COLLEGE OF ENGINEERING
CLIMATE AND SPACE SCIENCES AND ENGINEERING
UNIVERSITY OF MICHIGAN

Michael W. Liemohn • Professor

October 18, 2019

Dr. Nicola Fox, Heliophysics Division Director
National Aeronautics and Space Administration
Heliophysics Division
300 E Street, SW
Washington, DC 20546-0001

Dear Dr. Fox:

The Heliophysics Advisory Committee (HPAC), an advisory committee to the Heliophysics Division (HPD) of the National Aeronautics and Space Administration (NASA), convened on 1 October through 3 October 2019 at NASA Headquarters (HQ). The undersigned served as Chair for the meeting with the support of Dr. Janet Kozyra, HPAC Designated Federal Officer (DFO), of NASA-HPD.

Most HPAC members participated. Those in attendance at NASA HQ were Vassilis Angelopoulos (University of California, Los Angeles), Darko Filipi (Adcole Maryland Aerospace), George Ho (Johns Hopkins University Applied Physics Laboratory), Lynn Kistler (University of New Hampshire), Tomoko Matsuo (University of Colorado at Boulder), Rebecca Bishop (The Aerospace Corporation), and me. A few committee members attended via telecon: Paul Cassak (West Virginia University), Larisa Goncharenko (Massachusetts Institute of Technology (MIT) Haystack Observatory), and Cora Randall (University of Colorado, Boulder). This letter summarizes the meeting outcomes.

The meeting opened with you providing an update and overview of HPD activities during 2019. HPAC was greatly impressed by the many initiatives and new programs underway in HPD. HPAC congratulates HPD on their success in developing and implementing several new programs directed at early career heliophysics researchers. This includes the new ROSES element, Early Career Investigator Program, continued support of the FINESST graduate student fellowship program, the new PI Launchpad Workshop series beginning next month, and creation of the upcoming summer school on mission planning and development. We would also like to commend HPD on its numerous spaceflight opportunities:

> HPAC commends NASA's Heliophysics Division (HPD) for supporting a healthy number of new missions in the past year. This includes the AWE, PUNCH, TRACERS, and SunRISE missions in formulation, two concept studies for ride share with IMAP, two concept studies for technology demonstration, three Explorer Missions of Opportunity concepts, one ride share to Mars, and three lunar payload investigations. These missions address important science questions, expand

Climate and Space Research Building
2455 Hayward St., Ann Arbor, Michigan 48109-2143
T: 734 763-6229
liemohn@umich.edu | clasp.engin.umich.edu

capabilities of the Heliophysics Science Observatory (HSO), and provide important educational opportunities for students. HPAC commends NASA for their efforts supporting new missions and its commitment to continued support of these programs.

HPAC also notes that the influx of new mission opportunities provides HPD in particular, and NASA's Science Mission Directorate (SMD) in general, with an excellent opportunity to obtain important baseline information about the diversity of the applicant pool for these new mission opportunities. While data on applicant representation is scarce, recent HPD mission awards have underrepresented people selected as PI at approximately half the rate as for the broader grants program. This implies that mission leadership is even less diverse than the community as a whole, which itself is not representative. HPAC heard in a previous meeting during discussions with Michael New that SMD and HPD are implementing numerous new approaches to increase diversity of the applicant pool for mission leadership. This laudable effort deserves a careful assessment of its effectiveness in increasing participation by underrepresented people, and such an assessment can only be done by tracking representation data as a function of time. HPAC understands that demographic information is not solicited when proposals are submitted, which makes data on representation difficult, but believes that there are actions that could be taken to avoid missing out on this opportunity to obtain this potentially important information.

HPAC recommends that HPD encourages SMD to develop an approach to obtain representation data of applicants for new missions, whether by brute force or with a more systematic approach. The purpose is to be able to assess diversity of the applicant pool now and for longitudinal comparisons with future years to assess the effectiveness of the numerous programs SMD and HPD are carrying out.

During the first day's lunch, we heard from Dr. Lika Guhathakurta about the Frontier Development Laboratory, a summer program at Ames Research Center. She touched on two important aspects of using machine learning for heliophysics research – the need for "AI-ready" data sets and the requirement of sufficient computing resources. It was an interesting and engaging presentation.

After lunch, Ms. Jennifer Kearns briefed us on the Government Performance and Results Modernization Act (GPRAMA) process. We then spent some time examining the source material provided by HPD regarding this evaluation. We developed initial responses to the Annual Performance Indicators. On the second day, we finalized these summary paragraphs and voted on this topic, voting unanimously for a green rating (meeting or exceeding expectations) for all three heliophysics science indicators. Please see the accompanying letter for the full summary paragraphs of our GPRAMA findings.

HPAC then heard from the Living With a Star Program Analysis Group. We were pleased to hear that they spent this year focusing on revising the strategic science areas for the

Space Research Building, 2455 Hayward St.
Ann Arbor, Michigan 48109-2143
T: 734 763-6229
liemohn@umich.edu | clasp.engin.umich.edu

LWS program and on performance metrics for funded projects and teams. Here are our detailed findings:

> Dr. Linton, the co-chair of the Living With a Star Program Analysis Group (LPAG), presented a review of this year's LPAG activities. Besides drafting the new Focused Science Topics (FST), the group performed a review of the 2014 Strategic Science Areas. Based on this review LPAG recommends expanding, reordering, and refocusing the SSAs in order to better align with LWS program goals and complement the National Space Weather Action Plan and NASA's new Space Weather Science and Applications (SWxSA) program. Eight of the ten new SSAs are traced directly back to the originals. Of the two new SSAs, SSA-IX and SSA-X, one is derived from the original LWS Sun-Climate Theme, and the other is a new topic. HPAC would like to thank both the chairs, Drs. Linton and Coster, and the team for their excellent work drafting this year's FSTs as well revising the SSAs. In regards to the revised SSAs the committee recommends the following:
>
> - SSA-I to SSA-VIII be accepted as is by NASA as the new baseline SSAs.
> - SSA-IX, "Solar Impact on Climate", be included in the baseline going forward. Some HPAC members expressed concern that the word "climate" conveyed an ambiguous overlap with research traditionally supported by the Earth Science Division. This recommendation therefore includes a suggestion that the LPAG clarify the boundaries covered by this SSA, commensurate with the LWS "10-yr Vision Beyond 2015".
> - LPAG coordinate with the Cross-Division programs E.3 "Exoplanet Research Program" and E.4 "Habitable Worlds" prior to the permanent inclusion of SSA-X: "Stellar Impacts on Planetary Habitability".
>
>   The HPAC noted that the E.3 and E.4 program descriptions specifically state that only work not already funded through Living With a Star will be funded. Further, since LWS contributes funds to those programs, inclusion of the topic within LWS may not be appropriate. Thus, coordination with the Planetary Science Division and Astrophysics Division is paramount.
> - If SSA-X is included following coordination with the Planetary Science Division and the Astrophysics Division, it should be reviewed after 2-years to assess the community's continued support, participation, and proposal pressure.

Near the end of the first day, HPAC heard form Dr. Jim Spann of NASA HQ on the ongoing space weather activities of HPD. We commend HPD on these efforts and advocate for the creation of a space weather program analysis group. Here are our findings and recommendations regarding space weather:

> We applaud HPD's effort in expanding NASA's role in space weather science under the new Space Weather Science and Application (SWxSA) program. We are especially delighted to hear that HPD is engaging with other government agencies to address the National Space Weather Strategy and Action Plan. SWxSA would

Space Research Building, 2455 Hayward St.
Ann Arbor, Michigan 48109-2143
T: 734 763-6229
liemohn@umich.edu | clasp.engin.umich.edu

equally benefit from community inputs similar to the Living with a Star Program Analysis Group (LPAG) for the Living with a Star Program. We recommend:

- HPD to form a community-based Program Analysis Group (PAG) specifically for the SWxSA program with the purpose of soliciting and coordinating community input.

Furthermore, HPAC feels that additional PAGs would strengthen communication between the community and NASA HPD. 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 provide additional points of view and thereby broaden community representation. We recommend:

- HPD should investigate implementing additional PAGs. 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. However, there may be emerging technology or programs such as hosted payload or CubeSat/SmallSat that could also benefit from a PAG.

Wednesday morning began with a report from Dr. Mona Kessel on the HPD Research and Analysis programs. As noted above, we are excited to hear about the new programs targeting early career investigators, and other new programs in support of new initiatives identified by the last decadal survey.

HPAC was presented the NASA's R&A program budget status, selection rates and plans for FY20.

HPAC commends HPD on its efficient utilization of the recent uptick in funding. The increase in funding to the HGI program and the Technology program were laudable, as was the implementation of a well-thought out DRIVE centers program. These were all called for in the Decadal survey. Additionally, the establishment of several new programs, such as the Internal Scientist Funding Model, the Early Career Investigators Program and the Theory, Modeling, Simulation program, make for outstanding utilization of community resources. HPAC also commends the HPD on the increase of the success rates in the GI and SR selections, the bread-and-butter for the research community, which ultimately drives new ideas for Heliophysics exploration. They have gone up to 20% or greater, compared to the 15-20% levels in past years. The HPAC wishes to encourage HPD to continue this positive trend towards a goal of 33% in order to ensure the needed vitality in the field with benefits to be seen over a long-term period.

Space Research Building, 2455 Hayward St.
Ann Arbor, Michigan 48109-2143
T: 734 763-6229
liemohn@umich.edu | clasp.engin.umich.edu

HPAC also recommends that HPD examine and report back on selection rates based on panel rating, in addition to the overall selection rates regularly reported.

HPAC also has a separate comment on the particular issue of the upcoming trial of dual anonymous reviewing for next year's Heliophysics Guest Investigator program element:

We applaud HPD effort in experimenting with an innovative method (i.e., dual anonymous review) to improve the current HPD R&A grant proposal review process. We recognize that, unfortunately, both conscious and unconscious biases exist in the scientific communities. Dual anonymous review has been documented in other scientific communities that diminishes such a bias. We also recognize that with a relatively small population in the heliophysics community, whether we can successfully implement a true dual anonymous review process is uncertain at this time. We recommend:

- HPD provide diversity information of past R&A programs to HPAC in order for us to evaluate the extent of such bias in our review processes. This data will also serve as a baseline to establish metrics to re-evaluate the success of any new methodology implemented as part of our review process. HPD and SMD should use metrics to evaluate the effectiveness of their dual anonymous review implementation, paying specific attention to how rigorous the compliance requirements should be for references within the paper text. Comparison to implementations of other organizations, such as the Nature journal and NIH, would also be beneficial.
- HPD and SMD should also consult experts from other disciplines (e.g., sociology) to research and implement other innovative methods in parallel to the dual anonymous review.
- HPD should re-evaluate any newly implemented review processes and update HPAC regularly.

At lunch on Wednesday, HPAC heard a report from Dr. Richard Eastes on the first results from the Global Observations of the Limb and Disk (GOLD) mission of opportunity. HPAC was impressed with the fidelity of the observations and the productivity of the science team. HPAC was pleased to hear that the partnership of launching a NASA science payload on a commercial satellite is going so well. We look forward to the continued success of this mission.

In the early afternoon, HPAC learned about the upcoming Senior Review (SR) process. We are very glad that this will not be conducted as a subcommittee to HPAC, but rather following the review panel procedures. HPAC agrees with this change from the last SR round and thinks that this is the proper method of conducting this process. Our finding:

HPAC was presented the NASA's Senior Review proposal plans for FY20, which were revised significantly from previous years.

Space Research Building, 2455 Hayward St.
Ann Arbor, Michigan 48109-2143
T: 734 763-6229
liemohn@umich.edu | clasp.engin.umich.edu

> HPAC commends HPD on its revision of the SR process, in particular for (1) simplifying the review process for legacy missions continuing operations in a supporting role and (2) streamlining the requirements for continuing missions providing science in addition to system-observatory support. HPAC also commends HPD on elevating the importance of open algorithms and source code, not just open data preservation, using open repositories to safeguard the value arising from taxpayer investment in the data collected, and to ensure reproducibility of research. However, HPAC notes that source code preservation requirements might be interpreted too broadly, as they were presented to (apparently) include also the low-level programming language. This requirement would make higher-level open software written in widely used languages (such as IDL) non-compliant. HPAC notes that such code forms the basis of legacy processing and analysis routines, which would be costly and risky to change, putting undue pressure on an already stressed program. HPAC also notes that such a stringent interpretation of an "open source code" preservation requirement may not be consistent with the recommendations of the National Academy report on open source software policy (https://www.nap.edu/catalog/25217/open-source-software-policy-options-for-nasa-earth-and-space-sciences). Imposing such an open source requirement on the programming language being used may be unnecessary, costly, risky and counterproductive. HPAC recommends that NASA HQ revisit the rationale behind this requirement; if the Academy recommendations were to be found correctly interpreted, HPAC recommends that only future missions be subjected to this, giving them sufficient time to plan, cost, execute and test any code changes to open-source language. HPAC also recommends that HPD's definitions of "code," "algorithm," and other similar terms be made upfront, so there is no confusion for the proposers.

One of the critical elements of the HPAC meeting was receiving the report from the Science and Technology Definition Team (STDT) for the Geospace Dynamics Constellation (GDC) mission. We heartily approve this report and agree to its full release and usage by NASA HQ. We also commend the entire STDT team on producing a high quality report, and extend our special congratulations on a job well done to the co-chairs of the STDT, Dr. Aaron Ridley and Dr. Allison Jaynes, and the DFO for the STDT, Dr. Jared Leisner. Our full finding and recommendation list from this discussion is given in the accompanying letter devoted to the GDC STDT report.

The final presentation made to HPAC was from one of the Strategic Working Groups, on Archives. Our report on this presentation is as follows:

> We applaud HPD effort in developing a new and innovative strategy by forming the eight Strategic Working Groups (SWGs). We are particularly encouraged with the proactive approach by HPD to formulate these WGs in order to maximize the impact of HPD missions and research, and to anticipate the upcoming Heliophysics Decadal Survey.

Space Research Building, 2455 Hayward St.
Ann Arbor, Michigan 48109-2143
T: 734 763-6229
liemohn@umich.edu | clasp.engin.umich.edu

The briefing by Dr. Jeff Hayes and Ms. Dominique Chamely was helpful to understand the Archives WG's process in formulating future Heliophysics data management plan as well as the Strategic Data Management Working Group's efforts to develop a new SMD-wide policy for open data and open software. The HPAC recognizes: (1) the need to evaluate mission and R&A data products for their archival values to avoid intractable cost overruns; and (2) the benefit of having deliberate and robust open-source software implementation plans to assure reproducibility of data and to mitigate exorbitant software development burden on investigators.

We request to hear briefings on this and other SWGs in the future HPAC meetings.

In conclusion, HPAC thanks HPD and all others involved for convening this committee meeting and the extensive discussions we had with HQ staff. We would especially like to thank Dr. Kozyra for her organization efforts and to thank all of those that helped to make this meeting run so smoothly.

HPAC welcomes NASA Heliophysics Division requests for elaboration or clarification regarding any of these findings and recommendations from the committee.

Sincerely yours,

Michael W. Liemohn

Space Research Building, 2455 Hayward St.
Ann Arbor, Michigan 48109-2143

T: 734 763-6229
liemohn@umich.edu | clasp.engin.umich.edu