SWAP & LYRA:
READY FOR SCIENCE & SPACE WEATHER

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

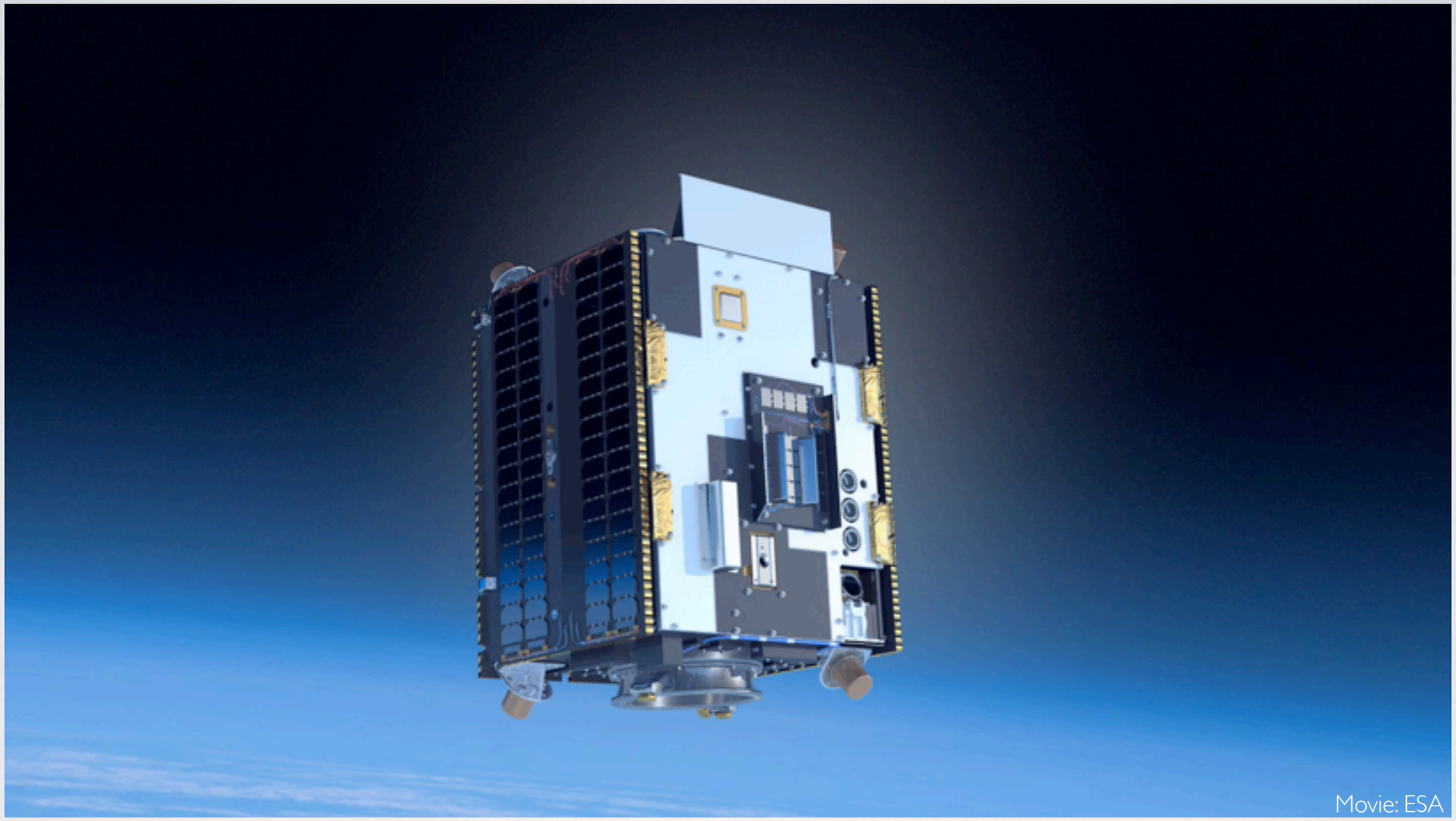
CESRA 2010 meeting ☀ La Roche en Ardenne, Belgium ☀ June 16, 2010

PROBA2

Project for **O**n-**B**oard **A**utonomy

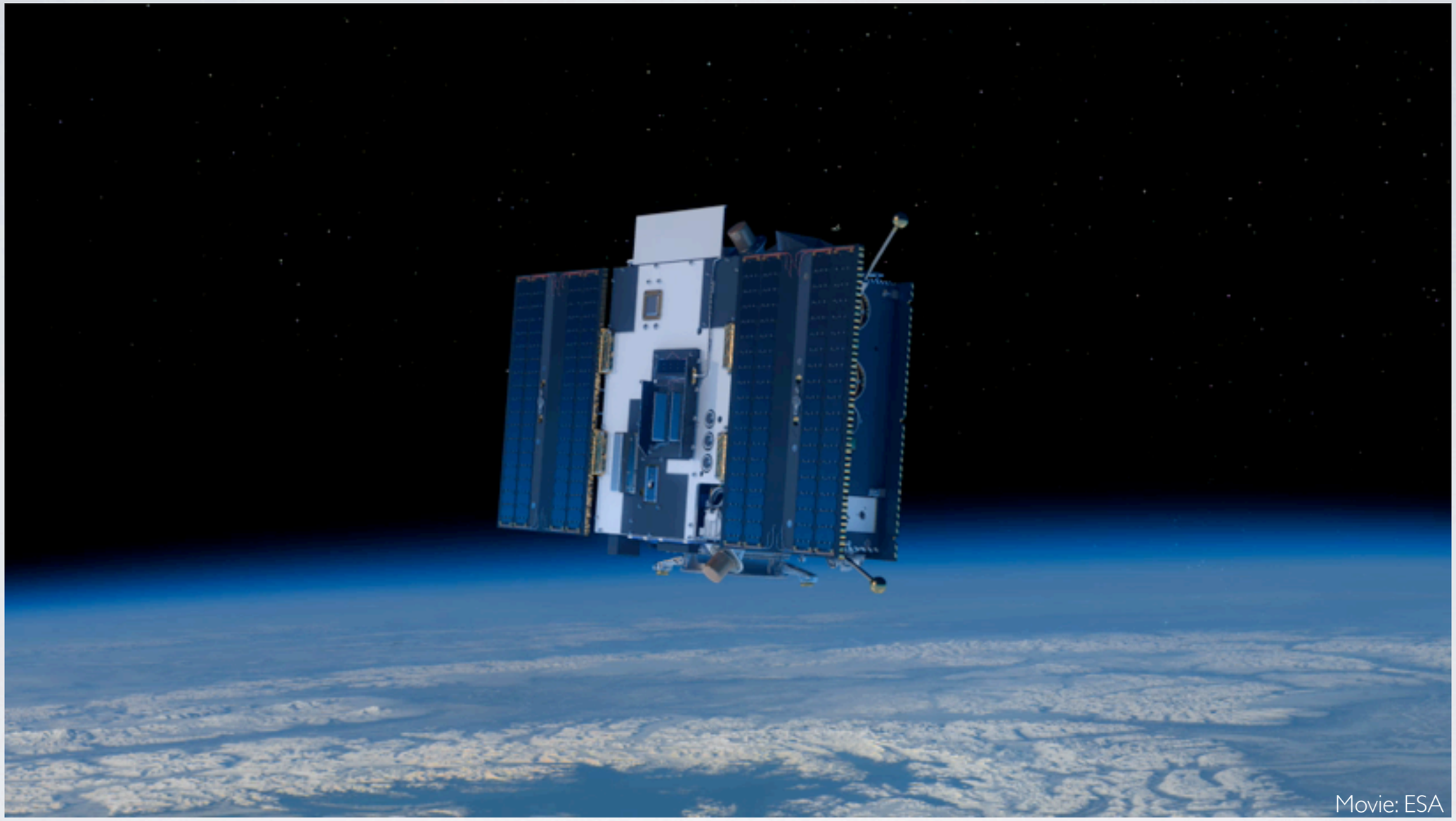
Microsatellite in sun-synchronous orbit ☀ 725 km altitude

Launched on Nov. 2, 2009



ESA TECHNOLOGY MISSION

4 innovative instruments: SWAP, LYRA, TPMU, DSLP
17 technological experiments
in-orbit demonstration



ESA SCIENCE MISSION

SWAP and LYRA observe the Sun in EUV and XUV

nominal operations since March

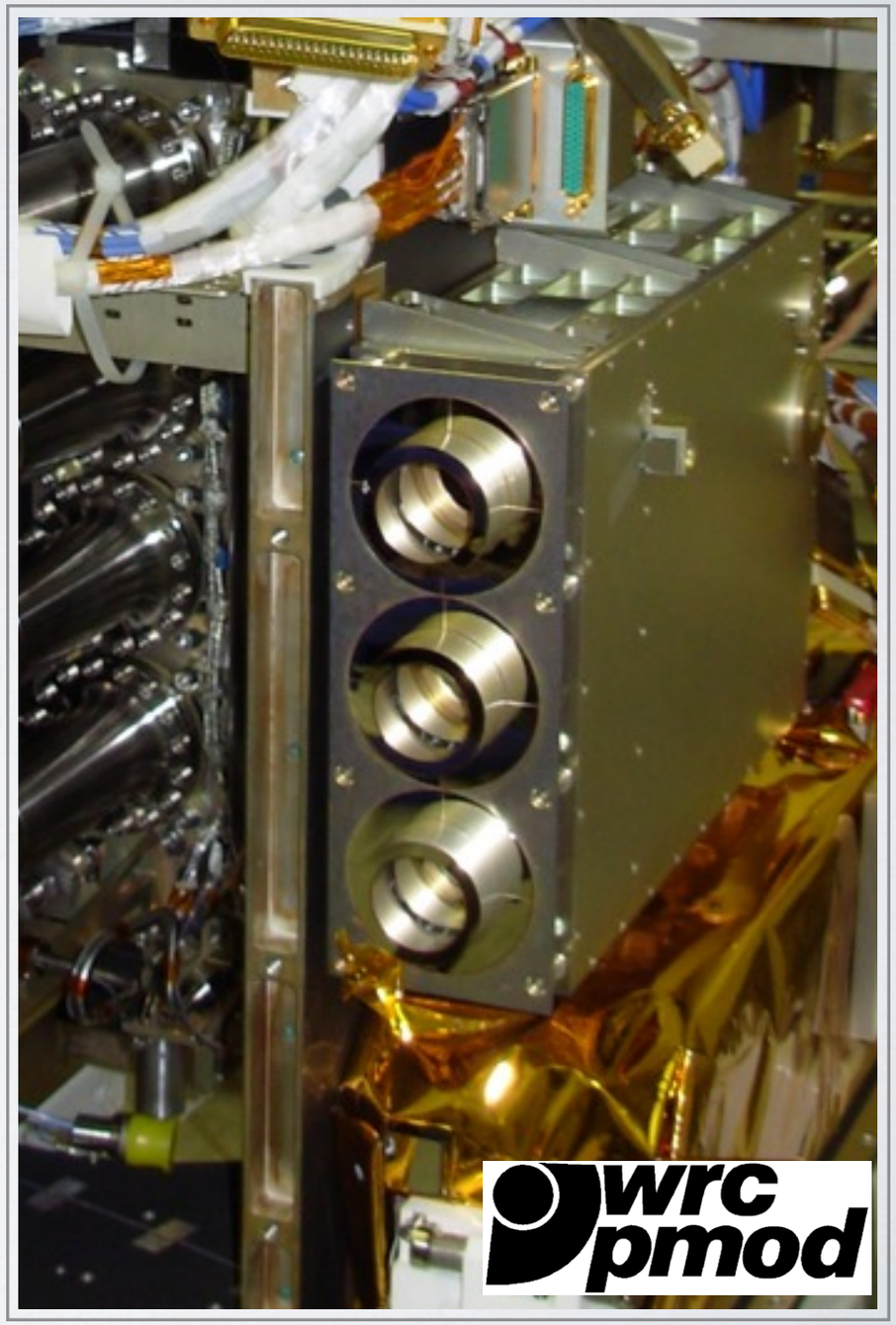
PROBA2 SCIENCE CENTER

Instrument commanding + data processing & storage at ROB

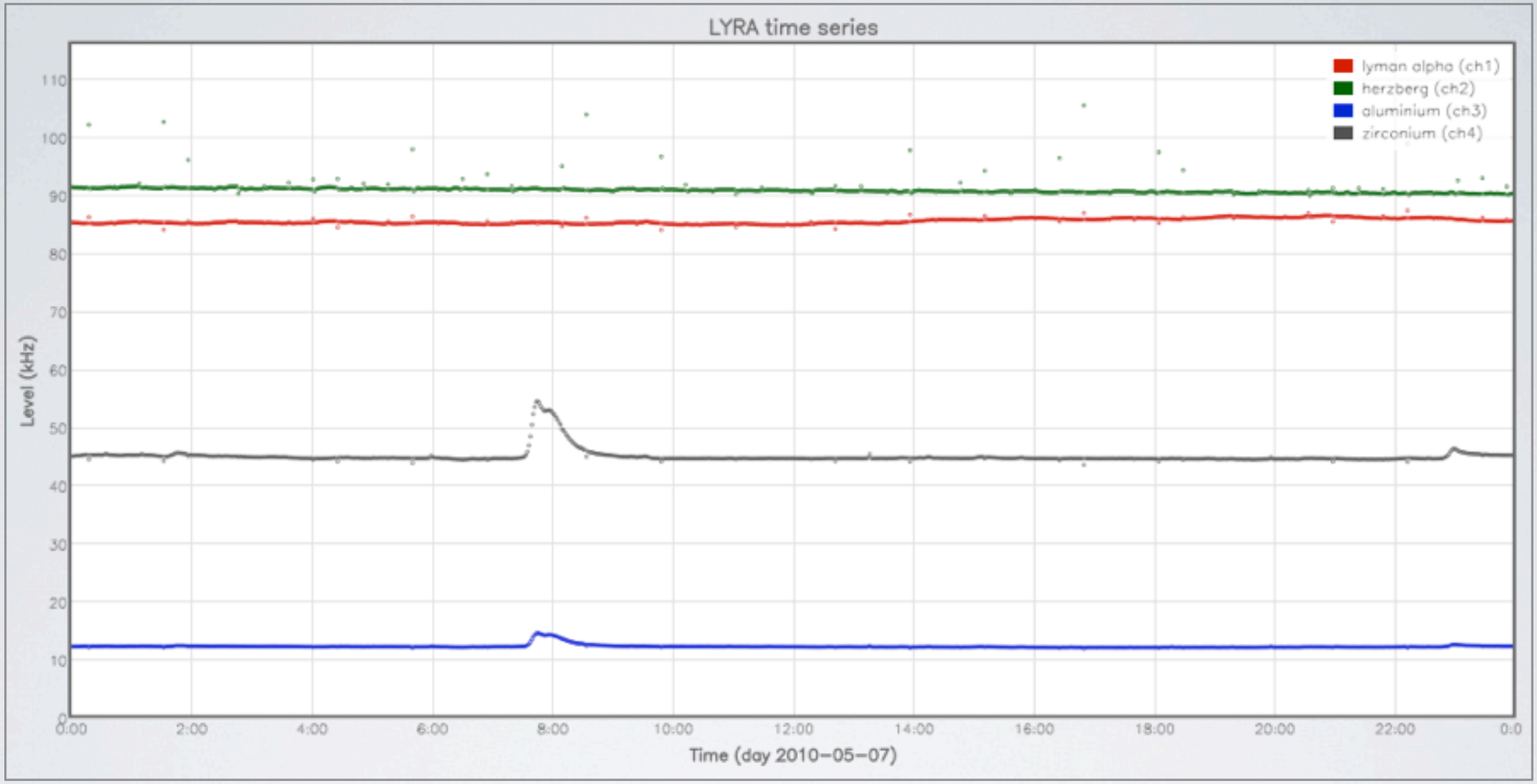
Data available in near-real time (~1hr after contact)

LYRA: LYMAN-ALPHA RADIOMETER

- **3** instrument units (redundancy)
- **4** spectral channels per head
- **3 types of detectors:** Silicon &
  2 types **diamond** detectors:
  - radiation resistant
  - insensitive to visible light
  compared to Si detectors
- **High cadence** up to 100Hz



LYRA CHANNELS



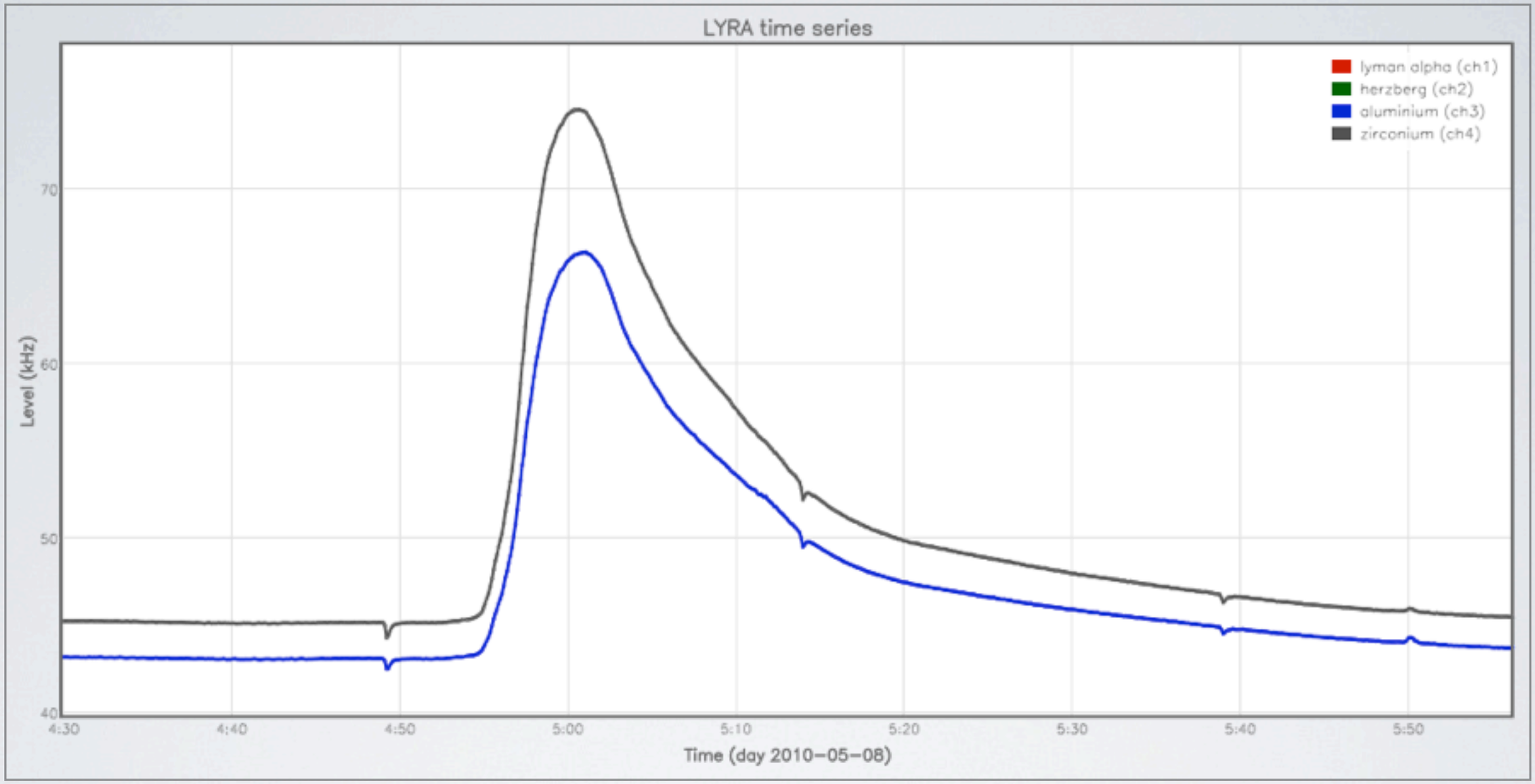
Lyman-α: 120-123 nm

Herzberg Continuum: 200-220 nm

Aluminum Filter: XUV & EUV (incl. He II at 30.4 nm) ~ 17-80 nm

Zirconium Filter: XUV & EUV (excl. He II) ~ 1-20nm

LYRA FLARES



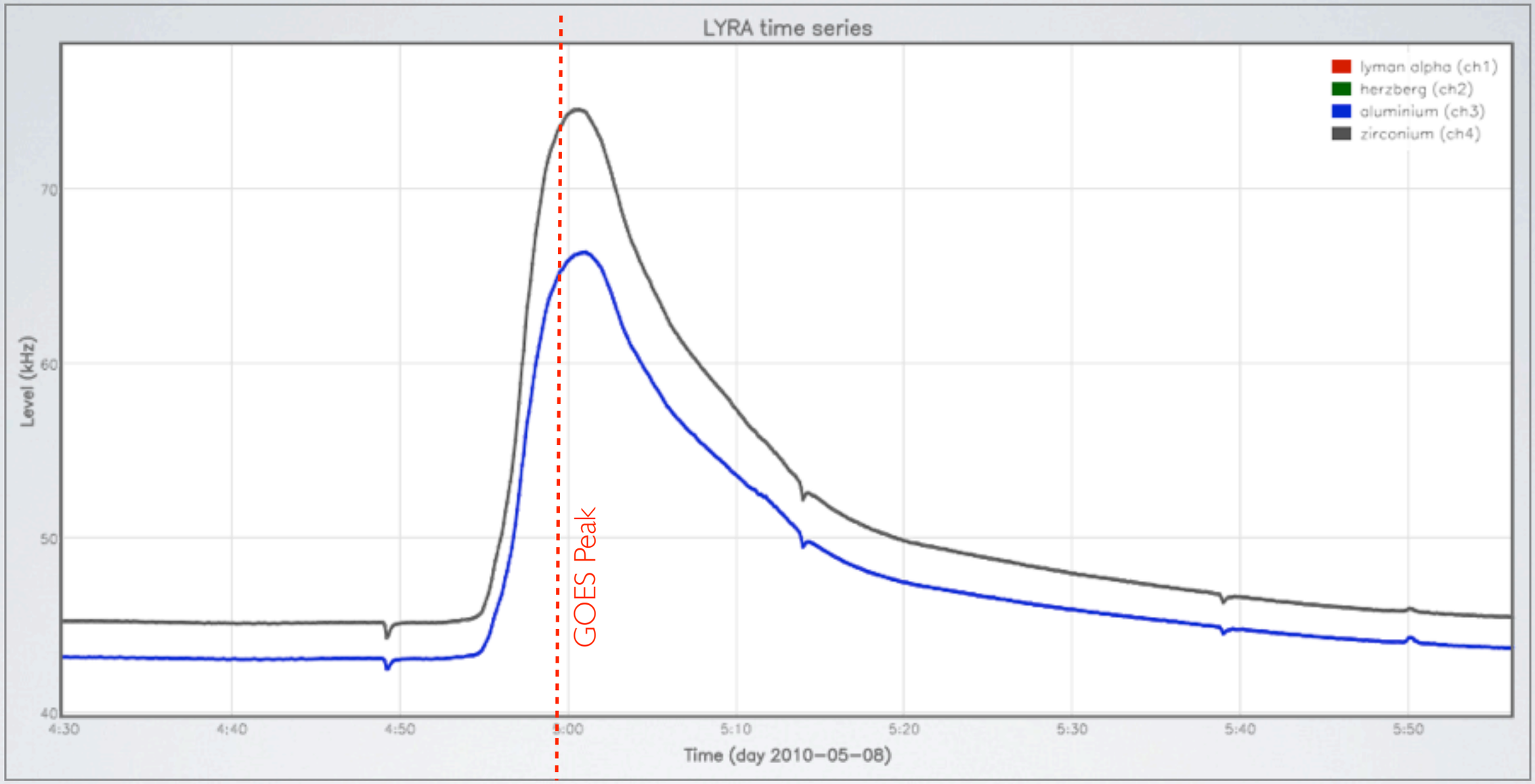
LYRA senses all flares in Zr & Al up to 10ms resolution

Ly-**α** contribution for impulsive flares

Different onset & peak times in different pass bands

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

LYRA FLARES



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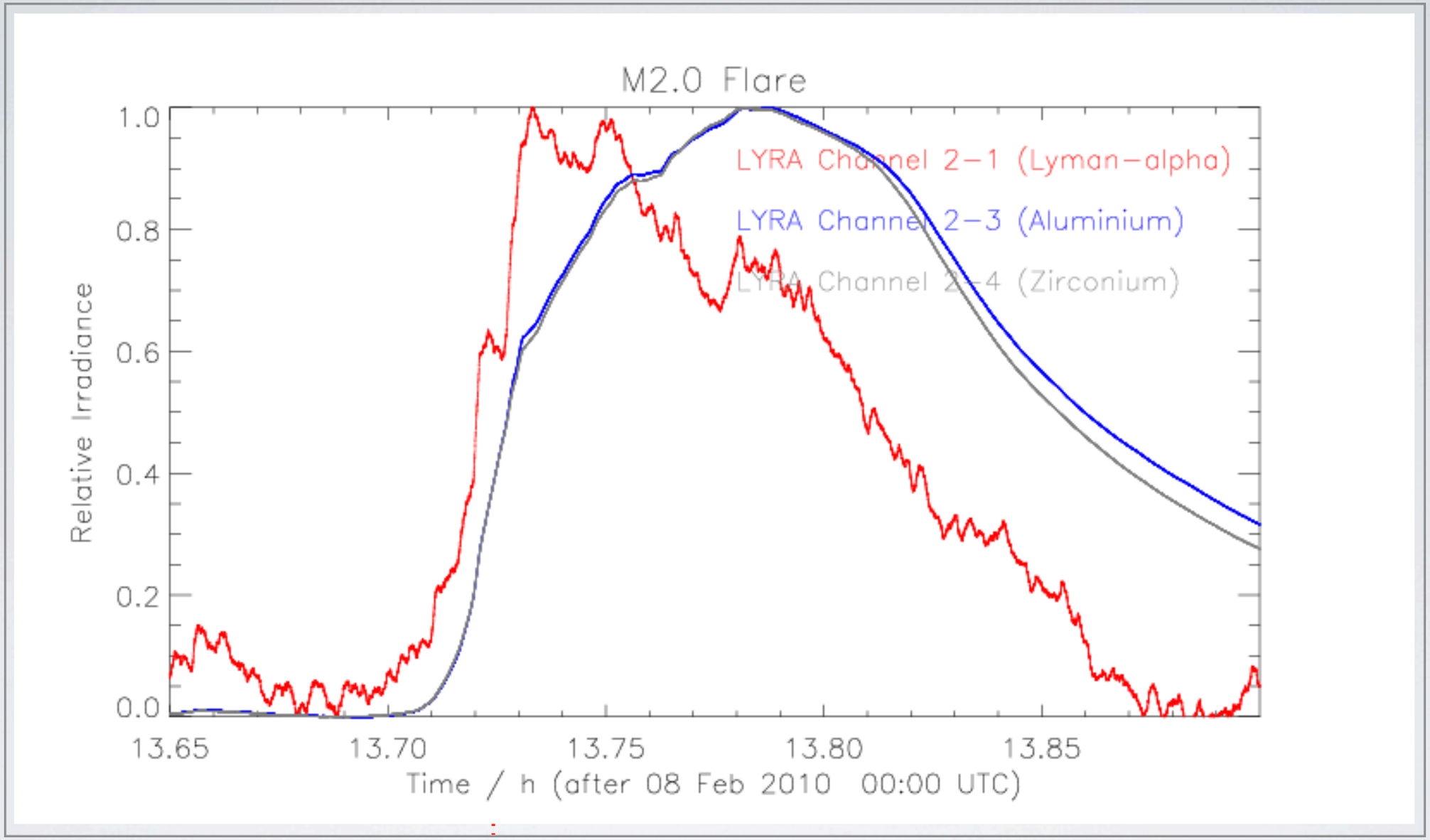

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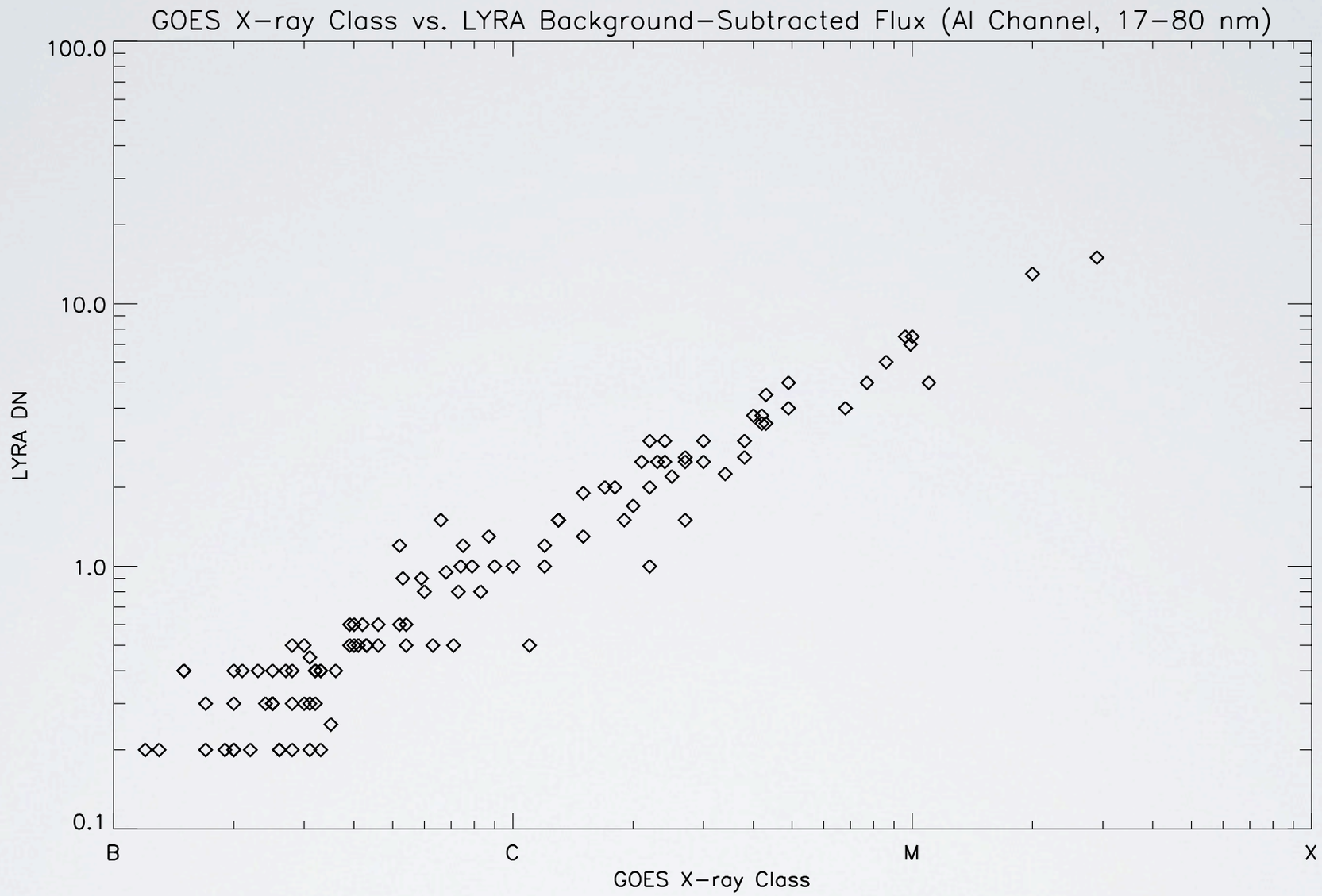

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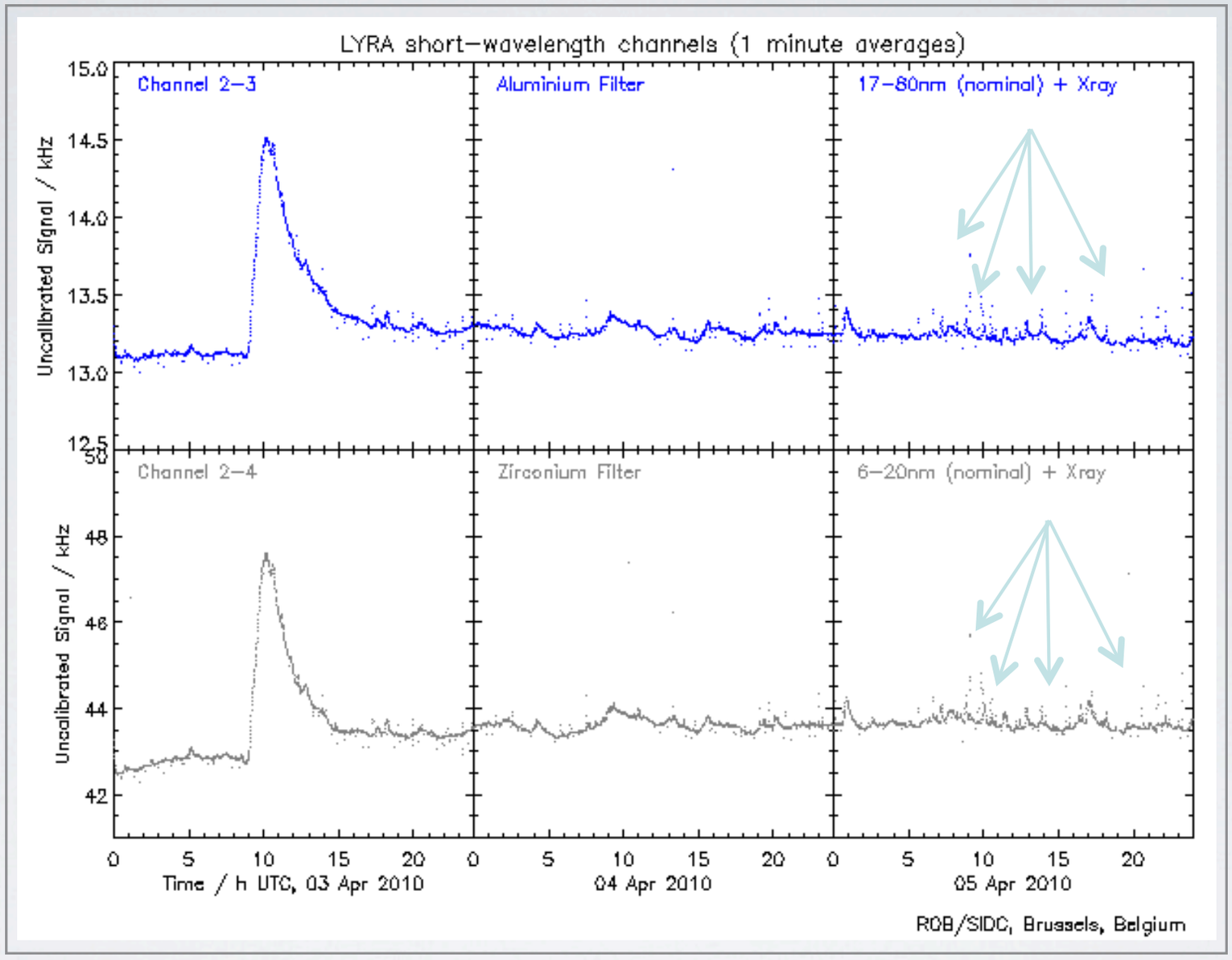
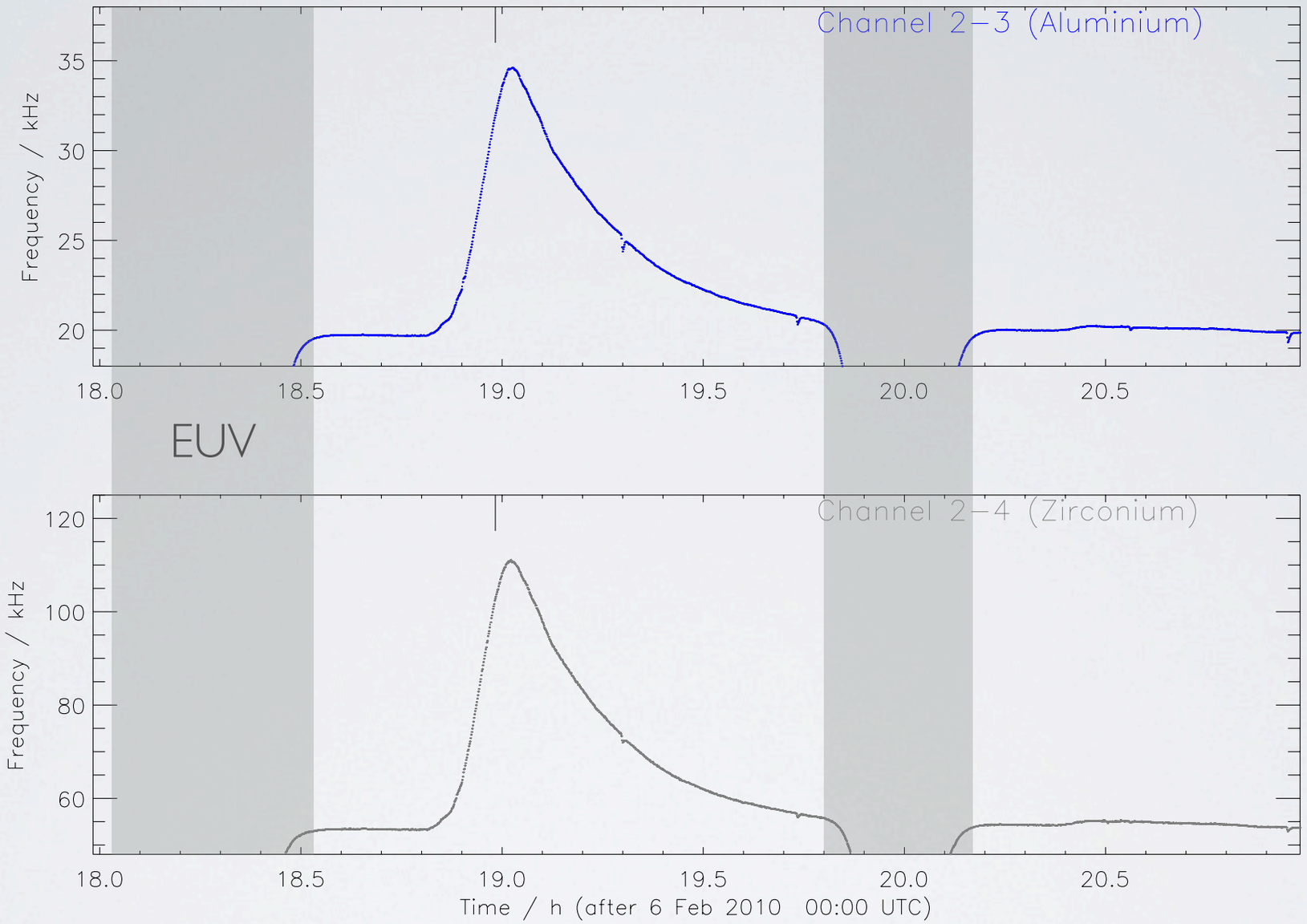
OTHER LYRA EVENTS



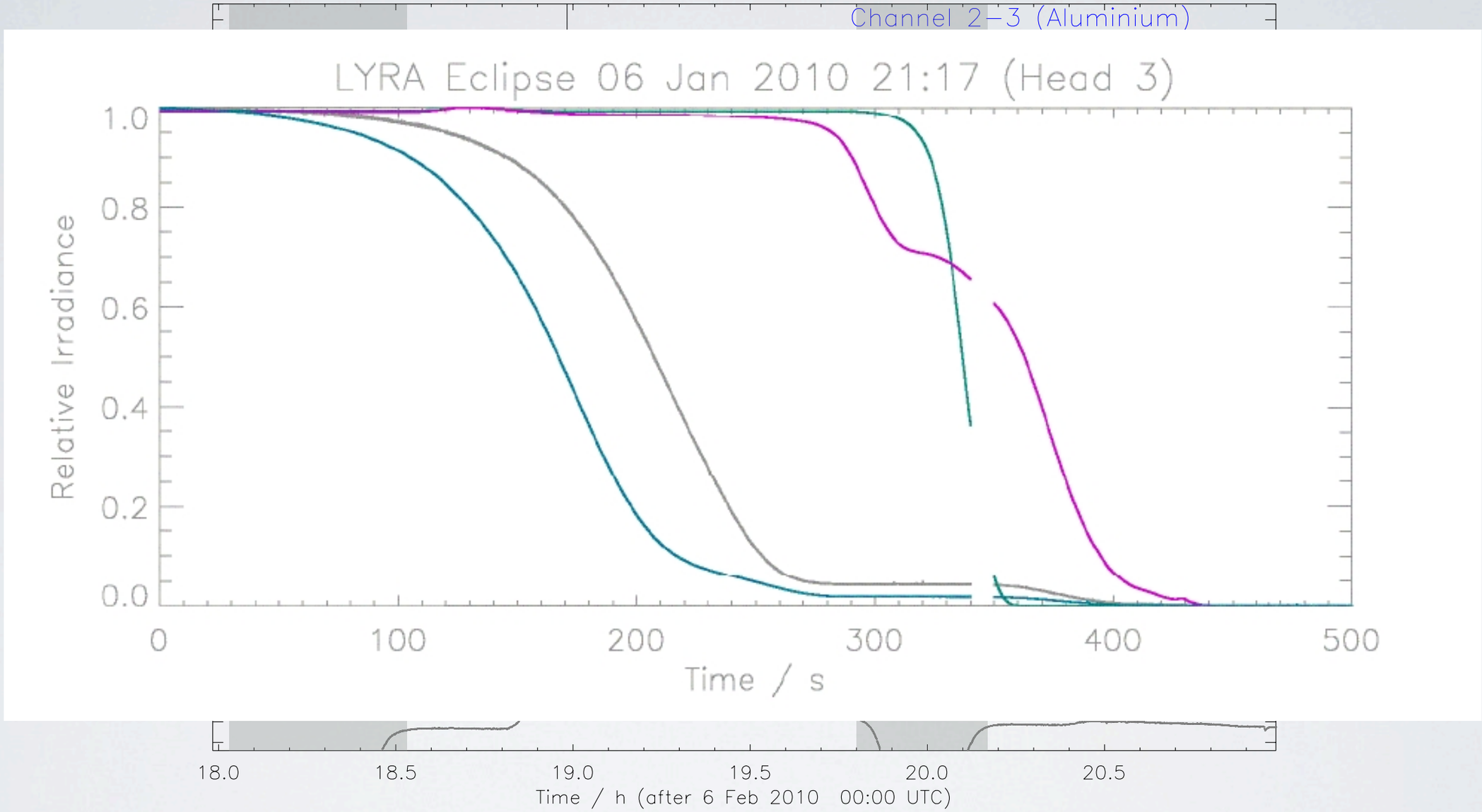
Geomagnetic perturbations:
around +-75deg latitude, 2-3 days after a CME

OTHER LYRA EVENTS



Nov-Feb: eclipse occultations by Earth's atmosphere & Earth

OTHER LYRA EVENTS



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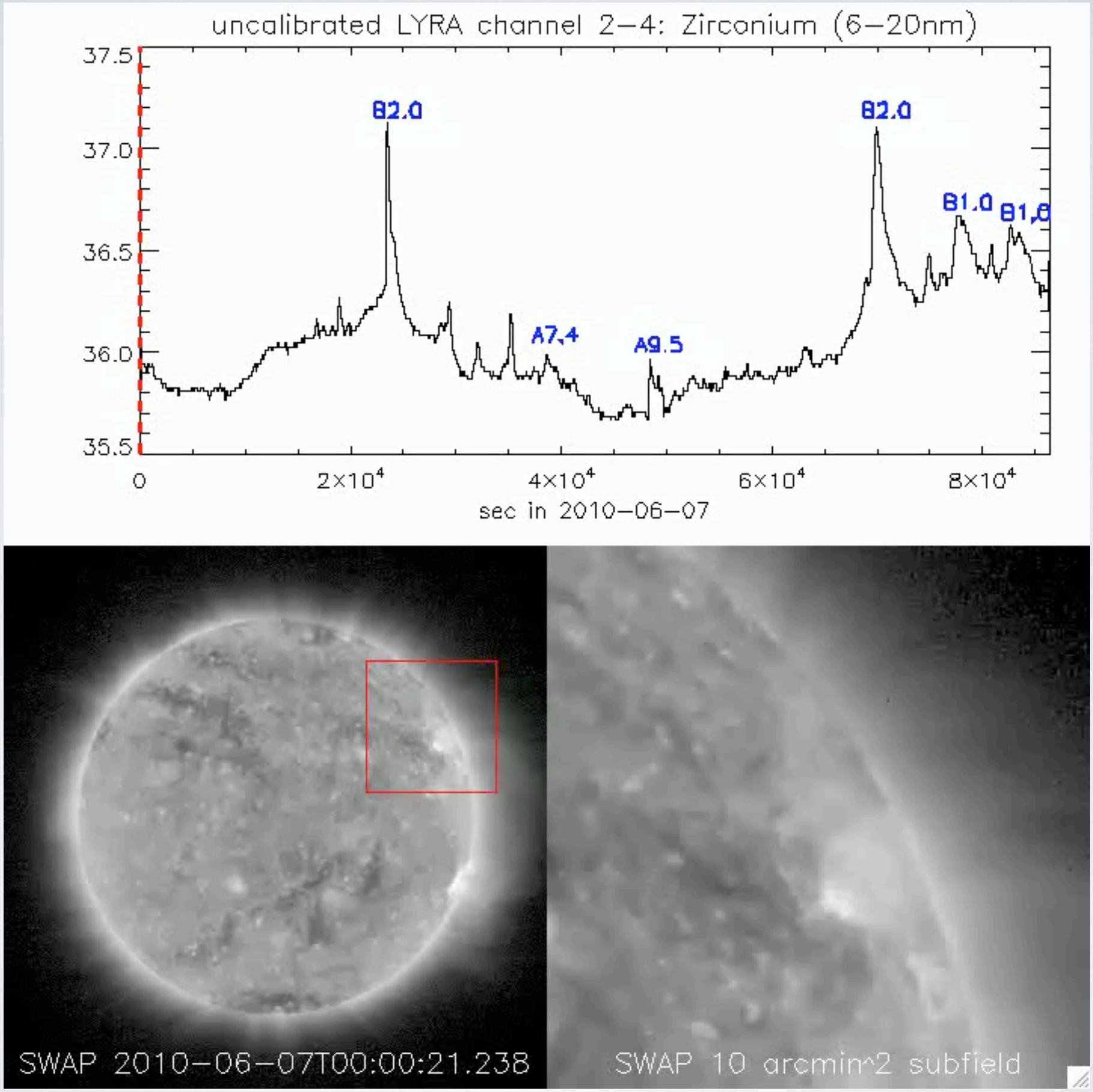
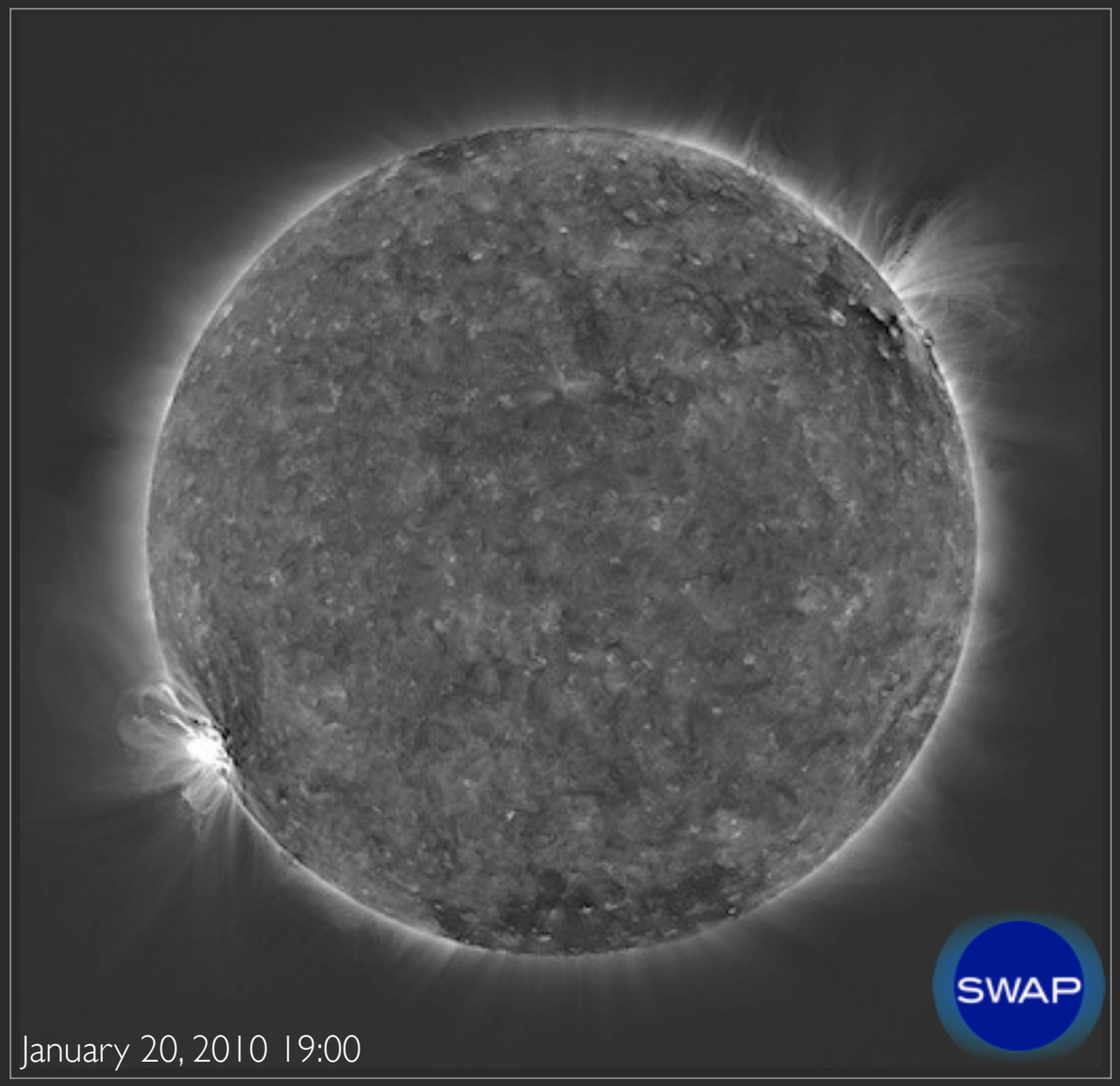
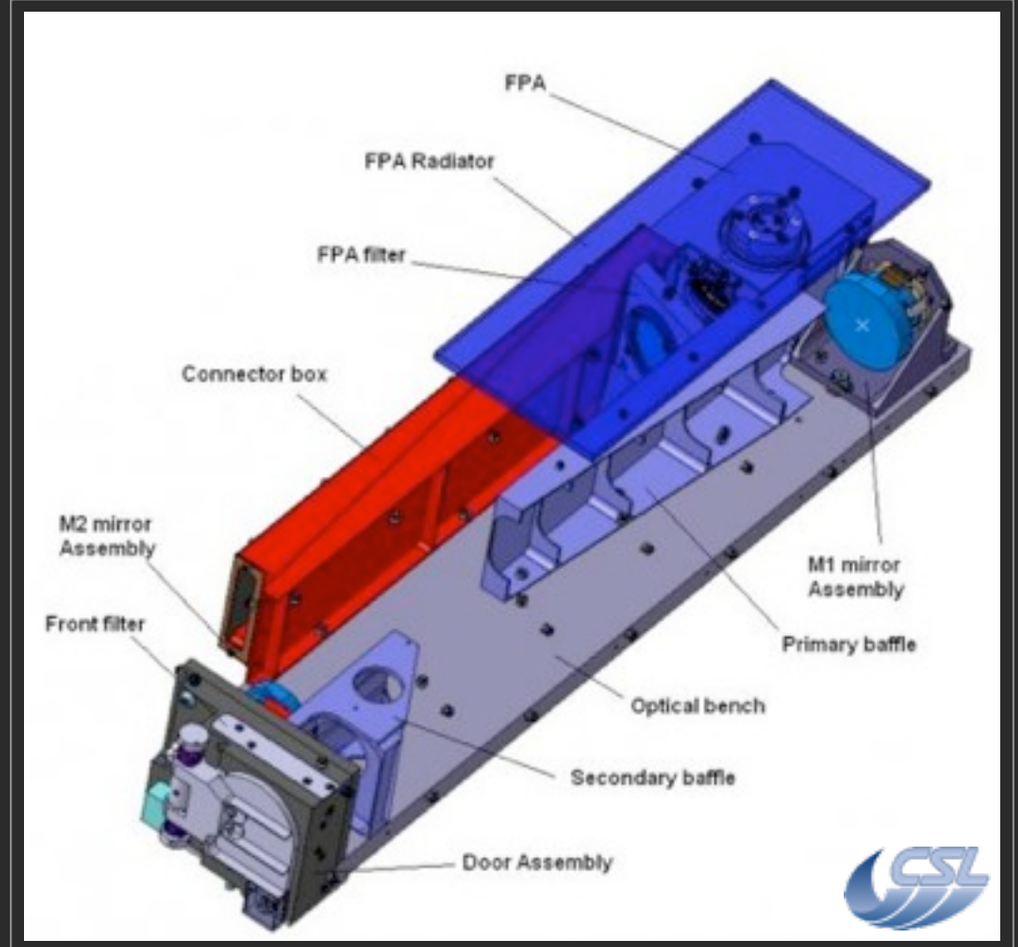
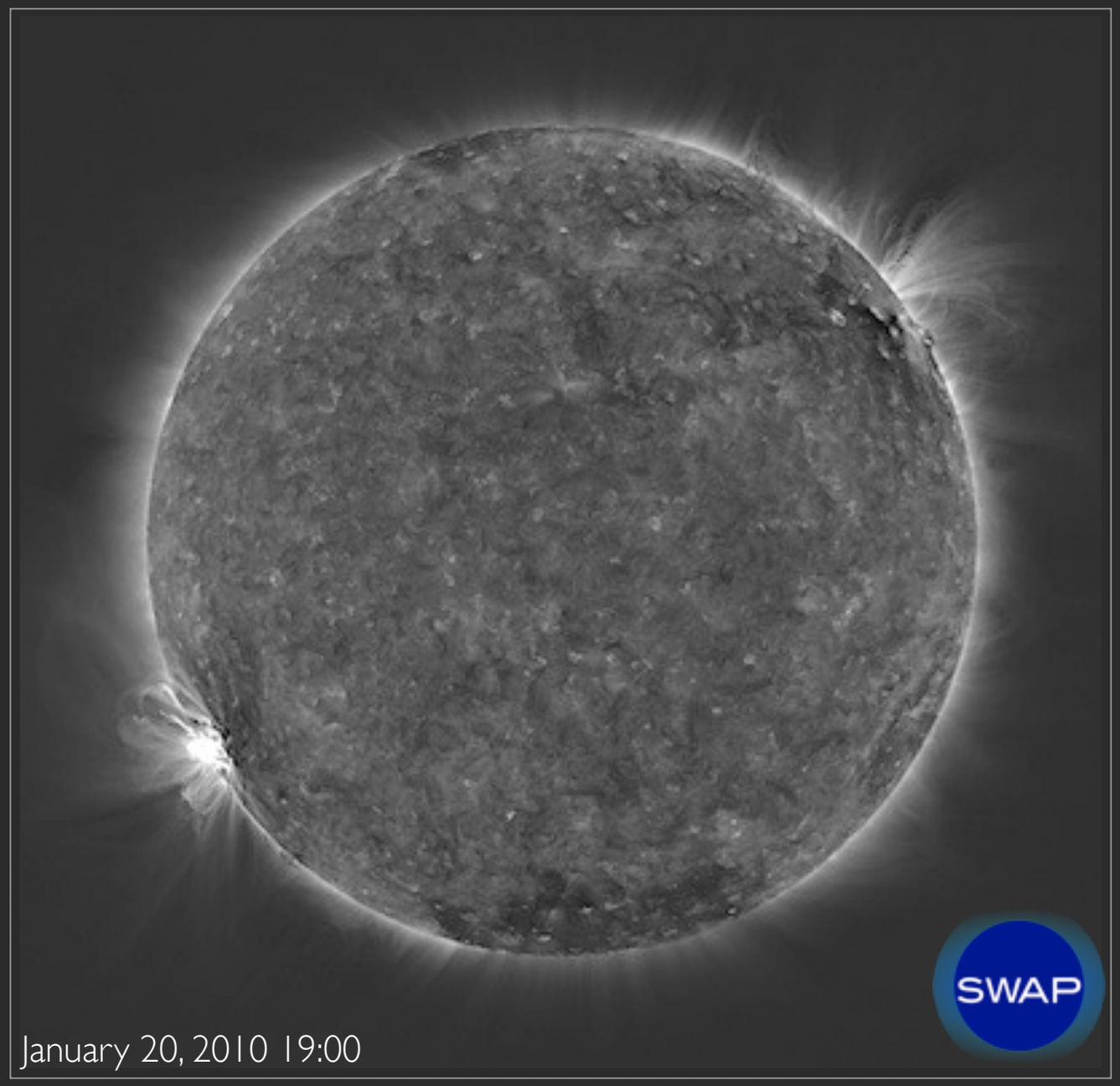

uncalibrated LYRA channel 2–4: Zirconium (6–20nm)
37.5
37.0
36.5
36.0
35.5
B2.0
B2.0
B1.0
A7.4
A9.5
0
2×10^4
4×10^4
6×10^4
8×10^4
sec in 2010–06–07
SWAP 2010–06–07T00:00:21.238
SWAP 10 arcmin^2 subfield

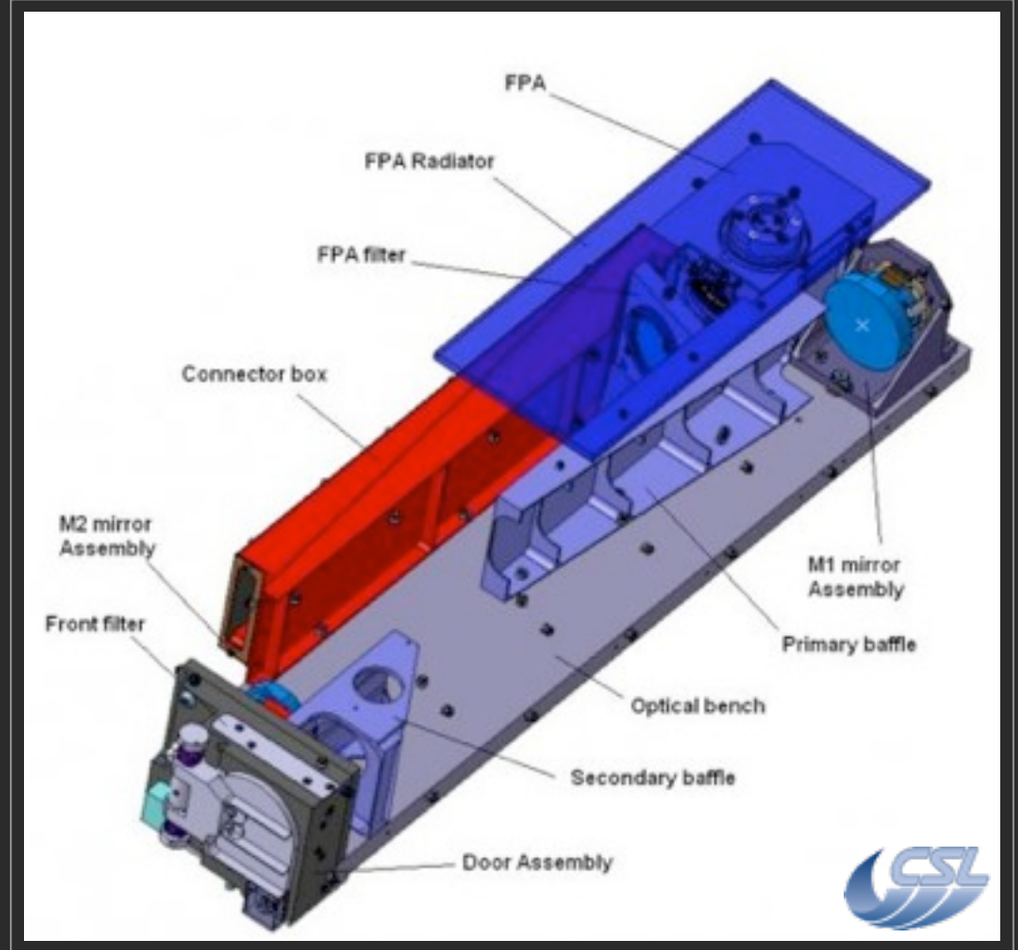




SWAP EUV IMAGER

Observes the 1 million degree corona in EUV light





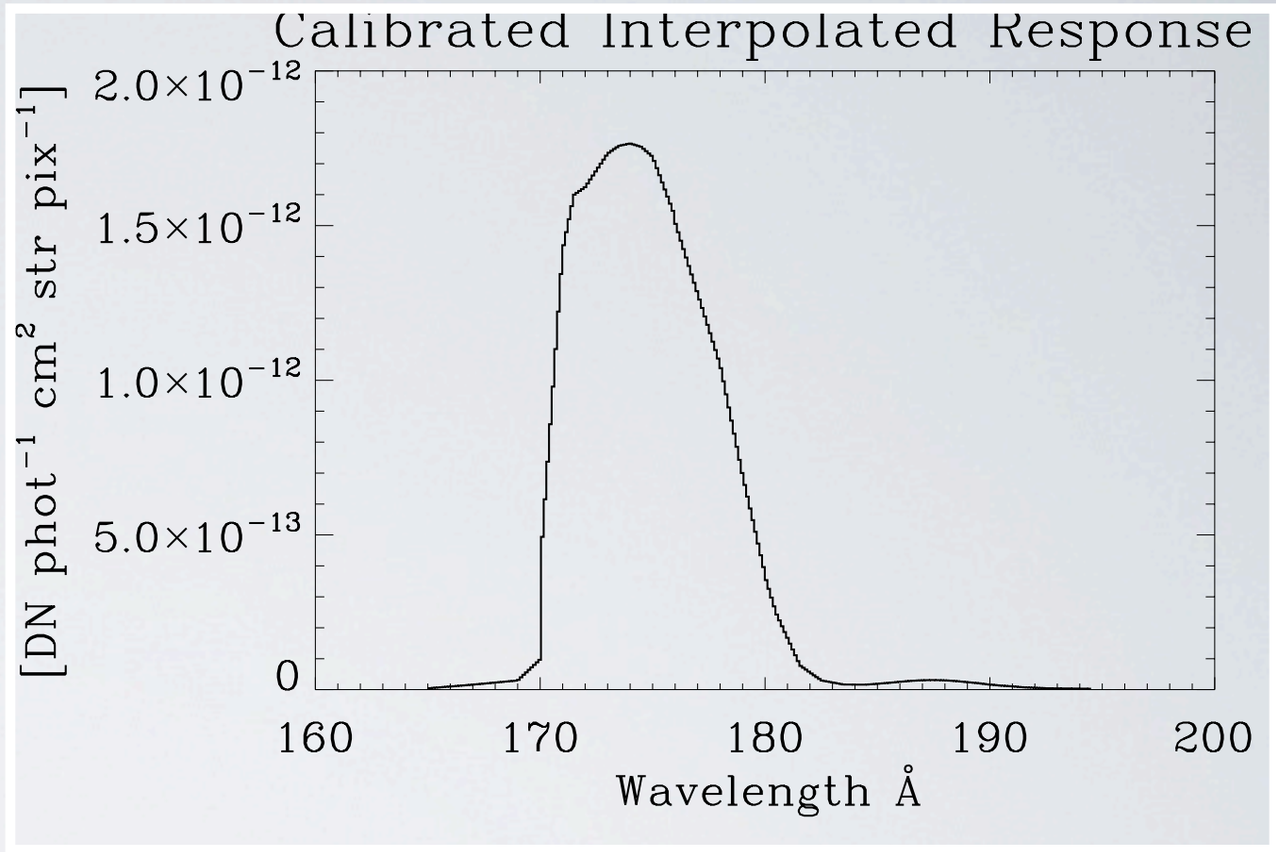
SWAP EUV IMAGER

Observes the 1 million degree corona in EUV light

Exercise in miniaturization: off-axis Ritchey-Chrétien scheme

SPECTRAL RESPONSE

Peak at 17.4nm
Comparable to EIT 17.1nm
& STEREO/EUVI 17.1nm
~1min cadence, 1K x1K CMOS



Raftery, 2009

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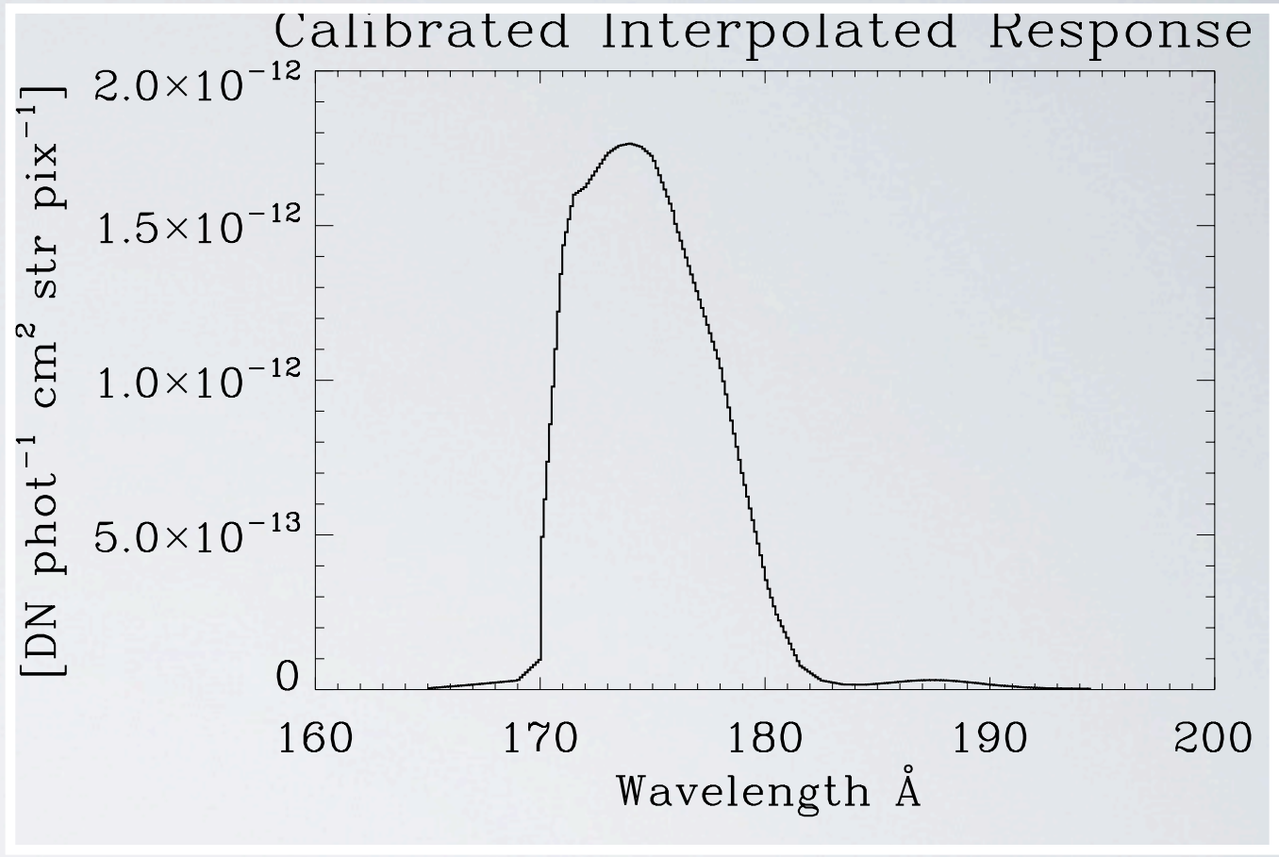
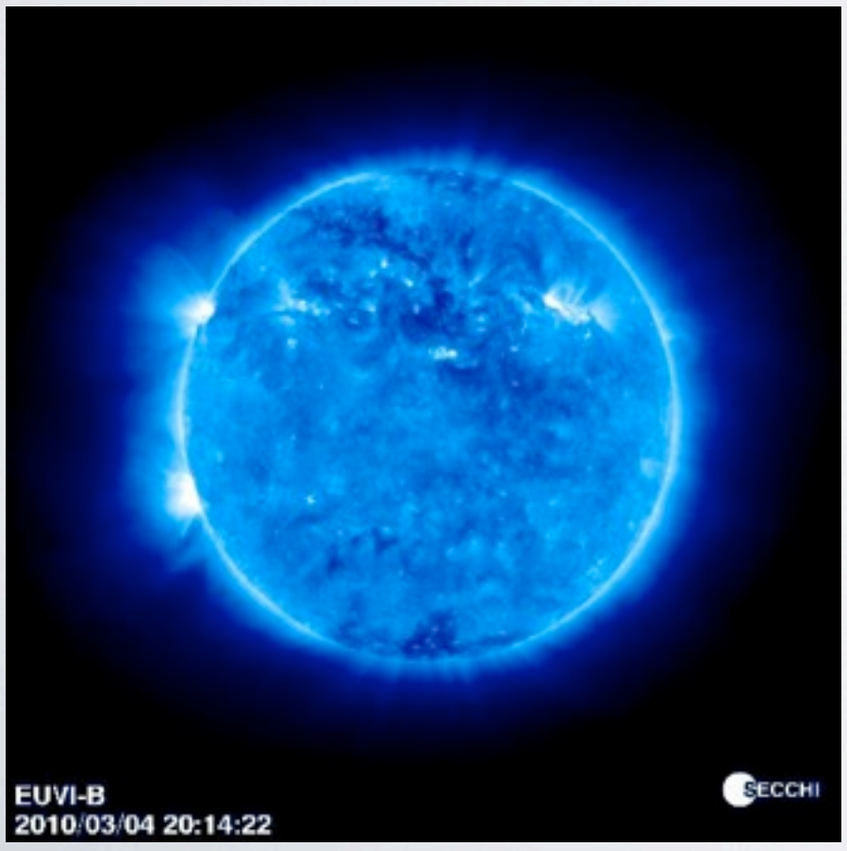
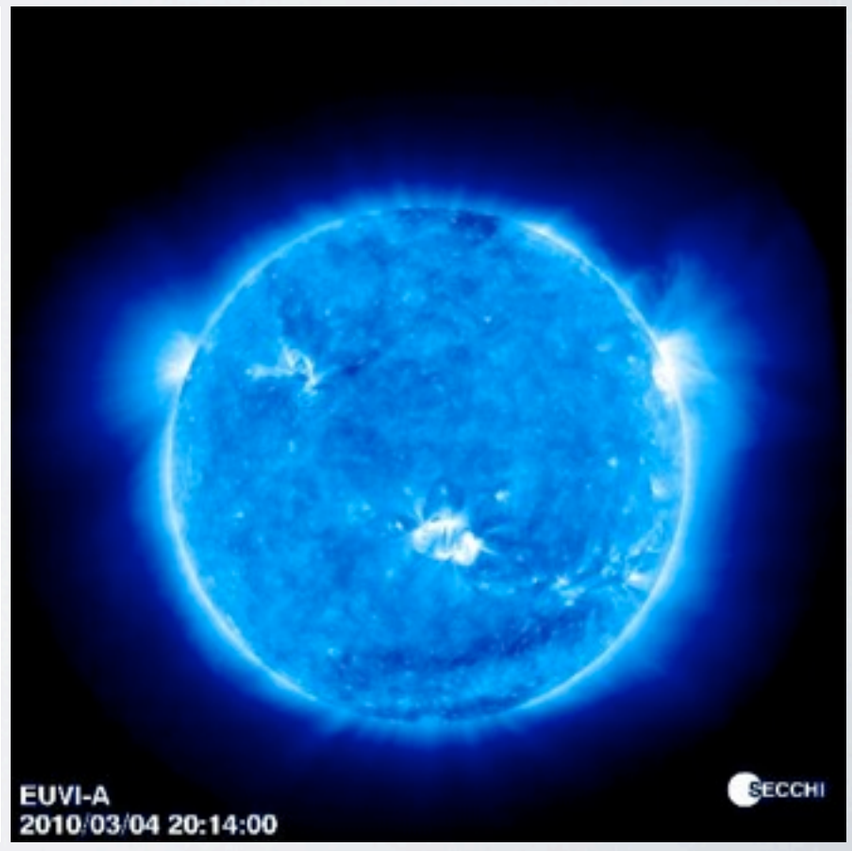
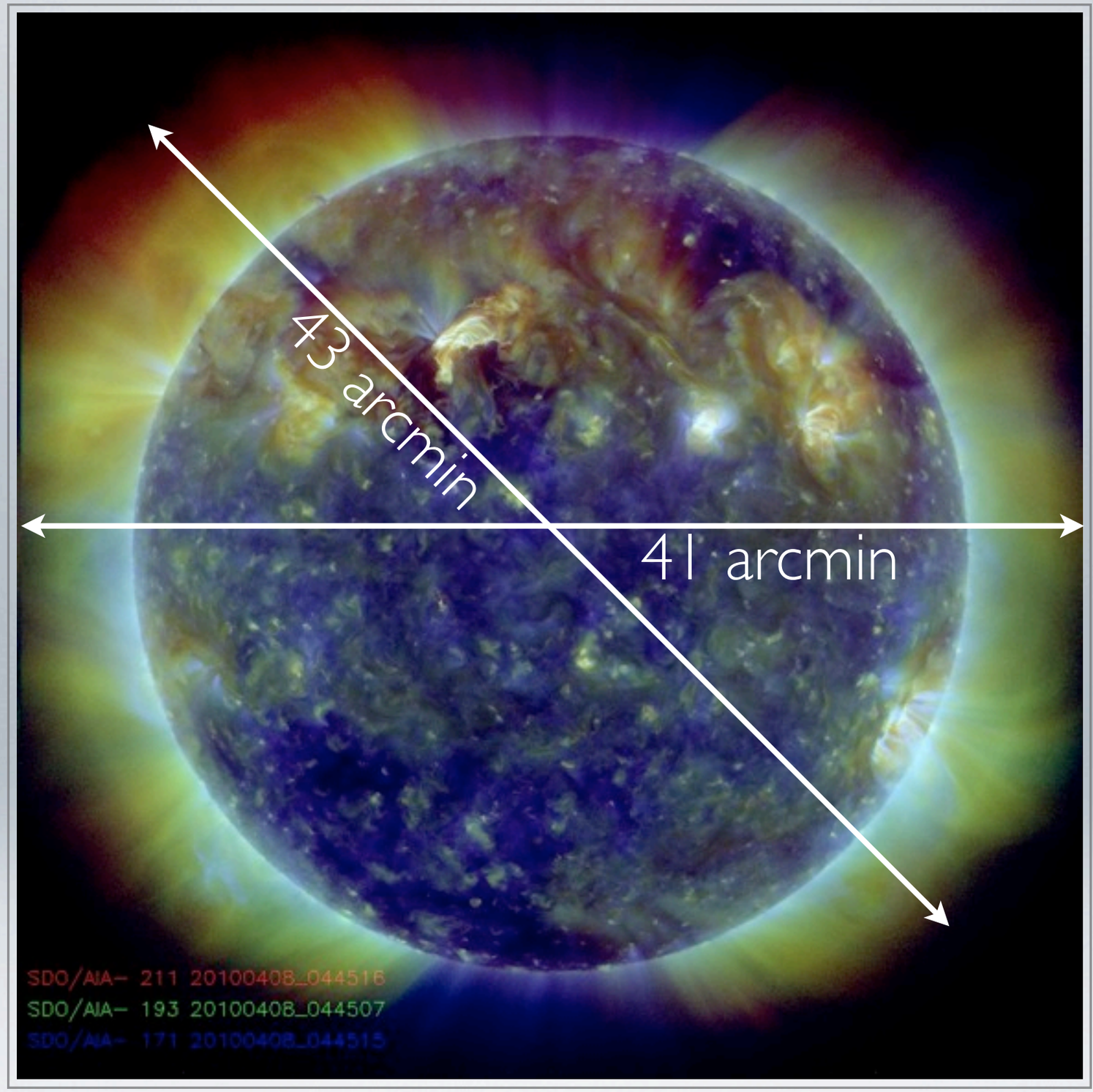
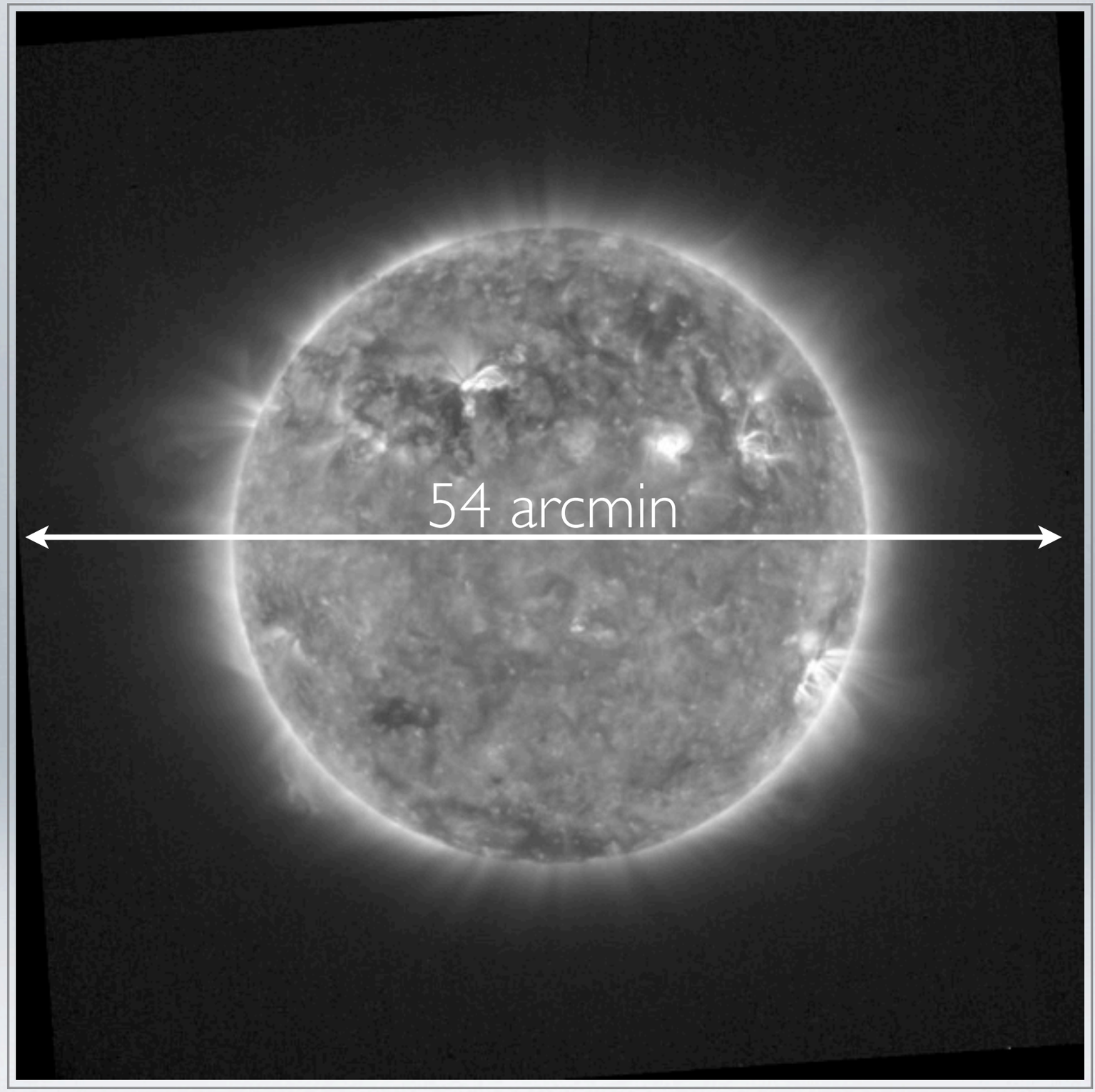




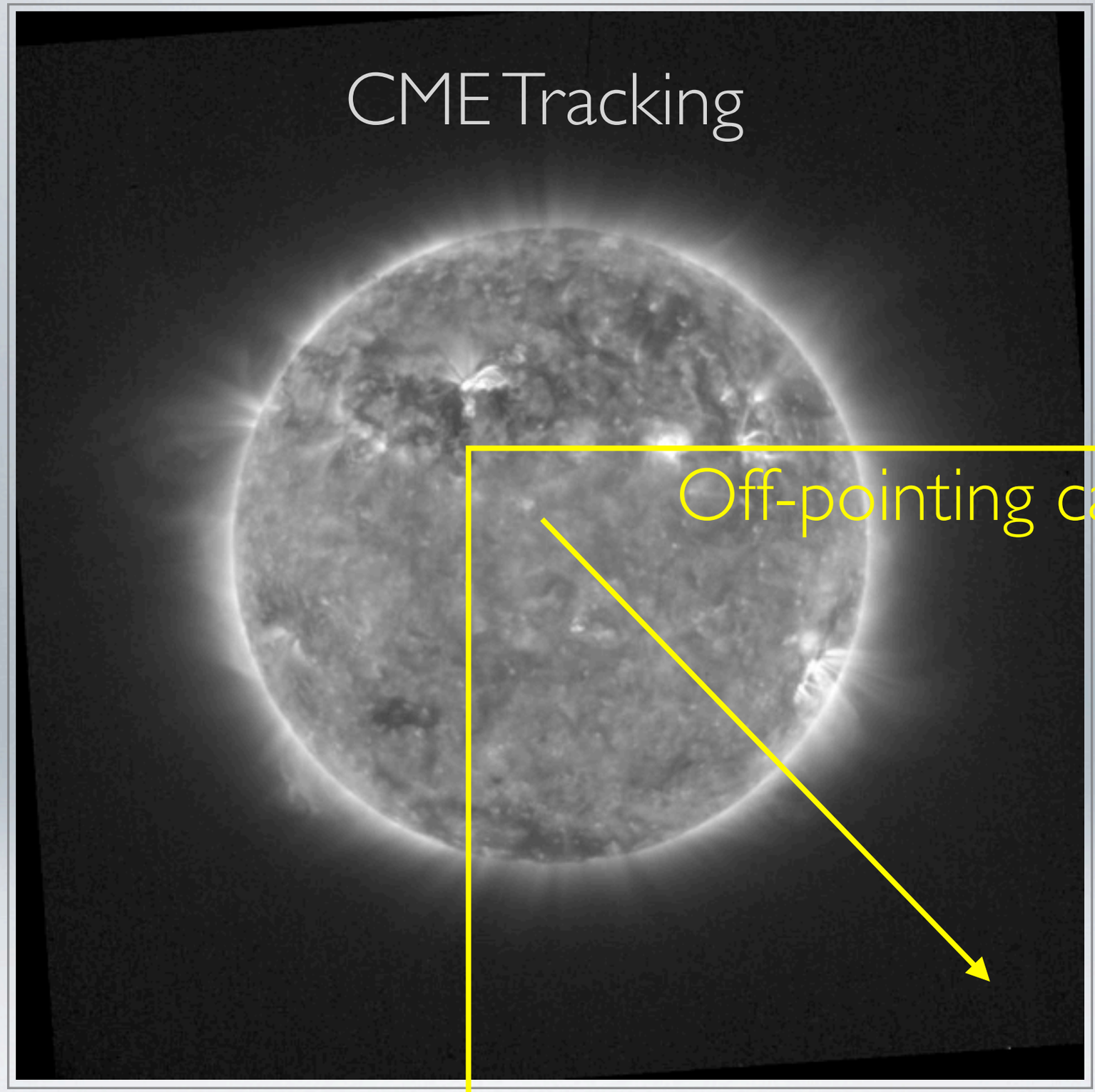




SWAP vs AIA on SDO

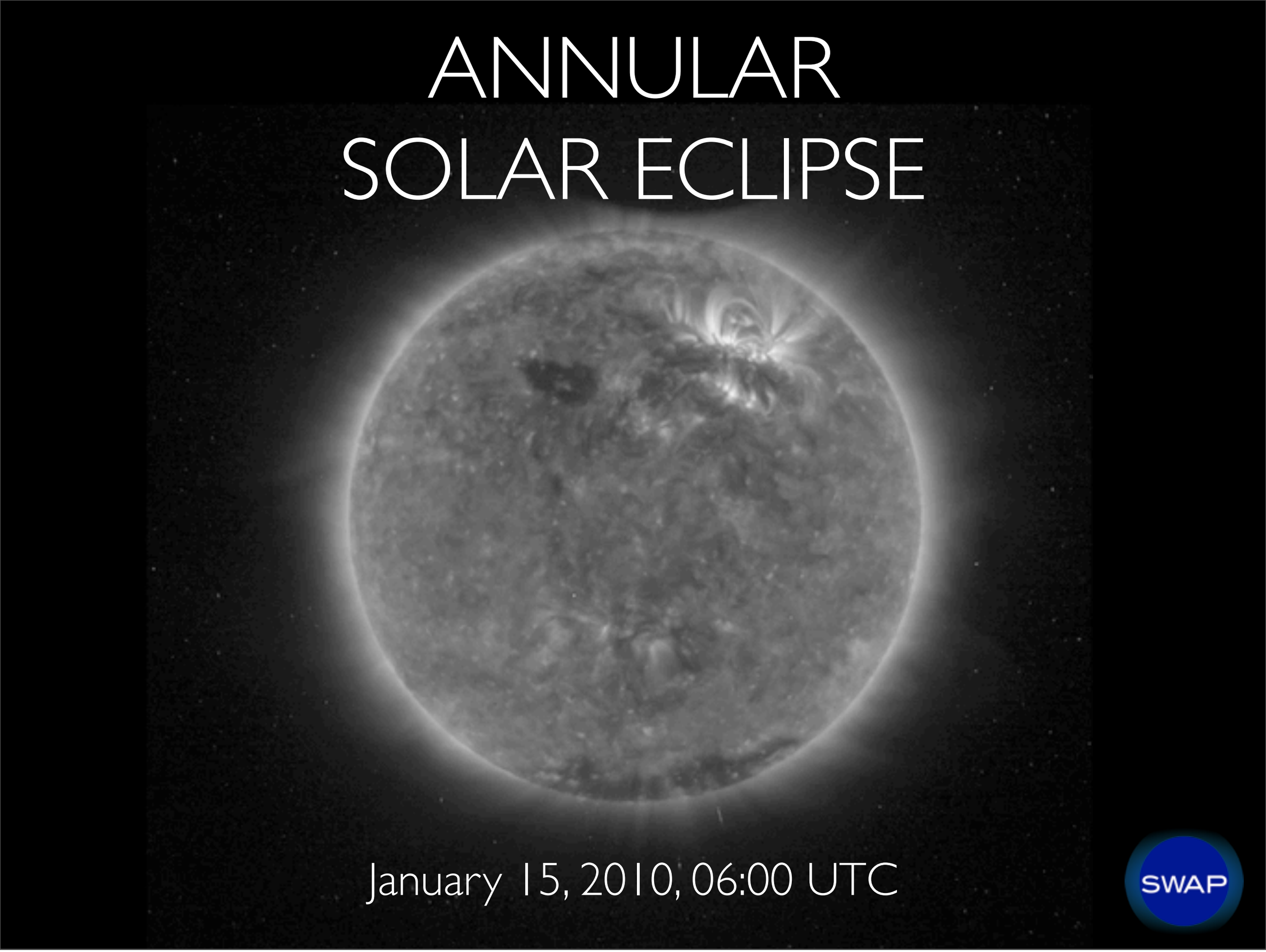


SWAP vs AIA on SDO

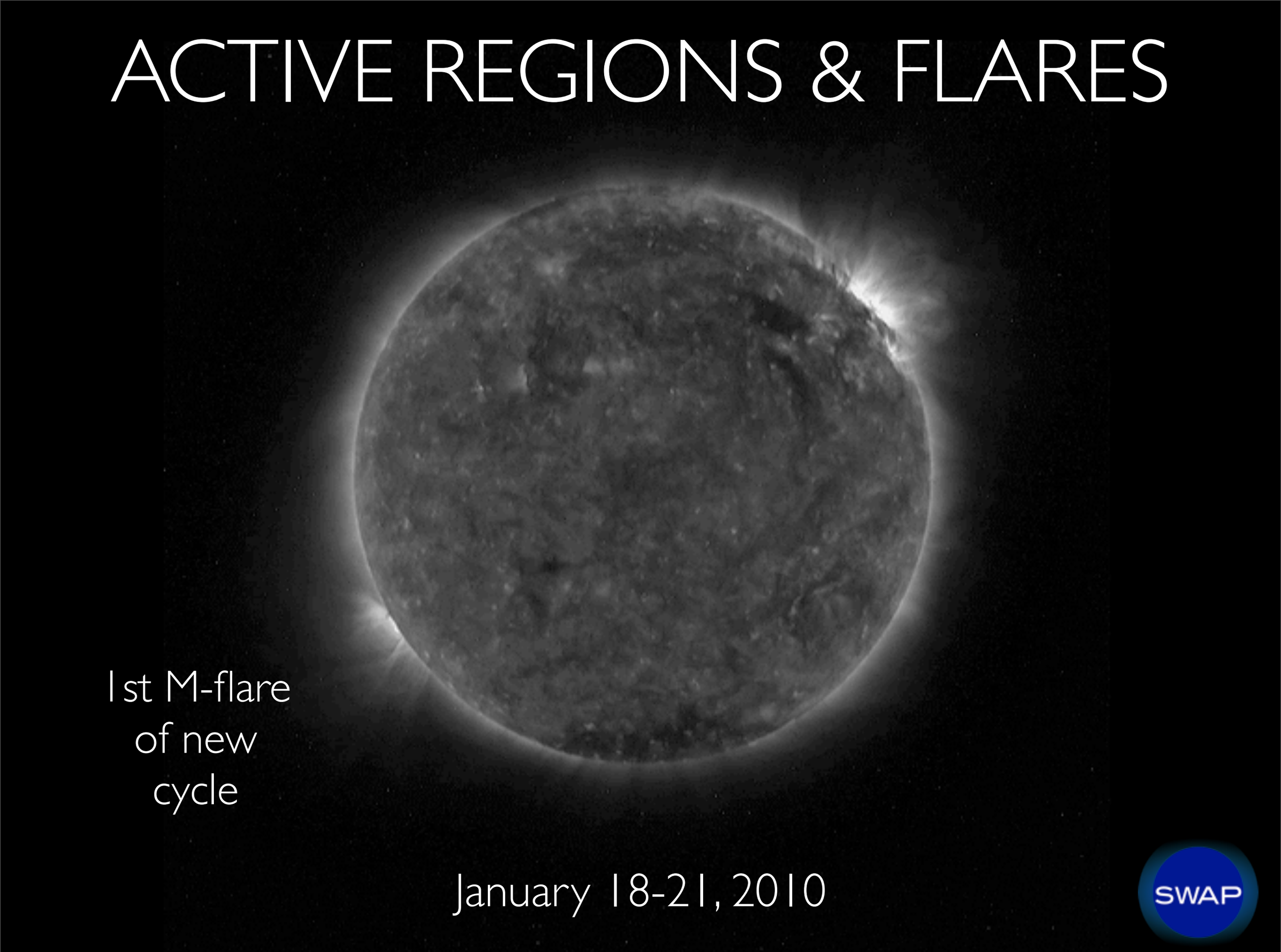


SWAP vs AIA on SDO

ANNULAR SOLAR ECLIPSE



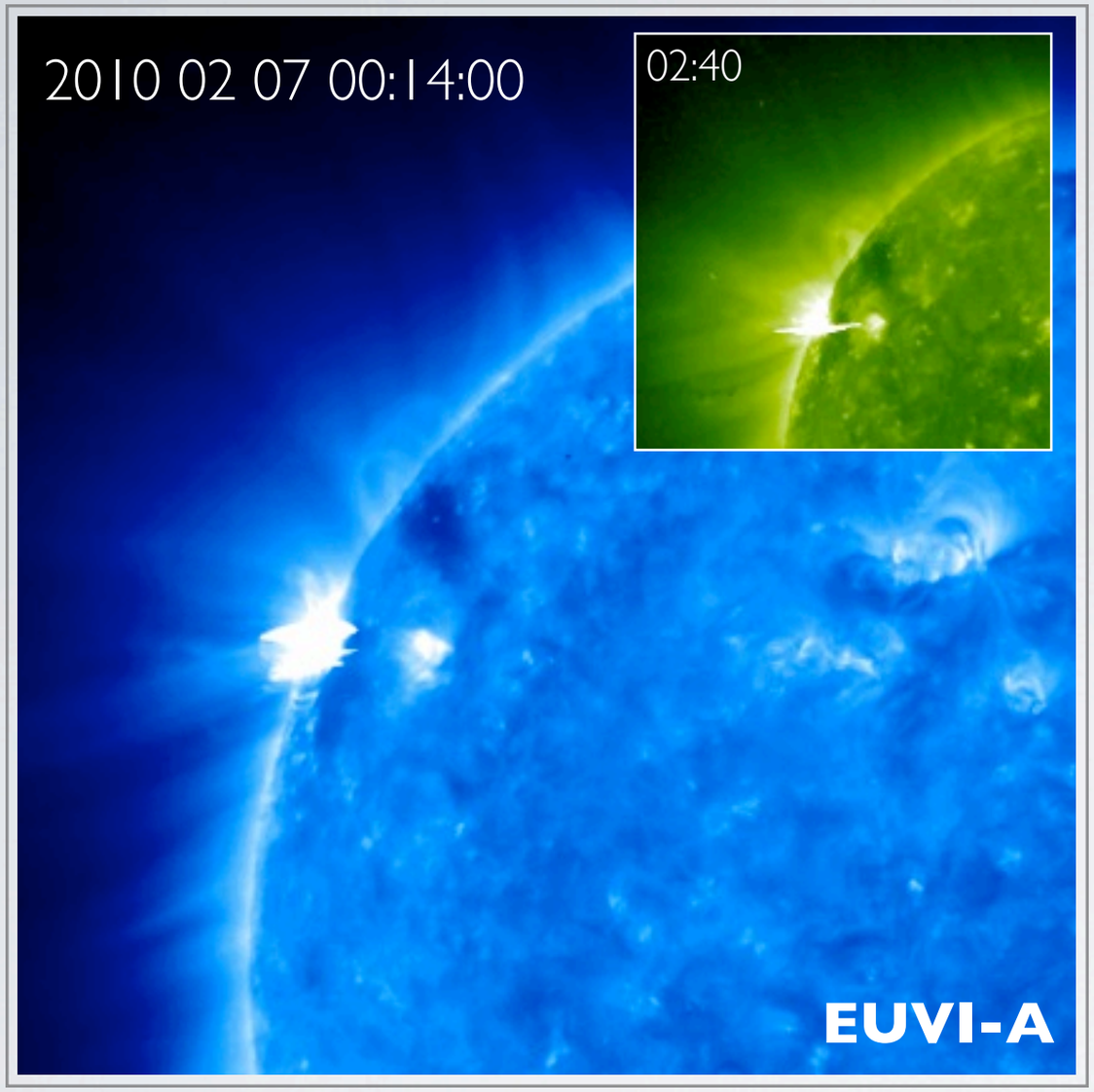
ACTIVE REGIONS & FLARES

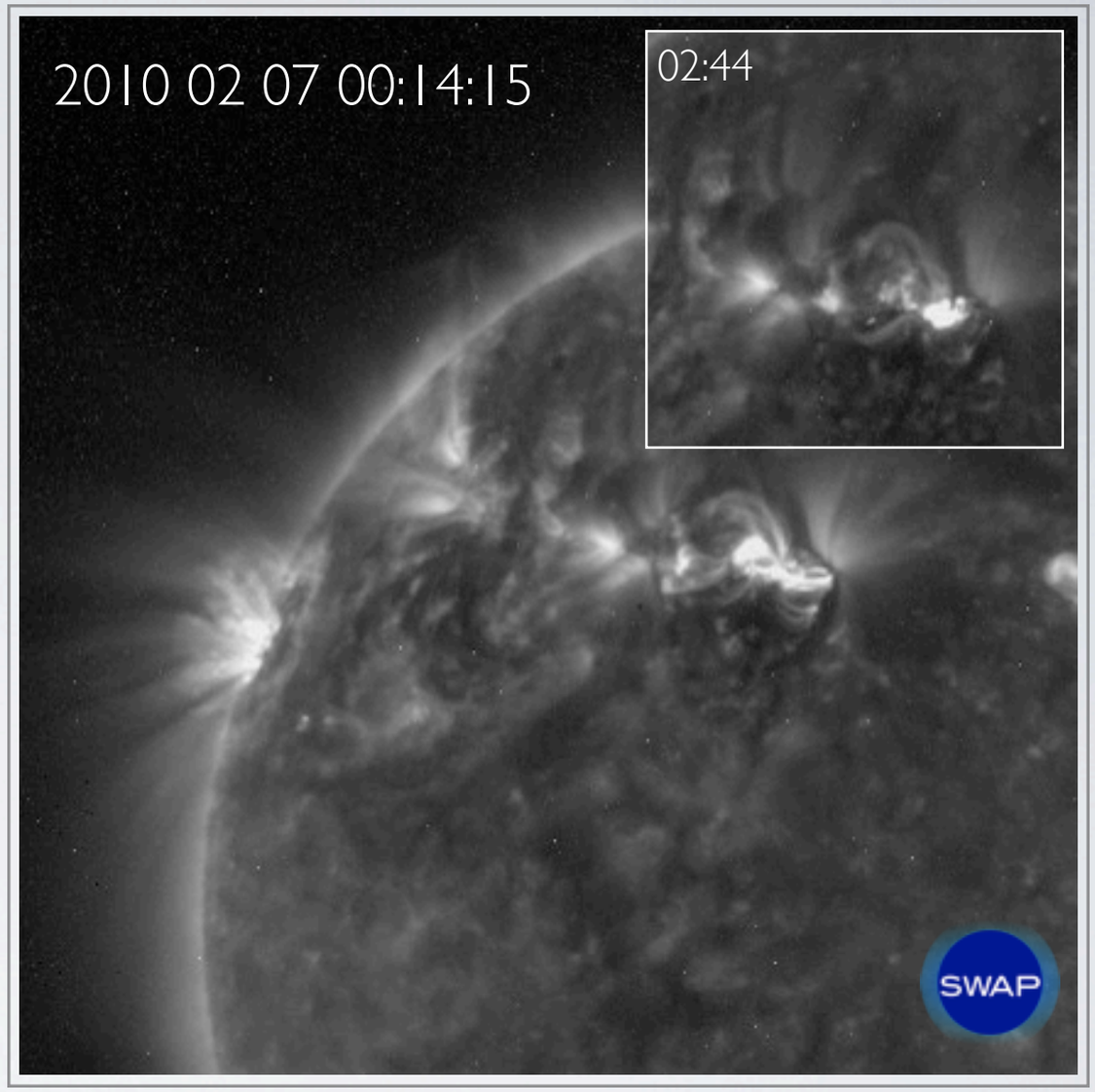


1st M-flare of new cycle

January 18-21, 2010

SWAP



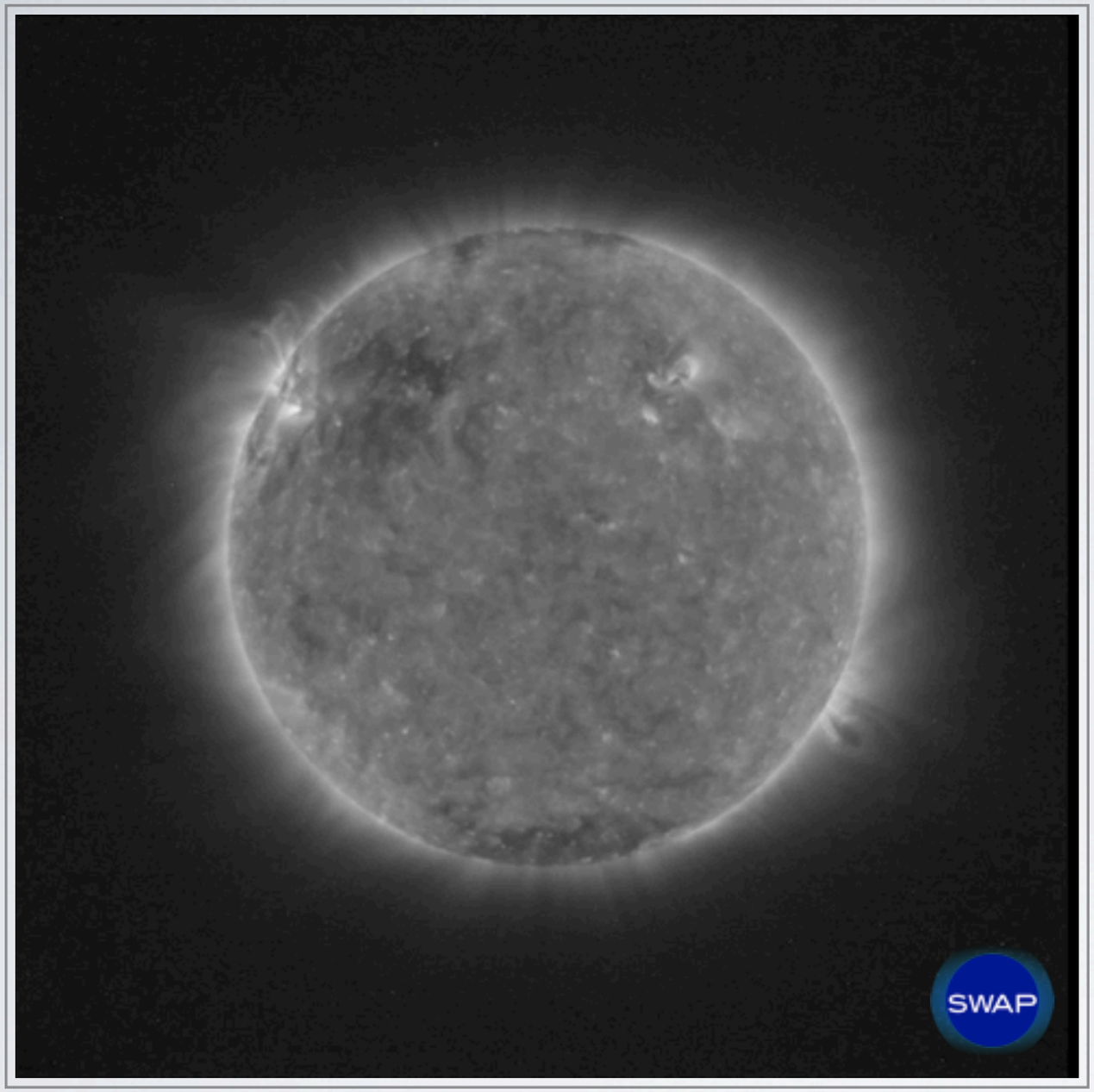


SOLAR FLARES

limited blooming due to CMOS detector

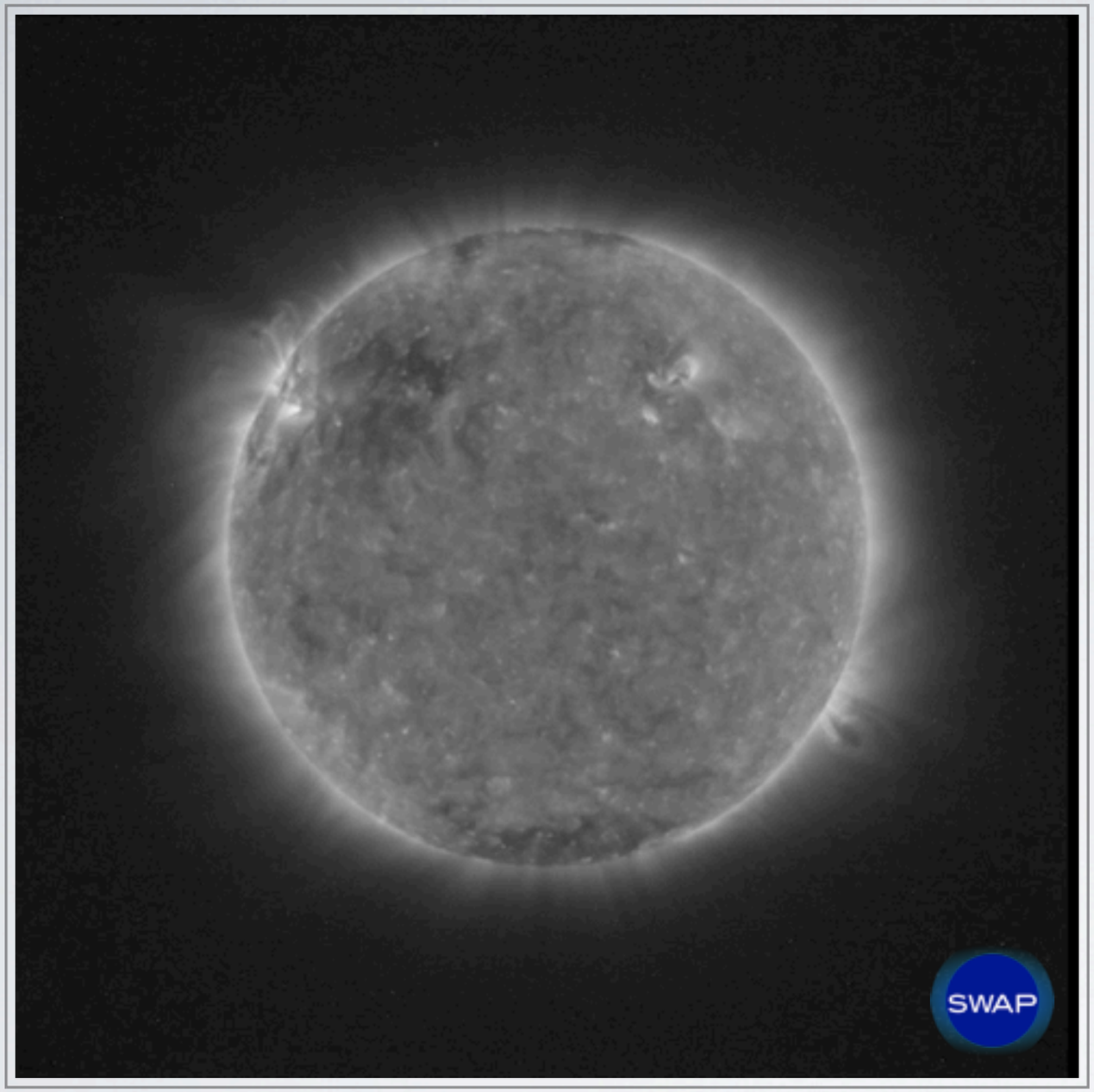
high cadence up to18s

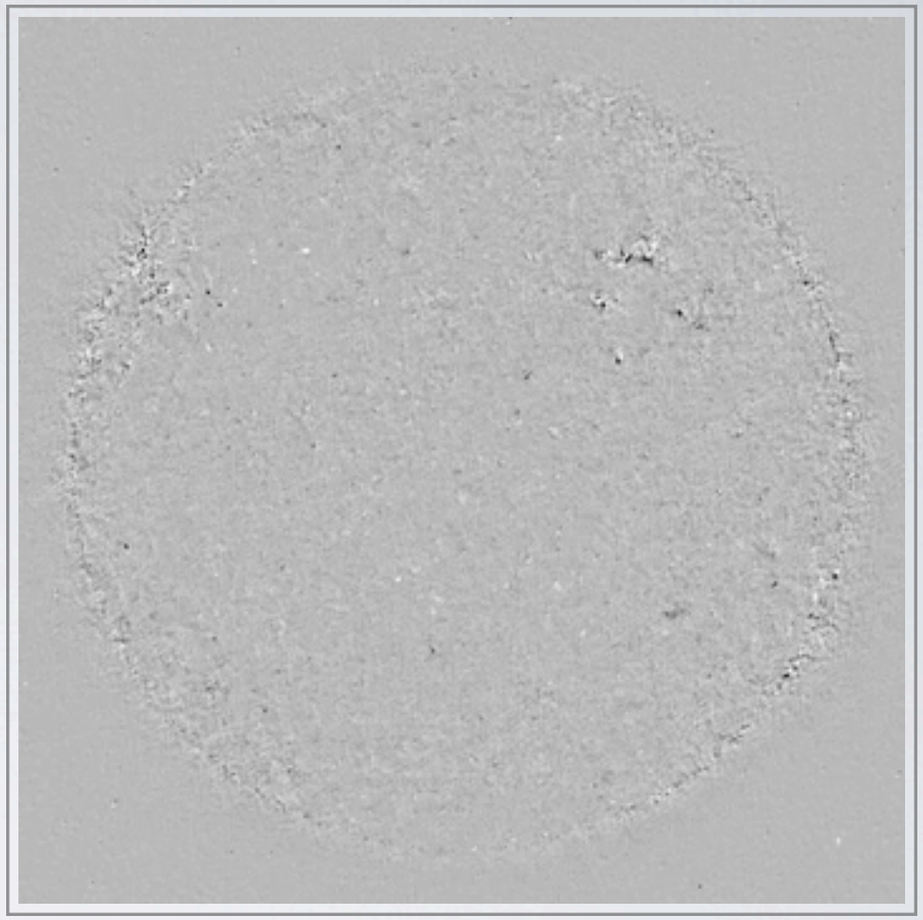
LYRA gives detailed temporal evolution (10ms)



EIT WAVES

several waves associated with the flares of Feb. 5-6, 2010





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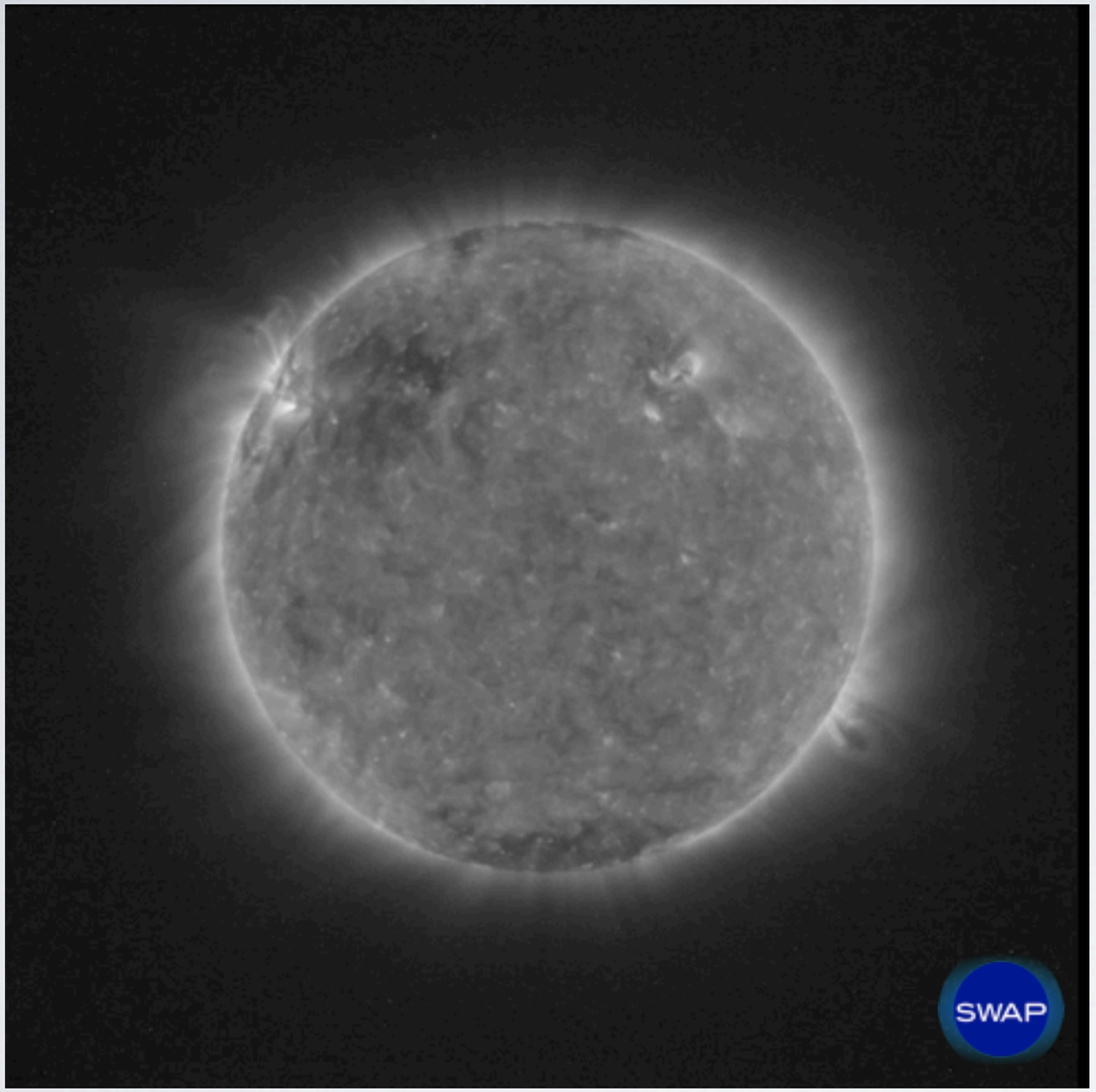

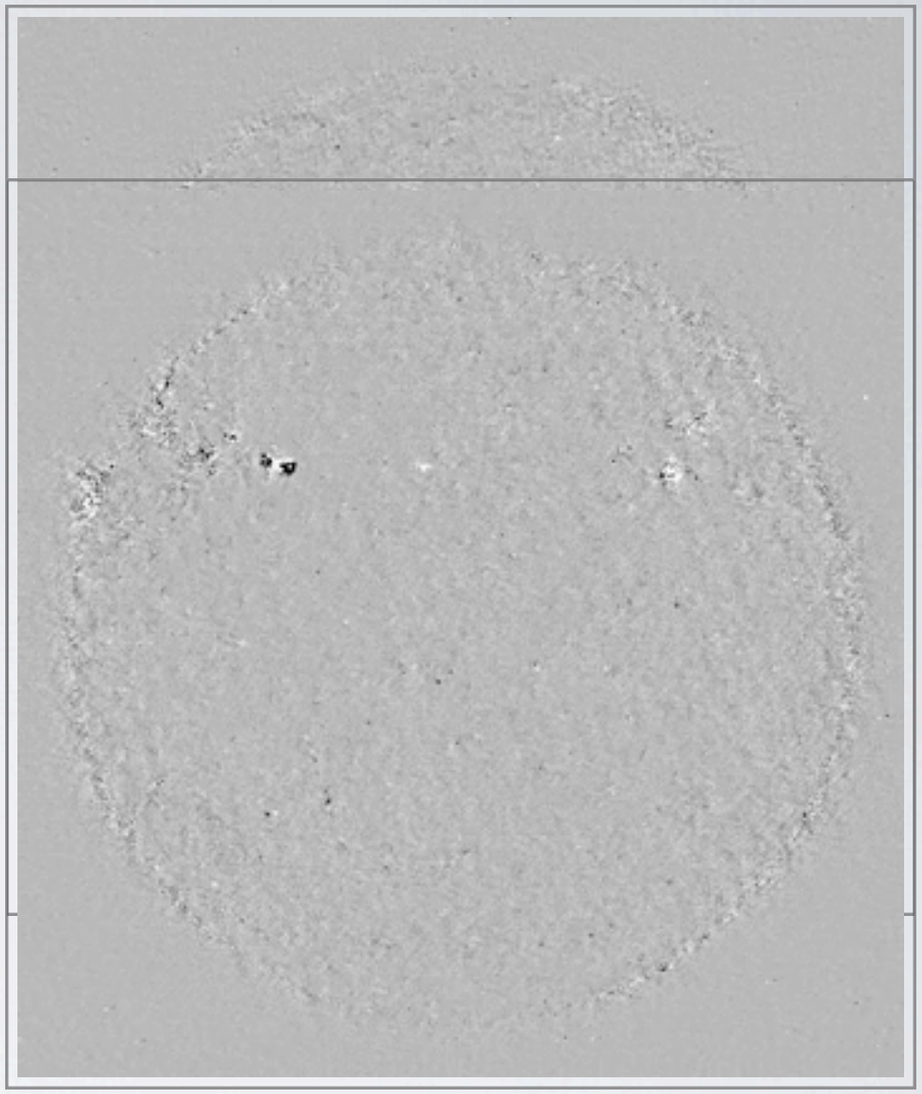

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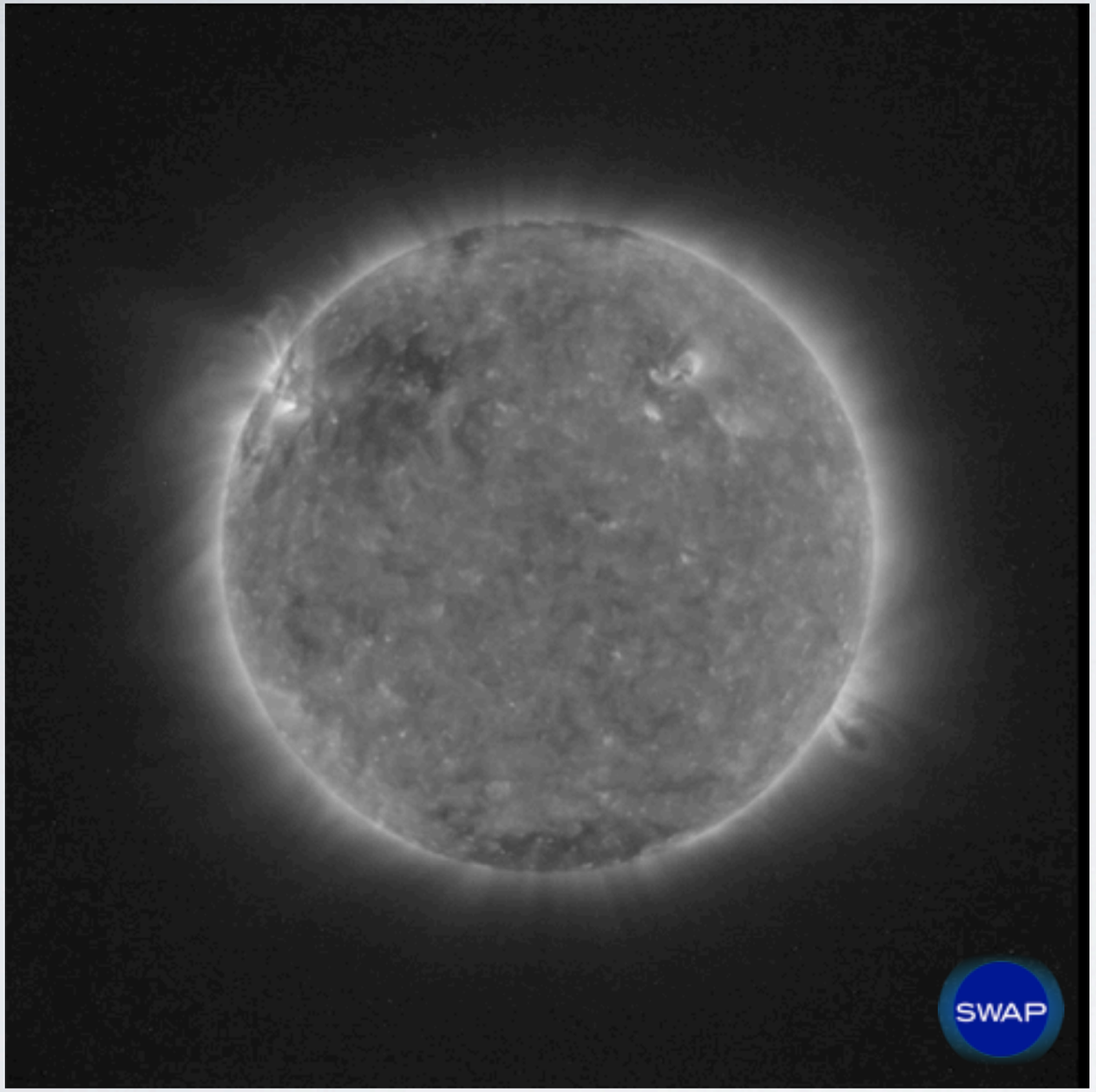

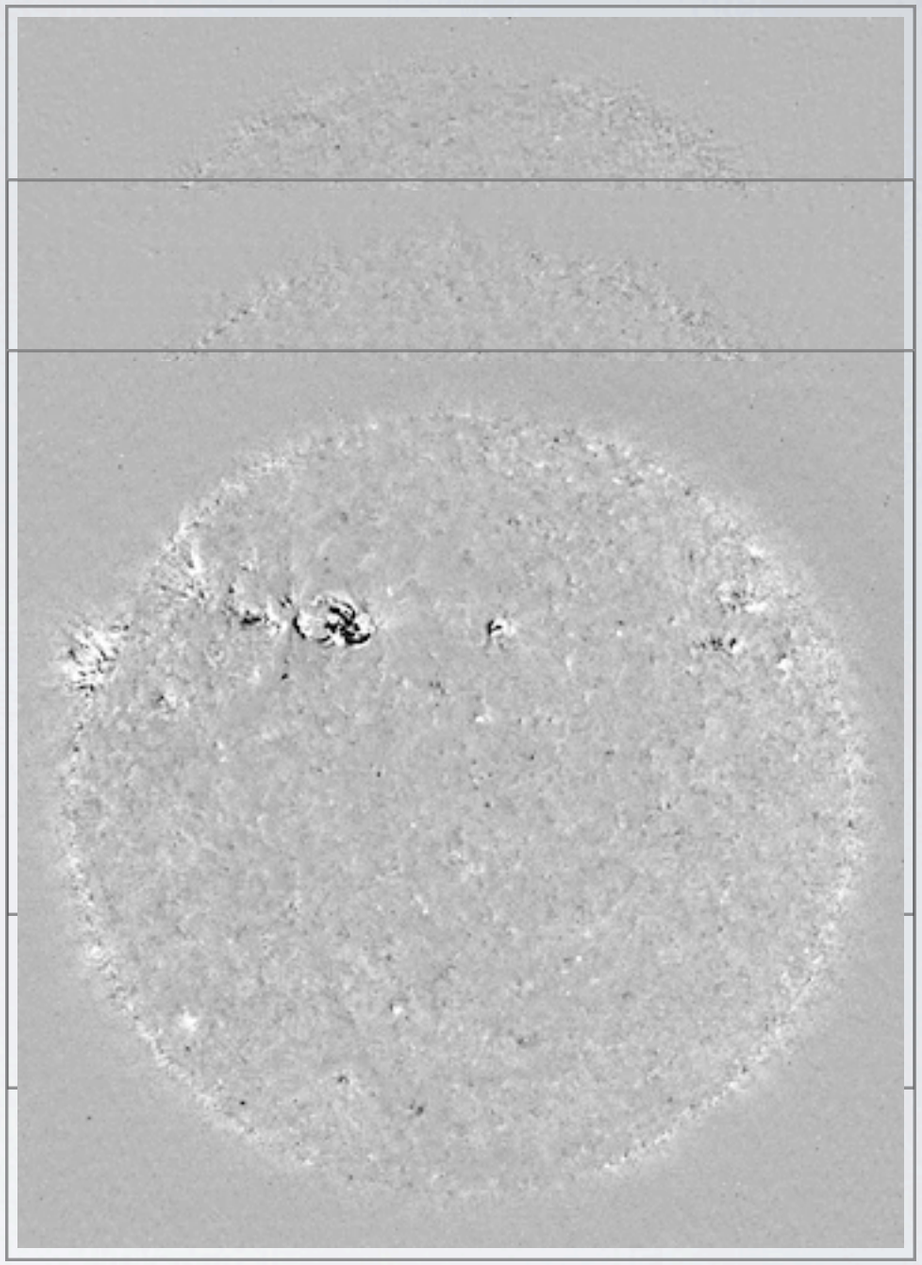

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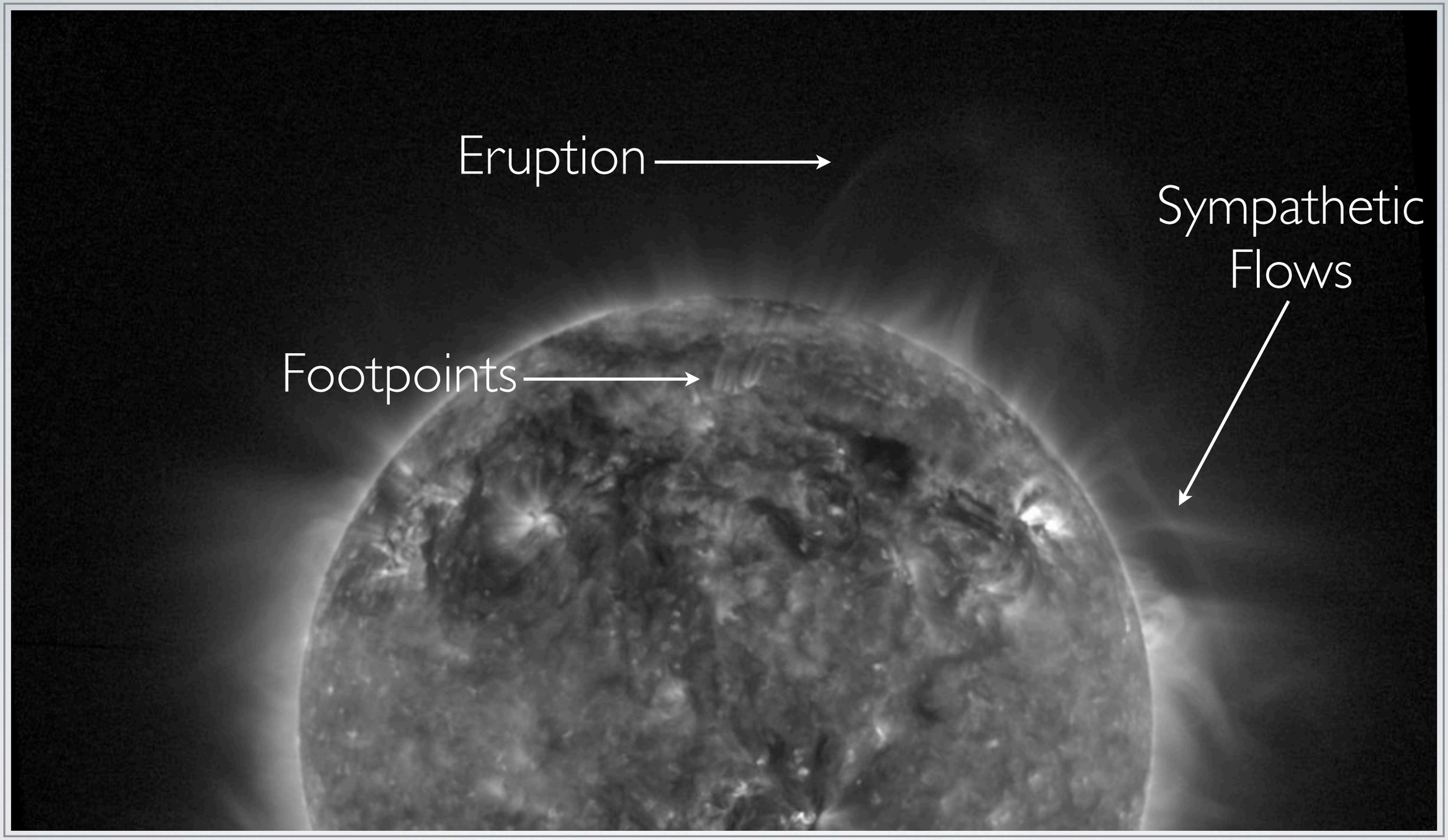
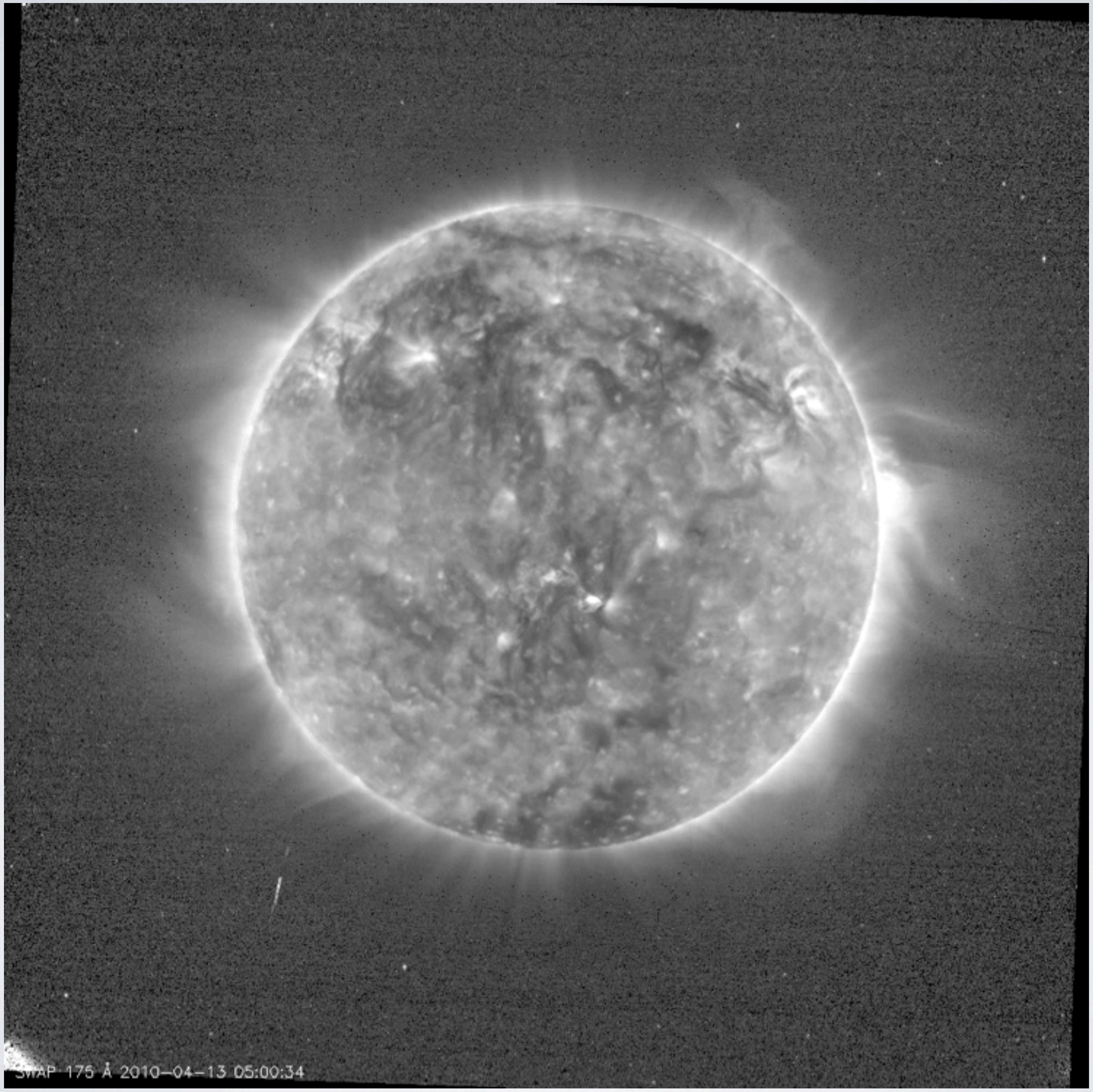
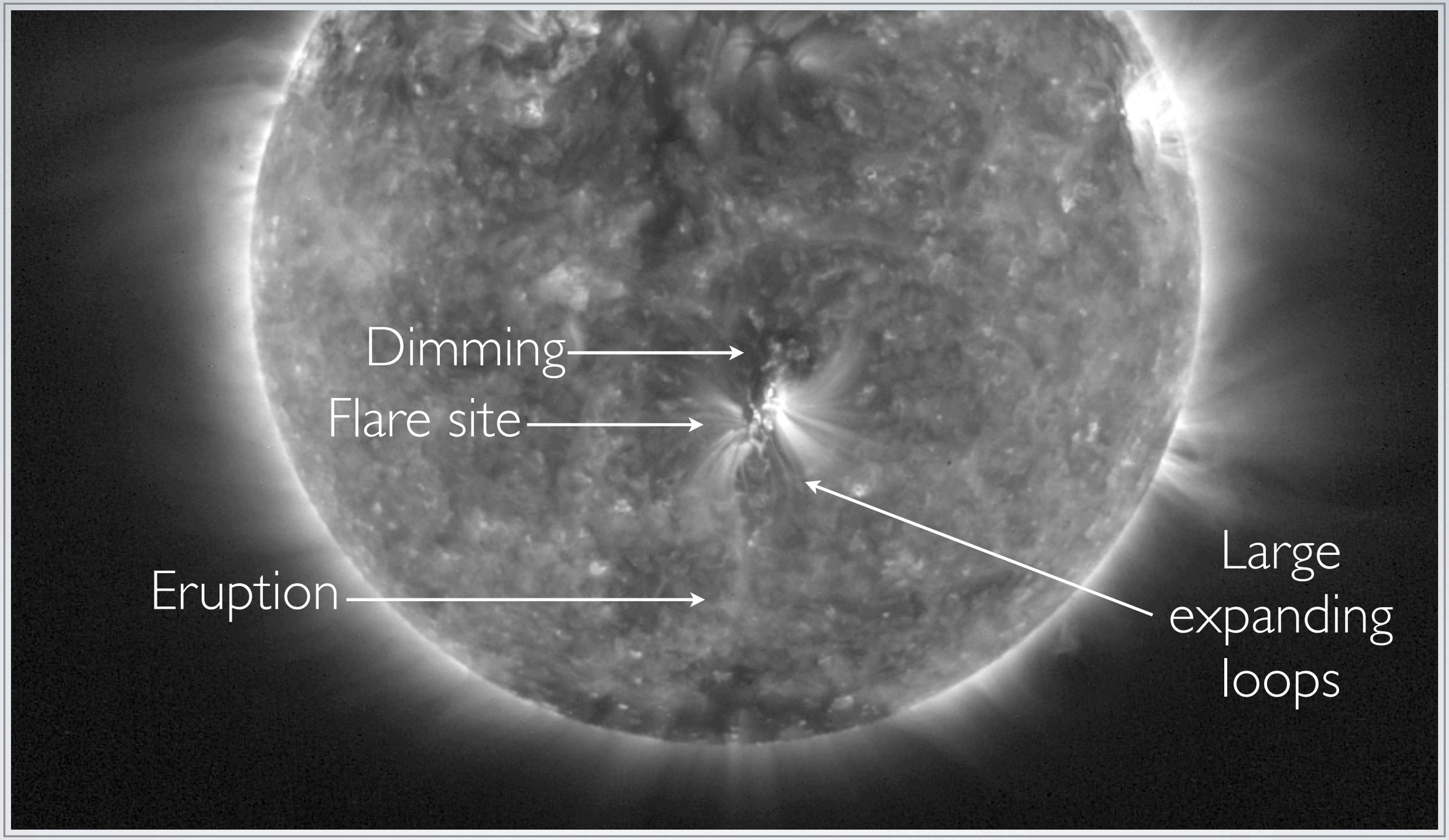


PROMINENCE ERUPTION

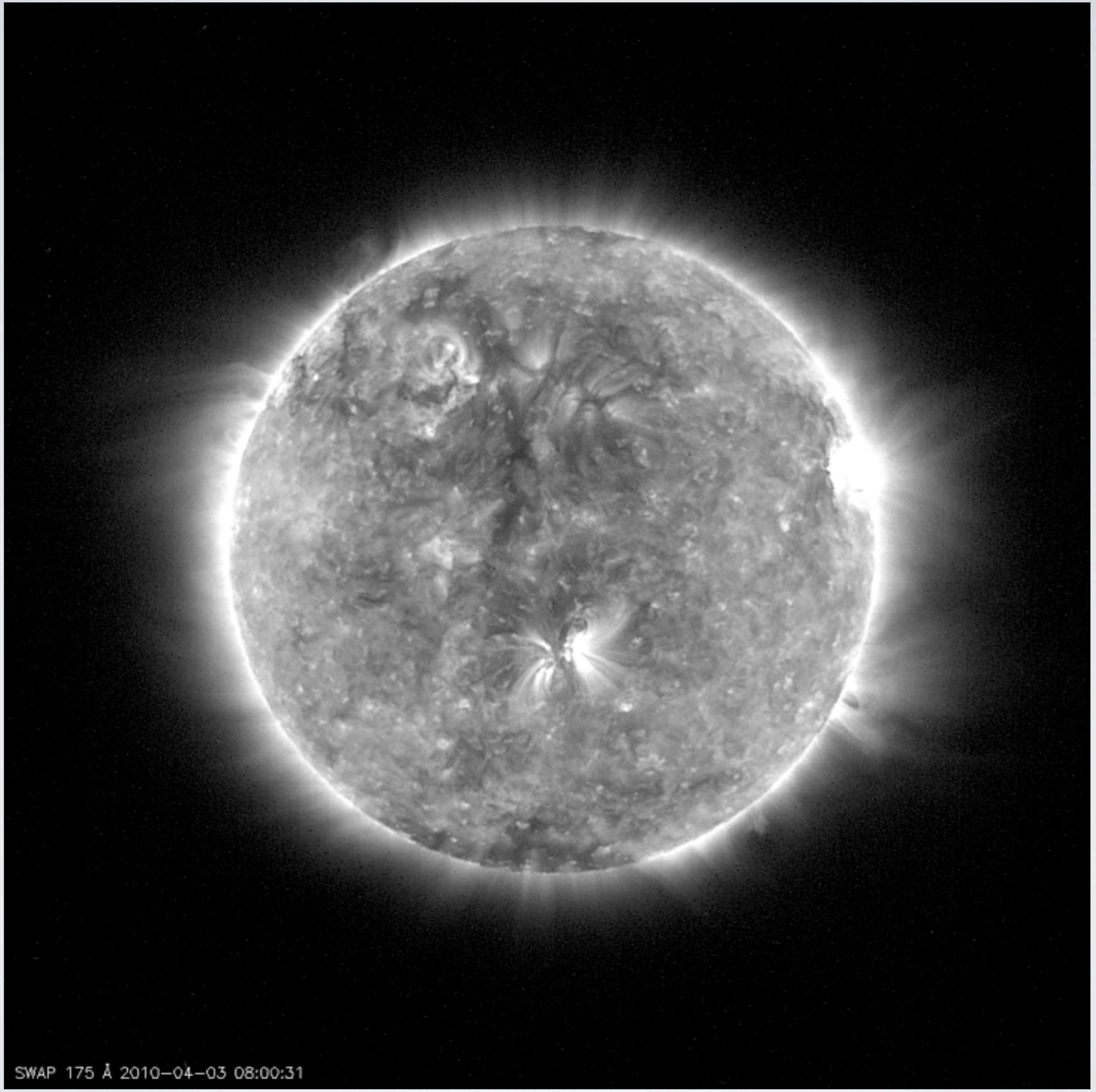
13 April 2010, 09:30 UTC

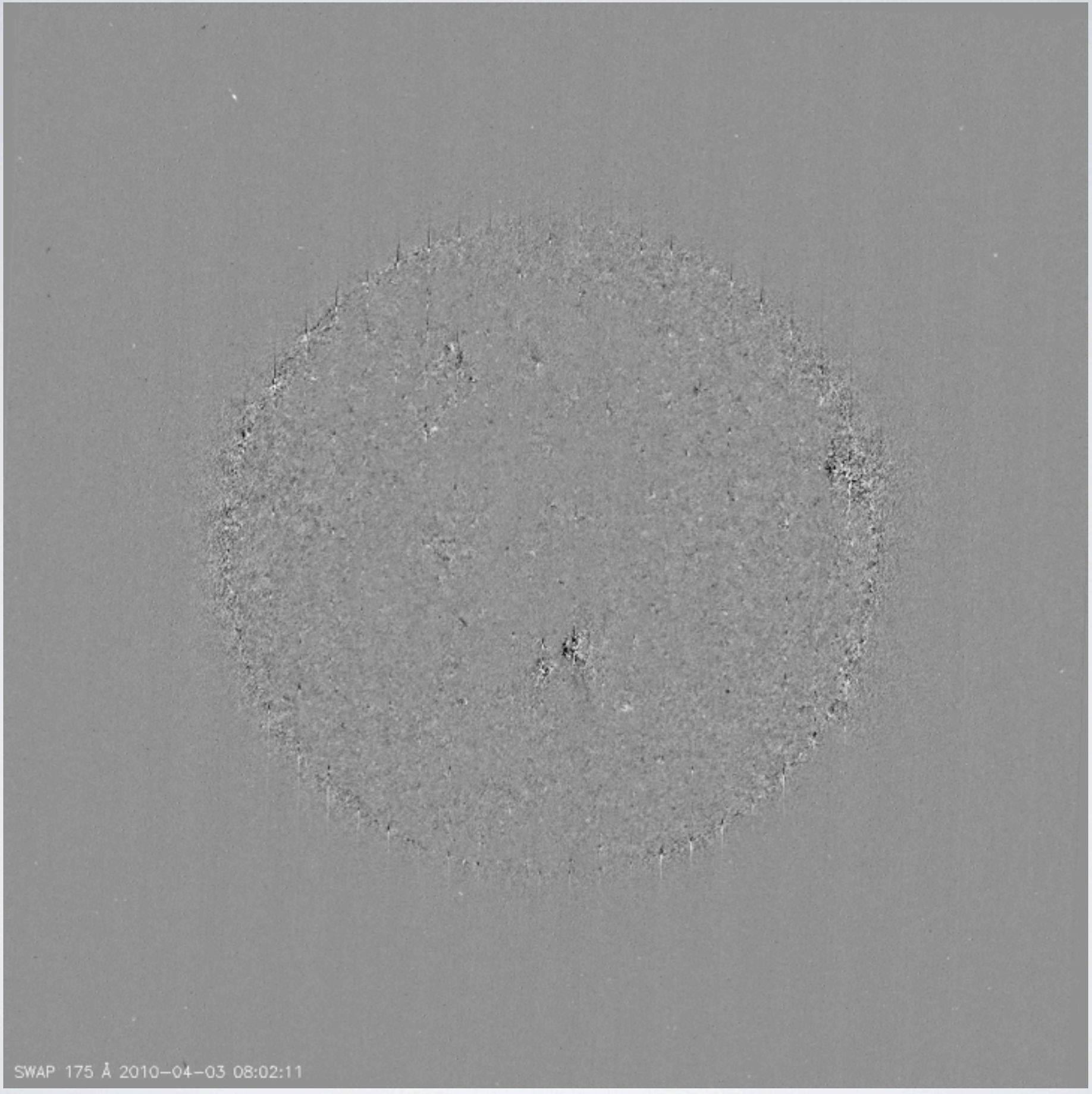

SWAP 175 Å 2010-04-13 05:00:34



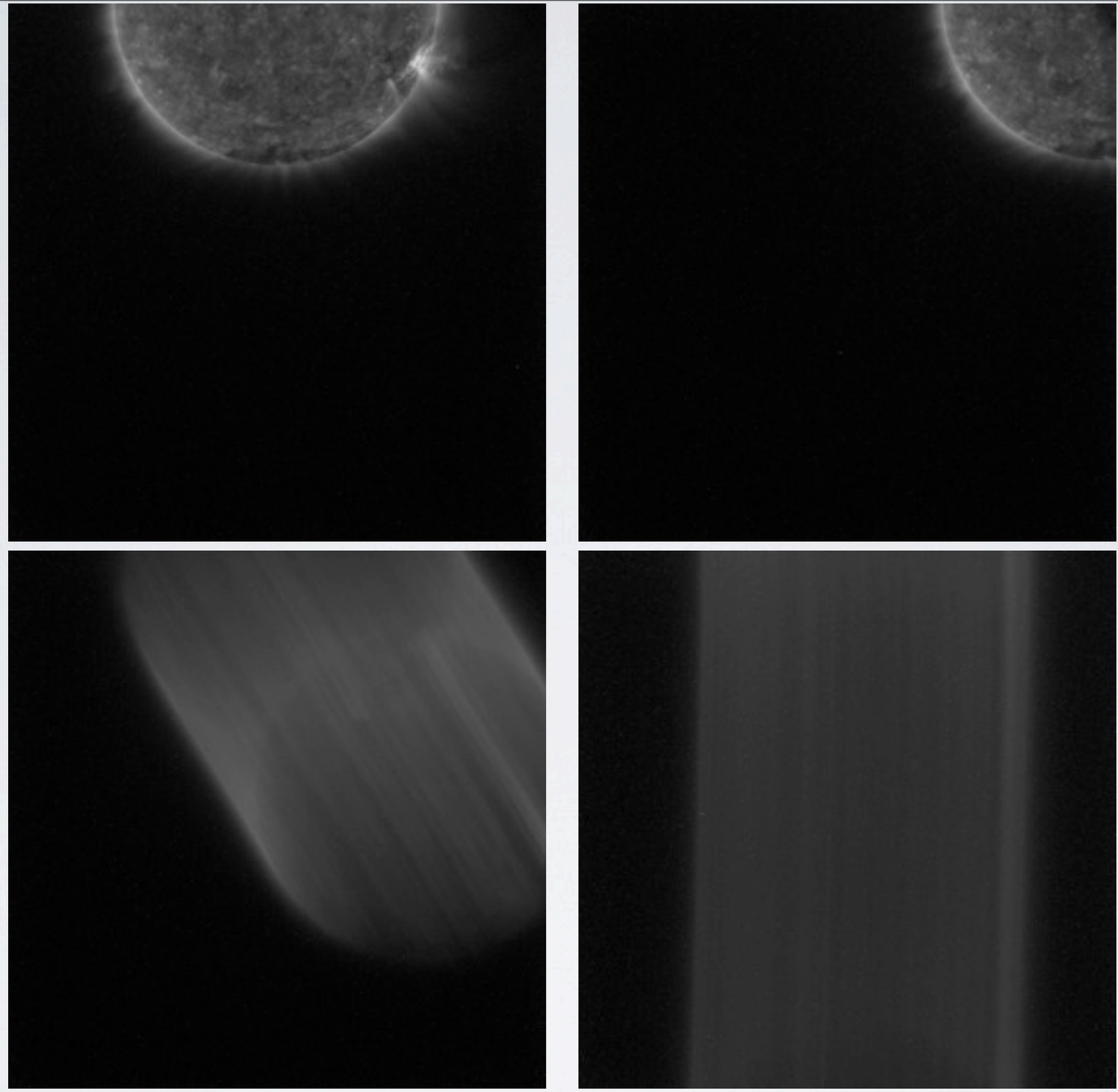
ERUPTION & FLARE

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


SWAP 175 Å 2010-04-03 08:00:31



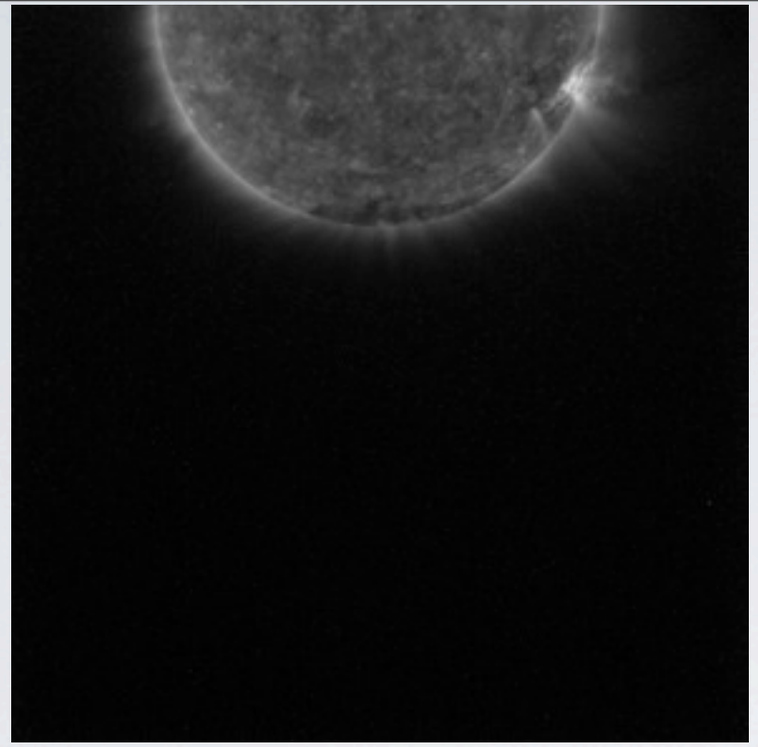
Thursday 17 June 2010

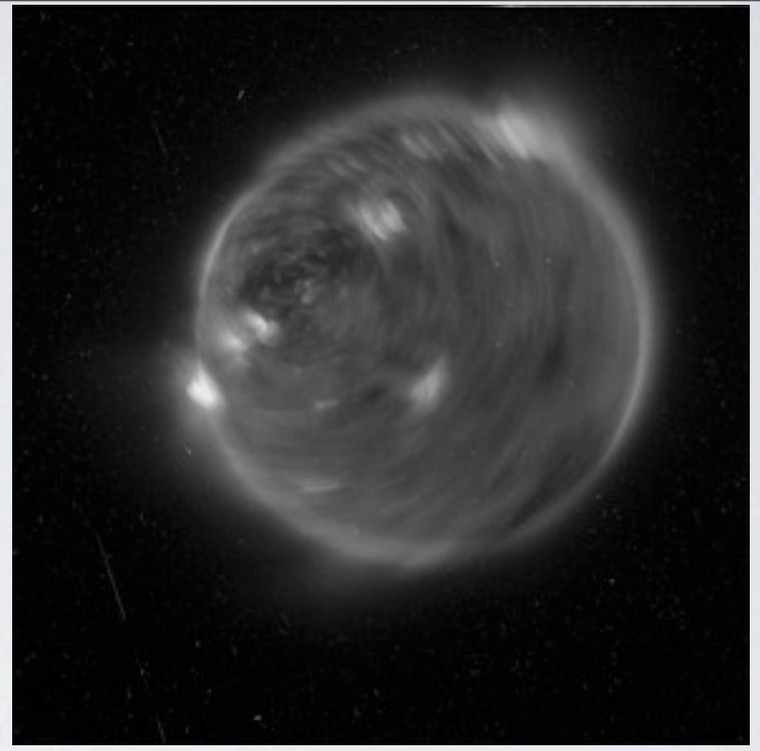


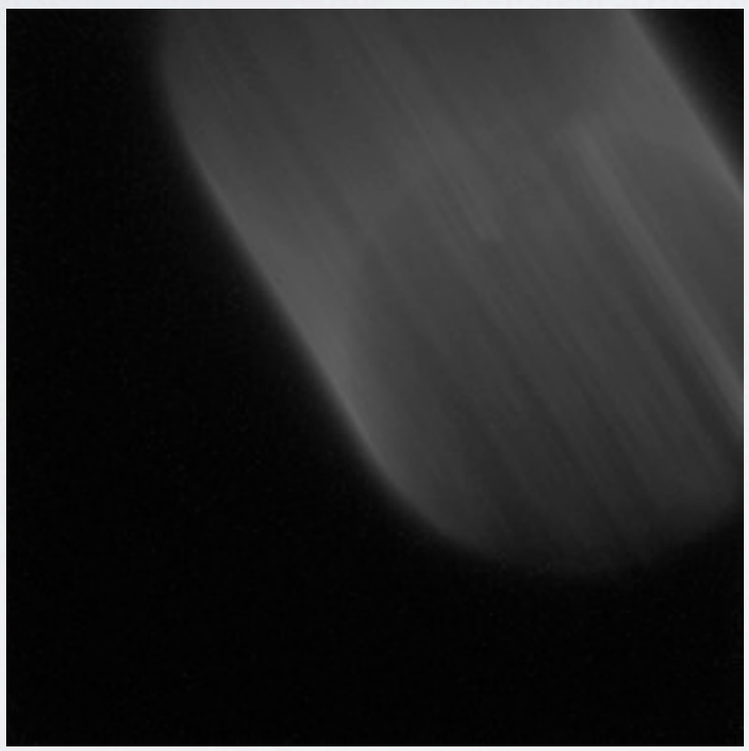
OFF-POINTING

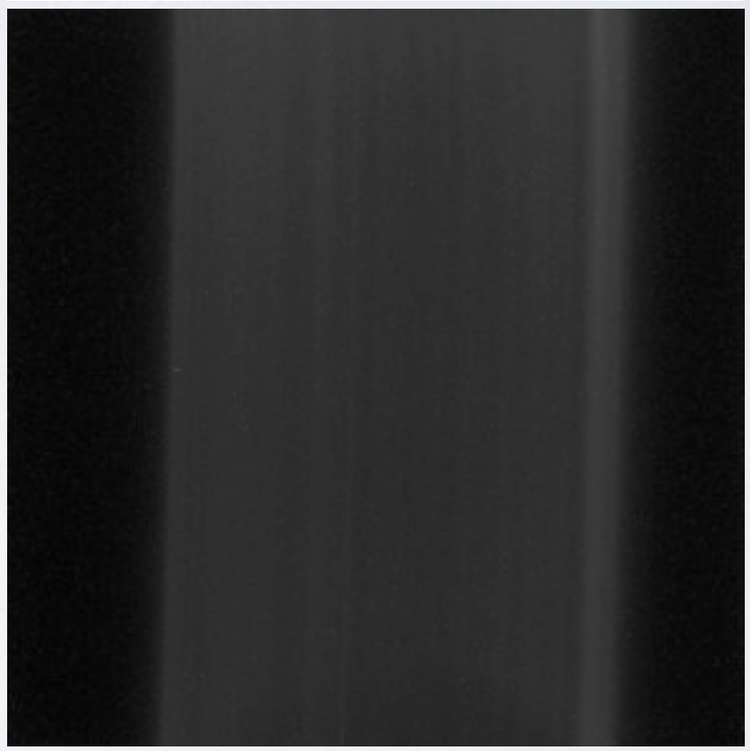
up to now mostly interesting for calibration

could be used for CME tracking









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OPEN DATA POLICY

Data are freely available to all users on
http://proba2.sidc.be/swap/data
http://proba2.sidc.be/lyra/data

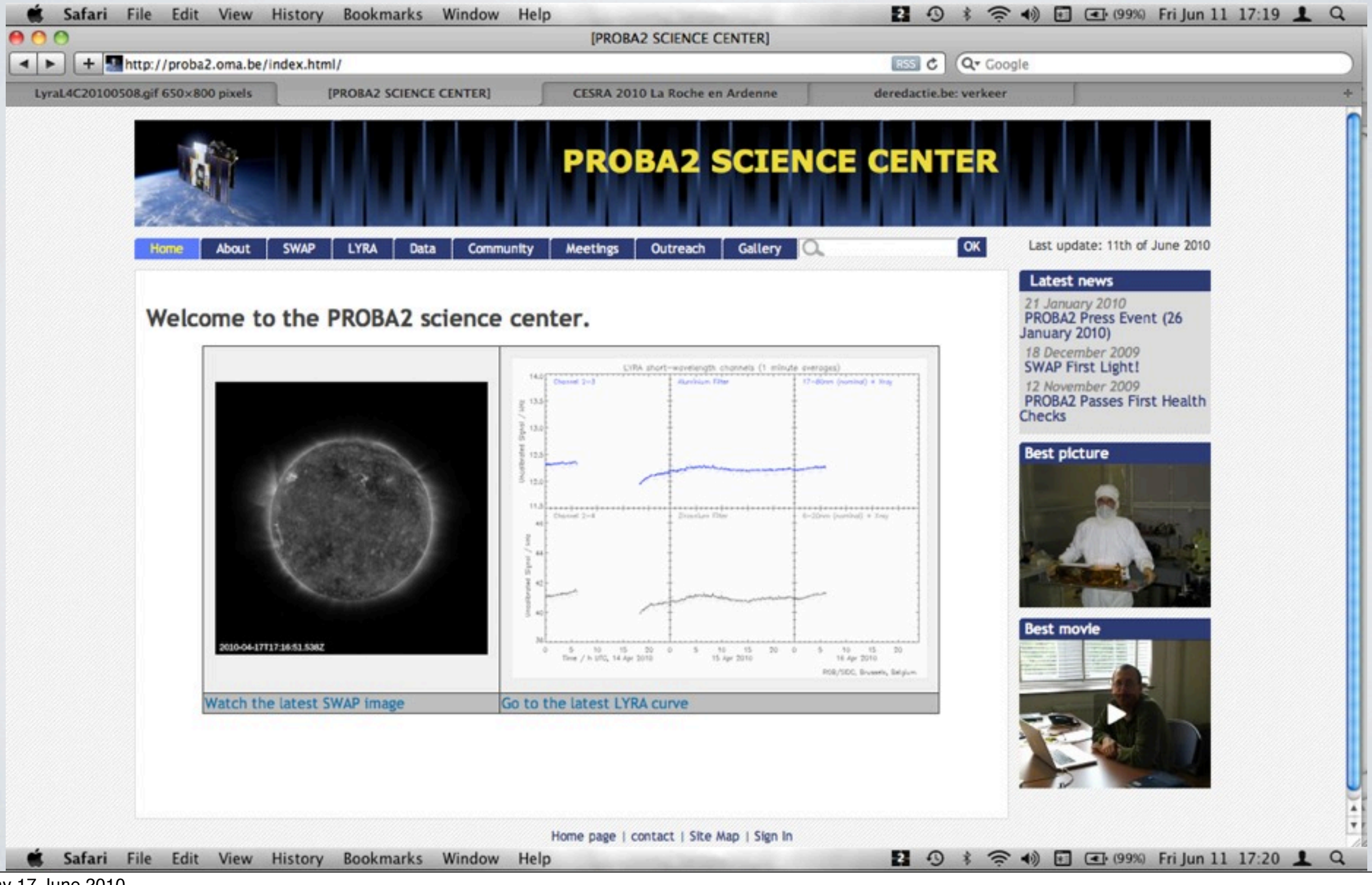
All data ordered in year/month/day folders
Fancy data browser to come

Raw Engineering FITS: reformatted, decompressed, long header
Base Science Data FITS: (preliminary) calibrated, science header
PNG & EPS files: for quicklook purposes
SWAP daily movies: for quicklook purposes

SSW will have software trees SWAP & LYRA very soon

FOR MORE INFORMATION

http://proba2.sidc.be/



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