

Findings from the 10th Meeting of the Small Bodies Assessment Group

Asteroid Redirect Mission. Though SBAG acknowledges that the Asteroid Redirect Mission (ARM) is continuing to evolve as the concept development matures, the current formulation has not resolved the issues detailed in previous SBAG findings of July, 2013. The objectives, requirements, and success criteria for the ARM are not clearly defined, including the relevance to planetary defense. There are substantial issues and challenges associated with the identification and characterization of potential targets. Together these combine for considerable schedule and cost uncertainty and risk for the ARM. As requested, SBAG in the near term will provide input for key small body science areas to inform NASA and the ARM formulation team, though we note that SBAG would be willing to provide input at earlier stages in the future.

Support of Target NEO 2 Findings. The Target NEO 2 workshop had widespread and broad community participation and enabled open discussion and debate of the Asteroid Redirect Mission (ARM) concept. The Target NEO 2 final report finds the need for: ARM requirements and mission success criteria to be clearly defined; an independent cost estimate; competition and peer review; reconsideration of the aggressive schedule; a well-constrained understanding of the target NEA population and the distribution of their physical characteristics; improvement of ground-based observatories and remote characterization follow-up procedures; and a robust NEO survey. SBAG finds that the Target NEO 2 workshop was highly valuable and successful at bringing together experts in the fields pertinent to the ARM concept, supports the well articulated findings in the final report, and urges that the report be used to inform and evaluate further ARM efforts.

Cadence of Discovery Missions. SBAG strongly supports the planetary Decadal Survey, which states the importance of regular competitive mission selections in the highly successful Discovery program. The Decadal Survey recommended cadence of a Discovery AO and mission selection every ≤ 24 months is not being achieved, and SBAG urges NASA and the administration to develop a plan to accomplish this Decadal Survey recommendation in the near future and for the rest of the decade.

Review of the Restructuring of the Research and Analysis Program. Restructuring of the Planetary Science Division's Research and Analysis Program should be required to pass a formal Senior Review prior to implementation to ensure it is able to provide the benefits identified by the 2011 Planetary Science Subcommittee report (Assessment of the NASA Planetary Science Division's Mission-Enabling Activities, led by Ron Greeley). As identified in the report, this includes an assessment of the work force impact and of revenue neutrality. SBAG finds that the submission of a draft ROSES 2014 document to the Planetary Science Subcommittee does not constitute sufficient review and assessment prior to implementation.

Solar System Workings Opportunity. The prior announced deadline of late February 2015 for the Solar System Workings program would result in a ≥ 20 month gap in proposal due dates for projects formerly submitted through Cosmochemistry, Planetary Geology and Geophysics,

Planetary Atmospheres, and Mars Fundamental Research programs. This would cause a serious interruption of funding, lack of opportunities for young career scientists, and damage to the small bodies and broader planetary science research communities. SBAG supports moving this due date to May/June 2014 to address this serious concern.

Dawn at Ceres Participating Scientists. SBAG strongly supports the involvement of participating scientists for Dawn at Ceres, with scientists selected before the encounter, contributing to the mission prior to orbit insertion, and participating in the orbital mission at Ceres. SBAG finds that the draft text for a "Dawn Focused Research and Analysis Program" has a fundamental issue that needs to be revised. The Program's core requirement that "Spacecraft data that have not been obtained (i.e., future mission data), or those that have not been placed in approved archives may not be proposed for use in DFRAP investigations" will not enable any new scientists to participate prior to and during the Dawn at Ceres encounter. Additionally, opportunities for involvement in the Dawn at Ceres mission, either through a participating scientist or other such program, must be fair, competitive, and equally open to all. SBAG opposes the announcement text as presently written and urges modifications that will allow scientists to participate in the active science mission at Ceres. Given Dawn's arrival at Ceres in April 2015, time is of the essence if the full potential of NASA's investment in the Dawn mission is to be retained.

Establishment of a Planetary Defense Coordination Office. The 2010 NASA Advisory Council Planetary Defense Task Force, following the NASA Authorization Acts of 2005 and 2008 that affirmed the need for the establishment of policy with respect to threats posed by near-Earth objects, recommended that NASA establish a Planetary Defense Coordination Office that would coordinate planetary defense activities across NASA, other U.S. federal agencies, foreign space agencies, and international partners. This has not yet been realized, and SBAG reiterates the importance of establishing such an office.

NEO Survey Telescope. NASA's Asteroid Initiative places emphasis on the exploration of near-Earth asteroids for planetary defense, science, and resource utilization. However, the necessary knowledge concerning the distribution of these objects and their respective characteristics is inadequate in order to successfully formulate NASA's plans for accomplishing the Asteroid Initiative. SBAG reiterates its previous findings that support the importance of a space-based survey telescope to NASA SMD and HEOMD goals and objectives. Although it is commendable that NASA is exploring alternative options for obtaining these data, a space-based NEO survey asset returns the greatest value with respect to exploration, planetary defense, science, resource utilization and does so in the most cost effective manner. Proper implementation of NASA's Asteroid Initiative would best be served through a peer-reviewed NEO survey telescope mission that is funded as an agency asset. Such a foundational asset that provides essential data to aid the overall long-term objectives of NASA should be supported across the entire agency and not only through the SMD NEO Program.

Planetary Science from Stratospheric Balloons. The development of a reusable stratospheric balloon platform has the potential to enable planetary science observations not possible from the ground and to complement space-based assets. Additionally, balloon investigations offer a useful opportunity for scientists to develop experience relevant to being a mission PI and offer a means to increase the TRL of instrumentation for future spacecraft missions. Competed opportunities

are needed for the community as a whole to realize those benefits, and a plan and timeline to transition the development program to compete opportunities should be defined and shared with the community. However, the present stratospheric balloon program has yet to demonstrate whether it is a scientifically valuable and cost-effective way to do planetary science. Planned observations need to demonstrate *a priori* their value/uniqueness and cost-effectiveness relative to available ground-based (not just IRTF) and space-based facilities and instrumentation.

Technology Budget. The technology budget has a 1/3 reduction from 2012 to 2014 (\$100M from \$161M) excluding the DOE infrastructure costs. The in-space propulsion technology (ISPT) program appears to be closing out completely. The electric propulsion options have been large PSD investments that have critical gaps and pose a poor risk posture for upcoming AOs. STMD is ramping up technology options that, in general, are not applicable to the evolutionary needs within PSD. Opportunities exist for STMD to leverage the past PSD investments and address critical gaps while being responsive to the science mission directorate technology needs. A clear dialogue/partnership between STMD and PSD to address these strategic PSD gaps is warranted. The remaining return on investment (ROI) appears high for both directorates. The SBIR developed Hall thruster PPU is one such example of a low remaining cost-to-go for high ROI.