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The MAJIS visible/NIR imaging spectrometer on board the ESA JUICE mission : updated design, implications for performances and science goals

Y. Langevin (1), G. Piccioni (2) and the MAJIS team
(1) Institut d'Astrophysique spatiale, CNRS/Université Paris Sud, Orsay, France, (2) Istituto di Astrofisica e Planetologia Spaziale, INAF, Rome

Abstract

MAJIS is the Visible/Near IR imaging spectrometer of the JUICE mission, the first « large » mission of the « cosmic vision » program of ESA, which will study the system of Jupiter with a specific interest for Ganymede during an orbital phase of at least 150 days. The MAJIS consortium involves laboratories and industrial partners from France, with CNES as the lead funding agency, Italy, with support from ASI, and Belgium, with support from BELSPO. The design of the instrument has been consolidated in preparation to the PDR. The operating wavelength ranges of the two channels, initially 0.4 – 1.9 µm for the VIS-NIR channel and 1.5 – 5.7 µm for the IR channel, are now 0.5 – 2.35 µm for the VIS-NIR channel and 2.25 – 5.54 µm for the IR channel. This shift of the crossover to a longer wavelength has made it possible to simplify the optical design while maintaining or improving the science performances. The passive cooling scheme has been confirmed, with an extension of the surface of the radiators so as to provide adequate margins for the required operating temperatures (≤ 140 K for the VIS-NIR detector, ≤ 90 K for the IR detector). H1RG detectors from Teledyne have been selected. These detectors are 1024 x 1024 pixels in size with a pitch of 18 µm. The effective area for photon collection will be constituted by 800 lines of 1016 pixels. Binning by 2 in the spatial direction will be implemented, with an IFOV of 150 µrad and a FOV of 0.06 rad. The nominal operating mode will implement binning by 2 in the spectral direction (508 spectral samples), providing a spectral sampling of 3.65 nm for VIS-NIR channel and 6.49 nm for the IR channel. It will be possible to select spectral ranges over which spectral binning will not be implemented, providing up to 640 spectral samples after selective spectral binning. The design of the electronics has been updated and simplified, with all electronic elements now implemented as a single module. Specific on-board processing procedures have been developped for improving data quality by limiting the impact of « spikes » generated by high energy electrons to at most 1% of the data elements. Updated performances for the major goals of MAJIS (surface of icy satellites, atmosphere of Jupiter, exospheres, small satellites and rings…) will be presented. The updated MAJIS design makes it possible to meet the objectives defined for MAJIS in the Science Requirement Document of the JUICE mission