

February 6, 2015

Findings from the 12th Meeting of the NASA Small Bodies Assessment Group (SBAG)

SBAG eagerly anticipates a banner year for small bodies science in 2015. While our science will advance across diverse fronts including telescopic, laboratory, and modeling investigations, the simultaneous spacecraft exploration of Ceres, the Pluto system, and comet Churyumov-Gerasimenko will focus public attention on small bodies science as never before. The anticipated flood of discoveries in 2015 is the fruit of decades of effort. *The attention it will attract gives the small body science community a spectacular opportunity to communicate the value of our work.* To build a healthy future, we all must make an extra effort this year to engage with the public over these exciting missions.

Need for a Near-Earth Object Survey

NASA's Asteroid Initiative comprises aspects of human exploration, planetary defense, resource utilization, and science related to near-Earth asteroids and comets. SBAG reiterates its previous findings that *a space-based near-Earth object (NEO) survey telescope would be a foundational asset that would most efficiently achieve the goals of NASA's Asteroid Initiative in the shortest amount of time.* Construction and implementation of such an asset should be supported by all three of NASA's major space exploration directorates and not just by the limited resources of the Near-Earth Object Observations (NEOO) program within the Science Mission Directorate (SMD). Cross directorate support for a space-based asteroid survey is fully consistent with the Asteroid Initiative already established as an agency-wide goal. It should be noted that a space-based NEO survey telescope would be capable of detecting human-accessible NEOs far enough in advance for their mission opportunities to be implementable.

Affirmation of the NAC Statement of Human Missions to NEOs in Their Native Orbits

The NASA Advisory Council (NAC) letter dated August 4, 2014 (<http://www.nasa.gov/sites/default/files/files/SquyresLetterToBolden.pdf>) states that: "It must also be noted that ARM [Asteroid Redirect Mission] is not a substitute for a [human] mission to an asteroid in its native orbit, which appears to be possible at a lower launch energy than previously believed based on recent data²⁻⁴. Such a long duration deep space mission would be a logical step toward the horizon goal of humans to Mars." *SBAG strongly supports this NAC statement and finds that a human mission to an asteroid in its native orbit has unique merits and value*, regardless of whether ARM is flown. SBAG maintains a summary chart of human-accessible near-Earth asteroid (NEA) data, updated every few months, at:

http://www.lpi.usra.edu/sbag/science/NHATS_Accessible_NEAs_Summary.png.

Asteroid Redirect Mission

SBAG appreciates NASA's efforts to engage and communicate with the planetary science community about the Asteroid Redirect Mission (ARM). SBAG further recognizes

that NASA's Asteroid Initiative has raised awareness and emphasized the importance of asteroids within NASA, to other U.S. Federal agencies, to the general public, and to our international partners.

Although SBAG has not endorsed either Option A (return an entire small asteroid) or Option B (capture and return a boulder from a large asteroid), the SBAG ARM Special Action Team Full Report, generated at the request of NASA, provides information and rationale for the relative benefits of the two options from science, planetary defense, and resource utilization perspectives:

(see: http://www.lpi.usra.edu/sbag/documents/SBAG_ARM_SAT_Full_Report.pdf).

SBAG encourages the use of this document if such factors are considered during the selection of the ARM capture system.

However, SBAG reiterates its concerns from the 11th SBAG meeting about the limited benefits of ARM for advancing asteroid science or furthering planetary defense strategies, and that limits in the current knowledge of near-Earth asteroids contribute to schedule and cost risks. ***SBAG supports continued engagement with the NASA ARM team as the concept is refined.***

Cadence of Discovery Missions

SBAG is encouraged by the release of the Discovery AO within 2014, a major step to achieving the strategy outlined in the Decadal Survey. The Discovery program has made important and fundamental contributions to planetary exploration, and is of crucial importance to the future scientific exploration of the Solar System. ***SBAG regards the Decadal Survey recommendation of a ≤ 24 month cadence as an essential guideline and notes that the selection of two missions from the current AO could provide a means to regain the Decadal Survey recommended average cadence of Discovery missions.***

Concern for the Minor Planet Center Status

The Minor Planet Center (MPC) is a unique and crucial facility for the small bodies community both within the United States and internationally. In addition to serving as the clearinghouse for all astrometric observations of asteroids and comets, the MPC also plays a central role in the chain of notification involving potential impactors. ***SBAG is concerned about recent changes at the MPC, including the resignation of the director and the center's overall status and future, and urges NASA to review the situation as soon as possible.*** Such a review should be conducted in conjunction with the International Astronomical Union, the organization under which the MPC is chartered.

Support for the NEO Program Development Plan

The recent NASA Office of Inspector General (OIG) Audit Report, *NASA's Efforts to Identify Near-Earth Objects and Mitigate Hazards*, includes five recommendations intended to improve NASA's efforts to discover, characterize, and mitigate near-Earth object threats, and NASA SMD's response outlines a general plan to make progress on the OIG report recommendations within the year.

(<http://oig.nasa.gov/audits/reports/FY14/IG-14-030.pdf>, 15 September, 2014)

SBAG supports NASA's response to the OIG report and considers the recommended development of a strategic plan for the NEO Program a highly valuable activity. In particular, SBAG urges the strategic plan to draw heavily on community reports (*i.e.*,

2010 NASA Advisory Council Planetary Defense Task Force; 2010 NRC Report: *Defending Planet Earth*) that outline planetary defense priorities. ***SBAG strongly supports the creation of a NASA Planetary Defense Coordination Office, a top recommendation of the 2010 NAC Task Force report. Furthermore, SBAG recommends that this new office (1) pursue goals specified in congressional direction, such as NEO population survey completion, (2) work towards development of NEO mitigation technologies through additional funded programs, including flight validation of the most promising mitigation system concepts, and (3) utilize cross-agency and international collaborations as warranted in accomplishing those goals.*** The OIG-recommended full-time equivalent analysis applied to a NEO Program strategic plan guided by planetary defense priorities will be highly informative in creating a program positioned to achieve NASA's planetary defense objectives.

Concern for NASA Educational Efforts

Historically, NASA has taken a leading role in communicating its discoveries to the nation and in inspiring future scientists and engineers. ***SBAG is concerned about the erosion of NASA's educational efforts as evidenced by two recent events: the deletion of a \$4-million education component of the OSIRIS-REx mission, and the marginalization of the small, local programs*** that were at the core of the supplementary Education and Public Outreach (EPO) grants to Principal Investigators.

Missions provide unprecedented educational opportunities, while securing public support for NASA programs and assuring a supply of scientifically literate students and teachers. SMD's goals of enabling STEM (Science, Technology, Engineering, and Mathematics) education; improving U.S. scientific literacy; and advancing national education goals are not served by deleting an educational component of *OSIRIS-REx's* outreach plan. Programs lost from the mission include Educators' and Students' Workshops, Graduate Student Fellowships, activities kits, internships at partner institutions, and traveling and permanent exhibits. ***SBAG supports a reinstatement of these OSIRIS-REx education programs within NASA's new educational policies and approaches.***

SBAG is also concerned with the erosion of "grass roots" EPO efforts that were served by programs such as the modest EPO supplements to research and analysis grants. Science is most effectively communicated by those producing it, partnering with education specialists. Dozens of local and grassroots EPO activities, which provide unique opportunities to reach underserved communities, have been deleted, placing their future in jeopardy. ***SBAG is concerned that the current SMD Science Education Cooperative Agreement Notice will not engage SMD scientists and will risk losing these valuable EPO activities.***

Concern for Technology Development Efforts

While the funding for technology appears to be relatively flat, ***both exploration and planetary science technology development efforts are in a time of transition and significant changes have occurred that are potential causes for concern by SBAG.*** The Space Technology Mission Directorate (STMD) may have objectives for technology development counter to near-term infusion opportunities commensurate with standard (e.g. TMCO) risk tolerance. While the restart of Pu-238 production has highly valuable

and broad applications across planetary science, the effects of devoting approximately one-third of NASA's PSD technology funds towards Department of Energy (DoE) infrastructure and Pu-238 production efforts on other explicit NASA technology development efforts remain to be seen. The Advanced Stirling Radioisotope Generator (ASRG) flight project and the In-Space Propulsion Technology program were both recently cancelled. The coordination and identification of needs for exploration and planetary science missions requires constant and proactive coordination between the "mission customers" and STMD, in addition to directorate-specific resources to address the gaps. The relationships are maturing and appear to be improving, but it is unclear how technology coordination is occurring and whether appropriate resources are available for both coordination and funding identified technology gaps.

NASA Advisory Council References:

2. *NHATS: Near-Earth Object Human Space Flight Accessible Targets Study:*
<http://neo.jpl.nasa.gov/nhats/>

3. *Barbee, B., NASA Small Bodies Assessment Group Science Nuggets.*
http://www.lpi.usra.edu/sbag/science/NHATS_Accessible_NEAs_Summary.png

4. *Barbee, B. W., Abell, P. A., Adamo, D. R., Alberding, C. M., Mazanek, D. D., Johnson, L. N., Yeomans, D. K., Chodas, P. W., Chamberlin, A. B., Friedensen, V. P., "The Near-Earth Object Human Space Flight Accessible Targets Study: An Ongoing Effort to Identify Near-Earth Asteroid Destinations for Human Explorers," 2013 IAA Planetary Defense Conference, Flagstaff, AZ, April 15-19, 2013 (downloadable from URL <http://tinyurl.com/NHATSPaper2013PDC>)*