
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 April and covers the revolutions 912 until 920. 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.

7 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.5424 Kg. The remaining propellant is in the order of 128.65Kg.

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 15th SPI annealing ended on 16/04/2010. 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) and detector #5 (failed since 19/02/2009). Operations for the annealing were performed nominally. The main activities performed were as follows:

Date/Time	Activity
2010-03-30 01:29:09Z	Configure SPI for start of Annealing and stop SPI active cooling
2010-03-30 02:40:00Z	Annealing Heater Main ON
2010-03-30 04:40:00Z	Annealing Heater Redundant ON
2010-03-30 17:10:00Z	Heat Pipe Heater Main ON, All Antifreeze Heaters (1A; 2A; 1B; 2B) OFF
2010-03-31 05:10:20Z	Heat Pipe Heater Redundant ON
2010-03-31 13:50:00Z	Cold plate temperature reached 373K (100degC)
2010-04-08 06:51:00Z	Stop SPI Annealing: Annealing Heater Main and Redundant OFF; Heat Pipe Heater Main and Redundant OFF; Antifreeze Heater 1A ON
2010-04-08 07:18:40Z	Start Toggling of Heat Pipe Heater to manage Cold box temperature: Heat Pipe Heater Main and Redundant ON
2010-04-08 13:25:10Z	Heat Pipe Heater Redundant OFF
2010-04-08 14:24:58Z	ACS switch-on and start of ACS calibration (also FEE#57 and FEE#81 ON)
2010-04-09 01:25:10Z	Heat Pipe Heater Main OFF and start toggling of Heat Pipe Heater Main (75% ON then 50% ON then 25% ON cycles)
2010-04-10 09:08:29Z	End of ACS Calibration
2010-04-11 11:12:31Z	Thermal braids temperature TM EU0398A reached 308K
2010-04-11 11:19:26Z	Start of cryocooler switch-on
2010-04-11 12:39:15Z	Cyrocooler switch-on complete and stroke set to 4x45
2010-04-12 07:25:10Z	End toggling of Heat Pipe Heater Main: Heat Pipe Heater Main OFF
2010-04-14 20:51:35Z	Cold plate temperature TM EU0392A reached 127K
2010-04-14 21:00:39Z	Selected narrow range cold plate temperature acquisition and restored PSD nominal threshold
2010-04-15 16:57:03Z	Cold plate temperature TM EU0392 reached 100K
2010-04-15 17:00:32Z	Camera switch-on start; HV of all GeD increased in steps to 0.5kV; 1kV; 1.5kV; 2kV; 2.5kV; 3kV; 3.5kV, 4kV with acquisitions in PHOTON mode in between from 2kV onwards
2010-04-15 20:16:23Z	Thermal braid temperature TM E0398 reached 86K

Date/Time	Activity
2010-04-15 20:30:00Z	Start of reduction of cryocooler stroke for 80K target (FCP_SPI1_0072)
2010-04-15 21:36:15Z	Camera switch-on end: SPI in PHOTON mode with all GeD HV at 4kV
2010-04-16 10:46:58Z	Restore nominal ACS configuration (FEE#57 and FEE#81 OFF) and nominal GeD HV (GeD#2, GeD#5 and GeD#17 HV set to 0.5kV).
2010-04-16 16:19:00Z	End of reduction of cryocooler stroke for 80K target: Stroke set to 4x37
2010-04-17 16:32:16Z	Cold plate temperature TM EU0392 reached 80.9K
2010-04-18 15:35:10Z	Set nominal IASW parameters (Cold Plate Monitoring temperature)

The Germanium detectors' temperature was kept in the range 80K $\pm$ 1K since the end of annealing. The performance of the cryocooler appears to have been recovered with this annealing.

Following the camera switch-on, performed on 15/04/2010, SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. On 16/04/2010 PSD Event reduction was enabled in line with OCR-273.

The assigned TM bandwidth in the science observation windows was 30 packets/cycle in revolutions 911-915 and 105 packets/cycle from revolution 916 onwards, except from 2010-04-22T01:03:25Z to 2010-04-22T05:52:46Z (OMC Flat Field Calibration), when it was 88 packets/cycle. The average telemetry occupation when the allocation was 105 packets/cycle was 87.5 packets/cycle. The following plot shows the TM bandwidth allocation and occupation during the reporting period:

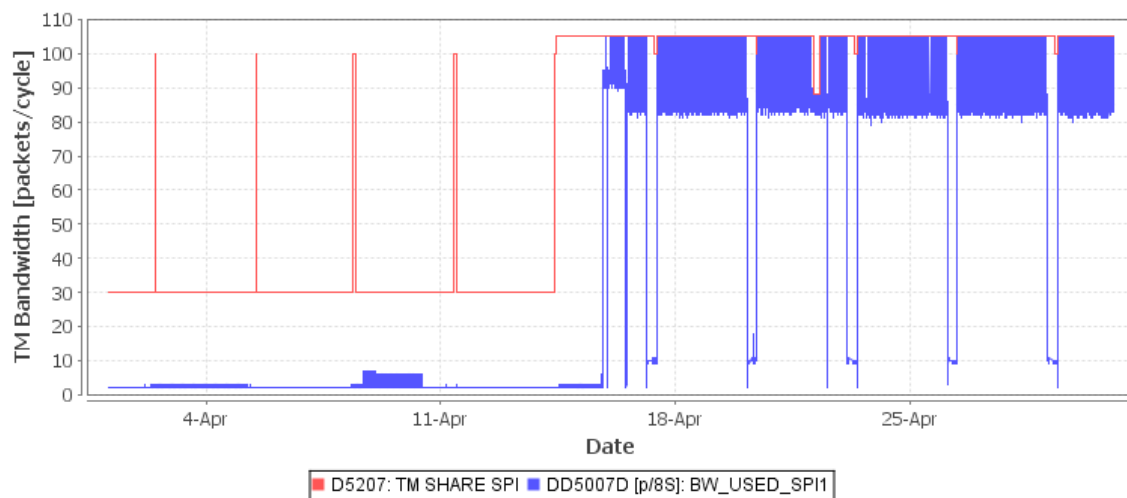


Figure 1: SPI TM bandwidth utilisation

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

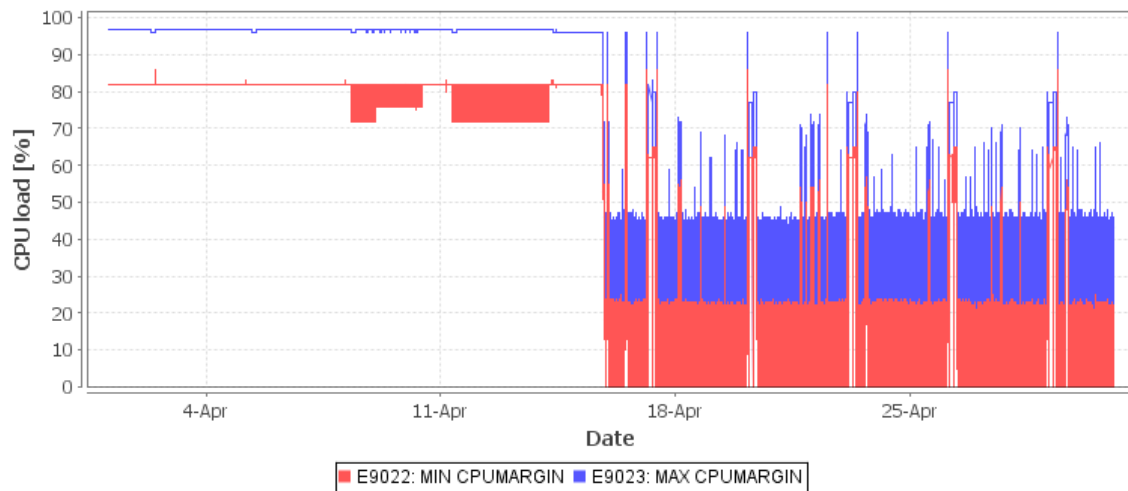


Figure 2: SPI IASW Performance

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

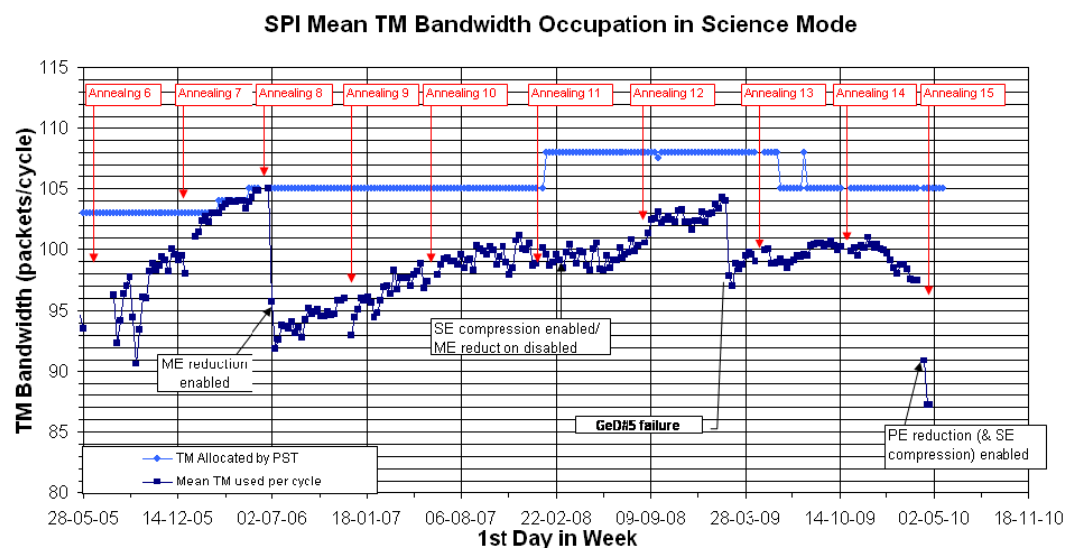


Figure 3: SPI TM bandwidth usage evolution since May 2005

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

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: 180 packets/cycle in revolutions 911-915 and 131 packets/cycle from revolution 916 onwards, except from 2010-04-22T01:03:25Z to 2010-04-22T05:52:46Z (OMC Flat Field Calibration), when it was 90 packets/cycle.
- IBIS mean bandwidth utilisation in science mode when the allocation was above 90 packets/cycle: 115.9 packets/cycle.

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

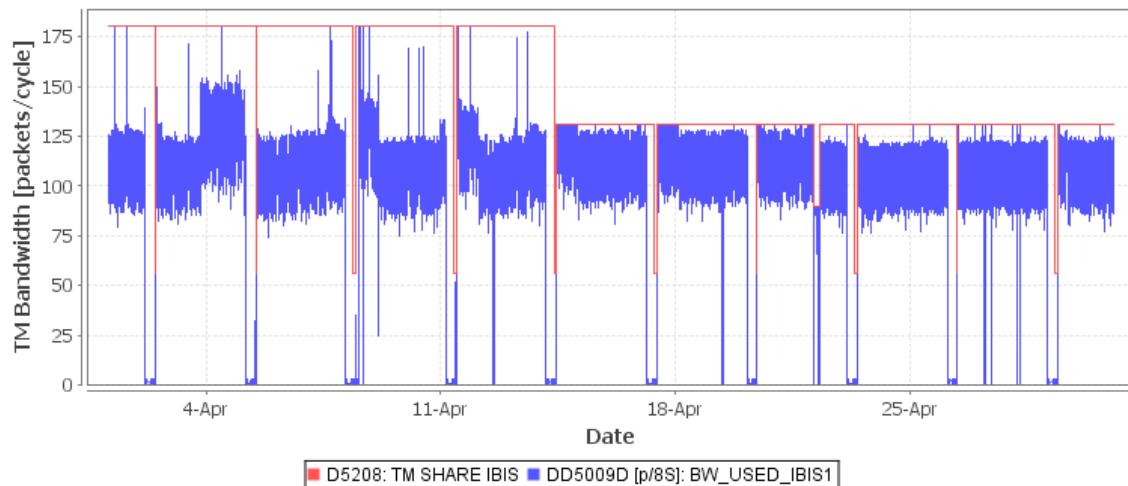


Figure 4: IBIS TM bandwidth utilisation

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

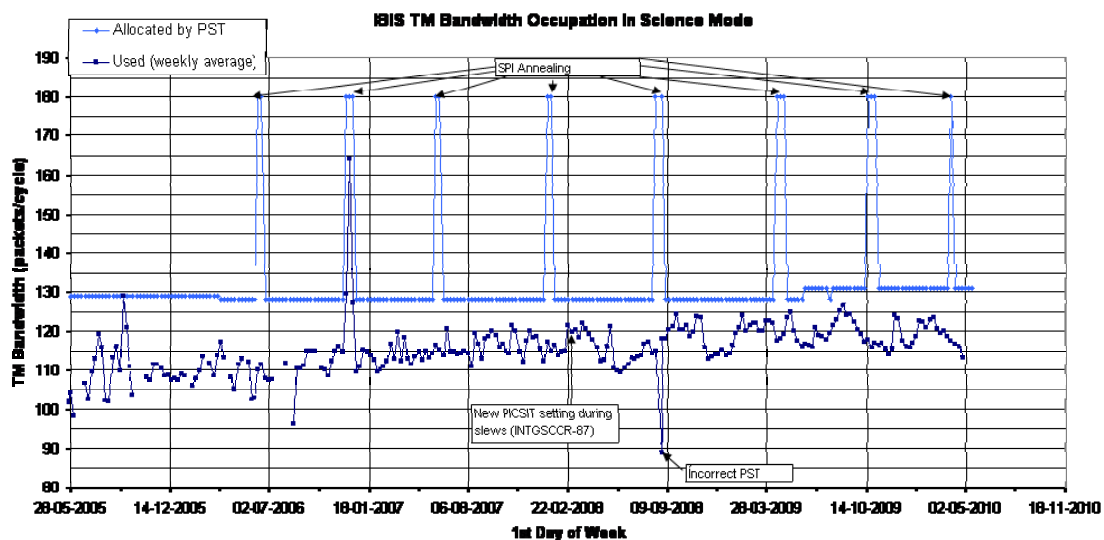


Figure 5: IBIS TM bandwidth usage evolution since May 2005

Note: Some more information concerning the IBIS operations is provided in Appendix 7.

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. From the start of the month until 2010-04-14T00:59:00Z, during the SPI annealing, both instruments were operating, with 15 packets/cycle per instrument allocated.

Note: Some more information concerning the JEM-X operations is provided in Appendix 7.

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 2010-04-22T01:03:25Z to 2010-04-22T05:52:46Z during the Flat-Field calibration, when it was 63 packets/cycle, and from the beginning of the month to 2010-04-14T01:39:13Z, during the SPI annealing, when it was 9 packets/cycle.

During this reporting period, 743 of the 751 planned science pointings were executed nominally, 2 pointings were lost to ground station problems, 1 to an AOCS problem, and 4 pointings were interrupted and another lost to IREM SEUs. There was also a Flat-field calibration, which was performed nominally.

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

2.2.5 IREM

The status of IREM is nominal.

The solar activity has increased again, with the number of sun spots increasing. The radiation belt exit for revolutions 914 & 915 experienced high radiation for some hours.

- On DoY 102 (12/04/2010), the 88th IREM SEU occurred, details in the appendix.
- On DoY 109 (19/04/2010), the 89th IREM SEU occurred, details in the appendix.
- On DoY 117 (27/04/2010), the 90th IREM SEU occurred, details in the appendix.
- On DoY 118 (28/04/2010), the 91st IREM SEU occurred, details in the appendix.

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

Radiation background

The background radiation level as measured by the instrument counters was generally low during the reporting period, however high radiation levels were experienced briefly after the planned radiation belt exit of revolutions 914, 915 and 921. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the reporting period:

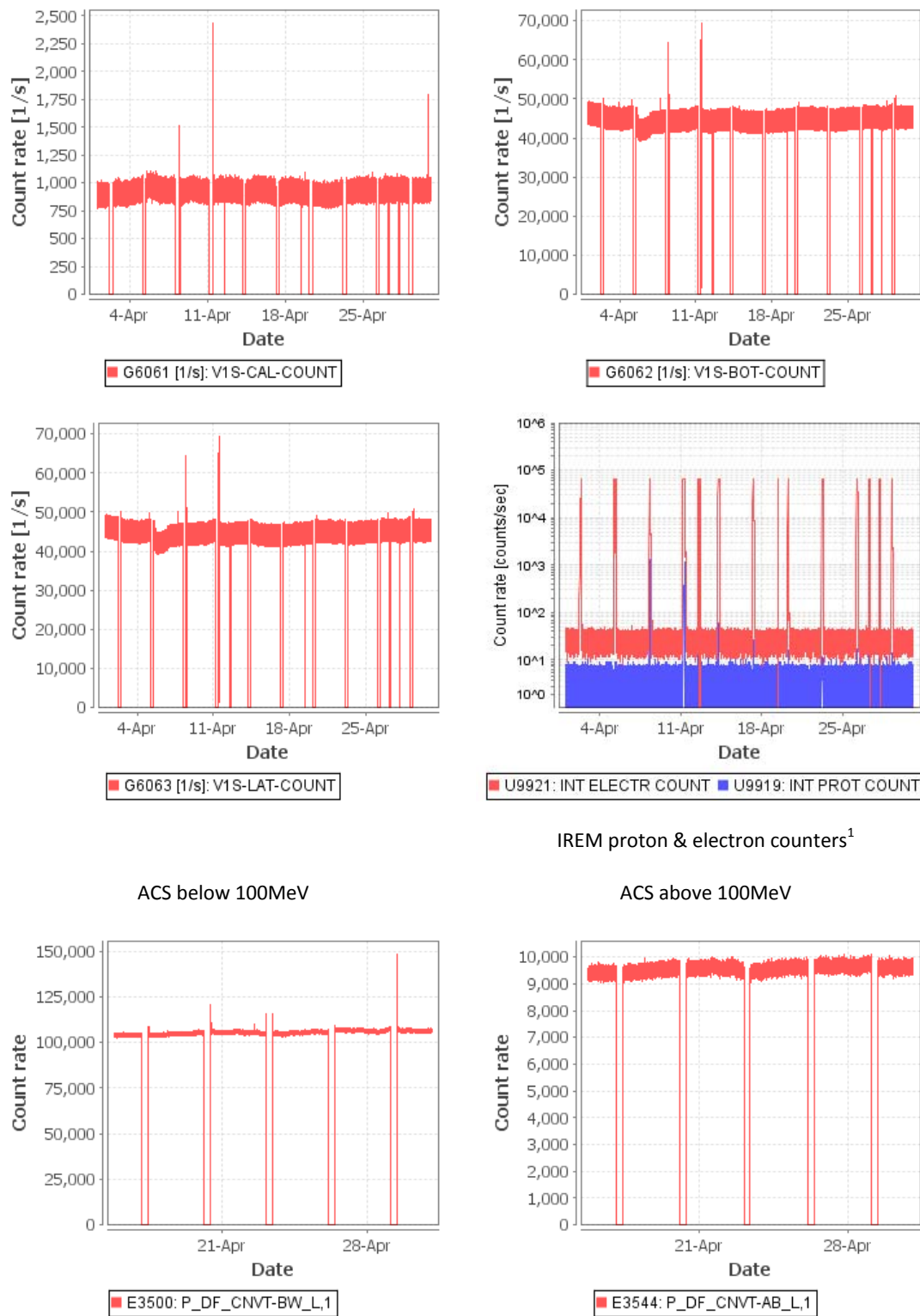


Figure 6: Instrument Count Rates

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

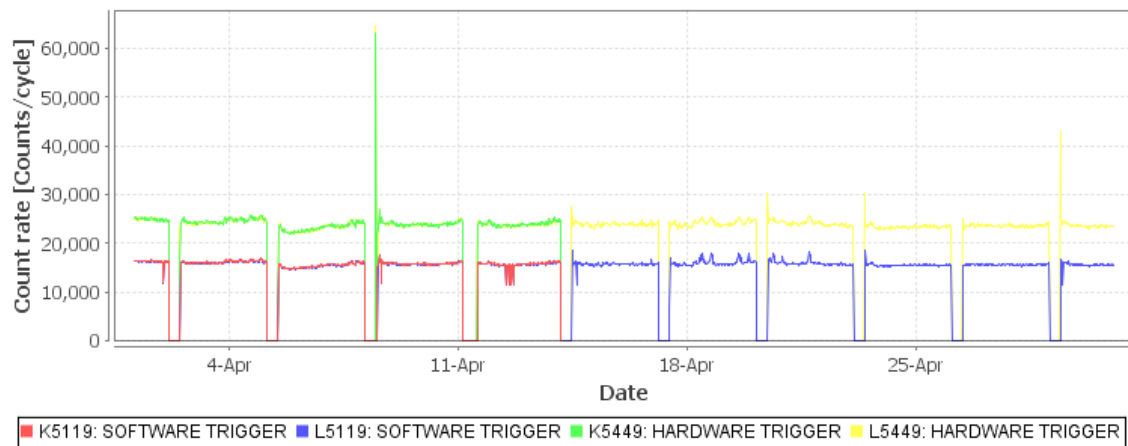


Figure 7: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

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.

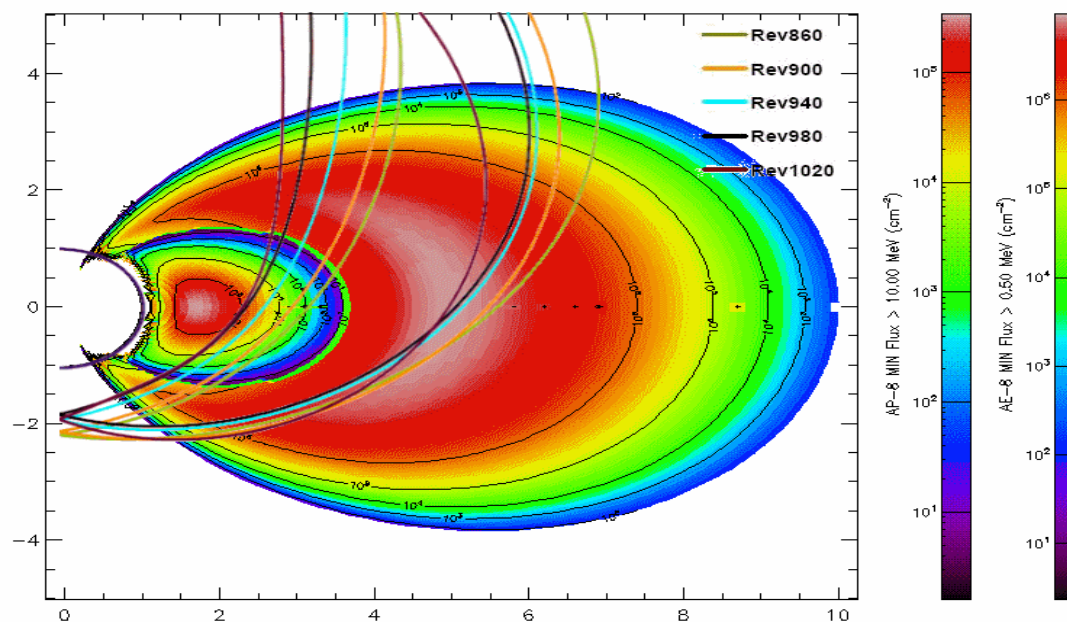


Figure 8: The predicted evolution of the orbit of Integral through the radiation belts

Plot not available this month.

Figure 9: Predicted radiation belt passages

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.

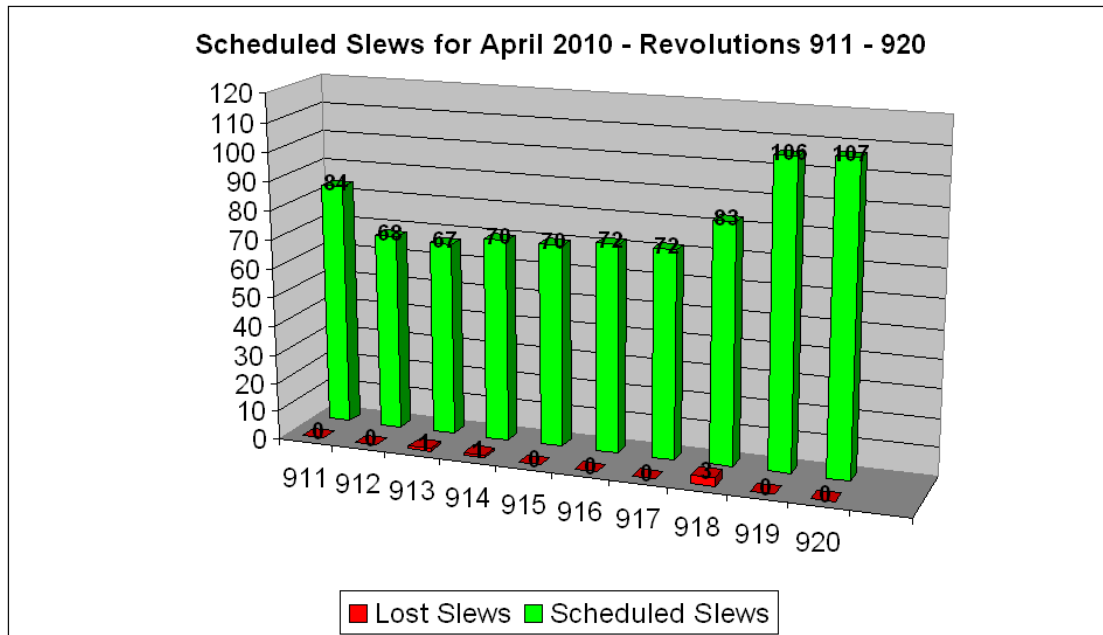


Figure 10: The number of slews scheduled compared to the number of slews lost

3.1 Mission Control System

This month the HFA_TM task was restarted six times on iddb (due to MUST retrievals) and one times on idda. The DDS on isdsc and iddb was restarted one time, because MUST was not importing data.

The ISDS and IFRD tasks on isdsa were restarted once as well as the AUX task on idda, the OLF task on idda and iddb. There were two occasions where no OLF files were received for some hours and one occasion where no ASF files were received for some hours.

On DOY093, DOY110 and DOY112 disk space error messages were received from the Flight Dynamics

system.

3.2 Ground Stations and Network

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

REDU

After the ground station handover from DSS27 to REDU on DOY094, the test Command shows "A" in on-board verification, the on-board counters remain unchanged. ECC was asked to recycle TC link, after which a test command was send ok.

On DOY095 Data gaps on VC-7 and bad frames were received. These drops in telemetry are due to RFI from an unidentified source, which do not correspond with the times of predicted Formosat RFI.

From DOY111, 00:37:00, to DOY112, 06:10:00, Bad frames were received frequently. Network could not see any problems on the station; the downlink signal level, SNR and uplink onboard AGC level were all good. Computer could not see any problems on the line. The probable cause is RFI. To see if the problems with the bad frames could be solved a ground station handover to Vil2 was done on DOY111 at 22:55:00, the operations were moved from the A-Chain to the B-Chain (MCS and NCTRS) at 23:09:00. On the same day at 23:20:00 a switch from primary line to ISDN backup line was made and at 03:22:00 the switch was made back to the prime line again. After each switch it seemed as if this solved the problem of the bad frames, but after a few minutes bad frames were received again. In the evening of DOY112 and on DOY113, DOY114, DOY155, DOY119 and DOY122 bad frames from Redu were received numerous times and again no problems on the station or on the line could be found.

A meeting will be held in May to see if RFI is indeed causing these problems or if there is another source.

DSS27

On DOY097 there was a drop in VC-0 and VC-7 for a few seconds.

Villafranca-2

On DOY117 Bad frames were received from VIL2.

Figure 11 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.

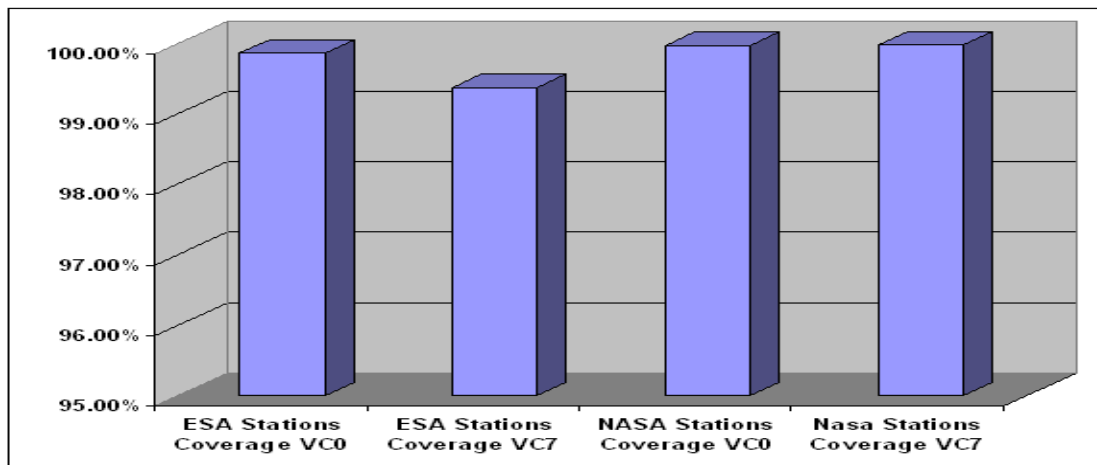


Figure 11: The usage of ESA ground stations compared to the usage of DSN ground stations

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 917 to 928, corresponding to the time range 17 April to 22 May. SPI annealing ended in revolution 916.

Observations have been planned for revolutions 912 (2-5 April) to 928 (20-22 May). Three further TOO requests were received, two of which were approved - GX 339-4 and XTE J1752-223. Together with the ongoing observations of 1A0535+262 this led to three TOO targets being observed within two revolutions (917 & 918).

TSFs have been received for revolutions 912 to 922.

3.3.2 Observation Status

New ECS files have been received for revolutions 896-898 and 900-906 (up to 18 March), filling previous gaps.

3.3.3 ISOC Science Data Archive

Problems in the ingestion of OSA 7 data have been identified and will be tackled as soon as possible.

Raw TM data are routinely transferred from MOC with some gaps still to be closed.

A new disk array, replacing several older disks, has been set up.

3.3.4 ISOC System

ISOC V25 to support the TAC process has been installed on the operational system.

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-281	08.04.2010	IMU-1 Temp Test invalid	Spacecraft	Pending
INT_SC-284	11.04.2010	Several loss of guide star during perigee passage	Spacecraft	Pending
INT_SC-285	12.04.2010	IREM Anomaly: Reset of IREM_CSCI S/W #88	Payload	Pending
INT_SC-286	19.04.2010	IREM Anomaly: Reset of IREM_CSCI S/W #89	Payload	Pending
INT-3101	21.04.2010	Severe RFI at REDU with impact on science operations	ESA station	Pending
INT_SC-288	27.04.2010	IREM Anomaly: Reset of IREM_CSCI S/W #90	Payload	Pending
INT_SC-289	28.04.2010	IREM Anomaly: Reset of IREM_CSCI S/W #91	Payload	Pending

5 Special Events & Future Milestones

- DCA move: Operations will be moved to a temporarily DCA, room D142, on May 04 and May 05. Operations will remain in D142 until the renovation works of the DCA, room E41, have been finished.
- MEOR June: Preparations are ongoing.
- Upgrade of the line to ISDC: It will be upgraded to 2MB.

6 Appendix

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

6.1 AOCS operations

During this period, 529 Open Loop Slews, 285 Closed Loop Slews and 20 Momentum Biases were executed (as reported by ACC OEM).

7 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 01/05/2010 is reported in the following plot:

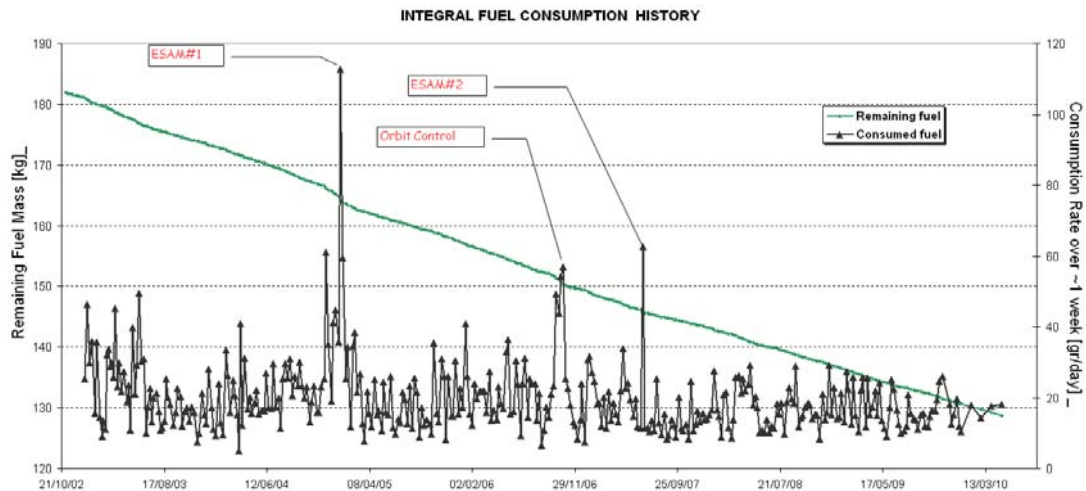


Figure 12: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

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.

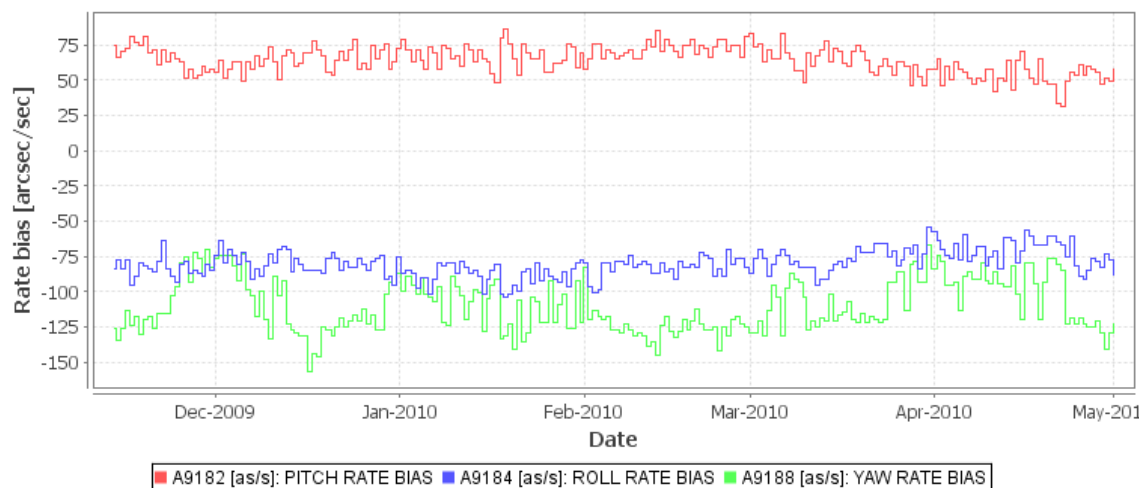


Figure 13: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

01/04/2010 (Day of Year 91, Revolution 911 to 911)

FDS TPF update failed for slew 09110053 (00:44:00Z). A mapping was commanded and the parameters for slew 09110053 were manually updated (spacontool).

No impact on the Timeline.

07/04/2010 (Day of Year 97, Revolution 913 to 913)

FDS TPF update failed for slew 09130041 (02:00:00Z). A mapping was commanded and the parameters for slew 09110053 were manually updated (spacontool).

No impact on the Timeline.

08/04/2010 (Day of Year 98, Revolution 913 to 914)

- Repeated loss of guide star during perigee passage (up to four times between 05:20:00Z and 06:12:00Z). IMU switched ON and OFF three times.

Several attempts to use recoverschedule were performed, but attitude determination would fail.

Later in the orbit, a mapping was commanded and recoverschedule used (successful attitude determination) to perform the recovery.

The RWB 0914_0050_M.RWB was executed (07:33:00Z) to recover the one missed in the Timeline.

A manual slew (0914_0502_M.OSL) was performed to go to attitude 09140004. Then a mapping was commanded and the parameters for slew 09140004 were manually updated (spacontool).

Slows 09140001, 09140002, 09140003 and 09140004 were missed from the Timeline. The OTF was not reached for their PIDs.

- IMU1 switched ON during the stable pointing of PID 09140012 (17:39:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 09140013 were manually updated (spacontool).

OTF was not reached for PID 09140012.

11/04/2010 (Day of Year 101, Revolution 914 to 915)

- Repeated loss of guide star during perigee passage (up to seven times between 03:20:00Z and 06:00:00Z). IMU switched ON and OFF three times.

Several attempts to use recoverschedule were performed in order to generate a CGS, but attitude determination would fail. FD was called and advice to perform the RWB in the Timeline on the current guide star at that time.

No impact on the Timeline.

- IMU1 switched ON during the stable pointing of PID 09150013 (18:56:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 09150014 were manually updated (spacontool).

OTF was not reached for PID 09150013.

17/04/2010 (Day of Year 107, Revolution 916 to 917)

IMU1 switched ON directly after perigee (05:30:00Z), prior to a RWB. FD was called and authorized to execute the RWB on the current star at that time.

19/04/2010 (Day of Year 109, Revolution 917 to 917)

IMU1 switched ON during the stable pointing of PID 09170060 (14:51:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 09170061 were manually updated (spacontool).

OTF was not reached for PID 09170060.

21/04/2010 (Day of Year 111, Revolution 918 to 918)

- As a consequence of TM/TC link problems from both Redu and Vilspa (from 18:30:00Z), the execution of slews 09180045, 09180046 and 09180047 failed.

The TPF 0918_0500_M.OSL was uplinked (22:41:00) to slew from attitude 09180044 to attitude 09180045.

After TM/TC link was recovered, a mapping was commanded and a manual slew was performed from attitude 09180045 to attitude 09080047.

The parameters for slew 09180048 were afterwards manually updated (spacontool).

Slews 09180045, 09180046 and 09180047 were missed from the Timeline.

OTF was not reached for PID 09180044, 09180045, 09180046 and 09180047.

- IMU1 switched ON during the stable pointing of PID 09180047 (23:40:00Z). After the IMU switched back OFF, a manual mapping was commanded and the parameters for slew 09180048 were manually updated (spacontool).

OTF was not reached for PID 09180047.

6.2 SPI

6.2.1 Operations

Stirling Compressors and Cryostat

The performance of the compressors is nominal and appears to be fully recovered following the annealing.

The cryocooler was in Standby until the start of active cooling on 11/04/2010. After switch-on, all four compressors were operated at full stroke (45) until 15-04-2010T20:30Z, when the stroke reduction to achieve 80K on the Cold Plate was started. The final stroke of 37 was reached at 16-04-2010T16:19Z and the 80K range on the Cold Plate was reached at 17-04-2010T16:32:16Z. Since then the Cold Plate temperature was maintained in the range 80K +/- 1K. The stroke of all four compressors was increased to 38 on 30-04-2010T13:03Z as the Cold Plate temperature had reached 80.9K.

The following plot shows the evolution of the Cold Plate, thermal braids and Cold Box temperatures since during the annealing cycle:

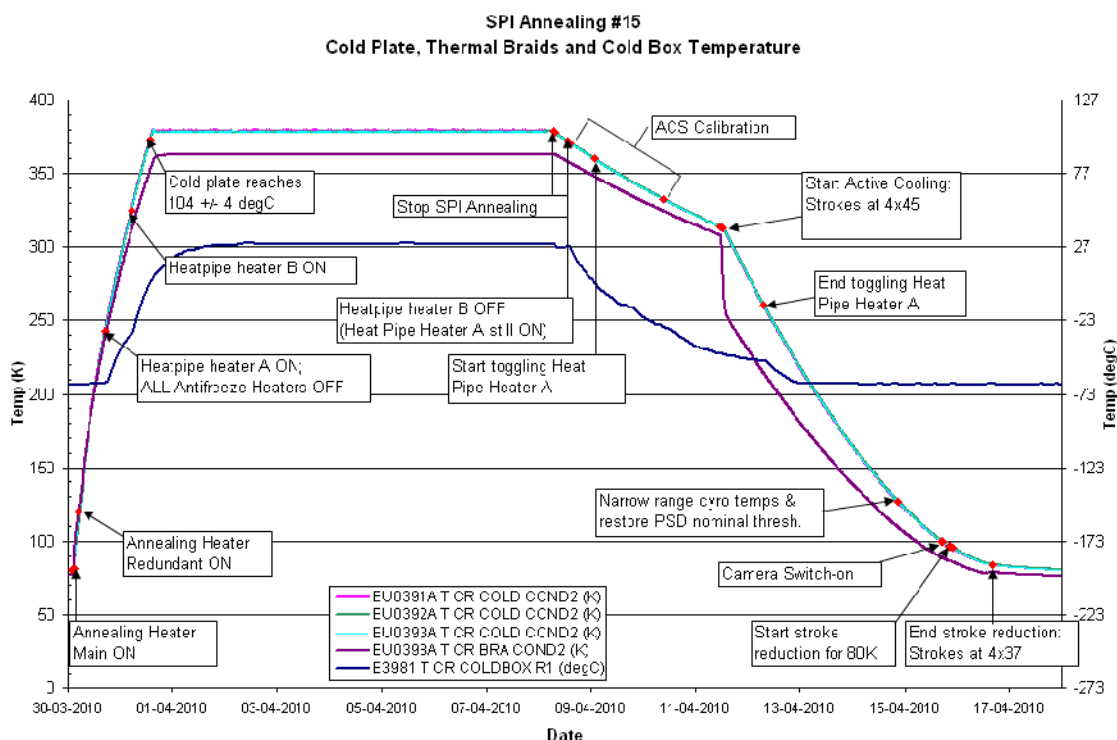


Figure 14 SPI Cold Plate, thermal braids and Cold Box temperature during annealing #15

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

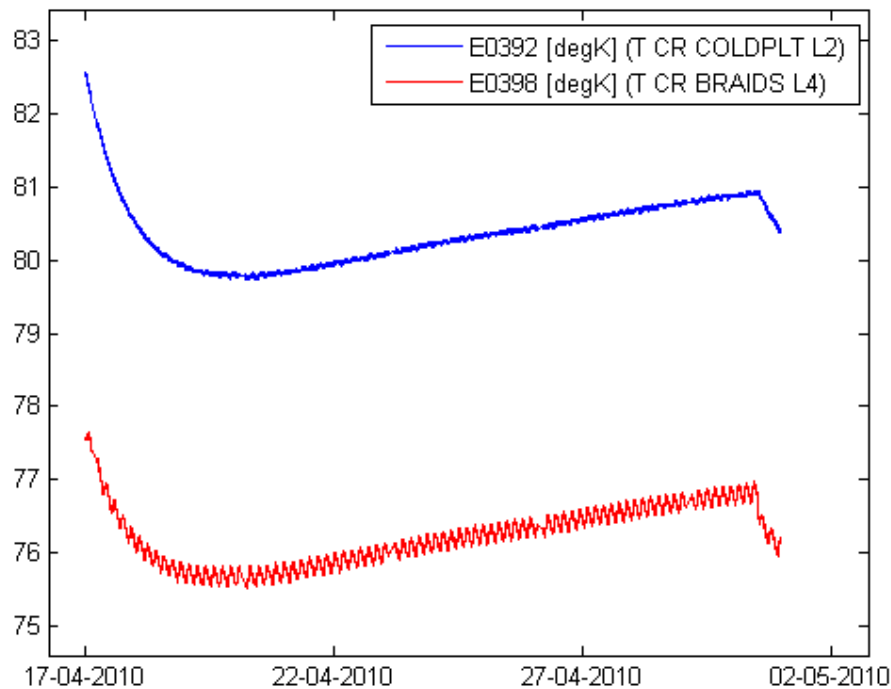


Figure 15 SPI Cold Plate and Thermal Briads Temperature since the end of Annealing #15

The drift of the Cold Plate temperature has returned to a nominal rate ($\sim 0.12\text{K/day}$ with compressor stroke of 37), i.e. similar to what was the case prior to the CDE2 LCL trip-off which occurred following annealing #14.

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

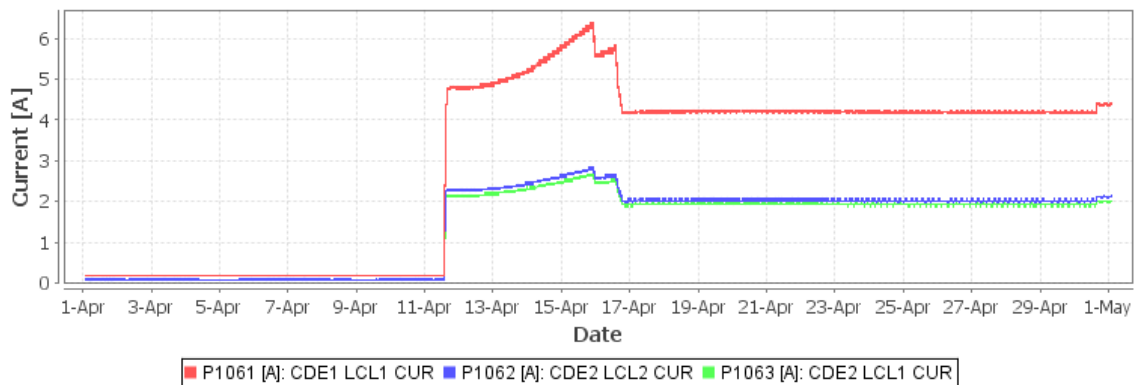


Figure 16: SPI CDE LCL current

DPE & IASW

The DPE health and IASW performance are nominal. The IASW version installed is v4.3.5. Due to the annealing operations, the IASW was in CONF mode until the camera switch-on performed on

15/04/2010. On 16/04/2010 between 10:12Z and 10:28Z the operations were performed to enable PSD Event lossy compression (PE reduction). Since this time both SE compression and PE reduction have been enabled. The spectra scaling factor has remained set to 7/19 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.

Due to the ongoing annealing operations, the ACS High Voltages were set to the minimum voltage (~980V) and the ACS was in CONF mode until the start of passive cooling, when the ACS Calibration was performed. The ACS Calibration was performed from 08-04-2010T14:24:58Z to 10-04-2010T09:08:29Z 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 16/04/2010 at 10:46:58Z.

AFEE

The health of the AFEE is nominal. 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. The following plot shows the AFEE DC output voltages over the reporting period.

Due to the ongoing annealing operations, all detector HVPs were off and only the LVPs left on, with the AFEE in CONF mode, until the SPI camera switch-on, which started on 15/04/2010 at 17:00Z.

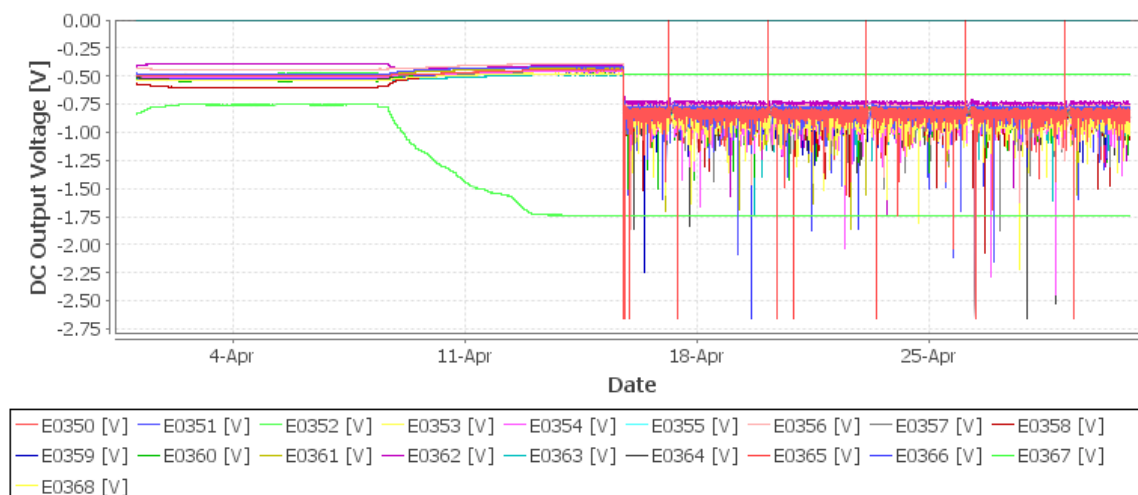


Figure 17: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)

DFEE

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

Due to the ongoing annealing operations, the DFEE was in CONF mode until the SPI camera switch-on, which started on 15/04/2010 at 17:00Z.



Figure 18: SPI GeD Non-Vetoed count rates. Note that the scale used for plotting is logarithmic

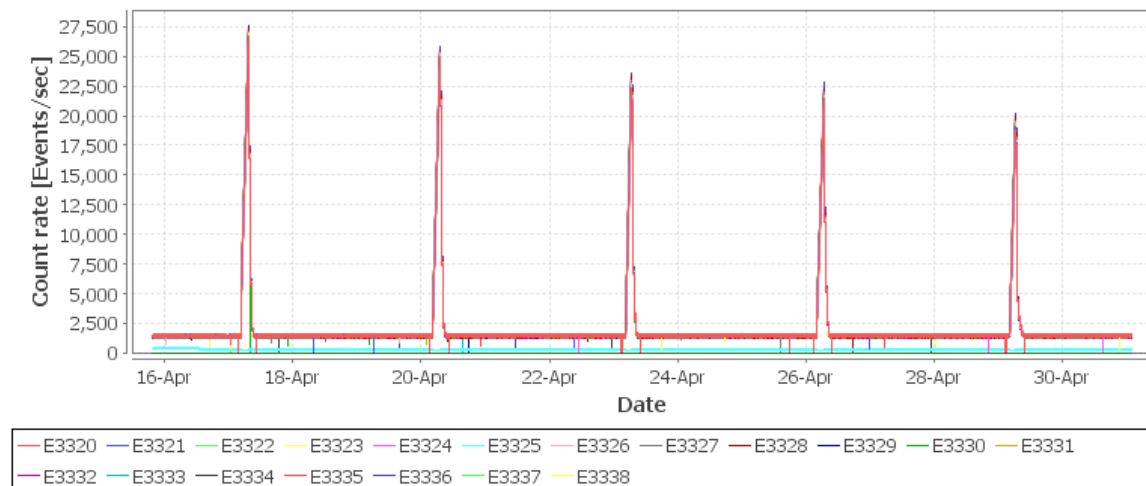


Figure 19: SPI GeD Time Tag count rates



Figure 20: SPI GeD Time Tag Saturated count rates

PSD

The health of the PSD is nominal. The following plot shows the PSD channel rates over the reporting period. Due to the ongoing annealing operations, the PSD was in CONF mode until the SPI camera switch-on, which started on 15/04/2010 at 17:00Z.

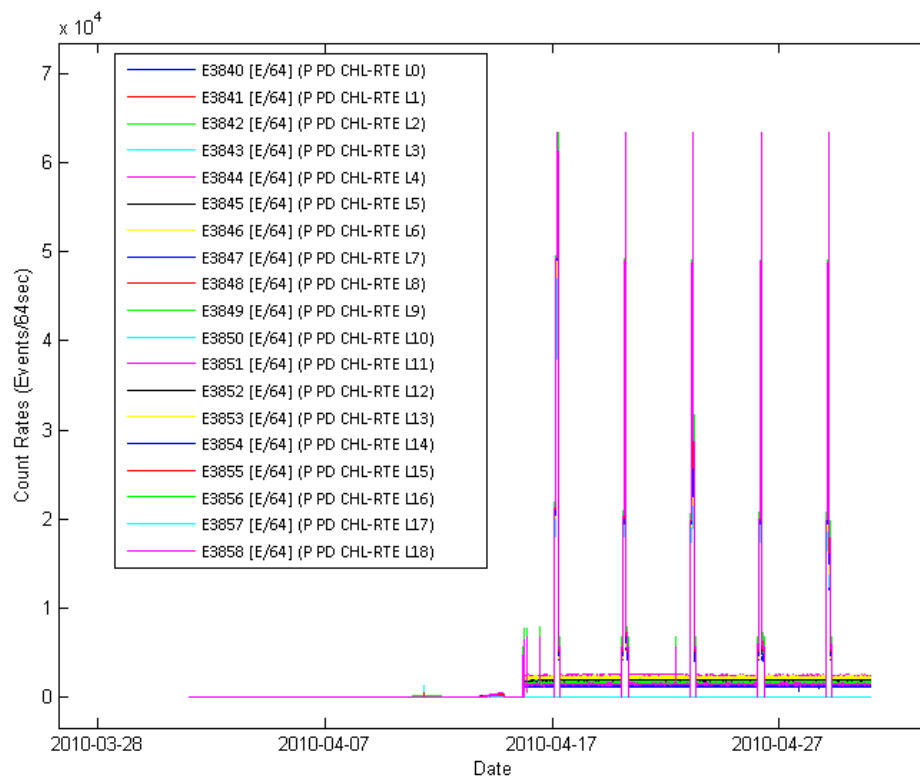


Figure 21: SPI PSD GeD Channel Rates

6.2.2 Event Log

- 40 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 may be reduced in the near future to avoid frequent issuing of these OEMs.

22-04-2010 (Day of Year 112, Revolution 918)

At 10:30:36Z the DFEE Control Lines configuration parameters were updated in order to disable the failed GeDs in the DFEE (current nominal configuration as per TPF ES1721_DF-CLPAR_fmconfig_0008.TPF), as it was observed that the failed GeDs were enabled. This had been the case since the start of eclipse season, when the DFEE configuration parameters were updated via the EDs EENTRY03 and EEXIT-03 in the Timeline. However this only has an adverse impact when PSD Event compression is enabled. The procedures and monitoring checks are being reviewed in order to ensure that the failed GeDs are disabled in the DFEE whenever PSD Event compression is enabled.

29-04-2010 (Day of Year 119, Revolution 920 - 921)

Due to continuing high background after the expected radiation belt exit of revolution 921, TM parameter E3500 (ACS Counts Below 100MeV) went OOL High at 07:57:47Z. As it returned within limits of its own accord at 08:03:31Z, no action was taken.

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:

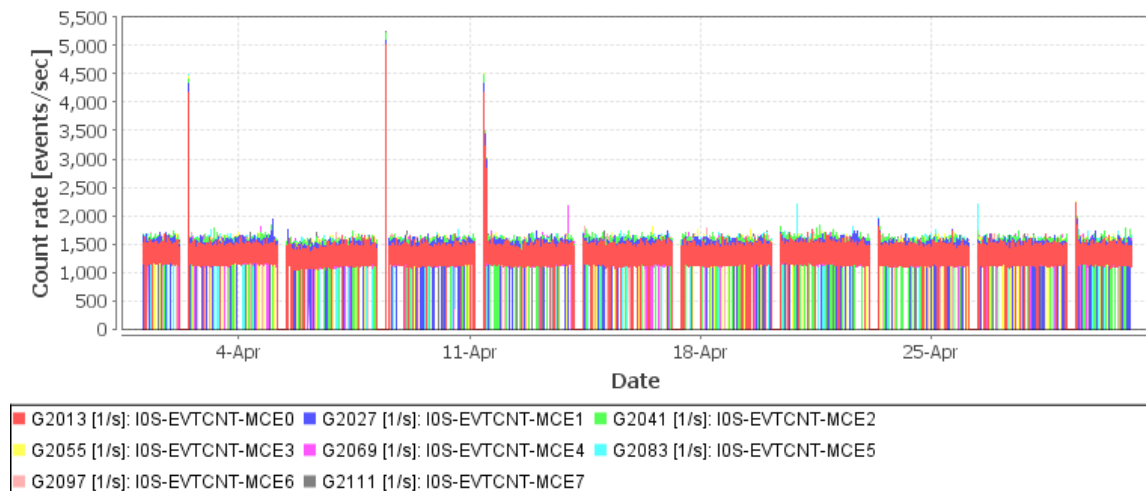


Figure 22: ISGRI MCE Counters

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 23: 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.

6.3.2 Event Log

- Due to continuing high radiation at radiation belt exit of revolutions 912, 914 and 915, 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. In revolution 914 this resulted in IBIS going autonomously to Safe and being reactivated manually at a later stage. For the other 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.

08-04-2010 (Day of Year 098, Revolution 913 - 914)

Due to continuing high radiation just before the planned radiation belt exit of revolution 914, after ISGRI had been commanded to Nominal mode via the Timeline, IBIS transitioned autonomously to Safe configuration at 2010.098.09.06.46Z. Consequently, the TC G0129 to put IBIS in Science Standard mode (part of ED GESTAN02) at 2010.098.09.21.38Z failed release. To ensure the safe configuration of IBIS, it was commanded again to Safe via FCP_IBIS1_0801 at 2010.098.09.33.04Z. Once the radiation levels had decreased to safe levels, IBIS was recovered as follows:

- At 2010.098.11.05.32Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2010.098.11.17.42Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

09-04-2010 (Day of Year 099, Revolution 914)

At 2010.099.00.56.58Z the TM parameters families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 2010.099.00.57.25Z the TM parameter families G5002 and G5003 for the PDM semi-module counters started going OOL Low. As these were followed at 2010.099.01.00.48Z 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.

12-04-2010 (Day of Year 102, Revolution 915)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 2010.102.11.08.07Z. It was recovered as follows:

- At 2010.102.12.01.10Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2010.102.12.17.35Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

19-04-2010 (Day of Year 109, Revolution 917)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 2010.109.07.12.08Z. It was recovered as follows:

- At 2010.109.07.25.49Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2010.109.07.41.02Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

27-04-2010 (Day of Year 117, Revolution 920)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 2010.117.03.35.36Z. It was recovered as follows:

- At 2010.117.04.17.11Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2010.117.04.30.27Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

28-04-2010 (Day of Year 118, Revolution 920)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 2010.118.02.32.33Z. It was recovered as follows:

- At 2010.118.02.59.30Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2010.118.03.10.09Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

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.

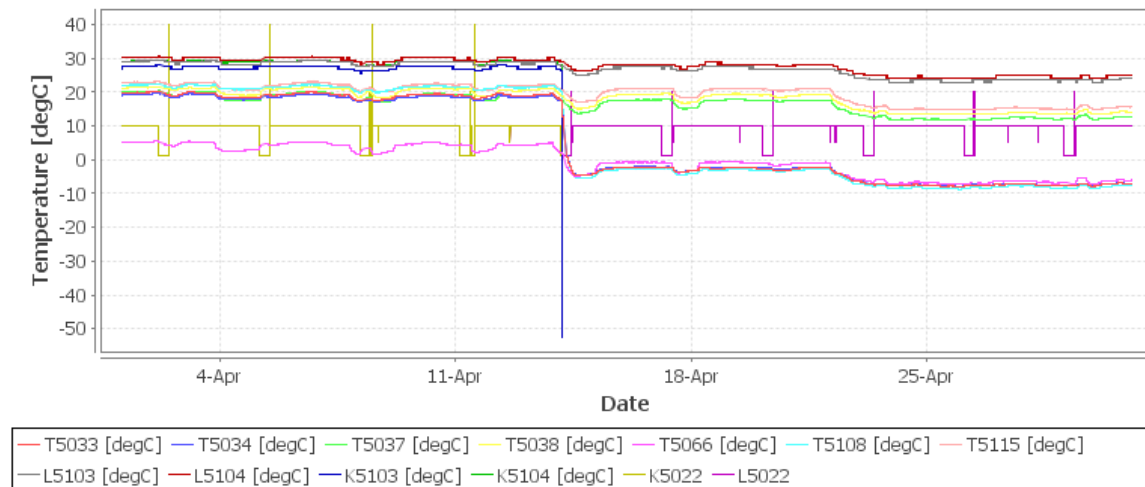


Figure 24: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

2010-04-02 (DoY 092 Rev 911-912)

At 09:10:45 & 09:11:49, parameters K5317 & L5317 respectively, exceeded hard limits. There was no impact as the reaction has been disabled.

2010-04-08 (DoY 098 Rev 913-914)

From 08:50:53 to 09:45:25, parameters K5317 & L5317 repeatedly exceeded hard limits. There was no impact as the reaction has been disabled. Later, from 09:27:57 to 09:33:55, parameters K5449 & L5119 exceeded hard limits, causing the High Voltage activation (at 09:29:00) for both JEMX-1 & 2 to fail uplink. The units were both recovered, and the timeline rejoined at 10:10:00.

2010-04-11 (DoY 101 Rev 914-915)

From 08:38:31 to 09:29:01, parameters K5317 & L5317 repeatedly exceeded hard limits. There was no impact as the reaction has been disabled. Later, from 09:22:29 to 09:33:55, parameters K5449 & L5119 exceeded hard limits, causing both JEMX-1 & 2 to go to SAFE mode. The units were both recovered, and the timeline rejoined at 12:00:00.

2010-04-12 (DoY 102 Rev 915)

At 11:08:46 JEMX-2 parameters L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#88). There was no impact as the reaction has been disabled.

2010-04-14 (DoY 104 Rev 915-916)

At 01:48, manual operations were commenced to turn off JEMX-1.

These consisted of:

- 01:48:32 FCP_JEM1_0120 JEMX1 SET BCP OVERRIDES inhibiting reaction to belt entry.
- 01:53:48 FCP_JEM1_9010 JEMX1 DFEE SWITCH OFF.
- 01:58:23 FCP_JEM1_0120 JEMX1 SET BCP OVERRIDES enabling reaction to belt entry.
- 02:00:28 FCP_JEM1_9001 JEMX1 DISABLE BCP DISTRIBUTION
- 02:06:47 FCP_JEM1_9000 JEMX1 DPE SWITCH OFF

2010-04-19 (DoY 109 Rev 917)

At 07:12:15 JEMX-2 parameters L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#89). There was no impact as the reaction has been disabled.

2010-04-27 (DoY 117 Rev 920)

At 03:36:12 JEMX-2 parameters L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#90). There was no impact as the reaction has been disabled.

2010-04-28 (DoY 118 Rev 920)

At 02:33:06 JEMX-2 parameters L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#91). There was no impact as the reaction has been disabled.

2010-04-29 (DoY 119 Rev 920-921)

From 07:59:52 parameter L5449 exceeded hard limits. No action was taken, and there was no impact.

6.5 OMC***6.5.1 Operations***

The status and performance of OMC is nominal.

6.5.2 Event Log**03-04-2010 (Day of Year 093, Revolution 912)**

At 18:15:14, a Trigger command was sent by ISDC. This command was rejected, as the unit was in Stand-by mode at the time. There was no impact.

2010.093.18.15.14.918	2010.093.18.15.18.847	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E E

08-04-2010 (Day of Year 098, Revolution 914)

At 05:58:00 at AOS, it was observed that during the perigee passage, the guide star had been lost. This forced an interruption of operations, and a recovery was performed. At 10:18, this was completed, and the timeline restored. The impact was the loss of pointing 09140004.

12-04-2010 (Day of Year 102, Revolution 915)

At 11:07:59 an IREM SEU (#88) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 11:37:50. The impact was an interruption of pointing 09150029 after 1520 from a planned 3479 seconds.

19-04-2010 (Day of Year 109, Revolution 917)

At 07:12:00 an IREM SEU (#89) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 07:22:46. The impact was an interruption of pointing 09170051 after 2105 from a planned 3000 seconds.

21-04-2010 (Day of Year 111, Revolution 918)

At 21:20, bad frames from Redu forced an interruption in operations. A recovery was performed, and the timeline rejoined at 23:38. The bad frames only stopped when a ground station handover to DSS-27 was performed at 06:10 the following morning. The impact was the loss of pointings 09180045 & 09180046, with 09180047 executed at an incorrect attitude. It was at this time that the following pair of commands was rejected:

2010.111.22.31.12.080	2010.111.22.31.23.877	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2010.111.22.31.18.080	2010.111.22.31.23.906	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 09180045.

27-04-2010 (Day of Year 117, Revolution 920)

At 03:35:28 an IREM SEU (#90) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 04:03:21. The impact was an interruption of pointing 09200033 after 224 from a planned 2000 seconds.

28-04-2010 (Day of Year 118, Revolution 920)

At 02:32:24 an IREM SEU (#91) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 02:55:05. The impact was an interruption of pointing 09200070 after 1848 from a planned 2000 seconds, and the loss of pointing 09200071.

6.6 IREM

6.6.1 Operations

Radiation belts entry and exit

The following plots show the Radiation Belt Entry (Figure 25, red line) and Exit times (Figure 26, blue line) obtained from the ISDC website, defined where the IREM TC3 (soft electrons) rate reads 600 counts. The blue line in Figure 25 and the magenta line in Figure 26 are the altitudes used by the MOC for planning purposes.

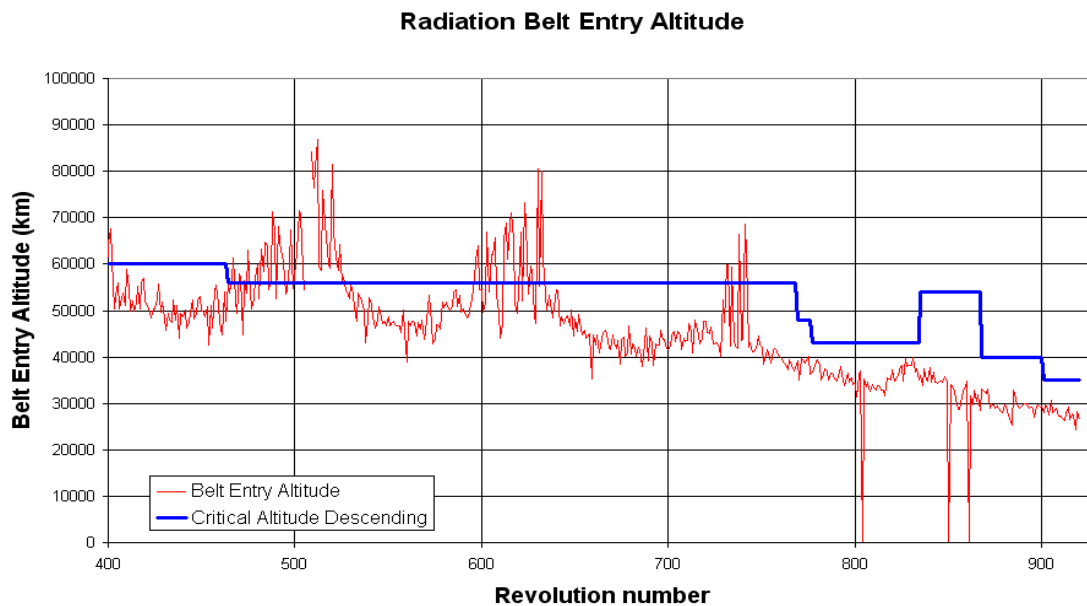


Figure 25: Radiation belt entry

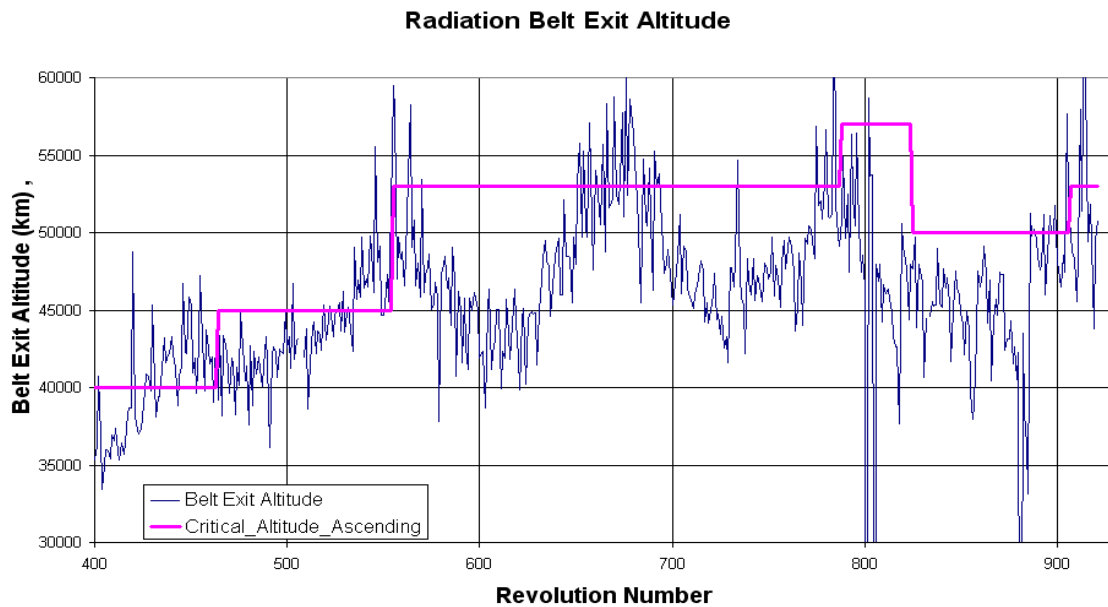


Figure 26: Radiation belt exit

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
911	RAD_ENTR R 2010-04-02T02:23:39Z	02/04/2010 03:32:54	21407.4	02-Apr-2010 03:17:10	24273.27	02-Apr-2010 04:17:10	11284.59
912	RAD_EXIT R 2010-04-02T09:25:15Z	02/04/2010 09:19:58	>>29829.9	02-Apr-2010 08:47:10	47216.16	02-Apr-2010 04:47:10	6150.374
912	RAD_ENTR R 2010-04-05T02:14:17Z	05/04/2010 03:28:30	19668.8	05-Apr-2010 03:06:07	24529.77	05-Apr-2010 04:06:07	11542.82
913	RAD_EXIT R 2010-04-05T09:15:41Z	05/04/2010 08:27:26	>>29844.4	05-Apr-2010 08:36:07	47018.39	05-Apr-2010 04:46:07	5549.822
913	RAD_ENTR R 2010-04-08T02:03:21Z	08/04/2010 03:08:14	22114.3	08-Apr-2010 03:03:36	22858.03	08-Apr-2010 03:53:36	12003.32

914	RAD_EXIT R 2010-04- 08T09:04:54Z	08/04/2010 11:59:18	75746.1	08-Apr-2010 08:23:36	46644.38	08-Apr-2010 04:33:36	5685.87
914	RAD_ENTR R 2010-04- 11T01:50:28Z	11/04/2010 02:49:34	23918.3	11-Apr-2010 02:48:34	23667.88	11-Apr-2010 03:48:34	10707.57
915	RAD_EXIT R 2010-04- 11T08:52:00Z	11/04/2010 10:17:58	64427.2	11-Apr-2010 08:08:34	46023.08	11-Apr-2010 04:18:34	5932.092
915	RAD_ENTR R 2010-04- 14T01:38:00Z	14/04/2010 02:40:22	21937.9	14-Apr-2010 02:34:32	24093.55	14-Apr-2010 03:34:32	11058.48
916	RAD_EXIT R 2010-04- 14T08:38:56Z	14/04/2010 07:42:06	43859.	14-Apr-2010 08:04:32	47425.54	14-Apr-2010 04:04:32	5990.956
916	RAD_ENTR R 2010-04- 17T01:26:38Z	17/04/2010 02:32:47	22083.9	17-Apr-2010 02:28:08	22647.1	17-Apr-2010 03:18:08	11662.65
917	RAD_EXIT R 2010-04- 17T08:26:48Z	17/04/2010 07:51:19	47493.6	17-Apr-2010 07:48:08	47021.67	17-Apr-2010 03:58:08	5390.278
917	RAD_ENTR R 2010-04- 20T01:14:27Z	20/04/2010 02:21:03	21481.8	20-Apr-2010 02:12:20	23452.95	20-Apr-2010 03:12:20	10360.04
918	RAD_EXIT R 2010-04- 20T08:14:32Z	20/04/2010 07:32:55	>>27922.8	20-Apr-2010 07:32:20	46378.2	20-Apr-2010 03:42:20	5633.917
918	RAD_ENTR R 2010-04- 23T01:00:30Z	Not available	-	23-Apr-2010 02:03:40	22213.03	23-Apr-2010 02:53:40	11232.97
919	RAD_EXIT R 2010-04- 23T08:00:27Z	23/04/2010 06:33:27	38918.8	23-Apr-2010 07:23:40	47338.03	23-Apr-2010 03:23:40	5989.764
919	RAD_ENTR R 2010-04- 26T00:48:44Z	26/04/2010 01:51:35	21601.7	26-Apr-2010 01:51:34	22386.33	26-Apr-2010 02:41:34	11319.35
920	RAD_EXIT R 2010-04- 26T07:47:49Z	26/04/2010 06:53:03	>>27977.5	26-Apr-2010 07:01:34	45712.32	26-Apr-2010 03:21:34	5195.178
920	RAD_ENTR R 2010-04- 29T00:39:21Z	29/04/2010 01:50:31	21958.5	29-Apr-2010 01:38:56	23040.48	29-Apr-2010 02:28:56	11928.39
921	RAD_EXIT R 2010-04- 29T07:37:35Z	29/04/2010 07:02:31	>>28026.9	29-Apr-2010 06:58:56	46959.31	29-Apr-2010 03:08:56	5203.797

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

12-04-2010 (Day of Year 102, Revolution 915)

At 11:07:58Z, a local reset of the IREM CSCI S/W (SEU #88) 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 2010.102.11:07:58Z (154866.1 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 15:06:00Z.

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 11:37:50Z and IBIS at 12:19:00Z.

19-04-2010 (Day of Year 109, Revolution 917)

At 07:11:59Z, a local reset of the IREM CSCI S/W (SEU #89) 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 2010.109.07:11:59Z (137434.3 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 09:37:00Z.

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 07.22.46Z and IBIS at 07:42:00Z.

27-04-2010 (Day of Year 117, Revolution 909 - 910)

At 03:35:27Z, a local reset of the IREM CSCI S/W (SEU #90) 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 2010.117.03:35:27Z (145683.9 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 07:28:00Z.

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 04.03.21Z and IBIS at 04:32:00Z.

28-04-2010 (Day of Year 118, Revolution 910)

At 02:32:23Z, a local reset of the IREM CSCI S/W (SEU #91) 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 2010.118.02:32:23Z (146972.1 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 04:34:00Z.

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 02:55:05Z and IBIS at 03:11:00Z.