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14th HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)
Going beyond the Earth-Moon system: Human Missions to Mars, Libration points, and NEO's (4)

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A SIMPLIFIED, MINIMAL RISK ARCHITECTURAL STRATEGY FOR THE EXPLORATION OF NEAR-EARTH OBJECTS

Abstract

The impetus for asteroid exploration is scientific, political, and pragmatic. The notion of sending human explorers to asteroids is not new. Piloted missions to these primitive bodies were first discussed in the 1960s, pairing Saturn V rockets with enhanced Apollo spacecraft to explore what were then called "Earth-approaching asteroids" (Cole, 1963 and 1964; Smith, 1966; Meston, et al. [editor], 1968). Two decades ago, NASA's Space Exploration Initiative (SEI) also briefly examined the possibility of visiting these small celestial bodies (Nash, et al., 1989; Davis, et al., 1990; Jones, et al., 1994). Most recently, the U.S. Human Space Flight Review Committee (Augustine, et al., 2009) suggested that near-Earth objects (NEOs) represent a target-rich environment for exploration via the "Flexible Path" option. The key is to complete the NEO survey and identify a sufficient number of targets to enable initial piloted missions of reasonable duration (<180 days), with longer missions possible with increased operational experience.

While roughly 87 percent of the large NEOs (>1 km diameter) have been discovered, only 2 to 3 percent of the NEO population down to 50-100 meters across have been discovered to date (Cheng, et al. 2011). Further, the majority of the NEOs identified by a study team across several NASA centers as "human-accessible" (Barbee, et al., 2010; Adamo, et al., 2010) have orbits that are too uncertain, or are probably too small, to consider mounting human expeditions.

We present a step-by-step architecture that provides an integrated forward path for international robotic and human missions to NEOs. Space agencies that are considering human NEO missions currently lack a robust catalog of human-accessible targets. The first step in developing such a catalog is conducting a space-based survey telescope. This catalog of candidate NEOs would then be transformed into a matrix of opportunities for robotic and human missions for the next several decades. This matrix would include critical mission parameters (e.g., required ΔVs, mission durations, departure opportunities, etc.) and would be shared with the international community. This matrix would not drive architectures or schedules, but would illustrate windows of opportunity that could be exploited by the respective agencies based on their capabilities and budgets. The overall return to the NEO community in terms of science, flight techniques and technology/instrument demonstration would be increased by this collaboration more than the contribution of any single agency, and would provide many more well-characterized targets for piloted missions (Abell, et al., 2009).