

Ceres Plume Chaser: A SmallSat Approach for Low Cost Exploration of the Solar System

The Herschel Space Observatory recently detected water vapor in plumes emanating from 1-Ceres, bringing the dwarf planet into the crosshairs of the search for building blocks of life in the solar system. This work describes a mission concept designed at NASA Ames Research Center for a mission to Ceres utilizing a small low-cost spacecraft, the *Plume Chaser*. This spacecraft will carry both a mass and an infrared spectrometer to characterize the vapor. In the event that a plume is not naturally encountered while in orbit, an ejecta plume will be created by a second impactor spacecraft titled *Plume Maker*, timed to enable a rendezvous by *Plume Chaser*. This enables additional subsurface chemistry, volatile content and material characterization, as well as new science complementary to the *Dawn* spacecraft.

The search for organics and assessing habitability are stepping stones toward the long-term goal of searching for life; these form the core of the mission's objectives. Science requirements, instrument selection, rendezvous trajectory spacecraft design and comparison with the Ceres-bound *Dawn* spacecraft are detailed. The volume of the spacecraft enables launch to GTO as a secondary payload, providing multiple launch opportunities per year. *Plume Maker's* design is identical to the *Plume Chaser*, replacing only the power system for planetary protection reasons, and fits within the constraints for a secondary payload launch.

The low cost of the design enables the exploration of multiple solar system bodies in a reasonable timeframe despite budgetary constraints; with only minor adaptation, the concept detailed in this work is applicable to the exploration of other icy moons, dwarf planets or asteroids, including Europa and Enceladus.