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# REUSABLE SPACECRAFT FOR FUEL-EFFICIENT MULTI-TARGET MAIN ASTEROID BELT SAMPLING MISSIONS

**Abstract**

A reusable spacecraft for fuel-efficient multi-target sampling missions through the Main Asteroid Belt and out to Jupiter's L4 and/or L5 – as a perpetual system – is described, premised on proven (existing) technologies. The spacecraft, equipped with a payload suite consisting of a color camera and infrared imaging spectrometer, a high-resolution panchromatic imager, and a thermal infrared spectrometer, is designed for near-asteroid surveyance. The data recorded could be transmitted during the mission as radio or optical waves from the spacecraft in deep space to Earth or an intervening relay antenna or substation. Upon the spacecraft's return to a Sun-Earth L1 halo orbit, the data, stored on physical hard drives, could be offloaded to specialized servicing spacecraft for further processing, storage, and/or transport. The paper also discusses the use of non-invasive asteroid data collection techniques, such as those used by NASA's Stardust mission, which collected emitted particles in an array of aerogel tiles. The initial flight plan for the mission involves a self-reliant launch from Earth, a potential Mars gravity assist, and maneuvers similar to NASA's Psyche Mission. On-orbit servicing at Sun-Earth L1 is crucial for refueling, equipment replenishment, and data/material offloading, enabling the spacecraft to perform successive multi-target sampling missions. This innovative approach could revolutionize asteroid sampling missions, making them more efficient and cost-effective.