PSS March 16, 2011, Teleconference

Dr. Ronald Greeley, Chair of the Planetary Science Subcommittee (PSS) opened the meeting, announcing that four members, Drs. Johnson, Cravens, Herzog and Slavin have all been approved for extensions in order to attend the April face-to-face meeting of the PSS, for the purpose of discussing the newly released Planetary Decadal Survey. Dr. Greeley outlined the purpose of teleconference, which was to prepare for both the next PSS meeting, followed by the NASA Advisory Council (NAC) Science Committee (SC), during which PSS must present its response to the Decadal Survey (DS).

Dr. James Green, Director of the Planetary Science Division (PSD) presented statistics from the release of the DS, and reminded everyone that there are great overviews of events that occurred at the Lunar and Planetary Science Conference (LPSC), including livestream broadcasts and NASA night presentations at www.solarsystem.nasa.gov/2013 Decadal. Dr. Green credited Steve Mackwell for his contributions to the event. Livestream statistics from the event included 8000 unique viewers from 98 countries.

Dr. Green presented charts that blocked out a notional budget for FY13 and beyond. The top line is $1.488B in FY12, which runs down to $1.18B per year in the outyears. The "notional" stamp means that dollar values can and will change according to recommendations accepted by the DS. The Planetary funding profile for the FY11 President's Budget Request was used by DS Steering Panel to make its decisions. The DS had also made the assumption that from 2016 and beyond, there would be a flat distribution of funds. There is a significant difference between the FY11 and FY12 budget requests, which must support Research and Analysis (R&A), Discovery and selection for Discovery 12, New Frontiers (including operating missions New Horizons and Juno); the lunar program containing the Lunar Science Institute (LSI), and LADEE operations, Mars current operations plus Mars 2016, and the Outer Planets program containing the extended Cassini mission and OP research.

With regard to the DS recommendations relative to the budget, Dr. Green maintained that it was clear that PSD cannot support all 5 flight programs in the Discovery, Mars, New Frontiers, Lunar, and Outer Planets (OP) themes. In addition, a major shift in programmatic structure was also recommended by the DS, which calls for maintaining Technology Development at a 6-8% level, as well as supporting R&A, and a New Frontiers $1B cost-capped mission, excluding the launch vehicle. In Discovery, the DS recommended enhancing the cost cap up to $0.5B in 2015 dollars. In the Flagship program, the DS recommended an Europa Orbiter, a Uranus orbiter probe, and an Enceladus Orbiter mission. PSD does not have a budget for either the recommended or cost-constrained program for the previously planned international Mars Astrobiology Explorer-Cacher (MAX-C) mission, and must therefore work hard on de-scoping or delaying the next Flagship mission. Therefore PSD will need to renegotiate with the European Space Agency (ESA) in moving forward; the division will have approximately $1B between now and 2018 to deal with any Flagship concepts, which is nowhere near what MAX-C is expected to cost. The current plan is to approach is to carry on with studies in the Flagship program, to prepare for the ESA bilateral meeting in March, and

then to plan to work with ESA to determine if the Mars 2018 mission can be accomplished within the established Letter of Agreement (LOA). PSD is also working with ESA to support the Laplace mission if it is selected, and is already committed to a competition for instrument selection, with up to 5 NASA instruments allowed on the mission of opportunity (MoO). There will be an associated competition for support for a Principal Investigator (PI) and interdisciplinary teams.

The National Research Council (NRC), in cooperation with the American Astronomical Society (AAS), will support Town Hall meetings for the purpose of discussing the DS, with 10 meetings planned between 15 March and 17 April. The key website to consult for more information on these meetings is also www.solarsystem.nasa.gov/2013 Decadal; the website will be updated regularly. In the meantime, NASA will be undertaking the 90-day process to respond to the NRC (June 2011) and expects PSS to review the response before it is finalized. NASA will also meet with the Office of Management and Budget (OMB) and the Office for Science and Technology Policy (OSTP) during this time, which will also be reflected in the DS response. The definitive answer for the DS recommendations will be contained in the FY13 budget submittal, to be presented in February 2012.

Dr. Greeley opened the meeting to discussion and questions. Dr. Chip Shearer asked for clarification of contents on chart 3, which appeared to show lunar science and OP lines to be decreasing. Dr. Green replied that any of these lines are now available for reprogramming. The DS is proposing that existing programs be completed: indeed LADEE will be completed; the Lunar Science Network will be presented as a New Frontiers competitive opportunity; and GRAIL will be completed. What is included in lunar science line currently is the operating budget for the Lunar Reconnaissance Orbiter (LRO), and the NASA Lunar Science Institute (LSI). LASER is also in that line. Both LASER and LSI are bookkept within the Lunar Quest program.

Dr. Cravens expressed concern about getting through the year with Juno, GRAIL and the Mars Science Laboratory (MSL). Dr. Green recognized that these missions will have to be top priority elements in the budget, with PSS support. The next situation to deal with is the FY10 level of dollars, which will determine how well PSD can proceed with LADEE and MAVEN. Within the R&A program, PSD is selecting fewer proposals and holding back budget in anticipation of the budget being even lower than the FY10 level. The division will be in trouble if the budget that gets passed is much less than FY10. Dr. Green pointed out that he spoken about this situation at length at LPSC, and that interested parties can watch the presentation on the website. Dr. Wadwha asked how PSD would proceed with the MAX-C de-scope. Dr. Green responded that there is already a set of NASA/ESA personnel working on it, having started at the LPSC and making progress. However they are still tackling enormous stumbling blocks, and talking realistically about the budget on both sides. ESA must de-scope ExoMars as well, allowing an opportunity to create a new agreement. The Mars Exploration Program Analysis Group (MEPAG) will be the primary conduit through which de-scope decisions will be made; the next meeting will be in Europe in June. ESA and NASA are still partnering but with a

renewed emphasis on working under cost constraints; this is also a perfect opportunity to sync up with the NASA ESA bilateral meeting.

Dr. Grant asked about the minimum set of requirements being used for the 2018 Max-C mission. Dr. Green explained that each group is looking at their own set of requirements. ExoMars is a technology demonstration for Entry Descent and Landing (EDL), and a rover that lands, moves and drills. For ESA it is really a matter of reaffirming key requirements. The NASA requirements are for critical caching technologies, as 2018 is the opportunity for a future Mars Sample Return. Dr. Grant asked that if assuming that 2018 can be brought into cost line, whether a Jupiter Europa Orbiter (JEO) would then be possible. Dr. Green reported having received no direction yet on how to reduce a $4.7B mission to a $1B mission; there is clearly not enough budget for an OP mission, as one cannot send a brick to Europa for $1B. The DS has asked PSD to study a number of options, including a de-scoped JEO. Nothing has been started for Europa in terms of study.

Dr. McKinnon asked from where the $1B figure had been derived. Dr. Green described it as a back-of-the-envelope calculation using both the present budget wedge and the DS recommendation. NASA must first understand if it has enough money for even partnering with ESA. If one could achieve a $2.5B mission for MAX-C, it would also be unexecutable because it is not clear that OMB and OSTP would allow NASA to increase its budget to that extent. Decision-making rules from the DS are also clear on this. Essentially, the NASA contribution to MAX-C is $1B, because everything beyond 2013 is a notional budget. There is no way to get to a $2.5B mission without compromising top Discovery and New Frontiers Decadal missions.

Dr. Sykes asked whether maintaining a Flagship level mission under a less favorable budget scenario could be realized by eating into other programs. Dr. Green recommended consulting Chapter 9 of the DS and look at the decision-making rules, which emphasize a balanced program. It is clear from previous NRC studies that Flagships have provided enormous science return for the dollar. NASA will need to leverage international partnerships, redesign, and re-focus on 50-50 international partnership for a Flagship mission. Until that process is done, PSD can't determine the final disposition of a Flagship. Dr. Limaye asked if there were a budget for a New Frontiers 4 start. Dr. Green replied that execution and selection of mission concepts will begin, which will include comet surface sample return and a Venus *in situ* explorer, but no relative priorities among these. None of these budget numbers are real until NASA works with OMB and the Administration. It must also be borne in mind that each and every number on the list will have to be re-done for New Frontiers, and that operating mission numbers will remain low. Real money will have to be provided in the new starts to get a program going in phases B and C.

Dr. Greeley commented that the New Frontiers nominal cost seems like a wild card as the amount for a heavy-lift vehicle will be within a large range. Dr. Green stated that PSD has a mechanism with the NASA Launch Service, on getting some initial prices on a not-to-exceed basis, and will budget at those numbers, which may conceivably be less once the vehicle is procured. This will change from mission to mission as each one is defined.

PSD also has to hope for cheaper commercial rides. Dr. Slavin asked, given the uncertainty, what the earliest date might be for seeing numbers for a MoO on Laplace? Dr. Green reported that ESA is putting together new science definition teams (SDTs) to look at their L-class missions, including an ESA-only contribution; this process will take a year, and will be discussed at the next OPAG meeting. In the meantime, NASA will know what a potential relationship might look like and will also have a look at their revised schedule; 2012 would be an optimistic date.

Dr. Castillo expressed concern about losing young dynamic scientists with the prospects dimming for a JEO. Dr. Green recommended asking ESA whether it had some plans for continuity in that vein; NASA has activities for researchers in OPR and R&A; the next study, however, for a JEO will be a joint ESA/NASA effort. From the US perspective, it is starting a new relationship with ESA and will have to hang on to the roller coaster ride. Dr. Reysenbach commented that the DS was hazy about JEO and the Uranus probe, and was concerned about the lack of time scale; does Uranus have to wait 5 years? Should there be a time limit on Europa? Should OPAG weigh in on this? Dr. Green commented that within several weeks, he hoped to understand if ESA will be a viable partner in other OP missions like Enceladus and Uranus. However, opportunities for new starts are remote in this budget environment; the critical aspect will be dollars. Right now PSD is emphasizing its top Flagship priority; if it doesn't happen, NASA will have to move on to the next opportunity.

Dr. Greeley asked whether a joint OP mission with ESA, with potential JGO participation, would be supported by OPAG. Dr. McKinnon thought this would very much be the case. Dr. Greeley then suggested, pending OPAG discussion, that perhaps PSS could endorse this participation ahead of time. There was general concurrence with this idea. Dr. Green agreed that he could carry this message to the bilateral meeting. Dr. Reysenbach noted that L-class mission teams studying ESA-only involvement may not have results until February 2012, and that it might be useful to have support for JGO from OPAG and PSS. Dr. Green agreed that such support would be beneficial, as well as support for reaffirming the ESA Laplace mission.

Asked about implementation of Advanced Stirling Radioisotope Generators (ASRGs), Dr. Green noted that the timescale would have to change; usage had been initially studied, but to put the generators into production would also mean that another engineering unit would have to be built. This would affect the test program and would require flight opportunities; PSD will have to study it more rigorously if a Europa mission is truly realizable. Dr. Sykes commented that technologies to enable larger class missions do not address smaller Discovery-class missions, and wondered about the balance of investment. Dr. Green expected PSS to discuss this issue, particularly if Flagships get moved out into the far future. While the number-one requirement for an OP mission is a Pu restart, PSS should also consider ASRGs for many other mission scenarios- Discovery in particular could be enabled by ASRGs. PSS expressed concern that an OP mission needs to survive several administrations. Dr. Green agreed, and noted that in discussions with ESA about Mars in particular, NASA must discuss a long-term partnership that stretches over a series of missions, and must work very closely together

with the goal of sample return, getting off the planet and returning to Earth. Commitment on both sides will be necessary. The DS provides support on the US side, assuming a long-term commitment. MAX-C will provide science return as soon as it touches down.

Dr. Sumner asked how the exclusion of the launch vehicle in mission planning for New Frontiers made missions more reliable or reasonable. Dr. Green felt that the value of excluding the launch vehicle was really all about holding the PI to a cost cap on the spacecraft or instrument, in a scenario of fluctuating launch costs. PSD will make some sort of estimate on the launch vehicle by working with NLS II and placing that cost in the budget. Having launch vehicle decisions under HQ control also allows better management of the portfolio. As the NLS II launch service contract came out in late 2010, there is no accurate estimate as of yet. OMB recognizes this and will help in redesigning the budget in response to the DS. PSD is hoping to formulate an architecture where it will be possible to more accurately cost both New Frontiers- and OP-class missions in a joint program with ESA. Dr. Sumner commented that within the de-scope of MAX-C, the cost driver was the size of the landing system for two rovers. Dr. Green described the level 1 requirement for MAX-C as building one rover that both drills and caches; NASA probably won't be able to afford two rovers. However, the science requirements have yet to play out. The DS has provided PSD with great flexibility, and gives it the opportunity to be faithful to the priorities.

Because a $1B cap includes the launch cost for a Flagship, Dr. Green noted that this would influence what type of partnership NASA would consider. The Mars Science Laboratory (MSL) costs about $2.5B for a mission that includes sky crane technology, a rover, and radioisotopic power; it is an enormous step forward for instruments and astrobiology. The Mars 2018 mission has approximately the same amount of money for an MSL-class capability. There is time to forge a new agreement and move ahead. The Obama administration strongly supports joint missions and partnerships. The DS is new, and PSD is adjusting to ground rules.

Dr. Jeff Johnson asked whether PSD had made plans for a mid-decade review. Dr. Green agreed that a mid-decade review would help prepare PSD for next DS, but that no plans were in progress at that time. He noted that there is a Congressional requirement that NRC weigh in how well NASA is executing the DS. Dr. Johnson commented that if there is too much of a disconnect between the DS and NASA implementation, the review may have to be sooner than 5 years. Dr. Green replied that PSD would stick to the written mandate.

Dr. Greeley suggested an agenda for the next PSS meeting to include an ethics briefing; a Larry Soderbloom talk on the DS to address questions or issues; an update on NASA/ESA discussions; OPAG meeting results on science de-scoping for OP missions; and MEPAG thoughts on minimum science requirements for MAX-C. Dr. Green encouraged PSS members to download Steve Squyres' presentation on the DS. Dr. Greeley commented that picking apart the DS would not be beneficial to the community and urged PSS members to examine the full list of recommendations in the DS, bearing in mind the need to de-scope and cancel some missions and avoiding the urge to revise

the DS. Dr. Greeley praised the DS group for carrying out a wonderful job in producing a valuable report, and he thanked PSS members who helped bring it about.

Dr. Greeley adjourned the meeting at approximately 3:48 pm.

Webex attendees

Michael	Amato	Goddard
David	Beaty	Mars Program Office
Josh	Cahill	John's Hopkins
Dennon	Clardy	NASA Marshal Space Flight Center
Ellen	Cohen	NASA
John	Cooper	NASA Goddard
Randall	Correll	Ball Aerospace
Thomas	Cravens	University of Kansas
David	Desmarais	NASA Ames Research Center
Jens	Feeley	NASA Headquarters
Bobbie	Fogel	NASA Headquarters
Julie	Gastinno	Caltech
John	Grant	NASA
Ronald	Greeley	AZ State University
Jim	Green	NASA
Will	Grundy	Lowell Obs
Amanda	Hendrix	JPL
Gregory	Herzog	Rutgers University
Puong	Huynh	NASA
Noah	Izenberg	John Hopkins
Jeff	Johnson	APL
Gordon	Johnston	NASA
Michael	Kelley	NASA Headquarters
Kim	Kuhlman	Planetary Science Institute
Brook	Lakew	NASA
Melissa	Lane	Planetary Science Institute
Gregory	Lee	Northrop Grumman
Sanjay	Limaye	City of Madison Wisconsin
Valerie	Lyons	NASA Glenn
John	McCarthy	Orbital Sciences
William	McKinnon	Washington University
Keith	Murray	NASA Langley
Michael	New	NASA Headquarters
Sara	Noble	Goddard
Adriana	O'Campo	NASA Headquarters
Robert	Pappalardo	JPL
Louise	Procter	APL
Jonathan	Rall	NASA Headquarters
Carol	Raymond	JPL
Kurt	Retherford	SWRI
AnnaLouise	Reysenbach	Portland State University
Ken	Rourke	Northrop Grumman
Nina	Scheller	NASA
Mitchell	Schulte	Headquarters
Teresa	Segura	Northrop Grumman

Kristen	Shapiro	Northrop Grumman
Charles	Shearer	PSS
Amy	Simon	NASA Goddard
Kelsey	Singer	Washington University
James	Slavin	NASA Goddard
Marcia	Smith	Space Policy Online
Paul	Steffes	GA Institute of Technology
Dawn	Sumner	University of CA
Jessica	Sunshine	UN of Maryland
Amy	Svitak	Space News
Mark	Sykes	Planetary Science Institute
George	Tahu	NASA
Tim	Tawney	NASA
Elizabeth	Tuttle	John Hopkins University Applied Physics Lab
Richard	Vondrak	NASA Goddard
Meenakshi	Wadhwa	AZ State University
Jonathan	Weinberg	Ball Aerospace
Catherine	Weitz	Planetary Science Institute
Greg	Williams	NASA
Rebecca	Williams	Planetary Science Institute
Joan	Zimmermann	Zantech IT
Marian	Norris	NASA