LYRA on-board PROBA2

EUV irradiance inter-calibration workshop

M. Dominique + LYRA team

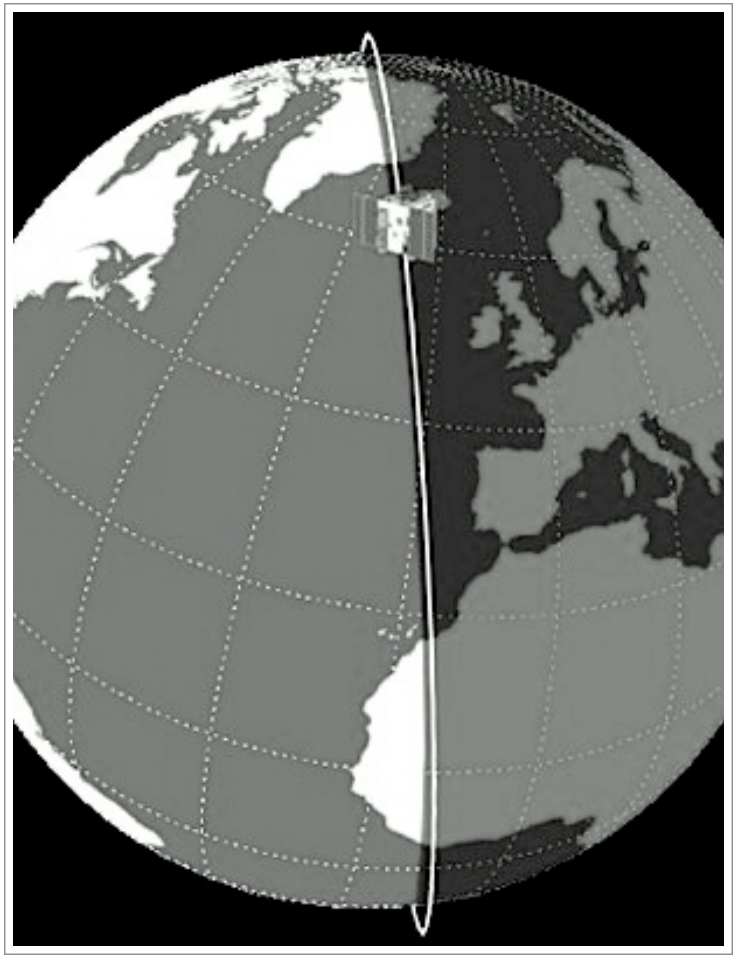
October 2011, LASP

PROBA2 orbit

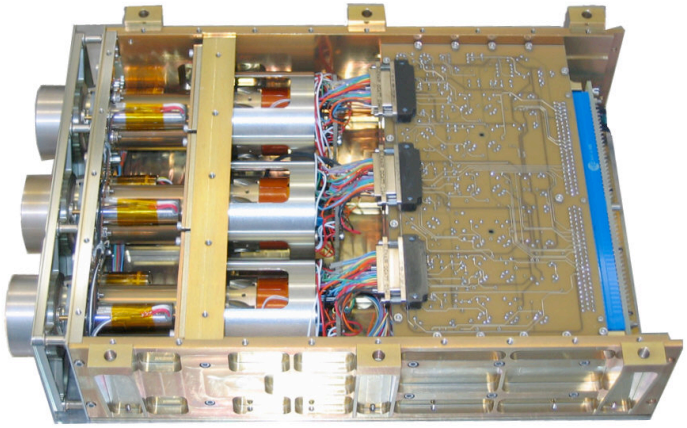
PROBA2 orbit:

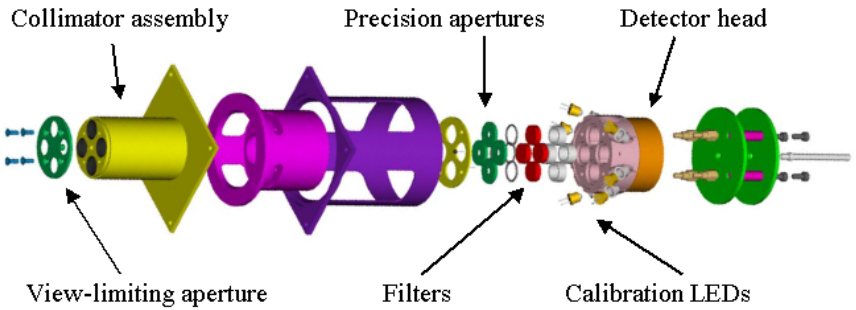
- Heliosynchronous
- Polar
- Dawn-dusk
- 725 km altitude
- Duration of 100 min

- Occultation season:
  - Visible:October-February
  - Maximum duration 20 min per orbit

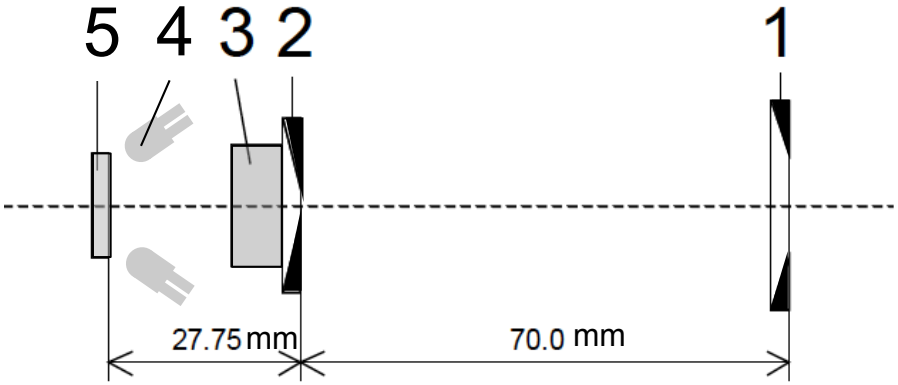


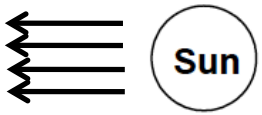
LYRA highlights



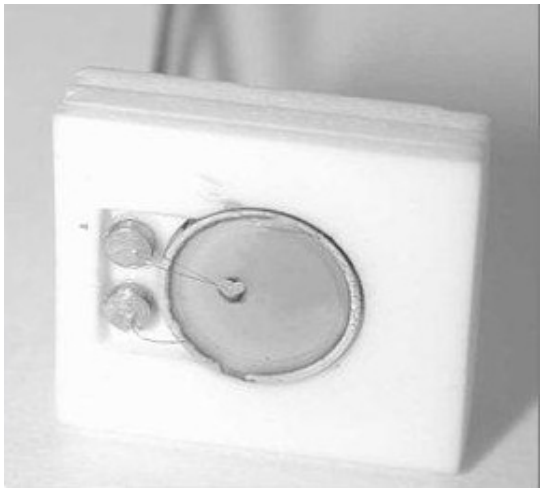


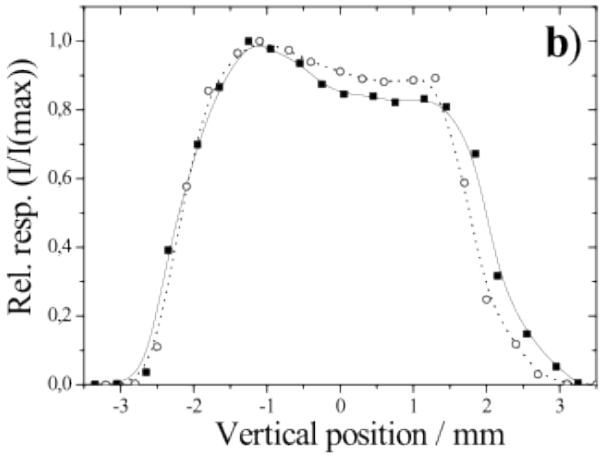
1: View-limiting aperture (Ø 8mm)
2: precision aperture (Ø 3mm)
3: filter
4: LEDs (λ 375 and 465 nm)
5: detector (Ø 4mm)

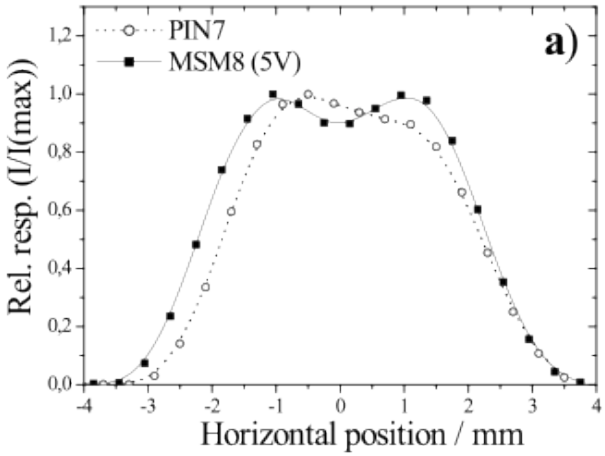




Diamond detectors



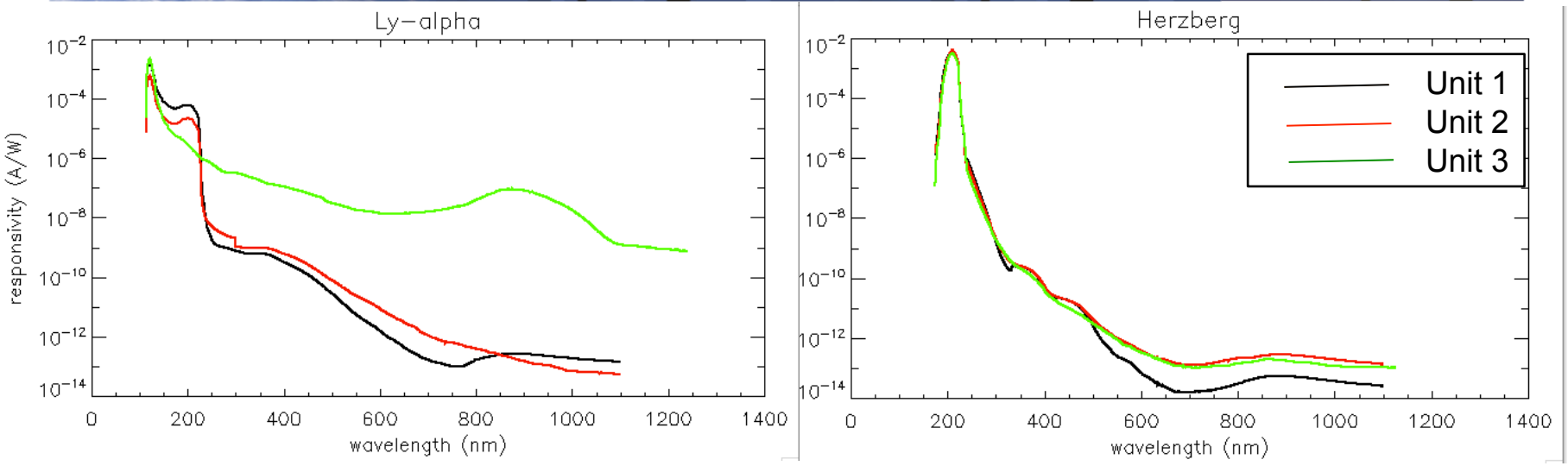


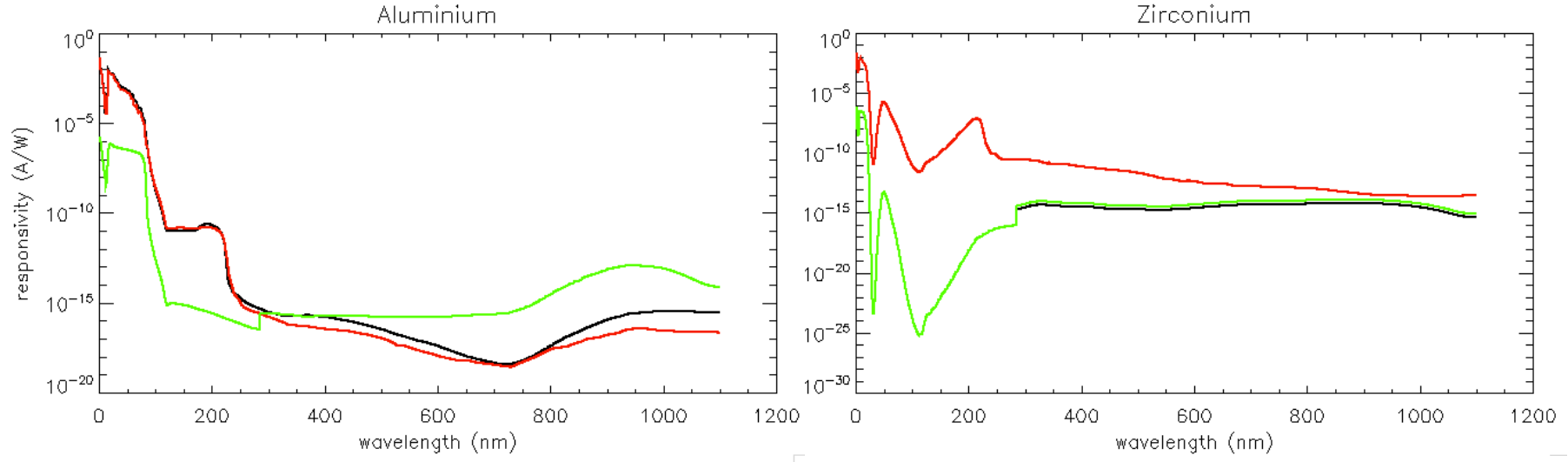


Details of LYRA channels

Channel	Filter label	Detector	Bandwidth	Purity
Unit 1				
1-1	Lyman-α [122XN]	MSM Diamond	120-123 nm	26%
1-2	Herzberg [220B]	PIN Diamond	190-222 nm	95%
1-3	Aluminium (158 nm)	MSM Diamond	17-80 nm + < 5 nm	96.8%
1-4	Zirconium (300 nm)	AXUV Si	6-20 nm + < 2 nm	97%
Unit 2				
2-1	Lyman-α [122XN]	MSM Diamond	120-123 nm	25.7%
2-2	Herzberg [220B]	PIN Diamond	190-222 nm	95%
2-3	Aluminium (158 nm)	MSM Diamond	17-80 nm + < 5 nm	97.2%
2-4	Zirconium (141 nm)	MSM Diamond	6-20 nm + < 2 nm	92.2%
Unit 3				
3-1	Lyman-α [122N+XN]	AXUV Si	120-123 nm	32.5 %
3-2	Herzberg [220B]	PIN Diamond	190-222 nm	95%
3-3	Aluminium (158 nm)	AXUV Si	17-80 nm + < 5 nm	96.6%
3-4	Zirconium (300 nm)	AXUV Si	6-20 nm + < 2 nm	95%

Filter + detector responsivity





Operation: systematic campaigns

	Integra-tion time	Units	Cover status	LED status	Pointing	Occur-ence
Range	10ms ➔ 10s	max. two at a time	open / close	off / 375nm / 465nm	0° (Sun) ➔ 3°	
Nominal	50 ms	U2	open	off	Sun	N/A
Back-up A	50ms	U2+3	open	off	Sun	1 / 2weeks
Back-up B	50ms	U2+1	open	off	Sun	1 / 3months
Calibra-tion	50ms	1) U2+1 2) U2+3	close	off (DC) on (LED)	N/A	1/ 2weeks
Paving	50ms	-	open	off	From 0° to 3°	occasio-nal

Operation: occasional campaigns

- Scientific campaigns
  - Observation of flares: unit 2 and 3
  - Occultations in all three units
  - Eclipses in all three units
- Bake-out => no real effect so far

Long term evolution

Work still in progress …

Various aspects (to be) investigated:

- Degradation due to contaminant layer
- Dark current evolution (detector degradation)
- Response to LED signal acquisition (detector spectral evolution)
- An alternative way to probe the spectral evolution (detector + filter): occultations
- Flat-field evolution

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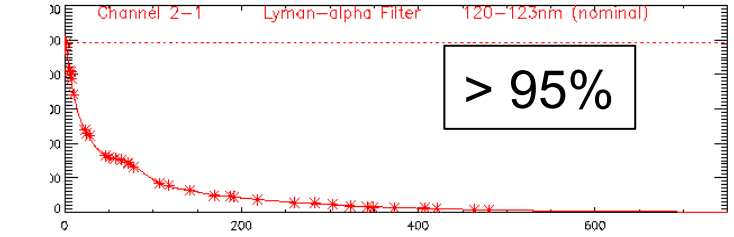
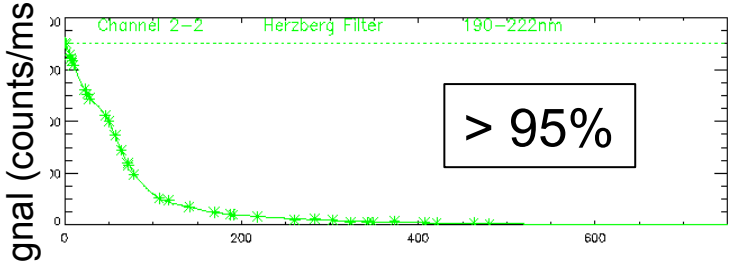
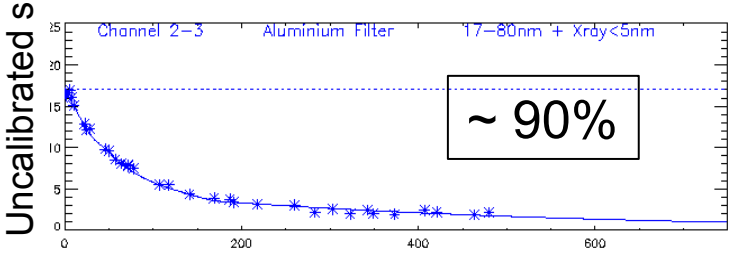
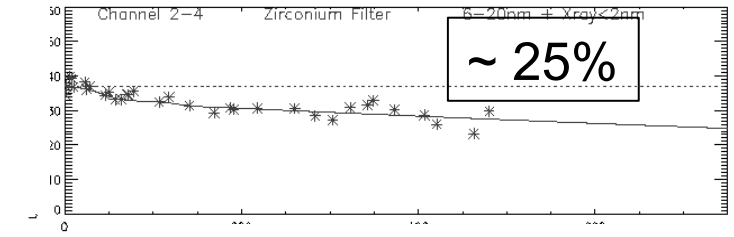
Degradation of unit 2



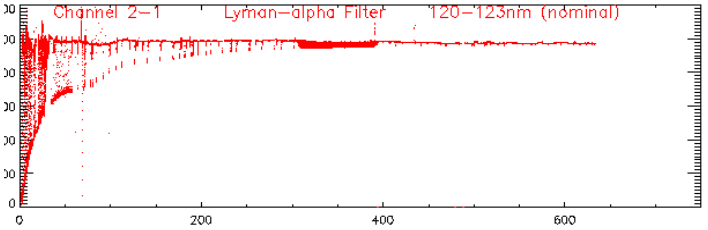


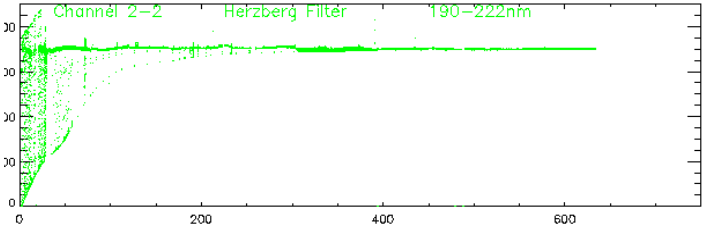


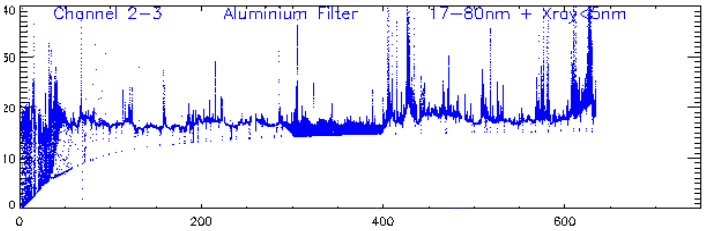


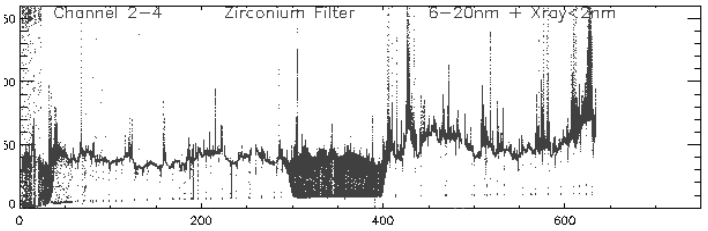
Uncalibrated signal (counts/ms)

Time after first light (days)





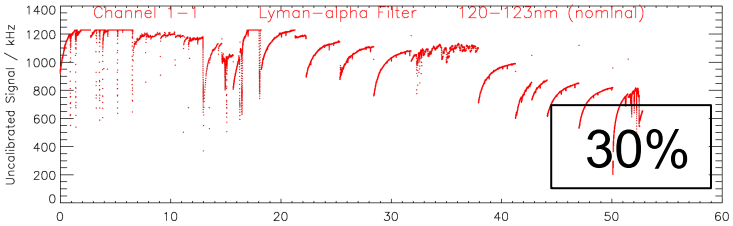


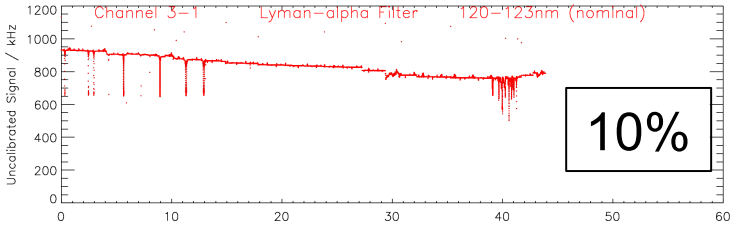


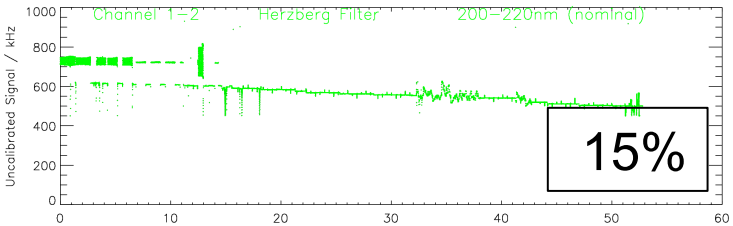
Corrected signal (counts/ms)

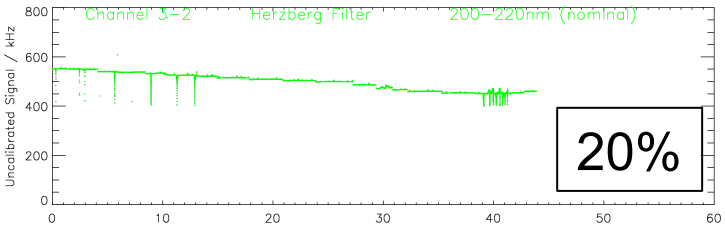
Time after first light (days)

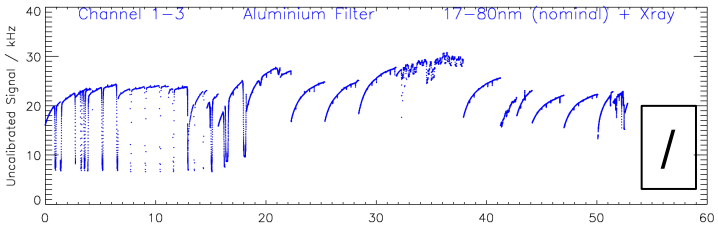
Degradation of units 1 and 3

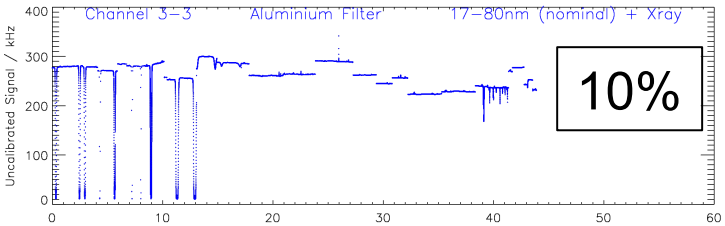


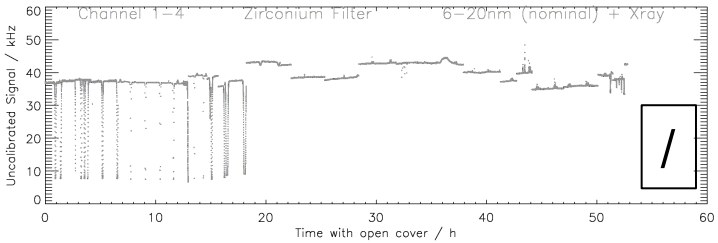


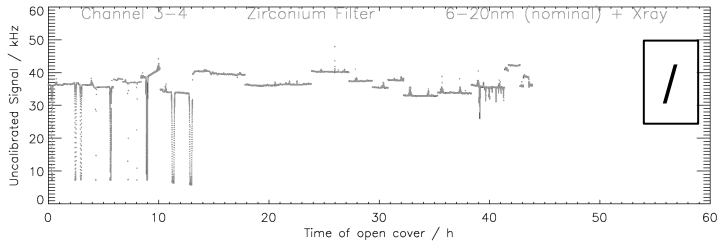












Long term evolution

Work still in progress …

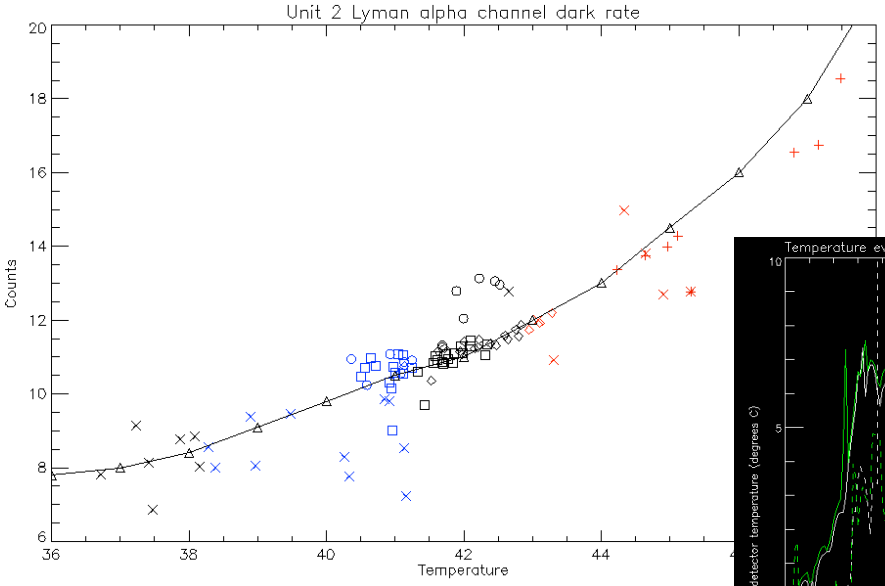
Various aspects (to be) investigated:

- Degradation due to contaminant layer
- Dark current evolution (detector degradation)
- Response to LED signal acquisition (detector spectral evolution)
- An alternative way to probe the spectral evolution (detector + filter): occultations
- Flat-field evolution

Dark current evolution

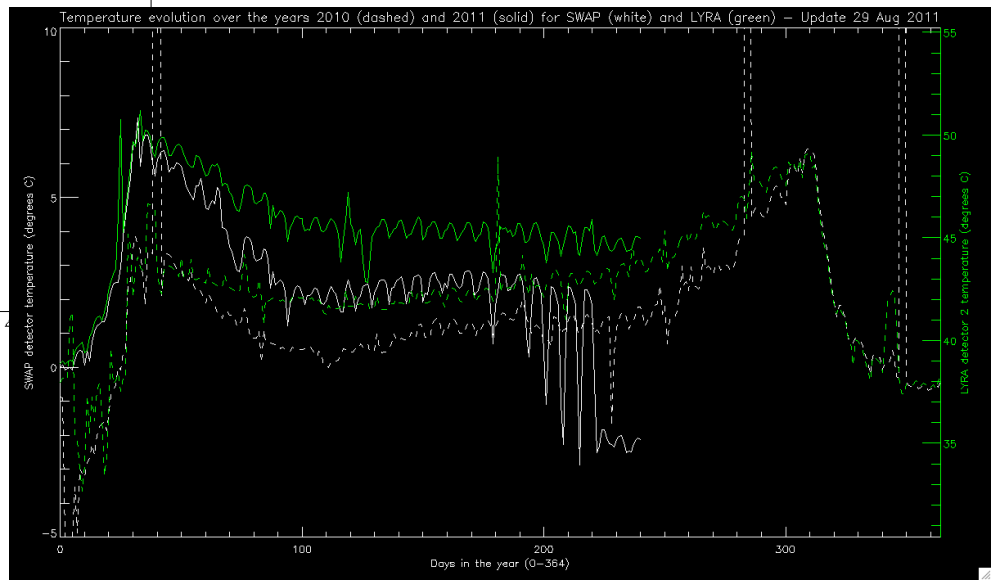
Variations correlated with temperature evolution

Dark current in Lyman alpha



I. Dammasch + M. Snow

Temperature evolution



A. De Groof

Long term evolution

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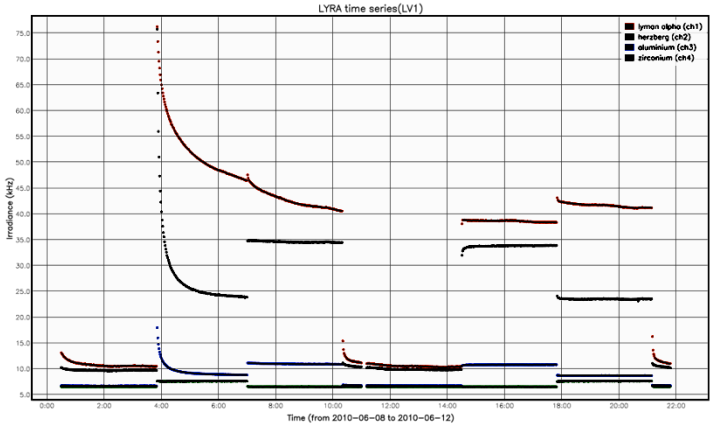
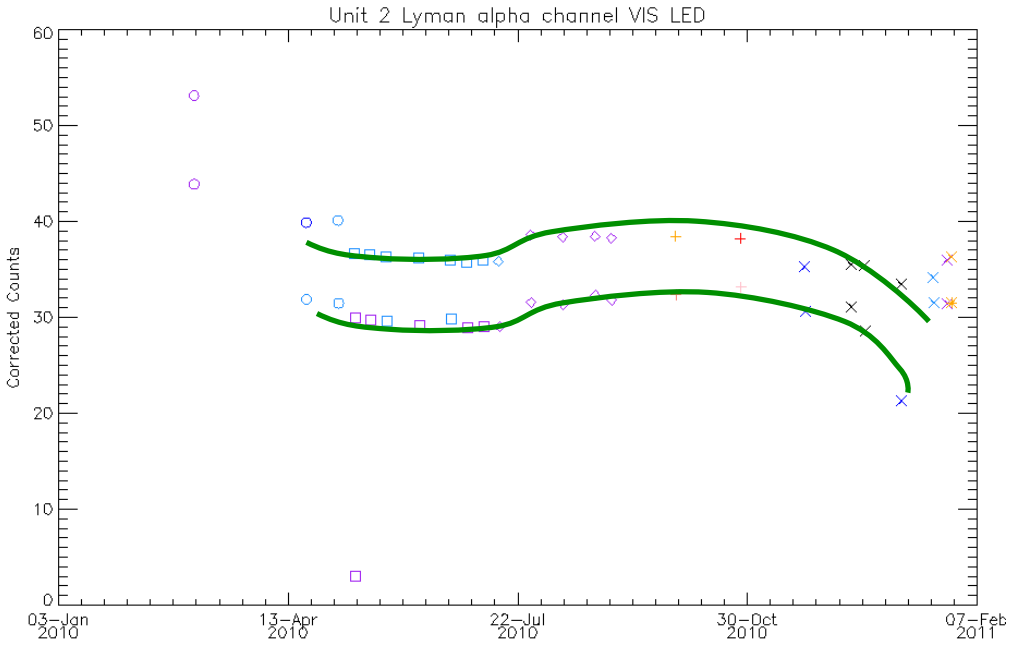
LED signal time series

- Very little change over the mission.
- Bimodal appearance is due to systematic difference between first and second measurements during each





M. Snow

Low detector degradation, if any

Long term evolution

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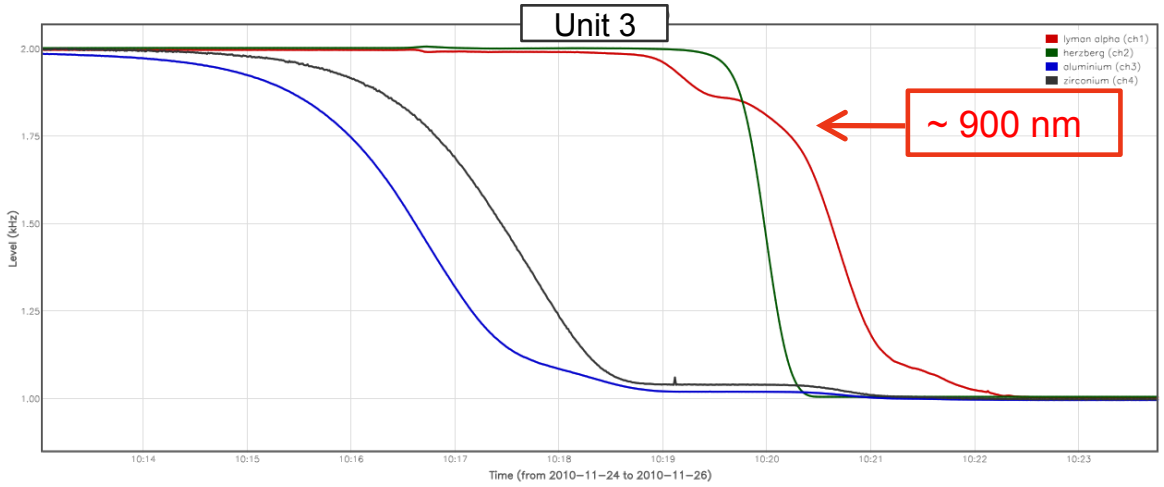
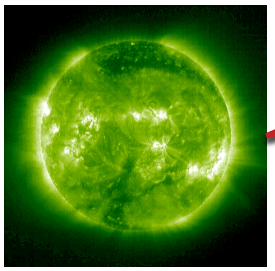
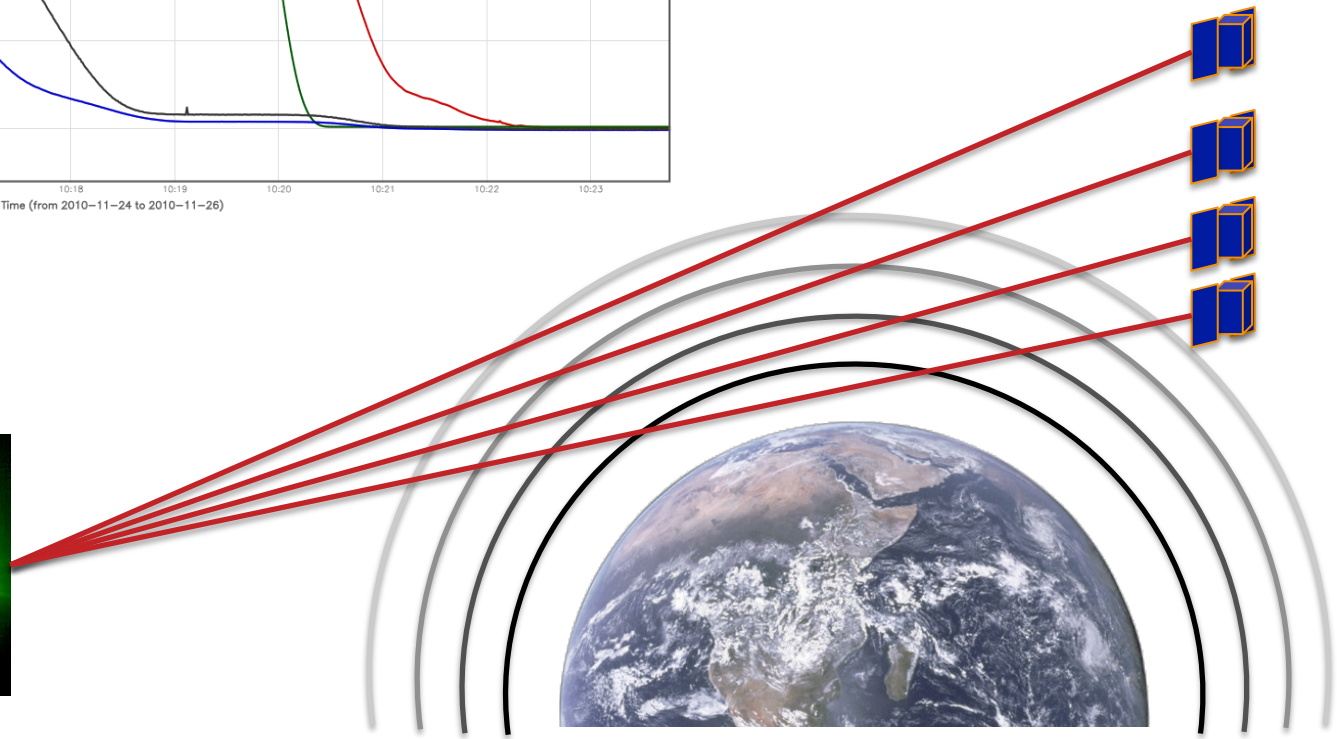
- Flat-field evolution

Probing the evolution of bandpasses: occultations







Long term evolution

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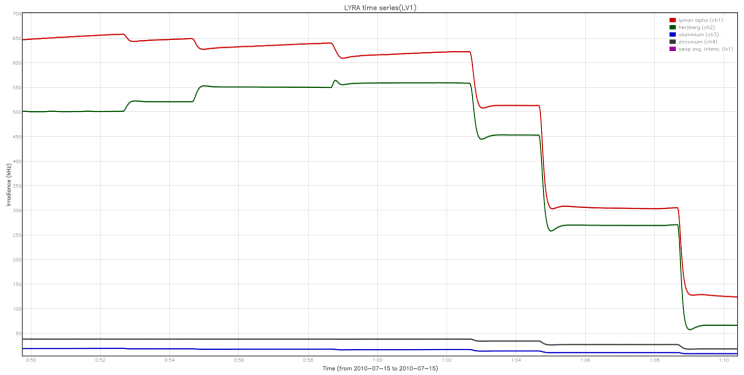
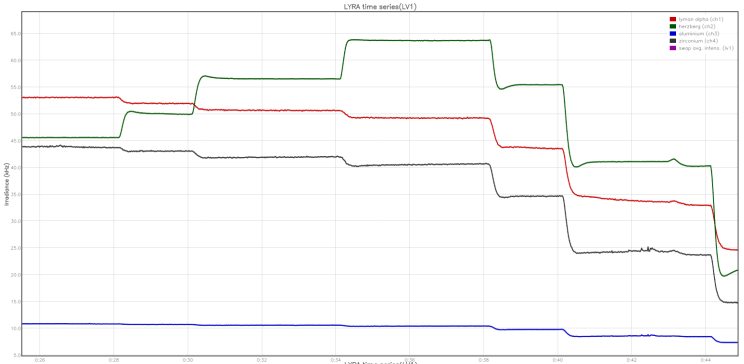
- Flat-field evolution

Flat-field evolution

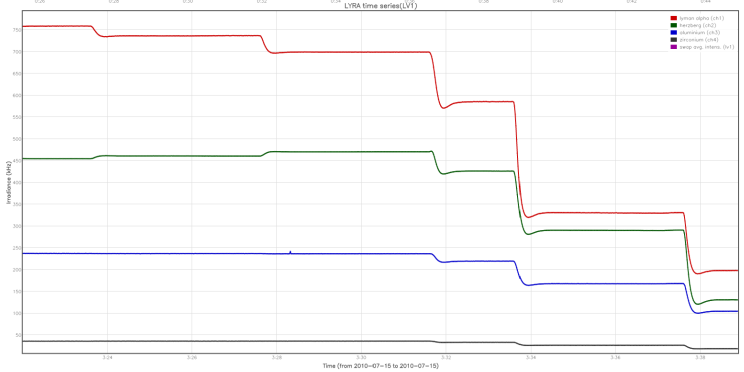
Unit 1

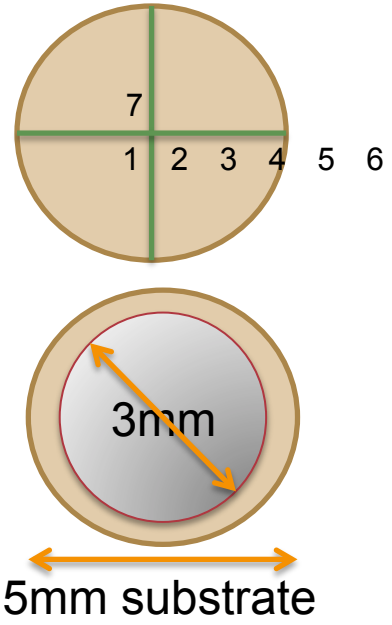


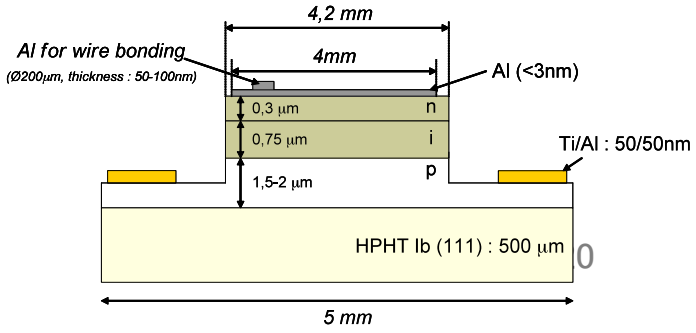
Unit 2
(nominal)



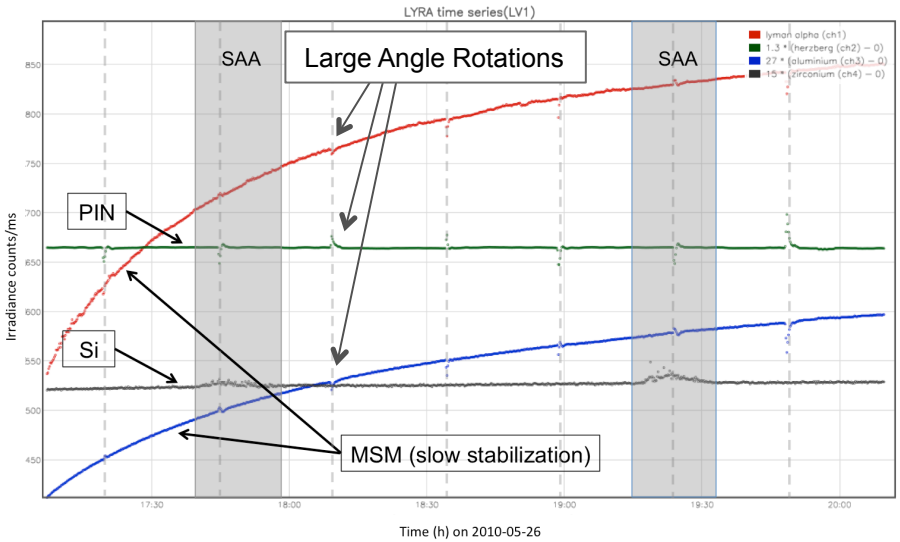
Unit 3

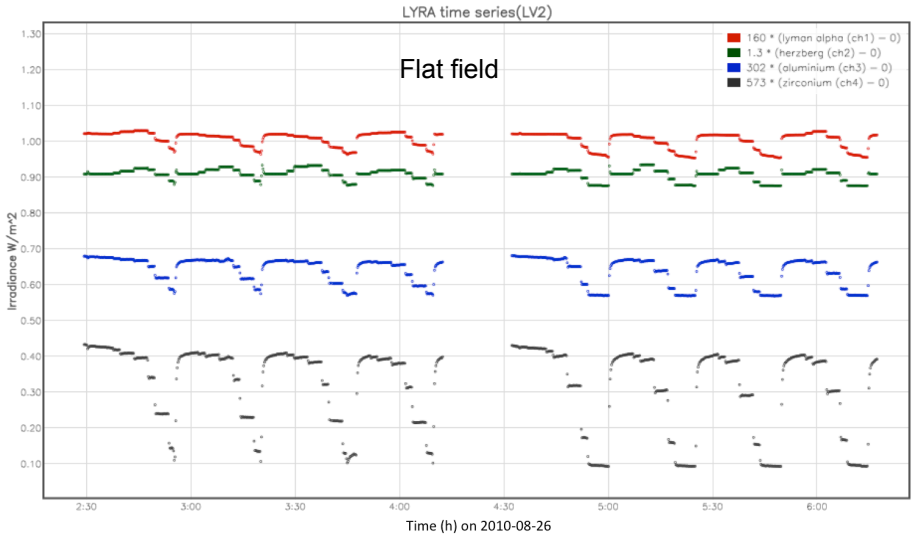




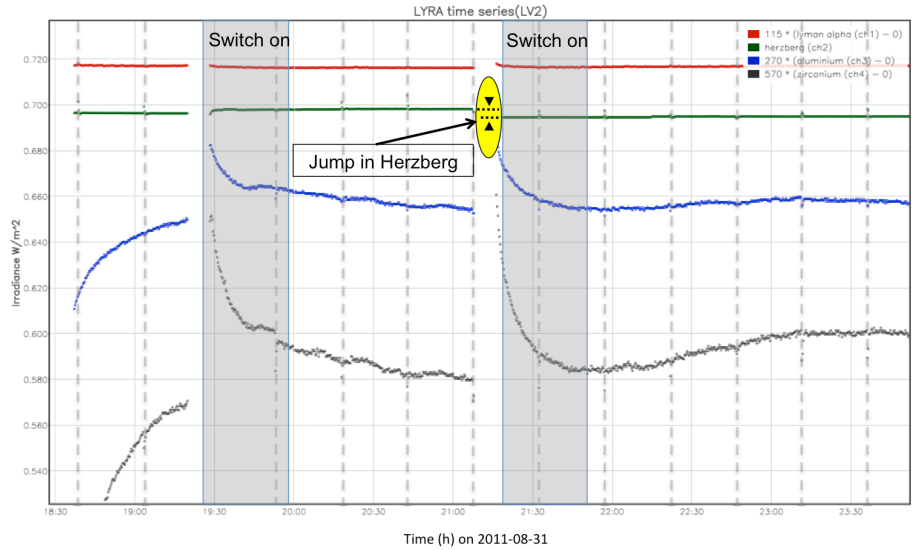


Non-solar features in LYRA data

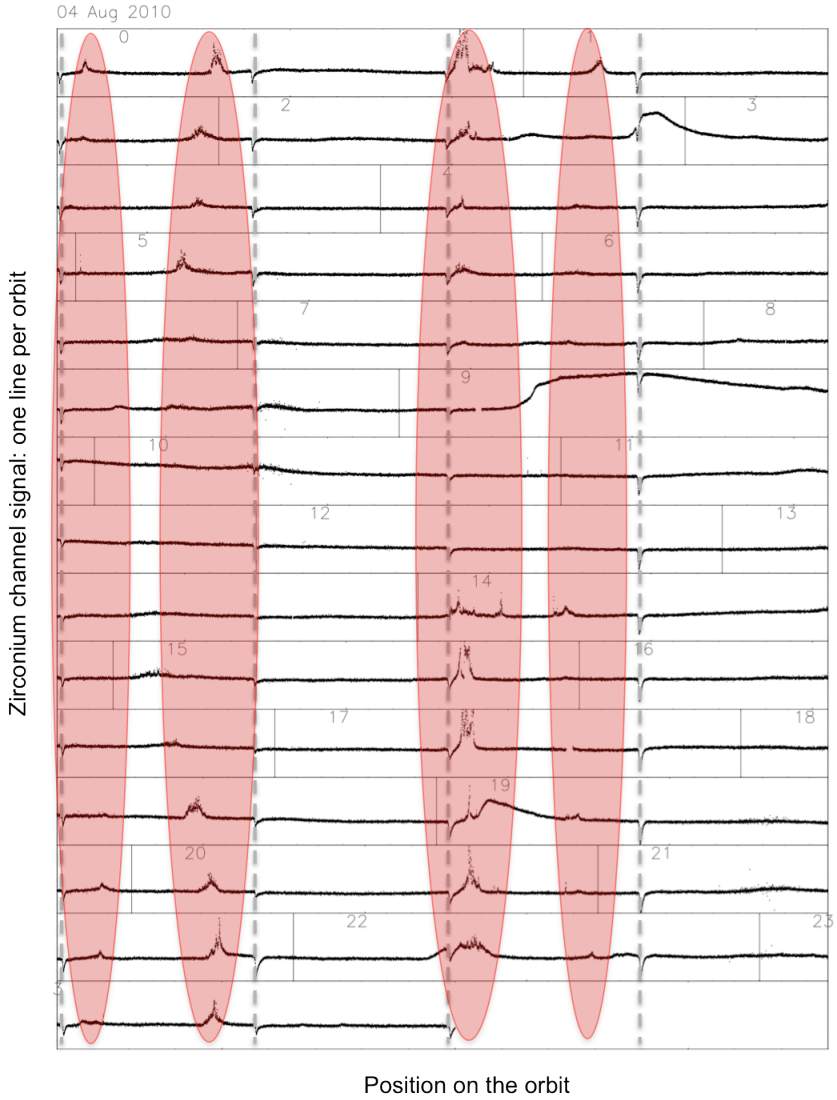




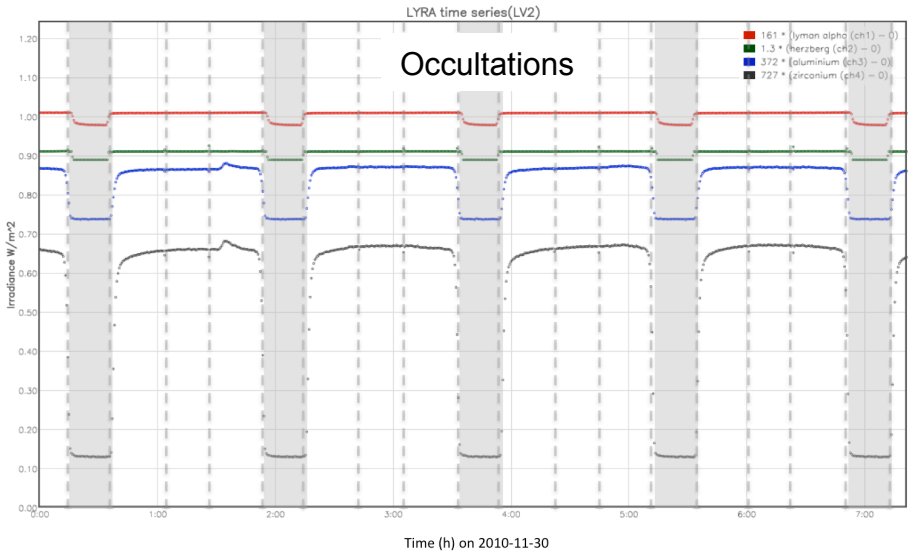
1. LAR: four times an orbit
2. SAA affects more Si detectors independently of their bandpass



Non-solar features in LYRA data



1. Occultation: from mid-October to mid-February
2. Auroral perturbation
   - Only when Kp > 3
   - Only affects Al and Zr channels independently of the detector type
   - Does not affects SWAP (though observing in the same wavelength range)



Data products

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 ... (outliers ...)
Level 2 basic science da			irradiance,
Level 3 averaged science			over 1 min,
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

Data products and quicklook viewer on http://proba2.sidc.be

Collaborations

ORB – KSB

wrc pmod

esa

CSL

aeronomie.be

iMO

NIMS

iemn Recherche Formation Transfert
UMR CNRS 8520

LASP

P.N.Lebedev Physical Institute of the Russian Academy of Science

LPC2E

belspo

MPS
Max-Planck-Institut für Sonnensystemforschung