EUROPEAN SPACE AGENCY

DIRECTORATE OF TECHNICAL & OPERATIONAL SUPPORT

MISSION OPERATIONS DEPARTMENT

INTEGRAL

Mission report

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

No. 390

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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 perfomed according to the planning inputs from ISOC combined with some manual commanding by MOC.

This report addresses the activities from Ocotber and covers the revolutions 973 untill 982 (included). The targets of these revolutions can be found on the ISOC web: http://integral.esac.esa.int/isocweb/schedule.html?action=intro .

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

2 Satellite status

2.1 Platform

2.1.1 AOCS

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

9 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.836 Kg. The remaining propellant is in the order of 125.16 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; available power from the arrays is of the order of 2100W.

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

The 16th SPI annealing started on 10/10/2010 and ended on 28/10/2010. Following this annealing 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). Operations for the annealing were performed nominally. In addition, OCRs 294, 296 and 297 were implemented. The times for the main activities performed were as follows:

Date/Time	Activity
2010-10-10 11:44:06Z	Configure SPI for start of Annealing and stop SPI active cooling
2010-10-10 12:45:00Z	Annealing Heater Main ON
2010-10-10 14:45:00Z	Annealing Heater Redundant ON
2010-10-12 00:09:53Z	Cold plate temperature reached 373K (100degC)
2010-10-19 11:42:00Z	Change of power supply configuration of CDE1 to 2 LCLs as per OCR #294
2010-10-20 08:10:00Z	Stop SPI Annealing: Annealing Heater Main and Redundant OFF
2010-10-20 08:48:36Z	ACS switch-on and start of ACS calibration (also FEE#57 and FEE#81 ON)
2010-10-22 23:30:26Z	Thermal braids temperature TM EU0398A reached 308K
2010-10-23 00:33:34Z	Start of cryocooler switch-on
2010-10-23 01:26:08Z	Cyrocooler switch-on complete and stroke set to 4x45
2010-10-23 06:03:30Z	End of ACS Calibration
2010-10-26 09:09:46Z	Cold plate temperature TM EU0392A reached 127K
2010-10-26 09:31:15Z	Selected narrow range cold plate temperature acquisition and restored PSD nominal threshold
2010-10-27 05:17:26Z	Cold plate temperature TM E0392 reached 100K
2010-10-27 06:39:47Z	Camera switch-on start; HV of all GeD increased in 500V steps to 0.5kV; 1kV; 1.5kV; 2kV; 2.5kV; 3kV; 3.5kV with acquisitions in PHOTON mode from 2kV onwards
2010-10-27 08:26:18Z	Thermal braid temperature TM E0398 reached 86K
2010-10-27 08:40:00Z	Start of reduction of cryocooler stroke for 80K target (FCP_SPI1_0072)
2010-10-27 10:10:25Z	Camera switch-on end: SPI in PHOTON mode with all GeD HV at 3.5kV
2010-10-28 04:29:00Z	End of reduction of cryocooler stroke for 80K target: Stroke set to 4x37
2010-10-28 09:01:12Z	GeD HV set to 4kV and data acquisition in PHOTON mode. HV of failed GeD#1, GeD#2, GeD#5 and GeD#17 set to 0.5kV.
2010-10-28 10:05:25Z	Set nominal GeD HV back to 3kV in line with OCR-297 and restore nominal ACS configuration (FEE#57 and FEE#81 OFF).
2010-10-28 15:56:52Z	Set nominal IASW parameters (Cold Plate Monitoring temperature) and change of PSD ULD (OCR-296)
2010-10-29 06:36:50Z	Cold plate temperature TM E0392 reached 80.9K

The Germanium detectors' temperature was kept in the range 80K+/-1K since the end of annealing.

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 105 packets/cycle up to revolution 976. From rev 976 to revolution 980 inclusive the TM allocation was 30 packets/cycle due to the annealing. From revolution 981 onwards the TM allocation was 99 packets/cycle, which is the new default TM allocation as 6 packets have been reallocated to JEM-X. The average telemetry occupation when the allocation was above 90 packets/cycle was 80.29 packets/cycle.

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

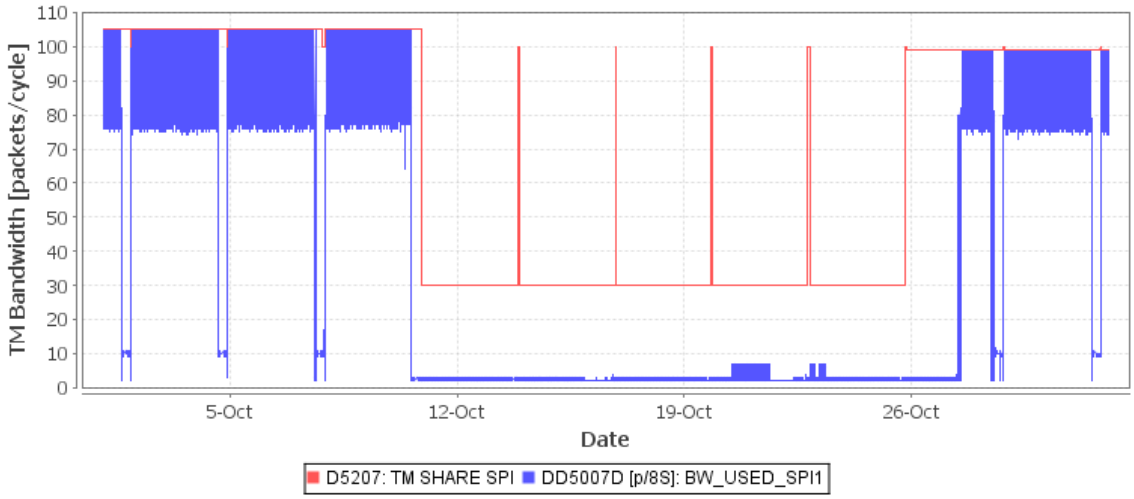


Figure 1: SPI TM bandwidth utilisation

The following plot shows the DPE CPU load during the reporting period:

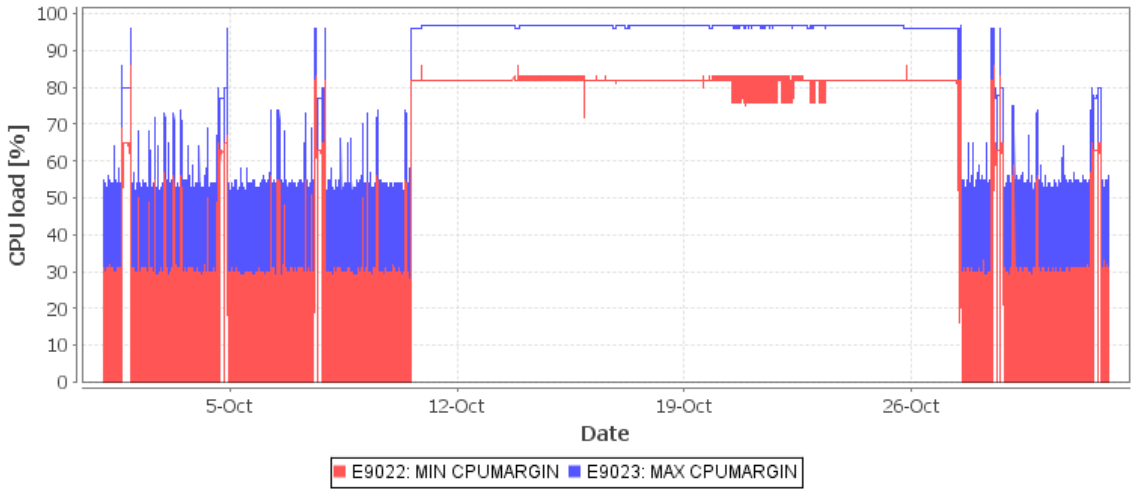


Figure 2: SPI IASW Performance

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

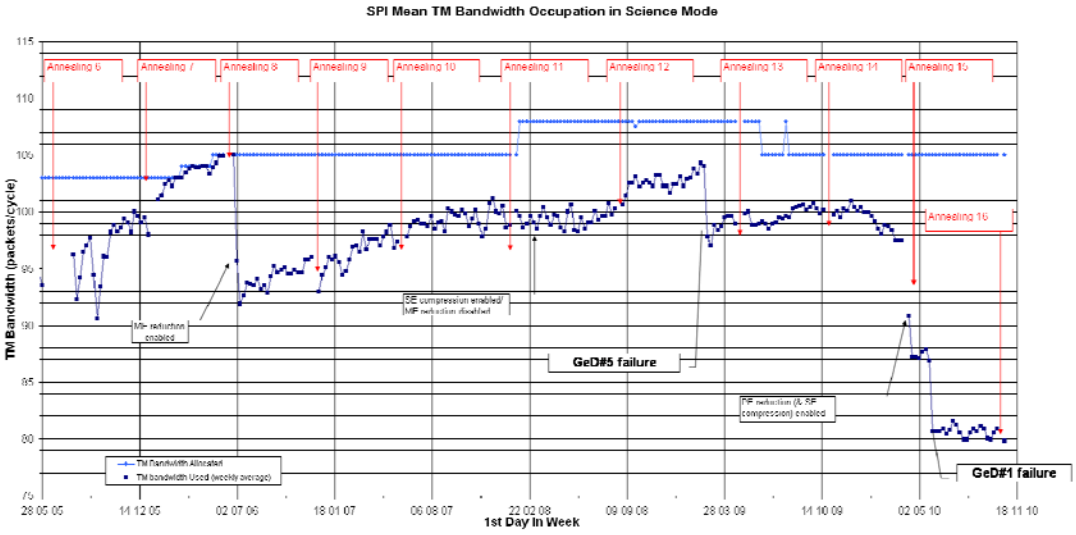


Figure 3: SPI TM bandwidth usage evolution since May 2005

Note: Some 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:
  - 131 packets/cycle until 2010-10-10T19:43:14Z;
  - 180 packets/cycle from 2010-10-10T19:43:14Z to 2010-10-25T18:38:32Z (SPI annealing), except on 2010-10-17 from 01:32:29Z to 05:21:00Z when it was 126 packets/cycle (OMC FFC);
  - 129 packets/cycle from 2010-10-25T18:38:32Z onwards (new nominal TM allocation as 6 packets/cycle have been reallocated to JEM-X).
- IBIS mean bandwidth utilisation in science mode: 112.05 packets/cycle.

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

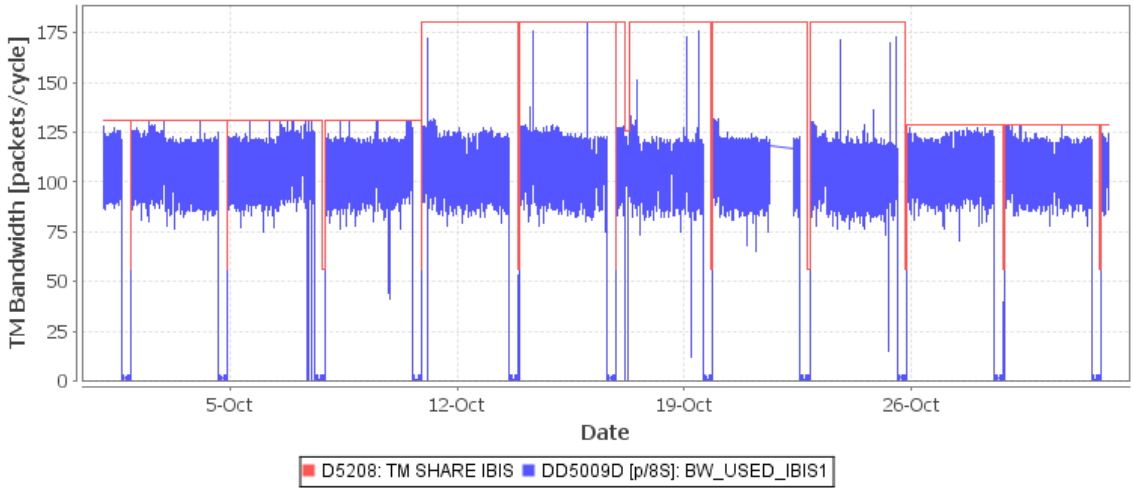


Figure 4: IBIS TM bandwidth utilisation

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

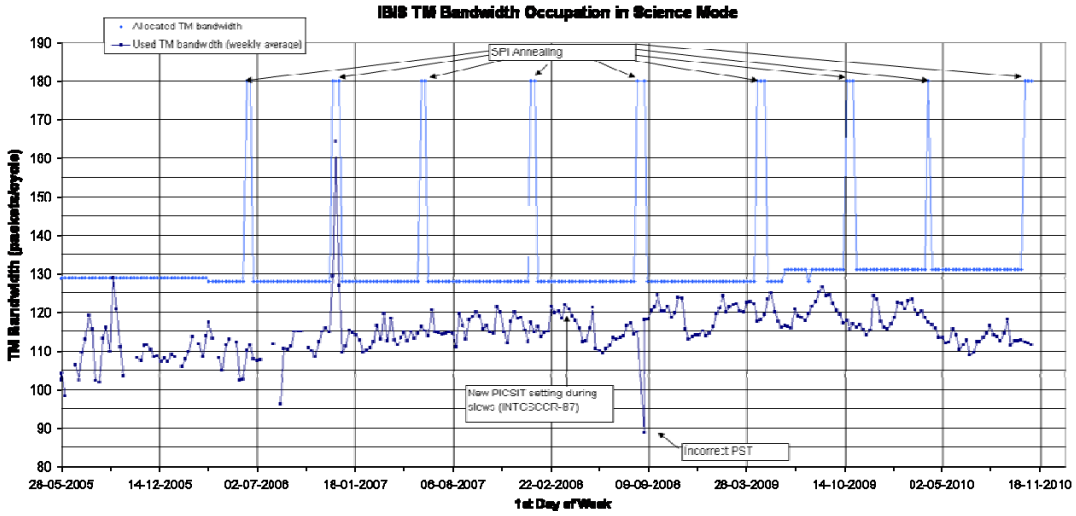


Figure 5: IBIS TM bandwidth usage evolution since May 2005

Note: Some 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-X2 was operated in Data Taking mode with a TM allocation of 8 packets/cycle. JEM-X1 was dormant (DPE OFF) with no TM slots allocated. At the end of revolutions 975, JEMX-1 was re-activated. In revolutions 976 to 980 during the SPI annealing (2010-10-10T19:43:14Z to 2010-10-25T10:57:04Z), the allocation was 15 packets each, and thereafter 8 packets each were allocated..

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 2010-10-10T19:43:14Z to 2010-10-25T11:36:10Z (Revs 976 to 980 inclusive) during the SPI annealing when it was 9 packets/cycle, and within that period from 2010-10-17T01:32:29Z to 2010-10-17T05:21:00Z (Revs 978) during the Flat-field calibration, when it was 63 packets/cycle.

During this reporting period, 853 of the 865 planned science pointings were executed nominally. Six pointings were lost to guide star problems. A pointing was lost and another interrupted by IREM SEUs. One pointing was shortened, when the CCCFs caused OMC to switch back to Standby mode. A TM drop at Redu caused the interruption and the loss of a further 2 pointings. In addition 1 Flat-field calibration was performed this month (nominally).

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

2.2.5 IREM

The status of IREM is nominal.

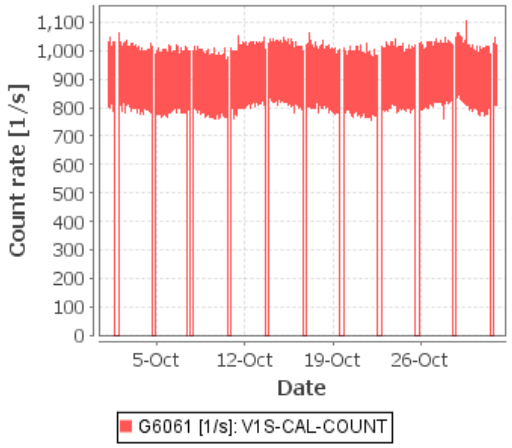
On DoY 280 (07/10/2010), the 97th IREM SEU occurred.

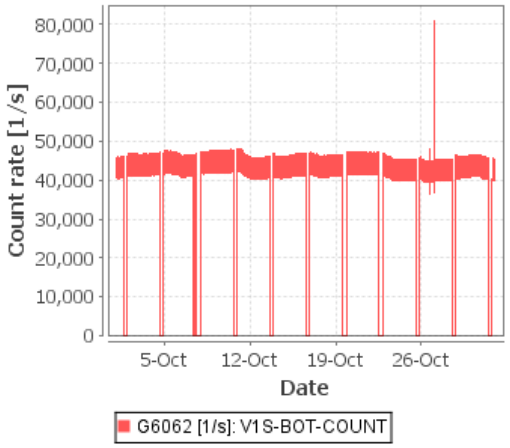
On DoY 283 (10/10/2010), the 98th IREM SEU occurred

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:





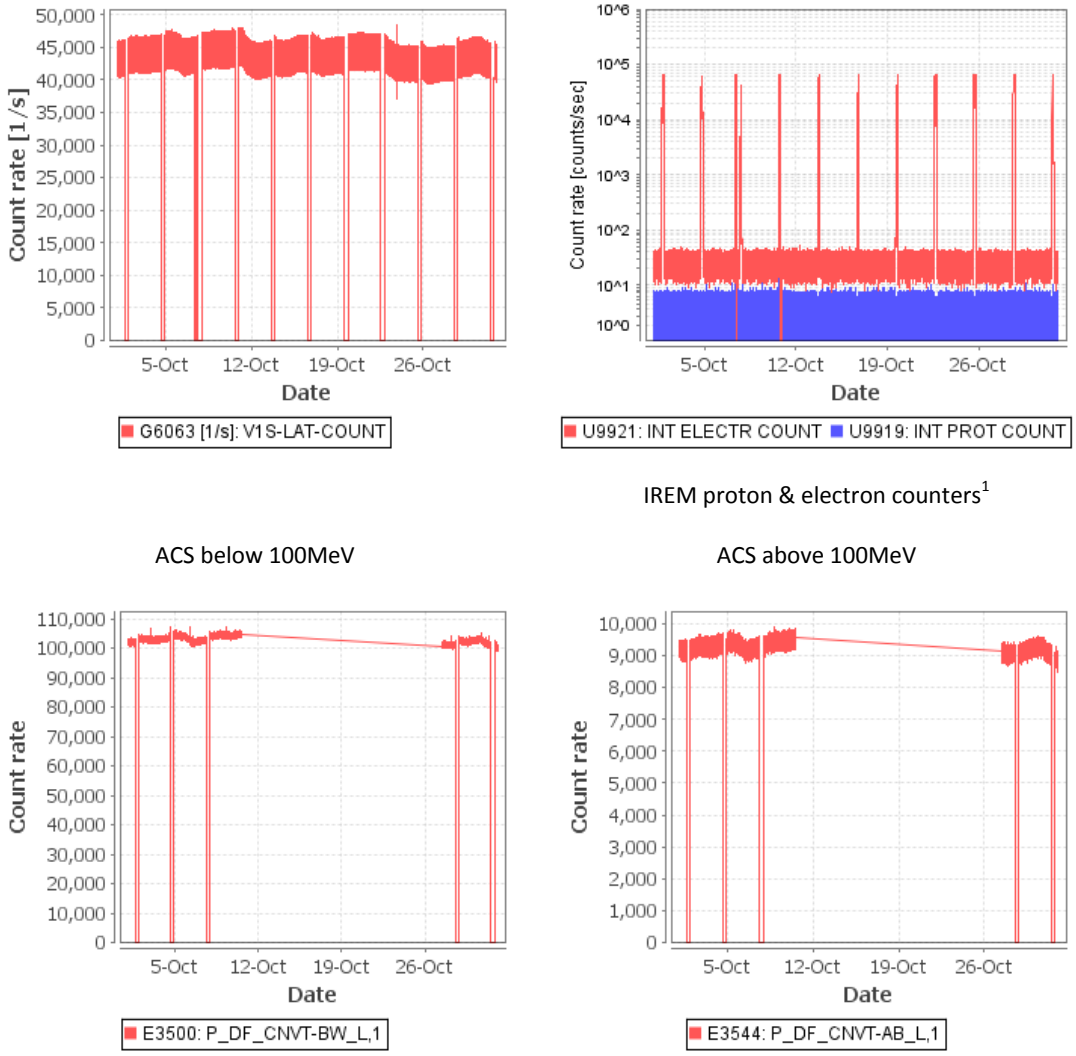


Figure 6: Instrument Count Rates

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

[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

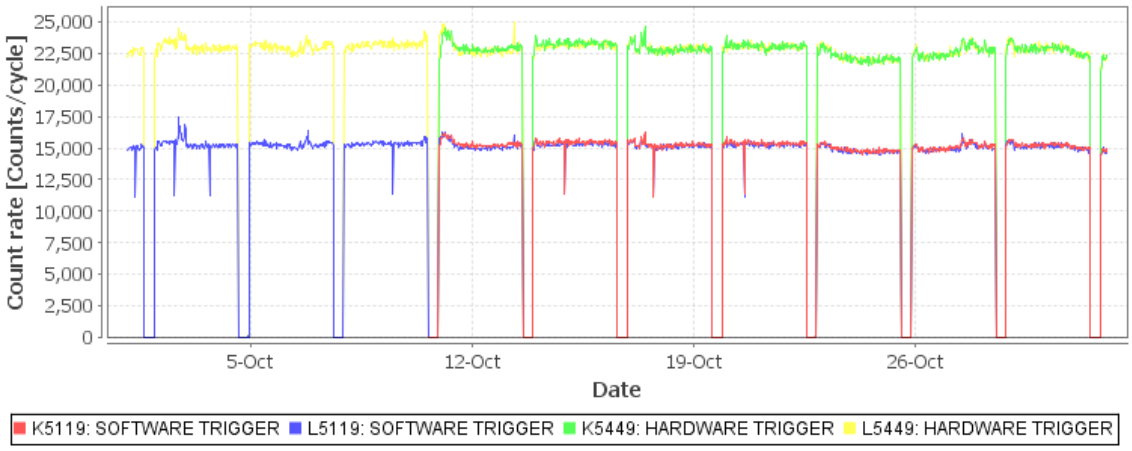


Figure 7: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

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.

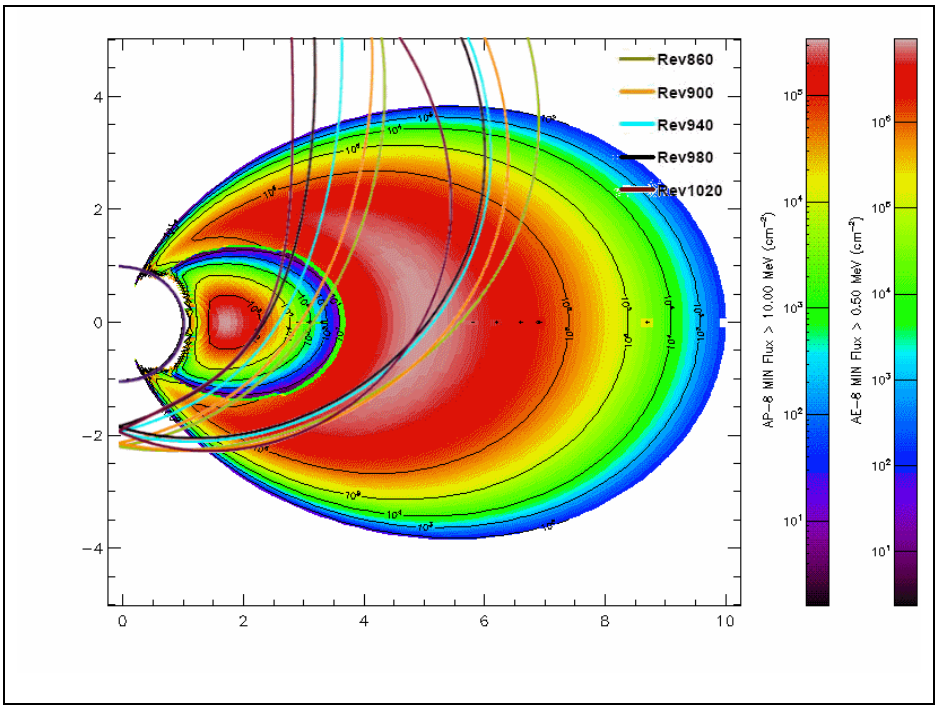


Figure 8: The predicted evolution of the orbit of Integral through the radiation belts

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.

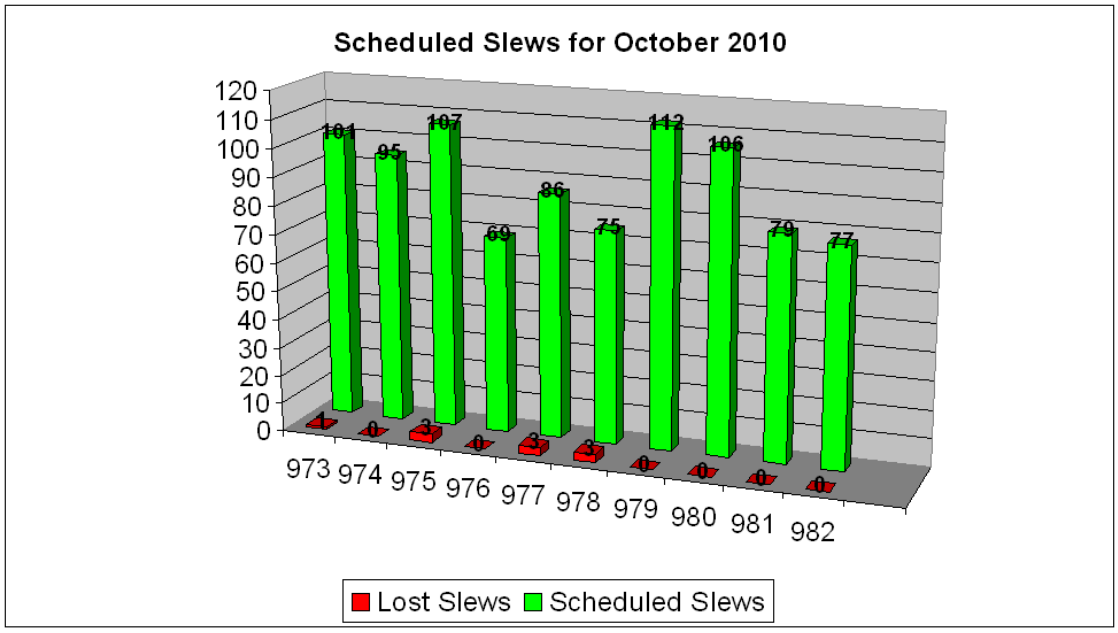


Figure 9: The number of slews scheduled compared to the number of slews lost

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 discovered that there were no files received 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, connection 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.

REDU

There were several occasions of RFI from an unknown source reported. On DOY289 bad frames were received and there was a data gap on VC-7. There was a problem with the FEC1 on DOY288 starting at 19:32:00, which was solved at 21:17:00 when commanding at REDU was resumed.

DSS24

On DOY287 there was a drop in TM on VC-0 and VC-7, possibly caused by RFI. See DR G110664.

DSS27

The supports with scheduled begin-of-track on DOY 281 at 06:35 and on DOY 281 at 23:15 were cancelled because the station was declared red. Instead support was provided from Redu-1. On DOY289 There was a problem with the transmitter (see G11066), hence a part of the scheduled pass was moved to REDU.

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.

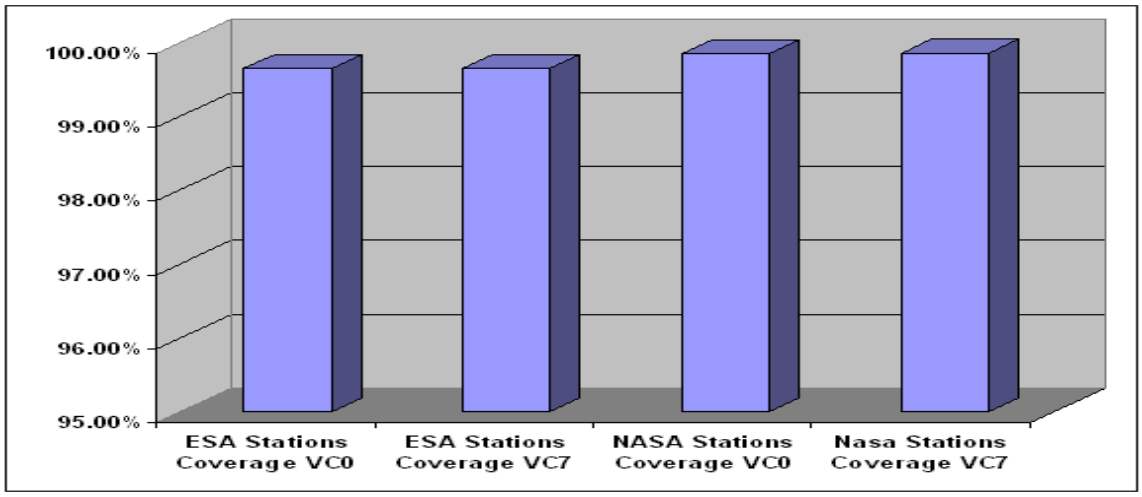


Figure 10: The usage of ESA ground stations compared to the usage of DSN ground stations

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 980 to 990, corresponding to the time range 22 October to 24 November.

New observations have been planned for revolutions 976 (10-13 October) to 988 (15-18 November).

A TOO observation of the blazar PKS 1830-211 was scheduled in revolution 981, during SPI annealing. AOCS calibration observations first foreseen for revolution 978 then 981 could finally not be scheduled, apparently due to differences in the FD software setup between MOC and ISOC.

TSFs have been received for revolutions 973 to 984.

3.3.2 Observation Status

New ECS files have been received for revolutions 955 to 967 (up to 16 September), missing 964.

3.3.3 ISOC Science Data Archive

Scw data has been ingested up to revolution 958.

Raw telemetry copied from MOC is available up to 24 October with some gaps. Work is ongoing to close the gaps.

3.3.4 ISOC System

ISOC software release V27.01 has been released on 18 October, V27.1 (source diagnostics for TAC Web pages) is being prepared.

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_SC-304	07.10.2010	IREM Anomaly: Reset of IREM_CSCI S/W #97, 07/10/2010	Payload	Closed
INT_SC-305	10.10.2010	IREM Anomaly: Reset of IREM_CSCI S/W #98, 10/10/2010	Payload	Testing
INT_SC-307	09.10.2010	AOCS: Anomalous wheelspeed oscillation on DOY282	Spacecraft	Pending
INT_SC-308	29.10.2010	AOCS: Anomalous wheelspeed oscillation on DOY302	Spacecraft	Pending
INT-3118	06.10.2010	TPF arrived with errors	FDS	Pending
INT-3119	11.10.2010	IREM crash recovery procedure: need to update	FOP	Pending
INT-3120	15.10.2010	REDU - Problems with Front End Controller (FEC)	ESA Stations	Closed
INT-3121	22.10.2010	IFTS not working	IMCS	Open
INT-3122	29.10.2010	CSL wheelspeeds not follow predicted wheel profile	FDS	Pending

5 Special Events & Future Milestones

The 16th SPI Annealing ended on 28.10.2010
The SPI CDE1 power supply configuration has been changed on 19.10.2010
From 10th October onwards both JEM-X units are operated in parallel as the nominal configuration.

FSS/STR Misalignment Calibration to be planned
Thruster Torque Calibration planned for 04.11.2010
Startracker blemish pixel survey to be planned
ISDC Communications Upgrade is an ongoing activity
Analysis for possible Earth observations in 2011
Routine use of DSN will be discontinued after December
New FOP release to be issued on 06.12.2010

6 Appendix

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

6.1 AOCS operations

During this period, 614 Open Loop Slews, 321 Closed Loop Slews and 25 Momentum Biases were executed (as reported by ACC OEM).

9 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 01/11/2010 is reported in the following plot:

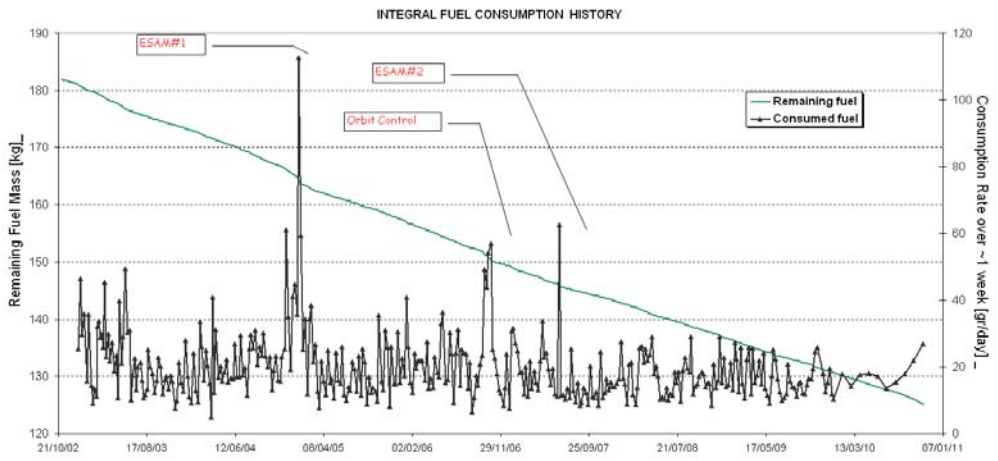


Figure 11: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

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.

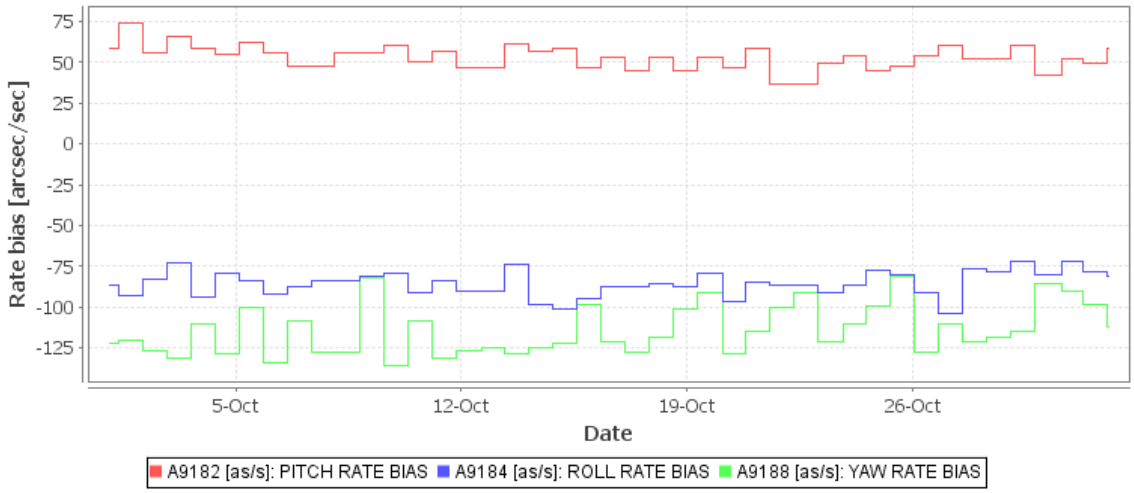


Figure 12: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

03/10/2010 (Day of Year 276, Revolution 973)

IMU1 switched ON during the stable pointing of PID 09730056 (09:12:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 09730057 were manually updated (spacontool).

OTF was not reached for PID 09730056.

09/10/2010 (Day of Year 282, Revolution 975)

IMU1 switched ON during the stable pointing of PID 09750062 (09:46:00Z). After the IMU switched back OFF, a manual slew was performed to go to attitude 09750064.

Then a mapping was commanded and the parameters for slew 09750065 were manually updated (spacontool).

OTF was not reached for PIDs 09750062, 09750063 and 09750064.

Slews 09750063 and 09750064 were missed from the Timeline.

15/10/2010 (Day of Year 288, Revolution 977)

As a consequence of Redu GS TM drops, the commanding release for slew 09770071 failed (20:22:00Z). AOCS subsystem was disabled. Slew 09770072 was also missed from the Timeline.

Once GS TC link was recovered, a manual slew was performed from attitude 09770070 to attitude 09770073.

After the manual slew was completed, the parameters for slew 09770074 were manually updated by the Spacon.

OTF was not reached for PIDs 09770071, 09770072 and 09770073.

Slews 09770071, 09770072 and 09770073 were missed from the Timeline.

19/10/2010 (Day of Year 292, Revolution 978 to 979)

IMU1 switched ON during the stable pointing of PID 09780067 (07:39:00Z). After the IMU switched back OFF, a manual slew was performed to go to attitude 09780070.

Then a mapping was commanded and the parameters for slew 09780071 were manually updated (spacontool).

OTF was not reached for PIDs 09780067, 09780068 and 09780069.

Slews 09780068, 09780069 and 09780070 were missed from the Timeline.

6.2 SPI

6.2.1 Operations

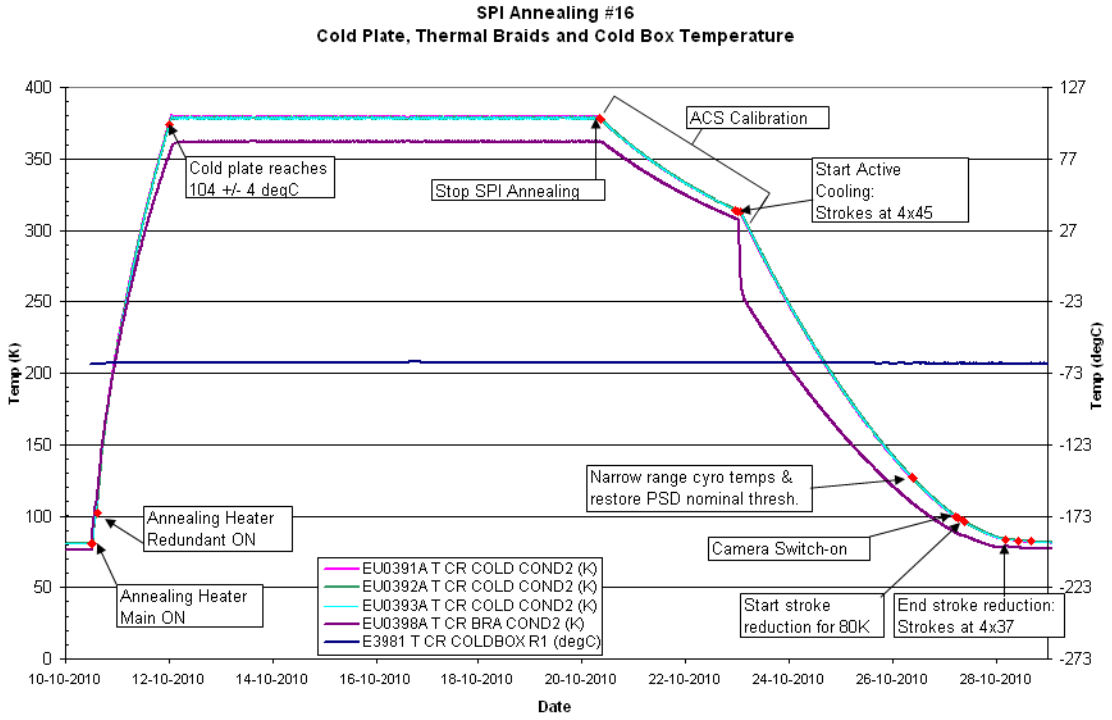
Stirling Compressors and Cryostat

On 2010-10-19 starting at 11:42:00Z the change of power supply configuration of CDE1 to 2 LCLs as per OCR #294 was successfully performed. The performance of the compressors is this new configuration so far appears nominal. However it has been determined that the sensor indicating the relay status is failed. Therefore CDE1 is now powered by both LCLs (both LCLs are closed and current is being drawn on both) however the CDE1 relay status is still showing "LCL1" only. The operations performed were as follows:

1) Initial test of CDE1 LCL2 by commanding the LCL to CLOSE, check status and then OPEN:
   a) Send TC P3061 and verify that TM P1160 CDE1 LCL2 STA = CLOSE and then
   b) Send TC P3060 and verify that TM P1160 CDE1 LCL2 STA = OPEN
2) Switch CDEs off: Execute FCP_SPI1_2520 SPICO: FROM STAND-BY TO OFF. (This procedure opened the LCLs of CDE2 as well.)
3) Change the internal CDE1 relay position and reactivate the CDEs with 2 LCLs each by executing FCP_SPI1_2570 SPICO 4 LCL CONFIG: FROM OFF TO STAND-BY (CDE1 Master). During the execution of this procedure, the CDE1 relay TC E9968 (step 3.2.1) failed, such that the relay status didn't change. Therefore, as foreseen, the TC E9968 was sent again 5 times individually. Each time the relay status did not change and the command failed Command Execution Verification.
4) Prior to continuing the foreseen recovery actions, it was decided to command the CDE1 LCL2 to CLOSE to see if any current was drawn, to double check that the relay status seen in telemetry was correct. The correctness of this sensor reading had been checked following the initial failure by looking at the telemetry after launch, when the relay was in the "LCL1+2" position. However a failure of this sensor since launch was in fact not ruled out. Upon closing the CDE1 LCL2, the nominal current for the CDE in Standby mode (~0.13 A) was

seen on the LCL. At this point it was clear that the failure was in the relay status sensor and the activation of both CDEs in the 4 LCL configuration was completed nominally.

The cryocooler had been put in Standby at the start of annealing on 10/10/2010 and remained in Standby until the start of active cooling on 23/10/2010. After the cryocooler switch-on, all four compressors were operated at full stroke (45) until 27-10-2010T08:40:00Z, when the stroke reduction to achieve 80K on the Cold Plate was started. The final stroke of 37 was reached at 28-10-2010T04:28:40Z and the 80K range on the Cold Plate was reached at 2010-10-29 06:36:50Z. Since then the Cold Plate temperature was maintained in the range 80K +/- 1K. The following plot shows the evolution of the Cold Plate, thermal braids and Cold Box temperatures during the annealing cycle.



The following plot shows the evolution of the cold plate and H bus temperature since the end of annealing:

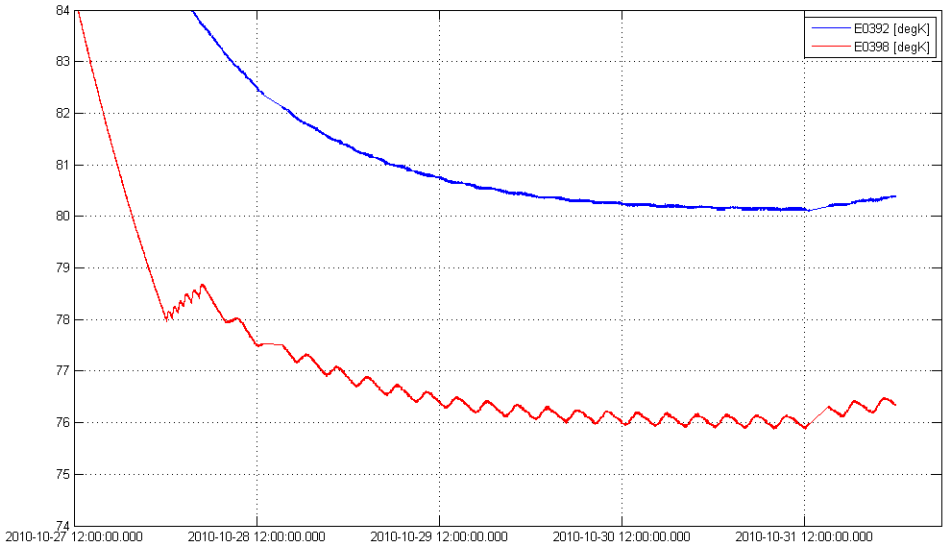


Figure 13: SPI Cold plate and H-bus temperature

The following plot shows the evolution of the CDE LCL currents during the reporting period. The spike in the CDE1 LCL currents on DOY 292 was at the time of the CDE1 switch-on as part of the operations to change the CDE1 relay position:

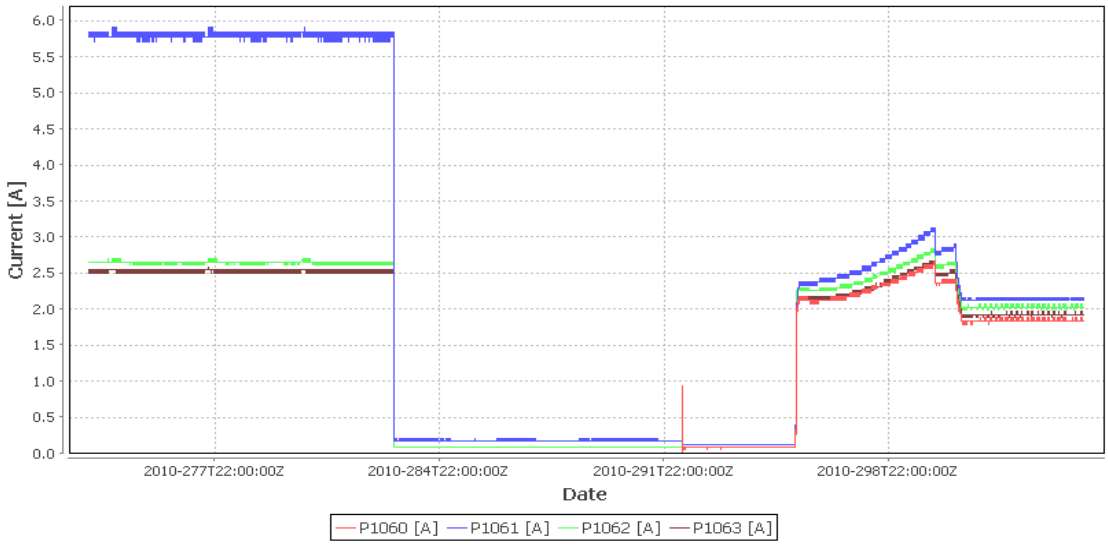


Figure 14: SPI CDE LCL current (P1060 CDE1 LCL2; P1061 CDE1 LCL1; P1062 CDE2 LCL2; P1063 CDE2 LCL1)

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. Due to the annealing operations, the IASW was in CONF mode from the start of annealing on 10/10/2010 until the camera switch-on performed on

27/10/2010. The spectra scaling factor has remained 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.

The ACS High Voltages were set to the minimum voltage (~980V) and the ACS was in CONF mode from the start of annealing on 10/10/2010 until the start of passive cooling, when the ACS Calibration was performed. The ACS Calibration was performed from 20/10/2010 at 08:48:36Z to 23/10/2010 at 06:03:30Z and for this the ACS HV was restored to nominal and also FEE#57 and FEE#81 were switched on. As no recovery of FEE#57 or FEE#81 was observed, they were switched off again on 28/10/2010 at 10:12:04Z.

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.

OCR-292 (Reduction of SPI GeD HV to 3kV for 1 rev for re-determination of GeD characteristics) was implemented in revolution 975, one revolution before the start of Annealing #16. The operations to implement this were performed on 07/10/2010 starting just prior to radiation belt entry of revolution 974, at 12:41Z, and completed at 13:09Z.

Due to the annealing operations, all detector HVPSs were switched off and only the LVPSs left on with the AFEE in CONF mode from the start of annealing on 10/10/2010 (rev 976) until the SPI camera switch-on, which started on 27/10/2010 at 06:40Z. Following the end of the camera switch-on, in line with OCR-297, the nominal GeD High Voltages have now been set to 3kV.

The following plot shows the AFEE DC output voltages over the reporting period.

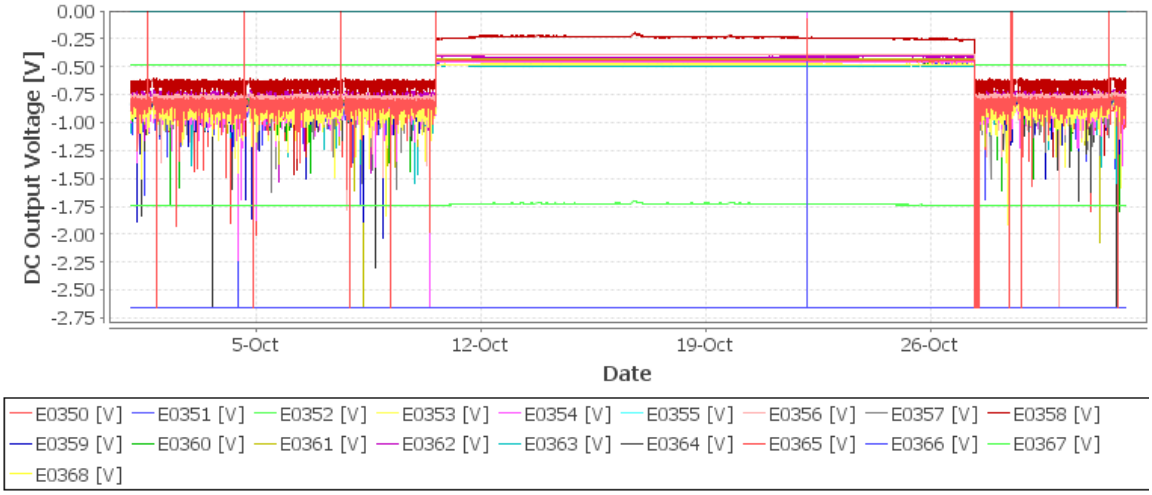


Figure 15: AFEE DC Output Voltages (data sampled every 8th packet (64sec)). Note that the spike on 22 October is artificial.

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.

Due to the ongoing annealing operations, the DFEE was in CONF mode from the start of annealing on 10/10/2010 until the SPI camera switch-on, which started on 27/10/2010 at 06:40Z.

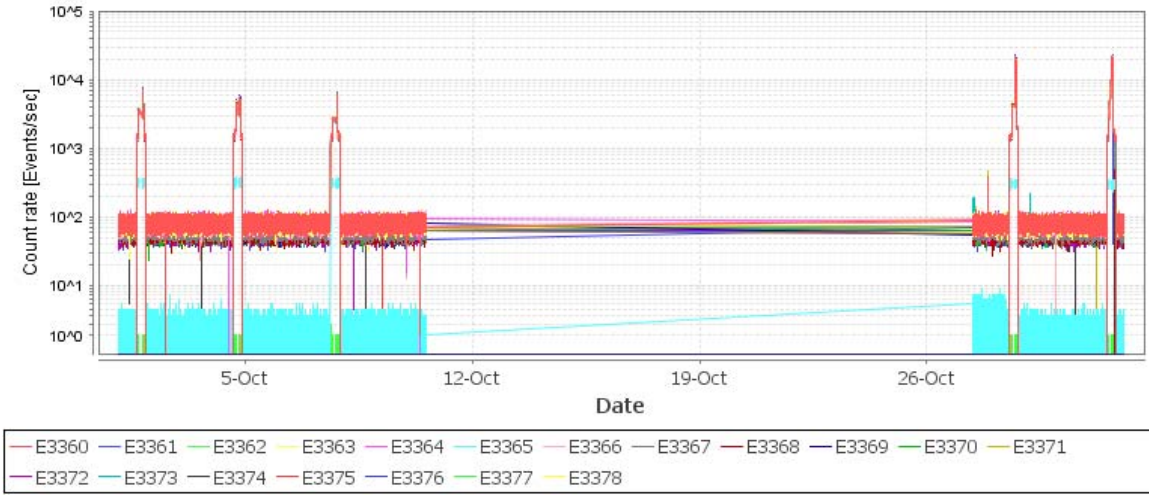


Figure 16: SPI GeD Non-Vetoed count rates. Note that the scale used for plotting is logarithmic

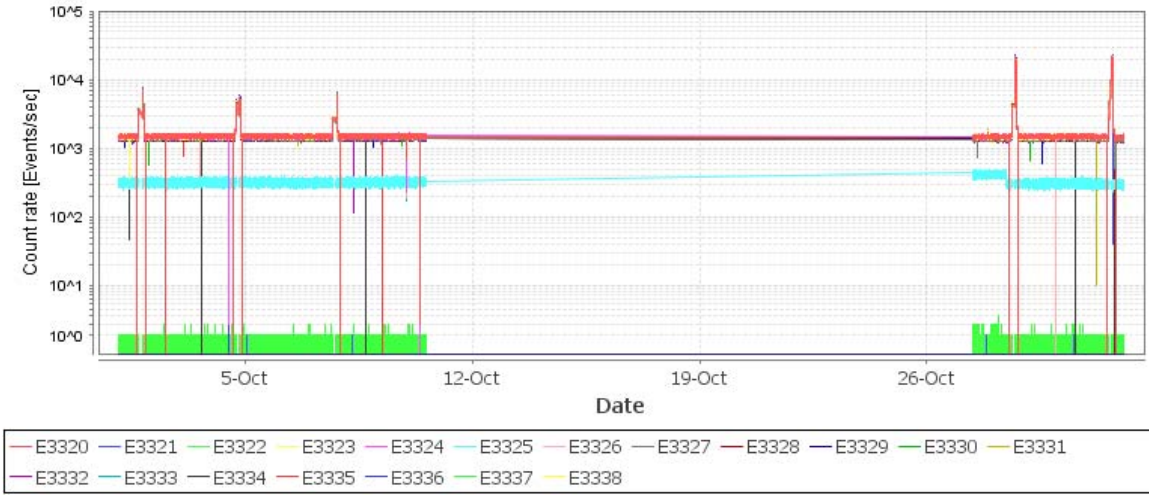


Figure 17: SPI GeD Time Tagged count rates (log scale).

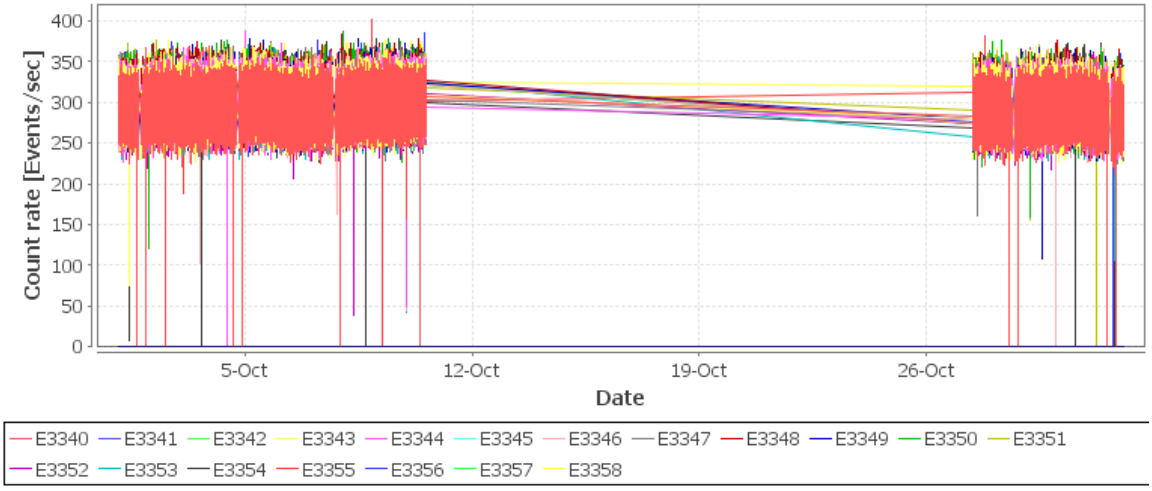


Figure 18: SPI GeD Time Tagged Saturated count rates

PSD

The health of the PSD is nominal. Due to the annealing operations, the PSD was in CONF mode from the start of annealing on 10/10/2010 until the SPI camera switch-on, which started on 27/10/2010 at 06:40Z. In line with OCR-296, the PSD High Energy Thresholds (ULD) were increased to the maximum value following the annealing, taking effect from revolution 982 onwards. The operations for this were performed on 28/10/2010 at 15:57Z, prior to radiation belt exit of revolution 982. The following plot shows the PSD channel rates over the reporting period:

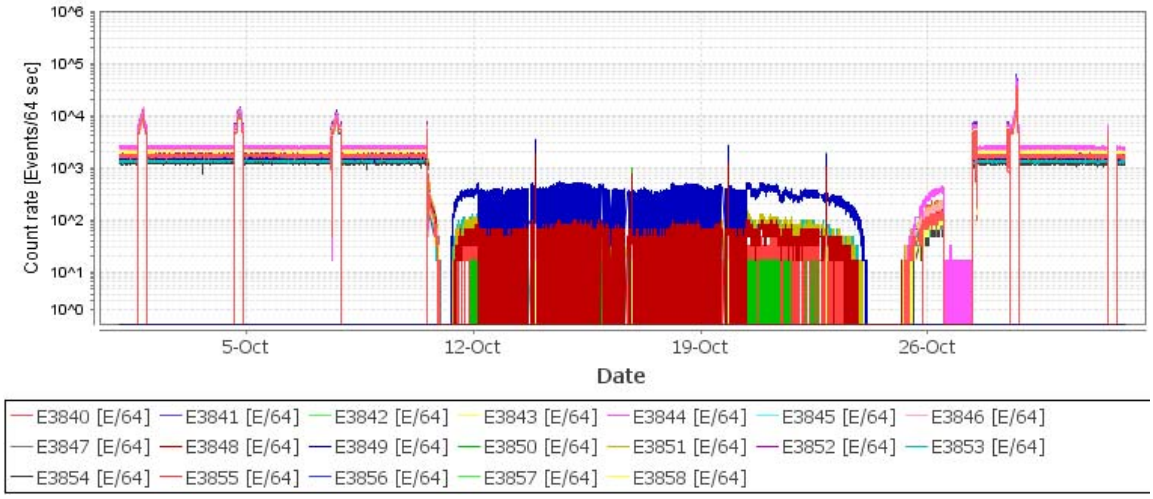


Figure 19: SPI PSD GeD Channel rates

6.2.2 Event Log

- Two occurrences (at 2010.281.09.42.50Z and 2010.302.01.40.46Z) of OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED were received. As in each case it was a single occurrence, no action was required.
- Several occurrences of OEM APID 1024 ID 229 EXCEPTION SPI1 PARTIAL FLAG OVERFLOW were received during the reporting period, in between the time of the camera switch-on post annealing and the time that the 80K range was reached on the Cold Plate. As they were each single occurrences and this is known to happen when the Cold Plate is warmer than nominal, no action was required.

6.3 IBIS

6.3.1 Operations

ISGRI

The health and performance of ISGRI was nominal during the reporting period. A fix for anomaly INT_SC-301 MCE5 High Count Rate had been implemented by the PI via the ISGRI Context Tables from revolution 970 (22/09/2010). Since then there have been some spikes on the count rates of MCE5 however the frequency and magnitude of these spikes is reduced. The following plot shows the ISGRI MCE counters during the reporting period:

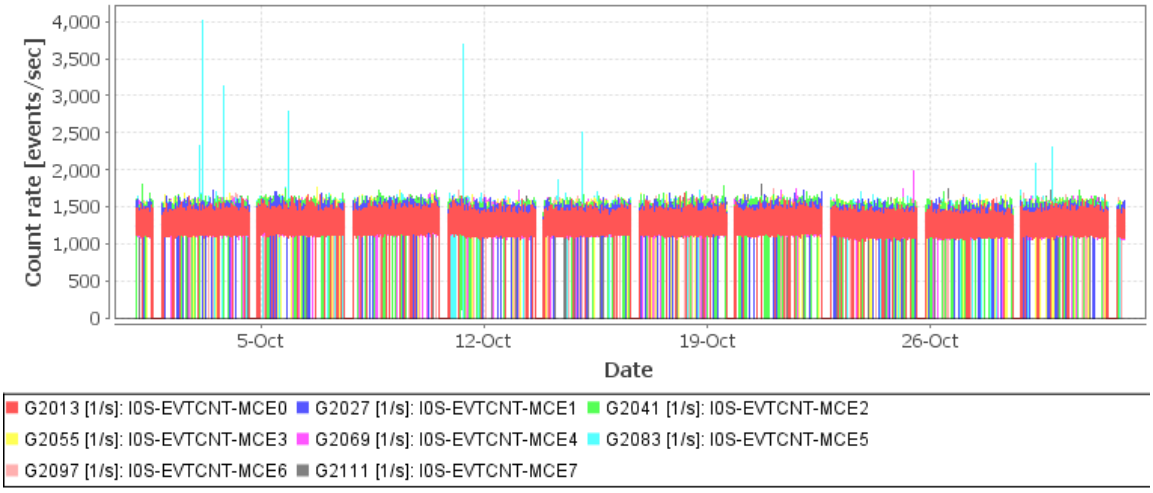


Figure 20: ISGRI MCE Counters

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

07/10/2010 (Day of Year 280, Revolution 974 to 975)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 07:15Z. It was recovered as follows:

- At 07:58Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 08:10Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

19/10/2010 (Day of Year 292, Revolution 978 to 979)

At 02:50Z the TM parameters families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 02:51Z the TM parameter families G5002 and G5003 for the PDM semi-module counters started going OOL Low. As these were followed at 02:54Z by OEM APID 1280 ID 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED, indicating that HEPI resynchronised autonomously, by which time all the above parameters had returned within limits, no action was taken.

25/10/2010 (Day of Year 298, Revolution 980 to 981)

At 04:38Z the TM parameters families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 04:39Z the TM parameter families G5002 and G5003 for the PDM semi-module counters started going OOL Low. As these were followed at 04:41Z by OEM APID 1280 ID 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED, indicating that HEPI resynchronised autonomously, by which time all the above parameters had returned within limits, no action was taken.

6.4 JEM-X

6.4.1 Operations

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

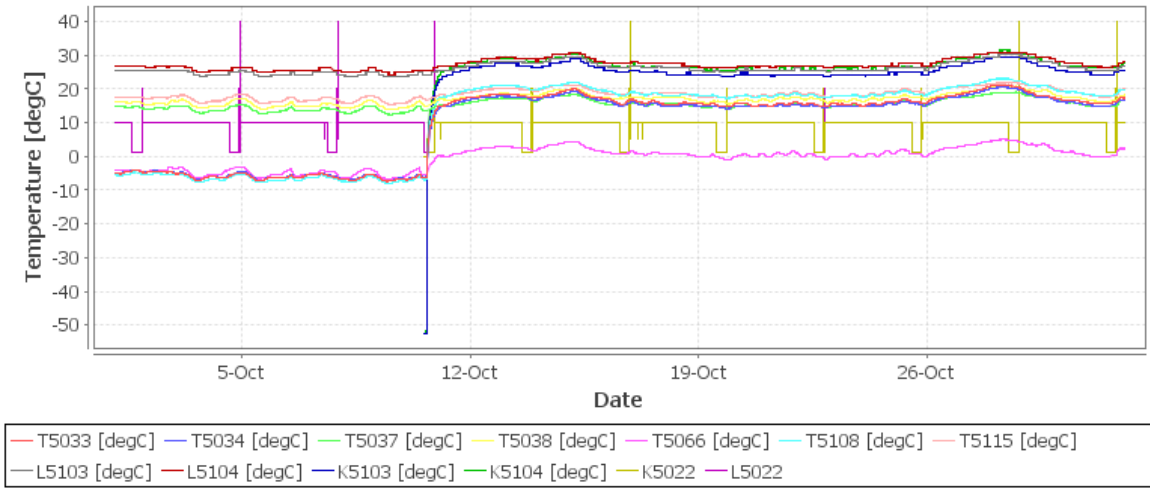


Figure 22: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

07-10-2010 (Day of Year 280, Revolution 974)

At 07:16:10 JEMX-2 parameters L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#97). There was no impact as the reaction has been disabled.

10-10-2010 (Day of Year 283, Revolution 975)

At 11:45, operations to activate JEMX-1 were commenced. At the indicated times, the following procedures were completed:

12:51:05	DEBWHI00 (Allocation of PST)
11:57:58 to 13:19	FCP_JEM1_0010 JEMX1 DPE AND CSSW ACTIVATION
13:21:04 to 13:27:45	FCP_JEM1_0015 JEMX1 IASW ACTIVATION
13:31:25 to 13:33:14	FCP_JEM1_0016 JEMX1 ENABLE BCP DISTRIBUTION
13:36:24 to 13:37:40	FCP_JEM1_0017 JEMX IASW EXTENDED TM CHECK
13:39:16 to 14:11:44	FCP_JEM1_0020 JEMX1 DFEE 1ST ACTIVATION AFTER DPE SWITCH

At 14:11:00, the transition to SAFE mode occurred automatically when the reaction to the broadcast packet was re-enabled.

The operations were completed before LOS at 14:11:44

6.5 OMC

6.5.1 Operations

The status and performance of OMC is nominal.

6.5.2 Event Log

03-10-2010 (Day of Year 276, Revolution 973)

At 09:12:00 a lost guide star forced an interruption to the timeline. A recovery was performed and normal service resumed at 09:29. The impact was the loss of pointing 09730056.

07-10-2010 (Day of Year 280, Revolution 974)

At 07:15:29 an IREM SEU (#97) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 07:40:30. The impact was pointing 09740089 was cut short from a planned 2858 to 344 seconds, and pointing 09740090 was lost.

09-10-2010 (Day of Year 282, Revolution 975)

At 09:22:00 another guide star problem forced a suspension of the timeline. A recovery was performed, and the timeline rejoined at 10:40. The impact was the loss of pointings 09750063 & 09750064.

10-10-2010 (Day of Year 283, Revolution 976)

At 23:57:29 the CCCFs activated after the IREM SEU recovery went off, which caused OMC to switch back to Stand-by in the middle of a pointing. At 00:02:00, the OMC pointing commands were manually re-sent. The impact was that pointing 07960007 was cut short from a planned 2858 to 2232 seconds.

15-10-2010 (Day of Year 288, Revolution 977)

At 19:32, a TM drop from Redu forced a suspension of the timeline. At 21:17, the links were recovered, and a recovery performed. The timeline was rejoined at 22:30. The impact was pointing 09770070 was cut short from a planned 3479 to 139 seconds, and pointings 09770071 & 09770072 were lost. It was at this time that the following pair of commands were rejected:

```
2010.288.21.27.16.914   2010.288.21.27.21.791   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

2010.288.21.27.22.914   2010.288.21.27.29.679   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E
```

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 09770072.

19-10-2010 (Day of Year 292, Revolution 978)

At 07:39, a lost guide star forced an interruption to operations. A recovery was performed, and the timeline rejoined at 09:01. The impact was the loss of pointings 09780068, 09780069 & 09780070. It was at this time that the following pair of commands were rejected:

```
2010.292.08.24.23.841   2010.292.08.24.27.025   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

2010.292.08.24.30.091   2010.292.08.24.35.136   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

2010.292.08.59.39.842   2010.292.08.59.47.443   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E

2010.292.08.59.46.092   2010.292.08.59.55.375   1792   RealTime   131     TC REJECT   REJECTED
TC1                                             0       0    65535   PR    N     E   E
```

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointings 09780069 & 09780070.

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.

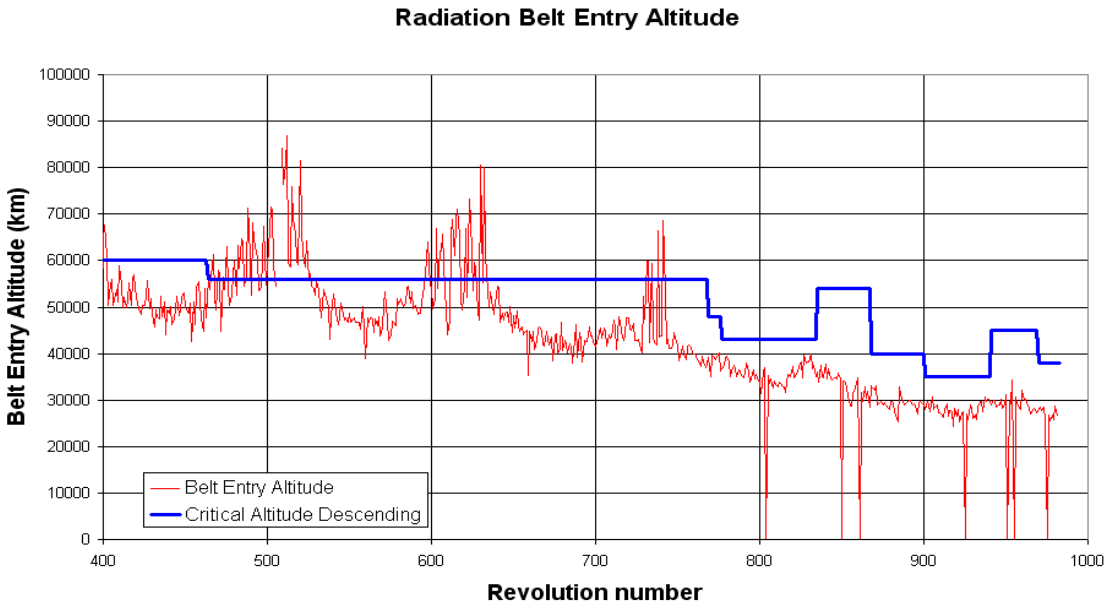


Figure 23: Radiation belt entry

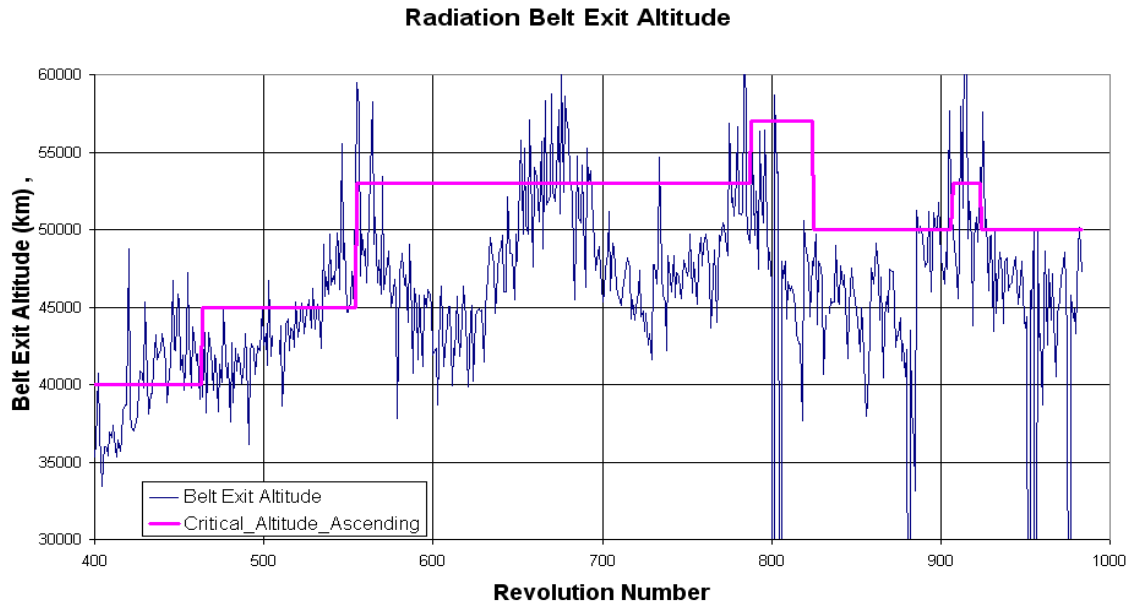


Figure 24: Radiation belt exit

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
972	RAD_ENTR R 2010-10-01T13:16:52Z	01/10/2010 14:36:32	21847.4	01-Oct-2010 14:47:07	20052.09	01-Oct-2010 15:27:07	10802.36
973	RAD_EXIT R 2010-10-01T20:06:36Z	01/10/2010 19:23:28	>>30372.8	01-Oct-2010 19:57:07	48131.29	01-Oct-2010 16:07:07	4417.558
973	RAD_ENTR R 2010-10-04T13:02:05Z	04/10/2010 14:18:08	21855.0	04-Oct-2010 14:26:53	21306.67	04-Oct-2010 15:16:53	9759.077
974	RAD_EXIT R 2010-10-04T19:51:24Z	04/10/2010 18:53:12	>>30400.5	04-Oct-2010 19:36:53	47286.95	04-Oct-2010 15:46:53	4591.216
974	RAD_ENTR R 2010-10-07T12:50:00Z	07/10/2010 14:17:12	19238.0	07-Oct-2010 14:17:58	20485.97	07-Oct-2010 15:07:58	8835.354
975	RAD_EXIT R 2010-10-07T19:38:16Z	07/10/2010 18:25:44	37614.1	07-Oct-2010 19:27:58	48043.95	07-Oct-2010 15:37:58	4212.794
975	RAD_ENTR R 2010-10-10T12:39:37Z	10/10/2010 13:58:40	21082.8	10-Oct-2010 14:12:18	19584.7	10-Oct-2010 14:52:18	10175.28
976	RAD_EXIT R 2010-10-10T19:27:12Z	N/A	N/A	10-Oct-2010 19:12:18	47112.59	10-Oct-2010 15:32:18	4096.528
976	RAD_ENTR R 2010-10-13T12:28:25Z	13/10/2010 13:49:53	21418.2	13-Oct-2010 14:00:52	19765.63	13-Oct-2010 14:40:52	10382.98
977	RAD_EXIT R 2010-10-13T19:16:03Z	13/10/2010 18:16:09	>>28469.4	13-Oct-2010 19:00:52	46937.99	13-Oct-2010 15:20:52	4139.694
977	RAD_ENTR R 2010-10-16T12:16:00Z	16/10/2010 13:44:41	19702.2	16-Oct-2010 13:50:57	19366.21	16-Oct-2010 14:30:57	10000.78
978	RAD_EXIT R 2010-10-16T19:03:51Z	16/10/2010 17:51:13	>>28455.4	16-Oct-2010 18:50:57	47189.03	16-Oct-2010 15:10:57	4203.824
978	RAD_ENTR R 2010-10-	19/10/2010 13:21:21	21820.5	19-Oct-2010 13:27:54	21058.63	19-Oct-2010 14:17:54	9395.831

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
	19T12:02:11Z						
979	RAD_EXIT R 2010-10-19T18:49:51Z	19/10/2010 17:43:05	38690.9	19-Oct-2010 18:37:54	47644.46	19-Oct-2010 14:47:54	4318.016
979	RAD_ENTR R 2010-10-22T11:49:02Z	22/10/2010 13:15:29	20332.7	22-Oct-2010 13:23:50	19324.71	22-Oct-2010 14:03:50	9872.194
980	RAD_EXIT R 2010-10-22T18:35:59Z	22/10/2010 17:26:25	38077.9	22-Oct-2010 18:23:50	47374.09	22-Oct-2010 14:43:50	4040.604
980	RAD_ENTR R 2010-10-25T11:36:39Z	25/10/2010 12:48:57	23955.2	25-Oct-2010 13:13:11	18970.39	25-Oct-2010 13:53:11	9491.222
981	RAD_EXIT R 2010-10-25T18:23:09Z	25/10/2010 17:39:21	42823.6	25-Oct-2010 18:13:11	47670.97	25-Oct-2010 14:23:11	4190.601
981	RAD_ENTR R 2010-10-28T11:22:08Z	28/10/2010 12:41:05	21764.4	28-Oct-2010 12:52:31	19161.79	28-Oct-2010 13:32:31	9713.837
982	RAD_EXIT R 2010-10-28T18:08:46Z	28/10/2010 17:35:45	>>30574.8	28-Oct-2010 17:52:31	47481.69	28-Oct-2010 14:02:31	4314.788
982	RAD_ENTR R 2010-10-31T11:07:53Z	31/10/2010 12:31:30	21100.0	31-Oct-2010 12:33:54	20352.07	31-Oct-2010 13:23:54	8583.8
983	RAD_EXIT R 2010-10-31T17:54:17Z	31/10/2010 17:00:34	>>30592.8	31-Oct-2010 17:33:54	46668.74	31-Oct-2010 13:53:54	4004.009

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

07-10-2010 (Day of Year 280, Revolution 974)

At 07:15:28Z, a local reset of the IREM CSCI S/W (SEU #97) 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 2010.280.07:15:28Z (84160.1 km). The unit had performed an automatic transition to Standard Mode (i.e. no block counter increasing, all the TM words= FFFF hex); just before the anomaly, radiation counters reported nominal values considering the position of the S/C along the orbit;

5) The recovery of the unit started immediately using procedure CRP_SYS_2570. The recovery of the unit started immediately using procedure CRP_SYS_2570. The first dump of the status word after the anomaly reported a value of BCC0 HEX = 48320 DEC = 1011110011000000, i.e the Checksum Failure Flag ON. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.

6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 09:31:00Z.

The IREM automatic transition to Standard Mode affected the instruments by forcing them to automatically enter Safe configuration, except for SPI and JEM-X whose automatisms are disabled according to the PIs request. OMC was recovered at 07:40:30Z and IBIS at 08:12:00Z.

10-10-2010 (Day of Year 283, Revolution 975)

At 14:04:08Z, a local reset of the IREM CSCI S/W (SEU #98) 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 2010.283.14:04:08Z (21082.8 km). The unit had performed an automatic transition to Standard Mode (i.e. no block counter increasing, all the TM words= FFFF hex); just before the anomaly, radiation counters reported nominal values considering the position of the S/C along the orbit;

5) The recovery of the unit started immediately using procedure CRP_SYS_2570. The 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 3CC0 HEX = 15552 DEC = 0011110011000000, i.e the Checksum Failure Flag ON and the Integral Ground link OFF. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.

6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 19:08:00Z.

The IREM automatic transition to Standard Mode did not affect the instruments as they were already in SAFE mode due to the upcoming perigee passage.