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MAJIS, the Moons And Jupiter Imaging Spectrometer, designed for the future ESA/JUICE mission

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The Moons And Jupiter Imaging Spectrometer (MAJIS) is the VIS-IR spectral mapper selected for JUICE (Jupiter Icy Moon Explorer), the first Large-class mission in the ESA Cosmic Vision Programme. Scheduled for a launch in 2022, JUICE will perform a comprehensive exploration of the Jovian system thanks to several flybys of Callisto, Ganymede and Europa, before finally entering orbit around Ganymede. During these phases, MAJIS will acquire hyperspectral data necessary to unveil and map the surface composition of different geologic units of the satellites. Transfers between successive satellites' flybys shall be devoted to remote observations of Jupiter's atmosphere and auroras. MAJIS' instrument design relies on a 75 mm pupil, f/3.2 aperture TMA telescope matching two Czerny-Turner imaging spectrometers. A dichroic element is used to split the beam between the two spectral channels. The VIS-NIR spectral channel covers the 0.4-1.9 μm range with a sampling of 2.3 nm/band. The IR channel works in the 1.5-5.7 μm range with a 6.6 nm/band sampling. The entire optical structure is passively cooled at cryogenic temperature $<$180 K. VIS-NIR and IR spectral channels use two 640x480 pixels MCT detectors passively cooled to $<$180 and $<$90 K, respectively, in order to reduce the dark current and thermal background and maximize the signal to noise ratio. MAJIS' optical design achieves a 3.4$\circ$ FOV with a 125 μrad IFOV, corresponding to a 30 km on-ground spatial swath width and a 62.5 m/pixel resolution from a 500 km orbit. To ensure optimal performances during the Jovian tour, thermomechanical and radiation effects analysis have been performed with the scope to assess instrument interfaces and to optimize design and shielding mass. The instrument has a high operational flexibility, thanks to: 1) a steerable mirror in the telescope, usable to aim the FOV, to build 2D images through scans and to compensate the spacecraft motion during fast flybys; 2) different presettable operative modes able to change spatial and spectral binning; 3) a spike filtering algorithm necessary to reduce the radiation noise caused by charged particles; 4) an on-board data compression module capable to reduce the data downlink volume. Currently MAJIS is in assessment and development A-B1 phase. The project is led by a French-Italian consortium. INAF-IAPS Rome (Italy) is responsible for the optical head, including optical and thermomecanical design, radiation and performances analysis and internal calibration unit. IAS Orsay (France) is in charge with detectors and analog to digital chain, including proximity, main electronics, data compressor, instrument overall performances measurement and calibration. Authors acknowledge finanacial support from CNES and ASI national space agencies.