

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 172
Week 01
09.01.06
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 31.12.05 until 06.01.06 (both dates inclusive) and covers the revolutions 393 and 394.

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 were Cas A /Tycho (RA 23:51:43.00; DEC +62:03:55.0) and an OMC Flat Field calibration centred around the attitude (RA 23:48:00.00; DEC +14:30:00.0). The activities consisted of raster dithering observations.

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.

A Leap Second was introduced on midnight 2005-12-31, to keep broadcast standards for time of day close to mean solar time, according to DOPS-GS-PR-1001-OPS-ONV (Leap Second Procedure)

No slews were missed from the Timeline during this period.

The fuel consumption over the period between 15/11/2005 and 05/01/2006 was 0.1336 kg. The remaining propellant is in the order of 157.2300 Kg.

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

3.1.2 Power

The EPS is 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 was identified.

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

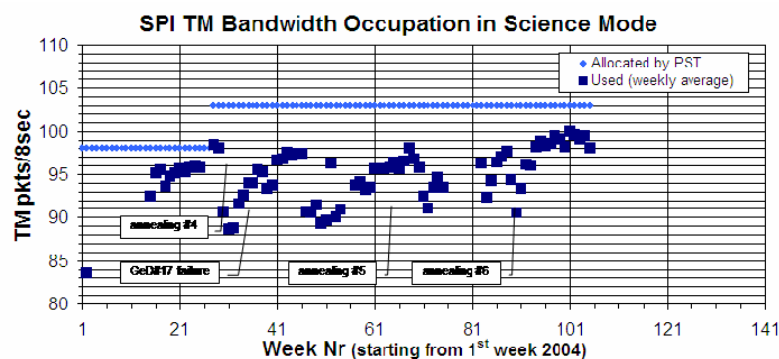
3.2.1 SPI

The overall status of the instrument is nominal.

During science operations, the instrument was kept in photon-by-photon mode, with spectra TM enabled, an assigned TM bandwidth in the science observation windows of 103 pkts/cycle and an average occupation of 98 pkts/cycle.

The Stirling compressors are working well, maintaining the detector cold-plate temperature within 85+/-1K.

The following plot shows the TM bandwidth occupation information.



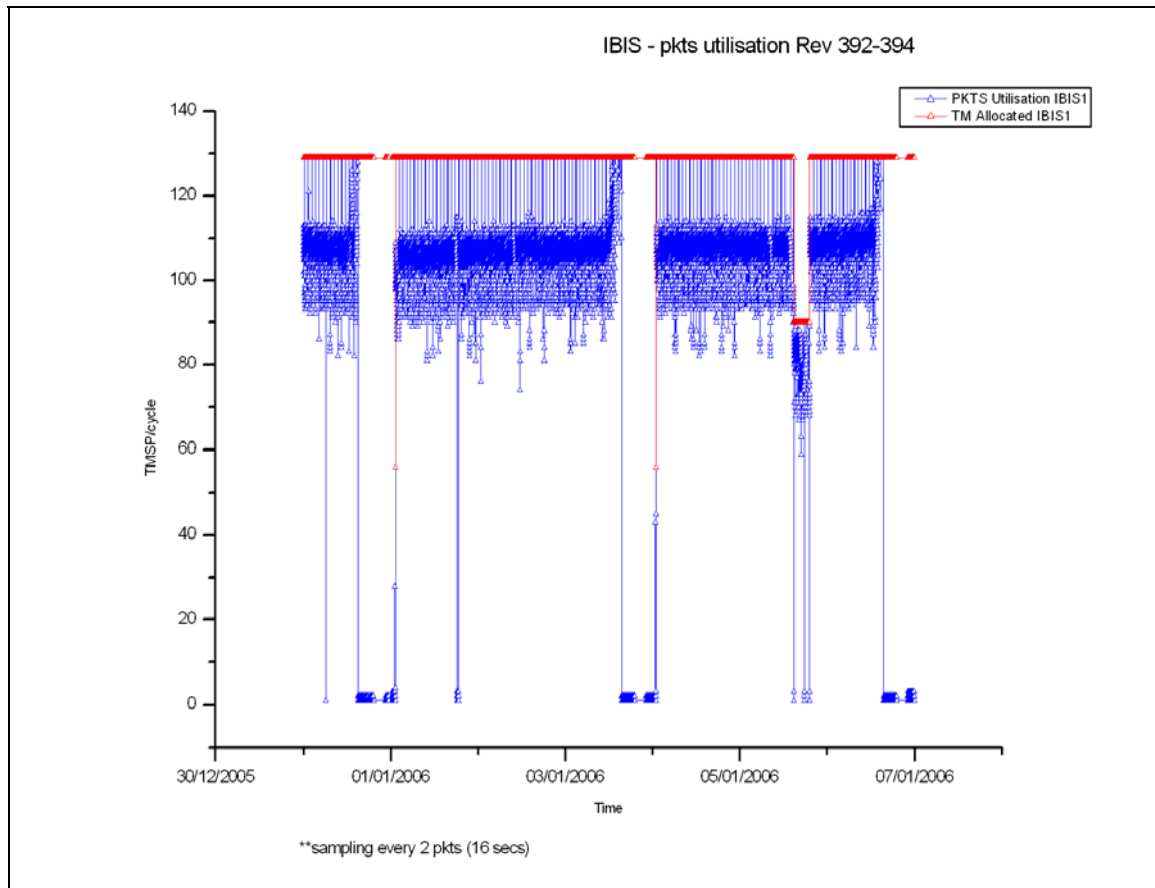
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

The Overall status of the unit is Nominal.

During the reporting period, the PST allocation to IBIS was 129 TMPS/cycle. However on DoY 2006.005 between 14:57:31Z and 19:19:10Z, it was 90 TMPS/cycle due to an OMC Flat Field Calibration. The IBIS mean bandwidth utilisation during the observation period was 107.17 TMPS/cycle, down 0.77 on last week.

A plot of the IBIS TM utilisation during the observation period 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 during science observations with a TM allocation of 8 packets/cycle and JEM-X2 was dormant (DFEE OFF) with a TM allocation of 1 packet/cycle.

Further information on the JEM-X operations can be found 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, all of the 127 planned science pointings for OMC were executed nominally, none were lost.

Note: Some more information concerning the OMC operations is provided in the Appendix Section 8.3.5.

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 quiet this week. Several sunspots were present but did not pose any threat of Solar Flare.

Reference: www.spaceweather.com

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

4 Ground Facilities

The Operational ground facilities performance was very good this week, no pointings were lost and only minor problems were reported. The overall performance was well above the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was very good this week, with only minor problems reported, which had no impact. The overall performance was well above the 95% requirement.

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. There were a few instances of bad frames and TM drops, but these had no impact on the mission. The overall performance though was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

A full report will be presented next week for the Christmas and New Year period.

4.3.2 ISDC

Status of ISDC observation processing on 09/01/2006:

- Latest Standard Analysis completed: observation 03200200011 (GRS 1915+105, Revolution 379) on 02/01/2006
- Latest products archived: observation 03200200011 (GRS 1915+105, Revolution 379) on 03/01/2006
- Latest observation products sent to the observer: observation 03200930001 (GX 17+2, Revolutions 369-370) on 02/01/2006

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 393

The observations in revolution 393 continued with raster dithering observations of the Cas A / Tycho supernova RA 23:51:43.00; DEC +62:03:55.0) lasting ~58.5 hours.

Throughout this observation all instruments were in their nominal science modes, except JEM-X2 for which the DFEE was off, and the TM allocation was IBIS 129; SPI 103; JEM-X1 8; JEM-X2 1; OMC 5.

Revolution 394

The observations in revolution 394 continued with a raster dithering observation of the Cas A / Tycho supernova (RA 23:51:43.00 ; DEC +62:03:55.0) lasting ~34.7 hours, followed by a staring observation at an OMC Flat Field attitude (RA 23:48:00.00; DEC +14:30:00.0) lasting ~3.4 hours, during which OMC Flat Field and Dark Current calibrations were performed. The raster dithering observation of Cas A / Tycho supernova (RA 23:51:43.00; DEC +62:03:55.0) was then resumed and performed for the remaining ~18.9 hours of observation time.

Throughout these observations SPI, IBIS and JEM-X1 were in their nominal science modes and the JEM-X2 DFEE remained off. During the OMC Flat Field observation OMC was in FFCalibration followed by DCCalibration mode and the TM allocation was IBIS 90; SPI 84; JEM-X1 8; JEM-X2 1; OMC 63. For the other observations OMC was in Science Normal mode and the TM allocation was IBIS 129; SPI 103; JEM-X1 8; JEM-X2 1; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2005-12-25T16:58:54.000Z	157.4676	F	Automatic TM processing.
2005-12-25T23:41:43.000Z	157.4486	F	Automatic TM processing.
2005-12-26T08:42:32.000Z	157.4294	F	Automatic TM processing.
2005-12-27T09:59:39.000Z	157.4121	F	Automatic TM processing.
2005-12-28T19:08:38.000Z	157.3978	F	Automatic TM processing.
2005-12-28T23:25:51.000Z	157.3636	F	Automatic TM processing.
2005-12-30T09:33:47.000Z	157.3500	F	Automatic TM processing.
2005-12-31T18:53:42.000Z	157.3369	F	Automatic TM processing.
2005-12-31T23:06:15.000Z	157.3247	F	Automatic TM processing.
2006-01-02T10:18:25.000Z	157.2990	F	Automatic TM processing.
2006-01-03T18:42:13.000Z	157.2834	F	Automatic TM processing.
2006-01-03T22:52:53.000Z	157.2743	F	Automatic TM processing.
2006-01-05T09:05:05.000Z	157.2588	F	Automatic TM processing.
2006-01-05T14:10:42.000Z	157.2391	F	Automatic TM processing.
2006-01-05T18:30:10.000Z	157.2300	F	Automatic TM processing.

8.3 Detailed Satellite Information

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

8.3.1 AOCS SUMMARY OPERATIONS REPORT, 31/12/2005 – 06/01/2006

AOCS operations were executed from the Automatic Timeline.

During this period, 36 Open Loop Slews, 101 Closed Loop Slews and 11 Momentum Bias were executed (TL + manual recovery).

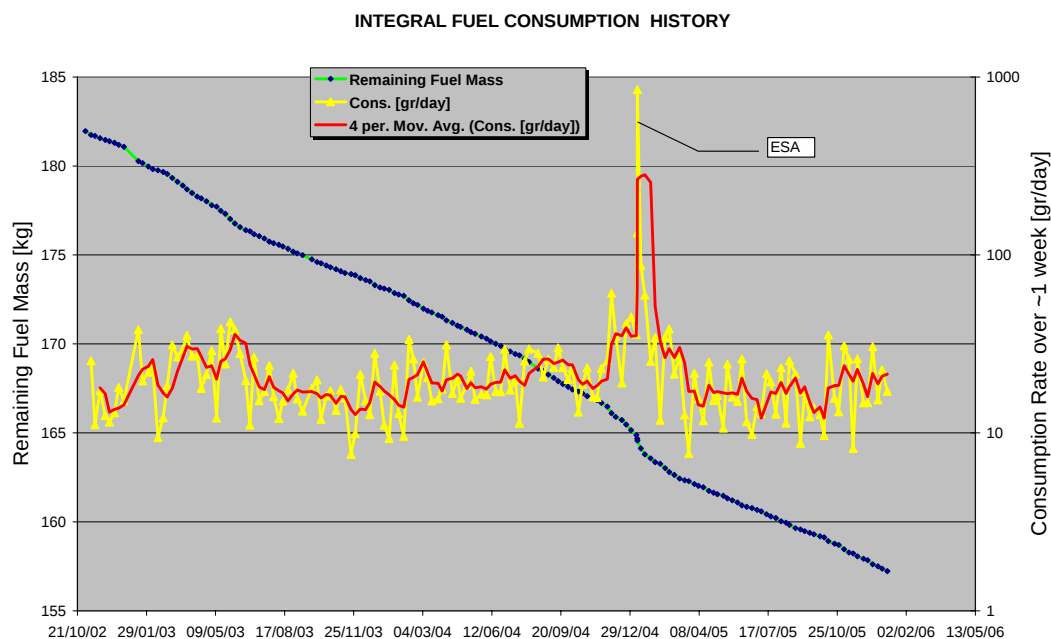
No slews were missed from the Timeline during this period.

Orbit Control

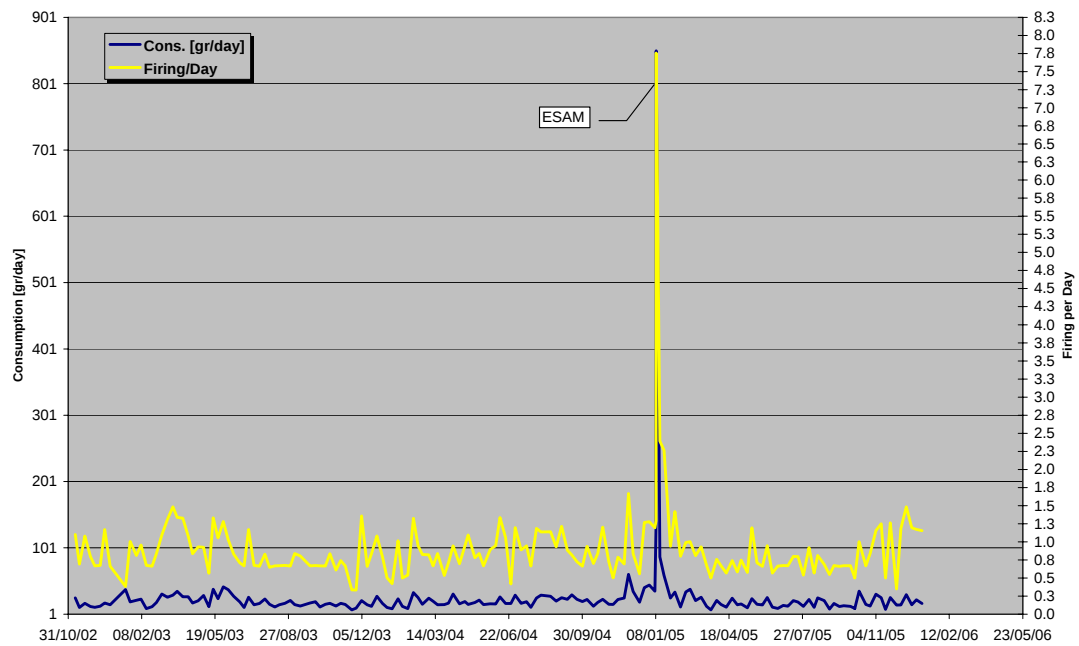
Provided on monthly basis

Fuel consumption

The fuel consumption (total, grams/day) over the period between 01/11/2002 and 05/01/2006 is reported in the plot below.

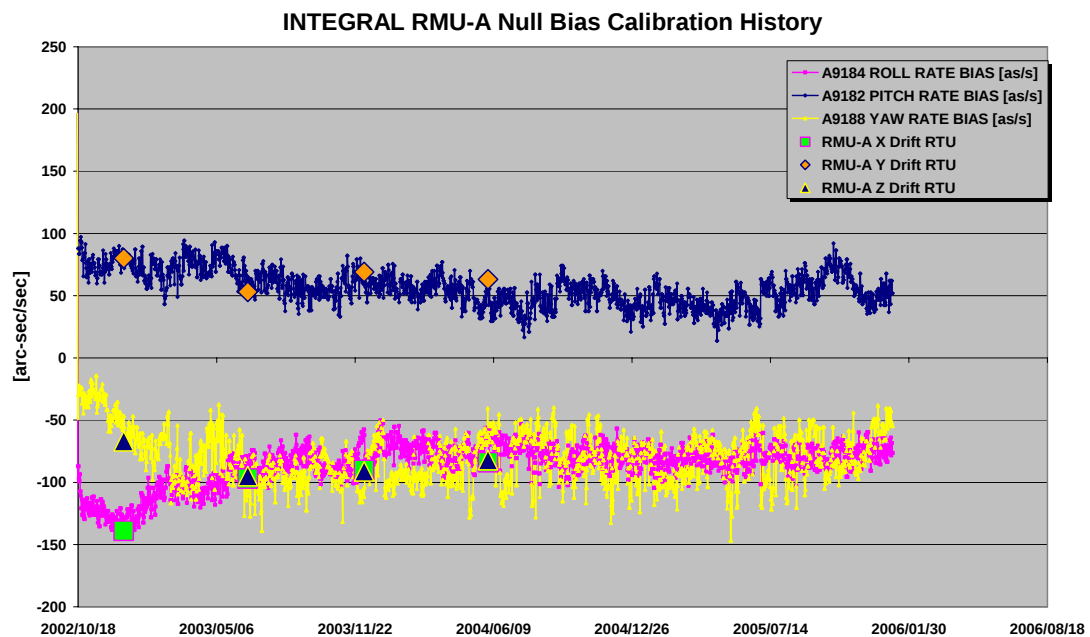


The firing\day over the period between 01/11/2002 and 05/01/2006 is reported in the plot below.

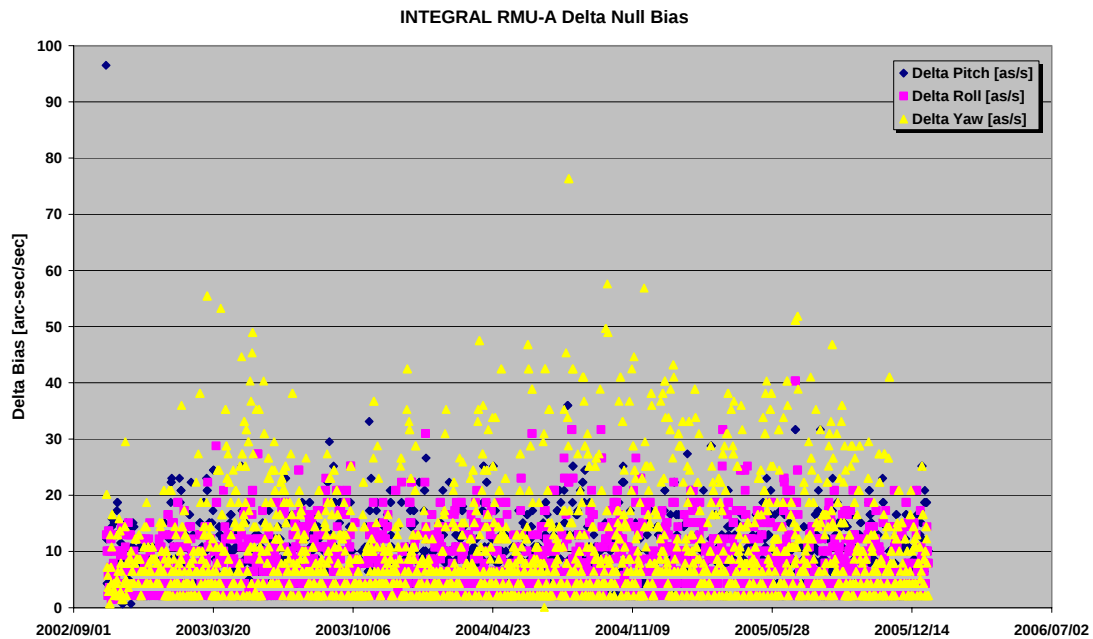


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 06/01/2006 is reported in the plot below.



The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 06/01/2006 is reported in the plot below.



31/12/05 (Day of Year 365, Revolution 392)

Nothing to report.

01/01/06 (Day of Year 001, Revolution 392-393)

Leap second: a Leap Second(**) was introduced on midnight 2005-12-31 . According to DOPS-GS-PR-1001-OPS-ONV (Leap Second Procedure), all missions were disconnected from the ground stations and all critical systems were in idle over the time of the leap second. Time servers were rebooted and verified that the operational machines picked up the right time, connection to the ground stations re-established and operations continued. Simultaneously the leap second was introduced into the time stamp generator at REDU.

In the Timeline for revolution 393 an extra long SATENG window was introduced to ensure no commanding was at the time of the leap second:

The operations were completed at 2006-01-01T00:22:00Z.

(**) A **leap second** is a one-second adjustment that keeps broadcast standards for time of day close to mean solar time. Leap seconds are used to keep time standards synchronized with civil calendars, the basis of which is astronomical.

Leap seconds are necessary because time is measured utilizing stable atomic clocks (TAI or International Atomic Time), whereas the rotation of the Earth has been slowing down. Traditionally, the second has been defined as 1/86400 of a mean solar day (see solar time). This is determined by the rotation of the Earth around its axis and its orbit around the Sun; time was measured by astronomical observations. However, the solar day has gradually become 1.7 ms longer every century, due mainly to the tidal acceleration of the Moon.

02/01/06 (Day of Year 002, Revolution 393)

Nothing to report.

03/01/06 (Day of Year 003, Revolution 393-394)

Nothing to report.

04/01/06 (Day of Year 004, Revolution 394)

Nothing to report.

05/01/06 (Day of Year 005, Revolution 394)

Nothing to report.

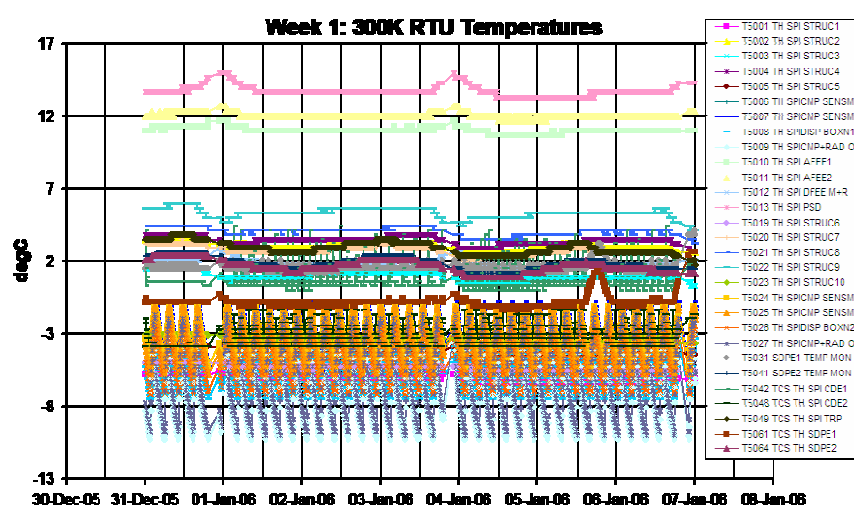
06/01/06 (Day of Year 006, Revolution 394-395)

Nothing to report.

8.3.2 SPI Operations

Unit Temperatures:

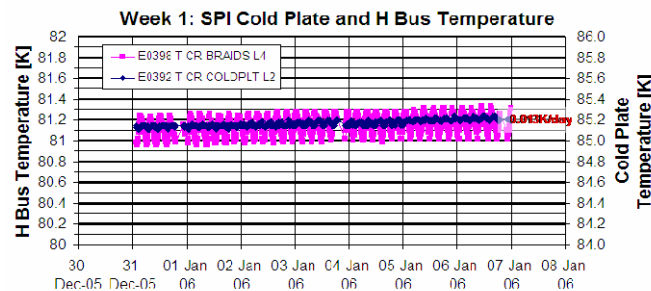
All the temperatures of the equipment are inside the operational limits. The following plot shows their evolution along the reporting period.



Stirling Compressors and Cryostat:

The performance of the compressors is nominal. The cold plate temperature was maintained at 85K $\pm$ 1K showing the expected positive drift.

The following plot shows the evolution of the cold-plate and H bus temperatures during the reporting period.

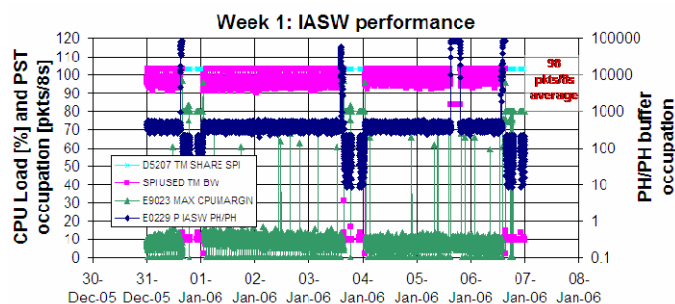


DPE & IASW:

The Iasw performance is nominal.

The current Iasw version installed is 432.

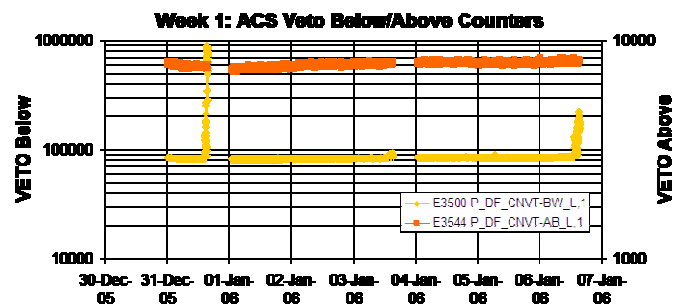
The following plot shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



ACS:

The performance of the ACS is nominal.

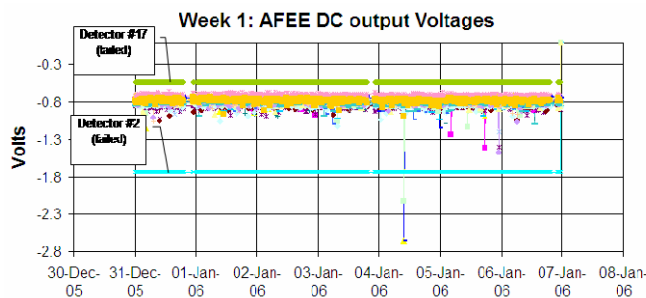
The following plot shows the ACS overall count rate evolution during the reporting period (due to problems in the data retrieval tool, some gaps could be present).



AFEE:

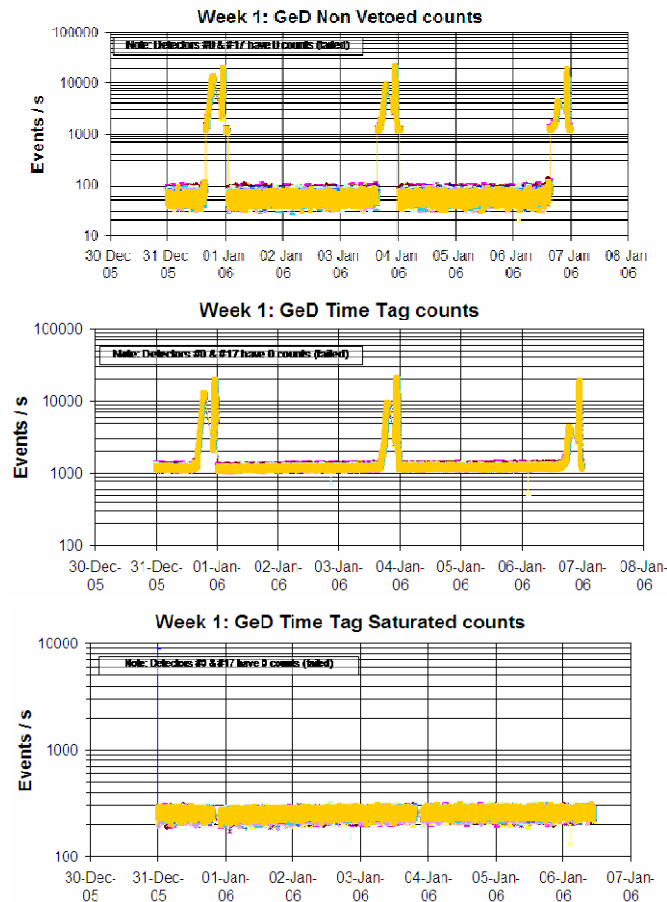
The performance of the AFEE and the detectors is nominal except for the detector #2, failed since 06.12.2003, and detector #17, failed since 17.07.2004

The following plot shows the dc voltage offset of the detector channels during the reporting period.



DFEE:

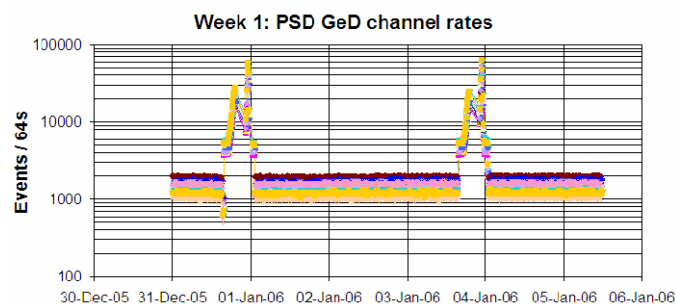
The performance of the unit is nominal. The following plots show the count rates of the detectors during the reporting period (due to problems in the data retrieval tool, some gaps could be present).



PSD:

The performance of the unit is nominal

The following plots show the PSD channel rates during the reporting period



SPI EVENTS LOG

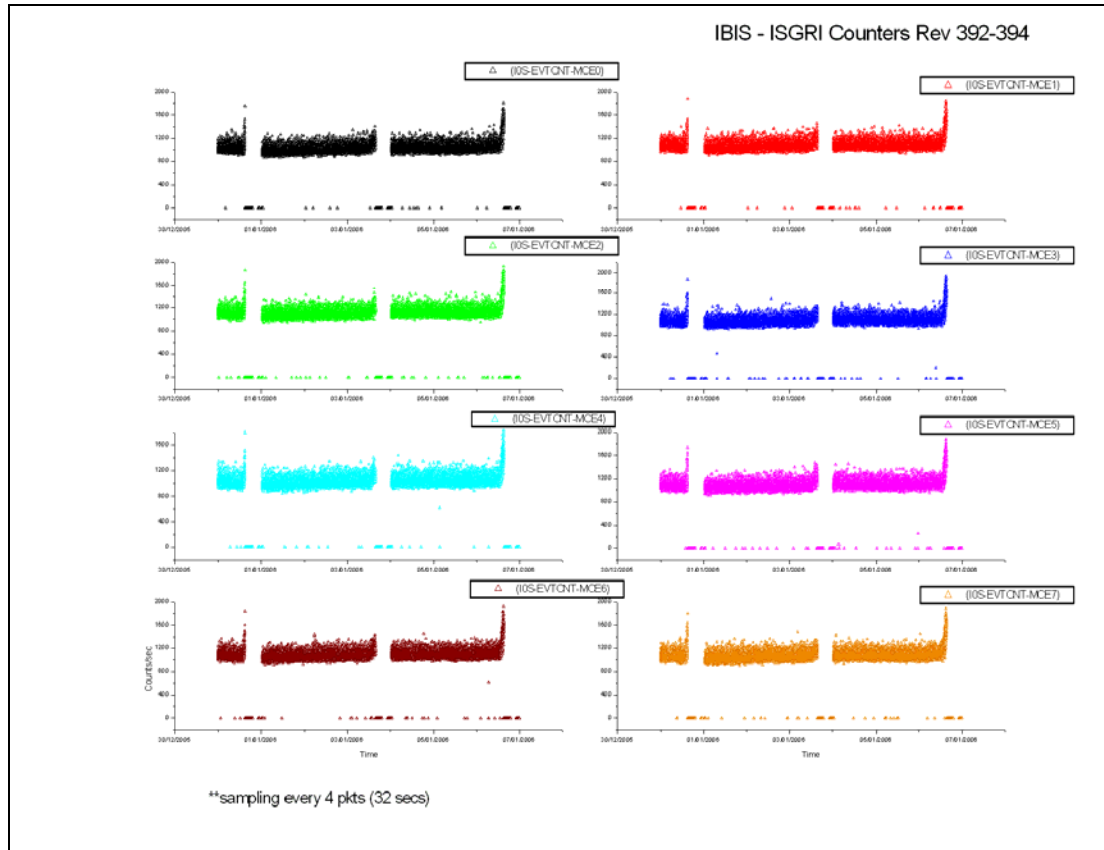
NOTE: The events log is extracted from the revolution pass summaries (courtesy of the Integral Analysts).

DOY Time	Event
004 - 09:40	TM E0351, E0356 00L, back in limits @ 09:51
005 - 19:43	EV: SPI1 constraint DPE culpre
005 - 19:43	EV: SPI1 SW error
006 - 13:48	TM E3500 00L
007 - 21:13	TM E3222 00L, back in limits @ 21:24

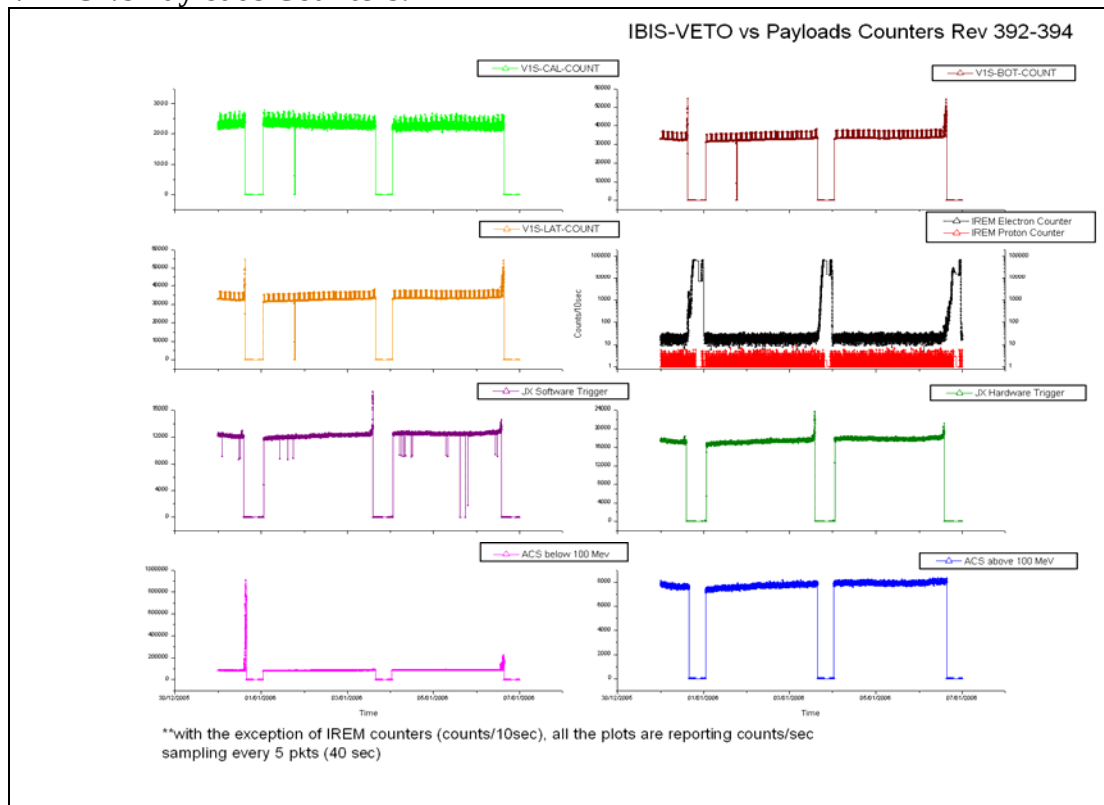
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

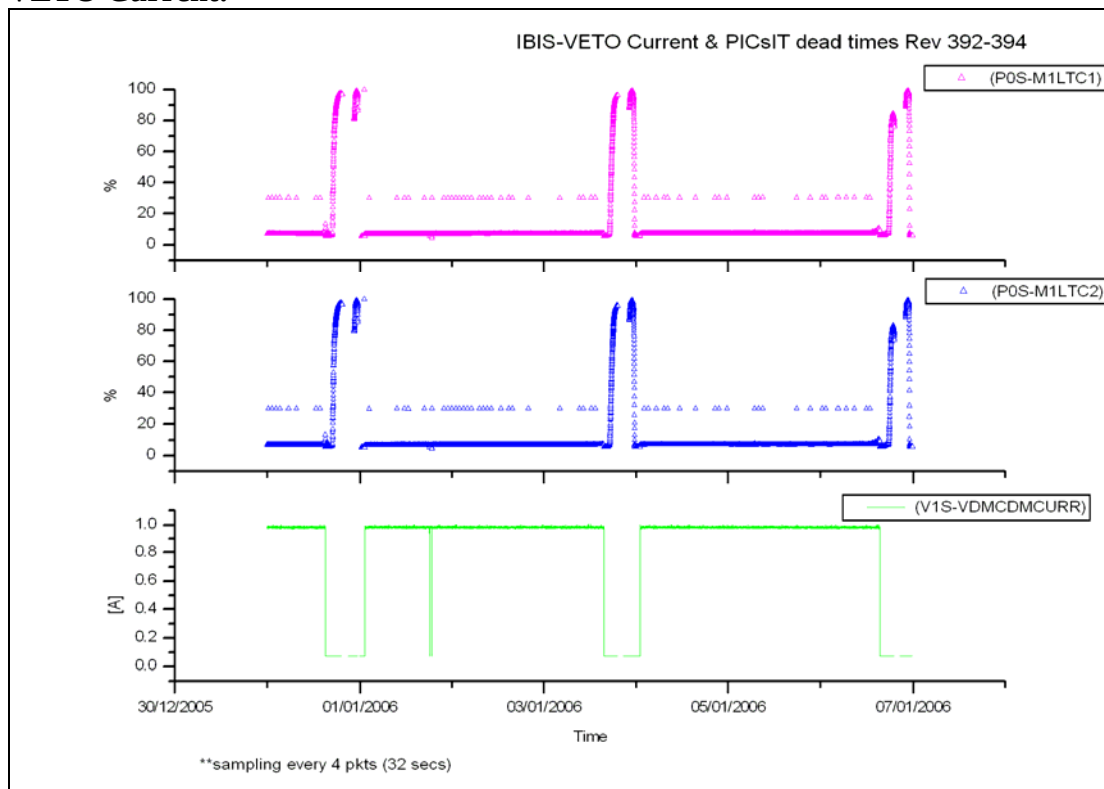


VETO vs Payloads Counters:

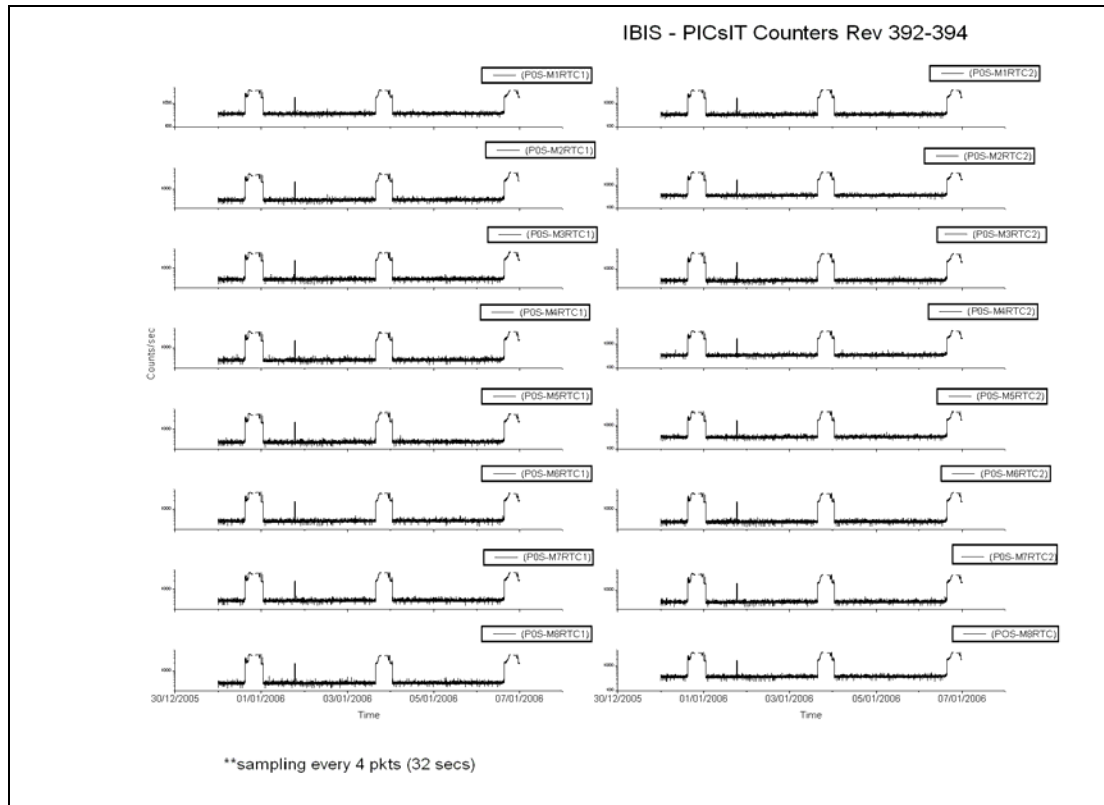


The week was characterised by low radiation.

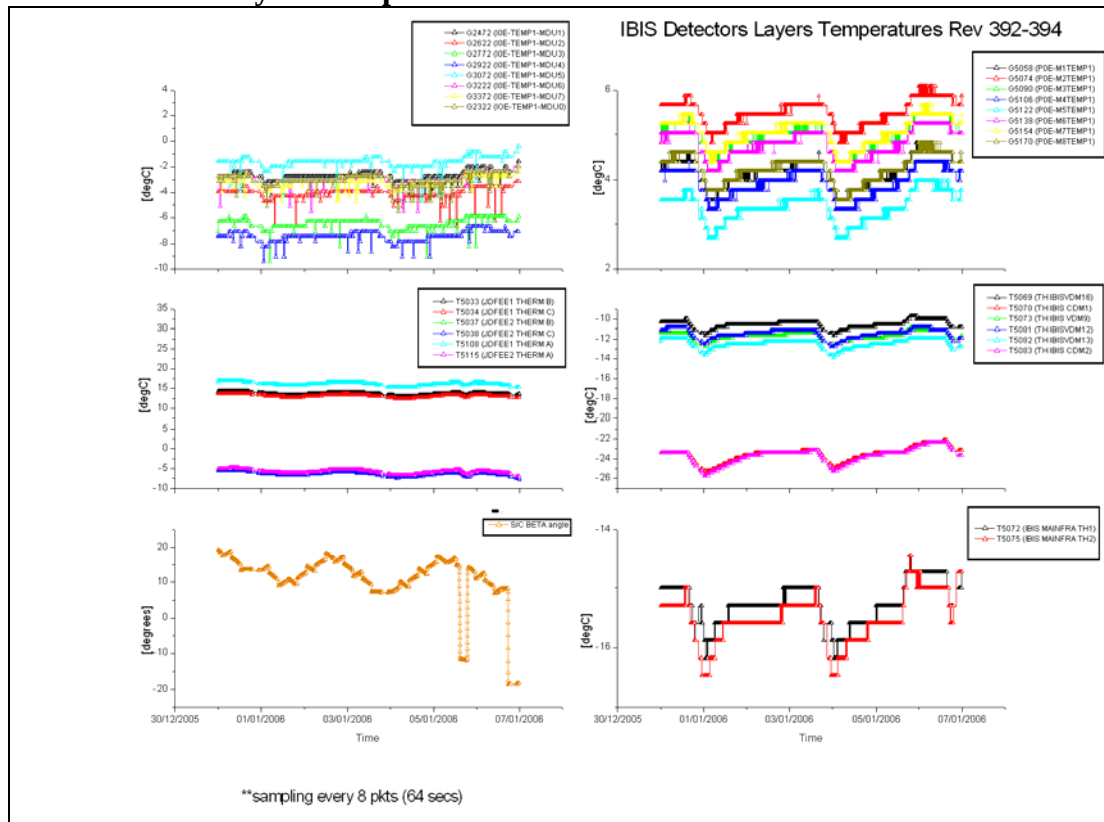
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report

DoY 2005.365 (31/12/2005):

At 15:00Z TM parameters G6062 (V1S-BOT-COUNT) and G6063 (V1S-LAT-COUNT) were reported OOL High for 1 minute. As this occurred while INTEGRAL was approaching the Radiation Belts, no action was taken.

At 15:02Z, IBIS went into Stand-By mode automatically due to high radiation background as INTEGRAL was approaching the Radiation Belts. The Belts entry was planned in the BCPKT at 15:45Z.

At 15:02Z, TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. It went back inside limits on DoY 2006.001 at 01:20Z. As this happened inside the Radiation Belts, according to V-VLT-1 no action was taken.

Inside radiation belts, TM parameters G5013 (P0S-M3RTC2), G5033 (P0S-M7RTC2) and G5037 (P0S-M8RTC1) were toggling OOL high. According to P-CNT-1, no action was taken.

DoY 2006.001 (01/01/2006): VETO Break-down (INT_SC-136)

At 18:08Z TM parameter G6037 (VETO VDM#3 HV) was reported OOL low-low with a value close to 0 V.

At the same time the following OEM APID 1280 ID 186 CLASS 2 was reported:

"IBIS1 VETO PMTXX IS ON AND CORRESPONDING HV MONIT IS ABOUT ZERO".

These anomalies flagged a High Voltage break-down on VETO module 3. The recovery was performed as indicated in the F-DIR (reaction V-HV-1):

- at 18:15Z, IBIS to Stand-By mode
- at 18:15Z, VETO to Stand-By mode
- at 18:17Z, VETO to Maintenance mode, monitoring for about 30 minutes
- at 18:44Z, VETO to Stand-By mode
- at 18:46Z, VETO to Nominal mode, G6037 back to nominal value (1025V)
- at 18:46Z, IBIS to Scientific Standard mode.

DoY 2006.003 (03/01/2006): PICsIT Time-Out

On DoY 2006.003 (03/01/2006) at 07:11:11Z, the following OEM APID 1280 ID 133 CLASS 2 was reported:

"IBIS1 IASW LSL TRANSFER FAILED (LOW LEVEL)"

together with OEM APID 1280 ID 131 CLASS 2:

"IBIS1 IASW LSL TRANSFER FAIL REPORT FOR HIGH-LEVEL MODULE RESET"

This anomaly is similar to the previous ones that flagged a Time-Out in several peripherals and that refer to the anomaly report INT_SC-113. This time, according to G1581 (parameter of OEM ID 131), the anomaly occurred with PICsIT.

IBIS incurred a timing problem on the Low Speed Line that affected the communication with PICsIT. During this time, a request for HK1 was sent to PICsIT without any answer due to the black-out in communication between the peripheral and the DPE. During this time no valid HK was collected from PICsIT therefore, what was reported in the HK1 was simply the IASW default (i.e all 0000...). This is confirmed by the reading of TM parameters that turned to raw value 0 (P0E-PDM status to OFF [raw 0] for example). The unit solved autonomously the internal conflict on the LSL and reported the valid HK1 for PICsIT in next cycle.

DoY 2006.003 (03/01/2006):

At 15:34Z TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. It went back inside limits on DoY 004 at 01:02Z. As this happened inside the radiation belts, according to V-VLT-1 no action was taken. Inside radiation belts, TM parameter G5008 (P0S-M2RTC2) was toggling OOL high. According to P-CNT-1, no action was taken.

DoY 2006.004 (04/01/2006):

At 00:35Z, TM parameters G2014 (I0E-OVFWPXADD-M1) failed. According to I-OVF-1, as this happened inside radiation belts, no action was taken.

DoY 2006.006 (06/01/2006):

At 14:03Z, TM parameter G8080 (S1E-VS HBRA-RT) was reported OOL High and back.

At 14:58Z TM parameter G6062 and G6063 were reported toggling OOL high until 15:20Z when INTEGRAL entered the Radiation Belts.

At 15:20Z TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.

Inside radiation belts, TM parameters G5007 (P0S-M2RTC1) and G5037 (P0S-M8RTC1) were toggling OOL high. According to P-CNT-1, no action was taken.

8.3.4 JEM-X Operations

8.3.4.1 JEM-X Count Rates

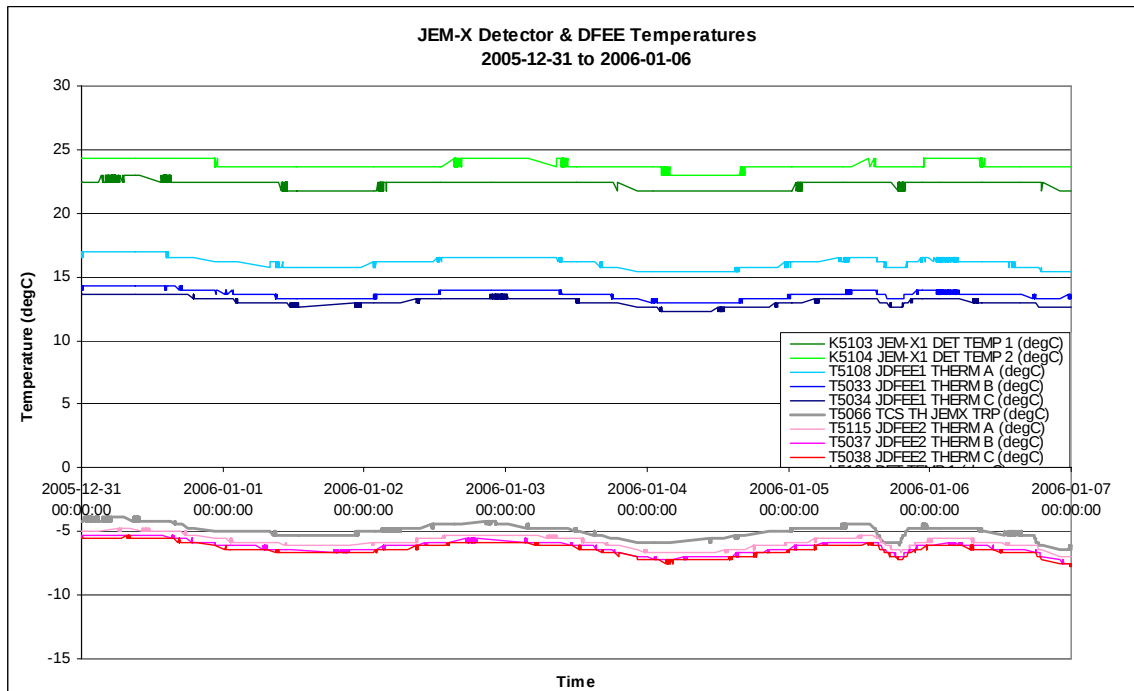
JEM-X count rates over the reporting period are displayed in the following graph¹.

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



8.3.4.2 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.



8.3.4.3 JEM-X Daily Report

2005-12-31 (DOY 365, Rev 392-393) to 2006-01-06 (DOY 006, Rev 394-395)

² Data sampled (1 frame in 8)

Nothing to report

8.3.5 OMC Operations

2005-12-31 (DOY 365, Rev 392) to 2006-01-04 (DOY 004, Rev 394)

Nothing to report

2006-01-05 (DOY 005, Rev 394)

From 14:57:32 to 17:46:25, an OMC Flat Field Calibration was successfully performed. One of the images taken during this period is shown below, courtesy of the OMC team. A Dark Current calibration was also successfully conducted from 17:50:32 to 18:06:33.

The image, located at RA 23:48:00.00; DEC +14:30:00.0 was taken in high-gain mode depicts the stars with almost identical magnitude. Those with vertical extensions are where the CCD was saturated. There are also a couple of faint traces of cosmic rays impinging on the image.



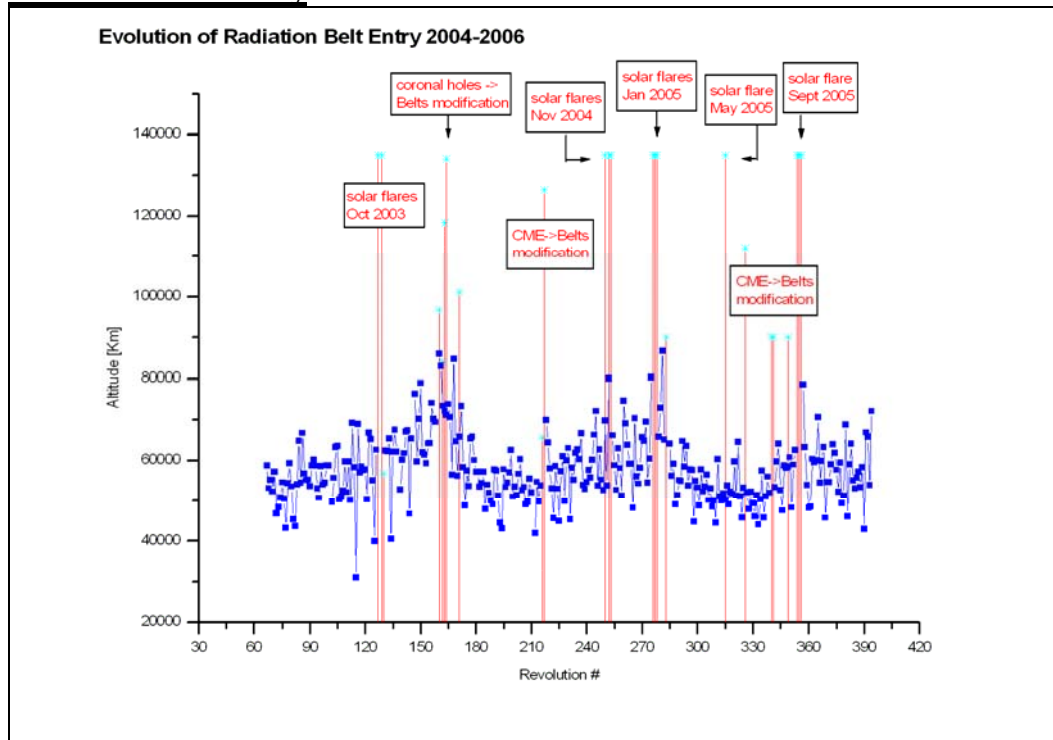
2006-01-06 (DOY 006, Rev 394)

Nothing to report

On DoY 365 at 15:21:41, DoY 003 at 15:34:28 and DoY 006 at 15:20:36 OMC was switched by the Timeline to SAFE mode, at the nominal time.

8.3.6 IREM Operations

Radiation Belts Entry



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]
392	RAD_ENTR R 2005-12-31T15:45:57Z	2005-12-31 14:59:24	<65814.4	2005-12-31 16:57:23	50746
393	RAD_EXIT R 2006-01-01T01:02:50Z	2005-12-31 23:46:53	>>23368.4	2006.01.01 00:17:23	32843
393	RAD_ENTR R 2006-01-03T15:34:24Z	2006-01-03 16:23:00	<53860.8	2006-01-03 16:46:40	50295
394	RAD_EXIT R 2006-01-04T00:50:44Z	2006-01-04 00:00:44	>>23353.2	2006-01-03 23:56:40	31840
394	RAD_ENTR R 2006-01-06T15:20:34Z	2006-01-06 13:42:20	<72106.0	2006-01-06 16:36:40	49671
395	RAD_EXIT R 2006-01-07T00:37:10Z	2006-01-06 23:31:48	>>23362.6	2006-01-06 23:46:40	32534

Reference

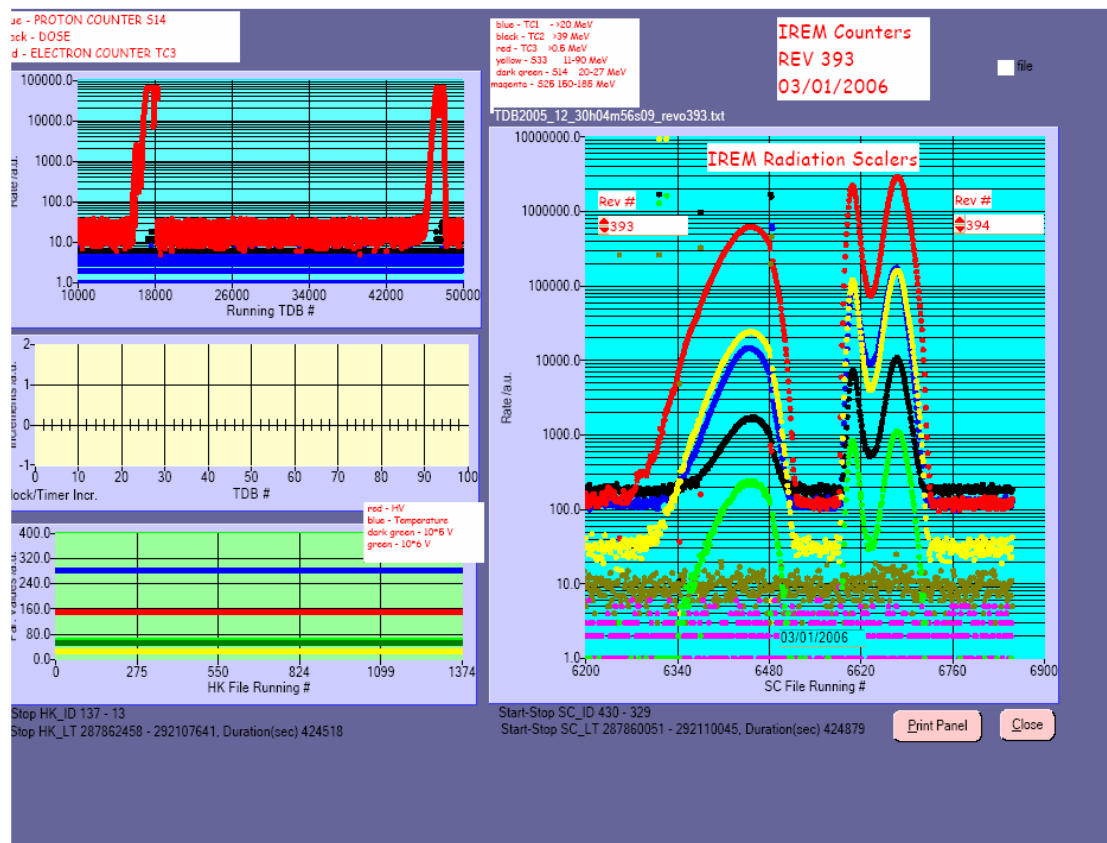
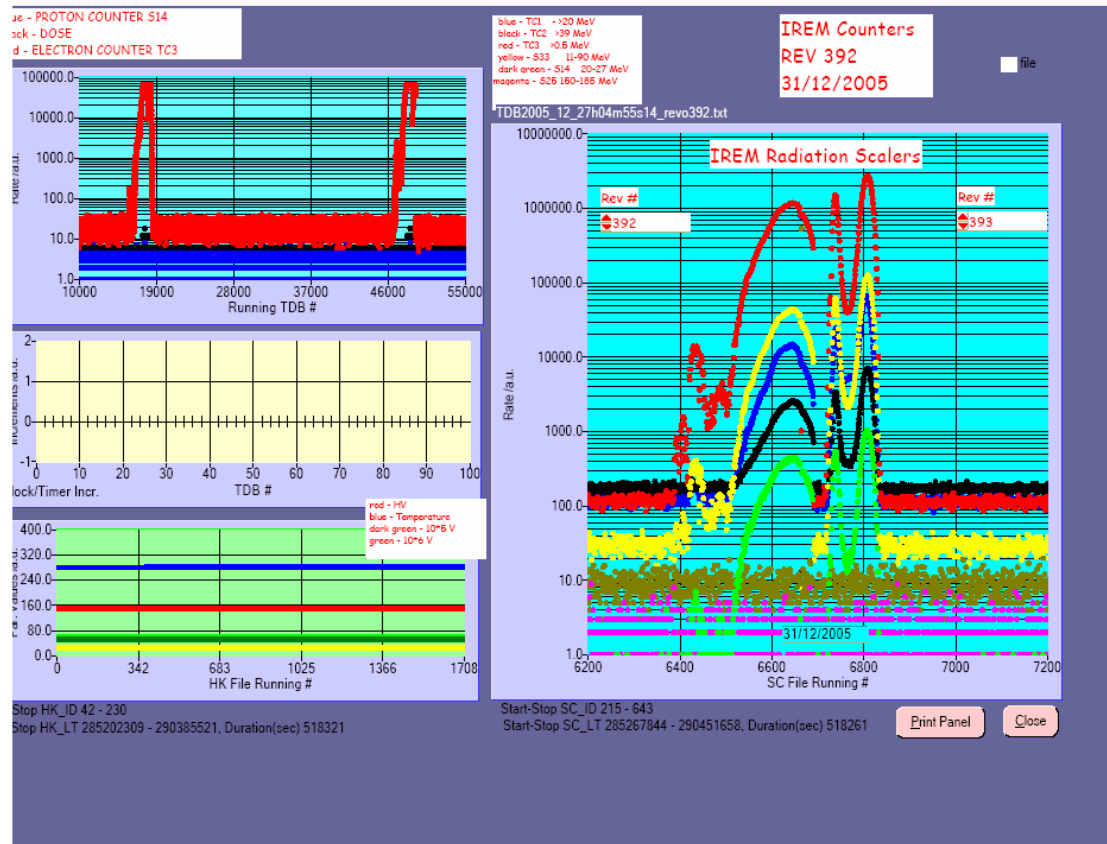
Very small error vs reference (less than 10 minutes)

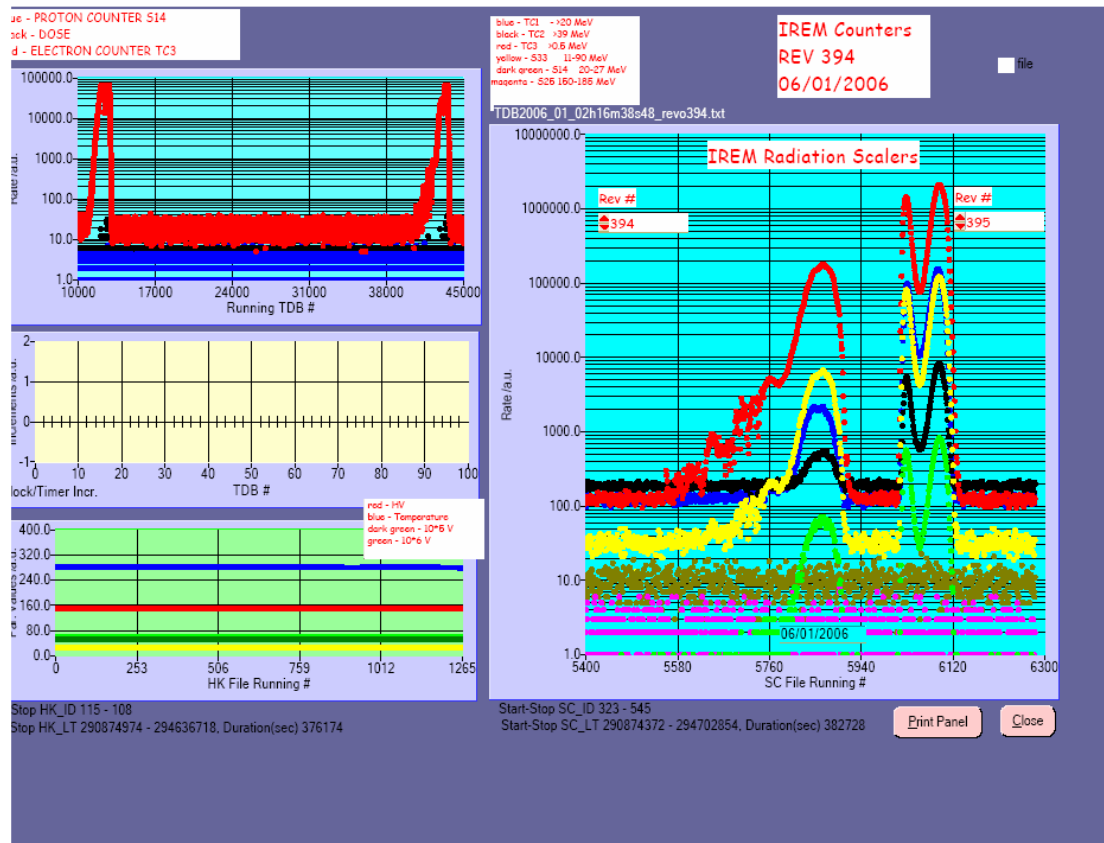
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

Radiation Spike

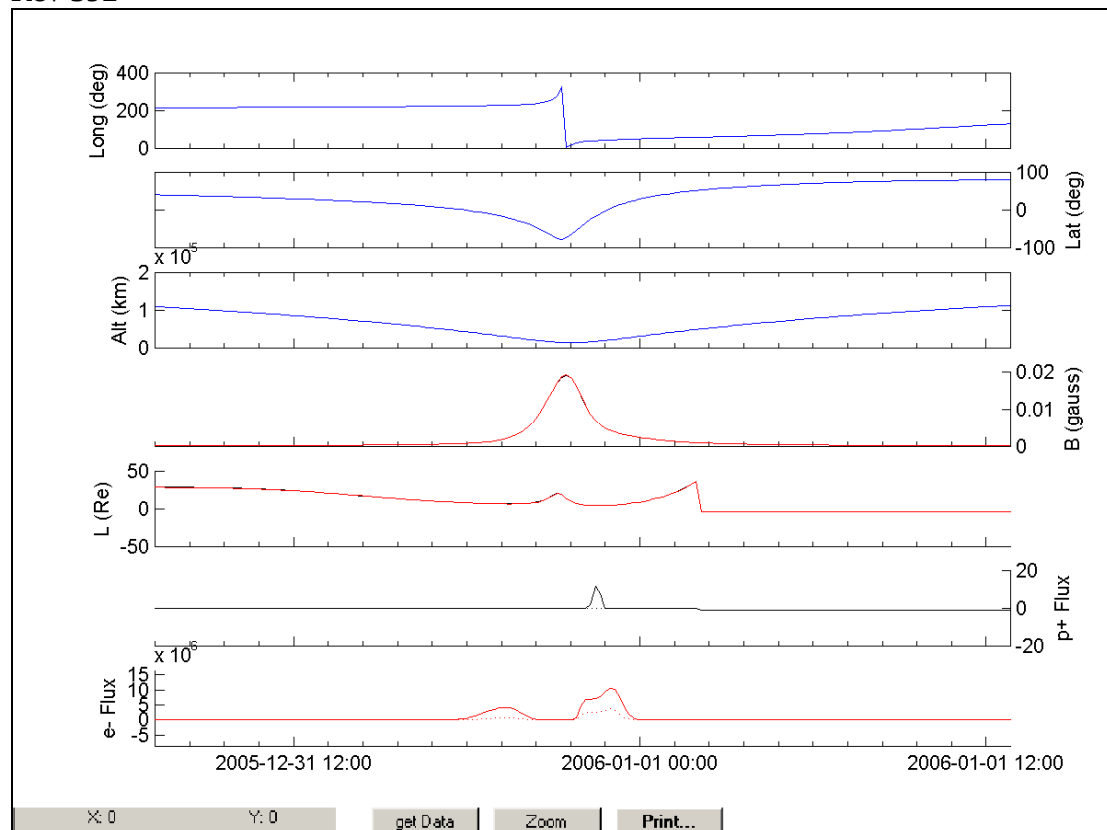
IREM radiation counters:



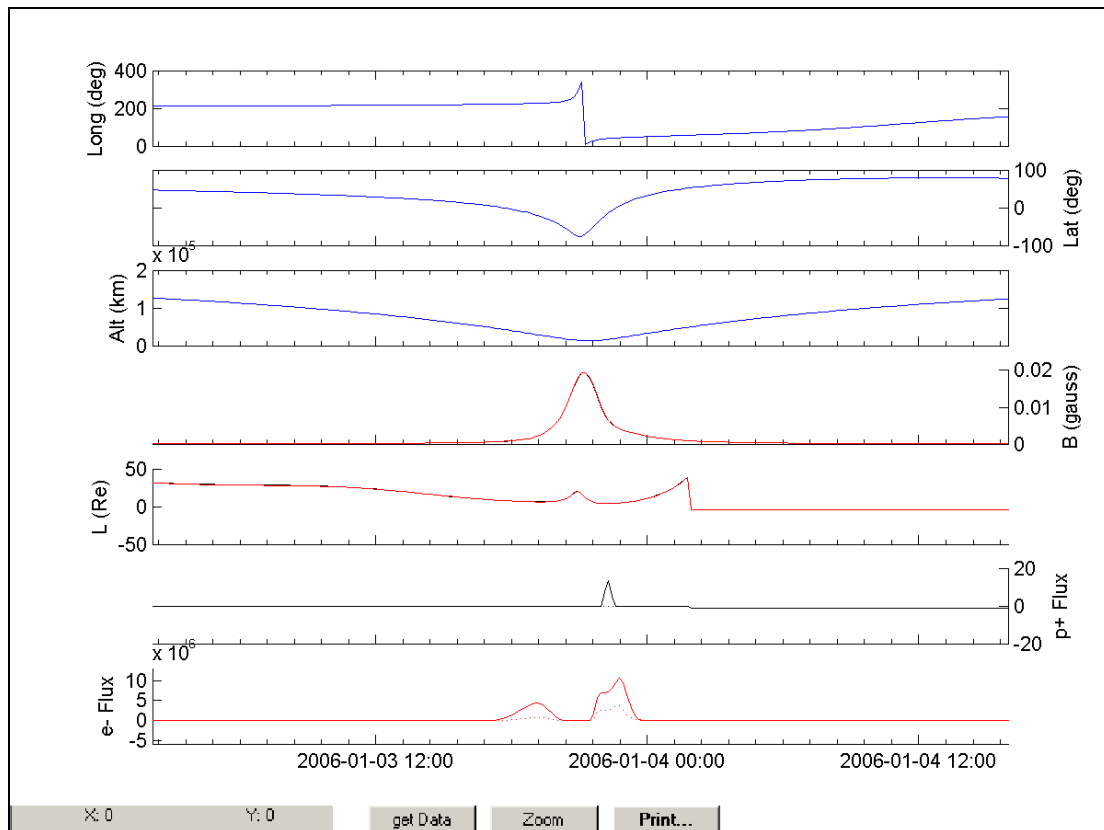


IREM Predicted Radiation Belt Passages:

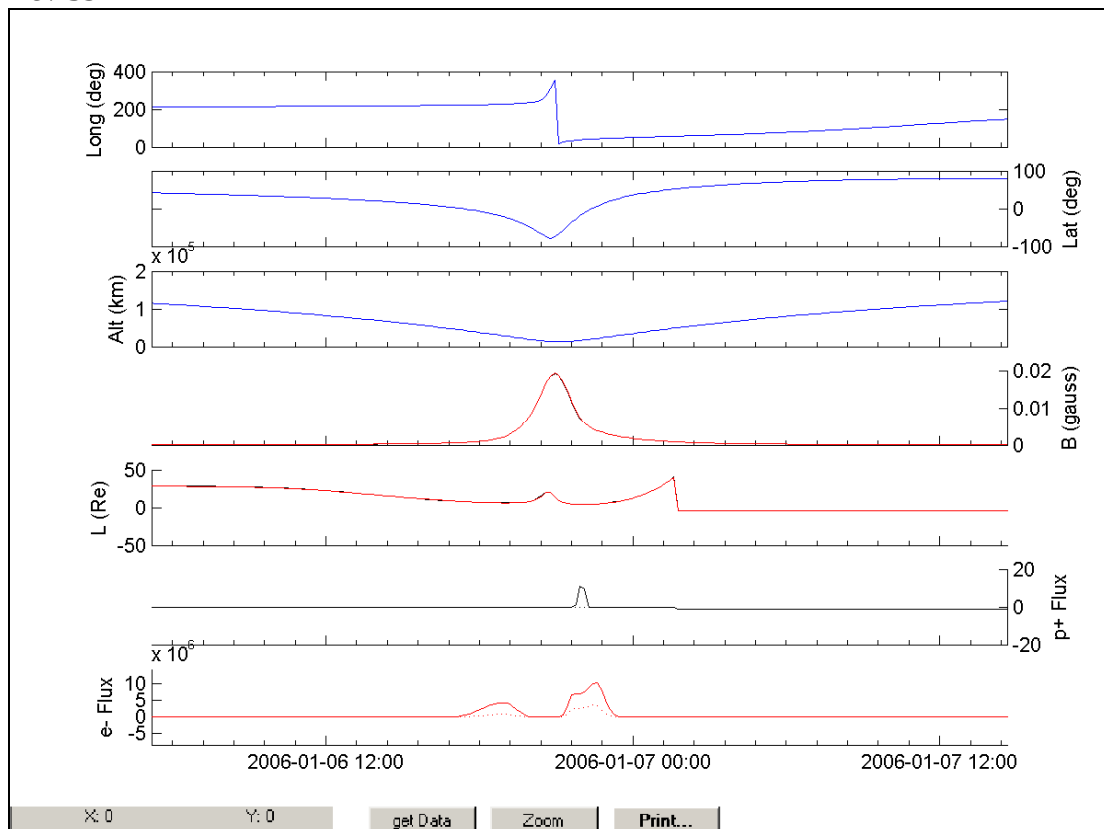
Rev 392



Rev 393



Rev 394



SEC-GOES Observed Particles Fluxes:

