NASA’s Flagship Mission to Jupiter’s Moon Europa: Exploring a Potentially Habitable World

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It is expected that Jupiter's moon Europa may have the three ingredients thought necessary for life to exist: liquid water, chemical elements from which to build organic molecules, and chemical energy. Europa is hypothesized to have the three ingredients in the form of: (1) an extensive saltwater ocean beneath an ice shell that is geodynamically active and relatively thin (several kilometers to several tens of kilometers thick); (2) key chemical elements derived from the primordial chondritic composition of the Jovian protoplanetary disk, plus delivery by asteroids and comets over time; and (3) a source of chemical energy for life, from the combination of irradiation of its surface to produce oxidants, plus hydrothermal activity and/or serpentinization at its ocean floor to produce reductants.

NASA recently approved the development of a flagship-level mission to explore Europa, with the specific goal of investigating its habitability. The spacecraft will launch some time in the next decade, and will arrive in the Jupiter system between 3 and 7 years later, depending on which launch vehicle and trajectory is selected. In order to survive the harsh Jovian radiation environment, the spacecraft will orbit Jupiter, dipping in and out of its radiation belts, and will encounter Europa at different positions in its orbit for a total of over 40 close flybys. This strategy allows data to be acquired from across most of the moon’s surface and enables particles and fields measurements to be made in the local vicinity.

High-priority science will be accomplished through interrogations of the moon’s ice shell, ocean, composition, geology, and current activity. The payload consists of five remote sensing instruments that cover the wavelength range from ultraviolet through radar and four *in-situ* instruments that measure fields and particles; moreover, gravity science can be achieved via the telecom system, and valuable scientific data could come from the spacecraft’s planned engineering radiation monitoring system. The remote sensing instruments are: an ultraviolet spectrograph (Europa-UVS); a wide-angle and narrow-angle visible camera system (EIS); an infrared spectrometer (MISE); a thermal instrument (E-THEMIS); and an ice-penetrating radar (REASON). The *in-situ* instruments are: a magnetometer suite (ICEMAG); a plasma instrument (PIMS); a time-of-flight mass spectrometer (MASPEX); and a dust analyzer (SUDA). Taken together, the payload has the potential to test hypotheses and make discoveries relevant to the composition, interior, and geology of Europa, in order to address the potential habitability of this intriguing moon.

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