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

INTEGRAL
Mission report

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

No. 409
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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 performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

This report addresses the activities from May and covers the revolutions 1166 until 1176 (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
- During this reporting period, 782 of the 868 planned science pointings were executed nominally. 8 pointings were lost and 1 shortened to AOCS problems. 6 pointing were lost to FD problems. 1 pointing was interrupted and 50 lost to high solar radiation. 19 pointings were lost to comms problems. 1 pointing had to be moved owing to paucity of stars for attitude determination. 1 Flat field calibration and 1 Earth Observation were performed this month.
- PLM operation interrupted on 17-18/05/2012 following a solar flare
- Earth observation EO 2.1 on May 9 / 10th
- Eclipse season starts 24/5/2012
- Preparation of SPI annealing #19
- E3.5 Testing

Summary of the overall status and performance of S/C

- Nominal for platform and payload
- IREM Anomaly: Reset of IREM_CSCI S/W #129 (16/04/2012)
- JEM-X2 DFEE CRC anomaly following eclipse on 2012-05-30

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
- Incorrect Time tag execution Time causes wrong antenna selection
- Reboot of both FD servers
- No SPI OOL during PSD channel rate malfunction
- IFTS 'target' directory deleted on IDDA
- AADs degradation checking
- Loss of TM and TC contact to Integral due to combination of errors
- EEXIT-03 interlock prevents uplink of ED DEBPG100

The previous weekly and monthly reports are available at the XMM-INTTEGRAL 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.

25 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.6519 Kg. The remaining propellant is in the order of 112.9853 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 18th SPI annealing, which ended on 09/12/2011, 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 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 2012-05-10T03:13:28Z to 2012-05-10T18:24:41Z (Earth Observation), when it was 95 packets/cycle and from 2012-05-10T23:00:03Z to 2012-05-11T04:28:33Z (OMC Flat Field Calibration), when it was 88 packets/cycle. The average telemetry occupation when the allocation was 99 packets/cycle was 75.7 packets/cycle.

The following plot shows the TM bandwidth allocation and occupation during the reporting period. The effect of the solar flare (17./18.05.) can clearly be seen.

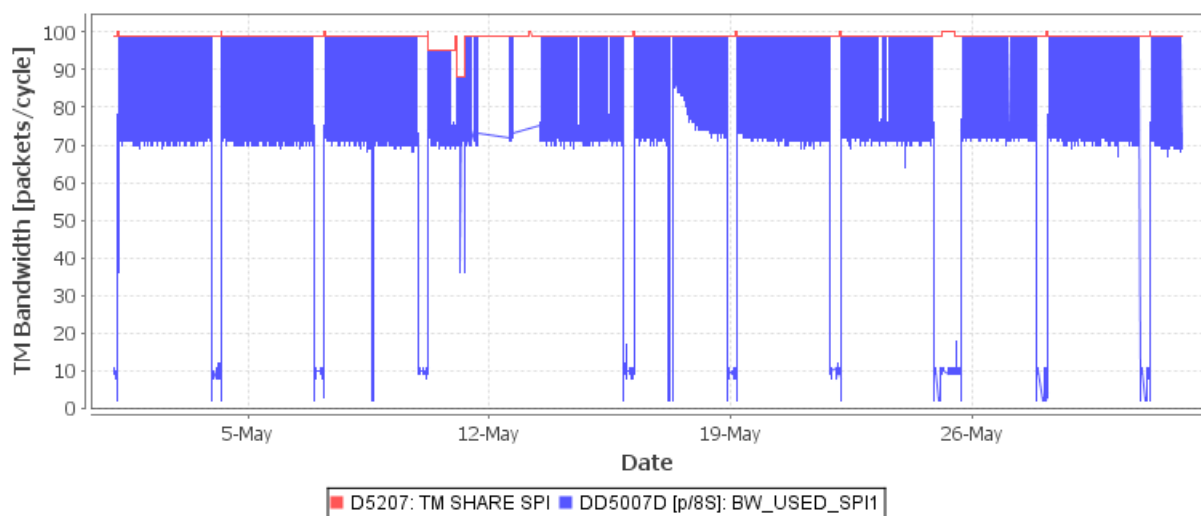


Figure 1: SPI TM bandwidth utilisation

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

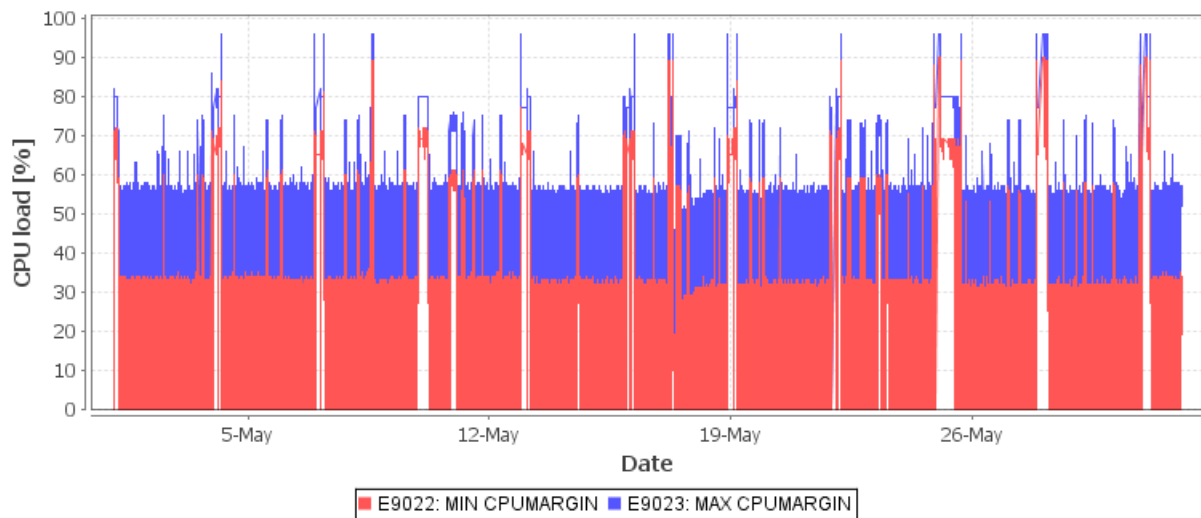


Figure 2: SPI IASW Performance

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

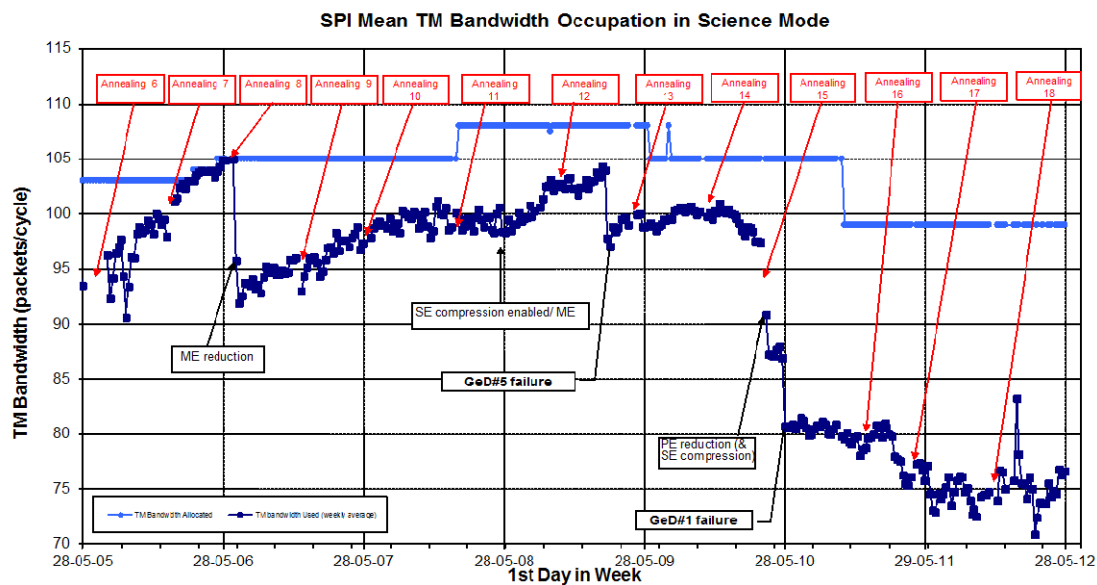


Figure 3: SPI TM bandwidth usage evolution since May 2005

Note: More information concerning the SPI operations is provided in Appendix 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 2012-05-10T23:00:03Z to 2012-05-11T04:28:33Z (OMC Flat Field Calibration), when it was 90 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 109.08 packets/cycle

The plot below shows the IBIS TM utilisation during the reporting period. The effect of the solar flare (17./18.05.) can clearly be seen.



Figure 4: IBIS TM bandwidth utilisation

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

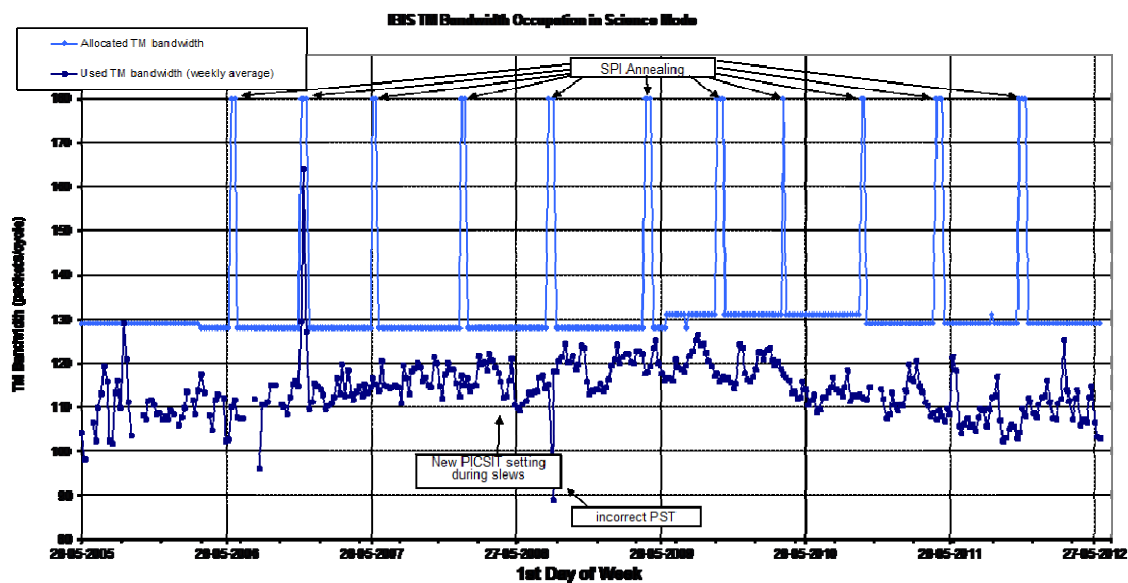


Figure 5: IBIS TM bandwidth usage evolution since May 2005

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:

- JEM-X1 & 2 were operated in Data Taking mode with a TM allocation of 8 packets/cycle, except from 2012-05-10T23:00:03Z to 2012-05-11T04:28:33Z 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 0.

2.2.4 OMC

OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle, except from 2012-05-10T03:13:28Z to 2012-05-10T18:24:41Z during the Earth Observation, when it was 9 packets/cycle, and from 2012-05-10T23:00:03Z to 2012-05-11T04:28:33Z during the Flat-field calibration, when it was 63 packets/cycle.

During this reporting period, 782 of the 868 planned science pointings were executed nominally. 8 pointings were lost and 1 shortened to AOCS problems. 6 pointing were lost to FD problems. 1 pointing was interrupted and 50 lost to high solar radiation. 19 pointings were lost to comms problems. 1 pointing had to be moved owing to paucity of stars for attitude determination. 1 Flat field calibration, and 1 Earth Observation were performed this month.

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

2.2.5 IREM

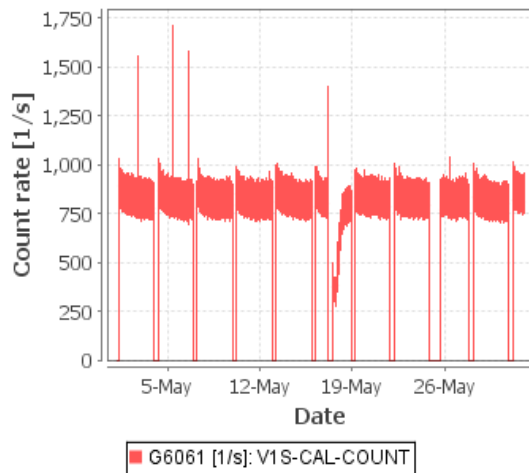
The status of IREM is nominal.

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

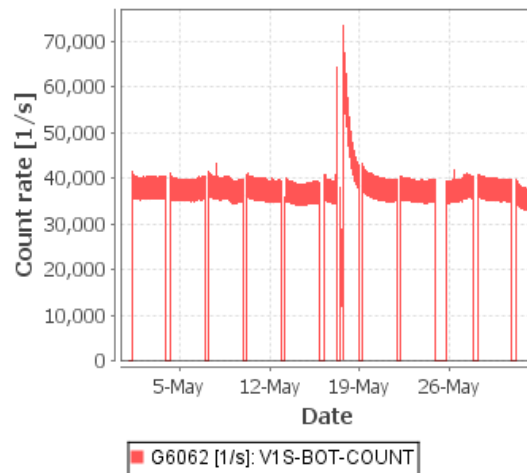
Radiation background

Except for a brief period around the 18th May, 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. The effect of the solar flare (17./18.05.) can clearly be seen.

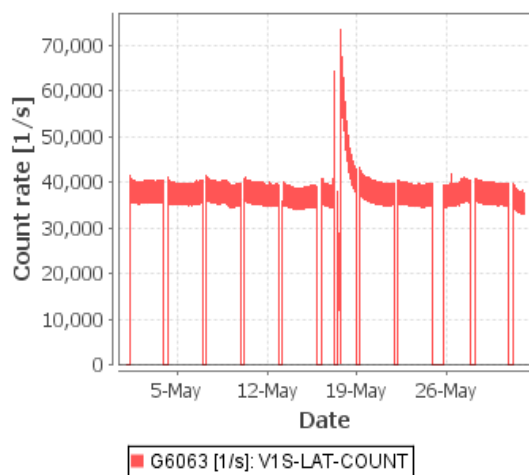
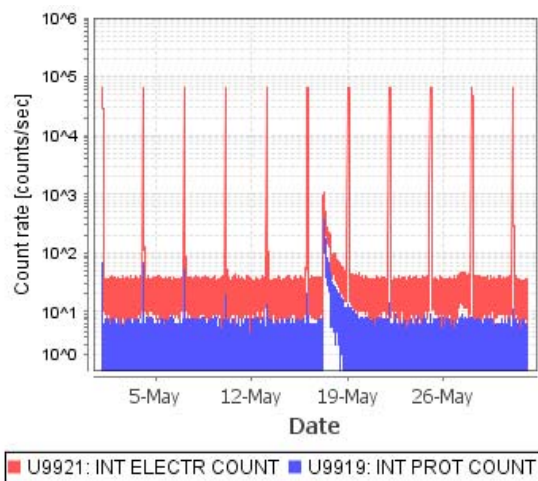
VETO Calibration Source Count Rate



VETO Bottom Count Rate



VETO Lateral Count Rate

IREM Proton & Electron Counters¹

ACS Below 100MeV

ACS Above 100MeV

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

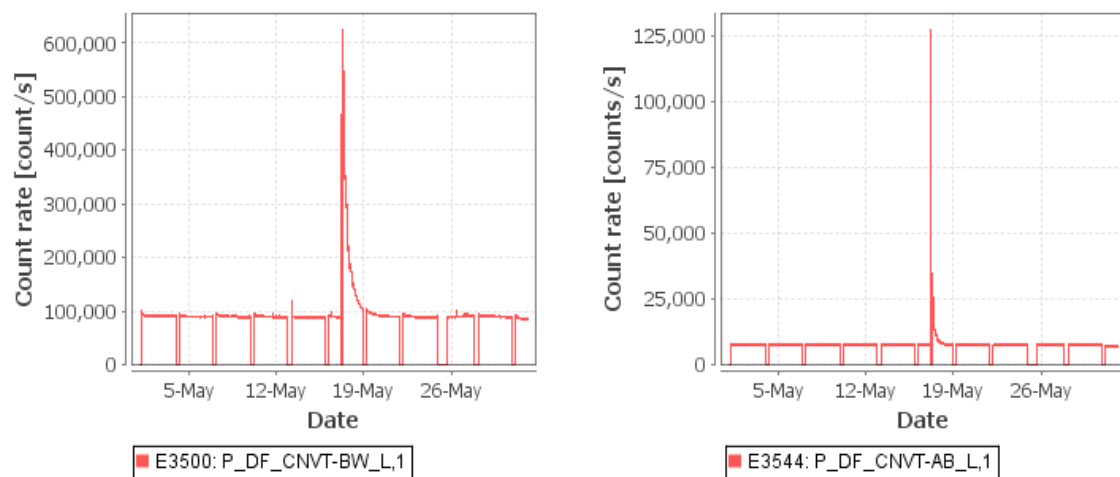


Figure 6: Instrument Count Rates

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

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

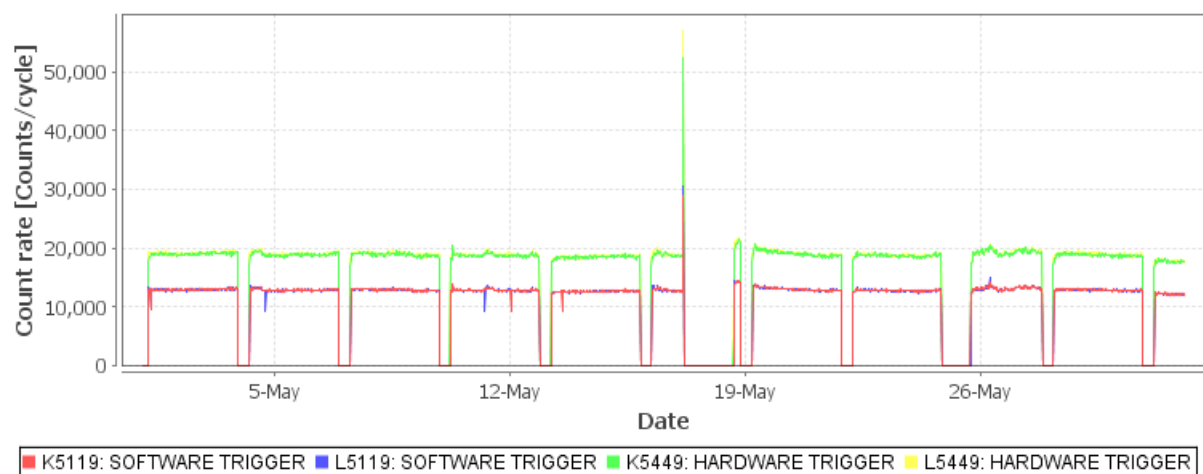


Figure 7: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

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.

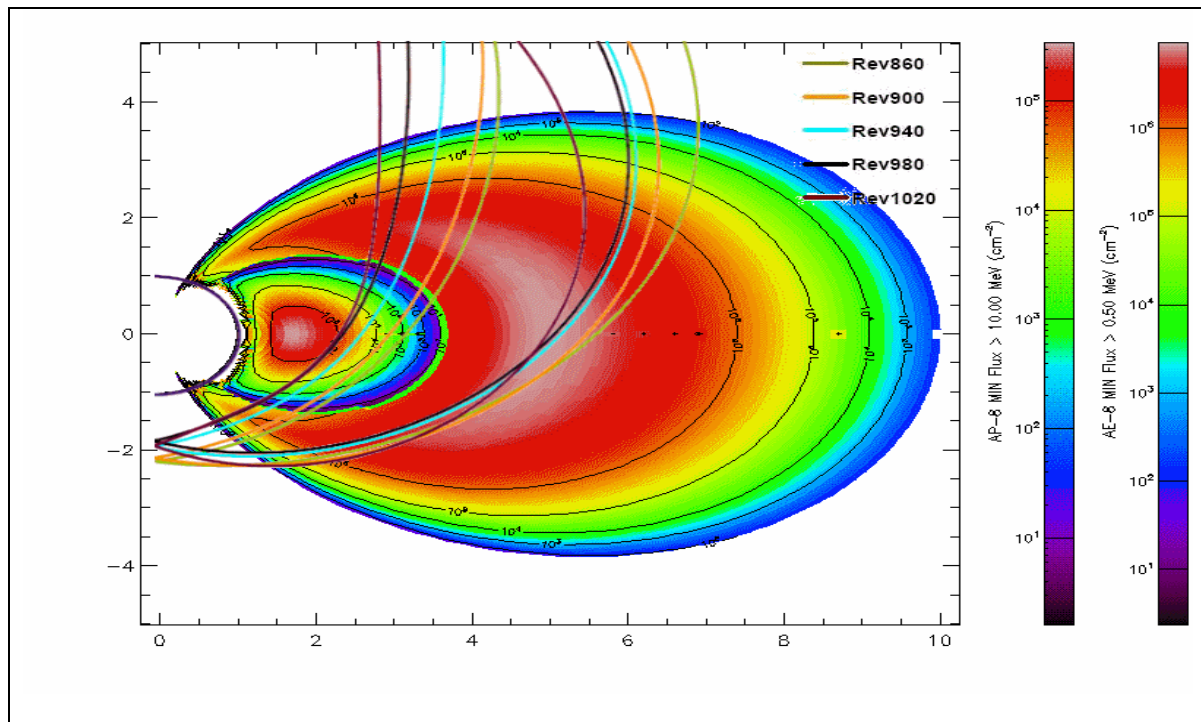


Figure 8: The predicted evolution of the orbit of Integral through the radiation belts

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.

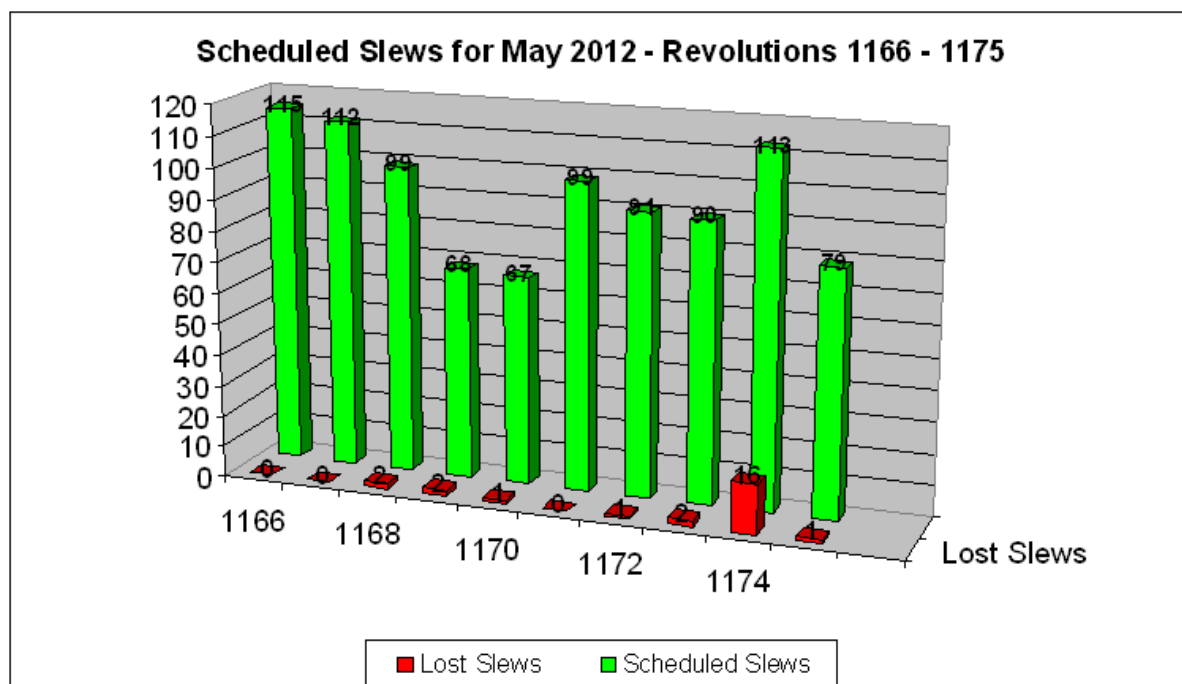


Figure 9: The number of slews scheduled compared to the number of slews lost

3.1 Mission Control System

Two short notice DB releases were installed on all operational machines.

IODB_3.1_0069 was installed on 15/05/2012 to update the limits for some SPI ACS monitoring parameters

IODB_3.1_0070 was installed on 22/05/2012 to fix a timing problem in the sequence EEXIT-03

A third DB release IODB_3.1_0070 is currently being implemented to fix an interlock problem in the EEXIT-03 sequence

The recovery of the vast backlog of gap checking, CD production, performance statistics (amongst other things) caused by the IFMS bug has been fully recovered.

There were several issues with the Integral File Transfer System (IFTS) where the transfer of specific files stopped working. On the first occasion upon further investigation it was seen that one of the IFTS directories had been deleted. The directory was recreated and all transfers were resumed correctly. On the second and third occurrences again the transfer of specific files was stopped. Here the usual recovery methods were not successful and SWS had to be called in. In both cases the problem was cleared after numerous re-starts, however the cause of the problems is still unknown.

3.2 Ground Stations and Network

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

DOY 122 (01/05/2012) - no incidents

DOY 123 (02/05/2012)

12:29:00 - G/S: Bad Frames from: VIL2, duration: 22 sec - Confirmed RFI (both chains)

DOY 124 (03/05/2012)

10:35:00 - ESTRACK requested to stop/start up-converter at G/S: REDU - Closed TC link

DOY 125 (04/05/2012) – no incidents

DOY 126 (05/05/2012)

13:24:00 - G/S: Data gaps VC-0 & VC-7 from G/S: RED - Confirmed RFI (both chains)

16:53:00 - G/S: Data gaps VC-0 & VC-7 from G/S: RED - Confirmed RFI (chain1 only)

DOY 127 (06/05/2012) – no incidents

DOY 128 (07/05/2012)

17:25:00 - Bad frames from WHM

17:26:00 - G/S: WHM reports temp masking which should clear itself, REDU TM links are put into process for the moment, Bad frames received and short TM drop (<1 min) at AZI 350-360° and EL 7-8°

DOY 129 (08/05/2012)

17:35:00 - G/S: Drop VC-0 & VC-7 from G/S: REDU Confirmed RFI - (both chains)

DOY 130 (09/05/2012)

14:03:00 - Problem on IFMS2 Redu. When VC0 and VC7 are connected in Input they stay in drop. IFMS2 and TMTCS2 restarted by Estrack. Problem cleared.

14:15:00 - Problem on IFMS2 Vilspa. When VC0 and VC7 are connected in Input they stay in drop. IFMS2 and TMTCS2 restarted by Estrack

14:26:00 - IFMS2 did not come back up at Vilspa. Cold reboot performed on site.

14:46:00 - IFMS2 at Vilspa ok now. Logs show that both IFMS2 (on both GS) went out of frame sync lock intermittently, and approx. 10 minutes apart. An IFMS restart solved the issue in both cases. The observed behaviour is under investigation by the IFMS SW support team. As per mission FCT request, the GS Engineer was also contacted on this issue, as well as more generally on the current SW configuration in place for IFMS/TMTCS at both Stations. Detailed feedback is expected to be received in the upcoming days.

DOY 131 (10/05/2012)

16:35:58 - INT reported drop in TM from WHM. Asked WHM and they reported BAD signal.

DOY 132 (11/05/2012) – no incidents

DOY 133 (12/05/2012) – no incidents

DOY 134 (13/05/2012)

17:10:00 - G/S: Bad Frames from: Redu - Confirmed RFI (both chains)

DOY 135 (14/05/2012) – no incidents

DOY 136 (15/05/2012) – no incidents

DOY 137 (16/05/2012)

06:31:00 - Lost TM from Redu. 1min. RFI - Confirmed RFI (both chains)

06:44:00 - Computer mention they are working on firewall. No visible interruptions seen

DOY 138 (17/05/2012) – no incidents

DOY 139 (18/05/2012) – no incidents

DOY 140 (19/05/2012)

22:08:00 - G/S: Bad Frames from:REDU - Confirmed RFI (both chains)

DOY 141 (20/05/2012) –

18:45:00 - G/S: Drop VC-0 from G/S:REDU - Confirmed RFI (both chains)

DOY 142 (21/05/2012)

19:48:00 - G/S: Drop VC-0 from G/S:REDU - Confirmed RFI (both chains)

DOY 143 (22/05/2012) – no incidents

DOY 144 (23/05/2012) – no incidents

DOY 145 (24/05/2012)

06:16:00 - G/S: Bad Frames from: REDU - Confirmed RFI (chain1 only)

DOY 146 (25/05/2012) –

01:01:00 - TC link to NO Bitlock - Network reports very weak signal received

01:15:00 - Lots of NO bitlock on TC link; lots of bad frames and TM drop

01:26:00 - G/S: Drop VC-0 & VC-7 from G/S: Redu

01:30:00 - After some investigation SPACON realized that at LOS we were on -Z antenna and at AOS wrong on +Z antenna due to an on board T.T. CMD to switch to +Z(CMD R3320 T.T. exec time 2012.145.20.25.51, release time: 2012.142.20.06.37)

01:56:00 - Request ECC to sweep to lock RX2 (CRP_RFS_2110 step 3.2.2)

03:50:00 - Request ECC to sweep to lock RX2 (previous TCs were configured for RX1)

04:44:00 - ECC shift handover. Configure station again for uplink to RX-2

05:00:00 - Test cmds sent ok

05:05:00 - FD are called in to recover AOCS, spacon will wait to recover the instruments until after the AOCS is back to nominal timeline operations.

07:10:00 - 2 TT TCs are uplinked. TC, R3320 with execution times set for 07:30:00 + 07:30:30 in order to manually switch the ant to +Z during the slew man

Feedback from the ECC:

Normally an automated schedule is used to configure the station for Integral support, so the ECC operators usually don't think about which Onboard Receiver configuration is in use (defaults are used for the jobs).

The ECC operator did not understand that the uplink frequency needed to be physically changed before restarting the uplink, rather than just changing the parameter setting on the GSRC page (Station Computer).

A specific ECC procedure for reconfiguring the Ground Station for Receiver-2 instead of Receiver-1 was put in place in order to address this point.

DOY 147 (26/05/2012)

04:21:00 - G/S: Bad Frames from Redu - Confirmed RFI

11:13:00 - G/S: Bad Frames from Redu - Confirmed RFI

DOY 148 – no incidents.

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.

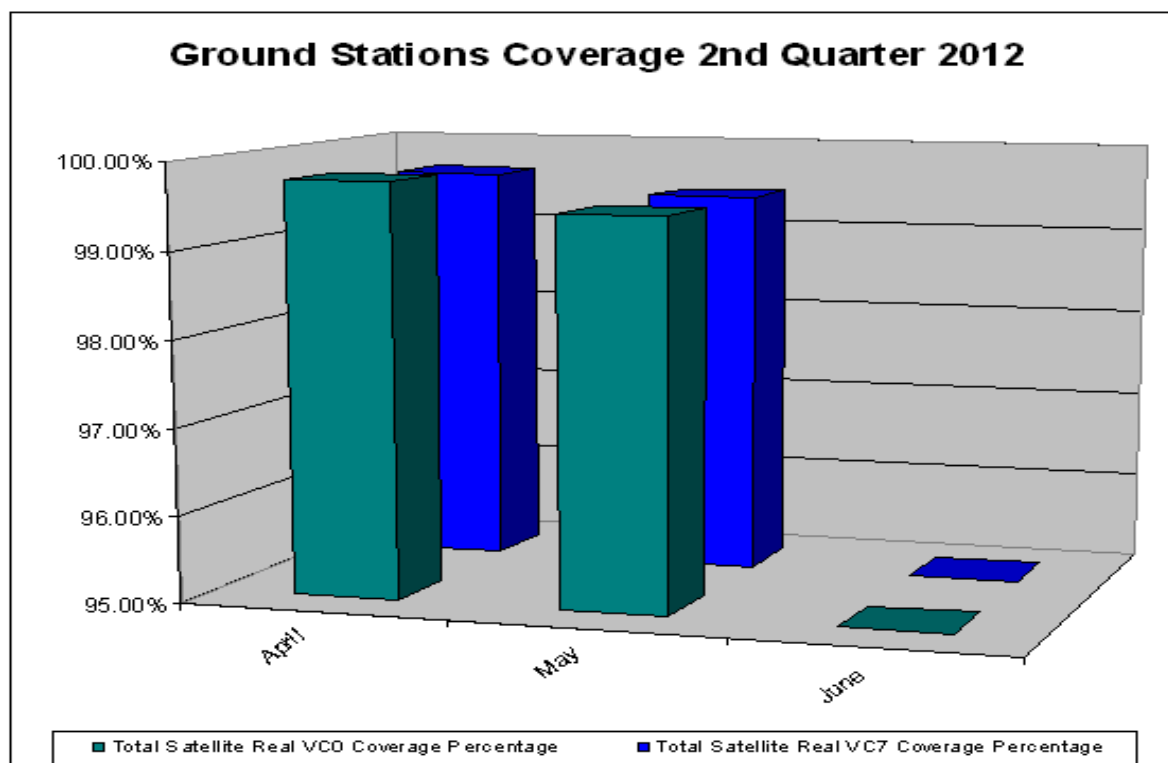


Figure 10: Comparison of VC0 to VC7 coverage

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 1183 to 1192, corresponding to the time range 21 June to 20 July.

New observations have been planned for revolutions 1178 (6-8 June) to 1192 (17-20 July), including the SPI annealing period from 1178 to 1183. No TOOs were scheduled.

TSFs have been received for revolutions 1177 to 1191.

3.3.2 Observation Status

New ECS files have been for revolutions 1163 to 1169, covering observations up to 12 May.

3.3.3 ISOC Science Data Archive

Work is ongoing on the development of the new ISDA.

3.3.4 ISOC System

ISOC system V32.2 was released on 4 June, with minor changes.

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-3270	2012-05-06	Incorrect Time tag Execution Time causes wrong Antenna selection	ESA Stations	Pending
INT-3271	2012-05-08	Reboot of both FD servers	FDS	Pending
INT-3272	2012-05-08	No SPI OOL during PSD channel rate malfunction	ODB	Closed
INT-3273	2012-05-17	PLM Operations interrupted following solar flare	Spacecraft	Closed
INT-3274	2012-05-21	IFTS 'target' directory deleted on IDDA	IMCS	Pending
INT-3275	2012-05-23	FD file servers crash	FDS	Closed
INT-3276	2012-05-24	AADs degradation	Spacecraft	Pending
INT-3277	2012-05-25	Loss of TM and TC Contact to Integral due to Combination of Errors.		Pending
INT-3278	2012-05-29	EEXIT-03 interlock prevents uplink of ED DEBPG100	IMCS	Testing
INT-3279	2012-05-29	list of solar flares affecting INTEGRAL operations		Closed
INT_SC-384	2012-05-08	SPI PSD channel rates malfunction	Payload	Closed
INT_SC-385	2012-05-30	JEM-X2 DFEE CRC Anomaly following eclipse on 2012-05-30	Payload	Closed

5 Special Events & Future Milestones

SPI annealing #19 starts 05/06/2012

6 Appendix

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

6.1 AOCS operations

During this period, 430 Open Loop Slews, 503 Closed Loop Slews and 25 Momentum Biases were executed (as reported by ACC OEM).

25 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 01/06/2012 is reported in the following plot:

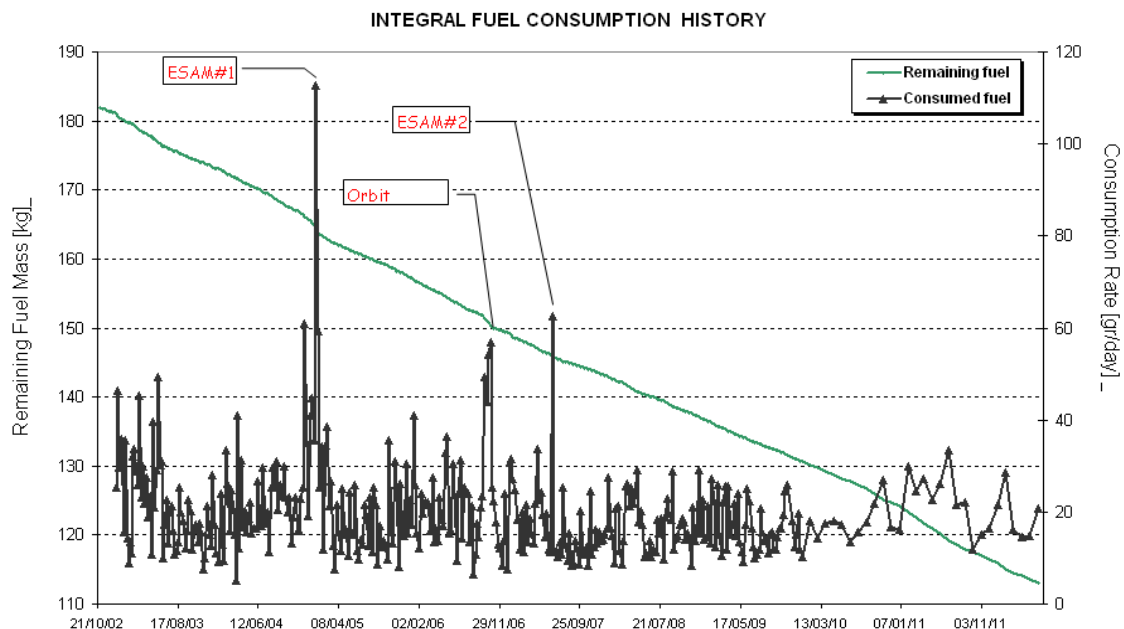


Figure 11: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

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.

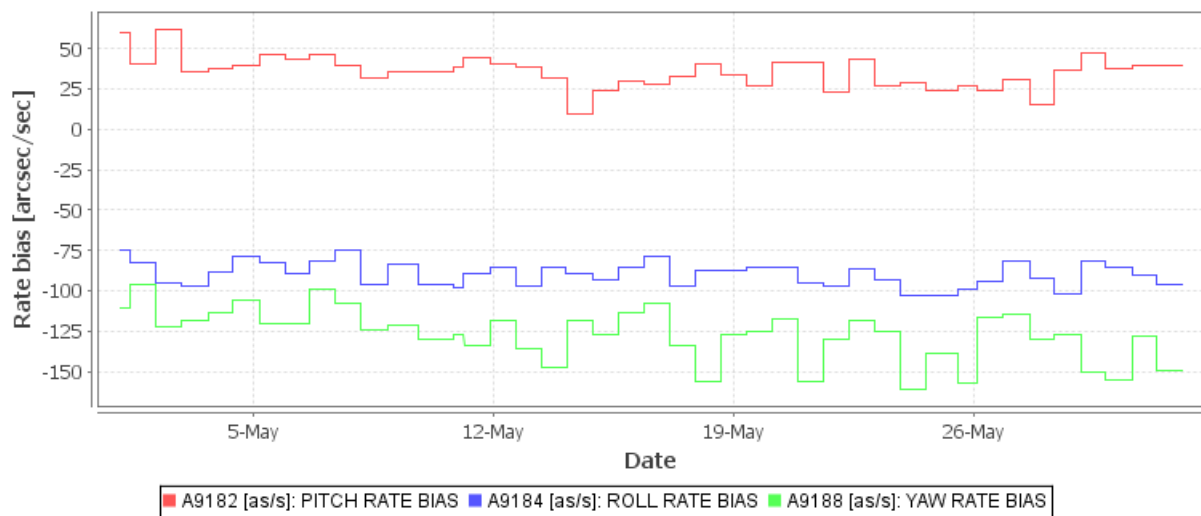


Figure 12: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

09-05-2012 (Day of Year 130, Revolution 1168)

At 10:09:42, operations commenced for the first Earth observation during 2012. The activities continued until 22:28 the following day during revolution 1169, when normal operations resumed.

No further incidences were reported in the ARTS system this month.

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 three eclipses at the end of the months are clearly visible. No stroke increased has been performed in the reporting period.

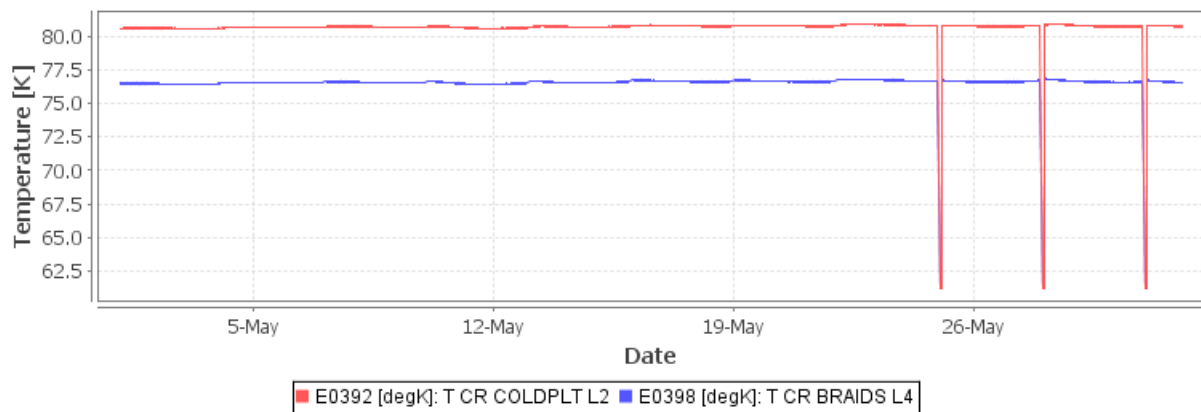


Figure 13: SPI Cold plate and H-bus temperature

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

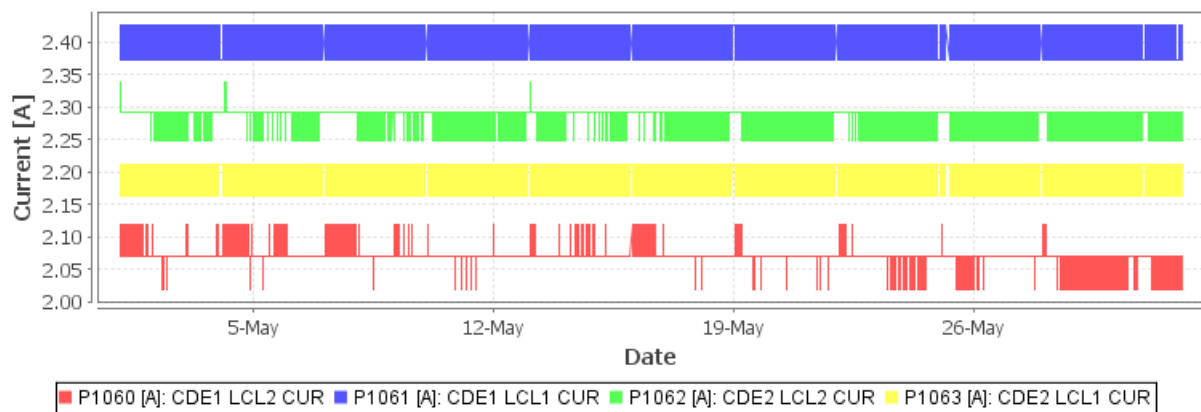


Figure 14: SPI CDE LCL current

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. The effect of the solar flare (17./18.05.) can clearly be seen.

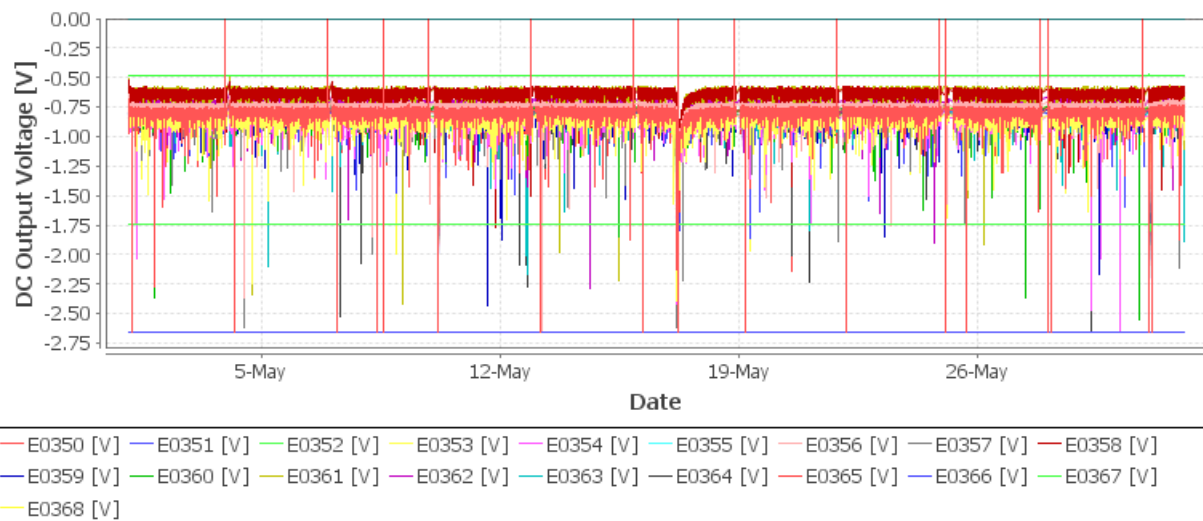


Figure 15: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)

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. The effect of the solar flare (17./18.05.) can clearly be seen.

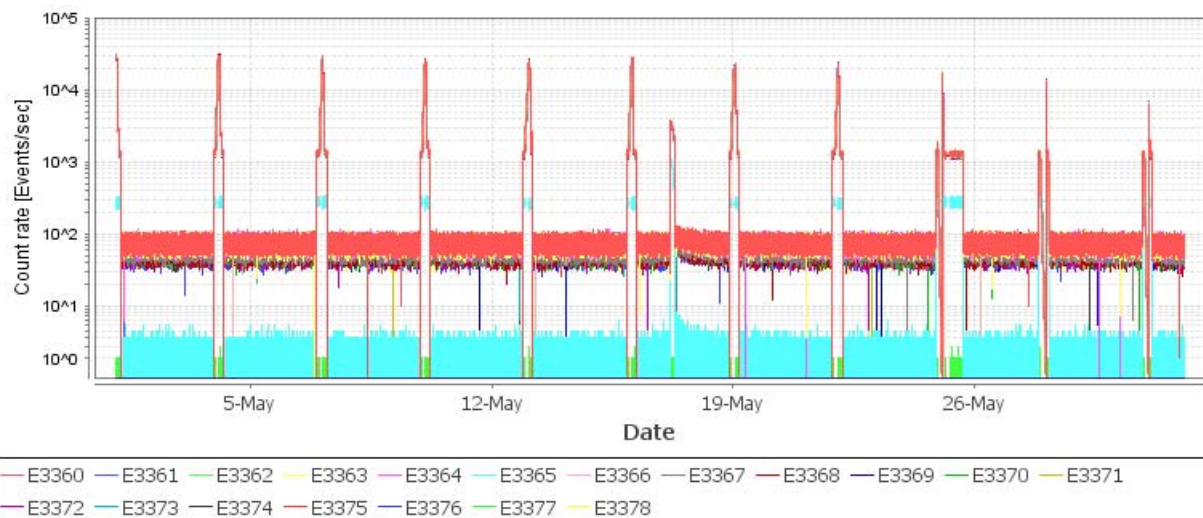


Figure 16: SPI GeD Non-Vetoed count rates. Note that the scale used for plotting is logarithmic.



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

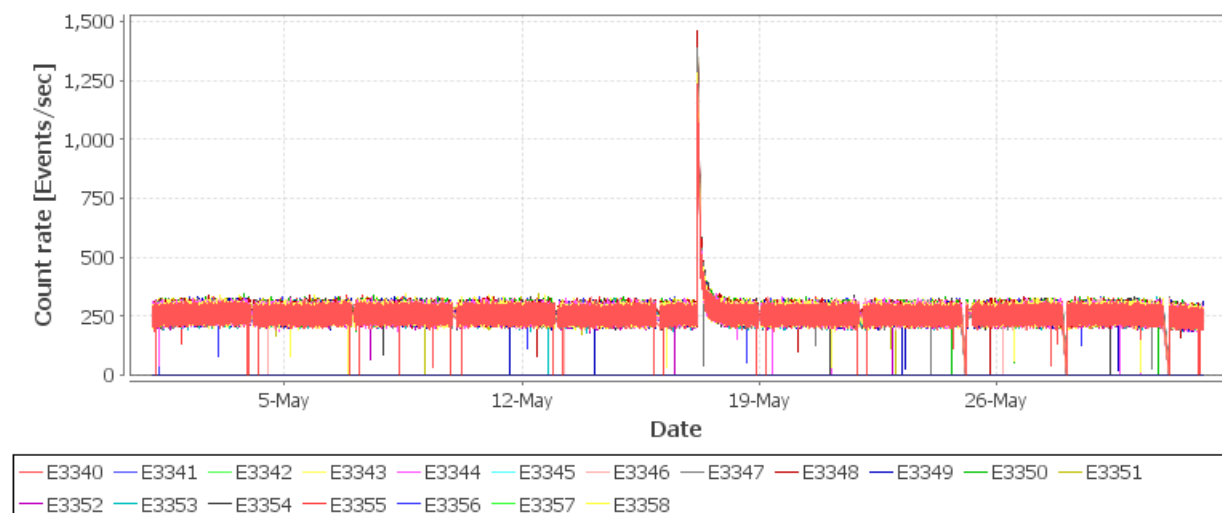


Figure 18: SPI GeD Time Tagged Saturated count rates. The effect of the solar flare (17./18.05.) can clearly be seen.

PSD

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

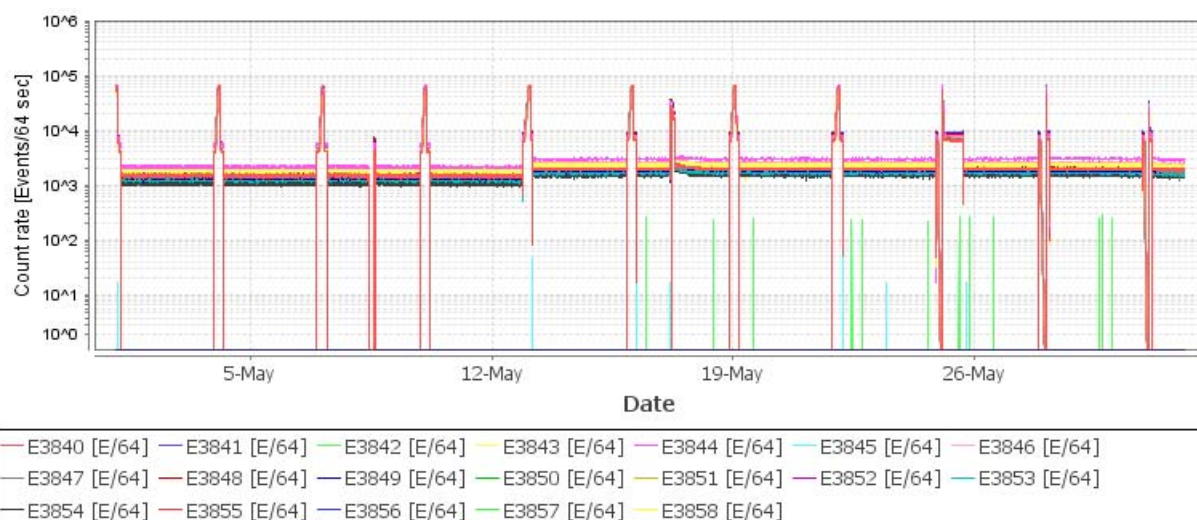


Figure 19: SPI PSD GeD Channel rates

6.2.2 Event Log

08-05-2012 (Day of Year 129, Revolution 1168)

SPI PSD channel rates malfunction: please see INT_SC-384

25-05-2012 (Day of Year 146, Revolution 1174)

A time-tag command with an incorrect execution time caused the on-board antenna to switch, which caused a drop in the link (around 01:00Z). Subsequent problems at the ground station prevented the link being re-established. At 05:00 the link was re-established, however all commands at the start of the revolution and attitude related commands had been missed. The timeline was eventually recovered at 13:15:34. SPI operation continued around 14:15Z.

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 effect of the solar flare (17./18.05.) can clearly be seen.

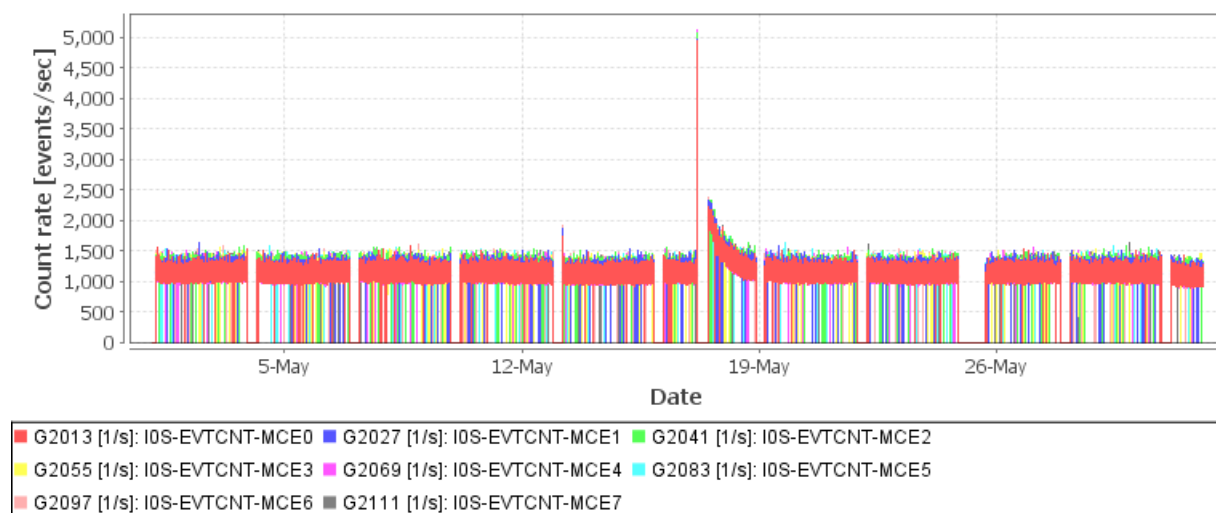


Figure 20: ISGRI MCE Counters

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. The effect of the solar flare (17./18.05.) can clearly be seen.



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

25-05-2012 (Day of Year 146, Revolution 1174)

A time-tag command with an incorrect execution time caused the on-board antenna to switch, which caused a drop in the link (around 01:00Z). Subsequent problems at the ground station

prevented the link being re-established. At 05:00 the link was re-established, however all commands at the start of the revolution and attitude related commands had been missed. The timeline was eventually recovered at 13:15:34. IBIS operation continued at 15:03Z.

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.

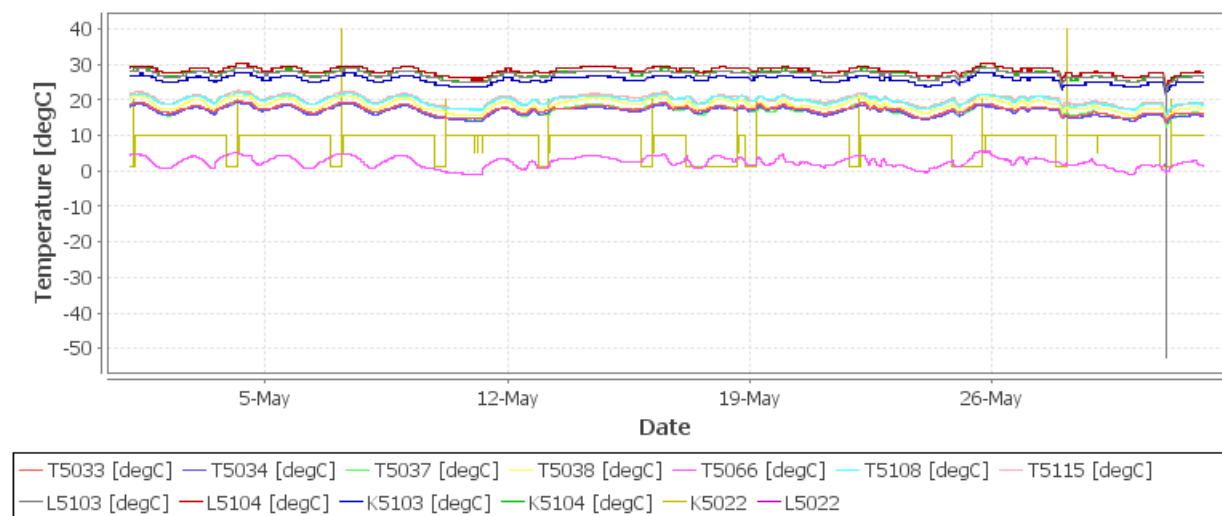


Figure 22: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

10-05-2012 (Day of Year 131, Revolution 1169)

At 23:00, a verifier crash aborted the uplink of the KEDATA02/LEDATA02 sequences. These were copied from the TC history, and re-uplinked at 23:13. There was no impact.

17-05-2012 (Day of Year 138, Revolution 1171)

At 01:57, both JEMX-1 & 2 went to SAFE mode due to high radiation from a solar flare.

18-05-2012 (Day of Year 139, Revolution 1171)

At 13:01, after the background radiation levels had fallen, the JEMXs were recovered in the following manner:

13:01 CRP_JEM1_5060 & CRP_JEM2_5060

13:07 KEACAL01 & LEACAL01

13:18 FCP_JEM1_1010 & FCP_JEM2_1010

13:51 KEDATA02 & LEDATA02

13:54 Re-enable JEMX1+2 in autostack

25-05-2012 (Day of Year 146, Revolution 1174)

After an on-board antenna problem, then a problem at the ground station, the post perigee switch on sequence failed. Once the problems had been cleared, a recovery was performed. This consisted of:

14:15 KEACAL01

14:28 KEHVAC01

14:31 LEACAL01

14:48 KEDATA02

14:52 LEHVAC01

15:08 LEDATA02

Completing the recovery. The impact was the loss of 12½ hours of science data.

6.5 OMC***6.5.1 Operations***

The status and performance of OMC is nominal.

6.5.2 Event Log**03-05-2012 (Day of Year 124, Revolution 1166)**

At 13:31:07, an AOCS problem forced an interruption to the timeline, a recovery was immediately performed, and the timeline rejoined at 14:03. The impact was the loss of pointing 11660103.

05-05-2012 (Day of Year 126, Revolution 1167)

At 20:36:17, an AOCS problem forced an interruption to the timeline, a recovery was immediately performed, and the timeline rejoined at 20:57. The impact was the loss of pointing 11670071.

07-05-2012 (Day of Year 128, Revolution 1168)

At 16:43:00, an AOCS problem forced an interruption to the timeline, a recovery was immediately performed, and the timeline rejoined at 17:27. The impact was the loss of pointing 11680025. It was at this time the following OEMs were received:

2012.128.16.46.14.113	2012.128.16.46.23.890	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0	65535 PR	N E E	
2012.128.16.46.20.238	2012.128.16.46.29.785	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 that pointing.

08-05-2012 (Day of Year 129, Revolution 1168)

At 01:58:00, an AOCS problem forced an interruption to the timeline, a recovery was immediately performed, and the timeline rejoined at 02:40. The impact was the loss of pointing 11680041. It was at this time the following OEMs were received:

2012.129.02.01.57.887	2012.129.02.02.07.888	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0	65535 PR	N E	E
2012.129.02.02.04.137	2012.129.02.02.13.622	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0	65535 PR	N E	E

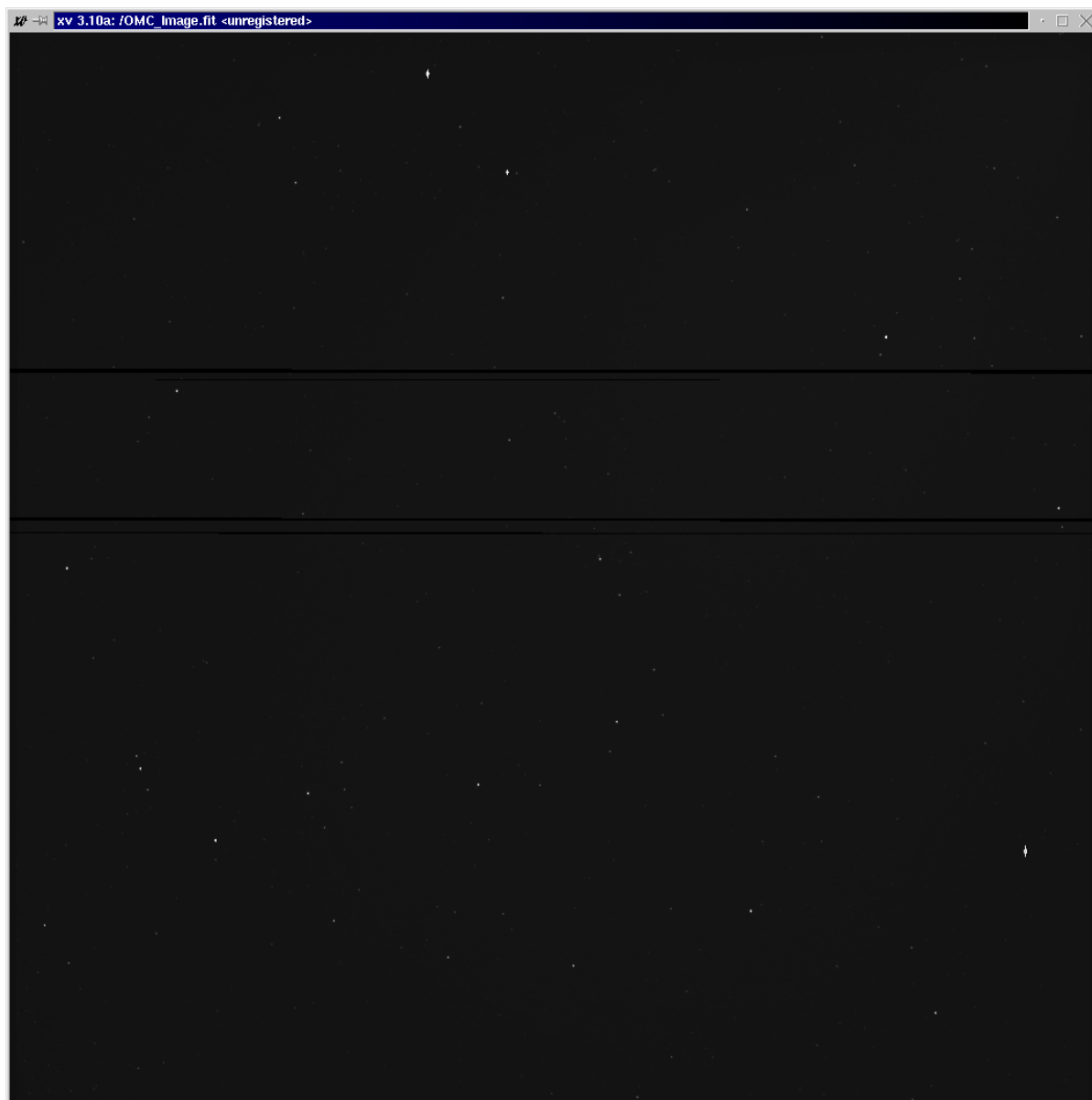
These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for that pointing.

09-05-2012 (Day of Year 130, Revolution 1168)

At 11:03:00, an FD problem forced an interruption to the timeline, a recovery was subsequently performed, and the timeline rejoined at 11:45. The impact was pointing 11680096 was executed at an incorrect attitude.

10-05-2012 (Day of Year 131, Revolution 1169)

On this day, Integral performed an Earth Observation. The following image was taken from raw data displayed on the OMC PI workstation shortly after the Earth had left the field of view.

**11-05-2012 (Day of Year 132, Revolution 1169)**

At 15:56, an FD problem forced an interruption to the timeline, a recovery was subsequently performed, and the timeline rejoined at 17:25. The impact was the loss of pointings 11690027 & 11690028. It was at this time the following OEMs were received:

2012.132.16.25.17.969	2012.132.16.25.23.123	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0 65535	PR	N E	E
2012.132.16.25.24.094	2012.132.16.25.30.439	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 11690027.

13-05-2012 (Day of Year 134, Revolution 1170)

At 21:23:54, the attitude defined for pointing 11700022 was re-defined, as there were an insufficient number of stars available for attitude determination. The result was that this pointing was executed off target.

14-05-2012 (Day of Year 135, Revolution 1170)

At 09:41, an AOCS problem forced an interruption to the timeline, a recovery was subsequently performed, and the timeline rejoined at 11:51. The impact was the loss of pointing 11700035. It was at this time the following OEMs were received:

2012.135.11.04.13.257	2012.135.11.04.18.825	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2012.135.11.04.19.007	2012.135.11.04.30.278	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E

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

17-05-2012 (Day of Year 138, Revolution 1171)

At 02:02:27, due to high radiation, OMC went to SAFE. After the radiation died down, the instrument was put back into Stand-by. At 13:49:46 the following day operations were resumed. The impact was pointing 11710033 was cut short from a planned 2200 to 905 seconds, and pointings 11710037 to 11710090 were lost. It was at this time the following OEMs were received:

2012.138.04.29.24.802	2012.138.04.29.36.467	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2012.138.04.29.30.052	2012.138.04.29.41.339	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2012.138.05.11.26.928	2012.138.05.11.35.096	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2012.138.05.11.33.053	2012.138.05.11.39.421	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E

These correspond to the rejected M1130 (RESET IM) and MU1310 (IMAGING-A) commands sent from the auto-stack for pointings 11710037 & 11710038.

19-05-2012 (Day of Year 140, Revolution 1172)

At 11:06:30, an AOCS problem forced an interruption to the timeline. A recovery was performed and the timeline rejoined at 11:24. The impact was the loss of pointing 11720016.

22-05-2012 (Day of Year 143, Revolution 1173)

At 07:13:27, an AOCS problem forced an interruption to the timeline. A recovery was performed and the timeline rejoined at 07:39. The impact was the loss of pointing 11730009.

23-05-2012 (Day of Year 144, Revolution 1173)

At 03:25, an FD problem forced an interruption to the timeline. After the problem had been fixed a recovery was performed. The timeline was rejoined at 06:16. The impact was the loss of pointings 11730039 and 11730040.

24-05-2012 (Day of Year 145, Revolution 1173)

At 11:10:27, an AOCS problem forced another interruption. A recovery was performed and the timeline rejoined at 11:47. OMC pointing 11730076 was not affected, pointing 11730077 was shortened from a planned 1961 to 1544 seconds.

25-05-2012 (Day of Year 146, Revolution 1174)

A time-tag command with an incorrect execution time caused the on-board antenna to switch, which caused a drop in the link. Subsequent problems at the ground station prevented the link being re-established. At 05:00 the link was re-established, however all the start of revolution and attitude related commands had been missed. The timeline was eventually recovered at 13:15:34. The impact was the loss of pointings 11740002, then 11740004 to 11740017 and 11740019 to 11740022 included (19 pointings).

27-05-2012 (Day of Year 148, Revolution 1174)

At 05:42, an FD problem forced an interruption to the timeline. A recovery was performed, and the timeline rejoined at 06:26. The impact was the loss of pointing 11740093.

29-05-2012 (Day of Year 150, Revolution 1175)

At 03:21, an AOCS problem forced an interruption to the timeline, a recovery was performed, and the timeline rejoined at 04:28. The impact was the loss of pointing 11750027. It was at this time the following OEMs were received:

2012.150.03.21.56.862 TC1	2012.150.03.22.04.548	1792 0	RealTime 0	131 65535	PR	TC REJECT N	REJECTED E
2012.150.03.22.02.987 TC1	2012.150.03.22.11.745	1792 0	RealTime 0	131 65535	PR	TC REJECT N	REJECTED E

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

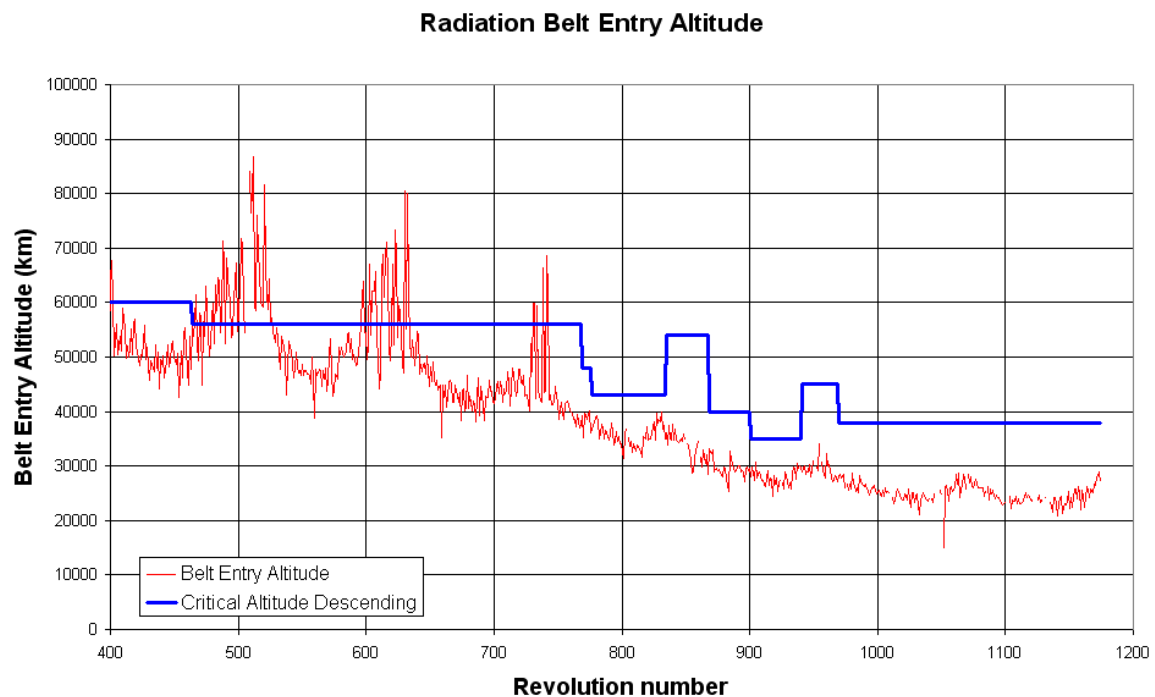
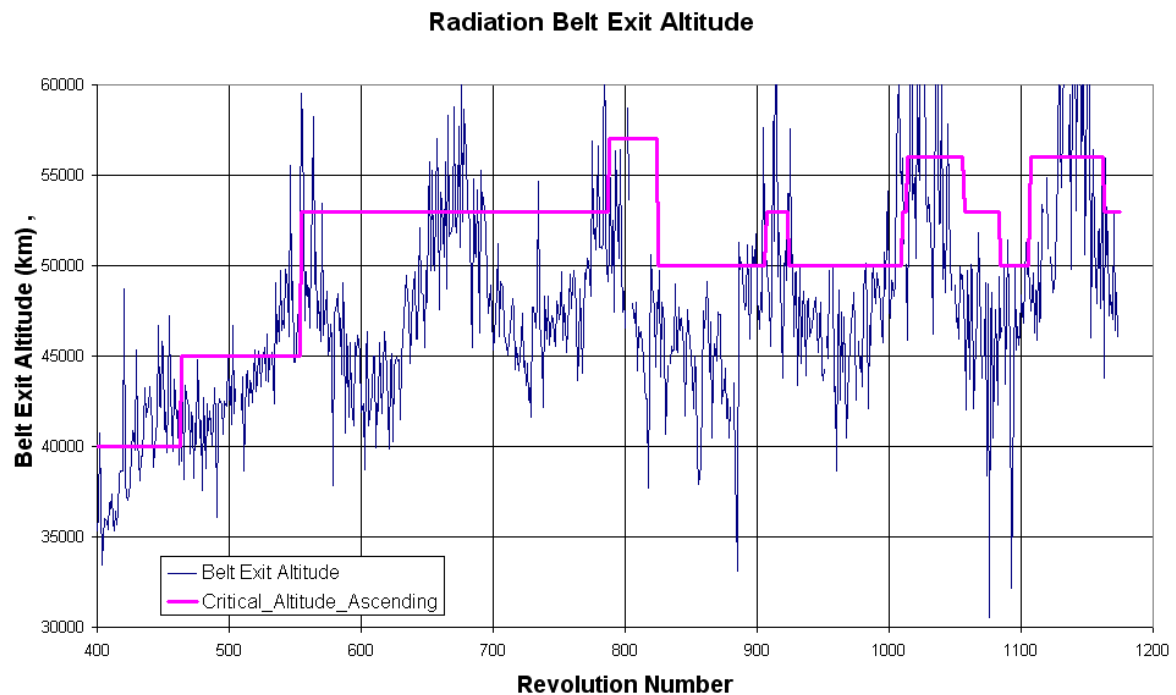


Figure 23: Radiation belt entry

**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.**

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
1166	RAD_EXIT R 2012-05-01T03:29:32Z	01/05/2012 02:49:12	52711	01-May-2012 03:08:32	49725.01	30-Apr-2012 23:21:47	3314.216
1166	RAD_ENTR R 2012-05-03T20:21:02Z	N/A	N/A	03-May-2012 21:48:32	18529.49	03-May-2012 22:28:32	8561.239
1167	RAD_EXIT R 2012-05-04T03:18:46Z	04/05/2012 02:12:57	48211	04-May-2012 02:48:32	48832.14	03-May-2012 23:08:32	3376.777
1167	RAD_ENTR R 2012-05-06T20:11:19Z	N/A	N/A	06-May-2012 21:37:18	19880.67	06-May-2012 22:27:18	7591.23
1168	RAD_EXIT R 2012-05-07T03:09:42Z	07/05/2012 02:16:41	50600	07-May-2012 02:47:18	49421.74	06-May-2012 22:57:18	3190.654

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
1168	RAD_ENTR R 2012-05-09T19:58:10Z	N/A	N/A	09-May-2012 21:27:43	19231.15	09-May-2012 22:07:43	9422.405
1169	RAD_EXIT R 2012-05-10T02:57:29Z	10/05/2012 01:56:01	49106	10-May-2012 02:37:43	49744.89	09-May-2012 22:47:43	3396.13
1169	RAD_ENTR R 2012-05-12T19:43:42Z	N/A	N/A	12-May-2012 21:10:26	19795.61	12-May-2012 21:50:26	10013.04
1170	RAD_EXIT R 2012-05-13T02:43:16Z	13/05/2012 02:49:45	60327	13-May-2012 02:20:26	49353.17	12-May-2012 22:30:26	3321.703
1170	RAD_ENTR R 2012-05-15T19:30:41Z	N/A	N/A	15-May-2012 20:54:33	20249.18	15-May-2012 21:44:33	8022.482
1171	RAD_EXIT R 2012-05-16T02:30:08Z	16/05/2012 01:13:21	46396	16-May-2012 02:04:33	49077.79	15-May-2012 22:14:33	3274.196
1171	RAD_ENTR R 2012-05-18T19:17:47Z	18/05/2012 20:31:38	29266	18-May-2012 20:48:44	18768.82	18-May-2012 21:28:44	8960.641
1172	RAD_EXIT R 2012-05-19T02:17:36Z	19/05/2012 01:17:54	49420	19-May-2012 01:48:44	48395.86	18-May-2012 22:08:44	3536.295
1172	RAD_ENTR R 2012-05-21T19:03:59Z	21/05/2012 20:18:42	29066	21-May-2012 20:29:55	20033.22	21-May-2012 21:19:55	7923.986
1173	RAD_EXIT R 2012-05-22T02:04:28Z	22/05/2012 00:45:06	45932	22-May-2012 01:39:55	49052.58	21-May-2012 21:49:55	3450.785
1173	RAD_ENTR R 2012-05-24T18:50:07Z	24/05/2012 19:59:38	30193	24-May-2012 20:20:38	18909.93	24-May-2012 21:00:38	9157.927
1174	RAD_EXIT R 2012-05-25T01:50:48Z	25/05/2012 00:51:38	49596	25-May-2012 01:30:38	49840.01	24-May-2012 21:40:38	3585.504
1174	RAD_ENTR R 2012-05-27T18:37:18Z	N/A	N/A	27-May-2012 20:08:55	18654.42	27-May-2012 20:48:55	8861.095
1175	RAD_EXIT R 2012-05-	28/05/2012 00:45:38	50832	28-May-2012 01:08:55	48444.47	27-May-2012 21:28:55	3599.274

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
	28T01:37:42Z						
1175	RAD_ENTR R 2012-05-30T18:26:18Z	N/A	N/A	30-May-2012 17:29:48	20269.83	30-May-2012 18:19:48	8163.509
1176	RAD_EXIT R 2012-05-31T01:26:33Z	31/05/2012 00:13:30	47153	30-May-2012 22:49:48	50227.2	30-May-2012 18:49:48	3376.323

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.