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A VALUABLE STEPPING STONE FOR HUMANS BEYOND THE MOON

Abstract

The U.S. program for human spaceflight is now roughly following the flexible path defined by the Obama Administration "Review of U.S. Human Space Flight Plans Committee": a step-by-step approach of human missions going beyond the Moon with intermediate waypoints such as Lagrange Points, Near-Earth Asteroids, and Phobos and Deimos, prior to a Mars landing. President Obama directed NASA to send astronauts to a Near-Earth Asteroid (NEA) by 2025.

Near-Earth asteroid missions will require 6- to 9-month mission durations, tons of supplies, a deep-space habitat, reliable life support systems, and multiple heavy-lift launches. Projected budgets and development schedules mean that a piloted NEA expedition is unlikely before 2030. Limiting astronauts to low Earth orbit for another two decades will diminish public interest in space exploration.

An attractive interim solution is a robotic mission, using today's technology, to move a very small asteroid within reach of astronauts.. In a preliminary design study, a single Atlas V launch could reach a representative NEA, 2008 HU4. Eight years after Earth escape, the craft would return the captured 8-m diameter asteroid (with an assumed mass less than 1300 metric tons) to a highly elliptical lunar orbit.

The vehicle's 40-kW SEP system can manage shorter flight times if the asteroid has lower mass or particularly favorable orbital characteristics. Thus, there is a high premium on finding suitable candidate asteroids and sufficiently characterizing their physical and orbital properties, enabling development of an attractive flight system and mission profile. A carbonaceous asteroid is the most desirable target both for its scientific value and its potential for resource utilization. Early search efforts have begun.

The preliminary mission design took a dual approach to safety: a captured asteroid in the right kind of high retrograde lunar orbit, if left untended, will likely impact the Moon. A 7-meter carbonaceous asteroid, with its low physical strength, will also be destroyed upon atmospheric entry.

This paper will describe possible astronaut operations and experiments at the NEA, e.g. grappling technologies, sample return, mining experiments, water and metal extraction, and other uses of space resources. The value of the proposed asteroid retrieval and subsequent human exploration will benefit both for continued space exploration and boost potential space commercialization activities.