

Europa Sample Return Mission Utilizing High Specific Impulse Refueled with Indigenous Resources

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We are proposing to conduct studies of a revolutionary new concept for conducting a Europa Sample Return Mission. Robotic spacecraft exploration of the Solar System has been severely constrained by the large energy requirements of interplanetary trajectories and the inherent delta V limitations of chemical rockets. Current missions use gravitational assists from intermediate planets to achieve these high-energy trajectories restricting payload size and increasing flight times. We propose a five-year Europa Sample Return Mission with very modest launch requirements enabled by MITEE. A new nuclear thermal propulsion engine design, termed MITEE (MIniature reacTor EnginE), has over twice the delta V capability of H_2/O_2 rockets (and much greater when refueled with H_2 propellant from indigenous extraterrestrial resources) enabling unique missions that are not feasible with chemical propulsion. The MITEE engine is a compact, ultra-lightweight, thermal nuclear rocket that uses hydrogen as the propellant. MITEE, with its small size (50 cm O.D.), low mass (200 kg), and high specific impulse (~1000 sec), can provide a quantum leap in the capability for space science and exploration missions. The Europa Sample Return Vehicle (ESRV) spacecraft has a two-year outbound direct trajectory and lands on the satellite surface for an approximate 150 day stay. During this time, the vehicle is refueled with H_2 propellant derived from Europa ice by the Autonomous Propellant Producer (APP), while collecting samples and searching for life. A small nuclear-heated submarine probe, the Autonomous Submarine Vehicle (ASV), based on MITEE technology, would melt through the ice and explore the undersea realm. The spacecraft has a two and one-half year return to Earth after departure from Europa with samples onboard. Spacecraft payload is 300 kg at the start of the mission and can be launched with a single, conventional medium-sized Delta III booster. The spacecraft can bring back 300 kg of samples from Europa.

EUROPA EXPLORATION AND SAMPLE RETURN MISSION

