

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 350
Week 23
08.06.09
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.

It addresses the activities from 30.05.09 until 05.06.09 (both dates inclusive) and covers the revolutions 810 and 811.

2 Summary of Activities

The operations were performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

The targets of these revolutions consisted of a raster dither of NGC 4151 (RA 12:10:32.00, DEC +39:24:19.0), an OMC Flat-Field calibration at attitude (RA 09:52:00.00, DEC +17:06:00.0) and a raster dither of the North Ecliptic Pole (RA 18:00:00.00, DEC +66:33:39.0).

Note: Some further information concerning the activities is provided in the Appendix.

3 Satellite Status

3.1 Platform

The performance of the platform was good. No new unexpected behaviour / malfunction was identified.

3.1.1 AOCS

The AOCS operations were performed from the timeline during this period. The week was characterised by repeated problems with attitude determination due to a lack of suitable stars within the Star-tracker field-of-view.

4 Slews were missed from TL, during the observation period.

The fuel consumption over the period between 30/05/2009 and 05/06/2009 was 0.0971 Kg. The remaining propellant is in the order of 134.0389 Kg.

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

3.1.2 Power

All the other units of EPS are working nominally; available power from the arrays is of the order of 2100W.

3.1.3 Thermal

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

3.1.4 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.

3.1.5 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.

3.2 Payload

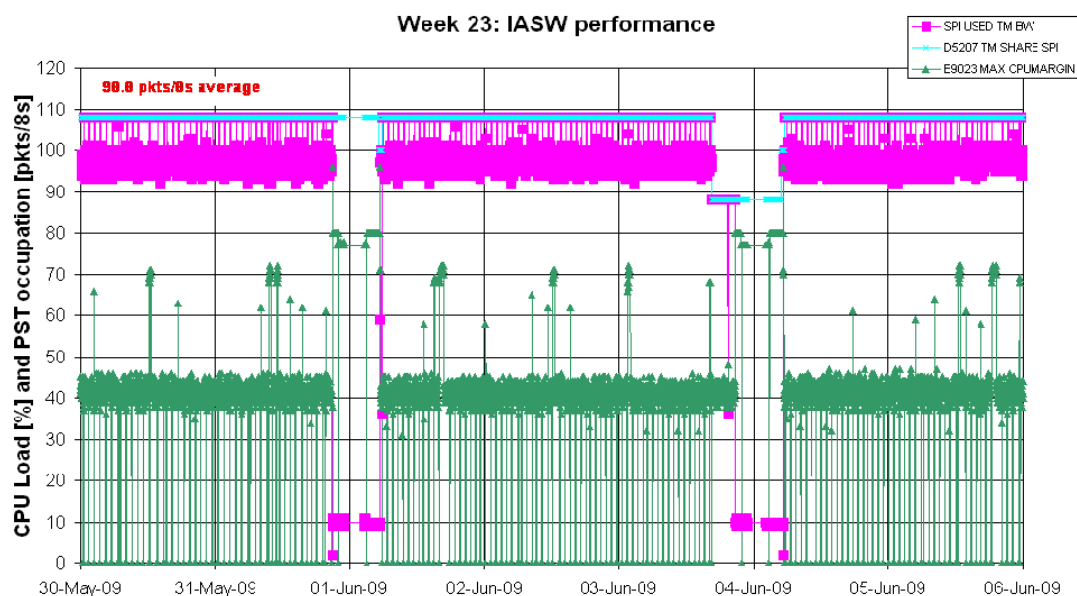
3.2.1 SPI

Following the 13th SPI annealing, which ended on 11/05/2009, 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).

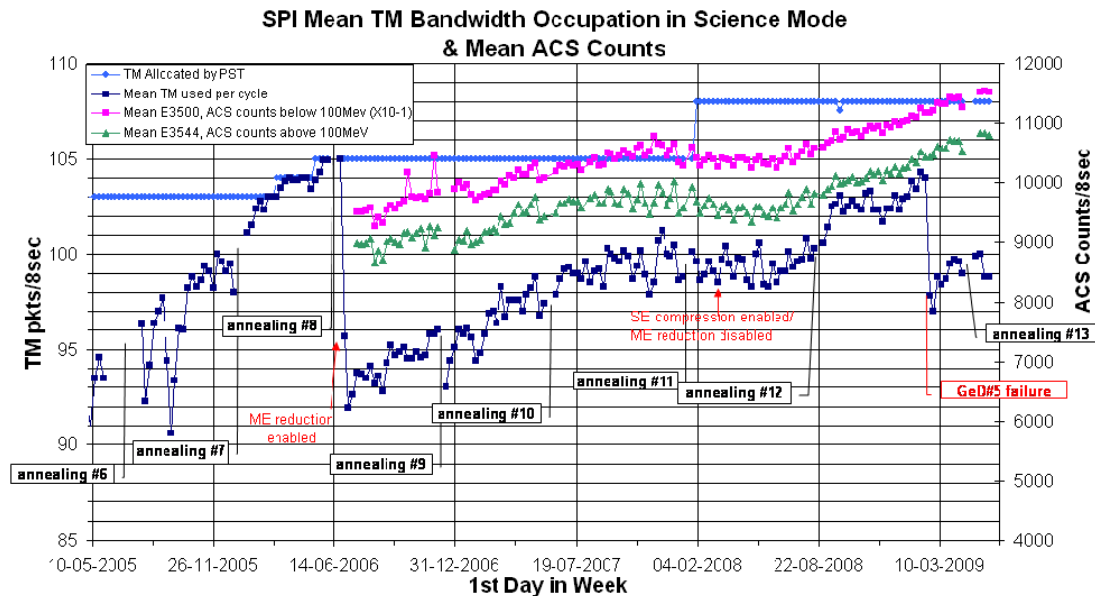
The Stirling compressors are working nominally. The Germanium detectors' temperature was kept in the range 80K $\pm$ 1K.

SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 108 packets/cycle, except from 2009-06-03T16:34:36Z until the end of revolution 810, when it was 88 packets/cycle due to an OMC Flat Field Calibration. The average telemetry occupation when the allocation was 108 packets/cycle was 98.8 packets/cycle.

The following plot shows the TM bandwidth allocation, occupation and DPE CPU load during the reporting period:



The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth since May 2005 along with the mean ACS count rate evolution (since July 2006). As can be seen, there is a strong correlation between the evolution of the background as measured by the ACS and the overall TM bandwidth usage.



Note: Some more information concerning the SPI operations is provided in the Appendix 8.3.2.

3.2.2 IBIS

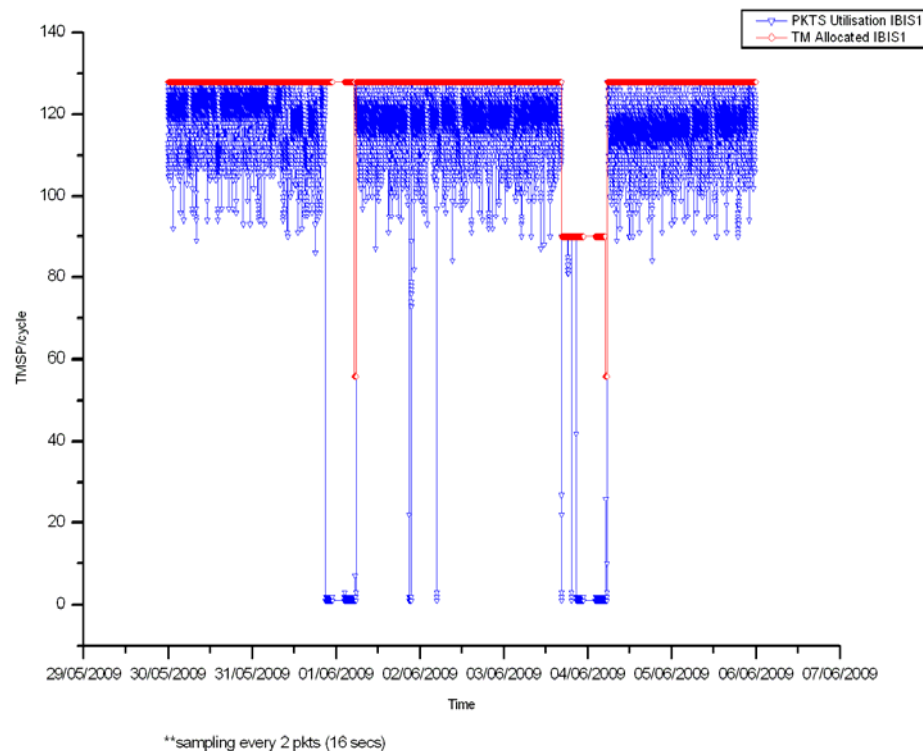
The overall status of IBIS is nominal.

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

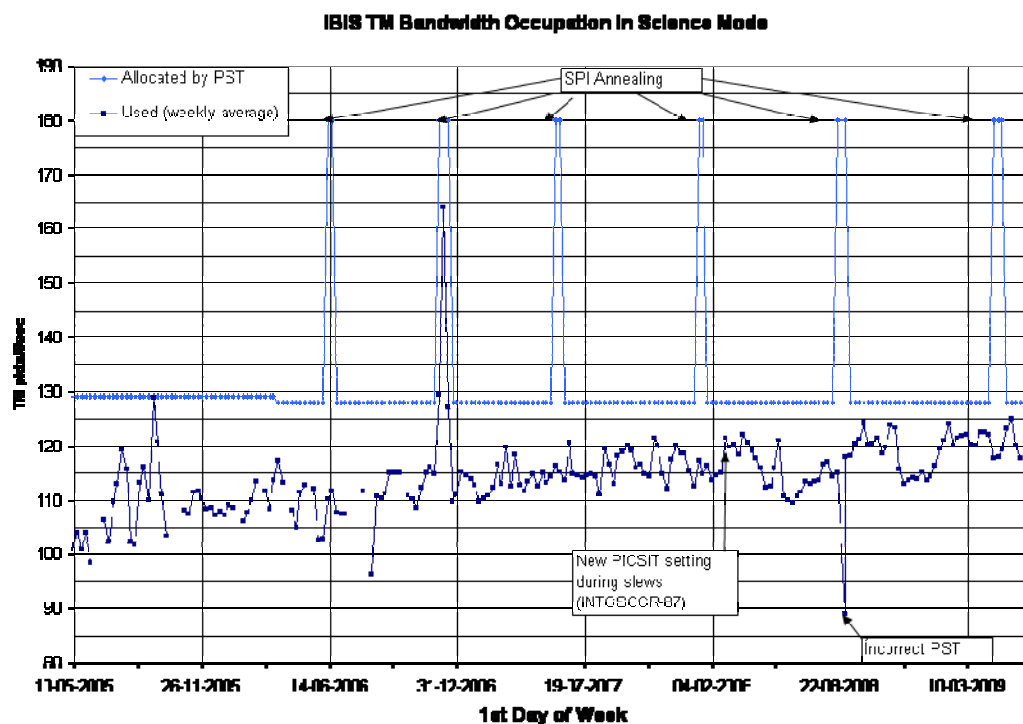
- PST allocation to IBIS above radiation belts: 128 packets/cycle, except from 2009-06-03T16:34:36Z until the end of revolution 810, when it was 90 packets/cycle due to an OMC Flat Field Calibration.
- IBIS mean bandwidth utilisation in science mode: 117.62 packets/cycle (down 2.41 on previous week)
- Percentage of TM cycles for which bandwidth usage was 128 packets/cycle: 5.15%

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

IBIS - TM Bandwidth Utilisation Rev 809-811



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



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

3.2.3 JEM-X

The status of both JEM-X units is nominal.

JEM-X operations were performed by the automatic Timeline.

JEM-X1 was operated in Data Taking mode with a TM allocation of 8 packets/cycle. JEM-X2 was dormant (DPE OFF) with no TM slots allocated.

Note: Some more information concerning the JEM-X operations is provided in the Appendix Section 8.3.4.

3.2.4 OMC

The status of OMC is nominal.

OMC operations were performed by the automatic Timeline. OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle.

During this reporting period, 135 of the 140 planned science pointings were executed nominally, 1 was interrupted, and 4 were lost.

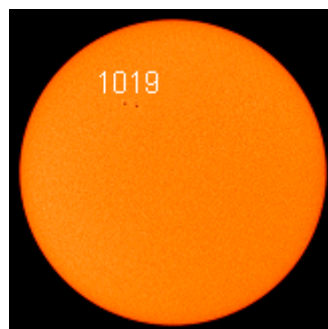
Note: Some more information concerning the OMC operations is provided in the Appendix.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

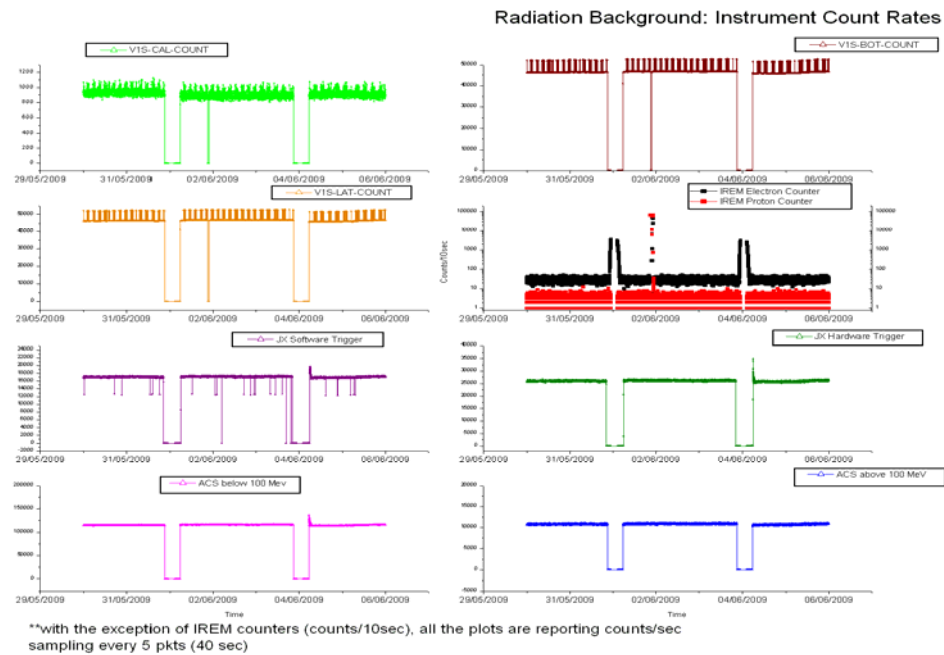
The observation period was characterised by low solar activity. A small sun-spot emerged on the 31st May, and remained for the rest of the week. The risk of solar flares was very low.



Note: Some more information concerning the IREM operations is provided in the Appendix Section 8.3.6.

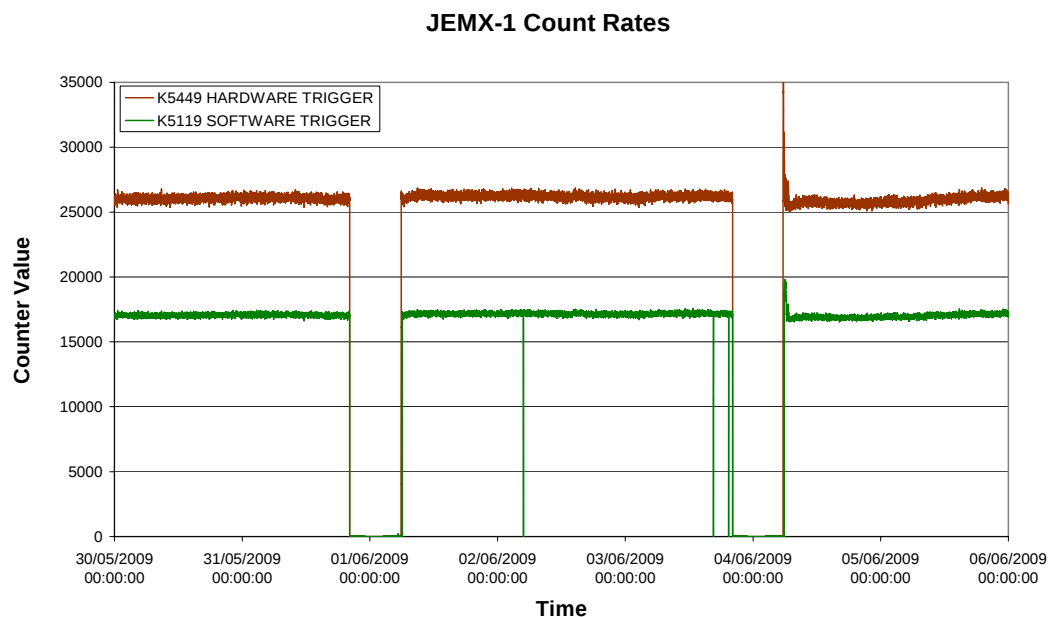
3.2.6 Radiation Background

The background radiation level as measured by the instrument counters was generally low during the reporting period, although a brief period of high radiation continued after the expected radiation belt exit of revolution 811. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the week:



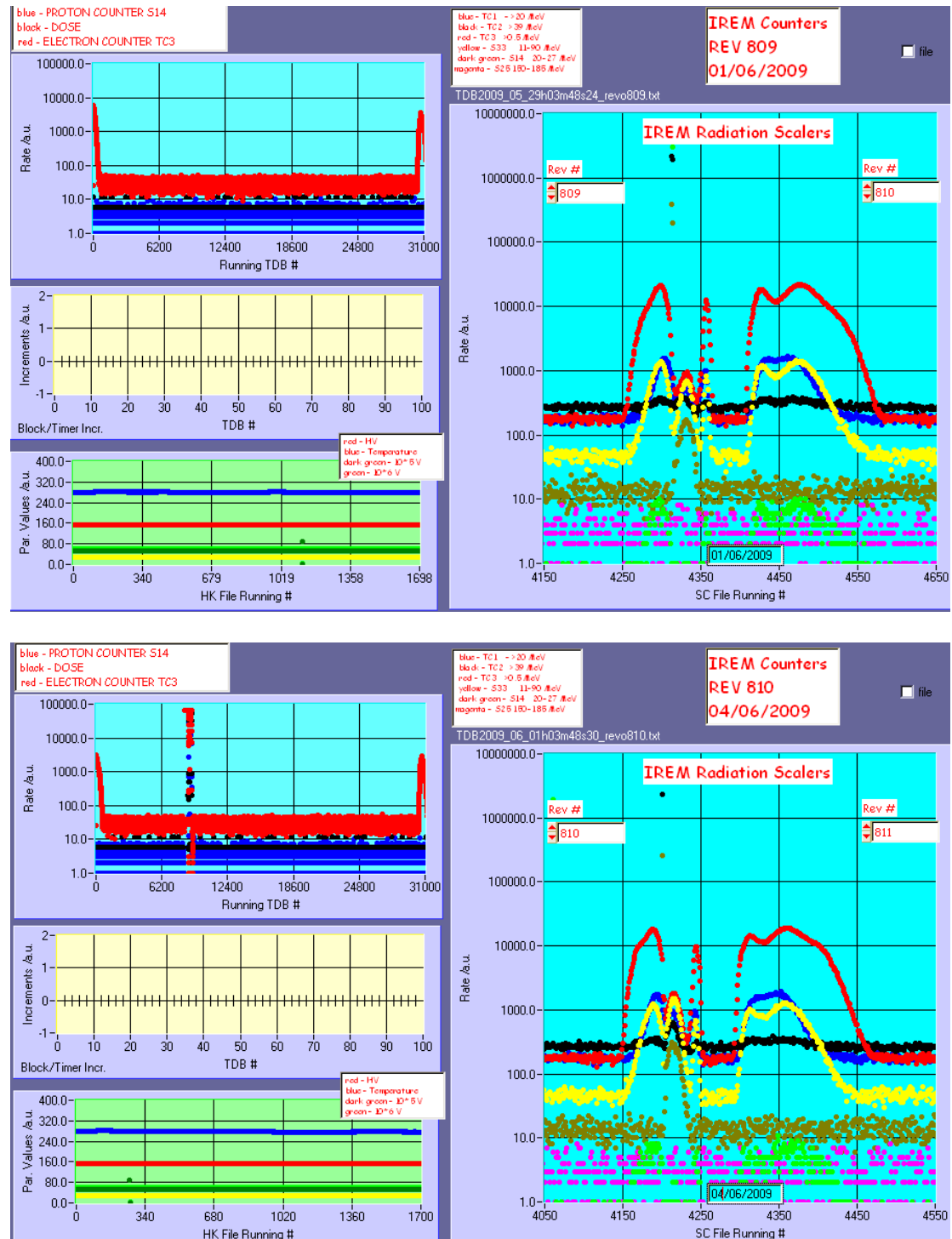
JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph¹.



¹ Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

IREM radiation counters:



4 Ground Facilities

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

4.1 Mission Operations Centre

The performance of the MOC was very good this week, there was 1 occasion when the links with ISDC dropped, necessitating a restart of the isds & ifrd, there was no impact.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week, there was one occasion of bad frames from VIL2, and 9 occasions from DSS27, one which was caused by high winds. The only impact was a slight delay in sending the KESAFE ED to JEMX1.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New or updated PSFs have been received for revolutions 814 to 818. In revolution 814 there was a problem with one PSF version containing a very short RMU.

New observations have been planned for revolutions 814 to 818. Revolution 811 had to be re-planned yet again due to a pointing position devoid of sufficient bright stars for the star-tracker. Revolution 817 received a new PSF just after having been planned for the first time, leading to a re-plan of 817 and 818.

New TSFs have been received for revolutions 811 and 812.

2. Observation status

New ECS files have been received for revolutions 798 and 799. Those for 795 and 796 are still missing.

3. ISOC Science Data Archive

A beta release of ISDA 3.0 has been installed internally and will be tested.

4. ISOC system

No news.

5. Problems

No new problems.

5 Special Events

6 Anomalies

The following anomaly report was entered into the ARTS system this week.

AR id	Date Created	Subject	Segment	Status
INT_SC-258	2009-06-09	IREM Anomaly: Reset of IREM_CSCI S/W #77, 01/06/2009	Payload	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Consumables

8.2 Detailed Satellite Information

This section contains some detailed information concerning the various subsystems of the satellite and instruments.

8.2.1 AOCS SUMMARY OPERATIONS REPORT, 30/05/2009 – 05/06/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 100 Open Loop Slews, 54 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

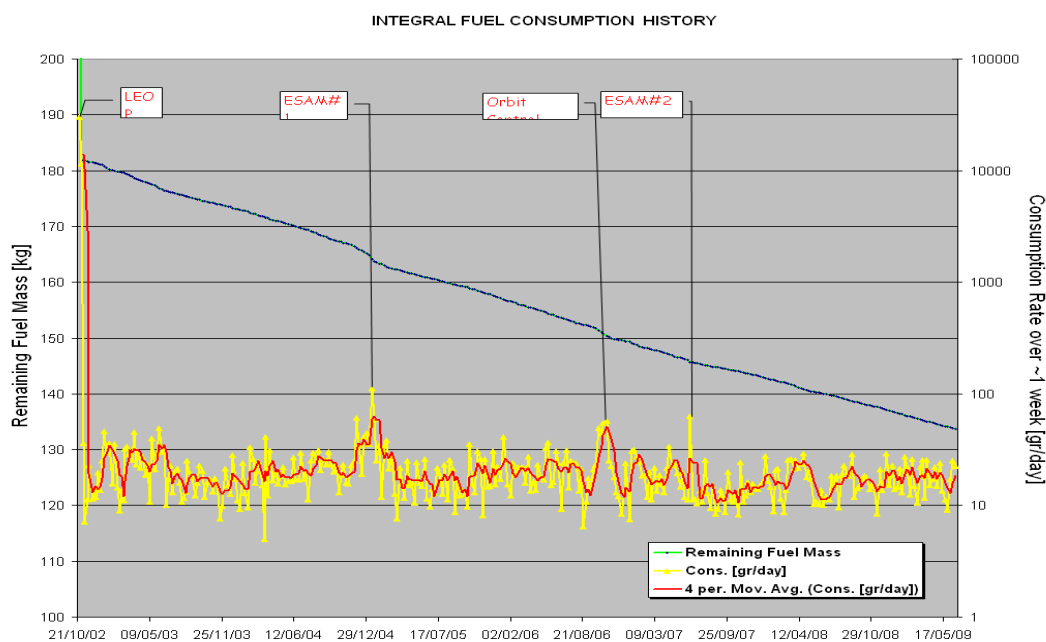
Four slews were missed from TL, during the observation period.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 05/06/2009 is reported in the plot below.

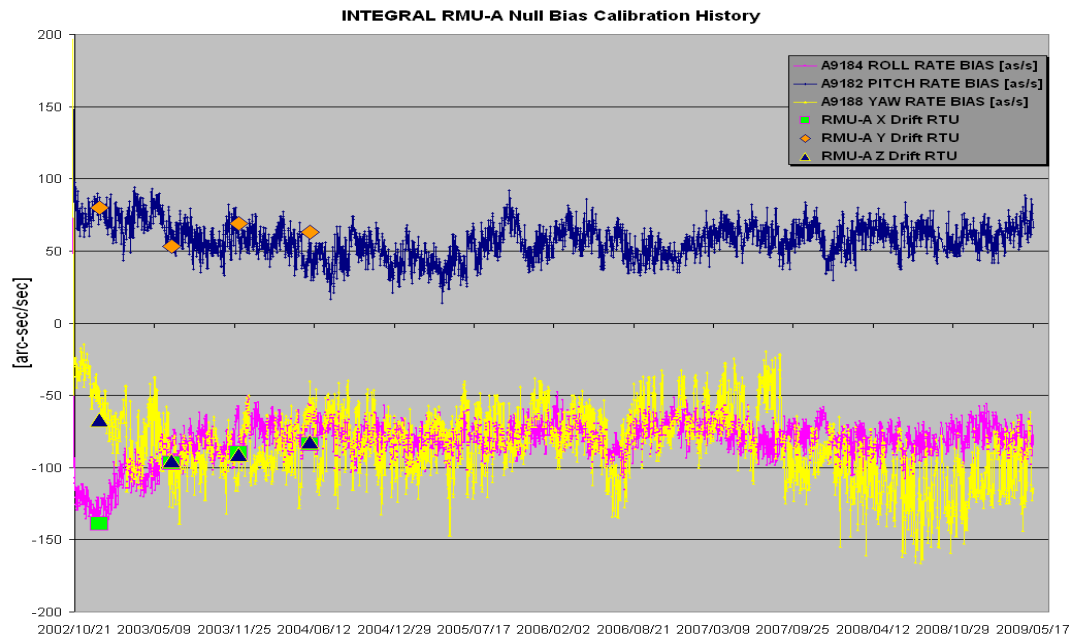


The above plot considers the ESAM fuel consumption spread over period of ~1 week.

The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 05/06/2009 is 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. At moment the current constraints (for drift update generation) on the FDS have been relaxed to cope with the current situation.



30/05/2009 (Day of Year 150, Revolution 809)

Nothing to report.

31/05/2009 (Day of Year 151, Revolution 809)

Insufficient number of guide stars: at 11:32:00z the FD system failed generate a TPF to update slew 08090054. At 11:35:00 a manual mapping was performed and the FD tool started. At 11:40:00, the attitude determination failed again with insufficient number of stars in the field of view. At 11:54:00 FD was contacted and advised to let next OSL go.

No impact on TL.

01/06/2009 (Day of Year 152, Revolution 809-810)

Insufficient number of guide stars: at 08:37:00z, the FD system failed to generate a TPF to update slew 08100006. At 08:39:00 a manual mapping was performed and the FD tool started. At 08:43:00, the attitude determination failed again with insufficient number of stars in the field of view. This was repeated at 08:45:00 & failed again at 08:50:00. At 08:53:00. FD was contacted and advised to let next OSL go.

No impact on TL.

Timeline suspended due to sparse stellar field: At 14:45:00 as per operational instruction INT_OPS_413, commanding for the AOCS and OMC was suspended. At 14:55, a manual star mapping was performed. This was followed at 15:10, by a manual OSL was performed from the attitude of PID 08100011 to PID: 08100013. At 15:22, another manual star mapping was executed, followed by a CSL to the attitude for pointing 08100013. The Timeline was recovered at 16:15:00.

Slew IDs 08100012 & 08100013 not executed.

02/06/2009 (Day of Year 153, Revolution 810)

Insufficient number of guide stars: at 02:09:00z, the FD system failed to generate a TPF to update slew 08100025. At 02:12:00 a manual mapping was performed and the FD tool started. At 02:16:00, the attitude determination failed again with insufficient number of stars in the field of view. At 02:55:00. FD came in and advised to let next OSL go.

No impact on TL.

03/06/2009 (Day of Year 154, Revolution 810)

Insufficient number of guide stars: at 00:34:00z, the FD system failed to generate a TPF to update slew 08100047. At 00:36:00 a manual mapping was performed and the FD tool started. At 00:40:00, the attitude determination failed again with insufficient number of stars in the field of view. At 00:41:00. FD was contacted and advised to let next CSL go. At 01:19:00, the Start guide star command failed release, the reason being, there was already a star in slot one. At 01:28, a manual mapping was performed and the FD tool started. This produced an OSL instead of a CSL. At 01:53:00, after consultation with FD, the manoeuvre was performed. At 02:04, a further manual mapping was performed. The Timeline was recovered at 02:12:00.

The impact was the loss of PID: 08100047.

Insufficient number of guide stars: at 03:19:00z, the FD system failed to generate a TPF to update slew 08100050. At 03:22:00 a manual mapping was performed and the FD tool started. At 03:27:00, the attitude determination failed again with insufficient number of stars in the field of view. FD advised to let next OSL go.

No impact on TL.

04/06/2009 (Day of Year 155, Revolution 810-811)

Insufficient number of guide stars: at 19:30:01z, the FD system failed to generate a TPF to update slew 08110018. At 19:31:00 a manual mapping was performed and the FD tool started. At 19:34:00, the attitude determination failed again with insufficient number of stars in the field of view. At 19:35:00. FD was contacted and advised to let next OSL go.

No impact on TL.

05/06/2009 (Day of Year 156, Revolution 811)

Insufficient number of guide stars: at 17:30:00z, the FD system failed to generate a TPF to update slew 08110040. At 17:35:00 a manual mapping was performed and the FD tool started. At 17:40:00, the attitude determination failed again with insufficient number of stars in the field of view. At 17:53:00. After calling FD, the spacontool was used to replace the planned CSL with an OSL. The timeline was recovered at 18:28:00.

The impact was the loss of PID: 08110040.

Insufficient number of guide stars: at 20:16:00z, the FD system failed to generate a TPF to update slew 08110043. At 20:19:00 a manual mapping was performed and the FD tool started. At 20:22:00, the attitude determination failed again with insufficient number of stars in the field of view. At 20:25:00. FD was contacted and advised to let next OSL go.

No impact on TL.

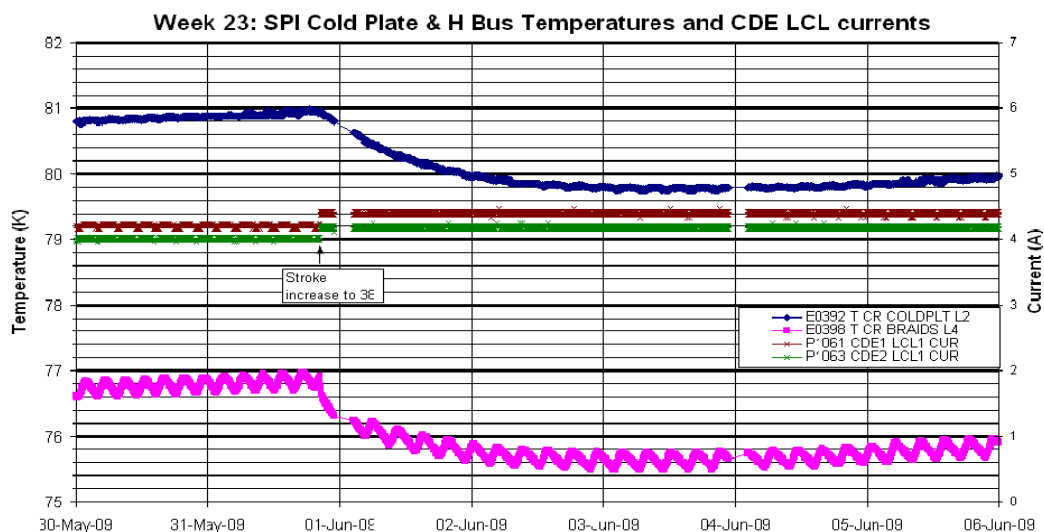
8.2.2 SPI Operations

Unit Temperatures: All the equipment temperatures are inside the operational limits.

Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

The stroke of all four compressors was set to 37 until 2009-05-31 at 20:25Z, when it was increased to 38 for both compressor pairs as the cold plate temperature (TM parameter E0392) had reached 80.9K.

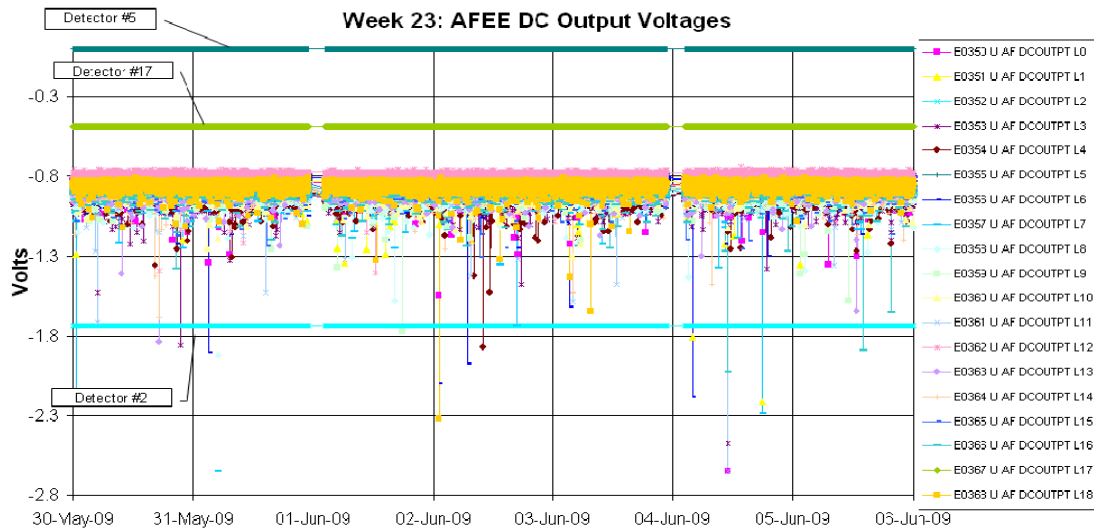
The following plot shows the evolution of the cold plate and H bus temperature as well as the CDE LCL currents during the reporting period:



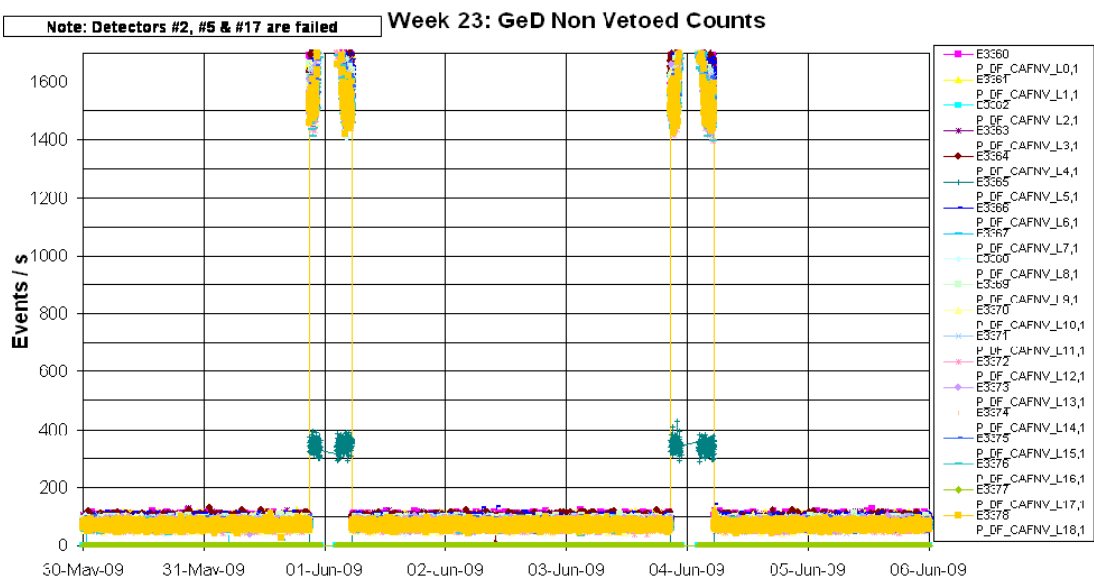
DPE & IASW: The DPE health and IASW performance are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The DPE CPU usage was nominal during the reporting period (see plot in Section 3.2.1).

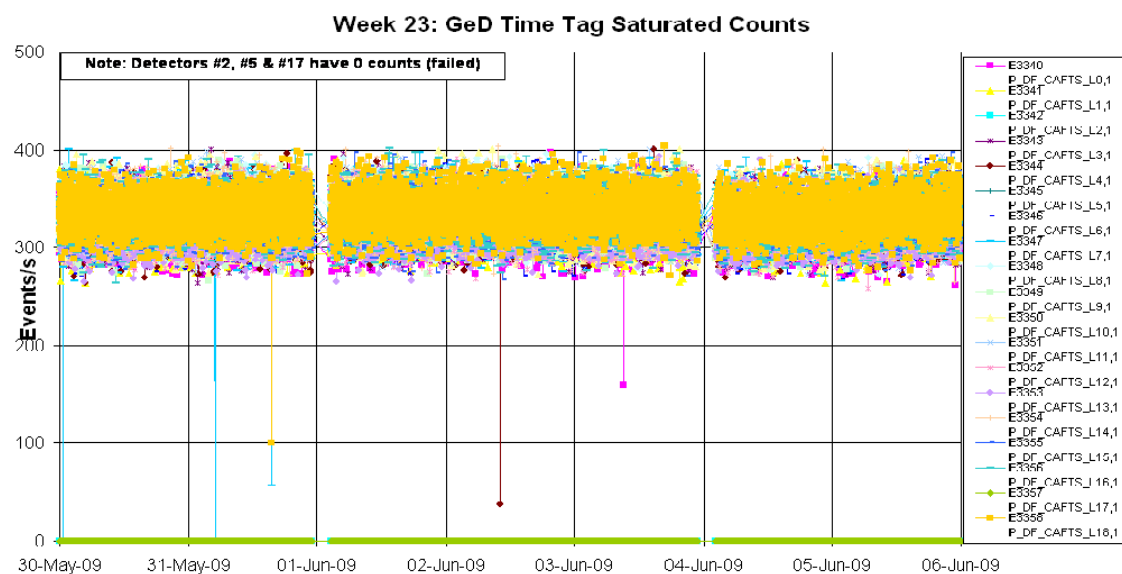
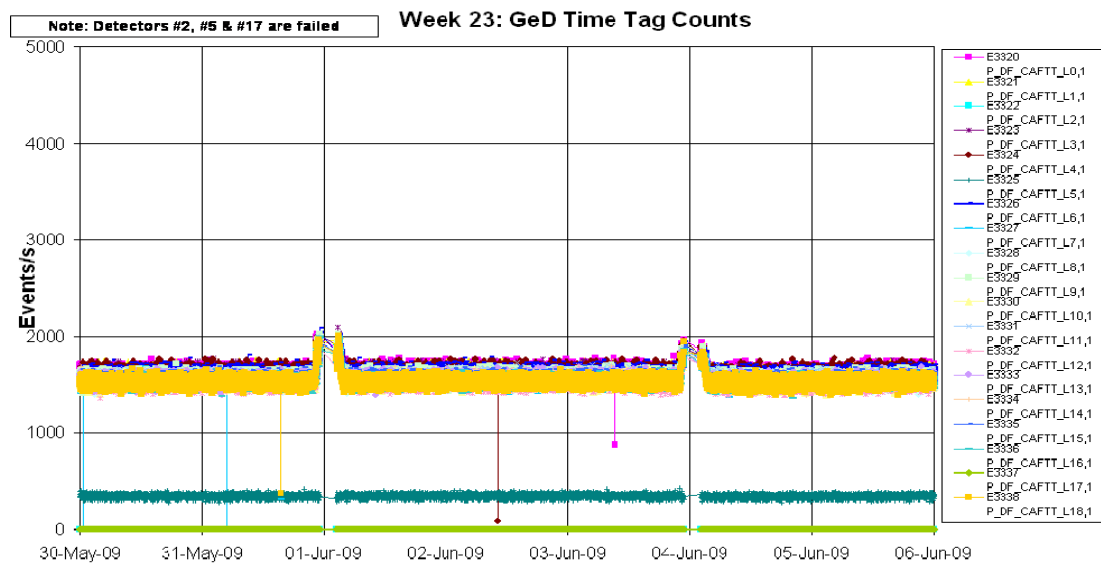
ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Section 3.2.6.

AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period. The values are 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.

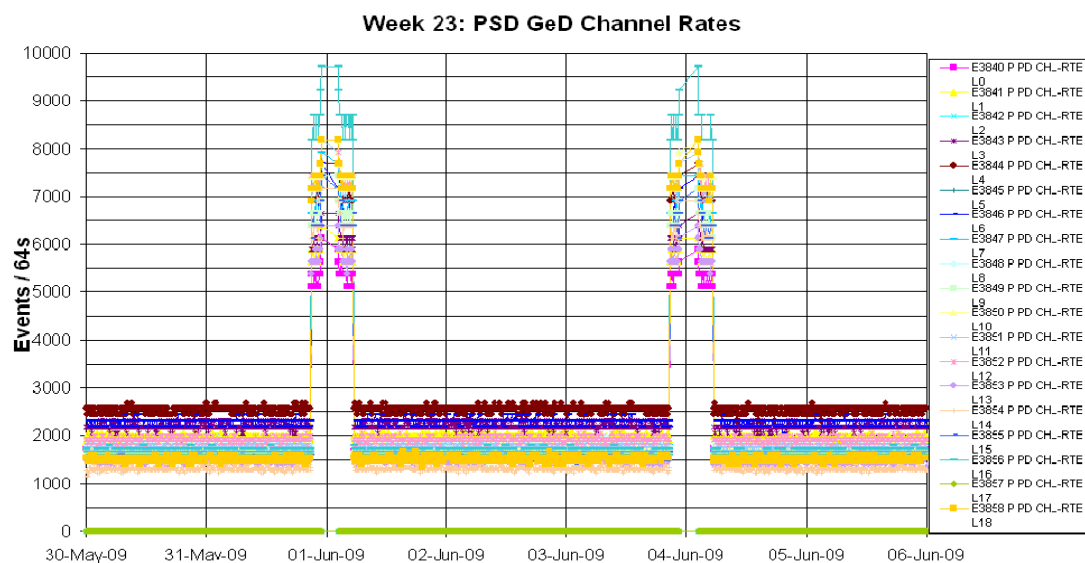


DFEE: The health of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.





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



Event Log:

The following non-nominal events occurred with SPI over the reporting period:

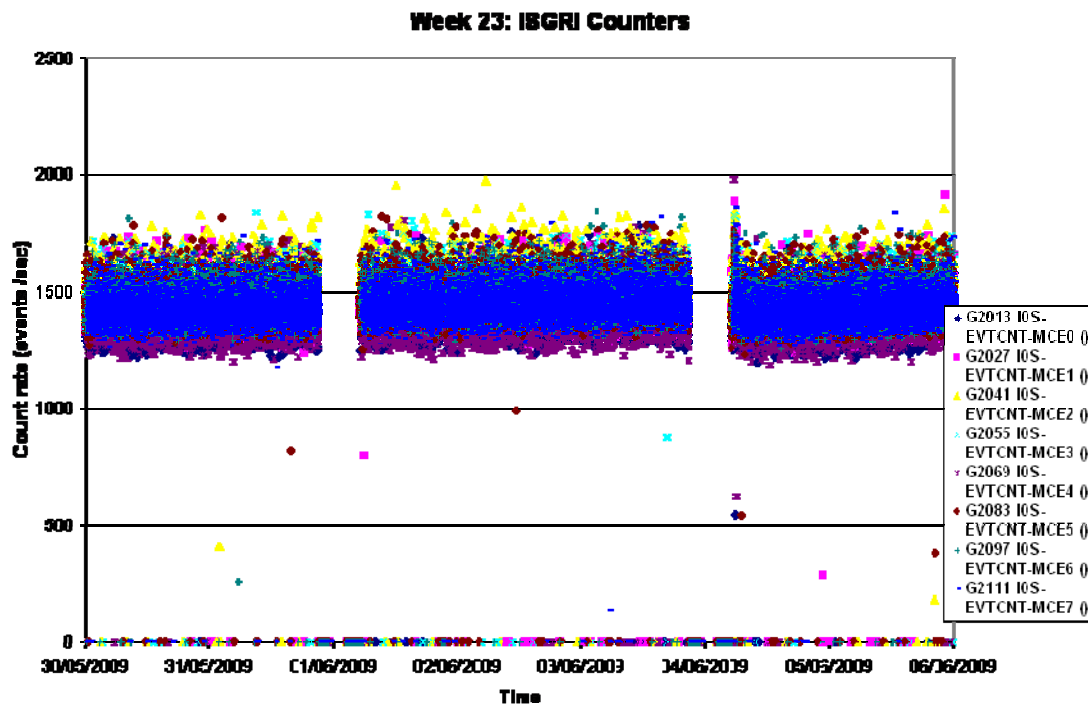
- On 2009-05-31 at 03:50:49Z TM parameter E2216 S AS DG5V L66 went OOL (value = PARAM > SPEC). This is the ACS FEE digital status 5 V #66. TC sequence ES1831 was then sent to report the ACS HK parameters at 03:57:11Z, after which this parameter returned within limits.
- Due to continuing high background radiation after the expected radiation belt exit of revolution 811, TM parameter E3500 (ACS Counts Below 100MeV) went OOL High on 2009-06-04 at 05:29:12Z. As it returned within limits of its own accord at 05:29:52Z, no action was taken.

8.2.3 IBIS Operations

Unit Temperatures: All the equipment temperatures were inside the operational limits throughout the week.

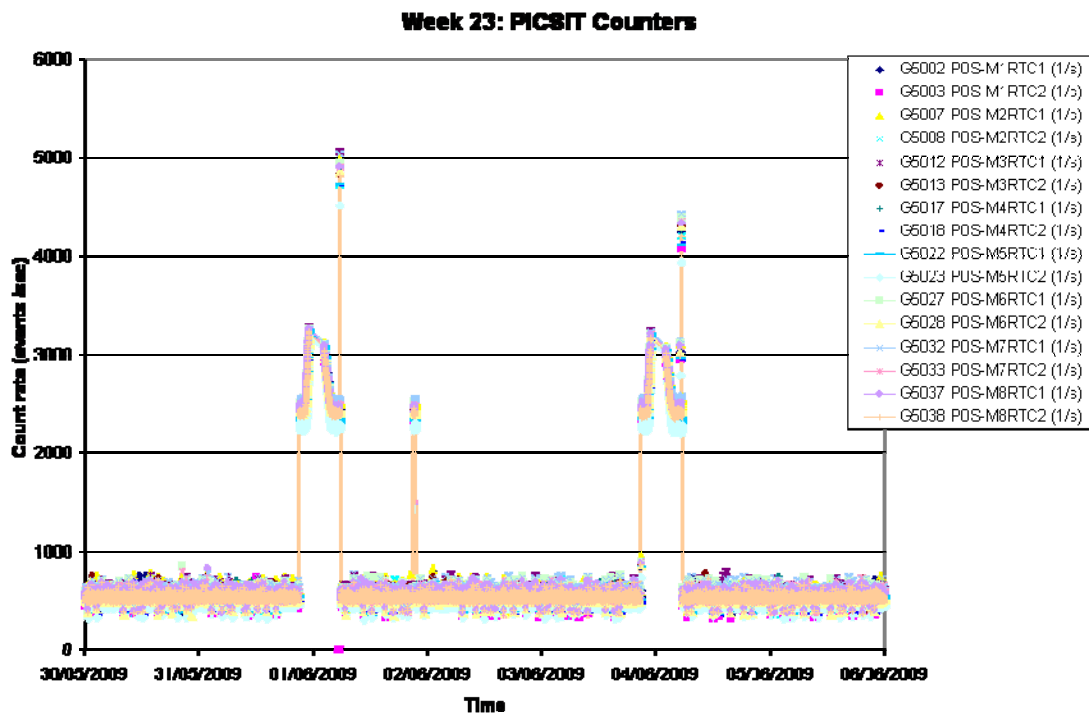
ISGRI

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



PICsIT

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



VETO

The health and performance of VETO was nominal during the reporting period. The following plot shows the VETO current and PICsIT dead-times during the week:



IBIS Daily Report

The usual Out Of Limits on TM parameter G8015 (S1E-A2_PMT_V), G5002 (POS-Mi_RTC1) and G5003 (POS-Mi_RTC2) families and G2000 family (IOE-OVFWPXADD-Mi) were received during the radiation belt passages.

TM parameter G6061 went OOL Warning Low several times during the week. This is the VETO calibration counter. As in each case it shortly returned within limits of its own accord, no action was taken. These frequent OOLs are due to a reduction in calibration counts as a result of the natural decay of the radioactive calibration source. The lower limit for this parameter will therefore be updated in the next database release.

2009-05-30 (DOY 150, Rev 809) to 2009-05-31 (DOY 151, Rev 809)

IBIS operations executed nominally.

2009-06-01 (DOY 152, Rev 809-810)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 20:56:57Z. It was recovered as follows:

- At 21:28:54Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 21:38:03Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

2009-06-02 (DOY 153, Rev 810)

IBIS operations executed nominally.

2009-06-03 (DOY 154, Rev 810)

At 20:42:51Z TM parameters G6062, G6063 (VETO bottom and lateral counters respectively) went OOL Warning High. As they returned within limits of their own accord at the next TM cycle, no action was taken.

2009-06-04 (DOY 155, Rev 810-811) to 2009-06-05 (DOY 156, Rev 811)

IBIS operations executed nominally.

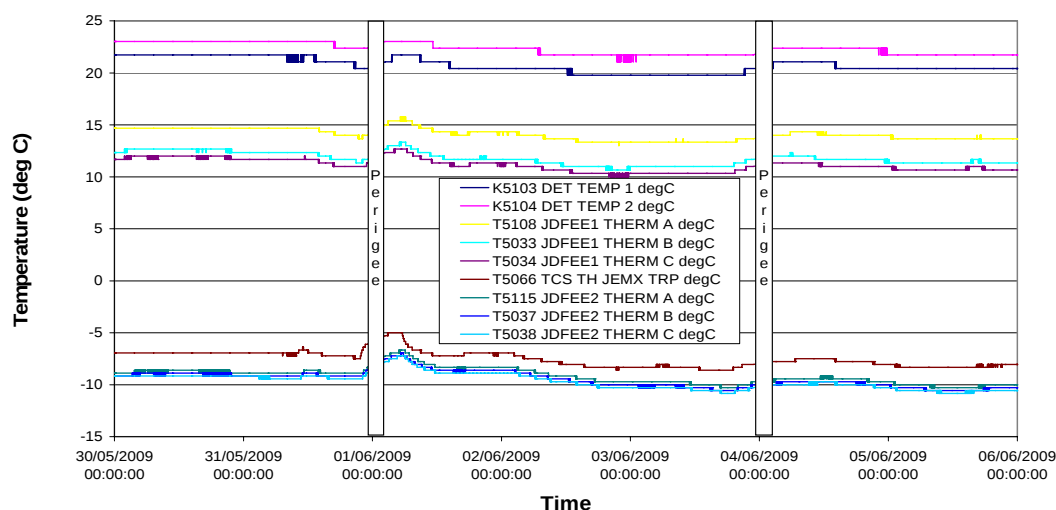
8.2.4 JEM-X Operations

JEM-X Temperatures

JEM-X Detector and DFEE temperatures, along with the temperature on the detector bench between the two units, over the reporting period are displayed in the following graph².

² Data sampled (1 frame in 8)

JEM-X Detector & DFEE Temperatures



JEM-X Daily Report

2009-05-30 (DoY 150 Rev 809) to 2009-05-31 (DoY 151 Rev 809)

JEM-X 1 operations executed nominally.

2009-06-01 (DoY 152 Rev 810)

At 20:57:26 JEMX parameters K5315, K5316 & K5317 went Out-of-Limits due to an IREM SEU (#77). There was no impact as the reaction has been disabled.

2009-06-02 (DoY 153 Rev 810)

JEM-X 1 operations executed nominally.

2009-06-03 (DoY 154 Rev 810)

At 20:01:25, the KESAFE02 ED failed release due to a ground station problem (High winds). Another ground station was brought on-line, and the ED manually sent at 20:09:00. the impact was 8 minutes extra science time!!.

2009-06-04 (DoY 155 Rev 811)

At 05:41:02, TM parameter K5449, exceeded soft limits.
 At 05:43:10, TM parameter K9128 exceeded soft limits.
 At 05:43:42, TM parameter KD5020D briefly had an incorrect status.
 At 05:47:18, TM parameter K5449 exceeded soft limits.
 No action was taken on any of the above events, and there was no impact.

2009-06-05 (DoY 156 Rev 811)

JEM-X 1 operations executed nominally.

8.2.5 OMC Operations

2009-05-30 (DoY 150, Rev 809) to 2009-05-31 (DoY 151, Rev 809)

Nothing to report.

2009-06-01 (DoY 152, Rev 810)

At 14:45, due to a sparse stellar field, it was necessary suspend operations during pointings 08100012 & 08100013. A recovery was performed at 16:15. The impact was the loss of those pointings.

At 20:56:46, an IREM SEU (#77) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 21:23:29. The impact was the interruption after 1321 from a planned 3200 seconds of pointing 08100018.

2009-06-02 (DoY 153, Rev 810)

Nothing to report.

2009-06-03 (DoY 154, Rev 810)

At 00:34, a paucity of guide stars prevented the slew update from being generated. A recovery was performed, and the timeline rejoined at 02:12. The impact was the loss of pointing 08100047. It was at this time the following OEMs were received:

2009.154.01.24.11.996	2009.154.01.24.19.745	1792	RealTime	131	TC REJECT
REJECTED TC1			0	0	65535 PR N
E E					
2009.154.01.24.17.996	2009.154.01.24.25.523	1792	RealTime	131	TC REJECT
REJECTED TC1			0	0	65535 PR N
E E					

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

2009-06-04 (DoY 155, Rev 811)

Nothing to report.

2009-06-05 (DoY 156, Rev 811)

At 17:35, more problems with lack of guide stars led to the loss of a slew. A recovery was performed, and the Timeline rejoined at 18:25. The impact was the loss of pointing 08110040. It was at this time the following OEMs were received:

2009.156.18.21.25.320	2009.156.18.21.35.037	1792	RealTime	131	TC REJECT
REJECTED TC1			0	0	65535 PR N
E E					
2009.156.18.21.31.132	2009.156.18.21.35.038	1792	RealTime	131	TC REJECT
REJECTED TC1			0	0	65535 PR N
E E					

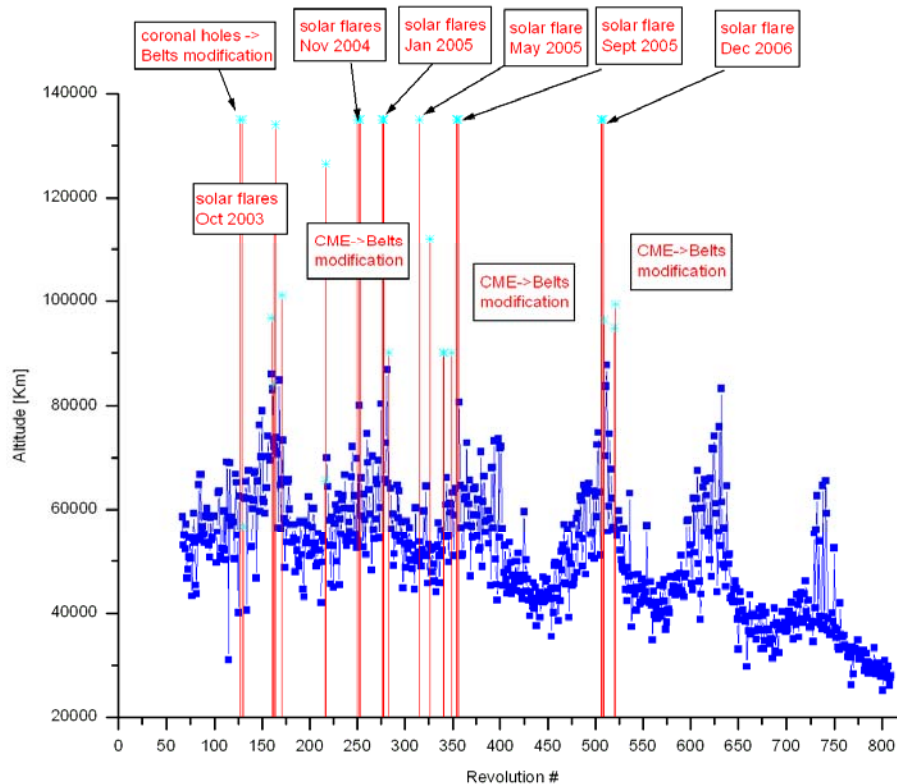
These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for that pointing.

On DoY 151 at 20:57:18 and DoY 154 at 20:46:06 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.2.6 IREM Operations

Radiation Belts Entry

Evolution of Radiation Belt Entry 2003-2008



IREM daily report

DoY 2009.152 (01/06/2009):

At 20:56:45Z, a local reset of the IREM CSCI S/W (SEU #77) 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 2009.152.20:56:45Z (137243.1 km). The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex); just before the anomaly, radiation counters reported nominal values considering the position of the S/C along the orbit;
- 5) The recovery of the unit started immediately using procedure CRP_SYS_2570. The 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 23:09:00Z.

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 21:23:29Z and IBIS at 21:40:00Z.

Electron Belts

REV	S/C BCPKT (electron)	Electron CUT-OFF Observed Entry/Exit	Observed Entry/Exit Altitude [Km]	Electron CUT-OFF Predicted Entry/Exit	Predicted Entry/Exit Altitude [Km]
809	RAD_ENTR R 2009-05-31T20:57:13Z	31/05/2009 22:22:05	27529.0	31-May-2009 21:58:38	32224
810	RAD_EXIT R 2009-06-01T05:30:07Z	01/06/2009 03:47:25	>>36229.1	01-Jun-2009 04:18:38	46588.44
810	RAD_ENTR R 2009-06-03T20:46:02Z	03/06/2009 22:15:33	28041.9	03-Jun-2009 21:46:40	32234.44
811	RAD_EXIT R 2009-06-04T05:18:04Z	04/06/2009 03:39:57	>>36277.7	04-Jun-2009 04:06:40	46700.18

Reference

High radiation

Very small error vs reference (less than 10 minutes)

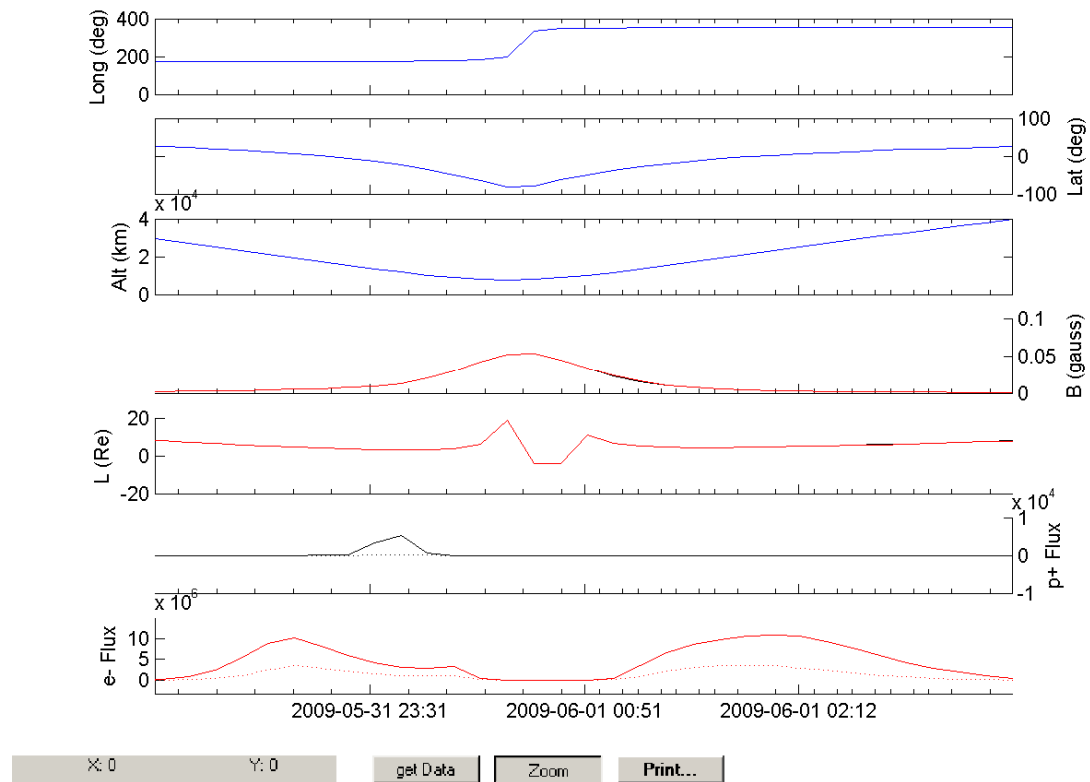
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM Predicted Radiation Belt Passages

Rev 809



Rev 810

