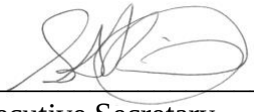
NASA ADVISORY COUNCIL
PLANETARY SCIENCE ADVISORY COMMITTEE

November 30, 2020

Virtual Meeting
Washington, DC

MEETING REPORT

Amy Mainzer, Chair



Stephen Rinehart, Executive Secretary

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November 30, 2020

Opening and Announcements, Introductions

Executive Secretary of the Planetary Science Advisory Committee (PAC), Dr. Stephen Rinehart welcomed members of the committee and held a roll call, and welcomed new members Drs. Conor Nixon, Serina Diniega, Joseph Westlake, and Jennifer Glass. Dr. Rinehart introduced Dr. Amy Mainzer, the newest PAC Chair, and made brief administrative remarks. He announced that the next PAC meeting was scheduled for March 1–2 , and that the PAC is now making an effort to plan out two meetings in advance.

PSD Status Report

Dr. Lori Glaze, Director of the Planetary Science Division (PSD), presented an update on the division, first expressing her appreciation for the members of the PAC, and to have had new members come on board. She noted that the PAC had been reduced to ten members, per the directive of the current administration. Given these limitations, Dr. Glaze felt that there may be gaps in discipline representation, which should ideally be filled when inviting new members to the Committee in the future; she asked that PAC members keep these potential gaps in mind.

The PSD has seen an exciting few months since the PAC's August meeting. The Division has a total of 29 missions: 15 in development, and 14 in operations. The Origins Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-REx) successfully executed its Touch-and-Go (TAG) sampling maneuver on 20 October at the Nightingale Crater on the asteroid Bennu. The sampling container actually penetrated some depth into the surface, thus the mission team feels there is a high probability of having obtained a large sample. The spacecraft contacted its target within 70 cm, and gathered so much sample that some started to escape, necessitating the decision to stow the sample securely in the Sample Return Capsule slightly ahead of schedule. The next big event is the landing of the Mars2020 (M2020) rover, Perseverance, at Jezero Crater on 18 February, 2021. Thirteen Participating Scientists were recently added to the M2020 Science Team; there were 119 proposals for the slots. Mars Sample Return (MSR) efforts are also well under way. Terms of Reference (TOR) have been signed by NASA and the European Space Agency (ESA) to establish a Caching Strategy Steering Committee. This committee will plan and lead a community workshop in January 2021. Other PSD launches in 2021 include the Double Asteroid Redirection Test (DART) mission (July) and the Lucy probe to seven Trojan asteroids (October). Both missions have proceeded on schedule despite the constraining conditions caused by the COVID-19 pandemic. PSD continues to keep a close eye on the missions to ensure that the schedule remains intact.

Within the small satellite program, Small Innovative Missions for Planetary Exploration (SIMPLEx), the CubeSat Particle Aggregation and Collision Experiment (Q-PACE), is expected to launch in December 2020, and LunaH-Map, a lunar hydrogen mapper, is scheduled to launch with the Artemis-1 mission in a year's time. From the SIMPLEx 2 call, Janus passed its Key Decision Point (KDP-C) in September, and has been confirmed; Janus will send two spacecraft to two binary asteroids. Escape and Plasma Acceleration and Dynamics Explorers (EscaPADE), a Heliophysics Division (HPD) mission, will hold its KDP-C in April 2021, and is looking for a launch opportunity. Lunar Trailblazer just passed KDP-C and is now a confirmed PSD mission. Lunar Trailblazer will perform high-spectral-resolution and thermal imaging of the Moon, to determine the form and concentration of water on the lunar surface (launch 2025).

The Discovery 2019 program remains on schedule; Dr. Glaze noted for the record that she has recused herself from the Discovery decision-making process. The New Frontiers 5 (NF5) call is scheduled to be released in Fall 2022; PSD released a community announcement on 5 November, and hopes to have a

final community announcement in the Spring, with the NF5 draft Announcement of Opportunity (AO) in Fall 2021. A Science Definition Team has been created for Artemis III; its report will help to ensure that science objectives at the Moon are met. The SDT was led by Dr. Renee Weber at Marshall Space Flight Center (MSFC). The final report is available online at: https://www.lpi.usra.edu/Artemis/.

PSD is supporting community initiatives as Decadal Survey panel meetings continue. COVID-19 augmentations and funded extensions to existing Science Mission Directorate (SMD)-funded grants are under way, aimed especially to the needs of early-career researchers, graduate students, and post-doctoral students. In addition, a Statement of Task has been sent to the Space Studies Board (SSB) of the National Academies of Science, Engineering, and Medicine (NASEM) to address diversity and inclusion in the leadership of competed space missions. The Next Principal Investigator (PI) Launchpad in is planned for early Summer 2021; the first PI Launchpad was very well received, and well attended.

Recently, Dr. Bruce Jakosky, a PI on the Mars Atmospheric and Volatile EvolutioN (MAVEN) mission, announced plans to retire by the end of 2021. This relatively rare occurrence prompted a discussion on how NASA handles mission PI transitions, and provided an opportunity to discuss how such transitions should be handled in the future. To that end, NASA is now encouraging succession planning in extended mission proposals, and will consider inserting additional wording in AOs regarding the process of replacing PIs.

Response to August 2020 findings

Regarding PAC Finding 1 on *Equity, Diversity, Inclusion, and Accessibility (EDIA),* Dr. Glaze felt it was a good suggestion, and said she will make an effort to have an EDIA representative at PAC meetings, beginning with the next PAC meeting in March 2021.

With regard to Finding 2, *No Due Dates (NoDD)* on proposals, Research and Analysis (R&A) Lead, Dr. Rinehart, has been doing a lot of work on this item. An implementation plan for NoDD is currently being developed. PSD is integrating feedback on NoDD and will be conducting an internal process review at SMD, followed by a community Town Hall to share the planning results.

Dr. Glaze said she absolutely agreed with Finding 3, which encouraged *Participating Scientist Programs*, adding that PSD is planning to run a PSP for the extended Juno mission, should it be selected for extension. The initial ROSES 2021 call will include an announcement to this effect.

In response to PAC Finding 4 on the *Planetary Defense Coordination Office (PDCO) Budget and the Near-Earth Object Survey Mission (NEOSM)*, NASA concurs with the community's view on the importance of NEOSM, and acknowledges the current budget challenges; PDCO continues to move NEOSM toward phase B, notwithstanding.

Dr. Glaze addressed Finding 5, *Transparency of the Mar Ice Mapper Mission (MIM),* noting that MIM does address a number of Mars Exploration Program Analysis Group (MEPAG)-identified science goals, as well as key goals of the Human Exploration and Operations (HEO) program. NASA is currently working to stand up a MIM Science Definition Team (SDT) to ensure that the science goals of the Mars program are sufficiently represented.

In response to Finding 6, *Prominence of Astrobiology in Future PAC Meetings*, NASA concurs with this finding and has added Dr. Mary Voytek, Senior Scientist for Astrobiology, who will be presenting today.

With regard to Finding 7, *R&A Impact(s) of Selection Rates below 20%,* NASA agrees with the need to ensure stability to R&A programs; however, in response to the PAC's recommendation to add $10M to

the R&A program, NASA also acknowledges the need to address R&A budgets at a strategic level. There are excessive constraints to moving budgetary funds between lines, presenting challenges to the recommended $10M figure.

Dr. Britney Schmidt asked if budget appropriations had been overly constrained, noting that the total top line for PSD is well funded, but this abundance does not seem to have flowed down to R&A, both this year and last year. Dr. Glaze said that Dr. Schmidt is essentially correct. However, PSD budget lines often increase in response to specific activities and programs that have been called out by Congress. She agreed that R&A is not keeping pace with the rate of increases across the rest of the budget, but she did want to point out that there have still been modest increases in R&A. That said, it is not legally possible for PSD to simply pull dollars out of specified programs in order to fund R&A.

Asked about the expected composition of the MIM SDT, Dr. Glaze said that she expected broader participation, and agree that the SDT should not be limited to civil servants. Dr. Dana Hurley commented that there should be at least some form of community input on such missions in the future, even if there is no specific representation on the SDT. Dr. Serina Diniega asked if NASA's recently ramped up efforts in Diversity and Inclusion had been tied to a 2018 workshop on the subject. Dr. Glaze said she believed that the initiative came directly from that workshop, which led to NASA creating the Statement of Task to the National Academies. PSD tends to do better than other divisions in this area, but recognized that it still has some work to do.

Mars Exploration Program

Mr. Eric Ianson, having replaced Mr. Jim Watzin as the Director of the Mars Exploration Program (MEP), gave his first briefing to the PAC. Mars continues to be a cornerstone of PSD as part of a robust portfolio. Mars is also becoming an international destination. In addition to Perseverance, the United Arab Emirates (UAE) and China have also launched spacecraft to Mars in 2020, making for an exciting time at the planet. Mr. Watzin is now working for the NASA Associate Administrator of Strategy and Plans. Mr. George Tahu has been appointed as acting Deputy Director for MEP, and Dr. Michael Meyer is continuing to serve as Lead Scientist for both MEP and MSR, providing the "science bridge" between the programs. In addition, Mars Sample Return (MSR) has been established as a new, distinct program within SMD. Mr. Jeff Gramling has been named as MSR Program Director. MEP and MSR are now separate programs, with program offices co-located at the Jet Propulsion Laboratory, maintaining close ties to Headquarters through Messrs. Gramling and Ianson. There are no current plans to hire a replacement Director of MEP, thus Mr. Ianson said he would continue to serve in this role in addition to his responsibilities as Deputy Director of PSD.

M2020/Perseverance had a spectacular launch in July, and is currently approaching a distance of 200 M miles from Earth. Mr. Ianson pointed out that the virtual experience of the launch had been quite successful despite COVID-19 restrictions. This first leg of MSR will do science of its own, and also carry out a helicopter technology demonstration, while laying the groundwork for the future MSR mission. PSD completed its 2019 Senior Review, in which operating missions did well: MAVEN, Odyssey, the Mars Reconnaissance Orbiter (MRO), and Curiosity have all been recommended for extended missions. MEP is also developing a "Bent Pipe" communications implementation on MRO to improve the orbital communications network in advance of the Perseverance rover's entry, descent, and landing (EDL). The Mars Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, (InSIGHT) has detected more than 450 marsquakes, while the mission team continues to work on the mole surface penetration in order to obtain thermal measurements of the subsurface.

A Mars Architecture Strategy Working Group (MASWG) has been formed in response to the Decadal Survey's Mid-Term Review, identifying four "mission arc" scenarios for Mars exploration beyond the Mars Sample Return campaign. ESA's ExoMars launch has been delayed to 2022, but NASA's MOMO-

MS mass spectrometer contribution to the mission is complete and has been integrated with the rover. NASA also continues to participate in the MMX partnership with the Japanese Space Agency (JAXA), with significant progress being made on the NASA MEGANE and P-Sampler contributions.

Mr. Ianson touched on a few MSR items: M2020/Perseverance Phase E operations and MSR sample curation on Earth remain under the MEP, reporting to the Mars Program Director. The Mars Ice Mapper (MIM) is continuing early planning activities. MIM's objectives include finding accessible ground ice that is viewed as critical to *in-situ* resource utilization (ISRU) for human exploration. NASA is working with the Canadian Space Agency (CSA), JAXA, and the Italian Space Agency (ASI) on a mission concept that could launch as early as 2026. Mr. Ianson noted that funding for MIM is being provided specifically from the Agency for this purpose, and that these funds are not available for use on other SMD/PSD programs. The basic concept for MIM is a Synthetic Aperture Radar (SAR) satellite flying in low Mars orbit. The MIM mission concept is considering the use of commercial communication relay satellites operating at a high-altitude equatorial orbit. MEP is continuing to invest in technology to explore low-cost ways to do more at Mars, leverage commercial activities, and develop capabilities such as terrain relative navigation (TRN). The Mars Data Analysis Program is maintaining roughly a 20% selection rate, with some increase in the award size.

Priorities for MEP include: maintaining NASA's position as a world leader in Mars exploration, ensuring close coordination with the Mars Sample Return program and Planetary Science Division, implementing priorities established in the 2023 Planetary Science Decadal Survey, and maintaining fiscal discipline to deliver a healthy Program within available resources.

Dr. Mainzer asked why a new, separate MSR program was created. Mr. Ianson said the decision was based on the fact that the Agency has directed that Flagship missions report directly to the responsible mission directorate. The other piece related to the separation is that MSR is a challenging and complex mission, leading to NASA's desire to focus on getting the technical implementation right. MSR is also quite different than other missions in MEP.

<u>Mars Sample Return Science</u>
Mr. Jeff Gramling presented recent accomplishments in Mars Sample Return. NASA signed a Memorandum of Understanding (MOU) with ESA in October. An Independent Review Board (IRB) completed a two-month study, and a Standing Review Board (SRB) was established for the Mission Concept Review (MCR). The MCR was completed in October, followed by the Directorate Program Management Council (DPMC) milestone in November. MSR is expected to enter Phase A in December of this year. The next two launches in the MSR sequence are the ESA launch of the Earth Return Orbiter (ERO), whose primary payload is the Capture and Containment Return System (CCRS) (to be provided by NASA), and the Sample Retrieval Lander (SRL). ESA will build and launch the ERO; NASA will build and launch SRL. The Mars Ascent Vehicle (MAV) will be built by NASA, and the Sample Fetch Rover (SFR) will be built and provided by ESA. After the samples are retrieved, the samples delivered by either the SFR and/or Perseverance will be placed into the Orbiting Sample (OS) container aboard the MAV, which will launch the OS into Mars orbit for rendezvous with, and transfer to the CCRS onboard the ERO. The samples will then return to Earth on the ERO, which will release the Earth Entry Vehicle (EEV) for a landing in the US.

The SRL will employ a technique called Extended Divert, with the intent of landing within 100 m of an identified cache site. Mr. Gramling presented an overview of Green Pathways across Jezero Crater, a Concept of Operations aimed at maximizing the efficiency and robustness of the Sample Fetch Rover. The Green Pathways planning tool will also lead to decisions as to where Perseverance will best place caches. MSR is continuing to look at the resiliency of the architecture and define sample safe states- for example, the sample tubes are designed to be stable on the Mars surface for 10 years, and OS orbit is

designed to be stable for more than 10 years. The OS is capable of returning as many as 30 samples. In Phase A, the team will continue to look at ways to improve resiliency and use probabilistic risk assessments.

MSR launch opportunities and backup scenarios have been determined: a 2026 launch date is considered the most favorable, and MSR is planning to maintain this objective through at least KDP-C. Backup dates are 2027 (ERO) and 2028 (ERO and SRL); launches beyond 2028 are less favorable in terms of landing capability (driven by Mars atmospheric pressure) and the potential need for radioisotopic power. To ensure science integration across programs, in addition to the involvement of Dr. Meyer, there are numerous other touchpoints among the different teams. There is also a second MSR Science Planning Group (MSPG2) that is addressing science and curation planning; its TOR was signed in April, and NASA expects its final report in Spring 2021. The Committee on Space Research (COSPAR) Sample Safety Assessment Protocol (SSAP) is also developing recommendations for determining when samples will be considered safe for open distribution. An open community workshop on Mars sample curation is planned for January 2021, as MSR moves to Phase A.

Dr. Joseph Westlake asked: does MSR change the current tasks for the upcoming Planetary Decadal Survey? Dr. Glaze said that the current Statement of Task (SOT) to the Decadal Survey requests that the Academies provide comment on the MSR program as currently laid out; this allows them to comment on implementation approach, suggest augmentations, etc. However, it is important to note that the Decadal Survey has not been asked to prioritize MSR. The SOT explicitly states that Survey can comment on whether or not NASA should go forward with MSR. Dr. Schmidt said that she thought that the absence of women, and people of color, in the Mars leadership roles was stunning. Dr. Glaze said she has had the discussion with Mr. Gramling and others, and that roles are still being filled; Dr. Maria Zuber is head of the SRB, e.g. Mr. Gramling commented that MSR has had to staff up quickly, and while the roster is not yet complete, he thoroughly believes in diversity and inclusion (D&I), and intends to support it. Mr. Ianson noted that in PSD as a whole, diversity is pretty good from a gender balance standpoint, but he conceded that the lack of female representation across the Mars programs is a fair point. Dr. Diniega asked if Extended Divert was an extension of TRN. Mr. Gramling affirmed that this was the case. Dr. Diniega asked if this was an existing technology, and Mr. Gramling subsequently confirmed that this was true. Dr. Meyer interjected that the caching strategy workshop in January will also address these questions, adding that pinpoint landing is great, but it opens up more complex problems with respect to sample placement.

Astrobiology Update

Dr. Mary Voytek addressed the evolution of Astrobiology research at NASA since 2008, as topics had been reorganized a number of times within PSD. In 2019, the NASA Astrobiology Institute sunsetted, replaced by the new Interdisciplinary Consortia for Astrobiology Research (ICAR), which issues five-year grants. There are now a number of opportunities in Astrobiology to interact with other PSD programs. In the ROSES20 call for Exobiology, 156 proposals were submitted, and the final selection rate was 14%. Historically, this was a bit higher than the 11% figure for 2019. Types of tasks that are funded in these calls include early evolution of life in the biosphere, and prebiotic evolution. In the ROSES18 call for Habitable Worlds (HW), there were 60 proposals, with a selection rate of 16.7%. The number of proposals for HW range between 50–70, and the trend for selection rates has been decreasing. NASA is not competing HW next year. The Planetary Science and Technology from Analog Research (PSTAR) ROSES19 call led to two selections related to Mars Exploration, one to Icy/Ocean Worlds, and one related to Venus Exploration. PSTAR is moving to biannual calls, and will not be solicited in 2021. Selection rates for PSTAR have also been erratic. The ICAR 2019 call received 46 Step-1 proposals, and 30 Step-2s, and selected 8 teams. Awards are expected in February 2021; they are five-year grants with an average value of $5M. ICAR is designed to be interdisciplinary in approach, answering a single compelling question in Astrobiology. Among some proposals selected: What life wants: Exploring the

natural selection of elements; Alien Earths: Which Nearby Planetary Systems Are Likely to Host Habitable Planets and Life?; The M-dwarf Opportunity: Characterizing Nearby M-dwarf Habitable Zone Planets; and Alternative Earths – How to Build and Sustain a Detectable Biosphere.

PSD also supports research coordination networks (RCNs), and will be hosting a Habitable Worlds 2 Workshop in February 2021. All the RCNs worked on white papers for the workshop, including the Prebiotic Chemistry and Early Earth Environments Consortium (PCE3), whose PIs predominantly come from the Exobiology and HW programs. PCE3 recently held a virtual workshop over a five-week period; a report will result from this exercise, and NASA did some polling on how this worked out, with the aim of maximizing return on future virtual workshops.

The NASA Astrobiology Postdoctoral program continues, but the budget will prevent selections in two programs in 2021, unfortunately. The Astrobiology Graduate Conference (AbGradCon 2020) has been re-scheduled in Tokyo, the 2019 conference having been cancelled due to COVID-19. NASA is considering an *in-situ* event, but it might need to be virtual. Other cancellations include the Astrobiology Science Conference, (AbSciCon), now postponed to 2022. As these conferences are best served by in-person meetings, plans now are to shoot for 2022 in Atlanta, GA.

Dr. Mainzer asked how the new Biological and Physical Sciences (BPS) in SMD would be interacting with Astrobiology. Dr. Voytek said that although BPS serves the needs of Planetary Protection in particular, there is some overlap in studies of the behavior of terrestrial microbial organisms in extreme environments. The interests of Astrobiology at the International Space Station (ISS), Gateway, Human Space Flight, and issues of forward contamination in space flight and exploration are limited. Dr. Diniega asked what sort of selection rate was deemed acceptable for PSTAR. Dr. Voytek said she had been hoping for more than 8.4%, but recognized that PSTAR proposals are expensive, 3–4 years at $1M per year. The best the program has done was when it was able to leverage funds outside of R&A specifically appropriated for life-detection technologies. Dr. Voytek didn't think the selection rates would ever be high, due to the high community interest, and the costs. Dr. Diniega asked how the decision was made (to hold or skip research calls). Dr. Rinehart commented that there was no good answer to the question, although the general feeling is that when rates go below 10%, it's hard to justify an annual call. All PSD research programs are dropping below 20% now, and under those conditions, he didn't know how to define when the program is healthy and when it's not. Dr. Voytek said that while Astrobiology would love to have more money, it's also important to not waste people's time. There are many discussions on maybe tailoring calls, and she welcomed feedback on this idea: maybe leave Mars out one year? Prebiotic chemistry? There is high proposal pressure, and high cost. Those are the two main dials to turn. Dr. Rinehart also welcomed feedback from the PAC on how to make these decisions.

PSD R&A Update

Dr. Rinehart, Director of the Planetary Research Program, briefly presented the completed statistics on the ROSES19 call (excluding Planetary Major Equipment and Facilities). Selection rates ranged from 9% for PSTAR, to 20% for Emerging Worlds, to 41% for the New Frontiers Data Analysis Program (NFDAP) ROSES 2020 selection rates thus far, based on six programs, are between 15–20%, approximately. Program statistics will now be posted on NSPIRES, along with the abstracts of selected proposals, to ensure better access for the entire community, and to allow for the ability to update numbers in the case of changes. PSD is also employing new tools for automatic compliance checking; it should be noted that non-compliant proposals may be returned without review. As required by the Office of Management of Budget (OMB), NASA is looking for ways to ensure that data is being archived and that papers are getting into PubSpace.

A call for COVID augmentations is expected imminently; all requests must address COVID-related issues, and support currently funded graduate students and post-doctoral students will be treated as a first

priority. Dr. Rinehart noted that the augmentation is being funded out of R&A funds for new research (15% of funds for new awards). NoDD programs are in the process of developing an implementation plan; ideally, PSD would like to roll out NoDD in March 2021, in time for the next ROSES call. In response to a recent Gaps Request for Information (RFI), which was released in December 2019, NASA received 97 responses, that resulted in five findings (e.g., there are some research topics that fall into gaps between programs, or even between Agencies). Dr. Rinehart briefly touched on eight actions that are under way as a result, and four new actions that have been identified. Dr. Rinehart offered to provide more detail at a future PAC meeting, if desired.

Dr. Rinehart gave an overview of the Fiscal Year 2020 (FY20) Congressional appropriation vs. the FY20 final budget. There were a few changes to note: New Frontiers was reduced (no impact), and Planetary was greatly increased. However, Dr. Rinehart reiterated the caveat that moving money between budget lines requires approval from many levels, up to OMB, and any changes must be within the bounds of the will of Congress. NASA can't change what Congress wants, and must justify changing any allocations. Most R&A funding is within the "All Other Planetary" wedge; 73% of this funding is Planetary Research. R&A funding also comes in small amounts from other lines ("R&A from other sources"). Looking at just PSD R&A, the two biggest components are Astrobiology and Planetary Research. Under this line, there is also Solar System Exploration Research Virtual Institute (SSERVI), Technology, the Internal Scientist Funding Model (ISFM), Facilities, Support, etc. Non-Astrobiology Research over the past five years has essentially flattened out. In addition, Astrobiology research had been "earmarked" by Congress in the past, but it is still not back to 2018 levels. PSD will be striving to get this back to a useful level over the next five years. Dr. Rinehart asked the PAC to bear in mind that some small variations in year-to-year numbers for individual programs are the result of PSD forward-funding or rephasing awards (delaying distribution of funds to a future year).

Dr. Mainzer asked if the variation in the Astrobiology budget was larger than shown. Dr. Rinehart said that in 2019, there was a planned budget, but there was still a $10 M cut to R&A, and that money got spread out to balance the books. Dr. Schmidt asked where "other sources" funding went. Dr. Rinehart said that some of that went to Icy Worlds, a popular topic in Congress for a while. PSD used some of that allocation to fund PSTAR in previous years, for example, but OMB can still decide whether or not such uses are aligned with Congressional desires. Dr. Schmidt was concerned that in particular, when a community gets narrowed to technology development, it might be important to clarify R&A needs when talking to Congress, in that these cuts greatly affect graduate students and soft-money researchers. Dr. Glaze noted that people in Astrobiology, for example, can compete in Icy Satellite Technology calls, or in the MATISSE and PICASSO; funding through "earmarks" is still sometimes possible if a proposal meets the intent of the Congressional appropriations. Dr. Rinehart added that there will be an Icy Satellite Technology call coming up, and possibly opportunities in lunar research. Dr. Voytek noted that the level for Astrobiology used to be effectively higher through these earmarks, after which funding dropped abruptly; she added that Dr. Rinehart has been working hard to get funding for Astrobiology in other ways. There is hope that things can get better. Dr. Rinehart said that in his personal view, he felt that PSD didn't communicate well that these earmarks had been a special case, and needs to be transparent about this in the future. It's important to work for a stable funding line that does not rely on these "extras."

Internal Scientist Funding Model Overview

Dr. Michael New provided the PAC an overview of the Internal Scientist Funding Model (ISFM). ISFM came out of a 2015 study, the Agency Competition Team, conducted at the request of Mr. Robert Lightfoot. The study produced six conclusions about the special nature of Civil Servant (CS) scientists; NASA employs about 1000 CS Scientists who fulfill roles that are quite unlike those in other government agencies. The roles of CS scientists at NASA are different from classic academic roles. NASA CS scientists are the stewards of NASA mission science requirements, including instrument team leadership; and they lay the foundations for future scientific missions through their unique knowledge and placement.

However, it was found that CS scientists at NASA spend too much time writing proposals to NASA to fund their work. Thus the ISFM was formed, to aid in furthering the national interest to host certain capabilities at NASA centers, and to support work that provides value to the science community. The ISFM was originally focused on SMD only as a pilot program; it will be evaluated in January 2021, based on measures of success.

ISFM's measures of success are: Reduce CS full-time equivalents (FTEs) in competed R&A by 25%; reduce proposals and time spent writing proposals; ensure hiring areas are approved by Headquarters; improve satisfaction and participation; and maintain a balance of external and internal funding. ISFM implementation was not uniform at first, and appeared chaotic to Centers, and therefore an SMD-wide implementation plan was eventually adopted in July 2019. The approach combines close coordination between Centers and Headquarters by external peer review to improve research plans. External mid-point reviews will be held regularly to determine which work packages will go forward. The Office of the Chief Scientist (OCS) is currently in the process of compiling data, to assess the first three years of the program. Dr. Diniega asked if ISFM was collecting any metrics on diversity and inclusion, especially with regard to Early Career researchers. Dr. New said he knew that many conversations are taking place on the subject of Early Careers, but that they are not specifically called out in ISFM. He suggested consulting with Louis Barbier on the matter. Dr. New said he didn't think D&I had been included. Dr. Diniega said it might be useful to track this information, given the new emphasis on D&I. Dr. New noted that NASA has historically been reluctant to collect demographic data. Dr. Rinehart said that thus far, he had seen a lot of involvement of Early Careers, and underrepresented groups, in ISFM, but he didn't have hard data to back that up just yet.

The ISFM Review

Dr. Rinehart presented results of the ISFM Interim Review, first noting that in the past year, changes were made to ISFM due to budget considerations. Some FY19 money was pulled back early in FY20, and one ISFM was moved out of R&A entirely. A decision was made to extend ISFM for a fourth year to enable to incorporation of lessons learned and to account for budget changes. For the review, each ISFM is required to submit a report detailing progress to date. The charge to the reviewers is to evaluate the scientific merit of the ISFMs on the basis of several measures: Has the ISFM made significant scientific progress? What is the broader impact and/or significance of the ISFMs? Is their plan forward reasonable? How valuable are suggested augmentations?

Each proposal was reviewed by at least one external reviewer and discussed in one of three panels.

Of the 16 ISFMs that were judged, 11 had scores of Very Good or better. Overall the review panels were very positive, finding that NASA does value the foundational work done by CS scientists: this work is often comprised of fundamental tasks that are considered "boring," and which provide extra value to the community by their nature. Two ISFMs did not score well; Headquarters has asked those teams for plans to address the weaknesses. In terms of programmatics, there have been issues with funds management and spending, due to both the most recent government shutdown and COVID-19. In terms of reducing proposals, the review found that there has been a noticeable drop in the number of proposals from Centers. The target was 25%, and overall the proposals are down 28%, which is important to note. That translates to about 40 proposals per year. Overall, the review found that ISFMs produce high-quality science, provide more community service in more diverse forms, reduce proposal pressure from Centers, and conduct science that covers the whole range of the PSD portfolio. The review did identify some things that could be done better: NASA will need to work with ISFMs to actively manage budgets and carry out reviews in a more timely manner, perhaps via site visits. Next year, NASA will call for new ISFM ideas from the Centers; these will be reviewed by Headquarters for scientific value, plans for contributions to the community, and possible reductions in submitted proposals. The total budget for new ISFMs will be capped at $20 M. Dr. Glaze offered the caveat that some of these future plans will be modified by the final review, which will change if the budget changes.

NASA ARC ISFM

Dr. Jeff Hollingsworth, Branch Chief Planetary Systems, gave his perspective on the execution of ISFM at the Ames Research Center (ARC). ARC started pursuing ISFM in late 2016/2017, for implementation in 2018, within the Planetary Systems Branch and Exobiology Branch, which entails seven "work packages." These are the Mars Climate Modeling Center; Planetary Formation and Exoplanets Theory; Center for Life Detection; Microbial Innovation and Ecosystems Research; Habitable Environments & Biosignatures; Evolutionary Processes That Drove the Emergence and Early Distribution of Life; and Laboratory Astrophysics Directed Work Package. Each of these packages underwent an Interim ISFM Review, with the following results:

Positive

- External critical feedback appreciated overall
- Science was timely, diverse and highly relevant to future mission planning; foundational research work in important planetary science areas; world-class science demonstrated; real-time course corrections demonstrated, especially during global pandemic
- Team has a positive impact on the community; science productivity (publications) was substantial/exemplary
- Significant progress developing state-of-the-art computational codes demonstrated and for eventual access by the community
- High-reward, high-risk projects and tasks; novel approaches to long-standing problems with strong impacts

Negative

- Limited strategies/plans were discussed with regard to cross-pollination among the described ISFM tasks
- Few meaningful ties and involvement to specific spacecraft missions; ARC ISFM Team appears insular
- Delivery of state-of-the-art tools to the community delayed, ineffective
- Little discussion how proposed activities would connect to RCNs
- Limited discussion of integrated future plans across ISFM components; progress falls somewhat below expectations, especially website population, community access

Overall, Dr. Hollingsworth described the ISFM effort as producing timely and diverse science of high impact, with larger projects than a typical ROSES award; demonstrating that ISFMs have decreased burden on CS proposal writing, yielding more time for service, science, and publication; having CSs more involved in SMD panel reviews, enabling better inclusion of early-career scientists in large and dynamic science teams, with key contributions; strengthening inter-Center connections and collaborative, supportive community science; enabling the development of tools and databases that are of service to the community, and more strategic assignments of CS staff; providing foundational research in important planetary science areas, with world-class science demonstrated in both extensibility and spacecraft mission support; and supporting high-reward, high-risks project and tasks, producing novel approaches to long-standing problems.

GSFC ISFM

Dr. Stephanie Getty, Deputy Director of the Solar System Exploration Division (SSED), reported on the institution of ISFM at Goddard Space Flight Center (GSFC), first thanking all the participants for their work, especially under the trying circumstances of this year. SSED hosts five ISFM work packages: Exosphere, Ionosphere, Magnetosphere Modeling; Fundamental Laboratory Research; Planetary Geodesy; Goddard Instrument Field Team; the Sellers Exoplanets Environments Collaboration. Dr. Getty

pointed out that the Work Package Leads are scientists, and are non-supervisory. Success metrics for the ISFM include the demonstration of improved productivity, strengthened cross-divisional science, better integration of science and missions; and improved funding stability that helps to promote equality for the soft money science community. The ISFM provides multiple mechanisms for Early Careers to be involved. Other broad benefits include: increased emphasis on service in the Internal Scientist community; reduced proposal burden to ROSES; and increased availability of review panelists; and minimized time writing proposals.

Dr. Getty briefly reviewed the ISFM mini-proposal process and template, and described implementation principles for ISFMs at GSFC: minimize time spent writing R&A proposals, while maintaining accountability in the pursuit of scientific excellence; use of a mini-proposal process, with flash-talks and SSED review panels; encouragement of collaboration across the SSED and Science Directorate, while respecting laboratory priorities through laboratory management involvement; appointment of interdisciplinary, non-manager team leads, including managers in review; pursuit of stable labor support for the CS workforce, and soft money workforce in critical areas; use of civil servant-led proposals including all team members needed to do their science; development of proposal writing skills for early-career CSs, with mentoring from mid-career and senior Internal Scientists; encouraging early-career scientists to propose to ROSES, and also have them involved in ISFM-funded projects; connecting to the community landscape and exploring new directions by maintaining about 20% competed work, and through regular communications with Headquarters.

Looking forward, GSFC will continue to implement ISFM while aiming to sustain traceability from winning ROSES awards; maintain involvement of early-career scientists; disseminate results through publications, conference abstracts, and presentations; encourage interdisciplinary science while maximizing mission science; maintain strong community and Headquarters connections; improve accessibility of data to the community; host cross-community, cross-disciplinary workshops; enable more scientists to serve on review panels; maintain active planning in light of pandemic impacts; and maintain strategic coordination across work packages through SSED management.

JSC ISFM

Dr. John Alred gave an overview of the implementation of ISFM at Johnson Space Center (JSC) and enumerated guiding principles. He said that in recent years, the Agency has tried to restrict the number of civil servants at JSC, thus it was important to note that many of the scientists in this particular ISFM effort are contractors. The output to date from JSC's ISFM work packages includes: 94 articles submitted to peer review in 2020; 15 first-author white papers submitted to the Planetary Decadal Survey; demonstrations of community service and mentoring, including projects with institutions (University of Houston, Northern AZ University); two early-career contractor-scientist proposals selected in Solar System Workings (SSW); the hosting of local workshops (some cancelled or postponed by COVID); maintaining weekly community outreach to schools and other audiences; populating Headquarters review panels; and providing support for the NPP program. JSC has five work packages whose leads are also non-managerial scientists: Coordinated Analysis, Mission Enabling Science; Geo- and Cosmochemistry; Organic Geo- and Cosmochemistry; and Planetary Process Simulation. Dr. Alred reported that he holds bi-weekly meetings with the ISFMs, which are also subjected to a quarterly review with JSC's ARES Division management.

Dr. Alred said that ISFM is working well thus far. Scientists at JSC have seen increased or sustained productivity; funding stability has enabled more strategic decision-making for laboratories, greater instrument access and more collaborations with external scientists, as well as more mentoring for early-career and underfunded scientists.

ISFM Discussion

Dr. Mainzer expressed concern about the low-scoring ISFMs, given the perennially depressed selection rates in R&A, commenting that it is really important to focus on the quality of proposals. Dr. Rinehart absolutely agreed that this was an alarming result, but thought that the low scorers were a product of a lack of clarity during the initiation of ISFM; essentially, it looks as if a couple of groups went off in the wrong direction. Dr. Rinehart felt that they could recover, and that feedback is critical to this recovery. These low scorers are being re-assessed, and in the future, NASA can choose to terminate any ISFMs in the second round. Another thought is that the Fair scores may not be as draconian as presented.
Dr. Hurley said she generally supported ISFM, and asked if they were all pilots for research. Dr. Rinehart said this was not the intent of ISFM; NASA wants to ensure that fundamental research is being done, and also wants early-career people to propose, and get Excellent scores, so as to be recognized. Dr. Getty noted that the number of mini-proposal awards, as a fraction of the overall portfolio, is still very small; GSFC uses them to give early-career scientists the chance to generate and mature their ideas. Dr. Rinehart added that there is also the high-risk, high-reward stuff, which is also a good focus for some ISFMs. Dr. Lynn Carter asked if ISFMs were tracking overhead costs, and administrative layers. Dr. Getty said that GSFC allocates a small charge at the management funding line for the ISFMs. Dr. Alred noted the same sort of accounting was done at JSC.

Dr. Mainzer asked how NASA assured that the ISFMs were meeting the strategic objectives of the Agency. Dr. Rinehart said that the Centers sent Headquarters white papers on the subjects, which the Agency assesses for their strategic value in relation to the NASA Strategic Plan. Dr. Mainzer asked how NASA assured whether Centers are tackling the work that is uniquely suited to them. Dr. Rinehart said he liked to think of Centers as a microcosm of the community, but that there are other things that Centers must do: train scientists to manage flight missions, for instance, or support curation activities. Dr. Glaze echoed Dr. Rinehart's remarks, given her experience as a CS scientist. Dr. Rinehart felt that there should not be hard boundaries between NASA and the community, relating that when he was a Program Scientist for the Transiting Exoplanet Satellite Survey (TESS), he recalled that it was very valuable to have conversations with other scientists in the science "ecosystem."

Dr. Justin Filiberto asked, in terms of service to the community: is the point of ISFM to make facilities and laboratories more open to the community? In his experience, he had found that sometimes access is free, and sometimes it's not. Dr. Rinehart noted that making facilities more accessible to the community is not a stated goal of ISFM, in that increasing accessibility to NASA facilities is not always practical and cost-effective. Decisions as to accessibility are done on a case-by-case basis. Dr. Jeff Hollingsworth agreed with this statement, adding that accessibility is based on a collaborative approach. Dr. Getty thought there were instances at GSFC where unique samples have become more available to the community; there's a combination of approaches with respect to accessibility, such as proposals, or impromptu agreements in response to new opportunities. Dr. Schmidt asked if the ISFMs had seen any concrete reductions in proposal pressure, or increased productivity. Dr. Rinehart said that he has definitely seen a reduction in proposals, and was seeing less "boom or bust" support for scientists, while anecdotally seeing that more scientists have become available for reviews.

Planetary Defense Coordination Office (PDCO) Update

Mr. Lindley Johnson presented an update on the Planetary Defense Coordination Office (PDCO), which has recently overseen a number of interesting discoveries and events. This past summer, the event of note was the appearance of the bright NEOWISE comet (C/2020 F3), a widely publicized comet that was seen from locations all over the world. Another observed NEO, 2020 SO, which is thought to be a Centaur upper stage from the 1966 Surveyor 2 launch, was temporarily captured from a heliocentric orbit. Spectroscopy will soon likely confirm its artificial nature. A new asteroid, 2020 QG, the closest approach that had yet been seen, was seen on 16 August, quickly followed by an object 5–11 m in size, observed at 375 km above Earth (about the altitude of ISS), on 13 November. The NEO Search program continues.

The Asteroid Terrestrial-impact Last Alert System (ATLAS) is progressing well, as are the Catalina Sky Survey, and the Panoramic Survey Telescope and Rapid Response System (PAN-STARRS). The Lincoln Near-Earth Asteroid Research (LINEAR)/Space Surveillance Telescope (SST) system is now in testing in Australia; PDCO expects to see some test observations later in 2020. PDCO also processes data for NEO detections from Caltech's Zwicky Transient Facility, and from the NEOWISE (warm) mission. Statistics on all near-Earth asteroids to date: 2440 discoveries (of all sizes) in 2019, with 2673 discovered thus far in 2020. PDCO expects to get to 2800 objects by the end of this calendar year. Near-Earth Asteroids (NEAs) of 140 m or larger account for about 500 discoveries per year; this rate continues to be steady, with 490 observed so far in 2020. NEAs discovered over the years now amount to nearly 25,000, 9437 of which have been of the >140 m category. The total population of NEOs of this size is estimated (by modeling) to be about 25,000, thus at the current discovery rate, it will take another 30 years to attain the George Brown Act goal of finding 90 percent of the NEO population down to 140 m in size. A speedier rate of discovery will require enhanced capabilities.

NASA and PDCO are preparing for the close approach of the asteroid, Apophis, which on April 13, 2029, will pass 31,000 km from Earth. Apophis is large enough to be visible to the human eye at that time. NASA is planning a workshop on both the scientific and Planetary Defense aspects of the Apophis approach. Apophis will make another close approach in March 2021, which will provide an early opportunity for observatories to view and characterize the asteroid.

The impacts of COVID on PDCO peaked in March of this year. Most facilities are back up; the Goldstone radar is back up and operating. However, the Arecibo facility in Puerto Rico will be decommissioned due to irrevocable damage from a cable failure earlier this year. NASA has funded planetary radar at Arecibo for a decade, and it is expected that there will be only a slight negative impact to NASA's NEO observation mission, as Arecibo was used by NASA only to characterize known objects. Goldstone has a greater pointing capability but a lesser range than Arecibo's planetary radar, thus some science on planets and distant asteroids will be affected. The Arecibo incident has also prompted new thought on what will be needed for new radar capabilities.

The NEO Surveillance Mission (NEOSM) continues to progress; its objectives are to find 65% of undiscovered potentially hazardous asteroids (PHAs), by searching for them in the infrared spectrum. NEOSM will progress to KDP-B by the end of this year. DART is still on track for launch in late 2021; integration and testing (I&T) is going well. Flight software is also progressing well, although the team will still have to work issues with testing DART's solar arrays, contending with a late delivery. The arrays won't arrive at the Applied Physics Laboratory (APL) until March 2021. NASA is hoping to shorten the schedule by working with the vendor. The delay is a result of COVID impacts on the manufacture of solar arrays. PDCO's budget of $150 M, is largely dedicated to DART (48%), and NEOSM (24%). In anticipation of the next Planetary Decadal Survey (DS), PDCO has made suggestions to the Small Bodies Panel concerning future planetary defense flight projects. The Survey could identify specific prioritized planetary defense goals for strategic missions, even if they are less than $500 M, and will look for opportunities within Planetary Science Flight missions for other PD-relevant missions. Mr. Johnson thought the best thing the Decadal Survey could do would be to provide guidelines on how to "right-size" the PDCO.

Analysis Group Discussion

The PAC was given the opportunity to ask specific questions to the various discipline Analysis Groups (AGs), given the compressed schedule. Dr. Hurley posed a question to the Lunar Exploration Analysis Group (LEAG), asking about its finding about how NF5 would proceed with respect to the Artemis landing site. Dr. Amy Fagan fielded the question, noting that Artemis is targeting landing at the South Pole, within 6 degrees. However, there will be impact melt. Science really needs to go to lunar South Pole/Aitken Basin (SPA), and requires a pristine sample. There is also some discomfort in the community

about what sample return from SPA really means, and about where exactly the Artemis landings will take place. Dr. Barbara Cohen commented that the question is well-posed, and needs to be addressed by the SDT, and to be clarified before teams start proposing. Dr. Glaze asked LEAG to contact Dr. Curt Niebur to have that latter conversation.

Dr. Conor Nixon cited an Outer Planets Analysis Group (OPAG) "late-breaking concern." Dr. Linda Spilker explained that the concern has to do with the decrease in budget for Decadal Survey mission studies, which had been reduced to $4 M from $10 M. OPAG is asking about why this happened, given that there will be an impact on the Decadal Survey with fewer mission studies. Dr. Glaze addressed the issue, noting that the average cost for each of the Planetary Mission Concept Studies were $1 M each, and that these studies were fairly detailed, performed over many months. The Decadal Survey mission studies in question, however, are designed to be much shorter, and to be conducted in less detail; these Decadal studies can therefore do much more with the money provided. Also, it's important to note that the funding for the Decadal Survey comes out of the R&A budget. Additionally, the $10 M allotted for these studies also covers other costs. There will also be a manpower shortage for carrying out these studies, aside from cost constraints. However, Dr. Glaze felt that the $4 M would still easily cover the 10 shorter Decadal Survey mission studies. The goal is for the Academies to get a look at a diverse set of possible missions to allow them to identify important gaps, and to acquire enough fidelity to do the independent cost estimates.

Dr. Jennifer Glass raised a question arising from a recent Venus discovery. Dr. Darby Dyar noted in response that the Venus Exploration Analysis Group (VEXAG) is considering finding funding for streaming its public outreach talks. Dr. Diniega asked the MEPAG to comment on its remarks on continuing to carry the 2026 launch dates for MSR. Dr. Aileen Yingst addressed the MEPAG's preliminary finding on the launch dates, noting that MEPAG would like to see the launches carried out as safely and expeditiously as possible, and felt that the IRB recommendations on launch dates need to be considered very seriously. There will be more to come on this subject as MEPAG deliberates further.

Dr. Nixon asked whether recent instrument descopes in the Europa Clipper mission would have effects on cost or schedule. Dr. Glaze addressed the question, noting that the instrument descopes are not impacting launch in any way. The greater concern is on cost; PSD did a risk assessment of three instruments over the summer, and concluded that it would put cost caps on two of the instruments. Some Level-1 requirements were loosened as well to help the mission manage the caps. PSD is monitoring the situation accordingly.

Asked whether there was a MExAG concern with the NF5 call, Dr. Steven Hauck said that the MExAG was primarily concerned with the fact that the cost cap represents a significant cut from NF4, which when inflated, will be large and that it represents a discrepancy with the information that PMCS studies were supplied for the Decadal Survey. MExAG is concerned about the effect on future Mercury missions. Dr. Glaze addressed the issue, noting that the cost cap relative to an inflated NF4; the preliminary announcement for NF5 is meant to allow the community to give feedback. The decisions to remove launch vehicles and Phase-E costs from the cost cap has allowed the scope of a NF mission to increase substantially. Essentially, this is an unbounded commitment. NASA needs to find a way to bound it, and how to find the true budget for NF5. If NF5 goes forward with a lower cost cap, it might cause a mismatch with the PMCS studies. Dr. Glaze preferred that the Survey be enabled to provide recommendations on an appropriate cost and scope of NF missions, and subsequent cadence.

Asked if the AG TORs had been completed, Dr. Glaze responded that this was so, and also that the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM) name is being changed to reflect its primary AG function, which is separate from its proposal review function. Dr. Barbara Cohen, incoming Chair of CAPTEM, confirmed this change, and felt it would not be much of a change to the

community. Requests for samples will still go through NSPIRES. CAPTEM is planning a full meeting in Spring, and is still thinking about a name change to make it clear that the review function is no longer part of its purview.

Discussion/Findings and Recommendations

Dr. Mainzer asked Dr. Glaze about other PSD impacts related to the Arecibo failure. Dr. Glaze said that her understanding was that the key issue is range; the loss of Arecibo means a loss of certain Venus observations, for instance. Other planetary observations will be more difficult, and in some cases not possible. Mr. Johnson commented that Venus is still within range, but that observations of the Main Belt and beyond will be more difficult. The issue comes down to power, mostly. Scheduling will also be more of a challenge, as the Goldstone facility supports critical communications. Arecibo's loss speaks to the need to invest in a new planetary radar capability. Dr. Glaze pointed out that most ground-based facilities are the responsibility of the National Science Foundation (NSF), with the exception of NASA's Infrared Telescope Facility (IRTF). Mr. Johnson commented that it will take a partnership of agencies to solve the problem, bearing in mind that Arecibo was originally a Defense Department structure. NASA has an opportunity to partner with the US Space Force, which has a need for cis-lunar situational awareness. Mr. Johnson felt that the best future course would be to pursue a new planetary radar capability; existing facilities are not cost-effective, and technology has moved on over the last 30 years. NASA needs to take advantage of new technology. Dr. Nixon asked if NASA was planning to free up time at Goldstone for short turnaround requests. Mr. Johnson said that the scheduling process has improved for short-notice requests, but it is also necessary to find time that is not taken up by critical spacecraft operations. Goldstone is not as flexible as Arecibo was in this respect. Dr. Glaze said it was important to note that Arecibo is being decommissioned, but that all its associated Education and Public Outreach activities will continue. There is a recently updated interactive visitor's center that Arecibo and NSF intend to maintain. Asked if there were a possibility of repairing Arecibo, Mr. Johnson thought it would be good to have some additional study of the possibility, but it is ultimately NSF's call. Dr. Glaze believed NSF's decision to decommission Arecibo was made primarily for safety reasons; if another cable broke, it could be catastrophic to people at the facility.

Dr. Diniega asked what the current cost estimates were for a three-satellite constellation of communications-linked spacecraft that is associated with MIM, and whether the constellation was considered integral to the MIM. The thought is that it would be a commercial contribution, but she was not sure it was a must-have. Mr. Ianson thought that the primary contributions to the constellation would be from partners, but that NASA might also make a small contribution; he added that the satellite constellation is not considered integral to the MIM, but it can improve overall communication relay. Asked what the connection between SMD and HEO was with regard to the Mars Program, Mr. Ianson said that SMD is funded directly to support MIM, because that's where the expertise resides. Funding was provided to PSD directly, and was in addition to baseline PSD's budget. If MIM does not go forward, the money goes away. Dr. Glaze added that she regarded MIM as an opportunity to build on international collaborations to expand on other complementary payloads, and an opportunity to do more science, given the Agency-level interest. These funds were identified by the White House and OMB. Dr. Diniega commented that MIM would require a solid SDT. Mr. Ianson responded that because MIM is an international mission, PSD can't drive every science aspect; the partnerships are not fully formed, but he thought that over the next six months, the community could have a more detailed discussion of what exactly MIM will entail.

Findings and Recommendations

Dr. Mainzer summarized some thoughts on findings:

- Finding- The PAC wants to encourage Mars program office in ensuring diversity inclusion measures. PAC members concurred with this thought.

- Finding- The PAC stresses the importance of strong science leadership in the Mars Ice Mapper Mission (MIM). Dr. Diniega suggested highlighting the importance of clear communication with the community regarding this issue. Dr. Schmidt recommended making the finding broader than MIM, specifically calling out the Mars exploration program org structure question, as it relates to MSR program? How do the two programs work together? Is there potential overlap with Discovery concepts? Keep these issues on the PAC radar.
- Finding- Keep an eye on the effects of separating MSR from the rest of MEP. Mr. Ianson commented that MSR is evaluated along with the other Flagships in the Decadal process. He also noted that the current programmatic separation will not affect future Participating Scientists' ability to access samples, and that the MSR office will probably cease to exist once the samples return.

PAC discussed a potential finding on ISFM. Dr. Glass suggested the PAC wait until clearer statistics become available from the OCS in January 2021, before making a finding. Dr. Rinehart noted that the PAC should also keep in mind that it is not just CS salaries in the budget wedge for ISFM—the wedge does include some soft money, including funds for post-docs and students, as well as for equipment and facilities that support the system. Dr. Glaze added that the ISFM funding wedge was used much like funds are used for ROSES proposals; these funds cover other costs that are associated with proposals. The PAC deferred the finding, pending more data.

Dr. Nixon recommended a finding on Arecibo. Dr. Mainzer thought it would be great to get an independent assessment from an outside organization, such as the Army Corps of Engineers, on Arecibo. Mr. Johnson noted that Arecibo did consult with the Corps, but no formal assessment was performed. Dr. Carter encouraged a better discussion of what would be lost if Arecibo is completely lost. Dr. Mainzer suggested the finding be worded to encourage NASA to replace the capability, and look at alternatives. Dr. Glass requested a more complete accounting of repercussions to the planetary community, as well as to PD? Mr. Johnson reiterated that the Arecibo radar is not used to detect NEAs; they have to be detected optically first. As far as the mandate to PDCO is concerned, there is no impact there.
****(Note: On 1 December, the Arecibo dish collapsed completely).****

Dr. Schmidt suggested a finding on R&A. Dr. Mainzer felt such a finding should remain confined as to how R&A relates to ISFM. Dr. Rinehart commented that it is hard to understand the budgets, and cautioned the PAC to temper expectations as to how much more can be learned. He suggested exploring the issue further at the March meeting. Dr. Rinehart added that the most influential driving factor responsible for depressing R&A selection rates is community proposal pressure, coupled with the money requested. Dr. Glaze advised the PAC to look at Congressional language as to specific requests, and reiterated that PSD is constrained from moving money around freely.

Dr. Mainzer adjourned the meeting at 6:12pm.

Appendix A

Attendees

Planetary Science Advisory Committee Members
Amy Mainzer, University of Arizona, **Chair**
Lynn Carter, University of Arizona
Serina Diniega, Jet Propulsion Laboratory
Justin Filiberto, Lunar and Planetary Institute
Jennifer Glass, Georgia Institute of Technology
Justin Hagerty, United States Geological Survey
Dana Hurley, Johns Hopkins Applied Physics Laboratory
Conor Nixon, NASA Goddard Space Flight Center
Britney Schmidt, Georgia Institute of Technology
Joseph Westlake, Johns Hopkins University Applied Physics Laboratory
Stephen Rinehart, NASA Headquarters, **Executive Secretary**

Other Attendees
R. Aileen Yingst
John Alred
Fran Bagenal
Meghan Bartels
Tracy Becker
Linda Billings
Regina Blue
Francesco Bordi
Bonnie Buratti
Aaron Burton
Paul Byrne
Mark Carreau
Brandi Carrier
Amy Chaput
Stephen Clark
Barbara Cohen
Jamie Cook
Cody Cox
Joseph Cruz
Roc Cutri
Lisa Danielson

Christopher Dateo
Maxime Devogele
Monty Di Biasi
Tammy Dickinson
Jason Dworkin
Darby Dyar
David Eisenman
Sylvia Espinasse
Amy Fagan
Kelly Fast
Luisa Fernanda Zambrano-Marin
Mark Fonda
Jeff Foust
Joseph Gasbarre
Stephanie Getty
Nana Ghaleb
Daniel Glavin
Lori Glaze
Jeffrey Gramling
Jeffrey Grossman
Justin Hagerty
Tim Haltigin
Diane Hammons
Brian Harvey
Steve Hauck
Lindsay Hays
Amanda Hendrix
Jeffrey Hollingsworth
Zhengwei Hu
Tristram Hyde
Eric Ianson
Gene Jasper
Lindley Johnson
Ben Kallen
Linda Karanian
Michael Kelley
Melissa Kirven-Brooks
Gerhard Kminek
William Knopf
Kelsie Krafton

Ravi Kumar Kopparapu
Melissa Lane
Cathirame Lee
James Lochner
Paul Mahaffy
Sean Marshall
Ricardo Martinez-Serrano
Richard Mattingly
Rebecca McCauley-Rench
Robin S Mdoka
Bonnie Meinke
Michael Meyer
David Millman
Amanda Moore
Jeff Moore
Melissa Morris
Dave Murrow
Quinton Nabors
Amanda Nahm
Michael New
Sarah Noble
Lucas Paganini
Michael Patterson
Alexander Pavlov
Diane Pugel
Kurt Retherford
Andrea Riley
Ed Rivera-Valentín
Carolina Rodriguez
Richard Rogers
John Rummel
Richard Ryan
Joan Salute
Delia Santiago-Materese
Mitch Schulte
Svetlana Shkolyar
David Smith
Marcia Smith
Krista Soderlund
Christophe Sotin

Linda Spilker
Paul Steffes
Thomas Sutliff
George Tahu
Patrick Taylor
Jennis Teate
Meagan Thompson
Bradley Thomson
Melissa Trainer
Bo Trieu
Azita Valinia
Flaviane Venditti
Anne Verbiscer
Anne Virkki
Paul Voosen
Mary Voytek
Shoshana Weider
Joe Westlake
John Whitehead
Ashlee Wilkins
Alexandra Witze
Joan Zimmermann
Richard Zurek

Appendix B
Committee Membership

Amy K. Mainzer, **Chair**
University of Arizona

Lynn Marie Carter
University of Arizona

Serina Diniega
Jet Propulsion Laboratory

Justin Filiberto
Lunar and Planetary Institute

Jennifer Glass
Georgia Institute of Technology

Justin Hagerty
United States Geological Survey

Dana Hurley
Johns Hopkins Applied Physics Laboratory

Conor Nixon
NASA Goddard Space Flight Center

Britney Schmidt
Georgia Institute of Technology

Joseph Westlake
Johns Hopkins University Applied Physics Laboratory

Stephen A. Rinehart
Executive Secretary, NASA Headquarters

Appendix C
Agenda

Planetary Advisory Committee (PAC) November 30, 2020 Meeting
VIRTUAL MEETING
Agenda

Time (Eastern)	Item & Speaker
10.00–10.10	**Welcome/around the table** Stephen Rinehart (all)
10.10–10.40	**Planetary Science Division (PSD) update** Lori Glaze
10.45–11.05	**Mars Exploration Program (MEP) update** Eric Ianson
11.05–11.25	**Mars Sample Return (MSR) update** Jeffrey Gramling
11.30–11.50	**Astrobiology update** Mary Voytek
11.55–12.25	**PSD R&A update** Stephen Rinehart
12.25–13.25	**BREAK**
13.25–13.55	**ISFM overview** Michael New/Stephen Rinehart
14.00–14.10	**ARC ISFM update** Jeffrey Hollingsworth
14.10–14.20	**GSFC ISFM update** Stephanie Getty
14.20–14.30	**JSC ISFM update** John Alred
14.30–15.00	**ISFM discussion time**

15.00–16.00	**BREAK**
16.00–16.30	**PDCO Update** Lindley Johnson
16.30–17.00	**AG updates – Q&A** PAC/AG reps
17.00–18.00	**Discussion and findings**
18.00	**Adjourn**

Appendix D

Presentations

1. Planetary Science Division Update; *Lori Glaze*
2. Mars Exploration Program Update; *Eric Ianson*
3. Mars Sample Return Science; *Jeffrey Gramling*
4. Astrobiology Update; *Mary Voytek*
5. Planetary Science Division Research and Analysis Update; *Stephen Rinehart*
6. Internal Scientist Funding Model Overview; *Michael New, Stephen Rinehart*
7. Ames Research Center ISFM Update; *Jeffrey Hollingsworth*
8. Goddard Space Flight Center ISFM Update; *Stephanie Getty*
9. Johnson Space Flight Center ISFM Update; *John Alred*
10. Planetary Defense Coordination Office; *Lindley Johnson*