WAYFARER: SMALL BODY EXPLORATION WITH A COMMON-FORMAT MICROSATELLITE.

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Introduction: There is a vast population of asteroids and comets with orbits that bring them into the inner Solar System and the vicinity of Earth. These *Near Earth Objects* (NEOs) have diameters of order from 10-10^4 m, and they are compositionally diverse. Their proximity to Earth makes them compelling targets for scientific study, but they are also important by virtue of their potential threat and as a source of resources for future space exploration. Over the past 30-years, spacecraft have experienced close-up encounters (flyby or co-orbital) with 12 asteroids and 6 Jupiter family comets (JFCs), revealing unexpected diversity in their shape, surface, and evolutionary characteristics (Fig. 1). The realization of planetesimals as distinct objects, even within the existing group classifications [1,2], has exposed many generalizations in our understanding of these objects.

Challenges: A logical next step in small body research is to explore the classification space indicated by the diversity identified to date. Such a study would need to adopt a statistical approach similar to that used to characterize comets and asteroids from the ground, and expand the types of objects (e.g. long period comets-LPCs) to those that have yet to be visited with spacecraft. However, the escalation in the rate of encounters implied by this goal is not consistent with the current mission model of custom, high capability, risk-averse spacecraft targeting single objects.

Implementation: In this presentation we describe the *Wayfarer* multi-encounter mission concept. *Wayfarer* incorporates features at the spacecraft and mission design levels that optimize it for low-cost exploration of objects in near-Earth orbital space. These include 1) a common architecture micro-spacecraft bus based on commercial components, 2) a limited suite of sensors that can be packaged for targeted explorations of small bodies, 3) unrestricted launch cadence with orbital storage, 4) flexible mission design (e.g. flyby, multi-target, co-orbit, impact), and 5) low-cost, university-based operations (Figure 2). The NEO/Comet *Wayfarer* implementation can be achieved using existing technology, but it is also intended as a pathfider for multi-spacecraft exploration of targets that are currently beyond the reach of independently operated microsatellites.

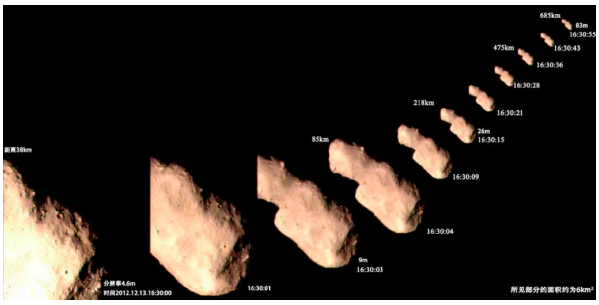

Figure 1. A sequence of images shows the encounter of 4179 Toutatis by the Chang'e spacecraft.

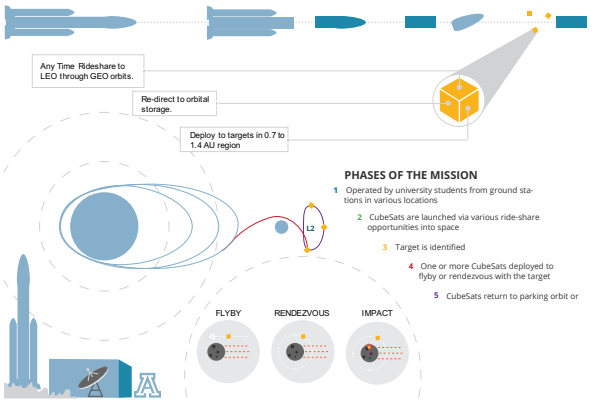

Figure 2. The phases of a *Wayfarer* mission, including luanch, storage, and multi-mission deployment.