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Science Goals of MAJIS, the Moons And Jupiter Imaging Spectrometer, selected for the ESA/JUICE mission

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The Moons And Jupiter Imaging Spectrometer (MAJIS) is the VIS-IR spectral mapper selected for the JUICE (Jupiter Icy Moon Explorer) L-class mission by ESA. Launched in 2022, JUICE will perform 35 targeted flybys of Galilean satellites (Callisto: 20; Ganymede: 13; Europa: 2) from January 2030 to September 2032, then a 9 months orbital phase around Ganymede. This comprehensive tour will make it possible to perform in-depth investigations of the atmosphere of Jupiter (including at high latitudes during a sequence of inclined orbits in mid-tour), Io, small satellites, rings and dust in the Jupiter system.

Spectral imaging in the visible and near-IR ranges is a key technique for characterizing the composition of both surfaces and atmospheres. MAJIS will provide spectral imaging observations of the Jupiter system with an unprecedented coverage, spatial resolution (0.125 mrad, e.g. 62.5 m / pixel for Ganymede on a 500 km altitude orbit and 125 km / pixel for Jupiter from the orbit of Ganymede) and spectral resolution (1280 spectral channels from 0.4 μm to 5.7 μm), adressing major science goals of JUICE:

- Determination of the icy, mineral and organic composition of the surface of satellites
- Relationship between composition and geological processes
- Detection of volatiles, relationship with cryovolcanic activity and exobiology
- Interaction of surfaces with the environment, characterization of exospheres
- Time evolution of hot spots on Io (40 distant encounters, down to 50 km/pixel)
- Exospheres of Galilean satellites, relationship with the surface and the environment
- Compositional relationship between small satellites and rings
- Stratospheric and thermospheric structure of the atmosphere of Jupiter
- Composition and general circulation of the atmosphere of Jupiter, clouds, hot spots
- Minor constituents (water, hydrocarbon chemistry)
- Vertical mixing in the stratosphere of Jupiter
- Observations of Auroral emissions

During the initial stages of the study phase, specific scenarios are investigated so as to best use spacecraft capabilities for science during critical mission phases such as the 500 km circular orbit arount Ganymede, the Europa flybys and the high inclination orbits. A large mass storage capability is foreseen, which is particularly useful for MAJIS given its large data output during satellite flybys and time evolution sequences for Jupiter. There will be limitations due to downlink, but the present allocation will already make it possible to obtain extensive coverage as well as many opportunities for HR observations by MAJIS.