

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 220
Week 49
11.12.06
Routine Phase

Prepared by: M. Walker (OPS-OFO)

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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 02.12.06 until 08.12.06 (both dates inclusive) and covers the revolutions 506 and 507.

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 entirely of a raster dither of the Galactic Plane Region 3.

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 during the observation period.

The fuel consumption over the period between 30/11/2006 and 07/12/2006 was 0.0713 Kg. The remaining propellant is in the order of 149.6229 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 has been 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

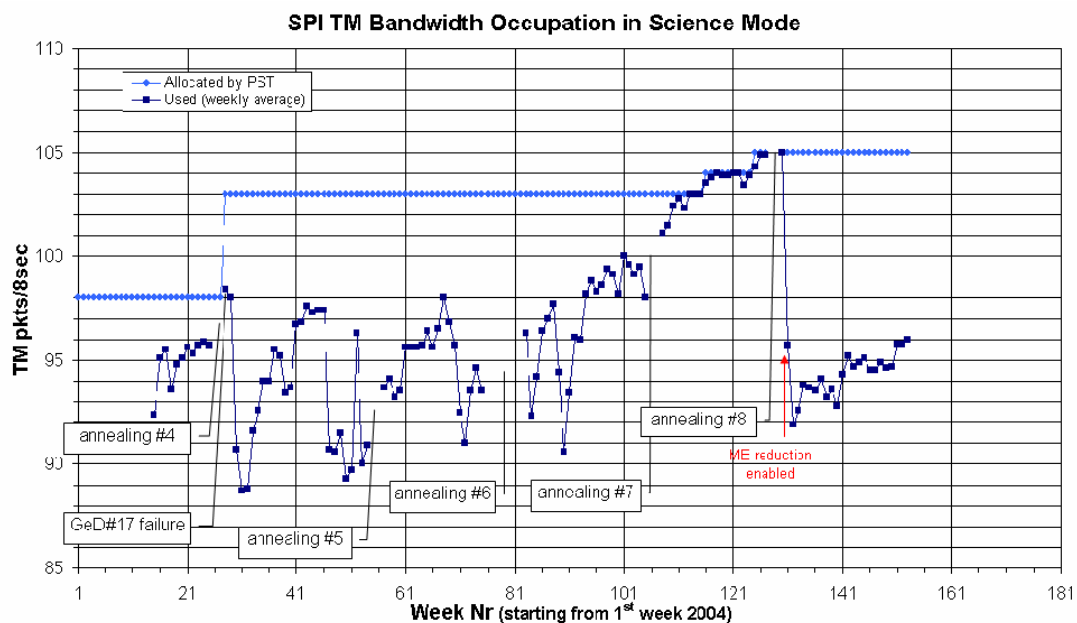
3.2.1 SPI

Following the 8th annealing, which ended on 26th June, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detectors #4 and #12 which are showing a slightly degraded energy resolution. The energy resolution of GeD#15 was recovered with the 8th annealing. Detector #2 is failed since 06.12.2003 and detector #17 since 17.07.2004.

The Stirling compressors are working nominally, maintaining the Germanium detectors at 80 +/-1K until the start of the 9th SPI annealing, on 4th December after radiation belt entry of revolution 505. This annealing is progressing nominally. The summary annealing timeline is included in the future activities section of this report. The following table reports the major events/steps performed so far (i.e. up to 8th December) since the start of the annealing:

Date/Time	Activity
04/12/2006 10:00Z	Configure SPI for start of Annealing and stop SPI active cooling
04/12/2006 11:23Z	Annealing Heater Main ON
04/12/2006 13:23Z	Annealing Heater Redundant ON
05/12/2006 23:22Z	Cold plate temperature reached 377K (104degC)

During science operations, the instrument was kept in photon-by-photon mode with spectra TM enabled and an assigned TM bandwidth of 105 packets/cycle. The average telemetry occupation when the allocation was 105 packets/cycle was 96 packets/cycle. From revolution 506 onwards, the assigned TM bandwidth was 46 packets/cycle and SPI was in CONF mode due to the annealing. The following plot shows the assigned and the average occupation of the SPI TM bandwidth.



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.

On DoY 2006.336 (02/12/2006) at 10:46Z, the IREM reset #38 occurred. Consequently IBIS went into Safe configuration. It was manually recovered by the operator and was back in Scientific Standard mode at 11:52Z.

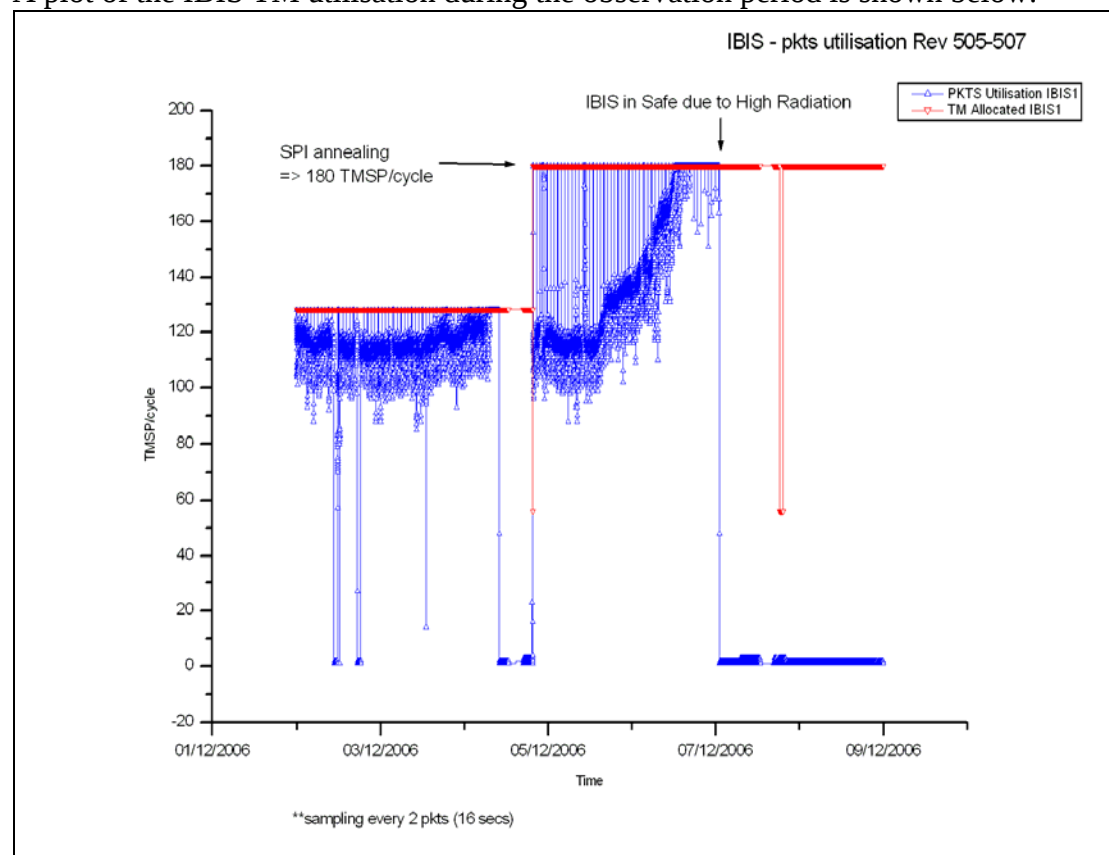
On DoY 2006.336 (02/12/2006) at 17:20Z, VETO VDM 15 reported a High Voltage Break-down. It was recovered as indicated in FDIR (action V-HV-1). IBIS was back into Scientific Standard mode at 18:25Z.

On DoY 2006.340 (06/12/2006) at 23:15Z, a MCE Time-Out was reported. Following FDIR indication, no action was performed as the unit recovered itself automatically.

On DoY 2006.341 (07/12/2006) at 01:17Z, due to High Radiation background, IBIS was forced into Safe mode. It remained in this configuration until the end of the reported period.

During the reporting period, the PST allocation to IBIS was 128 TMPS/cycle. However it was 180 TMPS/cycle from revolution 506 (started on 04/12/2006) onwards due to SPI annealing. The IBIS mean bandwidth utilisation during the observation period was 129.41 TMPS/cycle, up 14.66 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 with a TM allocation of 8 packets/cycle during science observations. JEM-X2 was dormant (DPE OFF) with no TM slots allocated.

Due to high background radiations conditions as a result of a solar flare, JEM-X1 made two autonomous transitions to Safe mode as follows:

- On 2006-12-05 at 10:29:47Z, returned to Data Taking at 13:33:16Z
- On 2006-12-06 at 18:45:15Z, remaining in Safe mode for the rest of the reporting period.

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, 91 of the 144 planned science pointings for OMC were executed nominally, 4 pointings were interrupted, 1 started late and 48 lost, mainly due to high radiation.

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.

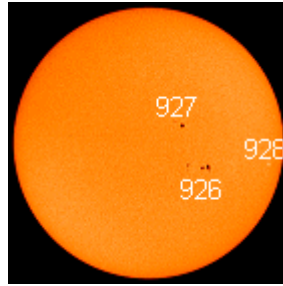
On 02/12/2006 at 10:46Z, the IREM reset #38 occurred, forcing IBIS and OMC into Safe mode. The unit was fully recovered by the operator at 13:44Z.

On 07/12/2006 at 23:49Z, the IREM reset #39 occurred. This time it had no impact on instruments as they were already in Safe configuration due to high radiation. The unit was fully recovered by the operator at 05:36Z.

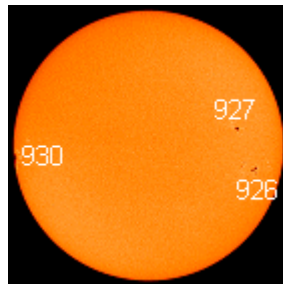
Solar Activity

The observation period was characterised by high solar activity.

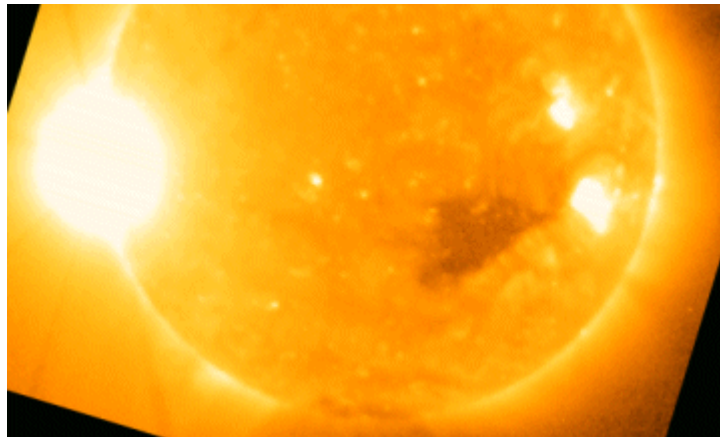
At the beginning of the observation period and up to 04/12/2006 big sunspot 926 was posing M-class threat. Two other sunspots (927 and 928) were present on the surface of the sun but posing no threat (see picture below of the sun on 03/12/2006).



On 05/12/2006 very active sunspot 930 appeared. It posed threat for X-class solar flares. The situation remained with high probability of solar flares up to the end of the observation period (see picture below of the sun on 05/12/2006).



On 05/12/2006 sunspot 930 unleashed an X9-class flare (see picture below), and on 06/12/2006 an X6 one.



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 excellent this week. No slews were lost. The overall performance was nearly 100%.

4.1 Mission Operations Centre

The performance of the MOC was excellent this week, with only one minor problem: the TC History task crashing reported. The overall performance was nearly 100%.

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. There were, however, several occasions of small TM drops from Redu, and one occurrence where the links with ISDC dropped, all without impact. The overall performance was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSF's have been received up to revolution 518. Observations have been planned up to revolution 516.

By decision of the Project Scientist, the planning for revolutions 508 and 509 was changed to different targets than originally foreseen. This caused re-planning of all revolutions from 508 to 513.

TSF's up to revolution 507 have been received.

2. Observation status

ECS have been received and processed up to revolution 497.

3. ISOC Science Data Archive

ISDA 2.6 was released on 5 December, including the INVITE visualization tool, which can be called from the light-curve data in the ISGRI catalogue.

4. ISOC system

The test of ISOC system v14.0 was held up due to a problem with the latest patch of Oracle that had not shown up in previous testing. The problem is being resolved.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 11/12/2006:

- Latest Standard Analysis completed: observation 04200870001 (Ginga 1826-24, Revolution 495) on 23/11/2006.

- Latest products archived: observation 04200240001 (PKS 0537-286, Revolution 493-494) on 24/11/2006.

- Latest observation products sent to the observer: observation 04200340009 (Gamma Ray Source 1915+105, Revolution 495) on 23/11/2006.

5 Special Events

6 Anomalies

The following problems that impacted operations were reported:

- On DoY 336, at 10:46, an IREM SEU (#38), knocked IBIS & OMC to safe mode. OMC was recovered to standby at 11:19, and at 11:21, after the imaging commands were manually sent, returned to Normal. IBIS was back in Science standby at 11:52. The impact was the interruption of pointing 05050015 and a late start in pointing 05050016.
- On DoY 341, at 23:49, another IREM SEU (#39) occurred. This had no impact, as IBIS & OMC were in SAFE mode anyway due to the high radiation levels. IREM was recovered at 05:37.

The following anomaly reports were entered into the ARTS system this week:

AR id	Date Created	Subject	Segment	Status
INT_SC-165	04/12/2006	IREM Anomaly: Reset of IREM_CSCI S/W #38, 02/12/2006	Payload	Open
INT_SC-166	04/12/2006	IBIS: VETO VDM 15 High Voltage break down	Payload	Open
INT_SC-167	08/12/2006	IREM Anomaly: Reset of IREM_CSCI S/W #39, 07/12/2006	Payload	Open

7 Future Milestones

The 9th SPI annealing started on 4th December at belts entry of rev. 505. Below is the summary timeline of the planned annealing activities:

9th SPI ANNEALING - revs 505-512					
ID	Task Name	Duration	Start	Resource Names	Timeline
2	Start SPI Annealing - Warm-up Phase	38.1 hrs	04 Dec 10:00	PST[20 pkts]	04 Dec 10:00 - 06 Dec 00:06
16	Annealing at 104degC	205 hrs	06 Dec 00:06	PST[20 pkts]	06 Dec 00:06 - 14 Dec 13:06
28	Stop SPI Annealing - Passive Cooling Phase	63.02 hrs	14 Dec 13:06	PST[20 pkts]	14 Dec 13:06 - 18 Dec 06:00
32	ACS Switch-on and Calibration	40.4 hrs	14 Dec 13:06	PST[20 pkts]	14 Dec 13:06 - 18 Dec 06:00
44	Start Cryocoolers - Active Cooling Phase	131 hrs	17 Dec 04:07	PST[20 pkts]	17 Dec 04:07 - 21 Dec 09:07
57	Camera Switch on & Performance Tests	22.5 hrs?	21 Dec 09:07	PST[105 pkts]	21 Dec 09:07 - 22 Dec 15:07
78	Active Cooling Fine Tuning	72 hrs	22 Dec 15:07		22 Dec 15:07 - 22 Dec 19:45
80	Resume SPI POS Observations	62 hrs	22 Dec 19:45	PST[105 pkts]	22 Dec 19:45 - 23 Dec 00:00

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 506

The observations in revolution 506 consisted entirely of a raster dither of the Galactic Plane Region 3, lasting ~58.9 hours.

Revolution 507

The observations in revolution 507 consisted entirely of a raster dither of the Galactic Plane Region 3, lasting ~58.9 hours.

Throughout these observations all instruments were in their nominal science modes, except JEM-X2, which was switched off, and SPI, which was undergoing annealing. The TM allocation was: IBIS 180; SPI 46; JEM-X1 15; JEM-X2 0; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2006-11-16T19:51:29.000Z	149.8508	F	Automatic TM processing.
2006-11-18T05:06:13.000Z	149.8073	F	Automatic TM processing.
2006-11-19T18:37:53.000Z	149.8039	F	Automatic TM processing.
2006-11-21T04:25:00.000Z	149.7865	F	Automatic TM processing.
2006-11-22T18:26:32.000Z	149.7801	F	Automatic TM processing.
2006-11-24T04:50:12.000Z	149.7545	F	Automatic TM processing.
2006-11-25T18:12:56.000Z	149.7504	F	Automatic TM processing.
2006-11-27T03:56:51.000Z	149.7281	F	Automatic TM processing.
2006-11-28T18:02:55.000Z	149.7250	F	Automatic TM processing.
2006-11-29T04:29:12.000Z	149.6942	F	Automatic TM processing.
2006-12-01T17:52:00.000Z	149.6890	F	Automatic TM processing.
2006-12-03T03:34:51.000Z	149.6679	F	Automatic TM processing.
2006-12-04T17:38:39.000Z	149.6562	F	Automatic TM processing.
2006-12-06T03:21:39.000Z	149.6335	F	Automatic TM processing.
2006-12-07T17:32:31.000Z	149.6229	F	Automatic TM processing.

This report was generated Fri Dec 8 08:00:32 GMT 2006

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, 02/12/2006 – 08/12/2006

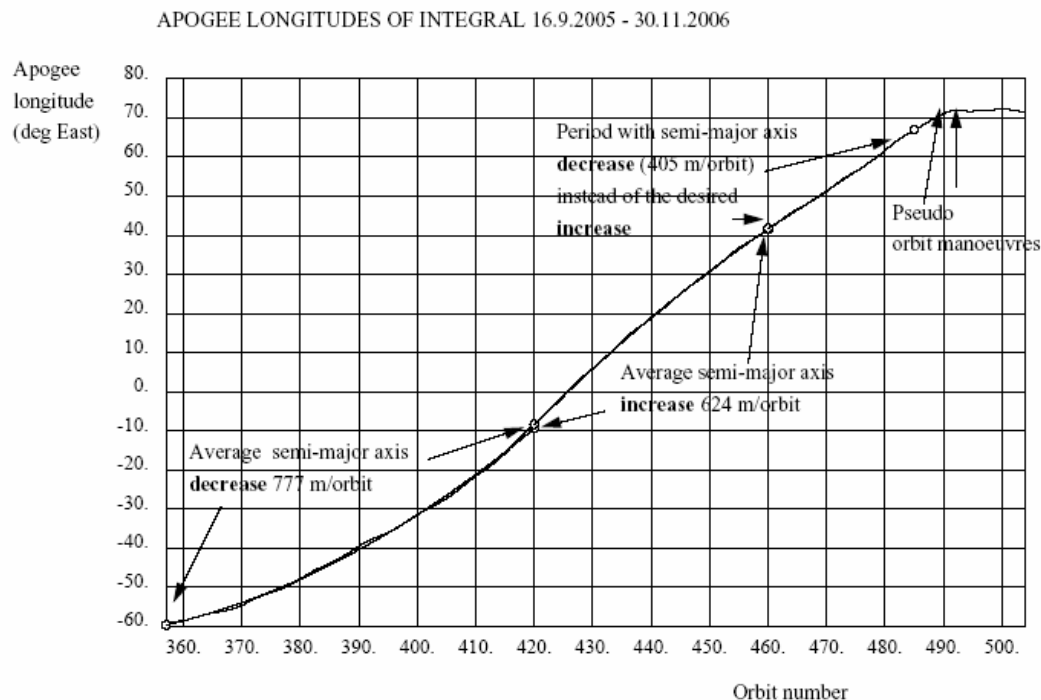
AOCS operations were executed from the Automatic Timeline.

During this period, 44 Open Loop Slews, 102 Closed Loop Slews and 4 Momentum Biases were executed.

No slews were missed from the TL during the observation period. Due to loss of guide star the OTF was not reached during PID 05060003.

Orbit Control

The attached plot shows the apogee longitude of Integral (in deg East) as a function of the orbit number for the period September 2005 - October 2006.



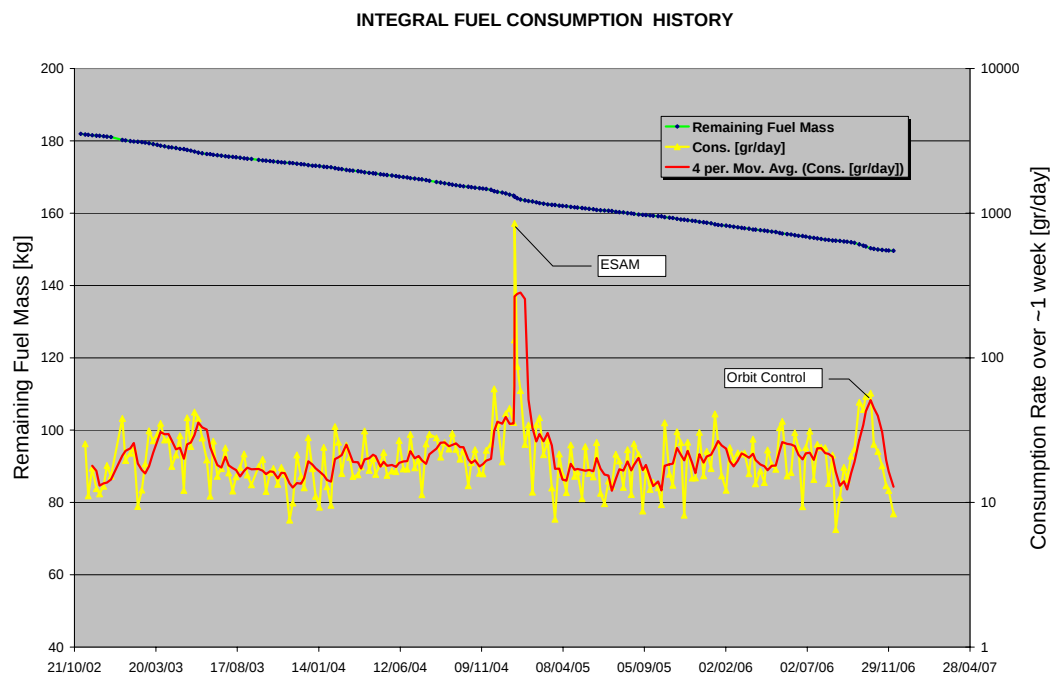
From September 2005 to March 2006 the momentum dumping manoeuvres were systematically executed in attitudes/at epochs to lower the orbit in order to initiate an eastward drift. The average semi-major axis decrease in this period was 777 m/orbit.

From March 2006 and onwards the momentum dumping manoeuvres should have been systematically executed in attitudes/at epochs to raise the orbit in order to decrease the eastward drift. Up to July this was successful, the average semi-major axis increase in this period was 624 m/orbit. After July this was no more the case, the average effect of the momentum dumping was an orbit lowering with on the average 404 m/orbit instead of the desired raising. Because of this, several "pseudo orbit manoeuvres" were executed in October 2006. These "pseudo orbit manoeuvres" were momentum dumping manoeuvres artificially made large, by aiming for large reaction wheel rate changes rather than small ones, when in attitudes/epochs for which corresponding orbital effects were advantageous for the orbit control.

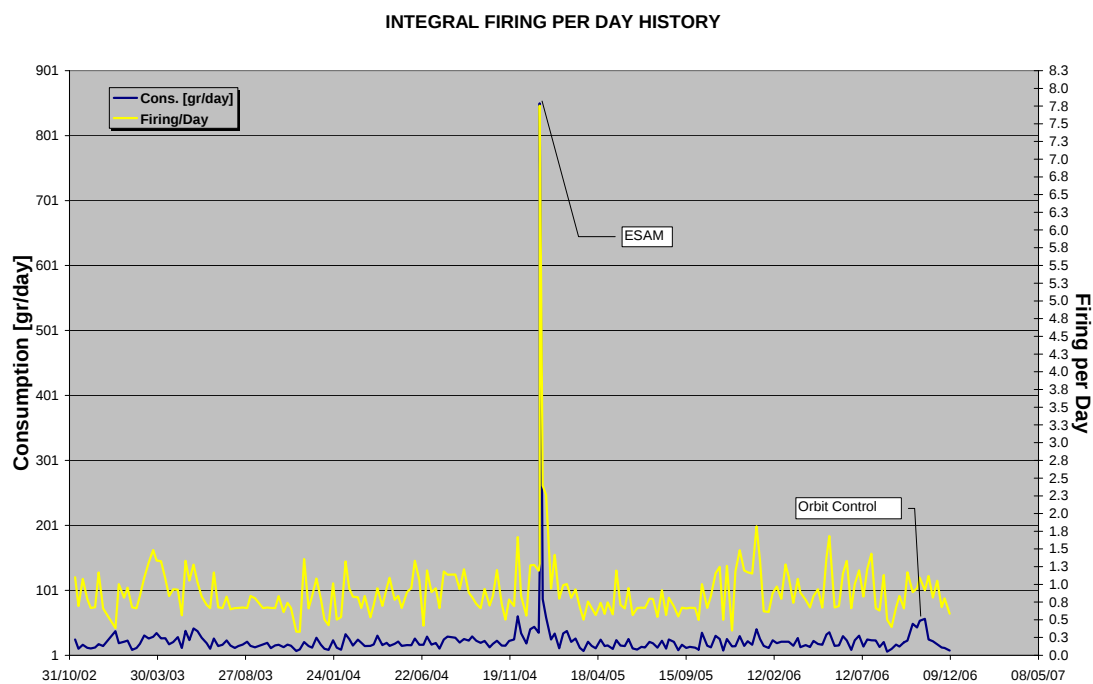
Fuel consumption

The fuel consumption (total, grams/day) over the period between 01/11/2002 and 07/12/2006 is reported in the plot below.

The large fuel consumption observed in the last months was due to the combination of the strategy to perform artificial large momentum dump manoeuvres when the pointing is suitable for orbit control and the starting of the eclipse season.

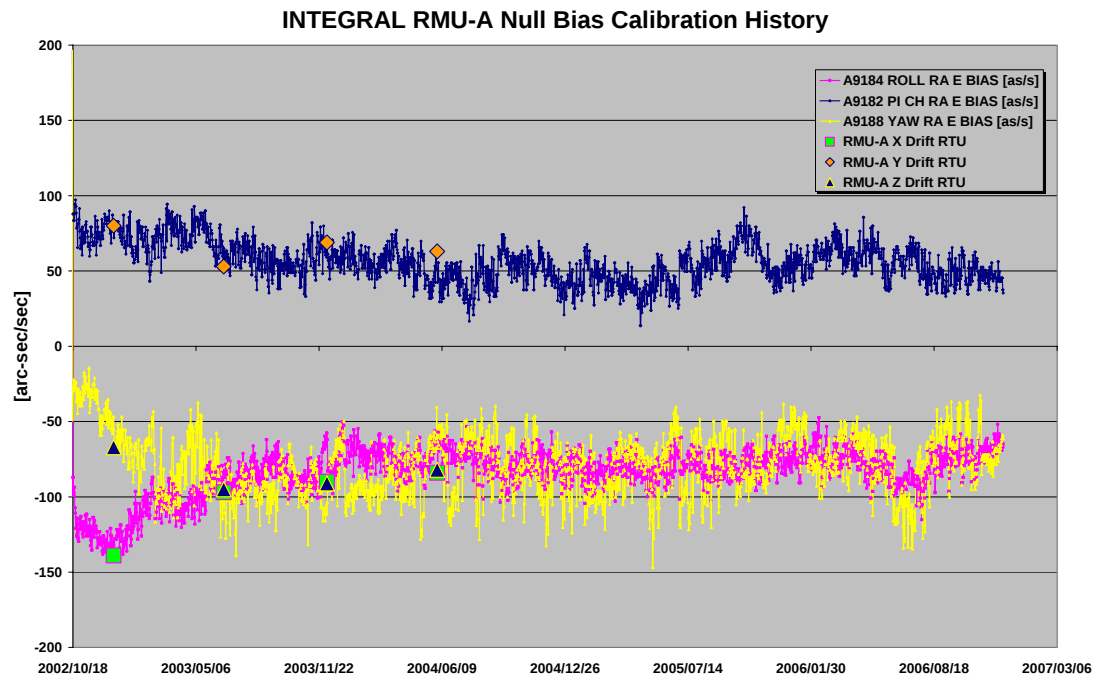


The firing\day over the period between 01/11/2002 and 07/12/2006 is reported in the plot below.

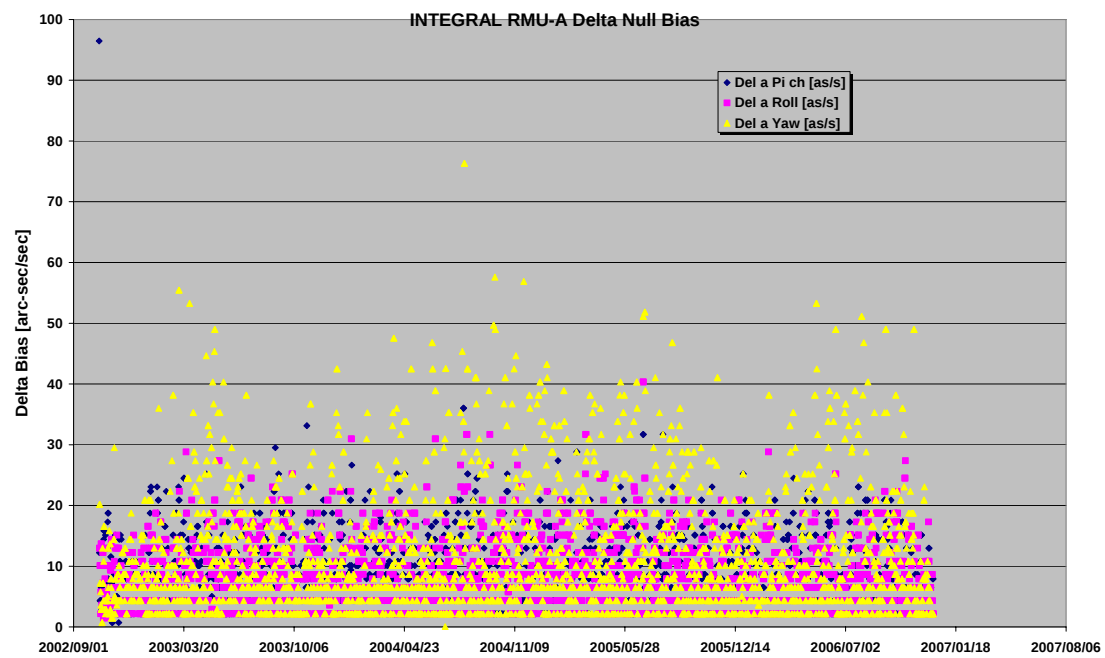


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 08/12/2006 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 08/12/2006 is reported in the plot below



02/12/06 (Day of Year 336, Revolution 505)

Nothing to report.

03/12/06 (Day of Year 337, Revolution 505)

Nothing to report.

04/12/06 (Day of Year 338, Revolution 505-506)

STR lost of guide star: at 22:22z, due to lost of the guide star, the IMU was switched ON by the ACC.

The guide star at moment of the false event was Mi 7.7 at CCD location [14192, 22062] quite close to the limit of the STR FOV. A new guide star, Mi 8.45 at CCD location [5571, -5020], was picked after the mapping commanded by the ACC autonomously.

No impact on TL except that the OTF was not reached during PID 05060003.

05/12/06 (Day of Year 339, Revolution 506)

Nothing to report.

06/12/06 (Day of Year 340, Revolution 506)

Nothing to report.

07/12/06 (Day of Year 341, Revolution 506-507)

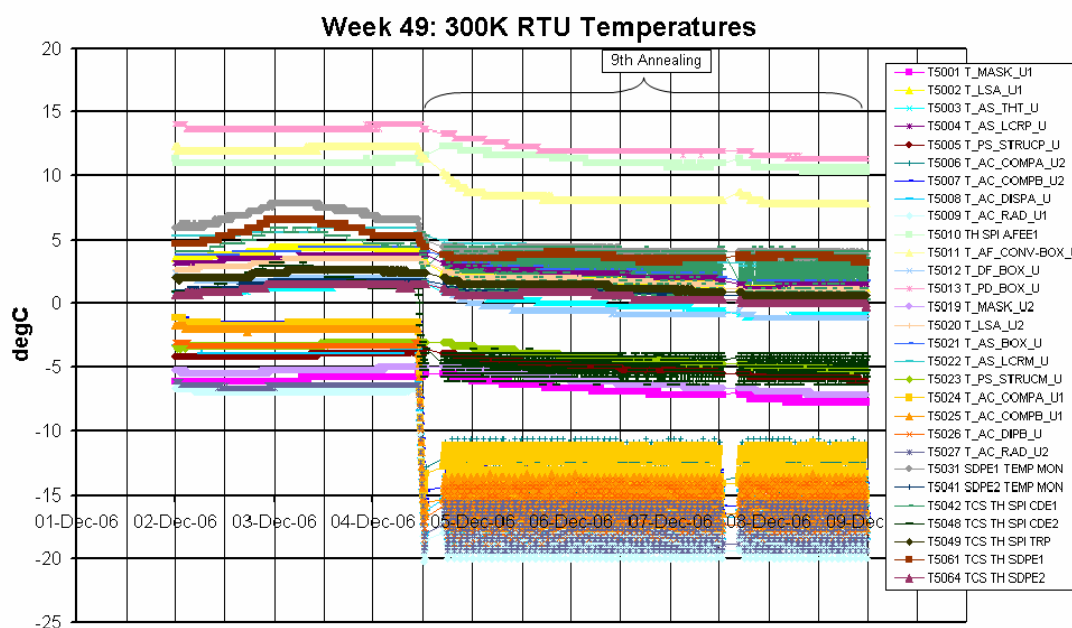
Nothing to report.

08/12/06 (Day of Year 342, Revolution 507)

Nothing to report.

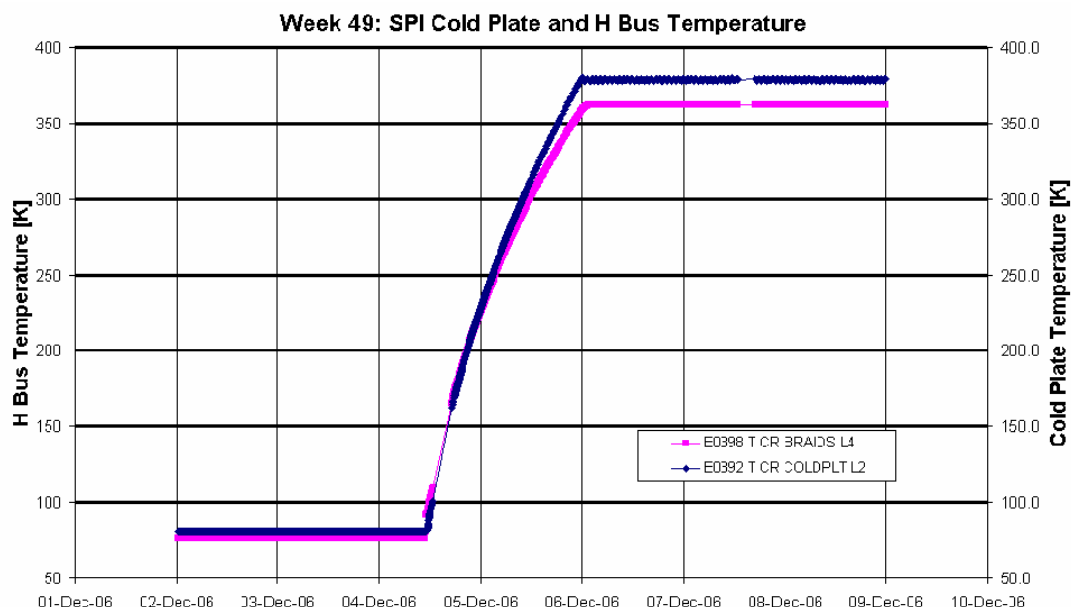
8.3.2 SPI Operations

Unit Temperatures: All the equipment temperatures are inside the operational limits. The following plot shows their evolution during the reporting period:



Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range to 80K $\pm$ 1K, until the start of the 9th annealing on the 4th December. The cold plate temperature reached 104degC on 05/12/2006 at 23:21Z.

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

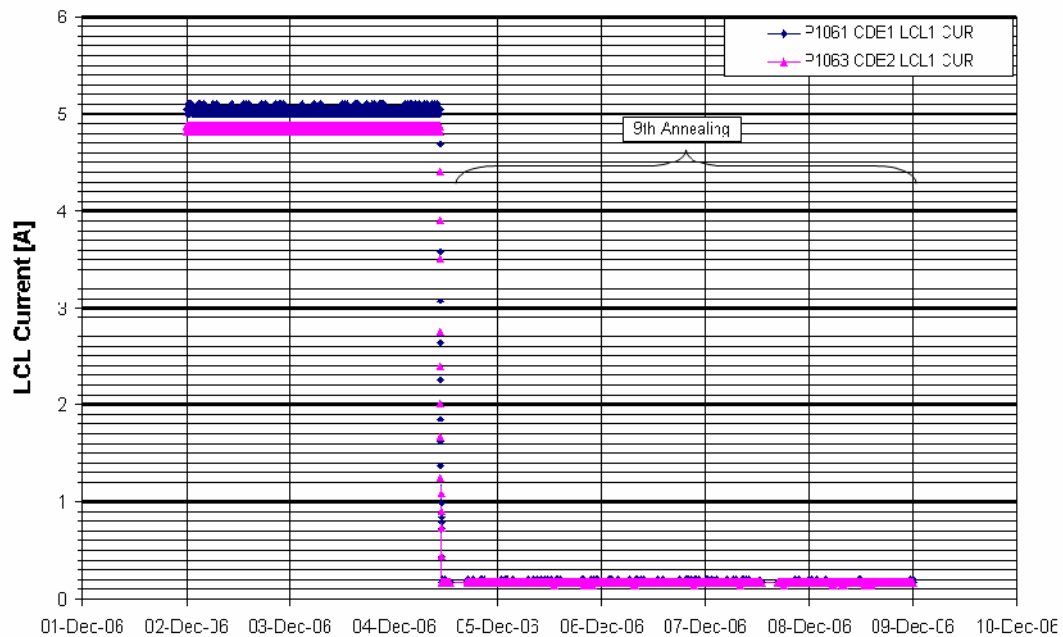


Before the start of annealing operations, the stroke of all four compressors was set to 41 and the average LCL currents of the CDEs were:

- Average CDE1 LCL Current = 5.03A
- Average CDE2 LCL Current = 4.84A

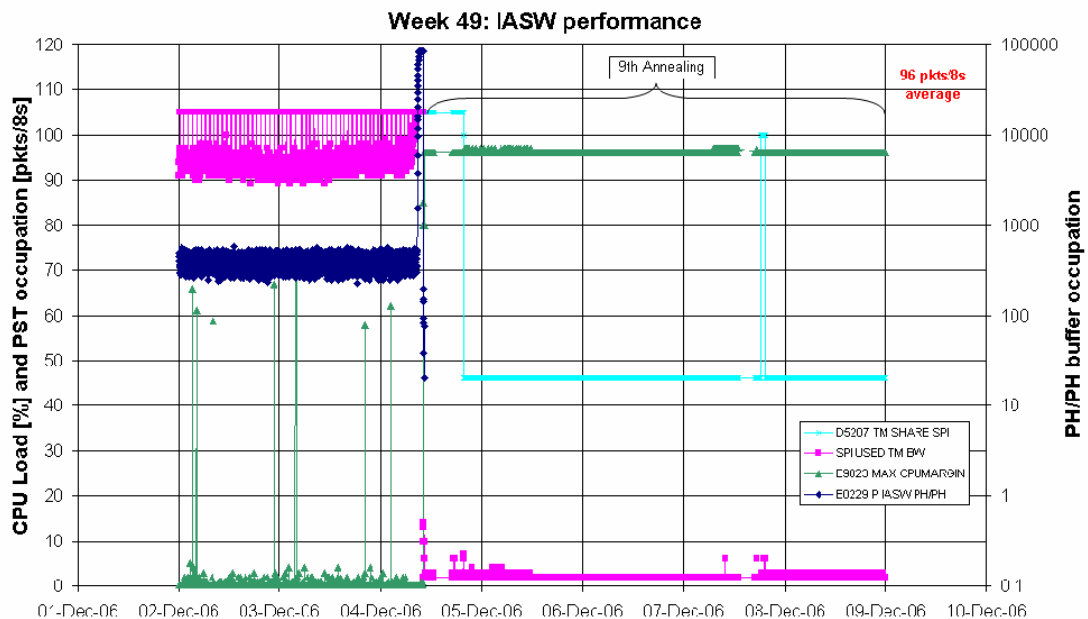
The following plot shows the evolution of the CDE currents during the reporting period.

Week 49: SPI CDE1 and CDE2 LCL Currents



DPE & IASW: The DPE health and IASW performance is nominal. The current IASW version installed is 432. The average TM bandwidth occupation of SPI was 96 packets/cycle over the science window, when the TM allocation was 105 packets/cycle. From revolution 506 onwards, the TM allocation was 46 packets/cycle and the IASW was in CONF mode due to the ongoing annealing.

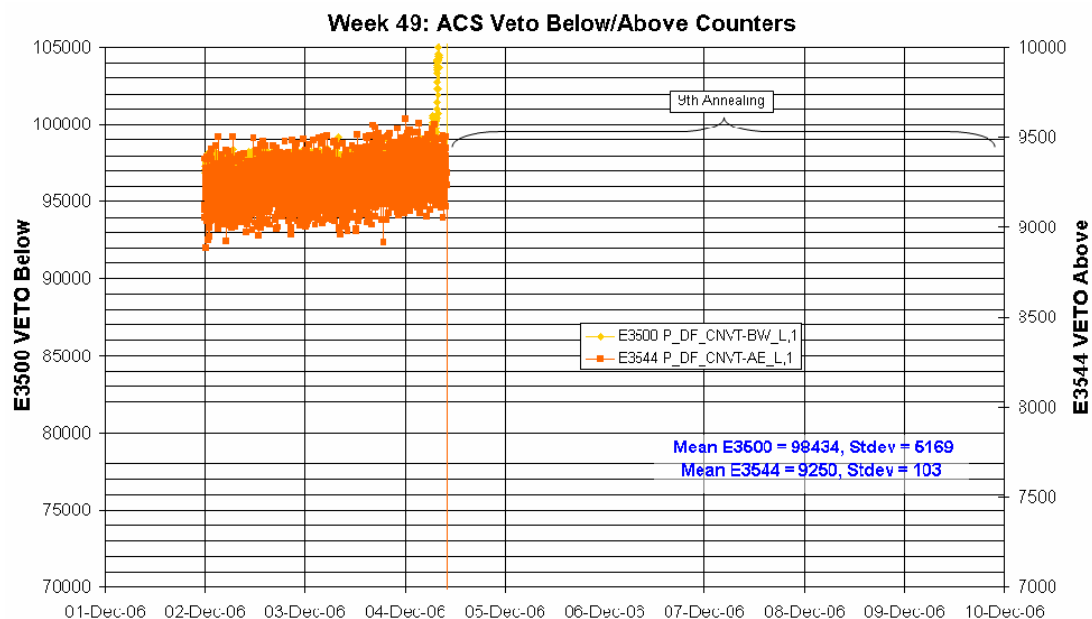
The following plot shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



ACS: The performance of the ACS is nominal. except for FEE 81 which remains switched off since the anomaly on 29/10/2006 (INT_SC-162). FEE #57 is also still OFF due to the anomaly on 5/8/2003 (INT_SC-61).

For the 9th annealing operations, started on 4th December, the ACS HVPSs have been set to the minimum voltage (~980V) and the ACS is in CONF mode.

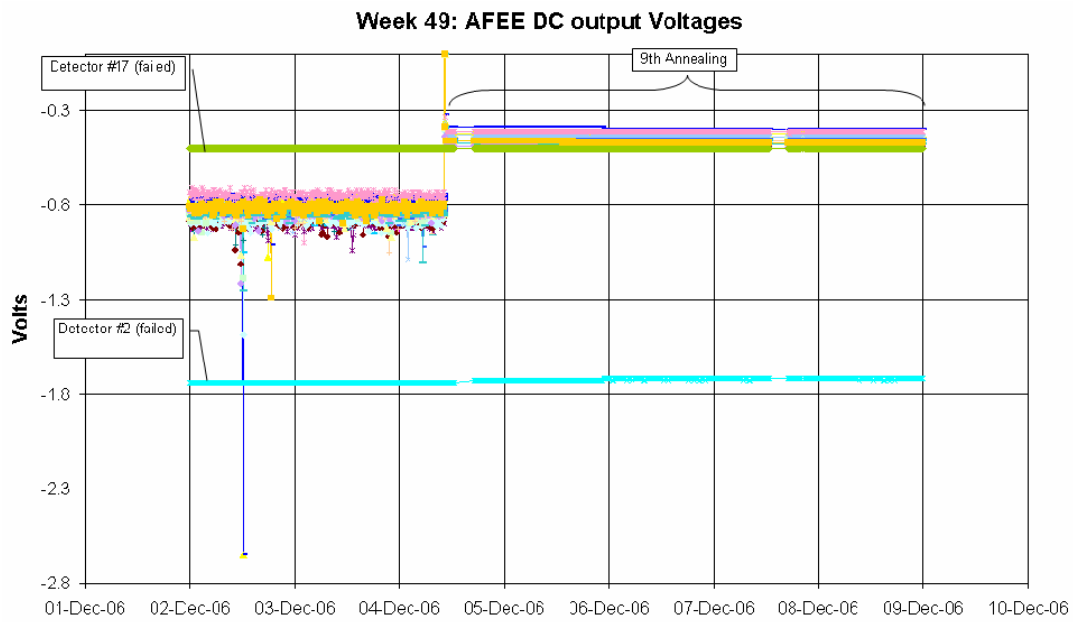
The following plot shows the ACS overall count rate evolution during the reporting period:



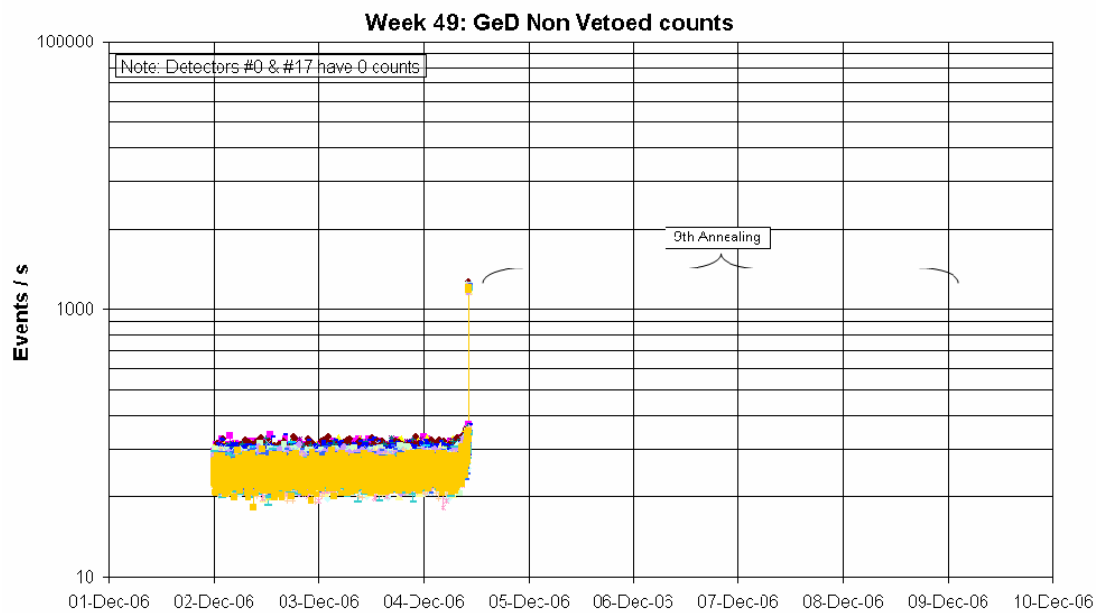
AFEE: The health of the AFEE is nominal. The performance of the AFEE and the detectors up to the start of the 9th annealing was nominal, except for the Ge detectors #4 and #12 which were showing a slightly degraded energy resolution. The energy resolution of GeD#15 had been recovered with the 8th annealing.

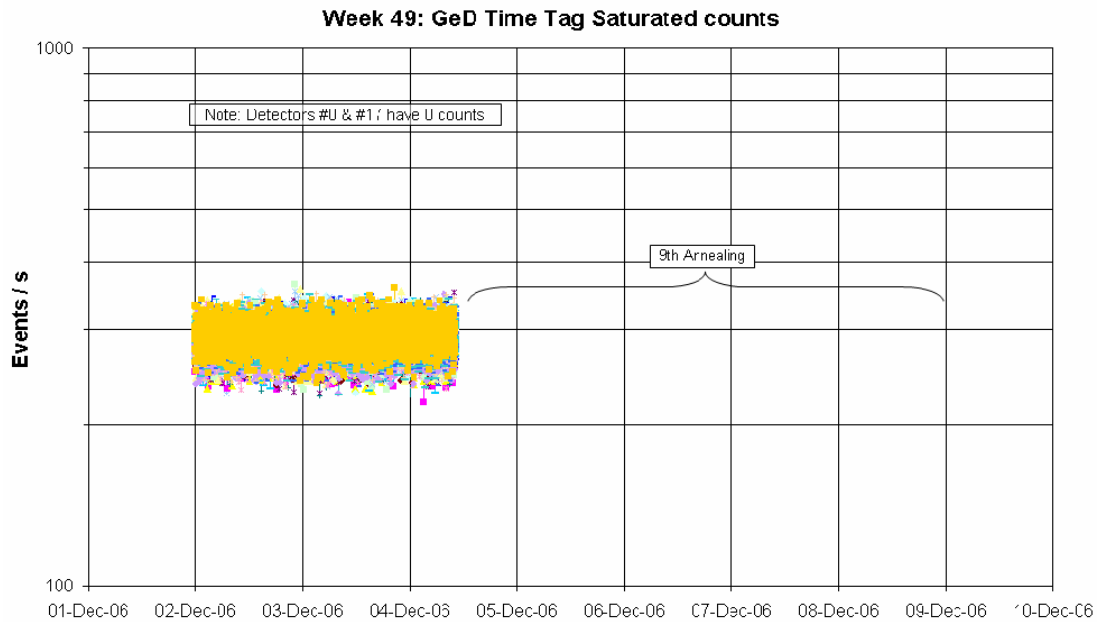
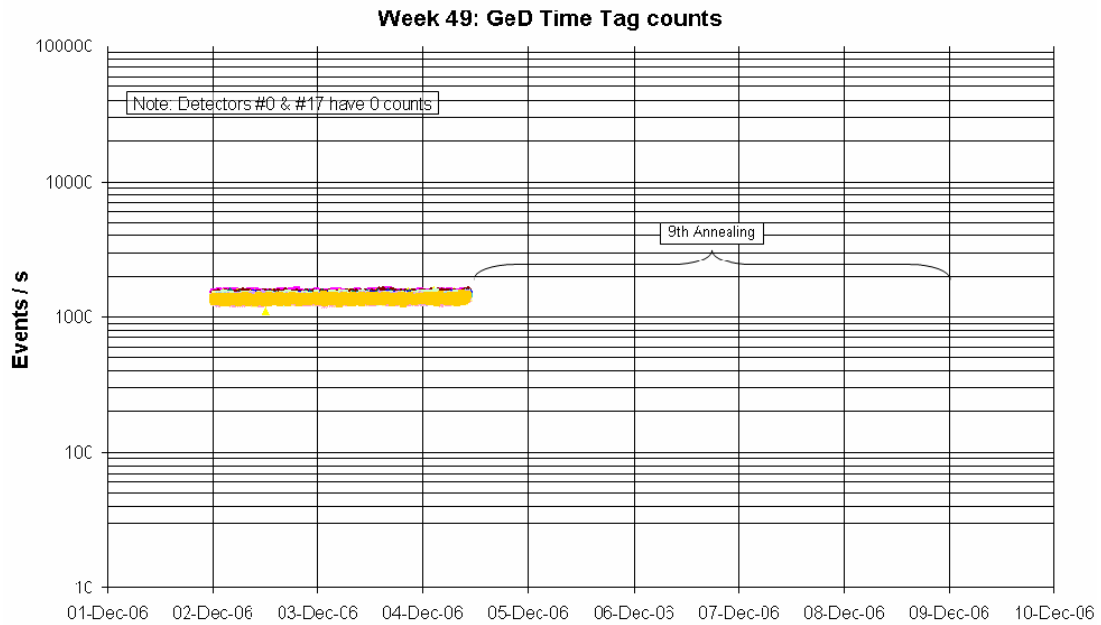
For the 9th annealing operations, started on 4th December, all detector HVPSs were switched off and only the LVPSs are left on.

The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06.12.2003 and detector #17 is failed since 17.07.2004



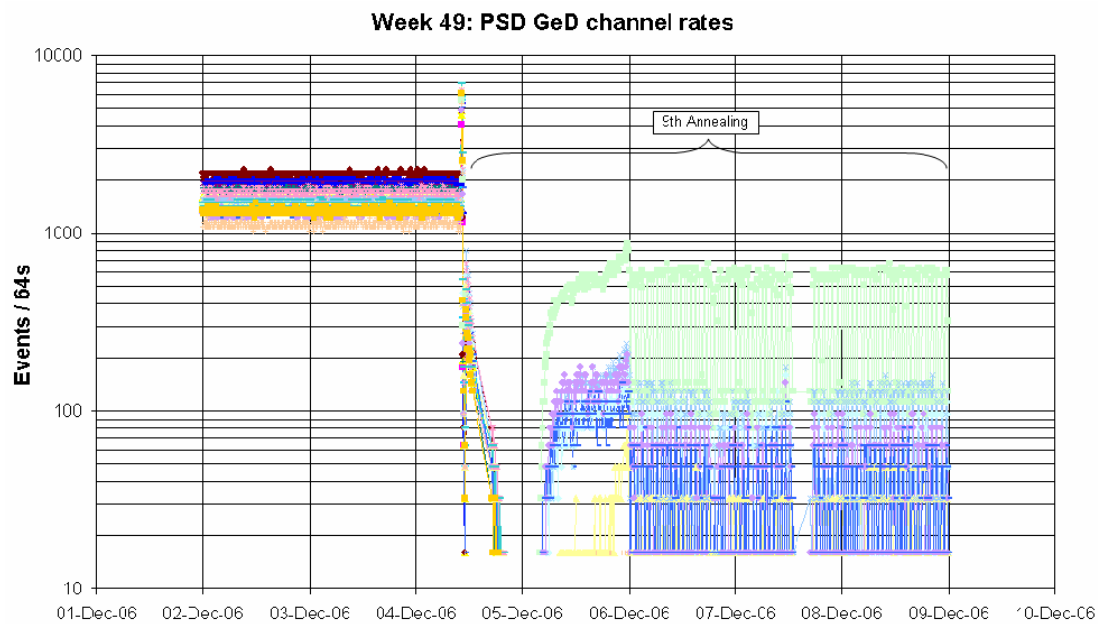
DFEE: The performance of the unit is nominal. For the 9th annealing operations, started on 4th December, the DFEE was in CONF mode. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event Count Rates during the reporting period.





PSD: The health of the unit is nominal. For the 9th annealing operations, started on 4th December, the PSD is in CONF mode.

The following plot shows the PSD channel rates during the reporting period. Note that the scale used is larger than usual.



Event Log:

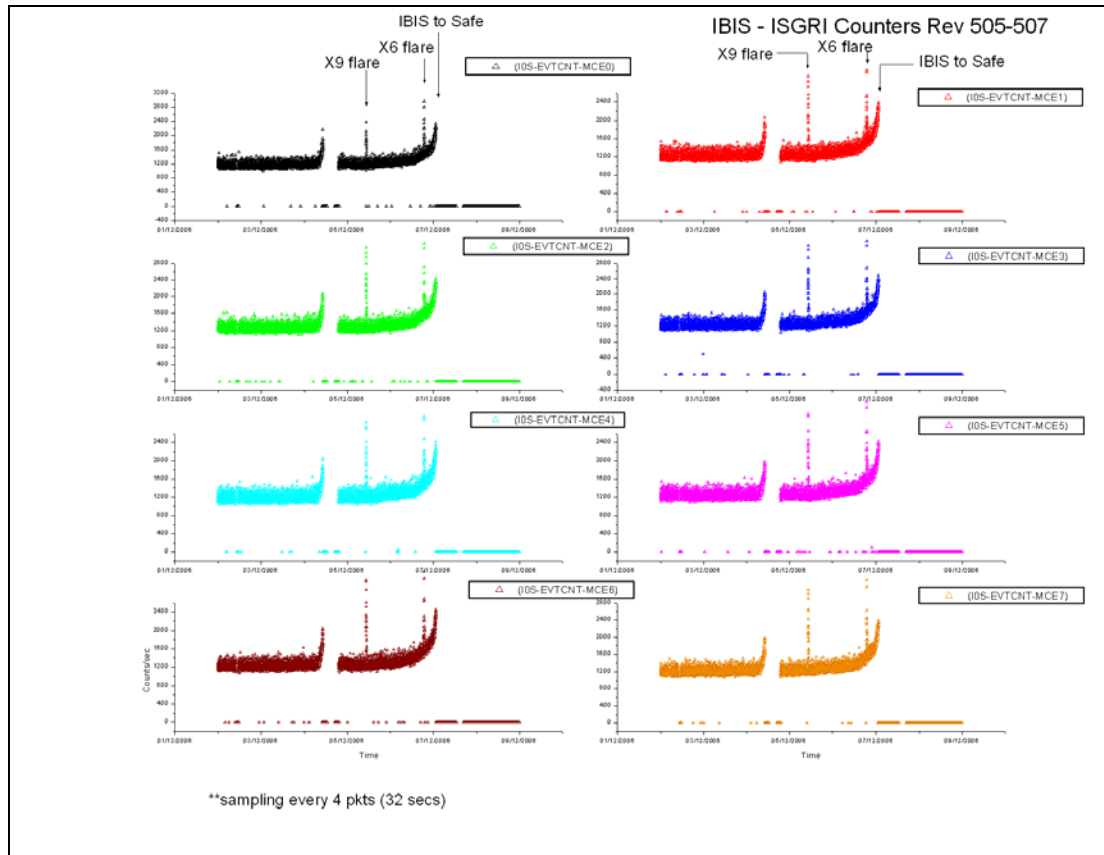
The following non-nominal events occurred on SPI during the reporting period:

- On 2006-12-02 at 11:04:51Z the TM parameter E1296 S AS IBS ST L went OOL (value = 1 [ERROR]), indicating an ISB response parity error on the Low Speed Line. This was during pointing ID 05050015. This parameter returned within limits when the next packet was received at 11:04:59Z.
- On 2006-12-02 at 12:08:25Z the TM parameters E0356 U AF DCOUTPT L6 and E0351 U AF DCOUTPT L1 went OOL Low (value = -2.652V). These are the DC output voltages for detectors #1 and #6. They returned within limits when the next packet was received at 12:19:05Z.
- On 2006-12-04 at 08:06:56Z the TM parameter E3500 P_DF_CNVT-BW_L starting going OOL High. This was ~2 hours before radiation belt entry of revolution 505. No action was taken.
- On 2006-12-05 at 08:13:45Z the TM parameter E3220 went OOL (value = PARAM > SPEC). This is the temperature status for the ACS FEE #56. It returned within limits when the next packet was received at 08:24:25Z.
- On 2006-12-07 at 12:42:39Z OEM APID 1024 ID 1 EXCEPTION SPI1 FIXED POINT OVERFLOW was received. This was during the LOS_CHK window of revolution 506, when the SPI1 DPE time verification TC was sent. This OEM is sometimes received when this TC is sent and no action was taken.
- TM parameter E2116 T AS PSAC L2 (Plastic Scintillator temperature) went OOL Low several times during the week. No action was taken as this is a known and recurring problem due to this thermistor being unreliable. The limit conditions for this parameter were updated in the IODB release propagated to the control system on 2006-12-07 (perigee passage of revolution 506-507), however since then the parameter has continued to go OOL Low occasionally as the value continues to decrease. Therefore new limits will be implemented in the next IODB release.

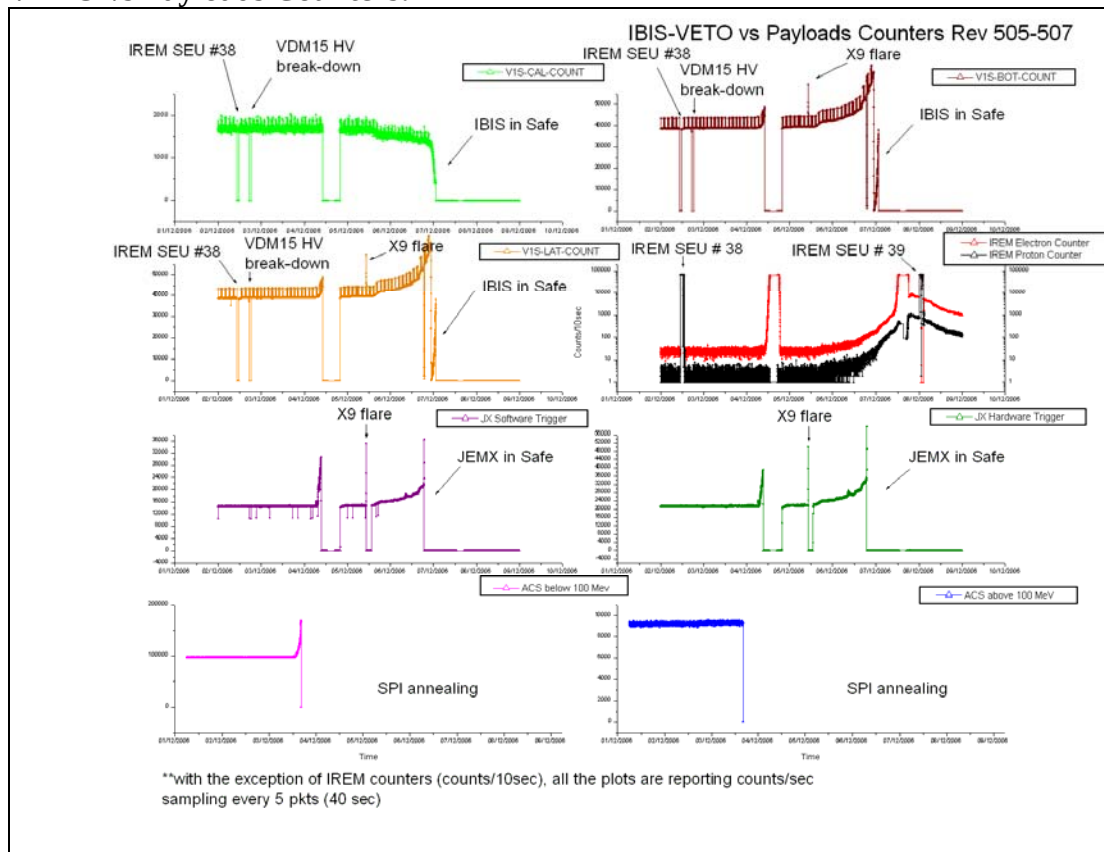
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

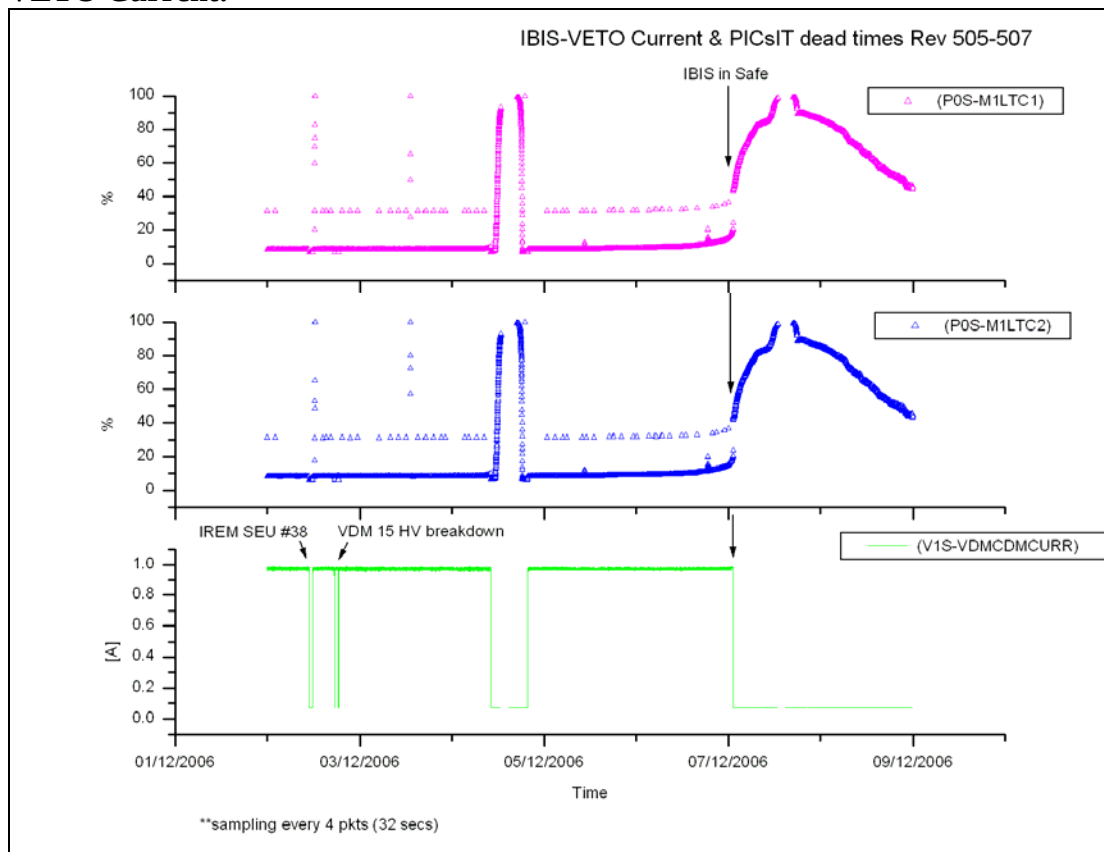


VETO vs Payloads Counters:

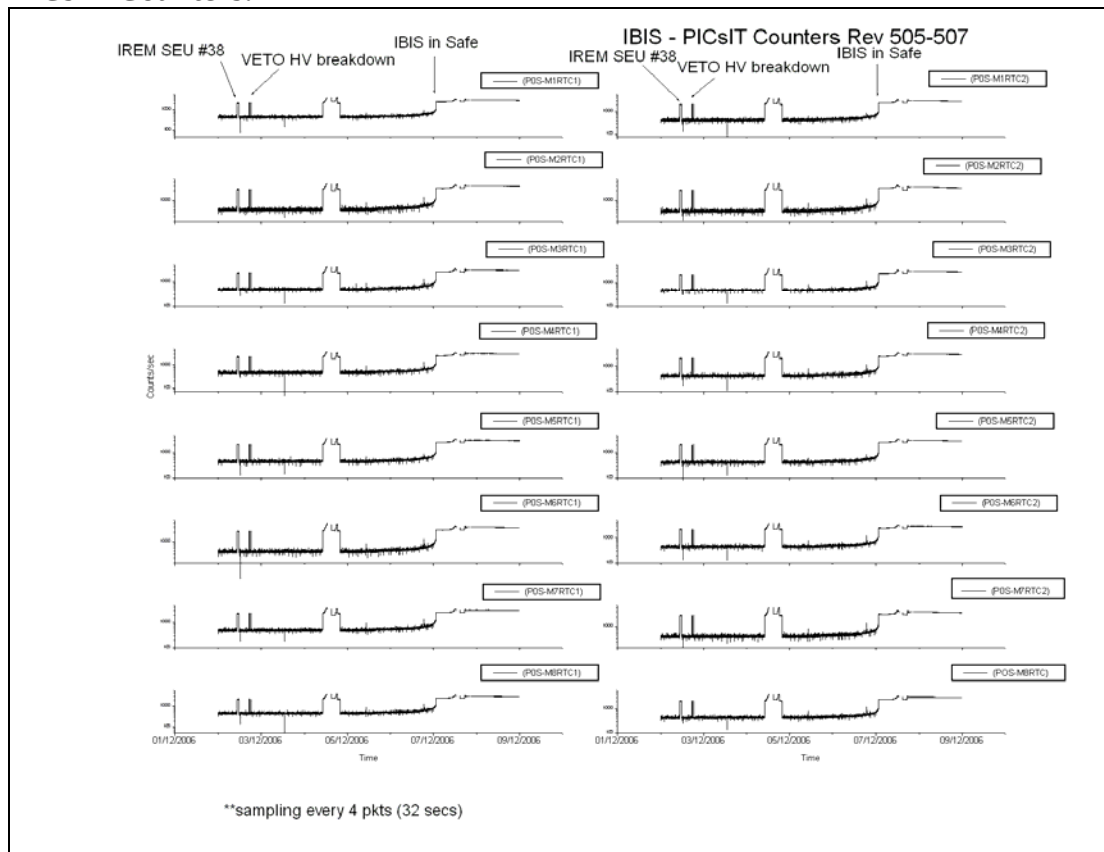


The week was characterised by high radiation.

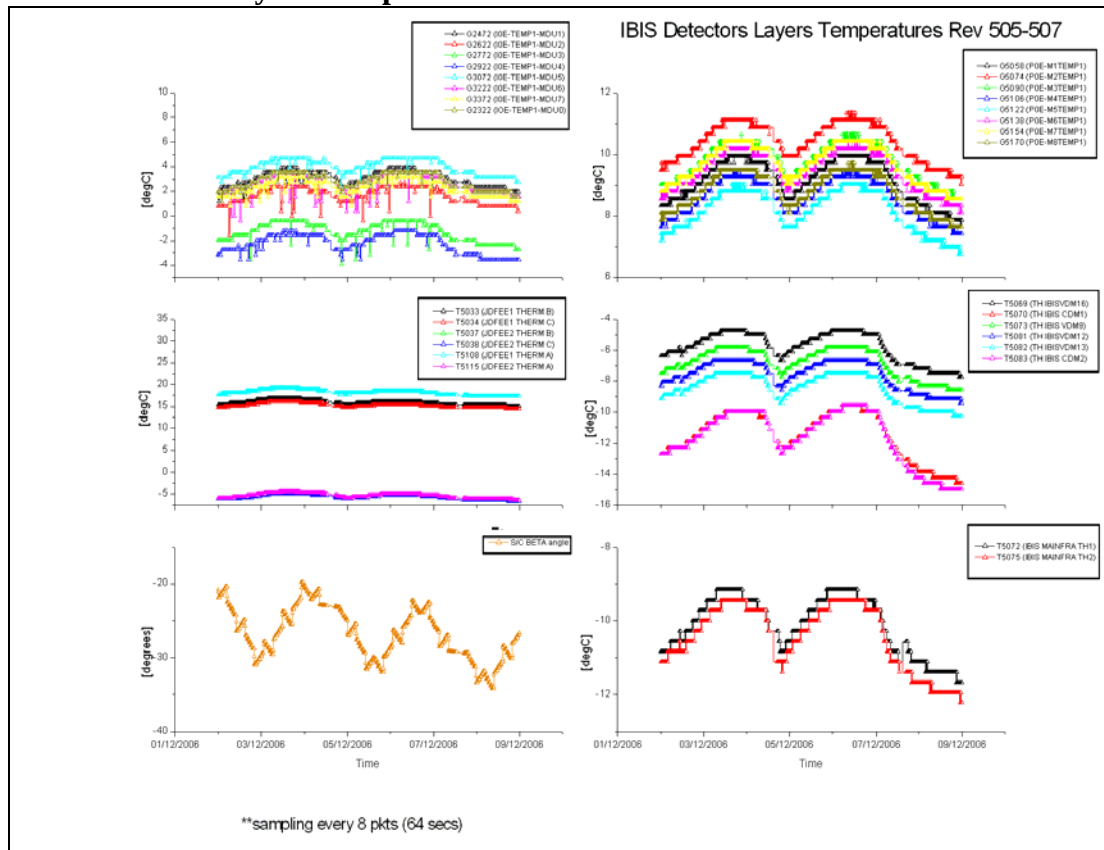
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report

The usual Out Of Limits on TM parameter G8015 (S1E-A2_PMT_V), families G5002 (P0S-Mi_RTC1) and G5003 (P0S-Mi_RTC2), families G2014 (I0E-OVFWPXADD-Mi) were reported at Radiation Belts passage.

DoY 2006.336 (02/12/20006): IREM SEU #38 (INT_SC-165)

At 10:46Z, the IREM reset # 38 occurred and forced IBIS in Safe configuration. The instrument was recovered by the operator following the guidelines (FCP_IBIS1_0803 and ED GESTAN02). IBIS was back in Scientific Standard mode at 11:52Z.

DoY 2006.336 (02/12/20006): VETO VDM15 HV break-down (INT_SC-166)

At 17:20Z, the following OEM (class 2, ID 186) was reported:

<<IBIS1 VETO PMTXX IS ON AND CORRESPONDING HV MONITORING IS ABOUT ZERO>>;

at the same time, TM parameter G6049 (V1S-VDM15HV) was reported Out Of Limit Low-Low with a value of ~0 (-55.8V).

During the anomaly, the currents dropped down due to the HV break-down of VDM #15, as well as the count-rates (due to missing contribution of module #15):

G6012 (VETO current)= 1.58 A
G6013 (VETO VDM/CDM current)= 0.93 A
G6062 (VETO BOT counter)= 38080 /s
G6063 (VETO LAT counter)= 38072 /s
G6050 (VETO VDM10 HV)= -55.8 V

No special radiation was reported at the time of the anomaly, according to the SEIS tool.

The anomaly was recovered by the operator following the recovery action V-HV-1:

- 1- Set IBIS-IASW in Stand-By
- 2- Set IBIS-VETO in Stand-By
- 3- Set IBIS-VETO in Maintenance and monitor for ~45mins
- 4- Set IBIS-VETO in Stand-By
- 5- Set IBIS-VETO in Nominal
- 6- Set IBIS-IASW in Science Standard.

At 18:25Z IBIS was back in Science Standard and VETO in Nominal.

DoY 2006.340 (06/12/20006): MCE3 Time-Out

At 23:15Z, 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".

These 2 OEMs were followed after few seconds by OEM APID1280 ID 222 CLASS 3:

"IBIS1 MCE3 TIME OUT",

the numbering system in the OEM goes from 0 to 7, this OEM indeed concerns HW MCE4.

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 ISGRI MCE3.

Summarising, IBIS incurred a timing problem on the Low Speed Line that affected the communication with the peripheral. During this time, a request for HK1 was sent to the MCE3 without any answer due to a black out in communication between the peripheral and the DPE. The IASW flagged the non-generation of HK1 from MCE3 as an on-board rejection (time-out) of the internal TC indicated in the OEM body. During this time no valid HK was collected from MCE3 therefore, what was reported in the HK1 was simply the IASW default (i.e all 0000...). This is confirmed by the reading of some TM parameters as the bias, operating mode and MDU temperatures all reporting the raw value 0. The unit solved autonomously the internal conflict on the LSL and reported the valid HK1 for MCE3 in the next cycle. No further action was requested as per recovery action I-REJ-1.

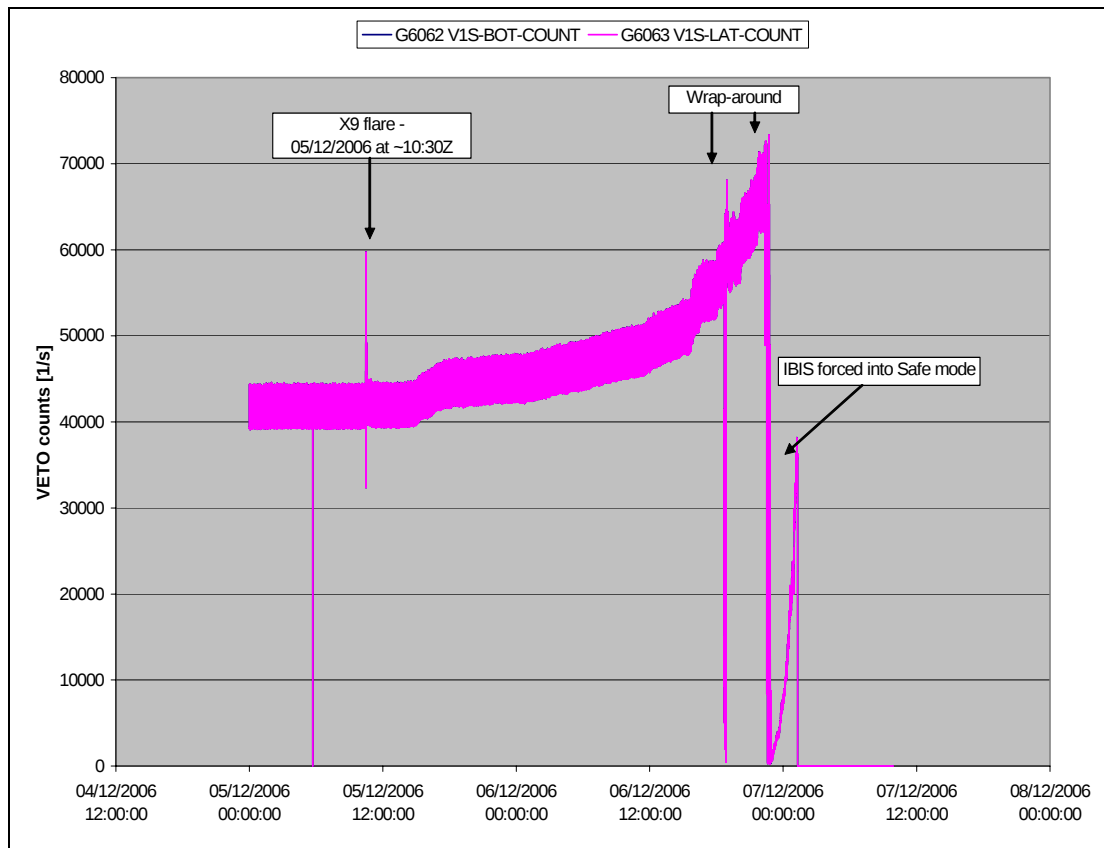
DoY 2006.341 (07/12/2006): High Radiation

At 01:17Z IBIS was forced in Safe configuration due to high radiation (X9 solar flare unleashed on 05/12/2006).

In fact IBIS VETO counts had been reported toggling Out Of Limit High since 06/12/2006 07:39Z (see plot below). On 07/12/2006 at 01:09Z TM family G2013 (ISGRI counts) was reported OOL High as well. At the same time, the IREM counts were below the thresholds (U9919 = 46 (threshold = 200) and U9921 = 255 (threshold = 384)).

As the radiation environment was high and, according to the SEIS tool, tends to increase even further, it was decided to put IBIS into a Safe configuration following FCP_IBIS1_0801.

IBIS remained in Safe mode until the end of the reported period.

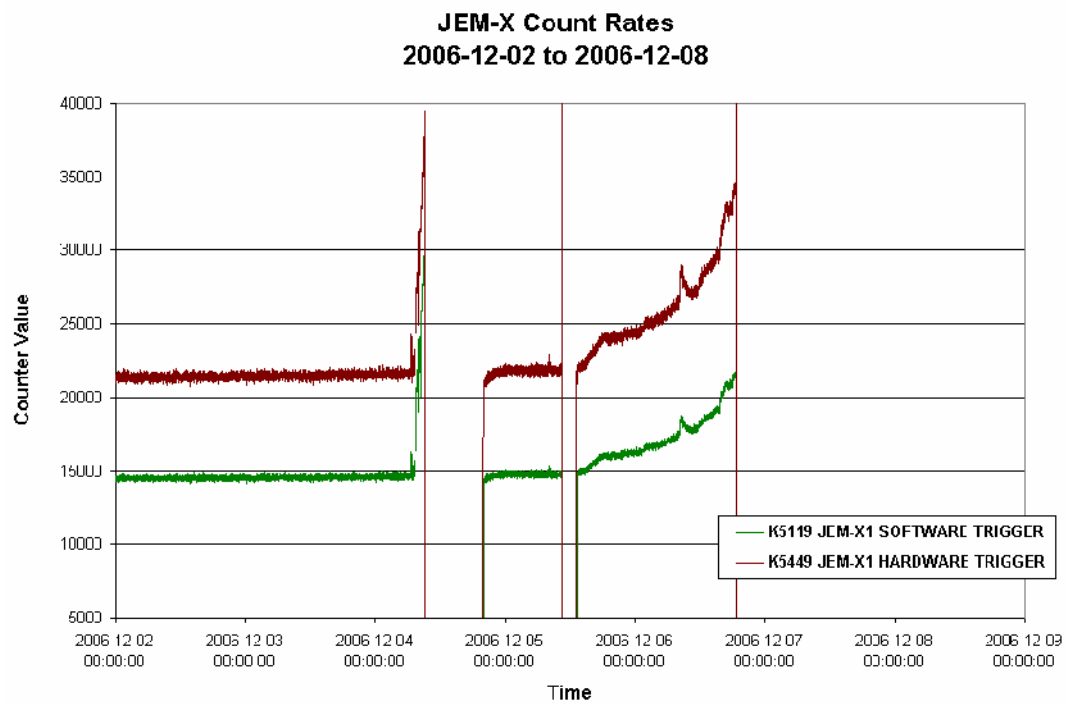


8.3.4 JEM-X Operations

JEM-X Count Rates

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

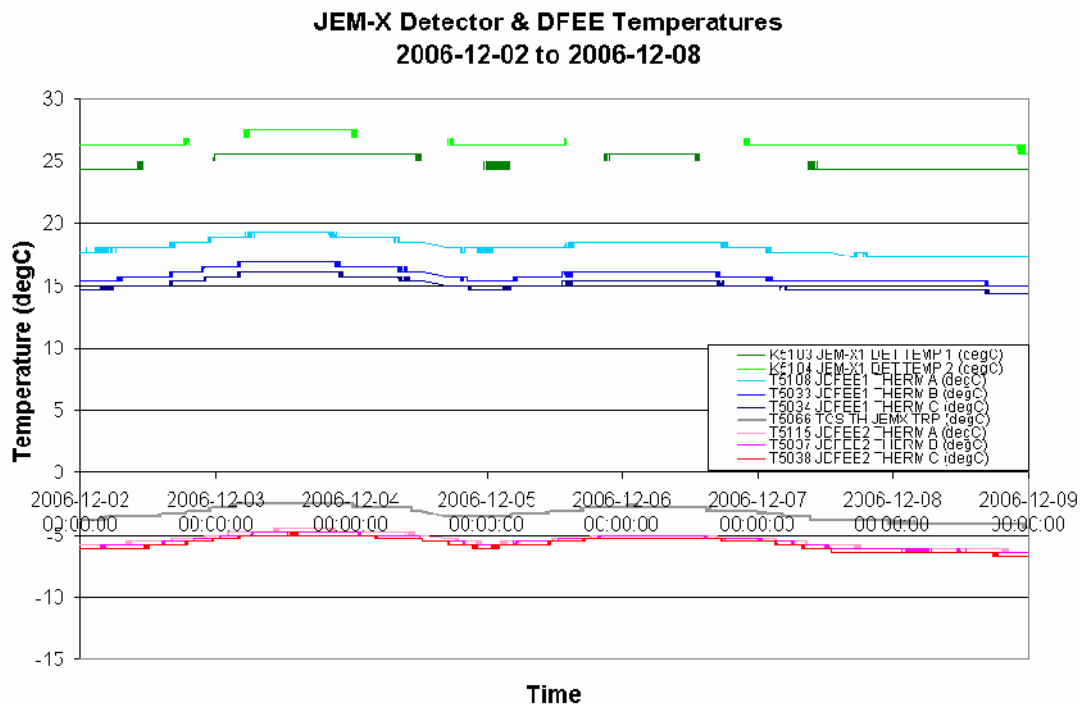
¹ Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.



JEM-X Temperatures

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

² Data sampled (1 frame in 8)



JEM-X Daily Report

2006-12-02 (DOY 336, Rev 505)

At 10:46Z an IREM SW reset (see INT_SC-165) caused the IREM RMC parameters K5315-K5317 to go OOL high (value = 65535). This did not affect JEM-X1 as the JEM-X reactions to IREM are disabled.

2006-12-03 (DOY 337, Rev 505)

JEM-X operations executed nominally.

2006-12-04(DOY 338, Rev 505-506)

Due to high background radiation conditions before the expected radiation belt entry of revolution 505, starting at 08:04:04Z the TM parameter K5449 HARDWARE TRIGGER began to toggle OOL High. This continued until JEM-X1 was commanded to Safe mode as planned in the Timeline at 09:12:54Z.

2006-12-05 (DOY 339, Rev 506)

Due to an X-class solar flare, at 10:27:48Z the TM parameter K5136 BUFFER LOSS went OOL High, at 10:28:04Z K5449 HARDWARE TRIGGER also went OOL and at 10:29:24Z K5119 SOFTWARE TRIGGER also went OOL High. At 10:29:47Z JEM-X1 made an autonomous transition to Safe mode, triggered by the Software Ratemeter. Two occurrences of OEM 189 JEM-X1 PROB DFEE 9 (Unexpected DFEE state reported in housekeeping) were received at this time, as the TM parameter K5462 DFEE STATE IASW was reporting state Setup while K5022 DFEE STATUS

was Safe. At 10:30:56Z FCP_JEM1_0040 was executed, setting K5462 DFEE STATE IASW to Safe as well and OEM 254 ERROR OFF was received.

After monitoring the background radiation conditions and observing that the IREM counts remained stably below the safe thresholds for JEM-X for a couple of hours, JEM-X1 was reactivated as follows:

- 12:59:55Z FCP_JEM1_0041 JEMX1 TRANSITION TO SETUP
- 13:06:34Z FCP_JEM1_1010 JEMX1 CONFIGURATION SETTING FOR SCIENCE OPS
- 13:33:16Z FCP_JEM1_0044 JEMX1 DATA TAKING

JEM-X1 operations continued nominally.

2006-12-06 (DOY 340, Rev 506)

Due to high particle background conditions as a result of the solar flare on the previous day, at 15:43:00Z the TM parameter K5449 HARDWARE TRIGGER started to go OOL High. At 18:43:08Z K5136 BUFFER LOSS went OOL High and at 18:44:36Z K5119 SOFTWARE TRIGGER also went OOL High. At 18:45:15Z JEM-X1 made an autonomous transition to Safe mode. Two occurrences of OEM 189 JEM-X1 PROB DFEE 9 (Unexpected DFEE state reported in housekeeping) were received at this time, as the TM parameter K5462 DFEE STATE IASW was reporting state Setup while K5022 DFEE STATUS was Safe. At 18:47:27Z FCP_JEM1_0040 was executed, setting K5462 DFEE STATE IASW to Safe as well and OEM 254 ERROR OFF was received.

JEM-X1 remained in Safe mode for the rest of the day.

2006-12-07 (DOY 341, Rev 506-507)

Due to continuing high background conditions, JEM-X1 remained in Safe mode for the rest of revolution 506. The Anode Calibration ED KEACAL01 was executed from the Timeline at the start of revolution 507 and JEM-X1 was commanded back to Safe mode at 19:20:40Z, after the autonomous transition to Setup mode at radiation belt exit. JEM-X1 remained in Safe mode for the rest of the day.

2006-12-08 (DOY 342, Rev 507)

JEM-X1 remained in Safe mode throughout the day.

8.3.5 OMC Operations

2006-12-02 (DOY 336, Rev 505)

At 10:46, an IREM SEU knocked the unit to safe mode. A recovery was promptly executed, and the unit was back to standby at 11:21. The impact was the interruption of pointing 05050015 after 1944 from a scheduled duration of 3533 seconds, and a 5 minute delay in the start of pointing 05050016.

2006-12-03 (DOY 337, Rev 505) to 2006-12-05 (DOY 339, Rev 506)

Nothing to report

2006-12-06 (DOY 340, Rev 506)

At 07:33:34, increasing background radiation forced the instrument to SAFE mode. The impact was the interruption late into pointing 05060035 and the loss of pointings 05060036 to 05060038 inclusive. It was at this time the following commands for pointing 05060036 were rejected:

2006.340.07.44.45.218	2006.340.07.44.56.592	1792	RealTime	131	TC REJECT	
REJECTED TC1			0	0	65535 PR	N
E E						
2006.340.07.44.51.156	2006.340.07.44.56.596	1792	RealTime	131	TC REJECT	
REJECTED TC1			0	0	65535 PR	N
E E						

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

At 10.18.43, the unit was returned to Stand-by, and 2 more pointings were successfully executed before the unit was again forced to SAFE mode at 13.01.58. This interrupted pointing 05060041 shortly after the start. The unit was again returned to stand-by at 13.17.35, only to be knocked again to SAFE at 15.24.37, which interrupted pointing 05060043 about half way through. OMC remain in SAFE mode for the rest of the week. The impact was the loss of pointings 05060044 to 05060060, and 05070001 to 05070028

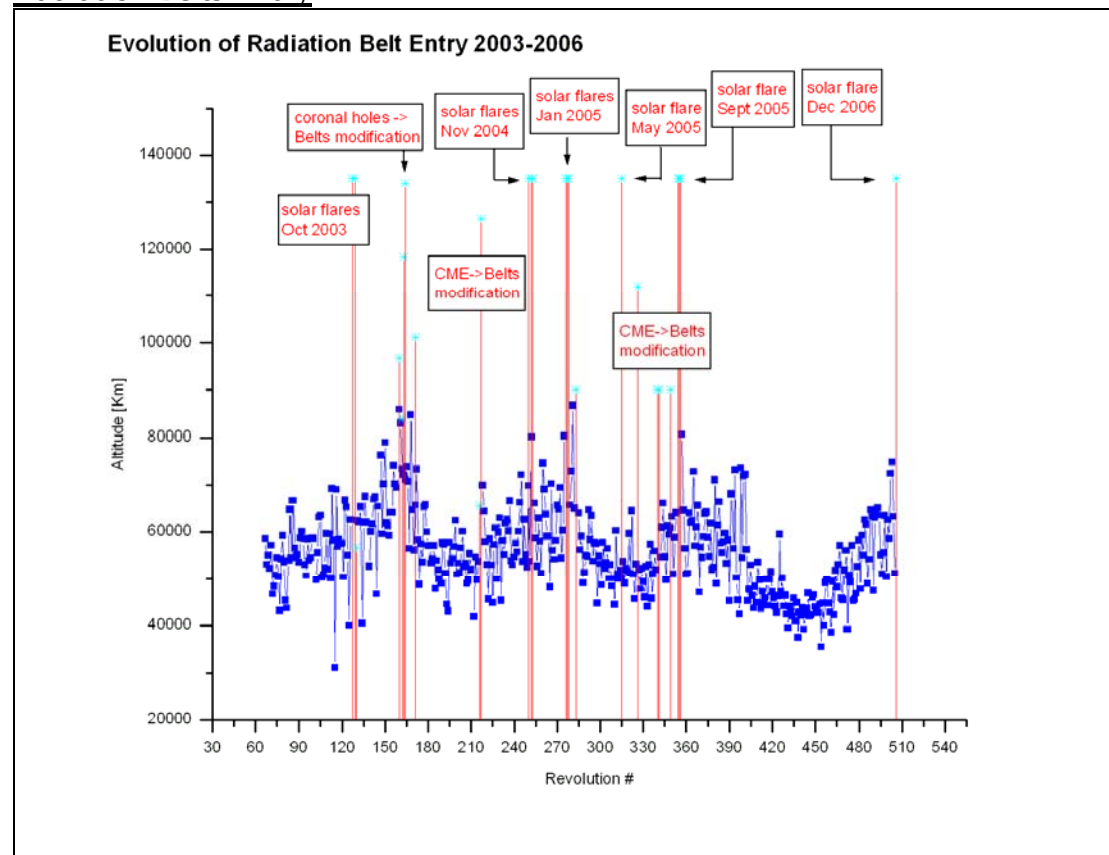
2006-12-07 (DOY 341, Rev 506) to 2006-12-08 (DOY 342, Rev 507)

The unit remained in SAFE mode continuously due to high radiation.

On DoY 338 at 10:08:46 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.3.6 IREM Operations

Radiation Belts Entry



IREM daily report

On 2006-12-02 at 10:46Z, a local reset of the IREM CSCI S/W (SEU #38) and on 2006-12-07 at 23:49Z a local reset of the IREM CSCI S/W (SEU #39) occurred as previously (see anomalies on 16/12/2002, 01/01/2003, 03/06/2003, 11/07/2003, 19/07/2003, 05/08/2003, 24/08/2003, 26/12/2003, 13/05/2004, 16/05/2004, 09/06/2004, 12/06/2004, 10/09/2004, 14/09/2004, 28/10/2004, 06/11/2004, 01/12/2004, 11/12/2004, 30/01/2005, 11/02/2005, 04/03/2005, 11/05/2005, 17/05/2005, 15/06/2005, 30/07/2005, 07/09/2005, 20/09/2005, 21/11/2005, 09/04/2006, 30/04/2006, 10/06/2006, 16/08/2006, 08/09/2006, 10/09/2006, 18/09/2006, 29/09/2006, 31/10/2006) the status of the unit, before the anomaly, 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 anomalies occurred at 2006.336.10.46Z at 124933.6km and at 2006.341.23.49Z at 78125.9km. 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 for SEU #38 at 11:46Z and at 00:18Z for SEU #39 using procedure CRP_SYS_2570. The first dump of the status word after the anomaly showed a value of BCC0 HEX = 48320 DEC = 1011110011000000, i.e the Checksum

Failure flag shows YES. The unit was still reporting the status as if it was in Integral mode with counting ON, accumulation ON and checksum failure flag 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) A dump of all the registers gave a status word BC80 HEX = 48256 DEC = 1011110010000000, ie. the unit was still reporting the status as if it was in Integral mode but the Checksum Failure flag was this time OFF and the checksum counter in the register number 3 incremented by 1 unit.

7) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 13:35Z for SEU # 38 and at 02:34Z for SEU #39.

For SEU#38, 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.

The recovery of the payload was performed with IBIS at 11:52Z and OMC re-enabled at 11:22Z.

SEU #39 had no impact on the Payload as instruments were already in Safe configuration due to high radiation.

The cause of these S/W resets is still under investigation, but it is apparently due to the unit's memory device that is sensitive to radiation.

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]
505	RAD_ENTR R 2006-12-04T10:08:43Z	2006-12-04 10:48:13	<51175.8	2006-12-04 10:58:44	48739
506	RAD_EXIT R 2006-12-04T19:29:50Z	2006-12-04 18:43:09	>>29728.4	2006-12-04 19:08:44	42490
506	RAD_ENTR R 2006-12-07T09:55:43Z	2006-12-06 06:06:13	149091.1	2006-12-07 10:23:31	49566
507	RAD_EXIT R 2006-12-07T19:16:10Z	-	-	2006-12-07 18:33:31	41611

Reference

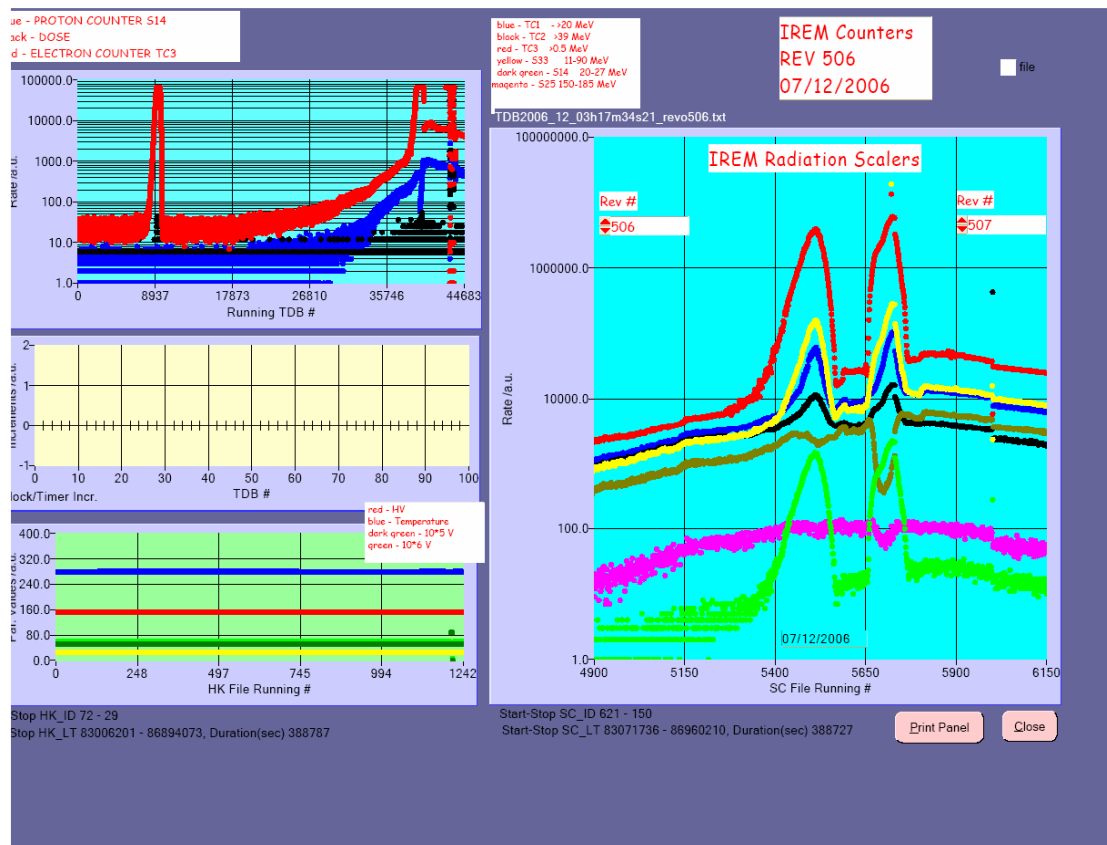
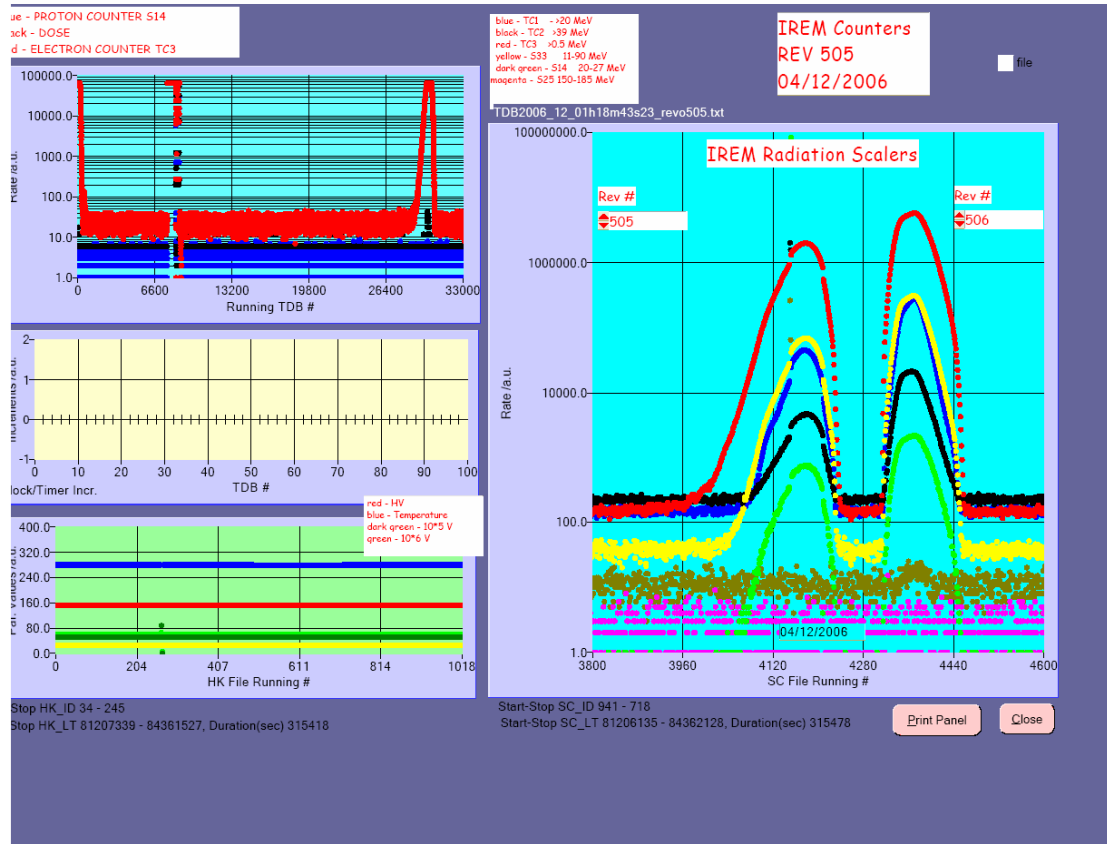
Very small error vs reference (less than 10 minutes)

Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

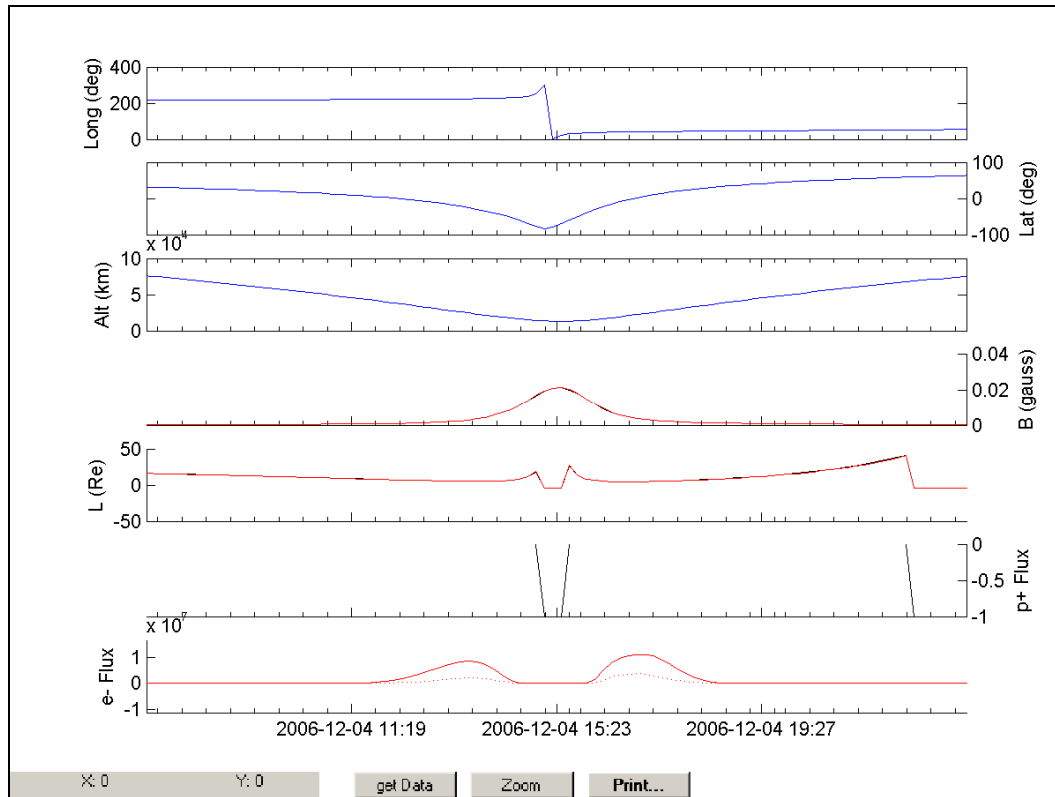
Radiation Spike

IREM radiation counters:

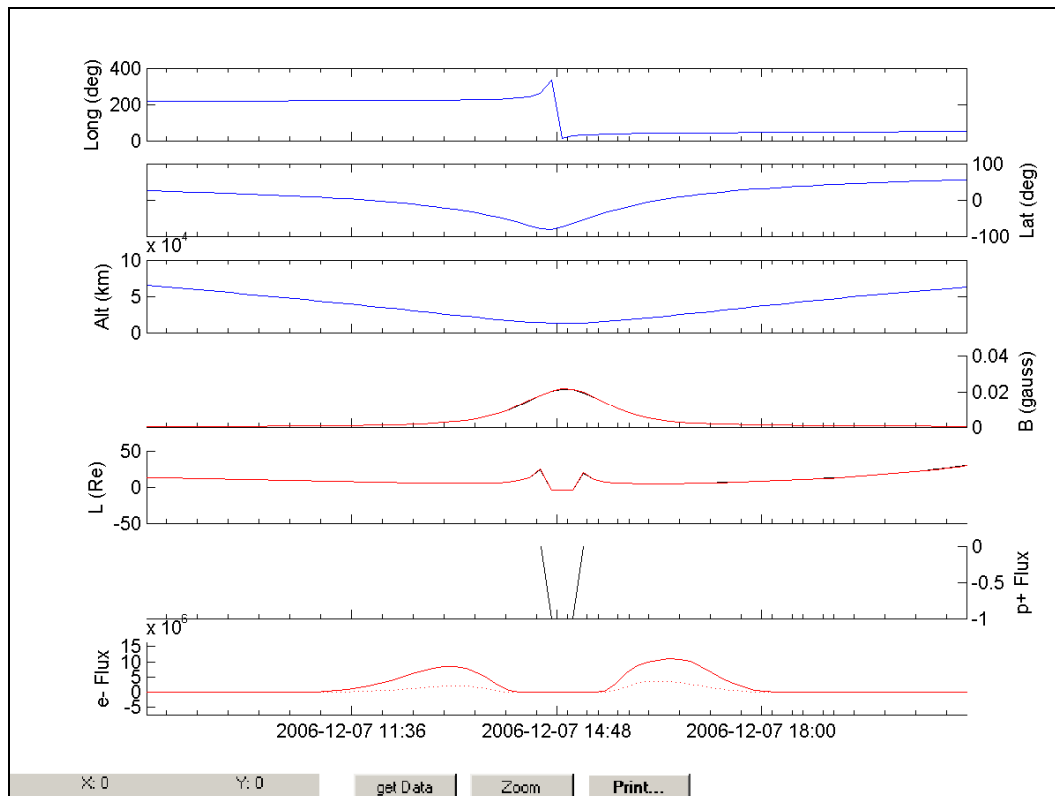


IREM Predicted Radiation Belt Passages

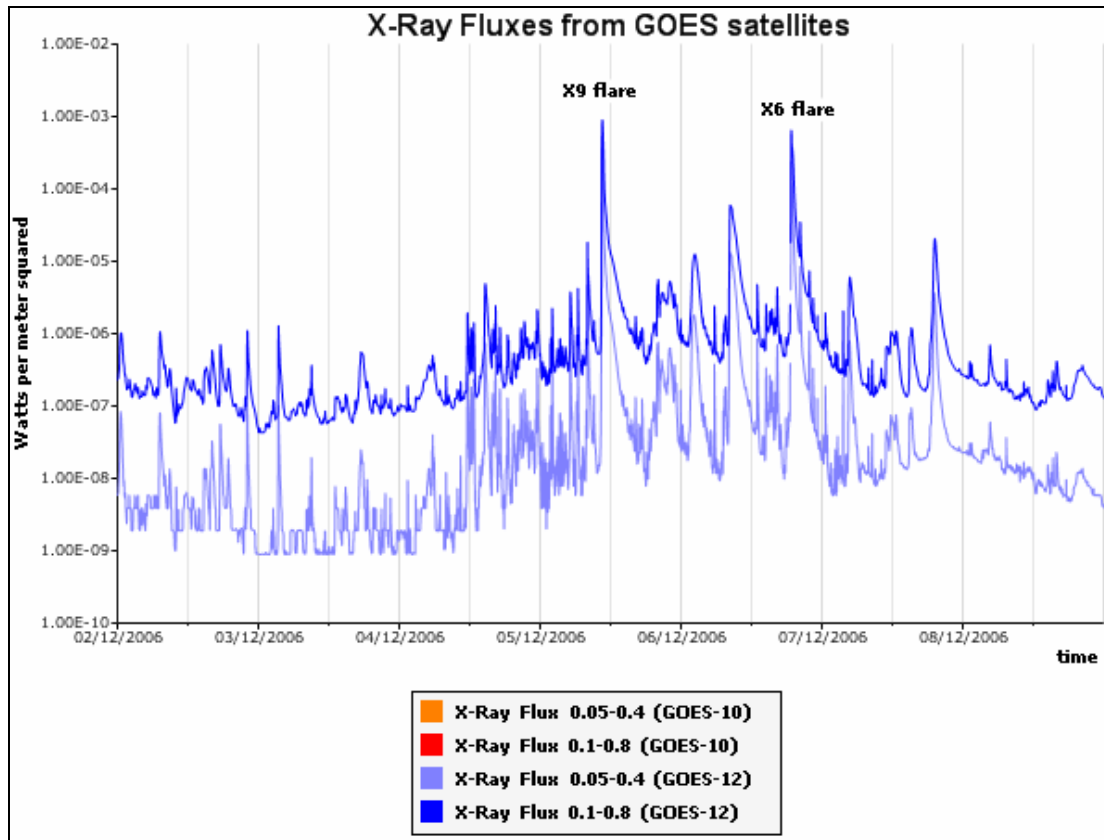
Rev 505



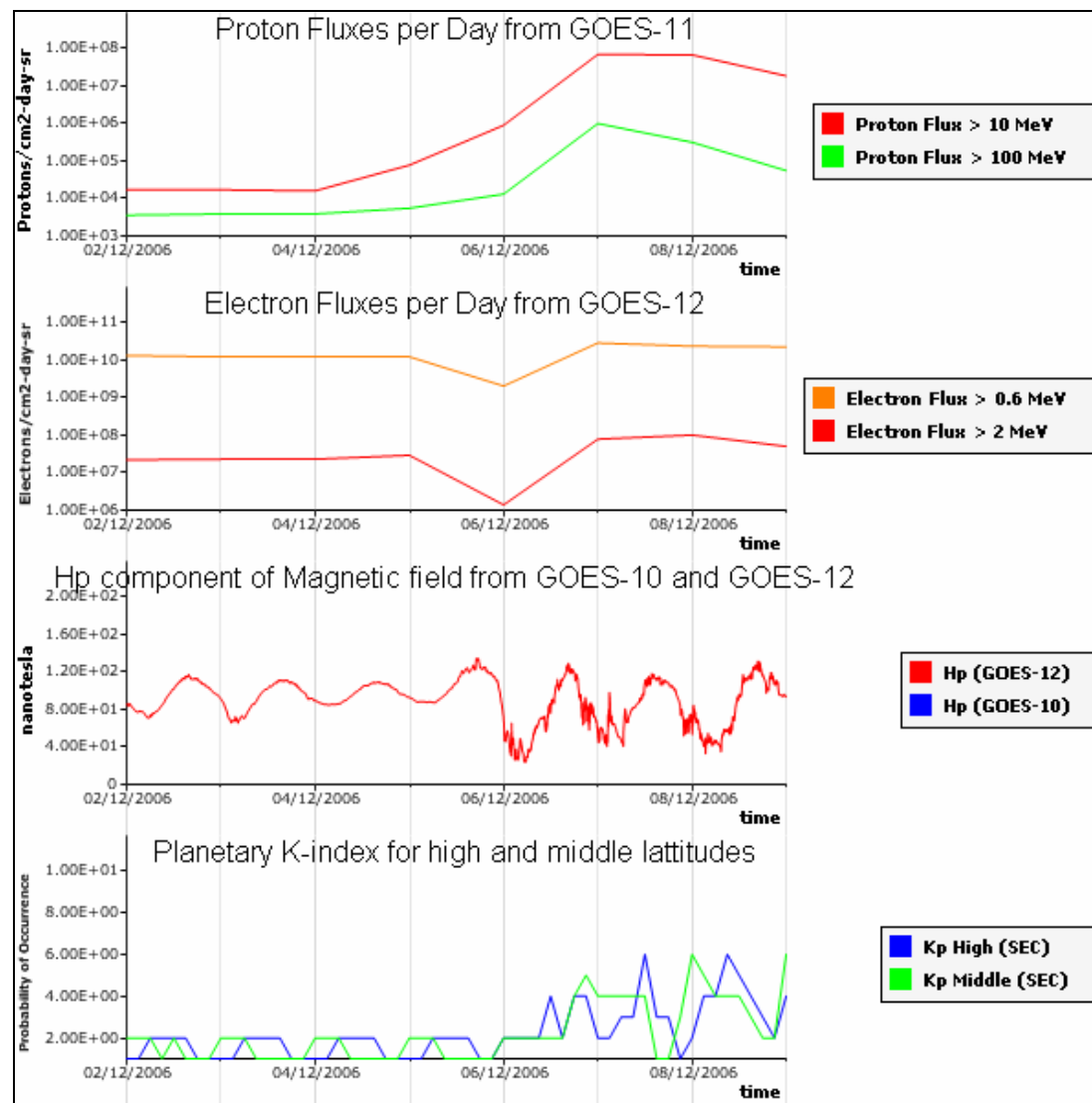
Rev 506



SEC-GOES Observed Particles Fluxes (using SEIS/RAT tool):



X-Ray fluxes start to be significant over 10^{-5} W/m² (corresponding to M-class flares). Above 10^{-4} W /m², they correspond to strong X-class flares.



Proton and electron flux report high radiation background.

Hp component of the Geomagnetic Field is essentially parallel to the Earth's rotation axis. A drop near 0 nT is associated with a significant variation in the magnetic field. Kp index is based on ground magnetometers. Kp ≥ 5 features storm-level geomagnetic activity.