MONITORING SOLAR ACTIVITY WITH PROBA2

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Royal Observatory of Belgium

Space Weather Workshop ☀ Boulder, Colorado ☀ April 30, 2010

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INTRODUCTION TO PROBA2

PROBA2 LAUNCH

November 2, 2009, 01:50:51 UTC ☀ Plesetsk, Russia

SPACECRAFT SEPARATION

November 2, 2009, 04:50:06 UTC ☀ 725 km altitude

ESA'S PROBA2 PROGRAM

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

ESA'S PROBA2 PROGRAM

4 science instruments: SWAP, LYRA, TPMU, DSLP
17 platform technology experiments

PROBA2 INSTRUMENTATION

Sun **W**atcher with **A**ctive Pixel System & Image **P**rocessing

PROBA2 INSTRUMENTATION

Large **Y**ield **Ra**diometer

PROBA2 INSTRUMENTATION

Thermal **P**lasma **M**easurement **U**nit

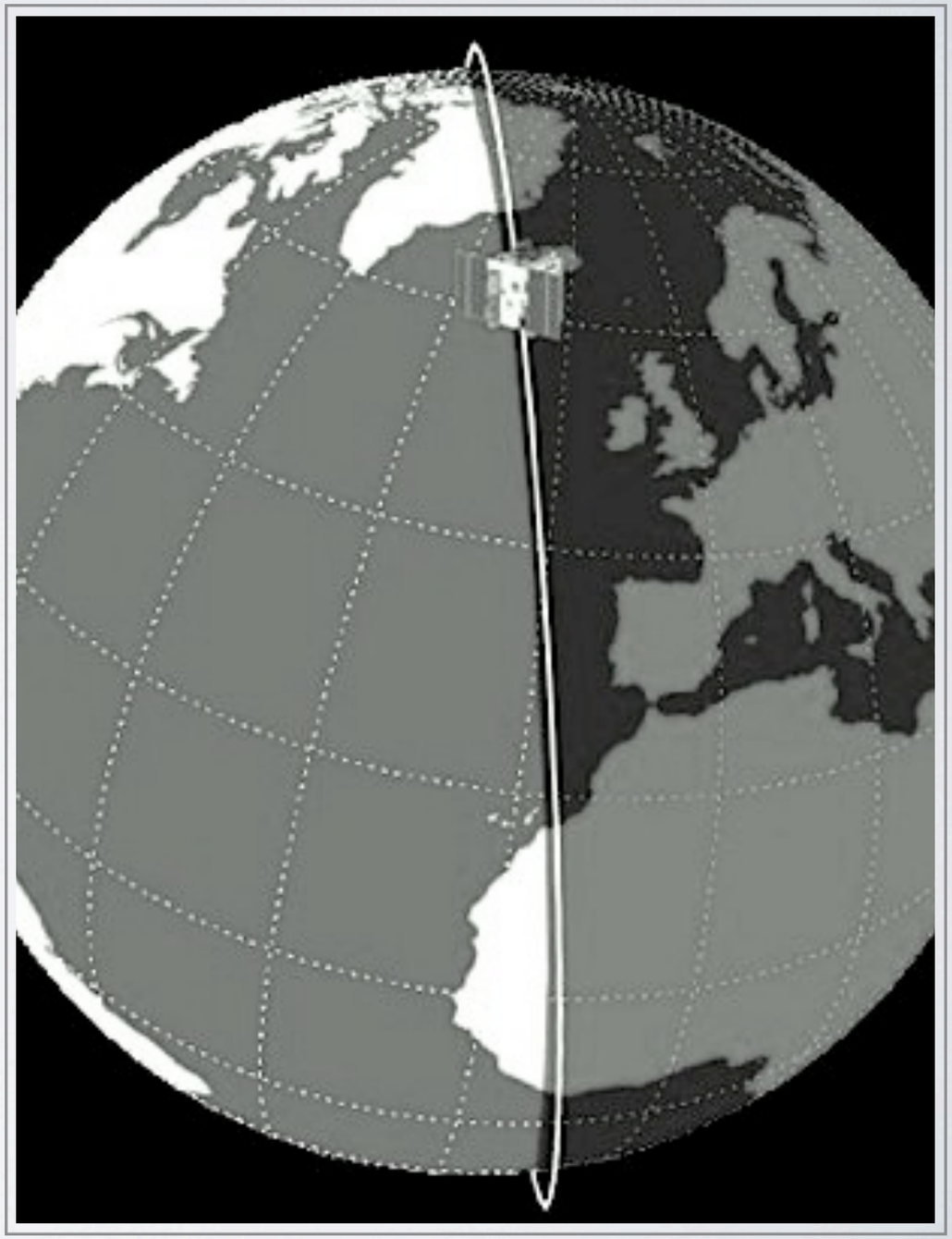
PROBA2 INSTRUMENTATION

Dual-**S**egmented **L**angmuir **P**robe

ORBIT

Polar Sun-Synchronous

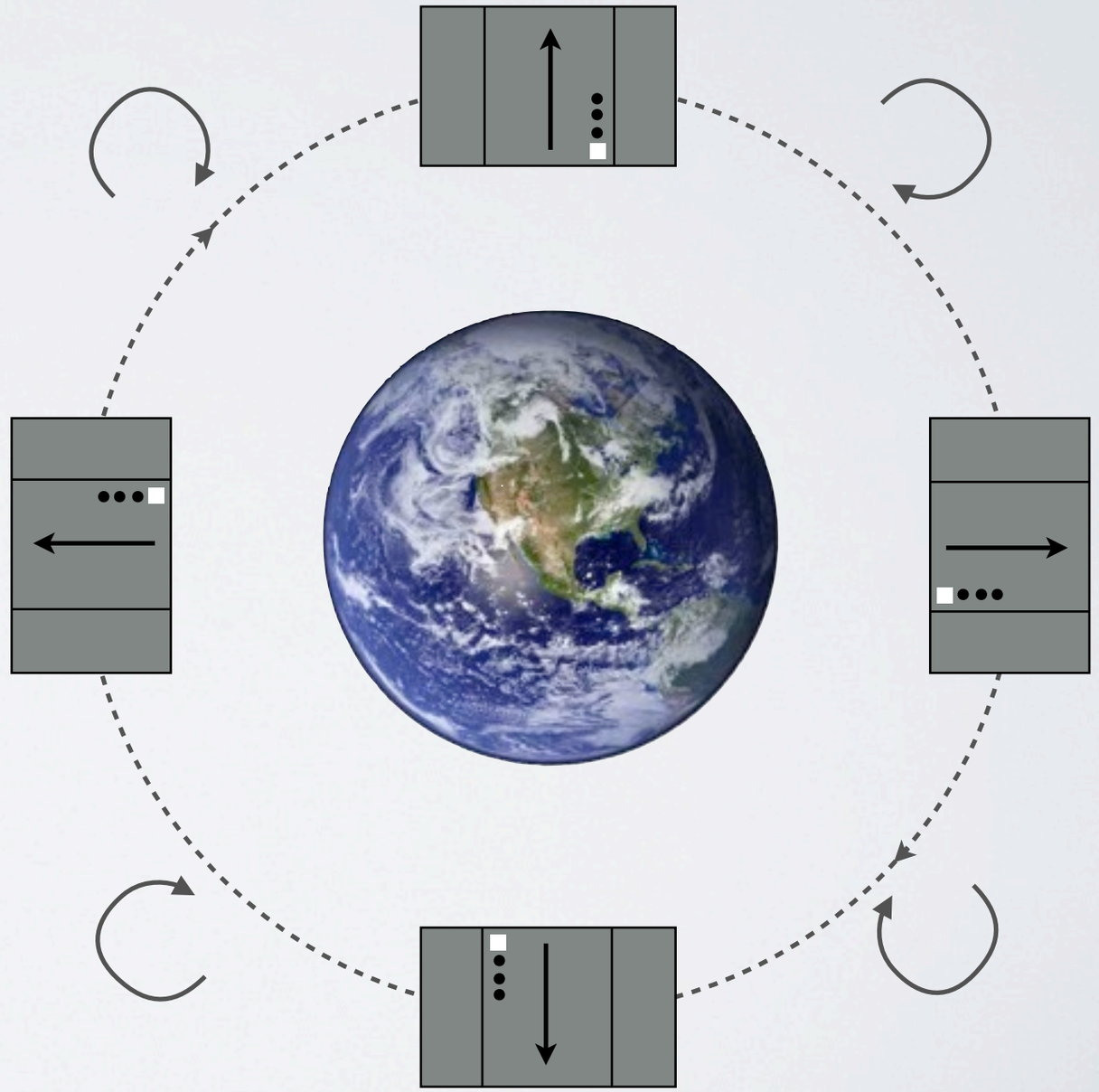
725 km altitude



ORBIT

≈90 minute period

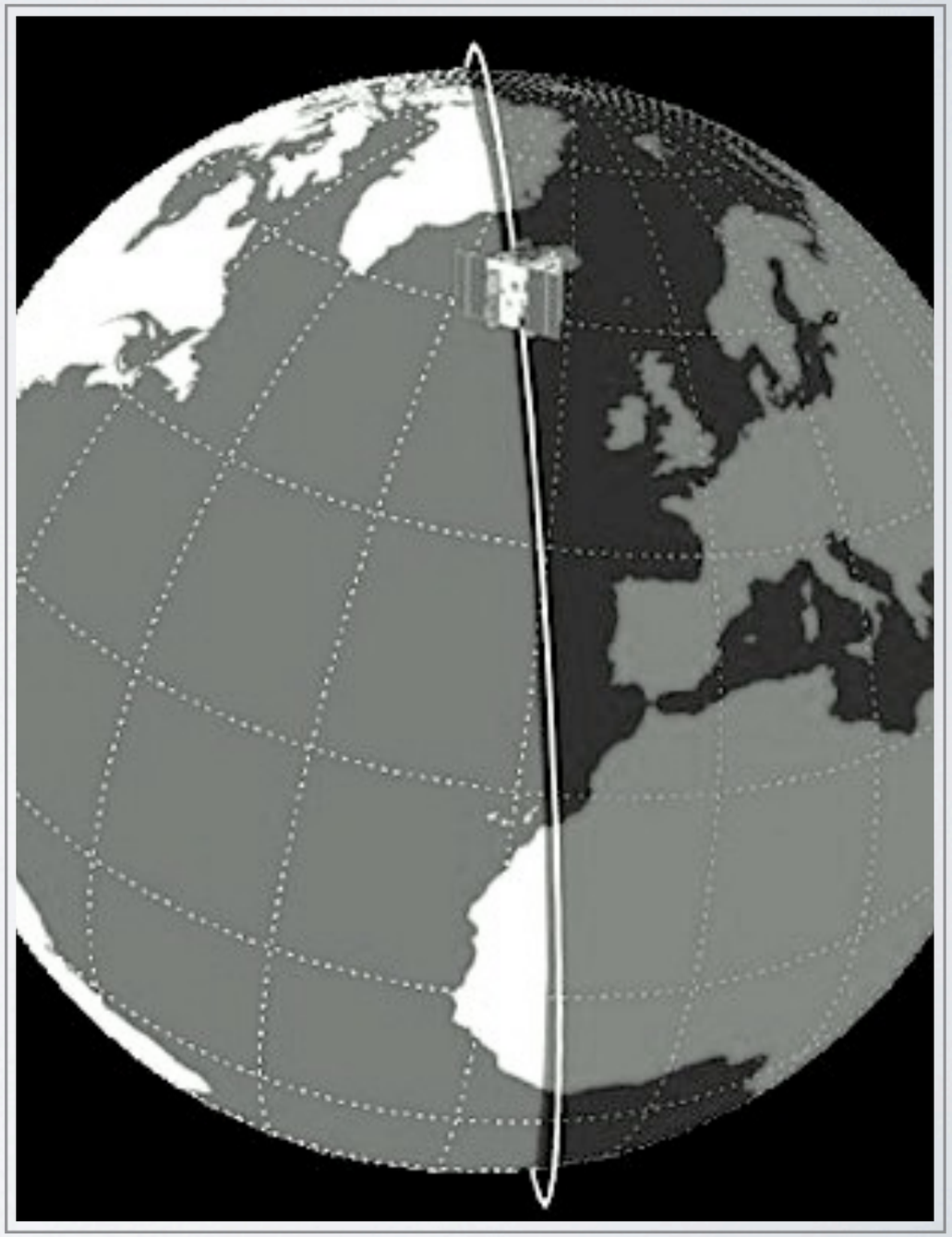
Large Angle Rotations
every 20 minutes



ORBIT

Eclipse season:

- Visible: November-January
- EUV: Slightly longer
- Maximum duration 18 min per orbit



GROUND STATIONS

Redu (Belgium) & Svalbard (Norway)

≈8 data downlinks/day

PROBA2 SCIENCE CENTER

Data processed & stored at ROB
Available in real time +30 min

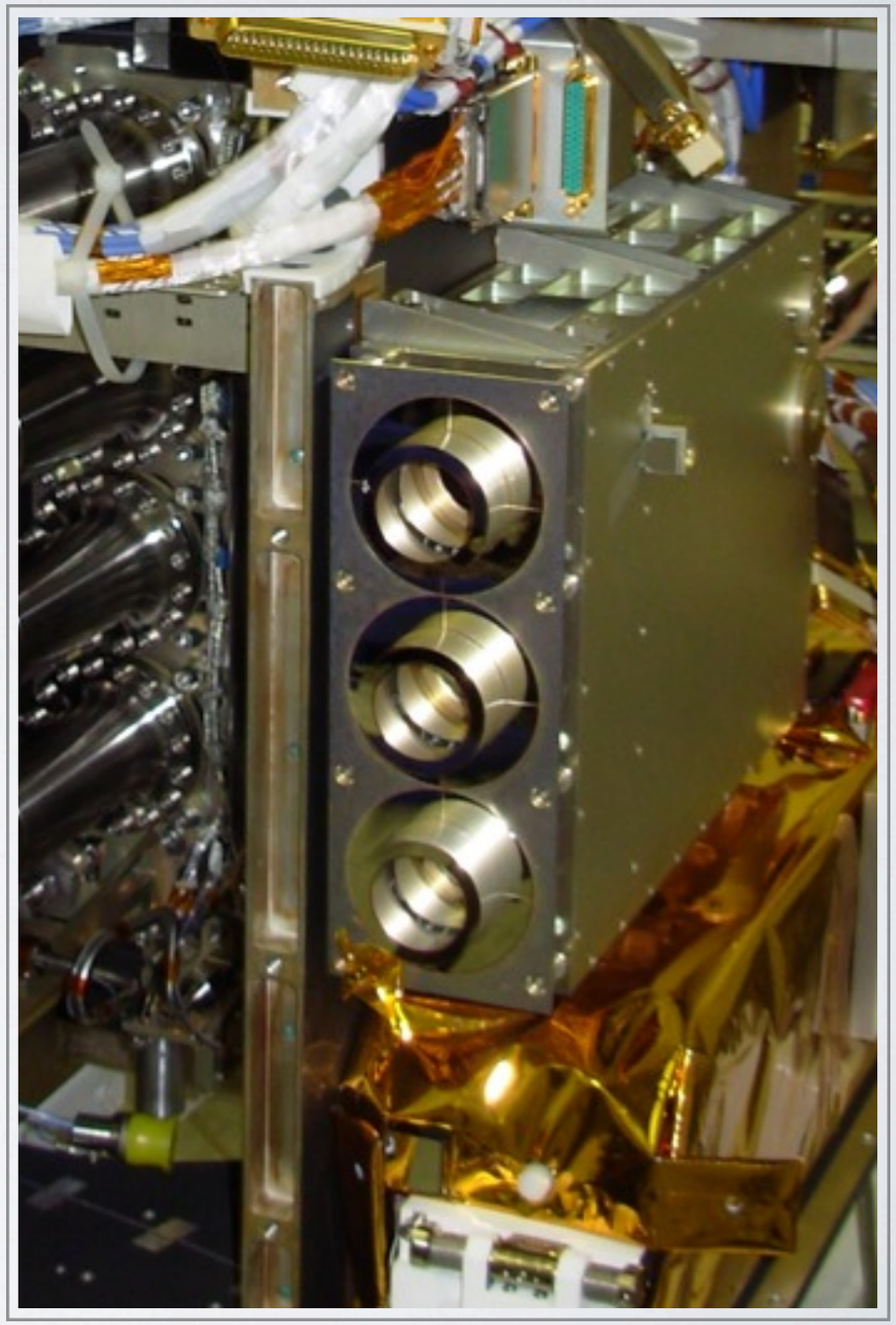
LYRA

PI: Jean-François Hochedez

INSTRUMENT OVERVIEW

Three detector heads

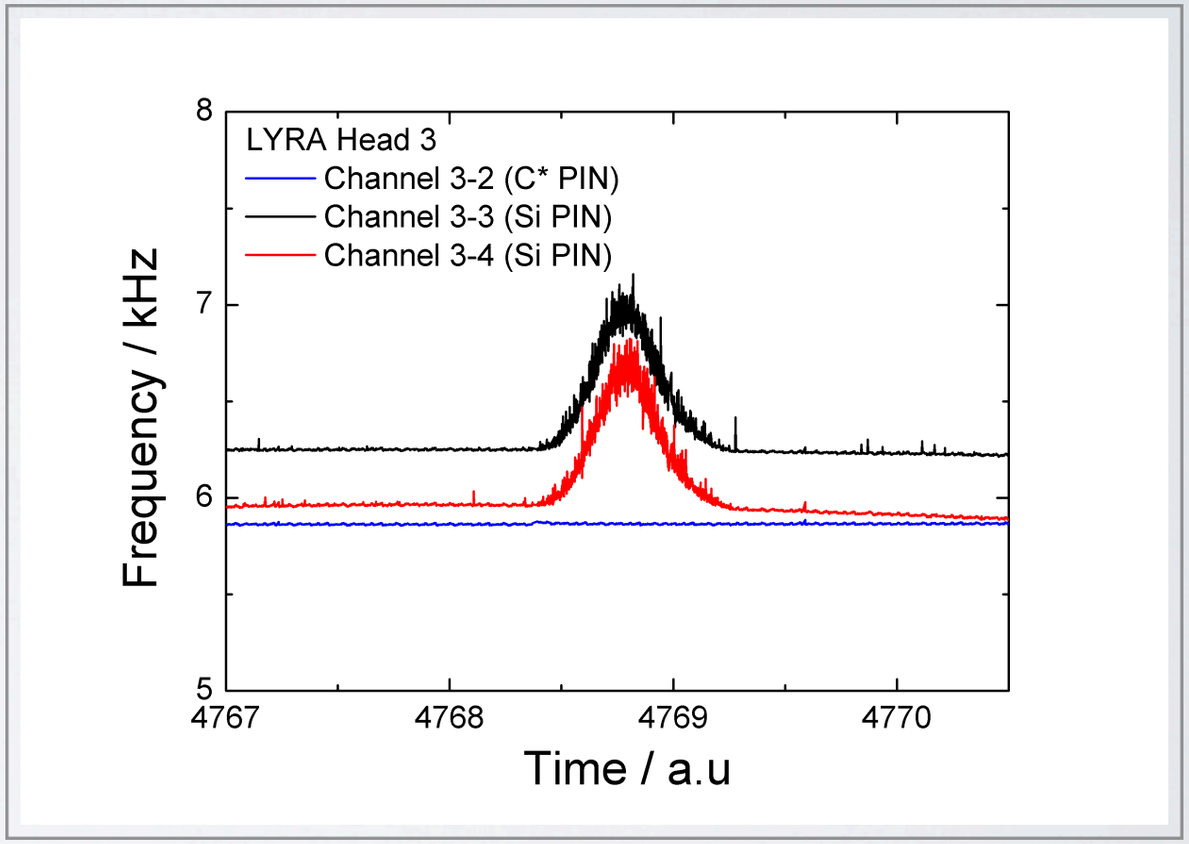
Four spectral channels per head



INSTRUMENT OVERVIEW

Diamond-Based Detectors:

Radiation & degradation resistant

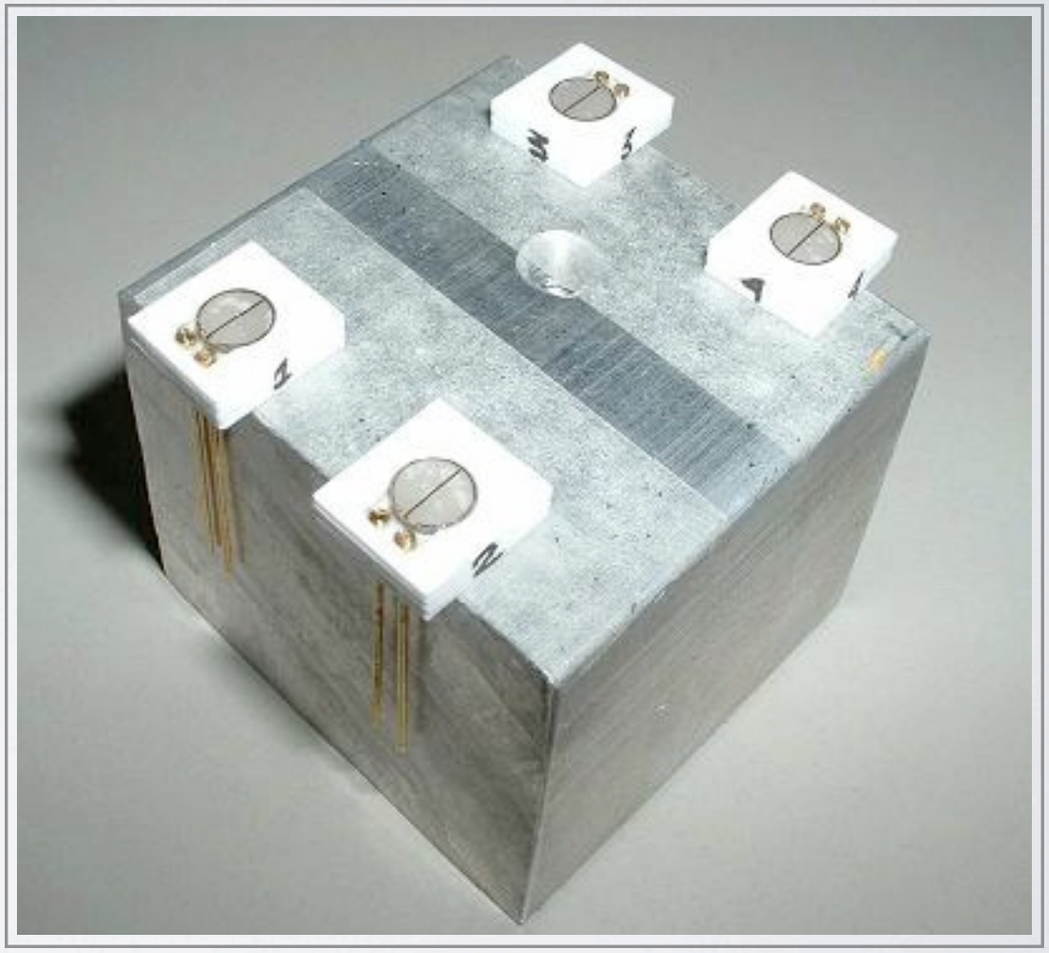


LYRA in South Atlantic Anomaly

INSTRUMENT OVERVIEW

Diamond-Based Detectors:

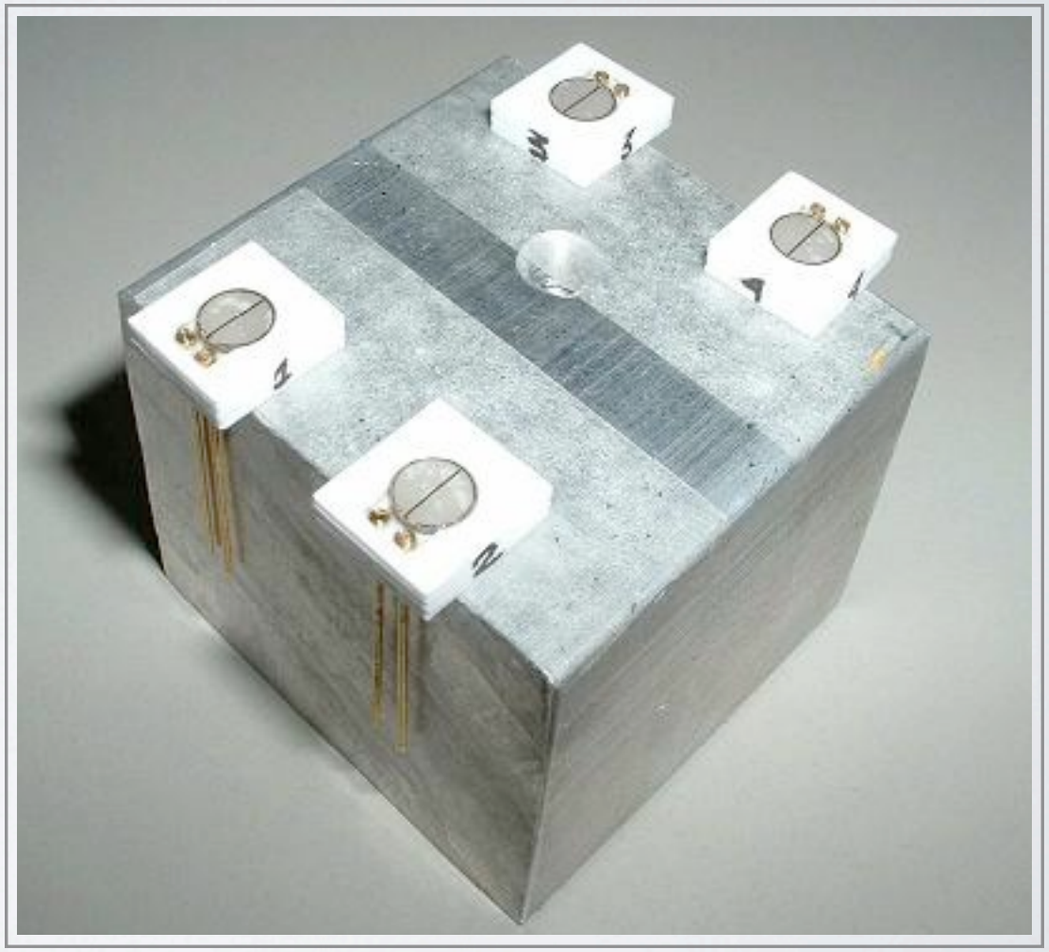
High sensitivity & linear response



INSTRUMENT OVERVIEW

Diamond-Based Detectors:

Insensitive to visible light
compared to Si detectors



INSTRUMENT OVERVIEW

Herzberg Continuum:
200-220 nm

Lyman-α: 120-123 nm

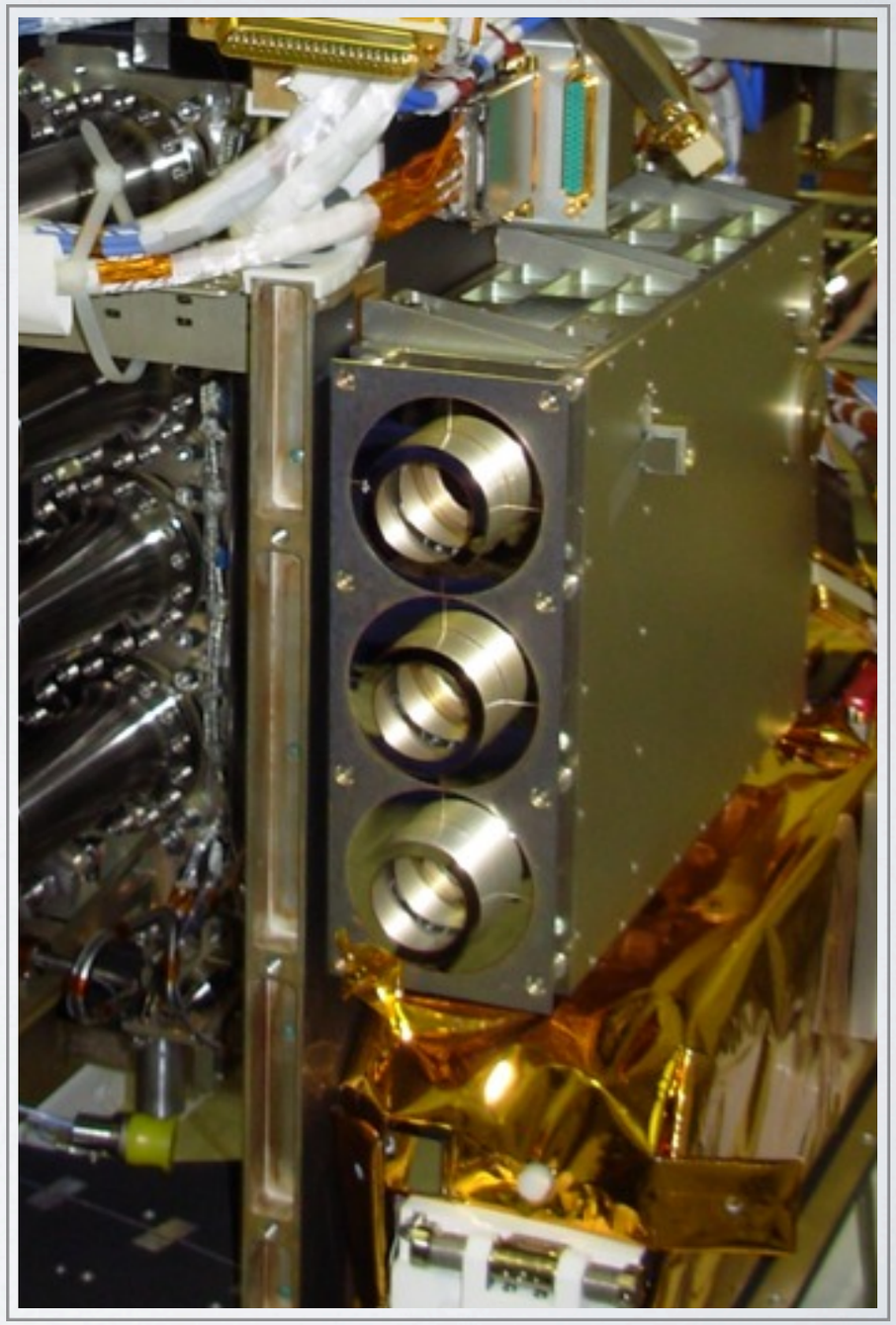
Aluminum Filter: 17-80 nm
(includes He II at 30.4 nm)

Zirconium Filter: 1-20 nm

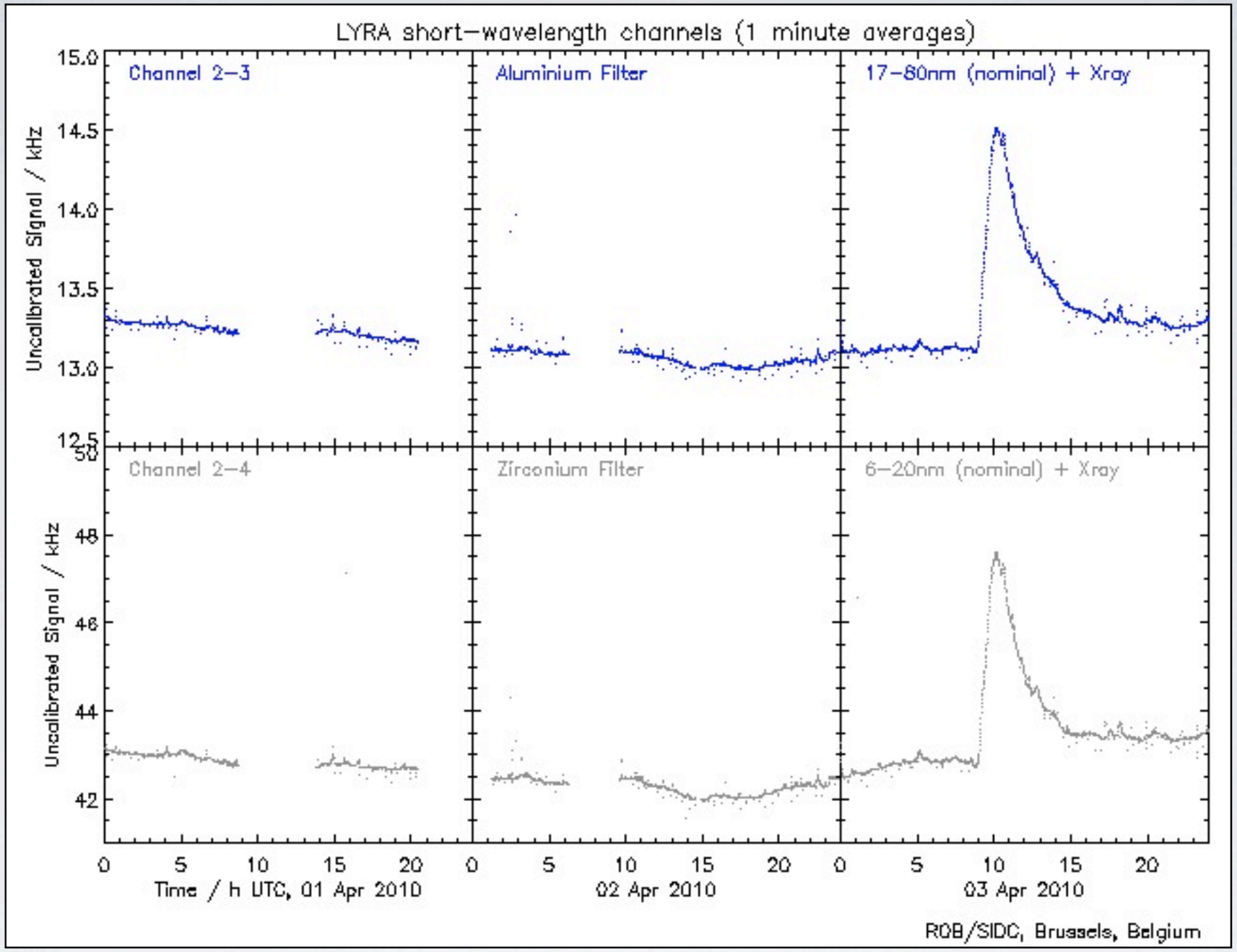
	Ly	Hz	Al	Zr
Unit 1	**MSM**	**PiN**	**MSM**	Si
Unit 2	**MSM**	**PiN**	**MSM**	**MSM**
Unit 3	Si	**PiN**	Si	Si

INSTRUMENT OVERVIEW

High cadence observations
(up to 100 Hz)



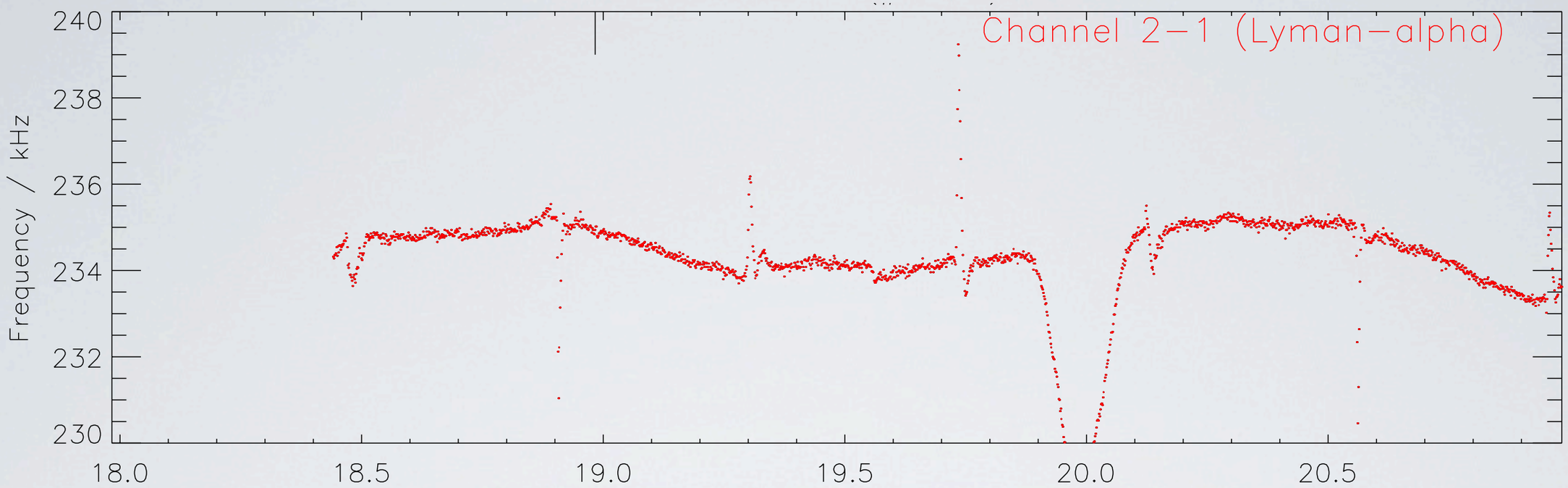
LYRA DATA



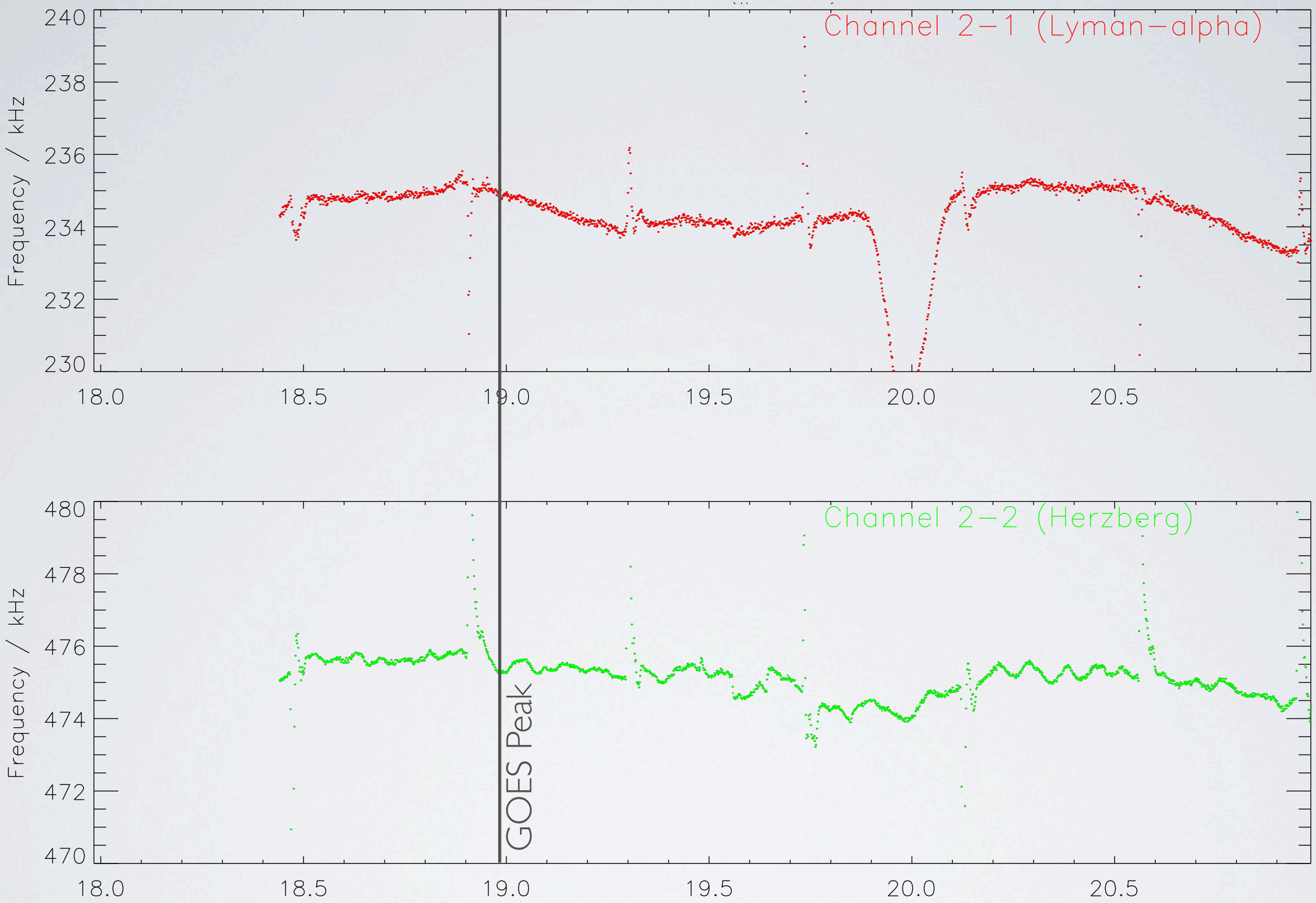
LYRA DATA PRODUCTS

Daily Overview Light Curves

http://proba2.sidc.be/



M2.9 Flare, 6 February 2010



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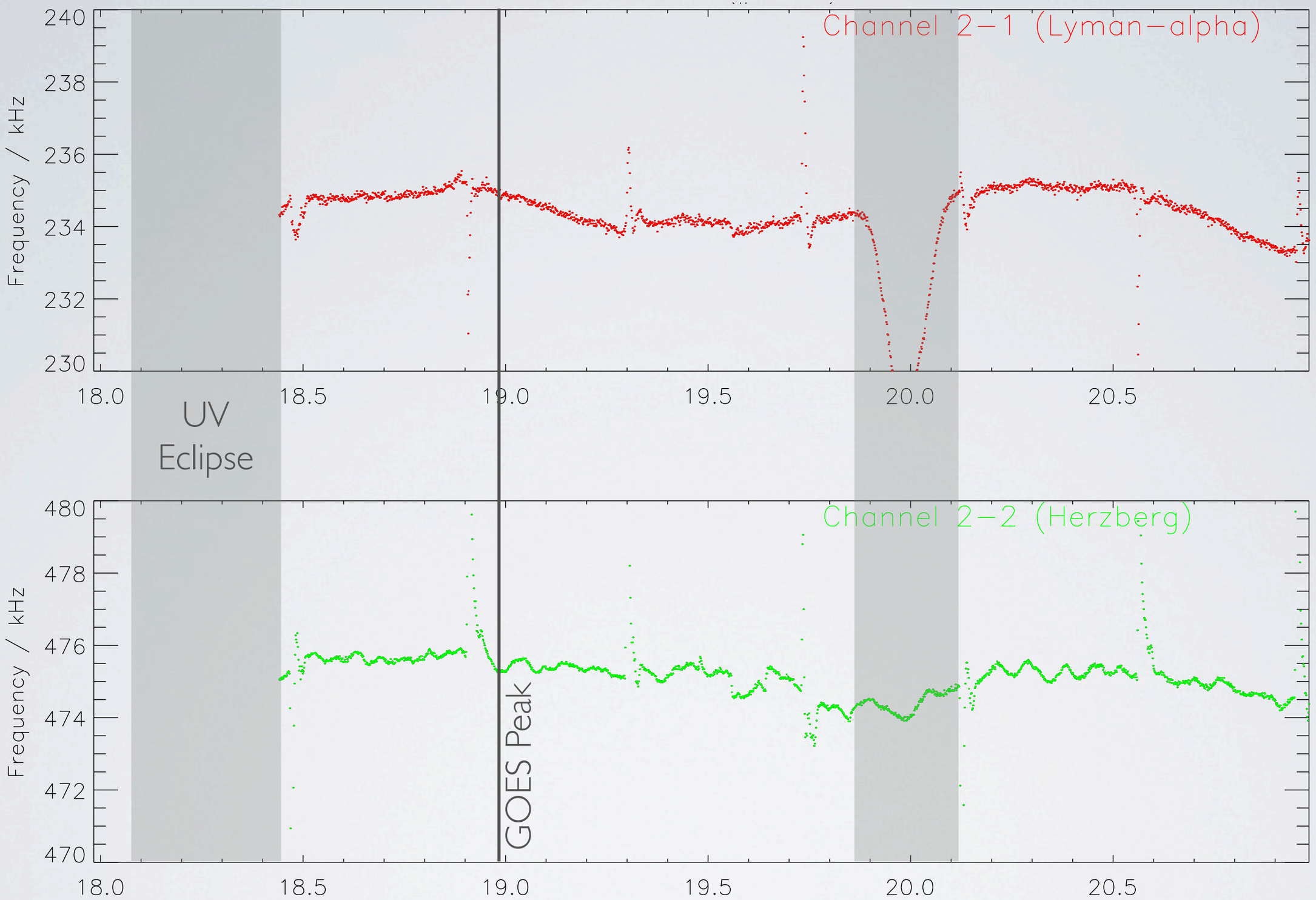

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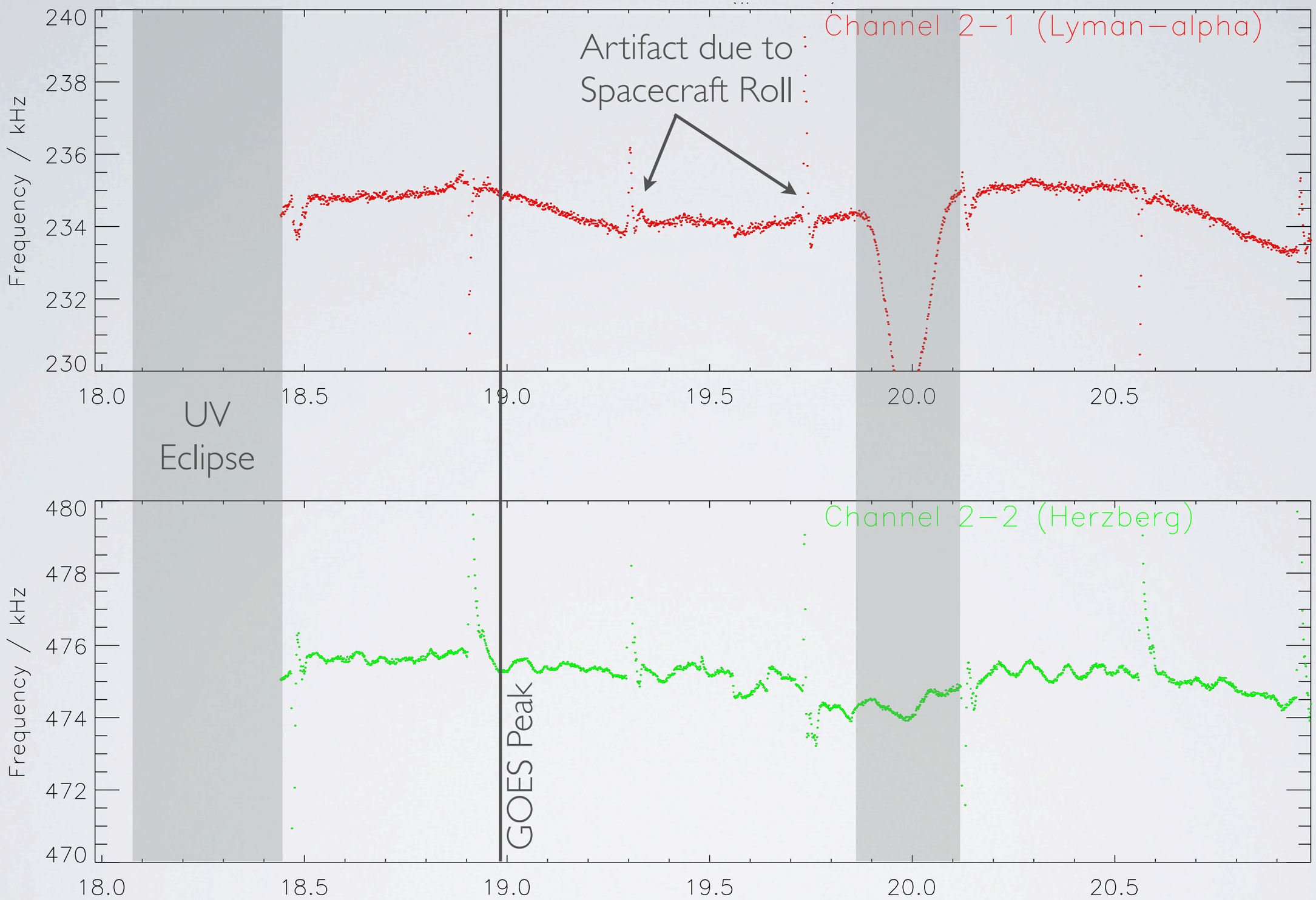

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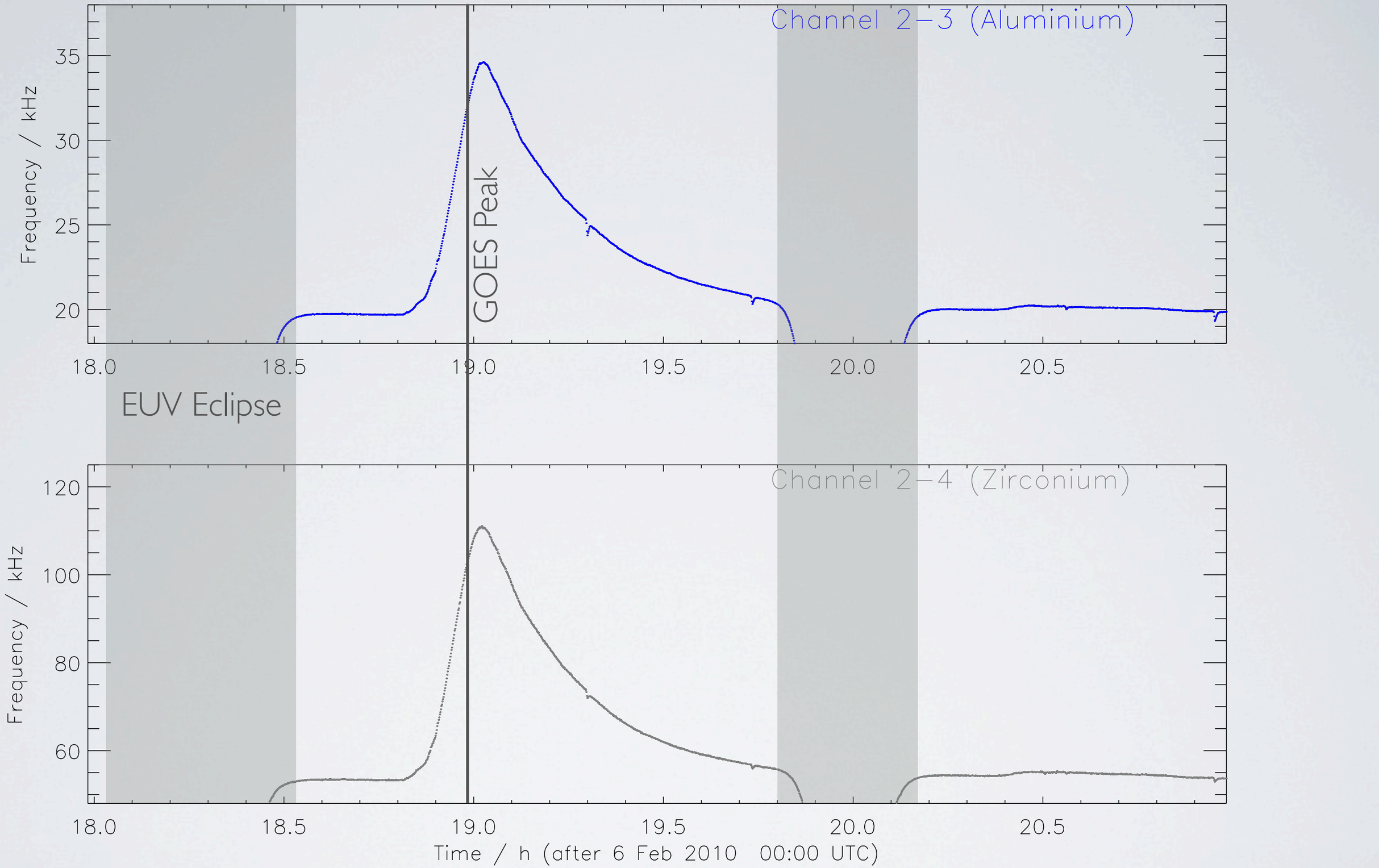
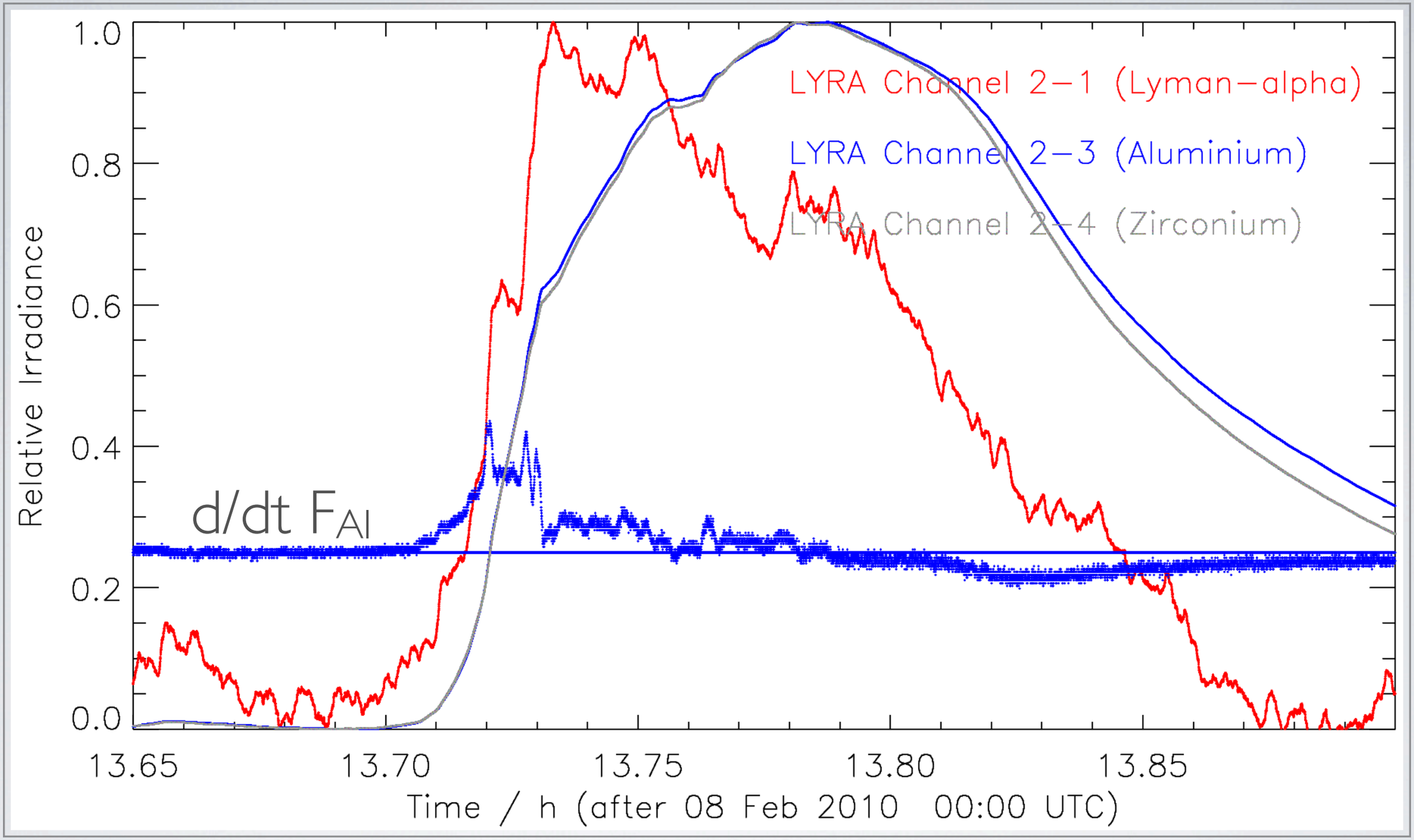
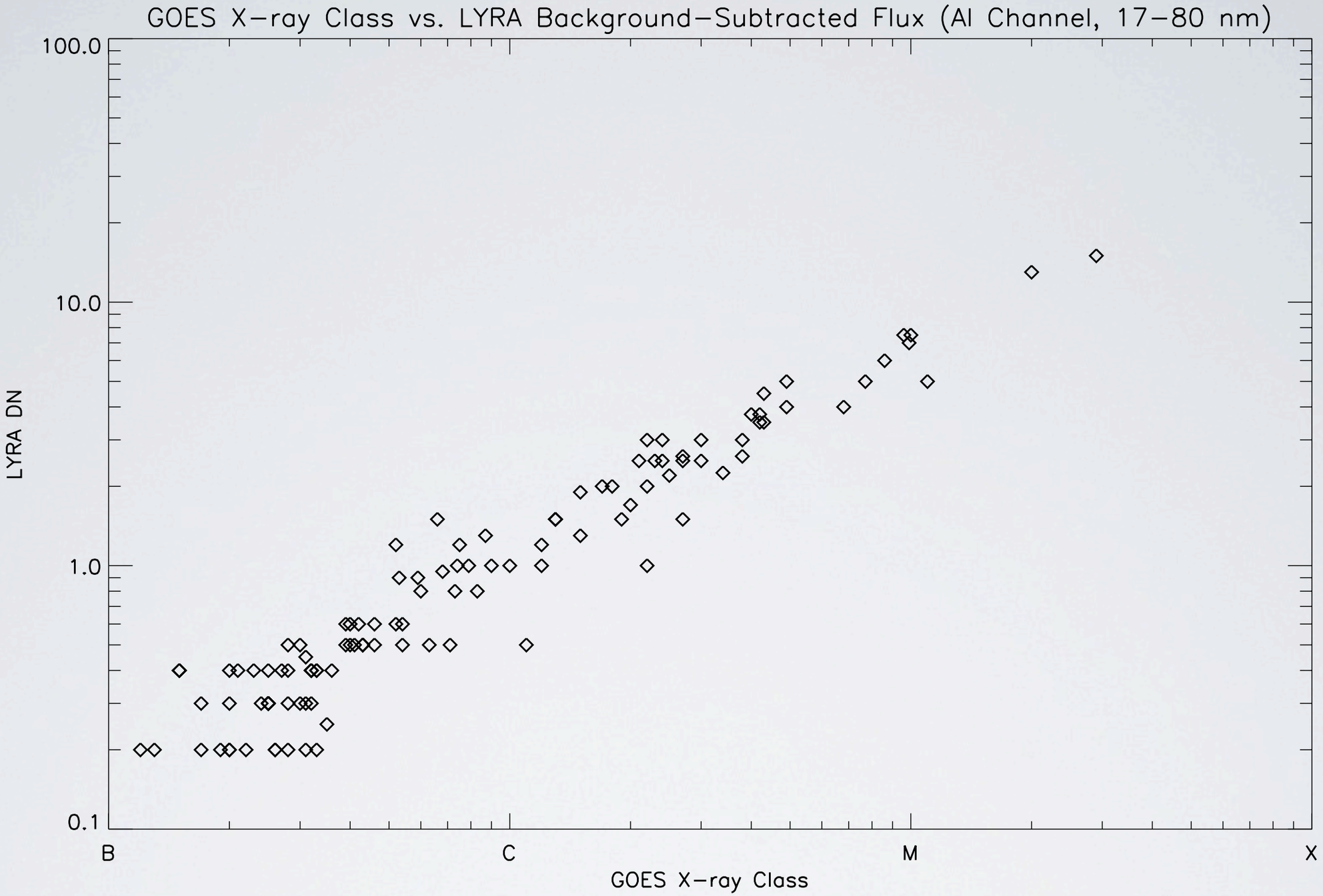


M2.9 Flare, 6 February 2010

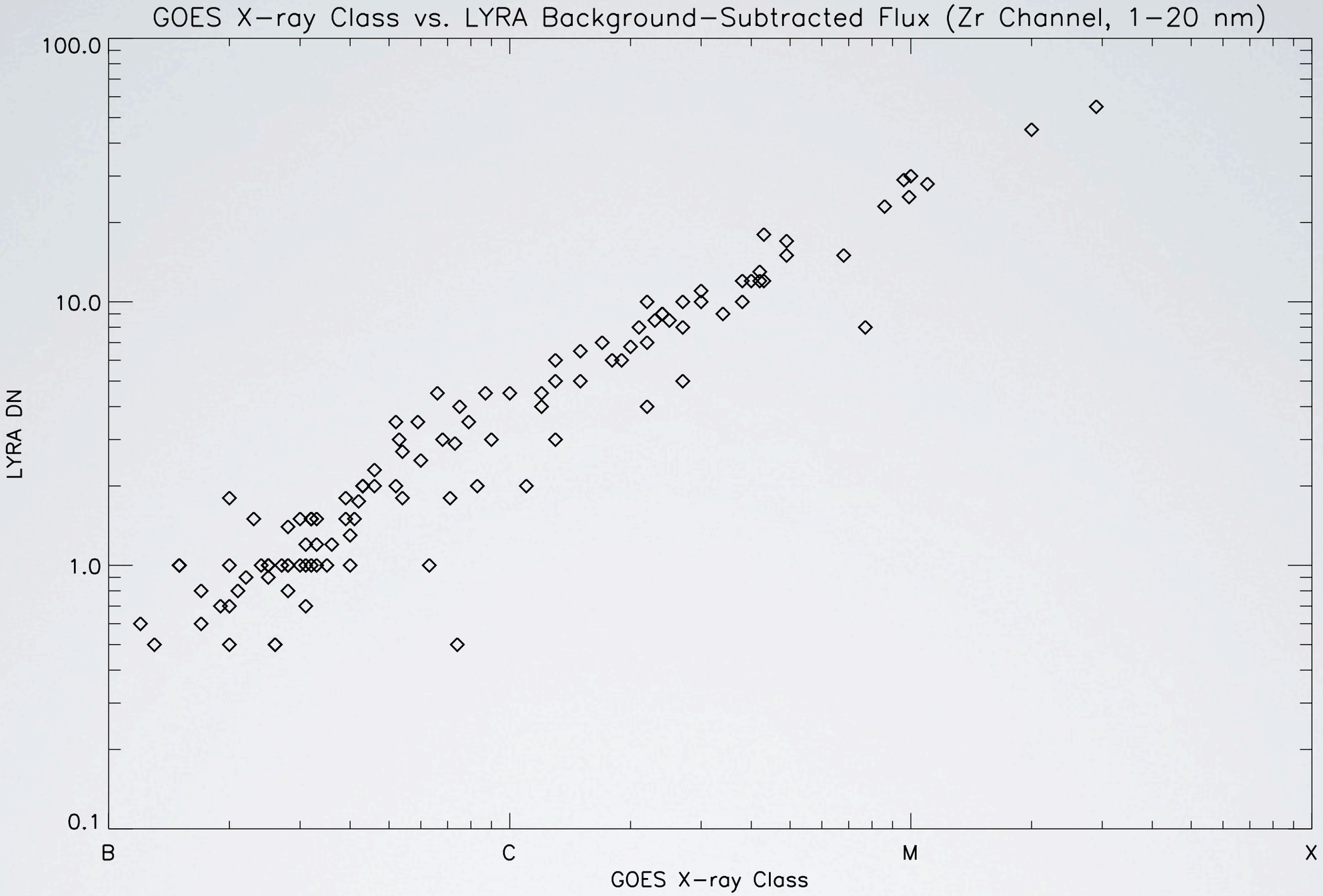


M2.0 Flare, 8 February 2010



LYRA & GOES FLUX

Flares observed in 2010, LYRA Al Channel

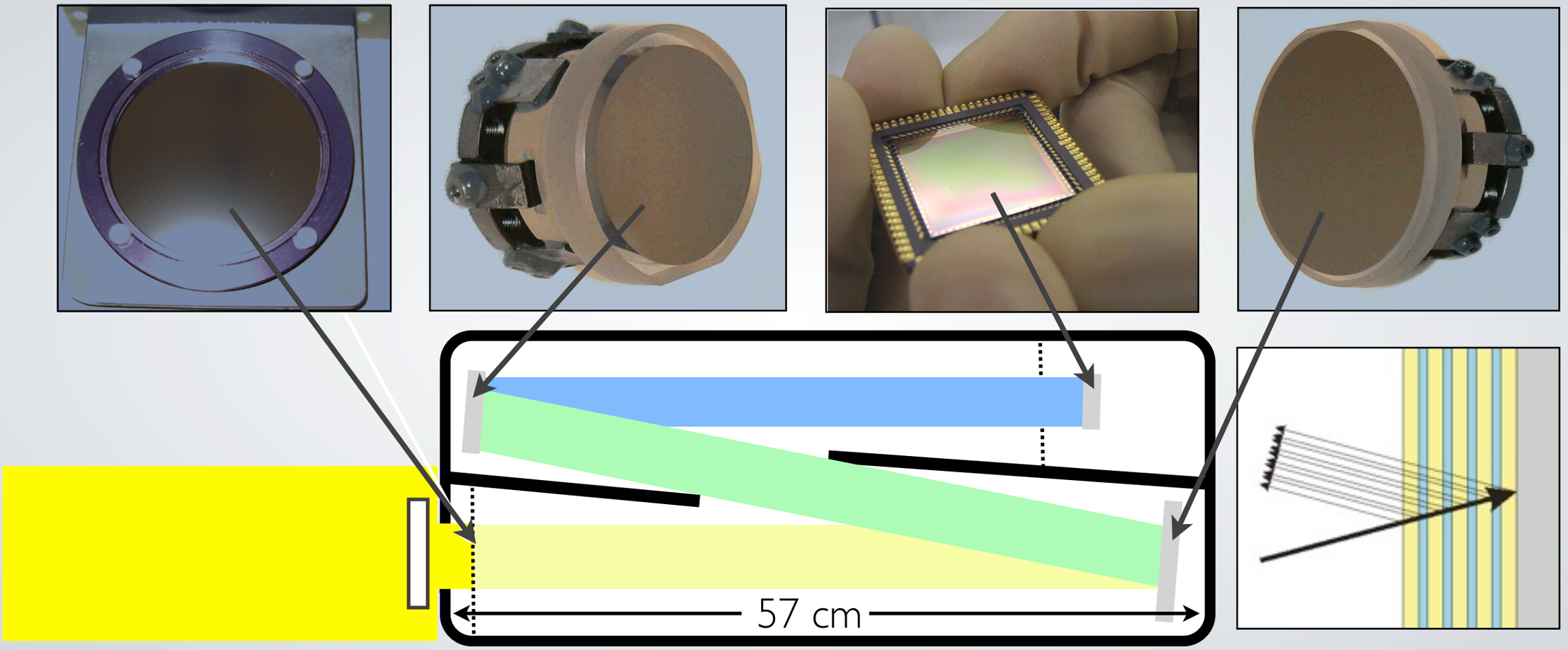


LYRA & GOES FLUX

Flares observed in 2010, LYRA Zr Channel

SWAP

PI: David Berghmans

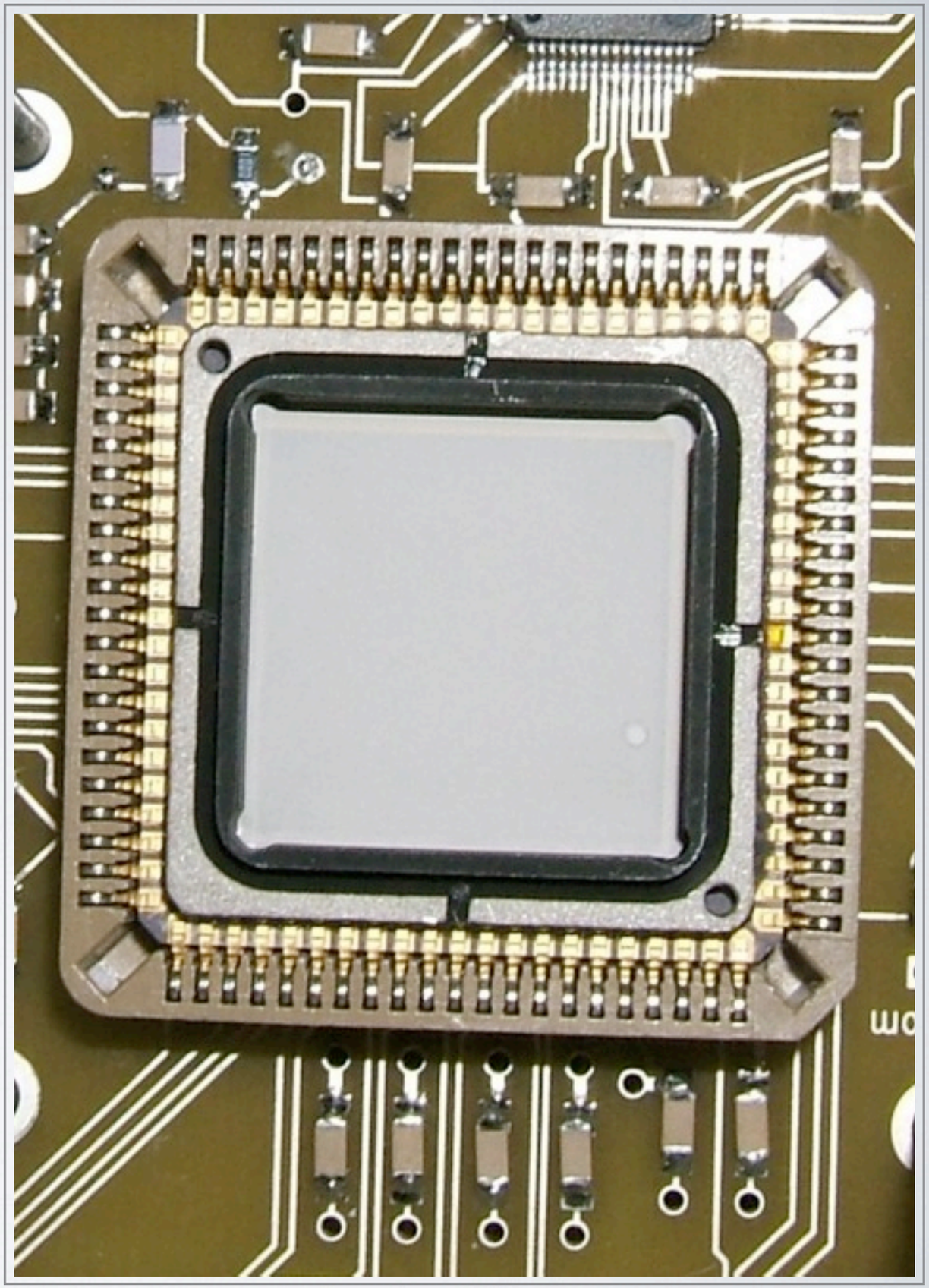


OPTICAL PATH

Off-Axis Ritchey-Chrétien Scheme

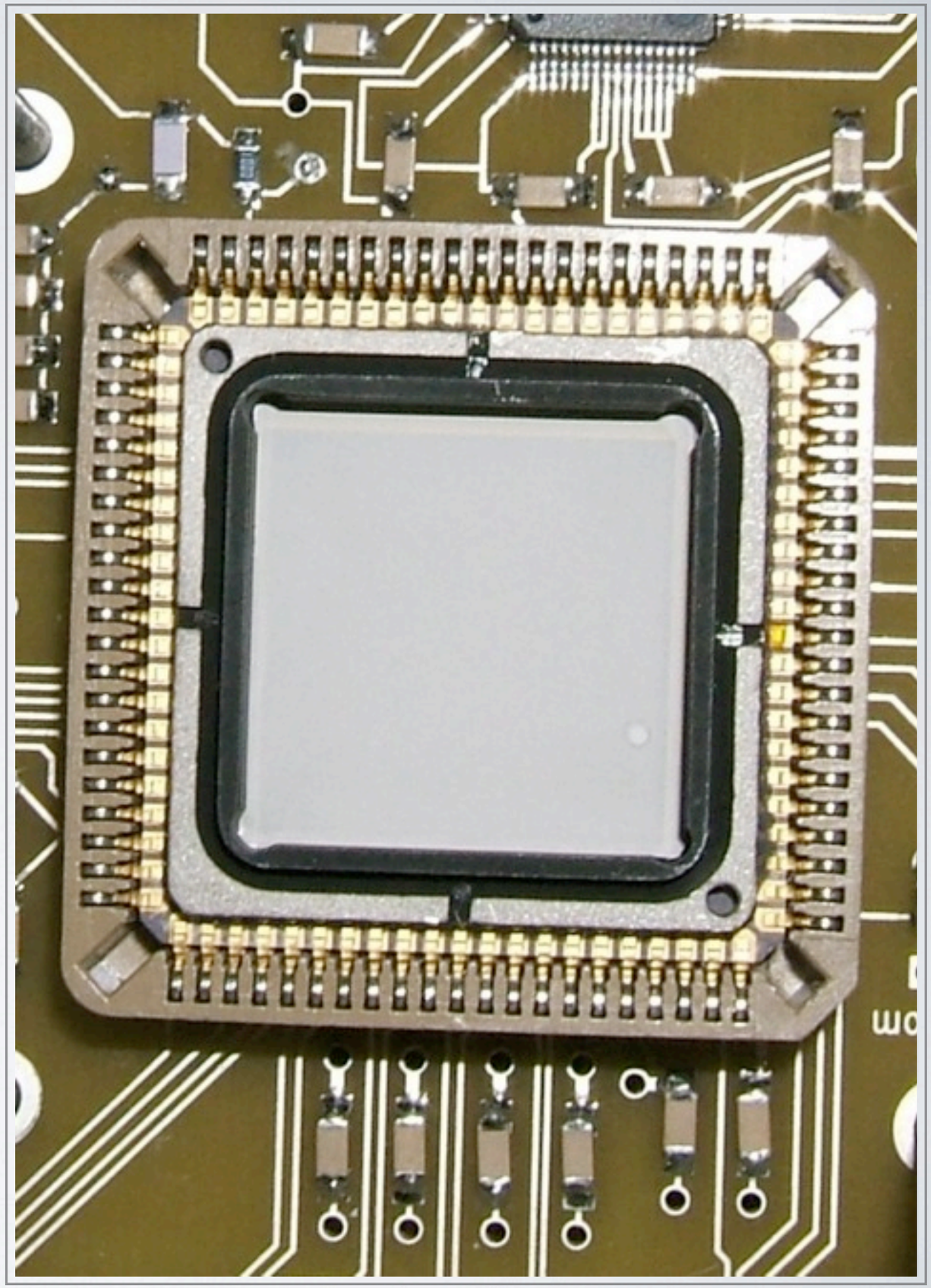
CMOS APS DETECTOR

1024×1024 Pixels



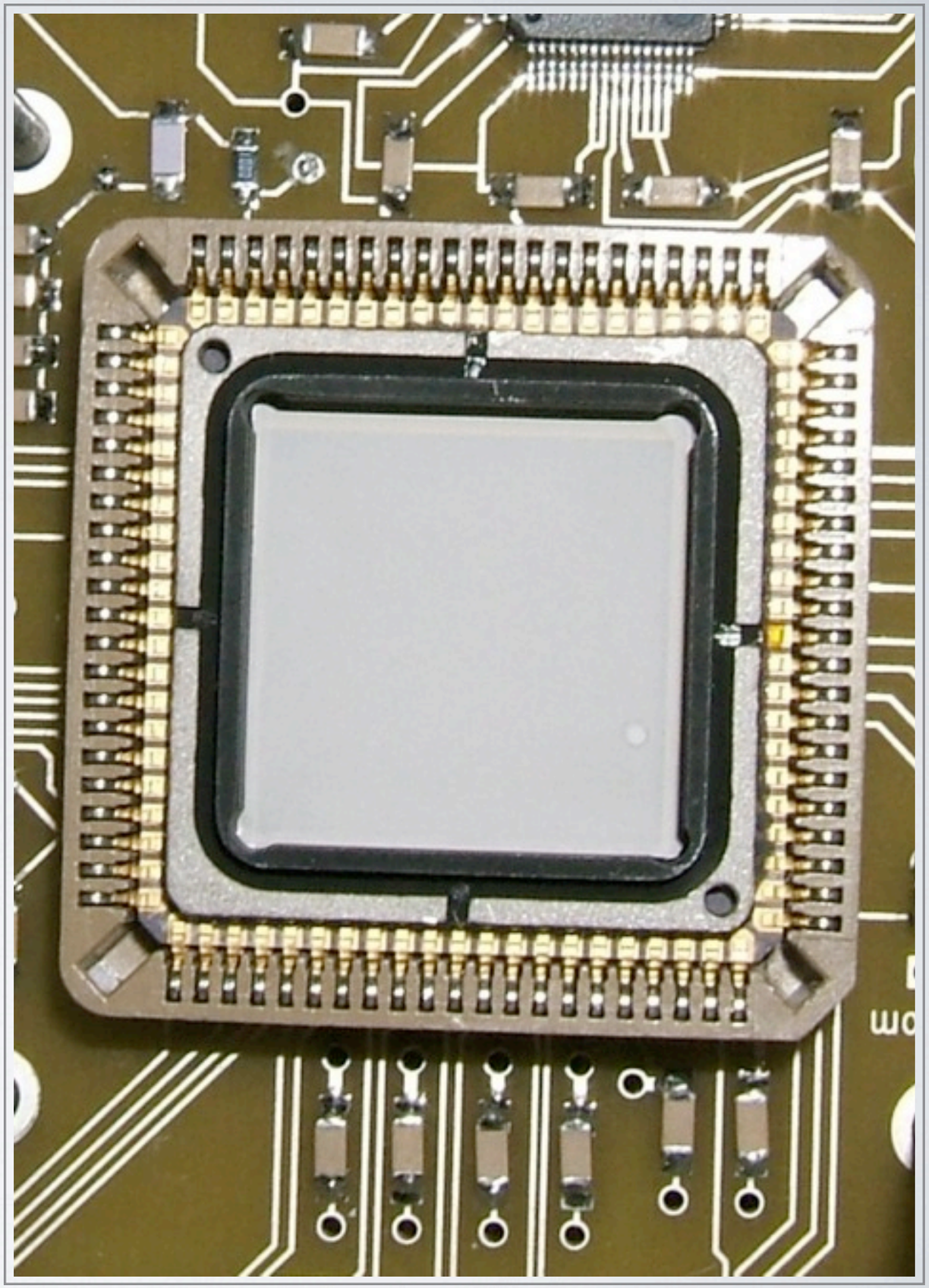
CMOS APS DETECTOR

Low power consumption



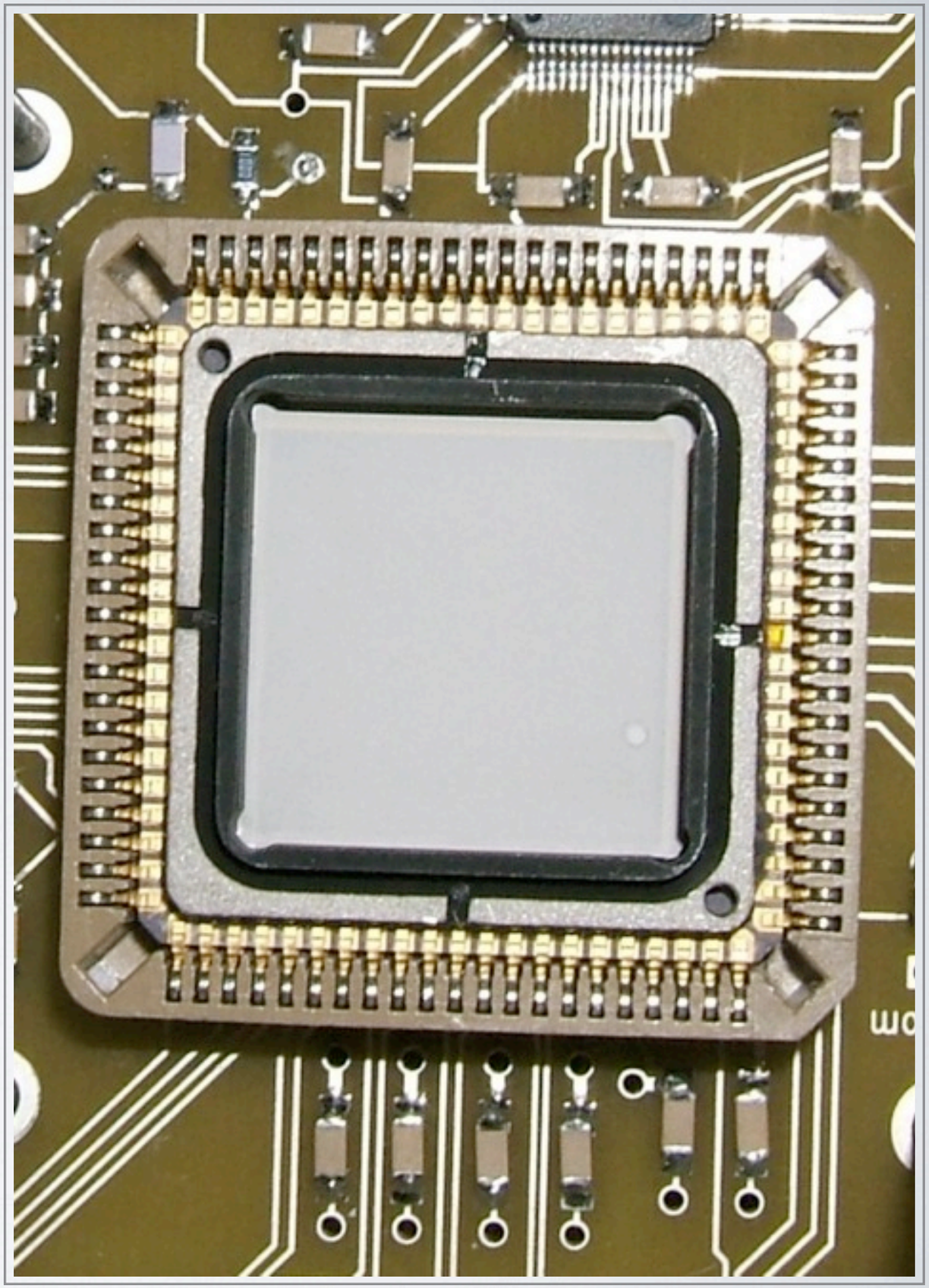
CMOS APS DETECTOR

P43 coating for EUV sensitivity



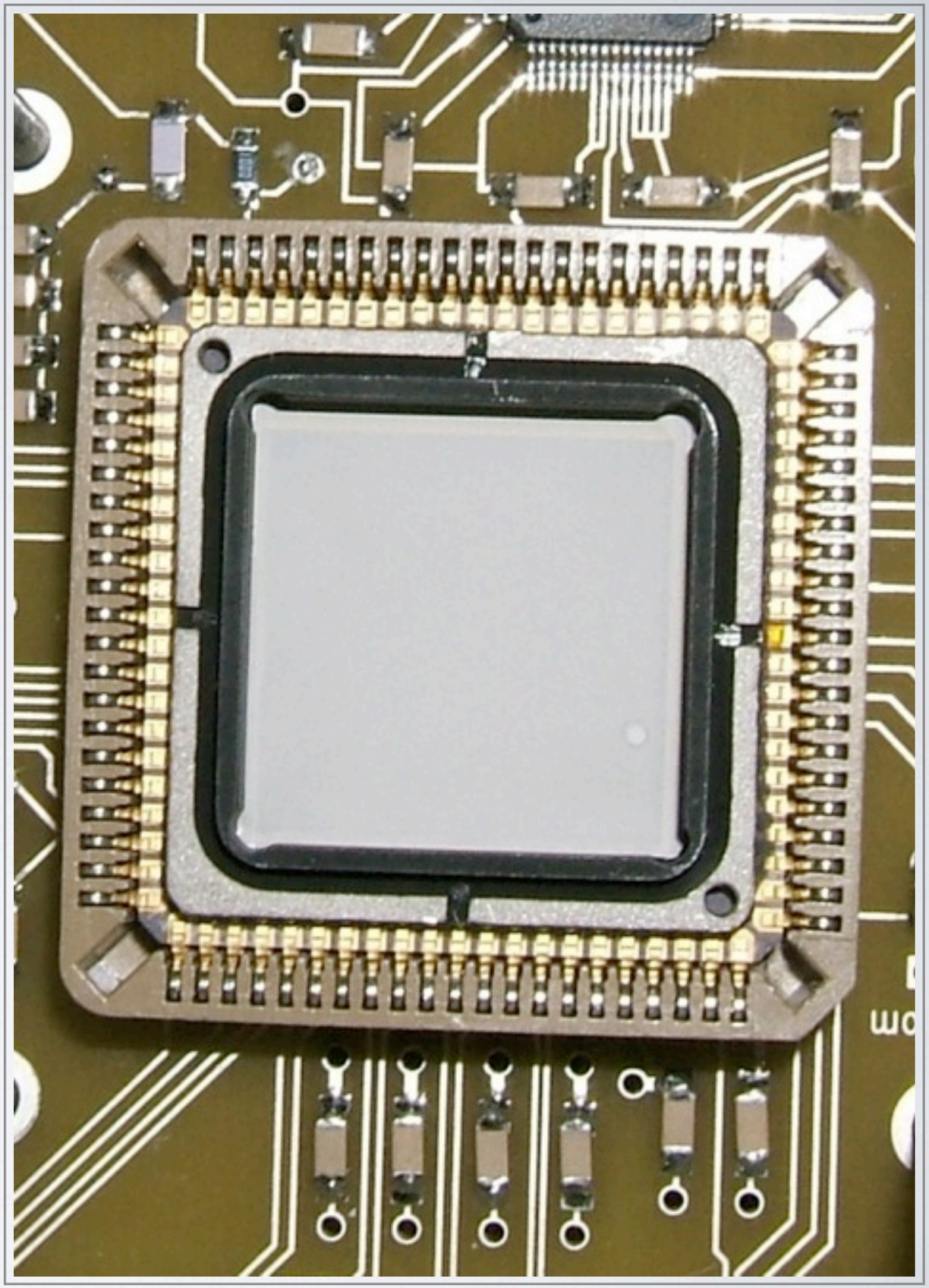
CMOS APS DETECTOR

First CMOS for solar physics in orbit



CMOS APS DETECTOR

No charge transfer as in CCD
No need for shutter



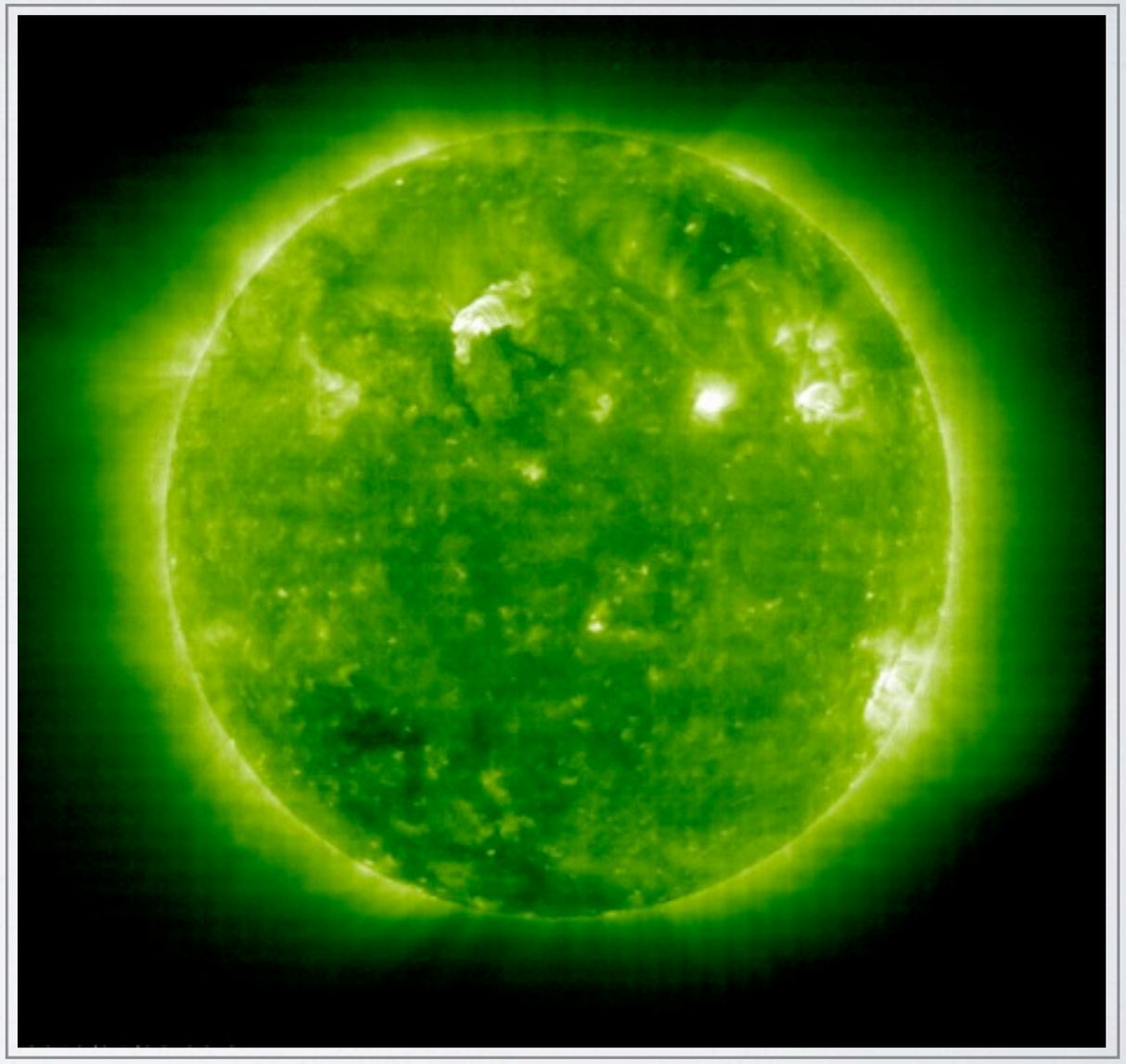
SWAP VS. EIT

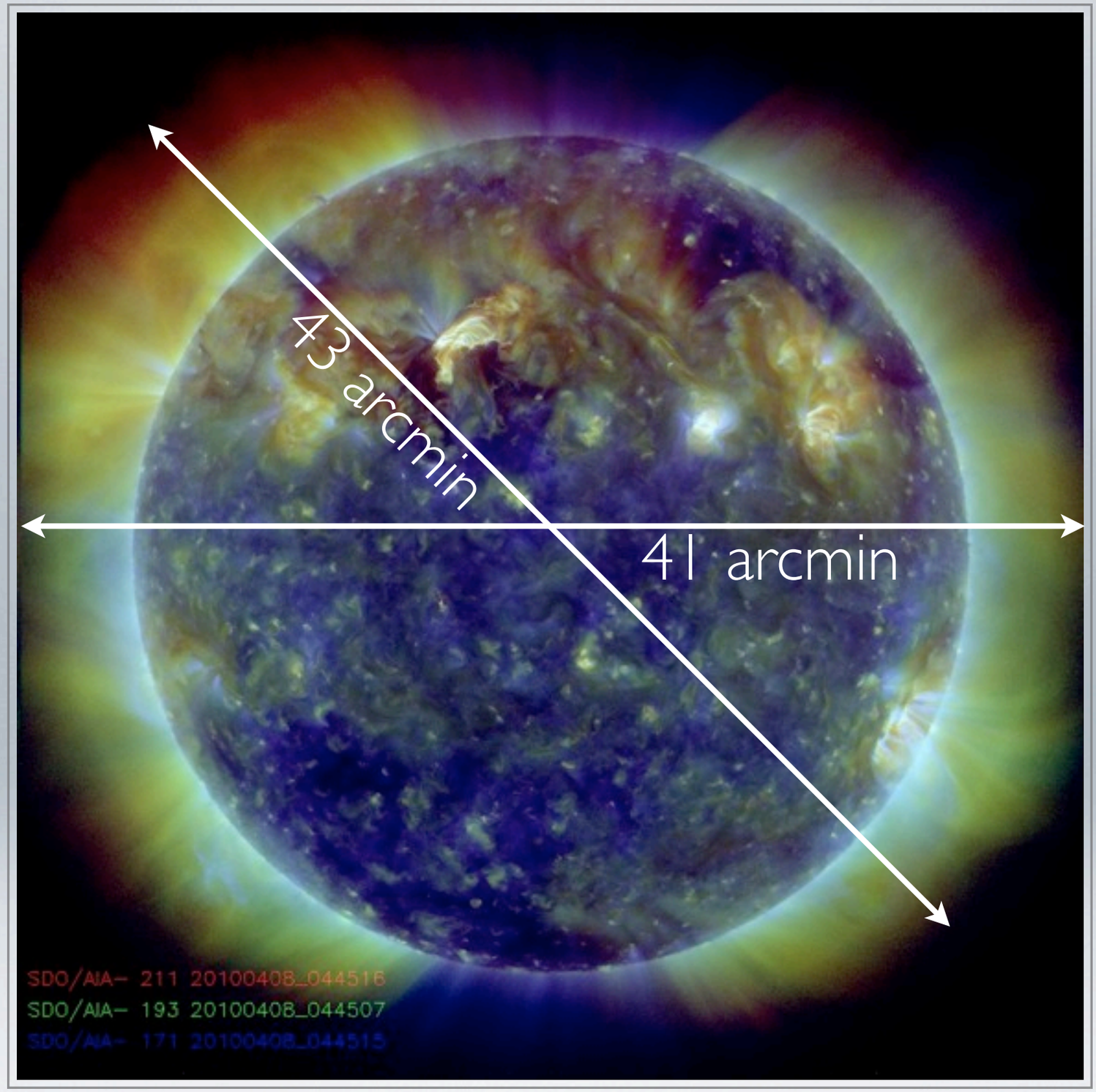
EIT: 17.1, 19.5, 28.4, 30.4 nm

- Sun-centered FOV
- 45 arcmin FOV
- ≈12 minute cadence
- Located at L1-point

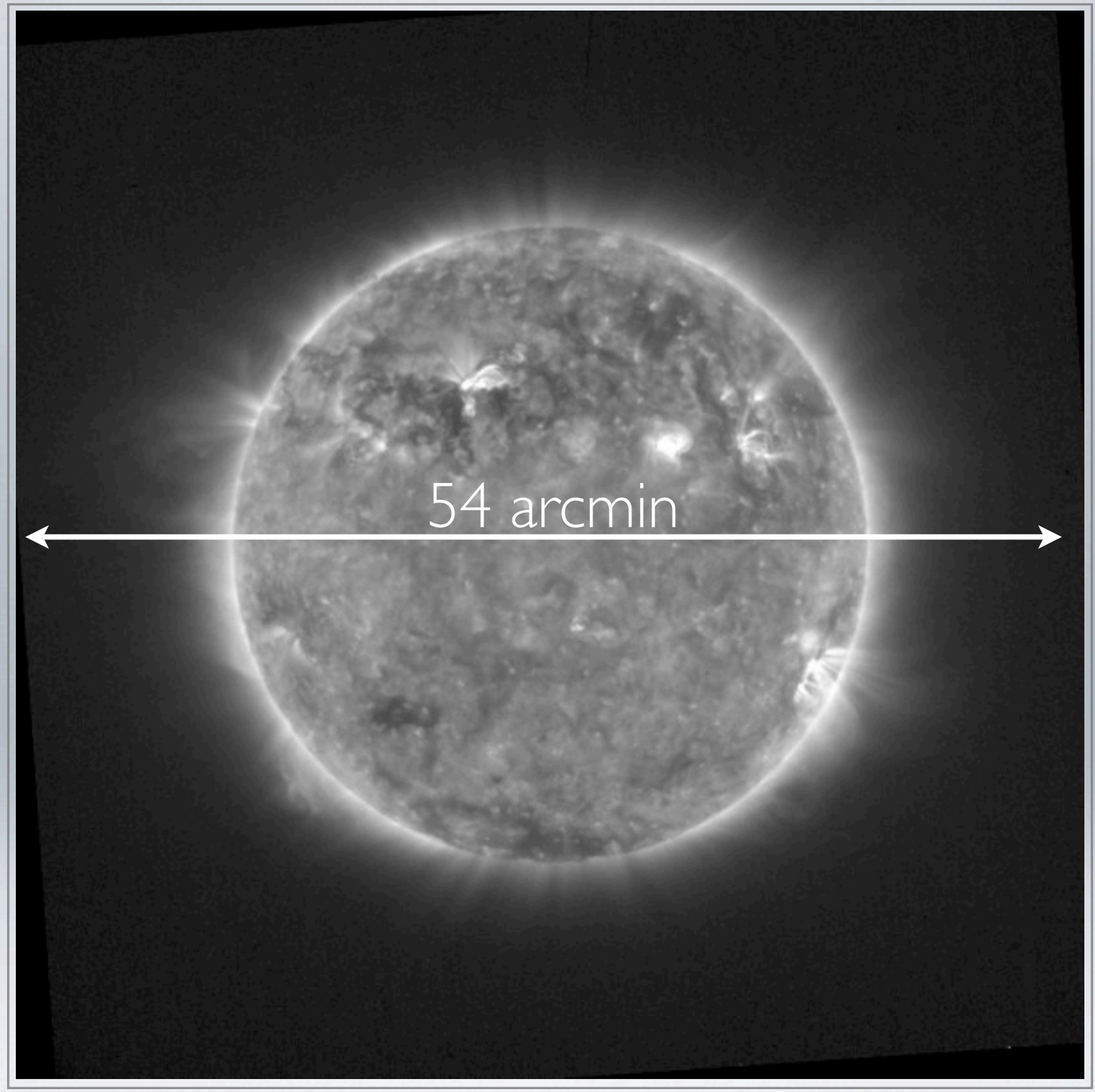
SWAP: 17.4 nm

- Flexible off-pointing
- 54 arcmin FOV
- ≈1 minute cadence
- Inside magnetosphere

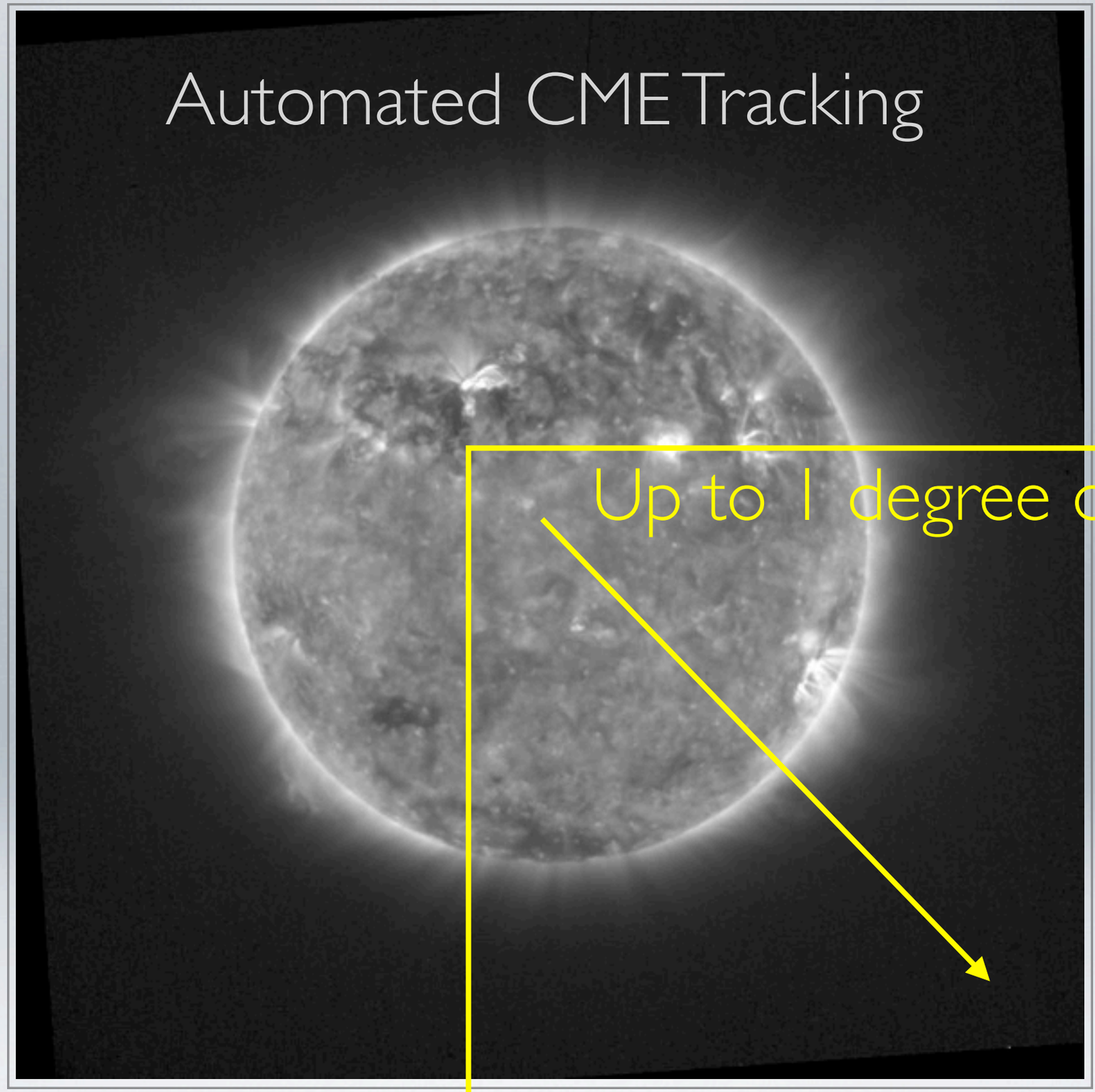




SWAP VS. AIA ON SDO



SWAP VS. AIA ON SDO



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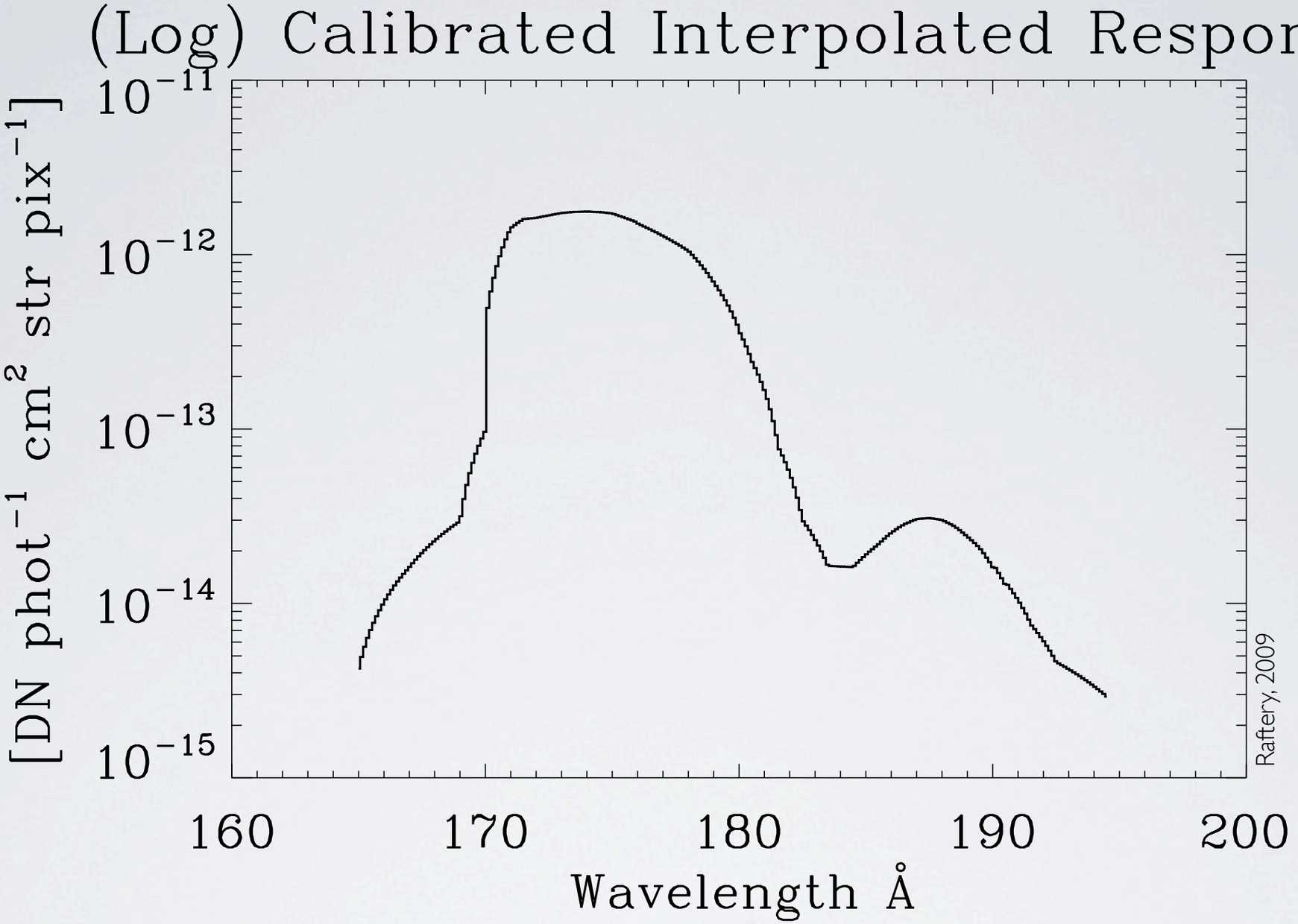
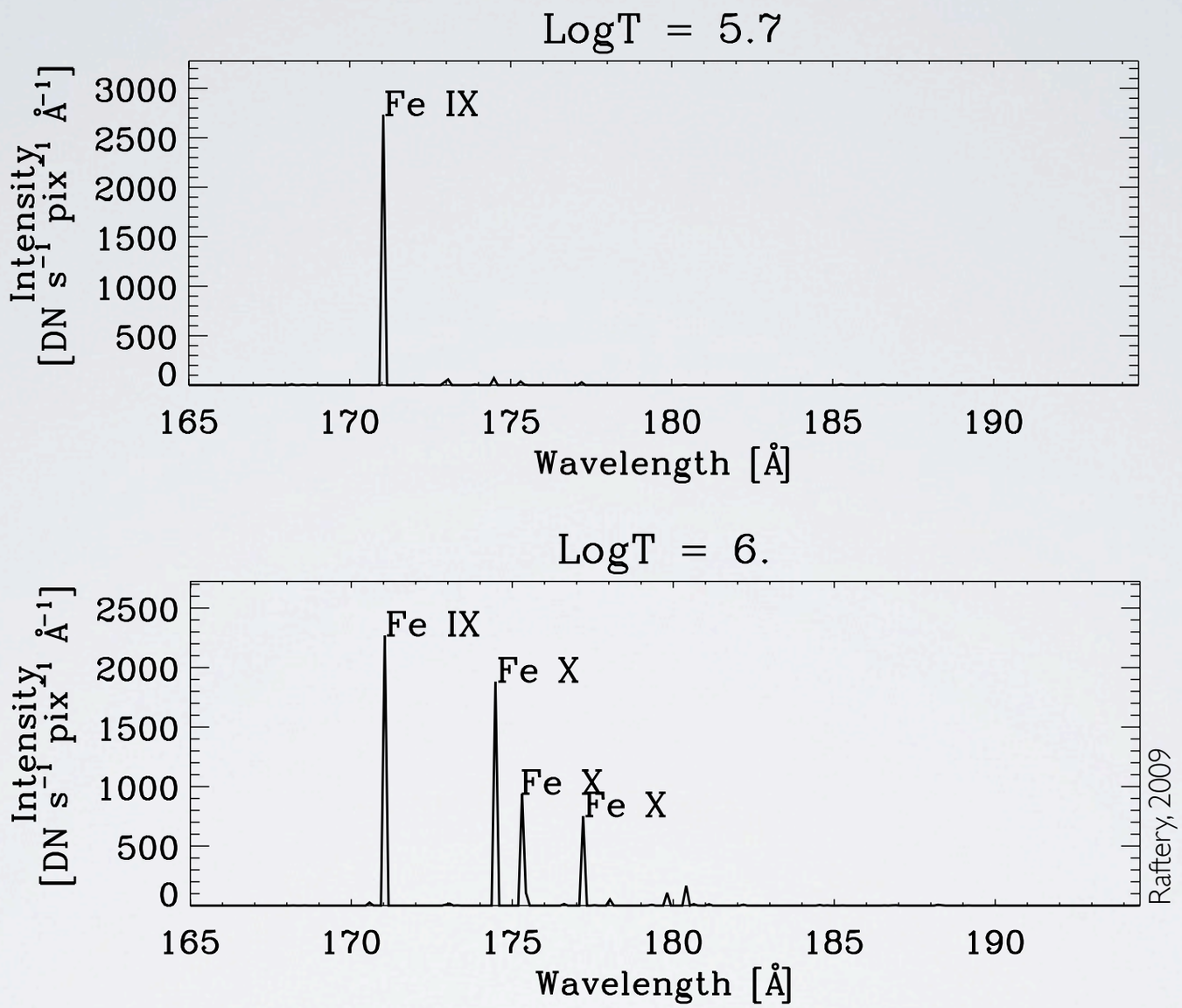


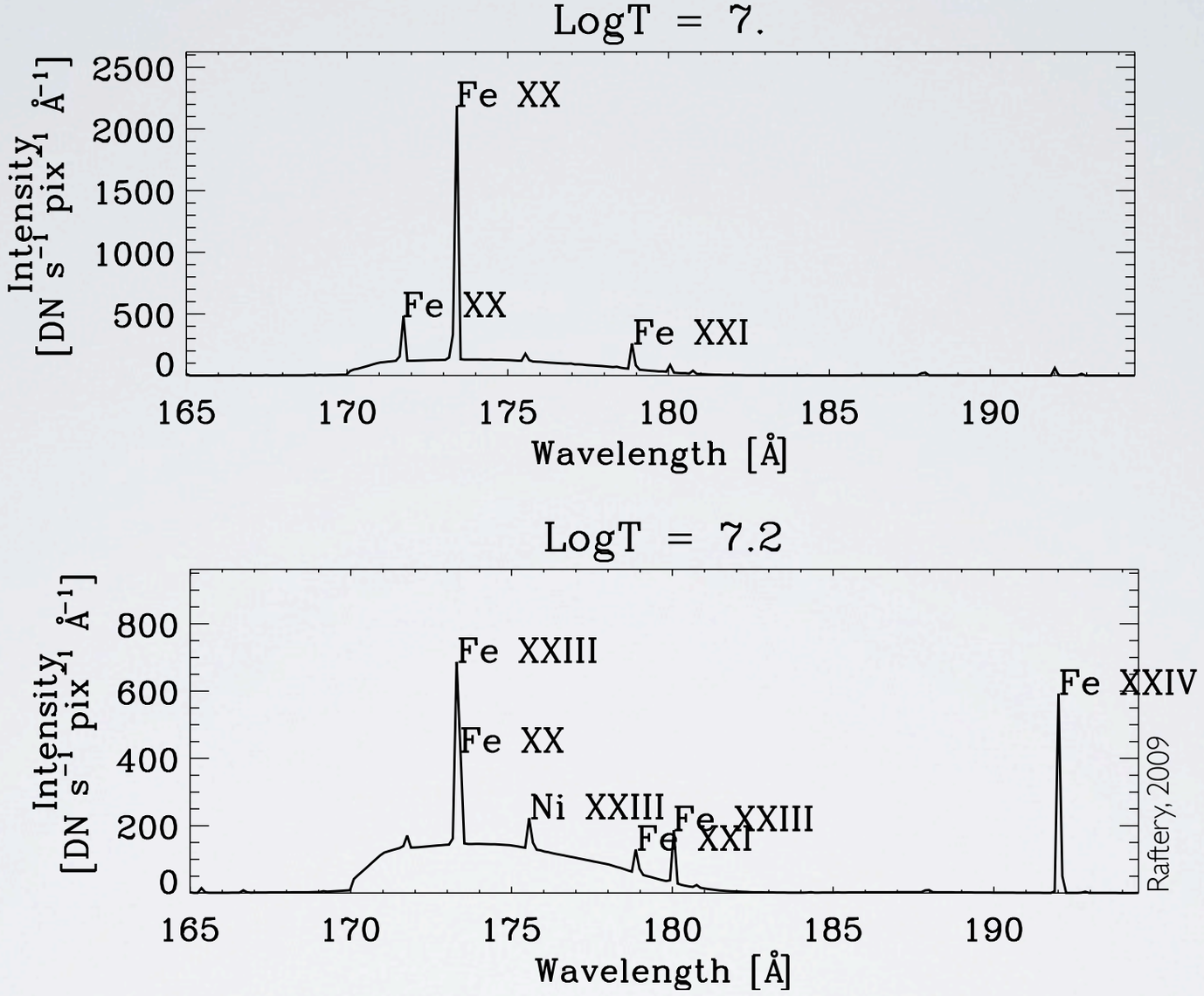
SPECTRAL RESPONSE

Measured with Synchrotron Beam at BESSY



SPECTRAL RESPONSE

Transmitted Lines at Selected Temperatures



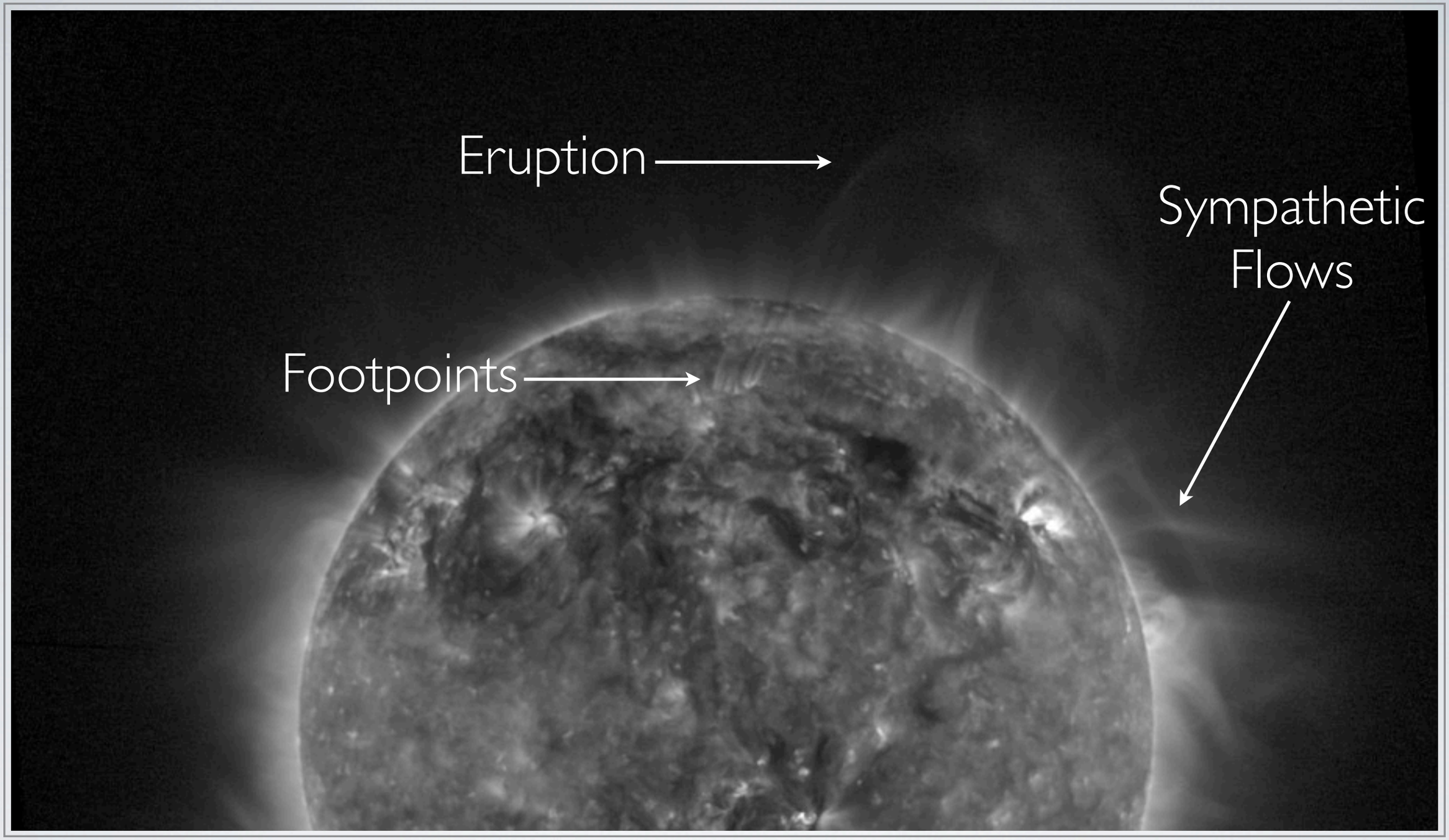
SPECTRAL RESPONSE

Transmitted Lines at Selected Temperatures

SWAP DATA

ANNULAR SOLAR ECLIPSE

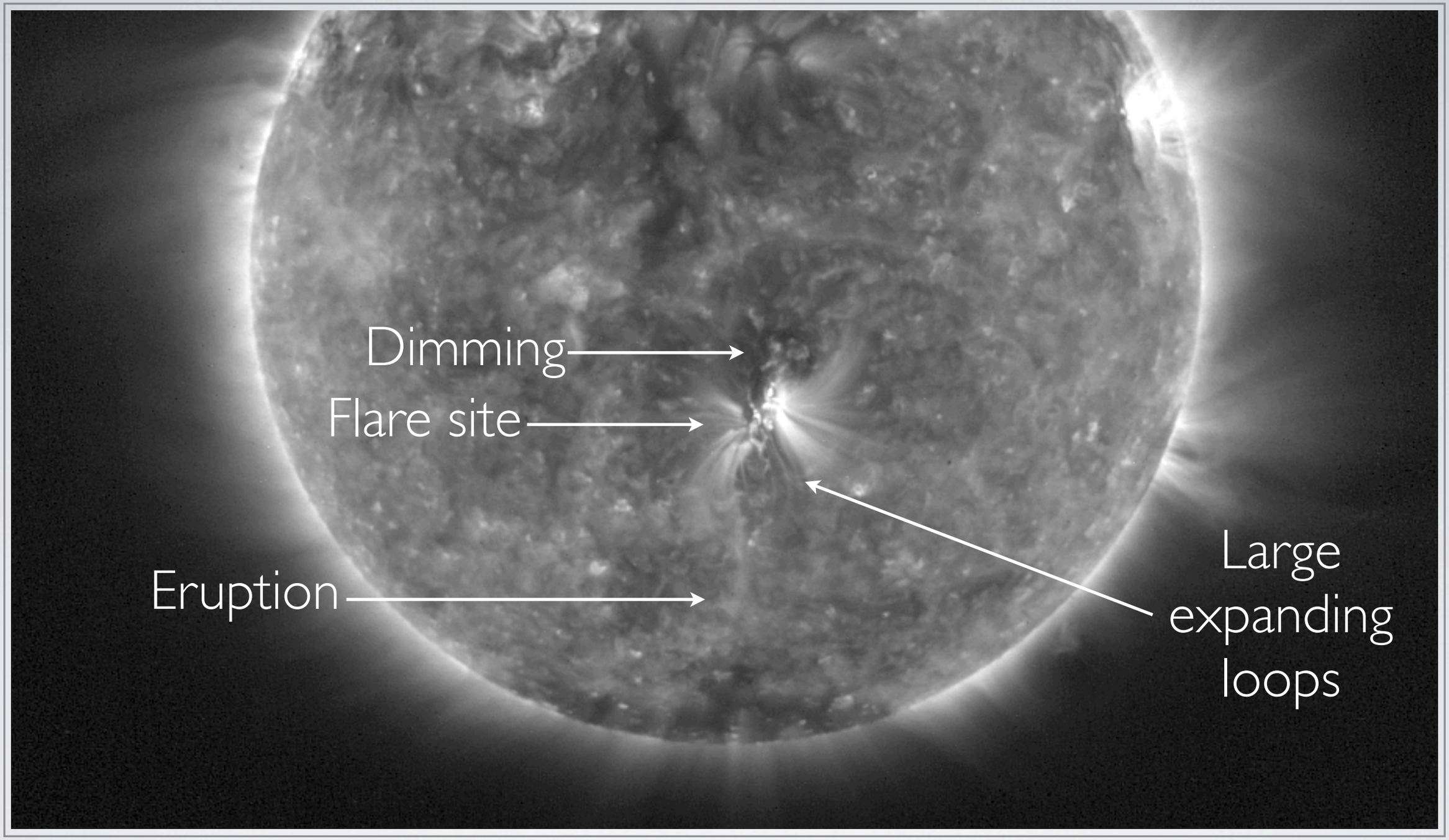
15 January 2010, 06:00 UTC



PROMINENCE ERUPTION

13 April 2010, 09:30 UTC

See attached movie



ERUPTION & FLARE

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

See attached movie

GETTING INVOLVED

OPEN DATA POLICY

Data will be freely available to all users from May 1 onwards

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 files: for quicklook purposes (available now)

SSW will have software trees SWAP & LYRA

HOW TO BE INVOLVED

Scientists are welcome to:

- use PROBA2 data
- propose special observation campaigns

Guest Investigator Program welcomes proposals for dedicated (joint) observations in the frame of a science project

- funds available for a stay at PROBA2 Science Center
- scientist can take part in the commanding of the instruments
- will gain expertise in the instrumental effects

- Announcement: May 3, 2010
- GI proposal deadline: June 1st (visits from Sep 2010 onwards)
- First Science Working Team - GI selection: June 14-16, Belgium

DATA & MORE INFORMATION

http://proba2.sidc.be/