Robotic Precursors to Human Exploration (03)
Asteroid Robotic Precursor Missions (3)

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THE NEED FOR ROBOTIC PRECURSOR MISSIONS TO POTENTIAL NEAR-EARTH ASTEROID TARGETS: CHARACTERIZING DESTINATIONS FOR FUTURE HUMAN EXPLORATION

Abstract

NASA and other space agencies have always taken the prudent step of utilizing precursor robotic spacecraft to obtain detailed information about the environments and destinations they wish to explore with humans. Many robotic spacecraft have already been sent to destinations, such as the Moon and

Mars, and several more robotic missions are planned. Near-Earth asteroids (NEAs) are no different in this respect from the Moon and Mars. A precursor spacecraft will perform basic reconnaissance of the target NEA under consideration to inform the subsequent human-led mission, thereby significantly reducing operational risk. The robotic spacecraft will assess the target for any potential hazards that may pose a risk to the deep space transportation vehicle, its deployable assets (e.g., surface science packages, rover system, etc.), and the crew. Additionally, the information obtained about the NEA's basic physical characteristics during the reconnaissance will also be crucial for planning operational activities and designing the in-depth scientific investigation of the candidate NEA.

NEAs may have one or more small companion bodies and/or complex surface morphologies, which may not be detectable by prior ground-based reconnaissance. In-depth examinations by robotic spacecraft would help identify the physical characteristics of NEAs targeted for human missions, as well as improve the scientific understanding or these diverse objects. The role of a robotic precursor mission to a NEA would be akin to the roles of the Ranger, Lunar Orbiter, and Surveyor missions that were critical for the success of the Apollo program. Knowledge of the NEA's gravitational field, shape, surface topography, spin state, and general composition, etc., would aid in planning for subsequent human-led proximity operations and optimize the time on station for detailed investigations/activities. This information would also identify and refine the scientific issues to be addressed by the subsequent human mission and define the instrument suites to be carried by the deep space transportation vehicle and its astronauts. Missions to NEAs conducted in this manner would also provide an important multinational synergy between the science and human exploration communities. Cooperation between these communities will be vital for the development of future international deep space exploration architectures for NEAs, the Moon, Mars and its moons (Phobos and Deimos), and other more distant destinations.