

# First high-resolution coordinated observations of an active region with Solar Orbiter and DKIST

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**and DKIST Team and Solar Orbiter Team**

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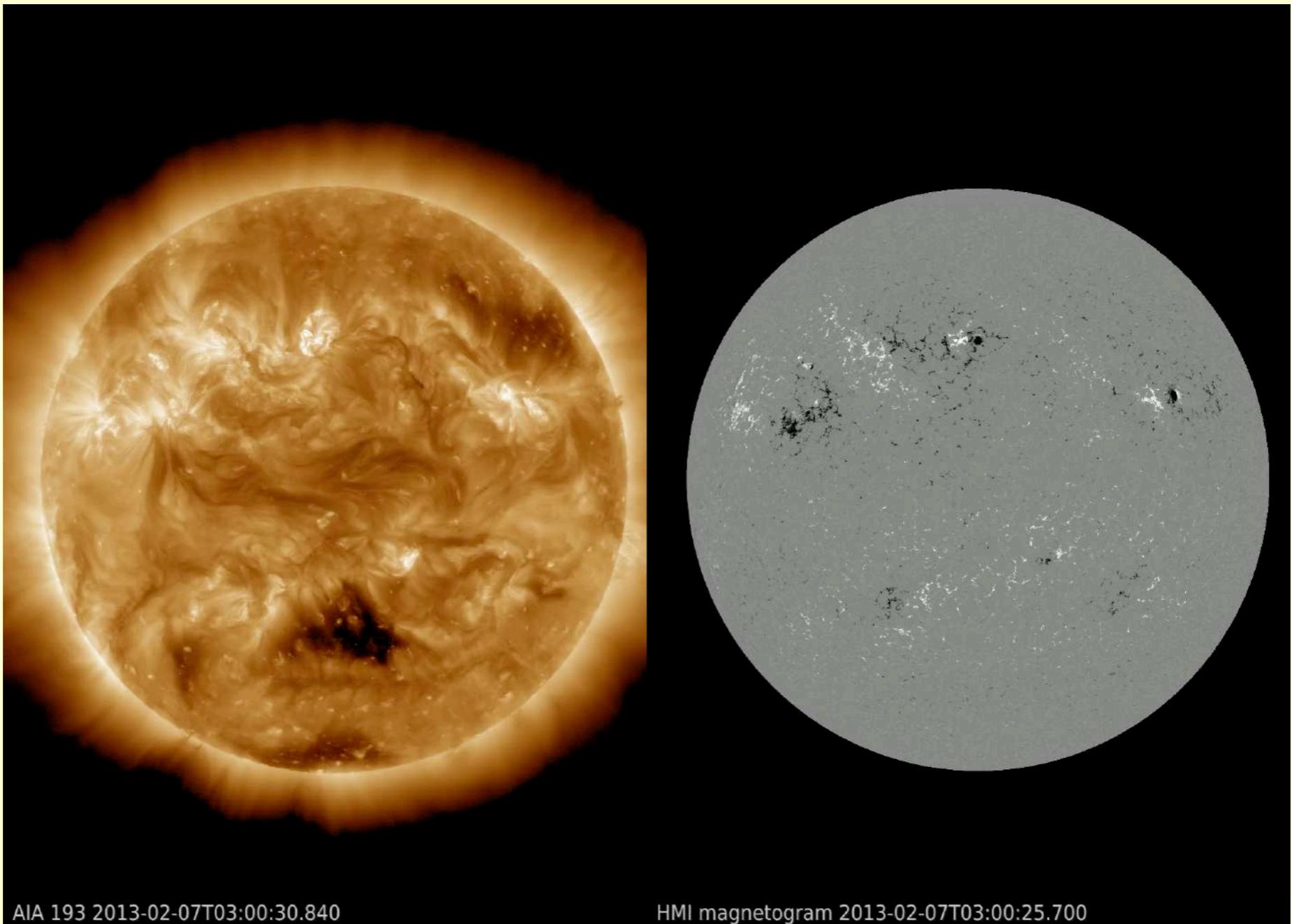
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<sup>3</sup>ESA

<sup>4</sup>National Solar Observatory (NSO), USA

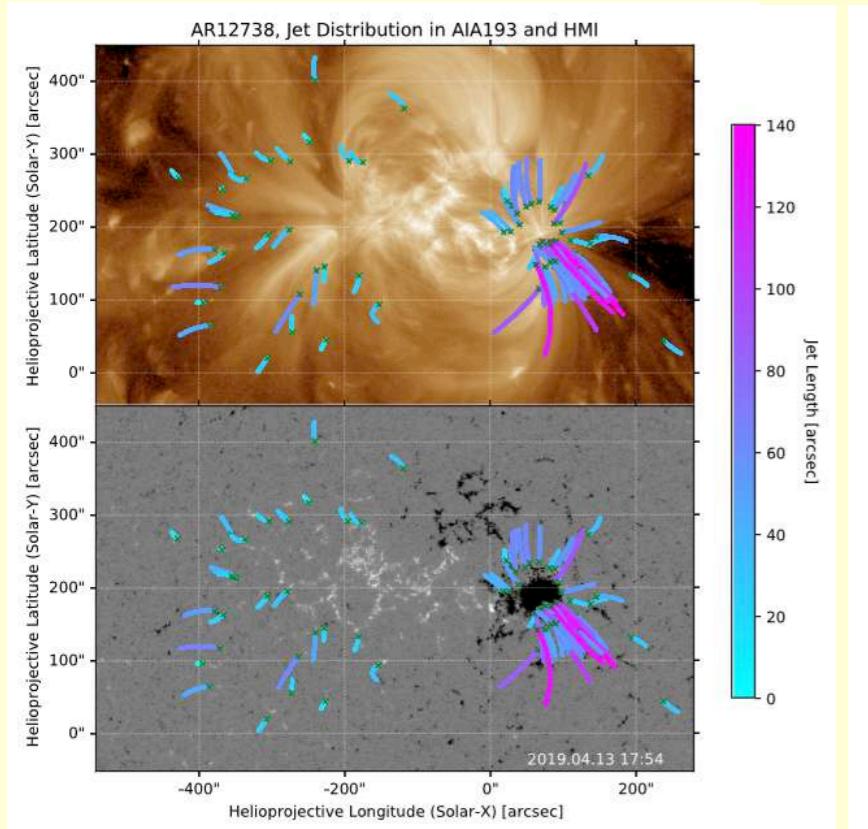
# Active region

- dynamics, temporary region of the solar disk
- strong and complex magnetic field
- associated with sunspot
- source of solar flares and coronal mass ejections

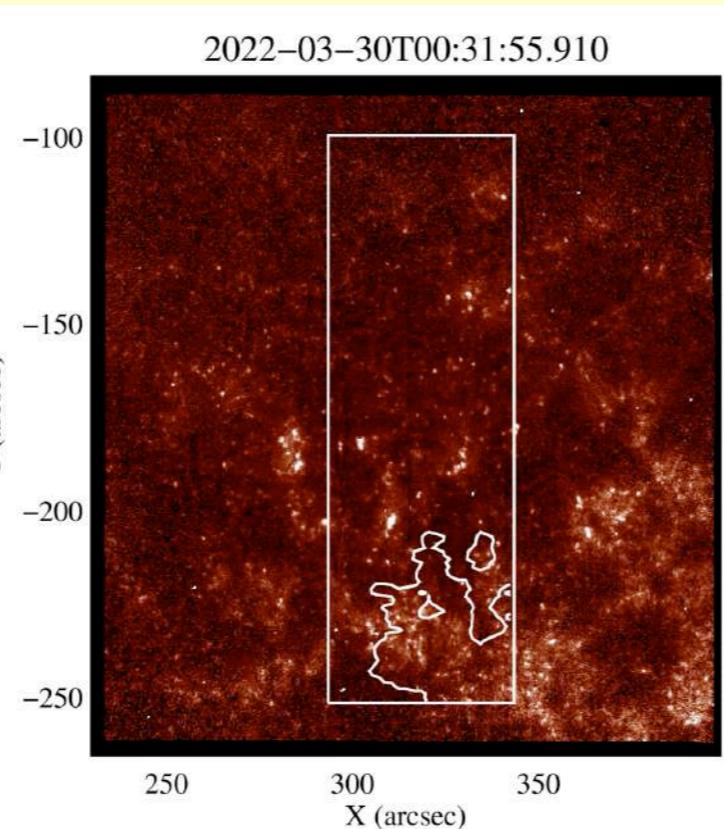


# Open questions

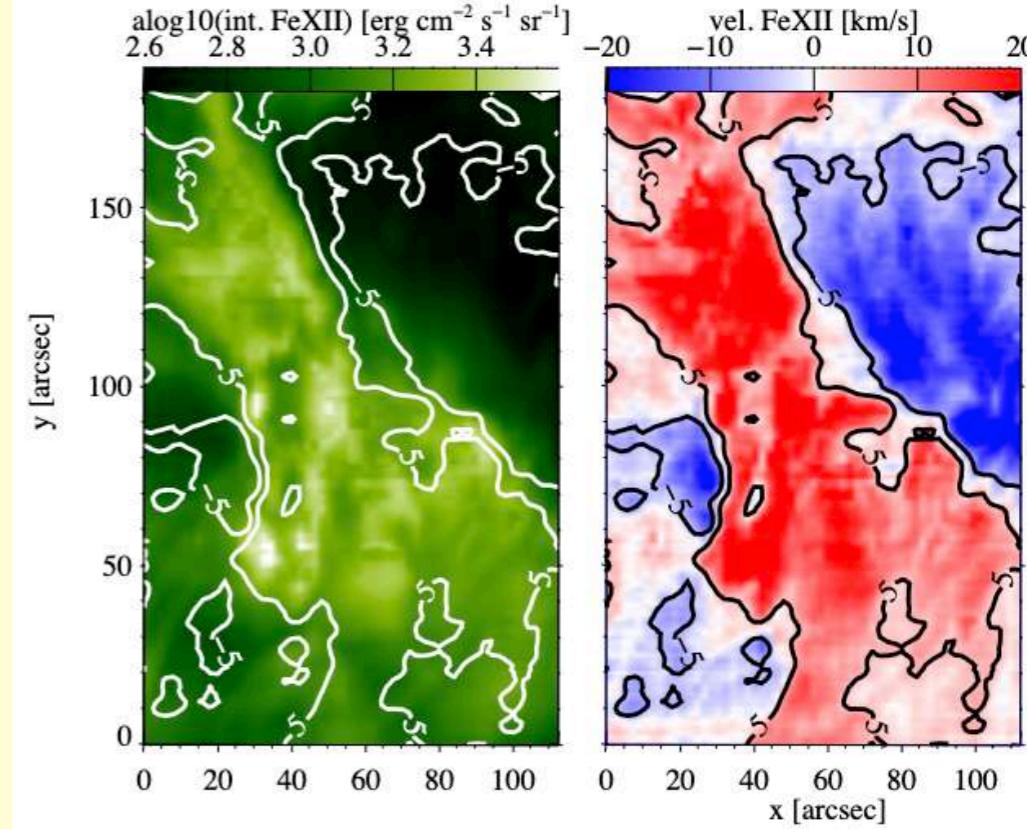
## Jets distribution in AR



## Small-scale structures in AR



## Upflow region at the AR borders



Odermatt et al. 2021

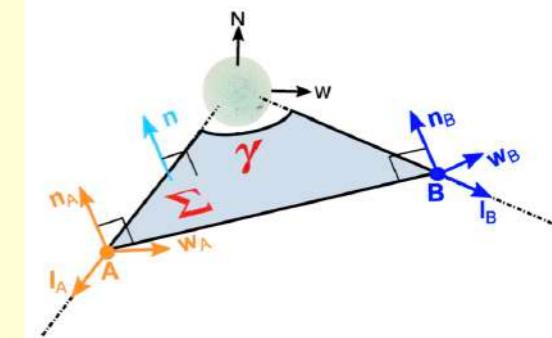
Barczynski et al. 2023

Barczynski et al. 2021

- how an active region structuring and dynamics change through time?
- what is role of the small-scale features in an active region evolution?
- what is a relation between the solar wind source properties and solar wind properties?

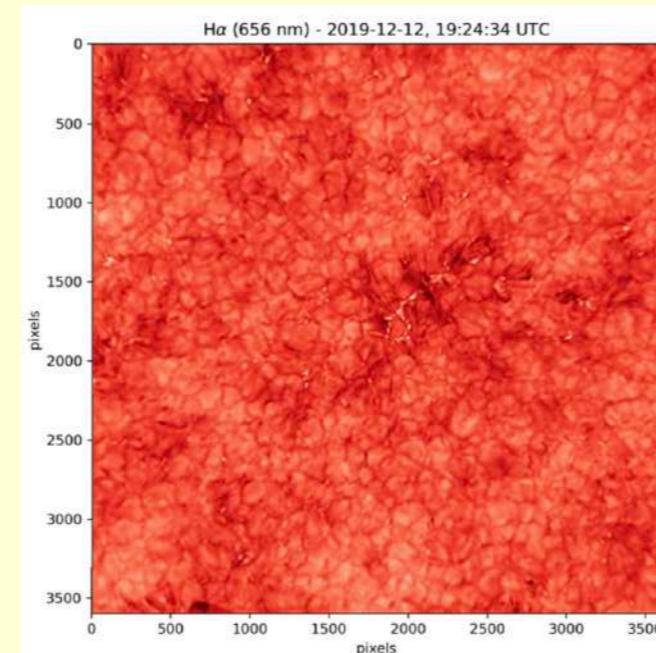
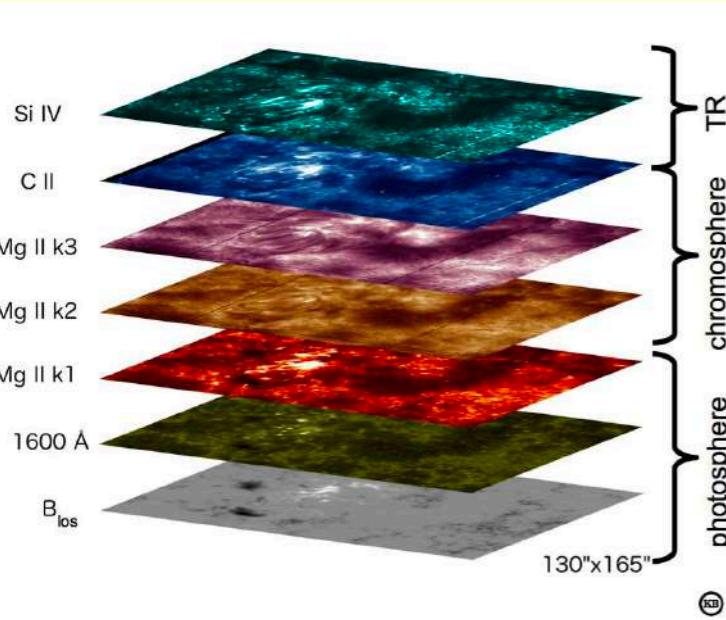
# Scientific aims

- 3D magnetic field topology-stereoscopic measurements

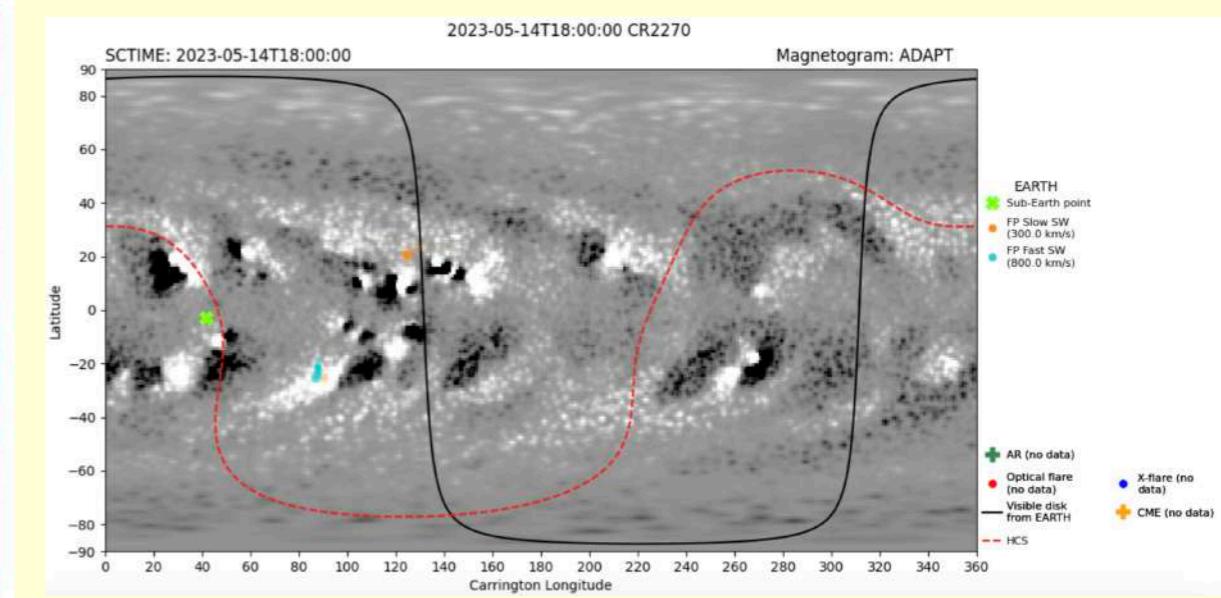


Valori et al. 2022

- the magnetic field and plasma relationship from the photosphere to the corona
- understand the plasma dynamics and heating events at different layers, and unprecedented high spatial resolution and high temporal cadence observation (DKIST VBI and SO/EUI-HRI)
- the connection between the solar wind sources and in-situ plasma measurements provided by Solar Orbiter

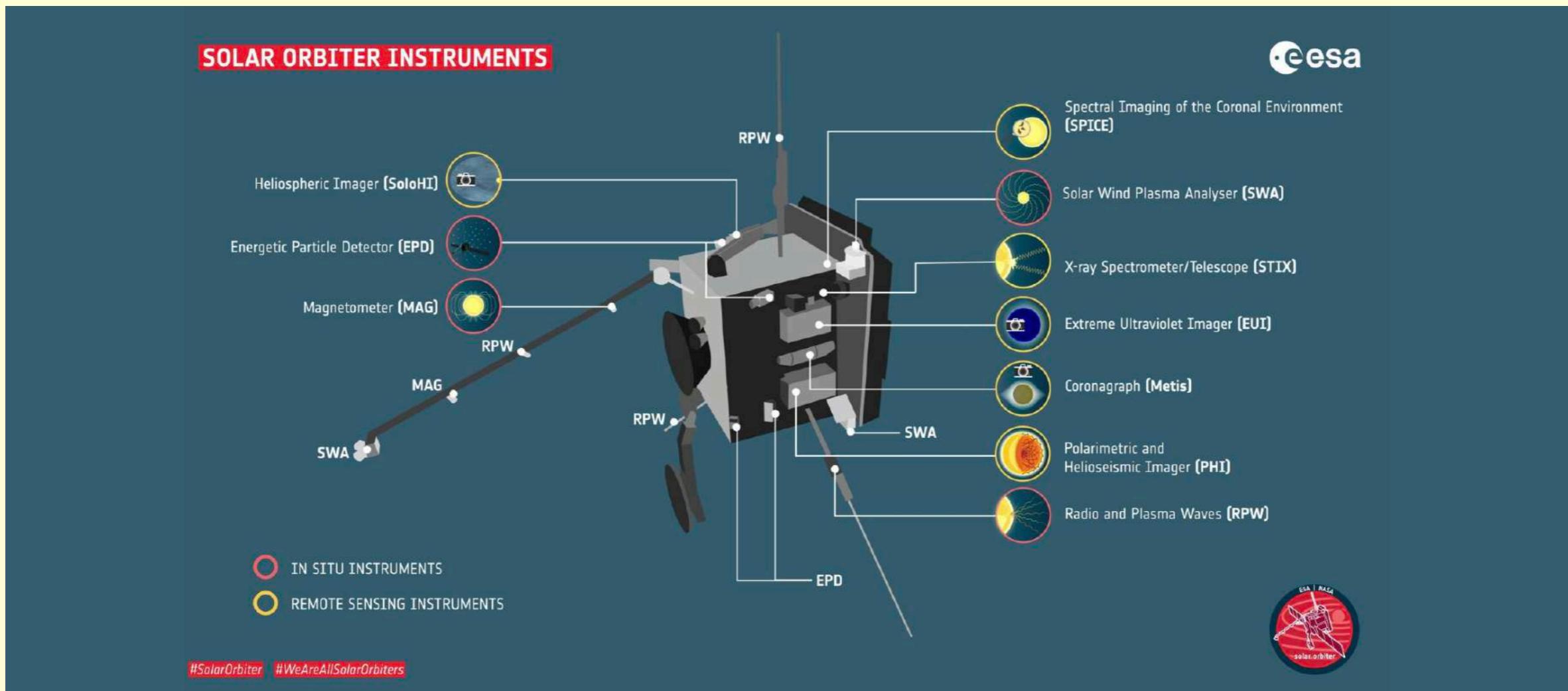


Wöger et al. 2021



Magnetic Connectivity Tool

# Solar Orbiter

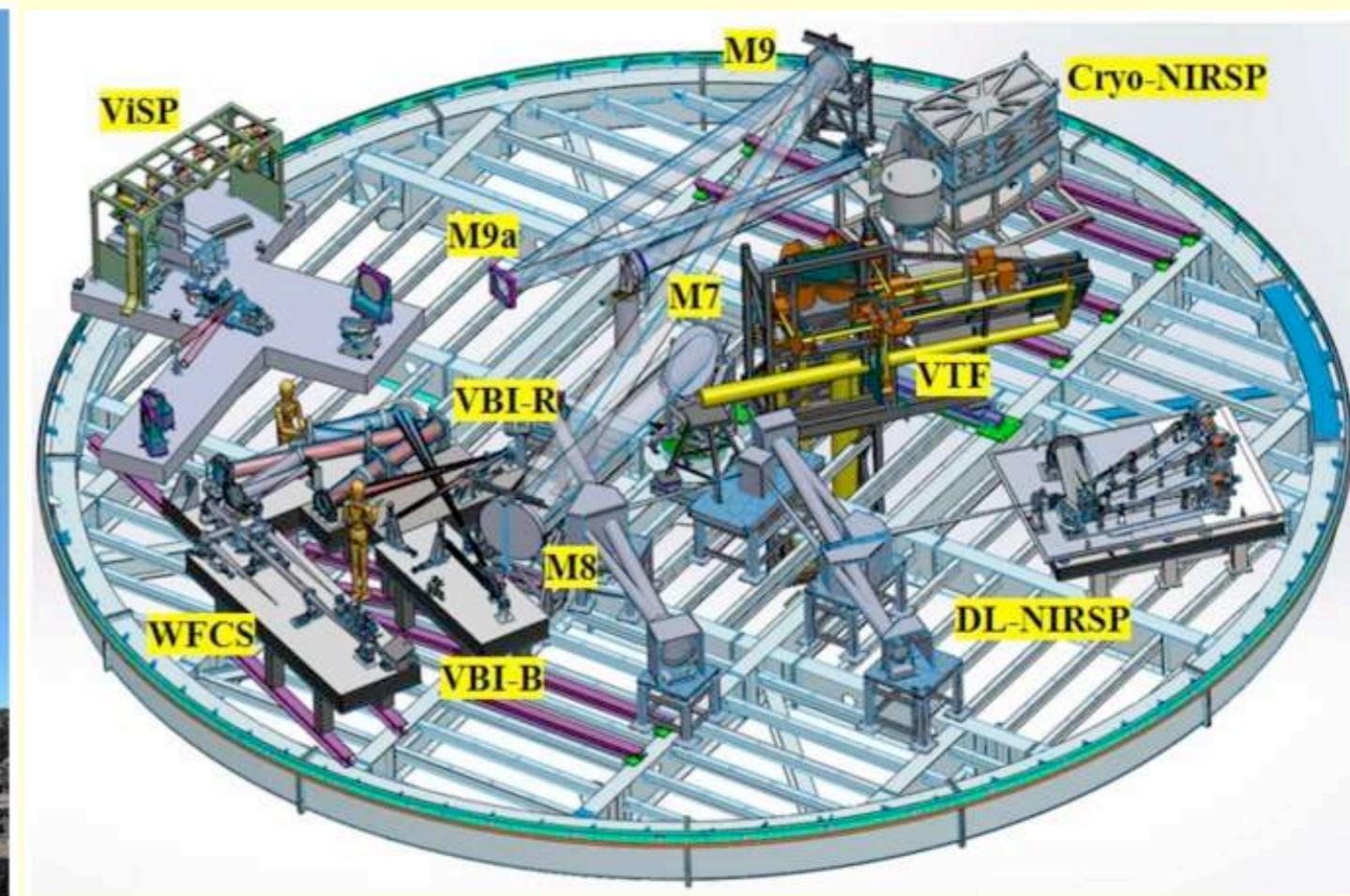
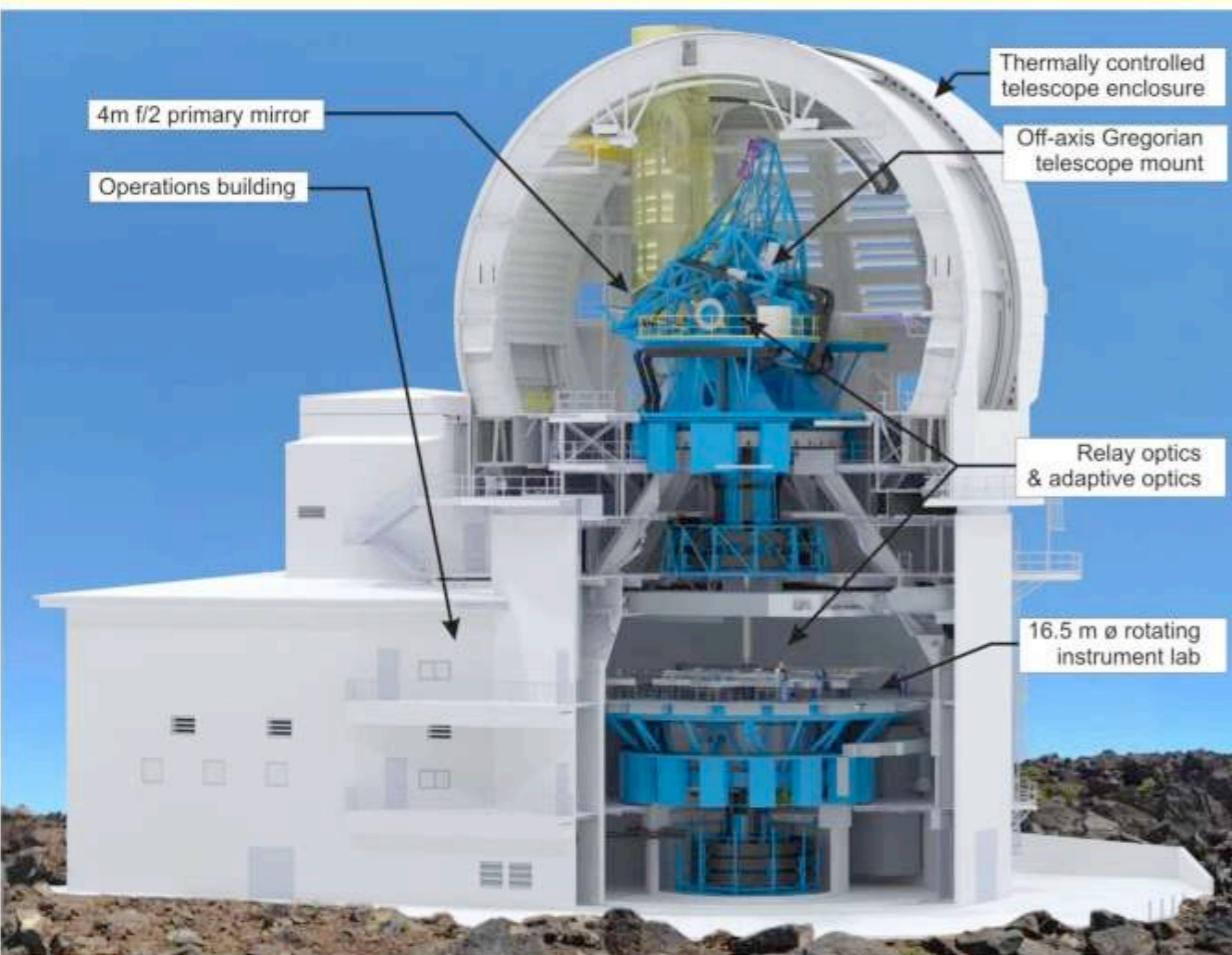


## Observation and measurements

- chromospheric & coronal imaging (EUI/HRI, EUI/FSI)
- transition region and chromospheric spectral line raster maps (SPICE)
- photospheric magnetograms (PHI)
- X-ray emission observation from a flare (STIX)
- Solar wind properties -in-situ instruments (SWA, MAG, EPD, RPW)

NASA

# Daniel K. Inouye Solar Telescope (DKIST)

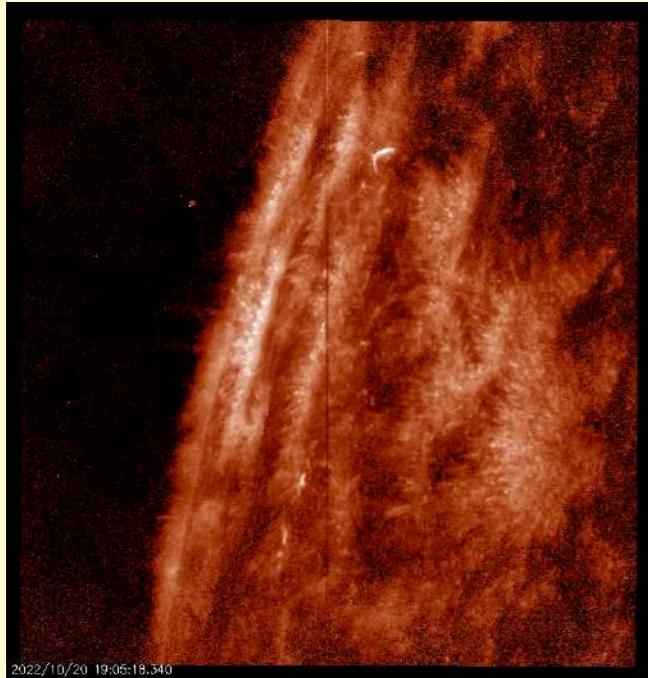


Rimmele et al. 2020 (SoPhy, 172, 295)

- **Visible Broadband Imager (VBI)**
  - photosphere and chromosphere imaging data used to investigate the small-scale features (VBI)
  - photosphere plane-of-sky velocities (VBI)
  
- **Visible Spectro-Polarimeter (ViSP)**
  - photosphere vector magnetograms (ViSP)
  - photosphere line-of-sight velocities (ViSP)
  
- **Cryogenic Near-IR Spectro-Polarimeter (Cryo-NIRSP)**
  - coronal magnetic field

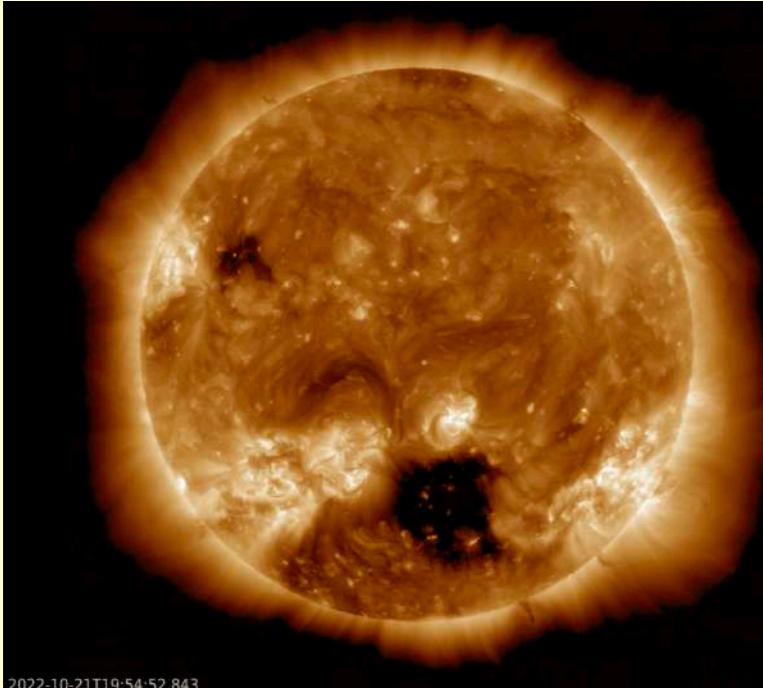
# Additional coordination

## Interface Region Imaging Spectrograph (IRIS)



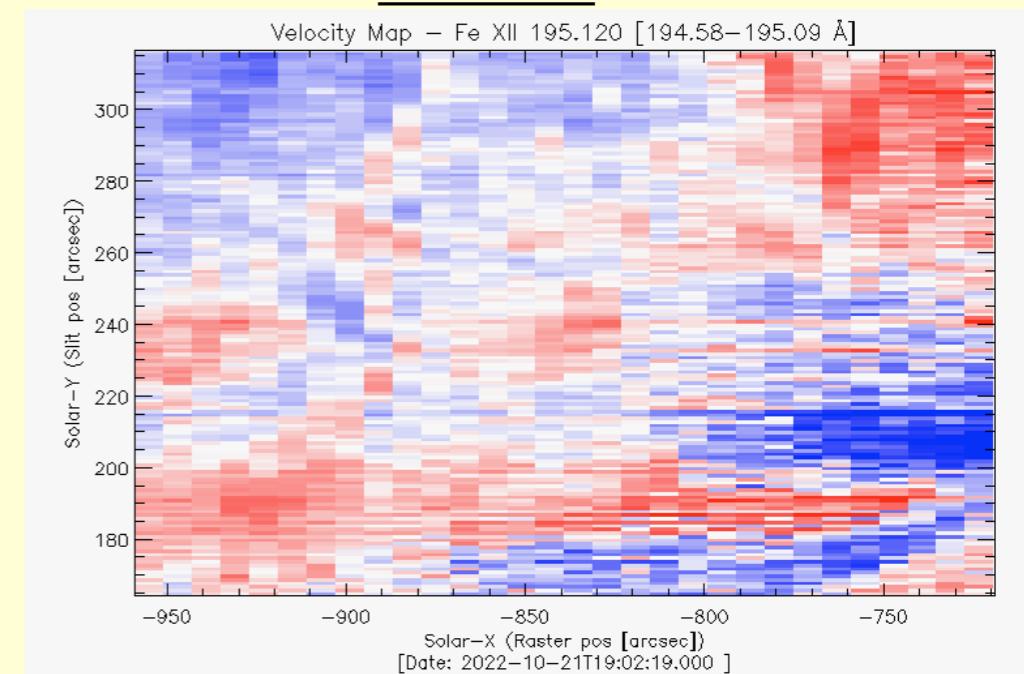
-imaging & spectroscopy data  
(chromosphere & TR)

## Solar Dynamics Observatory (SDO)



-imaging & magnetic field  
(continuous monitoring of the solar disk)

## Hinode



-imaging & spectroscopy data  
(TR & corona)

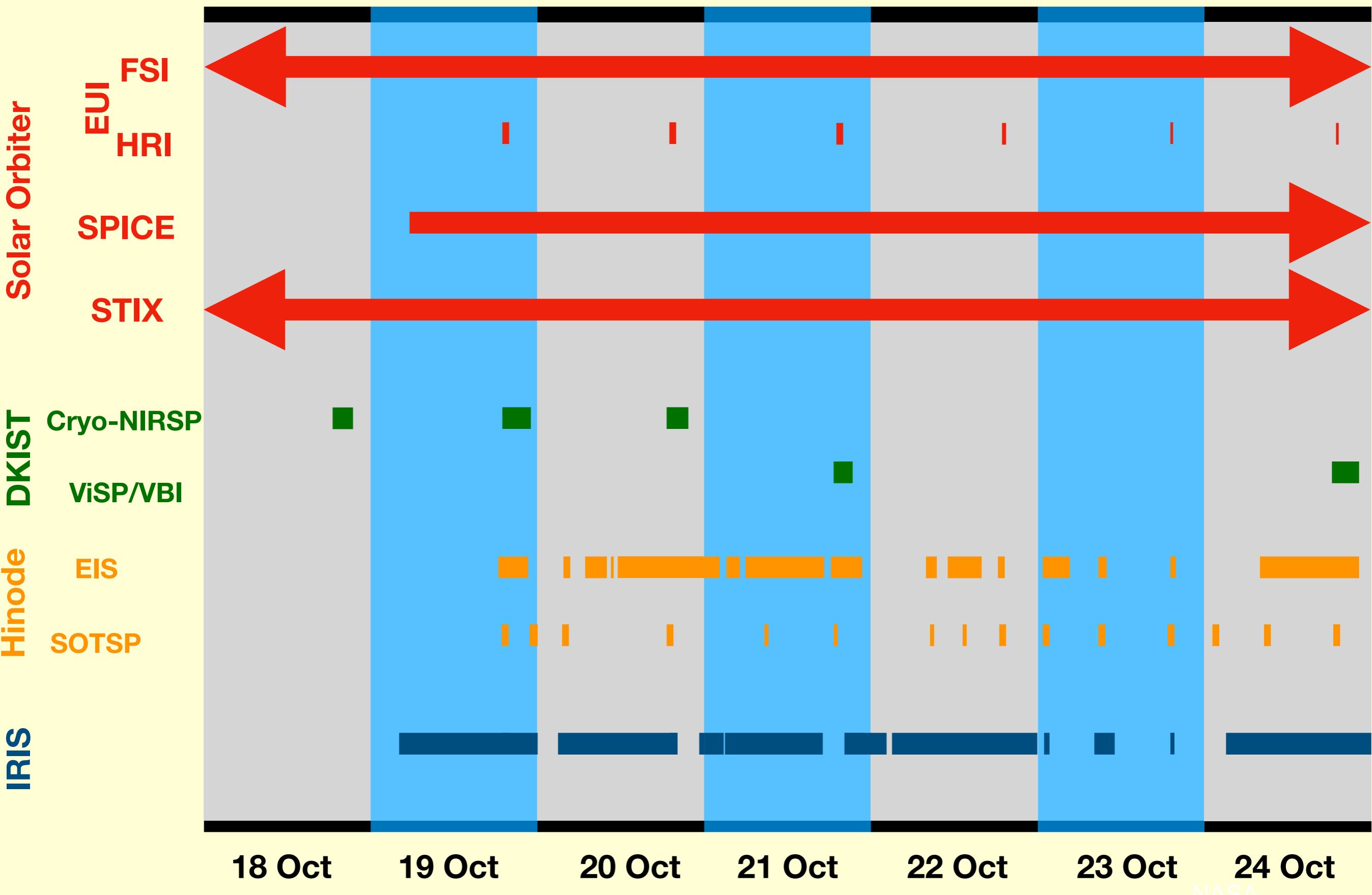
## Chinese H-alpha Solar Explorer (CHASE)



-imaging & spectroscopy data  
(photosphere & chromosphere)

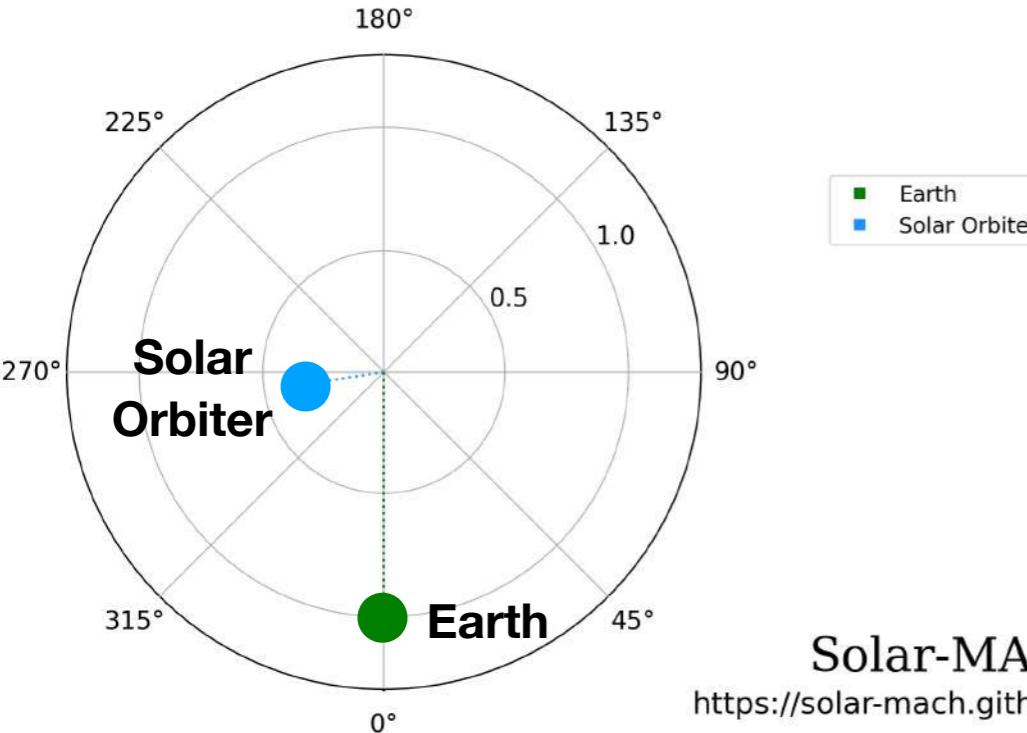
NASA

# Coordinated observations

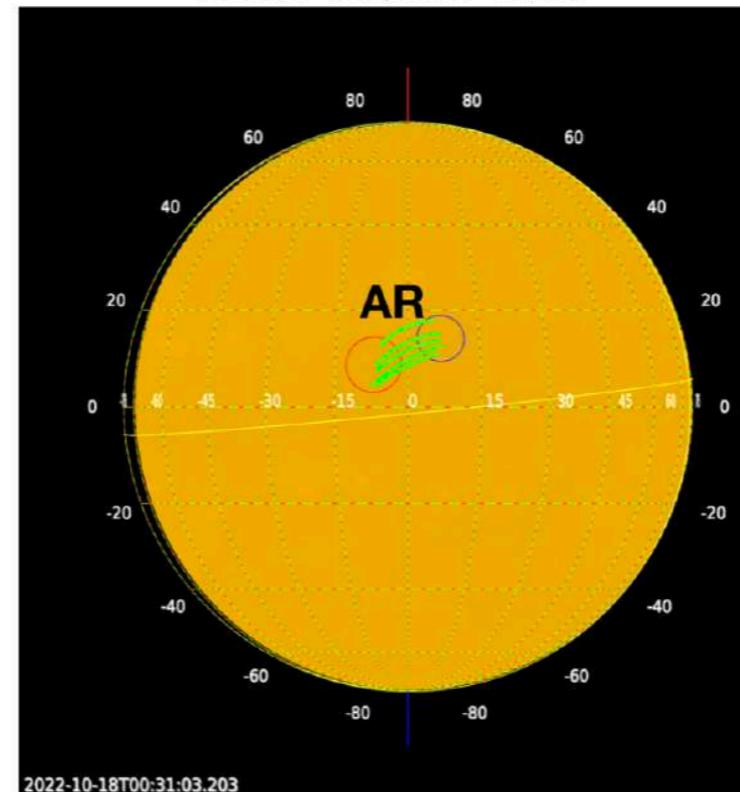


# Tracking active region

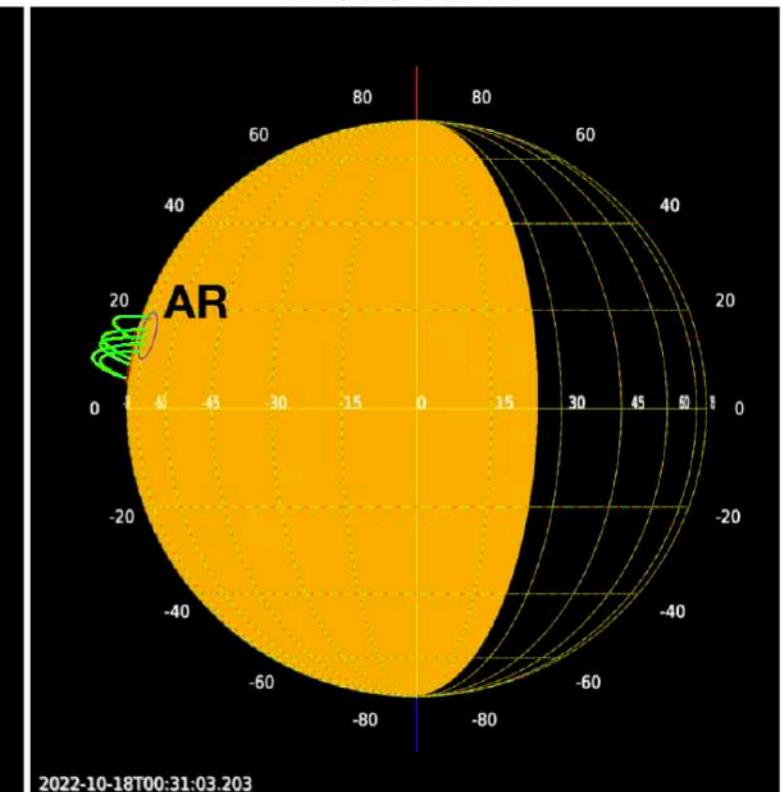
**18 Oct 2022**



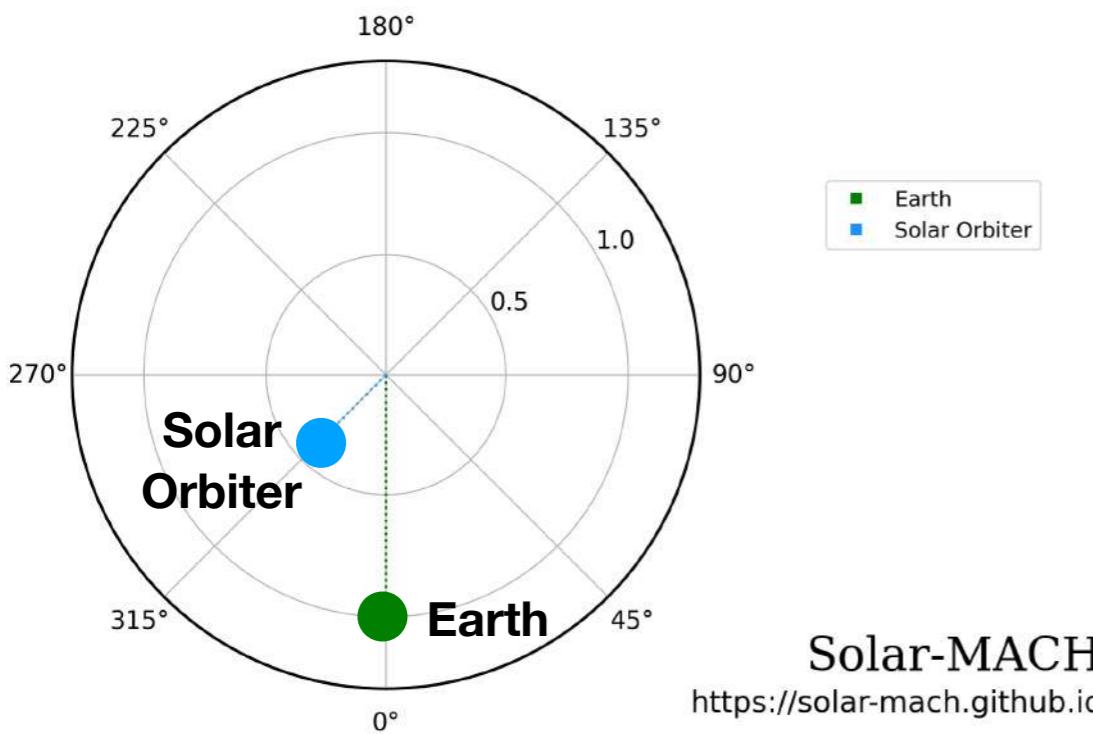
**Solar Orbiter view**



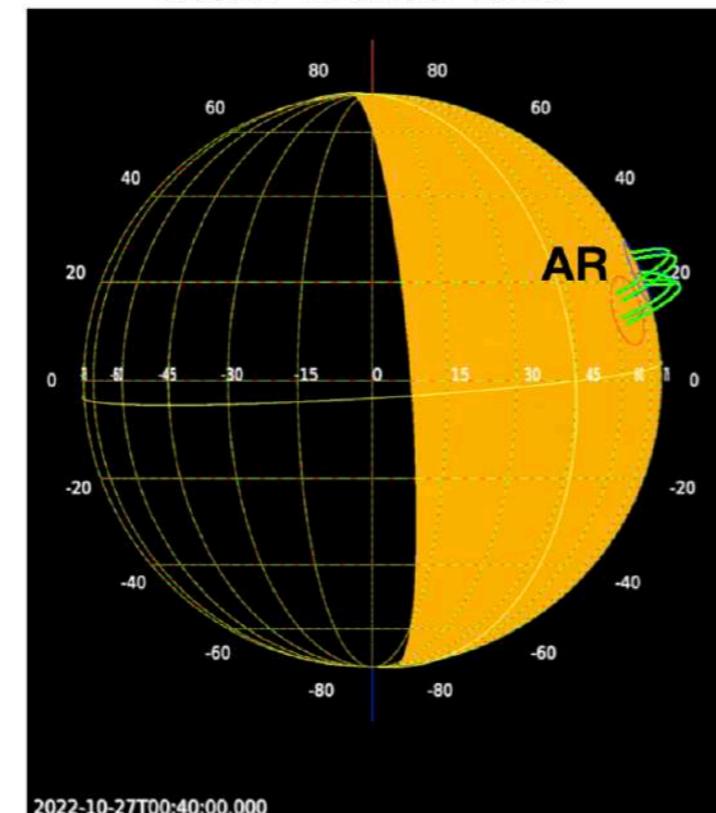
**Earth view**



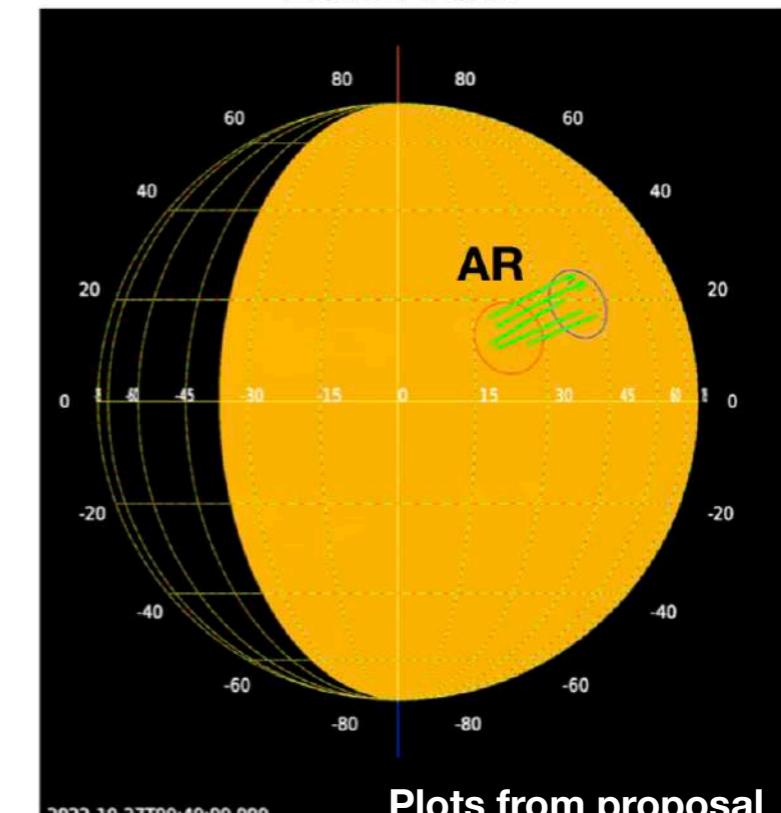
**27 Oct 2022**



**Solar Orbiter view**

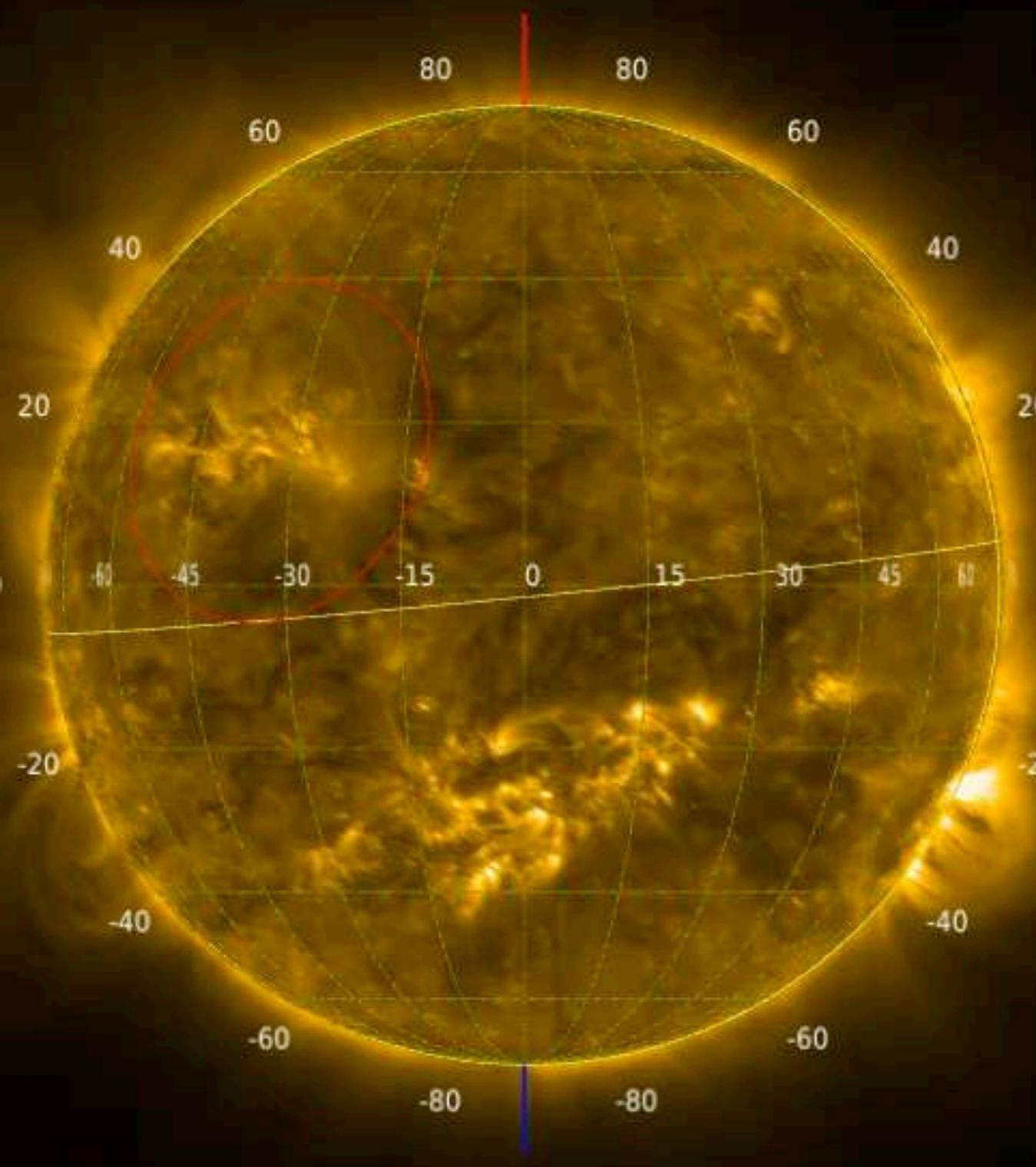


**Earth view**

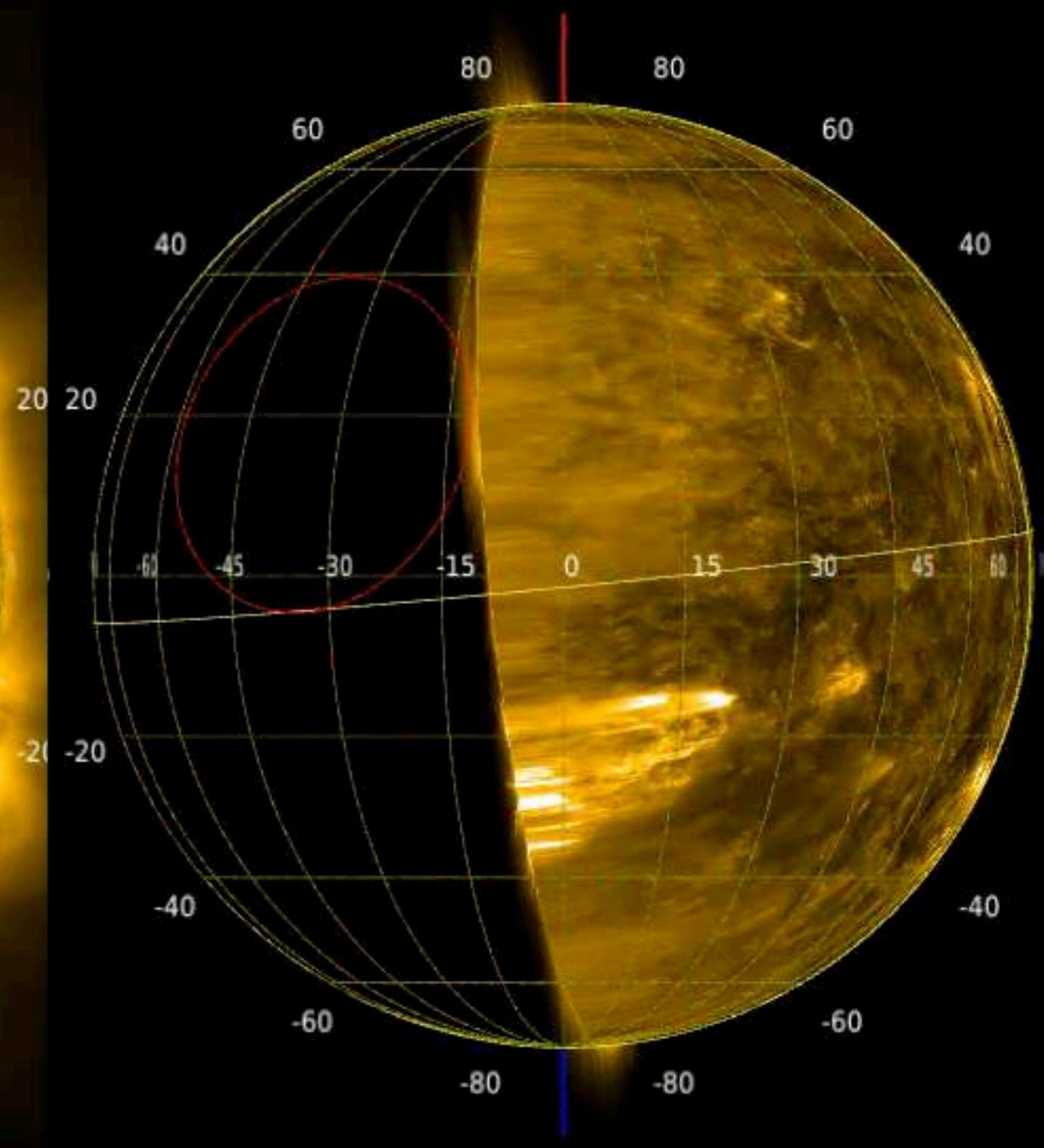


# Solar Orbiter imaging observation

**Solar Orbiter /EUI FSI 174**

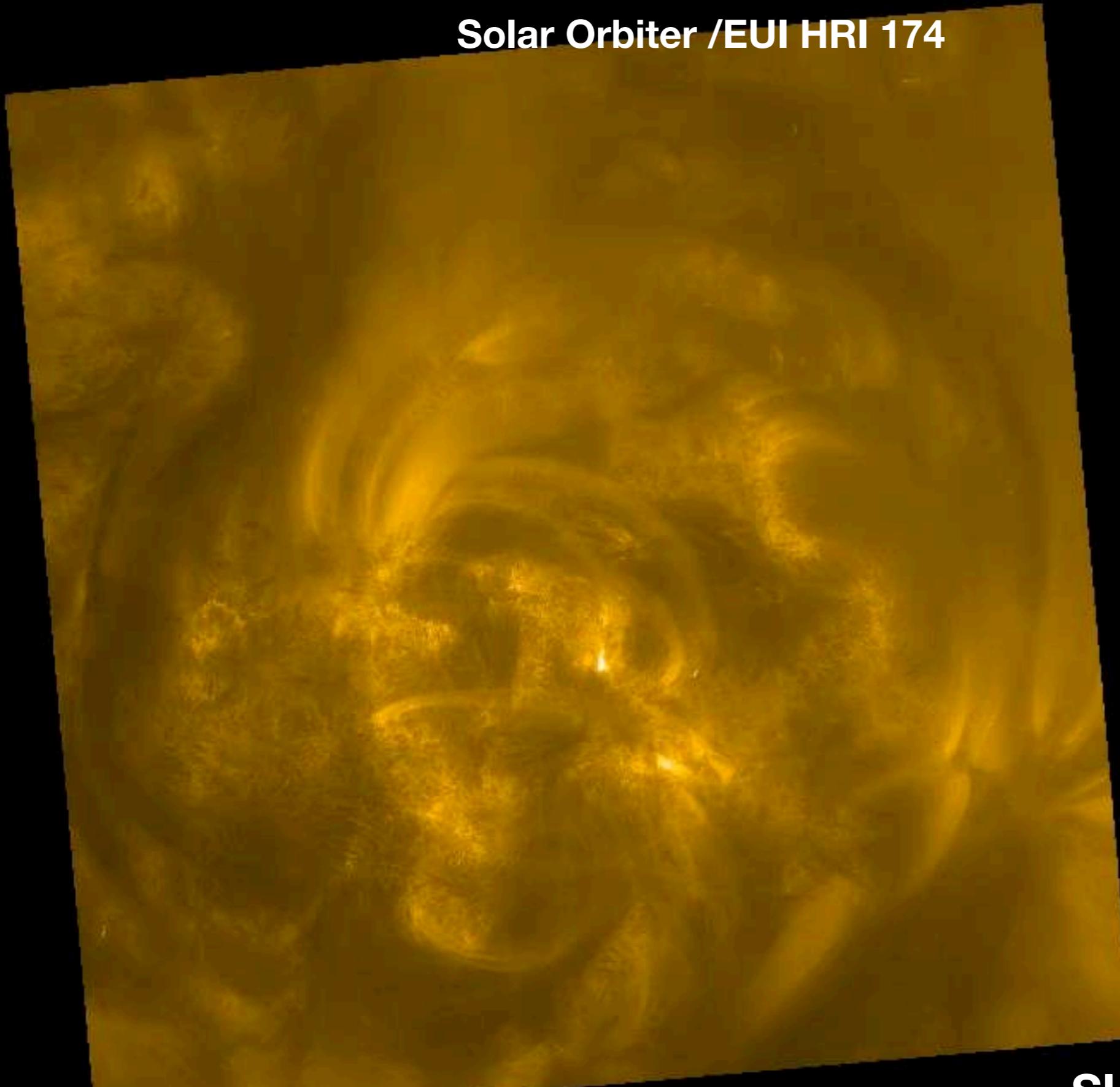


**SDO/AIA 171**



# Solar Orbiter imaging observation

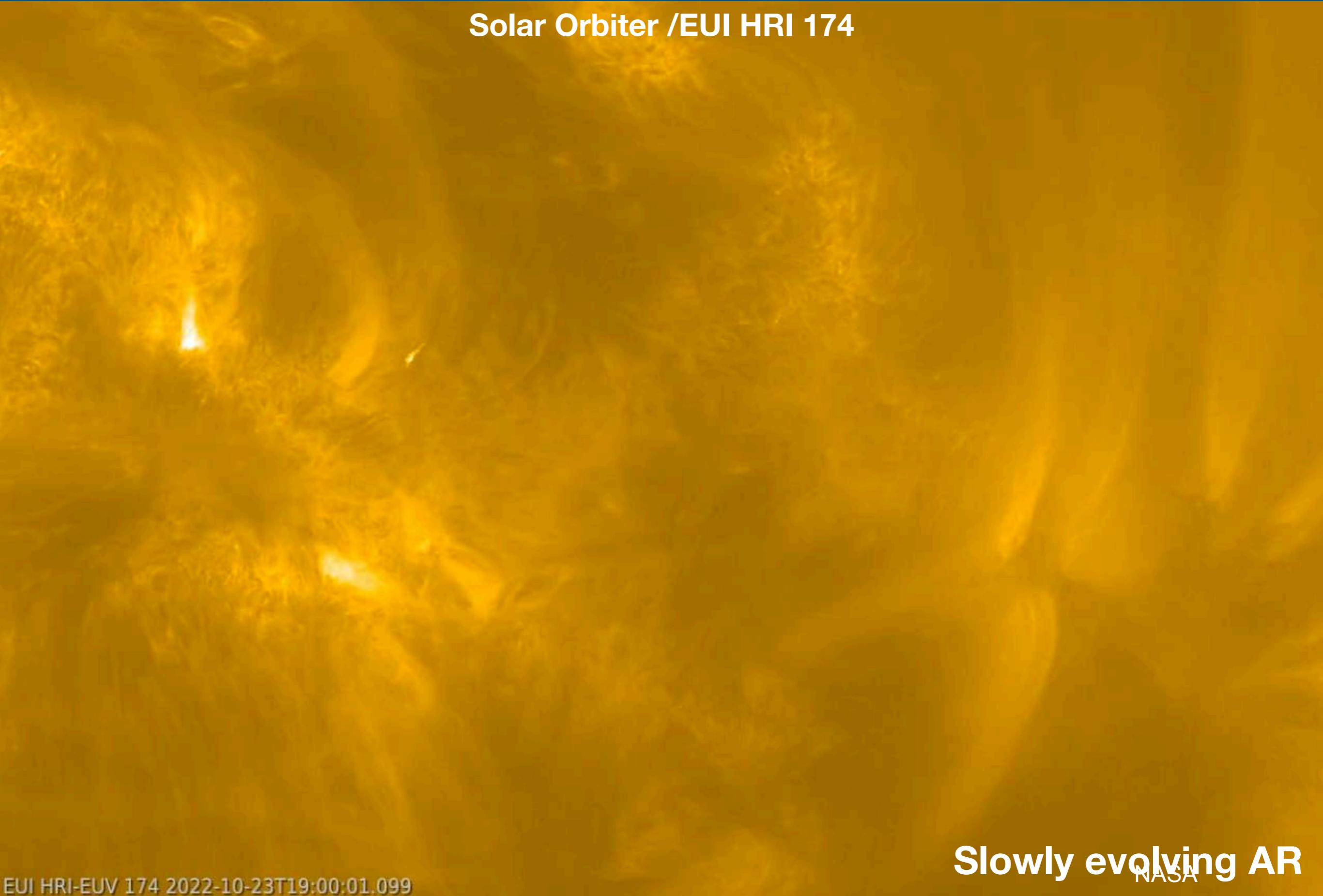
Solar Orbiter /EUI HRI 174



Slowly evolving AR

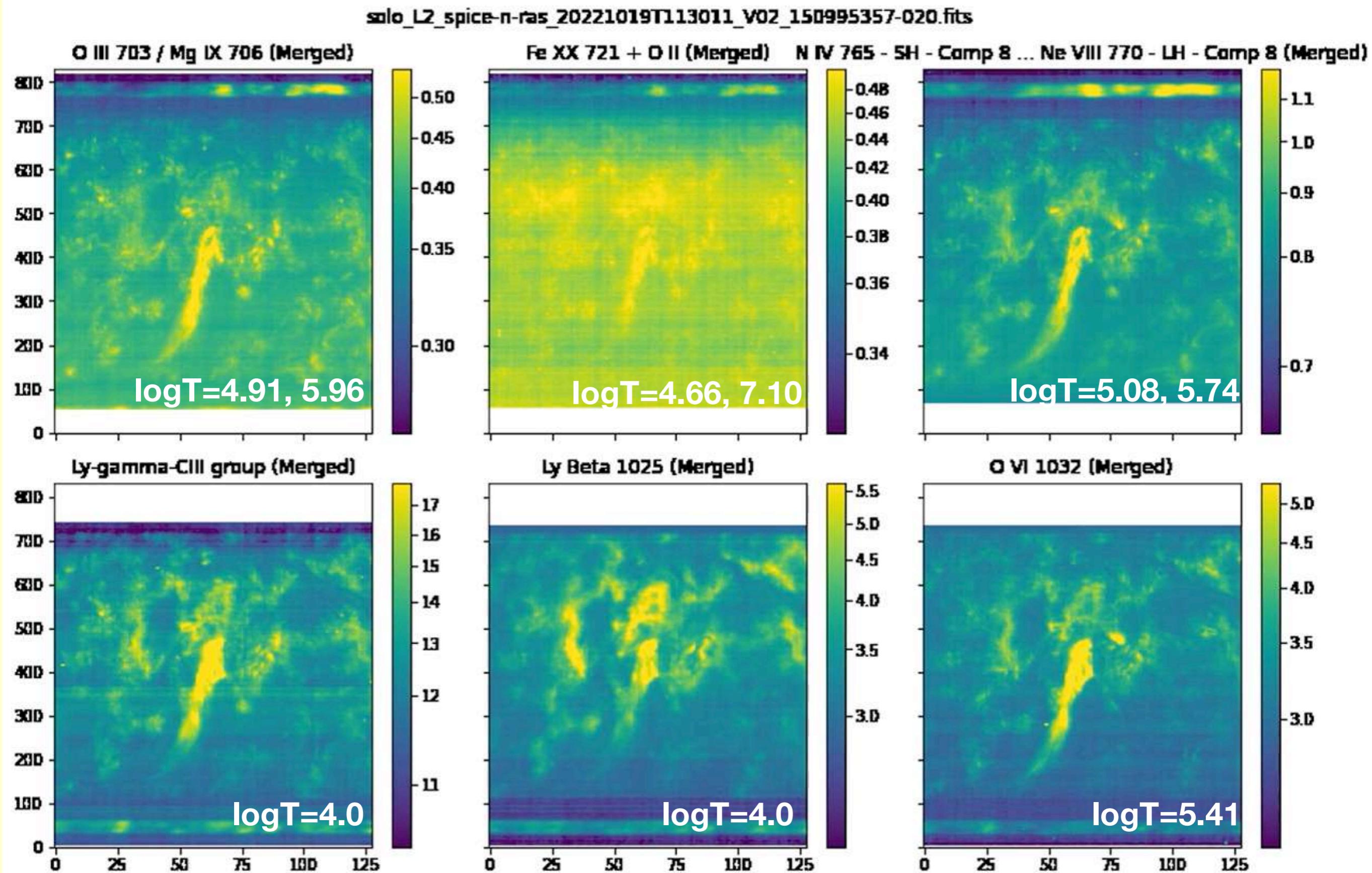
# Solar Orbiter imaging observation

Solar Orbiter /EUI HRI 174

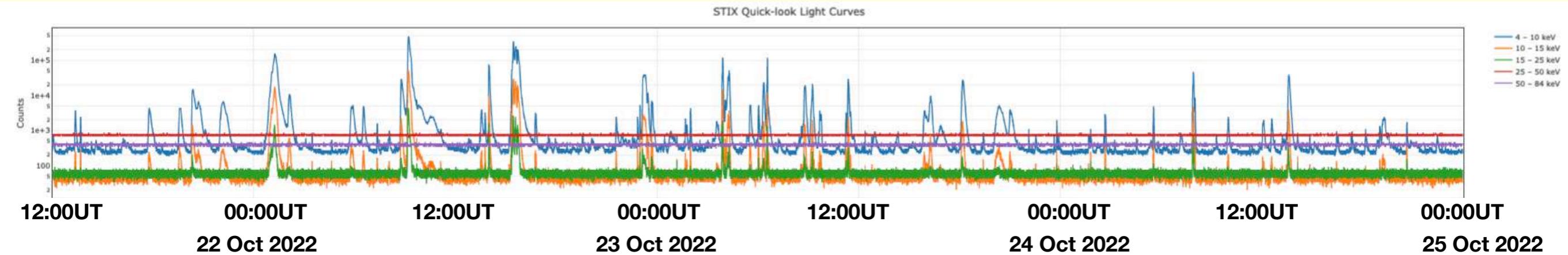
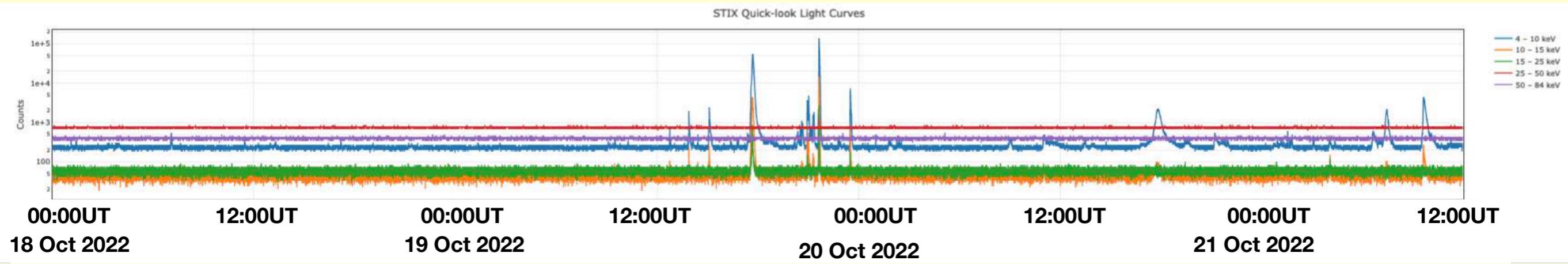


Slowly evolving AR  
NASA

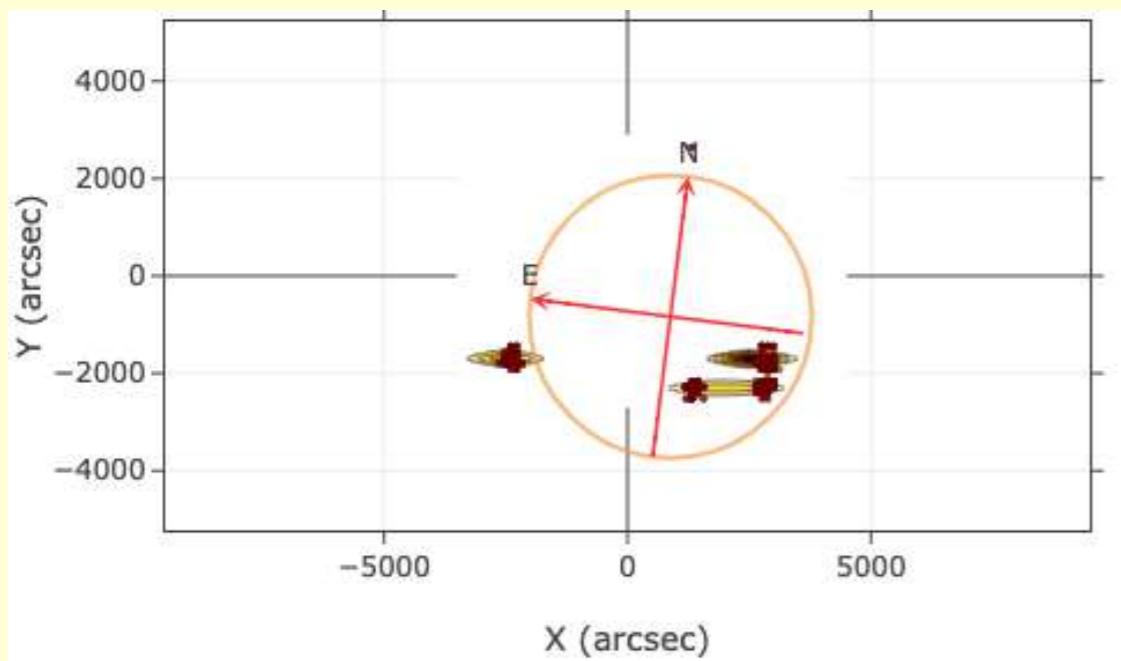
# SPICE observation



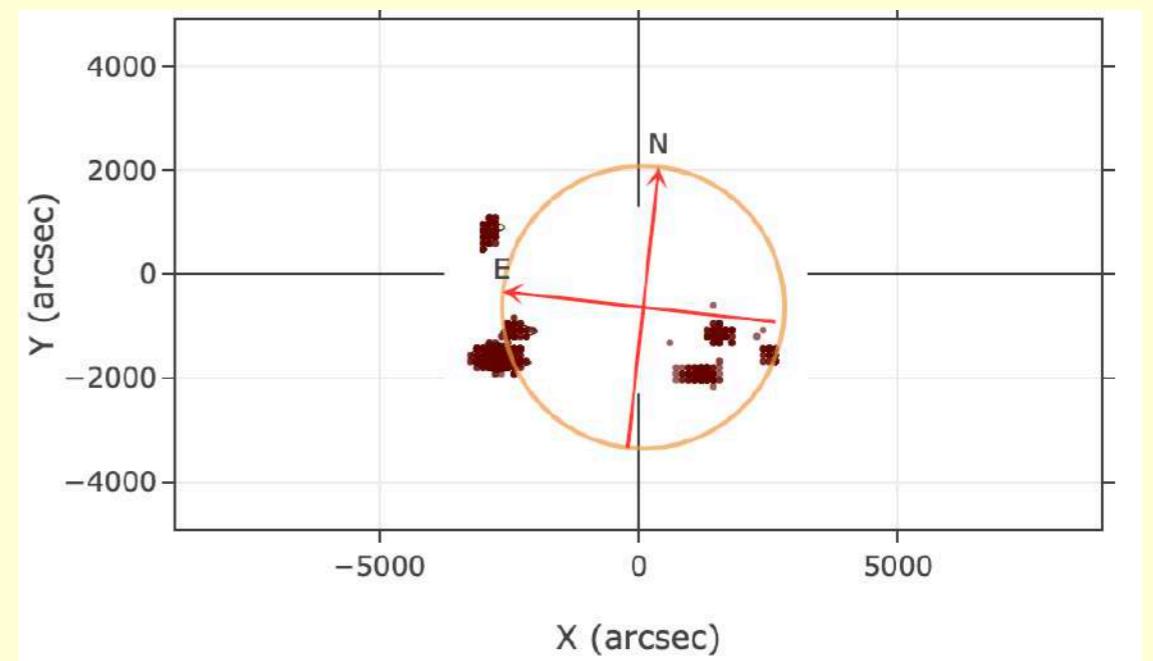
# STIX observation



**18-21 Oct 2022**



**21-24 Oct 2022**



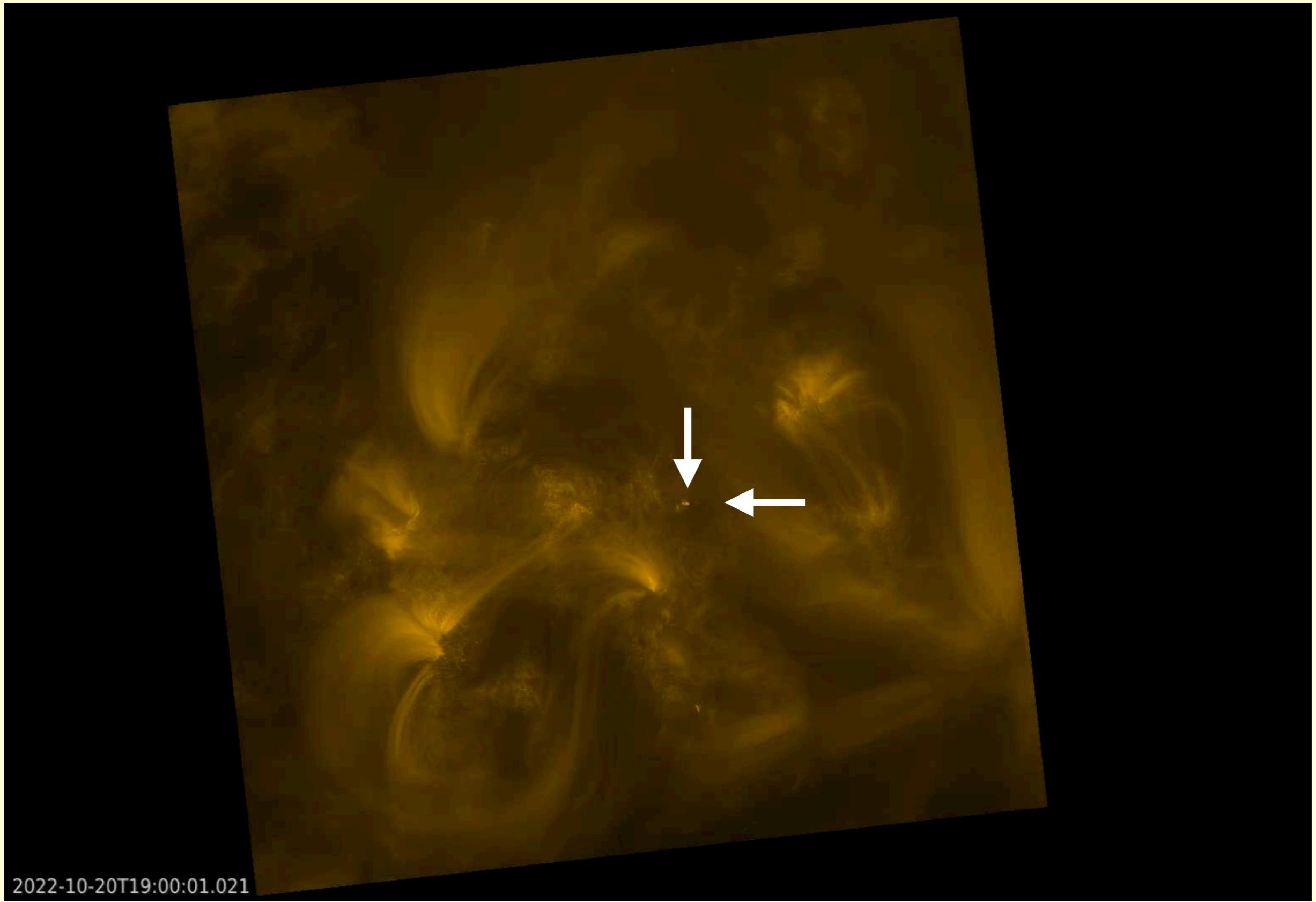
# DKIST -Cryo-NIRSP

- **Coronal imaging, Doppler velocity and FWHM maps**

Based on AGU 2022 presentation by Tom Schad

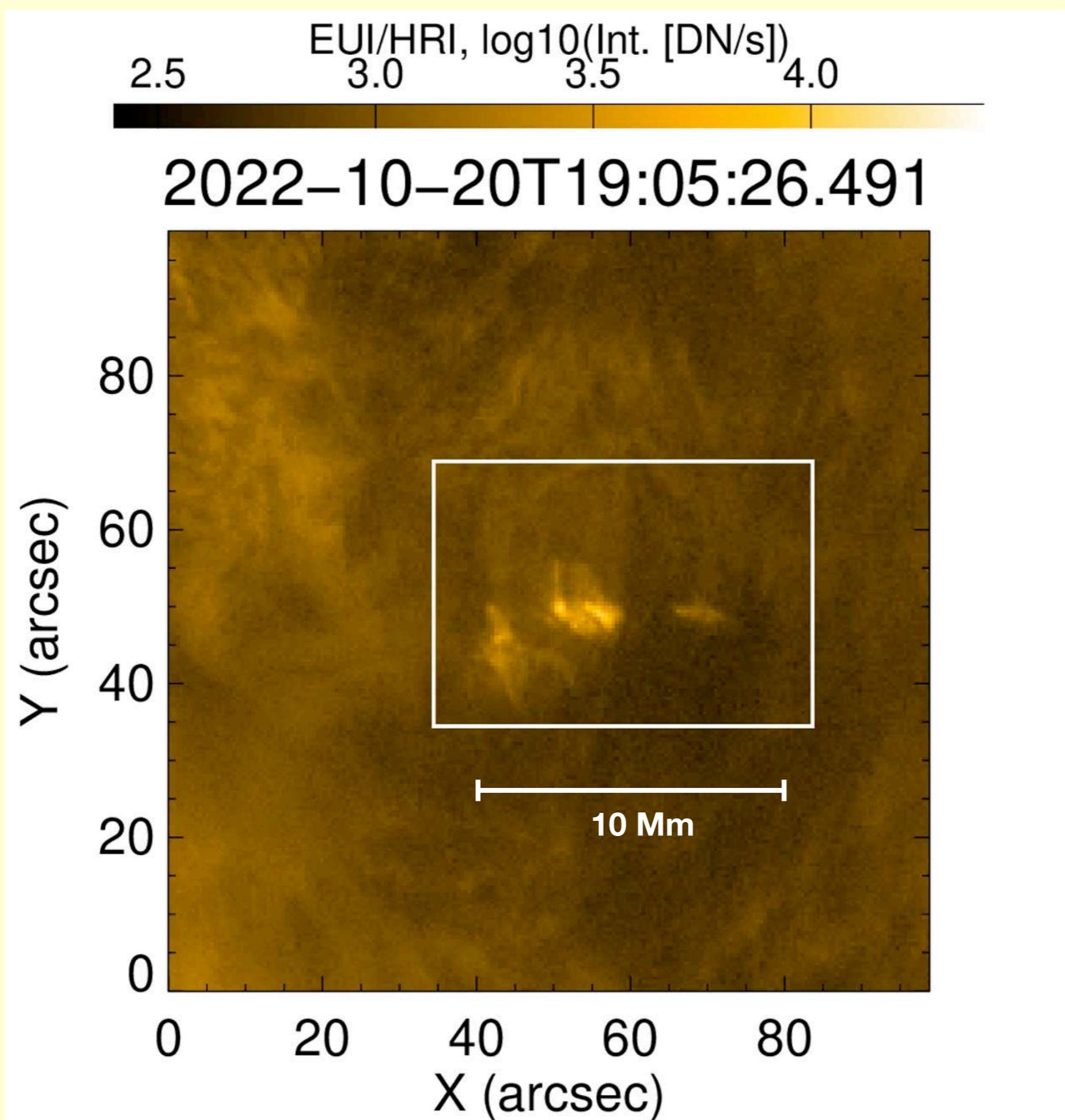
- **Stokes parameters map —> coronal magnetic field maps**

# EUI/HRI observations -“spider”

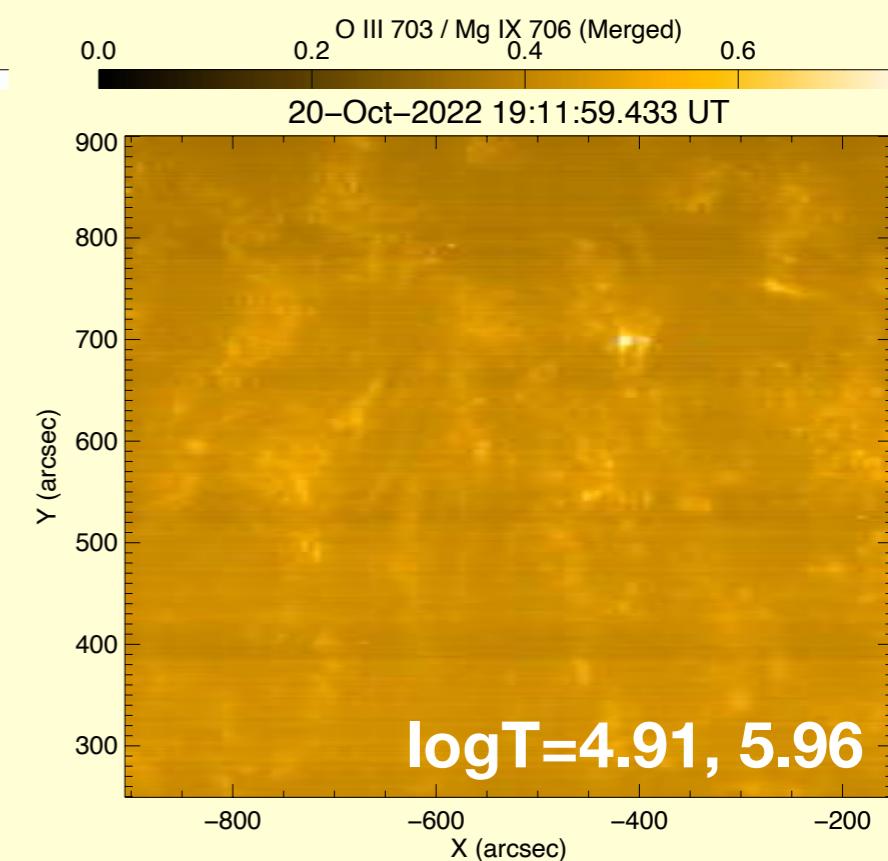
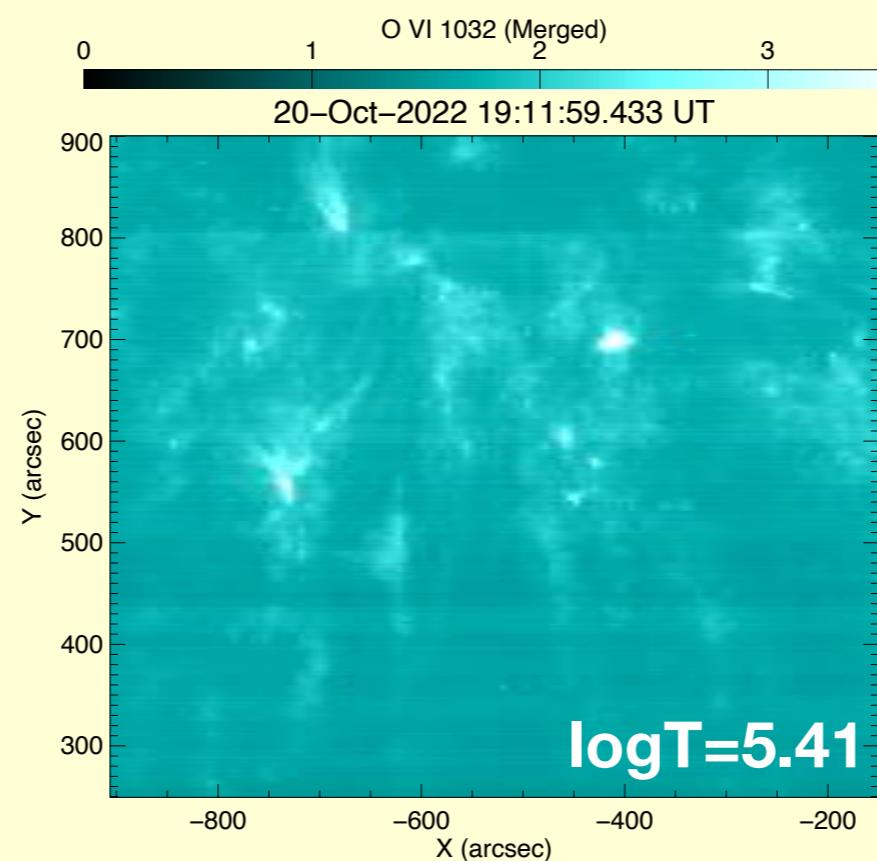
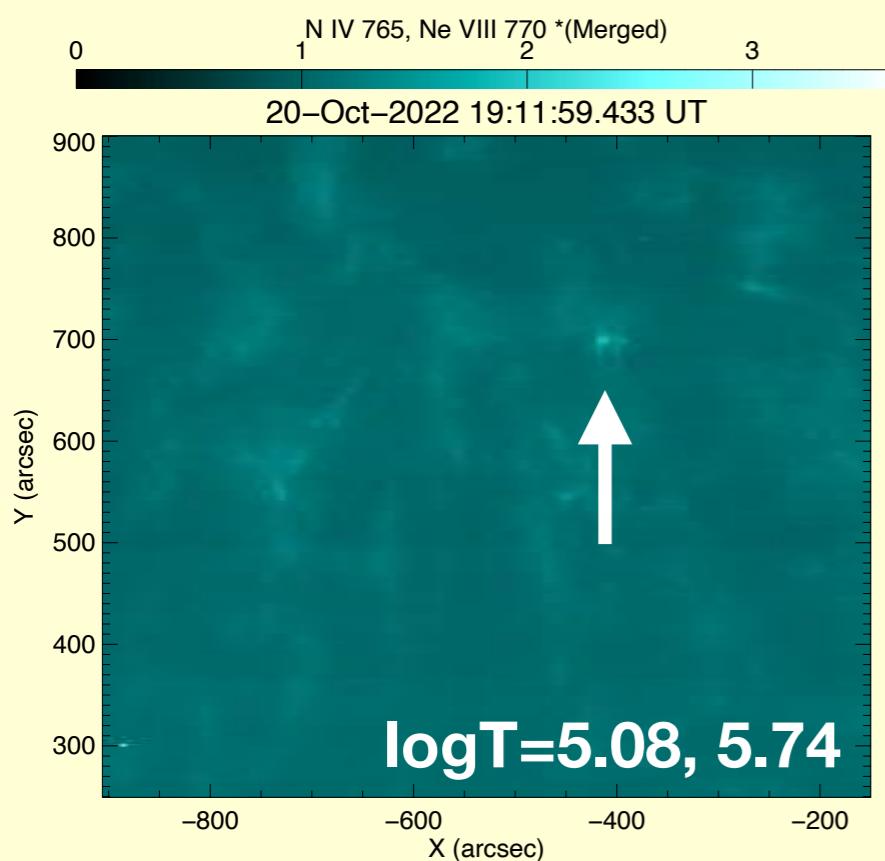
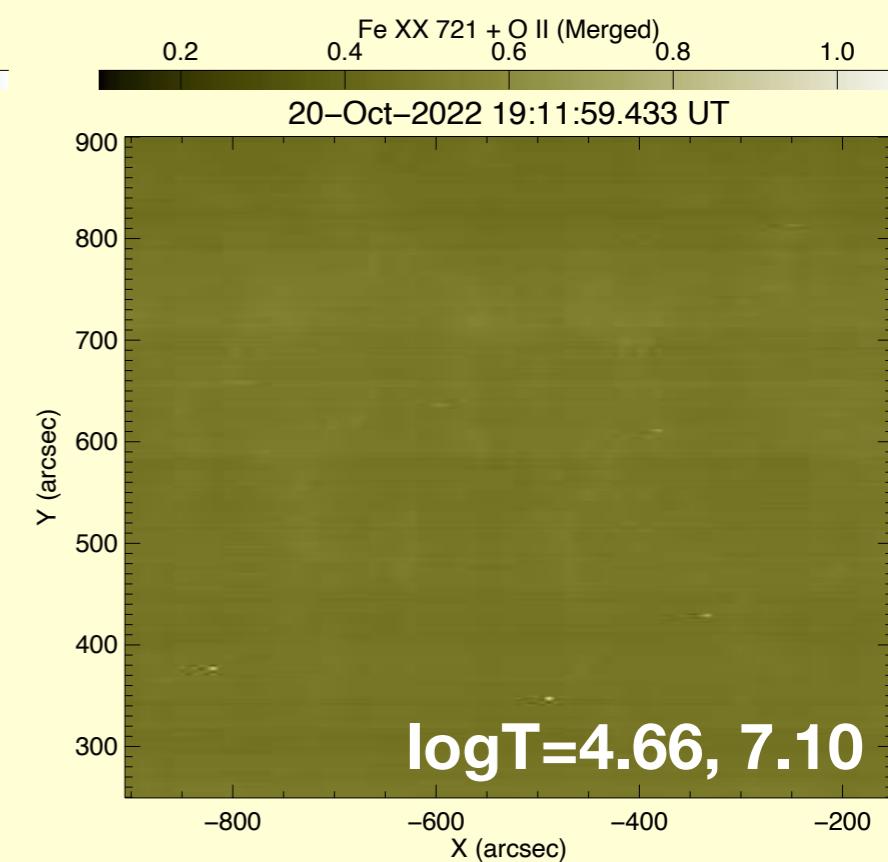
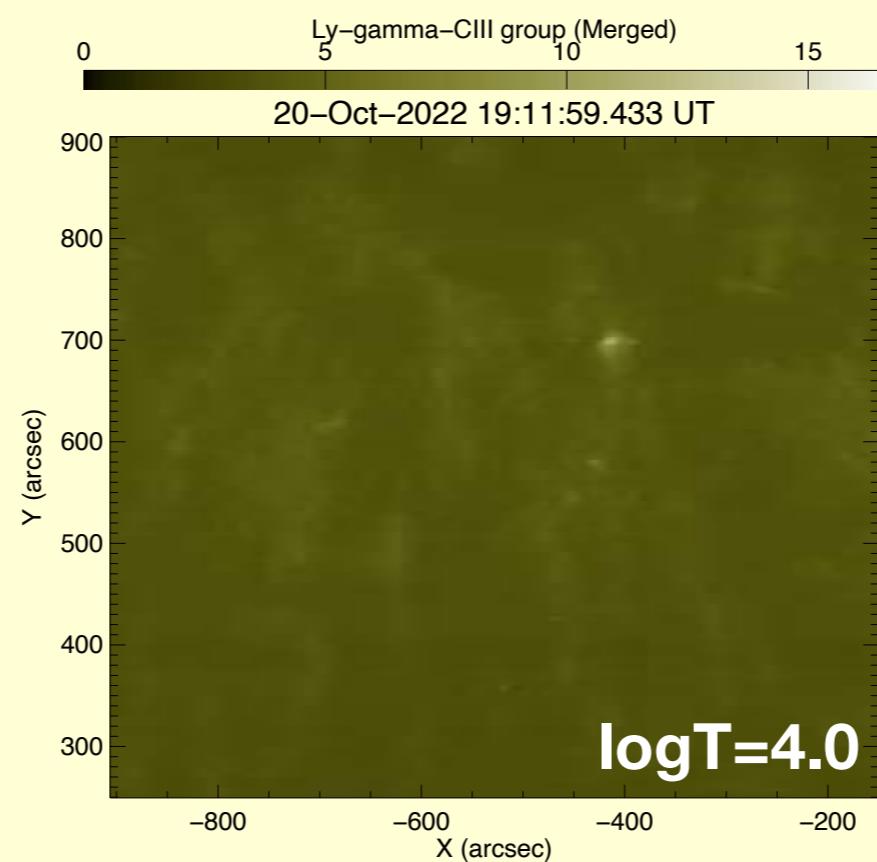
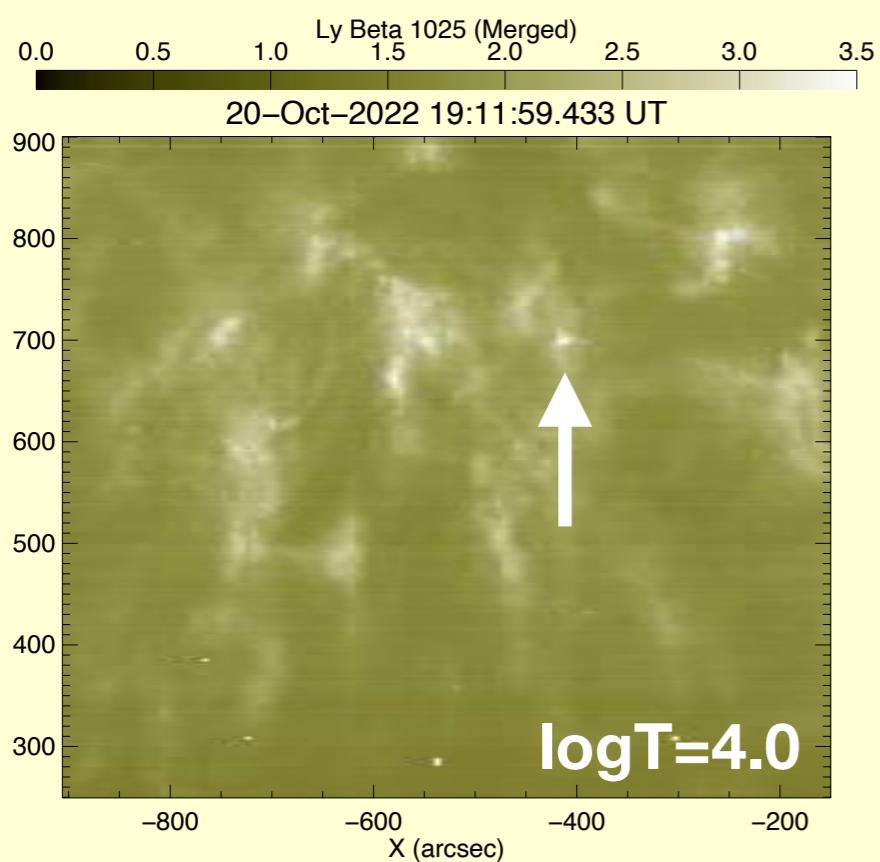


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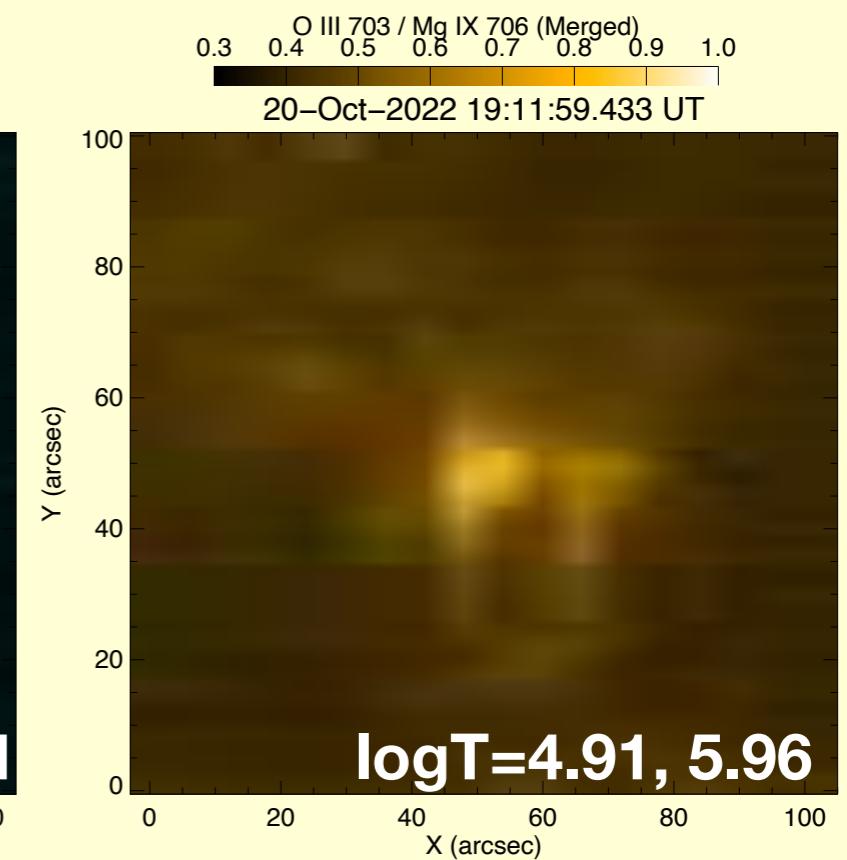
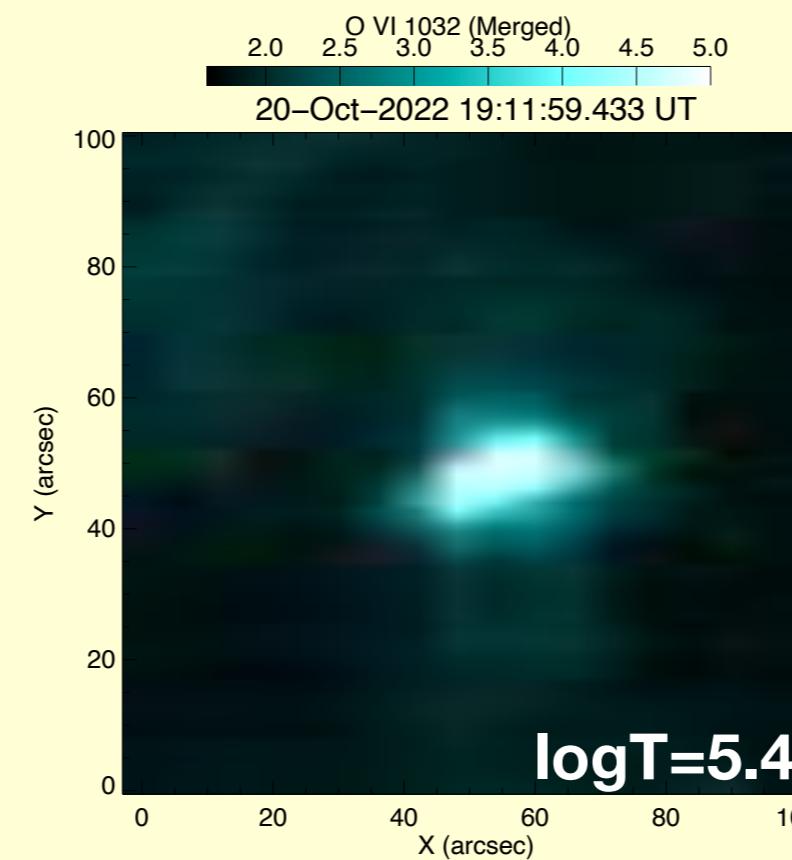
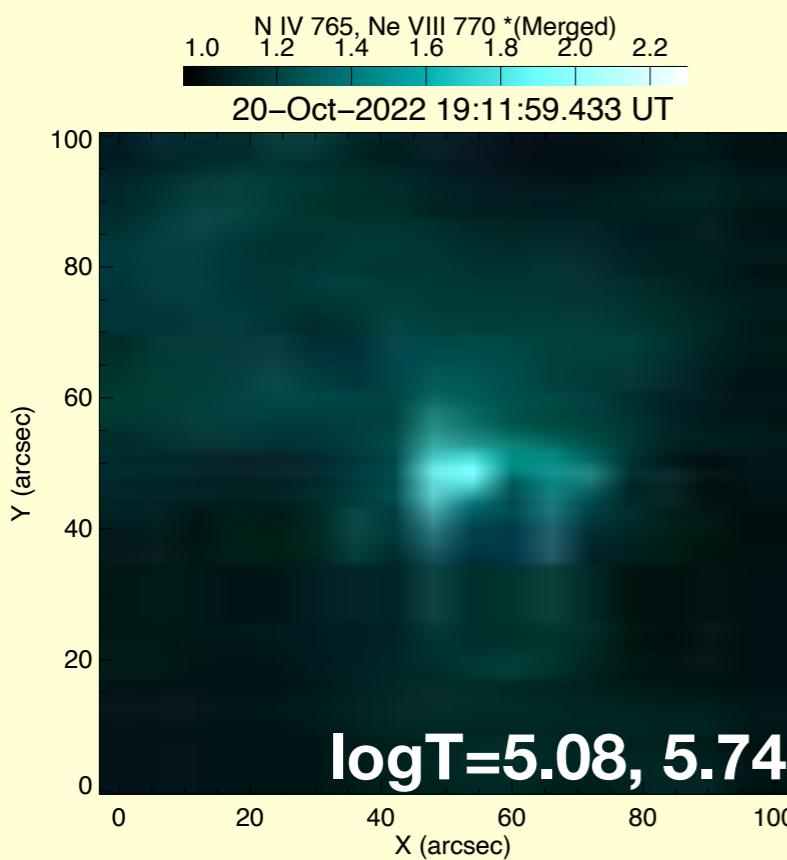
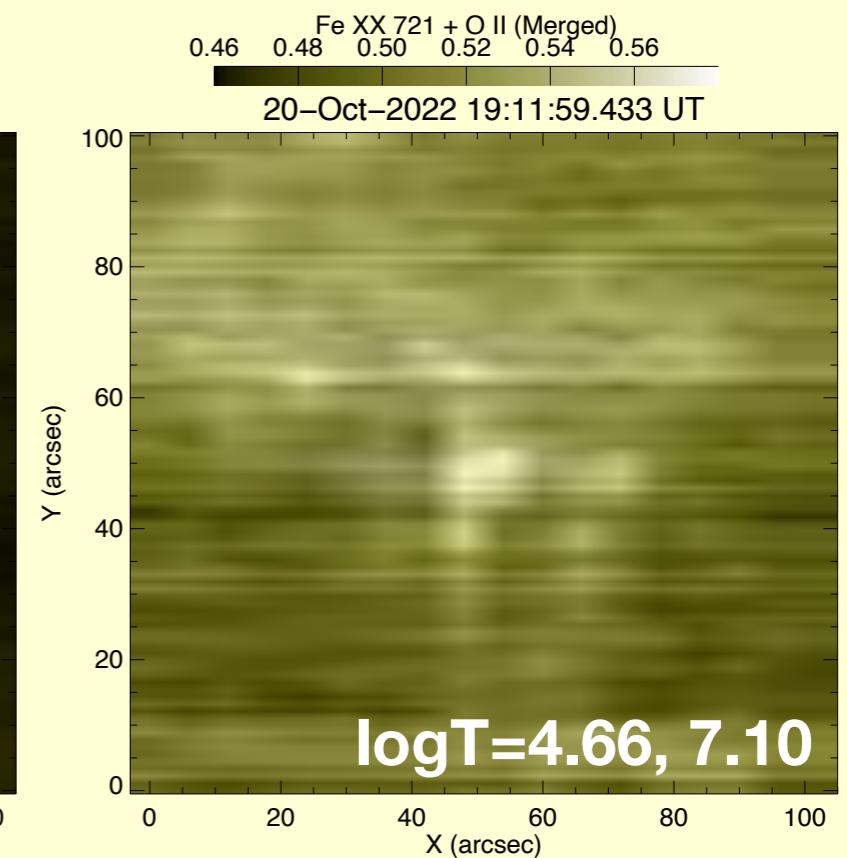
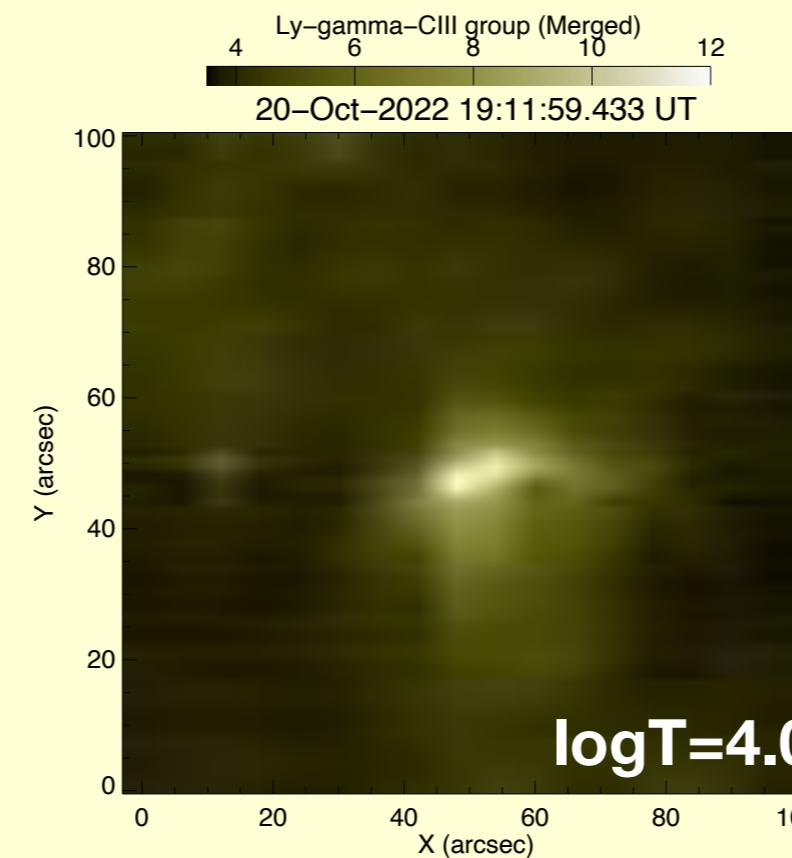
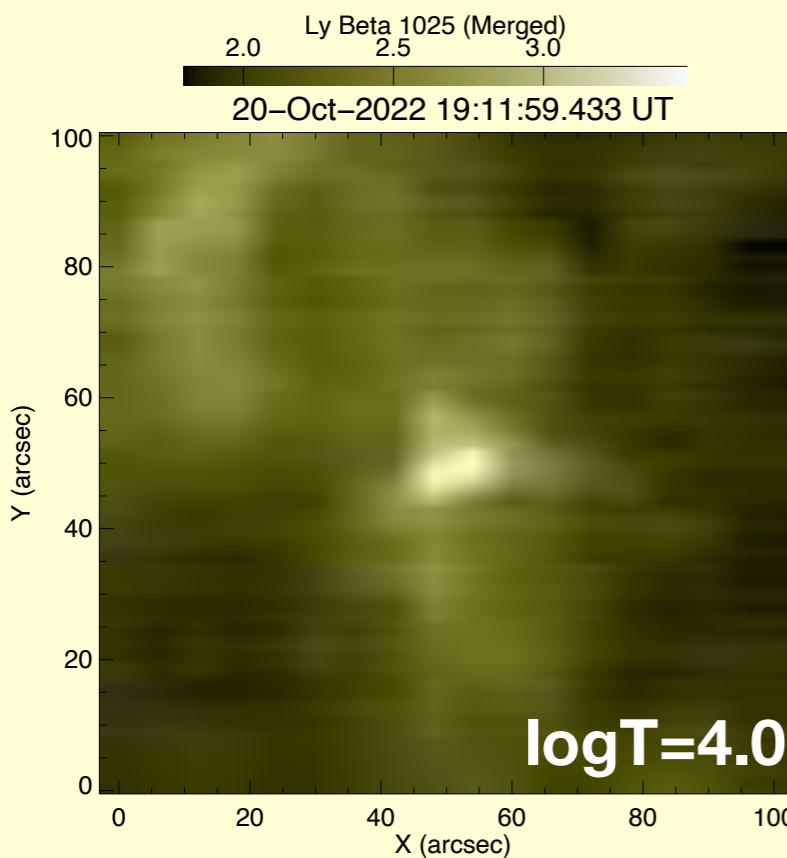
# EUI/HRI observations -“spider”



# SPICE observations -“spider”



# Zoom bright structures -SPICE (images) -“spider” <sup>17</sup>



# Conclusion

- The high-resolution coordinated observations between DKIST & Solar Orbiter are successful
- Data analysis process is on-going
- Further coordinate observation are needed

**Thank you for your attention!**

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