

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 346
Week 19
11.05.09
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 02.05.09 until 08.05.09 (both dates inclusive) and covers the revolutions 800, 801 and 802.

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 GRS 1915+105 (RA 19:15:11.50, DEC +10:56:44.0), a raster dither of PKS B2149-307 (RA 21:51:55.52, DEC -30:27:53.7), a raster dither of Eta Carinae (RA 10:45:03.59, DEC -59:41:04.3), and a hexagonal dither of the Coma Cluster (RA 12:59:48.70, DEC +27:58:50.0)

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.

No slews were missed from TL, during the observation period.

The fuel consumption over the period between 02/05/2009 and 08/05/2009 was 0.1825 Kg. The remaining propellant is in the order of 134.3704 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

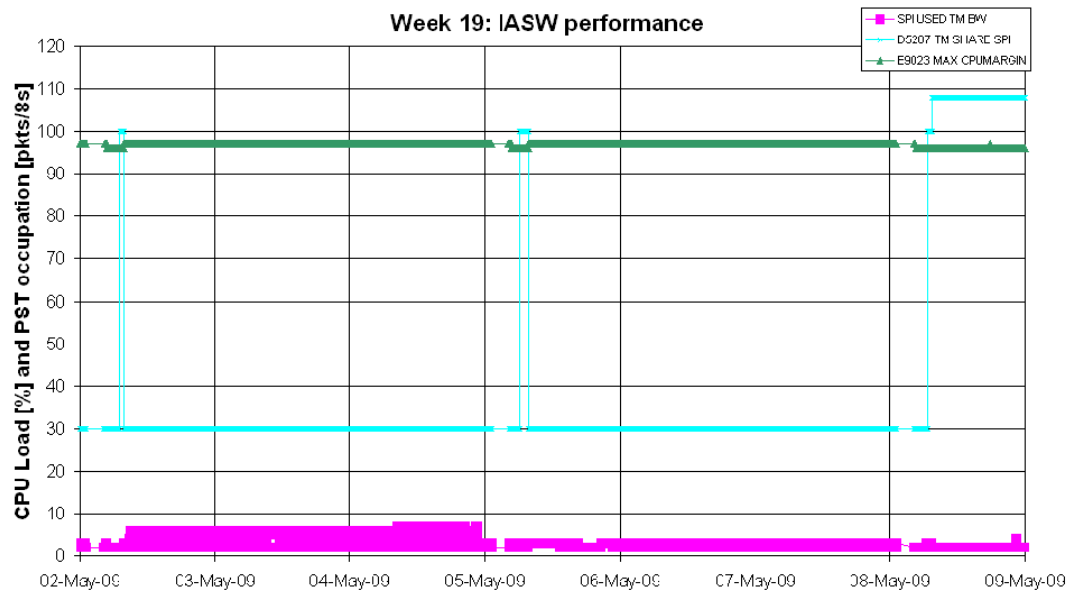
3.2.1 SPI

The overall status of the gamma-ray spectrometer is nominal. The 13th Annealing started on 19-04-2009 at 23:56Z. Operations for this annealing are progressing nominally. The main activities were as follows:

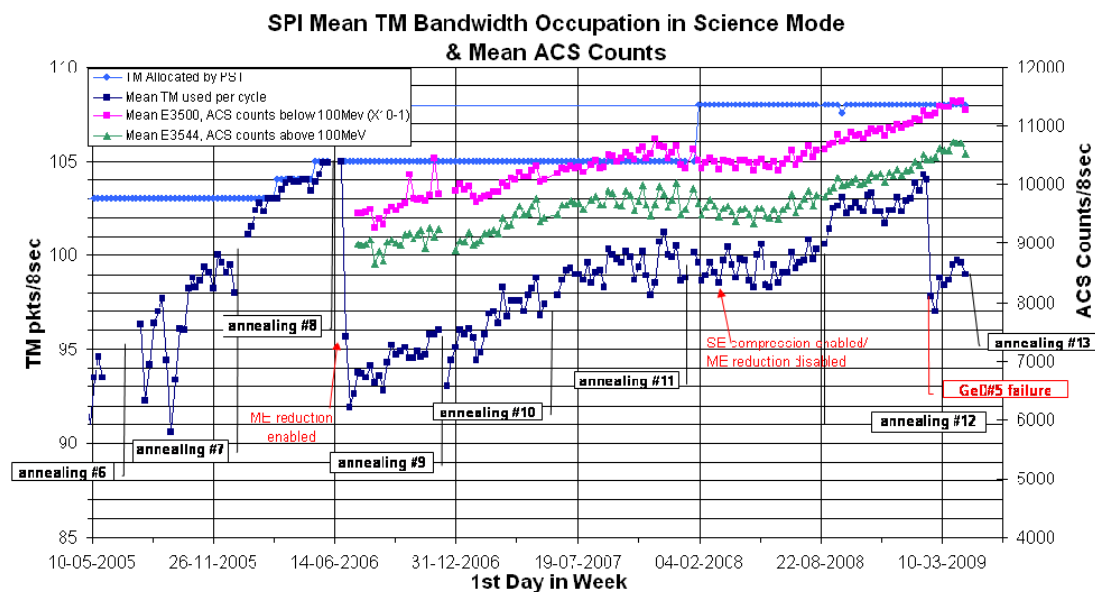
Date/Time	Activity
2009-04-19 23:56:00Z	Configure SPI for start of Annealing and stop SPI active cooling
2009-04-20 01:00:00Z	Annealing Heater Main ON
2009-04-20 03:00:00Z	Annealing Heater Redundant ON
2009-04-20 15:35:00Z	Heat Pipe Heater Main ON, All Antifreeze Heaters (1A; 2A; 1B; 2B) OFF
2009-04-21 03:35:20Z	Heat Pipe Heater Redundant ON
2009-04-21 12:00:00Z	Cold plate temperature reached 373K (100degC)
2009-05-02 08:00:00Z	Stop SPI Annealing: Annealing Heater Main and Redundant OFF; Heat Pipe Heater Main and Redundant OFF; Antifreeze Heater 1A ON
2009-05-02 08:18:43Z	Start Toggling of Heat Pipe Heater to manage Cold box temperature: Heat Pipe Heater Main and Redundant ON
2009-05-02 08:47:00Z	ACS switch-on and start of ACS calibration (also FEE#57 and FEE#81 ON)
2009-05-02 14:20:10Z	Heat Pipe Heater Redundant OFF
2009-05-03 02:20:10Z	Heat Pipe Heater Main OFF and start toggling of Heat Pipe Heater Main (75% ON then 50% ON then 25% ON cycles)
2009-05-04 22:36:00Z	End of ACS Calibration

2009-05-05 12:52:52Z	Thermal braids temperature TM EU0398A reached 308K
2009-05-05 12:57:12Z	Start of cryocooler switch-on
2009-05-05 14:15:00Z	Cryo-cooler switch-on complete and stroke set to 4x45
2009-05-06 08:20:10Z	End toggling of Heat Pipe Heater Main: Heat Pipe Heater Main OFF
2009-05-08 22:15:56Z	Cold plate temperature TM EU0392A reached 127K
2009-05-08 22:23:00Z	Selected narrow range cryo temps and restored PSD nominal threshold

Throughout the reporting period SPI was in CONF mode with a TM allocation of 30 packets/cycle due to the annealing. 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 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

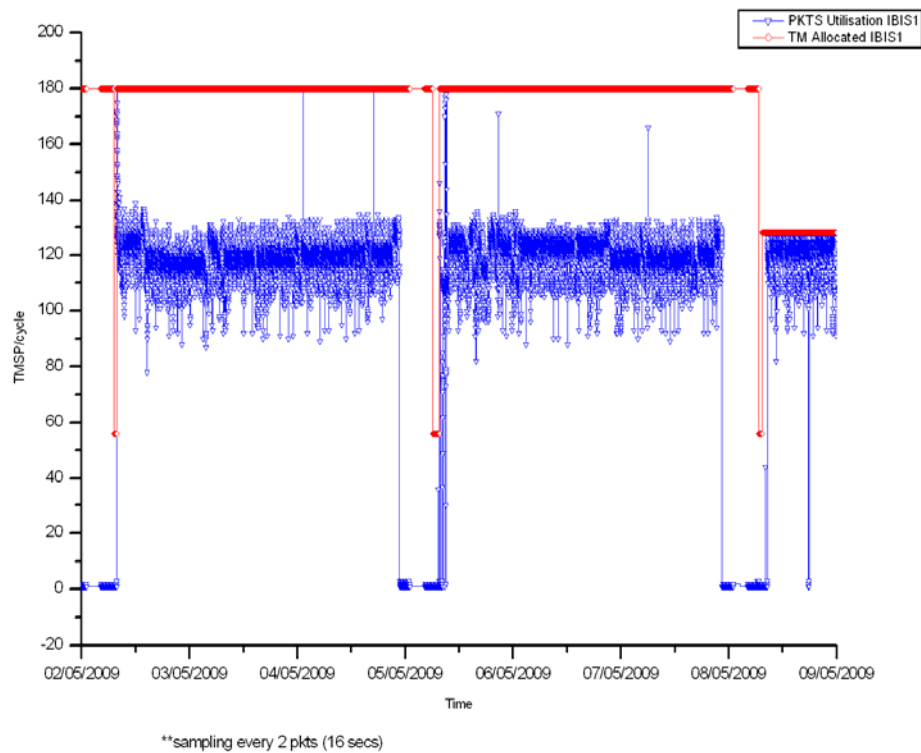
The overall status of IBIS is nominal.

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

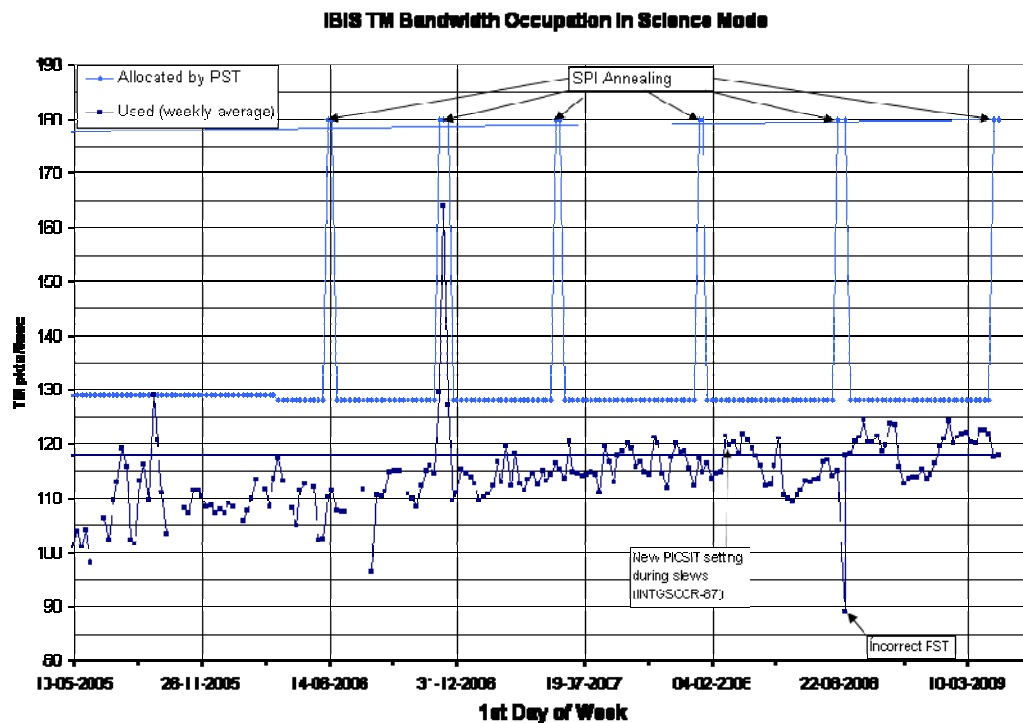
- PST allocation to IBIS above radiation belts: 180 packets/cycle in revolutions 799-801 and 128 packets/cycle in revolution 802.
- IBIS mean bandwidth utilisation in science mode: 119.34 packets/cycle (up 1.36 on previous week)
- Percentage of TM cycles for which bandwidth usage was ≥ 128 packets/cycle: 5.75%

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

IBIS - TM Bandwidth Utilisation Rev 799-802



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.

The week began with JEM-X 1&2 operating in Data Taking mode with a TM allocation of 15 packets/cycle. At the end of revolution 801, JEM-X2 was deactivated, and JEMX-1 operated thereafter alone in Data Taking mode, with the TM allocation set to 8 packets/cycle.

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 9 packets per cycle, except from 2009-05-08T07:09:48Z to the end of the week, when the allocation was 5 packets/cycle.

During this reporting period, 132 of the 133 planned science pointings were executed nominally, 1 was cut short.

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.

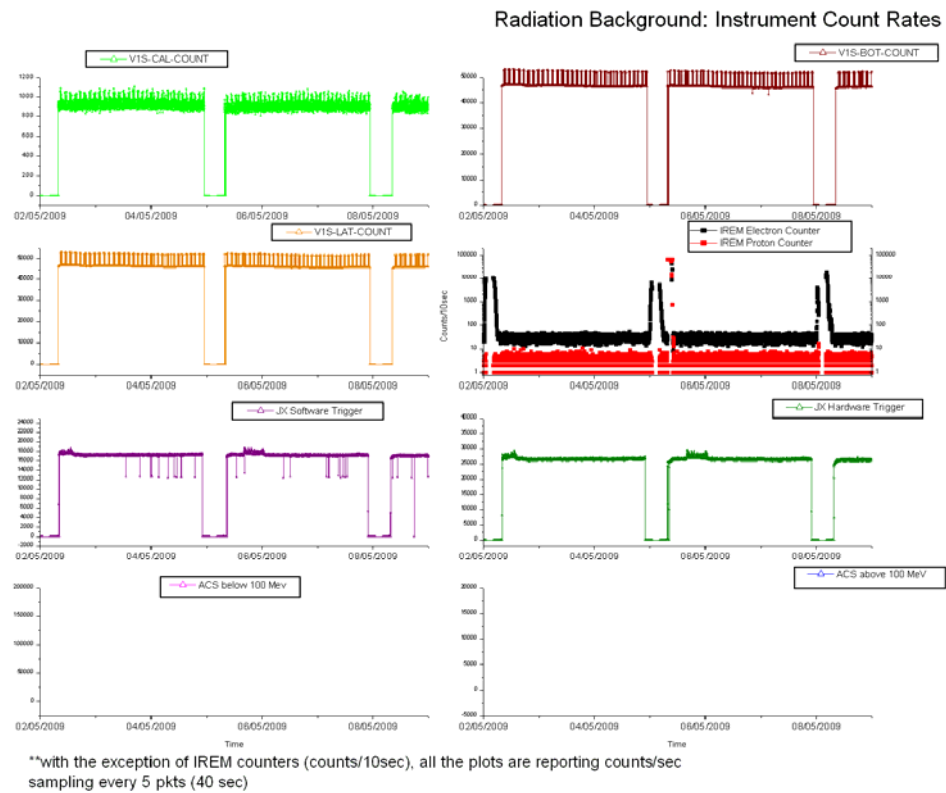
Solar Activity

The observation period was characterised by low solar activity. The sun was blank all week. The risk of solar flares was very low.

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

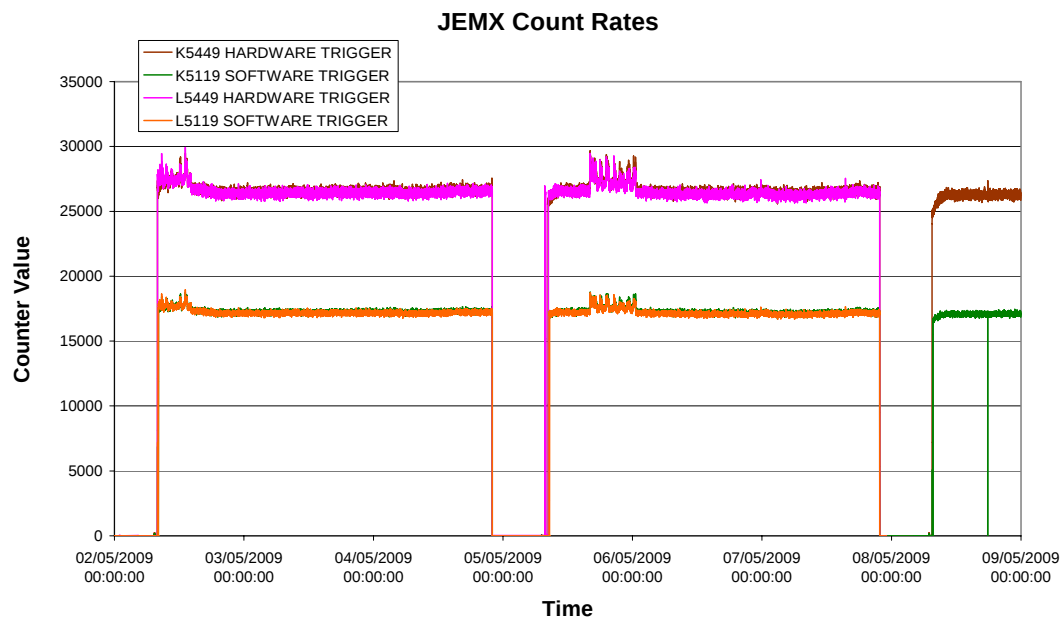
3.2.6 Radiation Background

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



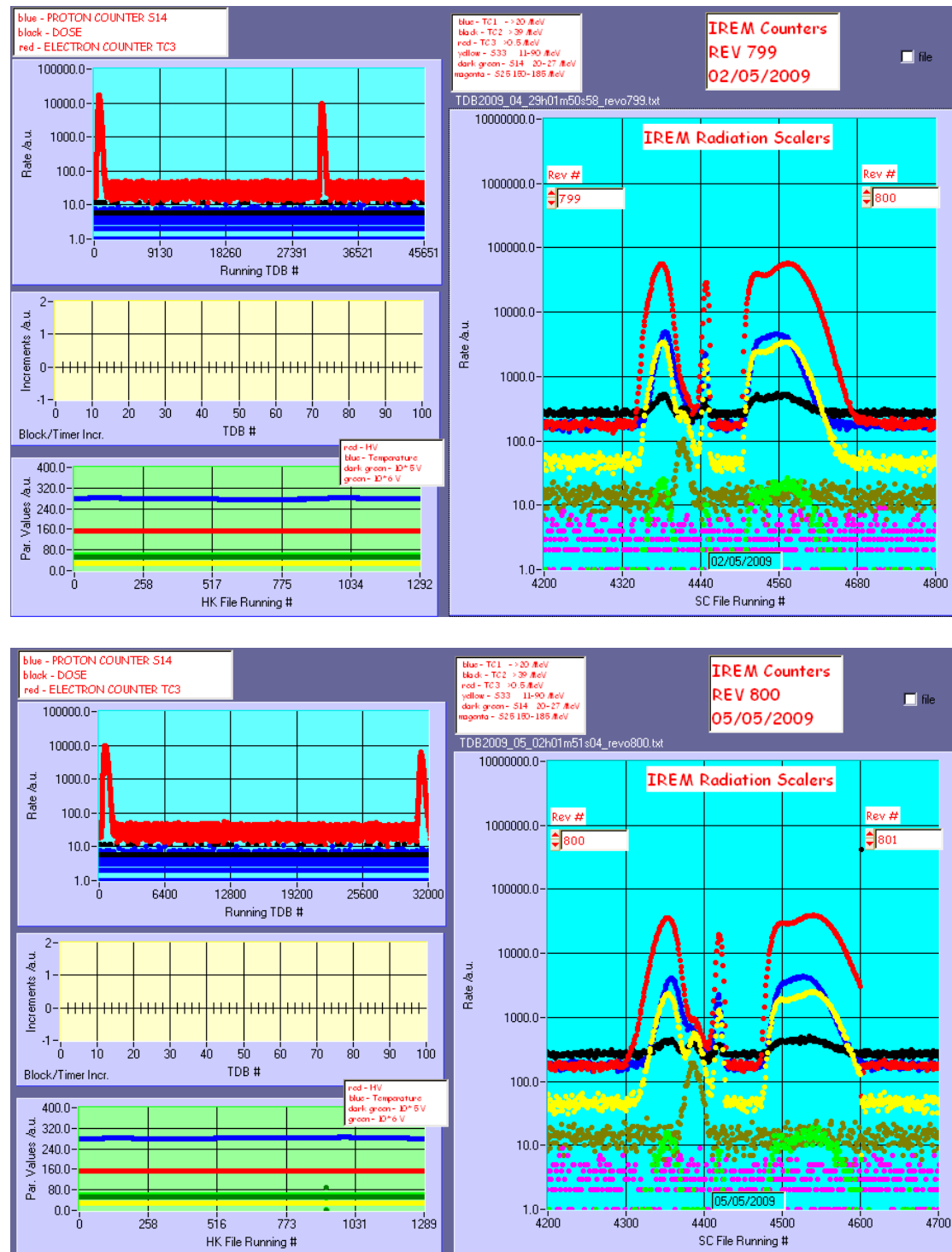
JEM-X Count Rates

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:



Ground Facilities

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

3.3 Mission Operations Centre

The performance of the MOC was good this week, there was 1 occasion when 3 GTP tasks crashed, these were re-started without impact.

3.4 Ground Stations & Network

The performance of the ground stations and Network not very good this week, there were around 20 occurrences of bad TM amounting to many hundreds of bad frames. This led to a missed instrument switch on for JEMX1 & 2, and on another occasion the IBIS start-up was missed. No pointings were lost however.

3.5 Science Ground Segment

3.5.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 805 to 807.

New observations have been planned for revolutions 803 and 804. Further planning is waiting for inputs from the instrument teams.

New TSFs have been received for revolutions 801 to 803.

2. Observation status

ECS files have been received and processed up to revolution 794.

3. ISOC Science Data Archive

No news.

4. ISOC system

ISOC system V22, supporting the second phase of the AO has undergone a first round of in-depth testing.

5. Problems

No new problems.

4 Special Events

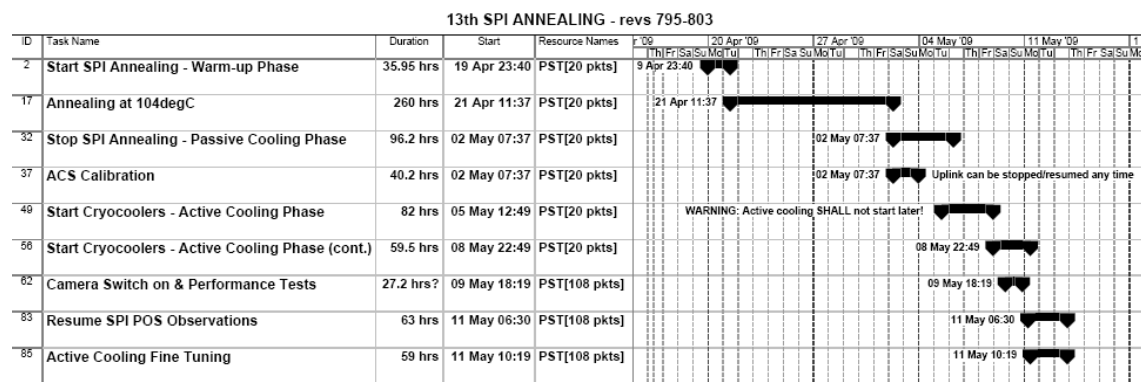
5 Anomalies

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

AR id	Date Created	Subject	Segment	Status
INT-3063	2009-05-04	VIL2 - IFMS problem (DOYs 124-130)	ESA Stations	Pending

6 Future Milestones

The 13th annealing operations started on 19th April at radiation belt entry of revolution 795. Below is the summary timeline of the planned annealing activities:



7 Appendix

The appendix includes various detailed information.

7.1 Consumables

7.2 Detailed Satellite Information

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

7.2.1 AOCS SUMMARY OPERATIONS REPORT, 02/05/2009 – 08/05/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 104 Open Loop Slews, 51 Closed Loop Slews and 6 Momentum Biases were executed (as reported by ACC OEM).

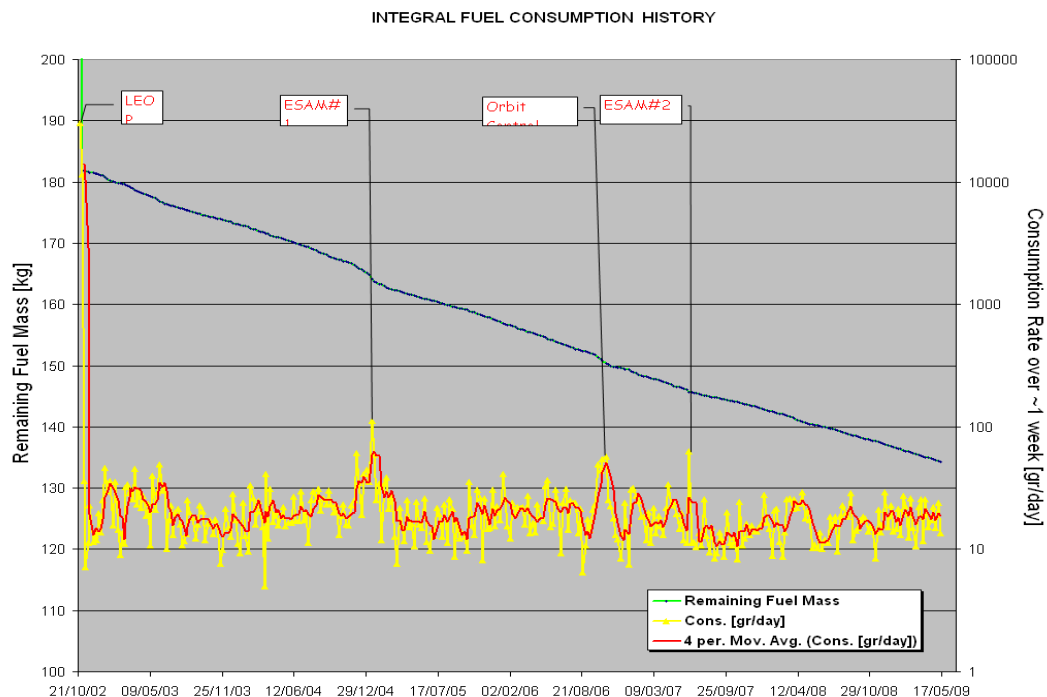
No slews were missed from TL, during the observation period.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 08/05/2009 is reported in the plot below.



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

02/05/2009 (Day of Year 122, Revolution 799-800)

Nothing to report.

03/05/2009 (Day of Year 123, Revolution 800)

Nothing to report.

04/05/2009 (Day of Year 124, Revolution 800)

Nothing to report.

05/05/2009 (Day of Year 125, Revolution 800-801)

Nothing to report.

06/05/2009 (Day of Year 126, Revolution 801)

Nothing to report.

07/05/2009 (Day of Year 127, Revolution 801)

Nothing to report.

08/05/2009 (Day of Year 128, Revolution 801-802)

Problem at VILSPA station: at 12:36z the FDS did not perform the update of the slew ID 08020007. A TM and TC drop in VILSPA station caused the TPF update to fail. A manual recovery was performed and the next slew updated in TL.

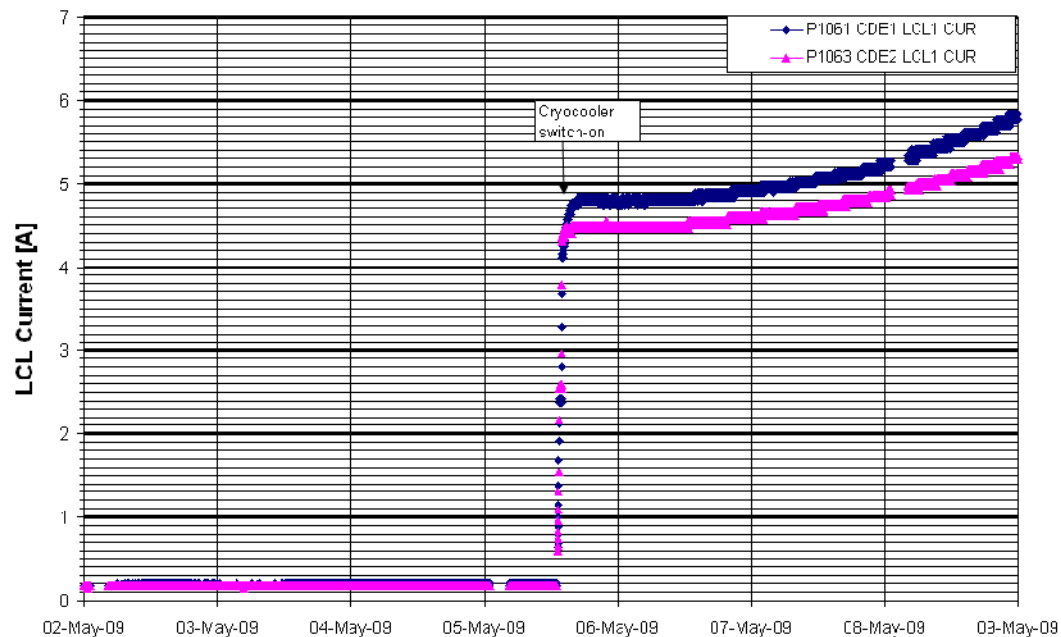
7.2.2 SPI Operations

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

Stirling Compressors and Cryostat:

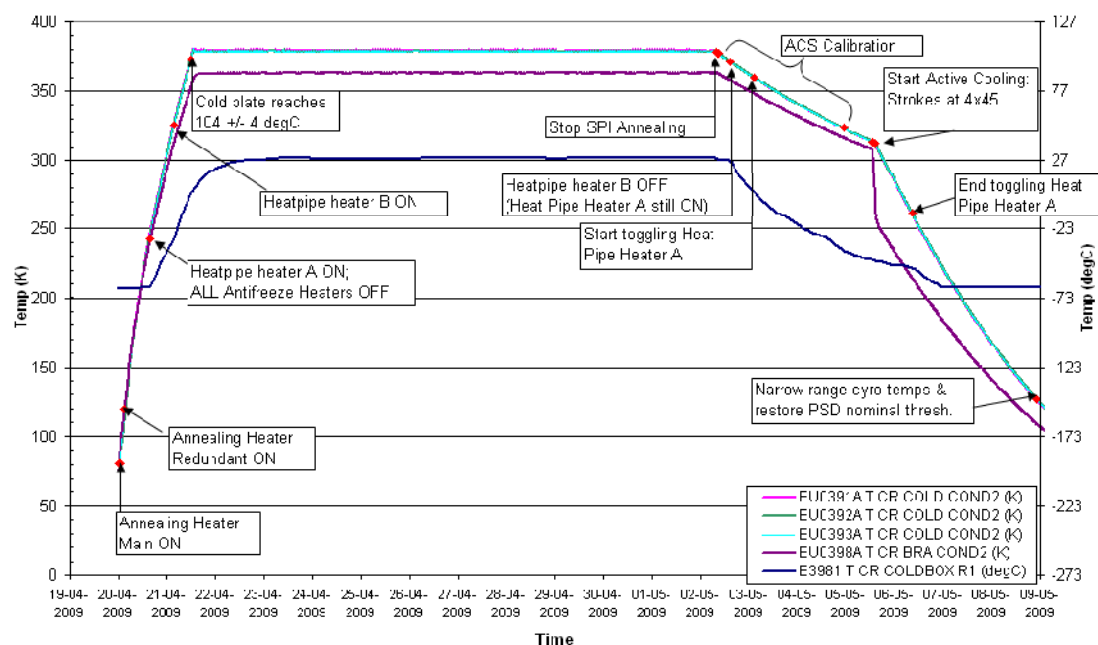
Due to the ongoing annealing operations, the cryocooler was in Standby mode until 2009-05-05 at 12:57Z, when it was switched on to start active cooling at full stroke. The switch-on and subsequent operations of the compressors was nominal. The following plot shows the CDE LCL currents over the reporting period:

Week 19: SPI CDE1 and CDE2 LCL Currents

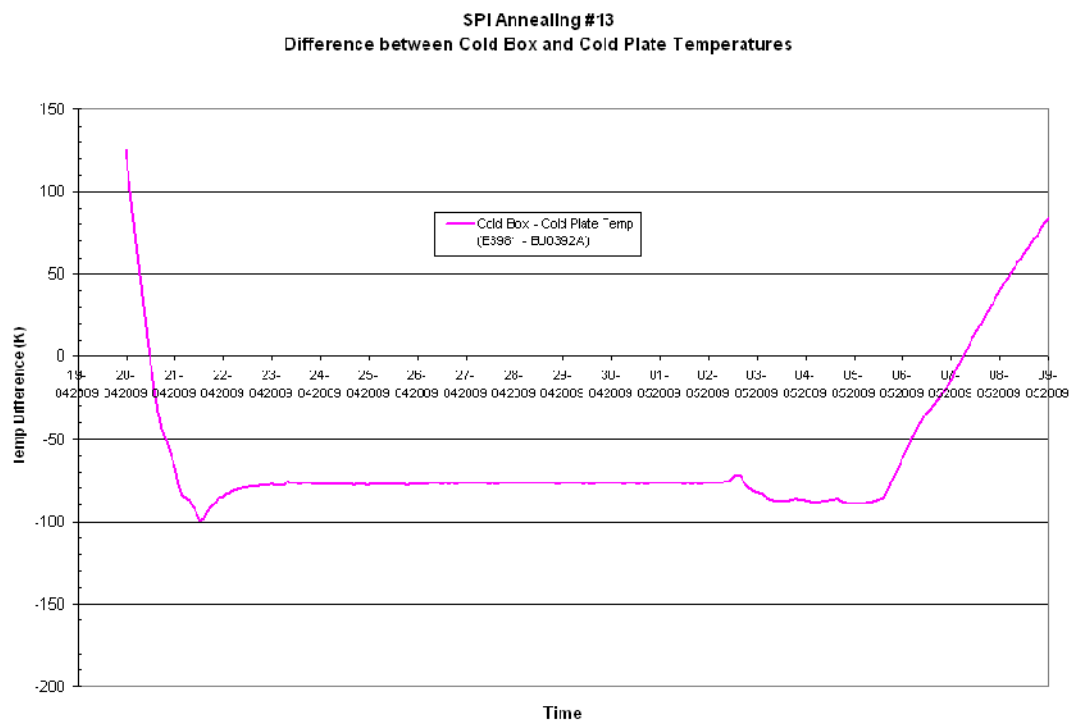


The following plot shows the evolution of the Cold Plate, Thermal Braids and Cold Box temperatures since the start of annealing:

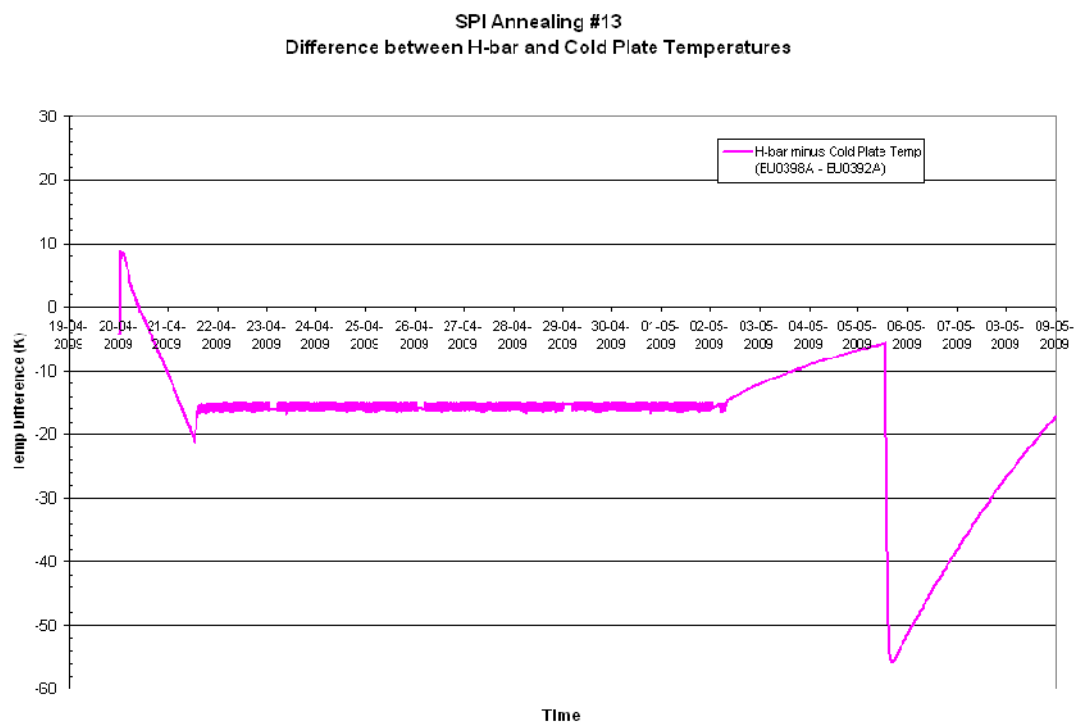
SPI Annealing #13 Cold Plate, Thermal Braids and Cold Box Temperature



The following plot shows the difference between the Cold Box and Cold Plate temperatures since the start of annealing:



The following plot shows the difference between the H-bar and Cold Plate temperatures since the start of annealing:



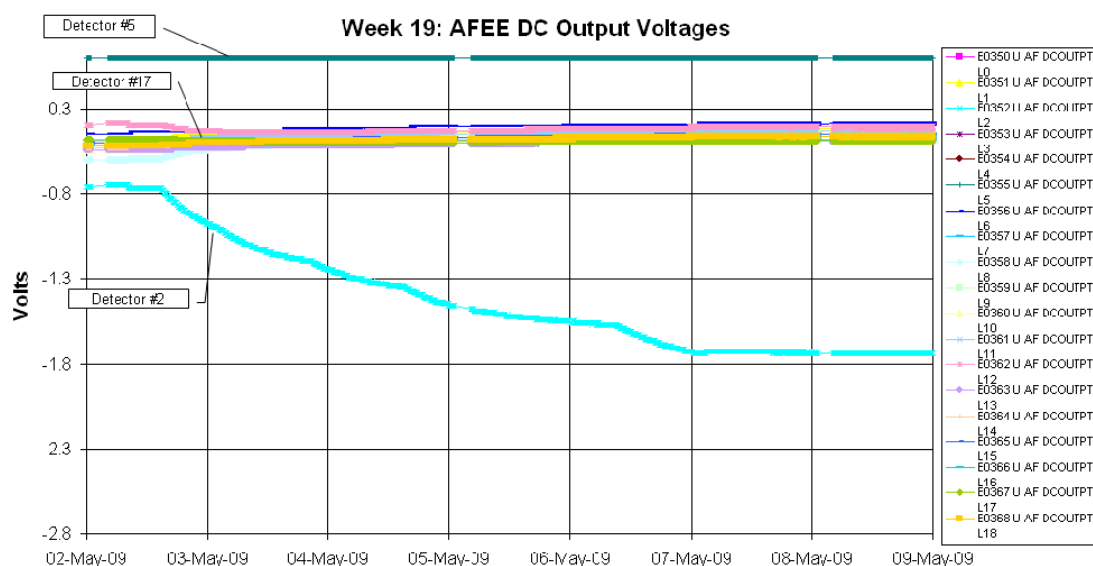
DPE & IASW: The DPE health and IASW performance are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. Due to the annealing operations, SPI was in CONF mode with a TM allocation of 30 packets/cycle. The DPE CPU usage was nominal during the reporting period, considering the IASW was in CONF mode.

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).

For the 13th annealing operations, which started on 19/04/2009, the ACS High Voltages were set to the minimum voltage (~980V) and the ACS was in CONF mode until 2009-05-02 at 08:47:00Z, when the ACS HV was set back to nominal at the start of the passive cooling phase and the ACS Calibration was started. The ACS Calibration was performed until 2009-05-04 at 22:36:00Z, after which the ACS remained in CONF mode with FEE HVs set to nominal. The failed FEEs (FEE #57 and FEE #81) were switched on for the ACS Calibration and left on for the rest of the reporting period.

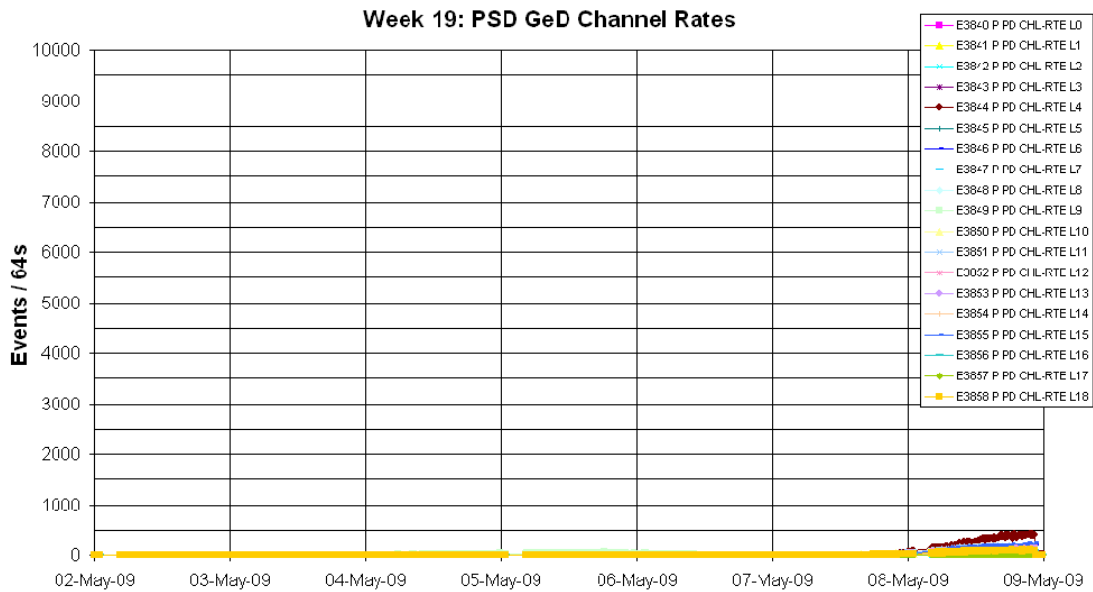
AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. The HV of the failed detectors are nominally set to 0.5kV.

For the 13th annealing operations, which started on 19/04/2009, all detector HVPSSs were switched off and only the LVPSs are left on and the AFEE was in CONF mode.



DFEE: The health of the unit is nominal. For the 13th annealing operations, which started on 19/04/2009, the DFEE was in CONF mode.

PSD: The health of the unit is nominal. For the 13th annealing operations, which started on 19/04/2009, the PSD was in CONF mode. The following plot shows the PSD channel rates over the reporting period.



Event Log:

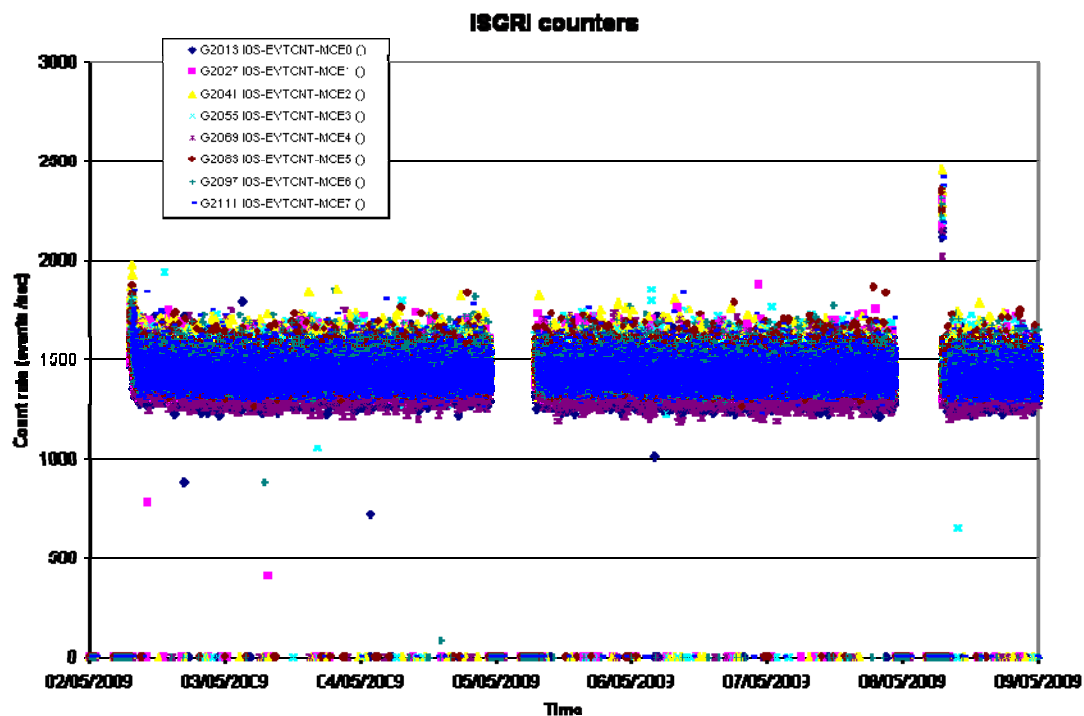
- No non-nominal events occurred with SPI during the reporting period.

7.2.3 IBIS Operations

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

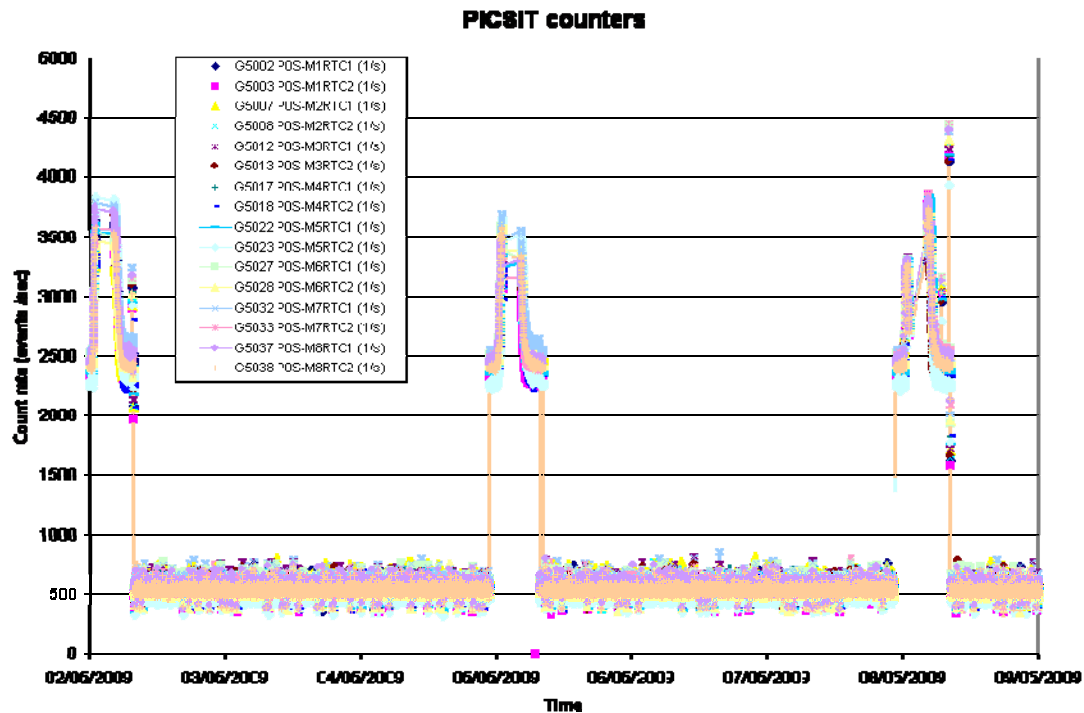
ISGRI

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



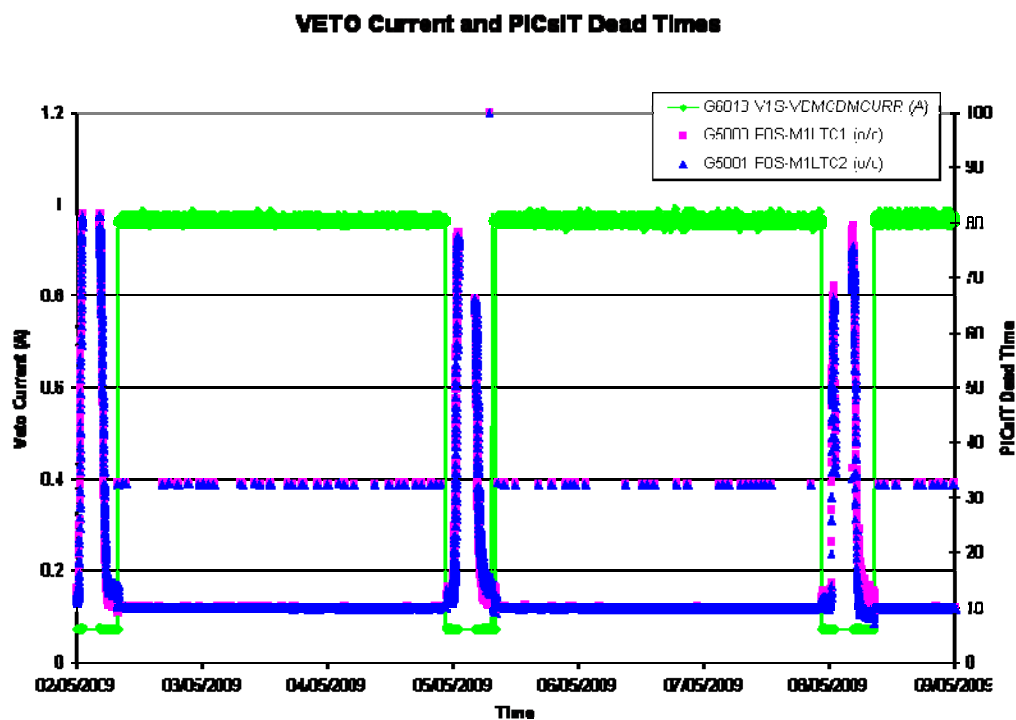
PICsIT

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 (P0S-Mi_RTC1) and G5003 (P0S-Mi_RTC2) families and G2000 family (I0E-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 returned within limits of its own accord at the next TM cycle, 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.

2009-05-02 (DOY 122, Rev 799-800) to 2009-05-04 (DOY 124, Rev 800)

IBIS operations executed nominally.

2009-05-05 (DOY 125, Rev 800-801)

At 20:30:58Z TM parameters G6062 and G6063 (VETO bottom and lateral counters respectively) went OOL Warning High. As they returned within limits of their own accord at 20:31:06Z, no action was taken.

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at between 07:46Z and 07:49Z (exact time unknown as there was a temporary loss of TM at this time). It was recovered as follows:

- At 08:07:48Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 08:24:30Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

Following this recovery, at 08:44Z TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 08:50:06Z FCP_IBIS1_0312
- 08:51:11Z TC G0129 uplinked to return IBIS to Science Standard mode.

As TM parameter X7500 was still OOL, the recovery was repeated as follows:

- 09:07:34Z FCP_IBIS1_0312
- 09:10:12Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

2009-05-06 (DOY 126, Rev 801) to 2009-05-07 (DOY 127, Rev 801)

IBIS operations executed nominally.

2009-05-08 (DOY 128, Rev 801-802)

Due to problems with the ground station resulting in loss of telemetry, at 06:51:35Z, the ED GEISCL03 in the Timeline was interrupted. Commanding to IBIS from the Timeline was disabled and subsequent commands for activation of IBIS at the start of revolution 802 were missed. IBIS was recovered manually as follows:

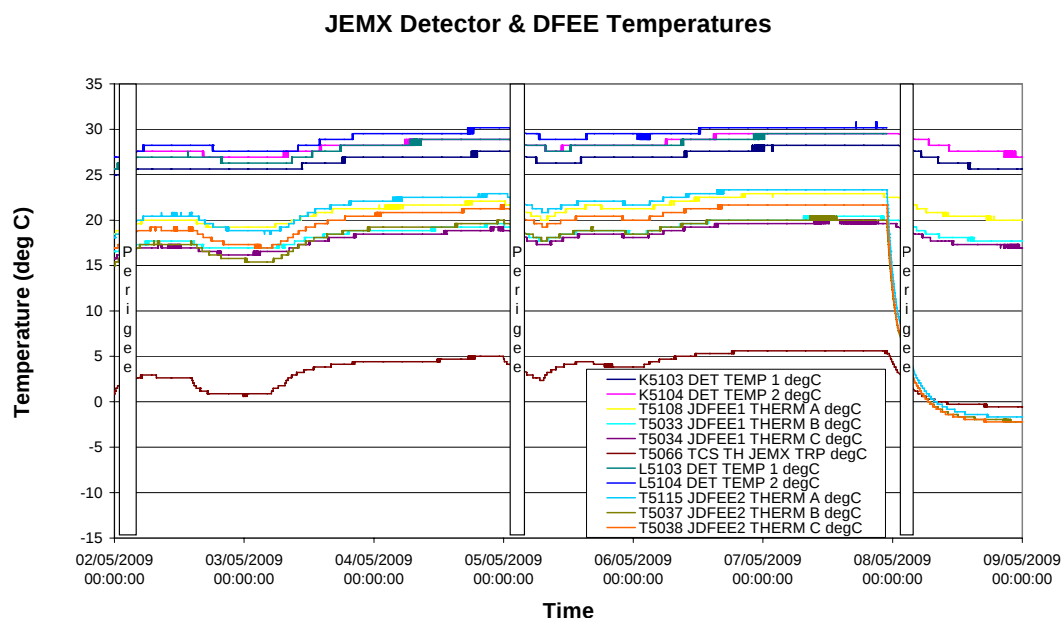
- 07:04:15Z CRP_IBIS1_0010 IBIS SAFE CONFIG (FAST) executed

- 07:07Z IBIS Context Tables re-uplinked. However this was interrupted by a further drop in TC links and therefore they were uplinked again starting at 07:23Z.
 - 07:45:45Z ED GEISCL03 re-uplinked
 - 08:22:04Z ED GEBENT02 re-uplinked
 - 08:24:38Z ED GEBEXT01 re-uplinked
 - 08:35:32Z ED GESTAN02 re-uplinked with planned observation parameters
- IBIS operations continued nominally.

7.2.4 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.



JEM-X Daily Report

2009-05-02 (DoY 122, Rev 800) to 2009-05-04 (DoY 124, Rev 800)

JEM-X 1 & 2 operations executed nominally.

2009-05-05 (DoY 125, Rev 801)

At 07:46, a drop in the TM links with VIL2 led to the loss of the sequences KEHVAC01, LEHVAC01, KEDATA02 & LEDATA02. A recovery was commenced, but an IREM SEU interrupted things, and the units were not fully operational until 08:34 & 08:36 respectively.

² Data sampled (1 frame in 8)

At 07:50:10 JEMX parameters K5315, K5316, K5317, L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#75). There was no impact as the reaction has been disabled.

2009-05-06 (DoY 126, Rev 801)

JEM-X 1 & 2 operations executed nominally.

2009-05-07 (DoY 127, Rev 801)

According to INT-OPS-404, operations were commenced to shut-down JEMX-2.

22:50 procedure FCP_JEM2_9010 JEMX-2 DFEE switch-off.

22:59 procedure FCP_JEM2_9001 JEMX-2 Disable BCP distribution

23:04 FCP_JEM2_9000 JEMX-2 DPE switch-off

2009-05-08 (DoY 128 Rev 802)

JEM-X 1 operations executed nominally.

7.2.5 OMC Operations

2009-05-02 (DoY 122, Rev 800) to 2009-05-04 (DoY 124, Rev 800)

Nothing to report.

2009-05-05 (DoY 125, Rev 801)

At 07:49, an IREM SEU forced OMC to SAFE mode. A recovery was performed, returning the unit to standby at 08:04:29. The impact was pointing 08010004 was cut short from a planned 3572 to about 521 seconds.

2009-05-06 (DoY 126, Rev 801) to 2009-05-07 (DoY 127, Rev 801)

Nothing to report.

2009-05-08 (DoY 128, Rev 802)

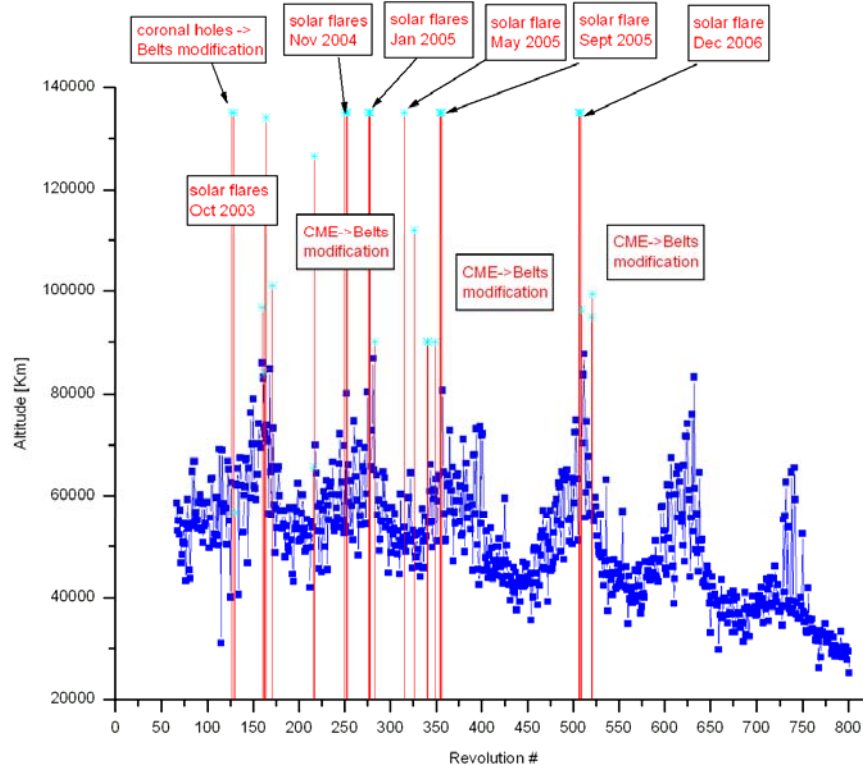
At 12:36, the TM & TC links from VIL2 were intermittently dropping in and out. This caused the OEM issued at the start of pointing 08020007 to be missed. The pointing itself proceeded nominally.

On DoY 124 at 22:46:12 and DoY 127 at 22:34:28 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

7.2.6 IREM Operations

Radiation Belts Entry

Evolution of Radiation Belt Entry 2003-2008



IREM daily report

DoY 2009.125 (05/05/2009):

At 07:49:39Z, a local reset of the IREM CSCI S/W (SEU #75) 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 2009.125.07.49:39Z (60794.0 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 09:56:00Z.

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 08:04:19Z and IBIS at 08:26:00Z.

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]
799	RAD_ENTR R 2009-05-01T22:59:40Z	02/05/2009 00:25:55	27773.9	02-May-2009 03:12:21	12552.93
800	RAD_EXIT R 2009-05-02T07:36:33Z	02/05/2009 05:54:51	>>34264.3	02-May-2009 06:32:21	47990.5
800	RAD_ENTR R 2009-05-04T22:46:05Z	05/05/2009 00:04:11	29467.6	05-May-2009 02:54:41	11901.98
801	RAD_EXIT R 2009-05-05T07:22:28Z	05/05/2009 05:50:51	>>36040.2	05-May-2009 06:14:41	47461.89
801	RAD_ENTR R 2009-05-07T22:34:25Z	08/05/2009 00:13:55	25208.3	08-May-2009 02:44:41	12207.77
802	RAD_EXIT R 2009-05-08T07:09:47Z	08/05/2009 06:49:23	54000.6	08-May-2009 06:04:41	47884.82

Reference

High radiation

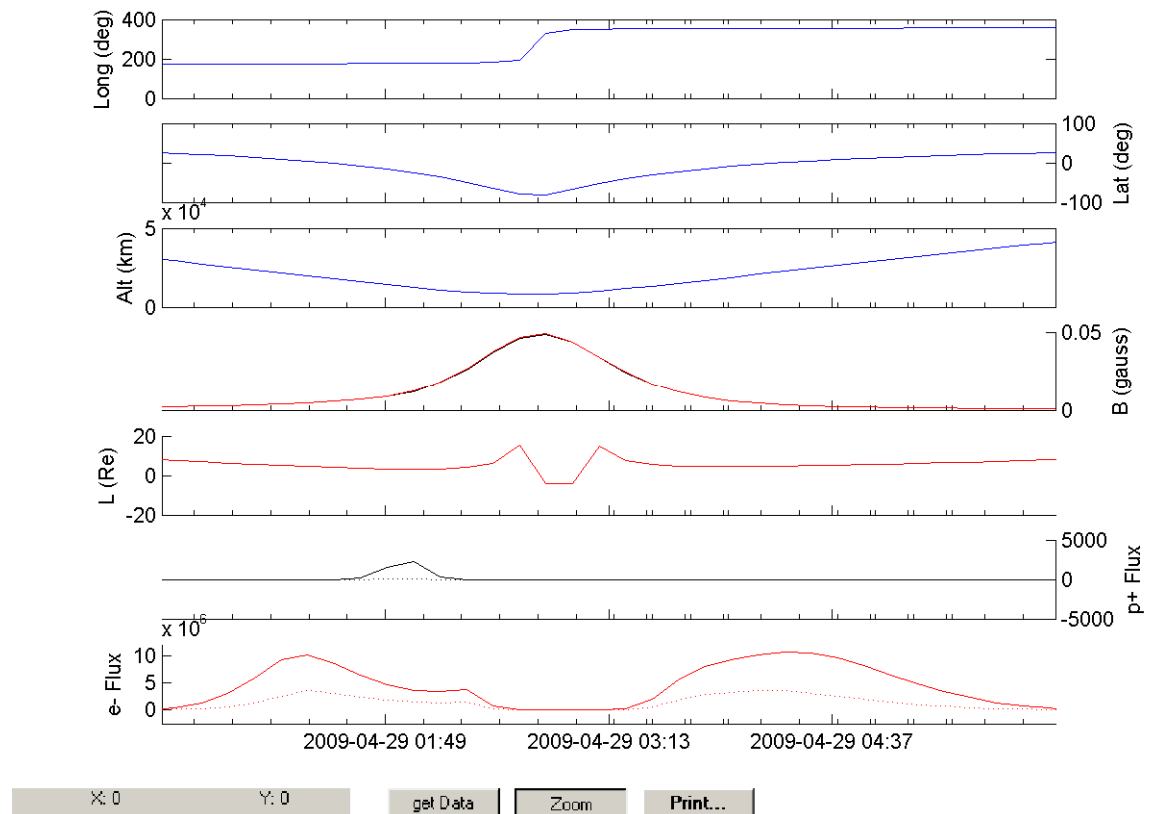
Very small error vs reference (less than 10 minutes)

Small error vs reference (between 10 and 30 minutes)

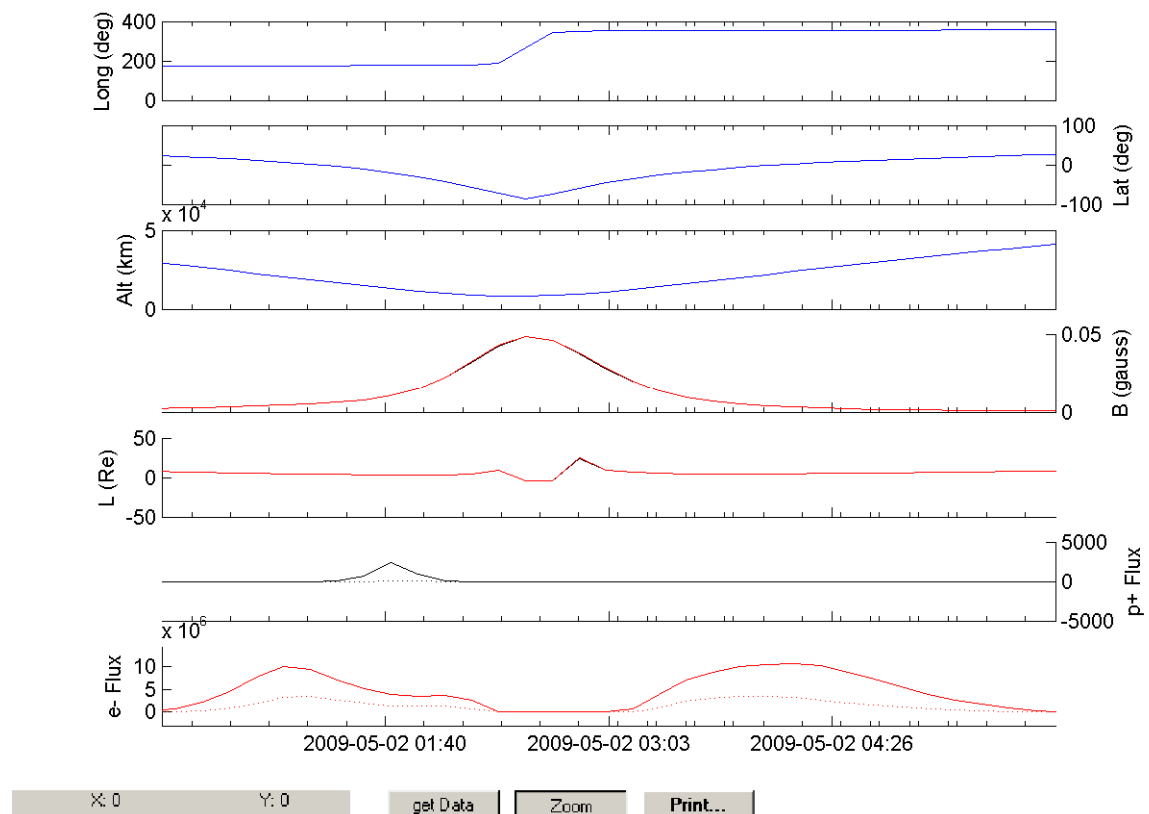
Large error vs reference (more than 30 minutes)

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

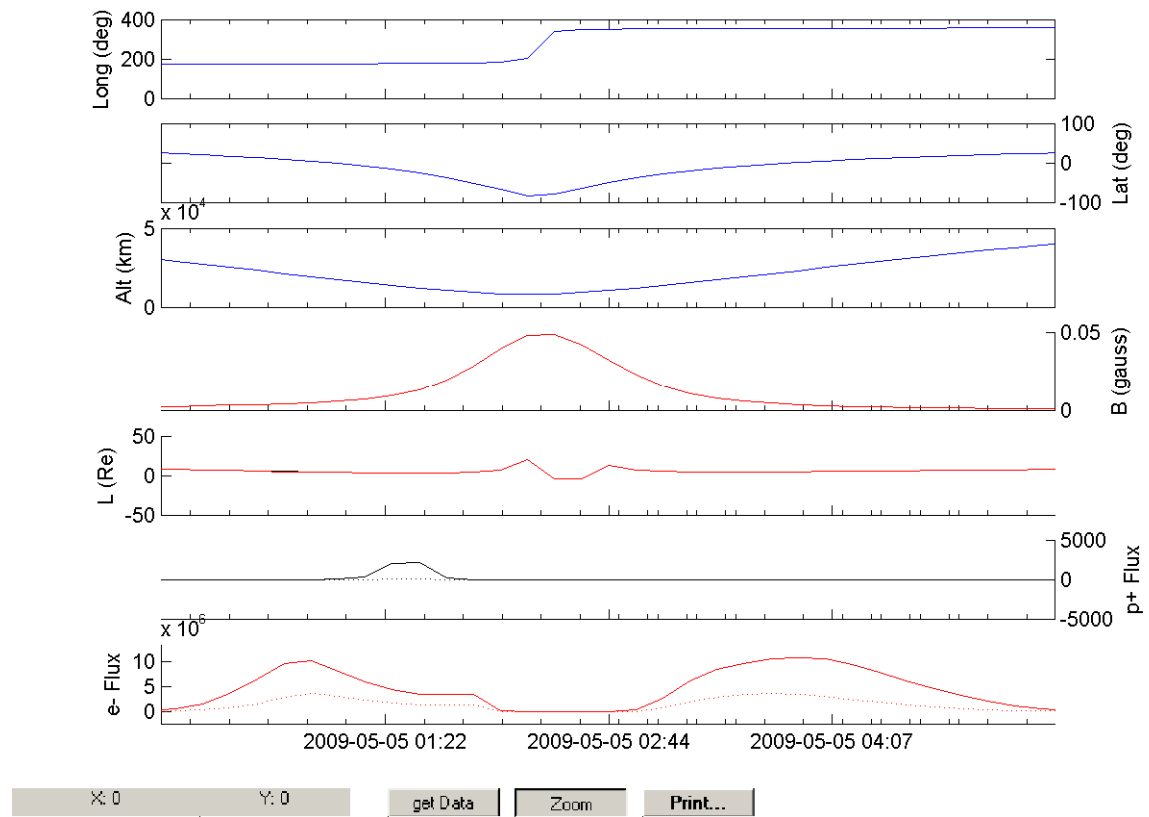
IREM Predicted Radiation Belt Passages



Rev 799



Rev 800



Rev 801

