

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 169
Week 50
19.12.05
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 10.12.05 until 16.12.05 (both dates inclusive) and covers the revolutions 386 and 387.

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 the Galactic Plane. The activities consisted of raster dithering and GPS 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.

11 (10 OSL, 1 CSL) slews were lost from the Timeline during this period due to a problem on DSS16 station.

The fuel consumption over the period between 11/11/2005 and 15/12/2005 was 0.2265 kg. The remaining propellant is in the order of 157.6140 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.

A spurious (SEU) switch-off of BCR2 occurred on 14/12/2005, after investigation the BCR was switched back on and has behaved nominally since, AR INT_SC_135 applies.

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

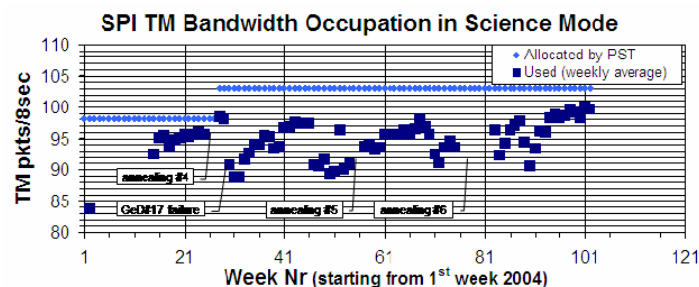
3.2.1 SPI

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 99.6 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.



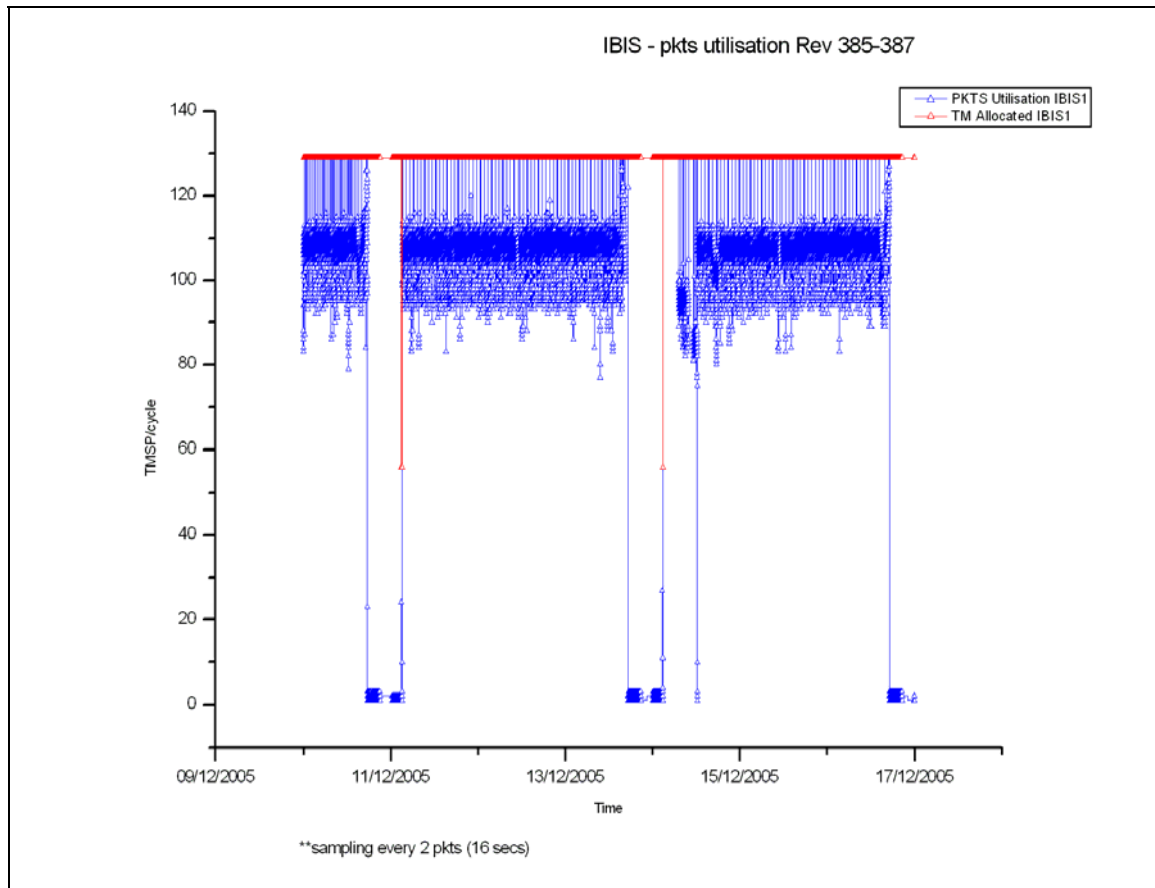
Note: Some more information concerning the SPI operations is provided in the Appendix.

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. The IBIS mean bandwidth utilisation during the observation period was 108.66 TMPS/cycle, up 0.29 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.

On 2005-12-13, due to a problem with DSS-16, JEM-X1 was commanded to Safe mode manually about 30 minutes earlier than planned in the Timeline before radiation belt entry of revolution 386.

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, 143 of the 149 planned science pointings for OMC were executed nominally, six were lost.

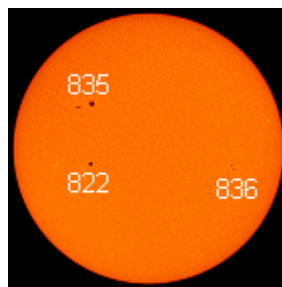
Note: Some more information concerning the OMC operations is provided in the Appendix Section 8.3.5.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low solar activity. During the observing period, several sunspots appeared on the sun (see picture below) but none of them posed a 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 performance of the Operational ground facilities was not so good this week, 10 pointings were lost when the TC from DSS-16 was not available. The overall performance below 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 well above the 95% requirement.

4.2 Ground Stations & Network

The performance of the ground stations and Network was, apart from the loss of the DSS-16 pass 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 below the 95% requirement due to the impact of the lost pass.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

No new PSF's were delivered, however new ones were delivered for revolutions 393 to 397. This forced a replanning to be made of the already sent revolutions 393 to 395. Revolution 396 has also been generated and sent. No ToO request was received. This

week it has also been agreed to perform the earth observation proposed by ISWT and IUG. There will be four observations in revolutions 401 and 404 to 406. The SPI annealing has also been discussed. It is now in the planning but final decision is still pending. TSF up to rev 392 are now available.

2. Observation status

ECS's for revolutions 375 to 378 were received. Corresponding OCS's plus the OCS' for the ECS's received last week has been sent to ISDC. No extra time is credited.

3. ISOC science data archive

Nothing to report this week.

4. ISOC system

Version 11.3 has been used. A version 12.0 is now available and will be installed Monday next week. This version contains proposal generation tool to support the AO 4. It includes also handling of key programmes.

5. AO 4 preparation

A first internal review of the updated documentation has been circulated and reviewed according to schedule. The relevant documentation will be sent out for review by PI's and ISWT members on Monday.

5. Problems

None

4.3.2 ISDC

Status of ISDC observation processing on 19/12/2005:

- Latest Standard Analysis completed: observation 03201090043 (Galactic Bulge, Revolution 370) on 17/12/2005
- Latest products archived: observation 03200860001 (SS433, Revolution 366-369) on 28/11/2005
- Latest observation products sent to the observer: observation 02297000020 (galactic disk $l < 0$, Revolution 347) on 03/10/2005

5 Special Events

6 Anomalies

There were a number of problems that impacted the operations:

- On DoY 347, at 16:05, after the handover from Redu to DSS-16, there was no TC available. The impact was the loss of pointings 03860061 to 03860064. During the recovery in the following revolution the pointings 03870001 to 03870006 inclusive were also lost.

The following anomaly report was entered into the ARTS system.

AR id	Date Created	Subject	Segment	Status
INT_SC-135	14/12/2005	BCR2 Spurious Switch-off #3	Spacecraft	Pending
INT-2818	14/12/2005	No uplink capability from DSS-16 due transmitter Air Flow interlock	NASA Station	Pending
INT-2819	14/12/2005	No VC-7 TM online complete from VIL2	ESA Stations	Pending
INT-2820	22/12/2005	FDS: generated RWB did not reach the target during the recovery of DoY 2005.348	FDS	Open

7 Future Milestones

Preparation is on-going for the earth observation, currently planned to take place in January.

The upgrade of the IMCS has been delayed for incorporation of an urgent fix which has become available from infrastructure, new release date will probably be early January depending upon the time taken to integrate and test this patch.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 386

In revolution 386 a raster dithering observation of Cas A /Tycho (RA 23:51:43.00; DEC +62:03:55.0) was performed throughout the available observation time (~60.5 hours).

Revolution 387

The observations in revolution 387 consisted of a GPS lasting ~7 hours, followed by a raster dithering observation of Cas A /Tycho (RA 23:51:43.00; DEC +62:03:55.0), performed for the remaining ~52 hours of observation time.

Throughout these observations 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.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2005-12-05T01:33:02.000Z	157.8833	F	Automatic TM processing.
2005-12-06T11:39:54.000Z	157.8613	F	Automatic TM processing.
2005-12-07T20:51:26.000Z	157.8488	F	Automatic TM processing.
2005-12-08T01:20:22.000Z	157.8405	F	Automatic TM processing.
2005-12-09T11:35:30.000Z	157.8224	F	Automatic TM processing.
2005-12-10T20:37:18.000Z	157.8009	F	Automatic TM processing.
2005-12-11T01:07:50.000Z	157.7845	F	Automatic TM processing.
2005-12-12T11:13:06.000Z	157.7596	F	Automatic TM processing.
2005-12-14T01:55:58.000Z	157.7310	F	Automatic TM processing.
2005-12-14T03:20:47.000Z	157.6890	F	Automatic TM processing.
2005-12-14T03:52:23.000Z	157.6820	F	Automatic TM processing.
2005-12-14T05:07:11.000Z	157.6610	F	Automatic TM processing.
2005-12-14T06:31:35.000Z	157.6370	F	Automatic TM processing.
2005-12-14T10:01:19.000Z	157.6180	F	Automatic TM processing.
2005-12-15T11:18:42.000Z	157.6140	F	Automatic TM processing.

This report was generated Fri Dec 16 08:00:28 GMT 2005

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, 10/12/2005 – 16/12/2005

AOCS operations were executed from the Automatic Timeline.

During this period, 43 Open Loop Slews, 109 Closed Loop Slews and 11 Momentum Bias were executed (TL + manual recovery). 11 (10 OSL, 1 CSL) slews were lost from the Timeline during this period due to a problem on the transmitter of DSS16 station.

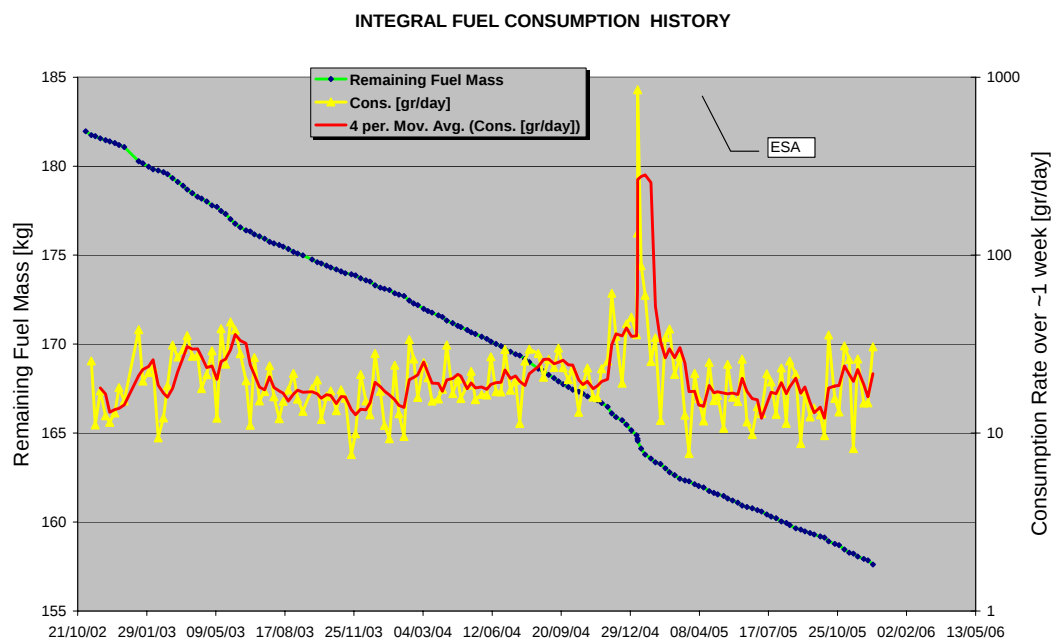
This is equivalent to 6.9 % of the total number of slews planned (159).

Orbit Control

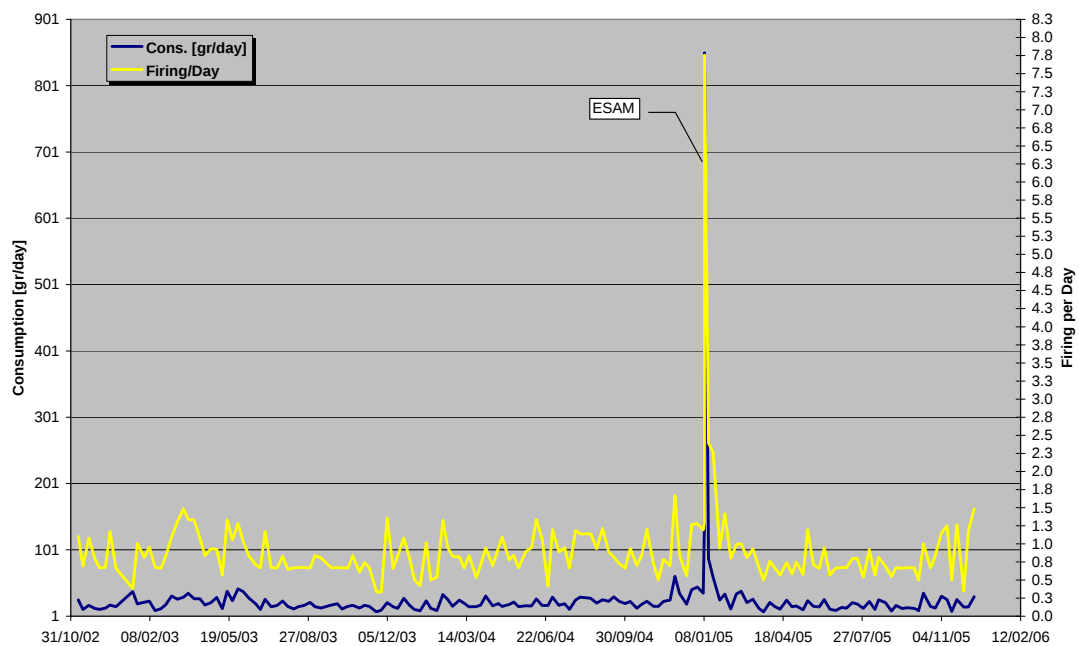
N.A. provided on monthly basis.

Fuel consumption

The fuel consumption (total, grams/day) over the period between 01/11/2002 and 15/12/2005 is reported in the plot below.

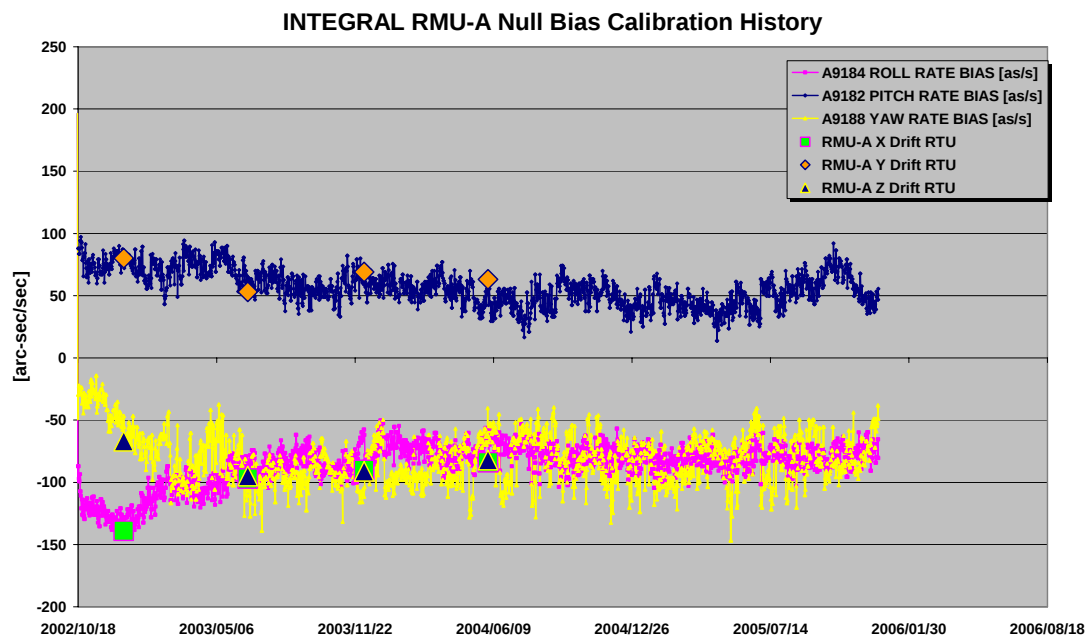


The firing\day over the period between 01/11/2002 and 15/12/2005 is reported in the plot below.

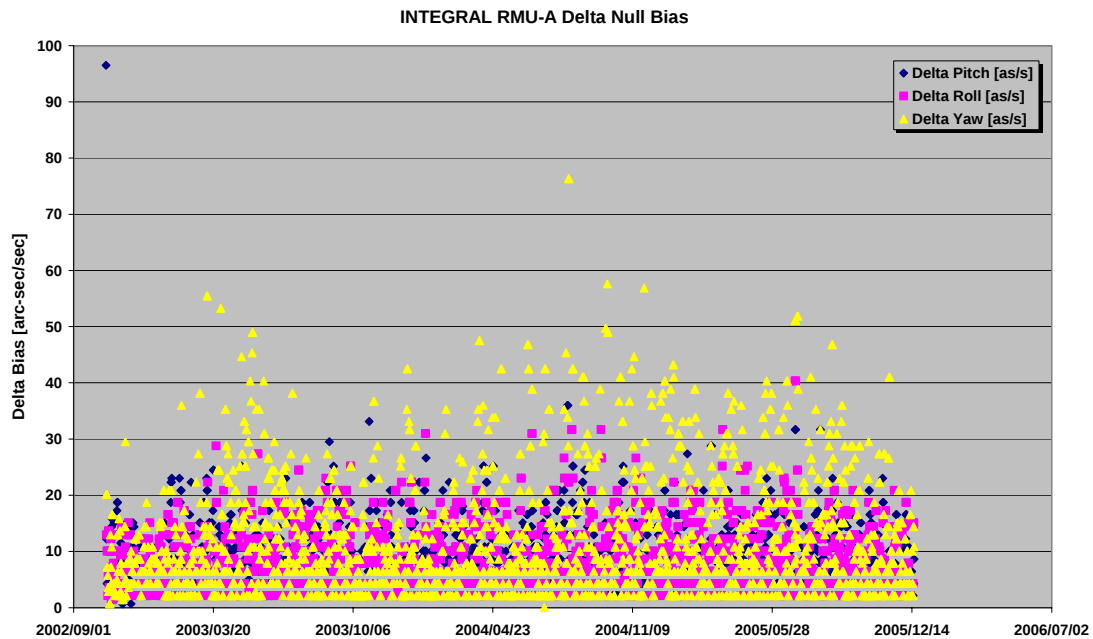


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 16/12/2005 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 16/12/2005 is reported in the plot below.



10/12/05 (Day of Year 344, Revolution 385)

Nothing to report.

11/12/05 (Day of Year 345, Revolution 385-386)

Nothing to report.

12/12/05 (Day of Year 346, Revolution 386)

Nothing to report.

13/12/05 (Day of Year 347, Revolution 386)

Slews missed from the Timeline: Due to a problem on DSS16 station (transmitter failure, see detailed problem report), the expected pass was performed for large part without uplink and the S\C was maintained for safety reason to the attitude of PID 03860060 (valid for the complete perigee passage, until 16/12 at 22:57:59). The guide star, Mi 8.15 at CCD location [-8645,-15551], and the wheels speeds evolution were verified suitable for the outage period. The roll angle was as well verified to be around zero (~ 0.08 deg).

The AOCS s/s was disabled in TL at 15:36z and the S\C monitored trough the downlink channel, working for all the duration of the pass (LOS TM 20:56z).

The following slews, 03860061 (OSL)-62(OSL)-63(OSL)-64(OSL), and one RWB were not executed from TL.

14/12/05 (Day of Year 348, Revolution 386-387)

Slews missed from the Timeline: on the start of revolution 387, a complex manual recovery was attempted. Hereafter follow the detailed description:

- 1) RWB to recover the accumulated momentum during the perigee passage (target speeds RW2~2950, RW3~1280, RW4~1327);
- 2) Manual Open Loop slew from attitude of PID 03860060 to the attitude (RA 01:57:37, DEC -24:21:36, POS 230:28:41);
- 3) The implementation of the previous long OSL required the execution of a new RWB (target speeds RW2~2072, RW3~669, RW4~530). Due to a problem in the FDS, the mentioned RWB did not reach the target and it required an additional corrective RWB (target speeds RW2~1720, RW3~779, RW4~642);
- 4) Manual Open Loop slew from attitude (RA 01:57:37, DEC -24:21:36, POS 230:28:41) to the attitude (RA 08:40:00, DEC -20:00:00, POS 130:00:00);
- 5) The implementation of the previous long OSL required the execution of a new RWB (target speeds RW2~1590, RW3~628, RW4~1337);
- 6) Manual Open Loop slew from attitude (RA 08:40:00, DEC -20:00:00, POS 130:00:00) to the attitude of PID 03870005;
- 7) The implementation of the previous long OSL required the execution of a new RWB to re-join the wheels profile (target speeds RW2~1390, RW3~2413, RW4~1158);
- 8) Manual Open Loop slew from attitude of PID 03870005 to the attitude of PID 03870007 to re-join the TL;
- 9) The next OSL for PID 03870008 was manually updated and executed from the Timeline;

The problem on the FDS that caused one of the RWB not to reach the expected target, is under investigation by the FD team.

The AOCS s/s was re-enabled in TL at 07:16z.

The following slews were not executed from TL while recovering the AOCS s/s: 03870001 (CSL)-02(OSL)-03(OSL)-04(OSL)-05(OSL)-06(OSL)-07(OSL).

15/12/05 (Day of Year 349, Revolution 387)

Nothing to report.

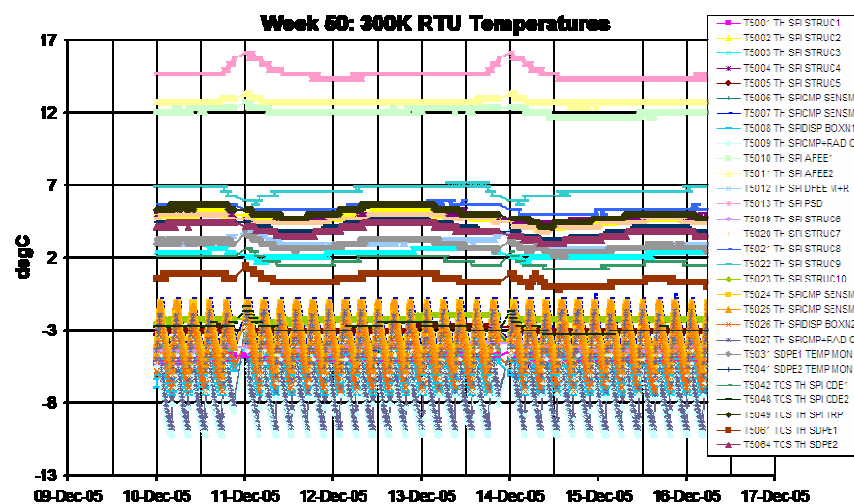
16/12/05 (Day of Year 350, Revolution 387)

Nothing to report.

8.3.2 SPI Operations

Unit Temperatures

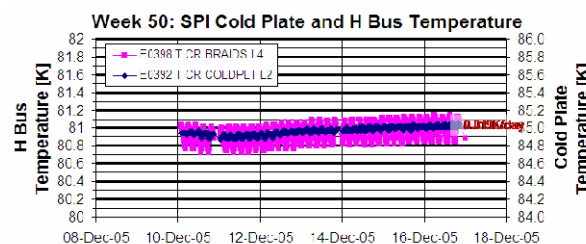
All the temperatures of the equipment are inside the operational limits. The following plot shows their evolution along the reporting period.



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.

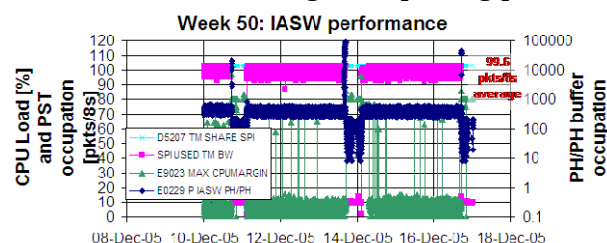


DPE & IASW

The Iasw performance is nominal.

The current Iasw version installed is 432.

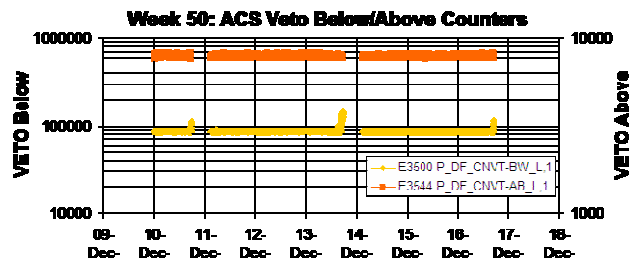
The following plot shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



ACS

The performance of the ACS is nominal.

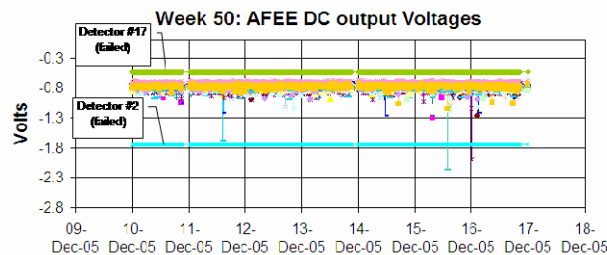
The following plot shows the ACS overall count rate evolution during the reporting period (due to problems in the data retrieval tool, some gaps could be present).



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

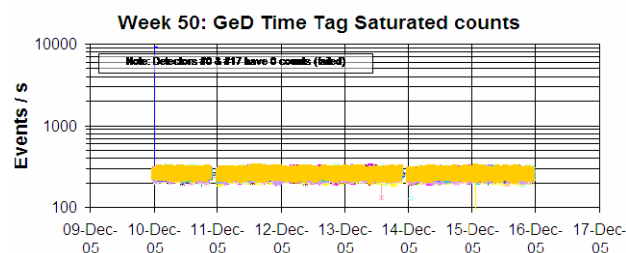
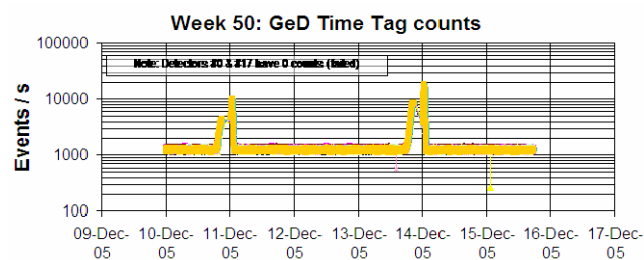
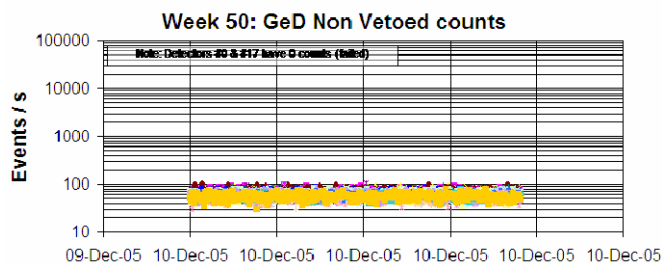
The following plot shows the dc voltage offset of the detector channels during the reporting period.



DFEE

The performance of the unit is nominal.

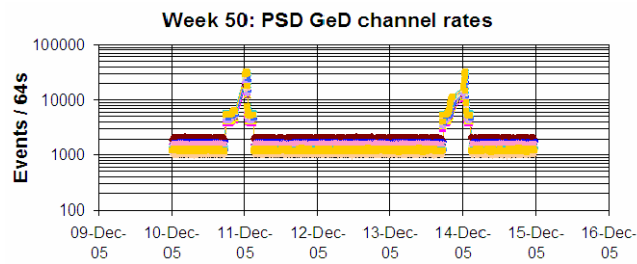
The following plots show the count rates of the detectors during the reporting period (due to problems in the data retrieval tool, some gaps could be present).



PSD

The performance of the unit is nominal

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



SPI EVENTS LOG

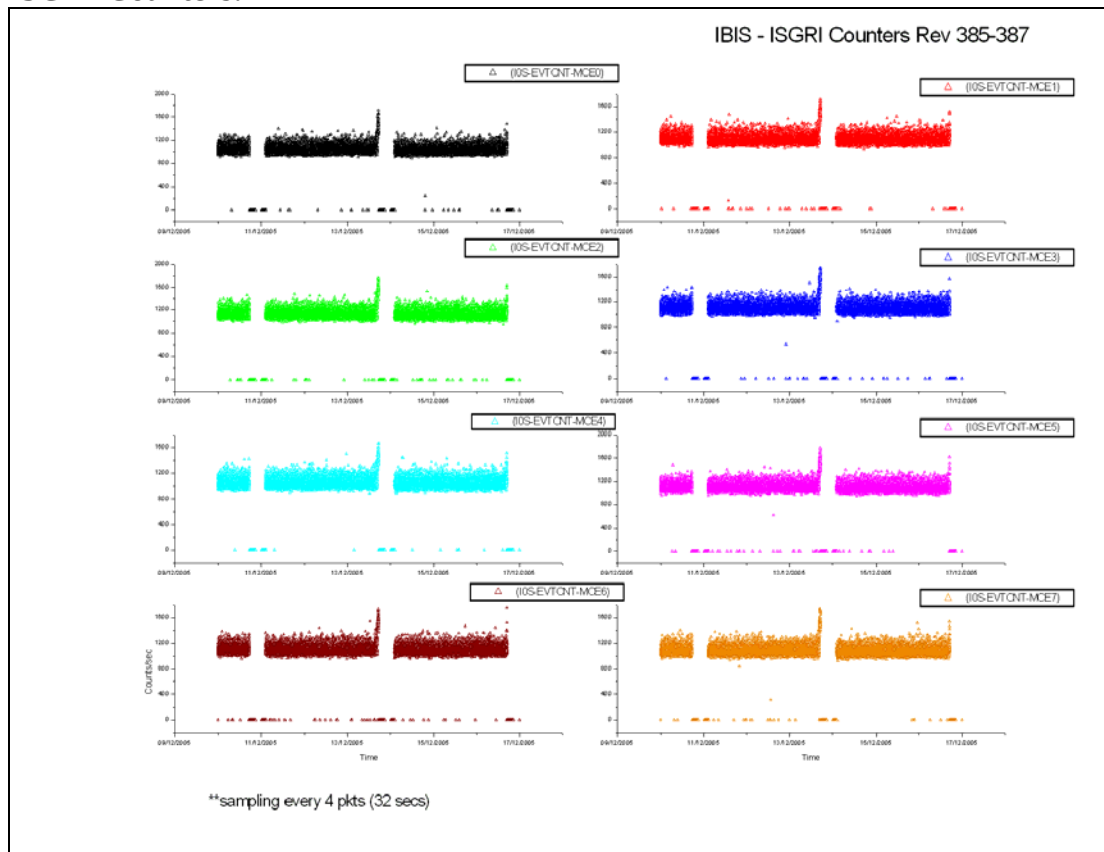
NOTE: The events log is extracted from the revolution pass summaries (courtesy of the Integral Analysts).

DOY Time	Event
344 / 17:39	TM E3500 "P_DF_CNVT-BW_L,1" backs into limits.
350 07:52-07:58	TM E2170 "S AS DG5V L20" violated the assigned Fix Check "CORRECT VAL". Seq. EEORTM01 "Report all SPI TM" uplinked TM E2170 back into limits.

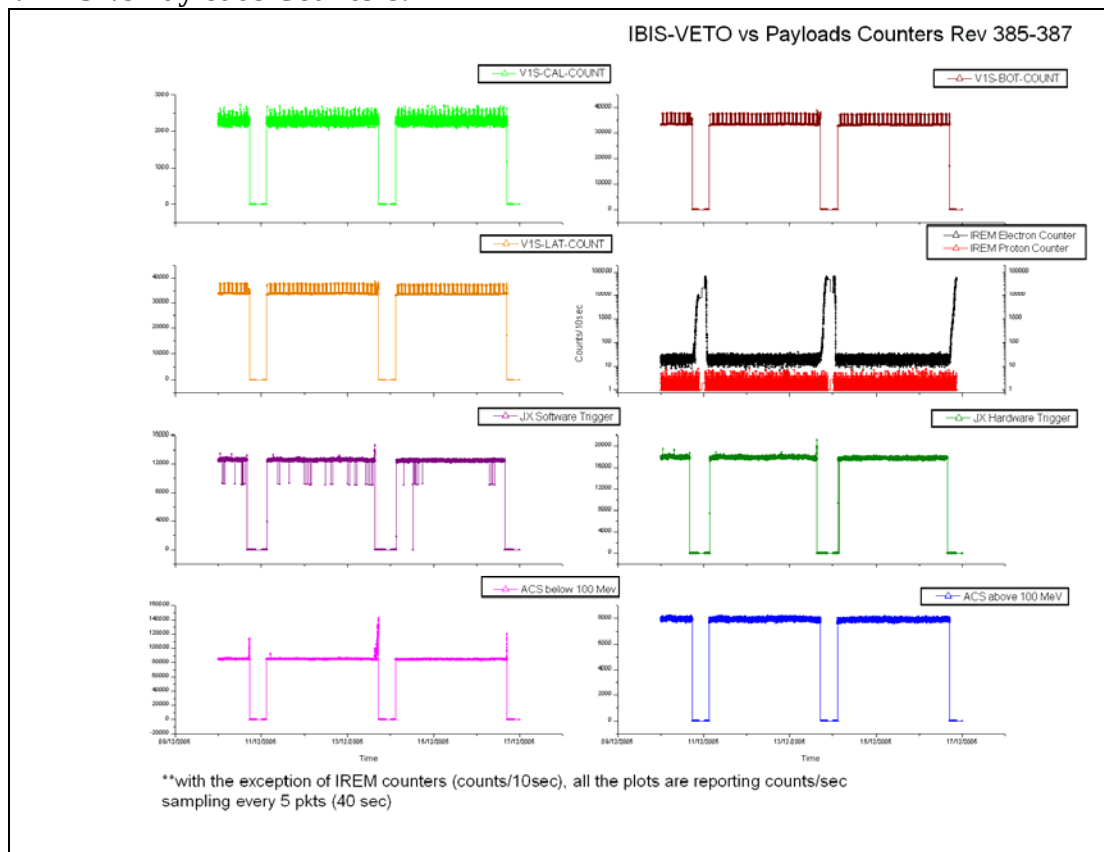
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

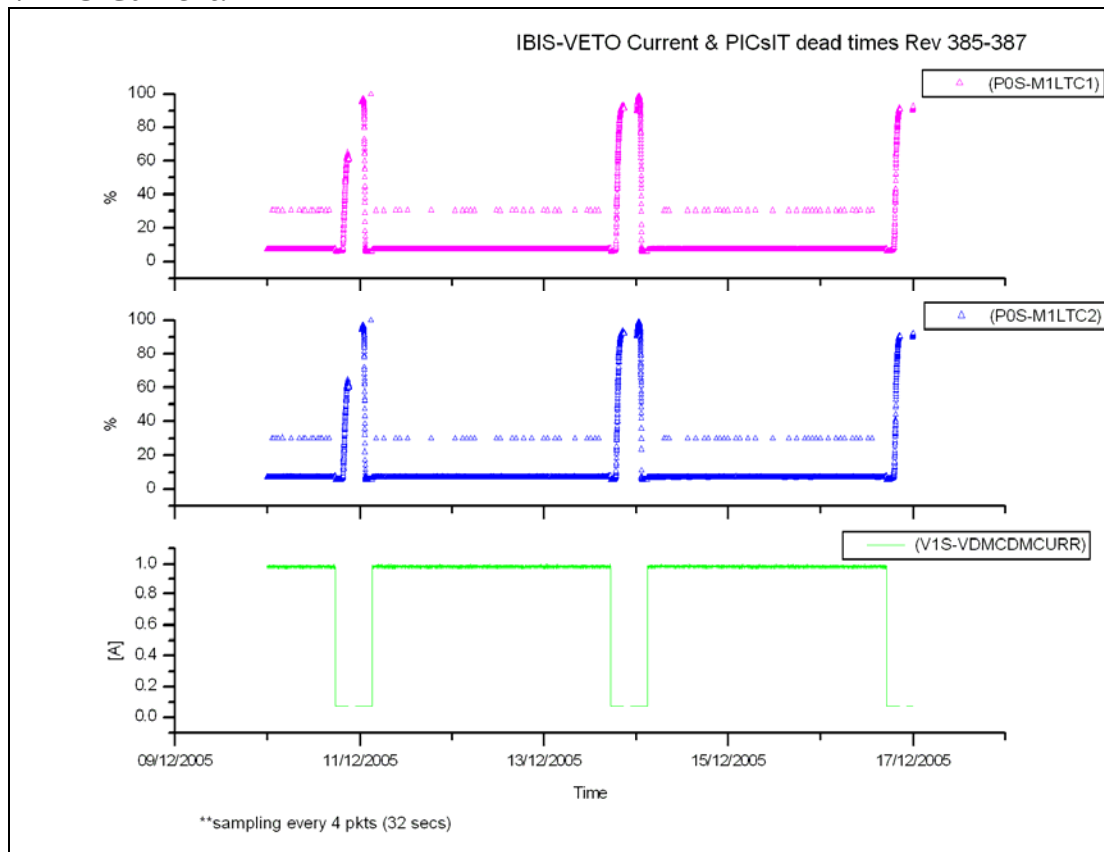


VETO vs Payloads Counters:

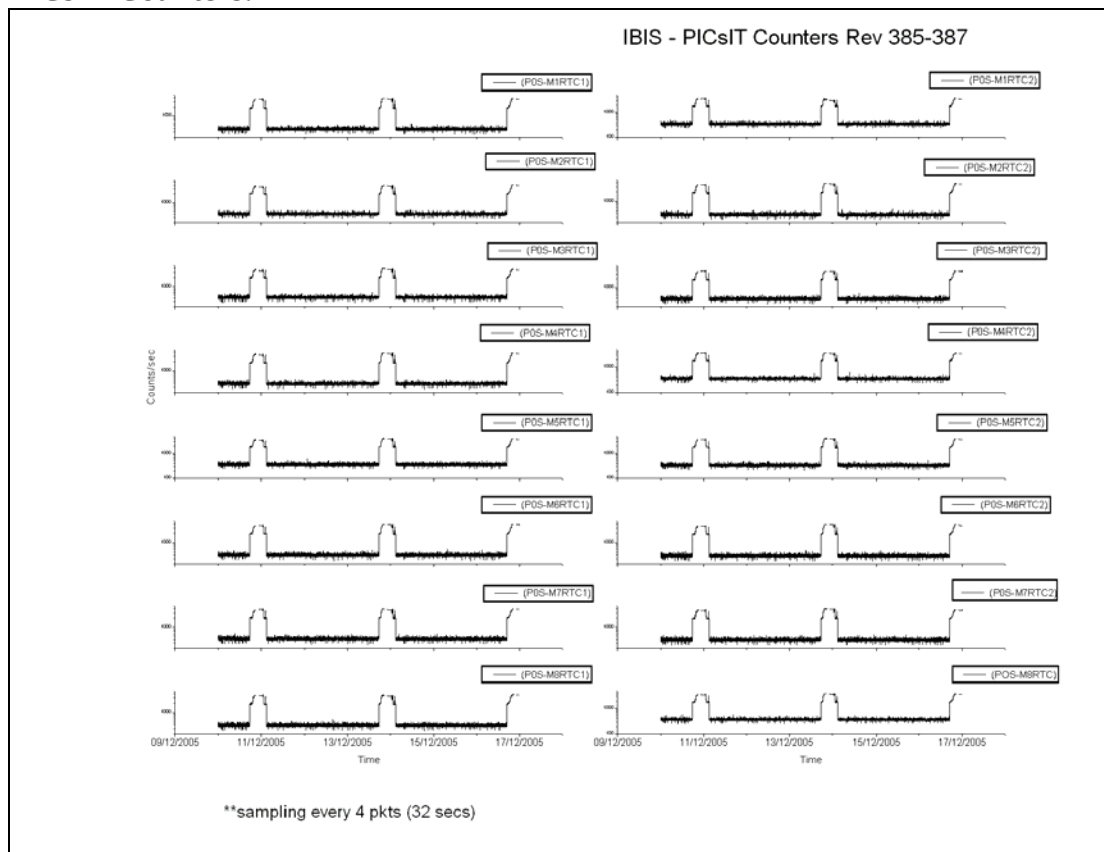


The week was characterised by low radiation.

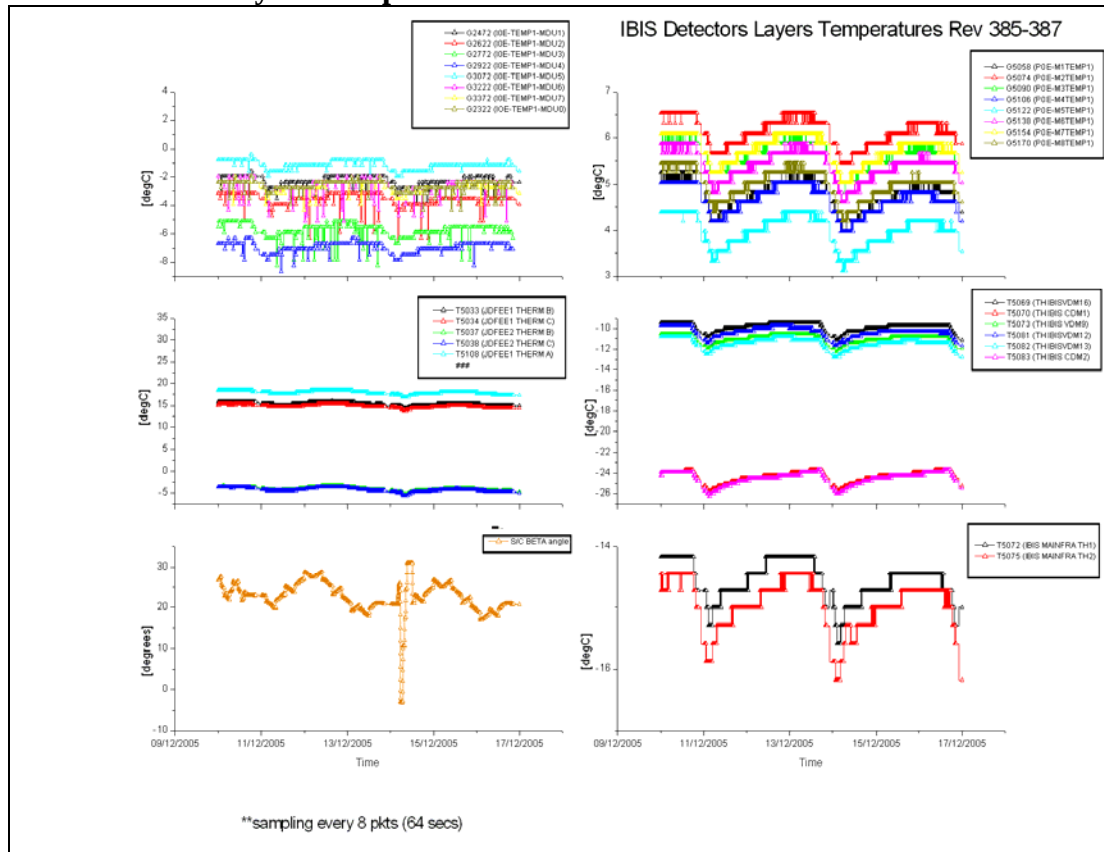
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report

DoY 2005.344 (10/12/2005)

At 17:38Z TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. It went back inside limits on DoY 345 at 03:10Z. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.

DoY 2005.345 (11/12/2005)

At 01:05Z, TM parameter G5013 (P0S-M3RTC2) went OOL high until 01:11Z. According to P-CNT-1, no action was taken.

At 02:40Z TM parameter G2014 (I0E_OVFWPXADD_M1) failed SCC and back. According to I-OVF-1, no action was taken.

At 02:51Z TM parameter G2084 (I0E_OVFWPXADD_M6) failed SCC and back. According to I-OVF-1, no action was taken.

DoY 2005.347 (13/12/2005)

At 17:22Z TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. It went back inside limits on DoY 348 at 02:54Z. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.

At 19:55Z, TM parameter G5022 (P0S-M5RTC1) went OOL high and back. According to P-CNT-1, no action was taken.

DoY 2005.348 (14/12/2005)

At 02:32Z TM parameter G2070 (I0E_OVFWPXADD_M5) failed SCC and back. According to I-OVF-1, no action was taken.

DoY 2005.350 (16/12/2005)

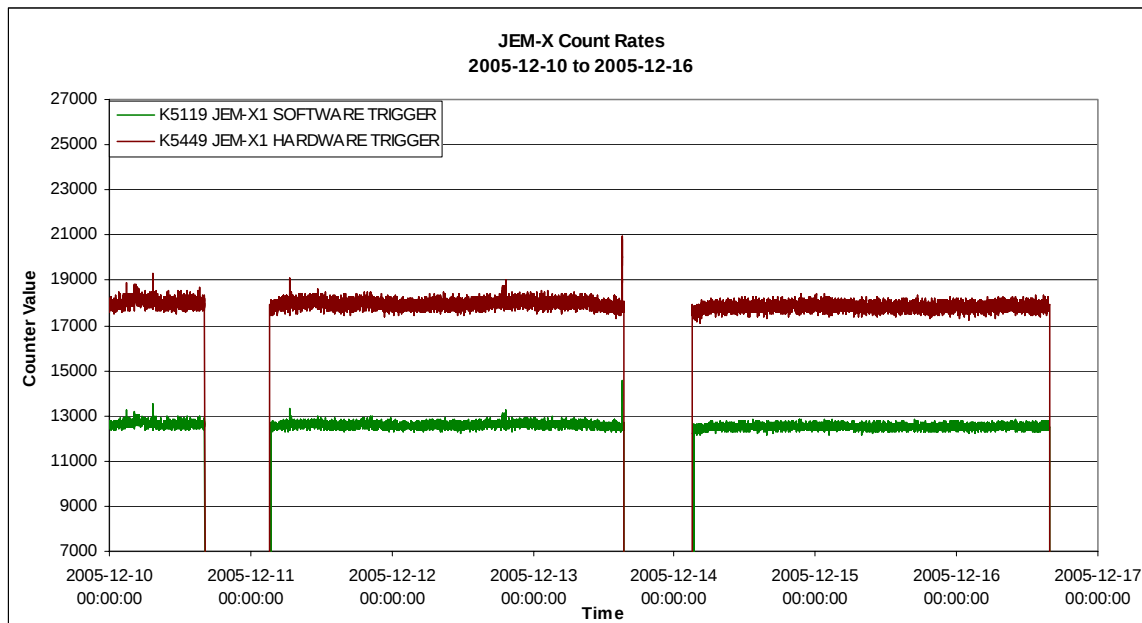
At 17:05Z TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.

At 19:54Z, TM parameter G5007 (P0S-M2RTC1) went OOL high and back. According to P-CNT-1, no action was taken..

8.3.4 JEM-X Operations

8.3.4.1 JEM-X Count Rates

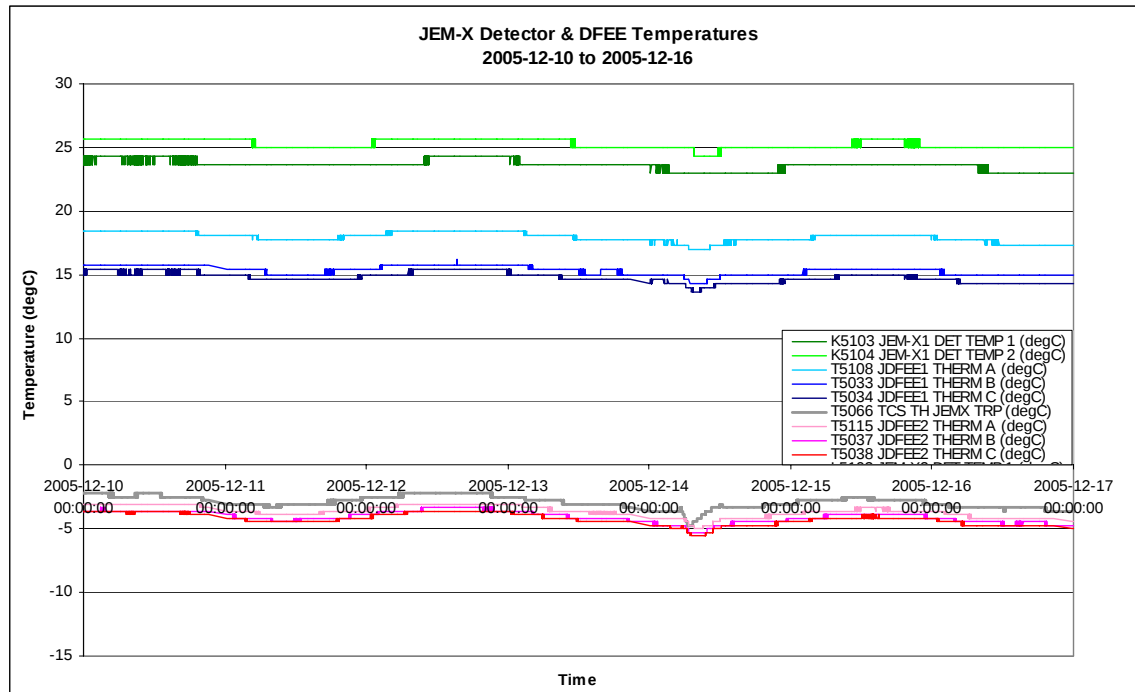
JEM-X count rates over the reporting period are displayed in the following graph¹.



8.3.4.2 JEM-X Temperatures

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

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

2005-12-10 (DOY 344, Rev 385-386) to 2005-12-12 (DOY 346, Rev 386)

Nothing to report

2005-12-13 (DOY 347, Rev 386-387)

Following a report from Network that there was a problem with the DSS-16 transmitter and that the upcoming Goldstone pass would be TM-only (Anomaly Report INT-2818), thus the ED KESAFE02 scheduled in the Timeline at 15:58:12Z would be missed, JEM-X1 was commanded to Safe mode manually via FCP_JEM1_0040 at 15:25:06Z, before the loss of TC from Redu.

2005-12-14 (DOY 348, Rev 387) to 2005-12-16 (DOY 350, Rev 387-388)

Nothing to report

8.3.5 OMC Operations

2005-12-10 (DOY 344, Rev 385) to 2005-12-13 (DOY 347, Rev 386)

Nothing to report

² Data sampled (1 frame in 8)

2005-12-14 (DOY 348, Rev 387)

From the beginning of the revolution at 00:10 until 07:16, due to an incorrect initial attitude caused by the loss of the DSS-16 pass, it was necessary to execute an extended recovery involving 5 Reaction Wheel Biases. The impact was the loss of pointings 03870001 to 03870006 inclusive. (The pointings missed during the lost pass did not affect OMC operations).

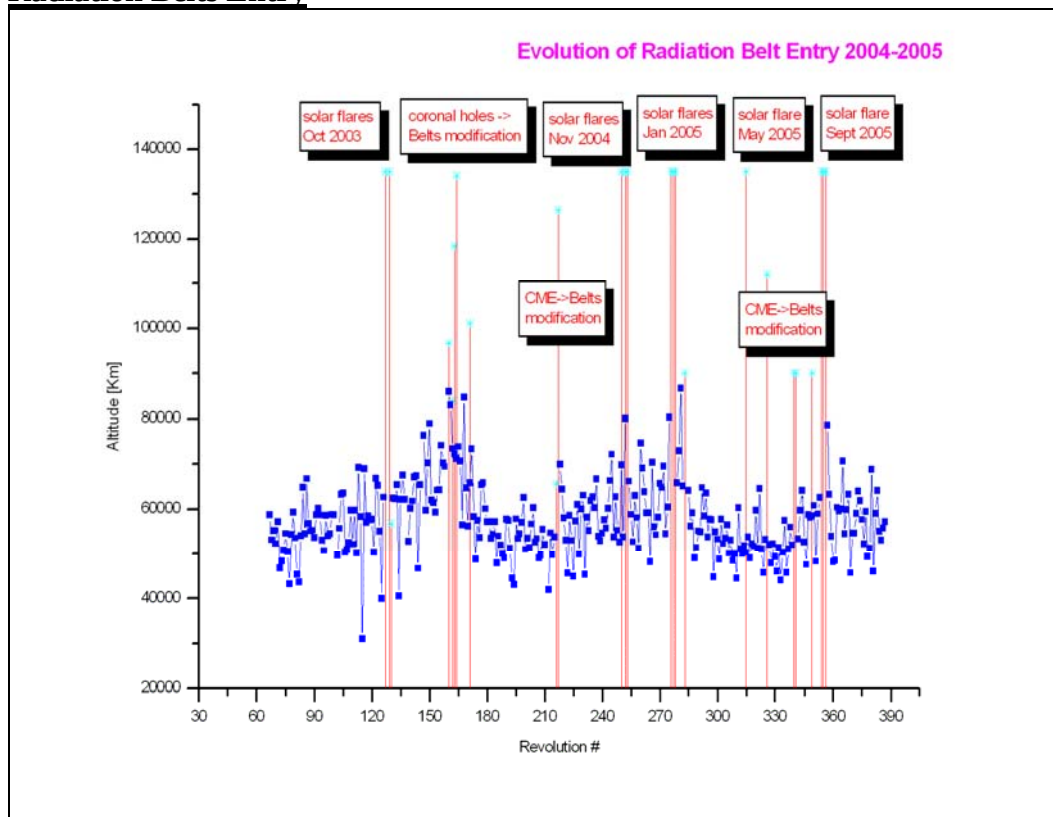
2005-12-15 (DOY 349, Rev 387) to 2005-12-16 (DOY 350, Rev 387)

Nothing to report

On DoY 344 at 17:38:44, DoY 347 at 17:22:36 and DoY 350 at 17:05:48 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]
385	RAD_ENTR R 2005-12-10T17:38:43Z	2005-12-10 18:31:39	52988.8	2005-12-10 18:51:13	51094
386	RAD_EXIT R 2005-12-11T02:56:50Z	2005-12-11 01:49:23	>>24970.0	2005-12-11 02:11:13	32277
386	RAD_ENTR R 2005-12-13T17:22:31Z	2005-12-13 17:55:31	55789.8	2005-12-13 18:36:28	51119
387	RAD_EXIT R 2005-12-14T02:41:05Z	2005-12-14 01:47:47	>>24980.1	2005-12-14 01:56:28	32185
387	RAD_ENTR R 2005-12-16T17:05:47Z	2005-12-16 17:23:24	>57220.3	2005-12-16 18:26:28	50617

Reference

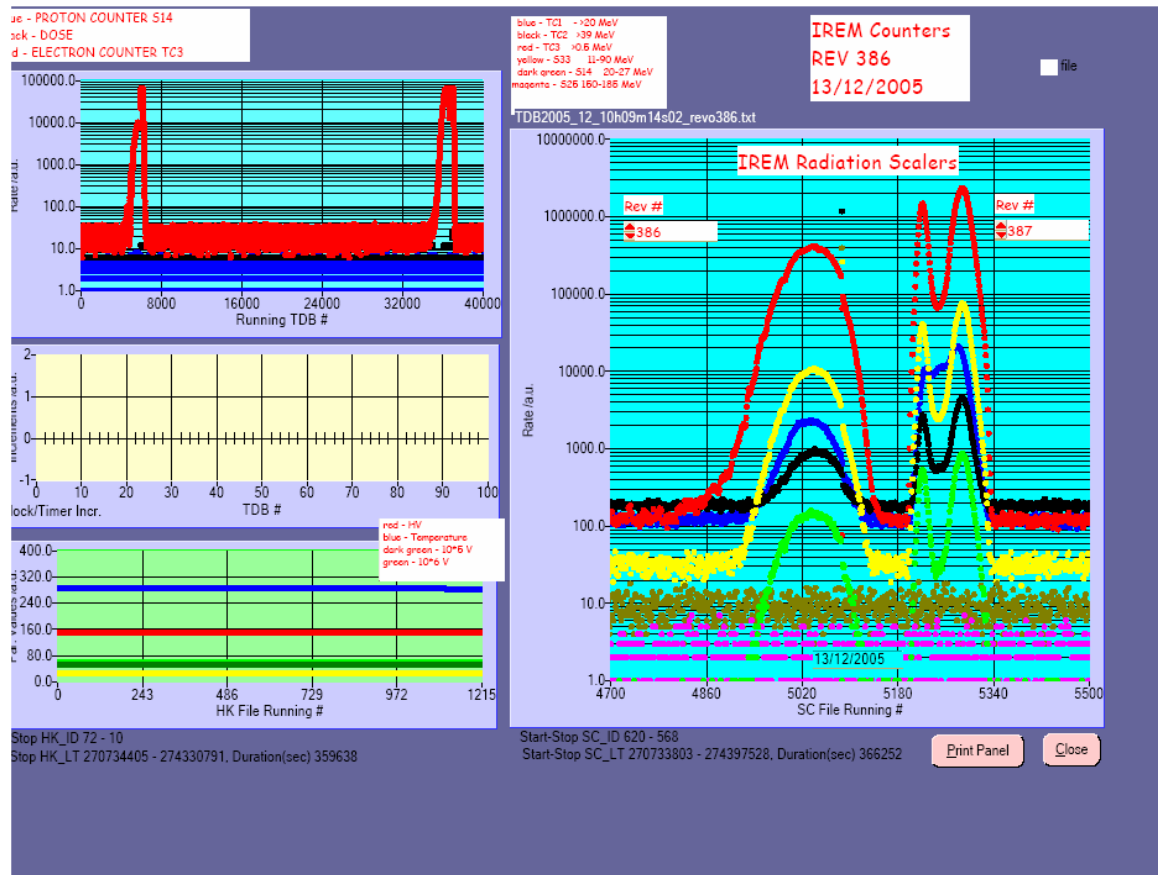
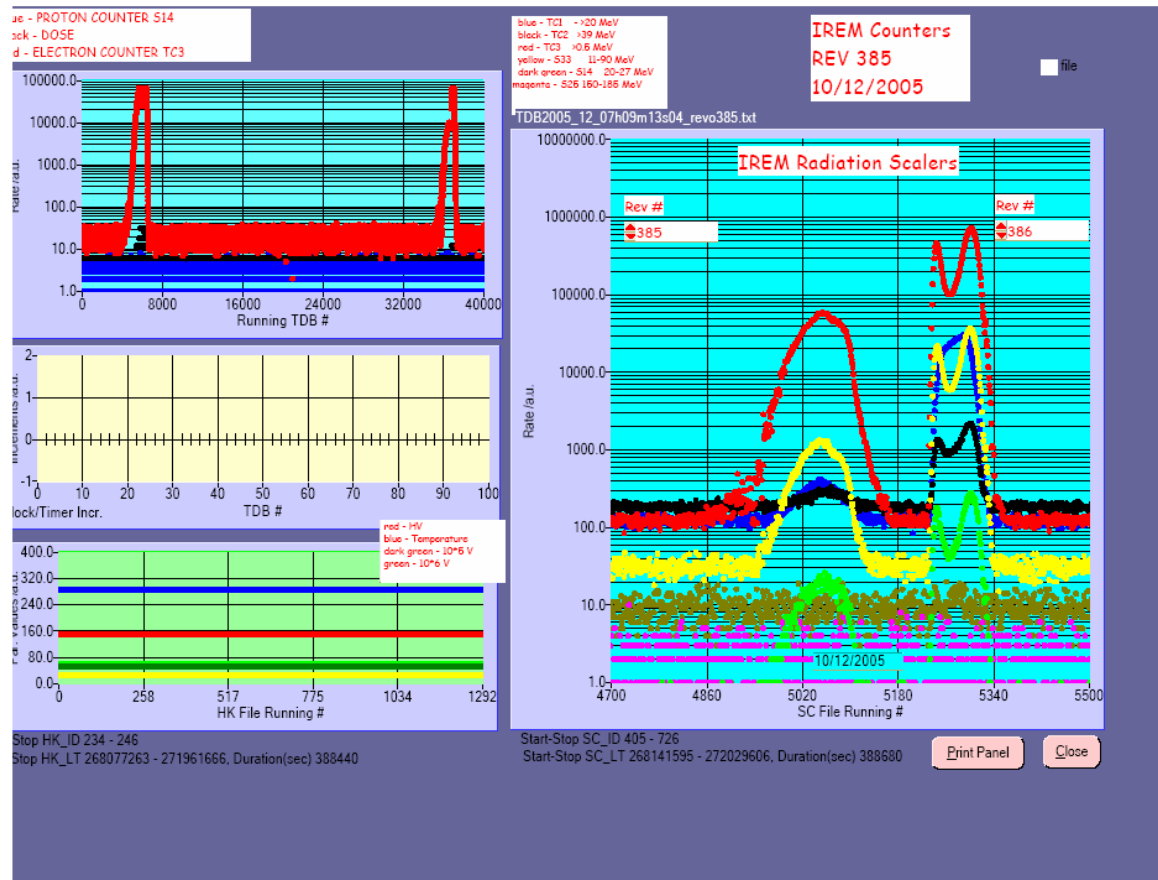
Very small error vs reference (less than 10 minutes)

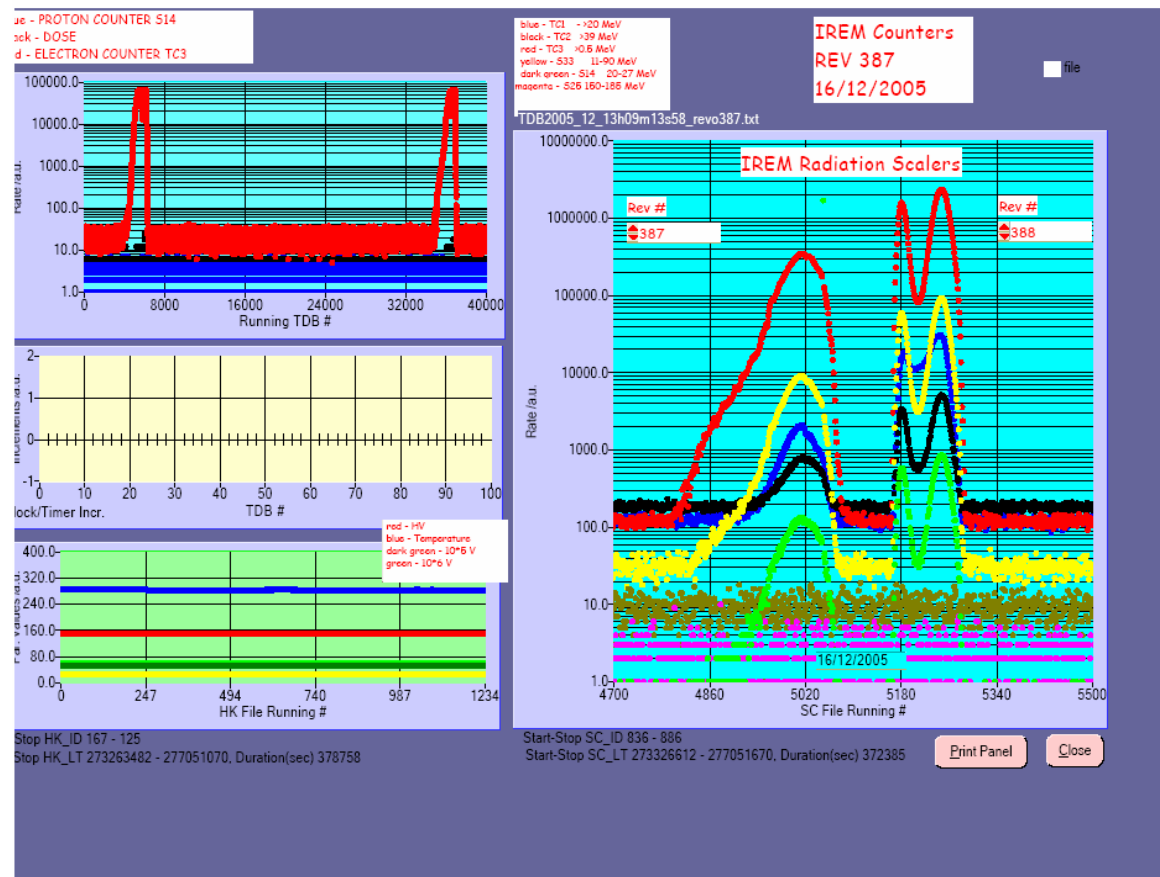
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

Radiation Spike

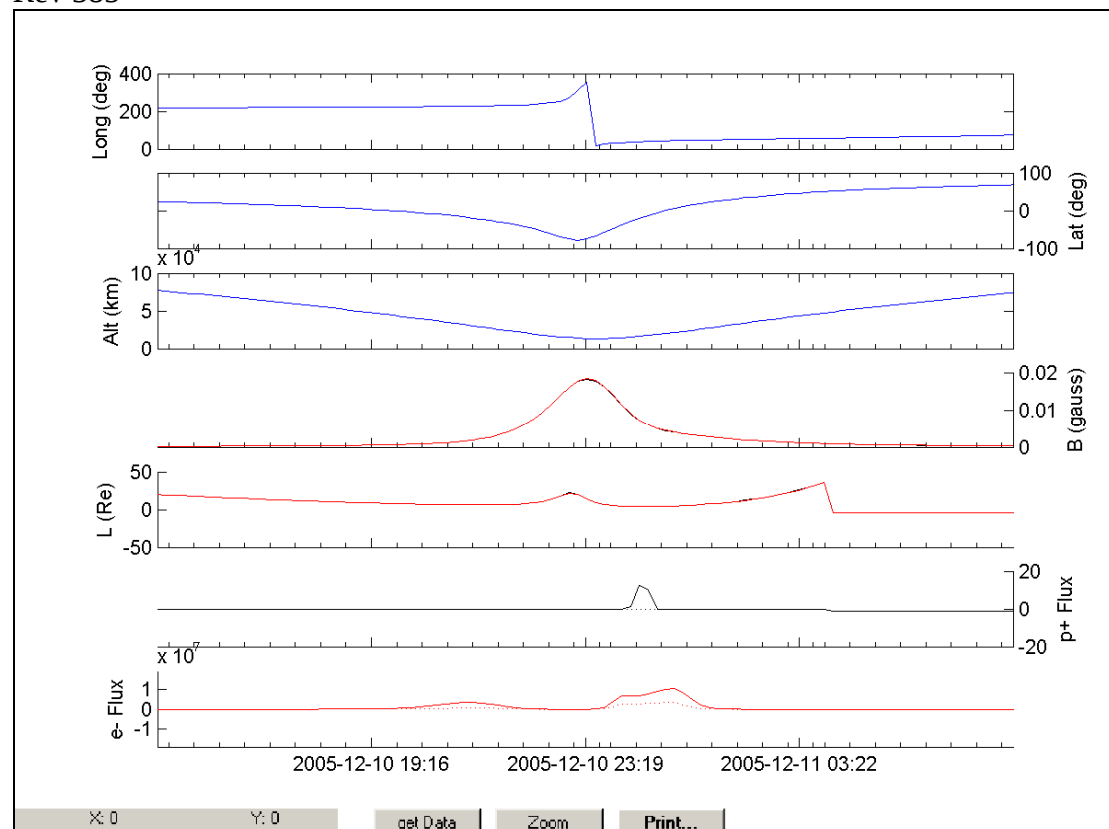
IREM radiation counters:



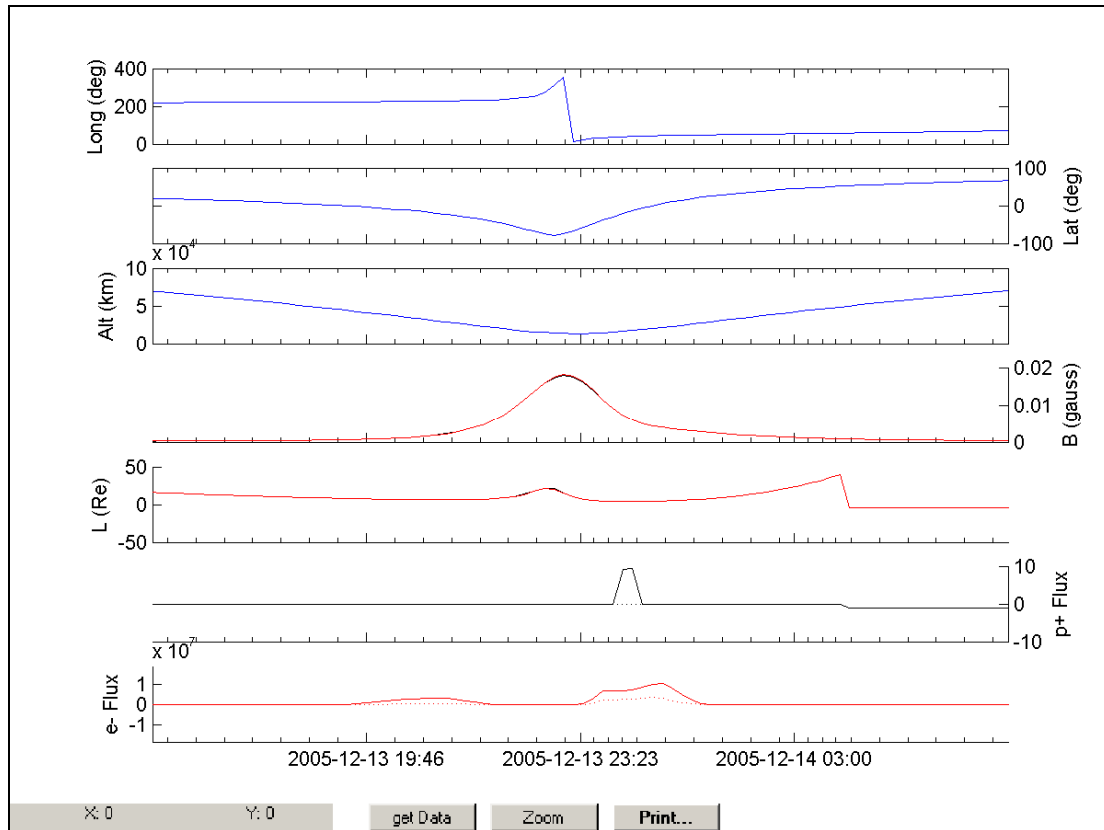


IREM Predicted Radiation Belt Passages:

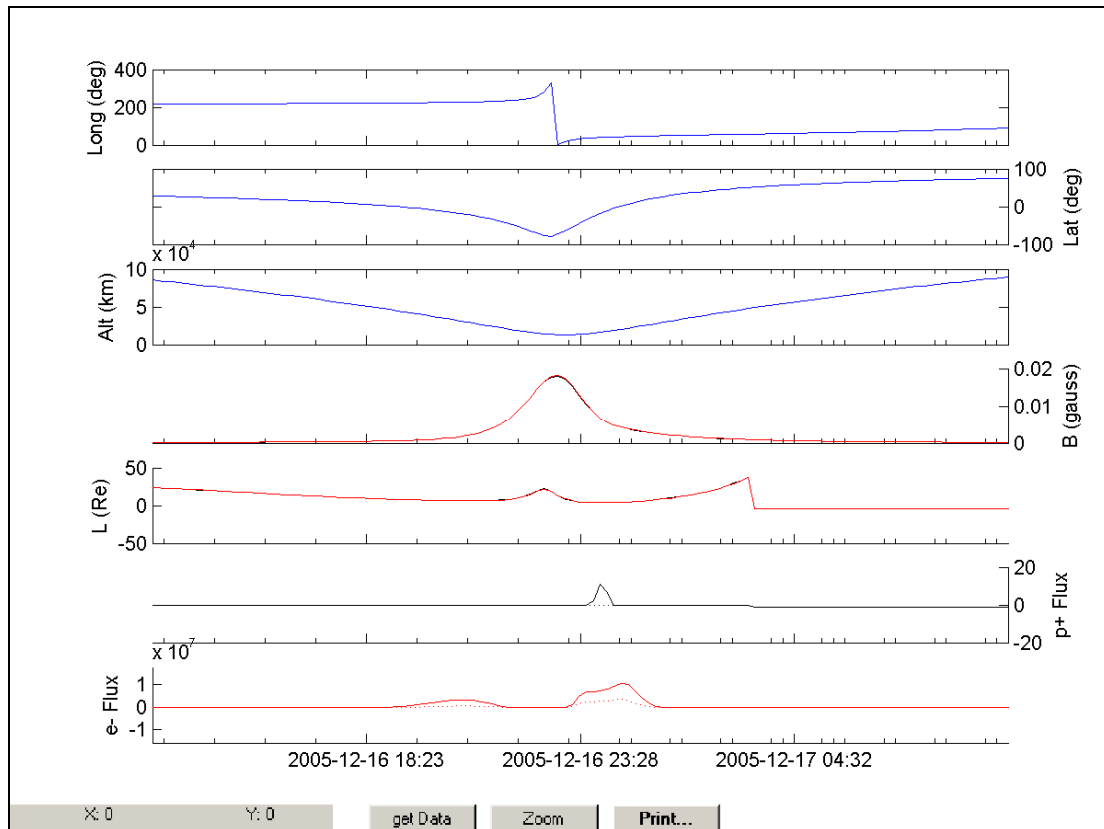
Rev 385



Rev 386



Rev 387



SEC-GOES Observed Particles Fluxes:

