

Summary of SWAP scientific Results

Jean-Marc Defise (CSL), David Berghmans (ROB), Dan Seaton (ROB), Elke D'Huys (ROB)



Royal Observatory of Belgium



Centre Spatial de Liège

PROBA-2 Symposium: 9 Years of Proba-2 Operations
2019 February 7-8, Redu

Summary of SWAP
scientific Results

The Discovery of the Middle Corona

Jean-Marc Defise (CSL), David Berghmans (ROB), Dan Seaton (ROB), Elke D'Huys (ROB)
Matthew West (ROB), Marilena Mierla (ROB)



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Discovery of
the Middle Corona

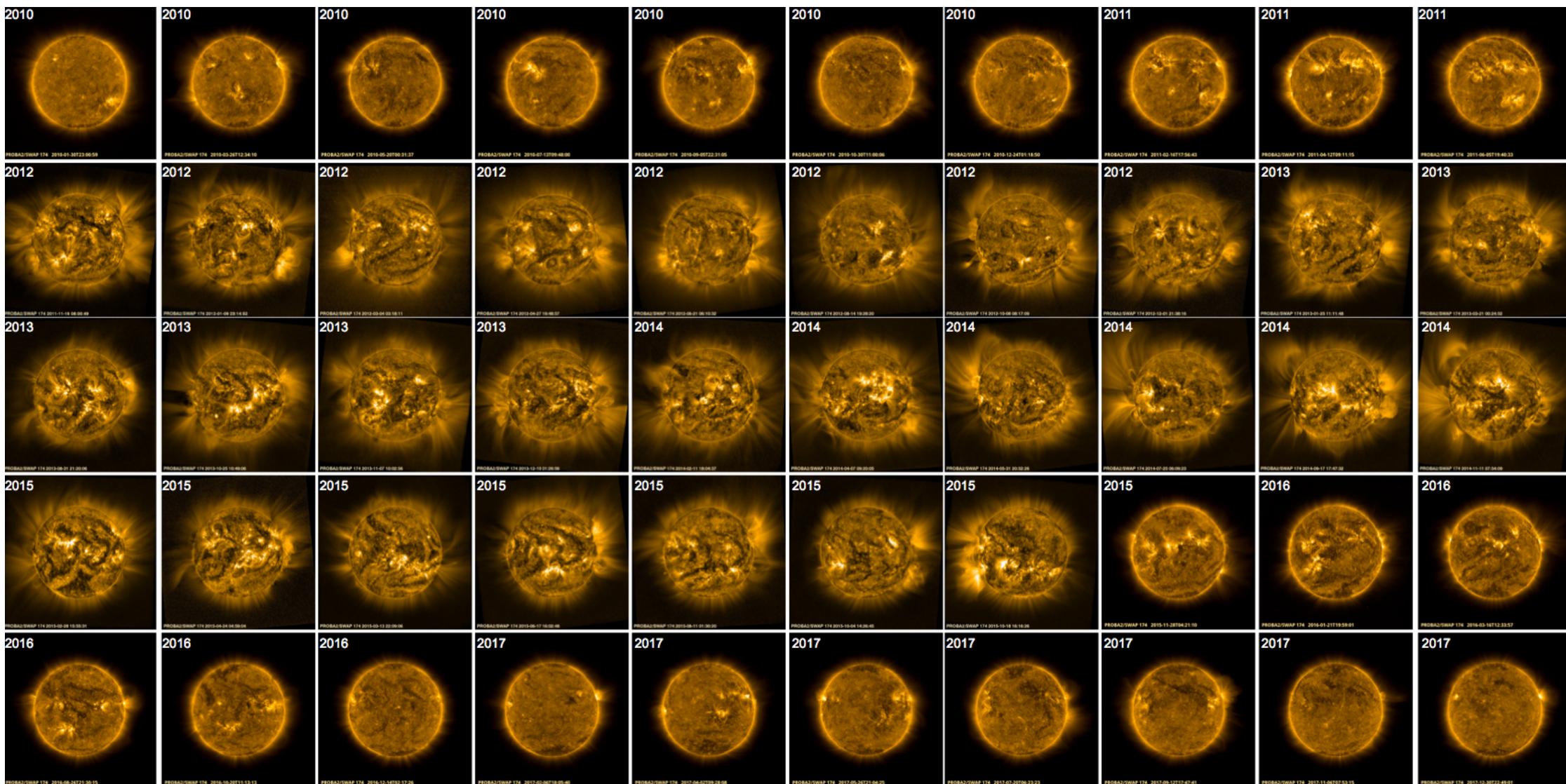
Mission Day
43

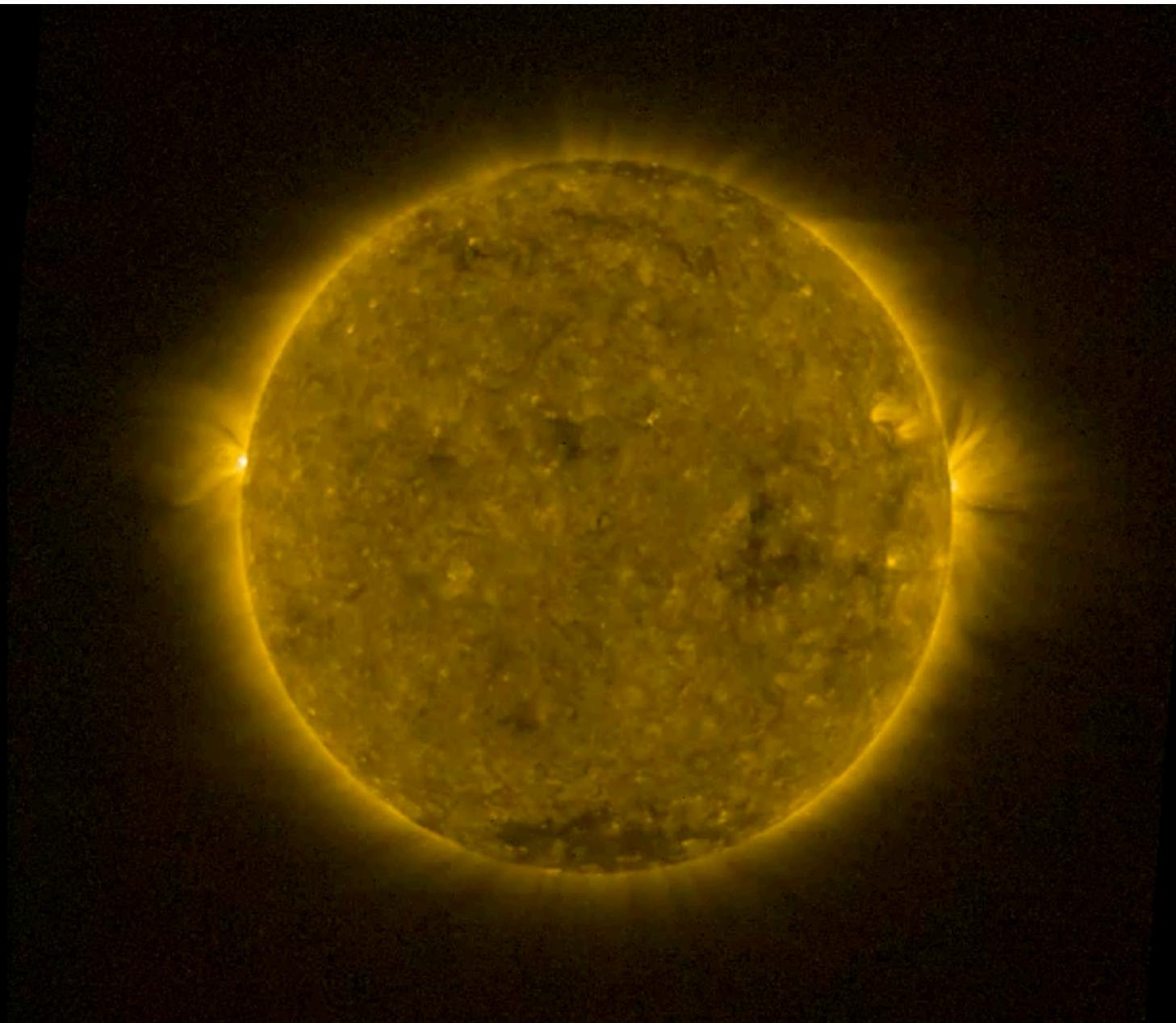
FIRST LIGHT

December 14, 2009, 21:44:19 UTC

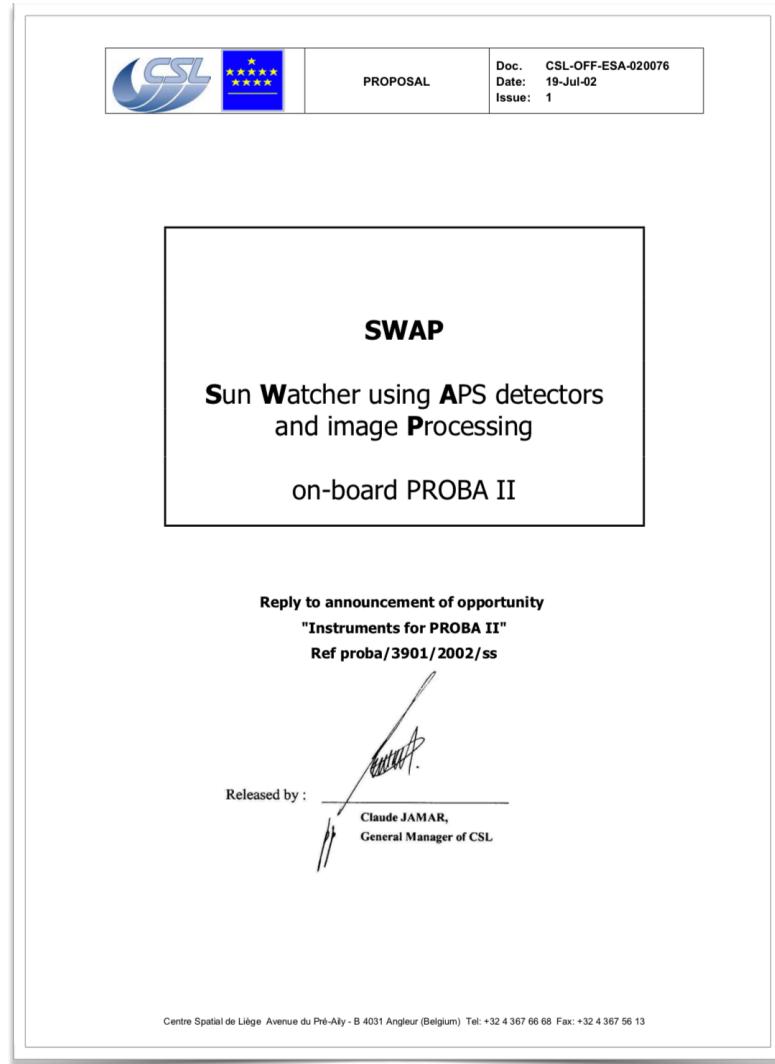


2 135 000 SWAP images, on average an image every 137 sec during 9.27 years





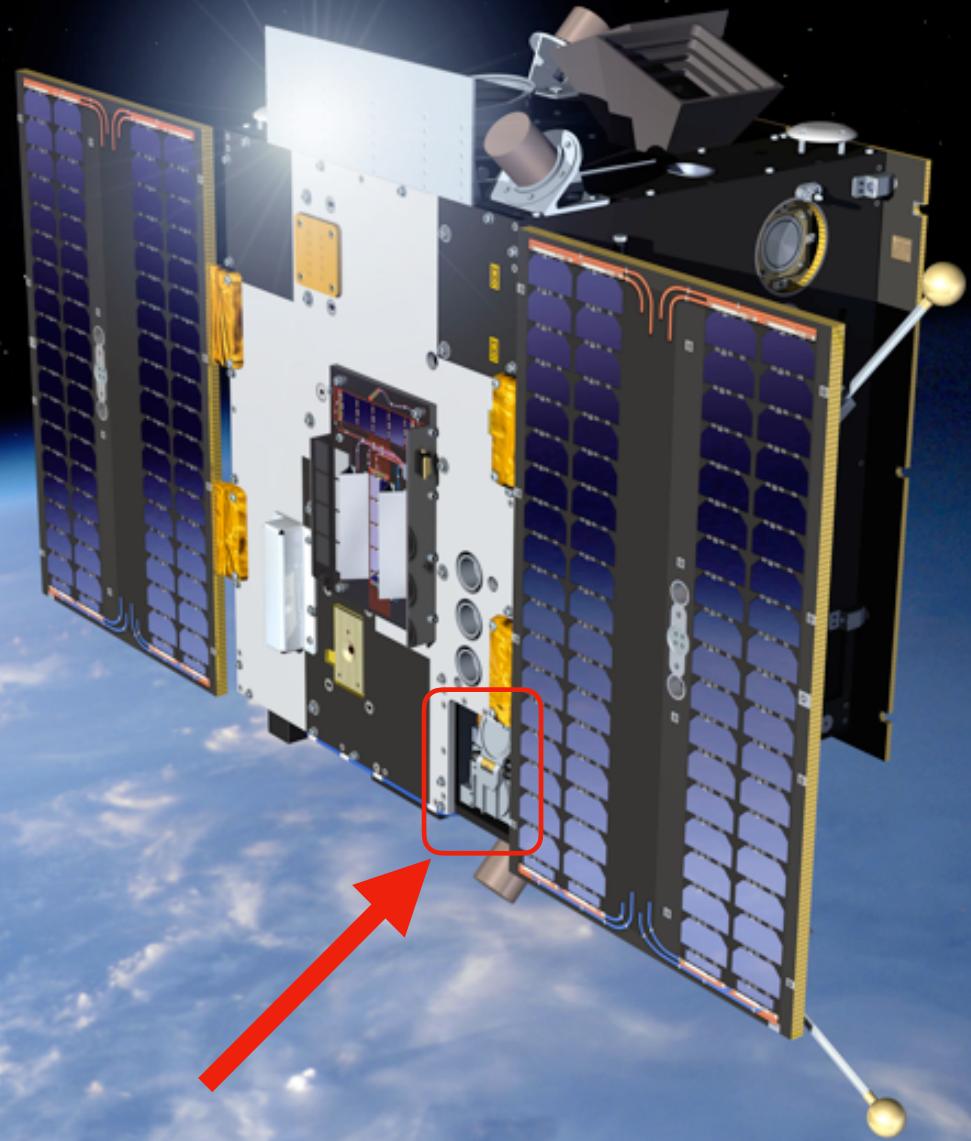
2002



2008

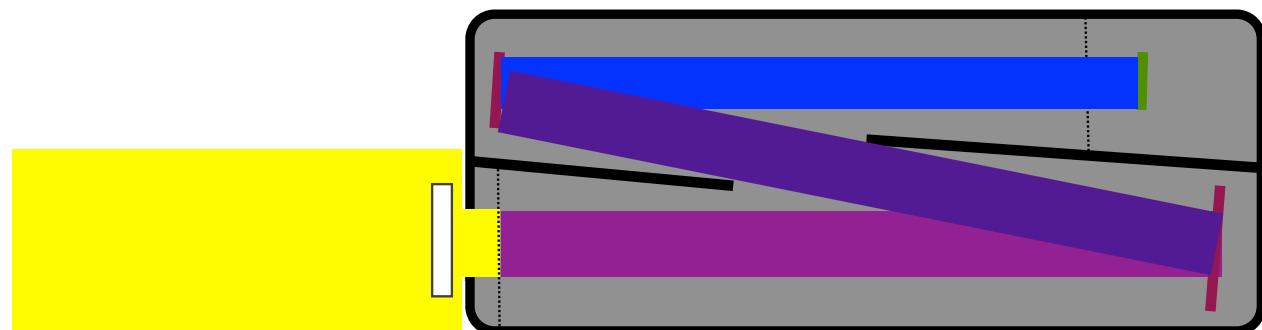


J.P. Halain PM of SWAP



SWAP: Sun Watcher using APS and Image Processing

Innovations



- off-axis telescope
- APS CMOS detector
- P43 EUV sensitivity
- compression & prioritisation

SWAP highlights

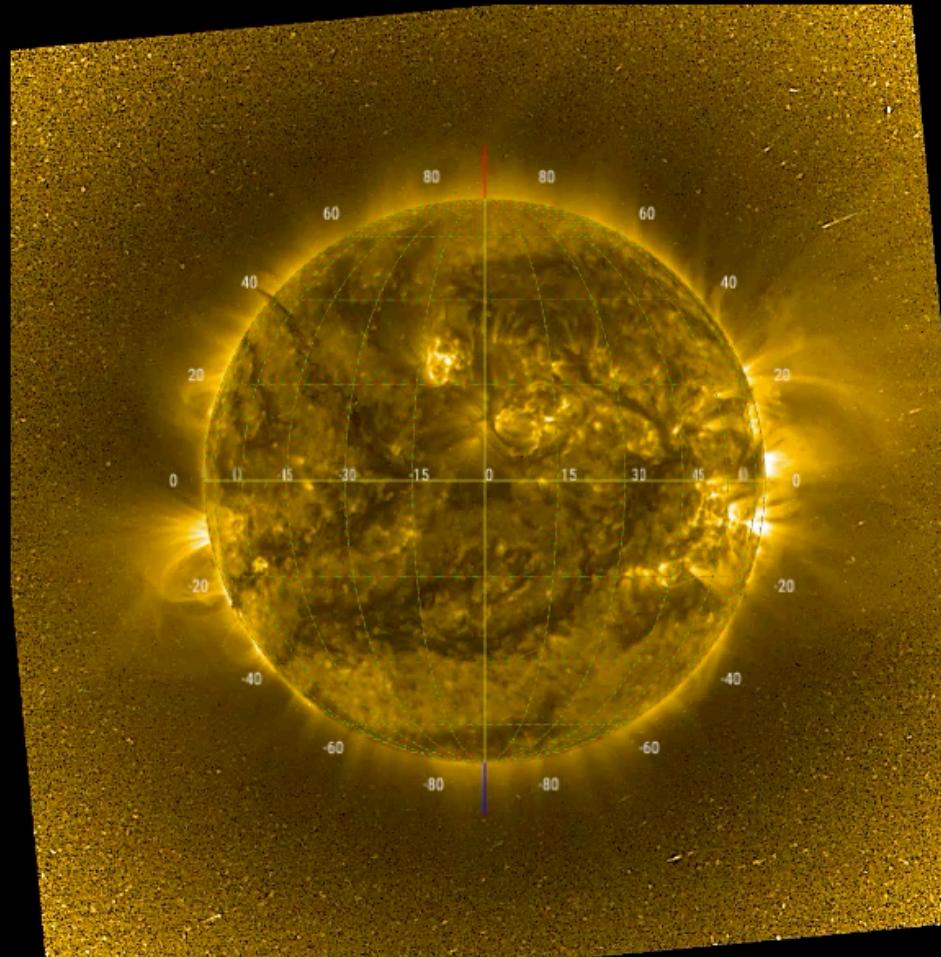


Royal Observatory of Belgium

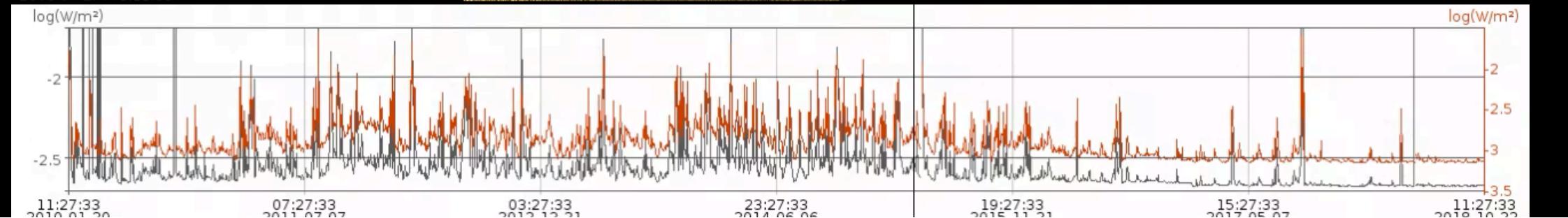
PROBA-2 Symposium: 9 Years of Proba-2 Operations
2019 February 7-8, Redu

Discovery of
the Middle Corona

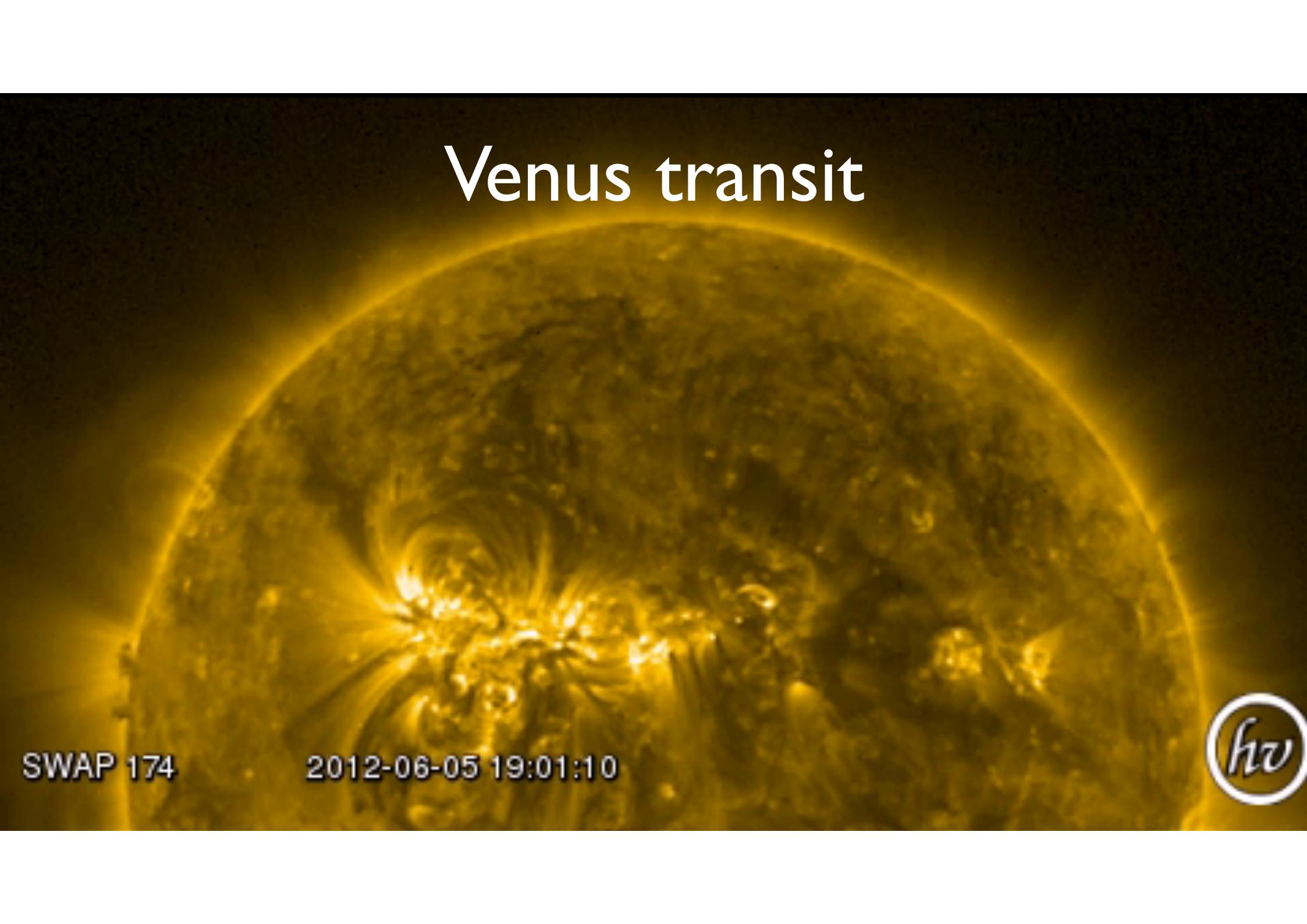
SWAP & LYRA ALL MISSION MOVIE



2015-04-27T10:33:08



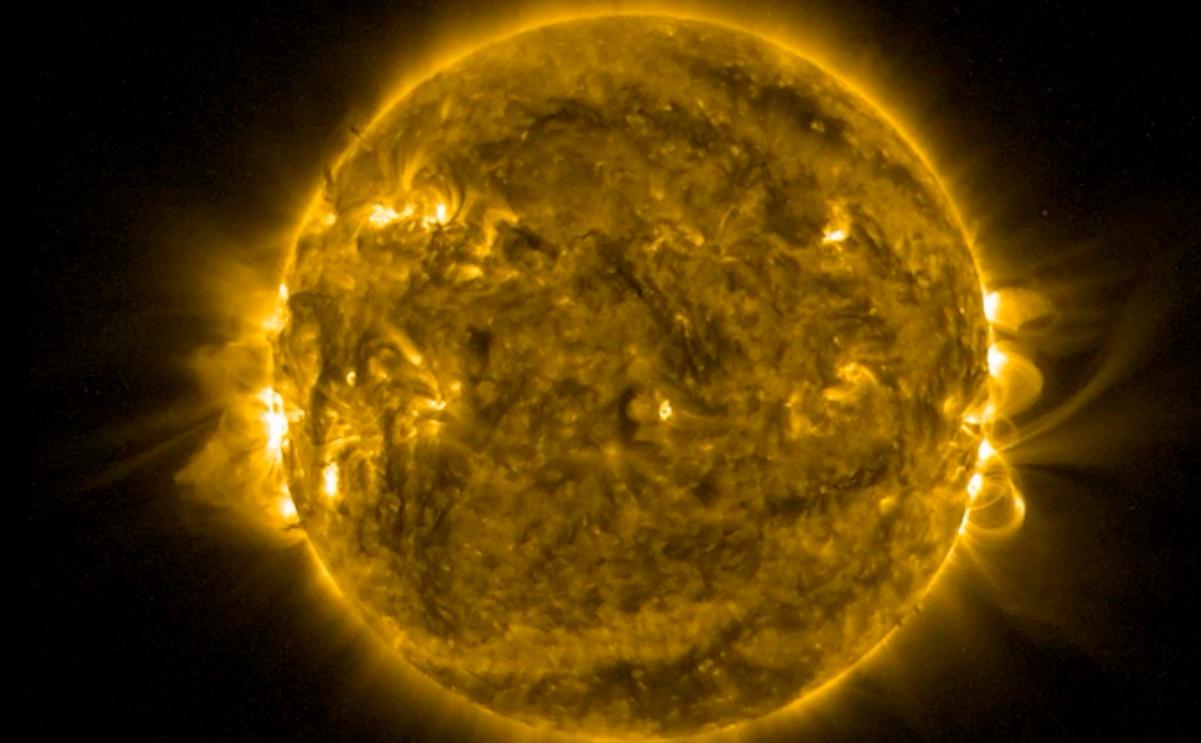
Venus transit



SWAP 174

2012-06-05 19:01:10

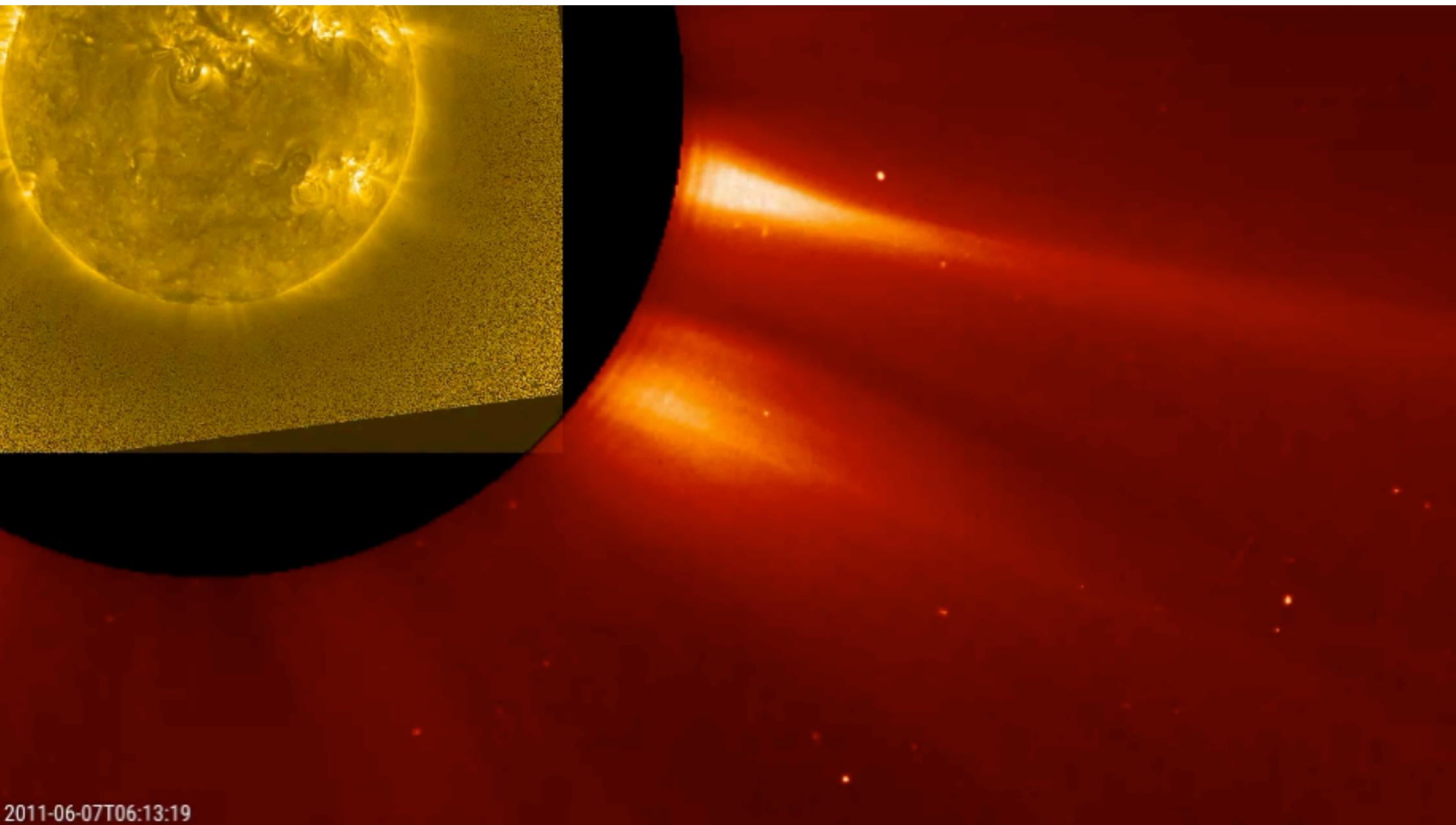




PROBA2/SWAP 174 Å 2015-03-20 08:30:15

In top 10 of ESA
most viewed
movies ever





2011-06-07T06:13:19

serendipity noun

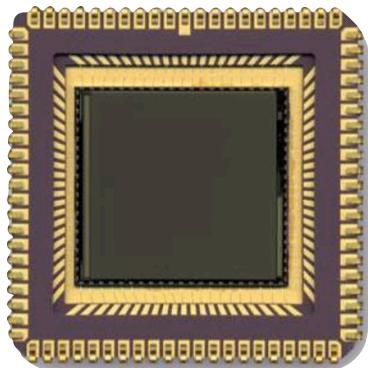
ser·en·dip·i·ty | \,ser-ən-dip-i-tē\

Definition of serendipity

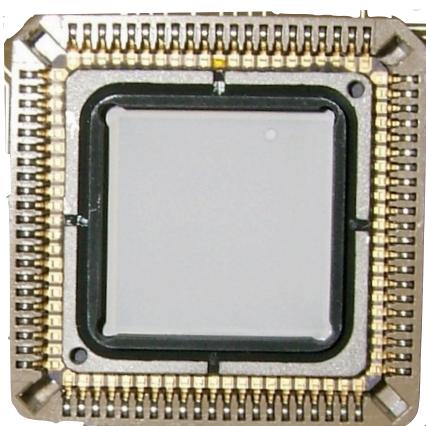
: the faculty or phenomenon of finding valuable or agreeable things not sought for
also : an instance of this

The Discovery of the Middle Corona

STAR 1000
15.4 x 15.4 mm²

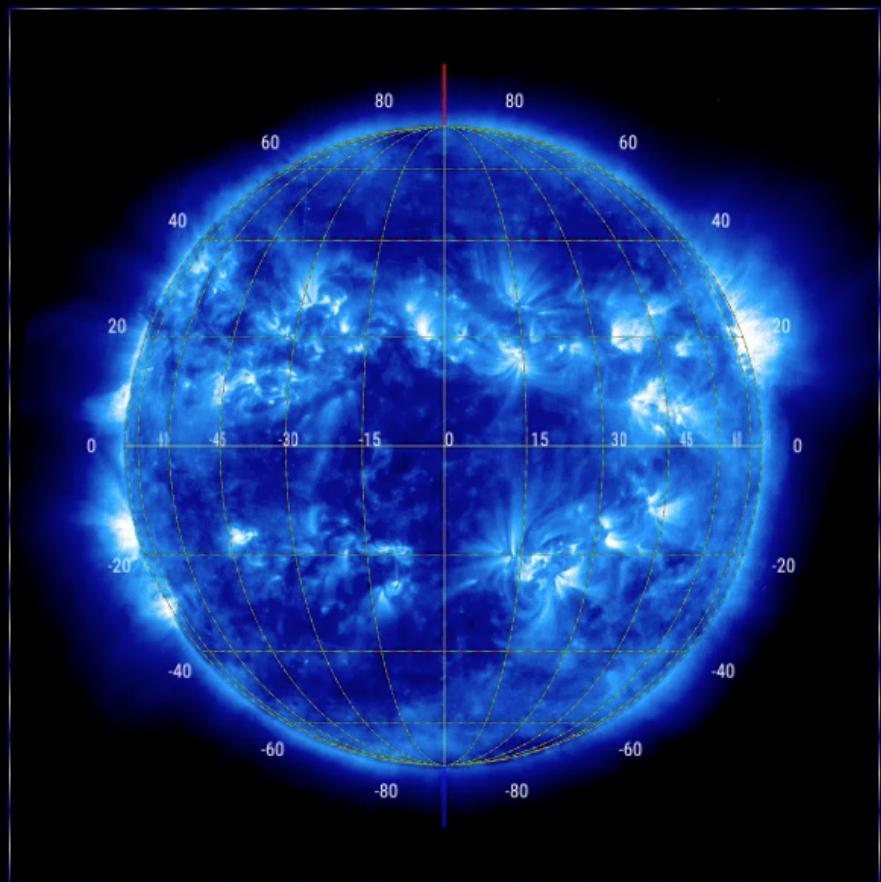


HAS
18.4 x 18.4 mm²

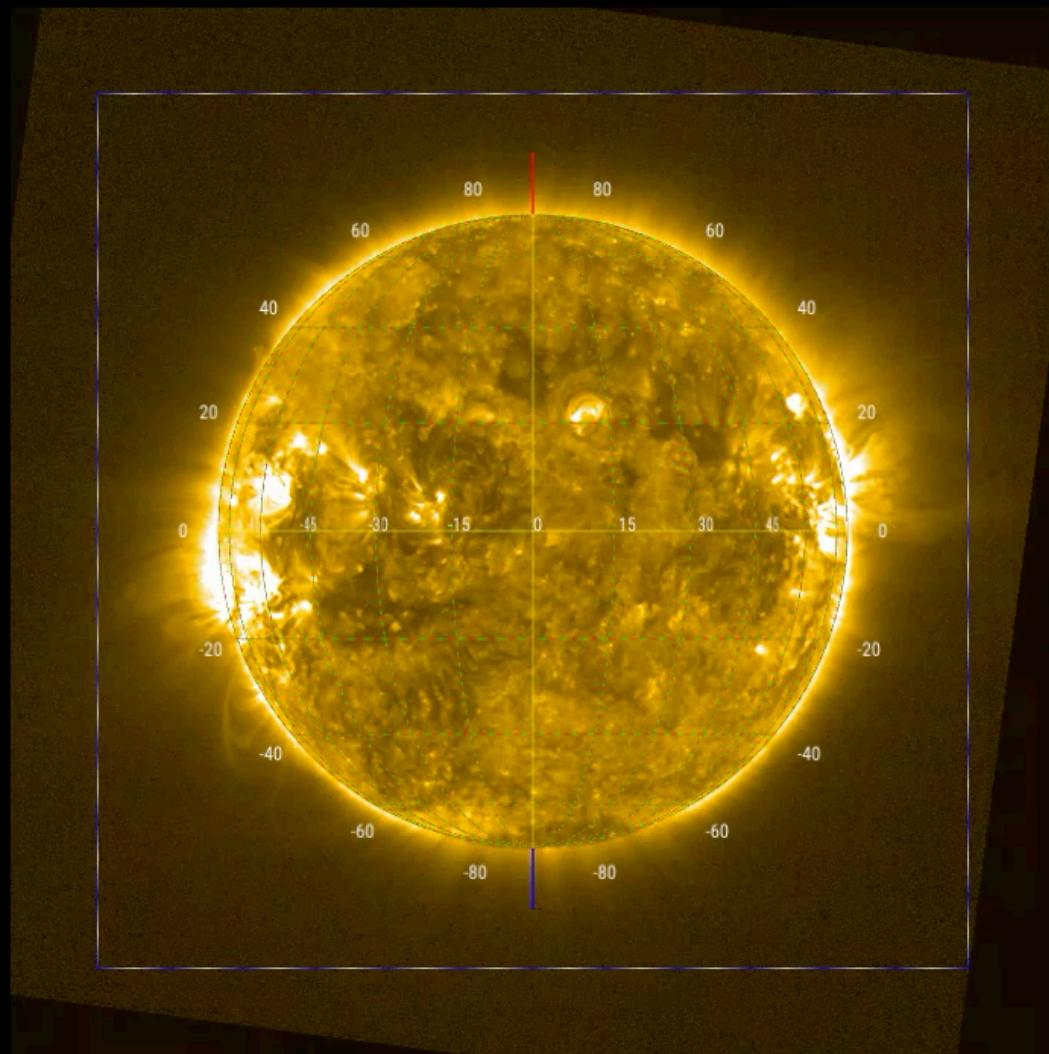


CMOS APS detector

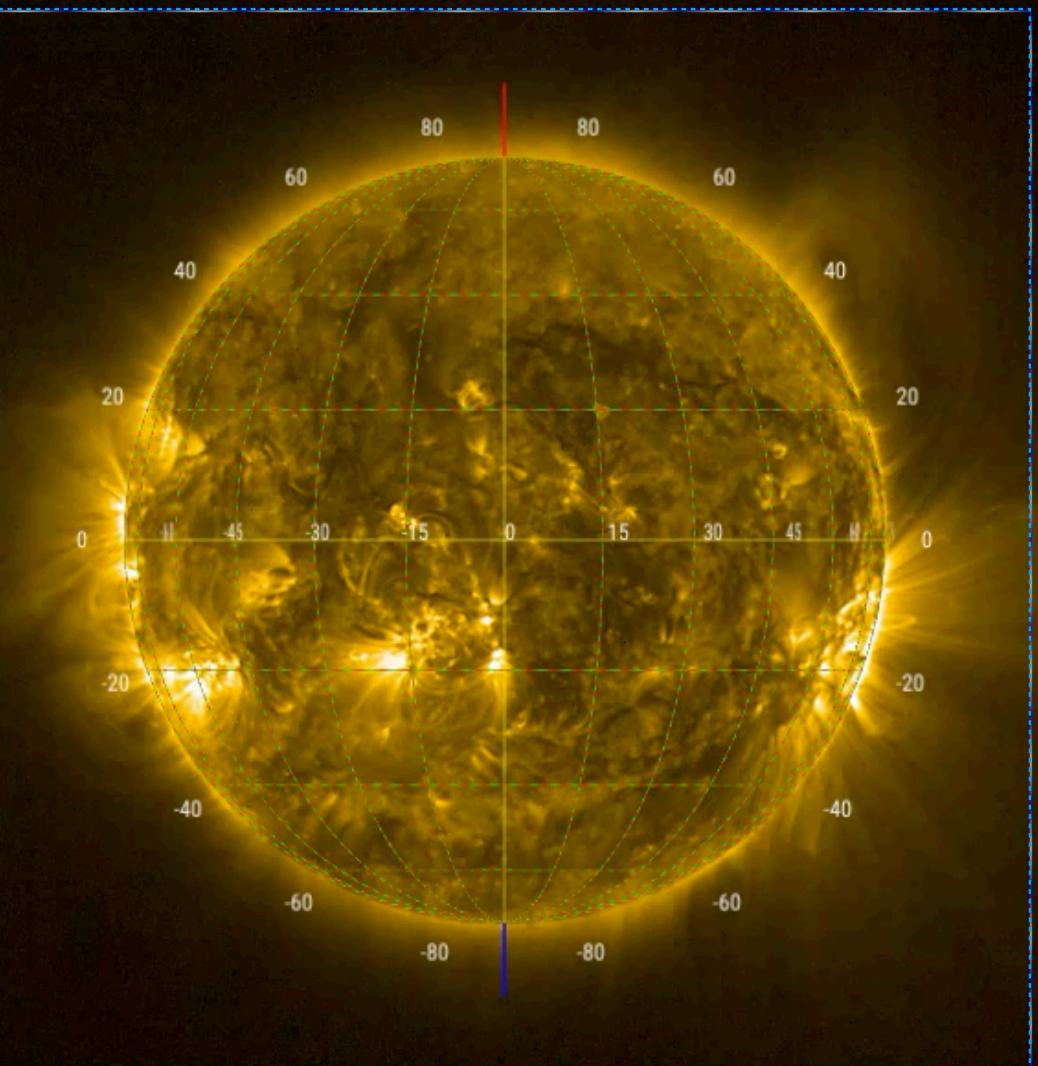
- first CMOS APS in orbit for solar physics
- low power consumption, radiation hard, no shutter
- 1024 x 1024 pixels
- coated with P43 for EUV sensitivity

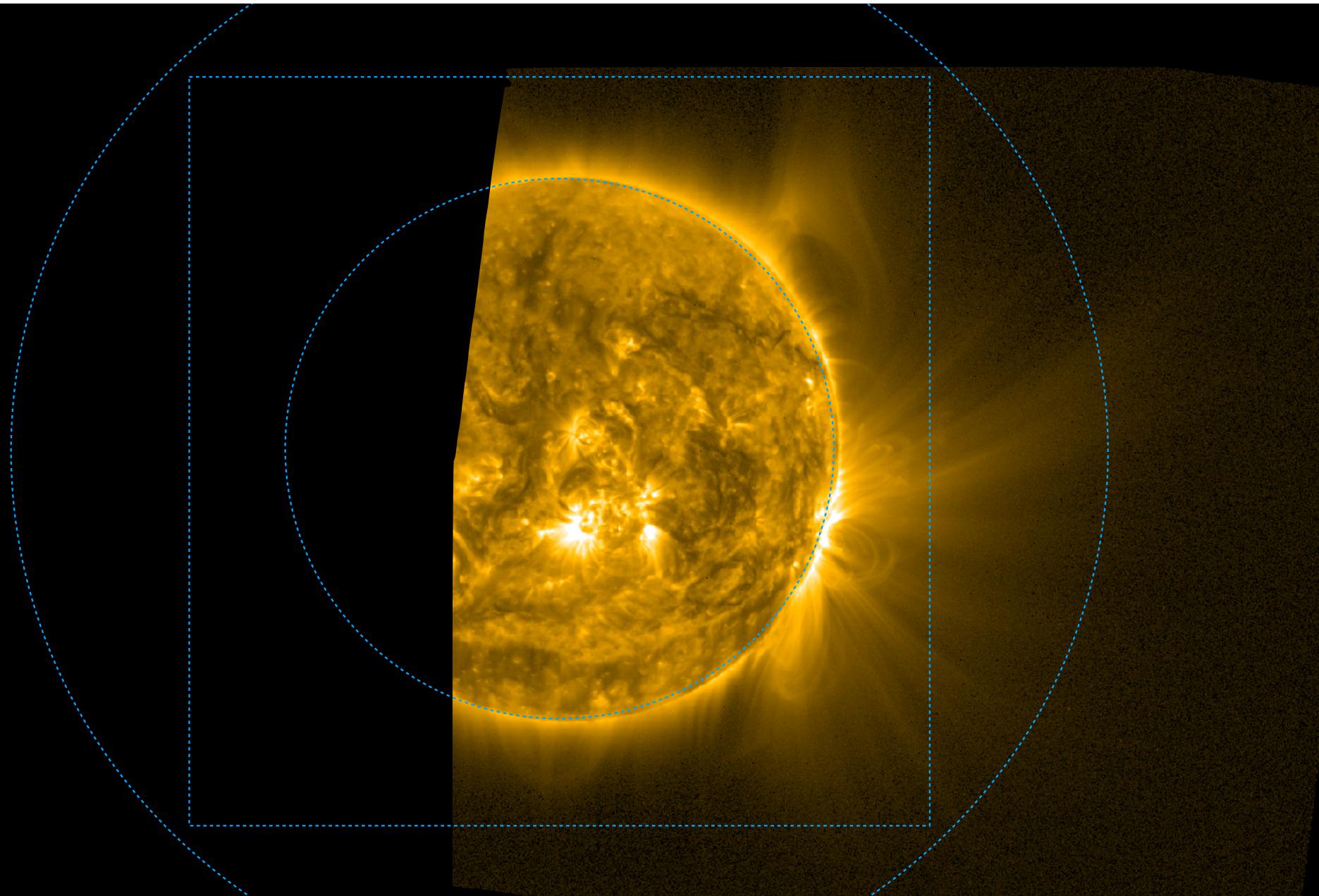


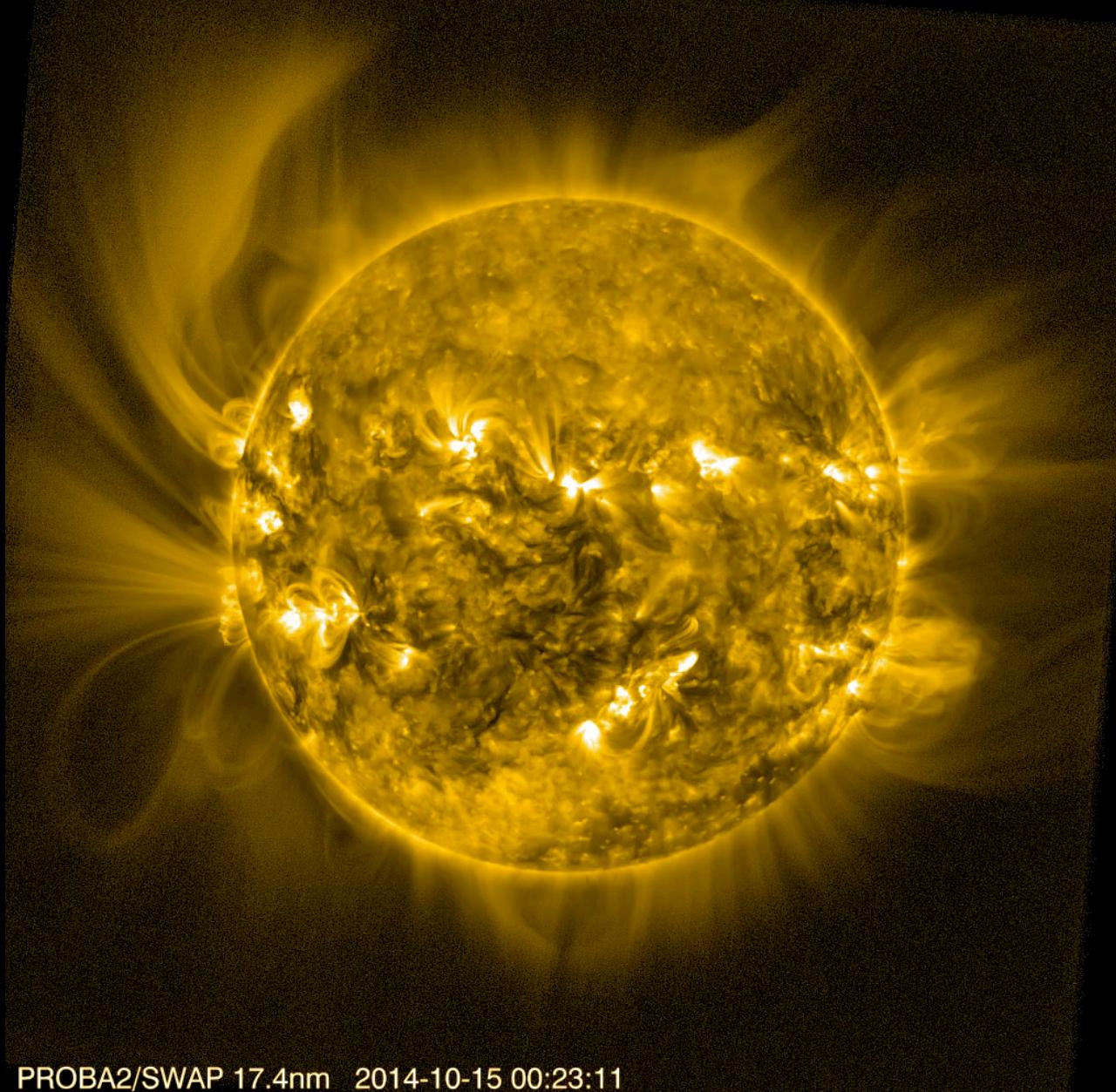
SOHO EIT 2011 December
field of view 45 arcmin



SWAP 2015 December
field of view 54 arcmin

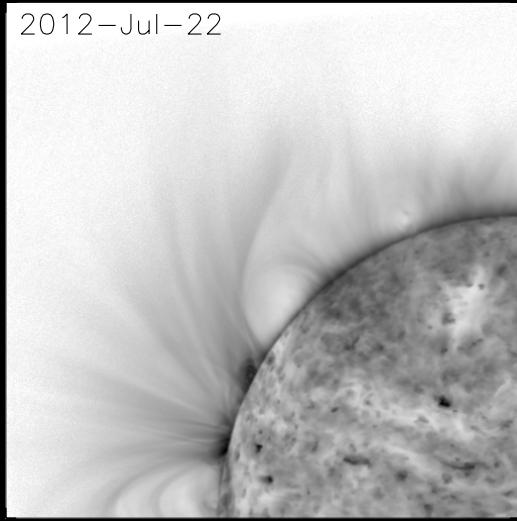




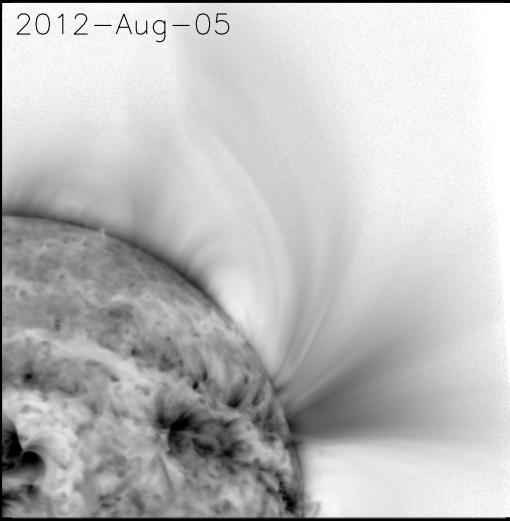


PROBA2/SWAP 17.4nm 2014-10-15 00:23:11

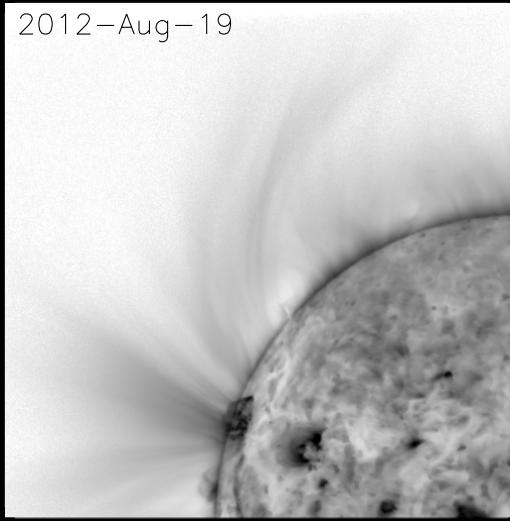
2012-Jul-22



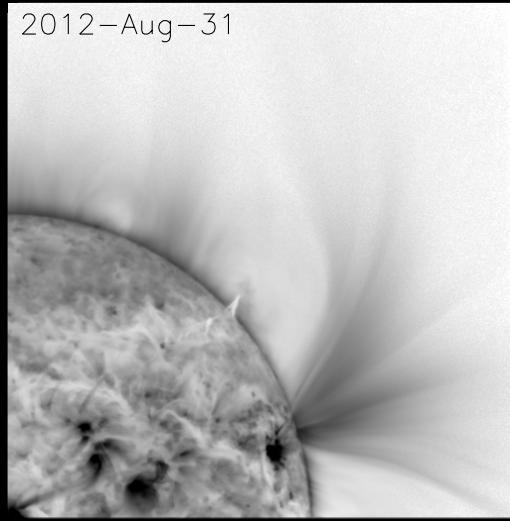
2012-Aug-05



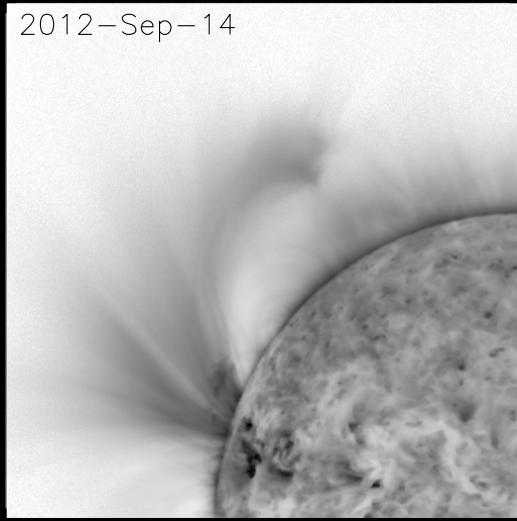
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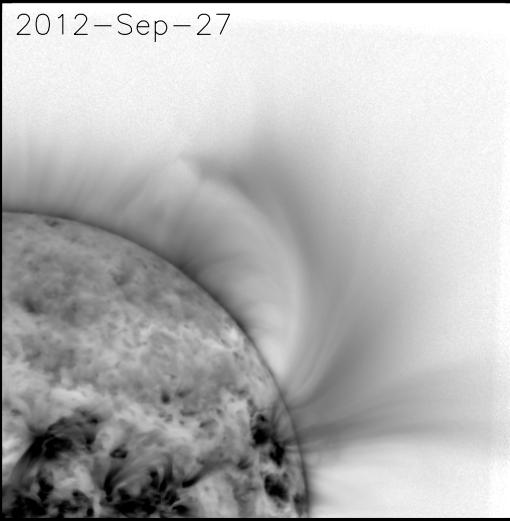
2012-Aug-31



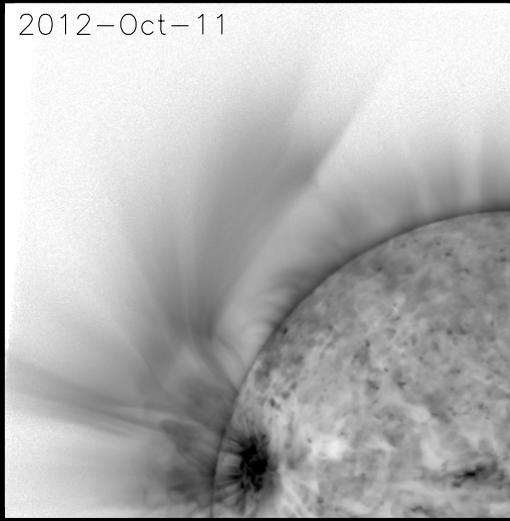
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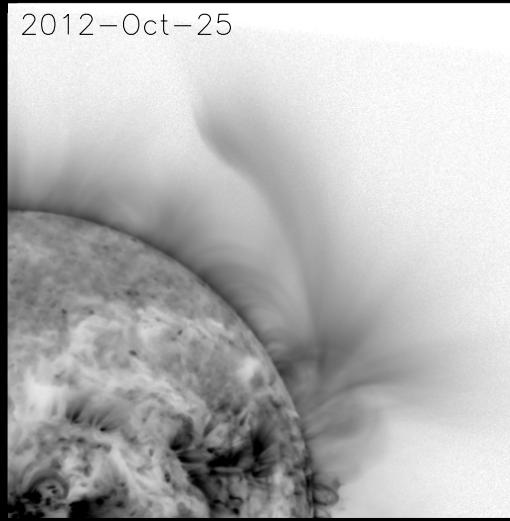
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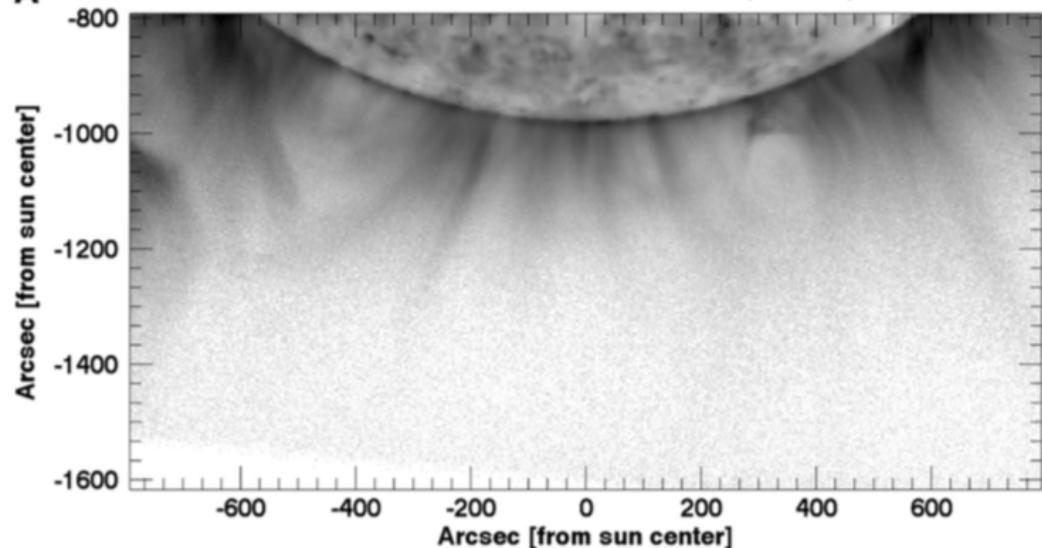
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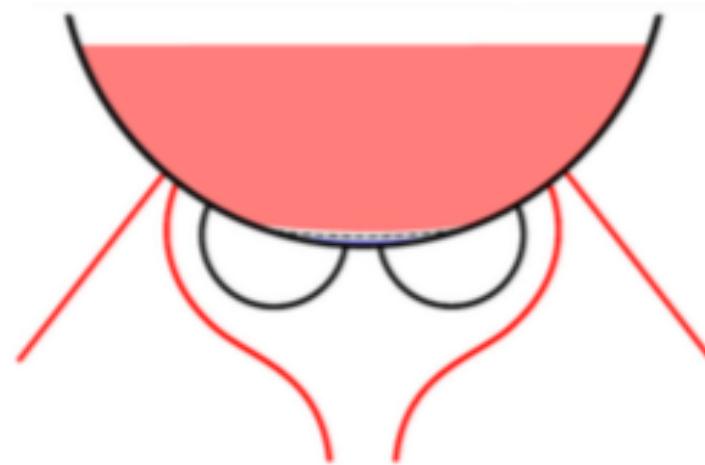
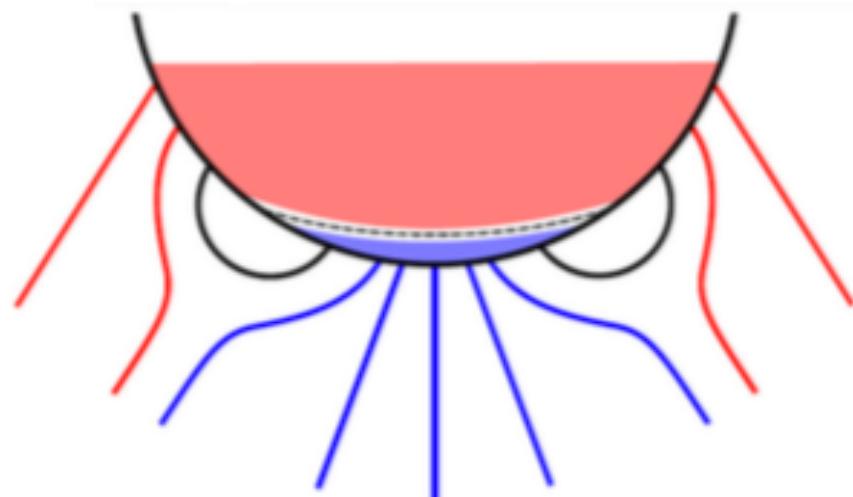
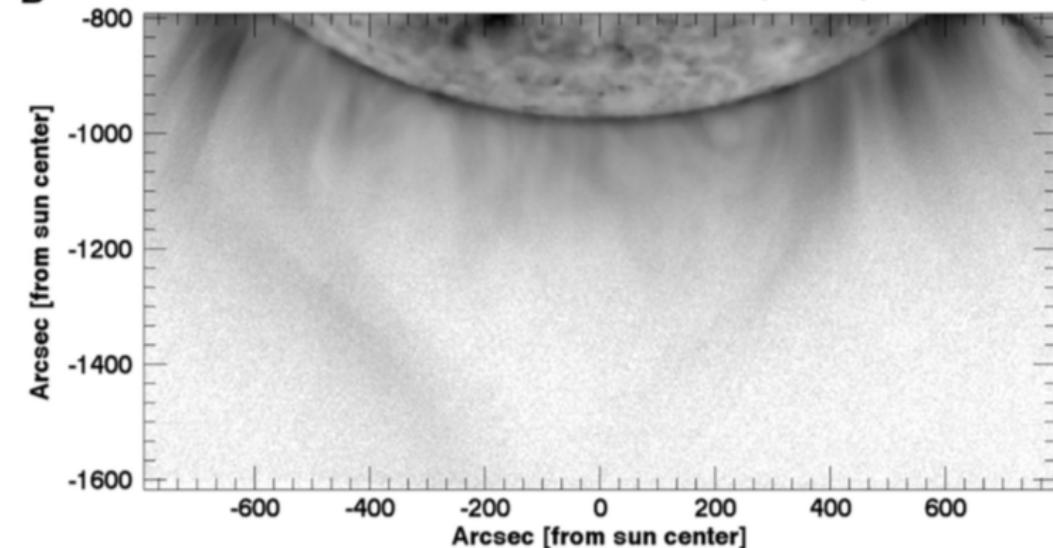
2012-Oct-25

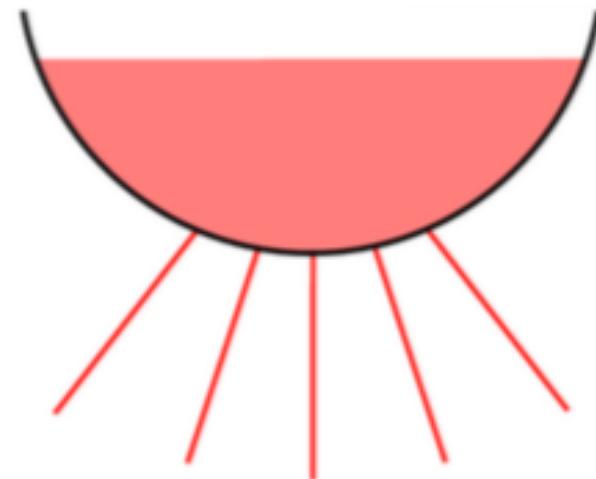
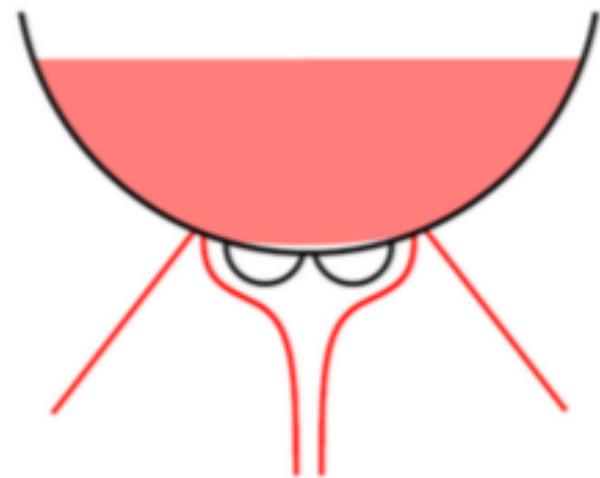
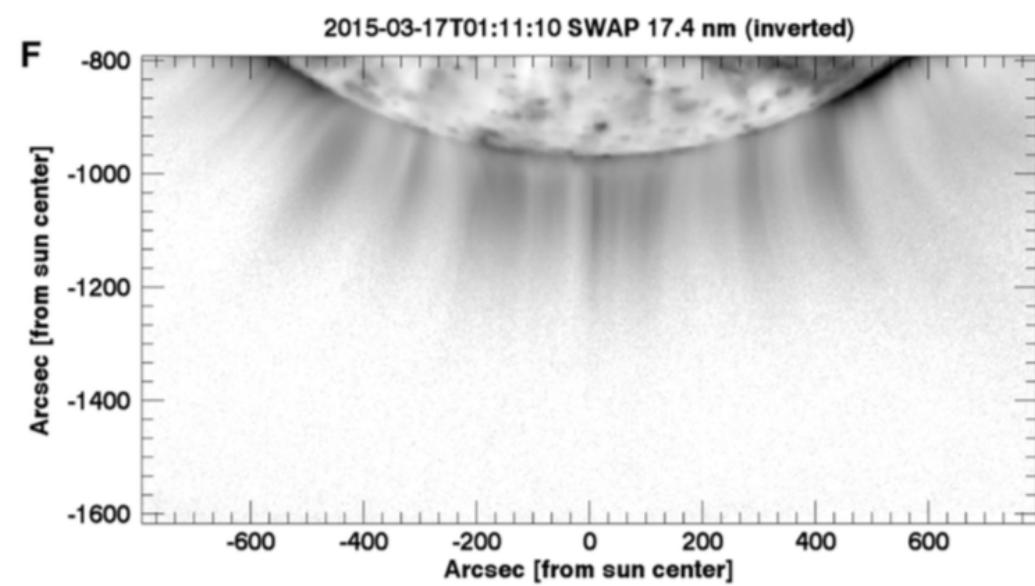
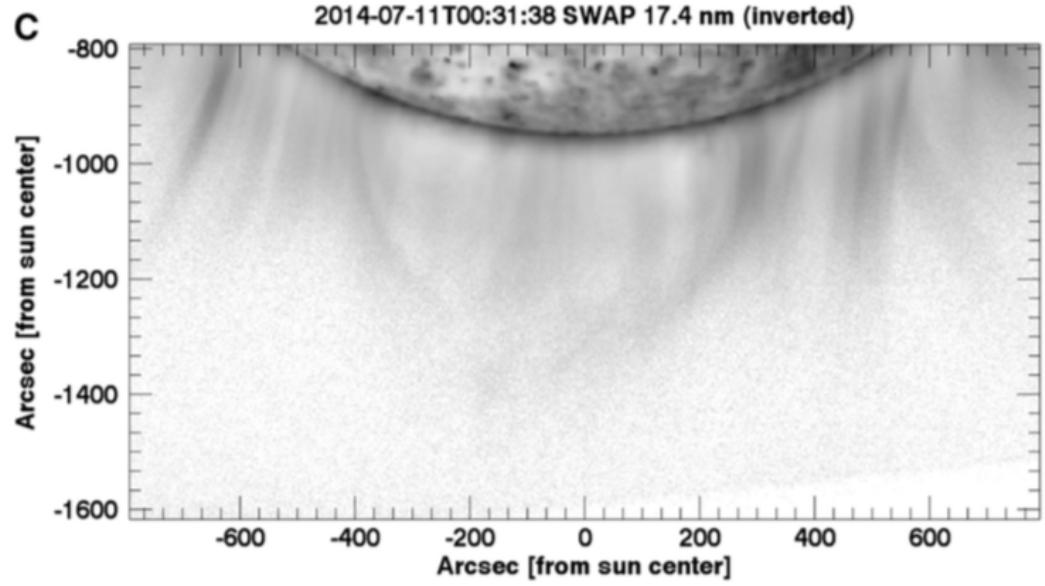


A 2014-01-15T09:43:13 SWAP 17.4 nm (inverted)

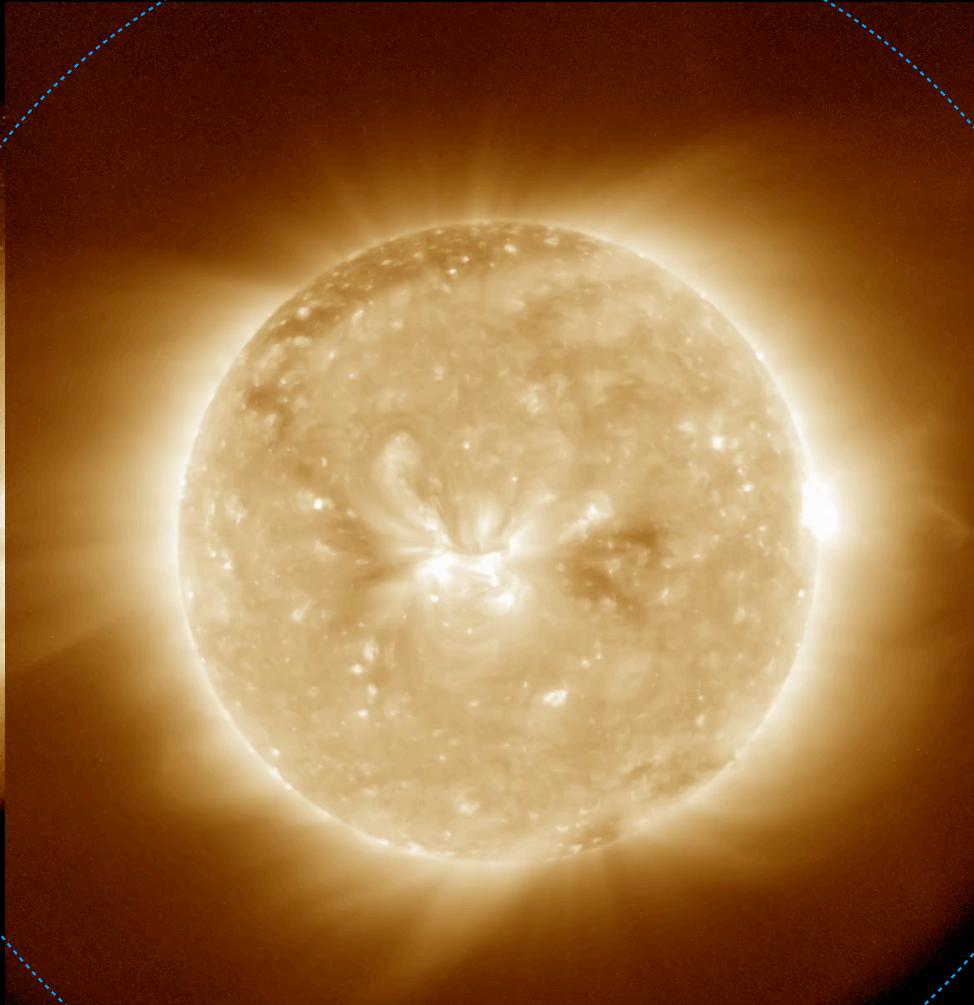


B 2014-02-23T01:15:57 SWAP 17.4 nm (inverted)





GOES-17 SUI
launched 2018 March 1
Dan Seaton

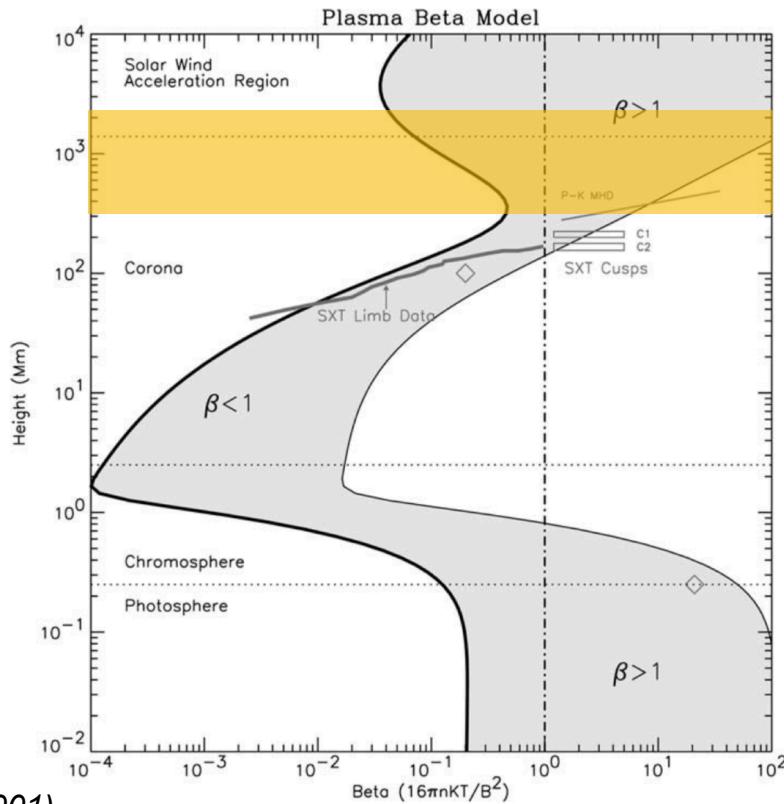


2018-08-10T00:23:39UTC GOES-17/SUFI 195A log10/ind, EXPTIME=20.0s/10.0s/20.0s, summing=2x2/1x1/2x2

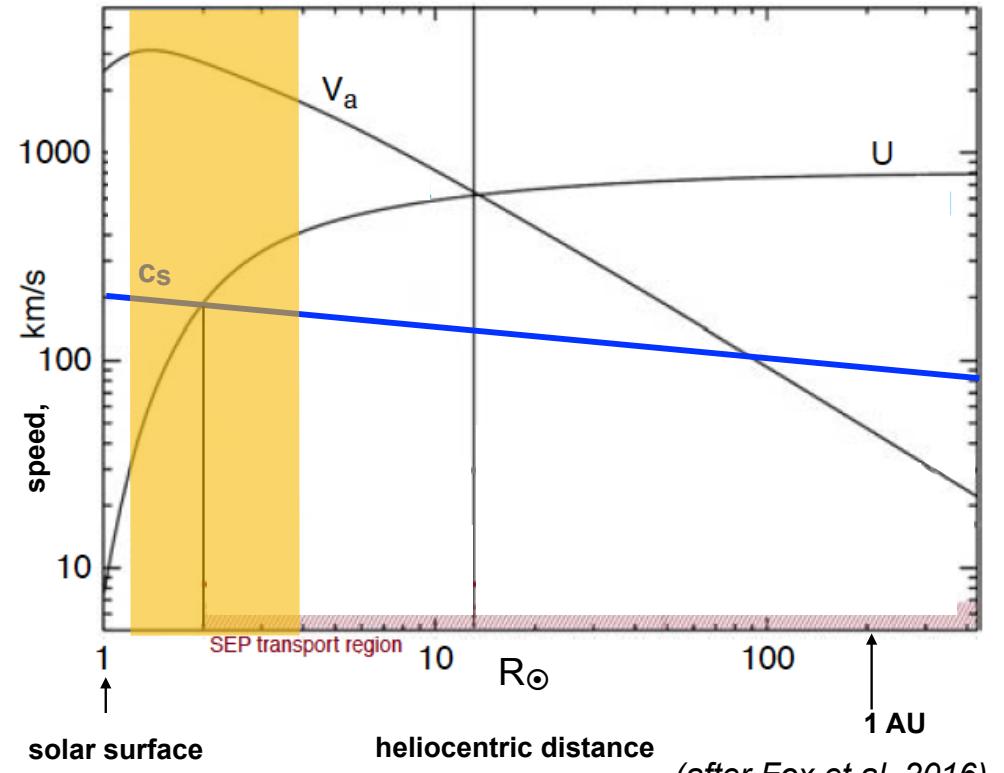
The Middle Corona, so what?



Physics of the Middle corona (0.5-> 4 Rsun)

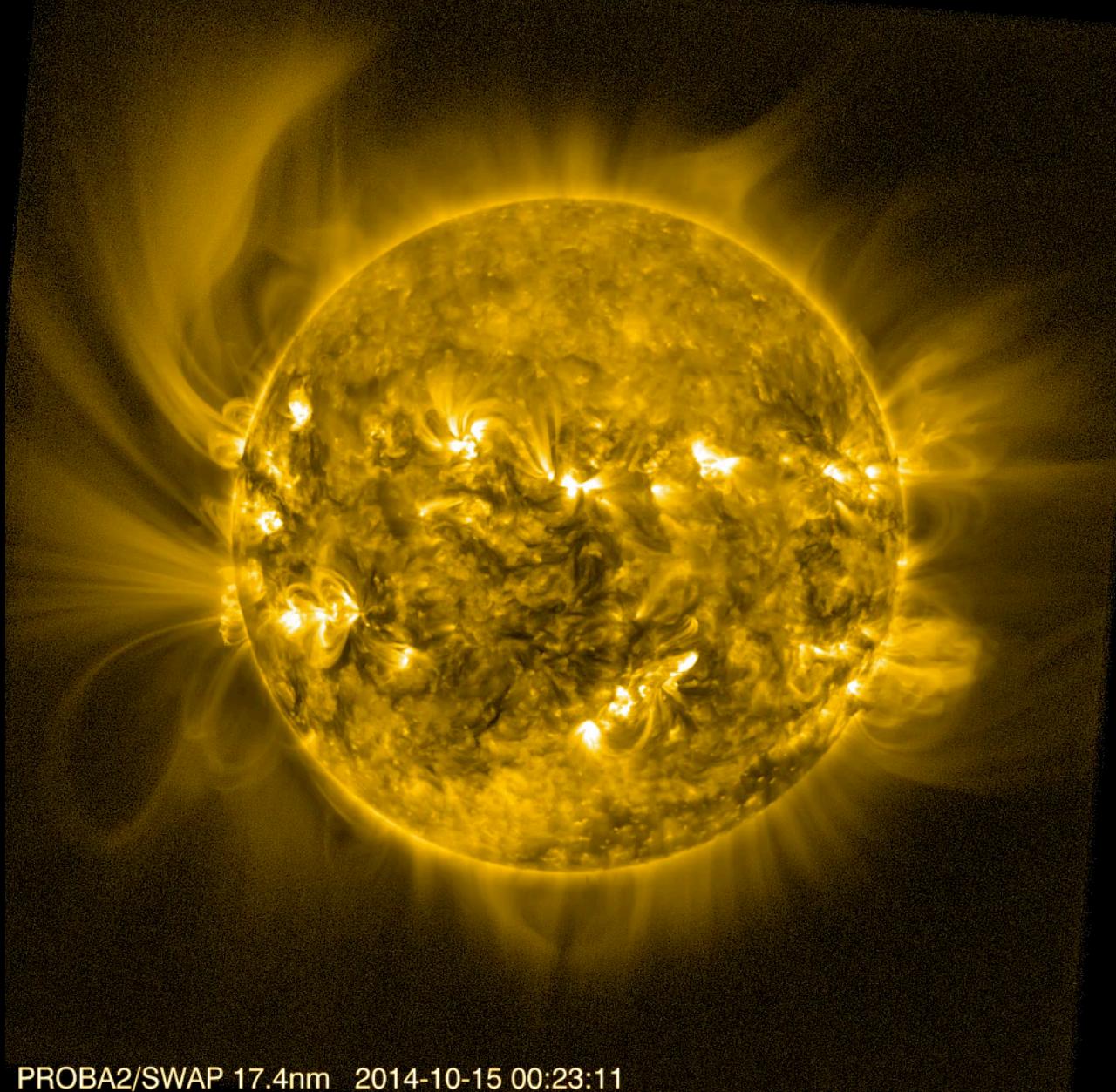


(Gary, 2001)



(after Fox et al. 2016)

- where the plasma switches from magnetic field to plasma outflow dominated
- the solar wind becomes supersonic, Alfvén speed reaches its maximum
- coronal mass ejections & energetic particles get accelerated

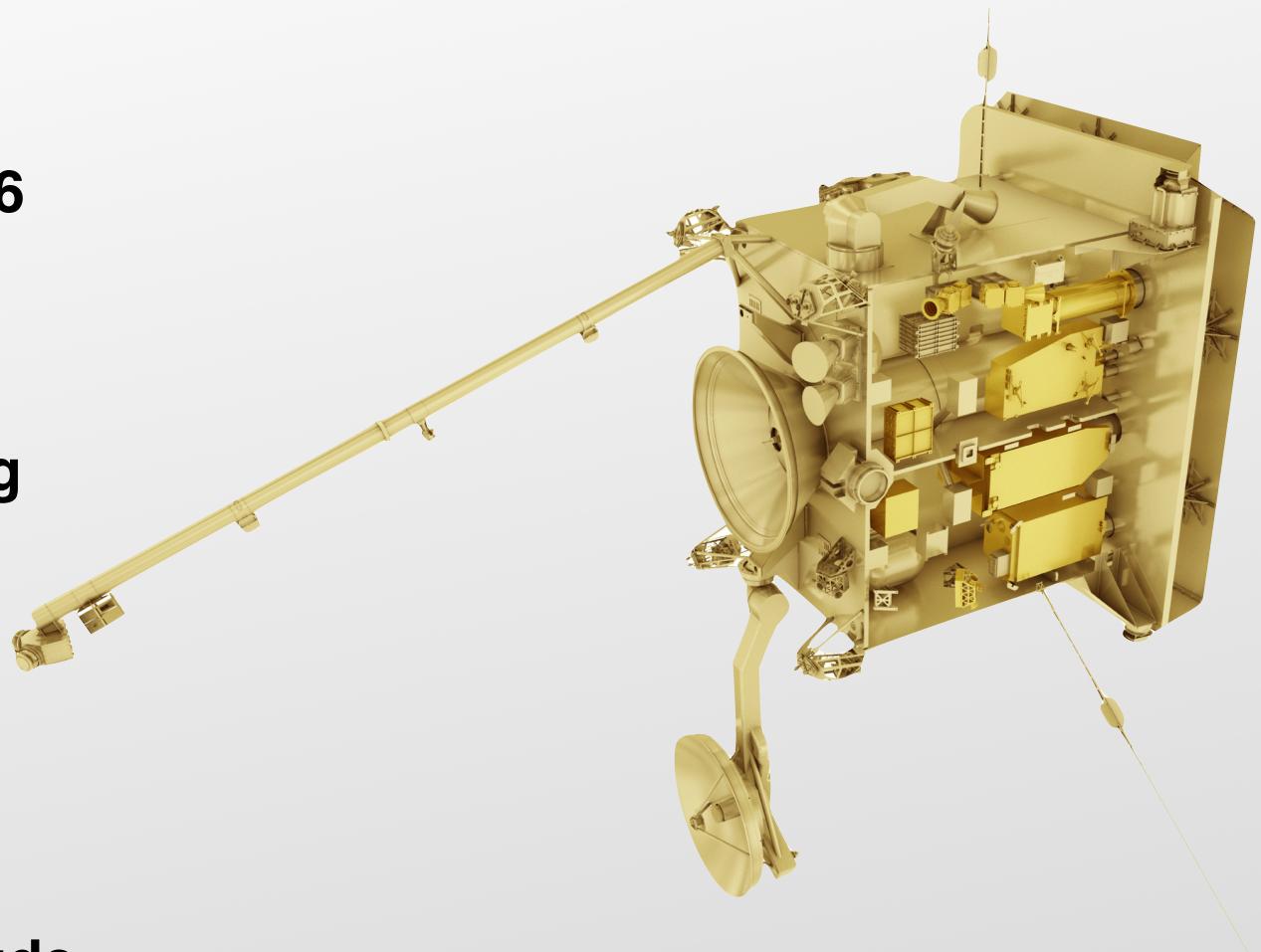


PROBA2/SWAP 17.4nm 2014-10-15 00:23:11

SWAP legacy as a prototype

Solar Orbiter

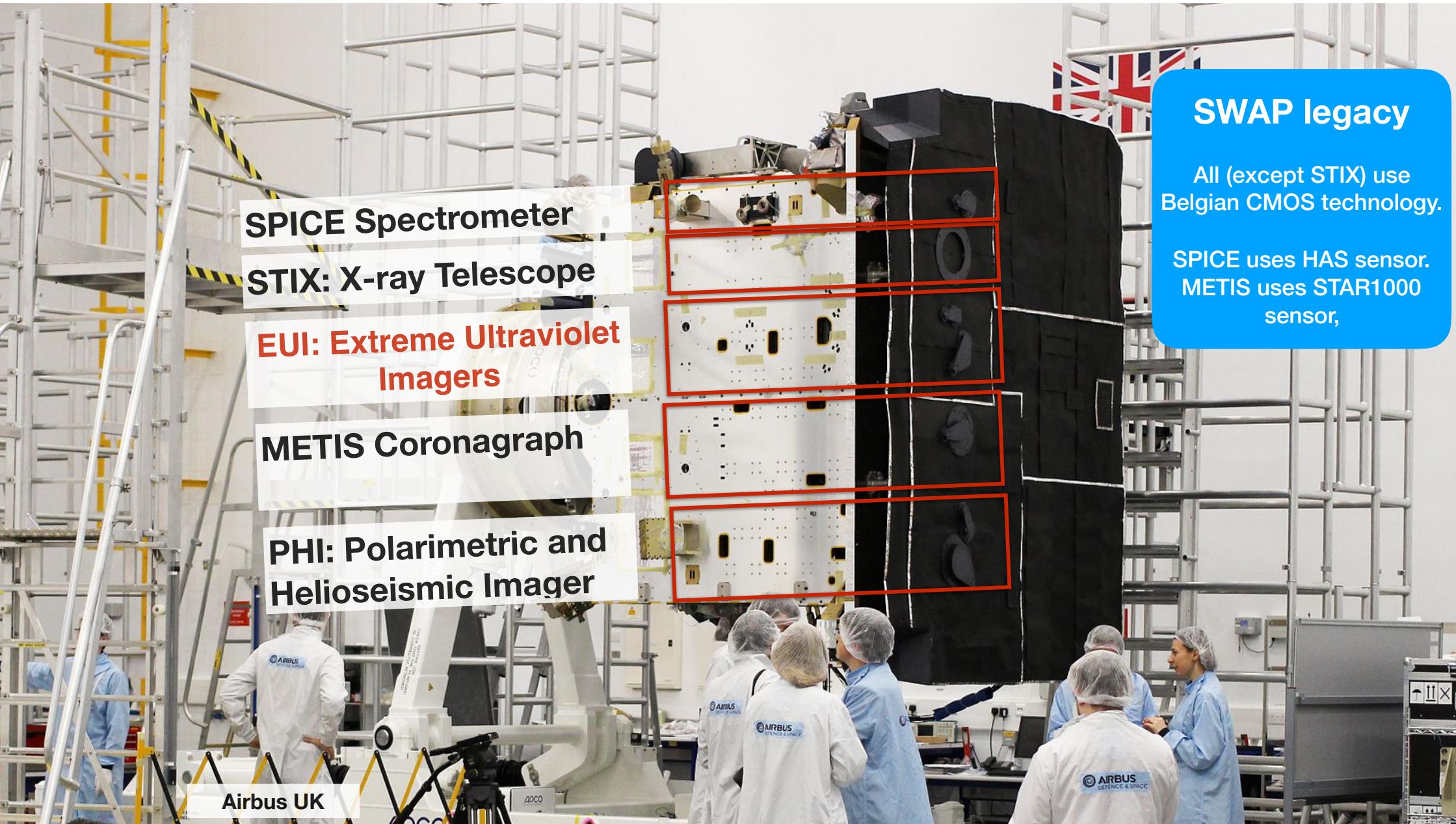
- Launch 2020 February 6
- 10 year mission
- 10 instruments,
in-situ & remote sensing
- >30 degrees solar latitude
- <0.3 AU from Sun





Airbus UK

**AIRBUS
DEFENCE & SPACE**



SWAP legacy

All (except STIX) use Belgian CMOS technology.

SPICE uses HAS sensor.
METIS uses STAR1000
sensor,

SPICE Spectrometer

STIX: X-ray Telescope

**EUI: Extreme Ultraviolet
Imagers**

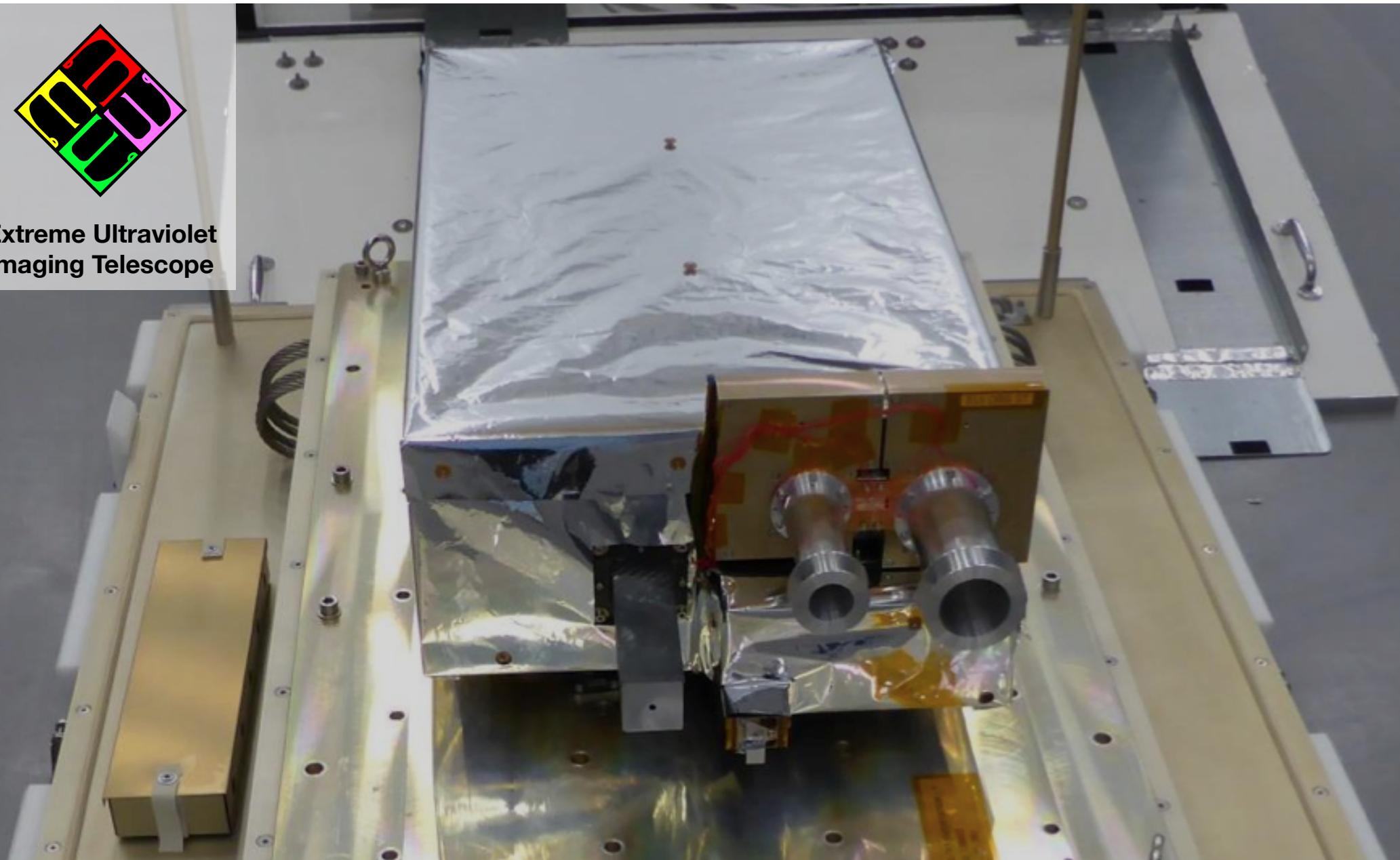
METIS Coronagraph

**PHI: Polarimetric and
Helioseismic Imager**

Airbus UK

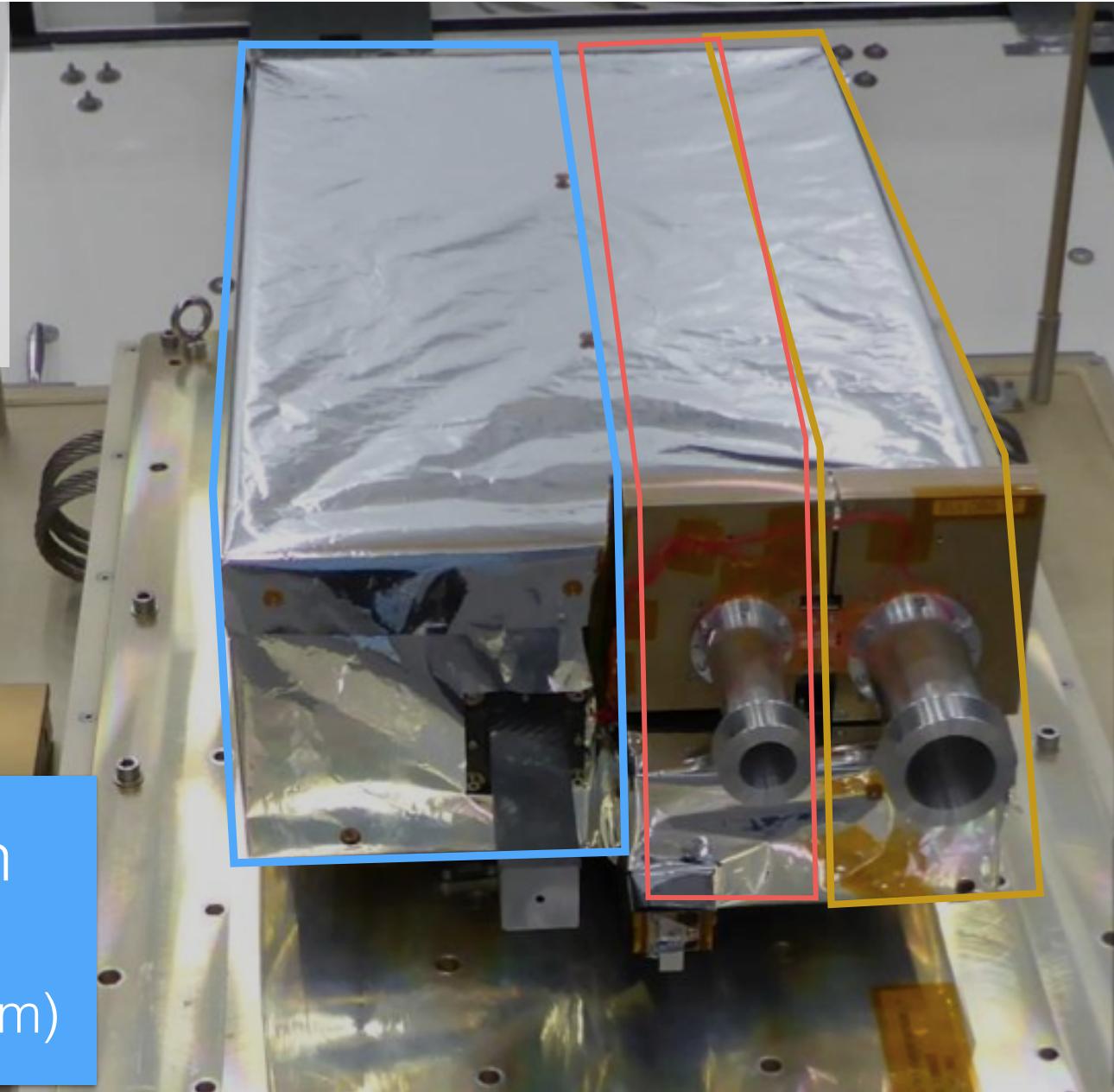


Extreme Ultraviolet
Imaging Telescope





Extreme Ultraviolet
Imaging Telescope



Full Sun
Imager
(17.4/30.4nm)

SWAP legacy

off-axis telescope

same bandpass

similar software concepts

FSI: the Middle Corona

High Res
Imager
17.4nm

High Res
Imager
Lyman-a



PROBA-3/ASPIICS

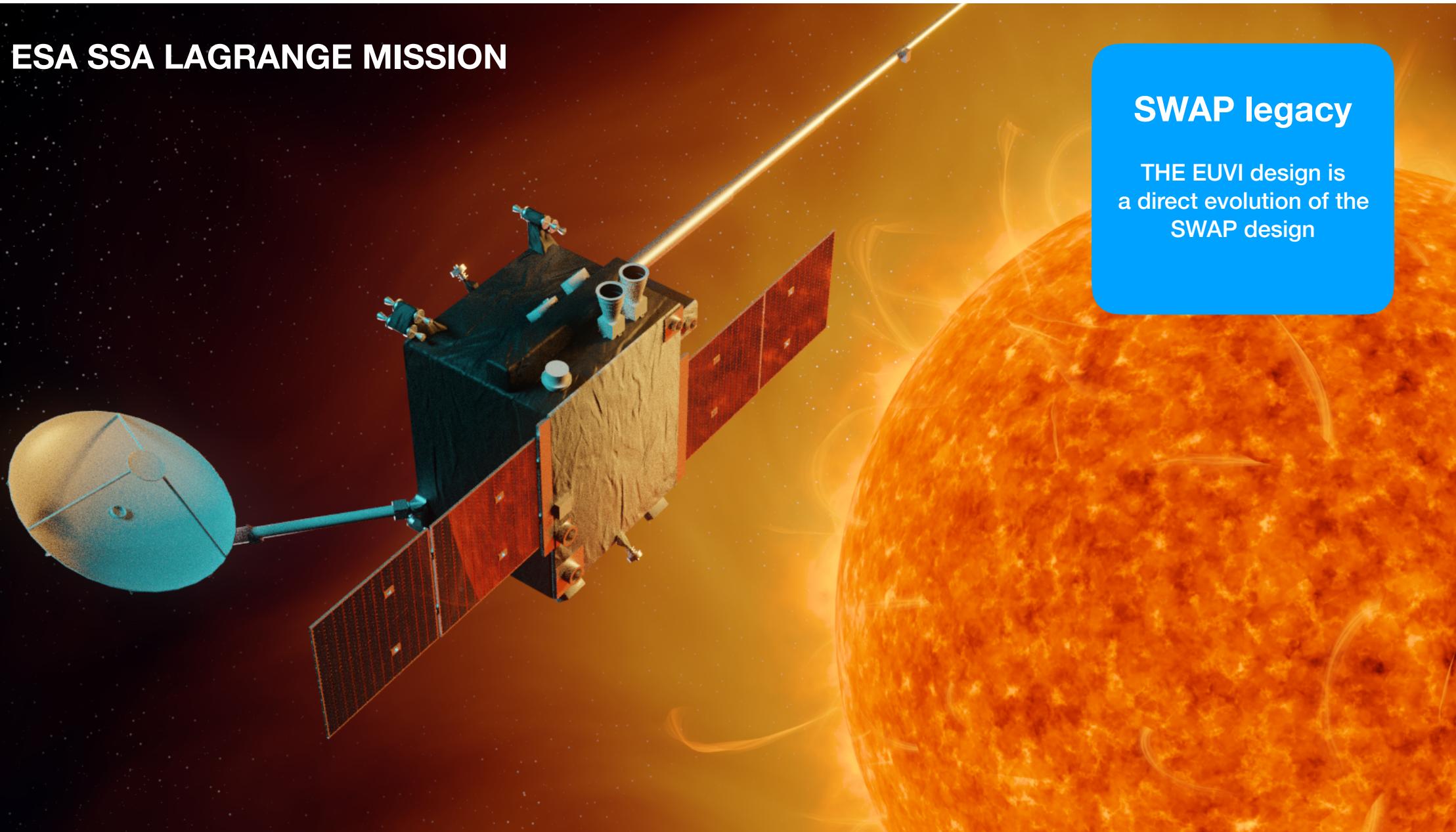
SWAP legacy

Belgian CMOS sensor

the Middle Corona

similar operation concepts

ESA SSA LAGRANGE MISSION



SWAP legacy

THE EUVI design is
a direct evolution of the
SWAP design





Thank you



PRODEX

