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Ms. Margaret Luce, Heliophysics Division Director (Acting)
National Aeronautics and Space Administration
Heliophysics Division
300 E Street, SW
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Dear Ms. Luce:

The Heliophysics Advisory Committee [HPAC] of the National Aeronautics and Space Administration [NASA] convened on 29 November through 1 December at NASA Headquarters [HQ]. The undersigned served as Chair for the meeting with the support of Janet Kozyra (HPAC Designated Federal Officer [DFO], NASA Heliophysics Division [HPD]). Other participating HPAC members in attendance at NASA HQ included Vassilis Angelopoulos (University of California, Los Angeles), Paul Cassak (West Virginia University), Heather Elliott (Southwest Research Institute), Darko Filipi (Adcole Maryland Aerospace), Larisa Goncharenko (Massachusetts Institute of Technology [MIT] Haystack Observatory), George Ho (Johns Hopkins University Applied Physics Laboratory), Lynn Kistler (University of New Hampshire), James Klimchuk (NASA Goddard Space Flight Center), Michael Liemohn (University of Michigan), Tomoko Matsuo (University of Colorado Boulder), Mari Paz Miralles (Smithsonian Astrophysics Observatory), Cora Randall (University of Colorado Boulder), and with Roger Smith (University of Alaska) attending via telecom. This letter summarizes the meeting outcomes.

At the start of the meeting on 29 November, your office provided a very helpful HPD update. The HPAC was glad to hear that the HPD continues to strive to align with Decadal Survey recommendations, in particular the DRIVE (Diversify, Realize, Integrate, Venture, Educate) initiative, and was much encouraged by the strong, continued HPD attention to high cadence HPD spaceflight mission opportunities. Further, the HPAC wishes to congratulate the HPD on its significant recent achievement in collaborative systems science of studying a solar storm with ten spacecraft and numerous models; and, it would like to convey its delight about renaming NASA HPD's high-payoff mission, the Solar Probe Plus, to the Parker Solar Probe [PSP] in honor of solar astrophysicist Dr. Eugene Parker.

Jennifer Kearns then briefed the HPAC about GPRAMA [Government Performance and Results Act] and the Heliophysics Science Performance Assessment on Strategic Objective 1.4, which is to understand the Sun and its interactions with Earth and the solar system, including space weather. The HPAC was tasked to review the HPD Fiscal Year 2017 progress in the area of this objective, with focused attention on these three Performance Goals:

1.4.1: Demonstrate progress in exploring the physical processes in the space environment from the Sun to Earth and throughout the solar system;

1.4.2: Demonstrate progress in advancing understanding of the connections that link the Sun, Earth, and planetary space environments, and the outer reaches of the solar system; and,

1.4.3 Demonstrate progress in developing the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

Resulting from substantial deliberation under the leadership of Mari Paz Miralles (for 1.4.1), Vassilis Angelopoulos (for 1.4.2), and Michael Liemohn (for 1.4.3), on 1 December the HPAC concluded that -- for all three Performance Goals -- expectations for the HPD research program were fully met in the context of the resources invested and, moreover, the HPD has newly achieved original and generative contributions. Accordingly, the HPAC unanimously voted in favor of green ratings for all three Performance Goals.

For Performance Goal 1.4.1, the HPAC substantiated its unanimous green rating as follows. Exploring fundamental plasma physical processes in our solar system is essential. Such knowledge is necessary to understand the conditions and evolution of our space environment from solar dynamics to the Heliosphere to the magnetic environments of Earth and other planets. This leads to new understanding as well as new insight into applications such as space weather and human exploration of the solar system. The HPD has provided new breakthroughs in many areas including discovering the rapid rotation of the Sun's core that reveals the physical mechanisms governing magnetic reconnection, and probing the heating processes in Earth's upper atmosphere. In summary, the HPD has made major progress in this area over the past year with significant achievements in elucidating key physical processes that impact our understanding of the space environment.

For Performance Goal 1.4.2, the HPAC substantiated its unanimous green rating as follows. The solar wind is heated and accelerated near the base of the Sun's atmosphere. Moving outward from the Sun it permeates the heliosphere and drives dynamic processes all the way to the edges of the solar system. On its way, it has profound effects on planetary environments, including Earth's own space environment, where it interacts with our upper atmosphere and its extension in near-Earth space, the magnetosphere. The HPD has provided new insights on how the Sun accelerates solar winds. At Earth, an emergent Heliophysics System Observatory of on-going and new missions has provided new insights on how the solar wind drives magnetospheric dynamics in our local neighborhood. Beyond Earth, heliophysics missions have explored how the solar wind interacts with the local interstellar medium and how it shapes the solar system boundaries. Additionally, NASA research has revealed how lower atmosphere waves invade the upper atmosphere, and how, contrary to expectation, thermospheric energy input from the Sun has remained constant over many solar cycles, despite the observed gradually decreasing solar activity. Recent research has also opened up new questions that will be addressed by the upcoming launches of the PSP, ICON (Ionospheric Connection Explorer), and GOLD (Global-scale Observations of the Limb and Disk) missions.

For Performance Goal 1.4.3, the HPAC substantiated its unanimous green rating as follows. NASA mission data and NASA-funded numerical models, across all heliophysics disciplines ranging from solar through magnetospheric to upper atmospheric physics, were used to advance understanding of space weather phenomena capable of adversely affecting life and society here on Earth as well as human and robotic explorers beyond Earth. In particular, multi-year and multi-satellite data sets were critical to imparting statistical

significance to long-term trends, quantifying the progression of solar disturbances to impact Earth and other planets, and in identifying truly extreme events.

In addition to the above-described evaluation of HPD progress about which the HPAC primarily engaged during this convening, the Subcommittee received seven relevant and informative presentations. These meeting activities and HPAC associated comments are summarized below.

First, on Thursday 30 November in the morning, the HPAC received a summary briefing about the November 2017 Heliophysics Senior Review [HSR] from the Review's DFO, Jeff Hayes, and the HSR Chair, James Spann. The HSR Panel, which consisted of 14 Special Government Employees [SGEs], convened from 30 October to 3 November to consider NASA's 16 heliophysics missions in the extended phase.

To assess the HSR Report, the HPAC considered:

Was the Panel fair and unbiased, and did it do a good and appropriate job? and,
Is the HPAC as a whole satisfied with the Report and the Report's conclusions?

Following discussion about the presented HSR Report, and also about the HSR Panel processes that Jim described in depth, the HPAC determined wholly positive answers to both of the above questions. With the exception of the two HPAC members, Vassilis Angelopoulos and Cora Randall, who had recused themselves from the deliberations on the basis of their particular status with considered missions, the participating members of the HPAC whose names are listed in the first paragraph of this letter then voted unanimously to accept and endorse the 2017 Heliophysics Senior Review Report. The HPAC would like to strongly commend the HSR Panel for its work, and congratulate NASA for exemplary execution of its mission and for its outstanding Heliophysics Science Observatory.

Second, on Thursday at lunchtime, Mona Kessel provided a helpful briefing about the NASA Internal Scientist Funding Model [ISFM]. She explained that the ISFM concept grew out of a grassroots push following the development of consensus awareness within NASA that NASA civil servant scientists spent significant time on proposals instead of participating in panels and other activities of benefit to the community. Subsequently, upper management at NASA decided to investigate ways to help the NASA in-house scientists become more effective, and the ISFM resulted from their effort.

HPAC ISFM Finding:

HPAC commends the Heliophysics Division [HPD] on their plan for implementing a fair and reasonable internal scientist funding model [ISFM] for research and analysis projects conducted by NASA civil servant scientists. Retaining a vibrant scientific presence at NASA centers that complements the community at large is a high priority for HPD. The HPD ISFM plan will alleviate funding uncertainty and help create separate populations of potential proposal review experts (NASA civil servants and the external research community) for some NASA Research Opportunities in Space and Earth Science [ROSES] programs.

Third, Thursday after lunch, Dan Moses provided an interesting and inspiring briefing to the HPAC on the topic of Heliophysics Cubesats. The HPAC wishes to express sincere kudos to the HPD for being pro-active regarding capitalizing on the promise of the Low-Cost

Access to Space [LCAS] CubeSat/SOM (Small Orbital Mission) revolution, and for incorporating lessons learned and community feedback in implementing them efficiently to enhance the science return from HPD's funding.

Towards assuring success in this important area, the HPAC provides the following.

HPAC LCAS CubeSat/SOM Finding:

(1) The HPD should follow the experience and best practices of the rocket program and the Explorers program (including the University-Class Explorers [UNEX] program of the early 1990's) in the programmatic (including contractual) aspects of how to institute the LCAS CubeSat and SOM elements.

a. For the SOM element:

- i. Treat the mission study report provided at the end of Phase-A as a contractual document, and allow a bridge phase option to ensure continuity; and,
- ii. Fund the work as a grant, not as a contract (which is cumbersome);

b. For both LCAS CubeSat and SOM elements:

- i. To ensure reviews match risk, adopt an >80% success posture; per this, the NASA Policy Directive 7120.8 is preferable; and,
- ii. Funding through NASA/Wallops is important, too, to ensure appropriate technical monitoring as well as (the most beneficial kind of) engineering help, which: matches flow of funding; allows reviewers to charge time; and, enables NASA to act in a support role.

If no action is taken then contractual delays could kill a program before it even gets started, and reviews can impose new requirements that can stress a team and endanger a program.

(2) The Step-2 review (of the Technical/Management/Cost [TMC] aspects) of the SOM element should occur through a process that is a scaled up version of a rocket review rather than as a scaled down version of an Explorers review. In other words, try to use NASA/Wallops for the review process rather than NASA/LaRC's Explorer TMC panel.

If no action is taken then cultural pre-conditioning of the review panel regarding success rates and risk posture might increase the cost of the program.

(3) LCAS CubeSats and SOMs are critical for training junior principal investigators [PIs] to become well-rounded scientists and flight-experienced early-career engineers. This is typically the role of Universities and small research and development [R&D] organizations. As mission costs rise, these organizations are at risk of being pushed out of competition by NASA Centers and large Federally Funded Research and Development Centers [FFRDCs], thereby endangering several small spaceflight instrumentation groups around the United States. The HPD should thoughtfully consider the best ways to manage the LCAS CubeSat and SOM categories. This could be addressed, for instance, by assessing the benefit of firewalling the 3-year average dollar amount of funding for this research distributed to NASA centers and large FFRDCs as compared with academic and small R&D organizations, using programmatic considerations.

If no action is taken then training of junior PIs to become well-rounded scientists and flight-experienced early-career engineers, which is typically achieved in lean flight-capable groups at academic and R&D organizations, and which is an activity that is critical for NASA and the nation, would be at risk. Like the rocket program in the past, now LCAS CubeSats and SOMs are also becoming a primary means for achieving such training. If the amount of

single-project funding (and level of requirements) for LCAS CubeSats and SOMs were to increase significantly, NASA Centers and large FFRDCs could increasingly come to dominate the proposal awards more so than in the past. It is in NASA's and the nation's long-term best interest to cultivate science and engineering at academic and predominantly basic research R&D organizations, and accordingly it is highly beneficial for the HPD to assure a class of missions that is well suited and remains competitively achievable for these organizations.

Fourth, Elsayed Talaat via telecom provided a Research & Analysis [R&A] program update starting on Thursday afternoon and wrapping up during lunchtime on Friday 1 December. Many topics of interest to the HPAC were addressed during this briefing. The HPAC is encouraged to provide individual HPAC member feedback about these topics directly to Elsayed and Janet Kozyra towards further discussion at upcoming HPAC meetings. Also, at this time, the HPAC as a whole would like to offer one comment, on the topic of Program Analysis Groups [PAGs].

HPAC PAG Finding:

Heliophysics science benefits greatly from two-way communication between the community and NASA Headquarters. The HPAC plays a vital role in this regard, but we feel that additional subcommittees, analogous to the Management Operation Working Groups [MOWGs] of the past, would significantly strengthen the communication. Subcommittees provide additional points of view and thereby broaden community representation. Furthermore, being focused, they can delve more deeply into specific issues. Careful thought must be given as to just what the focus of the subcommittees should be. They could be distinguished on the basis of scientific discipline, as in the traditional Solar-Heliospheric and Geospace MOWGs. Another option is to distinguish based on scientific approach, such as technology and observation versus theory and modeling. Our initial opinion is that the discipline distinction makes more sense, since activities of the HPD are driven ultimately by science, not technique. We use whatever combination of techniques needed to best answer a scientific question; we do not search for a question that will justify a particular technique. Ideally, the subcommittees would report to both the HPAC and Director of Heliophysics, and the HPAC would play the role of integrating the recommendations where appropriate and deciding which to pass on to the NASA Advisory Committee and the Science Mission Directorate [SMD] Associate Administrator.

Fifth, on Friday 1 December in the morning, Janet Kozyra provided a briefing about the HPD Science Centers in which she summarized a range of National Science Foundation [NSF] Center structure options and also discussed the HPD Request For Information [RFI] responses. Her clear description of the roles of the NSF Center Principal Investigators and associated Lead Institutions was very helpful. Also helpful was her thoughtful overview of the primary issue raised in the RFI responses, which was whether the Centers should be 'face-to-face' or virtual. Janet outlined that the dominant RFI viewpoint, substantiated by examples, is that the amount of face-time between team members positively correlates with a Center's success. Janet then provided a number of questions to the HPAC -- in areas including: numbers of Centers; 1-phase Centers, or 2-phase Centers with full award at Phase-2; virtual or not; an R2O-O2R component (or, e.g., possibly a R4O component but with no direct operational link) or not -- and she encouraged individual HPAC members to provide their feedback to her soon.

Sixth, also on Friday morning, Tsengdar Lee, the NASA High End Computing [HEC] program executive for SMD, provided a status update on NASA HEC and its support of HPD research. He described excellent progress in NASA modular facility expansion for high performance computing, and that enough HEC capacity is now straightforward to achieve. He added that since this build-out is tied to the budget process, HEC should be treated as a limited resource, like telescope time. For future resources he noted that advocacy, accompanied with clear documentation of the programmatic needs for the HEC resources, would be very beneficial. The HPAC was glad to hear this positive update, and in the next meeting will plan to address how best to help.

Finally, seventh, on Friday morning Dr. Michael New, SMD Acting Deputy Associate Administrator for Research, provided the R&A program Charge to the HPAC. In his presentation Michael noted the Charge questions to the HPAC as follows:

Does the SMD R&A program have effective processes in place to solicit, review and select high-impact/high-risk projects?

Does the SMD R&A program have effective processes in place to solicit, review and select focused, interdisciplinary, and interdivisional projects?

The HPAC discussed the optimal way forward to answer the R&A Charge questions, and determined that the process should be to form an HPAC Subcommittee with Chair and Co-Chair to be Jim Klimchuk and Paul Cassak, and that HPAC members interested in serving on the Subcommittee should promptly contact Jim and Paul and let them know about their interest. The first step of the Subcommittee should be to determine preferred methods of information collection for the Subcommittee Report and, when the Subcommittee has its desired collection plan in hand, the Subcommittee Chair and Co-Chair should provide the plan to the HPAC DFO and proceed following the DFO's direction. The HPAC then agreed that the Subcommittee Report should be provided to the full HPAC two weeks prior to the HPAC's next meeting when the Report will be discussed so that all HPAC members will have sufficient time to assess the Report before voting on it. The HPAC options during this meeting would include to vote to accept the Report: as-submitted by the Subcommittee; with updates that would be added by the full HPAC during this meeting's open sessions; or, with updates that would be requested by the HPAC during this meeting and achieved subsequently by the Subcommittee, and with the Subcommittee Report then resubmitted for HPAC voting at the following meeting. The HPAC also wishes to applaud the NASA SMD for addressing this serious issue that underpins space research readiness.

We welcome NASA Heliophysics Division requests to elaborate or clarify.

Sincerely,



Jill Dahlburg

Naval Research Laboratory

on behalf of the Heliophysics Advisory Committee

Cc: Elsayed Talaat, HPAC Designated Federal Officer
Janet Kozyra, HPAC Alternate Designated Federal Officer
Bradley Peterson, Chair, NASA Advisory Committee - Science Committee [NAC-SC]
Elaine Denning, NAC-SC Designated Federal Officer