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EUROPEAN SPACE AGENCY  
DIRECTORATE OF TECHNICAL & OPERATIONAL SUPPORT  
MISSION OPERATIONS DEPARTMENT

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INTEGRAL  
Mission report

INT-MOC-SYS-RP-1001-OPS-OAI

No. 399  
01.08.2011

Routine Phase

Prepared by: M. Walker (OPS-OAI) and INTEGRAL FCT

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# Distribution List

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|-----------------------------------|-------------------|-----------------------|-------------------------|
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| S. Fahmy                          | R. Hussock        | Redu:                 | B. Demelenne            |
| J. Martin                         | J. Howard         | ISDC                  |                         |
| F. Cordero                        | M. Butkovic       | R. Walter             | ISDC Shift Team         |
| F. Di Marco                       | J. Audric         | C. Ferrigno           |                         |
| S. DePadova                       |                   | ALENIA                |                         |
| D. Webert                         | Shift – Coord     | M. Montagna           | F. Ravera               |
| F. Schmidt                        | Scheduling Office | PI / Instrument Teams |                         |
| C. Lozano                         | T. Beck           | A. Bazzano (IBIS)     | W. Hajdas (IREM)        |
| M. Pantaleoni                     | M. Rossmann       | G. La Rosa (IBIS)     | S. Brandt (JEM X)       |
| M. Walker                         | M. Unal           | F. Lebrun (IBIS)      | E. De Miguel (OMC)      |
| U. Weissmann                      |                   | P. Ubertini (IBIS)    | J. P. Roques (SPI)      |
| N. von Krusenstiern               | A. Mantineo       | C. Brysbaert (SPI)    |                         |
| J. Hübner                         | K. Scott          |                       |                         |
|                                   |                   |                       |                         |
| INTEGRAL/XMM Flight Dynamics team |                   |                       |                         |
|                                   |                   |                       |                         |
|                                   |                   |                       |                         |

# 1 General

The Flight Control Team at MOC has compiled this report with some input provided by the Flight Dynamics Team, ISOC and ISDC. Nominal science operations were performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

This report addresses the activities from July and covers the revolutions 1064 until 1074 (included). The targets of these revolutions can be found on the ISOC web: <http://integral.esac.esa.int/isocweb/schedule.html?action=intro> .

The previous weekly and monthly reports are available at the XMM-INTEGRAL website: <http://xmm.esoc.esa.int/documentation/documentation.php3> .

## 2 Satellite status

### 2.1 Platform

#### 2.1.1 AOCS

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

10 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.6423 Kg. The remaining propellant is in the order of 118.56 Kg.

*Note: Some more information concerning the AOCS operations and the fuel budget is provided in the Appendix 6.1.*

#### 2.1.2 Power

All units of the EPS are working nominally.

#### 2.1.3 Thermal

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

#### 2.1.4 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.

### 2.1.5 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.

## 2.2 Payload

### 2.2.1 SPI

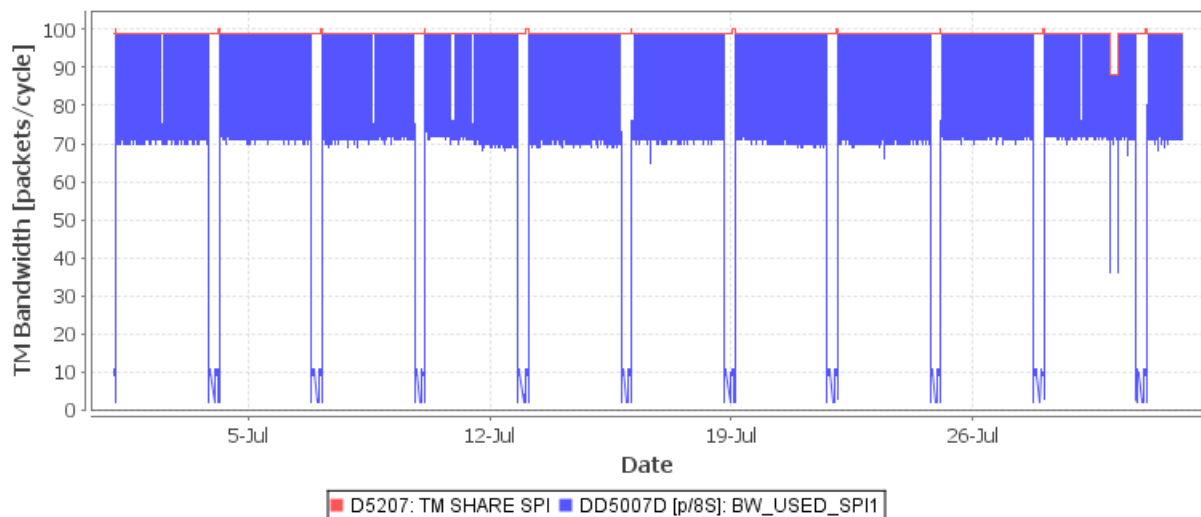
Following the 17th SPI annealing, which ended on 12/05/2011, the overall status of the gamma-ray spectrometer is nominal, except for detector #2 (failed since 06/12/2003), detector #17 (failed since 17/07/2004), detector #5 (failed since 19/02/2009) and detector #1 (failed since 27/05/2010).

The eclipse season started on 27/06/2011 and lasts until 17/08/2011. Eclipse operations for SPI are progressing nominally.

The Germanium detectors' temperature was kept in the range 80K $\pm$ 1K.

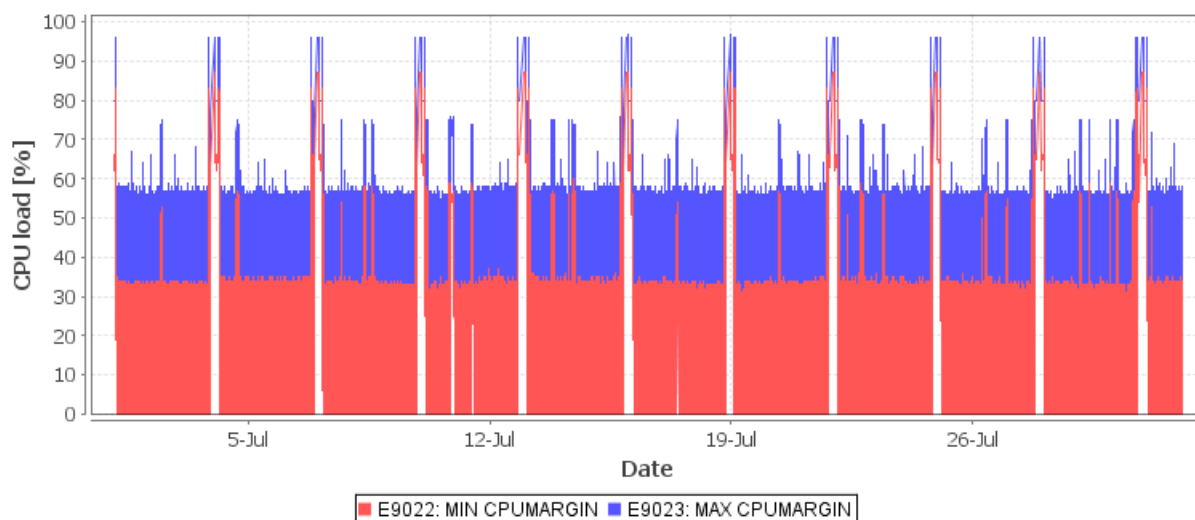
SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 99 packets/cycle, except from 2011-07-29T22:09:57Z to 2011-07-30T03:36:27Z (OMC Flat Field Calibration), when it was 88 packets/cycle. The average telemetry occupation when the allocation was 99 packets/cycle was 74.9 packets/cycle.

The following plot shows the TM bandwidth allocation and occupation during the reporting period.



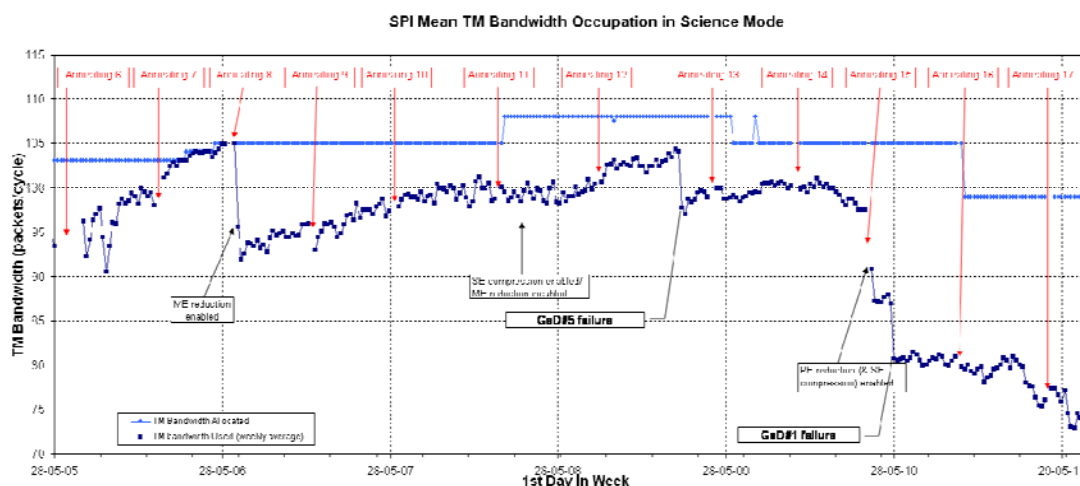
**Figure 1: SPI TM bandwidth utilisation**

The following plot illustrates the DPE CPU load during the reporting period.



**Figure 2: SPI IASW Performance**

The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth since May 2005.



**Figure 3: SPI TM bandwidth usage evolution since May 2005**

*Note: More information concerning the SPI operations is provided in Appendix O.*

### 2.2.2 IBIS

The overall status of IBIS is nominal. The eclipse season started on 27/06/2011 and lasts until 17/08/2011. Eclipse operations for IBIS are progressing nominally.

During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 129 packets/cycle, except from 2011-07-29T22:09:57Z to 2011-07-30T03:36:27Z (OMC Flat Field Calibration), when it was 90 packets/cycle

- IBIS mean bandwidth utilisation in science mode: 106.25 packets/cycle

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

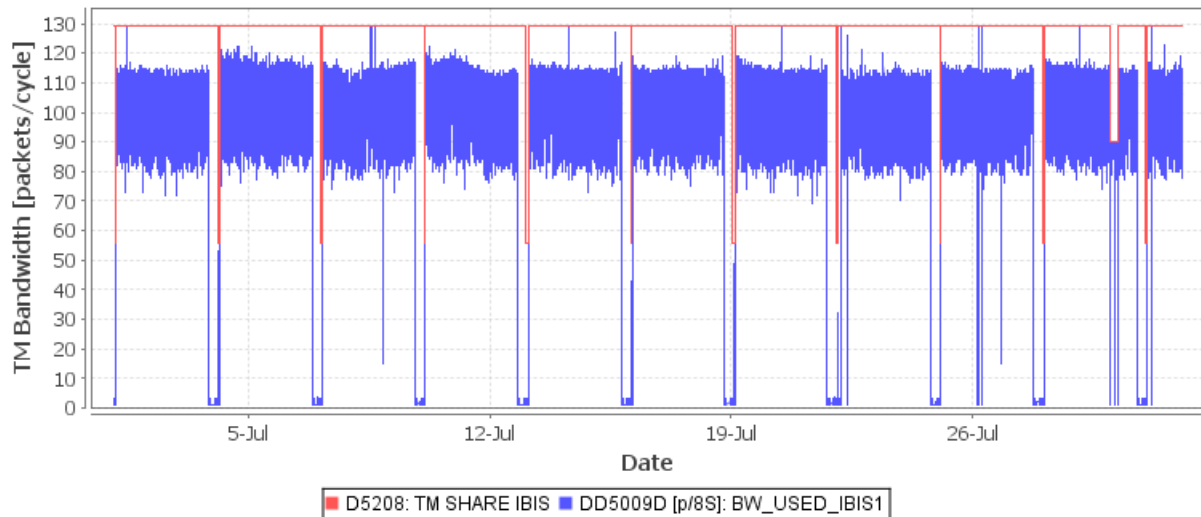


Figure 4: IBIS TM bandwidth utilisation

A plot of the IBIS weekly bandwidth utilisation since May 2005 is shown below.

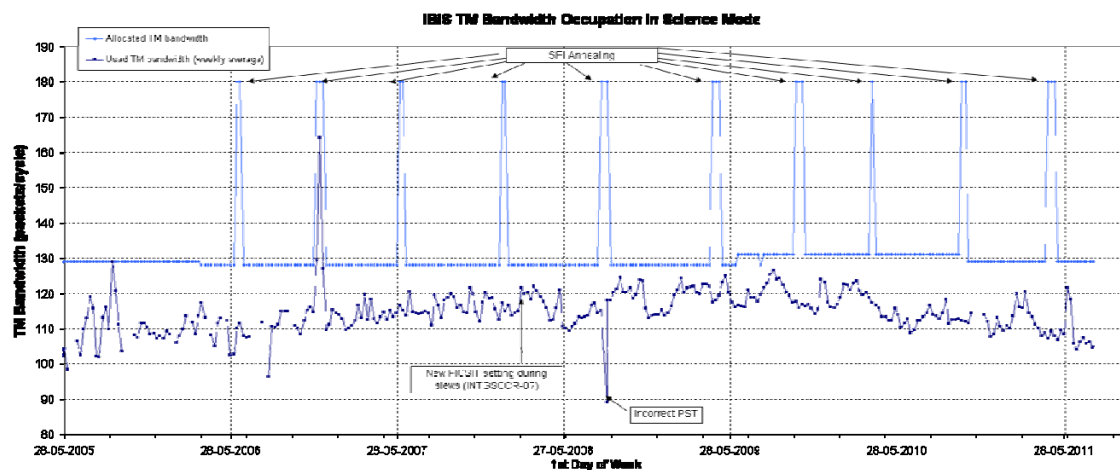


Figure 5: IBIS TM bandwidth usage evolution since May 2005

Note: More information concerning the IBIS operations is provided in Appendix 6.3.

### 2.2.3 JEM-X

The status of both JEM-X units is nominal:

- JEMX-1 & 2 were operated in Data Taking mode with a TM allocation of 8 packets/cycle each, except from 2011-07-29T22:09:57Z to 2011-07-30T03:36:27Z during the OMC Flat-field calibration, when it was 4 packets/cycle each.

*Note: Some more information concerning the JEM-X operations is provided in Appendix 6.4.*

### 2.2.4 OMC

The status of OMC is nominal.

OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle, except from 2011-07-29T22:09:57Z to 2011-07-30T03:36:27Z during the Flat-field calibration, when it was 63 packets/cycle.

During this reporting period, 799 of the 814 planned science pointings were executed nominally. 2 pointings were lost and 1 executed at an incorrect attitude due to problems at the ground station. 1 pointing was lost to AOCS issues. 1 pointing was lost to an FD problem. 5 pointings were lost and 1 interrupted due to an SEU which switched OMC off. 2 pointings were lost and 1 interrupted due to two separate IREM crashes. Finally 1 pointing was cut short after the CCCFs were scheduled as part of an IREM crash recovery. One Flat-field calibration was performed this month.

*Note: Some more information concerning the OMC operations is provided in Appendix 6.5.*

### 2.2.5 IREM

The status of IREM is nominal.

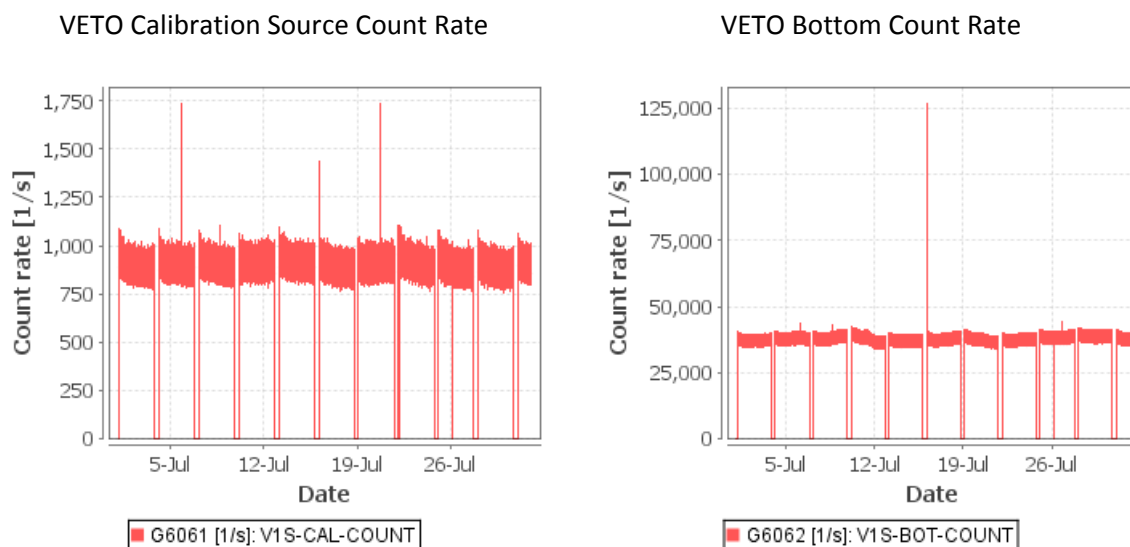
On DoY 202 (21/07/2011), the 110<sup>th</sup> IREM SEU occurred.

On DoY 207 (26/07/2011), the 111<sup>th</sup> IREM SEU occurred.

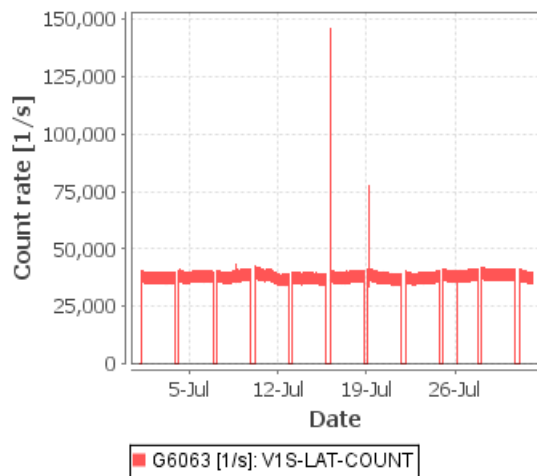
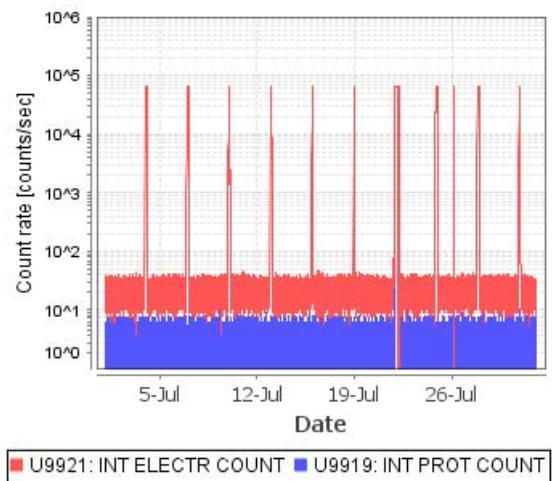
*Note: Some more information concerning the IREM operations is provided in Appendix 6.6.*

### Radiation background

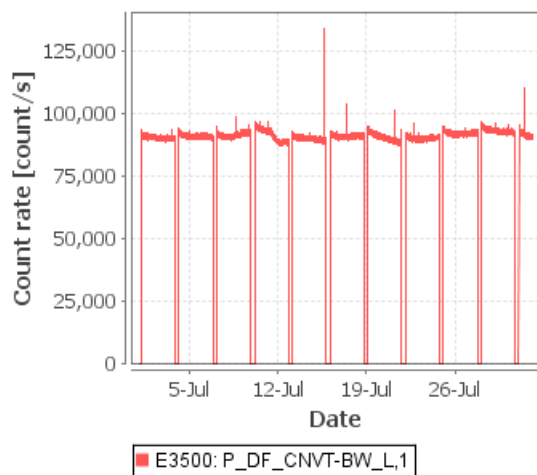
The background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the reporting period:



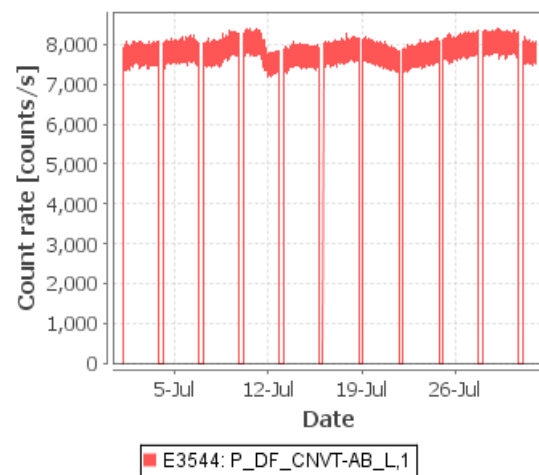
## VETO Lateral Count Rate

IREM Proton & Electron Counters<sup>1</sup>

## ACS Below 100MeV



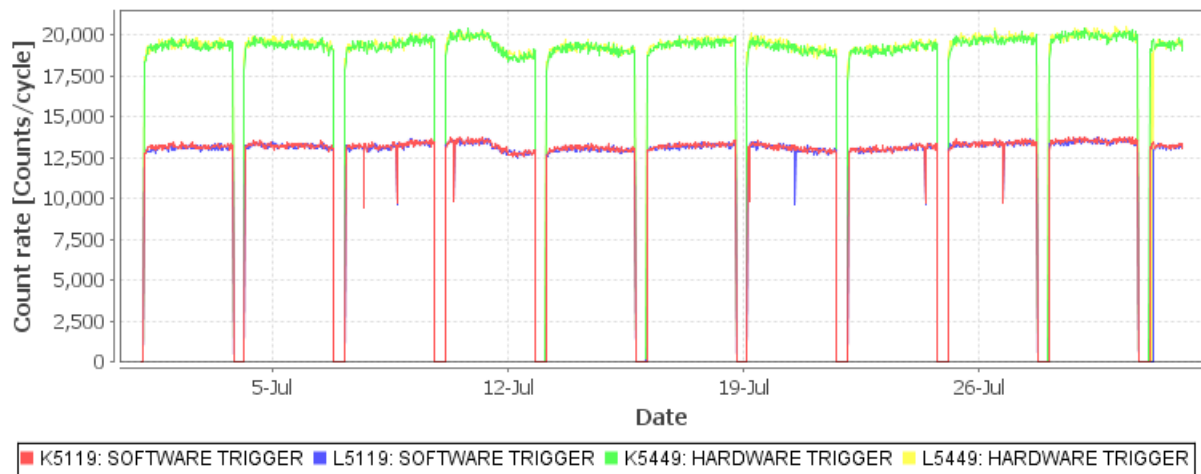
## ACS Above 100MeV

**Figure 6: Instrument Count Rates**

The JEM-X count rates are only plotted for the active JEM-X unit, the data is sampled every 8th packet (64sec).

<sup>1</sup> Note that the scale used in this plot is logarithmic.

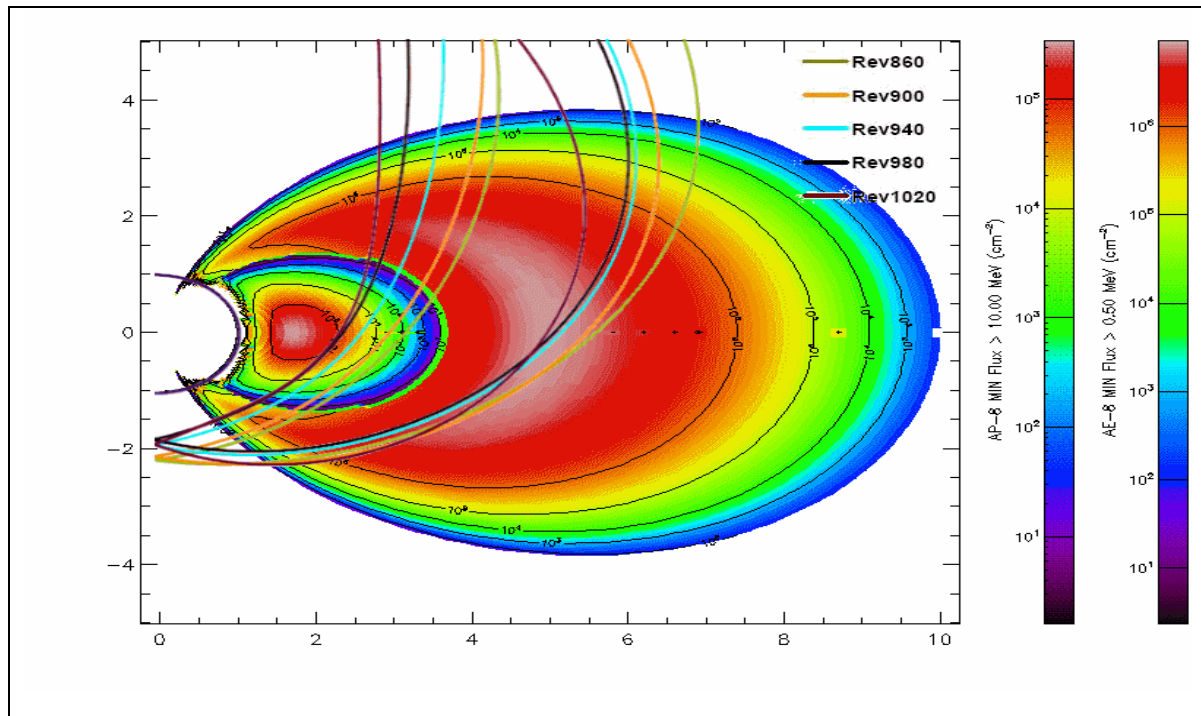
K5119/L5119 - JEM-X1/2 Software trigger, K5449/L5449 - JEM-X1/2 Hardware trigger



**Figure 7: JEM-X Count rates.** The smaller downward spikes in the figure are due to the slews of the spacecraft

### Radiation Belts

Figure 8 gives a prediction of the trapped radiation environment sensed by the S/C when descending into perigee; the different areas crossed, the Radiation Belt entry/exit points, the shape of the Radiation Belt passage and a rough estimation of the trapped proton and electron fluxes.



**Figure 8: The predicted evolution of the orbit of Integral through the radiation belts**

### 3 Ground Facilities

The Operational ground facilities performance was good this month. The overall performance was over the 95% requirement.

The following figure shows the number of slews executed and the number of slews missed per revolution. These numbers give a very good indication of the performance of the operational ground facilities, because it involves all the different elements of the ground facilities to complete all slews scheduled.

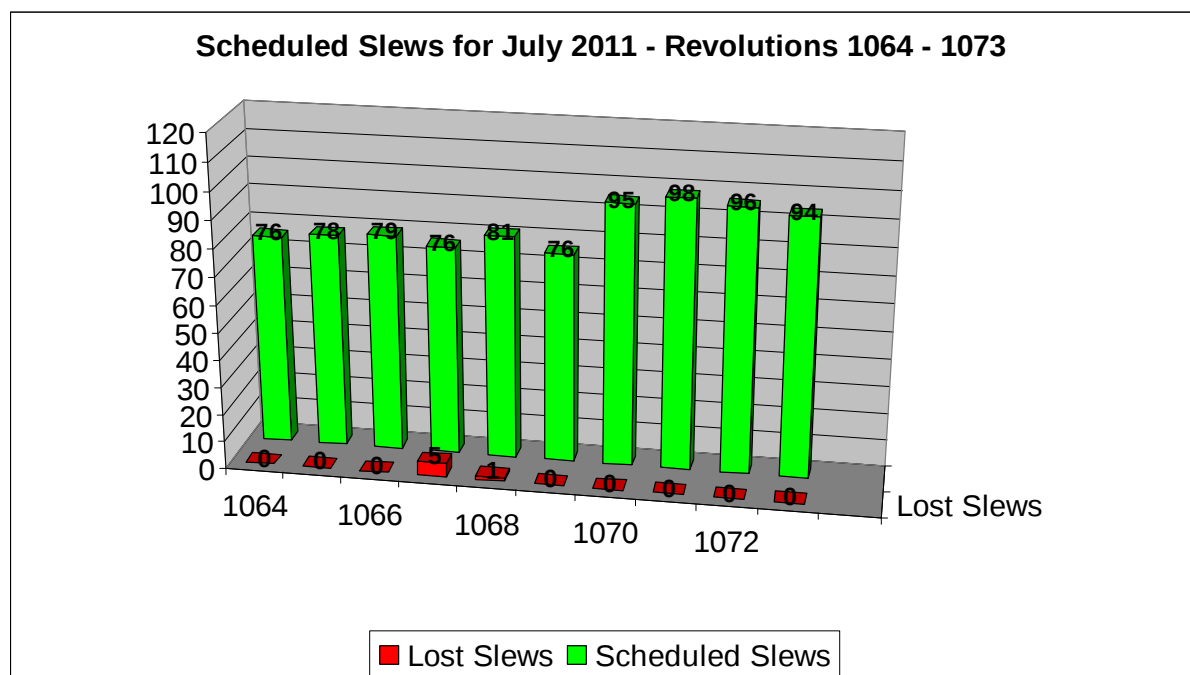


Figure 9: The number of slews scheduled compared to the number of slews lost

#### 3.1 Mission Control System

On DOY 187 the ECC Controller informed us that the ranging data was not being processed on Chain-1. Operations were switched to Chain-2. Chain-1 was rebooted.

On DOY 187 at AOS the manual and automatic stacks crashed on sun122. They were restarted without problems.

On DOY 193 a 4 minute gap was caused by an error in the ground station scheduling.

On DOY 196 at AOS the manual stack on sun122 and OMCH task on IMCA crashed. They were restarted without problems.

On DOY 199 at AOS the multiplexer crashed on IMCA. It was restarted without problems.

On DOY 209 the ISDC Operator reported that they had not received files since the previous day. The IFTS instances on IDDA were restarted, CCC were however not able to restart the IFTS instances

on ISDSA (this is currently under investigation). On the SPACON's request CCC rebooted ISDSA and restarted the applications which fixed the problem.

The connection to ISDC dropped 5 times and the ISDS and IFRD tasks needed to be restarted on 5 occasions.

## 3.2 Ground Stations and Network

The performance of the ground stations and Network was good this month.

2 TM drops and 3 data gaps were identified. Bad frames were received from REDU on 12 occasions mostly due to RFI.

Figure 10 shows the quality of the ground station performance. The data received from the ground stations is compared to the data that is expected to be received.

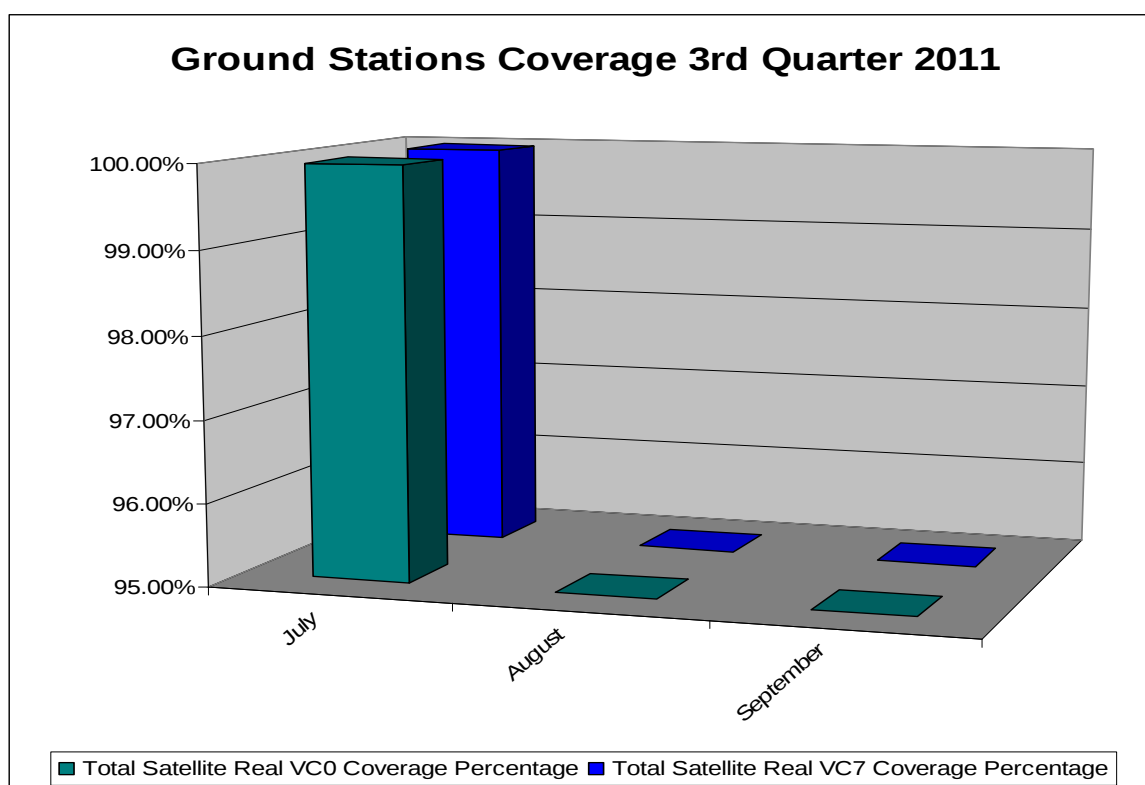


Figure 10: Comparison of VC0 to VC7 coverage

## 3.3 ISOC

### 3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 1071 to 1079, corresponding to the time range 22 July to 17 August.

New observations have been planned for revolutions 1065 (7-9 July) to 1079 (14-17 August) including TOO observations of the transient accreting pulsar 4U 0115+63 in revolutions 1065-1068 and 1070 which had to be adapted to the source evolution on short notice. In addition, planning for revolution 1066 was affected by a difficult to identify constraint from possible Startracker blinding by the Moon during an eclipse, while revolution 1068 required several iterations to find a valid planning fulfilling all requirements.

TSFs have been received for revolutions 1065 to 1075.

### **3.3.2 Observation Status**

New ECS files have been received for revolutions 1052 to 1064 (up to 03 July).

### **3.3.3 ISOC Science Data Archive**

Syncing of rev\_3 data has been done up to revolution 1051 (no change yet).

Raw telemetry copied from MOC is available up to 31 July.

Significant effort has been spent on the URD for the ISDA within the new archive framework at ESAC.

### **3.3.4 ISOC System**

ISOC software V30 was released for testing on 18 July, the updated PGT for data right proposals on 29 July.

An issue was found in several revolutions, where "ping-pong filters" are being placed in windows where they should not appear during eclipse times. This has been traced back to an incorrect handling in the ISOC S/W and will be fixed in the future.

### **3.3.5 Problems**

Observation planning for revolutions with non-standard observations is quite frequently affected by issues not apparent in the past and largely caused by the orbital evolution.

## **4 Anomalies**

Table 1 contains the anomalies that occurred in the reporting period:

**Table 1: Anomalies reported**

| AR id    | Date of occurrence | Subject                                                           | Segment | Status  |
|----------|--------------------|-------------------------------------------------------------------|---------|---------|
| INT-3167 | 2011-07-07         | TC: A3085 'RC SUN STEER INI' CEV "unverified"                     | IMCS    | Pending |
| INT-3168 | 2011-07-12         | IFMS: No Ranging data from REDU IFMS1 (DOY 187)                   | GFCC    | Pending |
| INT-3169 | 2011-07-06         | FDS cluster failover killed Job Scheduler without alarm (DOY 187) | FDS     | Closed  |

| AR id      | Date of occurrence | Subject                                                                  | Segment    | Status  |
|------------|--------------------|--------------------------------------------------------------------------|------------|---------|
| INT-3170   | 2011-07-13         | Update MCCM threshold for FDS disk space monitoring                      | IMCS       | Pending |
| INT-3171   | 2011-07-19         | Manual Editing during Timeline Preparation.                              | MPS        | Pending |
| INT-3172   | 2011-07-19         | TM offline playbacks not working from REDU                               |            | Pending |
| INT-3174   | 2011-07-20         | ISOC split SATENG window into 2 parts for Rev 1059.                      |            | Pending |
| INT-3176   | 2011-07-25         | Cannot generate Star Tracker command patch sequence using the OBSM tool. | IMCS       | Pending |
| INT-3177   | 2011-07-27         | Aux files not received by ISDC                                           | IMCS       | Pending |
| INT-3178   | 2011-07-24         | OBQD displays incorrect and contradictory                                | IMCS       | Pending |
| INT-3179   | 2011-07-25         | OBQD displays incorrect: TTAG buffer contents                            | IMCS       | Pending |
| INT-3180   | 2011-07-27         | CCC script to restart IFTS_SDS instance on isdsa did not work            | CCC        | Pending |
| INT_SC-330 | 2011-07-06         | JEM-X1 DFEE CRC Anomaly following eclipse on 2011-07-06                  | Payload    | Closed  |
| INT_SC-331 | 2011-07-17         | SEU on BD2A GSW2 LCL                                                     | Spacecraft | Pending |
| INT_SC-332 | 2011-07-15         | IBIS: VETO Reset / TC rejected during execution of VETO patch            | Payload    | Testing |
| INT_SC-333 | 2011-07-21         | IREM Anomaly: Reset of IREM_CSCI S/W #110, 21/07/2011                    | Payload    | Closed  |
| INT_SC-334 | 2011-07-26         | IREM Anomaly: Reset of IREM_CSCI S/W #111, 26/07/2011                    | Payload    | Closed  |
| INT_SC-335 | 2011-07-30         | JEM-X2 DFEE CRC Anomaly following eclipse on 2011-07-30                  | Payload    | Testing |

## 5 Special Events & Future Milestones

The ongoing eclipse season #19 ends on 17<sup>th</sup> August 2011.

Star-tracker blemish pixel survey planned for the 24<sup>th</sup> August 2011

Analysis for possible Earth observations in 2012

## 6 Appendix

The appendix contains some detailed information concerning the AOCS subsystem and the instruments.

### 6.1 AOCS operations

During this period, 363 Open Loop Slews, 524 Closed Loop Slews and 29 Momentum Biases were executed (as reported by ACC OEM).

10 slews were missed from the Timeline.

#### 6.1.1 Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 01/08/2011 is reported in the following plot:

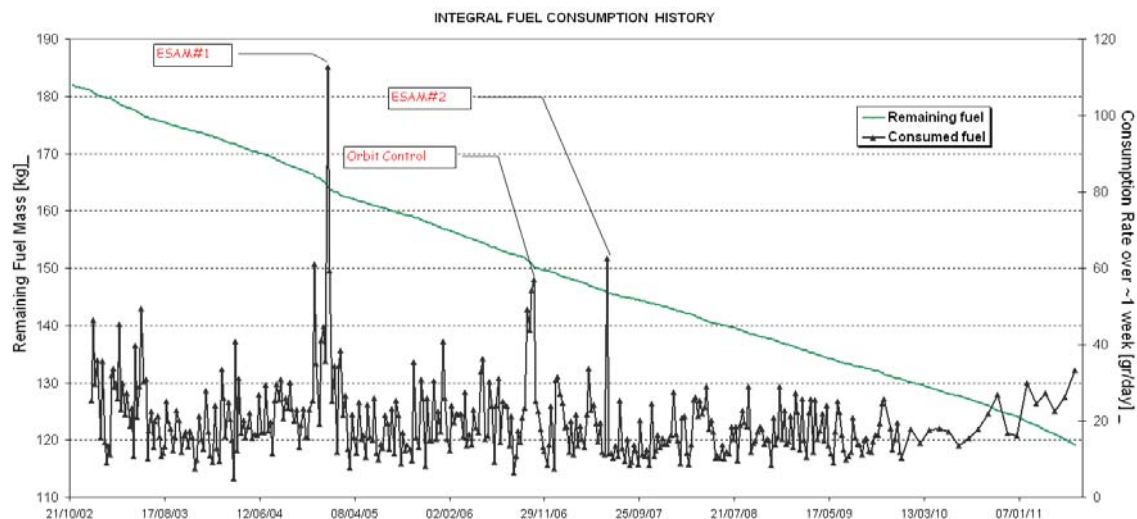


Figure 11: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

#### 6.1.2 The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the last month are 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.

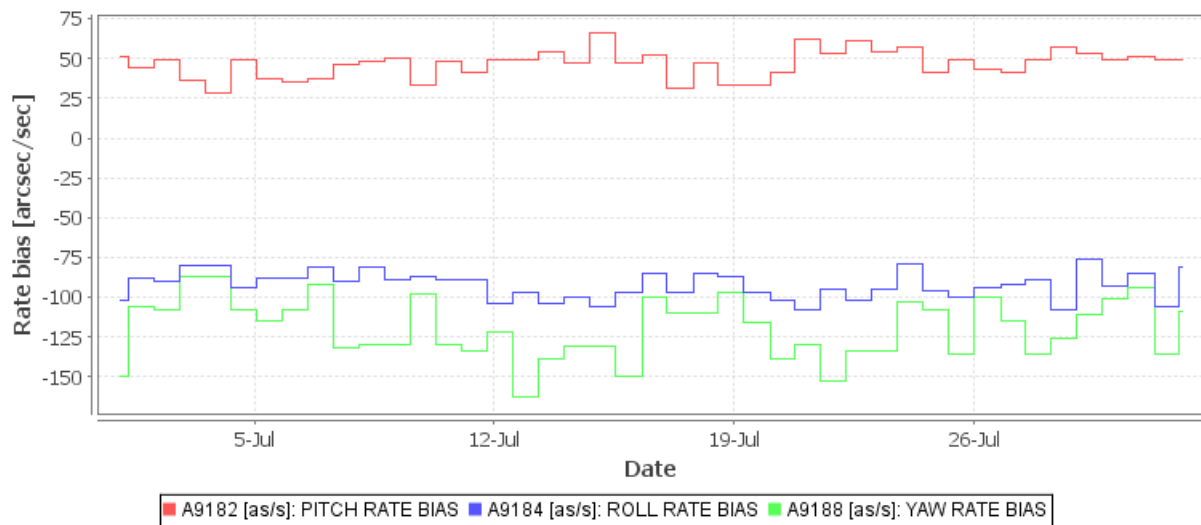


Figure 12: RMU pitch, roll and yaw. Historic data is available on request

### 6.1.3 Event log

#### 01/07/2011 (Day of Year 182, Revolution 1063 to 1064)

IMU1 switched ON during the stable pointing of PID 10640009 (07:53:01Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 10640010 were manually updated (spacontool).

OTF was not reached for PID 10640009.

No slew was missed.

#### 06/07/2011 (Day of Year 187, Revolution 1065)

- FDS TPF update failed for slew 10650068 (08:16:00Z).The AOCS was suspended in the Timeline, then a manual mapping was commanded and the parameters for 10650068 manually updated.

No impact in the Timeline

- FDS TPF update failed for slew 10650069 (09:10:00Z).The AOCS was suspended in the Timeline, then a manual mapping was commanded and the parameters for 10650069 manually updated.

No impact in the Timeline

#### **08/07/2011 (Day of Year 189, Revolution 1066)**

FDS TPF update failed for slew 10660049 (10:23:00Z). The AOCS was suspended in the Timeline, then a manual mapping was commanded and a slew was manually generated from attitude 10660048 to attitude 10660049.

After the manual slew was completed, the parameters for slew 10660050 were manually updated (spacontool).

Slew 10660049 was missed from the Timeline. The OTF was not reached for its PID.

#### **10/07/2011 (Day of Year 191, Revolution 1066 to 1067)**

Autostack commanding for slew 10670029 (17:35:04Z) failed release, because of GS problems. The AOCS was suspended in the Timeline, then a manual mapping was commanded and a slew was manually generated from attitude 10670028 to attitude 10670029.

Since the Timeline RWB was missed while performing the attitude recovery, a manual RWB was performed at 18:29:00Z.

After the manual RWB was completed, a manual mapping was commanded and a slew was manually generated from attitude 10670029 to attitude 10670030.

Because the GS problems continued, the AOCS recovery could not continue at this point. Once commanding capability was recovered, a slew was manually generated from attitude 10670030 to attitude 10670033.

After the manual slew was completed, the parameters for slew 10670034 were manually updated (spacontool).

Slows 10670029, 10670030, 10670031, 10670032 and 10670033 was missed from the Timeline. The OTF was not reached for their PIDs.

#### **14/07/2011 (Day of Year 195, Revolution 1068)**

Autostack commanding for slew 10680041 (04:36:00Z) failed release, because of GS problems. The AOCS was suspended in the Timeline, then a manual mapping was commanded and a slew was manually generated from attitude 10680040 to attitude 10680041.

After the manual slew was completed, the parameters for slew 10680042 were manually updated (spacontool).

Slew 10680041 was missed from the Timeline. The OTF was not reached for its PID.

#### **20/07/2011 (Day of Year 201, Revolution 1070)**

FDS TPF update failed for slew 10700064 (08:33:00Z). The AOCS was suspended in the Timeline, then a manual mapping was commanded and a slew was manually generated from attitude 10700063 to attitude 10700064.

After the manual slew was completed, the parameters for slew 10700065 were manually updated (spacontool).

Slew 10700064 was missed from the Timeline. The OTF was not reached for its PID.

### **29/07/2011 (Day of Year 210, Revolution 1073)**

- Autostack commanding for slew 10730042 (00:10:00Z) failed release. The AOCS was suspended in the Timeline, then a manual mapping was commanded and a slew was manually generated from attitude 10730041 to attitude 10730043.

After the manual slew was completed, the parameters for slew 10730044 were manually updated (spacontool).

Slews 10730042 and 10730043 were missed from the Timeline. The OTF was not reached for their PIDs.

- IMU1 switched ON during the stable pointing of PID 10730076 (22:43:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 10730077 were manually updated (spacontool).

OTF was not reached for PID 10730076.

No slew was missed.

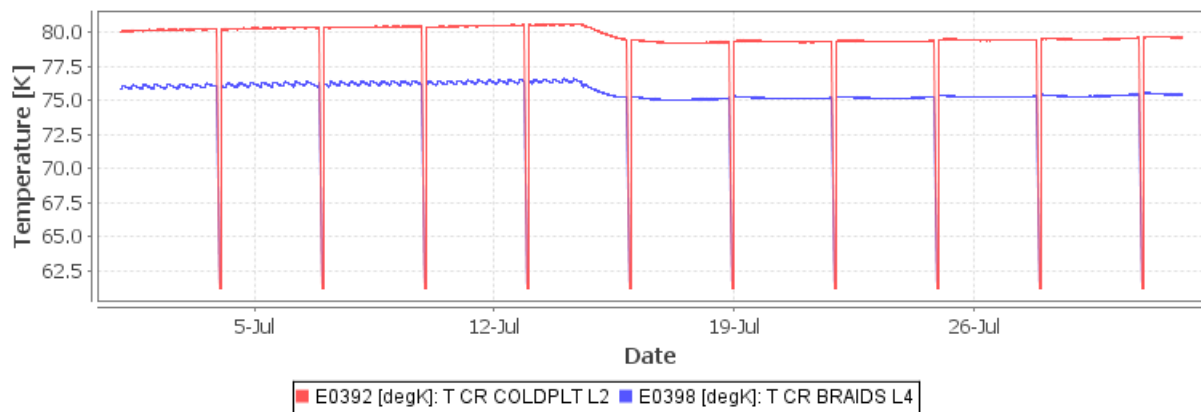
## **6.2 SPI**

### **6.2.1 Operations**

#### **Stirling Compressors and Cryostat**

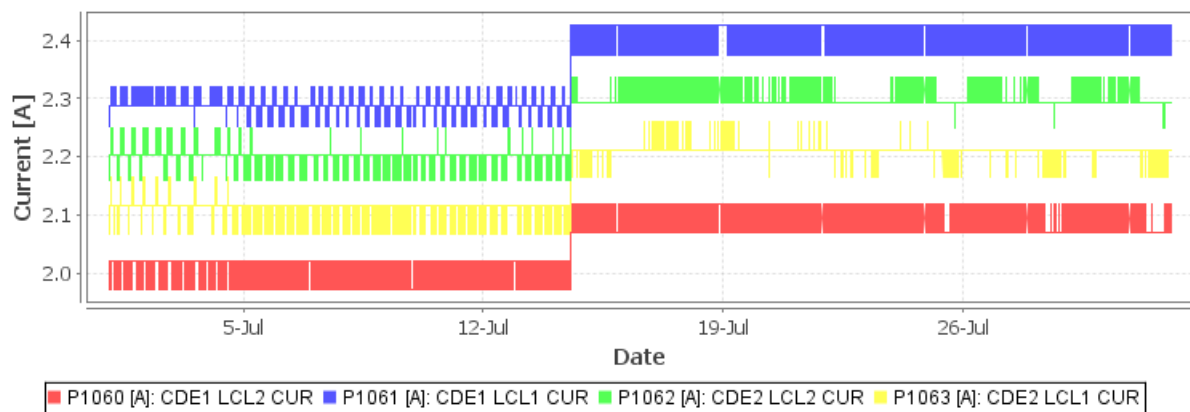
The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

The following plot shows the evolution of the cold plate and H bus temperature during the reporting period. The downward spikes in the cold plate temperature should be disregarded as these are zero values acquired when the AFEE is OFF during eclipse. The stroke of all four compressors was increased to 41 on 14-07-2011.



**Figure 13: SPI Cold plate and H-bus temperature**

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



**Figure 14: SPI CDE LCL current**

### DPE & IASW

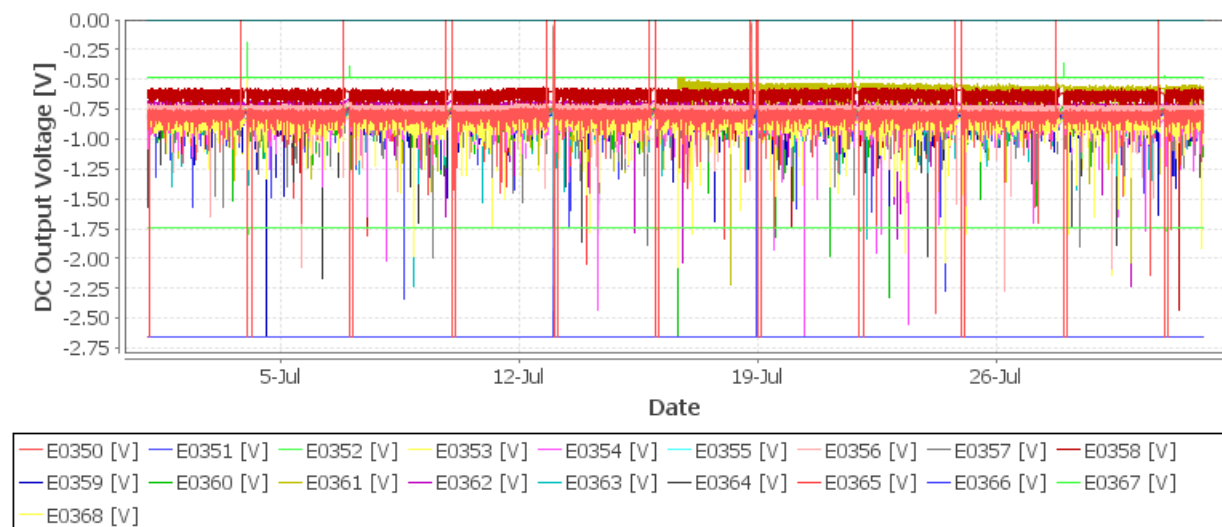
The DPE health and IASW performance are nominal. The IASW version installed is v4.3.5 with both SE compression and PE reduction enabled and the spectra scaling factor set to 7/19 SE. The DPE CPU usage was nominal during the reporting period (see Figure 2).

### 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). A plot of the ACS counts is given in Figure 6: Instrument Count Rates.

### AFEE

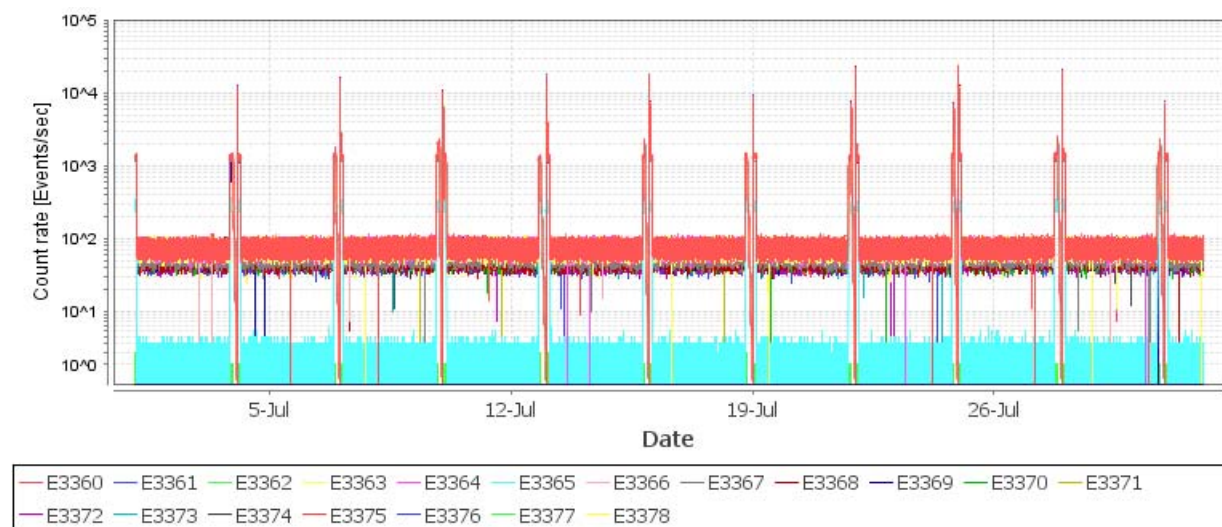
The health of the AFEE is nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004; detector #5 is failed since 19/02/2009 and detector #1 is failed since 27/05/2010. The HV of the failed detectors are nominally set to 0.5kV and events from these GeDs are disabled in the DFEE and PSD. The following plot shows the AFEE DC output voltages over the reporting period.



**Figure 15: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)**

### DFEE

The health of the unit is nominal. The following plots show the Non Vetoed, Time Tagged and Time Tagged Saturated Event count rates during the reporting period.



**Figure 16: SPI GeD Non-Vetoed count rates. Note that the scale used for plotting is logarithmic.**



**Figure 17: SPI GeD Time Tagged count rates. Note that the scale used for plotting is logarithmic.**



**Figure 18: SPI GeD Time Tagged Saturated count rates**

## PSD

The health of the PSD is nominal. The following plot shows the PSD channel rates over the reporting period.

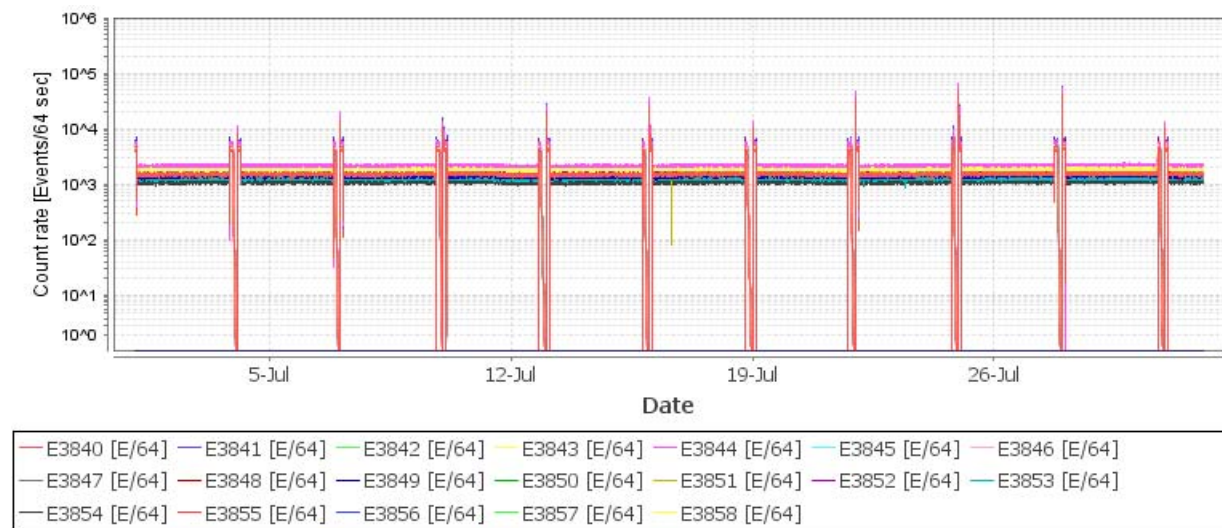


Figure 19: SPI PSD GeD Channel rates

## 6.2.2 Event Log

### 27-06-2011 until 17-08-2011 (Revolution 1063-1079)

Eclipse season #19: Lots of OOLs occur during the post eclipse activation. Until the next eclipse season, these OOLs should be dissolved.

### 14-07-2011 (Day of Year 195, Revolution 1059)

FCP\_SPI1\_2504 was executed to increase the stroke of all four compressors from 39 to 40 at a coldplate temperature of 80.5K (agreed with PI). SPI operations continued nominally.

### 15-07-2011 (Day of Year 196, Revolution 1068)

At 21.47Z OEM APID 1024 ID 1 EXCEPTION SPI1 FIXED POINT OVERFLOW was received. As it was a single occurrence, no action was required. SPI operations continued nominally.

### 16-07-2011 and 19-07-2011 (Day of Year 197 and 200)

At 00:29Z and 00:15Z respectively the SPI ED EEXIT-03 failed release from the timeline. The reason for the EEXIT-03 fail release seems to be due to the sequence EEXIT-03 colliding with GEBENT-02: EEXIT-03 fails release during the uplink of the parameters EU0102D, EU0518D, EU0201D with dynamic default (after the refresh of TM parameters) whenever there are 10 or more commands (mostly from GEBENT-02 sequence) between the refresh command and the following EEXIT-command with parameters set by dynamic default. This is due to the autostack only handling the next 10 commands. The investigations are ongoing. SPI operations continued nominally.

### 01-07, 07-07, 13-07 and 22-07-2011 (Day of Year 182, 188, 194, 203, Rev. 1064, 66, 68, 71)

E2121 (VCU AC current monitoring) was OOL hard HIGH at radiation belt entry. No action was required. SPI operations continued nominally.

## 6.3 IBIS

### 6.3.1 Operations

#### ISGRI

The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the reporting period:

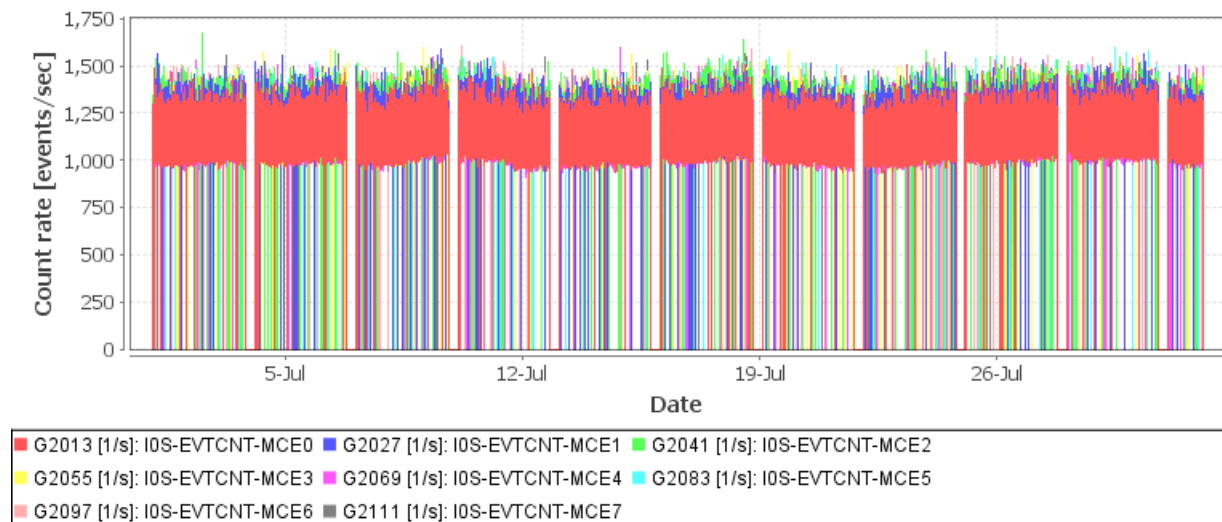


Figure 20: ISGRI MCE Counters

#### PICsIT

The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the reporting period:



Figure 21: PICsIT semi-module counters. Note that the scale used for plotting is logarithmic.

**VETO**

The health and performance of VETO was nominal during the reporting period. Plots of the VETO counters are given in Figure 6: Instrument Count Rates.

**6.3.2 Event Log****27-06-2011 until 17-08-2011 (Revolution 1063-1079)**

Eclipse season #19: Lots of OOLs occur during the post eclipse activation. Until the next eclipse season, these OOLs should be dissolved.

**03-07-2011 to 30-07-2011 (Day of Year 184 to 211, Revolution 1064 to 1073)**

OEM: "IBIS1 PICSIT NOISY SEMIMODULE..." occurred during the following periods:

|                       |       |                       |
|-----------------------|-------|-----------------------|
| 2011.184.22.58.03.372 | until | 2011.184.23.12.35.372 |
| 2011.187.23.03.47.541 | until | 2011.187.23.14.03.542 |
| 2011.190.22.39.23.697 | until | 2011.190.22.52.03.697 |
| 2011.193.22.49.31.853 | until | 2011.193.23.05.39.854 |
| 2011.199.22.03.00.200 | until | 2011.199.22.17.32.201 |
| 2011.202.22.03.32.366 | until | 2011.202.22.15.16.367 |
| 2011.205.21.55.40.536 | until | 2011.205.22.04.44.536 |
| 2011.211.21.02.44.876 | until | 2011.211.21.06.20.876 |

Since IASW was in stand by and the S/C inside the radiation belts, no action was required. IBIS operations continued nominally.

**08-07-2011 (Day of Year 189, Revolution 1066)**

At 19:28Z following OOLs occurred for two minutes:

G5068 & G5072 family (PDMi semi-module #1 & #2)

G5002 family (PICSIT event count-rates semi-module #1)

These were followed at 19:34Z (by which time all the above parameters had returned within limits) by OEM APID 1280 ID 132: "IBIS1 IASW HEPI RESYNCHRONISED" indicating that HEPI resynchronised autonomously. No action was required.

**15-07-2011 (Day of Year 196, Revolution 1068)**

At 22:21Z, during the uplink of the ED GEVESPO1 for the VETO SW patch post eclipse (uplinked at every unit reconfiguration after eclipse exit), a VETO reset occurred during the uplink of the patch due to a communication problem on the LSL line:

TC: GU0613TC (TC-V-DUMP-31) (ED: GEVESPO1) failed acceptance

TM: G8012 (S1E-A4 BI V) + G6030 (V1s-CDMO2STAT) failed Status Consistency Check with value = ON.

OEM: IBIS1 IASW TIME OUT TRANSMITTING LSL DATA

OEM: IBIS1 IASW EXTERNAL TC REJECTED COULD NOT BE EXECUTED

OEM: IBIS1 IASW TIME OUT TRANSMITTING LSL DATA

It seems that ED GEVESPO1 resulted in both CDM01 and CDM02 running with the wrong configuration: They were switched ON after the TC rejection. The reason of the LSL error and the cut in communication is unknown. It already happened during former eclipse seasons (see e.g. INT\_SC-130). The specified recovery actions for this anomaly were executed. Unfortunately the cross reference has not been followed correctly in some points (partly due to misunderstandings with the

on-call SOE). The recovery was completed by 2011-07-16 at 01:10Z and IBIS operations continued nominally. This delayed the activation of IBIS for science for 30 minutes.

### **22-07-2011 (Day of Year 203, Revolution 1071)**

At 00:09Z a local reset of the IREM CSCI S/W (SEU #110) was observed. The IREM reset forced IBIS to automatically enter Safe configuration inducing following OEMS:

2011.203.00.27.09.512 IBIS1 IASW EMERGENCY SWITCH OFF

2011.203.00.11.12.652 IBIS1 IASW EMERGENCY SWITCH OFF PERFORMED (GOTO STANDBY

2011.203.00.09.44.633 IBIS1 IASW EMERGENCY SWITCH OFF PERFORMED (GOTO STANDBY

Due to eclipse season the IREM crash was not detected until 00:37Z. IBIS recovery was completed by 2011-07-22 at 01:58Z and IBIS operations continued nominally.

### **26-07-2011 (Day of Year 207, Revolution 1072)**

At 01:24Z, a local reset of the IREM CSCI S/W (SEU #111) was observed. The IREM reset forced IBIS to automatically enter Safe configuration inducing following OEMS:

2011.207.01.24.49.251 IBIS1 IASW VETO SWITCH OFF PERFORMED DUE TO AUTOMATISM

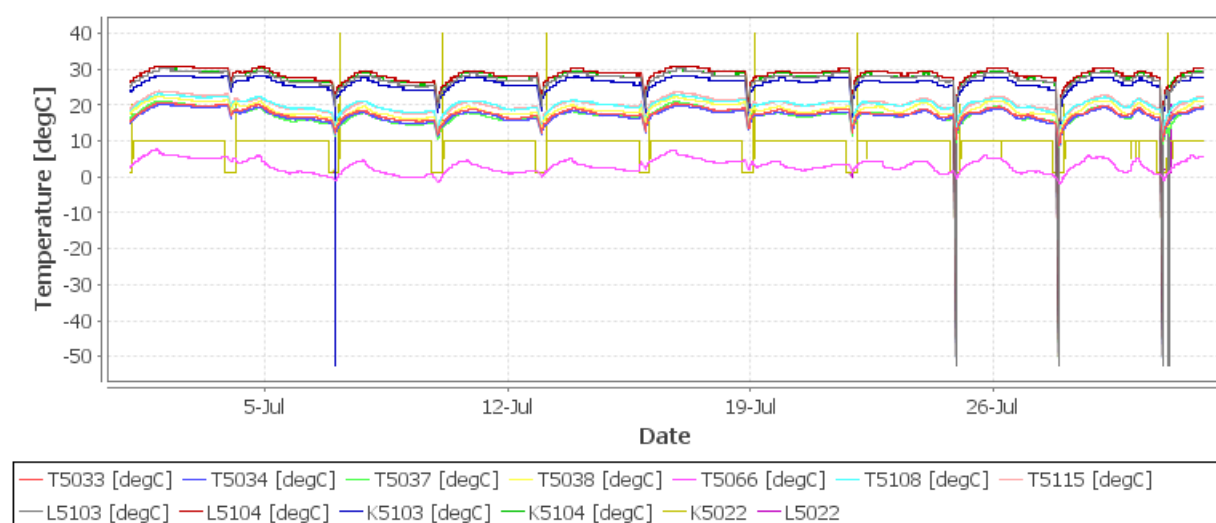
2011.207.01.24.48.856 IBIS1 IASW EMERGENCY SWITCH OFF PERFORMED (GOTO STANDBY

IBIS recovery was completed by 2011-07-26 at 01:50Z and IBIS operations continued nominally.

## **6.4 JEM-X**

### **6.4.1 Operations**

The Status of JEMX-1 & 2 is nominal. The following plot shows the JEMX DFEE and detector temperatures over the reporting period.



**Figure 22: JEMX Detector and DFEE Temperatures**

## **6.4.2 Event Log**

### **06-07-2011 (Day of Year 187, Revolution 1066)**

At 21:53:00, after AOS, it was observed that JEMX-1 had not switched-on correctly after the eclipse. The symptoms were as follows:

1) Following the execution of KECLXT01 ED, the JEM-X1 DFEE state (TM parameter K5022) remained MEMORY, instead of SAFE, and the Active Shutdown Level (TM parameter K5381) remained ECLIPSE instead of RAD. BELTS.

3) The DFEE CPU speed, TM parameter K5583 CPU MODE, remained at a value of 8 MHz WAIT (as at start-up) rather than the nominal value of 16MHz.

4) A power cycle was performed according to CRP\_JEM1\_5010 JEMX1 DFEE POWER CYCLE, consisting of:

- 22:24:00Z FCP\_JEM1\_9010 JEMX1 DFEE SWITCH OFF
- 22:42:00Z FCP\_JEM1\_0021 JEMX1 DFEE ACTIVATION

There was no impact on the timeline.

### **26-07-2011 (Day of Year 207, Revolution 1072)**

At 01:24:50 JEMX-1 & 2 parameters K5315, K5316, K5317, L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#111). There was no impact as the reaction has been disabled.

### **30-07-2011 (Day of Year 211, Revolution 1074)**

At 20:16:00, after AOS, it was observed that JEMX-2 had not switched-on correctly after the eclipse. The symptoms were as follows:

1) Following the execution of LECLXT01 ED, the JEM-X2 DFEE state (TM parameter L5022) remained MEMORY, instead of SAFE, and the Active Shutdown Level (TM parameter L5381) remained ECLIPSE instead of RAD. BELTS.

3) The DFEE CPU speed, TM parameter L5583 CPU MODE, remained at a value of 8 MHz WAIT (as at start-up) rather than the nominal value of 16MHz.

4) A power cycle was performed according to CRP\_JEM2\_5010 JEMX2 DFEE POWER CYCLE, consisting of:

- 23:51:00Z FCP\_JEM2\_9010 JEMX2 DFEE SWITCH OFF
- 00:08:00Z FCP\_JEM2\_0021 JEMX2 DFEE ACTIVATION
- 00:03:00 FCP\_JEM2\_1010 JEMX2 CONFIGURATION SETTING FOR SCIENCE OPS
- 01:14:00 FCP\_JEM2\_0040 JEMX2 TRANSITION TO SAFE
- 01:22:00 FCP\_JEM2\_0041 JEMX2 TRANSITION TO SETUP

- 01:31:00 LEACAL01 JEMX2 ANODE ELECTRONIC CALIBRATION AT PERIGEE EXIT
- 01:52:00 FCP\_JEM2\_1010 CONFIGURATION SETTING FOR SCIENCE OPS
- 02:27:00 LEDATA02 ACTIVATE JEM-X2 DATA TAKING MODE & SET TRIGGER LIMIT

The impact was the loss of 2 hours 40 minutes of science time.

## 6.5 OMC

### 6.5.1 Operations

The status and performance of OMC is nominal.

### 6.5.2 Event Log

#### 10-07-2011 (Day of Year 191, Revolution 1067)

At 17:35, RFI at the ground station caused a TM drop, which forced an interruption of operations. A recovery was performed and the timeline restored at 20:16. The impact was the pointing 10670029 was executed at the wrong attitude and pointing 10670033 was lost.

#### 14-07-2011 (Day of Year 195, Revolution 1068)

At 04:36, a TM drop from Redu caused the loss of the AOCS commands. A recovery was performed and the timeline rejoined at 05:04:00. The impact was the loss of pointing 10680041. It was at this time that the following pair of commands was rejected:

|                       |                       |      |          |          |           |          |
|-----------------------|-----------------------|------|----------|----------|-----------|----------|
| 2011.195.04.42.51.121 | 2011.195.04.42.58.624 | 1792 | RealTime | 131      | TC REJECT | REJECTED |
| TC1                   |                       | 0    | 0        | 65535 PR | N E E     |          |
| 2011.195.04.42.57.121 | 2011.195.04.43.04.886 | 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 that pointing.

#### 17-07-2011 (Day of Year 198, Revolution 1069)

At 08:45, there was an SEU on the BD2A GSW2 LCL monitored by parameter P2111 (P BD2A GSW2 STA). This caused further upsets on the LCLs monitored by P2112 (LCL STA OMC EU A), P2113 (LCL STA ODPE A), & T8501 (LCL STA CAM HT-A).

This switched the OMC DPE & EU off, and also a SPI heater.

The recovery executed was:

08:56:00 FCP\_EPS\_1513 is followed and TC P4077 is sent to return BD2A GSW2 LCL back to original status as per step 4.1

09:47:00 FCP\_OMC\_0010, primary checks are carried out and at step 2 ,BCP is showing as enabled when it should be disabled. So

10:12:00 FCP\_OMC\_9001 Disabled OMC BCP

10:19:00 FCP\_OMC\_9000 OMC DPE switch off

10:26:00 FCP\_OMC\_0010 DPE and CSSW activation

10:50:00 FCP\_OMC\_9810 (OMC DPE patch)

12:59:17 OMC DPE patch completed

13:01:00 FCP\_OMC\_0015 (OMC IASW ACTIVATION)

13:11:00 FCP\_OMC\_0016 (OMC ENABLE BCP DISTRIBUTION)

13:18:00 FCP\_OMC\_0020 (OMC EU ACTIVATION) (FCP\_EPS\_1513 step 5)

13:23:00 S/S OMC enabled on the A/S

The recovery was slowed by the lack of TM allocation needed to dump the OMC DPE S/W image. The impact was pointing 10690038 was cut short from a planned 3000 to 1200 seconds, and pointings 10690039 to 10690043 (5 pointings) were lost.

#### **20-07-2011 (Day of Year 201, Revolution 1070)**

At 08:33, a FD problem (insufficient stars in the star-tracker FOV) prevented the update for the next slew. A recovery was performed and the timeline rejoined at 09:44. The impact was the loss of pointing 10700064. It was at this time that the following pair of commands was rejected:

|                       |                       |      |          |       |    |        |          |
|-----------------------|-----------------------|------|----------|-------|----|--------|----------|
| 2011.201.09.30.56.865 | 2011.201.09.31.10.164 | 1792 | RealTime | 131   | TC | REJECT | REJECTED |
| TC1                   |                       | 0    | 0        | 65535 | PR | N      | E        |
| 2011.201.09.31.03.240 | 2011.201.09.31.10.280 | 1792 | RealTime | 131   | TC | REJECT | REJECTED |
| TC1                   |                       | 0    | 0        | 65535 | PR | N      | E        |

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

#### **21-07-2011 (Day of Year 202, Revolution 1071)**

Some time before AOS at 20:50:00 an IREM SEU (#110) occurred. Due to other activities, this was not immediately observed. At 00:05:00, the following day, the M1131 (RESET ROE) failed release. At 00:08:54, the commands for the first OMC pointing were rejected, and OMC disabled in the timeline. At 00:37, the IREM crash was noticed, and a recovery performed. The unit was returned to Stand-by at 01:41:54. The impact was the loss of pointings 10710002 & 10710004. It was at this time that the following pair of commands was rejected:

|                       |                       |      |          |       |    |        |          |
|-----------------------|-----------------------|------|----------|-------|----|--------|----------|
| 2011.203.00.08.54.699 | 2011.203.00.08.58.911 | 1792 | RealTime | 131   | TC | REJECT | REJECTED |
| TC1                   |                       | 0    | 0        | 65535 | PR | N      | E        |
| 2011.203.00.09.02.074 | 2011.203.00.09.05.187 | 1792 | RealTime | 131   | TC | REJECT | REJECTED |
| TC1                   |                       | 0    | 0        | 65535 | PR | N      | E        |

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 10710002.

### **26-07-2011 (Day of Year 207, Revolution 1072)**

At 01:24:50, an IREM SEU (#111) forced OMC to SAFE mode. A recovery was performed, and the timeline rejoined at 01:38:26. The impact was 10720043 was cut short from a planned 2083 to 169 seconds.

At 04:33:05, pointing 10720048 was interrupted after the CCCFs were executed as part of the recovery after the IREM crash. At 04:38:25, the pointing commands were manually resent. The impact was pointing 10720048 was cut short from a planned 2083 to 1456 seconds.

### **29-07-2011 (Day of Year 210, Revolution 1073)**

At 00:10:00, an AOCS command failed release, which forced a suspension of operations. A recovery was performed, and the timeline rejoined at 00:50:00. The impact was the loss of pointing 10730042. It was at this time that the following pair of commands was rejected:

|                       |                       |      |          |          |           |          |
|-----------------------|-----------------------|------|----------|----------|-----------|----------|
| 2011.210.00.13.41.966 | 2011.210.00.13.50.622 | 1792 | RealTime | 131      | TC REJECT | REJECTED |
| TC1                   |                       | 0    | 0        | 65535 PR | N E       | E        |
| 2011.210.00.13.47.966 | 2011.210.00.13.57.714 | 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 that pointing.

## **6.6 IREM**

### **6.6.1 Operations**

#### **Radiation belts entry and exit**

The following plots show the Radiation Belt Entry (Figure 23, red line) and Exit times (Figure 24, blue line) obtained from the ISDC website, defined where the IREM TC3 (soft electrons) rate reads 600 counts. The blue line in Figure 23 and the magenta line in Figure 24 are the altitudes used by the MOC for planning purposes.

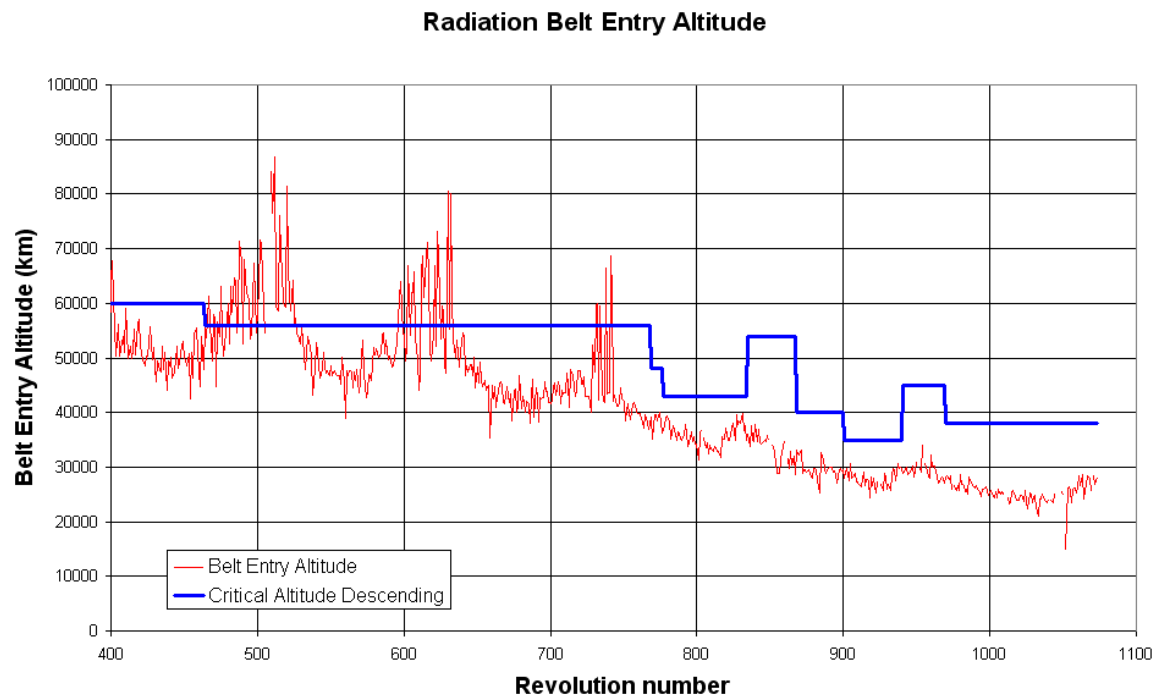


Figure 23: Radiation belt entry

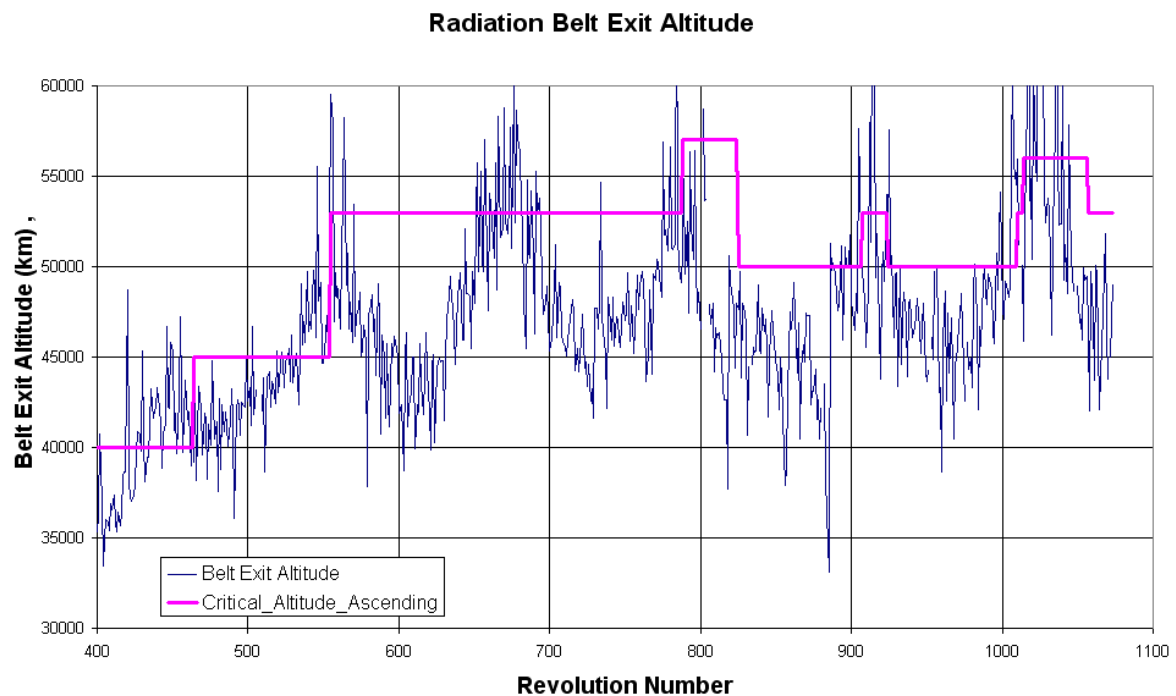


Figure 24: Radiation belt exit

**Table 2: Radiation belts. Radiation belt entry crossings are ignored if there is a subsequent gap of at least 30 minutes of low radiation.**

| Rev. number | Spacecraft BCPKT (electron)        | Observed entry/exit time by Electron CUT-OFF | Observed entry/exit altitude [km] by Electron CUT-OFF | Predicted entry/exit time by Electron CUT-OFF | Predicted entry/exit altitude [km] by Electron CUT-OFF | Predicted entry/exit time by Proton CUT-OFF | Predicted entry/exit altitude [km] by Proton CUT-OFF |
|-------------|------------------------------------|----------------------------------------------|-------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------|---------------------------------------------|------------------------------------------------------|
| 1064        | RAD_EXIT R<br>2011-07-01T01:27:01Z | 30/06/2011<br>23:55:35                       | 36770.6                                               | 01-Jul-2011<br>00:57:41                       | 48471.42                                               | 30-Jun-2011<br>21:07:47                     | 3631.447                                             |
| 1064        | RAD_ENTR R<br>2011-07-03T18:10:45Z | N/A                                          | N/A                                                   | 03-Jul-2011<br>19:37:41                       | 18662.04                                               | 03-Jul-2011<br>20:17:41                     | 8914.186                                             |
| 1065        | RAD_EXIT R<br>2011-07-04T01:11:46Z | 03/07/2011<br>23:44:15                       | 36770.0                                               | 04-Jul-2011<br>00:37:41                       | 48354.37                                               | 03-Jul-2011<br>20:47:41                     | 3581.424                                             |
| 1065        | RAD_ENTR R<br>2011-07-06T17:58:20Z | 06/07/2011<br>19:24:32                       | 20307.5                                               | 06-Jul-2011<br>19:34:13                       | 17418.84                                               | 06-Jul-2011<br>20:04:13                     | 10038.77                                             |
| 1066        | RAD_EXIT R<br>2011-07-07T00:58:49Z | 06/07/2011<br>23:34:40                       | 36812.9                                               | 07-Jul-2011<br>00:24:13                       | 47642.35                                               | 06-Jul-2011<br>20:44:13                     | 3384.359                                             |
| 1066        | RAD_ENTR R<br>2011-07-09T17:47:26Z | 09/07/2011<br>19:09:12                       | 20577.4                                               | 09-Jul-2011<br>19:20:28                       | 18020.84                                               | 09-Jul-2011<br>20:00:28                     | 8219.722                                             |
| 1067        | RAD_EXIT R<br>2011-07-10T00:47:42Z | 09/07/2011<br>23:36:08                       | 38701.2                                               | 10-Jul-2011<br>00:10:28                       | 47227.4                                                | 09-Jul-2011<br>20:30:28                     | 3385.93                                              |
| 1067        | RAD_ENTR R<br>2011-07-12T17:35:42Z | N/A                                          | N/A                                                   | 12-Jul-2011<br>19:06:57                       | 18766.99                                               | 12-Jul-2011<br>19:46:57                     | 9027.211                                             |
| 1068        | RAD_EXIT R<br>2011-07-13T00:36:30Z | 12/07/2011<br>23:49:20                       | 45230.3                                               | 13-Jul-2011<br>00:06:57                       | 48273.94                                               | 12-Jul-2011<br>20:26:57                     | 3652.072                                             |
| 1068        | RAD_ENTR R<br>2011-07-15T17:21:47Z | 15/07/2011<br>18:37:44                       | 23431.3                                               | 15-Jul-2011<br>18:52:47                       | 18909.4                                                | 15-Jul-2011<br>19:32:47                     | 9222.491                                             |
| 1069        | RAD_EXIT R<br>2011-07-16T00:23:16Z | 15/07/2011<br>23:05:28                       | 38607.4                                               | 15-Jul-2011<br>23:52:47                       | 48085.44                                               | 15-Jul-2011<br>20:12:47                     | 3700.045                                             |
| 1069        | RAD_ENTR R<br>2011-07-18T17:06:33Z | N/A                                          | N/A                                                   | 18-Jul-2011<br>18:35:45                       | 19317.5                                                | 18-Jul-2011<br>19:15:45                     | 9629.387                                             |
| 1070        | RAD_EXIT R<br>2011-07-             | 18/07/2011<br>22:34:56                       | 36730.0                                               | 18-Jul-2011<br>23:35:45                       | 47817.46                                               | 18-Jul-2011<br>19:55:45                     | 3598.52                                              |

| Rev. number | Spacecraft BCPKT (electron)        | Observed entry/exit time by Electron CUT-OFF | Observed entry/exit altitude [km] by Electron CUT-OFF | Predicted entry/exit time by Electron CUT-OFF | Predicted entry/exit altitude [km] by Electron CUT-OFF | Predicted entry/exit time by Proton CUT-OFF | Predicted entry/exit altitude [km] by Proton CUT-OFF |
|-------------|------------------------------------|----------------------------------------------|-------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------|---------------------------------------------|------------------------------------------------------|
| 1064        | RAD_EXIT R<br>2011-07-01T01:27:01Z | 30/06/2011<br>23:55:35                       | 36770.6                                               | 01-Jul-2011<br>00:57:41                       | 48471.42                                               | 30-Jun-2011<br>21:07:47                     | 3631.447                                             |
|             | 19T00:08:06Z                       |                                              |                                                       |                                               |                                                        |                                             |                                                      |
| 1070        | RAD_ENTR R<br>2011-07-21T16:53:09Z | 21/07/2011<br>17:51:12                       | 26111.7                                               | 21-Jul-2011<br>18:27:40                       | 17943.2                                                | 21-Jul-2011<br>19:07:40                     | 8195.251                                             |
| 1071        | RAD_EXIT R<br>2011-07-21T23:54:18Z | N/A                                          | N/A                                                   | 21-Jul-2011<br>23:27:40                       | 48855.46                                               | 21-Jul-2011<br>19:37:40                     | 3474.607                                             |
| 1071        | RAD_ENTR R<br>2011-07-24T16:39:55Z | 24/07/2011<br>17:51:52                       | 22562.3                                               | 24-Jul-2011<br>18:07:59                       | 19230.29                                               | 24-Jul-2011<br>18:47:59                     | 9504.179                                             |
| 1072        | RAD_EXIT R<br>2011-07-24T23:41:01Z | 24/07/2011<br>22:14:41                       | 36763.3                                               | 24-Jul-2011<br>23:07:59                       | 47943                                                  | 24-Jul-2011<br>19:27:59                     | 3547.367                                             |
| 1072        | RAD_ENTR R<br>2011-07-27T16:25:28Z | 27/07/2011<br>17:45:21                       | 22366.2                                               | 27-Jul-2011<br>17:59:06                       | 18106.24                                               | 27-Jul-2011<br>18:39:06                     | 8410.861                                             |
| 1073        | RAD_EXIT R<br>2011-07-27T23:27:00Z | 27/07/2011<br>22:26:49                       | >>38603.9                                             | 27-Jul-2011<br>22:59:06                       | 48653.52                                               | 27-Jul-2011<br>19:09:06                     | 3587.471                                             |
| 1073        | RAD_ENTR R<br>2011-07-30T16:10:34Z | 30/07/2011<br>17:20:25                       | 24840.6                                               | 30-Jul-2011<br>17:47:34                       | 18065.21                                               | 30-Jul-2011<br>18:27:34                     | 8371.192                                             |
| 1074        | RAD_EXIT R<br>2011-07-30T23:11:59Z | 30/07/2011<br>21:15:53                       | 32864.7                                               | 30-Jul-2011<br>22:47:34                       | 50153.24                                               | 30-Jul-2011<br>18:57:34                     | 3545.566                                             |

## 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)

## **6.6.2 Event Log**

### **21-07-2011 (Day of Year 202, Revolution 1071)**

At 20:50:00Z, at AOS, a local reset of the IREM CSCI S/W (SEU #110) was observed. The status of the unit, before the local reset of the IREM CSCI S/W, was nominal, here is a summary:

- 1) The temperatures were nominal;
- 2) The LCL current was nominal;
- 3) The last HK before the anomaly showed HV, 5V and 6V voltages inside limits;
- 4) The anomaly occurred before AOS at 2011.202.20:50:00Z (17621.3 km). The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex);
- 5) The recovery of the unit started immediately using procedure CRP\_SYS\_2570. The first dump of the status word after the anomaly reported a value of 38C0 HEX = 14528 DEC = 0011100011000000, i.e the ground link OFF, the command validity OFF and the Checksum Failure Flag ON. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.
- 6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP\_RM\_0081. The operation was completed at 03:14:00Z.

The IREM automatic transition to Standard Mode affected the instruments by forcing them to automatically enter Safe configuration, except for SPI and JEM-X whose automatisms are disabled according to the Pls request. OMC was recovered at 01:43:00Z and IBIS at 01:58:00Z.

### **26-07-2011 (Day of Year 207, Revolution 1072)**

At 01:24:49Z, a local reset of the IREM CSCI S/W (SEU #111) was observed. The status of the unit, before the local reset of the IREM CSCI S/W, was nominal, here is a summary:

- 1) The temperatures were nominal;
- 2) The LCL current was nominal;
- 3) The last HK before the anomaly showed HV, 5V and 6V voltages inside limits;
- 4) The anomaly occurred at 2011.207.01:24:49Z (156211.6 km). The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex); just before the anomaly, radiation counters reported nominal values considering the position of the S/C along the orbit;
- 5) The recovery of the unit started immediately using procedure CRP\_SYS\_2570. The first dump of the status word after the anomaly reported a value of BCC0 HEX = 48320 DEC = 1011110011000000, i.e the Checksum Failure Flag ON. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.
- 6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP\_RM\_0081. The operation was completed at 03:27:00Z.

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The IREM automatic transition to Standard Mode affected the instruments by forcing them to automatically enter Safe configuration, except for SPI and JEM-X whose automatisms are disabled according to the Pls request. OMC was recovered at 01:39:00Z and IBIS at 01:50:00Z