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Detecting radiation with Juno/JIRAM

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Abstract

The Jupiter InfraRed Auroral Mapper (JIRAM) is an imaging spectrometer on board the NASA Juno mission. Since August 2016 JIRAM has been observing both the atmosphere and auroral features of the giant planet. JIRAM also participates in the Juno Radiation Monitoring experiment, providing dedicated imager acquisitions to measure the high-energy particle environment at Jupiter. During the last year the JIRAM team has developed a new and complementary approach to monitor the radiation using a subset of spectrometer data. We present some results obtained with this new approach.

1. Introduction

JIRAM is an instrument aboard the NASA Juno spacecraft which combines a spectrometer (SPE), which operates in the 2-5 μm range, and an infrared imager (IMG), split in two spectral channels: L-filter (3.45±0.15 μm) and M-filter (4.78±0.24 μm) [1], sharing a common optical telescope. Exploiting its property, JIRAM is achieving incredible results in the observation of Jupiter's atmosphere and auroral region [2][3][4]. Taking into account that JIRAM detectors are sensitive to electrons with energy >5 MeV [5], JIRAM is currently performing radiation monitoring by the imager during each orbit. These images are dedicated to the study of the jovian radiation environment for the Juno Radiation Monitoring (RM) experiment [5][6].

In coordination with the RM team, the JIRAM team elaborated an alternative method to monitor the radiation environment exploiting a sub-matrix of the SPE detector. Moreover, the RM team is in parallel developing a new calibration to retrieve relatively low flux measurements achieved so far on orbit. Our two teams are collaborating and comparing results.

2. Method

Radiation hitting the JIRAM detectors causes an increase of spikes in the data and a consequent degradation of the images acquired (Figure 1).

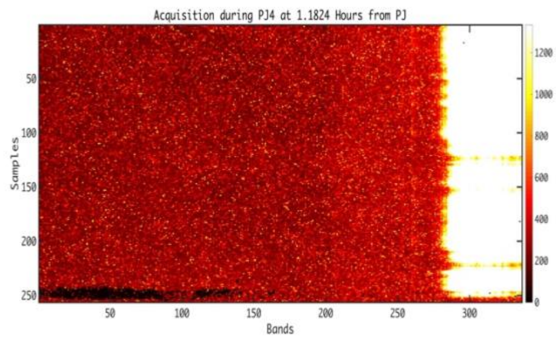

Figure 1: Example of a SPE focal plane hit by a large dose of radiation, acquired during the orbit 4. The bright region on the right is the thermal emission of Jupiter

In the last year, we developed a code which recognizes the spikes produced by radiation allowing us to estimate the omnidirectional electron flux.

Now we are working on the development of a new approach in order to monitor the radiation flux.

For our study, we are using a sub-matrix of the SPE detector. We select the region of the SPE where we have neither thermal emission nor reflected sunlight from Jupiter. This choice was made with the ultimate goal of being able to monitor the radiation simultaneously with the scientific measurements at Jupiter. In order to compare results from this new method and ones obtained by the RM experiment we are using the same instrumental setting and acquisition mode. Our approach is based on simulations of the radiation that hit the detector during the studied period.

When the energetic electron flux on the detector is so high that it precludes us from counting all of the single irradiated pixels, and the radiation signal is built up like in figure 1, we produce synthetic matrices, randomly hit by radiation and we compare them with the real ones acquired by the instrument. Then we can estimate the omnidirectional flux of electrons. We will present this new approach and the results obtained during our presentation.

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