

## FINDINGS FROM SBAG 8, JANUARY 14–16, 2013

(1) Comet ISON represents an exciting opportunity to study a bright, sun-grazing comet for many months prior to perihelion and (if it survives) after perihelion. A coordinated campaign that best utilizes ground-based, airborne, and spacecraft resources is of high scientific value for providing insight into the composition and structure of ISON, and information about the formation and evolution of primitive solar system material. Planetary Science Division funding support would be valuable and should be prioritized based on the cost and unique science return by the range of available ground-based, airborne/sub-orbital and space-based facilities.

HQ Response: PSD is supporting an extensive observations campaign, which Casey Lisse kindly stepped forward to coordinate at the last SBAG meeting. A workshop scheduled for 1-2 August at APL will detail the plans in work for that campaign.

(2) 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. Thus, such an initiative has value to the small bodies community, and it is appropriate that such an initiative be funded within mission or technology programs rather than research and analysis programs.

HQ Response: PSD is funding the Balloon Rapid Response for ISON (BRRISON) through residual Discovery Program funds as a way to kick-start such a capability for the planetary science community.

(3) The lack of opportunities for Discovery-class missions on a reasonable cadence, as originally established in the program and recommended by the Decadal Survey, demonstrates that the Discovery Program has been given a low priority by the NASA Administration. This results in a radical reduction in the number and diversity of target bodies and the ability to address the solar-system-wide strategic goals of the Planetary Science Division. It also bars the opportunity to implement some compelling, time-critical ride-along or secondary payloads, such as the ISIS concept presented at this meeting. The importance of a robust program of small, competed missions has been demonstrated by the high-value science returned from the investments made in existing and previous Discovery missions. The Planetary Science community recognizes the importance of the Discovery Program to achieve exciting new science and supports the return to the original two year cadence for these AOs and mission selections as recommended in the Decadal Survey. We note the Decadal Survey urged a return to the original goals of the program. These goals were two missions selected for flight every 18-24 months and an increased assumption of risk – goals that were realized in the first decade of the program. The community needs NASA to explain how it intends to accomplish these goals on what timescale and with what priority.

HQ Response: It is simply fact that the PSD budget has dropped well below any worst case scenario envisioned by the Decadal Survey. We had hoped to be able to reestablish the Discovery Program on at least a 36 month cadence, but even that has proven difficult at the budget levels established for Planetary Science. We need the communities continued support as we work through priorities in the challenging budget environment.

(4) We note that the spectacular success of the first near-Earth asteroid sample return mission, Hayabusa 1, by our Japanese colleagues and their plans for a follow-on sample return mission, Hayabusa 2, stands as a continuing reminder of the science that can be achieved by small missions (at the level of a technology demonstration mission in the case of Hayabusa 1!) in combination with a willingness to assume reasonable risks, which was one of the original principles of the Discovery program. A study should be undertaken to determine what kinds of missions would be afforded at different levels below current Discovery cost-caps.

HQ Response: We agree this is a concept that may be important to explore in this challenging budget environment. Only a detailed study effort could fully explore both the benefits and the disadvantages of such an approach. The study must also take into account the cost to US investigators for the launch vehicles.

(5) We congratulate our Chinese colleagues on the great success of the flyby of the near-Earth asteroid Toutatis by their Chang'e 2 spacecraft. It is a fine example of extracting continued important science from existing spacecraft assets that have completed their primary science investigations. This is an important lesson, about which we need to be reminded, particularly in an era when our ability to launch new science missions is severely reduced. These continuing observations are not just of value in and of themselves, but can leverage greater value of other science activities. For instance, the 'ground-truth' provided by the imaging of Toutatis by Chang'e 2 can be used to understand and increase the value of radar imagery of small bodies, which provide shape and other information on more objects to which we could ever hope to send spacecraft.

HQ Response: We too congratulate the Chinese on successful accomplishment of this challenging endeavor. We also routinely extend the operations of viable spacecraft past their prime missions to obtain bonus science or repurpose them for other investigations.

(6) The fact that a new \$1.5B initiative for the Mars 2020 Rover has been justified in part by the need to support the Administration goal of sending a human to Mars in the 2030s is incongruent with the continued failure of NASA to undertake the initiative for a ~\$0.5B NEO survey mission, which is critical to finding a target for the Administration goal of sending a human to an NEO by 2025. Funding a NEO survey mission has the collateral benefits of identifying potential NEO targets for ISRU and robotic

science missions, as well as Potentially Hazardous Objects for planetary defense. The community needs NASA to explain why such a foundational asset, that benefits multiple communities and stakeholders both on the national and international level, has not been made a priority.

HQ Response: It is also an Administration goal to leverage partnerships and the private sector where possible to achieve needed capabilities and objectives at less cost to the public. For this very important capability, the Administration has elected to partner with the B612 Foundation which has stepped forward to fund, build and operate this asset through a Space Act Agreement.

(7) The Antarctic Search for Meteorites program (ANSMET) is a valuable scientific resource to the small bodies community, as well as the lunar and Mars communities. With NSF's desire for NASA to accept the responsibility for funding and assuming the leadership of this activity, a new charter should be established, with community input, with the overall goal of establishing a way to ensure a sustained and regular ANSMET program for future years.

HQ Response: We agree and we are working with NSF and the Smithsonian to renew and refine the agreement for the ANSMET program to keep it viable for the future. All agree this is an important program. A draft agreement is expected in late summer.

(8) The recent successes of the Hayabusa and Chang'e 2 spacecraft missions, the upcoming launches of NEOSAT and Hayabusa 2, and the discussion at this meeting (and previous international venues) regarding robotic and human exploration of near-Earth asteroids, make it apparent that there is significant interest from our international partners in both robotic and human exploration missions to these targets. Given the Administration goal of sending humans to an asteroid by 2025, NASA should engage its international partners to enable higher level and more detailed coordination and collaboration on such near-Earth asteroid missions (e.g., OSIRIS REx and Hayabusa 2) and identify pathways in which international partners can contribute in meaningful ways to the human exploration mission.

HQ Response: NASA engages with potential international partners through a number of channels: bilateral meetings between space agencies; several international forums, both specific to exploration such as ISECG and small bodies such as IPEWG, and more general such as the IAC; and with specific opportunities such as participation with mission proposal teams on all of our solar system exploration mission AOs. Regarding the Asteroid Initiative, the RFI announced on 18 June is a specific pathway soliciting international participation. We believe it is not so much the level of engagement or the lack of pathways, but rather more detailed work with potential international partners to identify areas of strength that are needed where they could make a contribution. For instance, NASA and JAXA are in the process of completing an MOU with respect to supporting Hayabusa 2. That MOU is very similar with the arrangements that were made for NASA support of Hayabusa 1 and provides NASA with about 10% of the returned samples.



## FINDINGS FROM STEERING GROUP MEETING (AT LPSC), MARCH 20, 2013

(1) SBAG and PSS Status. The removal of AG Chairs as automatic members of the Planetary Science Subcommittee diminishes independent community input to PSS discussions and the generation of findings. Selected inclusion by PSD management of some — and not all — AG Chairs gives preferential influence to those communities.

HQ Response: The AG structure is currently under review. This finding will be used as input to that review. In the meantime, Don Yeomans is representing the small bodies community on the PSS and he should be utilized to the maximum extent in that position.

(2) The Need for a Dawn@Ceres Participating Scientist Program. Dawn is currently scheduled to reach Ceres in April 2015. It is important for a Dawn@Ceres Participating Scientist Program to be included by amendment to ROSES 2013 in the near-term. The Dawn@Vesta Participating Scientists have been of significant and continuing value to the Dawn mission, and based on that experience it is clear that Dawn@Ceres Participating Scientists need to be in place well before the Dawn arrival at Ceres. It is expected that the time between Amendment announcement and funding is about 15 months. Consequently, there should be no delay. Time is of the essence.

HQ Response: We believe and have demonstrated in the past (GRAIL) that a PSP can be initiated in a shorter time than 15 months. We seek to continue to provide PSP opportunities taking into account lessons learned from each experience. In the case of Dawn, a review of the implementation and results of the Dawn@Vesta must be undertaken before a Dawn@Ceres can be initiated. We are currently in the process of collecting input from the PSP program for Dawn@Vesta and will take that into account before we release a Dawn@Ceres PSP opportunity.

(3) The "Capture an Asteroid" Mission Proposal Being Considered by NASA. At our July 2012 meeting in Pasadena a presentation on an asteroid retrieval mission was given by John Brophy of JPL. While the meeting participants found it to be very interesting and entertaining, it was not considered to be a serious proposal because of obvious challenges, including the practical difficulty of identifying a target in an appropriate orbit with the necessary physical characteristics within the required lead time using existing or near- to long-term ground-based or space-based survey assets. When it came to our attention that this project was being seriously considered by the agency, SBAG — representing broad expertise in asteroid science and mission planning — offered to provide an independent technical review of this proposal. The NASA Small Bodies Assessment Group is co-chartered by HEOMD and SMD. The SBAG Terms of Reference state that it is responsible for "providing science input for planning and prioritizing human and robotic exploration activities for the small bodies of the Solar System." This includes near-Earth asteroids. Failure of HEOMD and SMD to utilize SBAG in this situation seems a peculiar decision and raises the serious question of the extent to which HEOMD and SMD wish to make decisions based on restricted input promoting specific outcomes.

HQ Response: The ARM was brought forward by the Administration as a Presidential Budget initiative. As such, to a certain point, information about it was embargoed by the Administration until the President's budget was announced – two months later this year. It was therefore not possible for HEOMD and SMD to use the community forums for input during this period. In fact, only a handful of individuals within both the Directorates knew of the budget initiative. Now that the budget announcement is out and the Asteroid Initiative formally introduced, we are engaging the community forums as you have seen with the Target NEO 2 Workshop and the SBAG 9 meeting.

(4) NEO Survey Missions and Competition. SBAG has made several findings regarding the importance of a space-based survey mission to identify NEO targets necessary for a human exploration mission. Such targets are also important for planetary defense and science missions. Requirements for this survey have been openly discussed (e.g., in the Target NEO workshop), but vary depending upon the detailed characteristics sought, including orbit, composition, size, and rotation state. Final objectives and requirements need to be informed by peer-review and would benefit from public comment by subject matter experts. Investments by the agency in a survey mission should be subject to open competition to ensure that defined requirements will be objectively and most cost-effectively met.

HQ Response: See the response to (6) above.

## FINDING FROM STEERING GROUP TELECON, APRIL 25, 2013

(1) Restarting the NEOWISE Mission. The small bodies community strongly supports the immediate restart of the NEOWISE mission. The WISE spacecraft is a unique asset that advances the National goal of sending humans to an NEO in the late 2020s by identifying objects not easily accessible from ground-based telescopes, while providing crucial physical characterization data on these potential targets (e.g., albedo, diameter, and rotation state). On the basis of the post-cryogenic mission performance, the NEOWISE mission is expected to discover ~200 new NEOs in three years of which 25% are expected to be Potentially Hazardous Objects. A total of ~2000 NEOs will be characterized. In addition to expanding our understanding of the NEO population, NEOWISE will also discover several comets and thousands of main-belt asteroids. However, there is urgency to restarting the NEOWISE mission since the spacecraft's orbit is decaying. WISE is in a Sun-synchronous 6am/6pm orbit and by early 2017, the predicted atmospheric drag on the spacecraft is expected to cause the orbital plane to precess into daylight, rendering the telescope unusable. Given that it will take 3-4 months to cool down, and an additional month to check out and recalibrate the sensors, time is of the essence.

HQ Response: We are currently evaluating a proposal from JPL to turn WISE back on in support of enhancing our NEO detection and characterization program. Assuming that we are able to secure the funding needed to adequately support a reactivated NEOWISE mission over an appropriate period of time, we then would move forward with this effort.