REPORT
of the
Planetary Science Subcommittee
of the NASA Advisory Council Science Committee

NASA HQ, Washington, DC
July 8-9, 2009

Introduction

The Planetary Science Subcommittee (PSS) of the NASA Advisory Council (NAC) Science Committee held its eleventh meeting on 8-9 July 2009 at NASA Headquarters, Washington DC. 12 of the 18 current members of the subcommittee attended the meeting, and one subcommittee members attended via telephone.

The agenda (attached) included a broad range of presentations and discussion topics. The morning of the first day began with a briefing by James Green, Director of the Planetary Science Division (PSD) of NASA's Science Mission Directorate (SMD), on division activities, as well as responses to PSS and NAC recommendations from earlier meetings. Doug McCuistion, Mars Exploration Program Director, summarized the current status of the Mars Exploration Program.

In the afternoon the subcommittee was joined by SMD Associate Administrator (AA) Ed Weiler, who answered questions for nearly two hours. There then followed presentations by chairs of the analysis groups — including the Venus Exploration Analysis Group (VEXAG), Lunar Exploration Analysis Group (LEAG), Mars Exploration Program Analysis Group (MEPAG), Outer Planets Assessment Group (OPAG), Small Bodies Assessment Group (SBAG), and Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM). Those presentations were followed by one on Mars Sample Return (MSR) planning by Lisa May, MSR Program Executive. Clive Neal, LEAG chair, also presented the Lunar Exploration Roadmap. The subcommittee then received their annual ethics briefing, given by Rebecca Gilchrist. The last agenda item of the first day was an evaluation of how well PSD had met its 2009 performance goals, an exercise led by Philippe Crane and carried out in conformance with the Government Performance and Results Act (GPRA). The subcommittee deliberated on the four PSD performance goals (3C.1 through 3C.4) for the year and judged that each goal had been achieved (and merited a rating of green).

The second day of the meeting began with a presentation by Ralph McNutt on the recent NRC study "Radioisotope Power Systems: An Imperative for Maintaining U.S. Leadership in Space Exploration". An update of the MAVEN mission to Mars was presented by the PI, Bruce Jakosky. The subcommittee received a briefing on the evolution of the Deep Space Network by John Rush. The Chair of the NRC's Planetary Science Decadal Survey, Steve Squyres, reported on the plan for activities by the Steering Committee, Panels and the scientifice community over the next couple of years. The meeting ended with a review of subcommittee findings and recommendations stemming from the two days of discussion.

This report, minutes of the meeting and all of the presentations are available for public distribution and are posted on the PSS website.

General Assessment of PSD Programs

Since PSS met in January two programs have moved into PSD (lunar robotics activities transferred from ESMD and responsibilities for NEOs transferred from Earth Science) and studies have been funded to study the Jupiter Europa Orbiter as the next outer planet flagship mission. The National Research Council has recently completed two studies (on the availability

of plutonium and on planetary protection for Mars sample return) and is embarking on two further studies (on detection of Near Earth Objects, and on the role of research and analysis (R&A) and mission-enabling activities) that potentially impact activities of the PSD. The NRC has also started the Decadal Survey of Planetary Sciences.

The continued growth in the Mars Science Laboratory budget and the increasing cost of launch vehicles both continue to stress the PSD budget. Priorities set by the Decadal Survey on (a) balance of mission size and (b) flagship missions, will guide strategic planning (and budget allocation) beyond 2012. In the meantime, the following are specific issues that the PSD needs to address on a shorter time frame.

Mars Science Laboratory

The persistent rise in estimates of what it will cost to launch the next mission to Mars, the Mars Science Laboratory (MSL), continues to be the dominant issue of the PSD. While there were encouraging reports of the positive impact of management of the project being lead by P. J. Theisinger, and Doug McCuistion presented charts stating how some of the key technical and management issues are being addressed, there remains substantial concerns about the technical development of the mission. Moreover, further issues have arisen since PSS last met in January relating to the availability of sufficient power to operate the necessary rover systems as well as the SAM instrument not meeting necessary environmental qualifications. Such ongoing technical issues have contributed to concerns about the budget. At the January meeting PSS supported additional funds, capped at $400M, be added to the MSL budget. Current estimates suggest that such funds might be sufficient but would only allow a ~13% margin which is below current standards for NASA SMD missions. Approximate estimates of the level of additional resources necessary to complete the mission range from $15M to $115M. Accurate assessment of the additional costs are to be provided by the "readiness to proceed" review to NASA HQ by late November. The strategy presented by PSD, supported by PSS, has been that any additional costs be provided first from within the Mars Program (*e.g.,* reduction in APA, reduction in the US contribution to potential 2016 and 2018 Mars missions) and that any funds taken from non-Mars programs would be repaid from future Mars Program budgets. PSS notes, however, that should the November estimate come in at the middle to upper end of the potential range (*i.e.,* >$50M) then substantial delays will be incurred in some combination of the Discovery, New Frontiers, LADEE and ILN missions. It is clear that the escalation in the MSL budget to date has already impacted exploration of Mars. Further cost growth, while relatively minor compared with the total MSL mission cost (~$2.3B), could have significant impact on exploration of not only Mars but also other scientific priorities of PSD. **PSS plans to meet soon after the Readiness to Proceed review in November and requests a report on the findings of that review, after which the PSS will make further recommendations.**

Potentially Hazardous Objects

The PSS recognizes that the large amount of observational data that will be produced by the congressionally mandated searches for the >140m diameter Potentially Hazardous Objects (PHOs) should be easily accessible to the scientific community to encourage expanded study of these objects. The large volume of data, generated with NASA support, should be archived in the NASA Planetary Data System (PDS). The PDS Small Bodies Node is responsible for ingesting and curating small body data, as well as facilitating access to these data by the scientific community. **PSS recommends that access to small body data holdings in the PDS should be reviewed to evaluate whether the necessary interfaces and tools are in place, particularly with regard to the large future data volumes from PHO searches. NASA should provide the resources necessary to develop any necessary enhancements to current PDS capabilities to**

provide easy identification and access to PHO and other small body data within PDS.

Radioisotope Power Systems

PSS was impressed with the thoroughness of the NRC study "Radioisotope Power Systems: An Imperative for Maintaining U.S. Leadership in Space Exploration" and notes the concerns expressed in the report of the potential lack of available plutonium-238 for missions where sunlight provides insufficient power (*e.g.,* missions to the surface of Venus, the Moon, Mars, as well as the outer solar system). **PSS endorses all recommendations of the NRC report but draws particular attention to their high-priority recommendation on ASRG development "NASA and the Department of Energy (DOE) should complete the development of the Advanced Stirling Radioisotope Generator (ASRG) with all deliberate speed, with the goal of demonstrating that ASRGs are a viable option for the Outer Planets Flagship 1 mission. As part of this effort, NASA and the DOE should put final-design ASRGs on life test as soon as possible (to demonstrate reliability on the ground) and pursue an early opportunity for operating an ASRG in space (*e.g.,* on Discovery 12)."**

Deep Space Network

NASA is reviewing its long-term communication needs via a committee (Architecture Team) in the Space Communications and Navigation (SCaN) Office. The presentation to PSS by John Rush (Director of Systems Planning at NASA's Space Communications Office) included a "notional integrated communication architecture" that seemed to indicate a strong emphasis on optical communication systems. While the substantial advantages of optical communication were presented, there are several key uses of radio communication on planetary science missions (*e.g.,* radio occultation of ionospheres) that would be lost with an optical system. It is also not clear how missions to the outer solar system would be implemented with an optical system. **PSS urges involvement of planetary scientists and engineers in the strategic planning of communication systems to ensure that the full range of needs of solar system exploration are incorporated in future space communication systems.**

International Lunar Network

The International Lunar Network (ILN) mission proposes to make measurements of global properties of the Moon utilizing multiple spacecraft distributed over the surface and would pave the way for emplacement of such geophysical networks on terrestrial planets beyond Earth. The heritage of the ILN mission can be traced to two NRC studies: the 2003 Planetary Science Decadal Survey (*New Frontiers in the Solar System: An Integrated Exploration Strategy*) and the 2007 *Scientific Context for the Exploration of the Moon*. Currently, there is no official ESA involvement in the ILN mission, although individual European countries have become involved. PSS argues that ESA participation would be a substantial enhancement to the mission and make it truly international. PSS notes Dr Weiler's positive report of the recent bilateral meeting between NASA's SMD and ESA (which focused on Mars and outer planets). **PSS urges NASA to expand the bilateral talks between NASA SMD and ESA to include official ESA participation in the International Lunar Network mission.**

Activities of Assessment and Analysis Groups

VEXAG chair Sanjay Limaye summarized current VEXAG activities and the principal issues facing the Venus science community. The Venus Science and Technology Definition Team (VSTDT) completed a report that is now available on the web. The Design Reference Mission recommended by the VSTDT includes an orbiter, two long-lived balloons as well as two landers. The report also identifies technologies that need to be developed in order to accomplish such a mission. Interest in exploring Venus continues to grow internationally. Japan is developing the Venus Climate Orbiter (VCO) for a May 2010 launch with orbit insertion planned for December 2010. ESA's Venus Express Mission continues to collect data from its polar orbit around Venus and likely to be extended through at least 2012 to enable joint observations with VCO. VEXAG will provide input to the Decadal Survey Inner Planets Panel and a number of White Papers are being developed. There is interest in undertaking an effort in Venus-Earth-Mars Comparative Climatology in the community. A Venus-Earth-Mars conference was held by ESA in May 2010 and a Chapman Conference will be proposed for 2011. A topical conference on Venus Atmosphere is also being considered (2010). There is a growing desire to foster international collaboration/coordination/participation in future missions to Venus. A number of abstracts on missions to Venus being developed or conceived are being submitted to the 8th IAA Low Cost Planetary Missions Conference (2009). The next VEXAG Meeting will be 28-29 October, 2009 in the Irvine, California area. This follows the second Next Decadal Study panel meeting, which will be at the Beckman Center, Irvine on 27-28 October. News on VEXAG activities is posted regularly on http://www.lpi.usra.edu/vexag/.

LEAG chair Clive Neal noted that LEAG has been very active since the last PSS meeting in January. LEAG organized two "specific action teams" (SATs): the LROC-SAT to evaluate the 50 sites chosen by Constellation for detailed study by the LRO Camera; and the Surface Scenarios SAT to evaluate the OSEWG surface scenario process and how lunar architectural requirements are generated. In addition, LEAG organized a town hall meeting at the 40th Lunar & Planetary Science Conference in March to discuss future lunar missions and to report community input to the Planetary Sciences Division of SMD. This began the gathering of community input for the Decadal Survey. Further efforts will be a day-long LEAG session at the Lunar Science Forum at Ames later in July and the submission of targeted white papers. The first version of the Lunar Exploration Roadmap will soon be released. The LEAG annual meeting will be held at the LPI 16-19 November, 2009, and will feature the first data from LRO/LCROSS, as well as focus on revising the Sustainability Theme of the roadmap. News on ongoing LEAG activities is posted on http://www.lpi.usra.edu/leag/.

MEPAG chair Jack Mustard summarized recent activities of the group. MEPAG held its semi-annual meeting on March 3-4, 2009 that marked the first discussions towards the inputs to the Decadal Survey. Developments in Mars exploration since the previous PSS meeting in January include continued progress by the missions now operating at Mars, early development of MAVEN as the next Scout mission, and continued assessment and planning of Mars exploration. Key efforts presented to the PSS first focused on the development of white paper themes to be delivered to the Decadal Survey by MEPAG, as well as the community activities relevant to the survey supported by MEPAG. Progress on the Joint Instrument Definition Team (JIDT), a joint ESA-NASA group studying options for a possible joint orbiter in 2016 was described. We also heard about two Science Analysis Group (SAG) activities, one involving the science and measurement objectives of a network mission for Mars, and the other regarding a capable rover mission in 2018 that would include sample caching technology development. Lastly Mustard summarized recent actions on expanding the international scope of MEPAG. The next MEPAG meeting will be on 29-30 July 2009 at Brown University in Providence, RI. News on MEPAG activities is posted regularly on http://mepag.jpl.nasa.gov/.

OPAG chair Bill McKinnon provided an update on OPAG activities. OPAG lauded NASA's recent prioritization of Outer Planets Flagship missions, and vigorously encourages NASA to do its utmost to advance preparations for the Europa Jupiter System Mission (ESJM), including support for instrument development, continued international collaboration, and reduction of radiation risk, and culminating as soon as practical in a new start. OPAG and its associated community are now deeply immersed in the writing of white papers, as well as one or more high-level summary white papers for the Planetary Science Decadal Survey. Among other findings, OPAG strongly recommends approval by NASA of the "extended-extended" Cassini mission, including the Juno-like end-of-mission scenario. In this regard, OPAG reiterates the need to involve new members of the outer planets community in the Cassini science teams, both to facilitate interdisciplinary science and to train the next generation of outer planet scientists in an active planetary mission. Finally, OPAG stresses the need to persevere in the development of new sources of plutonium for the radioisotope power systems that will be needed by future outer planets (and other) missions. The next OPAG meeting is 16-17 February 2010 in the Metro DC area. News on OPAG activities is posted regularly on http://www.lpi.usra.edu/opag/.

SBAG Co-Chair Hal Weaver discussed the current status of that group's activities so far this year. Faith Vilas resigned as SBAG Chair to serve on an NRC panel; she will, however, remain on the SBAG Steering Committee. Hal Weaver and Mark Sykes are the new SBAG Co-Chairs, with Sykes slated to take over as Chair after completing his service on an NRC committee. The inaugural SBAG community workshop was held 2009 January 12-13 at the University of Maryland, College Park. There were 42 in-person participants and another ~20 people participated via WebEx. At the workshop, groups were formed to work on various sections of the SBAG Strategy Document. The minutes and findings from the inaugural SBAG workshop can be found at: http://www.lpi.usra.edu/sbag. A major focus of SBAG activity during the coming year, and especially during the next several months, is the planetary Decadal Survey. Mark Sykes has set up a website to facilitate the preparation and submission of group Decadal Survey white papers from the small bodies community at: http://www.psi.edu/decadal/ . SBAG will hold a community workshop to discuss the Decadal Survey white papers at the DPS 2009 meeting in October.

CAPTEM chair Meenakshi (Mini) Wadhwa provided a summary of CAPTEM activities since the last report in October 2008. The main activity currently being undertaken by CAPTEM is the preparation of white papers in collaboration with MEPAG, LEAG and SBAG, and incorporating community input, for the upcoming Planetary Science Decadal Survey. An important issue discussed at the time of the last meeting of the CAPTEM in March 2009 was the recent increase in the requests for lunar samples in support of future lunar exploration. Since lunar samples returned by the Apollo missions represent an extremely limited resource of unique, irreplaceable materials for future investigations, CAPTEM will be seeking a prioritization from ESMD of studies in support of future lunar exploration. Finally, CAPTEM is also initiating a review of the curation of the samples that were returned by NASA's Stardust mission in January 2006. Further information on CAPTEM, its current membership and activities can be found at http://www.lpi.usra.edu/captem/.

As a final action, the PSS scheduled its next meeting for 3-4 December 2009 in Boulder, Colorado.

Planetary Science Subcommittee Meeting
9-10 July 2009
NASA Headquarters, Room 9H40

9 July (8:00 AM – 5:30 PM)		
8:00	Welcome & Other Administrative Matters	Fran Bagenal, Michael New
8:15	PSD Update Including: 2010 Budget Status of Outer Planets Flagship Report on ESA-NASA Bilateral Meeting in early July Current Status of MSL	Jim Green, Doug McCuistion
9:15	Discussion	Fran Bagenal
10:00	Break	
10:30	Q&A with the AA	Ed Weiler
11:30	Discussion	Fran Bagenal
12:00	Lunch	
1:00	Analysis Group & MOWG Reports	
	• VExAG	Sanjay Limaye
	• LEAG	Clive Neal
	• MEPAG	Jack Mustard
	• OPAG	Bill McKinnon
	• SBAG	Hal Weaver
	• CAPTEM	Mini Wadhwa
3:00	Annual Ethics Briefing	Office of General Counsel
4:00	Evaluation of GPRA Metrics	Phillipe Crane

10 July (8:00 AM – 3:00PM)

8:00	Welcome	Fran Bagenal
8:15	Report on NRC Study of Plutonium Availability	Ralph McNutt
9:15	Discussion	Fran Bagenal
10:00	Break	
10:30	Overview of the MAVEN mission	Bruce Jakosky
11:00	Evolution of the Deep Space Network	John Rush
12:00	Lunch	
1:00	Report on Planetary Science Decadal Study	Steve Squyres
2:00	Discussion, Formulation of Recommendations, Scheduling of Next meeting	Fran Bagenal
3:00	Adjourn	Fran Bagenal