

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 368
Week 41
12.10.09
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 03.10.09 until 09.10.09 (both dates inclusive) and covers the revolutions 851 and 852.

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 hexagonal dither of Galactic Bulge region (RA 17:45:36.00, -28:56:00.0), a custom pointing of the Galactic disk (RA 19:04:22.00, +06:17:13.0), a Galactic disc scan (RA 00:00:00.00, +00:00:00.0) and a hexagonal dither of 4U 1907+09 (RA 19:09:37.90, +09:49:49.0).

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.

Slew 08530005 was missed from the timeline.

The fuel consumption over the period between 03/09/2009 and 09/10/2009 was 0.0955 Kg. The remaining propellant is in the order of 132.1437 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

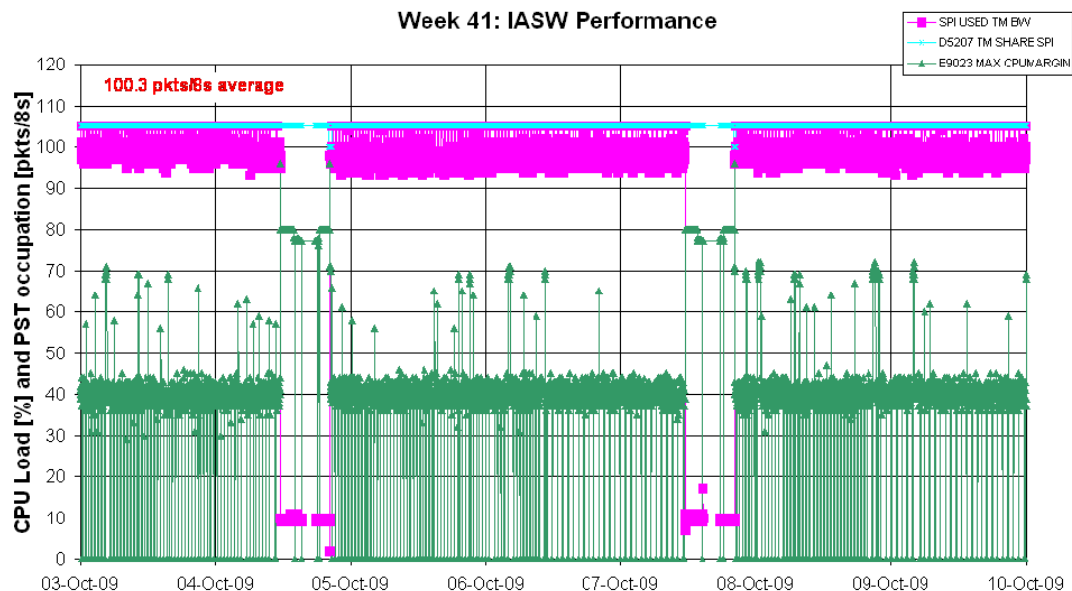
3.2.1 SPI

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.

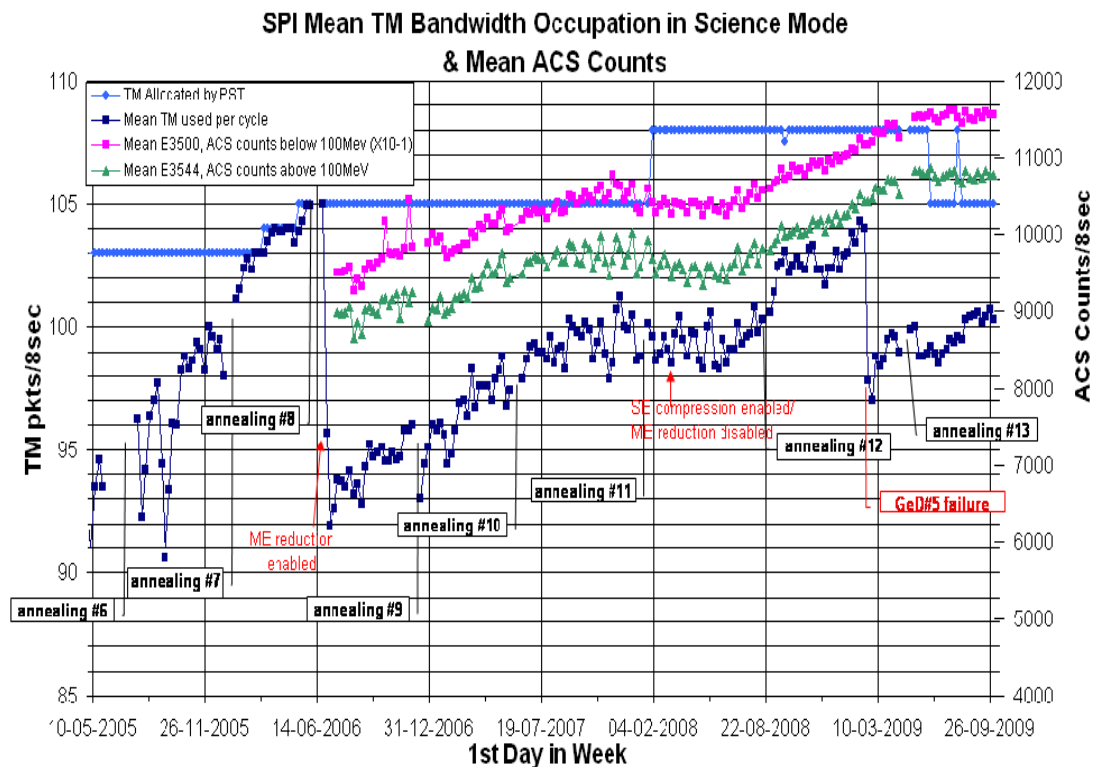
SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 105 packets/cycle and the average telemetry occupation was 100.3 packets/cycle.

The following plot shows the TM bandwidth allocation, occupation and DPE CPU load during the reporting period¹:



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.

¹ Data sampled every 8th packet (64sec)



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

3.2.2 IBIS

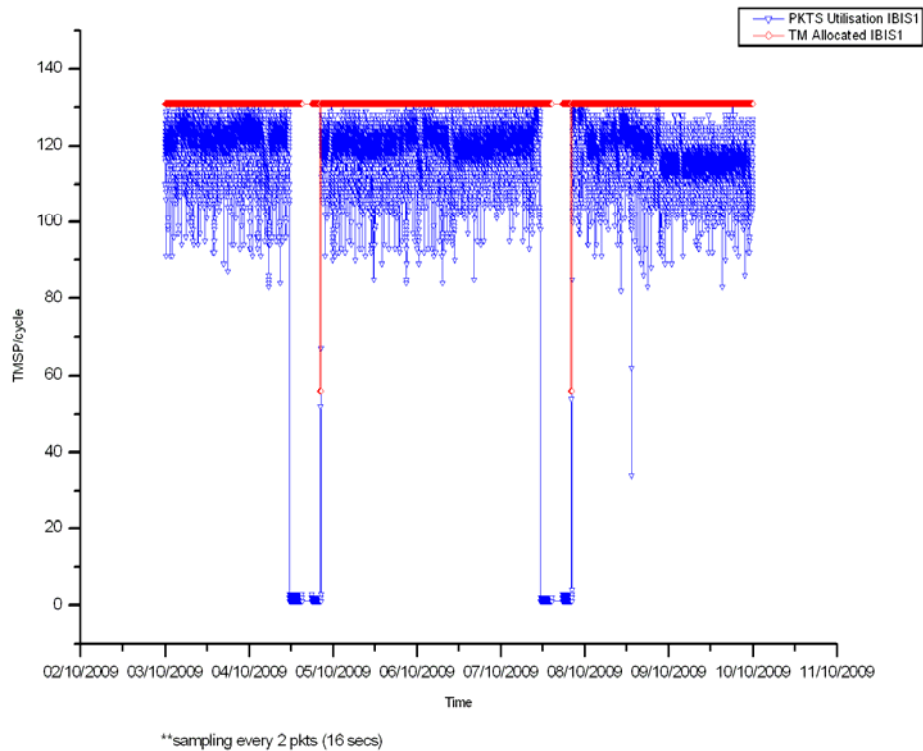
The overall status of IBIS is nominal.

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

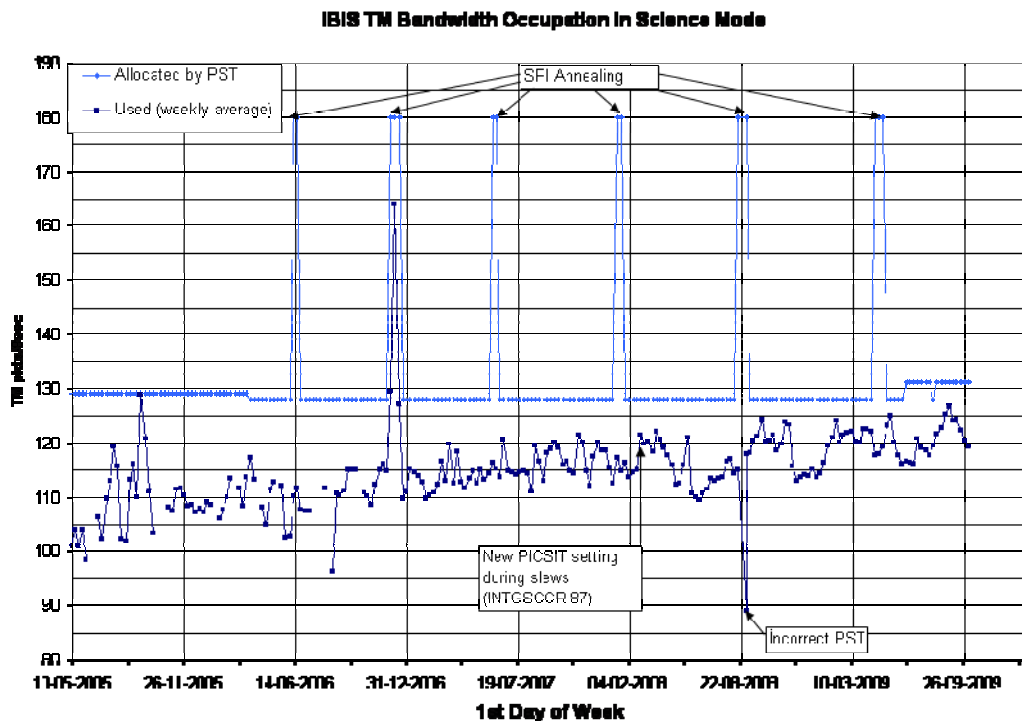
- PST allocation to IBIS above radiation belts: 131 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 119.31 packets/cycle (down 1.06 on previous week)
- Percentage of TM cycles for which full bandwidth was used: 2.2%

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

IBIS - TM Bandwidth Utilisation Rev 851-853



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.

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, 209 of the 210 planned science pointings were executed nominally, 1 was 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. The sun was blank all week. The risk of solar flares was very low.

Reference: www.spaceweather.com

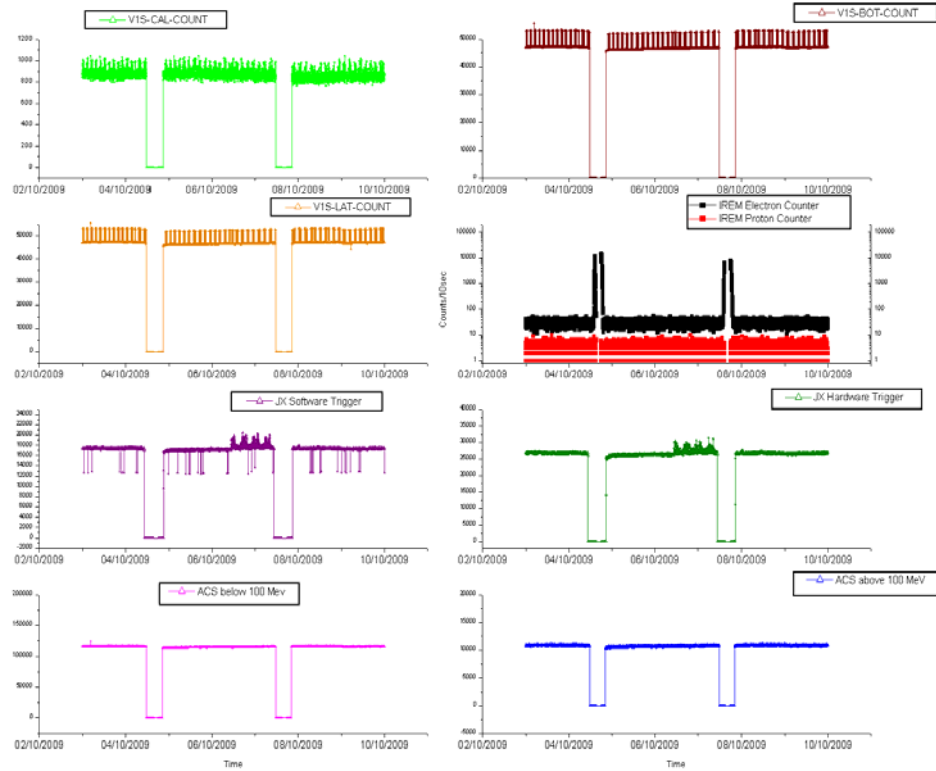
Note: Some more information concerning the IREM operations is provided in the Appendix.

3.2.6 Radiation Background

The background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the week²:

² Data sampled every 6th packet (48sec)

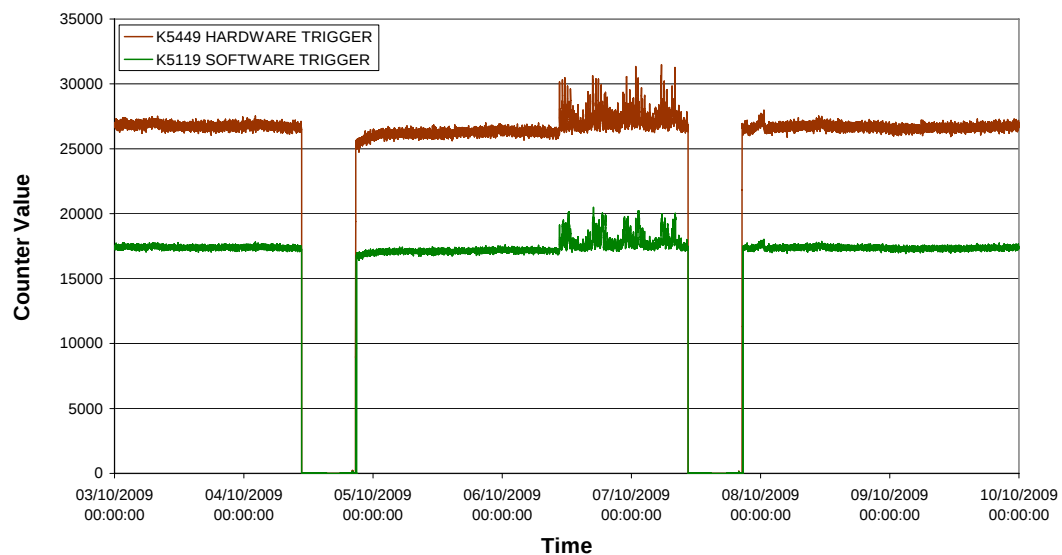
Radiation Background: Instrument Count Rates Rev 851-853



JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph³.

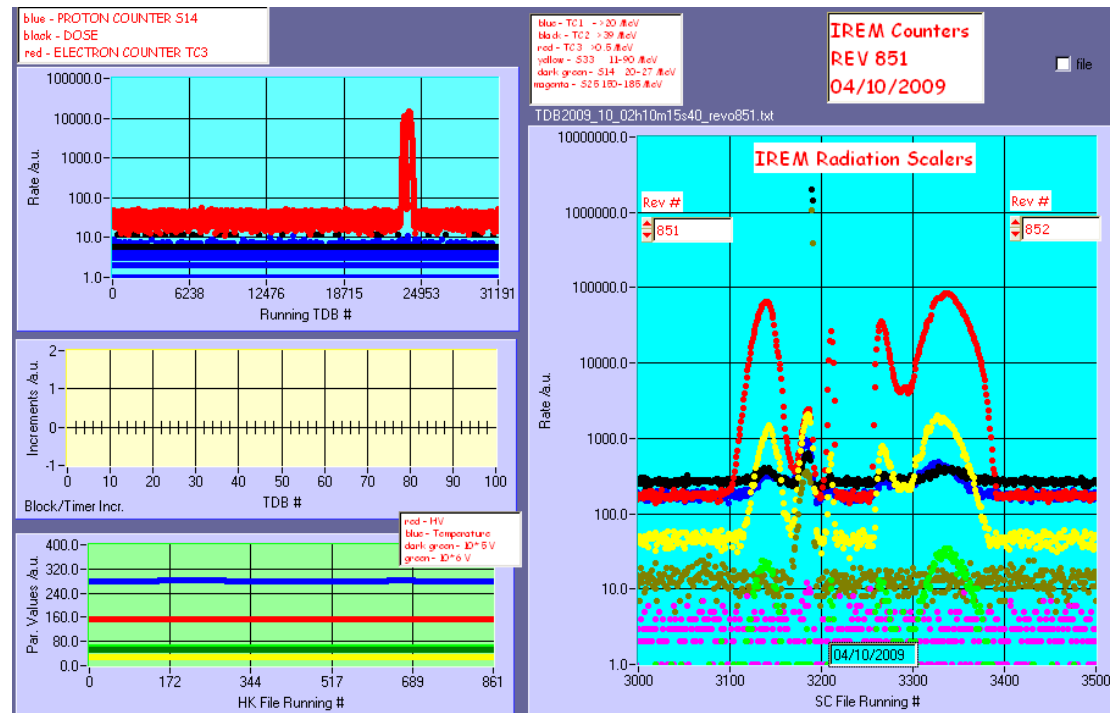
JEMX-1 Count Rates



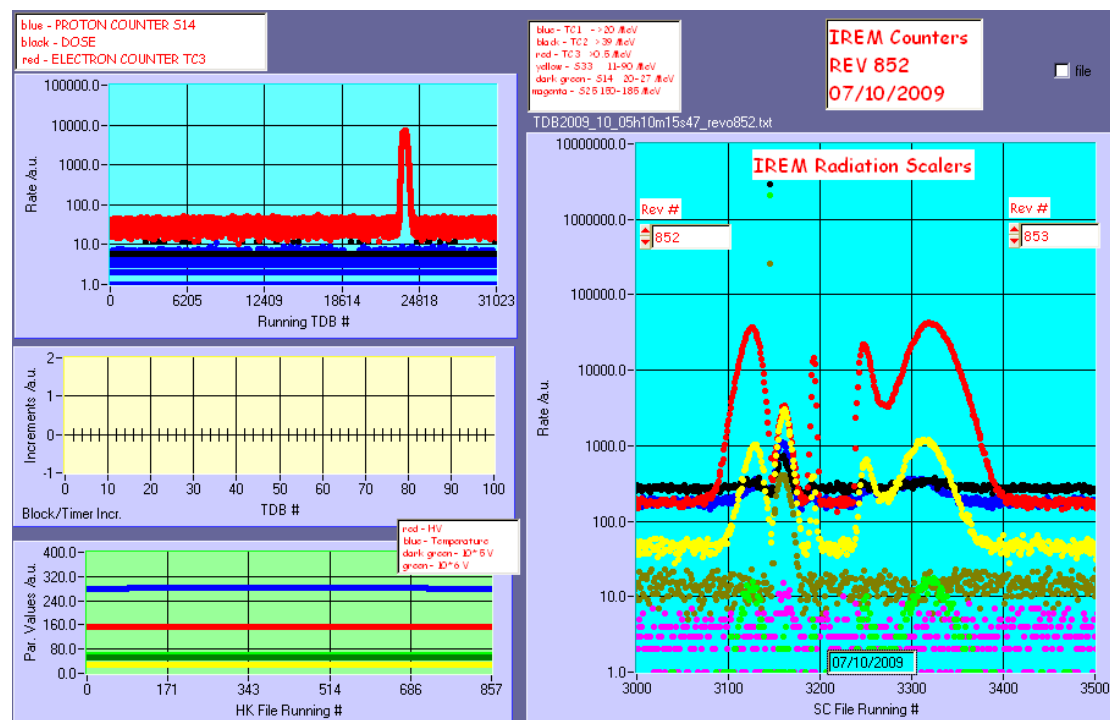
³ Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

IREM radiation counters:

Revolution 851



Revolution 852



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 were three occasions when the links to 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 a TM drop VC0 and VC7 from DSS27 due to early LOS at the station. The perigee antenna swap was performed manually. INCTRS SIs validation with Weilheim is pending and will be done in the next few days. A autotrack test session at VIL-2 station will be organized to check its performance up to 60 deg elevation and to issue a waiver for the mission requirement above that elevation.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 859-861. PSF updates were received for revolutions 860 (2x) and 861 (1x) due to handover changes.

Observations have been planned for revolutions 856-861. 856 and 857 were also replanned because of a wrong instrument and TM setting for JEM-X1 in 856. Note that from this revolution the default instrument taking science is JEM-X2. Note also that SPI annealing is running from 857-862, with non-default TM settings of the instruments in 857-861.

New TSFs have been received for revolutions 853 to 856.

2. Observation status

New ECS files have been received for revolutions 835-838 and 840.

3. ISOC Science Data Archive

No news.

4. ISOC system

No news.

5. Problems

No new problems. There was a confusion about the right configuration for JEM-X1 in revolution 856 (since it has to stay on during the SPI annealing in revolutions 857-861), but this was more or less resolved by a replan of this revolution at ISOC.

5 Special Events

6 Anomalies

The following anomaly occurred this week:

AR id	Date Created	Subject	Segment	Status
INT_SC-269	2009-10-05	Spurious Switch Off of P HLCL 4B2 (SPI Heater)	Payload	Pending
INT-3077	2009-10-09	Lose of guide star during TCM	FDS	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Detailed Satellite Information

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

8.1.1 AOCS SUMMARY OPERATIONS REPORT, 03/10/2009 – 09/10/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 115 Open Loop Slews, 112 Closed Loop Slews and 6 Momentum Biases were executed (as reported by ACC OEM).

Slew 08530005 was not executed from the timeline.

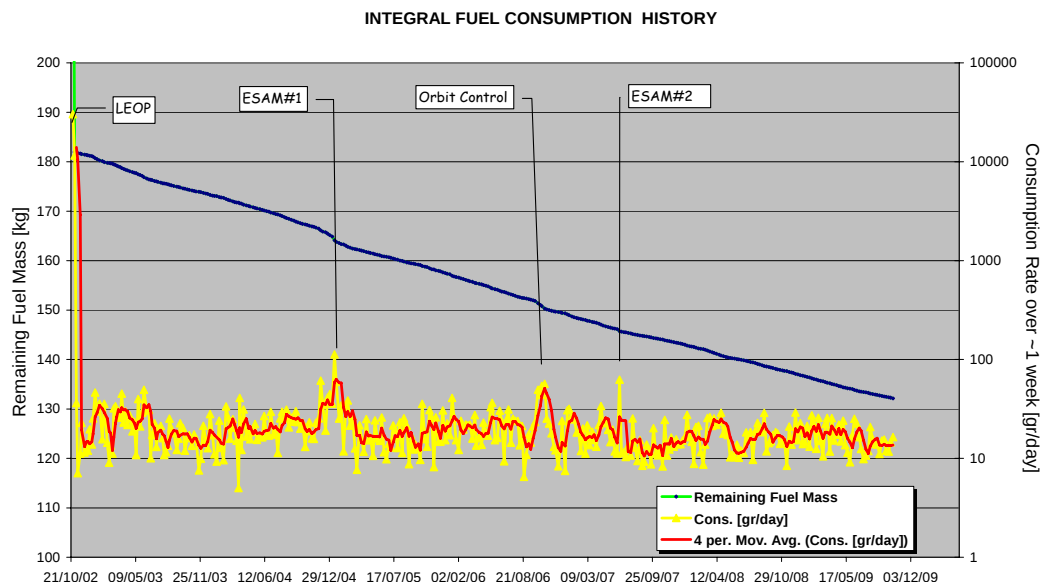
The OTF was not reached for PIDs 08520006, 08530004 and 08530005.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 09/10/2009 is reported in the plot below.

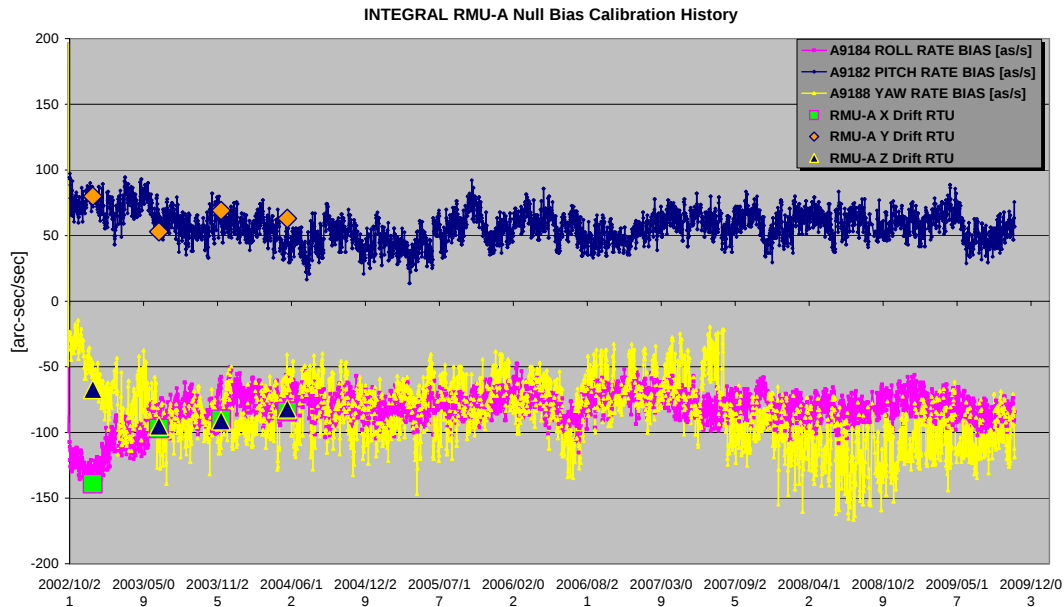


The above plot considers the ESAM fuel consumption spread over period of ~1 week.

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 10/10/2009 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.



Daily events Log:

03/10/2009 (Day of Year 276, Revolution 851)

Nothing to report

04/10/2009 (Day of Year 277, Revolution 851 to 852)

- IMU1 switched ON during the stable pointing of PID 08520006 (23:09:00Z). A manual mapping was commanded and the parameters for slew 08520007 manually updated (spacontool).

No impact on the Timeline.

OTF was not reached for PID 08520006.

05/10/2009 (Day of Year 278, Revolution 852)

Nothing to report

06/10/2009 (Day of Year 279, Revolution 852)

Nothing to report

07/10/2009 (Day of Year 280, Revolution 852 to 853)

- IMU1 switched ON during the stable pointing of PID 08530004 (21:54:00Z). A manual mapping was commanded after the IMU switched OFF.

A manual slew was performed from attitude 08530004 to attitude 08530005 and the parameters for slew 08530006 were afterwards manually updated (spacontool).

Slew 08530005 was missed from the Timeline.

OTF was not reached for PID 08530004 and 08530005.

08/10/2009 (Day of Year 281, Revolution 853)

Nothing to report

09/10/2009 (Day of Year 282, Revolution 853)

- IMU1 switched ON during TCM (RWB). The mapping at the end of the RWB sequence got interrupted, but enough stars had been tracked for attitude determination at that time.

The automatic update after the RWB took place nominally.

No impact in the Timeline.

8.1.2 SPI Operations

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

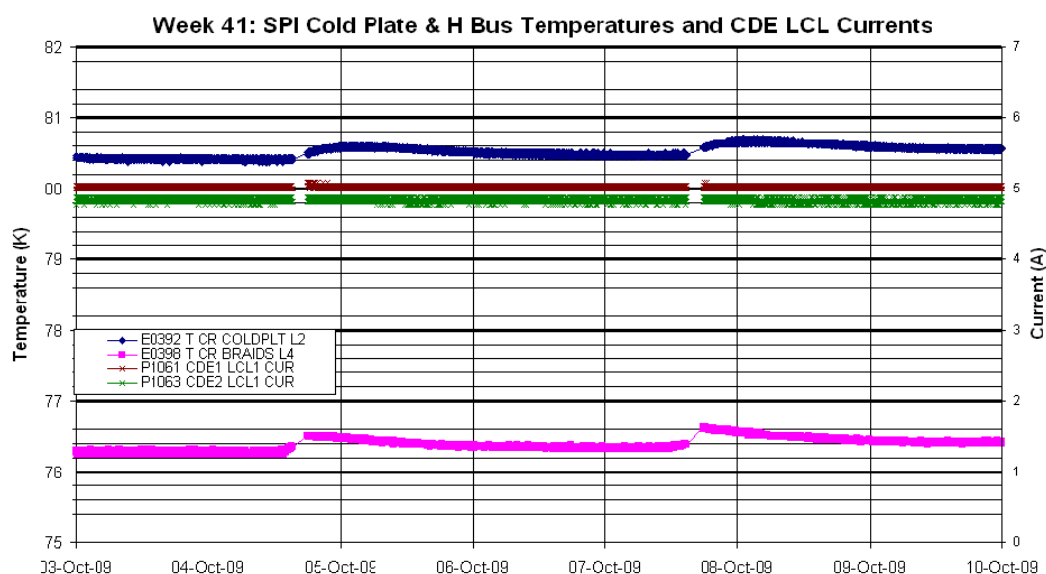
Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

The stroke of all four compressors was set to 41 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 5.02A
- CDE2 LCL Current = 4.82A

The following plot shows the evolution of the cold plate and H bus temperature as well as the CDE LCL currents during the reporting period⁴:

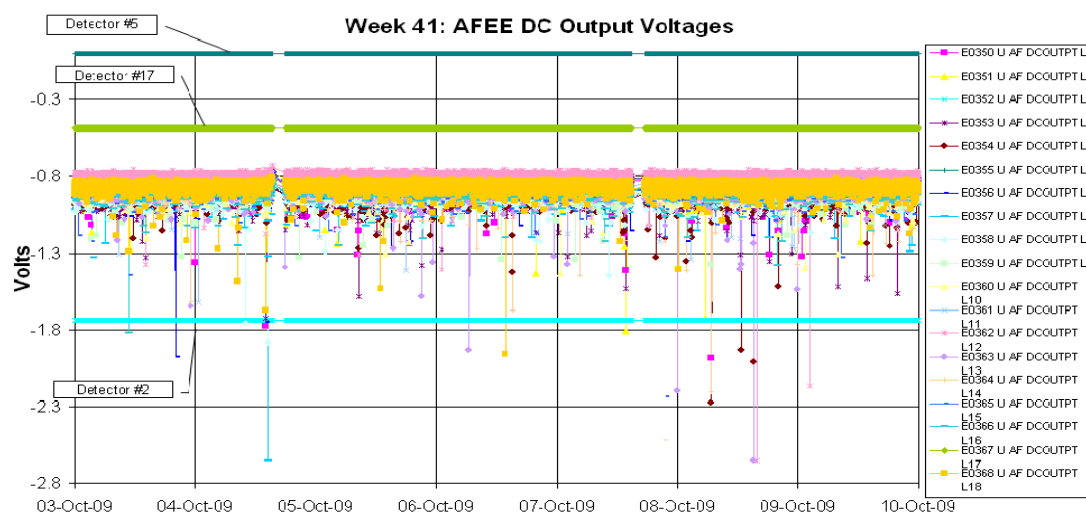
⁴ Data sampled every 8th packet (64sec)



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 period⁵. 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.



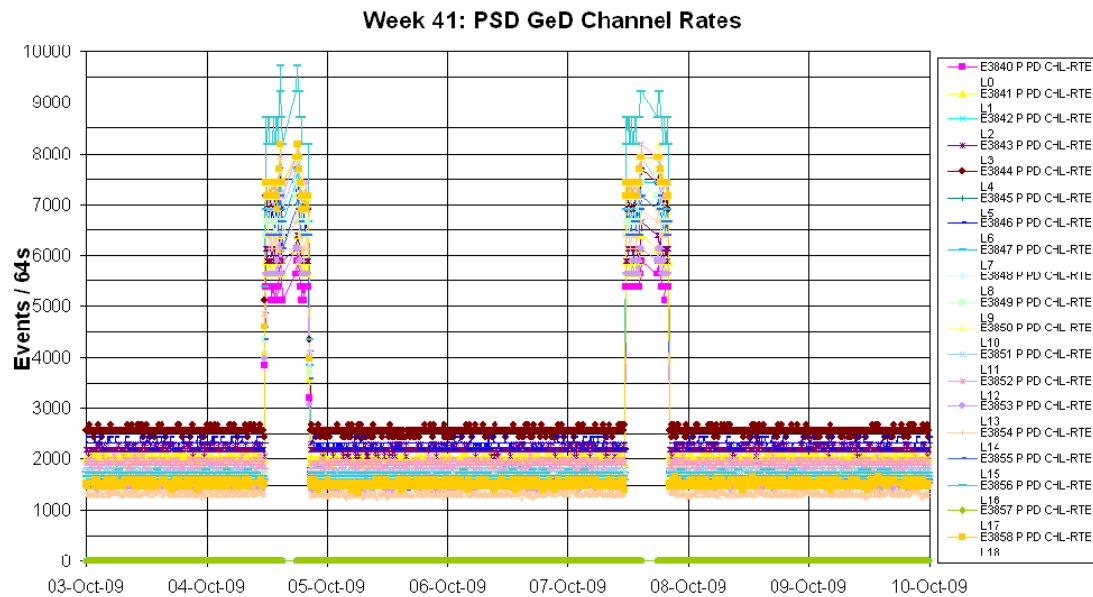
⁵ Data sampled every 8th packet (64sec)

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 period⁶.



⁶ Data sampled every 8th packet (64sec)

PSD: The overall health of the unit is nominal. The following plot shows the PSD channel rates over the reporting period⁷:



Event Log:

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

- On 2009-10-05 at 05:13Z TM parameter P2172 P HLCL 4B2 STA failed Status Consistency Check, having spuriously changed status from CLOSE to OPEN. This is a group switch powering several transistor switches (TSW), however the only TSW affected by this SEU on the HLCL (i.e. the only one whose status was previously CLOSE) was that of the ACS-Mask Heater B (TM parameter T8607 TSW STA ACS-B). In order to recover the following was performed:
 - 05:42:49Z FCP_TCS_1126 was executed to set T8607 to OPEN;
 - 05:43:53Z TC P4339 executed to set P2172 to CLOSE;
 - 05:44:29Z FCP_TCS_1126 executed to set T8607 to CLOSE again.
 SPI operations continued nominally. This is recorded as Anomaly Report INT_SC-269.

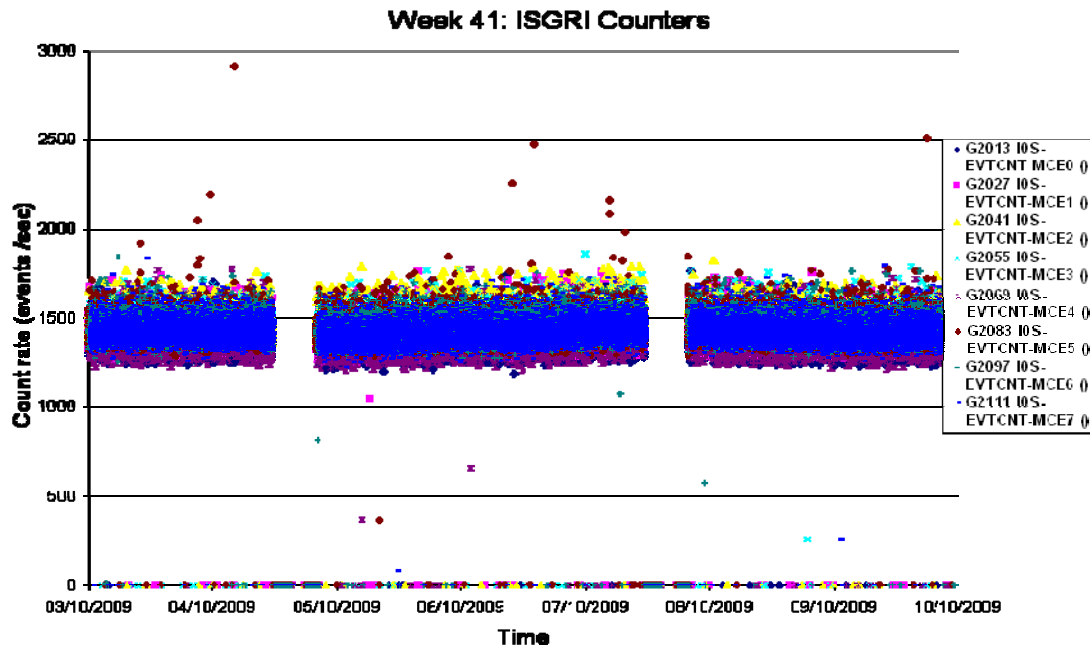
8.1.3 IBIS Operations

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

⁷ Data sampled every 8th packet (64sec)

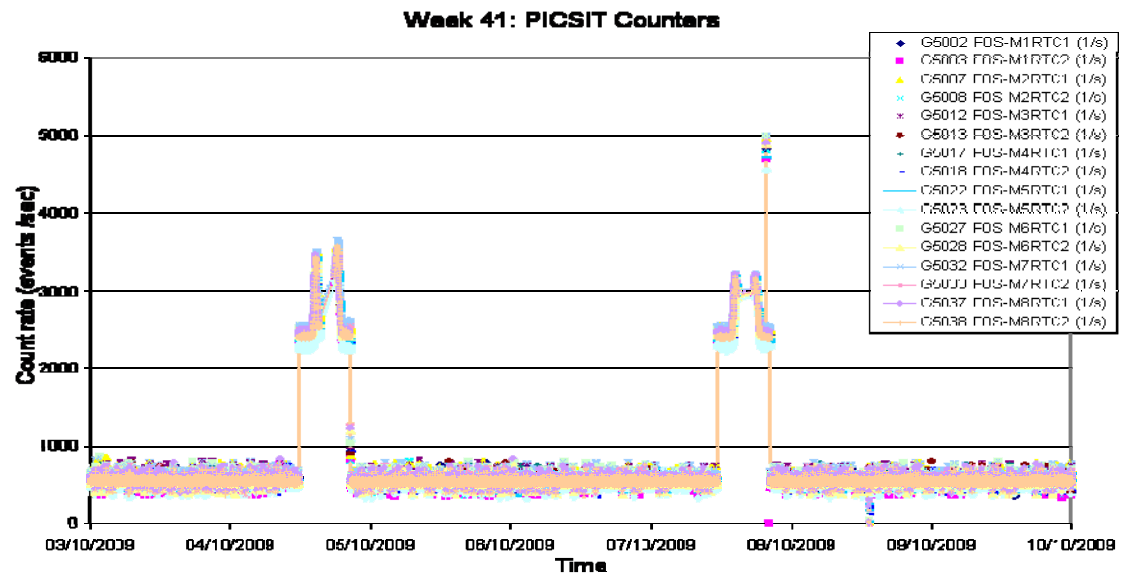
ISGRI

The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the week⁸:



PICsIT

The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the week⁹:

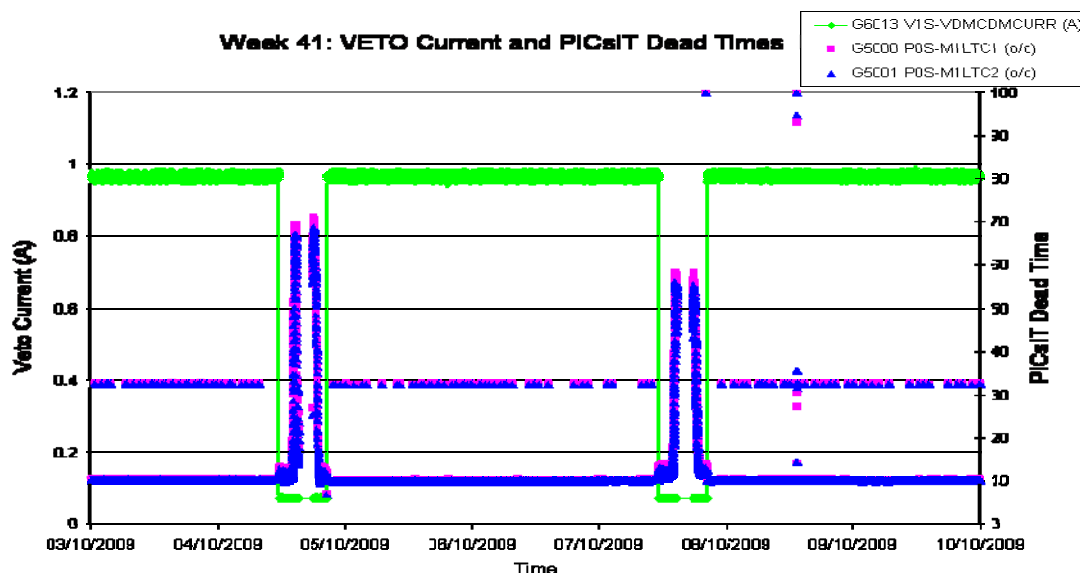


⁸ Data sampled every 4th packet (32sec)

⁹ Data sampled every 4th packet (32sec)

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 week¹⁰:



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 G2070 briefly toggled OOL several times during the week, indicating an overflow of the noisy pixel address buffer in MCE5. As in each case it returned within limits of its own accord, no action was taken.

2009-10-03 (DOY 276, Rev. 851) to 2009-10-07 (DOY 280, Rev. 852-853)

IBIS operations executed nominally.

2009-10-08 (DOY 281, Rev. 853)

At 13:21:51Z the TM parameters families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 13:22:50Z the TM parameter families G5002 and G5003 for the PDM semi-module counters started going OOL Low. As these were followed at 13:26:42Z 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.

2009-10-09 (DOY 282, Rev. 853)

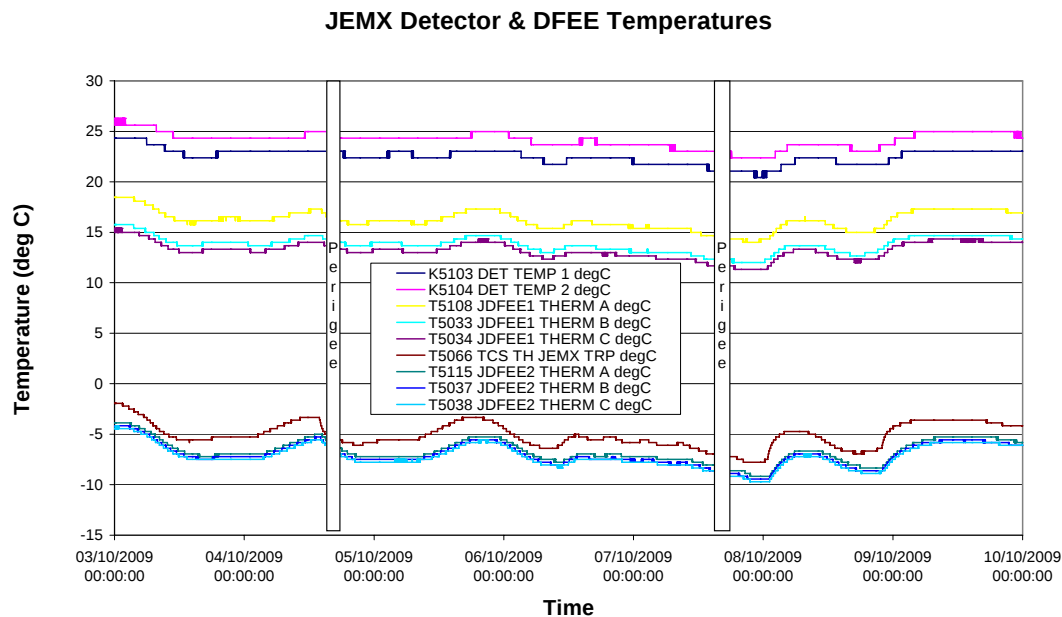
IBIS operations executed nominally.

¹⁰ Data sampled every 4th packet (32sec)

8.1.4 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 graph¹¹.



JEM-X Daily Report

2009-10-03 (DoY 276 Rev 851) to 2009-10-05 (DoY 278 Rev 852)

JEM-X 1 operations executed nominally.

2009-10-06 (DoY 279 Rev 852) to 2009-10-07 (DoY 280 Rev 852-853)

From DoY 279 11:11:17 to DoY 280 08:05:41 (rev. 852), there were repeated instances of TM parameter K5449 exceeding soft limits. This was during pointings 08520068 to 08520090 when the S/C was observing the source 4U 1907+09 (RA 19:09:37.90, Dec +09:49:49.0). No action was taken, and there was no impact.

2009-10-08 (DoY 281 Rev 853) to 2009-10-09 (DoY 282 Rev 853)

JEM-X 1 operations executed nominally.

¹¹ Data sampled (1 frame in 8)

8.1.5 OMC Operations

2009-10-03 (DoY 276, Rev 851) to 2009-10-06 (DoY 279, Rev 852)

Nothing to report.

2009-10-07 (DoY 280, Rev 852-853)

At 21:54, an AOCS problem forced an interruption in the timeline. A recovery was performed, and the timeline rejoined at 22:26. The impact was the loss of pointing 08530005.

2009-10-08 (DoY 281, Rev 853) to 2009-10-09 (DoY 282, Rev 853)

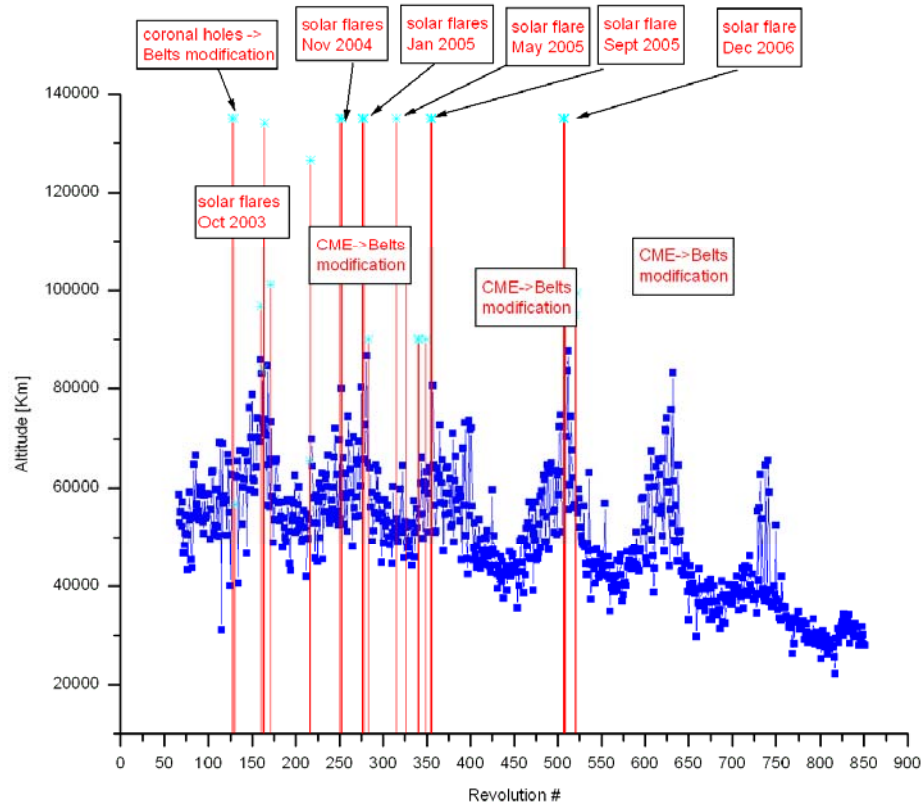
Nothing to report.

On DoY 277 at 11:33:08 and DoY 280 at 11:21:17 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.1.6 IREM Operations

Radiation Belts Entry

Evolution of Radiation Belt Entry 2003-2008



IREM daily report

Nothing to report.

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]
851	RAD_ENTR R 2009-10-04T11:33:06Z	04/10/2009 14:07:47	28001.5	04-Oct-2009 14:08:23	27877.35
852	RAD_EXIT R 2009-10-04T20:24:16Z	04/10/2009 19:03:24	>>32913.1	04-Oct-2009 20:08:23	47614.47
852	RAD_ENTR R 2009-10-07T11:21:10Z	07/10/2009 13:54:52	27783.9	07-Oct-2009 13:50:58	29102.1
853	RAD_EXIT R 2009-10-07T20:11:18Z	07/10/2009 19:08:20	>>32962.9	07-Oct-2009 19:50:58	46748.96

Reference

High radiation

Very small error vs reference (less than 10 minutes)

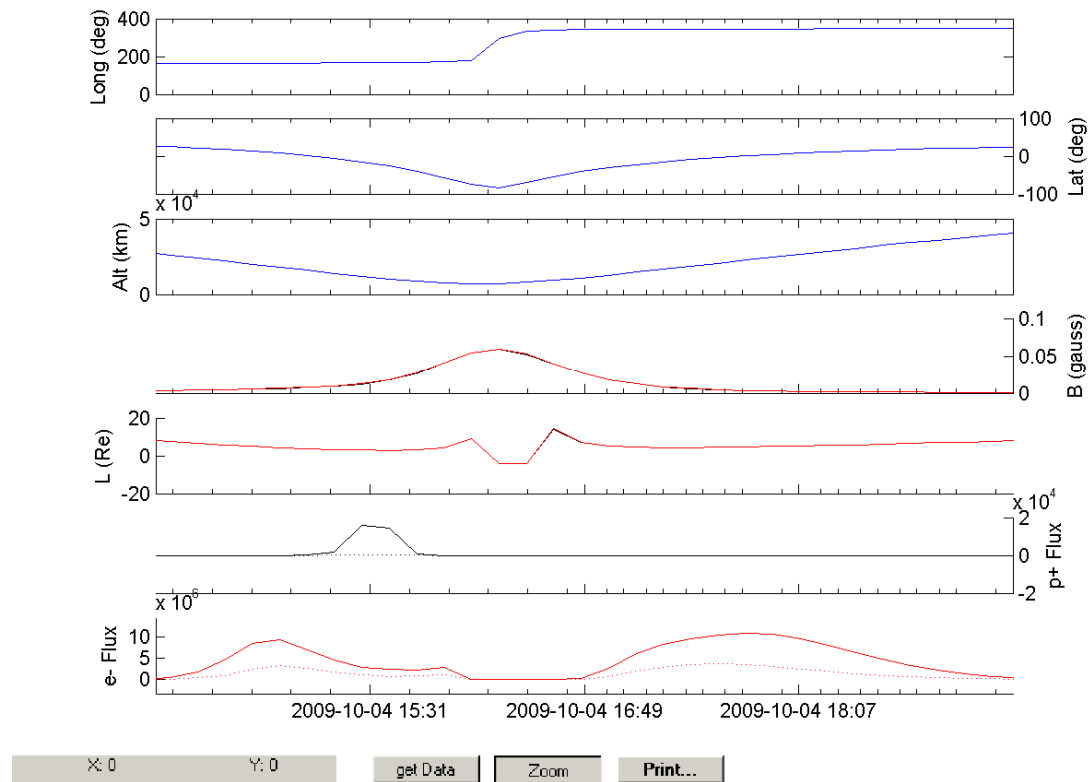
Small error vs reference (between 10 and 30 minutes)

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 851



Rev 852

