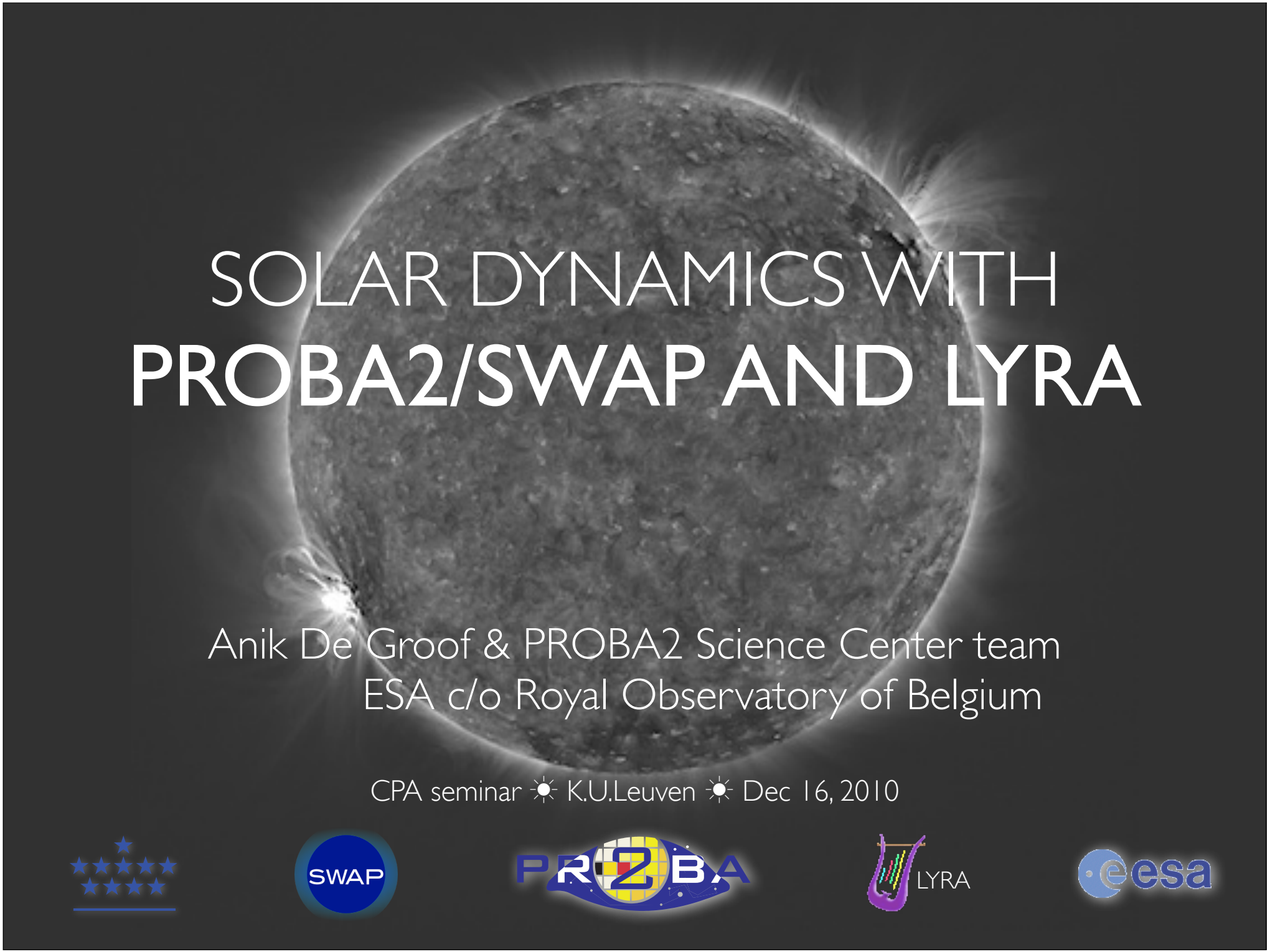


# SOLAR DYNAMICS WITH PROBA2/SWAP AND LYRA

Anik De Groof & PROBA2 Science Center team
ESA c/o Royal Observatory of Belgium

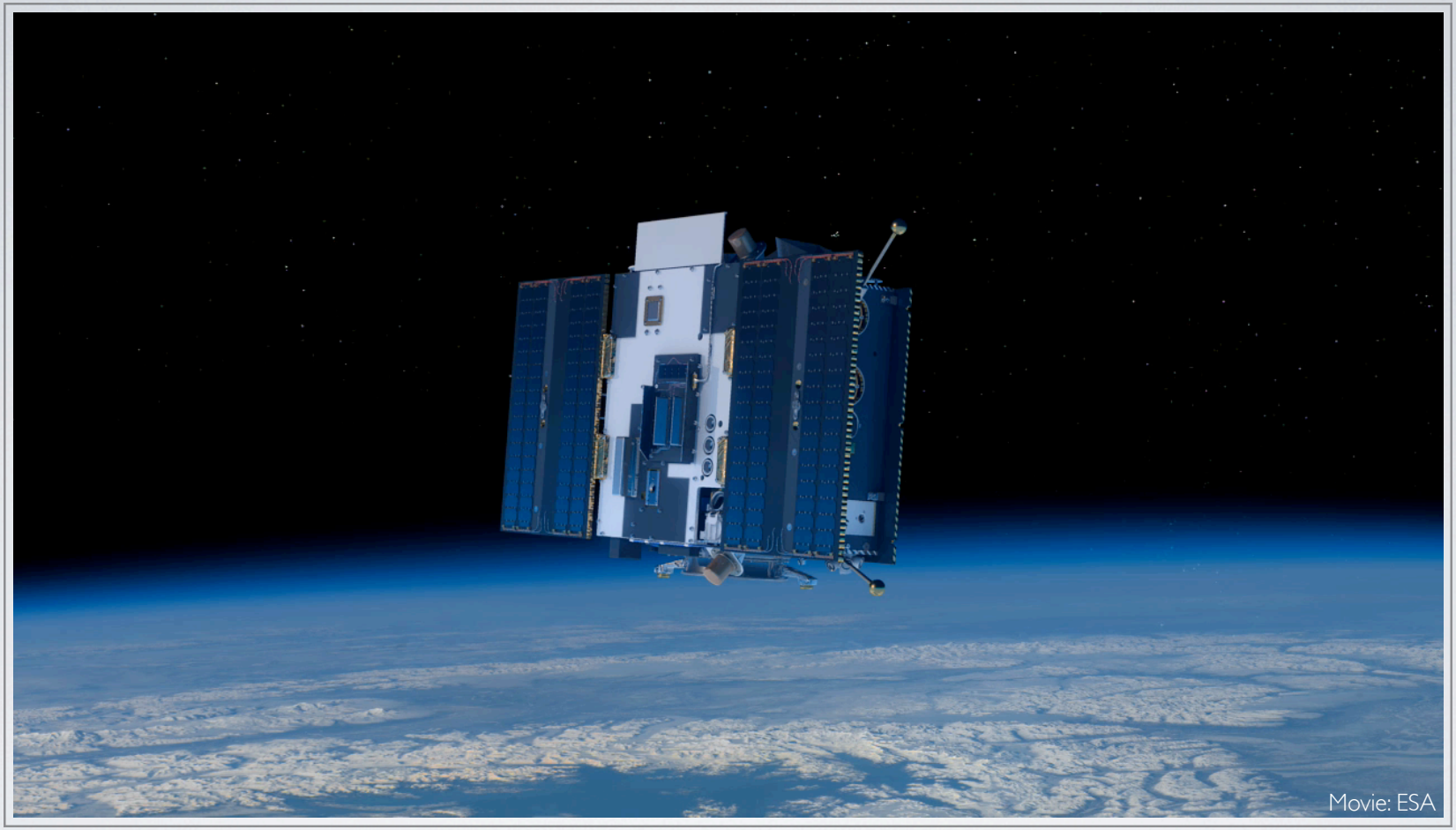
CPA seminar ☀ K.U.Leuven ☀ Dec 16, 2010


# PROBA2

**Pr**oject for **O**n-**B**oard **A**utonomy

Launched on Nov. 2, 2009

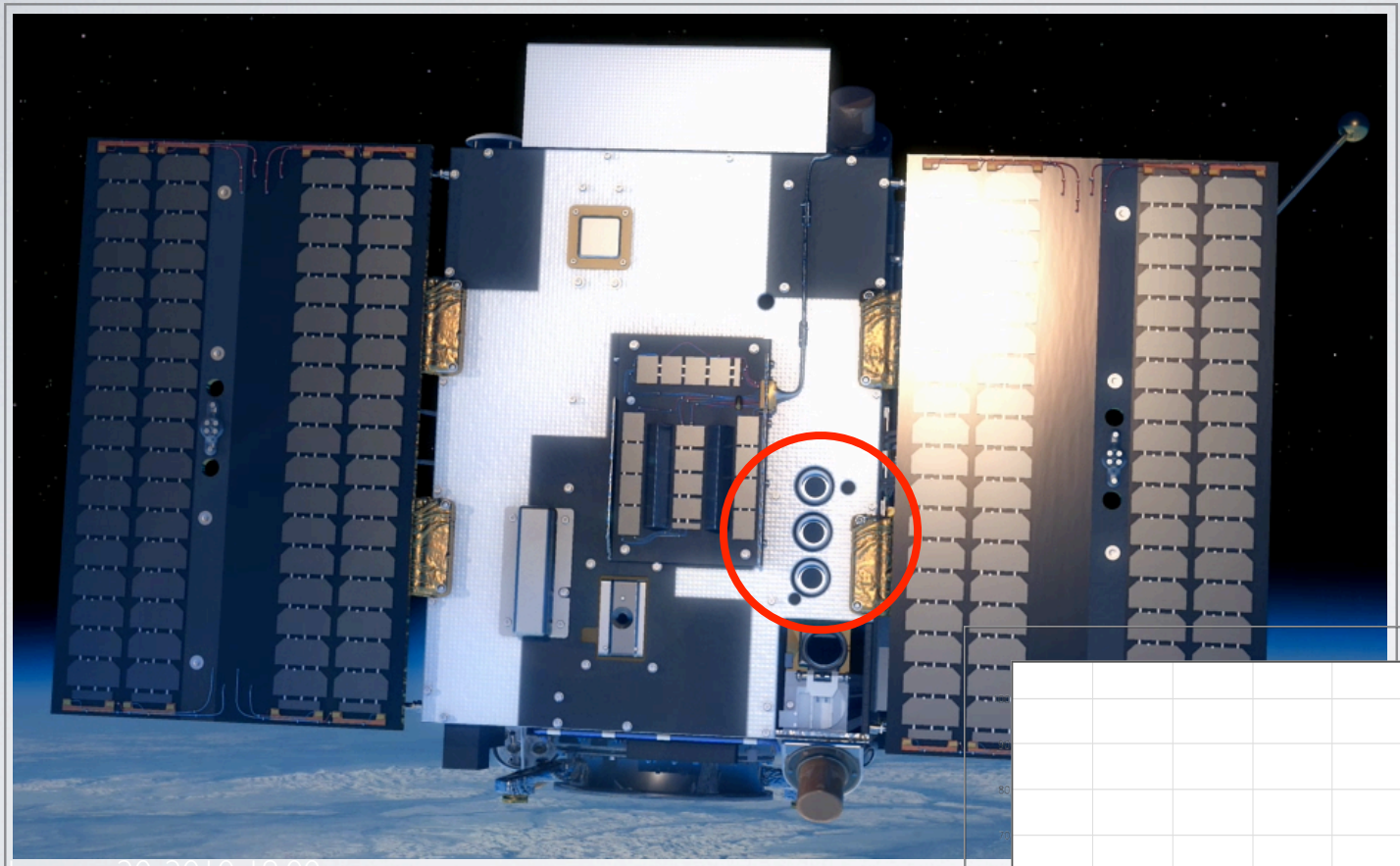
Microsatellite in sun-synchronous orbit ☀ 725 km altitude

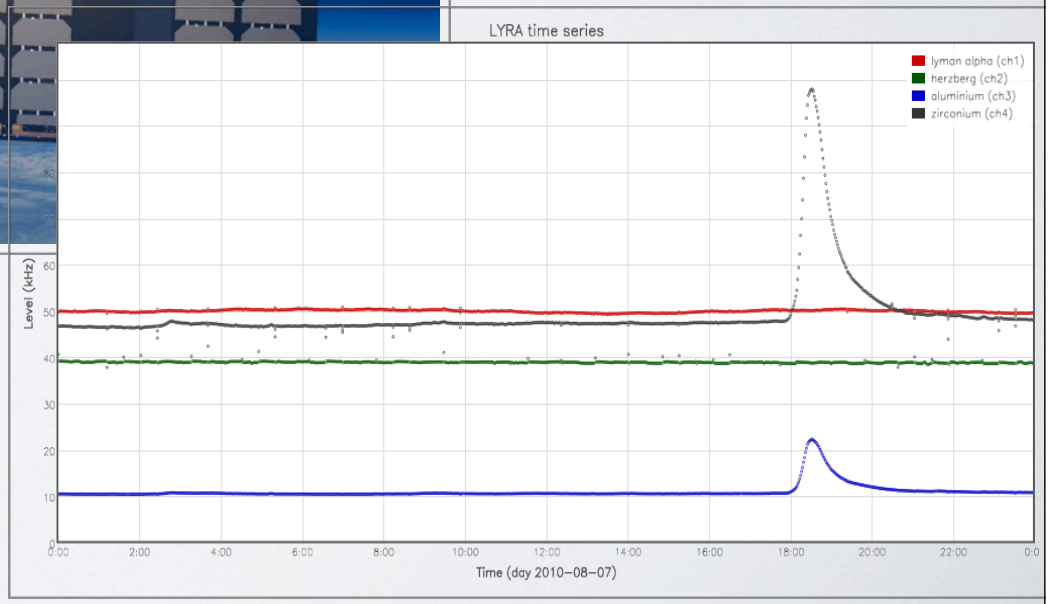



# ESA TECHNOLOGY & SCIENCE

4 innovative instruments - 17 technological experiments
SWAP and LYRA observe the Sun in EUV and XUV
nominal operations since March 2010

# PROBA2 SWAP & LYRA



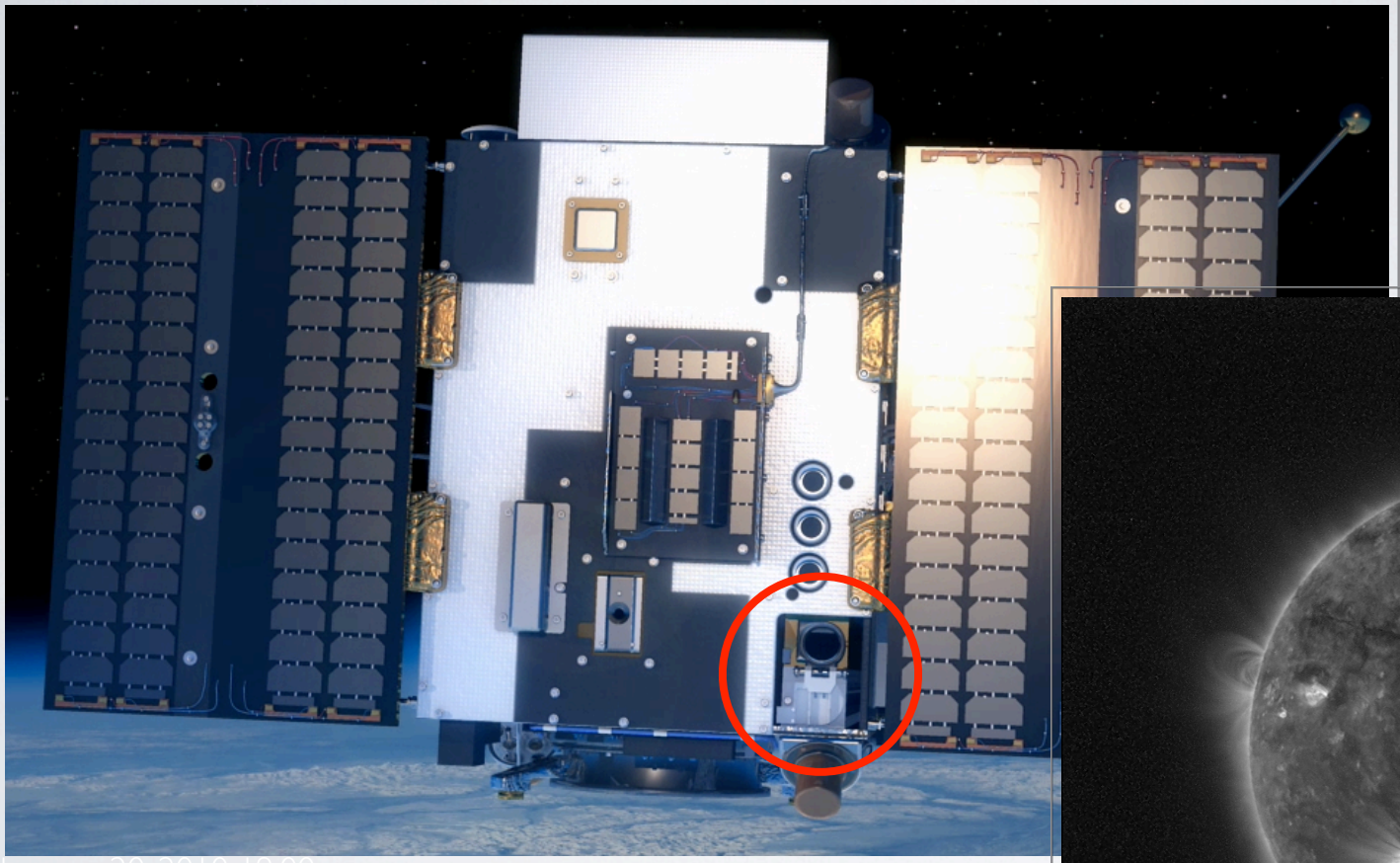



January 20, 2010 19:00

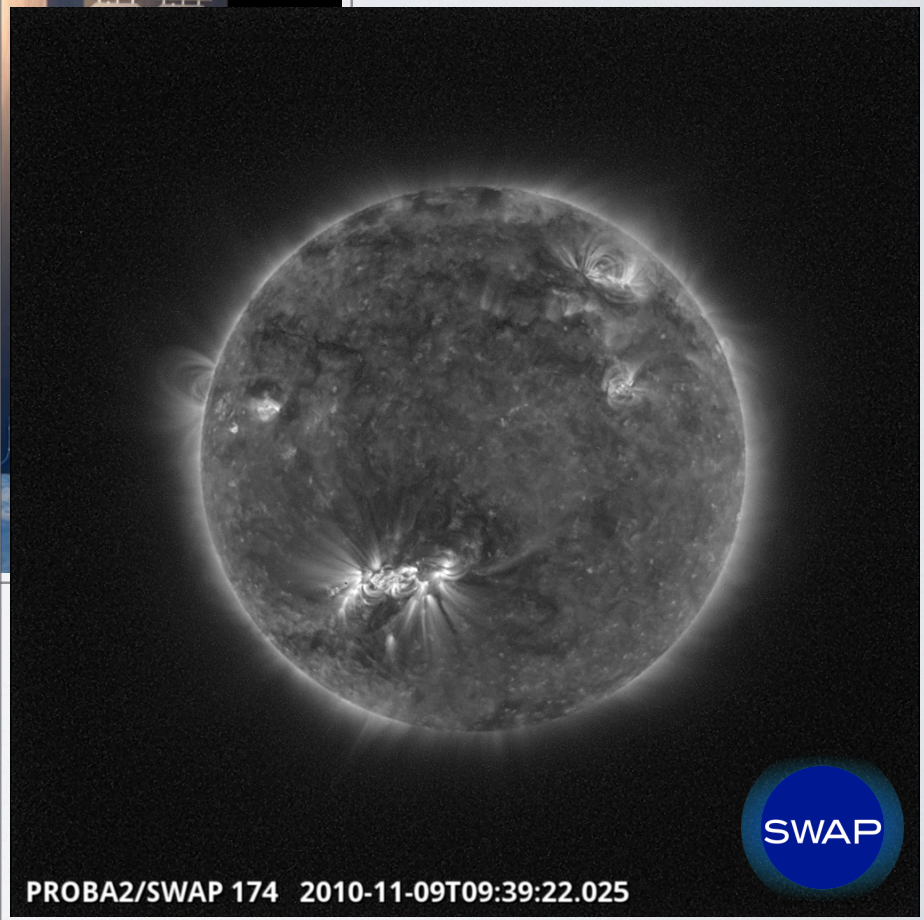
**LYRA radiometer**

3 redundant units - 4 wavelengths

# PROBA2 SWAP & LYRA



January 20, 2010 19:00




**SWAP EUV imager**

1 million° corona in EUV 17.4nm

# ORBIT & DOWNLINKS

Polar Sun-Synchronous

725 km altitude

Eclipses in Nov-Jan
(slightly longer for EUV)

Max 18min/orbit

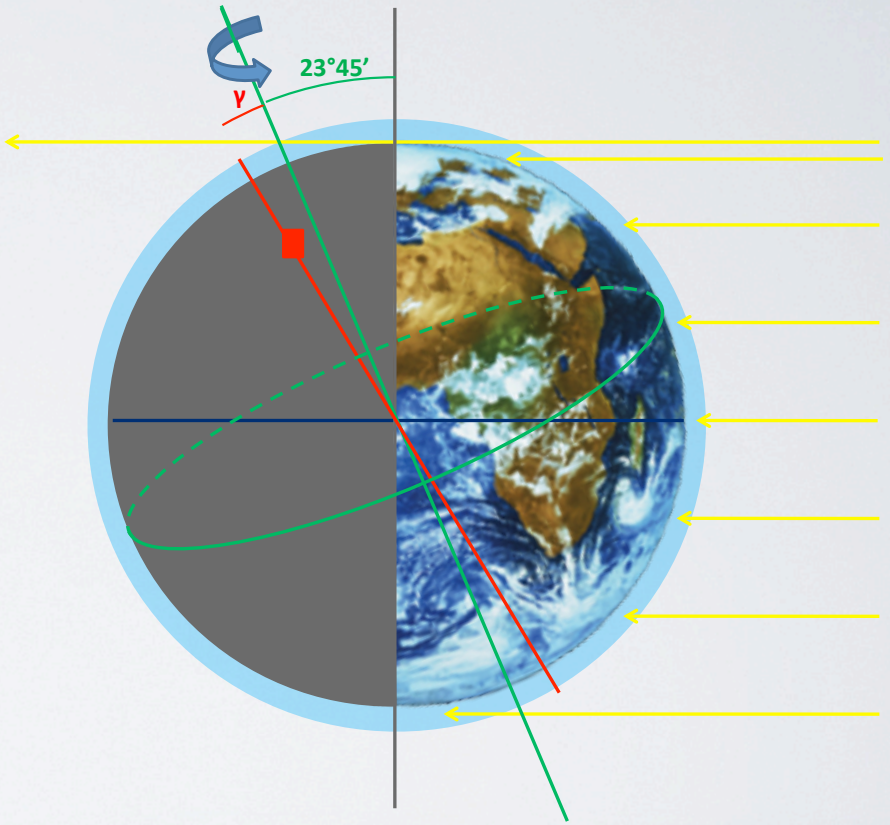
# ORBIT & DOWNLINKS

Polar Sun-Synchronous

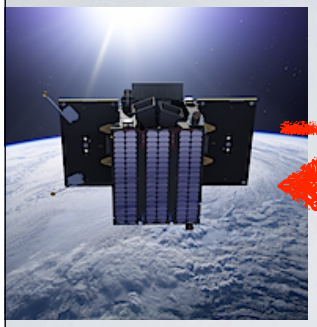
725 km altitude

Eclipses in Nov-Jan
(slightly longer for EUV)

Max 18min/orbit




*winter solstice*



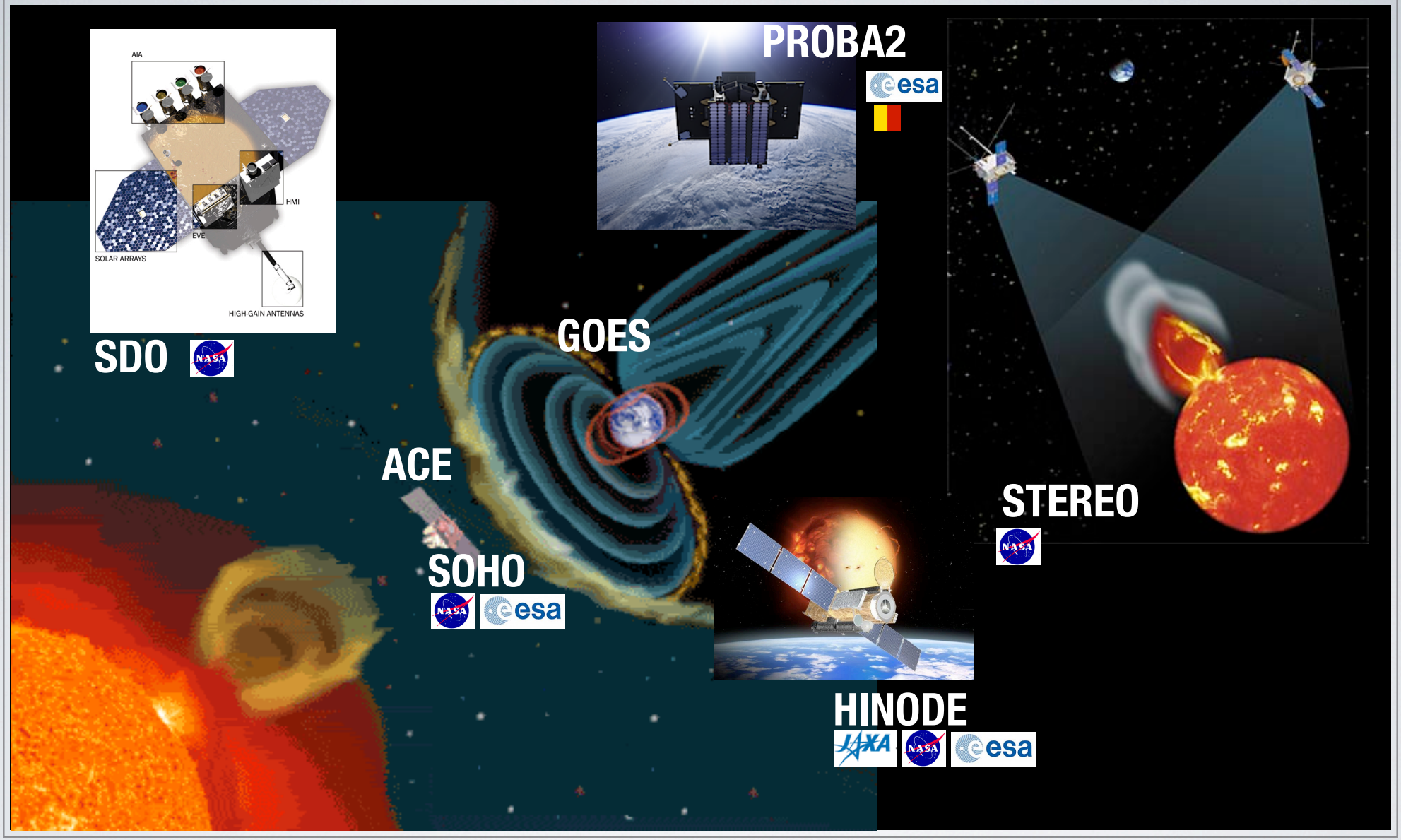


# PROBA2 SCIENCE CENTER

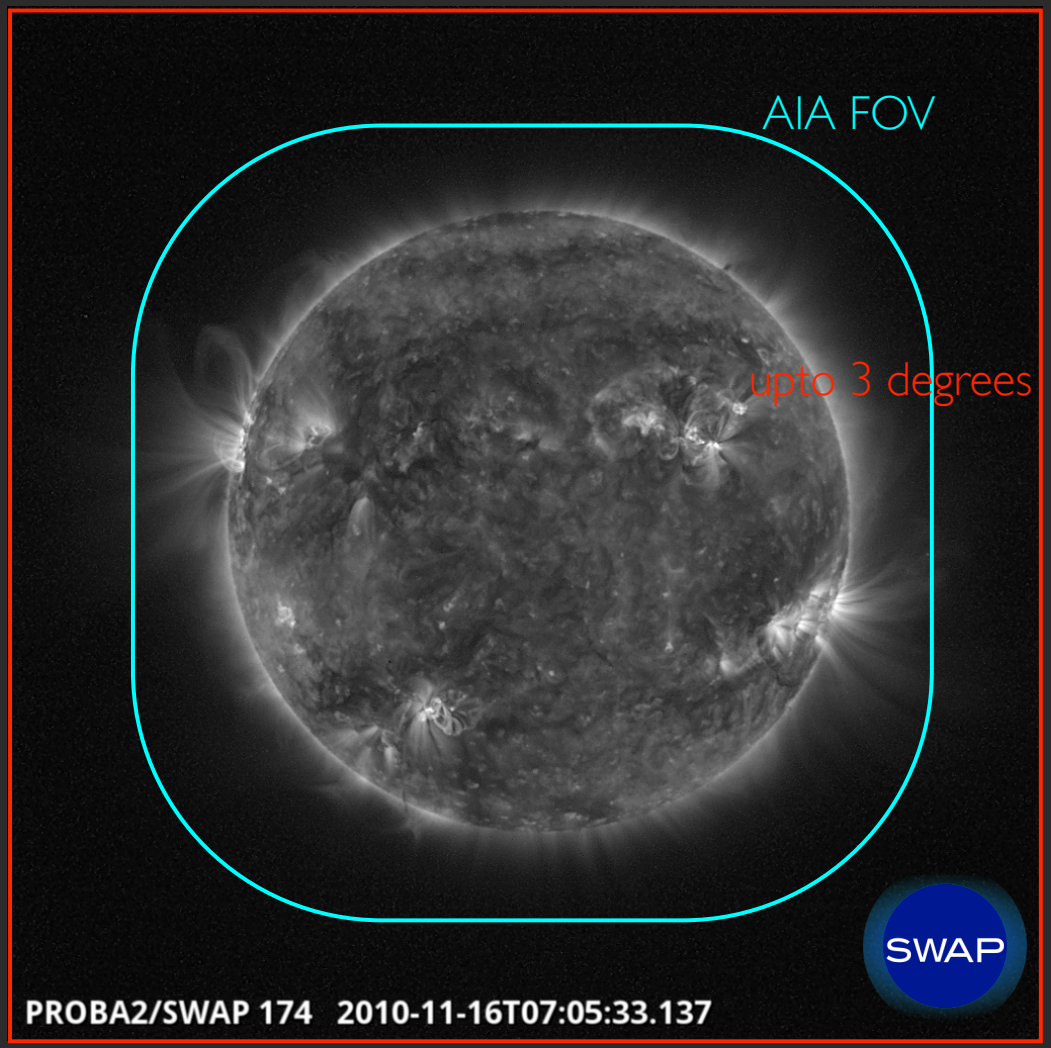
**Instrument commanding** & automatic data processing at ROB

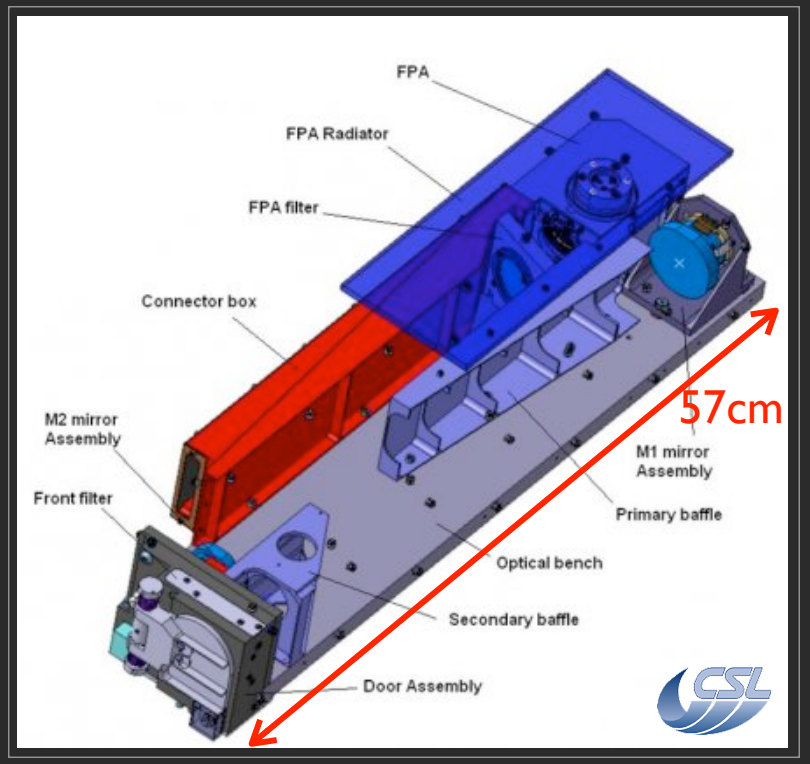
~9 contacts per day over Redu (MOC) & Svalbard

near realtime data + **flexibility!**




# MANY EYES ON THE SUN



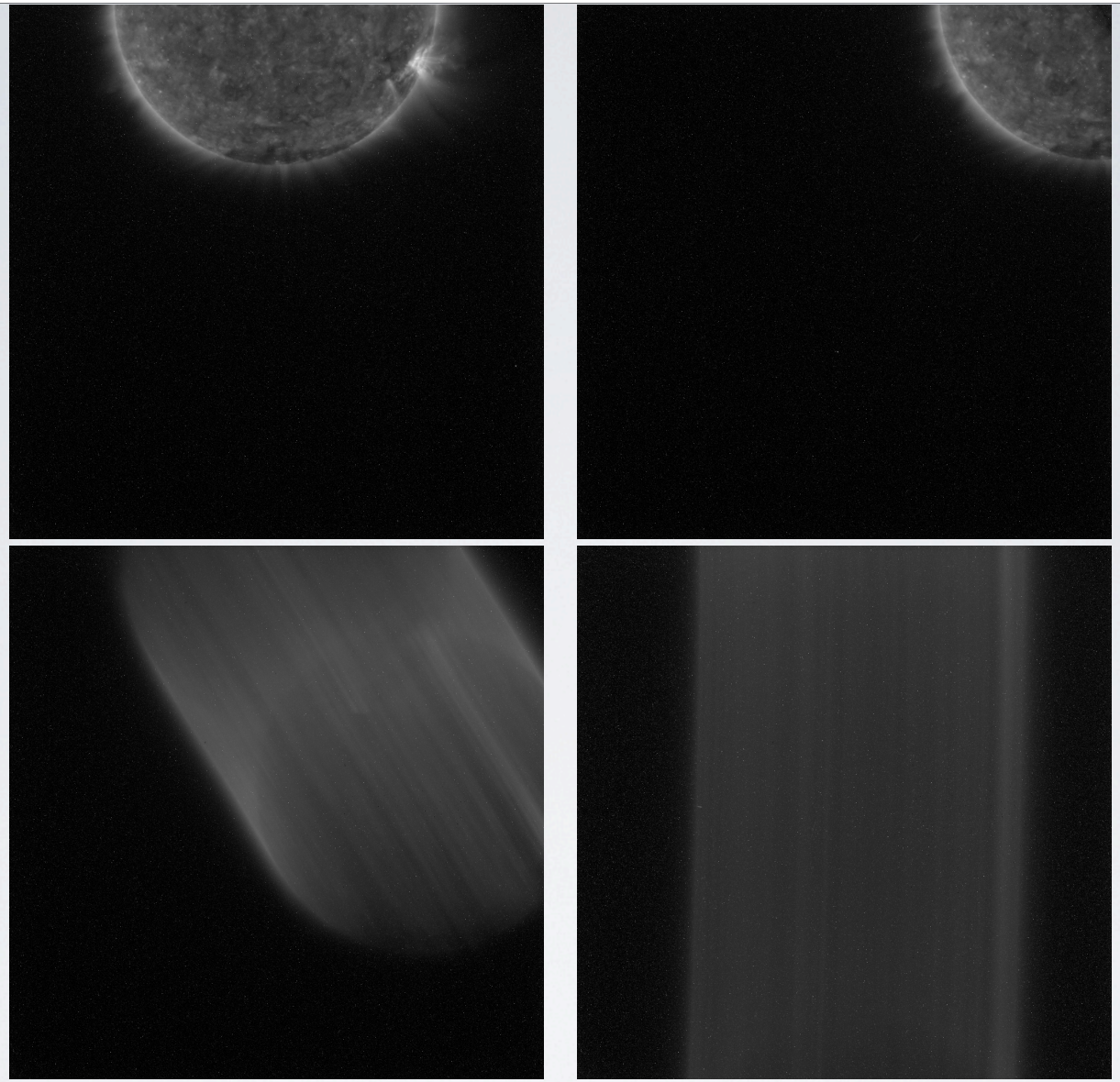




Exercise in miniaturization:
off-axis Ritchey-Chrétien scheme

# SWAP EUV IMAGER

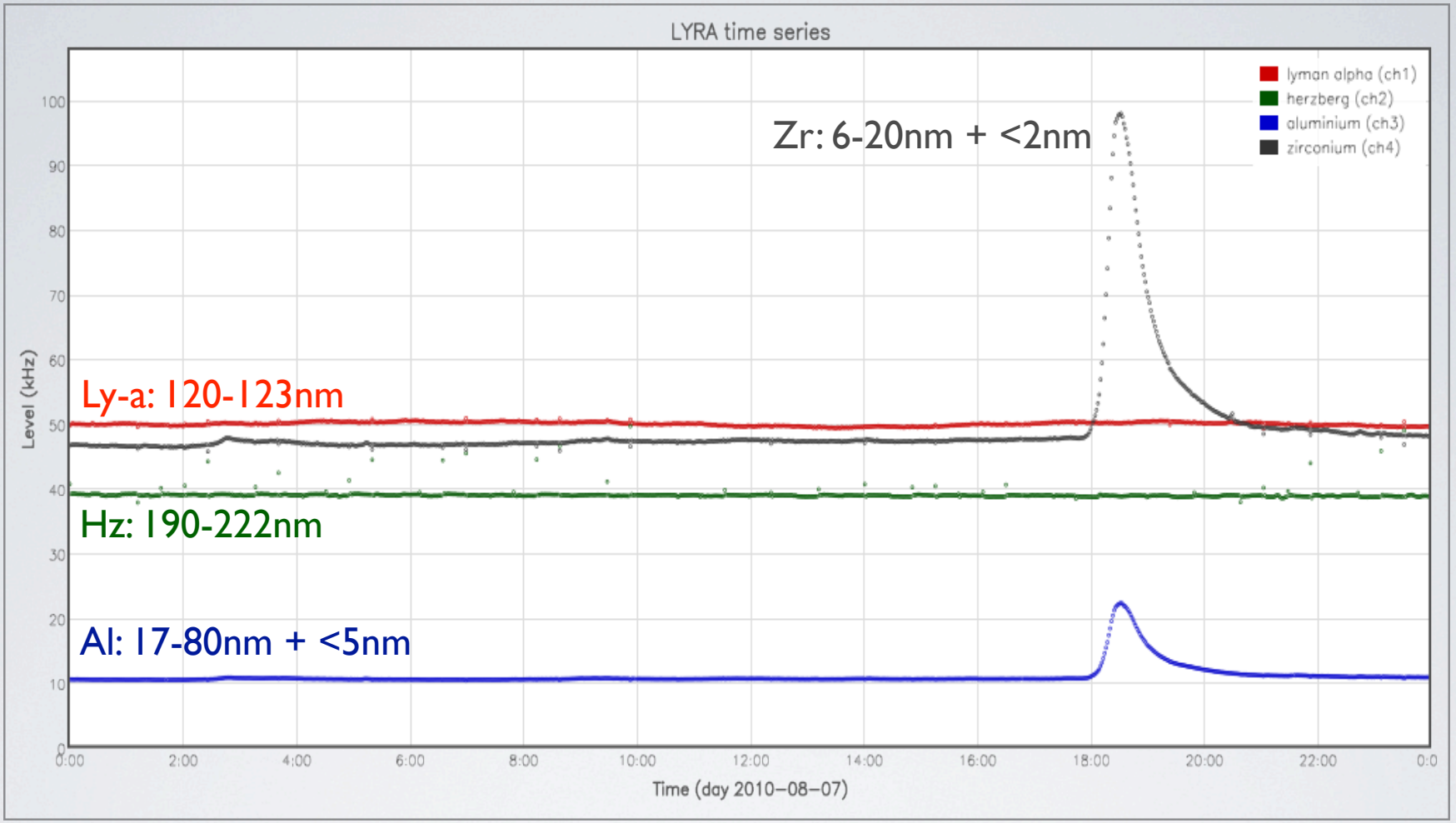
1 million° corona in EUV 17.4nm ☀ 1-2mins cadence (upto 30s)

large FOV ☀ 1Kx1K CMOS APS



# OFF-POINTING

up to now mostly interesting for calibration
could be used for CME tracking



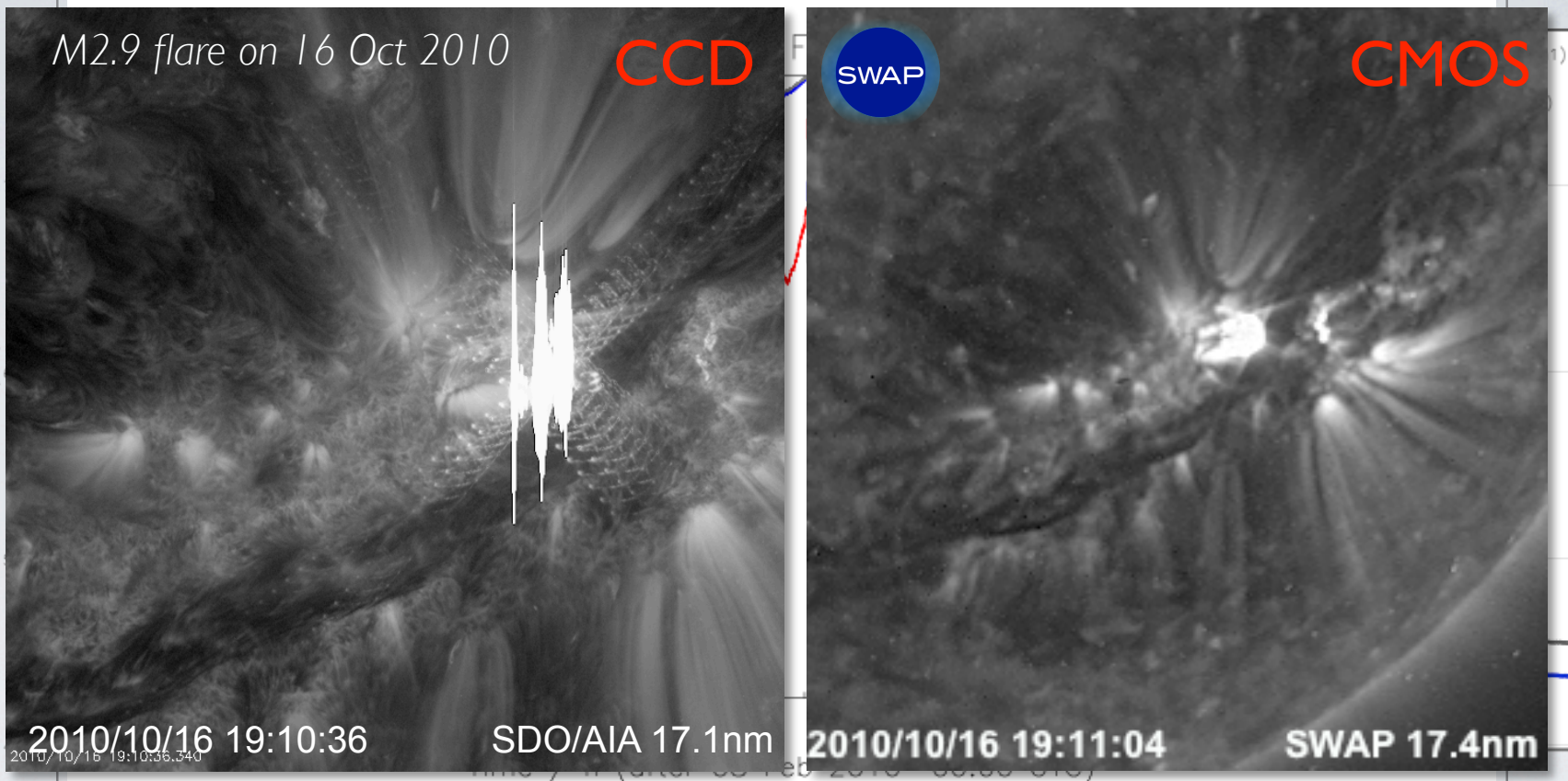

# LYRA RADIOMETER

3 instrument units - 4 spectral channels per head

3 types of detectors: diamond PIN/MSM & silicon

high cadence up to 100Hz

# SOLAR FLARES




LYRA senses all flares in Zr & Al up to **10ms resolution**

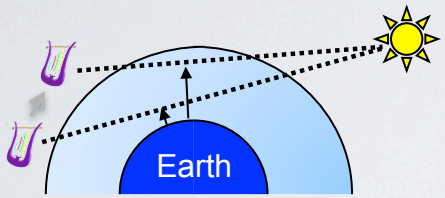
Good correlation to GOES flares with **better temporal resolution**

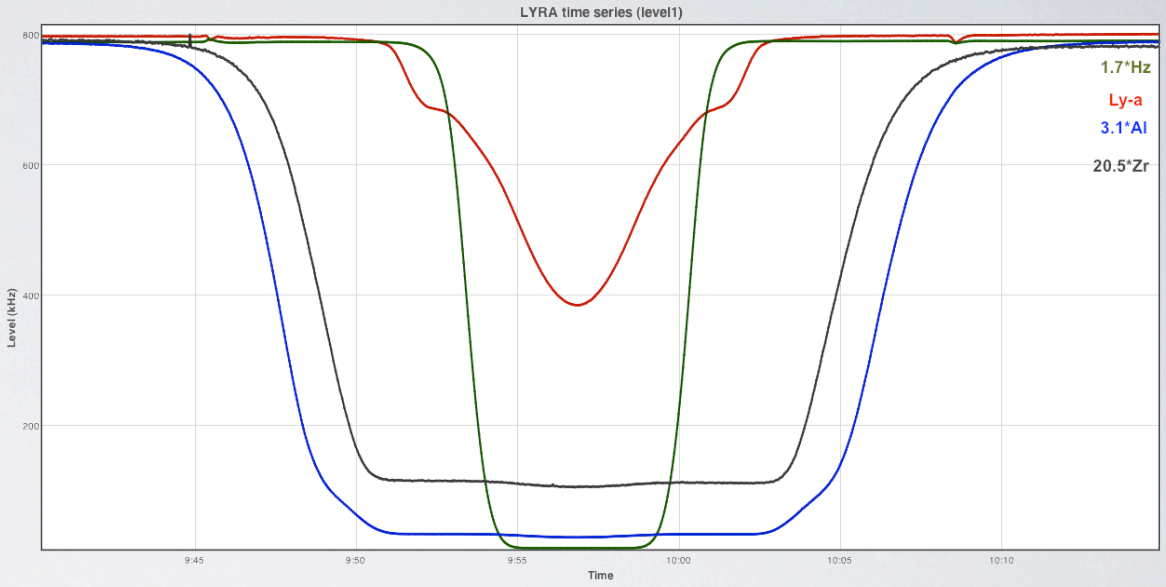
Different onset & peak times in different pass bands

Ly-**α** contribution for impulsive flares

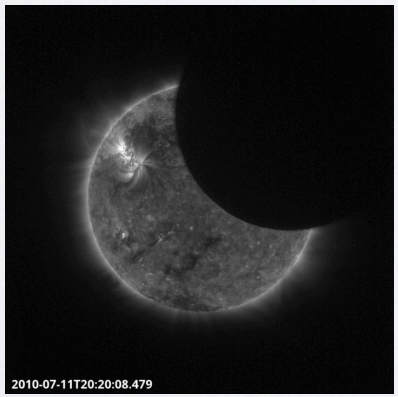
# LYRA DURING ECLIPSES

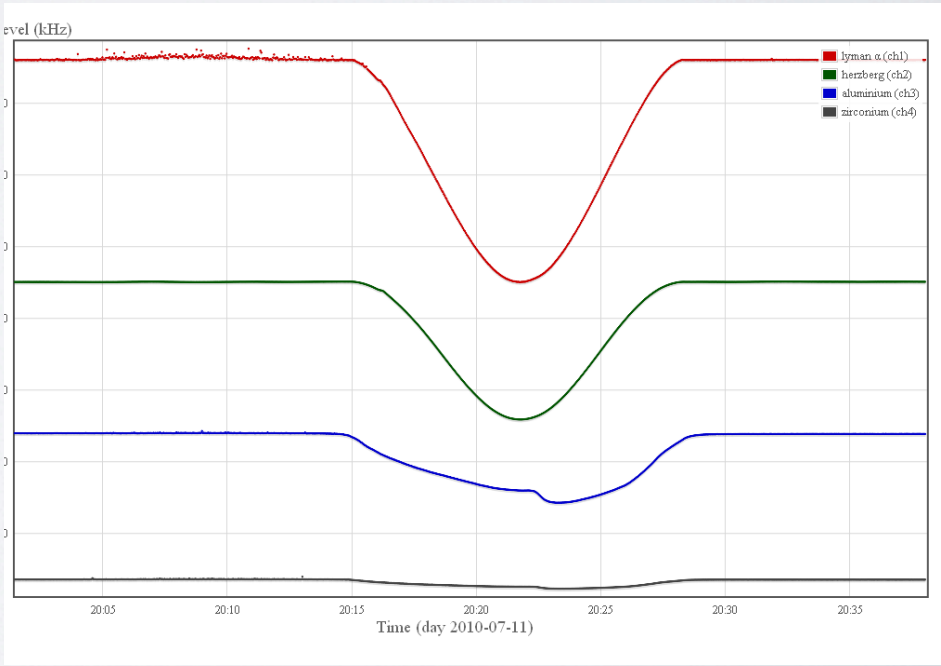
- eclipse occultations by Earth's atmosphere
  - → atmospheric layers are scanned

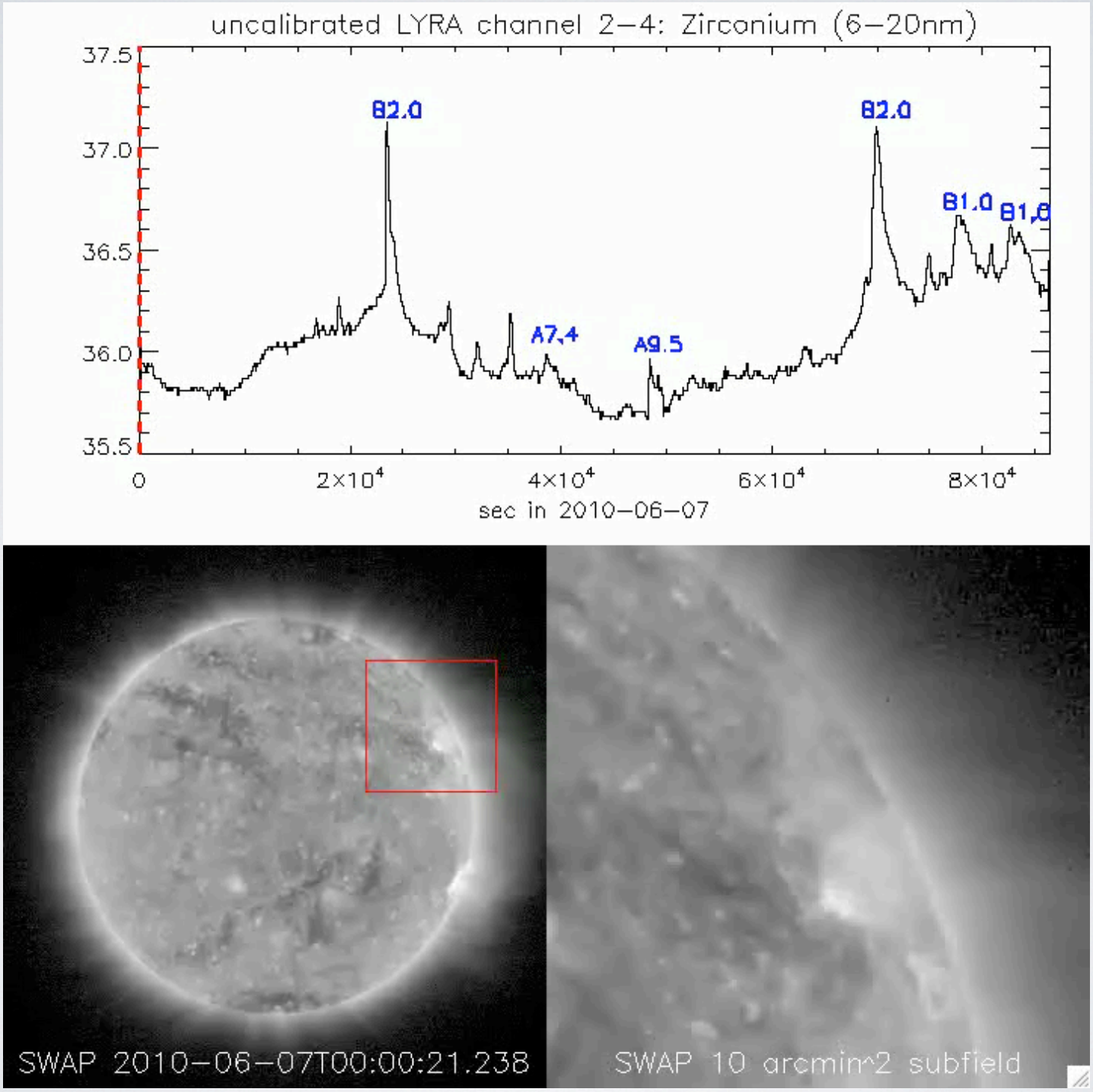


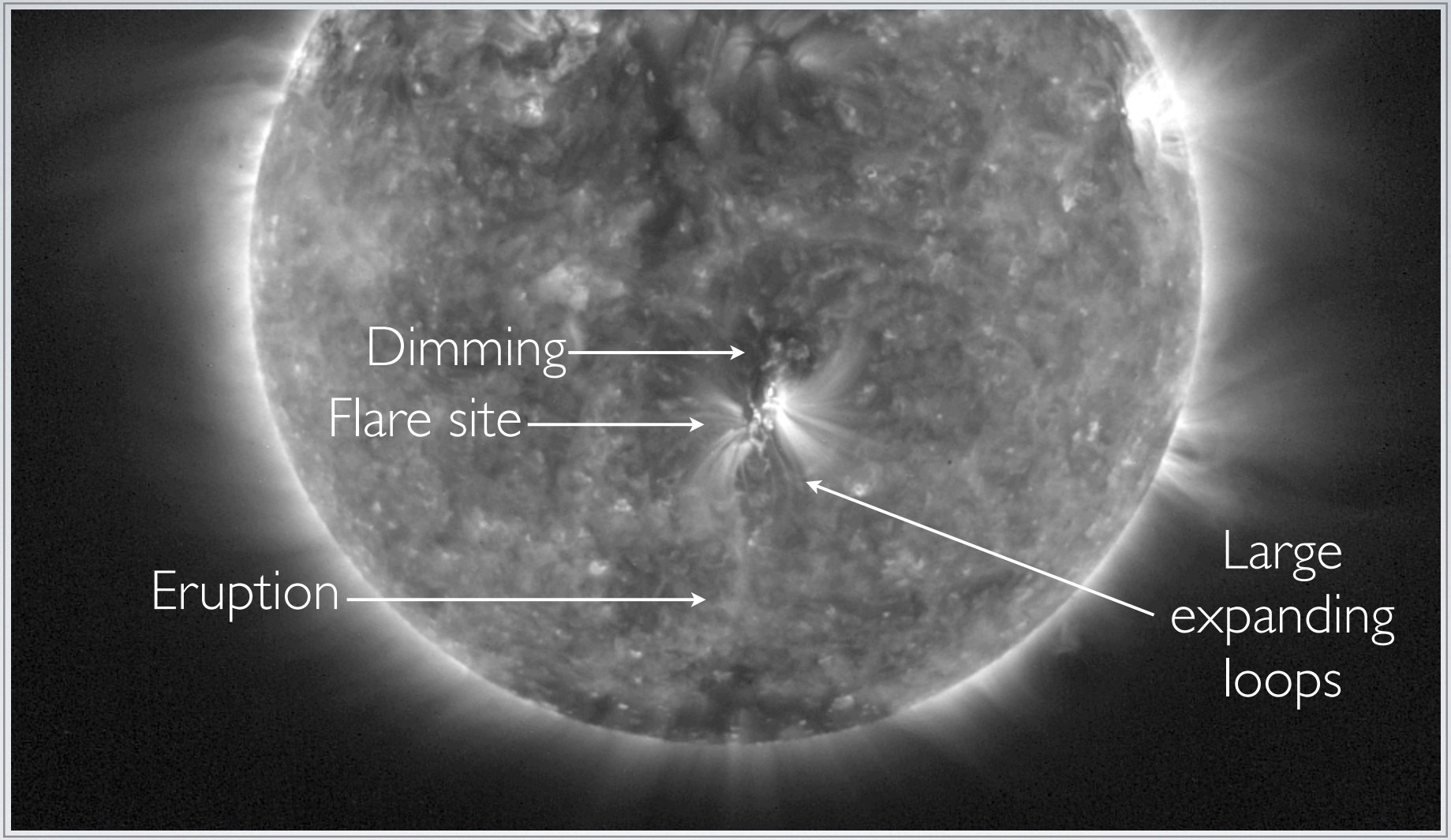




- sun-moon eclipses
  - → sources of irradiance



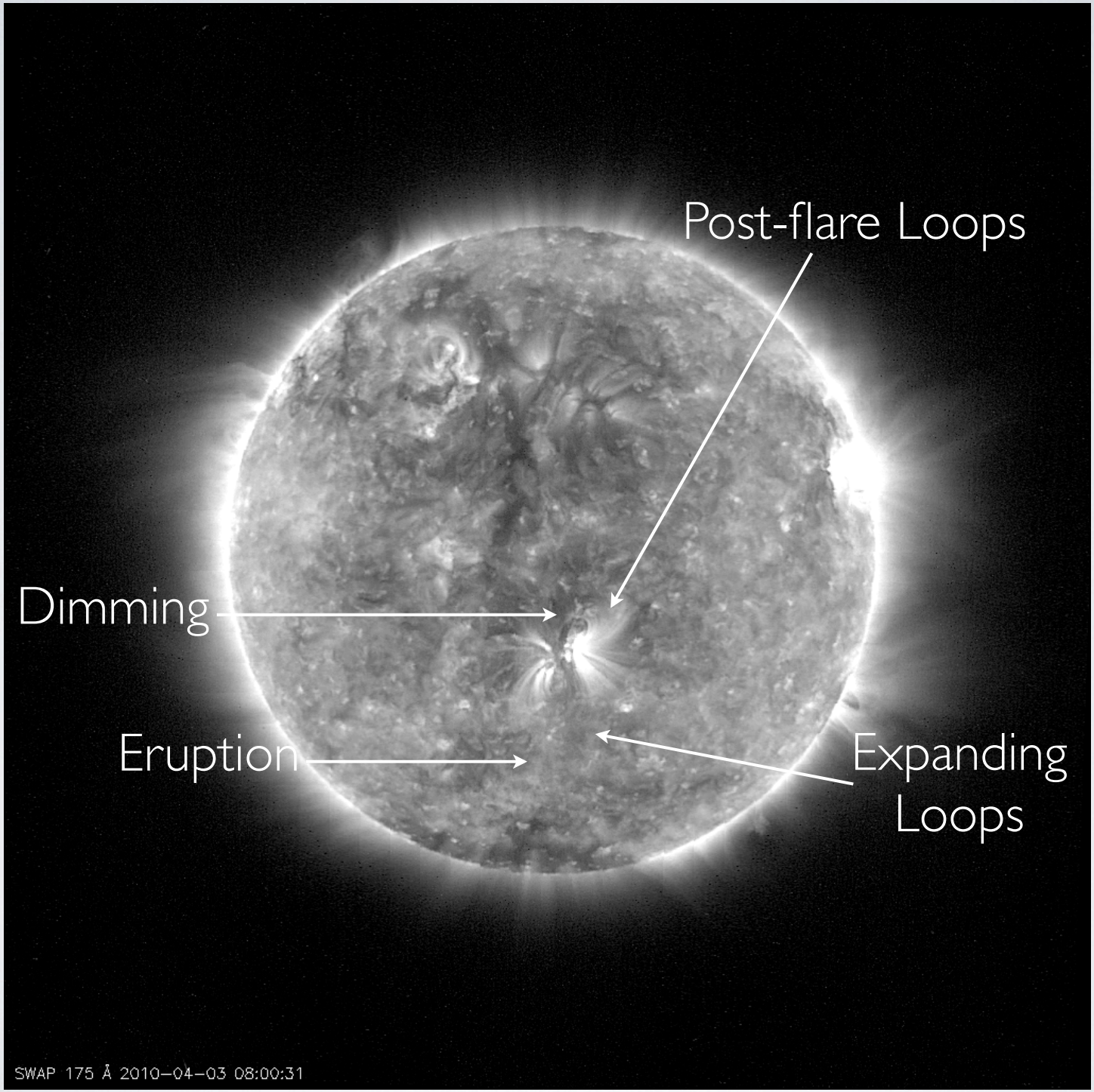



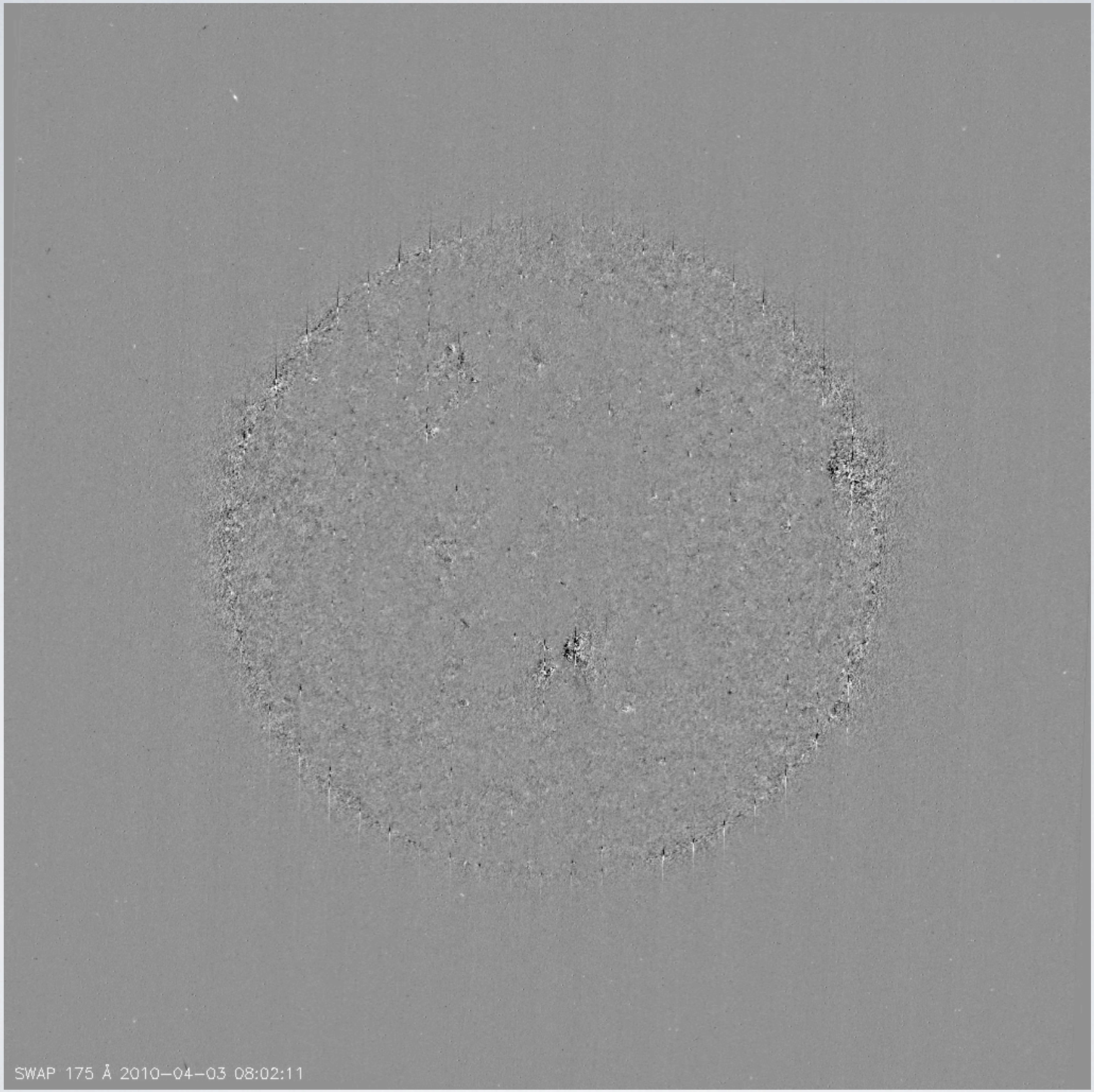

uncalibrated LYRA channel 2–4: Zirconium (6–20nm)
37.5
37.0
36.5
36.0
35.5
B2.0
B2.0
B1.0
A7.4
A9.5
0
2×10^4
4×10^4
6×10^4
8×10^4
sec in 2010–06–07
SWAP 2010–06–07T00:00:21.238
SWAP 10 arcmin^2 subfield

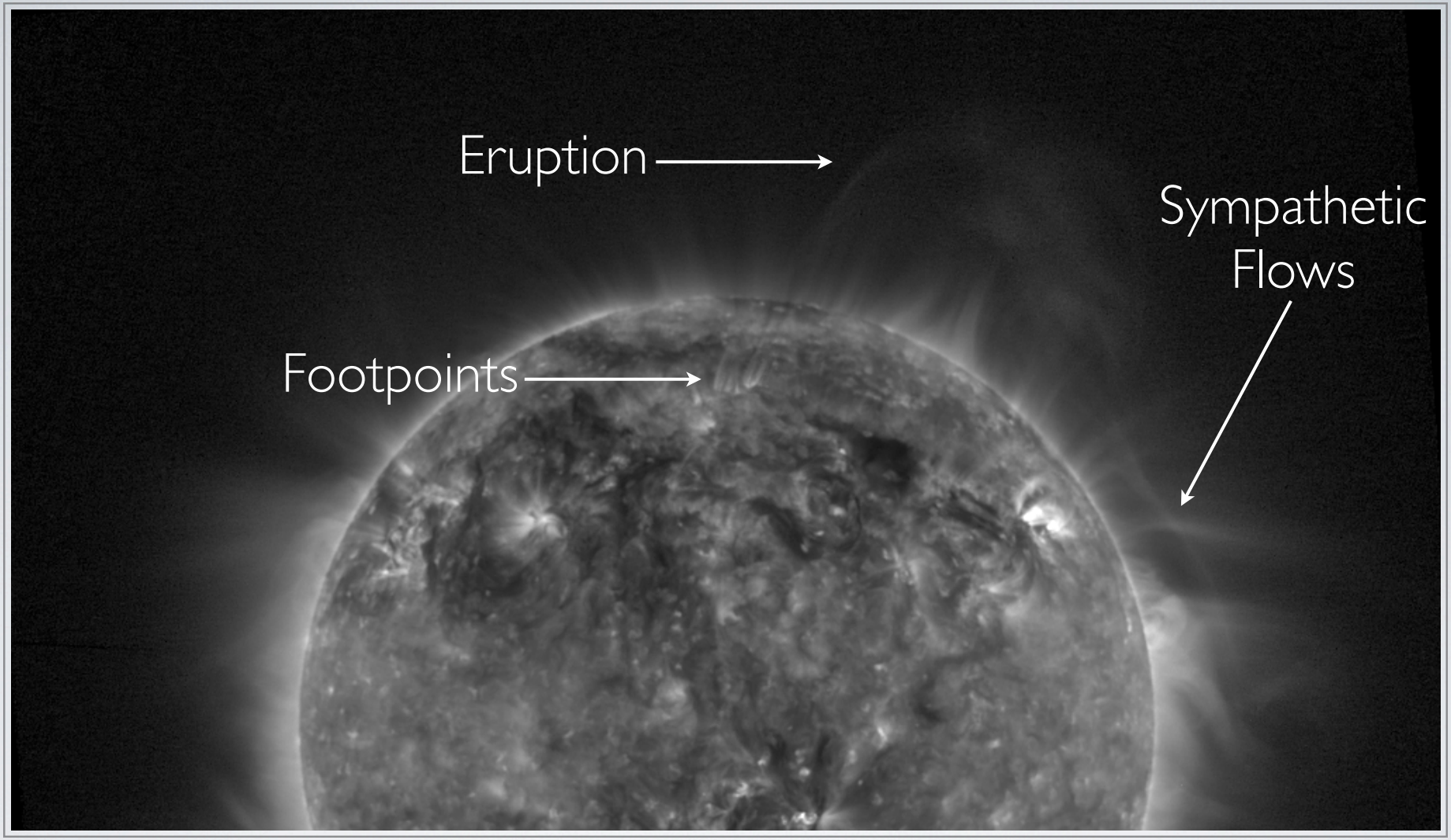



# ERUPTION & FLARE

3 April 2010, 09:30 UTC ☀ B7.4 Flare ☀ Geoeffective CME

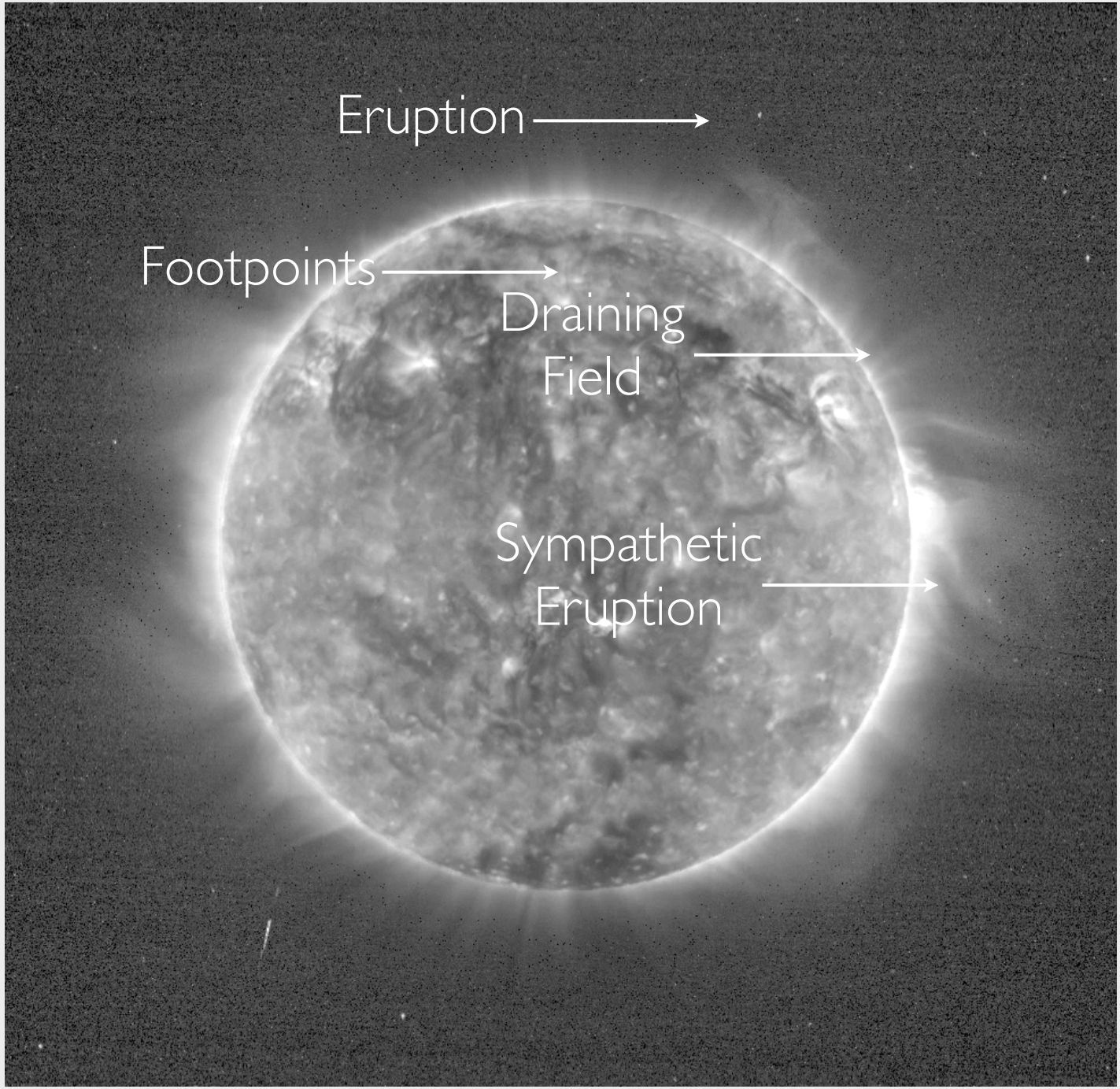

Post-flare Loops
Dimming
Eruption
Expanding Loops
SWAP 175 Å 2010-04-03 08:00:31


SWAP 175 Å 2010-04-03 08:02:11

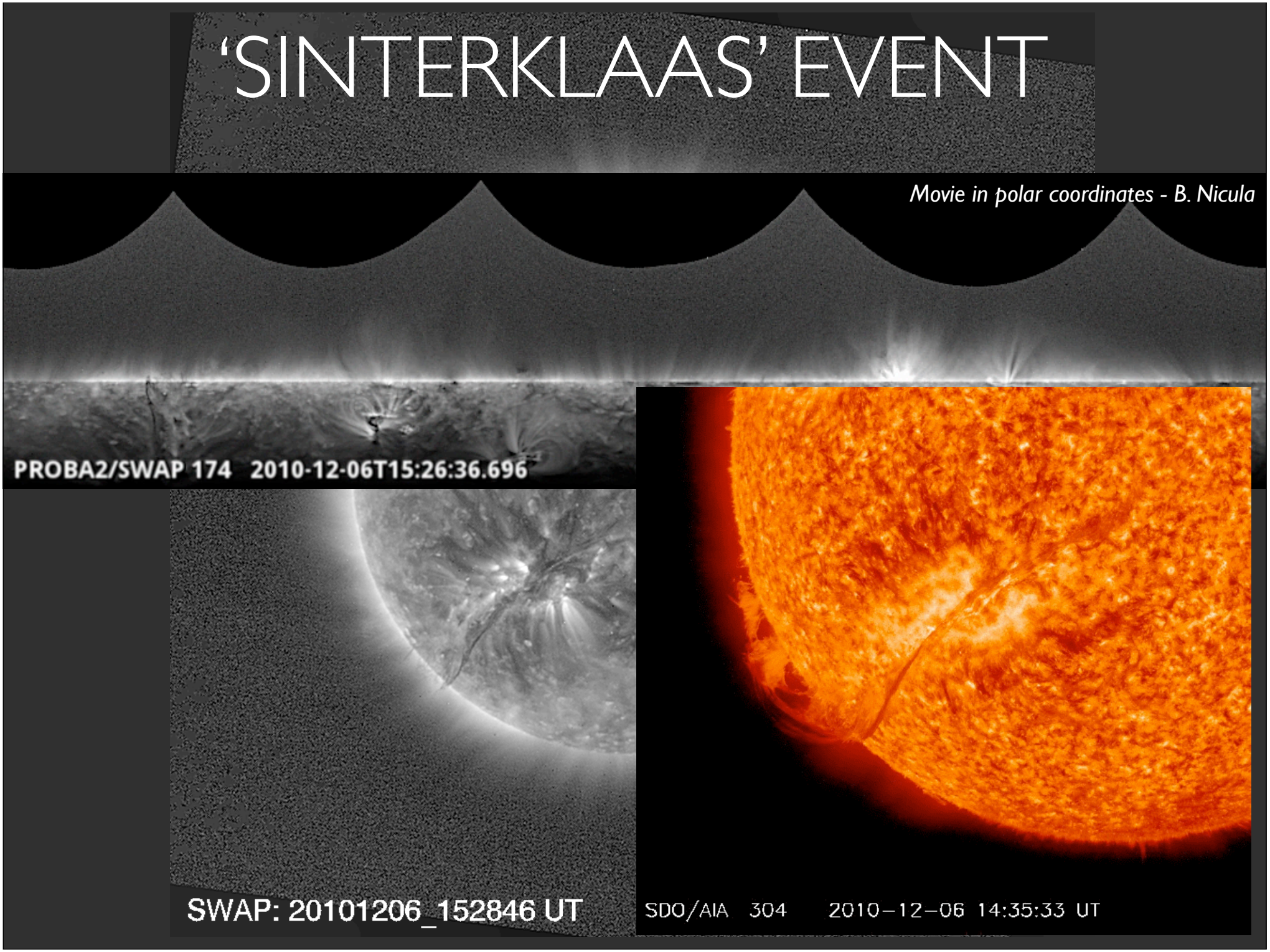



# PROMINENCE ERUPTION

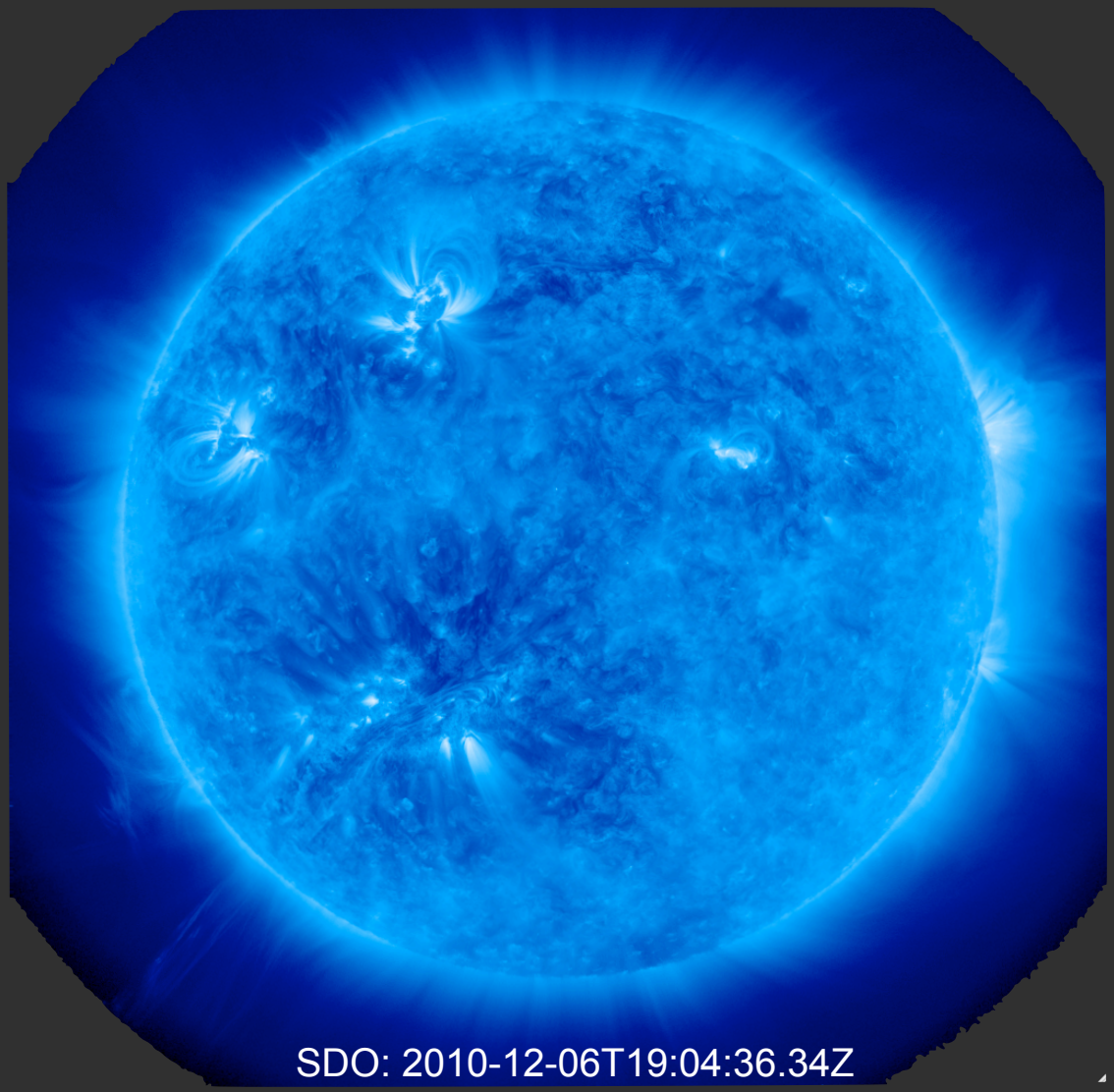
13 April 2010, 09:30 UTC


Eruption
Footpoints
Draining
Field
Sympathetic
Eruption

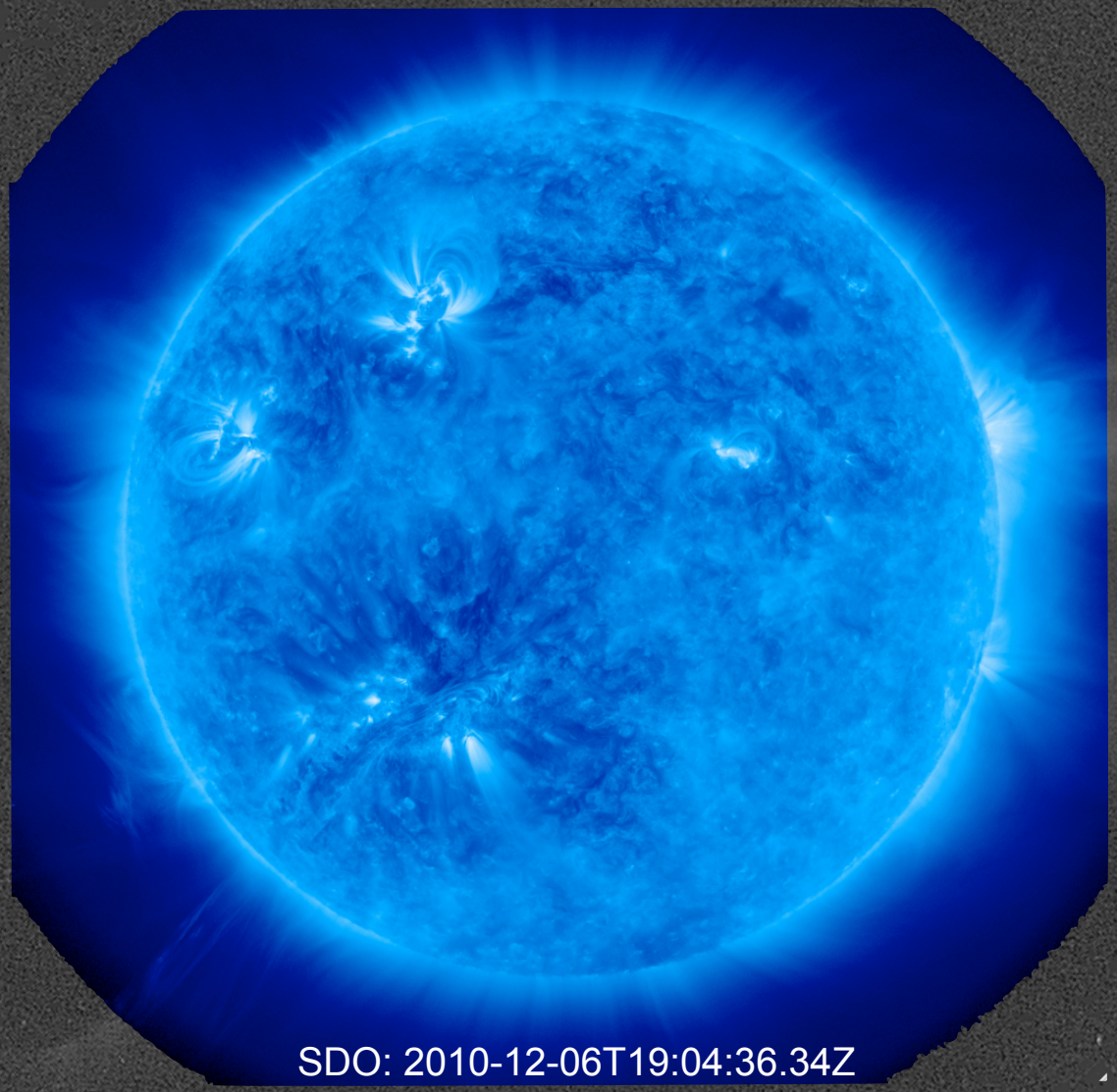
# ‘SINTERKLAAS’ EVENT



# ‘SINTERKLAAS’ EVENT



# ‘SINTERKLAAS’ EVENT



SDO: 2010-12-06T19:04:36.34Z

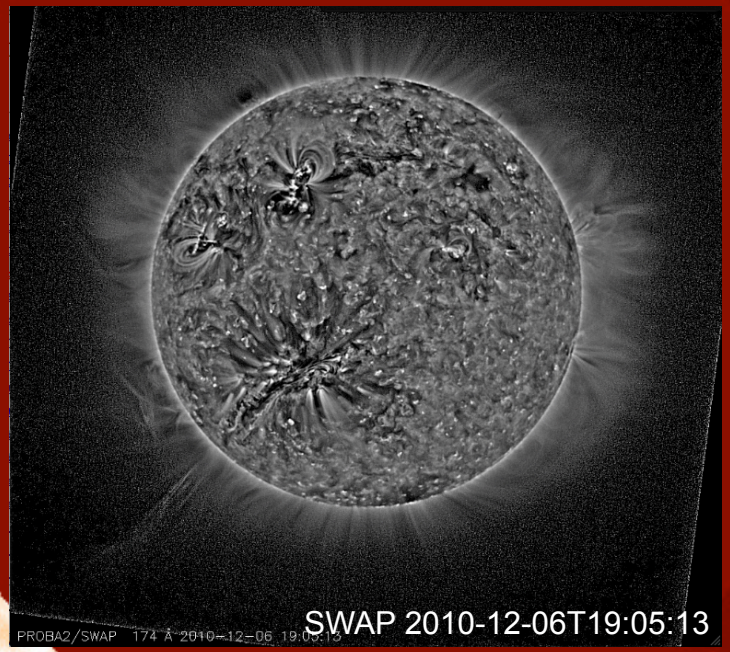
SWAP: 20101206_190408 UT

# ‘SINTERKLAAS’ EVENT

SWAP: 20101206_190408 UT

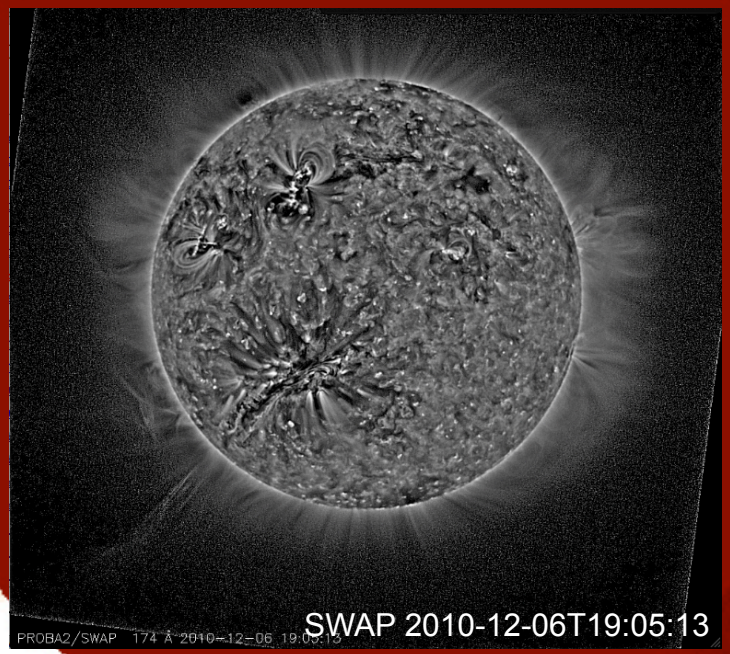
# ‘SINTERKLAAS’ EVENT

# ‘SINTERKLAAS’ EVENT



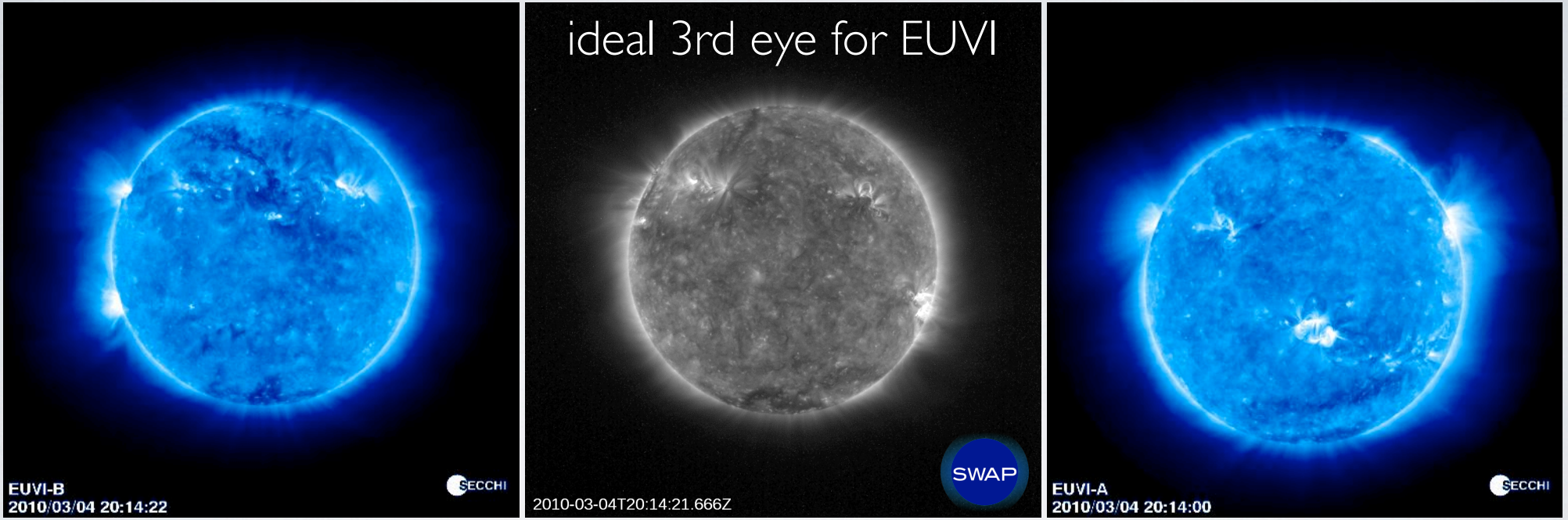

2010/12/06 19:00

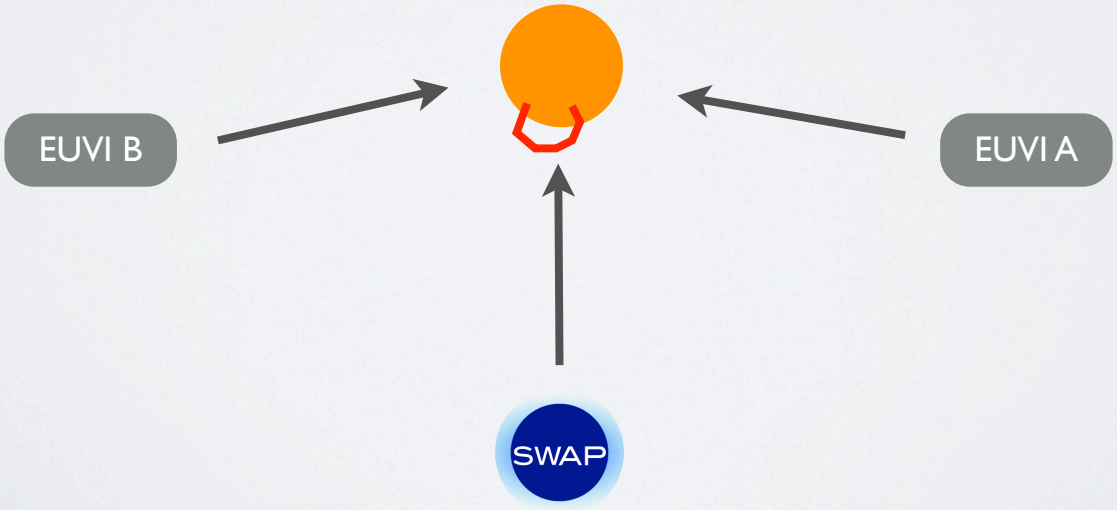
# ‘SINTERKLAAS’ EVENT




2010/12/06 19:48

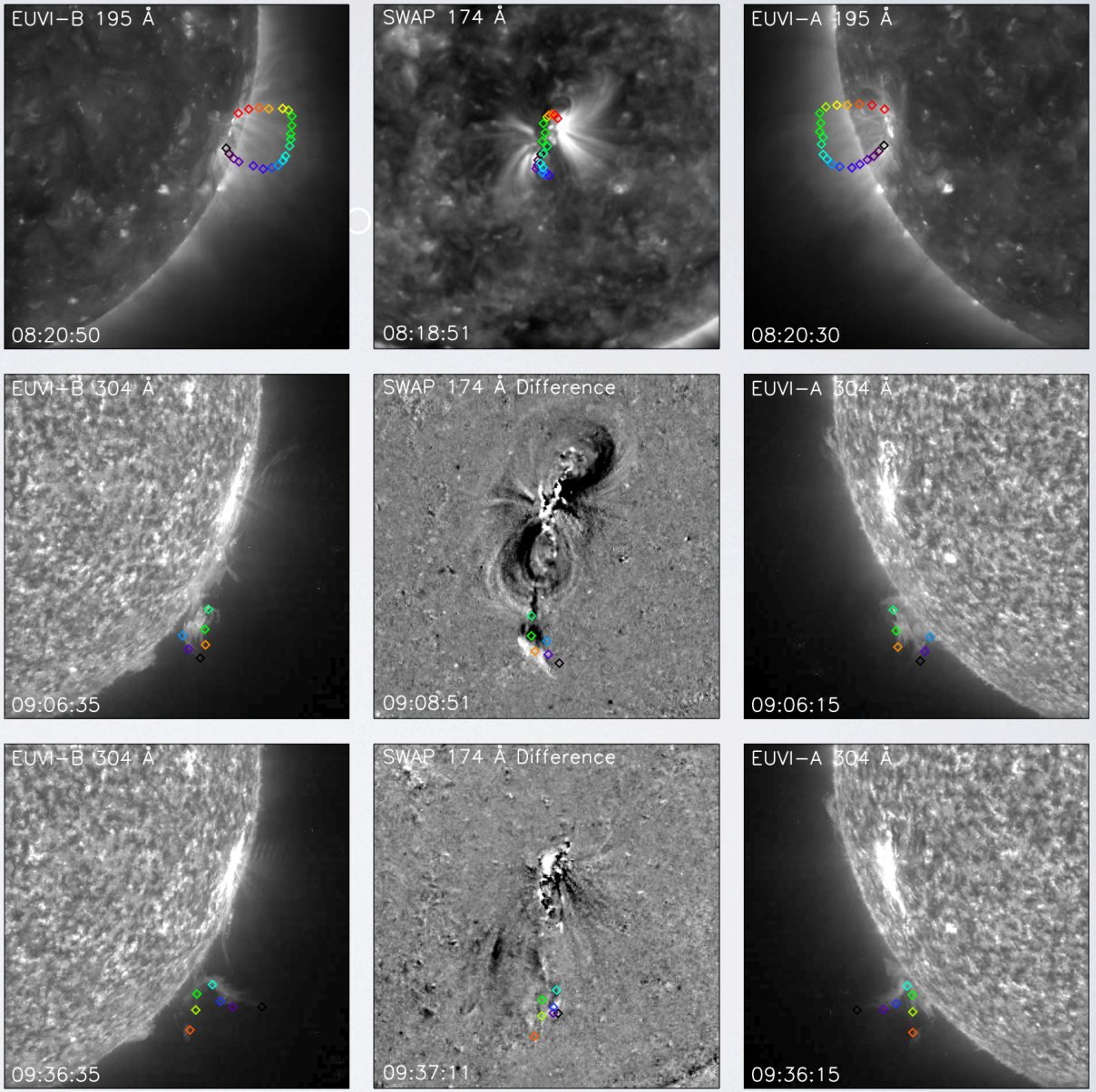
# 3D CME RECONSTRUCTIONS



# 3D CME RECONSTRUCTIONS

3 april 2010:
Earth-directed CME event seen in EUVI A, B and SWAP

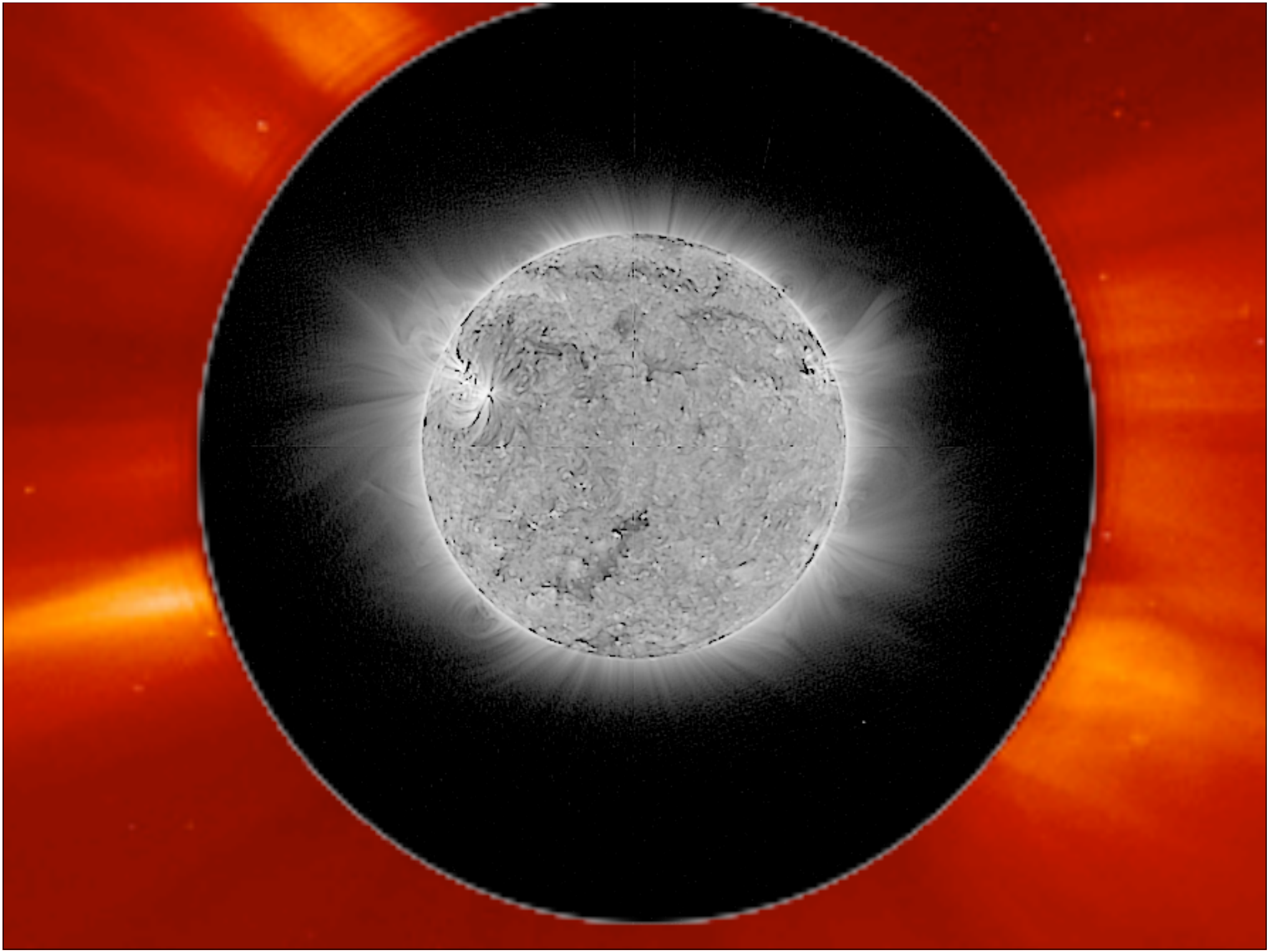



*Seaton et al, 2010*

# PARTIAL SOLAR ECLIPSE(S)

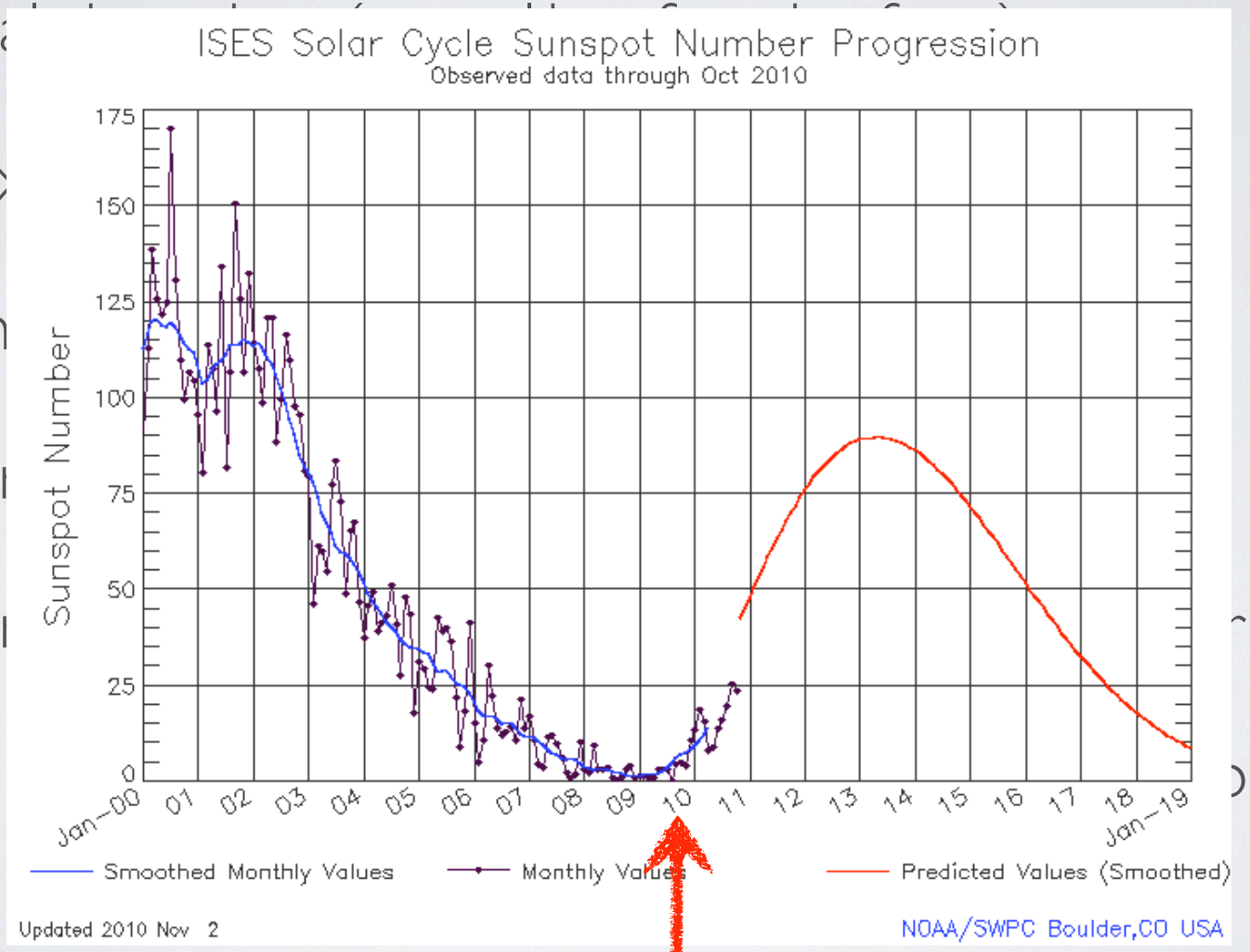
July 11, 2010, 17:00-23:00 UTC

SWAP



# OPPORTUNITIES FOR SCIENCE & SPACE WEATHER

- Near rea
- Very flex
  - comm
  - quick r
- On-boar ring - ...
- Waiting oloit all this




MORE TO COME!

# OPEN DATA POLICY

Data are freely available to all users on
http://proba2.sidc.be/**swap**/data/xxx
**lyra**
All data ordered in year/month/day folders
Fancy data browser to come

**SWAP**
quicklook PNG (qlviewer)
lv0 FITS: raw data (eng)
lv1 FITS: science data (bsd)
daily mp4 movies (mpg)
SWAP average intensity (swavint)

SWAP tree in SSW IDL:
http://www.solarmonitor.org/objects/swap/

**LYRA**
3-days uncalibrated quicklook (DailyImage)
lv**1** FITS: raw data (eng)

*lv**2** FITS: calibrated data (bsd)*
*lv**3** FITS: 1 min averaged, in W/m$^2$*
*lv**4** FITS: idem in PNG*

# HOW TO BE INVOLVED?

Breaking scientific results are very important for PROBA2
Lots of potential in the data
→ we are looking for you to use the SWAP and LYRA data!

PROBA2 helpdesk: swap_lyra@sidc.be

**17-18 February 2011: PROBA2 Science Meeting @ ROB**

Preliminary Sessions:

- Introduction, Overviews
- The static structure of the off-limb corona
- Fast solar oscillatory dynamics
- Flares & Eruptions
- Occultations (Earth aeronomy)
- SWAP/LYRA calibration splinters
- Conclusions, Strategy and Planning

# HOW TO BE INVOLVED?

Breaking scientific results are very important for PROBA2
Lots of potential in the data
→ we are looking for you to use the SWAP and LYRA data!

PROBA2 helpdesk: swap_lyra@sidc.be

## 17-18 February 2011: PROBA2 Science Meeting @ ROB

Preliminary Sessions:

- Introduction, Overviews
- **The static structure of the off-limb corona**
- Fast solar oscillatory dynamics
- Flares & **Eruptions**
- Occultations (Earth aeronomy)
- SWAP/LYRA calibration splinters
- Conclusions, Strategy and Planning

comparison with models

# FOR MORE INFORMATION

http://proba2.sidc.be/


Home | About | SWAP | LYRA | Data | Community | Meetings | Outreach | Gallery | OK | Last update: 27th of October 2010

Home page › Data

## SWAP & LYRA Data Distribution

**Raw PROBA2 data is received at ESA's ground station in Redu and transferred to the PROBA2 Science Center (P2SC) via ftp link. Once received by the P2SC, the data are automatically processed, calibrated, and prepared for public distribution. All data are freely available to the public. The links to the FITS files and quicklook data are listed below.**

PROBA2 has begun its scientific mission in March 2010 and the data of SWAP and LYRA are freely available. Apart from the quicklook images, several levels of science data products are released. Some levels of calibrated data are still under construction or are released in beta version.

For the time being we have online the following FITS files and quicklook PNG files in YYYY/MM/DD directories:

**SWAP:**

- SWAP raw images, i.e. level0 data, e.g. http://proba2.oma.be/swap/data/eng/2010/05/01/
- SWAP calibrated images, i.e. level1 data e.g. http://proba2.oma.be/swap/data/bsd/2010/05/01/
- SWAP quicklook data (png files), e.g http://proba2.sidc.be/swap/data/qlviewer/2010/05/01/
- SWAP daily movies (mp4 files) at http://proba2.sidc.be/swap/data/mpg/movies/overview.php

**LYRA:**

- LYRA raw 'standard' time curves, i.e. level1 data, e.g. http://proba2.oma.be/lyra/data/eng/2010/05/01/.

*These LYRA FITS files are automatically generated and always show the latest data available. The other data formats listed below*

http://proba2.sidc.be/