



Michael W. Liemohn · Professor

July 30, 2020

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 30 June through 1 July 2020, virtually through Webex. The undersigned served as Chair for the meeting with the support of Dr. Janet Kozyra, HPAC Designated Federal Officer (DFO), of NASA-HPD. This letter summarizes the meeting outcomes, including our findings and recommendations.

All of the members of HPAC participated. Specifically, the membership of HPAC is as follows: Vassilis Angelopoulos (University of California, Los Angeles), Rebecca Bishop (The Aerospace Corporation), Paul Cassak (West Virginia University), Darko Filipi (BizTek International LLC), Lindsay Glesener (University of Minnesota), 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 Boulder), William H. Matthaeus (University of Delaware), Mari Paz Miralles (Smithsonian Astrophysical Observatory), Cora Randall (University of Colorado, Boulder), and me.

The meeting opened with you giving an overview of the state of HPD. We were pleased to hear about HPD's successful recent launch of Solar Orbiter and the healthy status of all of the Heliophysics division missions. This includes the HERMES payload on the Gateway and plans for a request for information regarding community input for instrumentation and spacecraft related to NASA's return to the moon.

Thank you for leading off this briefing with details of the HPD response to COVID-19. We developed a finding on this point:

HPAC acknowledges the swift and carefully thought-out COVID-19 response by the SMD and HPD through a number of measures, including the prioritization of mission-critical projects, the institution of grant

administration flexibility, and the facilitation and encouragement of continued payment of stipends and salaries for graduate students, post-docs, soft-money researchers, and other lab staff during this time of uncertainty. HPAC is grateful for the HPD's COVID-19 response, which has thus far helped mitigate and minimize the impact on the missions and R&A programs, and recognizes the difficulty in setting up new policy and programs until the full extent of the impacts of the pandemic becomes clear.

For the health and vitality of the Heliophysics community, it is critical to maintain a strong, diverse pipeline of the next generation of Heliophysics scientists. Members of the Heliophysics community who are especially impacted by the pandemic include (1) those who have contracted and are at higher risk for contracting the disease, or whose family members have contracted the disease, (2) parents of small children whose daycare options are limited or too risky, and (3) international scholars who face restricted travel and visa accessibility. HPAC notes that all of these factors are likely to have the strongest impact on underrepresented minority (URM) populations within the Heliophysics community. For those who have experienced an interruption in work due to one of these factors, there has likely not only been an interruption in scholarly work on existing grants, but also an interruption in the writing of proposals and seeking of new positions, which will significantly affect their continuity of funding and employment.

HPAC thus recommends that the HPD further explore the possibility of initiatives to assist those most likely not to enter and/or stay in the field due to lack of opportunities and uncertainty resulting from the COVID-19 pandemic, including college and graduate students, post-docs, early-career scientists, soft-money researchers, and URM and international scholars. For example, it may be helpful to set up targeted training opportunities, short-term internships, scholarships, and quick turnaround pandemic bridge fund opportunities, and to develop a partnership with foreign agencies based on a no-exchange of fund basis to set up stopgap funding opportunities to have international scholars remain engaged in HPD science activities. Some recent graduates are facing difficulties in connecting with prospective employers, as many in-person conferences and job fairs have been cancelled. Additionally, many URM members lack the necessary networking and self-promotional skills, making them particularly disadvantaged. HPAC encourages the HPD to discuss with the SMD directors and NASA administrators the issue of childcare accessibility, and urge NASA leaders to speak more directly to political leaders about the risk to our workforce if the childcare issue is not addressed at the necessary level.

In your opening remarks, you also detailed HPD activities regarding racism and diversity. We have another finding on the issue of diversity, equity, and inclusion (DEI) in heliophysics:

We are living in a time of great social upheaval following the highly-publicized brutality against Black Americans – a time when people of all races are challenging themselves to fix inequities due to hundreds of years of oppression, and a time for those in power to remove barriers that institutionalized racism have imposed. HPAC commends HPD for posting an important message on Facebook about these issues, for bringing it up at this HPAC meeting, and for soliciting input from the community – through HPAC and beyond – on how HPD can improve.

HPAC feels this response is a good start but is insufficient. The presentation at this HPAC meeting did not share what HPD has done internally in the last couple of months to address these matters. It is crucial for *HPD itself* to take initiative to make HPD more equitable and inclusive for Black people, which will show Black people in the Heliophysics community that their voices are being heard. Input from the community is necessarily limited because (a) Heliophysicists are a relatively homogeneous community that is mostly not trained in diversity, equity, and inclusivity (DEI), and (b) there are structures in place within HPD that the community cannot have perspective on. HPAC recommends that HPD asks itself difficult questions about where problems exist in its structure and culture, how to address them, and how to explicitly show the Black Heliophysics community that they are valued and welcome.

HPAC notes a challenge for HPD as a federal agency is its timescales are long, while the push for equality is very rapid. HPAC recommends HPD to not only focus on long-term changes that will occur after the collection of demographic data that NASA is laudably compiling, but to also not miss the opportunity to capitalize on the present movement.

HPAC has recommendations to augment ideas obtained of HPD, which follow here and in a separate recommendation on building a diverse pipeline. Programs can include (a) broadening participation in NASA Heliophysics research at predominantly Black institutions through a funding stream for collaborations with those at other institutions, (b) incentivizing Heliophysics outreach and education activities in targeted areas and minority serving institutions (perhaps in partnership with the Office of STEM Engagement), (c) funding Heliophysics research experiences for undergraduates (REUs) for Black students, (d) funding new faculty lines of Black heliophysicists and faculty in Heliophysics at predominantly Black institutions, and (e) improving the inadequate implicit bias training that HPD proposal panelists take.

The recommendations in the preceding paragraph are consistent with the advice of the AIP 2020 report “*The Time Is Now: Systemic Changes to Increase African Americans with Bachelor’s Degrees in Physics and Astronomy*”, which found that the dearth of Black and African American physics degrees is

primarily due to (1) the lack of a supportive environment and (2) the tremendous financial barriers faced, on average, by Black students and by the institutions that serve them. The report highlighted the need for institutions, scientific societies, and agencies to aid in breaking down these barriers. Given the significant amount of research done in the area of improving DEI, HPAC recommends that HPD consult external reports and experts where appropriate. While the ideas and recommendations here are aimed at addressing inequities in the Black community, similar approaches may also be beneficial for other minority populations.

We wrote another finding on the need to support diversity not only within the current space physics research community but also at all levels of the education system, supporting a diverse pipeline in science, technology, engineering, and mathematics (STEM):

The Decadal Survey, its Midterm Evaluation and NASA's Response all point to the importance of addressing diversity and inclusion, both in the current Heliophysics programs and in the outlook for the future of the Heliophysics workforce. Diversity issues tend to divide somewhat arbitrarily into ethnic diversity issues and gender diversity issues. The impetus for enhanced activity in achieving ethnic diversity, particularly with regard to Black Americans, is emphasized in another finding and is further addressed here with regard specifically to the pipeline. In gender diversity, the Heliophysics community currently lags behind its peers in other Earth and space science areas on issues of diversity at all career levels (https://honors.agu.org/files/2018/09/2018-section-membership-by-gender-and-career-stage_Sept12.pdf). HPAC urges the HPD to actively address these issues.

Implementation of this priority will require addressing two somewhat distinct areas: the pipeline that supplies the Heliophysics community workforce, and the processes by which candidates are selected for advancement. The pool includes applicants for graduate programs, grants and awards, selection of PIs, service on committees, etc. Ongoing and planned studies of demographics in Heliophysics programs and related activities (e.g., faculty positions) are important for tracking the status and promoting progress in achieving goals of inclusion and diversity. The path to attaining diversity with programs will mainly rely on removing structural biases and barriers. The pipeline issue is broader and traditionally has been viewed as less within the purview of Heliophysics research, an involvement that usually begins at the university or grad school levels. HPAC recommends HPD revisit its potential for positive feedback on the pipeline and its diversity when opportunities arise.

The pipeline begins at early stages of young peoples' development: in college, high school or even grade school, when interests in STEM subjects such as Heliophysics are formed and can be nurtured. It is here that the concepts of

physics belonging and identity, so critical to motivation and success in later career stages, first form. There are possibilities for heliophysicists to engage in activities that might exert positive forces on these earlier stages and HPAC urges the Division to be sensitive, aware and creative in anticipating these possibilities. By no means to limit this scope, some directions might be: (i) HPD sponsorship of (summer) teacher training programs for elementary and high school teachers at HP University labs and NASA Centers; (ii) similarly-themed heliophysics summer camps for students; (iii) encouragement and resources for graduate level training in heliophysics science and technology subjects for students at MS or PhD who have interest in teaching at K-12 levels; (iv) funding for programs to present assembly-style STEM recruitment presentations at grade school and high schools, possibly involving presentations from several HPD-supported researchers. Such activities might be targeted to reach youth from underrepresented groups. We note that organizations already exist with expertise in these areas and established access to schools and teachers; the capabilities of these organizations can be leveraged. HPAC urges HPD to stand ready to engage in creative responses to this long-term process that can lead to a more diverse and inclusive workforce in future generations of NASA scientists. Responses need not be limited to large-scale professional public outreach specialists, but can and should also involve NASA-supported researchers who come forward with energy and creativity in these directions. EPO supplements, as formerly were an option in Heliophysics grants, may be a means to support such grass roots activities, while special support lines for graduate training for aspiring STEM educators might also be made available on a supplementary basis.

In addition to the above suggestions regarding potential support for diversity in the pre-graduate pipeline, HPAC recommends HPD to implement new strategies to retain diversity in the workforce at different career levels, with special emphasis on transition from student to early career and from early career to mid-career, where large losses in diversity, especially gender diversity, occur. These strategies might include: (i) emphasis on mentoring and recognition of mentorship activities in Heliophysics community; (ii) accommodations and recognition of need for flexible work arrangements for new parents; (iii) flexibility in consideration of parenting-related challenges during performance evaluation.

You reminded us of the 8 strategic working groups within HPD, assessing long-term policies and practices for the division. We have received briefings from some of these working groups at recent meetings; we highly encourage HPD to keep cycling these into the agenda of upcoming HPAC meetings, to keep us aware of the developments in HPD long-range planning activities.

We were glad to hear the Senior Review is underway and, thus far, going smoothly, and

that planning is beginning for the next Decadal Survey. HPAC was pleased to hear that ACE and SOHO are now infrastructure missions rather than extended mission science satellites; this is a useful transition for these two programs. Regarding the last Decadal Survey, you mentioned plans to try to achieve the DYNAMIC science without a full flagship-level mission. We have a finding on this point:

The Decadal Survey Midterm Assessment Report states that NASA should take the steps necessary to prepare for the release of an AO on a DYNAMIC-like mission. It was indicated to HPAC that it is unlikely that funding for a Solar Terrestrial Probes DYNAMIC-like mission will be available within the next decade. In light of this situation, the Heliophysics Division intends to use existing or forthcoming data from missions such as ICON, GOLD, AWE, and the GDC to achieve DYNAMIC science. In addition, there is discussion of new instrument or small mission opportunities to fill in measurement gaps. HPAC is disappointed that a DYNAMIC-like STP mission will probably not be affordable, but applauds prioritizing DYNAMIC science with existing or forthcoming data. We recommend that plans for obtaining measurements from as-yet-unidentified instruments or small missions be solidified and that community input on these plans be solicited in the near future.

You then gave an overview of the HPD R&A programs. We are excited about the conversion of the HGIO program element into one using dual anonymous peer review; we look forward to future briefings about its implementation and results. We are also pleased to hear about the “mock panel” exercise conducted for HQ staff to train them on best practices for panel facilitation. HPAC extends a warm welcome to Dr. Amy Winebarger as she joins the HQ staff on detail from Marshall Space Flight Center, and we commend you on the other recent personnel hiring in the division. Regarding the R&A programs, we have a finding about the availability of additional information:

HPAC commends HPD for sharing information about the grants program, especially the breakdown of funding as a function of the various funding opportunities. HPAC recommends sharing additional information about funding rates to allow a better assessment of the health of the R&A program, specifically data on the funding rate as a function of proposal ranking (E, E/VG, etc.). These data are requested at least annually and in perpetuity. HPAC also requests that waterfall charts be accompanied by a table with the numerical data.

We then heard a briefing from Dr. Jim Spann about space weather activities at NASA HQ. We are pleased that space weather received explicit mention in the latest NASA Science Plan (in strategy 1.4) and the plans of HPD to fully engage in many of the 6 goals of Space Weather (Observe, Analyze, Predict, Transition, Support, and Partner) across the agency. We especially like the creation of the Space Weather Council as a subcommittee to HPAC, and we

look forward to seeing the upcoming request for information about space weather instruments and missions for science (SWIMS). We had a discussion about the use of research to operations (R2O), operations to research (O2R), and back again, resulting in this finding:

We applaud the effort undertaken by NASA Heliophysics to produce a robust and comprehensive Space Weather strategy. We especially found the structure of the six goals, Observe, Analyze, Predict, Transition, Support, Partner, to be well organized and thought out, encompassing the entire Research to Operations to Research cycle. We are pleased to see the plan to engage DoD, USGS, and international agencies in addition to NOAA. However, we are concerned about obstacles to communication resulting from each organizations' needs and requirements (e.g., secrecy surrounding information deemed sensitive). We are very interested in seeing the infrastructure that will be developed to enable effective communication and planning discussions among the organizations including the new Space Weather Council. Finally, while we understand the intention of using the term Operation to Research when describing selected project grants in order to highlight the importance of these activities, we recommend using a different label that better emphasizes the entire research-operation-research cycle.

We filled the rest of the first day with a discussion about the Decadal Survey, starting with the NASA response to the Survey Midterm Report, released since our last meeting, and HPD's preparations for the next Survey. We appreciate HPD's efforts to respond to the Midterm Report. We especially like the inclusion of decision rules for implementation of missions and setting programmatic priorities for research programs. On other aspects, HPAC has some specific comments and recommendations about this response:

HPAC finds that the responses from NASA to the 2019 "Progress Toward Implementation of the 2013 Decadal Survey for Solar and Space Physics: A Midterm Assessment" were largely satisfactory. There was one key area where more information is desired. On page S-2 of the midterm assessment, it was pointed out that a NASA OIG report showed the NASA HPD budget since the beginning of the decadal survey has not kept up with inflation, and has lagged all the other SMD divisions and the NASA SMD budget overall (a 14 percent increase for HPD compared to 30 percent for SMD). HPAC requests that HPD share any insights it might have as to the reason for this trend and seeks guidance on what can be done in collaboration with SMD, NASA, and OMB to ensure the HPD budget deficiencies are addressed. HPAC stands ready to help.

In addition to these comments about the Midterm Assessment, we have a recommendation for NASA to consider when drafting the charge to the National Academies regarding committee selection for the next Decadal:

A successful decadal survey provides a crucial roadmap for maximizing the impact of Heliophysics research and ensuring that tax payers' money is well spent. In order to be successful, the effort must be led by a committee that is fully representative of the science community. All of the relevant stakeholders must have a voice. This includes the full diversity of science disciplines, research techniques, institution types, gender, race, etc. It is not a matter of checking all the boxes. More importantly, the committee must have the confidence of the community. Its members must be regarded as individuals who fairly and effectively represent the full range of interests. To ensure that this is the case, the committee selection process should solicit as much input from the community as possible. The process must also be fully transparent to engender vital community buy-in. We recommend that HPD convey these ideas to the National Academy.

On Wednesday, we heard a presentation from Aly Mendoza-Hill, a program executive in HPD and the Rideshare lead for SMD, on increasing accessibility to space with rideshare opportunities. We commend HPD and SMD on their efforts with this program, especially with the use of EELV Expendable Secondary Payload Adapter (ESPA) rings to provide secondary payload capability and take full advantage of unused lift capacity. We had a discussion about the use of solid fuel boosters within an ESPA ring to provide enhanced access to orbits beyond the location of the main payload. We have the following finding on this topic:

HPAC commends HPD on its proactive stance on creating new, frequent, low-cost launch opportunities for SMD, stemming from the available throw weight on NASA missions. HPAC recognizes the challenges in pairing secondaries to a prime, especially given late-changing prime target orbital elements. HPAC also recognizes the difficulty in extending such launch opportunities to those of commercial primary launches. HPAC recommends that NASA take a closer look at standardizing the ESPA offering with a solid motor, which is an inexpensive way to reach a variety of orbits from a range of initial launch orbits, such as GTO or LEO (NASA or commercial), thereby creating new opportunities for a wide variety of secondaries.

HPAC then heard a briefing from Dr. Janet Kozyra on the Heliophysics DRIVE Science Centers. We are pleased to learn that there were 9 selections for Phase 1 spanning all HPD research disciplines and that the June 2020 kick-off meeting with HPD for these centers was a success. We commend HPD on the success of the start of this program and look forward to continued briefings on it in the years ahead.

Finally, we heard a presentation from Dr. Jared Leisner on the progress towards initiation of the Geospace Dynamics Constellation (GDC) mission. At our last meeting, we received, discussed, and accepted the GDC Science and Technology Definition Team (STDT) report. HPAC was pleased to hear that HPD immediately moved forward with the creation of an internal

GDC implementation committee to develop specific mission concept architectures. We look forward to the release of this committee's report and the continued development of the GDC mission.

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 at HQ who 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,

A handwritten signature in black ink, appearing to read "Michael Liemohn". The signature is fluid and cursive, with a long horizontal stroke at the end.

Michael W. Liemohn