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Interplanetary CubeSats: Opening the Solar System to a Broad Community at Lower Cost

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Abstract

Interplanetary CubeSats could enable small, low-cost missions beyond low Earth orbit (LEO). This class is defined as having a mass of <~10 kg, cost of <$30 M, and mission duration of up to five years. Over the coming decade, a stretch of each of six distinct technology areas, creating one overarching architecture, could enable comparatively low-cost Solar System exploration missions with capabilities far beyond those demonstrated in small satellites to date. The six technology areas are (1) CubeSat electronics and subsystems extended to operate in the interplanetary environment, especially radiation and duration of operation; (2) optical telecommunications to enable very small, low-power uplink/downlink over interplanetary distances; (3) solar sail propulsion to enable high ΔV maneuvering using no propellant; (4) navigation of the Interplanetary Superhighway to enable multiple destinations over reasonable mission durations using achievable ΔV; (5) small, highly capable instrumentation enabling acquisition of high-quality scientific and exploration information; and (6) onboard storage and processing of raw instrument data and navigation information to enable maximum utility of uplink and downlink telecom capacity, and minimal operations staffing. The NASA Innovative Advanced Concepts (NIAC) program selected Interplanetary CubeSats in 2011 for further investigation, some results of which are reported here for Phase 1.

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