Update on Advanced Development Initiatives for Europa Lander and Other In-Situ Ocean World Missions.

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Introduction: The Europa Lander mission concept has identified several engineering challenges, particularly for de-orbit, descent, landing, and surface mission phases. NASA investments in numerous technologies addressing these challenges have been used to help enable a future Europa lander and other in-situ ocean world exploration mission concepts. Despite significant challenges from the Covid-19 restrictions, significant progress has been made in key areas. This poster updates the progress for these initiatives.

For de-orbit, descent, and landing: Development and testing of two lidar brassboards will mature a key sensor for autonomous hazard detection. Innovative landing leg and footpad concepts are needed to safely land on high-topographic-relief terrain and maintain stability throughout surface operations. Solid rocket propellant and ignition systems testing ensure performance in the harsh Europan radiation and thermal environment. A low-thrust throttleable engine is required to support landing a medium-mass lander on a low-gravity world.

Surface Mission: Cryogenic material excavation, sampling, and transfer techniques under vacuum are necessary to provide samples to analytic instruments. Autonomous surface operations enable the lander to complete science mission objectives in the limited mission time necessitated by Europa's high radiation environment. The short duration of the baseline surface mission compels improvements in surface resource efficiency realized via a lightweight, low-power motor controller, high-specific-energy batteries, and a high-efficiency X-band antenna. Planetary protection challenges are addressed through metagenomic analysis and testing as well as an end-of-mission incineration system. Potential spacecraft material and thruster plume contamination in a high-radiation cryogenic environment needs to be characterized and mitigated.

Completion of these initiatives substantially reduces the risk of implementing a future Europa lander. The results are also applicable to mission concepts proposed for other worlds with low-gravity, no-atmosphere, high-radiation, and/or cryogenic environments

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