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|---|---|---|
| P2SC-ROB-WR-389<br>- 20170904<br>Weekly report #389         | <b>P2SC Weekly report</b>   |  |
| Period covered:<br>Date:<br><br>Written by:<br>Approved by: | Mon Sep 04 to Sun Sep 10, 2017<br>13 Sep 2017<br><br>Laurence Wauters<br>Matthew West   | Royal Observatory<br>of Belgium<br>-<br>PROBA2 Science<br>Center                    |
| To:   | LYRA PI, marie.dominique@sidc.be<br>SWAP PI, david.berghmans@sidc.be  | <a href="http://proba2.sidc.be">http://proba2.sidc.be</a><br>++ 32 (0) 2 3730559    |
| cc:   | ROB DIR, ronald@oma.be<br>ESA Redu, Etienne.Tilmans@esa.int<br>ESA D/SRE, Joe.Zender@esa.int<br>ESA D/TEC, Juha-Pekka.Luntama@esa.int |   |

## 1. Science

### Solar & Space weather events

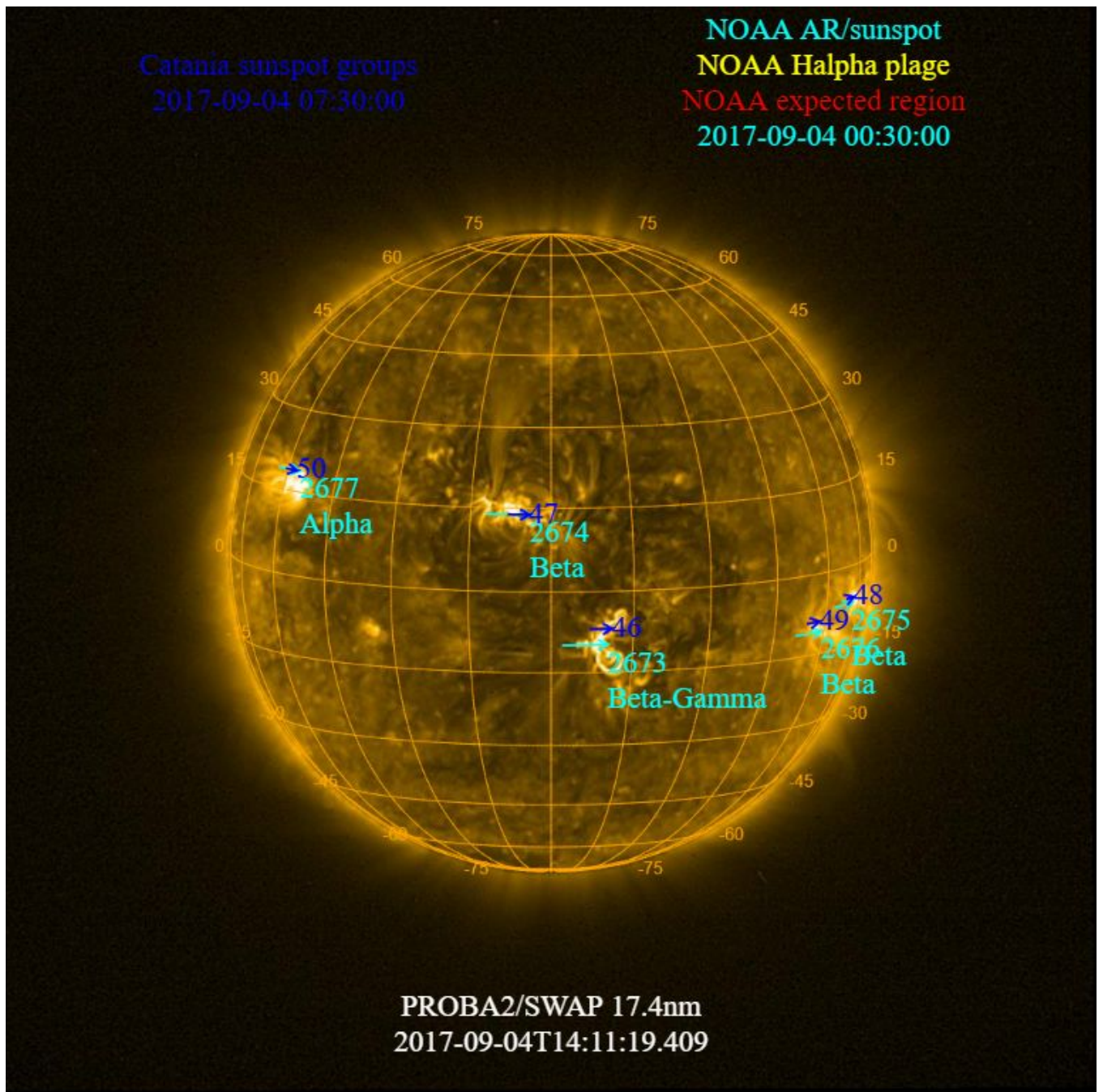
The level of solar activity<sup>1</sup> fluctuated between **moderate and very high** this week.

Only M- and X-flares are mentioned, the most energetic one(s) per day are presented in **bold**:

|          | Monday<br>04 Sep                                       | Tuesday<br>05 Sep                   | Wednesday<br>06 Sep                       | Thursday<br>07 Sep                            | Friday<br>08 Sep                          | Saturday<br>09 Sep             | Sunday<br>10 Sep |
|----------|--|-------------------------------------|---|---|---|--------------------------------|------------------|
| Activity | moderate   | moderate                            | very high                                 | high  | moderate                                  | moderate                       | high             |
| Flares   | M1.2,M1.5<br>,M1.1,M1.<br>7,M1.5, <b>M5</b><br>.5,M2.1 | <b>M4.2</b> ,M1.<br>0,M3.8,M<br>2.3 | X2.2, <b>X9.3</b> ,<br>M2.5,M1.4,<br>M1.2 | M2.4,M1<br>.4, <b>M7.3</b> ,<br>X1.3,M3.<br>9 | M1.3,M1.2<br>, <b>M8.1</b> ,M2.<br>9,M2.1 | M1.1,<br><b>M3.7</b> ,<br>M1.1 | <b>X8.2</b>      |

<sup>1</sup> See appendix. All timings are given in UT.

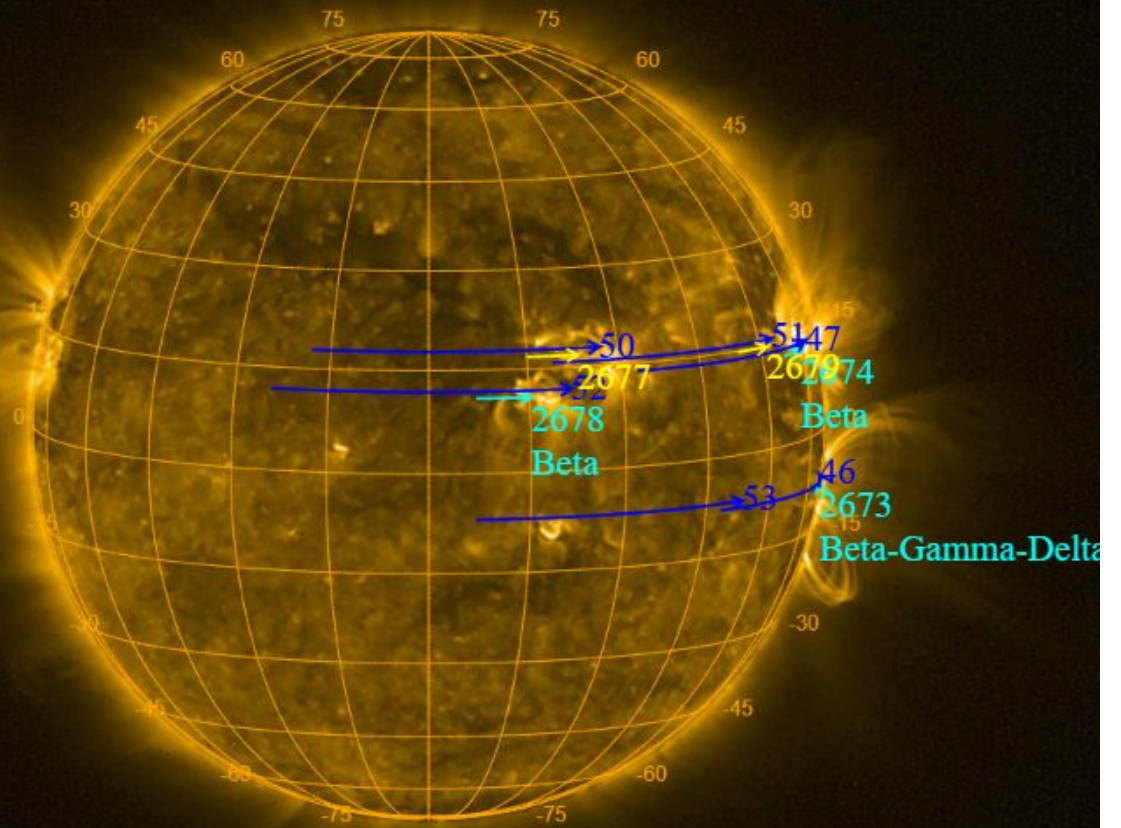
The SWAP images of Sep 04 and Sep 10 are shown below, with annotated active regions.



<http://sidc.be/soteria/soteria.php>

Catania sunspot groups  
2017-09-07 10:48:00

NOAA AR/sunspot  
NOAA Halpha plage  
NOAA expected region  
2017-09-10 00:30:00



PROBA2/SWAP 17.4nm  
2017-09-10T14:12:58.302

## Solar Activity

Solar flare activity fluctuated between **moderate and very high** during the week.

In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed: <http://proba2.oma.be/ssa>

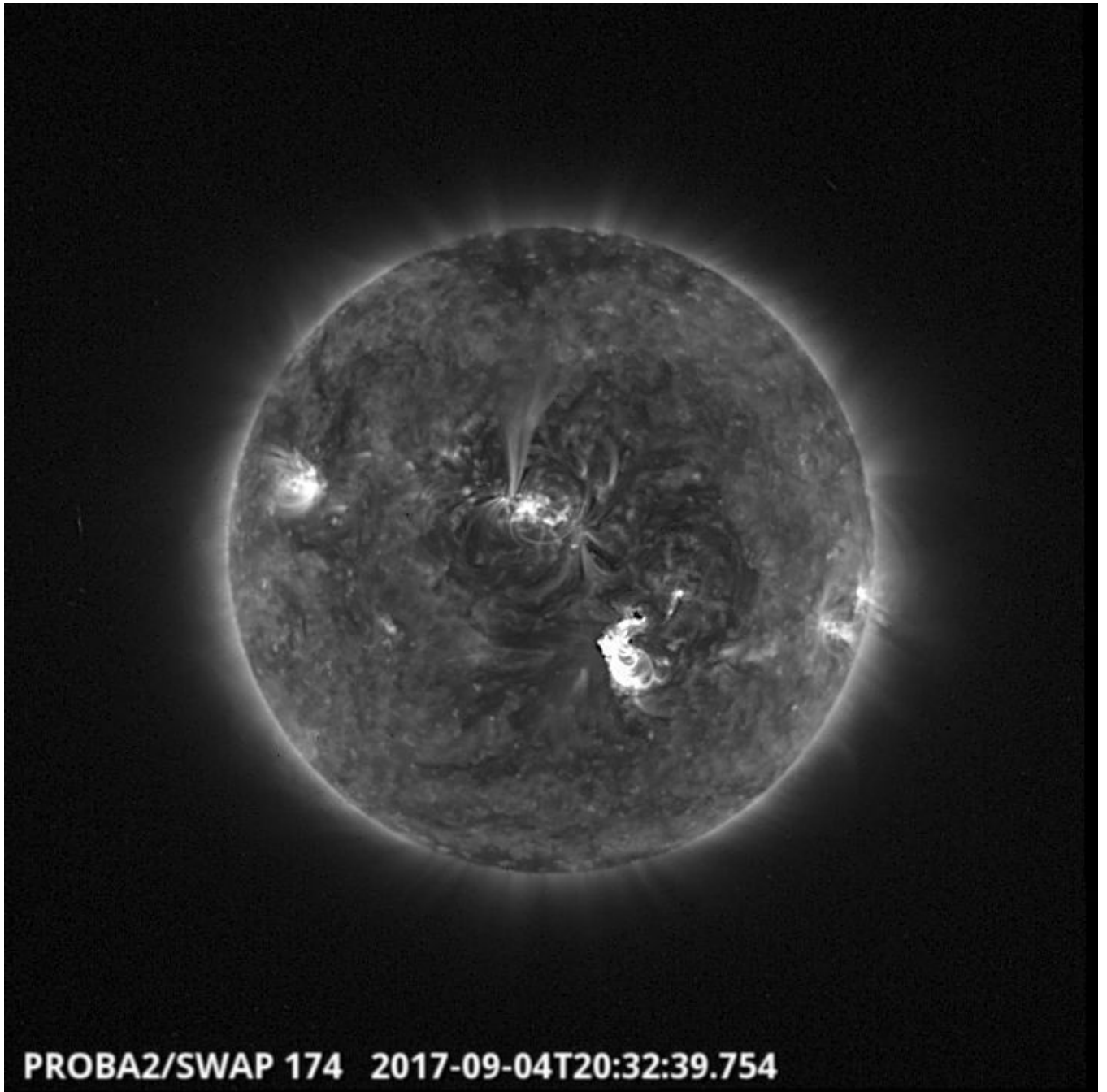
This page also lists the recorded flaring events.

A weekly overview movie can be found [here](#) (SWAP week 389).

Details about some of this week's events, can be found further below.

If any of the linked movies are unavailable they can be found in the P2SC movie repository [here](#)

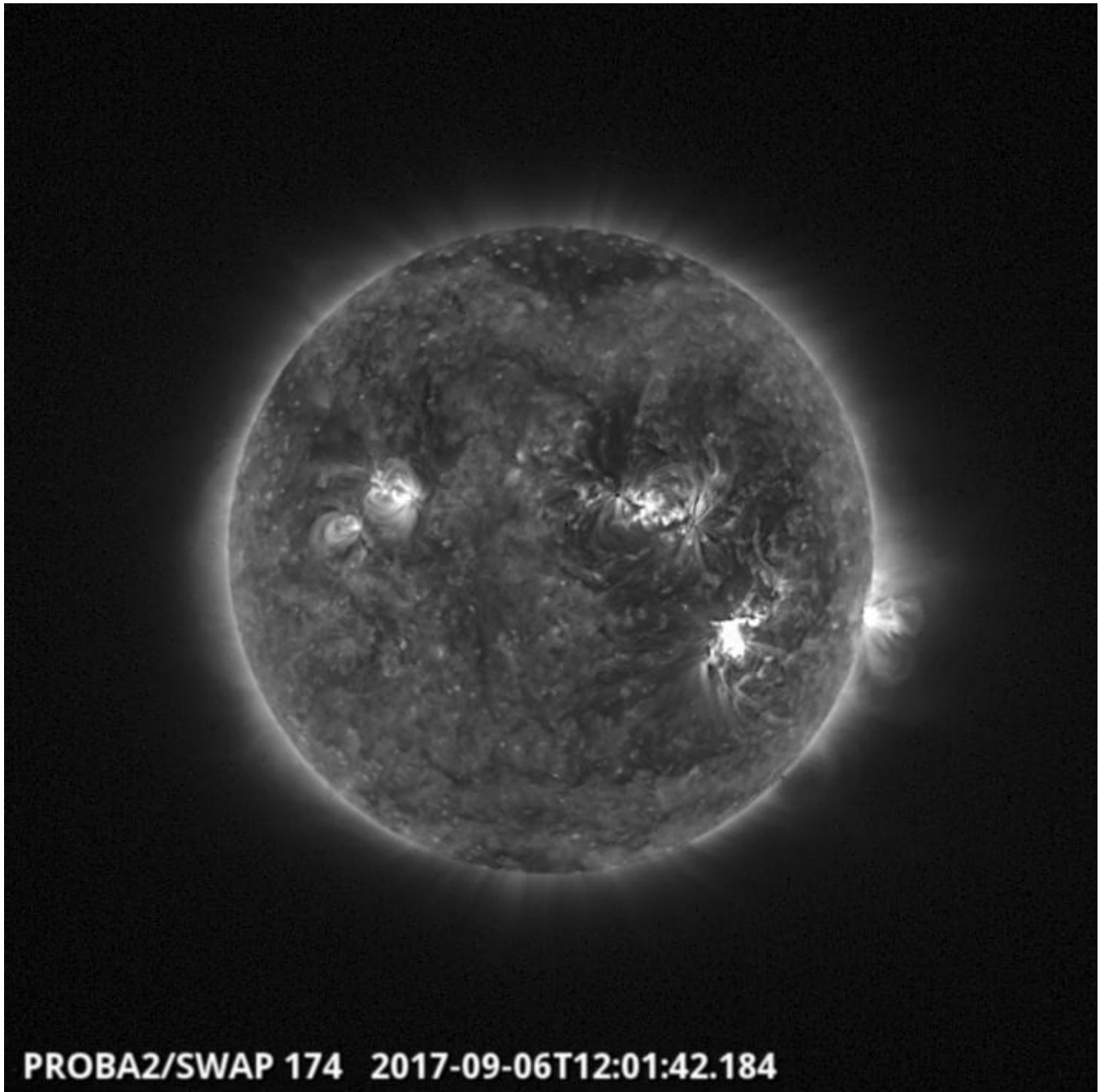
Monday Sep 04



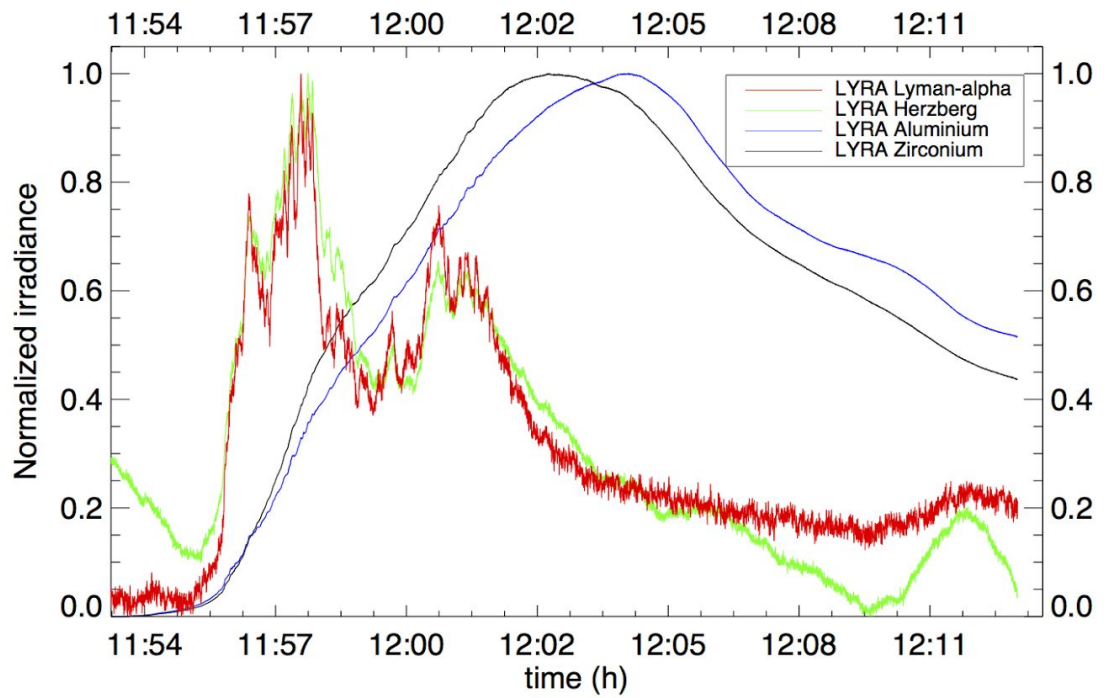
**An M5.5 class flare peaking at 18:48 UTC on 2017-Sep-04, was produced by NOAA active region 2673 in the South west part of the Sun, and can be seen in the SWAP image above. This active region, 2673, dominated the activity for the whole week.**

Find a movie of the events [here](#) (SWAP movie)

Wednesday Sep 06



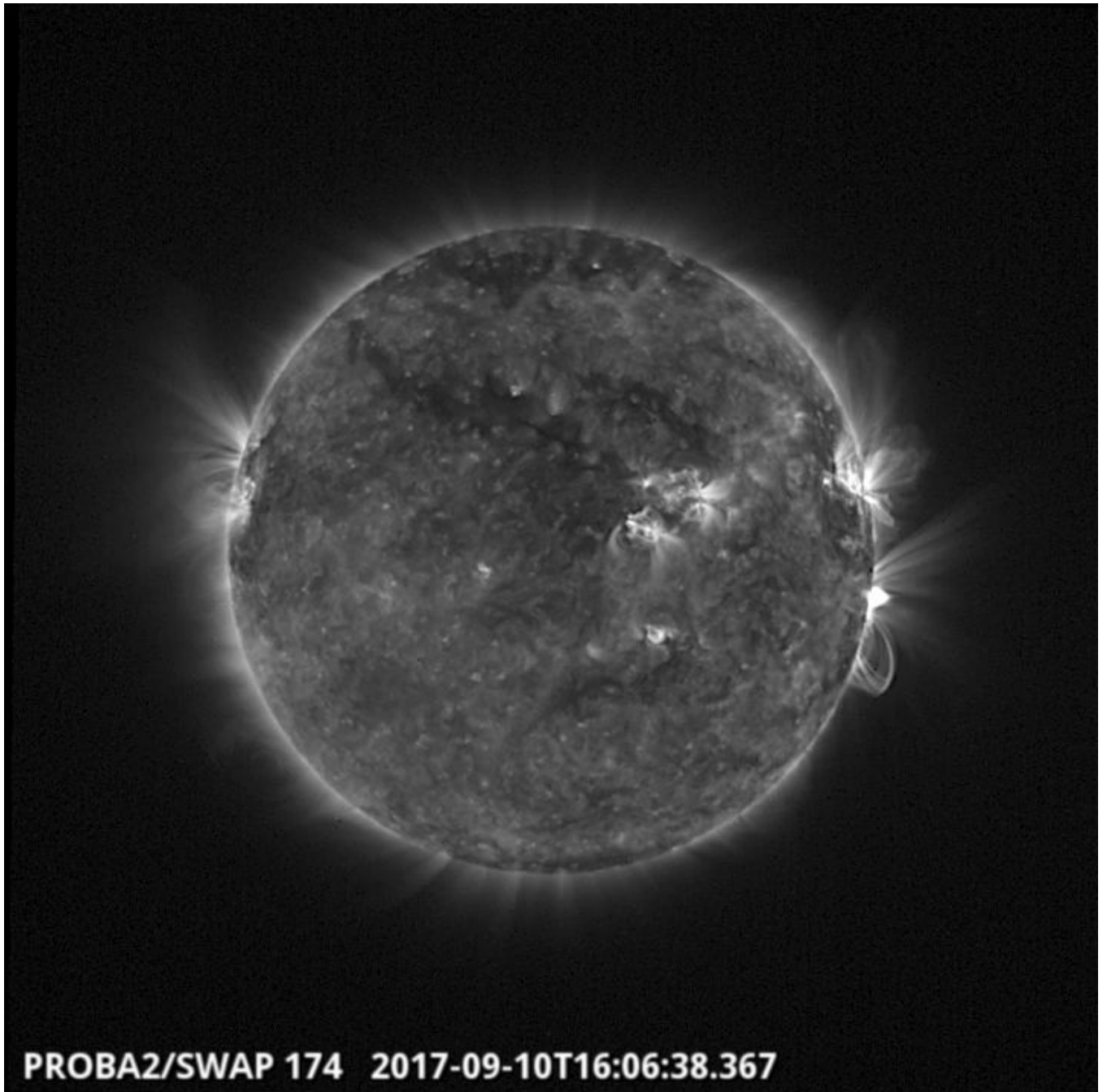
The Sun produced a strong solar X9.3 class flare on 2017-Sep-6. This flare occurred in NOAA AR 2673 peaking at 12:02 UT in the North-West part of the Sun with a full halo CME. It was preceded by many other strong flares, including an X2.2 class flare peaking at 09:10 UT. The X9.3 class flare is the strongest observed since 2006-Dec-5, when a X9.0 class flare was observed. Since PROBA2 was only launched in 2009, this means that this is the strongest flare that has ever been observed by the solar instruments SWAP and LYRA on-board the satellite. Find a movie of the events [here](#) (SWAP movie)



**The image above shows the LYRA observations of the X9.3 flare in 4 different wavelength channels. This unique dataset will certainly be studied with great interest by the LYRA team.**

Find more explanation [here](#)

Sunday Sep 10



The Sun produced a strong X8.2 flare on 2017-Sep-10. This flare occurred in NOAA AR 2673 peaking at 12:02 UTC at the West limb of the Sun with a full CME halo.

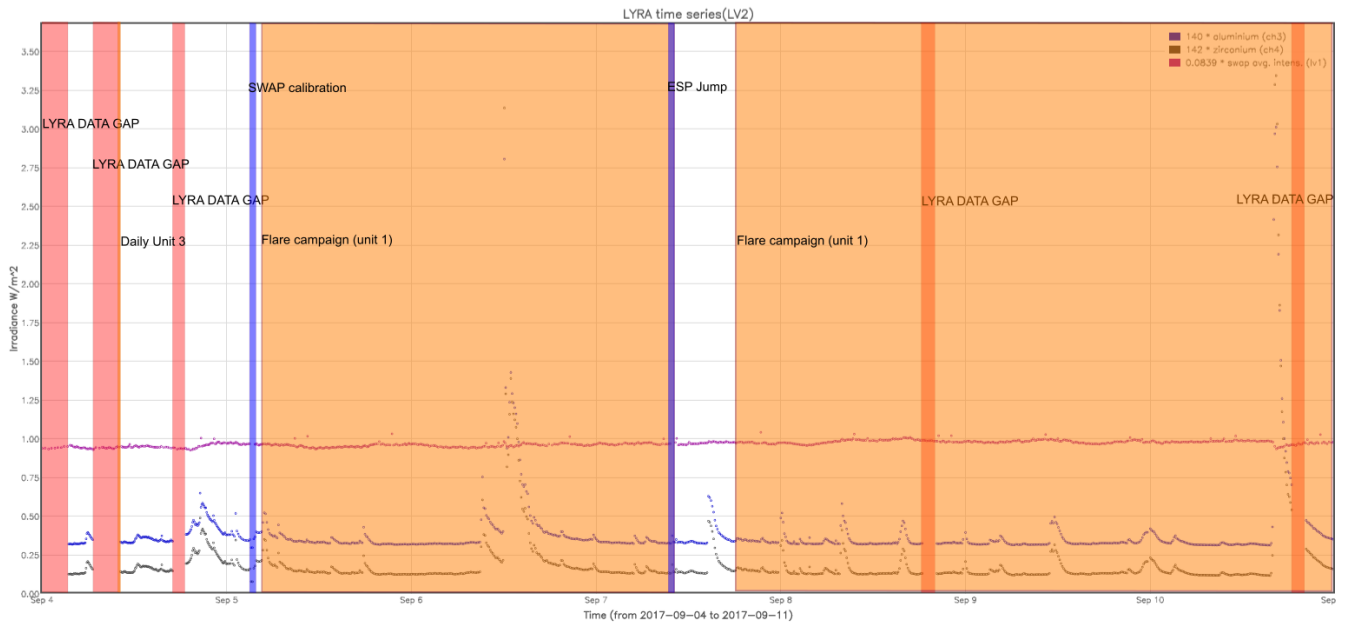
Find a movie of the event [here](#) (SWAP movie)



An overview of the weekly LYRA & SWAP data is provided below:

The following curves are visible:

- black: Zirconium Channel LYRA Unit 2
- blue: Aluminium Channel of LYRA Unit 2
- purple: SWAVINT (SWAP Average Intensity; integrated solar intensity per SWAP image pixel )



The blue shaded periods related to SWAP, correspond to, from left to right:

- Bi-weekly calibration, 2017-Aug-05
- ESP jump, 2017-Sep-07

The orange shaded periods related to LYRA correspond to, from left to right:

- Daily unit 3 campaign, 2017-Sep-04
- Flare campaign unit 1, 2017-Sep-05 until 2017-Sep-07
- Flare campaign unit 1, 2017-Sep-07 until 2017-Sep-10

The red shaded periods related to other issues corresponds to:

- LYRA data gaps on 2017-Sep-04
- LYRA data gap due to corrupted packet on 2017-Sep-08 and 2017-Sep-10 (appears dark orange in plot above)

## **Outreach, papers, presentations, etc.**

Please consult <http://proba2.oma.be/science/publications> for a list of interesting articles using SWAP & LYRA data, as well as a link to the complete article list.

The science section of this weekly report is also published in the weekly STCE newsletter (<http://www.stce.be/newsletter/newsletter.php>).

Several presentations related to PROBA2 were presented at the ESPM Meeting in Budapest, Hungary – September, 2017. These included:

Further Exploration Of Post-Flare Giant Arches by West M.

Multi-instrument observations of sub-minute quasi- periodic pulsations in solar flares by Dominique, M.

Lifecycle of a large-scale polar coronal pseudostreamer/cavity system by Guennou, C.

Studies of CME-driven shocks with UV and Visible Light coronagraphic observations by Bemporad, A.

There was 1 paper published in the last week, entitled: “Multi-instrument observations of the solar eclipse on 20 March 2015 and its effects on the ionosphere over Belgium and Europe” by Zender et al. In this paper the authors studied the solar irradiance variability and its association with the underlying magnetic field over the period January 2011–January 2016. They used observations from LYRA and SWAP on PROBA2, together with AIA and HMI observations from SDO. By using the Spatial Possibilistic Clustering Algorithm (SPoCA) with SWAP and AIA observations, and overlaying the reduced contours on HMI observations, the the authors were able to segregate coronal features by creating segmentation maps of active regions (ARs), coronal holes (CHs) and the quiet sun (QS), and see the corresponding underlying field, and photospheric magnetic counterparts. Using the segmented maps, the authors then compute full- disk and feature-wise averages of EUV intensity and line of sight (LOS) magnetic flux density over ARs/CHs/QS/FD. The variability in these quantities is compared with that of LYRA irradiance values. SWAP is used heavily throughout for the segmentation procedure, and LYRA is used for irradiance comparison. The authors found that the EUV intensity over the different coronal features are well correlated with the underlying magnetic field. In addition, variations in the full-disk integrated intensity and magnetic flux density values are correlated with the LYRA irradiance variations.

## **Guest Investigator Program**

- None

## 2. LYRA instrument status

### Calibration

None (due to Flare campaign).

### IOS & operations

| Monday<br>04 Sep               | Tuesday<br>05 Sep                       | Wednesday<br>06 Sep                     | Thursday<br>07 Sep                      | Friday<br>08 Sep                        | Saturday<br>09 Sep                      | Sunday<br>10 Sep                        |
|--------------------------------|---|---|---|---|---|---|
| Nominal acquisition + daily U3 | Nominal acquisition + Flare campaign U1 | Nominal acquisition + Flare campaign U1 | Nominal acquisition + Flare campaign U1 | Nominal acquisition + Flare campaign U1 | Nominal acquisition + Flare campaign U1 | Nominal acquisition + Flare campaign U1 |
| LYIOS00638                     | LYIOS00639                              | LYIOS00640                              | LYIOS00640 & LYIOS00643                 | LYIOS00643                              | LYIOS00644                              | LYIOS00645                              |

The following science campaigns were performed by LYRA:

- Daily unit 3 campaign, 2017-Sep-04
- Flare campaign unit 1, 2017-Sep-05 until 2017-Sep-07
- Flare campaign unit 1, 2017-Sep-07 until 2017-Sep-10

### LYRA detector temperature

LYRA detector 2 temperature globally varied between 45.01 and 50.87 °C.

### 3. SWAP instrument status

#### Calibration

Calibration campaign on Tuesday this week.

#### MCPM errors

The number of MCPM recoverable errors increased from 11663 and 11669.

The number of MCPM unrecoverable errors remained at 0.

#### IOS & operations

| Monday<br>04 Sep       | Tuesday<br>05 Sep                       | Wednesday<br>06 Sep    | Thursday<br>07 Sep                  | Friday<br>08 Sep       | Saturday<br>09 Sep     | Sunday<br>10 Sep       |
|------------------------|---|------------------------|-------------------------------------|------------------------|------------------------|------------------------|
| Nominal<br>acquisition | Nominal<br>acquisition +<br>calibration | Nominal<br>acquisition | Nominal<br>acquisition+<br>ESP jump | Nominal<br>acquisition | Nominal<br>acquisition | Nominal<br>acquisition |
| IOS00714<br>481 images | IOS00714<br>671 images                  | IOS00714<br>626 images | IOS00714<br>684 images              | IOS00714<br>689 images | IOS00714<br>705 images | IOS00714<br>673 images |

Special operations for SWAP, this week:

- Bi-weekly calibration, 2017-Aug-05
- ESP jump , 2017-Sep-07

#### SWAP detector temperature

The SWAP Cold Finger Temperature globally varied between -1.05 and 0.07 °C.

#### **4. PROBA2 Science Center Status**

The main operator is Laurence Wauters.

The following changes were made to the P2SC:

- None.

## 5. Data reception & discussions with MOC

### Passes

The delivery of the passes for this week (passes 25080 to 25145) was nominal, except for:

- 25080,25081,25084, recovered in 25087 pass

### Data coverage HK

All HK data files (LYRA\_AD) have been received, except:

- None.

### Data coverage SWAP

All SWAP Science data files (BINSWAP) have been received, except:

- 25080,25081,25084
- BINSWAP\_25087\_RED3\_2017.09.04T19.11.02.tar containing data from 30-Aug to 4-Sep 18:39 UT (pass 25080,25081,25084) has been successfully processed.

Total number of images between 2017 Sep 04 0UT and 2017 Sep 11 0UT: 4665

Highest cadence in this period: 30 seconds

Average cadence in this period: 129.64 seconds

Number of image gaps larger than 300 seconds: 176

Largest data gap: 33.67 minutes

### Data coverage LYRA

All LYRA Science data files (BINLYRA) have been received, except:

- 25080, 25081 resulting in a data gap from 2017-09-04 00:00 to 2017-09-04 03:28:46.
- 25084 resulting in a data gap from 2017-09-04 06:39:42 to 2017-09-04 10:09:33.
- BINLYRA\_25087\_RED3\_2017.09.04T19.11.02.tar went to failed due to not enough space for LYTMR to process it as it is very large: containing data from 30-Aug to 4-Sep 18:39 UT..
- Pass 25125 on 2017-Sep-08 received but is corrupted (size issue).
- Pass 25144 on 2017-Sep-10 received but is corrupted (size issue).

## 6. APPENDIX: Frequently used acronyms

|         |   |
|---------|---|
| 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                                   |
| DAC     | Data Acquisition Controller                               |
| DBR     | Deployment, backup & recovery                             |
| DDA     | Decommutated data archive                                 |
| ESP     | Experimental Solar Panel                                  |
| FITS    | Flexible Image Transport System                           |
| FOV     | Field Of View FPA Focal Plane Assembly                    |
| FPGA    | Field Programmable Gate Arrays                            |
| GPS     | Global Positioning System                                 |
| HK      | Housekeeping  |
| IOS     | Instrument Operations Sheet                               |
| LED     | Light Emitting Diode                                      |
| 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                                   |
| OBSW    | On board Software   |
| PI      | Principal Investigator                                    |
| P2SC    | PROBA2 Science Center                                     |
| ROB     | Royal Observatory of Belgium                              |
| SAA     | South Atlantic Anomaly                                    |
| SEU     | Single Event Upset  |
| SoFAST  | Solar Feature Automated Search Tool                       |
| SWAP    | Sun Watcher using APS detector and image Processing       |
| SWAVINT | SWAP AVerage INTensity                                    |
| 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   |
| TC      | Telecommand   |
| UTC     | Coordinated Universal Time                                |
| UV      | Ultraviolet   |
| VFC     | Voltage to Frequency Converter                            |

## **7. APPENDIX Solar Activity Definitions**

In the science section we use the following solar activity standards.

The standard scale for solar activity is:

- very low (almost no flares, only B)
- low (a few C flares)
- moderate (many C flares and at least an M flare)
- high (several M flares and an X flare)
- very high (continuous background of C flares, numerous M flares, more than one X flare)