VANDERBILT UNIVERSITY
NASHVILLE, TENNESSEE 37235
TELEPHONE (615) 322-7311
Department of Physics & Astronomy • Direct phone 322-2828
Fax: 343-7263

December 6, 2023

Dr. Mark Clampin
Astrophysics Director
Science Mission Directorate
National Aeronautics and Space Administration (NASA)

Dear Mark,

The NASA Astrophysics Advisory Committee (APAC) had its Fall meeting on October 19-20, 2023 . The meeting was conducted in a hybrid mode, with the majority of APAC members being present with Senior Division management at NASA HQ, and aided by WebEx[tm] video conferencing technology, a digital portal and a chat-window to assist in exchanging APAC, invited speaker, and community comments. The following members of the APAC attended the meeting in person: Regina Caputo, Hsiao-Wen Chen, Jessica Gaskin, Erika Hamden, Kelly Holley-Bockelmann (chair), Alina Kiessling, Mark Mozena, and Grant Tremblay, while the following attended virtually: Daniela Calzetti, Ryan Hickox (deputy chair), Shirley Ho, Shardha Jogee, and Illaria Pascucci.

Each day, Dr. Hasan began the meeting by welcoming all the APAC members, and explaining the committee's purpose. Dr. Hasan reminded the APAC members who had conflicts of interest with specific topics on the agenda that they were allowed to listen to the presentation but could not participate in the committee's discussion as they are conflicted. Dr. Hasan then read aloud the Federal Advisory Committee Act (FACA) rules. Dr. Holley-Bockelmann then welcomed the members and the public to the meeting.

The committee received updates on the following topics:

The State of the Astrophysics Division – Mark Clampin
COPAG, PhysPAG, ExoPAG Discussion – Shoulah Nikzad, Justin Finke, Illaria Pascucci
NASA Astrobiology Program – David Grinspoon
GPRAMA Overview – Jennifer Kearns
Roman Status – Julie McEnery
Habitable Worlds Observatory – Julie Crooke, Shawn Domagal-Goldman
Gamma Ray Transient Network SAG Report – Eric Burns
NASA Hubble Fellowship Program – Nino Cucchiara
Research and Analysis Update – Stefan Immler
NASA Space Communications and Navigation – Jeffrey Hayes

All presentations are available at the APAC website. The APAC thanks all of the presenters for their time and efforts to provide detailed and informative presentations.

The APAC has the following specific findings and recommendations in response to the presentations and subsequent discussions.

Findings

The APAC is highly concerned that the meager anticipated NASA budget for FY 24 and beyond places significant fiscal strain on the Astrophysics Division, particularly in light of costly efforts such as Artemis and Mars Sample Return. The lack of APD resources prohibits the necessary execution of top priorities in the Astro2020 Decadal that could result in significant setbacks and loss to the astrophysics community.

The APAC appreciates that the Astrophysics Division Director discussed the budgetary constraints imposed by non-discretionary budget wedges and openly shared the priorities dictating how the remaining discretionary wedge is allocated. The APAC acknowledges the difficulty of prioritization within such a limited budget and deeply values the work of the Division to mitigate the impact of budget cuts across the portfolio.

The scientific and technological return of the NASA astrophysics fleet is simply outstanding. The APAC continues to be impressed by the paradigm-shifting discoveries made by APD missions, many of which are performing better than mission design. Hubble and Chandra, in particular, are over a generation old and are still delivering spectacular results, including many that show strong multiwavelength synergy with JWST. As flagship missions, both Hubble and Chandra were intended to be vanguards of the fleet and they remain so today. Guest Observer proposals are oversubscribed by roughly a factor of 6 for both missions and in the past 5 years, publications from these two missions are larger than all other APD missions combined. The APAC commends APD and its partners, especially the Hubble and Chandra teams, for their excellence and creativity in managing, operating, and maintaining these world-class missions.

The APAC recalls that the 2022 Senior Review ranked both Chandra and Hubble as Tier 1 missions and argued for enhanced support if budgetarily feasible. In July 2022, the APAC fully endorsed the Senior Review, noting that these missions "*will continue to enable impactful science over the next five-year horizon and provide key capabilities to advance NASA Astrophysics Division strategic science questions informed by Decadal Surveys*". The APAC is therefore concerned that amid a potentially contracting budget outlook, cuts to the operations budgets of Hubble and Chandra may bring added risk of shortening the remaining life of the last two Great Observatories, both of which continue to enable impactful discoveries across NASA science, provide enormous synergy with

JWST, and fly capabilities that may not be replicated for decades to come, such as subarcsecond X-ray imaging and UV capability. The APAC further finds that the message that Chandra and Hubble are problematic to operate is a troubling narrative – the more germane point is that, through long-standing APD support, these world-class facilities continue to enable groundbreaking science while maintaining high efficiency through operational ingenuity. A shorter-than-natural lifetime for either Hubble or Chandra, induced by budget cuts, would bring an enormous loss that would not be filled for many decades.

Space Communications and Navigation infrastructure is in dire need of maintenance and critical upgrades. Both the Near Space Network (NSN) and the Deep Space Network (DSN) are aging and severely oversubscribed, with demand exceeding capacity continuously over the last decade. The Artemis campaign required more than 5 times the resources of a typical launch, which impacted APD missions TESS and particularly JWST. In addition, the prioritization of CubeSats resulted in an overall loss of science from the rest of the APD mission suite.

In the two years since the NASA Hubble Fellowship Program (NHFP) Panel Report was completed, the NHFP working group has implemented some of the 32 recommendations and has developed an implementation plan for the others. In addition, the working group has concentrated on socializing the report and gathering feedback from the community, culminating in a AAS Special Session in January 2024. The APAC is particularly impressed with the NASA Hubble Fellows' own work, such as the Fellows Anti-Racism Initiative (FARI), which embodies the panel report's fundamental recommendations of 1) a new definition of excellence and 2) a change in the culture of the community.

The Roman mission is on track for an October, 2026 launch date. WIth some aspects performing better than design reference, such as the slew/settle time, the team anticipates the potential for a more robust observing strategy. The coronagraph in particular may perform better than the threshold technical requirement (TTR) within a single waveband, thereby enabling more science; the team is working toward exceeding the TTR on a best effort basis. The APAC notes that the community-focused participation model employed by the Roman team both raised the mission profile and resulted in over 130 core community survey pitches covering a broad scientific footprint. The APAC looks forward to following the progress of the community survey definition process. The APAC also appreciates the discussion of optimizing Roman for time-domain astrophysics use cases.

Running 75 pages, the Gamma-ray Transient Network Science Analysis Group Report is exceptionally detailed and well-justified. The APAC appreciates that the SAG took a critical look at immediate and relatively low-cost ways to amplify the impact of current

missions on TDAMM science. The APAC also noted the first 32 pages are a timely review of gamma-ray transient astronomy that could be useful on arXiv.

The Astrophysics R+A program retreat provided a valuable opportunity to think critically about the proposal and review process, and to generate creative and meaningful ideas for pilot initiatives.The APAC lauds the program for its foresight and leadership within SMD.

The APAC is pleased with the early science commissioning of Euclid and XRISM and appreciates the broader portfolio enabled by these international partnership missions. The committee also looks forward to the imminent launch of GUSTO.

Recommendations

On the heels of the 2022 Senior Review and anticipating another imminent and comprehensive Senior Review, the APAC is concerned about the large effort and added expense of the proposed “mini Senior Review” for Chandra and Hubble. The APAC is also not entirely clear on the purpose or consequences of this effort, and indeed there is considerable apprehension in the community and in the APAC that the exercise would result in lifetime-shortening budget cuts or premature cancellation for either mission. Therefore, the APAC recommends that APD reconsider the need for a mini Senior Review, and that the intent of the mini Senior Review be made more transparent, if one is to be held.

To determine future budget decisions, the APAC recommends that a decision matrix is generated that accounts for near- and long-term impacts to astrophysics and the astrophysics community for models that prioritize preserving irreplaceable scientific capabilities versus those that impose a flat cut for each mission. Examples of these capabilities include UV imaging and spectroscopy offered by Hubble and high angular resolution in X-ray offered by Chandra.

The APAC further recommends that this decision matrix be informed by community input, perhaps by a Request for Information (RFI), as we note that the Decadal did not weigh in on the relative prioritization of protecting the current program of record versus investing in future programs.

Given the relatively high costs associated with maintaining and building on existing communications infrastructure (primarily related to TDRSS and DSN), and the recent successes of the Deep Space Optical Comm (DSOC) demo on the Psyche mission and with the Integrated Laser Communications Relay Demonstration Low Earth Orbit User Modem and Amplifier Terminal (ILLUMINA-T) with Laser Communications Relay Demonstration (LCRD) on ISS, the APAC recommends that APD explore the benefits, feasibility, and possible future implementation of optical communications on

astrophysics missions. Further, we recommend a Request for Information to better understand the space communication needs and concerns of the astrophysics community, as well as to explore the applicability and timescale of optical services to APD missions.

The APAC is pleased to learn that APD is considering pursuing its own graduate fellowship program to either replace or augment FINNEST. We recommend that APD explore the feasibility of a graduate fellowship opportunity that has flexibility to address the unique needs and priorities of the APD community.

Although it is clear that a new large Gamma-ray mission is not possible in the current budgetary climate, the APAC nonetheless endorses several of the other recommendations from the GTN SAG report that represent low-risk, relatively low-cost, yet high-reward changes to current mission operations. For example, the report made a convincing case that TDAMM science would be better enabled by increasing the Swift downlink cadence. The APAC recommends APD conduct a trade study on the recommendations from this report that concern existing mission capabilities (starting at page 42). Further, we recommend that the division explore cross-divisional partnerships to sustain and amplify the impact of the Interplanetary Network.
The APAC also recommends that future SAG reports include an executive summary to spell out the findings and recommendations for APAC consideration.

The APAC approves the terms of reference for the Future Innovations in Gamma-ray Science Study Analysis Group (FIGSAG) within PhysCOS.

The APAC would like the Roman team to consider mechanisms to increase community participation from researchers at less resourced institutions. It may be useful to consult the Rubin Observatory on its Discovery Alliance program for a potential framework.

Inspired by the GTN SAG report, the APAC recommends that APD analyze the current astrophysics portfolio to identify potential low-cost high-impact upgrades to mission operation, including joint data analysis, and/or cross-agency cooperation, to better facilitate TDAMM science. This may be an excellent charge to the TDAMM SIG and TDAMMCOM SAG.

Relatedly, the APAC recommends that the Roman team expand the approach used to adapt the mission to better enable time domain astrophysics to optimize multi-messenger astrophysics as well.

The APAC looks forward to receiving the Terms of Reference for Student Science Interest Group.

The APAC encourages the NHFP to continue to explore ways to expand the range of institutions that host Hubble Fellows, for example by encouraging applicants to consider a range of possible institutions, providing incentives or resources for smaller or less-resourced institutions to serve as hosts.

The APAC recommends that APD consider the legal, financial, logistical and scientific ramifications of after-launch international partnerships.

The APAC was impressed by the plans to decrease the burden on PIs and Institutions by simplifying the ROSES solicitation and associated proposal requirements, and considering requesting a simplified budget for R&A proposals. While APD is planning on a pilot program in ROSES-25 for an investigation that is non-technology based, the APAC recommends APD develop a plan to test this out on a technology-based program such as APRA or SAT and, if feasible, implement a similar pilot also in ROSES-25.

Requests for Information:

The APAC requests more insight into the "APD principles document for handling reduced budgets" mentioned in Mark's APD update, as this will help inform future budget decision recommendations.

The APAC requests a presentation from the Scientific Organizing Committee of the . October, 2023 workshop, "Windows on the Universe: Establishing the Infrastructure for a Collaborative Multi-messenger Ecosystem" and the subsequent international meeting on the same topic.

The APAC would like to have an update from Roman about the status of the community survey process.

The APAC would like an update on the progress toward addressing the challenging recommendations for the NHFP and would also like an update on the demographics of the fellows, including the graduate institution and the fellow host institution.

The APAC requests an update on the status of initiatives to address equity, inclusion and belonging for the LGBTQIA+ community, within NASA, the astrophysics community, and in the public. If there are no initiatives, the APAC requests that APD consider ways to improve belonging and restore trust for this community.

The APAC would like to have a more detailed discussion of NASA's plans regarding sharing research software, including the community feedback received during the

October meeting, and especially concerning the retention and promotion of early career researchers.

The APAC looks forward to an update from the AWESOM SAG.

The APAC would like more information on the plans for a mini Senior Review for Hubble and Chandra.

Sincerely,

Kelly Holley-Bockelmann, on behalf of APAC