

**INTEGRAL**  
**Mission Report**  
**INT-MOC-SYS-RP-1001-OPS-OAI**  
**No. 338**  
**Week 11**  
**16.03.09**  
**Routine Phase**

Prepared by: F.Schmidt (OPS-OAI) and INTEGRAL FCT

## LIST OF CONTENTS

|       |                                                              |    |
|-------|--------------------------------------------------------------|----|
| 1     | General.....                                                 | 3  |
| 2     | Summary of Activities.....                                   | 3  |
| 3     | Satellite Status.....                                        | 3  |
| 3.1   | Platform.....                                                | 3  |
| 3.1.1 | AOCS.....                                                    | 3  |
| 3.1.2 | Power.....                                                   | 4  |
| 3.1.3 | Thermal.....                                                 | 4  |
| 3.1.4 | OBDH.....                                                    | 4  |
| 3.1.5 | RFS.....                                                     | 4  |
| 3.2   | Payload.....                                                 | 4  |
| 3.2.1 | SPI.....                                                     | 4  |
| 3.2.2 | IBIS.....                                                    | 5  |
| 3.2.3 | JEM-X.....                                                   | 7  |
| 3.2.4 | OMC.....                                                     | 7  |
| 3.2.5 | IREM.....                                                    | 7  |
| 4     | Ground Facilities.....                                       | 8  |
| 4.1   | Mission Operations Centre.....                               | 8  |
| 4.2   | Ground Stations & Network.....                               | 8  |
| 4.3   | Science Ground Segment.....                                  | 8  |
| 4.3.1 | ISOC.....                                                    | 8  |
| 4.3.2 | ISDC.....                                                    | 9  |
| 5     | Special Events.....                                          | 9  |
| 6     | Anomalies.....                                               | 9  |
| 7     | Future Milestones.....                                       | 9  |
| 8     | Appendix.....                                                | 10 |
| 8.1   | Overview of Revolutions.....                                 | 10 |
| 8.2   | Consumables.....                                             | 10 |
| 8.2.1 | Detailed Fuel Book-keeping.....                              | 10 |
| 8.3   | Detailed Satellite Information.....                          | 11 |
| 8.3.1 | AOCS SUMMARY OPERATIONS REPORT, 07/03/2009 – 13/03/2009..... | 11 |
| 8.3.2 | SPI Operations.....                                          | 17 |
| 8.3.3 | IBIS Operations.....                                         | 23 |
| 8.3.4 | JEM-X Operations.....                                        | 27 |
| 8.3.5 | OMC Operations.....                                          | 30 |
| 8.3.6 | IREM Operations.....                                         | 31 |

## DISTRIBUTION LIST

| Addressees           | Copy | Addressees            | Copy |
|----------------------|------|-----------------------|------|
| D/OPS                |      | ESAC                  |      |
| G. Winters D/OPS     | 1    | P. Kretschmar         | 1    |
| J. F. Kaufeler OPS-G | 1    | V. Gomez SCI-O        | 1    |
| N. Bobrinsky OPS-ON  | 1    | E. Kuulkers           | 1    |
| A. Rudolf OPS-OA     | 1    | K. Engan              | 1    |
|                      |      |                       |      |
|                      |      | ESTEC/SCI-A           |      |
| M. Schmidt           | 1    | Nicola Rando          | 1    |
| R. Southworth        | 1    |                       |      |
| F. Di Marco          | 1    | ESA HQ                |      |
| F. Cordero           | 1    | D. Southwood D/SCI    | 1    |
| M. Walker            | 1    |                       |      |
| S. DePadova          | 1    | ESTEC                 |      |
| S. Fahmy             | 1    | J. Louet SCI-P        | 1    |
| F. Schmidt           | 1    |                       |      |
| M. Kirsch            | 1    | ESTEC / PG            |      |
| D. Webert            | 1    | G. Sarri              | 1    |
| M. Panteleoni        | 1    |                       |      |
| J. Martin            | 1    | ESTEC/RSSD            |      |
|                      |      | M. Kessler SCI-SD     | 1    |
| A. Mantineo          | 1    | C. Winkler            | 1    |
| K. Scott             | 1    | A. Parmar             | 1    |
|                      |      |                       |      |
|                      |      | ISDC                  |      |
| SPACONs              | 1    | R. Walter             | 1    |
| I. Bayliss           | 1    | ISDC Shift Team       | 1    |
| G. Di Girolamo       | 1    |                       |      |
| F. Dreger            | 1    | ALENIA                |      |
| G. Gienger           | 1    | M. Montagna           | 1    |
| S. Pallaschke        | 1    | F. Ravera             | 1    |
| W. Hell              | 1    |                       |      |
| K.J. Schulz          | 1    | PI / Instrument Teams |      |
| M.A. Larsen          | 1    | J. P. Roques – SPI    | 1    |
|                      |      | G. La Rosa – IBIS     | 1    |
| M. Butkovic          | 1    | P. Ubertini – IBIS    | 1    |
| D. Heinzer           | 1    | A. Bazzano - IBIS     | 1    |
| U. Feucht            | 1    | F. Lebrun - IBIS      | 1    |
| Shift – Coord        | 1    | S. Brandt – JEM X     | 1    |
| Scheduling Office    | 1    | E. De Miguel - OMC    | 1    |
| T. Beck              | 1    | W. Hajdas – IREM      | 1    |
| M. Rossmann          | 1    |                       |      |
| M. Unal              | 1    | JPL / Goldstone       |      |
| P. Maldari           | 1    | D. Holmes             | 1    |
|                      |      | J. Valencia           | 1    |
|                      |      | Jesse Velasco         | 1    |
| Redu                 |      | Julia Bell            | 1    |
| B. Demellenne        | 1    | DSN - MPSETD          | 1    |
|                      |      |                       |      |
|                      |      |                       |      |

## 1 General

The Flight Control Team at MOC has compiled this report with some input provided by the Flight Dynamics Team, ISOC and ISDC.

It addresses the activities from 07.03.09 until 13.03.09 (both dates inclusive) and covers the revolutions 781, 782 and 783.

## 2 Summary of Activities

The operations were performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

The targets of these revolutions consisted of a raster dither of the Galactic Centre (RA 17:45:40.03, DEC -29:00:28.1), a raster dither of the Galactic disk,  $l=-25$  (RA 16:27:14.74, DEC -48:57:19.9), a raster dither of the Galactic disk,  $l=+25$  (RA 18:36:53.70, DEC -07:03:19.4) and a raster dither of Eta Carinae (RA 10:45:03.59, DEC -59:41:04.3).

*Note: Some further information concerning the activities is provided in the Appendix.*

## 3 Satellite Status

### 3.1 Platform

The performance of the platform was good. No new unexpected behaviour / malfunction was identified.

#### 3.1.1 AOCS

The AOCS operations were performed from the timeline during this period.

As part of the AOCS preparation for the summer eclipse season, the onboard AMD thresholds were set to their eclipse values at the beginning of rev 782. In the same time frame were verified the AMD dead band value, the IMU timers, the load of the TT sequence to re-enable the IMU Auto Switch-Off function in the ACC and the Eclipse ACC\FDE\FCE timers.

The summer 2009 first eclipse operations were nominal from the AOCS point of view.

Six slews were missed from TL, during the observation period, due to loss of guide star and problem on DSS27 station.

The fuel consumption over the period between 07/03/2009 and 13/03/2009 was 0.1639 Kg. The remaining propellant is in the order of 135.4418 Kg.

*Note: Some more information concerning the AOCS operations and the fuel budget is provided in the Appendix.*

### **3.1.2 Power**

All the other units of EPS are working nominally; available power from the arrays is of the order of 2100W.

### **3.1.3 Thermal**

The thermal control of the satellite is working well. The temperatures are currently all within the specified operational limits.

### **3.1.4 OBDH**

The OBDH subsystem is working flawlessly. No on-board communications problem has been identified.

The PST was over-subscribed by 3 packets, which were allocated to SPI during the Instrument window for the entire reporting period.

### **3.1.5 RFS**

The RF subsystem is working properly. The link margin is sufficient to ensure proper TM reception and execution of commands with the ranging channel enabled.

## **3.2 Payload**

### **3.2.1 SPI**

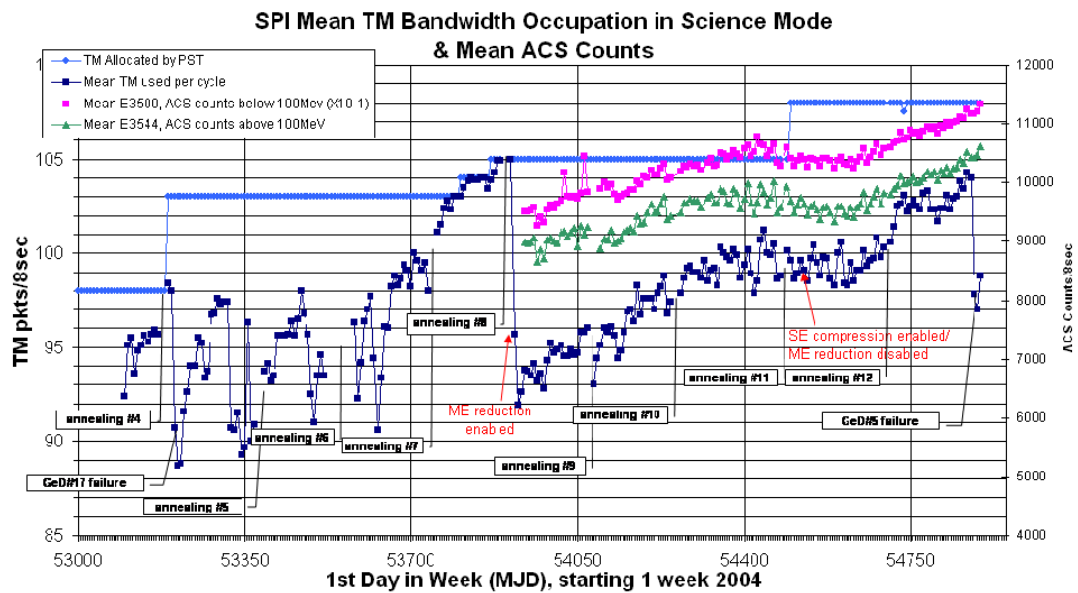
Following the 12th annealing, ended on 04/09/2008 at 23:50Z, the overall status of the gamma-ray spectrometer is nominal, except for detector #2 (failed since 06/12/2003); detector #17 (failed since 17/07/2004) and detector #5 (failed since 19/02/2009). The energy resolution of the previously degraded GeD#12 has improved following this annealing and the bias of this detector is now set to 4kV as for the other detectors.

The Stirling compressors are working nominally. The Germanium detectors temperature was kept in the range 80K $\pm$ 1K throughout the week.

During science operations, the instrument was kept in photon-by-photon mode with spectra TM enabled. The assigned TM bandwidth in the science observation windows was 108 packets/cycle and the average telemetry occupation was 98.8 packets/cycle.

The first eclipse of the 13th eclipse season occurred on 2009-03-12. Eclipse operations for SPI were performed nominally.

The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth along with the mean ACS count rate evolution (since July 2006). As can be seen, there is a strong correlation between the evolution of the background as measured by the ACS and the overall TM bandwidth usage.



*Note: Some more information concerning the SPI operations is provided in the Appendix 8.3.2.*

### 3.2.2 IBIS

The overall status of the unit is nominal.

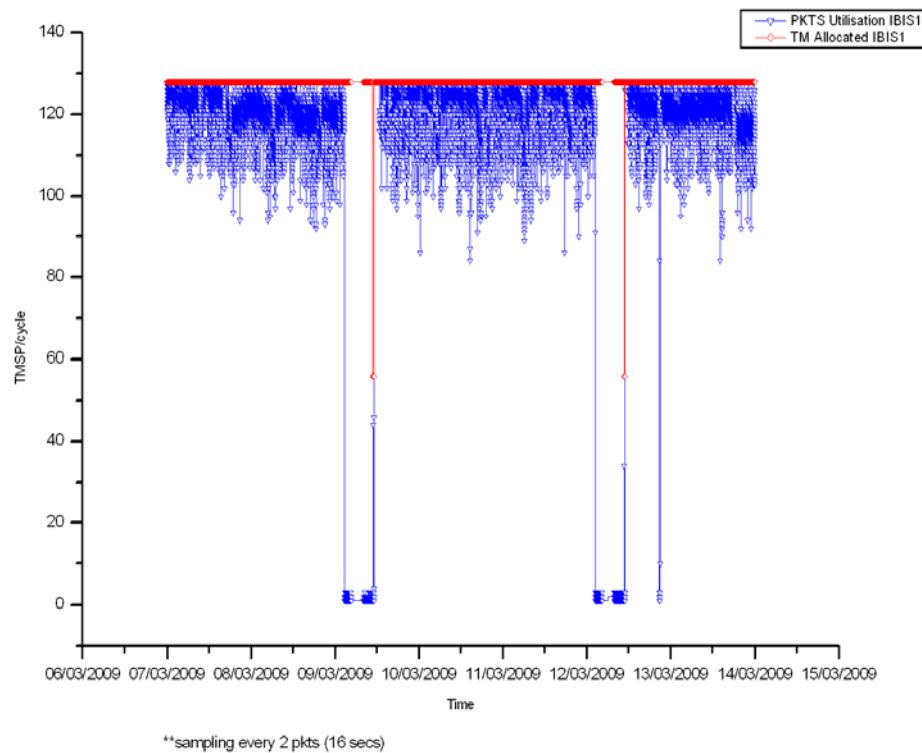
The first eclipse of the 13th eclipse season occurred on 2009-03-12. Eclipse operations for IBIS were performed nominally.

During the reporting period, the TM bandwidth statistics were as follows:

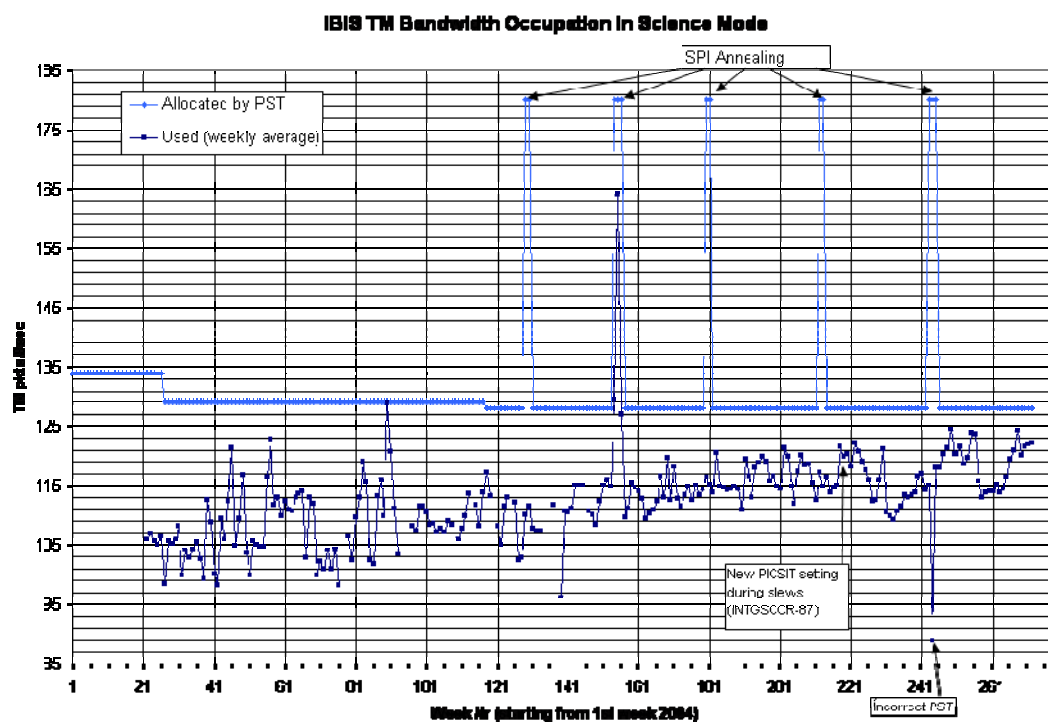
- PST allocation to IBIS above radiation belts: 128 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 122.15 packets/cycle (up 0.17 on previous week)
- Percentage of TM cycles in which full bandwidth (128 packets/cycle) was used: 25.47%

The plot below shows the IBIS TM utilisation during the reporting period.

IBIS - TM Bandwidth Utilisation Rev 781-783



A plot of the IBIS weekly bandwidth utilisation since 2004 is shown below:



Note: Some more information concerning the IBIS operations is provided in the Appendix.

### **3.2.3 JEM-X**

The status of both JEM-X units is nominal.

JEM-X operations were performed by the automatic Timeline.

JEM-X1 was operated in Data Taking mode with a TM allocation of 8 packets/cycle. JEM-X2 was dormant (DPE OFF) with no TM slots allocated.

*Note: Some more information concerning the JEM-X operations is provided in the Appendix Section 8.3.4.*

### **3.2.4 OMC**

The status of OMC is nominal.

OMC operations were performed by the automatic Timeline. OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets per cycle.

During this reporting period, 190 of the 192 planned science pointings were executed nominally, 2 were lost.

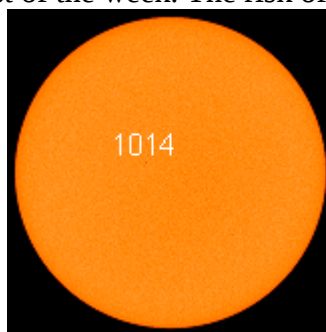
*Note: Some more information concerning the OMC operations is provided in the Appendix.*

### **3.2.5 IREM**

The overall status of the unit is nominal.

#### **Solar Activity**

The observation period was characterised by low solar activity. The Week began (7<sup>th</sup> March) with sun-spot #1014 visible, by the following day, it had disappeared, and the sun remained blank for the rest of the week. The risk of solar flares was very low.



*Reference: [www.spaceweather.com](http://www.spaceweather.com)*

*Note: Some more information concerning the IREM operations is provided in the Appendix Section 8.3.6.*

## **4 Ground Facilities**

The Operational ground facilities performance was good this week. Six pointings were lost due to ground problems. The overall performance was over the 95% requirement.

### **4.1 Mission Operations Centre**

The performance of the MOC was good this week. 6 slews were missed from the Timeline, due to loss of guide star and problem on DSS27 station. The OTF was not reached on 1 occasion. Due to two extended objects present in the FOV of the STR (M8 and M20 Nebulae) the OTF was also not reached on another occasion.

### **4.2 Ground Stations & Network**

The performance of the ground stations and Network was good this week. On DoY 066 at 17:09Z missing frames were received from Redu. On DoY 070 at 06:31Z a drop in TM from Goldstone occurred, which caused the loss of a slew manoeuvre. On DoY 072 at 19:12Z the Spacon was not able to command from VIL2, due to the fact that the carrier was still up at Redu G/S.

### **4.3 Science Ground Segment**

#### **4.3.1 ISOC**

##### **1. Mission planning**

New PSFs have been received for revolutions 787 to 789.  
No new observations have been planned.

New TSFs have been received for revolutions 784 and 785.

##### **2. Observation status**

A new ECS file has been received for revolution 773, the file for 772 is missing.

##### **3. ISOC Science Data Archive**

The new INGEST software has been successfully installed and data has been ingested up to revolution 759. All information related to the 3rd ISGRI catalogue data has been provided to the SAT. Archive documentation has been updated.

##### **4. ISOC system**

Work is continuing on V22 (post TAC s/w).

##### **5. Problems**

No new problems.

#### **4.3.2 ISDC**

Status of ISDC observation processing on 13/03/2009:

- Latest Standard Analysis completed: observation 06200620004 (1E 1547.0-5408, Revolution 0768) on 08/03/2009.
- Latest products archived: observation 06200620004 (1E 1547.0-5408, Revolution 0768) on 09/03/2009.
- Latest observation products sent to the observer: observation 06200620004 (1E 1547.0-5408, Revolution 0768) on 09/03/2009.

### **5 Special Events**

- Eclipse Season starts 12/3/2009

### **6 Anomalies**

No anomaly reports were entered into the ARTS system this week.

### **7 Future Milestones**

## 8 Appendix

The appendix includes various detailed information.

### 8.1 Overview of Revolutions

#### Revolution 781

The observations in revolution 781 began with a raster dither of the Galactic Centre (RA 17:45:40.03, DEC -29:00:28.1), lasting ~28.0 hours. They continued with a raster dither of Eta Carinae (RA 10:45:03.59, DEC -59:41:04.3), lasting ~29.6 hours, until the end of the revolution.

#### Revolution 782

The observations in revolution 782 began with a hexagonal dither of the Galactic bulge region (RA 17:45:36.00, DEC -28:56:00.0), lasting ~3.5 hours. This was followed by a raster dither of the Galactic disk,  $l=-25$  (RA 16:27:14.74, DEC -48:57:19.9), lasting ~12.5 hours. They continued with a raster dither of the Galactic disk,  $l=+25$  (RA 18:36:53.70, DEC -07:03:19.4), lasting ~12.5 hours. This was followed by another raster dither of the Galactic disk,  $l=-25$  (RA 16:27:14.74, DEC -48:57:19.9), lasting ~12.5 hours. They continued with a raster dither of the Galactic disk,  $l=+25$  (RA 18:36:53.70, DEC -07:03:19.4), lasting ~12.5 hours, until the end of the revolution.

#### Revolution 783

The observations in revolution 783 began with a raster dither of the Galactic Centre (RA 17:45:40.03, DEC -29:00:28.1), lasting ~30.0 hours. They continued with a raster dither of Eta Carinae (RA 10:45:03.59, DEC -59:41:04.3), lasting ~27.8 hours, until the end of the revolution.

Throughout these observations all instruments were in their nominal science modes, except JEM-X2, which is switched off. The TM allocation was IBIS 128; SPI 108; JEM-X1 8; JEM-X2 0; OMC 5.

### 8.2 Consumables

#### 8.2.1 Detailed Fuel Book-keeping

|                          |          |   |                          |
|--------------------------|----------|---|--------------------------|
| 2009-02-28T09:24:00.000Z | 135.6680 | F | Automatic TM processing. |
| 2009-03-01T18:59:48.000Z | 135.6480 | F | Automatic TM processing. |
| 2009-03-03T09:08:57.000Z | 135.6327 | F | Automatic TM processing. |
| 2009-03-04T19:14:13.000Z | 135.6148 | F | Automatic TM processing. |
| 2009-03-06T08:59:37.000Z | 135.6057 | F | Automatic TM processing. |
| 2009-03-07T16:32:52.000Z | 135.5720 | F | Automatic TM processing. |
| 2009-03-09T09:03:29.000Z | 135.5378 | F | Automatic TM processing. |
| 2009-03-10T04:46:35.000Z | 135.4780 | F | Automatic TM processing. |
| 2009-03-12T09:19:21.000Z | 135.4705 | F | Automatic TM processing. |

This report was generated Fri Mar 13 08:00:18 GMT 2009

### 8.3 Detailed Satellite Information

This section contains some detailed information concerning the various subsystems of the satellite and instruments.

#### 8.3.1 AOCS SUMMARY OPERATIONS REPORT, 07/03/2009 – 13/03/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 138 Open Loop Slews, 66 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

6 slew (5 OSL, 1 CSL ) were missed from TL, during the observation period, due to loss of guide star and problem on DSS27 station.

This is equivalent to  $\sim 2.9\%$  of the total number of slews planned (207).

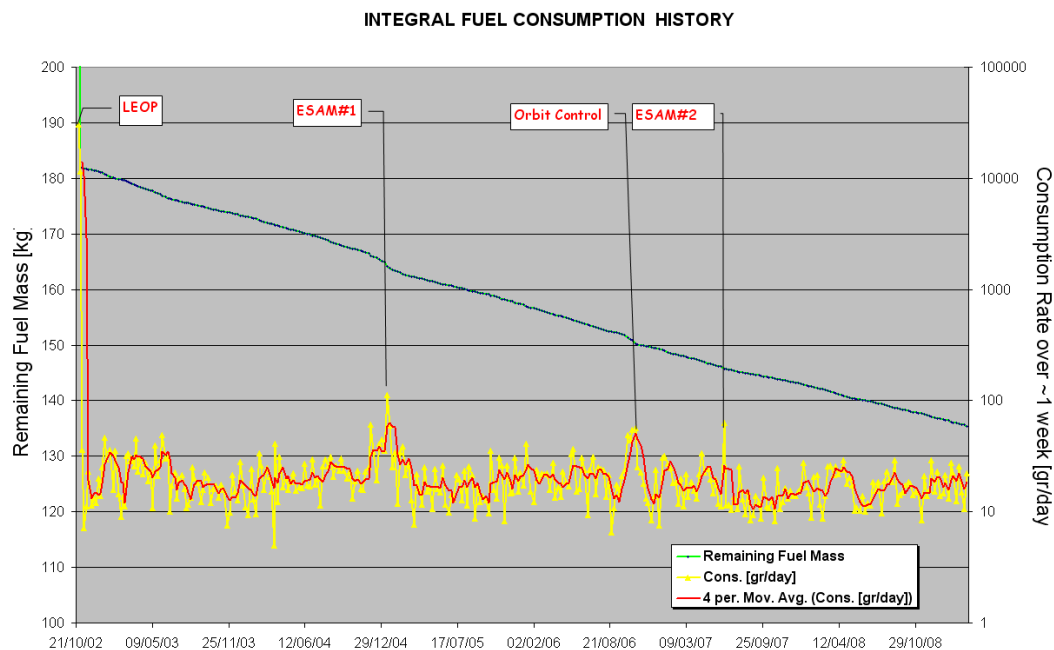
The OTF was not reached during part of PIDs 07810024 - 07830012, due to loss of guide star.

#### Orbit Control

No update.

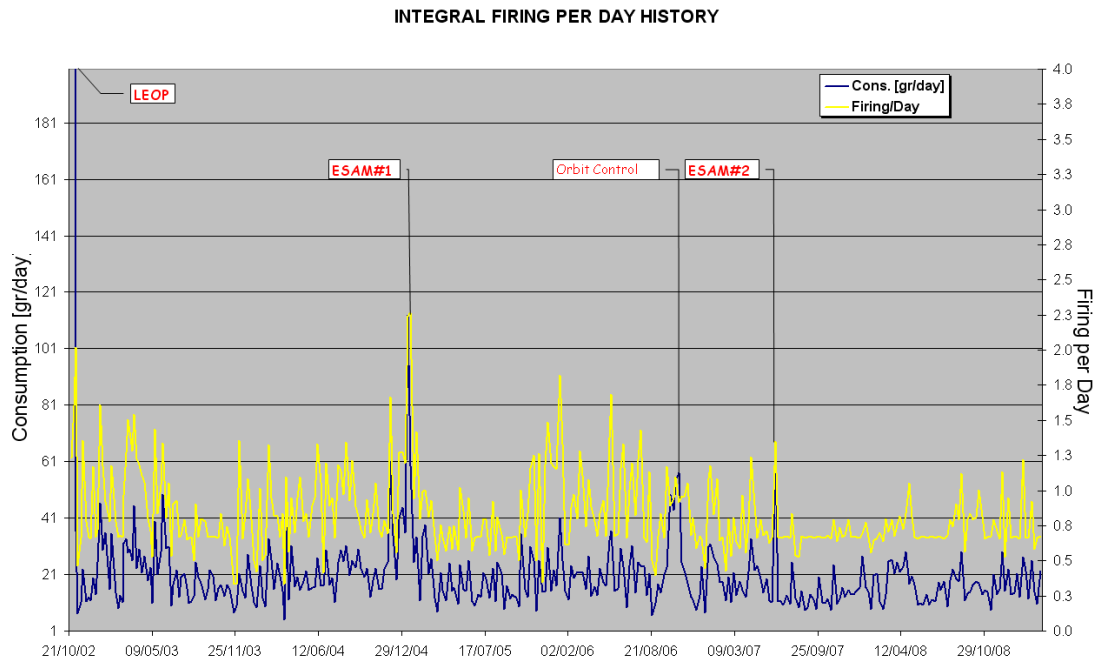
#### Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 13/03/2009 is reported in the plot below.



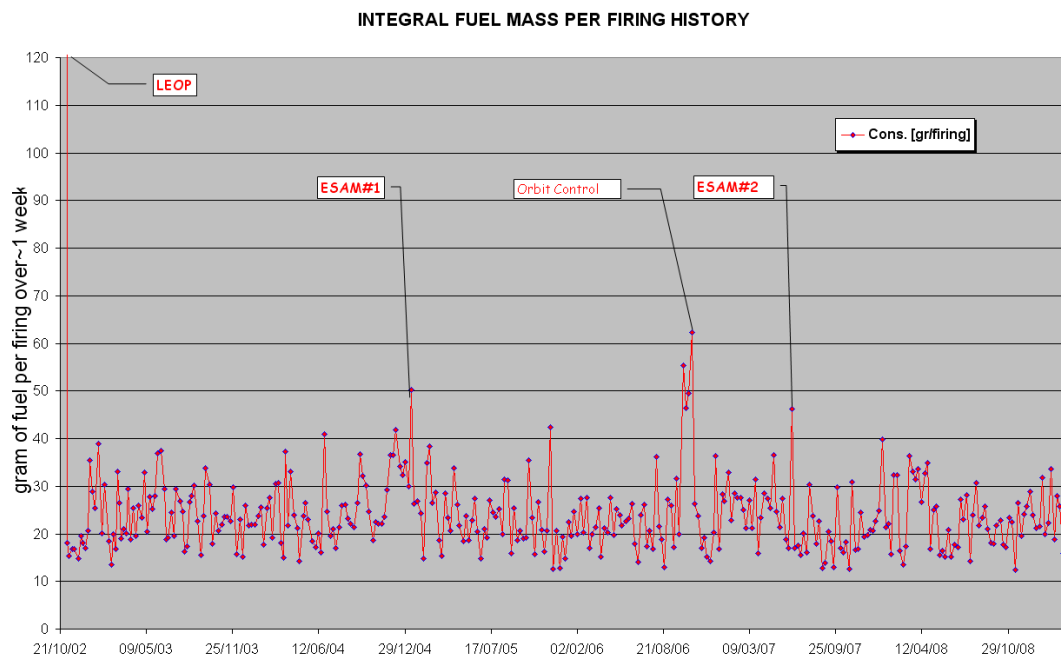
The above plot considers the ESAM fuel consumption spread over period of  $\sim 1$  week.

The firing per day over the period between 01/11/2002 and 13/03/2009 is reported in the plot below.



The above plot considers the ESAM fuel consumption spread over period of ~1 week.

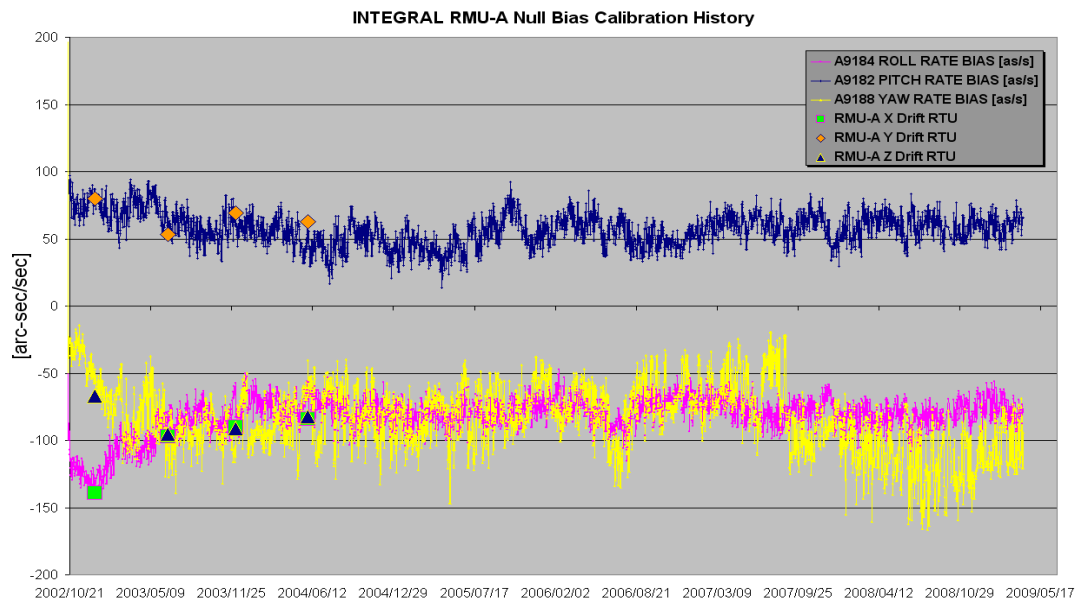
The fuel per firing over the period between 01/11/2002 and 13/03/2009 is shown in the plot below.



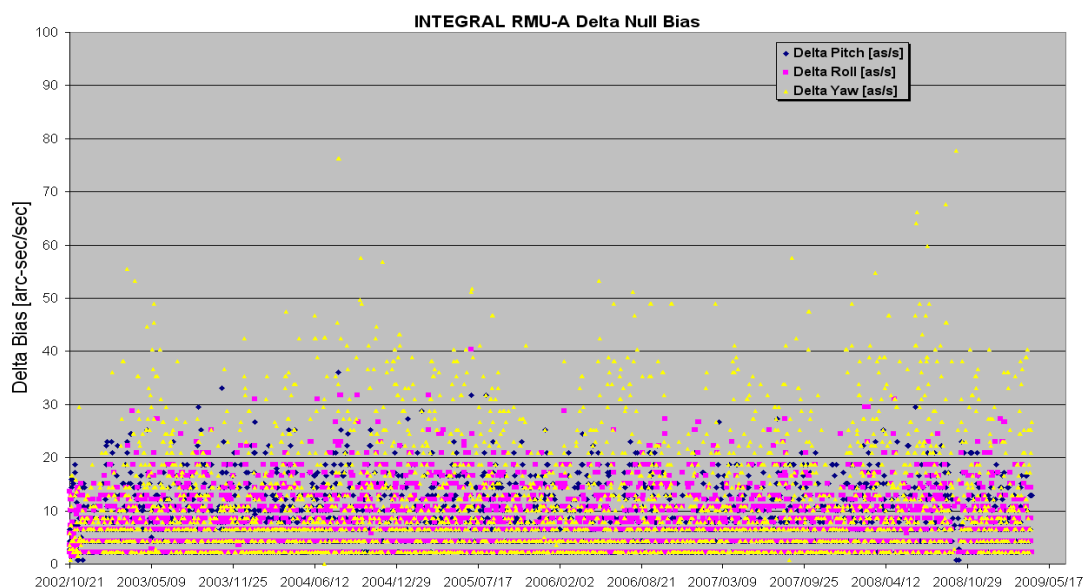
### The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 13/03/2009 is reported in the plot below.

The evolution of the drift on yaw channel is under constant monitoring but the values are still well within the specs. At moment the current constraints (for drift update generation) on the FDS have been relaxed to cope with the current situation.



The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over period between 01/11/2002 and 13/03/2009 is reported in the plot below.



**07/03/2009 (Day of Year 066, Revolution 781)**

**Loss of guide star:** at 10:20:00z a loss of the selected guide star occurred during PID 07810024. The origin of the event is likely due to false event affecting the STR.

Doc. Title : INTEGRAL Mission Report #338  
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OAI  
Date : 16/03/09

Issue : 1  
Rev. : 0  
Page : 14

As foreseen by the IPS logic, the ACC did switch ON the IMU 1, a new automatic mapping was commanded and a new guide star picked.

The AOCS s/s was disabled in TL at 10:21z.

A manual recovery was started from attitude of PID 07810024 to the attitude of PID 07810026 (including corrective Close Loop Slew).

The next slew 07810027 was manually updated in TL.

The AOCS s/s was enabled in TL at 11:11z.

The following slews were missed in TL: PID 07810025 (OSL) - 07810026 (OSL)

The OTF was not reached during part of PID 07810024.

#### **08/03/2009 (Day of Year 067, Revolution 781)**

Nothing to report.

#### **09/03/2009 (Day of Year 068, Revolution 781-782)**

Nothing to report.

#### **10/03/2009 (Day of Year 069, Revolution 782)**

Nothing to report.

#### **11/03/2009 (Day of Year 070, Revolution 782)**

**Problem at DSS 27 station:** at 06:31z a problem on TM links at DSS27 station caused the slew ID 07820079 to fail release.

After the TM link back a manual recovery was performed from the attitude of PID 07820078 to the attitude of PID 07820081. The next slew ID 07820082 was manually updated in TL.

The AOCS s/s was enabled in TL at 07:50z.

The following slews were missed in TL: PID 07820078 (OSL) -79 (OSL) – 80 (CSL) – 81 (OSL)

#### **12/03/2009 (Day of Year 071, Revolution 782-783)**

The Summer 2009 eclipse operations were nominal from the AOCS point of view. Hereafter is reported a summary of the eclipse passage during rev 782-783:

Doc. Title : INTEGRAL Mission Report #338  
 Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OAI  
 Date : 16/03/09

Issue : 1  
 Rev. : 0  
 Page : 15

|                            |                  |                                |                           |                                |                        |                             |                  |
|----------------------------|------------------|--------------------------------|---------------------------|--------------------------------|------------------------|-----------------------------|------------------|
|                            |                  | <b>AOCS ECLIPSE MONITORING</b> |                           |                                |                        | Revolution:                 | 782              |
|                            |                  | Summer 2009                    |                           |                                |                        | Date:                       | 12/03/2009       |
|                            |                  |                                |                           |                                |                        | DoY:                        | 71               |
| <b>INPUT</b>               |                  | Penumbra Start:                | 12/03/2009 04:25:38       | LOS:                           | 12/03/2009 04:28       |                             |                  |
| Penumbra Start             | 12/03/2009 04:26 | Umbra Start:                   | 12/03/2009 04:28:45       | AOS:                           | 12/03/2009 07:55       |                             |                  |
| Penumbra End               | 12/03/2009 04:49 | Umbra End:                     | 12/03/2009 04:47:07       |                                |                        |                             |                  |
| Umbra Start                | 12/03/2009 04:28 | Penumbra End:                  | 12/03/2009 04:49:48       |                                |                        |                             |                  |
| Umbra End                  | 12/03/2009 04:47 |                                |                           |                                |                        |                             |                  |
|                            |                  | Eclipse Duration:              | 0:24:10                   |                                |                        |                             |                  |
| ACC Sample Time:           | 11/03/2009 14:17 | Eclipse Duration [sec]:        | 1450                      |                                |                        |                             |                  |
| FDE Sample Time:           | 11/03/2009 14:17 |                                |                           |                                |                        |                             |                  |
| FCE Sample Time:           | 11/03/2009 14:17 | IMU Health Check Start         | 12/03/2009 01:12          |                                |                        |                             |                  |
|                            |                  | Eclipse Imminent Flag          | 12/03/2009 03:25:58       |                                |                        |                             |                  |
| ACC Eclipse Counter:       | 192426           | ACC IMU AutoCal Start          | 12/03/2009 03:40:24       |                                |                        |                             |                  |
| ACC Eclipse Start:         | 242271           | ACC IMU AutoCal End            | 12/03/2009 04:00:24       |                                |                        |                             |                  |
| ACC Eclipse End:           | 245363           |                                |                           |                                |                        |                             |                  |
|                            |                  | Sun out of FSS FoV             | 12/03/2009 04:27          |                                |                        |                             |                  |
| FDE Eclipse Start:         | 242690           | Sun back in FSS FoV            | 12/03/2009 04:47          |                                |                        |                             |                  |
| FDE Left to Eclipse Start: | 50498            |                                |                           |                                |                        |                             |                  |
| FDE Eclipse Duration:      | 2212             |                                |                           |                                |                        |                             |                  |
|                            |                  | <b>Eclipse Timers</b>          | <b>From Loaded Timers</b> | <b>Actual From Telemetry</b>   |                        | <b>UM [sec]</b>             | <b>LSB [sec]</b> |
|                            |                  |                                | <b>Absolute</b>           | <b>WRT Pen. Start [sec]</b>    | <b>Absolute</b>        | <b>WRT Pen. Start [sec]</b> |                  |
| FCE Eclipse Start:         | 242734           | ACC Eclipse Start              | 12/03/2009 04:07:58       | -1060.00                       | 12/03/2009 04:07       | -1062.00                    | -1064            |
| FCE Left to Eclipse Start: | 50542            | FDE Eclipse Start              | 12/03/2009 04:18:51       | -407.00                        |                        |                             | 404 176          |
| FCE Eclipse Duration:      | 2168             | FCE Eclipse Start              | 12/03/2009 04:19:35       | -363.00                        |                        |                             | 360 176          |
|                            |                  |                                |                           |                                |                        |                             |                  |
|                            |                  |                                | <b>From Loaded Timers</b> | <b>Actual From Telemetry</b>   |                        | <b>UM [sec]</b>             | <b>LSB [sec]</b> |
|                            |                  |                                | <b>Absolute</b>           | <b>WRT Pen. End [sec]</b>      | <b>Absolute</b>        | <b>WRT Pen. End [sec]</b>   |                  |
|                            |                  | FCE Eclipse End                | 12/03/2009 04:55:43       | 355                            |                        |                             | 360 176          |
|                            |                  | FDE Eclipse End                | 12/03/2009 04:55:43       | 355                            |                        |                             | 360 176          |
|                            |                  | ACC Eclipse End                | 12/03/2009 04:59:30       | 582                            | 12/03/2009 04:59       | 580.00                      | 578              |
|                            |                  |                                |                           |                                |                        |                             |                  |
|                            |                  | IMU                            | Uplink                    | Execution                      | WRT Penumbra End [sec] |                             |                  |
|                            |                  | IMU Auto Off Enable            | 09/03/2009 08:43:47       | 12/03/2009 05:01:32            | 704                    |                             |                  |
|                            |                  |                                |                           |                                |                        |                             |                  |
|                            |                  | IMU On                         | 12/03/2009 01:15          | IMU H/C Noise Roll [as/s]      | 0.2265                 |                             |                  |
|                            |                  | IMU Off                        | 12/03/2009 05:01          | IMU H/C Drift Roll [as/s]      | 0.1661                 |                             |                  |
|                            |                  | IMU On Time                    | 3:45:56                   | IMU Auto Cal Drift Roll [as/s] | 0.2211                 |                             |                  |

**STR 1750 fault:** at 21:02:16z the IMU 1 went ON at the end of OSL 07830012, likely caused by two extended objects present in the FOV of the STR (M8 and M20 Nebulae). A manual recovery was attempted several times by commanding a mapping: the mappings resulted shortened in duration and the IMU1 went ON.

The AOCS was disabled in TL at 21:06z.

The anomalous condition above was identified as STR 1750 fault.

STR was not able to establish stable pointing due to extended celestial objects in FoV, as consequence of STR 1750 fault several OOLs were reported from the STR:

|       |                    |            |                       |
|-------|--------------------|------------|-----------------------|
| A5104 | 'CCD TEMP FLAG'    | status-OOL | (value= OUT OF RANGE) |
| A5103 | 'OPTICS TEMP FLAG' | status-OOL | (value= OUT OF RANGE) |
| A5101 | 'COOLER V FLAG'    | status-OOL | (value= OUT OF RANGE) |
| A5100 | 'P/S -12V FLAG'    | status-OOL | (value= OUT OF RANGE) |
| A5099 | 'P/S +12V FLAG'    | status-OOL | (value= OUT OF RANGE) |
| A5098 | 'P/S +5V FLAG'     | status-OOL | (value= OUT OF RANGE) |
| A5097 | 'H/C 2 FLAG'       | status-OOL | (value= INVALID)      |
| A5091 | '1750 FAULT'       | status-OOL | (value= FAULT)        |
| A5089 | 'H/C 1 FLAG'       | status-OOL | (value= INVALID)      |

A manual recovery was performed by assuming the Spacecraft in target for PID 07830012 (with small error) and updating the next slew by using the attitude reconstruction from the last valid mapping.

From offline investigation resulted that two extended objects were present in the STR FOV at the moment of the IMU 1 ON event occurred (at the end of the OSL ID 7830012). One of those was the Nebula M8 about at the centre of STR FOV. This likely caused the STR 1750 failure.

No slew was lost in TL.

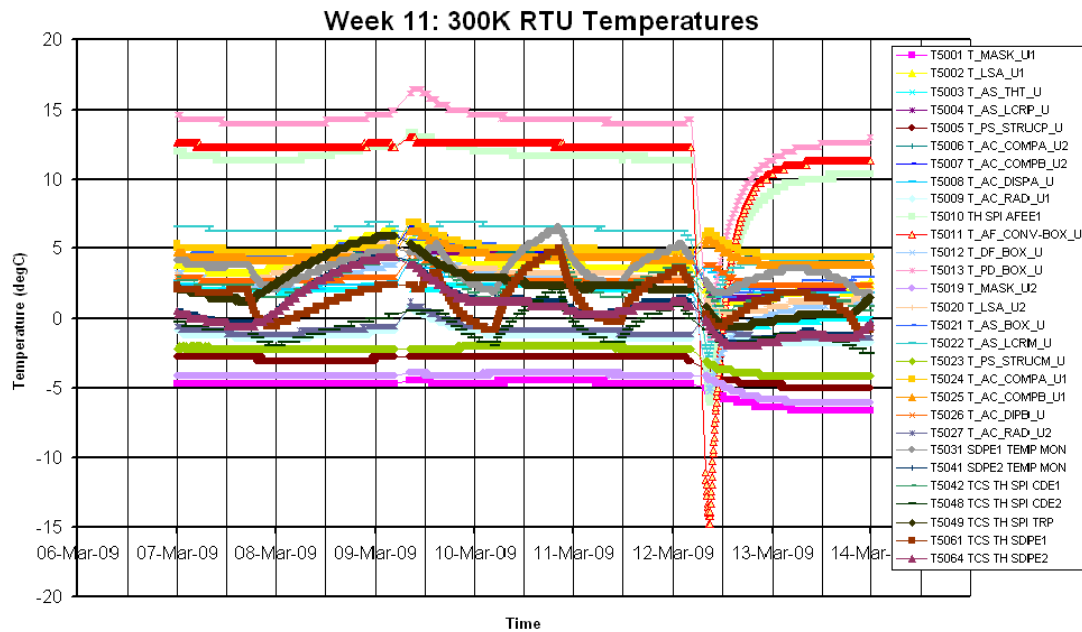
The OTF was not reached during part of PID 07830012.

**13/03/2009 (Day of Year 072, Revolution 783)**

Nothing to report.

### 8.3.2 SPI Operations

**Unit Temperatures:** All the equipment temperatures are inside the operational limits. The following plot shows their evolution during the reporting period.



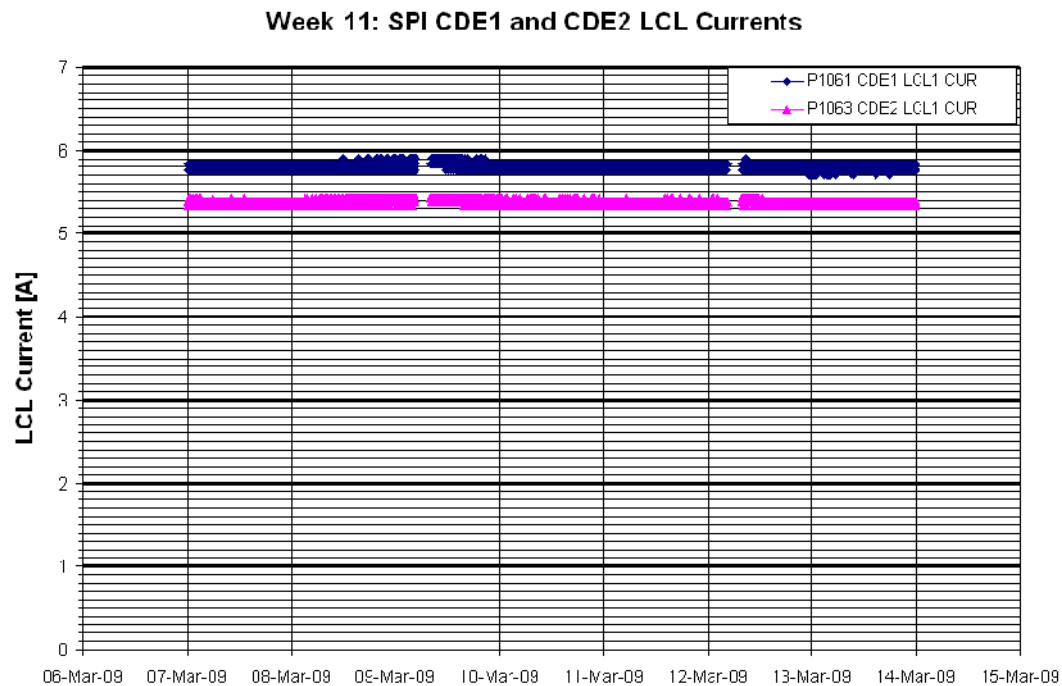
**Stirling Compressors and Cryostat:** The performance of the compressors is nominal.

The cold plate temperature was maintained in the range 80K +/-1K.

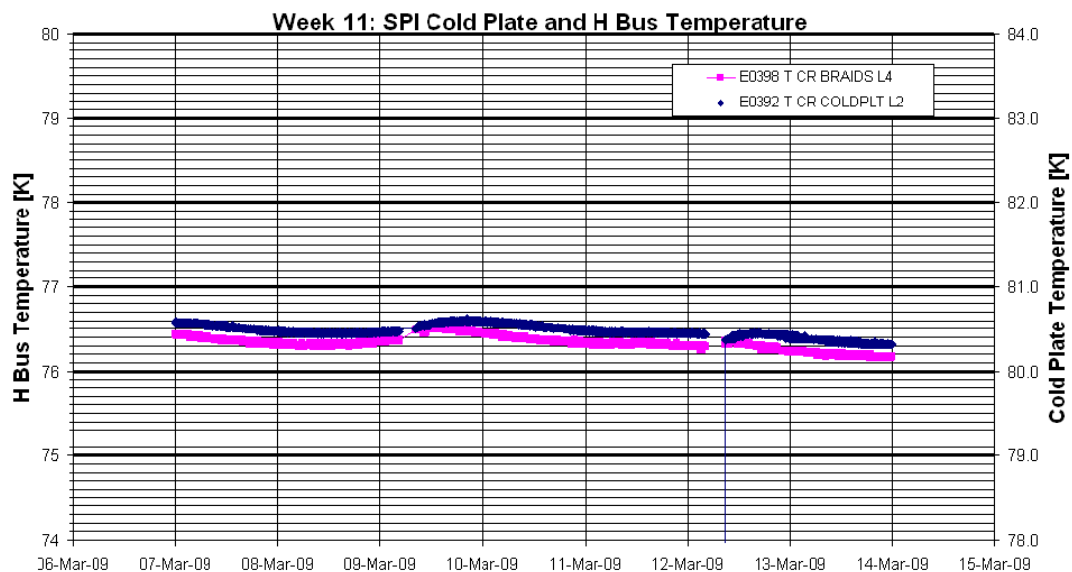
The stroke of all four compressors was set to 43 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 5.81A
- CDE2 LCL Current = 5.37A

The following plot shows the evolution of the CDE LCL currents during the reporting period.



The following plot shows the evolution of the cold plate and H bus temperatures during the reporting period.



**DPE & IASW:** The DPE health and IASW performance are nominal.

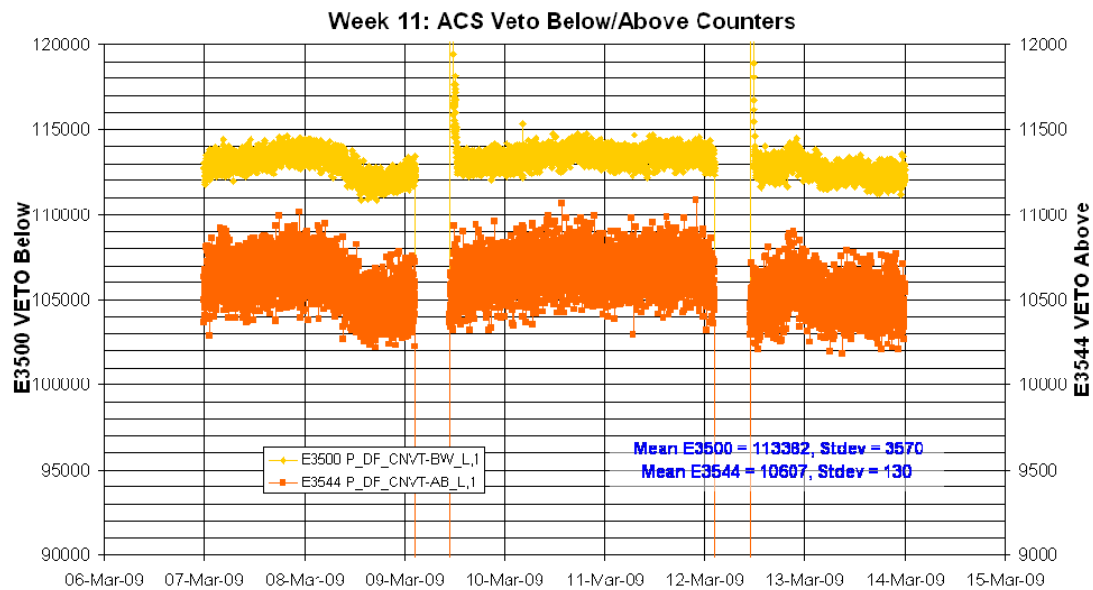
The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The average TM bandwidth occupation of SPI was 98.8 packets/cycle over the science window when the TM allocation was 108 packets/cycle.

The following plot shows the IASW performance in terms of TM bandwidth occupation and DPE CPU load during the reporting period.

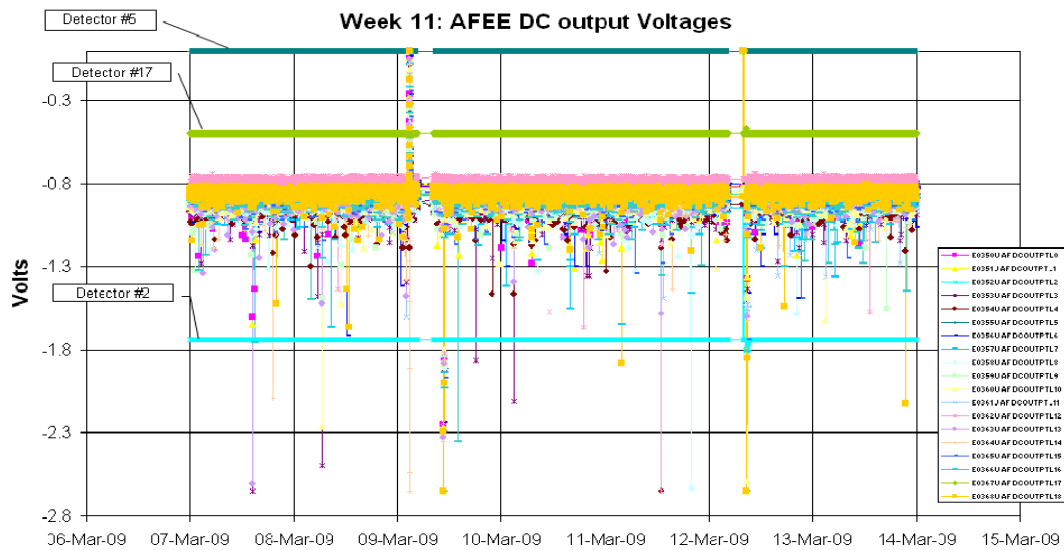


**ACS:** The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT\_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT\_SC-61).

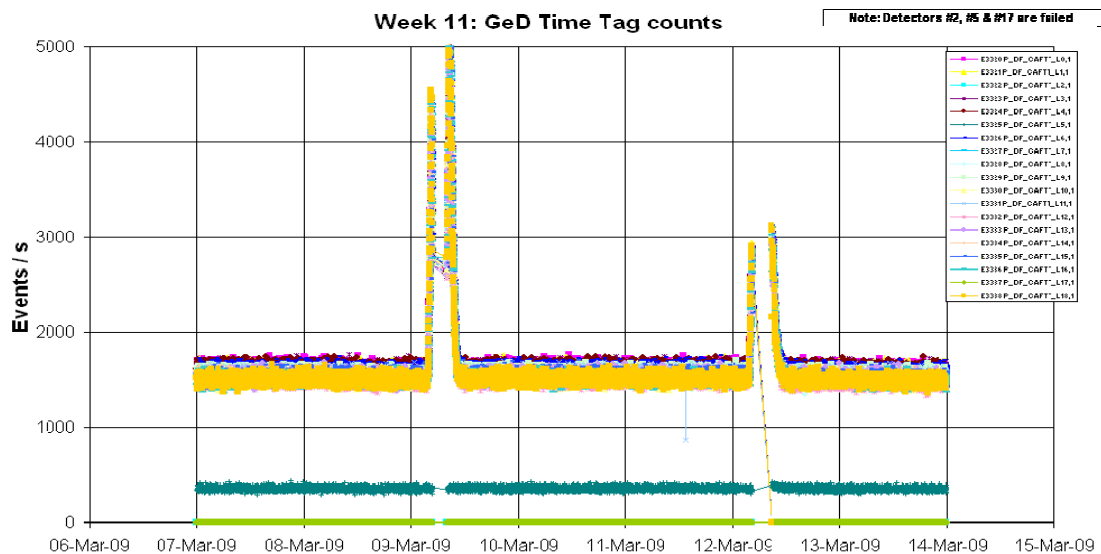
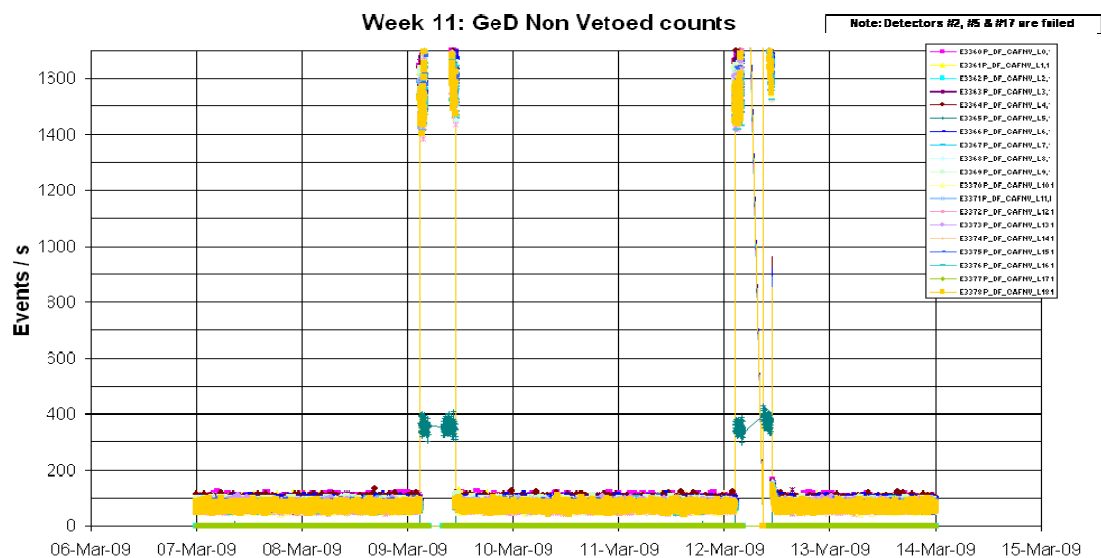
The following plot shows the ACS overall count rate evolution during the reporting period:

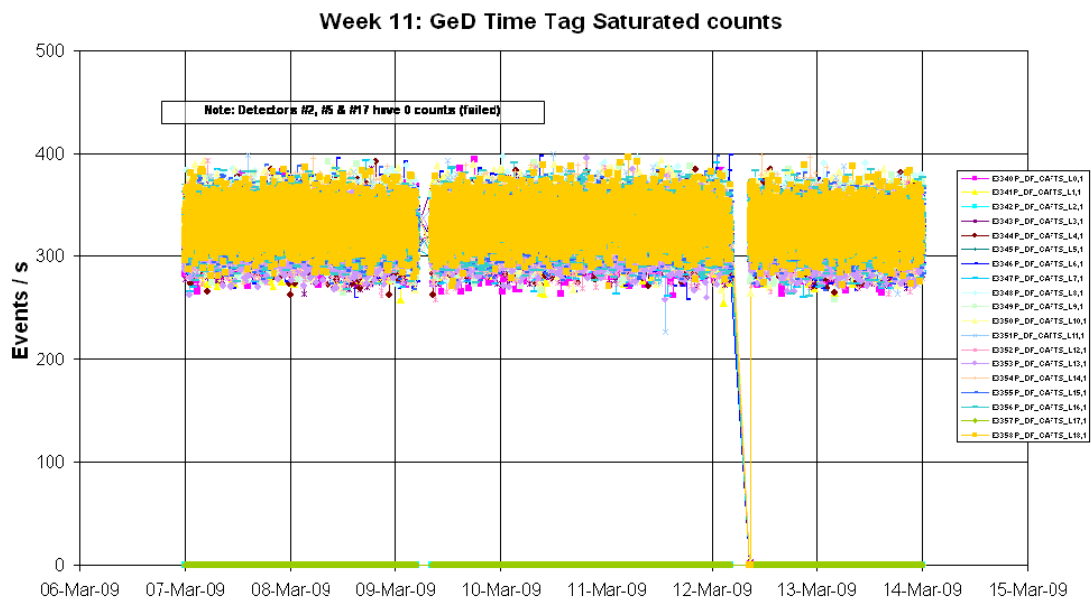


**AFEE:** The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009 (the HV of the failed detectors are set to 0.5kV).

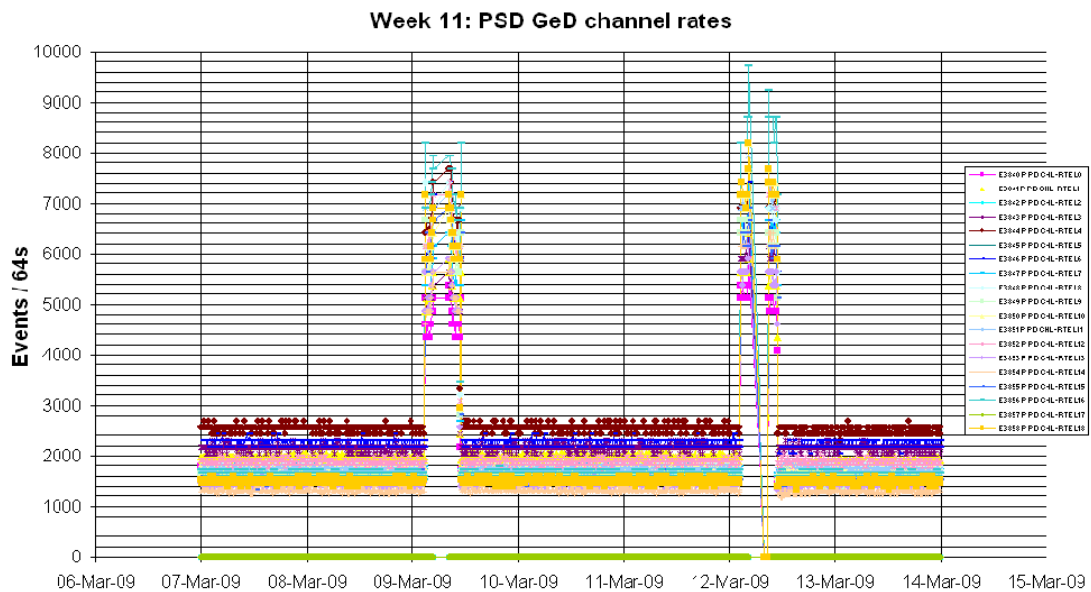


**DFEE:** The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.





**PSD:** The health of the unit is nominal. The following plot shows the PSD channel rates during the reporting period. The failed detectors (GeD#2, GeD#5 and GeD#17) are disabled in the PSD.



### Event Log:

- In line with OCR-242, a test of a new radiation belt configuration for SPI was performed during the radiation belt passage of revolution 781 to 782 on Monday 9 March 2009. The operations performed were as follows:

#### **Set test safe configuration:**

- 02:44:59Z Disable radiation belts reaction and automatic reconfiguration by sending TPF ES1700\_IASW-PAR\_disbelts\_0012.TPF to exit PROTÉGÉ state.
- 02:45:43Z Execute FCP\_SPI1\_0160 to go to CONF mode.
- 02:48:14Z Execute FCP\_SPI1\_1713 using ES1713\_AF-HVSET\_1500volt\_0001.TPF (before uplink editing TC E0001 to set TC parameters E5012; E5015 and E5027 to 0.5kV). This set the HV for all nominal detectors to 1.5kV.
- 02:54:37Z Execute FCP\_SPI1\_0130 to return to PHOTON mode.
- 02:55:38Z Re-enable radiation belts reaction and return to protégé by sending TPF ES1700\_IASW-PAR\_fmconfig\_0015.TPF.

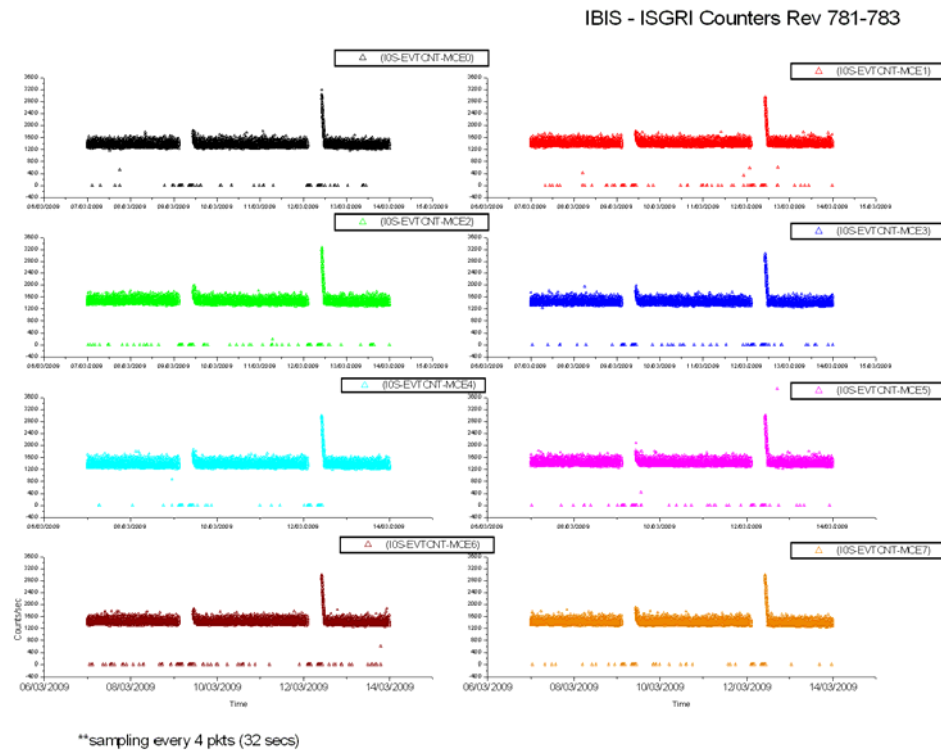
#### **Re-establish nominal configuration:**

- 10:43:51Z Disable radiation belts reaction and automatic reconfiguration by sending TPF ES1700\_IASW-PAR\_disbelts\_0012.TPF to exit PROTÉGÉ state.
  - 10:44:38Z Execute FCP\_SPI1\_0160 to go to CONF mode.
  - 10:46:14Z Execute FCP\_SPI1\_1713 using ES1713\_AF-HVSET\_fmconfig\_0007.TPF (before uplink editing TC E0001 to set TC parameter E5015 to 0.5kV). This set the HV for all nominal detectors to 4kV and that of the failed detectors to 0.5kV.
  - 10:52:34Z Execute FCP\_SPI1\_0130 to return to PHOTON mode.
  - 10:53:05Z Re-enable radiation belts reaction and return to protégé by sending TPF ES1700\_IASW-PAR\_fmconfig\_0015.TPF.
- Due to continuing high radiation after the expected radiation belt exit of revolution 782, TM parameter E3500 (ACS CntVetoBelow) started toggling OOL High on 2009-03-09 at 11:07:07Z. As it had returned stably within limits of its own accord by 12:20:11Z, no action was taken.
  - Due to continuing high radiation after the expected radiation belt exit of revolution 783, TM parameter E3500 (ACS CntVetoBelow) went OOL High on 2009-03-12 at 10:56:35Z. As it returned within limits of its own accord at 11:49:31Z, no action was taken.

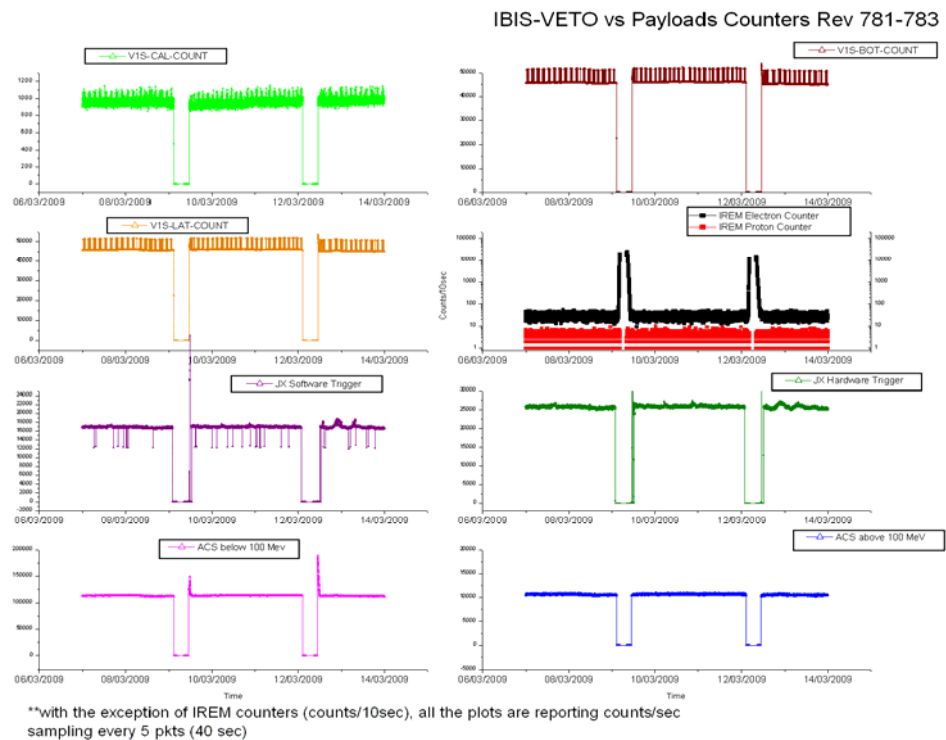
### 8.3.3 IBIS Operations

#### IBIS Event Counters Plots

#### ISGRI Counters:

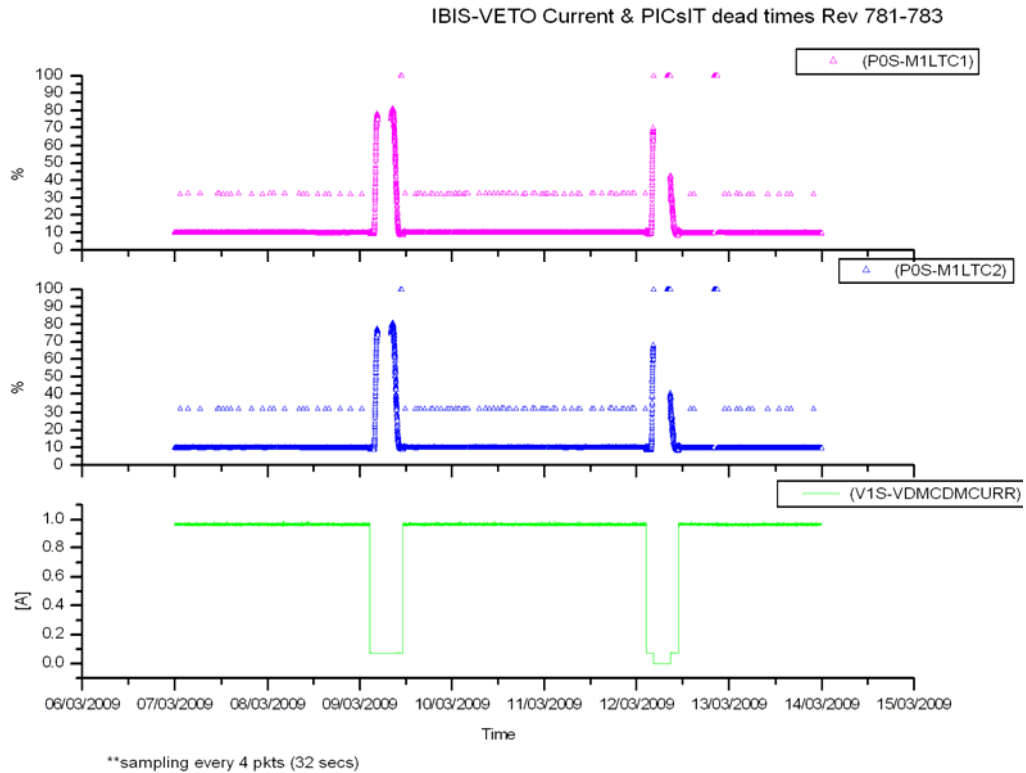


#### VETO vs Payload Counters:

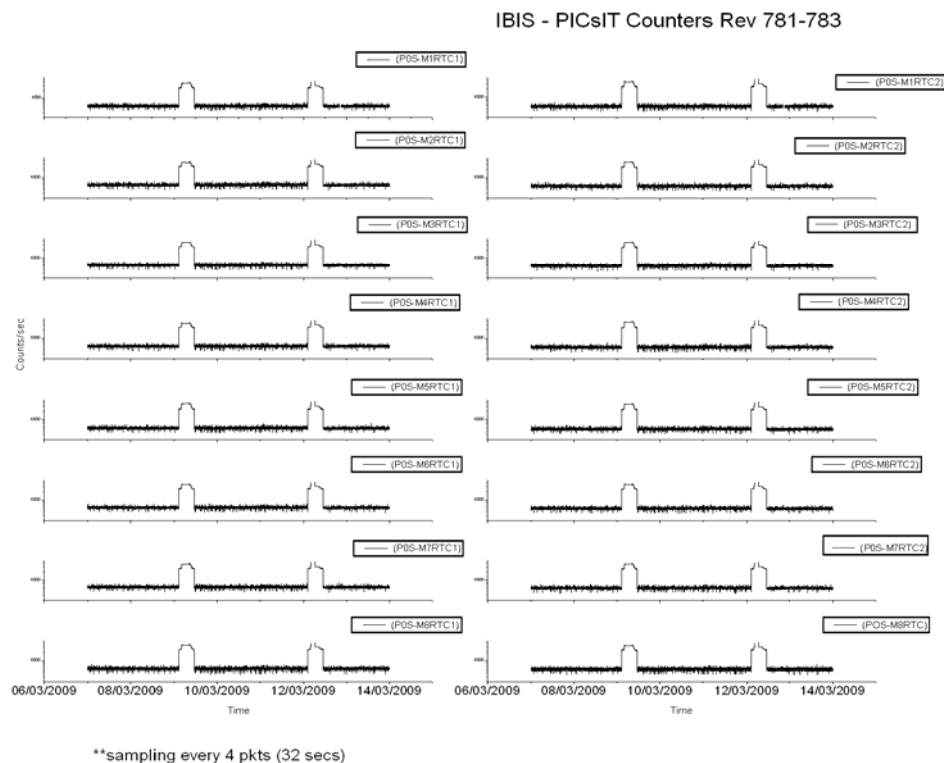


The background radiation level was low during the week, although short periods of high radiation were experienced by the instruments after the expected radiation belt exit of revolutions 782 and 783.

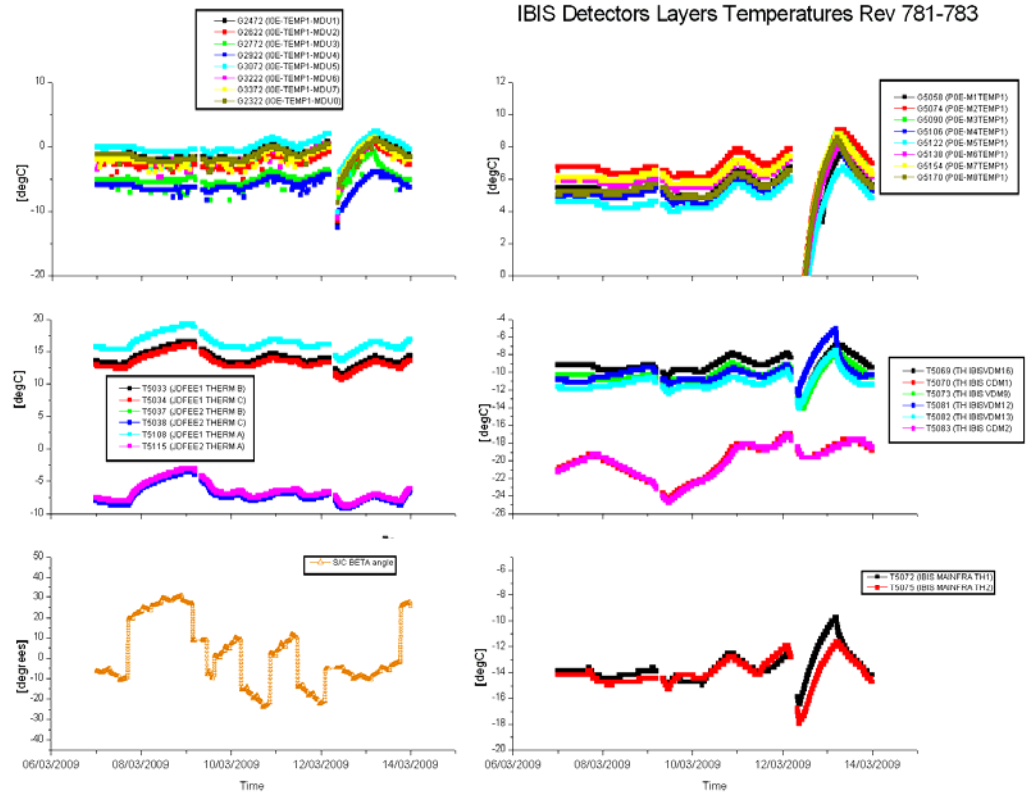
## VETO Current:



## PICsIT Counters:



## IBIS Detectors Layers Temperatures:



\*\*sampling every 8 pkts (64 secs)

### **IBIS daily report:**

The usual Out Of Limits on TM parameter G8015 (S1E-A2\_PMT\_V), G5002 (POS-Mi\_RTC1) and G5003 (POS-Mi\_RTC2) families and G2000 family (IOE-OVFWPXADD-Mi) were received during the radiation belt passages.

#### **2009-03-07 (DOY 066, Rev 781) to 2009-03-08 (DOY 067, Rev 781)**

IBIS operations executed nominally.

#### **2009-03-09 (DOY 068, Rev 781-782)**

Due to continuing high radiation after the expected radiation belt exit of revolution 782, TM parameters G6062, G6063 (VETO bottom and lateral counters respectively) started toggling OOL Warning High at 11:32:06Z. As they returned stably within limits of their own accord at 11:38:30Z, no action was taken.

#### **2009-03-10 (DOY 069, Rev 782) to 2009-03-11 (DOY 070, Rev 782)**

IBIS operations executed nominally.

#### **2009-03-12 (DOY 071, Rev 782-783)**

TM parameter G2070 went OOL several times during the day, indicating an overflow of the noisy pixel address buffer in MCE5. As in each case it returned within limits of its own accord after a few TM cycles, no action was taken.

At 20:10:15Z TM parameter G5047 (PDM1: on/off status) went OOL (value = OFF), indicating that PICSIT PDM01 had switched OFF. At the same time, OEM APID 1280 ID 170 EXCEPTION IBIS1 PICSIT LATCHED UP MODULE NOTIFICATION was received. In order to recover, a restart of PDM01 was performed as follows:

- 20:51:31Z FCP\_IBIS1\_0313 (IBIS transition to StandBy)
- 20:55:12Z FCP\_IBIS1\_0315 PICSIT PDM1 OFF
- 20:58:32Z FCP\_IBIS1\_0103 PICSIT PDM1 Activation, step 3.3 only (heater configuration left unchanged)
- 21:03:11Z FCP\_IBIS1\_0083 to re-enable PDM1
- 21:04:52Z TC G0129 sent to return IBIS to Science Standard mode.

IBIS operations continued nominally.

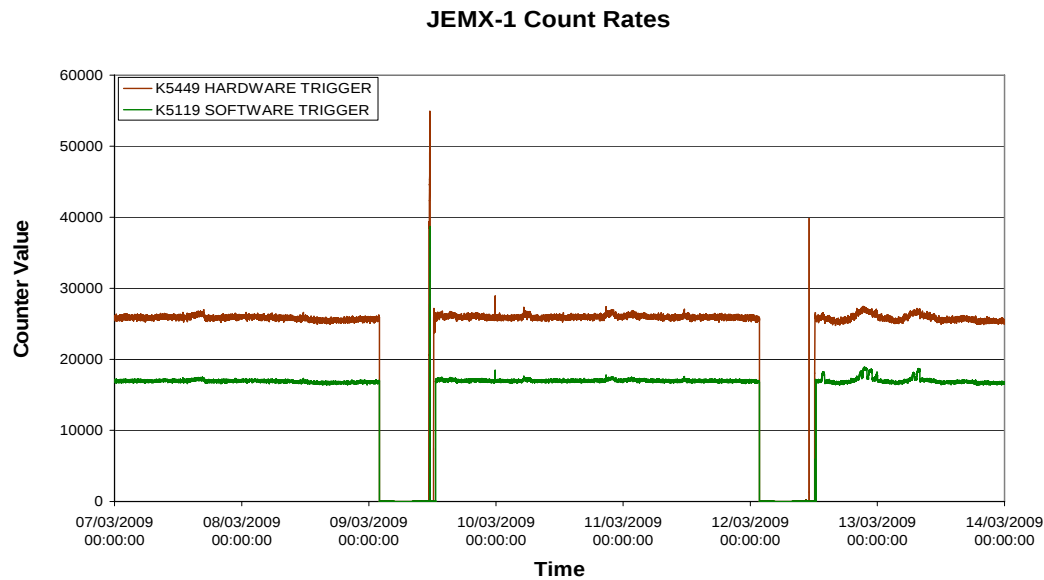
#### **2009-03-13 (DOY 072, Rev 783)**

IBIS operations executed nominally.

### 8.3.4 JEM-X Operations

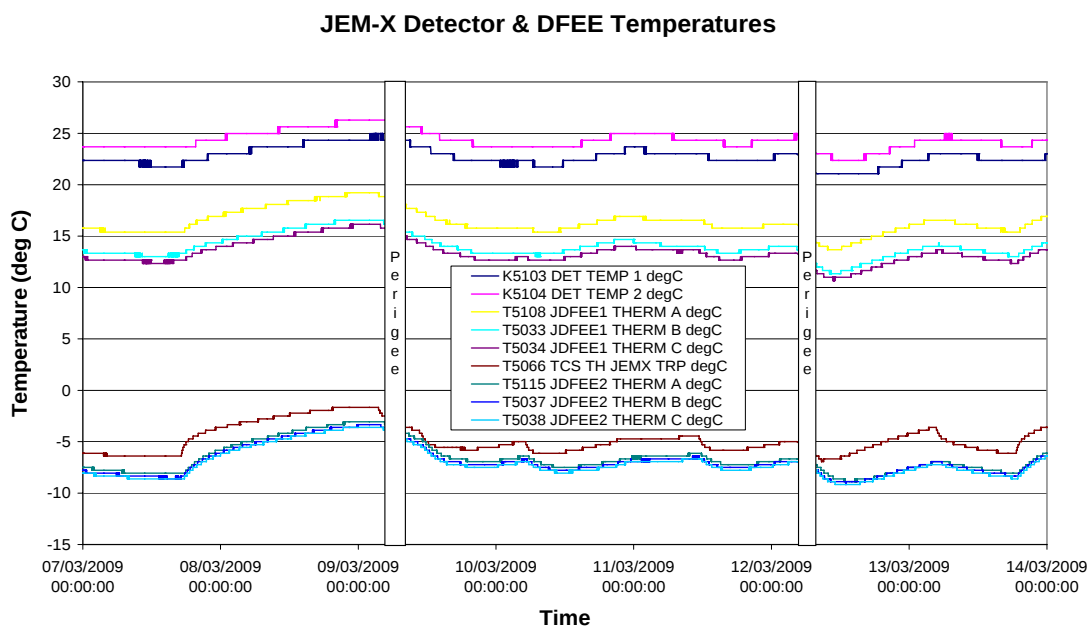
#### JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph<sup>1</sup>.



#### JEM-X Temperatures

JEM-X Detector and DFEE temperatures, along with the temperature on the detector bench between the two units, over the reporting period are displayed in the following graph<sup>2</sup>.



<sup>1</sup> Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

<sup>2</sup> Data sampled (1 frame in 8)

## **JEM-X Daily Report**

### **2009-03-07 (DoY 066, Rev 781) to 2009-03-08 (DoY 067, Rev 781)**

JEM-X 1 operations executed nominally.

### **2009-03-09 (DoY 068, Rev 781-782)**

At 11:21:21, parameter K5449 exceeded soft limits.

This began a series of out-of-limits, which culminated in the instrument going to SAFE mode at 11:33.

As part of a manual recovery, the following was executed:

At 11:59:00 procedure FCP\_JEM1\_0041 to switch to SETUP

At 12:06:00 procedure FCP\_JEM1\_1010 High Voltage switch-on

At 12:35:00, procedure FCP\_JEM1\_0044 returning the instrument to Data-Taking, the impact was about an hour delay in the start of science operations.

### **2009-03-10 (DoY 069, Rev 782) to 2009-03-11 (DoY 070, Rev 782)**

JEM-X 1 operations executed nominally.

### **2009-03-12 (DoY 071, Rev 782-783)**

The eclipse exit ED KECLEX01, was time-tagged during the previous revolution, to be executed at 04:55:00, instead of from the Timeline at 08:45:59. The effect on the temperature is striking, as there is barely any drop at all.

At 08:14:33, parameter K5317 exceeded its hard limit, no action taken

At 11:09:31, command K0013 failed uplink due to PTV failure. This command is part of the High Voltage switch on ED, KEHVAC01, and the failure was due to high radiation. Other command failures occurred around 11:15, when the Timeline attempted to switch the unit to Data-Taking. After a pause, the High Voltage activation ED was manually resent at 12:03, and at 12:19:00 the KEDATA02 was sent putting the instrument into Data-Taking. The impact was about an hour delay in the start of science observations.

Doc. Title : INTEGRAL Mission Report #338  
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OAI  
Date : 16/03/09

Issue : 1  
Rev. : 0  
Page : 29

## 2009-03-13 (DoY 072, Rev 783)

At the indicated times, the following OEMs were received:

|                             |                       |      |          |       |    |         |
|-----------------------------|-----------------------|------|----------|-------|----|---------|
| 2009.072.08.54.08.129       | 2009.072.08.54.09.556 | 1536 | RealTime | 5     |    | ANOMALY |
| JEM-X1 CSSW INT ER EXCEPTIO |                       | 0    | 0        | 65535 | PR | N       |
| E E                         |                       |      |          |       |    |         |
| FIX6                        |                       | 0    |          |       |    |         |
| K9079                       | MESS CLASS            | 2    |          |       |    |         |
| K9080                       | MESS ID               | 5    |          |       |    |         |
| K9074                       | TASK ID 16            | 12   |          |       |    |         |
| K9067                       | LOGICAL ADDRESS       | 4989 |          |       |    |         |
| 2009.072.08.54.08.129       | 2009.072.08.54.09.636 | 1536 | RealTime | 5     |    | ANOMALY |
| JEM-X1 CSSW INT ER EXCEPTIO |                       | 0    | 0        | 65535 | PR | N       |
| E E                         |                       |      |          |       |    |         |
| FIX6                        |                       | 0    |          |       |    |         |
| K9079                       | MESS CLASS            | 2    |          |       |    |         |
| K9080                       | MESS ID               | 5    |          |       |    |         |
| K9074                       | TASK ID 16            | 12   |          |       |    |         |
| K9067                       | LOGICAL ADDRESS       | 4989 |          |       |    |         |
| 2009.072.08.54.08.129       | 2009.072.08.54.09.638 | 1536 | RealTime | 5     |    | ANOMALY |
| JEM-X1 CSSW INT ER EXCEPTIO |                       | 0    | 0        | 65535 | PR | N       |
| E E                         |                       |      |          |       |    |         |
| FIX6                        |                       | 0    |          |       |    |         |
| K9079                       | MESS CLASS            | 2    |          |       |    |         |
| K9080                       | MESS ID               | 5    |          |       |    |         |
| K9074                       | TASK ID 16            | 12   |          |       |    |         |
| K9067                       | LOGICAL ADDRESS       | 4989 |          |       |    |         |
| 2009.072.08.54.08.129       | 2009.072.08.54.09.638 | 1536 | RealTime | 5     |    | ANOMALY |
| JEM-X1 CSSW INT ER EXCEPTIO |                       | 0    | 0        | 65535 | PR | N       |
| E E                         |                       |      |          |       |    |         |
| FIX6                        |                       | 0    |          |       |    |         |
| K9079                       | MESS CLASS            | 2    |          |       |    |         |
| K9080                       | MESS ID               | 5    |          |       |    |         |
| K9074                       | TASK ID 16            | 12   |          |       |    |         |
| K9067                       | LOGICAL ADDRESS       | 4989 |          |       |    |         |
| 2009.072.08.54.08.129       | 2009.072.08.54.09.639 | 1536 | RealTime | 5     |    | ANOMALY |
| JEM-X1 CSSW INT ER EXCEPTIO |                       | 0    | 0        | 65535 | PR | N       |
| E E                         |                       |      |          |       |    |         |
| FIX6                        |                       | 0    |          |       |    |         |
| K9079                       | MESS CLASS            | 2    |          |       |    |         |
| K9080                       | MESS ID               | 5    |          |       |    |         |
| K9074                       | TASK ID 16            | 12   |          |       |    |         |
| K9067                       | LOGICAL ADDRESS       | 4989 |          |       |    |         |
| 2009.072.08.54.08.129       | 2009.072.08.54.09.640 | 1536 | RealTime | 5     |    | ANOMALY |
| JEM-X1 CSSW INT ER EXCEPTIO |                       | 0    | 0        | 65535 | PR | N       |
| E E                         |                       |      |          |       |    |         |
| FIX6                        |                       | 0    |          |       |    |         |
| K9079                       | MESS CLASS            | 2    |          |       |    |         |
| K9080                       | MESS ID               | 5    |          |       |    |         |
| K9074                       | TASK ID 16            | 12   |          |       |    |         |
| K9067                       | LOGICAL ADDRESS       | 4989 |          |       |    |         |
| 2009.072.08.54.08.129       | 2009.072.08.54.09.640 | 1536 | RealTime | 5     |    | ANOMALY |
| JEM-X1 CSSW INT ER EXCEPTIO |                       | 0    | 0        | 65535 | PR | N       |
| E E                         |                       |      |          |       |    |         |
| FIX6                        |                       | 0    |          |       |    |         |
| K9079                       | MESS CLASS            | 2    |          |       |    |         |
| K9080                       | MESS ID               | 5    |          |       |    |         |
| K9074                       | TASK ID 16            | 12   |          |       |    |         |
| K9067                       | LOGICAL ADDRESS       | 5336 |          |       |    |         |

No action was taken, and there was no impact.

### 8.3.5 OMC Operations

#### 2009-03-07 (DoY 066, Rev 781) to 2009-03-10 (DoY 069, Rev 782)

Nothing to report.

#### 2009-03-11 (DoY 070, Rev 782)

At 06:31, a drop in TM from DSS27 forces an interruption in the Timeline. A recovery was performed and the Timeline rejoined at 07:50. The impact was the loss of pointings 07820079 & 07820080. It was at this time the following OEMs were received:

|                       |                       |      |          |     |       |        |
|-----------------------|-----------------------|------|----------|-----|-------|--------|
| 2009.070.07.06.49.264 | 2009.070.07.07.00.253 | 1792 | RealTime | 131 | TC    | REJECT |
| REJECTED TC1          |                       |      | 0        | 0   | 65535 | PR N   |
| E E                   |                       |      |          |     |       |        |
| 2009.070.07.06.55.264 | 2009.070.07.07.00.292 | 1792 | RealTime | 131 | TC    | REJECT |
| REJECTED TC1          |                       |      | 0        | 0   | 65535 | PR N   |
| E E                   |                       |      |          |     |       |        |

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 07820080.

#### 2009-03-12 (DoY 071, Rev 782) to 2009-03-13 (DoY 072, Rev 782)

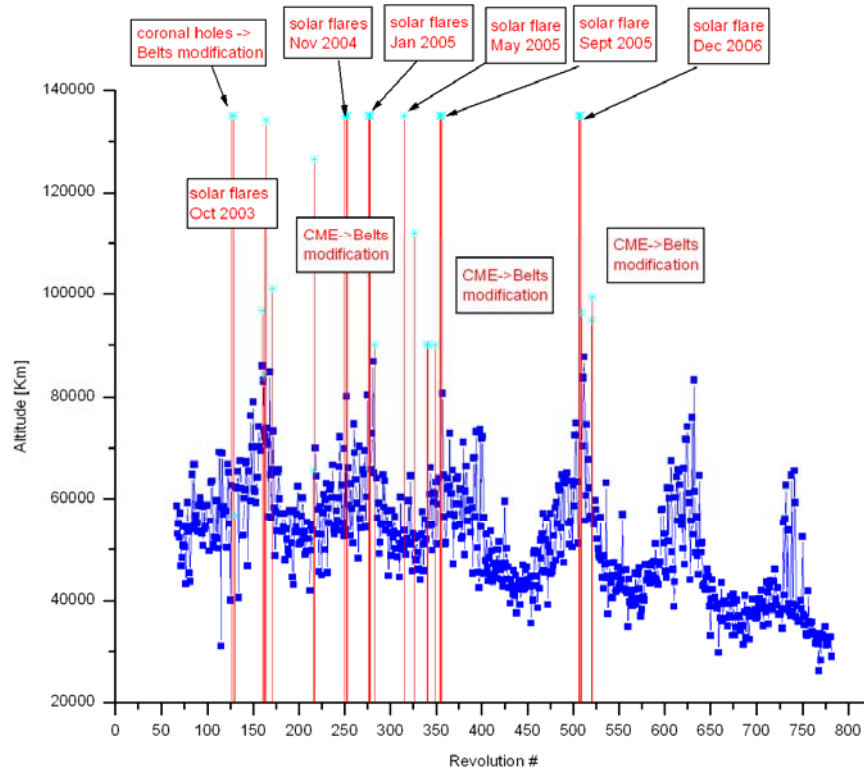
Nothing to report.

On DoY 068 at 02:44:09 and DoY 071 at 02:30:01 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

### 8.3.6 IREM Operations

#### Radiation Belts Entry

Evolution of Radiation Belt Entry 2003-2008



#### IREM daily report

Nothing to report.

#### Electron Belts

| REV | S/C BCPKT (electron)            | Electron CUT-OFF<br>Observed<br>Entry/Exit | Observed<br>Entry/Exit<br>Altitude<br>[Km] | Electron CUT-OFF<br>Predicted<br>Entry/Exit | Predicted<br>Entry/Exit<br>Altitude<br>[Km] |
|-----|---------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|
| 781 | RAD_ENTR R 2009-03-09T02:44:07Z | 09/03/2009<br>03:49:12                     | 32924.1                                    | 09-Mar-2009<br>03:41:09                     | 34454.62                                    |
| 782 | RAD_EXIT R 2009-03-09T10:58:32Z | 09/03/2009<br>10:16:56                     | >> 35706.4                                 | 09-Mar-2009<br>10:21:09                     | 46579.66                                    |
| 782 | RAD_ENTR R 2009-03-12T02:29:53Z | 12/03/2009<br>03:50:56                     | 29052.1                                    | 12-Mar-2009<br>03:36:07                     | 33727.49                                    |
| 783 | RAD_EXIT R 2009-03-12T10:44:01Z | 12/03/2009<br>10:18:16                     | >> 42352.9                                 | 12-Mar-2009<br>10:16:07                     | 47295.84                                    |

Reference

High radiation

Very small error vs reference (less than 10 minutes)

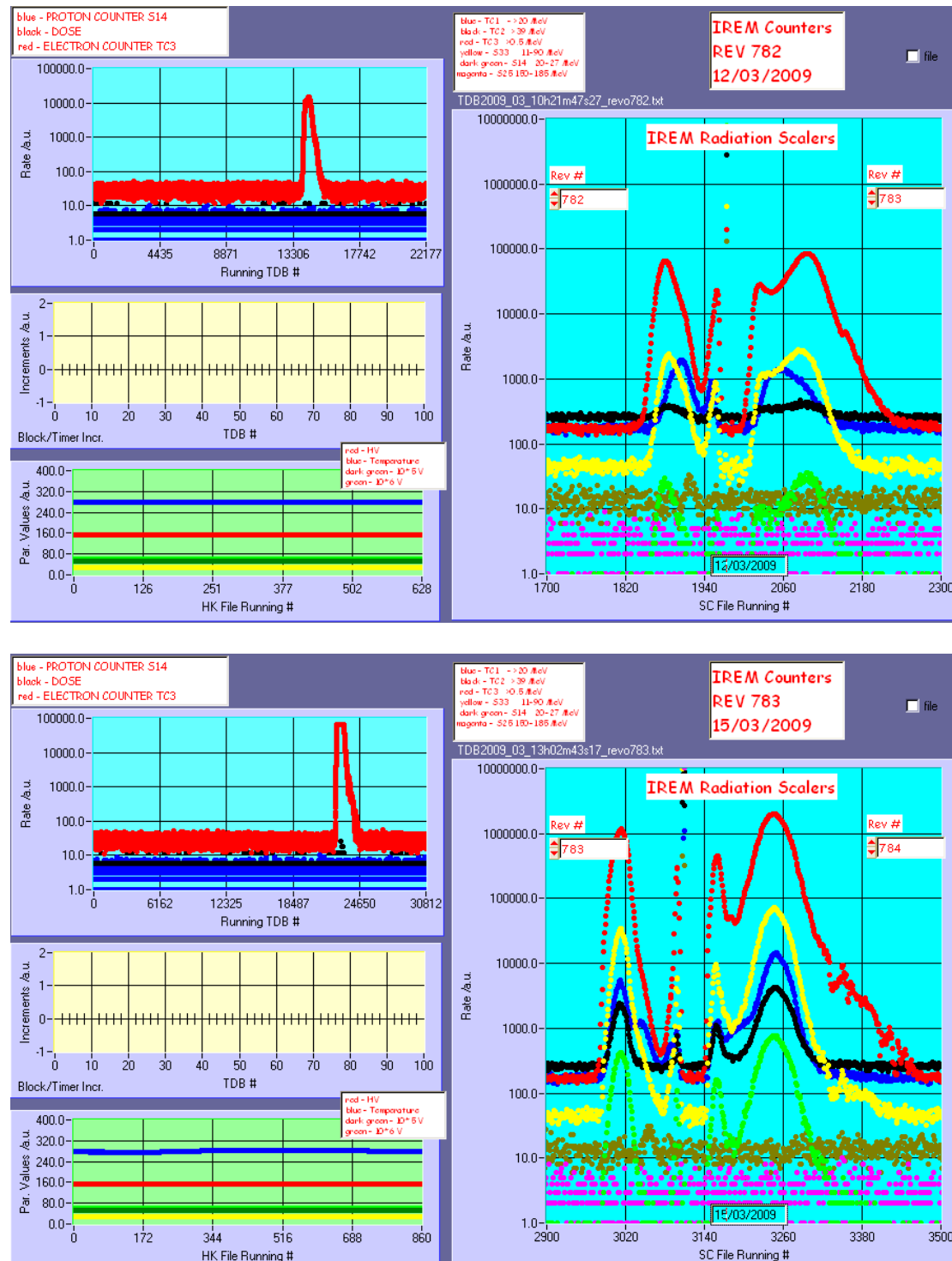
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

\* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

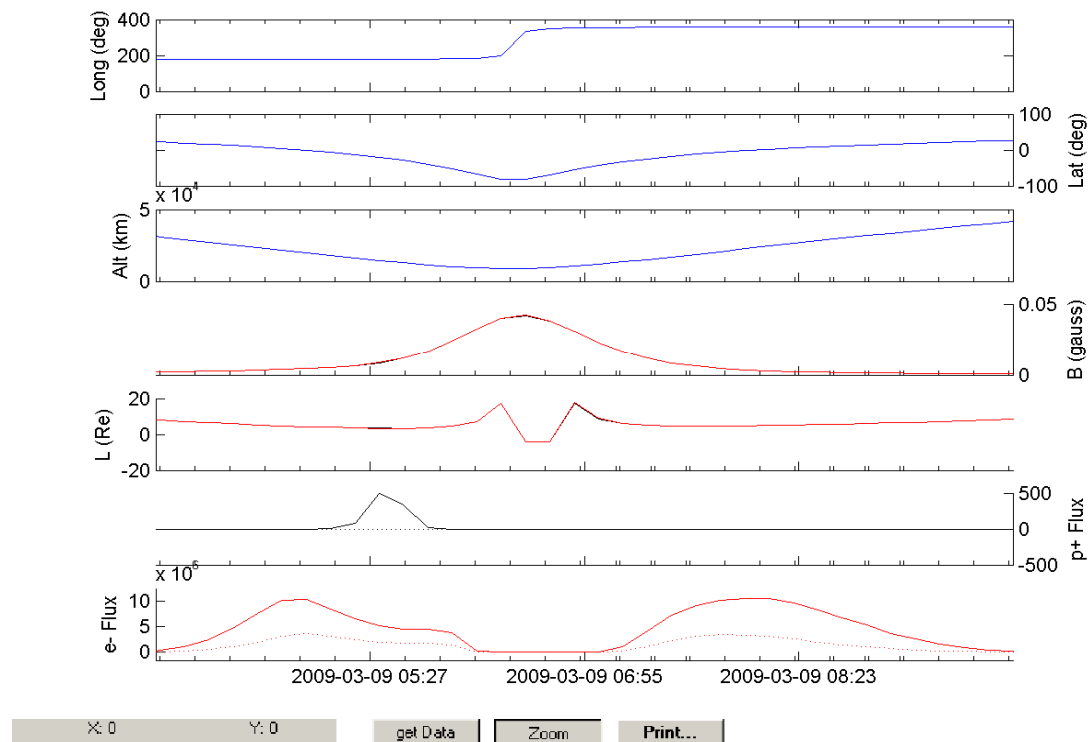
## IREM radiation counters:

The plot for revolution 781 is not available

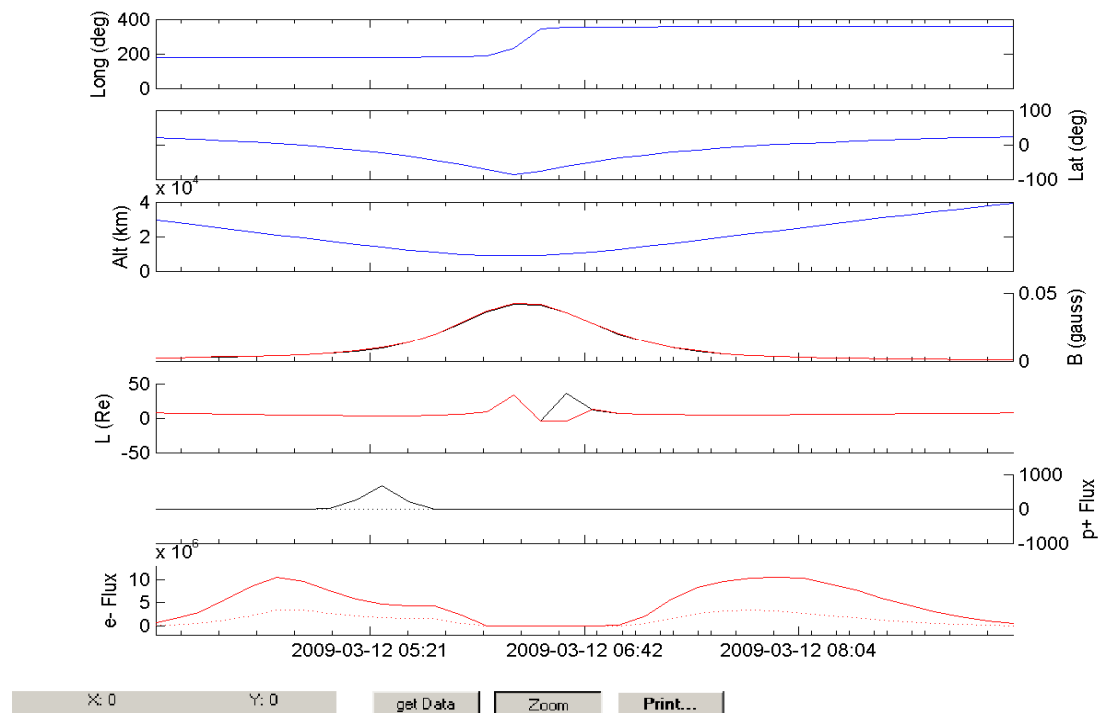


## **IREM Predicted Radiation Belt Passages**

Rev 781



Rev 782



# Radiation Assessment

Generated with SEIS Report and Analysis tool.

## INTRODUCTION

This note summarises the space weather status over the observation period

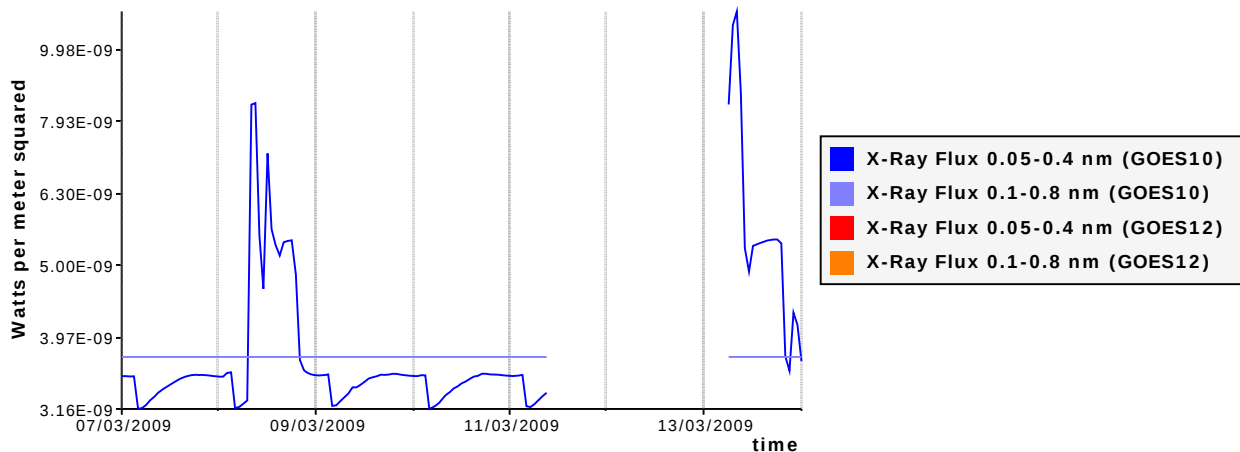
## DAILY SUN

see in WR section 3.2.5

## RADIATION FLUXES

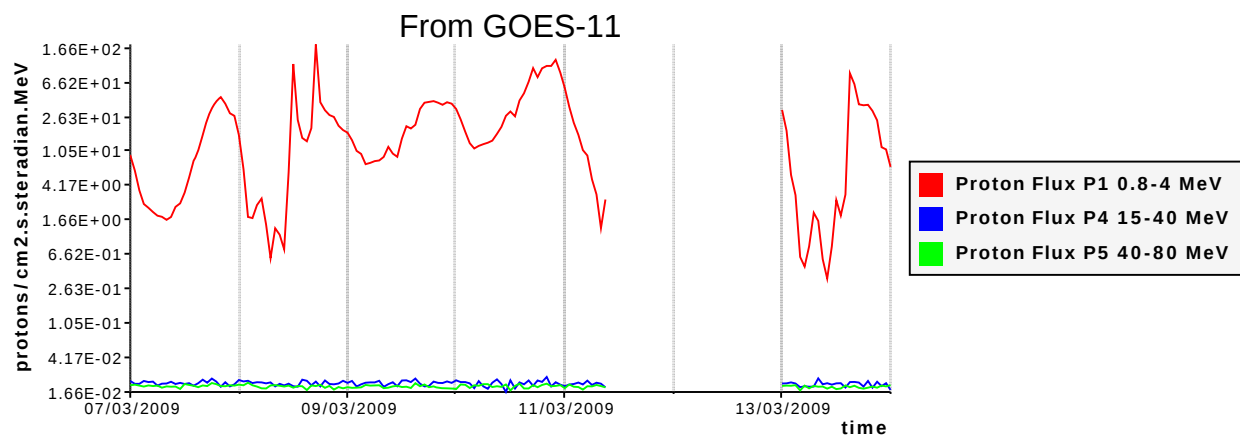
### X-ray fluxes

X-ray fluxes for different energies are presented below as reported by GOES satellites. From  $1\text{E-}5$   $\text{W/m}^2$ , they start featuring significant radiation activity corresponding to M-class solar flares from  $1\text{E-}5$  to  $1\text{E-}4$   $\text{W/m}^2$ , and to X-class solar flares from  $1\text{E-}4$  and onwards.



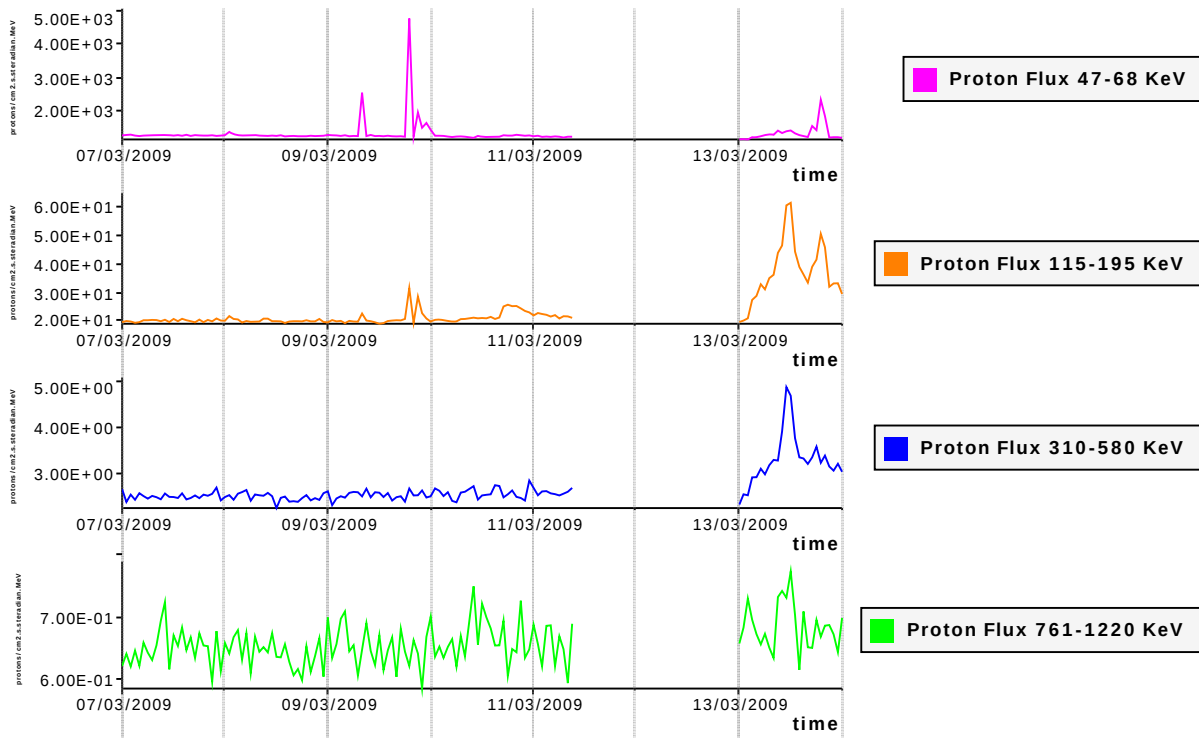
### Proton fluxes (GOES-11)

Proton fluxes as measured by GOES satellites are presented in the following plot. Usually P1 oscillates between  $1\text{E}+1$  and  $1\text{E}+2$ , while P2 and P3 evolve around  $1\text{E-}2$ .



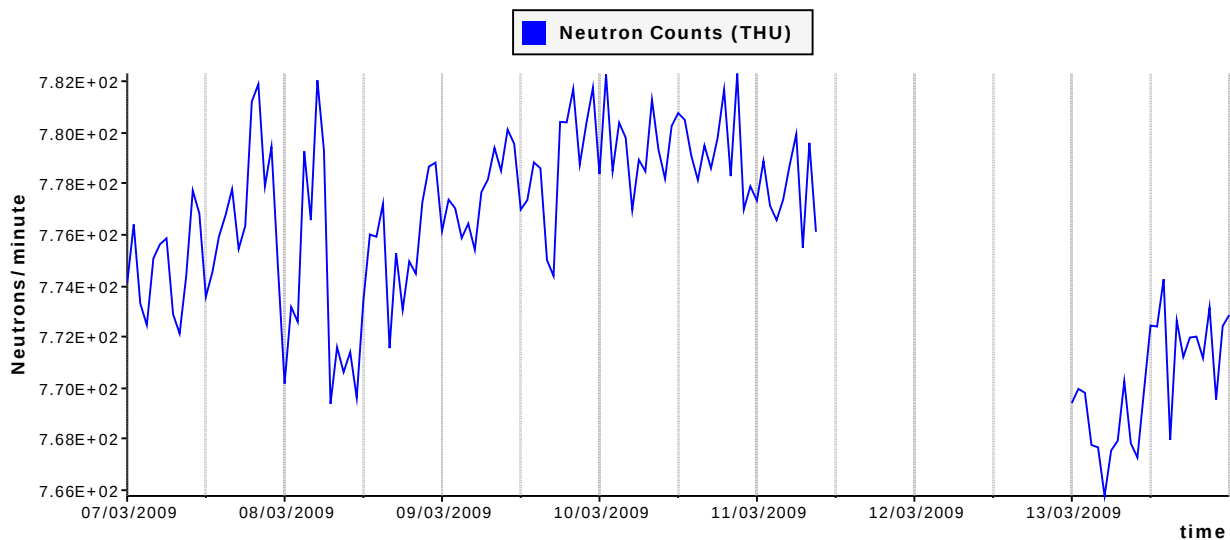
## Proton fluxes (ACE)

Proton fluxes as measured by ACE satellite are presented in the following plot.



## Neutron counts

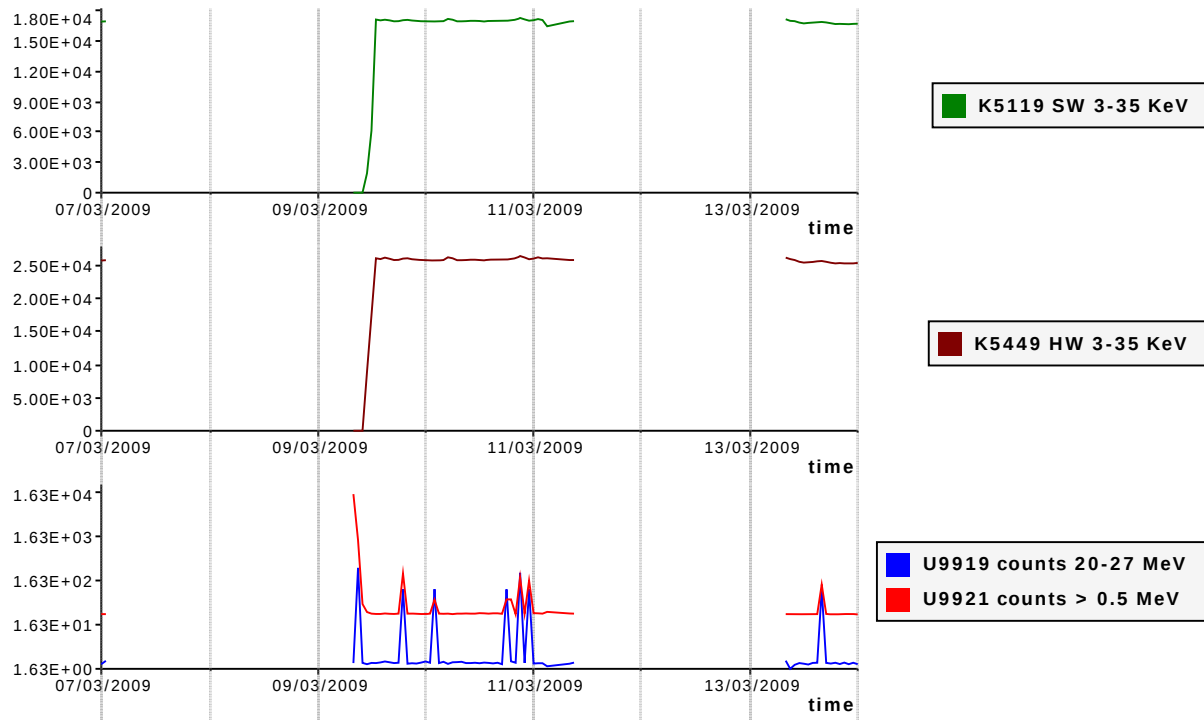
The neutron counts for the last 3 days are presented in the following plot. Nominally they remain stable around 7.2E+2.



## IREM and JEM-X (INTEGRAL)

IREM proton and electron fluxes as well as JEM-X1 software and hardware triggers are presented in the following plots.

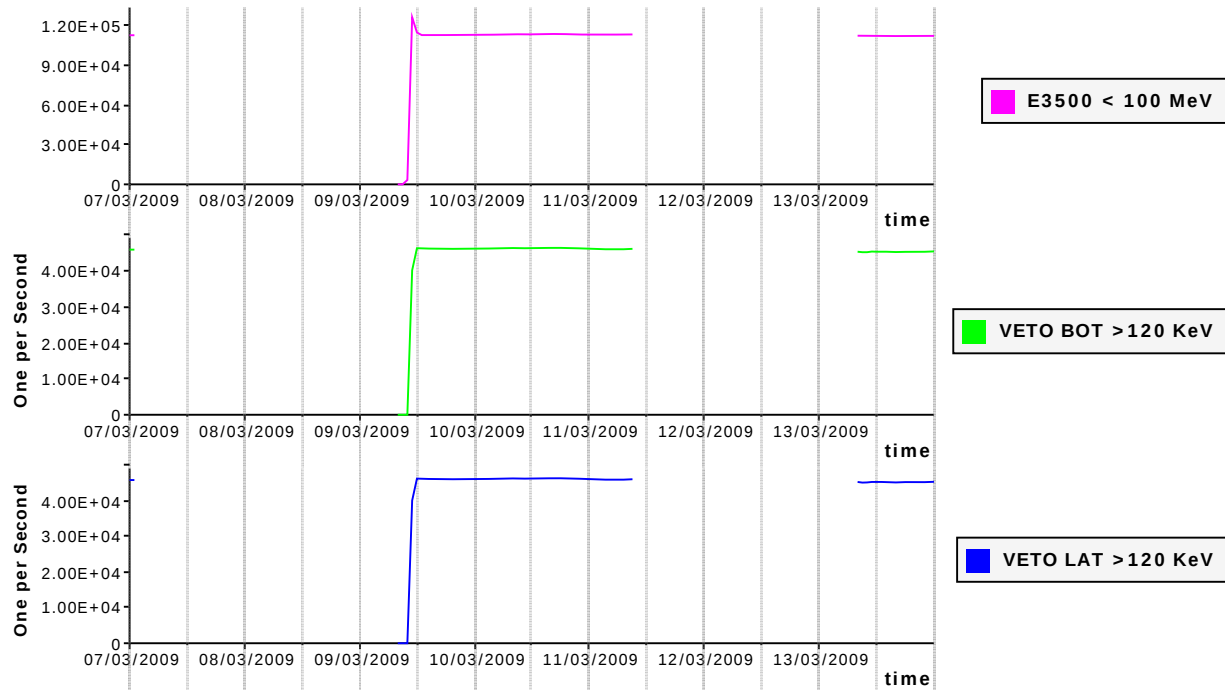
Nominal values are respectively about 1 and 18 for IREM counts, and, 13000 and 19000 for JEM-X ones.



## SPI and IBIS (INTEGRAL)

SPI-ACS counters below 100MeV as well as IBIS-VETO bottom and lateral counters are presented in the following plots.

Nominal values are respectively about 90000 for SPI counts, and 36000 for IBIS ones.



## SOLAR FLARES FORECAST

The probabilities of M and X-class solar flares during the last month are presented below. Chances of solar flare start to be meaningful from 15%.

