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The Europa Jupiter System Mission Jupiter Europa Orbiter Mission Overview

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The Europa Jupiter System Mission (EJSM) would be an international mission that would achieve Decadal Survey and Cosmic Vision goals. The baseline EJSM architecture consists of two flight elements operating concurrently in the Jovian system: the NASA-led Jupiter Europa Orbiter (JEO) and the ESA-led Jupiter Ganymede Orbiter (JGO). The two spacecraft would execute a joint exploration of the Jovian system before settling into orbit around Europa and Ganymede, respectively. In this paper, we present an overview of the Jupiter Europa Orbiter concept.

Aiming for an early 2020 launch opportunity, JEO would use chemical propulsion with Venus and Earth gravity assists to arrive at Jupiter approximately 6 years later. Capture into the Jovian system would involve a large propulsive maneuver facilitated by an Io gravity assist. The gravity assist would result in a lower spacecraft propellant load relative to a Ganymede gravity assist, but would increase the radiation exposure on the flight system. To perform system science and place JEO into an energetically optimized position to be captured into orbit around Europa, an ∼30-month Jupiter system tour would be performed. The tour would notionally include 4 Io flybys, 9 Callisto flybys, 6 Ganymede flybys, and 6 Europa flybys. Our analysis shows that the mission trajectory while in the Jupiter system is very flexible and could be easily altered to accommodate changes in programmatic or scientific priorities. There is sufficient flexibility to alter flight times, tour lengths, and orbital insertion timing to adjust the overlap of the two flight systems in orbit at Jupiter. The EJSM notional architecture provides numerous opportunities for coordinated synergistic observations of the Jupiter and Ganymede magnetospheres, Io and its torus, the atmosphere of Jupiter, and the icy satellites. Each spacecraft would participate in synergistic, dual-spacecraft, investigations along with performing stand-alone measurements to achieve the overall mission goals. After entering Europa orbit, JEO would spend a month performing science observations in a 200-km circular orbit. The spacecraft would then descend to a 100 km-circular orbit to perform high-resolution observations of the surface, subsurface and local space environment for another 8-11 months. The science operation strategy would be designed to achieve the highest priority Europa science objectives earliest. The mission would ultimately conclude with the flight system impacting Europa.

In comparison to other missions the flight system's conceptual design is very similar to other large orbital spacecraft (e.g. Cassini, Galileo, Mars Reconnaissance Orbiter). Key design drivers on the spacecraft are Jupiter's radiation environment, planetary protection considerations, high propulsive needs to get into Europa orbit, the large distance from the sun and Earth, and the accommodation of the instrument payload. To best meet the EJSM science objectives, the Jupiter Joint Science Definition Team recommended a model payload consisting of remote-sensing and in situ instruments, and use of the X-band and Ka-band spacecraft telecommunications systems for radio science. Although engineering advances would be needed for JEO, it is anticipated that no new technologies would be required to execute the mission. The JEO mission architecture provides an optimal balance between science, risk, and cost. The JEO design is a robust mission concept that is ready to be initiated now.