EUROPEAN SPACE AGENCY

DIRECTORATE OF TECHNICAL & OPERATIONAL SUPPORT

MISSION OPERATIONS DEPARTMENT

INTEGRAL

Mission report

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

No. 411

01.08.2012

Routine Phase

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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 perfomed 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 1186 untill 1196 (inclusive). The targets of these revolutions can be found on the ISOC web:

http://integral.esac.esa.int/isocweb/schedule.html?action=intro .

Summary of the main activities during the reporting period

- Nominal science operations apart from solar flare which forced OMC to safe for 2.5 days
- Eclipse operation until 17/07/2012 & reconfiguration after last eclipse
- IMCS E3.5.4 installation on A chain
- New NCTRS S/W installation on B chain
- Decrease of rad. belt exit altitude from rev. 1193
- E3.5.4 on A chain: alarm roll back & temp change (PTV check set to 20)
- IFDS configuration update (implement RMU drift analysis results)

Summary of the overall status and performance of S/C

- Nominal for platform and payload
- IBIS PICsIT PDM06 LATCH UP
- IBIS VETO crash during VETO activation
- JEM-X2 DFEE CRC anomaly following eclipse on 2012-07-05
- Problems experienced reactivating JEM-X after verifier crash
- SEU on LCL STA PTX1 (TM parameter P1121)
- PDU watchdog incorrect status
- Spurious switch off BCR1and BDR2 in combination with a switch on of reconditioning Relay K09

Summary of the overall status and performance of the ground segment

- Ongoing occasional RFI at Redu, some sources identified, filter installed for testing
- Ongoing occasional interruptions to ISDS-ISDC link
- Recovery following IMU switch ON
- PLM Operations interrupted following solar flare on 07/07/2012 affecting only OMC
- PLM Operations interrupted following solar flare on 08-09/07/2012 affecting only OMC
- PLM Operations interrupted following solar flare on 12-13/07/2012 affecting only OMC
- PLM Operations interrupted following solar flare on 17-20/07/2012 affecting only OMC
- PLM Operations interrupted following solar flare on 23-26/07/2012 affecting only OMC
- Spurious SCC FAIL OOL on several TMs following AOS (after IMCS E3.5.4 installation)

- IFTS not working after FDS reboot
- FDS unexpected server reboot
- Packet generation times stamped differently on A- and B-chains
- Message: "Global SCC reset message submitted" is missing in the event logger since DOY 131
- IFMS Software Problems Detected during Earth Observation Preparation

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

2 Satellite status

2.1 Platform

2.1.1 AOCS

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

7 slews were missed from the Timeline due to ground segment issues. For slews interrupted due to other issues (guide star problems, etc) please see the INTEGRAL weekly reports: http://10.33.199.49/documentation/wops.php

The fuel consumption over the reporting period was 0.6241 Kg. The remaining propellant is in the order of 111.3684 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 19th SPI annealing, which ended on 22/06/2012, 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 Germanium detectors' temperature was kept in the range 80K+/-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 2012-07-09T14:37:13Z to 2012-07-09T19:25:18Z (OMC Flat Field Calibration), when it was 88 packets/cycle. The average telemetry occupation when the allocation was 99 packets/cycle was 72.3 packets/cycle.

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

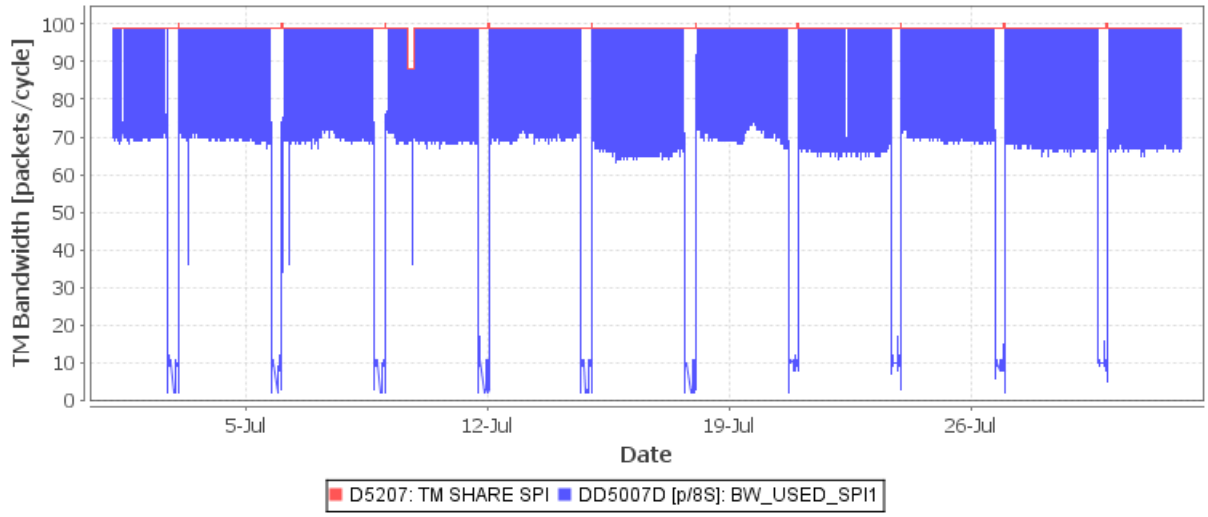


Figure 1: SPI TM bandwidth utilisation

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

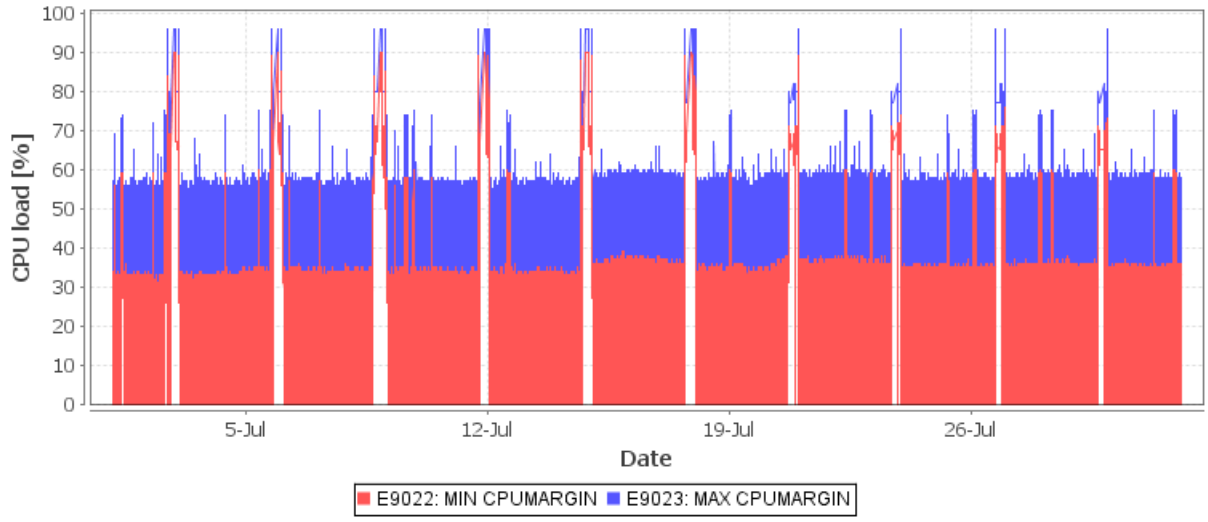


Figure 2: SPI IASW Performance

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

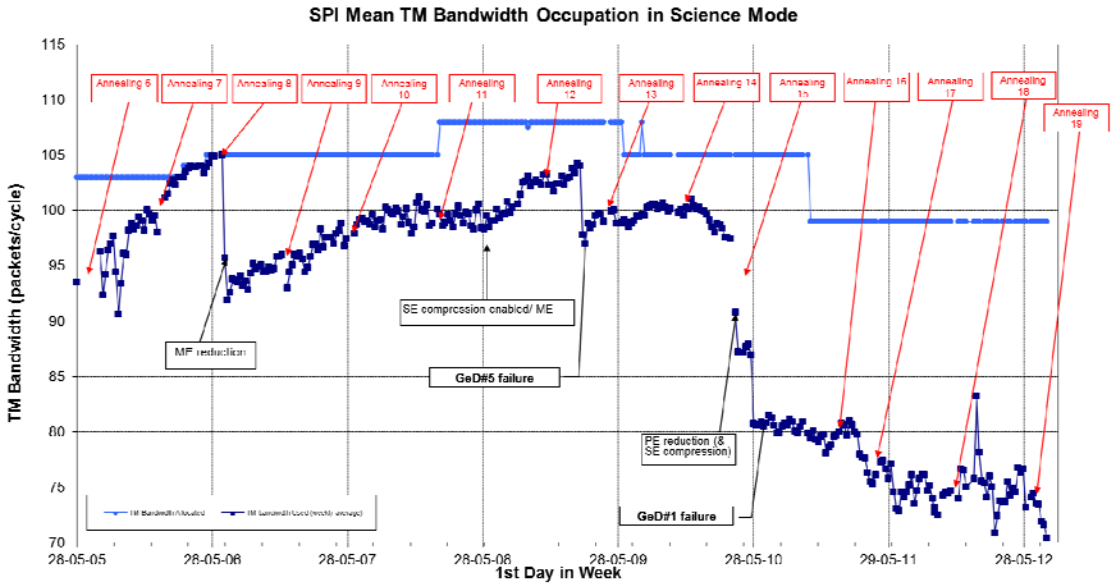


Figure 3: SPI TM bandwidth usage evolution since May 2005

The following plot is a zoomed in view of the plot above and shows the evolution of the assigned and the average occupation of the SPI TM bandwidth since May 2010.

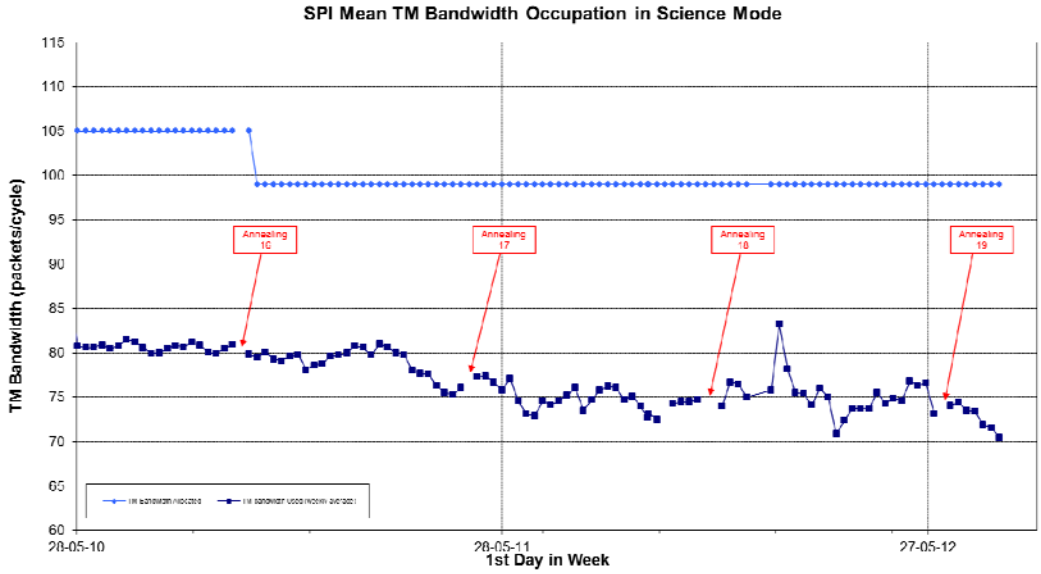


Figure 4: SPI TM bandwidth usage evolution since May 2010

Note: More information concerning the SPI operations is provided in Appendix 6.2.

2.2.2 IBIS

The overall status of IBIS is nominal.

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 2012-07-09T14:37:13Z to 2012-07-09T19:25:18Z (OMC Flat Field Calibration), when it was 90 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 112.81 packets/cycle

The plot below shows the IBIS TM utilisation during the reporting period. The periods of high solar radiation can clearly be seen from the TM utilisation.

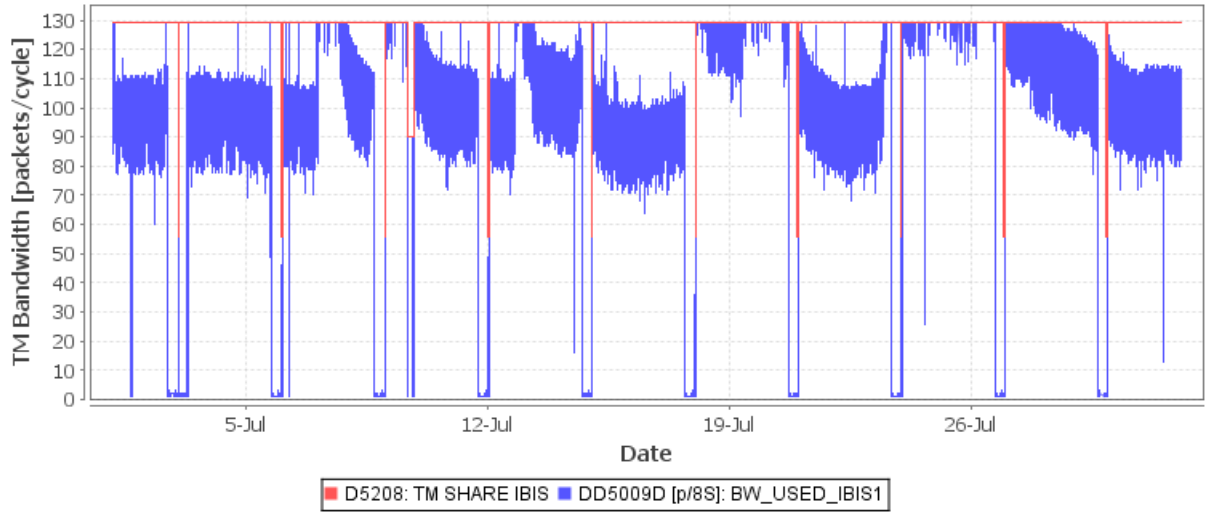


Figure 5: IBIS TM bandwidth utilisation

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

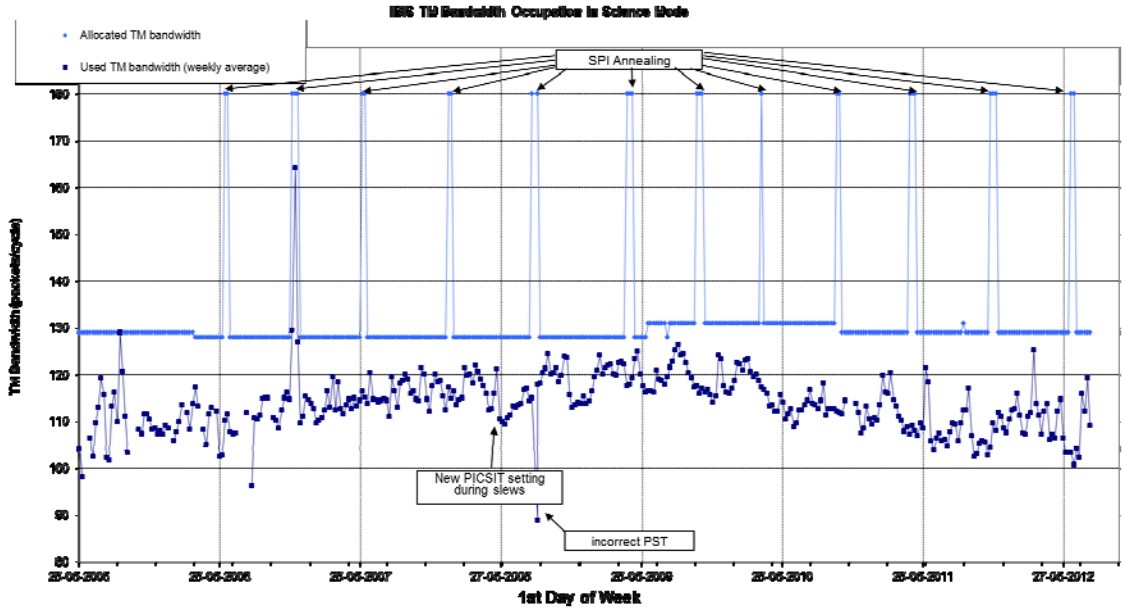


Figure 6: IBIS TM bandwidth usage evolution since May 2005

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:

- JEM-X1 & 2 were operated in Data Taking mode with a TM allocation of 8 packets/cycle, except from 2012-07-09T14:37:13Z to 2012-07-09T19:25:18Z 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 2012-07-09T14:37:13Z to 2012-07-09T19:25:18Z during the Flat-Field calibration, when it was 63 packets/cycle.

During this reporting period, 571 of the 748 planned science pointings and a Flat Field calibration were executed nominally. 164 were lost and 5 interrupted by high radiation. 4 were lost to FD problems, 3 to leap second activities and 1 to a verifier crash.

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

2.2.5 IREM

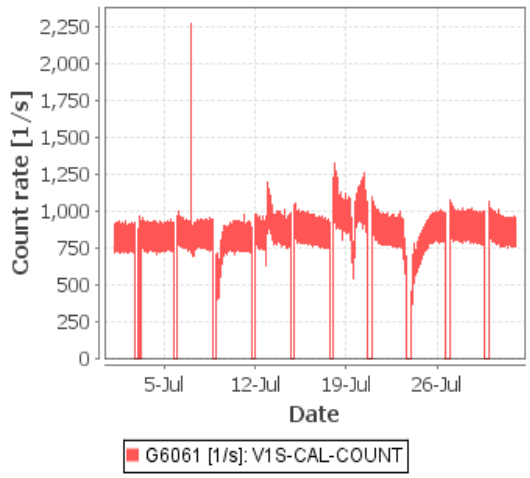
The status of IREM is nominal.

Note: Some more information concerning the IREM operations is provided in Appendix 0.

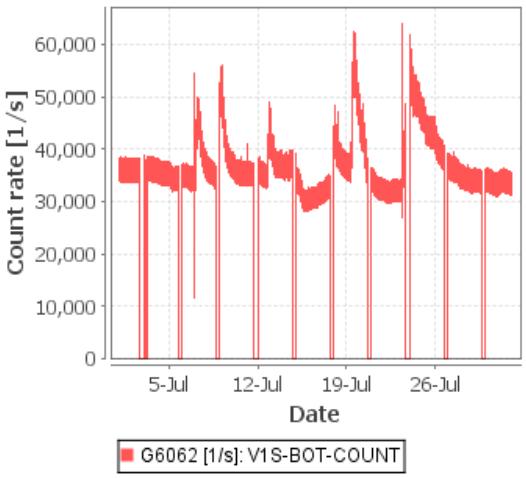
Radiation background

The background radiation level as measured by the instrument counters was variable this month, with several extended periods of high radiation. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the reporting period:

VETO Calibration Source Count Rate



VETO Bottom Count Rate



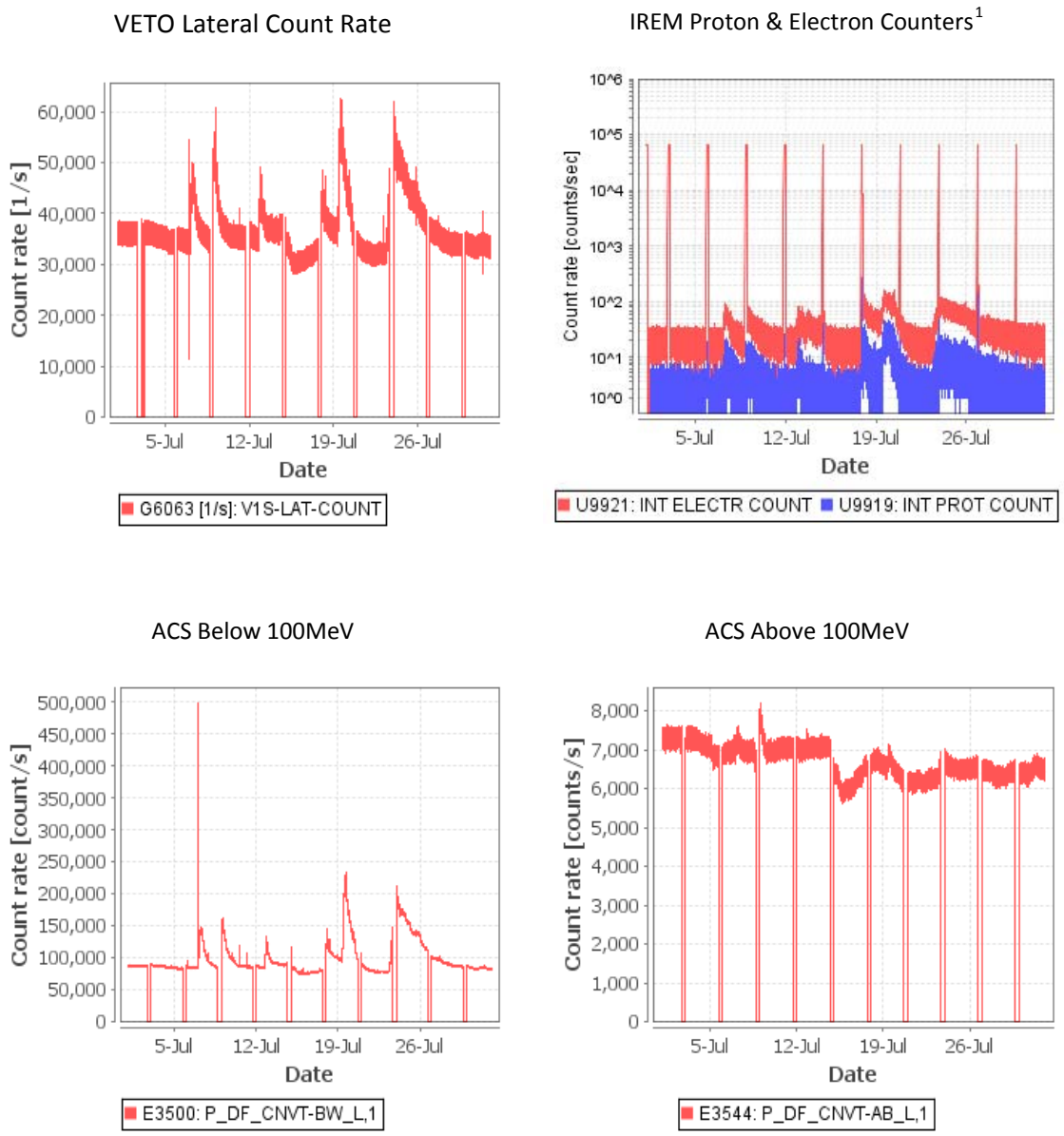


Figure 7: Instrument Count Rates

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

[1] Note that the scale used in this plot is logarithmic.

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

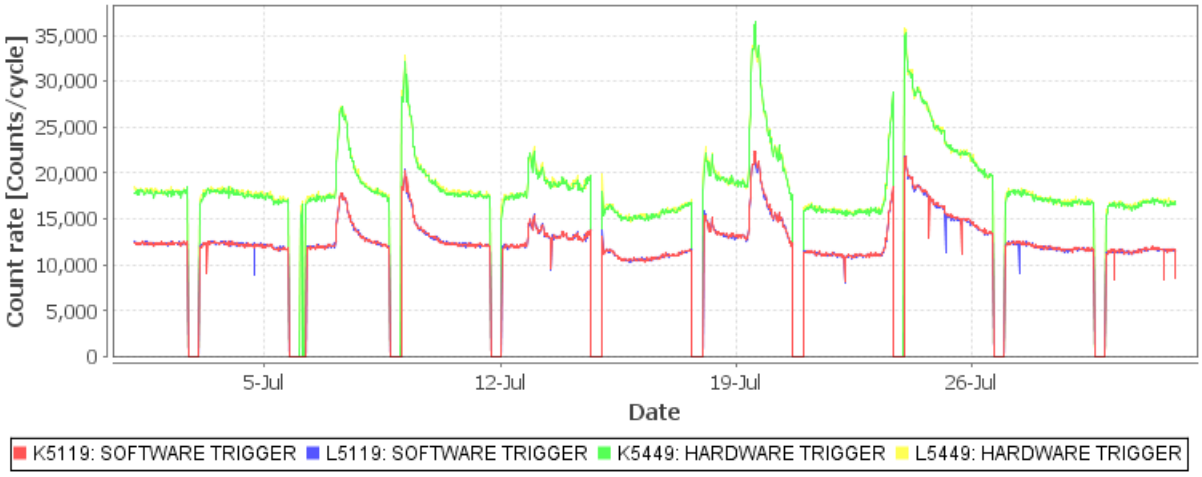


Figure 8: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

Radiation Belts

Figure 9 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.

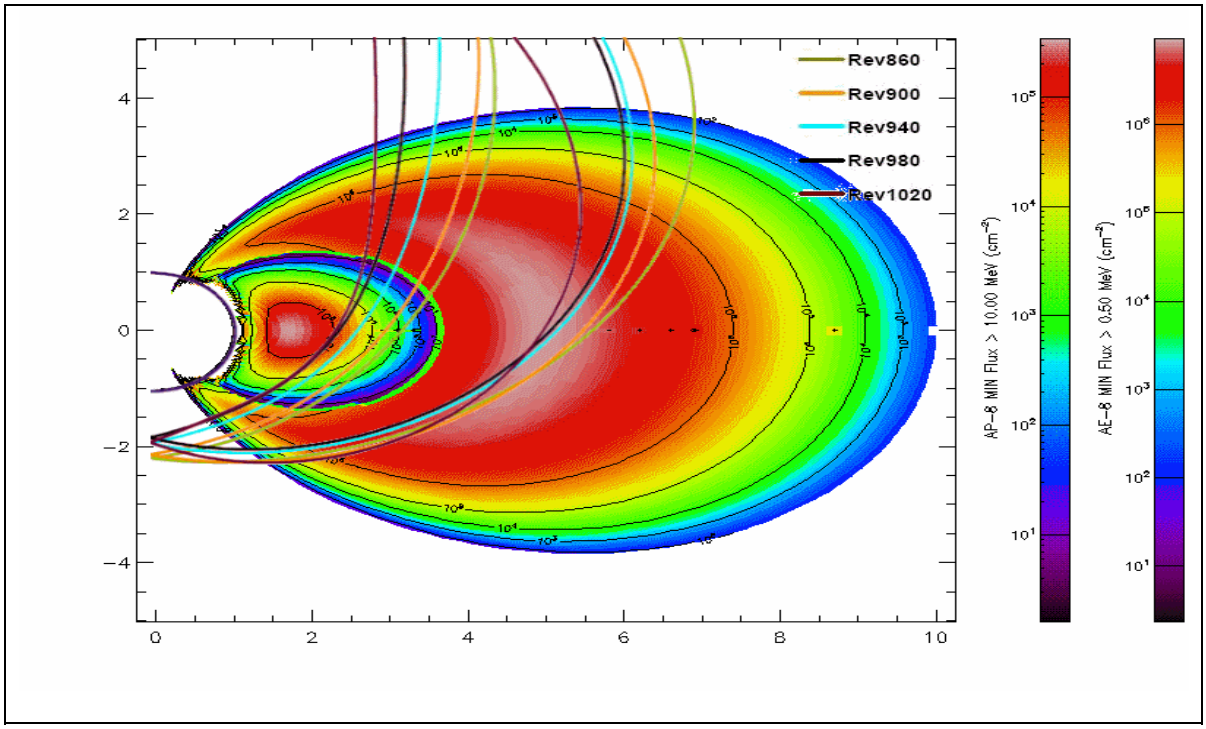


Figure 9: The predicted evolution of the orbit of Integral through the radiation belts

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.

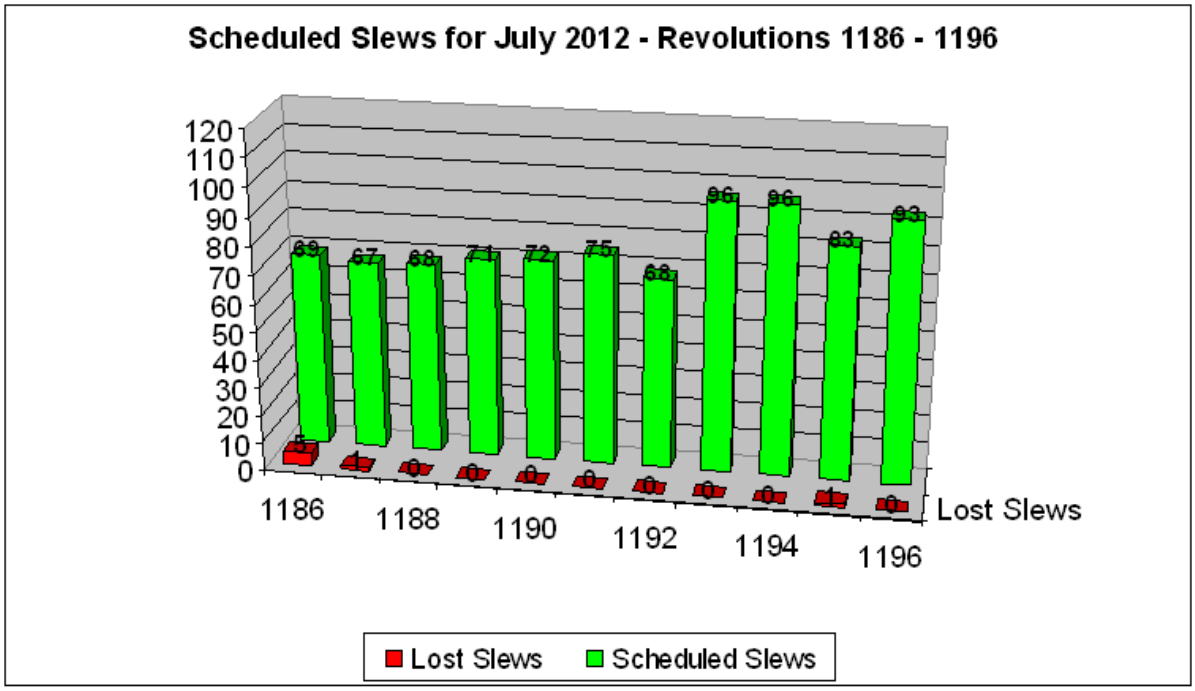


Figure 10: The number of slews scheduled compared to the number of slews lost

3.1 Mission Control System

- A new software release IMCS 3.5.4 was tested and installed on the A-chain. The installation on the B-chain was delayed due to a time stamping issue (AR INT-3292).
- After the software release one temporary change was lost. This was later manually reinstalled.
- One change in the new software release was temporarily deactivated as it was generating numerous unnecessary alarms for some parameters. These need to be changed in the next Database release. Once the new DB has been installed the software change can be reactivated.
- At AOS of revolution 1191 the TCO validity was out of limits. While checking this it was noticed that the correlated packet generation time was incorrect for several packets and furthermore were different on the A- and B-chains. This is currently under investigation.
- In preparation for the upcoming critical Earth Observation a detailed timeline of events

was created by the FCT. All SCOS applications were restarted and checked. The Ground station chains for REDU and VILSPA were to be restarted, however after the first restart (chain 2 at REDU) problems it was not possible to start uplink on this chain. After investigation and consultation with various parties it believed to have been caused by a faulty hardware unit. This will be replaced as soon as possible.

3.2 Ground Stations and Network

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

REDU

DOY 192 (2012-07-10)

10:08:00 G/S: Data gaps from Redu → RFI (both chains)

DOY 194 (2012-07-12)

13:02:00 G/S: Data gaps from Redu → RFI (both chains)

18:32:00 G/S: Data gaps from Redu → RFI (both chains)

DOY 200 (2012-07-18)

18:03:00 G/S: Data gaps from Redu → RFI (both chains)

18:20:00 G/S: Data gaps from Redu → RFI (both chains)

Figure 11 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.

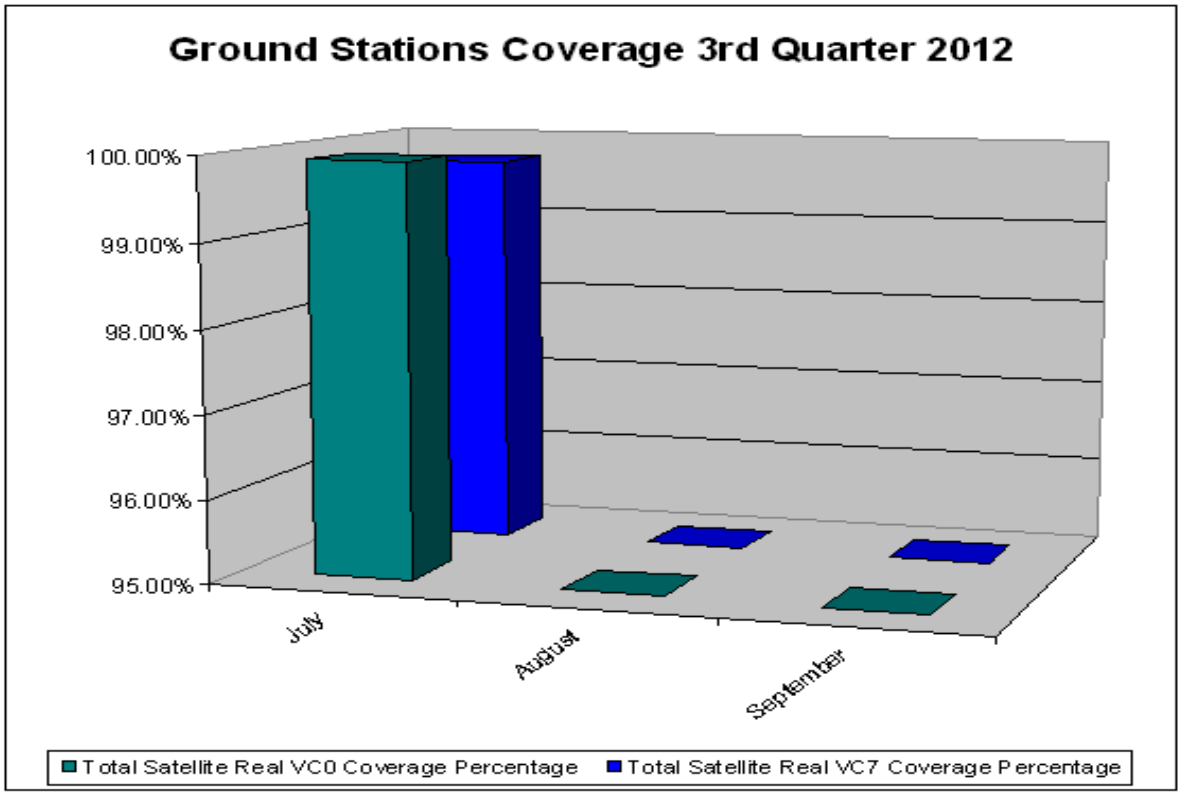


Figure 11: Comparison of VC0 to VC7 coverage

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 1193 to 1202, corresponding to the time range 20 July to 19 August.

New observations have been planned for revolutions 1193 (20-22 July) to 1202 (16-19 August), including the second and third Earth Observation of the new cycle.

TSFs have been received for revolutions 1192 to 1197.

3.3.2 Observation Status

New ECS files have been for revolutions 1170 to 1183, covering observations up to 23 June.

3.3.3 ISOC Science Data Archive

Work is ongoing on the development of the new ISDA and the corresponding documentation.

3.3.4 ISOC System

ISOC system V33.0 was released on 30 July, with updates to the tools used by observers in the upcoming AO call.

3.3.5 Problems

No new problems.

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-3284	2012-07-08	Recovery following IMU switch ON	Offline Tools	Testing
INT-3285	2012-07-07	PLM Operations interrupted following solar flare	Payload	Closed
INT-3286	2012-07-12	PLM Operations interrupted following solar flare	Payload	Closed
INT-3287	2012-07-08	PLM Operations interrupted following solar flare	Payload	Closed
INT-3288	2012-07-02	IFTS not working after FDS reboot	IMCS	Closed
INT-3289	2012-07-05	FDS unexpected server reboot	FDS	Testing
INT-3291	2012-07-17	Message: "Global SCC reset message submitted" is missing in the event logger since DOY 131	IMCS	Pending
INT-3292	2012-07-14	Packet generation times stamped differently on A- and B-chains		Pending
INT-3293	2012-07-17	PLM Operations interrupted following solar flare (DoY 199 - 202)	Payload	Pending
INT-3294	2012-07-23	PLM Operations interrupted following solar flare	Payload	Closed
INT-3295	2012-07-30	IFMS Software Problems Detected during Earth Observation Preparation	ESA Stations	Testing
INT_SC-392	2012-07-03	IBIS VETO crash during VETO activation	Payload	Closed
INT_SC-393	2012-07-01	IBIS PICsIT PDM06 LATCH UP	Payload	Testing
INT_SC-394	2012-07-05	JEM-X2 DFEE CRC Anomaly following eclipse on 2012-07-05	Payload	Testing
INT_SC-395	2012-07-05	Problems experienced reactivating JEM-X after Verifier crash.	IMCS	Closed
INT_SC-396	2012-07-12	SEU on LCL STA PTX1 (TM parameter P1121)	Spacecraft	Pending
INT_SC-397	2012-07-14	PDU Watchdog incorrect status	Spacecraft	Closed
INT_SC-398	2012-07-18	Spurious switch off BCR1and BDR2 in combination	Spacecraft	Pending

		with a switch on of reconditioning Relay K09		

5 Special Events & Future Milestones

E3.5 Testing
IMCS E3.5.4 installation on B chain
Virtualised Solaris environments
Re-assign 10 TM packets from SPI to JEM-X1 & 2 (5+5) starting Rev. 1200
DB release (deadline for DB inputs: 27.07.)
Kiruna tracking test
Perth TM/TC test
INTEGRAL Earth observation EO 2.2 on 02/08/2012

6 Appendix

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

6.1 AOCS operations

During this period, 352 Open Loop Slews, 465 Closed Loop Slews and 26 Momentum Biases were executed (as reported by ACC OEM).

7 slews were missed from the Timeline due to ground segment issues. For slews interrupted due to other issues (guide star problems, etc) please see the INTEGRAL weekly reports: http://10.33.199.49/documentation/wops.php

6.1.1 Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 01/08/2012 is reported in the following plot:

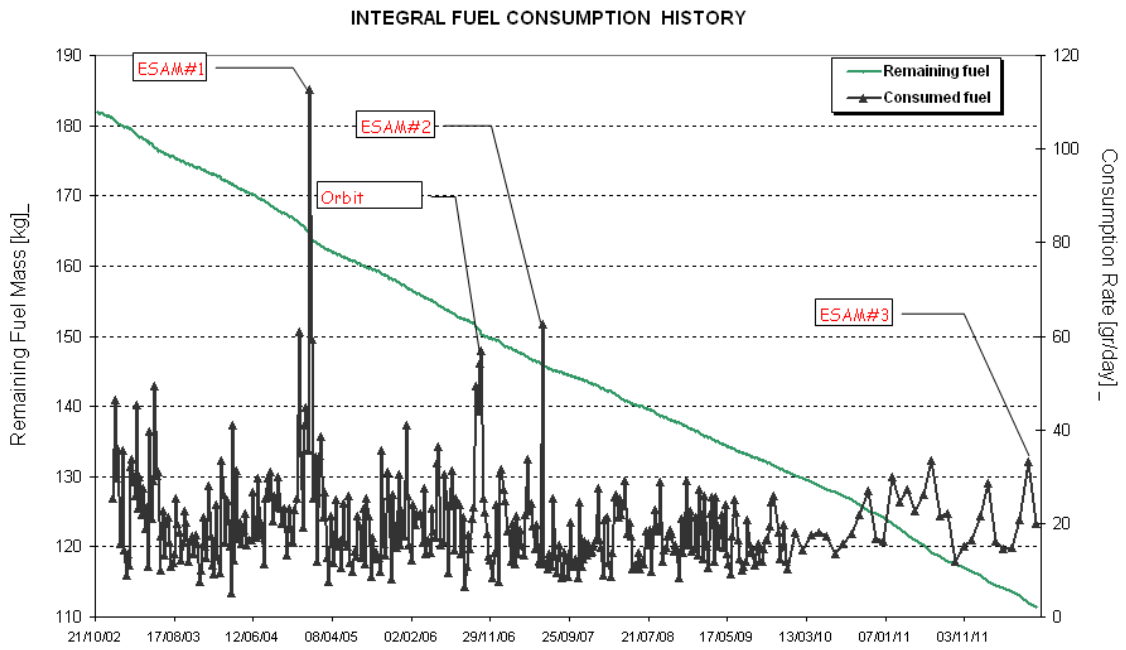


Figure 12: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

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.

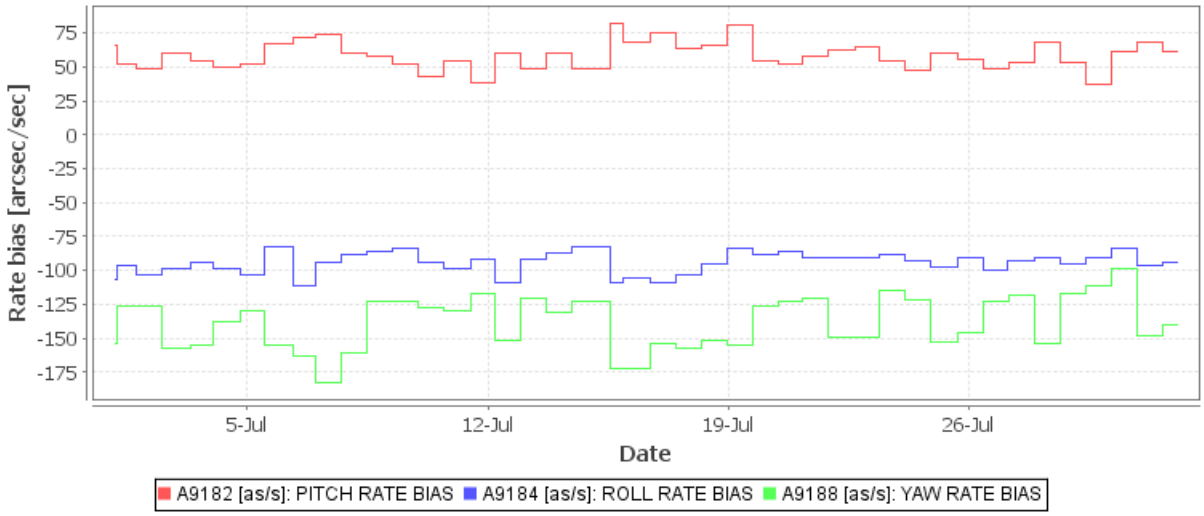


Figure 13: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

Please refer to the INTEGRAL weekly reports for all AOCS issues not considered as anomaly (e.g., TPF update failures that forced an interruption to the timeline and have led to a loss of a slew , TC Start Sun Steer Law failed at CEV level completion, events where the IMU came on due to the loss of a guide star,..). In the following, only the AOCS anomalies are listed which occurred during the reporting period.

02-07-2012 (Day of Year 184, Revolution 1186)

IFTS not working after FDS reboot, which resulted in two PIDs being lost: see INT-3288

05-07-2012 (Day of Year 187, Revolution 1187)

FDS unexpected server reboot, which resulted in a PREQ being lost: see INT-3289

08-07-2912 (Day of Year 190, Revolution 1188)

Issues during recovery following IMU switch ON on DOY190: see INT-3284

12-07-2012 (Day of Year 194, Revolution 1190)

SEU on LCL STA PTX1 (RCS PT01 pressure transducer, TM parameter P1121): see INT_SC-396

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 stroke of all four compressors was increased to 38 on 23-07-2012 leading to a decrease of the temperature of the cold plate as well to an increase of the SPI CDE LCL currents. The 8 dips correspond to eclipses.

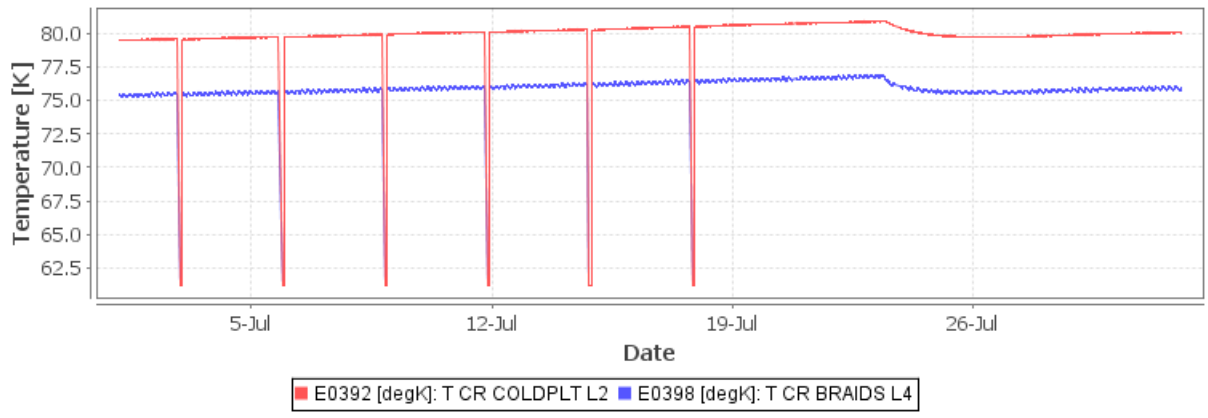


Figure 14: SPI Cold plate and H-bus temperature

The following plot shows the evolution of the CDE LCL currents during the reporting period. The impact of the stroke increase can clearly be seen.

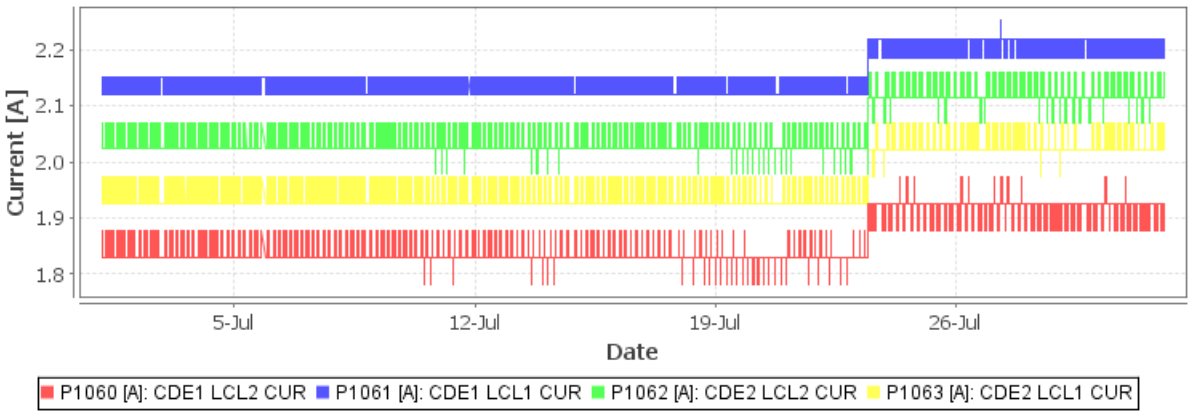


Figure 15: SPI CDE LCL current

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 7: 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.

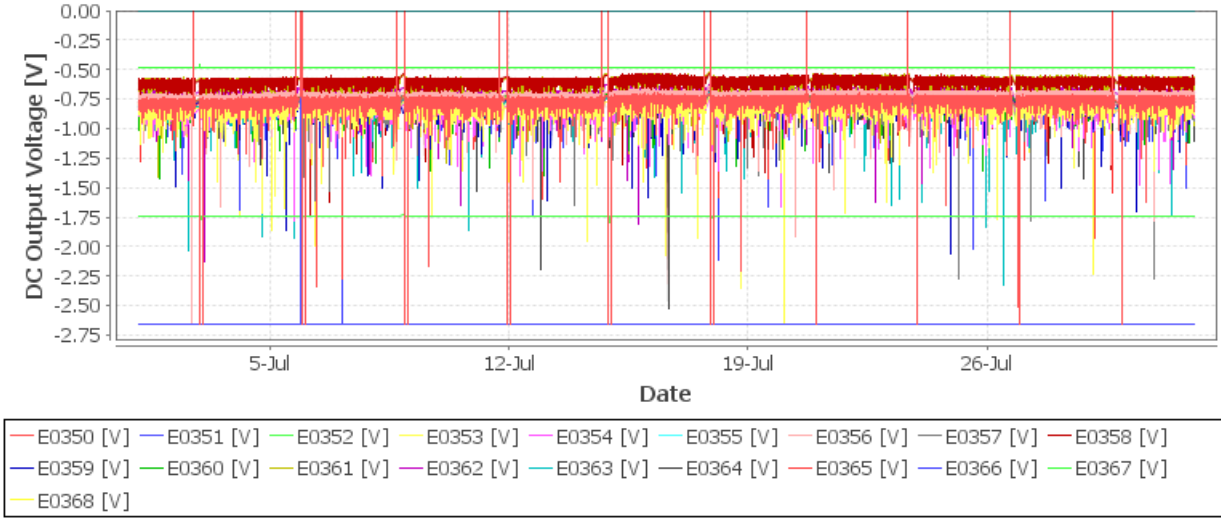


Figure 16: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)

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.

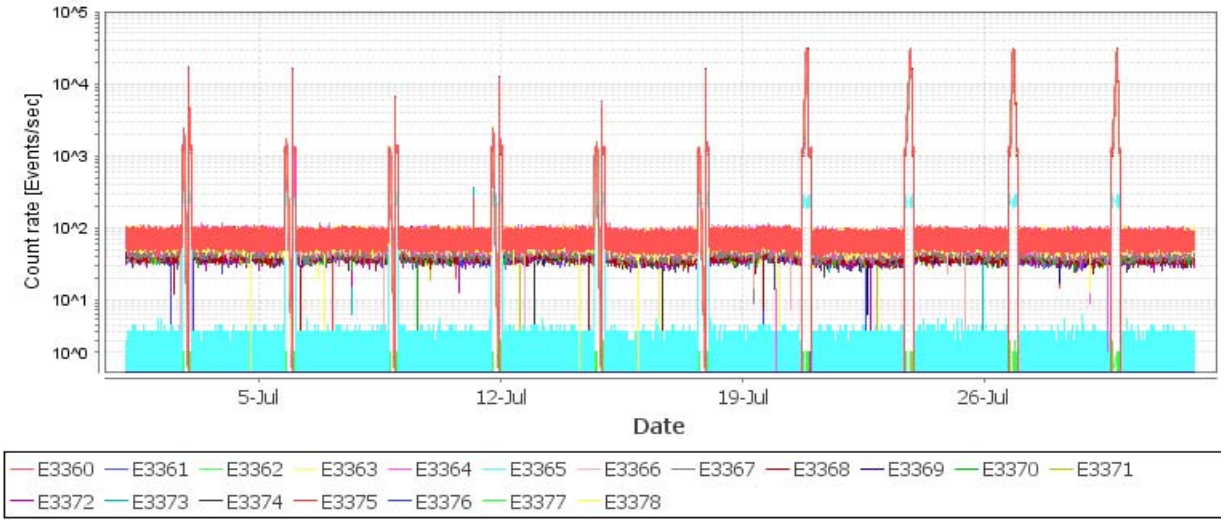


Figure 17: SPI GeD Non-Vetoed count rates. Note that the scale used for plotting is logarithmic.

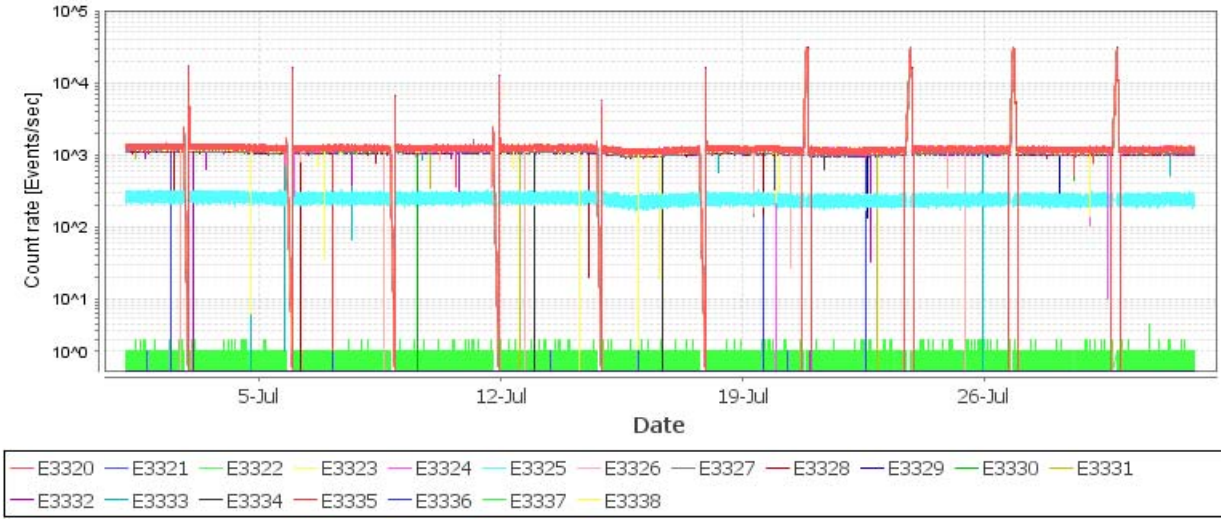


Figure 18: SPI GeD Time Tagged count rates. Note that the scale used for plotting is logarithmic.

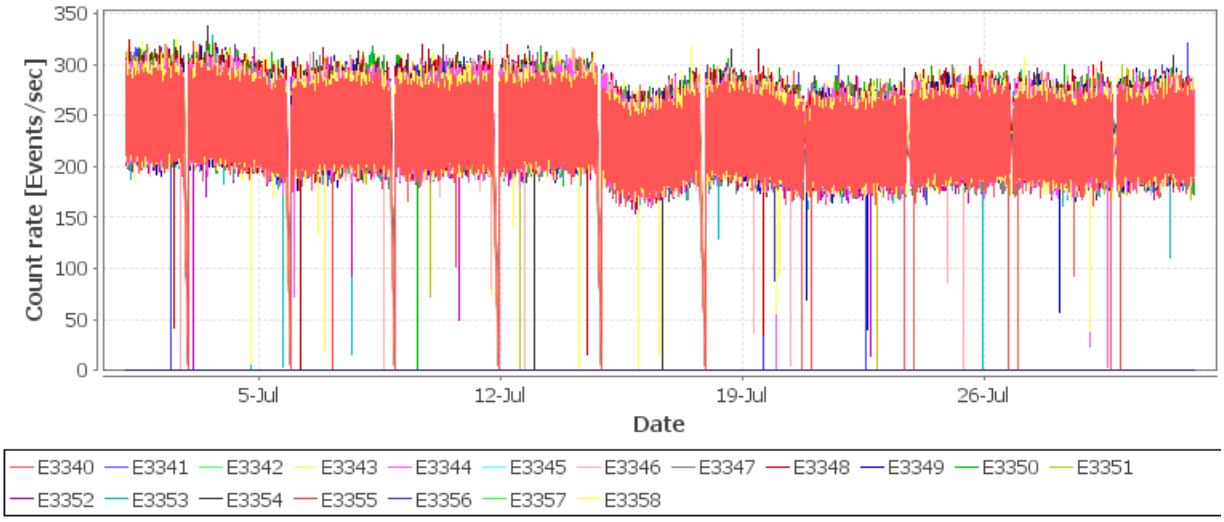


Figure 19: SPI GeD Time Tagged Saturated count rates. The impact of the increased solar radiation throughout the months can be seen.

PSD

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

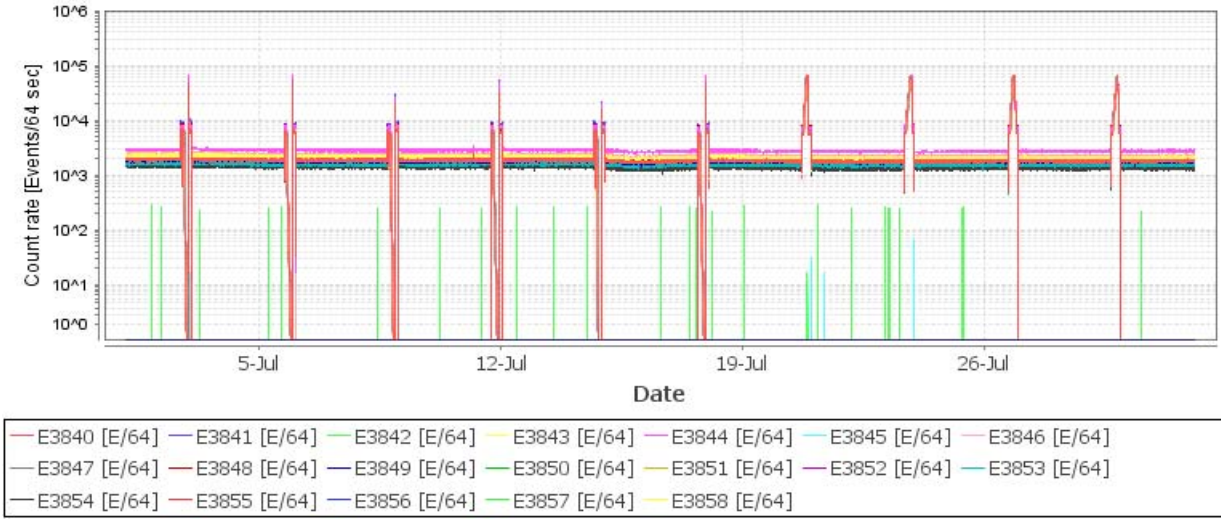


Figure 20: SPI PSD GeD Channel rates

6.2.2 Event Log

No SPI anomalies occurred in the reporting period.

23-07-2012 (Day of Year 1, Revolution 1125)

On 23-07-2012 at 09:11Z the stroke of all four compressors was increased to 38 as a reaction to a S/H OOL on the TM E0392 'T CR COLDPLT L2' S/H-OOL.

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. The increased solar radiation throughout the months is reflected in the count rates:

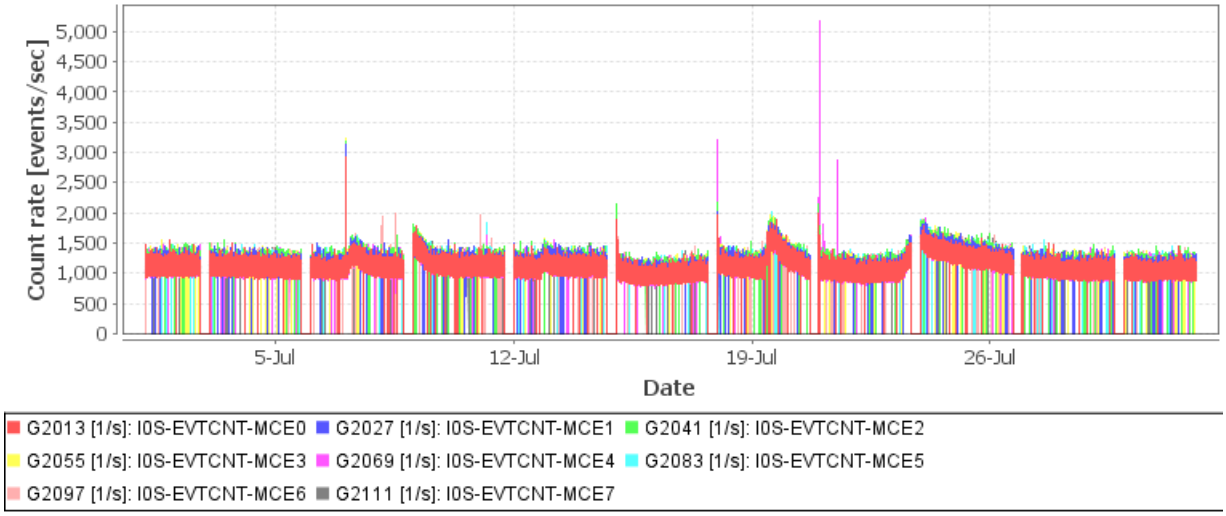


Figure 21: ISGRI MCE Counters

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.

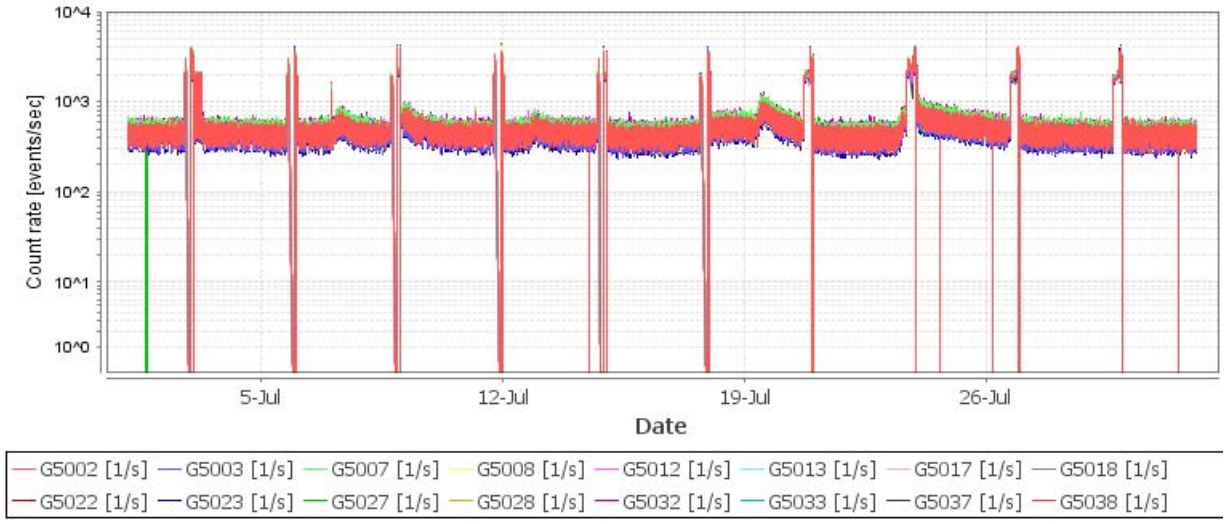


Figure 22: PICsIT semi-module counters. Note that the scale used for plotting is logarithmic.

VETO

The health and performance of VETO was nominal during the reporting period. Plots of the VETO counters are given in Figure 7: Instrument Count Rates.

6.3.2 Event Log

01-07-2012 (Day of Year 183, Revolution 1186)

IBIS PICsIT PDM06 LATCH UP (see INT_SC-393): On 2012-07-01 at 14:01:27Z TM parameter G5042 (PDE-PDM6STB) went OOL with value = OFF, indicating that PICsIT PDM06 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 PDM06 was performed. IBIS operations continued nominally at 15:13Z.

03-07-2012 (Day of Year 185, Revolution 1187)

IBIS VETO crash during VETO activation at 2012.184.23.19.11.200: please see INT_SC-392.

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.

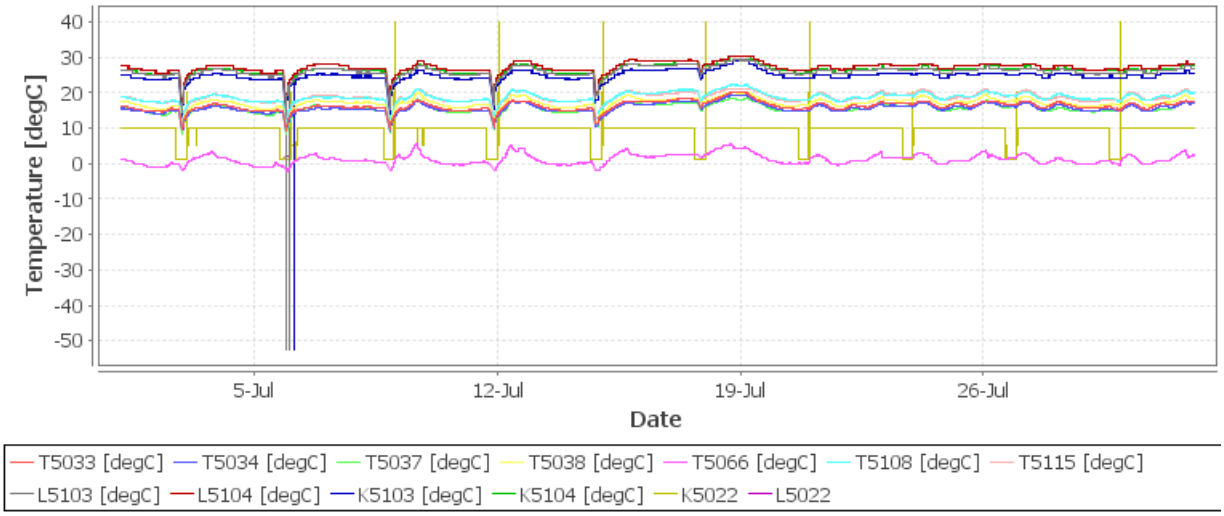


Figure 23: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

05-07-2012 (Day of Year 187, Revolution 1188)

At 20:10Z after AOS, it was observed that JEMX-2 had not switched-on correctly after the eclipse. To recover, a DFEE power cycle was performed according to CRP_JEM2_5011. The unit was recovered before the start of science operations (see anomaly report INT_SC-394). During the recovery, further problems were experienced when the verifier crashed (see anomaly report INT_SC-395) leaving the operator no log as to which commands were uplinked, and which not. The above procedure was then re-applied. There was no science impact from either anomaly.

6.5 OMC

6.5.1 Operations

The status and performance of OMC is nominal.

6.5.2 Event Log

01-07-2012 (Day of Year 183, Revolution 1186)

At 00:16, operations were suspended owing to the on-going leap second activities. At 02:41, once this was completed and the timeline restored OMC operations began. The impact was the loss of pointings 11860025 to 11860027. It was at this time the following OEMs were received:

```
2012.183.02.24.07.934   2012.183.02.24.13.864   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

2012.183.02.24.14.309   2012.183.02.24.19.958   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E
```

These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointing 11860027.

02-07-2012 (Day of Year 184, Revolution 1186)

At 12:45, a FD problem forced an interruption of the timeline. At 13:57, the recovery was completed, and the timeline restored. The impact was the loss of pointings 11860064 & 11860065. It was at this time the following OEMs were received:

```
2012.184.13.12.05.764   2012.184.13.12.11.843   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

2012.184.13.12.11.764   2012.184.13.12.23.753   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E
```

These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointing 11860064.

05-07-2012 (Day of Year 187, Revolution 1187)

At 13:44, a FD problem forced an interruption of the timeline. At 14:33, the recovery was completed, and the timeline restored. The impact was the loss of pointing 11870064. It was at this time the following OEMs were received:

```
2012.187.14.11.53.679   2012.187.14.12.00.766   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

 2012.187.14.11.47.679     2012.187.14.12.00.735     1792     RealTime     131        TC  REJECT
REJECTED TC1                                              0        0    65535   PR     N      E
E
```

These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointing 11870064.

05-07-2012 (Day of Year 187, Revolution 1188)

At 23:15:00, a verifier crash forced an interruption to the timeline. Although the task was immediately restarted, pointing 11880002 was lost.

07-07-2012 (Day of Year 189, Revolution 1188)

At 04:19:08, OMC went to SAFE mode due to high radiation. It remained in this state until 19:01:13, when it was recovered to stand-by. The impact was pointing 11880033 was interrupted after 816 from a planned 3530 seconds and the loss of pointings 11880034 to 11880047. It was at this time pairs of OEMs like:

```
2012.189.05.04.40.887   2012.189.05.04.46.202   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E

2012.189.05.04.47.012   2012.189.05.04.52.767   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E
```

were received. These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointings 11880034 to 11880047 inclusive.

08-07-2012 (Day of Year 190, Revolution 1189)

At 23:06:44, OMC went to SAFE mode due to high radiation. It remained in this state until 12:24:14 the following day, when it was recovered to stand-by. The impact was the loss of pointings 11890002 to 11890021 (19 pointings).

12-07-2012 (Day of Year 194, Revolution 1190)

At 18:16:29, OMC went to SAFE due to high radiation. At 03:11:25 the following day, after radiation levels had dropped, OMC was switched back to standby, and at 03:50:28 it was back in Science mode. The impact was pointing 11900027 was interrupted after 2089 from a planned 3530 seconds, and pointings 11900028 to 11900036 inclusive were lost (9 pointings).

17-07-2012 (Day of Year 199, Revolution 1192)

At 22:03:49, OMC switched to SAFE mode due to high radiation. At 12:08:29, the following day, after the radiation had died down. The unit was switched back to stand-by, and at 12:17:16 it was back in Science mode. The impact was the loss of pointings 11920001 to 11920016 (16 pointings).

18-07-2012 (Day of Year 200, Revolution 1192)

At 17:42:37, OMC went to SAFE mode due to high radiation. At 21:43:22, after the radiation levels had died down the unit was recovered, and at 23:50:28 it was back in Science mode. The impact was the interruption of pointing 11920023 after 753 from a planned 3000 seconds, and the loss of pointings 11920024 to 11920027 (4 pointings). It was at this time the following OEMs were received:

```
2012.200.18.20.26.882   2012.200.18.20.29.381   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E

2012.200.18.20.33.132   2012.200.18.20.39.690   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E
```

These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointing 11920024.

19-07-2012 (Day of Year 201, Revolution 1192)

At 09:11:33 OMC switched to SAFE mode due to high radiation. It remained in this state until the end of the revolution. The impact was the interruption of pointing 11920039 after 2673 from a planned 3530 seconds, and the loss of pointings 11920040 to 11920067 (28 pointings).

20-07-2012 (Day of Year 202, Revolution 1193)

At 21:38, the TC M1131 (Reset ROE, MEBEXT01) failed release as OMC was still in SAFE mode. OMC was then manually returned to standby, and the M1131 command resent, there was no impact.

22-07-2012 (Day of Year 204, Revolution 1193)

At 04:46, a FD problem forced an interruption to the timeline. A recovery was performed, and the timeline rejoined at 06:16. The impact was the loss of pointings 11930052. It was at this time the following OEMs were received:

```
2012.204.05.48.11.320   2012.204.05.48.16.849   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E

2012.204.05.48.17.070   2012.204.05.48.23.109   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E
```

These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointing 11930052.

23-07-2012 (Day of Year 205, Revolution 1194)

At 13:45:41, due to high radiation, OMC went to SAFE mode. On 26/07/2012 at 02:35:29 once radiation levels had fallen, it was switched back to stand-by, and at 03:01:57 was back in Science mode. The impact was pointing 11930094 was interrupted after 4144 from a planned 6487 seconds and the loss of pointings 11940002 through to 11940084 (74 pointings). It was at this time the pairs of OEMs like:

```
2012.205.21.32.15.661   2012.205.21.32.20.980   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E

2012.205.21.32.23.161   2012.205.21.32.28.931   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E
```

were received. These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointings 11940002 to 11940006 inclusive.

6.6 IREM

6.6.1 Operations

Radiation belts entry and exit

The following plots show the Radiation Belt Entry (Figure 24, red line) and Exit times (Figure 25, blue line) obtained from the ISDC website, defined where the IREM TC3 (soft electrons) rate reads 600 counts. The blue line in Figure 24 and the magenta line in Figure 25 are the altitudes used by the MOC for planning purposes.

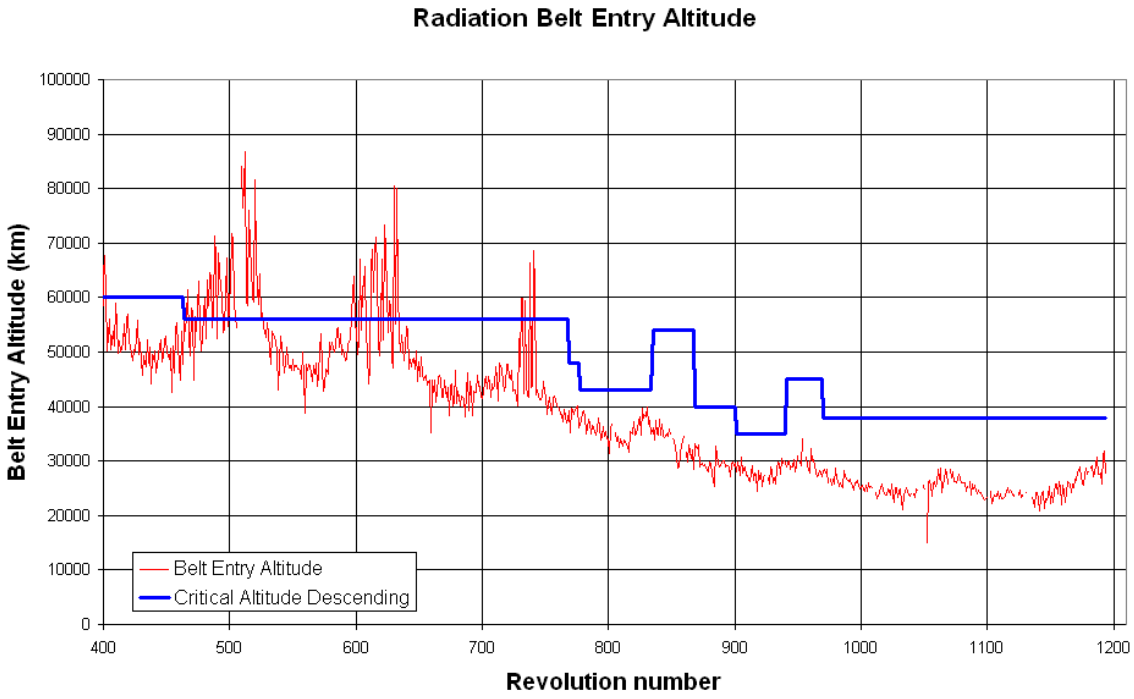


Figure 24: Radiation belt entry

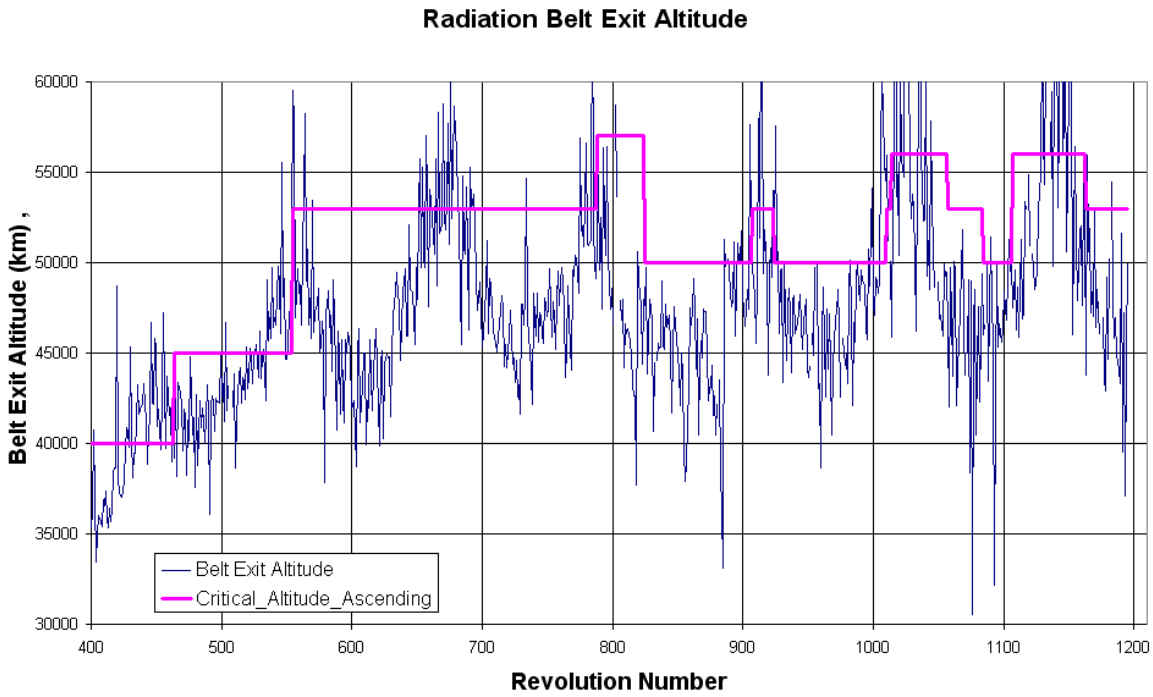


Figure 25: Radiation belt exit

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

Revo 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
1186	RAD_ENTR R 2012-07-02T16:05:16Z	02/07/2012 17:12:35	30744	02-Jul-2012 17:28:43	20462.14	02-Jul-2012 18:18:43	8585.522
1187	RAD_EXIT R 2012-07-02T23:08:38Z	02/07/2012 21:40:27	44466	02-Jul-2012 22:48:43	50028.38	02-Jul-2012 18:48:43	3842.295
1187	RAD_ENTR R 2012-07-05T15:50:21Z	05/07/2012 16:46:27	33241	05-Jul-2012 17:20:37	19178.74	05-Jul-2012 18:00:37	9618.839
1188	RAD_EXIT R 2012-07-05T22:54:01Z	05/07/2012 21:24:51	44239	05-Jul-2012 22:30:37	49311.04	05-Jul-2012 18:40:37	3860.587
1188	RAD_ENTR R 2012-07-08T15:36:30Z	N/A	N/A	08-Jul-2012 17:03:33	19711.69	08-Jul-2012 17:43:33	10124.11

Revo 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
1189	RAD_EXIT R 2012-07-08T22:39:47Z	N/A	N/A	08-Jul-2012 22:13:33	49013.8	08-Jul-2012 18:23:33	3724.616
1189	RAD_ENTR R 2012-07-11T15:23:36Z	11/07/2012 16:43:00	28172	11-Jul-2012 16:50:09	19949.92	11-Jul-2012 17:30:09	10380.11
1190	RAD_EXIT R 2012-07-11T22:26:55Z	11/07/2012 21:45:40	52655	11-Jul-2012 22:10:09	50447.17	11-Jul-2012 18:10:09	3738.485
1190	RAD_ENTR R 2012-07-14T15:10:01Z	14/07/2012 16:18:20	30753	14-Jul-2012 16:33:30	20735.19	14-Jul-2012 17:23:30	8870.463
1191	RAD_EXIT R 2012-07-14T22:13:44Z	14/07/2012 21:54:44	56253	14-Jul-2012 21:53:30	49819.02	14-Jul-2012 17:53:30	3902.673
1191	RAD_ENTR R 2012-07-17T14:56:02Z	N/A	N/A	17-Jul-2012 16:20:57	20728.55	17-Jul-2012 17:10:57	8848.121
1192	RAD_EXIT R 2012-07-17T21:59:44Z	N/A	N/A	17-Jul-2012 21:40:57	49850.11	17-Jul-2012 17:40:57	3875.941
1192	RAD_ENTR R 2012-07-20T14:44:11Z	N/A	N/A	20-Jul-2012 16:13:57	19422.81	20-Jul-2012 16:53:57	9809.811
1193	RAD_EXIT R 2012-07-20T21:28:24Z	20/07/2012 19:58:44	40462	20-Jul-2012 21:23:57	49250.11	20-Jul-2012 17:33:57	3716.996
1193	RAD_ENTR R 2012-07-23T14:33:20Z	N/A	N/A	23-Jul-2012 15:56:11	20672.9	23-Jul-2012 16:46:11	8681.555
1194	RAD_EXIT R 2012-07-23T21:17:02Z	N/A	N/A	23-Jul-2012 21:16:11	50056.11	23-Jul-2012 17:16:11	3681.779
1194	RAD_ENTR R 2012-07-26T14:22:42Z	26/07/2012 15:40:44	28536	26-Jul-2012 15:53:12	19102.37	26-Jul-2012 16:33:12	9470.66
1195	RAD_EXIT R 2012-07-26T21:06:29Z	26/07/2012 20:37:32	51462	26-Jul-2012 21:03:12	49491.4	26-Jul-2012 17:13:12	3744.706
1195	RAD_ENTR R 2012-07-	N/A	N/A	29-Jul-2012 15:38:32	19524.07	29-Jul-2012 16:18:32	9952.999

Revo 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
	29T14:11:07Z						
1196	RAD_EXIT R 2012-07-29T20:55:27Z	29/07/2012 19:55:49	46150	29-Jul-2012 20:48:32	49101.74	29-Jul-2012 16:58:32	3781.112

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

Nothing to report.