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**ROBOTIC MISSIONS TO SMALL BODIES AND THEIR POTENTIAL
CONTRIBUTIONS TO HUMAN EXPLORATION AND PLANETARY DEFENSE**

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ABSTRACT

Introduction: Robotic missions to small bodies will directly address aspects of NASA's Asteroid Initiative and will contribute to future human exploration and planetary defense. The NASA Asteroid Initiative is comprised of two major components: the Grand Challenge and the Asteroid Mission. The first component, the Grand Challenge, focuses on protecting Earth's population from asteroid impacts by detecting potentially hazardous objects with enough warning time to either prevent them from impacting the planet, or to implement civil defense procedures. The Asteroid Mission involves sending astronauts to study and sample a near-Earth asteroid (NEA) prior to conducting exploration missions of the Martian system, which includes Phobos and Deimos.

The science and technical data obtained from robotic precursor missions that investigate the surface and interior physical characteristics of an object will help identify the pertinent physical properties that will maximize operational efficiency and reduce mission risk for both robotic assets and crew operating in close proximity to, or at the surface of, a small body. These data will help fill crucial strategic knowledge gaps (SKGs) concerning asteroid physical characteristics that are relevant for human exploration considerations at similar small body destinations. These data can also be applied for gaining an understanding of pertinent small body physical characteristics that would also be beneficial for formulating future impact mitigation procedures.

Small Body Strategic Knowledge Gaps: For the past several years NASA has been interested in identifying the key SKGs related to future human destinations. These SKGs highlight the various unknowns and/or data gaps of targets that the science and engineering communities would like to have filled in prior to committing crews to explore the Solar System. An action team from the Small Bodies Assessment Group (SBAG) was formed specifically to identify the small body SKGs under the direction of the Human Exploration and Operations Missions Directorate (HEOMD), given NASA's recent interest in NEAs and the Martian moons as potential human destinations. The action team organized the SKGs into four broad themes:

- 1) Identify human mission targets;
- 2) Understand how to work on and interact with the small body surface;
- 3) Understand the small body environment and its potential risk/benefit to crew, systems, and operational assets; and
- 4) Understand the small body resource potential.

Of these four SKG themes, the first three have significant overlap with planetary defense considerations. The data obtained from investigations of small body physical characteristics under these three themes can be directly applicable to planetary defense initiatives.

Conclusions: Missions to investigate small bodies can address small body strategic knowledge gaps and contribute to the overall success for human exploration missions to asteroids and the Martian moons. In addition, such reconnaissance of small bodies can also provide a wealth of information relevant to the science and planetary defense of NEAs.
