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The Visible and InfraRed Hyperspectral Imaging Spectrometer (VIRHIS): a study for EJSM

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Abstract

The VIS-IR imaging spectrometer for the EJSM mission, named VIRHIS (*Visible and InfraRed Hyperspectral Imaging Spectrometer*), is perfectly suitable to obtain a comprehensive picture of the Jupiter system by combining information of the surfaces of the Galilean satellites, the Jupiter's atmosphere, and the other targets: the ring system, the small inner satellites, and possibly irregular satellites. The level of details and the extended mapping capabilities of this instrument will unveil crucial aspects of the Jovian system, including the investigation of the nature and location of chemical compounds (especially organic and non-ice constituents) on the surfaces of the Galilean satellites, the characterization of their exospheres, the monitoring of peculiar aspects (Io and Europa torii, Io's volcanic activity), the study of Jupiter's atmosphere at different levels (including aurorae and magnetic footprints) and the spectral characterization of the whole Jupiter system (including ring system, small inner moons, and other targets of opportunity).

The VIRHIS instrument baseline for JGO (Jupiter Ganymede Orbiter) is an advanced imaging spectrometer that in one compact instrument combines two spectral channels operating in the 0.4-2.2 µm and 2.0-5.2 µm ranges. It can operate both in pushbroom and in scanning mode, according to the different operational phases and scenario of the mission. The instrument can collect simultaneously 480 spectra taken across the spectrometer's slit, corresponding to a 3.44° × 125 µrad FOV and allowing image reconstruction during time. To meet the scientific requirements a spectral sampling of 2.8-5.0 nm/band is assumed, respectively, for the 0.4-2.2 and 2.0-5.2 µm ranges. Two HgCdTe sensors arrays are foreseen as focal planes for the VIS-NIR and IR spectral channels. The instrument will be designed to survive in the harsh radiation environment as well as to be compliant with the decontamination procedures imposed by the planetary protection rules. A delta study will be executed in order to make the VIRHIS concept applicable to the JEO (Jupiter Europa Orbiter) mission requirements. The consortium proposing the VIRHIS study has a relevant heritage in VIS-NIR imaging spectrometers guaranteed over decades on full payloads or subsystems and technical aspects including optical design, scan mirror, focal plane arrays, signal digitalization, data compression, thermo-mechanical design, internal calibration units and Jovian radiation shielding (Cassini/VIMS, Rosetta/VIRTIS, Venus-Express/VIRTIS, Dawn/VIR-MS, Mars-Express/OMEGA, BepiColombo/SIMBIO-SYS, Juno/JIRAM).

In this paper we present the study proposal that will define with a sufficient detail the characteristics, interfaces, resources and expected performances of the instrument.