

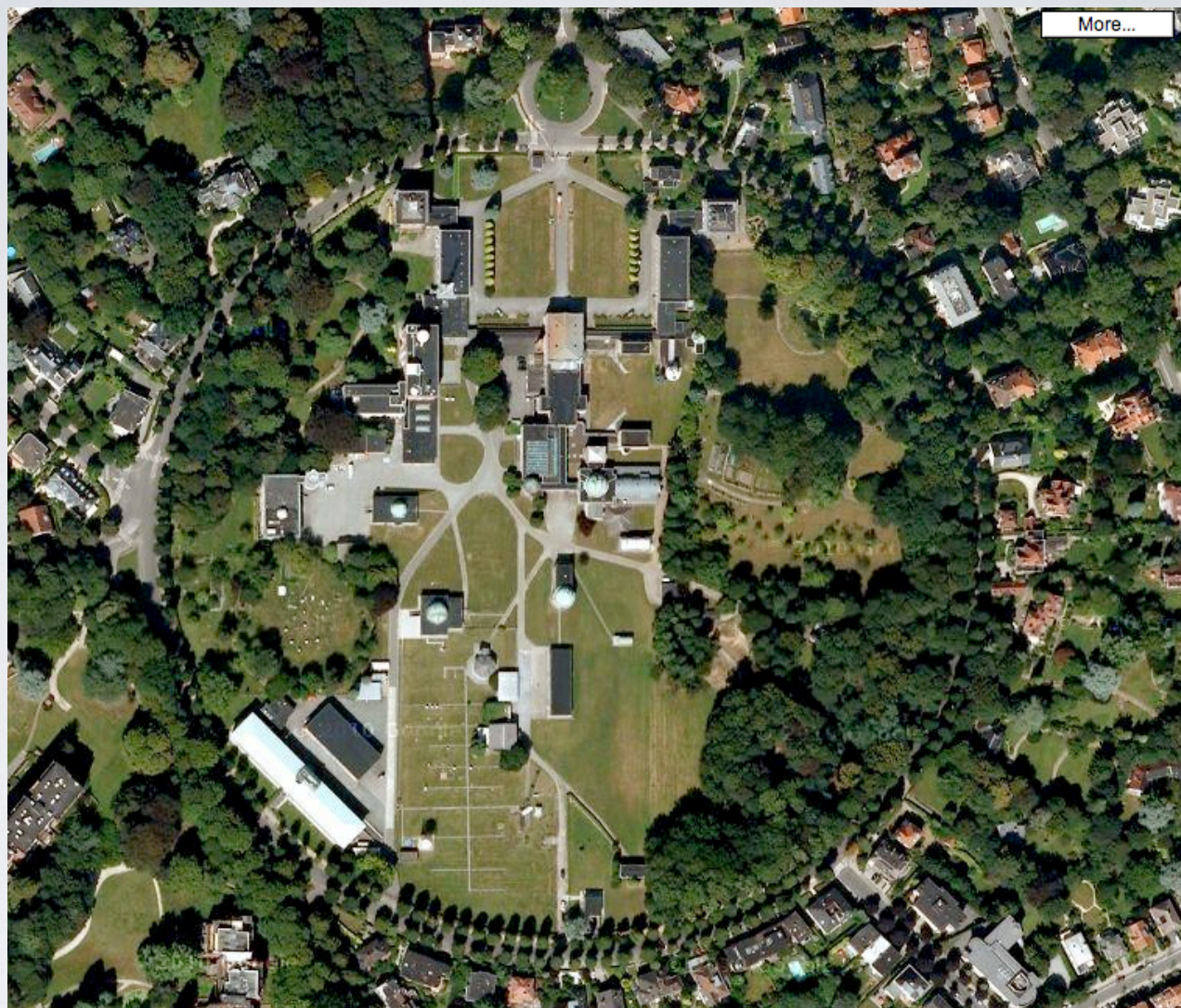
FIRST SCIENCE RESULTS FROM PROBA2

David Berghmans & PROBA2 Science Center
Royal Observatory of Belgium

QINETIQ ☼ Kruibeke ☼ September 3, 2010

david.berghmans@gmail.com

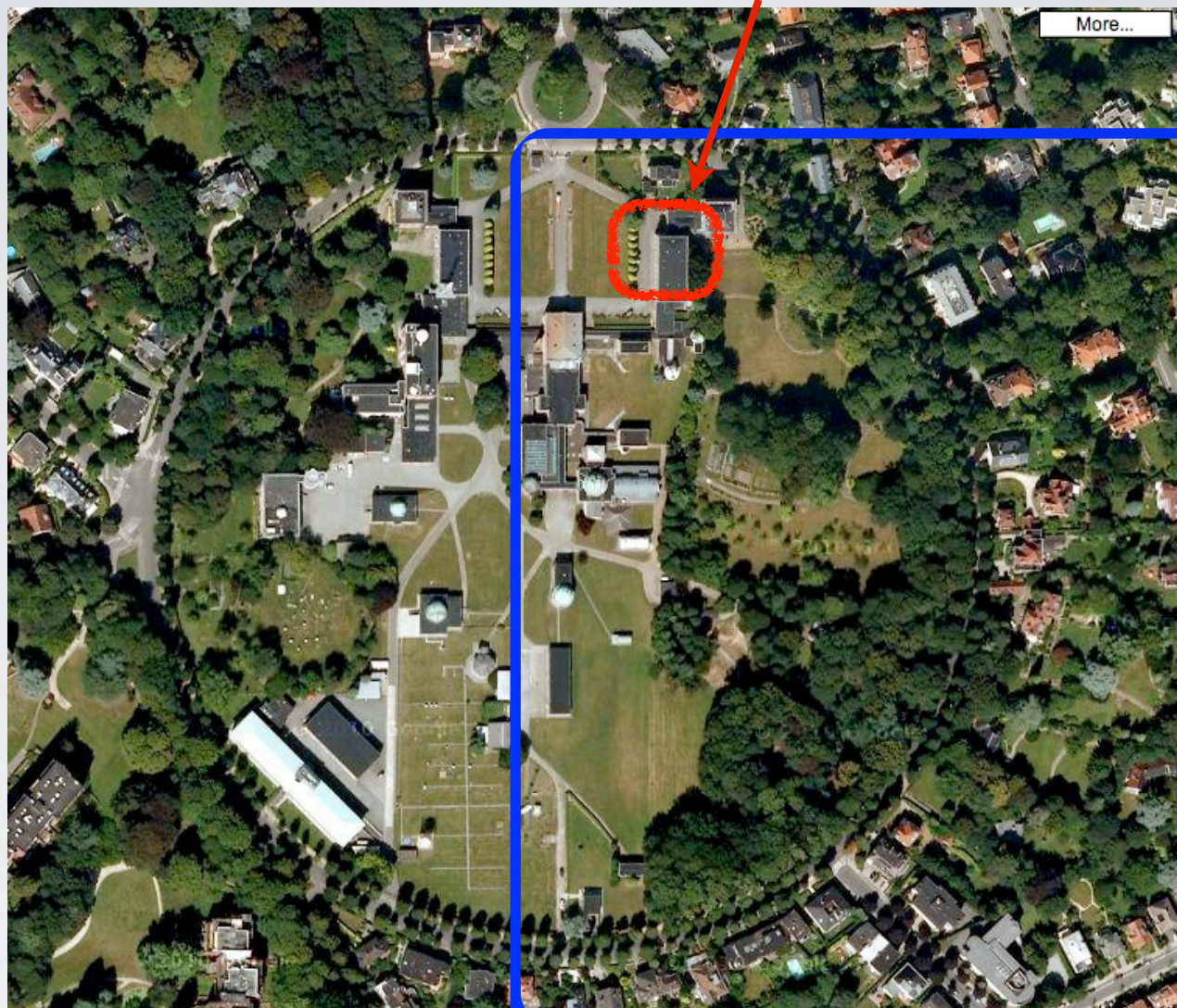




KSB

RINGLAAN 3, UKKEL

P2SC



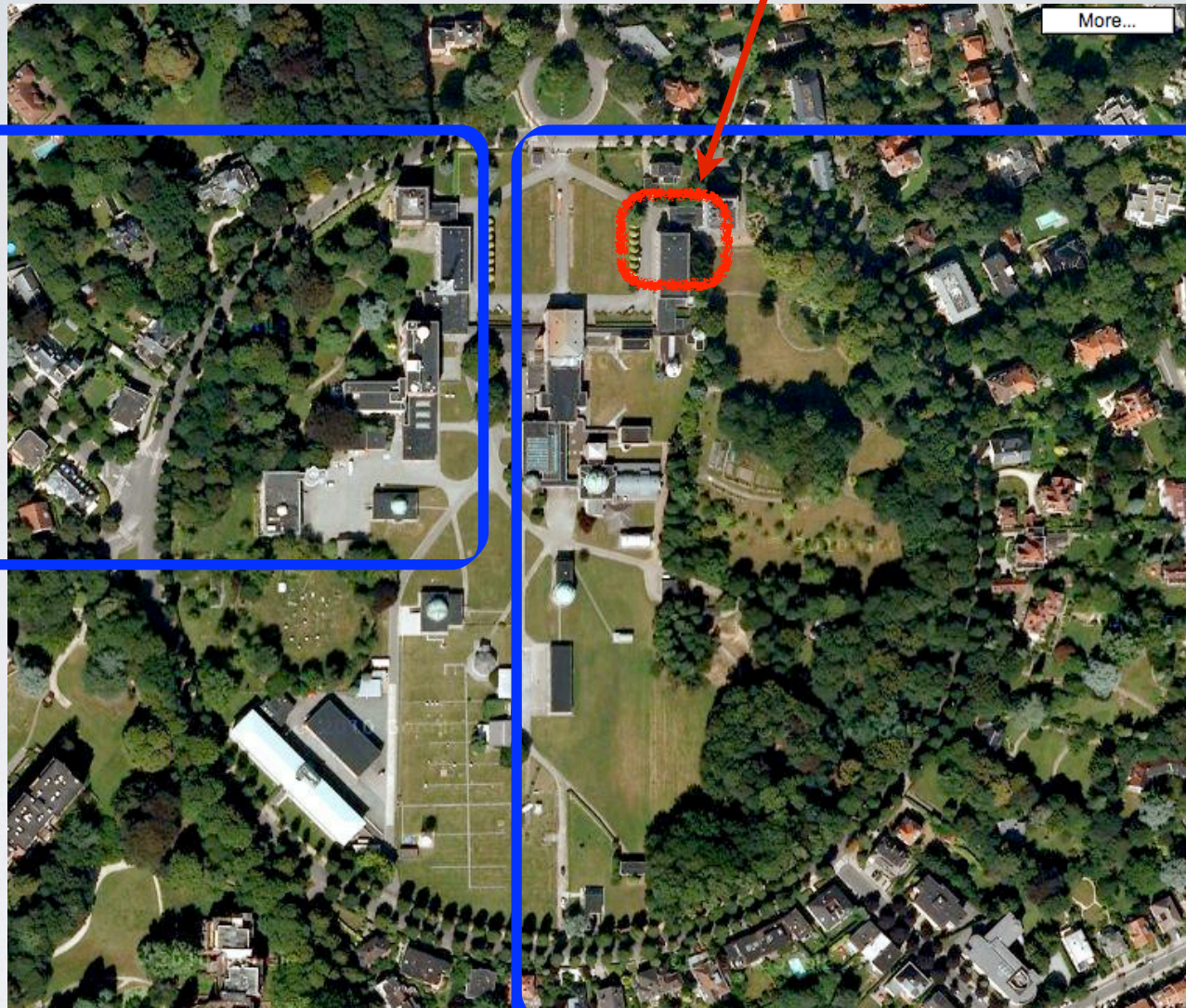
KSB

RINGLAAN 3, UKKEL

P2SC

KMI

KSB



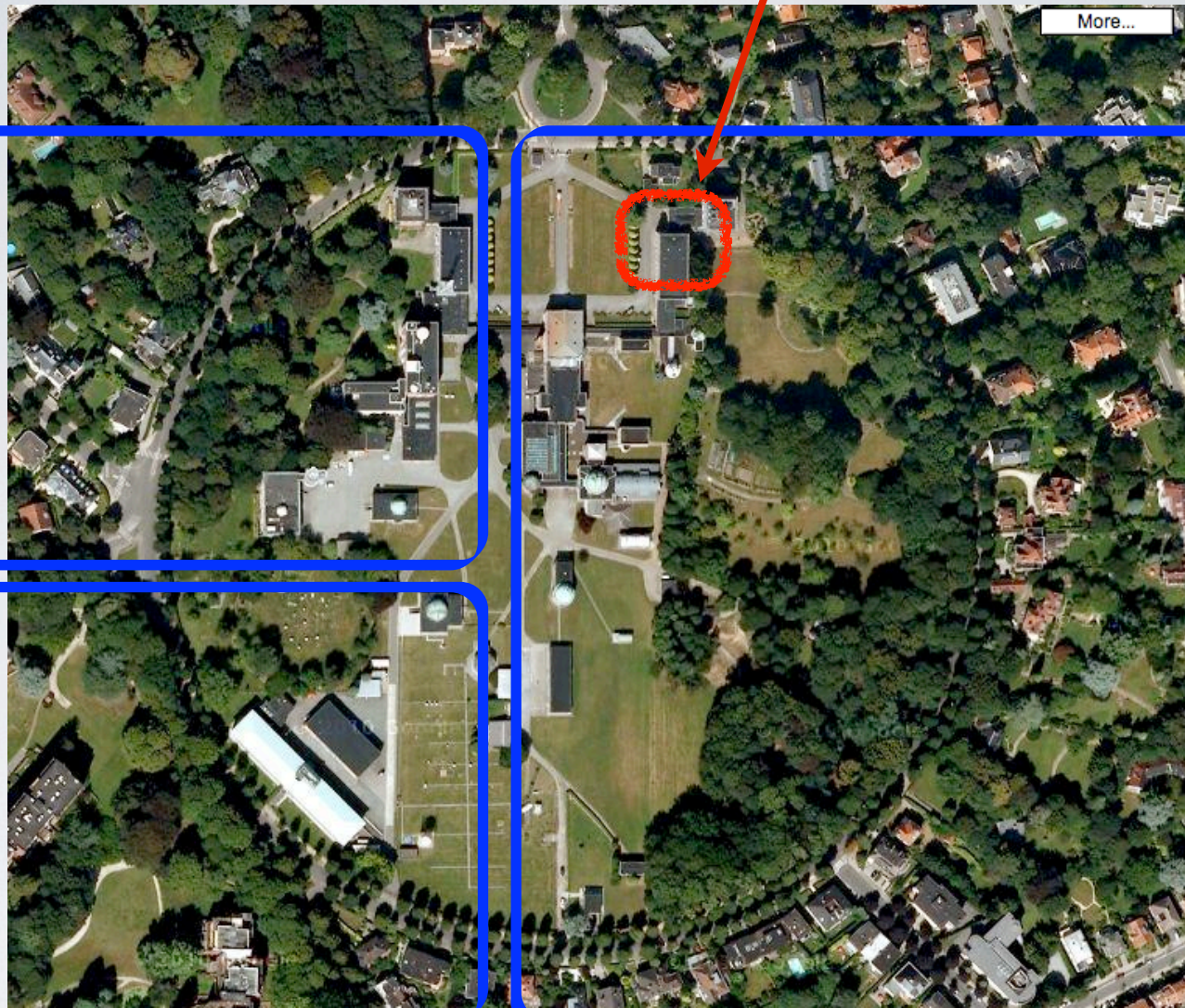
RINGLAAN 3, UKKEL

P2SC

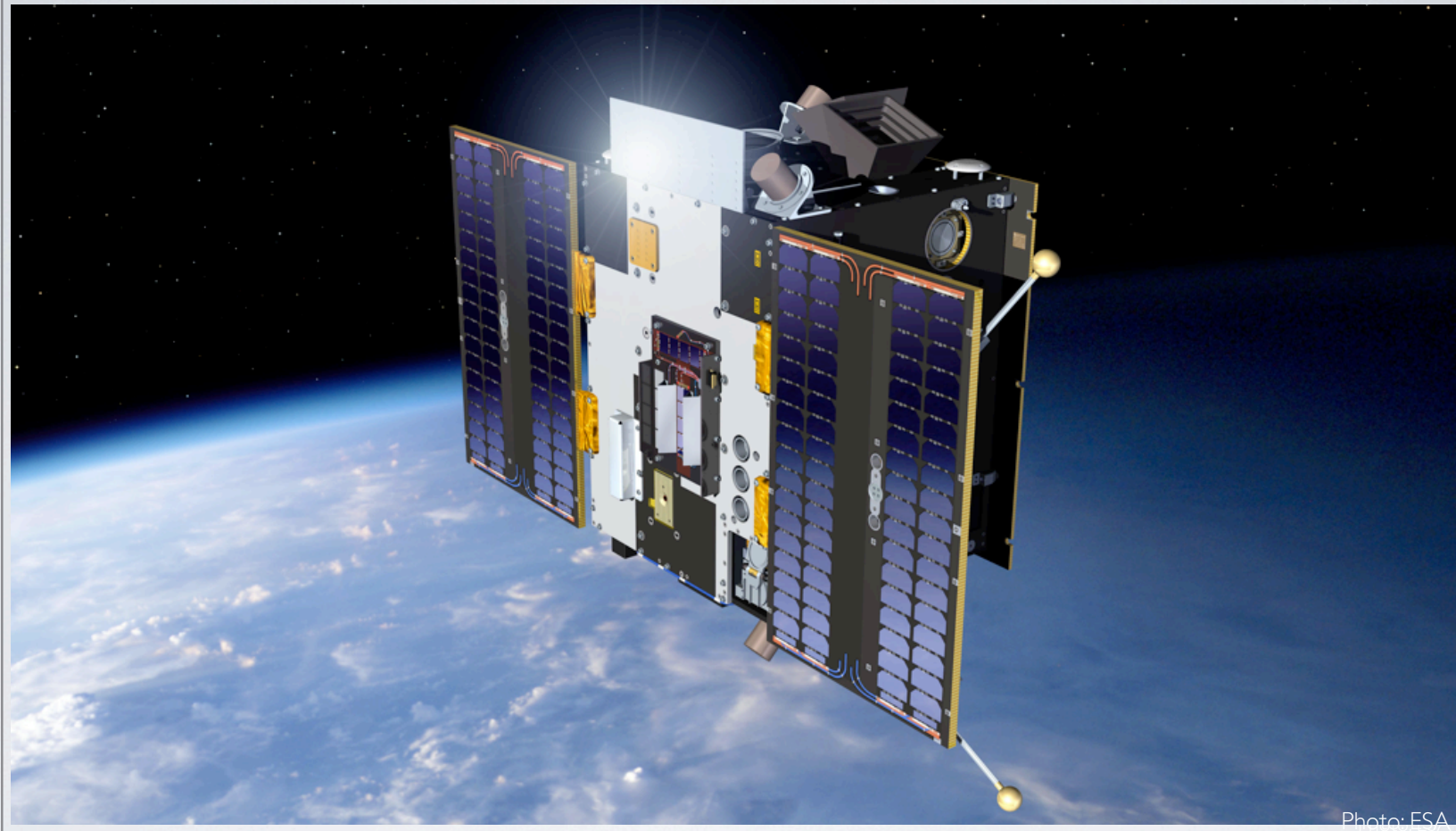
KMI

KSB

BIRA

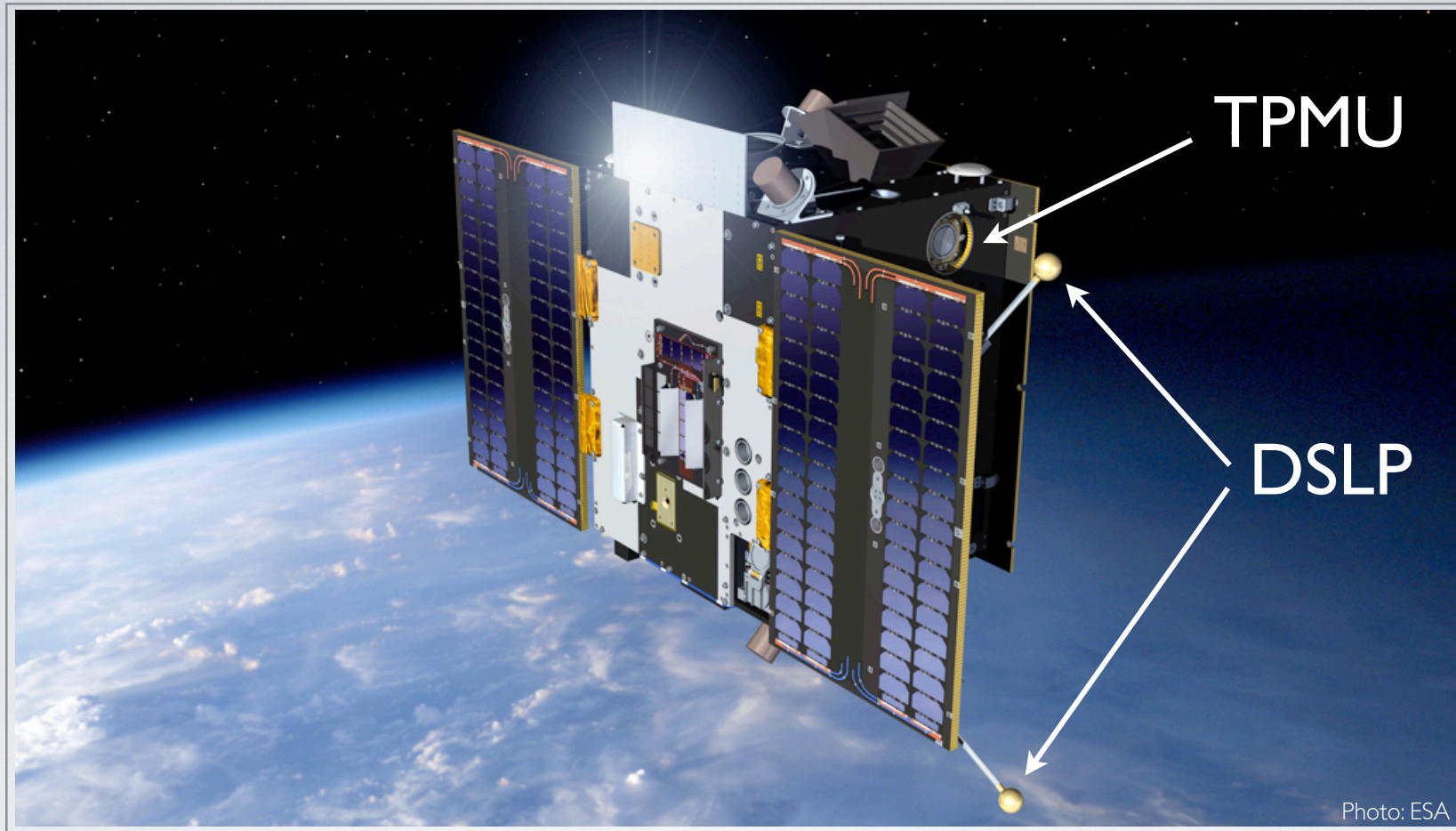


RINGLAAN 3, UKKEL



Project for On-Board Autonomy 2

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



PROBA2 INSTRUMENTATION

Thermal **P**lasma **M**easurement **U**nit
Dual-**S**egmented **L**angmuir **P**robe



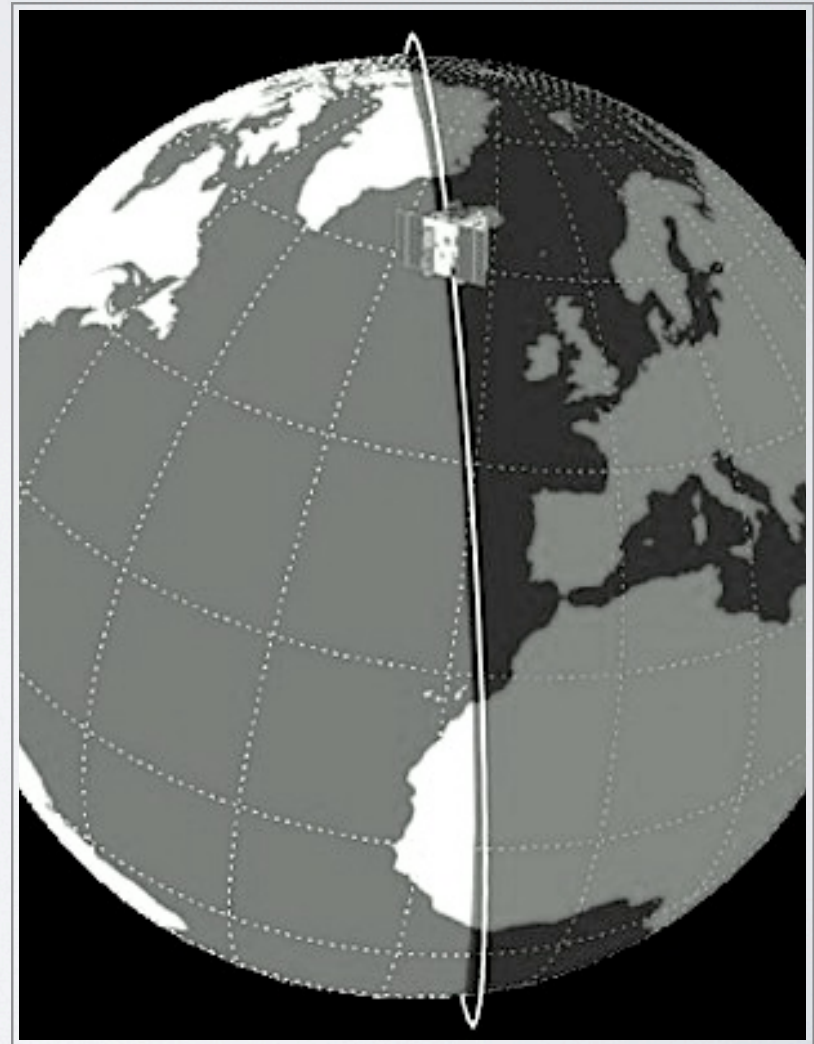
PROBA2 INSTRUMENTATION

Large **Y**ield **R**adiometer

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

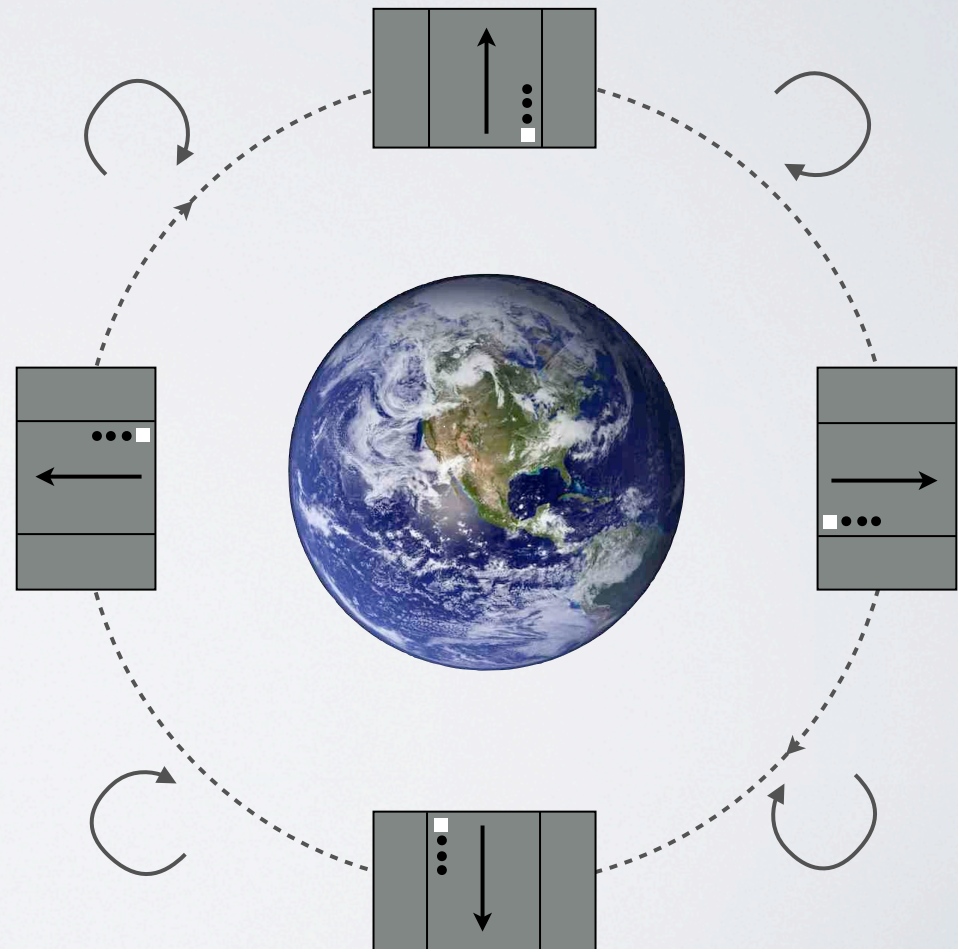
ORBIT

- Polar Sun-Synchronous
- 725 km altitude
- eclipse season: Nov-Jan
- rotations every 25 min



ORBIT

- Polar Sun-Synchronous
- 725 km altitude
- eclipse season: Nov-Jan
- rotations every 25 min

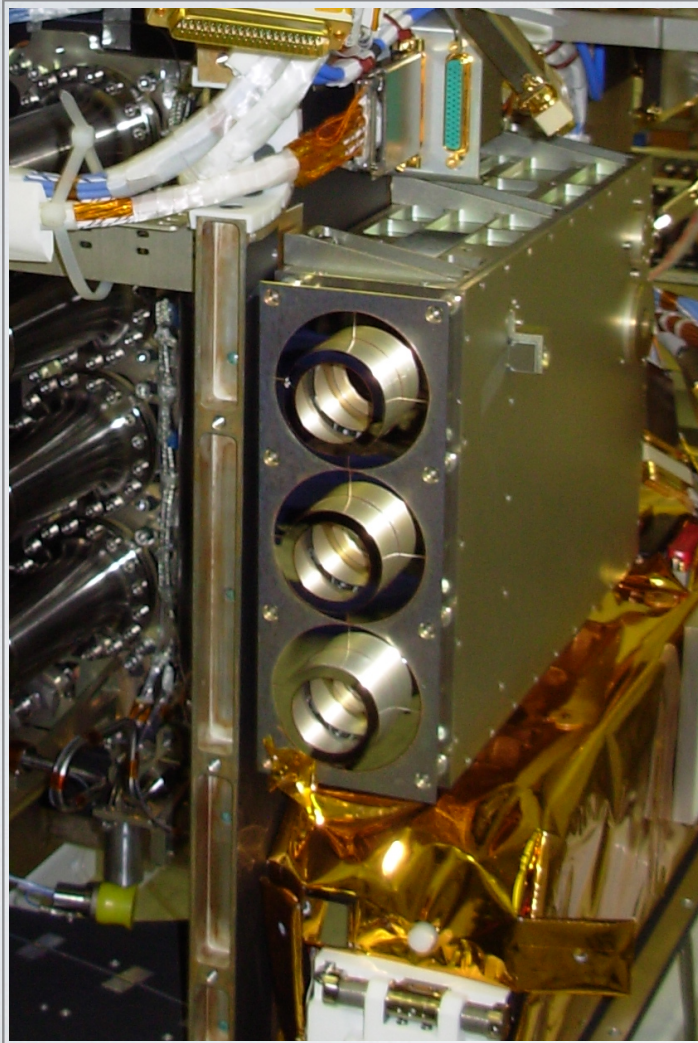


LYRA

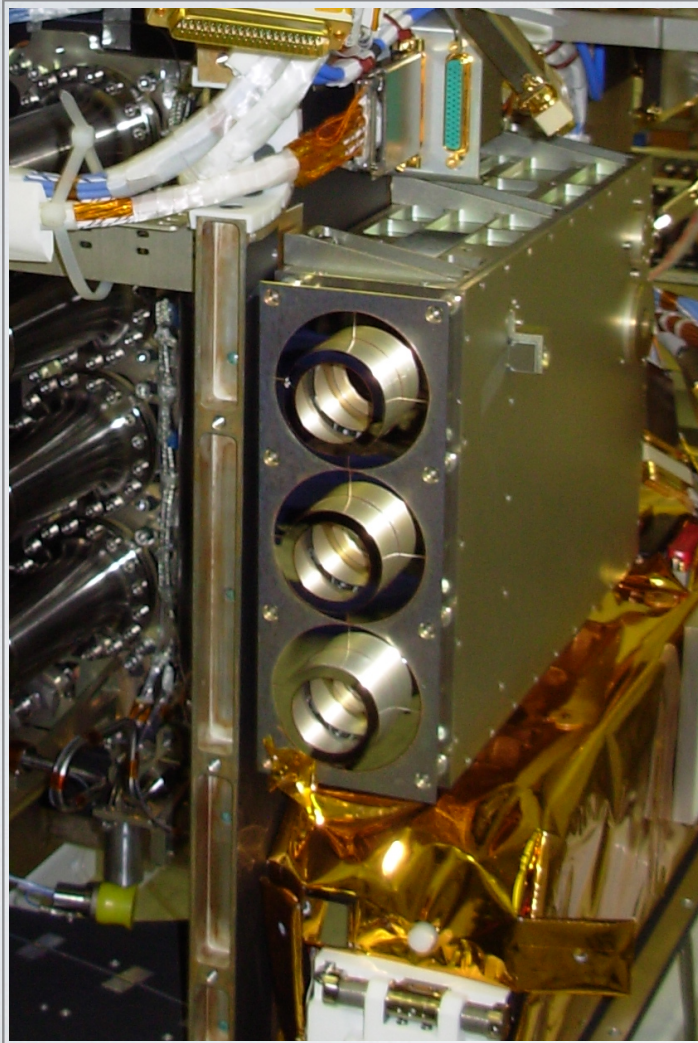
PI: Jean-François Hochedez (ROB),
Marie Dominique (ROB)

Important Swiss Contribution:
Werner Schmutz (PMOD-WRC)

INSTRUMENT OVERVIEW



INSTRUMENT OVERVIEW



	Ly	Hz	Al	Zr
Unit 1				
Unit 2				
Unit 3				

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				
Unit 2				
Unit 3				

INSTRUMENT OVERVIEW

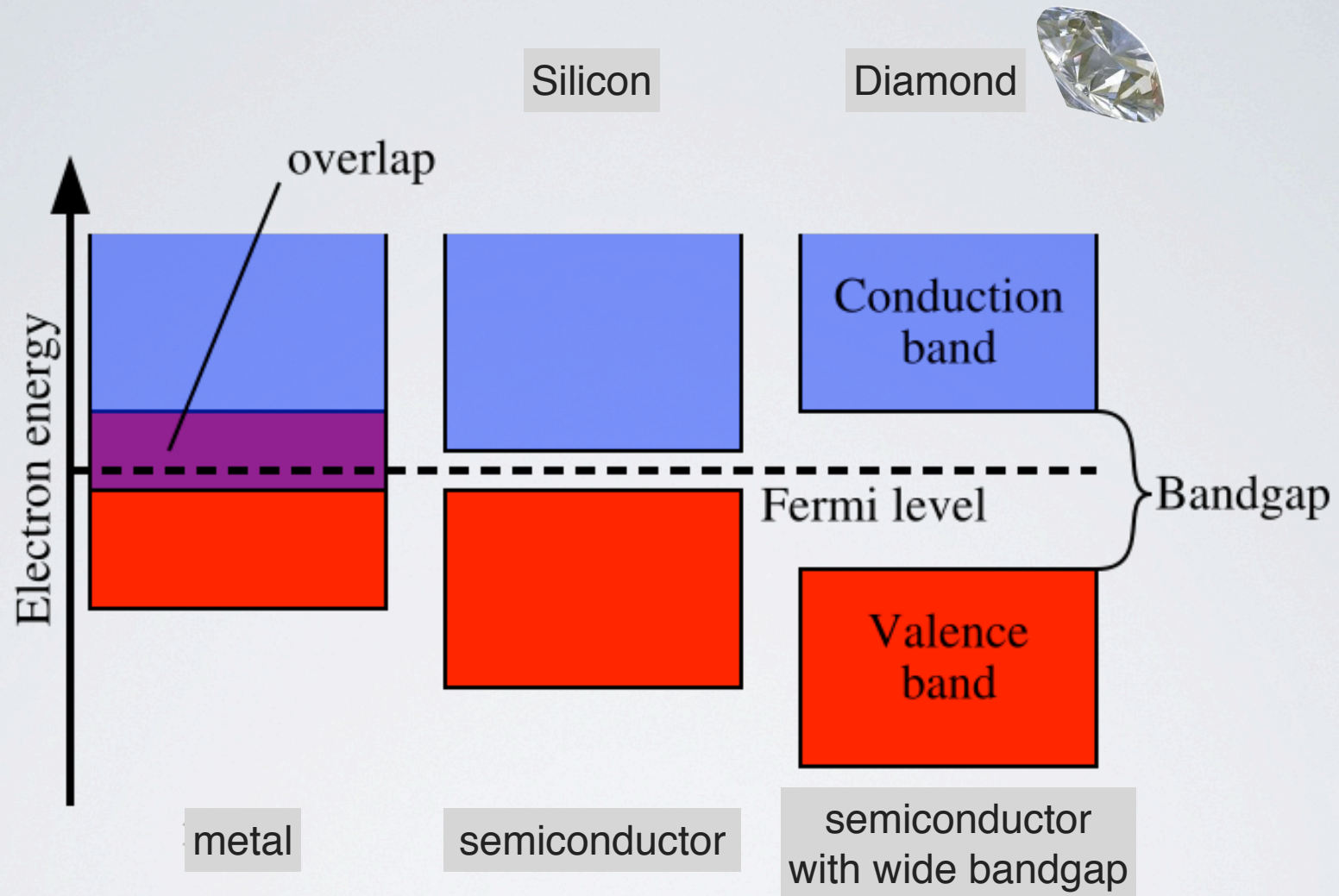
Herzberg Continuum:
200-220 nm

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				Si
Unit 2				
Unit 3	Si		Si	Si

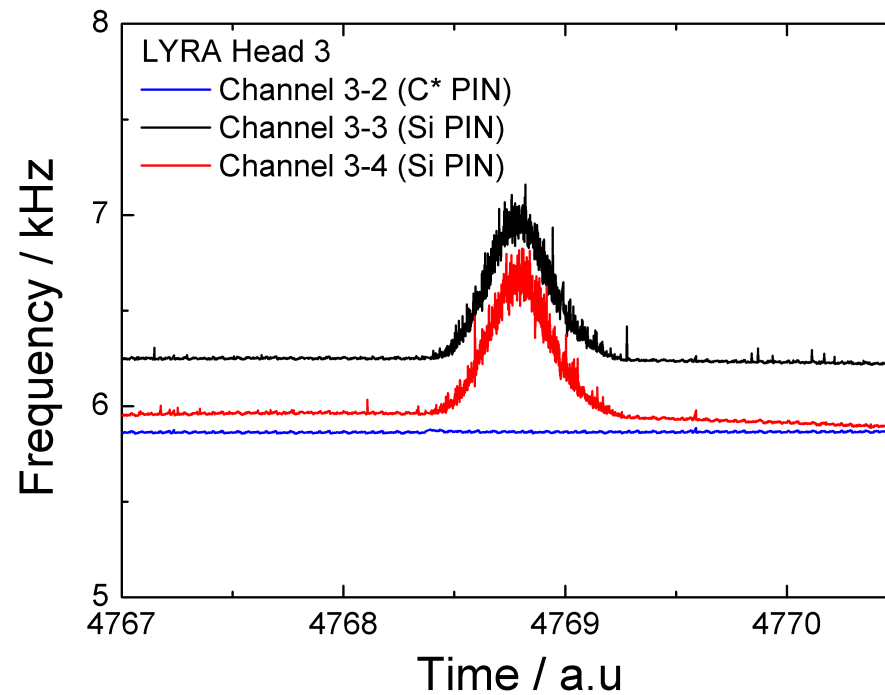


DIAMOND IS A SEMI-CONDUCTOR WITH A WIDE BANDGAP

INSTRUMENT OVERVIEW

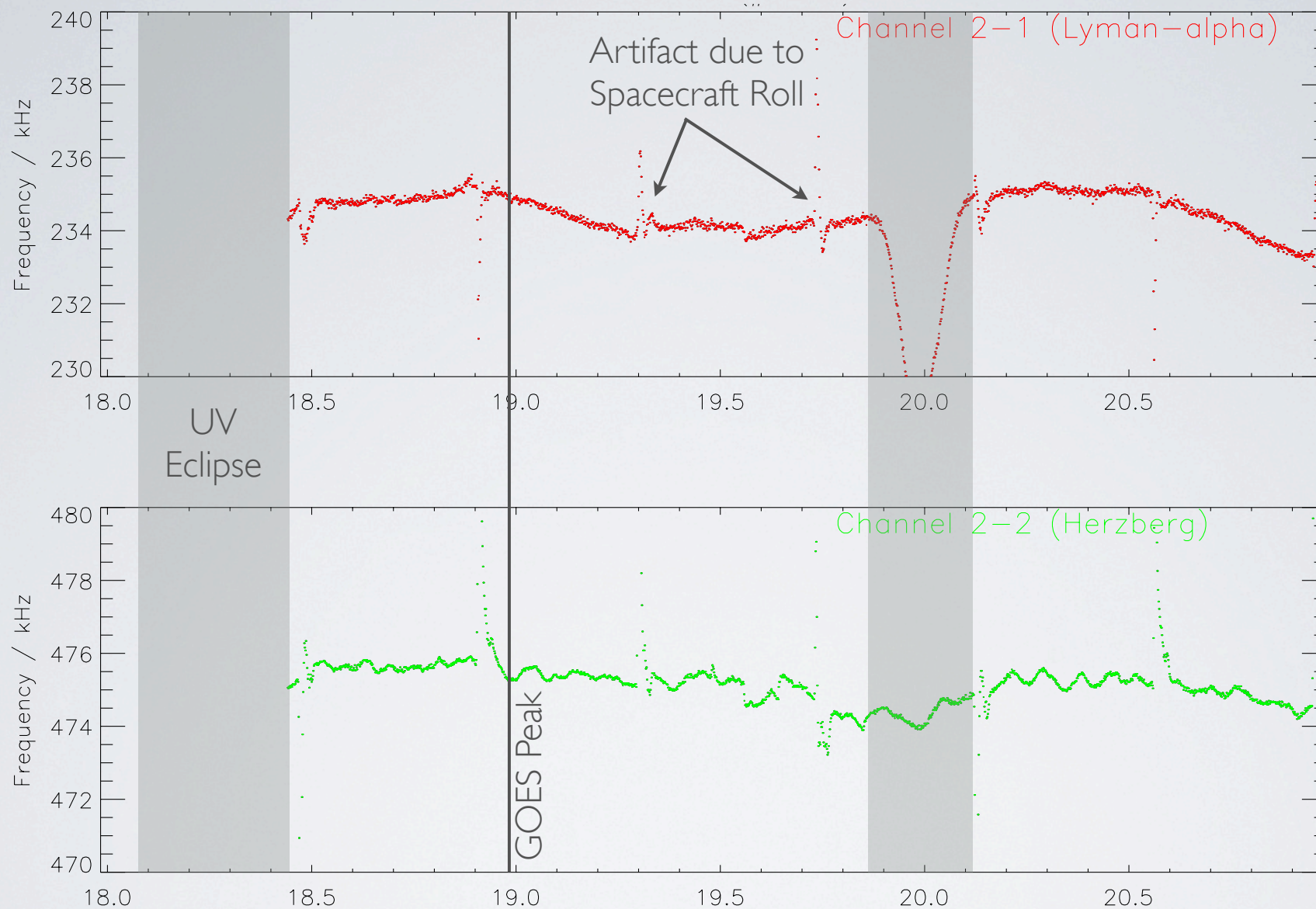
Diamond-Based Detectors:

Radiation and
degradation
resistant

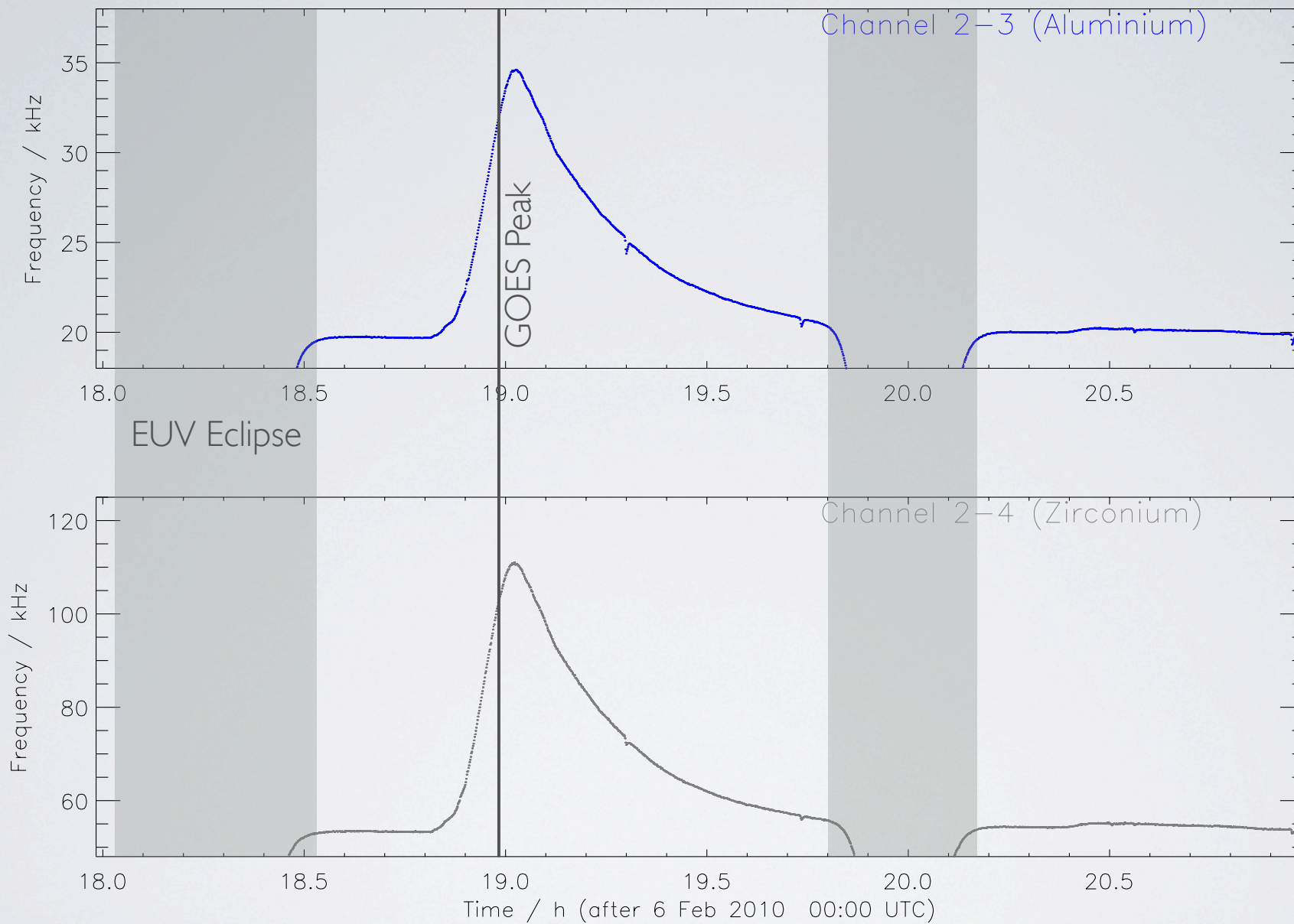


LYRA in South Atlantic Anomaly

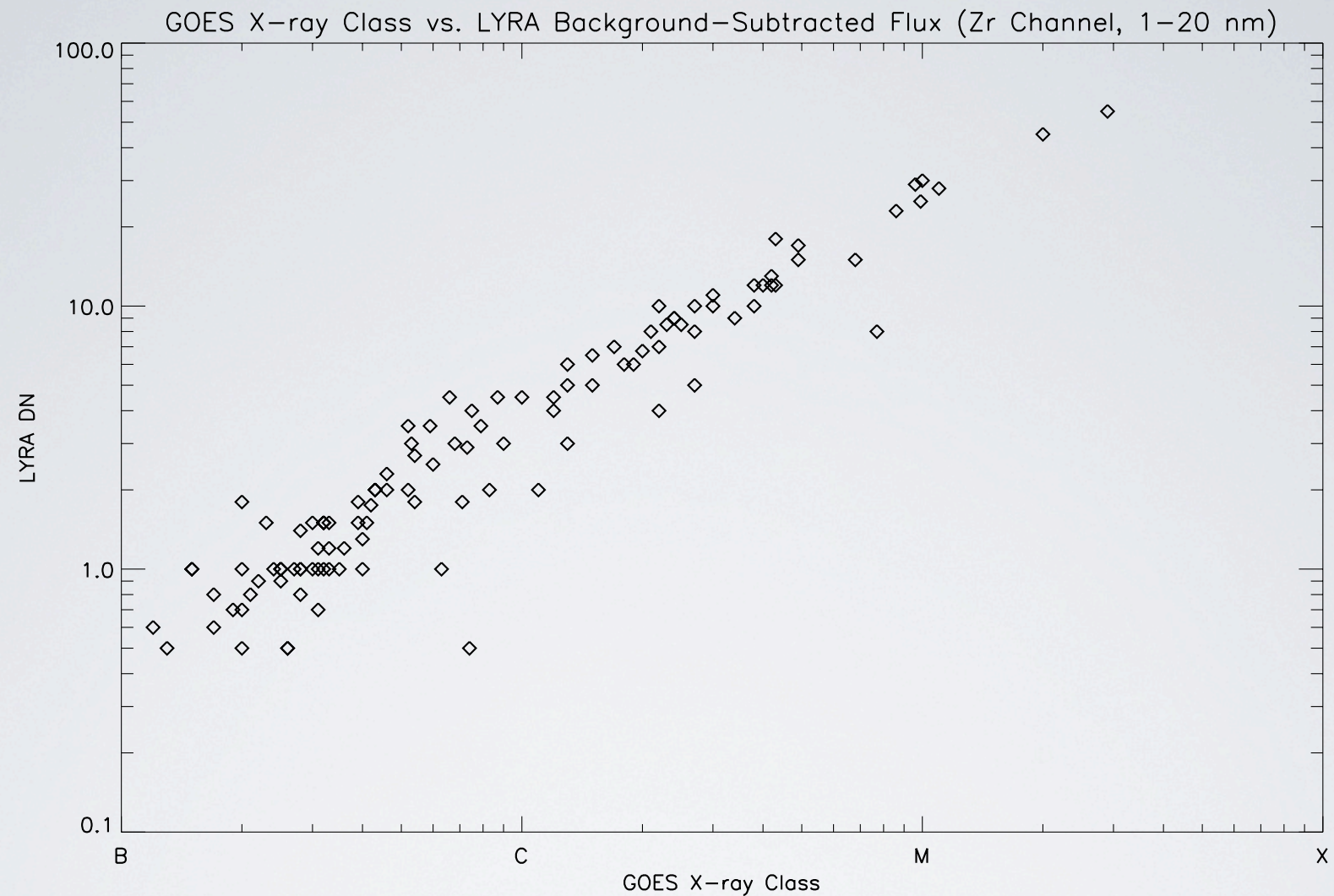
LYRA DATA



M2.9 Flare, 6 February 2010



M2.9 Flare, 6 February 2010

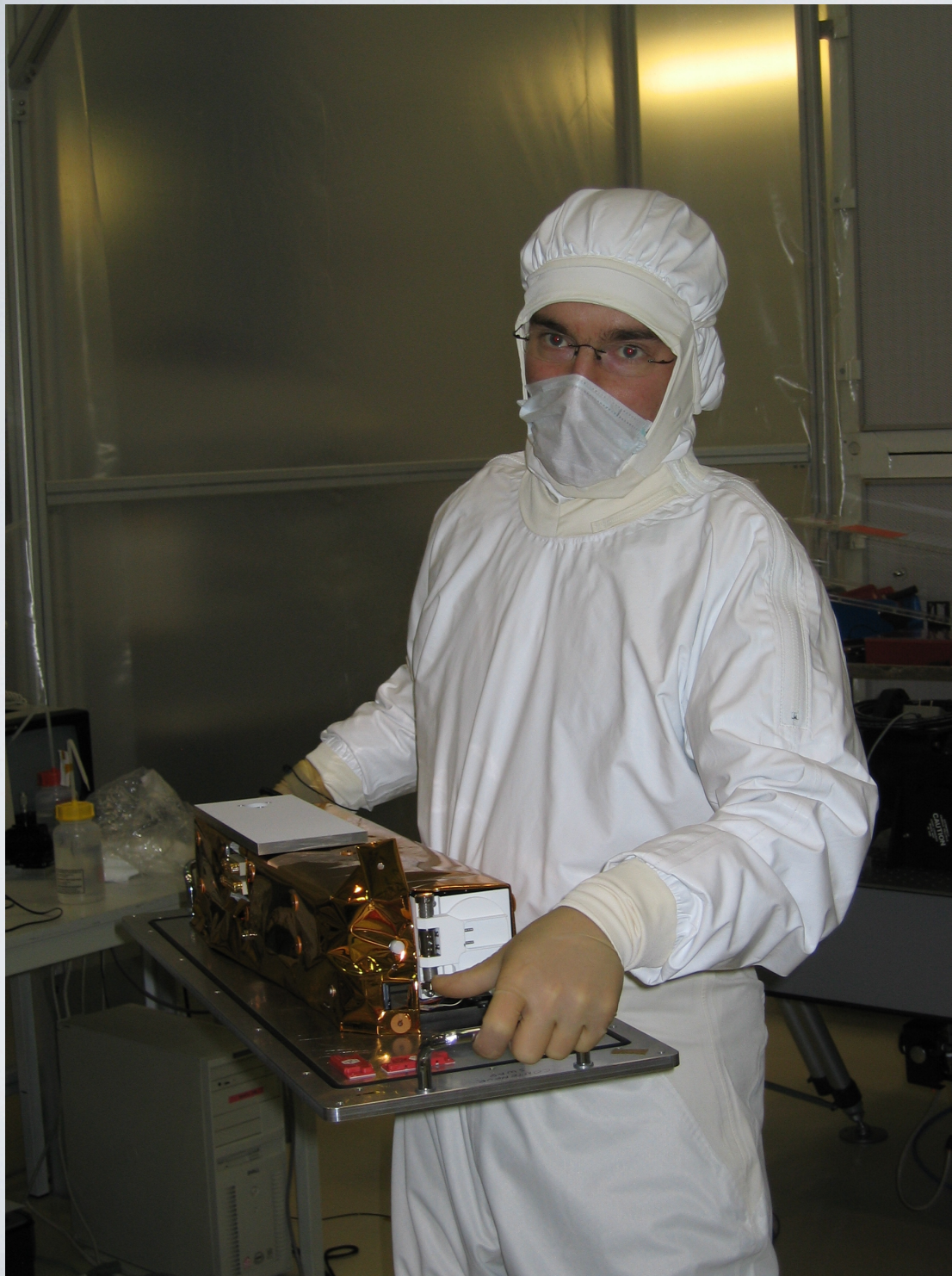


LYRA & GOES FLUX

Flares observed in 2010, LYRA Zr Channel

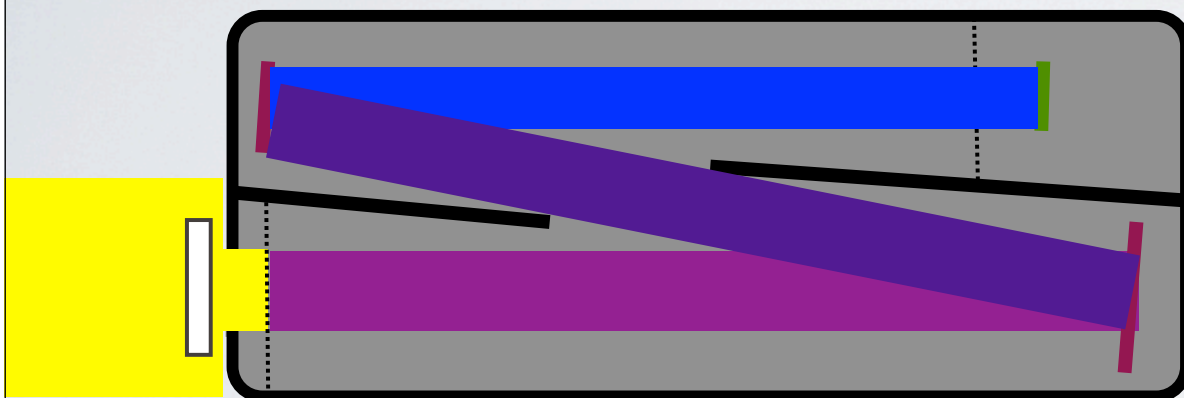
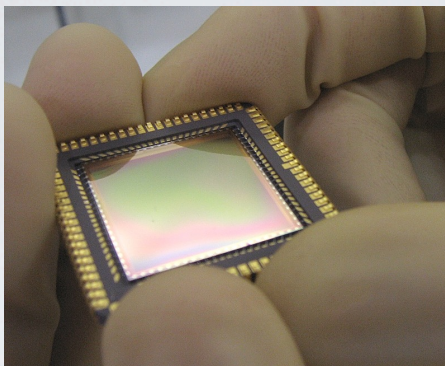
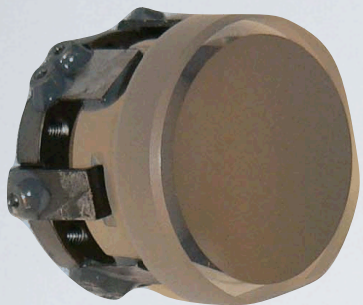
SWAP

PI: David Berghmans (ROB)
Jean-Marc Defise (CSL)

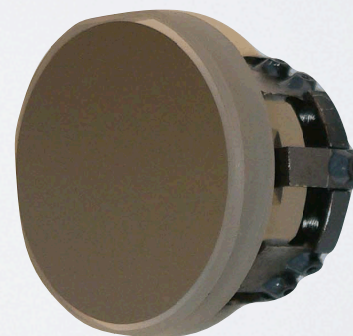
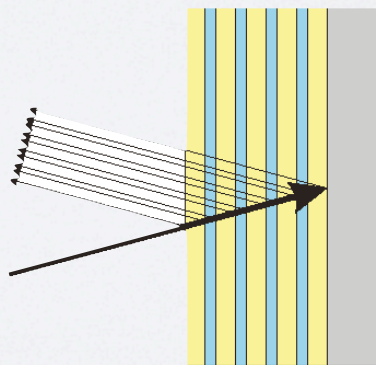
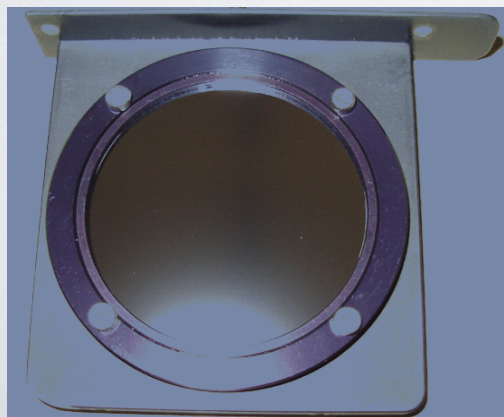


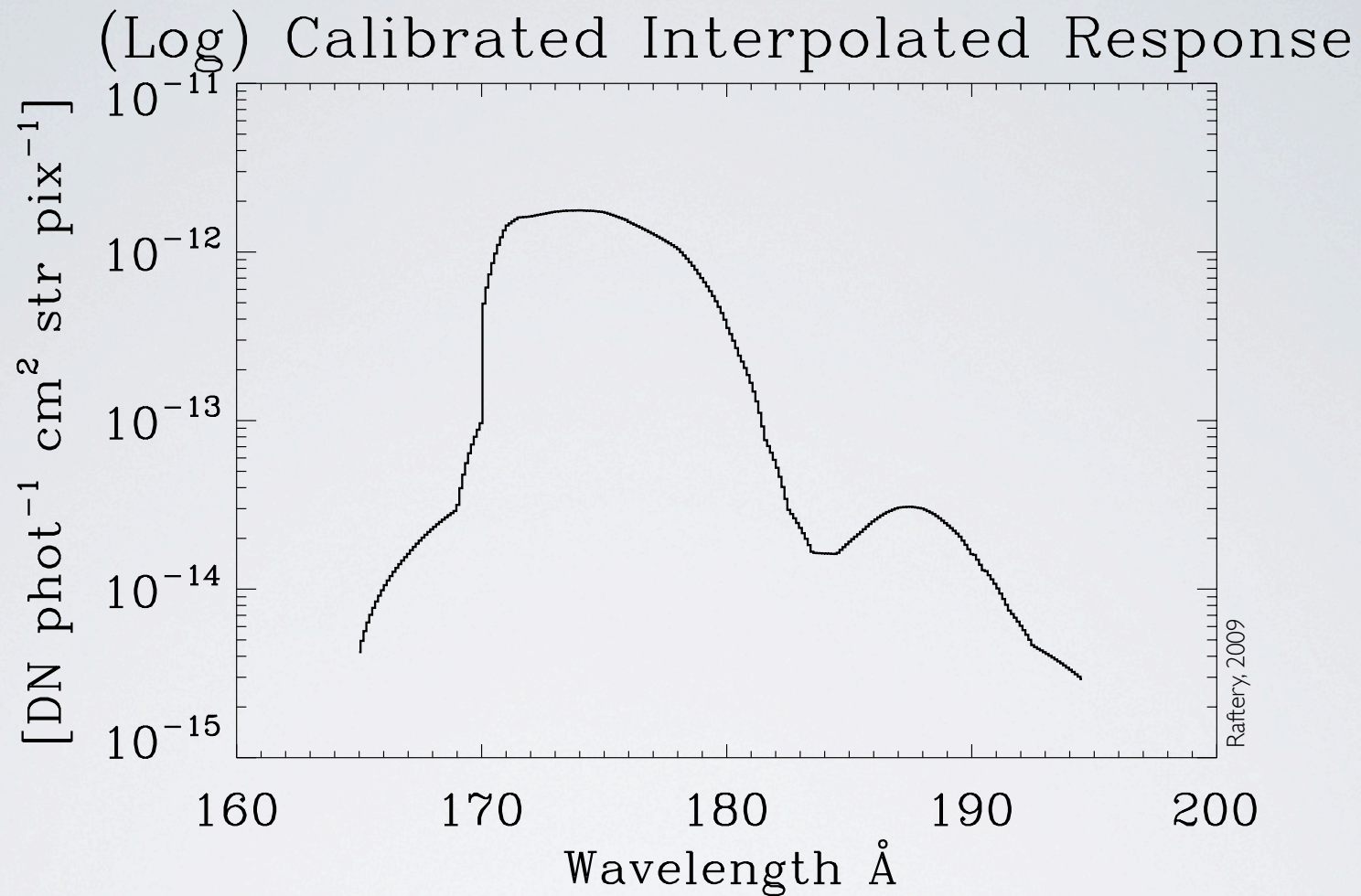
Sun Watcher using APS and Image Processing

JP Halain (Centre Spatial de Liege)
SWAP project manager



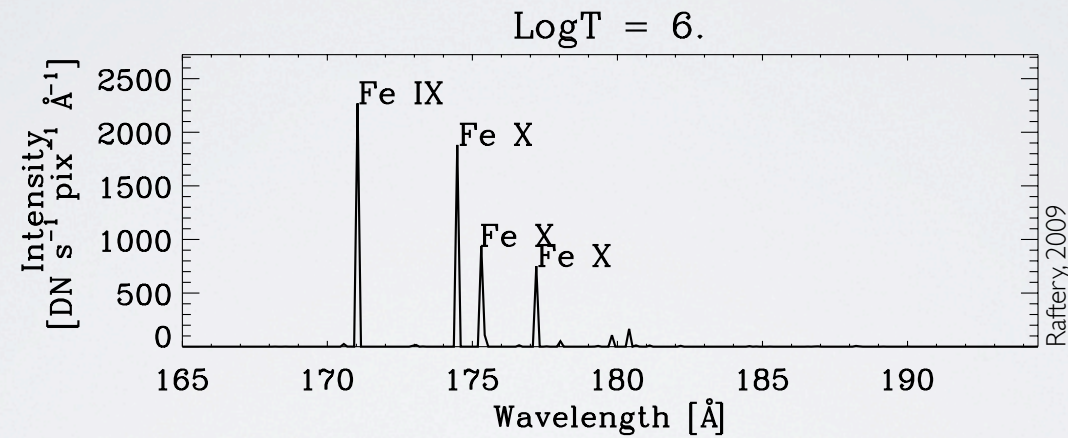
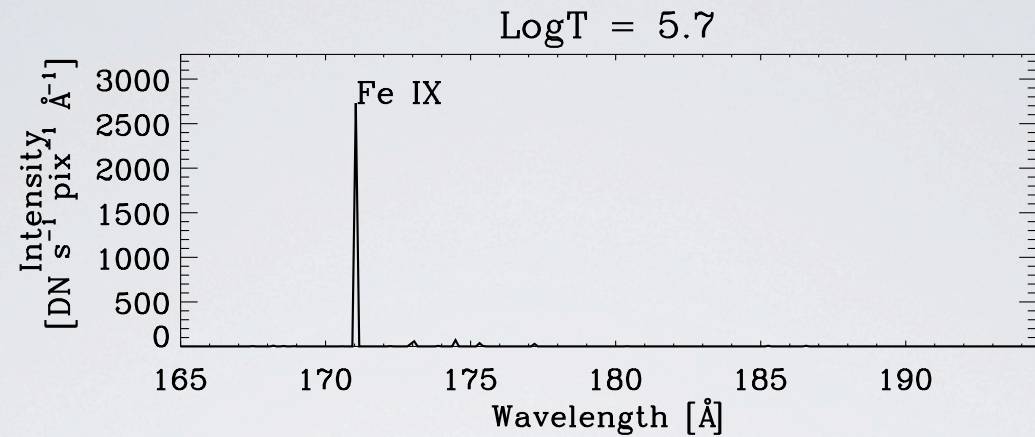
Sun Watcher using APS
and Image Processing





SPECTRAL RESPONSE

Measured with Synchrotron Beam at BESSY



Raftery, 2009

SPECTRAL RESPONSE

Transmitted Lines at Selected Temperatures

CMOS APS DETECTOR

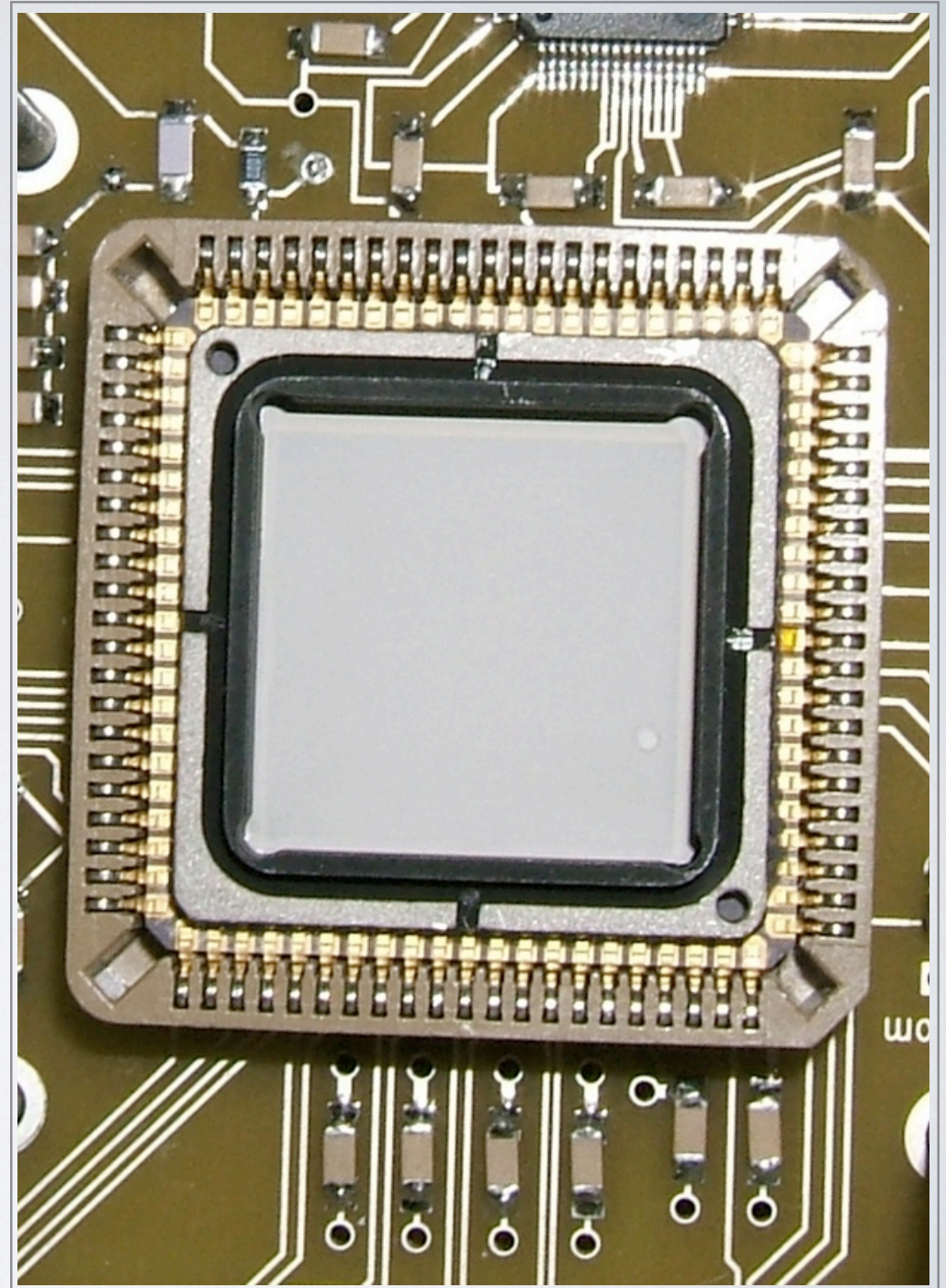
Fillfactory
(Mechelen, now Cypress)

1024×1024 Pixels star-tracker
P43 coating for EUV sensitivity

Low power consumption

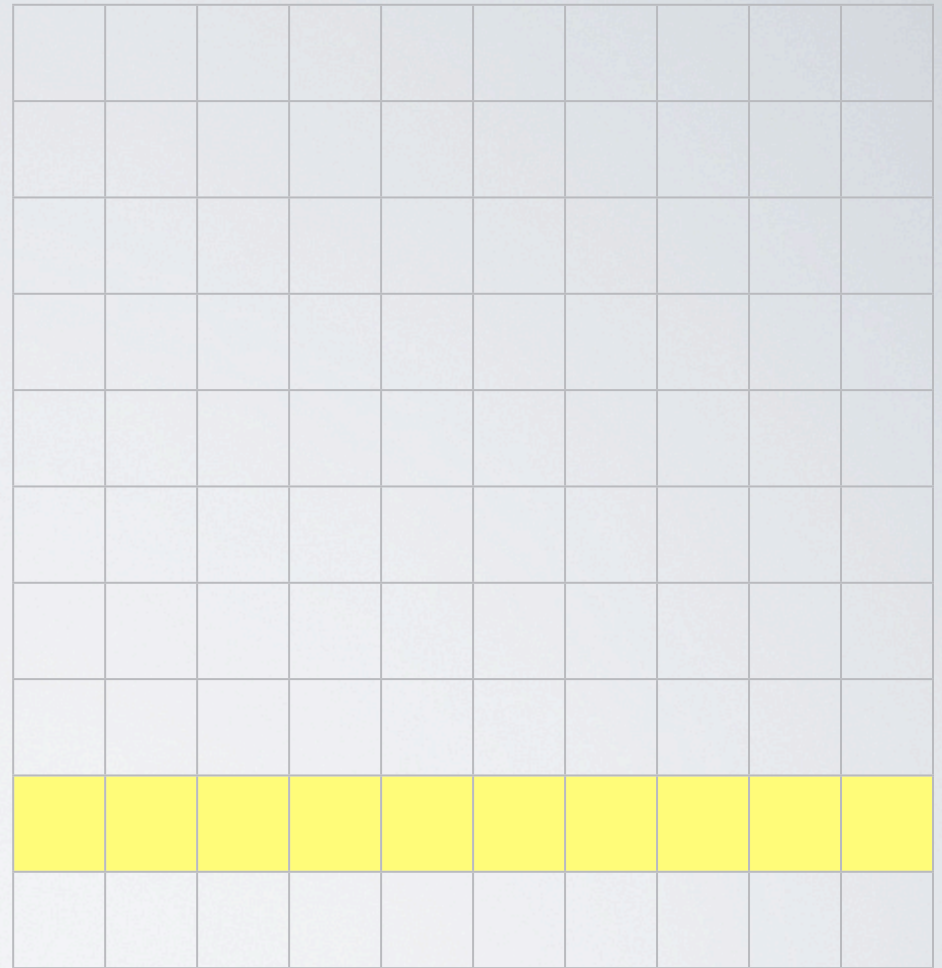
First CMOS for solar physics
in orbit

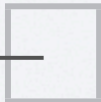
No charge transfer as in CCD
No need for shutter



CCD READOUT

Charge Transfer

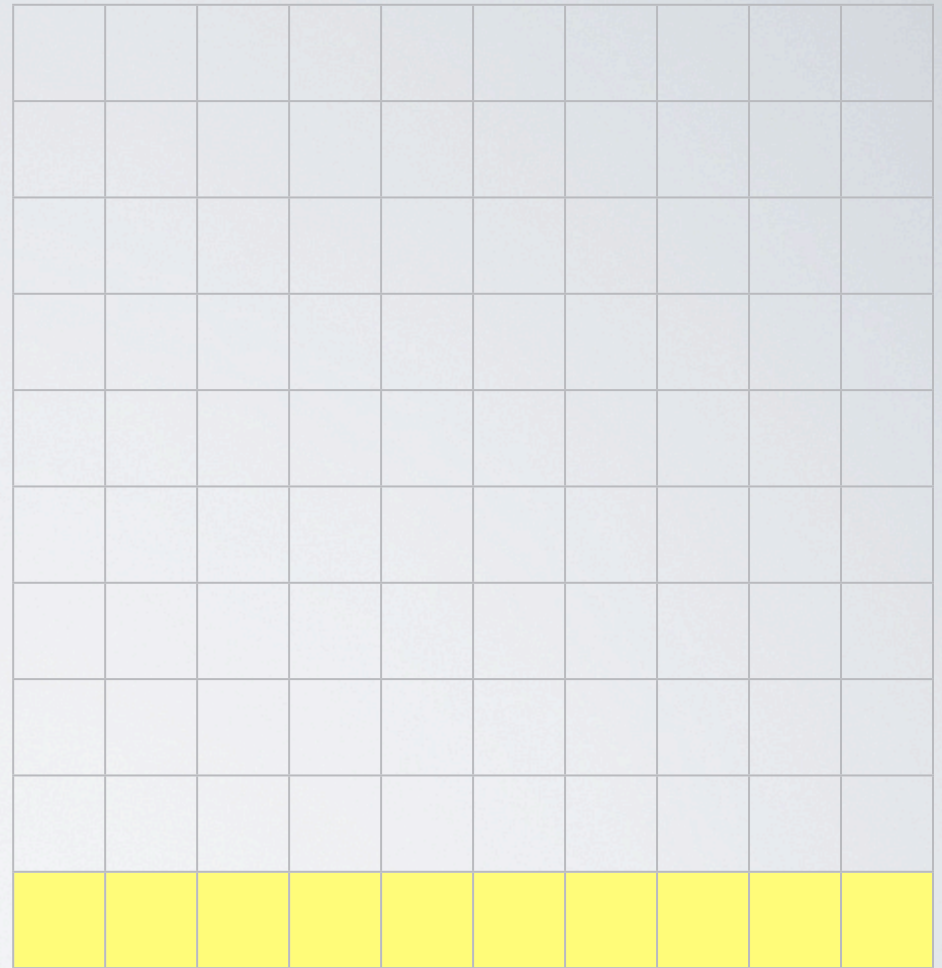


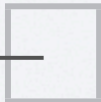
To ADC ← 



CCD READOUT

Charge Transfer

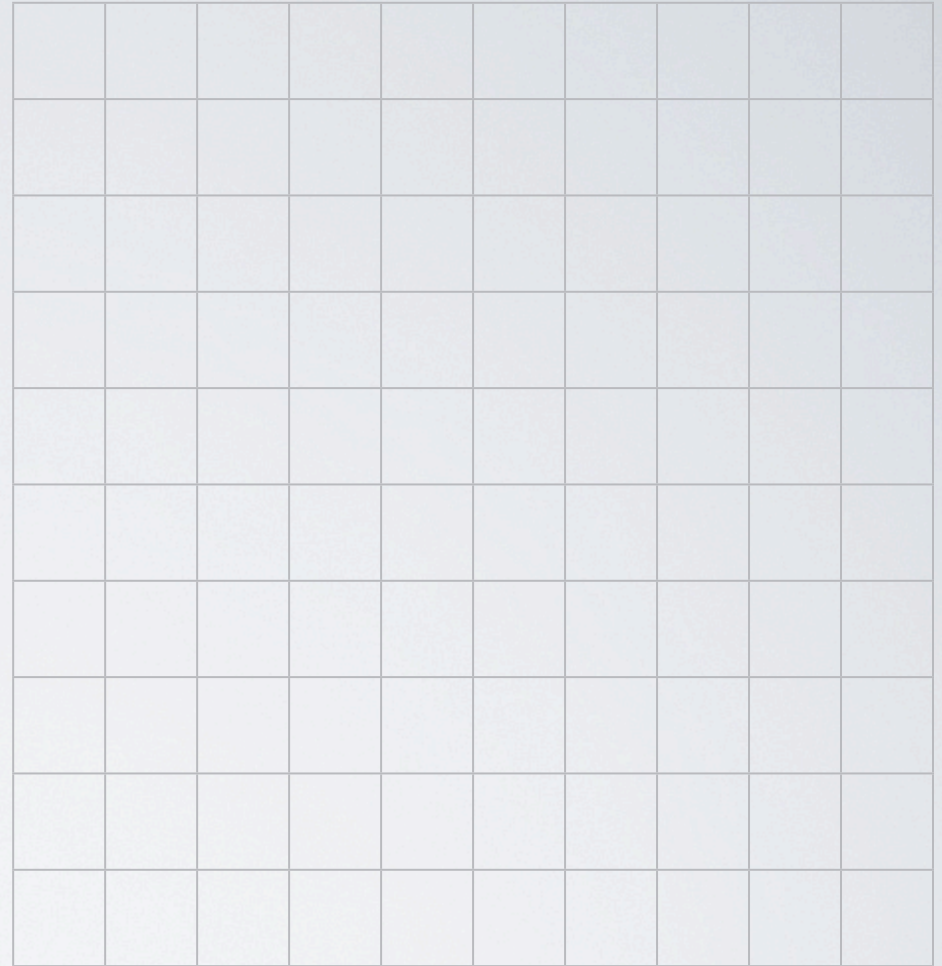


To ADC ← 

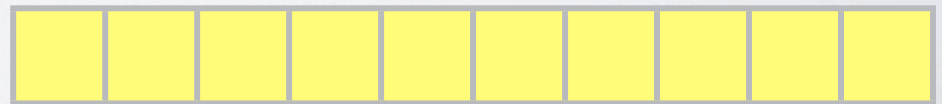
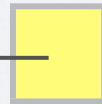


CCD READOUT

Charge Transfer

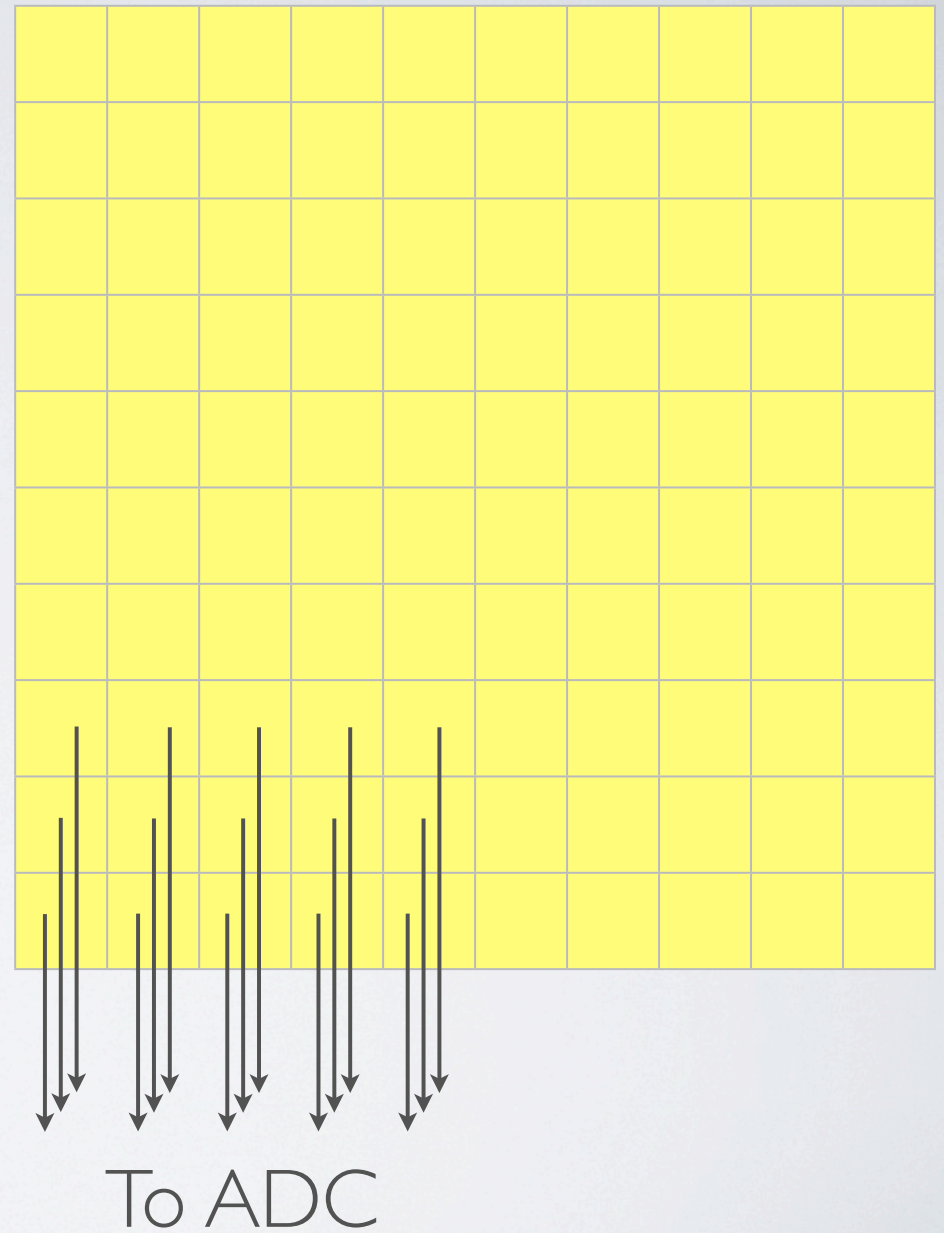


To ADC



CMOS APS READOUT

No Charge Transfer



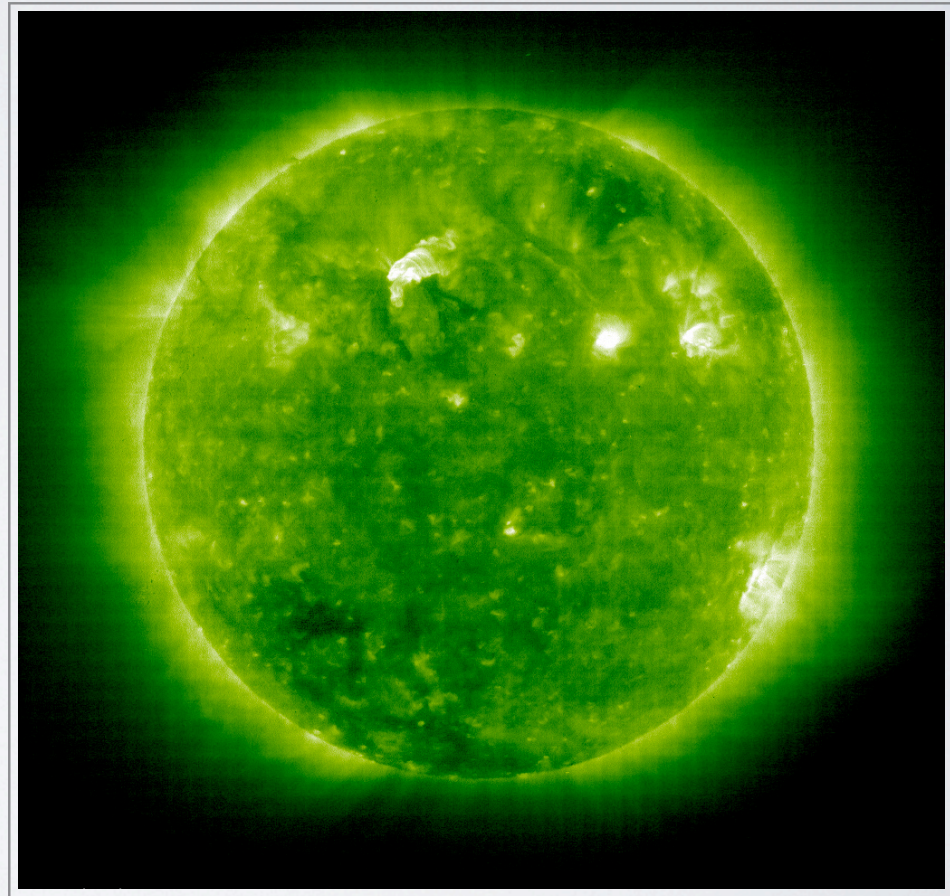
SWAP VS. EIT

EIT: 17.1, 19.5, 28.4, 30.4 nm

- Sun-centered FOV
- 45 arcmin FOV
- $\approx$ 12 minute cadence
- Located at L1-point

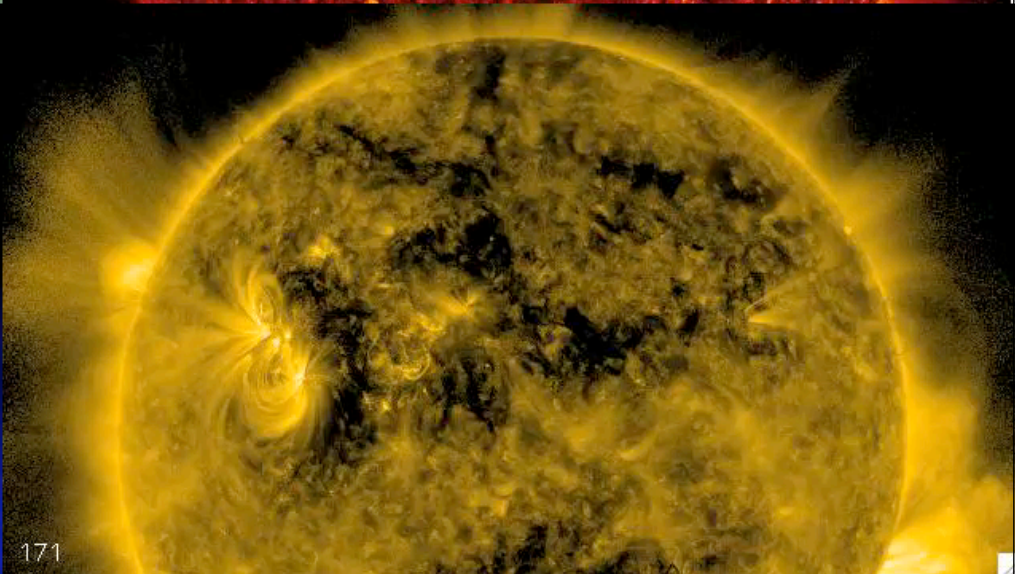
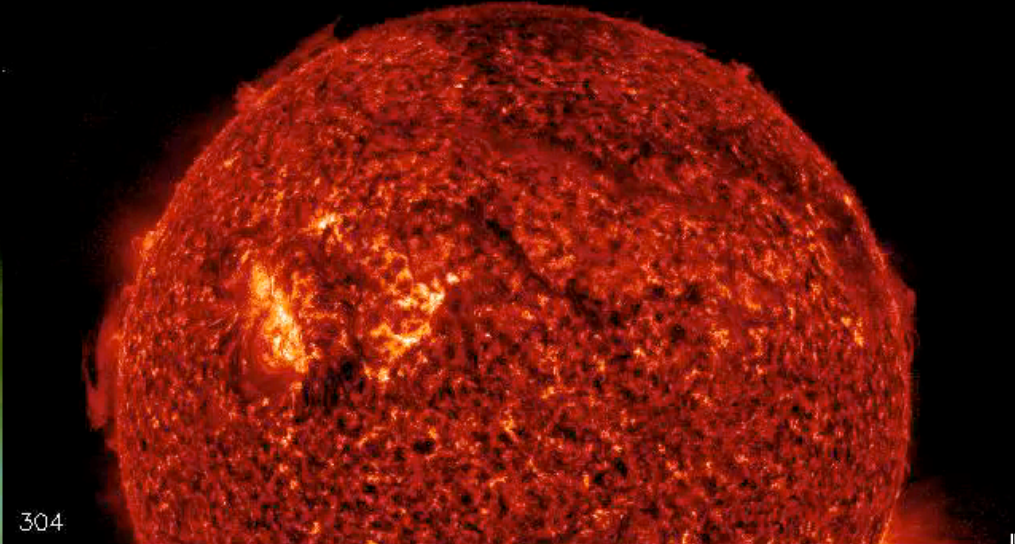
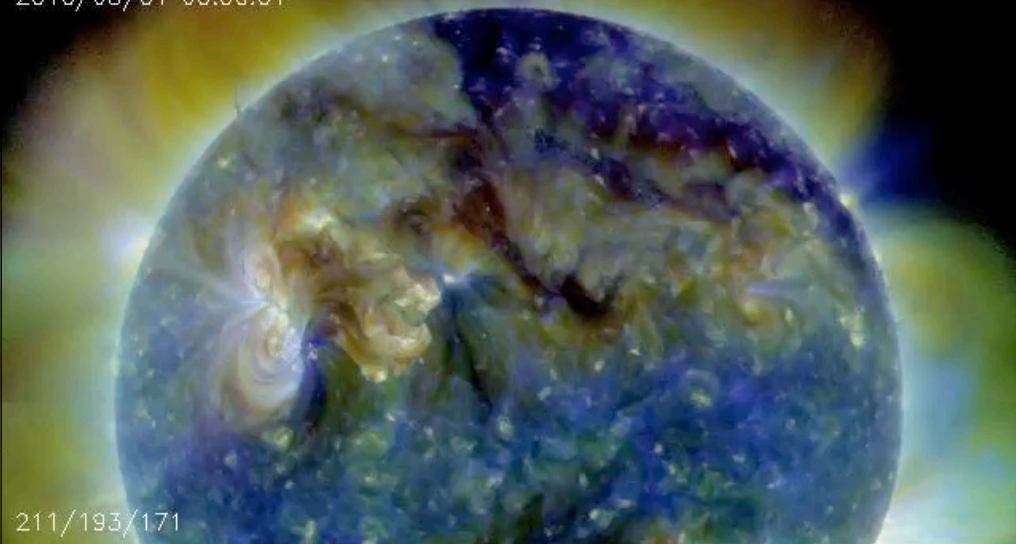
SWAP: 17.4 nm

- Flexible off-pointing
- 54 arcmin FOV
- $\approx$ 1 minute cadence
- Inside magnetosphere

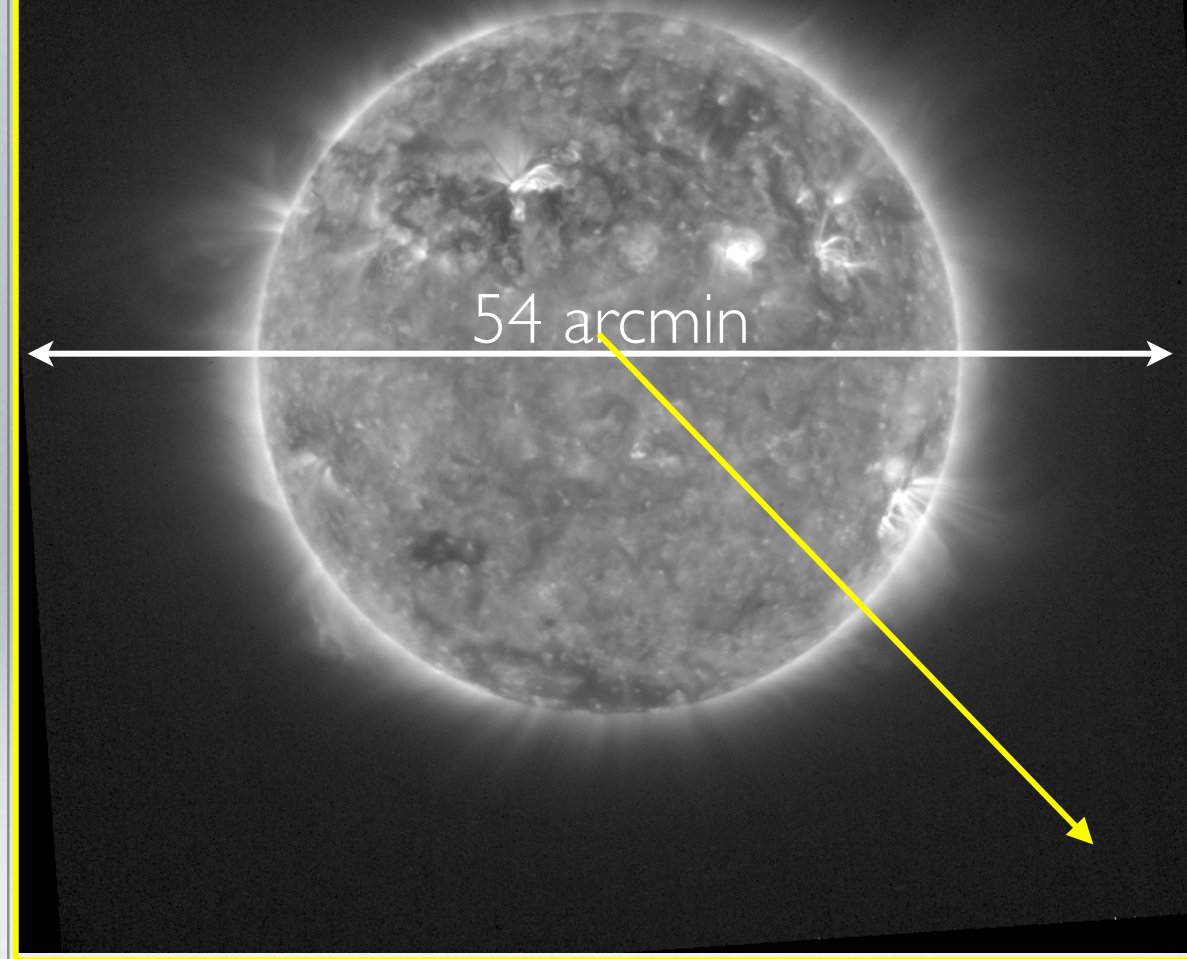


SDO (NASA)

2010/08/01 00:00:01



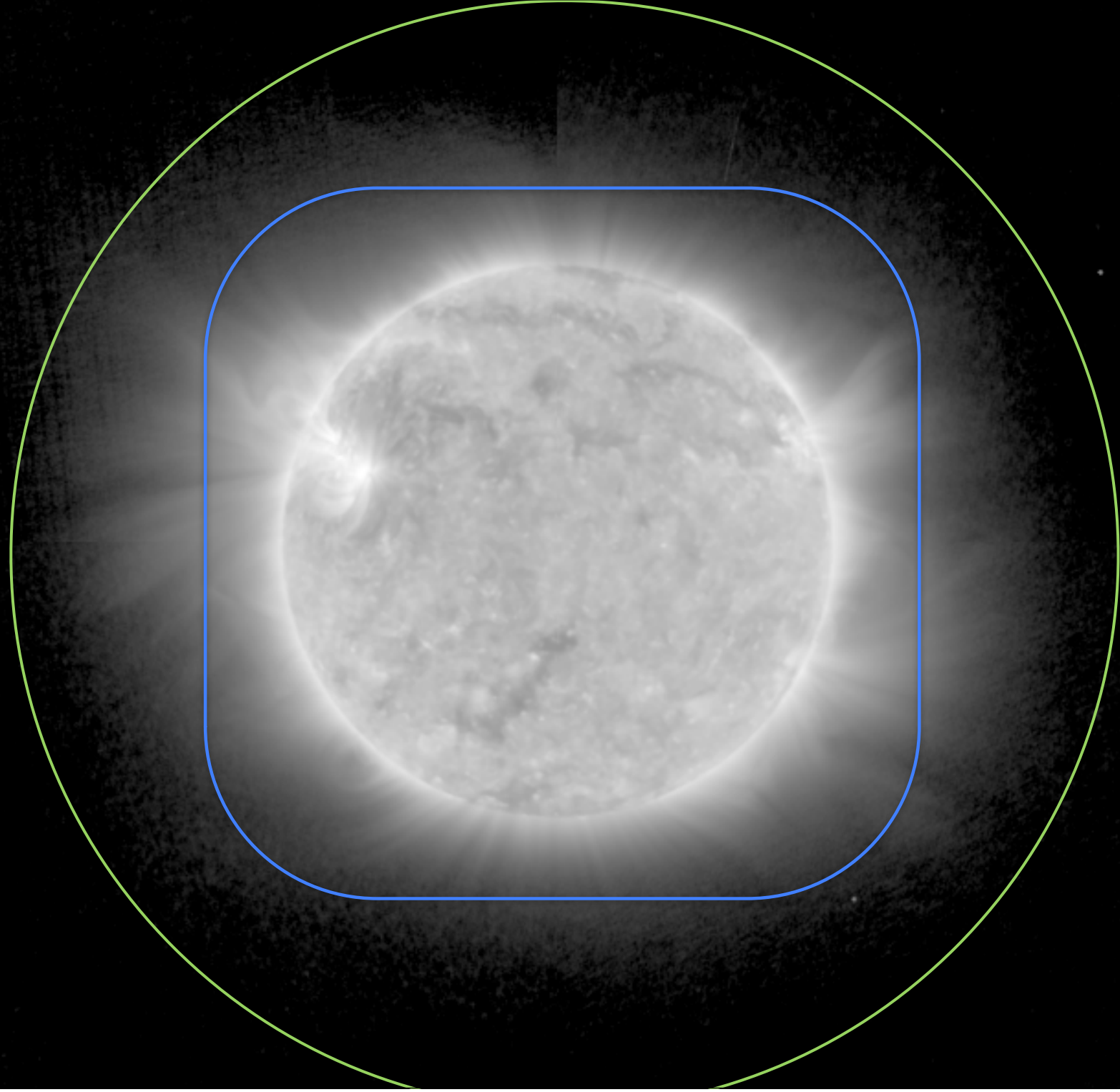
Off-pointing CME Tracking

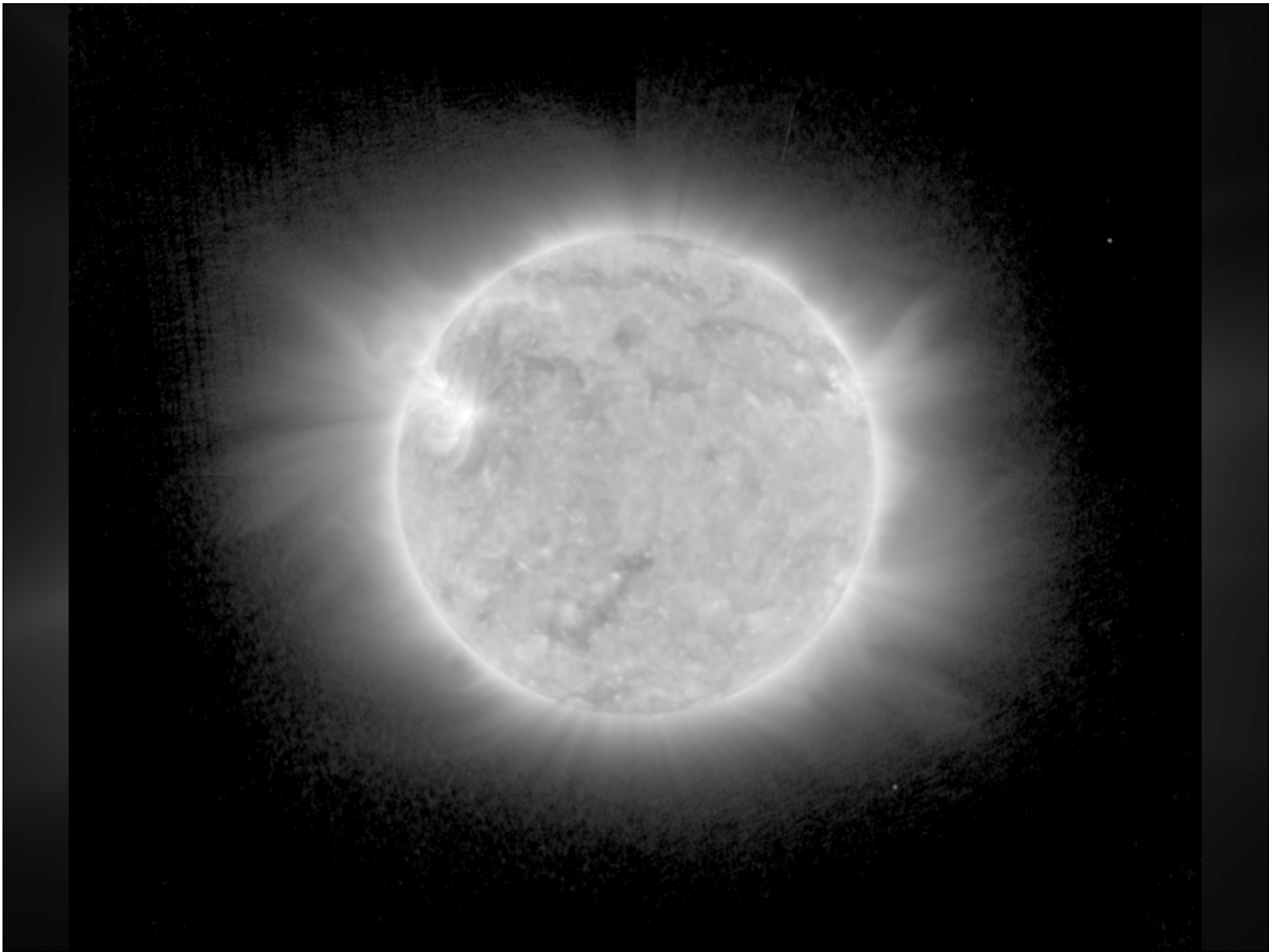


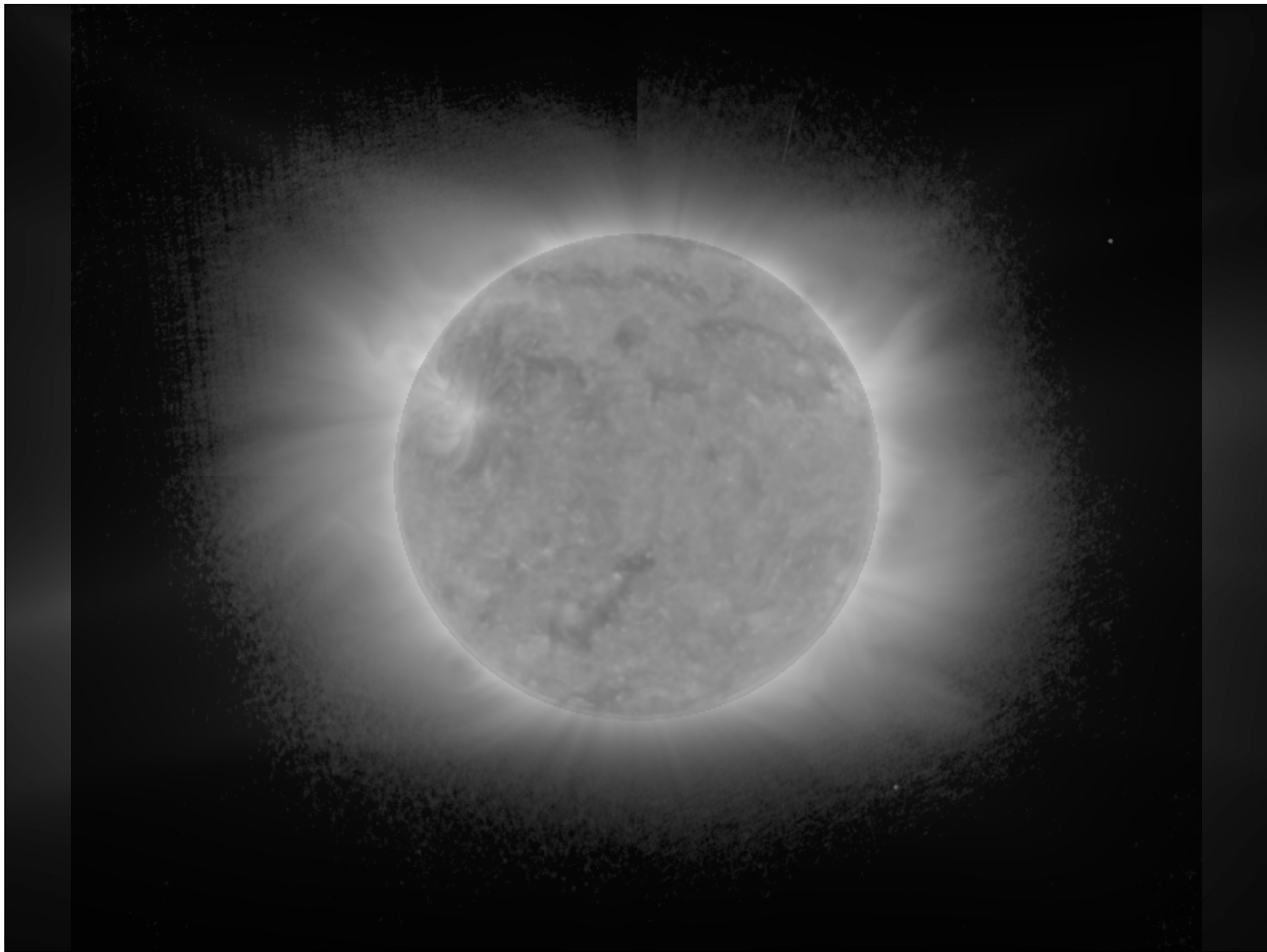
SWAP VS. AIA ON SDO

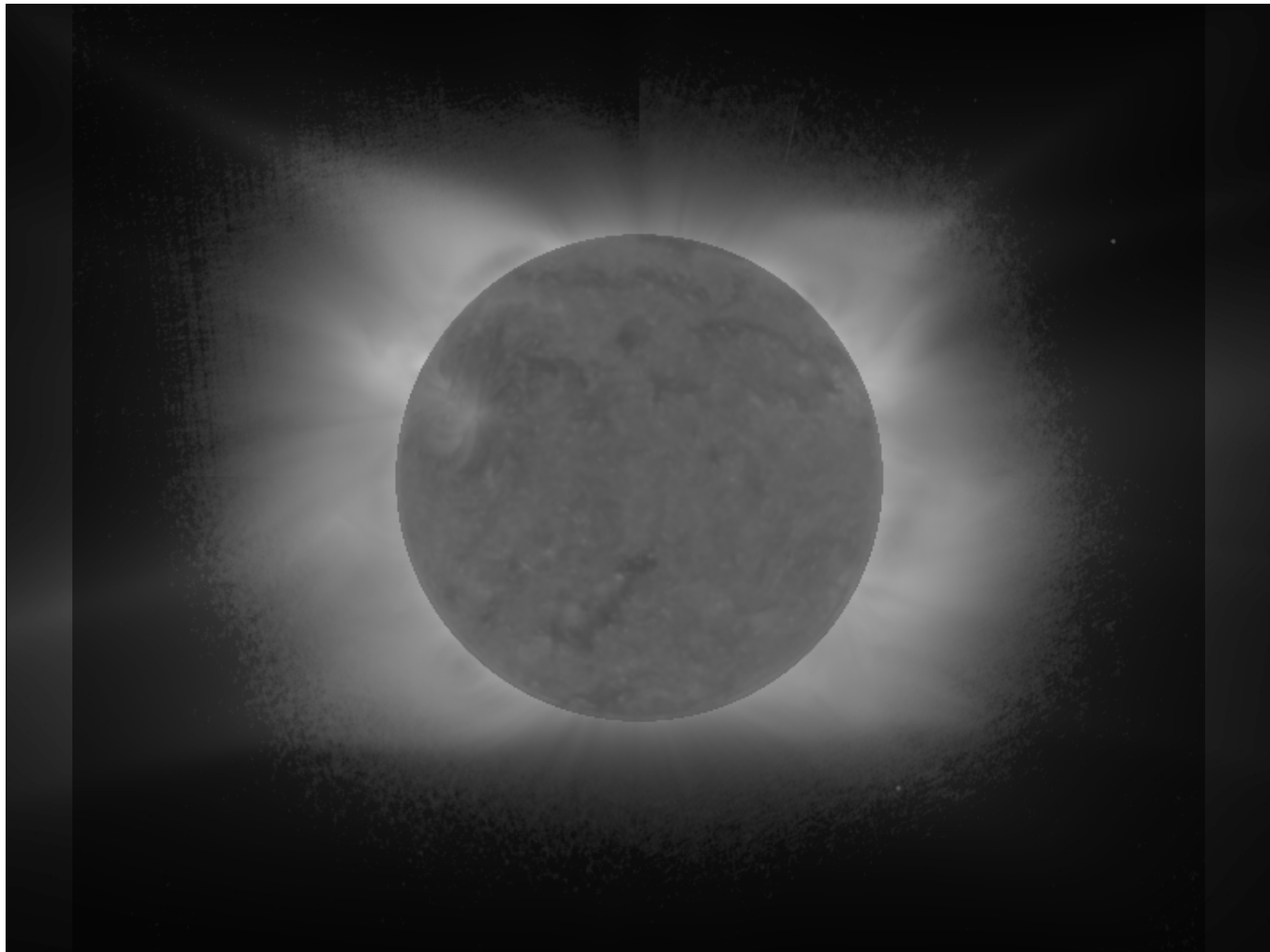
SWAP DATA

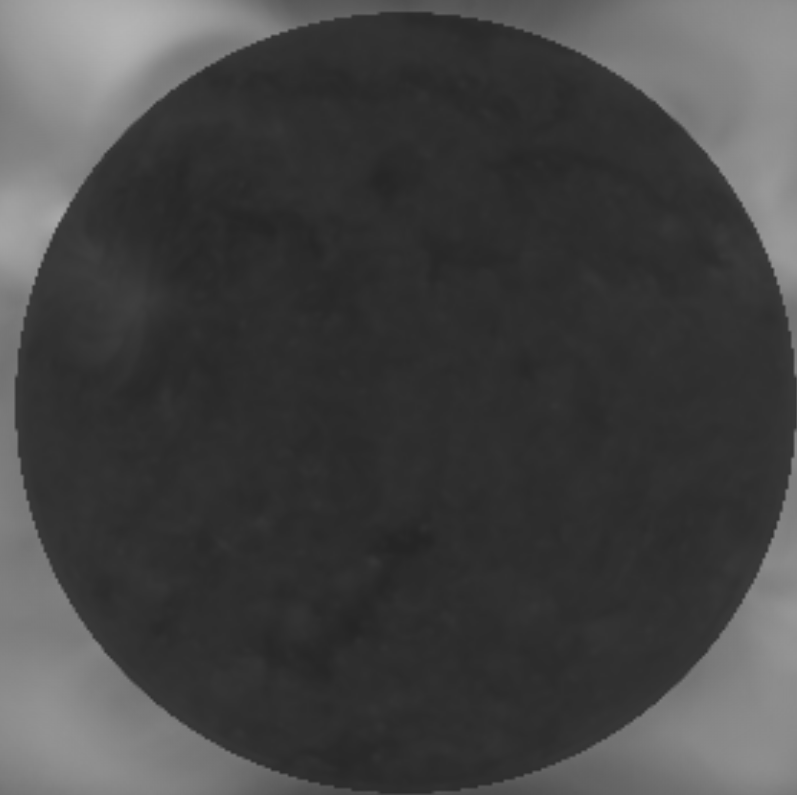
Work by Vladimir Slemzin (Lebedev) 11 July











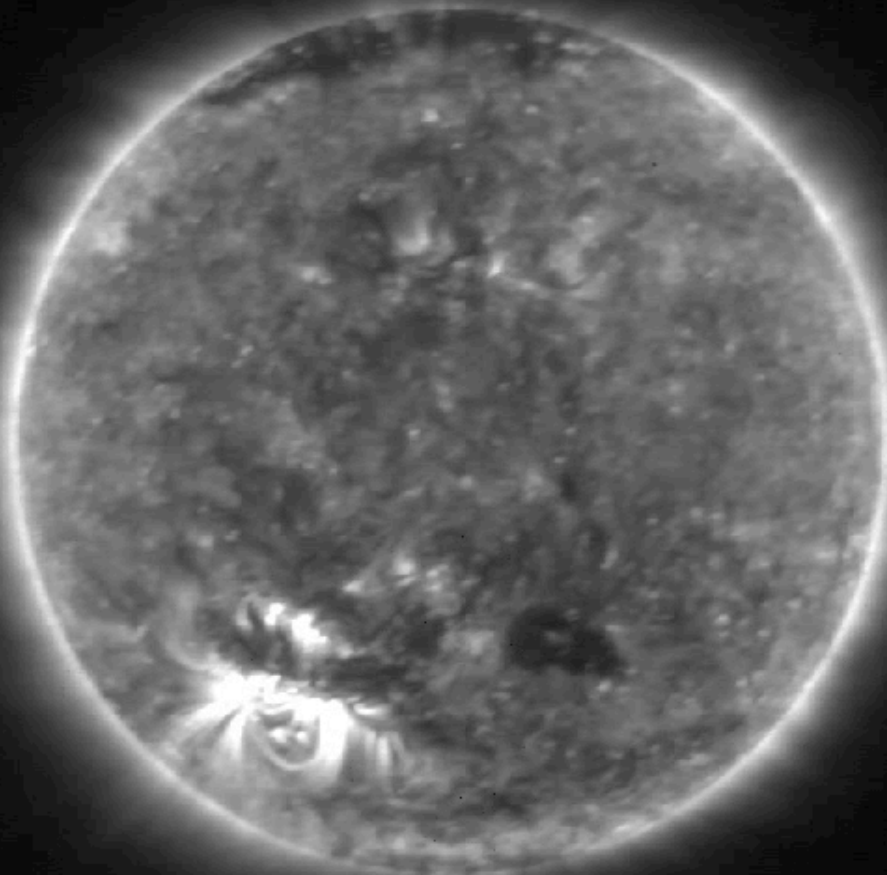
John Linker, Zoran Mikic

<http://www.predsci.com/corona/jul10eclipse/jul10eclipse.html>



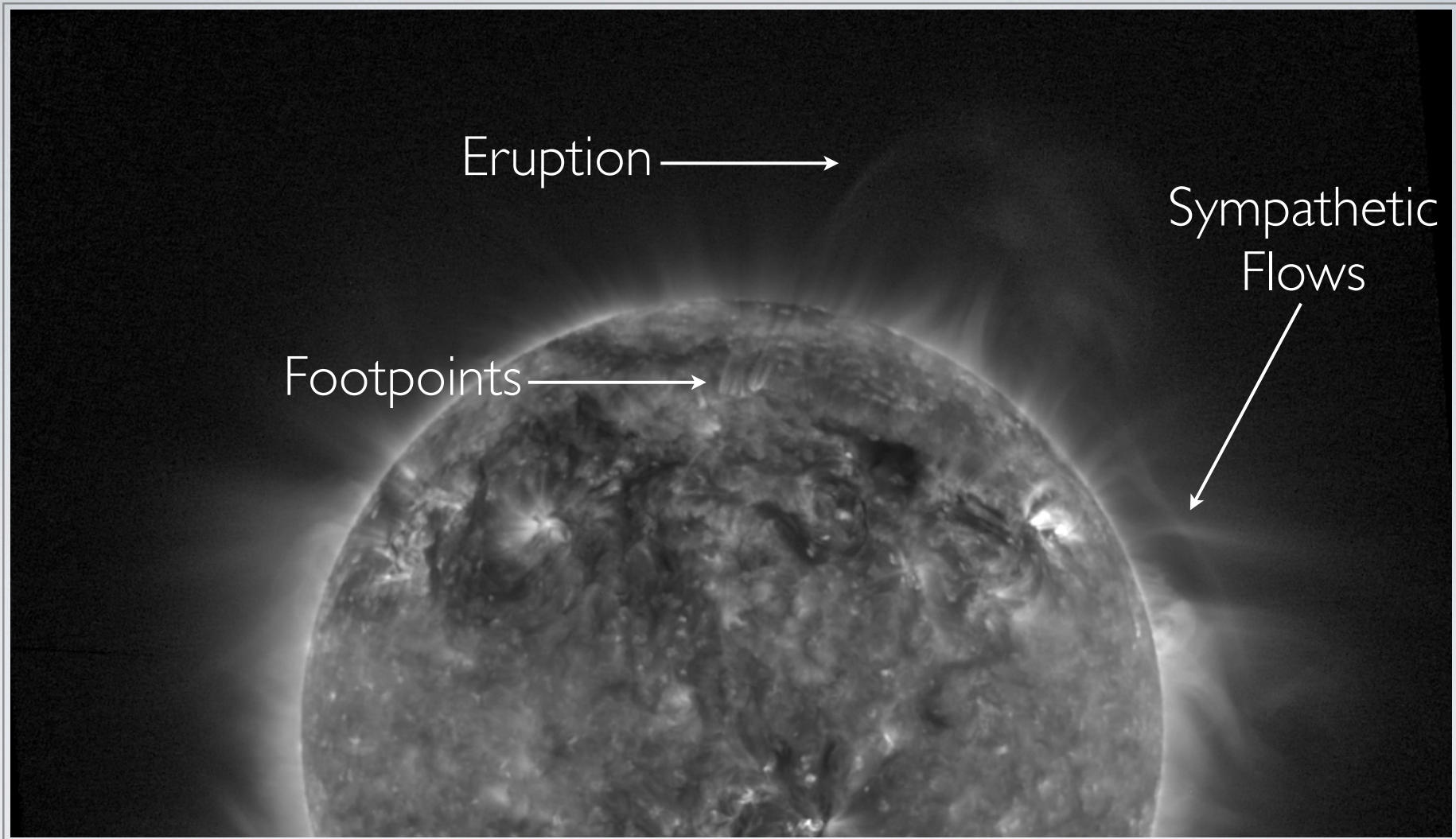
Eclipse July 11 2010
simulated

ANNULAR SOLAR ECLIPSE



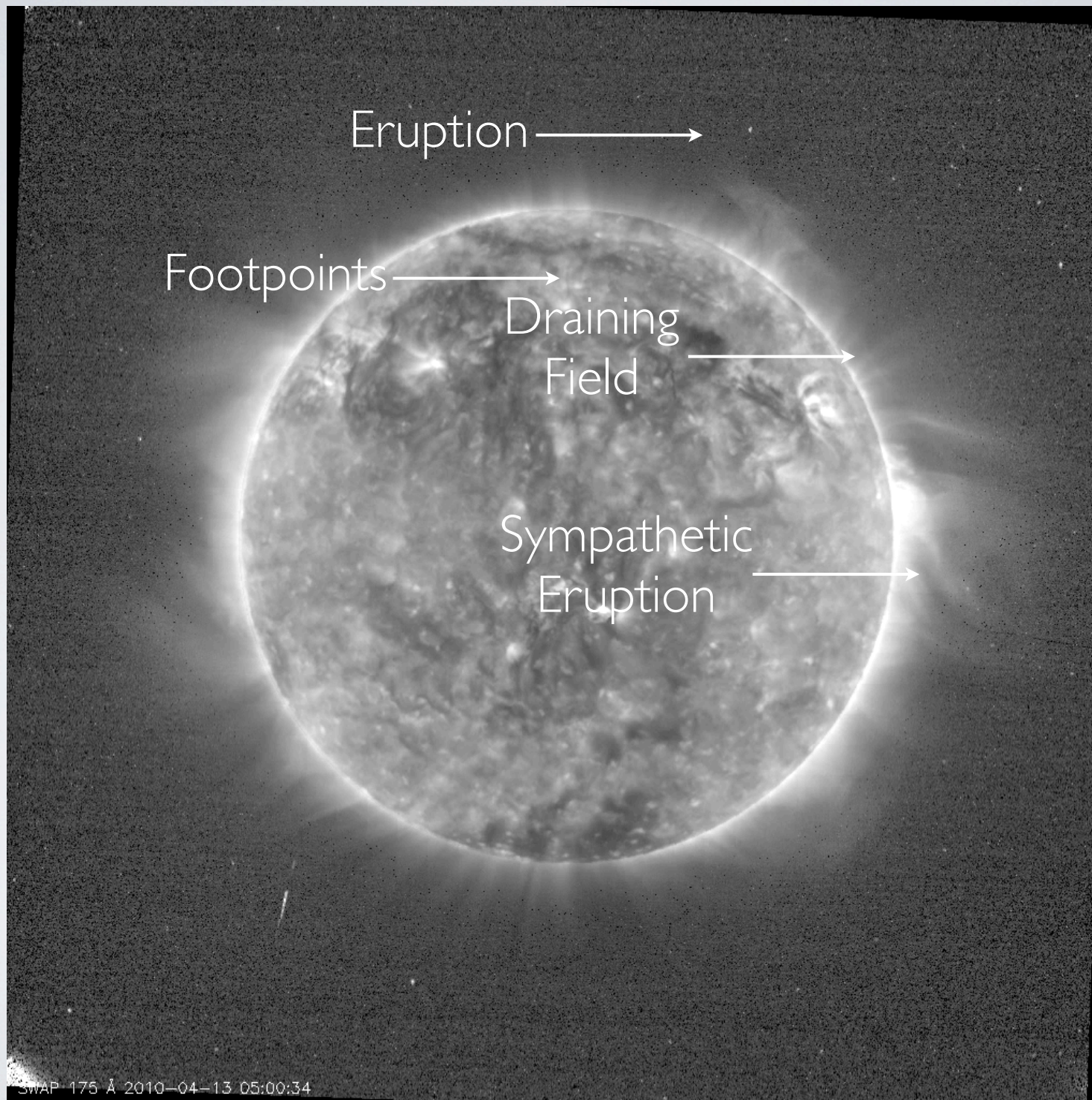
15 January 2010, 06:00 UTC

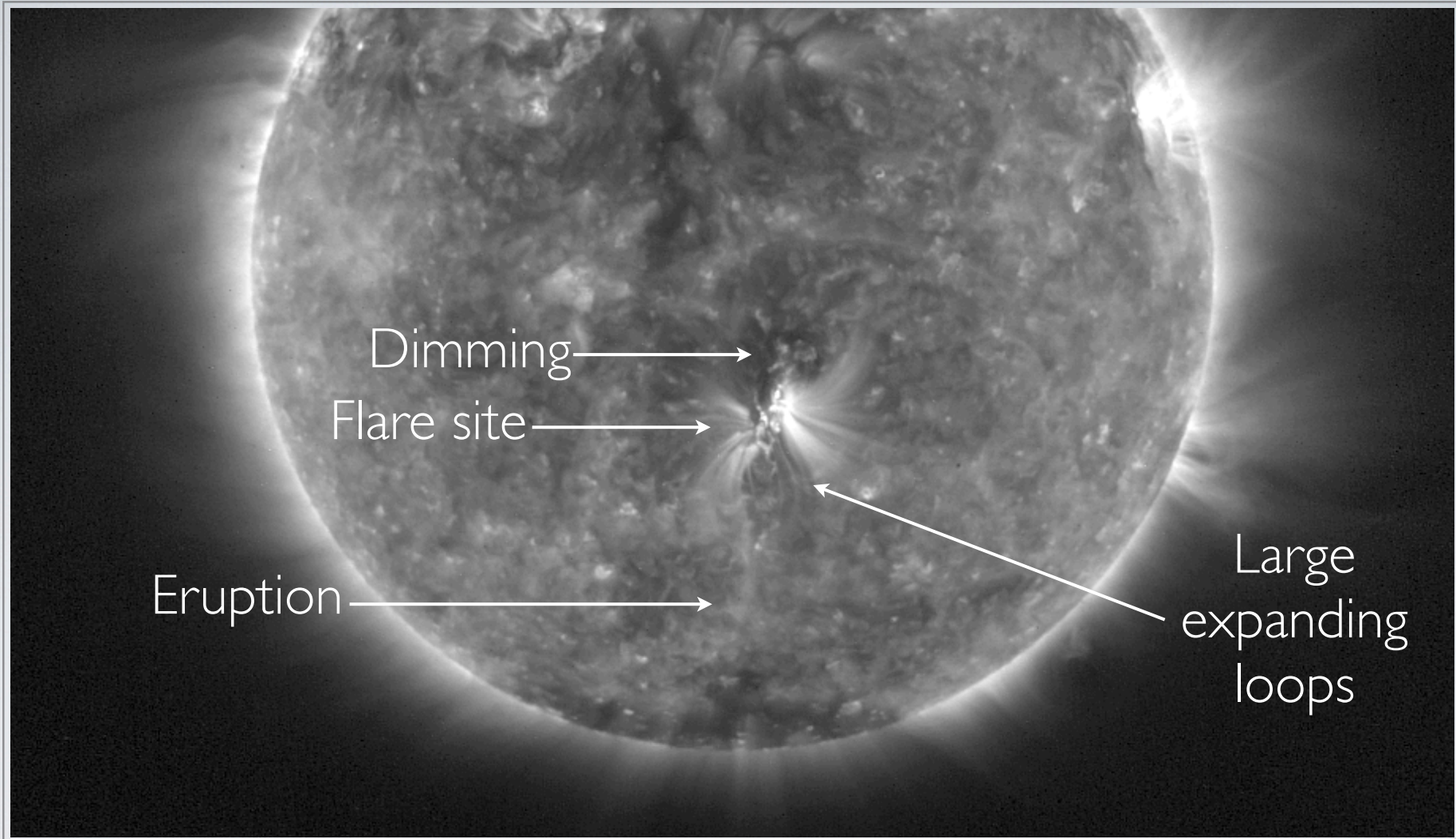




PROMINENCE ERUPTION

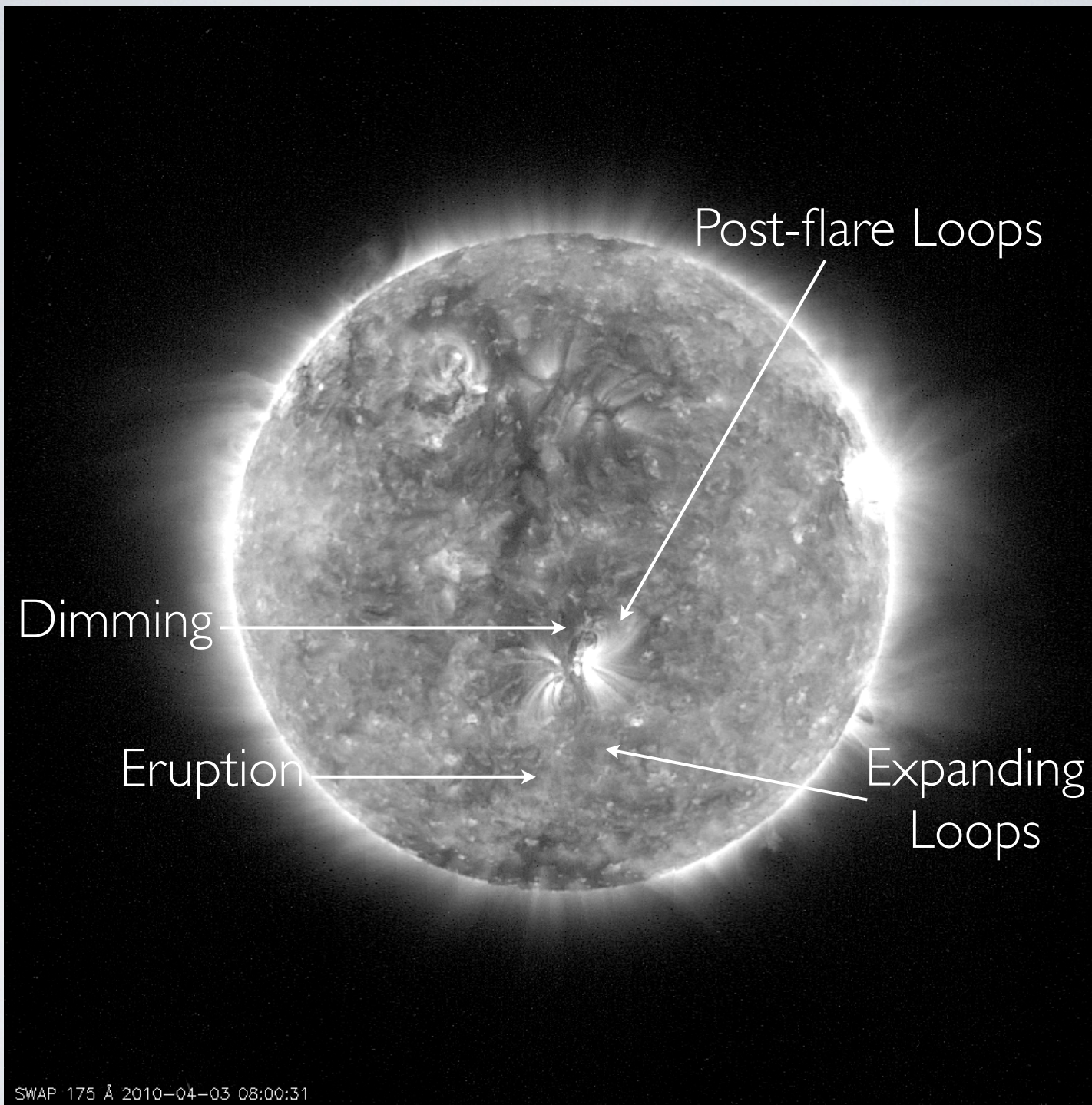
13 April 2010, 09:30 UTC

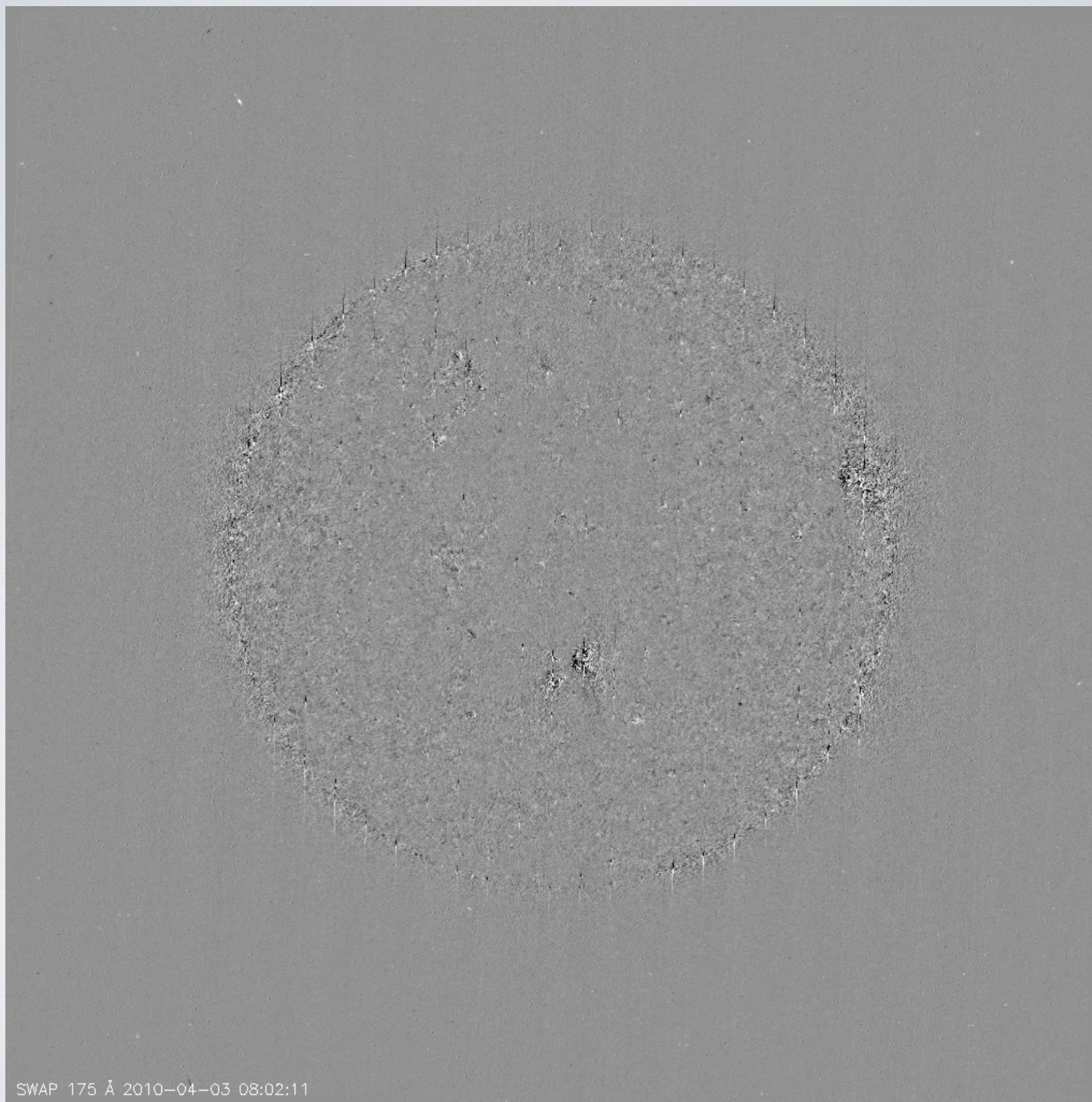




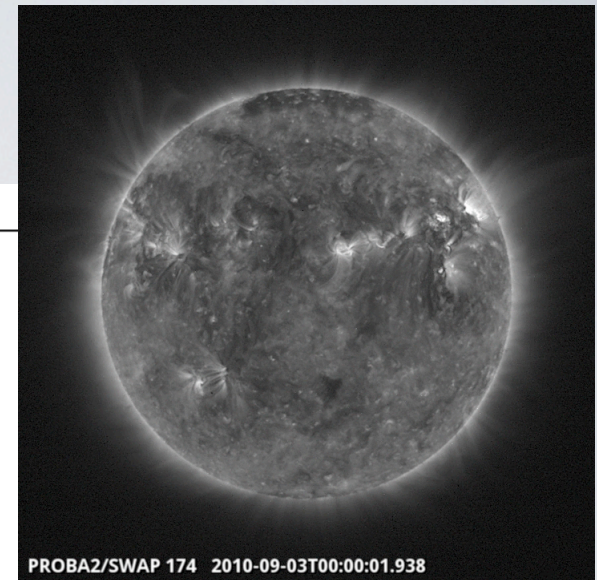
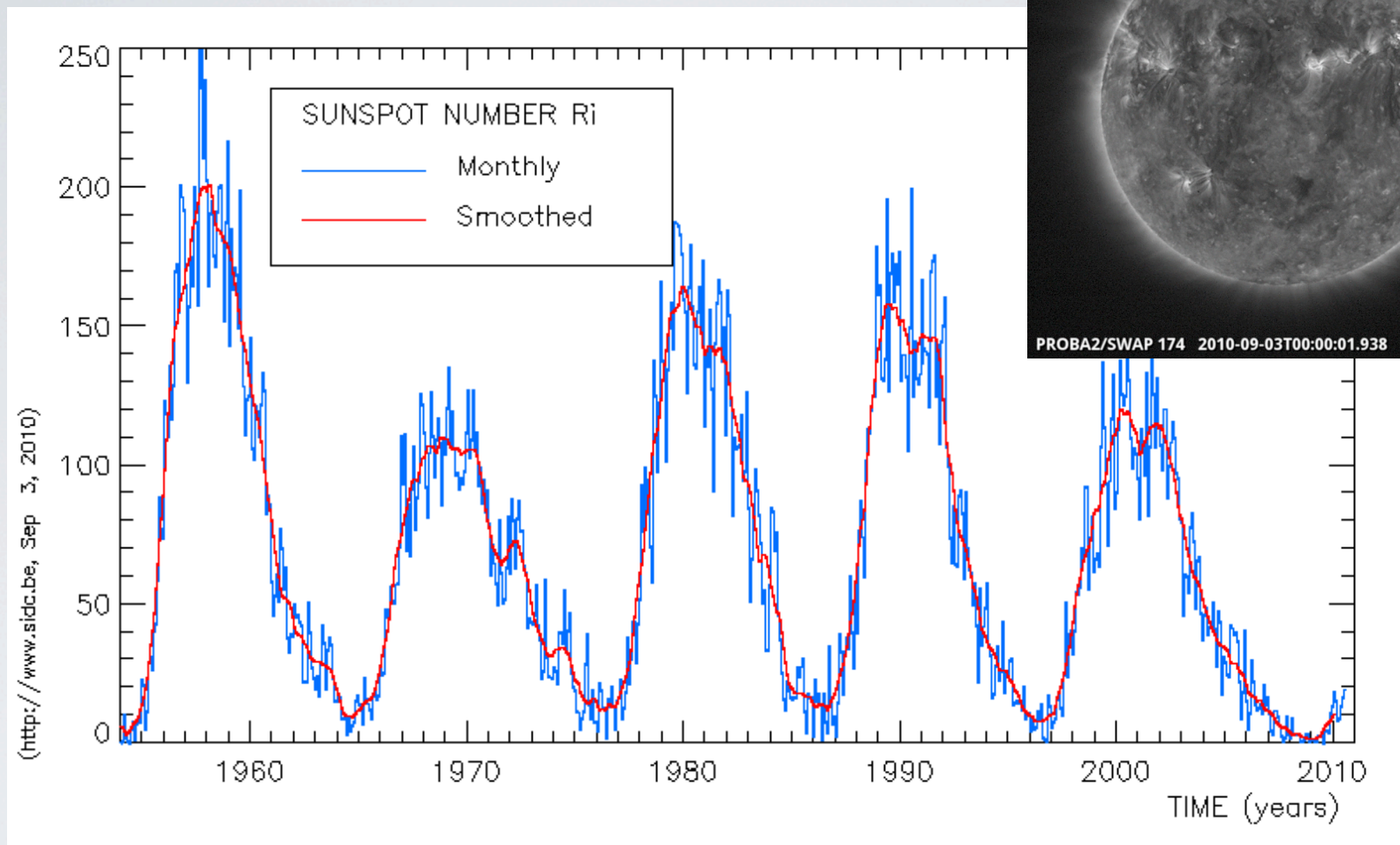
ERUPTION & FLARE

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



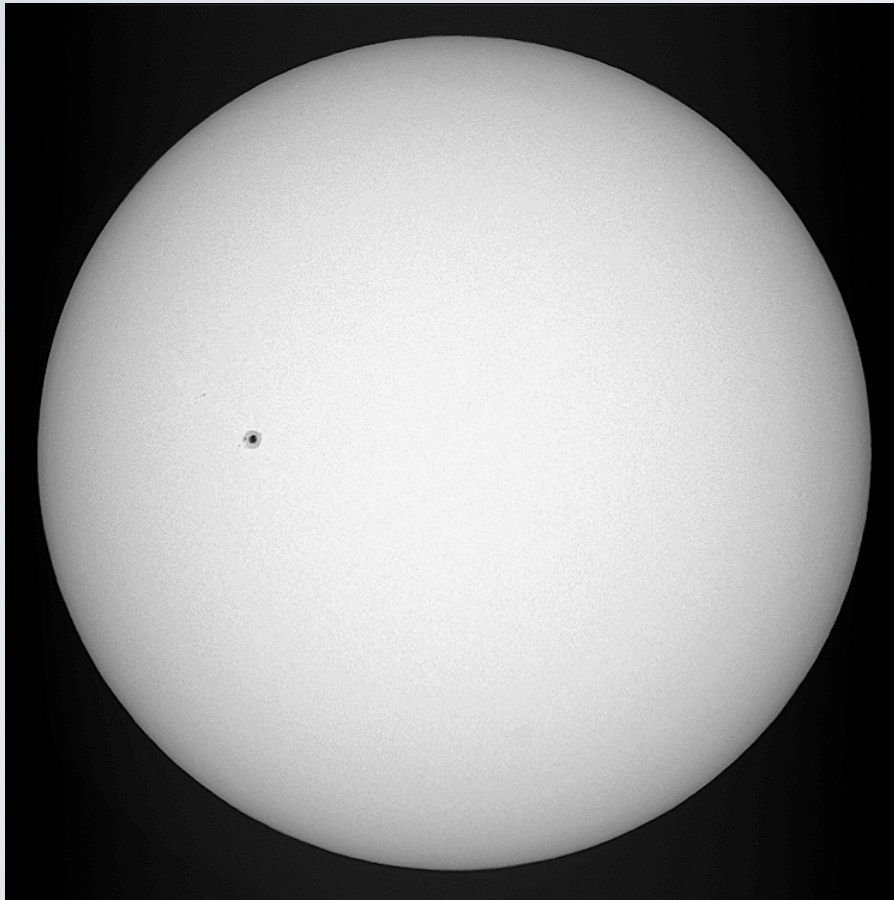


SWAP 175 Å 2010-04-03 08:02:11

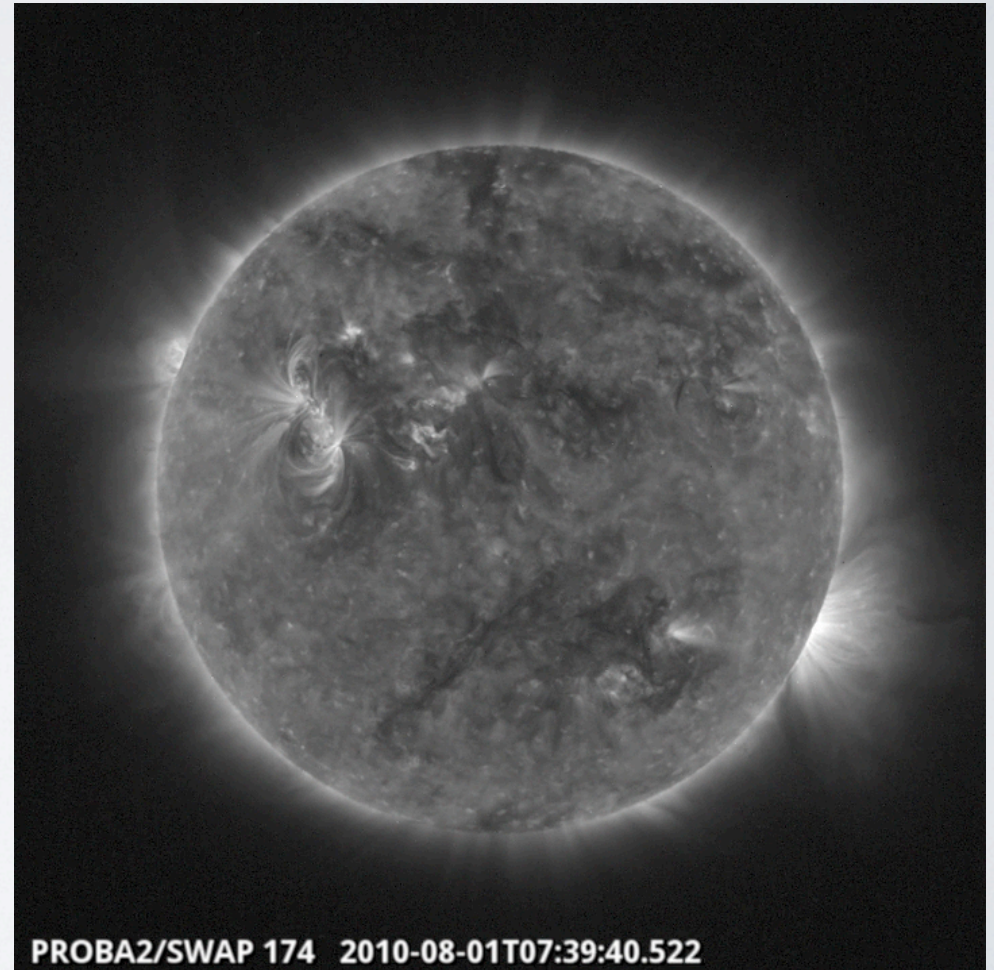


TODAY'S SOLAR WEATHER

AUGUST 1: ROB FORECASTED A MAGNETIC STORM

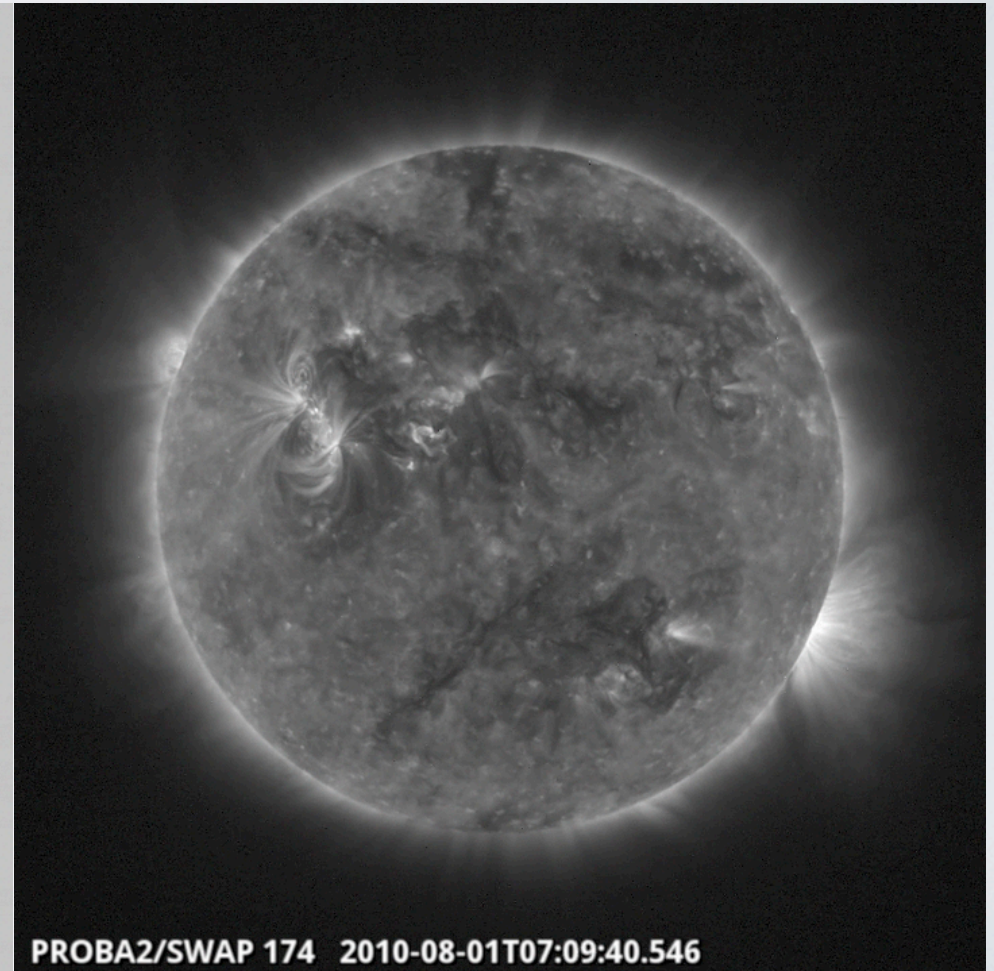
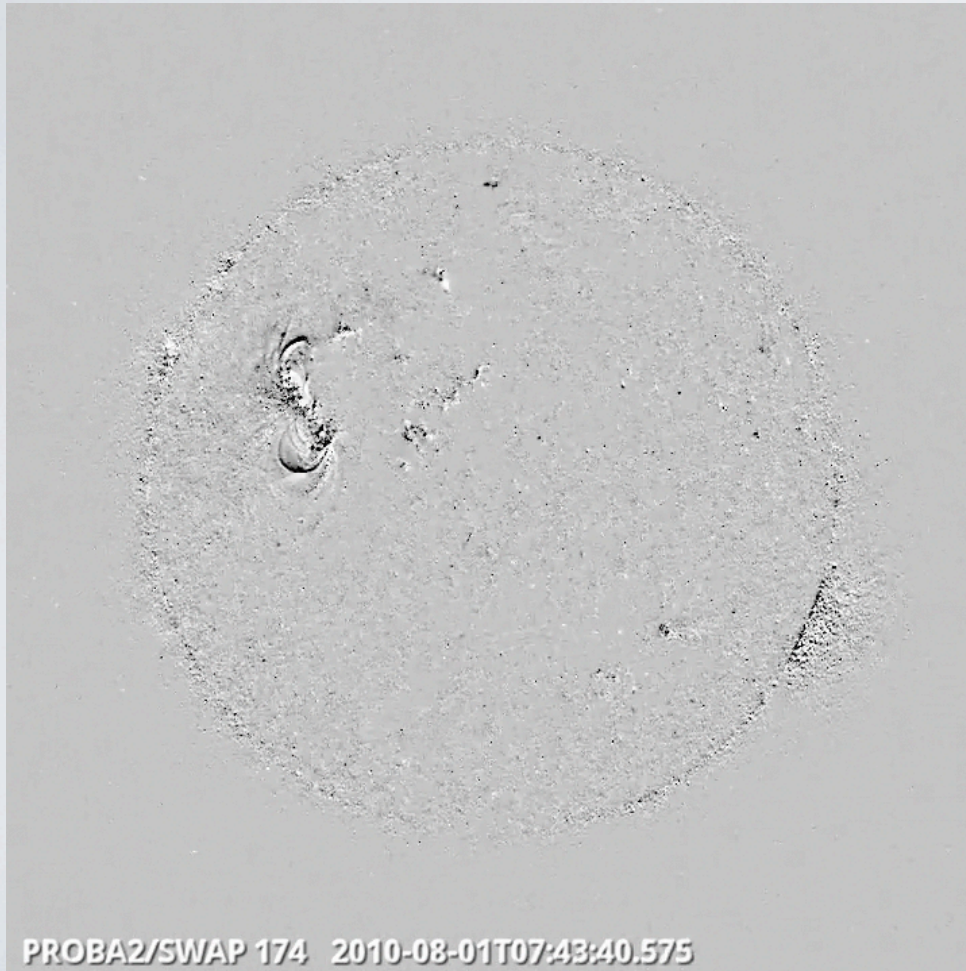


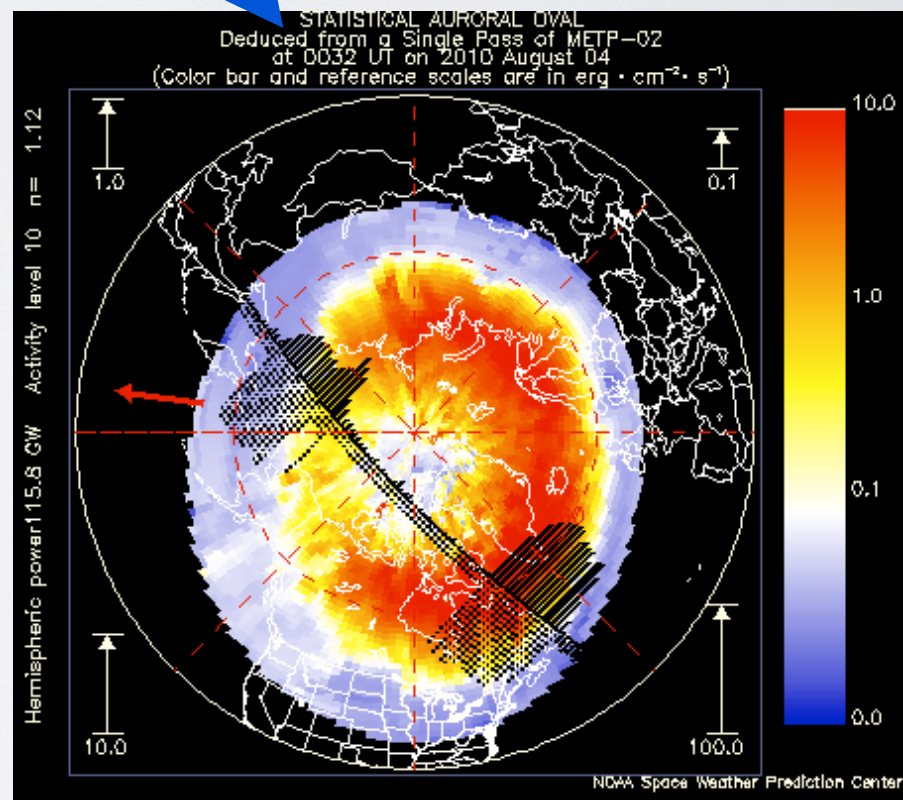
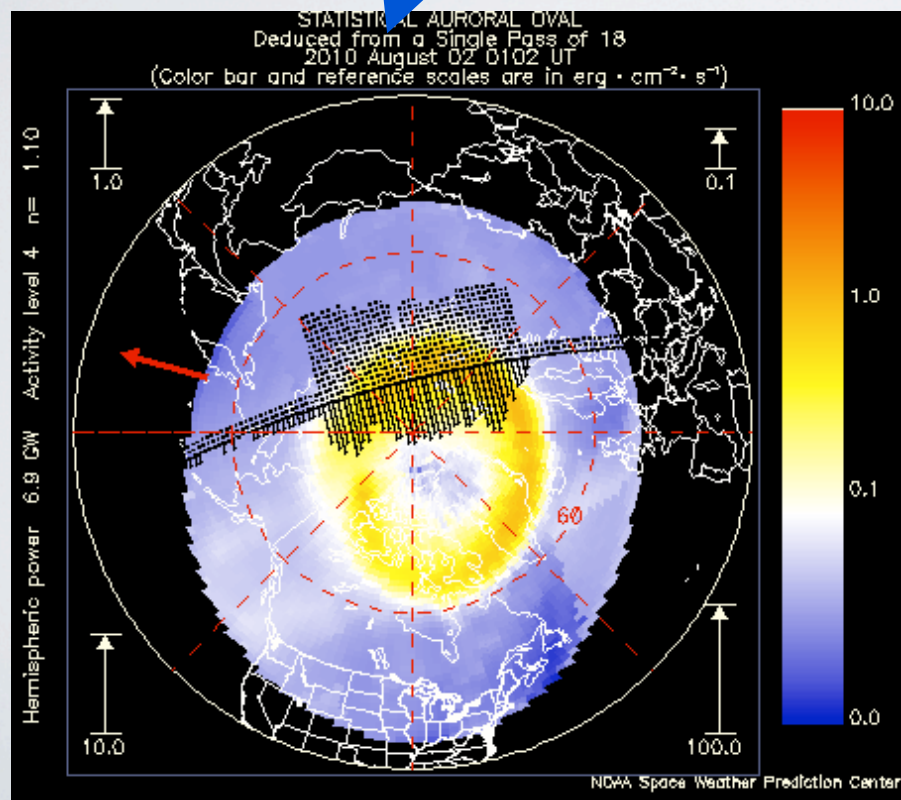
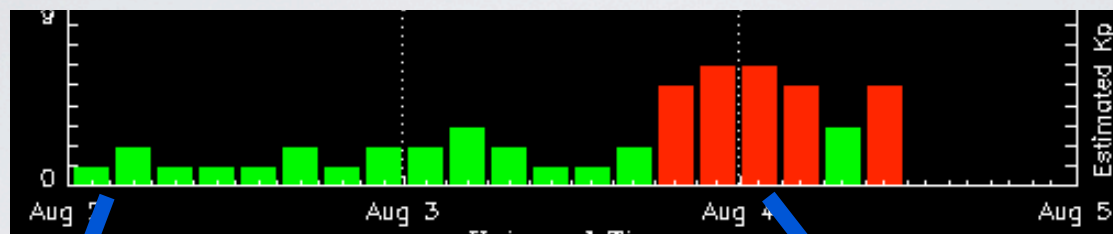
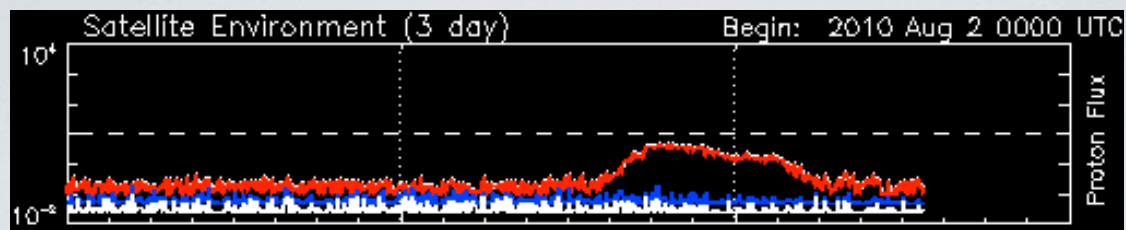
Royal Observatory of Belgium – SIDC
Observation Date: 01/08/2010 Time of Day (UCT): 08:17:49
Instrument: WHITE-LIGHT Exposure Time: 0.001



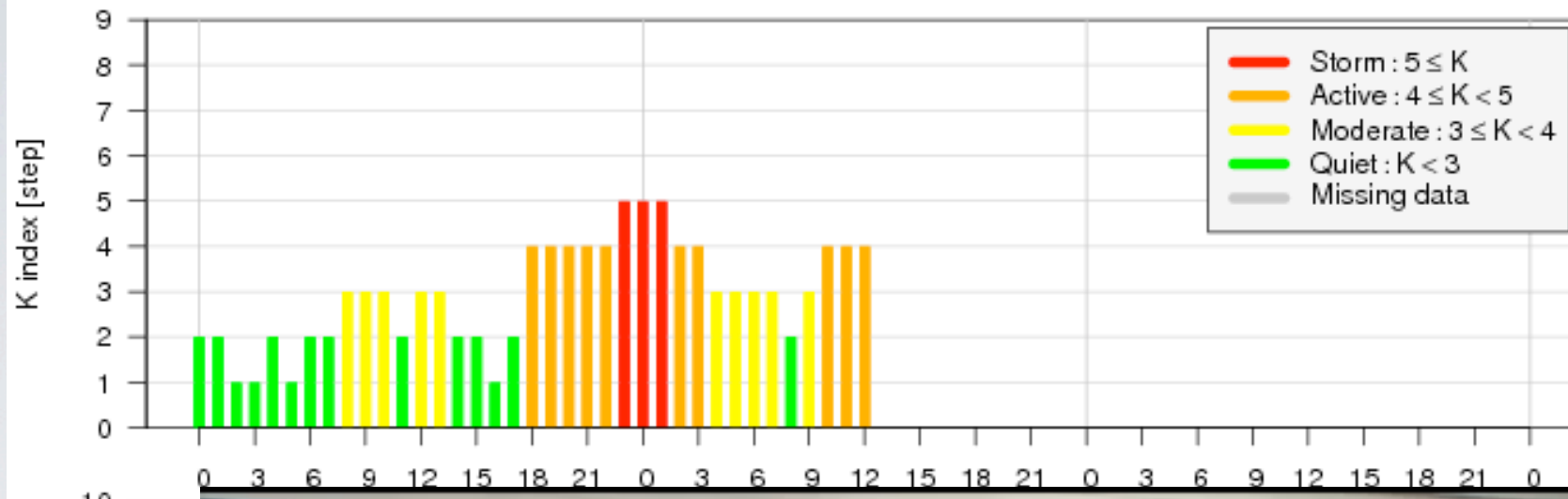
PROBA2/SWAP 174 2010-08-01T07:39:40.522

AUGUST 1: ROB FORECASTED A MAGNETIC STORM





Local K index at Dourbes (50.1 °N, 4.6 °E)
(ground-based measurements)



Solar
Weather
effects in
Belgium???



Thanks for building a lovely platform ;-).