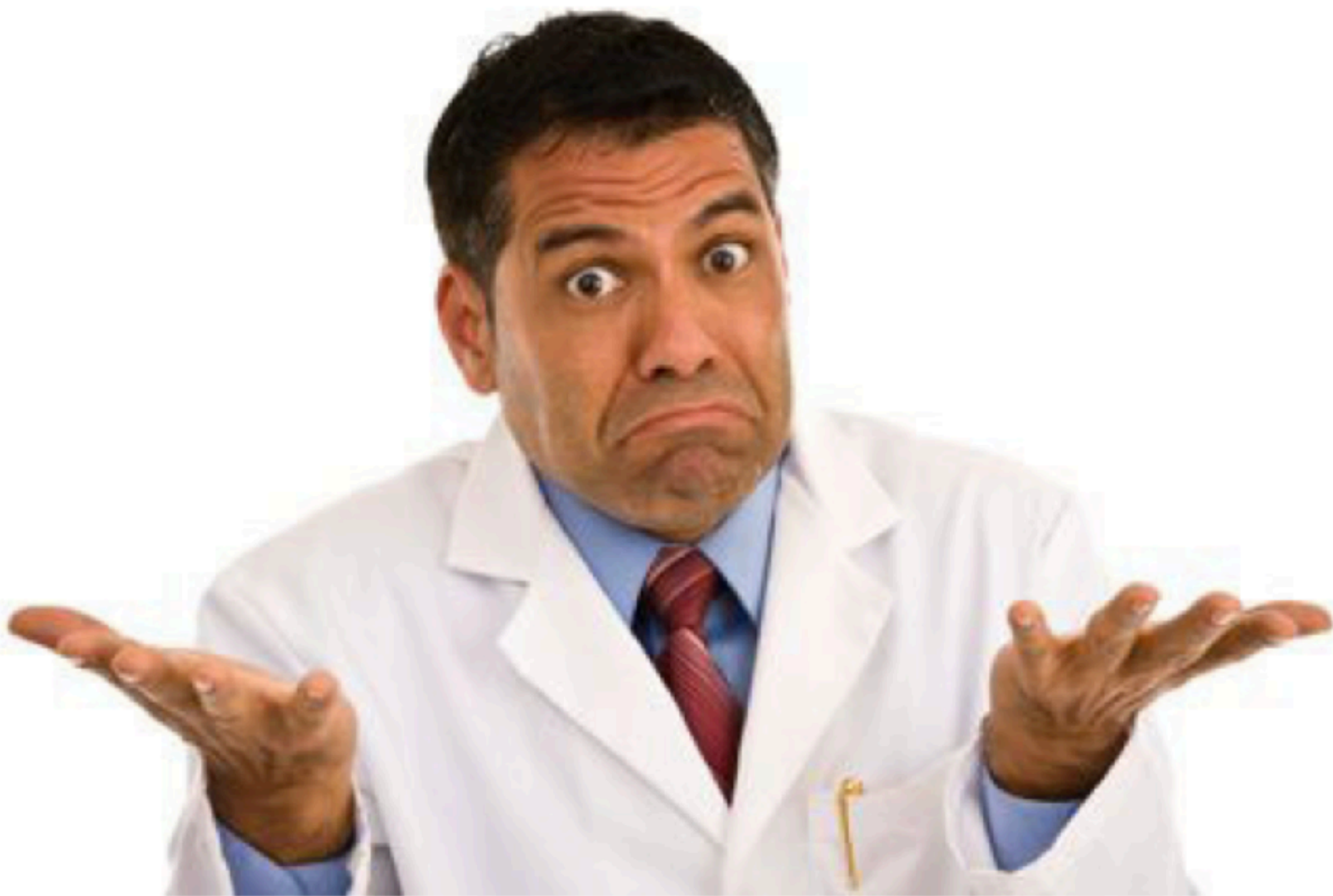


L2: De Zon

Petra Vanlommel, David Berghmans
Koninklijke Sterrenwacht van België



**Wat is er zo
bijzonder
aan de zon?**



De enige ster die:

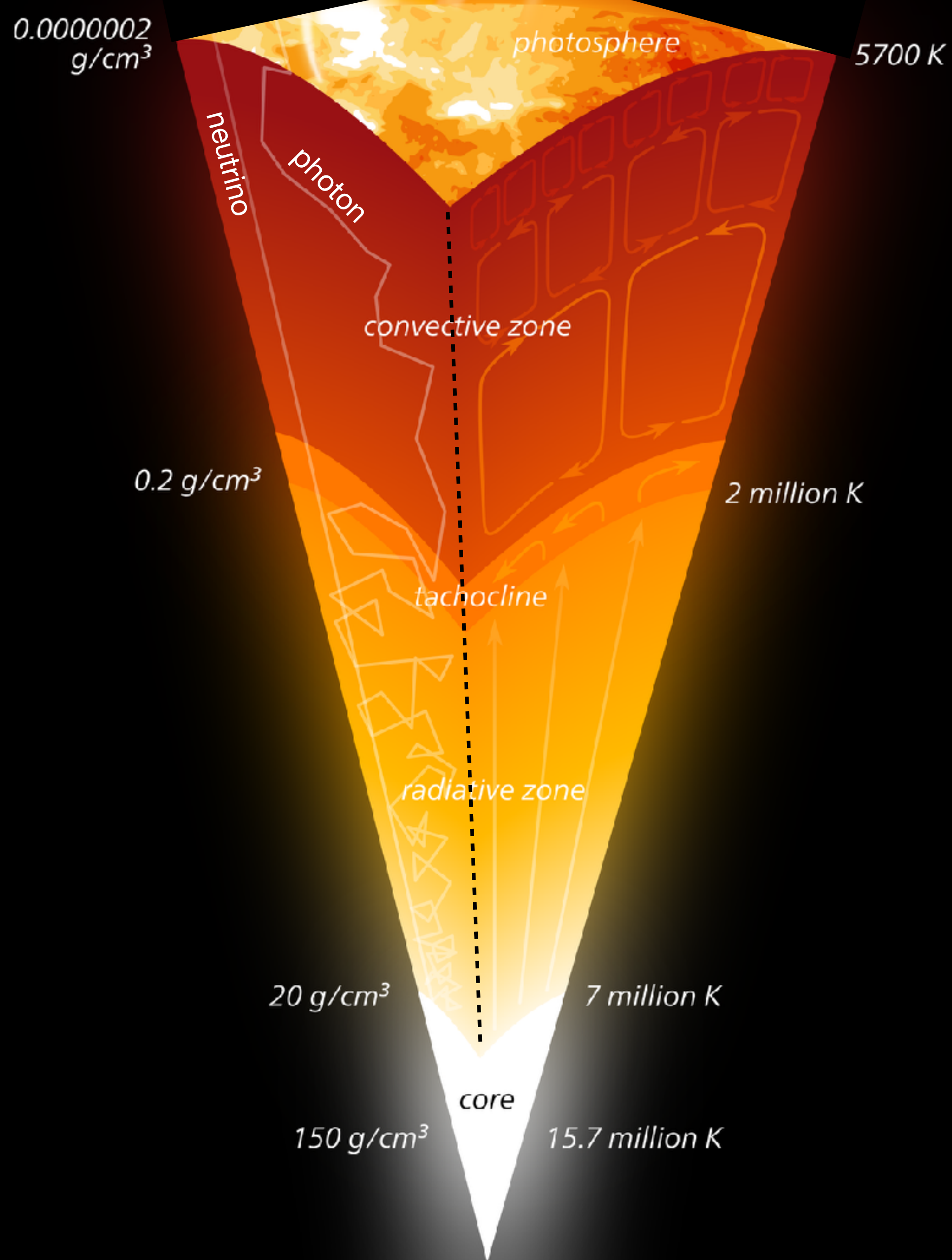
- 1. we in detail ruimtelijk kunnen waarnemen**
- 2. die een directe invloed heeft op Aarde**

De enige ster die:

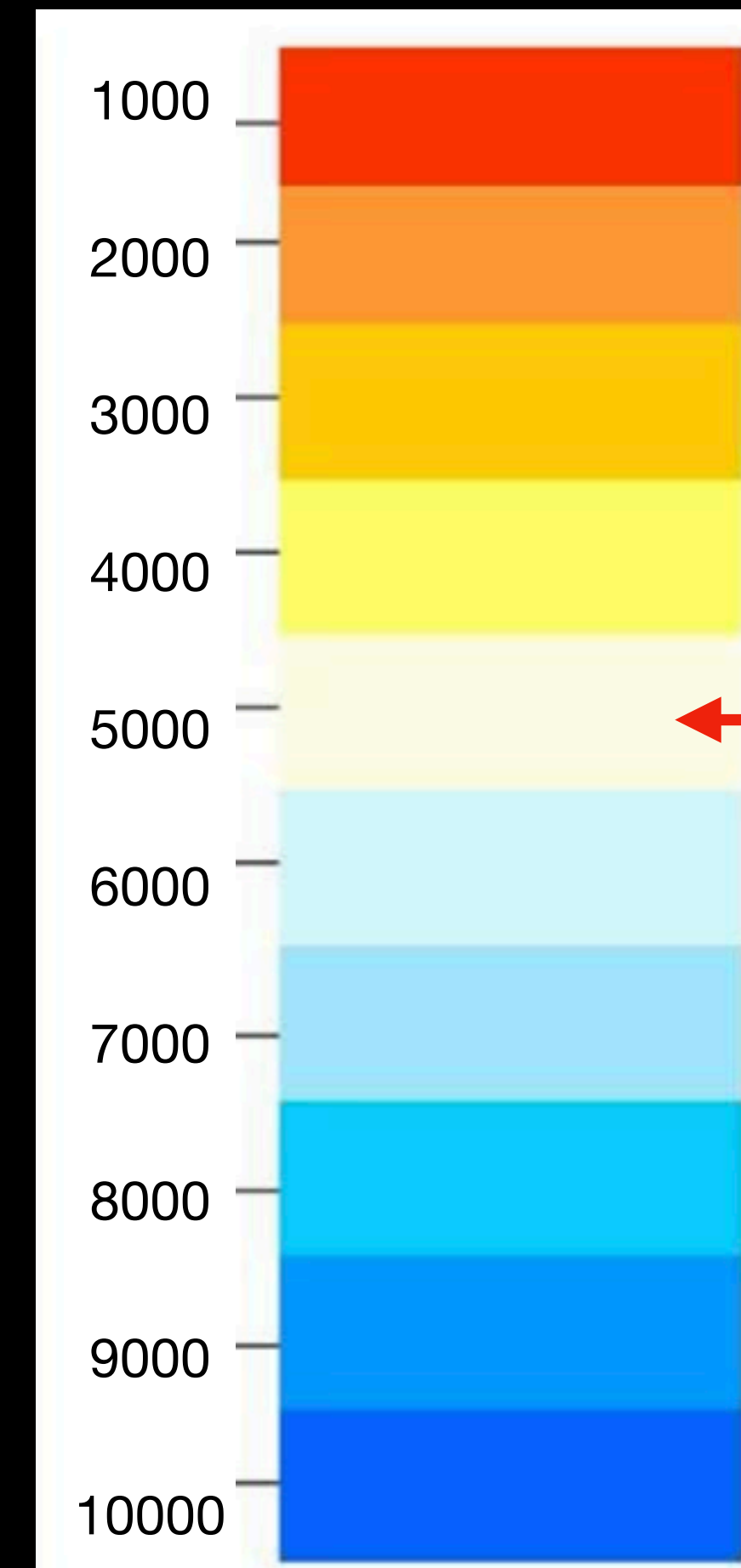
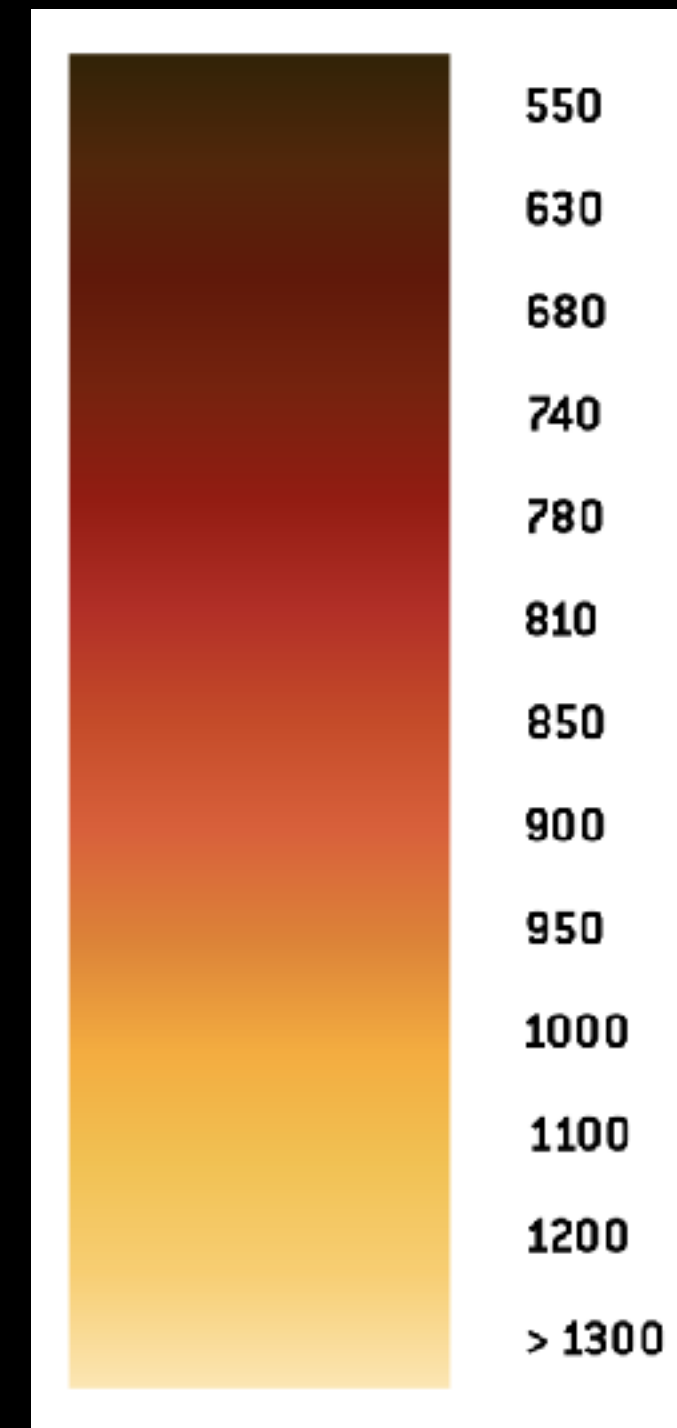
- 1. we in detail ruimtelijk kunnen waarnemen**
- 2. die een directe invloed heeft op Aarde**

- structuur van de zon en de zonne-atmosfeer
- hoge resolutie beelden van de EUV telescoop
- ruimteweer. Wat is het en wat doen we eraan?

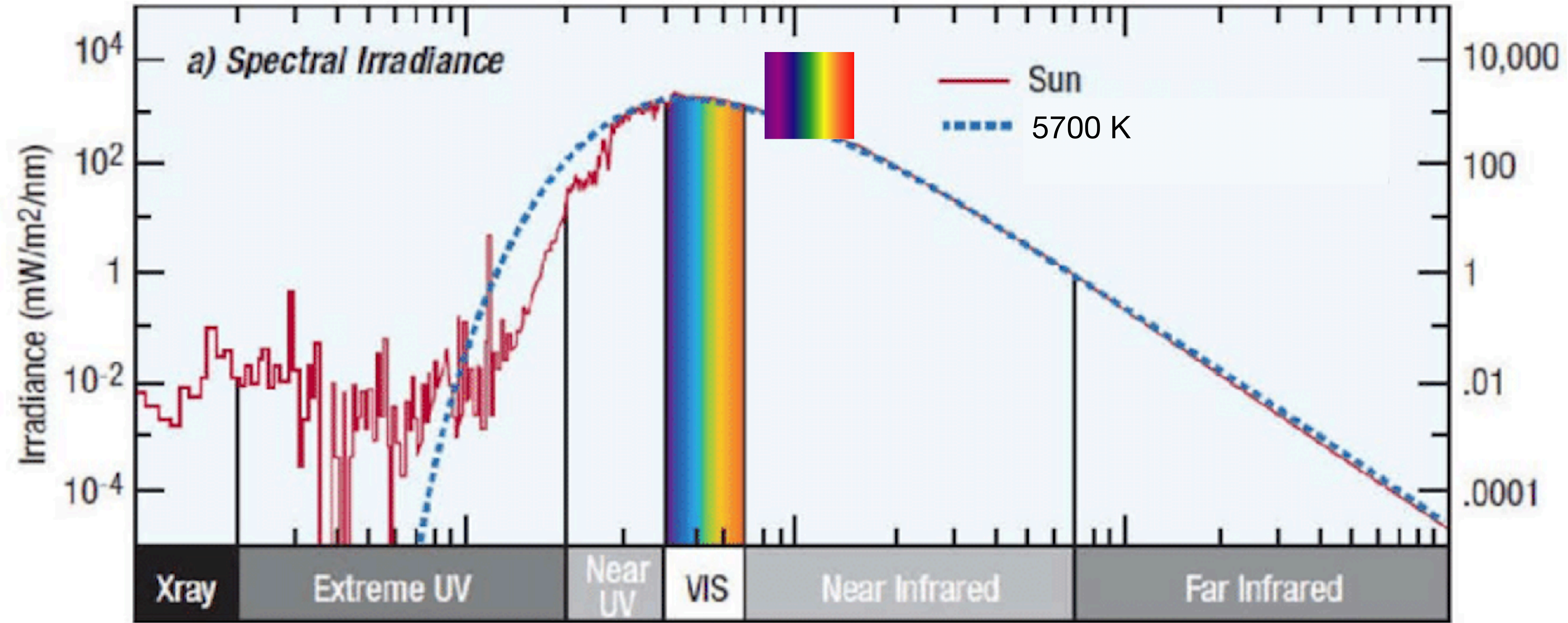
Binnenkant van de Zon



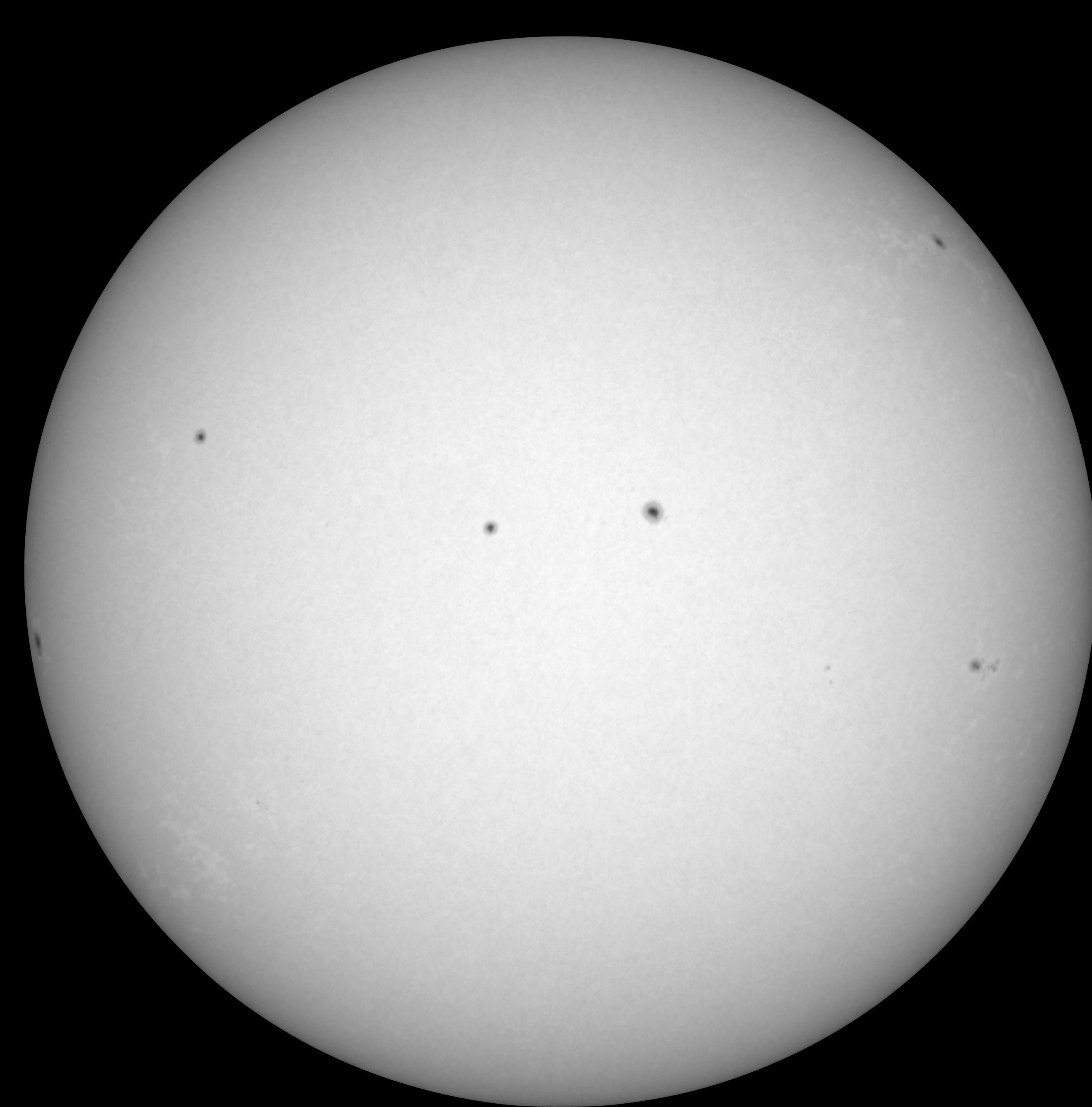
Gloeitemperaturen smeedijzer (C)



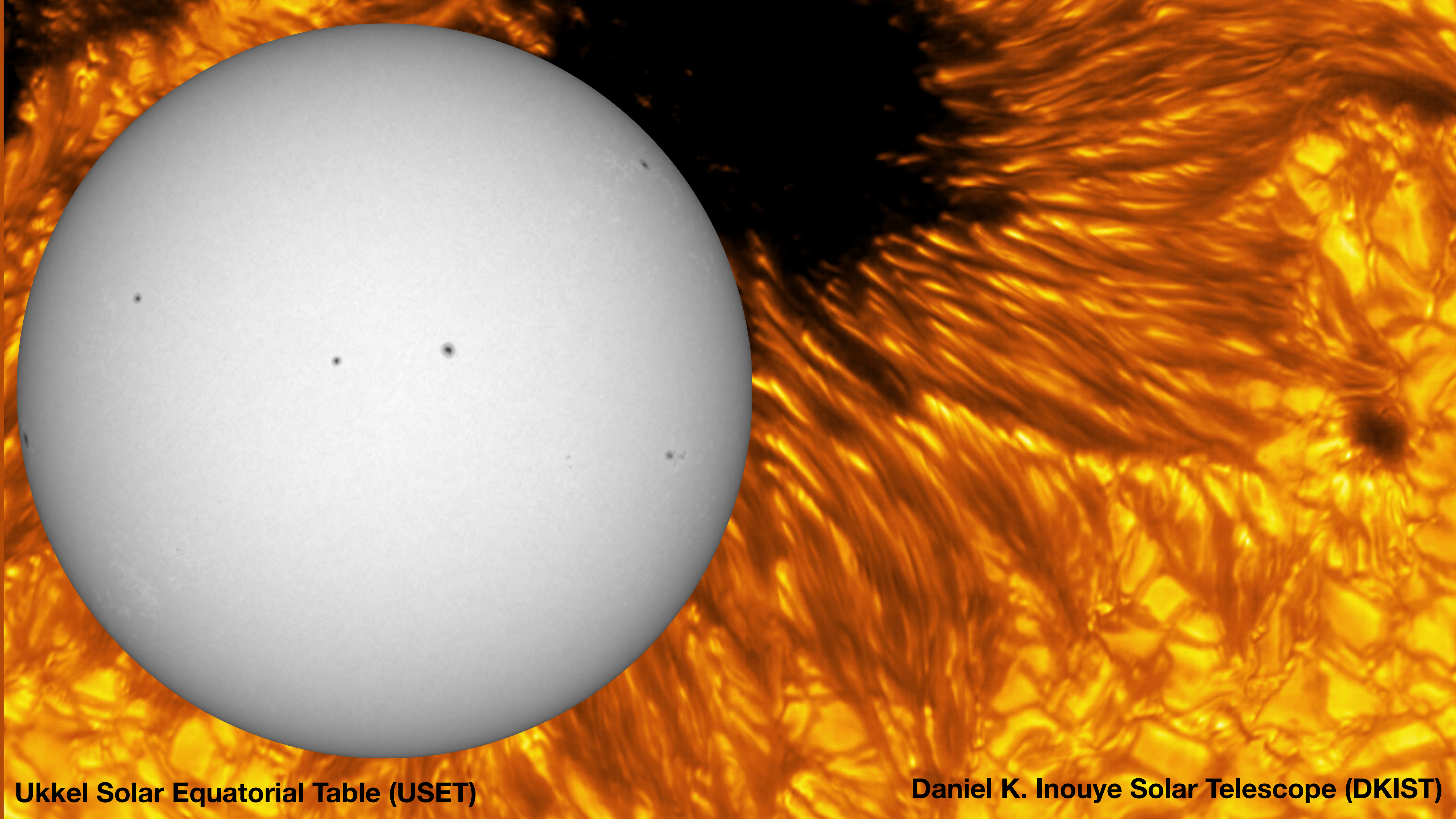
“Oppervlak” van de zon: Fotosfeer 5700 C







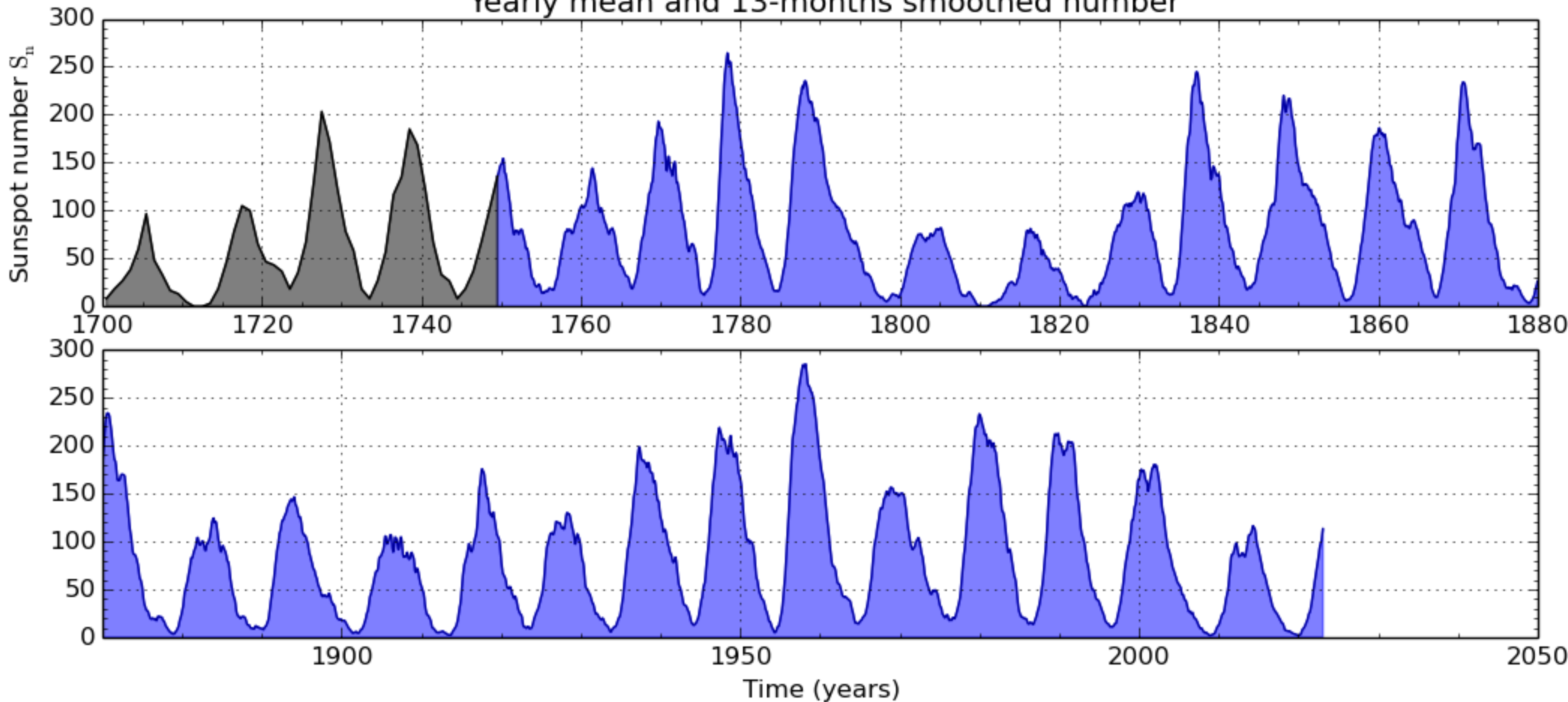
Ukkel Solar Equatorial Table (USET)



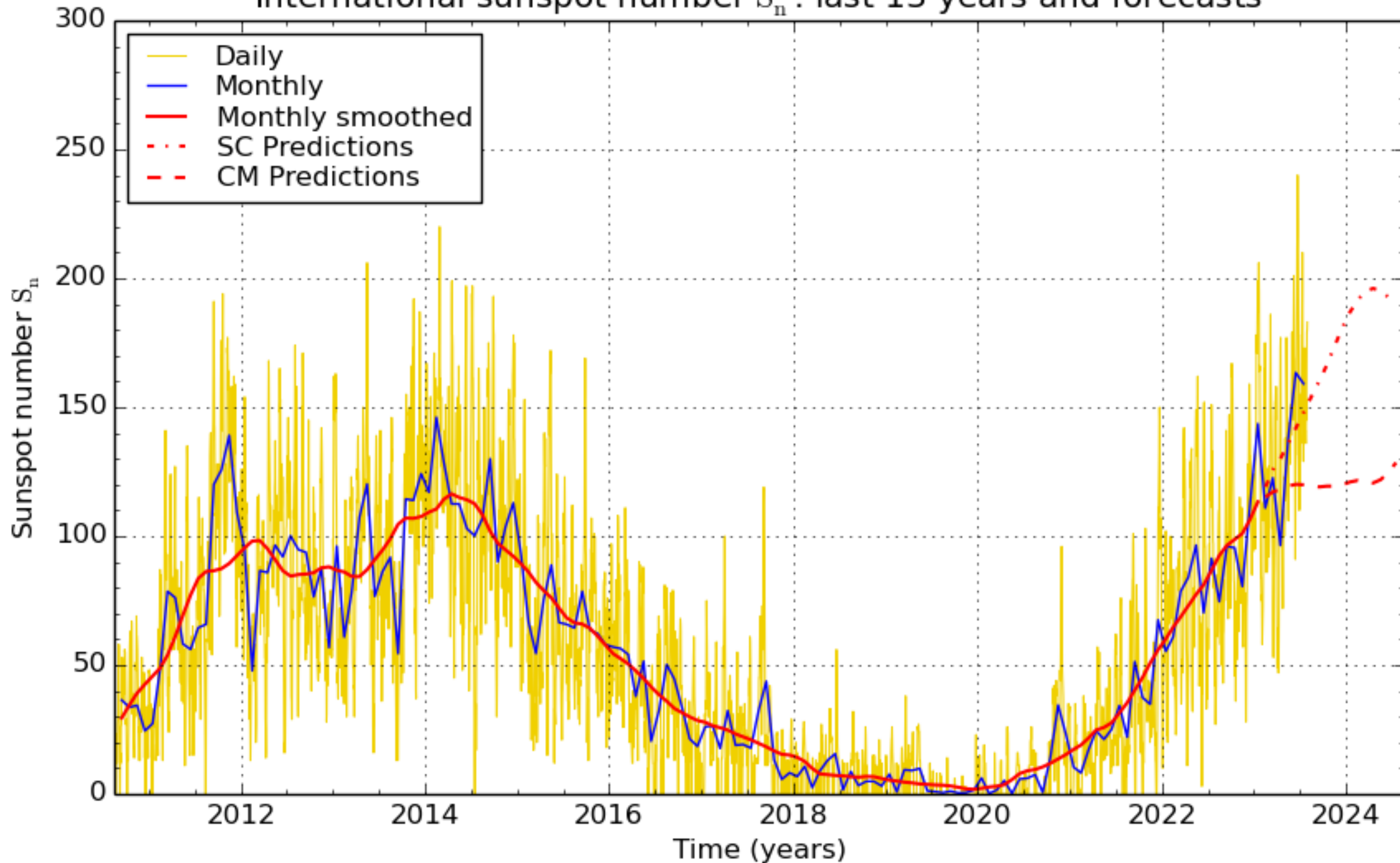
Ukkel Solar Equatorial Table (USET)

Daniel K. Inouye Solar Telescope (DKIST)

International sunspot number S_n :
Yearly mean and 13-months smoothed number



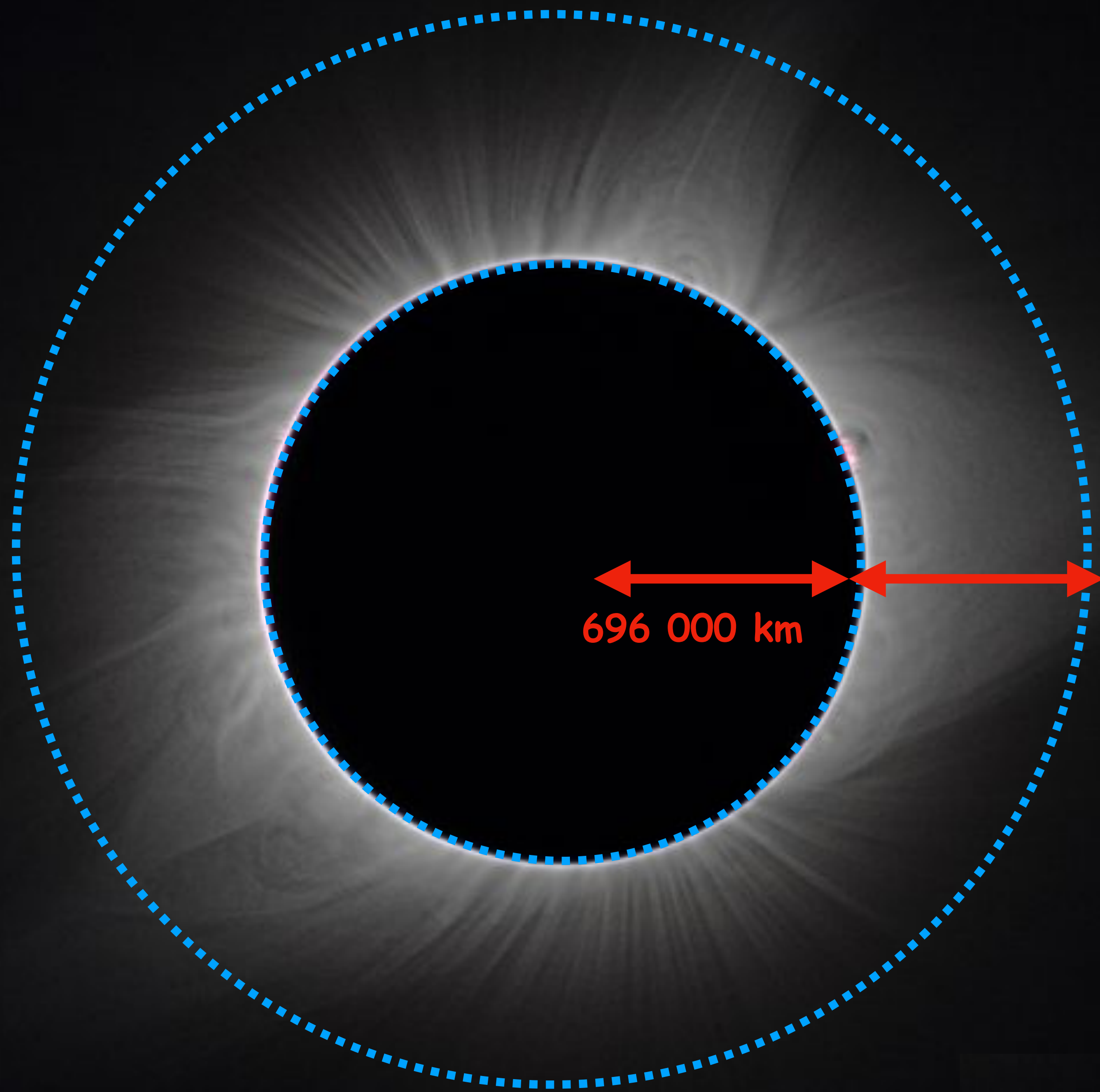
International sunspot number S_n : last 13 years and forecasts





Svalbard, Norway 2015 April 20

© Thanakrit Santikunaporn



$$P = P_0 \exp\left(-\frac{z}{H}\right)$$

$$H = \frac{kT}{Mg}$$

g= 270 m/s²

M=1

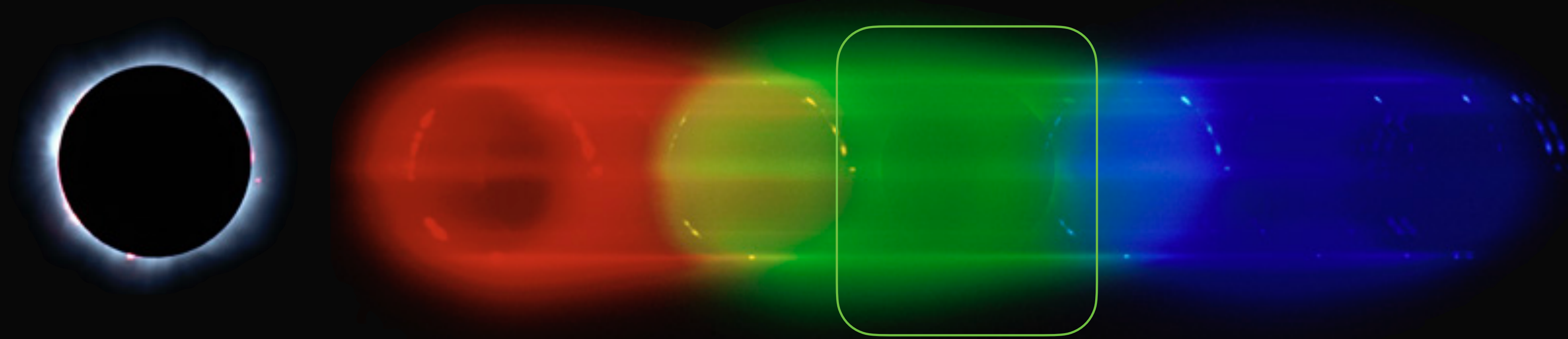
~~**T= 5700**~~

>1 million C

~~**H=270km**~~

>696 000 km

Eclipse 1999, Hungary



530.3nm

Coronium

Bengt Edlen (~1930): Fe XIV

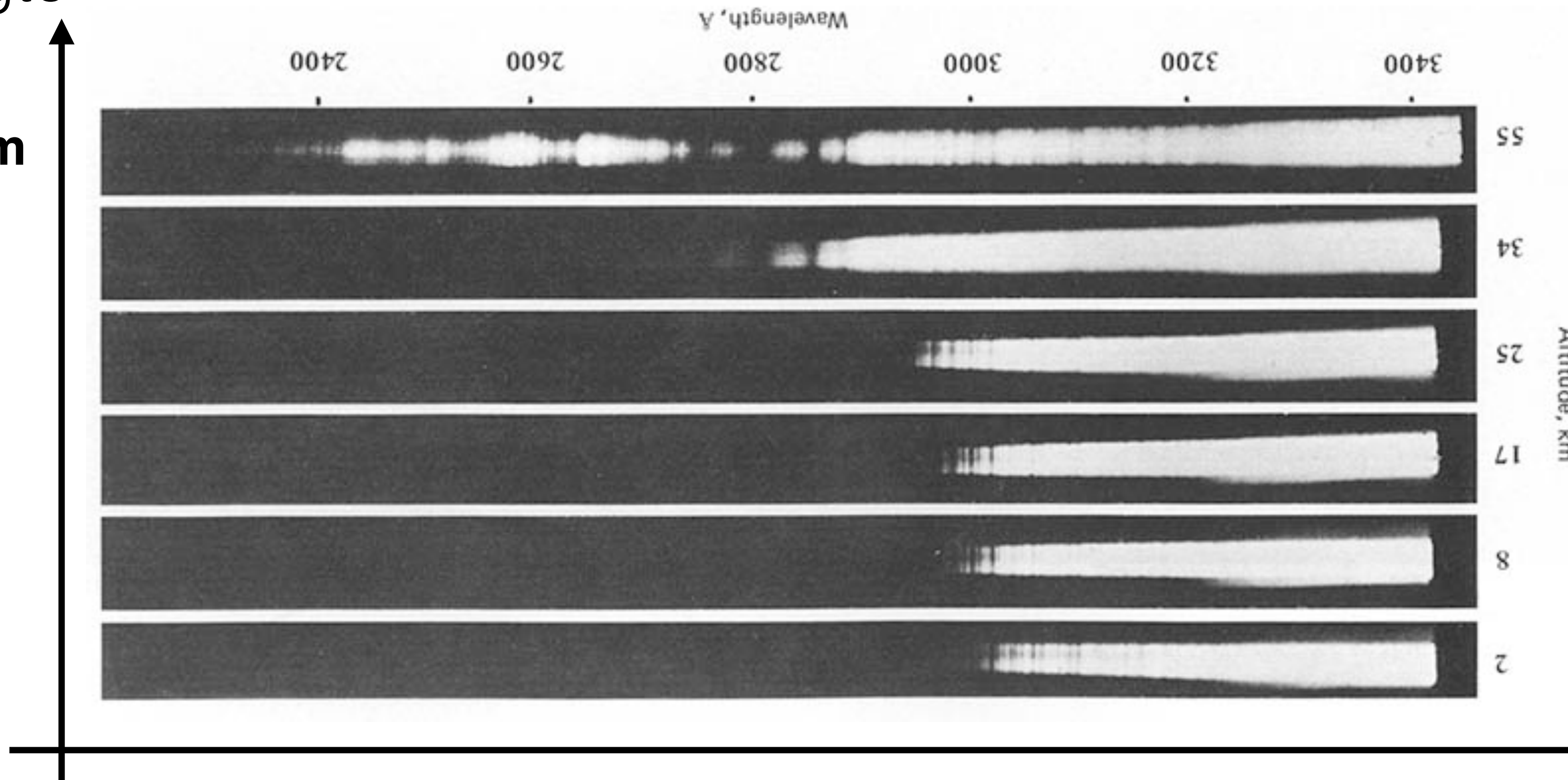


NRL experiment: Spectrograaf op een V2-rocket in 1946

hoogte

55km

2km



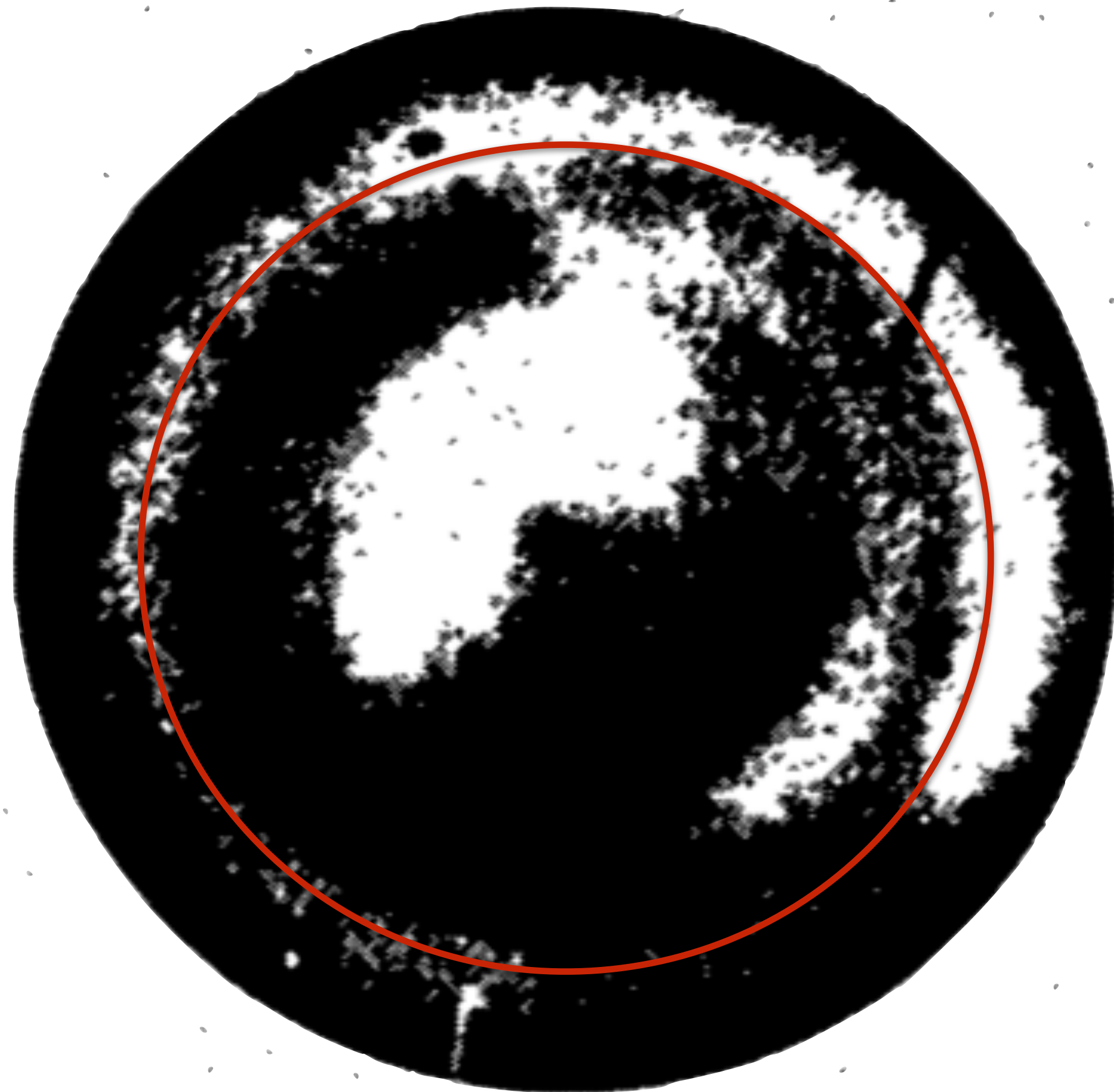
2400A

3400Ang

golflengte

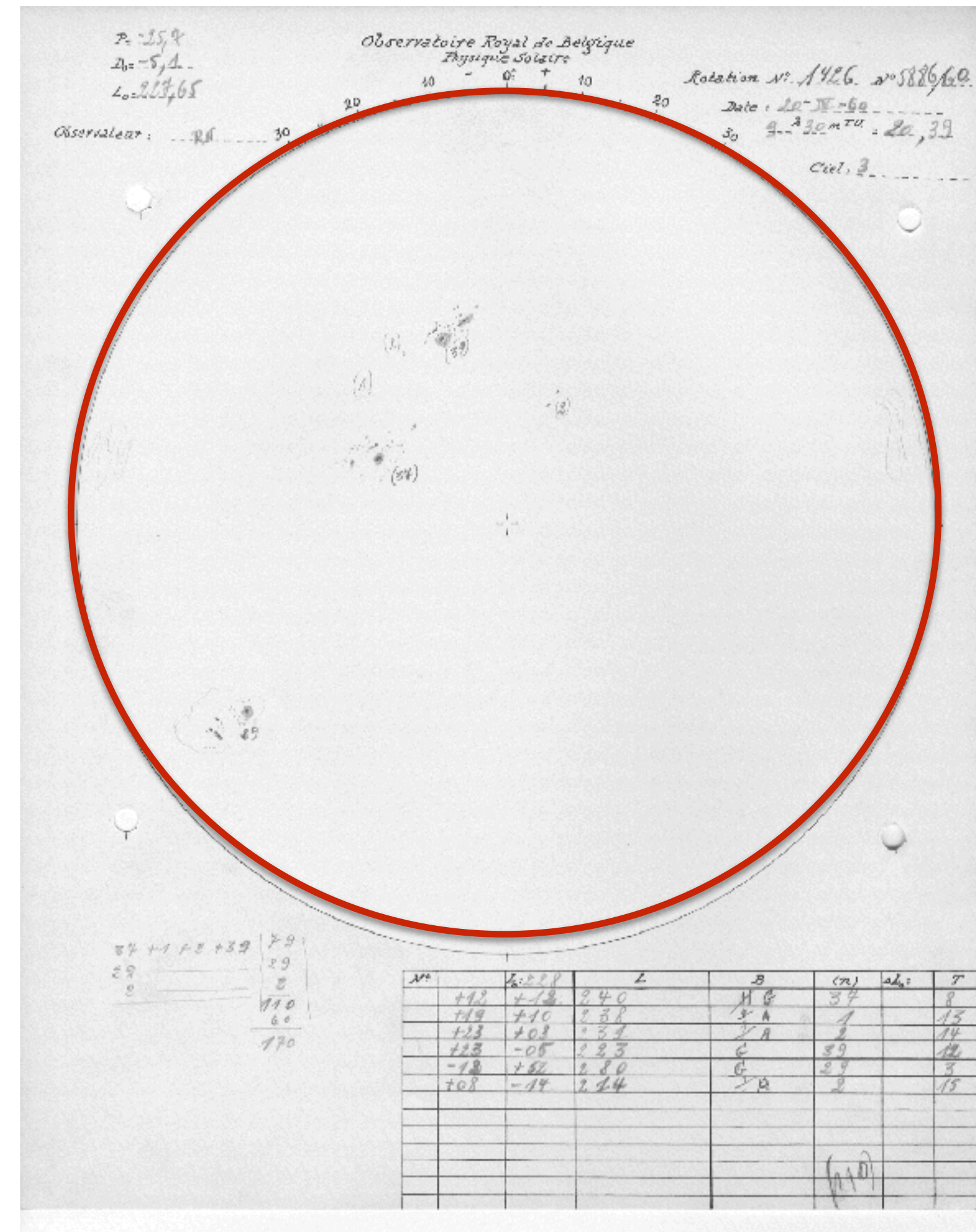
[Tousey \(1967\) ApJ, 149, 239](#)

SOLAR X-RAY PHOTOGRAPH
NRL, APRIL 19, 1960



Pinhole camera
flown in 1960

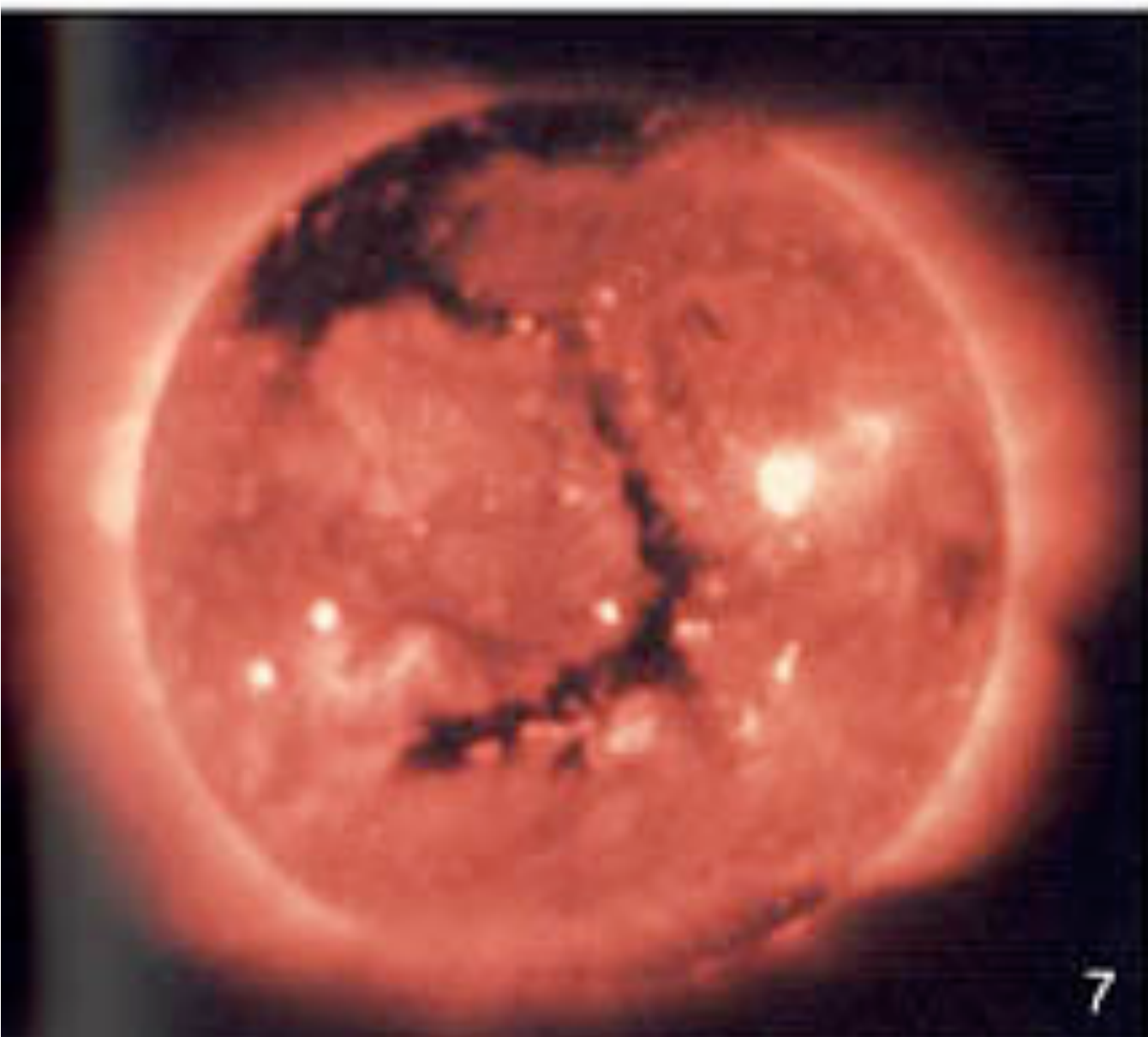
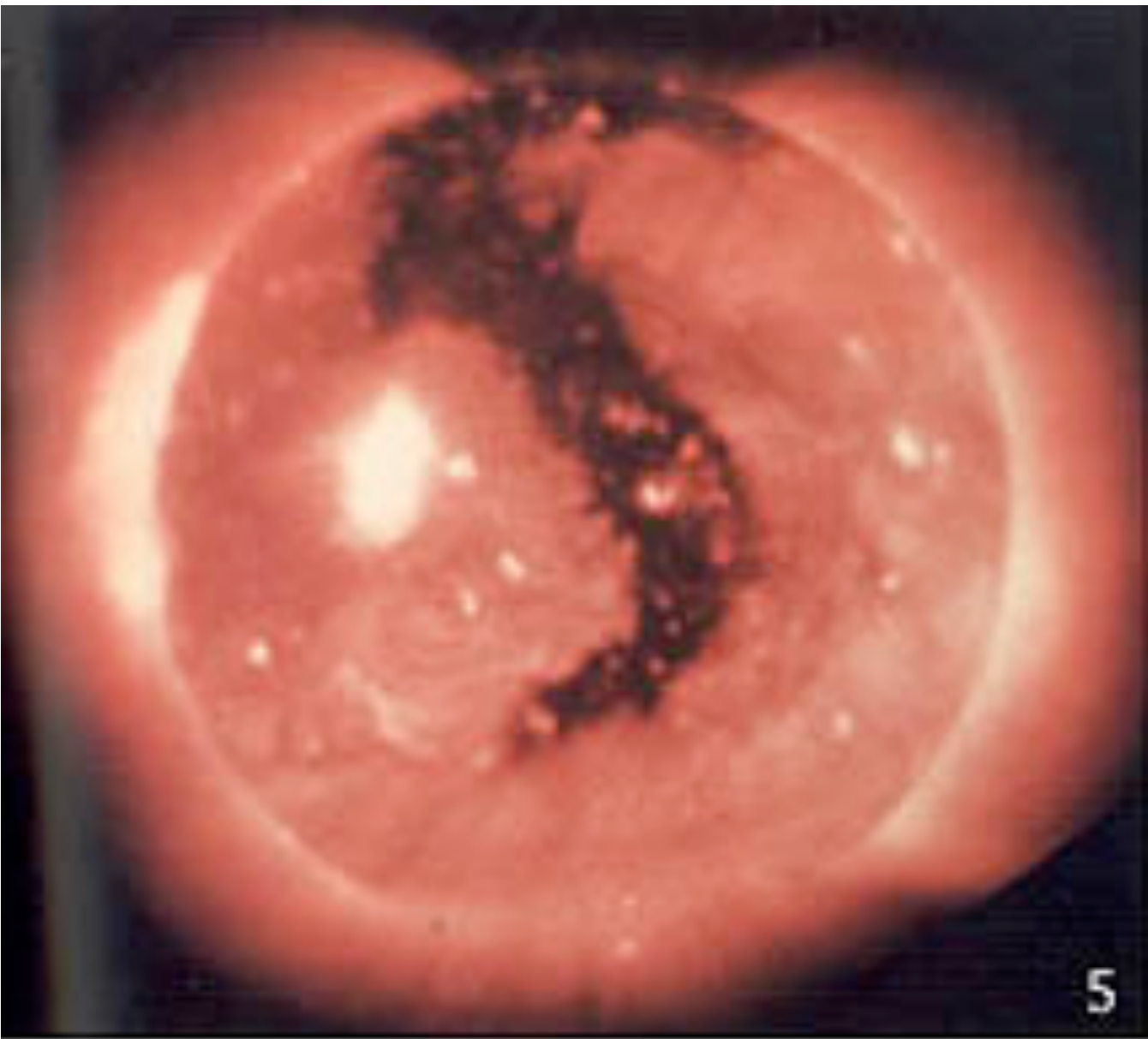
[Friedman \(1963\) IAUS, 16, 45](#)

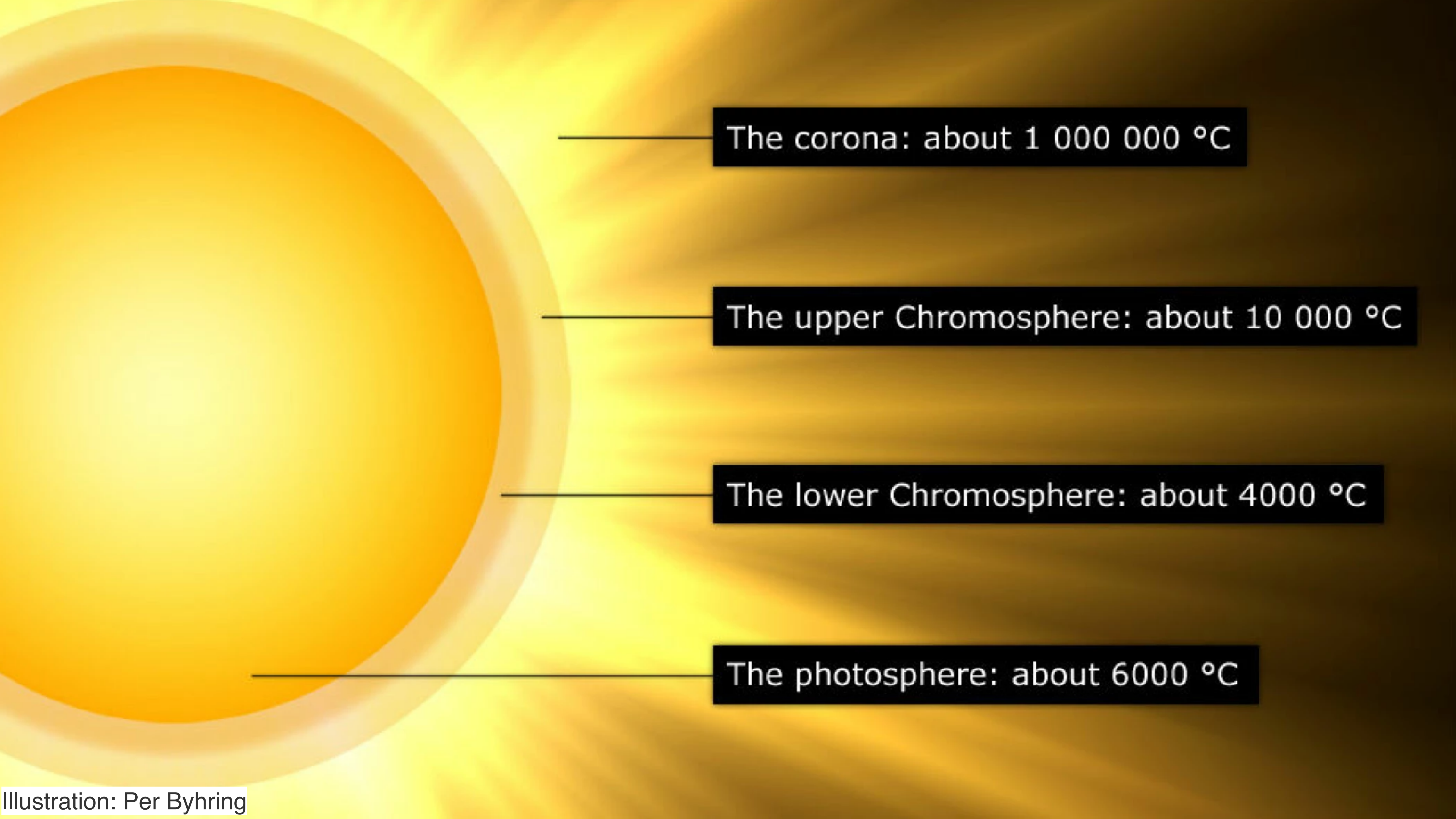


April 20 1960 Sunspot drawing
from Royal observatory of Belgium

Skylab (1973-74)

<http://history.nasa.gov/SP-402/ch1.htm>



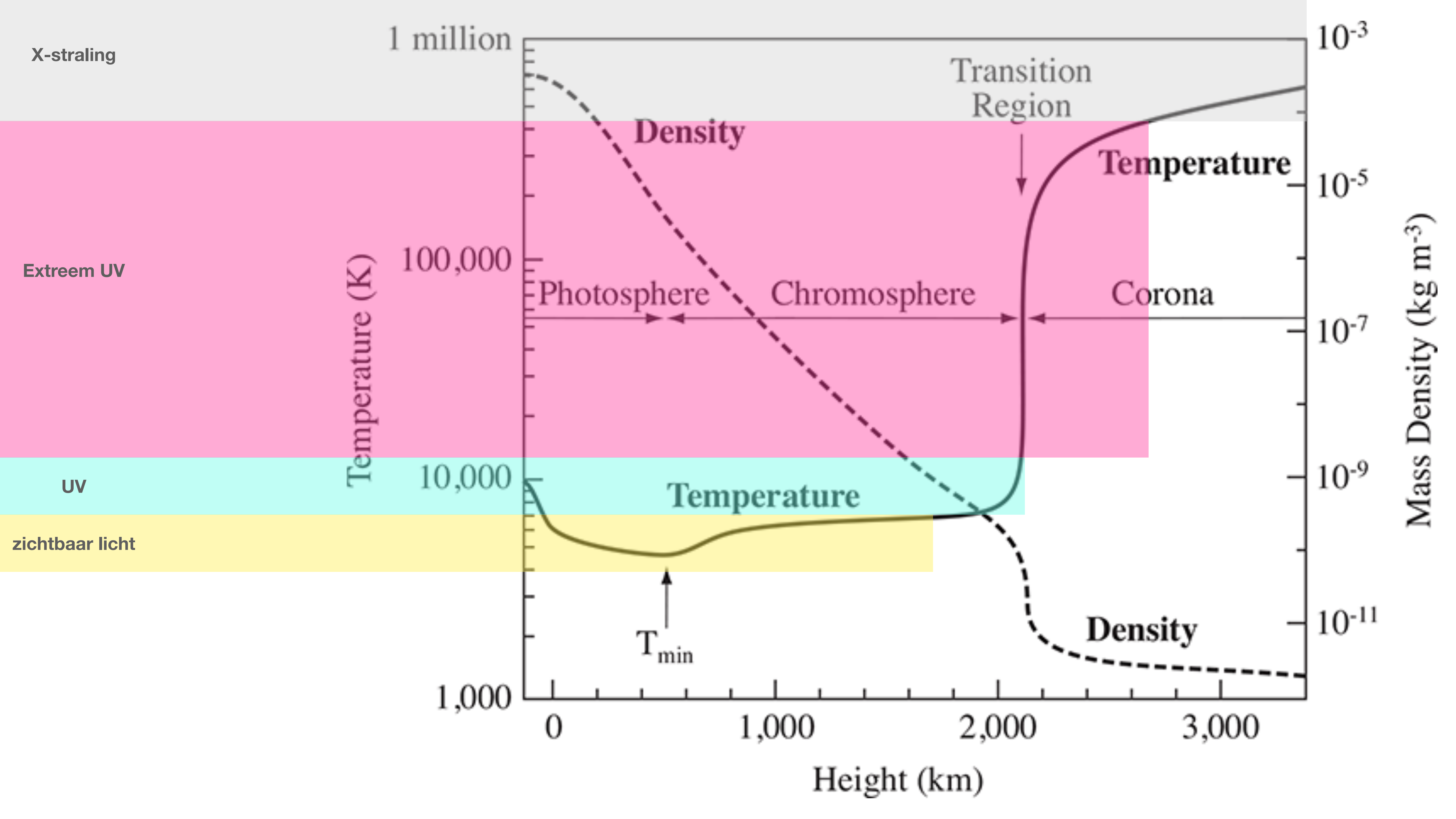


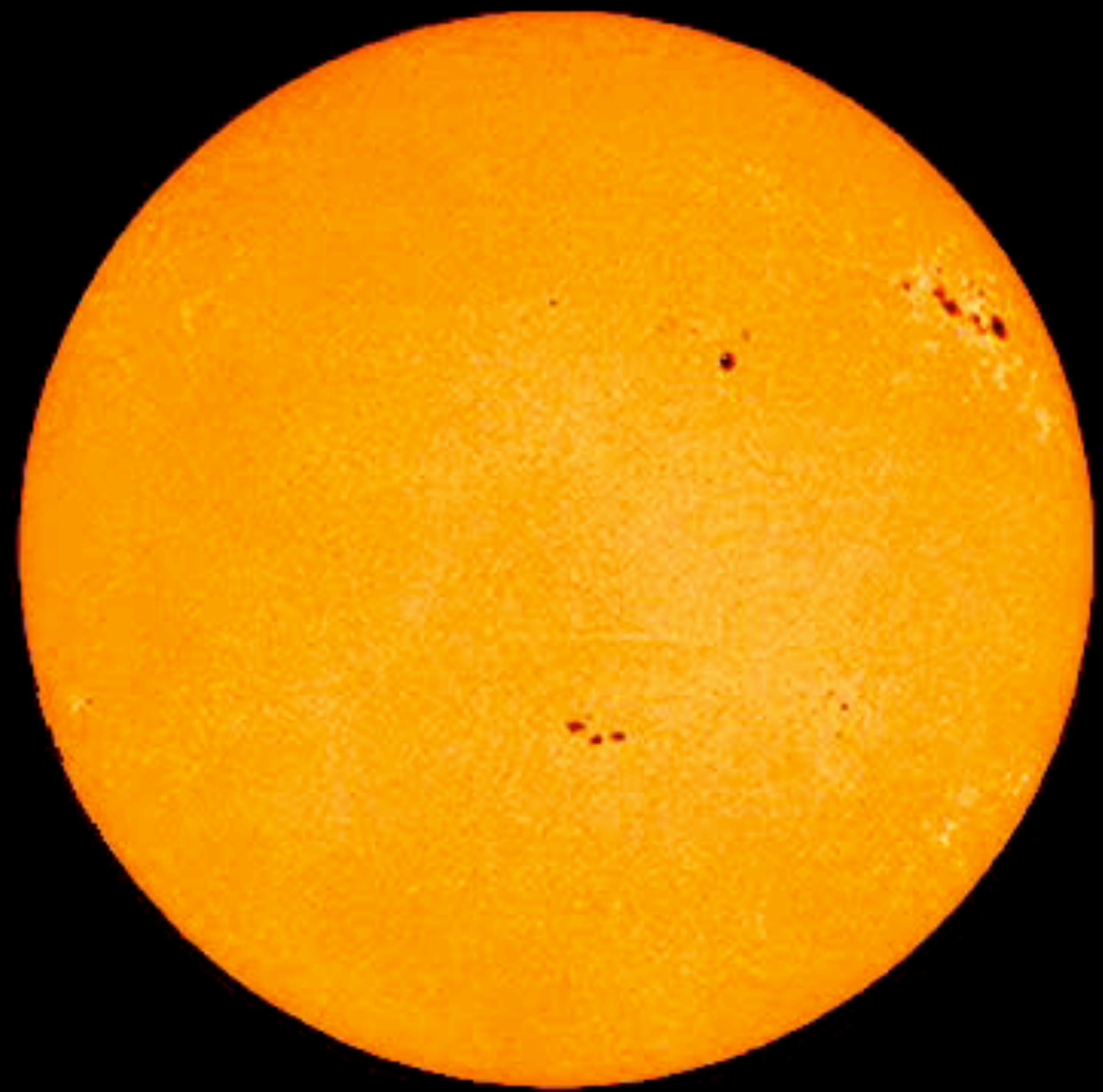
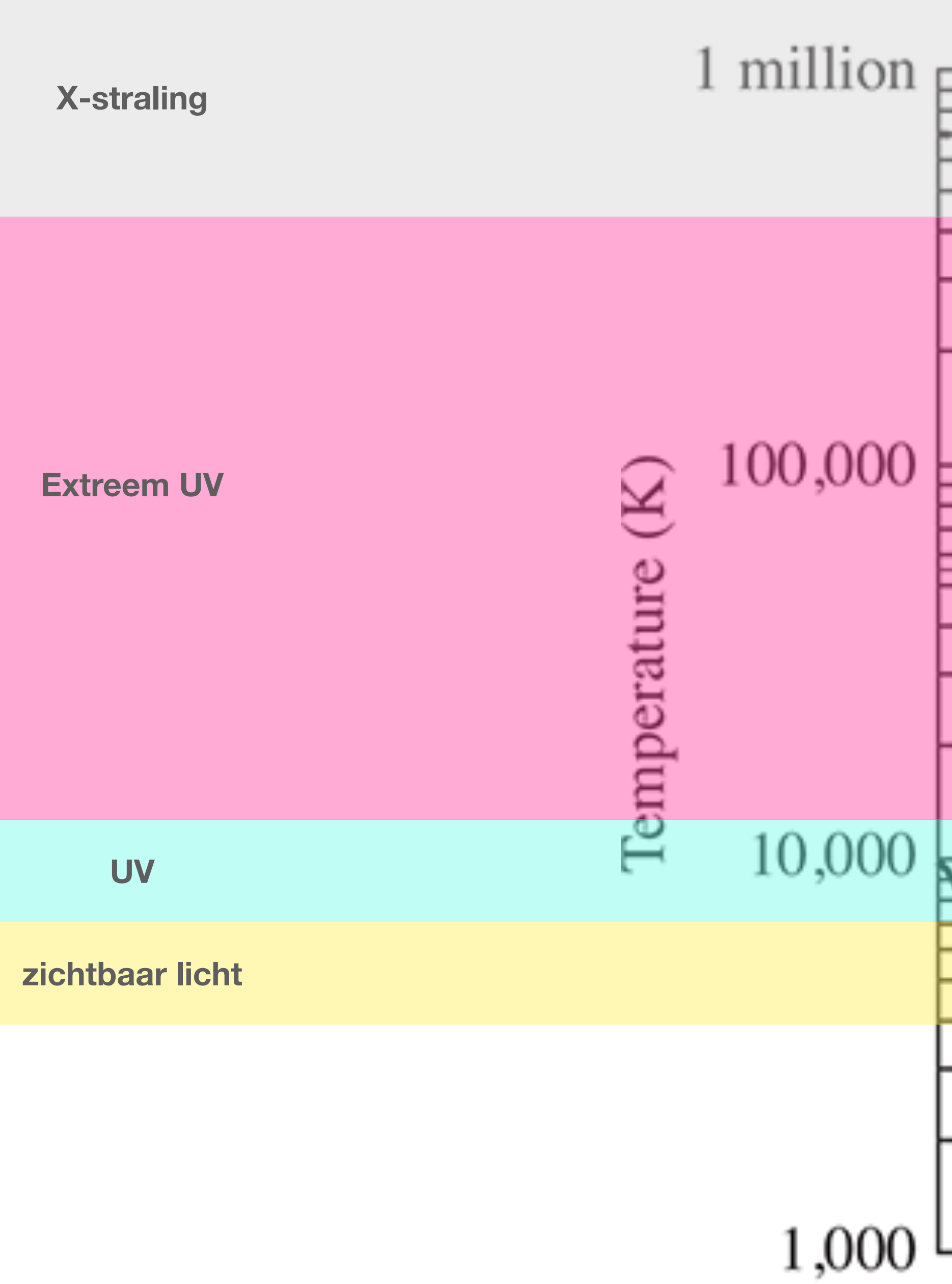
The corona: about 1 000 000 °C

The upper Chromosphere: about 10 000 °C

The lower Chromosphere: about 4000 °C

The photosphere: about 6000 °C





6,000 degrees K



The Extreme Ultraviolet Imager on Solar Orbiter





Lancering (2020 Feb 10)
met NASA Atlas raket



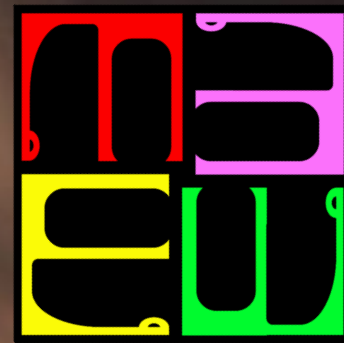
SPICE Spectrometer

STIX: X-ray Telescope

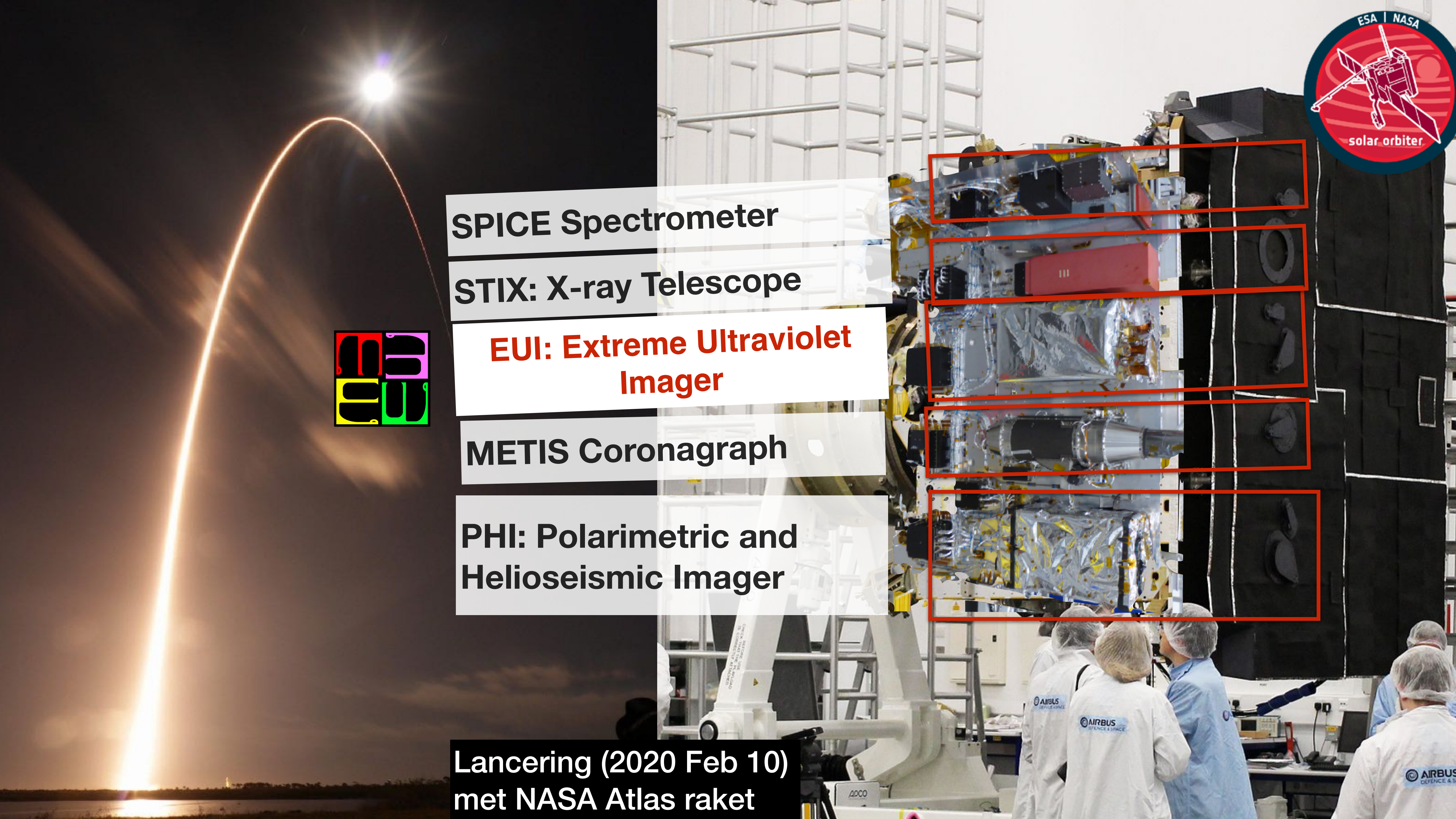
EUI: Extreme Ultraviolet Imager

METIS Coronagraph

PHI: Polarimetric and Helioseismic Imager



**Lancering (2020 Feb 10)
met NASA Atlas raket**



De "Extreme Ultraviolet Imager" (EUI) is gebouwd door:



Centre Spatial de Liège



Institut d'Astrophysique Spatiale



Laboratoire Charles Fabry,
Institut d'Optique



Max Planck Institute for
Solar System Research



Physikalisch-Meteorologisches
Observatorium Davos



UCL-Mullard Space Science Laboratory



Koninklijke Sterrenwacht van België



Full Sun
Imager

High
Resolution
EUV

High
Resolution
Lyman-a

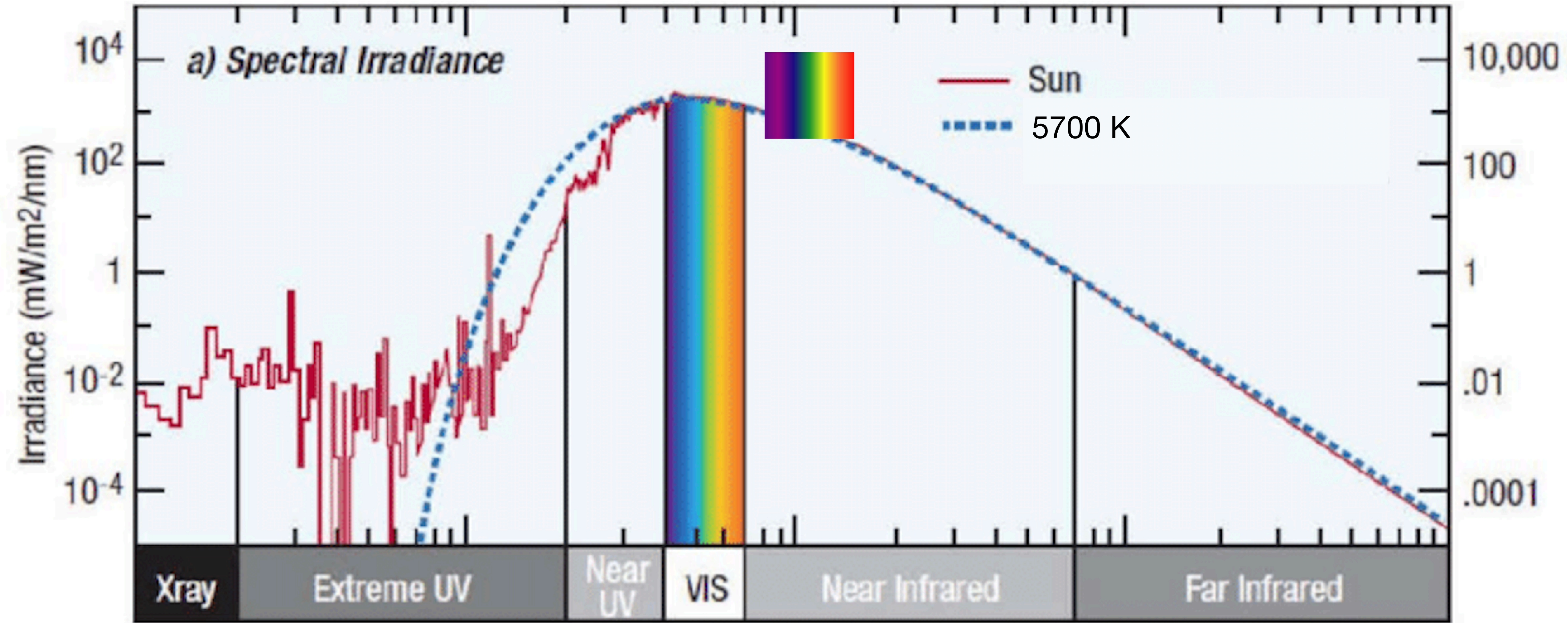


EUI OBS ST

30mm

47.4mm

2.75mm edge



Vanwege de kleine gaten in het hitteschild is het nodig om heldere delen van het spectrum te gebruiken

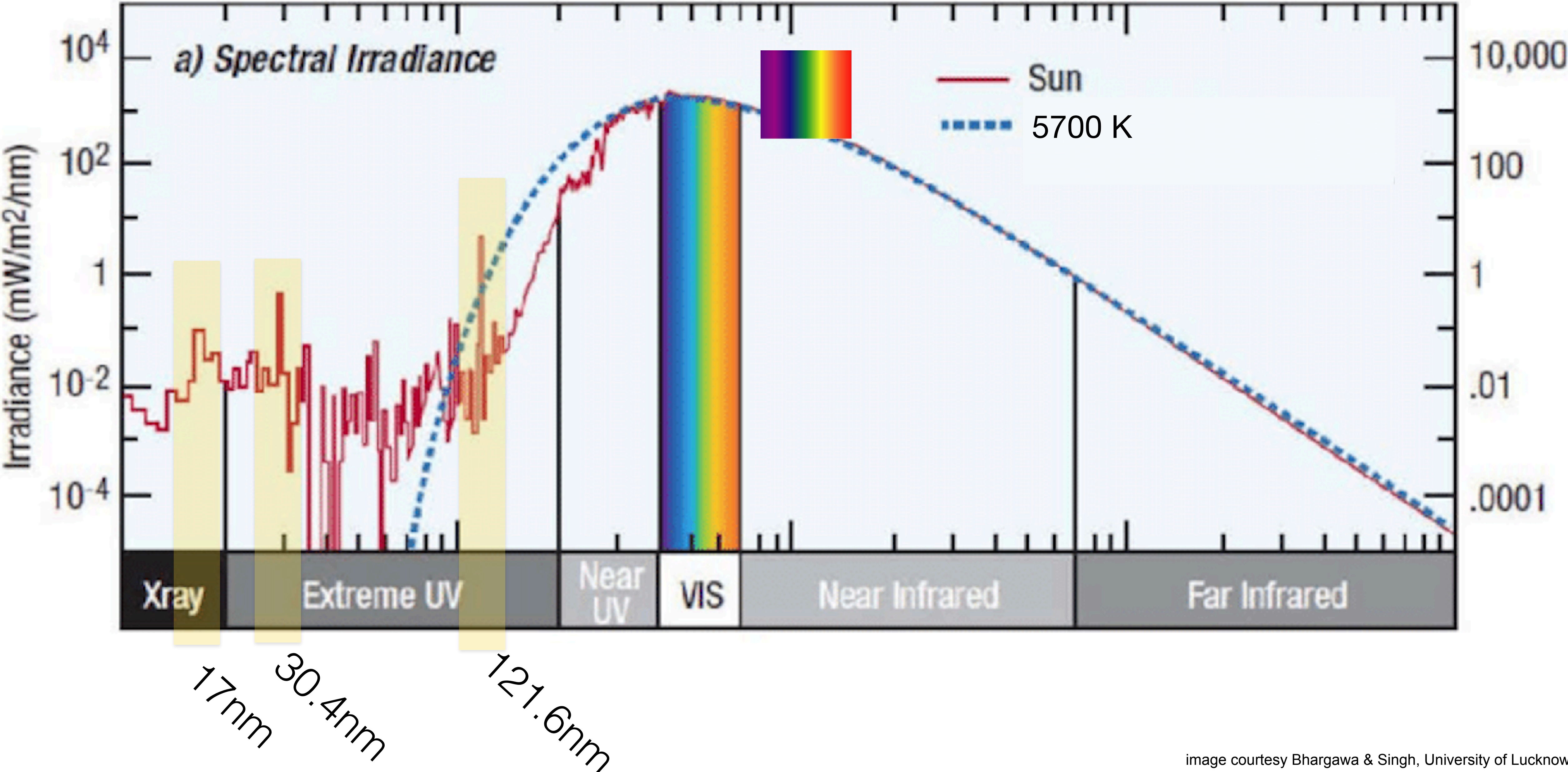
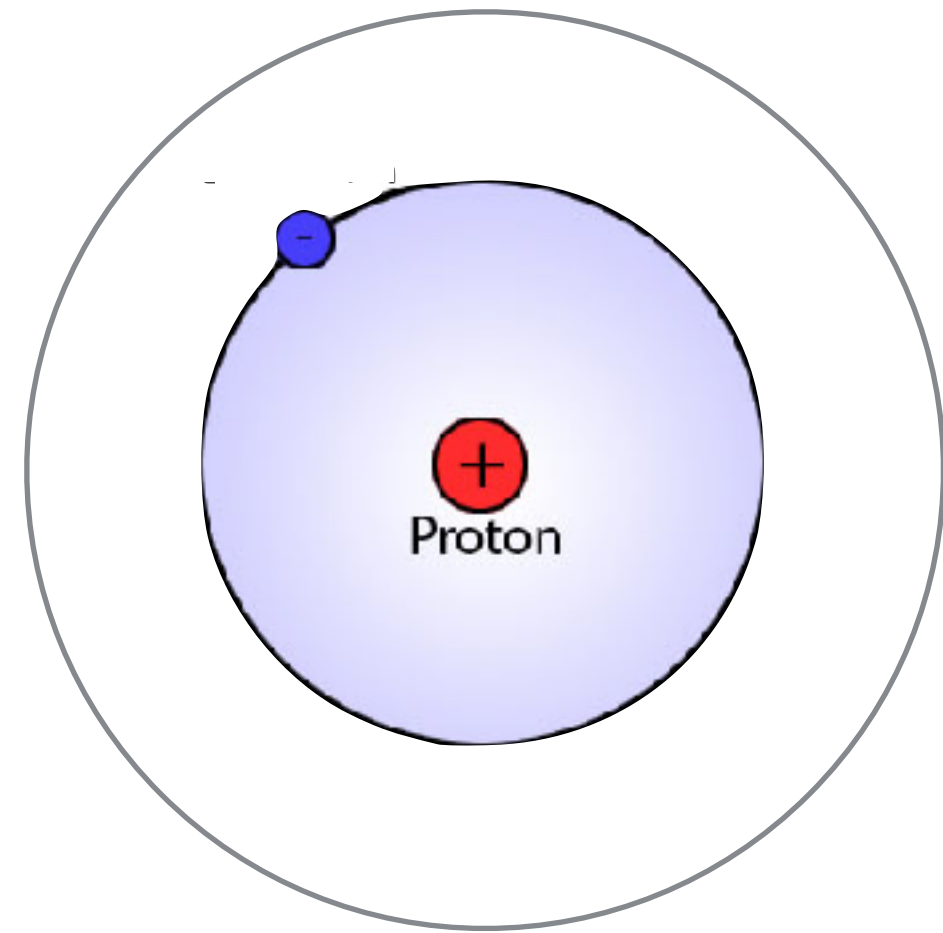
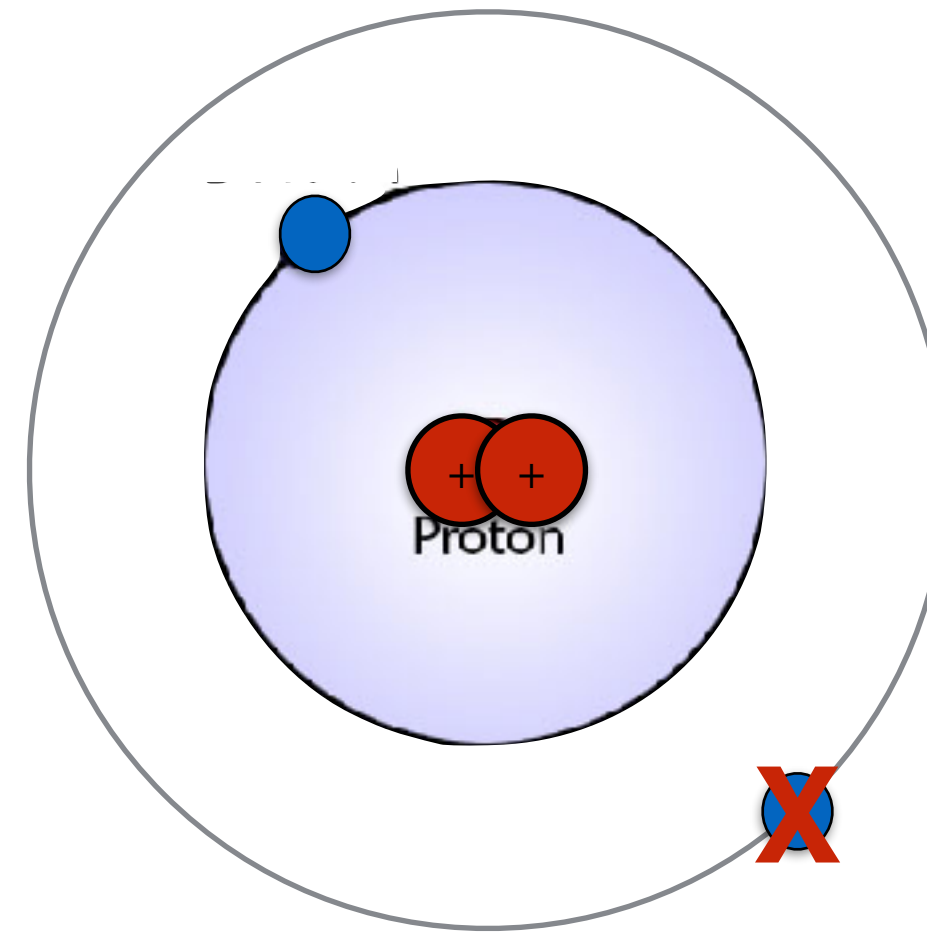


image courtesy Bhargawa & Singh, University of Lucknow

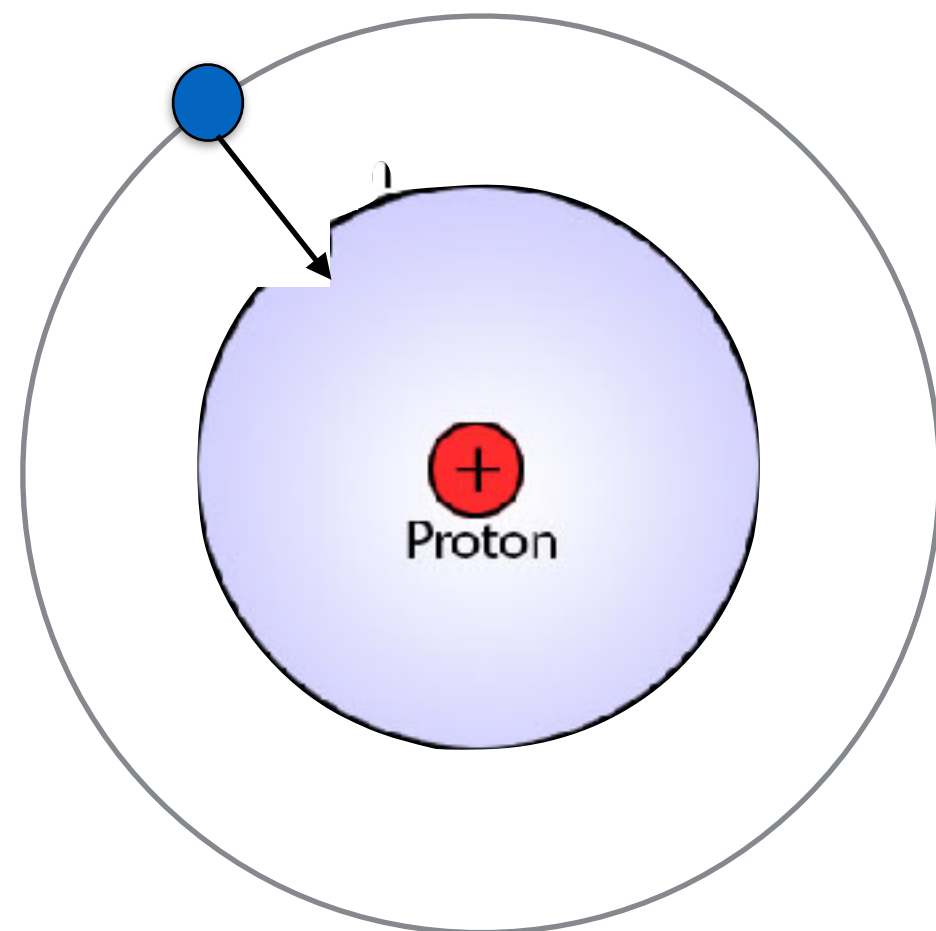
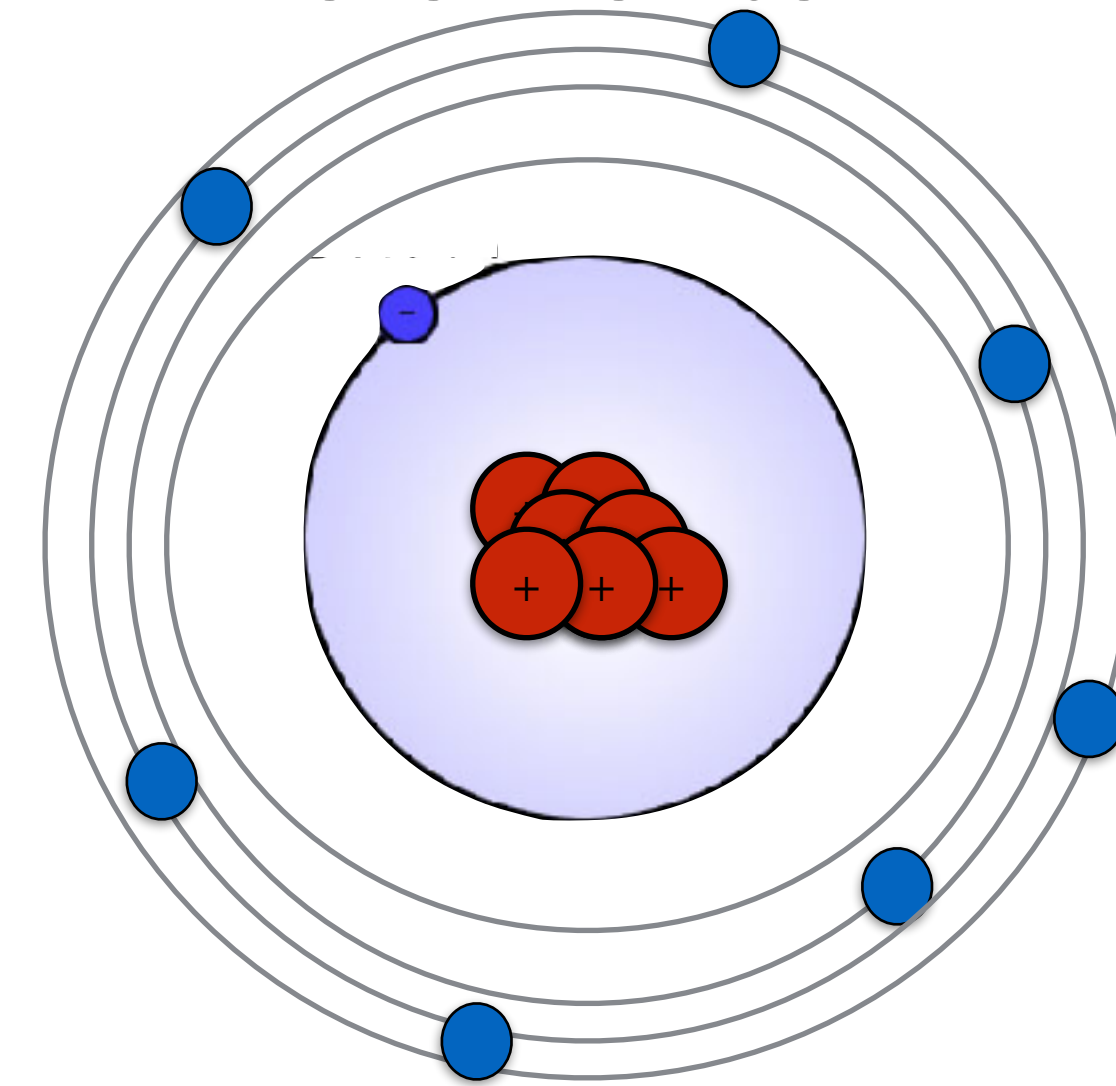
>70% waterstof



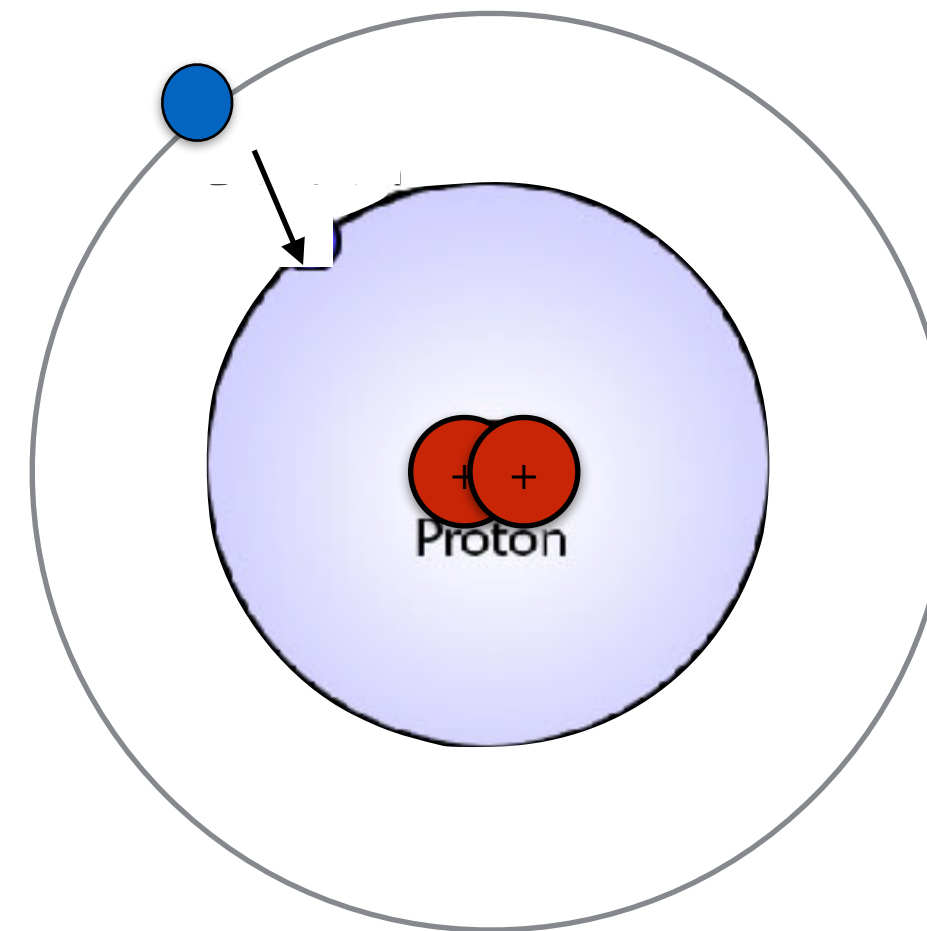
<30% helium



1% zwaardere elementen



H I Lyman alfa 121.6nm
chromosfeer

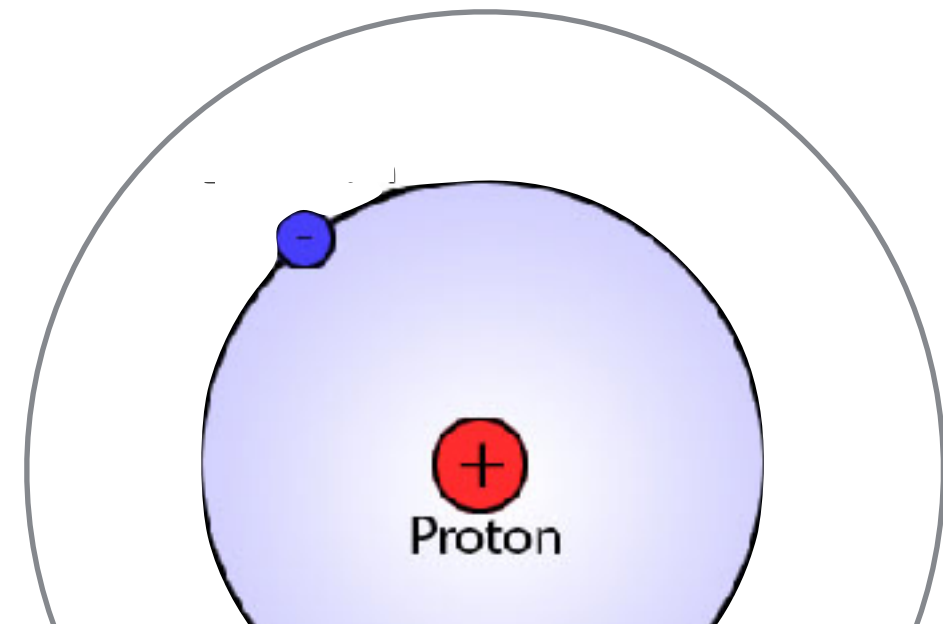


He II 30.4nm
transitie laag

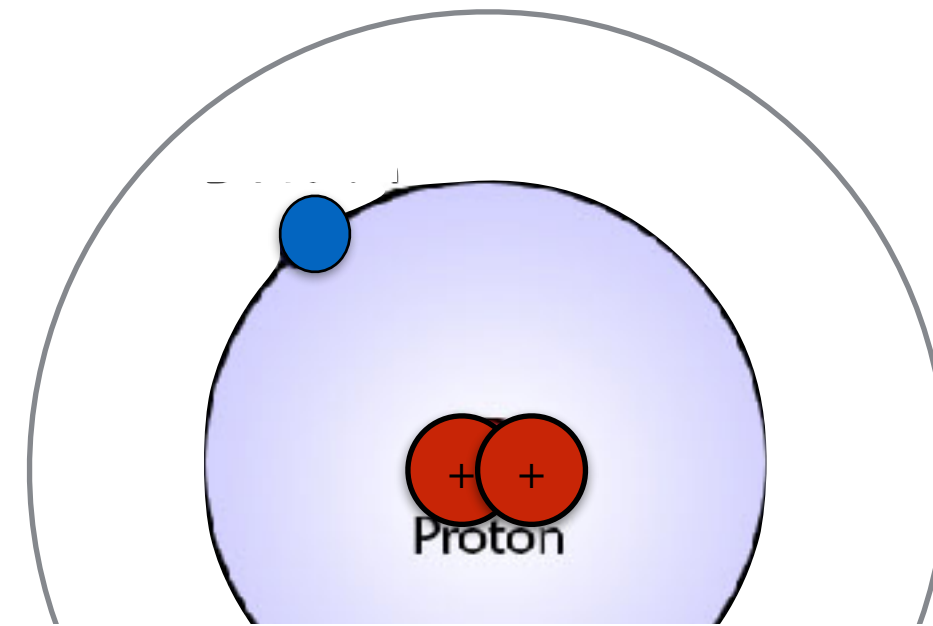
...te ingewikkeld...

Fe IX, X, XI ~ 17nm
lage corona

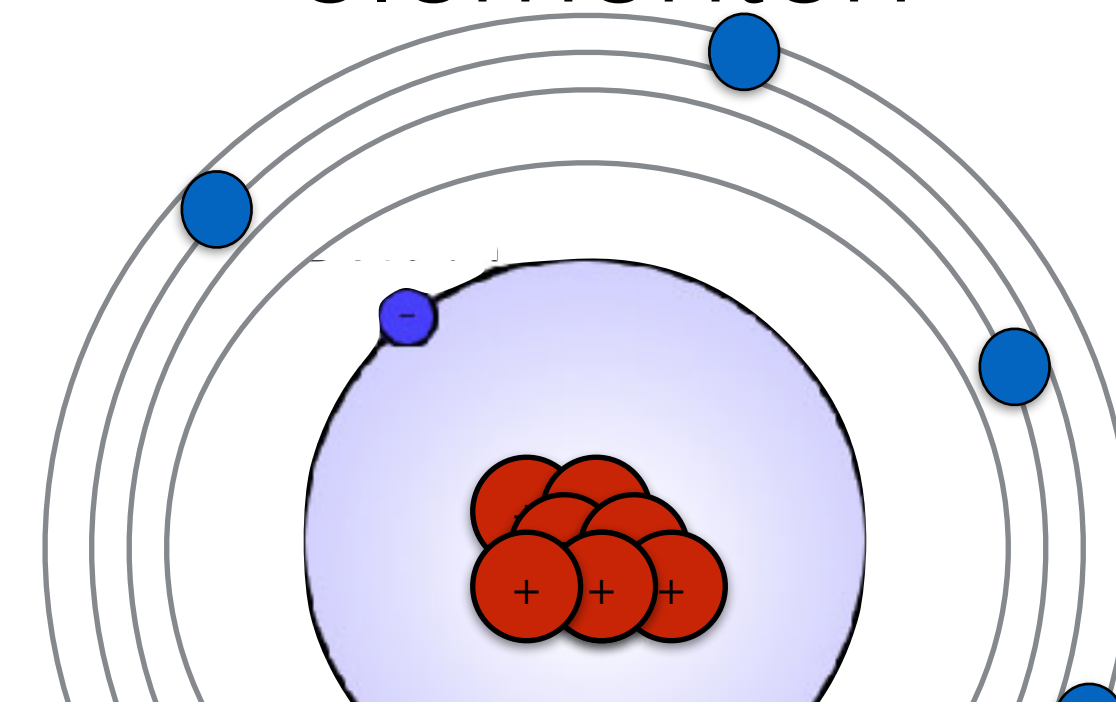
>70% waterstof



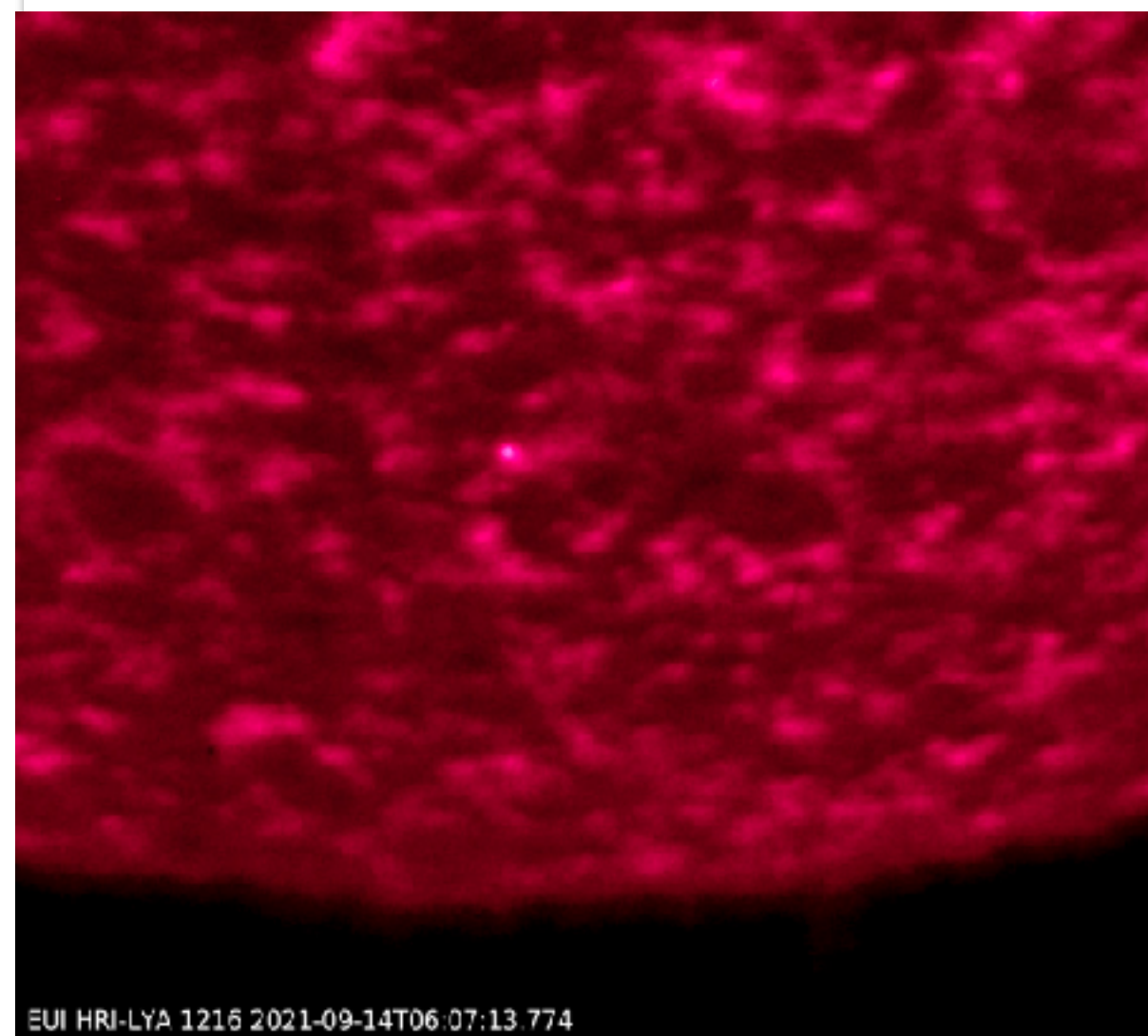
<30% helium



1% zwaardere elementen

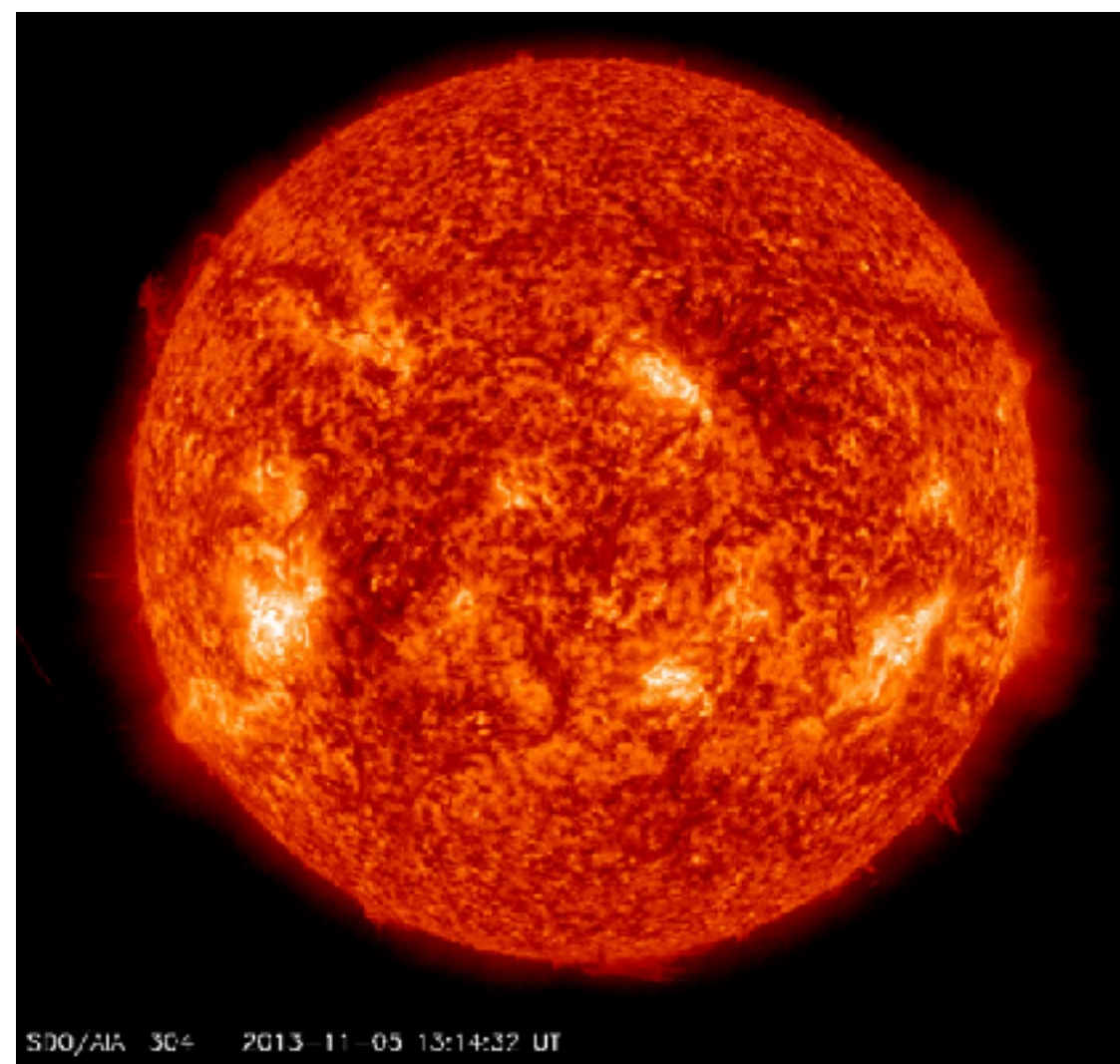


EUI/HRIEUV



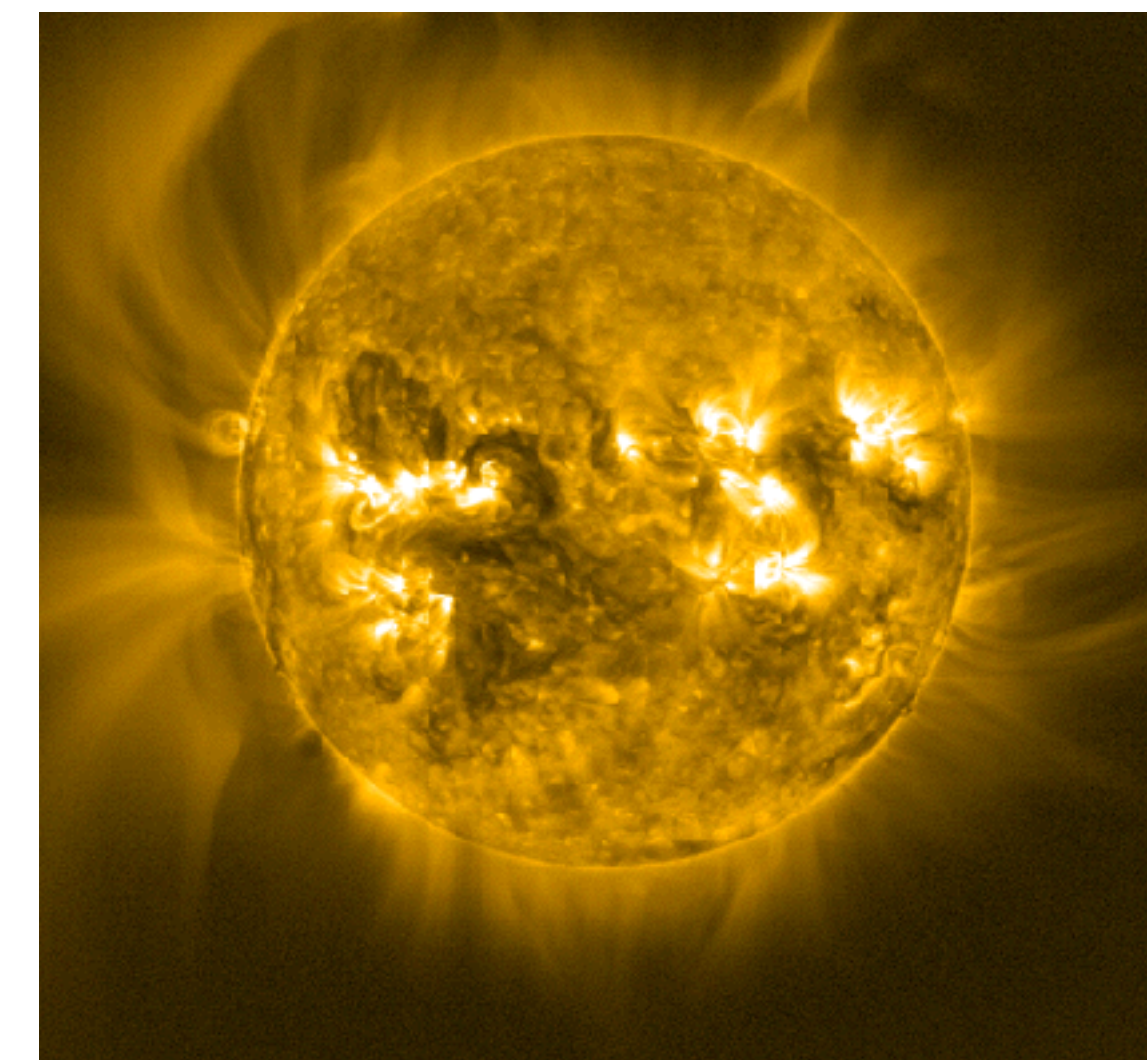
H I Lyman alfa 121.6nm
chromosfeer

SDO/AIA

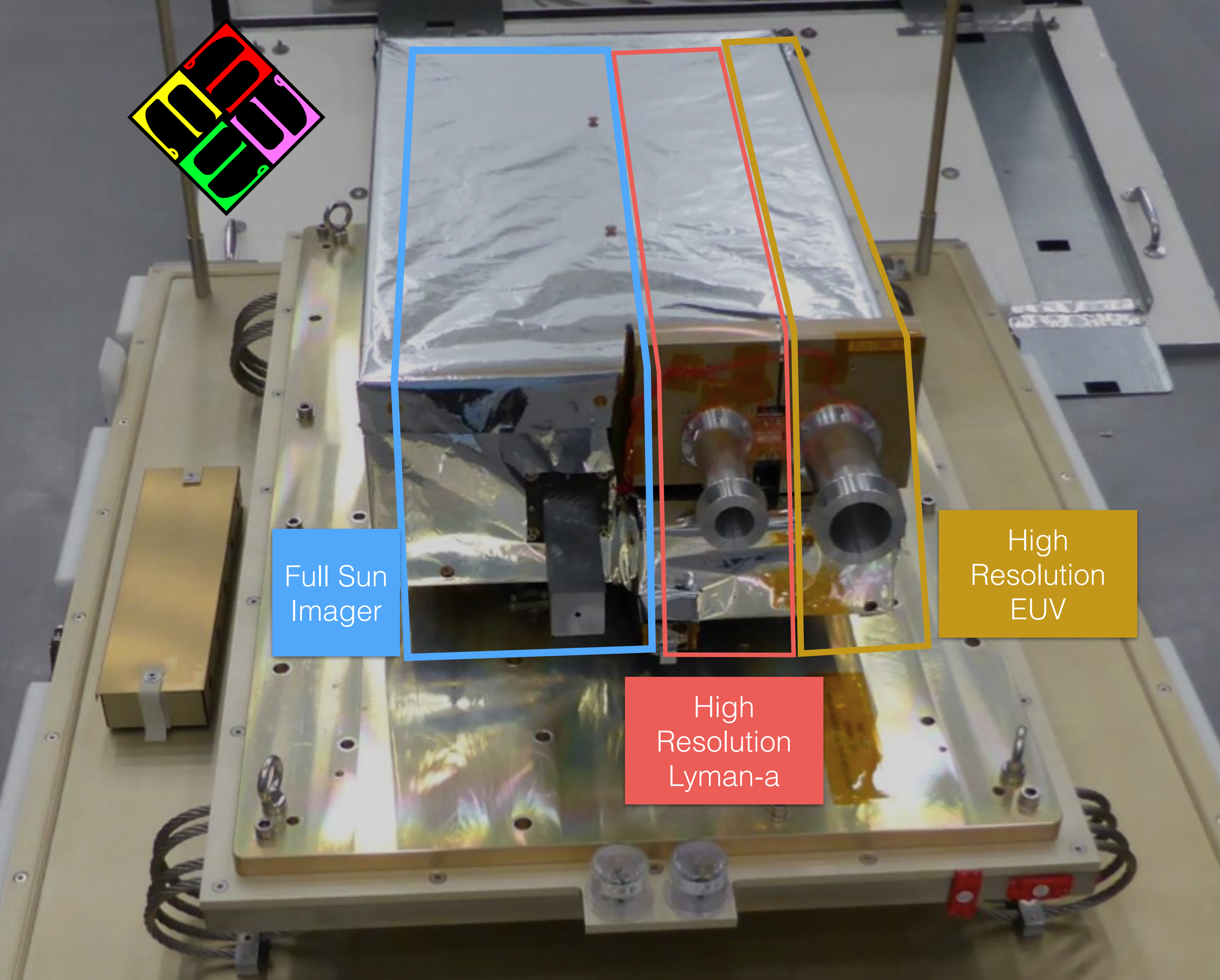


He II 30.4nm
transitie laag

PROBA2/SWAP



Fe IX, X, XI ~ 17nm
lage corona



Full Sun Imager

High Resolution Lyman-a

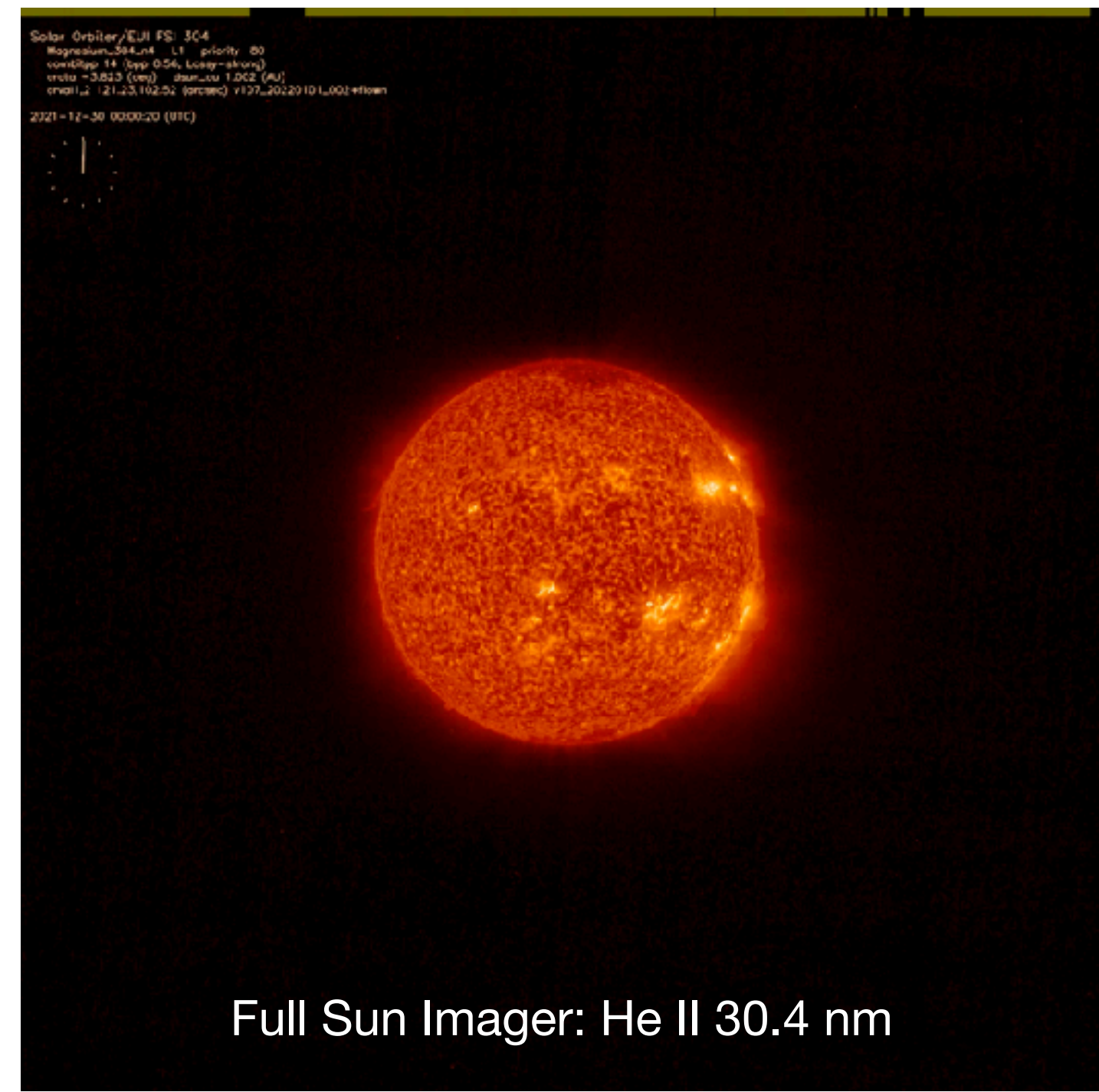
High Resolution EUV

	FSI	HRIEUV HRILYA
beeldveld	3.8 deg ~ 4 Rs	17 arcmin ~ 0.3 Rs
pixelhoek	~4.5 arcsec ~920km	~0.5 arcsec ~100km
beeld frequentie	minuten	seconden

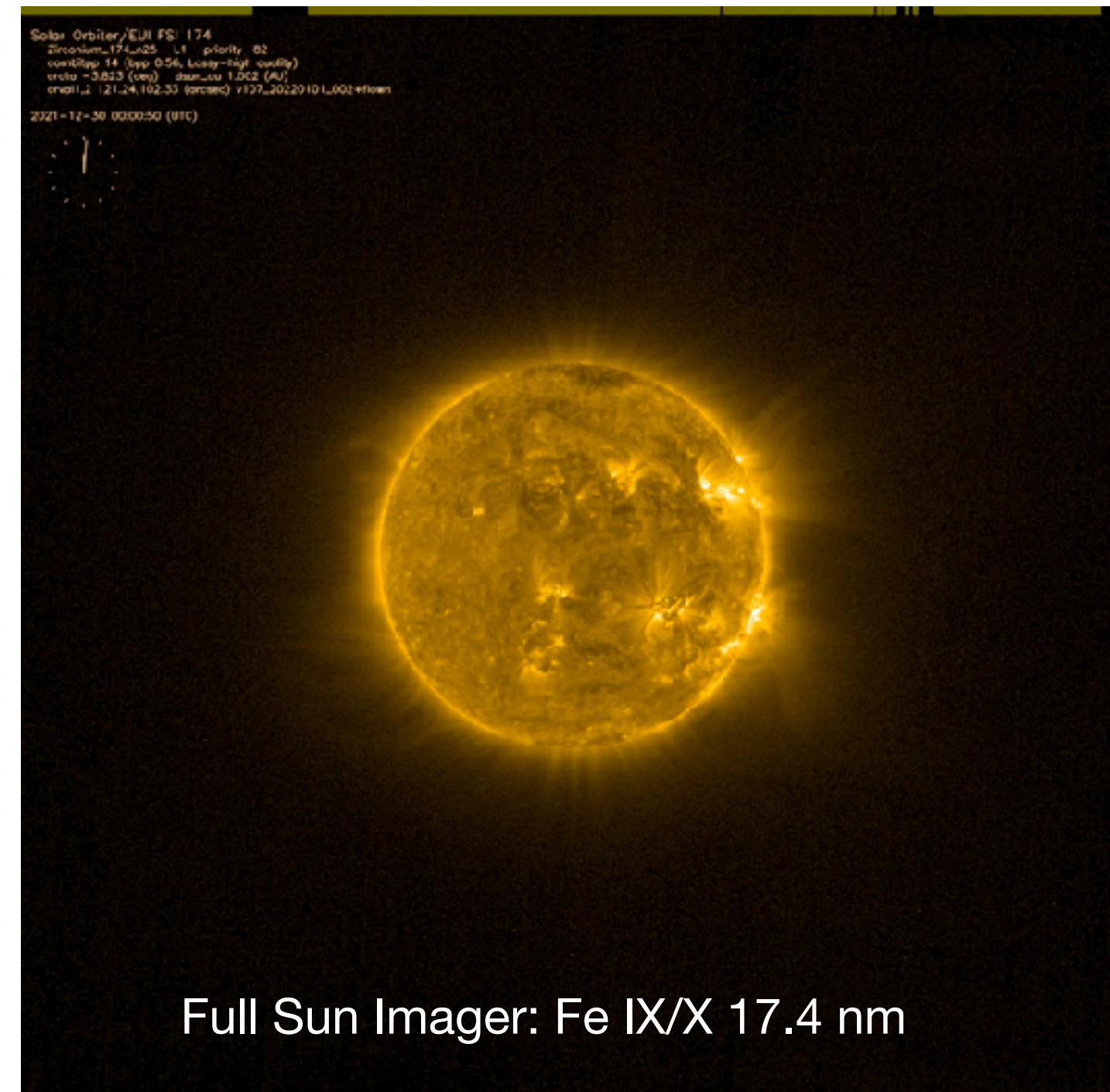
rood: bij perihelium



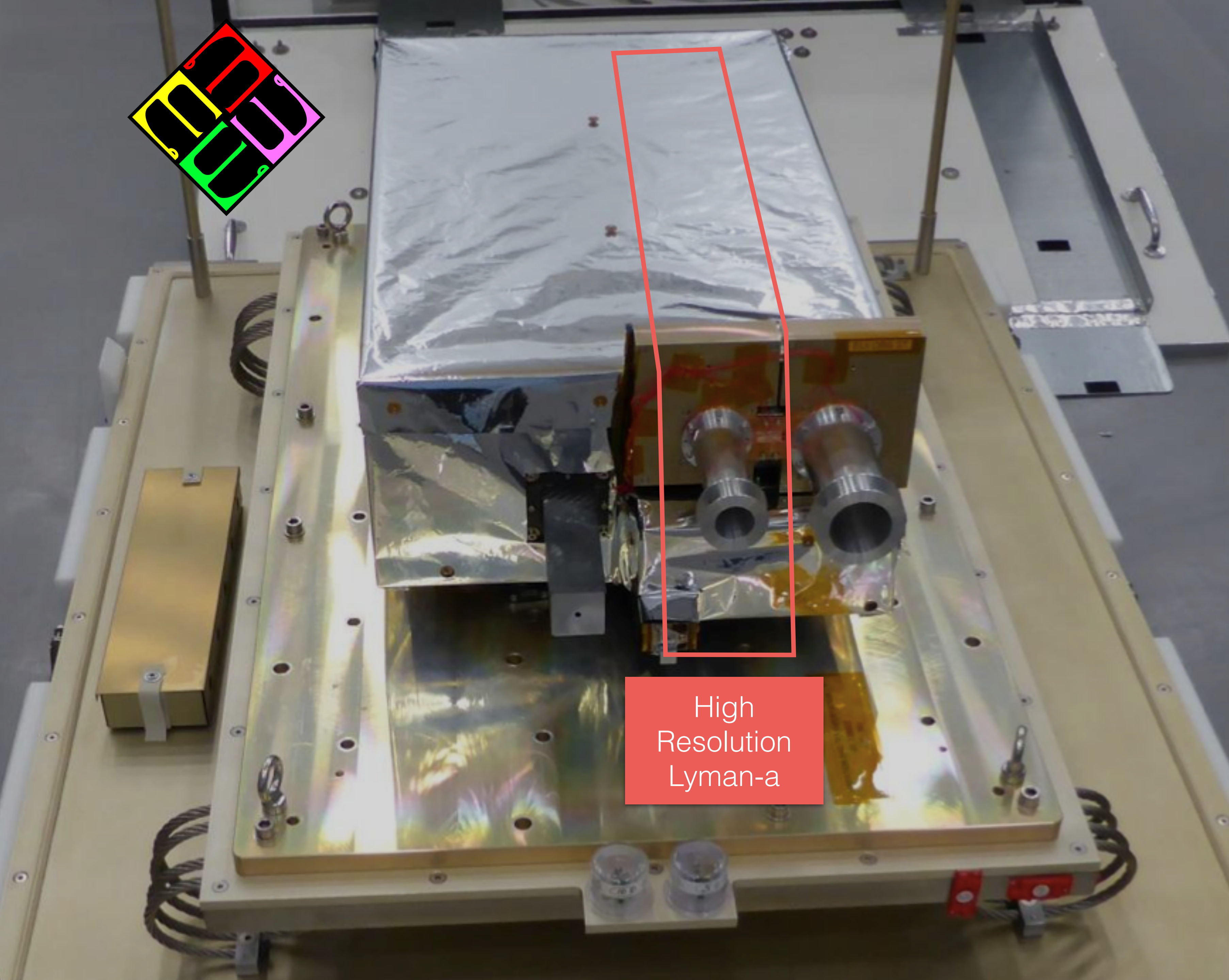
Full Sun
Imager



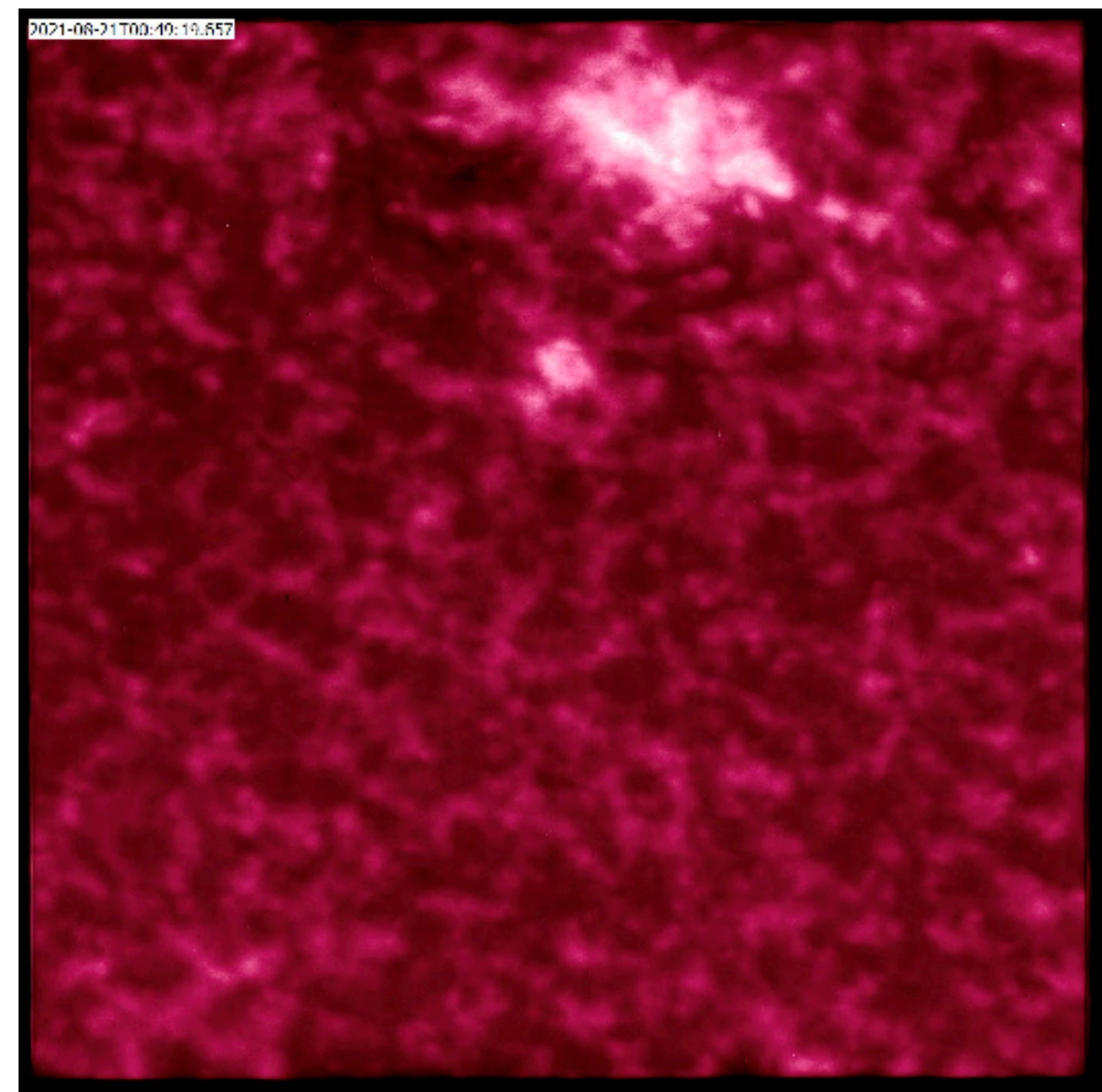
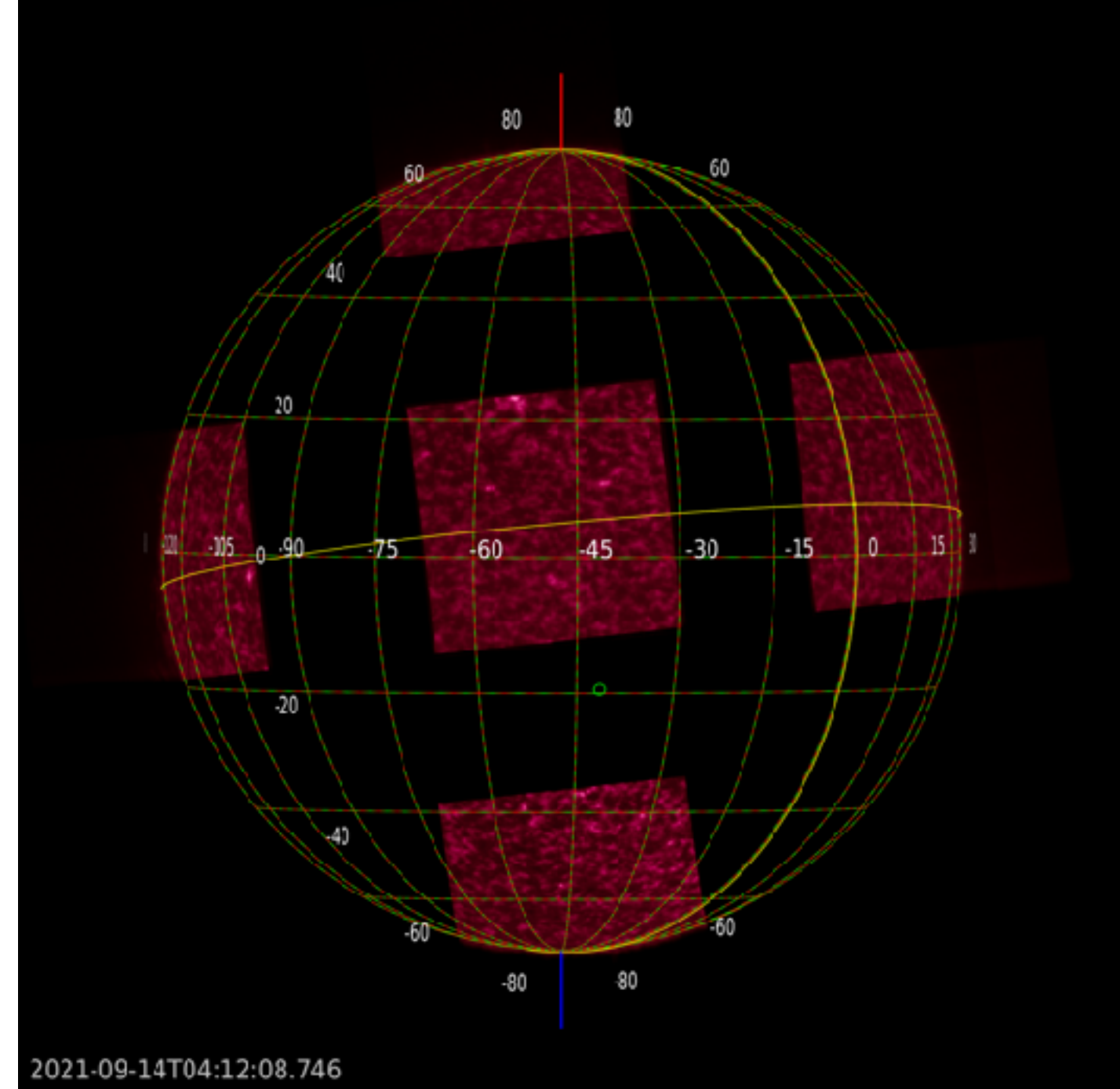
Full Sun Imager: He II 30.4 nm

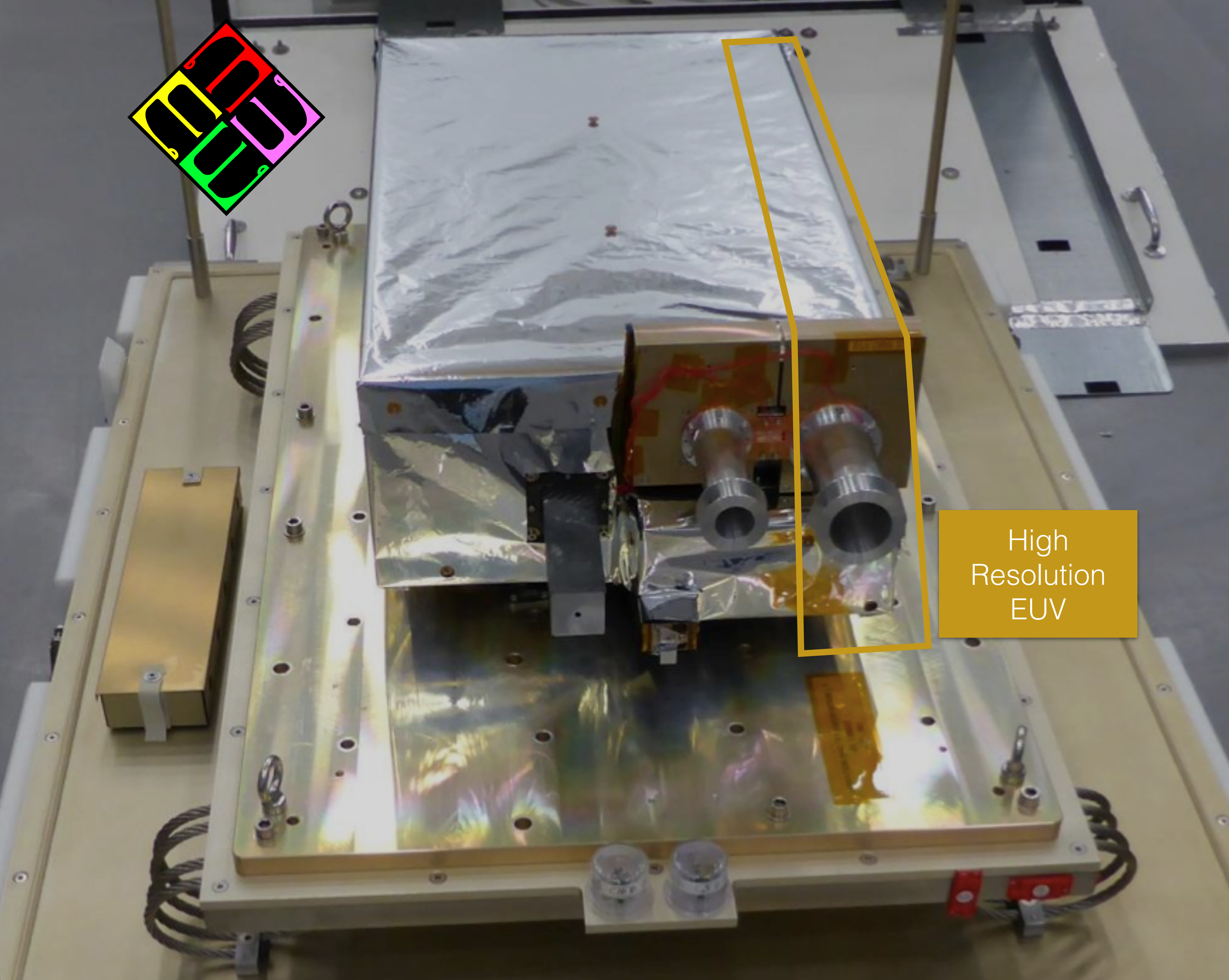


Full Sun Imager: Fe IX/X 17.4 nm

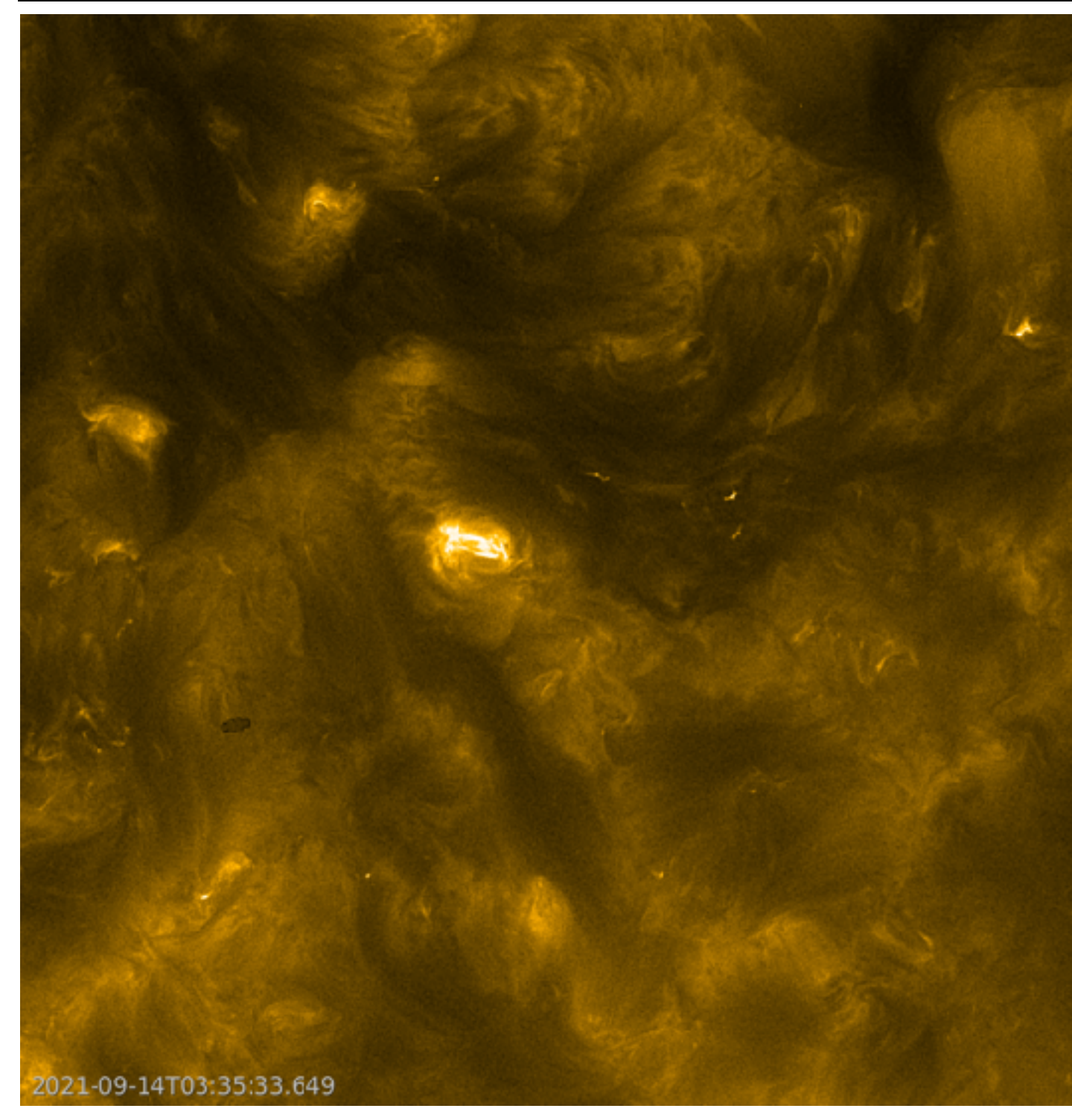
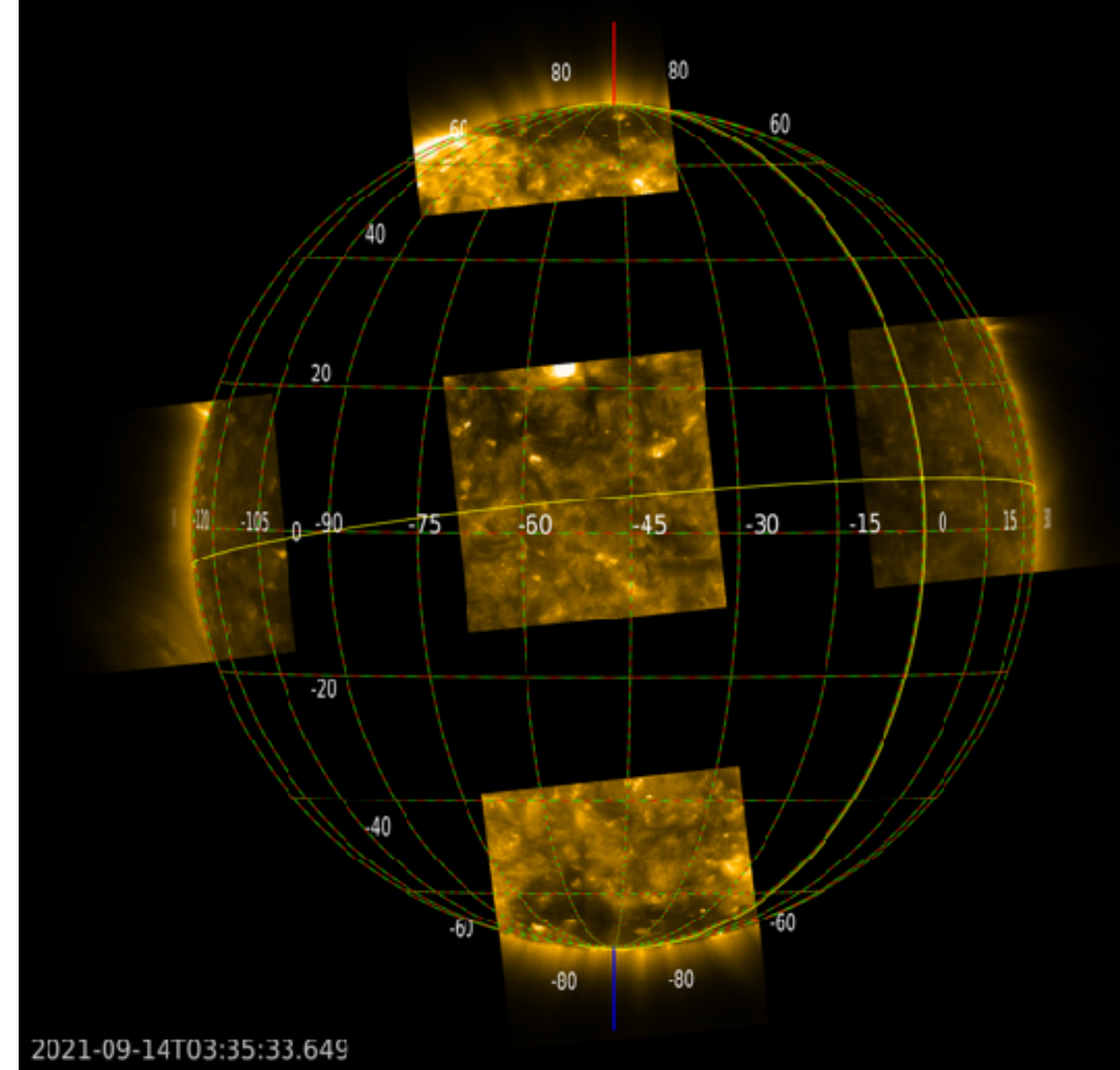


High Resolution Lyman-a





High Resolution EUV



2022 maart 7
op 1 lijn met de aarde

5x5 Mosaic image made by HRIEUV telescope of EUI on 2022 March 7
Solar Orbiter was halfway the Earth-Sun line

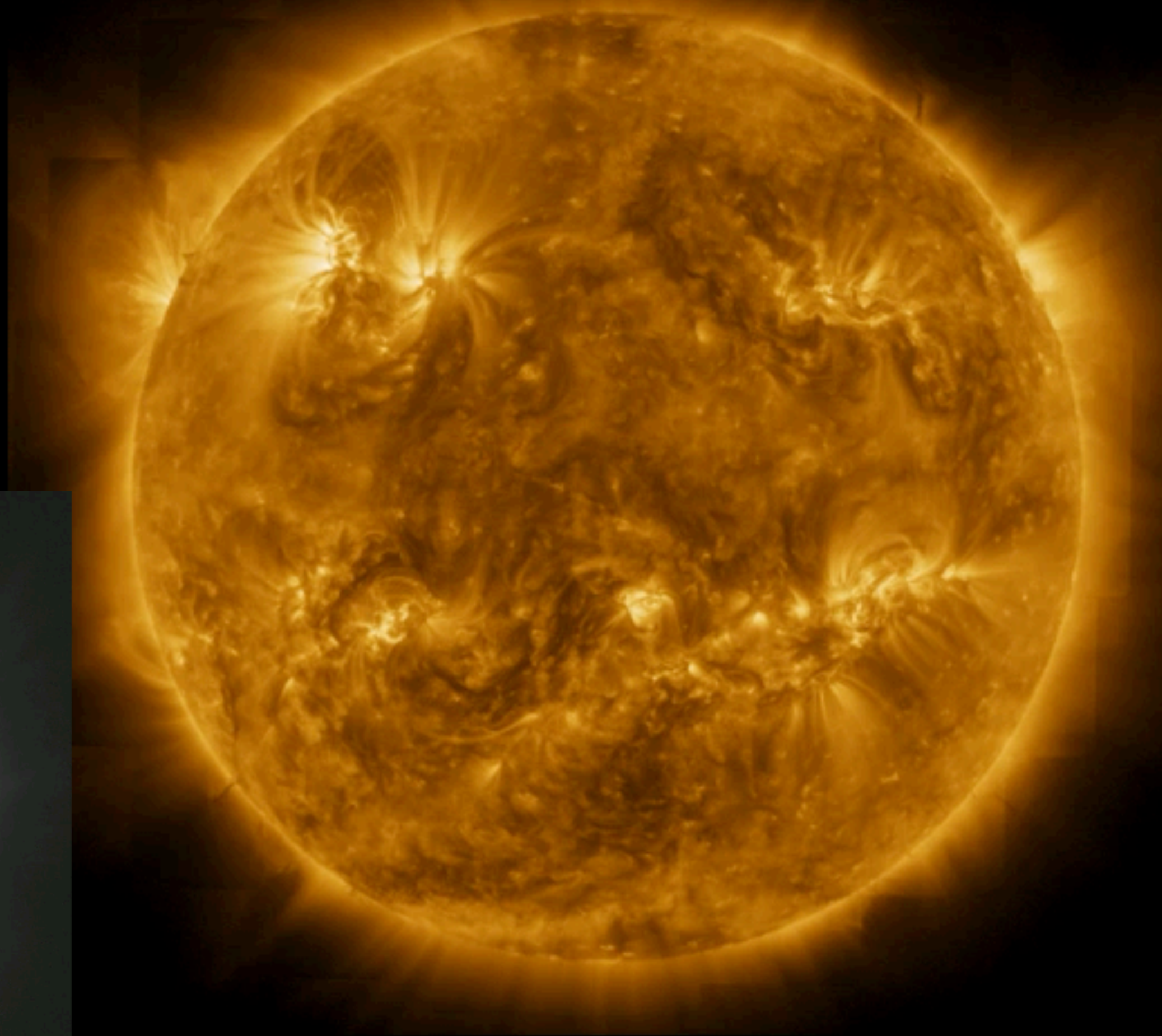
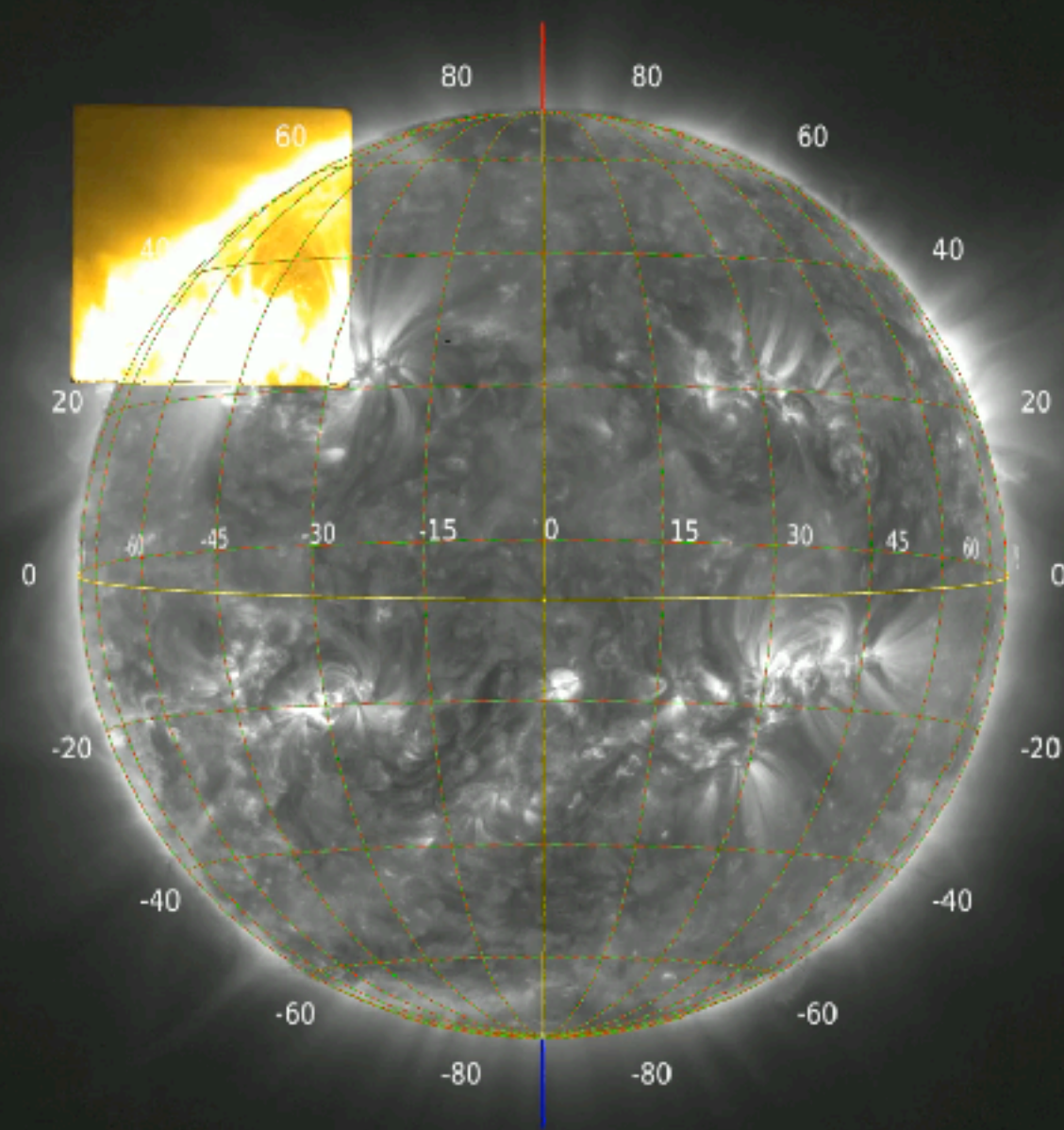


Image processing by Emil Kraaikamp (ROB)
ESA&NASA/Solar Orbiter/EUI team



5x5 Mosaic image made by HRIEUV telescope of EUI on 2022 March 7
Solar Orbiter was halfway the Earth-Sun line

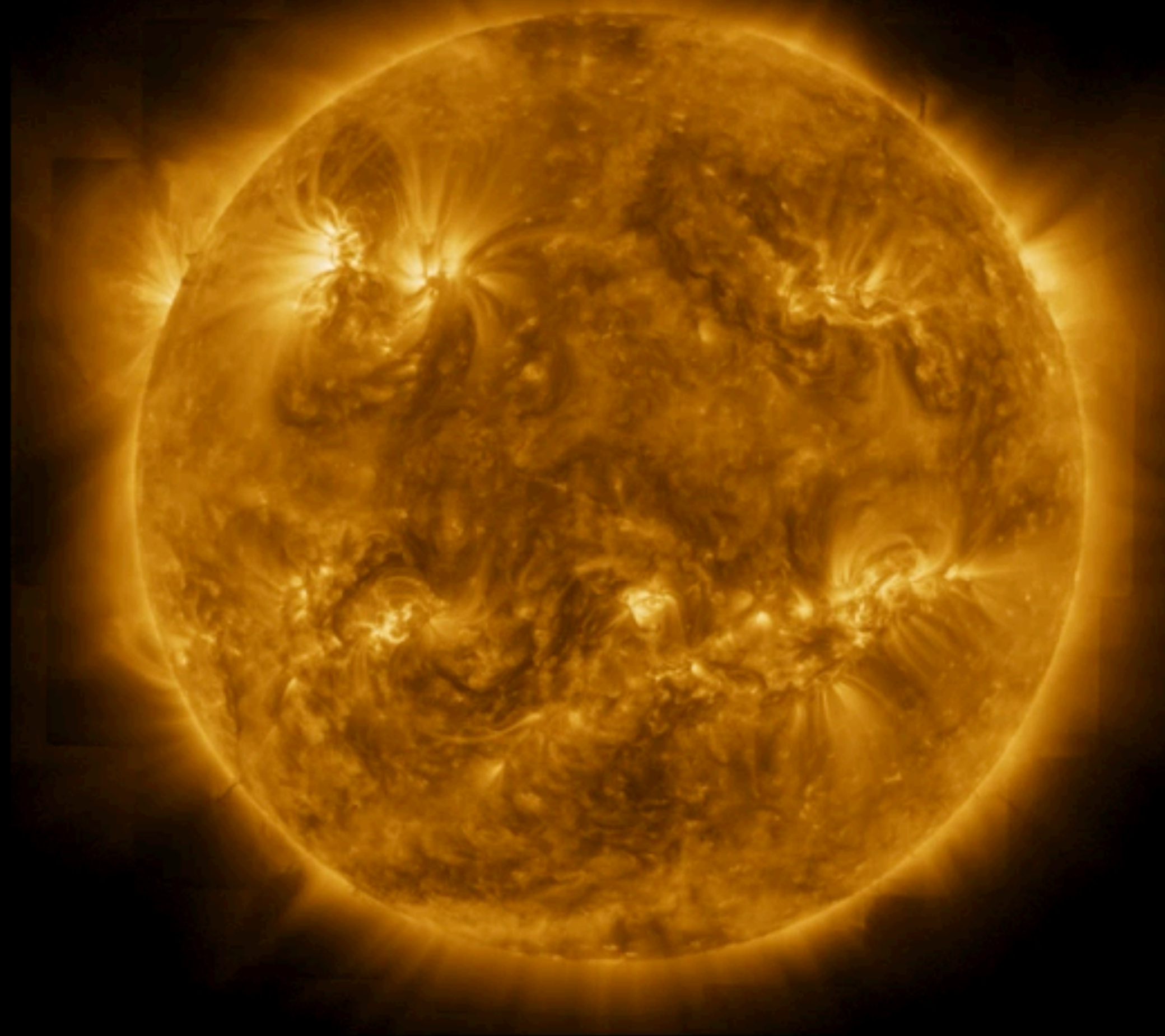
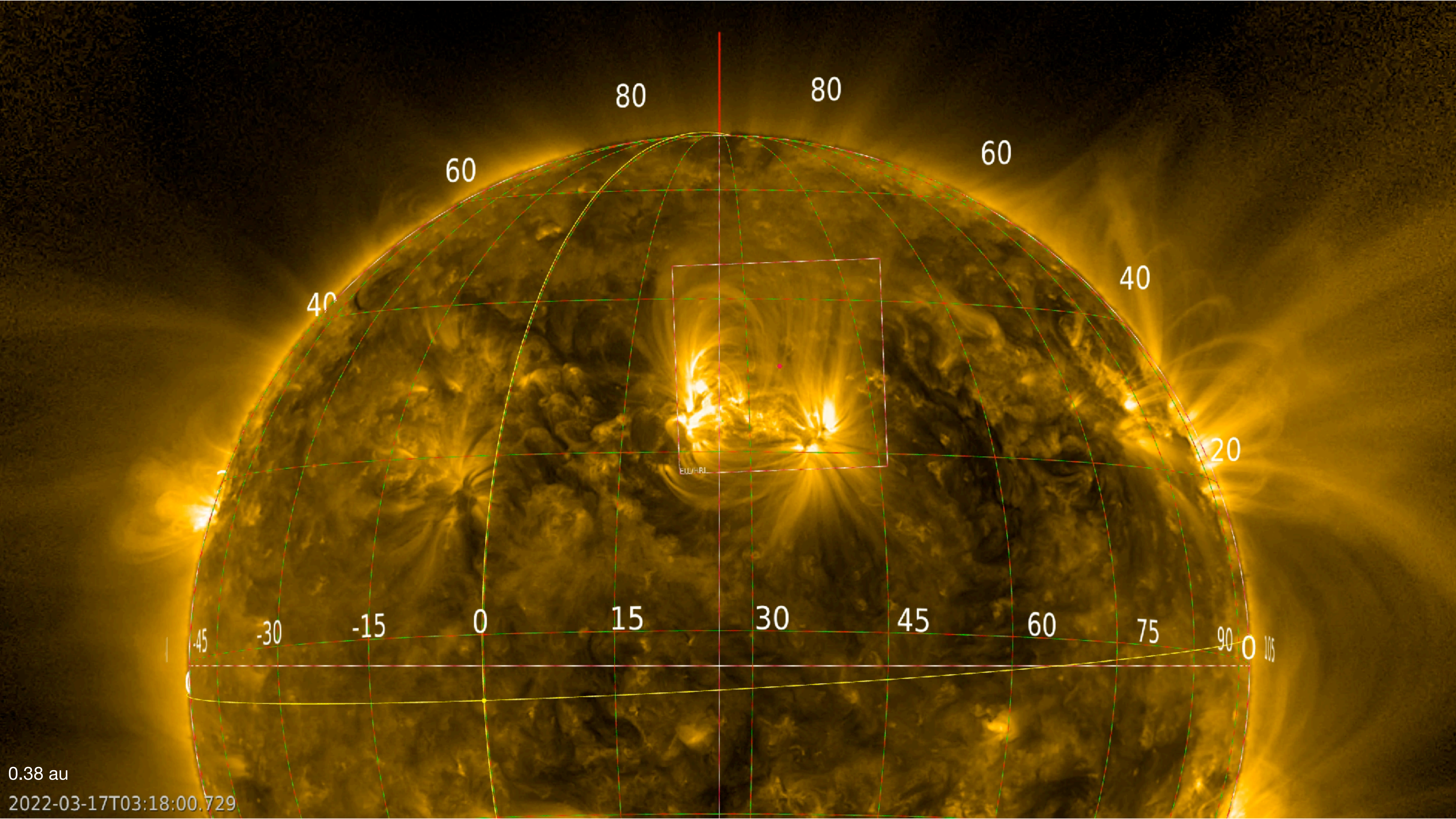


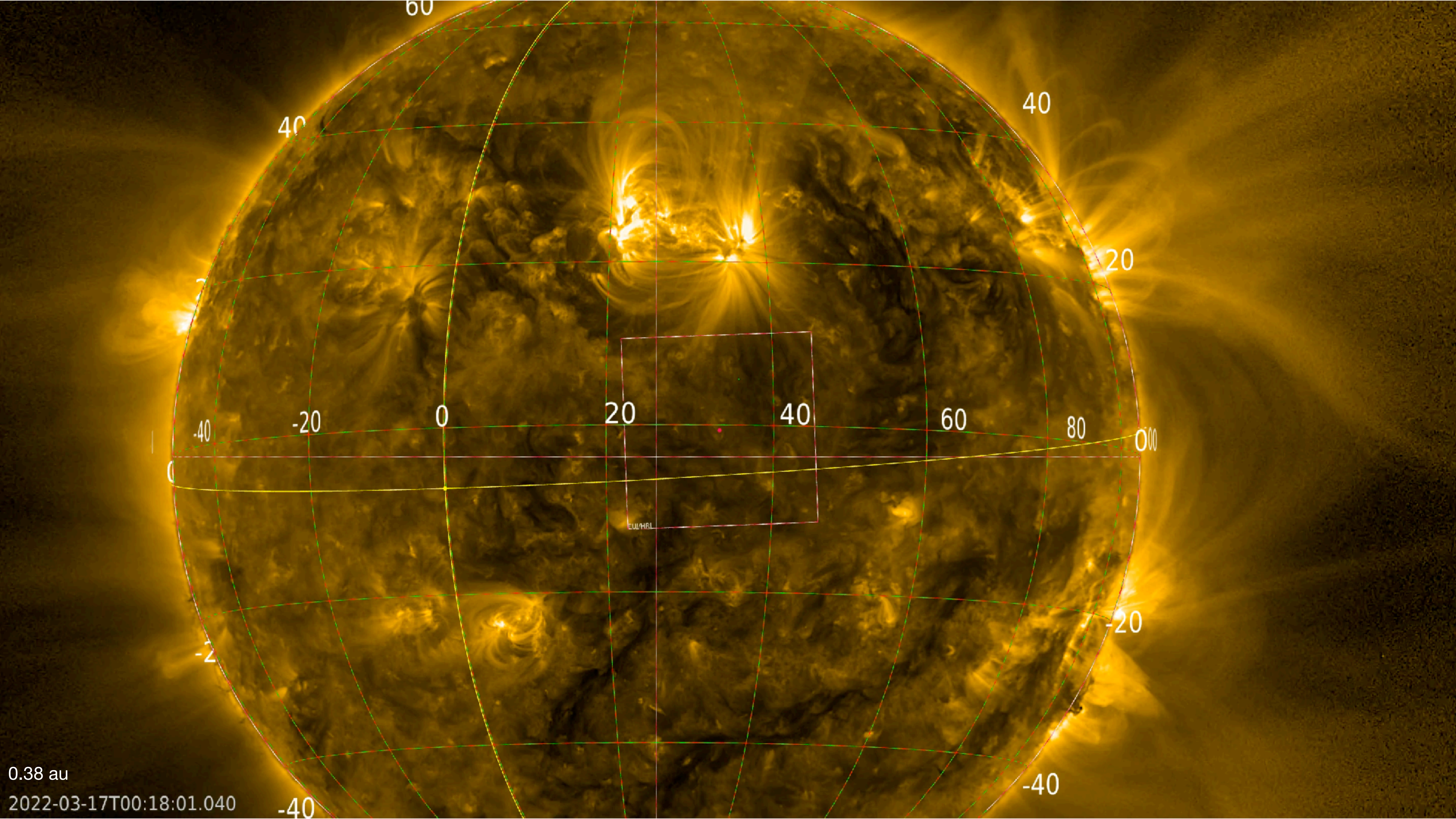
Image processing by Emil Kraaikamp (ROB)
ESA&NASA/Solar Orbiter/EUI team

**2022 maart 17-30
perihelium**



0.38 au

2022-03-17T03:18:00.729

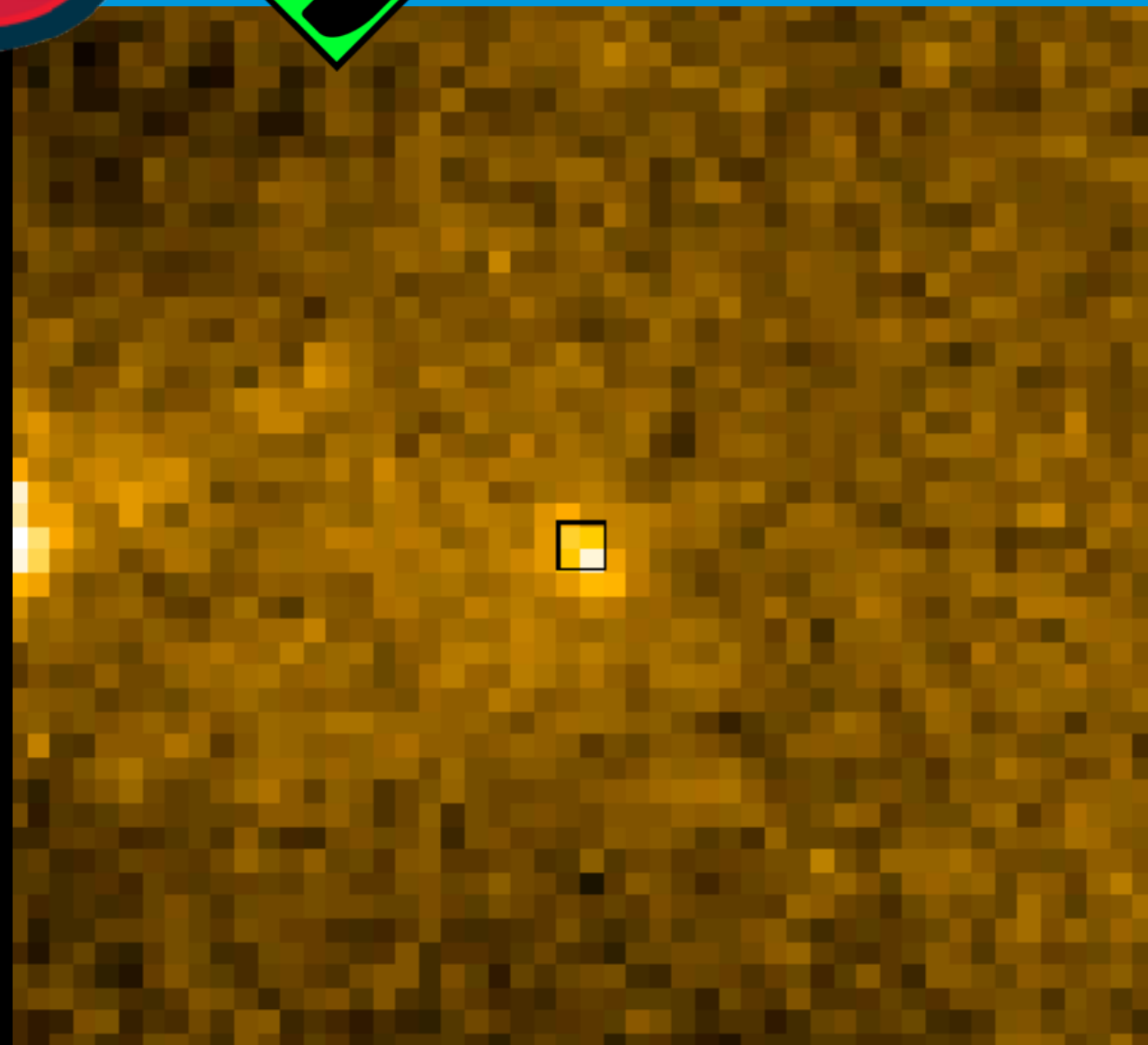
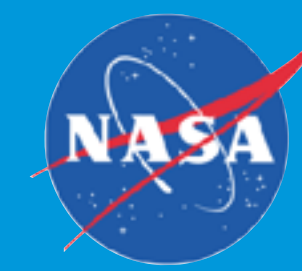


0.38 au

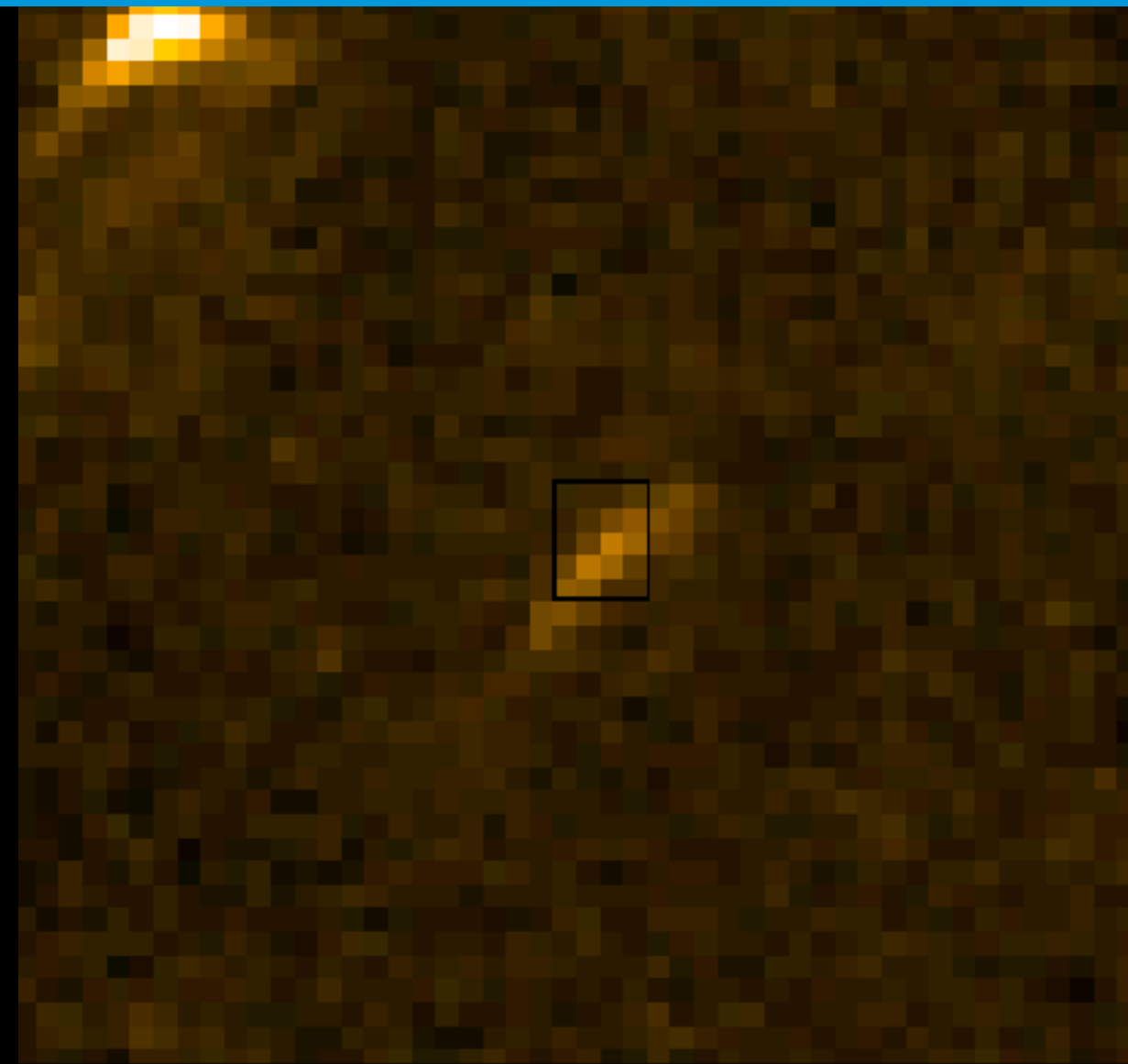
2022-03-17T00:18:01.040



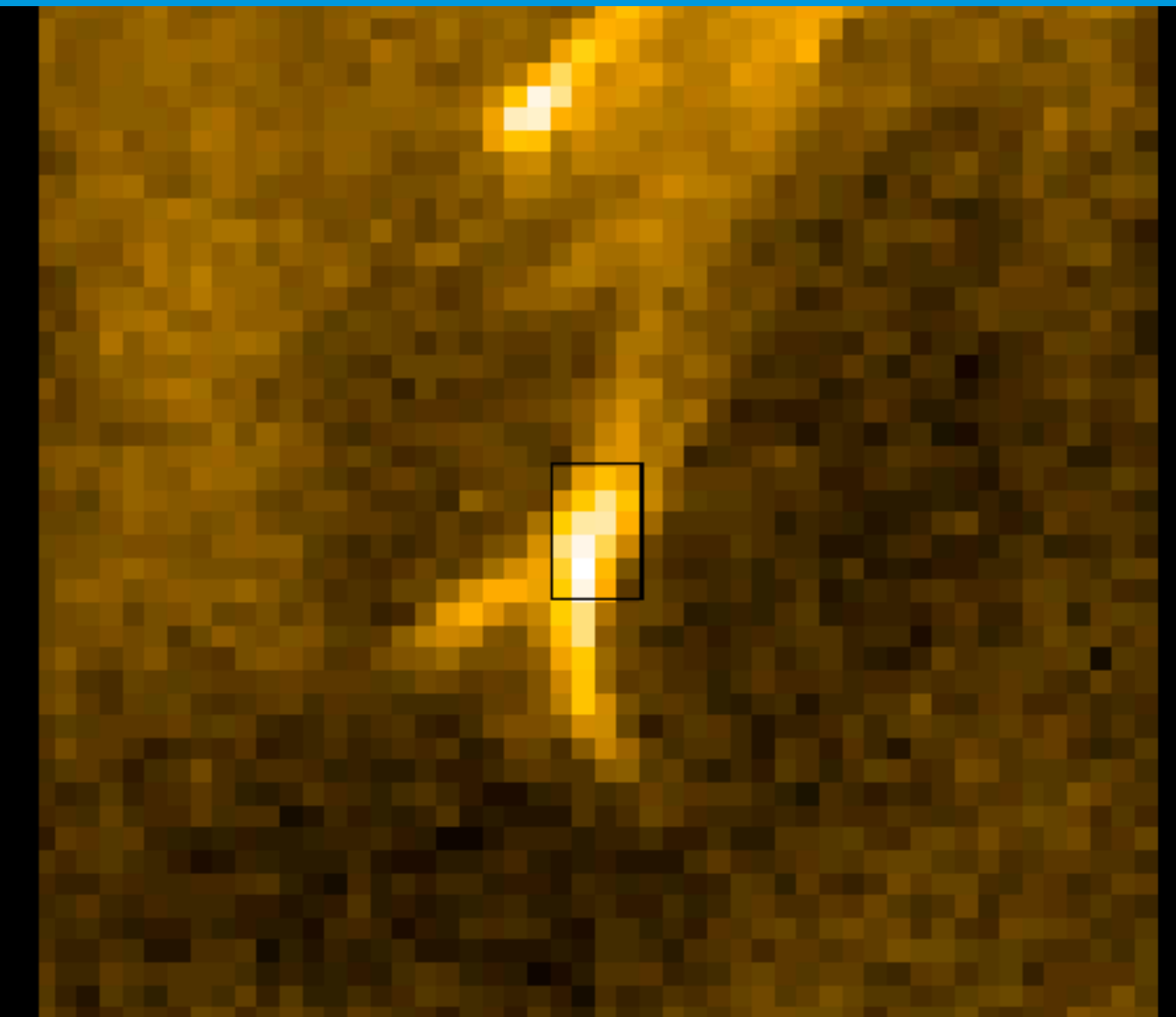
Campfires = Quiet Sun EUV brightenings Observed by HRIEUV



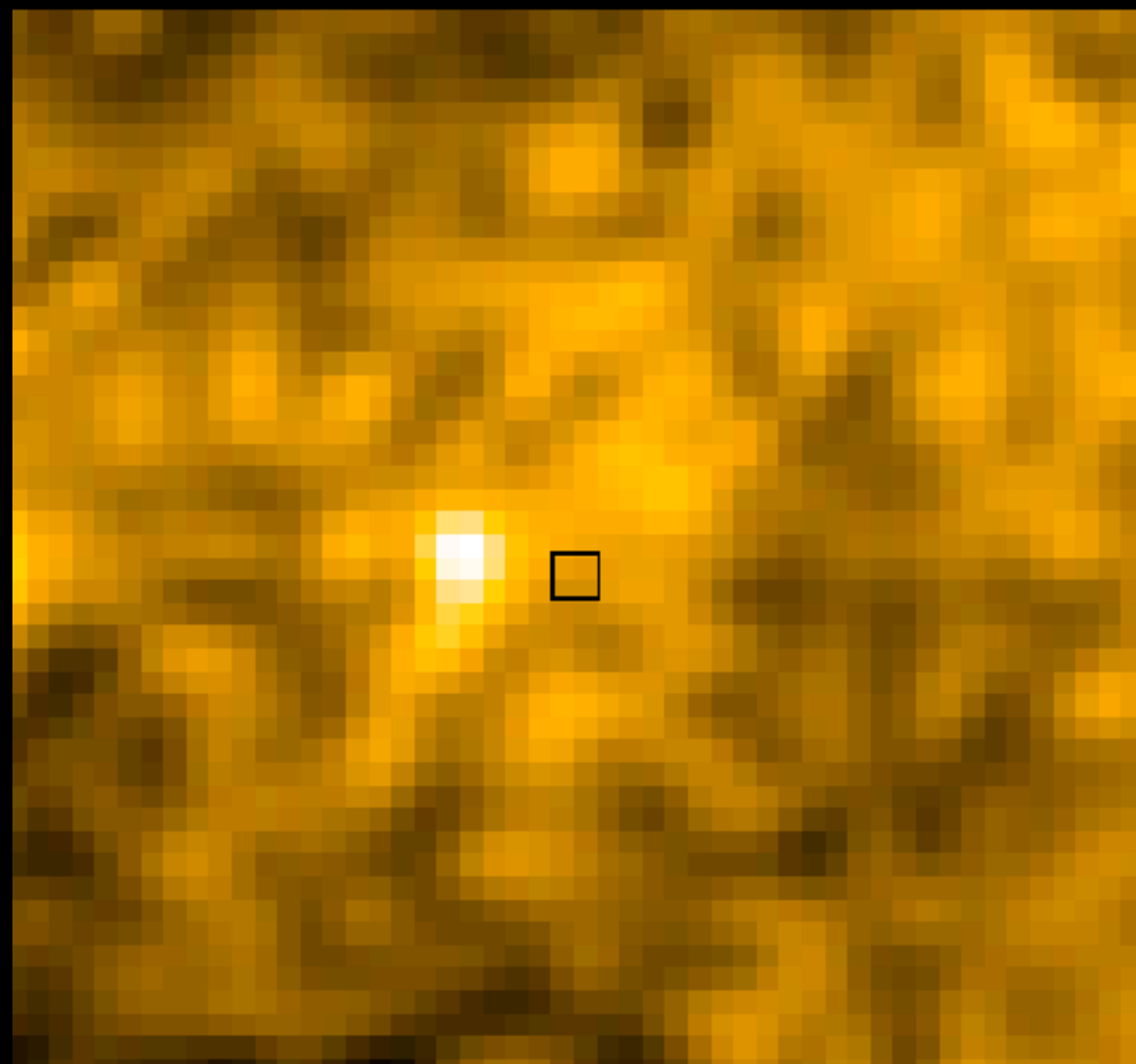
HRIEUV 10x10 Mm2



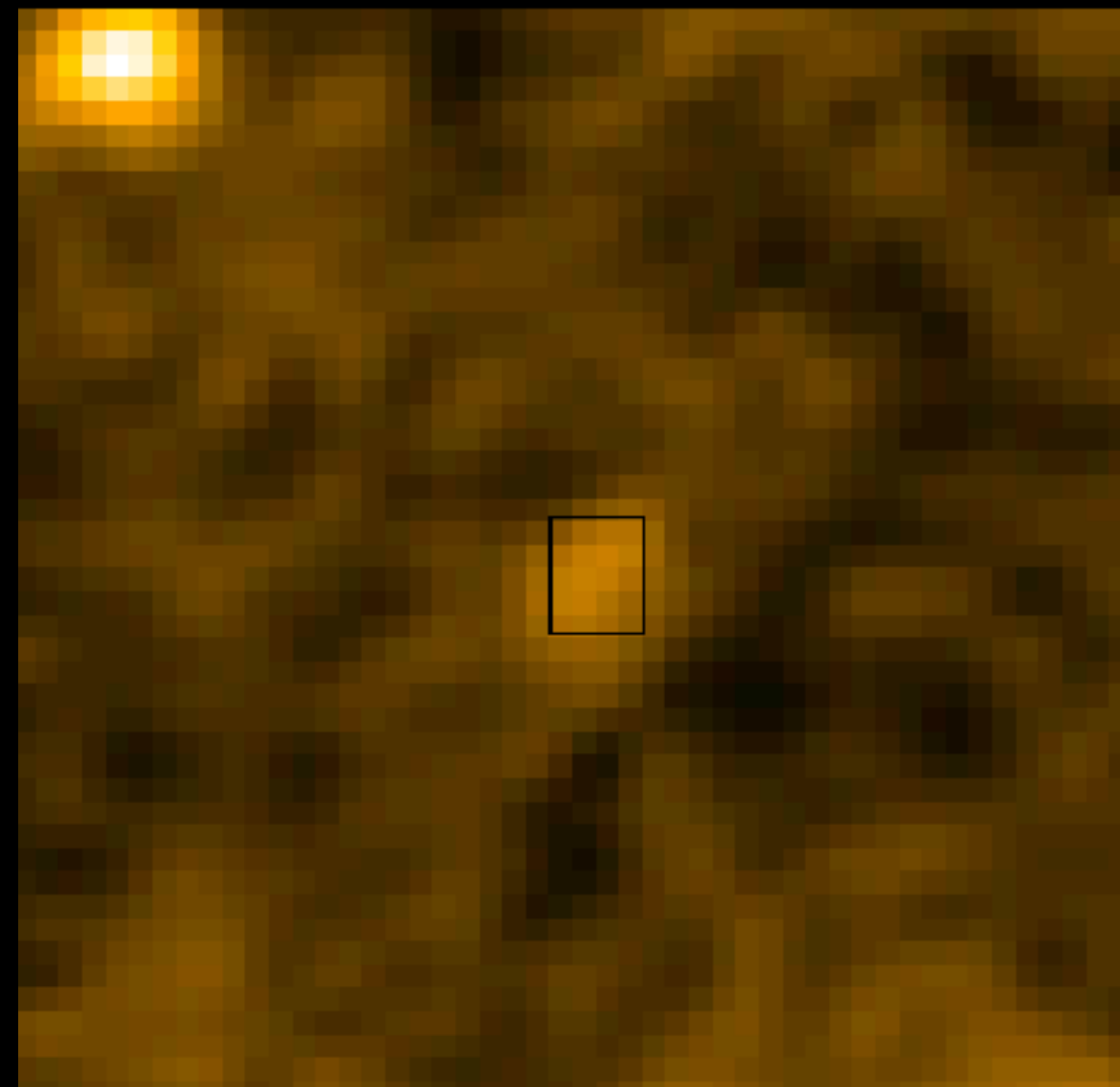
HRIEUV 10x10 Mm2



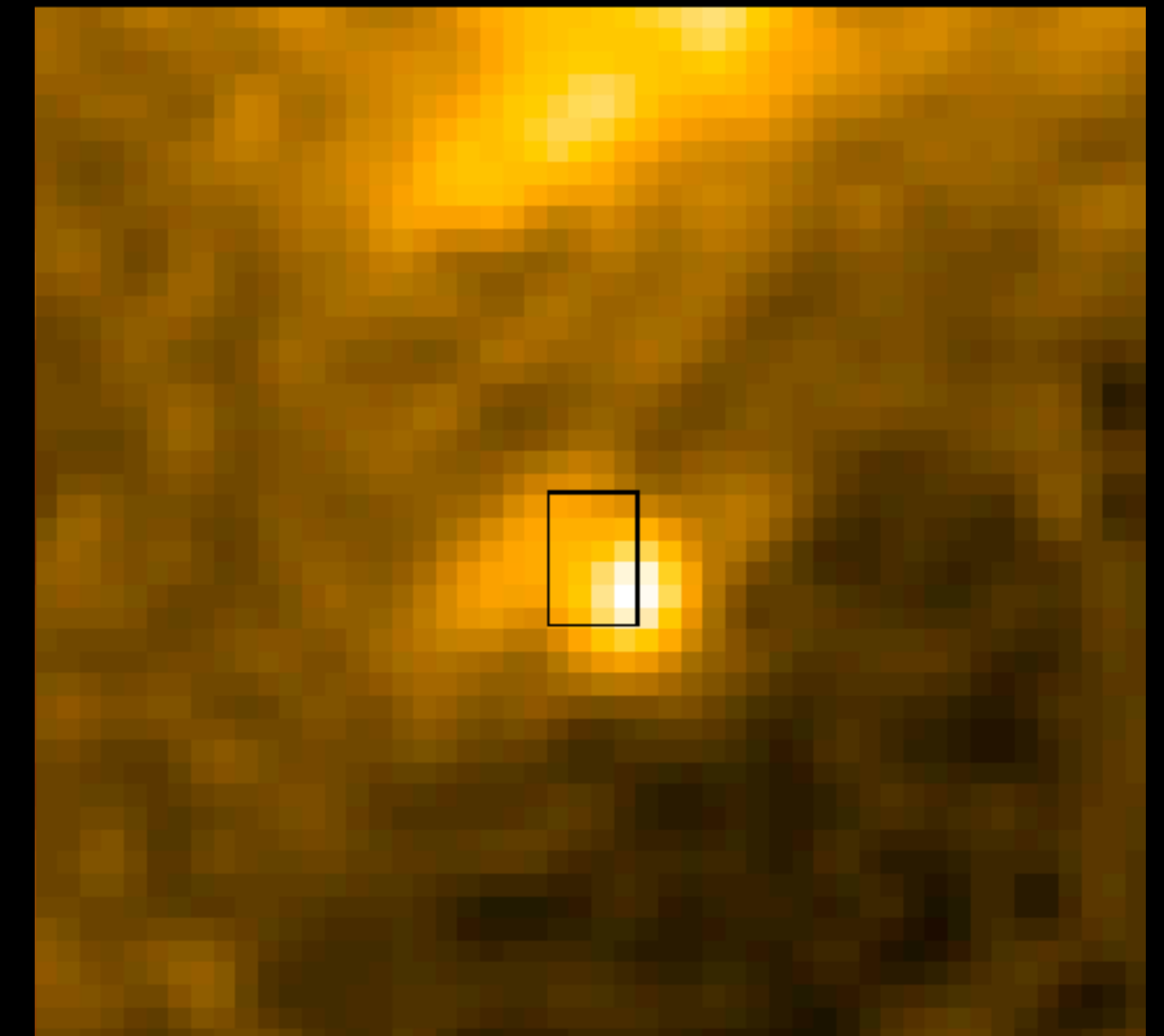
HRIEUV 10x10 Mm2



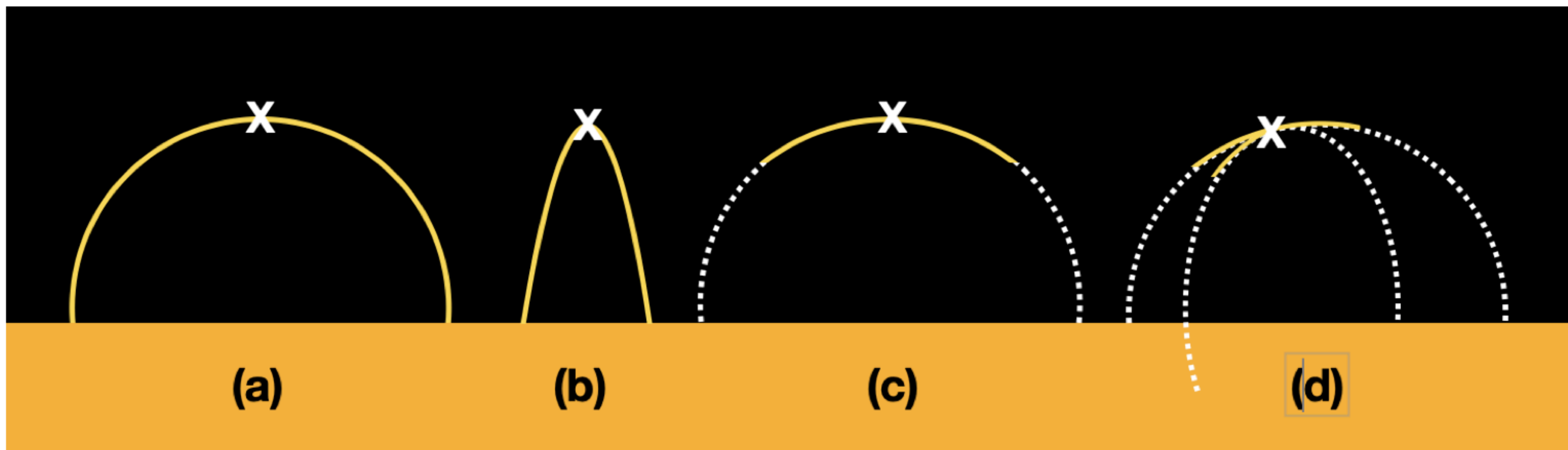
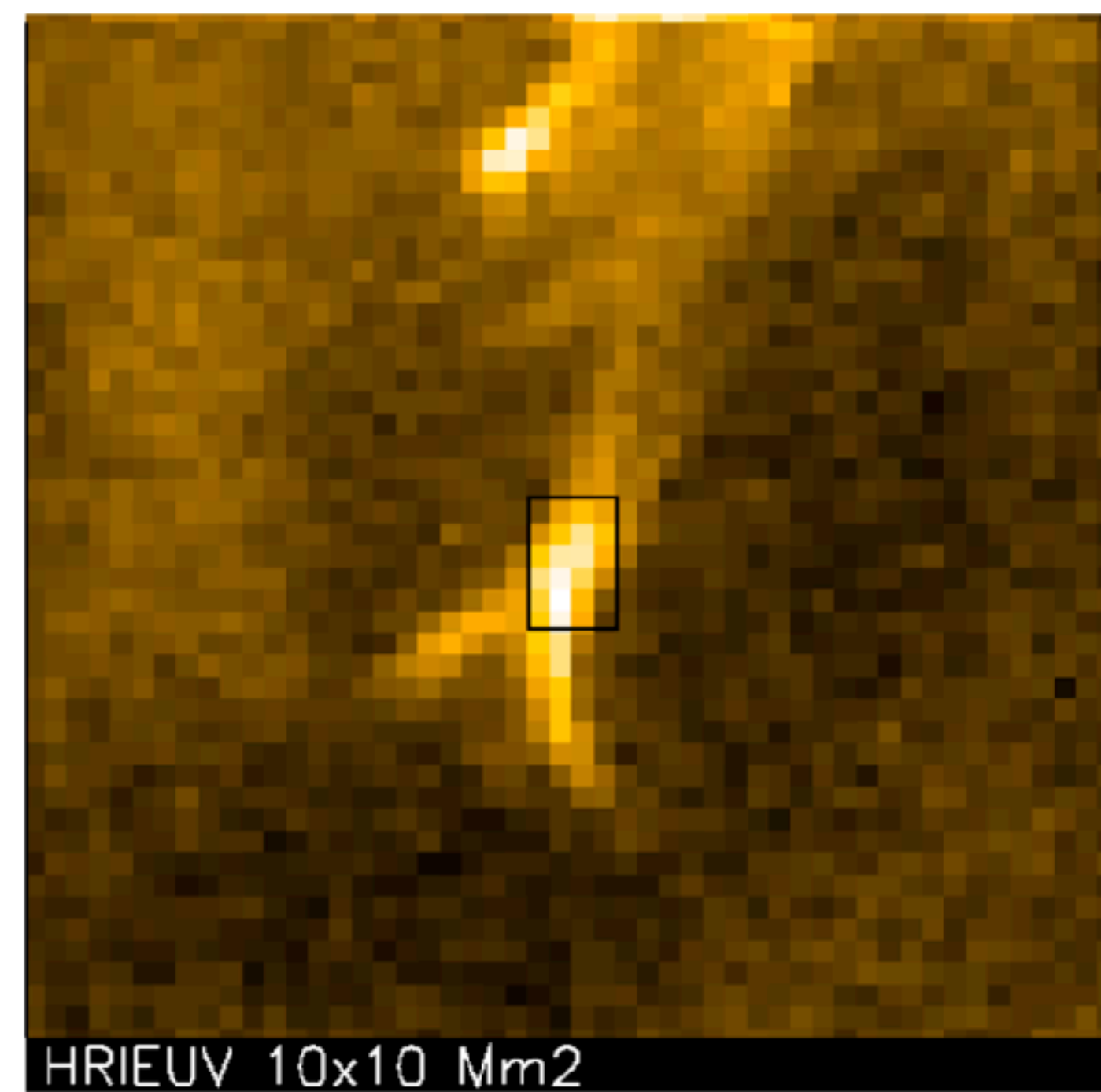
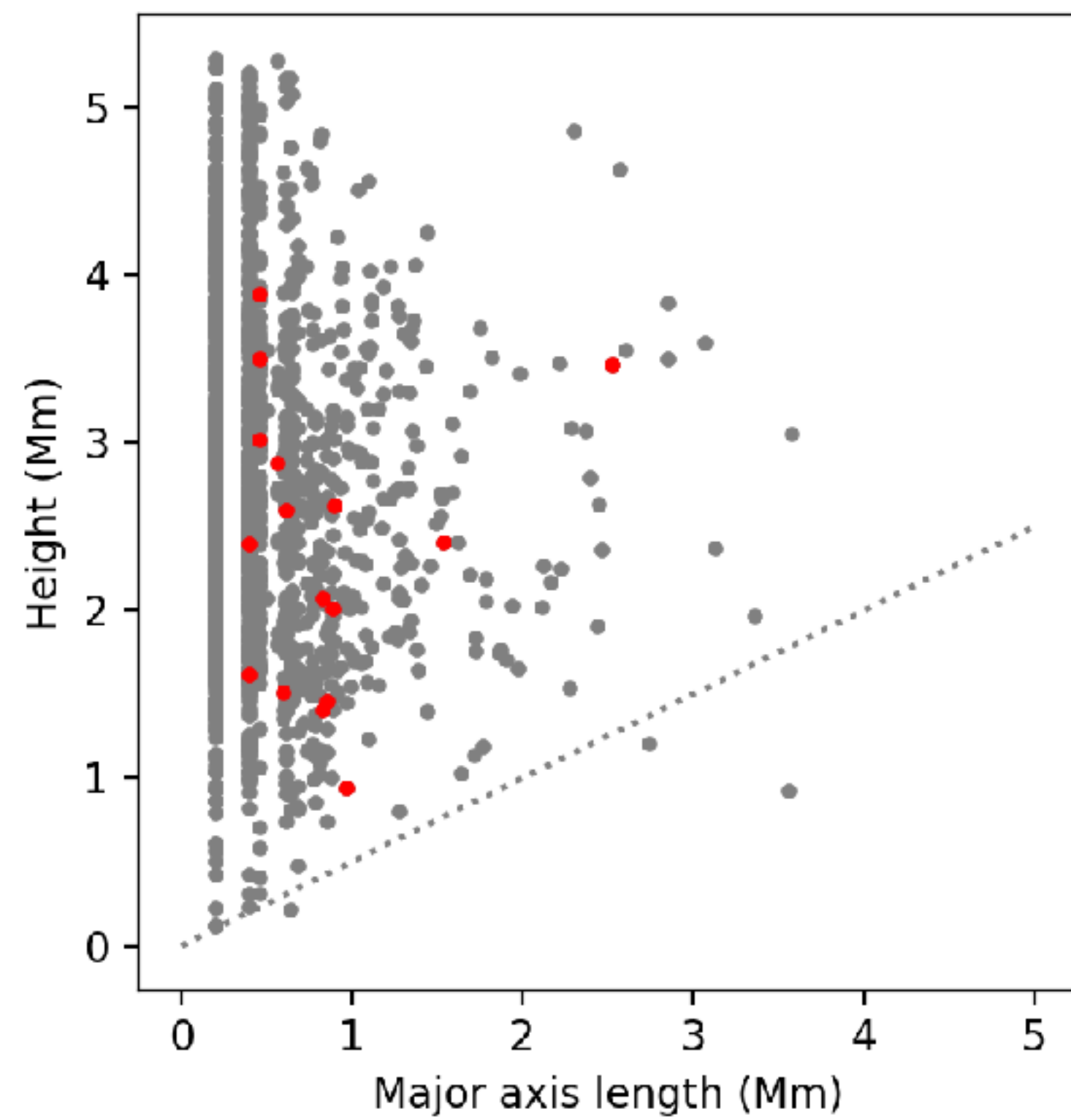
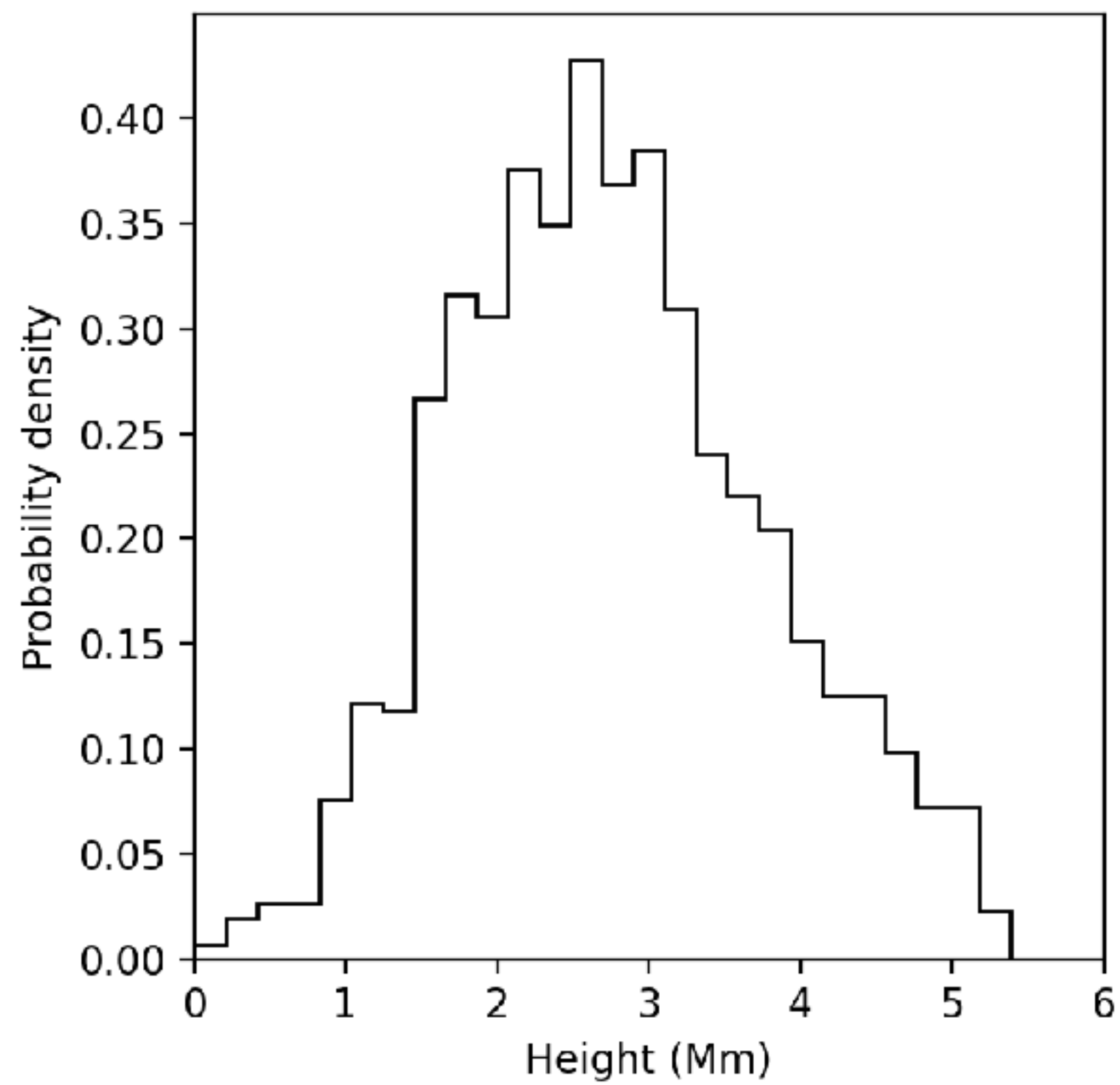
AIA171 10x10 Mm2 (+1s)



AIA171 10x10 Mm2 (+0s)



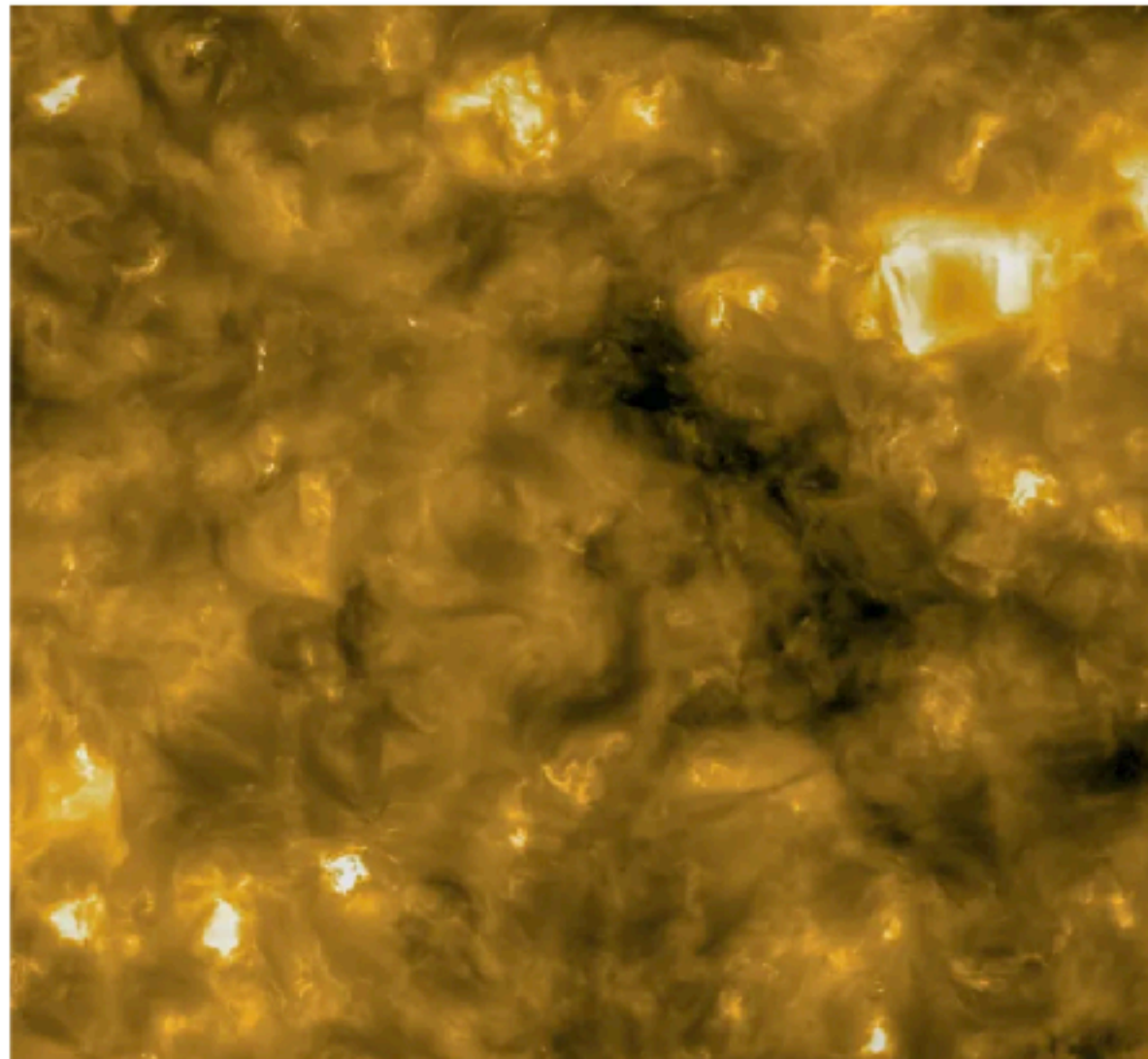
AIA171 10x10 Mm2 (+5s)



Gather 'round the campfire

Launched in February 2020, ESA's Solar Orbiter is currently looping around the sun, using gravitational encounters with Venus to help boost it into an orbit where it can see the sun's poles. For now, the spacecraft is busy studying our home star with a variety of onboard instruments that will help illuminate our understanding of its influence on Earth.

Last May, those cameras caught sight of some 1,500 miniature flares in the low solar atmosphere—or rather, flares that are miniature by solar standards, since some of them would span entire continents. The small eruptions last for tens of seconds, and the team named them "campfires."



Solar Orbiter mission shares closest sun, reveals 'campfires' near its sur



By Ashley Strickland, CNN

Updated 0103 GMT (0903 HKT) July 17, 2020



- 00:54 See the Solar Orbiter launch into space
- 01:26 Bodycam video shows chaotic moments after 'Rust' shooting
- 01:38 Video shows pilots switching planes mid-air, one crash lands

Find Out What The EIU Reports as the Top Technologies Crucial to IT Organizational Success [DOWNLOAD](#)

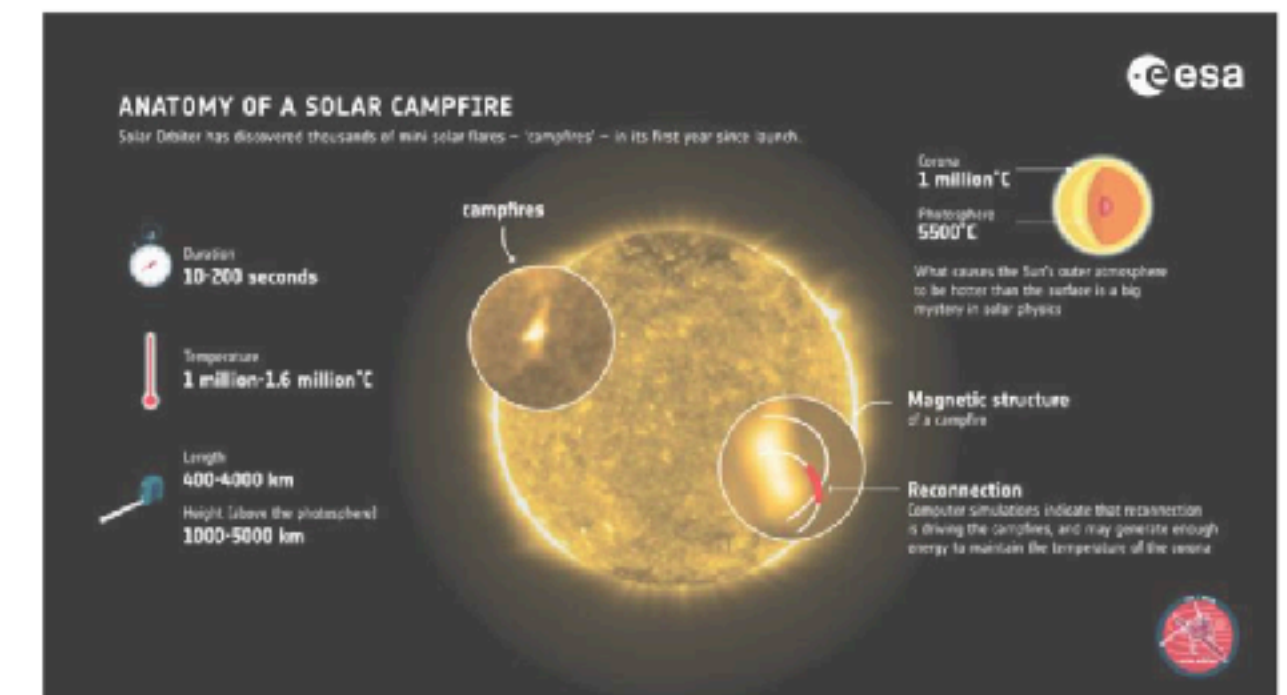
Home / Astronomy & Space / Astronomy

APRIL 27, 2021

'Campfires' offer clue to solar heating mystery

by European Space Agency

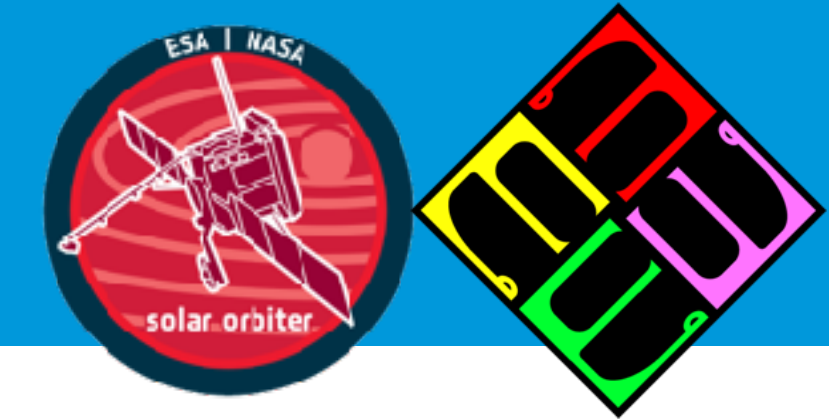
- 67
- 28
- Share
- Email



This graphic provides a summary of what ESA's Solar Orbiter mission, as well as computer modelling, has revealed...

Computer simulations show that the miniature solar flares nicknamed 'campfires,' discovered last year by ESA's Solar Orbiter, are likely driven by a process that may contribute significantly to the heating of the sun's outer atmosphere, or corona. If confirmed by further observations this adds a key piece to the puzzle of what heats the solar corona—one of the biggest mysteries in solar physics.

Campfires are one of many subjects being

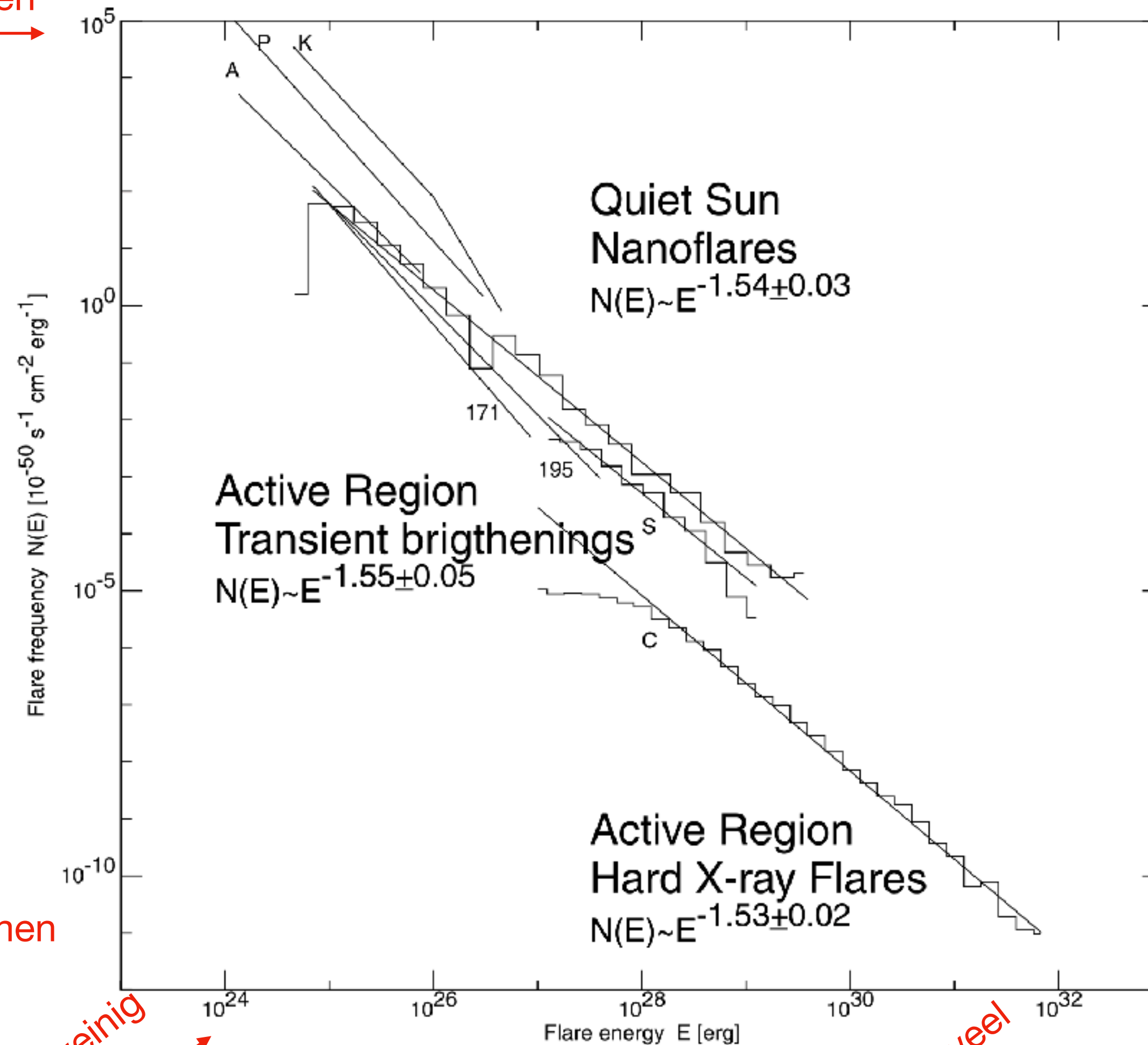


Waarom zijn “kampvuren” belangrijk?



Verdeling van de energie-inhoud van kleine zonnevlammen

veel zonnevlammen



weinig zonnevlammen

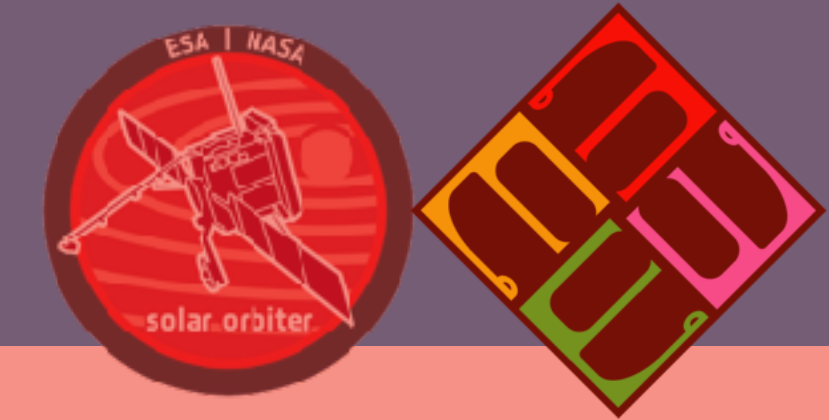


zeer weinig energie



zeer veel energie

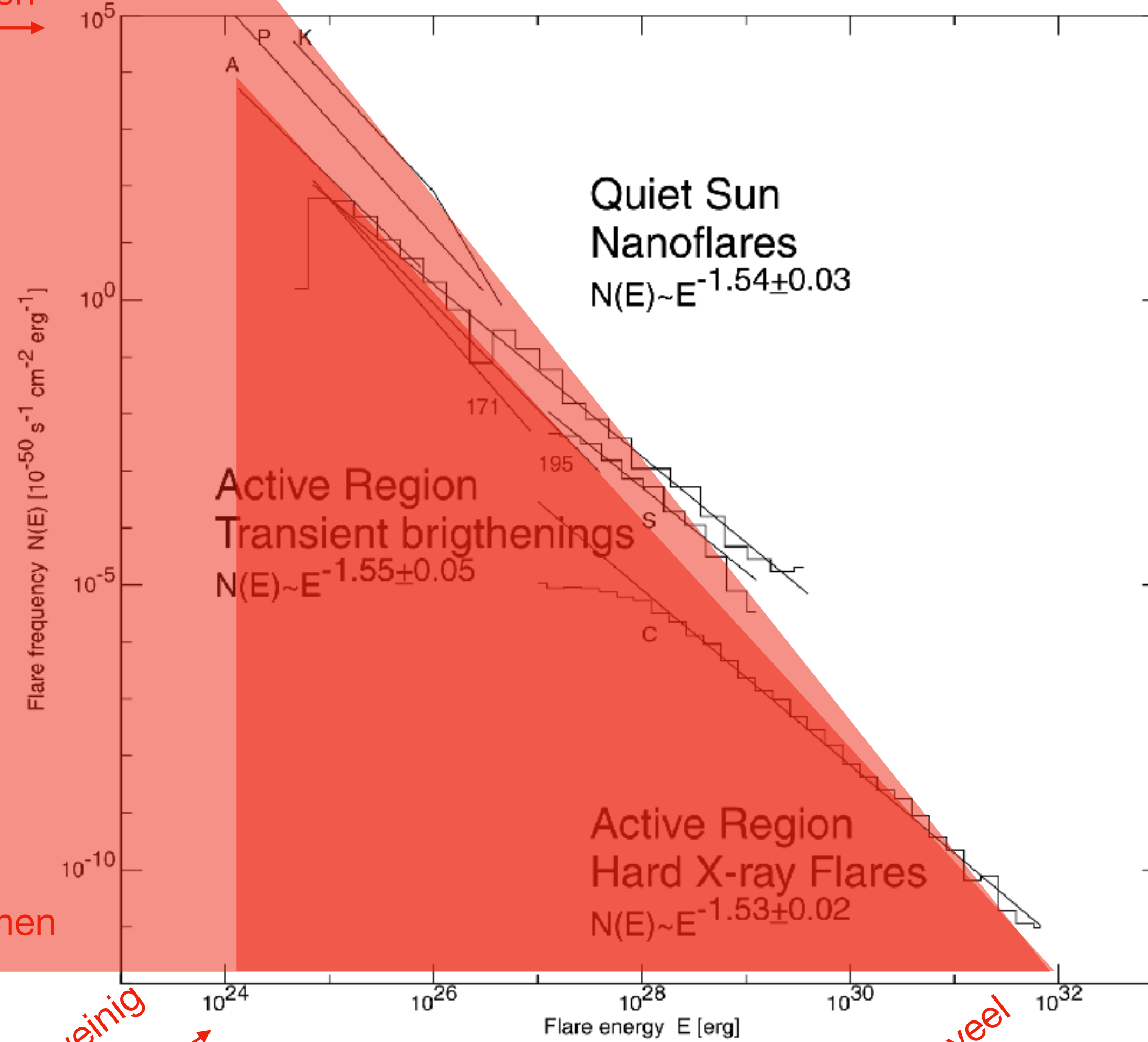




Waarom zijn “kampvuren” belangrijk?



veel zonnevlammen

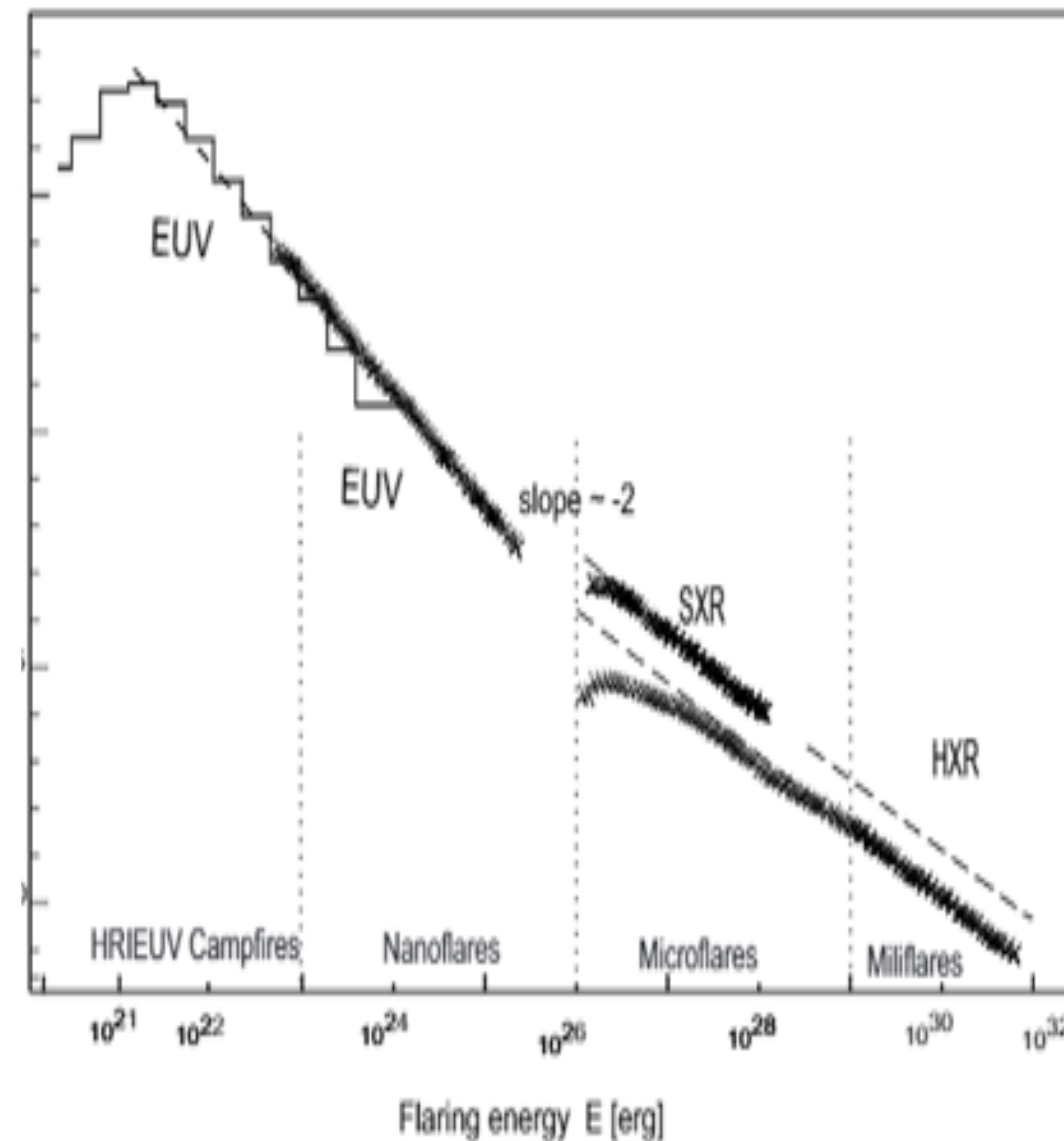


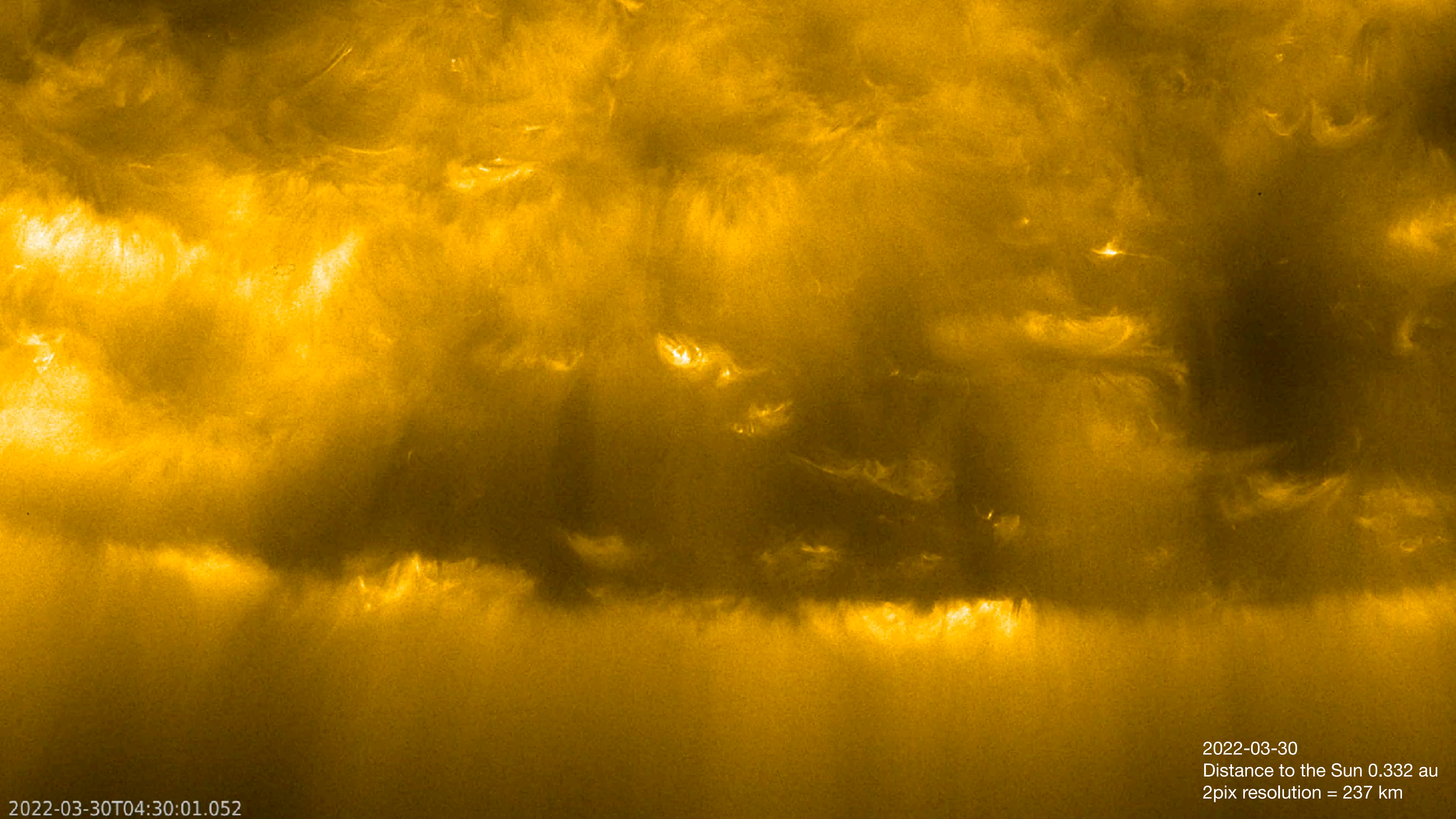
weinig zonnevlammen



zeer weinig energie

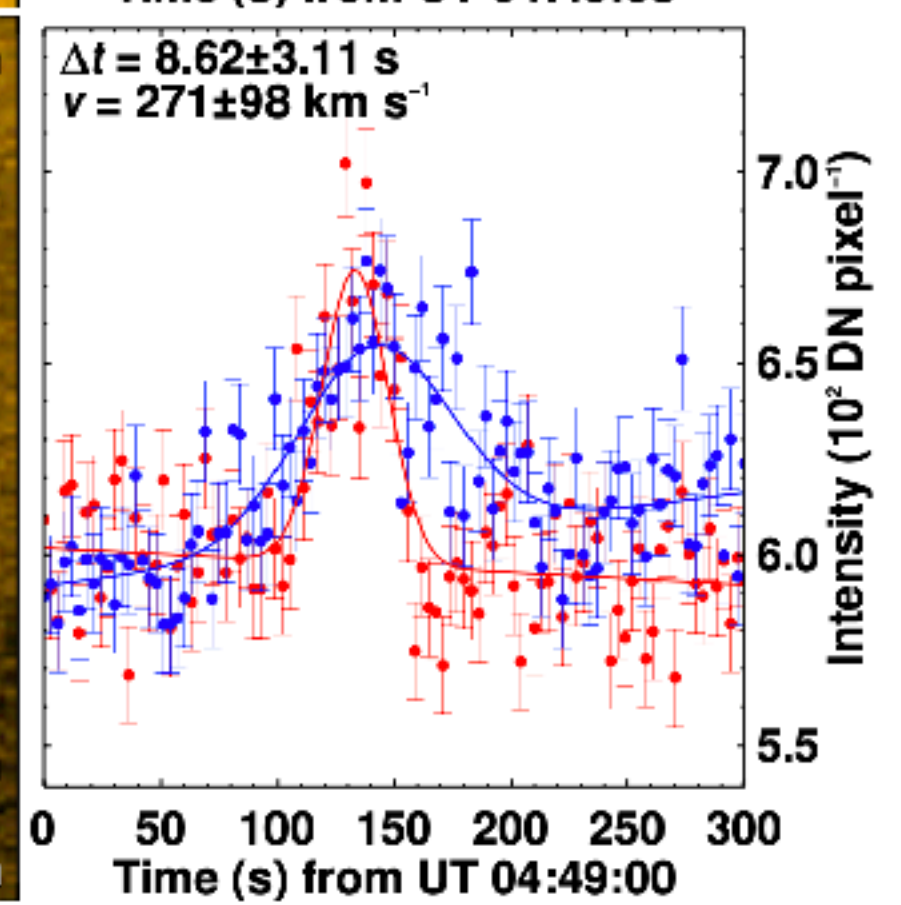
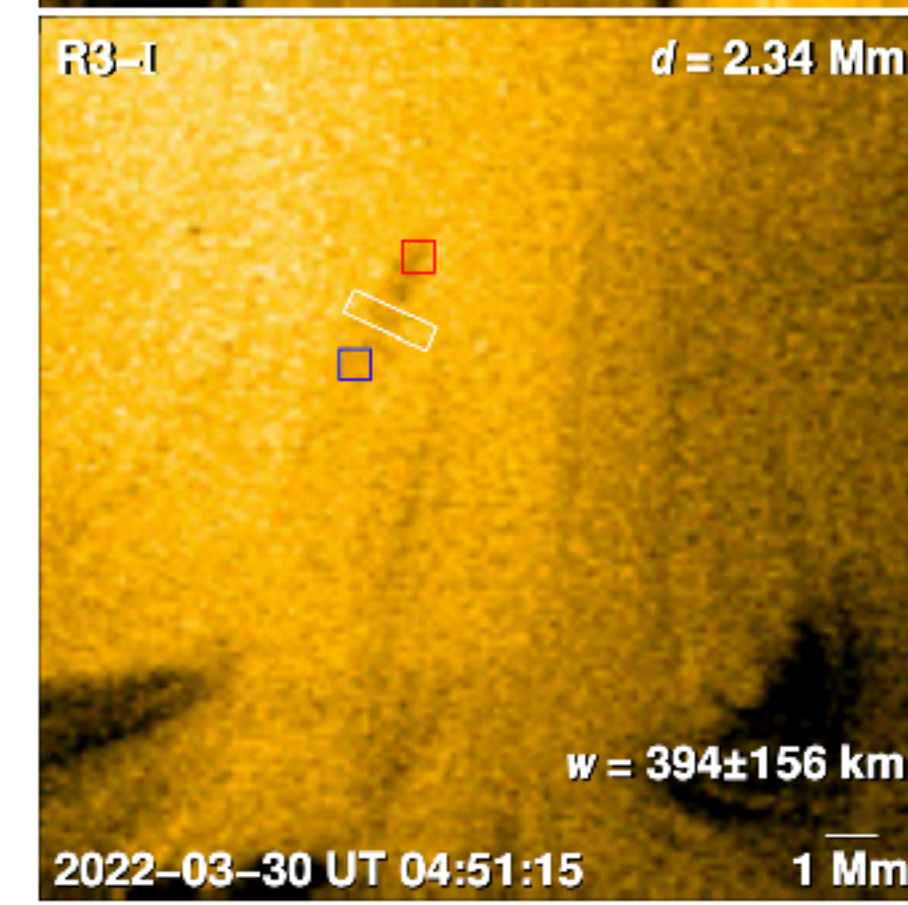
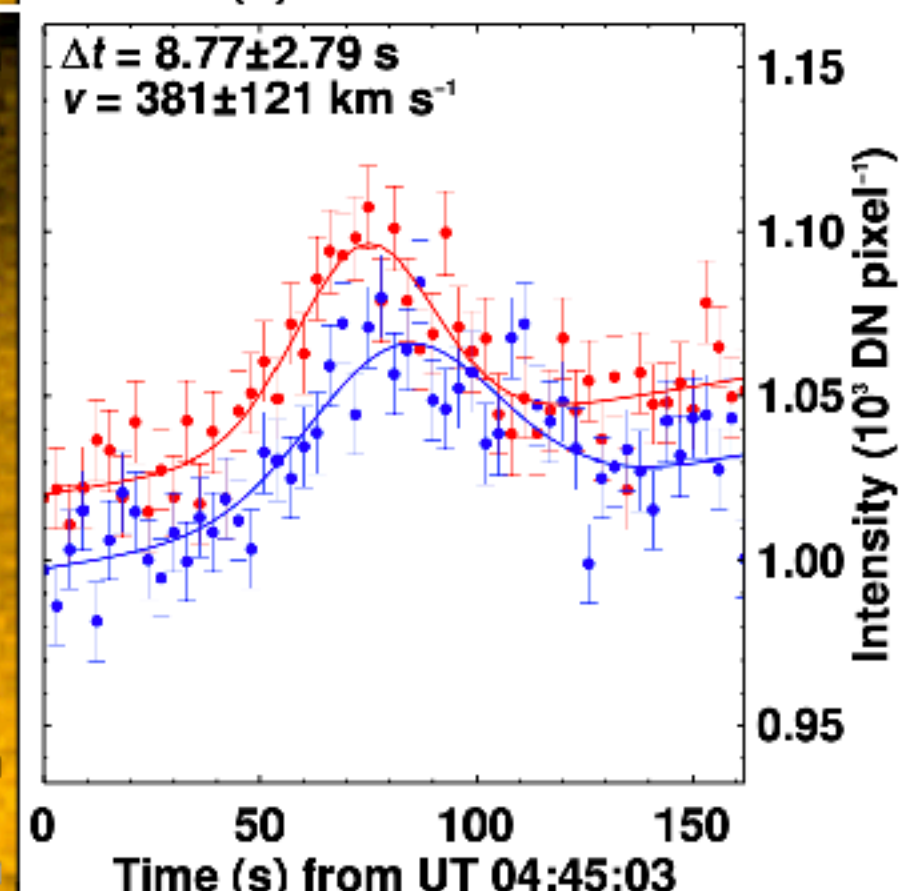
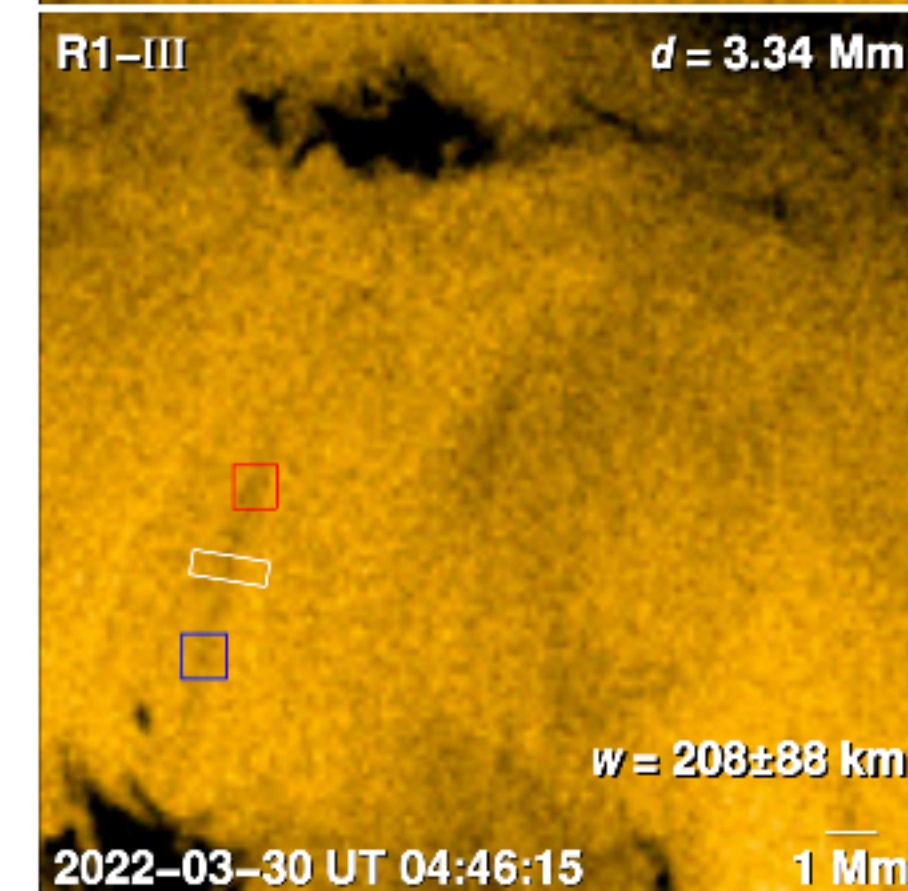
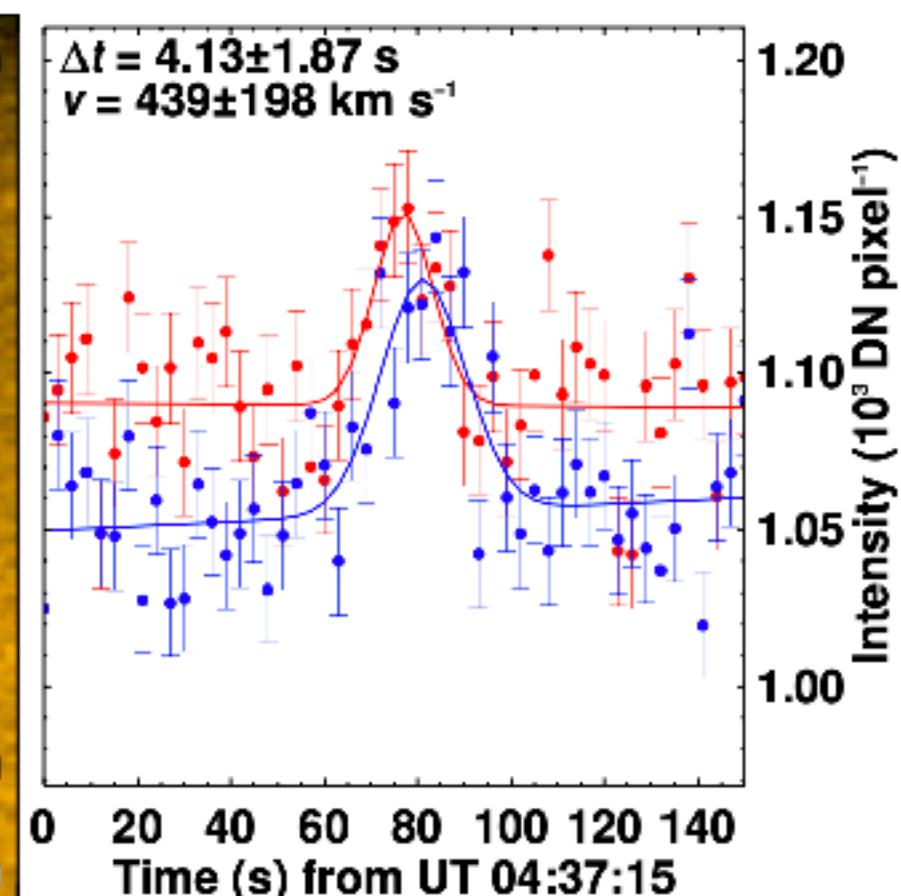
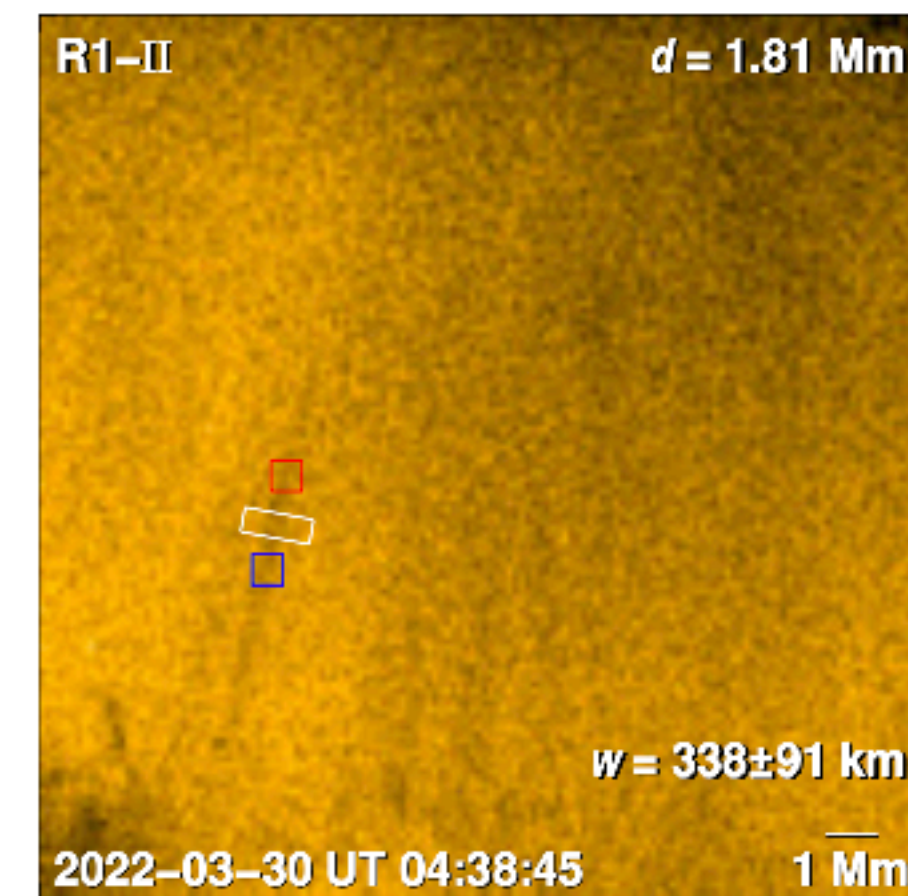
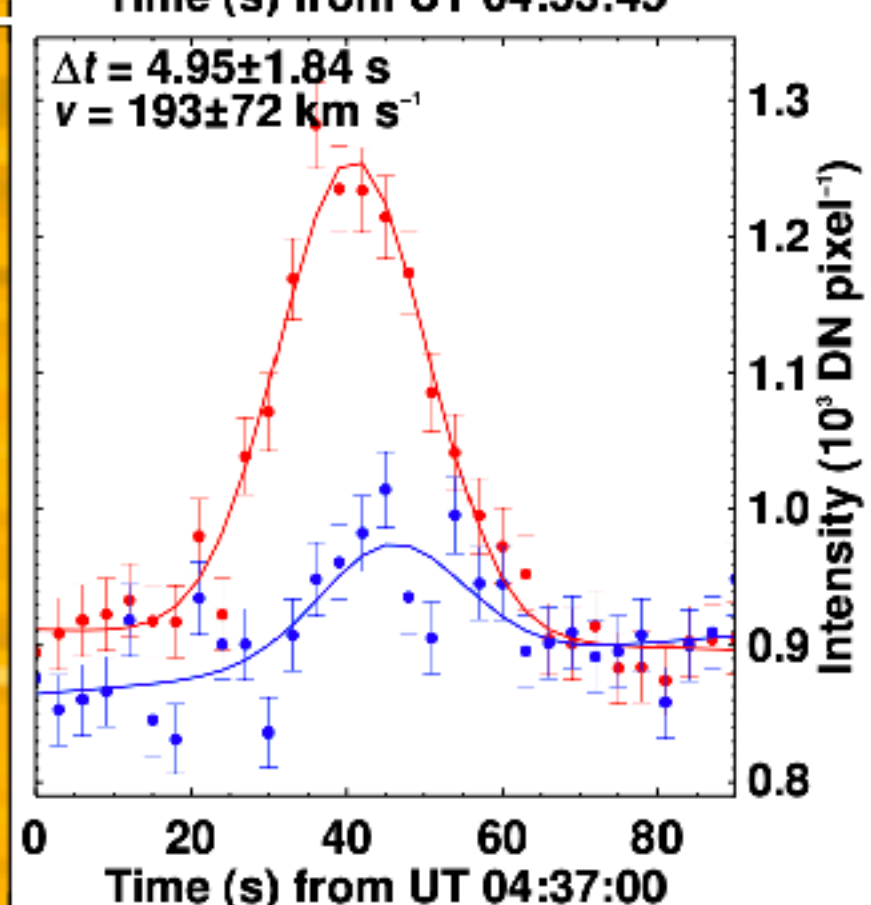
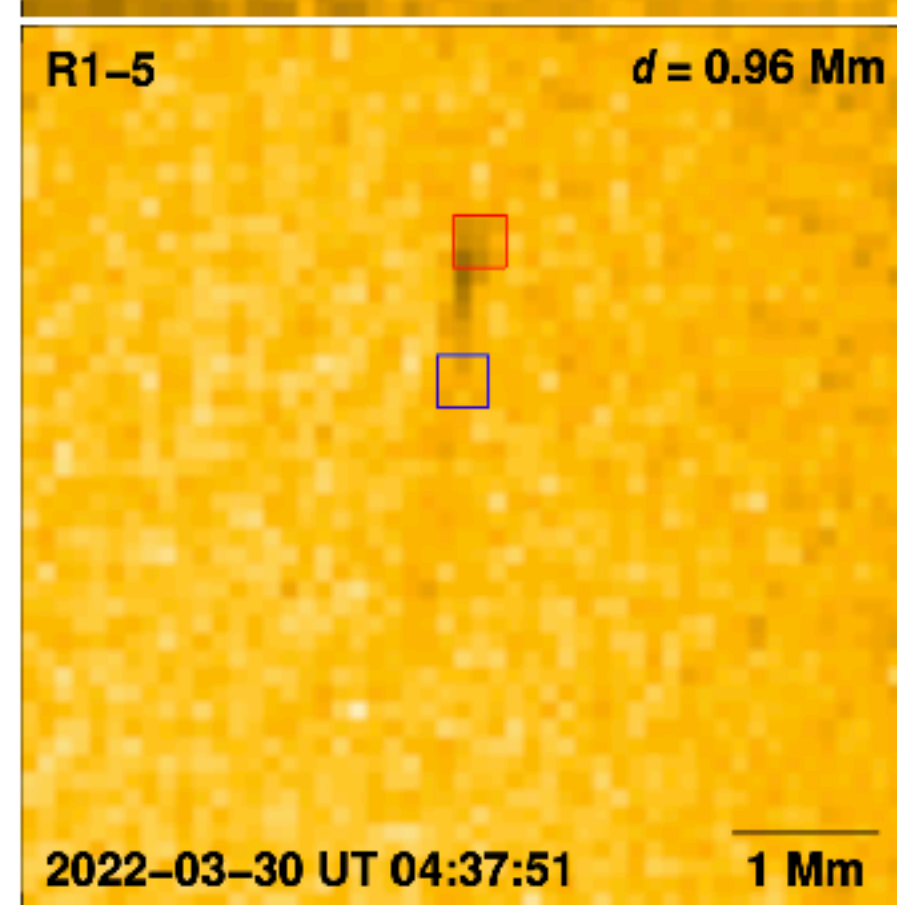
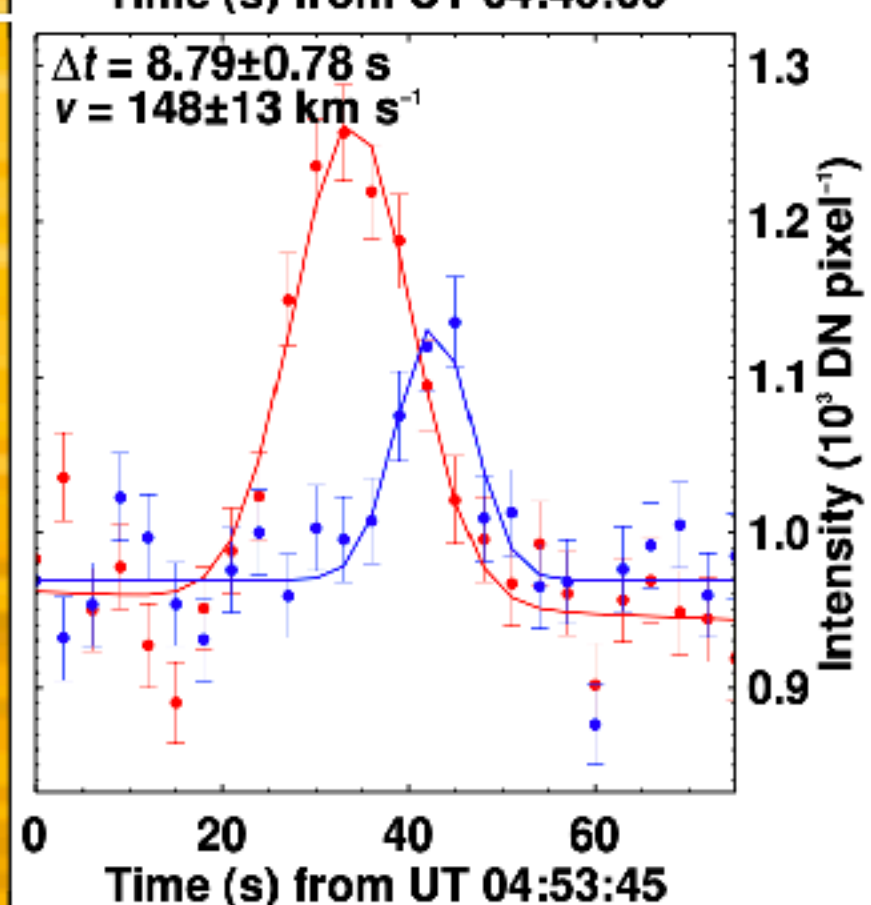
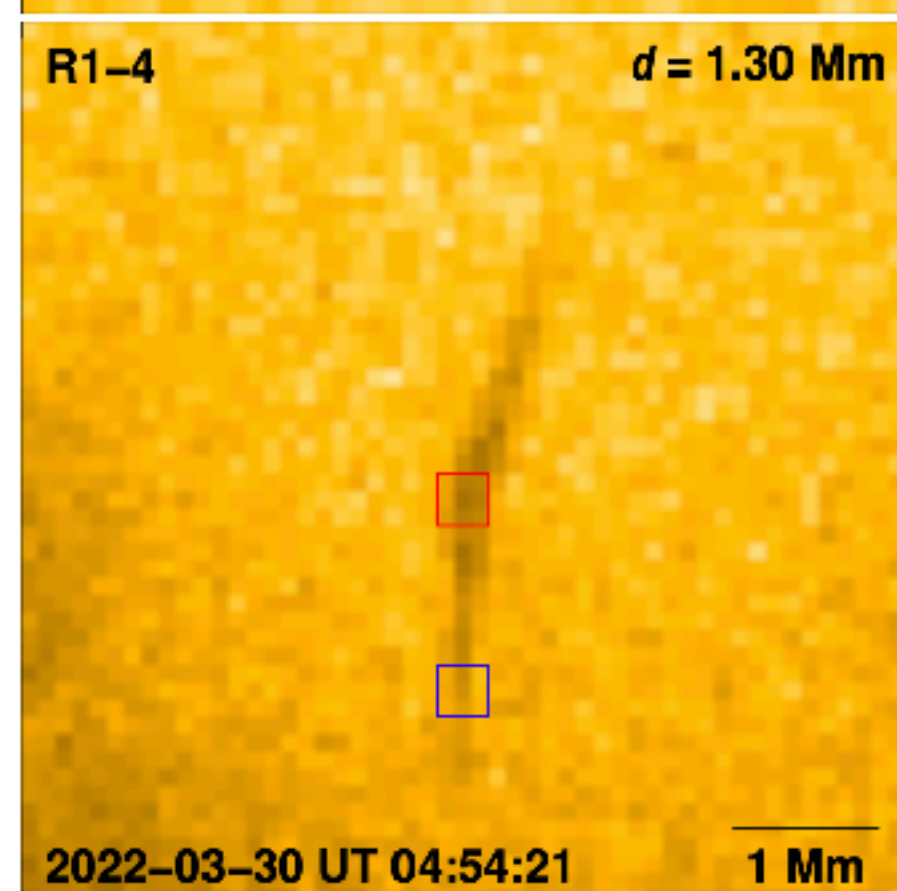
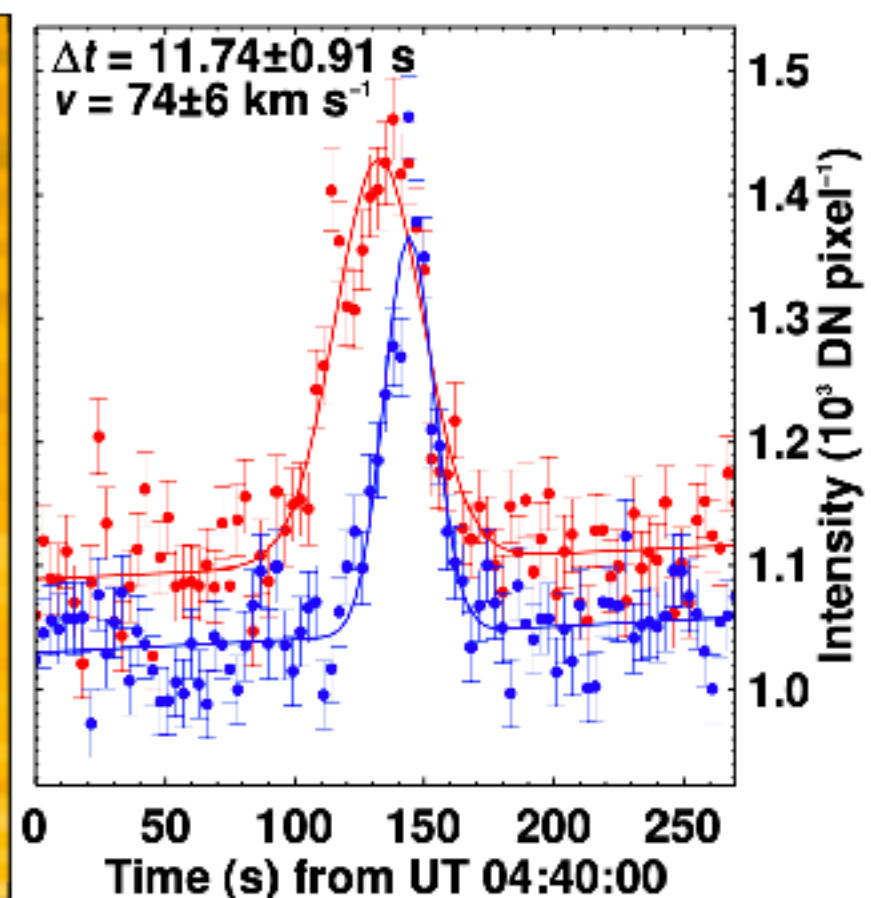
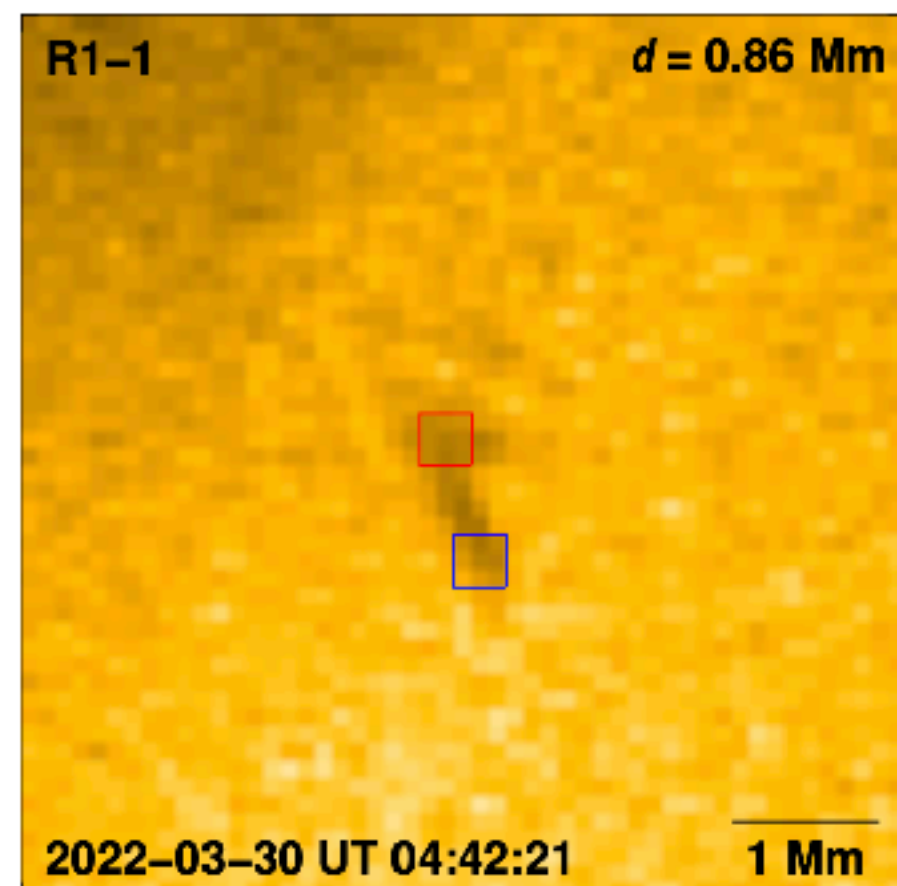
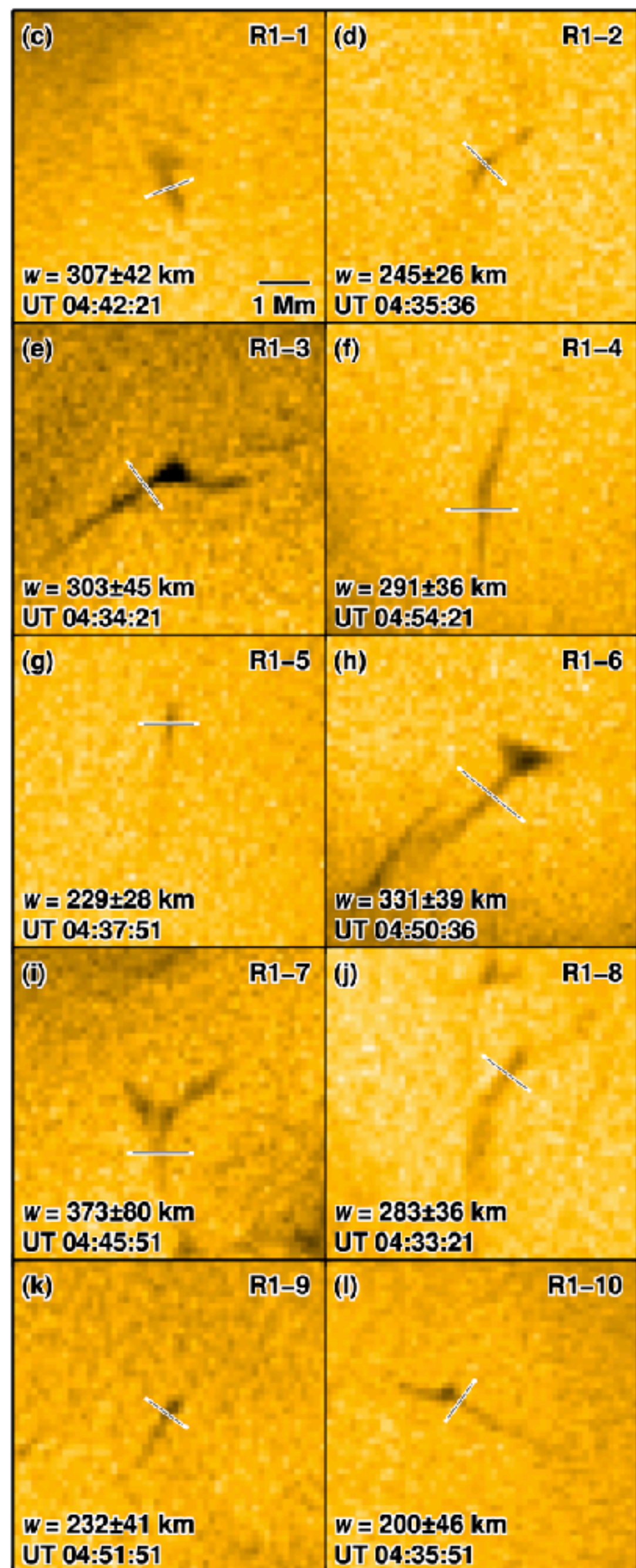
zeer veel energie

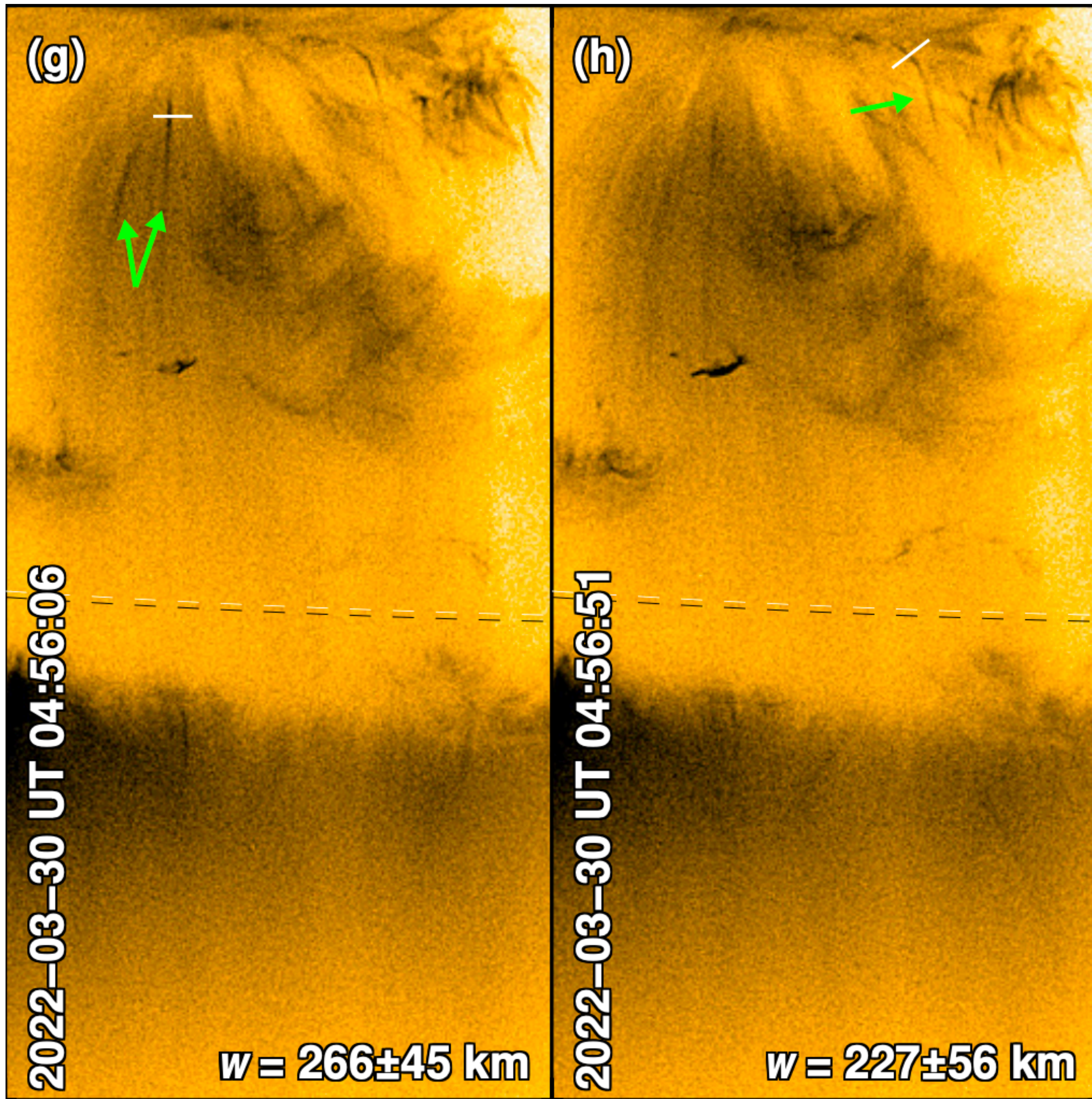


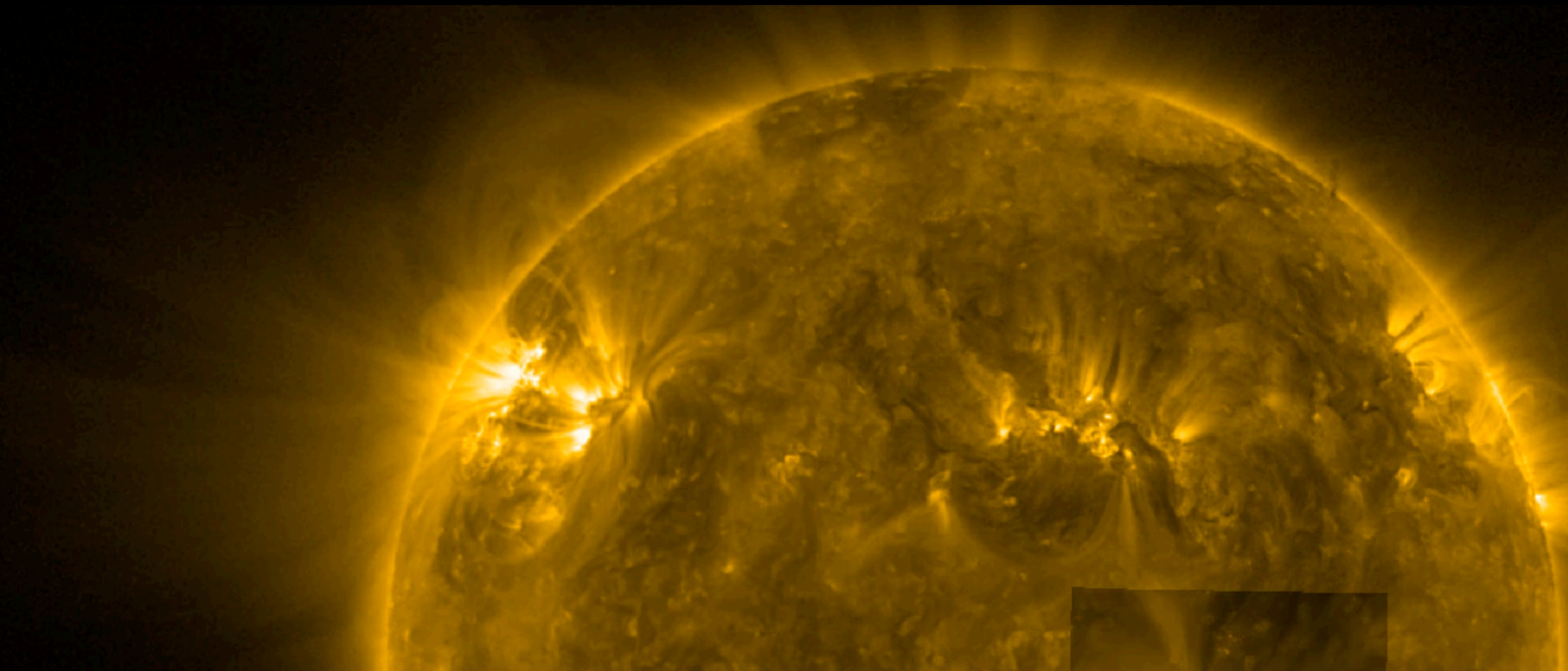


2022-03-30T04:30:01.052

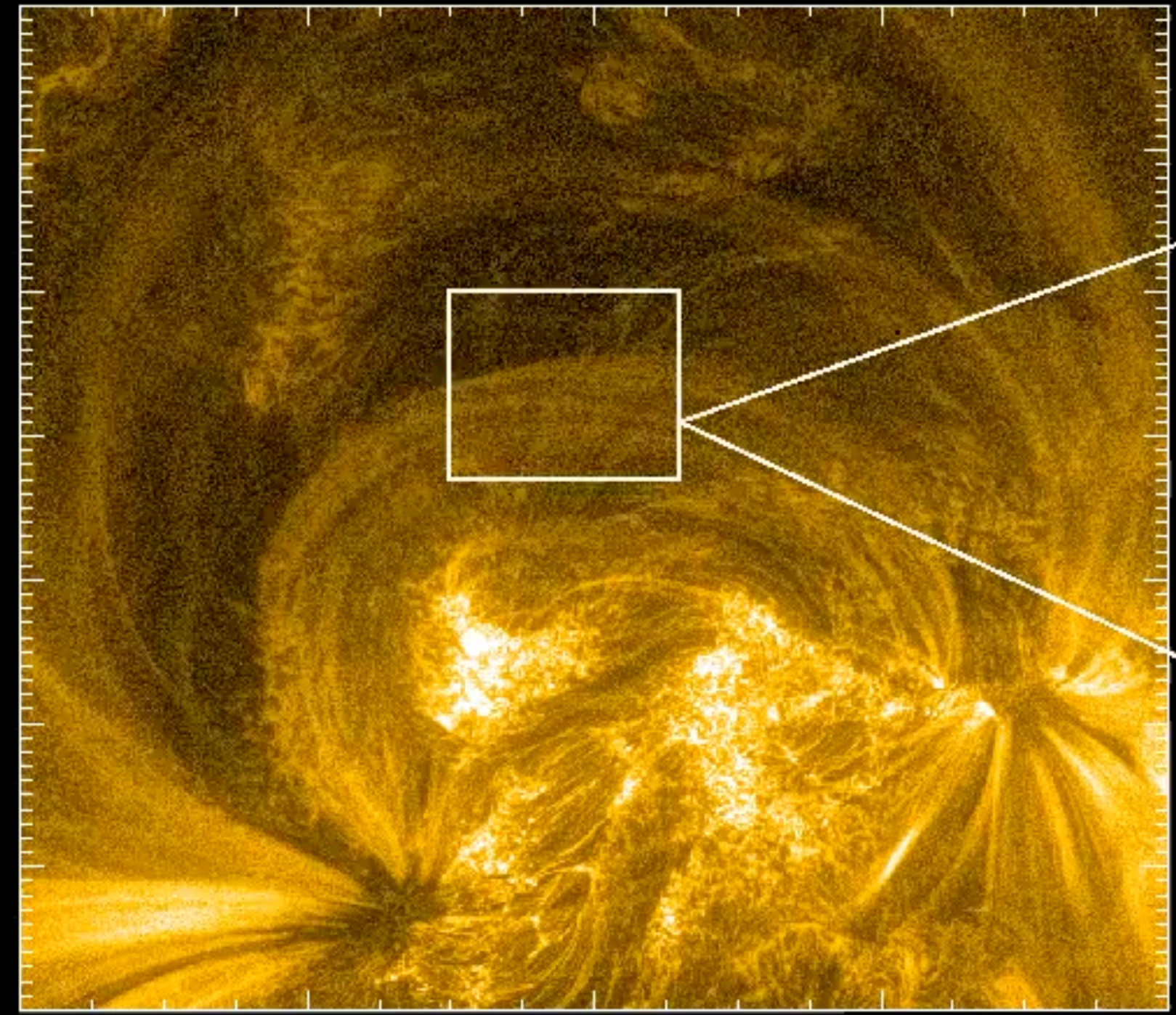
2022-03-30
Distance to the Sun 0.332 au
2pix resolution = 237 km



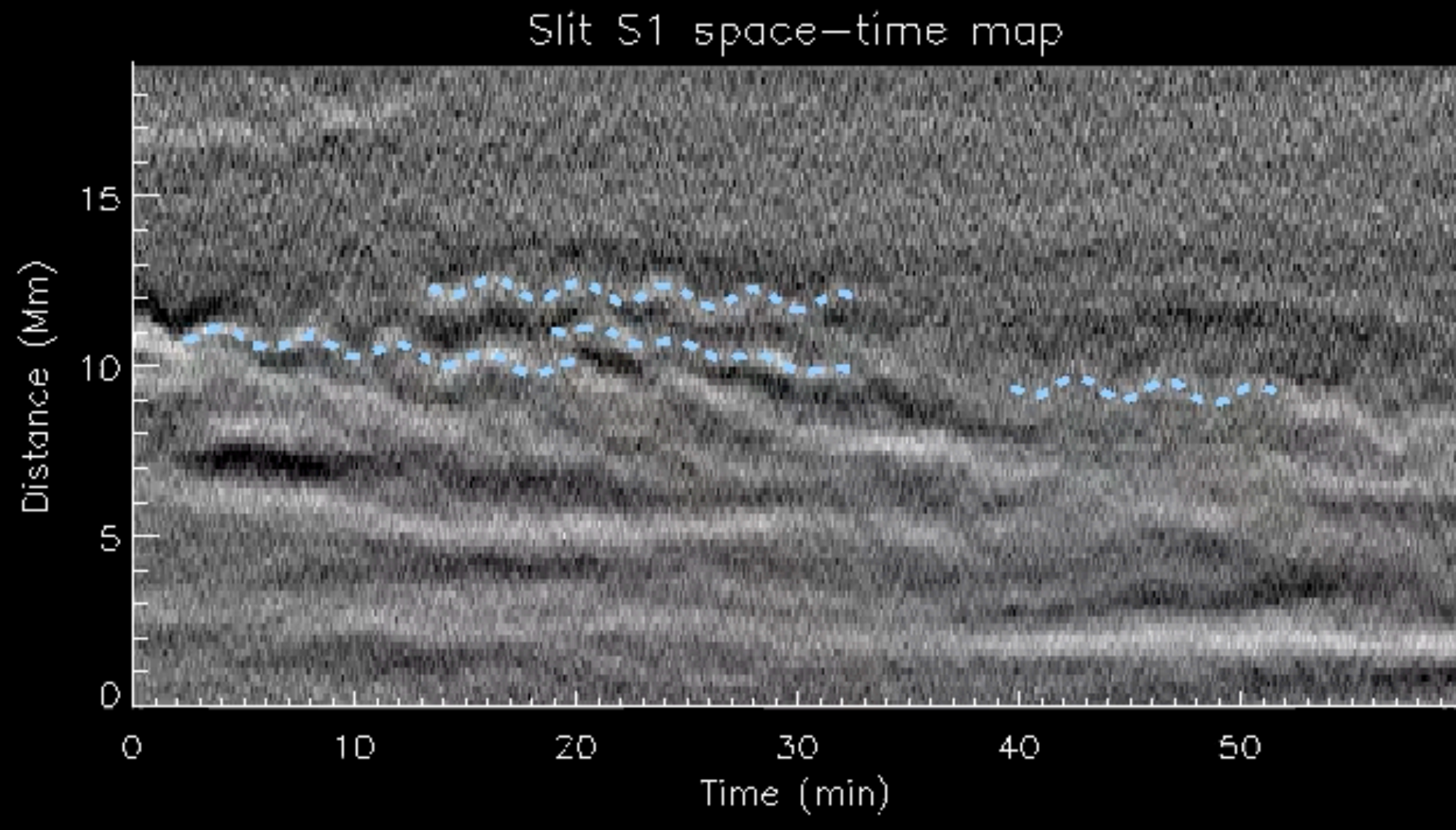
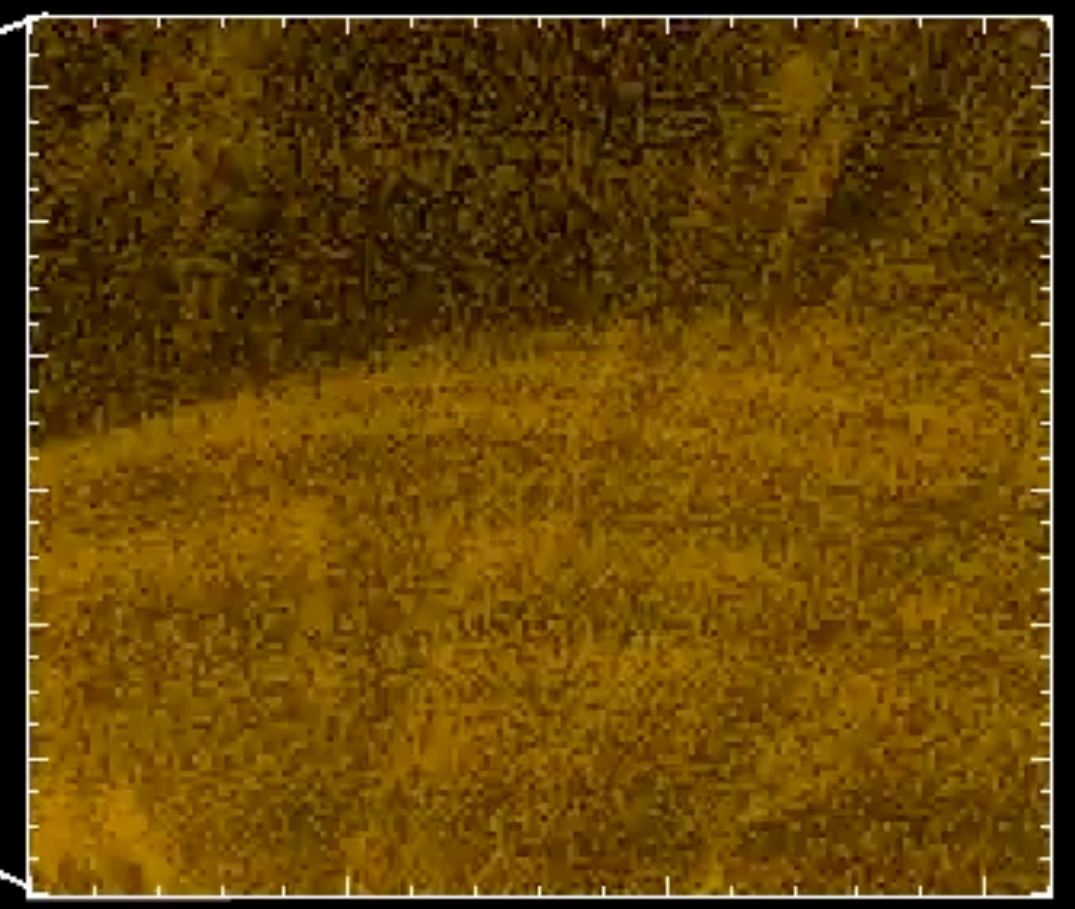




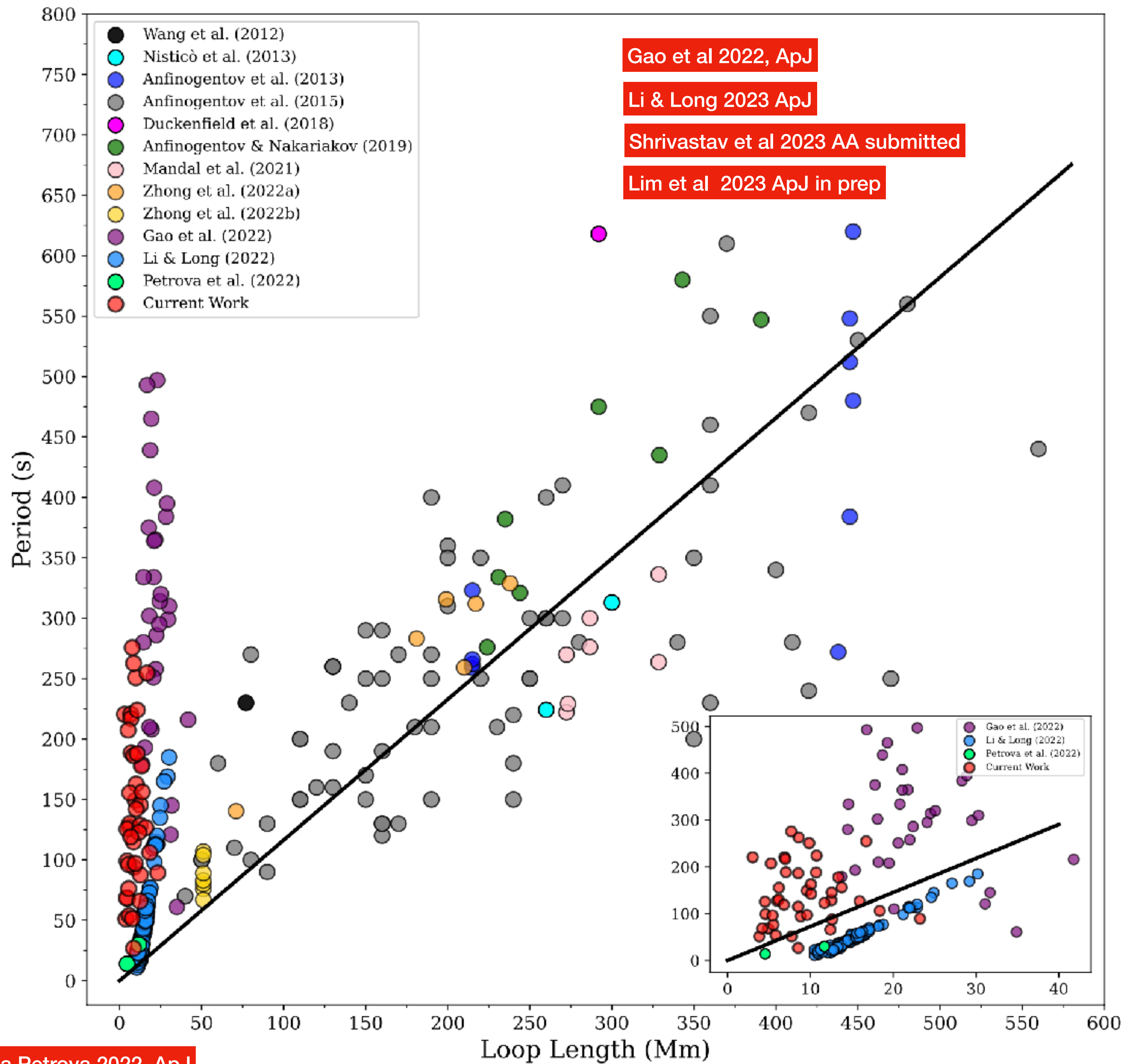
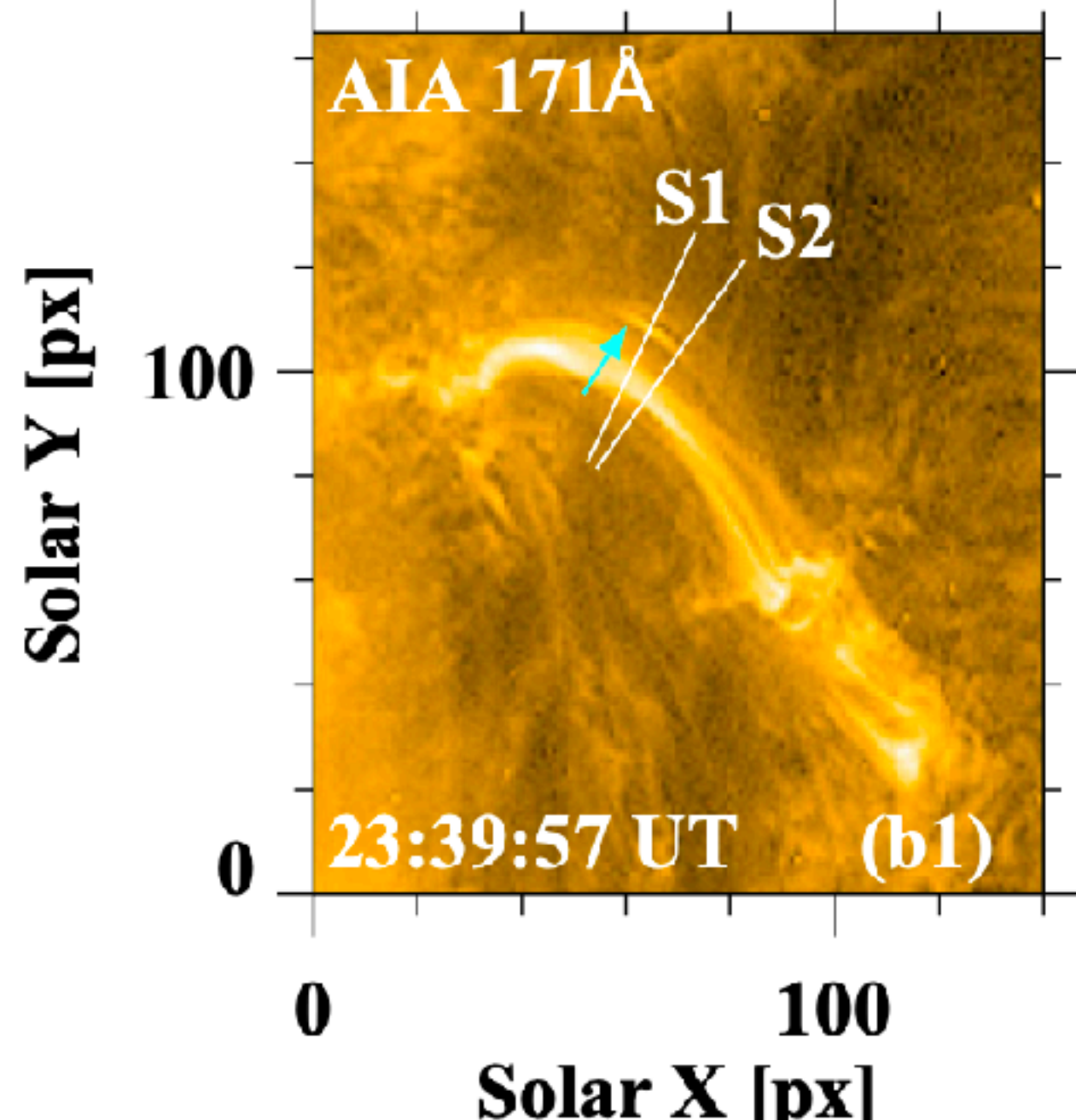
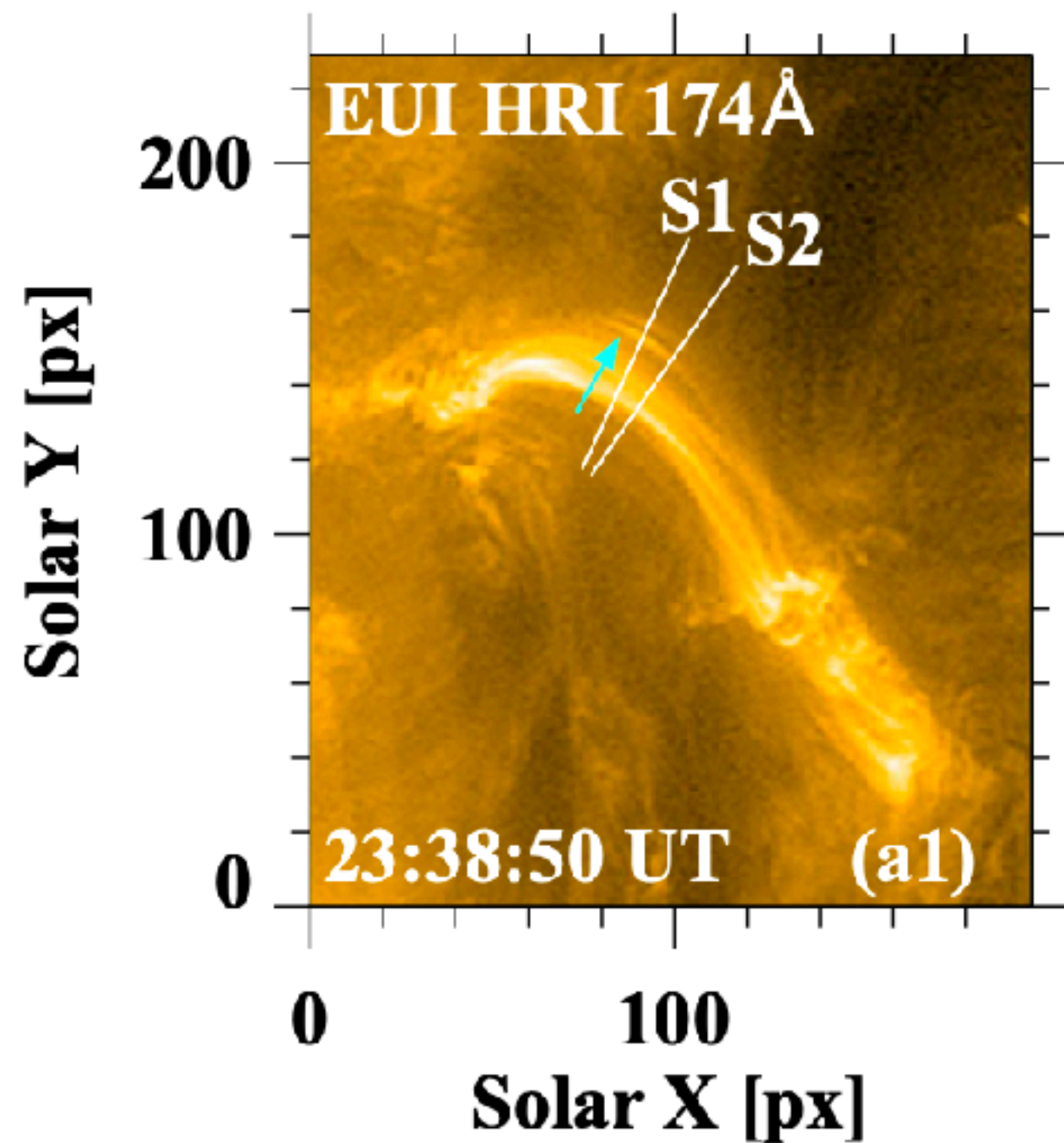
EUI : 2022-03-04 : Day-2



10:48:50UT + 0 s



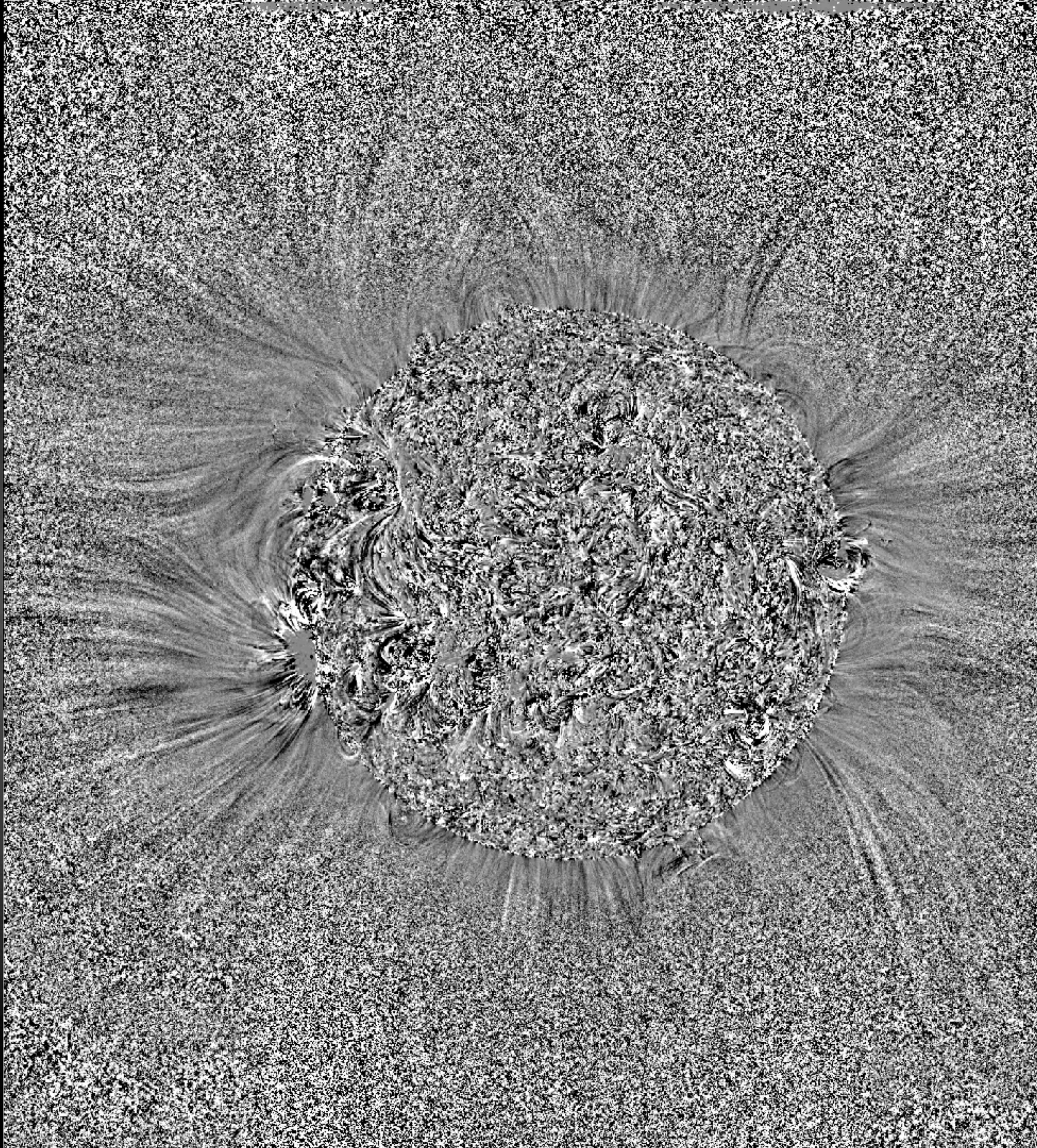
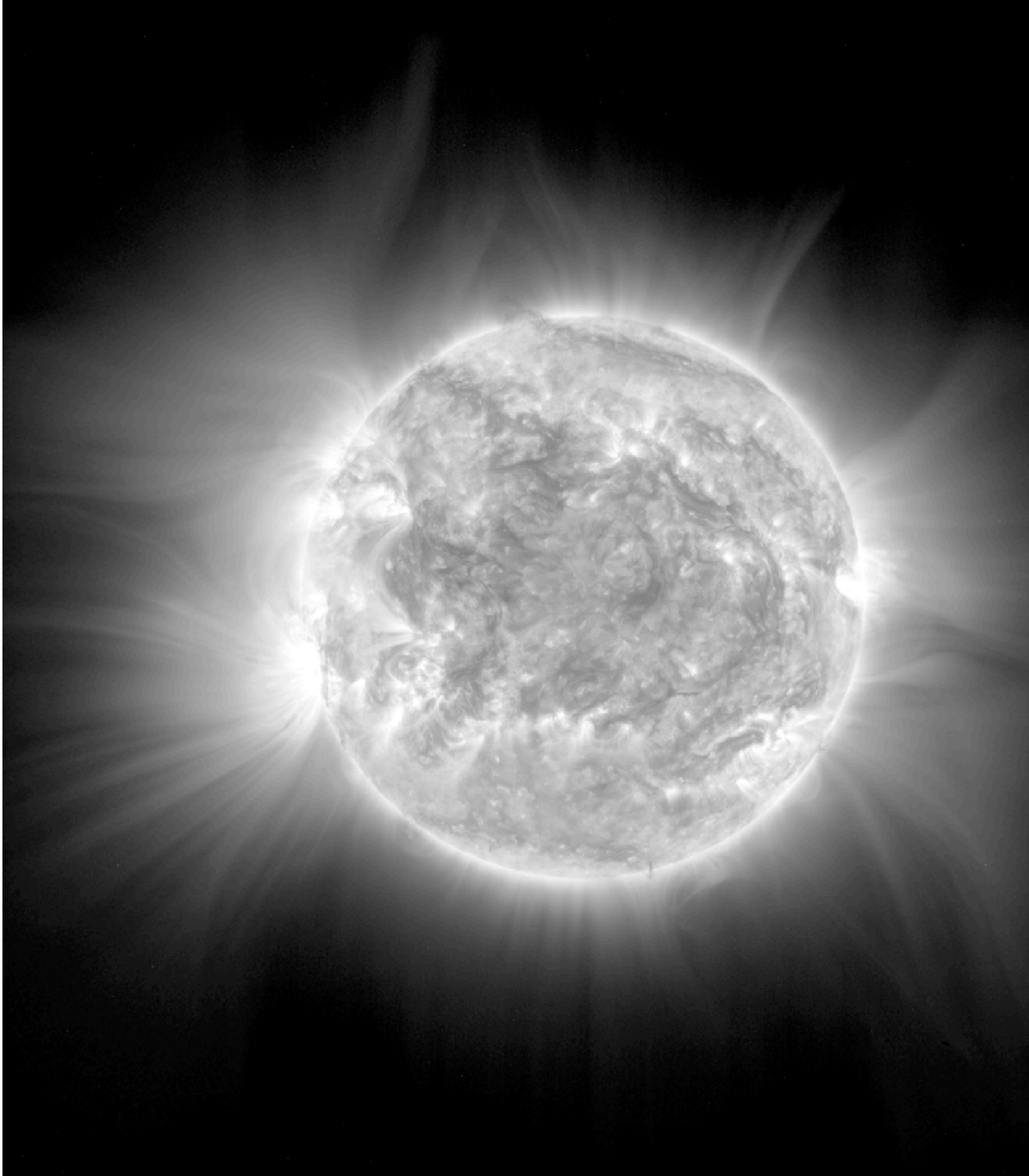
Slit S1 space-time map

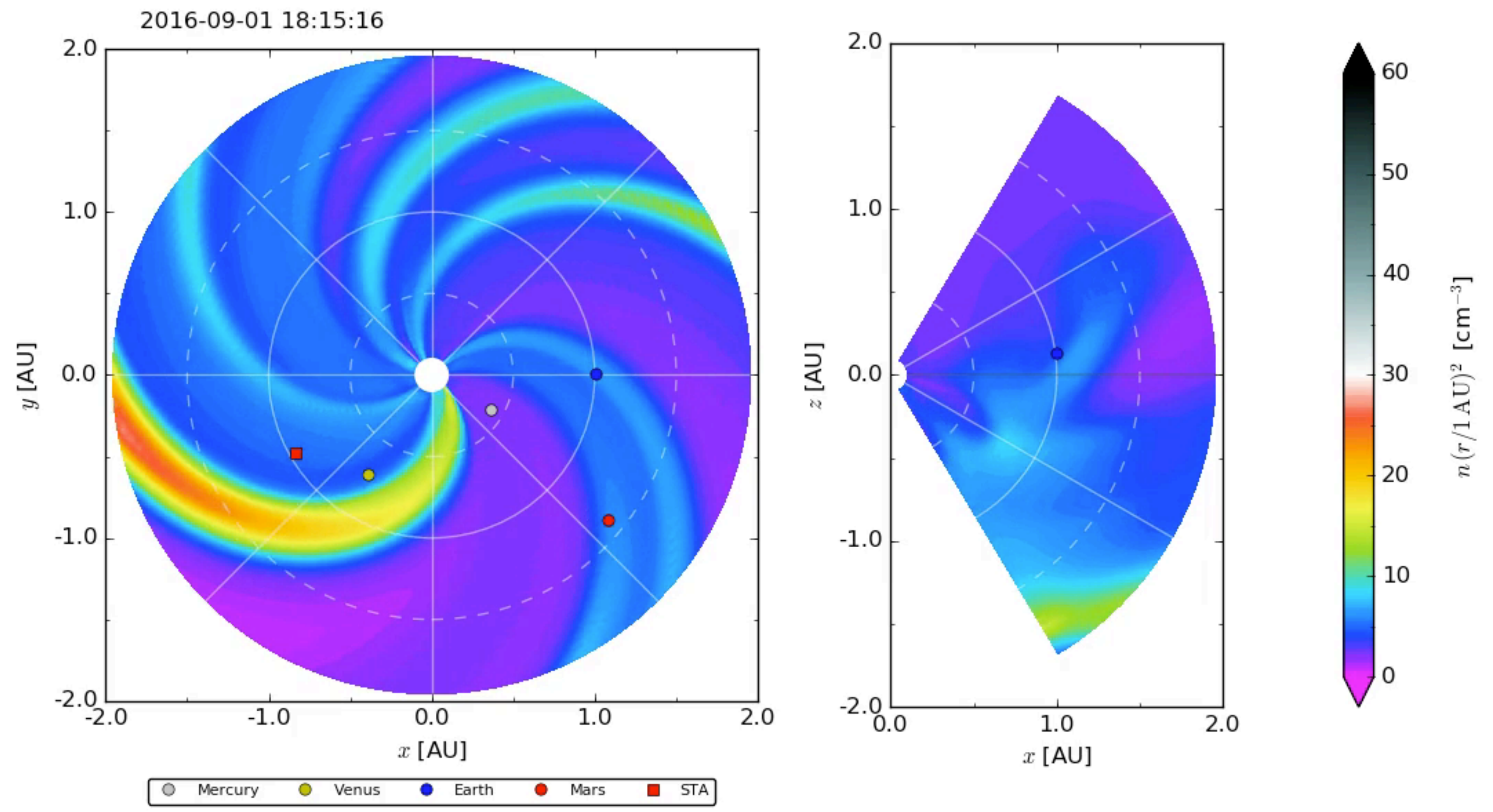




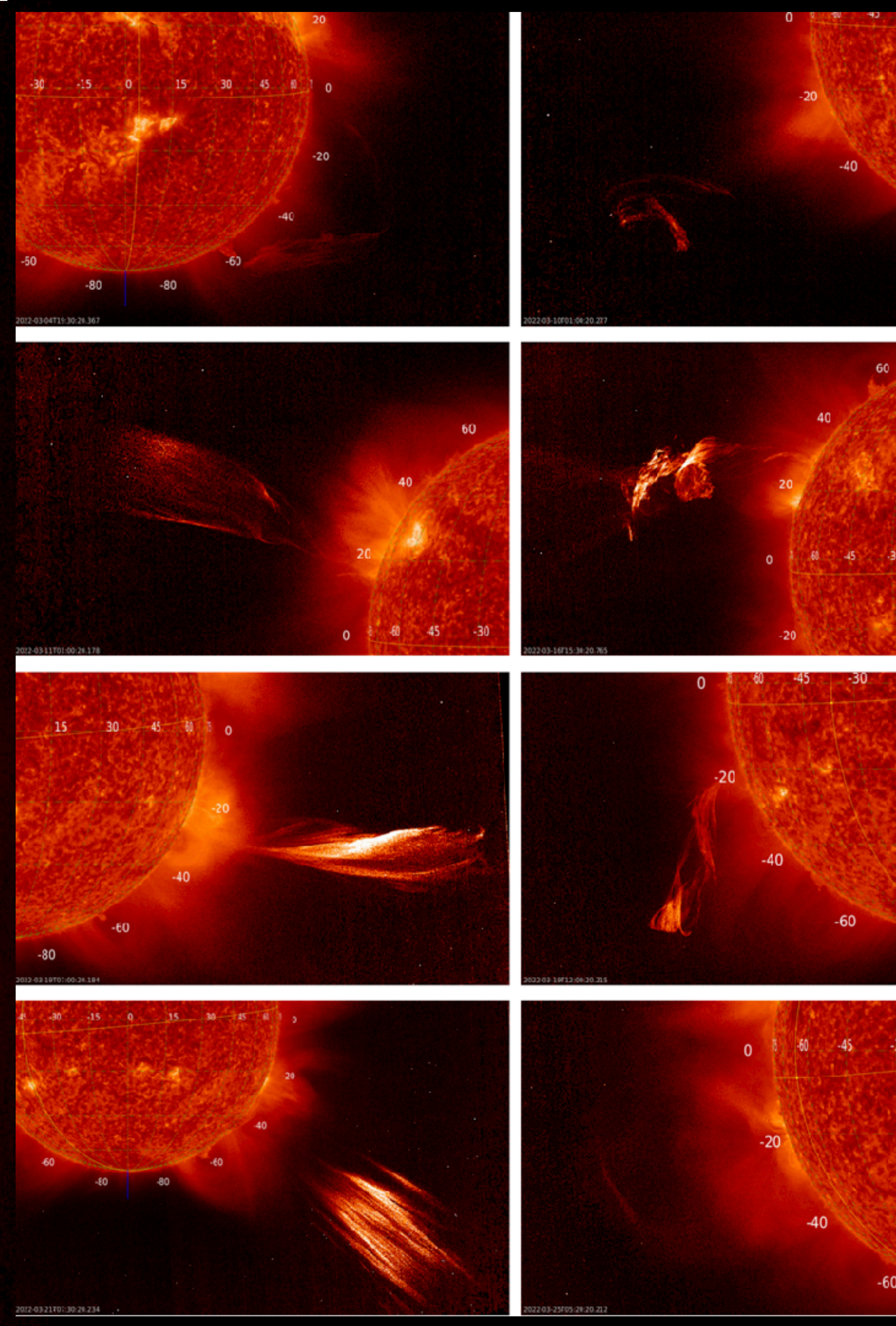
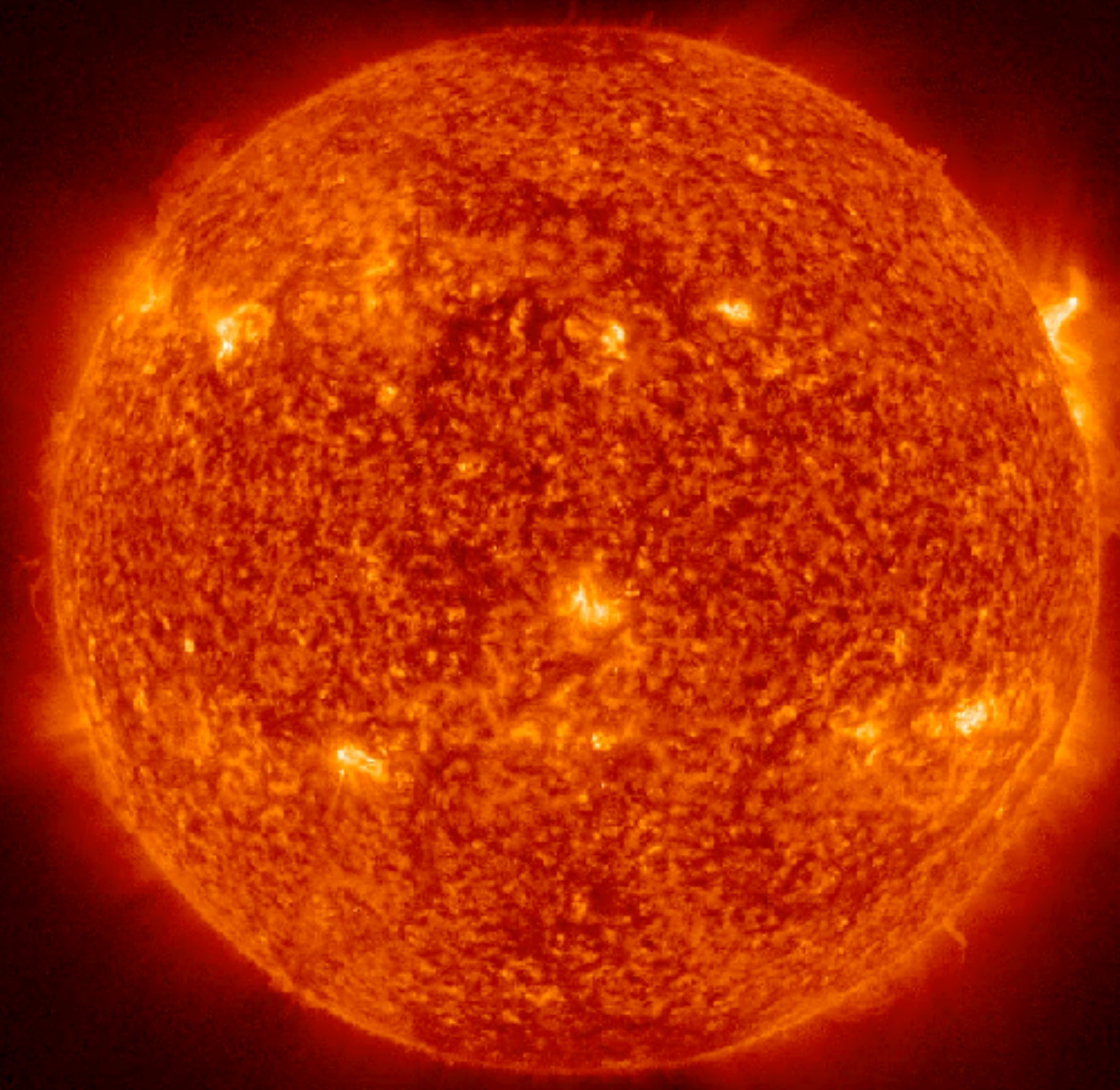
Who cares?

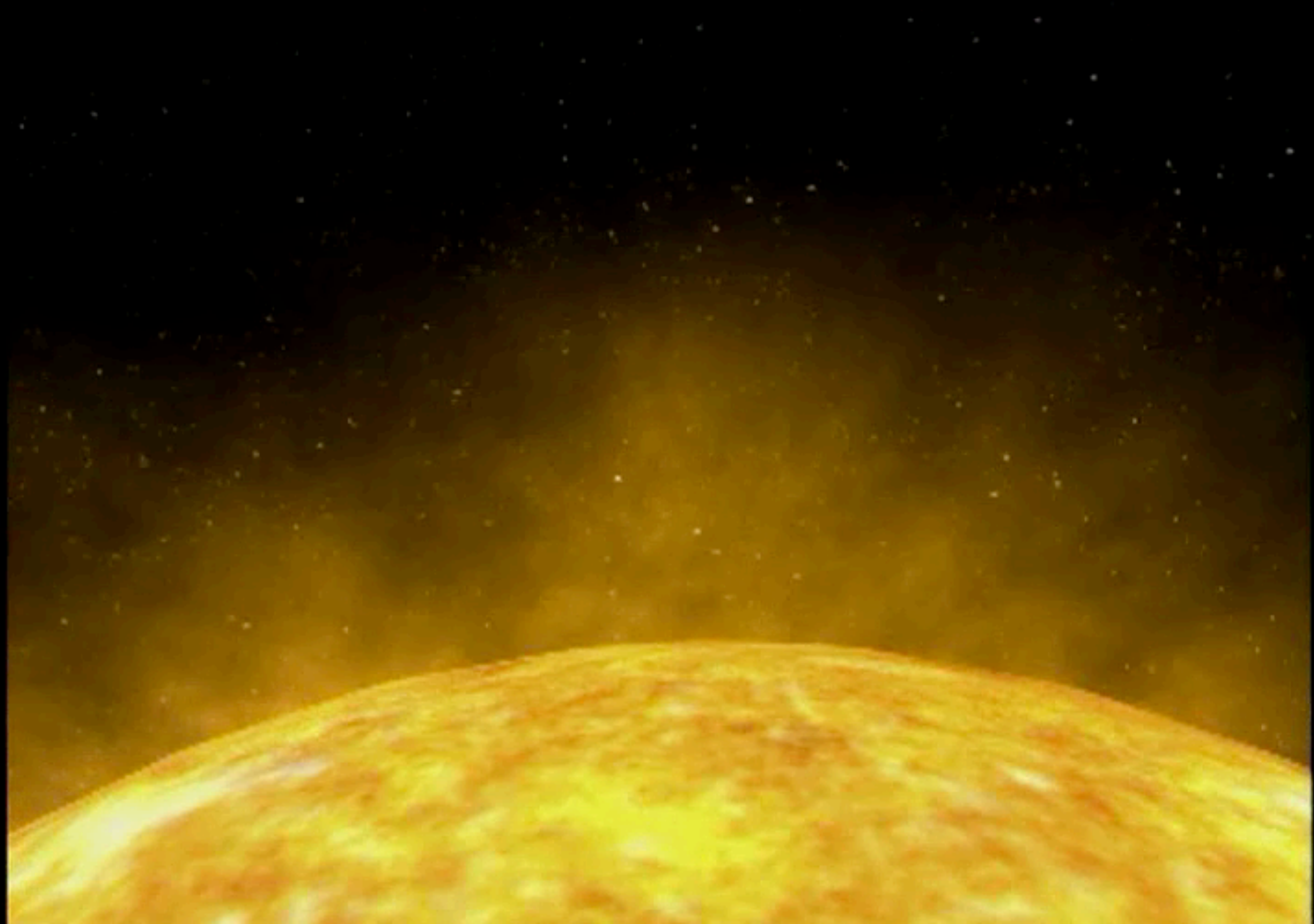
Ruimteweer

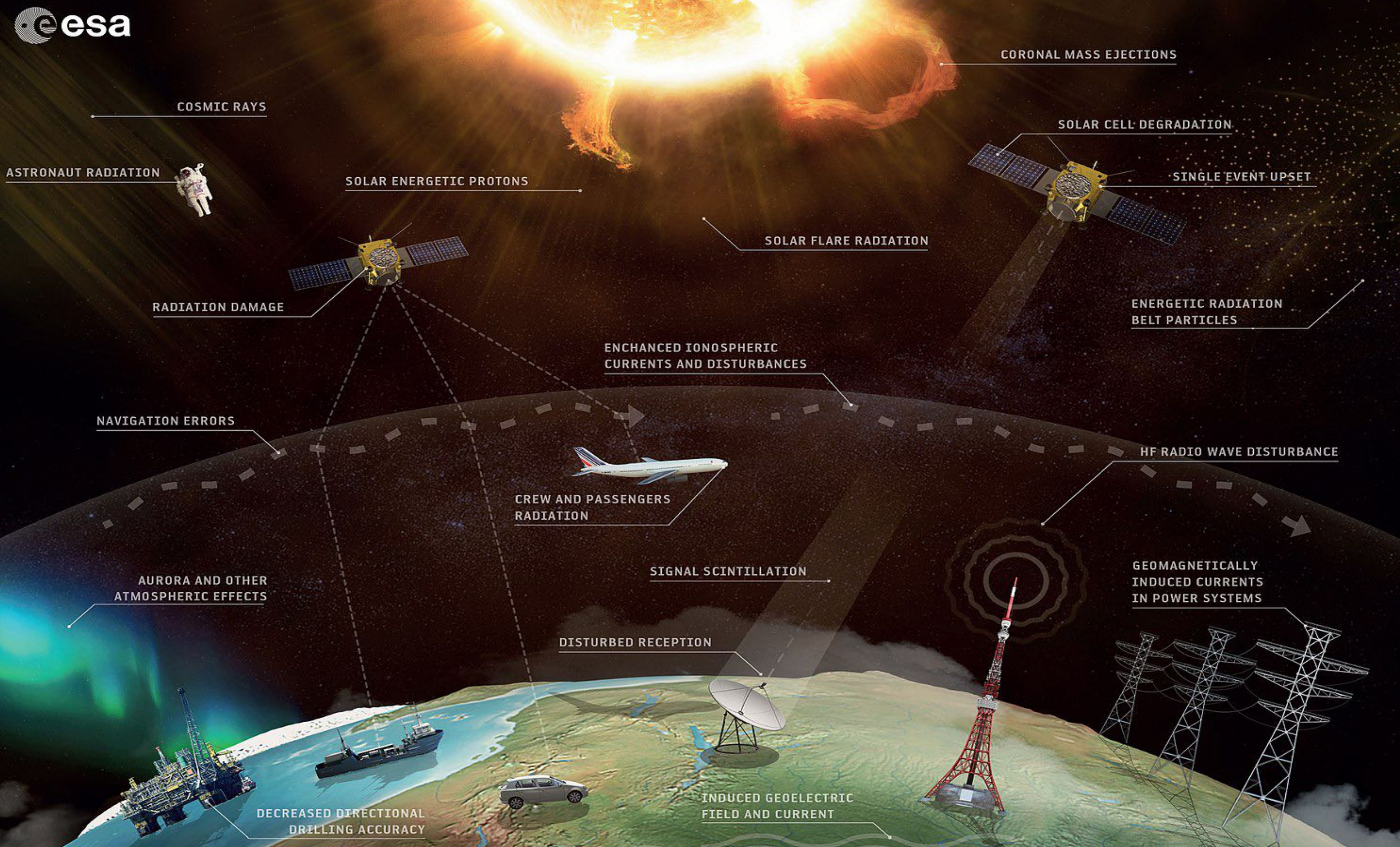




EUHFORIA, realtime simulations of the inner heliosphere







CORONAL MASS EJECTIONS

COSMIC RAYS

ASTRONAUT RADIATION

SOLAR ENERGETIC PROTONS

SOLAR CELL DEGRADATION

SINGLE EVENT UPSET

SOLAR FLARE RADIATION

RADIATION DAMAGE

ENERGETIC RADIATION BELT PARTICLES

ENHANCED IONOSPHERIC CURRENTS AND DISTURBANCES

NAVIGATION ERRORS

CREW AND PASSENGERS RADIATION

HF RADIO WAVE DISTURBANCE

AURORA AND OTHER ATMOSPHERIC EFFECTS

SIGNAL SCINTILLATION

GEOMAGNETICALLY INDUCED CURRENTS IN POWER SYSTEMS

DISTURBED RECEPTION

DECREASED DIRECTIONAL DRILLING ACCURACY

INDUCED GEOELECTRIC FIELD AND CURRENT



0000061601

FNXX02 EFKL 150645

SWX ADVISORY

DTG: 20210515/0645Z

SWXC: PECASUS

ADVISORY NR: 2021/18

NR RPLC: 2021/17

SWX EFFECT: HF COM SEV

OBS SWX: 23/0535Z EQS W045 - E045

FCST SWX +6 HR: 23/1800Z NOT AVBL

FCST SWX +12 HR: 23/0000Z NOT AVBL

FCST SWX +18 HR: 23/0600Z NOT AVBL

FCST SWX +24 HR: 23/0600Z NOT AVBL

RMK: SPACE WEATHER EVENT (MAXIMUM USABLE
FREQUENCY DEPRESSION) IS IN PROGRESS. IMPACT ON HIGHER HF
COM FREQUENCY BANDS EXPECTED. LOWER FREQUENCY BANDS MAY BE
LESS IMPACTED.

NXT ADVISORY: WILL BE ISSUED BY 20210515/1222Z=



Bedankt

<http://sidc.be/eui>

david@oma.be

Koninklijke Sterrenwacht van België

