EUROPEAN SPACE AGENCY
DIRECTORATE OF TECHNICAL & OPERATIONAL SUPPORT
MISSION OPERATIONS DEPARTMENT

INTEGRAL
Mission Report

INT-MOC-SYS-RP-1001-OPS-OF

No. 180
Week 09

06.03.06

Routine Phase

Prepared by: M. Walker (OPS-OFO)

LIST OF CONTENTS

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		DSN - MPSETD	1
ESTEC/SCI-A			
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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 25.02.06 until 03.03.06 (both dates inclusive) and covers the revolutions 412 and 413.

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 a Galactic Plane Survey, a hexagonal dither of the Galactic Bulge region (RA 17:45:36.00; DEC -28:56:00.0), and finally a Galactic Centre Deep Exposure.

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 slew lost during the observation period.

The fuel consumption over the period between 24/02/2006 and 03/03/2006 was 0.1521 kg. The remaining propellant is in the order of 155.9596 Kg.

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

3.1.2 Power

The EPS is working nominally, available power from the arrays is of the order of 2100W.

3.1.3 Thermal

The thermal control of the satellite is working well. The temperatures are currently all within the specified operational limits.

3.1.4 OBDH

The OBDH subsystem is working flawlessly. No on-board communications problem was identified.

3.1.5 RFS

The RF subsystem is working properly. The link margin is sufficient to ensure proper TM reception and execution of commands with the ranging channel enabled.

3.2 Payload

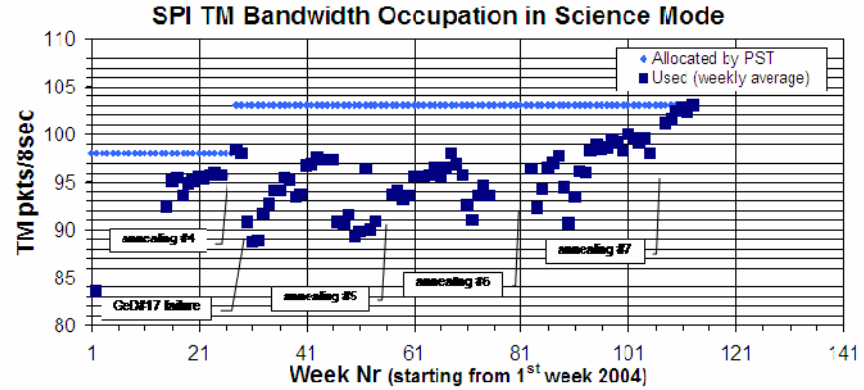
3.2.1 SPI

Following the 7th annealing, ended on 24th January, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detector #15, which is showing an anomalous energy resolution.
Since 09.02.2006 the detector is working with slightly reduced high voltage setting, where the energy resolution is almost nominal at low energy, degraded by approx 10% at 1764 keV and 20 % at 2.7 MeV. Detector #2 is failed since 06.12.2003, detector #17 since 17.07.2004.

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 103 pkts/cycle.
The telemetry downlink of SPI has therefore reached saturation: in these conditions, the Photon telemetry was still correctly transmitted in the science windows, as the internal photon buffer was able to cover temporary acquisition burst, except when close to the belts (1-2 hours).

The Stirling compressors work nominally, maintaining the Germanium detectors at 85K +/-1K.

The following plot shows the assigned and the average occupation of the SPI TM bandwidth.



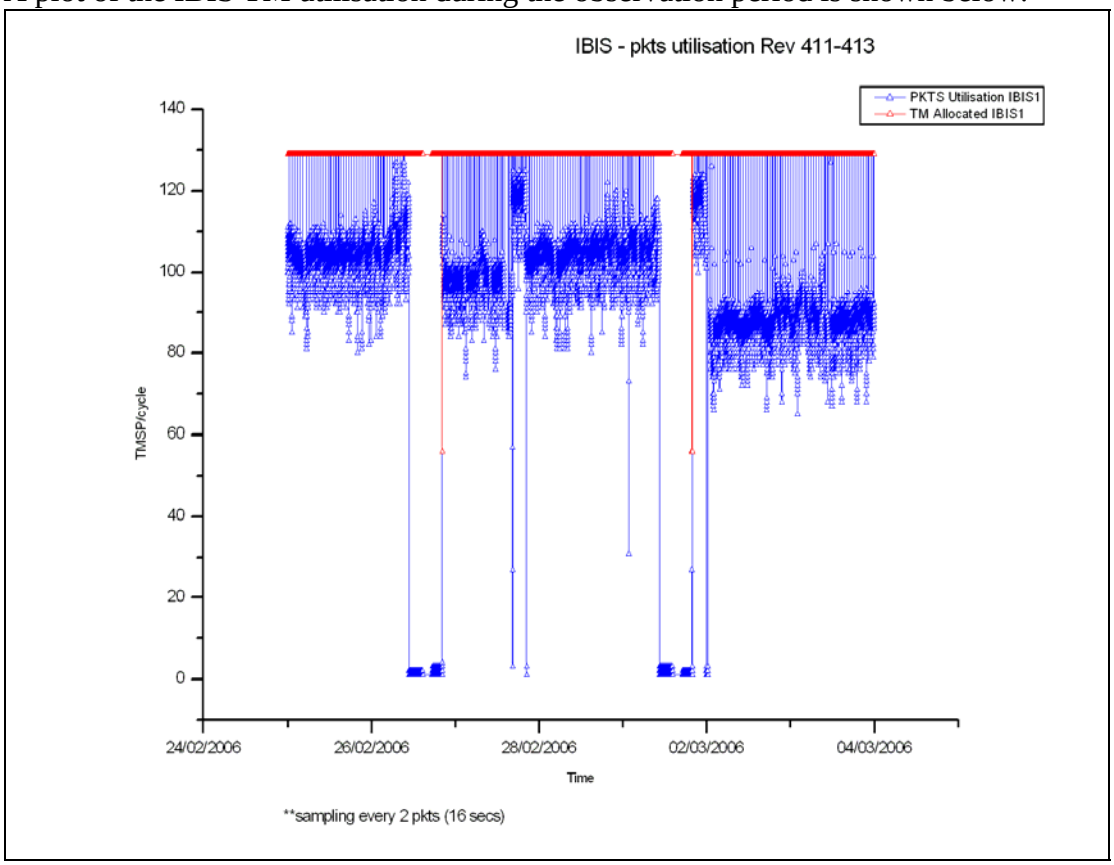
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

The Overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 129 TMPS/cycle. The IBIS mean bandwidth utilisation during the observation period was 101.4 TMPS/cycle, down 12.18 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 throughout the reporting period, with a TM allocation of 8 packets/cycle. JEM-X2 was dormant (DFEE OFF) with 1 packet/cycle.

Further information on the JEM-X operations can be found in the Appendix Section 8.3.4.

3.2.4 OMC

The status of OMC is nominal.

OMC operations were performed by the automatic Timeline. OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle.

During this reporting period, 191 of the 193 planned science pointings for OMC were executed nominally, one pointing started late, and one was 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 very low solar activity.
The Sun was blank during most of the observation period.

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 good this week. A problem with the Command Verifier led to the loss of a pointing. There were several minor problems with ground station and ISDC links, but these had no impact. The overall performance was well above the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was good this week, a pointing was lost when the Command Verifier died and there were minor problems with the DCA Clock. The overall performance was well above the 95% requirement.

4.2 Ground Stations & Network

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

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning
New PSF's for revolutions 417 to 421 have been received. Planning for all these revolutions has been performed and sent to MOC. Replanning of revolutions 414 and 415 were performed because of a received and approved ToO follow up request for the source XTE J1817-330.
TSF's up to revolution 417 are now available. The intention is to perform the already mentioned AOCS calibration and the CRAB calibration in revolution 422.

2. Observation status
ECS's for revolutions 398,400,402, 403 and 406 were received. All except revolution 398 have all been processed by ISOC
and the corresponding OCS's sent to ISDC. No extra time has been credited.

3. ISOC science data archive
The performance problems detected during the testing of the beta versions of ISDA have been subject of substantial investigations this week. This has resulted an updated beta release of the ISDA with significantly improved performance.
It is therefore expected the ISDA would be ready for release to the public next week. The actual release will depend on the XMM and ISO archives of the XSA and the ISO archives. All three archives need to be released simultaneously due to new interoperability features between them. This week has again seen the system crash twice. The hardware manufacturer DELL has been approached but claims it to be a software problem. This is not the ESA position since there is in ISOC one more computer of the same type and with the same basic software. This one works without problems.

4. ISOC system
The version 12.1 was has continued to be used this week without problems. The work on the version 12.2 has progressed satisfactorily. Beta releases of the software packages used by the science community have been tested internally this week. See also below.

5. AO 4 preparation
All AO documentation is now complete. The proposal generation tool PGT is also ready. The Observation Time Estimator OTE has now got flies to enable the tool to be used for energies up to 8.9 MeV. The SPI and IBIS manuals have been verified against OTE w.r.t sensitivity curves. For the Target Visibility Predictor the only outstanding problem is the missing inputs from MOC / Flight Dynamics.

6. Problems
None besides the communication problem mentioned above.

4.3.2 ISDC

Status of ISDC observation processing on 06/03/2006:

- Latest Standard Analysis completed: observation 03200160002 (NGC 4945, Revolution 400) on 06/03/2006

- Latest products archived: observation 03200560001 (Cas A /Tycho, Revolutions 386-395) on 07/02/2006

- Latest observation products sent to the observer: observation 02297000019 (Cas A, Revolutions 352 & 384-385) on 13/02/2006

5 Special Events

6 Anomalies

There was just one problem relating to the ground segment that impacted the operations:

- On DoY 061, at 00:04, the Command Verifier crashed, causing the loss of pointing 04130010.

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

AR id	Date Created	Subject	Segment	Status
INT_SC-142	06/03/2006	SPI PSD Channel Rates Malfunction	Payload	Open

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 412

The observations in revolution 412 began with a Galactic Plane survey, which lasted ~15.3 hours. This was followed by a hexagonal dither of the Galactic Bulge region (RA 17:45:36.00; DEC -28:56:00.0), which lasted ~3.5 hours. Finally a Galactic Centre Deep Exposure was executed for ~34.7 hours.

Revolution 413

The observations in revolution 413 began with a hexagonal dither of the Galactic Bulge region (RA 17:45:36.00; DEC -28:56:00.0), which lasted ~3.5 hours. This was followed for the remainder of the revolution by a Galactic Centre Deep Exposure, which lasted ~54.2 hours.

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

```
2006-02-17T14:50:18.000Z     156.2657    F   Automatic TM processing.
2006-02-17T18:55:46.000Z     156.2366    F   Automatic TM processing.
2006-02-20T19:06:10.000Z     156.2058    F   Automatic TM processing.
2006-02-23T14:18:10.000Z     156.1918    F   Automatic TM processing.
2006-02-23T18:20:18.000Z     156.1486    F   Automatic TM processing.
2006-02-24T03:27:39.000Z     156.1117    F   Automatic TM processing.
2006-02-26T12:40:01.000Z     156.0893    F   Automatic TM processing.
2006-02-26T14:03:53.000Z     156.0721    F   Automatic TM processing.
2006-02-26T18:03:53.000Z     156.0650    F   Automatic TM processing.
2006-02-27T03:10:34.000Z     156.0396    F   Automatic TM processing.
2006-02-27T10:21:55.000Z     156.0217    F   Automatic TM processing.
2006-02-27T14:12:04.000Z     156.0067    F   Automatic TM processing.
2006-03-01T13:48:57.000Z     155.9897    F   Automatic TM processing.
2006-03-01T17:48:17.000Z     155.9790    F   Automatic TM processing.
2006-03-03T04:08:29.000Z     155.9596    F   Automatic TM processing.

This report was generated Fri Mar 3 08:00:26 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, 25/02/2006 – 03/03/2006

AOCS operations were executed from the Automatic Timeline.

During this period, 129 Open Loop Slews, 76 Closed Loop Slews and 9 Momentum Bias were executed (TL).

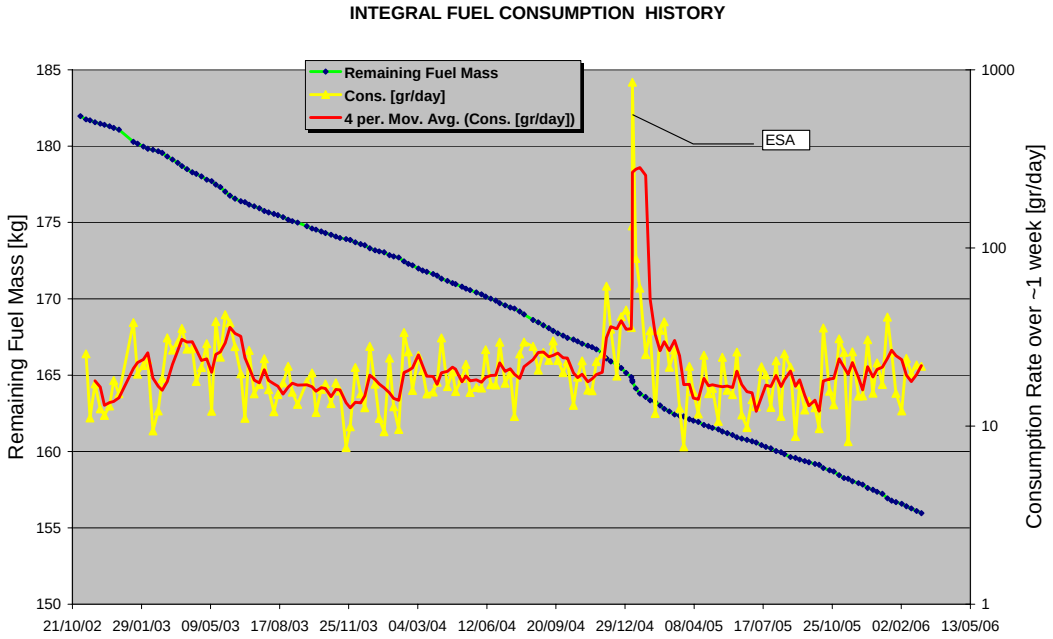
No slew lost during the observation period.

Orbit Control

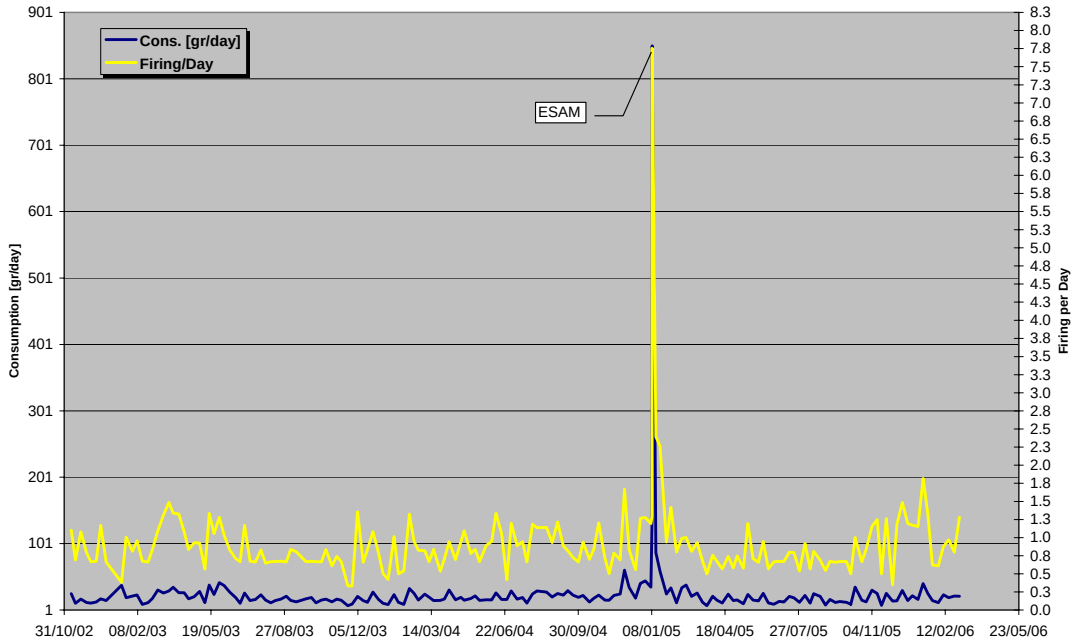
At present time the plan is to reverse the control and to increase the semi-major axis as from mid March 2006 and onwards. The "Redu only" situation could be reached in the second half of 2006, possibly mid August. The apogee longitude would then be about 32 deg East.

Fuel consumption

The fuel consumption (total, grams/day) over the period between 01/11/2002 and 03/03/2006 is reported in the plot below.

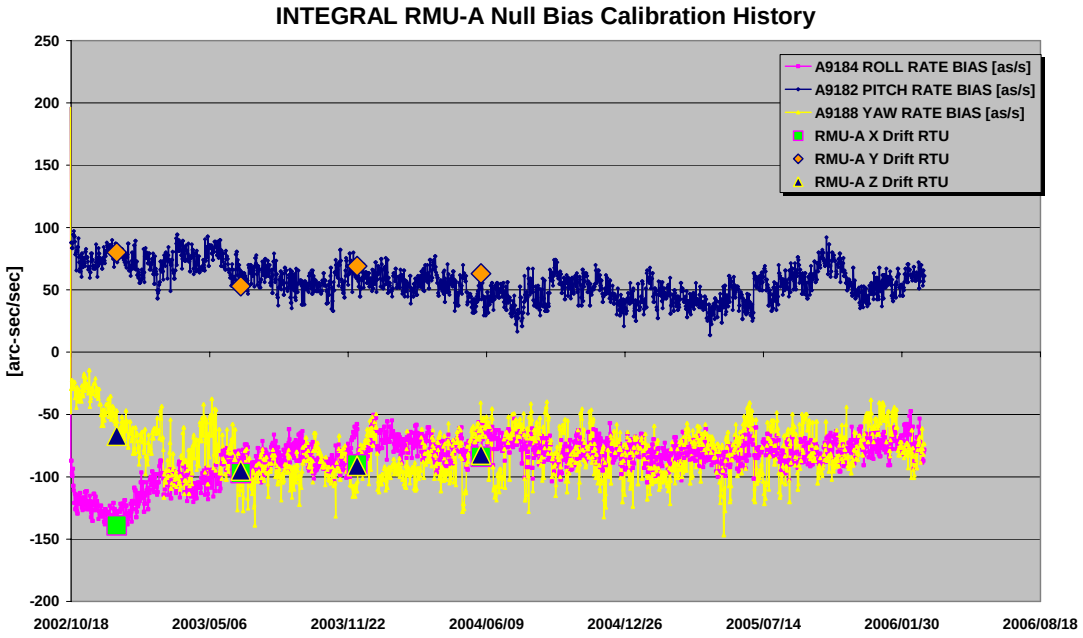


The firing\day over the period between 01/11/2002 and 03/03/2006 is reported in the plot below.

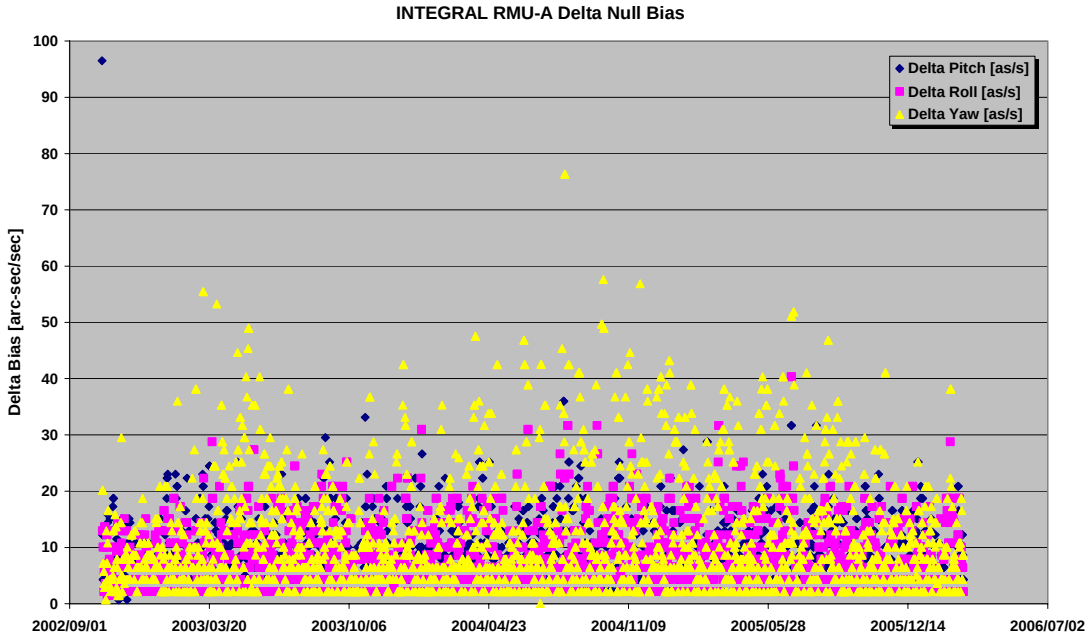


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 03/03/2006 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 03/03/2006 is reported in the plot below.



25/02/06 (Day of Year 056, Revolution 411)

Nothing to report.

26/02/06 (Day of Year 057, Revolution 411-412)

Nothing to report.

27/02/06 (Day of Year 058, Revolution 412)

Nothing to report.

28/02/06 (Day of Year 059, Revolution 412)

Nothing to report.

01/03/06 (Day of Year 060, Revolution 412-413)

Nothing to report.

02/03/06 (Day of Year 061, Revolution 413)

Slew sequence failed partially release: at 00:04Z, due to a problem on IMCS CMD Verifier Task, the slew sequence for ID 04130010 (OSL) failed partially release (mapping TCs).

The manual update for the next slew (ID 04130011) from TL was performed at 00:19Z.

No impact on TL reported, the OTF was not reached due to parallel problem on the Broadcast packet sequence for PID 04130010.

03/03/06 (Day of Year 062, Revolution 413)

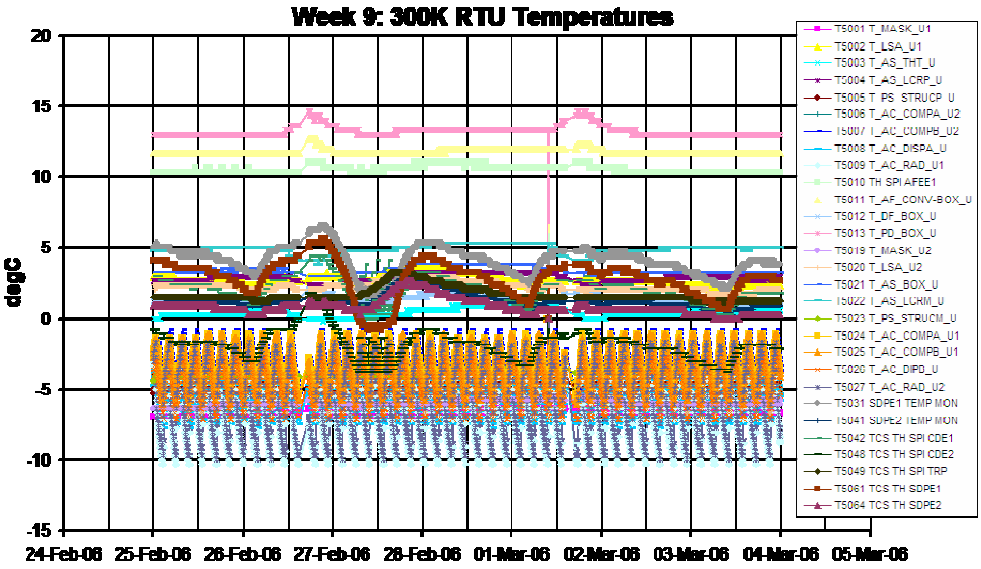
Guide star released: at 11:01Zz the ACC reported lost of guide star: the guide star, was released and the IMU1 switched ON and a new guide star was picked in the first automatic mapping, which was kept afterwards. The OTF was not reached during the PID 04130056.

A manual recovery was then performed and the following slew ID 04130057 manually updated.

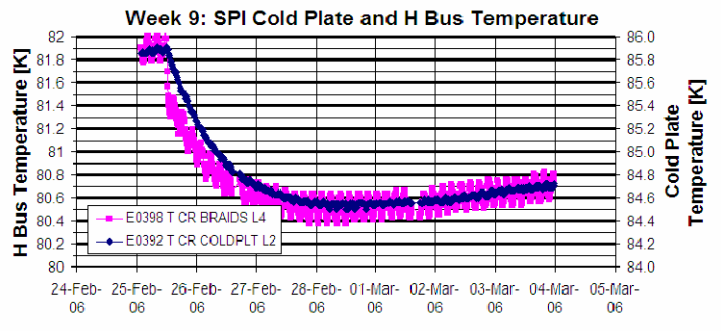
No impact on TL reported.

8.3.2 SPI Operations

Unit Temperatures:
All the equipment temperatures are inside the operational limits. The following plot shows their evolution along the reporting period (due to problems in the data retrieval tool, only day 18th Feb is available).



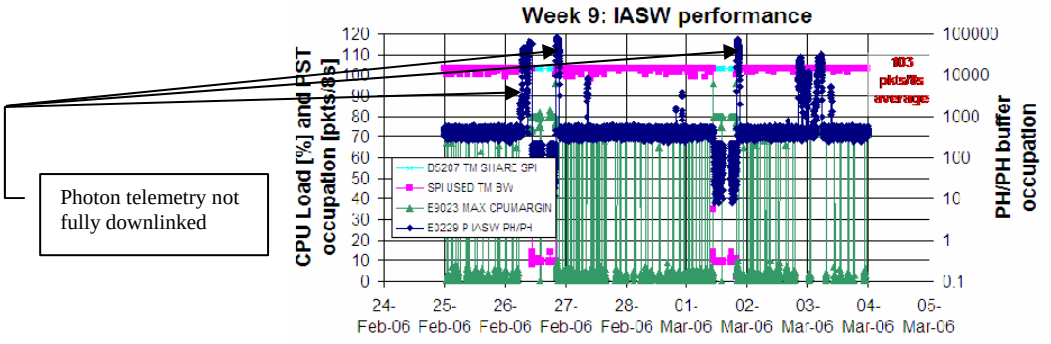
Stirling Compressors and Cryostat:
The performance of the compressors is nominal. The cold plate temperature was maintained at 85K+/-1K showing the expected positive drift.
The following plot shows the evolution of the cold-plate and H bus temperatures during the reporting period.



DPE & IASW:

The Iasw performance is nominal. The current IASW version installed is 432.

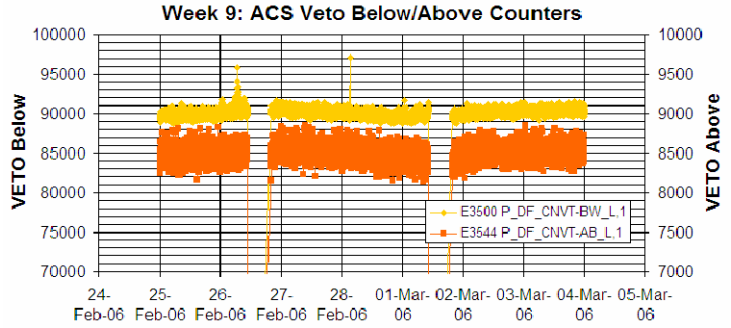
The following plot shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



ACS:

The performance of the ACS is nominal.

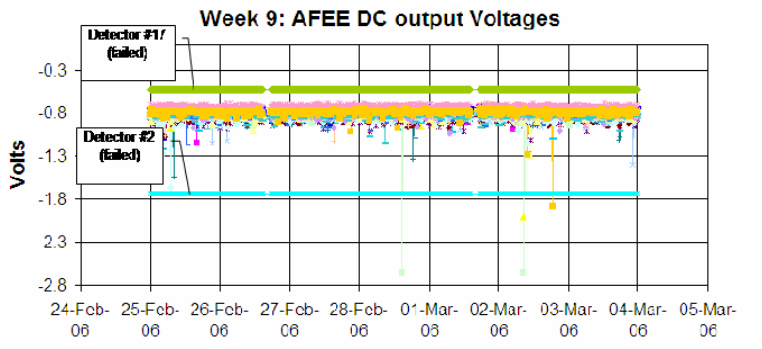
The following plot shows the ACS overall count rate evolution during the reporting period



AFEE:

The performance of the AFEE and the detectors is nominal, except for detector #15, which shows a degraded energy resolution. The anomaly has been recorded in the ESOC Anomaly Report and Tracking System (ARTS) as INT_SC-140.

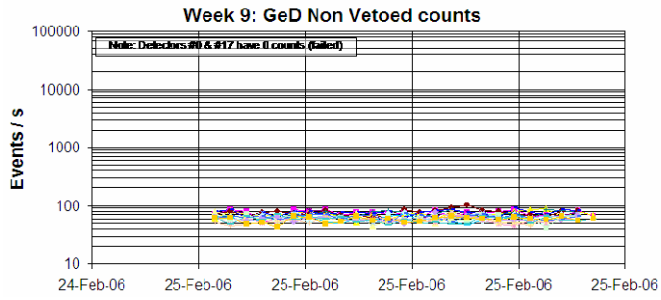
The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06.12.2003 and detector #17 is failed since 17.07.2004.

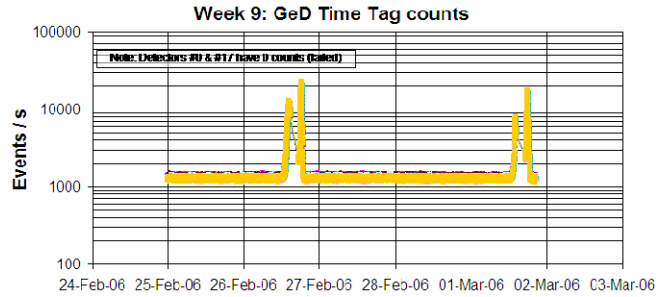


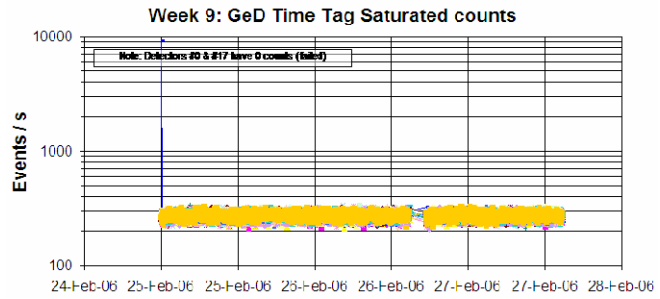
DFEE:

The performance of the unit is nominal.

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).



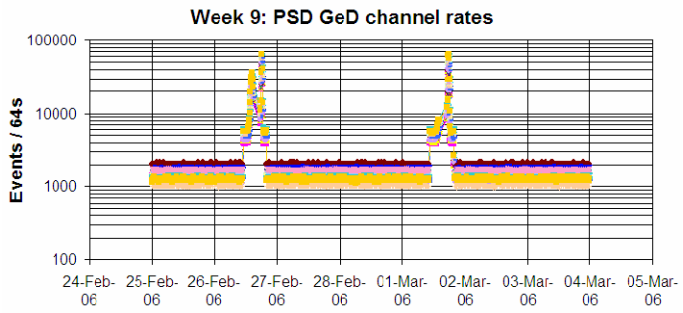




PSD:

The performance of the unit is nominal.

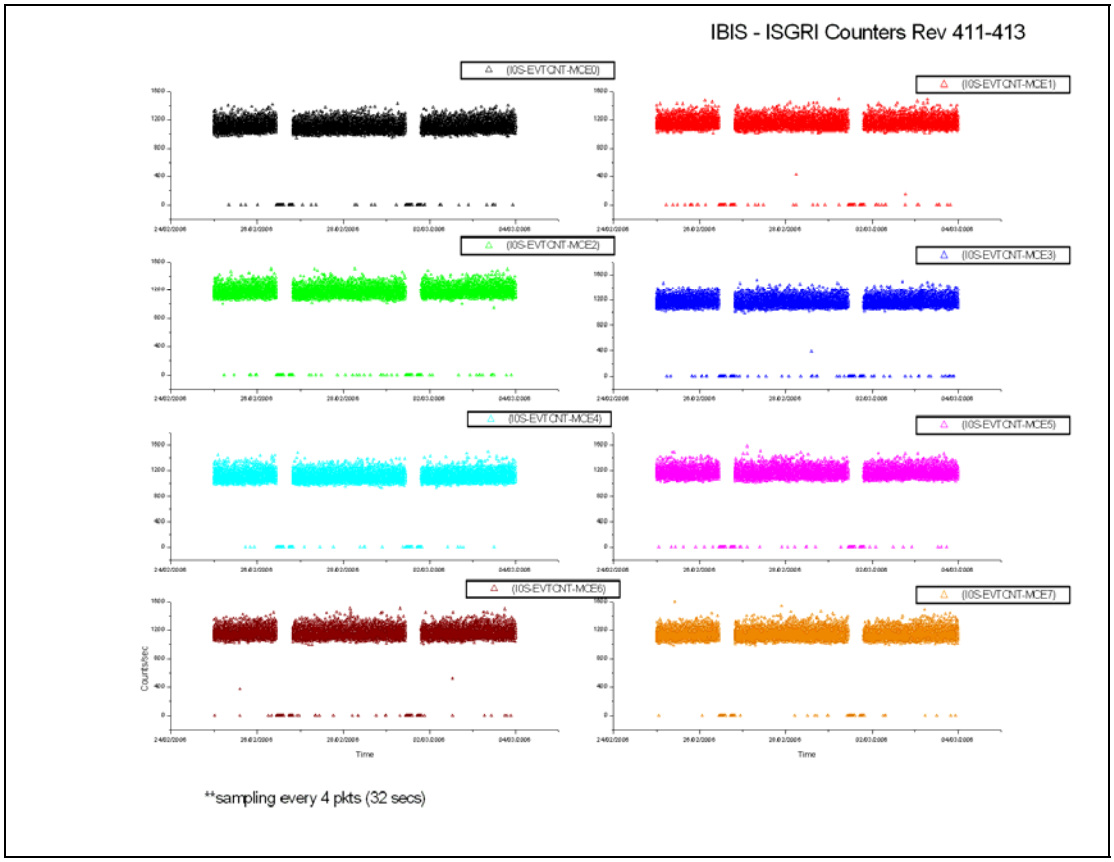
The following plots show the PSD channel rates during the reporting period



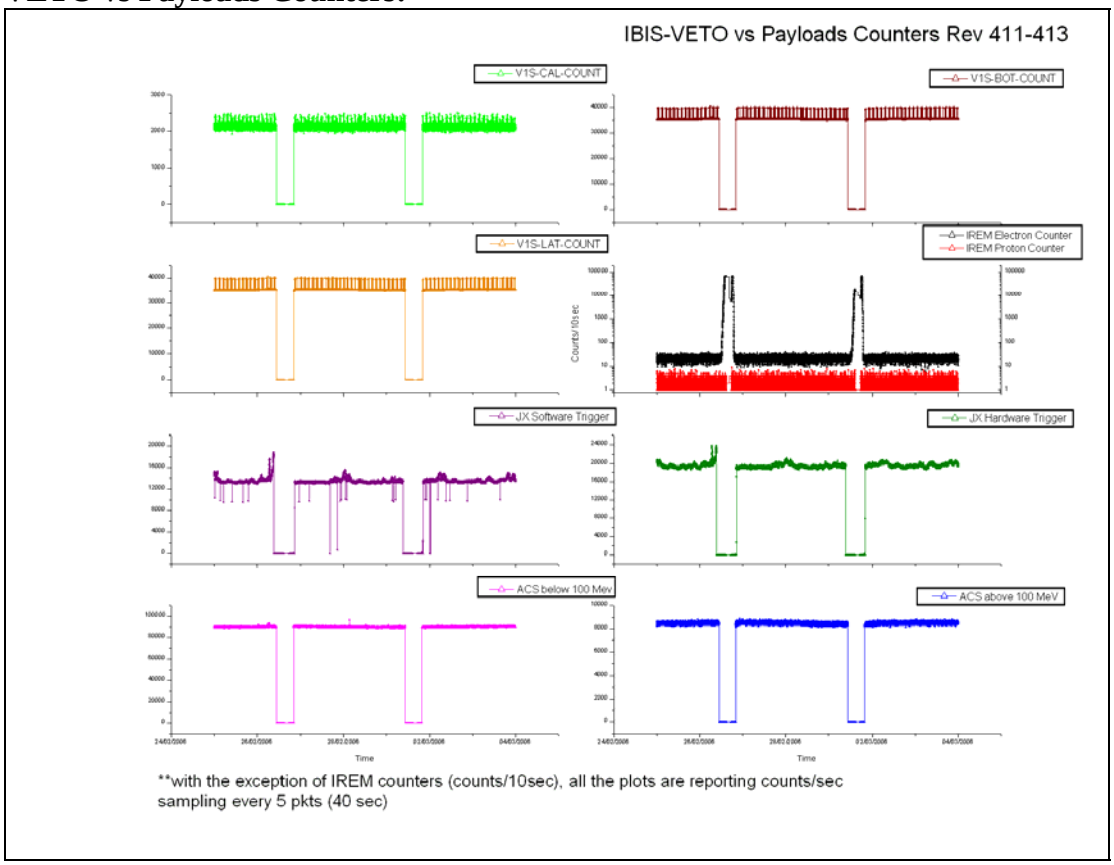
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

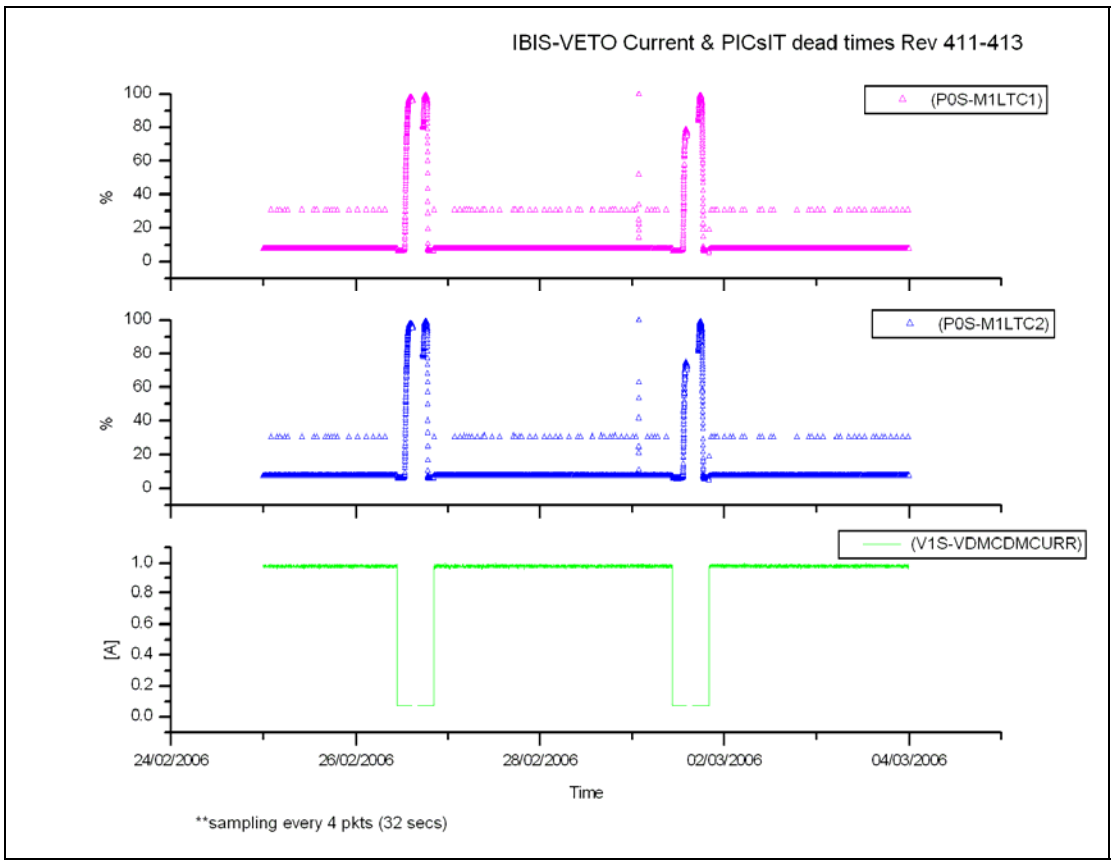


VETO vs Payloads Counters:

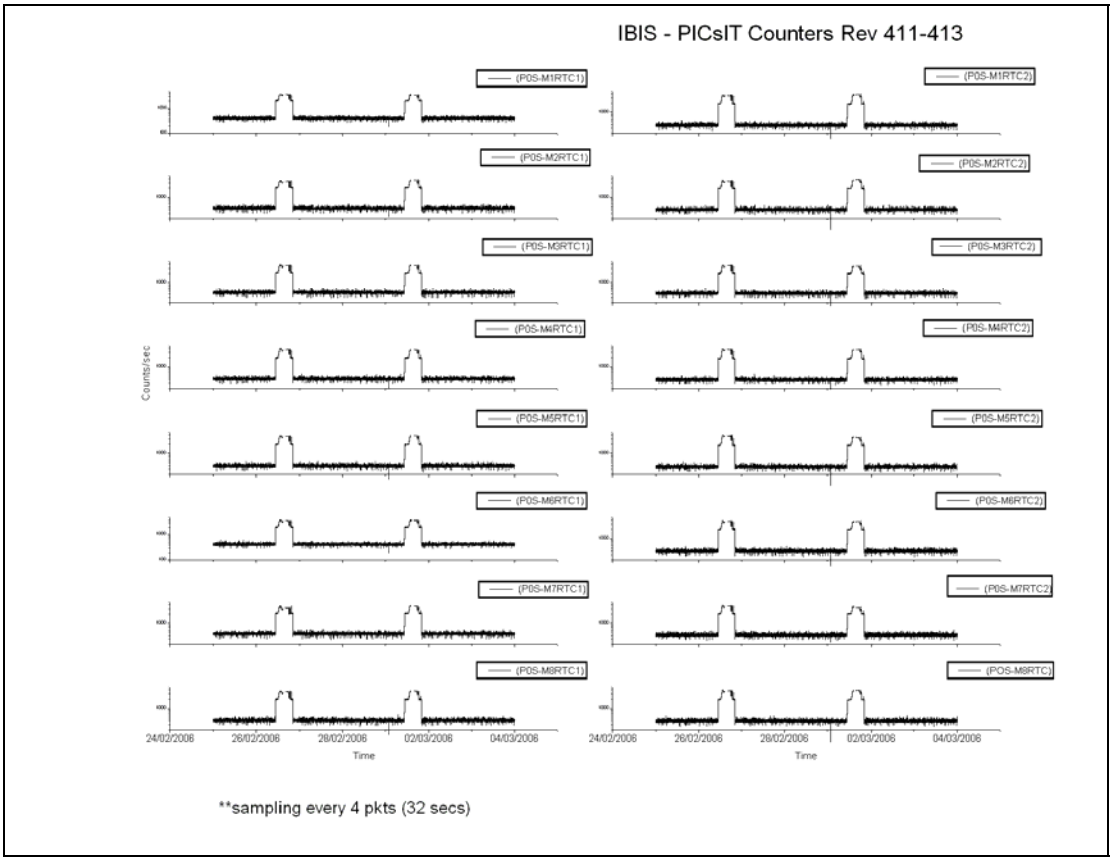


The week was characterised by low radiation.

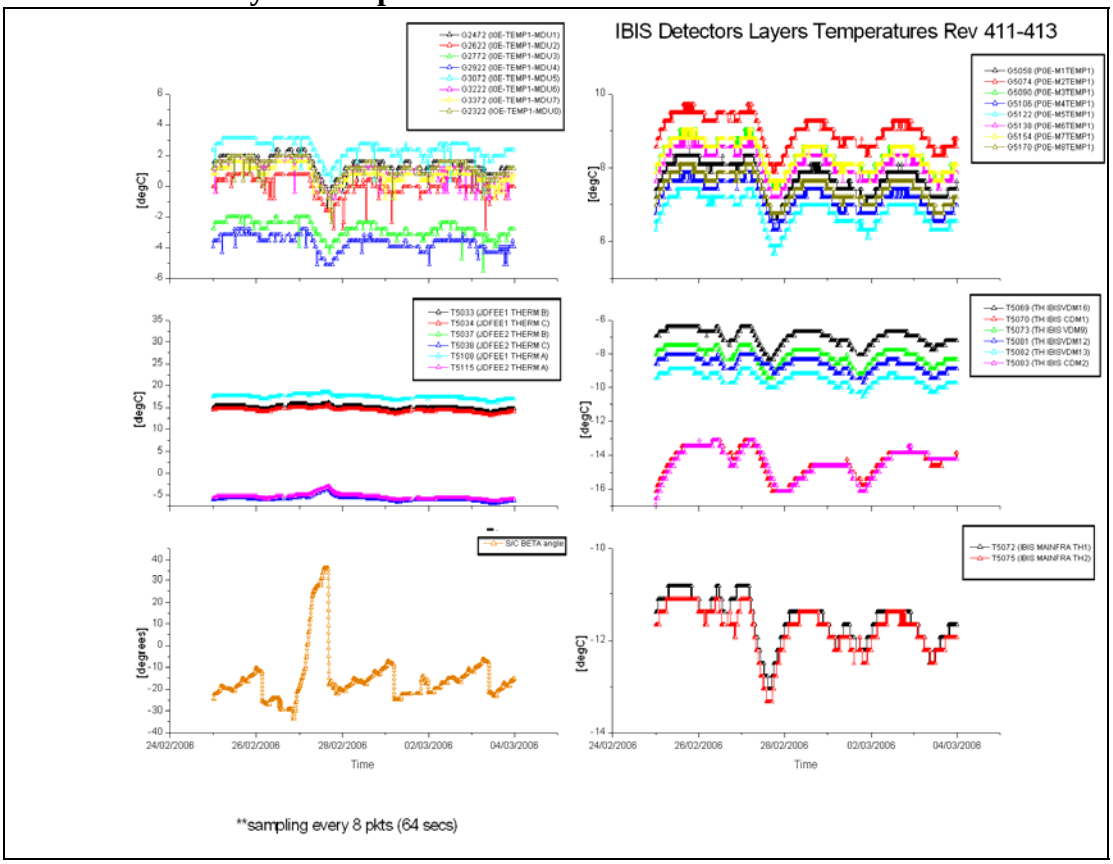
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report

DoY 2006.057(26/02/2006):

At 10:49Z, TM parameter G8015 was reported Out Of Limit high. It went back inside limit at 20:16Z. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.

Inside the radiation belts, TM parameter G5017 (P0S-M4RTC1) was toggling OOL high. According to P-CNT-1, no action was taken.

At 19:49Z, TM parameter G2084 (I0E-OVFWPXADD-M6) failed SCC and back. According to I-OVF-1, as this happened inside radiation belts, no action was taken.

DoY 2006.060 (01/03/2006):

-At 01:44Z TM parameters from families G5068 (P0S-MiF1ERRF) and G5072 (P0S-MiF2ERRF) failed SCC.
-At 01:47Z TM families G5002 (P0S-MiRTC1) and G5003 (P0S-MiRTC2) were reported OOL low-low.
-At 01:51Z, OEM ID 132 “IBIS1 IASW HEPI RESYNCHRONISED” was reported.
The succession of these 3 anomalies features a HEPI resynchronisation. According to P-FIF-1, no action is required.

At 10:34Z, TM parameter G8015 was reported Out Of Limit high. It went back inside limit at 20:02Z. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.

At 19:49Z, TM parameter G2014 (I0E-OVFWPXADD-M1) failed SCC and back. According to I-OVF-1, as this happened inside radiation belts, no action was taken.

DoY 2006.061 (02/03/2006):

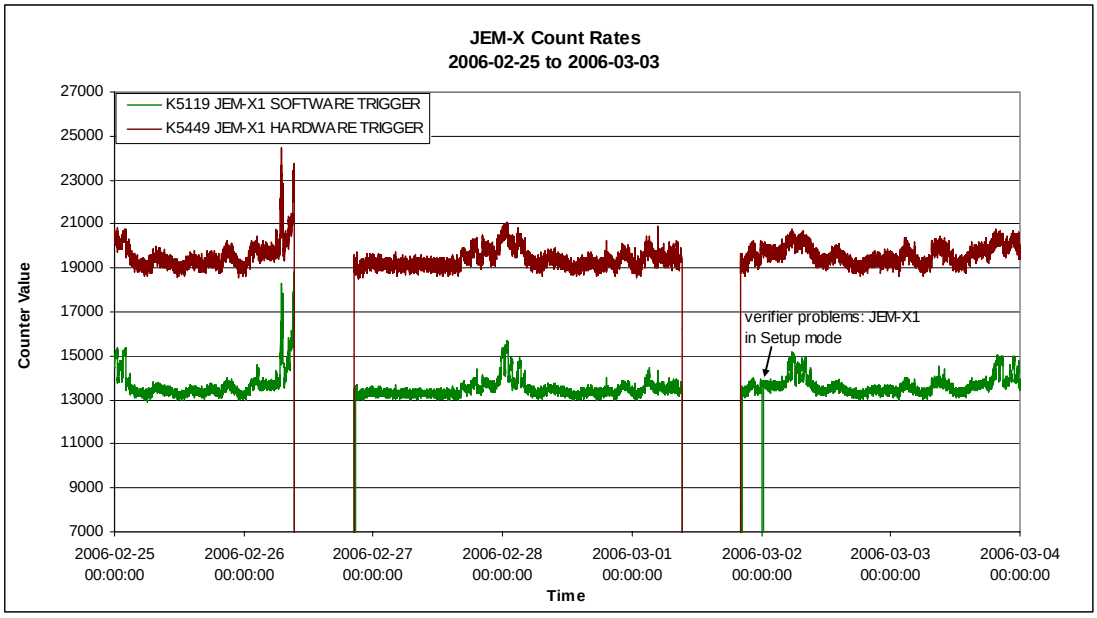
As the Command Verifier died, commands were missed from the Timeline. Therefore, ED GESTAN02 was manually uplinked at 00:31Z.

8.3.4 JEM-X Operations

8.3.4.1 JEM-X Count Rates

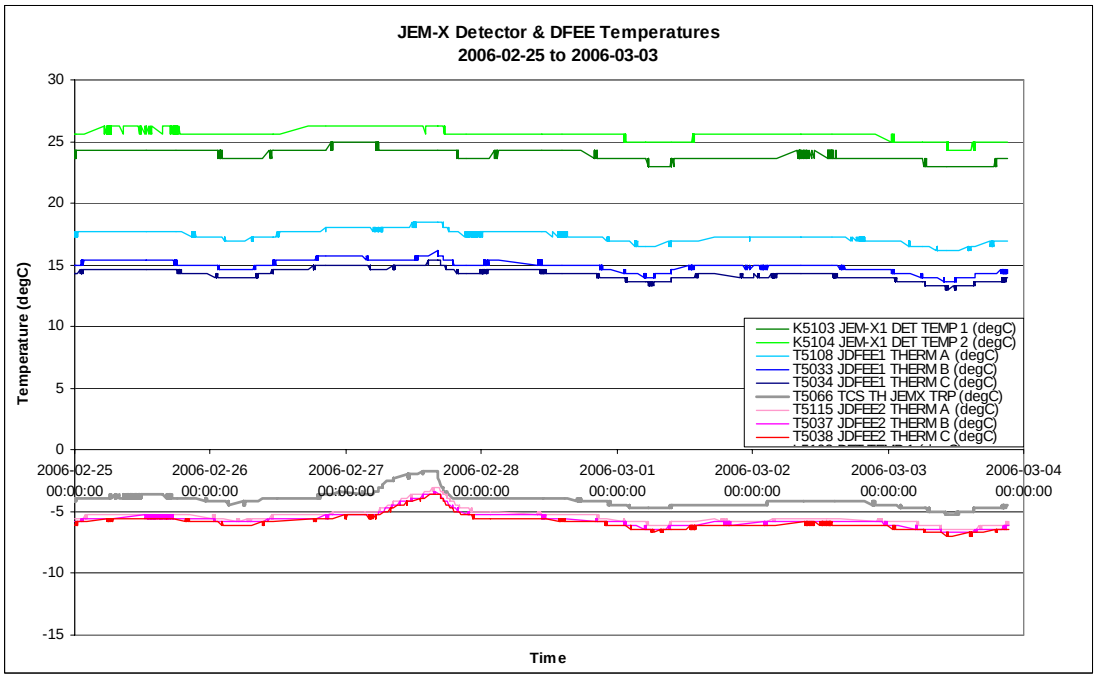
JEM-X count rates over the reporting period are displayed in the following graph[1].

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



8.3.4.2 JEM-X Temperatures

JEM-X Detector and DFEE temperatures, along with the temperature on the detector bench between the two units, over the reporting period are displayed in the following graph[2].



[2] Data sampled (1 frame in 8)

8.3.4.3 JEM-X Daily Report

2006-02-25 (DOY 056, Rev 411) to 2006-02-28 (DOY 059, Rev 412)

Nothing to report

2006-03-01 (DOY 060, Rev 412-413)

Starting at 09:11:37Z, due to a temporary loss of the TC link, the TC KU0014 and onwards of the ED KESAFE02 failed release. Once the problem was fixed, these TCs were re-uplinked manually starting at 09:17:08Z.

2006-03-02 (DOY 061, Rev 413)

Due to a problem with the command verifier task of the MCS, at 00:04:13Z the first TC (K0009 STATE SETUP) of the ED KEDATA02 was unverified (although JEM-X1 had in fact transitioned to Setup mode) and the other TCs of the ED were missed. After the verifier was restarted, the entire ED KEDATA02 was re-uplinked manually starting at 00:27:06Z.

2006-03-03 (DOY 062, Rev 413)

Nothing to report

8.3.5 OMC Operations

2006-02-25 (DOY 056, Rev 411) to 2006-03-01 (DOY 060, Rev 412)

Nothing to report

2006-03-02 (DOY 061, Rev 413)

At 00:04, the Command Verifier died, causing the loss of pointing 04130010.

At 00:49, after slew 04130011, the On Target Flag was not reached, the impact was that pointing 04130011 was shortened by about 15 minutes.

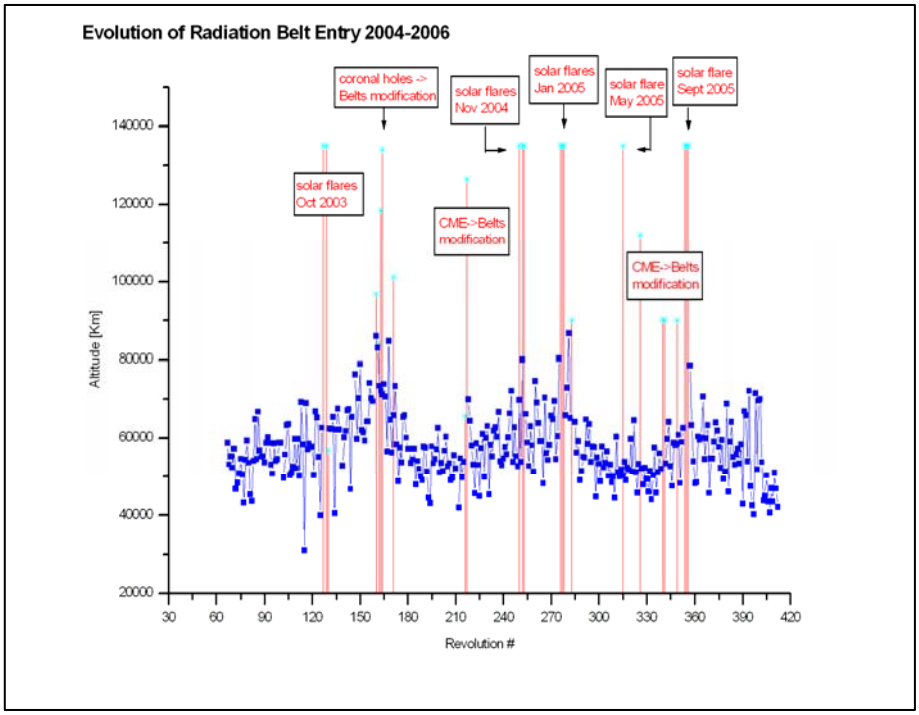
2006-03-03 (DOY 062, Rev 413)

Nothing to report

On DoY 057 at 10:49:43 and DoY 060 at 10:34:39 OMC was switched by the Timeline to SAFE mode, at the nominal time.

8.3.6 IREM Operations

Radiation Belts Entry



IREM daily report

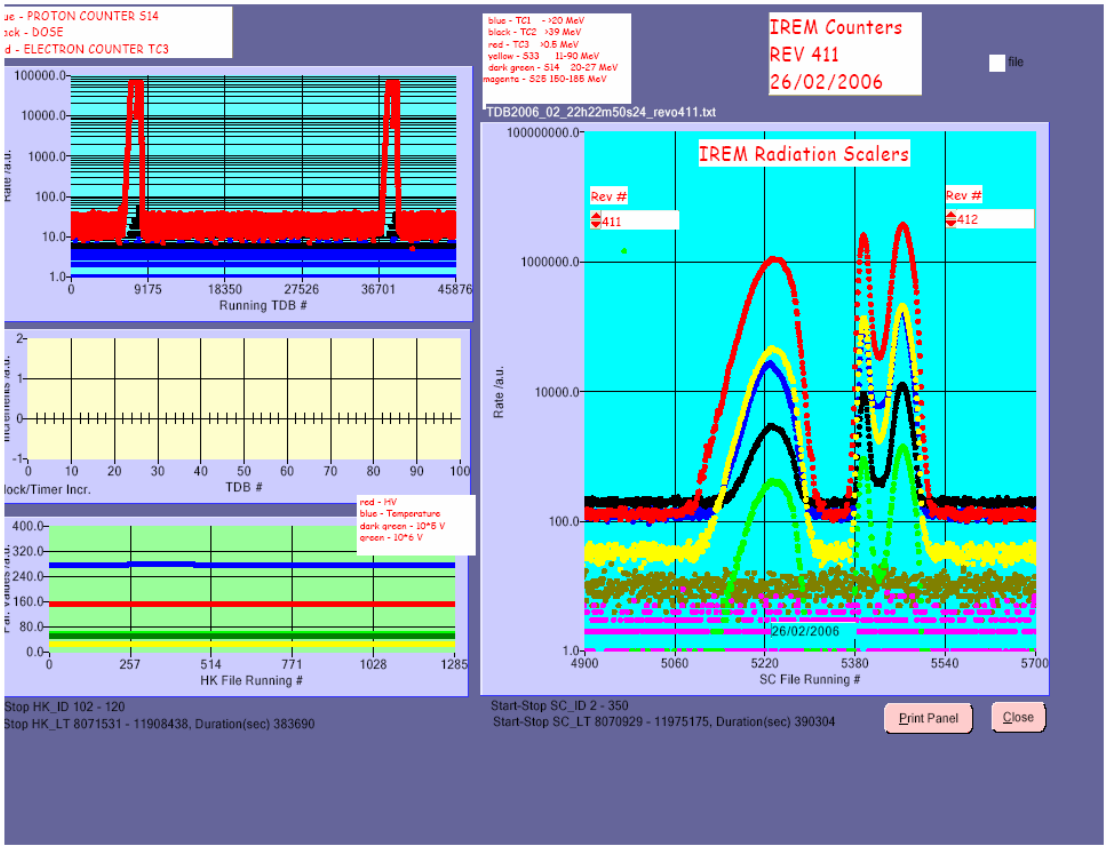
Nothing to report.

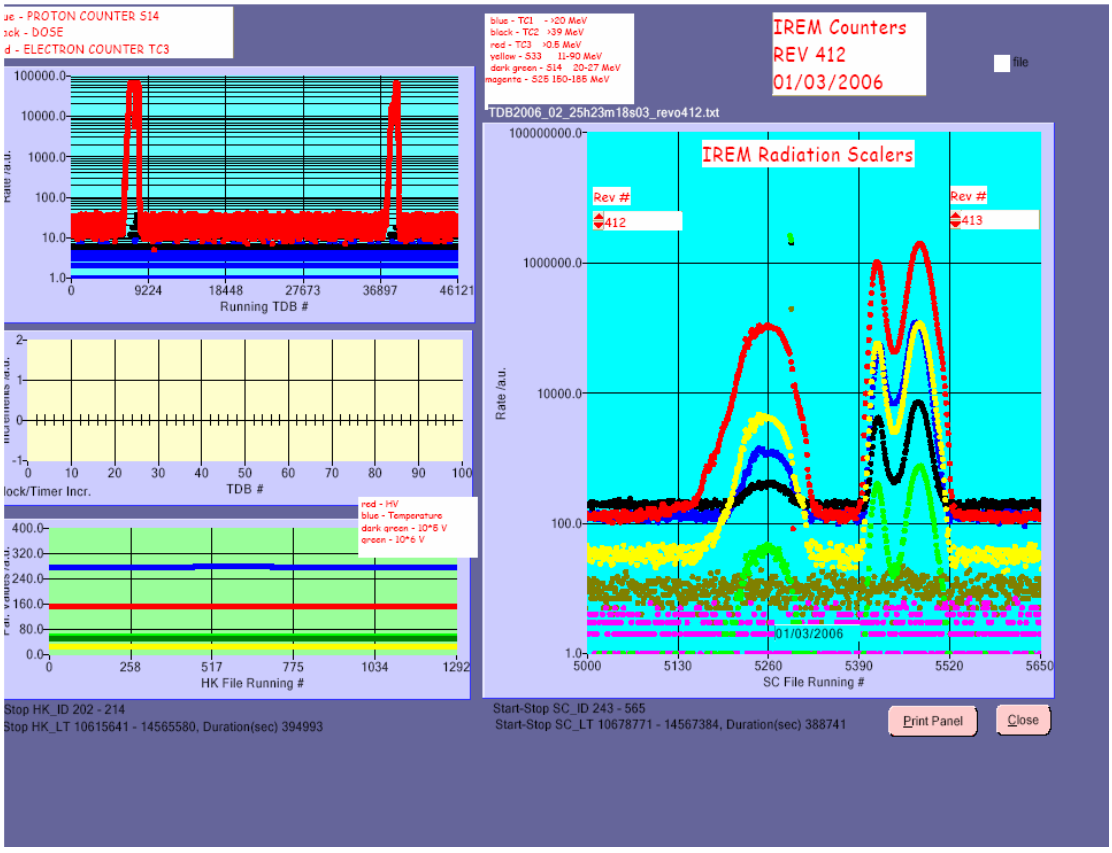
Electron Belts

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]
411	RAD_ENTR R 2006-02-26T10:49:41Z	2006-02-26 12:23:34	>46859.1	2006-02-26 12:08:24	49683
412	RAD_EXIT R 2006-02-26T20:04:07Z	2006-02-26 19:13:42	>>23304.2	2006-02-26 19:18:24	32749
412	RAD_ENTR R 2006-03-01T10:34:36Z	2006-03-01 12:48:54	<42148.5	2006-03-01 11:59:21	49041
413	RAD_EXIT R 2006-03-01T19:49:25Z	2006-03-01 18:54:15	>>23313.6	2006-03-01 19:09:21	33399

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

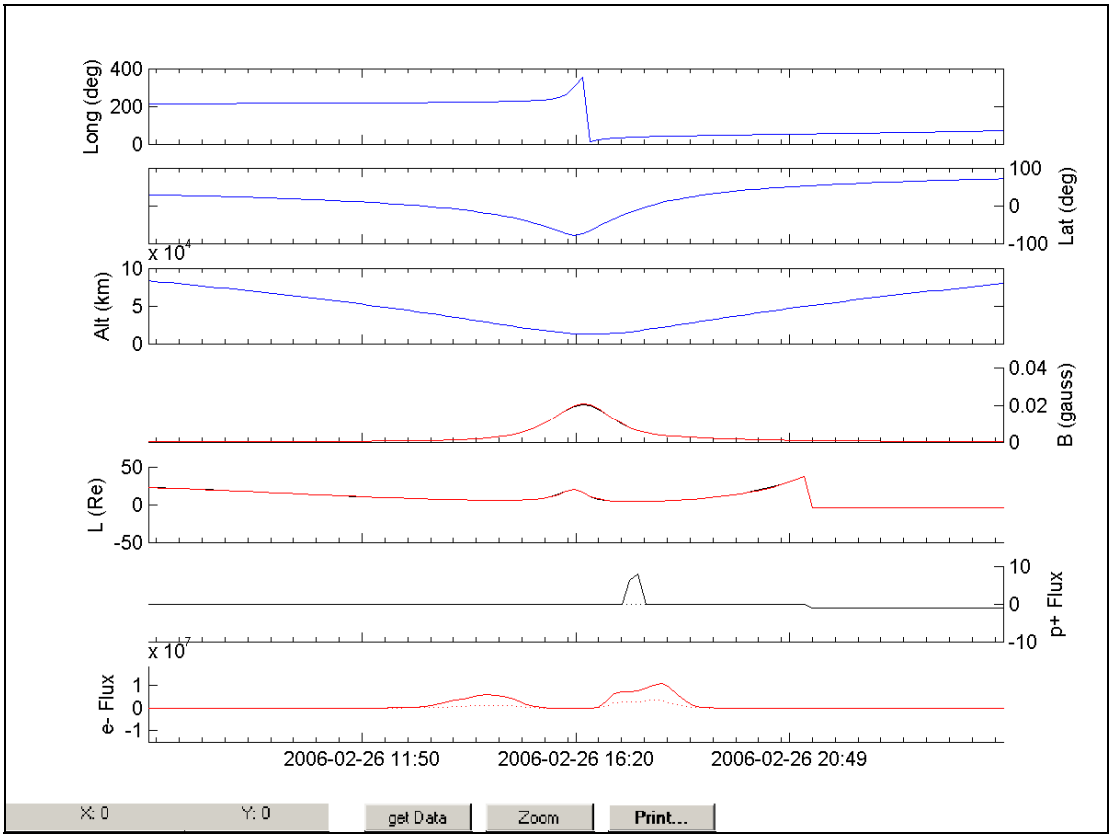
IREM radiation counters:



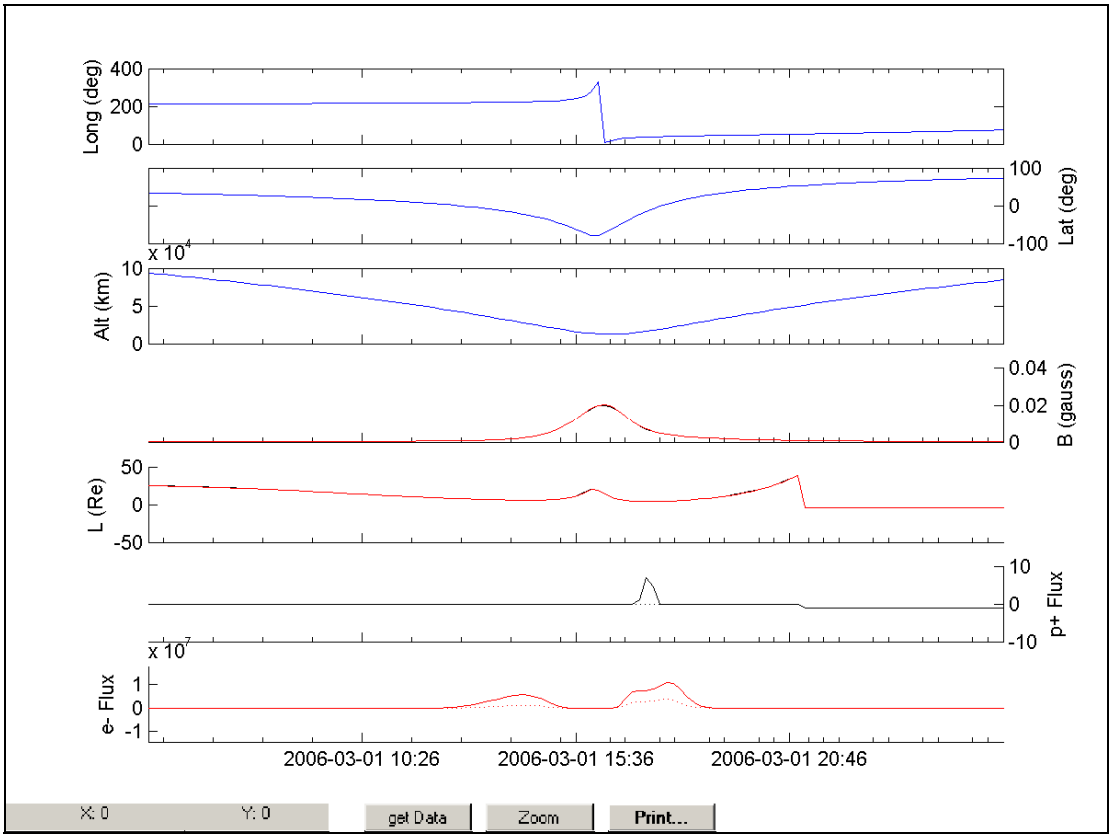


IREM Predicted Radiation Belt Passages:

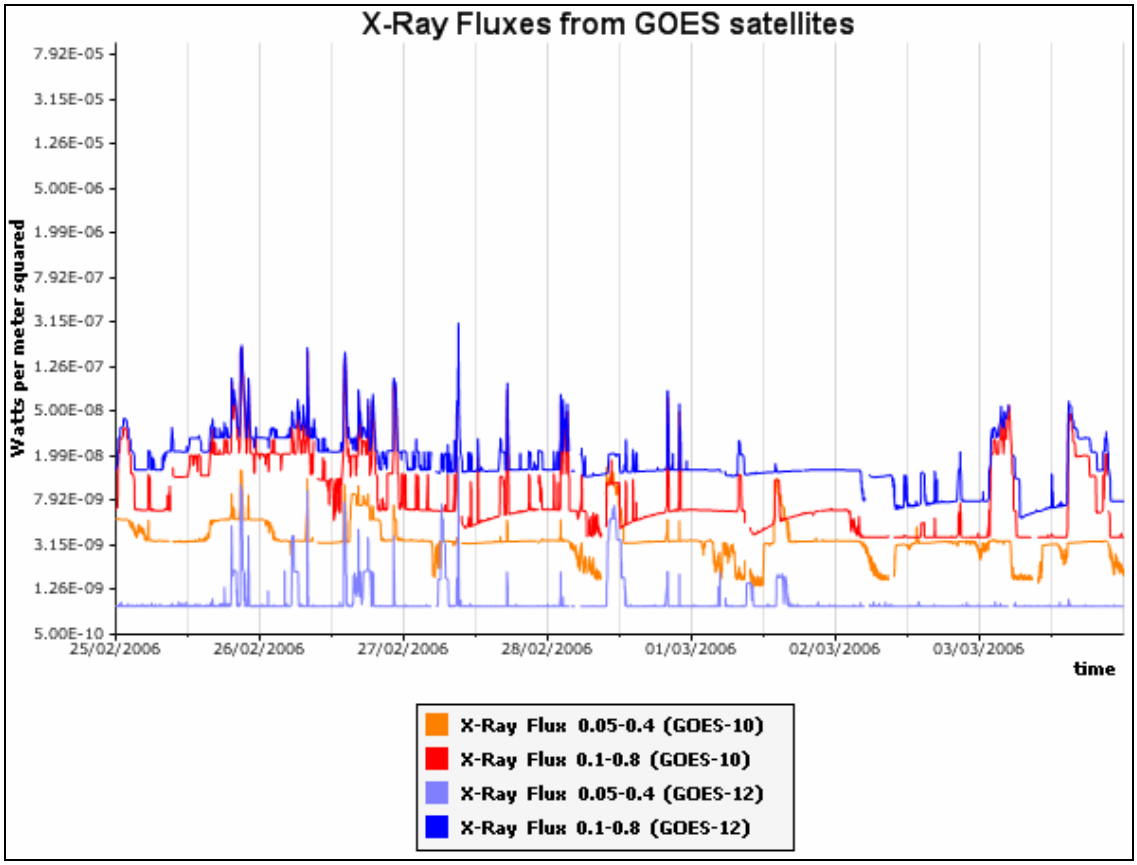
Rev 411

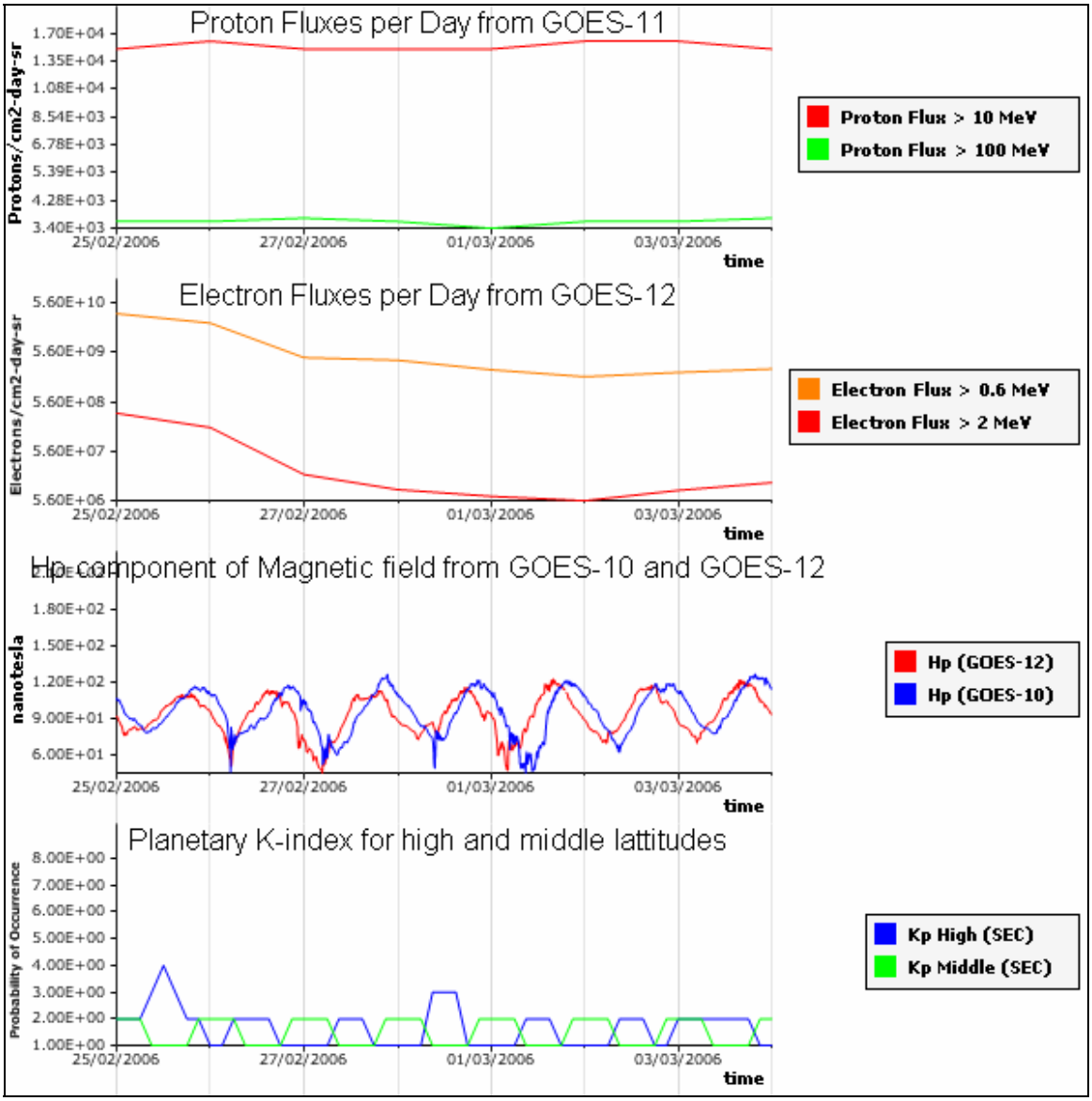


Rev 412



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




Proton Fluxes per Day from GOES-11
Protons/cm2-day-sr
1.70E+04
1.35E+04
1.08E+04
8.54E+03
6.78E+03
5.39E+03
4.28E+03
3.40E+03
25/02/2006
27/02/2006
01/03/2006
03/03/2006
time
Proton Flux > 10 MeV
Proton Flux > 100 MeV
Electron Fluxes per Day from GOES-12
Electrons/cm2-day-sr
5.60E+10
5.60E+09
5.60E+08
5.60E+07
5.60E+06
25/02/2006
27/02/2006
01/03/2006
03/03/2006
time
Electron Flux > 0.6 MeV
Electron Flux > 2 MeV
Hp component of Magnetic field from GOES-10 and GOES-12
nanotesla
1.80E+02
1.50E+02
1.20E+02
9.00E+01
6.00E+01
25/02/2006
27/02/2006
01/03/2006
03/03/2006
time
Hp (GOES-12)
Hp (GOES-10)
Planetary K-index for high and middle lattitudes
Probability of Occurrence
8.00E+00
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
25/02/2006
27/02/2006
01/03/2006
03/03/2006
time
Kp High (SEC)
Kp Middle (SEC)