



Joint Europa Mission (JEM) : A multi-scale study of Europa to characterize its habitability and search for life.

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Europa is the closest and probably the most promising target to perform a comprehensive characterization of habitability and search for extant life. We propose that NASA and ESA join forces to design an ambitious planetary mission we call JEM (for Joint Europa Mission) to reach this objective. JEM will be assigned the following overarching goal: Understand Europa as a complex system responding to Jupiter system forcing, characterize the habitability of its potential biosphere, and search for life in its surface, sub-surface and exosphere.

Our observation strategy to address these goals will combine three scientific measurement sequences: measurements on a high-latitude, low-latitude European orbit providing a continuous and global mapping of planetary fields (magnetic and gravity) and of the neutral and charged environment during a period of three months; in-situ measurements at the surface, using a soft lander operating during 35 days, to search for bio-signatures at the surface and sub-surface and operate a geophysical station; measurements of the chemical composition of the very low exosphere and plumes in search for biomolecules.

The implementation of these three observation sequences will rest on the combination of two science platforms equipped with the most advanced instrumentation: a soft lander to perform all scientific measurements at the surface and sub-surface at a selected landing site, and a carrier/relay/orbiter to perform the orbital survey and descent sequences. In this concept, the orbiter will perform science operations during the relay phase on a carefully optimized halo orbit of the Europa-Jupiter system before moving to its final European orbit. The design of both orbiter and lander instruments will have to accommodate the very challenging radiation mitigation and Planetary Protection issues.

The proposed lander science platform is composed of a geophysical station and of two complementary astrobiology facilities dedicated to bio-signature characterization experiments operating respectively in the solid and in the liquid phases, fed by a common articulated arm. The “Astrobiology Wet Laboratory” will be a specific European contribution.

We propose an innovative distribution of roles to make JEM an appealing and affordable joint venture for the two agencies: while NASA would provide an SLS launcher, the lander stack and mission operations, ESA would provide the carrier-orbiter-relay platform. The delivery of the orbiter by ESA could take advantage of a double European heritage: an adaptation of the ORION ESM bus to JEM, complemented by avionics derived from JUICE.