

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



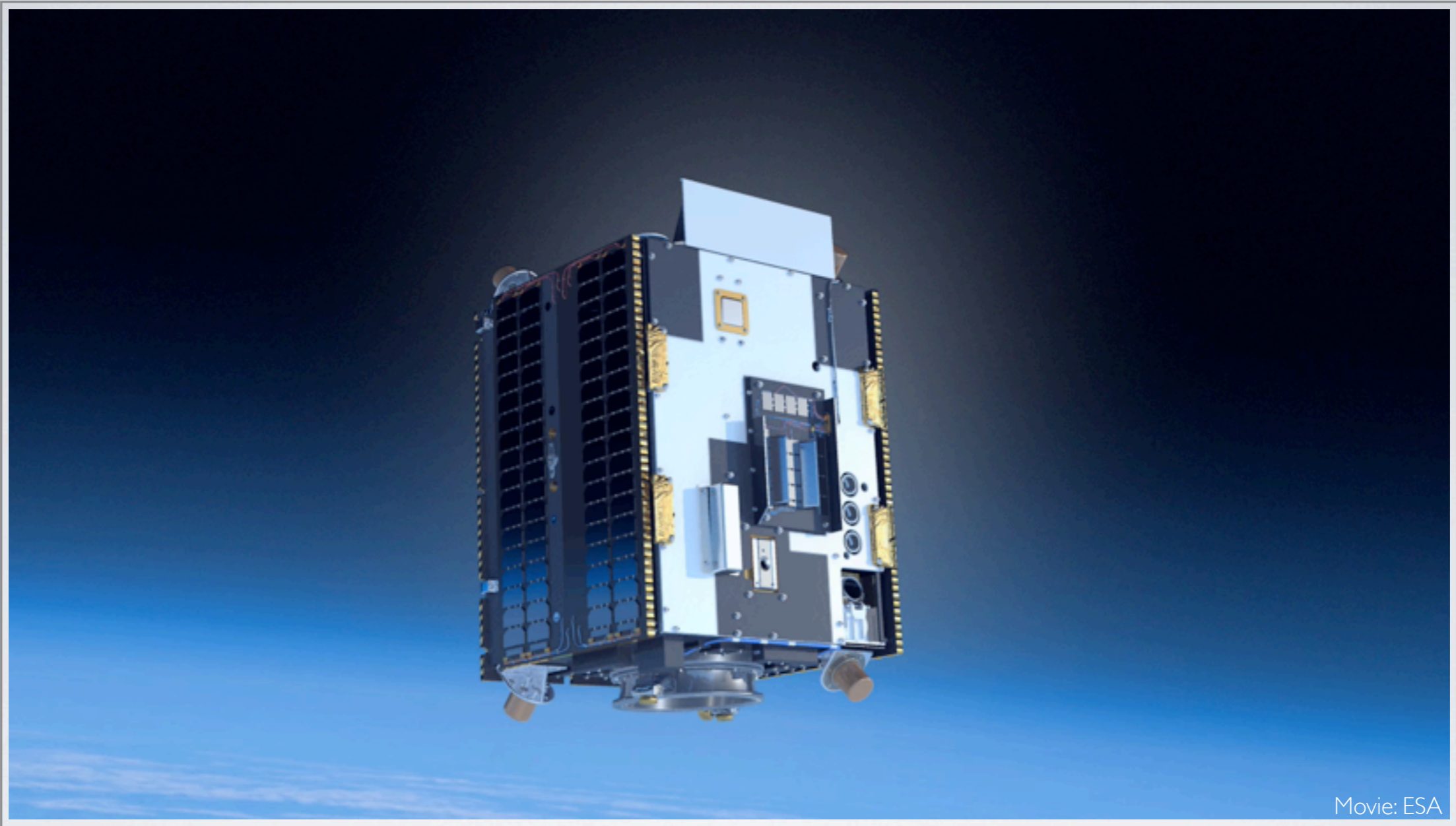


PROBA2

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

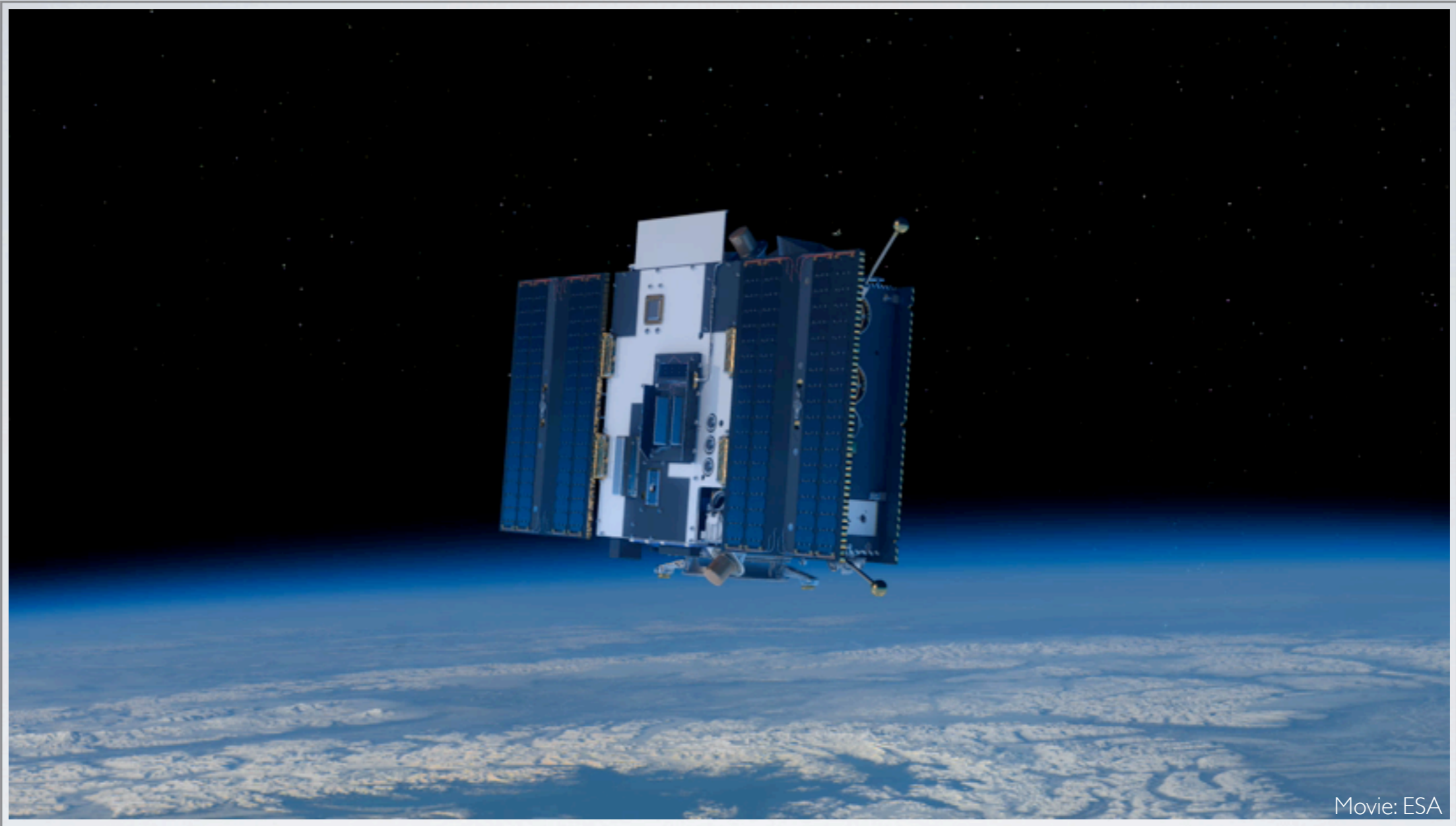
Microsatellite in sun-synchronous orbit ☀ 725 km altitude

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 (~ 1 hr after contact)

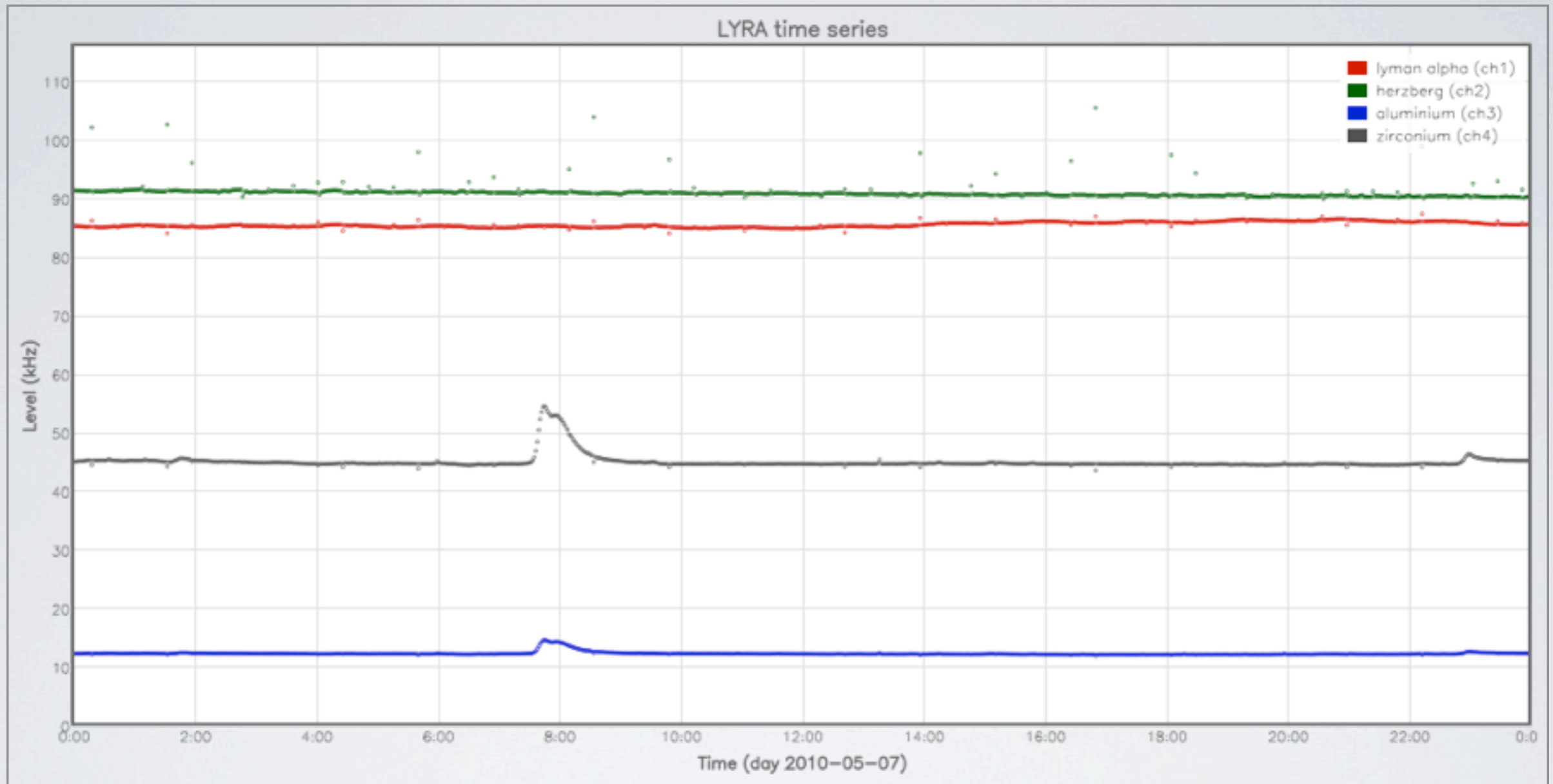
LYRA: LYMAN-ALPHA RADIOMETER

- **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



wrc
pmod

LYRA CHANNELS



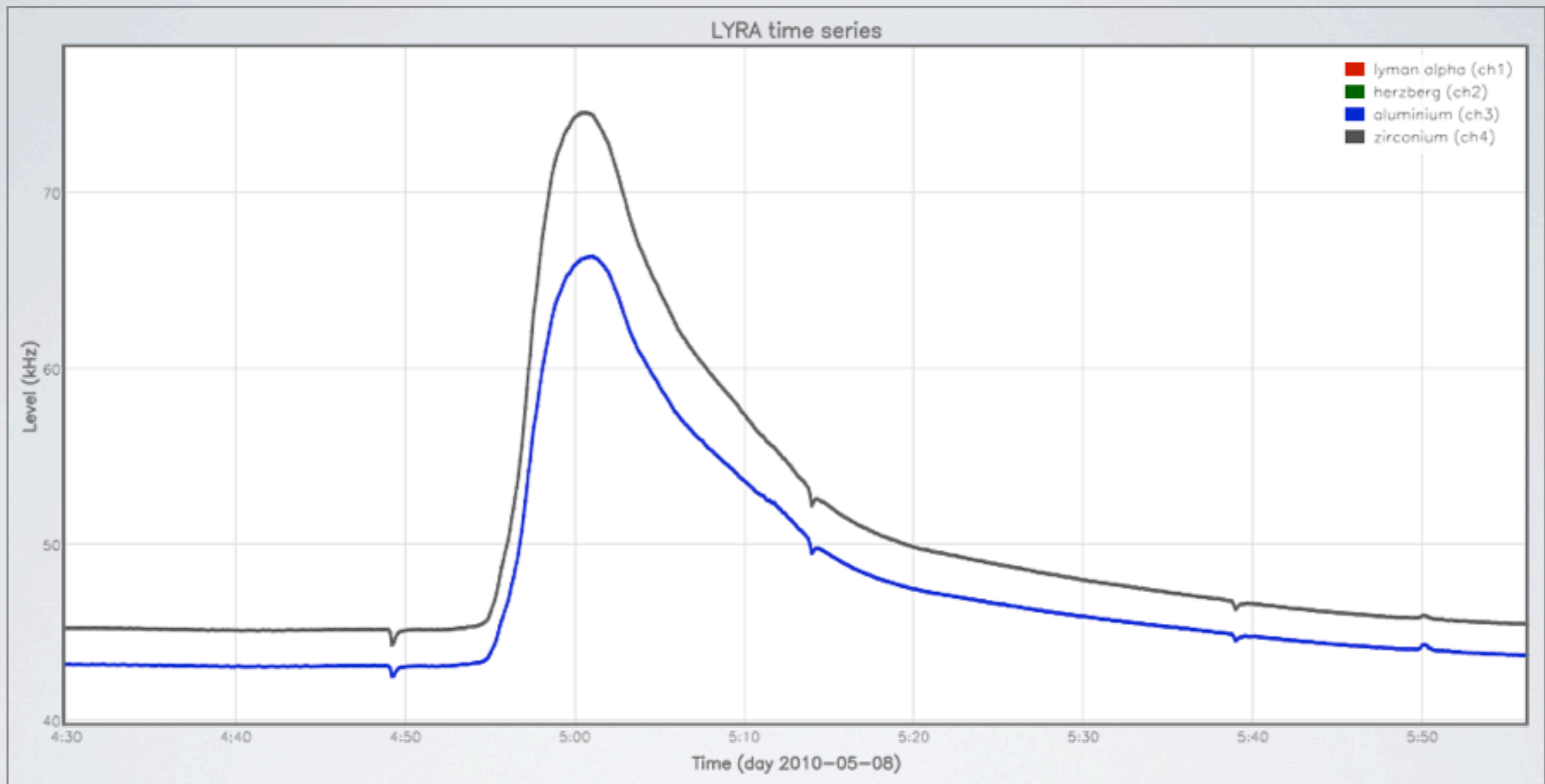
Lyman- α : 120-123 nm

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



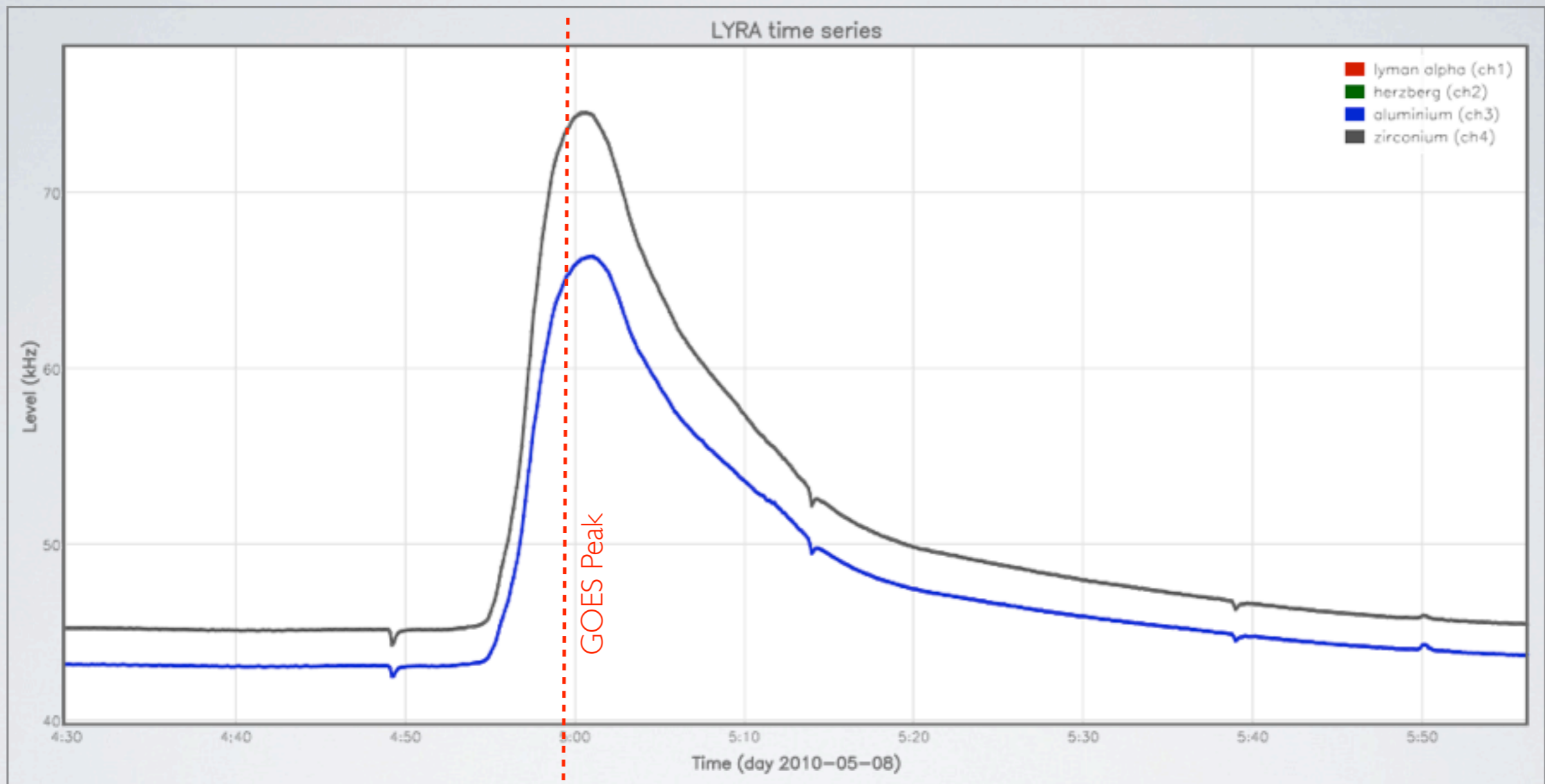
LYRA senses all flares in Zr & Al up to 10ms resolution

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



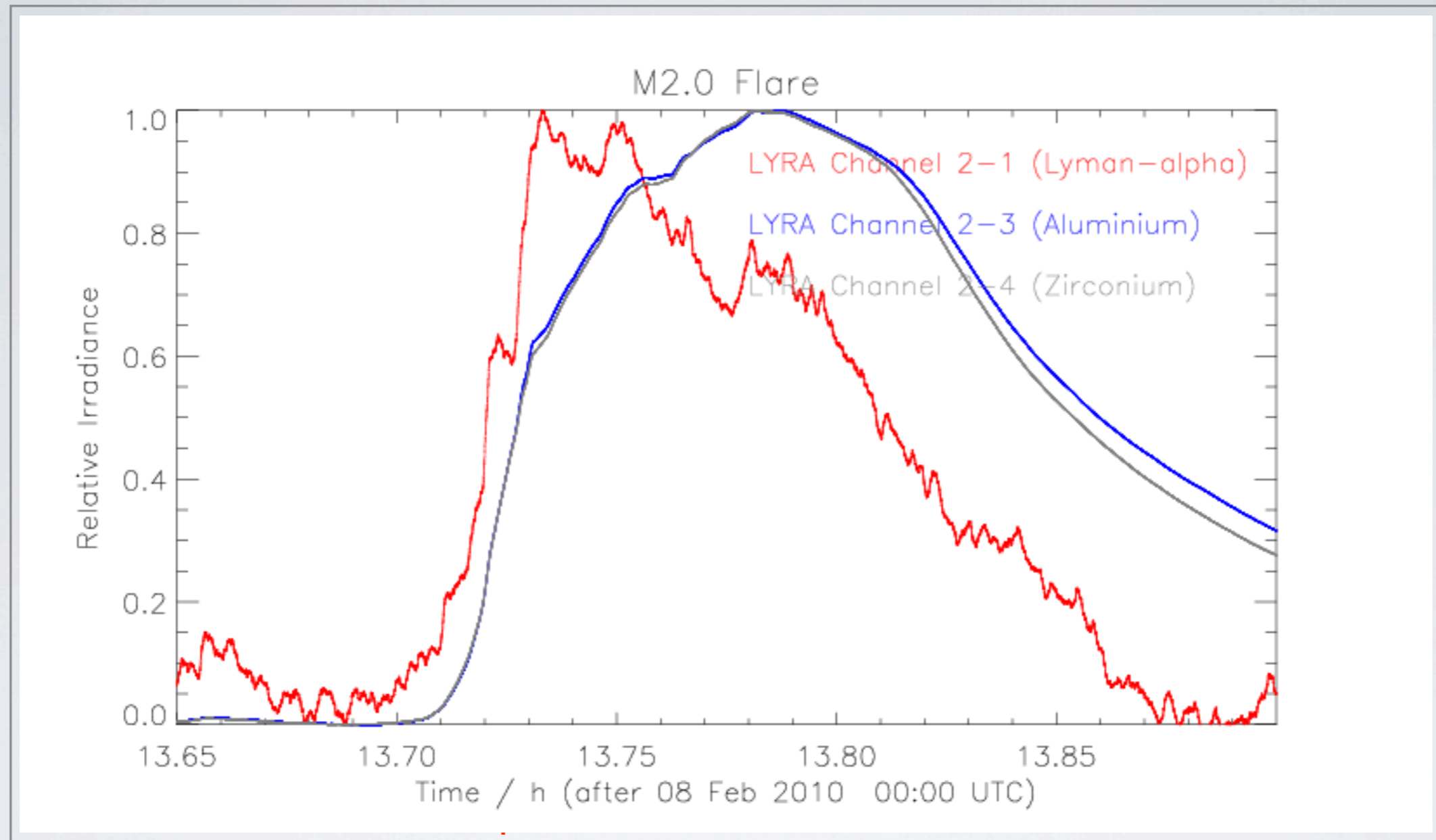
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LYRA FLARES



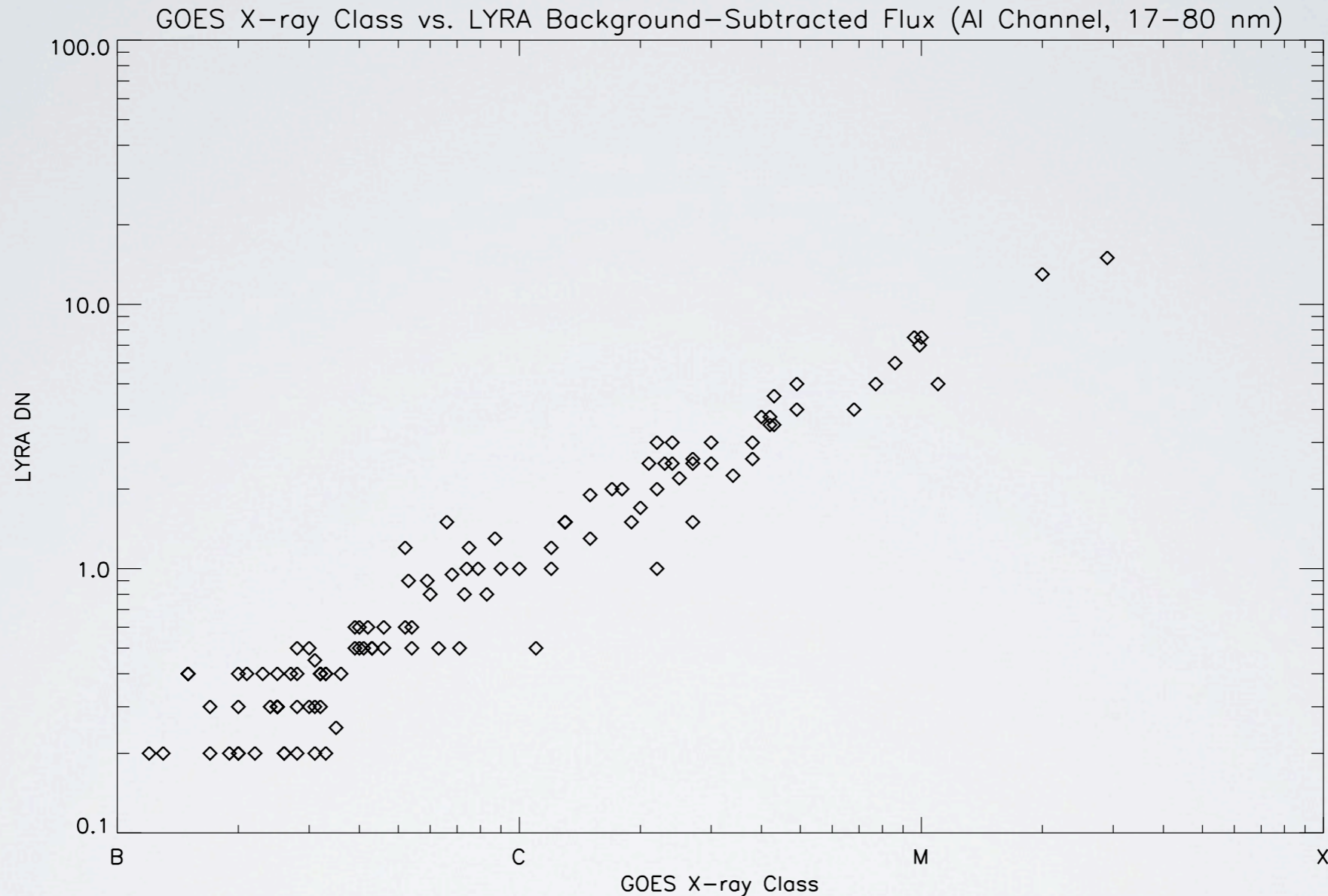
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LYRA FLARES



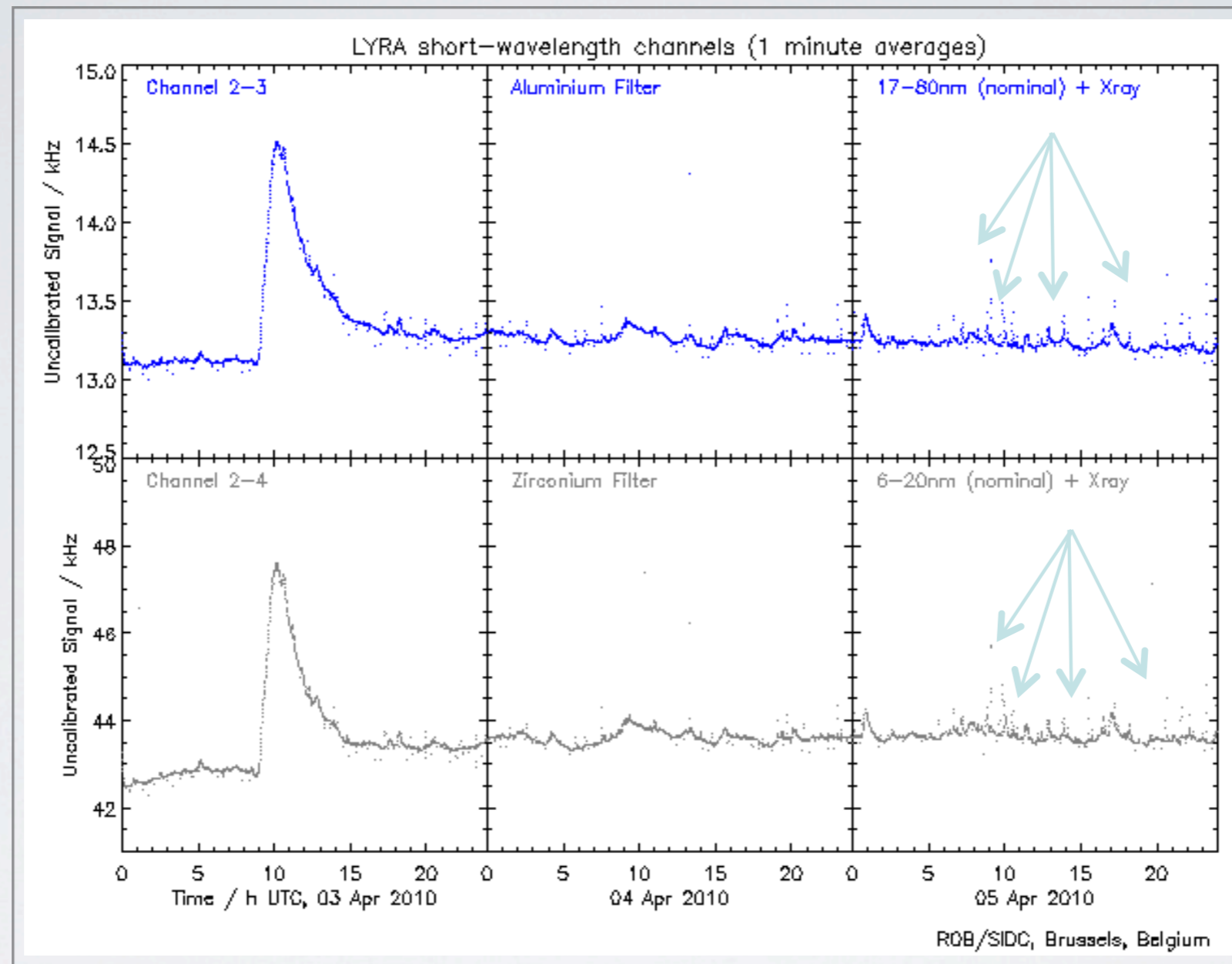
LYRA senses all flares in Zr & Al

Ly- α contribution for impulsive flares

Different onset & peak times in different pass bands

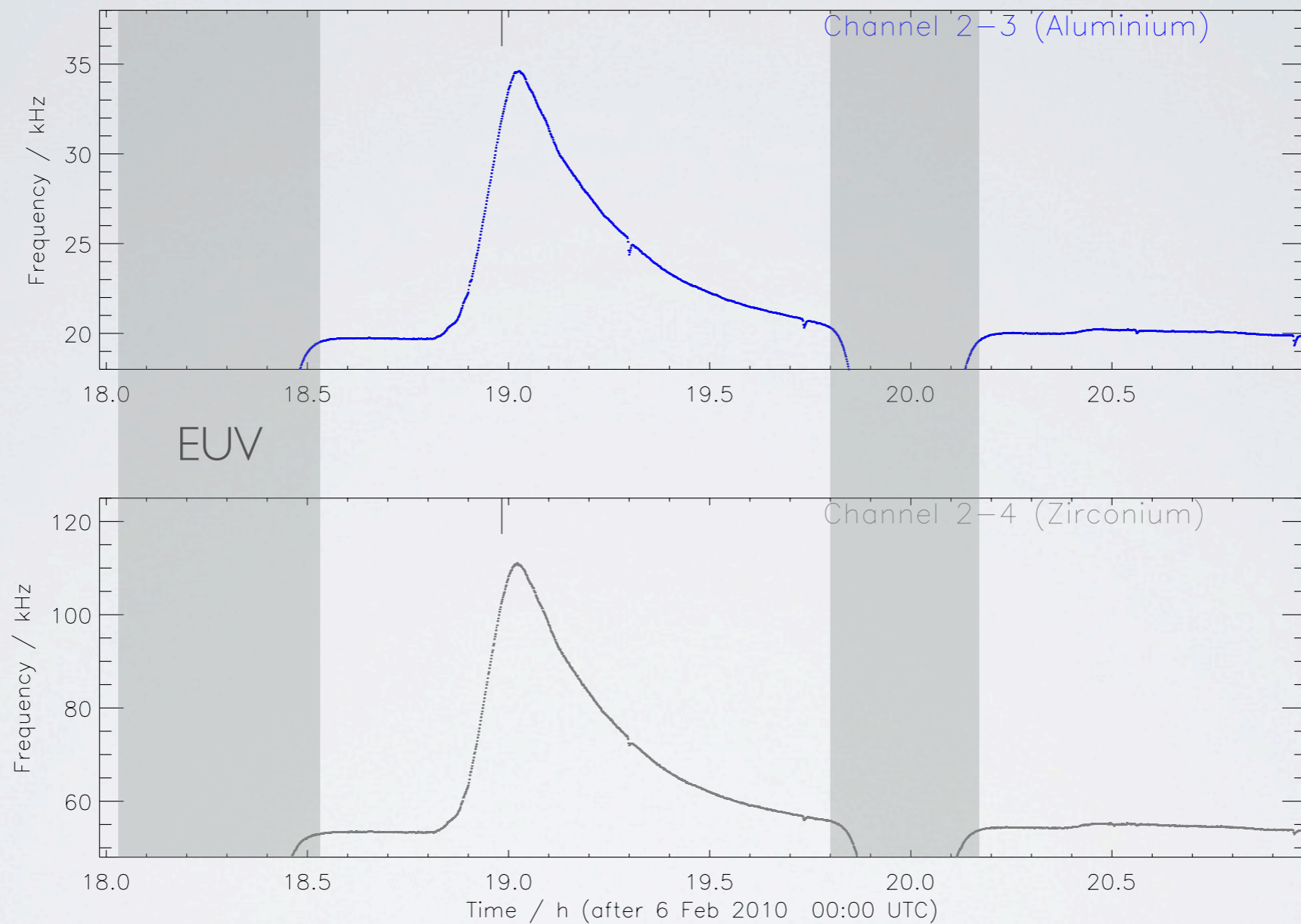
Good correlation to GOES flares with **better temporal resolution**

OTHER LYRA EVENTS



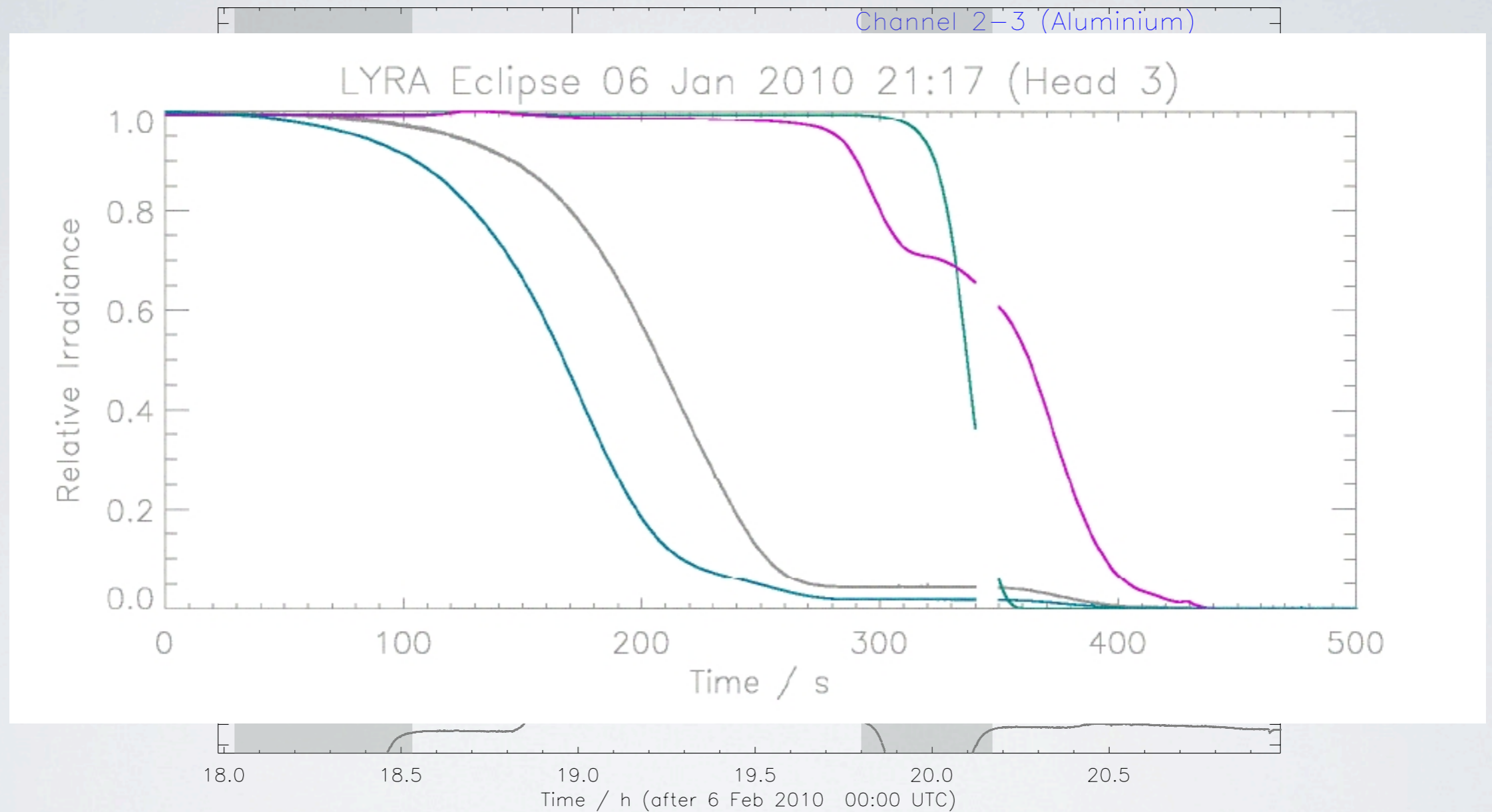
Geomagnetic perturbations:
around $\pm 75^\circ$ latitude, 2-3 days after a CME

OTHER LYRA EVENTS

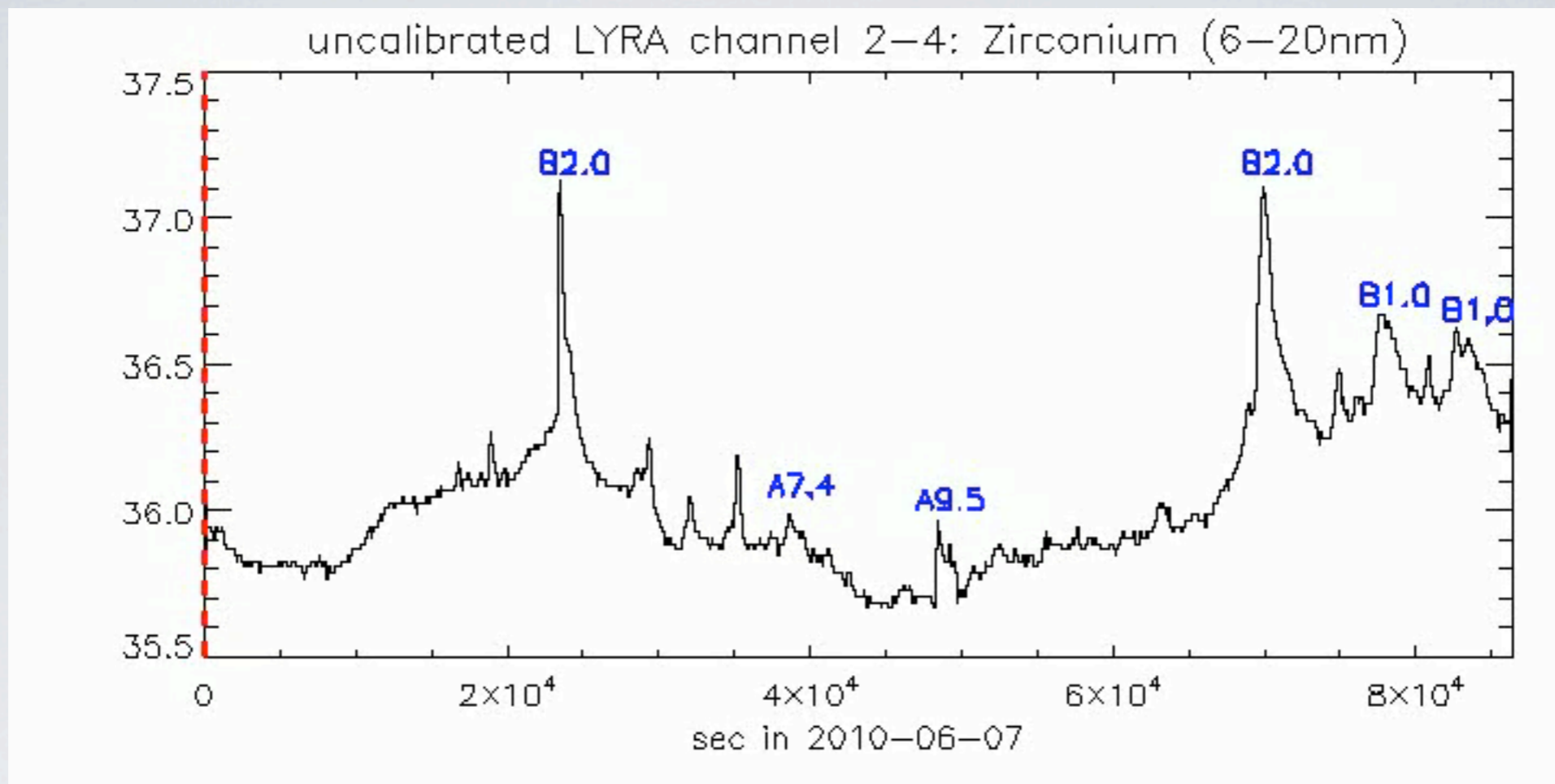


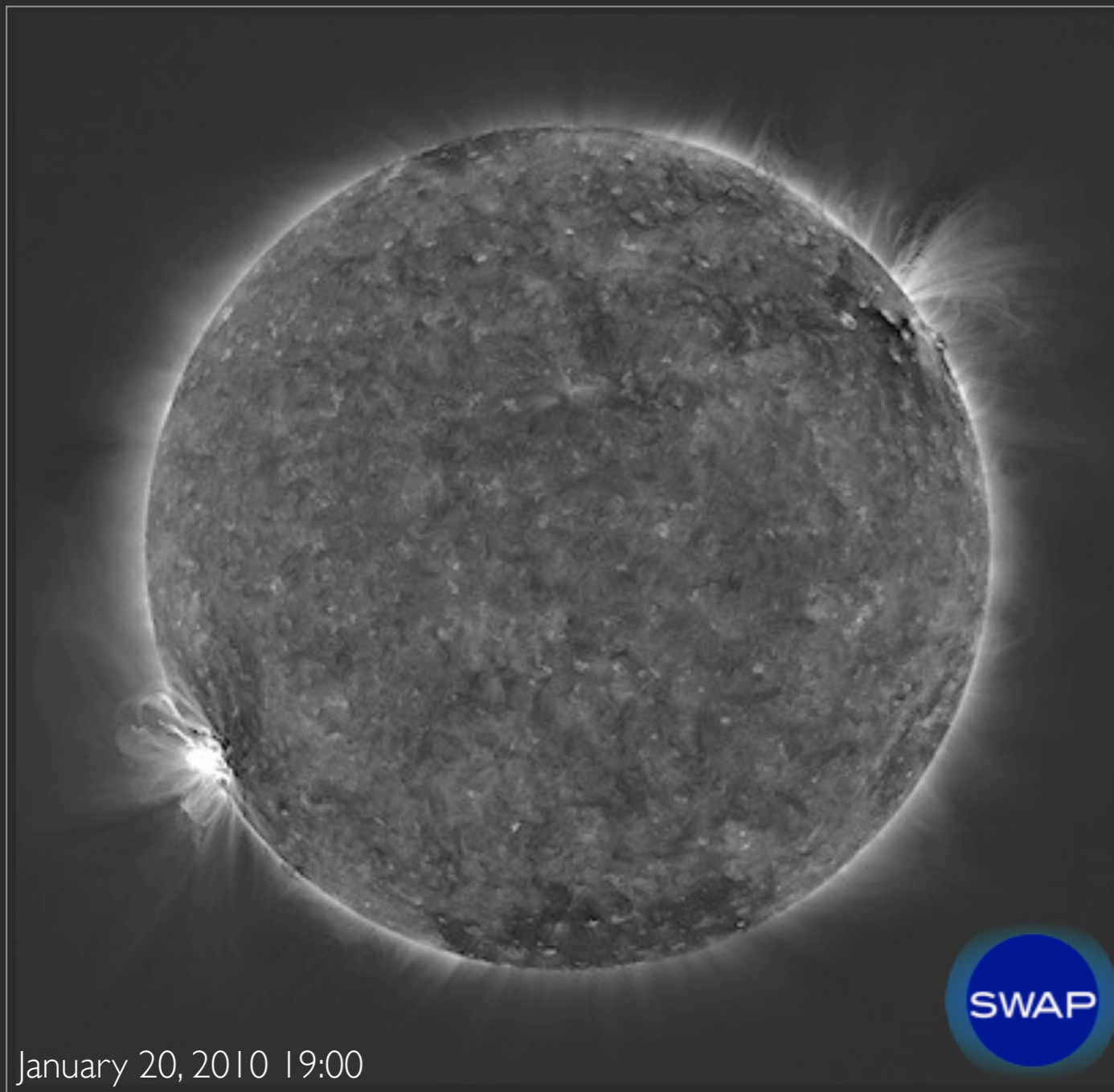
Nov-Feb: eclipse occultations by Earth's atmosphere & Earth

OTHER LYRA EVENTS

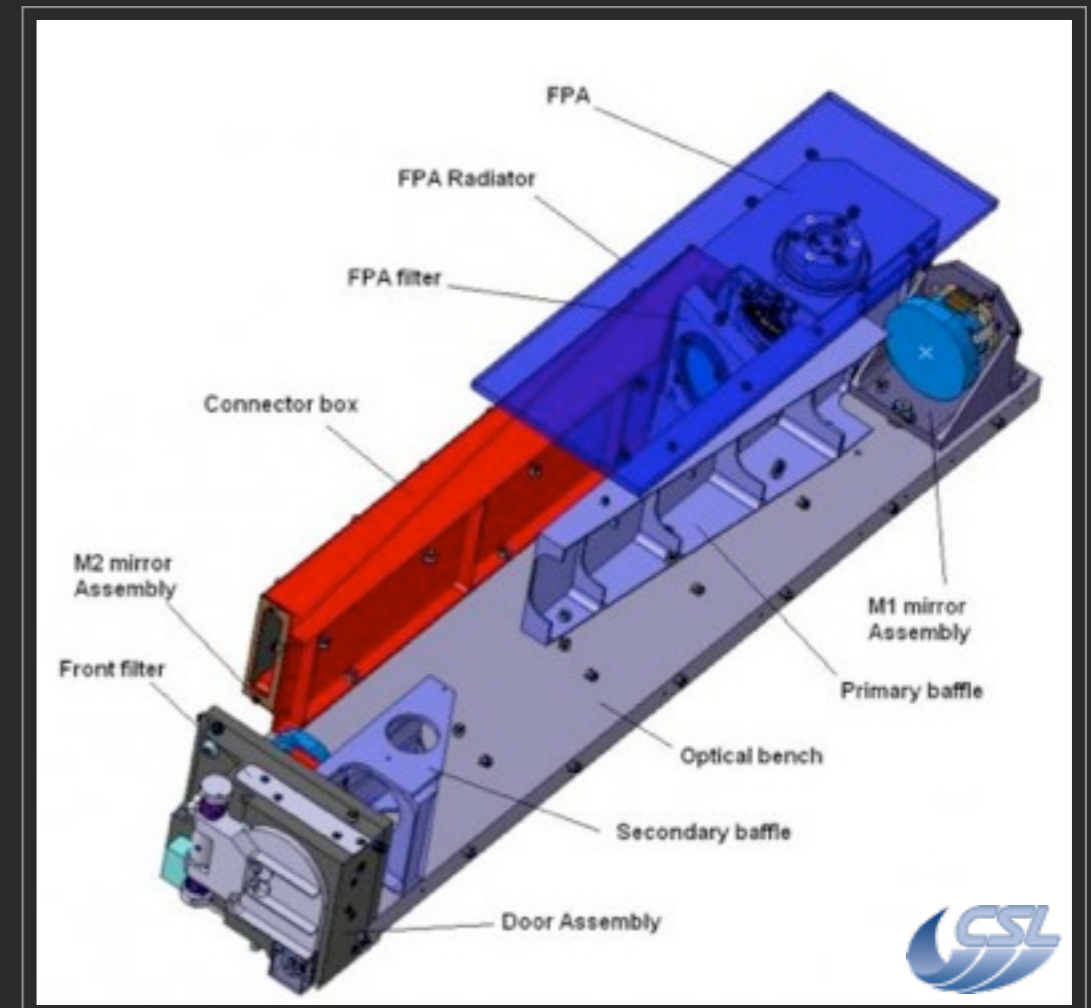


Nov-Feb: eclipse occultations by Earth's atmosphere & Earth



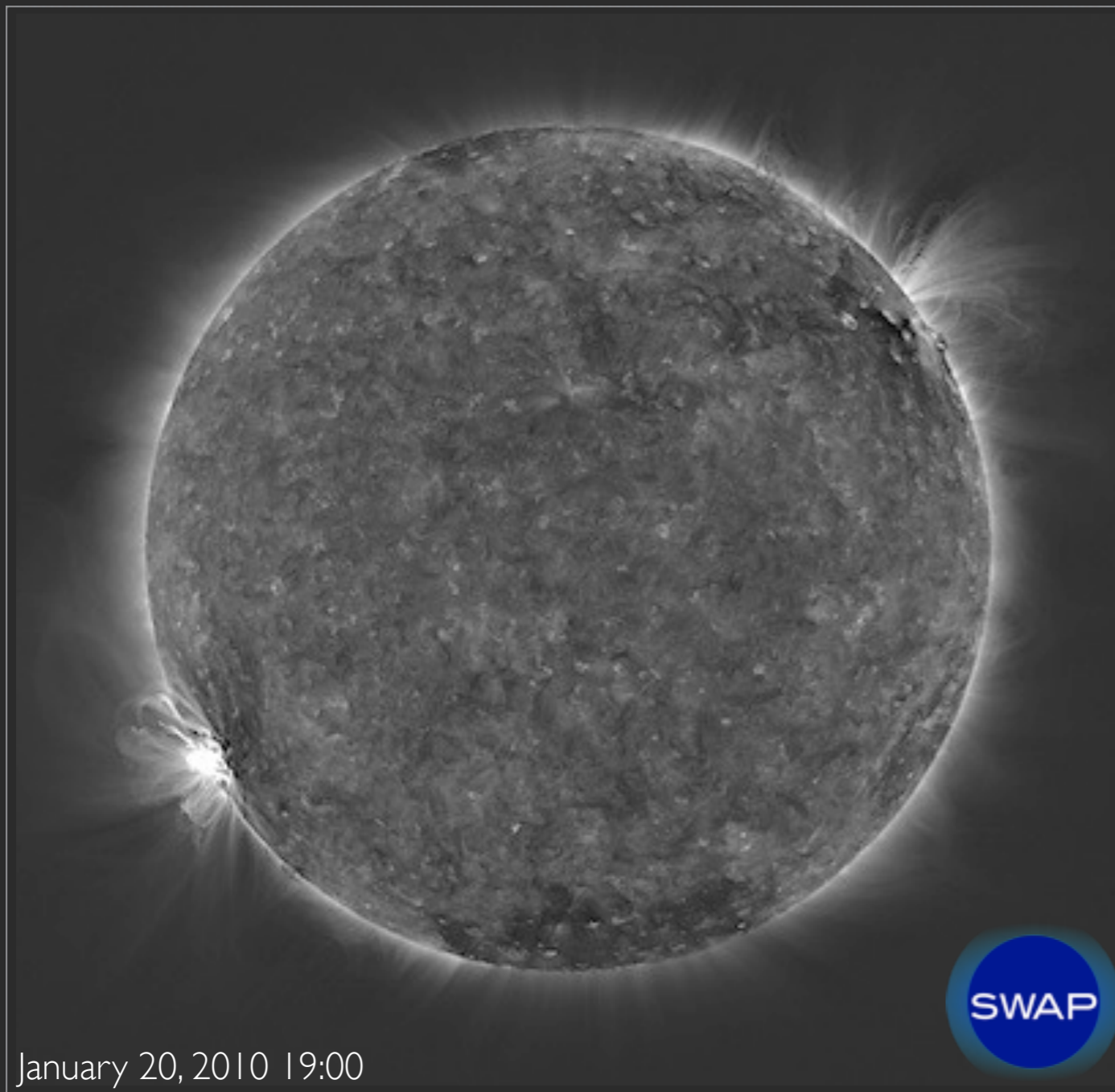


January 20, 2010 19:00

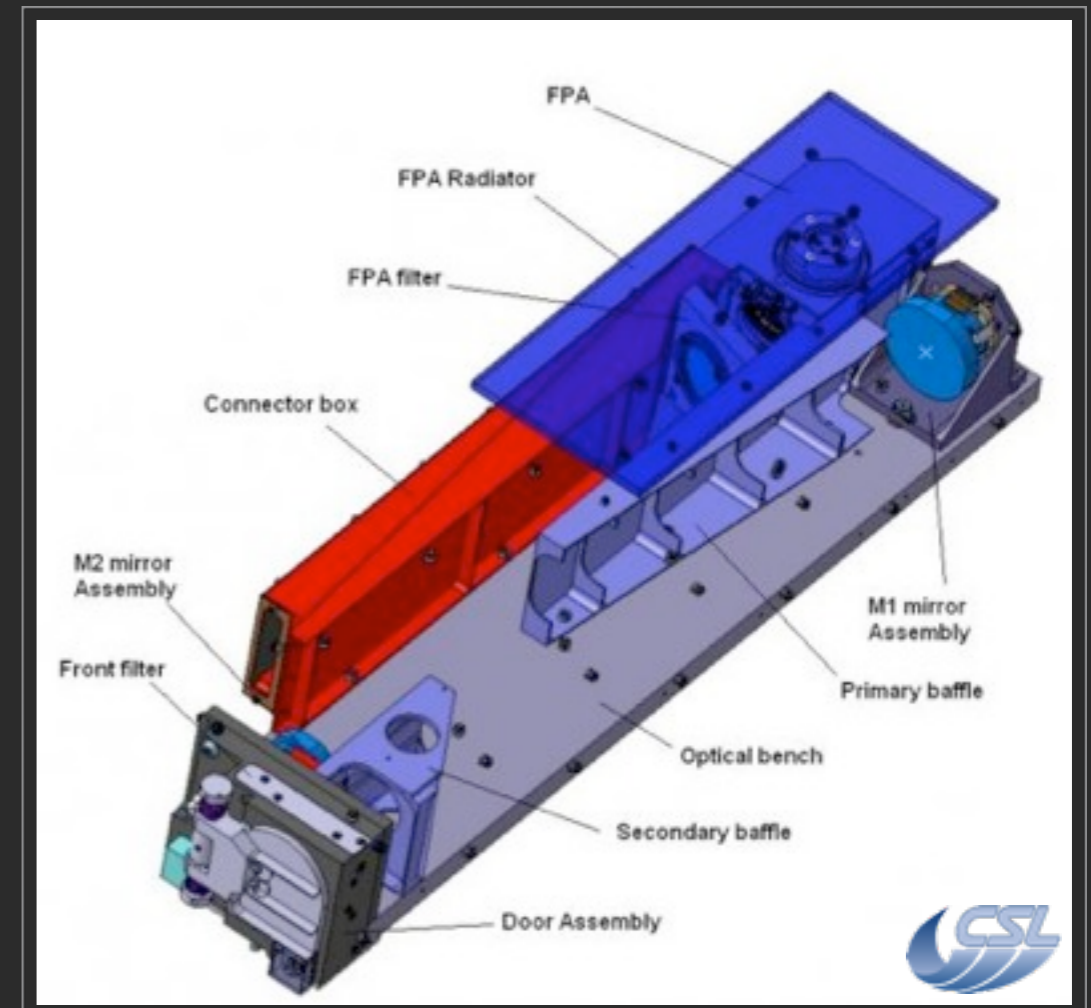


SWAP EUV IMAGER

Observes the 1 million degree corona in EUV light



January 20, 2010 19:00



SWAP EUV IMAGER

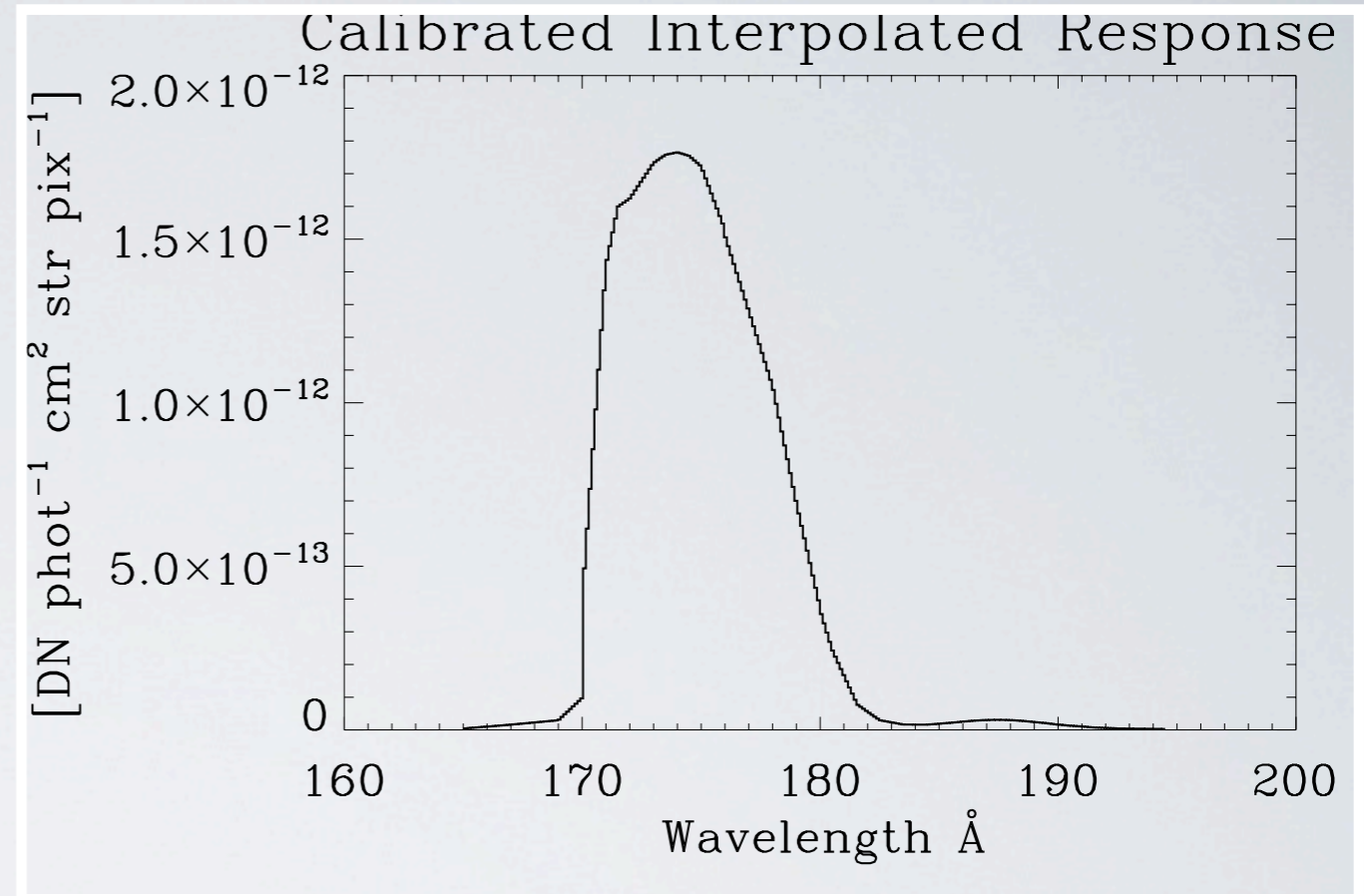
Observes the 1 million degree corona in EUV light
Exercise in miniaturization: off-axis Ritchey-Chrétien scheme

SPECTRAL RESPONSE

Peak at 17.4nm

Comparable to EIT 17.1nm
& STEREO/EUVI 17.1nm

~ 1 min cadence, 1K x 1K CMOS

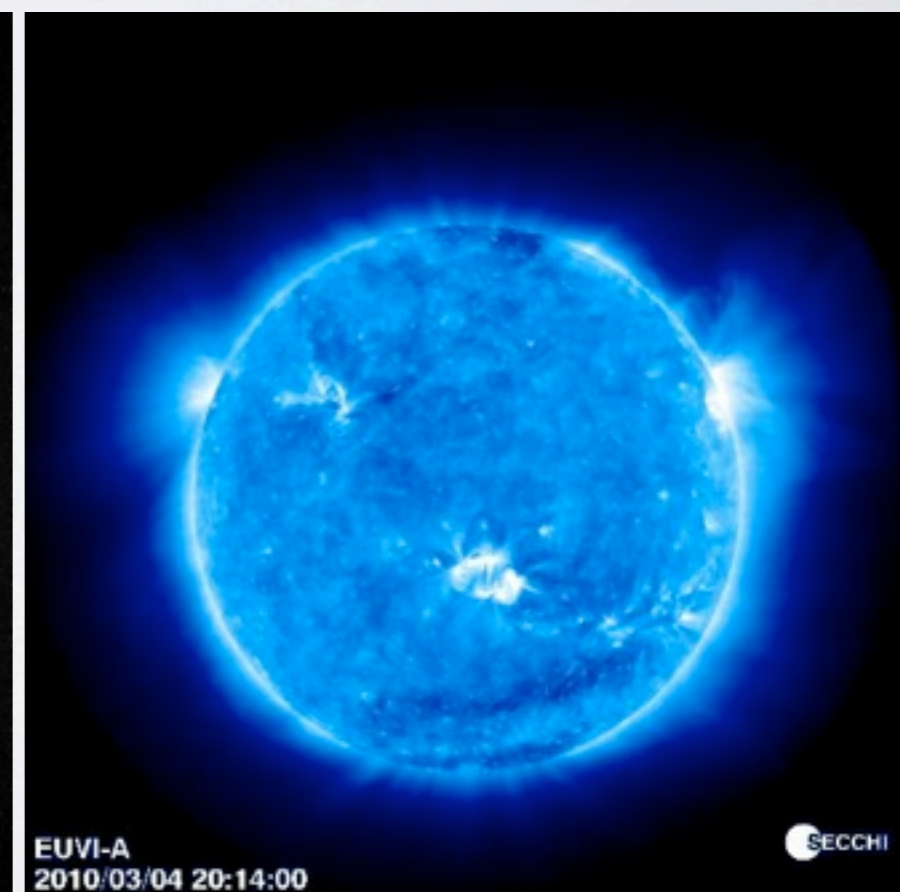
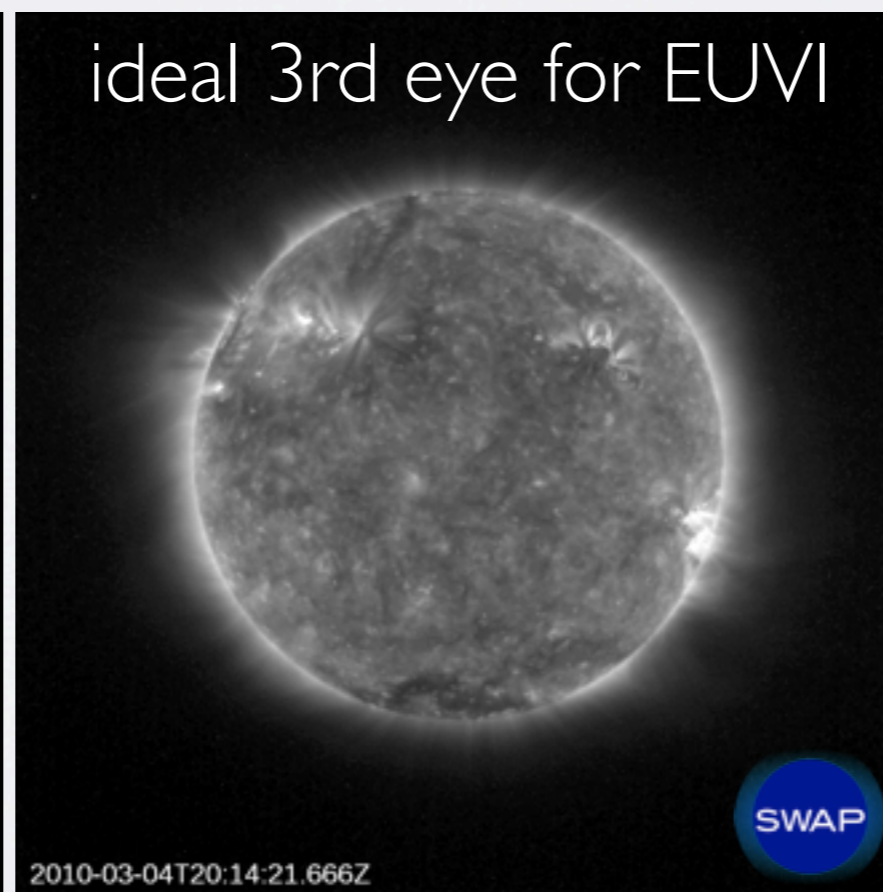
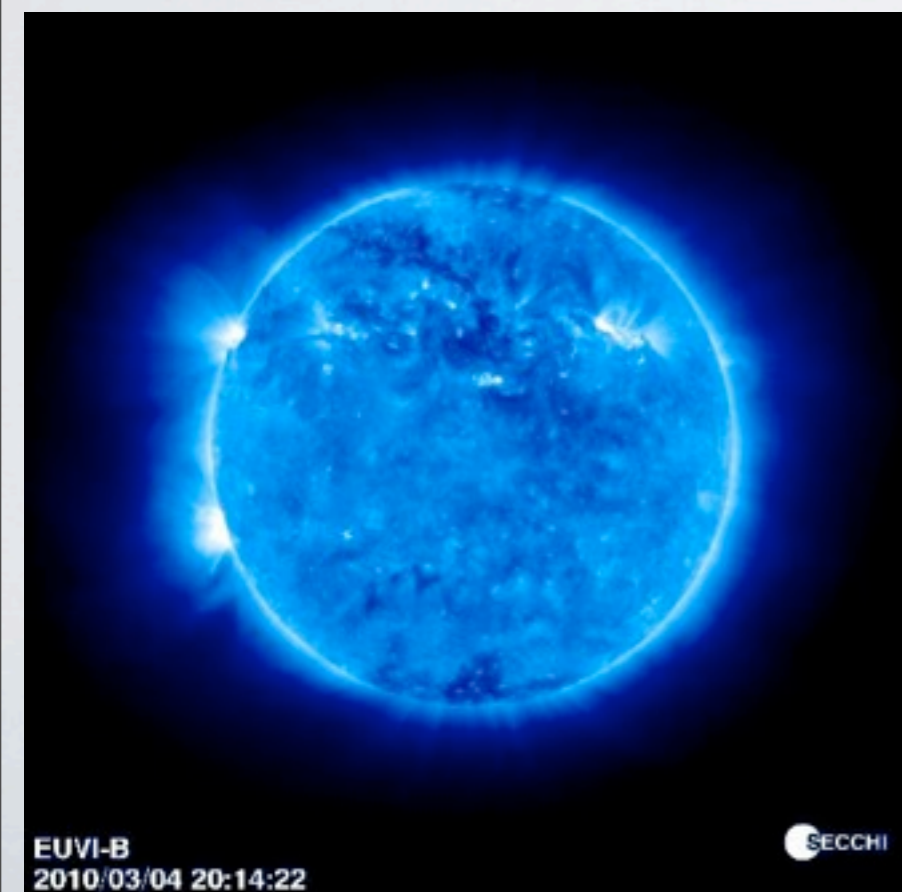
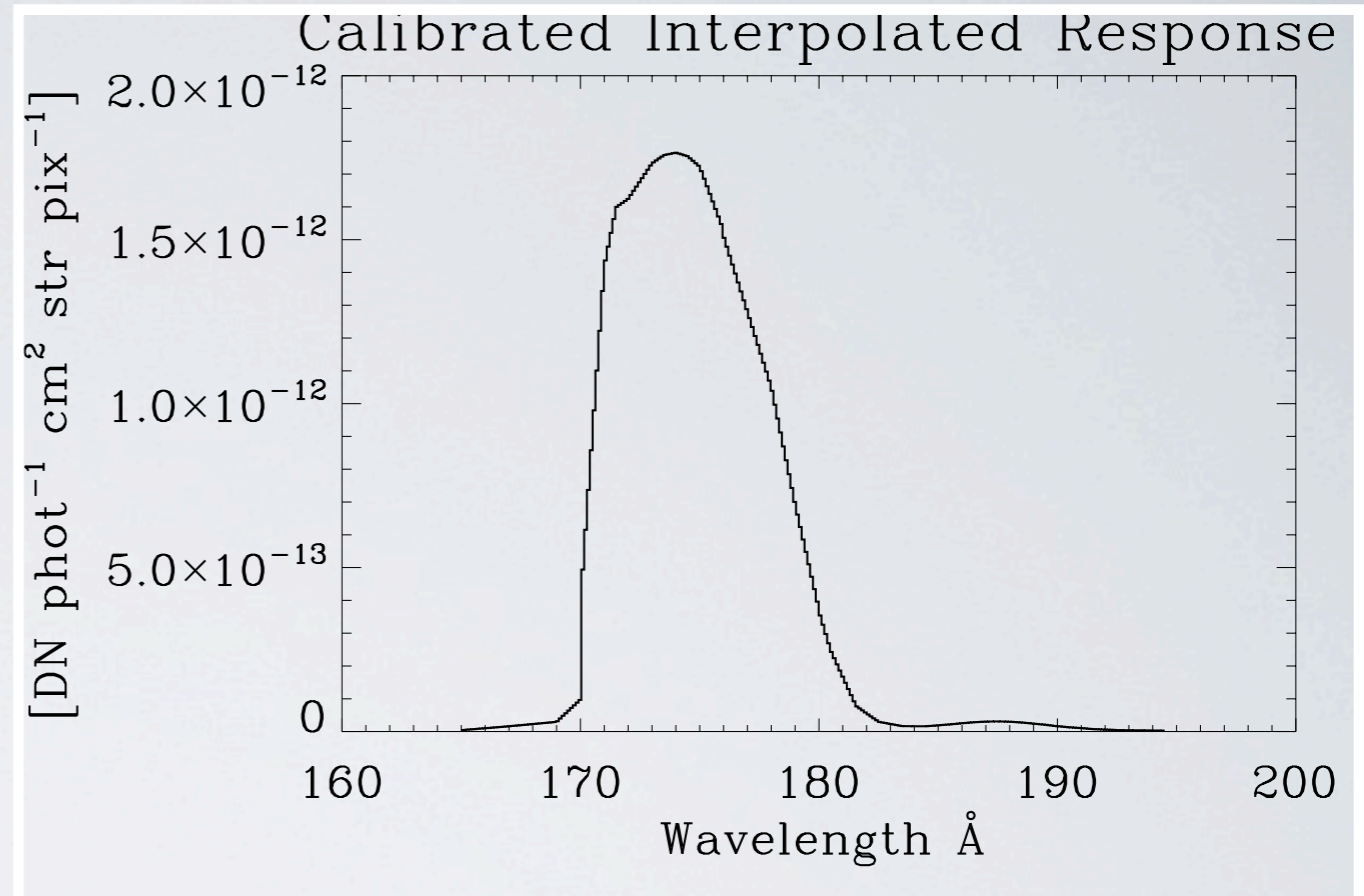


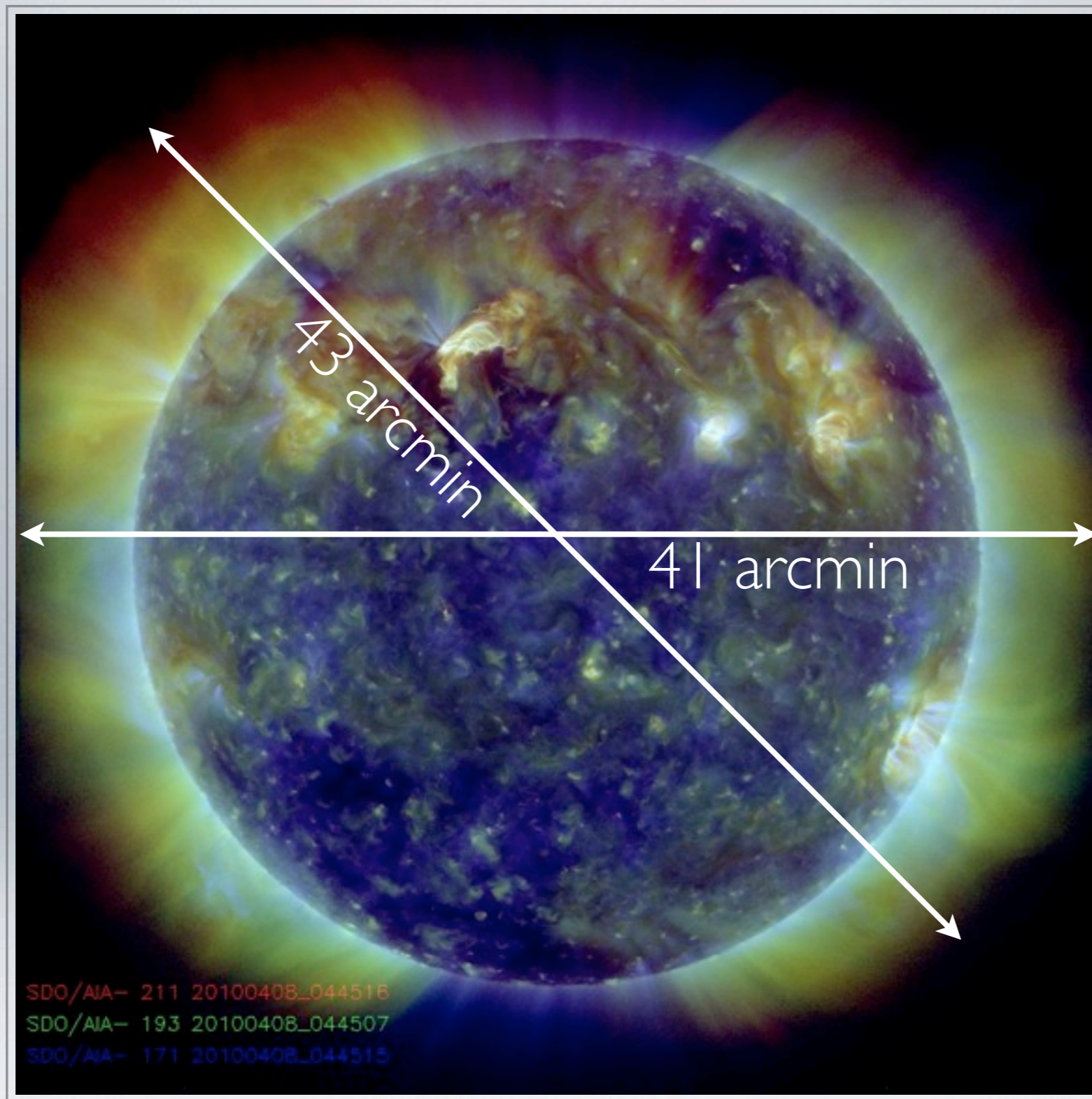
SPECTRAL RESPONSE

Peak at 17.4nm

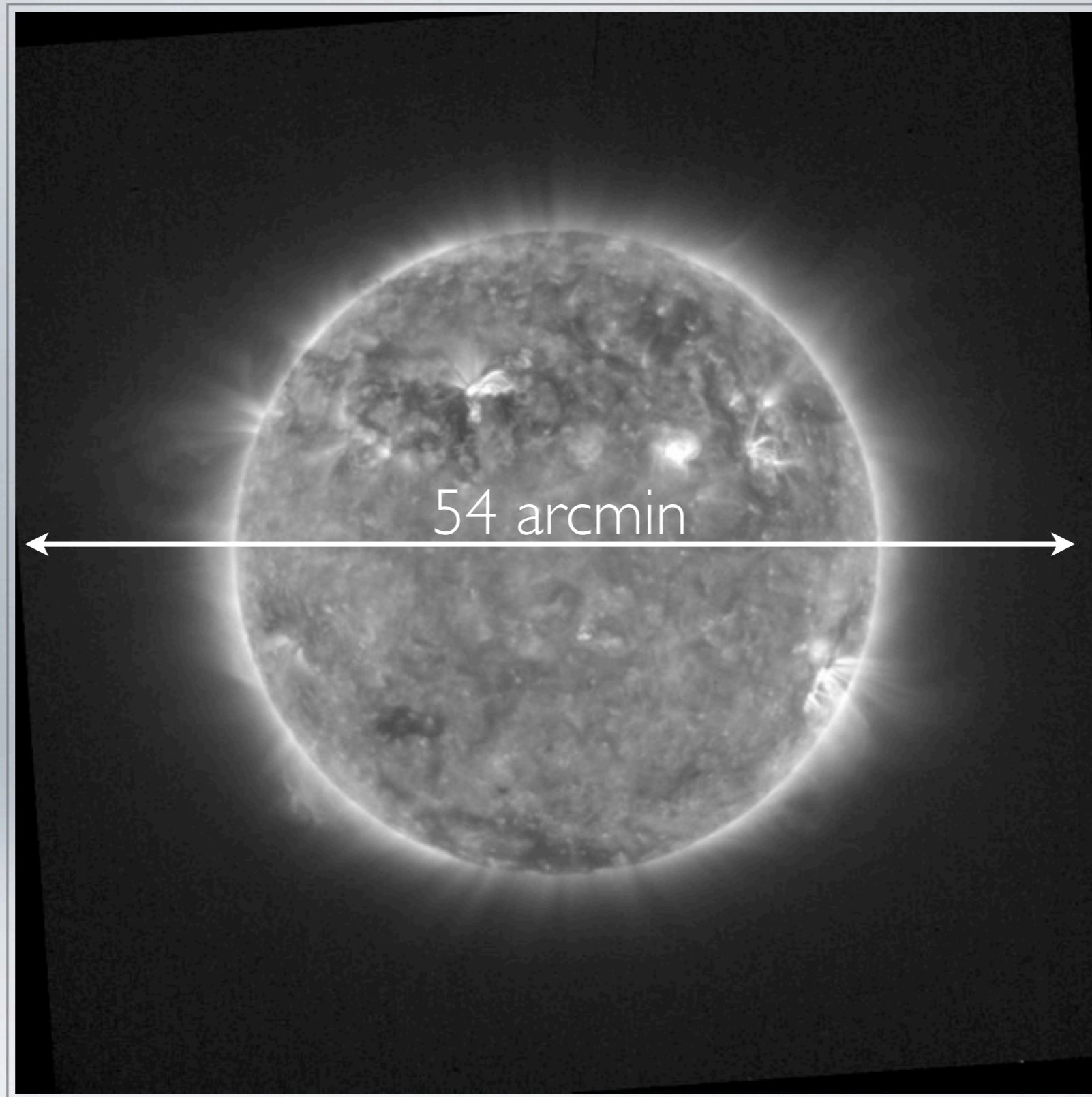
Comparable to EIT 17.1nm
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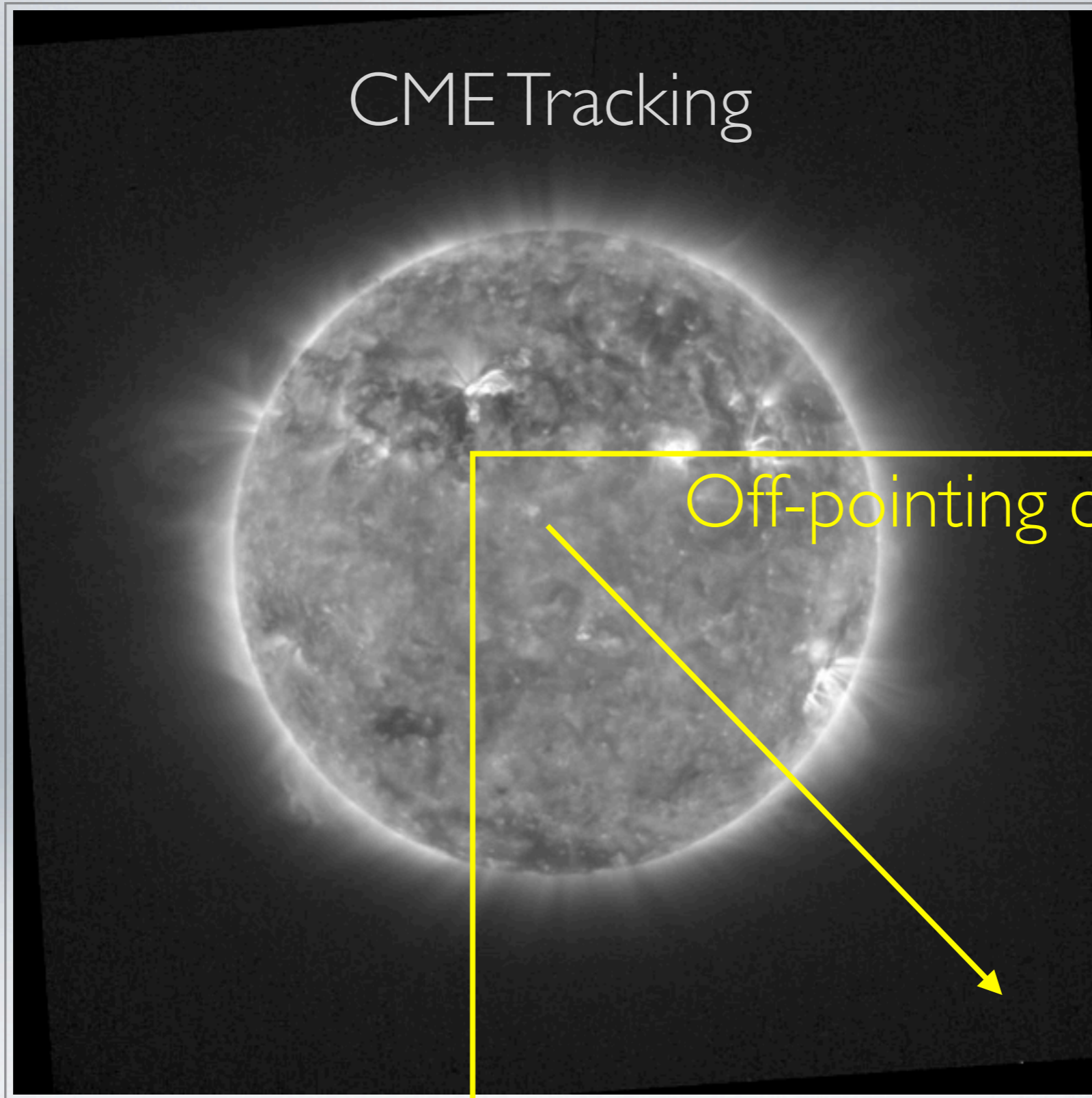


SWAP vs AIA ON SDO



SWAP vs AIA ON SDO

CME Tracking



Off-pointing capability

SWAP vs AIA ON SDO

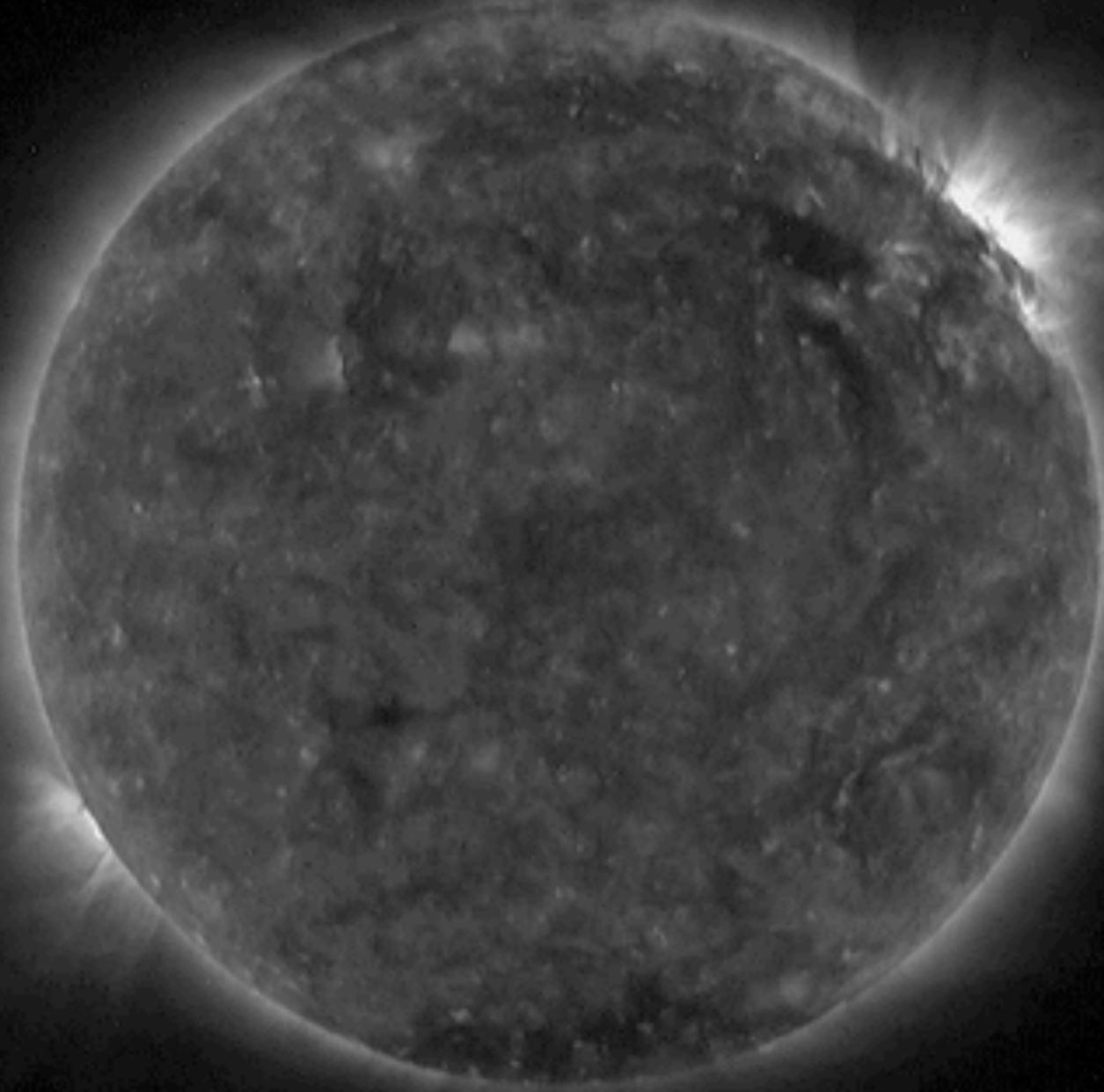
ANNULAR SOLAR ECLIPSE



January 15, 2010, 06:00 UTC



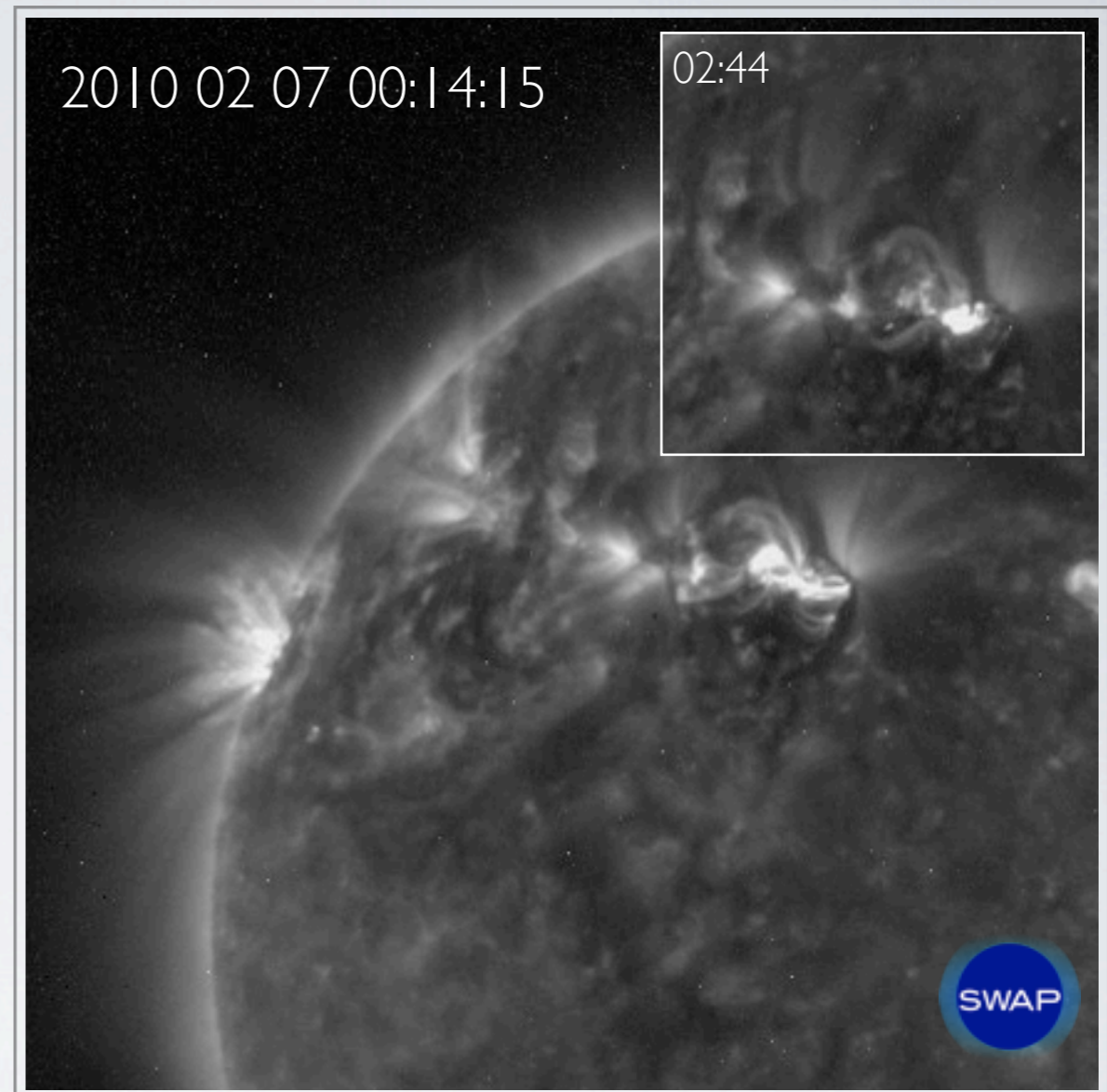
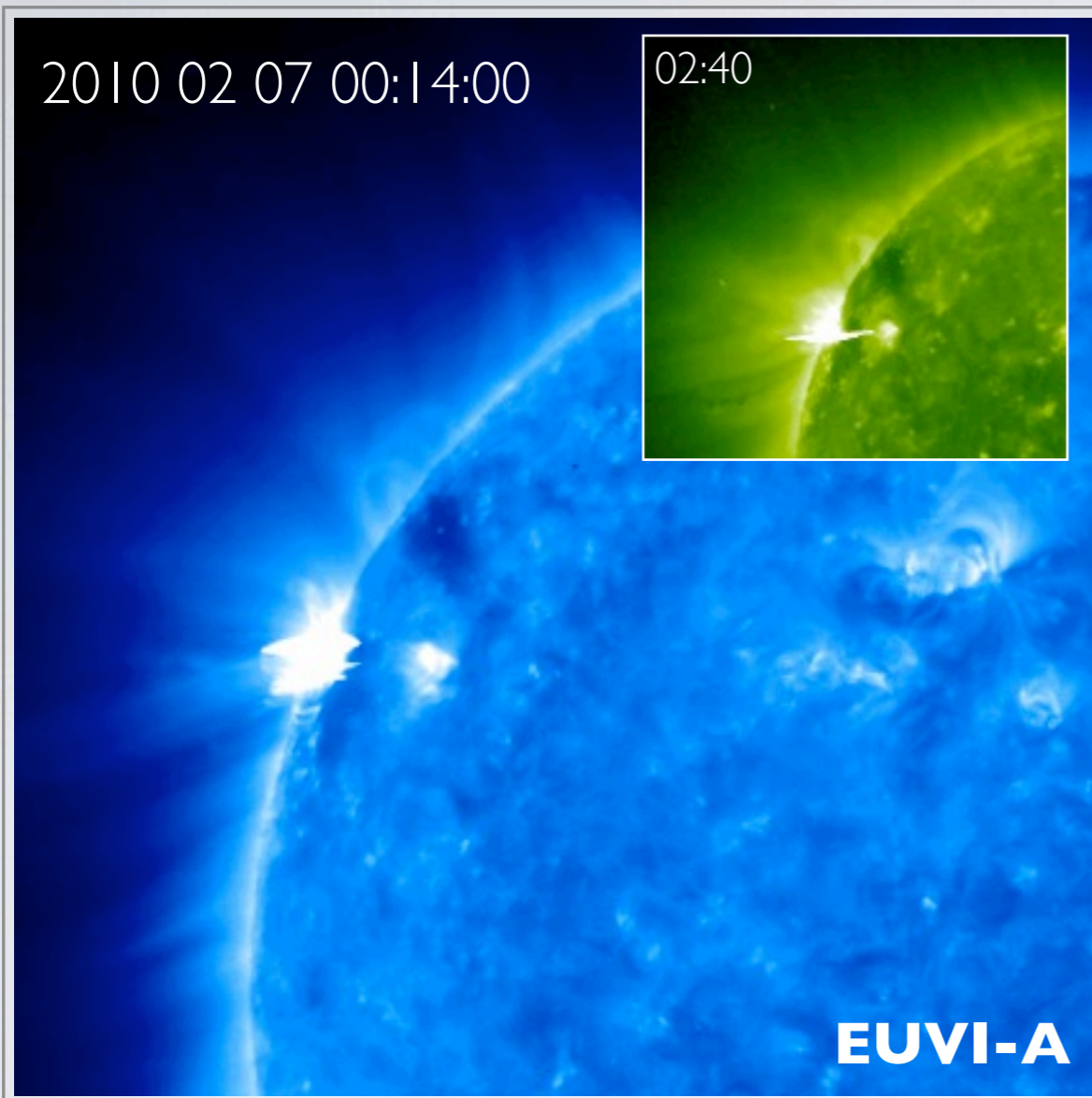
ACTIVE REGIONS & FLARES



1st M-flare
of new
cycle

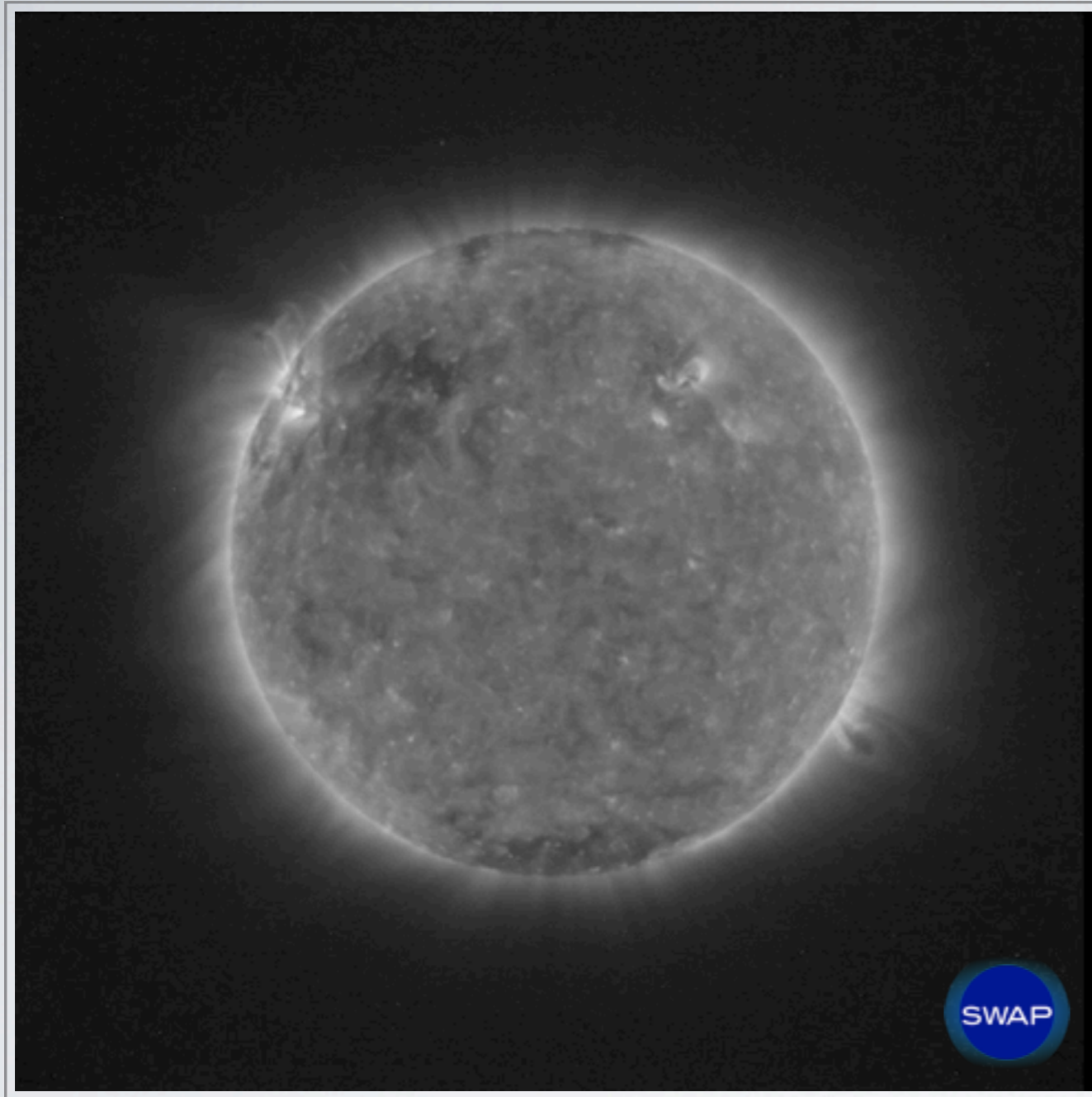
January 18-21, 2010





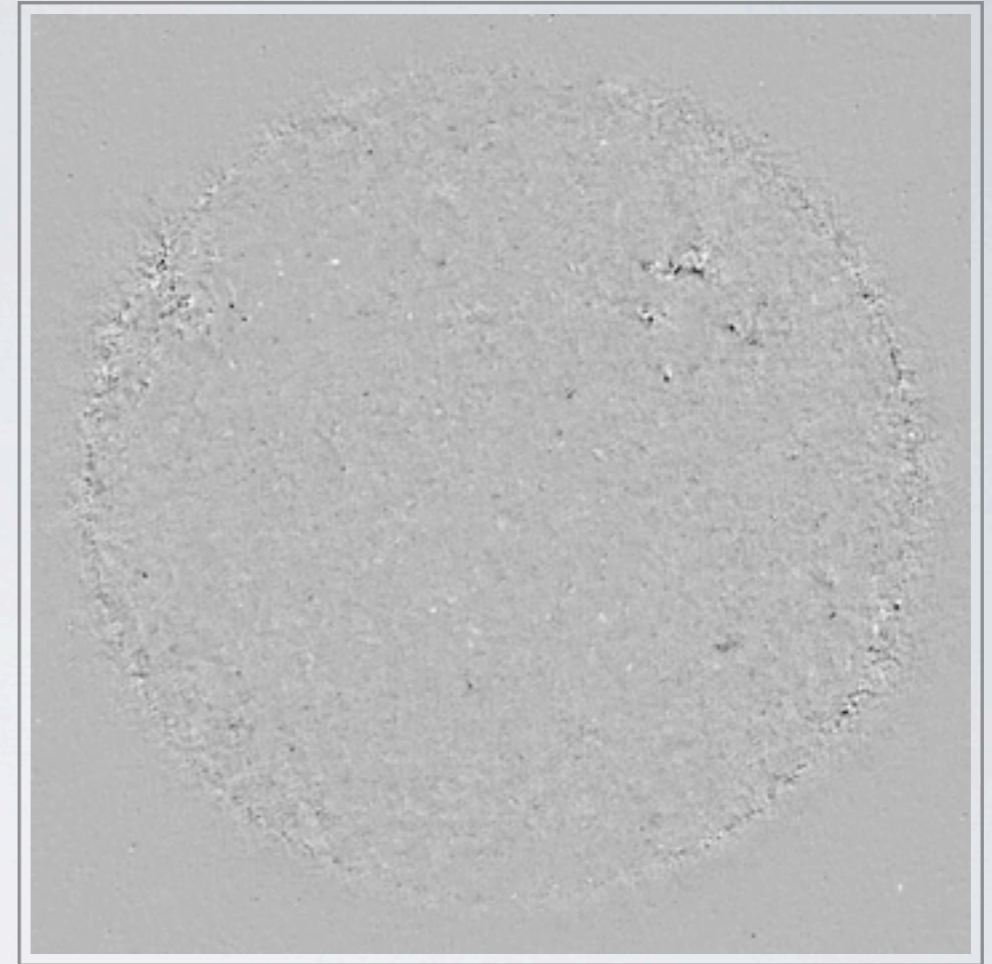
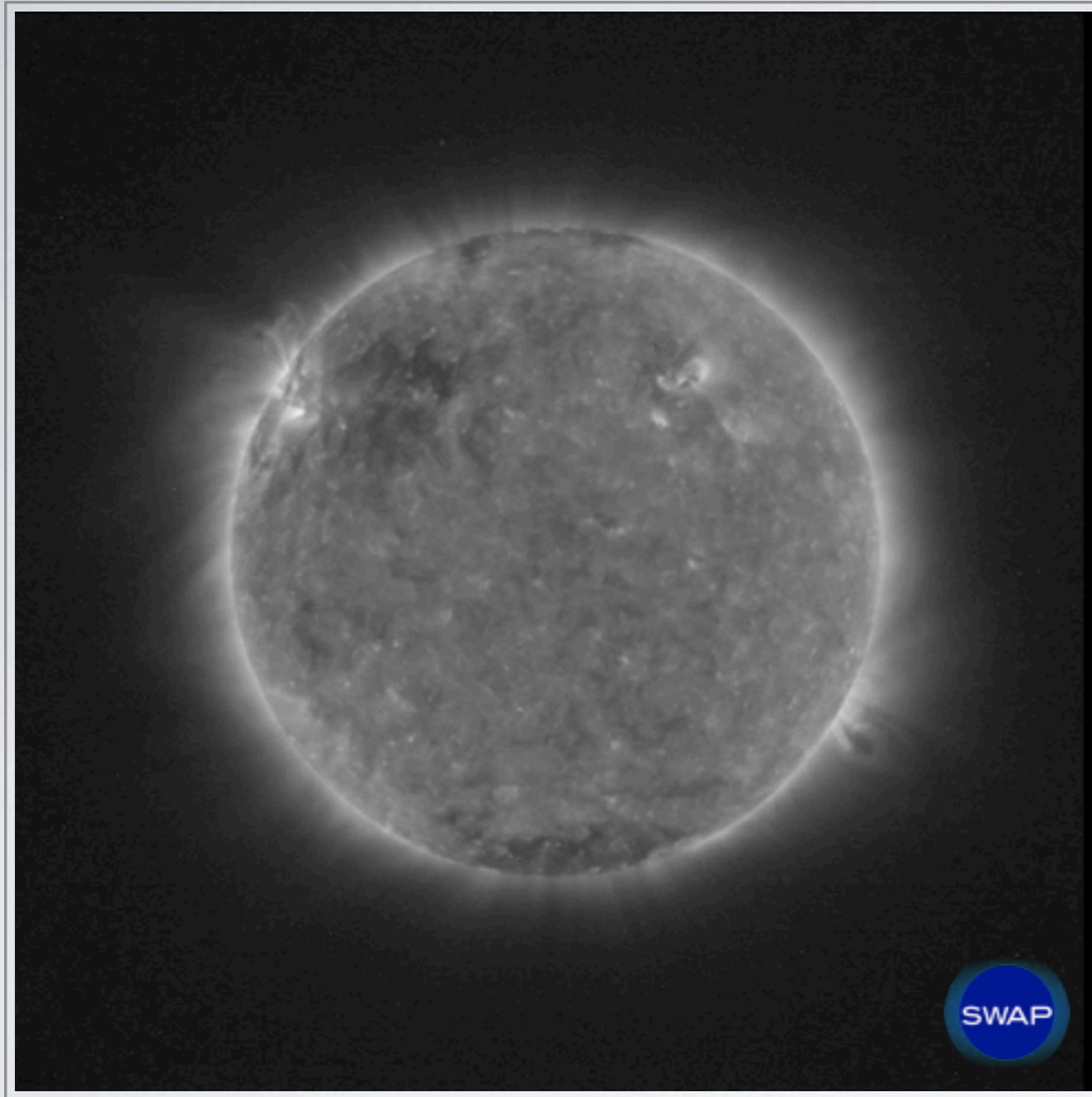
SOLAR FLARES

limited blooming due to CMOS detector
high cadence up to 18s
LYRA gives detailed temporal evolution (10ms)



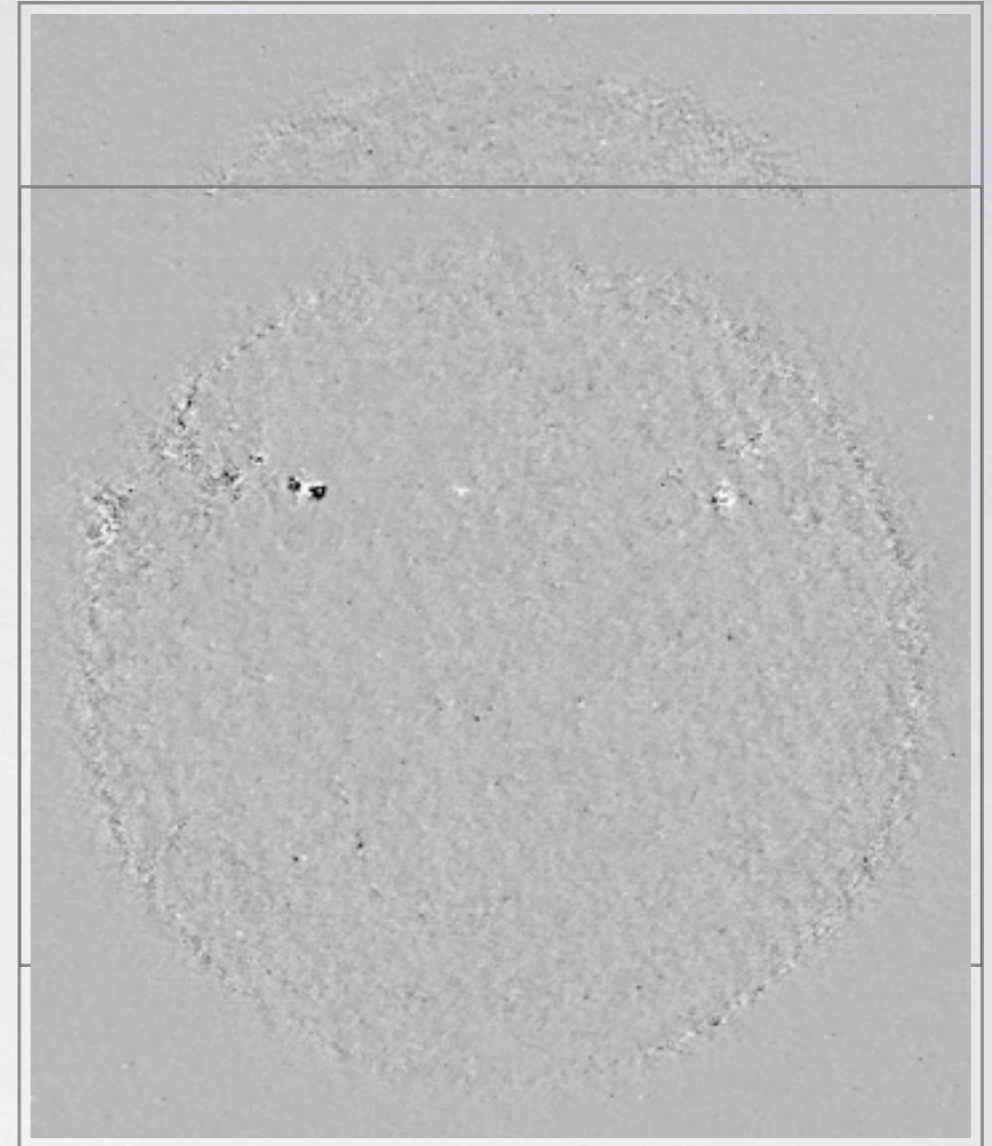
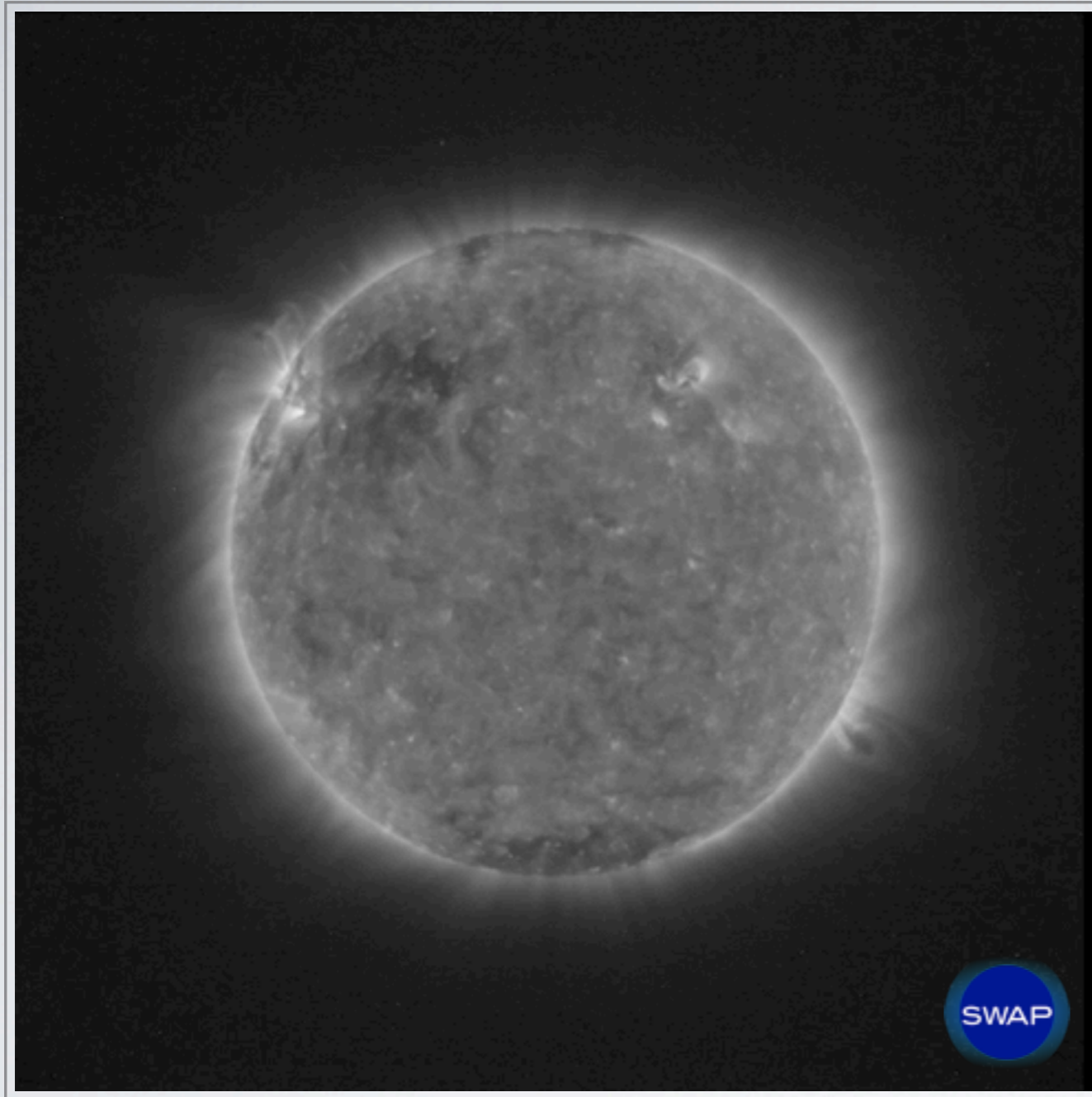
EIT WAVES

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



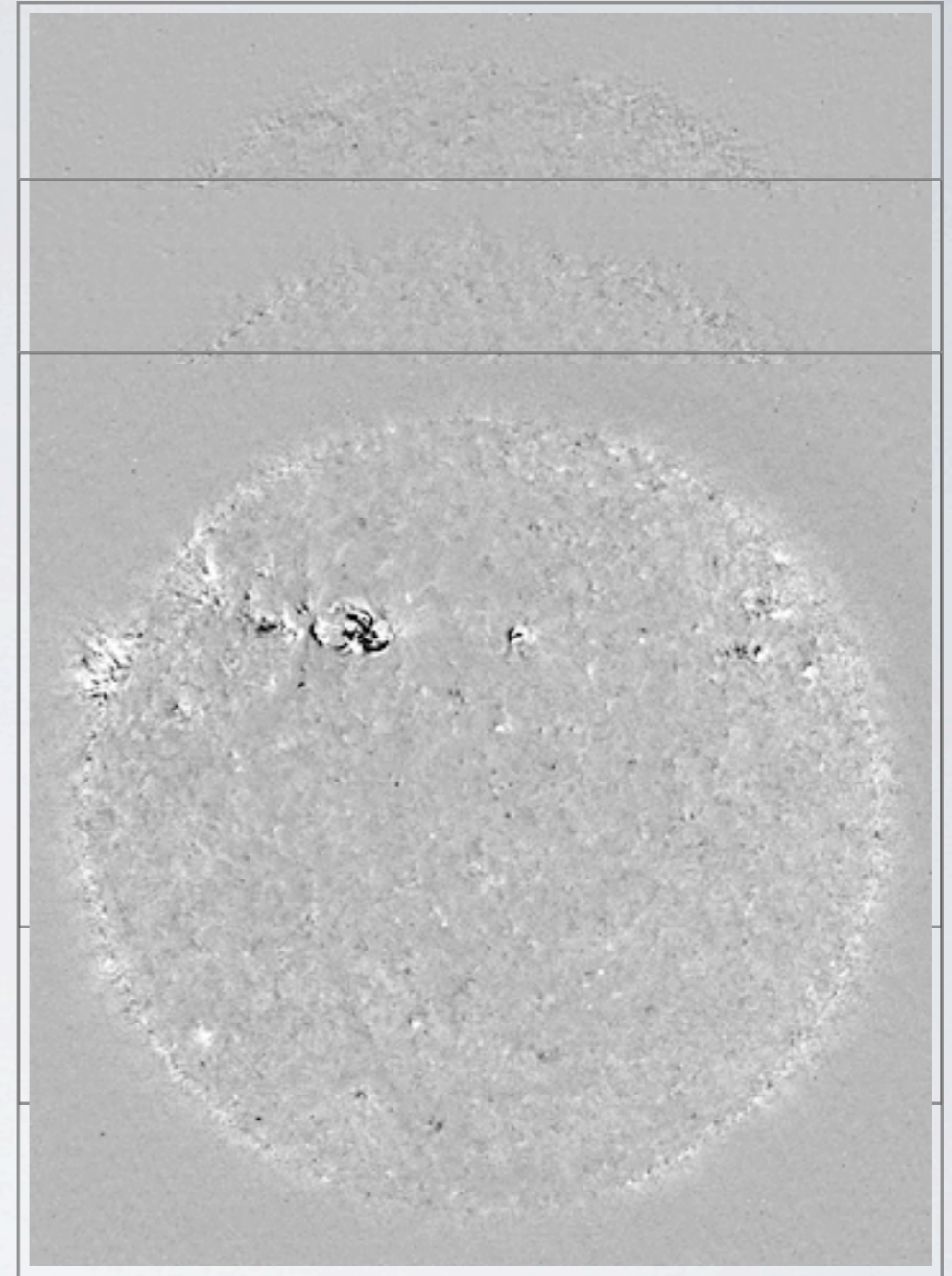
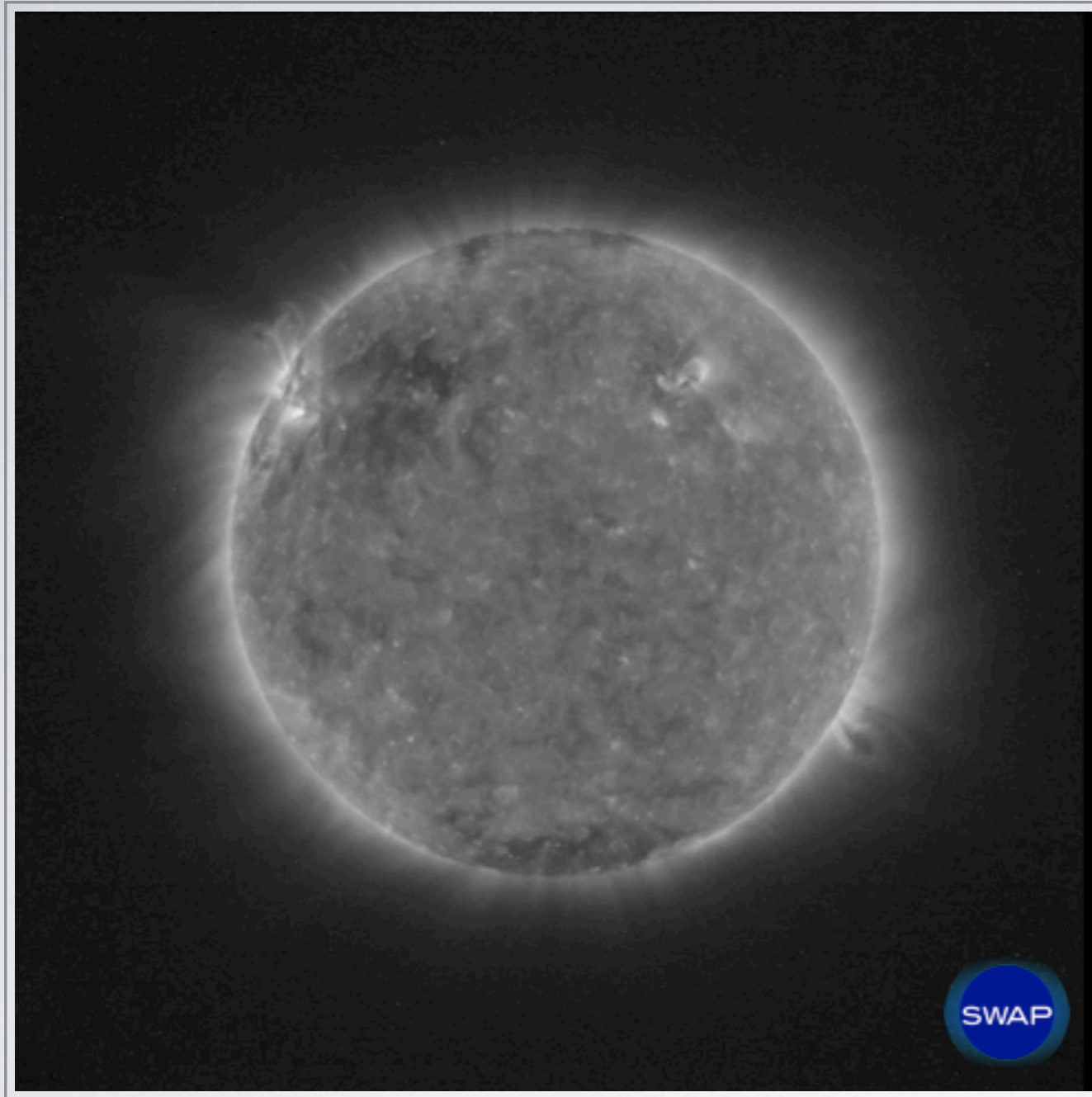
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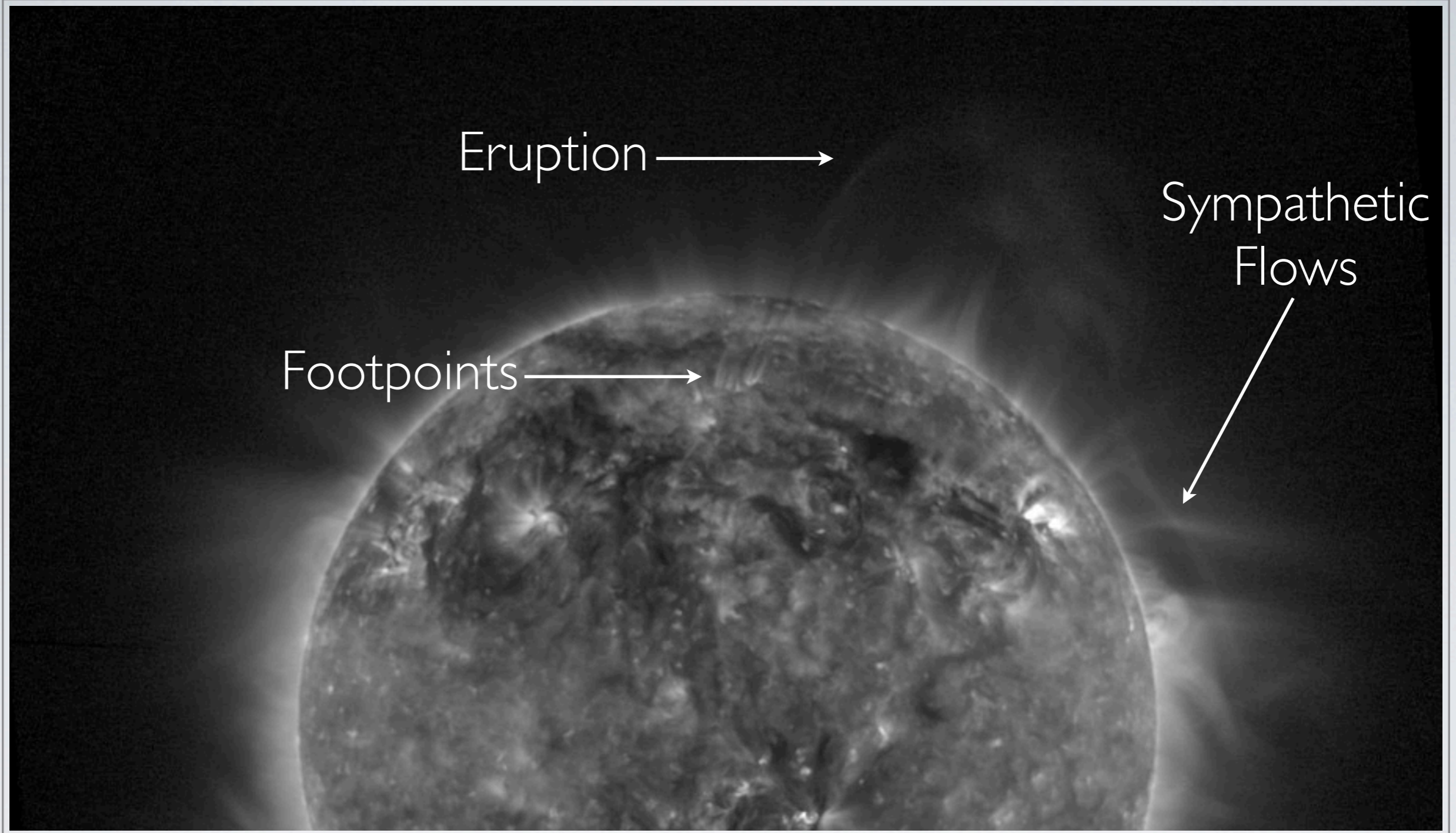
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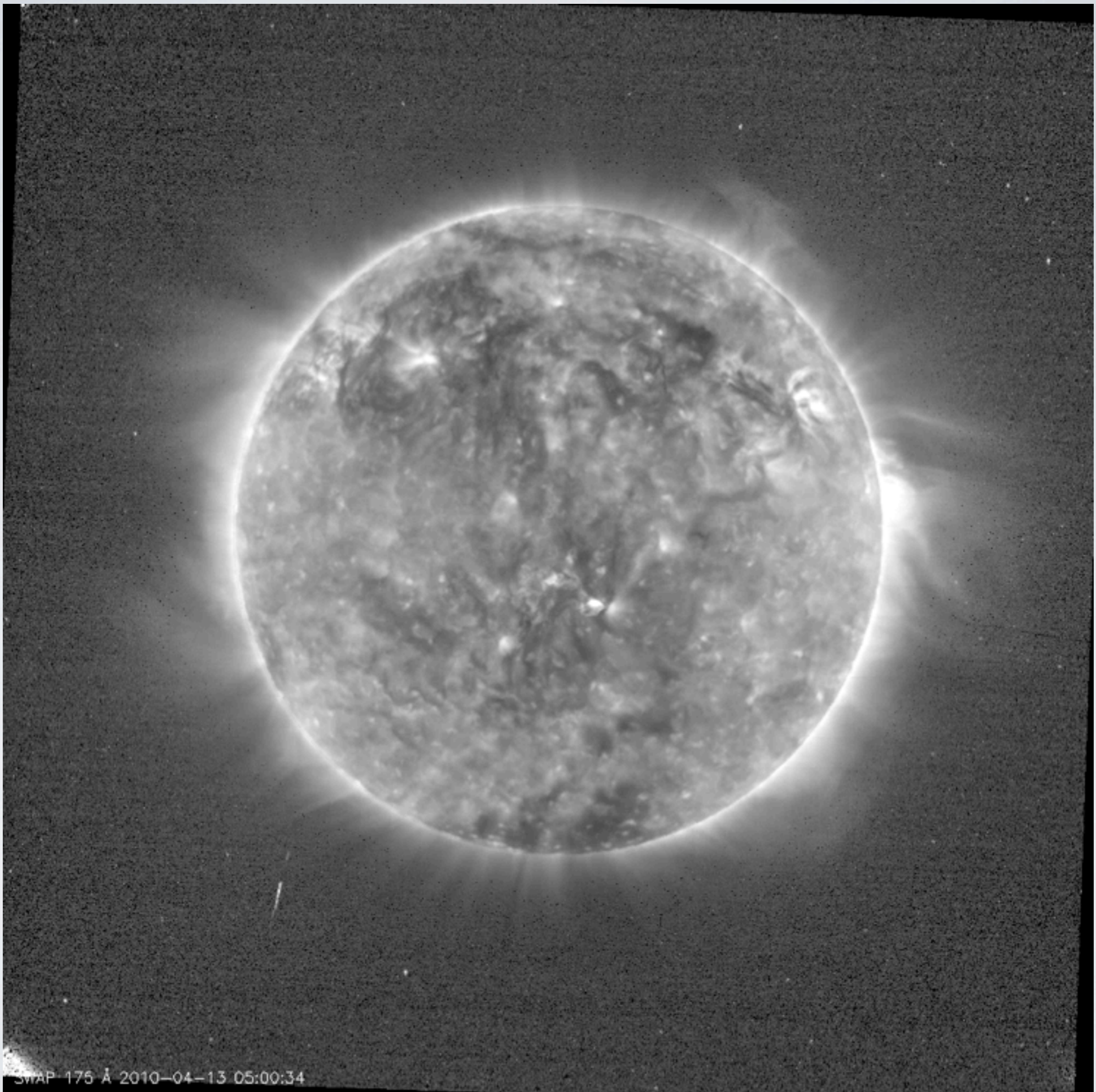
EIT WAVES

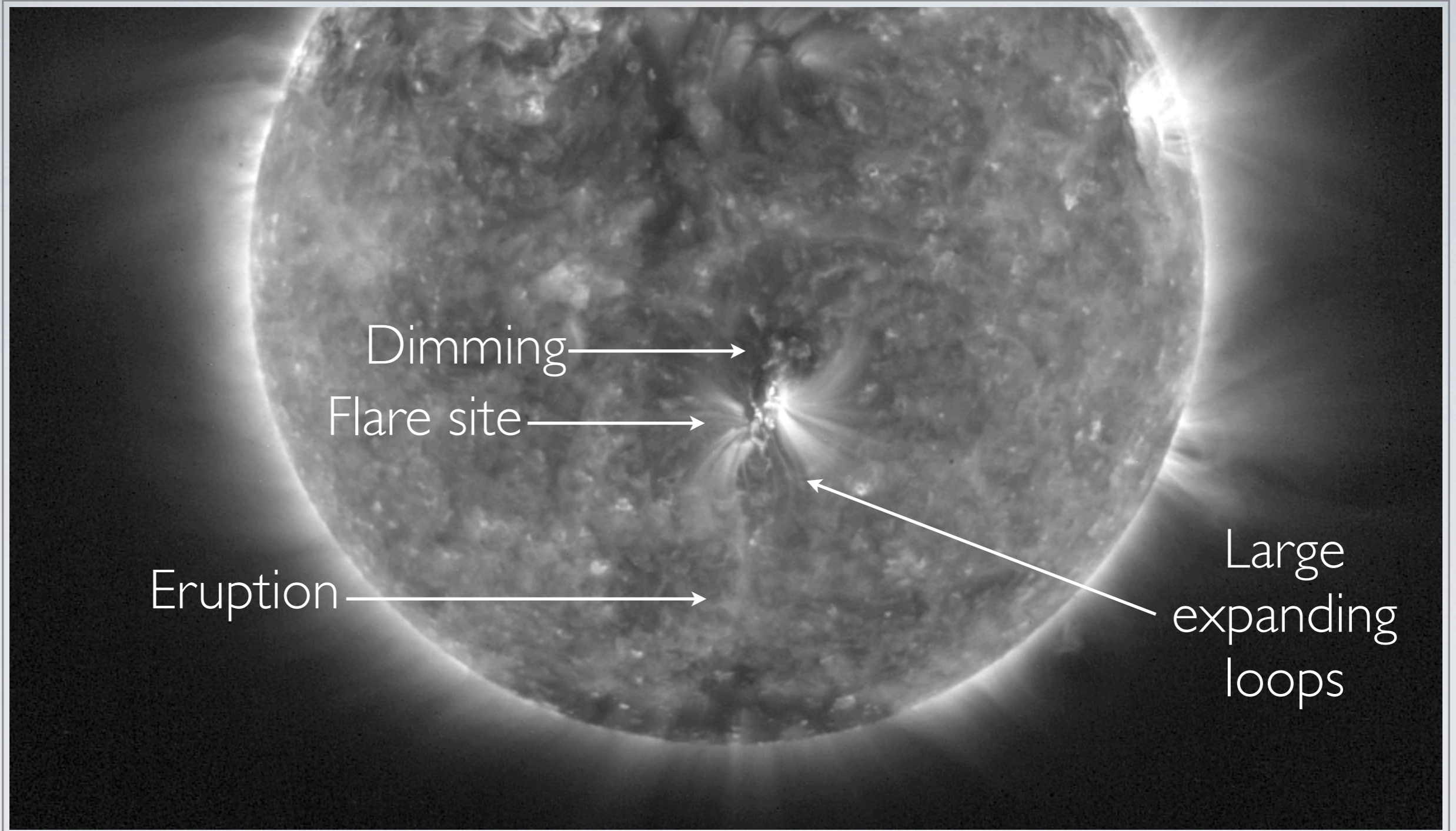
several waves associated with the flares of Feb. 5-6, 2010



PROMINENCE ERUPTION

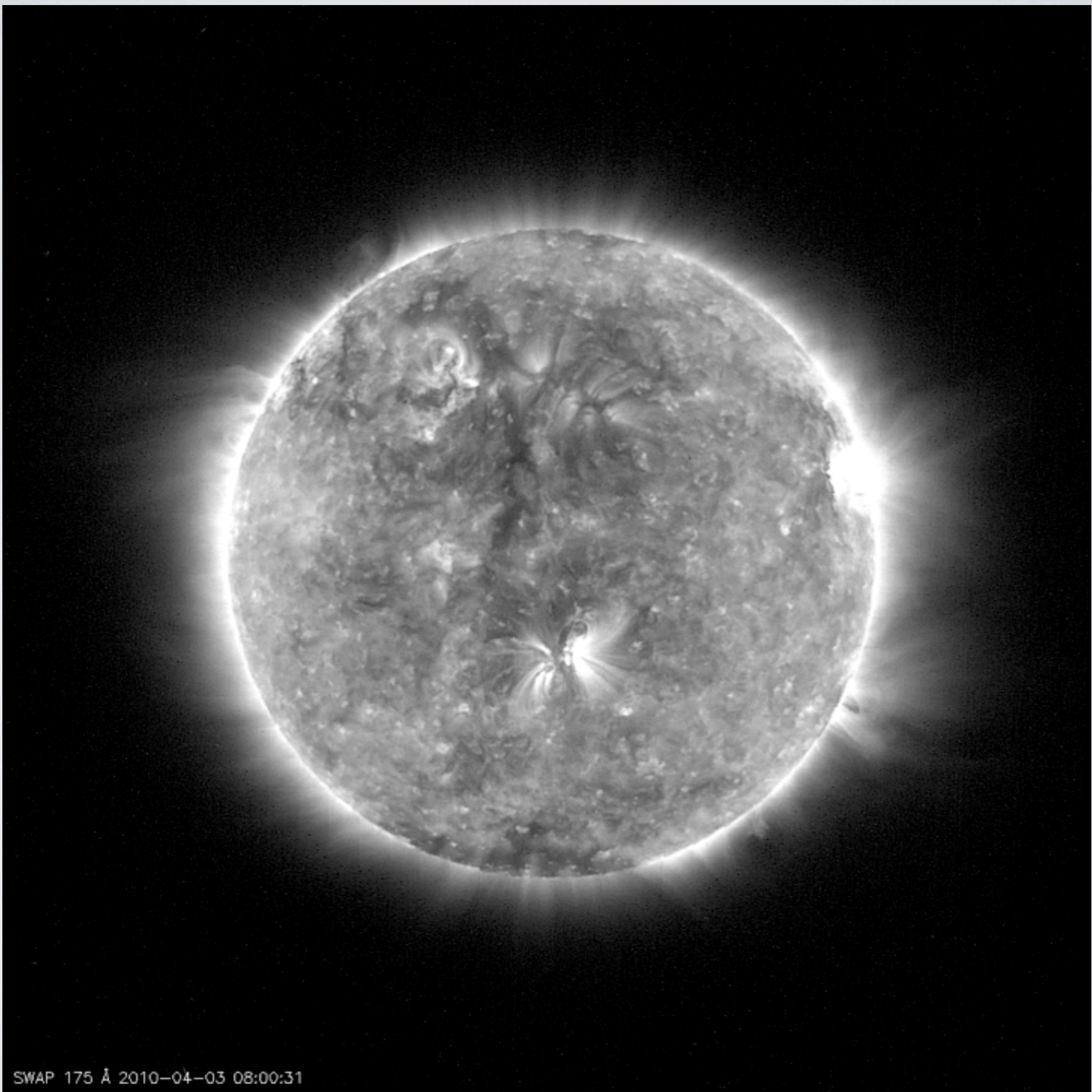
13 April 2010, 09:30 UTC



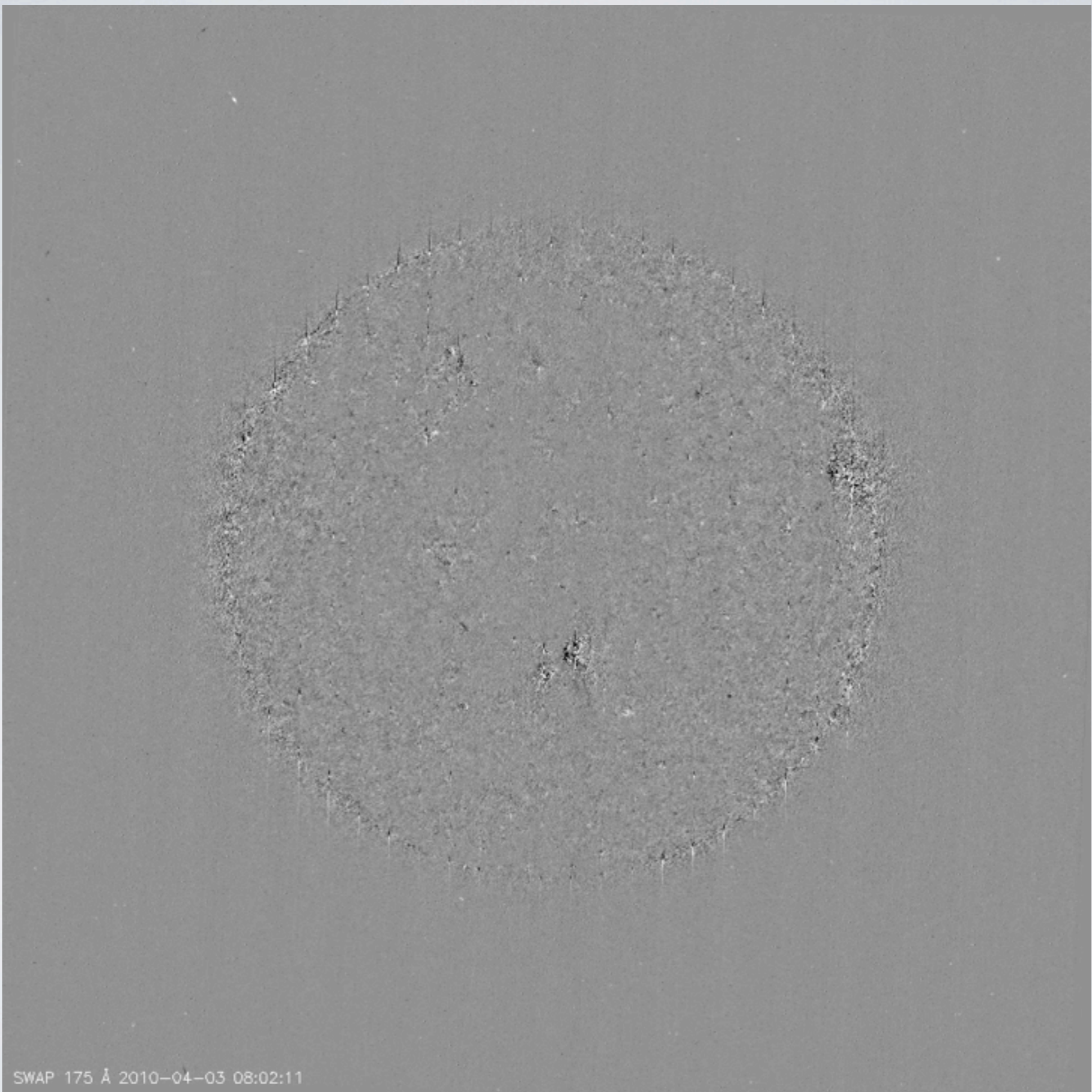


ERUPTION & FLARE

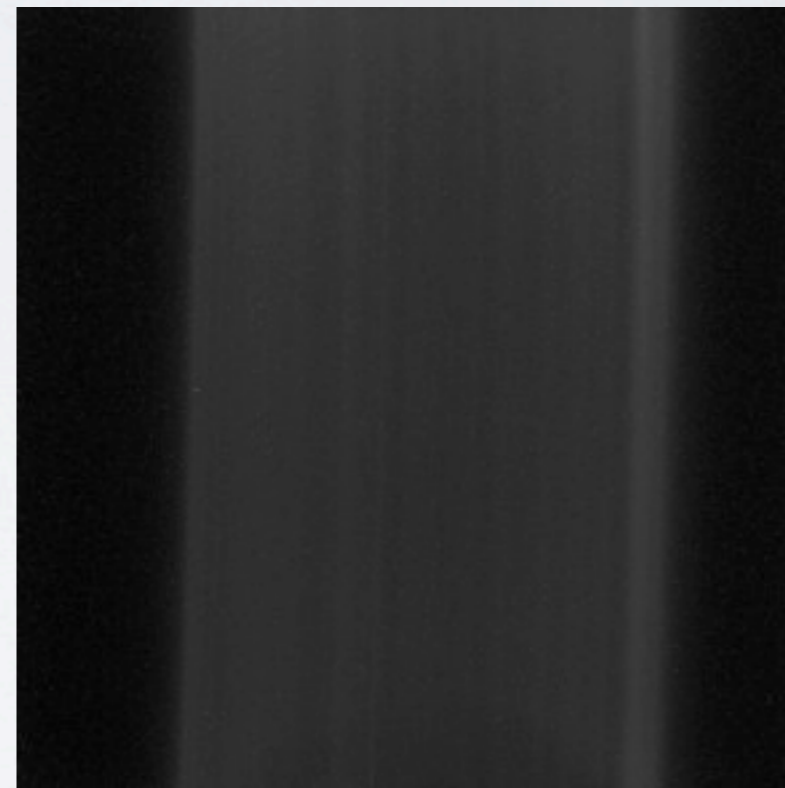
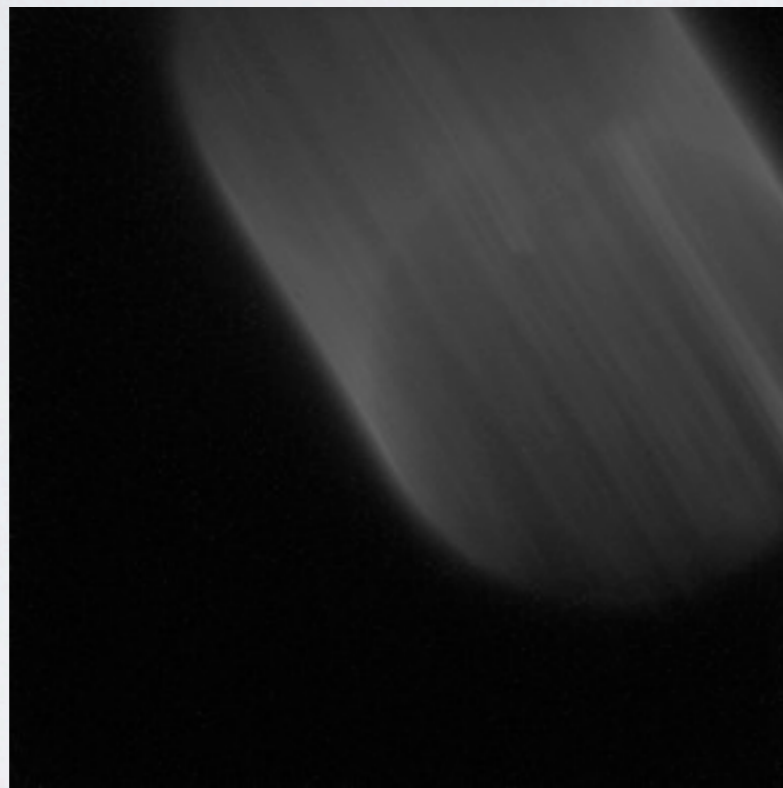
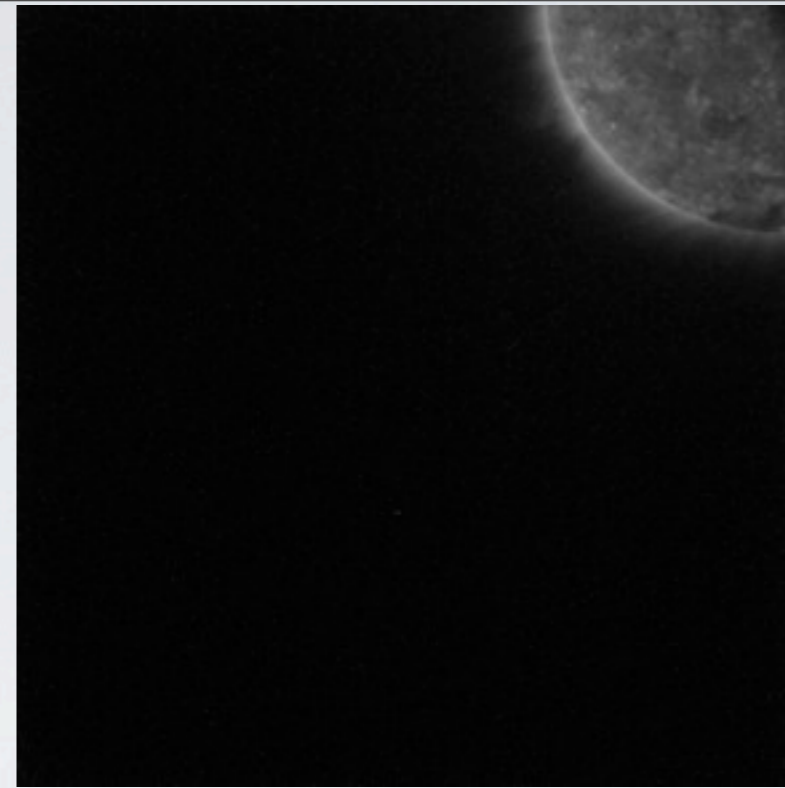
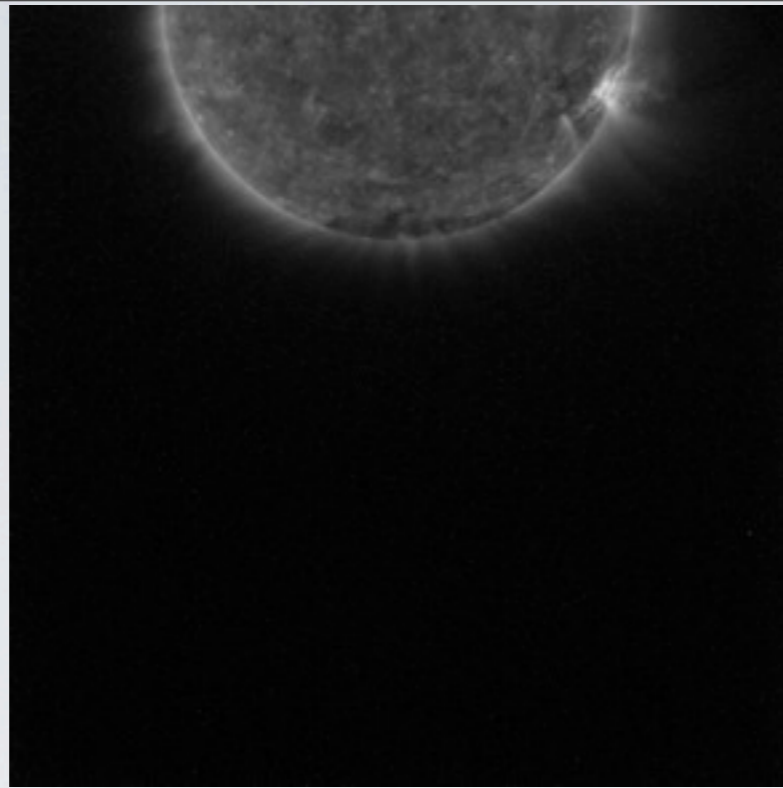
3 April 2010, 09:30 UTC ☀ B7.4 Flare ☀ Geoeffective CME



SWAP 175 Å 2010-04-03 08:00:31

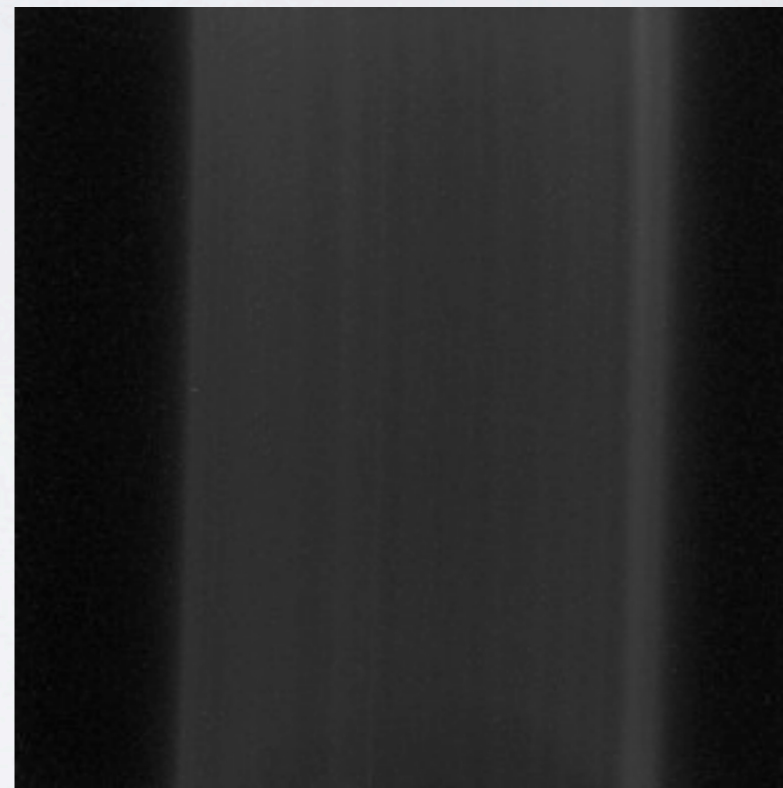
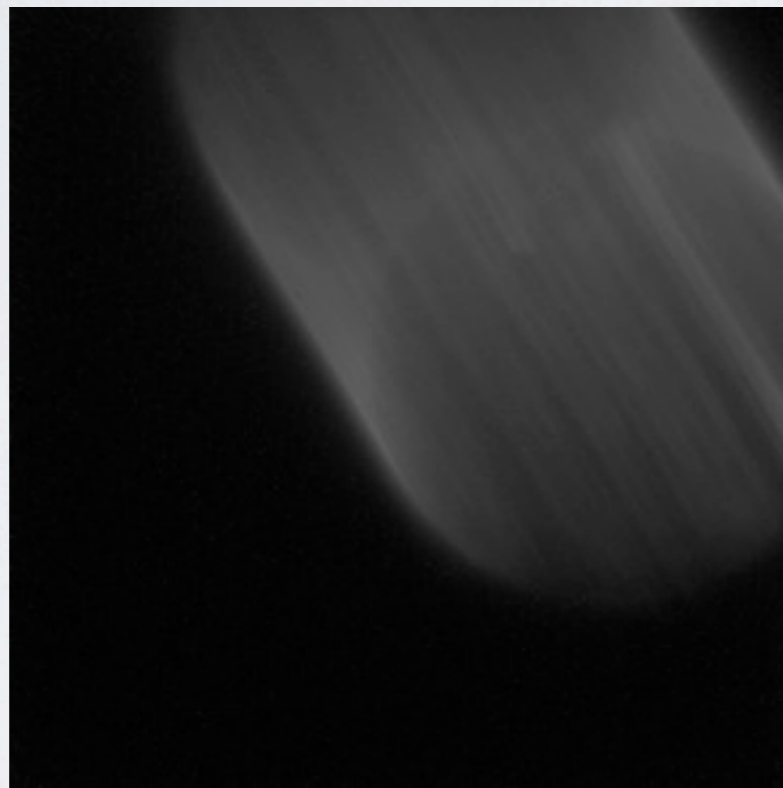
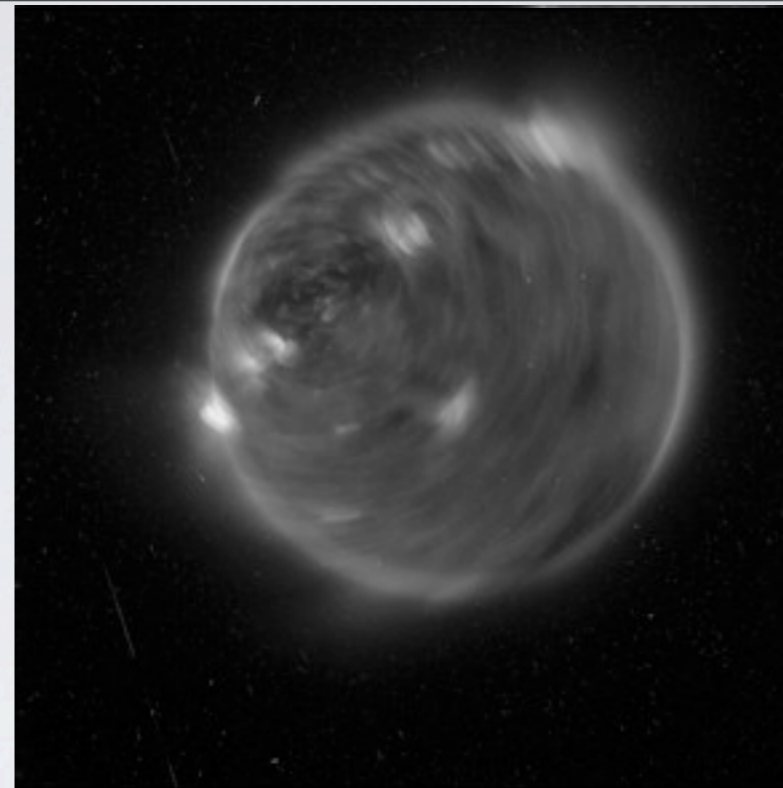
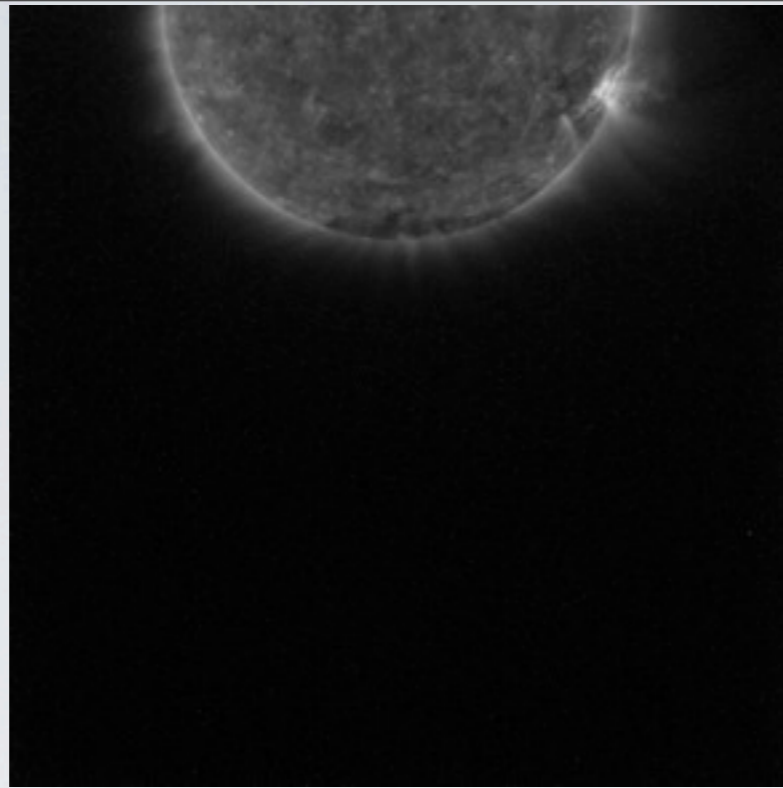


SWAP 175 Å 2010-04-03 08:02:11



OFF-POINTING

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



OFF-POINTING

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

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/>

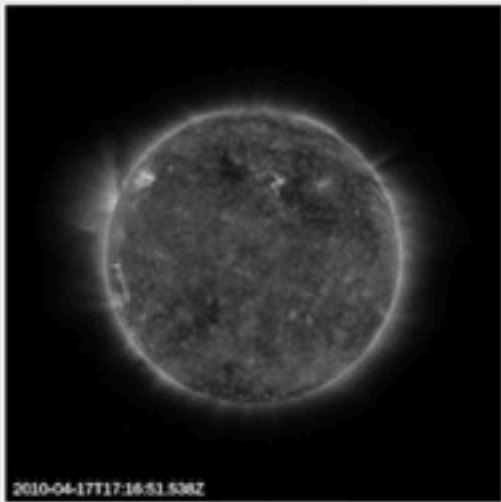
The screenshot shows a Safari browser window displaying the PROBA2 Science Center website. The browser's address bar shows the URL <http://proba2.oma.be/index.html/>. The website's header features a large banner with the text "PROBA2 SCIENCE CENTER" in yellow. Below the banner is a navigation menu with links for Home, About, SWAP, LYRA, Data, Community, Meetings, Outreach, and Gallery. A search bar and an "OK" button are also present. The main content area includes a welcome message, a SWAP image of the Moon, and LYRA data plots. A sidebar on the right contains sections for "Latest news", "Best picture", and "Best movie". The browser's status bar at the bottom shows the date and time as Friday, June 11, 2010, at 17:20.

LyraL4C20100508.gif 650x800 pixels [PROBA2 SCIENCE CENTER] CESRA 2010 La Roche en Ardenne deredactie.be: verkeer

PROBA2 SCIENCE CENTER

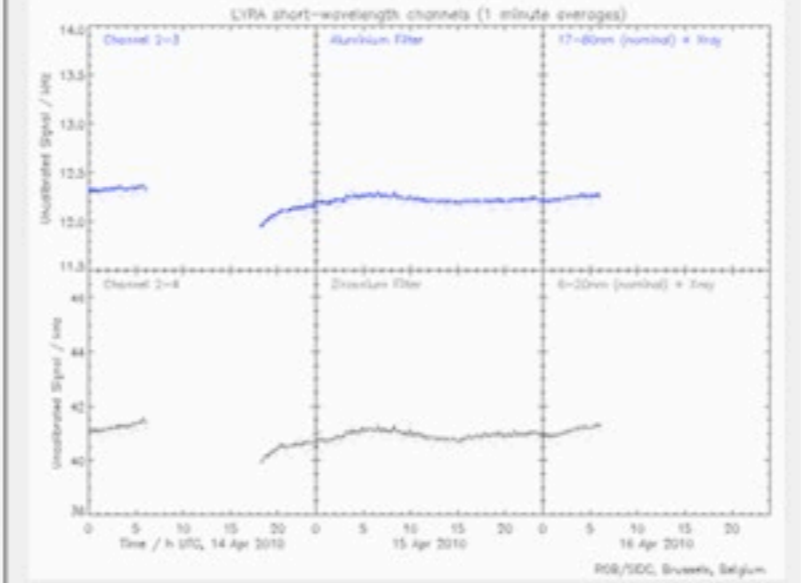
Home About SWAP LYRA Data Community Meetings Outreach Gallery OK Last update: 11th of June 2010

Welcome to the PROBA2 science center.



2010-06-17T17:16:51.536Z

[Watch the latest SWAP image](#)



LYRA short-wavelength channels (1 minute averages)

Channel	Filter	Wavelength Range
Channel 2-3	Aluminum Filter	17-80nm (summed) + Sky
Channel 2-4	Zincium Filter	6-20nm (summed) + Sky

Time / h UTC, 14 Apr 2010 15 Apr 2010 16 Apr 2010


ROB/SIDC, Brussels, Belgium

[Go to the latest LYRA curve](#)


Latest news

- 21 January 2010
PROBA2 Press Event (26 January 2010)
- 18 December 2009
SWAP First Light!
- 12 November 2009
PROBA2 Passes First Health Checks

Best picture



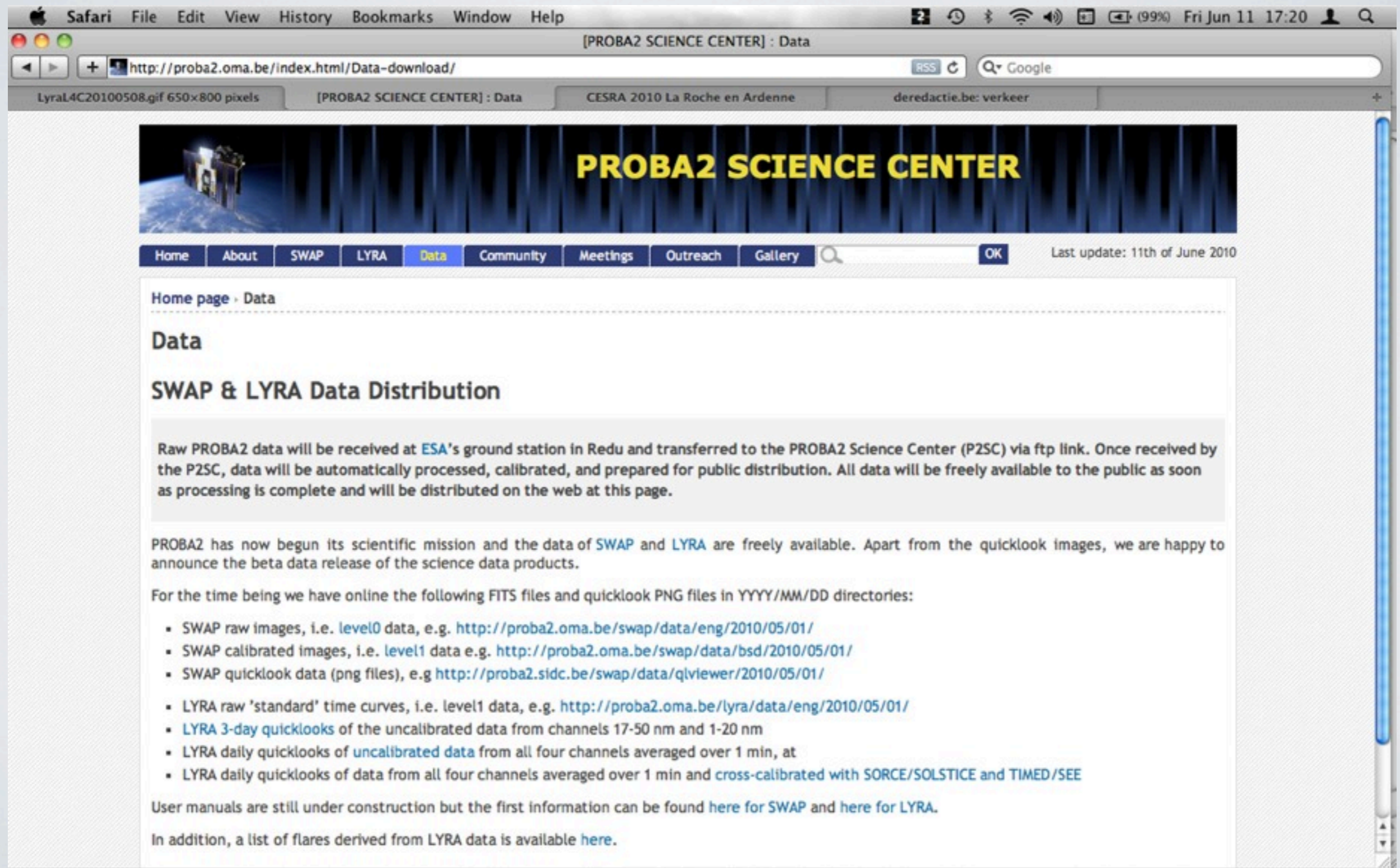
Best movie



Home page | contact | Site Map | Sign In

FOR MORE INFORMATION

<http://proba2.sidc.be/>



The screenshot shows a Safari browser window displaying the PROBA2 Science Center website. The browser's address bar shows the URL <http://proba2.oma.be/index.html/Data-download/>. The website's header features a blue background with a satellite image and the text "PROBA2 SCIENCE CENTER" in yellow. Below the header is a navigation menu with links for Home, About, SWAP, LYRA, Data (highlighted), Community, Meetings, Outreach, and Gallery. A search bar and an "OK" button are also present. The main content area is titled "Data" and "SWAP & LYRA Data Distribution". It contains a paragraph explaining that raw PROBA2 data is received at ESA's ground station in Redu and transferred to the PROBA2 Science Center (P2SC) via ftp link. It also mentions that data will be automatically processed, calibrated, and prepared for public distribution. Below this, it states that PROBA2 has now begun its scientific mission and the data of SWAP and LYRA are freely available. It lists the following FITS files and quicklook PNG files in YYYY/MM/DD directories:

- 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/>
- LYRA raw 'standard' time curves, i.e. level1 data, e.g. <http://proba2.oma.be/lyra/data/eng/2010/05/01/>
- LYRA 3-day quicklooks of the uncalibrated data from channels 17-50 nm and 1-20 nm
- LYRA daily quicklooks of uncalibrated data from all four channels averaged over 1 min, at
- LYRA daily quicklooks of data from all four channels averaged over 1 min and cross-calibrated with [SORCE/SOLSTICE](#) and [TIMED/SEE](#)

User manuals are still under construction but the first information can be found [here](#) for SWAP and [here](#) for LYRA.

In addition, a list of flares derived from LYRA data is available [here](#).