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

INTEGRAL
Mission report

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

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Routine Phase

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1 General

The Flight Control Team at MOC has compiled this report with some input provided by the Flight Dynamics Team, ISOC and ISDC. Nominal science operations were performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

This report addresses the activities from May and covers the revolutions 921 until 931 (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-INTTEGRAL 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.

8 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.53 Kg. The remaining propellant is in the order of 128,12 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

Following the 15th SPI annealing, which ended on 16/04/2010, 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). More details on the failure of GeD#1 are given in the Appendix.

The Germanium detectors' temperature was kept in the range 80K $\pm$ 1K.

SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 105 packets/cycle, except from 2010-05-08T20:47:27Z - 2010-05-09T00:33:57Z and 2010-05-28T17:09:09Z until the end of revolution 930 (OMC Flat Field Calibrations), when it was 88 packets/cycle. The average telemetry occupation when the allocation was 105 packets/cycle was 87.4 packets/cycle.

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

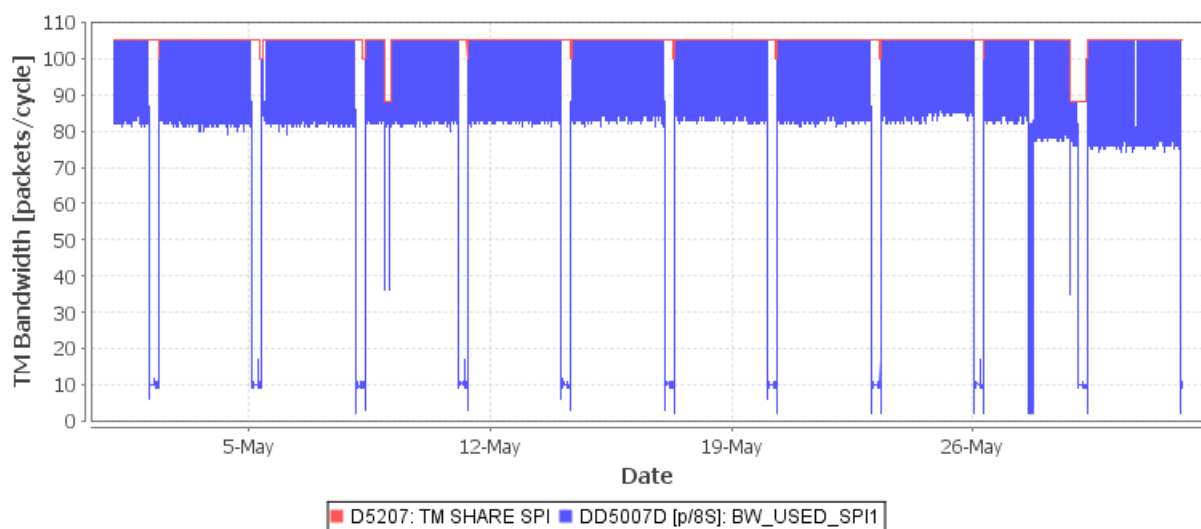


Figure 1: SPI TM bandwidth utilisation

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

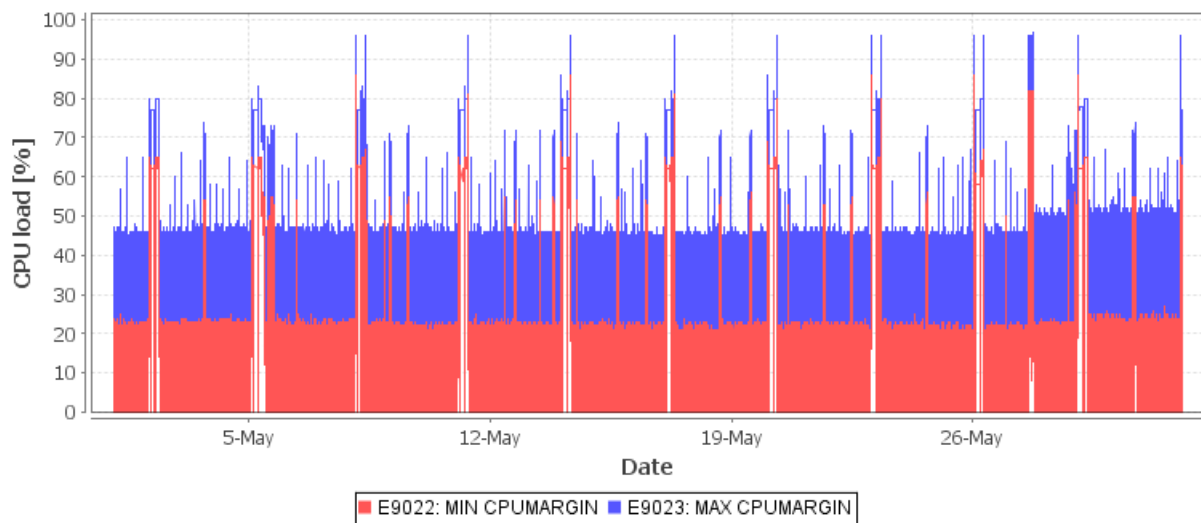


Figure 2: SPI IASW Performance

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

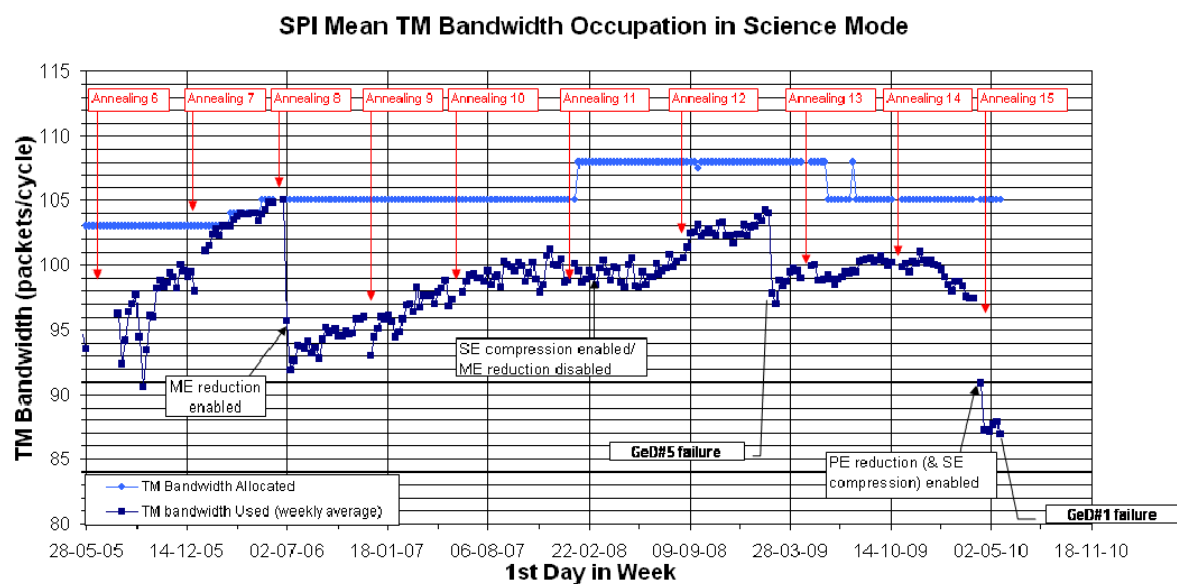


Figure 3: SPI TM bandwidth usage evolution since May 2005

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, except from 2010-05-08T20:47:27Z - 2010-05-09T00:33:57Z and 2010-05-28T17:09:09Z until the end of revolution 930 (OMC Flat Field Calibrations), when it was 90 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 113.38 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:

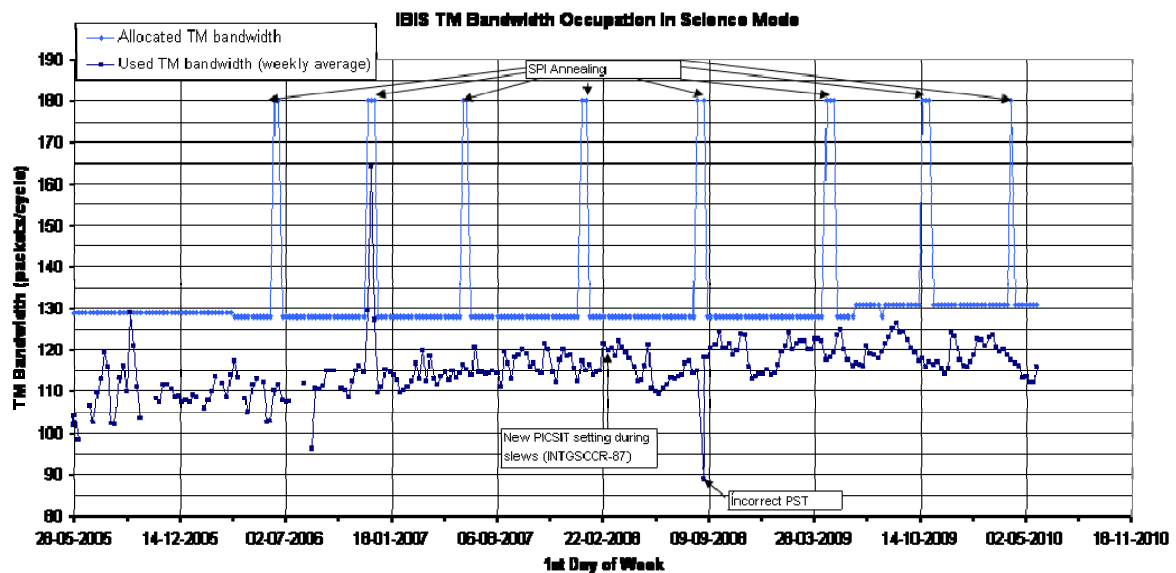


Figure 5: IBIS TM bandwidth usage evolution since May 2005

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.

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 2010-05-08T20:47:27Z to 2010-05-09T00:33:57Z and from 2010-05-28T17:09:09Z to 2010-05-28T22:44:44Z during the Flat-Field calibrations, when it was 63 packets/cycle.

During this reporting period, 863 of the 872 planned science pointings were executed nominally, 4 pointings were lost and 2 interrupted due to AOCs problems, in addition 2 pointing were interrupted and another lost by an IREM SEU. There were also 2 Flat-field calibrations, which were performed nominally.

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

2.2.5 IREM

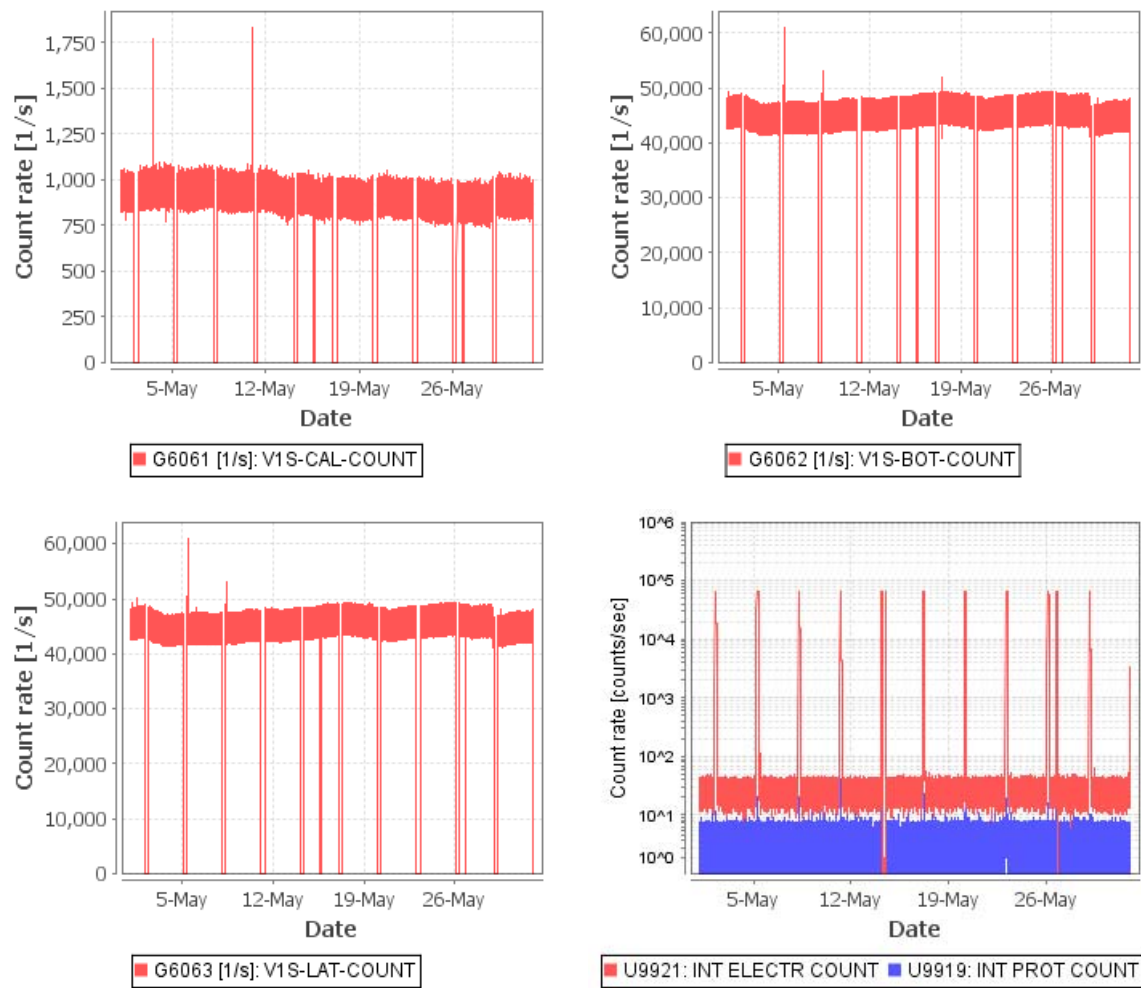
The status of IREM is nominal.

On DOY 134 (14/05/2010), the 92nd and on DOY 146 (26/05/2010), the 93rd IREM SEU occurred, details in the appendix.

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

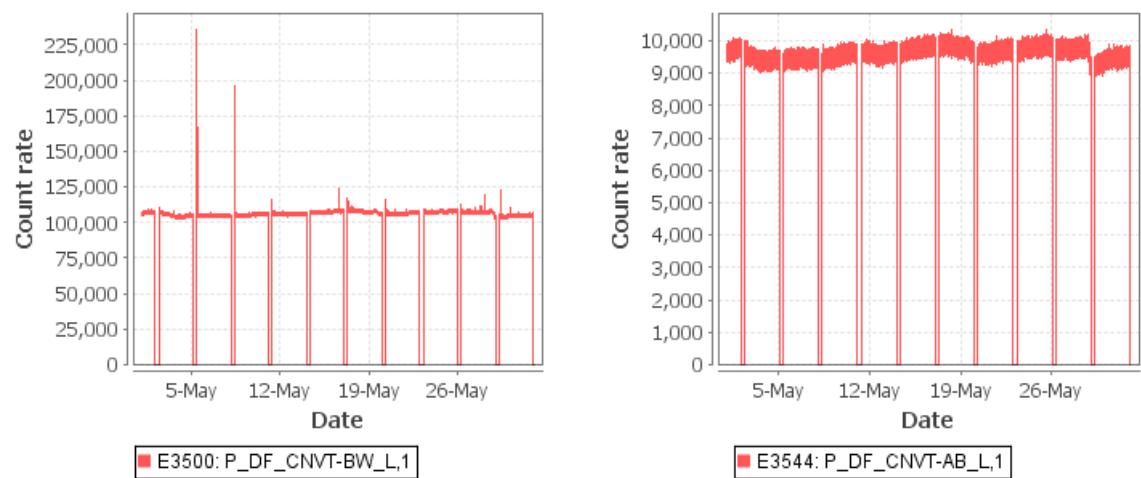
Radiation background

The background radiation level as measured by the instrument counters was generally 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:

IREM proton & electron counters¹

ACS below 100MeV

ACS above 100MeV

**Figure 6: Instrument Count Rates**¹ Note that the scale used in this plot is logarithmic.

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

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

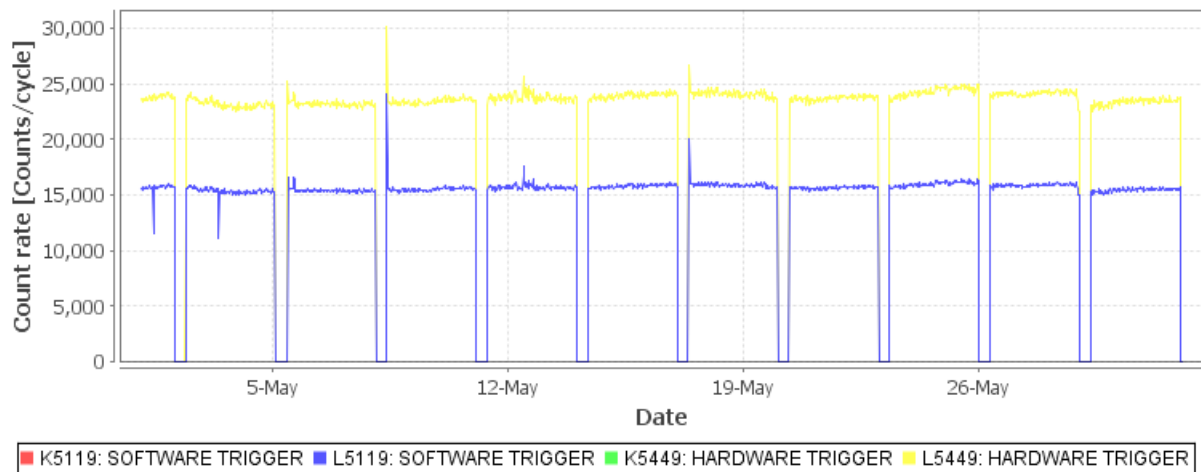


Figure 7: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

Radiation Belts

Figure 8 gives a prediction of the trapped radiation environment sensed by the S/C when descending into perigee; the different areas crossed, the Radiation Belt entry/exit points, the shape of the Radiation Belt passage and a rough estimation of the trapped proton and electron fluxes.

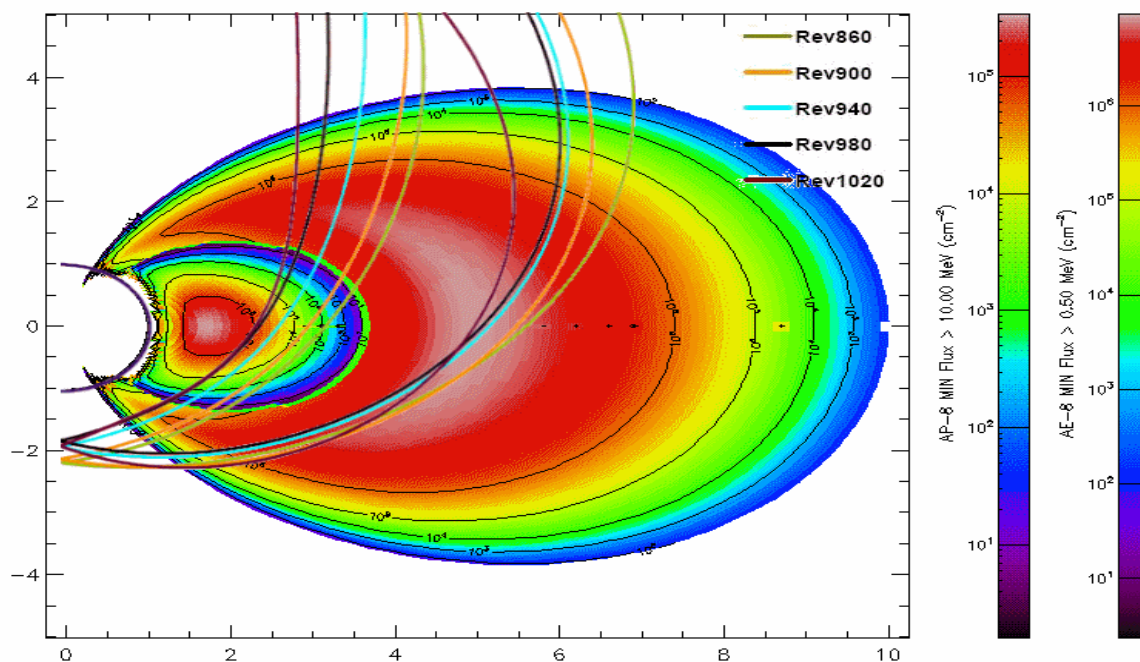


Figure 8: The predicted evolution of the orbit of Integral through the radiation belts

3 Ground Facilities

The Operational ground facilities performance was good this month. The overall performance was over the 95% requirement.

The following figure shows the number of slews executed and the number of slews missed per revolution. These numbers give a very good indication of the performance of the operational ground facilities, because it involves all the different elements of the ground facilities to complete all slews scheduled.

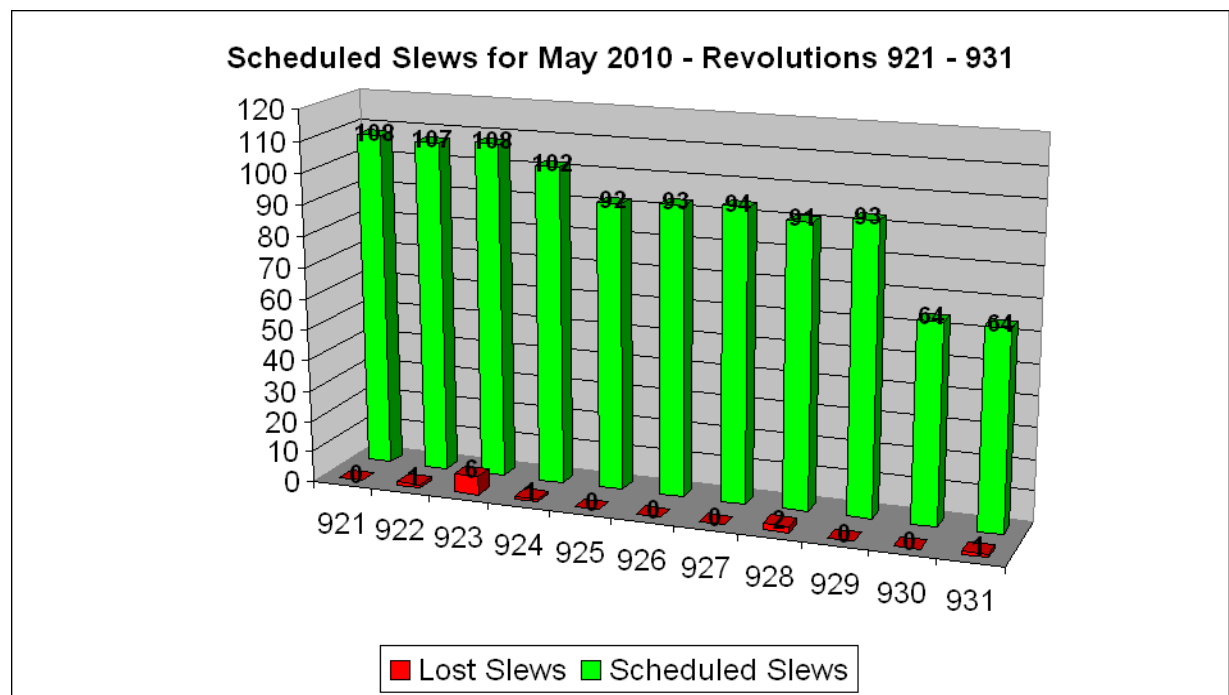


Figure 9: The number of slews scheduled compared to the number of slews lost

3.1 Mission Control System

This month the HFA_TM task was restarted seven times on iddb (due to MUST retrievals) and one time on idda. There were four occasions where the ISDS and IFRD tasks on isdsa had to be restarted and two occasions where these tasks had to be restarted on isdsb. A restart of the OLF task on iddb was required once and there were four occasions where the AUX and ARCH tasks had to be restarted.

On DOY127 the IPF for CSL (09.18) was not received on the auto-stack, a restart of the FTS solved the problem. On DOY134 the FTS instances were restarted too. On DOY137 the IBIS and IREM PI workstations were not connecting for a period of time.

A new database was imported on DOY127.

3.2 Ground Stations and Network

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

REDU

On DOY122 and DOY146 there was a drop in VC-0 & VC-7 combined with bad frames. Furthermore there were drops in VC-0 & VC-7 on DOY123 and bad frames were received on DOY128, DOY136 and DOY148.

Due to external RFI there was a drop in VC-0 & VC-7 on DOY139, there were data gaps on DOY141 (VC-7) and DOY143 (VC-0 & VC-7) and bad frames were received on DOY137, DOY139, DOY146 and DOY149.

On DOY127 the FEC needed a reboot; therefore Vilspa was requested to support.

DSS27

On DOY124 there was a drop in VC-0 and VC-7. On DOY132 the ground station handover to DSS27 was delayed by two hours due to problems at the station. On the same day there was a loss in telemetry for a few seconds.

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.

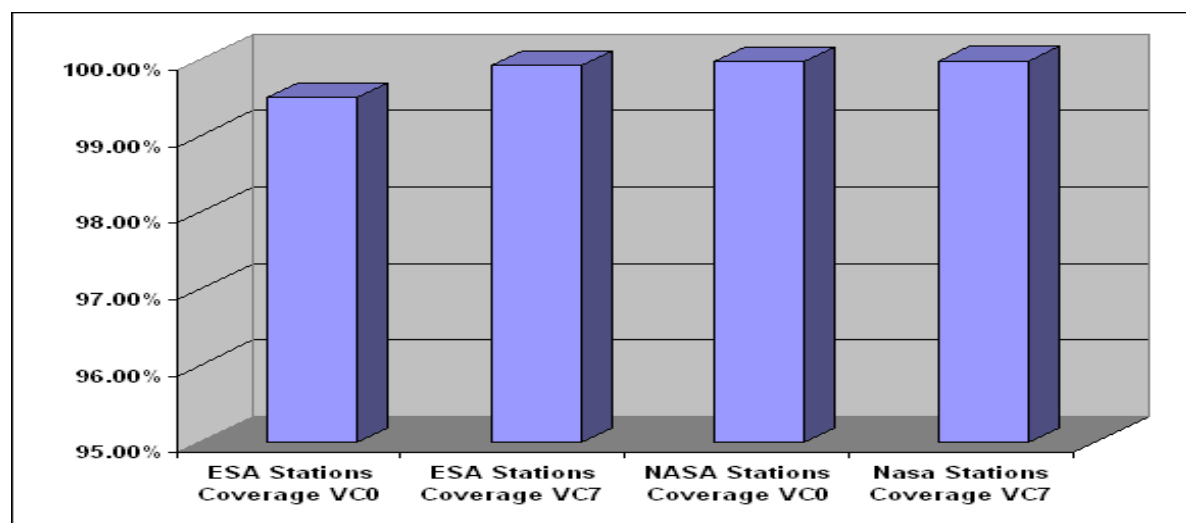


Figure 10: The usage of ESA ground stations compared to the usage of DSN ground stations

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 929 to 937, corresponding to the time range 23 May to 18 June.

Observations have been planned for revolutions 925 (11-13 May) to 936 (13-15 June). Revolutions 925-928 had to be re-planned as no valid bias could be found for revolution 925.

One TOO notification was received, but the event turned out to be of a different type that originally assumed and no Integral observations were called for.

TSFs have been received for revolutions 923 to 933.

3.3.2 Observation Status

New ECS files have been received for revolutions 907-915 (up to 13 April).

3.3.3 ISOC Science Data Archive

A beta release of ISDA 3.1 has been done on 11 May.

3.3.4 ISOC System

ISOC V25.1 has been developed and will be released in early June.

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-3102	04.05.2010	AOCS: Anomalous RW speeds oscillation	FDS	Pending
INT-3103	05.05.2010	AOCS: IMU ON during RWB	Spacecraft	Closed
INT-3105	05.05.2010	Redundancy in FD TM retrieval	FDS	Pending
INT-3104	11.05.2010	Incorrect Radiation Belt exit time set in Broadcast packet	FDS	Open
INT_SC-290	11.05.2010	AOCS Mode transition failure	Spacecraft	Pending
INT_SC-291	14.05.2010	U9921 OOL LOW LOW after IREM crash recovery		Pending
INT_SC-292	14.05.2010	IREM Anomaly: Reset of IREM_CSCI S/W #92	Payload	Pending
INT_SC-293	26.05.2010	IREM Anomaly: Reset of IREM_CSCI S/W #93	Payload	Pending
INT_SC-294	27.05.2010	SPI GeD#1 Anomaly	Payload	Pending
INT_SC-295	15.05.2010	IBIS VETO VDM14 HV Breakdown	Payload	Pending

5 Special Events & Future Milestones

MEOR June: Preparations are ongoing.

6 Appendix

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

6.1 AOCS operations

During this period, 545 Open Loop Slews, 402 Closed Loop Slews and 21 Momentum Biases were executed (as reported by ACC OEM).

8 slews were missed from the Timeline.

6.1.1 Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 01/06/2010 is reported in the following plot:

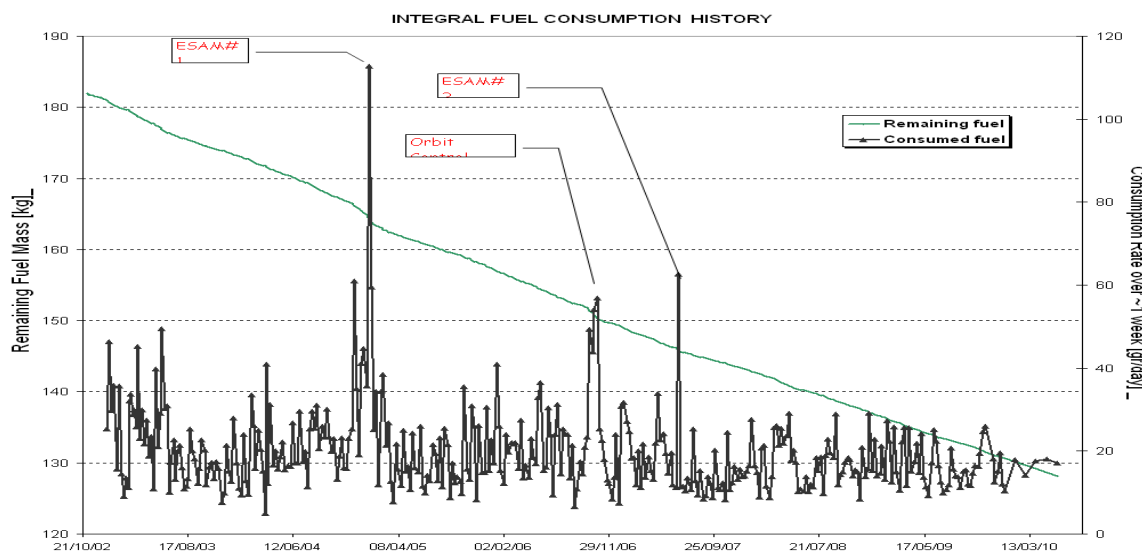


Figure 11: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

6.1.2 The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel as from November 2009 up to date are reported in the plot below. Historic data is not available at the moment, but present in the archives. The evolution of the drift on yaw channel is under constant monitoring but the values are still well within the specs.

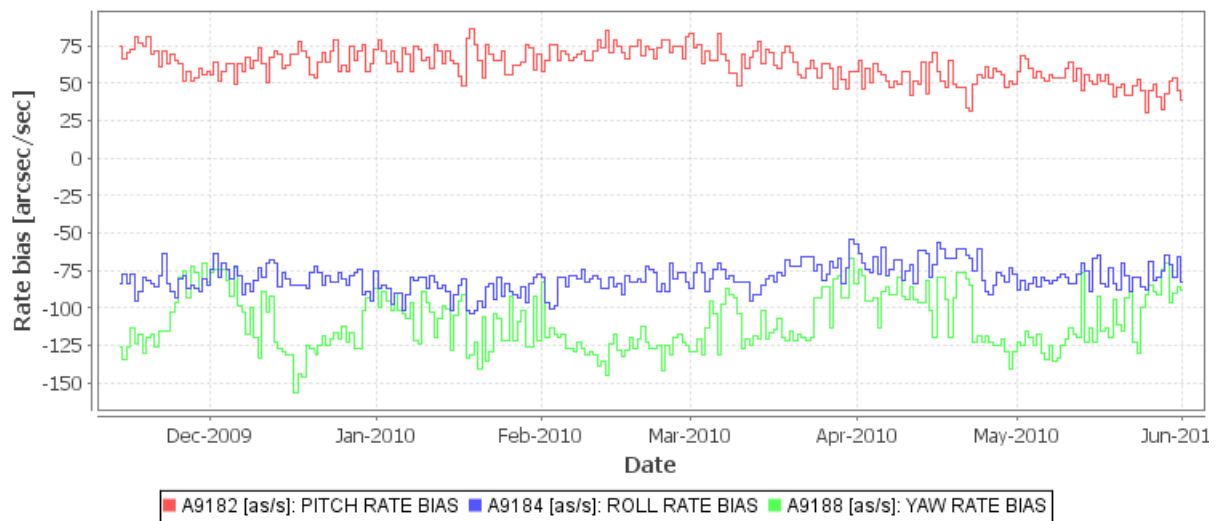


Figure 12: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

04/05/2010 (Day of Year 124, Revolution 922)

OTF was lost for PID 09220087 (11:59:00Z), because of toggling of the guide star position in the STR.

05/05/2010 (Day of Year 125, Revolution 922 to 923)

IMU1 switched ON (as a consequence of the loss of the guide star) during the commanding of a RWB sequence (04:51:00Z). While the recovery was taking place, slews 09230001 to 09230005 were missed from the Timeline (neither the OTF was reached for any of them). AOCs operations were resumed at 08:46Z

06/05/2010 (Day of Year 126, Revolution 923)

IMU1 switched ON during the stable pointing of PID 09230039 (07:11:00Z). After the IMU switched back OFF, a manual slew (0923_0502_M.OSL) was performed to go to attitude 09230040.

Then a mapping was commanded and the parameters for slew 09230041 were manually updated (spacontool).

OTF was not reached for PIDs 09230039 and 09230040.

Slew 09230040 was missed from the Timeline.

10/05/2010 (Day of Year 130, Revolution 924)

IMU1 switched ON during the stable pointing of PID 09240063 (00:35:00Z). After the IMU switched back OFF, a manual slew (0924_0500_M.OSL) was performed to go to attitude 09240064.

Then a mapping was commanded and the parameters for slew 09240065 were manually updated (spacontool).

OTF was not reached for PIDs 09240063 and 09240064.

Slew 09240064 was missed from the Timeline.

11/05/2010 (Day of Year 131, Revolution 924 to 925)

IMU1 switched ON (as a consequence of the loss of the guide star) during the commanding of a RWB sequence (04:30:22Z). Seconds later, an ACC transition TCM to IPS failed. AOCS SOE was called in and the transition was performed manually.

No impact on the Timeline.

14/05/2010 (Day of Year 134, Revolution 925 to 926)

IMU1 switched ON during the perigee passage (05:28:31Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 09260001 were manually updated (spacontool).

No impact on the Timeline.

20/05/2010 (Day of Year 140, Revolution 927 to 928)

FDS TPF update failed (attitude determination) for slew 09280015 (13:01:00Z). FD was called in and generated a manual slew from attitude 09280014 to attitude 09280015.

After the manual slew was completed, the parameters for slew 09280016 were manually updated (spacontool).

Slew 09280015 was missed from the Timeline.

OTF was not reached for PID 09280015.

21/05/2010 (Day of Year 141, Revolution 928)

IMU1 switched ON during the stable pointing of PID 09280055 (18:07:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 09280056 were manually updated (spacontool).

OTF was not reached for PID 09280055.

30/05/2010 (Day of Year 150, Revolution 931)

Mapping commands release failed after slew 09310033. The mapping was commanded manually and the update for slew 09310034 generated afterwards.

OTF was not reached for PID 09310033.

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 stroke of all four compressors was set to 38 until 2010-05-19T12:55Z when it was increased to 39 on all four compressors as the Cold Plate temperature had reached 80.9K. The CDE LCL currents for a given stroke setting are stable.

The following plot shows the evolution of the Cold Plate and H bus temperature during the reporting period. Note that the spike on 27/05/2010 is fictitious. It is due to false telemetry values during the AFEE reset performed in response to the GeD#1 failure.

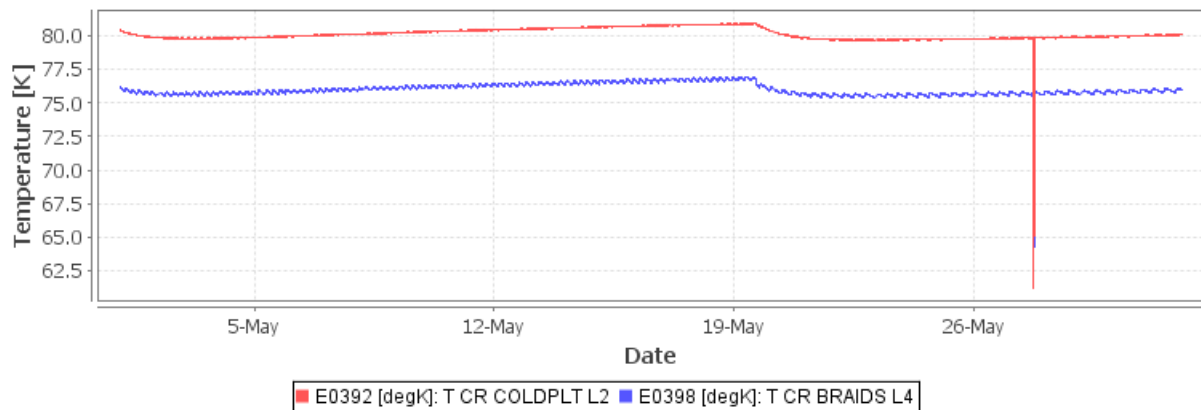


Figure 13: SPI Cold plate and H-bus temperature

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

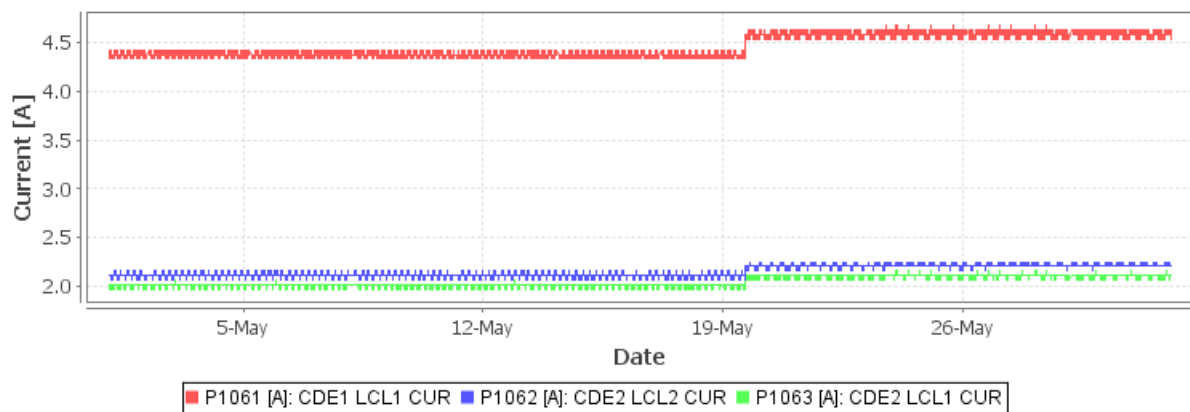


Figure 14: SPI CDE LCL current

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 8/19 SE. The DPE CPU usage was nominal during the reporting period (see Figure 1).

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, however an additional Ge Detector failure (GeD#1) occurred this month, on 27-05-2010. Since this anomaly, the AFEE DC output voltage of GeD#1 (TM E0351 in the plot below) has remained unchanged at -2.65V. In an attempt to recover this failure, an AFEE reset was performed on 27-05-2010 however this did not recover the detector and the HV of GeD#1 was then set to 0.5kV, as for the other failed detectors. Further details of this anomaly are given in the Event Log section below.

Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. 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.

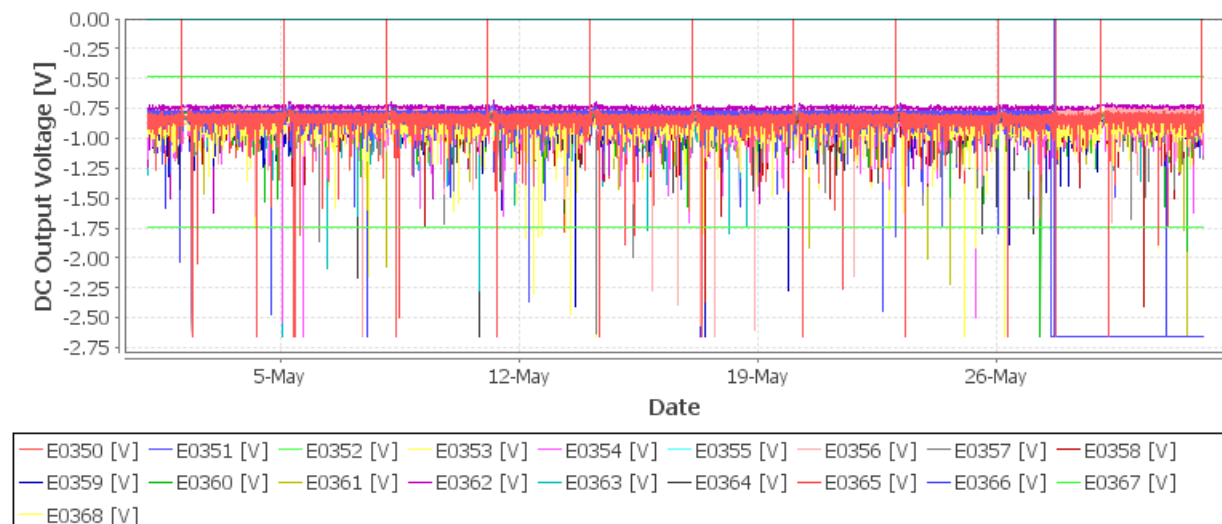


Figure 15: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)

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

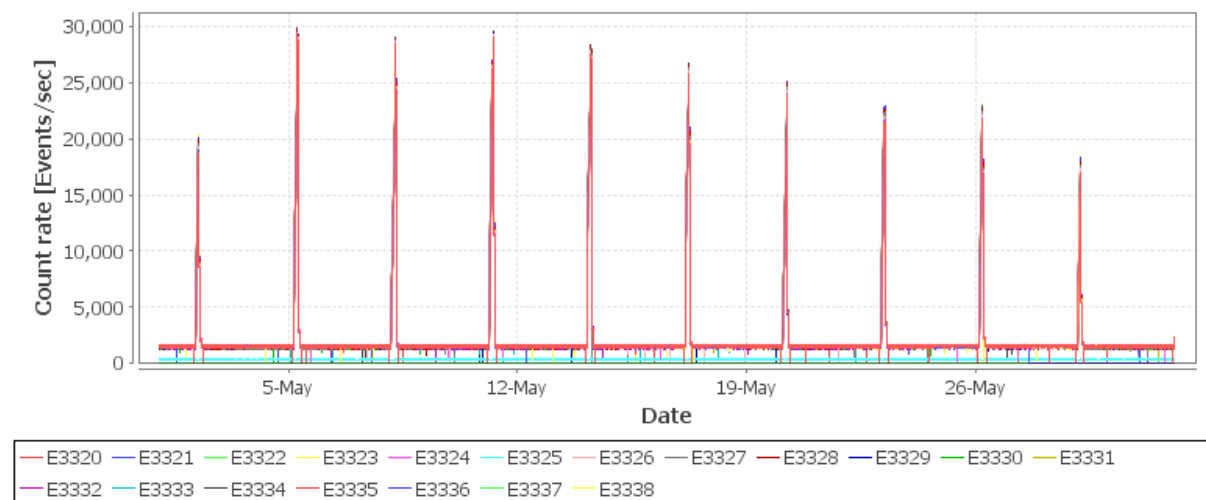


Figure 17: SPI GeD Time Tagged count rates

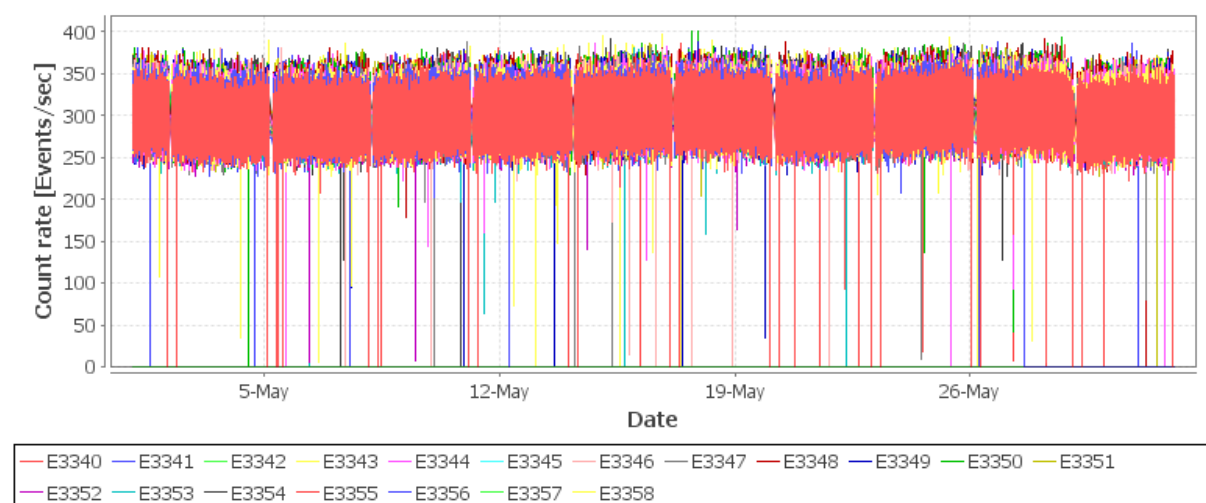


Figure 18: SPI GeD Time Tagged Saturated count rates

PSD

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

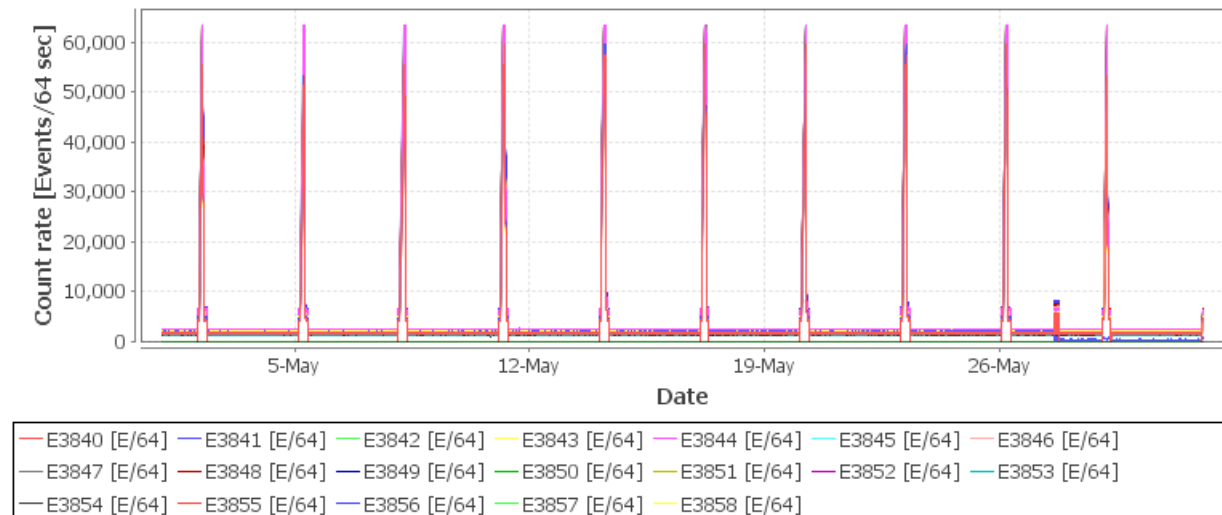


Figure 19: SPI PSD GeD Channel Rates

6.2.2 Event Log

- 96 occurrences of OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED were received during the reporting period. No action was required however the spectra scaling factor will be reduced to avoid frequent issuing of these OEMs.
- Prior to radiation belt exit of revolutions 923-927 inclusive, E4009 toggled OOL for up to 30 minutes, indicating errors on the HSL. This was due to a high count rate inside the belts at the start of these revolutions. In addition, due to continuing high radiation after the expected radiation belt exit of revolutions 923 and 924, TM parameter E3500 (ACS Count Rate Below 100MeV) toggled OOL high for up to 45 minutes after radiation belt exit of these revolutions.

03-05-2010 (Day of Year 123, Revolution 922)

At 03.40.04Z TM parameter E3190 went OOL (value = NO EXIST VAL). This is the ACS FEE temperature status #26. At 03.49.44Z TC sequence ES1831 was sent to report the ACS HK TM and the parameter returned within limits.

27-05-2010 (Day of Year 147, Revolution 930)

An anomaly on SPI Ge Detector #1 occurred on 27-05-2010 at 12:45Z. The symptoms are similar to those of previous GeD failures, namely:

- All AFEE count rates (TM parameters E3321; E3341 and E3361) went to zero.
- The PSD channel rates (TM parameter E3841) decreased to an anomalously low value of ~300 versus a nominal value of ~1800.

- The pre-amplifier DC output voltage (TM parameter E0351) went to a non-nominal value of -2.65V instead of $\sim -0.9V$.

The situation remained as such for 30 minutes, after which a transition to CONF and back to PHOTON mode was performed, however the GeD#1 AFEE count rates remained zero. After this, the HV of GeD#1 was set to 0.5kV (operations performed from 13.20.59Z-13.32.40Z). During the HV reduction no change in the pre-amplifier output voltage, as would normally have been seen, was observed. This is also characteristic of previous detector failures.

Following consultation with the SPI PI, the GeD#1 AFEE analogue chain was reset, first by switching off the High Voltage Power Supply and then the Low Voltage Power Supply and then powering the detector chain back on in stages. This was performed from 14.41.44Z-15.14.30Z. This did not cure the anomaly. In particular, the GeD#1 DC output voltage returned immediately to a value of -2.65V following the power-on of the LVPS. Following this a full reset of the AFEE was performed (CRP_SPI1_3010 executed at 15.41.11Z) but this also did not recover GeD#1.

SPI was returned to Photon mode at 16:06Z with the HV of GeD#1 at 0.5kV as for the other failed detectors. Further investigations are ongoing into the characteristics of this anomaly in conjunction with the PI. This anomaly is recorded as AR INT_SC-294.

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:

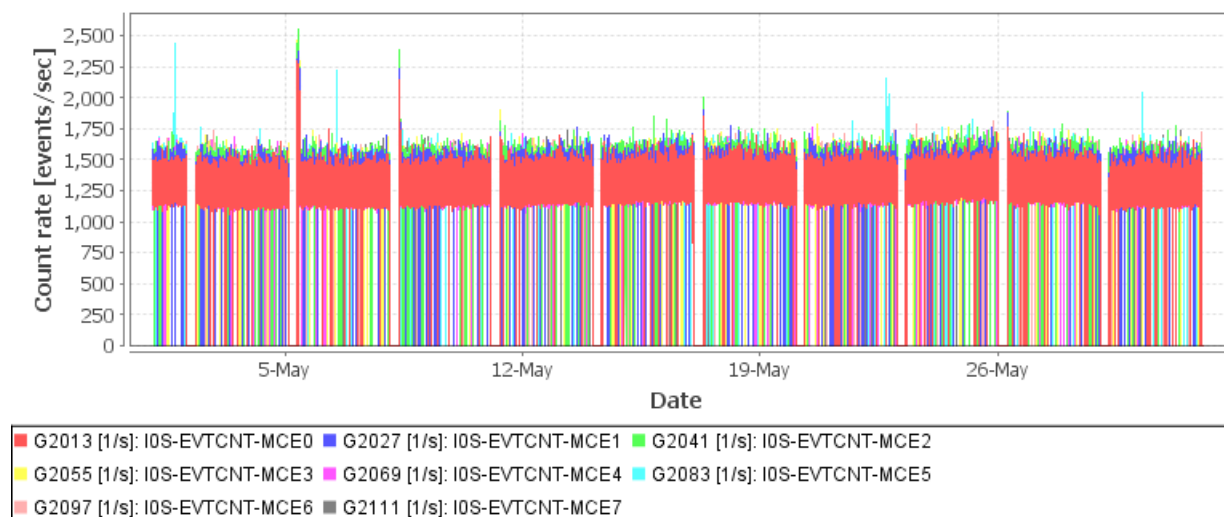


Figure 20: ISGRI MCE Counters

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. A HV breakdown of VETO VDM14 occurred on 15-05-2010 however this was recovered nominally. Further details are given in the Event Log section below. Plots of the VETO counters are given in Figure 6: Instrument Count Rates.

6.3.2 Event Log

- Due to continuing high radiation at radiation belt exit of revolutions 923 and 924, the ISGRI MCE counters (TM parameter family G2013) and the VETO count rates (TM parameters G6062 and G6063) toggled OOL for a while after the expected radiation belt exit of these revolutions. There was no impact on operations; the parameters returned within limits of their own accord as the background radiation level decreased and no action was taken.

02-05-2010 (Day of Year 122, Revolution 921-922)

At 19:37Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 2010.122.20.35.06Z FCP_IBIS1_0312
- 2010.122.20.43.09Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

10-05-2010 (Day of Year 130, Revolution 924)

At 04:43Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 2010.130.05.25.08Z FCP_IBIS1_0312
- 2010.130.05.26.16Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

15-05-2010 (Day of Year 135, Revolution 926)

At 12.48.31Z, the VETO VDM14 HV went OOL Alarm Low: TM G6048 (V1S-VDM14HV) = -18.5V [0 Raw].

At the same time several OEM APID 1280 ID 186 ANOMALY IBIS1 VETO PMTXX IS ON AND CORRESPONDING HV MONIT IS ABOUT ZERO began to be received (8 OEMs every 8 second cycle).

No other alarms were generated and no change was observed in the VETO counters or current. The VDM14 HV remained at zero until the following recovery procedure was executed:

- 12.55.09Z Set IBIS-IASW in Stand-By (TC G0125).
- 12.55.51Z Set IBIS-VETO in Stand-By (TC G0601). At this point all the VETO HVs went to zero as expected and the OEMs APID 1280 ID 186 Class 2 stopped.
- 12.58.24Z Set VETO in Maintenance (TC G0634 TC-V-MAINT) and VETO HVs and counters monitored for 45 minutes.
- 13.49.24Z Set VETO in Stand-By (TC G0601).
- 13.52.07Z Set VETO in Nominal (TC G0600).
- 13.52.48Z Set IBIS-IASW in Science Standard (TC G0129).

Following the recovery the performance of VETO and all VETO parameters were nominal. This is recorded as Anomaly Report INT_SC-295.

16-05-2010 (Day of Year 136, Revolution 926)

There were 2 occurrences of OEM EVENT ID 132 IBIS1 IASW HEPI RESYNCHRONIZED:

- 2010.136.05.11.03.445 2010.136.05.11.07.129 1280 RealTime 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED
- 2010.136.20.29.34.326 2010.136.20.29.38.940 1280 RealTime 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED

No action was required.

25-05-2010 (Day of Year 145, Revolution 929)

There was 1 occurrences of OEM EVENT ID 132 IBIS1 IASW HEPI RESYNCHRONIZED:

- 2010.145.19.26.54.995 2010.145.19.26.57.645 1280 RealTime 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED

No action was required.

26-05-2010 (Day of Year 146, Revolution 929-930)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 2010.146.16.50.37Z. It was recovered as follows:

- At 2010.146.17.09.13Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2010.146.17.19.23Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

28-05-2010 (Day of Year 148, Revolution 930)

Following a ground station handover at 06:50Z, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 2010.148.07.35.37Z FCP_IBIS1_0312
- 2010.148.08.22.44Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

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 and DFEE detector temperatures over the reporting period.

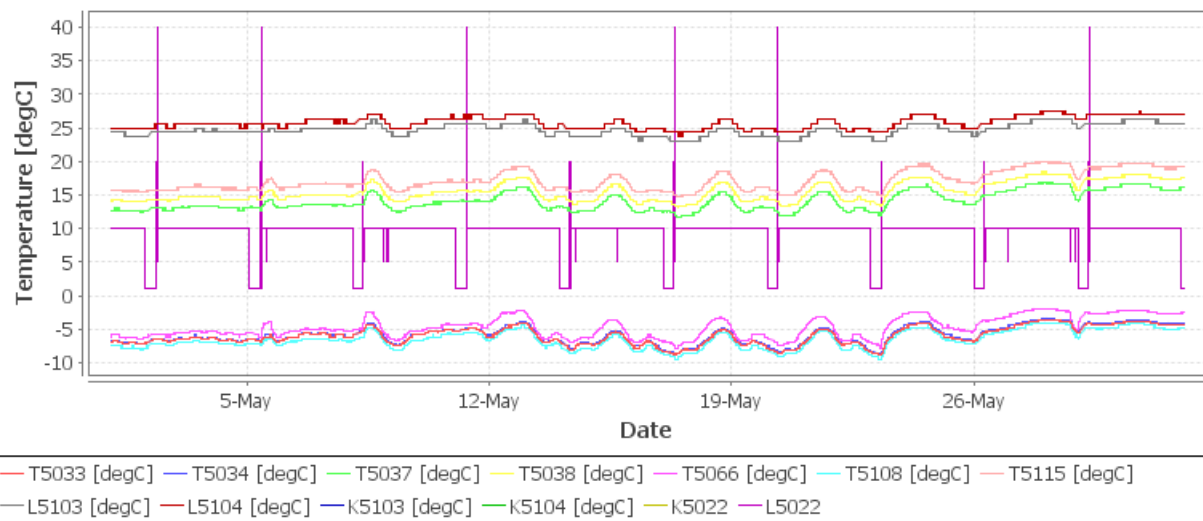


Figure 22: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

02-05-2010 (Day of Year 122, Revolution 922)

The following out-of-limits were noted:

- 23:02:17, 23:03:44 & 23:28:57 L5136 outside soft limits.

03-05-2010 (Day of Year 123, Revolution 922)

The following out-of-limits were noted:

- 06:44:57 & 07:28:52 L5136 outside soft limits.

05-05-2010 (Day of Year 125, Revolution 923)

At 04:51, after AOS, an AOCS problem forced a delay in the start of operations. A recovery was performed, and the timeline rejoined at 08:44. The impact was a delay of 1 hour in the start of operations.

The following out-of-limits were noted:

- 07:07:13, 07:08:34 & 07:09:49 L5317 outside hard limits.
- 07:40:01 L5449 outside soft limits.
- 07:42:02 L9122 outside soft limits.
- 07:47:30, 07:49:29 L5136 outside soft limits.
- 08:00:58 L5317 outside hard limits.
- 08:02:26 L5119 outside soft limits.
- 08:02:17 L5119 outside hard limits.

- 08:02:26 L9104 outside soft limits.

08-05-2010 (Day of Year 128, Revolution 924)

The following out-of-limits were noted:

- 07:08:09 L5449 outside soft limits.
- 07:10:18 L9134 outside soft limits.
- 07:15:45 & 07:17:45 L5136 outside soft limits.
- 07:25:29, 07:27:13, 07:28:09 & 07:32:03 L5449 outside soft limits.
- 07:47:13 L5136 outside soft limits.
- 07:48:09 & 07:48:41 L5449 outside soft limits.
- 09:07:30 L5136 & L5449 outside soft limits.

11-05-2010 (Day of Year 131, Revolution 925)

The following out-of-limits were noted:

- 06:21:01 & 06:25:05 L5317 outside hard limits.
- 15:47:13 & 19:20:44 L5136 outside soft limits.

14-05-2010 (Day of Year 134, Revolution 926)

At 06:52:29, the TCs L0021 & LU0014 (part of the LEDATA02 ED) failed their cev. A recovery was performed, and the ED manually sent. JEMX-2 was re-enabled at 07:05. The impact was the loss of 15 minutes science data.

24-05-2010 (Day of Year 144, Revolution 429)

The following out-of-limit was noted:

- 01:29:40 L5136 outside soft limits.

26-05-2010 (Day of Year 146, Revolution 930)

The following out-of-limit was noted:

- 07:35:30 L5136 outside soft limits.

At 16:51:06 JEMX-2 parameters L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#93). There was no impact as the reaction has been disabled.

6.5 OMC

6.5.1 Operations

The status and performance of OMC is nominal.

6.5.2 Event Log

05-05-2010 (Day of Year 125, Revolution 923)

At 04:51, after AOS, an AOCS problem forced a delay in the start of operations. A recovery was performed, and the timeline rejoined at 08:46. The impact was the loss of pointings 09230004 & 09230005.

06-05-2010 (Day of Year 126, Revolution 923)

At 07:11, an AOCS problem forced an interruption. A recovery was performed, and the timeline rejoined at 07:45. The impact was pointing 09230040 was shortened to 1248 from a planned 2000 seconds.

10-05-2010 (Day of Year 130, Revolution 924)

At 00:35, an AOCS problem forced an interruption. A recovery was performed, and the timeline rejoined at 01:03:01. The impact was pointing 09240064 was shortened to 1912 from a planned 2000 seconds.

11-05-2010 (Day of Year 131, Revolution 925)

At 06:43:00, the M1131 Reset ROE command failed release. This was caused by a mission planning error, where the Rad Exit time, had not been correctly updated. The command was manually sent 2 minutes later, after OMC was put to stand-by by the broadcast packet. There was no impact.

20-05-2010 (Day of Year 140, Revolution 928)

At 13:01, a Flight dynamics problem prevented a slew update. The operations were stopped and a recovery performed. The timeline was rejoined at 14:03. The impact was the loss of pointing 09280015. It was at this time that the following pair of commands was rejected:

2010.140.13.37.06.697	2010.140.13.37.17.035	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0	65535 PR	N E	E
2010.140.13.37.12.822	2010.140.13.37.23.247	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 that pointing.

26-05-2010 (Day of Year 146, Revolution 930)

At 16:50:25 an IREM SEU (#93) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 17:06:01. The impact was an interruption of pointing 09300012 after 3169 from a planned 3530 seconds, and the loss of pointing 09300013.

At 21:29:00, as a precaution, OMC was manually sent to standby, and back to normal mode. This resulted in pointing 09300017 being cut short from a planned 3530 to 1856 seconds.

30-05-2010 (Day of Year 150, Revolution 931)

At 14:24:00 the Star tracker mapping command failed, which forced a suspension of operations. A recovery was performed, and the timeline rejoined at 14:41. The impact was the loss of pointing 09310033.

During the month, there were 4 occurrences (on DoY 129 at 07:48:45, DoY 131 at 11:39:03 & DoY 133 at 12:36:39 & 13:17:42) of the OEM pair:

RealTime	5	ANOMALY	OMC CSSW INT ER	0	0	65535	PR	N	E	E
RealTime	7	EXCEPTION	OMC CONSTRAINT D	0	0	65535	PR	N	E	E

These occur, when OMC is pointing at a crowded area of the sky, and are harmless.

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.

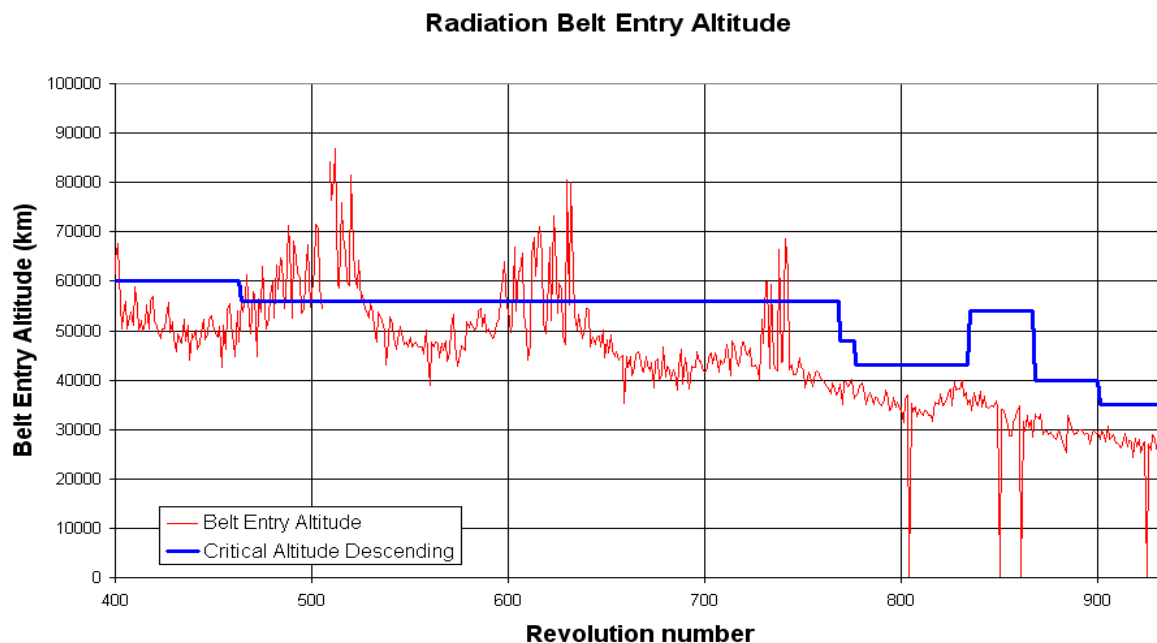
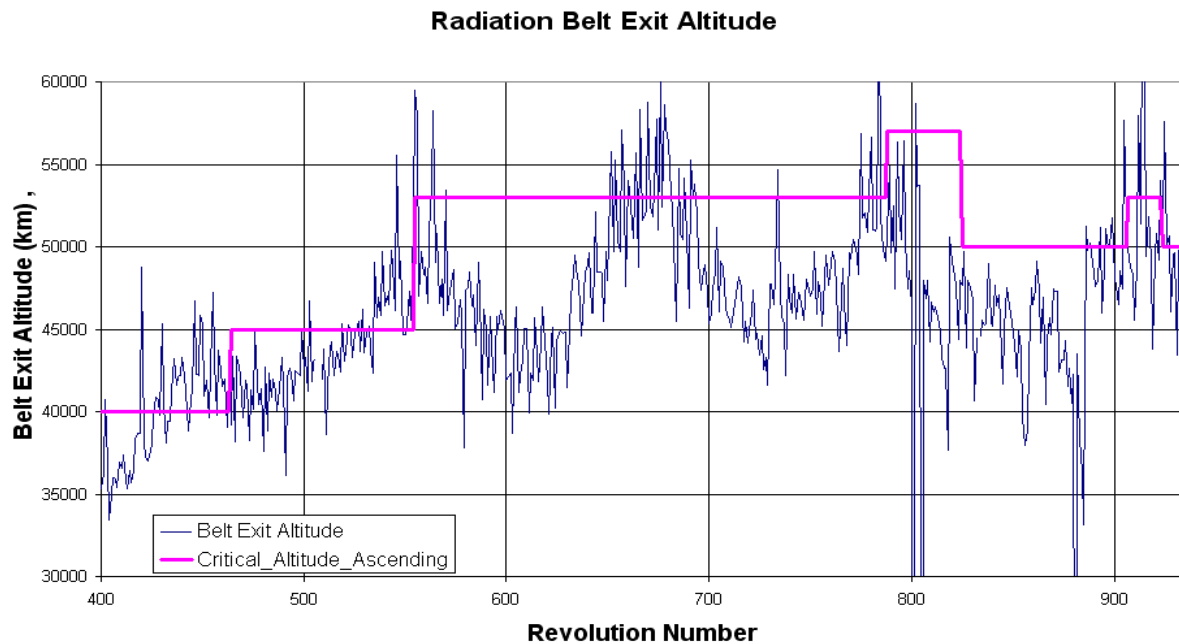


Figure 23: Radiation belt entry

**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
921	RAD_ENTR R 2010-05-02T00:30:04Z	02/05/2010 01:33:43	23619.1	02-May-2010 01:35:06	21859.39	02-May-2010 02:25:06	10734.88
922	RAD_EXIT R 2010-05-02T07:28:04Z	02/05/2010 06:34:31	>>28039.2	02-May-2010 06:45:06	46203.57	02-May-2010 02:55:06	5559.8
922	RAD_ENTR R 2010-05-05T00:19:05Z	05/05/2010 01:25:04	21792.6	05-May-2010 01:22:19	22580.77	05-May-2010 02:12:19	11494.71
923	RAD_EXIT R 2010-05-05T07:17:19Z	05/05/2010 08:18:00	61209.6	05-May-2010 06:32:19	45602.03	05-May-2010 02:52:19	5183.249
923	RAD_ENTR R 2010-05-08T00:07:04Z	08/05/2010 01:17:04	22114.4	08-May-2010 01:03:59	23885.18	08-May-2010 02:03:59	10663.58

924	RAD_EXIT R 2010-05- 08T06:45:44Z	08/05/2010 06:21:04	45172.8	08-May-2010 06:23:59	46227.51	08-May-2010 02:33:59	5591.095
924	RAD_ENTR R 2010-05- 10T23:54:24Z	11/05/2010 01:00:00	22238.3	11-May-2010 00:55:19	22916.77	11-May-2010 01:45:19	11802.42
925	RAD_EXIT R 2010-05- 11T06:52:22Z	11/05/2010 06:42:32	50702.7	11-May-2010 06:15:19	47053.13	11-May-2010 02:25:19	5178.179
925	RAD_ENTR R 2010-05- 13T23:42:31Z	14/05/2010 00:40:24	23750.0	14-May-2010 00:43:42	22793.58	14-May-2010 01:33:42	11616.35
926	RAD_EXIT R 2010-05- 14T06:39:49Z	Not Available	-	14-May-2010 05:53:42	45602.38	14-May-2010 02:13:42	5032.742
926	RAD_ENTR R 2010-05- 16T23:30:06Z	17/05/2010 00:35:20	21796.7	17-May-2010 00:32:58	22492.87	17-May-2010 01:22:58	11331.02
927	RAD_EXIT R 2010-05- 17T06:27:26Z	17/05/2010 05:42:56	46152.4	17-May-2010 05:42:58	45793.69	17-May-2010 02:02:58	5026.096
927	RAD_ENTR R 2010-05- 19T23:16:18Z	Not Available	-	20-May-2010 00:23:25	21773.73	20-May-2010 01:13:25	10615.29
928	RAD_EXIT R 2010-05- 20T06:13:41Z	20/05/2010 04:59:12	>>28074.9	20-May-2010 05:33:25	46326.35	20-May-2010 01:43:25	5462.28
928	RAD_ENTR R 2010-05- 22T23:03:30Z	Not Available	-	23-May-2010 00:11:38	21520.5	23-May-2010 01:01:38	10291.58
929	RAD_EXIT R 2010-05- 23T05:40:58Z	23/05/2010 05:03:44	43862.5	23-May-2010 05:21:38	46627.42	23-May-2010 01:31:38	5232.151
929	RAD_ENTR R 2010-05- 25T22:53:27Z	25/05/2010 23:53:13	23678.6	26-May-2010 00:02:32	21534.8	26-May-2010 00:52:32	10250.24
930	RAD_EXIT R 2010-05- 26T05:30:16Z	26/05/2010 05:01:13	45734.2	26-May-2010 05:12:32	46704.17	26-May-2010 01:22:32	5138.273
930	RAD_ENTR R 2010-05- 28T22:43:44Z	Not Available	-	28-May-2010 23:45:14	22997.35	29-May-2010 00:35:14	11759.49
931	RAD_EXIT R 2010-05- 29T05:20:29Z	29/05/2010 04:10:01	28154.6	29-May-2010 04:55:14	45565.86	29-May-2010 01:15:14	4941.186
931	RAD_ENTR R 2010-05- 31T22:32:30Z	31/05/2010 23:43:05	19784.1	31-May-2010 23:35:14	22430.52	01-Jun-2010 00:25:14	11206.7

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

14-05-2010 (Day of Year 134, Revolution 926)

At 03:28:48Z, a local reset of the IREM CSCI S/W (SEU #92) 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 was observed at AOS for revolution 926: 2010-05-14T03:28:48Z (17340.5 km). The unit had performed an automatic transition to Standard Mode (ie. 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 & 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) At 07:30, the patch was performed and the S/W re-started, however, this was not successful, as the counts were far too low.
- 7) The patch was performed again, this time successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 10:40:00Z.

The IREM automatic transition to Standard Mode occurred during the perigee passage, and as a consequence the other instruments were unaffected.

26-05-2010 (Day of Year 146, Revolution 930)

At 16:50:25Z, a local reset of the IREM CSCI S/W (SEU #93) occurred. 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 2010.146.16:50:25Z (119706.7 km). The unit had performed an automatic transition to Standard Mode (ie. 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 18:32:00Z.

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 Pls request. OMC was recovered at 17.06.01Z and IBIS at 17:19:00Z.