*The National Academies of*
SCIENCES • ENGINEERING • MEDICINE
DIVISION ON ENGINEERING AND PHYSICAL SCIENCES
SPACE STUDIES BOARD

**MEETING OF THE COMMITTEE ON ASTROBIOLOGY AND PLANETARY SCIENCE, FALL 2018**
**September 11-13, 2018**
**Beckman Center — 100 Academy Way, Irvine, CA — Huntington Room**

## Tuesday, September 11, 2018

7:15 am Carpools meet in hotel lobby
7:30 am *Working breakfast available in the dining room*

### OPEN SESSION

**Remote Access Information**
**U.S. (phone):** +1 (646) 558-8656 or +1 (669) 900-6833 **Meeting ID**: 312 973 594
**Link**: https://nasem.zoom.us/j/312973594

| | | |
|---|---|---|
| 8:25 am | Welcome | Christopher House and William McKinnon<br>CAPS Co-Chairs |
| 8:30 am | Planetary Science Division Update | Lori Glaze<br>NASA HQ |
| 9:30 am | Possible Scientific Objectives of Mars Sample Return:<br>Results of the iMost Study | David Beaty, JPL<br>Monica Grady, Open University (*via* Zoom)<br>Harry "Hap" McSween, University of Tennessee, Knoxville (*in absentia*)<br>Elliot Sefton-Nash, ESA (*in absentia*) |
| 10:30 am | *Break* | |
| 10:45 am | Astrobiology Program Update | Mary Voytek<br>NASA HQ |
| 11:30 am | Commercial Lunar Payload Services | Steven Clarke<br>NASA HQ (*via* Zoom TBC) |
| 12:30 pm | *Working lunch available in the dining room* | |
| 1:30 pm | Commercial Hosting Lessons Learned from the MAIA Earth Venture Instrument Project | Barbara Hilton, Langley Research Center<br>Kevin Burke, JPL |
| 2:30 pm | Astrobotic Peregrine Lunar Lander | Ander Solorzano<br>Astrobotic |
| 3:30 pm | *Break* | |

| | | |
|---|---|---|
| 3:45 pm | Capability-Driven Lunar Services | Matthew Kuhns<br>Masten Space Systems |
| 4:45 pm | CLPS and Commercial Capabilities, General Discussion | Committee & Guests |
| 5:30 pm | *Meeting adjourns to alternate location for working dinner* | |
| 6:00 pm | Working Dinner at Roy's Newport Beach – Fashion Island<br>453 Newport Center Dr, Newport Beach, CA 92660 | |

## Wednesday, September 12, 2018

7:15 am Carpools meet in hotel lobby
7:30 am *Working breakfast available in the dining room*

### OPEN SESSION

**Remote Access Information**
**U.S. (phone):** +1 (646) 558-8656 or +1 (669) 900-6833 **Meeting ID**: 411 445 308
**Link**: https://nasem.zoom.us/j/411445308

| | | |
|---|---|---|
| 8:30 am | Axiom Labs Lunar Lander Capabilities | Udit Shah<br>Axiom Labs/TeamIndus |
| 9:30 am | NASA Astrobiology Institute | Penny Boston (*via* Zoom)<br>NASA Ames Research Center |
| 10:15 am | *Break* | |

### THE COMMITTEE WILL GO INTO CLOSED SESSION FOLLOWING THE BREAK

## Thursday, September 13, 2018

7:15 am Carpools meet in hotel lobby
7:30 am *Working breakfast available in the dining room*

### OPEN SESSION

**Remote Access Information**
**U.S. (phone):** +1 (646) 558-8656 or +1 (669) 900-6833 **Meeting ID**: 411 445 308
**Link**: https://nasem.zoom.us/j/411445308

| | | |
|---|---|---|
| 8:30 am | Visions and Voyages Midterm Assessment Briefing | Louise Prockter<br>LPI |

### CLOSED SESSION

## STATEMENT OF TASK FOR CAPS MEETING REPORT

**CAPS Short Report: Review of the Planetary Science Aspects of the Administration's Lunar Science and Exploration Initiative**

**Background**

On Monday December 11, 2017, President Trump signed the White House Space Policy Directive No. 1, which signaled a change in national space policy by providing for a U.S.-led, integrated program with private sector partners for a human return to the Moon, followed by missions to Mars and beyond. The policy calls for NASA to "lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities." The effort will more effectively organize government, private industry, and international efforts toward returning humans on the Moon, and will lay the foundation that will eventually enable human exploration of Mars. NASA provided additional details of its plans to implement the new directive in its FY 2019 budget proposal. The task described below is only concerned with those aspects lunar and exploration initiative within the purview of Planetary Science Division (PSD) of NASA's Science Mission Directorate (SMD).

The National Academies' 2011 Planetary Decadal Survey, *Visions and Voyages for Planetary Science in the Decade 2013-2022* (*V&V*), recommended two key New Frontiers missions—a sample-return from the South Pole-Aitkin Basin and a geophysical network—to address priority lunar science goals.[1] The survey report also discussed the relationship these and other robotic lunar missions and the activities of NASA's human exploration program, as it existed at that time.[2] *V&V* is broadly sympathetic to a "synergistic" relationship between science and human exploration goals—pointing to the positive example of the Lunar Reconnaissance Orbiter—and containing a recommendation urging "the human exploration program to examine the decadal survey and identify—in close coordination and negotiation with the SMD—objectives whereby human-tended science can advance fundamental knowledge."[3]

Nevertheless, the survey report tempered its positive views on potential synergistic relationships human exploration and science goals with two caveats. First, "most of the key scientific lunar… goals can be achieved robotically."[4] Second, "it is vital to maintain the scientific focus [of peer-reviewed science missions such as those in the New Frontiers and Discovery programs] and not to incorporate human exploration requirements after the mission has been selected and development has begun."[5]

In addition to NASA's new emphasis on human exploration efforts directed at the Moon, unforeseen (at the time *V&V* was drafted) commercial ventures are now close to providing access to lunar orbit and, more importantly, the lunar surface. The activities outlined in the administration's FY 2019 budget proposal potentially offer a new opportunity to address lunar science and exploration goals.

CAPS will receive background materials from NASA on the lunar science and exploration initiative prior to its March 2018 meeting and will receive presentations from NASA and other relevant experts at its March and September 2018 meetings. The committee is also investigating the possibility of augmenting its expertise in lunar science and exploration goals by appointing a consultant to assist with the drafting of the report.

**Statement of Task**

The National Academies of Sciences, Engineering, and Medicine will appoint the Committee on Astrobiology and Planetary Sciences (CAPS) to operate as an ad-hoc committee. The overarching purpose of the committee is to support scientific progress in astrobiology and planetary science and assist the federal government in integrating and planning programs in these fields by providing advice on the implementation of decadal survey recommendations. The CAPS provides an independent, authoritative forum for identifying and discussing issues in astrobiology and planetary science between the research community, the federal government, and the interested public.

[1] See *V&V*, pp. 127-128, 130-131, and 266-268

[2] See *V&V*, pp. 56-63.

[3] See *V&V*, p.62.

[4] See *V&V*, pp. 61-62.

[5] See *V&V*, p. 60.

The CAPS will issue reports that will provide guidance to federal agencies that support astrobiology and planetary science research. The CAPS scope spans space-based and supporting ground-based planetary research within our own planetary system, including, for example, geosciences, atmospheres, particles and fields of planets, moons, and small bodies, as well as astrobiology, planetary astronomy, and planetary protection. The CAPS' scope also includes appropriate cross-disciplinary areas and consideration of budget and programmatic aspects of the implementation of the decadal survey.

The Committee will build on the current decadal survey of the field, *Vision and Voyages for Planetary Science in the Decade 2013-2022* (*V&V*) and monitor the progress of its recommended priorities for the most important scientific and technical activities in that report and recommendations in the mid-decadal review report due to be issued in 2017.

The committee will carry out its charge by undertaking the following tasks:

1. At each of its in-person meetings, as appropriate, the committee may prepare concise assessments of progress on the implementation of the decadal survey's recommended scientific and technical activities. The assessments will be based on evidence gathered by the committee at its in-person and virtual meetings. The committee's assessment reports may include findings and conclusions on key strategies being pursued by the agencies and the status of agency actions that relate to the state of implementation. The reports may also highlight scientific discoveries and engineering and technical advances relevant to progress on the science objectives identified in VVPS and in addition will focus on one or more of the following types of issues:
   - The scientific impact of a change in the technical and engineering design, cost estimate, schedule, or programmatic sequencing of one or more of the survey-recommended activities;
   - The impact of a scientific advance on the technical and engineering design, schedule, or programmatic sequencing of one or more survey-recommended activities;
   - The scientific impact of a course of action at a decision point described in the survey report and recommended therein as being suitable for consultation with an independent decadal survey implementation committee;
   - The scientific impact of implementing recommendations from the mid-decadal review and other relevant Academies' reports.

2. At an in-person meeting, the committee may prepare a concise report with advice on the preparation for future decadal and mid-decadal studies. These reports will be based on evidence gathered by the committee at its in-person and virtual meetings. Future decadal and mid-decadal studies will be carried out by an ad hoc committee appointed by the Academies under a separate task.

3. For advisory activities assessed to require a more in-depth review than is possible through the normal operation of the CAPS, the committee will assist the Academies in formulating the task and committee membership for such studies which will be designed as separate tasks.

Specifically at the CAPS' September 2018 meeting, the committee will prepare a concise report on the following topic: CAPS Short Report—Review of the Planetary Science Aspects of the Administration's Lunar Science and Exploration Initiative: Commercial Opportunities. In keeping with its charge to examine "the impact of changing budget priorities, especially those that challenge the fundamental assumptions of *V&V*, on the implementation of decadal survey priorities and on planetary science research more broadly," CAPS will draft a short report addressing the following topics:

1. Discuss how new commercial ventures could provide realistic opportunities to address meaningful lunar science and exploration objectives; and
2. Suggest other activities that might be undertaken before the completion of the next planetary science decadal survey that could expand our lunar knowledge and capabilities and are consistent with *V&V*.

## REMOTE CONNECTION DETAILS

**Zoom Web Conference & Telecon Instructions**

Join from a computer:

1. Click on the URL (below). A popup will appear that says "Open URL:Zoom Launcher;" Click the "Open" button and let Zoom load (may take a minute).
2. Once loaded, Zoom will automatically display another pop-up for the audio connection. Please click the "call me" tab and enter the phone number you would like to be called at (i.e. home, office, mobile). Click "Call me" and follow the prompts.

Join from a mobile device:

1. Download the Zoom app from your phone's app store (if you don't have it installed already).
2. Click on the URL (below), or open the Zoom app and enter the Meeting ID: (below), and press join. Enter your name if requested.
3. The Zoom app will automatically display a pop-up window for the audio connection. Select the "Call my Phone" option from the menu, enter your phone number, press call, and follow any prompts.

Join by phone only:

1. Connection quality is much better via Zoom's "Call me" feature from the webconference, so we strongly recommend that you connect this way.
2. If you are not able to do so, you can dial 1-877-853-5257 (Toll Free) and enter the Meeting ID: (below). International numbers are available at: https://nasem.zoom.us/zoomconference?m=dm0fun9LyXrhECcUWQt2Wwdh_9TUrhXG

*NOTICE: The Zoom service allows audio and any materials exchanged or viewed during the session to be recorded and shared. Please be aware that by participating in this activity, you consent to your voice, likeness, and any materials you provide, being recorded for use and dissemination, without payment of any compensation for such use, in any language, format, or media now known or later devised, and you release the National Academies of Sciences, Engineering, and Medicine from any and all claims, liability, or damages arising from any such use. The Academies will proceed in reliance upon such consent and release. If you do not consent to the foregoing, please do not join the session.*

## GENERAL NOTES

**Beckman Center:** Is located at 100 Academy Way, Irvine, CA 92617. Directions are available at the following website: http://www.thebeckmancenter.org/about/mapanddirections/index.htm.

**Parking:** Parking is free and space is usually plentiful. Participants are requested to park in the designated areas only and not on the lawn, driveways or in delivery entrances. Please observe all ONE WAY and NO PARKING signs.

**Wi-Fi Connection:** To connect to the Wi-Fi chose "Visitor" then open up a browser and click "Accept terms and conditions." You will then be connected to the internet.

## NOTES FOR PRESENTERS

If your presentation contains unpublished data, ITAR controlled and/or other sensitive information, please be aware that the open sessions at the meeting may be recorded and/or webcast. Presentation materials given to the committee may be posted on a publicly accessible website. Please edit your presentations accordingly.

Mac users should assume that their presentation will be displayed via one of the NRC's PCs. If your presentation is graphics heavy and best displayed via your own laptop, you should also bring a plain-vanilla pdf version of your presentation with you. The audience in the meeting room will see your presentation via your laptop and we will webcast the pdf file.

At some point a staff member will be asking you to sign a consent form allowing us to use your presentation, specifically to post it on our website.

**The following information is provided for any members of the general public who may be in attendance**

This meeting is being held to gather information to help the committee in its charge. This committee will examine the information and material obtained during this, and other public meetings, in an effort to inform its work. Although opinions may be stated and lively discussion may ensue, no conclusions are being drawn nor will recommendations be made. Observers who draw conclusions about the committee's work based on this meeting's discussions will be doing so prematurely. Furthermore, individual committee members often engage in discussion and questioning for the specific purpose of probing an issue and sharpening an argument. The comments of any given committee member may not necessarily reflect the position he or she may actually hold on the subject under discussion, to say nothing of that person's future position as it may evolve in the course of the project. Any inference about an individual's position are therefore also premature.

**RECORDING OF THE MEETING**

This meeting will be recorded by the NRC. Please be aware that by attending the meeting, you consent to your voice being recorded for use by the NRC for the purpose of note-taking. This recording will not be publicly released, shared outside of the NRC, or used for other public purposes.