EPSC Abstracts
Vol. 12, EPSC2018-1169, 2018
European Planetary Science Congress 2018

Design of the calibration bench for the characterization of MAJIS/JUICE VIS-NIR detectors

Miriam E. Cisneros-González (1), David Bolsée (1), Nuno Pereira (1), Ann C. Vandaele (1), Özgür Karatekin (2), Boris Giordanengo (2), Samuel Gissot (2), Yves Langevin (3), François Poulet (3), Cydalise Dumesnil (3), Claudia Ruiz-de-Galarreta-Fanjul (3), Benoît Lecomte (3), Antoine Arondel (3), John Carter (3), Guiseppe Piccioni (4), Gianrico Filacchione (4) and MAJIS Team
(1) Royal Belgian Institute for Space Aeronomy (IASB-BIRA), Brussels, Belgium, (2) Royal Observatory of Belgium (ROB), Brussels, Belgium, (3) Institute of Space Astrophysics (IAS), Orsay, France, (4) National Institute for Astrophysics (INAF), Rome, Italy. (miriam.cisneros@aeronomie.be)

Abstract

The MAJIS (Moons And Jupiter Imaging Spectrometer) instrument [1] is part of the science payload of the ESA L-Class mission JUICE (Jupiter ICy Moons Explorer) [2] to be launched in 2022 and arrival at Jupiter in 2030. The instrument and in particular its detectors need to be characterized in the laboratory before being calibrated at instrument level. Here we present the work that will be carried out at IASB-BIRA and ROB in order to fully characterize and calibrate the VIS-NIR detectors of MAJIS, both at spare mode as at flight mode, focused in the calibration bench design.

1. Introduction

MAJIS (Moons And Jupiter Imaging Spectrometer) is an instrument part of the science payload of the ESA L-Class mission JUICE (Jupiter ICy Moons Explorer) to be launched in 2022 and arrival at Jupiter in 2030 to perform detailed observations of the giant gaseous planet Jupiter and three of its largest moons Ganymede, Callisto and Europa, for at least three years. MAJIS will perform imaging spectroscopy through two channels: VIS-NIR (0.50-2.35 μm) and IR (2.25-5.54 μm), to characterize the Jovian atmosphere and magnetosphere, and to determine the global composition of surface materials of the icy moons. IASB-BIRA and ROB will contribute to MAJIS with the characterization of the VIS-NIR detectors, which includes the measurements of their power consumption, power dissipation, dark current, Read-Out Noise (RON), full-well capacity, conversion gain, persistence, linearity, defective pixels, quantum efficiency, fixed pattern noise and operability.

2. Set-up and Preliminary results

The opto-electronical calibration bench will guarantee the cleanliness of its components and the necessary stable thermal conditions to characterize the HgCdTe detectors (≤140K). It will provide a thermal control unit, N_2 flushing for the light path outside the vacuum chamber, the remote control of the spectrometer, temperature and vacuum monitoring, and a security system to avoid conditions which could damage the detector and other critical components (including both operation and storing), besides the data processing software to analyze the detector response. The facility will be developed at a dark clean room environment class 10000 at the IASB-BIRA laboratories.

Since some parameters require different illumination conditions, beam uniformity, exposure time, and/or data acquisition procedure for their measurement, three configurations have been established. The first one will be used to develop tests under dark conditions (shutter closed), the second one to assure light uniformity over the surface detector (integrating sphere), and the third one to provide as close as possible the light beam that the detector should receive from MAJIS (integrating sphere + focusing array). An additional configuration could be added to measure the Modulating Transfer Function (MTF) of the detectors. Figure 1 shows a preliminary schematic of the design. The optical components of the facility will include a stable light source covering the spectral range of MAJIS followed by a variable aperture and a filter wheel, then the light beam will be directed to a monochromator by an integrating sphere at the entrance. The monochromator will include its own wheel filter and a PBS detector to have a reference of the diffracted light beam at the output of the spectrometer. For the second configuration the spectra will be directed using an optical fiber to an integrating sphere (with another PBS detector as reference) and to the detector. For the third configuration the spectra from the integrating sphere will be focused by an optical array into the detector. The electronic shutter will be in front of the detector in every configuration.

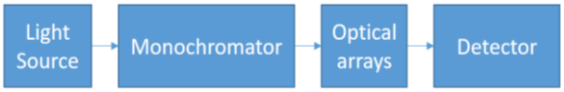

Figure 1: Preliminary schematic of the calibration bench. Optical arrays include the necessary elements to develop every measurement according to the configurations stablished: shutter closed, integrating sphere, and integrating sphere + focusing array, respectively. Some of these elements shall be inside of the vacuum chamber.

It is worth to mention that flux calculations shall be carried out in order to determine the irradiance and thermal emission of each component and their expected influence over the detector response (Signal-to-Noise Ratio). The results are considered to evaluate the preliminary design and make changes if necessary.

3. Conclusions

This document describes the objectives and the foreseen designs of the calibration bench which will be used to characterize the MAJIS/JUICE VIS-NIR detectors at the IASB-BIRA laboratories, and some of expected results. The facility should be validated at the beginning of 2019.

Acknowledgements

This project acknowledges funding by the Belgian Science Policy Office (BELSPO) by PRODEX-11 Project Proposal: 'Characterization of JUICE/MAJIS VIS-NIR detectors'.

References

[1] Langevin, Y., and MAJIS Team: MAJIS (Moons And Jupiter Imaging Spectrometer) for JUICE: objectives for the Galilean satellites, European Planetary Science Congress, Vol. 8, pp. EPSC2013-548-1, 2013.

[2] Grasset, M. K., et al.: JUpiter ICy moons Explorer (JUICE): An ESA mission to orbit Ganymede and to characterise the Jupiter system, Planetary and Space Science, Vol. 78, pp. 1-21, 2013.