P2SC-ROB-WR-036-20101115 Weekly report #036	**P2SC Weekly report**	
Period covered: Date: Written by: Released by:	Mon Nov 15 to Sun Nov 21 2010 Wed Nov 24 2010 Carlos Cabanas Carlos Cabanas	Royal Observatory of Belgium PROBA2 Science Center
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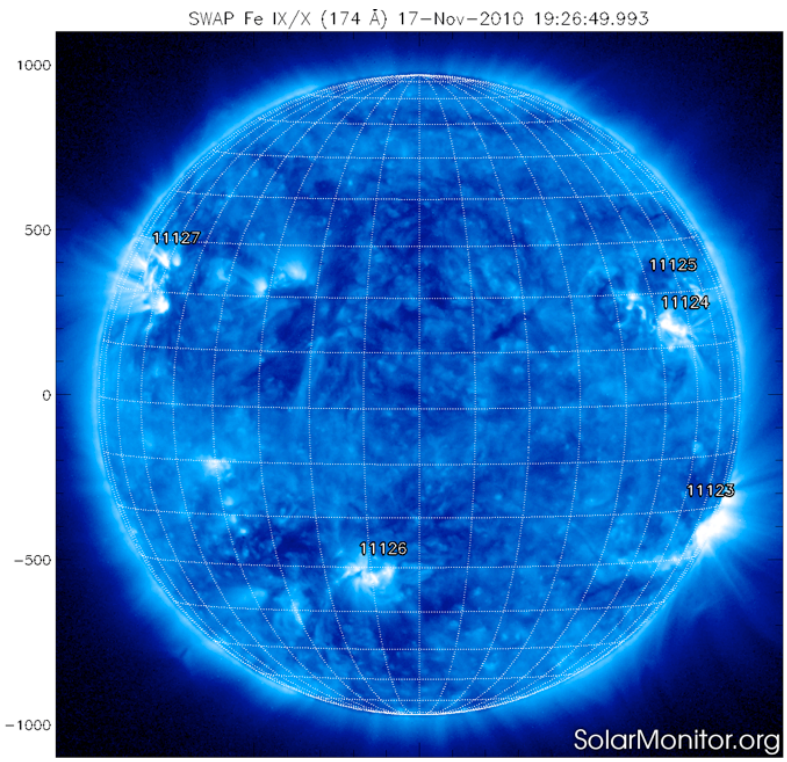
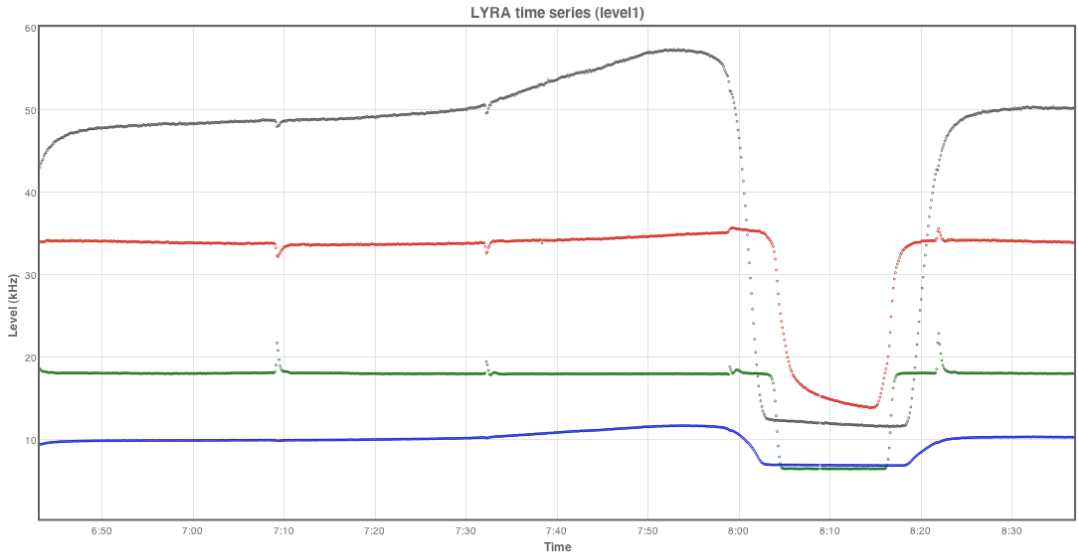
1. Science

Solar & Space weather events

NOAA AR 1124 produced a C2.3 (and several B) flares on Nov. 15th peaking at 07:49 UT. NORA AR 1123 was also active at the beginning of the week producing B flares of low intensity. Very quiet space weather conditions persisted during the rest of the week.



Lyra saw the C2.3 flare just before an eclipsed period.



The solar activity at the beginning of the week is noticed by Zirconium and Aluminium channels. The decrease over the week is mainly due to temperature effects. Due to the visible eclipses, the S/C and instruments are much cooler than a few weeks ago (see temperature evolution in Sect 2. below).

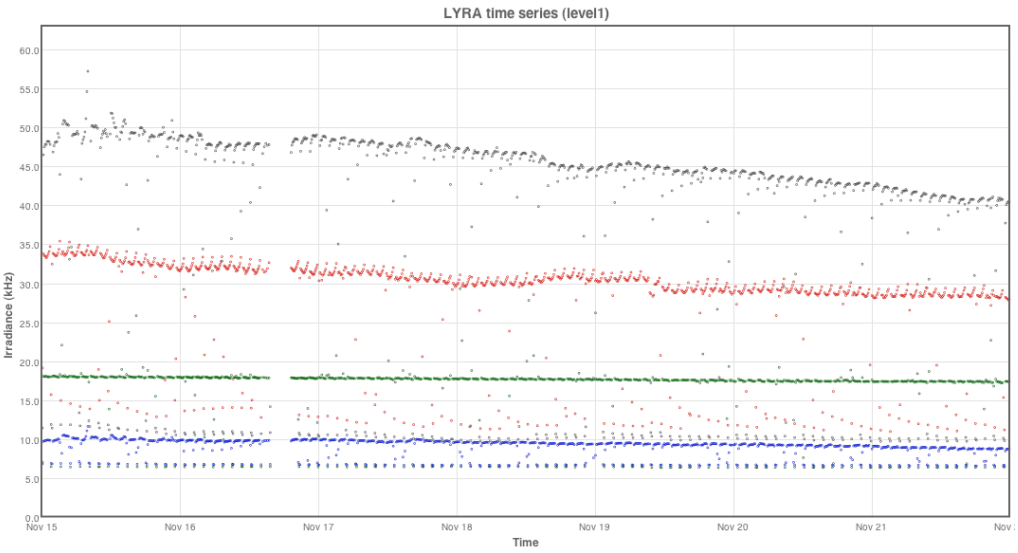
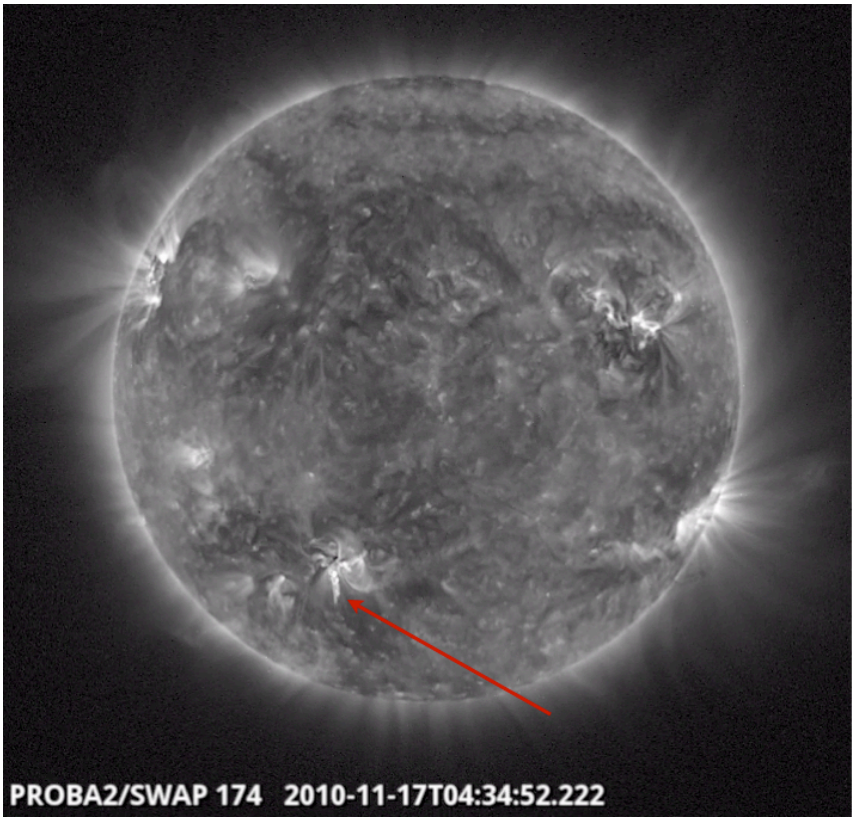


Figure: Unit2 Lyra Curves during the reported period.

Start of the visible eclipse season
The visible eclipses started on November 10.

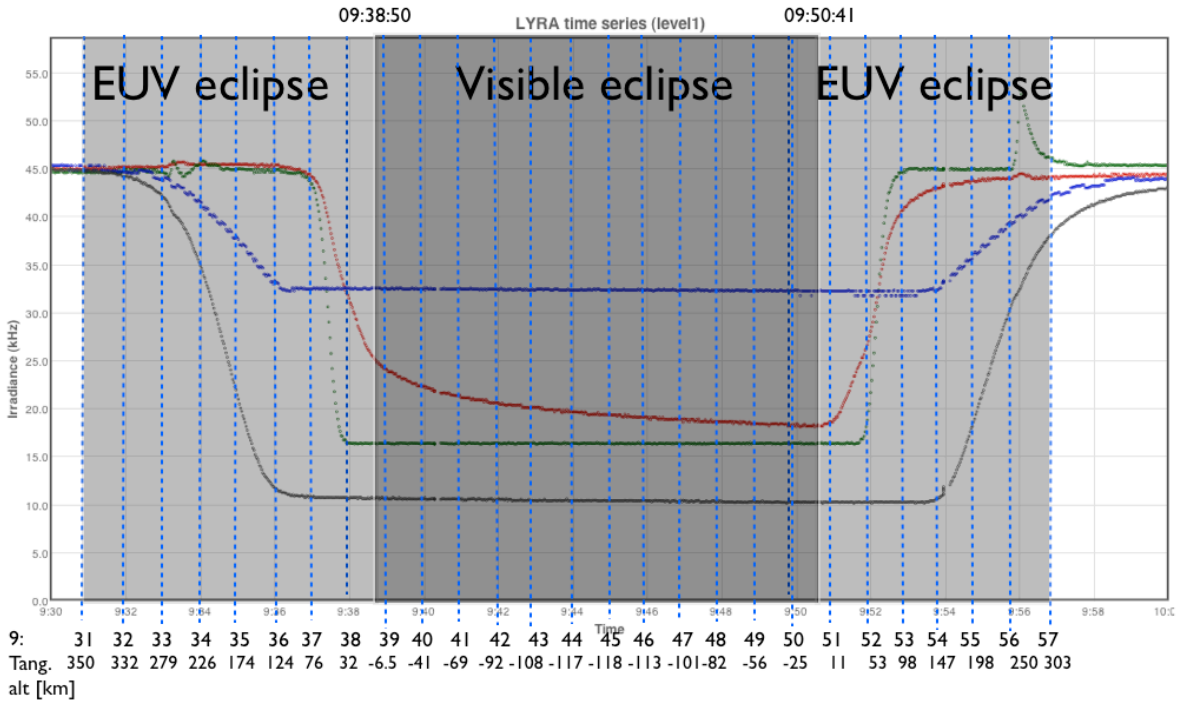
Scientific campaigns

Spectacular JET saw by SWAP on 2010-11-17T04:34:00Z. (It can be found at http://proba2.sidc.be/swap/data/mpg/movies/20101117_swap_movie.mp4)



A LYRA occultation campaign was planned on Nov. 19th.
Below we can see the acquired data:

UNIT2 during occultation campaign on Nov. 19th.



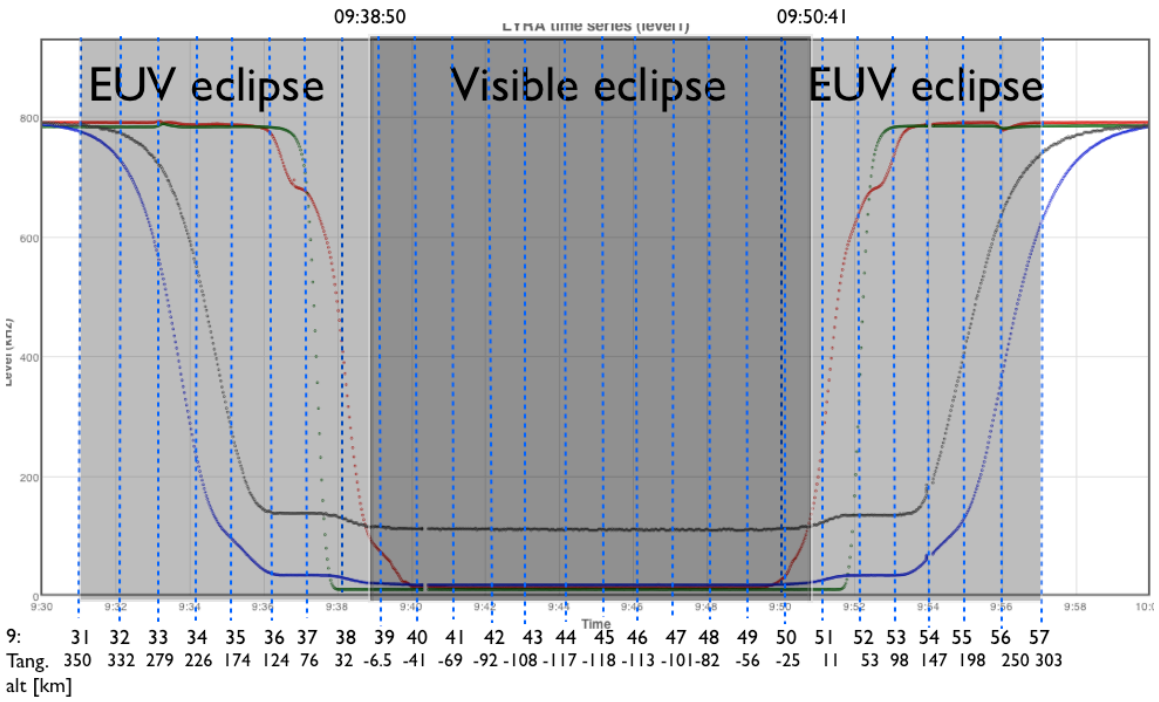
- Zirconium channel (gray color, 6-20 nm, MSM diamond photoresistor).
- Aluminium channel (blue color, 17-80 nm, MSM diamond photoresistor).
- Lyman alpha channel (red color, 120-123 nm, MSM diamond photoresistor).
- Herzberg channel (green color, 200-223 nm, PIN diamond photodiode).

The above figure shows very well the relation *atmosphere absorption vs signal wavelengths*.

The atmosphere absorption is higher for the short wavelengths channels (Zirconium Aluminium).

It is interesting how the signal drops for Lyman alpha and Herzberg when the PROBA2-Sun tangential altitude becomes smaller than 76 km.

UNIT3 during occultation campaign on Nov. 19th.



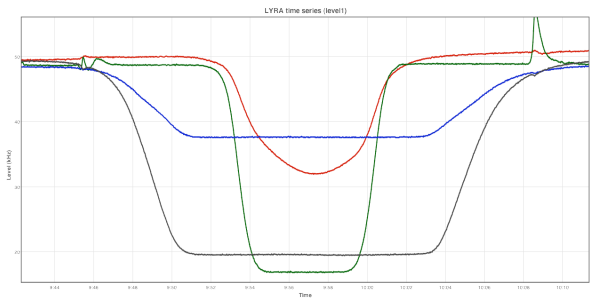
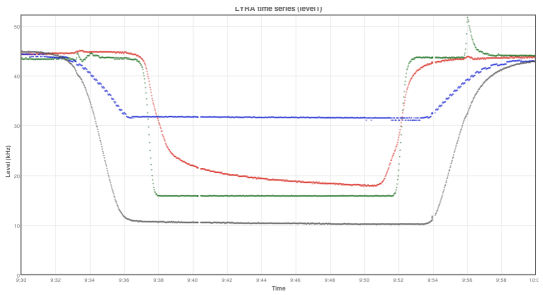
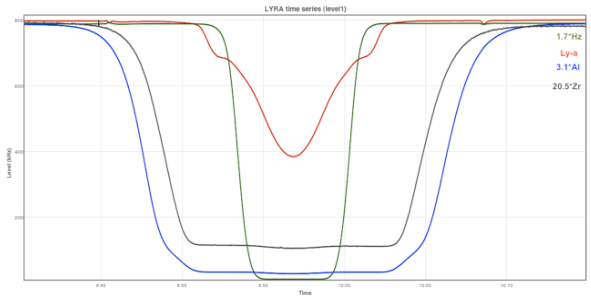
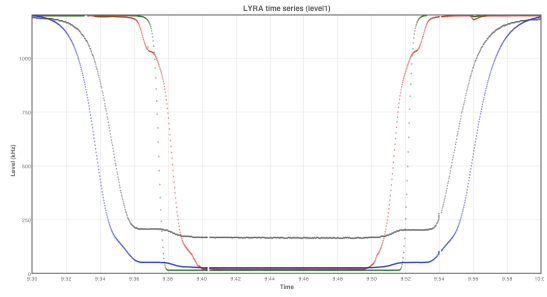
- Zirconium channel (gray color, 6-20 nm, Si).
- Aluminium channel (blue color, 17-80 nm,Si).
- Lyman alpha channel (red color, 120-123 nm,Si).
- Herzberg channel (green color, 200-223 nm, PIN diamond photodiode).

The asymmetry in the MSM channels is due to the latency in the detector signals. Signals never fall off immediately as time is needed to stabilize to the new signal value. This effect is the strongest in channel 2-1 (Ly alpha in unit 2) as the measured signal is multiplied by 10 onboard.

Another difference between unit 2 and unit 3 is that the Ly-alpha channel shows a ‘knee’ around 76 km tangential altitude, but only in unit 3 (see the explanation below *). Herzberg signal extincts completely at 76 km tangential altitude, while Lyman alpha presents a flat response. It seems that the Lyman alpha signal experiments no absorption crossing this layer of the atmosphere. After 76 km Lyman alpha signal goes on decreasing.

* However, a similar ‘knee’ was also seen in unit 2 (MSM) during the first eclipse season, at BOL. The only plausible explanation up to now is that the degradation is wavelength dependent, i.e. stronger for longer wavelengths.

Below we can see a comparing profile between Nov 9th. and Nov19th campaigns:

	Nov. 9th.	Nov. 19th.
Unit 2		
Unit 3		

Outreach, papers, presentations, etc.

PROBA2 mission extension approved.
ESA's Science Programme Committee has approved the extension of PROBA2 operations until 31-dec-2012.

Seventh European Space Weather Week
The seventh European Space Weather Week took place in Brugge, Belgium, from Monday 15th November to Friday 19th November 2010.

The meeting was jointly organised by the Belgian Solar-Terrestrial Center of Excellence (STCE), ESA, the Space Weather Working Team and the COST ES0803 communities. The local organisation was done by the STCE and the Royal Observatory of Belgium (ROB).

Five session were scheduled. Each session was divided into oral and poster sessions with plenty of time devoted to discussion.

The first session, labelled as S*AA Space Weather in Support of Europena Critical Infrastructure* had for objectives to give an overview of the Space Weather element of the European Space Situational Awareness undertaking, the way the ESA programme aims at the development of an operational system intended to meet user requirements, and the related R&D activities especially sponsored by ESA and the EC FP7.

The second session, which took place on Tuesday 16th. Nov, was named as *Spacecraft Environments and Effects*. In this session emphasis was placed on presenting and discussing spacecraft effects, especially those due to space radiations and how the satellites are affected.

The third session,*Tracking Heliospheric Phenomena: New Observing and Analysis Strategies,* started with a number of review talks relating to newly available (ex: SDO data) and future data sources and ended providing an overview of the image processing tools and sophisticated algorithms to identify the significant aspects of the observations.

The fourth session, *Space Weather Products and Services*, focused on the traditional and newly emerging operational services for different groups of users. The session delivered an annual updated of what has been developed and can be regarded as operational as well as what products as services where recently updated: updated data services, specific models, forecasts and real-time monitoring products of the operaitanal status

The last session, *Space Weather Models: from Research to Applications,* offered spaces where to learn about potential or operative applications derived from models, and as contact point where to promote synergies between scientific and applied groups and companies.

Below, you can find a summary of the posters and oral presentations given by P2SC team members.

POSTERS

Solar Irradiance Variations of an Active Region observed with SWAP and LYRA

Dammasch, Ingolf1; Yalim, Mehmet Sarp2; Seaton, Daniel1; De Groof, Anik3; Berghmans, David1, Dominique, Marie1
1Royal Observatory of Belgium, SIDC, BELGIUM;
2K. U. Leuven, CPA, BELGIUM
3European Space Agency c/o Royal Observatory of Belgium, BELGIUM

ESA's microsatellite PROBA2 was launched in November 2009, with two instruments on board which are commanded from the Royal Observatory of Belgium: The imager SWAP and the radiometer LYRA observe solar radiation in extreme ultraviolet and soft X-ray. LYRA delivers solar irradiances with high temporal resolution in four spectral intervals, while SWAP delivers approx. one image per minute of the solar corona. These observations will be used to describe the passing of active region 1087 across the disk, between 06 and 23 July 2010, with respect to short-term (flare) and long-term variability. One aim is to separate the SXR and the EUV influences on two of the LYRA channels with the help of SWAP data (EUV) integrated over the whole disk, and GOES data (SXR). SWAP and LYRA flare intensities

Multispacecraft Observations of 3 and 8 April 2010 Coronal Mass Ejections

Mierla, Marilena1; Rodriguez, Luciano1; Berghmans, David1; Besliu-Ionescu, Diana2; Chifu, Iulia3; Dammasch, Ingolf1; De Groof, Anik4; Demetrescu, Crisan2; Dobrica, Venera2; Gissot, Samuel1; Hochedez, Jean-Francois1; Inhester, Bernd3; Magdalenic, Jasmina1; Maris, Georgeta2; Nitoiu, Daniela2; Seaton, Daniel1; Srivastava, Nandita5; West, Matt1; Zhukov, Andrei1
1Royal Observatory of Belgium, BELGIUM;
2Institute of Geodynamics of Romanian Academy, ROMANIA;
3Max-Planck Institute for Solar System Research, GERMANY;
4European Space Agency, BELGIUM;
5Udaipur Solar Observatory, INDIA

Two halo CMEs were observed by the LASCO/SOHO coronagraph on 3 and 8 April 2010. These events were observed as limb CMEs by STEREO-A and -B spacecraft. On-disk, EUV images recorded by SWAP/PROBA2, EUVI/STEREO and EIT/SOHO show EIT waves, EUV dimmings, as well as post-eruptive arcades. Both CMEs were associated with flares (observed by LYRA/PROBA2) and erupting filaments. Slowly drifting radio continuum in the frequency range of 70-20 MHz was observed in association with 3 April 2010 event. The CMEs were detected in-situ by ACE and they both produced geomagnetic storms when interacting with the Earth magnetic field. We apply the reconstruction techniques described in Mierla et al. 2009 to these events in order to infer their 3D structure, the true speed and the direction of propagation. The travel time to the Earth is calculated using the speeds derived from the 3D reconstruction techniques. Comparison of the calculated travel time with the true arrival time is done in order to improve the reconstruction results. Analysis and comparison of the source regions will be also presented and discussed.

ORAL PRESENTATIONS

SWAP and LYRA Onboard PROBA2, new EUV Instruments for Space Weather monitoring

De Groof, Anik1; Berghmans, David2; Dominique, Marie2
1ESA c/o Royal Observatory of Belgium, BELGIUM;
2Royal Observatory of Belgium, BELGIUM

PROBA2 is an ESA micro-satellite, launched on November 2, 2009 from Russia. PROBA2 carries two solar monitoring instruments, the LYRA UV radiometer and the SWAP telescope (Sun Watcher using Active Pixel System detector and Image Processing) for coronal imaging and space weather monitoring. We will overview the technical characteristics, the performance of SWAP and LYRA and the opportunities brought by the PROBA2 platform. The available PROBA2 data products and services will be presented, giving special attention to the unique complementarity of the SWAP images as compared to SOHO/EIT, STEREO/SECCHI, and SDO/AIA. Similarly, the complementarity of LYRA data as compared to other radiometers as GOES, TIMED-SEE, SORCE will be discussed. SWAP and LYRA have an open data policy and data products are available in near-real time, up to one hour after the facts.

A Three-Dimensional SWAP-STEREO Reconstruction of a Mass-Loading Type Eruption

Seaton, Daniel; Mierla, Marilena; Berghmans, David; Dolla, Laurent; Zhukov, Andrei
Royal Observatory of Belgium, BELGIUM

On 3 April 2010 an eruptive flare (GOES class B7.4) near sun center triggered a geoeffective CME that has been blamed for the failure of the Galaxy 15 telecommunications satellite. Here we present a three-dimensional reconstruction of this eruption using observations from SWAP onboard PROBA2 and SECCHI onboard STEREO. PROBA2 is an ESA spacecraft with four space weather monitoring instruments including SWAP, the EUV coronal imager from which many of these observations were obtained.
Our analysis of this event shows that it unfolded in two parts: an initial flow of cooler material from very low in the

corona, followed by a flux rope eruption higher in the corona. We conclude that mass off-loading from the first part triggered a rise, and, subsequently, catastrophic loss of equilibrium of the flux rope.
We discuss the implications of this analysis on CME and flare initiation models and additional possibilities for joint operations using PROBA2 and other space based observatories like Hinode, SDO, and STEREO.

Temporal and Frequency Variations of Flares observed by LYRA Onboard of PROBA2.

Zender, J.1; Foing, B.1; Vagg, D.2; Dominique, M.3; Dammasch, I.3; Schmutz, W.4
1ESA/ESTEC/SRE, NETHERLANDS;
2Waterford University, IRELAND;
3Royal Observatory of Belgium, BELGIUM;
4 Physikalisch-Meteorologisches Observatorium Davos, SWITZERLAND

The radiometric data obtained onboard of PROBA2 using the LYRA channels in the EUV and Soft-Xray are analyzed and compared against other space weather data, i.e. the SWAP imager onboard of PROBA2 satellite and the x-ray detectors onboard of the GOES-14 satellite. A temporal analysis quantifies the variations during the flare event. The rise and decay time and the flux changes are discussed for the different bands. We introduce the wavelet methodology and present the results for flare analysis applied to the LYRA channels using this method.

Impact of the Particle Environment on SWAP and LYRA Data

Dominique, Marie1; Berghmans, David1; Dolla, Laurent1; Kruglanski, Michel2; De Donder, Erwin 2;Schmutz, Werner2
1Royal Observatory of Belgium, BELGIUM;
2Belgian Institute of Space Aeronomy, BELGIUM; ;3Physikalisch-Meteorologisches Observatorium Davos (PMOD/WRC), SWITZERLAND

PROBA2 is an ESA micro-satellite in a polar, low Earth orbit at an altitude of about 725km. The coronal imager SWAP and the UV radiometer LYRA, observe the Sun from the ESA's PROBA2 platform for more than six months.
The SWAP and LYRA observations have been episodically perturbated by the particles environment through which the spacecraft propagates. For example, both instruments clearly show the effect of the South Atlantic Anomaly. In conjunction with enhanced geomagnetic activity, LYRA also records signatures of propagation through the auroral regions.
An analysis of these perturbations in both SWAP and LYRA data is proposed. In particular we focus on the behavior of the new detector technology used in LYRA (rad-hard wide-bandgap detectors, based on diamond) in such particle enviroments.

Fine Structure of the Solar Inner Corona and its Relationship with Coronal Streams

Slemzin, Vladimir1; Urnov, Alexander1; Kuzin, Sergey1; Harra, Louise2; Berghmans, David3; Goryaev, Farid3
1P.N. Lebedev Physical Institute, RUSSIAN FEDERATION;
2UCL-MSSL, UNITED KINGDOM;
3Royal Observatory of Belgium, BELGIUM

The inner solar corona (R=1 ÷ 2Rsun) plays an important role as the intermediate region where the restructuring of the magnetic field from closed to open configurations and the formation of the solar wind streams takes place. Ulysses' results showed the global map of the solar wind and stimulated searches of the solar wind sources. However, most of existing EUV telescopes, such as SOHO/EIT, STEREO/EUVI, SDO/AIA cannot see the corona above R=1.3Rsun. So far, investigations of coronal streams were limited to white-light coronagraphic studies of the streamers at the distances above R=2 Rsun. The first EUV observations of the inner corona up to 2.5 Rsun were obtained with the CORONAS-F/SPIRIT telescope-coronagraph during the last solar maximum (2001-2002) and revealed the existence of quasi-stationary ray-like structures stretching from active regions to white-light streamers. Recently HINODE/EIS has detected the Doppler shifts of the coronal emission lines produced by the coronal outflows at the edges of ARs. New EUV telescopes such as TESIS aboard CORONAS-Photon and SWAP aboard PROBA2 have extended field of views which fill the existing gap and allows us to study the relationship between the EUV coronal rays and outflows detected by HINODE/EIS. This report presents preliminary results of observations of the inner corona with new EUV telescopes - CORONAS/TESIS and PROBA2/SWAP along with the plasma diagnostics using the simultaneous Hinode/EIS data in the current period of extremely low solar activity 2009-2010. It was found that there is a correspondence between the maps of the EUV line intensities, temperature profiles of column DEMs and stream velocities obtained by EIS at the disk center and the fine structure of the corona observed by EUV telescopes above the limb. For the cases under study a comparison is made with the ACE data to verify the assumption that these coronal streams represent components of the solar wind.

Benoit Callebaut (from ROB) carried out an oral presentation: *The Soteria Virtual Observatory : Offering Users Easier Way to discover Data.* Soon PROBA2 SOC will be a server provider for the SVO with SWAP and LYRA data.

2. LYRA instrument status

Calibration
No LYRA calibration sequence was scheduled this week.

IOS & operations

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Nominal acquisition (LYRA00110)	Nominal acquisition (LYRA00110)	Nominal acquisition (LYRA00110)	Nominal acquisition (LYRA00110)	Unit2/3 eclipse campaign + Nominal acquisition (LYRA00111)	Nominal acquisition (LYRA00110)	Nominal acquisition (LYRA00110)

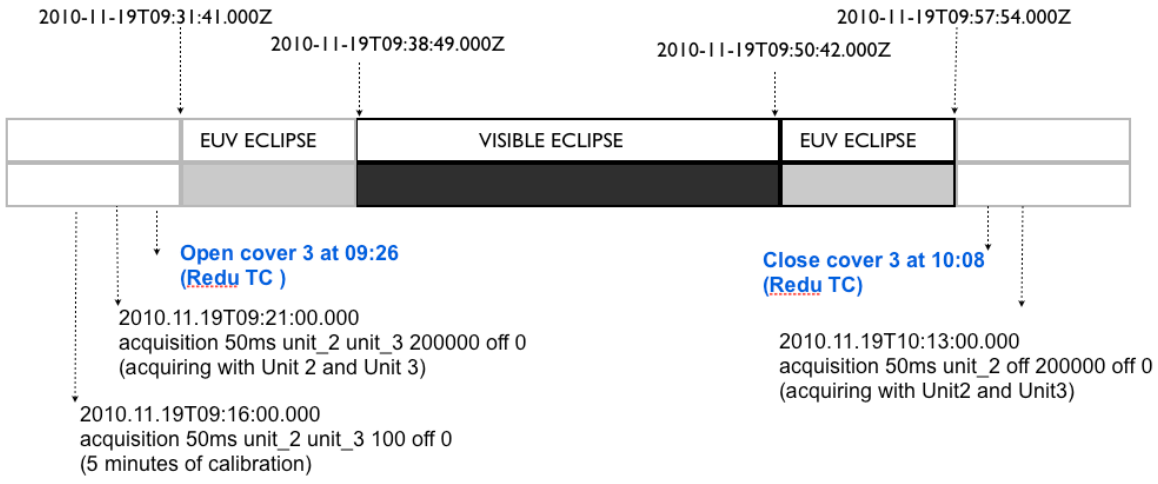
IOS LYRA00110

...
2010.11.10T11:13:00.000 acquisition 50ms unit_2 off 200000 off 0 (last command)

IOS LYRA00111

2010.11.19T09:16:00.000 acquisition 50ms unit_2 unit_3 100 off 0
2010.11.19T09:21:00.000 acquisition 50ms unit_2 unit_3 200000 off 0
2010.11.19T10:13:00.000 acquisition 50ms unit_2 off 200000 off 0
...

UNIT3 ECLIPSE CAMPAIGN



Temperatures

LYRA temperatures maintain a decreasing tendency due to the eclipsed periods.
The most relevant bump in Unit 3 happens when its cover opens.
Plasma payload effects are present as usual affecting the three units.
The isolated housekeeping gap of the week is visible.

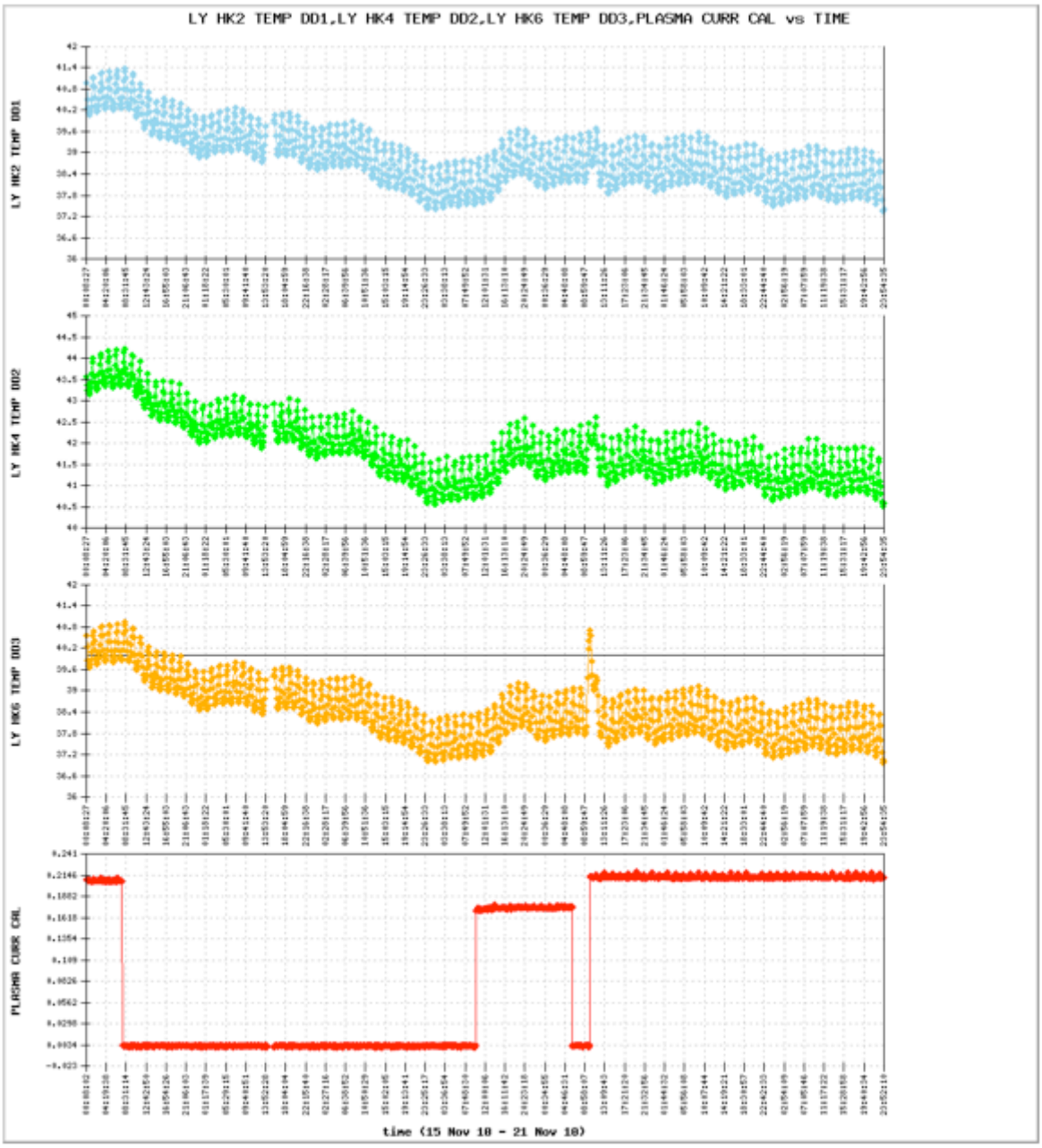
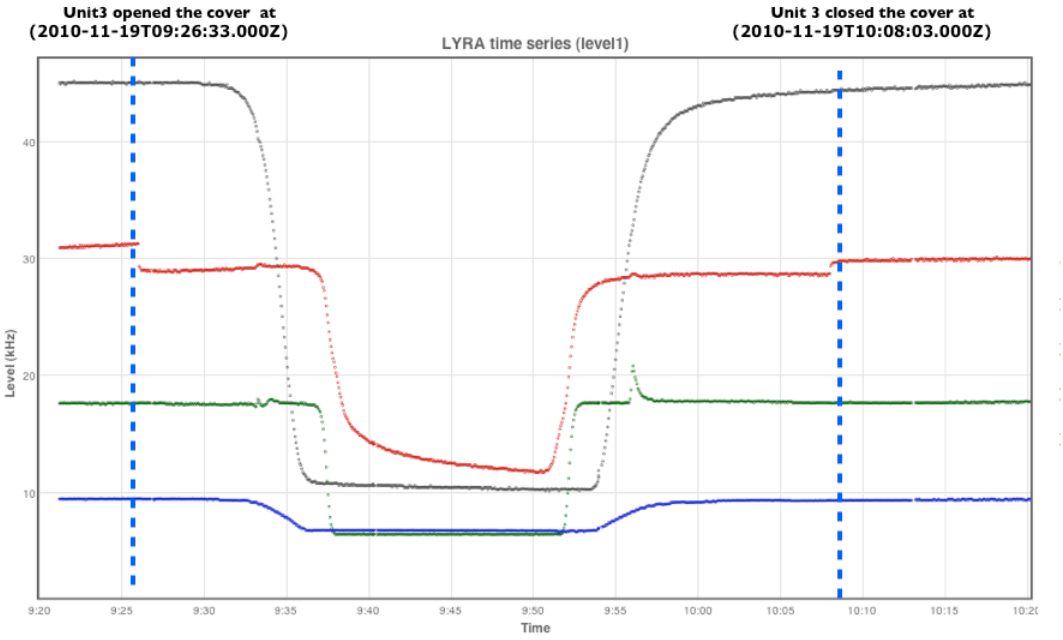


Figure: LYRA temperatures from 15Nov to 21Nov.

Anomaly 1 (onboard)

Lyman alpha jumped in Unit2 when Unit3 opened and closed the cover.
Temperature effects are ruled out since the signal decreases when opening the cover and increases when closing it.
Unit2 'Zirconium, Aluminium and Herzberg' channels were not influenced by the Unit3 covers.



Anomaly 2 (at SOC side)

Commanding LYRA directly (opening/closing doors) from REDU via tele-commands during the occultation campaigns have some impacts in the P2SC pipeline:

LY-EDG is not aware whether LYRA UNIT3 cover is opened or closed. Normally it checks for this information from the commanding_database. As the door opening/closing was not commanded with the PTI (instead, it was commanded directly via telecommand from REDU), this information is missed in the commanding database. Therefore during the occultations campaigns the scientific data is considered as calibration data because LY-EDG thinks that the UNIT3 cover is closed.
The result is that the unit 3 data corresponding to the occultation campaigns ends in bca FITS instead of bsd FITS.

The problem can not be easily solved faking the 'commanding database' : a warm_up implies more operations than opening/closing the covers.

3. SWAP instrument status

MCPM errors

The number of MCPM errors remained unchanged (recoverable: 208, unrecoverable:0).

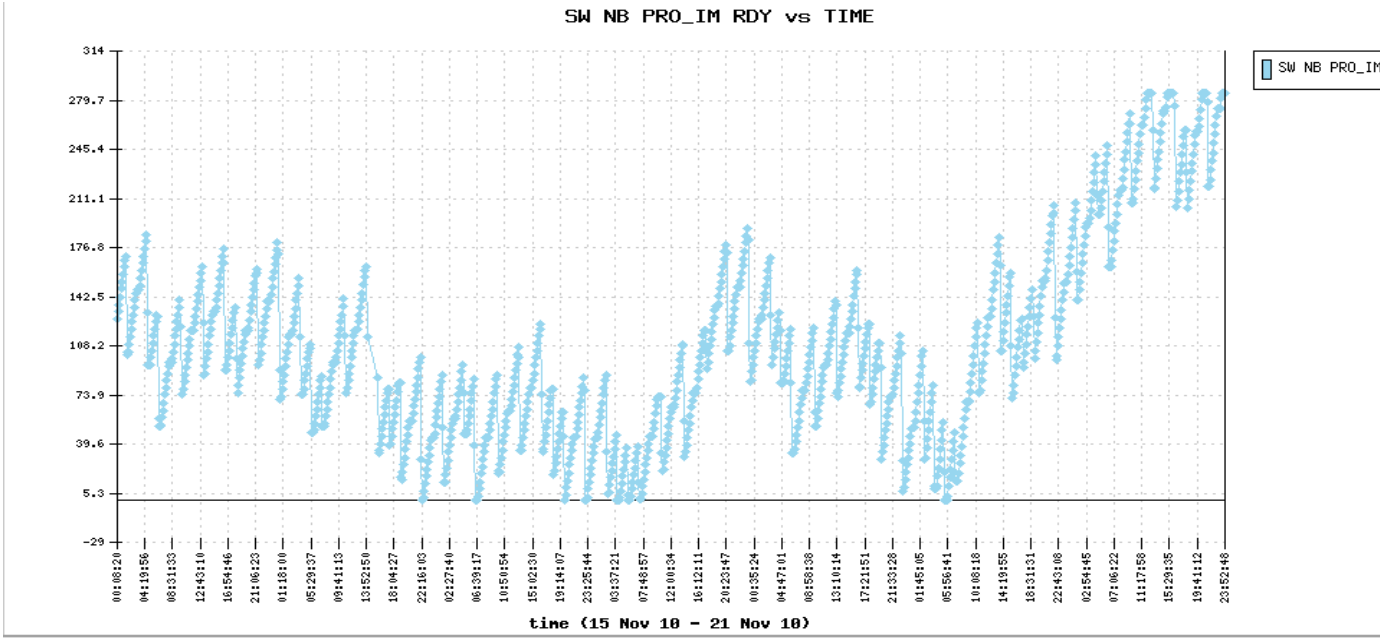
IOS & operations

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Nominal + eclip jumping Cadence:100 IOS00204	Nominal + eclip jumping Cadence:100 IOS00204	Nominal + eclip jumping Cadence:100 IOS00204	Nominal + eclip jumping + ESP test Cadence:100 IOS00204	Nominal + eclip jumping Cadence:100 IOS00204	Nominal + eclip jumping Cadence:80 IOS00205	Nominal + eclip jumping Cadence:80 IOS00205

SWAP has been nominally imaging throughout the period making use of the automated eclipse skipping mechanism implemented at P2SC.
The nominal imaging cadence was 100s during the week.
Skipping imaging during eclipsed period let us rise the cadence up to 80s to make the most of the telemetr capacity.

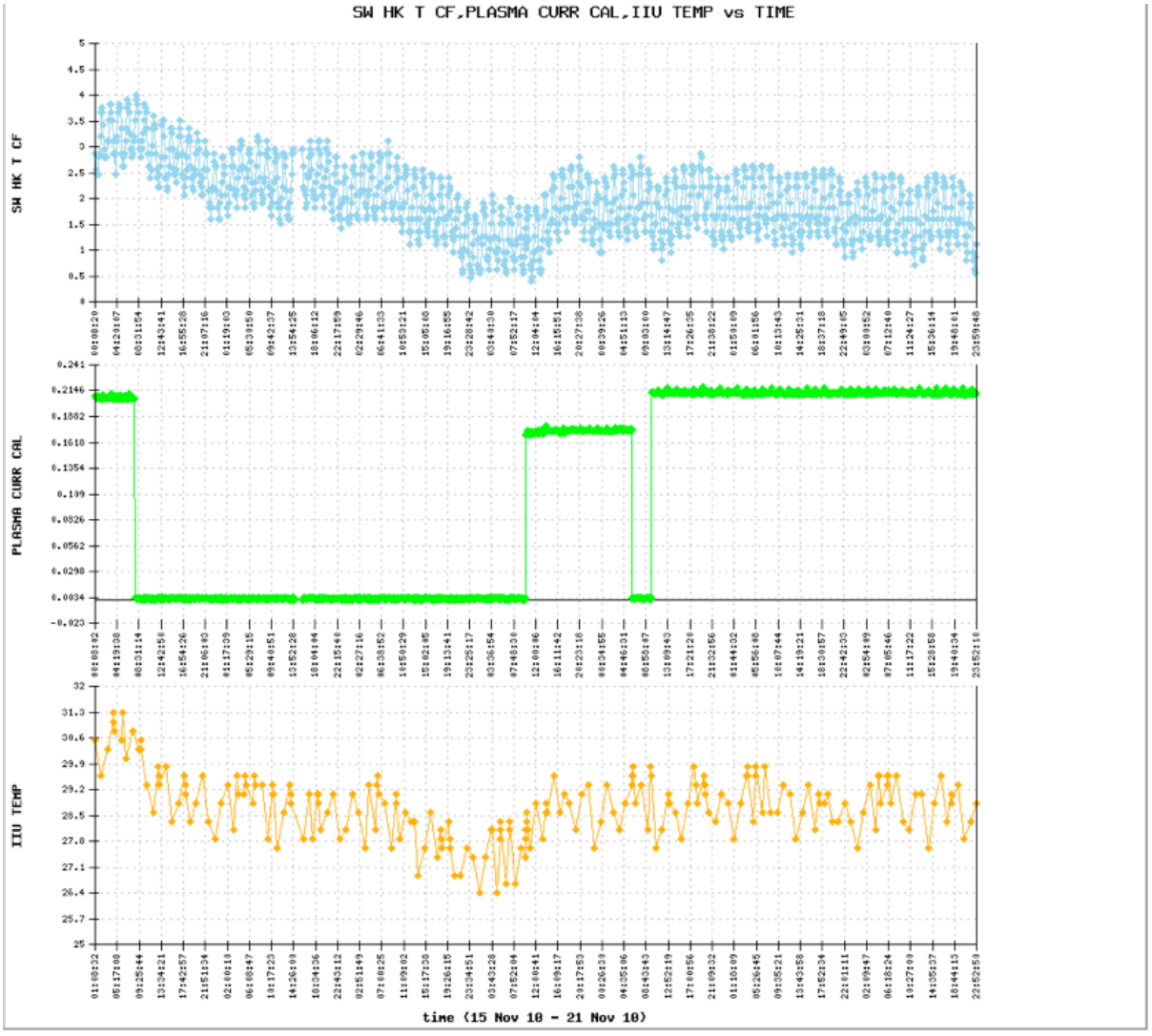
Calculation of the maximum possible cadence (Which is a bit too much, so overwriting is going to happen but the system was designed for that, and having a full buffer is good in case somehow SWAP switches off unexpected.)
orbit in min: 100 eclipse duration per orbit: 1700 number of orbits per day: 14.5 IDL> print, (100*60.-1700.)*14.5 = 62350.0 So for an 80s period, we would produce the following number of images: IDL> print, ((100*60.-1700.)*14.5)/80. = 779.375

Below we can see the number of processed images stored in the buffer during the reported period:



SWAP detector and IIU temperature

SWAP and IIU temperatures maintain a decreasing tendency due to the eclipsed periods. Plasma payload effects are present as usual affecting the CF and IIU temperatues..

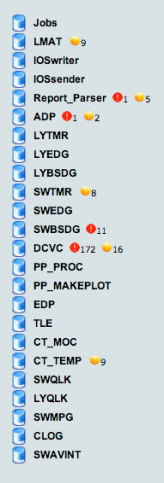


4. PROBA2 Science Center Status

Carlos Cabanas was operator during this week. SWAP daily movies were created manually. No tools were updated on the operational server.

P2SC status at the end of the week

This is how the P2SC pipeline looked like at the end of the reported period:



- ***Logging, Monitoring and Activity Trigger*** (LMAT) warned the operator nine times, pointing that *Lyra Quick Look* (LYQKL) and *Lyra Base Science Data Generator* (LYBSDG) were taking too long and the status changed to not responding.

- The ***Report Parser*** detected one error and five warnings during the week.It failed when moving PSR_AD_LYRA_2999.txt and TC_LYRA_Report_3019.log to the *failed directory.* This happened because the file detection system triggered twice the *Report Parser* tool with the same file as input. It does not have a major impact on the pipeline except extra work for the operator when dismissing these errors/warnings.

- ***Ancillary Data Processor*** (ADP) logged one error and two warnings during the week. One error and one warning was caused due to the same problem explained in the Report Parser paragraph: ADP was triggered twice with the same input: LYRA_AD_2976_RED3_2010.11.17T20.11.29.tar.

  The warning was given when processing LYRA_AD_2965_SVA1_2010.11.16T15.54.47.tar.gz. *(LYRA_AD_2010_11_16_15_50_45_AOCS_ORB_Ancillary_Data_2010.11.16T13.51.07.000000_2010.11.16T15.40.05.000000.log - Length of state array less than Lagrange polynomial degree: 8 <= 9*)

- ***SWAP Telemetry Reformatter*** (SWTMR) detected eight warning due to a couple of images were corrupted (see more in section.5 under *Data coverage SWAP*)

- ***SWAP Base Science Data Generator*** (SBSDG) encountered eleven errors during the week, mainly due to the lack of housekeeping as result of the data gap of Nov.16.

- ***Data Consistency and Validation Checker*** (DCVC) found logged hundred seventy two errors and sixteen warnings. All of them can be explained by the fact that LYRA Cover 3 is being opened/closed directly by telecommand from REDU instead from ROB. Thus the ROB commanding_database does not contain this information, so when the housekeeping arrived these inconsistencies are noticed.

- ***Cleaning Tool of Temp Directory*** (CT_TEMP) encountered problems trying to clean the SWBSDRP_logs.db because it does not exist.

5. Data reception & discussions with MOC

Data coverage HK

- Gap from 14:00 to 15:40 aprox on Nov. 16th. REDU said : *It seems that pass 2965 has been scheduled at Svalabard with a wrong configuration*

Data coverage SWAP

- BINSWAP_2982_SVA1_2010.11.18T11.05.40.tar
  BINSWAP20101118080058000019499 9PROCESSED - Packet CRC does not validate
- BINSWAP_3004_RED3_2010.11.20T19.14.05.tar
  BINSWAP20101120174028000019658 9PROCESSED - Truncated packet: 33636 < 56698

Total number of images between 2010 Nov 15 0UT and 2010 Nov 22 0UT: 4392
Highest cadence in this period: 80 seconds
Average cadence in this period: 137.61 seconds
Number of image gaps larger than 300 seconds: 101 (all eclipse gaps + data gap of pass 2965)
Largest data gap: 53.70 minutes (eclipse + ESP test)

Data coverage LYRA

Below we can see the data gap from 14:00 to 15:40 aprox on Nov. 16th.

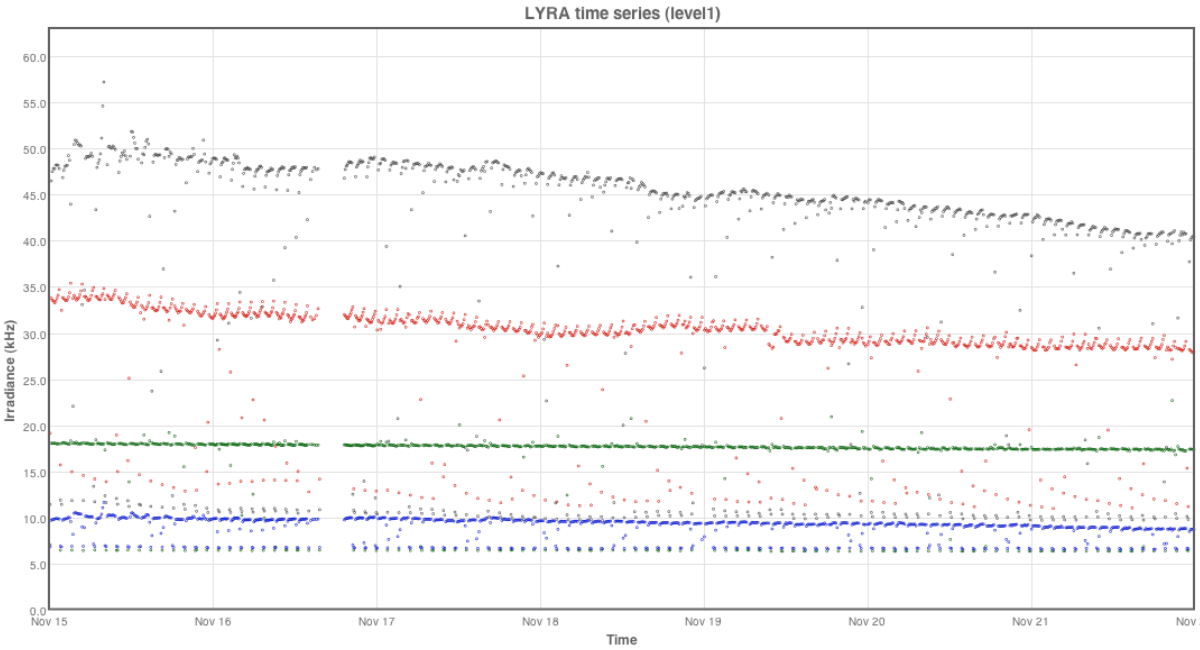


Figure: Unit2 Lyra Curves during the reported period.

6. APPENDIX Frequently used acronyms

ADP	Ancillary Data Processor
ADPMS	Advanced Data and Power Management System
AOCS	Attitude and Orbit Control System
APS	Active Pixel image Sensor
ASIC	Application Specific Integrated Circuit
BBE	Base Band Equipment
CME	Coronal Mass Ejection
COGEX	Cool Gas Generator Experiment
CRC	Cyclic Redundancy Check
DR	Destructive Readout
DSLP	Dual Segmented Langmuir Probe
EIT	Extreme ultraviolet Imaging Telescope
FITS	Flexible Image Transport System
FOV	Field Of View FPA Focal Plane Assembly
FPGA	Field Programmable Gate Arrays
GPS	Global Positioning System
HAS	High Accuracy Star tracker
HK	Housekeeping
ICD	Interface Control Document
IIU	Instrument Interface Unit
IOS	Instrument Operations Sheet
LED	Light Emitting Diode
LEO	Low Earth Orbit
LYRA	LYman alpha RAdiometer
LYTMR	LYRA Telemetry Reformatter (software module of P2SC)
LYEDG	LYRA Engineering Data Generator (software module of P2SC)
MCPM	Mass Memory, Compression and Packetisation Module
MOC	Mission Operation Center
NDR	Non Destructive Readout
OBET	On board Elapsed Time
OBSW	On board Software
PE	Proximity Electronics
PGA	Programmable Gain Amplifier
PI	Principal Investigator
P2SC	PROBA2 Science Center
PPT	Pointing, Positioning and Time (software module of P2SC)
ROB	Royal Observatory of Belgium
SAA	South Atlantic Anomaly
SCOS	Spacecraft Operation System
SEU	Single Event Upset
SOHO	Solar and Heliospheric Observatory
SWAP	Sun Watcher using APS detector and image Processing
SWBSDG	SWAP Base Science Data Generator
SWEDG	SWAP Engineering Data Generator (software module of P2SC)
SWTMR	SWAP Telemetry Reformatter (software module of P2SC)
TBC	To Be Confirmed
TBD	To Be Defined
TBW	To Be Written

TC	Telecommand
TPMU	Thermal Plasma Measurement Unit
UTC	Coordinated Universal Time
UV	Ultraviolet