COLLEGE OF ENGINEERING
CLIMATE AND SPACE SCIENCES AND ENGINEERING
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Ms. Margaret Luce, Heliophysics Division Director (Acting)
National Aeronautics and Space Administration
Heliophysics Division
300 E Street, SW
Washington, DC 20546-0001

Dear Ms. Luce:

The Heliophysics Advisory Committee [HPAC] of the National Aeronautics and Space Administration [NASA] convened on 5 April through 6 April at NASA Headquarters [HQ]. The undersigned served as Vice-Chair for the meeting with the support of Janet Kozyra (HPAC Designated Federal Officer [DFO], NASA Heliophysics Division [HPD]). All HPAC members participated. Those in attendance at NASA HQ included Jill Dahlburg (Outgoing Chair, Naval Research Laboratory), Vassilis Angelopoulos (University of California, Los Angeles), Heather Elliott (Southwest Research Institute), Darko Filipi (Adcole Maryland Aerospace), Bart De Pontieu (Lockheed Martin), 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), Tomoko Matsuo (University of Colorado at Boulder), William Matthaeus (University of Delaware), Mari Paz Miralles (Harvard-Smithsonian Center for Astrophysics), Cora Randall (University of Colorado, Boulder), and Roger Smith (University of Alaska). Paul Cassak (West Virginia University) attended via telecon. This letter summarizes the meeting outcomes.

The meeting opened with you providing an HPD science and technology overview and a discussion about the budget. The HPAC was glad to hear that the HPD is well-aligned with the three SMD strategic objectives: (1) science and exploration including the lunar gateway; (2) safeguarding and improving life including R2O and O2R; and (3) executing a balanced and integrated science program.

The HPAC was delighted to hear that DRIVE funding has increased from $115M in FY16 to $164M for FY18, and up to $178M by FY19. Per the HPD's DRIVE planning overall, the HPAC suggests that it would be very helpful to hear a focused talk about DRIVE at the next convening, which includes these topics:

> We applaud the improvements to several programs under the DRIVE implementation. However, we also note that the success rate for proposals in the critical HGI and HSR programs remain under 20%. This is widely viewed as too low a success rate to sustain and develop a healthy heliophysics community, as these are mainstream programs for

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funding research by scientists at all states of their careers, and are essential for supporting the heliophysics science and missions. In particular, 10% – 20% success rate are not high enough to recruit or maintain young people in the field. From both a short-term and a long-term perspective, it is highly desirable to take steps to bring these percentages up in a timely fashion to ~30% by better balancing the increased DRIVE funding across the various R&A sub-programs. To further our discussion on this issue, it would be useful to be provided information on the budgets of all the sub-programs and their increases since DRIVE was implemented.

HPAC also was very pleased to hear about HPD's ongoing focus on a high and reliable cadence for upcoming mission Announcements of Opportunity (AOs). HPAC would like to thank you for the beneficial discussion on this topic, in particular regarding the release of a MIDEX AO before announcing the outcome from the ongoing SMEX Phase A projects. Our finding on this topic is as follows:

The Midex AO is currently scheduled to come out toward the end of CY 2018. The selections for the SMEX AO are scheduled for ~March 2019. The committee recognizes the importance of maintaining a good pace of new missions, and is pleased that the resources are available to support the Midex AO at this time, but sees some disadvantages. A delay of 6 months would still keep the 2-3 year cadence recommended by the Decadal Survey.

Advantages of keeping to schedule:
-- This maintains a fast pace of opportunities for new missions
-- The money is available in the current budget, and future budgets are more uncertain.

Disadvantages of releasing the Midex AO before the results from the SMEX are out:
-- The specific science addressed by the selected SMEX missions would likely not be selected again for the Midex, so some Midex proposals may end up being at a disadvantage.
-- Postponing the AO allows the Midex proposals to be tailored based on the SMEX selection to complement the science, creating the best Heliophysics Observatory.
-- With five SMEX proposals in Phase A, a significant part of the community will be engaged in finalizing the site visits for the Phase A during the critical Midex proposal time, making it more difficult for them to participate.
-- The AO would come out very soon after the MOO proposals are due, leading to a continuous heavy load of mission proposal preparation requiring significant internal institute resources, as well as a continuous heavy review load for the community.

In the area of your report about ongoing progress, HPAC wishes to congratulate HPD on the outstanding and powerful Heliophysics Observatory for which all missions are "in the green" and all are very productive.

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The committee then heard a status briefing about the GDC Science and Technology Definition Team (STDT) from Jared Leisner. We are looking forward to hearing more soon. At this point in time, our only suggestion is that Dr. Leisner convey to the STDT at least some information about all of the RFI community responses. We would also like him to consider to inform those RFI respondents whose detailed reports would not be conveyed to the STDT, for the planning purposes of those RFI contributors.

Next, the committee delved into addressing the research and analysis (R&A) charge from Dr. Zurbuchen. Question 1 addressed the issue of how NASA SMD can most effectively support high-risk/high-payoff proposed projects and question 2 addressed the issue of how NASA SMD can best support interdisciplinary and interdivisional projects. Following a general discussion about questions 1 and 2, each of the subquestions were fielded to a member of the HPAC to coordinate responses and the drafting of our report to the SMD at the next NAC Science Committee meeting. Our full comments on the R&A Charge question set are contained in the accompanying Powerpoint slide set. If you would like us to continue considering these questions and to provide additional input on these topics, then please let us know and the HPAC will take this up again at its next meeting. A summary statement of our findings is as follows:

> High Impact/High Risk projects: We define these as those projects that will "rewrite the textbooks." We recommend starting at ~5% dedicated to these projects, with program evaluations to adjust this in future years. We recommend that review panelists undergo special training on evaluating this type of proposal. We recommend “lessons learned” final reports in addition to technical outcomes, made public so others can understand and build on the work. We are split on whether to have a separate call or not, perhaps even both approaches could be implemented, and perhaps even have a special procurement process for such projects.
>
> Interdisciplinary/interdivisional projects: we suggest that SMD "go slowly and adjust." Start with perhaps ~1% of R&A Divisional budgets devoted to interdivisional research. We identified many examples of how Heliophysics researchers could contribute to interdivisional work. Interdisciplinary work should be identified by the proposer for special consideration by the panel. We are split on whether to have a separate ROSES-E call for these projects or have them submitted through regular ROSES elements in A-D, but designated by the proposer as interdivisional. Perhaps both approaches could be implemented.

HPAC then heard an update from Dr. Jeff Hayes about the NASA HEC high performance computing support for the Heliophysics community. At the beginning of a briefing about HPD strategic planning, the HPAC, first, would like to note that Dr. Hayes has been providing outstanding support for the community's HEC needs and we would like to offer our sincerest thanks for his thoughtful and helpful leadership here. From a perspective that HEC is now in high demand across all of NASA, HPAC would like to offer these observations for moving forward:

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The HPAC appreciated the review of the current HEC allocation process and recognizes the increased need for resources from the High End Computing (HEC) division for heliophysics. We commend the Heliophysics division for its intention to expand the CPU allocation for Heliophysics at the High End Computing division by investing in an additional module of CPUs that will increase the current allocation by 25% (increase of 12 M SBUs).

To address the current underutilization of CPU allocations and better optimize the usage of CPU allocations within the Heliophysics division's HEC projects, we recommend that the Heliophysics Division take into account current practices from other high end computing environments (e.g. at the DOC and DOE or other SMD divisions) by:

-- informing the community about the consequences of underutilization of CPU allocation, both for individual PIs (reduced allocation in next year) and the Heliophysics computing community (loss of CPU time)
-- closely monitoring (e.g., on a quarterly basis) the CPU usage of all projects and report the usage of all PIs to the whole heliophysics computing community
-- facilitating a (possibly automated) program in which unused CPU allocations are identified, and after negotiation with the PIs, re-allocated to other projects (within the fiscal year) that have indicated a desire for additional resources.

There are varying opinions on whether this CPU-time swap-program should be imposed or voluntary and lessons could be learned from other HEC environments. If an imposed program is implemented, removal of allocations for unused resources should not be overly punitive (unless a long term pattern exists). If a voluntary program is implemented, PIs should be incentivized to join the swap program.

At a future meeting, the HPAC would like hear more about how other SMD divisions ensure optimal utilization of CPU allocations.

Given the current oversubscription of HEC resources within the Heliophysics division and the continuously increasing user base, the HPAC suggests that, in the medium term, the review process should take into account the balance between the needs of missions, research and analysis and other programs.

Following Dr. Hayes' HEC update, Dr. Jim Spann then provided a status briefing about HPD strategic planning, with a focus on the following: (1) maximizing mission cadence; (2) assessing programs; and (3) maximizing research. The HPAC would like to note that human resources should be included in HPD strategic planning in order to ensure the right mix of personnel expertise in the future.

We recommend that strategic planning should include consideration of human resources development to ensure that critical mass of experts is available in the future across all Heliophysics disciplines. The Solar and Space Physics Decadal Survey 2013 indicates that while Ph.D. production rate for solar and space physics has increased in years 2001-2010, the number of advertised positions in the field has decreased. In particular, the

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number of advertised faculty positions reached a decadal low in the last year surveyed, 2010. The HPAC suggests to continue monitoring the health of the field of solar and space physics.

Dr. Janet Kozyra then provided an update about planning toward the HPD science centers. She presented a thoughtful roll-out concept, based from considerable research about the implications of social sensitivity in collaborative science, such as the NAS 2015 team science report and Hoegl's 2005 work, that found that small cohesive teams of 6 to 7 people were the most productive. Hence, Dr. Kozyra suggested that, as a guideline for a highly productive yet large-scope center, the structure of 6-7 areas/locations, with 6-7 people at each of the areas/locations, for ~36 center members total, would be optimal. The HPAC was glad to hear this update and is looking forward to the next steps, which should be very positive for the community.

On the second day, the HPAC heard a briefing from Dr. Spann about the promising Lunar Gateway. He described some of the high priority science that the Gateway will enable, such as the RAD environment, dusty plasmas, space weather, and CubeSats/smallsats.

Dr. Terry Onsager then provided a very helpful and comprehensive briefing about the status of the space weather coordinated effort between NASA, NOAA, and other federal agency partners, with NASA focusing mostly on research. Since this is collaborative research, the agreements and understanding about intellectual property issues must be carefully thought through. The HPAC fully concurs with Dr. Onsager's observation about this aspect, which is the need for recognition that this is an issue that we need to address front and center, involving the entire community. HPAC was then glad to hear Dr. Spann's comment that this topic is being thought through at HQ via the developing "science-to-applications" program, within which the topic of transitioning between research and operations will be addressed, towards developing an iterative "rules of the road" structure. Finally, the HPAC agrees with Dr. Onsager's incisive summary comment that "we are at the early stages of generational changes." We look forward to more updates on this topic at future HPAC meetings.

We welcome NASA Heliophysics Division requests for elaboration or clarification.

Sincerely yours,

Michael W. Liemohn

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

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