

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 222
Week 51
27.12.06
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 16.12.06 until 22.12.06 (both dates inclusive) and covers the revolutions 510, 511 and 512.

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 4 (RA 21:44:04.54, DEC +53:09:58.7).

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.

Two slews were missed during the observation period, due to problem on the link with REDU station.

The fuel consumption over the period between 16/12/2006 and 19/12/2006 was 0.1091 Kg. The remaining propellant is in the order of 149.4125 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.

On DOY 350 (16/12/2006) at 17.54.45z the following parameters went out of limits with the following values:

- P3001 BDR2 ON/OFF STAT = OFF
- P3004 BCR1 ON/OFF STAT = OFF
- P3016 BAT1 RECO K09 = ON
- P3040 BCE2 PROT ENA M = DISABLED
- P3060 ECL WG2 ENA STA = DISABLED
- D5113 ECD2 EOC STAT = BAT NOT FULL

Additionally, at this time, the following parameters changed status

- P3024 BCE2 BAT1 CHAR = FULL CHARGE
- P3025 BCE2 BAT2 CHAR = FULL CHARGE

No OOL was indicated, as the mode parameters controlling the applicability of their limits were invalid at this time.

At 17.57.41z an OEM was received, indicating battery 2 end of charge. At this time parameter D5113 went back in limits and P3025 returned to TRICKLE CHARGE.

Investigation revealed that probably the MRU had experienced a SEU which changed the status of the above parameters, the change in status of P3025 had started battery 2 recharge, this was correctly terminated by the ECD task once the minimum charge capacity had been restored to battery 2. Battery 1 did not enter recharge mode as BCR1 had also been switched off by the SEU.

The recovery consisted of the following:

Re-enable Wing 2 Eclipse detection (P3060), FCP_EPS_1300

Re-enable BCE 2 Battery protection (P3040), FCP_EPS_1290

Switch-off reconditioning relay K09 (P3016), FCP_EPS_1280 step 5.6.

Switch BCR1 on (P3004), FCP_EPS_1231

Switch BDR2 on (P3001), FCP_EPS_1245.

After this recovery, parameter P3024 still indicated FULL CHARGE, however battery 1 was under trickle charge. This was because when BCR1 was switched on it came up in default trickle charge mode. As this was only the redundant charge mode status (BCE1 indicated Trickle charge) and the EPS behaviour was nominal in all respects this status was left.

On 18/12/2006 after testing the procedure on the simulator, the status was cleared by commanding battery 1 to full charge mode and allowing the battery 1 charge to be terminated by the ECD software - as had happened with battery 2 immediately after the SEU.

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

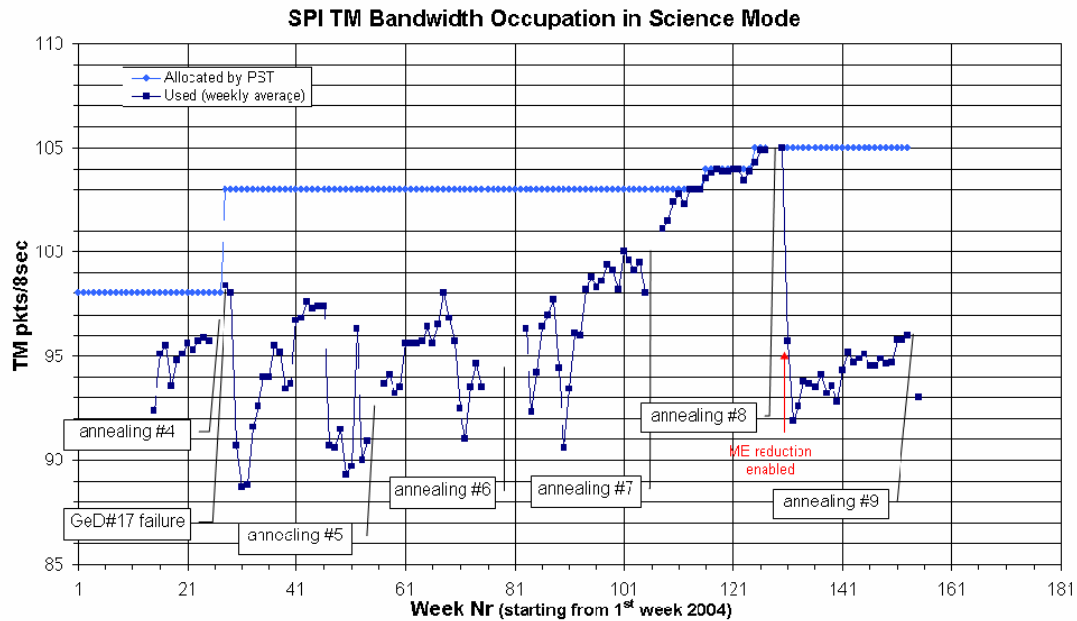
Following the 9th annealing, which ended on 22nd December, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution. The energy resolution of GeD#4 was recovered with this annealing. Detector #2 is failed since 06.12.2003 and detector #17 since 17.07.2004.

The following table reports the major events/steps performed so far (i.e. up to 22nd 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 23:21:37Z	Cold plate temperature reached 377K (104degC)
14/12/2006 13:06Z	Stop SPI Annealing: Annealing Heater Main and Redundant OFF; Heat Pipe Heater Main and Redundant OFF; Antifreeze Heater 1A ON
17/12/2006 04:58:57Z	Thermal braids temperature TM EU0398A reached 308K
17/12/2006 04:52Z	Start of cryocooler switch-on
17/12/2006 06:45Z	Cyrocooler switch-on complete and stroke set to 4x45
17/12/2006 06:53Z	ACS switch-on and calibration start (FEE#57 and FEE#81 ON) N.B. This was postponed from 14th December due to high background radiation conditions following a solar flare.
19/12/2006 02:08Z	End of ACS Calibration
20/12/2006 13:39:37Z	Cold plate temperature TM EU0392A reached 127K
20/12/2006 14:07Z	Selected narrow range cyro temps and restored PSD nominal threshold
21/12/2006 06:49Z	Camera switch-on start
21/12/2006 09:18:59Z	Cold plate temperature TM EU0392 reached 100K
21/12/2006 09:50Z	Camera switch-on end: SPI in PHOTON mode with all GeD HV at 4kV except for GeD#2 (0.5kV) GeD#17(0.5kV) and GeD#12 (2.5kV)
21/12/2006 11:58:59Z	Thermal braid temperature TM E0398 reached 86K
21/12/2006 12:41:05Z	Start of reduction of cryocooler stroke for 80K target (FCP_SPI1_0072)
21/12/2006 15:03Z	To CONF, set nominal ACS HV config (FEE#57 and FEE#81 OFF) and return to PHOTON
21/12/2006 15:25Z	To CONF, set GeD#12 HV to 3kV and return to PHOTON
22/12/2006 08:34:00Z	End of reduction of cryocooler stroke for 80K target: Stroke set to 4x37
22/12/2006 19:33Z	To CONF, set nominal IASW parameters and return to PHOTON
22/12/2006 23:32:19Z	Cold plate temperature TM EU0392 reached 80.9K

Due to the ongoing annealing operations, the instrument was kept in CONF mode and the assigned TM bandwidth was 46 packets/cycle until the start of revolution 511 (19/12/2006), when the TM allocation reverted back to the nominal 105 packets/cycle in the science window. The average telemetry occupation in PHOTON mode when

the allocation was 105 packets/cycle was 93 packets/cycle. The following plot shows the assigned and the average occupation of the SPI TM bandwidth.



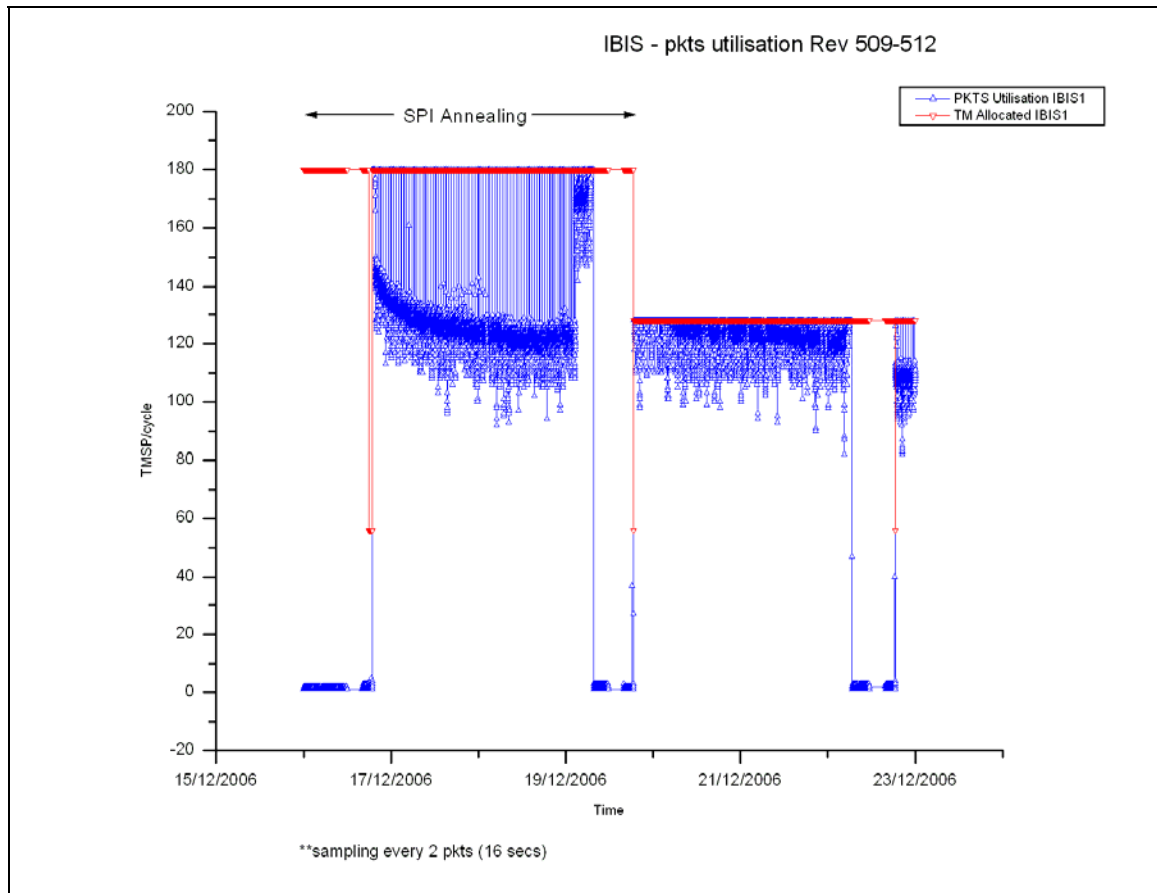
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

The overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 180 TMPS/cycle until revolution 510 included, due to on-going SPI annealing, and 128 TMPS/cycle afterwards. The IBIS mean bandwidth utilisation during the observation period (when IBIS was in Science mode) was 127.09 TMPS/cycle, down 37.02 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, JEM-X1 started the reporting period in Safe mode and remained in Safe until it was activated nominally at the start of revolution 510. It made three further autonomous transitions to Safe mode as follows:

- On 2006-12-19 at 07:13:44Z, ~1 hour earlier than planned before radiation belt entry of revolution 510;
- On 2006-12-22 at 06:42:53Z, ~1.5 hours earlier than planned before radiation belt entry of revolution 511;
- On 2006-12-22 at 18:51:12Z, being recovered back to Data Taking at 20:58:08Z.

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, 182 of the 184 planned science pointings for OMC were executed nominally, 2 were delayed due to hits on the line with Redu.

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 moderate solar activity.

Very active sunspot 930 disappeared from the surface of the sun at the beginning of the observation period.

From 19-12-2006 up to the end of the week, the sun was blank, hence posing no threat of strong solar flares.

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. 2 slews were delayed. The overall performance was well over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was good this week. There were, however, a couple of incidents: On one occasion, the connection was lost to the TM RT Cache, and on another occasion, the TC history task crashed, neither had any apparent impact. The overall performance was nearly 100%.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. There were, however, five occasions of small TM drops from Redu, two of which caused delays in the start of pointings, and one occasion of data dropping from Vilspa. The overall performance was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

Updated PSF versions were received from MOC for revolutions 515-518 and these revolutions were replanned as fast as possible. Further PSFs were received for revolutions 519 and 520, observations have been planned up to 519.

TSF's up to revolution 515 have been received.

2. Observation status

Received (and processed) ECS up to revolution 503, missing 501 and 502.

3. ISOC Science Data Archive

No news.

4. ISOC system

Version 14.0 has been formally released on Monday but will only be implemented in operations after the holiday season on 8 January.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 27/12/2006:

- Latest Standard Analysis completed: observation 04200340011 (Gamma Ray Source 1915+105, Revolution 499) on 20/12/2006.

- Latest products archived: observation 04200340010 (Gamma Ray Source 1915+105, Revolution 497) on 20/12/2006.

- Latest observation products sent to the observer: observation 04200240001 (Gamma Ray Source 1915+105, Revolution 497) on 20/12/2006.

5 Special Events

6 Anomalies

The following problems that impacted operations were reported:

- On DoY 350, at 17:54:45, an SEU within the MRU triggered a status change in a number of parameters. An investigation and recovery was immediately performed. There was no impact, see section 3.1.2 for details.
- On DoY 351, at 23:45, a hit on the line with Redu caused the failure of the AOCS commands. A manual recovery was performed, and the OSL executed at 00:03. The impact was a delay in the start of pointing 05100042.
- On DoY 355, at 22:47, a hit on the line with Redu caused the failure of the AOCS commands. A manual recovery was performed, and the OSL executed at 00:03. The impact was a delay in the start of pointing 05110072.

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

AR id	Date Created	Subject	Segment	Status
INT_SC-169	18/12/2006	SEU on MRU Affects Several Parameters.	Spacecraft	Pending
INT-2895	19/12/2006	Time Correlation Offset at Handover to VIL2.	ESA Stations	Pending
INT_SC-170	19/12/2006	IBIS-VETO Calibration, Bottom and Lateral Counters reported reduced count-rates	Payload	Open
INT-2896	20/12/2006	Problems with test pass at Goldstone	NCTRS	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 510

The observations in revolution 510 consisted entirely of a raster dither of the Galactic Plane Region 4 (RA 21:44:04.54, DEC +53:09:58.7), lasting ~58.5 hours.

Revolution 511

The observations in revolution 511 consisted entirely of a raster dither of the Galactic Plane Region 4 (RA 21:44:04.54, DEC +53:09:58.7), lasting ~57.8 hours.

Revolution 512

The observations in revolution 512 consisted entirely of a raster dither of the Galactic Plane Region 4 (RA 21:44:04.54, DEC +53:09:58.7), lasting ~58.5 hours.

Throughout this observation, all instruments were in their nominal science modes, except JEM-X2, which is switched off, and SPI, which was still undergoing annealing during revolution 510. The TM allocation was IBIS 180; SPI 46; JEM-X1 15; JEM-X2 0; OMC 5, during that revolution, and IBIS 128; SPI 105; JEM-X1 8; JEM-X2 0; OMC 5 for the rest of the reporting period

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

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.
2006-12-09T03:09:54.000Z	149.5839	F	Automatic TM processing.
2006-12-10T17:13:34.000Z	149.5556	F	Automatic TM processing.
2006-12-12T03:34:18.000Z	149.5392	F	Automatic TM processing.
2006-12-13T16:59:34.000Z	149.5307	F	Automatic TM processing.
2006-12-15T03:16:49.000Z	149.5216	F	Automatic TM processing.
2006-12-16T16:50:37.000Z	149.4933	F	Automatic TM processing.
2006-12-18T02:48:25.000Z	149.4719	F	Automatic TM processing.
2006-12-19T16:39:49.000Z	149.4125	F	Automatic TM processing.

This report was generated Fri Dec 22 08:00:43 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, 16/12/2006 –22/12/2006

AOCS operations were executed from the Automatic Timeline.

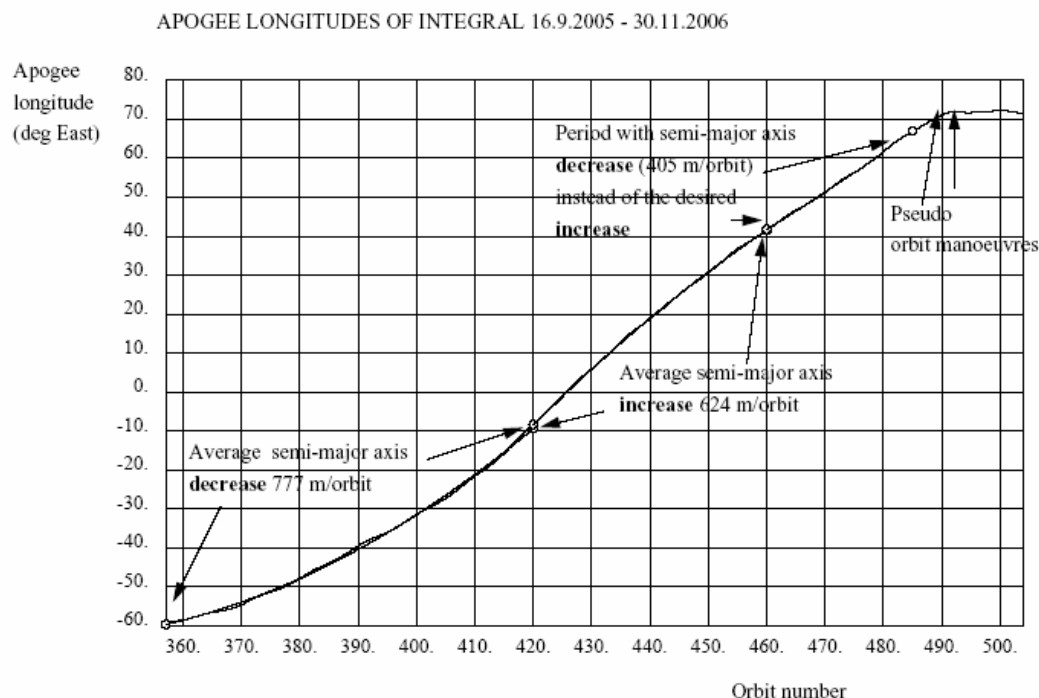
During this period, 82 Open Loop Slews, 109 Closed Loop Slews and 4 Momentum Biases were executed.

2 slews (OSL) were missed from the TL during the observation period due to problem on the link with REDU station. Due to problem at planning level, the OTF was not reached during PID 05100002.

This is equivalent to a ~ 1 % of the total number of slews (191)

Orbit Control

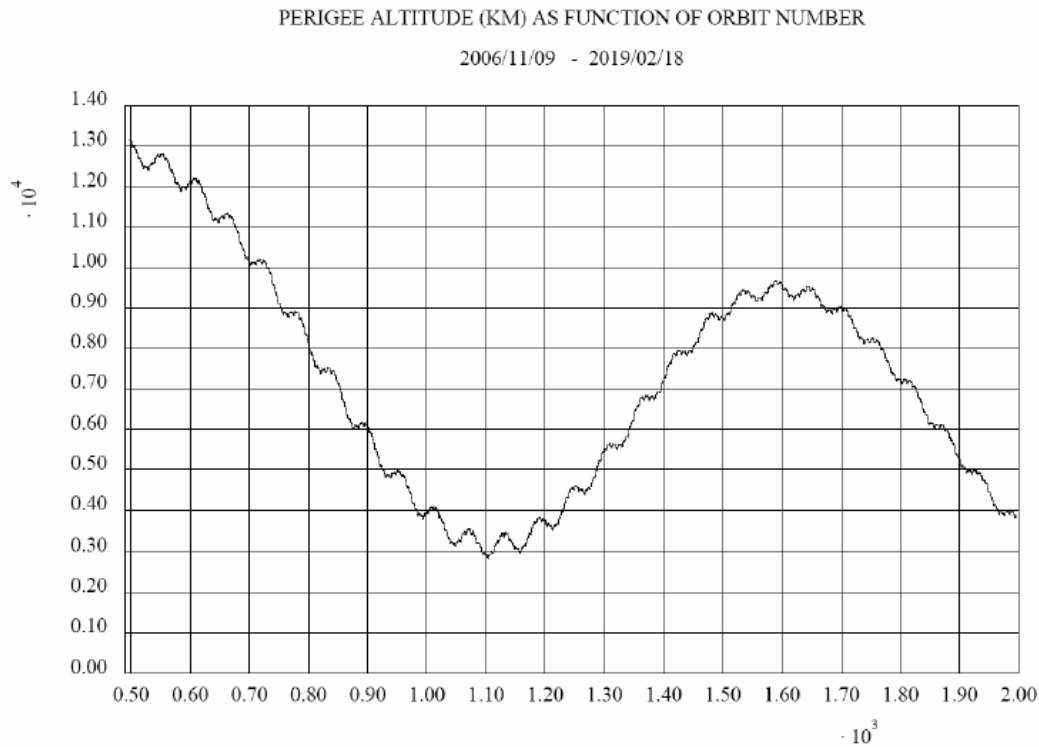
The attached plot shows the apogee longitude of Integral (in deg East) as a function of the orbit number for the period September 2005 - October 2006.



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.

A recent analysis on the evolution of the perigee altitude evidenced a lowering of the perigee altitude when considering the over-extended phase of the mission. A plot of the perigee altitude for the period 2006/11/09 - 2019/02/18, is shown below.



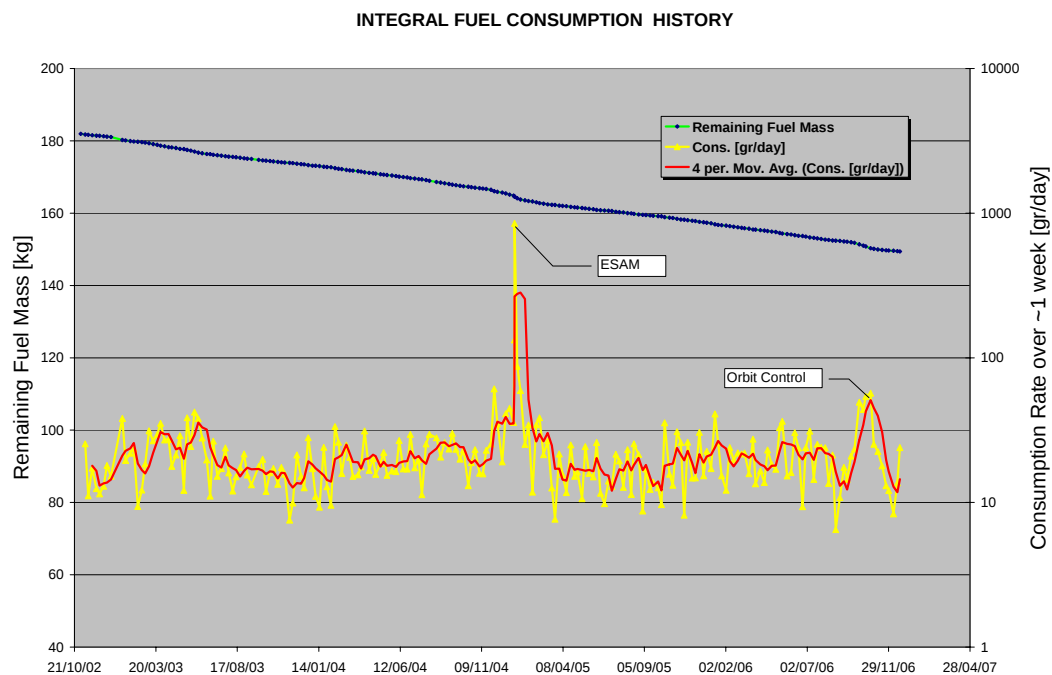
Perigee Height history; abscissa orbit number; ordinate perigee altitude in 10E+4 Km

The perigee altitude apparently only decreases to a minimal value of about 3000 km in 2012 and will then increase to reach a maximal value of about 9500 km in 2016.

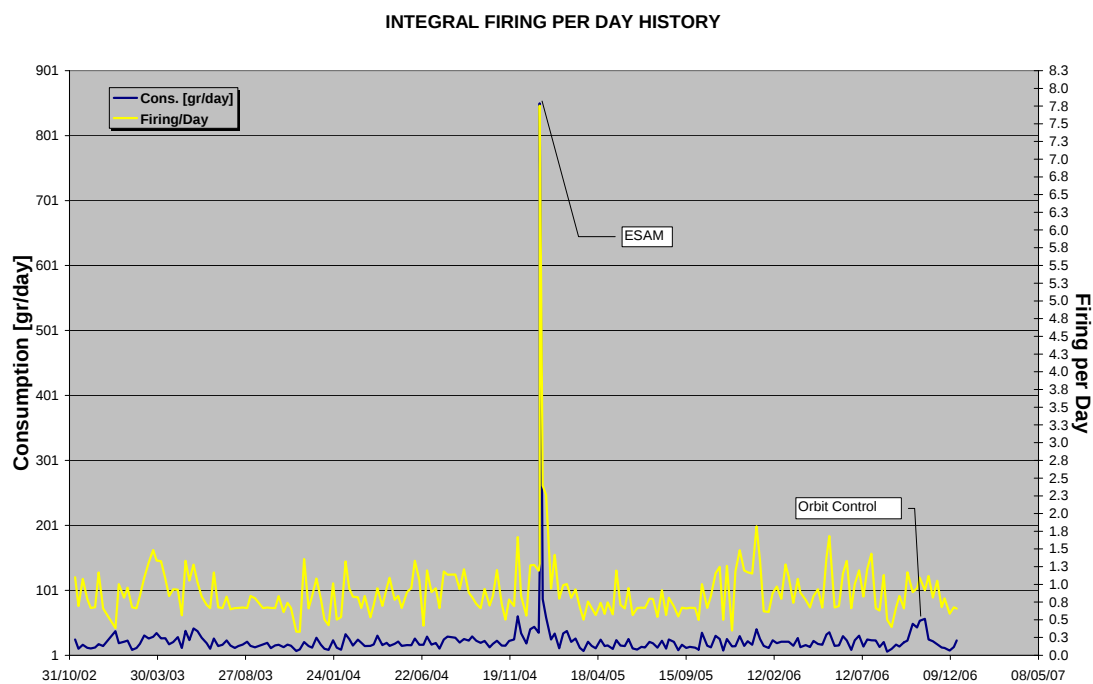
Fuel consumption

The fuel consumption (total, grams/day) over the period between 01/11/2002 and 19/12/2006 is reported in the plot below.

The large consumption rate 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.

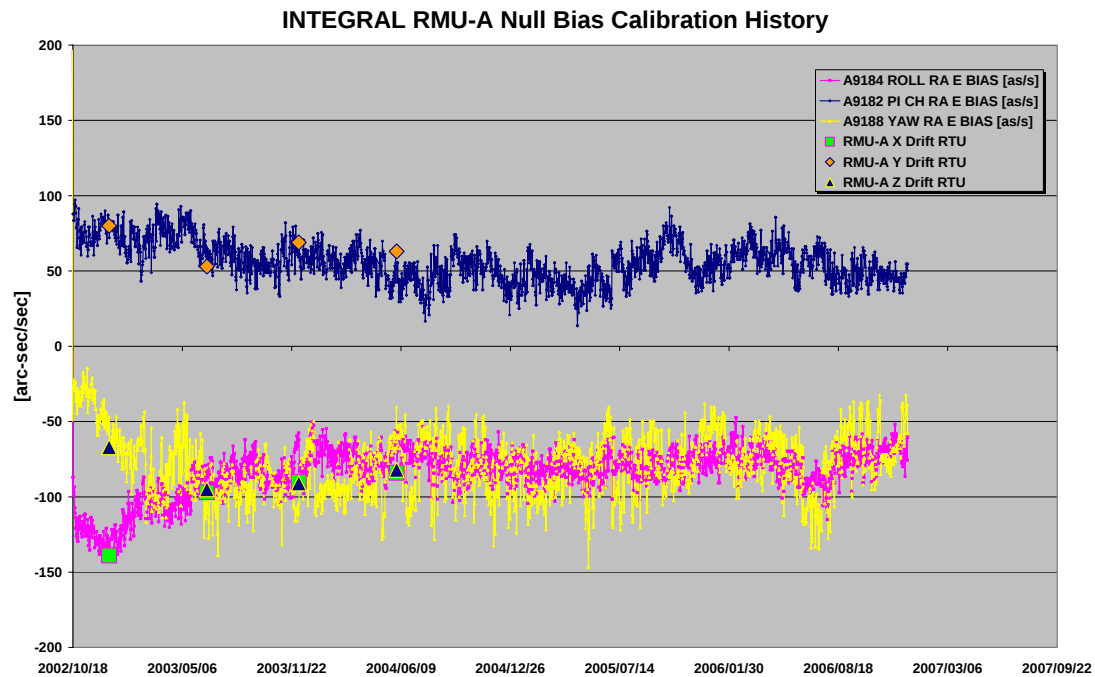


The firing\day over the period between 01/11/2002 and 19/12/2006 is reported in the plot below.

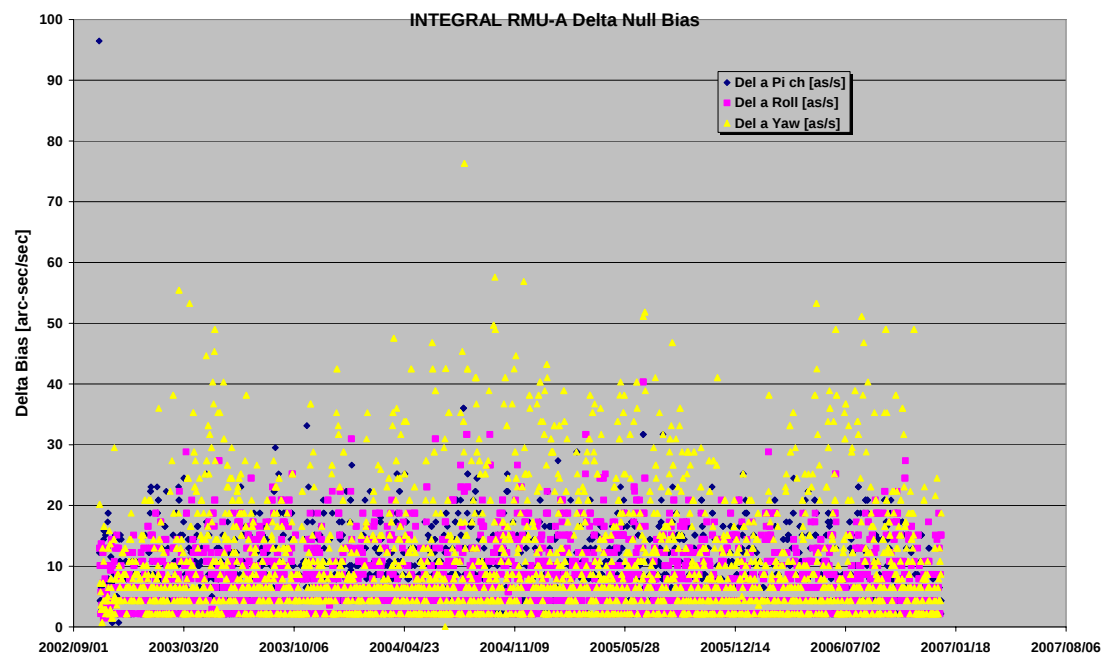


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 22/12/2006 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 22/12/2006 is reported in the plot below



16/12/06 (Day of Year 350, Revolution 509-510)

STR ACC Threshold exceeded: at perigee passage of rev 509, the STR SEU threshold was exceeded several time due false events generated by the high radiation environment.

During the event occurred at 16:13:20z, the IMU 1 was switched ON and an automatic mapping commanded by the ACC.

The guide star was Mi 7.95 at CCD location [2920, 9053]. The new guide star picked after automatic mapping was Mi 4.85 at CCD location [-16741, 1301].

The new guide star was maintained for following RWB activity at the beginning of rev 510, being the coordinates valid for the bias execution. No recovery needed.

No impact on TL reported

OTF not reached: the execution of slews ID 05100001-2 was observed lasting less than expected in the EPOS. This was due to a manual replanning of the first two slews of the rev 510 performed by FD. This caused the execution of slew 05100002 to clash with the command uplink for enabling SSL (at the end of the slew). Due to this reason the OTF was not reached during PID 05100002.

17/12/06 (Day of Year 351, Revolution 510)

Problem at REDU station: at 23:45z due to a problem on the link with REDU station, the slew ID 05100042 failed release.

A manual recovery was then performed from attitude of PID 05100041 to the attitude of PID 05100042. The next slew ID 05100043 was manually update in TL.

The following slew was not executed form TL: 05100042(OSL).

18/12/06 (Day of Year 352, Revolution 510)

Nothing to report.

19/12/06 (Day of Year 353, Revolution 510-511)

STR ACC Threshold exceeded: at perigee passage of rev 510, the STR SEU threshold was exceeded due false events generated by the high radiation environment.

During the event, occurred at 15:50:23z, the IMU 1 was switched ON and an automatic mapping commanded by the ACC.

The guide star was Mi 6.7 at CCD location [-2725, -10803]. The new guide star picked after automatic mapping was Mi 8.4 at CCD location [8280, -6894].

A manual recovery was performed (under request of FD Team) and a new guide star, Mi 6.05 at CCD location [-17597, 14861], was selected, such to have a brighter star during the following RWB activity.

No impact on TL reported

20/12/06 (Day of Year 354, Revolution 511)

Nothing to report.

21/12/06 (Day of Year 355, Revolution 511)

Problem at REDU station: at 22:47z due to a problem on the link with REDU station the slew ID 05110072 failed release.

A manual recovery was then performed from attitude of PID 05110071 to the attitude of PID 05110072. The next slew ID 05110073 was manually update in TL.

The following slew was not executed form TL: 05110072 (OSL).

22/12/06 (Day of Year 356, Revolution 511-512)

STR ACC Threshold exceeded: at perigee passage of rev 511, the STR SEU threshold was exceeded due false events generated by the high radiation environment.

During the event, which occurred at 16:04:34z, the IMU 1 was switched ON and an automatic mapping was commanded by the ACC.

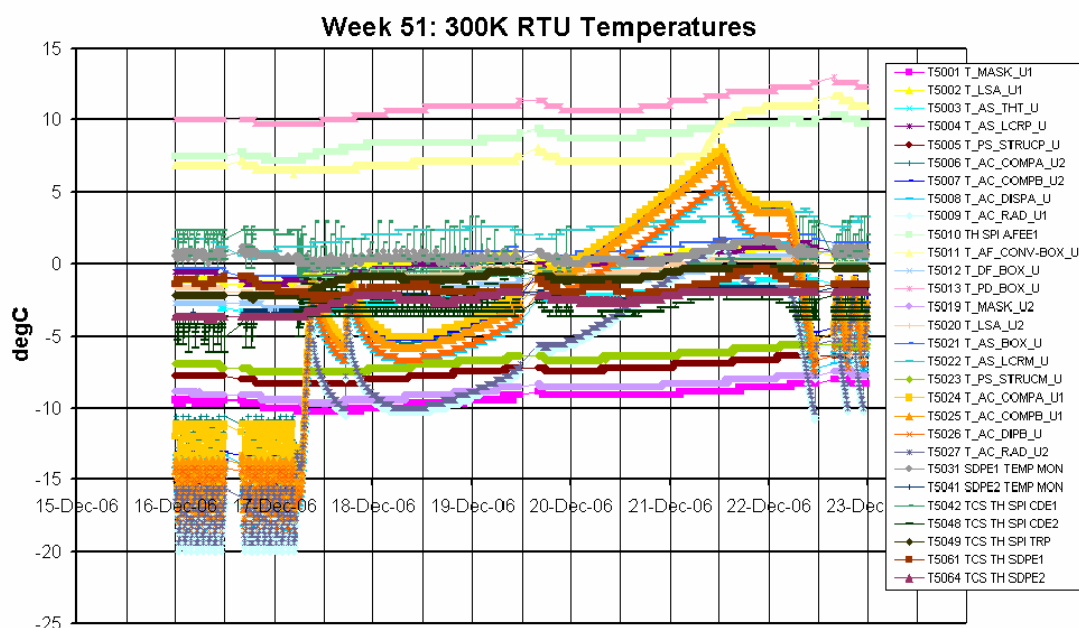
The guide star was Mi 8.15 at CCD location [-21882, 6]. The new guide star picked after automatic mapping was Mi 8.5 at CCD location [6953, 1386].

A manual recovery was performed (under request from FD Team) and a new guide star, Mi 6.0 at CCD location [11725, -2140], was selected. The following RWB activity was performed manually and the next slew manually updated in TL.

No impact on TL reported, except the manual execution of the RWB at the beginning of the revolution 512.

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:

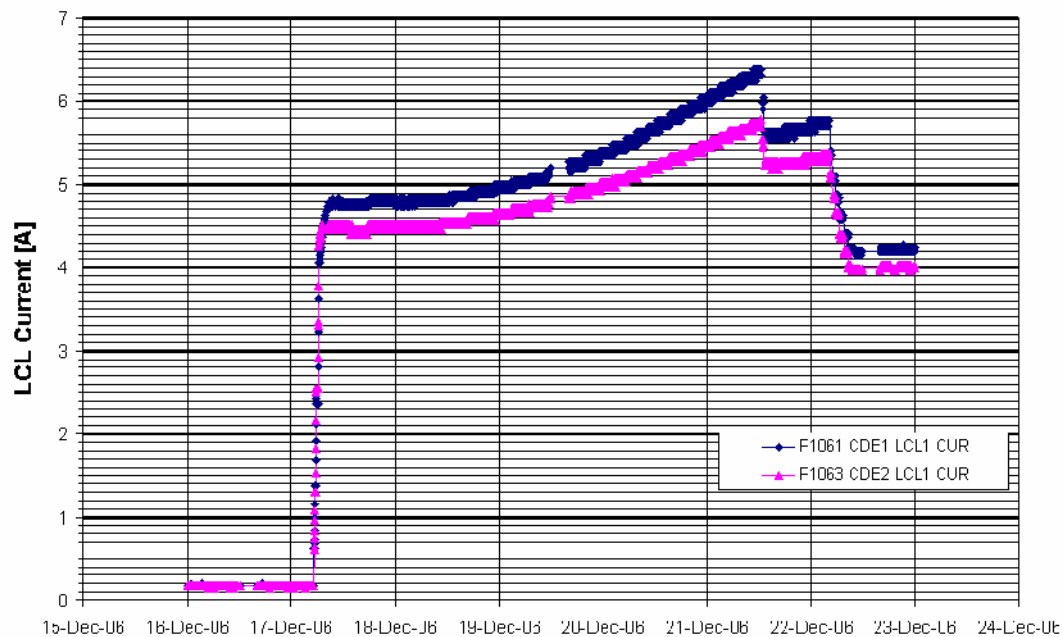


Stirling Compressors and Cryostat: The performance of the compressors is nominal. Due to the ongoing annealing operations, the cryocooler was off until 17/12/2006 at 04:52Z, when the cryocooler switch-on was started. The switch-on was completed on 17/12/2006 at 06:45Z, after which the compressors were run at full stroke (45) until 21/12/2006 at 12:41:05Z, when the reduction of the compressor stokes was started to reach a cold plate temperature of 80K. The stroke changes performed were as follows:

Time (Z)	Stroke Change
2006-12-21 12.45.00	CDE1 to 44
2006-12-21 12.45.30	CDE2 to 44
2006-12-21 13.15.30	CDE1 to 43
2006-12-21 13.16.00	CDE2 to 43
2006-12-22 04.16.30	CDE1 to 42
2006-12-22 05.01.30	CDE2 to 42
2006-12-22 04.16.00	CDE1 to 41
2006-12-22 05.02.00	CDE2 to 41
2006-12-22 05.47.00	CDE1 to 40
2006-12-22 05.47.30	CDE2 to 40
2006-12-22 06.32.30	CDE1 to 39
2006-12-22 06.33.00	CDE2 to 39
2006-12-22 07.33.00	CDE1 to 38
2006-12-22 07.33.30	CDE2 to 38
2006-12-22 08.33.30	CDE1 to 37
2006-12-22 08.34.00	CDE2 to 37

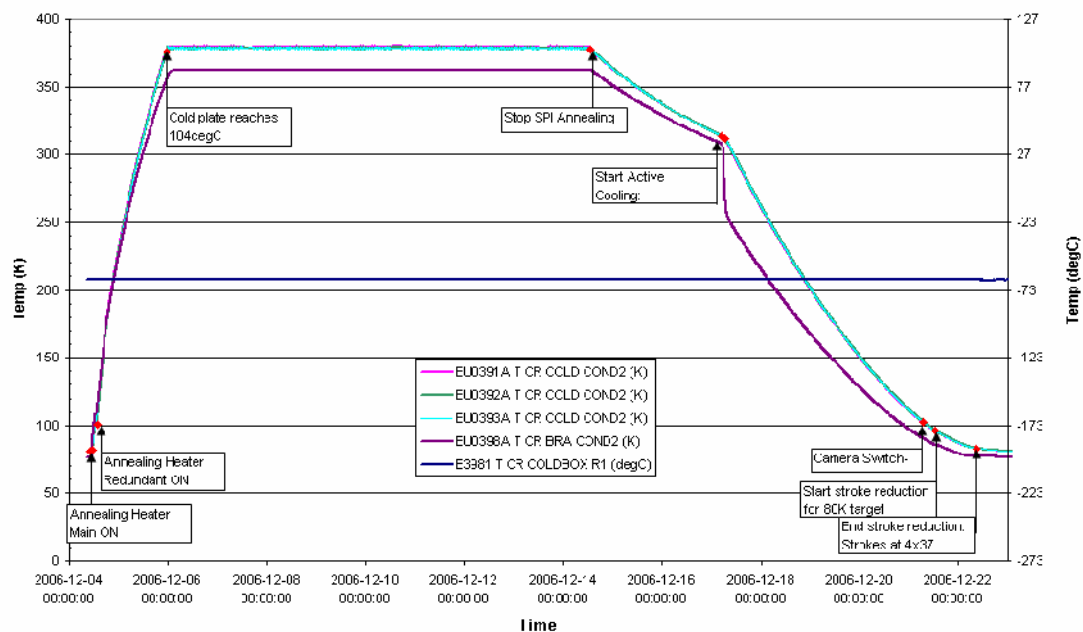
The following plot shows the evolution of the CDE currents during the reporting period:

Week 51: SPI CDE1 and CDE2 LCL Currents

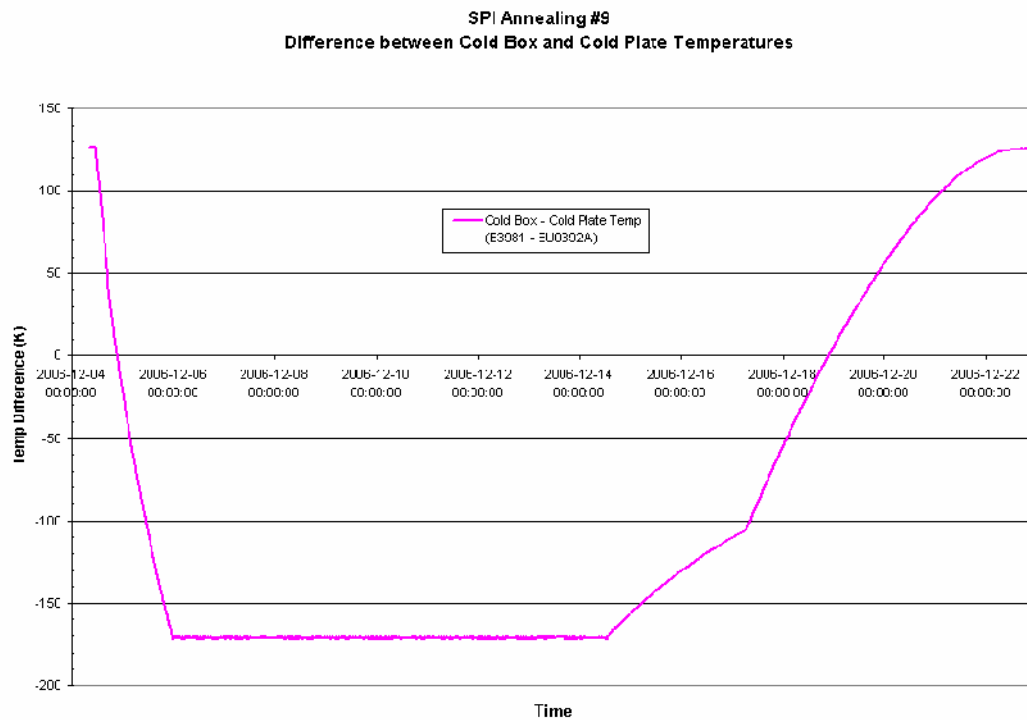


The following plot shows the evolution of the cold plate and H bus temperatures since the start of annealing.

SPI Annealing #9 Cold Plate, H-Bar and Cold Box Temperatures

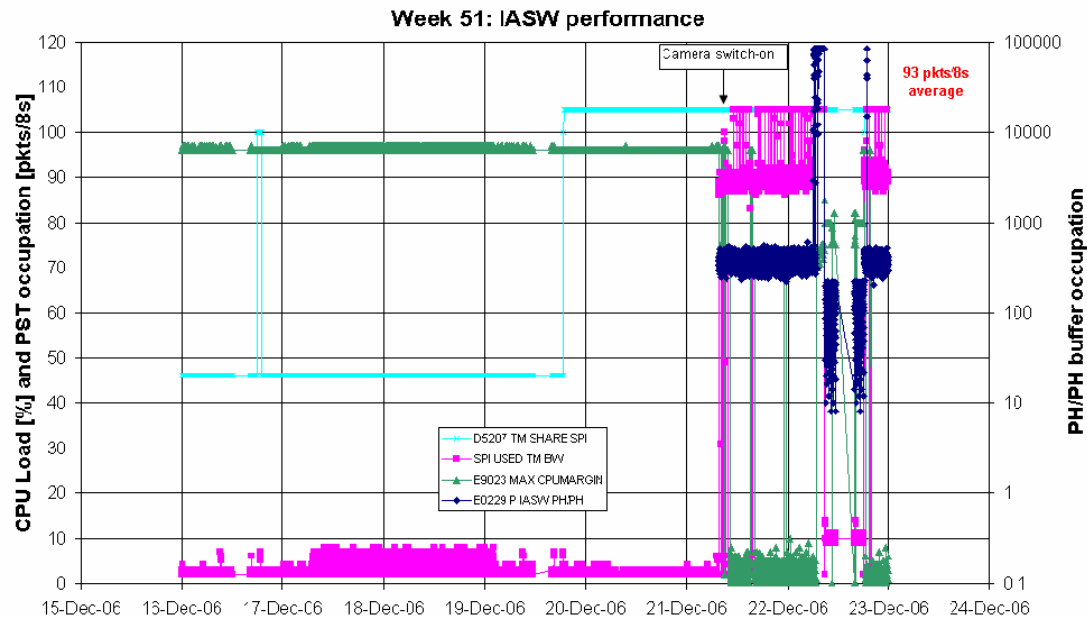


The following plot shows the difference between the cold box and cold plate temperatures since the start of annealing.

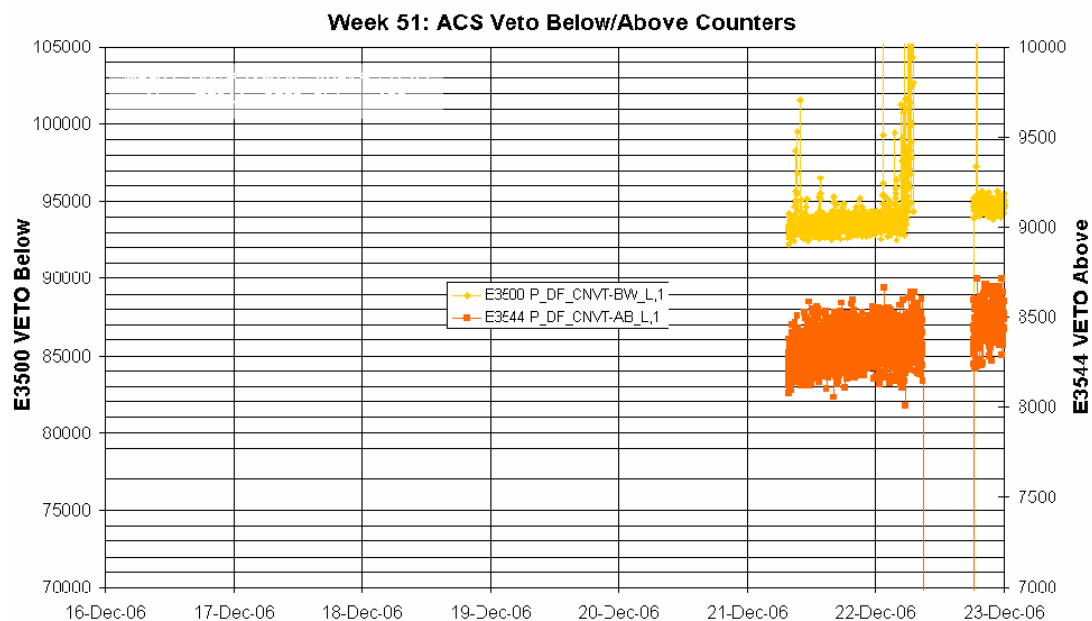


switch-on, the average TM bandwidth occupation of SPI was 93 packets/cycle in the science window, when the TM allocation was 105 packets/cycle.

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



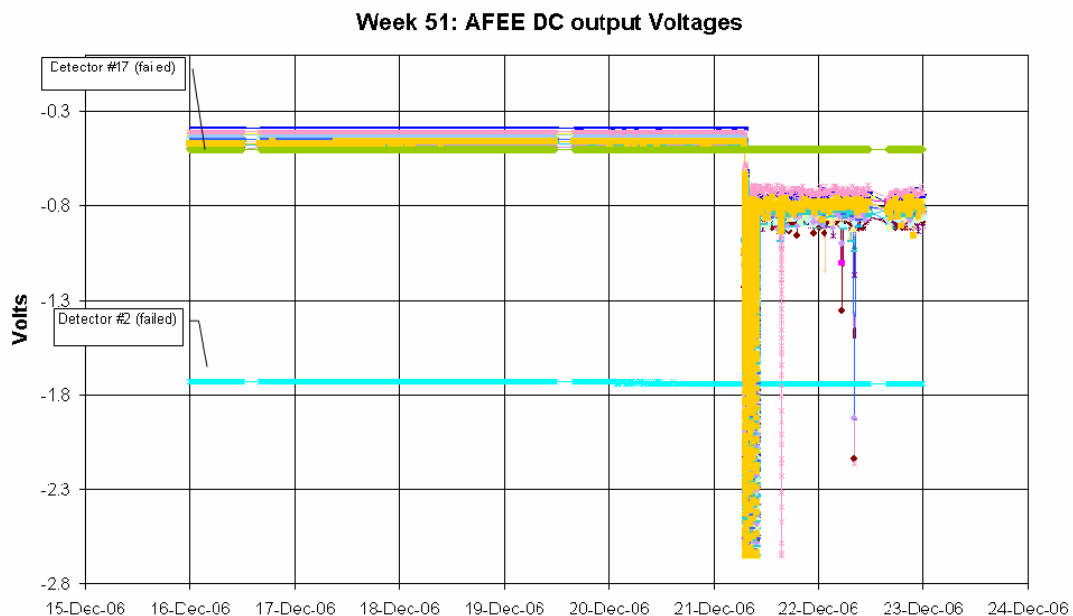
ACS: The performance of the ACS is nominal except for FEE 81 which remains switched off since the anomaly on 29/10/2006 (INT_SC-162). FEE #57 is also still OFF due to the anomaly on 5/8/2003 (INT_SC-61). Due to the ongoing annealing operations, started on 4th December, the ACS HVPSs were set to the minimum voltage (~980V) and the ACS was in CONF mode until 17/12/2006 at 06:53Z, when the ACS switch-on and calibration was started. For this, FEE#57 and FEE#81 were switched ON again. The ACS calibration was completed on 19/12/2006 at 02:08Z. On 21/12/2006 at 15:03Z FEE#57 and FEE#81 were switched OFF again.



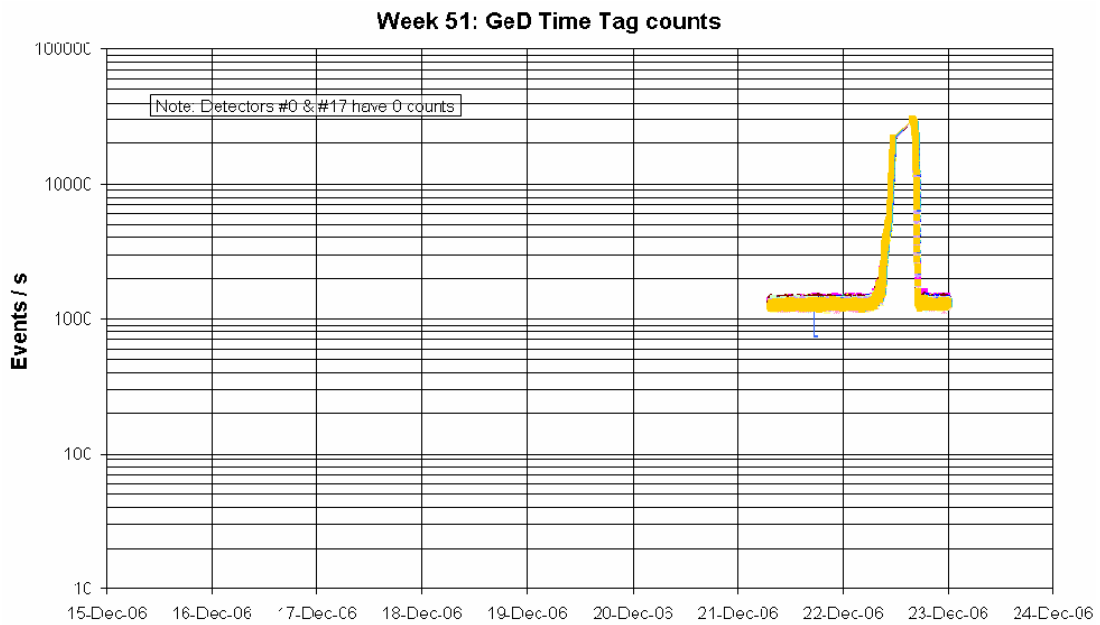
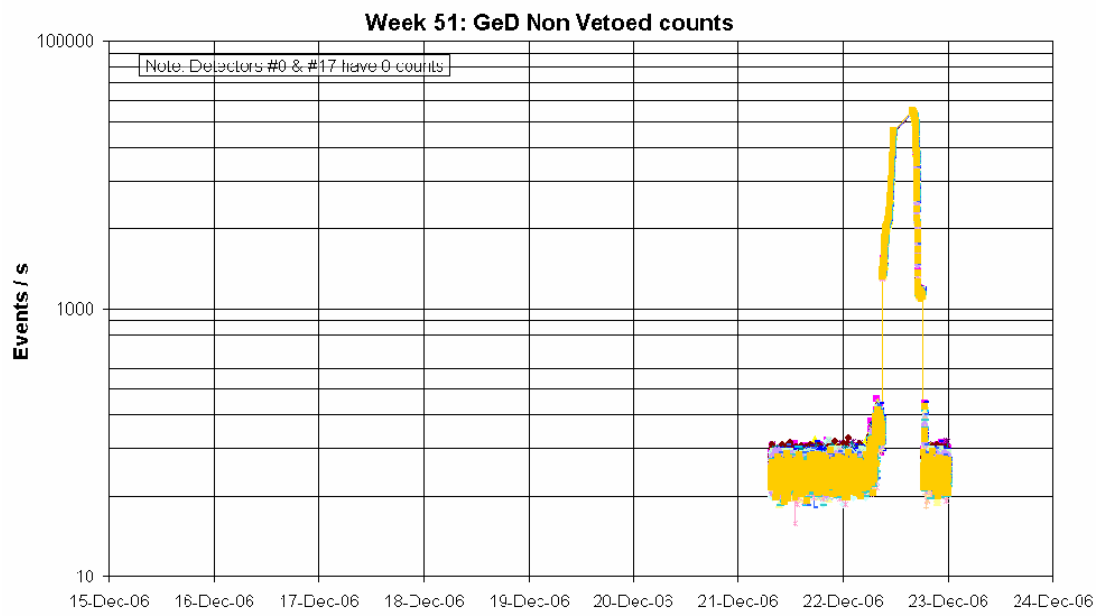
AFEE: The performance of the AFEE and the detectors is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution. The energy resolution of GeD#4 was recovered with this annealing.

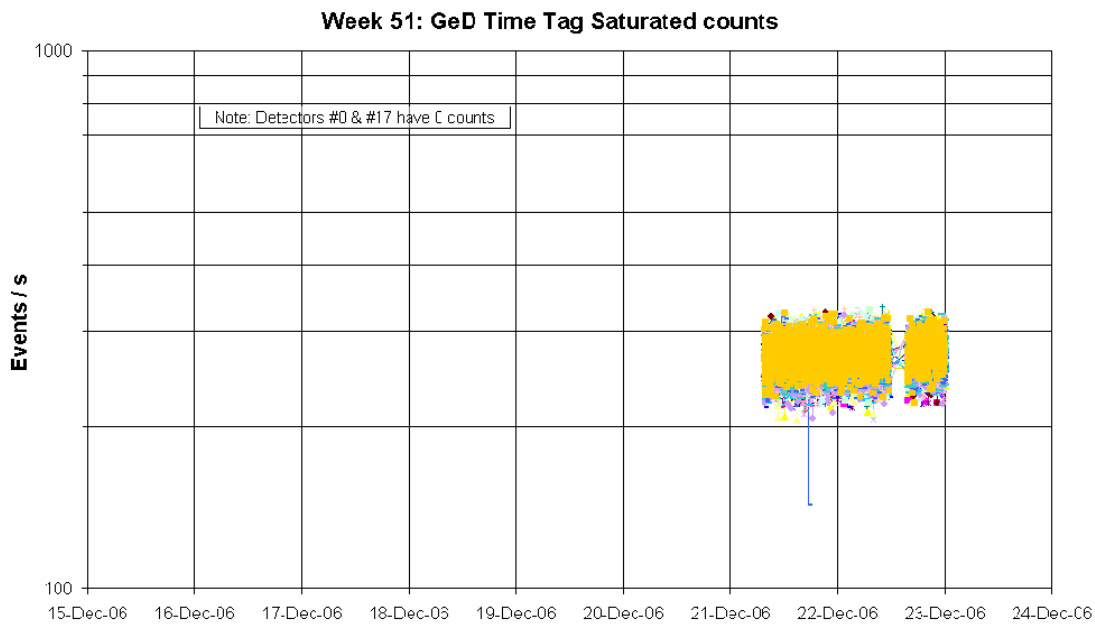
For the annealing operations, which started on 4th December, all detector HVPSs were switched off and only the LVPSs were left on until 21/12/2006 at 06:49Z, when the camera switch-on started at the end of the annealing. Following the camera switch-on, ending on 21/12/2006 at 09:50Z, the HV of GeD#12 was left at 2.5kV (instead of the nominal 4kV) due to the observed degradation in the energy resolution of this detector. On 21/12/2006 at 15:25Z the HV for GeD#12 was increased to 3kV, remaining at this value for the rest of the reporting period.

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



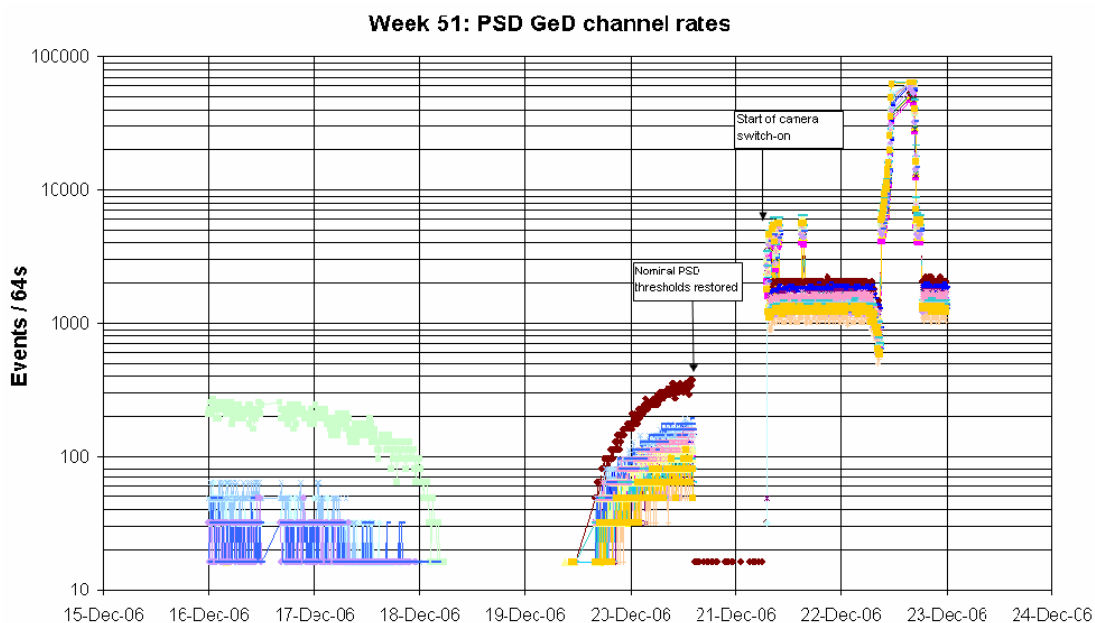
DFEE: The performance of the unit is nominal. Due to the ongoing annealing operations, started on 4th December, the DFEE was in CONF mode until 21/12/2006 at 06:49Z, when the camera switch-on started. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event Count Rates during the reporting period.





PSD: The health of the unit is nominal. Due to the ongoing annealing operations, started on 4th December, the PSD was in CONF mode until 21/12/2006 at 06:49Z, when the camera switch-on started.

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:

- TM parameter E2115 T AS PSAC L1 (Plastic Scintillator temperature) fluctuated in and of limit Low occasionally during the week.
- Between 2006-12-17 at 23:46Z and 2006-12-20 at 14:34Z TM parameter E3277 S AS HV-ST L81 (FEE HV status #81) went OOL (value = PARAM <

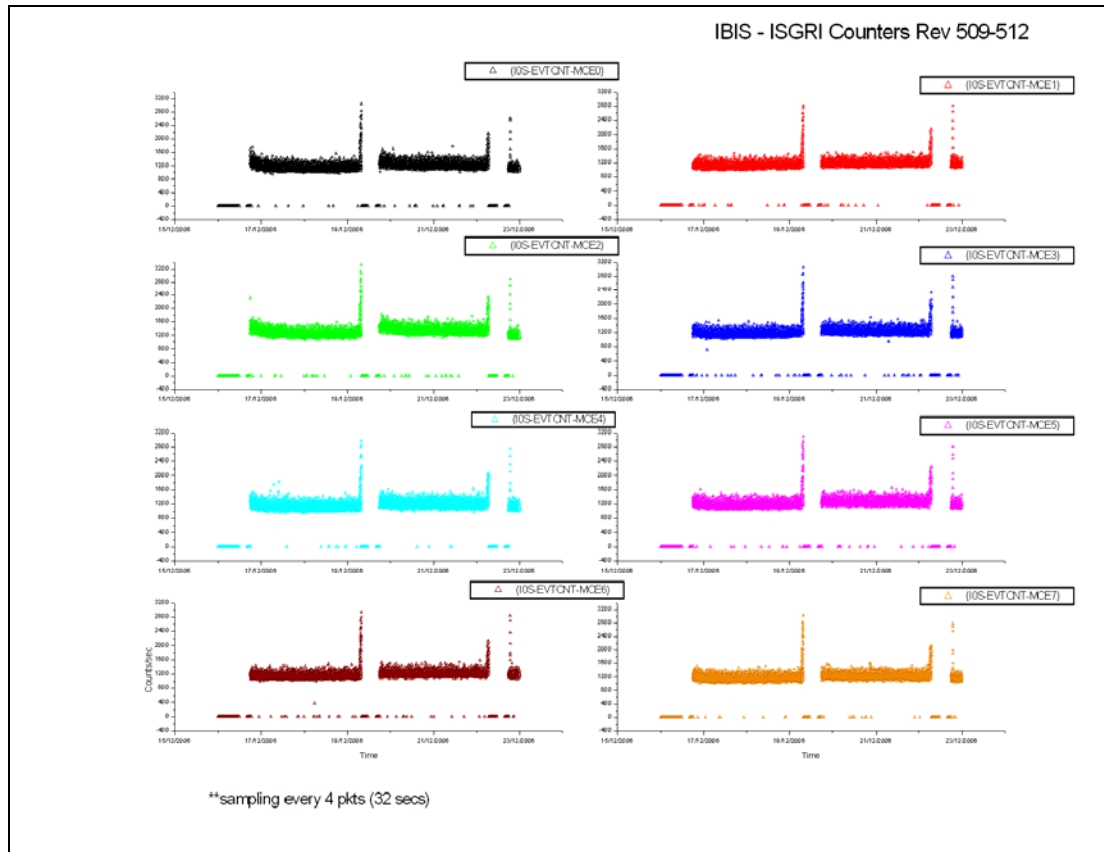
SPEC) occasionally. This was due to the fact that the FEE#81 was ON during this time and the known anomaly (INT_SC-162) is still present.

- On 2006-12-22 at 06:14:42Z the TM parameter E3500 P_DF_CNVT-BW_L starting going OOL High. This was ~2.5 hours before radiation belt entry of revolution 511 and therefore no action was taken.
- On 2006-12-22 at 08:08:21Z E3854 P PD CHL-RTE L14 (PSD Channel rate for detector 14) went OOL Low (value = 544) but returned within limits at 08:15:49Z.
- On 2006-12-22 from 15:45:08Z to 16:48:04Z TM parameter E4009 S DF HSLERR L fluctuated OOL, indicating errors on the HSL. This was just after AOS of revolution 512.
- 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 will be updated in the next IODB release.

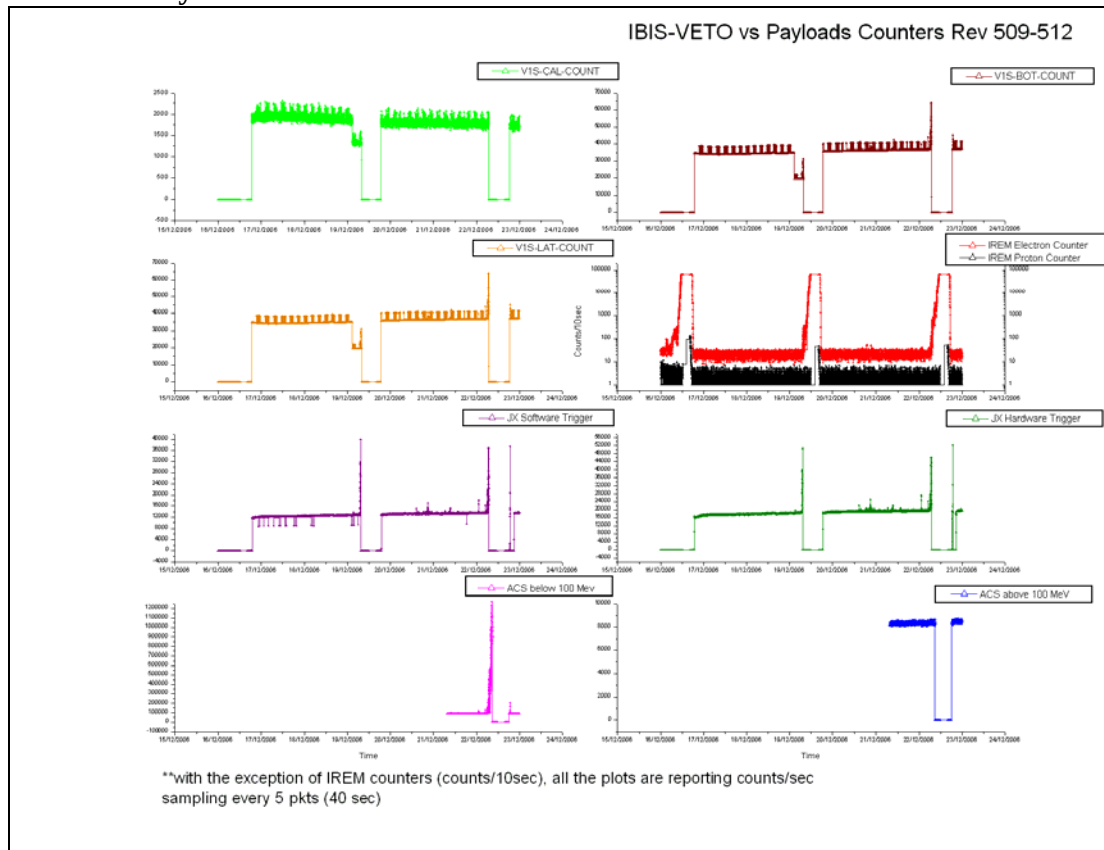
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

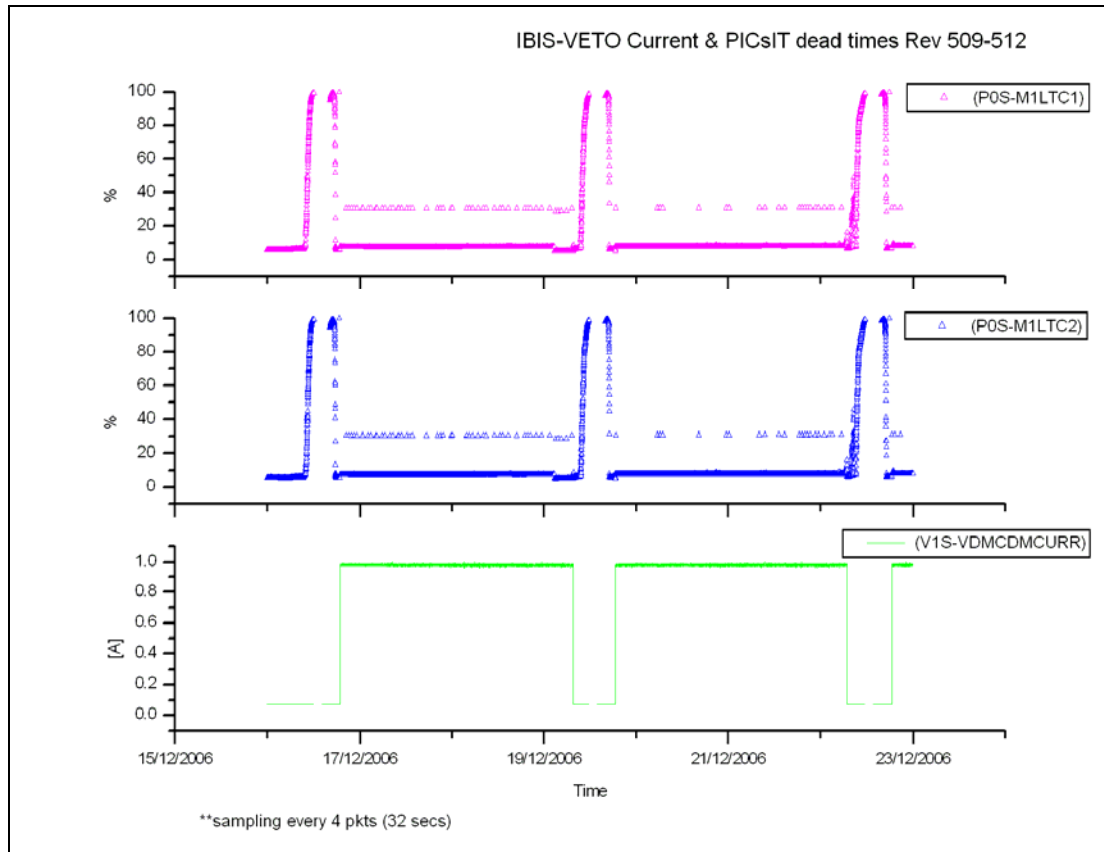


VETO vs Payloads Counters:

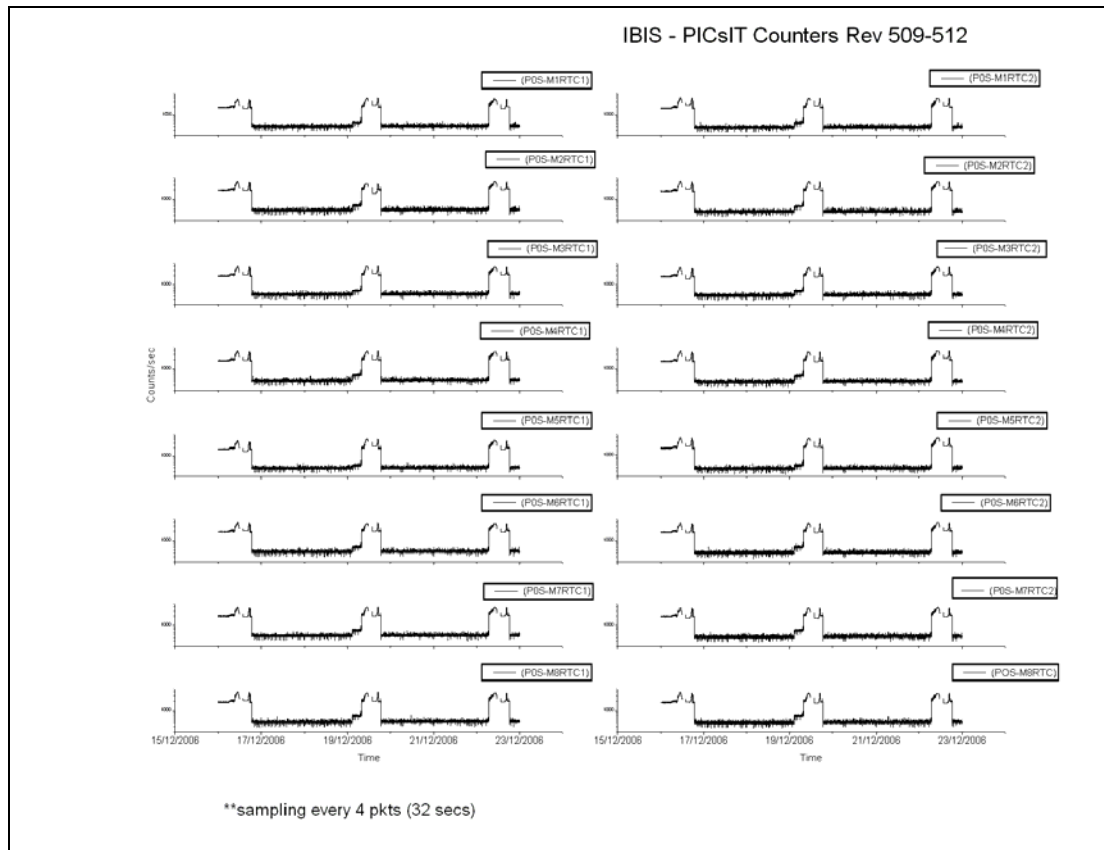


The week was characterised by low radiation.

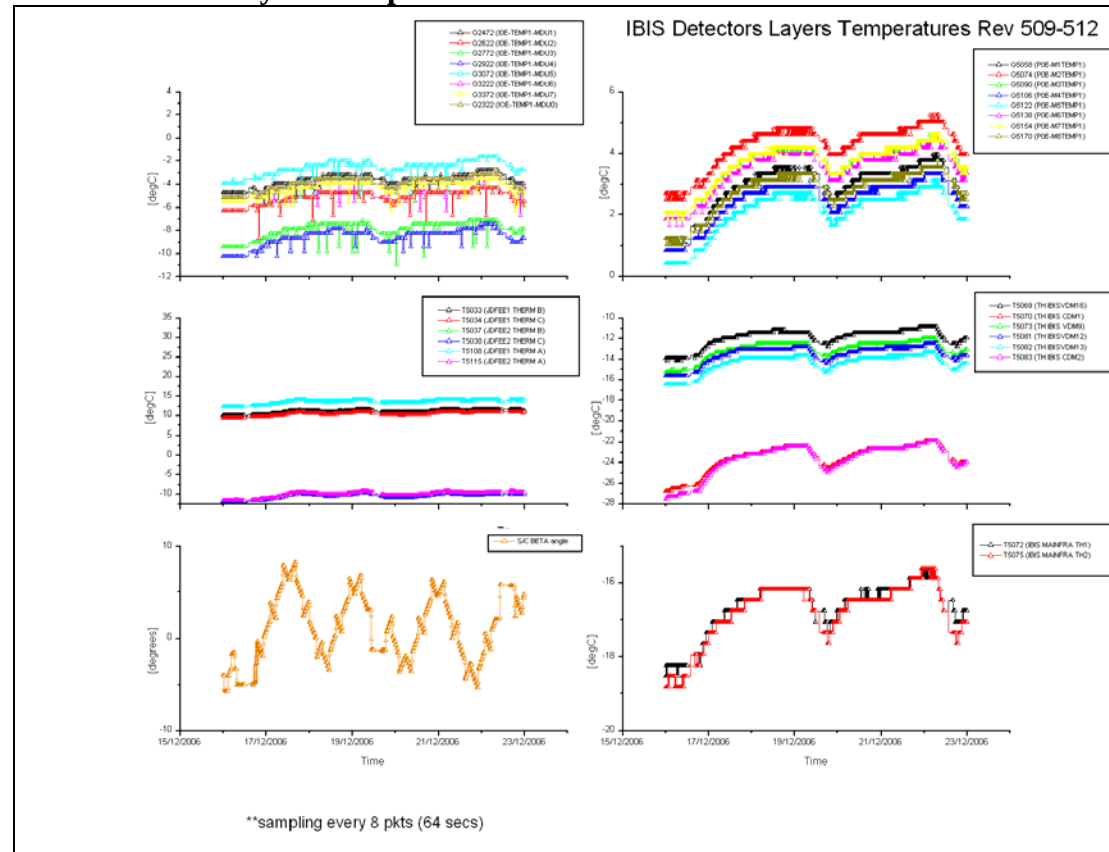
VETO Current:



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 2006.350 (16/12/2006):

Due to high radiation, IBIS was in Safe configuration until the end of revolution 509. It was reactivated as per timeline on DoY 350 (16/12/2006) at the beginning of revolution 510.

DoY 2006.353 (19/12/2006): VETO reduced count-rates (INT_SC-170)

At 02:43Z, TM parameter G6047 (V1S-VDM13-HV) was reported Out Of Limit "Low-Low". This caused parameters G6061 (V1S-CAL-COUNT), G6062 (V1S-BOT-COUNT) and G6063 (V1S-LAT-COUNT) to report a drop, triggering the OOL "warning low" for G6061.

The VDM13 High Voltage came back into limits automatically at 02:46Z. However the counters remained low (but not triggering OOL) until next Radiation Belts entry on DoY 353 at 07:42Z.

DoY 2006.353 (19/12/2006):

At 07:42Z, IBIS went automatically into a Safe configuration due to high radiation as the S/C approached the Radiation Belts. The expected Belts entry was planned in the timeline at 09:06:06Z but the intense solar flare that hit the Earth in the previous week, has probably affected the shape of the Belts.

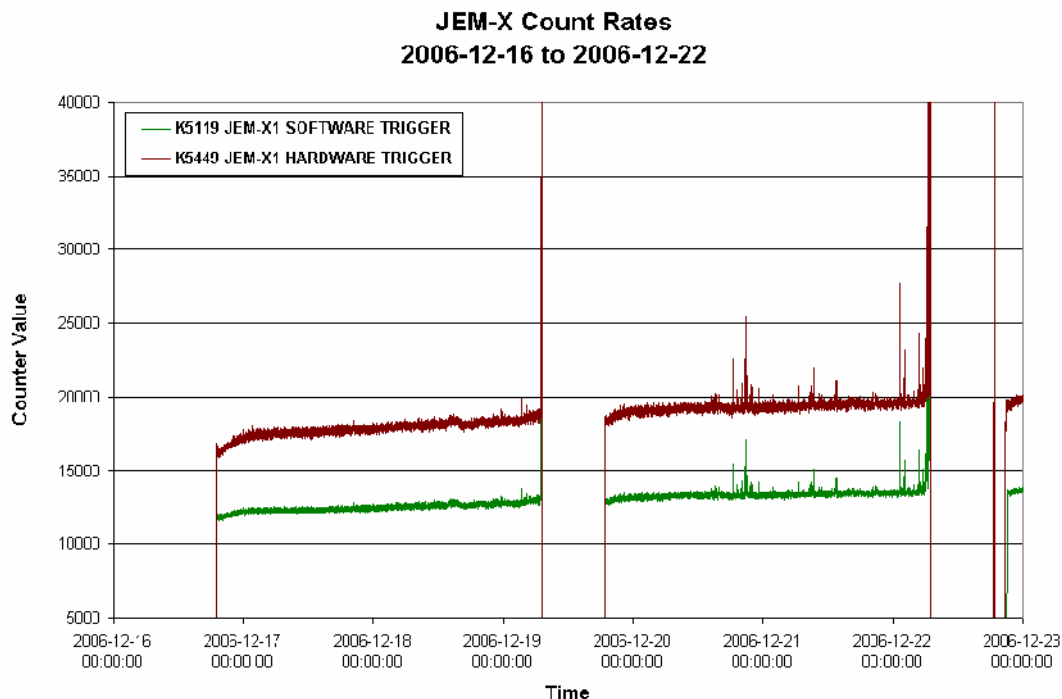
DoY 2006.356 (22/12/2006):

At 06:51Z, IBIS went automatically into a Safe configuration due to high radiation as the S/C approached the Radiation Belts. The expected Belts entry was planned in the timeline at 08:55:46Z but once again the shape of the Belts have probably been affected by the intense solar activity.

8.3.4 JEM-X Operations

JEM-X Count Rates

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

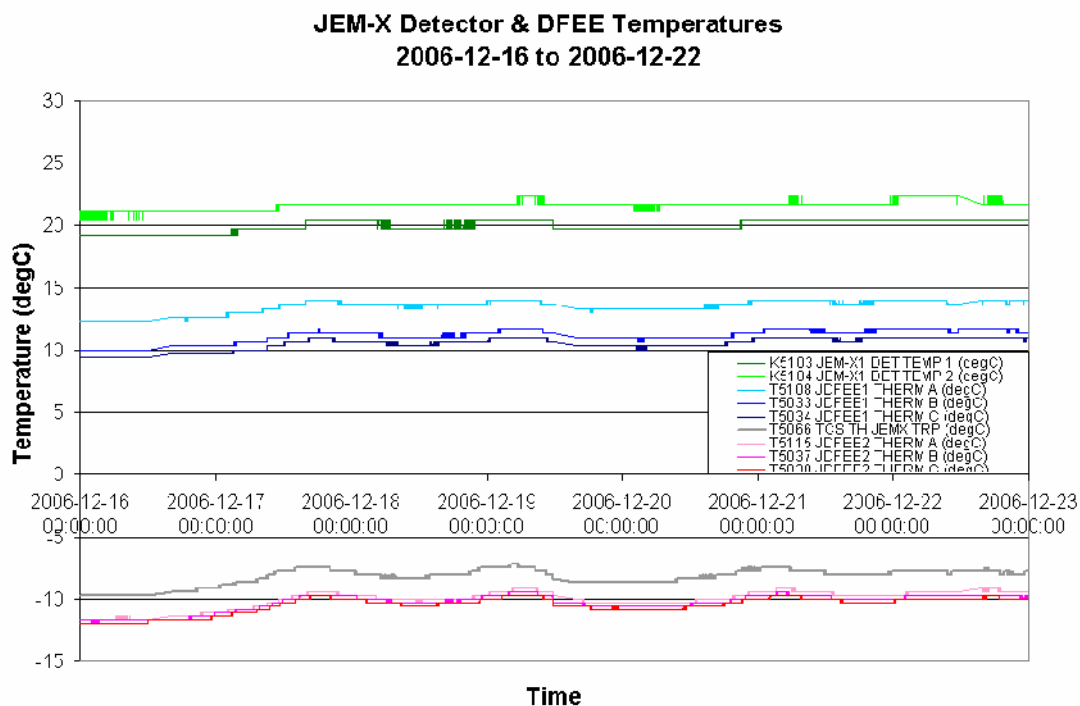


JEM-X Temperatures

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.

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

² Data sampled (1 frame in 8)



JEM-X Daily Report

2006-12-16 (DOY 350, Rev 509-510)

Due to continuing high background conditions, JEM-X1 remained in Safe mode for the rest of revolution 509. It was activated by the Timeline at the start of revolution 510 and operations continued nominally.

2006-12-17 (DOY 351, Rev 510) to 2006-12-18 (DOY 352, Rev 510)

JEM-X operations executed nominally.

2006-12-19 (DOY 353, Rev 510-511)

Due to high background radiation conditions, at 07:02:28Z the TM parameters K5449 HARDWARE TRIGGER and K5136 BUFFER LOSS started toggling OOL High. This was ~1 hour before the planned transition to Safe mode before radiation belt entry of revolution 510. At 07:13:08Z K5119 SOFTWARE TRIGGER also went OOL High and at 07:13:44Z 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) was received at this time, as the TM parameter K5462 DFEE STATE IASW was reporting state Setup while K5022 DFEE STATUS was Safe. At 07:20:09Z FCP_JEM1_0040 was executed, setting K5462 DFEE STATE IASW to Safe as well and OEM 254 ERROR OFF was received.

2006-12-20 (DOY 354, Rev 511) to 2006-12-21 (DOY 355, Rev 511)

JEM-X operations executed nominally.

2006-12-22 (DOY 356, Rev 511-512)

Due to high background radiation conditions, at 06:13:01Z the TM parameter K5136 BUFFER LOSS started toggling OOL High and at 06:35:25Z K5449 HARDWARE TRIGGER also went OOL High. This was ~1.5 hours before the planned transition to Safe mode before radiation belt entry of revolution 511. At 06:42:53Z K5119 SOFTWARE TRIGGER also went OOL High and at 06:54:47Z JEM-X1 made an autonomous transition to Safe mode, triggered by the Software Ratemeter. OEM 189 JEM-X1 PROB DFEE 9 (Unexpected DFEE state reported in housekeeping) was received at this time, as the TM parameter K5462 DFEE STATE IASW was reporting state Setup while K5022 DFEE STATUS was Safe. When the ED KESAFE02 was sent from the Timeline at 08:00:16Z K5462 DFEE STATE IASW was set to Safe as well and OEM 254 ERROR OFF was received.

Just after the activation of JEM-X1 at the start of revolution 511, at 18:49:41Z the TM parameters K5449 HARDWARE TRIGGER and K5136 BUFFER LOSS went OOL High. At 18:50:45Z K5119 SOFTWARE TRIGGER also went OOL High and at 18:51:12Z JEM-X1 made an autonomous transition to Safe mode. OEM 189 JEM-X1 PROB DFEE 9 (Unexpected DFEE state reported in housekeeping) was received at this time, as the TM parameter K5462 DFEE STATE IASW was reporting state Setup while K5022 DFEE STATUS was Safe. At 18:53:04Z 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 as measured by IREM and observing that they returned stably within the safe thresholds for JEM-X1, JEM-X1 was reactivated as follows:

- 20:19:02Z FCP_JEM1_0041 JEMX1 TRANSITION TO SETUP
- 20:26:47Z FCP_JEM1_1010 JEMX1 CONFIGURATION SETTING FOR SCIENCE OPS
- 20:58:08Z FCP_JEM1_0044 JEMX1 DATA TAKING

JEM-X1 operations continued nominally.

8.3.5 OMC Operations

2006-12-16 (DoY 350, Rev 509)

Nothing to report.

2006-12-17 (DoY 351, Rev 510)

On DoY 351, at 23:45, a hit on the line with Redu caused the failure of the AOCS commands. A manual recovery was performed, and the OSL executed at 00:03. The OMC commands were manually sent at 00:08. The impact was an 18 minute delay in the start of pointing 05100042.

2006-12-18 (DoY 352, Rev 510) to 2006-12-20 (DoY 354, Rev 511)

Nothing to report.

2006-12-21 (DoY 355, Rev 511)

On DoY 355, at 22:47, a hit on the line with Redu caused the failure of the AOCS commands. A manual recovery was performed, and the OSL executed at 23:05. The OMC commands were manually sent at 23:09, with OMC switching to science mode at 23:13:58 when the OTF was set. The impact was a 21 minute delay in the start of pointing 05110072. It was at this time the following commands were rejected:

2006.355.22.52.11.940	2006.355.22.52.15.450	1792	RealTime	131	TC REJECT
REJECTED TC1			0	0	65535 PR N
E E					
2006.355.22.52.18.065	2006.355.22.52.25.197	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.

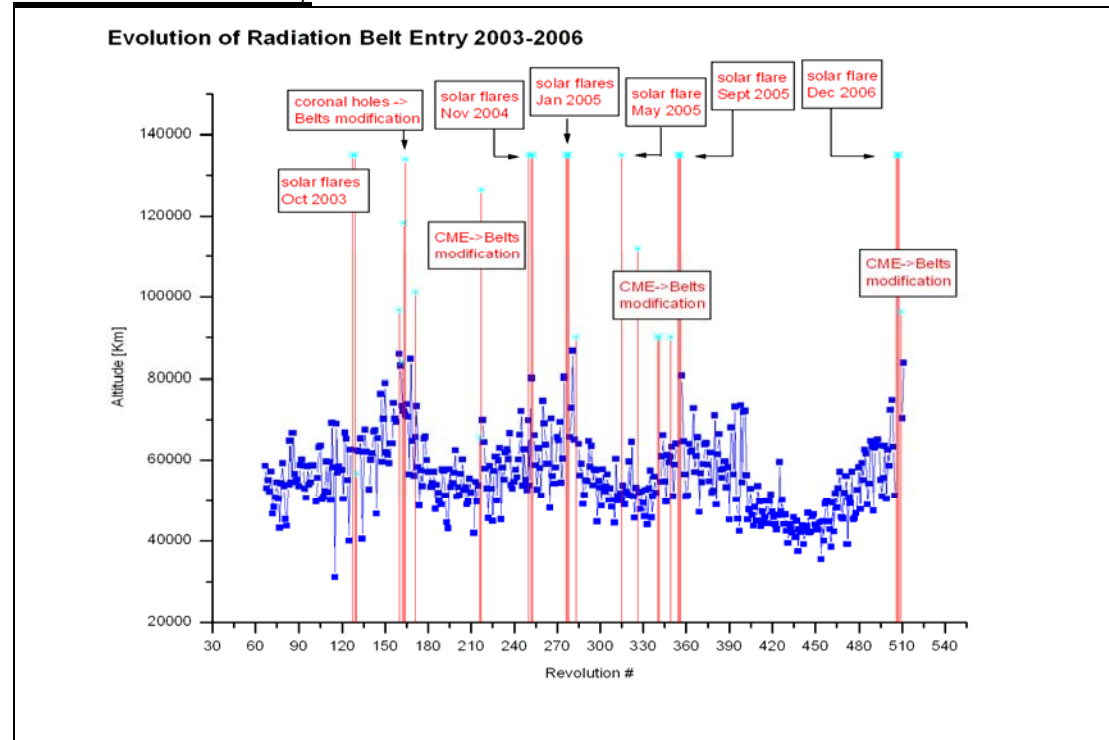
2006-12-22 (DoY 356, Rev 512)

Nothing to report.

On DoY 350 at 09:18:06, DoY 353 at 09:06:07 and DoY 356 at 08:13:43 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

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]
509	RAD_ENTR R 2006-12-16T09:18:00Z	2006-12-16 02:56:13	96249.1	2006-12-16 10:07:51	49221
510	RAD_EXIT R 2006-12-16T18:38:02Z	2006-12-16 17:46:21	<38165.5	2006-12-16 18:17:51	42110
510	RAD_ENTR R 2006-12-19T09:06:06Z	2005-12-19 07:03:25	703778.9	2006-12-19 10:03:16	48405
511	RAD_EXIT R 2006-12-19T18:25:23Z	2006-12-19 17:05:25	>>29744.9	2006-12-19 18:03:16	41626
511	RAD_ENTR R 2006-12-22T08:55:46Z	2006-12-22 04:49:49	83673.1	2006-12-22 09:53:16	48894
512	RAD_EXIT R 2006-12-22T18:14:15Z	2006-12-22 17:07:09	>>29751.9	2006-12-22 17:53:16	41199

Reference

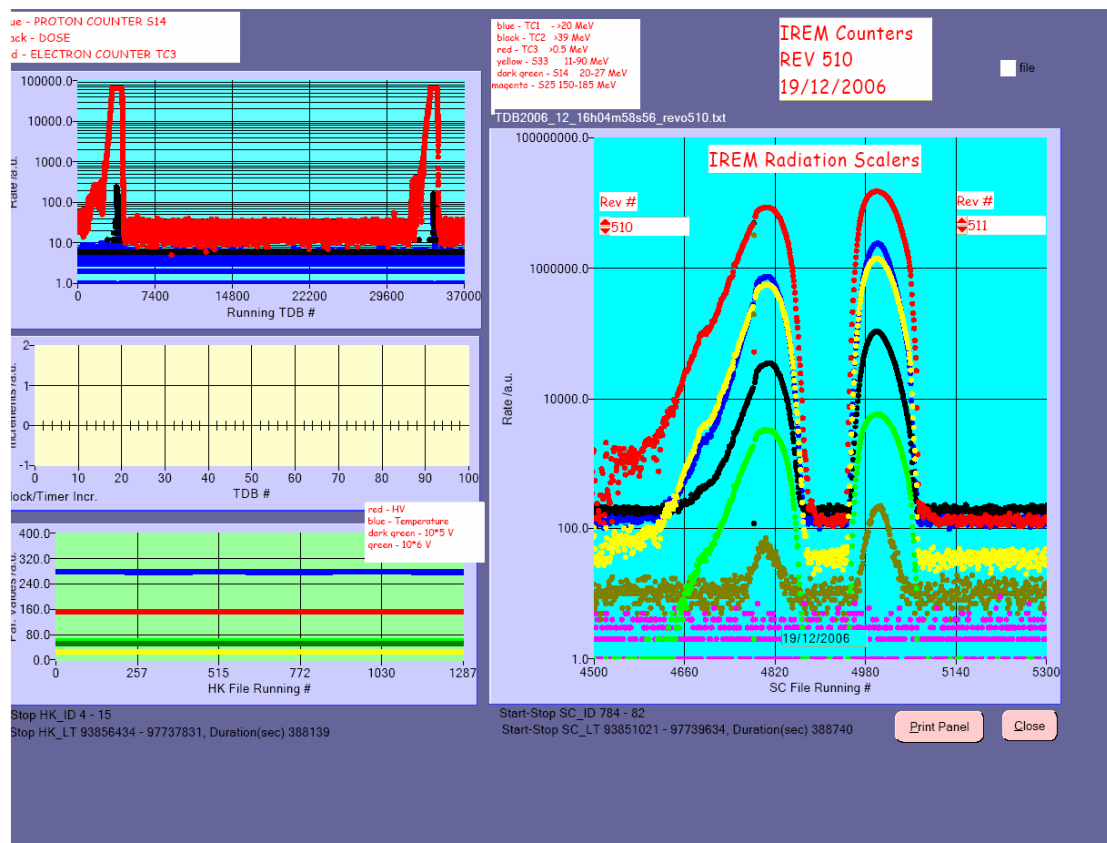
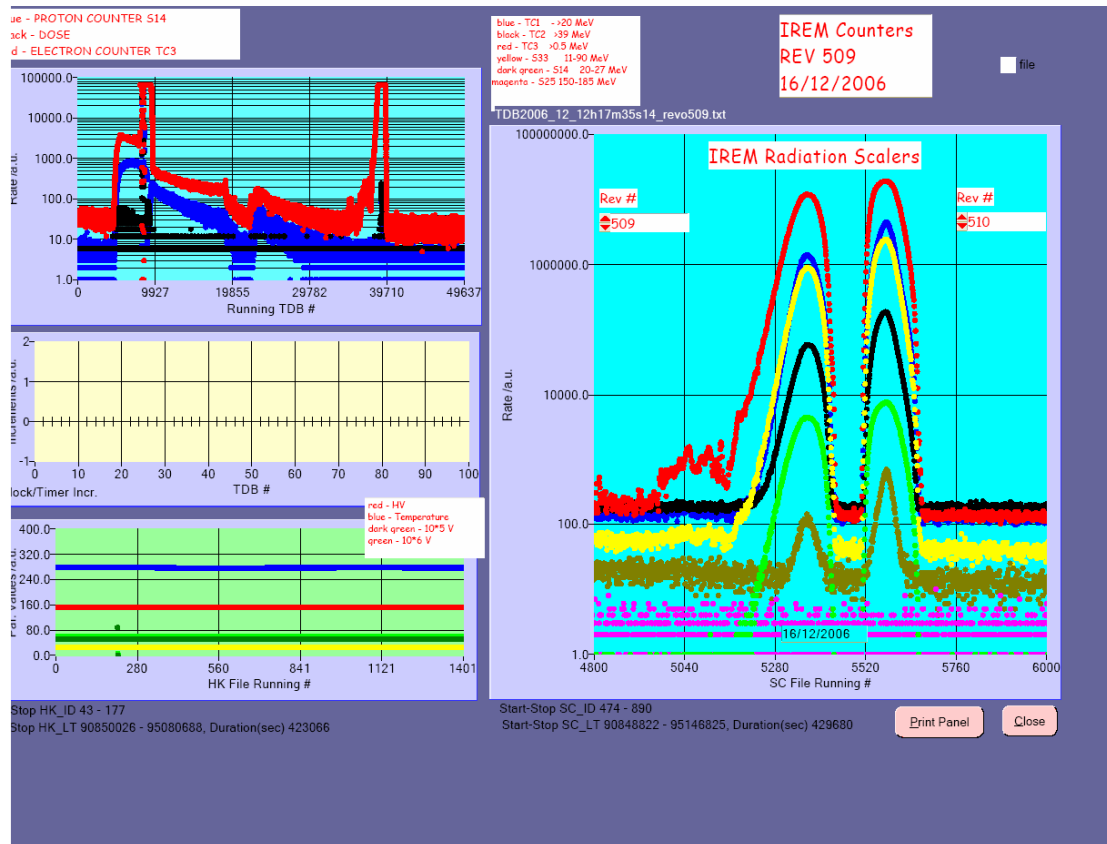
Very small error vs reference (less than 10 minutes)

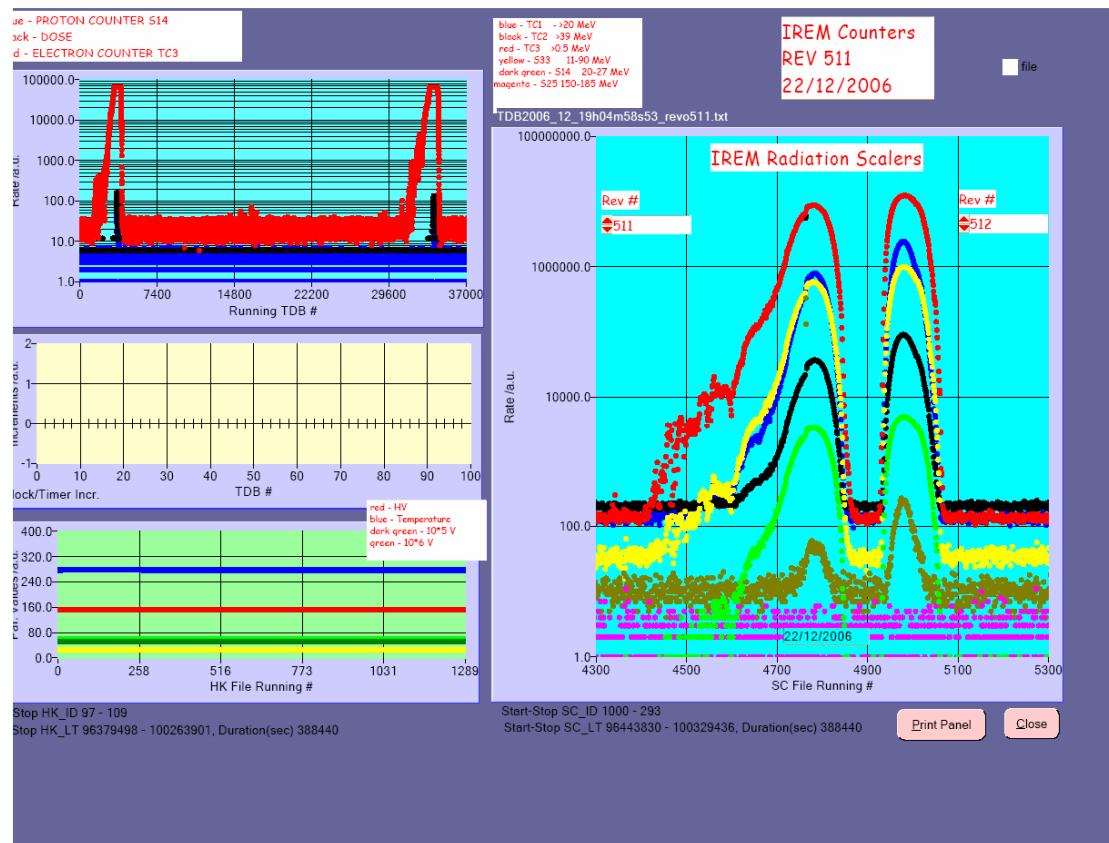
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

Radiation Spike

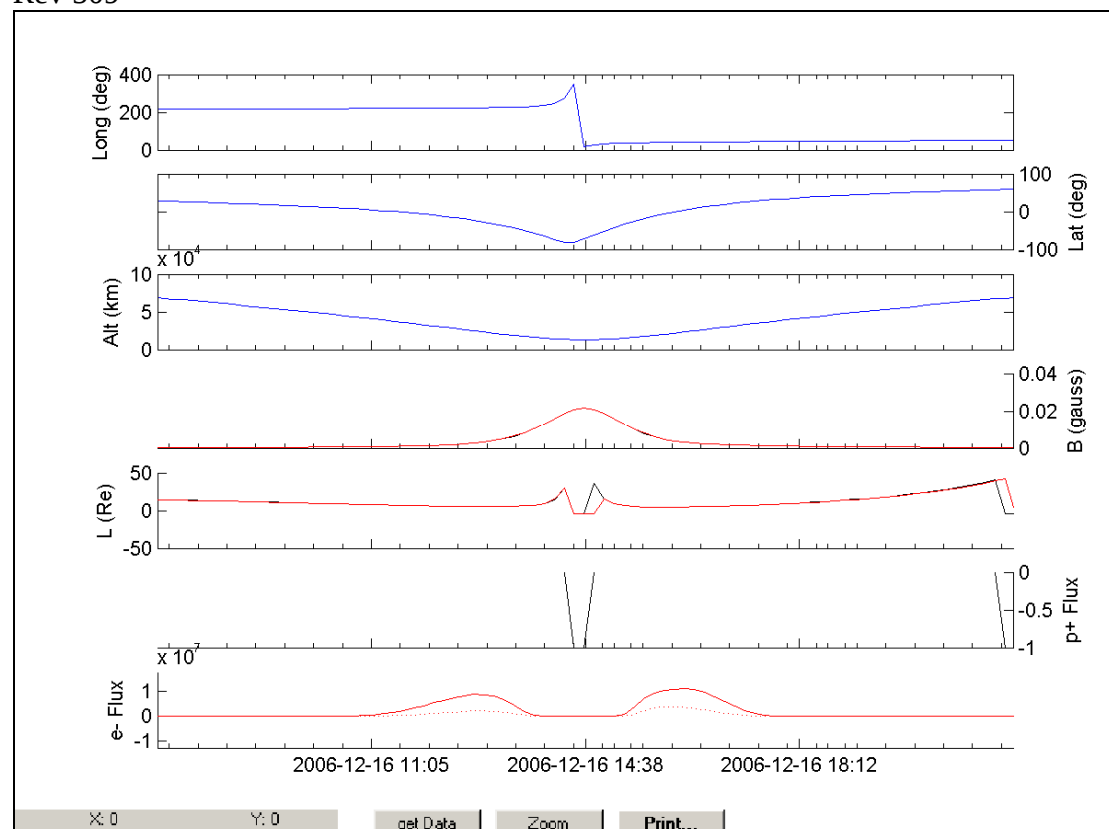
IREM radiation counters:



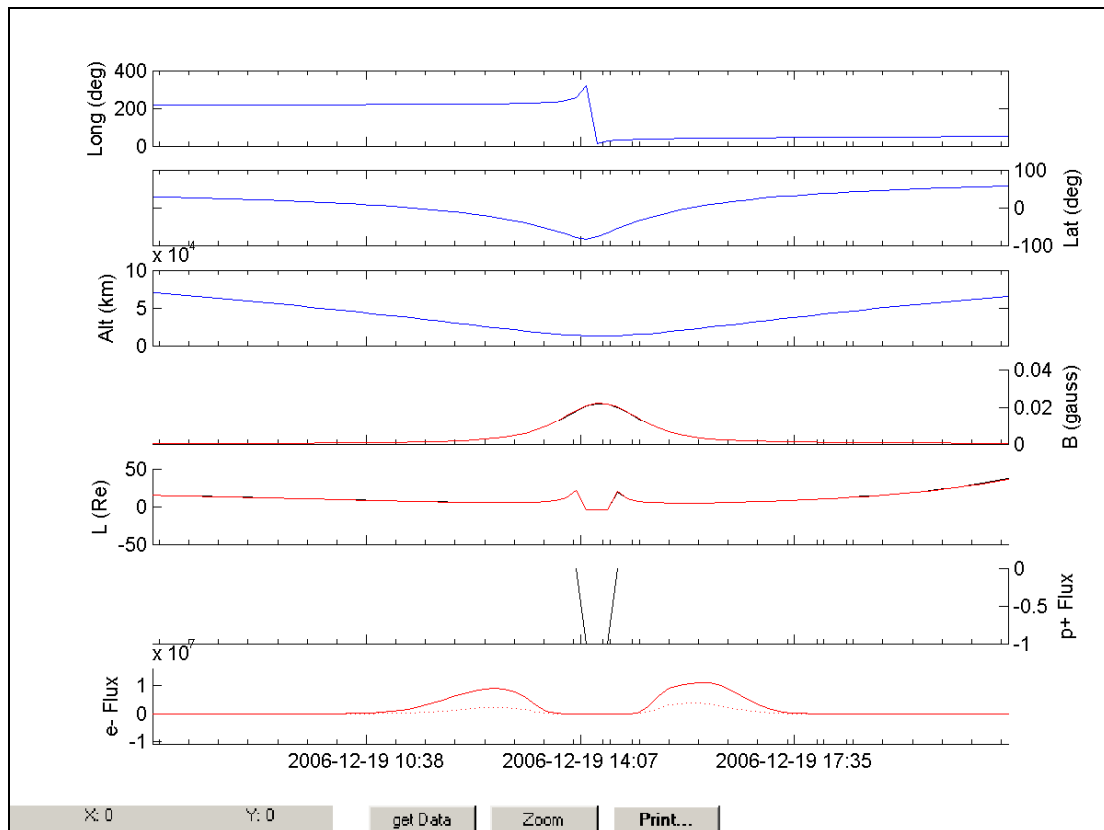


IREM Predicted Radiation Belt Passages

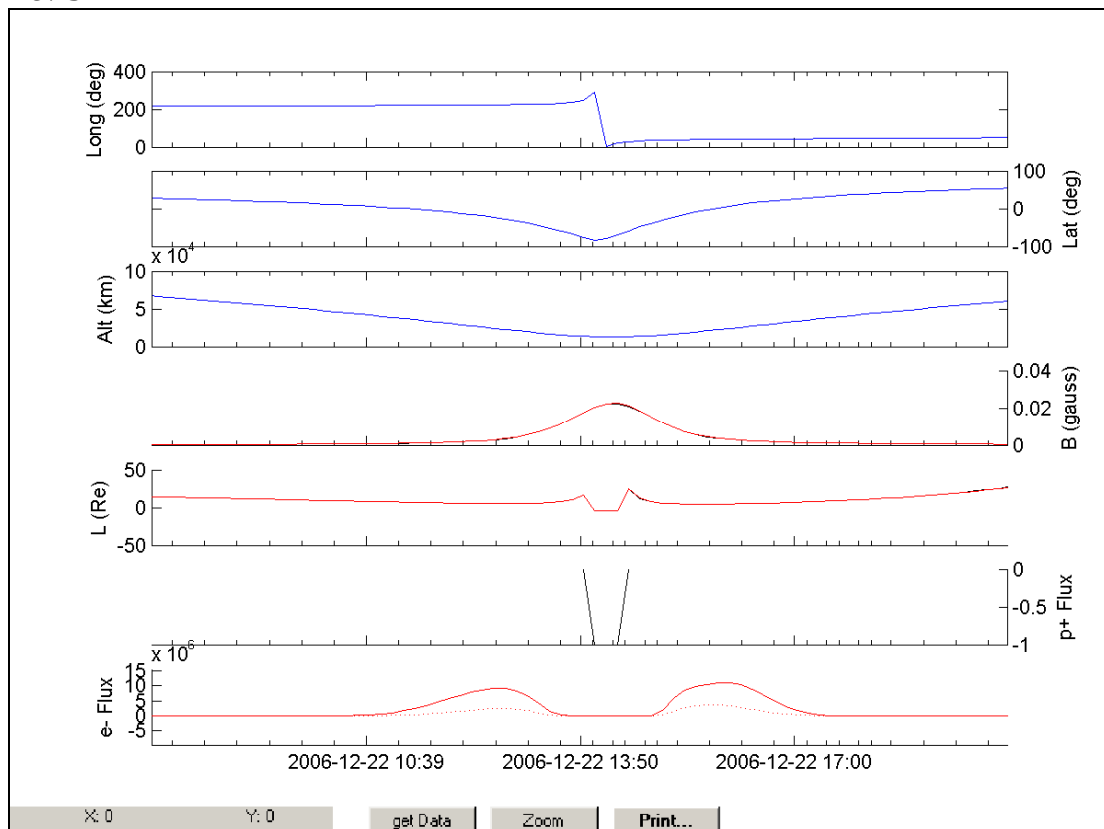
Rev 509



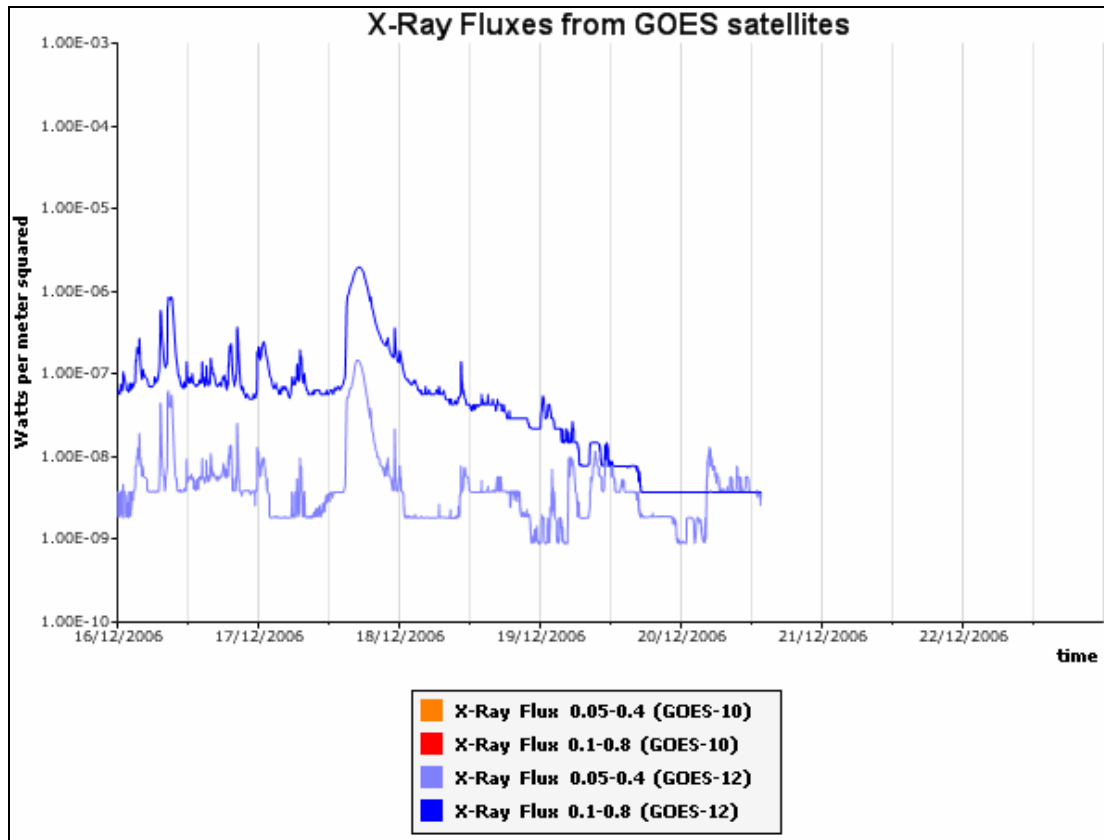
Rev 510



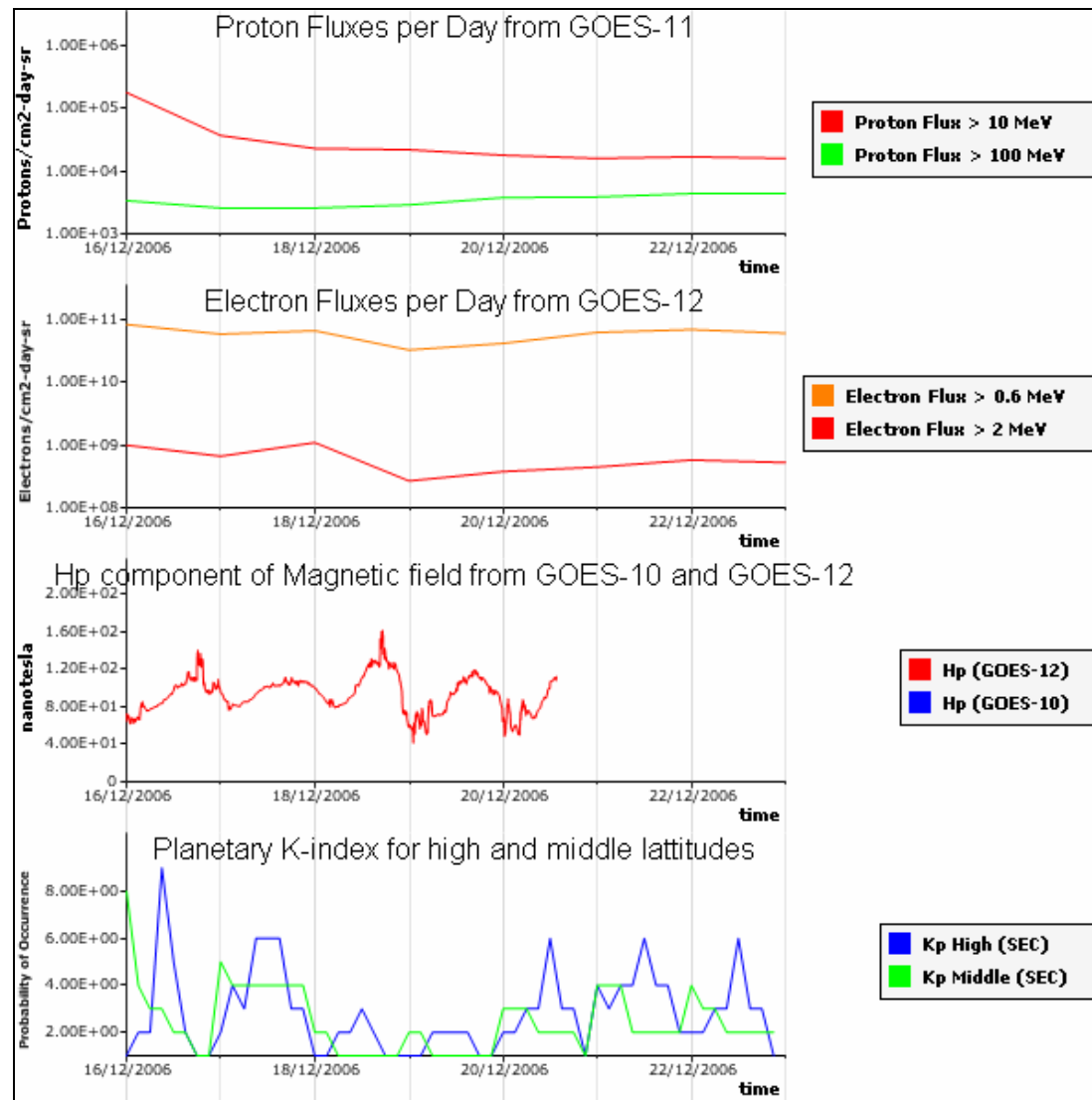
Rev 511



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



X-Ray fluxes start to be significant over 10^{-5} W/m^2 (corresponding to M-class flares). Above 10^{-4} W/m^2 , they correspond to strong X-class flares.



Proton and electron flux report low 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.