

INTEGRAL Radiation Analysis (*)

SPI - LCL SEU

(*) This report presents a study of the radiation environment through the anomaly period in terms of protons, electrons and x-ray fluxes, as well as solar activity. In a second step, radiation impacts are investigated on the spacecraft, the payload and the science part. Finally, a comparison with Cluster and XMM radiation effects during the same period is reported.

Date of anomaly: 2005-12-01 08:36:00Z
Revolution: 382
Altitude 113 000 km
subsystem: SPI
Anomaly description: LCL SEU
Period analysis: 9 hours
ARTS number: INT_SC-133

History of anomalies on INTEGRAL in the past 10 days : 21/11/2005, IREM SEU #28.

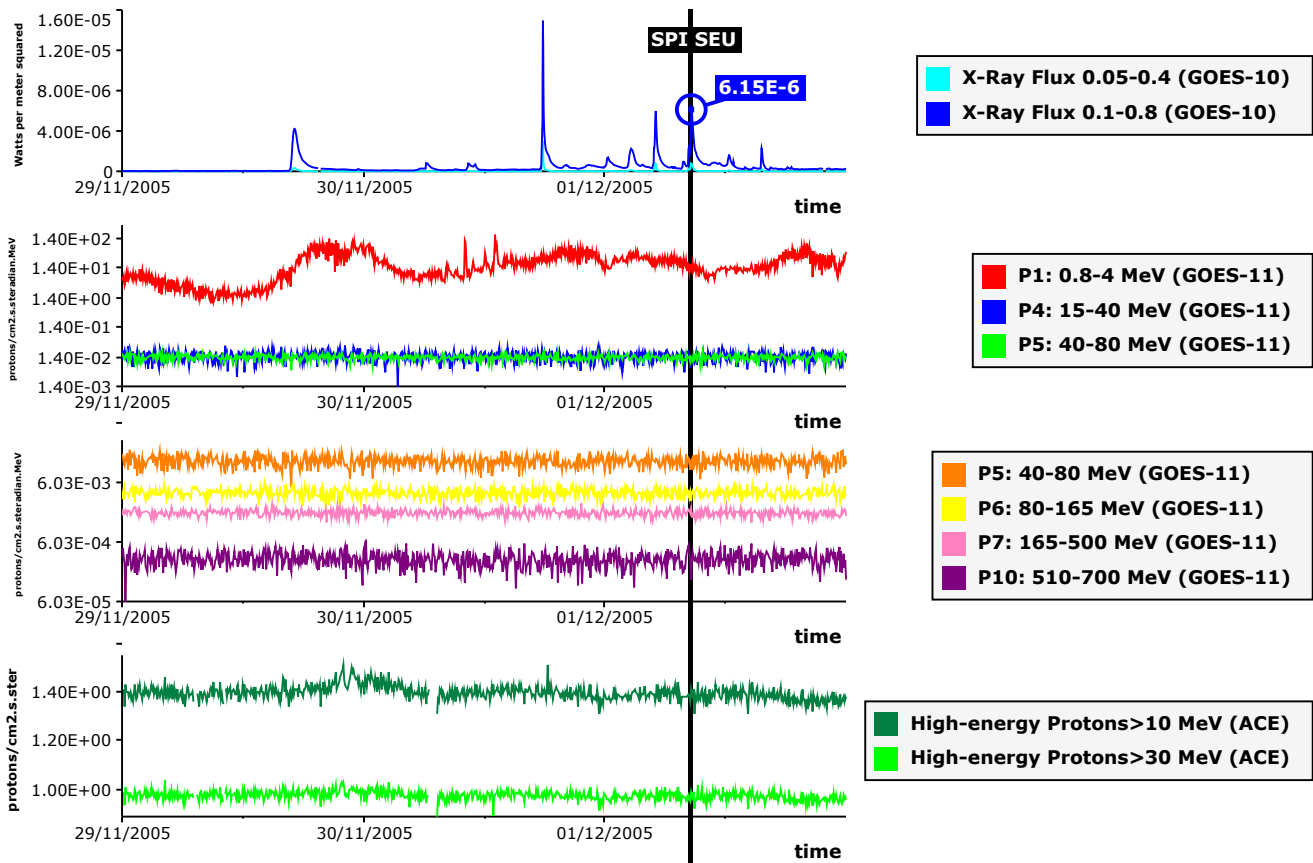
1. Radiation Environment

1.1. Solar activity (ESA/NASA)

On the 1st of December, the observation period was characterised by moderate to high solar activity. Sunspot 826 had grown rapidly to a big sunspot, it already unleashed an M1-solar flare on 30th November and kept on posing a threat of strong solar flares on the 1st of December.

1.2. Satellite Environment

X-ray and proton fluxes as measured by GOES satellites are presented below, referring to the analysis period across the failure. They report low activity on the 1st of December but a meaningful X-ray spike on the 30th of November (X-ray spikes being significant from $10E-5$ W/m²).



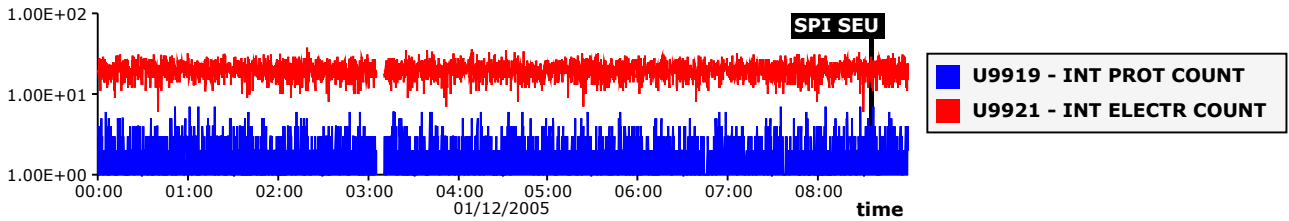
1.3. Radiation belt evolution

The evolution of the Radiation Belt entry before the anomaly was within the expected range of values, considering the season.

1.4. Radiations measured by INTEGRAL detectors

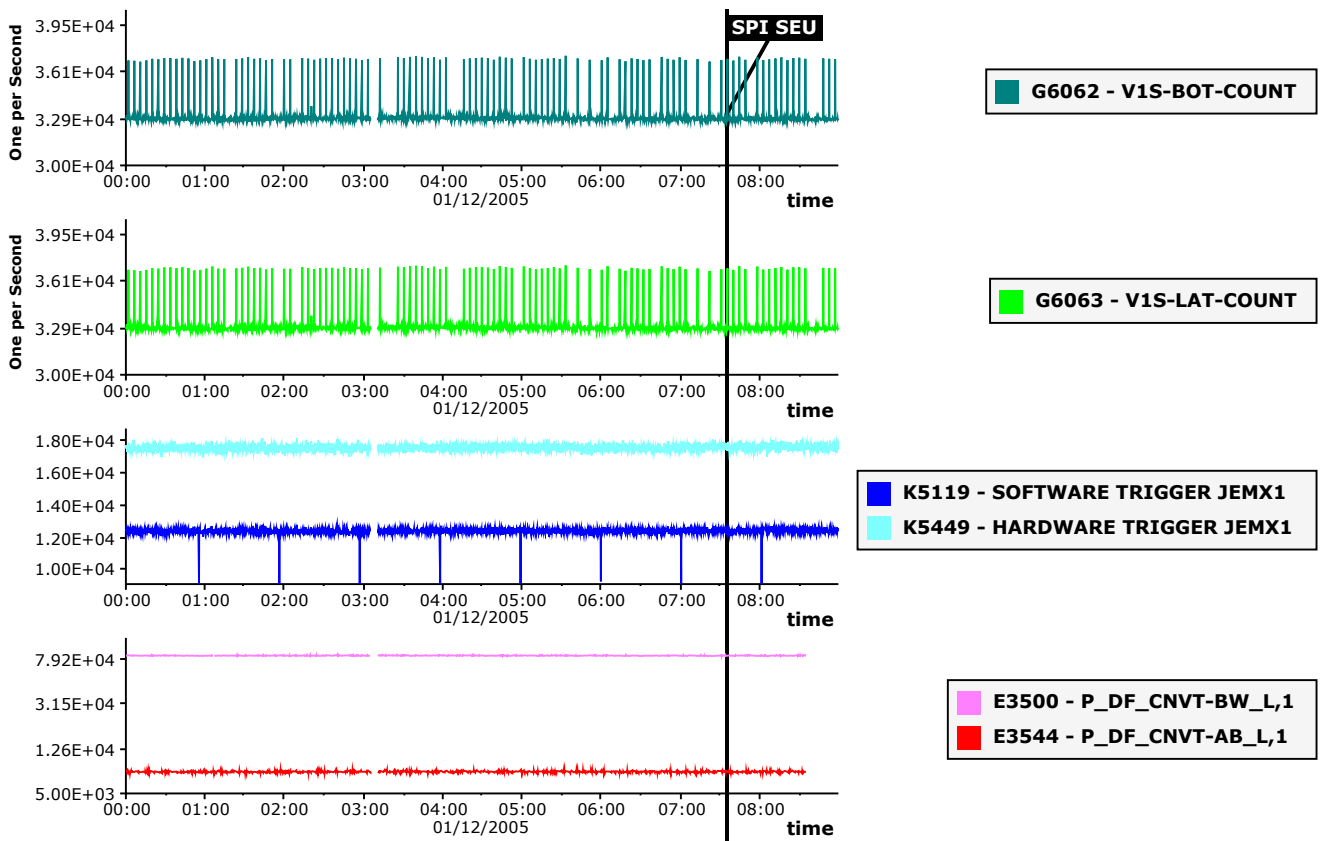
1.4.1. IREM counters

IREM counters for the given period do not report any suspicious behaviour. At the exact time of the anomaly the electron and proton counts are respectively 18 and 1 (nominal background).



1.4.2. Radiation background

The comparison between the count-rates reported by IBIS-VETO, JEM-X hardware/software triggers and SPI-ACS, gives an indication of the stability of the background environment (heavy particles) across the anomaly.



2. Radiation impacts on INTEGRAL

2.1. Spacecraft

No unusual event, due to high radiation, was observed on the platform (AOCS, OBDH, TCS, EPS and RF) during the analysis period. Batteries current and start trackers did not present unexpected behaviour/anomaly.

2.2. Payload

No unusual event, due to high radiation, was observed on the payload (IBIS, OMC, JEMX) during the analysis period before the anomaly.

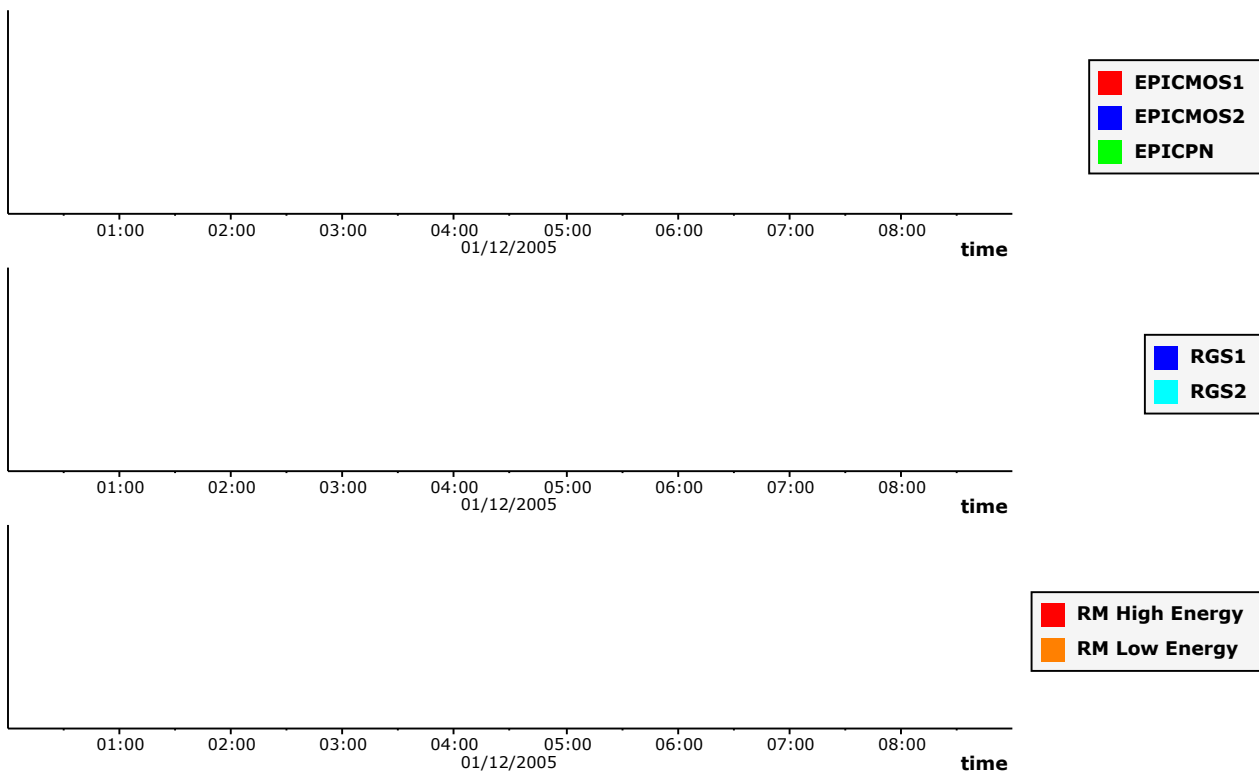
2.3. Science

No loss of data, due to high radiation, was reported during the analysis period before the anomaly.

3. Radiation impacts on other missions

3.1. XMM

No anomaly due to high radiation was reported during the analysis period. TBC



3.2. ENVISAT

No anomaly due to high radiation was reported during the analysis period. TBC

4. Conclusion

According to on-board and external sources, the radiation environment did not present peculiar activity before the anomaly. No high spikes or unexpected values were observed.

No radiation impact was reported on INTEGRAL during the analysis period before the anomaly, nor on XMM or ENVISAT.

The following plot presents the projection of INTEGRAL on Earth at the time of the anomaly.

