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

INTEGRAL
Mission report

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

No. 408
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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 April and covers the revolutions 1156 until 1165 (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.
- E3.5 Testing

Summary of the overall status and performance of S/C

- Nominal for platform and payload
- During this reporting period, 892 of the 907 planned science pointings were executed nominally. 6 pointings were lost to AOCS problems. 1 pointing was lost and 1 cut short to low elevation problems at Weilheim. 1 pointing was lost and other interrupted to an IREM SEU. 2 pointings were lost to comms maintenance. 1 pointing was lost and another executed at the wrong attitude due to problems at VIL2. Finally, 1 pointing was interrupted when the CCCFs were activated. 1 Flat field calibration was performed this month.

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
- ATV support
- Lost connection to TM CPD
- WEILHEIM loss of TM due to low elevation
- TM Desktop: not possible to go to live

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.

24 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.4454 Kg. The remaining propellant is in the order of 113.6372 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, except from 2012-04-03T18:11:12Z to 2012-04-03T22:24:34Z (OMC Flat Field Calibration), when it was 88 packets/cycle. The average telemetry occupation when the allocation was 99 packets/cycle was 74.27 packets/cycle.

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

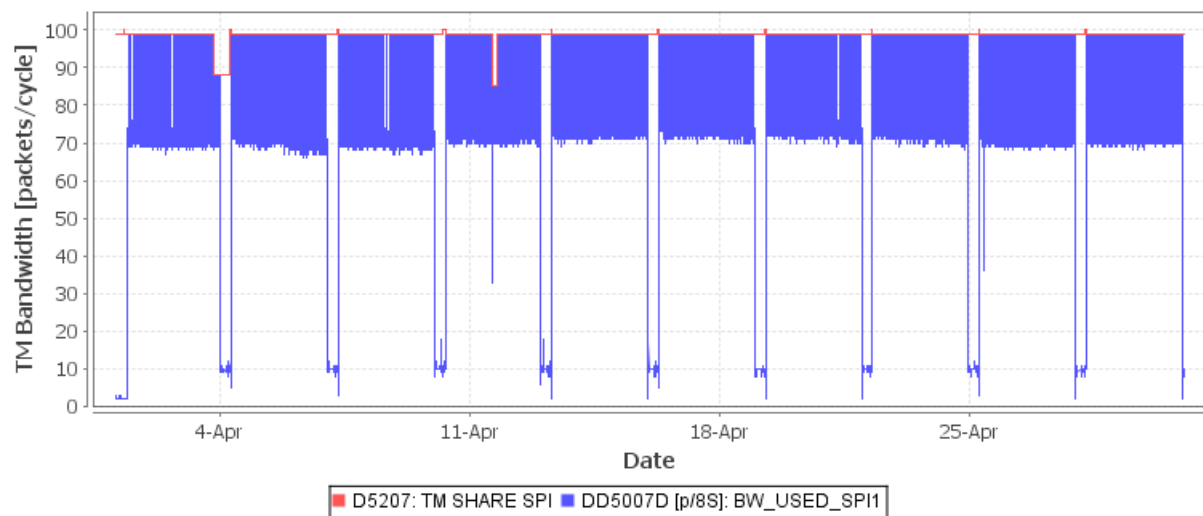


Figure 1: SPI TM bandwidth utilisation

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

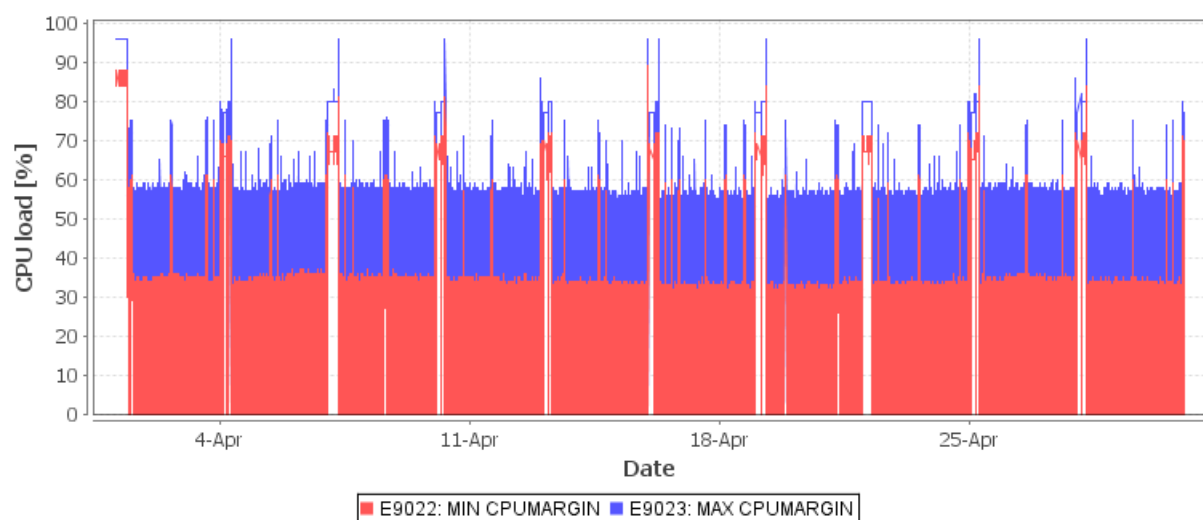


Figure 2: SPI IASW Performance

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

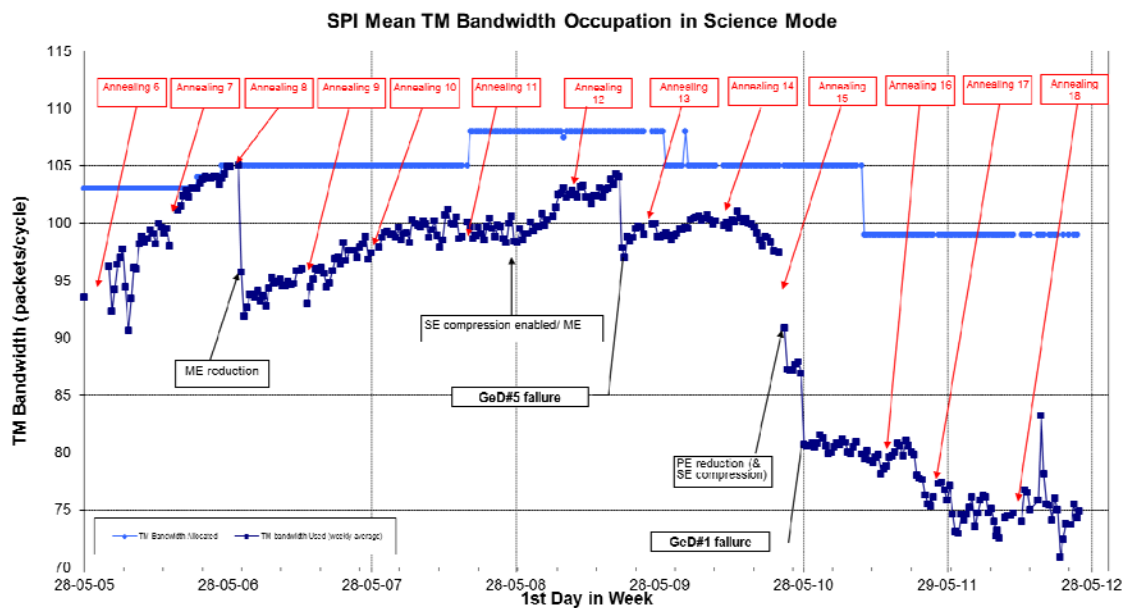


Figure 3: SPI TM bandwidth usage evolution since May 2005

Note: More information concerning the SPI operations is provided in Appendix 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 2012-04-03T18:11:12Z to 2012-04-03T22:24:34Z (OMC Flat Field Calibration), when it was 90 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 109.31 packets/cycle

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

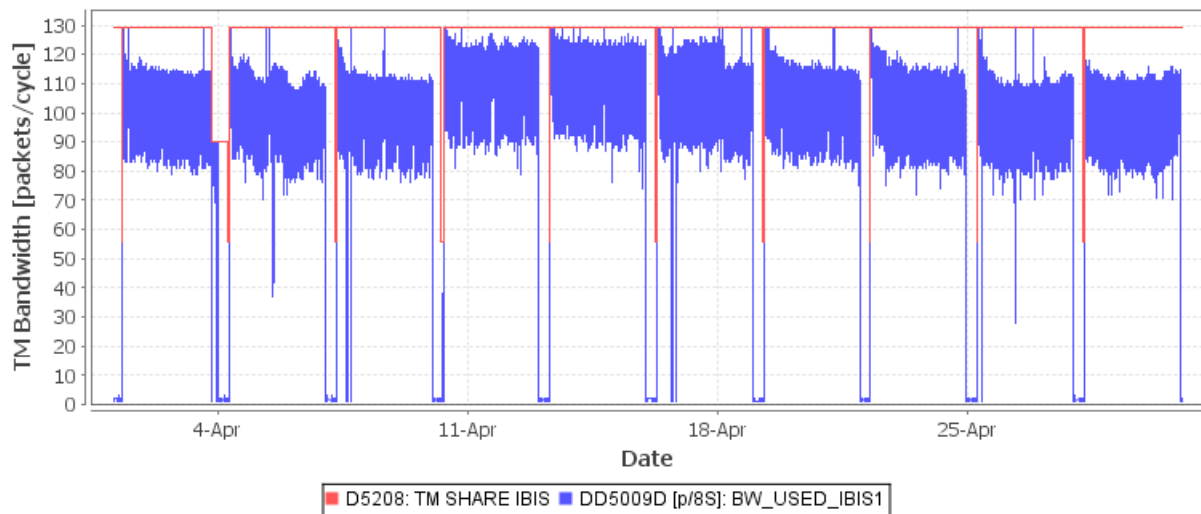


Figure 4: IBIS TM bandwidth utilisation

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

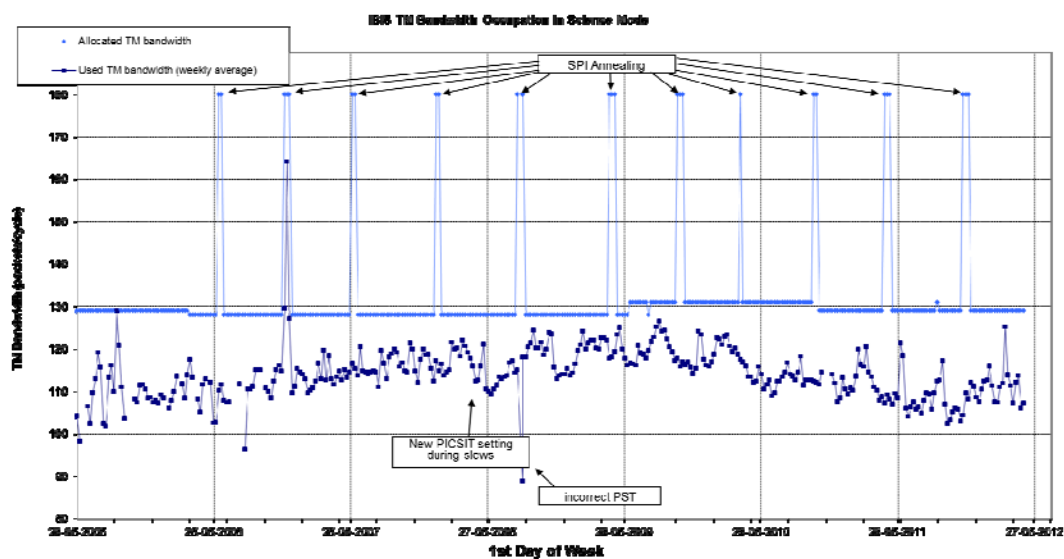


Figure 5: IBIS TM bandwidth usage evolution since May 2005

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

2.2.3 JEM-X

The status of both JEM-X units is nominal:

- JEM-X1 & 2 were operated in Data Taking mode with a TM allocation of 8 packets/cycle, except from 2012-04-03T18:11:12Z to 2012-04-03T22:24:34Z during the OMC Flat-field calibration when the allocation was 4 packets/cycle each.

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

2.2.4 OMC

The status of OMC is nominal.

OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle, except from 2012-04-03T18:11:12Z to 2012-04-03T22:24:34Z during the Flat-field calibration, when it was 63 packets/cycle.

During this reporting period, 892 of the 907 planned science pointings were executed nominally. 6 pointings were lost to AOCs problems. 1 pointing was lost and 1 cut short to low elevation problems at Weilheim. 1 pointing was lost and other interrupted to an IREM SEU. 2 pointings were lost to comms maintenance. 1 pointing was lost and another executed at the wrong attitude due to problems at VIL2. Finally, 1 pointing was interrupted when the CCCFs were activated. 1 Flat field calibration was performed this month.

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

2.2.5 IREM

The status of IREM is nominal.

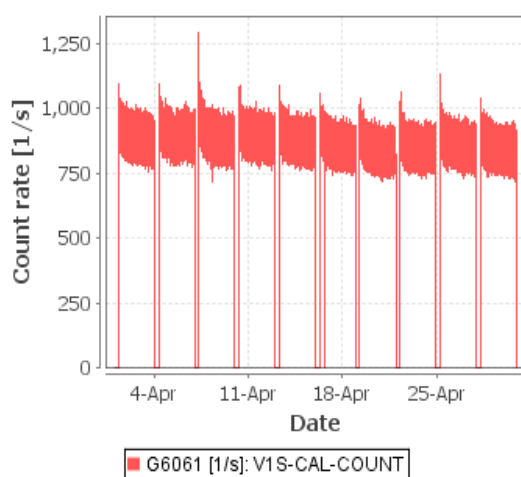
On DoY 107 (16/04/2012), the 129th IREM SEU occurred.

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

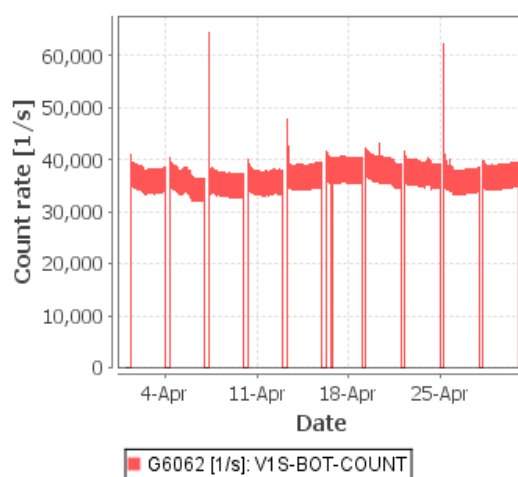
Radiation background

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

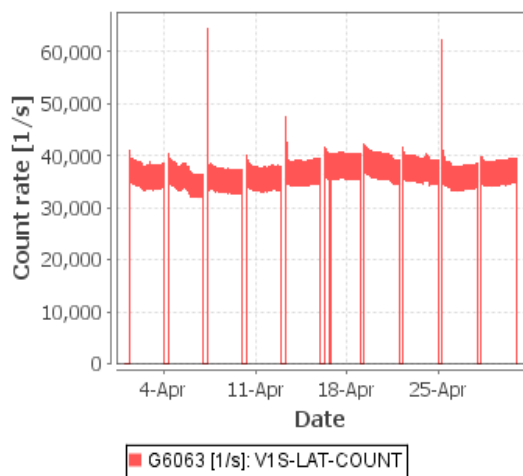
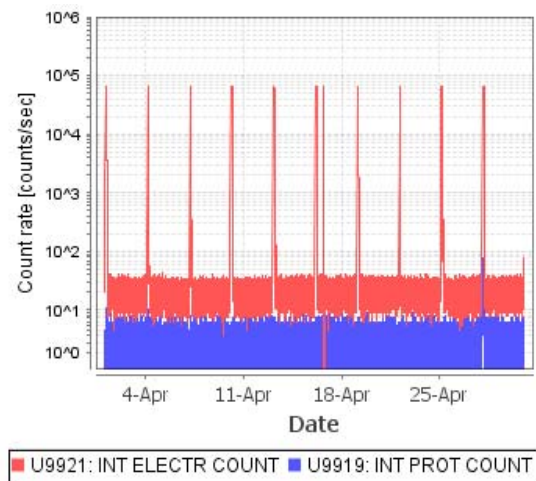
VETO Calibration Source Count Rate



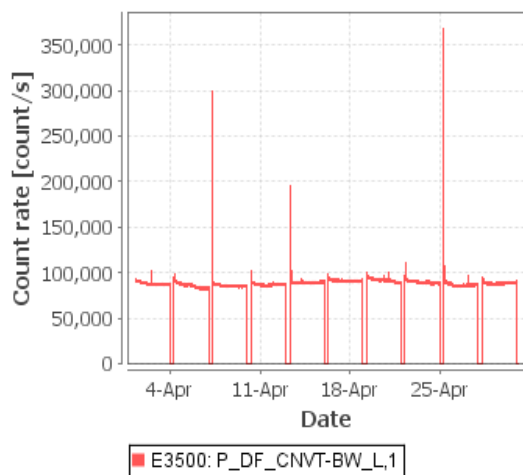
VETO Bottom Count Rate



VETO Lateral Count Rate

IREM Proton & Electron Counters¹

ACS Below 100MeV



ACS Above 100MeV

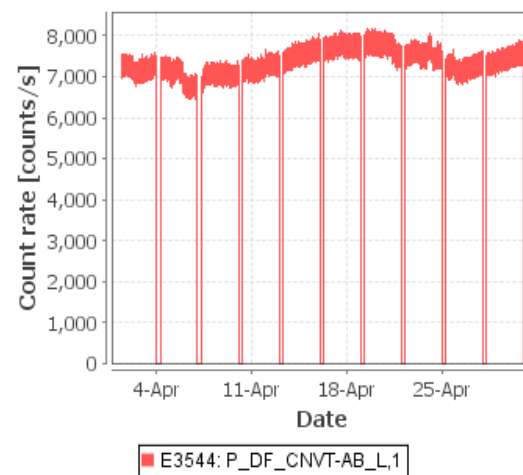


Figure 6: Instrument Count Rates

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

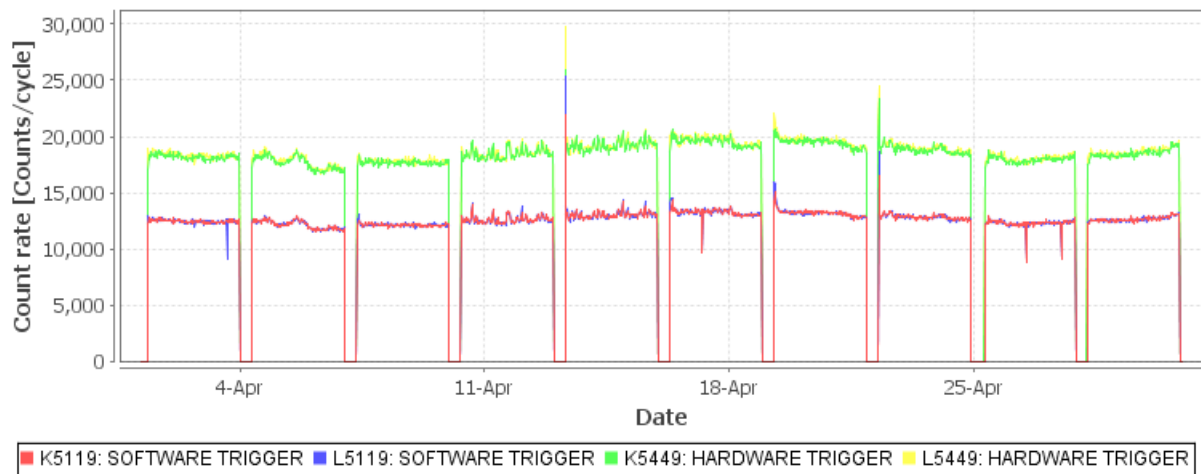


Figure 7: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

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.

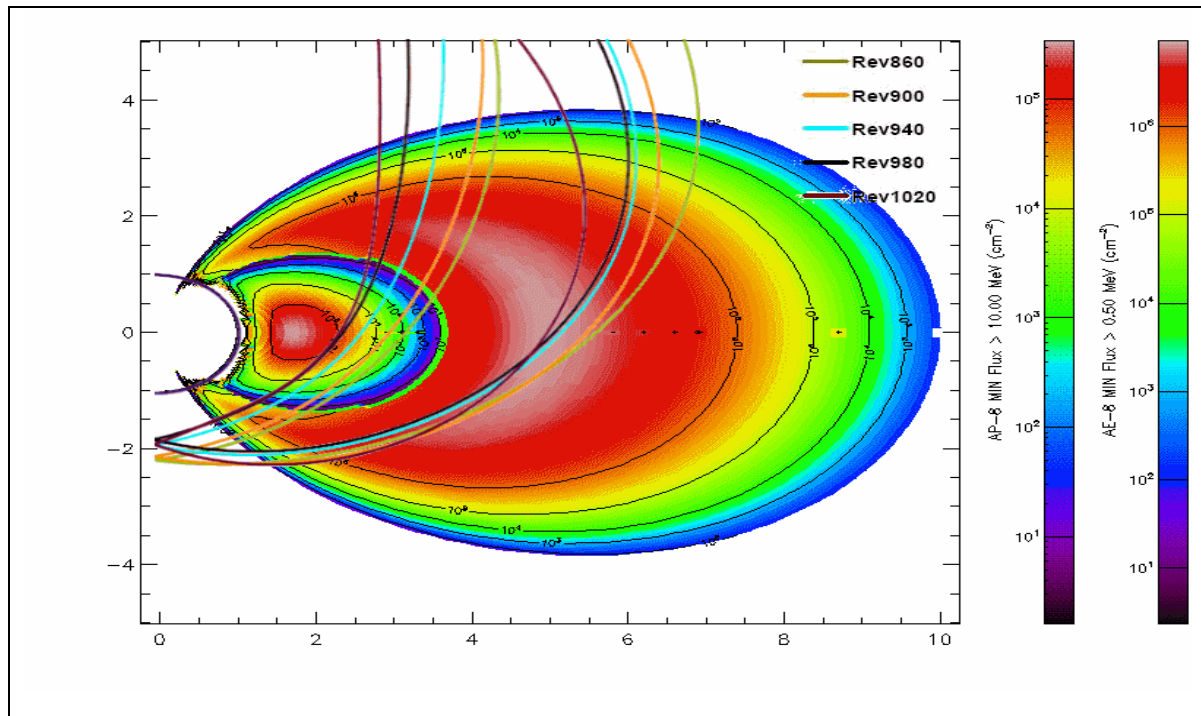


Figure 8: The predicted evolution of the orbit of Integral through the radiation belts

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.

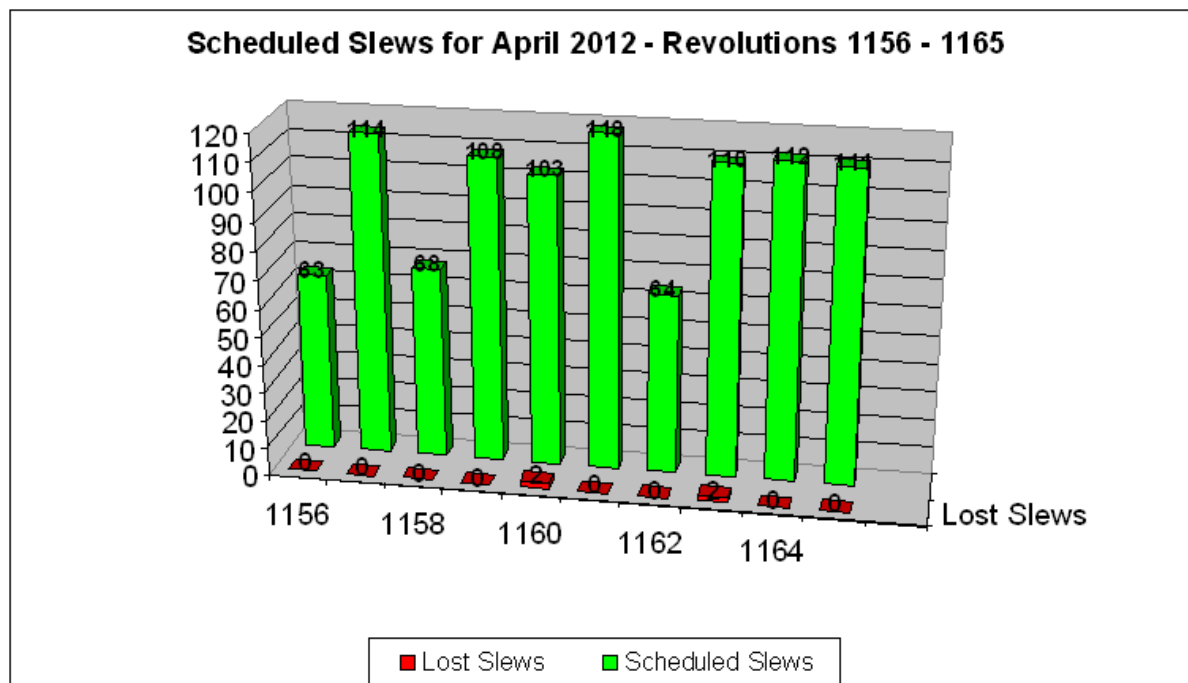


Figure 9: The number of slews scheduled compared to the number of slews lost

3.1 Mission Control System

- The problems reported last month concerning the retransmission of old data from the groundstation to the MCS was finally traced back to a bug in the IFMS software. A software upgrade to the newest version was very recently performed on the REDU IFMSs which should fix this. The problem has not yet been seen since then and we are continuing to monitor this closely. Currently we are also recovering the vast backlog of gap checking, CD production, performance statistics (amongst other things) which were directly affected by this bug.

- The ATV Spacecraft emergency also impacted us as they are using our prime as well as our backup stations. Ground station coverage had to be carefully planned/ scheduled within suitable commanding gaps. Various operational instructions were put in place to perform manual station handovers.

- The long expected software release was tested on the D-chain and some minor issues were fixed.

One SPR was disabled completely as the implementation did not meet the requirements. It has now been installed on the C-chain for further testing.

DLR's Weilheim groundstation was successfully re-validated after various changes on both sides. During validation it was noticed that the station masking information was incorrect causing TM loss at 7° elevation.

3.2 Ground Stations and Network

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

DOY 092 (01/04/2012)

02:42:00 : G/S: TM-Links aborted on NCTRS-A (TMTCS1) not possible to reconnect TM from TMTCS1 using TMTCS2 instead- no backup available

06:35:00: Move TC to TMTCS2. Test Command ok. TM and TC now all connected to TMTCS2

06:38:00: Ask network to restart TMTCS1

06:55:00: TMTCS1 back up. Connect TM VCO and 7 on NCTRS-B ok.

Feedback from the GS team & the TMCTS SW support:

It was again an occurrence of the segmentation fault of the TPS process like experienced several times before: this should disappear with the next software release 3.3.5.

DOY 114 (23/04/2012)

no incidents

DOY 115 (24/04/2012)

2012-04-24 13:26:00 (115) G/S: Drop VC-0 & VC-7 from G/S: VIL2, duration: 2 min

2012-04-24 13:59:47 (115) G/S: Drop VC-0 & VC-7 from G/S: VIL2, duration: 2 mins

2012-04-24 14:06:01 (115) G/S: Drop VC-0 & VC-7 from G/S: VIL2, duration: 1.5 min

2012-04-24 14:25:17 (115) G/S: Drop VC-0 & VC-7 from G/S: VIL2, duration: 2 min

2012-04-24 15:57:00 (115) G/S: Data gaps on VC-7 from G/S:MAS, processed VIL2 VC-7 again

Under investigation by the GS Engineer

DOY 116 (25/04/2012)

no incidents

DOY 117 (26/04/2012)

no incidents

DOY 118 (27/04/2012)

no incidents

DOY 119 (28/04/2012)

no incidents

DOY 120 (29/04/2012)

no incidents

DOY 121 (30/04/2012)

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.

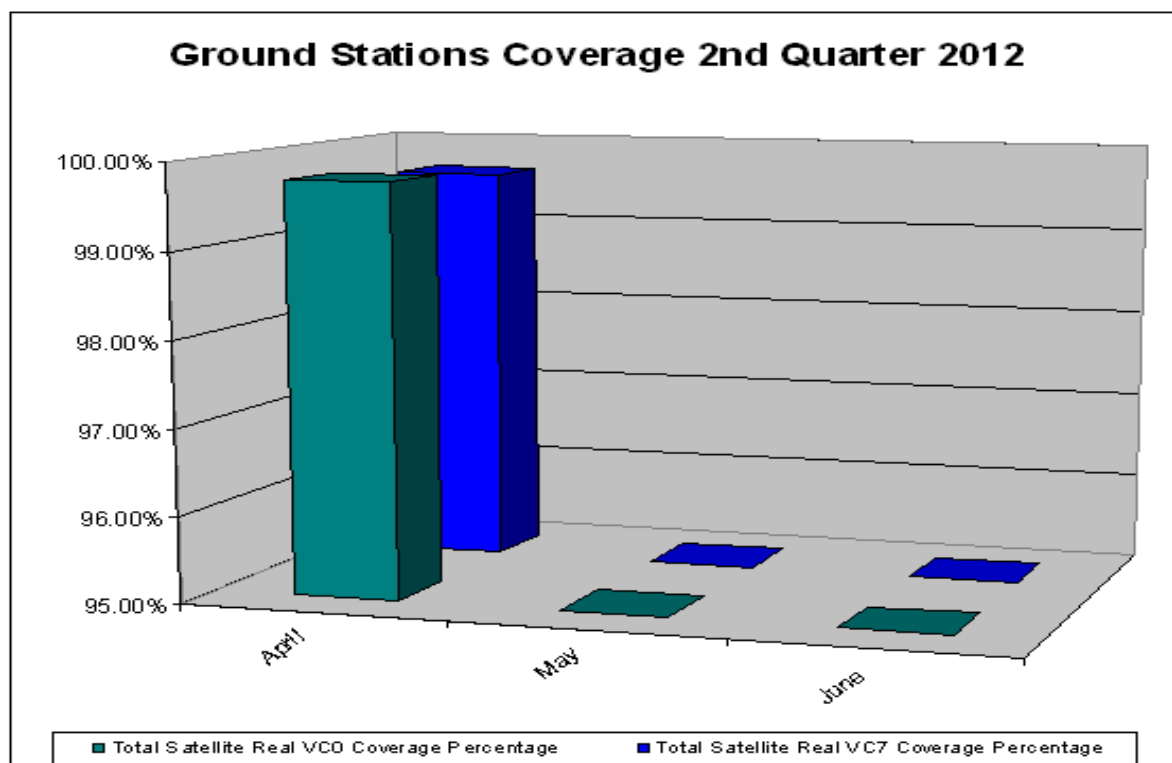


Figure 10: Comparison of VC0 to VC7 coverage

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 1165 to 1172, corresponding to the time range 28 April to 21 May.

New observations have been planned for revolutions 1163 (22-24 April) to 1170 (13-15 May). TOO observations of the new X-ray transient MAXI J1305-704 led to re-planning of revolution 1162 (19-21 April) on 18 April. The first of the new series of Earth/CXB observations was implemented around the perigee passage from 1168 to 1169.

TSFs have been received for revolutions 1158 to 1169.

3.3.2 Observation Status

No new ECS files have been received in April. The last received is for revolution 1142 (covering observations up to 21 February).

3.3.3 ISOC Science Data Archive

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

ISDA 3.1.4 was released on 16 April, improving data download via a VO interface at ESAC.

3.3.4 ISOC System

Working on V32.1 with various improvements, especially handling of ping-pong filters.

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-3260	2012-04-01	SPI in CONF mode after exiting rad belts	Payload	Pending
INT-3261	2012-04-11	SYS: CMDHverifier on IMCA lost connection to TM CPD	IMCS	Pending
INT-3262	2012-04-13	WEILHEIM loss of TM due to low elevation		Pending
INT-3263	2012-04-15	TM Desktop: not possible to go to live	IMCS	Pending

AR id	Date of occurrence	Subject	Segment	Status
INT-3264	2012-04-16	Some parameters of AND E1713 not included in TQD Display list	IMCS	Pending
INT-3265	2012-04-16	TQD shows inconsistent information	IMCS	Pending
INT-3266	2012-04-17	Incorrect release time displayed for manually sent TCs with relative release times	IMCS	Pending
INT-3267	2012-04-18	Comms Maintenance Causes Loss of VIL2 Links	COMMS	Pending
INT_SC-382	2012-04-07	IBIS PICSIT PDM01 LATCH UP	Payload	Testing
INT_SC-383	2012-04-16	IREM Anomaly: Reset of IREM_CSCI S/W #129, 16/04/2012	Payload	Testing

5 Special Events & Future Milestones

E3.5 Testing

Preparation for Earth Observation 2.1 on May 9/10th

Preparation for SPI annealing

Preparation for leap second (June)

DB change planned for May 2012

Virtualised Solaris environments

MCS development

6 Appendix

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

6.1 AOCS operations

During this period, 353 Open Loop Slews, 611 Closed Loop Slews and 22 Momentum Biases were executed (as reported by ACC OEM).

24 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 01/05/2012 is reported in the following plot:

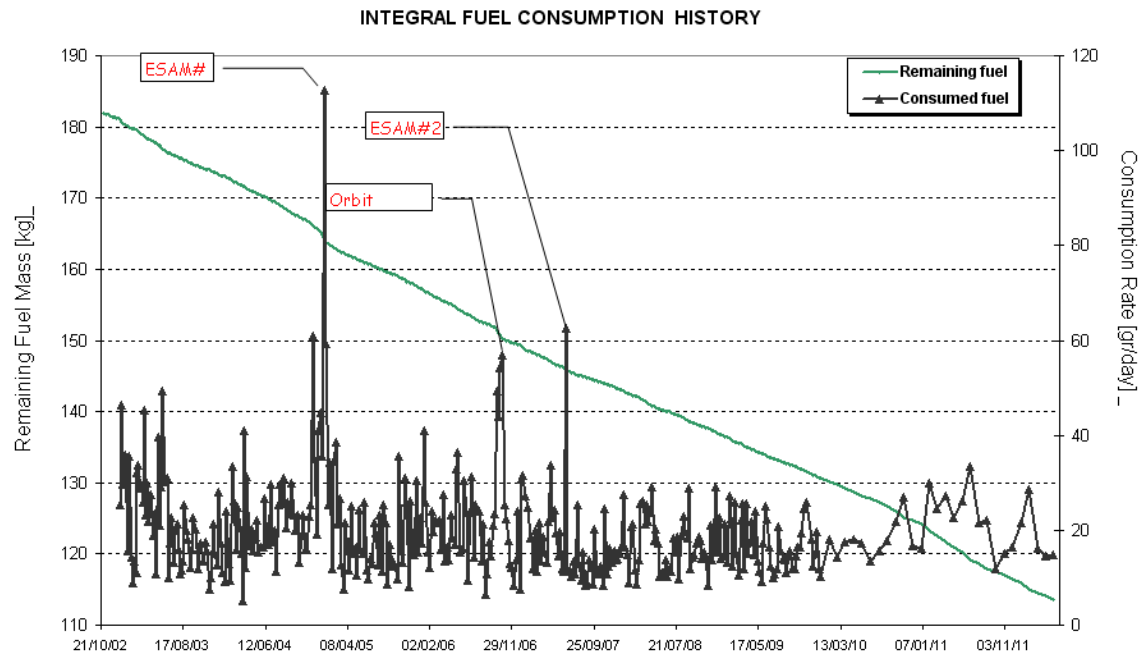


Figure 11: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

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.

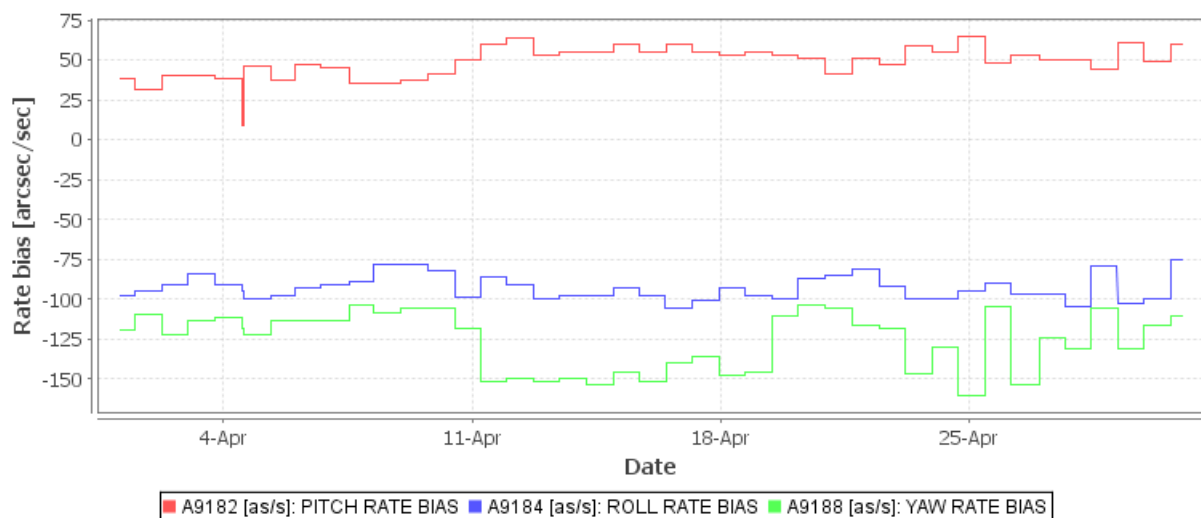


Figure 12: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

01-04-2012 (Day of Year 092, Revolution 1156)

At 09:11, the Start Guide star command failed release. A recovery was performed, and the timeline rejoined at 10:20.

The impact was the loss of PIDs 11560005 & 11560006.

02-04-2012 (Day of Year 093, Revolution 1156)

At 19:42, no TPF update for slew 11560039, due to the NFS server being down

At 19:43, the AOCS was suspended in the timeline.

At 20:12, TPF update received.

At 20:15, AOCS re-enabled in timeline.

There was no impact

03-04-2012 (Day of Year 094, Revolution 1156)

At 11:57, the Start Guide star failed release. A recovery was performed, and the timeline rejoined at 13:15.

The impact was the loss of PIDs 11560054 & 11560055.

05-04-2012 (Day of Year 096, Revolution 1157)

At 07:44, the IMU switched ON during the stable pointing of PID 11570048. The AOCS was suspended in the timeline. After the IMU switched back OFF, a recovery was performed and a manual slew to the attitude of PID 11570049. At 08:16, the timeline was recovered.

The impact was the loss of PID 11570049.

06-04-2012 (Day of Year 097, Revolution 1157)

At 20:06, the FD update for slew 11570111 failed. A manual Reaction Wheel bias was necessary, followed by a manual slew to the attitude of PID 11570114. The AOCS remained disabled until the end of the revolution.

The impact was the loss of PIDs 11570112, 11570113, & 11570114.

07-04-2012 (Day of Year 098, Revolution 1158)

At 02:10, after AOS, it was observed that the guide star had been swapped during perigee. Further investigation showed the IMUs had been activated during the LOS. A recovery consisting of a manual mapping, followed by a manual Change of guide star, was performed.

There was no further impact.

08-04-2012 (Day of Year 099, Revolution 1158)

At 12:07:41, the Start Guide star command failed release.

At 12:19:51, during the recovery, the Start Guide star command again failed release.

Another recovery was performed, and the timeline rejoined at 12:40.

PIDs 11580035 & 11580036 were missed from the Timeline.

10-04-2012 (Day of Year 101, Revolution 1159)

At 02:31, it was observed that during perigee passage a number of guide star swaps had occurred. The IMU had switched on at 00:26 and off at 00:45. A manual mapping was performed, and it was determined that the current guide star was suitable for the Reaction Wheel Bias. No further action was taken, and there was no impact.

At 17:01:07, the IMU switched ON during the stable pointing of PID 11590022. The AOCS was suspended in the timeline. After the IMU switched back OFF, a recovery was performed and a manual slew to the attitude of PID 11590023. At 17:30, the timeline was recovered.

The impact was the loss of PID 11570023.

13-04-2012 (Day of Year 104, Revolution 1160)

At 12:52, the Start Guide star command failed release. A recovery was performed, and the timeline rejoined at 13:16.

The impact was the loss of PID 11600013 with the slew to PID 11600014 manually executed.

At 18:51, due to low elevation from the ground station, all TM dropped. Therefore at 19:00, the TPF update for slew 11600024 failed.

At 19:50, after the TM was back, a manual recovery started to the attitude of PID 11600025.

At 20:05, the timeline was rejoined.

The impact was the loss of PIDs 11600024 and PID 11600025.

14-04-2012 (Day of Year 105, Revolution 1160)

At 16:47:31, the IMU switched on. At 16:57:31, after it switched back off a recovery was performed and a manual slew performed to the attitude of PID 11600058.

At 17:15, the timeline was recovered.

The impact was the loss of PIDs 11600057 & 11600058.

18-04-2012 (Day of Year 109, Revolution 1161)

At 00:44, the Start Guide star command failed release. A recovery was performed, and the timeline rejoined at 01:05.

The impact was the loss of PID 11610083.

At 13:20, due to a drop in TM, the CSL 11610105 was missed. The TM was recovered at 13:24, and a manual slew was performed to the attitude of PID 11610106, with the timeline restored at 13:56.

The impact was the loss of PIDs 11610105 & 11610106.

19-04-2012 (Day of Year 110, Revolution 1162)

At 01:18, it was observed that the guide star had changed during the perigee passage.

At 01:30, after a manual mapping was performed, it was determined that the star was suitable for the reaction wheel bias. No further action was taken, and there was no impact.

21-04-2012 (Day of Year 112, Revolution 1162)

At 02:53, the Start Guide star command failed release.

At 03:07 and 03:18, during the recoveries the Start Guide star command failed twice more.

At 03:38, during the third attempt, a recovery was succeeded to the attitude of PID 11620047.

The impact was the loss of PIDs 11620046 & 11620047.

24-04-2012 (Day of Year 115, Revolution 1163)

At 14:48, after a drop of TM, the commands for PID 11630100 failed.

At 15:03, a manual slew to the attitude of PID 11630100 was performed, but further TM drops prevented the completion of the recovery.

At 15:30, another manual slew to the attitude of PID 11630101 was performed.

The impact was the loss of PIDs 11630100 & 11630101.

25-04-2012 (Day of Year 116, Revolution 1164)

An AOCS calibration exercise was performed consisting of:

08:00:30, FCP_AOC_1522 Update RCS-A torque reciprocal,

08:05 by FCP_AOC_1045 Update AMD ON TIME PARAMETERS RCS-A,

08:19 with FCP_AOC_1120 UPDATE S/C INERTIAS,

08:39, FCP_AOC_1205 UPDATE TIM THRESHOLDS,

09:10 FCP_AOC_1206 UPDATE SAS THRESHOLDS,

These operations were all successful.

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.

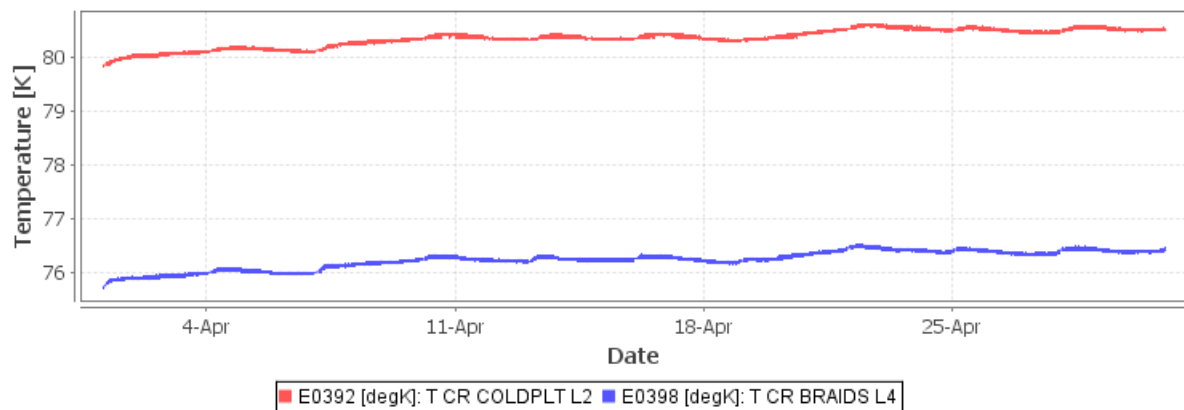


Figure 13: SPI Cold plate and H-bus temperature

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

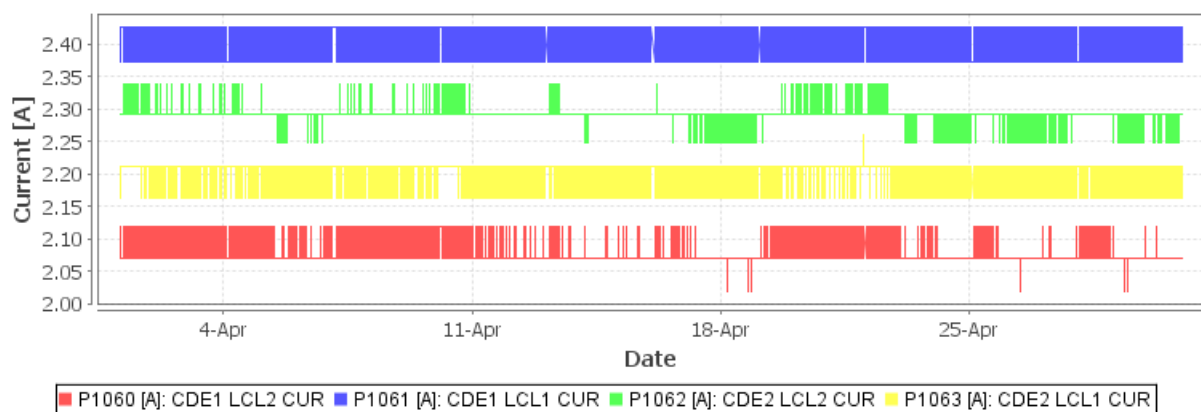


Figure 14: SPI CDE LCL current

DPE & IASW

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

ACS

The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Figure 6: Instrument Count Rates.

AFEE

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

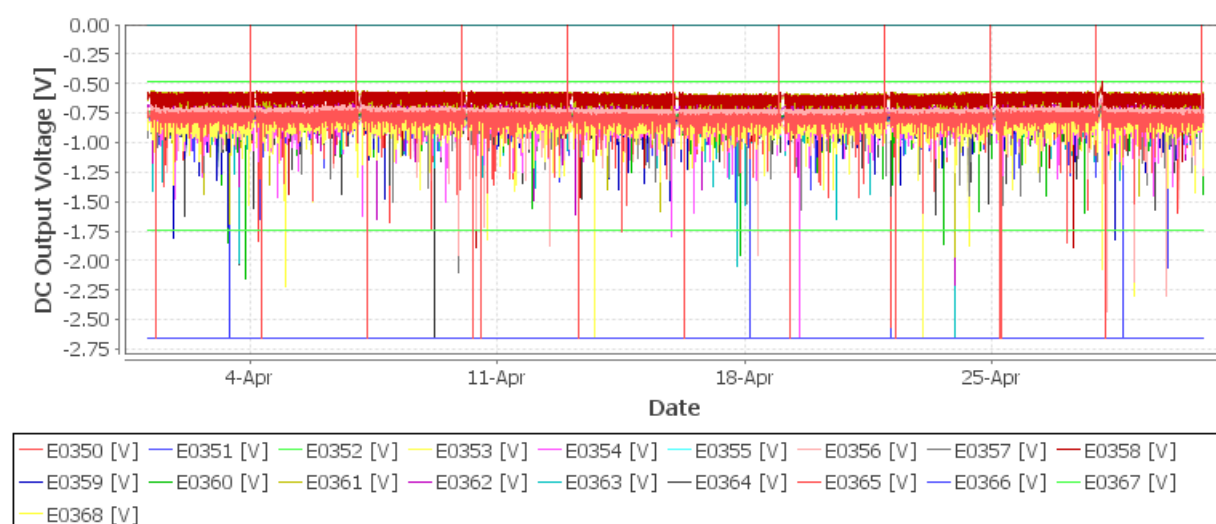


Figure 15: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)

DFEE

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



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

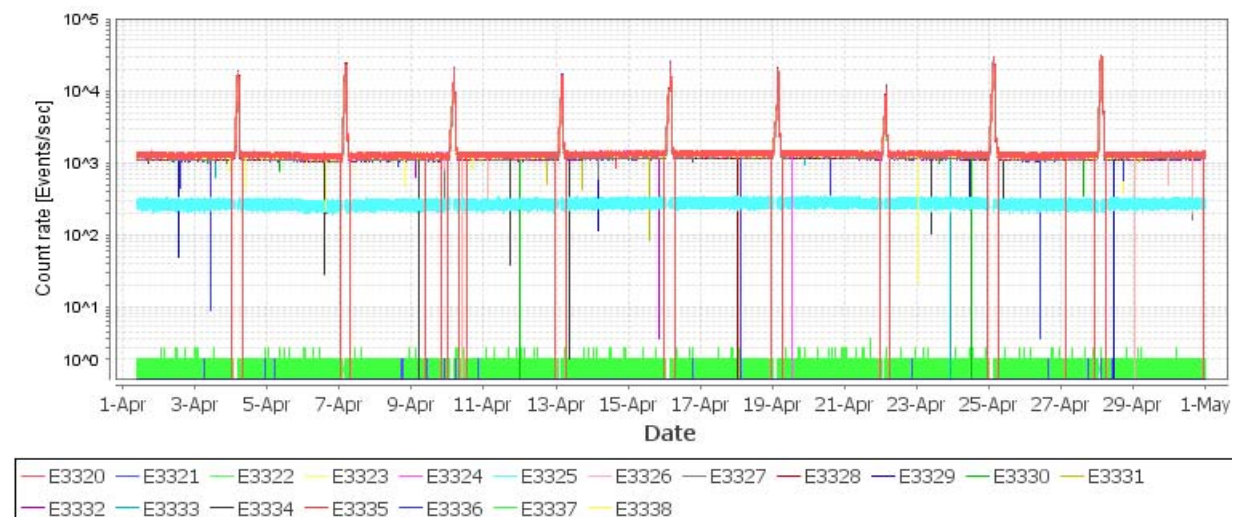


Figure 17: SPI GeD Time Tagged count rates. Note that the scale used for plotting is logarithmic.

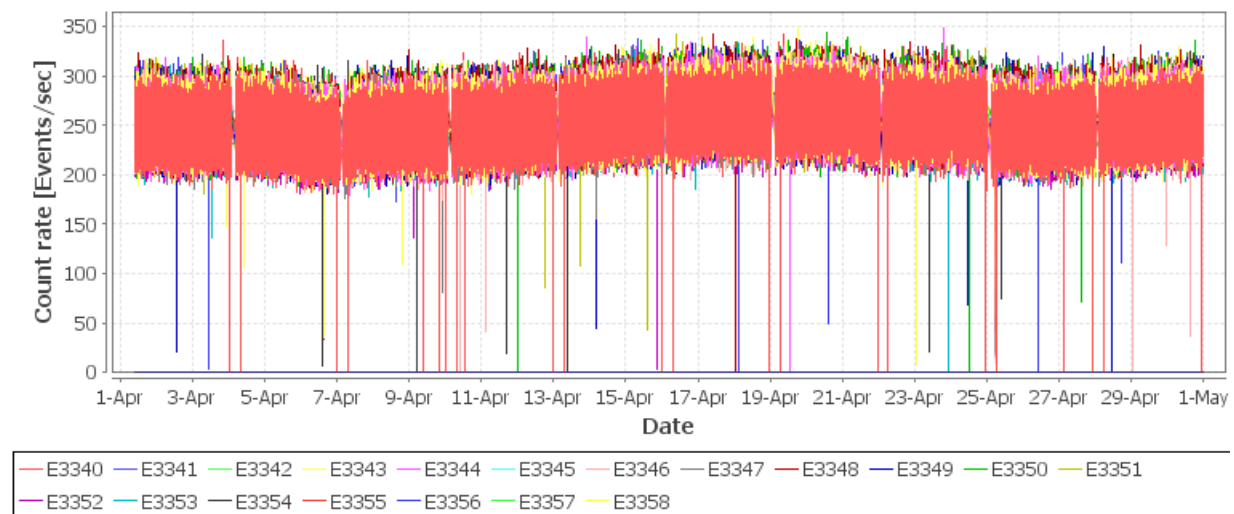


Figure 18: SPI GeD Time Tagged Saturated count rates

PSD

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



Figure 19: SPI PSD GeD Channel rates

6.2.2 Event Log

No SPI anomalies occurred in the reporting period.

6.3 IBIS

6.3.1 Operations

ISGRI

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

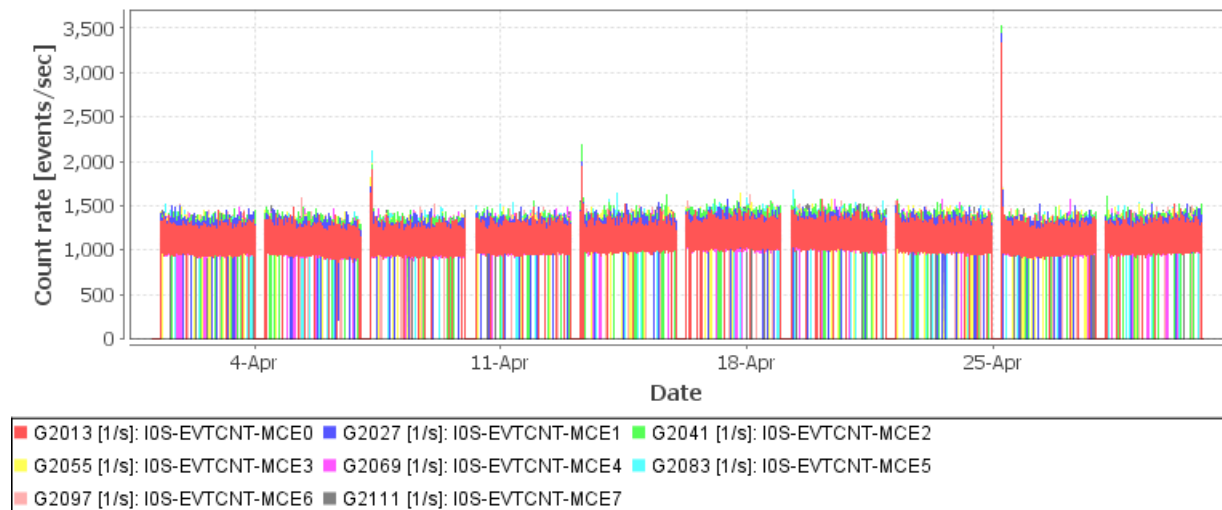


Figure 20: ISGRI MCE Counters

PICsIT

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



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

VETO

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

6.3.2 Event Log**07-04-2012 (Day of Year 98, Revolution 1158)**

IBIS PICSIT PDM01 LATCH UP: see INT_SC-382

16-04-2012 (Day of Year 107, Revolution 1161)

IREM Anomaly: Reset of IREM_CSCI S/W #129, 16/04/2012 which forced IBIS to automatically enter safe configuration. Please see INT_SC-383.

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.

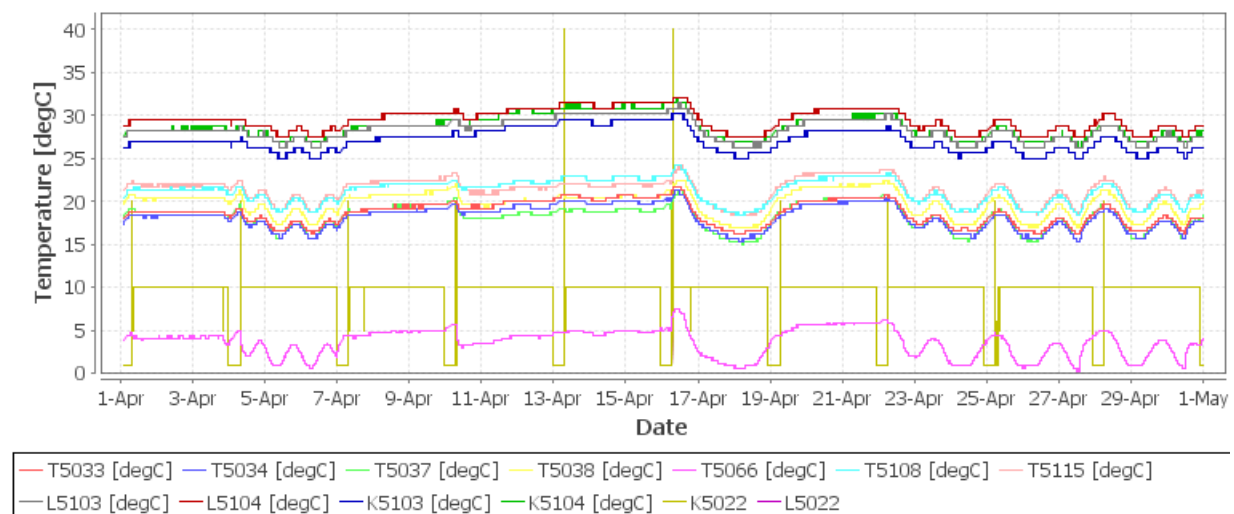


Figure 22: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

25-04-2012 (Day of Year 116, Revolution 1164)

At 04:19:43 high radiation at belts exit due to a solar flare caused the start up sequences for JEMX-1 & 2 to fail. At 05:04 a manual activation was started on both units, which was successfully completed at 05:59.

6.5 OMC

6.5.1 Operations

The status and performance of OMC is nominal.

6.5.2 Event Log

01-04-2012 (Day of Year 092, Revolution 1156)

At 09:11, an AOCS problem forced an interruption to the timeline. A recovery was performed, and timeline resumed at 10:17. The impact was the loss of pointing 11560005. It was at this time the following OEMs were received:

2012.092.09.14.50.860	2012.092.09.15.00.168	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0	65535 PR	N E E	
2012.092.09.14.56.860	2012.092.09.15.04.321	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.

03-04-2012 (Day of Year 094, Revolution 1156)

At 11:57, an AOCS problem forced an interruption to the timeline. A recovery was performed, and timeline resumed at 12:50. The impact was the loss of pointing 11560054. It was at this time the following OEMs were received:

2012.094.12.00.18.749	2012.094.12.00.27.570	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0	65535 PR	N E E	
2012.094.12.00.24.999	2012.094.12.00.33.571	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.

05-04-2012 (Day of Year 096, Revolution 1157)

At 07:44, an AOCS problem forced an interruption to the timeline. A recovery was performed, and timeline resumed at 08:15. The impact was the loss of pointing 11570049.

13-04-2012 (Day of Year 104, Revolution 1160)

At 12:52, an AOCS problem forced an interruption to the timeline. A recovery was performed, and timeline resumed at 13:20. The impact was the loss of pointing 11600014. It was at this time the following OEMs were received:

2012.104.12.55.47.745	2012.104.12.55.54.272	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2012.104.12.55.53.870	2012.104.12.56.01.140	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.

At 18:51, a drop in TM from Weilheim due to low elevation forced a suspension of the timeline. At 19:50, after the TM was recovered and a recovery was performed. The timeline was rejoined at 20:05:00. The impact was the loss of pointing 11600024, with 11600025 cut short from a planned 2140 to 1368 seconds.

16-04-2012 (Day of Year 107, Revolution 1161)

At 14:49:05, an IREM SEU (#129) forced OMC to SAFE mode. A recovery was performed, and the timeline rejoined at 15:50:00. The impact was 11610021 was cut short from a planned 2858 to 2185 seconds, and pointing 11610022 was lost.

At 17:36:24, when the CCCFs were activated as part of the recovery from the IREM SEU, OMC went to stand-by. The impact was pointing 11610025 was cut short from a planned 2858 to 304 seconds.

18-04-2012 (Day of Year 109, Revolution 1161)

At 00:42, an AOCS problem forced an interruption to the timeline. A recovery was performed, and timeline resumed at 01:11. The impact was the loss of pointing 11610083. It was at this time the following OEMs were received:

2012.109.00.47.45.988	2012.109.00.47.54.594	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2012.109.00.47.52.113	2012.109.00.48.01.591	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.

At 13:19, due to comms maintenance, the VC0 & VC7 TM dropped. This caused an interruption in the timeline. At 13:24, the TM was restored, and a recovery performed. At 14:01, the timeline was restored. The impact was the loss of pointing 11610105 & 11610106.

21-04-2012 (Day of Year 112, Revolution 1162)

At 02:53, an AOCS problem forced an interruption. At 03:45, a recovery was performed, and the timeline rejoined. The impact was the loss of pointing 11620046.

24-04-2012 (Day of Year 115, Revolution 1163)

At 14:48, a drop in TM from VIL2 forced a suspension of operations. A recovery was performed, and timeline resumed at 16:01. The impact was the loss of pointing 11630100, with pointing 11630101 executed at an incorrect attitude. It was at this time the following OEMs were received:

2012.115.14.52.53.792	2012.115.14.53.01.739	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2012.115.14.52.59.792	2012.115.14.53.08.519	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 pointing 11630100.

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.

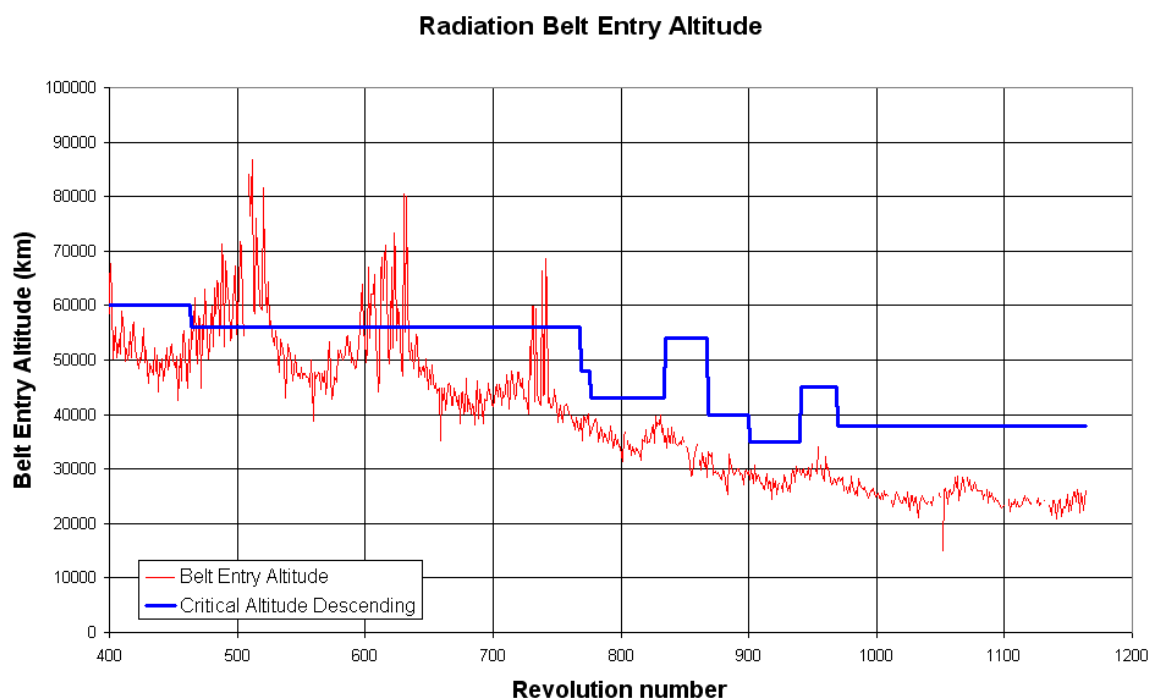
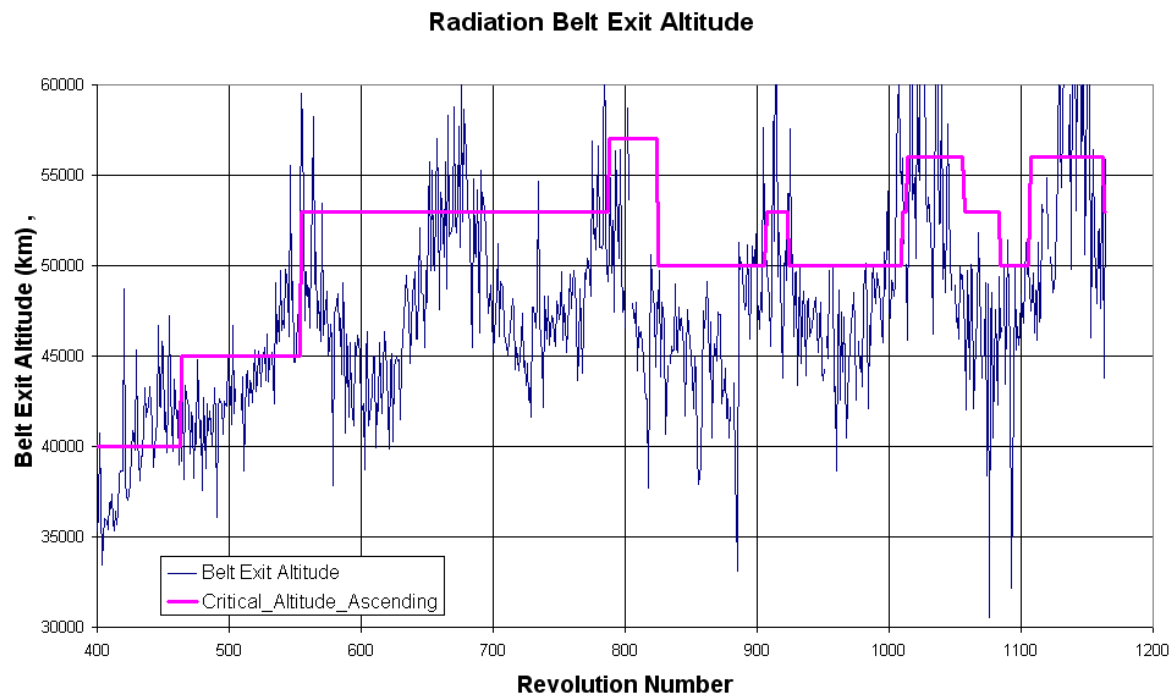


Figure 23: Radiation belt entry

**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
1155	RAD_ENTR R 2012-03-31T22:37:33Z	01/04/2012 00:03:19	26370	01-Apr-2012 00:09:58	18757.54	01-Apr-2012 00:49:58	8778.665
1156	RAD_EXIT R 2012-04-01T05:54:14Z	01/04/2012 04:53:11	52517	01-Apr-2012 05:09:58	48712.22	01-Apr-2012 01:29:58	3268.02
1156	RAD_ENTR R 2012-04-03T22:25:16Z	03/04/2012 23:58:07	24674	04-Apr-2012 00:02:17	17554.09	04-Apr-2012 00:42:17	7490.613
1157	RAD_EXIT R 2012-04-04T05:41:18Z	04/04/2012 04:23:43	49610	04-Apr-2012 05:02:17	49634.49	04-Apr-2012 01:12:17	2923.441
1157	RAD_ENTR R 2012-04-06T22:14:51Z	N/A	N/A	06-Apr-2012 23:52:51	17323.15	07-Apr-2012 00:32:51	7252.464

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
1158	RAD_EXIT R 2012-04-07T05:30:36Z	07/04/2012 05:59:03	66519	07-Apr-2012 04:42:51	48150.72	07-Apr-2012 01:02:51	2929.61
1158	RAD_ENTR R 2012-04-09T22:04:31Z	09/04/2012 23:32:55	25694	09-Apr-2012 23:38:59	17909.68	10-Apr-2012 00:18:59	7902.538
1159	RAD_EXIT R 2012-04-10T05:20:49Z	10/04/2012 04:33:27	54834	10-Apr-2012 04:38:59	49303.05	10-Apr-2012 00:48:59	3012.008
1159	RAD_ENTR R 2012-04-12T21:51:20Z	N/A	N/A	12-Apr-2012 23:28:23	17553.89	13-Apr-2012 00:08:23	7601.651
1160	RAD_EXIT R 2012-04-13T05:08:20Z	13/04/2012 06:08:47	71108	13-Apr-2012 04:28:23	49457.2	13-Apr-2012 00:38:23	3107.334
1160	RAD_ENTR R 2012-04-15T21:37:04Z	N/A	N/A	15-Apr-2012 23:07:50	19188.54	15-Apr-2012 23:47:50	9255.504
1161	RAD_EXIT R 2012-04-16T04:54:06Z	16/04/2012 04:16:56	56509	16-Apr-2012 04:07:50	48364.55	16-Apr-2012 00:27:50	3188.48
1161	RAD_ENTR R 2012-04-18T21:23:54Z	N/A	N/A	18-Apr-2012 23:00:48	17571.83	18-Apr-2012 23:40:48	7569.927
1162	RAD_EXIT R 2012-04-19T04:40:39Z	19/04/2012 03:44:56	53422	19-Apr-2012 04:00:48	49524.2	19-Apr-2012 00:10:48	3024.306
1162	RAD_ENTR R 2012-04-21T21:11:26Z	N/A	N/A	21-Apr-2012 22:47:26	17827.58	21-Apr-2012 23:27:26	7863.857
1163	RAD_EXIT R 2012-04-22T04:09:05Z	22/04/2012 02:42:00	44454	22-Apr-2012 03:47:26	49289.11	21-Apr-2012 23:57:26	3086.92
1163	RAD_ENTR R 2012-04-24T20:57:49Z	N/A	N/A	24-Apr-2012 22:26:00	19753.33	24-Apr-2012 23:06:00	9900.433
1164	RAD_EXIT R 2012-04-25T03:56:00Z	25/04/2012 04:20:56	63197	25-Apr-2012 03:36:00	49521.34	24-Apr-2012 23:46:00	3190.029
1164	RAD_ENTR R 2012-04-	27/04/2012 22:00:40	28548	27-Apr-2012	19312.21	27-Apr-2012	9424.348

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
	27T20:44:03Z			22:13:28		22:53:28	
1165	RAD_EXIT R 2012-04- 28T03:42:18Z	28/04/2012 02:54:48	51529	28-Apr-2012 03:13:28	48202.61	27-Apr-2012 23:33:28	3230.924
1165	RAD_ENTR R 2012-04- 30T20:31:39Z	30/04/2012 21:58:16	26256	30-Apr-2012 22:03:28	18880.83	30-Apr-2012 22:43:28	8950.718

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

16-04-2011 (Day of Year 107, Revolution 1161)

At 14:49:04Z, a local reset of the IREM CSCI S/W (SEU #129) was observed. The status of the unit, before the local reset of the IREM CSCI S/W, was nominal, here is a summary:

- 1) The temperatures were nominal;
- 2) The LCL current was nominal;
- 3) The last HK before the anomaly showed HV, 5V and 6V voltages inside limits;
- 4) The anomaly occurred at 2012.107.14:49:04Z (118023.2 km). The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex);
- 5) The recovery of the unit started immediately using procedure CRP_SYS_2570. The first dump of the status word after the anomaly reported a value of BCC0 HEX = 48320 DEC = 1011110011000000, i.e the Checksum Failure Flag ON. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON, and ground link ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.
- 6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 16:34:00Z.

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The IREM automatic transition to Standard Mode affected the instruments by forcing them to automatically enter Safe configuration, except for SPI and JEM-X whose automatisms are disabled according to the PIs request. OMC was recovered at 15:11:00Z and IBIS at 15:24:00Z.