

2021 November 08

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

Dear Paul,

The NASA Astrophysics Advisory Committee (APAC) had its Fall meeting over two-days, 2021 October 13<sup>th</sup> and 15<sup>th</sup>. Due to the continuing COVID19 environment and related NASA operational and travel restrictions, the entire two-days of the meeting were conducted virtually using WebEx™ videoconferencing technology accompanied by digital portal and chat-window to assist in exchanging comments. The following members of the APAC attended the meeting: Manuel Batista, Kelly Holley-Bockelman (APAC Vice Chair), Jessica Gaskin, Hashima Hasan (APAC Executive Secretary), Erika Hamden, Ryan Hickox, Shirley Ho, Margaret Meixner, Michael Meyer, Mark Mozena, Lou Strolger, and Chick Woodward (APAC Chair).

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 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. 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 APAC thanks all of the presenters for their time and efforts to provide crisp and informative presentations. In addition to the agenda, the presentations for the meeting are posted at <https://science.nasa.gov/researchers/nac/science-advisory-committees/apac>

The brevity of the APAC's report and recommendations are largely due to strategic and programmatic uncertainties as the committee and Astrophysics Division (APD) await recommendations from the 2020 Astronomy and Astrophysics Decadal Survey release.

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

## ***GRPAMA 2021***

The APD has successfully advanced the state of knowledge related to key division science goals during fiscal year (FY) 2021. The APAC voted by unanimous consensus that activities supported by NASA APD have satisfactorily addressed challenges on two strategic science goals: Multiyear Performance Goal 1.1.2: NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe; and Multiyear Performance Goal: 1.1.4: NASA shall demonstrate progress in discovering and studying planets around other stars.

The APAC discussions included groundbreaking science topics that spanned multiple NASA science goals and missions. The range of topics considered for inclusion in the GPRAMA included gravitational lensing through the eyes of NuSTAR, HST, and XMM-Newton, to new results on the first persistent plasma waves in interstellar space by VOYAGER, to the discovery by TESS of three young and hot planets around a sun like our very own. The interdisciplinary set of performance goals for the Science Mission Directorate (SMD) science program that seeks to “advance discovery in emerging fields by identifying and exploiting interdisciplinary opportunities between traditional science disciplines SMD has traditionally operated” was discussed in conjunction with representatives from the Planetary Science Division and the Heliophysics Division. Contributions to the Multiyear Performance Goal: 1.1.5: NASA shall demonstrate progress in improving understanding of the origin and evolution of life on Earth to guide the search for life elsewhere, exploring and finding locations where life could have existed or could exist today, and exploring whether planets around other stars could harbor life, were offered.

### **Findings**

The APD has successfully continued to progress towards division science goals and advanced the state of knowledge during fiscal year (FY) 2021.

The APD has satisfactorily addressed challenges on two strategic science goals: Multiyear Performance Goal 1.1.2: NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe; and Multiyear Performance Goal 1.1.4: NASA shall demonstrate progress in discovering and studying planets around other stars.

The progress towards meeting the performance goal is judged to be **GREEN** (10 individual votes).

## ***ASTROPHYSICS DIVISION (APD) UPDATE***

APD continues to manage a very active portfolio of mission and opportunities for the community. Several launches are imminent, including the Imaging X-ray Polarimetry Explorer (IXPE) which ships to Cape Canaveral for launch on 9 December and the James Webb Space Telescope, which is slated for launch on 18 December 2021. PRISM calls in ROSES will

provide opportunities for APD science experiments to compete for lunar surface science, exercising the expanding commercial lunar payload services (CLIPs) ventures. The APAC was also informed that the next SMeX opportunity would be announced March 2022.

The Nancy Grace Roman Telescope mission CDR is complete, 28 of the flight-quality detectors are delivered and being assessed, while various competitive opportunities for funding have been released. However, supply-chain and pandemic-related work-force issues are affecting Roman schedule resulting in commitment dates being moved out seven months. Consequently, changes in overall cost and budget (in excess of \$380M) have been incurred. SPHEREx also is encountering challenges to cost and schedule.

NASA is a coordinating partner in a tri-agency group examining synergies between Euclid, Roman and the ground-based Rubin survey telescope. The APAC encouraged APD to continue this dialogue. The APAC also was intrigued by the bilateral NASA/DOE RFI focused on leveraging synergies between Euclid and Roman including high-latitude wide area and high-latitude time-domains surveys. The APAC advised APD to consider advantages of future space- and ground-based scientific coordination, cognizant of additional recommendations flowing from the 2020 Decadal survey.

The APAC was briefed regarding the status of the successful balloon campaigns at Ft. Sumner, where seven successful payloads were flown. However, no Antarctica campaign is forthcoming this year due to continued COVID 19 restrictions. These ongoing logistical and personnel challenges related to the pandemic continue to impact mission progress.

The APAC was also encouraged the APD was taking initial budgetary steps to open a wedge on a Probe-class mission if this is a recommend outcome from the pending Decadal Survey.

APD continued to provide the APAC with updates regarding advancing workforce diversity and inclusion. APD discussed the roll-out of the IDEA requirement in mission AO requirements. The APAC endorsed this course of action. APD is taking a leadership role within SMD in transforming the internal workforce, panel review, and proposal evaluation process to include a broader array of voices at the table as encapsulated in the new NASA 5<sup>th</sup> core value of inclusion. APD outlined actions to have a stronger presence and affinity group conferences and is developing means to initiate bridge programs supporting minority serving institutions (MSIs) and historically Black colleges and universities (HBCUs). The APAC applauds these ongoing efforts.

Part of the Division update included “Improving Inclusion at NASA” - “NASA is committed to a culture of diversity, inclusion, and equity, where all employees feel welcome, respected, and engaged.” This includes “Astrophysics Division task force working to align division-level practices with the NASA core value and SMD science strategy. Examining the research and analysis (R&A) process for better inclusion and diversity.” As part of inclusion criteria for a pilot program, proposers to the Astrophysics Theory Program (APT) are asked to include plans that sustain a positive and inclusive working environment. While these initiatives and efforts are essential components of diversity, equity, and inclusion (DEI), it is unclear to what extent families and work-life balance are included.

APD also discussed developments with the implementation of Science Policy Directive (SPD) 41 and their response to community challenges with meeting new obligations that will likely drive costs. The APAC reflected that the NASA funded curation infrastructure should be interoperable with other extant repositories and archives across SMD divisions and other relevant federal labs (e.g., NIST). Careful build-out is necessary to avoid unnecessary duplication of effort and infrastructure. The APAC cautioned that certain software codes, artificial intelligence machine learning algorithms, etc., developed from NASA funding activities to be placed in code repositories as a requirement of SPD-41, may have national security and ITAR issues.

The APAC was apprised of division personnel moves, including the potential transition of the Division Director, Paul Hertz, at some point in 2022.

### **Findings**

APD has a full manifest of new flight missions for the next 6 to 8-month period that will enable scientific advancement in many fields.

The development and mission lifecycle costs of the Roman Observatory have notably increased over original mission commitments.

### **Recommendations**

The APAC requests APD provide regular updates on the cost and schedule developments of the Roman Observatory.

The APAC recommends APD provide an update on the cost and schedule developments of the SPHEREx.

The APAC recommends specific inclusion of family situations to help improve work-life balance in DEI initiatives and that regular updates are provided on the status of the DEI pilot program for NASA Centers and civil-servants.

The APAC requests a presentation on the sounding rocket program at its next meeting.

The APAC requests an update on SPD-41 policies and implementation activities at its next meeting.

### ***JAMES WEBB SPACE TELESCOPE MEMORIALIZATION CONVERSATION***

The APAC engaged APD management in a lengthy conversation regarding James Webb. The APAC had repeatedly requested an update from the NASA, specifically the NASA historian (or appropriate designee), on the status of the Webb investigation and the historical lens through which to evaluate the context of past activities within the current framework of NASA's five-key Agency goals, including the NASA 5<sup>th</sup> pillar. The acting Chief NASA historian, Brian Odom,

addressed the APAC on NASA's decision to decline reconsidering the memorialization of this mission at this juncture as part of the APD updates. Given the Agency Administrator's "one-sentence" justification in a terse press release for staying the course, the process lacked transparency. The decision matrix appeared unsubstantiated by a thorough forensic investigation of all archival materials. The brief-out discussed methodologies, the available and accessible archives researched by a NASA-funded contract historian (the Truman archives were inaccessible due to COVID 19 pandemic restrictions), the historical context of the "Lavender Scare" period, and the case docket of Norton vs. Macy as they relate to Webb's federal service. The NASA assessment at this juncture is that no demonstrable facts or documents could be identified to suggest direct culpability or direct evidence of specific actions by Webb in enacting policies in the Lavender Scare period.

However, the APAC was dismayed that no formal record of decisions document or associated findings were prepared summarizing this assessment. Odom stated that the past is never closed, and if additional information is discovered, a new conversation with NASA management could ensue. The APAC feels Odom's statement enforces the need for an open report of the full nature and scope of the historic investigation. This would reassure NASA stakeholders that all allegations, rumors, and anecdotes circulating in the community have been gathered and addressed.

Public comments on the naming issue received through the APAC portal were substantial. Rebuilding confidence in the APD and the Agency's decision-making process as transparent, equitable, and balanced will require a long-term commitment.

### **Findings**

The rationale and explanation from the Agency were wholly insufficient, non-transparent, and uninformative regarding the naming decision communicated to the astronomical community and other stakeholders regarding the James Webb Space Telescope.

### **Recommendations**

The APAC strongly recommends APD critically review whether naming of flagship missions as it has traditionally occurred within the Division over the last few decades is appropriate, or whether APD should align with other SMD divisions in their naming of NASA flight assets.

The APAC requests APD work with the NASA Historian to document fully and completely in a written report the current status of investigation of archival materials, conversations, and other sources that culminated in the Administrator's decision of record to maintain the current memorialization of the NASA next generation infrared space observatory, pending imminent launch, as the James Webb Space Telescope (JWST).

## ***JAMES WEBB SPACE TELESCOPE UPDATE***

The APAC, APD, the astronomical community, and other stakeholders are looking forward to the launch of Webb. Currently at Kourou, 11 days of margin remain in the schedule. The APAC was briefed on the plans for community education and outreach events and media coverage pivoting around the launch event. The commissioning timeline sequence post-launch was discussed highlighting key milestones and constraints that drive the schedule, in particular the cooling curve. It is expected that by day 120 there will be a focused telescope ready for science commissioning.

The APAC also discussed how the community will exploit the unparalleled science opportunity that Webb affords with the project and the Cycle 1 outcomes and lessons learned. The APAC noted that the research and analysis budget for Cycle 1 did not match the considerable work-scope and scale of effort necessary for proposing teams to deliver on the transformative opportunity that Webb will enable. The project signaled their awareness to this issue, suggesting that short falls in required research and analysis commitments were a matter of cash-flow that could be rectified. As Webb is a \$10B+ Agency life-cycle commitment to realizing a great observatory, the APAC expressed concern to APD that inadequate funding levels to support teams would be deleterious to success.

### **Findings**

The current JWST Cycle 1 funding wedge for research and analysis is insufficient to support the complex and pioneering work of the astronomical community to exploit the science opportunities afforded by the Observatory.

### **Recommendations**

The APAC strongly advises the APD work aggressively to more fully fund investigators research and analysis requirements for the JWST Cycle 1 work-efforts and to manage resources to accelerate meeting the full-funding of these efforts to maximize timely and impactful return on the \$10B national investment in the flagship mission.

The APAC requests an update on the on-orbit Webb mission status and observing readiness at the committee's next meeting.

## ***SENIOR REVIEW PROCESS***

APD detailed to the APAC plans, schedules, and procedures for the 2022 Senior Review. Major missions included in the review portfolio include Chandra, Fermi, HST, NICER, New Horizons (just the astrophysics possibilities in an appendix), NuSTAR, SOFIA, Swift, TESS, XMM-Newton. The review architecture will have individual panels for Chandra, HST, and SOFIA while the remaining assets will be consolidated into a single Rest-of Missions panel. The APAC will review the outcomes of the Senior Review process and make its formal recommendation to

APD in 2022 May. The latter hard delivery date is driven by the need to complete APD proposed budget formulations for the fiscal year 2023.

### **Findings**

The APD plan for the Senior Review, including inclusion of SOFIA in the process is endorsed.

### **Recommendations**

The APAC requests APD establish a target window for the APAC review of the Senior Review report commensurate with the timeline stated in the Senior Review plan.

The APAC requests a copy of the Senior Review Lessons Learned document prepared by Dan Evans, NASA SMD, prior to its next meeting.

## ***NASA HUBBLE SCIENCE FELLOWSHIP (NHSF) REVIEW***

The APAC discussed at length the first detailed review of the impact of the NASA Hubble Fellow program in 30 years. The review was detailed and highlighted how strategic stewardship of the program's objectives can be of advantage to APD in its efforts to aligning future workforce cohorts with NASA core values, including expansion of inclusion, diversity, and equity extremely thoughtful and enlightening. There are several noteworthy recommendations in the NHFS report that the APAC advises APD to review and distill into a success-oriented implementation strategy in the near future to pivot the program objectives.

### **Findings**

The NASA Hubble Fellow program is of high strategic value to APD workforce development objectives.

The NHSF review makes interesting recommendations that should be considered in formulating an implementation plan.

### **Recommendations**

The APAC recommends APD implement a more regular review of the NHSF program on a five-year cycle to assess outcomes and enable adjustments to the programmatic objectives as the dynamics and needs of the astrophysical community evolve.

The APAC requests APD develop an implementation action strategy to respond to the key recommendations found in the NHFS review, reporting back to the APAC at the 2020 March meeting.

## ***ATHENA UPDATE***

The APAC was apprised that the mission requirement of 5 arcsecond resolution may not be achievable with the technology for the Athena optics, potentially compromising key science objectives. Specifically, a broader PSF would cause Athena to reach the confusion limit for point source detection in deep surveys, which could significantly degrade the ability to identify faint high redshift growing black holes and associate them with their host galaxies. The APAC is eager to learn of the results of the study that Athena Science Study Team will carry out to determine the impact of a potential 10 arcsecond point-spread-function (PSF) limit. APD should pay close consideration to the results of this study when determining the role of Athena in NASA's astrophysics portfolio. There also was considerable discussion around the challenge of developing the cooling technology needed for the required microcalorimeter spectroscopy capability of the Athena mission. This technical issue has the potential to delay the mission and raise mission costs.

### **Findings**

The poor resolution of the optics that will degrade the science objectives and cooling requirements for Athena may pose a technical challenge that may delay schedule and drive mission costs.

### **Recommendations**

The APAC requests an update on the outcome of the science analysis that the European Space Agency (ESA) is leading related to the 10 arcsecond resolution performance and impacts to key mission science programs.

The APAC advises that the Athena project carefully track whether key science objectives may have to be substantially revised in light of the current technology challenges in meeting a key mission-requirements.

## ***PIONEERS UPDATE***

With presentations from the Aspera and Pandora teams, the APAC was encouraged that all four Pioneers missions currently under study (2 this meeting and two from earlier in the year) to be representative of the interesting array of science that can be achieved with a \$20M cost cap.

The APAC thanks the Pandora project team for their update. The project seems to be taking excellent advantage of existing assets and leveraging in an appropriate way previous investment in technology development by NASA and other stakeholders. In particular use of the CODA mirror technology as well as re-purposing high quality spare detectors from JWST are excellent examples of this. The possibilities of coordinating observations with HST as well as JWST is particularly exciting.



The APAC also thanks the Aspera team for their update. This project has a diverse study team with a significant fraction of early career researchers in leadership roles. Aspera had just completed its Site Visit and Requirements Review prior to presenting at the APAC meeting. Aspera leverages existing heritage from FUSE and utilizes improvements in UV MCPs from Sensor Sciences LLC and extreme UV mirror coatings from GSFC. Use of micro-channel plate detectors that have flight heritage will minimize development risks, while the science objectives are tightly focused. Aspera will require rideshare orbits that provide a stable thermal environment necessary to keep the experiment optics in alignment, while geocoronal emission is the biggest observational challenge. This mission is an example of the big science that is achievable on small platforms.

Overall, the APAC continues to be impressed that the Pioneers program is fulfilling an important niche in the development of capabilities, as well as testing implementation of technology that could in future be used in larger mission concepts. The APAC reflected that the Pioneers program is providing new opportunities for a wider range of potential principal investigators (PIs) to gain valuable NASA leadership experience. However, the APAC is concerned that access to existing NASA assets may be limited to the cognoscenti rather than all potential users. The APAC discussed this latter situation with APD management and challenged the division to investigate actions to broaden access to an asset knowledge base repository that potential future proposers might find of use to lower cost and retire risk.

### **Findings**

The Pioneers solicitation is initially achieving the desired APD strategic goal of bringing in new workforce team talent and PIs into NASA mission-space through competitive selection processes.

### **Recommendations**

The APAC suggests APD develop a rudimentary database of either available flight spares from current and/or past NASA missions or of mission concept studies that had substantial investments in enabling technologies (above TRL 5) and some basic characteristics (wavelength, detector pixel-size, etc.) that may indicate what types of spares are available to facilitate new PIs in developing compelling missions within the Pioneers' cost cap.

The APAC recommends APD insert language in future Pioneers announcement of opportunities (AOs) that alerts potential PIs to the availability of hardware or enabling technologies and provides points of contact for follow-up.

### ***EUCLID UPDATE***

The APAC appreciated the discussion about the large data volumes from Euclid and the potential computational challenges in data handling and analysis. The APAC notes that upcoming NASA missions, including the Nancy Grace Roman Space Telescope, are actively exploring utilizing cloud computing to make access to large data sets more efficient and equitable, and encourages

the Euclid team to consider potential cloud computing resources in its plan for distributing data and analysis tools.

The APAC also noted the updates on the Euclid timelines, recently selected US Science participations focusing on constraining Dark Energy, the infrared Background Radiation Anisotropies, and precision studies of galaxy growth. The APAC was apprised on the progress of the JPL led and GSFC tested detectors and was notified successful integration of all NASA provided hardware had occurred. The APAC excitedly awaits the launch of Euclid in 2022.

### **Recommendations**

The APAC advises APD to strategically identify appropriate cloud-based infrastructure options to facilitate analysis and theoretical modeling of the large data volumes from missions like Euclid by the wide community and undertake a trade study assessing the opportunity cost for this potential up-scope to the US Euclid project.

### ***PAG UPDATES***

Action on various facets of PAG activities awaits release of the 2020 Decadal Survey (DS) before progressing forward. PhysPAG has been leading cross-PAG activities on diversity, equity, and inclusion (DEI) issues. PhysPAG led the involvement in the SACNAS conference presentations. It is still forming the AWESOM SAG, in particular it is still working on the terms-of-reference (TOR) to ensure it is complementary to the many efforts at NASA HQ. They will include aspects of the DS and present it to APAC by the March 2022 meeting. COPAG has been establishing three new SIGs, one on Stars has started and two, Interstellar medium and Galaxies, are in formation. All three mirror DS panels and are meant to digest the report. The IRSTIG and UVSTIG are both very active and planning meetings around the AAS meeting to discuss the DS and their respective futures. EXOPAG is recruiting members to two SIGs, one on exoplanet demographics and a second on synergies between exoplanets and solar system bodies. At the AAS meeting, EXOPAG plans a face-to-face meeting to discuss the DS and include two talks by early career astronomers. The APAC learned that many PAGs and their associated SIGS and SAGs are still strained by the impacts of the Covid-19 pandemic environment that has lessened effectiveness of some the community volunteer efforts. The APAC notes that the Exo-Explorer program (EXOPag) fosters communication and networking for a diverse group of early career scientists and suggests other PAGES study this activity model to understand whether there are benefits from replicating this model within their communities.

### **Findings**

The cross-PAG TOR has not yet matured in methods, objectives and goals.

## **Recommendations**

The APAC requests the leads finalize cross-PAG TOR for the SAG by the next APAC meeting of the committee, which among other issues, reflects any Status-of-the-Profession workforce goals contained within the 2020 Decadal Survey.

The APAC recommends APD invite the Exo-Explorer program developer Tiffany Katrina and their collaborators to present to the committee its next meeting.

## ***RESEARCH AND ANALYSIS (R&A) UPDATE***

The APAC understands that some researchers may be concerned by lack of experience or a range of perspectives on the best ways to fulfill the new review criteria for diversity, equity, and inclusion (DEI) in the community through NASA selections. While all proposers will not begin the process as experts, part of the value of the new requirements will be to encourage proposers to educate themselves on best practice in these areas. APD should take special care to provide enhanced documentation on the review criteria, as well as perhaps a point of contact for those seeking help in being responsive to the new criteria.

The APAC engaged in a substantial discussion regarding a new two-level evaluation of proposals by science peers and DEI experts. Some APAC members caution that departing from the peer-review process may have unintended consequences on R&A program selection. In addition, the evaluations should make every effort not to negatively impact researchers in smaller, less resourced institutions and states of the country where DEI activities maybe particularly restricted by law. Overall, requiring DEI Inclusion Plans in SMD solicitations is an important action implementation consistent with the goals of the new NASA 5<sup>th</sup> pillar of core values to diversify and broaden the workforce.

## **Recommendations**

The APAC requests a complete debrief on the Inclusion Plan Pilot Program findings at its next meeting.

## ***KECK REVIEW***

The APAC was informed that APD is considering a potential continuation of its cooperative agreement to facilitate community access to the W.M. Keck Observatory (WMKO) telescopes. Currently of order 90 to 100 nights per annum, are available to support of APD science missions and projects. Competitive access is managed through the NASA Exoplanet Science Institute (NExSci), including archive support and guest observed funding. The average oversubscription rate is 5.6. NASA as a formal partner receives special consideration for scheduling awarded telescope time allocations and can take part in observatory planning. NASA missions benefitting from complementary programs executed on Keck include TESS, JWST, Kepler, and various

Planetary missions. NASA Keck archival data can be used in proposed scientific studies under the Astrophysics Data Analysis Program (ADAP).

### **Findings**

Access to Keck Observatory nights provides complementary observing opportunities and an astronomical archive that advances the science goals associated with many NASA missions.

Modification of the current 18-month exclusive use period for data products is required to better match the shorter periods in place for other NASA missions.

### **Recommendations**

The APAC advises APD seek continuance of Keck access.

The APAC requests APD consider adding any proposal solicitation for continued NASA-funded community access to Keck include a requirement for providing a data management plan (DMP) and archive access plan that aligns with the NASA Science Information Policy (SPD-41 as implemented).

The APAC recommends realigning the scope and duration of the limited use exclusive period for data acquired through NASA-funded Keck access to be consistent with current APD mission practice.

The APD advises APD to include terms and requirements in any agreement for community open access to data archives, including all necessary reduction and analysis software algorithms.

The APAC advises, consistent with SMD expectations, that a Diversity, Equity, and Inclusion (DEI) plan should be reflected in any proposal submitted in response to APD requests.

Sincerely,



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