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

INTEGRAL
Mission Report

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

No. 118
Week 52

27.12.04

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 18.12.04 until 24.12.04 (both dates inclusive) and covers the revolutions 267 & 268.

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 the Galactic Plane; 3C273 (RA 12:29:6.70; DEC +02:03:08.0); and CAS-A (RA 23:51:39.6; DEC +61:41:40.5). The activities consisted of GPS, staring and raster dithering observations. In addition, FSS/STR Misalignment, SAS calibrations and Spacecraft Inertia Calibration were performed.

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.

Reported on 19/12/2004 (rev 266) an anomaly on RMU-A unit: an unexpected change of status for the RMU-A LCL forced the switch OFF of the unit. The unit was recovered and no operational impact reported due to the anomaly.

As part of the AOCS periodic calibrations, after the end of the eclipse season, the FSS/STR Misalignment calibration, the SAS calibration and the RW\Inertia calibrations were performed. The pointings required for the Calibrations were planned in dedicated engineering windows in the Timeline of revolution 267.
The operation executed nominally from the Automatic Timeline.

6 slews were missed from the Timeline during this period:

• 4 slews (3CSL and 1 OSL) were missed in revolution 266 due to problem on NCTRS-A machine;

• 1 slew (CSL) was missed in revolution 268 due to TPF failing the time validation;

• 1 slew (OSL) was missed in revolution 268 due to problem on DSS16 station;

The fuel consumption over the period between 18/12/2004 and 23/12/2004 was 0.259 kg. The remaining propellant is in the order of 165.4668 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

See next week's report for details.

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

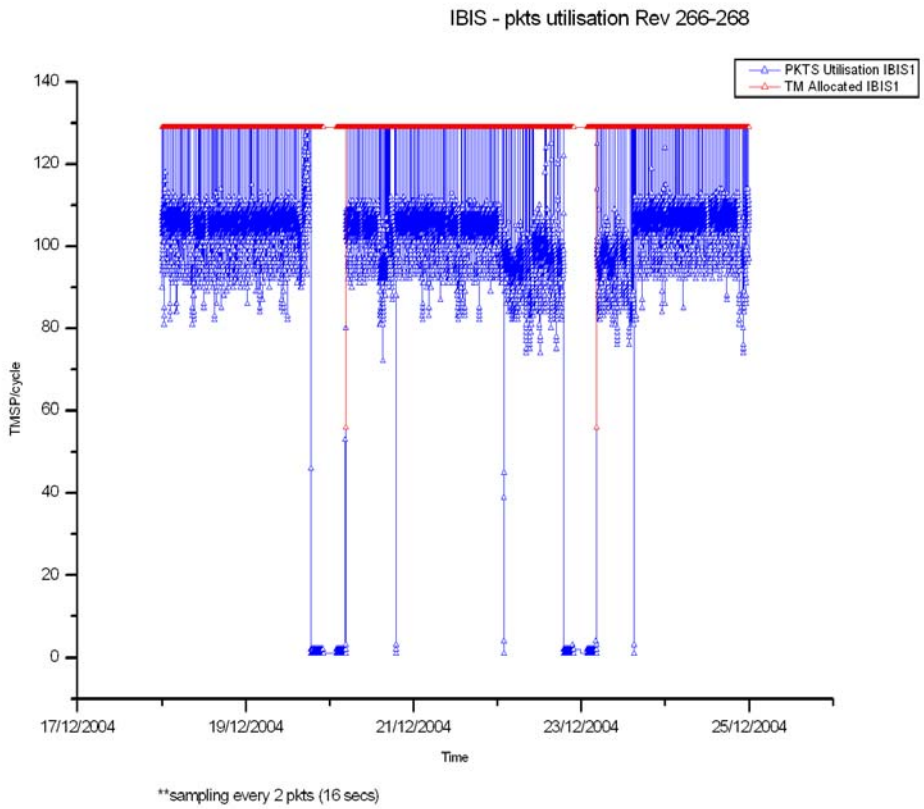
3.2.2 IBIS

The Overall status of the unit is Nominal.

The week was characterised by low to moderate solar activity.

During the reporting period the PST alloction to IBIS was 129 TMPS/cycle.The IBIS mean bandwidth utilisation during the observation period was 105.6 TMPS/cycle, up 5.7 on last week.

A plot of the IBIS TM utilisation during the observation period is shown below:



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

3.2.3 JEM-X

The status of both JEM-X units is nominal.

JEM-X operations were performed by the automatic Timeline.

JEM-X1 was operated in Data Taking mode during science observations, with a TM allocation of 8 packets/cycle. JEM-X2 remained dormant (DFEE OFF) with a TM allocation of 1 packet/cycle.

Two surges in the radiation background level during this period were reflected in the JEM-X1 S/W and H/W Trigger Rates. However, none of the instances resulted in the Safe mode.

The manual disabling of the internal RMC flags were performed after each anode calibration sequence as requested by OR-189.

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.

During the reporting period OMC operations were performed by the automatic timeline, with the TM allocation to OMC of 5 packets/cycle.

There were 199 OMC pointings executed nominally, 6 were lost.

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

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low to moderate solar activity.

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

4 Ground Facilities

The performance of the Operational ground facilities was poor this week, although still above the system performance requirements, a total of 6 pointings were lost due to ground problems.

4.1 Mission Operations Centre

The performance of the MOC was fair this week, 4 pointings were lost due to nctrs problems, and one due to a late arrival of a TPF update.

4.2 Ground Stations & Network

The performance of the ground stations and Network was in general good this week. There were some problems with bad frames from Redu, which caused the loss of 1 pointing. The overall performance was above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSF's up to revolution 277.
All these revolutions have been planned. No re-planning has taken place. The planning is now advanced up to mid January to have comfortable margins over the Christmas period. Any potential re-planning during the latter part of the week will be reported in weekly report 1 of 2005.

TSF's completed up to revolution 273.

2. Observation status

No new ECS's received this week

3. ISOC science data archive
Nothing to report

4. ISOC system
Version 10.6.5 is still in operational use.

5. Problems.
No new problem to report.

4.3.2 ISDC

Status of ISDC observation processing on 27/12/2004:

- Latest Standard Analysis completed: observation 02200280001 (GRS 1915+105, Revolution 246) on 11/12/2004

- Latest products archived: observation 02297000016 (IGR J16320-4751, Revolution 226) on 01/12/2004

- Latest observation products sent to the observer: observation 02297000016 (IGR J16320-4751, Revolutions 226) on 08/12/2004

5 Special Events

6 Anomalies

There were a number of problems that impacted the operations:

- On DoY 353, at 06:00, the Global Overview MMI on sun129, isn't showing imcs-b, however, the application launcher on sun127 shows imcs-b as fine.
- At 08:42, an AOCS command failed release due to nctrs problems, which caused the commanding to time out. The impact was the loss of pointings 02660048. Further difficulties rebooting the nctrs caused the loss of the next three pointings.
- At 17:22, 32 bad TM frames were received from Redu, there was no impact.
- On DoY 357, at 13:58, the following error was reported:
  EV: HFAretri.-idda-WARNING-Software-"CCOM-hfaSide::get data request -> rcvMsg: cannot get …", there was no impact.
- On DoY 358, at 15:09, at TPF failed validation, due to a late arrival, the following guide star command failed release. The impact was the loss of pointing 02680017.
- At 19:54, bad TM frames from Redu caused the loss of pointing 02680025.

The following new anomaly reports were entered into the ARTS system.

AR id	Date Created	Subject	Segment	Status
INT_SC-106	20/12/2004	AOCS: RMU-A LCL unexpected change of status	Spacecraft	Pending
INT_SC-108	22/12/2004	AOCS: STAR TRACKER1750 Processor Fault on 22/12/2004	Spacecraft	Pending
INT-2688	21/12/2004	DOY 353: NCTRS-A stops logging all events.	NCTRS	Pending

7 Future Milestones

Appendix

The appendix includes various detailed information.

7.1 Overview of Revolutions

Revolution 267

The activities in revolution 267 consisted of the following:

- 14 hour engineering window in which the FSS/STR Misalignment and SAS calibrations were performed;
- Raster dithering observation of 3C273 (RA 12:29:6.70; DEC +02:03:08.0) lasting ~30 hours;
- 8 pointings of a GPS lasting ~5 hours;
- 8 hour engineering window in which the Spacecraft Inertia Calibration was performed;
- 4 pointings of a GPS lasting for the remaining ~3 hours of observation time.

Throughout these observations SPI, IBIS and JEM-X1 were in their nominal science modes and the JEM-X2 DFEE remained off. During the AOCS Calibrations, OMC was in Standby mode and otherwise was in Science Normal mode. The TM allocation was IBIS 129; SPI 103; JEM-X1 8; JEM-X2 1; OMC 5.

Revolution 268

The observations in revolution 268 started with 13 pointing of a GPS lasting in total ~7.9 hours, followed by a raster dithering observations of the point source 3C273 (RA 12:29:06.7 7; DEC +02:03:08.0) lasting ~27.7 hours and a raster dithering observations of point source CAS-A (RA 23:51:39.6; DEC +61:41:40.5) for the remaining ~ 18 hours of observation time.

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

7.2 Consumables

7.2.1 Detailed Fuel Book-keeping

```
2004-12-06T14:30:20.000Z     165.9618    F   Automatic TM processing.
2004-12-08T04:52:32.000Z     165.8968    F   Automatic TM processing.
2004-12-11T04:40:16.000Z     165.8869    F   Automatic TM processing.
2004-12-11T13:05:53.000Z     165.8150    F   Automatic TM processing.
2004-12-14T04:28:32.000Z     165.7845    F   Automatic TM processing.
2004-12-14T12:51:52.000Z     165.7379    F   Automatic TM processing.
2004-12-17T03:58:08.000Z     165.7258    F   Automatic TM processing.
2004-12-17T12:19:13.000Z     165.7128    F   Automatic TM processing.
2004-12-18T13:12:44.000Z     165.6562    F   Automatic TM processing.
2004-12-19T18:49:35.000Z     165.6296    F   Automatic TM processing.
2004-12-19T20:19:59.000Z     165.5971    F   Automatic TM processing.
2004-12-19T21:35:43.000Z     165.5701    F   Automatic TM processing.
2004-12-20T02:39:36.000Z     165.5370    F   Automatic TM processing.
```

```
2004-12-23T02:28:47.000Z     165.5158    F   Automatic TM processing.
2004-12-23T11:21:20.000Z     165.4668    F   Automatic TM processing.

This report was generated  Fri Dec 24 08:00:20 GMT 2004
```

7.3 Detailed Satellite Information

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

7.3.1 AOCS Summary Operations Report 18/12/2004-24/12/2004

AOCS operations were executed from the Automatic Timeline.

During this period, 72 Open Loop Slews, 176 Closed Loop Slews and 9 Momentum Bias were scheduled. 6 slews were missed or executed manually. This is equivalent to a ~ 2.4 %.

18/12/04 (Day of Year 353, Revolution 266)

Slews missed from the Timeline: Due to a problem on NCTRS-A machine, the slews 02660048(OSL), 0049(CSL), 0050(CSL), 0051(CSL), were not executed. A manual close loop slew was then performed to the attitude of PID 02660051. The next slew (CSL) for PID 02660052 was manually updated and executed from the Timeline.

19/12/04 (Day of Year 354, Revolution 266)

RMU-A LCL unexpected change of status: at 03.56.07z, the TM parameter P1117 (LCL RMU-A) reported an unexpected change of status from ON to OFF. Following this change of status the RMU-A unit, used by the FCE system, went OFF. No other out of limits or OEMs were received at the time of the anomaly.

The recovery started at 04:54z, after a preliminary analysis of the failure.
After the switch ON of the RMU-A, was performed a first check of the unit health status and executed (twice) an RMU-A calibration.

After the recovery the unit reported power consumption and temperatures inside limits. The calibration of the unit was performed twice in order to check the consistency of the unit channel outputs.

During the anomaly, the LCL FCE A (SPDU-A board 4) and LCL FCE B (SPDU-B board 4) did report nominal values. The status of the FCE is currently nominal.

At the time of the anomaly no other unusual behavior was observed on the S/C; Radiation levels were normal, and the Satellite was at a height of about 130000 Km in the descending path of the orbit.

Alenia Spazio confirmed that the observed event is probably not consequence of the radiation environment but due to a spurious LCL switch off. Being no incongruent condition between the status of the SPDU LCL and the unit has been observed, the conclusion from Alenia is that the problem seems be caused again by the SPDU that

unexpectedly issued a command. The difference with the other observed cases (see AR INT_SC-89) is that the radiation environment was very quiet and therefore the correlation with a possible SEU is not straight- forward.

A relevant anomaly report (INT_SC-106) has been generated.

20/12/04 (Day of Year 355, Revolution 266-267)

Execution of the FSS/STR Misalignment Calibration: As part of the periodic AOCS calibrations, the FSS/STR Misalignment calibration and SAS calibration were performed in revolution 267. This operation was executed completely from the Timeline in a dedicated Engineering window

from 2004-12-20T04:41:32z Start of Window for FSS/STR + SAS Calibration

to 2004-12-20T18:41:32z End of Window for FSS/STR + SAS Calibration

The FSS/STR calibration itself consists of 3 pointings of 0.8 degrees offset at each corner (Roll= +- 4.5° Pitch = +- 25°) of the FSS FoV and tracking four stars (in addition to the Guide Star) for the duration of each pointing. A 14 hours window was assigned to this calibration.

Execution of the SAS Calibration: As requested already in the past by FCT, four additional pointings were inserted at the end of the sequence of slews for the FSS/STR calibration, to be used for the calibration of the SAS Alpha and Beta Scale Factors and update of the SAS thresholds. These included four pointings with (Alpha, Beta) equal to (0.0, +4.9), (0.0, -4.9), (+4.9, 0.0) and (-4.9, 0.0) degrees.
This operation was executed completely from the Timeline.

21/12/04 (Day of Year 356, Revolution 267)

Nothing to report.

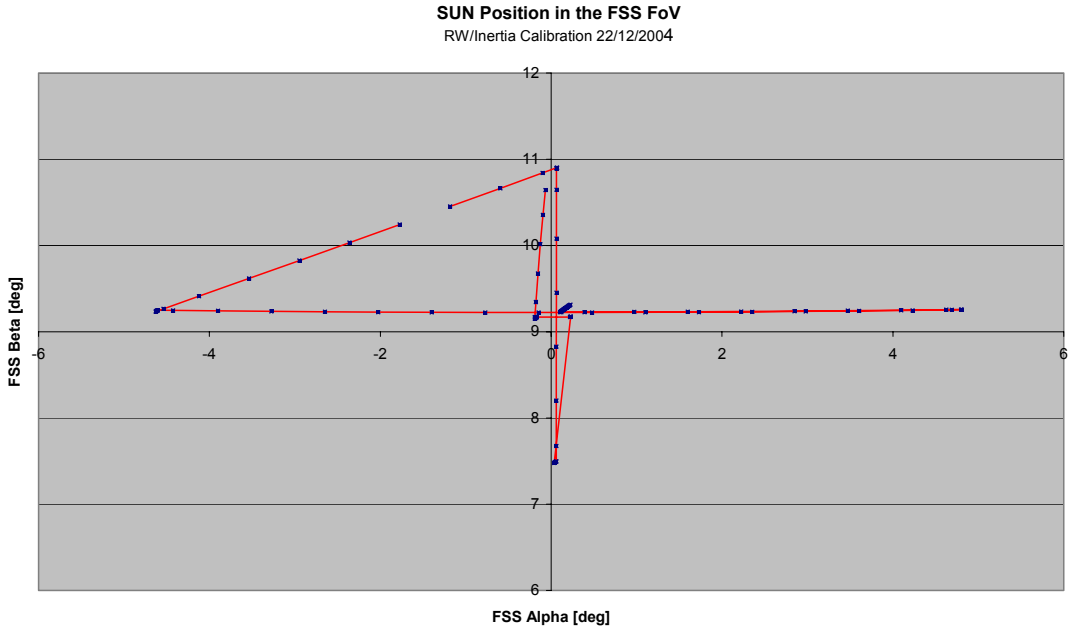
22/12/04 (Day of Year 357, Revolution 267)

Execution of the Reaction Wheel Inertia Calibration: An Engineering window of 8 hours was dedicated in the Timeline to the RW/Inertia periodic calibration

from 2004-12-22T07:22:58z (Start of Window for Periodic Inertia Calibration)

to 2004-12-22T15:22:58z (End of Window for Periodic Inertia Calibration)

This operation ran completely from the Timeline. The calibration was performed around a roll angle of ~ 0 degrees and a pitch angle of ~9 degrees. Hereafter follows the plot of the Sun position in the FSS FoV during the calibration.



STR 1750 processor fault: at 1:40:44z a STR 1750 processor fault occurred during the execution of the Open Loop Slew 02670052. The sequence of the events were:

1:23:40z	Open Loop Slew Start
1:40:08z	Mapping start
1:40:36z	Open Loop Slew End
1:40:45z	Mapping End prematurely
1:40:45z	New Mapping start and new guide start picked

The fault, which occurred about at the end of the slew resulted in the abortion of the on-going mapping (duration shortened) and start of a new mapping.
The fault was reported in HK Telemetry as 1750 fault, failure of S/W health checks and out of range (OOLs) conditions for the secondary voltages and CCD temperature, in the TM cycle when the false was detected.

No IMU was switched ON, because the problem occurred during the execution of an Open Loop Slew. Probably as it was in the past a bright object present in STR FoV could have caused this fault. No operational impact was reported due to this fault.
An anomaly report (INT_SC-108) has been generated accordingly.

23/12/04 (Day of Year 358, Revolution 267-268)

Slew missed from the Timeline: Due to problems with the TPF update (TPF exceeding time validation) for the slew ID 02680017(CSL), the slew was not executed. A manual close loop slew was then performed to the attitude of PID 02680017 and the pointing was partially recovered. The next slew for PID 02680018 was manually updated and executed from the Timeline.

Slew missed from the Timeline: Due to problems (reported bad frames) at DSS16 station the slew 02680025(OSL) was not executed. A manual open loop slew was then performed to the attitude of PID 02680025 and the pointing was partially recovered. The next slew for PID 02680026 was manually updated and executed from the Timeline.

24/12/04 (Day of Year 359, Revolution 268)

Nothing to report.

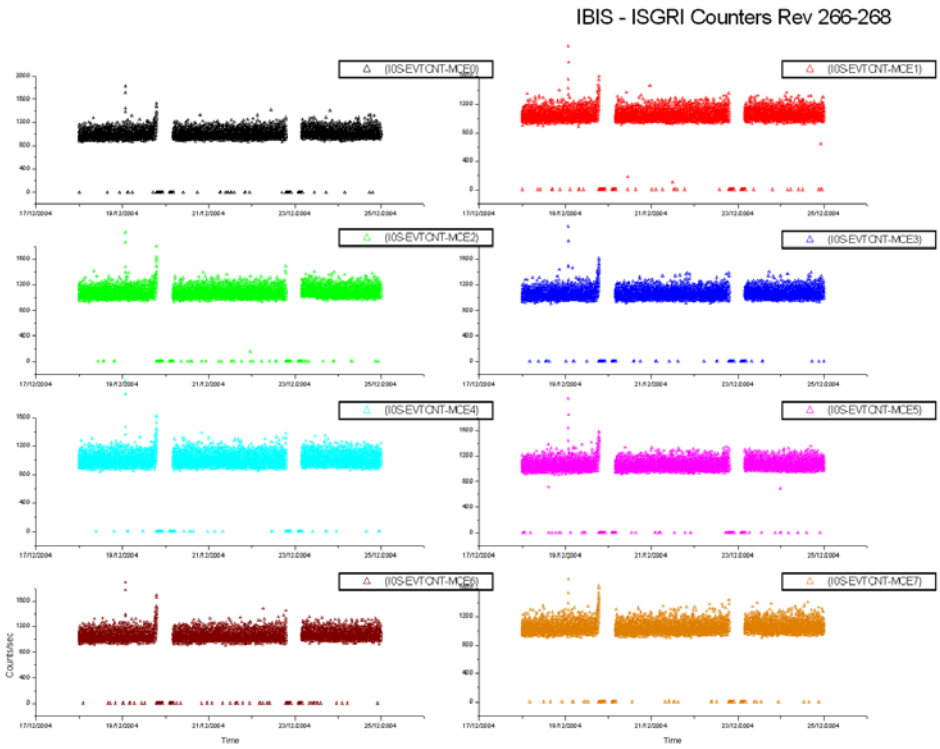
7.3.2 SPI Operations

See next week's report for details.

7.3.3 IBIS Operations

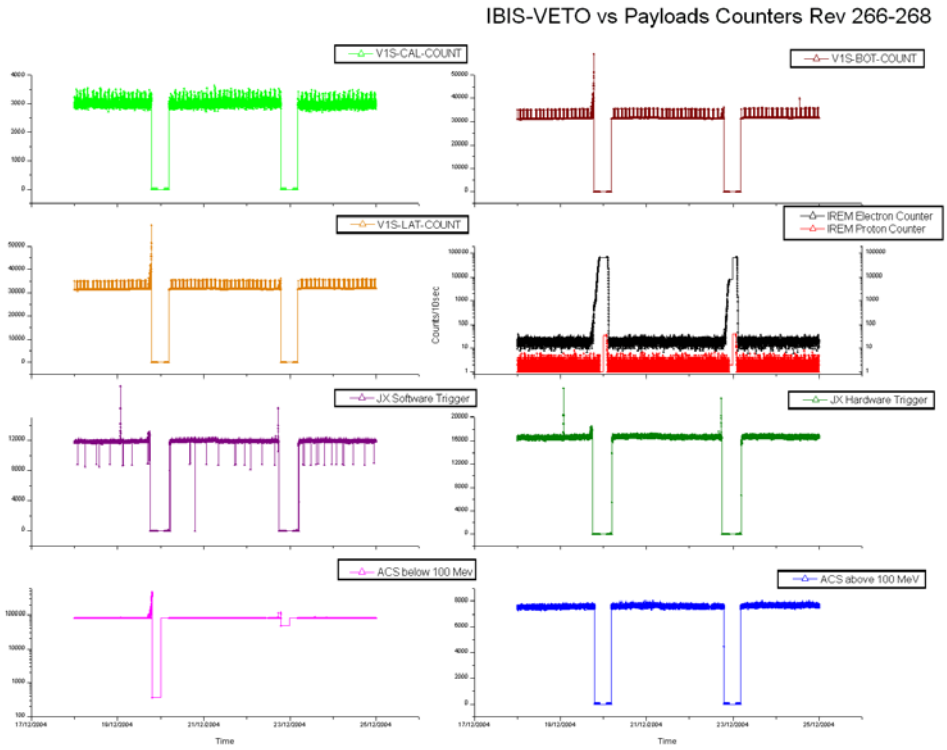
IBIS Event Counters Plots.

ISGRI Counters:



**sampling every 4 pkts (32 secs)

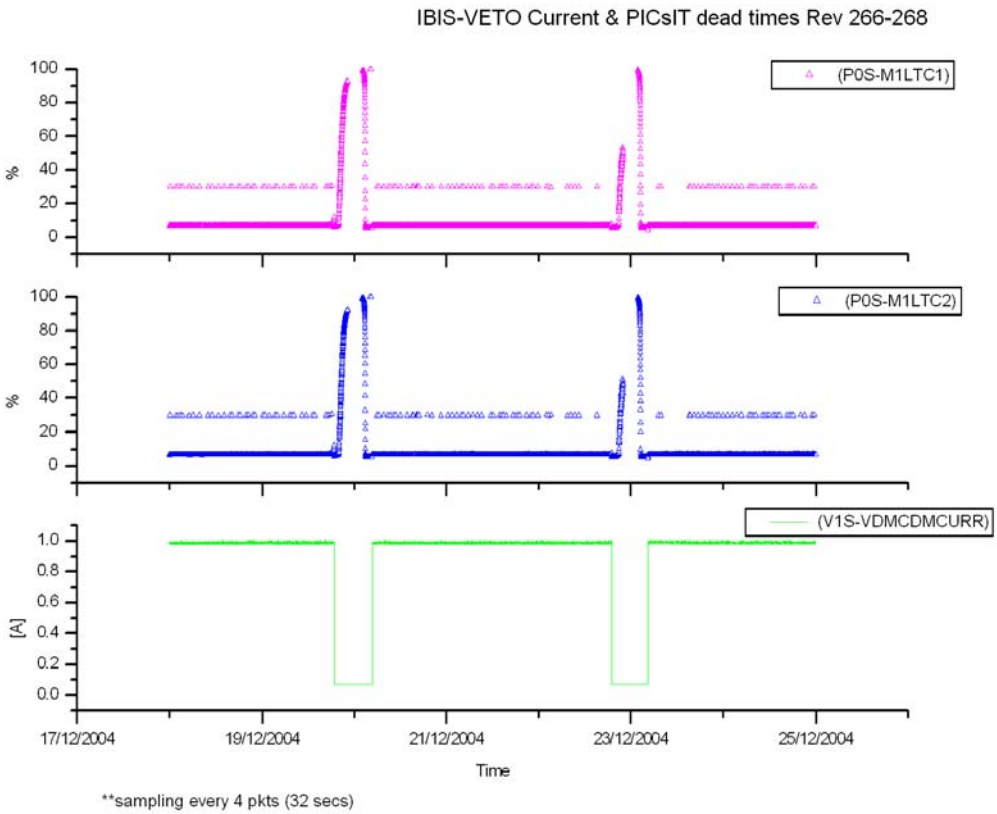
VETO vs Payloads Counters



**with the exception of IREM counters (counts/10sec), all the plots are reporting counts/sec sampling every 5 pkts (40 sec)

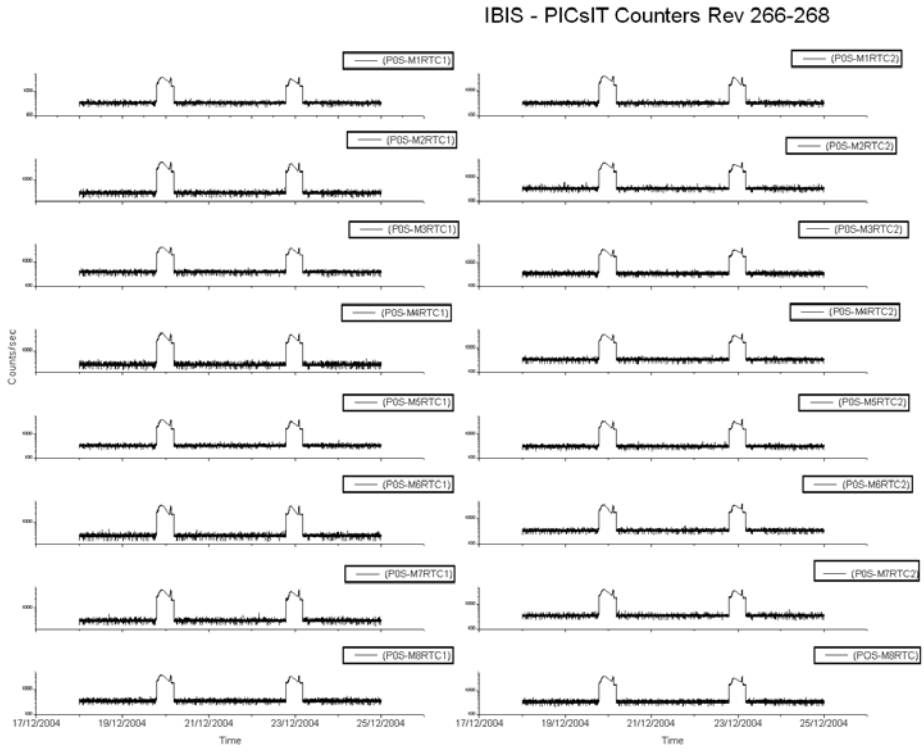
The week was characterized by low to moderate solar activity.

Veto Current:



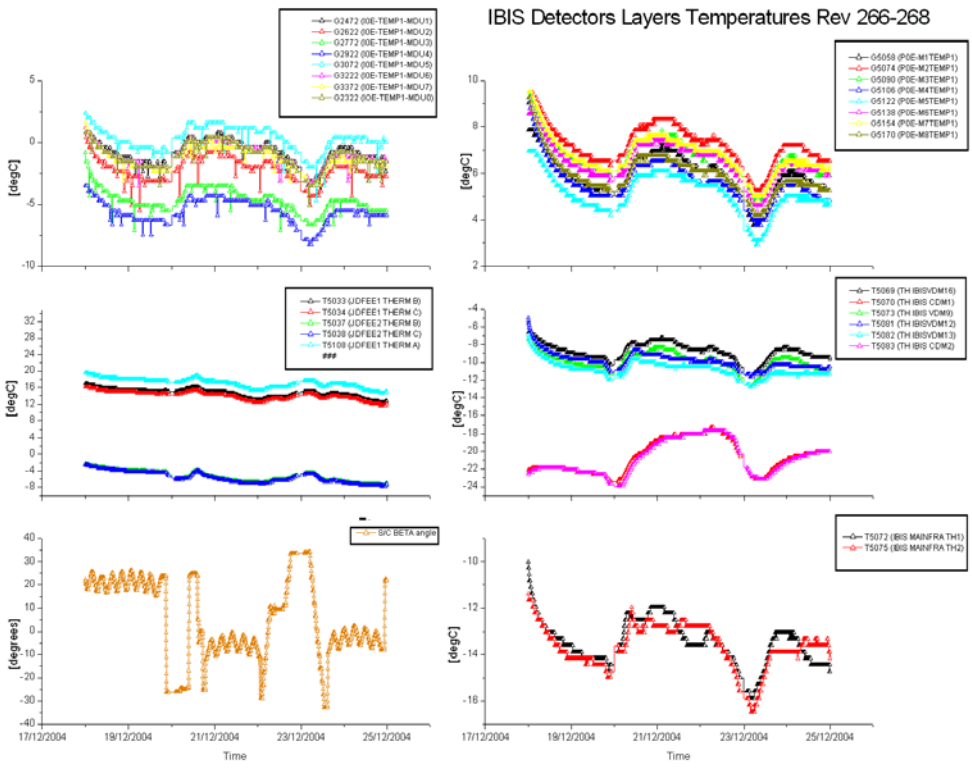
**sampling every 4 pkts (32 secs)

Picsit Counters:



**sampling every 4 pkts (32 secs)

IBIS Detectors Layers Temperatures



**sampling every 8 pkts (64 secs)

IBIS daily report

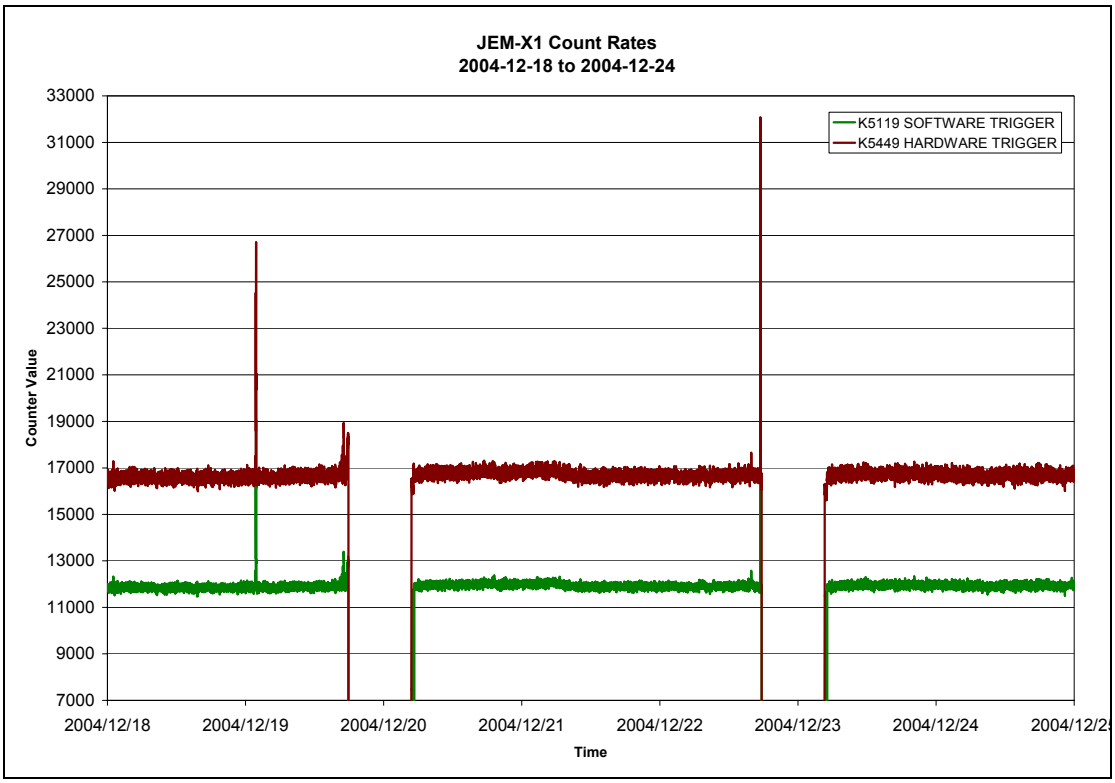
DoY 354 (19/12/2004)
At 18:44Z IBIS entered Stand-by mode due to Radiation Belts in advance compared to BCPKT time (19:15Z).

DoY 358 (23/12/2004)
At 02:15Z TM G5008 (POS-M2RTC2) was reported OOL high. According to OOL reaction P-CNT-1, as this happened during belts passage no action was taken.

7.3.4 JEM-X Operations

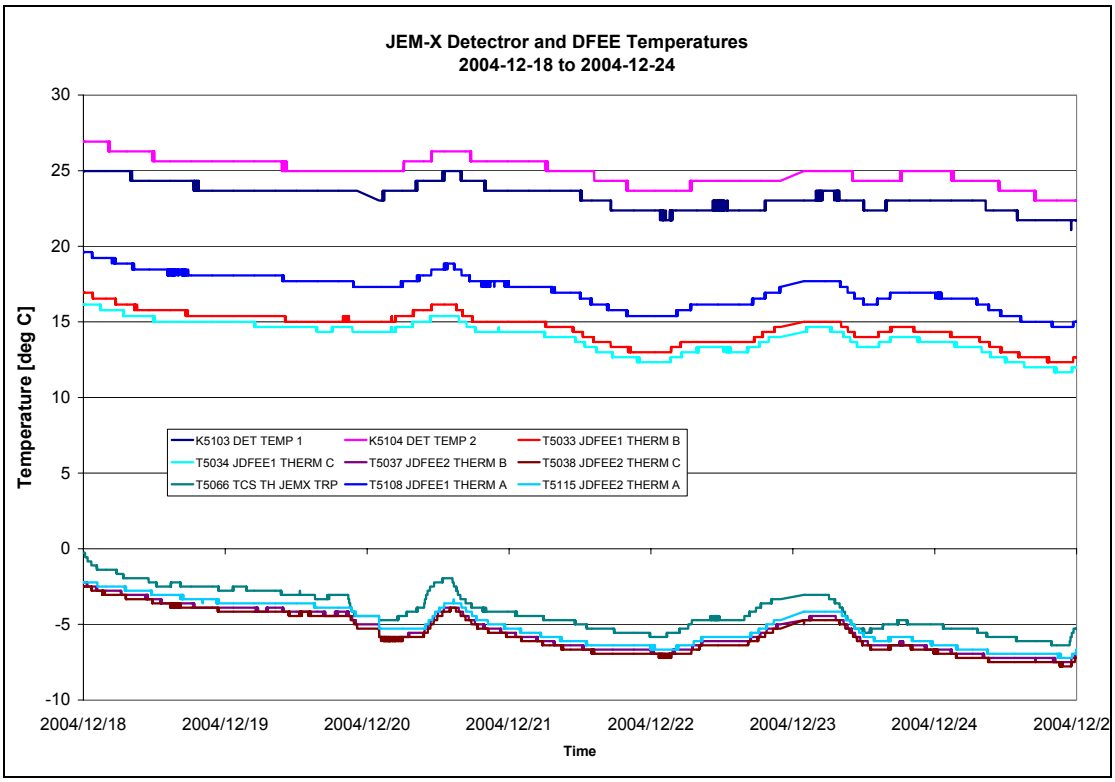
7.3.4.1 JEM-X Count Rates

JEM-X1 count rates over the reporting period are displayed in the following graph (Data sampled 1 TM Cycle in 4 and smoothed to remove spikes in S/W Trigger due to flushing of the buffer after slews).



7.3.4.2 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 (data sampled 1 TM Cycle in 8).



7.3.4.3 JEM-X Daily Report

2004-12-18 (DOY 353, Rev 266)
Nothing to report.

2004-12-19 (DOY 354, Rev 266)
The high radiation background, which caused the transition of IBIS to Standby mode, was registered as well by the JEM-X1 H/W and S/W counters. This can be seen on the "JEM-X1 Counts Rate" plot.

2004-12-20 (DOY 355, Rev 266-267)
At 04:22z OR-0189 was executed to manually disable the internal JEM-X1 RMC flags after the anode calibration sequence.

2004-12-21 (DOY 356, Rev 267)
Nothing to report.

2004-12-22 (DOY 357, Rev 267)
At 17:29z a surge in the radiation background levels caused the sudden rise of the JEM-X1 H/W and S/W trigger rates. The software trigger rate reached the high alarm limit, but it did not cause transition to Safe mode, thanks to the short duration of this surge. There was also an out-of-limit warning on the Buffer Loss level (TM K5136).

2004-12-23 (DOY 358, Rev 267-268)
At 04:10z OR-0189 was executed to manually disable the internal JEM-X1 RMC flags after the anode calibration sequence.

2004-12-24 (DOY 359, Rev 268)
Nothing to report.

7.3.5 OMC Operations

On DoY 353, at 08:42, a failed AOCS command interrupted the timeline causing the loss of pointing 02660048. Further problems with the nctrs caused the loss of pointings 02660049, 02660050 02660051, it was at this time that the following pairs of commands were rejected:

```
2004.353.09.17.49.096 2004.353.09.17.38.060   1792  Real Time Rejection 131
REJECTED TC1
        FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=265
2004.353.09.17.57.296 2004.353.09.17.45.060   1792  Real Time Rejection 131
REJECTED TC1
        FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0 M9069=266
2004.353.09.52.44.217 2004.353.09.52.38.812   1792  Real Time Rejection 131
REJECTED TC1
        FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=267
2004.353.09.52.52.435 2004.353.09.52.45.562   1792  Real Time Rejection 131
REJECTED TC1
        FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0 M9069=268
2004.353.10.24.52.368 2004.353.10.24.42.813   1792  Real Time Rejection 131
REJECTED TC1
        FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=269
2004.353.10.24.59.912 2004.353.10.24.49.313   1792  Real Time Rejection 131
REJECTED TC1
        FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0 M9069=270
```

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 02660049, 02660050 & 02660051.

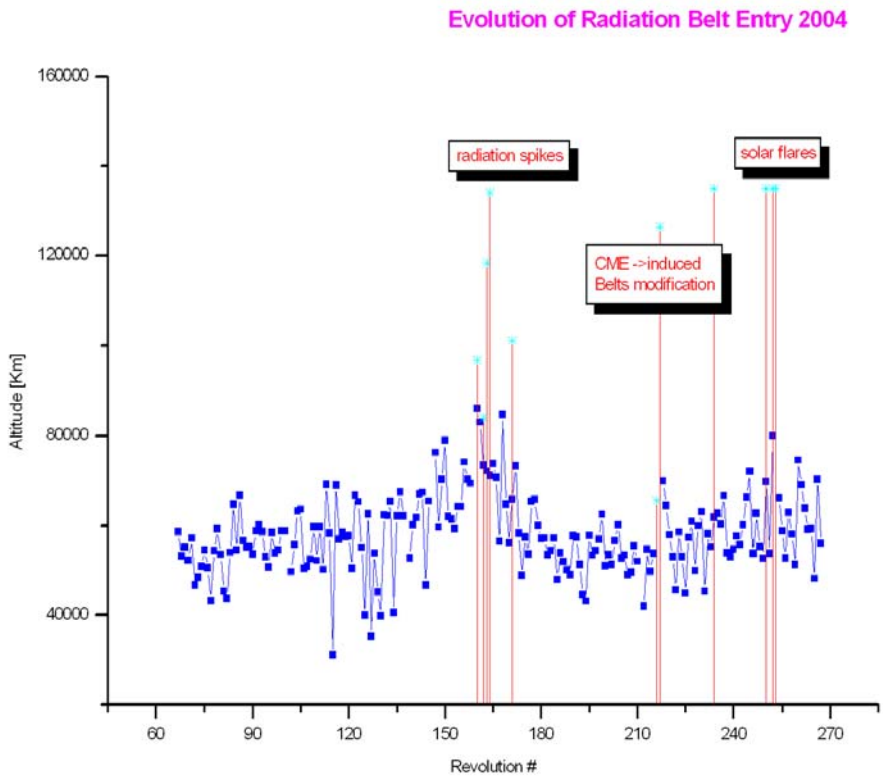
On DoY 358, at 15:11, a delayed AOCS TPF caused a guide star command to fail. This caused the loss of pointing 02680017. The instrument switched to science mode at the correct time, but with an incorrect attitude.

At 19:54, bad TM frames from Redu caused the loss of pointing 02680025.

On DoY 354 at 19:15:59 and DoY 357 at 19:05:09, OMC was switched by the Timeline to SAFE mode, at the nominal times.

7.3.6 IREM Operations

Radiation Belts Entry



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]
266	RAD ENTR R 2004-12-19T19:15:39Z	2004-12-19 17:51:13	70315.7	2004-12-19 19:59:55	54066.44
267	RAD EXIT R 2004-12-20T04:27:15Z	2004-12-20 03:01:53	>24882.8	2004-12-20 03:09:55	27816.77
267	RAD ENTR R 2004-12-22T19:04:52Z	2004-12-22 19:38:09	<56057.7	2004-12-22 19:47:31	54233.53
268	RAD EXIT R 2004-12-23T04:17:02Z	2004-12-23 02:38:49	<24889.5	2004-12-23 03:07:31	29155.21

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

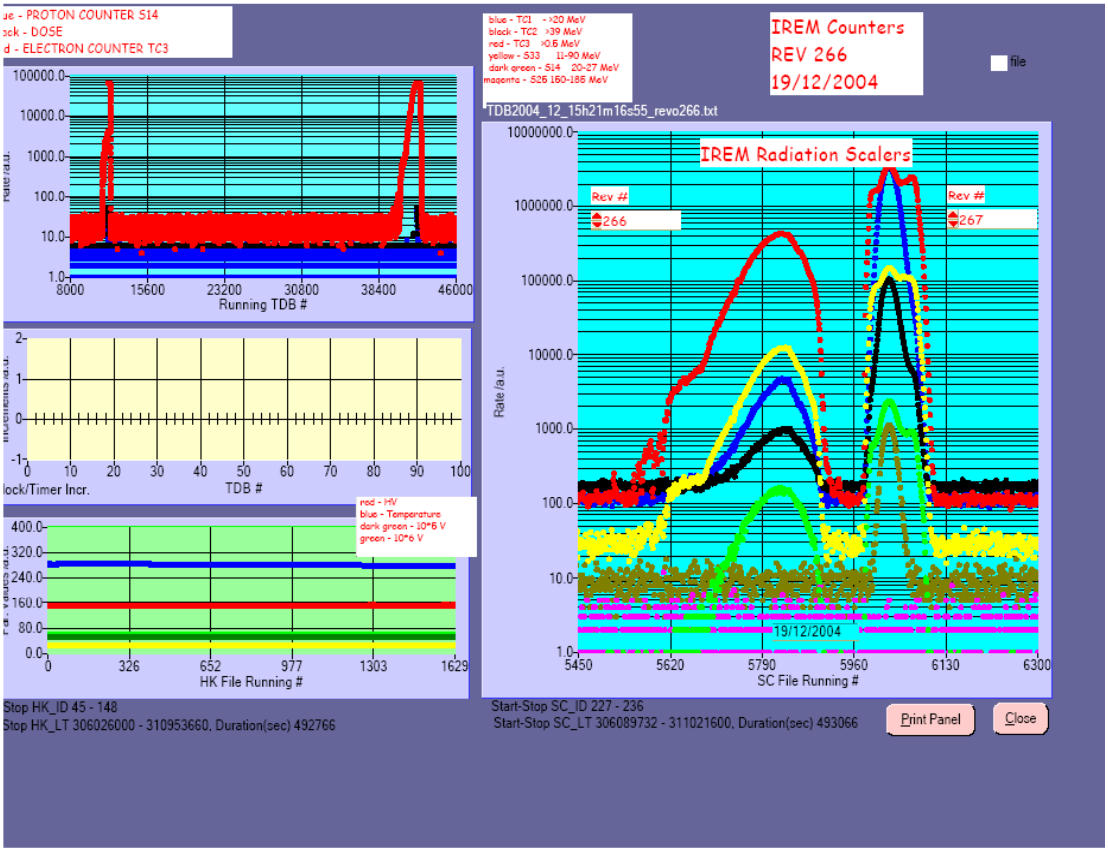
Proton Belts

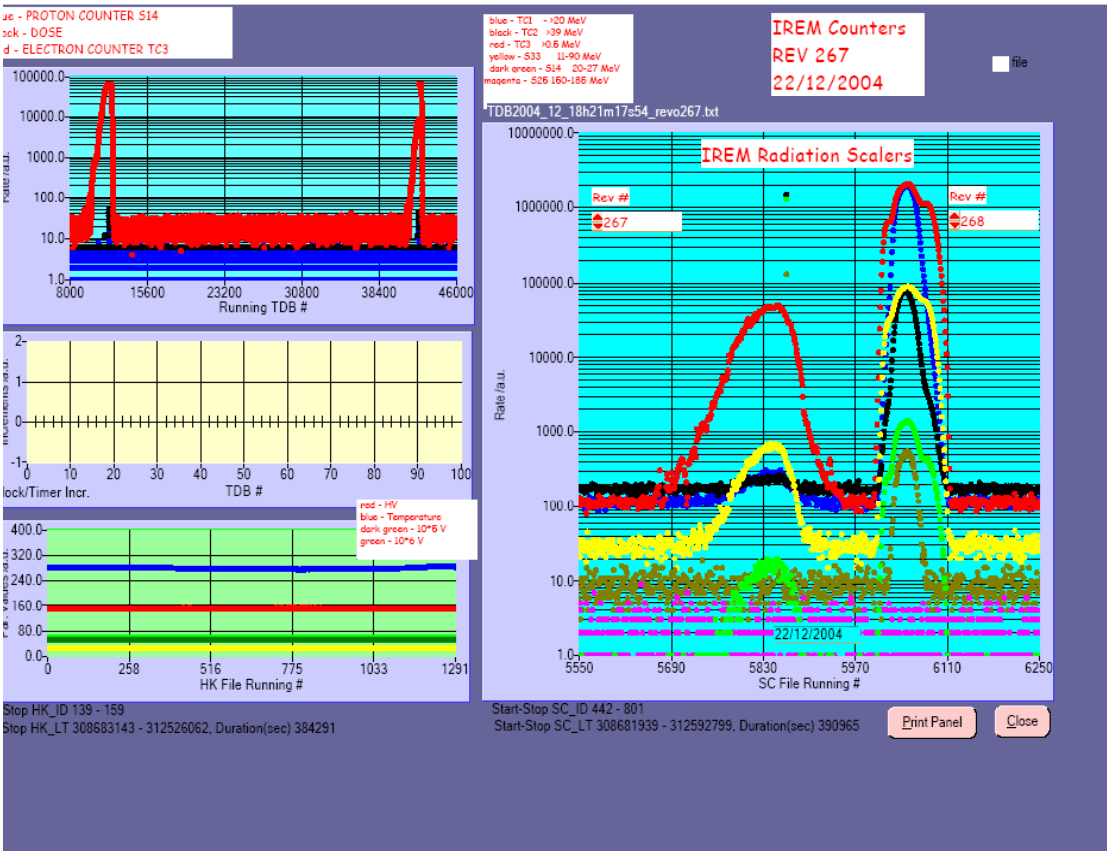
The flux of protons >8MEV computed by RadMon, did not exceed the threshold. Therefore, no predicted proton cut-off is provided for this week.

IREM daily report

Nothing to report.

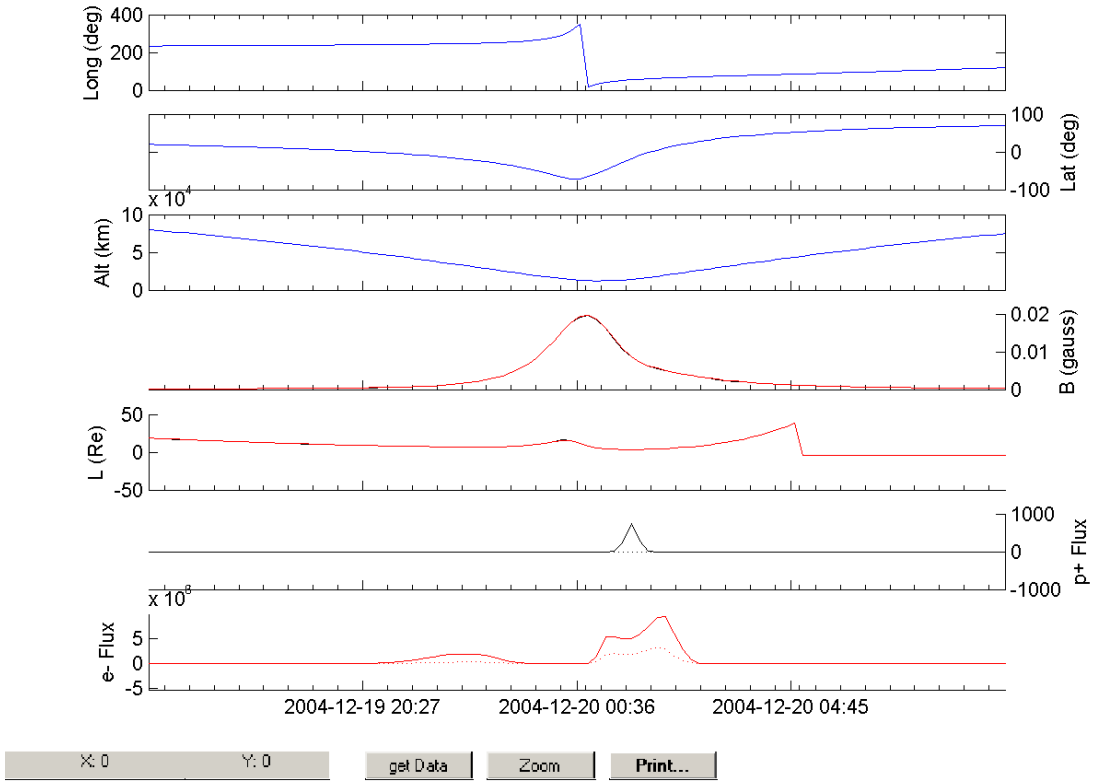
IREM radiation counters



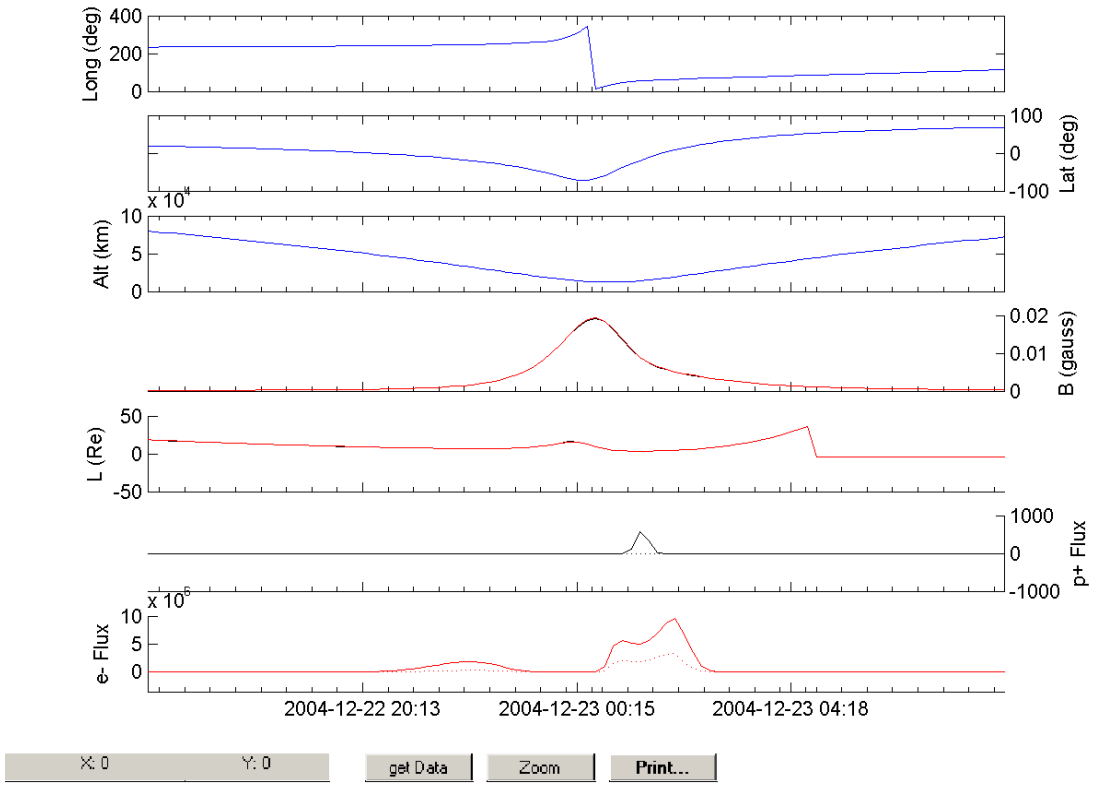


IREM Predicted Radiation Belt Passages.

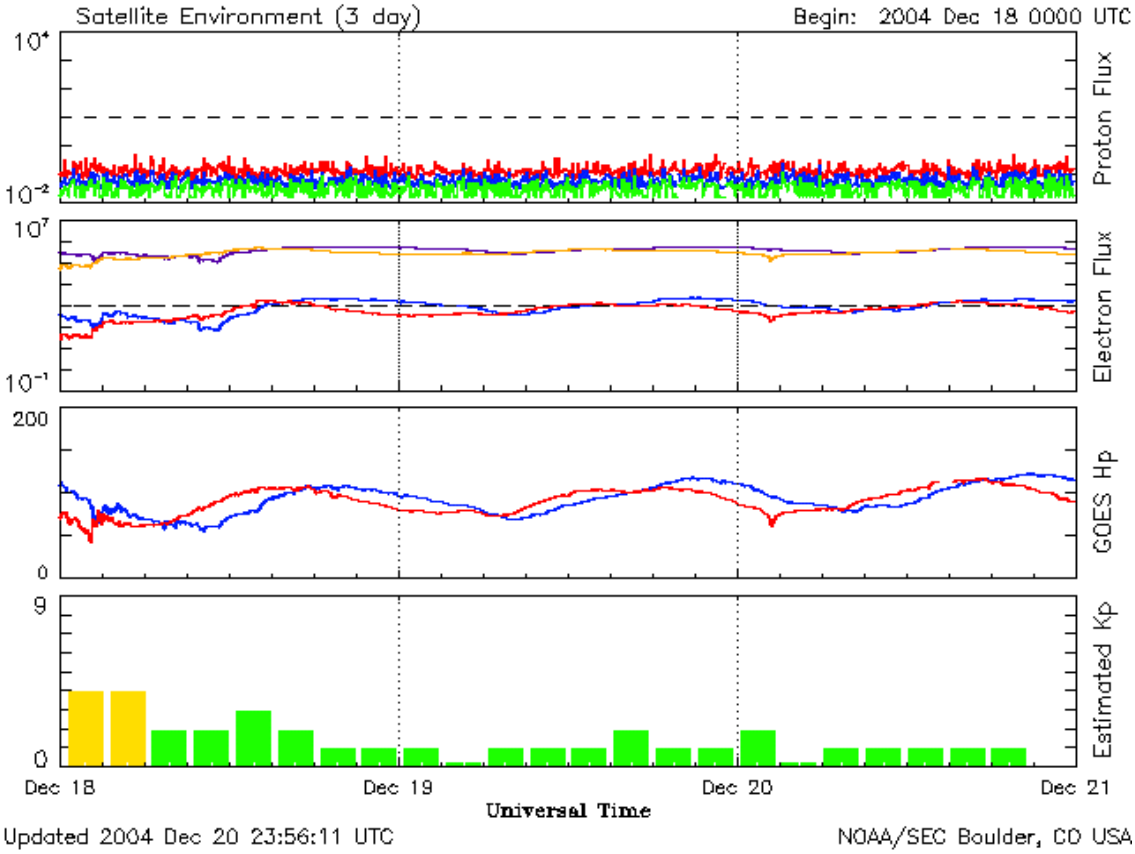
Rev 266

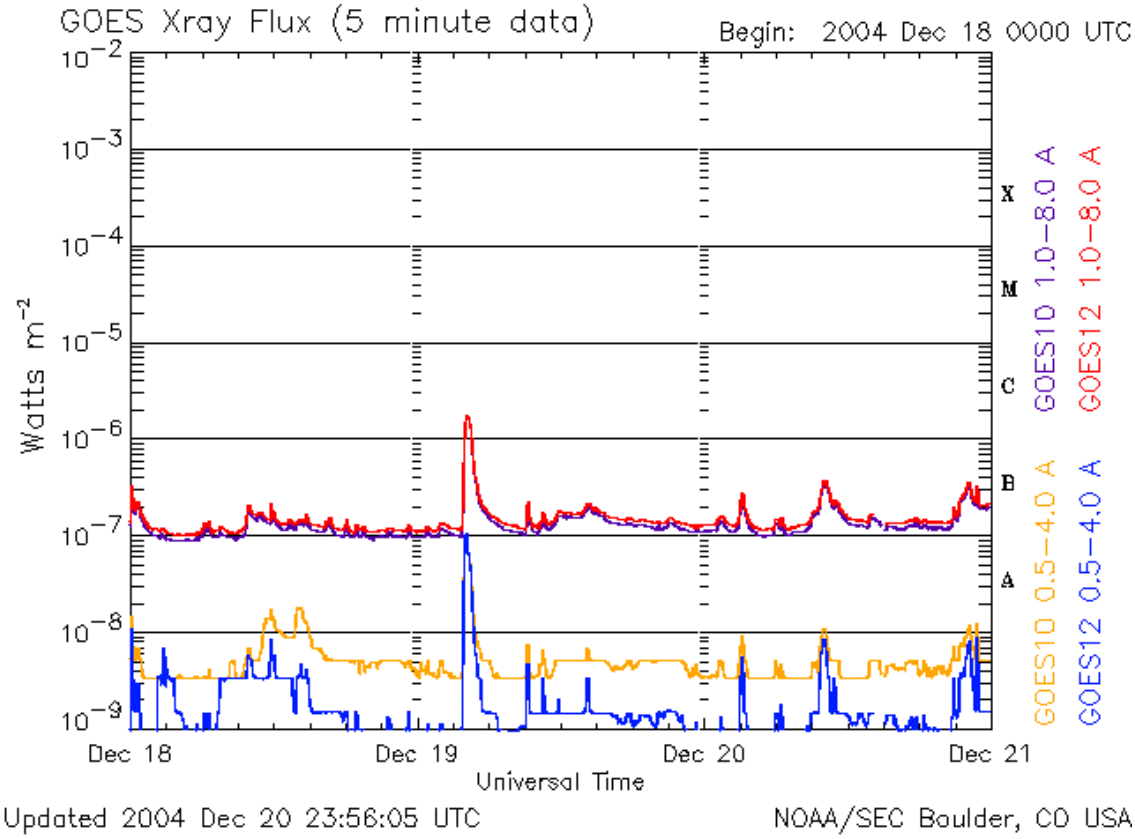


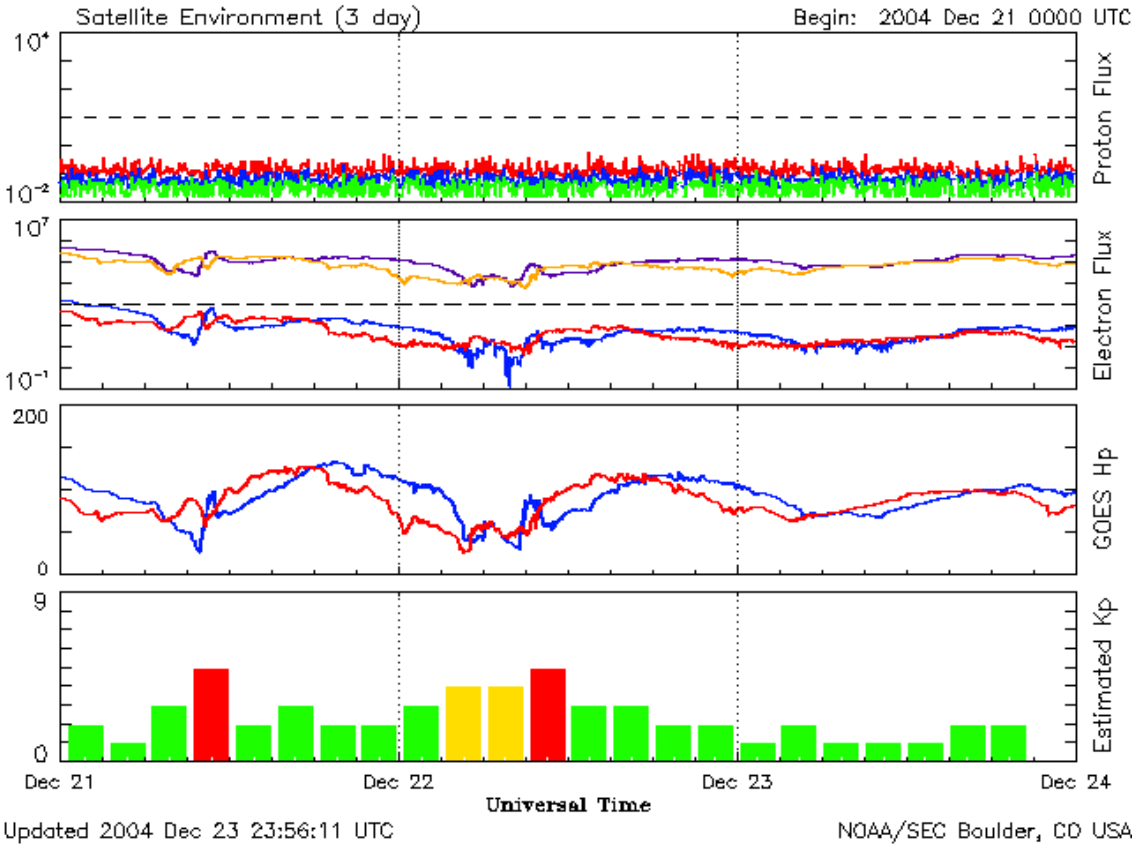
Rev 267

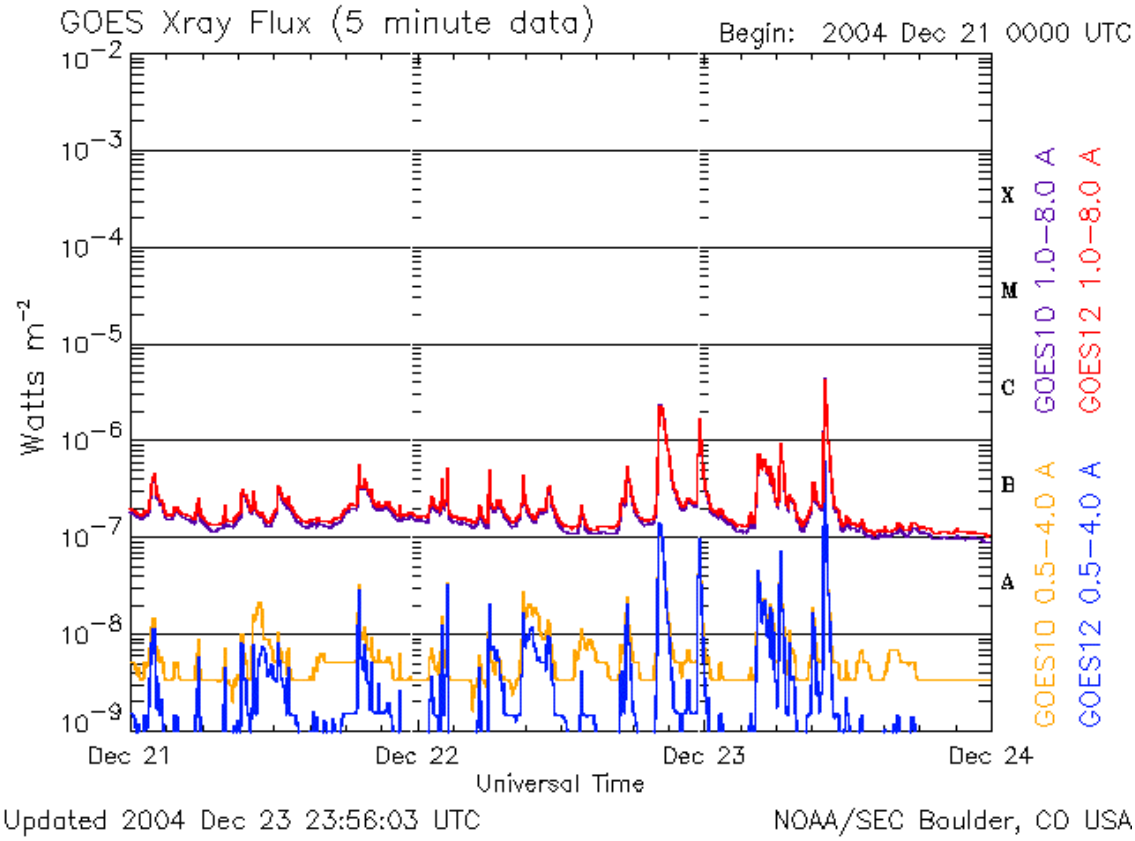


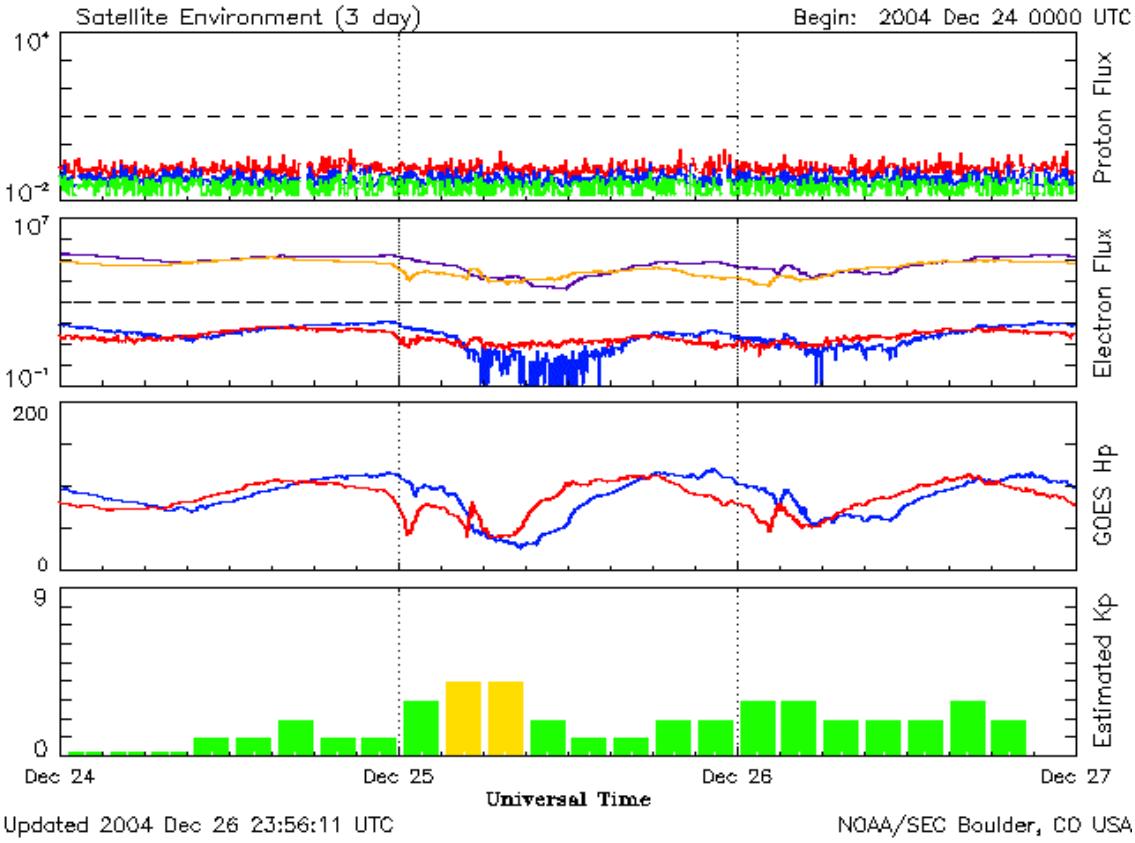
SEC-GOES Observed Particles Fluxes.

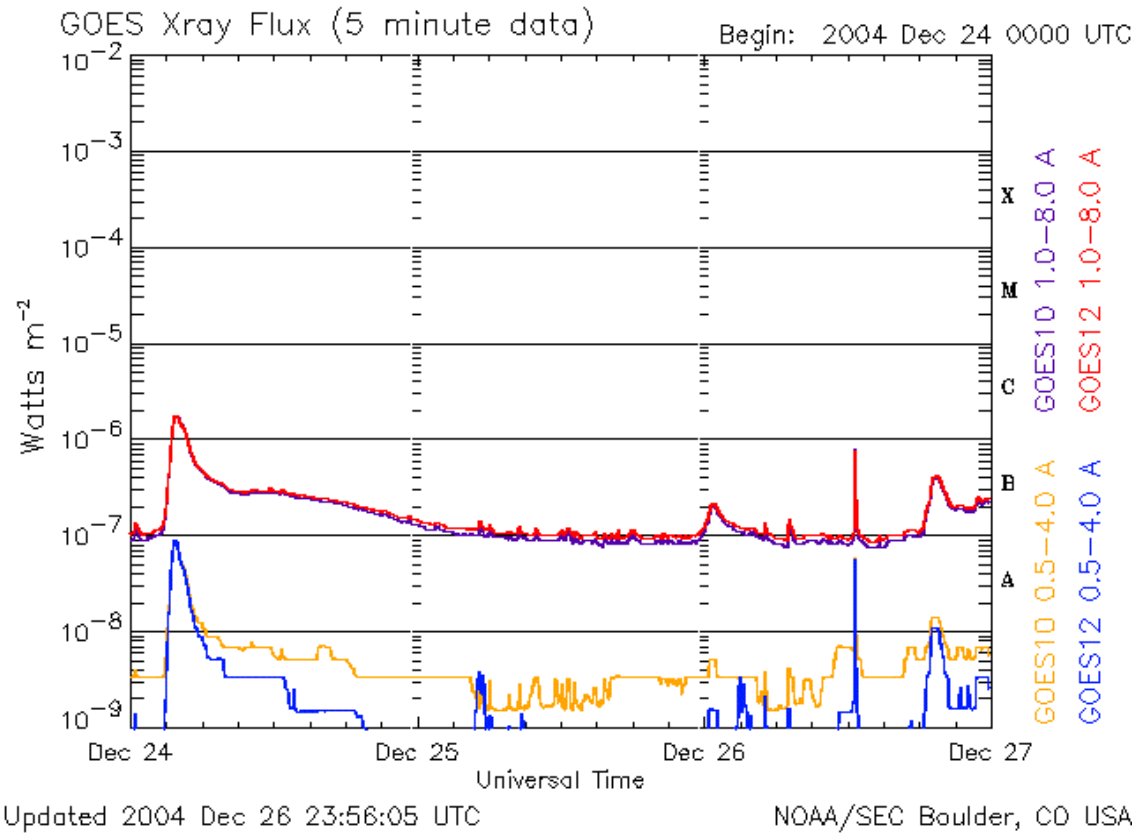





Satellite Environment (3 day)
Begin: 2004 Dec 21 0000 UTC
Proton Flux
Electron Flux
GOES Hp
Estimated Kp
Dec 21
Dec 22
Dec 23
Dec 24
Universal Time
Updated 2004 Dec 23 23:56:11 UTC
NOAA/SEC Boulder, CO USA


GOES Xray Flux (5 minute data)
Begin: 2004 Dec 21 0000 UTC
Watts m-2
X
M
C
B
A
GOES10 1.0–8.0 A
GOES12 1.0–8.0 A
GOES10 0.5–4.0 A
GOES12 0.5–4.0 A
Dec 21
Dec 22
Dec 23
Dec 24
Universal Time
Updated 2004 Dec 23 23:56:03 UTC
NOAA/SEC Boulder, CO USA


Satellite Environment (3 day)
Begin: 2004 Dec 24 0000 UTC
Proton Flux
Electron Flux
GOES Hp
Estimated Kp
Dec 24
Dec 25
Dec 26
Dec 27
Universal Time
Updated 2004 Dec 26 23:56:11 UTC
NOAA/SEC Boulder, CO USA


GOES Xray Flux (5 minute data)
Begin: 2004 Dec 24 0000 UTC
Watts m-2
X
M
C
B
A
GOES10 1.0–8.0 A
GOES12 1.0–8.0 A
GOES10 0.5–4.0 A
GOES12 0.5–4.0 A
Dec 24
Dec 25
Dec 26
Dec 27
Universal Time
Updated 2004 Dec 26 23:56:05 UTC
NOAA/SEC Boulder, CO USA