

NASA ADVISORY COUNCIL

Planetary Science Advisory Committee

July 2, 2018

Teleconference

MEETING MINUTES

Anne Verbiscer, Chair

Jonathan Rall, Executive Secretary

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Monday, July 2, 2018

Opening, Announcements

Dr. Jonathan Rall, Executive Secretary of the Planetary Science Advisory Committee (PAC) of the NASA Advisory Committee (NAC), opened the meeting. He announced that Dr. James Green is now NASA's Chief Scientist, and that Dr. Lori Glaze is now the Acting Director for the Planetary Science Division (PSD). Dr. Rall then reviewed the meeting rules.

PSD Status Report and Q&A

Dr. Glaze welcomed the PAC members, noting that she had been a member of the Planetary Science Subcommittee (PSS) before it became a full committee. She began her presentation with an update on mission status. The Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-Rex) mission will begin observations of the asteroid Bennu in August. NASA launched the Interior Structure from Seismic Investigations, Geodesy and Heat Transport (InSight) mission on May 5. The mission team does not anticipate that the dust storm on Mars will affect InSight's November landing, as the radar will work regardless. There will be a detailed analysis of the Entry, Descent, and Landing (EDL) features during and after landing. Opportunity Rover has been in power-save mode for several weeks due to the dust storm. A recent attempt to communicate with Opportunity was unsuccessful, but another attempt was scheduled to take place in a couple of weeks.

Dr. Glaze next presented the PSD fleet chart. The Double Asteroid Redirection Test (DART), which will test ideas on how to adjust the orbit of an asteroid, is under development; the mission will be led by The Johns Hopkins University Applied Physics Laboratory (APL). DART was about to go into Key Decision Point C (KDP-C), and is planned for a 2021 launch. The Near-Earth Object Wide-field Infrared Survey Explorer (NEOWISE), which is characterizing asteroids and Near-Earth Objects (NEOs), is continuing survey operations through December 2018. Funding for the European Space Agency's (ESA's) Rosetta mission should be in place to continue collaborations between NASA and ESA scientists.

The operating budget for FY18 was close to approval, and the President's Budget Request (PBR) for FY19 provides PSD with a modest increase. Much of that relates to lunar exploration and planetary defense. The PBR will enable trade studies and support a Europa Clipper launch as early as 2025. A new Lunar Discovery and Exploration Program will support public/private partnerships in achieving science and human exploration goals. The budget also supports Research and Analysis (R&A).

Space Policy Directive 1, which was signed in December of 2017, states that the United States will resume exploration of the Moon as part of an effort to extend exploration and knowledge further into the Solar System. The FY19 PBR will significantly increase NASA's lunar exploration budget for this high-visibility program. As the endeavor requires coordination throughout NASA, the Science Mission Directorate (SMD) has appointed Mr. Steve Clarke to lead the Directorate's effort. The budget and work will remain in PSD; much of the funding is meant to jumpstart a commercial landing capability.

The PBR also includes a significant funding increase for planetary defense, which will encompass detection, characterization, assessment, mitigation, and coordination with other government agencies, including the Office of Science and Technology Policy (OSTP), the Federal Emergency Management Agency (FEMA). Dr. Glaze described a range of NEO-related activities, including DART. NASA is discussing additional observations and assessments with Agenzia Spaziale Italiana (ASI, the Italian space agency). A portion of the budget will fund study of new methods of object detection. PSD will provide a

full briefing on planetary defense at the next PAC meeting. At the time of the teleconference, the Planetary Defense Office (PDO) had detected more than 18,000 NEOs. The White House had recently released a National Near Earth Object Preparedness Action Plan via an interagency working group. The 2017 NEO Science Definition Team (SDT) report determined that ground-based detection methods are insufficient, and called for a space-based capability.

Dr. Glaze believes that R&A is the backbone of PSD's work, so it is critical to have a healthy program with a healthy budget. This will be one of her focus areas. The InSight participating scientist program proposals are almost completely through the review process. Progress has also been made in the Korean Pathfinder Lunar Orbiter participating scientist program and in the guest investigator program for ESA's Bepi Colombo mission, although there are no details yet.

The Internal Scientist Funding Model (ISFM) seeks to better use the civil servant workforce at the NASA centers, while also reducing proposal pressure. NASA has asked the centers to identify scientific research areas that have been consistently well-reviewed and funded through R&A, so that the Agency can determine each center's core capabilities. The plan is to examine the average R&A funding levels, fund the ISFM at 80 percent of the average, and have the remaining 20 percent come through proposals. The peer review process will keep the scientists sharp. ISFM will benefit the community by decreasing the number of proposals submitted to Research Opportunities in Space and Earth Sciences (ROSES). It should also free up civil servant time by reducing the time they spend writing proposals. Finally, the funded scientists will be available to collaborate on other investigators' proposals. The funding will give these scientists more time to assist the community. NASA will be tracking a variety of metrics, such as the number of proposals and the number of ISFM scientists serving on review panels. Dr. Glaze then presented examples of the types of projects funded at several centers, including the Goddard Space Flight Center (GSFC), Ames Research Center (ARC), Johnson Space Center (JSC), and others. Some projects involve collaboration among SMD divisions. For example, PSD is doing the Exosphere-Ionosphere-Magnetosphere Modeling (EIMM) work package in conjunction with the Heliophysics Division (HPD).

A call was issued for smallsats and cubesats as part of the Small Innovative Missions for Planetary Exploration (SIMPLEx) effort. Step 2 proposals were due in late July, and PSD was still seeking non-conflicted reviewers. There will be another cycle, as this is going to be a standing call. The next round will be in about a year. PSD is trying to streamline this.

The Radio-isotope Power Systems (RPS) have been redacted from the Discovery Announcement of Opportunity (AO). PSD planned to issue the draft AO later in 2018. For New Frontiers, the Phase A study reports were due at the end of the year, with down-selection planned for mid-2019. PSD was considering the Comet Astrobiology Exploration Sample Return (CAESAR) probe and sample return mission to the comet Churyumov-Gerasimenko, as well as Dragonfly, a drone to explore Saturn's largest moon, Titan. The Preliminary Design Review (PDR) for Europa Clipper was to occur in a few months. The goal had been to have a 2022 launch, though the PBR would push that back to 2025. PSD is working to resolve this issue and hopes for an early ride on the Space Launch System (SLS).

As SMD moves forward with more collaborative, inter-disciplinary projects, astrobiology has become a focus of inter-divisional work. The NASA Astrobiology Institute (NAI) is one avenue, and the Nexus for Exoplanet System Science (NExSS) is another. The latter is based on a Research Collaboration Network (RCN). Currently, the 20-year-old NAI is being examined to help determine the best way forward. The success of NExSS is largely attributable to the fact that it is run by the community.

The National Academy of Sciences (NAS) has just completed the planetary science mid-term review and will release it once internal NAS review is complete. The next PSD Decadal Survey (DS) is on schedule for early 2022. The Committee on Astrobiology and Planetary Sciences (CAPS) has reviewed a number

of completed mission studies and provided a list of additional studies that can serve as inputs to the DS. Dr. Green had initiated the studies on dwarf planets and Venus. However, these studies are subject to Federal Advisory Committee Act (FACA) regulations, which has slowed them down considerably, in large part due to the process of appointing panelists as Special Government Employees (SGEs). Dr. Glaze asked PAC to consider if there might be another way to do these studies in time to provide them as feedback for the next DS, or if there are other ways to go forward. She also asked them for feedback on the order and priority of the additional studies.

PAC made a number of recommendations at the previous meeting, which Dr. Glaze addressed. First, PAC suggested multiple improvements to the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). The system is undergoing some modifications, and all of the recommendations are under consideration. NASA is also trying to improve the reviewer experience. Dr. Rall would elaborate on that in his presentation. Similarly, Dr. James Watzin would discuss the recommendations regarding the Mars 2020 mission and sample return. PAC sought creation of a Mercury Assessment Group, which is something Dr. Glaze endorses and considers timely. She wants the Mercury community to have a voice going into the next DS. To that end, she has identified a PSD program scientist who can be a liaison with this community, and hopes to establish the group soon.

The RPS recommendation has been superseded by events. The recommendation that greater attention be paid to Venus is a challenge. Both Discovery and New Frontiers are competed programs, and the selections cannot be dictated. Dr. Glaze encourages the Venus community to continue proposing, and gave dates for upcoming opportunities. She looks forward to new documentation from the Venus Exploration Assessment Group (VEXAG) to help develop a strategy going forward.

As PAC advised, Dr. Glaze would like to see the Early Career Fellowships (ECFs) reinstated, and PSD was working on that. Dr. Rall would provide more detail in his presentation, but Dr. Glaze is seeking an ECF call as part of ROSES18. Standardization of data formats is an area in which Dr. Glaze was still getting up to speed. She supports the use of standardized formats and accessible archival data and would like PAC to assess the needs of the community, producing a report on what is and is not working, as well as specifics on where they would like this to go. Finally, the planetary defense updates will begin with PAC's next face-to-face meeting, with highlights offered in conference calls.

Dr. Anne Verbiscer, PAC Chair, thanked Dr. Glaze for her presentation. She noted that the budget appeared to reduce funding for ocean worlds and outer planets by about \$400 million. Dr. Glaze said that this reflects a disconnect between Congress and the White House regarding the right funding level. For the past couple of years, Congress has provided funds beyond the PBR. A launch of Europa Clipper before 2025 will require funding beyond what is in the PBR.

Dr. Amy Mainzer gave a clarification on NEOWISE, explaining that the mission team has not seen evidence of sunlight in the telescope. There is some seasonal warming, but detection continues at the same rate as in years past. It will heat up again next summer. Dr. Glaze said that she hopes NASA can keep NEOWISE going for as long as possible. While they are prepared for the worst, they are hoping for the best.

Dr. Robin Canup asked if the block grants to centers will be revenue neutral. She also asked about the RCNs compared to institutes. Dr. Glaze explained that the ISFM funds are not quite block grants, but reflect work consistently funded and well-reviewed in the past. The plan will come out of those R&A lines. She said that it is revenue-positive because only 80 percent of that amount is given to the centers. Dr. Rall added that the selections fluctuate in terms of balance. The model was based on a 3-year average. There will be on- and off-ramps, along with external peer reviews.

Dr. Glaze said that she was still learning about the RCNs. The projects that are funded are put together from existing R&A programs, with a small amount of additional funding to facilitate interactions and collaborations. The primary difference is that RCNs are managed independently with a little direction from NASA Headquarters, but NAI has a central node to facilitate collaboration.

Dr. Justin Hagerty pointed out that the Mapping and Planetary Special Data Infrastructure Team (MAPSIT) is working on a standardization roadmap. Dr. Rall read a question that had come in electronically, about the impact of the James Webb Space Telescope (JWST) on PSD. Dr. Glaze said that there has been a lot of activity at NASA regarding the new launch date and the likely cost increase of about \$800 million. However, this is an incredible mission, and it is important to ensure its success. The financial impact will not hit SMD divisions in FY19, but the impact beyond that is unknown. Dr. Aki Roberge expressed concern about maintaining some of the more successful NAI activities. Dr. Glaze replied that NASA is trying to identify such activities in order to retain NAI's core functionality.

PSD R&A Status

Dr. Rall reported that ROSES 2018 was released in February, and the ECF framework was being developed. The new Cooperative Agreement Notice (CAN) for facilities is on hold at the moment while NAS studies it. The NAS study on the R&A restructuring is out. A new policy calls for archiving documents on NASA-funded work into PubSpace, a subset of PubMed. There is also new language in many ROSES calls specific to lunar research. Review panels are becoming increasingly difficult to staff, an inadvertent consequence of the R&A reorganization. PSD is examining how to streamline the process. In the meantime, the need still exists for panelists and external reviewers. Dr. Rall asked that community members either agree to participate or refer people.

Facilities now fall under the Planetary Major Equipment and Facilities (PMEF), which had previously been PME. There is now a single deadline for investigator and facility instruments, and the threshold is \$50,000. The Lunar Discovery and Exploration Program (LDEP) just released the Solar System Exploration Research Virtual Institute (SSERVI) CAN 3. There are new ROSES elements, including the Development and Advancement of Lunar Instrumentation (DALI) and others. PSD is developing archiving systems for lunar sample data.

R&A created some templates to help proposers and reviewers. The Program made all of its ROSES17 deadlines. The New Frontiers Data Analysis Program (NFDAP) moved to ROSES18, and two programs have pending decisions. NASA Earth and Space Science Fellowships (NESSF) award amounts are now higher, to be more in line with other graduate research programs. The budget has not increased, however; the additional funding comes from the programs.

Dr. Rall reviewed the R&A selections by grade, noting that some are descoped, and sometimes otherwise superior proposals are declined due to programmatic reasons, such as their similarity to other strong proposals. ROSES15 was a good year for getting funds out, though that is often a function of when the appropriations actually occur. The keyword analysis had not been updated since PAC's last meeting, but there will be more at the next meeting. Dr. Rall reviewed the highlights, noting that PSD had hired a data scientist to do the analysis and work with program officers. Fluctuations sometimes reflect earmarks. Small bodies growth is almost all due to hazardous objects, while outer bodies growth is largely due to non-specified planets.

Regarding the PAC recommendations for reviews and NSPIRES, PSD needs to find a timely way to notify external reviewers that they have been selected. This will likely require an automated process. The other NSPIRES recommendations – to notify external reviewers when reviews are assigned; to make external reviews visible to all reviewers; and to allow group chiefs to see review status – will require changes to NSPIRES itself, which goes beyond PSD. Therefore, PSD is giving the recommendations to

the NASA Research Education Support Services (NRESS), which manages NSPIRES. Dr. Rall will have an update at the next face-to-face PAC meeting.

PAC had recommended a two-tier program for ECF, and that the ECF funds be made portable so that the Principal Investigators (PIs) can take their money to their first real jobs. It was also recommended that there be no requirement that the job be a tenure-track position. PSD is talking to the National Science Foundation (NSF) about a similar program (CAREER) at that agency. If appropriate, PSD will model its program after the one at NSF.

Dr. Dana Hurley asked about R&A funding health. Dr. Rall replied that while there is no definition of a healthy selection rate, the current 20 percent rate is an improvement over recent years. The R&A budget has grown tremendously over the last 8 years, and he expects continued growth, but proposal pressure continues to exceed the growth rate. Dr. Glaze added that PSD would like to see higher selection rates. The ISFM work packages were motivated in part by to get some competition out of the system.

Dr. Canup asked about the budget and scope of facilities under the PMEF program. Dr. Rall explained that it fluctuates dramatically from one year to the next, so while this is a logical step, he was not ready to give an answer. The hope is that the facilities part will go up to a threshold, after which it will have to go to the CAN.

Mars Update

Dr. Watzin provided an overview of the Mars Program, noting that NASA has not heard from Opportunity Rover for several weeks due to the Mars dust storm. The Agency recently made an attempt to communicate, but neither expected nor received a response. The team also worked to build capacity into the batteries of the Mars Reconnaissance Orbiter (MRO) in order to correct an issue. The Mars Atmosphere and Volatile Evolution (MAVEN) mission will be dropping to a lower orbit in order to facilitate communications with the Mars 2020 mission. Mars 2020 successfully completed Systems Integration Review (SIR) and KDP-D, as well. The Mars Program's missions and systems in development are going well, but this is a large program with many challenges, and some instruments have fallen behind.

NASA delivered the Mars Organic Molecule Analyzer (MOMA) instrument for ESA's ExoMars mission. NASA technology development for Mars Sample Return (MSR) is making good progress, and Curiosity Rover has had some recent successes, such as the first successful drilling without a drill feed. More than 400 scientific papers based on Curiosity have been published thus far. The Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) is adequate to complete mission objectives. Dr. Watzin provided more detail about the dust storm, which has turned out to be much larger than anticipated. Opportunity was affected, though Curiosity was not. Even after it peaks, the storm will take time to dissipate. In October, NASA is sponsoring a workshop for Mars 2020 site selection. Dr. Watzin listed the primary candidates, with their strengths and weaknesses. On the technology development front, a helicopter/rotor for Mars had a good feasibility demonstration and will fly on Mars 2020 as a technology demonstration.

The FY18 budget was above the PBR and enabled a lot of work against the schedule. All operating missions and technology maturation were fully funded. The FY19 PBR is favorable, with \$50 million for MSR. Other highlights include the launch of InSight, which should land on Mars in November and which carries cubesats for a fly-by; the ESA Trace Gas Orbiter (TGO), which reached its operating orbit; and plans by the United Arab Emirates (UAE) to build a Mars science lab facility, for which they sought NASA input. NASA will provide some instrumentation for the Japanese Space Agency's (JAXA's) Martian Moons Exploration (MMX) mission, which is planned for a 2024 launch.

Interest in MSR stems from the growth and complexity of the science, as well as the limitations of on-planet analysis. Dr. Watzin described some of the many functions and instruments available on Earth that cannot function on, or be launched to, Mars. Mars 2020, the first in a series of three planned MSR missions, will collect samples and characterize their environment. The next mission in the series will retrieve the samples and take them into a Mars orbit, and the third mission will rendezvous with that orbit and return the samples to Earth. Mars 2020 will be able to collect 40 samples. NASA believes this can be done affordably and under a cost cap. There will be calculated risks, which call for the examination of tradeoffs. There is no plan for new developments beyond the current technology maturation activities. The plan involves leveraging of international partnerships.

There are many reasons to do MSR now. The technology and expertise are at a level where it can be implemented affordably. The infrastructure for this effort is aging but functioning well. The science has also matured. The critical technology is ready to move to next phase. NASA signed an agreement with ESA that details the respective responsibilities of the two agencies. ESA would be responsible for the rendezvous orbiter for returning the samples, and the lander will be a joint project. This is a wonderful opportunity to meet long-term goals of the science community. In the mean time, ESA and China are both working on sample return missions, and NASA hopes to obtain part of the sample return from MMX.

Lunar Update

Dr. Sarah Noble and Mr. Clarke discussed the status of NASA's lunar activities. Dr. Noble said that NASA hopes to update existing data, also making it available to the public. Community input has been very helpful, coming in through workshops and reports, especially via the Lunar Exploration Analysis Group (LEAG). NASA and LEAG will hold a joint workshop in the fall.

Mr. Clarke said that his focus is on Commercial Lunar Payload Services (CLPS). Three participating NASA mission directorates – SMD, the Human Exploration and Operations Mission Directorate (HEOMD), and the Space Technology Mission Directorate (STMD) – posted a draft Request for Proposals (RFP) in late April. This is meant to be a multi-vendor catalog through which there will be managed payloads. It will help commercial services get started, but NASA does not want to be the main buyer indefinitely. When NASA sought information on payloads currently available, there were 16 responses, which are under review.

GSFC is working on retroreflectors, which are quick and easy. The SIMPLEx-2 AO was recently released, and NASA received 47 Step-2 proposals for DALI. The Agency is particularly interested in instruments for small, stationary landers, with emphasis on those that are at Technology Readiness Level (TRL) 6. The Stand Alone Missions of Opportunity Notice (SALMON) focuses on engineering models in order to enhance science/technology partnerships. International participation can occur through partnerships with U.S. researchers, and multiple instruments are allowed within the weight limit. The two-stage process starts with getting the instrument ready to fly, but with no guarantee of flight. Step 2 is to integrate the instrument onto a specific flight opportunity.

Mr. Clarke described the retroreflectors, which will fly on all missions to the lunar surface and which will be used by lunar orbiters as well. Part of the strategy is to increase accuracy over time. NASA tested four legacy Resource Prospector instruments and determined that they can all obtain useful science; they will be integrated into early CLPS missions. The early landers are expected to last 1 lunar day, equal to 14 Earth days. There may also be missions of longer duration. This is a long-term strategy to conduct science on the moon, traveling with human exploration missions.

Dr. Hurley asked about the current thinking on how the commercial landers will select landing sites and how the science will mesh. Dr. Noble replied that this is uncertain until NASA selects the providers. The Agency will probably start by going to the providers' destination choices, but NASA will have the ability

to direct them to certain locations. There will be multiple landings and NASA will try to sort the instruments to the right places. Dr. Roberge asked about the number of interested companies. Dr. Noble replied that there are several, and more than a dozen were at Industry Day. Dr. Glaze added that the expected response is about a half dozen. Only one is necessary to make the program viable.

Dr. Timothy Lyons said that much of this has been stimulated by a favorable budget, and budgets change. He asked about plans to protect the key elements of this work. Mr. Clarke explained that he is trying to set up a sustainable program. The Space Council, White House, and Congress all support going to the Moon, and now there are commercial interests offering good content. If there is progress in the next couple of years, the business side will become more sustainable. He thinks the CLPS approach is very practical.

Dr. Ashlee Wilkins asked if there are plans to have a special group address this. Dr. Glaze explained that Dr. Green gave CAPS a specific charge on this topic, and she will be talking with CAPS about lunar exploration in September. Dr. Rall read a question submitted remotely, asking about the role of cubesats in the lunar roadmap. Dr. Noble replied that HEOMD funds a few of these, which Mr. Clarke said had been selected over a year ago. SMD will work with HEOMD and STMD to fly additional payloads. This is part of the strategy.

Discussions and Findings

Dr. Verbiscer started PAC discussion of the request to prioritize and conduct additional CAPS studies. Dr. Roberge expressed concern about the fact that the studies are taking time to get stood up due to the FACA rules. There was a suggestion to send the studies to the Analysis Groups (AGs). Dr. Glaze said that another thought might be for PAC to have a finding that the SDT members not be SGEs. A finding might allow PSD to bring it forward as an issue. It needs to be addressed. The key thing is to do the studies, and the FACA requirements are an impediment. Dr. Verbiscer agreed. It was noted that a number of planetary defense studies had already been done. Dr. Roberge asked about the number of CAPS studies that can be done before the DS. Dr. Glaze said that funding and time are both factors. Time is probably the greater constraint. She would like to get these done to the extent possible, however, so they can serve as input to the DS. Guidance on where to start would help.

The dedicated space telescope would involve a Low Earth Orbit (LEO) looking outward to do planetary observations. This concept has come up in the past, but it has not fared well in competitive programs. Dr. Roberge asked about the possibility of partnering with the Astrophysics Division (APD). Dr. Glaze said that she would encourage that. The mission studies should include the capabilities, gaps, and efficient utilization. Dr. Roberge noted that APD was in the midst of studies for future missions, and PSD might want to provide input. She also disclosed that she is on one of the teams. The key word in the CAPS study list might be “dedicated” and there might be a need to ensure planetary interests are heard.

Dr. Britney Schmidt said that she and Dr. Roberge had talked about the need for these observations, and she believes that some of these mission concepts need to change their model. Dr. Roberge added that a more formal partnership might be necessary, with Dr. Glaze talking to Dr. Paul Hertz, her counterpart in APD. There needs to be better collaboration, and it might be worth seeing if APD can help satisfy some part of the desire for a dedicated telescope. There has been dissatisfaction with what PSD received from APD in the past, which is why the conversations should take place early. Dr. Glaze said that some of the discussions are occurring. She wanted to know where PSD lacks sufficient input. Dr. Roberge replied that she understands that the planetary capability could have been added earlier with JWST. The Wide Field Infrared Space Telescope (WFIRST) is moving ahead and, while planetary scientists have provided some input as white papers, there appears to be no process for those analyses to be formally considered during mission development.

Dr. Schmidt agreed that PSD is missing input on astrophysics missions. A formal agreement to collaborate might help. The flip side is that many in the planetary community would not want to see PSD invest in these telescopes. Nonetheless, more PSD input would probably be beneficial. Dr. Lyons agreed. The delays on JWST are shocking, and he worries that Congress will become impatient. He wondered if there might be re-strategizing so that more people are at the table. Dr. Roberge pointed out that the next APD DS will happen before PSD's next one. If the planetary community wants input, they need to provide it now. Dr. Verbiscer said that that was a good point.

Dr. Verbiscer wondered about taking "space" out of the discussion of a new telescope. The dedicated ground-based telescope is aging and could stand to be improved with a more current design. This would be a separate item. Dr. Canup liked the idea of removing space from the description, but was wary of adding more items. Dr. Schmidt agreed. The dedicated versus pooled resources discussion must come to a head soon. Dr. Verbiscer said that her preference would then be to take "space" out of the last item. Dr. Mainzer pointed out that Ms. Doris Daou has done a great job of making sure that astrophysics assets are represented at planetary meetings, in order to engage with the planetary science community and inform them on what is available.

In discussing priorities, it was noted that the last PSD DS held MSR as the highest priority, though that was based on the Europa mission being more expensive; they were otherwise tied. Dr. Verbiscer noted that many items on the list were New Frontiers targets, and it was suggested that new science from the past decade should rank higher than what was in the previous DS. Dr. Glaze stated that some of the recommended studies had already begun, including Ceres under the dwarf planet concept, an MRS study being done internally, and a Venus flagship mission that has been tasked to GSFC but for which members had not been solicited. Dr. Verbiscer added that Io science was studied prior to the last DS and had been designated for New Frontiers. She wondered how much PAC should rely on that study.

Dr. Schmidt said that part of the issue is that New Frontiers only selects targeted missions. She wanted to discuss whether this is the right approach. Dr. Verbiscer agreed, noting that she would advocate for an open New Frontiers program. Dr. Mainzer added that she would like to see the science, including new discoveries, as the driver. Dr. Schmidt maintained that that is the only way to ensure that community priorities are addressed. The planetary community needs to think more outside the box and not focus on which segment of the community has the most recent flagship mission. Dr. Hurley wanted a better idea of NASA's interests for the New Frontiers program. She wondered about how new ideas are to be tested. Dr. Chris German asked for clarification on the Saturn probe, and the approach to take now. Dr. Glaze said that she understood CAPS to want a flagship mission that could address multiple targets, beyond the New Frontiers concept. It might include a probe, but that is for the SDT to decide.

Dr. Hagerty thought PAC members might need time to digest the materials before setting priorities. Dr. Rhonda Stroud agreed, adding that she wanted to look at the CAPS report. Dr. Rall pointed out that although some discussion could continue via email, PAC should have something in writing before the meeting adjourned. Dr. Mainzer asked if it would be possible to have a finding that stated which studies are in progress and which need to be prioritized; Dr. Rall said that that would work.

Dr. Verbiscer next asked about ISFM. Dr. Canup stated that she has seen this go full circle. She wanted to know how the areas will be updated. She was also concerned that PSD is swinging to a "crazy" number of proposals, which called for creative thinking on how to address it. Dr. Glaze said that there was a degree of learning as they went along with this, although SMD is guided by the goal of reducing the number of proposals. Dr. Michael New of SMD is looking at guidance for all four divisions on how work packages will operate. More guidance is coming, and Dr. Glaze hopes to have some metrics at the next meeting.

Dr. Lyons said that for investigators whose only option is writing proposals, there will be a different perception. He would like NASA to be completely transparent about this process. Dr. Glaze agreed, stating that this is a primary goal of hers, and she wants feedback and input from the community. Dr. Stroud said that the Department of Energy (DOE) and the Naval Research Lab (NRL) have similar issues and have implemented similar systems for handling this. She favors the change and wants to see how it will be implemented with both on- and off-ramps. She advised examining the lessons learned at DOE and NRL, in terms of how they fund their own lab personnel. It is important to avoid becoming static. Dr. Rall said that he has been part of this effort all along. The primary goal was to improve the efficiency of NASA's appropriated dollars so that NASA-funded scientists are not spending the bulk of their time on writing proposals. In addition, civil servants are limited on where they can apply for funds. Dr. Glaze added that civil servants need to be available for the community, so freeing up their time is another goal.

Dr. Rall pointed out that workers at Federally Funded Research and Development Centers (FFRDCs) such as the Jet Propulsion Lab (JPL) are precluded from ISFM participation. This is just for NASA centers. Dr. Stroud said that it is different when investigators have to cover their own salaries as opposed to funding students. The daily life of the civil servants need to be understood. Drs. Canup and German urged transparency, particularly in the selection process, the targeting of scientists, and the checks and balances.

Dr. Verbiscer proposed a draft finding stating that PAC appreciates the effort to increase efficiency in the use of science dollars, but ISFM has to be transparent in its implementation.

For the mission studies, Dr. Daou provided the following link:
http://sites.nationalacademies.org/ssb/ssb_067577

Dr. Mainzer asked about the plans for planetary defense in context of other programs. Dr. Rall explained that the FY19 budget must be final before PSD can state anything definite. Dr. Glaze said that even if PSD is not ready to report at the next meeting, the Division can agree to provide the information as soon as it is available.

Dr. Hurley raised an issue she had heard in the community, that some ongoing missions are not getting budget guidance in a timely manner. This is causing problems, especially when it comes to proposing for missions in the extended mission phase. Dr. Glaze said that the next Senior Review will take place in 2019. Dr. Hurley said that all of the missions were extended for a year without further information. Dr. Verbiscer said that she has heard similar concerns. Dr. Glaze explained that part of the issue is that the guidance will depend on the FY20 budget, and the FY19 budget is not yet in place. NASA has constraints. Dr. Verbiscer thought it might be appropriate to have an expression of concern as a finding. Dr. Hurley wanted to include a request to develop a timeline, but Dr. Verbiscer said that PSD probably could not do much about the funding and timeline, due to constrained budget numbers.

There was no specific date for the next meeting, which will be face-to-face in the fall, probably September or October. Dr. Daou would poll the members to determine their availability.

Dr. Verbiscer said that there were four draft findings, addressing mission studies, ISFM, planetary defense, and concern about missions in extended phase in context of FY19 budget cuts. She noted that MRO and New Horizons had big cuts. Dr. Glaze added that they had also discussed FACA requirements for SDTs. Dr. Francis McCubbin asked if the SDTs might draw from the existing SGEs as a pool to speed things along. Dr. Glaze replied that PAC has the only SGEs at this point. Dr. Verbiscer said that there was a request for PAC to consider another way to do this. Dr. Glaze said that the intent is to provide input to the DS. She thought the AG idea was reasonable and worth exploring further. Dr. Verbiscer proposed a PAC finding that NASA explore using the AGs. Dr. Rall added that there was no current way to have the

SDTs operate outside of the FACA bounds, but a finding could reopen the discussion. Dr. Glaze explained that not all agencies interpret the rules as requiring such groups to meet FACA requirements. This was strictly a NASA interpretation. She liked the perspective of having flagship missions evaluated through the SDT process, with less formal evaluation of smaller missions.

Dr. Verbiscer endorsed having open New Frontiers calls as well. Another idea was to place less emphasis on multiple flagship ideas, with more consideration of proof-of-concept and segmented ideas. Dr. Glaze thought that approach might work with medium-class missions. The motivation for having the studies on flagship missions was to provide the DS panels with information. Doing something less than a full study might simply duplicate what the DS panels would do anyway. The idea was to provide substance. Dr. Schmidt questioned whether flagship missions are warranted on some of the topics. She works on Ceres, for example, and thinks it might not be worth a flagship mission. She would rather study medium-class candidates first, then identify those that might scale up.

Dr. Verbiscer said that there was plenty of material for the findings. She would write some drafts and send them to the members for additional edits. She then thanked the presenters and participants.

Adjourn

The meeting was adjourned at 5:12 p.m.

Participants

Committee members

Anne Verbiscer, University of Virginia, *Chair, Planetary Science Advisory Committee*
Jonathan Rall, NASA, *Executive Secretary*
Robin Canup, Southwest Research Institute
Justin Filiberto, Southern Illinois University – Carbondale
Chris German, Woods Hole Oceanographic Institute
Justin Hagerty, U.S. Geological Survey
Dana Hurley, Johns Hopkins University Applied Physics Laboratory
Timothy Lyons, University of California – Riverside
Amanda Mainzer, Jet Propulsion Laboratory
Francis McCubbin, NASA Johnson Space Center
Aki Roberge, NASA Goddard Space Flight Center
Britney Schmidt, Georgia Institute of Technology
Rhonda Stroud, U.S. Naval Research Laboratory

NASA attendees

Lori Glaze, *Acting Director, Planetary Science Division*
Damara Benson
Steve Clarke
Doris Daou
Robert Fogel
Michael Meyer
Sarah Noble
Betsy Pugel
Christy Rivera
James Watzin

WebEx participants

James Bauer
Lynn Bowman
Ben Caine
James Campbell
Stephen Clark
Barbara Cohen
Monty DiBiasi
Norm Eisenberg
Mary Faller
Robert Fogel
Frank Fomby
Jeff Foust
Doug Gage
Tim Gehringer
James Green
Jeff Grossman
Mark Hofstadter
Grace Hu, OMB
Doug Isbell
Gordon Johnston
Linda Karanian
William Knopf
Alfred McEwen
Bob McMillan
Lindsay Milliken

Melissa Morris
Mark Mozena
John Reynolds
Elizabeth Sheley
Scott Smas
Marcia Smith
Krista Soderlund
Paul Steffes
George Tahu
Jennifer Troxell
Thomas Utz
Jonathan Weinberg
Ashlee Wilkins
Richard Zurek

Appendix B
Membership Roster

Anne Verbiscer, Chair
University of Virginia

Jonathan A. R. Rall, Executive Secretary
Planetary Science Division
Science Mission Directorate
NASA

Lynn Marie Carter
Department of Planetary Sciences
University of Arizona

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Justin Hagerty
Astrogeology Science Center U.S. Geological Survey

Dana Hurley
Planetary Exploration Group
Johns Hopkins University Applied Physics Laboratory

Timothy Lyons
University of California – Riverside

Amanda Mainzer
Jet Propulsion Laboratory

Francis McCubbin
NASA Johnson Space Center

Aki Roberge
Exoplanets and Stellar Astrophysics Laboratory
NASA Goddard Space Flight Center

Britney Schmidt
School of Earth and Atmospheric Sciences
Georgia Institute of Technology

Rhonda Stroud
Materials Science and Technology Division
U.S. Naval Research Laboratory

**Appendix C
Presentations**

1. *Planetary Science Division Status Report*, Lori Glaze
2. *Planetary Science R&A Update*, Jonathan Rall
3. *Mars Exploration Program Update*, James Watzin
4. *Lunar Update*, Sarah Noble, Steve Clarke

**Appendix D
Agenda**

**Planetary Science Advisory Committee Teleconference
July 2, 2018**

Monday, July 2, 2018, 1:00 p.m – 5:00 p.m.

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|------|--------------------------|--------------------------------|
| 1:00 | Opening, Announcements | (J. Rall) |
| 1:05 | PSD Status Report + Q&A | (L. Glaze) |
| 2:00 | PSD R&A Status | (J. Rall) |
| 2:30 | Mars Update | (J. Watzin) |
| 3:00 | Lunar Update | (S. Clarke/S. Noble/D. Schurr) |
| 3:30 | Discussions and Findings | |
| 5:00 | Adjourn | |