

2020 March 26

Dr. Paul Hertz
Astrophysics Director
Science Missions Directorate
National Aeronautics and Space administration (NASA)

Dear Paul,

The NASA Astrophysics Advisory Committee (APAC) had its Spring face-to-face meeting on 2020 March 5-6 at NASA Headquarters, Washington, DC. The following members of the APAC attended the meeting: Laura Brenneman, John Conklin (Vice Chair), Asantha Cooray, Massimiliano Galeazzi, Jessica Gaskin, Hashima Hasan (APAC Executive Secretary), William Jones, Suvrath Mahadevan, Margaret Meixner, and Michael Meyer. APAC members Kelly Holley-Bockelman, Leonidas Moustakas, and Lucianne Walkowitz participated virtually by WebEx.

Public lines were opened, and Dr. Hasan began the meeting by welcoming all the APAC members, and explaining its purpose. Dr. Hasan reminded APAC members who had conflicts of interest with specific topics on the agenda that as conflicted members they were allowed to listen to the presentation but could not participate in the committee's discussion. Dr. Hasan then reviewed the Federal Advisory Committee Act (FACA) rules. Dr. Woodward then welcomed the members to the meeting, outlined the agenda, and reiterated some of the FACA and conflict of interest rules. APAC members proceeded to introduce themselves.

The agenda consisted of the following presentations:

- Astrophysics Division Update – Paul Hertz
- ROSES R&A Update – Stefan Immler
- ExoPAG, COPAG, and PhysPAG reports – Michael Meyer, Margaret Meixner, Graca Rocha (virtual)
- Astrophysics Pioneers Program – Michael Garcia
- WFIRST update – Jeff Kruk
- Science Data Management Working Group report – Pat Knezek
- James Webb update – Eric Smith
- LISA update – Ira Thorpe (virtual)
- SOFIA update – Naseem Rangwala

A science talk by Dr. Raphaelle Hayward entitled “Engaging in global issues as a Sagan Fellow” was given during the lunch break to the APAC on 2020 March 05.

The APAC thanks all the presenters for their time and efforts to provide crisp and informative presentations.

The APAC (“the committee”) has the following findings and recommendations as a result of the presentations and subsequent discussions.

ROSES

The APAC thanks Stefan Immler for the detailed ROSES update. The committee appreciates the statistics on the gender balance of the proposals, the panels and the selected proposals. The average selection rates seem healthy. The finding that the selections are consistent with the submissions is good to hear. Moreover, the committee is very supportive of NASA’s plan to conduct ROSES 2020 and future years proposal calls in a dual-anonymous fashion because this approach also mitigates unconscious bias of many types (gender, institutional, ethnic, etc.) and keeps the focus on the science proposed. However, the committee acknowledges that dual-anonymous reviews would work for technology and hardware development programs is more challenging as many of these efforts are unique, are often renewals, and are well known by others in the field who might be reviewers.

Finding

The committee finds the ROSES portfolio well-managed and the proportions of allocations appropriate.

Recommendation

The committee requests further information on how dual-anonymous review may be implemented for technology or hardware programs.

Exoplanet Research Program (XRP)

The committee notes the Exoplanet Program Analysis Group’s concern over the XRP program and suggests close monitoring of the program and scrutiny of success rates. Feedback from and communication with the community might help avoid unintended consequences during this evolution as discussed in the findings presented to the APAC.

Finding

The proposal selection rate for the XRP program is substantially lower than the mean/median of the research and analysis (R&A) programs (excluding FINESST). While selection rates alone are not an indicator of programmatic balance, this is potentially an area of concern.

Recommendation

The committee requests that NASA examine this program in the context of the broader R&A portfolio to determine if it is underfunded.

FINESST

The APAC was pleased to hear of the progress made in funding more graduate student research through the FINESST program. As reported by Paul Hertz and Stefan Immler, the R&A program has incorporated community feedback – including that obtained from the APAC during previous meetings – and doubled the budget allocated to the FINESST program beginning in FY19. This increase in funding has resulted in a corresponding increase in the number of accepted applications and the acceptance rate. Forty-five (45) to forty-eight (48) fellows are now supported through the program at a time. The FINESST program made up 1.1% of the Astrophysics R&A budget in FY19.

Of the 188 submitted applications during FY19, 11% were accepted compared with 4-5% in previous cycles. Sixty-three percent (63%) of the submissions were from male PIs while 37% were from female PIs, based on an informal NASA attempt to ascertain PI gender identity using first names. These percentages were consistent with the gender diversity of the selection panel and, roughly, Astrophysics as a whole. Interestingly, the selected proposals were closer to an even inferred gender distribution: 57% male to 43% female.

The APAC commends the R&A program for these notable improvements and would like to see future reports on the FINESST program. Specifically, following the figures for funding and gender diversity of submitting and selected PIs in FY20 and beyond would be very instructive, especially as so many R&A programs move to dual-anonymous peer reviews.

Finding

The APAC is delighted to see that the FINESST funding has doubled to increase the selection rates in response to our last recommendation to increase funding.

Recommendation

The APAC requests additional information on any longitudinal reports on the FINESST programs and other R&A elements targeting young scientists as an agenda item on future committee meetings.

Other Workforce Development Activities

The Nancy Grace Roman Technology Fellowships is a program that provides an important gateway for promoting innovation and skills development at early career stages. Continuation is important for future strategic mission needs of NASA. The PI Launchpad is a wonderful initiative to educate new scientists and engineers who are interested in submitting a NASA space mission proposal in the next few years but don't know where to start. The committee encourages SMD to keep these workforce development initiatives ongoing and track whether they result in an increase in new PIs for proposals.

Finding

The committee applauds the attention to programs that are increasing participation of the youngest scientists, from diverse backgrounds, in SMD disciplines and technology areas.

Recommendation

The committee requests that SMD inform the APAC of findings of the recently initiated National Academies study of NASA PI diversity and workforce inclusion.

The APAC recommends that SMD consider innovative incubators and opportunities through which new PI or PI-candidates implement skills developed through NASA-supported activities, such as PI-Launchpad or Nancy Grace Roman Technology Fellowships.

Dual-Anonymous Review

A concern expressed by the APAC related to the efficacy of assigning a gender identity to the PIs using first names for the purpose of investigating gender diversity. Whether this is done via algorithm or by a human, this method of gender identification is clearly fraught, and this is without even considering the lack of a non-binary gender category. NASA is legally restricted from asking the PIs to self-identify, which greatly hinders the agency's ability to study its record of gender diversity in proposal submissions and selections. The hope is that a dual-anonymous peer review will result in a less-biased (ideally unbiased) selection of proposals, but the difficulty remains in evaluating whether this result has been achieved. The committee understands the agency's interest in monitoring success rates as a function of gender; however, caution is warranted in interpreting analysis of 'pseudo-data' based on software used to guess gender identity.

Finding

Implementation of dual-anonymous review is noteworthy and will benefit SMDs strategic science and workforce goals.

Recommendation

The committee requests further information on how dual-anonymous review may be implemented for those Programs that must show specific progress on on-going projects as part of the evaluation.

ExoPAG, PhysPAG, COPAG Reports

There were no actions needed from the APAC regarding COPAG. However, the COPAG requests that the PhysPAG assist with the solicitation of members from their constituency for the SAG11 Cosmic Dawn. In addition, the COPAG is interested in co-sponsoring the two EXOPAG groups on creating a catalog of host stars for future exoplanet missions.

The COPAG has a Technology Interest Group (TIG) led by Sarah Tuttle. The COPAG noticed that the day before the winter 2020 AAS meeting, there was a large population of technology minded people from industry, academia, and NASA in attendance to hear Dr. Paul Hertz at the Joint PAG session. The APAC believes a TIG meeting that involves both scientists and technologists would be interesting. All three PAGS should work together to organize sessions at the winter AAS meetings in the future to allow cross-PAG activities to be attended by all interested community members.

Highlights of the PhysPAG presentation included informing the PhysPAG executive committee of the APAC's desire to consider potentially reorganizing the PhysPAG SIGS to be science-driven rather than wavelength/spectrum siloed. The PhysPAG also articulated the need to improve communication and interaction with the community, including a wide dissemination and discussion of the MMA SAG and Great Observatories SAG reports to foster development of long-range objectives.

Finding

A Technology Interest Group (TIG) meetings planned during appropriate professional meetings that involving both scientists and technologists would be interesting and beneficial SMDs activities.

The committee notes the completion of the PhysPAG Multi-Messenger Astrophysics report and commends the work of the many individuals who contributed to this effort. The committee found that the PAGs were involved in multiple, similar potentially overlapping efforts involving the Great Observatories Program or Multi-Messenger Astrophysics and noted that it might be beneficial to work together on these to better inform the community.

Recommendation

APAC agrees that the following actions are appropriate for the ExoPAG; close-out of SAG19, close of SIG1, and the initiation of SIG3.

The committee should respond to the request from the ExoPAG on the new SAGs at a future meeting of the APAC.

Astrophysics Pioneers Program

Michael Garcia presented a discussion of the Pioneers programs, described as an initiative to support 'large APRA investigations' while limiting the overhead relative to the Explorer program. The committee was enthusiastic regarding the potential of this initiative to fulfill community needs.

The structure of the Pioneers program is likely to attract investigations that differ from the current population of large APRA programs in a number of ways. Specifically, the relatively large amount of funding (of order \$20M) and relatively short period of performance (effectively 4 years) results in a burn rate that is significantly higher than any APRA program. That higher burn rate, coupled with a launch date that is more firm than a typical APRA flight program, will influence both the nature of the appropriate investigations, and also tend to favor those institutions, universities, and NASA centers with more resources over smaller university led programs, due to the former's ability to spend at that rate. Unlike APRA, the Pioneers program aims to support those investigations that require little or no technological development. Especially for investigations relying on balloon flights, there may be no time for anything but shovel-ready projects that rely only on commercially available hardware. This time crunch could favor those investigations that are particularly well-matched with the existing capabilities of the NASA centers.

As an example, the schedule timeframe for a Pioneers balloon mission would be incredibly compressed, with less than 2 years to fabricate, integrate and test, especially if several months are budgeted to analyze the data and publish. The short timeline may restrict the class of experiments that can be accommodated, as well as the complexity of the payloads.

The committee's consensus is that the program will increase the number of customers looking for launches across the balloon and rocket platforms. In many cases, these are already at capacity within the APRA program, unless the launch rates can be increased. Additional support of the suborbital program offices, and CSBF, may be required to accommodate the launch pressure.

Lastly, provisions and contingencies to mitigate inevitable launch delays are not yet clear. These delays will happen, and they should be anticipated when thinking about award rates in order to prevent a pileup of payloads.

Finding

The committee believes that the astrophysics Pioneers program will foster investigations that are qualitatively different than the current ecosystem of large APRA investigations.

Recommendation

The committee request at the next meeting of the APAC further information on the Pioneers program as additional program details are developed by NASA and public comment is received from the community on the draft solicitation.

The committee requests further insight into explicit provisions regarding the management of launch delays within the astrophysics Pioneers program.

The committee recommends that NASA reconsider the 5-year timeframe for selected Pioneers investigations. NASA might consider excluding Phase E from the Program timeframe to allow for mode development time, while maintaining the possibility of funding Phase E.

WFIRST

The APAC thanks WFIRST Project Scientist Jeffrey Kruk for an update on the WFIRST development and notes the highly positive development of the project passing the Confirmation Review and entering Phase C of its development. The committee was informed that the coronagraph instrument (CGI) was moved to Class D, with no Level-1 baseline performance requirements, and subject to its own separate cost-cap. This action was taken to maintain WFIRST cost and schedule.

The committee was pleased to hear that NASA is pursuing an early acquisition of the launch vehicle for WFIRST and encourages NASA to select a launch vehicle for WFIRST as soon as possible to avoid continuing to drive launch-specific design and requirements on the spacecraft that may not be ultimately needed. While the APAC has continuing concerns about the CGI cost and schedule impact on WFIRST, the committee does not provide any immediate advice on this

matter for the Astrophysics Division Director given that these items have presumably been covered in detail in the recently concluded WFIRST reviews.

Finding

The committee believes that moving the coronagraph instrument (CGI) to Class D a technology demonstration activity with no Level-1 baseline performance requirements, and its own separate cost-cap, was appropriate to maintain WFIRST cost and schedule.

Recommendation

The committee finds the discussion of the ground system architecture for WFIRST timely, but not yet complete, and requests an update on this scientifically critical system in future meetings. The committee would also like an updated presentation on the CGI development at its next meeting.

Science Data Management Working Group

The committee was pleased to hear that the agency is undertaking a holistic consideration of its data management needs going forward. Acknowledging that this process is at an early stage, the APAC notes that present efforts have focused on management of data itself; arguably, management strictly of NASA mission data and related data products (whether ancillary mission data, or user-generated High Level Science Products) is the area in which NASA is most prepared, having already developed resources such as the MAST, IRSA, and HEASARC.

The committee emphasizes that forming a similarly coherent, well-supported process around software is of equal importance, as software (which may range from formally distributed packages to user-created boutique analysis tools) is the instrument through which insight is derived from data. SMD has the potential to provide leadership for these practices going forward.

The committee further stresses that while connections with private companies (e.g., Amazon Web Services) should be pursued, the agency should be aware that single partnerships can be vulnerable to failure (e.g., if Github went out of business tomorrow, or just decided to change its cost structure, they would singlehandedly destabilize software distribution across the entire astronomical community).

Finding

The SMD, coordinating with other NASA science divisions, should develop data management guidelines and policies that serve the broader astrophysics community and are consistent with strategic Agency directives. The APAC agrees that an SMD-level Data officer will help to facilitate the development of these guidelines.

Recommendation

The committee recommends that NASA consider the additional burden on the PI and maintain flexibility in implementation so as not to unnecessarily over constrain and overburden teams.

JWST

The APAC would like to thank Eric Smith for providing an update on the progress of the James Webb Space telescope. The committee was encouraged to see steady progress since our last update and that one year prior to the March 2021 launch, the project still has 2 months of schedule reserve.

In terms of open technical issues, new traveling wave tunable amplifier (TWTA) and command and telemetry process (CTP) replacement units have been installed and tested, and importantly, the CTP failure mechanism that was seen by the project previously has been replicated. This builds confidence that the failure is now well-understood and that both of these issues are now less concerning. On the other hand, the Ariane 5 fairing depressurization issue is still open and using the new vents and pressure transducers, the measured pressure delta at separation is still above the 18-Pa requirement. The team will rely on one final Ariane 5 launch in the relevant configuration to achieve the required pressure differential with a few changes that they believe will solve the problem.

Two new technical issues were also presented to the APAC: (1) the failure of 1 out of 116 Non-Explosive Actuators (NEAs) to open during a recent test, and (2) some Membrane Release Devices (MRDs) are currently showing negative structural margin because of combined mechanical and pressure loads. While the JWST team has what appear to be viable fixes for both of these new issues, the APAC would like to recognize that technical risks for the mission still exist.

Finding

JWST continues pacing toward the 2021 March 31 launch date with modest schedule reserve prior to LRD.

Recommendation

The committee requests a status update of outcomes from the acoustic and vibration testing (“the workmanship test”) conducted as part of the Observatory Environmental Test schedule in May and June 2020, including how findings from these activities impact reassessment of launch data readiness.

LISA

The APAC thanks Ira Thorpe for a thorough presentation of NASA’s current involvement in the LISA program and potential future areas of contribution. The NASA LISA Study Office, in particular, has identified five areas of investment in advance of final adoption where NASA’s supported science could have a leading role (telescope, laser system, charge management system, phasemeter, and microthrusters). During the committee’s discussions, questions were raised about whether the choice of technologies should also consider broader application to other missions. However, the consensus was that the focus technologies should be on the LISA mission and maximizing NASA’s future contribution to the mission. Concerns about the ground-segment data management during LISA operations were also expressed by the committee during

the presentation, due to the peculiar output of LISA, where data cannot be “divided” between partner institutions as it typically happens for other missions.

Finding

The committee advises that the LISA project office carefully manage the development of the science ground segment and potential U.S. contributions in light of best practices of open data access and the broad public utilization of discovery products.

Recommendation

The committee requests that a copy of the NASA LISA Study TEAM (NLTS) report be provided for review prior to the summer APAC meeting if practicable.

SOFIA

The APAC thanks SOFIA Project Scientist Naseem Rangwala for the update related to the implementation of recommendations made by the SOMER and FMR reviews. The committee also had an opportunity to hear from members of the SOFIA management team that were in attendance (remote dial-in) and from the SOMER Panel Chair.

The committee has three main concerns related to the recommendations of these reviews and their implementation. To improve scientific productivity and to bring about a culture driven by science to the SOFIA Project, the FMR/SOMER review panel reports recommended a number of items to be implemented by the Project Office. The APAC does not have access to all of these recommendations. These recommendations are also not part of the executive summaries of each report that was made available to the committee.

The top SOMER recommendation concerns the separation of mission (flight) and science operations. The Project chose not to implement that recommendation, with the Project's response to the APAC request for information (RFI) stating that “... *they (SOMER panel) lacked the experience working with such an integrated observatory...*” and therefore, that the recommendations could not be practically implemented. Without access to the rationale that is presumably laid out in the review reports (the APAC received only redacted copies with this information removed from the document), the committee is not in a position to give advice on whether the Project's finding on the feasibility of the split is well-founded, or not. Furthermore, when asked to summarize the primary motivation behind the FMR/SOMER recommendation to split the operations, the SOFIA Project Office stated that the current combined structure made it difficult to construct well-defined metrics, and therefore to quantify the cost efficiency of the Project's operational phase.

The second issue discussed by the committee concerns science metrics that were recommended to the Project by the FMR panel. These concentrate on maximizing the science return of the observatory. The presentation contained several metrics, e.g., publications exceeding 100 per year and a H-index of 44, that the Project aims to reach by 2022. Several members of the committee expressed concerns that there is no sufficient evidence that the Project would be able to increase the publication rate of SOFIA papers to 100 per year from the current rate of 30 per year in about two years.

The third issue concerns the number of flights from New Zealand. Despite reorganization and cost reductions to flight operations, the Project Office plans to operate 24 to 28 flights from New Zealand in 2020 compared to 32 that were completed in 2019. The drop in the dispatch rate is a substantial reduction in the observational capabilities as Southern flights have shown to be the most productive scientifically.

The committee was also concerned with the increasing development costs and lagging schedule for the next SOFIA facility instrument HIRMES.

Finding

The committee finds that the SOFIA Project is challenged to markedly increase science productivity and impact for its costs.

Recommendation

The committee recommends that the FMR/SOMER Panel Chairs (or their designees) provide, and present at the next meeting of the APAC, a listing of their recommendations with a brief summary of rationale for each recommendation.

The committee requests the FMR/SOMER Panel Chairs (or their designees) comment on the makeup, and the mandate, of the SOFIA operations advisory group that was formed in response to the FMR/SOMER report.

The APAC requests that the Project provide additional guidance on how science metric goals can be achieved and what changes the Project will implement to achieve those goals. The APAC also further recommends that, after careful study, if the Project determines that they cannot reach these goals in 2022, that the Project Office should then provide realistic goals that can be achieved in 2020.

The APAC also requests statistics related to the number of unique PIs in all GOs, as well as the overall quality of the proposals, the distribution of hours requested in the proposals, and the distribution of hours allocated by the SOFIA time allocation committee (TAC).

The committee requests a detailed response from the Project Office outlining reasons for the drop in the number of flights from New Zealand in 2020 compared to 2019. In addition, the APAC requests a cost ROM for what it would take to have a second crew to support more New Zealand flights.

Sincerely,



Dr. Charles E. Woodward,
APAC Chair (on behalf of the Committee)
Professor, Minnesota Institute of Astrophysics – University of Minnesota
woodw024@umn.edu
612-624-0254