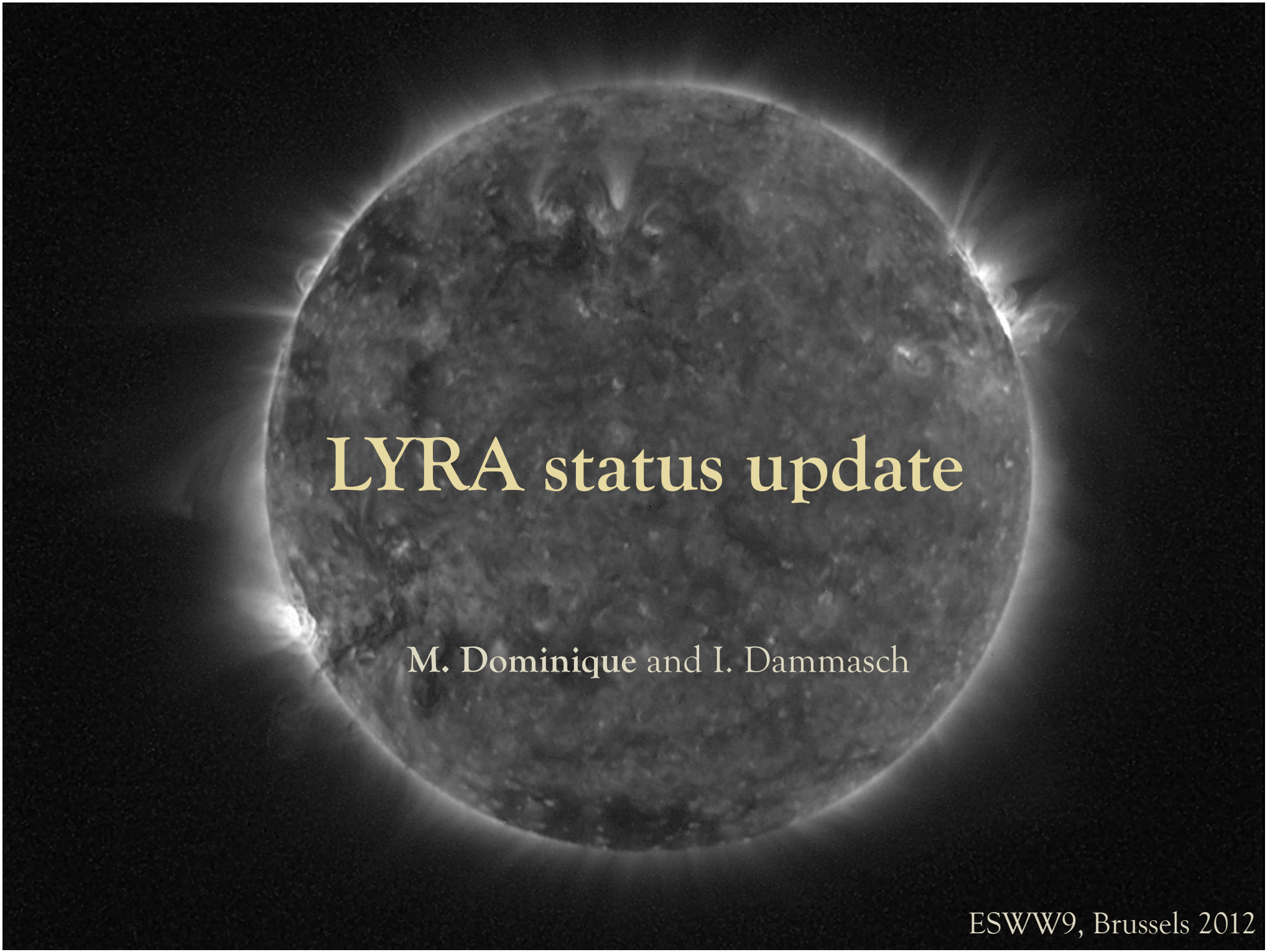
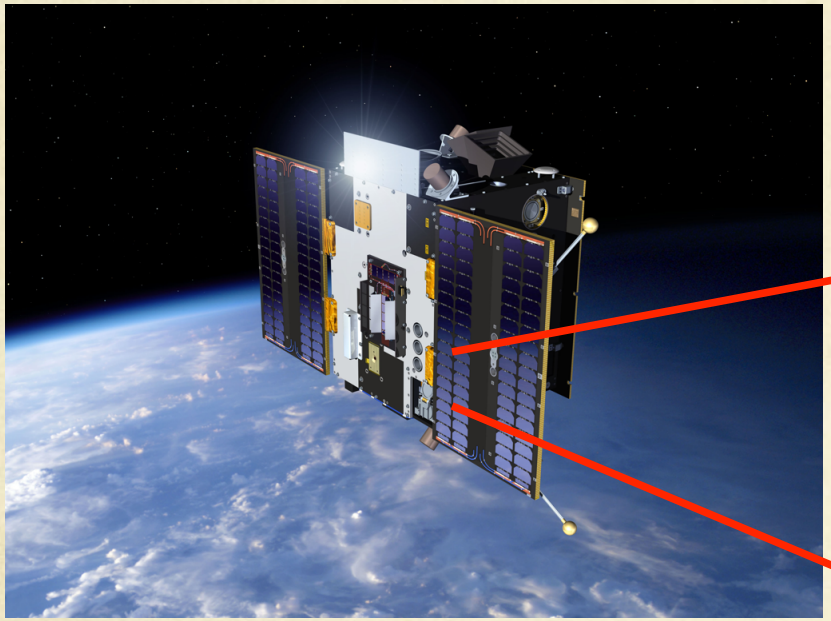
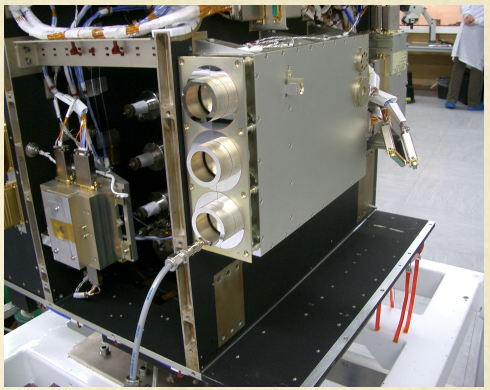

LYRA status update
M. Dominique and I. Dammasch
ESWW9, Brussels 2012

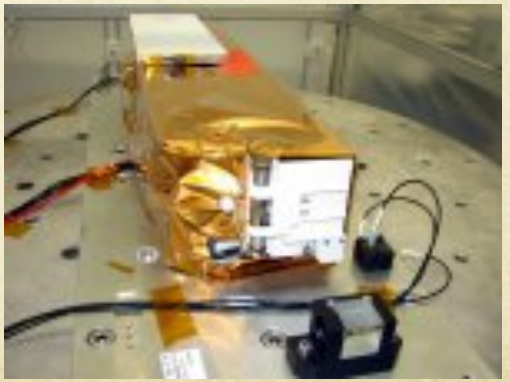
PROBA2: an ESA microsat



LYRA

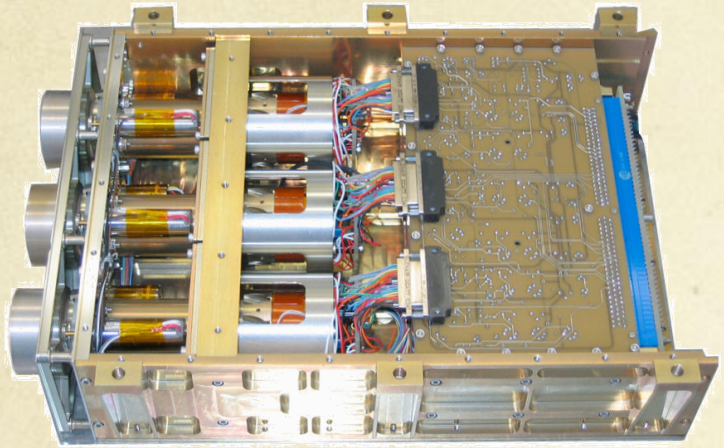


SWAP



- Launched on November 9, 2009
- 17 technology demonstrators + 4 scientific instruments
- LYRA first light on January 6, 2010
- Dawn-dusk heliosynchronous orbit, 700 km altitude

LYRA highlights



LYRA channels	
Lyman alpha	120-123 nm
Herzberg	190-222 nm
Aluminium	17-80 nm + <5nm
Zirconium	6-20 nm + <2nm

- **3 redundant units** protected by independent covers
- **4 broad-band channels**
- High acquisition cadence: **nominally 20Hz**
- 3 types of detectors:
  - Standard silicon
  - 2 types of **diamond detectors**: MSM and PIN
    - radiation resistant
    - blind to radiation > 300nm
- **Calibration LEDs** with λ of 370 and 465 nm

Mission status

- Mission currently founded till end 2012. Waiting for the decision about its extension …
- Topical issue to be released soon
- Third Guest Investigator programme
  - A. Jones (LASP) and D. McMullin (SSRC): Analysis of LYRA degradation
  - A. Inglis (NASA-GFSC): Quasi-Periodic Pulsations in flares
- Reprocessing of all LYRA products (online since September)
- New PROBA2 website with a SSA page
- Archiving the data at ESAC

Usual data products: now reprocessed

Product	File extension on LYRA website	Format	Characteristics
Level 1 engineering data	*_lev1_std(bst).fits	FITS	unprocessed solar irradiance, in *counts/ms*
	*_lev1_cal(bca).fits	FITS	unprocessed calibration data, in *counts/ms*
	*_lev1_met.fits	FITS	ancillary data: temperature, pointing ...
	*_lev1_rej(bre).fits	FITS	rejected samples (outliers ...)
Level 2 basic science data			rated solar irradiance, $/m^{-2}$
Level 3 averaged science data	*_lev3_std.fits	FITS	level 2 averaged over 1 min, in Wm^{-2}
Level 4 A quicklooks	*.png	image	daily plot of calibrated data for all LYRA channels
Level 4 B quicklooks	*.png	image	3-days GOES-like plot of calibrated data in Aluminium and Zirconium channels
Level 5 flare list	html	text file	List of flares with links to LYRA and GOES flux profiles

proba2.oma.be

Calibration

Includes:

- Dark-current subtraction
- Additive correction of degradation
- Rescale to 1 AU
- Conversion from counts/ms into physical units (W/m2)

ATTENTION: this conversion uses a synthetic spectrum from SORCE/SOLSTICE and TIMED/SEE at first light
=> LYRA data are scaled to TIMED/SORCE ones

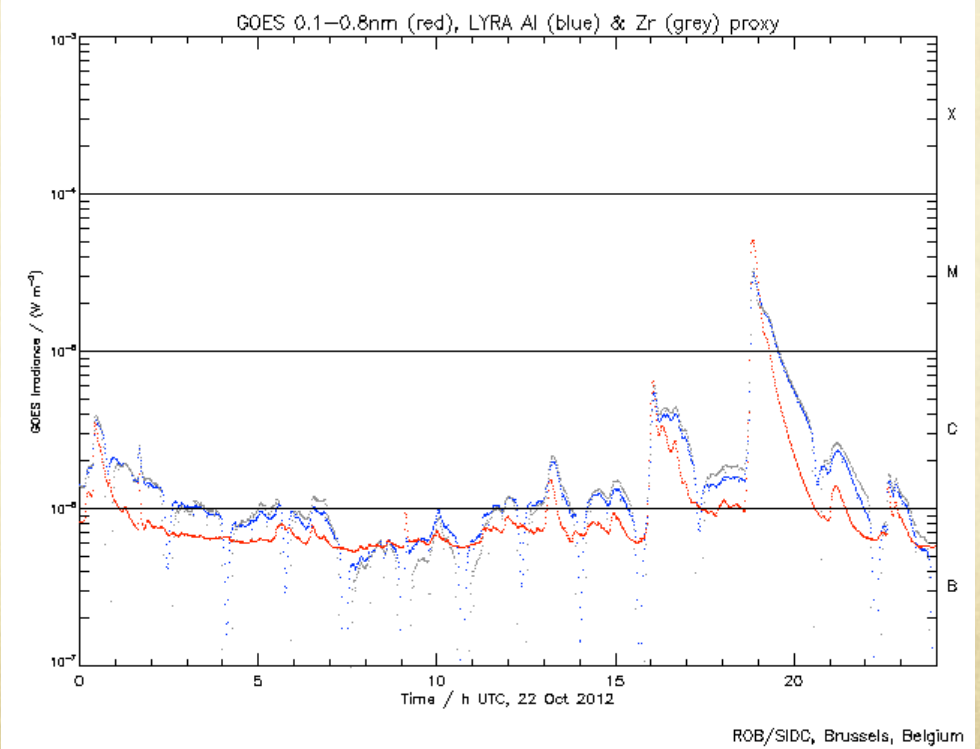
Does not include (yet)

- Flat-field correction
- Stabilization trend for MSM diamond detectors

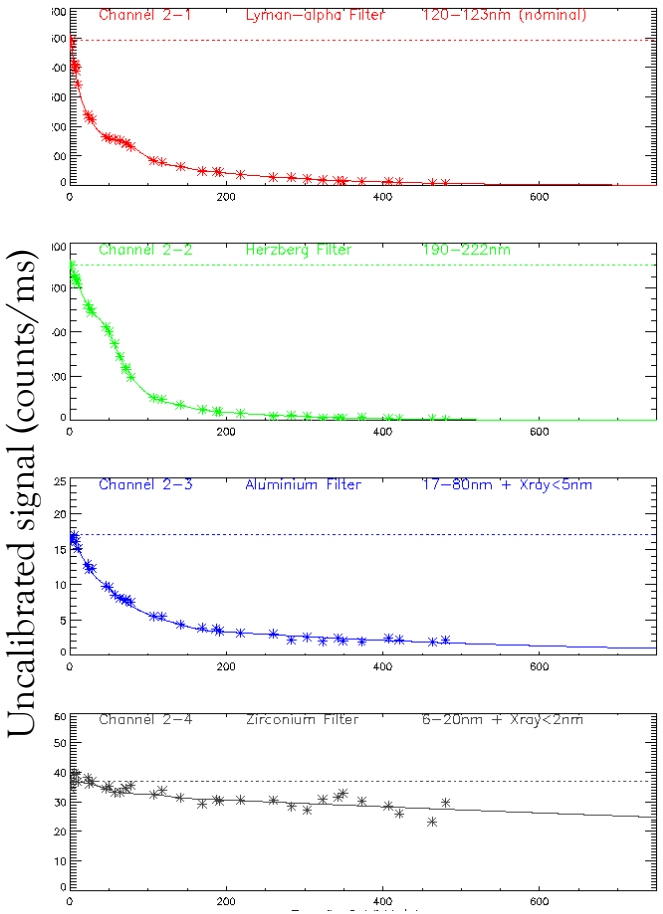
A new data product!

- A proxy of GOES flare curve based on LYRA data is available on http://proba2.oma.be/ssa or on

  http://solwww.oma.be/users/dammasch/GoesVsLyra.html

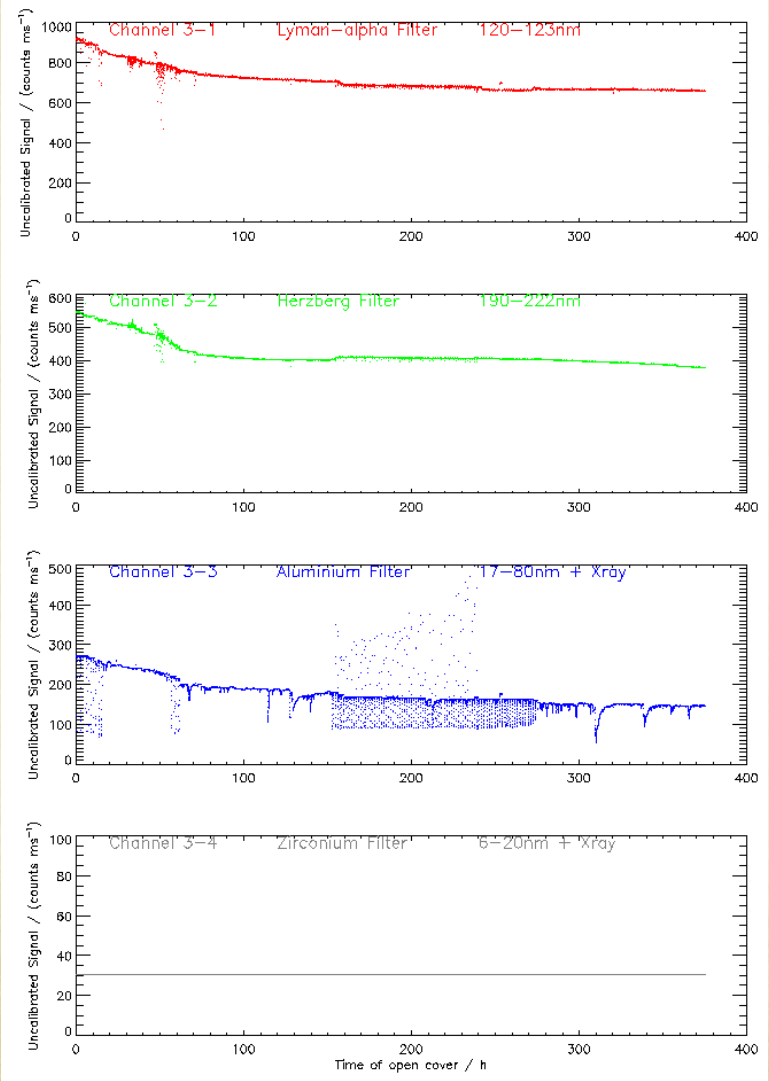


Degradation of unit 2 – the nominal unit



- Current degradation
  - Ch1 : >99%
  - Ch2 : >99%
  - Ch3 : 90%
  - Ch4 : 30%

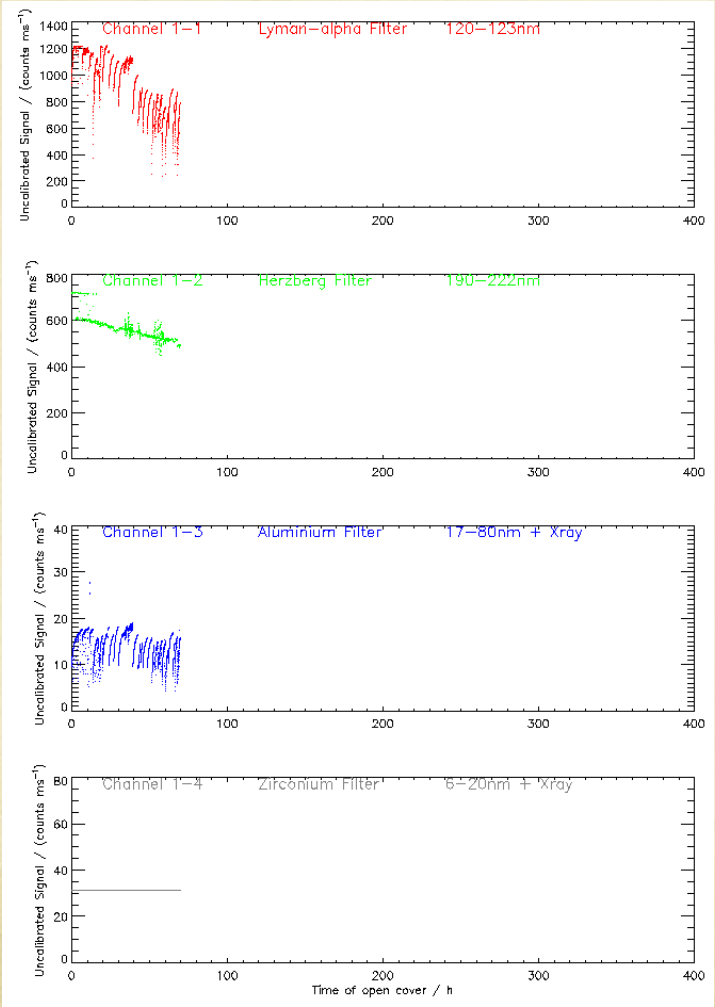
Degradation of unit 3 – dedicated campaigns



- Current degradation
  - Ch1 : 34%
  - Ch2 : 66%
  - Ch3 : 57%
  - Ch4 : 10%

after removal of the long-term solar variability provided by channel 4

Degradation of unit 1 – calibration



- Current degradation:
  - Ch1 : 50%
  - Ch2 : 15%
  - Ch3 : 20%
  - Ch4 : /
- Approximate values

Degradation: long term evolution

Work still in progress …

Various aspects investigated:

- Degradation due to a contaminant layer
- Ageing caused by energetic particles

Investigation means:

- Dark current evolution (detector ageing)
- Response to LED signal acquisition (detector spectral evolution)
- Spectral evolution (detector + filter):
  - Occultations
  - Cross-calibration
  - Response to specific events like flares
- Measurements in laboratory on identical filters and detectors

Degradation: long term evolution

Work still in progress …

Various aspects investigated:

- Degradation due to a contaminant layer
- Ageing caused by energetic particles

STCE project gathering all the spectrometers and photometers observing the EUV

In the frame of the eHeroes FP project

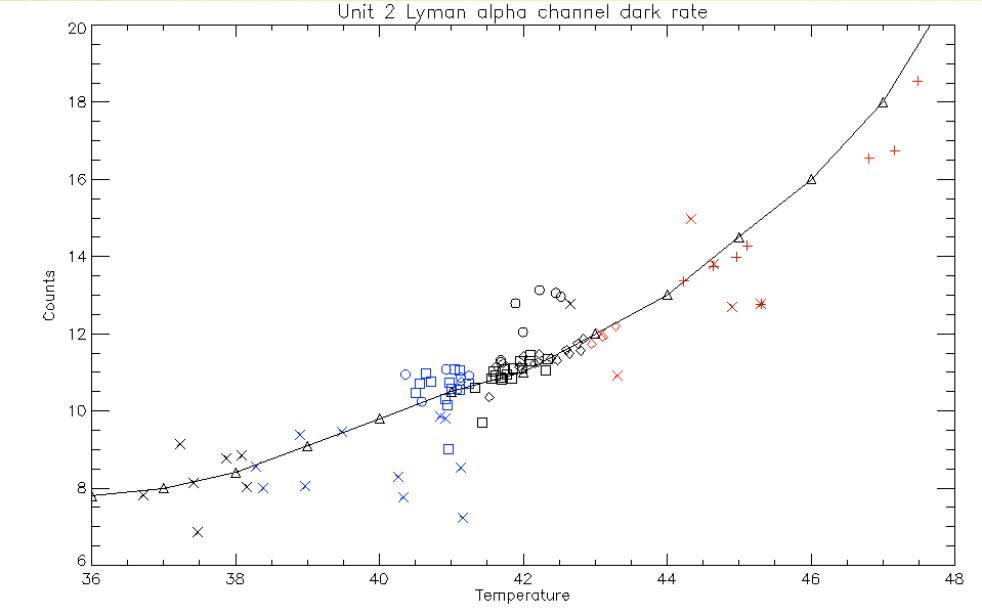
Investigation means:

- Dark current evolution (detector ageing)
- Response to LED signal acquisition (detector spectral evolution)
- Spectral evolution (detector + filter):
  - Occultations
  - Cross-calibration
  - Response to specific events like flares
- Measurements in laboratory on identical filters and detectors

Dark current + LED signal evolution: unit2 (nominal, all diamond)

DC variations correlated with temperature evolution

Dark current in Lyman alpha

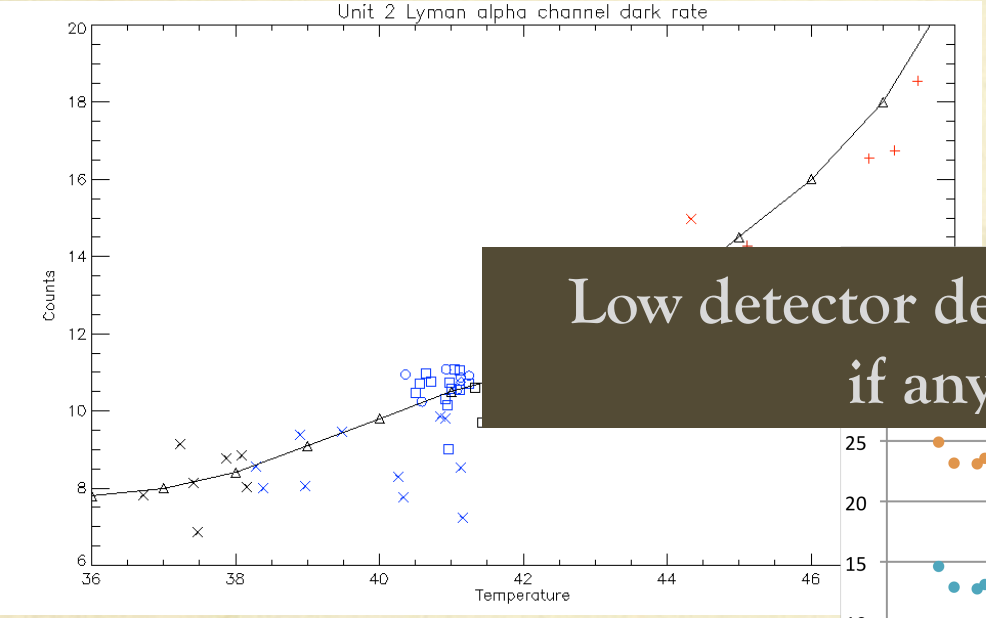


I. Dammasch + M. Snow

Dark current + LED signal evolution: unit2 (nominal, all diamond)

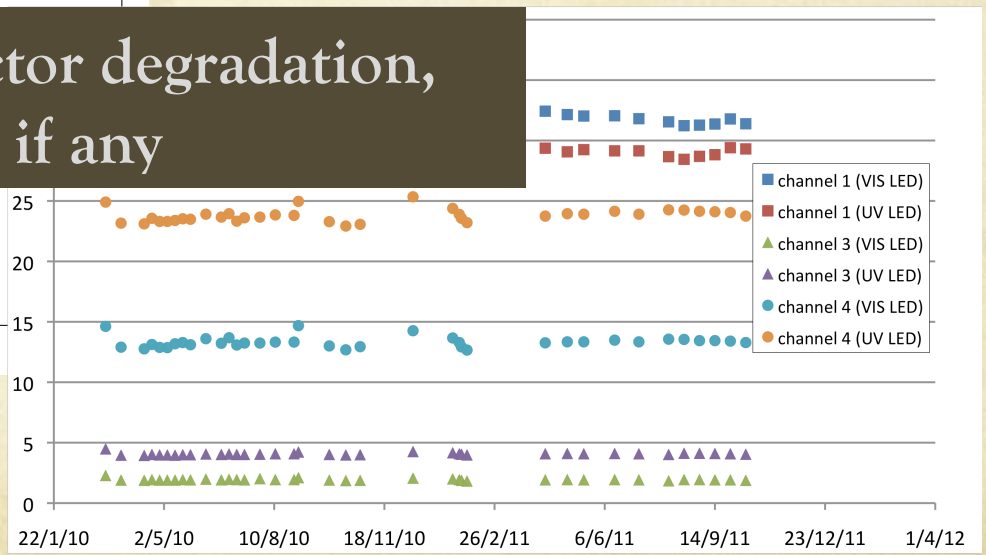
LED signal constant over the mission

Dark current in Lyman alpha



I. Dammasch + M. Snow

LED signal evolution
Unit 2 – dark current subtracted



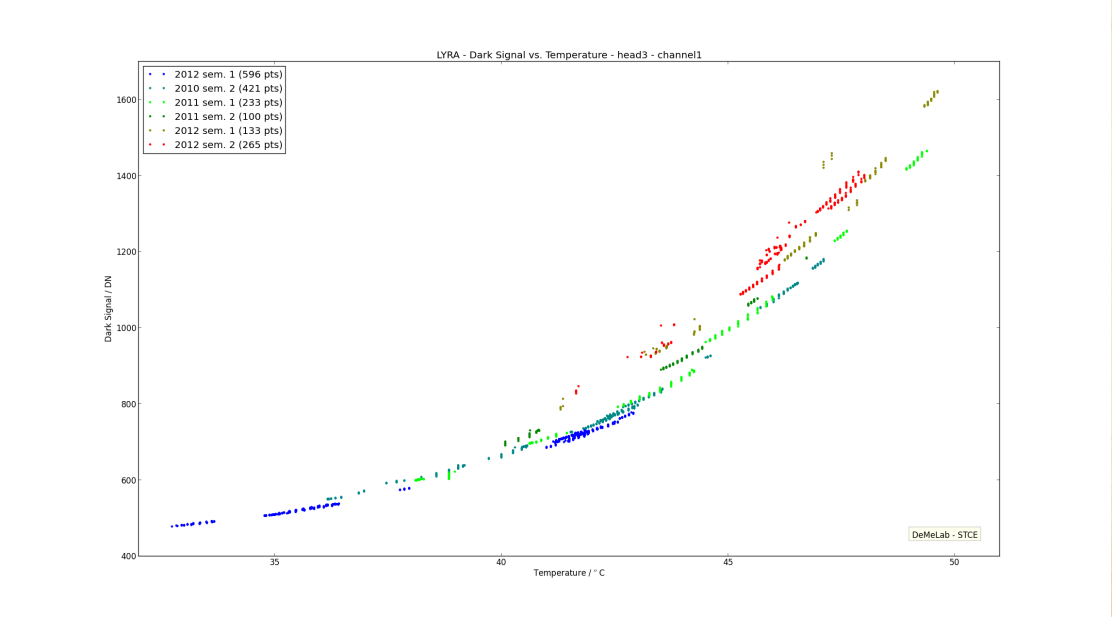
Low detector degradation, if any

M. Devogele

Dark current evolution - unit 3 (back-up, Si)

- DC increases slightly with time

  => Small degradation observed on unit 3

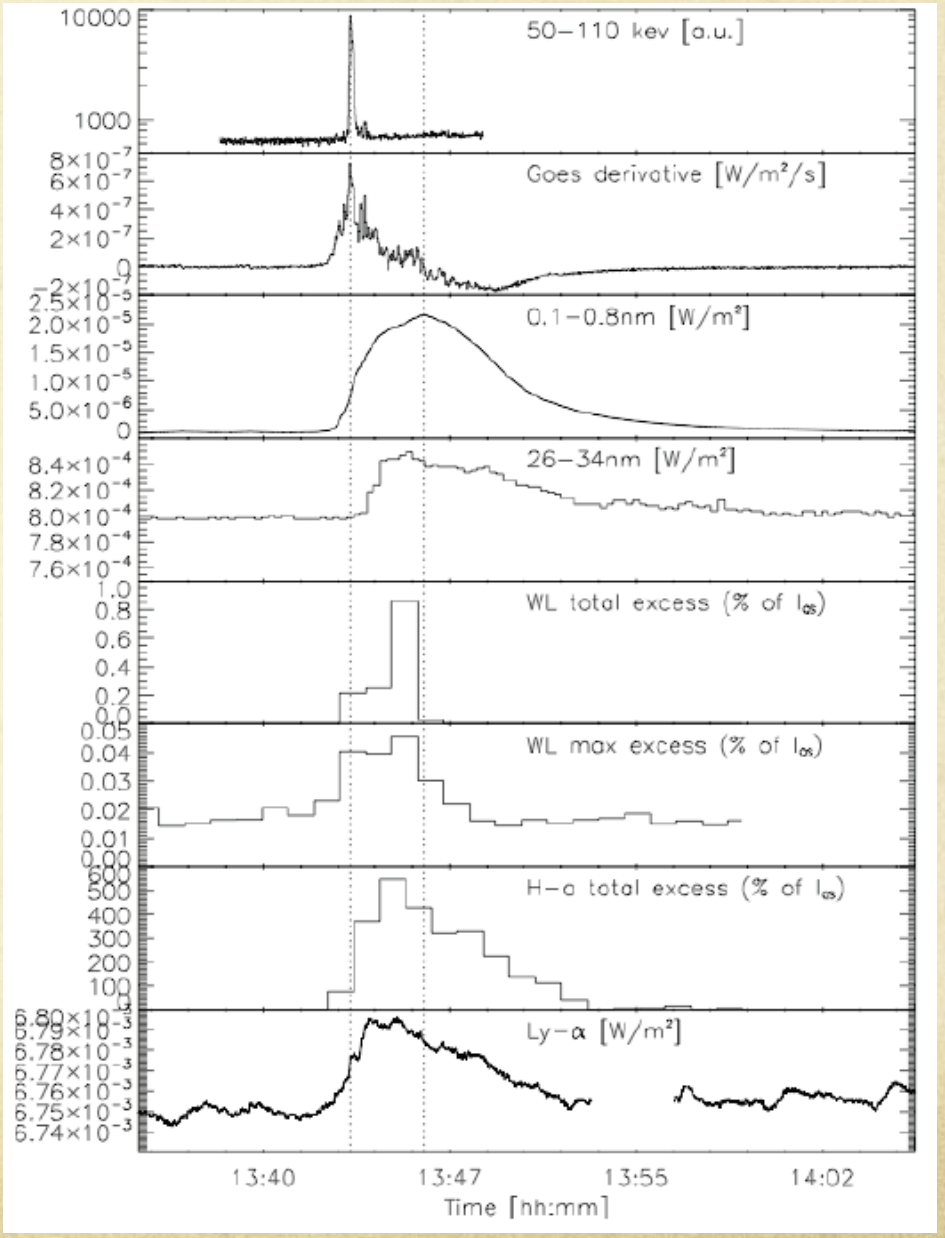


Main fields of investigation

- Flares
  - Detection of Lyman-alpha flares
  - Multi-wavelength analysis of flares
  - Short time-scale events, especially quasi-period pulsations
- Variability of long term solar spectral irradiance
- Sun-Moon eclipses
- Occultations
- Analysis of the degradation process and of ageing effects caused by energetic particles
- Performances of wide-bandgap detectors
- Comparison to other instruments (GOES, EVE ...)

Solar flares with LYRA: Ly-α flare

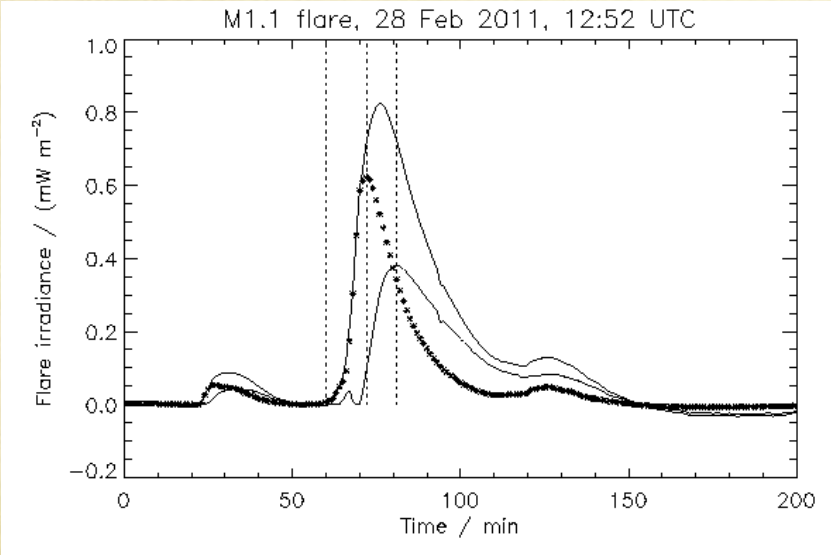
- LYRA has observed about 10 flares in Ly-α
- Attention: to take into account the low purity of the channel
- Degradation rapidly prevents for any new flare detection in this channel
- Occasional campaigns with unit 3

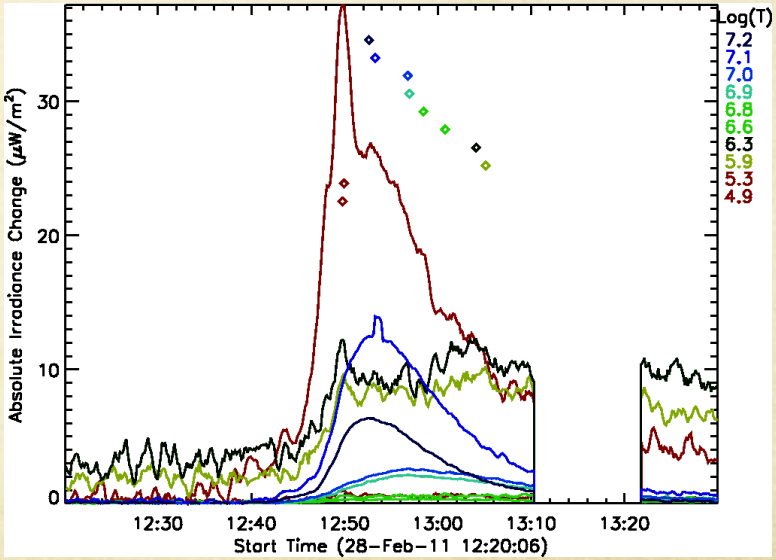


Kretzschmar et al. (2012, topical issue)

Multi-wavelength analysis of flares

- Comparing with other instruments (e.g. SDO/EVE)
  - Separate the SXR from EUV component
  - Build a plot of the thermal evolution of flare

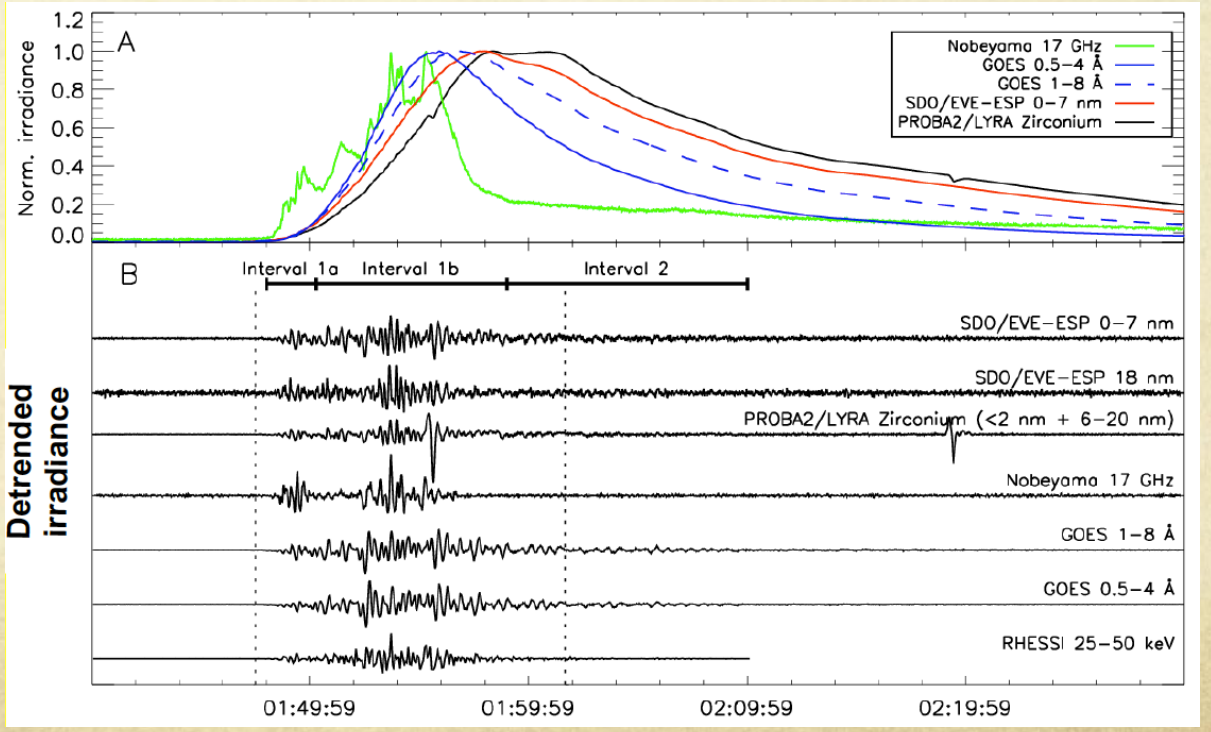




P. C. Chamberlin (NASA/GSFC)

Solar flares with LYRA: QPP

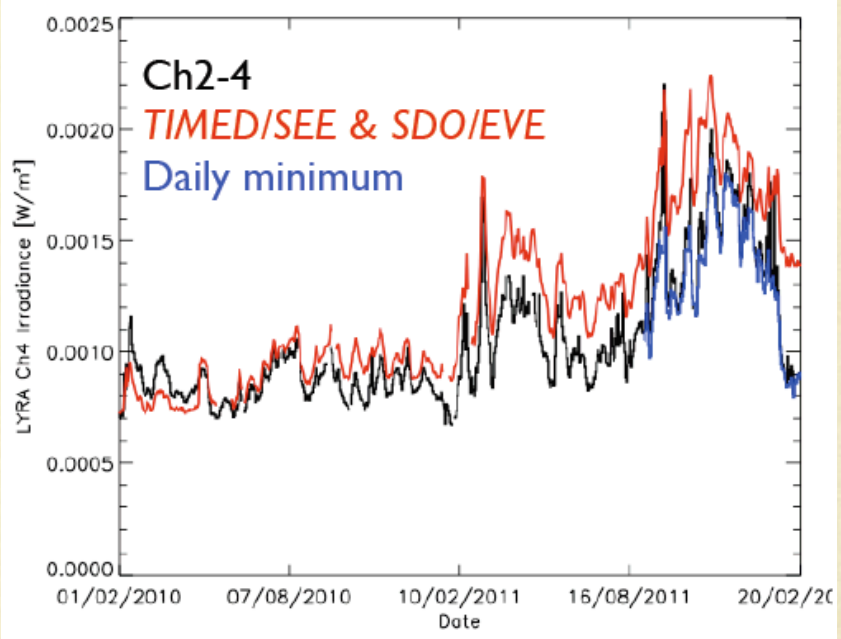
- QPP = quasi-periodic pulsations of solar irradiance observed during the impulsive phase of solar flares
- Detection of periods as short as a few seconds
- Comparison with other instruments from radio to HXR
- Heliosismology: might provide information about the magnetic environment in the coronal loop



Van Doorsselaere et al. (2011), Dolla et al. (2012)

Comparison to other missions: SDO/EVE

- LYRA channel 4 can be reconstructed from a synthetic spectrum combining SDO/EVE and TIMED/SEE

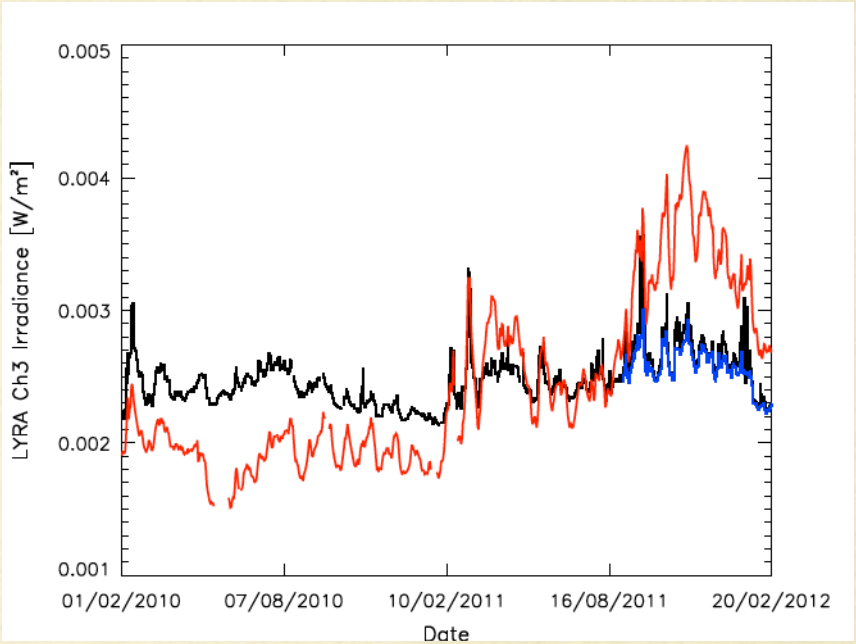


Kretzschmar et al. (2012, SWSC)

Comparison to other missions: SDO/EVE

- Reconstruction of LYRA channel 3 doesn't match the measured time-series

  => To use a spectrally dependant correction for degradation



Kretzschmar et al. (2012, SWSC)

Guest Investigator proposal of Andrew Jones and Don Mc Mullin

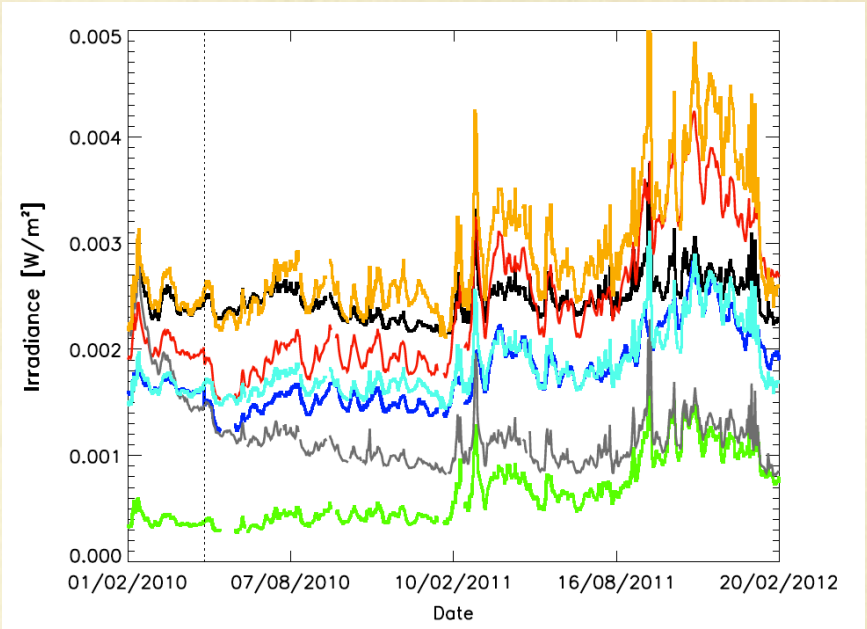
Comparison to other missions: SDO/EVE

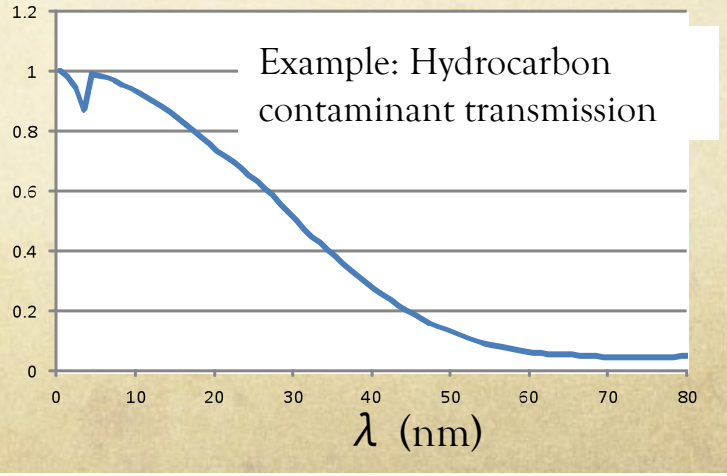
- first attempt: independent correction of the EUV and SXR contributions to Al channel, based on their respective correlations to Zr channel

  => encouraging results

- Next step: build a correction for degradation that is fully spectrally resolved

  => hypothesis on the nature of contaminants





Collaborations

THANK YOU!