EUROPEAN SPACE AGENCY

DIRECTORATE OF TECHNICAL & OPERATIONAL SUPPORT

MISSION OPERATIONS DEPARTMENT

INTEGRAL

Mission report

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

No. 407

01.04.2012

Routine Phase

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

Table of Contents

1 General 4
2 Satellite status 4
2.1 Platform 4
2.2 Payload 5
3 Ground Facilities 12
3.1 Mission Control System 12
3.2 Ground Stations and Network 13
3.3 ISOC 16
4 Anomalies 17
5 Special Events & Future Milestones 18
6 Appendix 18
6.1 AOCS operations 18
6.2 SPI 20
6.3 IBIS 28
6.4 JEM-X 30
6.5 OMC 31
6.6 IREM 33

Distribution List

ESOC	
	SPACONs
N. Bobrinsky (OPS-L)	F. Sheasby
A. Rudolph (OPS-OA)	F. Dreger
J. Miro (OPS-G)	A. Mcdonald
J. Roldan	W. Hell
M. Kirsch	K.J. Schulz
R. Southworth	M.A. Larsen
S. Fahmy	R. Hussock
J. Martin	J. Howard
F. Cordero	M. Butkovic
F. Di Marco	J. Audric
S. DePadova	
D. Webert	Shift – Coord
F. Schmidt	Scheduling Office
C. Lozano	T. Beck
M. Pantaleoni	M. Rossmann
M. Walker	M. Unal
U. Weissmann	
N. von Krusenstiern	A. Mantineo
J. Hübner	K. Scott
INTEGRAL/XMM Flight Dynamics team	

ESAC	
A. Parmar (SRE-OA)	P. Kretschmar (SRE-OAG)
M. Kessler (SRE-O)	E. Kuulkers (SRE-OAG)
ESTEC	
C. Winkler (SRE-SA)	G. Sarri (SRE-PP)
N. Rando (SRE-PAM)	H. Evans (TEC-EES)
S. Taylor (TEC-EPG)	
ESA HQ:	T. Reiter (D-HSO)
Redu:	B. Demelenne
ISDC	
R. Walter	ISDC Shift Team
C. Ferrigno	R. Rohlfs
ALENIA	
M. Montagna	F. Ravera
PI / Instrument Teams	
A. Bazzano (IBIS)	W. Hajdas (IREM)
G. La Rosa (IBIS)	S. Brandt (JEM X)
F. Lebrun (IBIS)	E. De Miguel (OMC)
P. Ubertini (IBIS)	J. P. Roques (SPI)
C. Brysbaert (SPI)	

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 March and covers the revolutions 1145 untill 1155 (included). 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, 851 of the 1113 planned science pointings were executed nominally. 2 pointings were lost to AOCS problems. 4 pointings were lost to FDS problems. 1 was interrupted when the CCCFs were activated. 10 pointings were lost to a verifier crash. Finally, 1 pointing was cut short and 244 lost to high radiation.
- E3.5 Testing

Summary of the overall status and performance of S/C

- Nominal for platform and payload
- High radiation following solar flares (07-12/03/2012)
- SPI DPE1 CPU Reset (25/03/2012)
- FSS/STR + SAS calibration (26/03/2012)
- IBIS deactivation and activation in rev. 1155 to clear the frequent LSL errors (i.e., to fix the anomalous condition on the communication line between the DPE and the MCEs) observed since the last DPE crash (29-30/03/2012)
- Increased fuel consumption probably related to the perigee attitude selected to shelter the SPI cooler from the earth albedo

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

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.

22 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.4376 Kg. The remaining propellant is in the order of 114.0826 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+/-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. The average telemetry occupation was 73.33 packets/cycle.

A SPI DPE1 CPU reset occurred on 25/03/2012 at 22:49Z. At the time of the anomaly, SPI was in photon mode and its status was nominal. The anomaly occurred close to rad belt entry and right during a spectra building compression transmission. IASW mode was INIT and the generation time of the OEMs received every 8s correspond to the time of the last OBT wrap around. The recovery of the instrument started straight away and lasted until 26/03/2012 at 15:53Z. SPI operations continued nominally.

The following plot shows the TM bandwidth allocation and occupation during the reporting period. The period of high solar activity as well as the SPI DPE reset can clearly be seen.

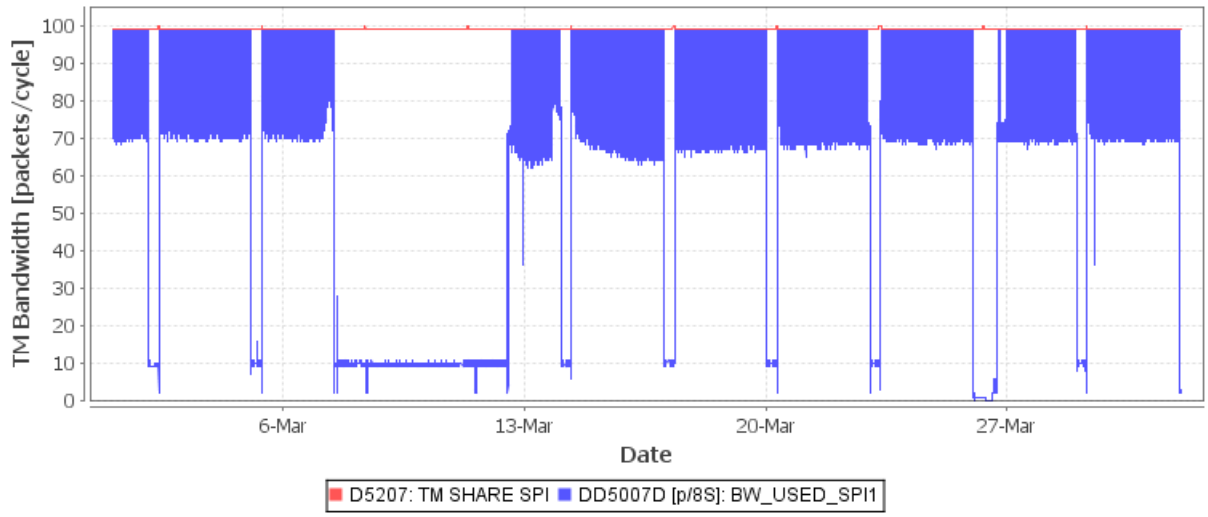


Figure 1: SPI TM bandwidth utilisation

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

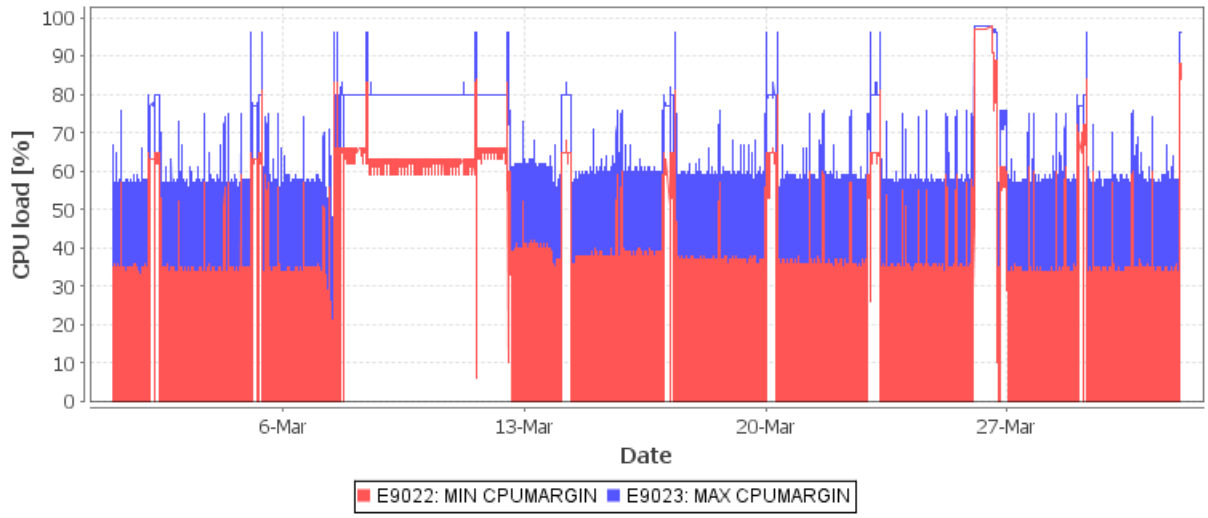


Figure 2: SPI IASW Performance

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

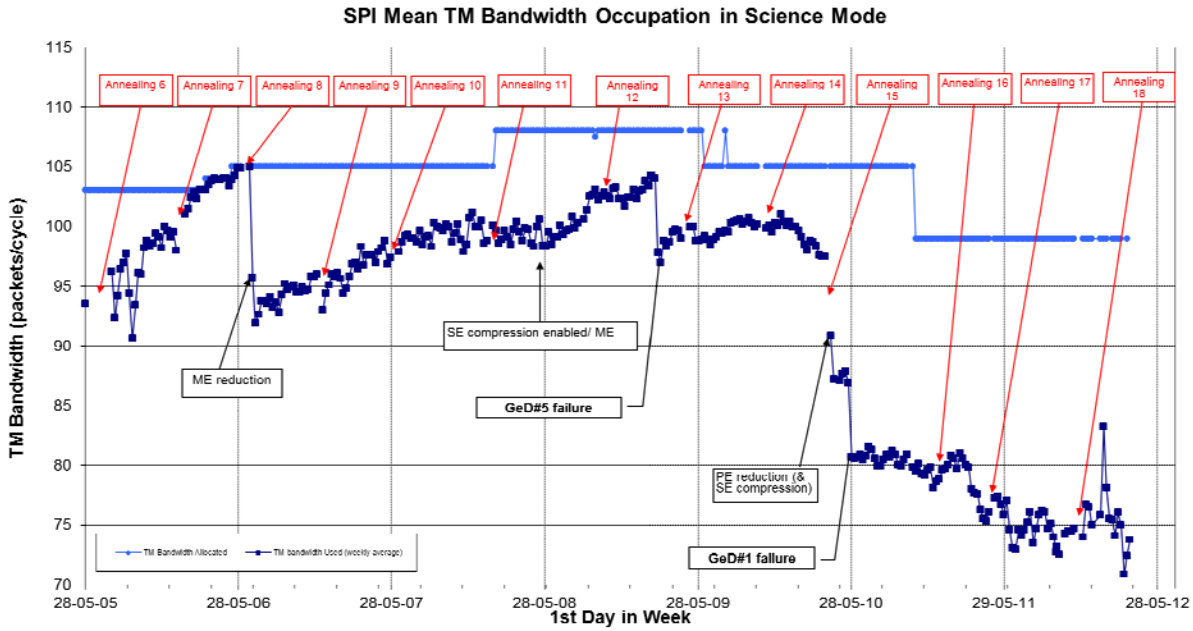


Figure 3: SPI TM bandwidth usage evolution since May 2005

Note: More information concerning the SPI operations is provided in Appendix 0.

2.2.2 IBIS

The overall status of IBIS is nominal, expect the anomalous behavior described in the following:

Since the IBIS DPE reset on DOY 2012.44, the following OEMs APID 1280 are reported occasionally (in average more than once per day):
- ID 133 CLASS 2: “IBIS1 IASW LSL TRANSFER FAILED (LOW LEVEL)”
- ID 131 CLASS 2: “IBIS1 IASW LSL TRANSFER FAIL REPORT FOR HIGH-LEVEL MODULE RESET”
- ID 230 CLASS 3: “IBIS1 MCE7 TIME OUT” (after a few seconds)

The group of messages flag an anomalous condition on the communication line between the DPE and the MCEs (the low speed link). The anomaly lasts only a few TM cycles. The unit solves the internal conflict on the LSL autonomously. IBIS operations continues nominally.
An MCE7 switch off and switch on has been performed, but did not cure the anomaly. The risk of a damage on MCE7 during the actual anomaly (i.e., the event of no communication), that might lead to a loss of this subsystem was considered to be minimal.
For recovering the anomaly, it was decided with all relevant parties, that a IBIS deactivation and activation should be performed. Since the anomaly had little impact on both science and operations, it was decided to wait for a suitable time slot for the deactivation and activation of IBIS. The whole recovery was performed in rev. 1155 (29-30.03.2012) and took about 18.5 hours.

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
- IBIS mean bandwidth utilisation in science mode: 114.65 packets/cycle

The plot below shows the IBIS TM utilisation during the reporting period. The period of high solar activity as well as the IBIS deactivation and activation can clearly be seen.

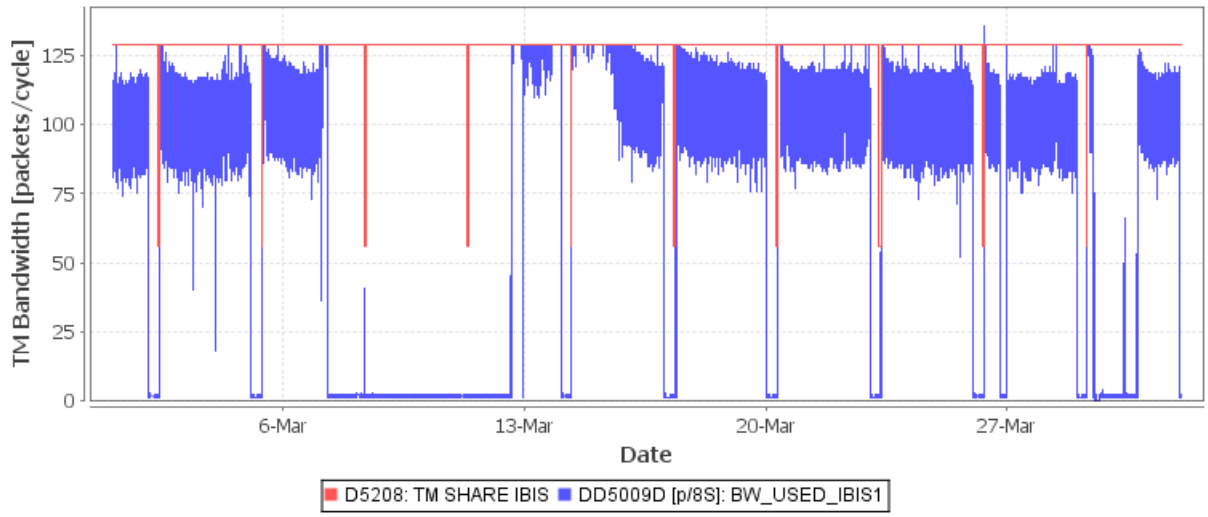


Figure 4: IBIS TM bandwidth utilisation

A plot of the IBIS weekly bandwidth utilisation since May 2005 is shown below. The solar flare can clearly be seen as a peak in the TM bandwidth usage.

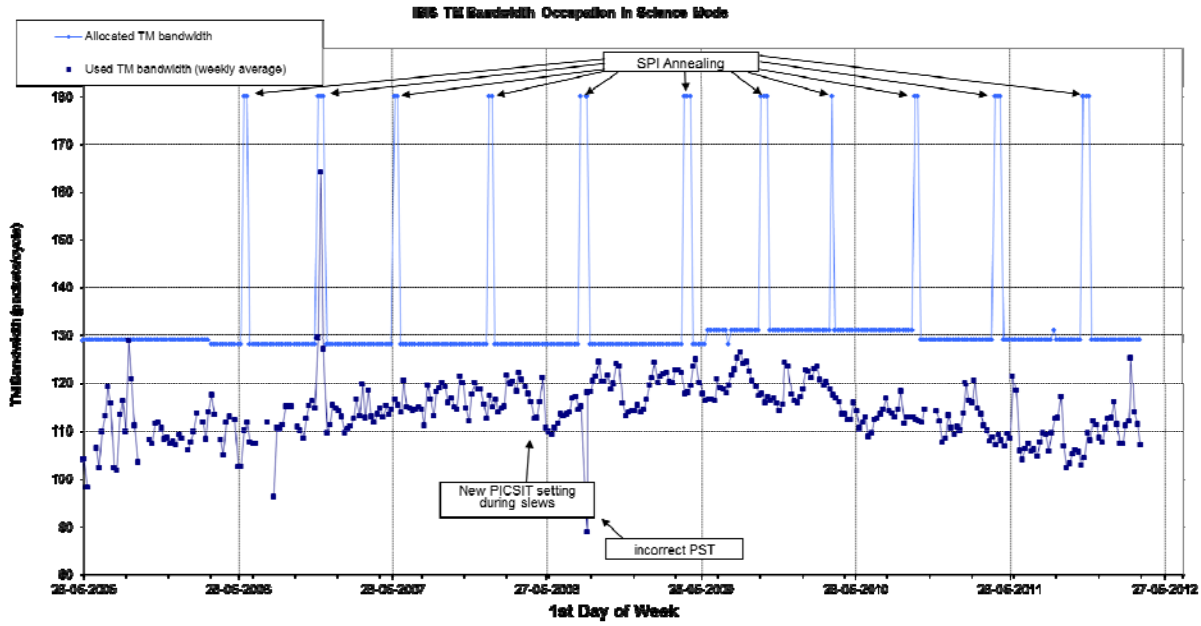


Figure 5: IBIS TM bandwidth usage evolution since May 2005

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.

- During the month, there were 2 extended periods where operations were not possible due to high radiation levels.

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. No Flat-field calibrations were performed this month.

During this reporting period, 851 of the 1113 planned science pointings were executed nominally. 2 pointings were lost to AOCS problems. 4 pointings were lost to FDS problems. 1 was interrupted when the CCCFs were activated. 10 pointings were lost to a verifier crash. Finally, 1 pointing was cut short and 244 lost to high radiation.

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

2.2.5 IREM

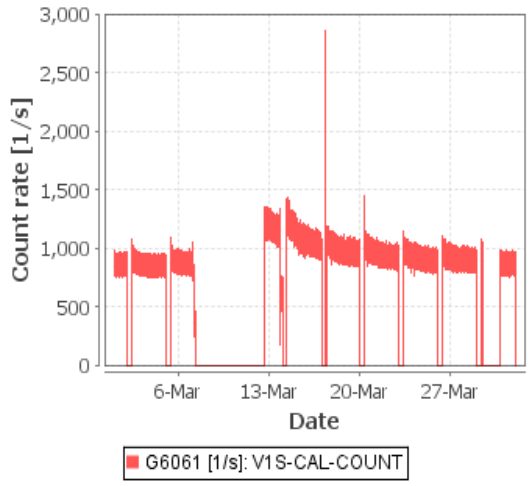
The status of IREM is nominal.

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

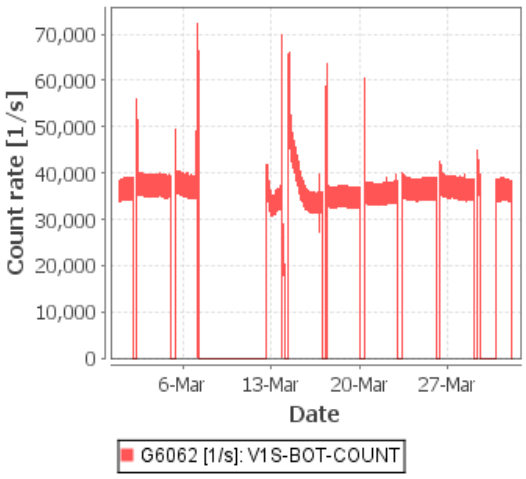
Radiation background

The background radiation level as measured by the instrument counters was low during the reporting period, except from the 7th to 15th March, when a solar flare caused radiation levels to increase significantly. 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



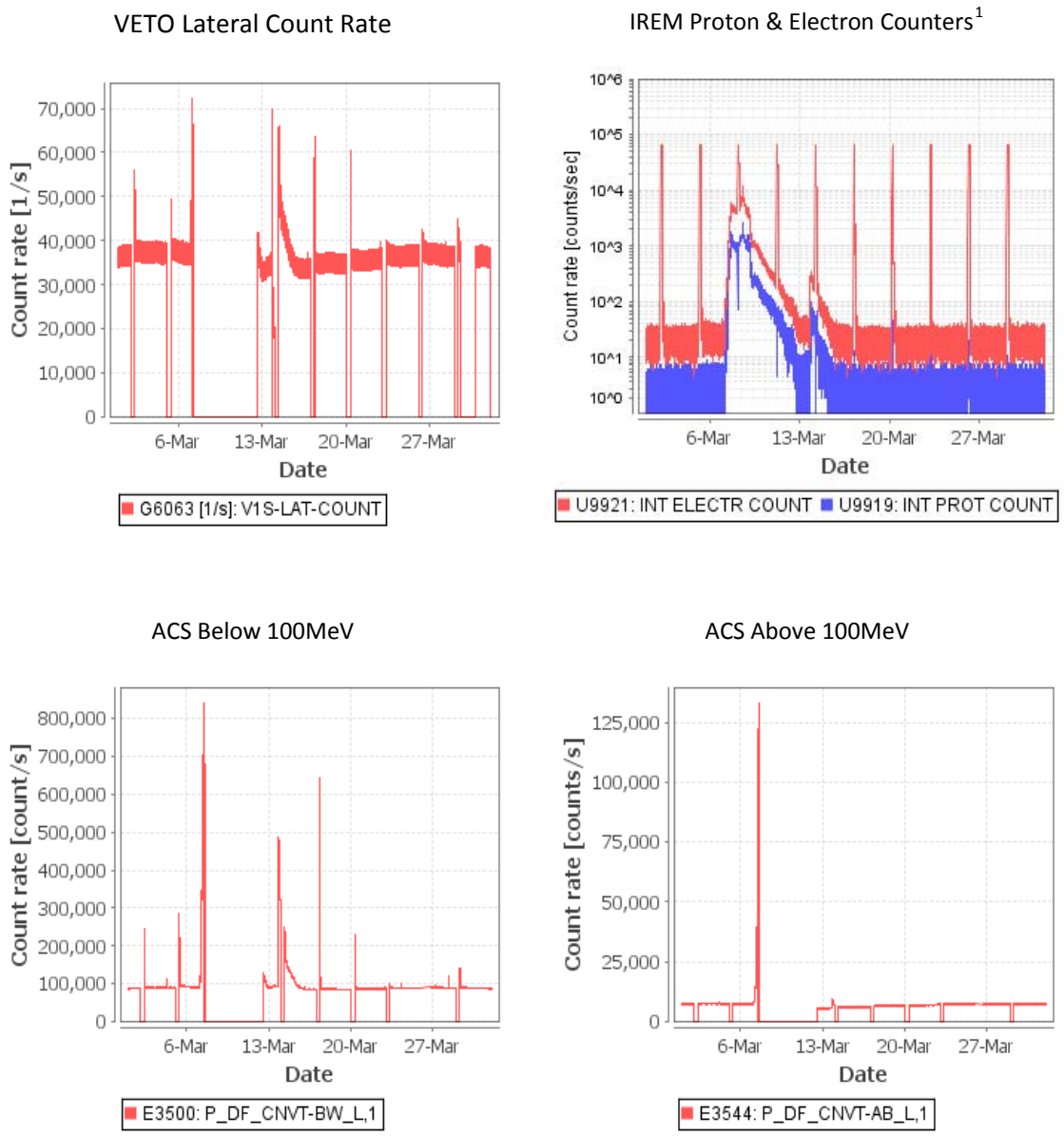


Figure 6: Instrument Count Rates

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

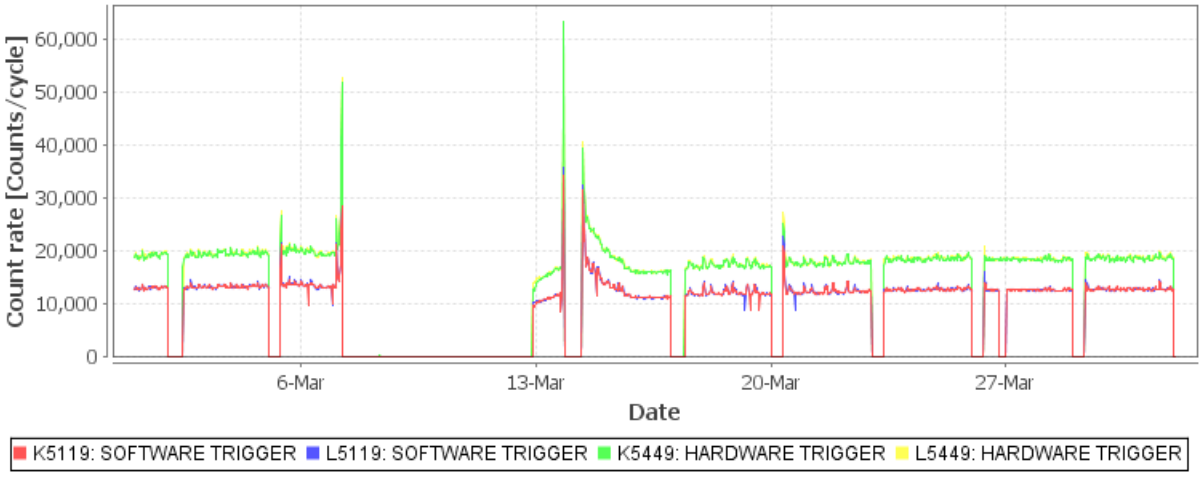


Figure 7: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

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.

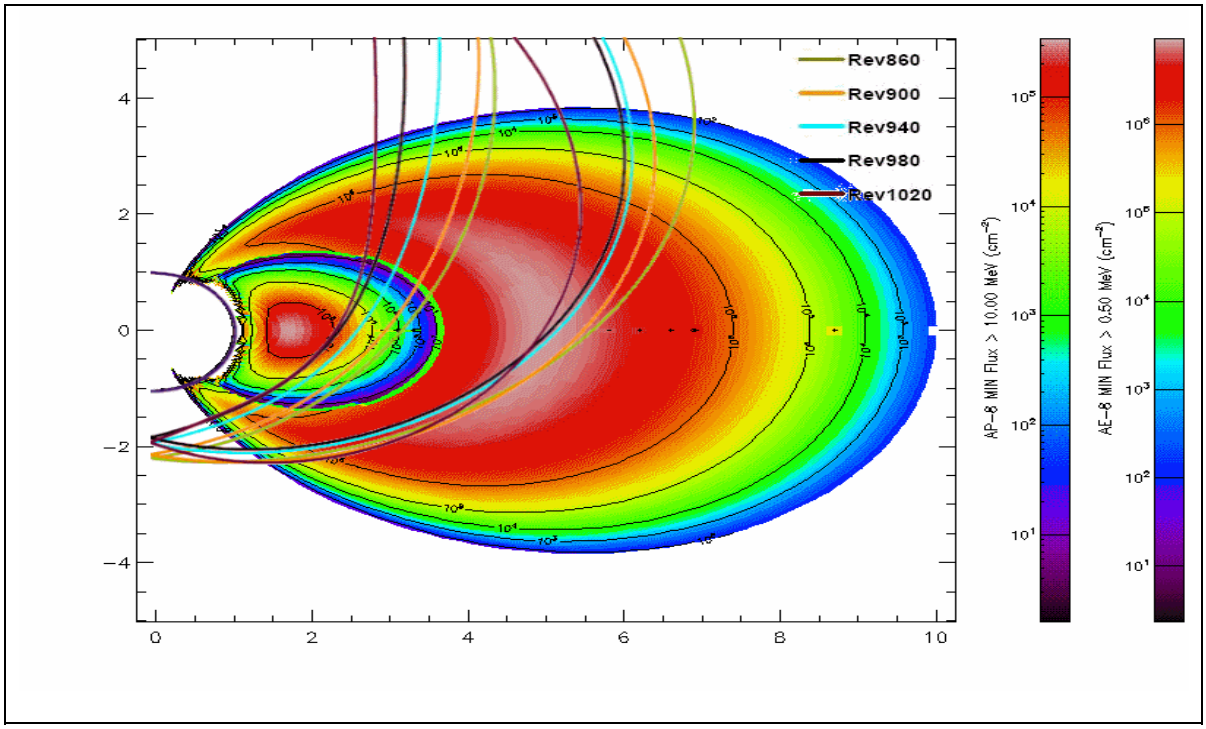


Figure 8: The predicted evolution of the orbit of Integral through the radiation belts

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.

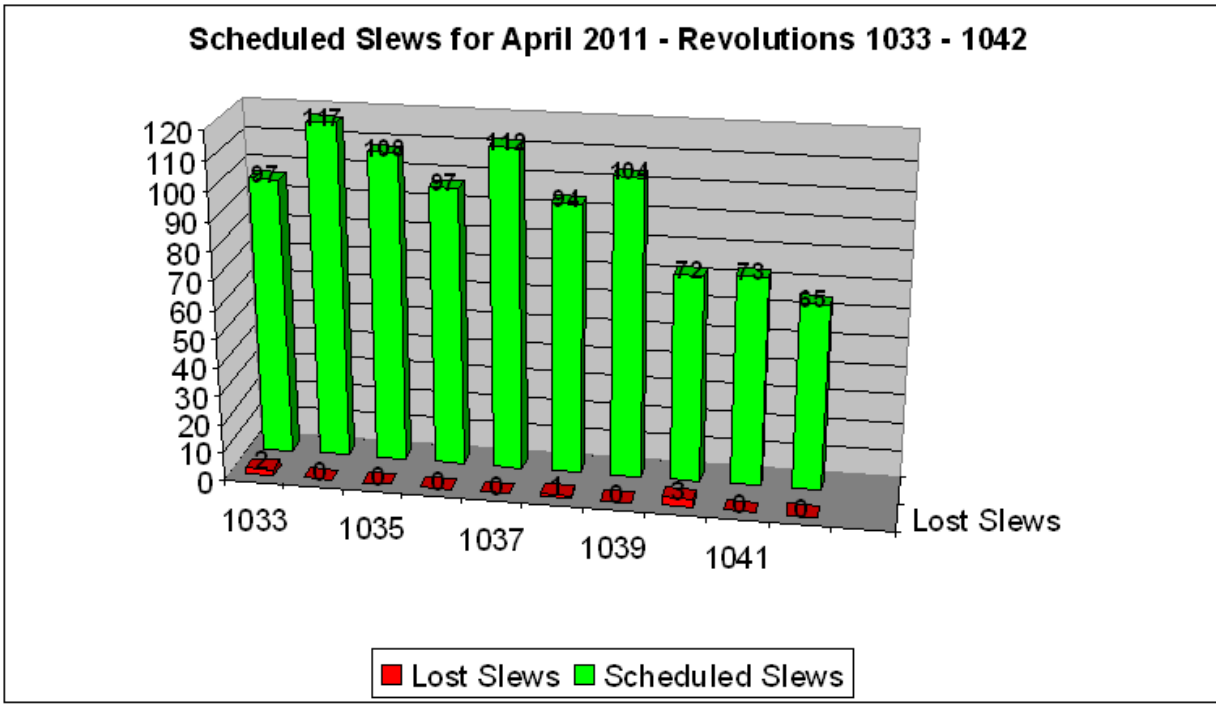


Figure 9: The number of slews scheduled compared to the number of slews lost

3.1 Mission Control System

The problems with the ISDS data transfer have been fixed, both ISDC and the PI workstations are connected to the A-chain again. On several days this month there were problems with OLF file transfer. On DOY296 it was dicovered that there were no files recievd as of the start of revolution 980. The servers idda and isdsa were restarted to clear the problems. In week 42 the FTS instance stopped causing a delay in reception of planning files from ISOC.
The AUX and ARCH tasks have been restarted on idda twice to resume the CD production. The ISDS and IFRD taskes were restarted twice on isdsa this month and once on isdsb. On DOY278 the HFA_TM and DDSS tasks on IDDB were restarted to resume MUST retrievals. On DOY278 and DOY 292 the connection to TM CPD was lost, connetcion was restored automatically. There was no impact on operations.

3.2 Ground Stations and Network

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

DOY 061 (2012-03-01) - no incidents

DOY 062 (2012-03-02) - no incidents

DOY 063 (2012-03-03) - 04:04:00: G/S: Bad frames from Redu -> Confirmed RFI (both chains)

DOY 064 (2012-03-04) - no incidents

DOY 065 (2012-03-05) - 18:24:00: G/S: Drop from Redu, -> Confirmed RFI (1 chain only)

DOY 066 (2012-03-06) - 10:11:00: G/S: Bad Frames from Redu -> Confirmed RFI (both chains)

19:06:00: G/S: Bad Frames from Redu -> Confirmed RFI (both chains)

DOY 067 (2012-03-07) - no incidents

DOY 068 (2012-03-08) - 04:34:00: ECC configured wrong TMTCS. Re-configuring for TMTCS2 and re-sweeping

Feedback from the ECC Team: One hour before AOS, ECC operator; Tried a reset of ISSC 1 which failed. So he re-started W/S and STC along with all the switches. When ISSC 1 was back the LDC 2 became inoperable. LDC 1 was made prime for support. At AOS TC Chain 1 was made prime and a test command was sent “which failed” So Chain 2 was made prime for support.

Feedback from the GS Team: Spectral purity of VIL2 Upconverter #1 Local Oscillator just checked (no free time available since this incident was reported) and found 5 KHz / 12 dBc spurious bands. Problem solved after disconnecting/ connecting back the Station 5 MHz reference signal (U/C PLO was not properly locked to external reference).

06:04:00: G/S: Bad Frames from Vil2 -> Confirmed RFI (both chains)

18:03:00: G/S: Bad Frames from Redu -> Confirmed RFI (1 chain only)

DOY 069 (2012-03-09) - no incidents

DOY 070 (2012-03-10) - 12:40:00: G/S: Data gaps from Redu -> Confirmed RFI (both chains)

DOY 071 (2012-03-11) - no incidents

DOY 072 (2012-03-12) - no incidents

DOY 073 (2012-03-13) - 04:15:00: G/S: Data gaps from Redu -> Confirmed RFI (both chains)

16:04:00: G/S: Data gaps from Redu -> Comms confirms hit on the line

DOY 075 (2012-03-15) - no incidents

DOY 076 (2012-03-16) - no incidents

DOY 077 (2012-03-17) - 03:51:00: Problem on TMTCS1, VC0 does not connect. TMTCS2 used on Prime chain -> Under investigation by the GS Engineer.

14:26:00: G/S: VC-0 Link in drop since 13:17z --> recycle VC-0 Link --> still in drop (TMTCS1)

14:28:00: G/S: VC-0 Link autom. aborted from NCTRS-B

14:34:00: G/S: VC-0 Link opened on NCTRS-B --> still in drop

14:36:00: G/S: VC-0 Link autom. aborted from NCTRS-B MZ

15:09:00: G/S: restart NCTRS-B after confirmation from ESTRACK that everything looks nominal from their side

15:12:00: G/S: VC-0 Link opened on NCTRS-B --> still in drop MZ

15:13:00: G/S: VC-0 Link autom. aborted from NCTRS-B MZ

15:20:00: G/S: reported to ESTRACK that the restart of NCTRS-B had no effect VC-0 Link directly in drop after opening, checked also on NCTRS-A. Problem not related to NCTRS application. TM-Links from TMTCS1 still not able to connect properly --> still no backup chain.

Feedback from the G/S Team: INT TMTC1 does not respond to any command / we can not reboot it and Integral NCTRS can not connect to it. It looks like that it is IFMS1 (TCDS1) that is again delivering data with the year 1958. GS Team to fully reboot IFMS1 at the end of this pass, as well as TMTCS1 just to be on the safe side.

Note: ARTS anomaly report (already existing) on this very same problem: ESTK_PR-535 (created on 2012-02-24): RED-1 IFMS2 generating time stamps with 1958 as Year for the TM

DOY 078 (2012-03-18) - 06:02:00: G/S: Bad Frames from Redu -> Confirmed RFI -> (both chains)

DOY 079 (2012-03-19) - no incidents

DOY 080 (2012-03-20) - no incidents

DOY 081 (2012-03-21) - 20:08:00: G/S: Bad Frames from Redu -> Confirmed RFI -> (1 chain only)

DOY 082 (2012-03-22) - 15:17:00: G/S: Data gaps from VIL2 -> Confirmed RFI (both chains)

18:45:00: G/S: Data gaps from Redu -> Confirmed RFI (1 chain only)

DOY 083 (2012-03-23) - 19:41:00: G/S: Bad Frames from Redu -> SMOS RFI (both chains)

DOY 084 (2012-03-24) - 02:21:00: G/S: Bad Frames from Redu -> GRACE-1 RFI (1 chain only)

19:05:00: G/S: TM Drop from Redu -> Confirmed RFI (both chains)

DOY 085 (2012-03-25) - no incidents

DOY 086 (2012-03-26) - 11:28:00: G/S: TM Drop from Redu -> COMMS: hit on the prime line (2sec)

12:06:00: G/S: TM Drop from Redu -> COMMS: hit on the prime line (3sec)

12:45:21: G/S: TM Drop from Redu -> COMMS: hit on the prime line (2sec)

13:01:37: G/S: TM Drop from Redu -> COMMS: hit on the prime line (2sec)

DOY 087 (2012-03-27) - 16:59:00: G/S: Bad Frames from Redu -> Confirmed RFI (1 chain only)

DOY 088 (2012-03-28) - no incidents

DOY 089 (2012-03-29) - 02:56:00: G/S: RED2_VC0 & RED2_VC7 links dropped out on INCTRB

03:14:00: RED2_VC0 & RED2_VC7 links back in again after a reboot of TMTCS2

Feedback from the GS team & the TMCTS SW support: This is the same incident as happened several times before, and for the very same reason: some internal communication disruption (re-occurrence of tmtcs#1200, basically a segmentation fault of the TPS process). For the next TMTCS version 3.3.5, which currently under test by the TMTCS SW team, this problem should be fixed.

DOY 090 (2012-03-30) - 03:39:00: G/S: TM Drop from Redu, duration: ca 4 min, reason: sudden drop on S/N for unknown reason on both TMTCSes

G/S charts confirm prolonged RFI period, observed on both chains. According to ESOC FD predictions, a double interference (NOAA 1 & PRISMA (MANGO)) took place on that occasion, most likely causing a period of RFI "longer" than what is usually observed.

DOY 091 (2012-03-31) – 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.

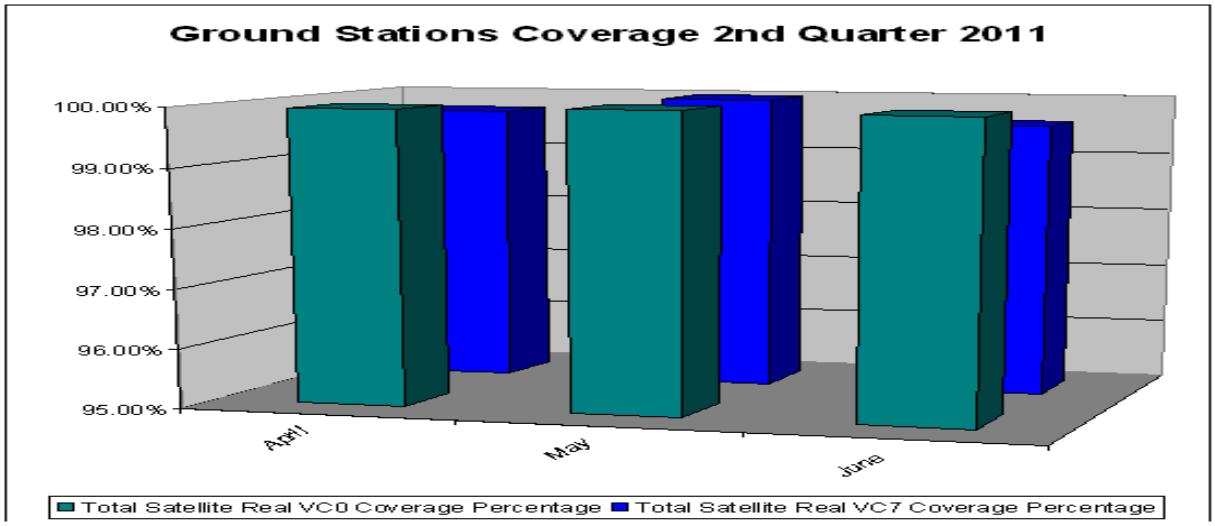


Figure 10: Comparison of VC0 to VC7 coverage

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 1153 to 1164, corresponding to the time range 23 March to 24 April.

New observations have been planned for revolutions 1148 (8-10 March) to 1162 (19-21 April). These include the Crab calibration observations in 1159 and 1160. Revolutions 1154 & 1155 were re-planned to accommodate star-tracker calibration observations in 1154.

TSFs have been received for revolutions 1147 to 1157.

3.3.2 Observation Status

New ECS files have been received for revolutions 1126 to 1142 (covering observations up to 21 February).

3.3.3 ISOC Science Data Archive

There were still some gaps in the raw telemetry received from MOC.

New disk arrays are being set up and the repartition between ISOC and the Science Archive Team is being settled.

A meeting at ISDC to discuss the new interface between ISDC and the Science Archive Team at ESAC took place on 29+30 March.

3.3.4 ISOC System

ISOC software V32 was released as planned on 5 March to support the new call for observing proposals. V32.1 with various improvements, especially handling of ping-pong filters is scheduled for release in April.

3.3.5 Problems

The Flight Dynamics server continues to produce exception messages, the investigation is ongoing.

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-3247	2012-03-08	SPI AFEE HV still 3kV during rad. belt due to reaction on BCPKT being disabled	Payload	Pending
INT-3248	2012-03-07	PLM and SVM Operations Interrupted Following Solar Flare	Spacecraft	Pending
INT-3249	2012-03-12	Problems experienced during IBIS re-activation after solar flare.	FOP	Pending
INT-3250	2012-03-14	MCS Time Correlation task starts Buffering Packets	IMCS	Pending
INT-3251	2012-03-19	TM paramater G8016 has different values on 2 different ANDs for a given time during retrieval	IMCS	Pending
INT-3252	2012-03-22	CEV & PTV for command M1461 not set up correctly.	ODB	Open
INT-3253	2012-03-22	SW delivery to the FDS	FDS	Pending
INT-3254	2012-03-22	RWB/CGS needed prior to OSL 11520107	FDS	Pending
INT-3255	2012-03-26	CSLs that need to be done as OSLs real time	FDS	Pending
INT-3256	2012-03-26	CCCF causes Verifier Crash?	IMCS	Pending
INT-3257	2012-03-30	Wrong & inconsistent SCC fail marking on TM Spacon	IMCS	Pending
INT-3258	2012-03-30	Mismatch between recover-schedule and update-slew message	FDS	Pending
INT-3259	2012-03-30	IBIS mainframe under-temperature	Payload	Pending

AR id	Date of occurrence	Subject	Segment	Status
		detected by SECL software		
INT-3268	2012-03-07	SPI OOL during solar flare: automatic reconfiguration capability & PE Compression	Payload	Pending
INT_SC-377	2012-03-07	SPI OOL during solar flare: automatic reconfiguration capability & PE Compression	Payload	Rejected
INT_SC-378	2012-03-11	SPI PSD malfunction -> different than "normal" PSD channel rate malfunctions	Payload	Pending
INT_SC-379	2012-03-17	IBIS: IREM counters triggering IBIS automatism, but automatic transitions & OEMs separated by 25:16 min	Payload	Closed
INT_SC-381	2012-03-25	SPI DPE1 CPU reset	Payload	Closed

5 Special Events & Future Milestones

Earth Observation planned for 9th-10th May 2012

6 Appendix

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

6.1 AOCS operations

During this period, 562 Open Loop Slews, 457 Closed Loop Slews and 21 Momentum Biases were executed (as reported by ACC OEM).

22 slews were missed from the Timeline. Note that the timeline remained disabled during revolution 1148 and partially during 1149.

6.1.1 Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 01/04/2013 is reported in the following plot:

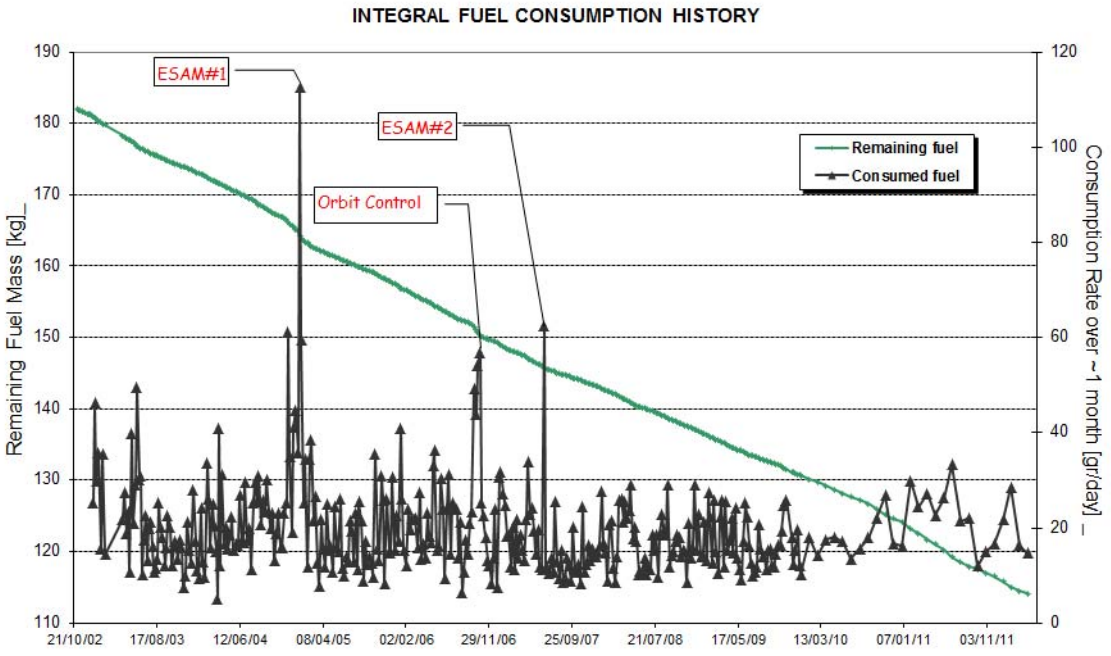


Figure 11: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

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.

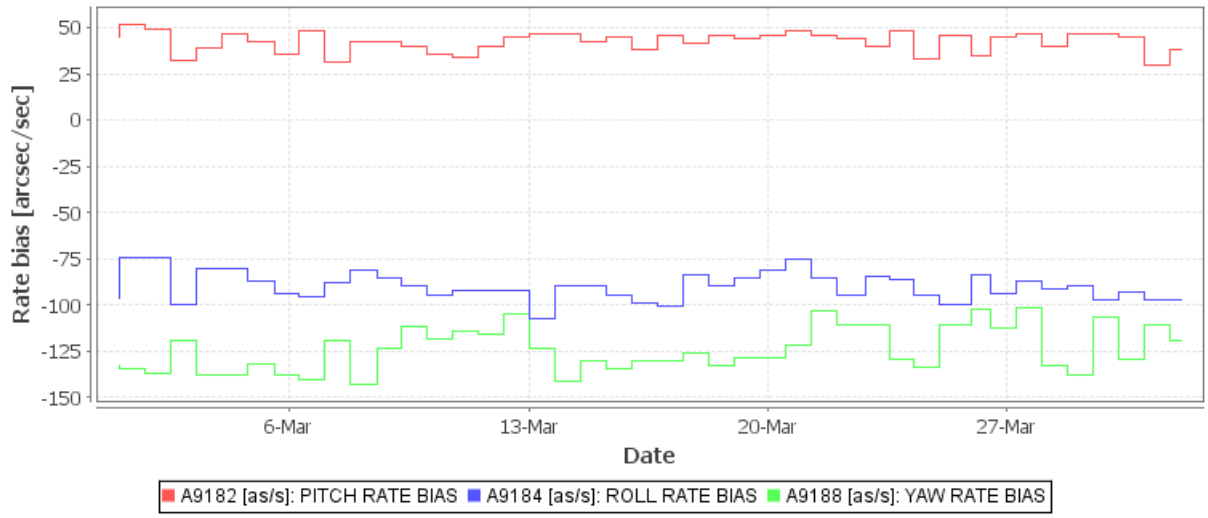


Figure 12: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

04/03/2012 (Day of Year 64, Revolution 1146)

- IMU1 switched ON during the stable pointing of PID 11460092 (08:12:00Z). After the IMU switched back OFF, a manual slew was performed from attitude 11460091 to attitude 11460092.

Then a mapping was commanded and the parameters for slew 11460093 were manually updated (spacontool).

OTF was not reached for PIDs 11460091 and 11460092.

Slew 11460092 was missed from the Timeline.

- IMU1 switched ON during the stable pointing of PID 11460106 (15:55:06Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 11460107 were manually updated (spacontool).

OTF was not reached for PID 11460106.

No slew was missed.

- FDS TPF update failed for slew 11460108 (16:22:00Z). The AOCS was suspended in the Timeline, then a manual mapping was commanded and a slew was manually generated from attitude 11460107 to attitude 11460108, followed by another mapping and another manual slew from attitude 11460108 to 11460109

After the second manual slew was completed, the parameters for slew 11460110 were manually updated (spacontool).

Slews 11460108 and 11460109 were missed from the Timeline. The OTF was not reached for their PIDs.

05/03/2012 (Day of Year 65, Revolution 1146 to 1147)

- Guide star was lost and IMU1 switched ON during perigee passage (02:51:30Z). After AOS, the SPACON commanded a manual mapping in order to check whether the current guide star was suitable for a RWB.

Since that was not the case, a manual CGS was generated and uplinked prior to the RWB.

No impact in the Timeline.

- IMU1 switched ON during the stable pointing of PID 11470005 (09:39:35Z). After the IMU switched back OFF, a manual slew was performed from attitude 11470005 to attitude 11470006.

Then a mapping was commanded and the parameters for slew 11470007 were manually updated (spacontool).

OTF was not reached for PIDs 11470005 and 11470006.

Slew 11470006 was missed from the Timeline.

07/03/2012 (Day of Year 67, Revolution 1147)

- IMU1 switched ON during the stable pointing of PID 11470091 (10:18:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 11470092 were manually updated (spacontool).

OTF was not reached for PID 11470091.

No slew was missed.

- Following a major solar flare, it is decided to slew INTEGRAL from attitude 11470098 to a safe attitude (15:09:00Z), which remains unconstraint during the following days.

AOCS subsystem disabled in the Timeline.

Slews 11470099 to 11470112 were missed from the Timeline. The OTF was not reached for their PIDs

08/03/2012 (Day of Year 68, Revolution 1147 to 1148)

- AOCS subsystem disabled in the Timeline

- Guide star was lost and IMU1 switched ON during perigee passage (02:47:00). After AOS, the SPACON checked that the guide star was still the same as before perigee, so no action was taken.

No impact in the Timeline.

09/03/2012 (Day of Year 69, Revolution 1148)

AOCS subsystem disabled in the Timeline

10/03/2012 (Day of Year 70, Revolution 1148)

AOCS subsystem disabled in the Timeline

11/03/2012 (Day of Year 71, Revolution 1148 to 1149)

AOCS subsystem disabled in the Timeline

12/03/2012 (Day of Year 72, Revolution 1149)

In order to resume operations, a manual slew is performed from the safe attitude to attitude 11490054 (10:08:19Z), followed by a RWB to join the predicted profile for revolution 1149.

After the RWB, a corrective CSL was performed to attitude 11490054. Then a manual mapping was commanded and the parameters for slew 11490055 were manually updated (spacontool).

AOCS is back in schedule at 13:06:00Z

14/03/2012 (Day of Year 74, Revolution 1149 to 1150)

Guide star was lost and IMU1 switched ON during perigee passage (03:53:19Z). After AOS, the SPACON commanded a manual mapping in order to check whether the current guide star was suitable for a RWB.

Since that was not the case, a manual CGS was generated and uplinked prior to the RWB.

No impact in the Timeline.

17/03/2012 (Day of Year 77, Revolution 1150 to 1151)

Guide star was lost and IMU1 switched ON during perigee passage (03:52:00Z). After AOS, the SPACON commanded a manual mapping in order to check whether the current guide star was suitable for a RWB.

Since that was not the case, a manual CGS was generated and uplinked prior to the RWB.

No impact in the Timeline.

20/03/2012 (Day of Year 80, Revolution 1151 to 1152)

Guide star was lost and IMU1 switched ON during perigee passage (03:35:00Z). After AOS, the SPACON commanded a manual mapping in order to check whether the current guide star was suitable for a RWB.

Since that was not the case, a manual CGS was generated and uplinked prior to the RWB.

No impact in the Timeline.

21/03/2012 (Day of Year 81, Revolution 1152)

- FDS TPF update failed for slew 11520041 (04:04:00Z) since it cannot be done as a CSL anymore but an OSL is needed instead.

A mapping was commanded and a manual slew was generated from attitude 11520040 to attitude 11520041. After the manual slew was completed, the parameters for slew 11520042 were manually updated (spacontool).

Slew 11520041 was missed from the Timeline. The OTF was not reached for its PID.

- FDS TPF update failed for slew 11520058 (14:36:00Z) since it cannot be done as a CSL anymore but an OSL is needed instead.

A mapping was commanded and a manual slew was generated from attitude 11520057 to attitude 11520058. After the manual slew was completed, the parameters for slew 11520059 were manually updated (spacontool).

Slew 11520058 was missed from the Timeline. The OTF was not reached for its PID.

22/03/2012 (Day of Year 82, Revolution 1152)

- Caused by a faulty SW delivery to the FDS, the automatic update slew failed (08:53:00Z) for slews 11520089 and 11520090. A manual mapping was commanding and a manual slew was generated from attitude 11520088 to attitude 11520090.

After the manual slew was completed, the parameters for slew 11520091 were manually updated (spacontool).

The automatic update failed then again for slew 11520092, so it was done manually via spacon tool.

After a roll back in the FD SW, the update for slew 11520093 was performed successfully.

Slews 11520089 to 11520090 were missed from the Timeline. The OTF was not reached for their PIDs.

- FDS TPF update failed for slew 11520107 (20:34:37Z).The AOCS was suspended in the Timeline , then a manual mapping was commanded and a manual slew failed to be generated due to wheelspeed constraint violation (RWB needed)

A reaction wheel bias was manually executed. Following its completion, a manual mapping was commanded and a slew was manually generated from attitude 11520106 to attitude 11520109.

After the manual slew was completed, the parameters for slew 11520110 were manually updated (spacontool).

Slews 11520107 to 11520109 were missed from the Timeline. The OTF was not reached for their PIDs.

23/03/2012 (Day of Year 83, Revolution 1152 to 1153)

FDS TPF update failed for slew 11530032 (21:10:00Z) since it cannot be done as a CSL anymore but an OSL is needed instead.

A mapping was commanded and a manual slew was generated from attitude 11530031 to attitude 11530032. After the manual slew was completed, the parameters for slew 11530033 were manually updated (spacontool).

Slew 11530032 was missed from the Timeline. The OTF was not reached for its PID.

24/03/2012 (Day of Year 84, Revolution 1153)

IMU1 switched ON during the stable pointing of PID 11530052 (08:28:19Z). After the IMU switched back OFF, a manual slew was performed from attitude 11530052 to attitude 11530053.

Then a mapping was commanded and the parameters for slew 11530054 were manually updated (spacontool).

OTF was not reached for PIDs 11530052 and 11530053.

Slew 11530053 was missed from the Timeline.

25/03/2012 (Day of Year 85, Revolution 1153)

IMU1 switched ON during the stable pointing of PID 11530100 (10:27:00Z). After the IMU switched back OFF, a manual slew was performed from attitude 11530100 to attitude 11530102.

Then a mapping was commanded and the parameters for slew 11530103 were manually updated (spacontool).

OTF was not reached for PIDs 11530100, 11530101 and 11530102.

Slews 11530101 and 11530102 were missed from the Timeline.

26/03/2012 (Day of Year 86, Revolution 1153 to 1154)

- Perform FSS/STR misalignment plus SAS calibration (09:00:00Z).

- Autostack commanding for slew 11540023 (17:42:00Z) failed release, due to problems in the MCS (Verifier crashed). The AOCS was suspended in the Timeline, then a manual mapping was commanded and a slew was manually generated from attitude 11540022 to attitude 11540024.

After the manual slew was completed, the parameters for slew 11540025 were manually updated (spacontool).

Slews 11540023 and 11540024 were missed from the Timeline. The OTF was not reached for their PIDs.

28/03/2012 (Day of Year 88, Revolution 1154)

IMU1 switched ON during the stable pointing of PID 11540090 (08:18:00Z). After the IMU switched back OFF, a manual slew was performed from attitude 11540090 to attitude 11540091.

Then a mapping was commanded and the parameters for slew 11540092 were manually updated (spacontool).

OTF was not reached for PIDs 11540090 and 11540091.

Slew 11540091 was missed from the Timeline.

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. No stroke increased was performed in the reporting period.

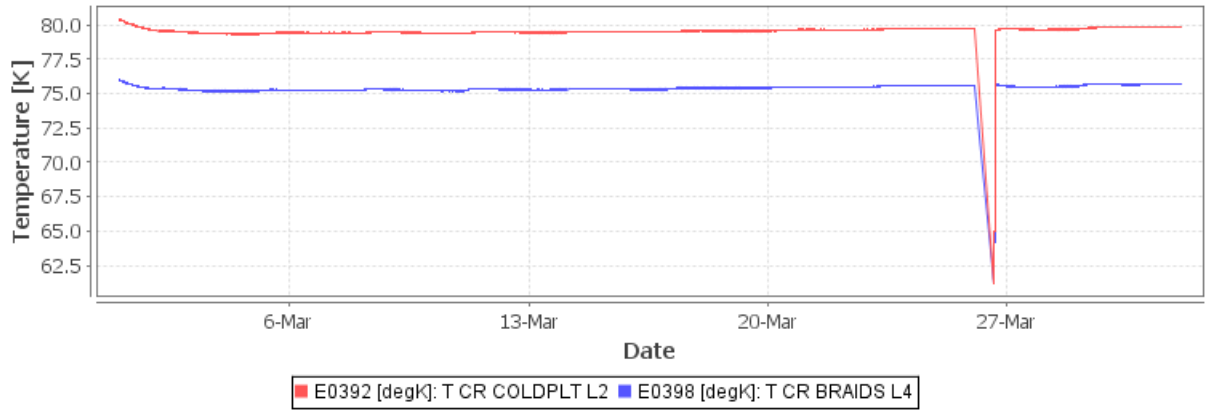


Figure 13: SPI Cold plate and H-bus temperature

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

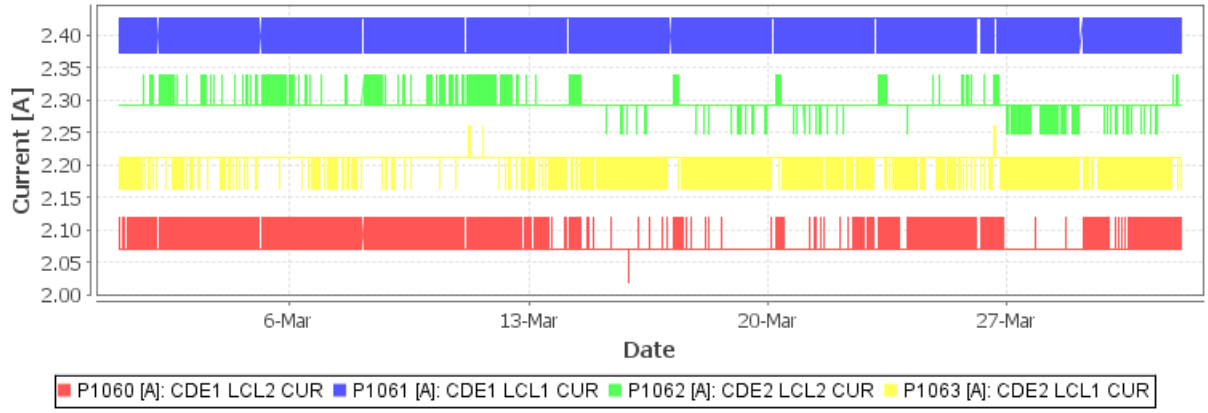


Figure 14: SPI CDE LCL current

DPE & IASW

The DPE health and IASW performance are nominal, despite the IBIS1 DPE reset experienced on 25/03/2012. 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, except for the period of the DPE reset (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 high solar background can clearly be seen.

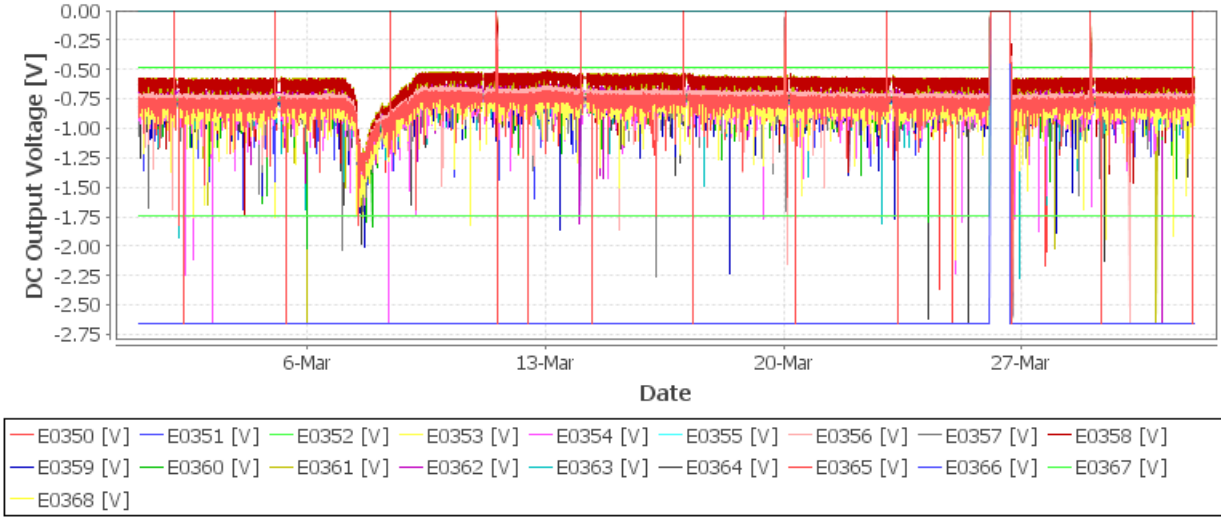


Figure 15: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)

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 high solar background can clearly be seen in the count rate.

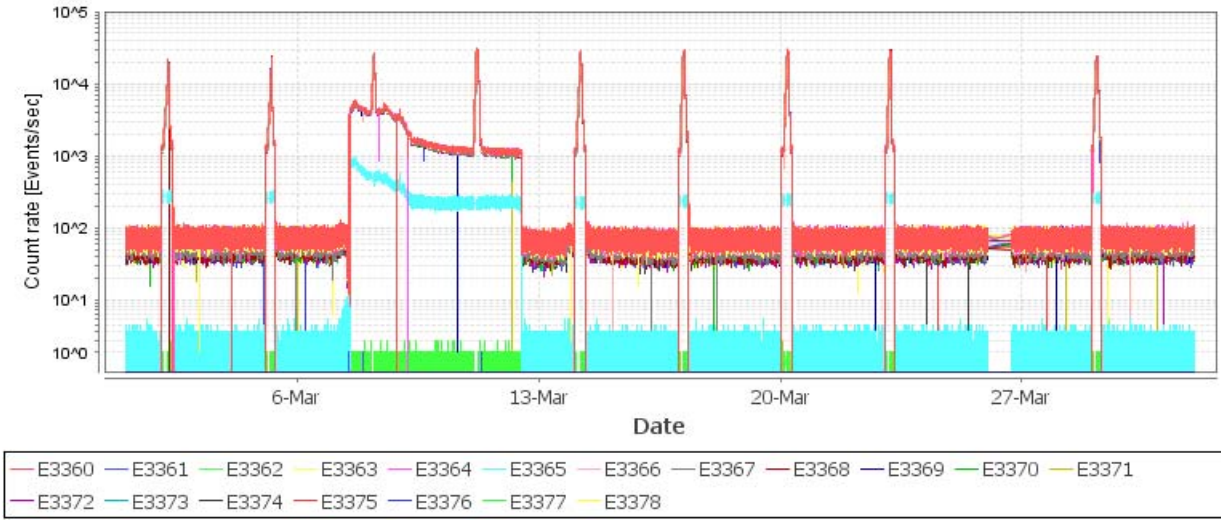


Figure 16: SPI GeD Non-Vetoed count rates. Note that the scale used for plotting is logarithmic.

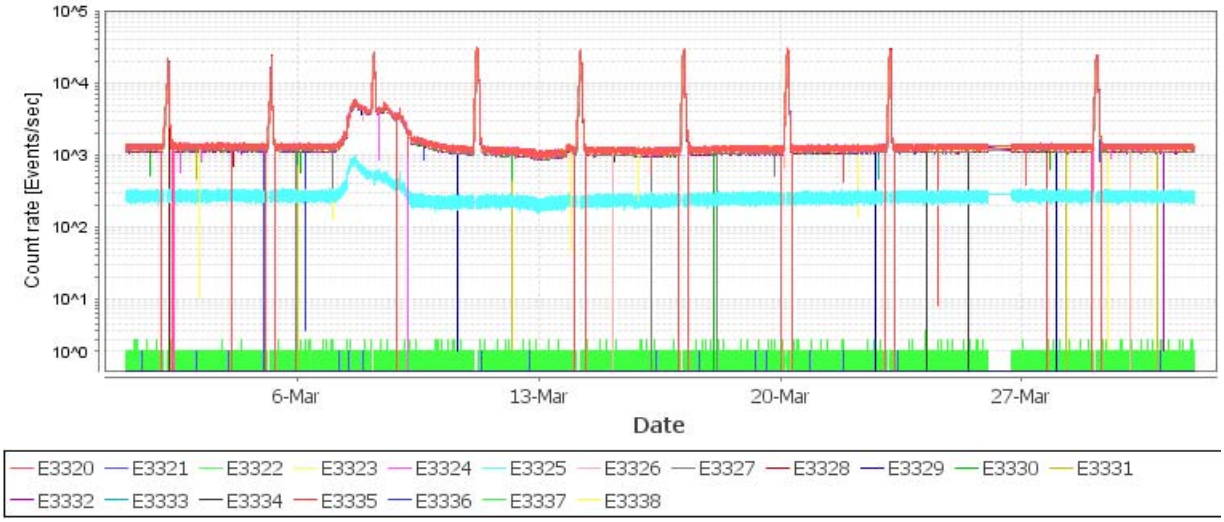


Figure 17: SPI GeD Time Tagged count rates. Note that the scale used for plotting is logarithmic.

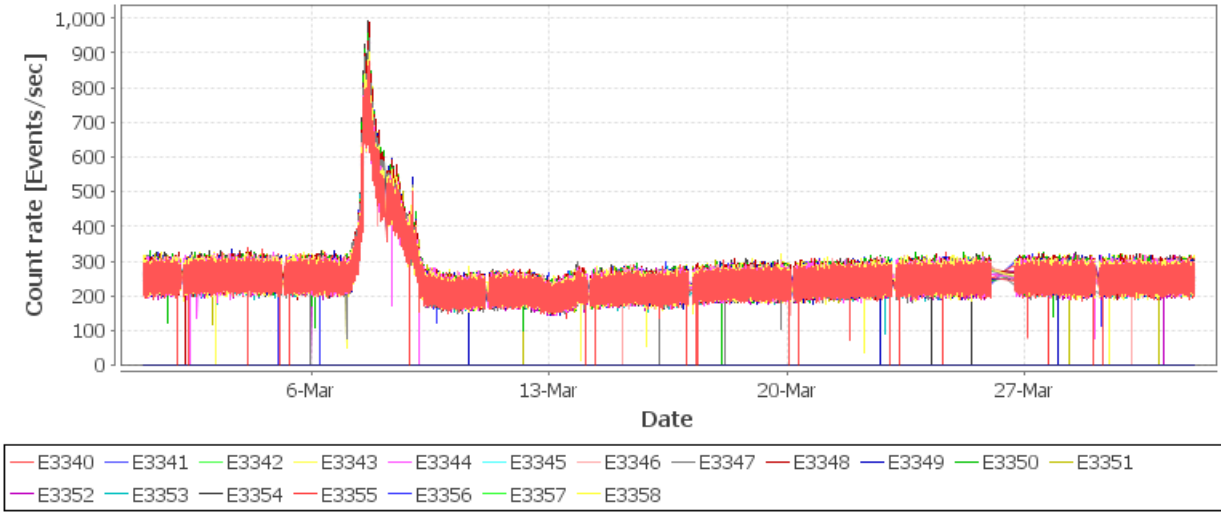


Figure 18: SPI GeD Time Tagged Saturated count rates

PSD

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

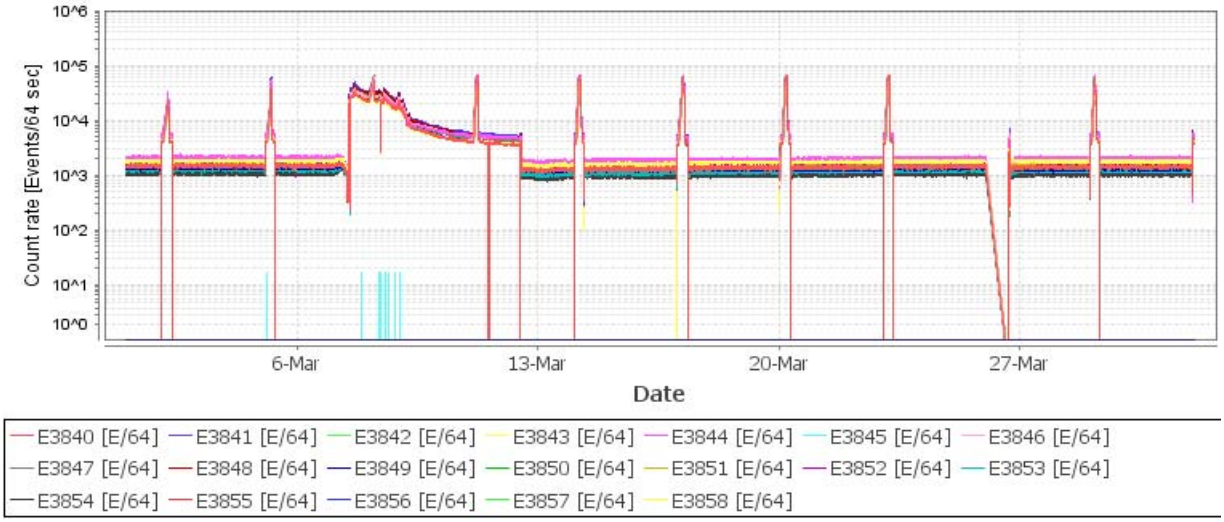


Figure 19: SPI PSD GeD Channel rates

6.2.2 Event Log

25-03-2012 (Day of Year 85, Revolution 1153)

Shortly before rad belt entry on 25/03/2012 at 22:49Z (before the planned execution of OCR#318) an anomaly occurred on the SPI DPE1 resulting in an autonomous CPU reset. At the time of the anomaly, SPI was in photon mode and its status was nominal. The anomaly occurred close to rad belt entry and right during a spectra building compression transmission. IASW mode was INIT and the generation time of the OEMs received every 8s correspond to the time of the last OBT wrap around. The recovery of the instrument started straight away and lasted until 26/03/2012 at 15:53Z. 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. The high solar background can clearly be seen in the count rate as well as the IBIS deactivation and activation (as described above).

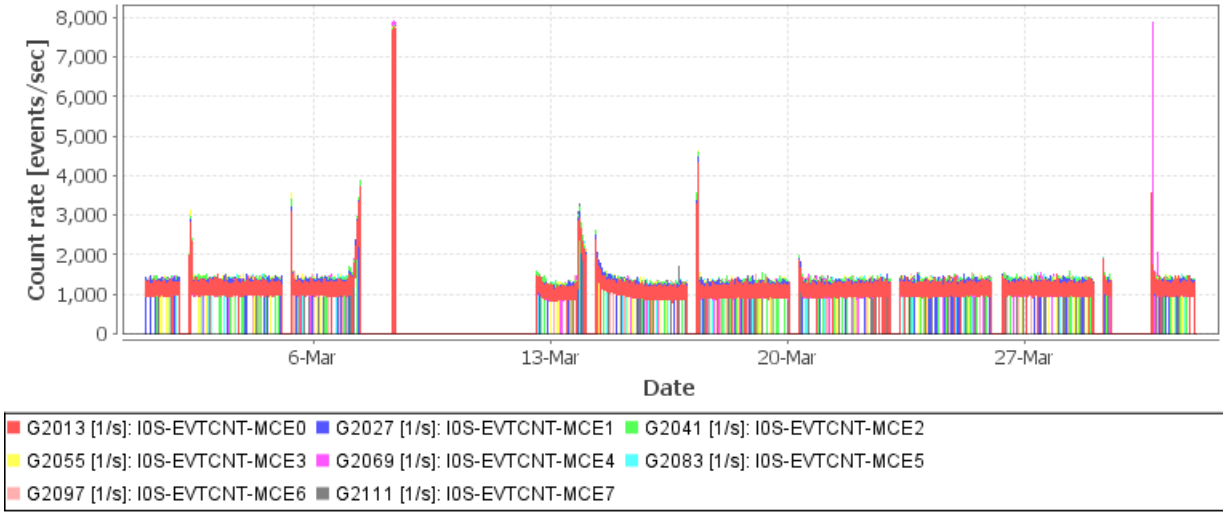


Figure 20: ISGRI MCE Counters

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.

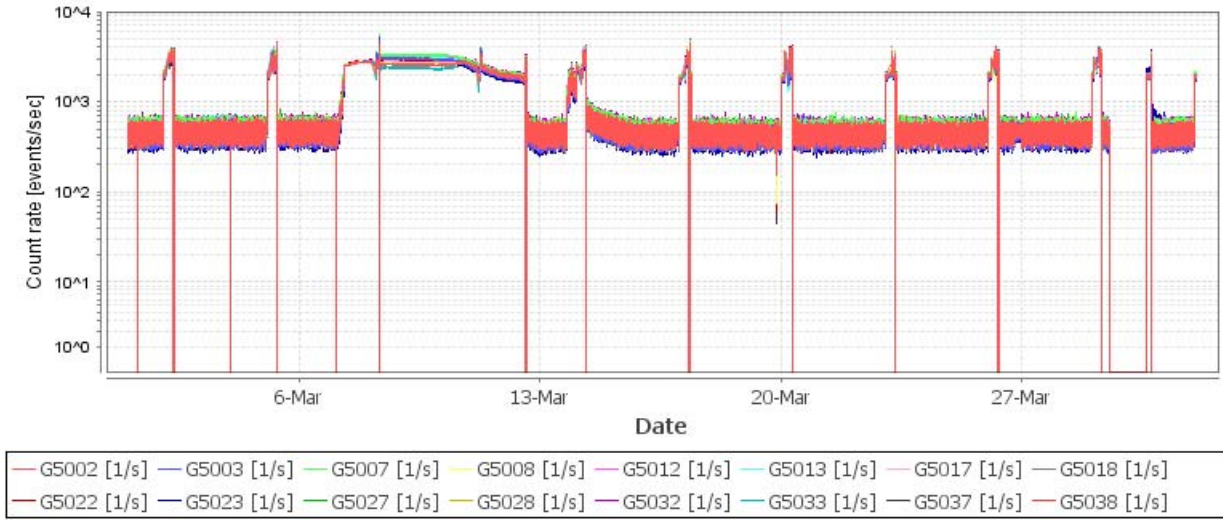


Figure 21: PICsIT semi-module counters. Note that the scale used for plotting is logarithmic.

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

Throughout the month

Since the IBIS DPE reset on DoY44, the following OEMs APID 1280 are reported occasionally (in average more than once per day):
- ID 133 CLASS 2: “IBIS1 IASW LSL TRANSFER FAILED (LOW LEVEL)”

- ID 131 CLASS 2: “IBIS1 IASW LSL TRANSFER FAIL REPORT FOR HIGH-LEVEL MODULE RESET”
- ID 230 CLASS 3: “IBIS1 MCE7 TIME OUT” (after a few seconds)

The group of messages flag an anomalous condition on the communication line between the DPE and the MCEs (the low speed link). The anomaly lasts only a few TM cycles. The unit solves the internal conflict on the LSL autonomously. IBIS operations continues nominally.
An MCE7 switch off and switch on has been performed, but did not cure the anomaly. The risk of a damage on MCE7 during the actual anomaly (i.e., the event of no communication), that might lead to a loss of this subsystem was considered to be minimal.
For recovering the anomaly, it was decided with all relevant parties, that a IBIS deactivation and activation should be performed. Since the anomaly had little impact on both science and operations, it was decided to wait for a suitable time slot for the deactivation and activation of IBIS.

29/30-03-2012 (Day of Year 89-90, Revolution 1155)

IBIS deactivation and activation to recover the above anomaly for eliminating the risk of losing MCE7. The whole recovery was performed in rev. 1155 (29-30.03.2012) and took about 18.5 hours.

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.

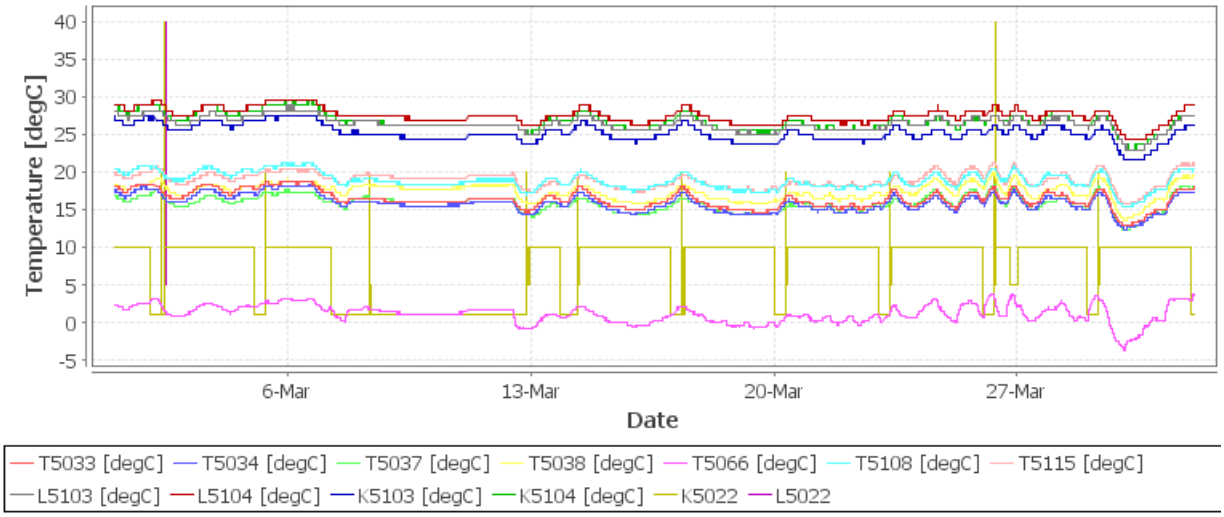


Figure 22: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

02-03-2012 (Day of Year 62, Revolution 1146)

At 08:24, due to increased radiation at belt exit, both JEMX-1 & 2 failed to activate the high voltage. After 2 hours, the radiation levels reduced, and at 10:42 & 11:02, JEMX-1 & 2 respectively were restored to DATA TAKING.

07-03-2012 (Day of Year 67, Revolution 1147 - 1149)

At 05:54, due to radiation from a solar flare, both JEMX-1 & 2 switched to SAFE mode. They remained in this state until 20:34 on 12/03/2012 (DoY 72). The impact was the loss of JEMX data from pointings 11470083 through to 11490066.

13-03-2012 (Day of Year 73, Revolution 1149 - 1151)

At 18:43 & 18:50, again due to a solar flare JEMX-1 & 2 switched to SAFE mode. They remained in this state until 09:23 on 17/03/2012 (DoY 77). The impact was the loss of JEMX data from pointings 11490103 through to 11510007.

6.5 OMC

6.5.1 Operations

The status and performance of OMC is nominal.

6.5.2 Event Log

04-03-2012 (Day of Year 064, Revolution 1146)

At 16:22:00, a problem with the AOCS TPF update (insufficient number of stars for attitude determination) forced an interruption of the timeline. A recovery was performed, and the timeline restored at 17:42. The impact was the loss of pointing 11460108, with pointing 11460109 executed at an incorrect attitude. It was at this time the following OEMs were received:

```
2012.064.16.49.42.783   2012.064.16.49.53.814   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E

2012.064.16.49.49.533   2012.064.16.49.59.898   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 11460108.

05-03-2012 (Day of Year 065, Revolution 1147)

At 09:39:35, due to an AOCS problem (loss of a guide star), the timeline was interrupted. A recovery was performed, and the timeline resumed at 10:14. The impact was the loss of pointing 11470005.

07-03-2012 (Day of Year 067, Revolution 1147)

At 04:09:50, due to increasing levels of radiation, OMC was forced to SAFE mode for the remainder of the orbit. The impact was pointing 11470079 was cut short from a planned 1800 to 1712 seconds and the loss of the remainder of the revolution (30 pointings). All pointings of revolution 1148, (114) were lost. It was at this time the following OEMs were received:

```
2012.067.04.11.41.791   2012.067.04.11.52.281   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N      E   E

2012.067.04.11.47.916   2012.067.04.11.52.300   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 11470080.

12-03-2012 (Day of Year 072, Revolution 1149)

At 19:38:37, a recovery was performed, and OMC was returned to science mode in time for pointing 11490065. Pointings 11490002 to 11490064 were lost (57 pointings).

13-03-2012 (Day of Year 073, Revolution 1149)

At 18:20:22, high radiation again forced OMC to SAFE. The impact was the loss of pointings 11490103 to 11490111 inclusive (9 pointings).

14-03-2012 (Day of Year 074, Revolution 1150)

At 15:39:55, an attempt was made to recover the instrument, however, at 15:46:54, another radiation spike returned the unit to SAFE.

15-03-2012 (Day of Year 075, Revolution 1150)

At 03:02:42, once the radiation had subsided, the unit was manually commanded to stand-by, and at 03:32:54, OMC was back in science mode. The impact was the loss of pointings to 11500002 to 11500036 (34 pointings).

22-03-2012 (Day of Year 082, Revolution 1152)

At 08:53:00, a FD problem forced a suspension of the timeline. A recovery was performed, and the timeline resumed at 10:23. The impact was the loss of pointings 11520089 & 11520090.

23-03-2012 (Day of Year 083, Revolution 1153)

At 21:10, a FD problem forced an interruption to the timeline. A recovery was performed, and timeline resumed at 21:48. The impact was the loss of pointing 11530032. It was at this time the following OEMs were received:

```
2012.083.21.38.24.864   2012.083.21.38.32.090   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

2012.083.21.38.30.981   2012.083.21.38.45.019   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.

25-03-2012 (Day of Year 085, Revolution 1153)

At 10:27, the loss of a guide star forced an interruption to operations. A recovery was performed and the timeline resumed around 11:14. The impact was the loss of pointing 11530101.

26-03-2012 (Day of Year 086, Revolution 1154)

At 17:19:11, the CCCFs which had been enabled as part of an earlier SPI operation, executed. This caused OMC to go to stand-by. At the same time the verifier crashed. After an investigation and a recovery, OMC was put back to science at 23:11:43. The impact was pointing 11540022 was cut short from a planned 1980 to 304 seconds and pointings 11540023 to 11540033 (10 pointings) were lost.

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.

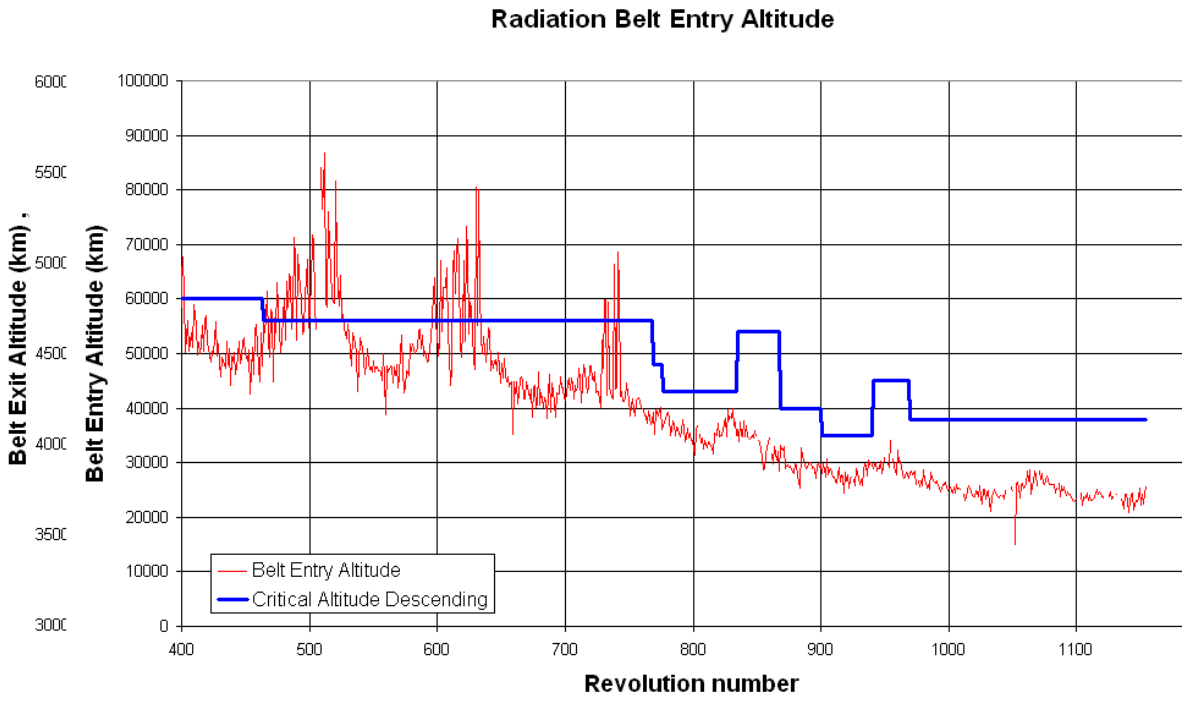


Figure 23: Radiation belt entry

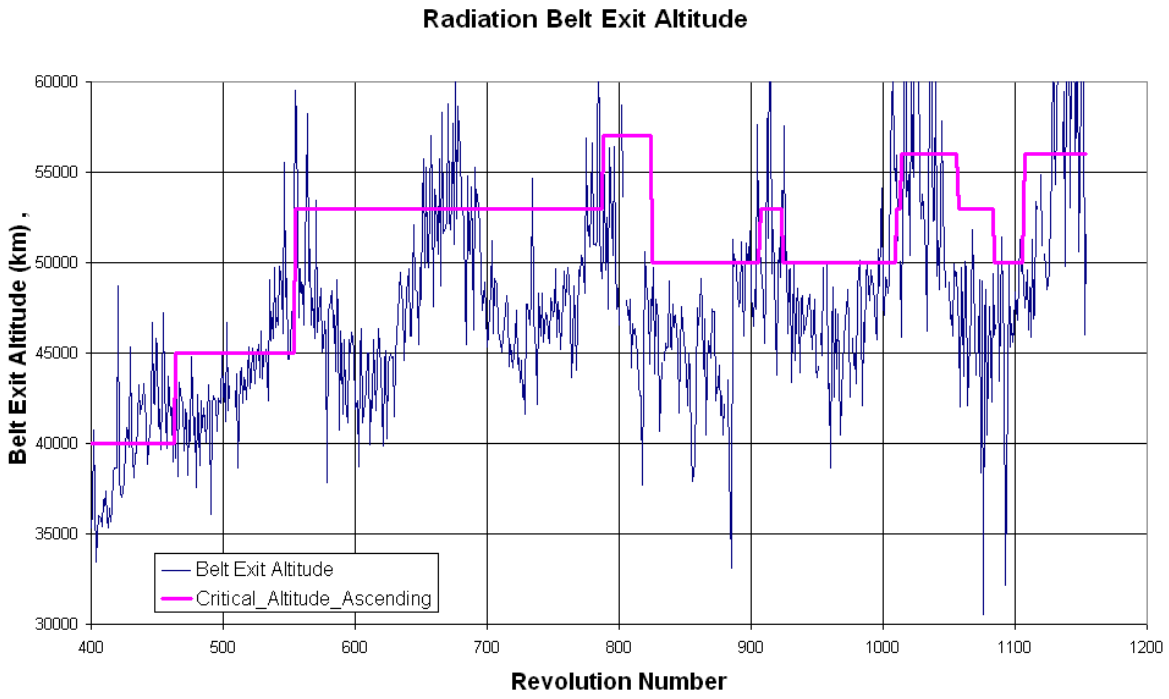


Figure 24: Radiation belt exit

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
1145	RAD_ENTR R 2012-03-02T00:45:42Z	N/A	N/A	02-Mar-2012 02:16:28	18845.75	02-Mar-2012 02:56:28	8969.757
1146	RAD_EXIT R 2012-03-02T08:03:54Z	02/03/2012 09:13:57	72399	02-Mar-2012 07:16:28	48469.95	02-Mar-2012 03:36:28	3400.887
1146	RAD_ENTR R 2012-03-05T00:31:53Z	N/A	N/A	05-Mar-2012 02:03:42	18424.97	05-Mar-2012 02:43:42	8490.905
1147	RAD_EXIT R 2012-03-05T07:49:38Z	05/03/2012 09:00:05	72453	05-Mar-2012 07:03:42	48843.03	05-Mar-2012 03:13:42	3184.442
1147	RAD_ENTR R 2012-03-	N/A	N/A	08-Mar-2012 01:49:35	18859.86	08-Mar-2012 02:29:35	8872.37

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
	08T00:20:11Z						
1148	RAD_EXIT R 2012-03-08T07:37:04Z	N/A	N/A	08-Mar-2012 06:49:35	48664.36	08-Mar-2012 03:09:35	3214.106
1148	RAD_ENTR R 2012-03-11T00:09:59Z	N/A	N/A	11-Mar-2012 01:40:38	18631.14	11-Mar-2012 02:20:38	8621.691
1149	RAD_EXIT R 2012-03-11T07:26:27Z	N/A	N/A	11-Mar-2012 06:40:38	48845.53	11-Mar-2012 03:00:38	3273.816
1149	RAD_ENTR R 2012-03-13T23:58:52Z	N/A	N/A	14-Mar-2012 01:26:41	19263.7	14-Mar-2012 02:06:41	9327.474
1150	RAD_EXIT R 2012-03-14T07:15:43Z	N/A	N/A	14-Mar-2012 06:26:41	48322.97	14-Mar-2012 02:46:41	3158.746
1150	RAD_ENTR R 2012-03-16T23:45:30Z	N/A	N/A	17-Mar-2012 01:14:14	19476.72	17-Mar-2012 01:54:14	9579.636
1151	RAD_EXIT R 2012-03-17T07:02:46Z	17/03/2012 08:26:14	74207	17-Mar-2012 06:24:14	49769.9	17-Mar-2012 02:34:14	3170.229
1151	RAD_ENTR R 2012-03-19T23:31:14Z	20/03/2012 01:03:10	24894	20-Mar-2012 01:05:00	18178.87	20-Mar-2012 01:45:00	8200.222
1152	RAD_EXIT R 2012-03-20T06:48:15Z	20/03/2012 09:01:10	80553	20-Mar-2012 06:05:00	49081.1	20-Mar-2012 02:15:00	3076.991
1152	RAD_ENTR R 2012-03-22T23:18:08Z	N/A	N/A	23-Mar-2012 00:47:59	19174.37	23-Mar-2012 01:27:59	9189.619
1153	RAD_EXIT R 2012-03-23T06:34:40Z	23/03/2012 05:02:14	47025	23-Mar-2012 05:47:59	48472.09	23-Mar-2012 02:07:59	3103.924
1153	RAD_ENTR R 2012-03-25T23:05:19Z	26/03/2012 00:37:42	24720	26-Mar-2012 00:38:24	18303.57	26-Mar-2012 01:18:24	8309.198
1154	RAD_EXIT R 2012-03-	26/03/2012 05:28:14	53811	26-Mar-2012 05:38:24	49026.38	26-Mar-2012 01:48:24	3057.709

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
	26T06:21:55Z						
1154	RAD_ENTR R 2012-03-28T22:51:25Z	29/03/2012 00:16:30	26514	29-Mar-2012 00:22:52	18968.39	29-Mar-2012 01:02:52	9025.397
1155	RAD_EXIT R 2012-03-29T06:08:18Z	29/03/2012 05:50:38	59629	29-Mar-2012 05:22:52	48517.76	29-Mar-2012 01:42:52	3246.7

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.