15 h 18 m)

VL total/polarized brightness complemented by UV simultaneous observations



Highest possible cadence in pB

Status of the analysis: preliminary validation of Metis VL and UV data. L0 data all in the Metis Database. L2 data being processed.

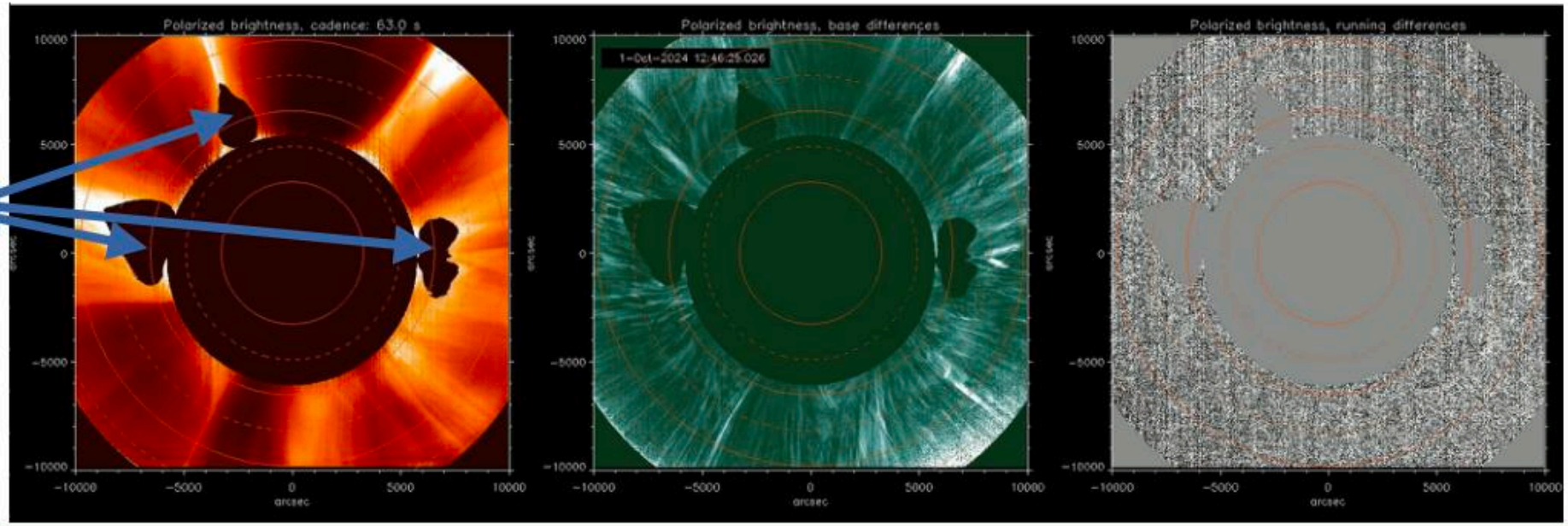
EUI/FSI data available though JHelioviewer. No analysis yet of SoloHI data and other instruments.

# Issues with the data

Preliminary analysis of pB and tB data shows strong saturation in bright areas.

The detector integration time is the minimum for this kind of acquisition (15 s per polarization angle, or 20 s for total brightness acquisitions): there is no way to mitigate this issue.

As noted in all previous LTPs, artifacts due to debris frequently interrupt the sequence of observations.



# Fast Wind

SOOP coordinator: Slimane Mzerguat

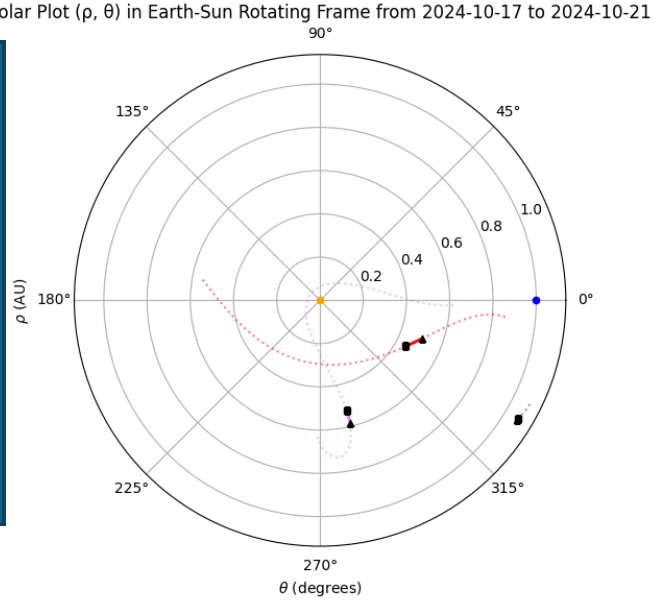
# Fast Wind SOOP LTP 17

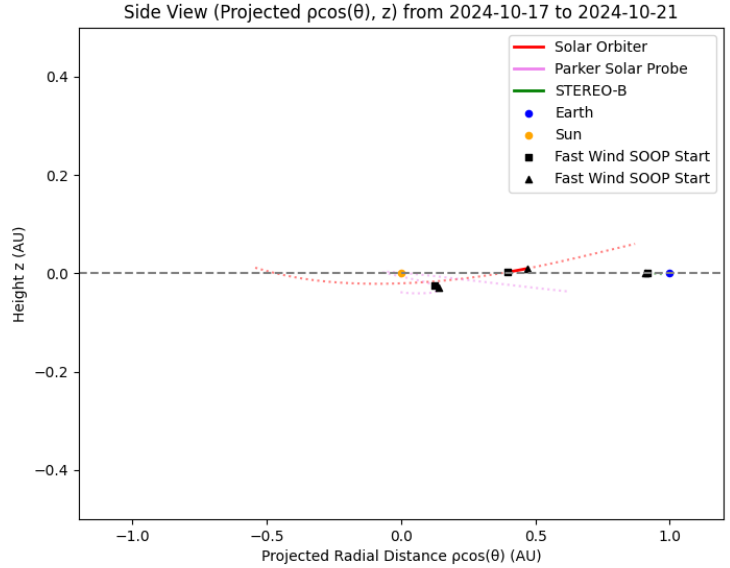
Feedback meeting

# SOOP Description

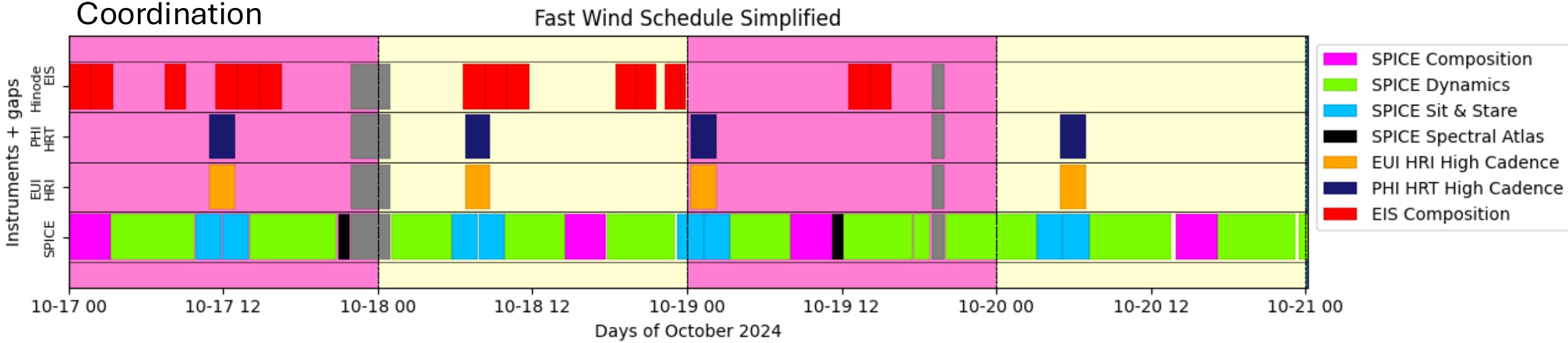
SOOP Objectives:

- Tracking the fast wind sources and the connectivity to the solar wind around Solar Orbiter and Earth.
- In case there is no connectivity: high cadence observations of coronal holes.

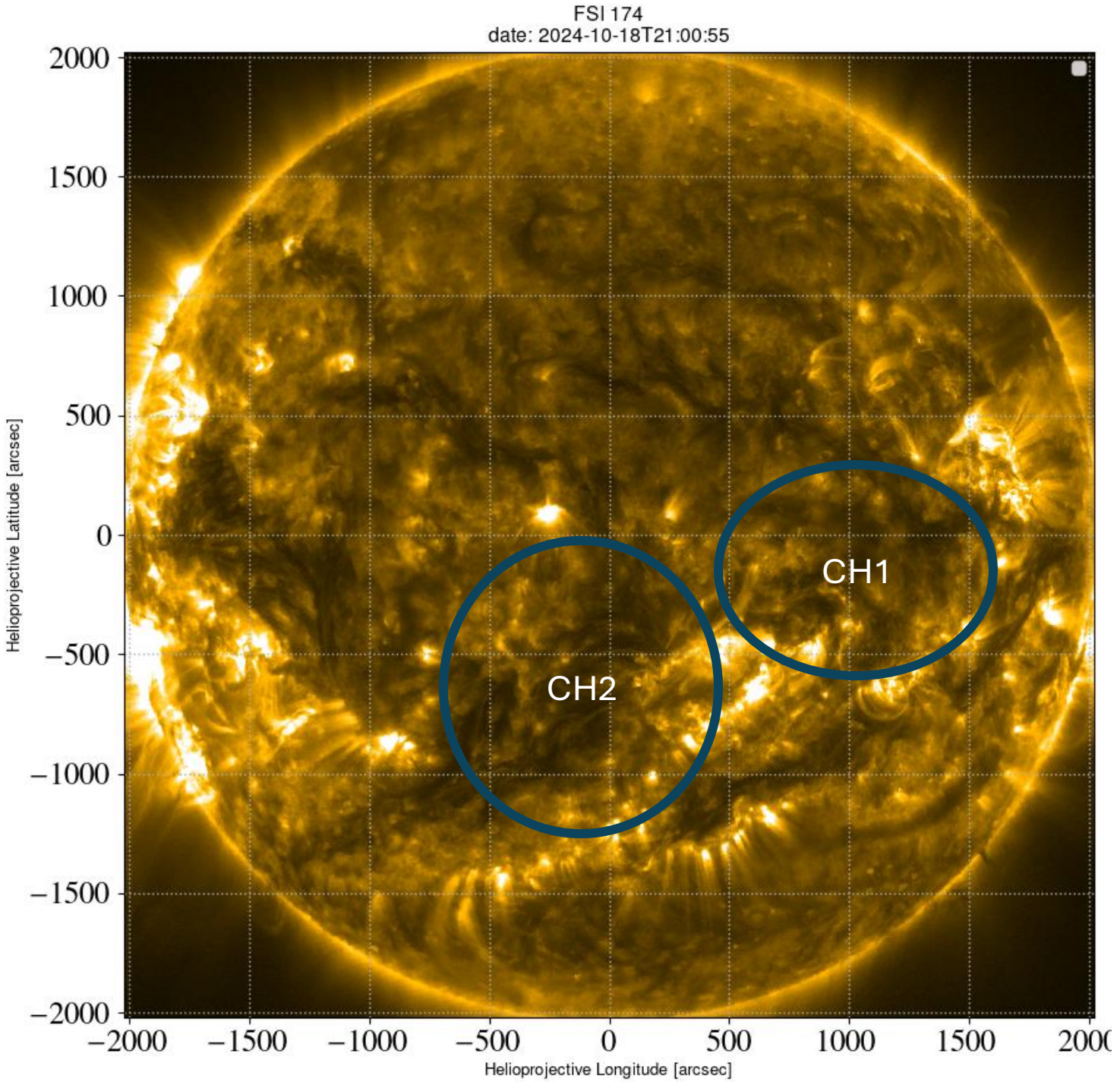



Hinode and IRIS Coordination

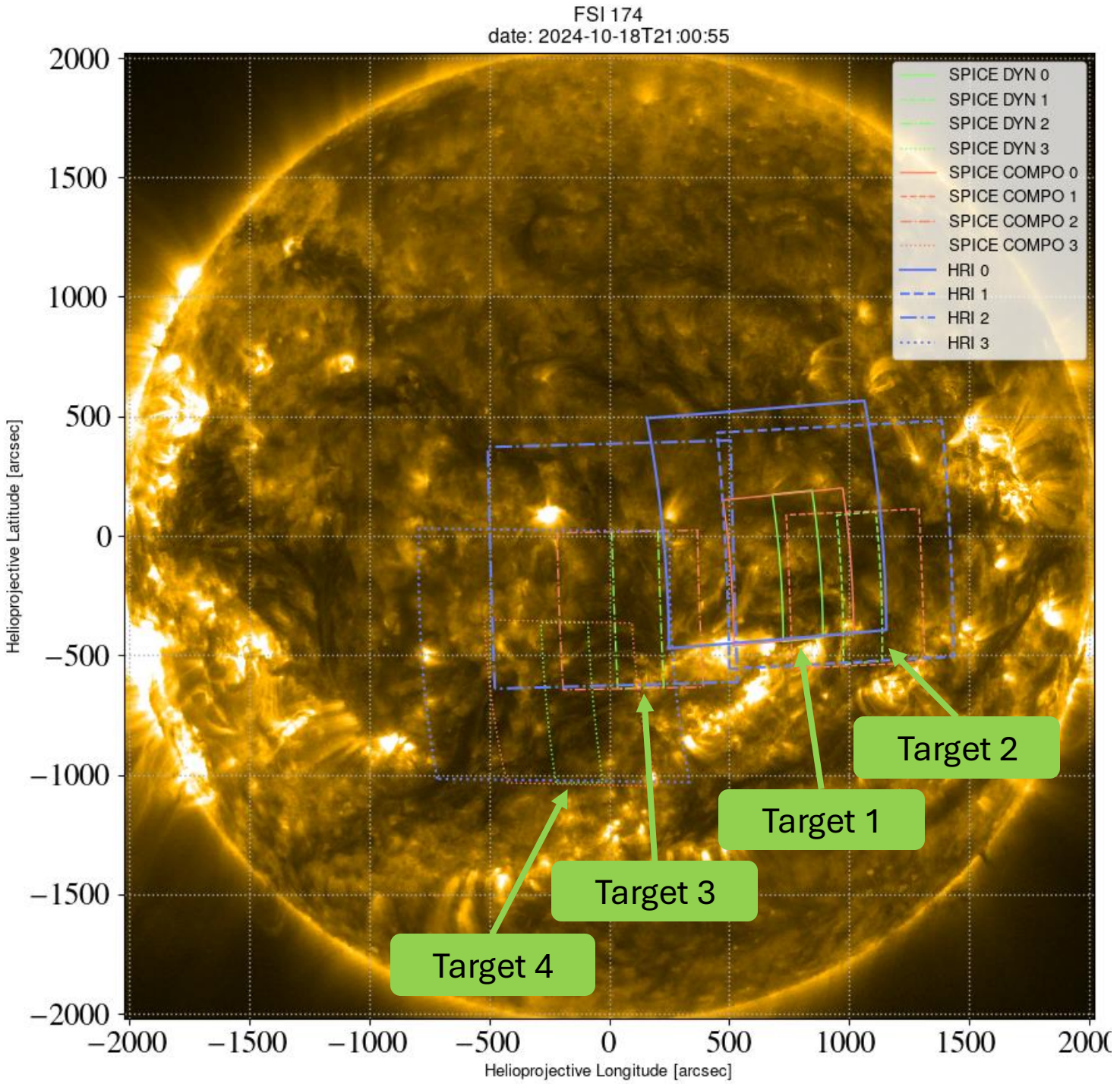


# Targets




Both CHs are small => relatively slow wind was expected (discussions w/ MADAWG)

# Targets


FSI 174
date: 2024-10-18T21:00:55
SPICE DYN 0
SPICE DYN 1
SPICE DYN 2
SPICE DYN 3
SPICE COMPO 0
SPICE COMPO 1
SPICE COMPO 2
SPICE COMPO 3
HRI 0
HRI 1
HRI 2
HRI 3
Target 2
Target 1
Target 3
Target 4
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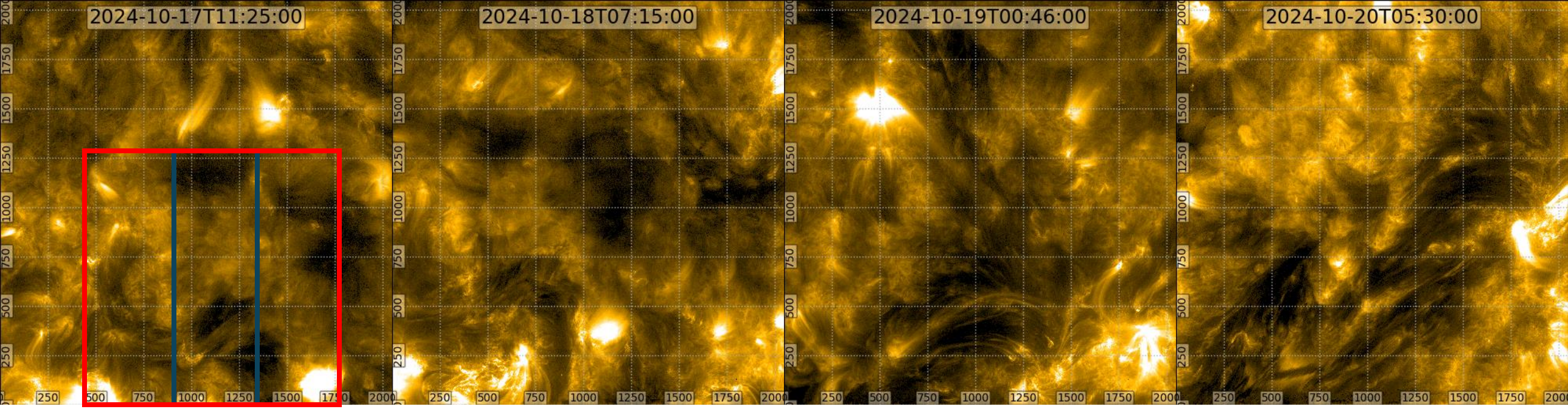
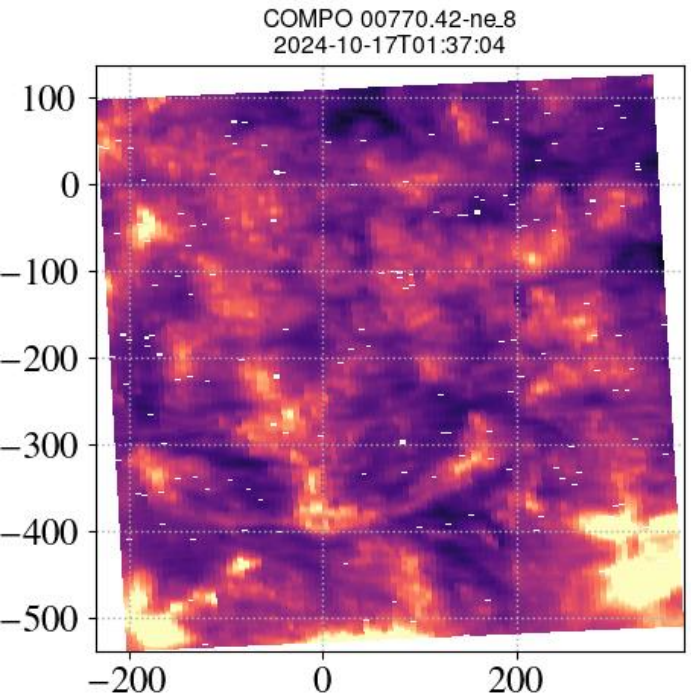
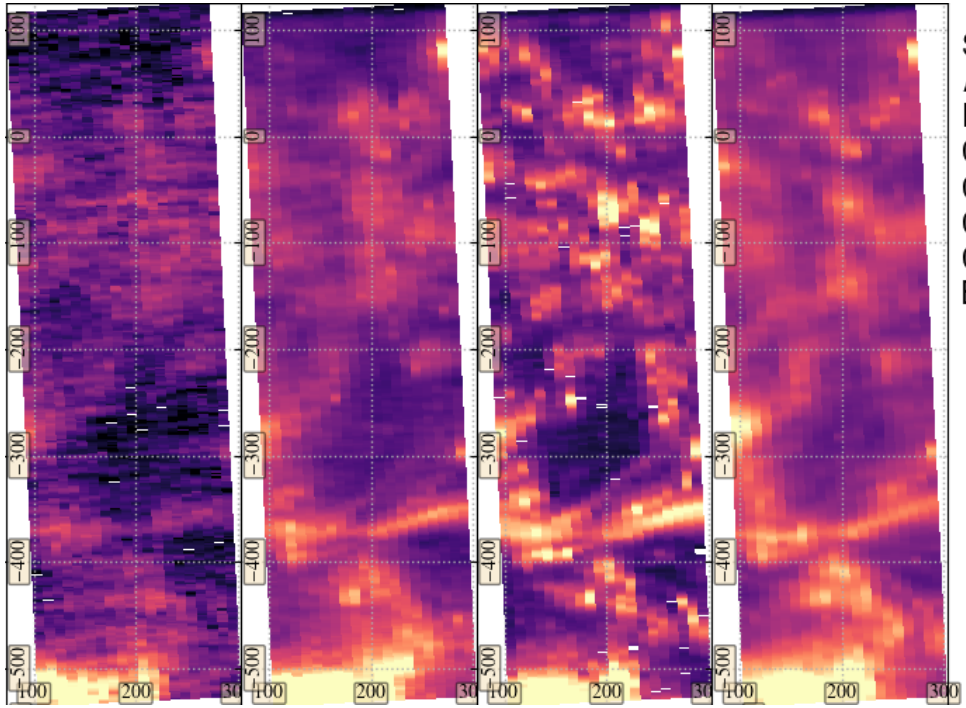
0
−500
−1000
−1500
−2000



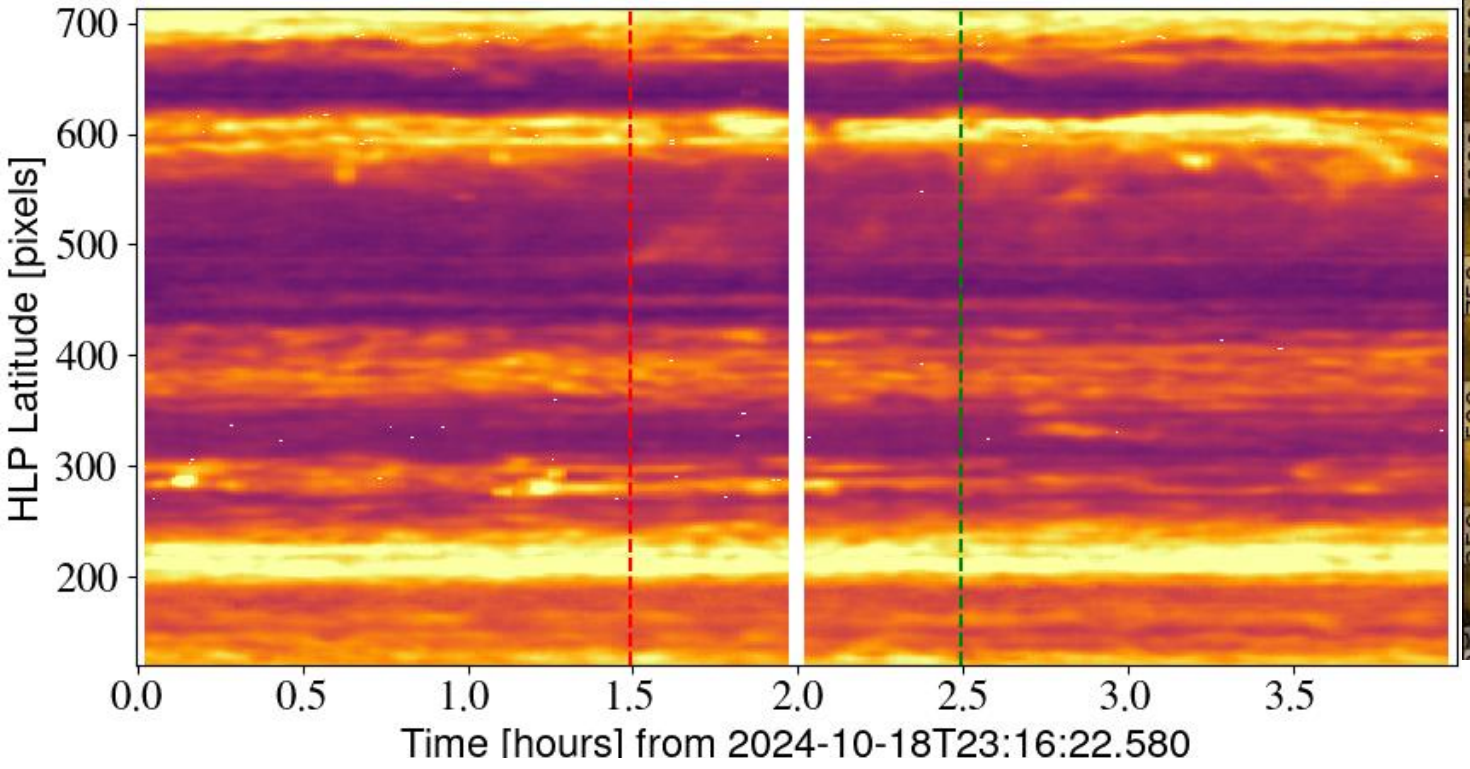



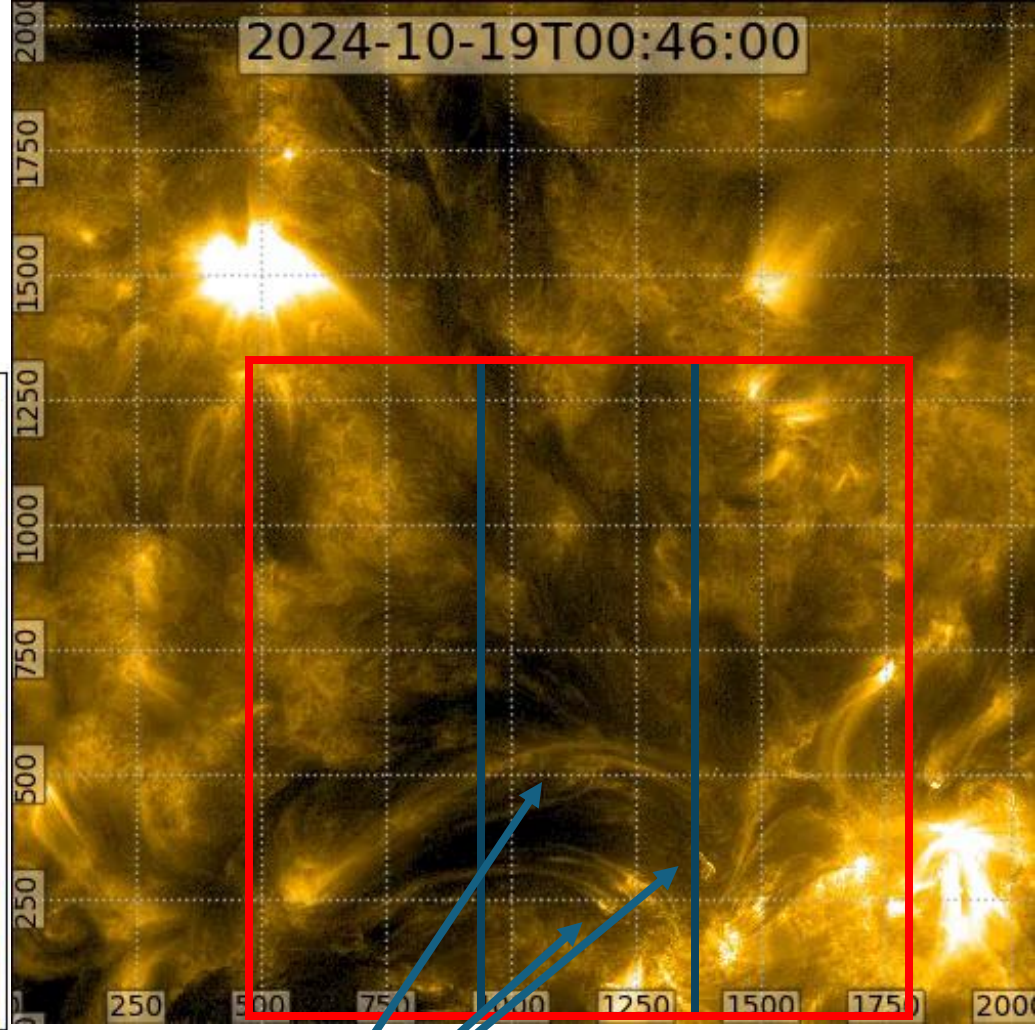
SPICE
AVG: 2024-10-17T09:39:53
LINES:
00706.02-mg_9
00770.42-ne_8
00765.15-n_4
01025.72-h_1
EXPOSURE: 30.0

Next step: investigate composition in the different regions scanned over time

New addition !

Example of a Sit & Stare w/ Ne VIII 770A
(also available w/ Mg IX, N III, N IV, LyB)



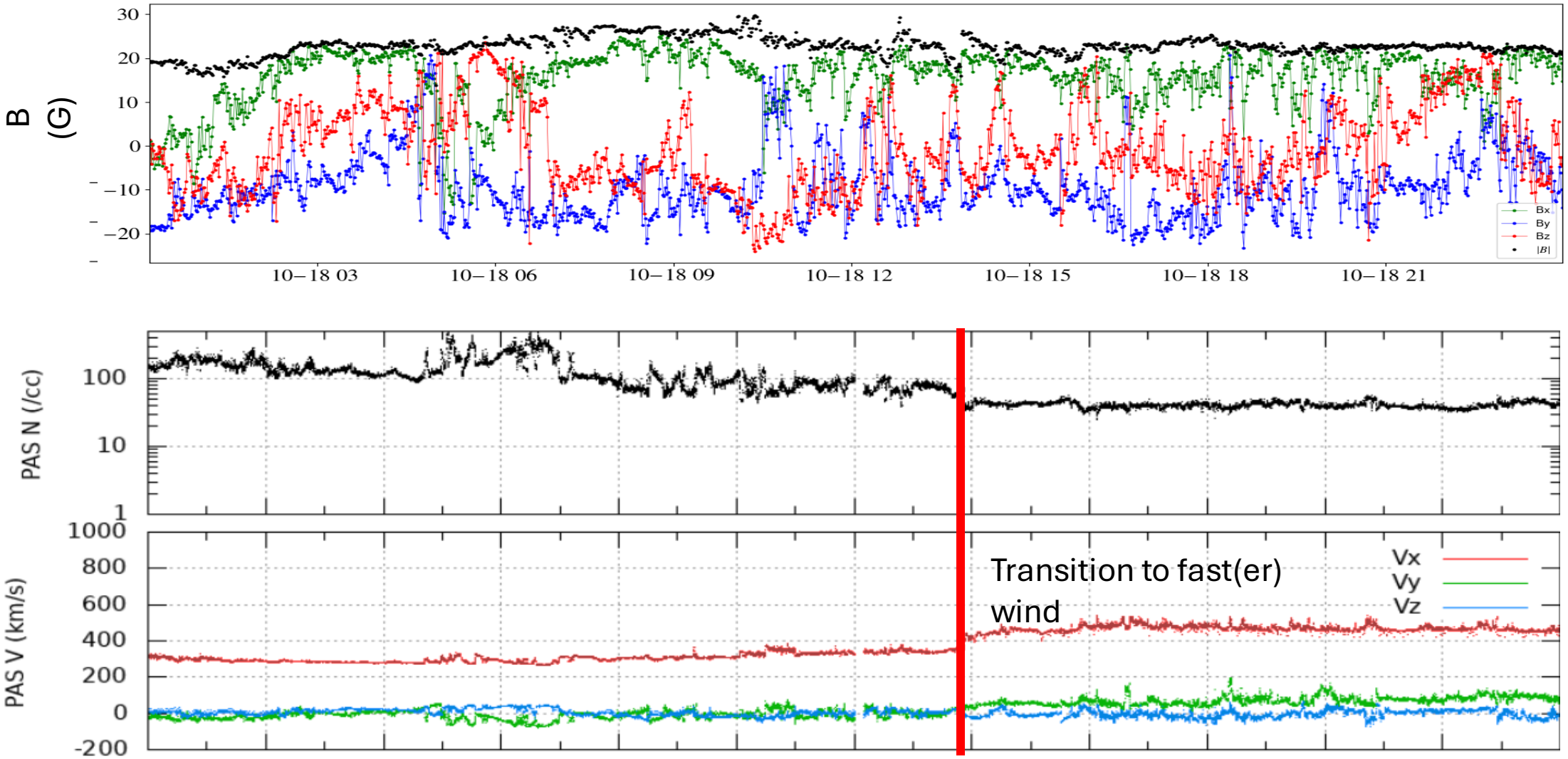

Next step = co-alignment to be made +
comparisons w/ different temperatures

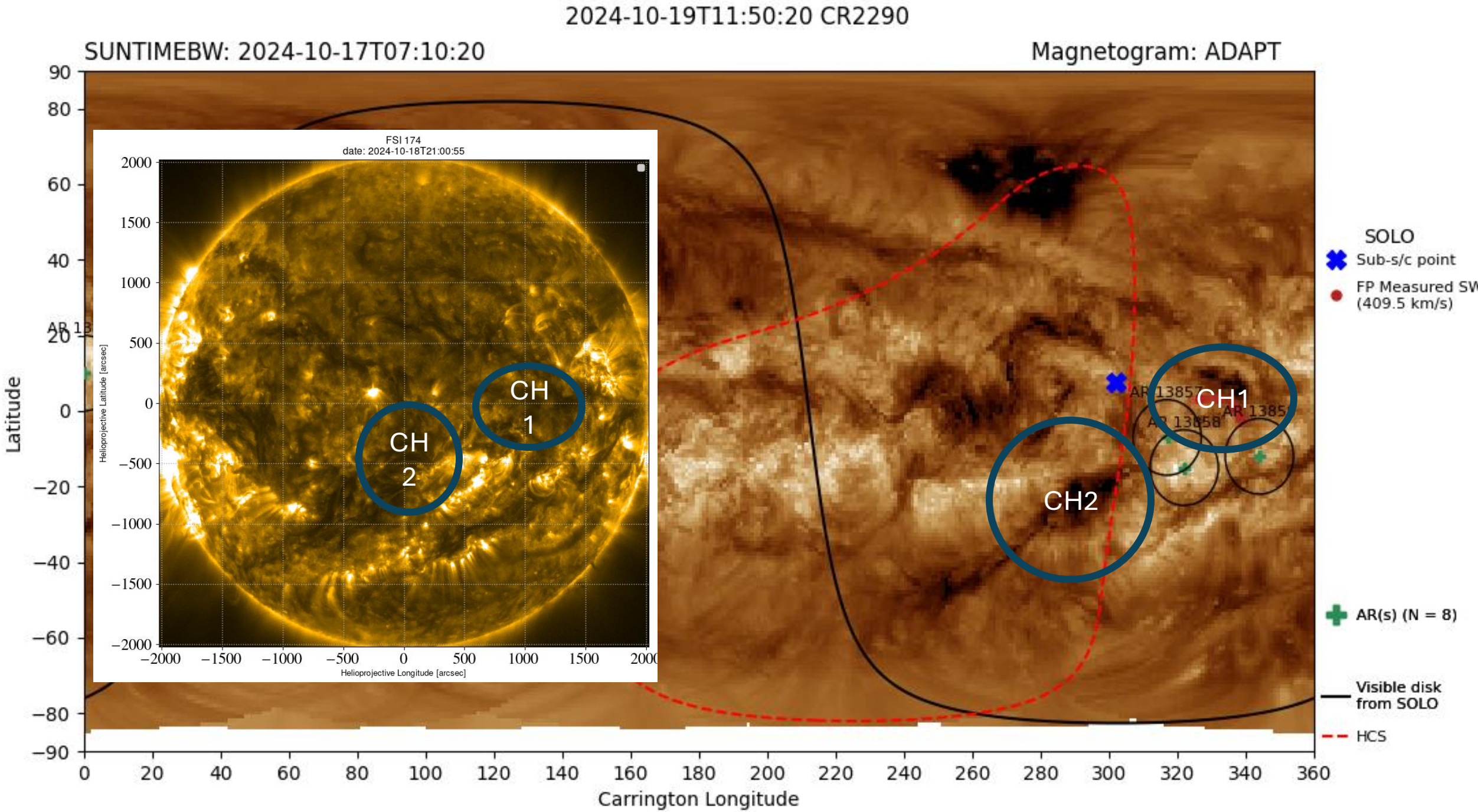
Small scale reconnection events
= can we compare these with
SPICE observations?

# Other instruments

- PHI HRT: Successful
- Hinode: Successful
- IRIS: Successful
- Solar Orbiter In-situ observations: SWA-PAS+MAG Successful

# Connectivity

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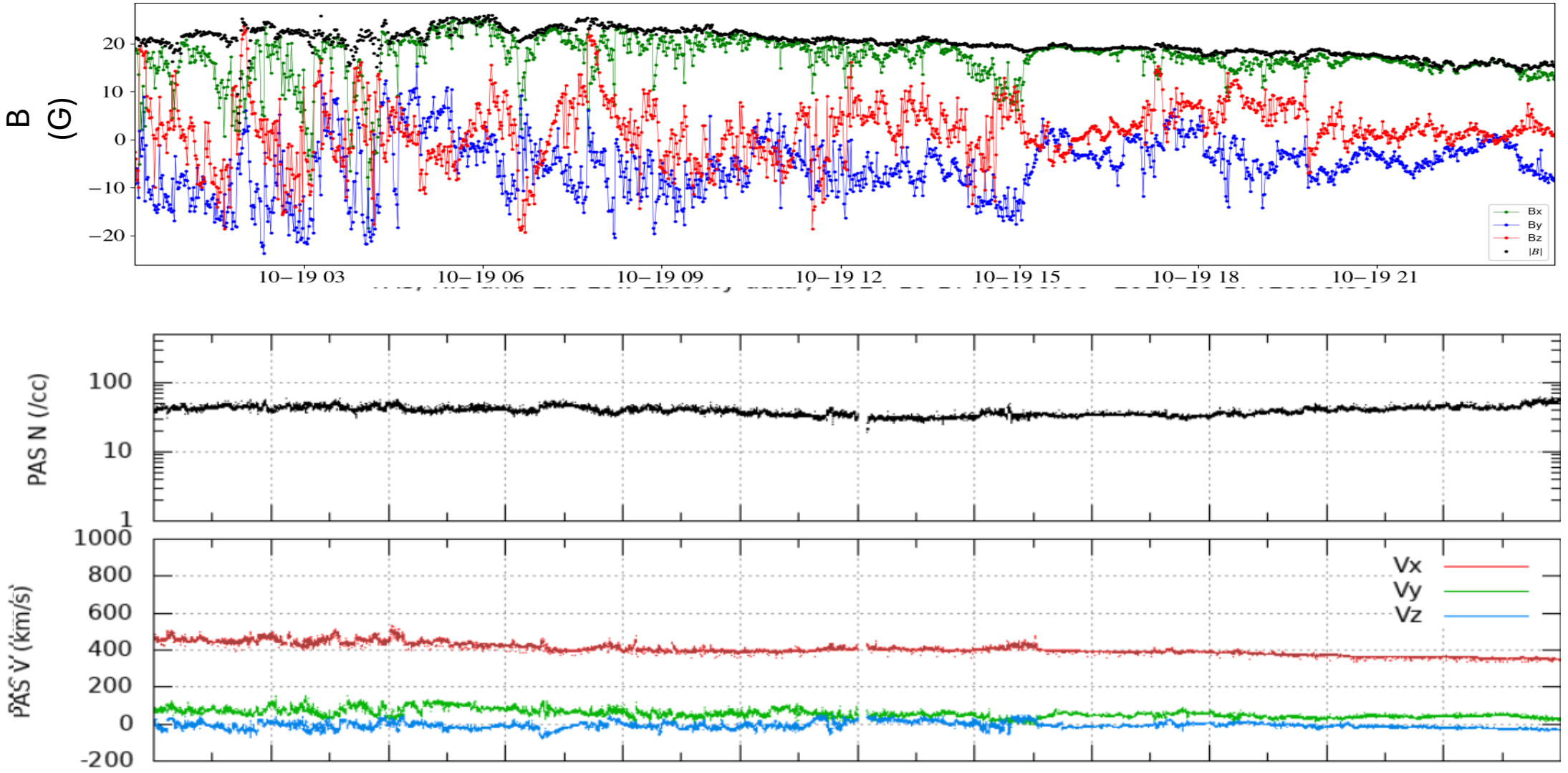
SUNTIMEBW: 2024-10-17T07:10:20
Magnetogram: ADAPT
FSI 174
date: 2024-10-18T21:00:55
CH 1
CH 2
CH1
CH2
AR 13857
AR 13858
AR 13859
SOLO
Sub-s/c point
FP Measured SW
(409.5 km/s)
AR(s) (N = 8)
Visible disk
from SOLO
HCS
Latitude
Carrington Longitude
Helioprojective Latitude [arcsec]
Helioprojective Longitude [arcsec]

# Solar Orbiter Insitu In-situ



# Conclusion

- The SOOP run successfully without major issues.
- The pointing was correct
- Coordination with Hinode and IRIS ran as planned.
- We have at least one successful target that connected with Solar Orbiter (according to connectivity tool)
- Sit & Stare provides good data for studies of dynamical features, but risky for connectivity purposes

Future run planned in LTP19 with similar observation setup.

# Polar Observations

SOOP coordinator: Juan Blanco

# Polar Observations SOOP
# RSW 18

J. Blanco

- R_SMALL_HRES_MCAD_Polar-Observations: RS9_111 (Oct 17-18) -- RSW18

- Two slightly different pointings: (D = 0.46 AU, Latitude = 7.6 deg, Angle Earth = -26 deg)

**Oct 17 22:00-0:00**, geometrical pole
**Oct 18 0:00-1:00**, inner pointing, 72 deg lat

- Coordinated with PHI, EUI, SPICE, Hinode – HOP 494

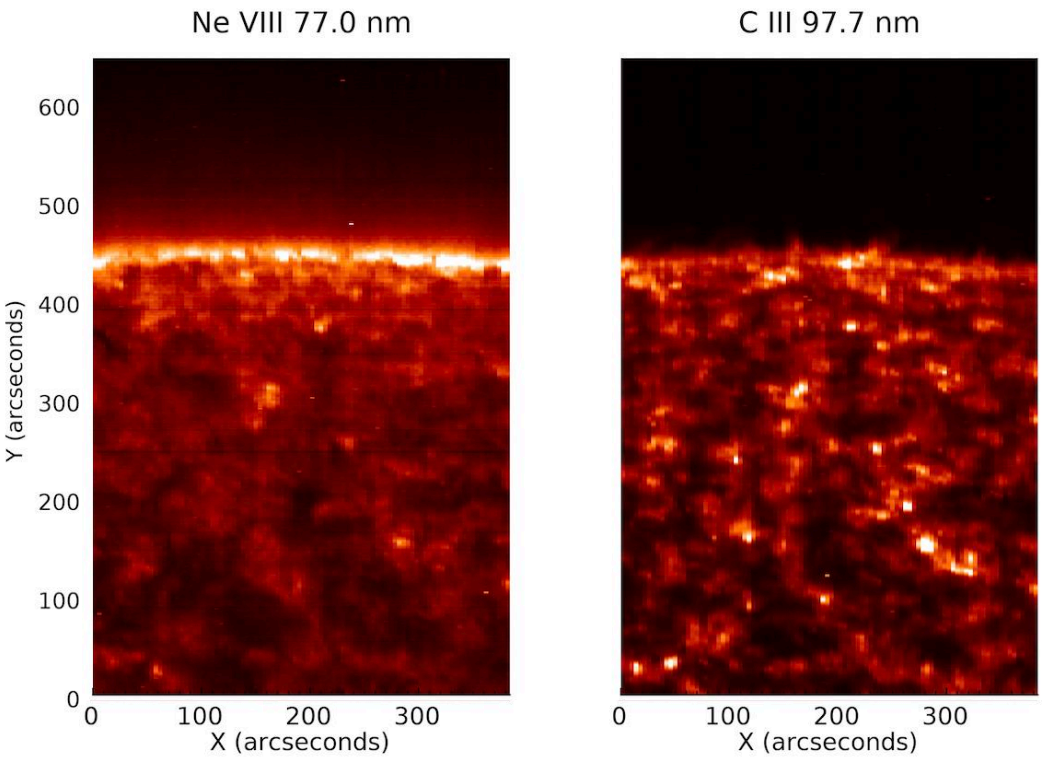
- **All observations on ground. EUI & SPICE look good quality, PHI still under evaluation & calibration**

| SOOP | PHI | EUI (HRI) | SPICE | Hinode |
|---|---|---|---|---|
| Polar pointing (17 Oct 22:00-0:00) | Cad: 1 m bursts / 20 m<br>Cropped: 1.5 k x 1.5 k / equiv. rectangular cropping | 22:30-23:30<br>5 s cad. | Slow limb raster<br>6.3' FOV | SP: 320" x 164" map<br>XRT: standard polar mode<br>EIS: ID 618 (HOP81_new_study_v2) |
| Inner pointing (18 Oct 0:00-1:00) | Cad: 1 m bursts / 20 m<br>Cropped: 1.5 k x 1.5 k | -- | Fast (short exp.) limb raster<br>11' FOV | |

All data from all instruments on-ground and looks of good quality
Calibrations on-going for PHI, Hinode

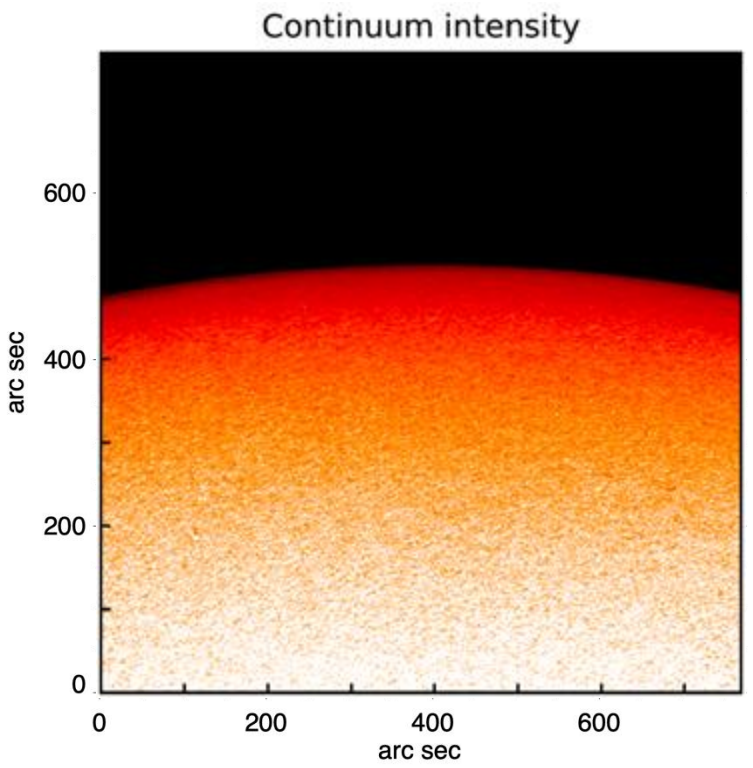
Remarks:

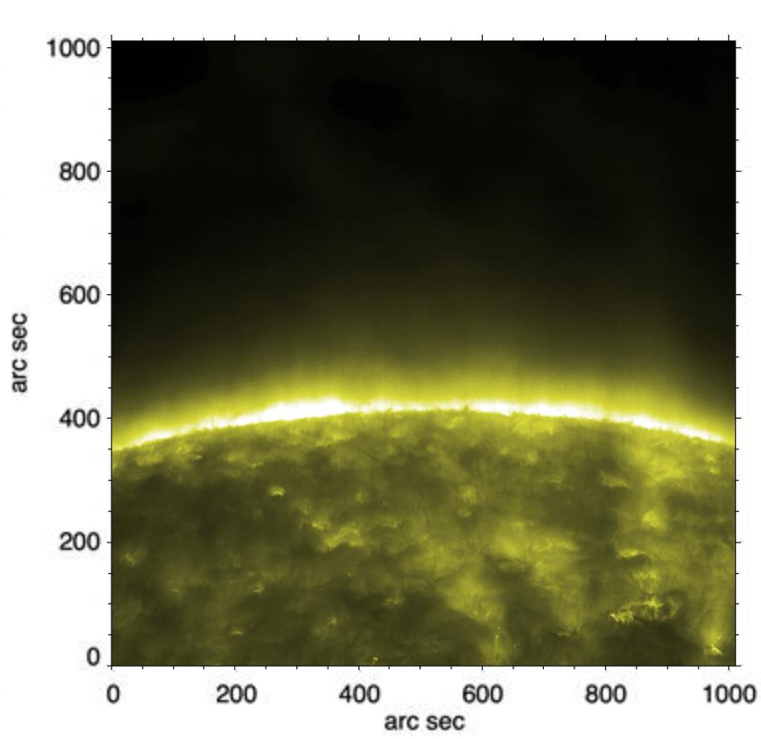
- Inner pointing much better for PHI performance, in quality and stability
- PHI 3-minutes averaging shows large improvement S/N
- Further PD reconstruction
- Pointing positions matching

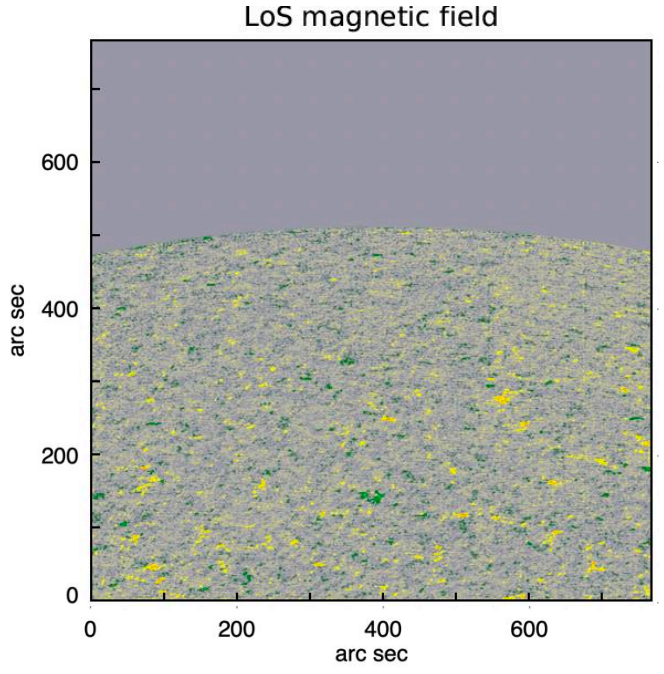


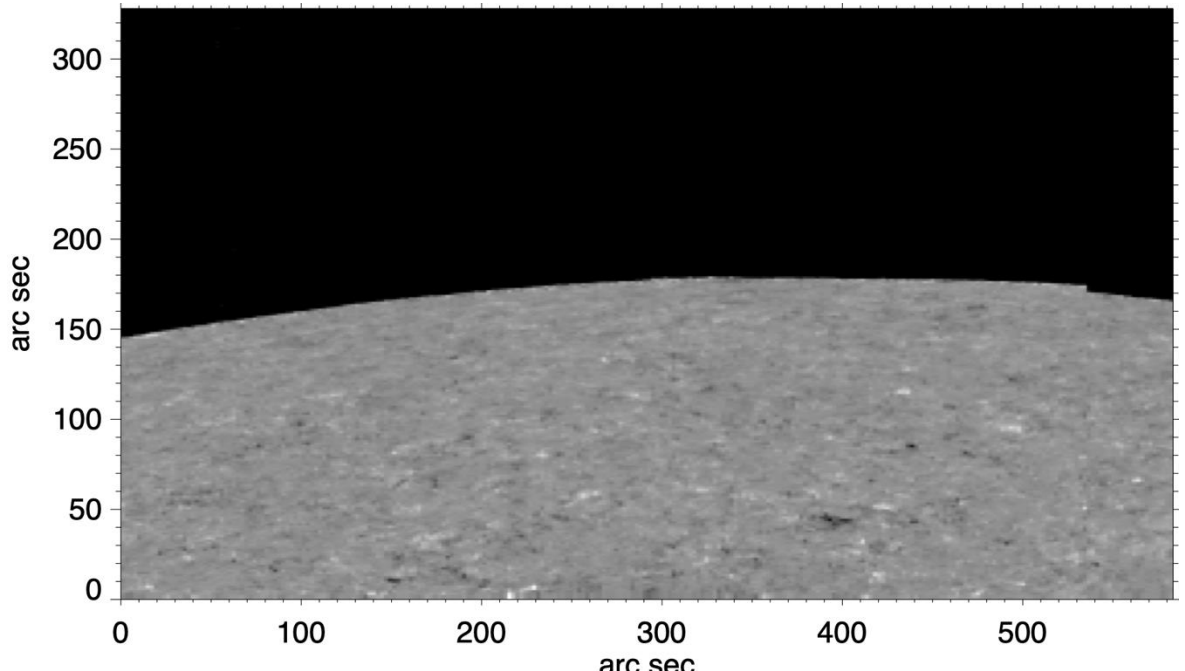




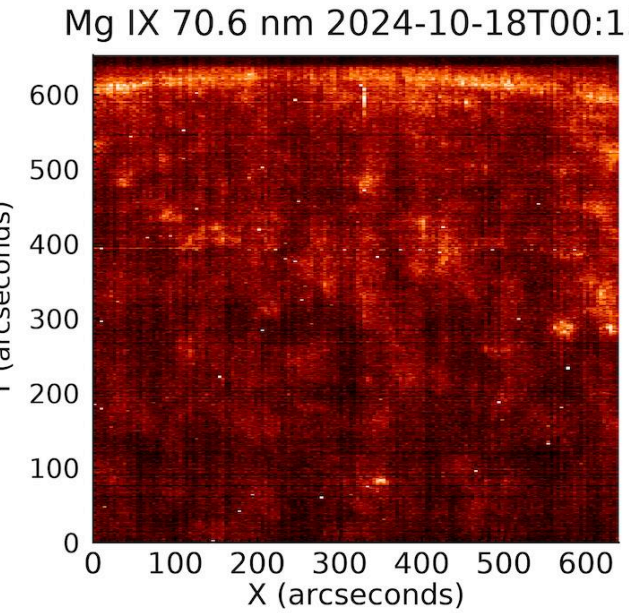


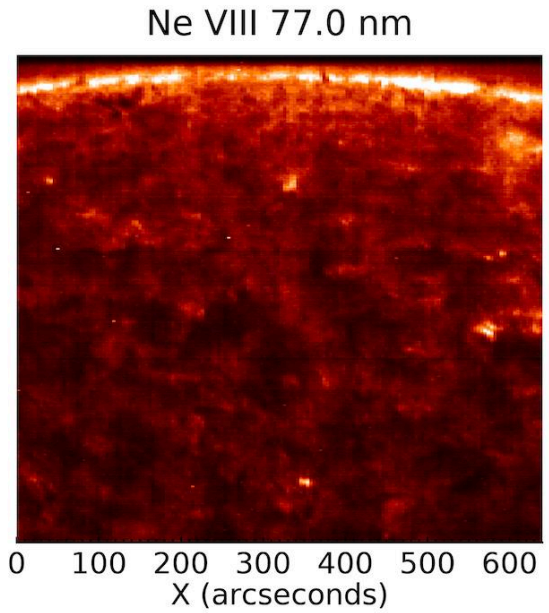



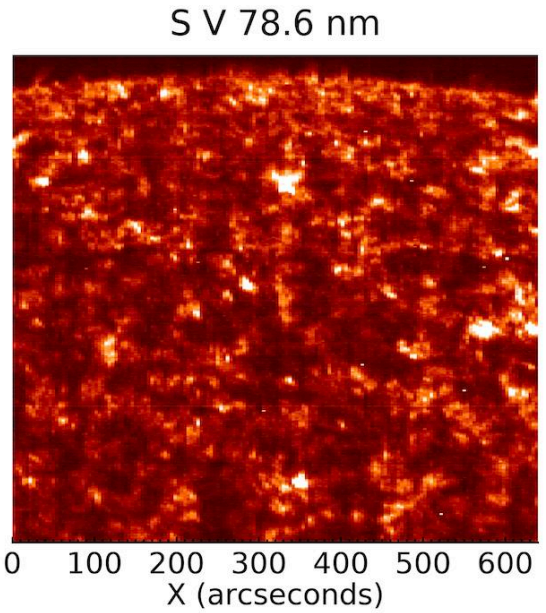



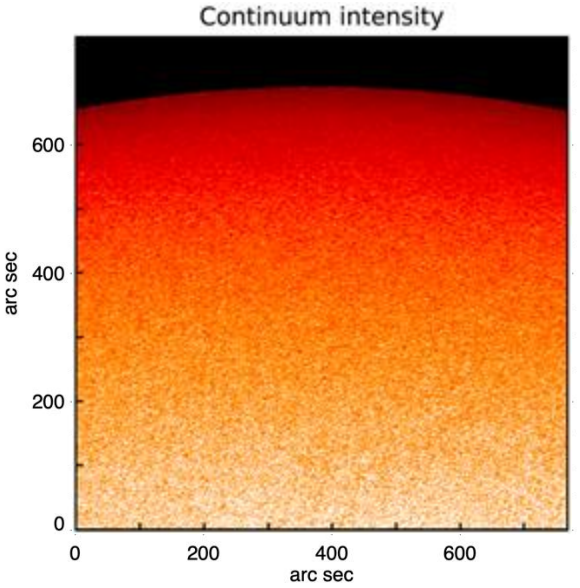



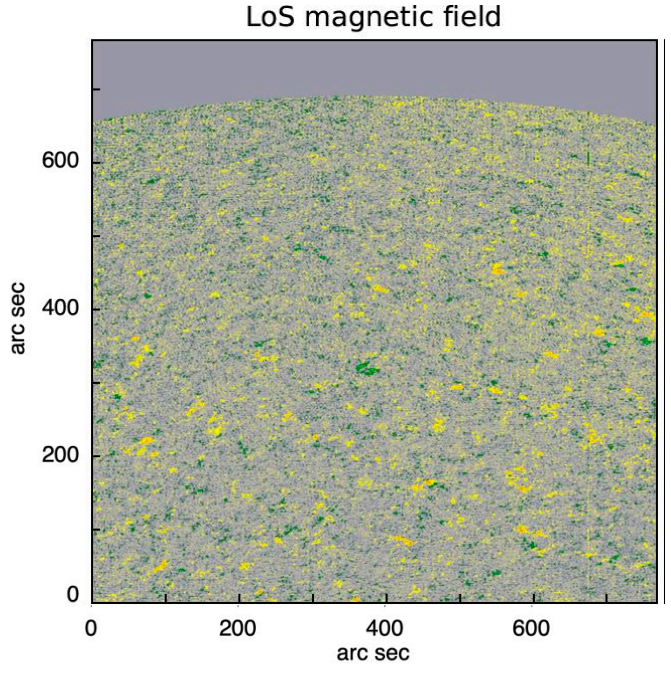

Hinode longitudinal
2024-10-17 22:05 (app. 3hours)
Tip-tilt reset on the end (right) of scan

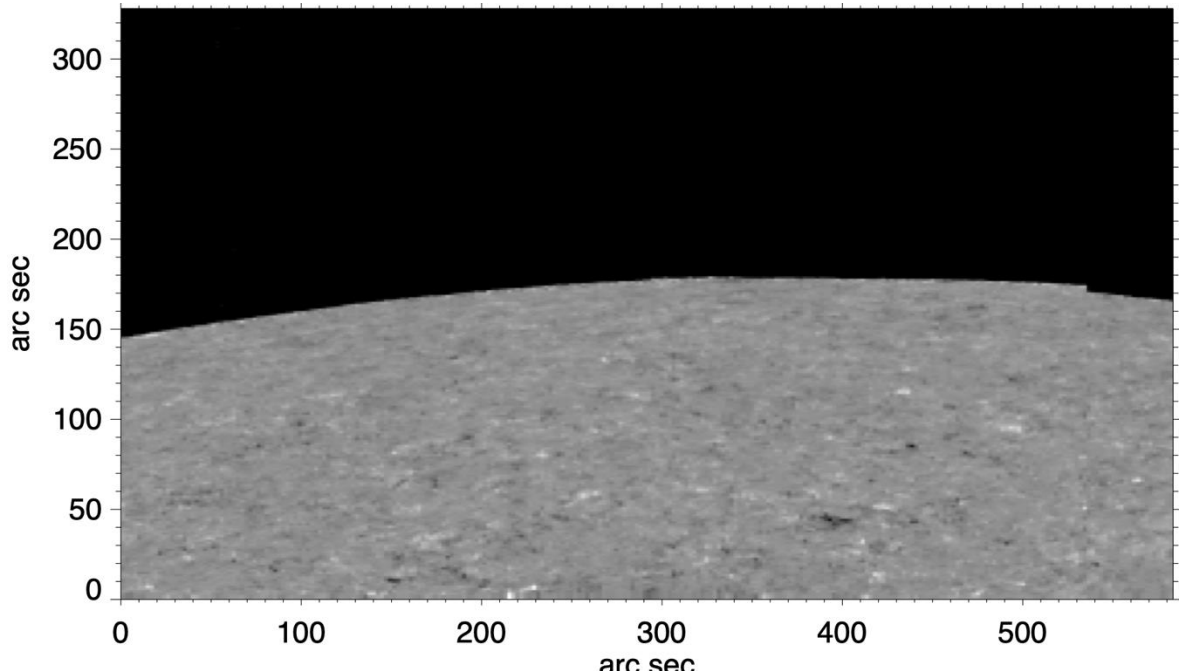



Hinode longitudinal
2024-10-17 22:05 (app. 3hours)
Tip-tilt reset on the end (right) of scan

# Eruption Watch

SOOP coordinator: Clementina Sasso

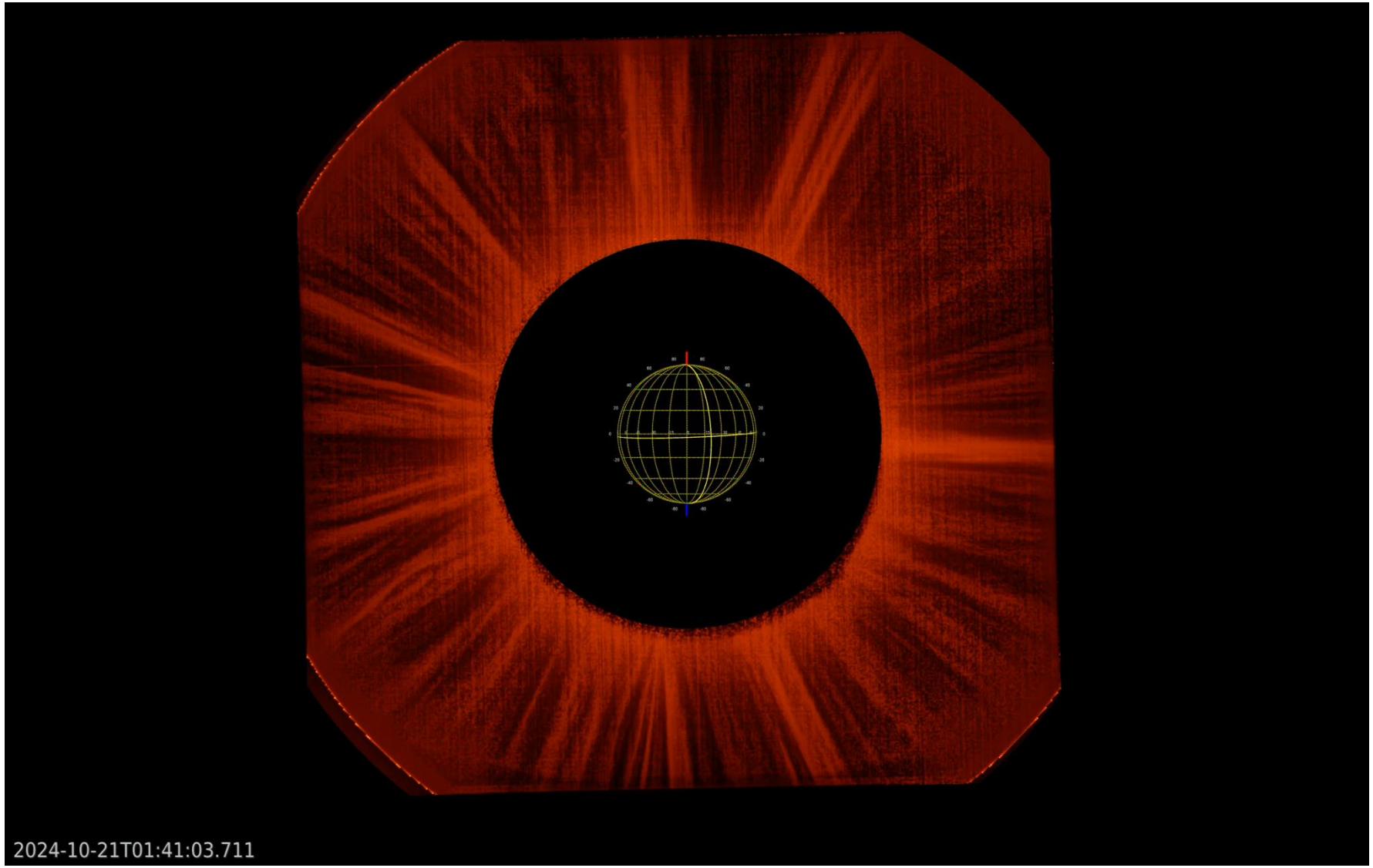
# L_FULL_HRES_HCAD_Eruption-Watch

**LTP17** 21.10.2024 - 27.10.2024 (STP331)

stop 22.10 (03:20-13:00)

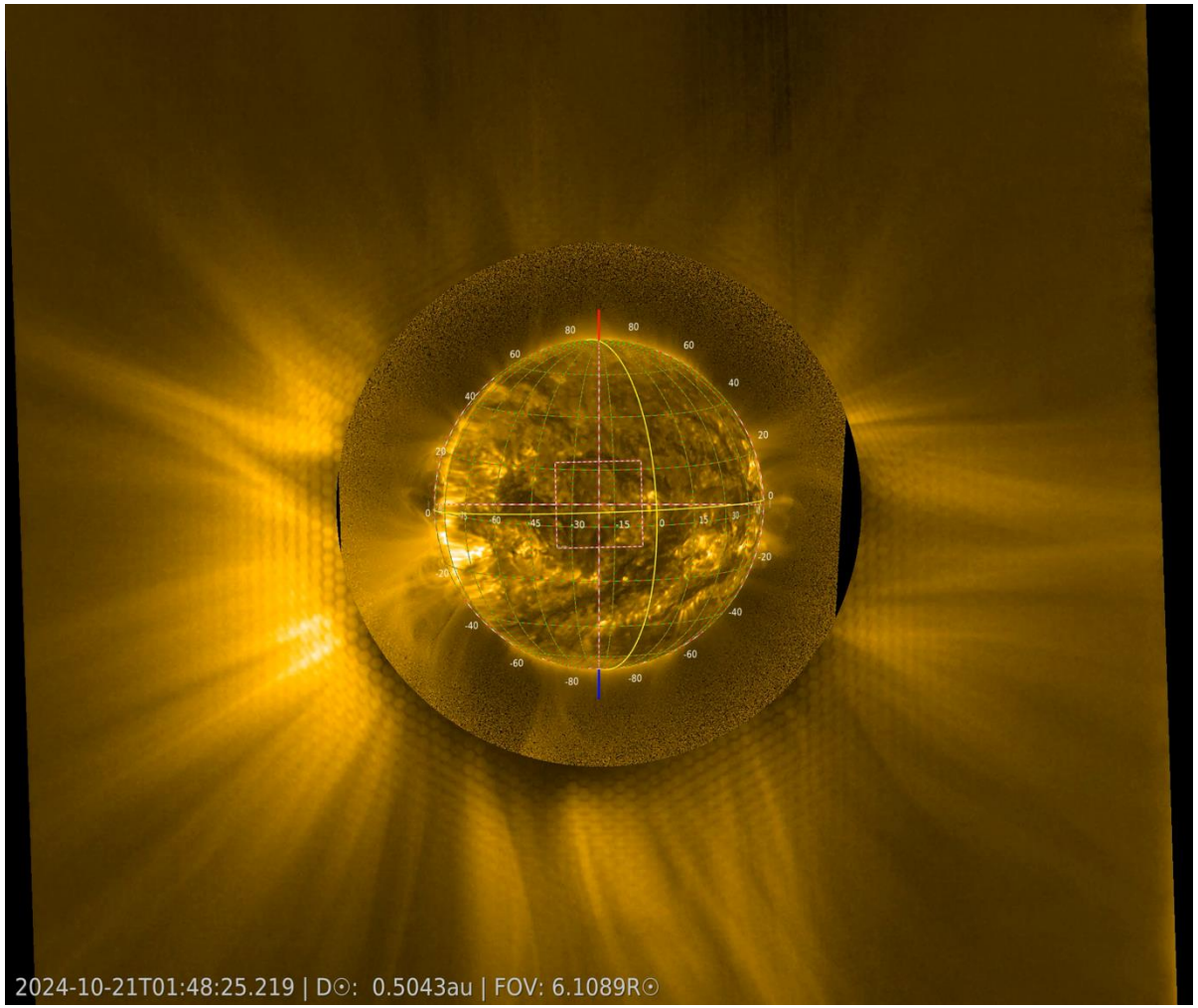
- **Metis:** GLOBAL (cadence 10 min) + CMEOBS (cadence 1 min)
- **SolO-HI:** Shock mode
- **EUI:** FSI coronagraphic mode
- **PHI:** Synoptic_FDT_4 (cadence 6 h)
- **SPICE:** Waves and composition mode type raster
- **STIX:** Normal mode, standard operations

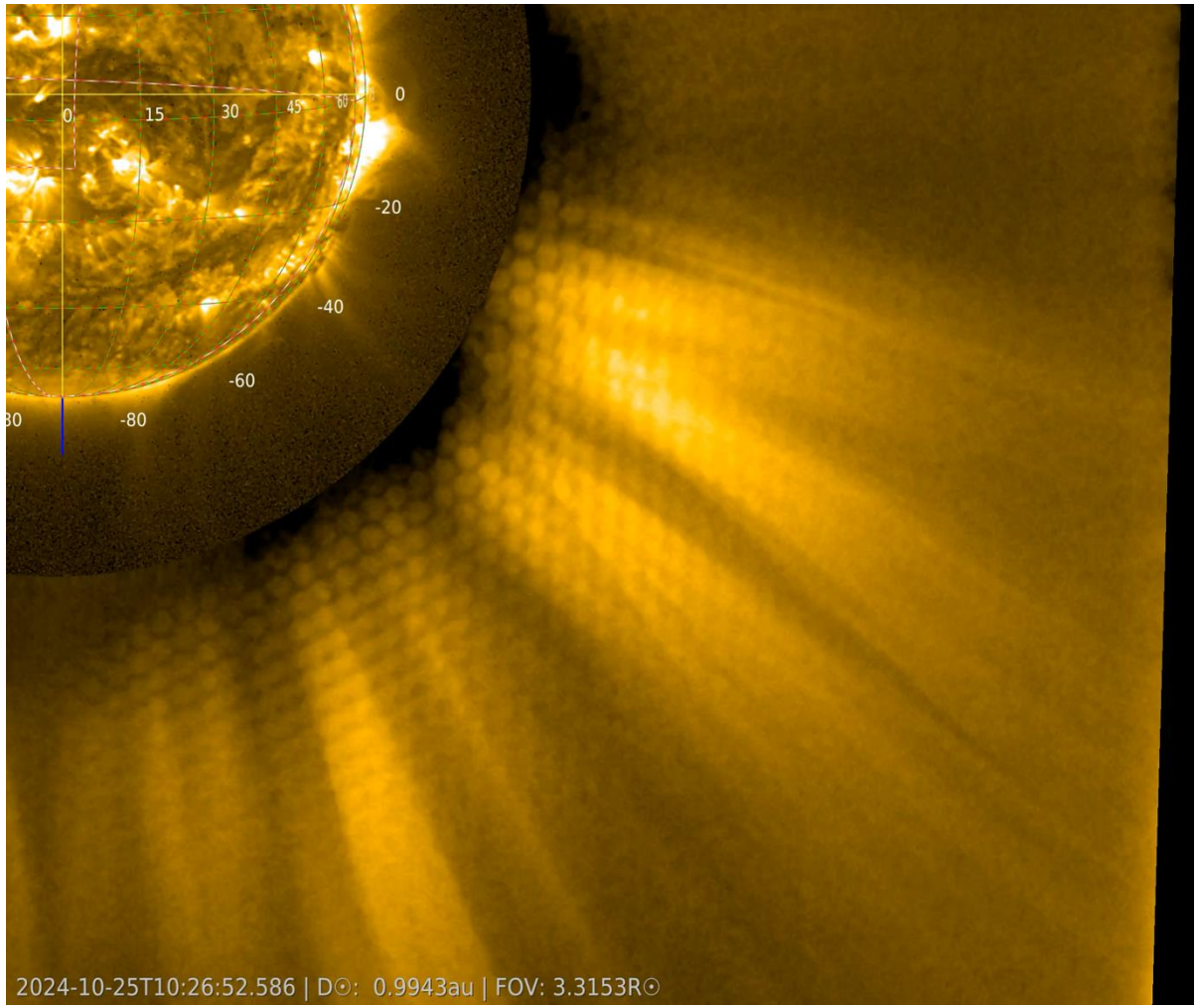
**Metis:** GLOBAL (cadence 10 min) + CMEOBS (cadence 1 min)
VL and UV



# SolO-HI

# **EUI:** FSI coronagraphic mode

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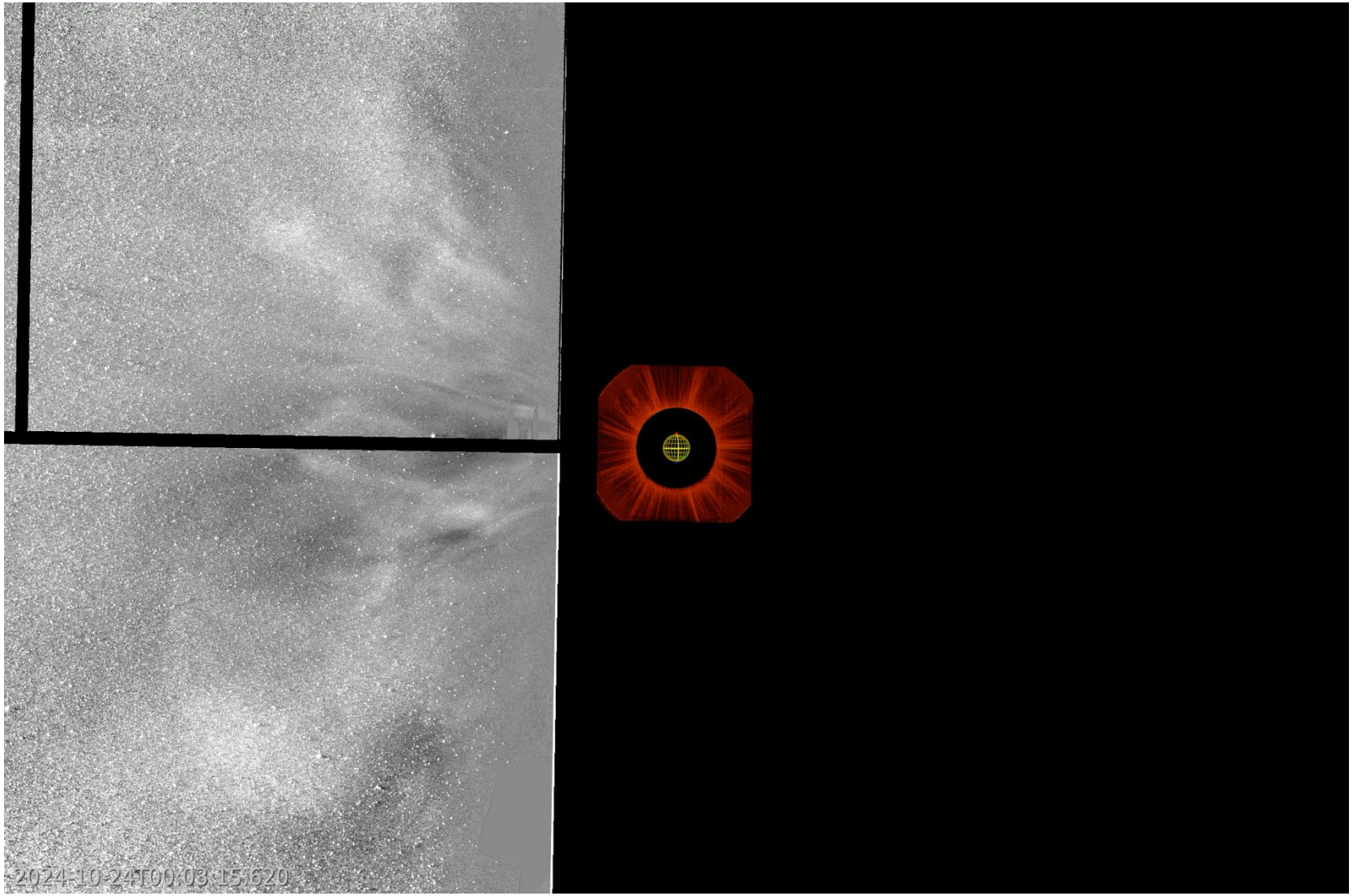
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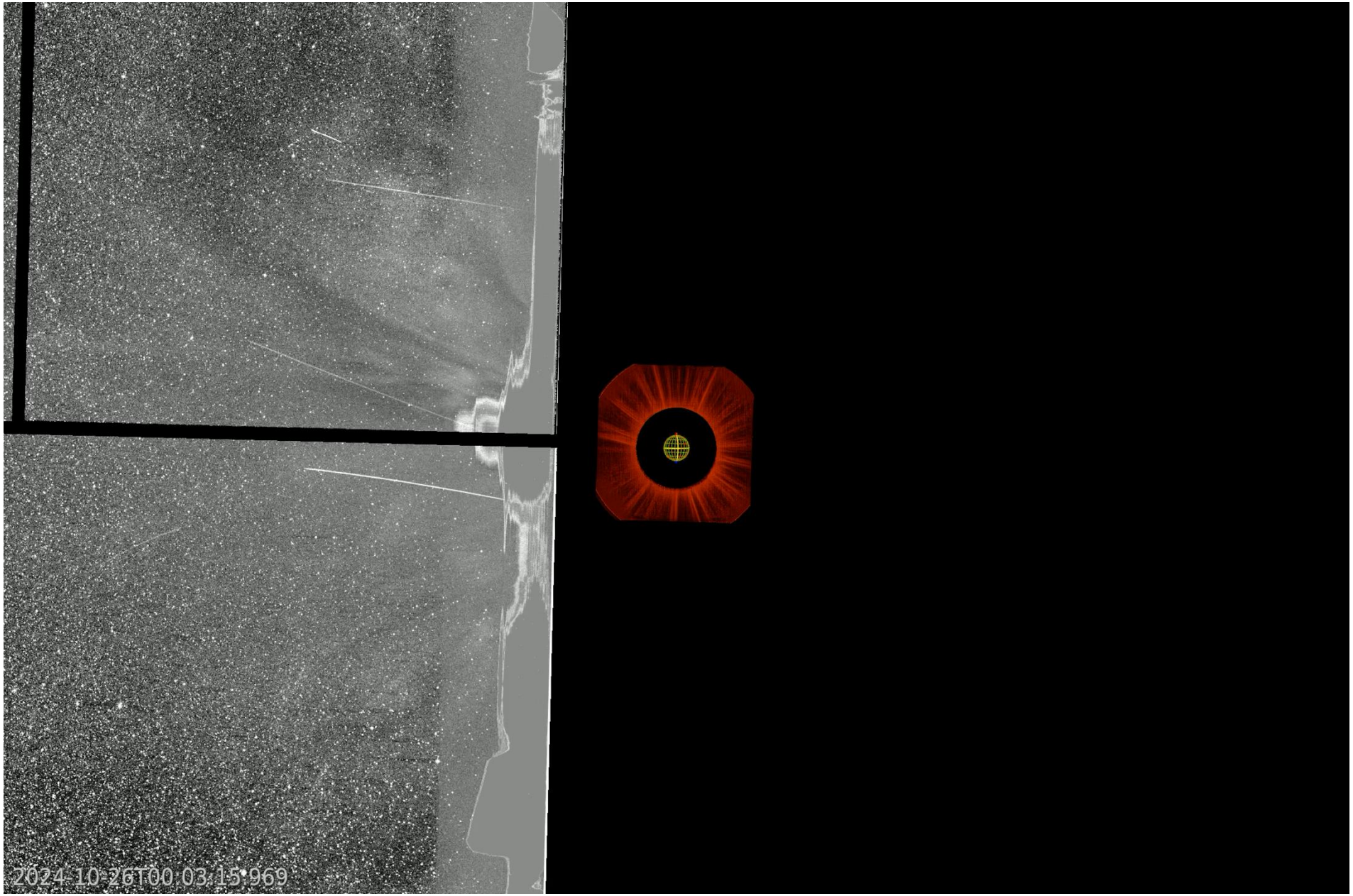
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# AR Long Term

SOOP coordinators: Clara Froment, Xiaohong Li, Henrik Eklund

**Aim**: Follow an AR during a part of its lifetime, from its appearance off-limb, its passage on-disk and disappearance at the other limb over an extended period of time thanks to Solar Orbiter's co-rotation windows.

We aim at characterising the properties of TNE cycles, in terms of periods, total duration, velocities of the coronal flows and condensations, variation in elemental abundances.

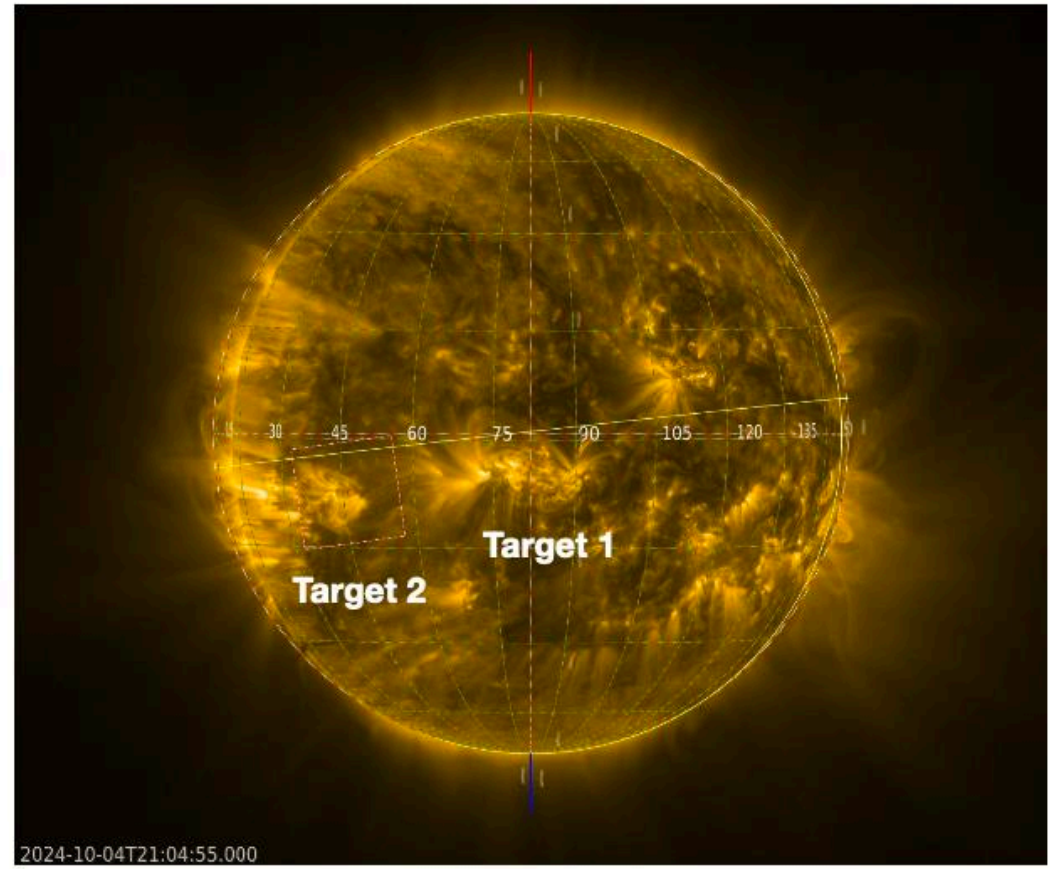
Variation of R_SMALL_MRES_MCAD_AR-Long-Term: SOOP Long term tracking of AR
From October 2 at 6:15 UT to October 16 at 00:00 UT: **14 days** (interruption of 11 hours on October 8)

**SOOP coordinators:** Clara Froment, Xiaohong Li and Henrik Eklund

**2 targets:**

- Target 1: AR 13849/AR13850, for 3 days: October 2 to October 4 (turned out to be too big for the FOVs)
- Target 2: AR 13852, and the emerging AR 13854, for 10 days: October 5 to October 15

Our daily pointing decisions available at:
https://codimd.math.cnrs.fr/0UIx_4gMR_ecyqtYOuOExg



| Solar Orbiter | EUI | PHI | SPICE |
|---|---|---|---|
| FSI | HRI | HRT | |
| 10 min continuous (174 & 304 Å)<br>+ extends one extra day after the end of the SOOP | 5 s (174 Å) for 1 hour per day:<br>9:00-10:00 UT on Oct 2-5 and Oct 12-15;<br>19:00-20:00 UT on Oct 8; 9:15-9:45 UT and 19:15-19:45 UT on Oct 6,7,9,10,11.<br><br>The alternation of early and late UT hour was decided to accommodate for both SST and GREGOR, and DKIST co-observations, respectively. | 60-min at hh:30 (mid-time of the HRI window). | Composition rasters: 64-min rasters: 64 slits positions, 60-s exposure (and 6'' slits) |

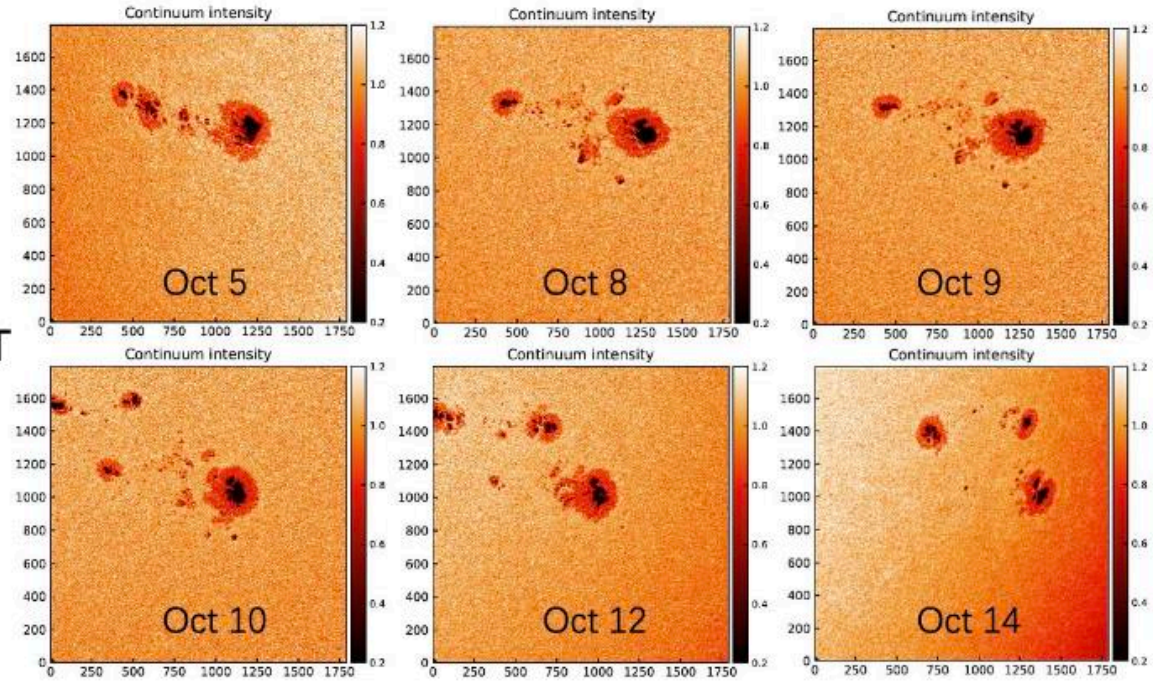
Co-observations, for both targets (Hinode and IRIS), not always the same pointings between ground-based and IRIS/Hinode

| Hinode | IRIS | SST | GREGOR | DKIST |
|---|---|---|---|---|
| HOP 0490<br>focused on EIS observations:<br>- velocities for the coronal flows<br>- raster every 40 min, quasi-continuously from Oct 11 at 19 UT to Oct 13 at 16UT | Sit-and-stare and rasters<br><br>labelled as SO coordination: EUI or SPICE; SST coord.; SUIT coord | CRISP & CHROMIS<br><br>Off-limb (H$\alpha$, Ca II H) and on-disk (H$\alpha$, Ca II 8542 and Fe I 6173 I) + mosaics | GRIS - Spectropolarimeter (He I 10830 & Ca II 8542)<br>and High-resolution Fast Imager (HiFI+) | Off-limb CryoNIRSP<br>(Coronal Magnetic Field Mapping, Coronal Waves + Density Mapping, Polarimetry of Cool Condensations)<br><br>ViSP and VBI full-field<br>(large map and full-field; small map and center-field) |

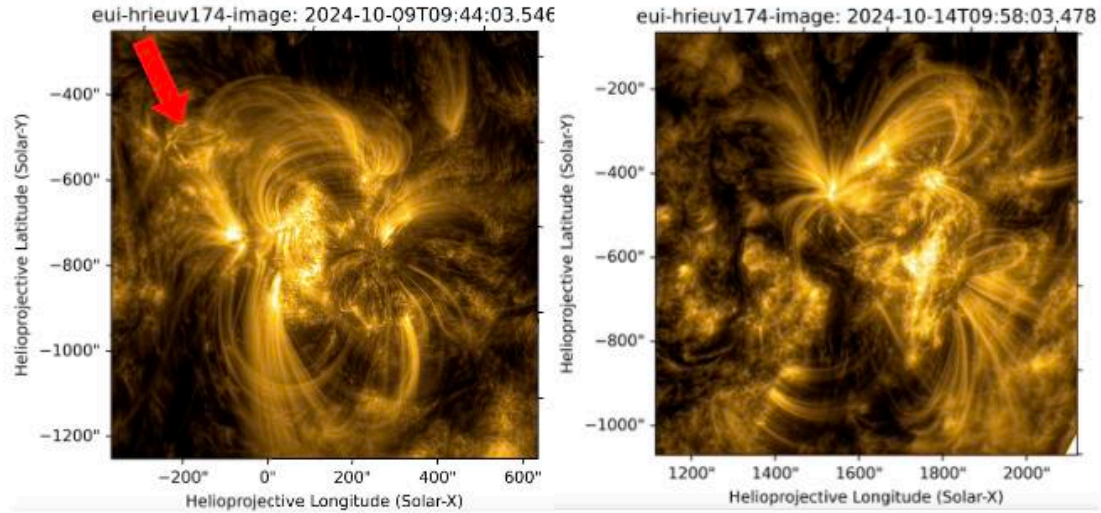
## Details of highlights observations

### 1 Emergence of new AR

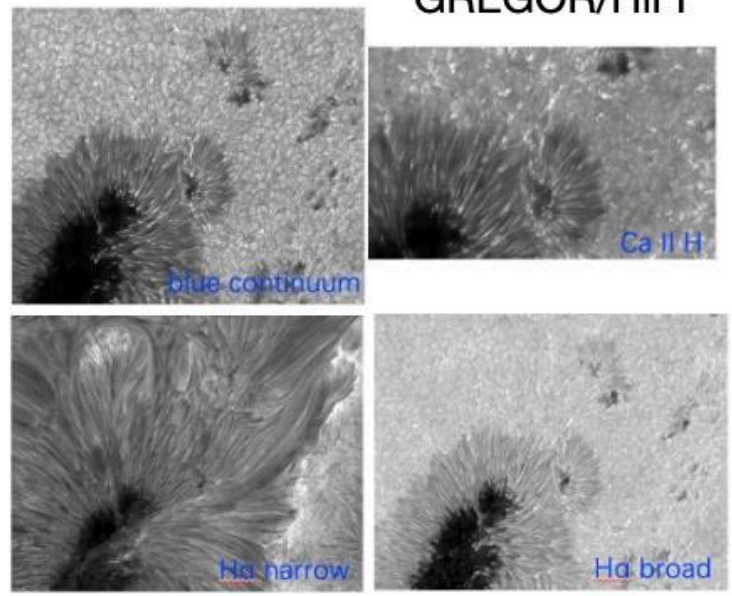
PHI/HRT

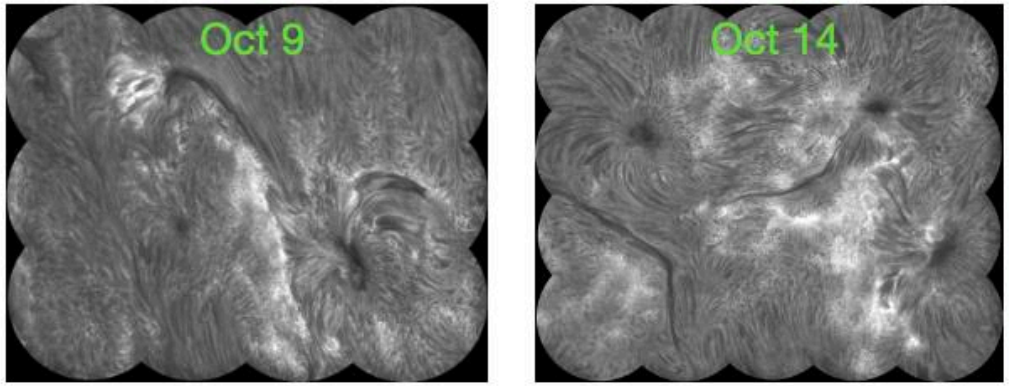



EUI/HRI

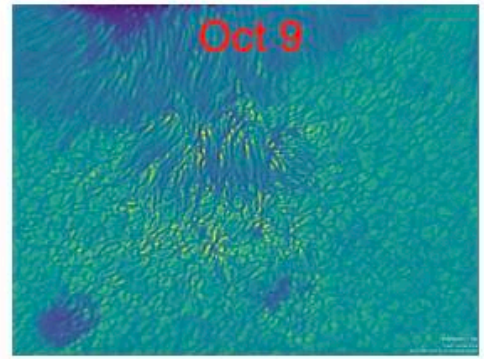



GREGOR/HiFI



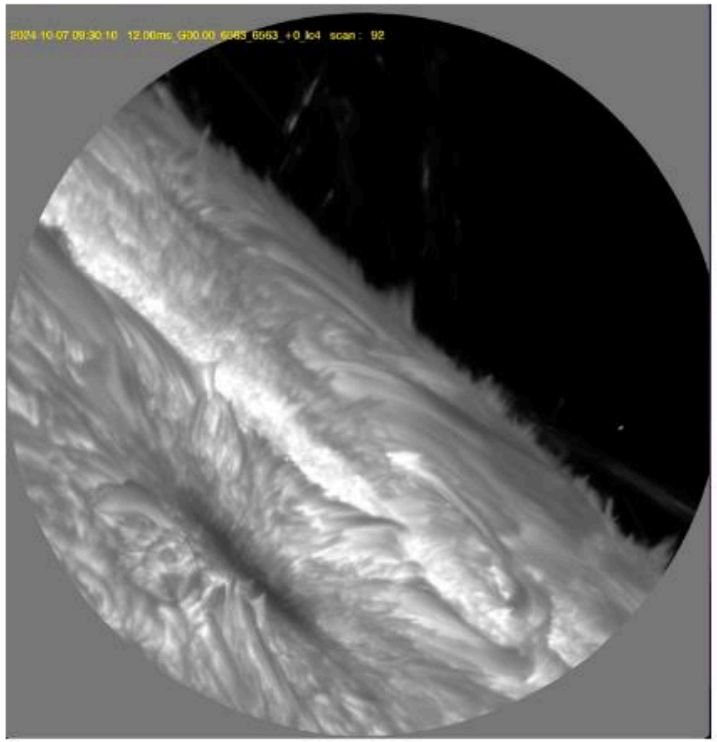

SST H$\alpha$ line center mosaic



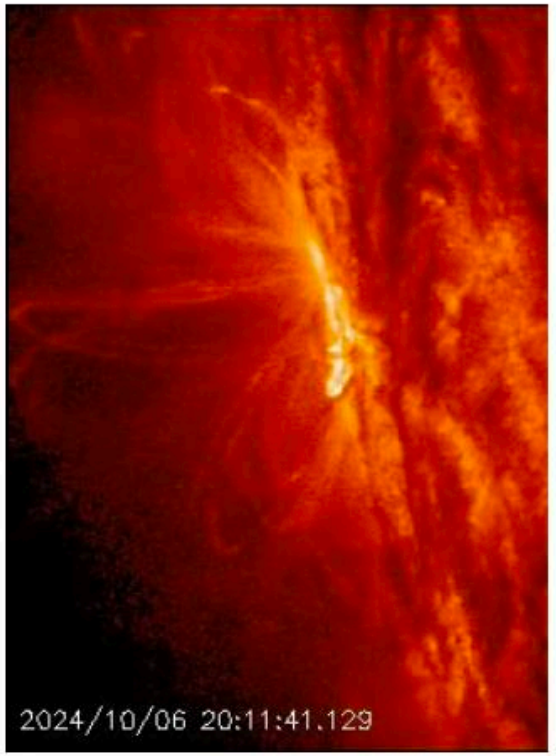

DKIST/VBI

## Details of highlights observations

### 2 Coronal rain



SST/CRISP



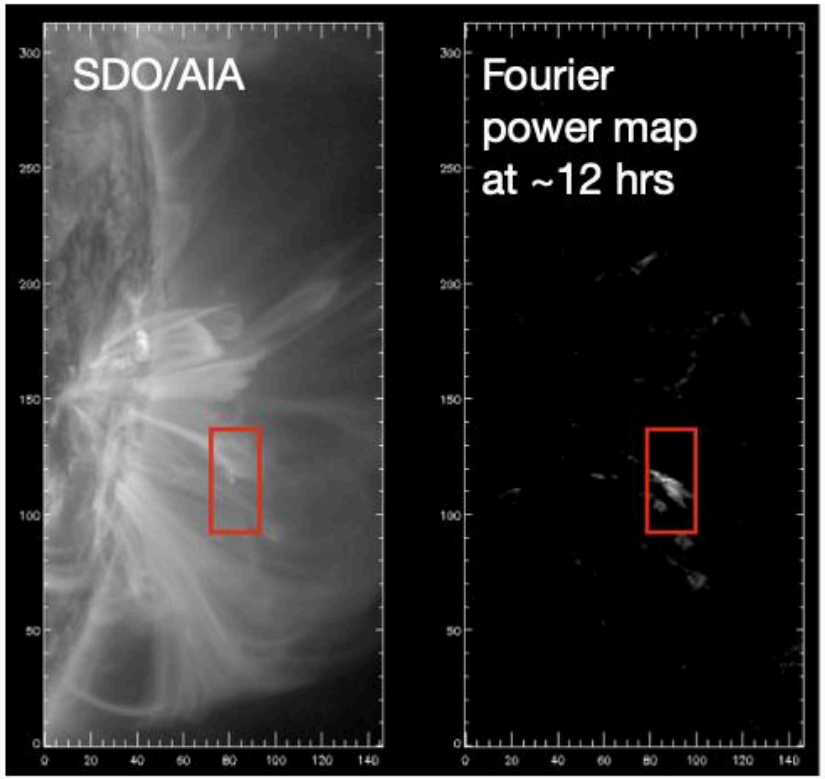

SDO/AIA 304 Å

Only at the East limb as seen from Earth on this slide, but we still have to explore the datasets as there is of course more!

- Also with IRIS (first target) and DKIST/Cryo-NIRSP
- Still have to look at EUI/HRI datasets into details for coronal rain

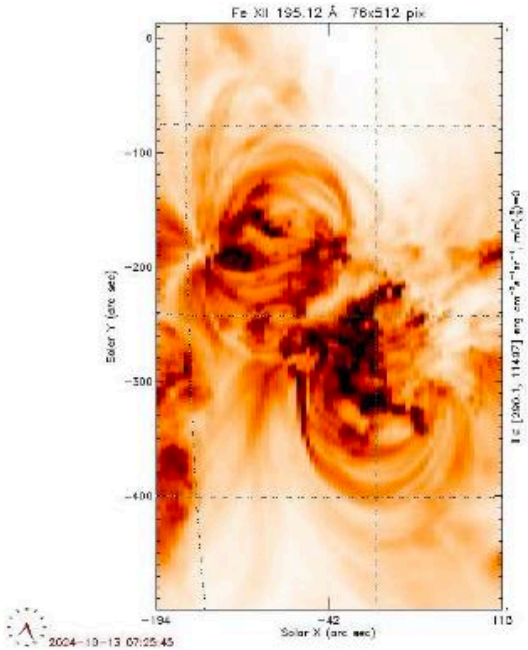
## Details of highlights observations

3 EUV pulsations search



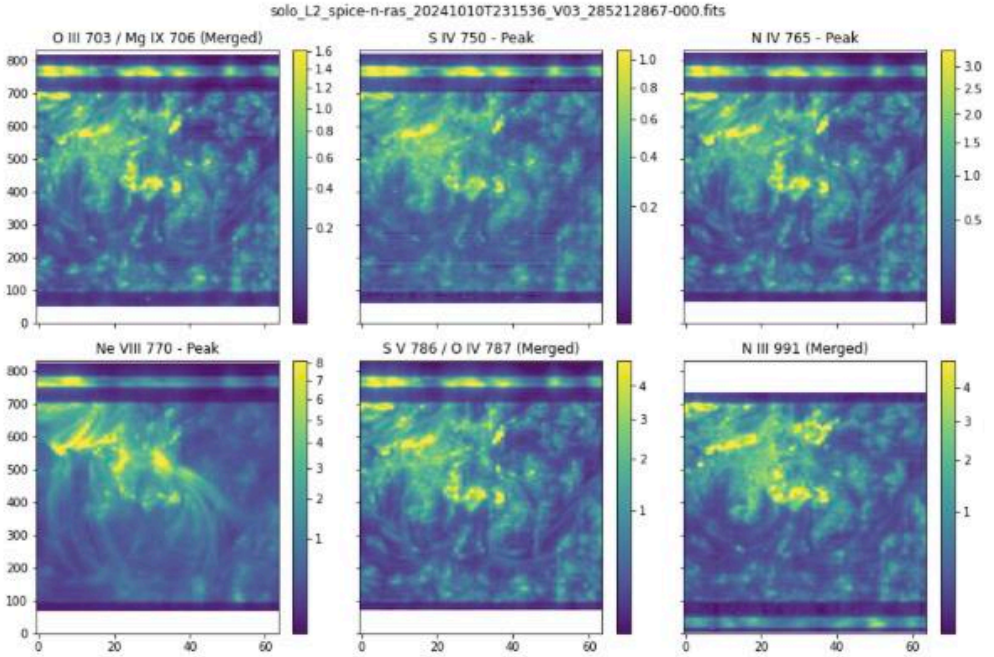

- Detection for long-period EUV pulsations is ongoing (with SDO data for the moment)
- Some promising signal in AR 13850 when seen at the West limb
- Still have to look at the on-disk observations and of course the 14-days long continuous EUI/FSI observations!

Spectroscopic data for the future detailed studies




Hinode/EIS data to look for the associated coronal flows

SPICE data with the composition rasters



## What worked very well

- Monitoring of the targets by starting some weeks before (looking for TNE pulsations, potential decay of the targets)
- Smooth PDMs thanks to the preparation ahead (discussions between the coordinators, with the co-observers, etc…)
- Choice of the targets: Target 2 observed for 10 days! Observations of the emerging AR 13854, etc
- A wealth of versatile datasets with Solar Orbiter (EUI, PHI, SPICE, and others such as STIX) but also many others co-observating facilities (IRIS, Hinode, SST, GREGOR, DKIST, etc…)

**Many thanks to the PIs, instrument teams, co-observers and for the support for the PDMs!**

## What could be improved

- Not so easy for us to understand how to place the FOV with foresight constraints, cropping, etc.
  -> Some qualitative infos in the documentation we get for the PDM but some numbers ahead would be nice
  -> It was important for the SPICE study (designed for spacecraft pointing and in the end we used HRI boresight)
- For ground-based co-obs, they preferred to have the coordinates at the time of the appearance of the region as seen from Earth (not only at the end of the sequence)
  -> Taken in account during the SOOP
- Coordination communication challenging, possible misunderstandings with IRIS and Hinode planners (Hinode for the major flare watch, IRIS outside of our target at the East limb). The aforementioned addition on the coordination webpage confused some of the coordinating parties. For the ground coordination, slack discussions made it smoother.

  -> Have a chat or even better short telecon with coordinating parties, when we change the targets, would avoid this kind of things.
  -> Ask for pointing in the draft IRIS emails, we usually only get it in the final plan when it is too late to react

# Major Flare

SOOP coordinators: Andrew Inglis, Terry Kucera

# Summary of Major Flare Watch on 2024-10-15

- The Major Flare Watch was very successful. Four significant flares were observed by combinations of Solar Orbiter and supporting instrumentation.

- An M2-class flare was captured with exceptional quality by EUI/HRI at approximately 18:30 UT. Many other smaller eruptions and brightenings observed by HRI.

- SPICE observed two C-class flares in sit and stare mode. Unfortunately, the M2 flare did not overlap with the SPICE slit.

- Excellent high cadence supporting observations from Hinode and IRIS.

# Summary of Major Flare Watch on 2024-10-15

**15:00 UT:** MFW begins

**16:25 UT:** Small C2-class flare observed by SPICE

**18:00 UT:** EUI/HRI high cadence observations begin

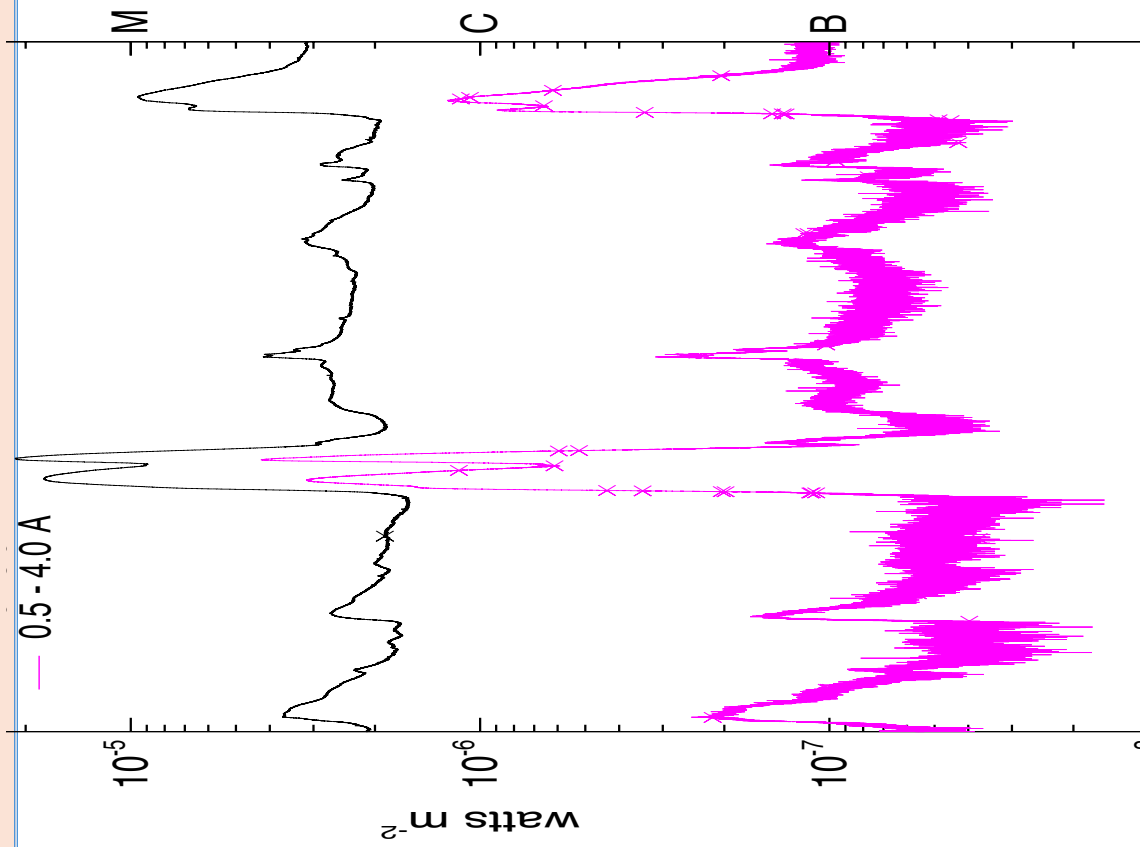
**18:30 UT:** M2 solar flare, observed by EUI!
*not seen by SPICE, slit did not overlap*

**18:00 – 22:00 UT***:* many other small and moderate jets observed by EUI/HRI

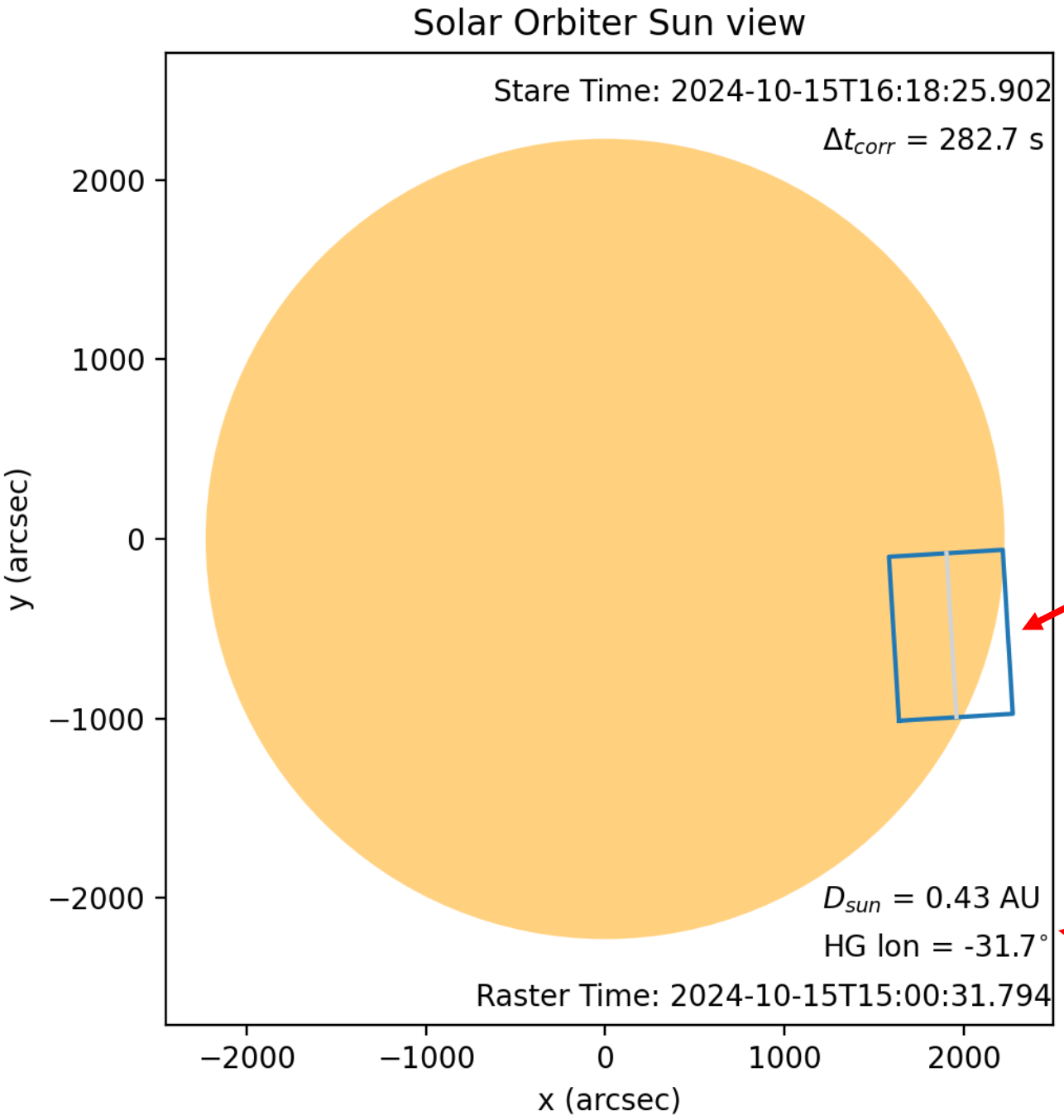
**22:00 UT:** EUI/HRI high cadence observations end.

**23:15 UT:** C9-class flare observed by SPICE

**23:59 UT:** MFW ends




IRIS and Hinode also supported this flare watch with high cadence observations, successfully observing multiple flares.




For this Major Flare Watch, we were observing AR 13852. SPICE FOV is shown.

Solar Orbiter was trailing Earth by ~32 degrees at this time. SolO was at 0.43 AU from the Sun.

**Summary of flares observed by each instrument supporting the Major Flare Watch**

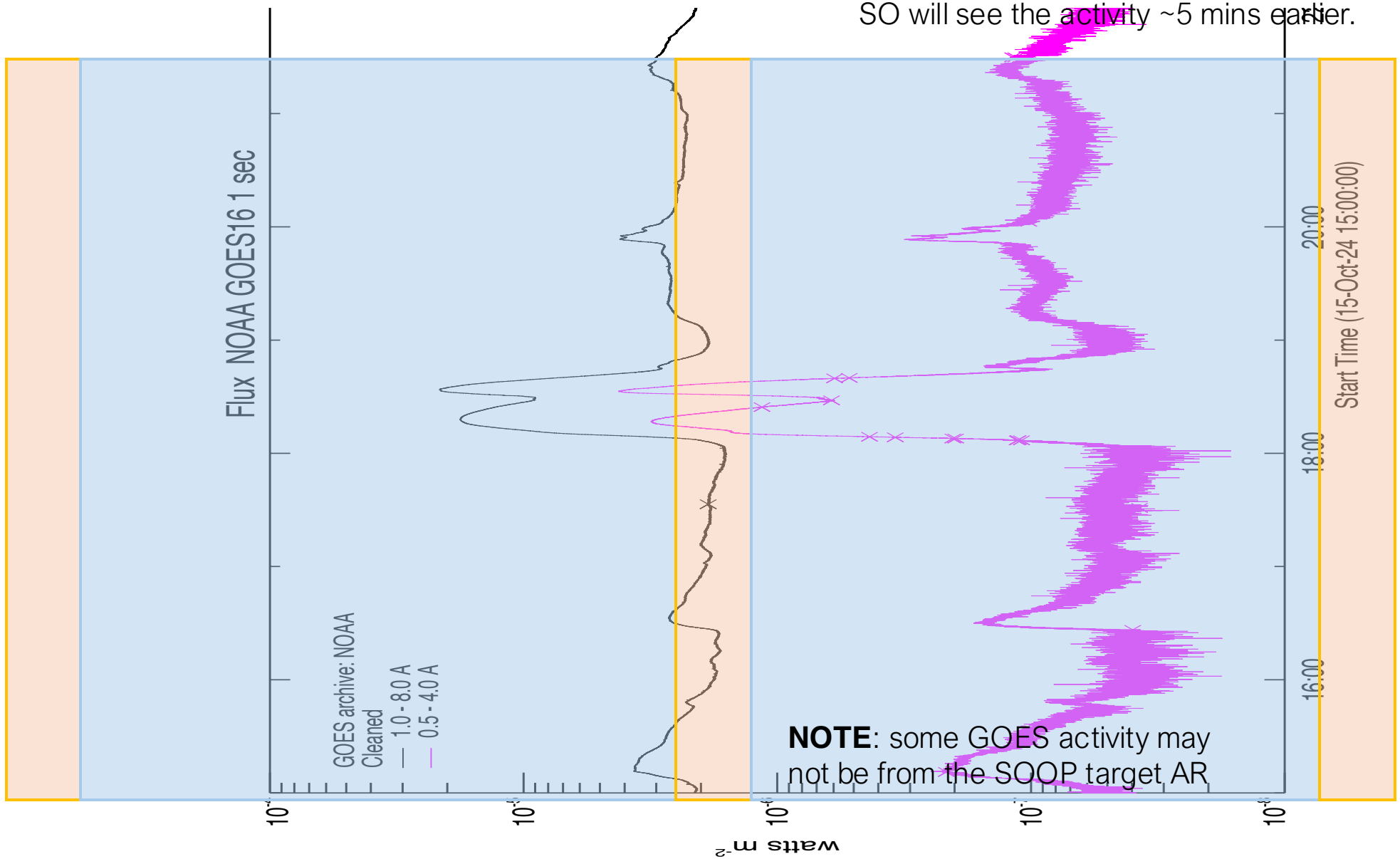
| FLARE | SPICE | EUI/ HRI | Hinode/ EIS | Hinode /XRT | IRIS slit | IRIS SJI | STIX |
|---|---|---|---|---|---|---|---|
| **C2.6 (16:24)** | Yes | No | TBD | Yes | Yes | Yes | Yes |
| **M2.1 (18:28)** | No | Yes | Yes | Yes | No | No | Yes |
| **C4.0 (19:49)** | No | Yes | TBD | Yes | Yes | Yes | Yes |
| **C9.4 (23:09)** | Yes | No | Yes | Yes | Yes | Yes | Yes |

# SPICE observations timeline

Context raster

Sit and stare

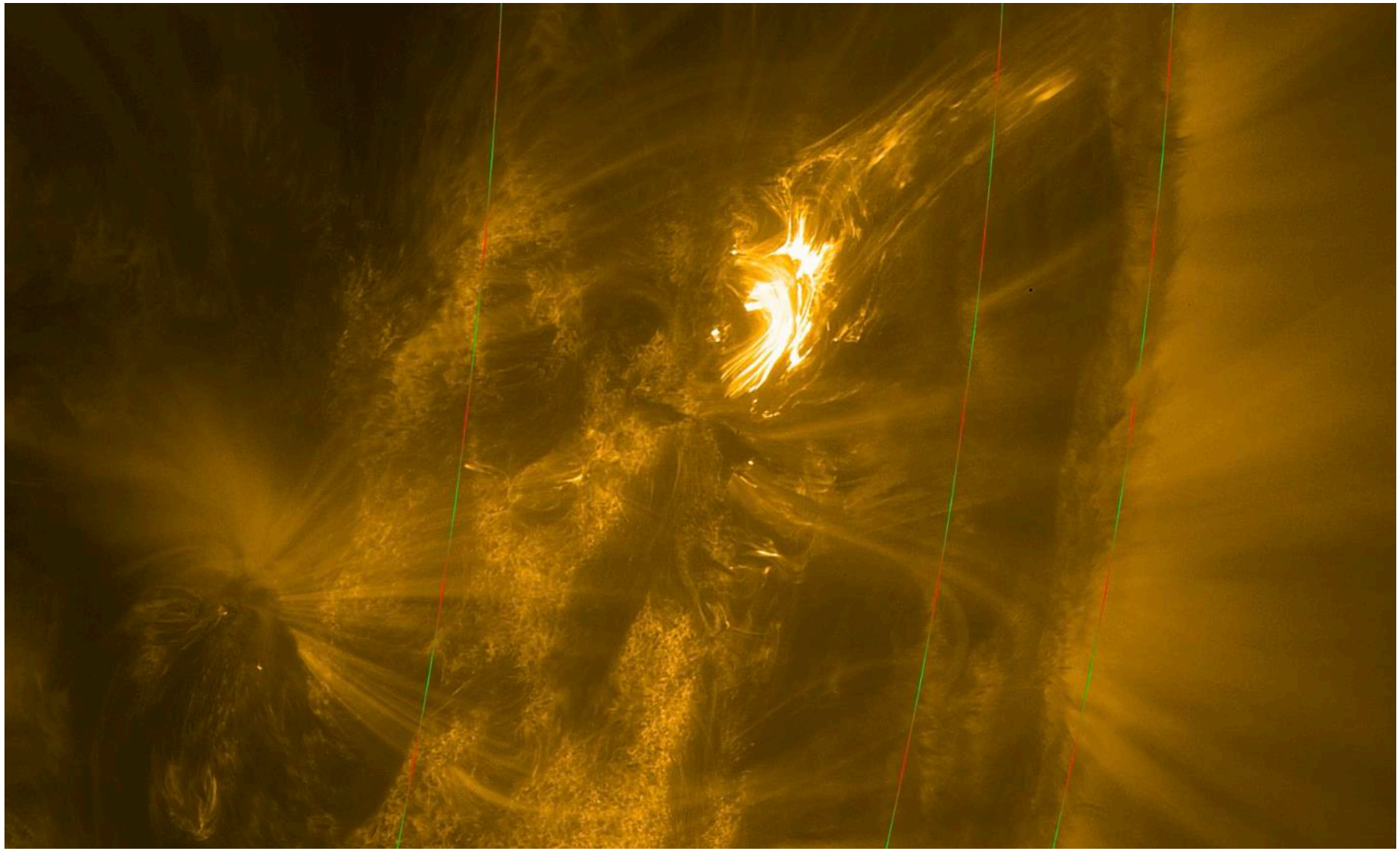
**NOTE:** There is a 282s dt between Earth and Solar Orbiter, which is not accounted for in this plot. SO will see the activity ~5 mins earlier.



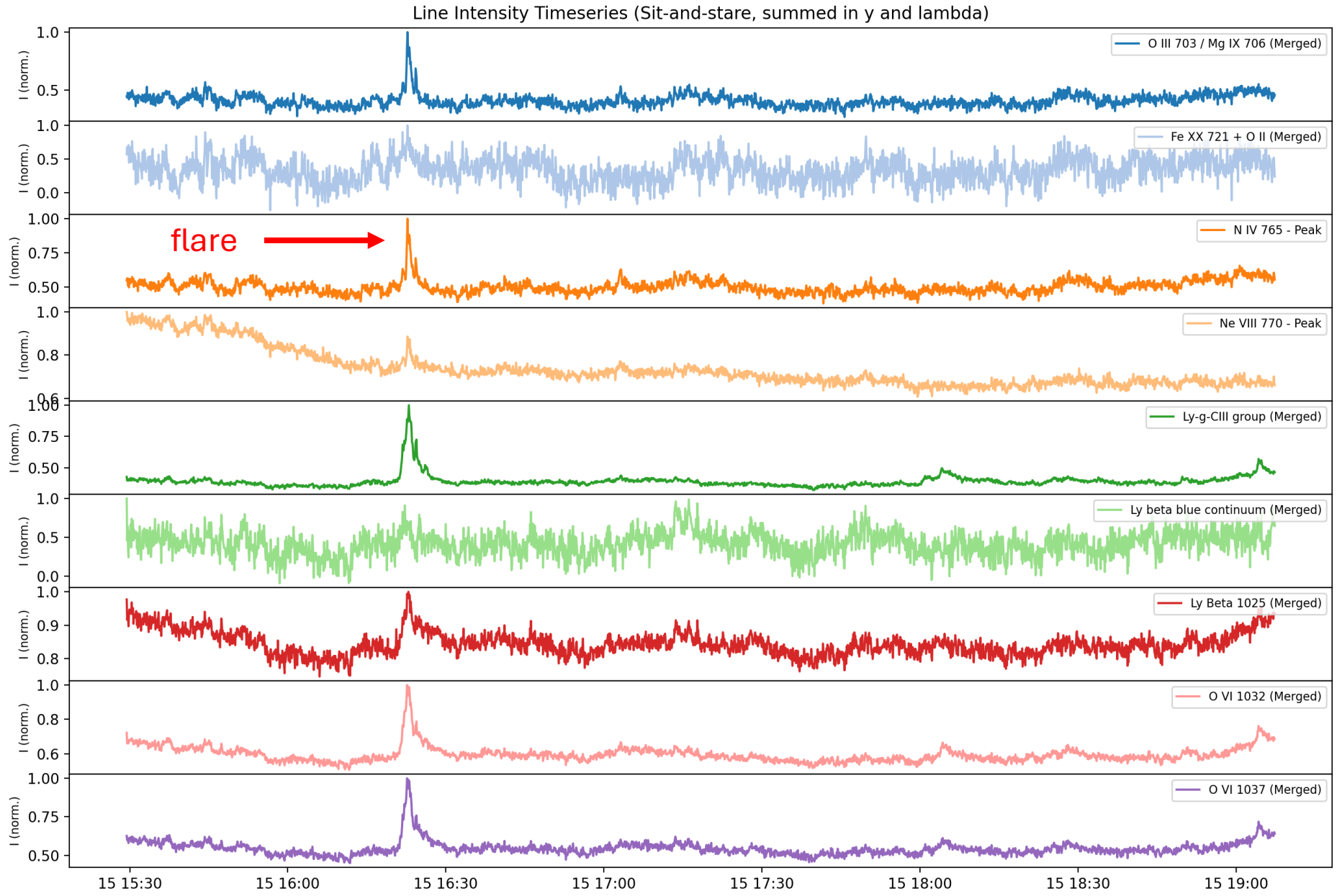

**NOTE**: some GOES activity may not be from the SOOP target AR

# Successful EUI/HRI observations of multiple flares

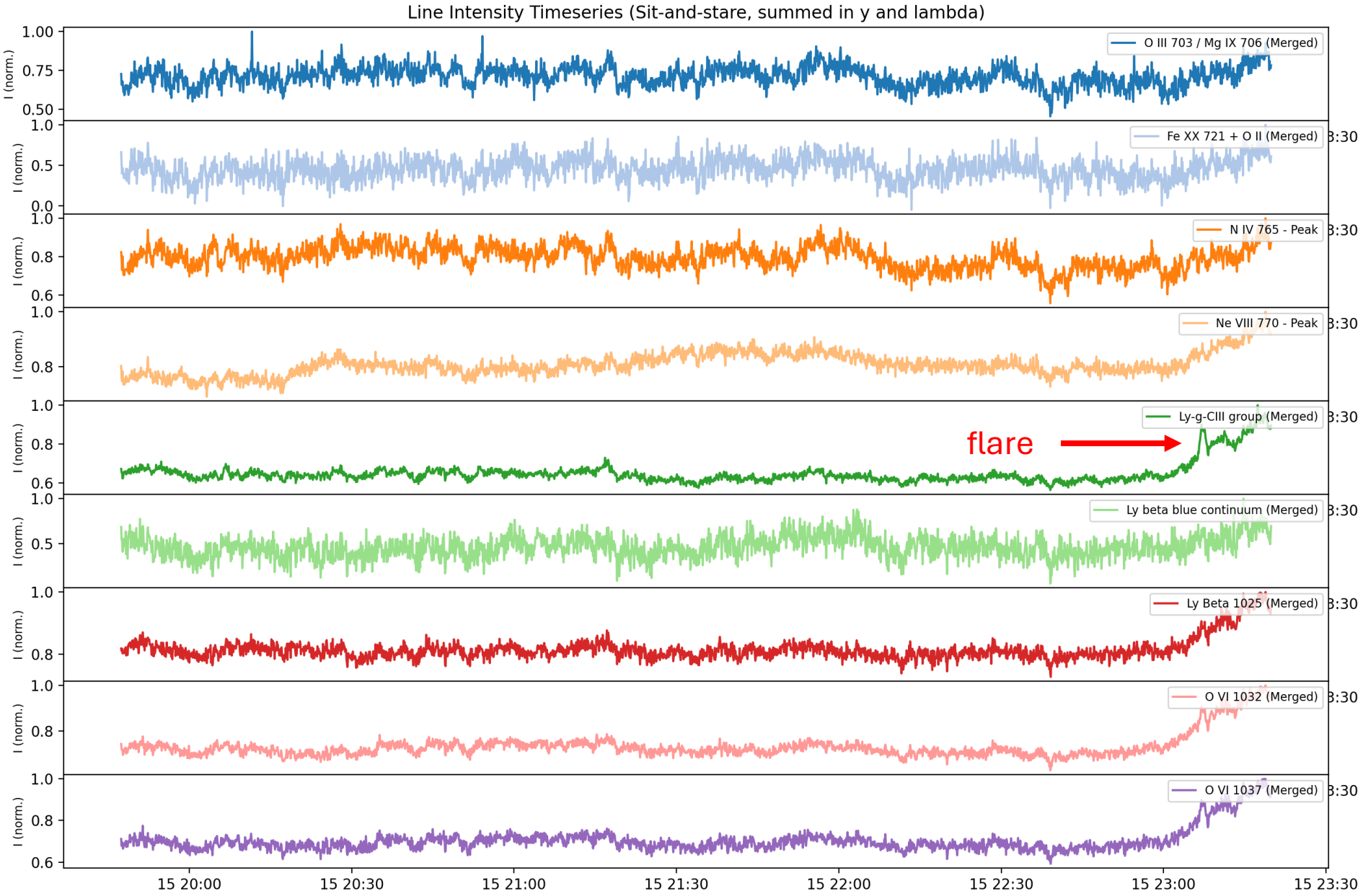
An M2-class flare was observed at high cadence by EUI/HRI. Many smaller flares and brightenings were observed during the HRI high cadence window between 18:00 UT and 22:00 UT.



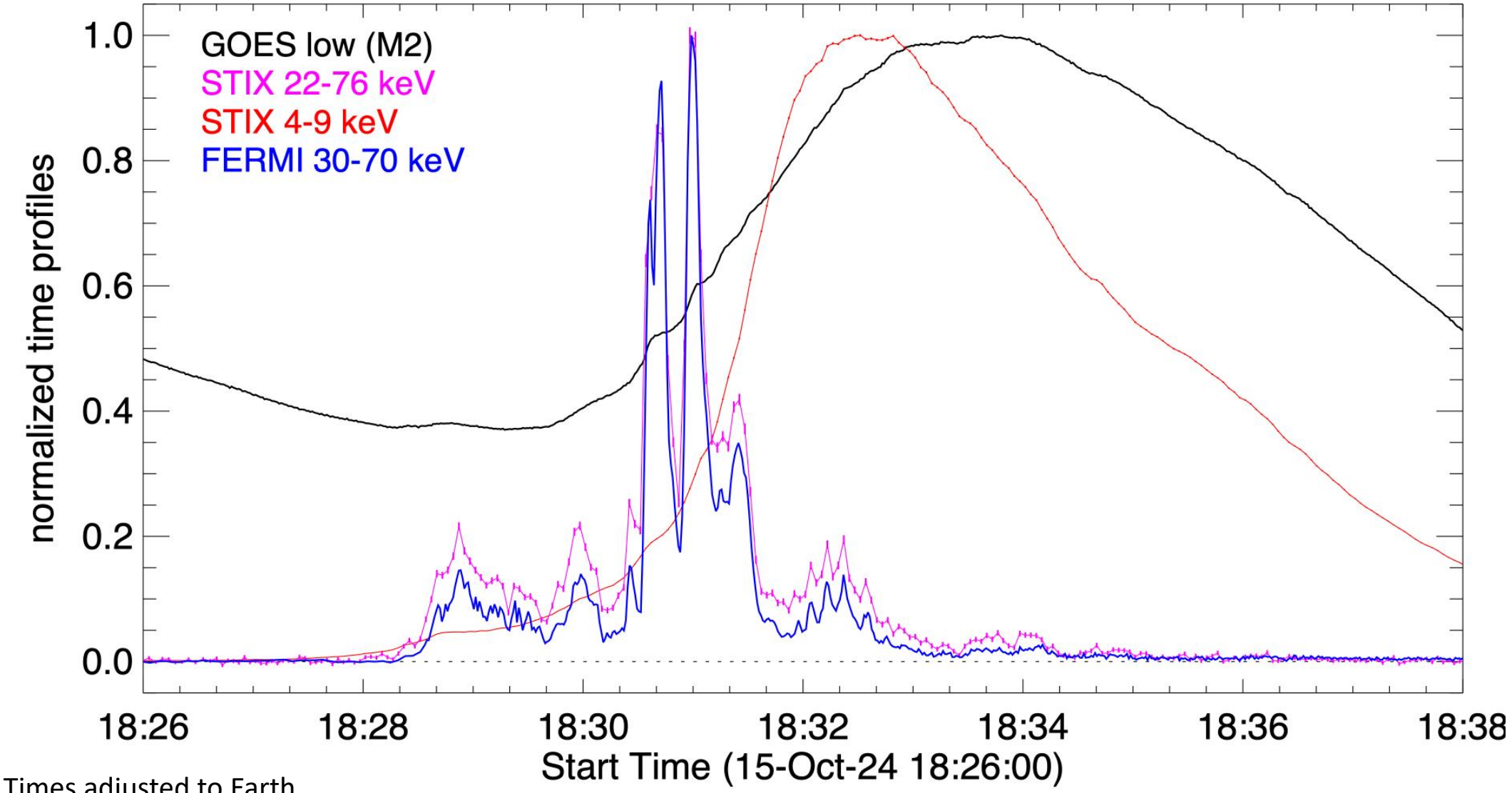
# SPICE timeseries (15:30 – 19:15 UT)



# SPICE timeseries (19:45 – 23:15 UT)



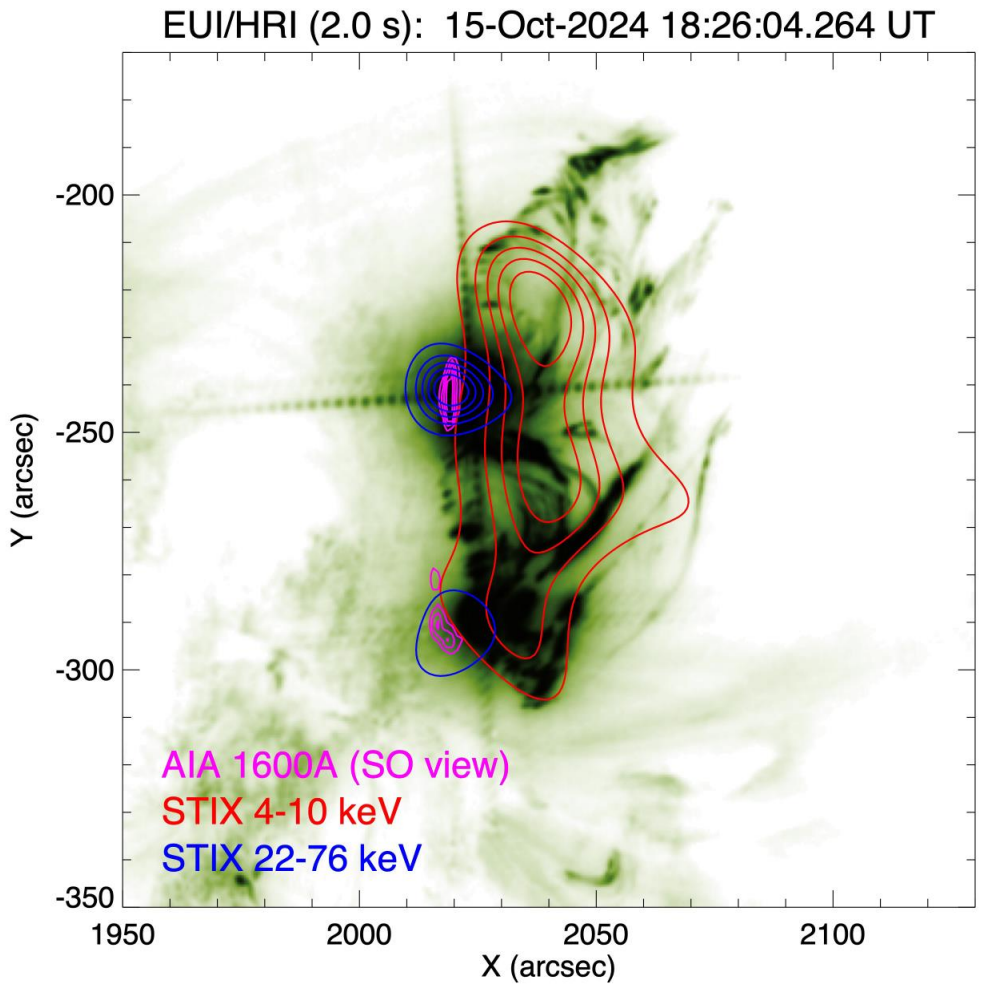
# STIX observations (plots courtesy of Sam Krucker)

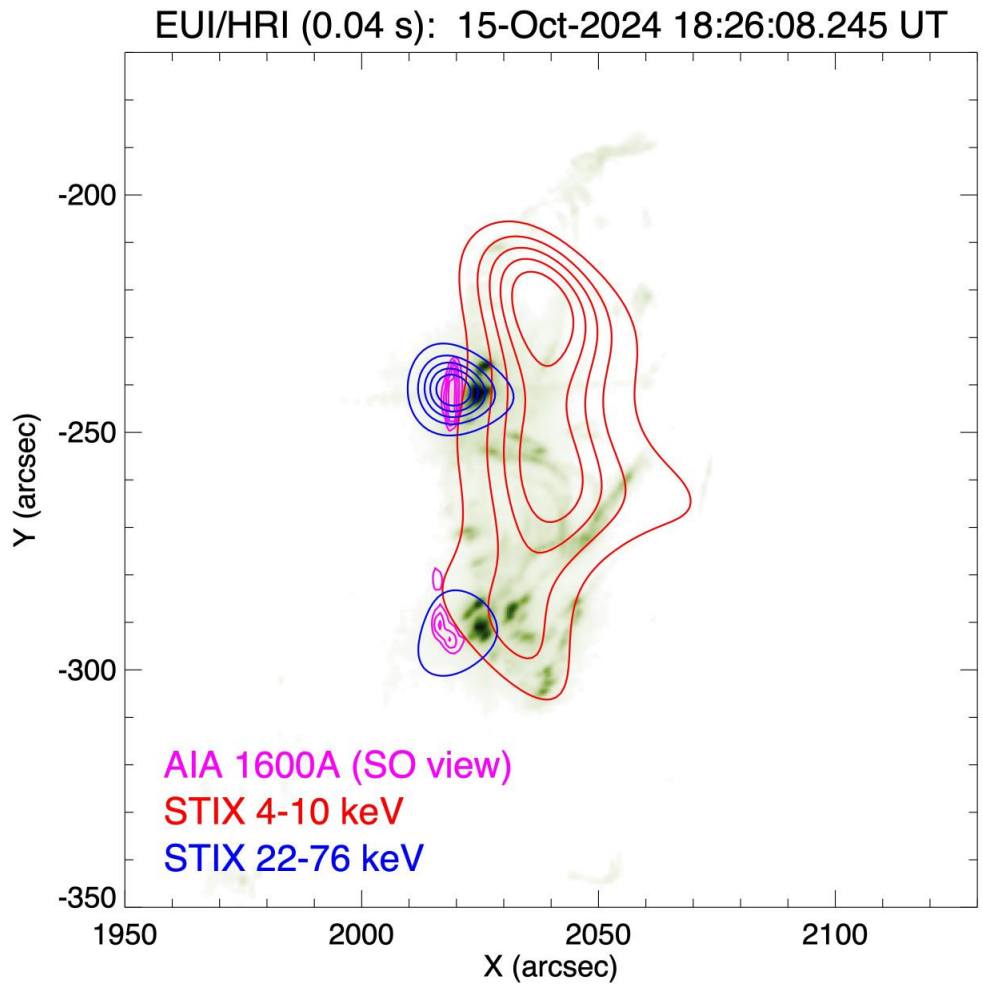



Times adjusted to Earth

**STIX observations (plots courtesy of Sam Krucker)**

# HRI aligned to FSI & rotated to ‘match’ AIA UV



# Planning lessons learned

This flare watch was very successful, but there are still some lessons we can learn to improve in the future.

- Originally, the MFW was planned to be interleaved with the AR Long Term SOOP. Unfortunately, the MFW turned out to have poor synergy with AR Long Term:
  - AR Long term required a **quiet AR** and to keep the **same target for many days**.
  - For MFW, we want an **active AR**, and **flexibility to change target** as needed.

- The compromise solution was to have one longer flare watch (10 hr).
  - However, EUI/HRI can only run in high cadence for 4-6 hours.

- In future, double-check for synergy (or at least no conflict) with surrounding SOOPs.
- Better to have multiple 4-6 hr flare watches than one extra long watch, since EUI/HRI observations are highly sought after.