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

INTEGRAL
Mission report

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

No. 403
01.12.2011

Routine Phase

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

Table of Contents

1	General.....	5
2	Satellite status.....	6
2.1	Platform	6
2.1.1	AOCS.....	6
2.1.2	Power	6
2.1.3	Thermal	6
2.1.4	OBDH	6
2.1.5	RFS.....	6
2.2	Payload	6
2.2.1	SPI.....	6
2.2.2	IBIS.....	9
2.2.3	JEM-X.....	10
2.2.4	OMC.....	10
2.2.5	IREM	11
3	Ground Facilities	14
3.1	Mission Control System	14
3.2	Ground Stations and Network.....	14
3.3	ISOC	15
3.3.1	Mission Planning	15
3.3.2	Observation Status	15
3.3.3	ISOC Science Data Archive	15
3.3.4	ISOC System	16
3.3.5	Problems	16
4	Anomalies	16

5	Special Events & Future Milestones.....	17
6	Appendix	17
6.1	AOCS operations.....	17
6.1.1	Fuel consumption.....	17
6.1.2	The RMU-A null bias calibration.....	18
6.1.3	Event log.....	18
6.2	SPI.....	20
6.2.1	Operations.....	20
6.2.2	Event Log.....	25
6.3	IBIS.....	26
6.3.1	Operations.....	26
6.3.2	Event Log.....	27
6.4	JEM-X.....	29
6.4.1	Operations.....	29
6.4.2	Event Log.....	29
6.5	OMC.....	30
6.5.1	Operations.....	30
6.5.2	Event Log.....	30
6.6	IREM.....	31
6.6.1	Operations.....	31
6.6.2	Event Log.....	34

Distribution List

ESOC		ESAC	
	SPACONs	A. Parmar (SRE-OA)	P. Kretschmar (SRE-OAG)
N. Bobrinsky (OPS-L)	F. Sheasby	M. Kessler (SRE-O)	E. Kuulkers (SRE-OAG)
A. Rudolph (OPS-OA)	F. Dreger	V. Gomes (DG-V)	
J. Miro (OPS-G)	A. McDonald	ESTEC	
		C. Winkler (SRE-SA)	G. Sarri (SRE-PP)
J. Roldan	W. Hell	N. Rando (SRE-PAM)	H. Evans (TEC-EES)
M. Kirsch	K.J. Schulz	S. Taylor (TEC-EPG)	
R. Southworth	M.A. Larsen	ESA HQ:	T. Reiter (D-HSO)
S. Fahmy	R. Hussock	Redu:	B. Demelenne
J. Martin	J. Howard	ISDC	
F. Cordero	M. Butkovic	R. Walter	ISDC Shift Team
F. Di Marco	J. Audric	C. Ferrigno	R. Rohlf's
S. DePadova		ALENIA	
D. Weibert	Shift – Coord	M. Montagna	F. Ravera
F. Schmidt	Scheduling Office	PI / Instrument Teams	
C. Lozano	T. Beck	A. Bazzano (IBIS)	W. Hajdas (IREM)
M. Pantaleoni	M. Rossmann	G. La Rosa (IBIS)	S. Brandt (JEM X)
M. Walker	M. Unal	F. Lebrun (IBIS)	E. De Miguel (OMC)
U. Weissmann		P. Ubertini (IBIS)	J. P. Roques (SPI)
N. von Krusenstiern	A. Mantineo	C. Brysbaert (SPI)	
J. Hübner	K. Scott		
INTEGRAL/XMM Flight Dynamics team			

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 November and covers the revolutions 1105 until 1115 (included). The targets of these revolutions can be found on the ISOC web: <http://integral.esac.esa.int/isocweb/schedule.html?action=intro>.

Summary of the main activities during the reporting period

- Routine science operations continued in November. Additionally 15 days of Target of Opportunity Observations were devoted to the new Supernova 2011fe.
- Start of SPI Annealing #18
- OMC in safe mode due to high radiation for 13 hours
- During this reporting period, 622 of the 639 planned science pointings were executed nominally. 1 pointing was lost due to an FD problem, 1 pointing was lost and 3 interrupted due to IREM crashes, and 11 pointings lost and one interrupted due to high radiation. One Flat-field calibration was performed this month.
- E3.5 Testing

Summary of the overall status and performance of S/C and G/S

- Nominal for platform and payload
- Slews completed successfully: 99.7% (679 / 681), the requirement is 95%.
- Data return: 99.96% housekeeping, 99.87% science, the requirement is 95%
- Ongoing occasional RFI at Redu, source mostly unknown / some sources identified
- Increased fuel consumption this year is probably related to the perigee attitude selected to shelter the spectrometer cooler from the earth albedo. Since August this special attitude has not been used and fuel consumption is back in line with the long term mean. Post SPI annealing in December this special attitude will again be adopted for several months.
- The Perigee altitude reached a minimum height of 2756km on 25/10/2011 and has started to increase again. This very low perigee has led to increased exposure to proton radiation with the consequences of:

- An increased rate of solar array degradation.
- Indications of an increased number of star tracker blemish pixels.

This condition will probably persist until late 2013. As the power margin is currently still very good it is hoped that it will not be necessary to constrain the solar aspect angle.

- Only minor anomalies occurred (3 recurring and one new anomaly on the spacecraft, some on the ground segment) with no significant impact on mission performance, which remained above requirements
- IREM Anomaly: Reset of IREM_CSCI S/W #117 (10/11/2011)
- IREM Anomaly: Reset of IREM_CSCI S/W #118 (17/11/2011)

The previous weekly and monthly reports are available at the XMM-INTTEGRAL website: <http://xmm.esoc.esa.int/documentation/documentation.php>.

2 Satellite status

2.1 Platform

2.1.1 AOCS

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

2 slews were missed from the Timeline.

The fuel consumption over the reporting period was 0.4981 Kg. The remaining propellant is in the order of 116.5374 Kg.

Note: Some more information concerning the AOCS operations and the fuel budget is provided in the Appendix 6.1.

2.1.2 Power

All units of the EPS are working nominally.

2.1.3 Thermal

The thermal control of the satellite is working well. The temperatures are currently all within the specified operational limits.

2.1.4 OBDH

The OBDH subsystem is working flawlessly. No on-board communications problem has been identified.

The PST was over-subscribed by 3 packets, which were allocated to SPI during the Instrument window for the entire reporting period.

2.1.5 RFS

The RF subsystem is working properly. The link margin is sufficient to ensure proper TM reception and execution of commands with the ranging channel enabled.

2.2 Payload

2.2.1 SPI

Following the 17th 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).

The Germanium detectors' temperature was kept in the range 80K $\pm$ 1K until the start of the 18th SPI annealing on 21/11/2011 at 08:03Z. Operations for the SPI annealing #18 were performed according

to OCR 316. Following anomaly took place: The annealing should have taken place with the outgassing of the cold box at +30degC. On 22/11/2011 (DOY 326) after the switch ON of the heat pipe heater main and the switch OFF of the antifreeze heater 1 main as par SPI annealing #18 procedure (OCR#316), a steady increase of the AFEE DC output voltages of the detectors 2, 8 and 11 was observed. Therefore it was decided by the SPI PI to continue SPI annealing without the outgassing of the cold box. The cold box temperature was set to -65 degC again and maintained there for the rest of the annealing cycle. The 18th SPI will end on 09/12/2011.

The times for the main activities for SPI annealing #18 in November were as following:

Date/Time	Activity
2011-11-21 06:58:00	Configure SPI for start of Annealing and stop SPI active cooling
2011-11-21 08:28:00	Annealing Heater Main ON
2011-11-21 11:59:00	Annealing Heater Redundant ON
2011-11-21 23:13:10	Heat Pipe Heater Main ON, All Antifreeze Heaters (1A; 2A; 1B; 2B) OFF
2011-11-21 23:13:18	Heat Pipe Heater Redundant ON
2011-11-22 05:26:54	Heat Pipe Heater Main OFF, Antifreeze Heater 1 main ON
2011-11-22 05:29:00	Detetele TT TC for Heat Pipe Heater Redundant ON
2011-11-22 19:47:28	Cold plate temperature reached 373K (100degC)

SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 99 packets/cycle, except from 2011-11-12T05:02:59Z to the end of revolution 1108 at 2011-11-12T10:13:40Z (OMC Flat Field Calibration), when it was 88 packets/cycle, and from 2011-11-21T15:36:04Z to the end of the month during the SPI annealing when it was 30 packets/cycle. The average telemetry occupation when the allocation was 99 packets/cycle was 74.4 packets/cycle.

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

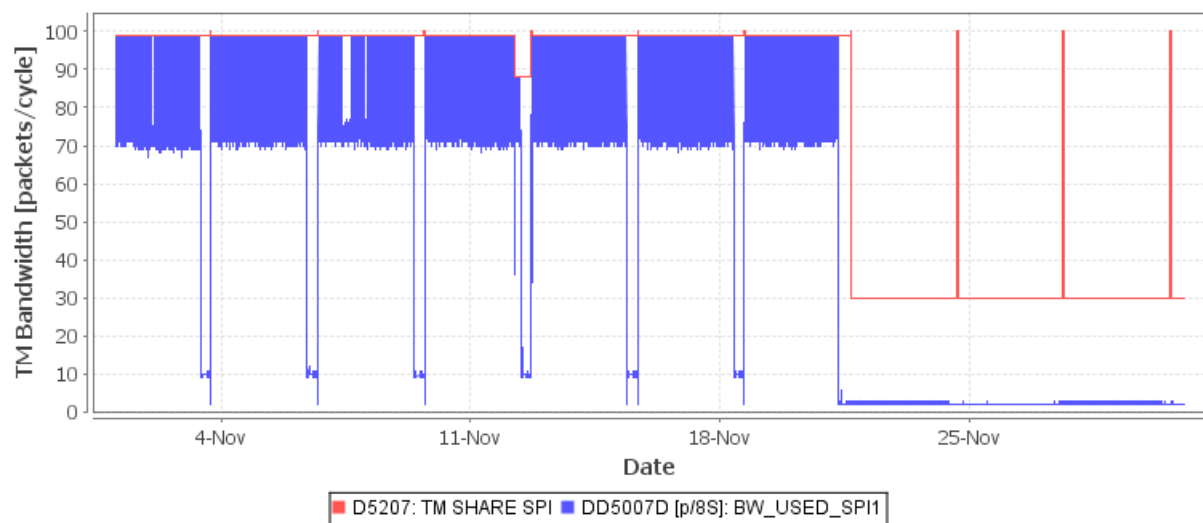


Figure 1: SPI TM bandwidth utilisation

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

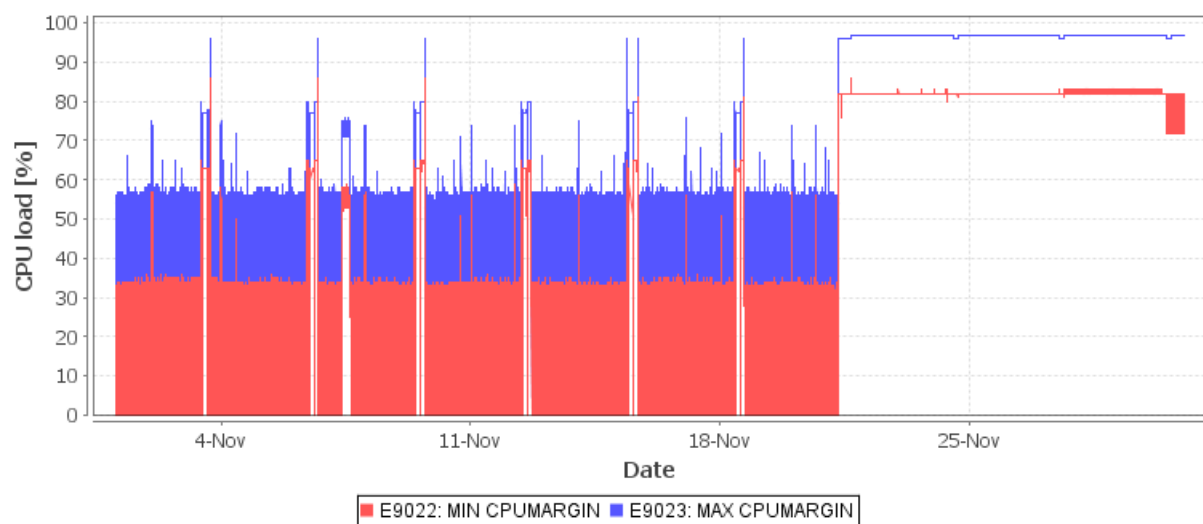


Figure 2: SPI IASW Performance

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

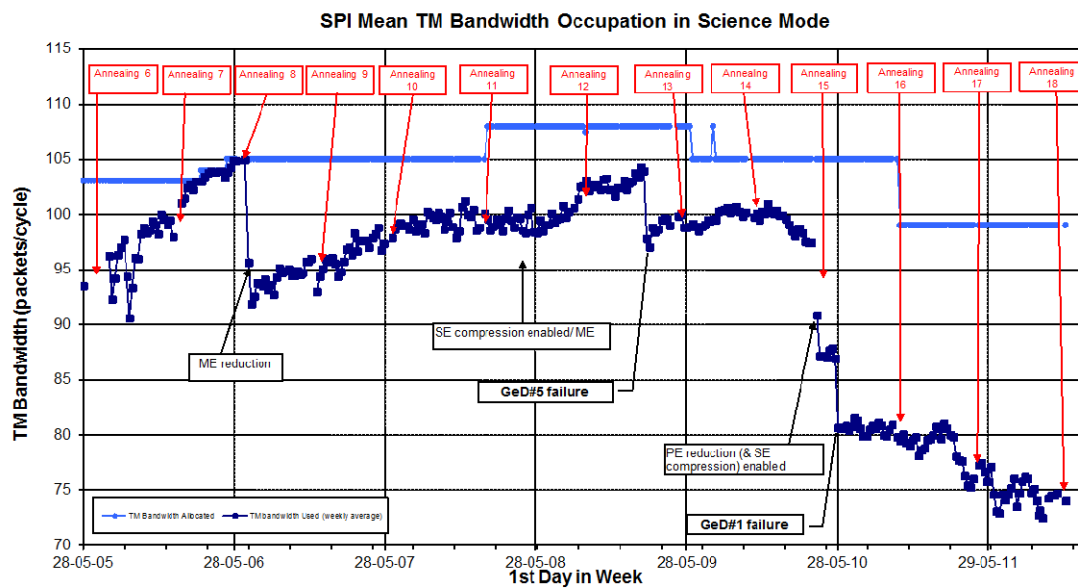


Figure 3: SPI TM bandwidth usage evolution since May 2005

Note: More information concerning the SPI operations is provided in Appendix 6.2.

2.2.2 IBIS

The overall status of IBIS is nominal.

During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 129 packets/cycle, except from 2011-11-12T05:02:59Z to the end of revolution 1108 at 2011-11-12T10:13:40Z (OMC Flat Field Calibration), when it was 90 packets/cycle, and from 2011-11-21T15:36:04Z to the end of the month during the SPI annealing when it was 180 packets/cycle.

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

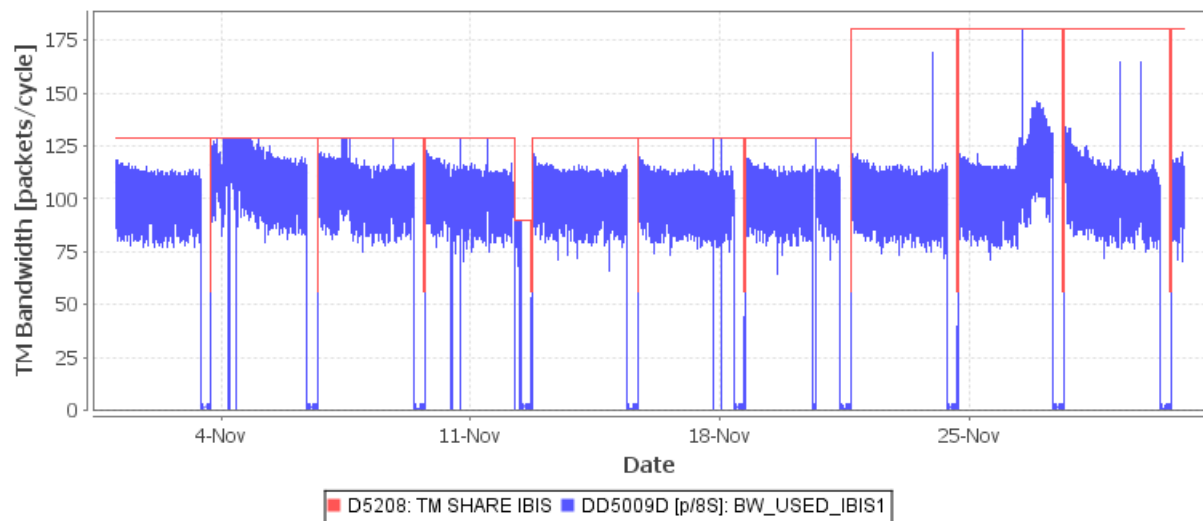


Figure 4: IBIS TM bandwidth utilisation

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

2.2.3 JEM-X

The status of both JEM-X units is nominal:

- JEM-X1 & 2 were operated in Data Taking mode with a TM allocation of 8 packets/cycle each, except from 2011-11-12T05:02:59Z to the end of revolution 1108 at 2011-11-12T10:13:40Z (OMC Flat Field Calibration), when it was 4 packets/cycle each, and from 2011-11-21T15:36:04Z to the end of the month during the SPI annealing when it was 15 packets/cycle each.

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

2.2.4 OMC

The status of OMC is nominal.

OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle, except from 2011-11-12T05:02:59Z to the end of revolution 1108 at 2011-11-12T10:13:40Z during the Flat-field calibration, when it was 63 packets/cycle, and from 2011-11-21T15:36:04Z to the end of the month during the SPI annealing when it was 9 packets/cycle.

During this reporting period, 622 of the 639 planned science pointings were executed nominally. 1 pointing was lost to an FD problem, 1 pointing was lost and 3 interrupted due to IREM crashes, and 11 pointings lost and one interrupted due to high radiation. One Flat-field calibration was performed this month.

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

2.2.5 IREM

The status of IREM is nominal.

On DoY 314 (10/11/2011), the 117th IREM SEU occurred

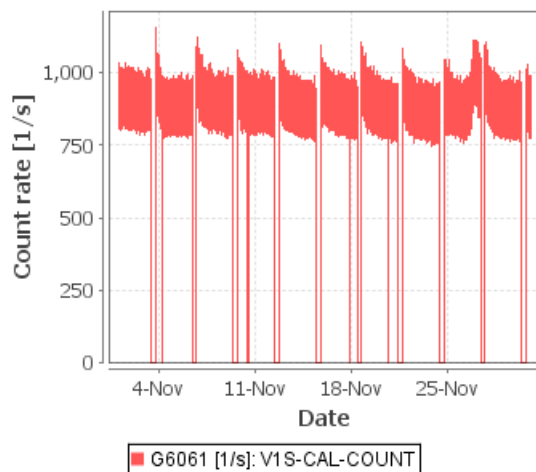
On DoY 321 (17/11/2011), the 118th IREM SEU occurred

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

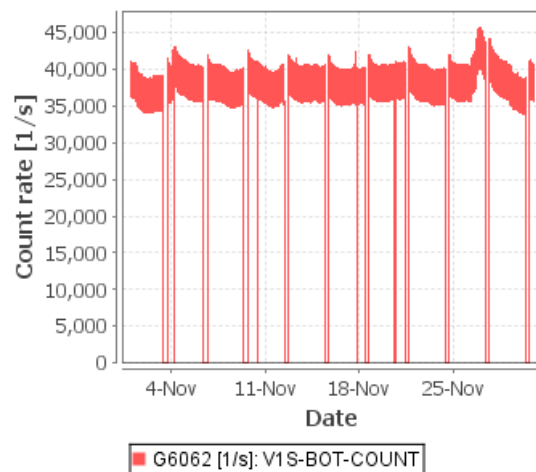
Radiation background

With the exception of the 26th and 27th of the month, when high radiation forced OMC to SAFE, the background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the reporting period:

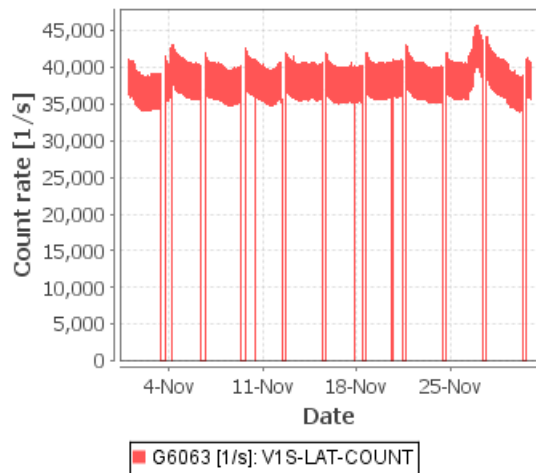
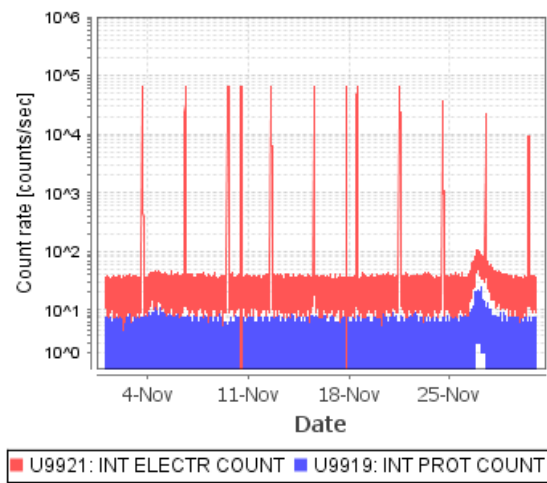
VETO Calibration Source Count Rate



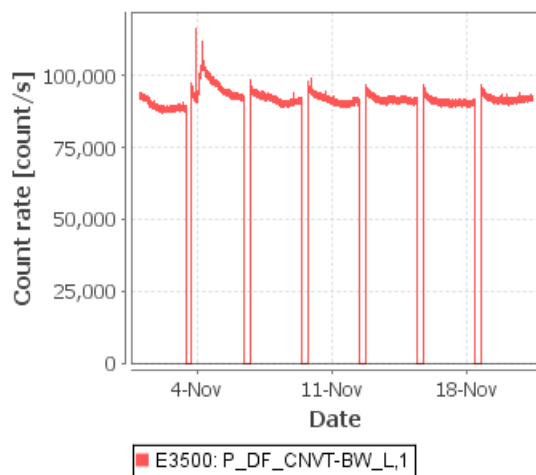
VETO Bottom Count Rate



VETO Lateral Count Rate

IREM Proton & Electron Counters¹

ACS Below 100MeV



ACS Above 100MeV

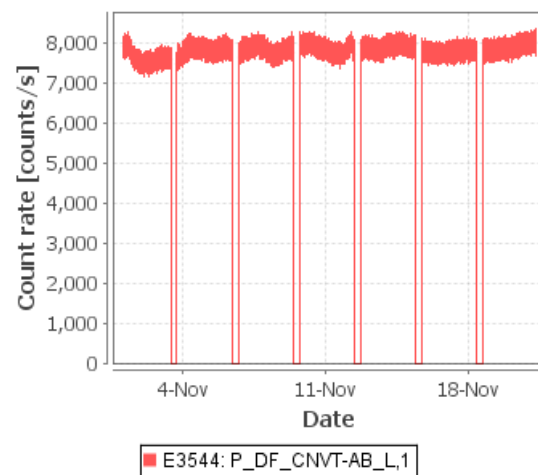


Figure 5: Instrument Count Rates

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

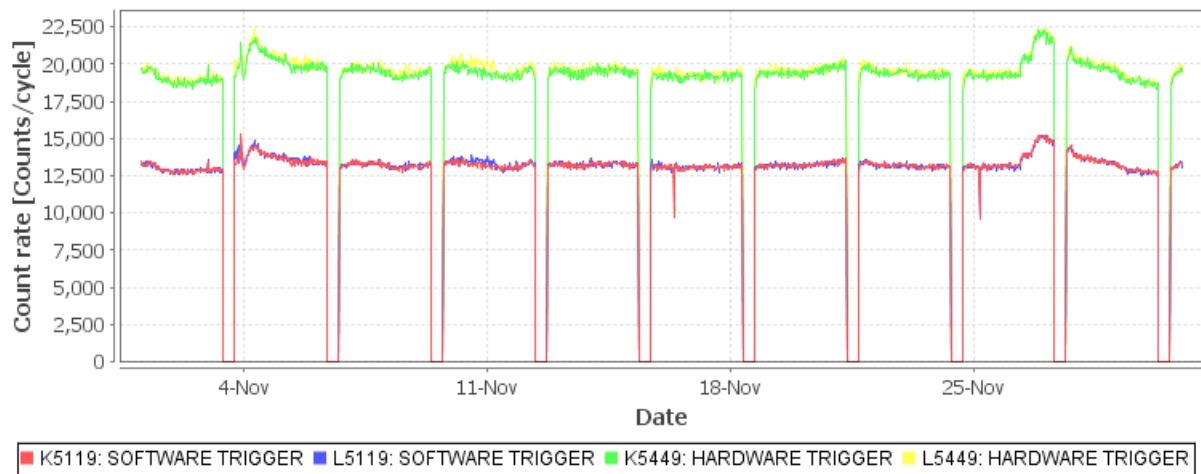


Figure 6: JEM-X Count rates. The smaller downward spikes in the figure are due to the slews of the spacecraft

Radiation Belts

Figure 7 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.

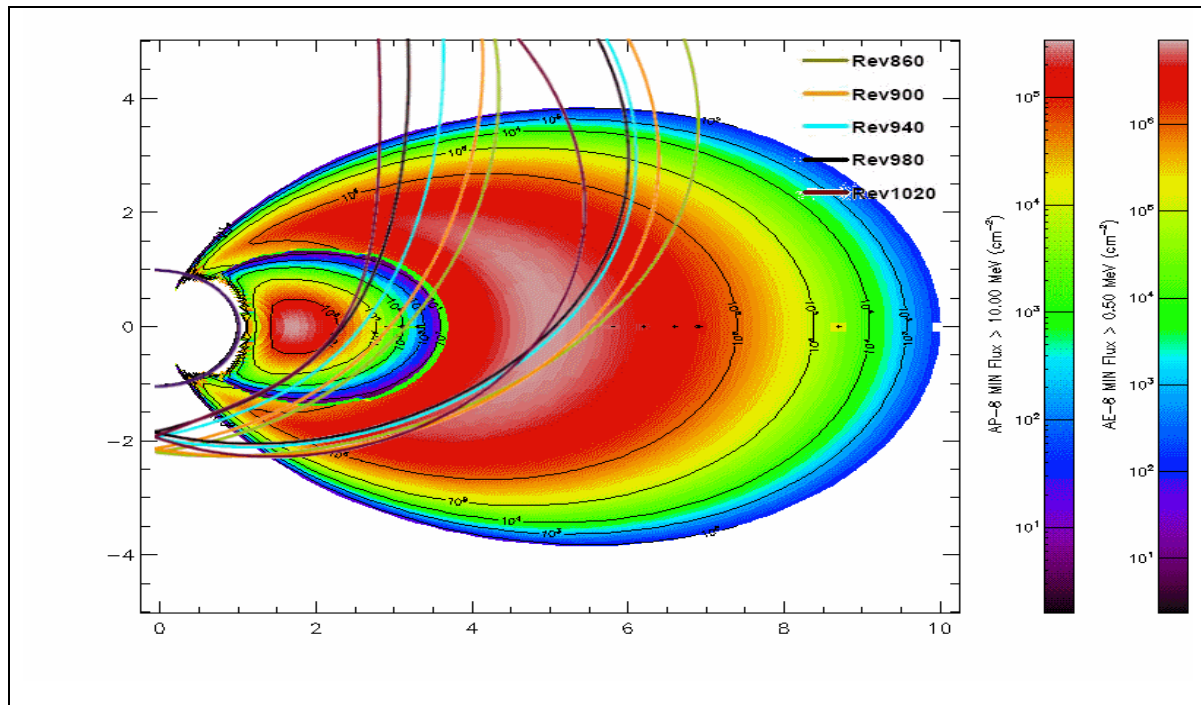


Figure 7: The predicted evolution of the orbit of Integral through the radiation belts

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.

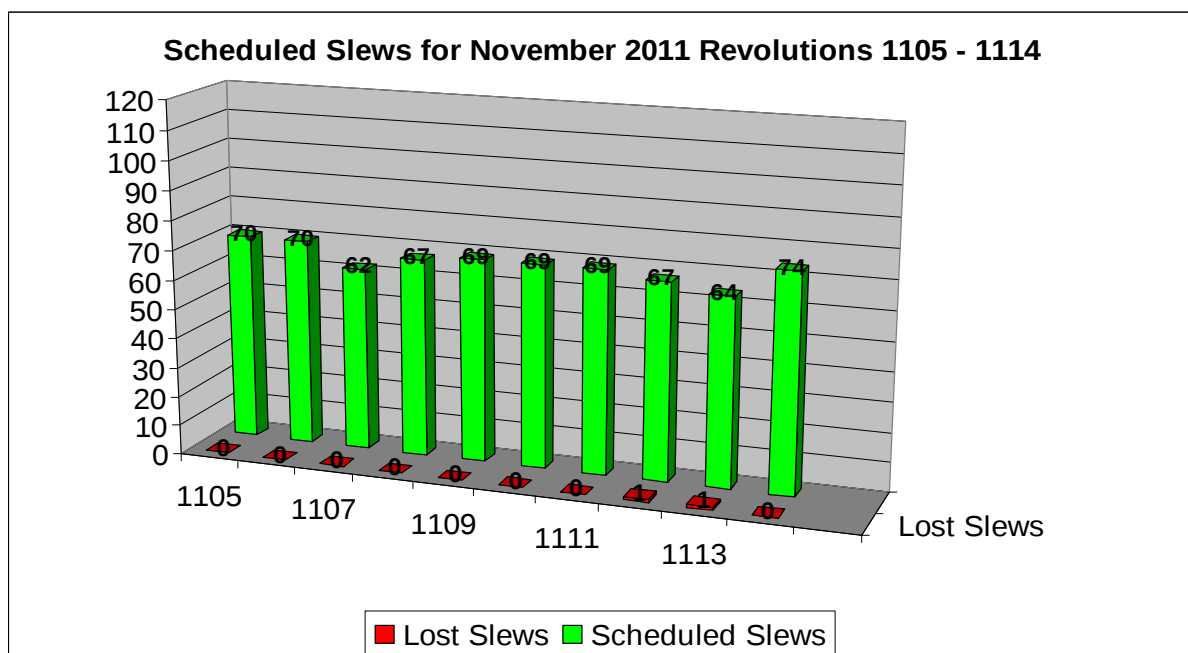


Figure 8: The number of slews scheduled compared to the number of slews lost

3.1 Mission Control System

Not available this month.

3.2 Ground Stations and Network

Not available this month.

Figure 9 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.

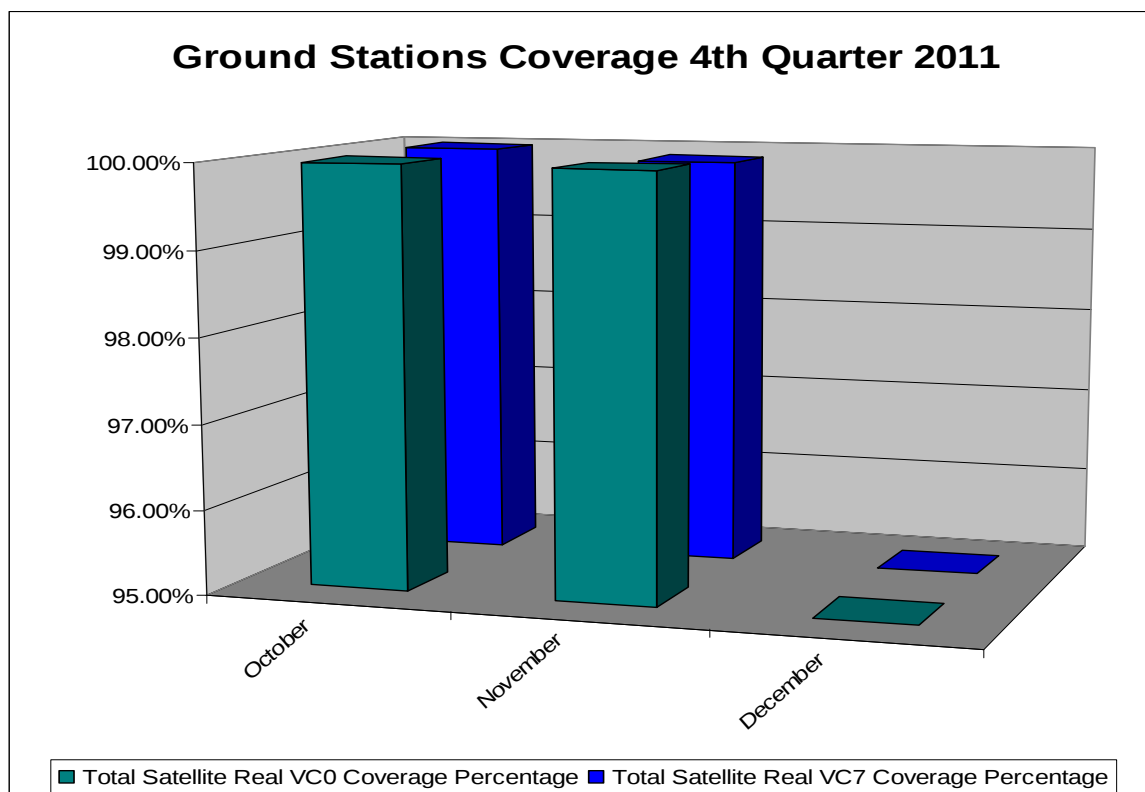


Figure 9: Comparison of VC0 to VC7 coverage

3.3 ISOC

3.3.1 Mission Planning

New or updated PSFs have been received for revolutions 1112 to 1123, corresponding to the time range 21 November to 26 December.

New observations have been planned for revolutions 1112 (21-24 November) to 1119 (12-15 December), covering the SPI annealing period. Revolutions 1114 and 1115 had to be re-planned in order to find a valid reaction wheel profile.

TSFs have been received for revolutions 1119 to 1118.

3.3.2 Observation Status

New ECS files have been received for revolutions 1096 to 1100 (covering observations up to 19 October).

3.3.3 ISOC Science Data Archive

Syncing of rev_3 data has been done up to revolution 1051, no change since last report.

Raw telemetry copied from MOC is available up to 20 November.

The ICD for the new ISDA has been further discussed with the ESAC archive team. A Product Definition Document is being prepared.

3.3.4 ISOC System

ISOC software V31.1 was released for testing on 22 November.

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-3209	2011-11-07	Time parameters as dynamic defaults do not work	IMCS	Pending
INT-3210	2011-11-08	IFTS 'target' directory deleted on IDDA	IMCS	Pending
INT-3211	2011-11-16	MCS File station.dat not populated for WHM	IMCS	Pending
INT-3212	2011-11-21	Update slew failure. CGS/RWB generated	FDS	Pending
INT-3213	2011-11-24	IMCA - Store of packet (65535:80:.....) messages - restart of IMCA required	IMCS	Closed
INT-3214	2011-11-26	Attitude determination failures during revolution 1113	FDS	Pending
INT-3215	2011-11-26	OMC to SAFE mode due to high radiation.	Offline Tools	Pending
INT-3216	2011-11-28	Faulty fan in VSDS device (in container with sun121)		Pending
INT_SC-348	2011-11-04	IBIS VETO VDM14 HV Breakdown	Payload	Pending
INT_SC-349	2011-11-10	IREM Anomaly: Reset of IREM_CSCI S/W #117, 10/11/2011	Payload	Closed
INT_SC-350	2011-11-17	IREM Anomaly: Reset of IREM_CSCI S/W #118, 17/11/2011	Payload	Testing
INT_SC-351	2011-11-21	IBIS VETO VDM05 HV Breakdown	Payload	Pending
INT_SC-352	2011-11-22	SPI: AF DC output voltages OOL for L2, L8 and L11 during SPI annealing #18	Payload	Pending

5 Special Events & Future Milestones

Next S/C database update scheduled for early December 2011.

Eclipse season starts on 24th December, with a double eclipse expected on 23rd January 2012 continuing until 7th February.

IMU calibration planned for 14th December 2011.

Star Tracker Blemish Pixel survey is delayed until February.

Spi Annealing due to finish on 9th December.

FSS/Star Tracker calibration 21st March 2012.

E3.5 testing is on-going.

6 Appendix

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

6.1 AOCS operations

During this period, 336 Open Loop Slews, 346 Closed Loop Slews and 24 Momentum Biases were executed (as reported by ACC OEM).

2 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 01/12/2011 is reported in the following plot:

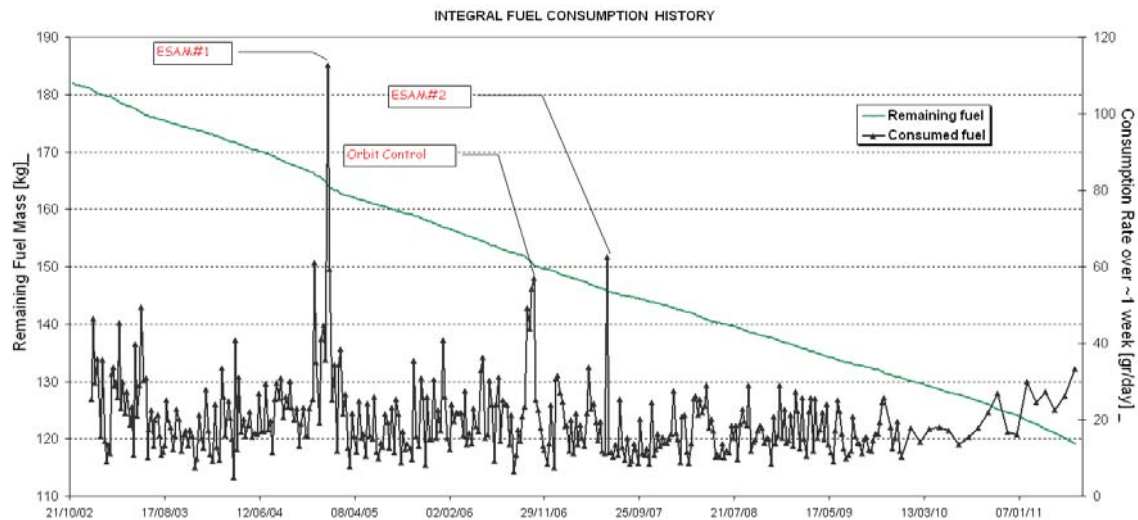


Figure 10: Fuel consumption. Note: ESAM fuel consumption is spread over period of ~1 week.

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.

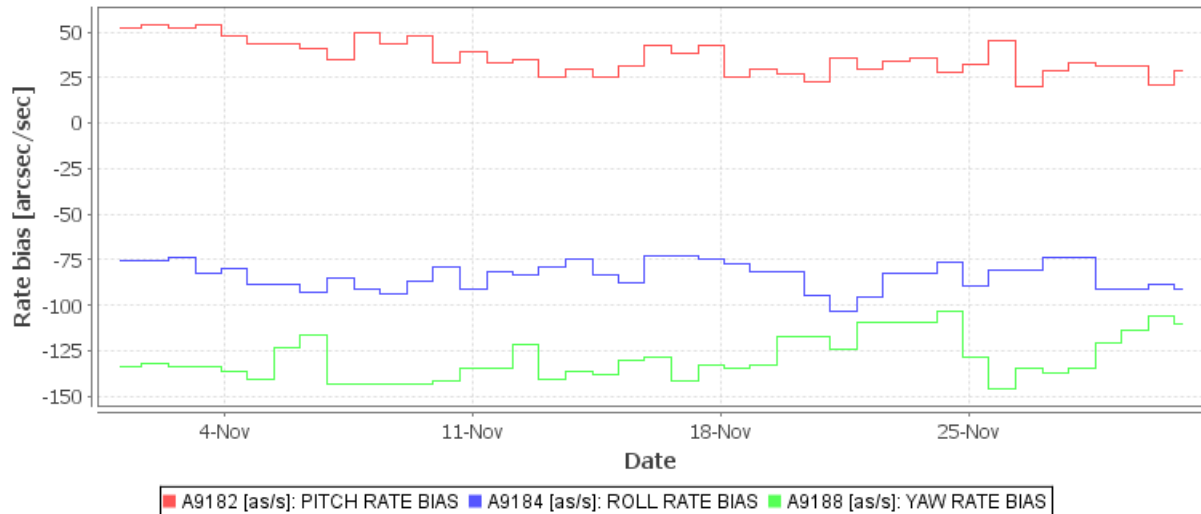


Figure 11: RMU pitch, roll and yaw. Historic data is available on request

6.1.3 Event log

03/11/2011 (Day of Year 307, Revolution 1106)

IMU1 switched ON during perigee passage (11:47:57Z). After the AOS at Redu the AOCs was suspended in the timeline then a manual mapping was performed to generate a new CGS. FD informed that a RWB was not needed. A manual mapping was commanded and the next slew was updated on the Timeline. There was no impact on the Timeline.

07/11/2011 (Day of Year 311, Revolution 1107)

Reaction Control System calibration performed from 08:00:00Z to 14:10:00Z. There was no impact on the Timeline.

12/11/2011 (Day of Year 316, Revolution 1109)

IMU1 switched ON during perigee passage (11:05:03Z). After the AOS at Redu it was seen that the star in slot1 still had the correct coordinates as per previous CGS which is correct for the RWB. There was no impact on the Timeline.

15/11/2011 (Day of Year 319, Revolution 1110)

IMU1 switched ON during perigee passage (10:54:53Z). After the AOS at Redu the AOCS was suspended in the timeline then a manual mapping was performed to generate a new CGS prior to the RWB. There was no impact on the Timeline.

16/11/2011 (Day of Year 320, Revolution 1110)

Uplink of AOCS calibrated parameters: SAS thresholds, TIM Thresholds, RCS on times, RCS reciprocal torques and S/C inertias (from 07:41:00Z until 09:05:00Z). There was no impact on the Timeline.

17/11/2011 (Day of Year 321, Revolution 1110)

FDS TPF update failed for slew 11100036 (01:03:26Z) due to FDS problems. The AOCS was suspended in the timeline then a manual mapping was commanded in order to update the parameters for slew 11100036 manually.

This failed, as a CGS/RWB was necessary. FD was called in and manually generated a TPF which was applied to the Autostack, updating the parameters for slew 11100036.

19/11/2011 (Day of Year 323, Revolution 1111)

FDS TPF update failed for slew 11110024 (12:50:57Z) due to not enough stars in the field of view. FD was called in. The AOCS was suspended in the timeline, then a manual mapping was commanded and the parameters for slew 11110024 were manually updated.

There was no impact on the Timeline.

21/11/2011 (Day of Year 325, Revolution 1112)

IMU1 switched ON during perigee passage (10:31:01Z). After the AOS at Redu the AOCS was suspended in the timeline then a manual mapping was performed. FD was called in as the RWB was missed (12:29:17Z). A manual CGS was commanded. A manual RWB was commanded then a manual mapping was performed to update the parameters for slew 11120001. There was no impact on the Timeline.

23/11/2011 (Day of Year 327, Revolution 1112)

FDS NFS Server was not responding (21:29:00Z). FD was called in. The AOCS was suspended in the timeline then a manual mapping was commanded and a slew was manually generated from attitude 11120055 to attitude 11120056. After the manual slew was completed, the Spacantool was used to update slew 11120057.

Slew 11120056 was missed from the Timeline. The OTF was not reached for its PID.

24/11/2011 (Day of Year 328, Revolution 1113)

TPF to update the parameters for slew 11130001 was generated by the FDS but was not applied on Autostack. This was caused by the IFTS instances not reconnecting properly after a Mission Control System start. FD resent the TPF manually which updated the Autostack. There was no impact on the Timeline.

26/11/2011 (Day of Year 330, Revolution 1113)

- FDS TPF update failed for slew 11130043 (09:53:05Z) due to not enough stars in the field of view. FD was called in. The AOCS was suspended in the timeline then a manual mapping was commanded and a TPF was generated to update slew 11130043. There was no impact on the Timeline.

- FDS TPF update failed for slew 11130044 (10:01:00Z). Not enough stars were detected to perform a closed loop slew. An open loop slew TPF was generated. The AOCS was suspended in the timeline then a manual mapping was commanded. A slew was manually generated from attitude 11130043 to attitude 11130044. A manual mapping was commanded and a TPF was generated to update slew 11130045.

Slew 11130044 was missed from the Timeline. The OTF was not reached for its PID

- FDS TPF update failed for slew 11130050 (16:10:00Z), caused by lack of stars for attitude determination. The AOCS subsystem was suspended in the Timeline, then a mapping was commanded and an attempt was made to reconstruct the attitude. This failed as well.

FD was called in and the parameters for slew 11130050 were manually generated. There was no impact on the Timeline.

6.2 SPI

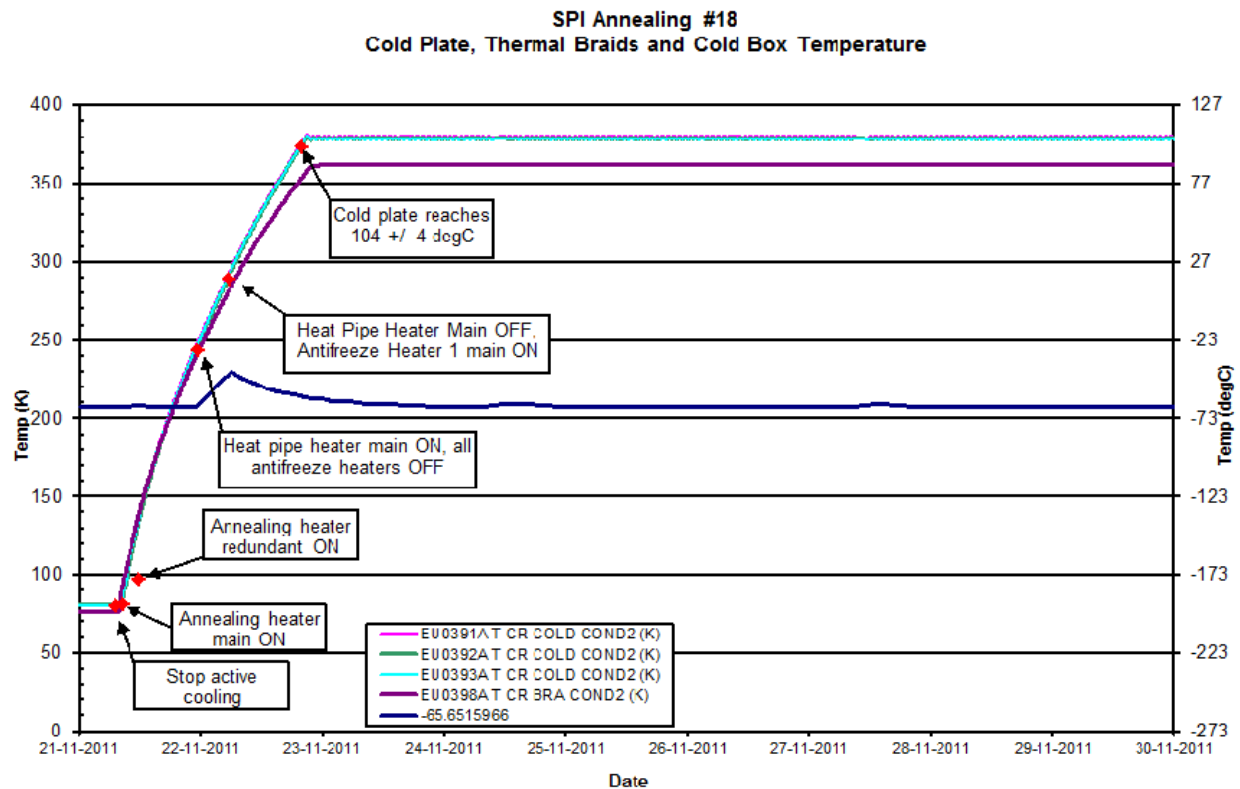
6.2.1 Operations

Stirling Compressors and Cryostat

The stroke of all four compressors was 42 and the cold plate temperature was maintained in the range 80K +/- 1K throughout the month until the start of the 18th SPI annealing on 21/11/2011. The annealing should have taken place with the outgassing of the cold box at +30degC. On 22/11/2011 (DOY 326) after the switch ON of the heat pipe heater main and the switch OFF of the antifreeze heater 1 main as par SPI annealing #18 procedure (OCR#316), a steady increase of the AFEE DC output voltages of the detectors 2, 8 and 11 was observed. Therefore it was decided by the SPI PI to continue SPI annealing without the outgassing of the cold box. The cold box temperature was maintained at -65 degC for the rest of the annealing cycle.

The cryocooler had been put to standby and remained in standby for the rest of the month.

The following plot shows the evolution of the cold plate, thermal braids and cold box temperatures during the annealing cycle in November.



The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K until the start of the SPI annealing #18 on 21/11/2011. The following plot shows the evolution of the cold plate and H bus temperature during the reporting period.

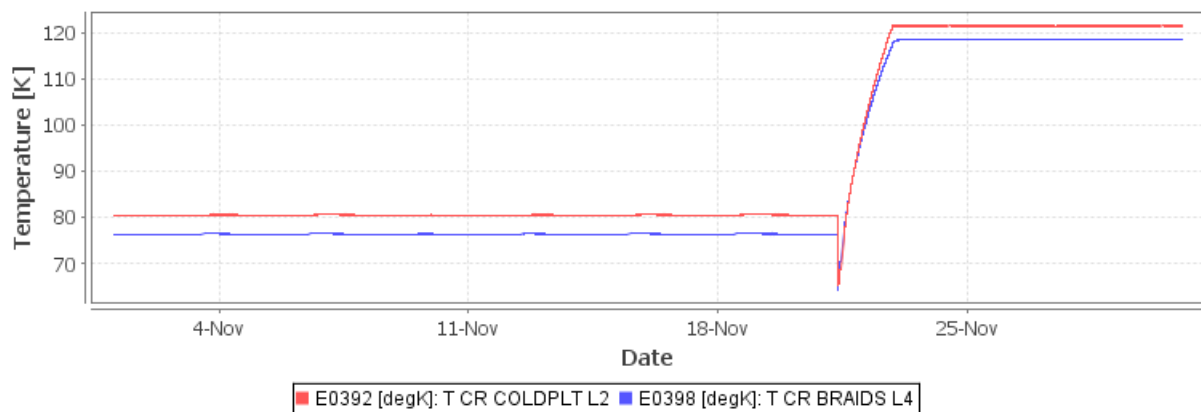


Figure 12: SPI Cold plate and H-bus temperature

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

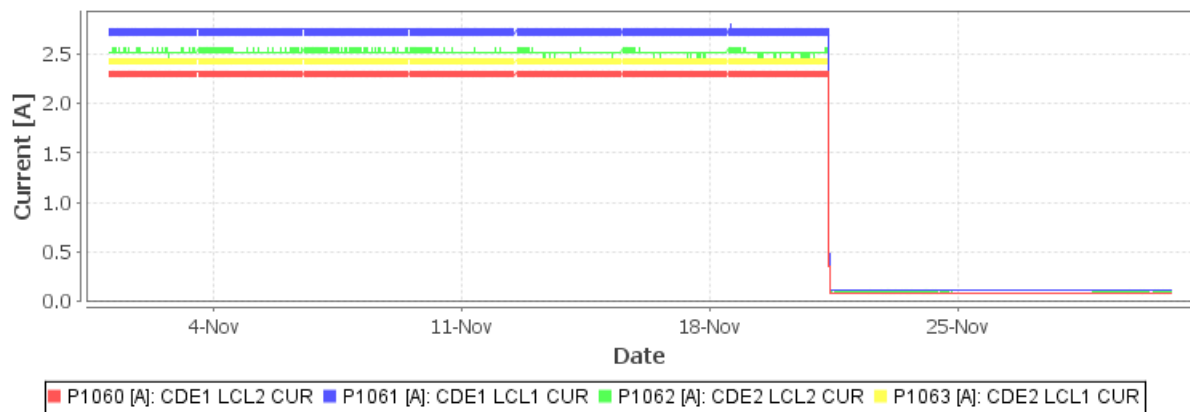


Figure 13: SPI CDE LCL current

DPE & IASW

The DPE health and IASW performance are nominal. The IASW version installed is v4.3.5 with both SE compression and PE reduction enabled and the spectra scaling factor set to 7/19 SE. The DPE CPU usage was nominal during the reporting period (see Figure 2). Due to the annealing operations, the IASW was in CONF mode until the camera switch-on performed on 09/12/2011.

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). 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. A plot of the ACS counts is given in Figure 5: Instrument Count Rates.

AFEE

The health of the AFEE is nominal. Detector #2 is failed since 06/12/2003, detector #17 is failed since 17/07/2004, detector #5 is failed since 19/02/2009 and detector #1 is failed since 27/05/2010. The HV of the failed detectors are nominally set to 0.5kV and events from these GeDs are disabled in the DFEE and PSD. The following plot shows the AFEE DC output voltages over the reporting period. Due to the ongoing annealing operations, all detector HVPs were off and only the LVPSs left on, with the AFEE in CONF mode, until the SPI camera switch-on, which starts on 09/12/2011.

The anomaly on 22/11/2011 (DOY 326) after the switch ON of the heat pipe heater main and the switch OFF of the antifreeze heater 1 main for outgassing the cold box at +30degC as par SPI annealing #18 procedure (OCR#316), can be seen in the plot: a steady increase of the AFEE DC output voltages of the detectors 2, 8 and 11 was observed. Therefore it was decided by the SPI PI to continue SPI annealing without the outgassing of the cold box. After the outgassing of the coldbox was aborted, the AFEE DC output voltages decreased again as the temperature of the coldbox decreased. The cold box temperature was maintained at -65 degC and the DC output voltages were stable for the rest of the annealing cycle.

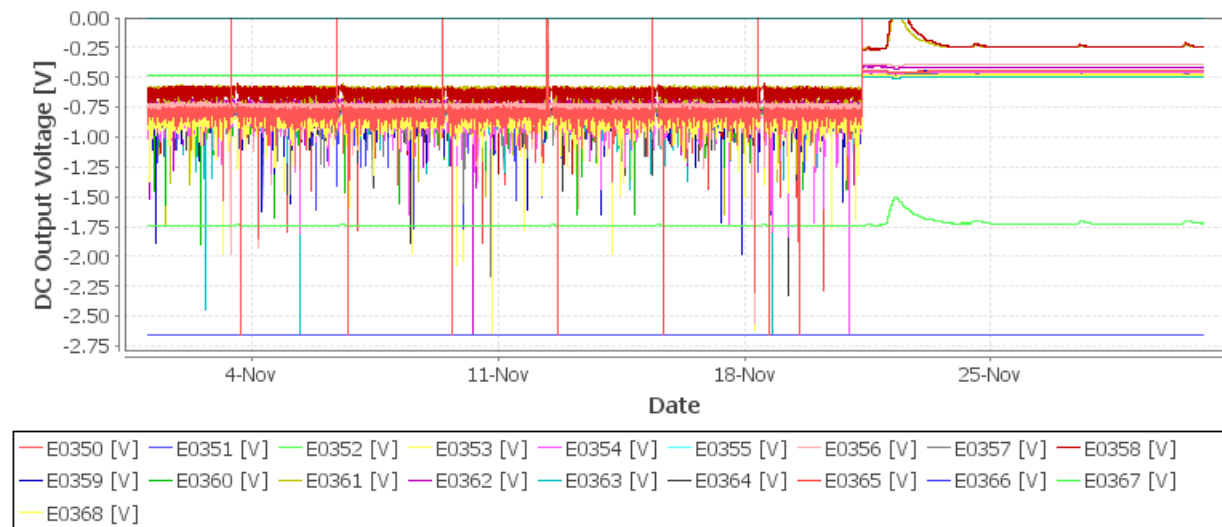


Figure 14: AFEE DC Output Voltages. Note that the data is sampled every 8th packet (64sec)

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. Due to the ongoing annealing operations, the DFEE was in CONF mode until the SPI camera switch on, which started on 09/12/2011.



Figure 15: SPI GeD Non-Vetoed count rates. Note that the scale used for plotting is logarithmic.

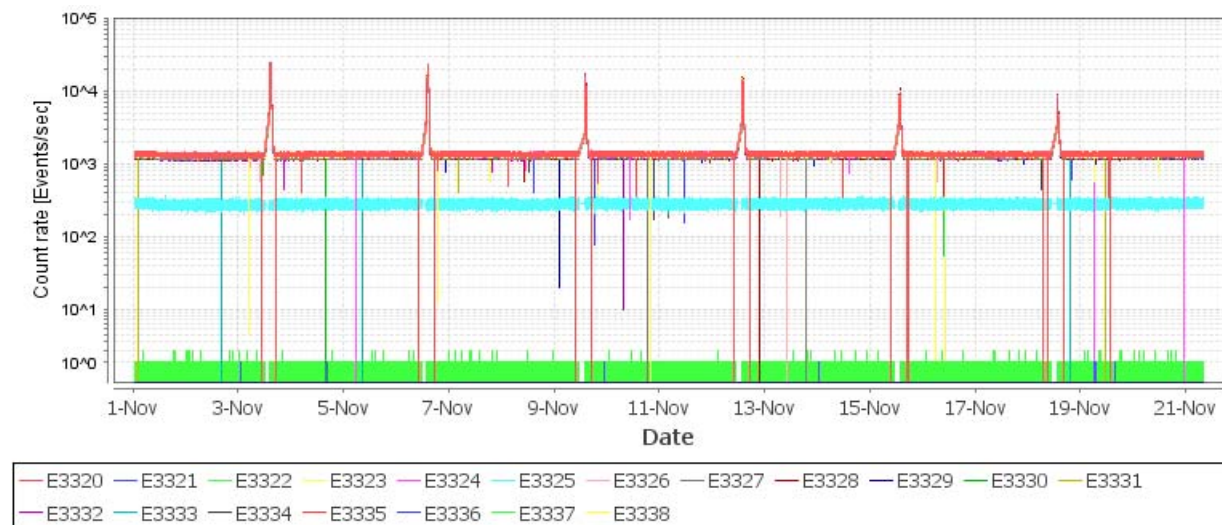


Figure 16: SPI GeD Time Tagged count rates. Note that the scale used for plotting is logarithmic.

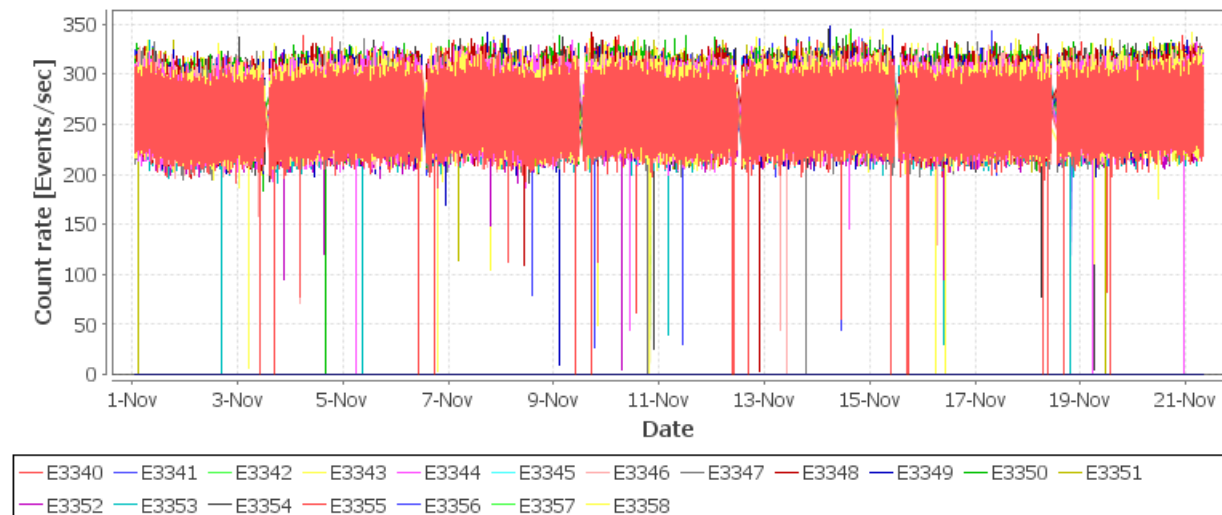


Figure 17: SPI GeD Time Tagged Saturated count rates

PSD

The health of the PSD is nominal. The following plot shows the PSD channel rates over the reporting period. Due to the ongoing annealing operations, the PSD was in CONF mode until the SPI camera switch-on, which started on 09/12/2011.

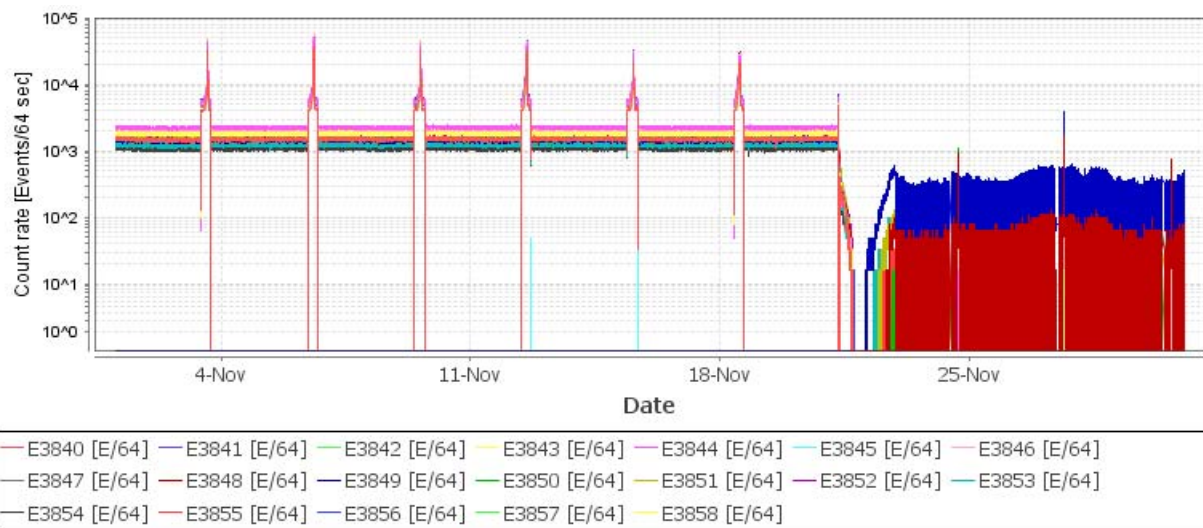


Figure 18: SPI PSD GeD Channel rates

6.2.2 Event Log

15-11-2011/30-11-2011 (Day of Year 319/334, Revolution 1109/1114)

Two occurrences (at 2011.319.09.37.04Z and 2011.334.08.33.45Z) of OEM APID 1024 ID 1 EXCEPTION SPI1 FIXED POINT OVERFLOW were received. As in each case it was a single occurrence, no action was required.

21-11-2011 until 09-12-2011 (Day of Year 325-343, Revolution 1112-1118)

SPI annealing #18 (OCR#316): planned with outgassing of the coldbox

22-11-2011 (Day of Year 326, Revolution 1112)

After the switch ON of the heat pipe heater main (TC T5010) and the switch OFF of the antifreeze heater 1 main as par SPI annealing #18 procedure (OCR#316) a steady increase of the AFEE DC output voltages of the detectors 2, 8 and 11 was observed (see Figure 16 above). This resulted in following OOL:

- 01:34Z TM parameter E0352 (U AF DCOUTP L2) OOL S/H with value -1.6432 V
- 01:43Z TM parameter E0358 (U AF DCOUTP L8) OOL H/H with value -0.0936 V
- 02:34Z TM parameter E0361 (U AF DCOUTP L11) OOL H/H with value -0.0936 V

The voltages further increased and reached the value 0 for both E0358 and E0361. The DC output voltage of the other detectors have not changed. (Note: The baseline of the AFEE DC output voltages of detectors #8 and #11 seem to be higher as for the other detectors.)

Consulting the SPI PI JPR it was decided to continue SPI annealing without the outgassing of the cold box. Therefore it was proceeded as following:

- Execute FCP_SPI1_0180 step 2.3 and 2.5 to switch heat pipe heater main OFF (TC T5010) and to switch antifreeze heater 1 main ON (TC 5021)
- The TT TC T5111 (heat pipe redundant heater switch on) were deleted and TC D3301 was sent to update OBQD (step 2.6 of FCP_SPI1_0180)

This resulted in the following:

- The temperature of the coldbox decreased again: The rate of the decrease was about half of the preceding increase of the temperature of the coldbox (about 3.6K/hour for the increase vs 1.7K/hour for the decrease).
- E0352 (U AF DCOUTP L2), E0358 (U AF DCOUTP L8) and E0361 (U AF DCOUTP L11) decreased slowly as the temperature of the cold plate decreased (decrease of L8 with a delay since it reached 0V before L11)
- E0361 (U AF DCOUTP L11) back within limits at 14:20:22Z
- E0358 (U AF DCOUTP L8) back within limits at 18:20:14Z
- E0352 (U AF DCOUTP L2) back within limits at 19:32:30Z
- The DOutput voltage of the other detectors have not changed

The anomaly is recorded as Anomaly Report INT_SC-352. SPI annealing continued nominally (without outgassing of the cold box).

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:

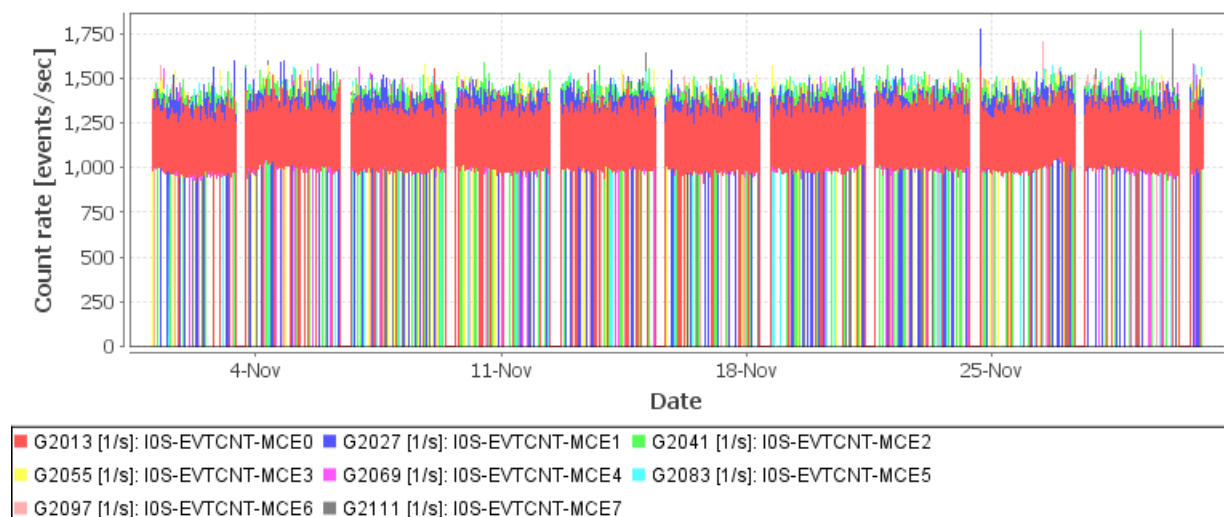


Figure 19: ISGRI MCE Counters

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 20: 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 5: Instrument Count Rates.

6.3.2 Event Log

04-11-2011 (Day of Year 308, Revolution 1106)

IBIS VETO VDM14 HV Breakdown: At 03:54:41Z, 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:

- 03:58:10 (308) FCP_IBIS1_0313 IASW to Stand-By (TC G0125)
- 04:04:51 (308) FCP_IBIS1_0203 VETO to Stand-By (TC G0601). At this point all the VETO HVs went to zero as expected, the OOL disappeared (04:04Z) and the OEMs APID 1280 ID 186 Class 2 stopped (04:05Z).
- 04:06:00 (308) Called on-call SOE
- 04:13:50 (308) S/S IBIS disabled on the A/S
- 04:36:21 (308) SOE on-call instruction: Set VETO in Nominal (TC G0600)
- 04:38:22 (308) HV now nominal. Set IBIS-IASW in Science Standard (TC G0129)
- 04:44:25 (308) S/S IBIS enabled on the A/S
- 04:45:22 (308) CCCF enabled

Afterwards the performance of VETO and all VETO parameters were nominal.

The Xref has not been followed correctly. The recovery steps should have been the following:

- IBIS-IASW to Stand-By (TC G0125)
- VETO to Stand-By (TC G0601)
- VETO to Maintenance (TC G0634 TC-V-MAINT) & monitor VETO HVs and counters for 45 minutes
- Afterwards:
 - VETO to Stand-By (TC G0601)
 - VETO to Nominal (TC G0600)
 - IBIS-IASW to 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-348. IBIS operations continued nominally.

10-11-2011 (Day of Year 314, Revolution 1108)

Due to IREM SEU #117, IBIS transitioned autonomously to Safe configuration at 2011.314.09.20.23.221Z. It was recovered as follows:

- At 2011.314.10.02.59Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2011.314.10.19.46Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled (10:24:47Z).

IBIS operations continued nominally.

17-11-2011 (Day of Year 321, Revolution 1110)

Due to IREM SEU #118, IBIS transitioned autonomously to Safe configuration at 2011.321.18.28.23Z. It was recovered as follows:

- At 2011.314.18.51.39Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 2011.321.19.00.48Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled (19:02:27Z).

IBIS operations continued nominally.

20-11-2011 (Day of Year 324, Revolution 1111)

On 2011-11-20 (DOY 324) at 2011.324.13.37.39Z the VETO VDM05 HV went OOL Alarm H/L: TM G6039 (V1S-VDM05HV) = -43.7V [0 Raw].

At the same time several OEM APID 1280 ID 186 (Class 2) ANOMALY IBIS1 VETO PMTXX IS ON AND CORRESPONDING HV MONIT IS ABOUT ZERO was received (8 OEMs every 8 second cycle). No other alarms were generated and no change was observed in the VETO counters or current.

The VDM05 HV remained at zero until the recovery procedure was executed:

- 13:45:13 (324) FCP_IBIS1_0313 IASW to Stand-By (TC G0125)
- 13:59:59 (324) FCP_IBIS1_0203 VETO to Stand-By (TC G0601). At this point all the VETO HVs went to zero as expected, the OOL disappeared and the OEMs APID 1280 ID 186 Class 2 stopped.
- 14:45:12 (324) VETO to Maintenance (TC G0634 TC-V-MAINT) & monitor VETO HVs and counters for 45 minutes
- 15:30:07 (324) FCP_IBIS1_0203 VETO to Stand-By VETO to Stand-By (TC G0601)
- 15:32:19 (324) Set VETO in Nominal (TC G0600)
- 15:33:59 (324) HV now nominal. 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-351. IBIS operations continued nominally.

6.4 JEM-X

6.4.1 Operations

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

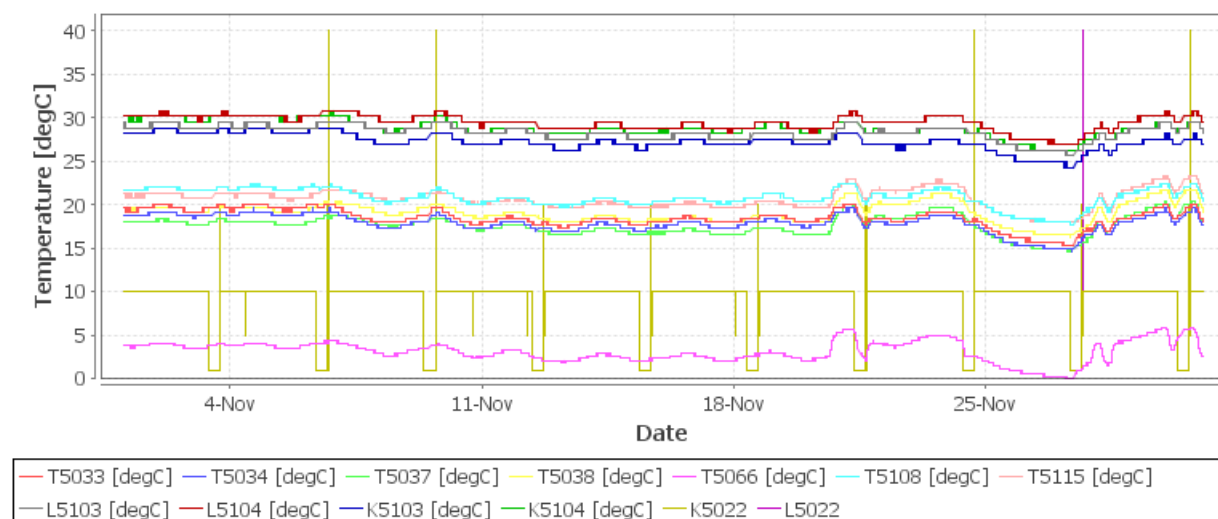


Figure 21: JEMX Detector and DFEE Temperatures

6.4.2 Event Log

10-11-2011 (Day of Year 314, Revolution 1108)

At 09:20:23 JEMX-1 & 2 parameters K5315, K5316, K5317, L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#117). There was no impact as the reaction has been disabled.

17-11-2011 (Day of Year 321, Revolution 1110)

At 18:28:23 JEMX-1 & 2 parameters K5315, K5316, K5317, L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#118). 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

10-11-2011 (Day of Year 314, Revolution 1108)

At 09:20:24, an IREM SEU (#117) forced OMC to SAFE mode. A recovery was performed, and the timeline rejoined at 09:36:40. The impact was 11080019 was cut short from a planned 3334 to 1831 seconds.

At 16:37:35, after the CCCFs executed as part of the above IREM recovery, OMC went to Standby. The impact was that pointing 11080027 was cut short from a planned 3334 to 304 seconds.

17-11-2011 (Day of Year 321, Revolution 1110)

At 18:28:24, an IREM SEU (#118) forced OMC to SAFE mode. A recovery was performed, and the timeline rejoined at 18:48:03. The impact was 11100054 was cut short from a planned 3334 to 105 seconds.

18-11-2011 (Day of Year 322, Revolution 1110)

At 00:17:20, after the CCCFs executed as part of the above IREM recovery, OMC went to Standby. The science commands were then manually re-uplinked. The impact was that pointing 11100060 was cut short from a planned 3334 to 2393 seconds.

23-11-2011 (Day of Year 327, Revolution 1112)

At 21:29, a Flight Dynamics problem forced an interruption to the timeline. At 22:25, after a recovery, operations were resumed. The impact was the loss of pointing 11120056. It was at this time that the following pair of commands were rejected:

2011.327.22.03.38.783	2011.327.22.03.44.393	1792	RealTime	131	TC	REJECT	REJECTED
TC1		0	0	65535	PR	N	E
2011.327.22.03.44.783	2011.327.22.03.52.169	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 that pointing.

24-11-2011 (Day of Year 328, Revolution 1113)

At 19:34:32, after OMC went to science mode for pointing 11130006, there were 81 centring cycles. This was caused after the attitude for this pointing had been manually altered by 1° in yaw, as there were insufficient stars available for attitude determination at the original location. OMC then searched around electronically for its intended pointing direction.

26-11-2011 (Day of Year 330, Revolution 1113)

At 18:18:41 OMC went to SAFE mode due to a high proton count. It was at this time that the following pair of commands were rejected:

2011.330.19.10.29.820	2011.330.19.10.32.504	1792	RealTime	131	TC REJECT	REJECTED
TC1		0	0	65535 PR	N E E	
2011.330.19.10.35.945	2011.330.19.10.40.436	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 11130052.

The radiation remained high for the rest of the orbit.

On DoY 331, at 07:40:00, 2 minutes before belt entry, it was manually recovered back to Standby. The impact was pointing 11130051 was cut short from a planned 3572 to 481 seconds, and pointings 11130052 – 11130062 (11 pointings) were lost.

6.6 IREM

6.6.1 Operations

Radiation belts entry and exit

The following plots show the Radiation Belt Entry (Figure 22, red line) and Exit times (Figure 23, blue line) obtained from the ISDC website, defined where the IREM TC3 (soft electrons) rate reads 600 counts. The blue line in Figure 22 and the magenta line in Figure 23 are the altitudes used by the MOC for planning purposes.

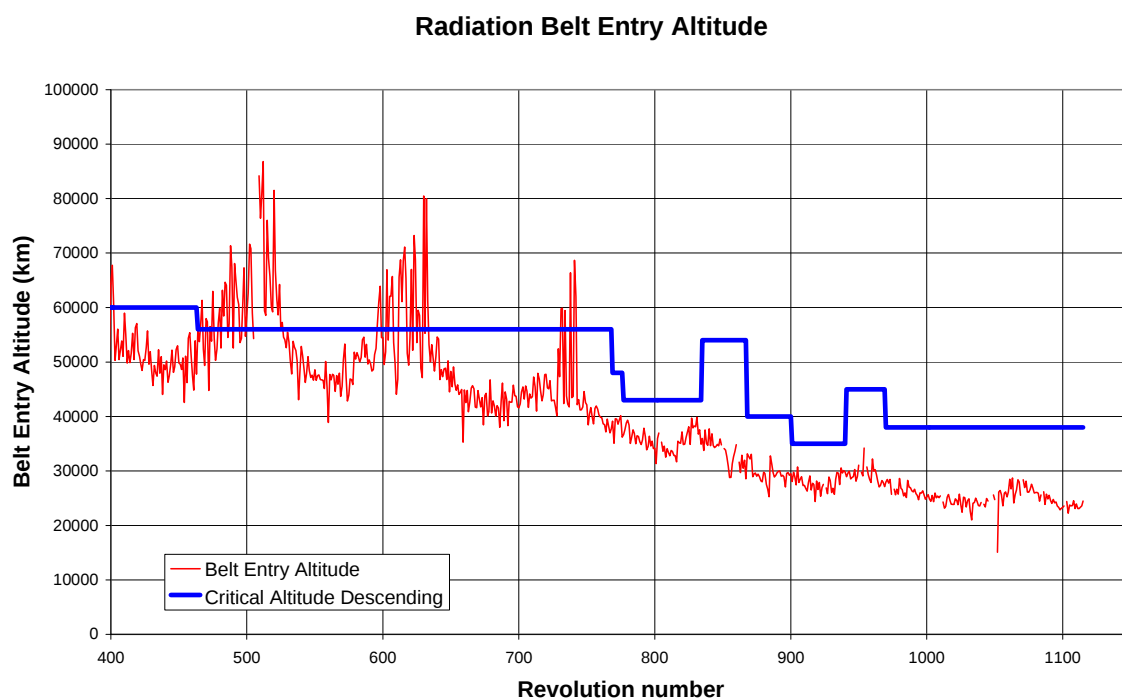
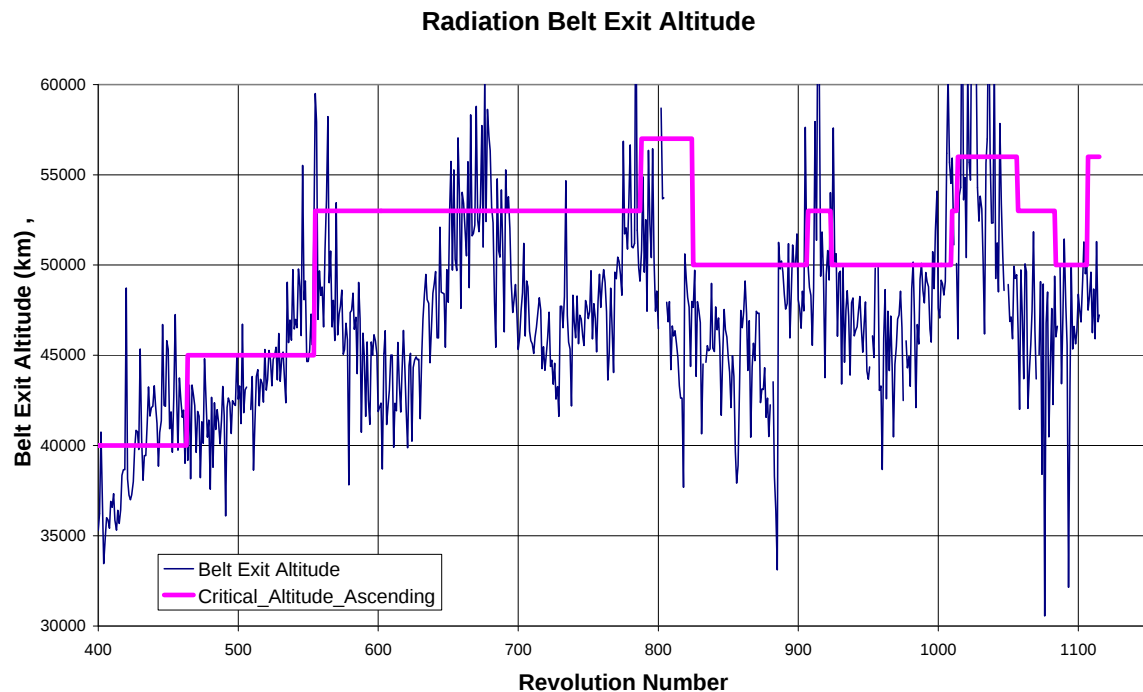


Figure 22: Radiation belt entry

**Figure 23: 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
1105	RAD_ENTR R 2011-11-03T09:21:43Z	03/11/2011 10:56:22	19237.9	03-Nov-2011 10:48:14	18753.01	03-Nov-2011 11:28:14	8733.634
1106	RAD_EXIT R 2011-11-03T15:59:20Z	03/11/2011 15:24:54	45698.6	03-Nov-2011 15:48:14	48791.22	03-Nov-2011 12:08:14	3208.958
1106	RAD_ENTR R 2011-11-06T09:08:26Z	N/A	N/A	06-Nov-2011 10:42:38	17621.54	06-Nov-2011 11:22:38	7528.92
1107	RAD_EXIT R 2011-11-06T16:23:52Z	06/11/2011 14:59:26	>>29135.6	06-Nov-2011 15:32:38	47984.3	06-Nov-2011 11:52:38	2873.675

1107	RAD_ENTR R 2011-11- 09T08:55:50Z	09/11/2011 10:30:22	17117.9	09-Nov-2011 10:24:54	18769.35	09-Nov-2011 11:04:54	8704.81
1108	RAD_EXIT R 2011-11- 09T16:11:12Z	N/A	N/A	09-Nov-2011 15:24:54	48864.75	09-Nov-2011 11:44:54	3132.48
1108	RAD_ENTR R 2011-11- 12T08:42:47Z	12/11/2011 10:13:27	19887.0	12-Nov-2011 10:18:19	17411.67	12-Nov-2011 10:58:19	7378.467
1109	RAD_EXIT R 2011-11- 12T15:58:41Z	12/11/2011 14:44:07	>>29103.8	12-Nov-2011 15:08:19	48034.05	12-Nov-2011 11:28:19	2984.13
1109	RAD_ENTR R 2011-11- 15T08:28:51Z	N/A	N/A	15-Nov-2011 10:00:03	18477.32	15-Nov-2011 10:40:03	8478.022
1110	RAD_EXIT R 2011-11- 15T15:45:08Z	15/11/2011 14:16:31	>>29081.4	15-Nov-2011 15:00:03	48927.4	15-Nov-2011 11:10:03	3068.333
1110	RAD_ENTR R 2011-11- 18T08:15:51Z	N/A	N/A	18-Nov-2011 09:44:43	18887.99	18-Nov-2011 10:24:43	8867.102
1111	RAD_EXIT R 2011-11- 18T15:31:52Z	18/11/2011 14:15:19	>>29096.9	18-Nov-2011 14:44:43	48711.93	18-Nov-2011 11:04:43	3151.26
1111	RAD_ENTR R 2011-11- 21T08:04:40Z	N/A	N/A	21-Nov-2011 09:36:33	18289.61	21-Nov-2011 10:16:33	8217.645
1112	RAD_EXIT R 2011-11- 21T15:20:18Z	21/11/2011 13:50:23	>>29121.9	21-Nov-2011 14:26:33	47507.25	21-Nov-2011 10:46:33	2913.622
1112	RAD_ENTR R 2011-11- 24T07:54:36Z	N/A	N/A	24-Nov-2011 09:32:41	16854.93	24-Nov-2011 10:02:41	9288.413
1113	RAD_EXIT R 2011-11- 24T15:10:33Z	24/11/2011 14:19:51	>>29102.8	24-Nov-2011 14:22:41	48421.27	24-Nov-2011 10:42:41	3060.585
1113	RAD_ENTR R 2011-11- 27T07:42:30Z	N/A	N/A	27-Nov-2011 09:18:49	17522.56	27-Nov-2011 09:58:49	7568.346
1114	RAD_EXIT R 2011-11- 27T14:59:26Z	27/11/2011 15:36:32	61380.5	27-Nov-2011 14:08:49	47831.85	27-Nov-2011 10:28:49	3106.888
1114	RAD_ENTR R 2011-11- 30T07:28:32Z	N/A	N/A	30-Nov-2011 08:56:47	19402.83	30-Nov-2011 09:36:47	9522.33

1115	RAD_EXIT R 2011-11- 30T14:46:03Z	30/11/2011 13:22:08	>>29002.2	30-Nov-2011 13:56:47	48135	30-Nov-2011 10:16:47	3221.551
------	--	------------------------	-----------	-------------------------	-------	-------------------------	----------

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

10-11-2011 (Day of Year 314, Revolution 1108)

At 09:20:23Z, a local reset of the IREM CSCI S/W (SEU #117) 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 before AOS at 2011.314.09:20:23Z (142305.1 km). The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex);
- 5) The recovery of the unit started immediately using procedure CRP_SYS_2570. The first dump of the status word after the anomaly reported a value of BCC0 HEX = 48320 DEC = 1011110011000000, i.e the Checksum Failure Flag ON. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON, and ground link ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.
- 6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 12:07:45Z.

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 09:43:00Z and IBIS at 10:24:00Z.

17-11-2011 (Day of Year 321, Revolution 1110)

At 18:28:23Z, at AOS, a local reset of the IREM CSCI S/W (SEU #118) 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 before AOS at 2011.321.18:28:23Z (126338.3 km). The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex);

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

6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 20:16:00Z.

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 18:48:00Z and IBIS at 19:02:00Z.