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September 20, 2022

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

Dear Mark,

The NASA Astrophysics Advisory Committee (APAC) had its Summer meeting on July 20-21, 2022. This was the first hybrid APAC meeting since the COVID-19 pandemic, with about half the participants meeting in person at NASA Headquarters and the other half joining virtually using WebEx video conferencing technology accompanied by a digital portal and a chat-window to assist in exchanging APAC and community comments. There were some logistical challenges of a hybrid meeting, including the loss of the video recording, but the overall success of the hybrid format indicates that it may be the preferred option for the foreseeable future. The following members of the APAC attended the meeting in-person: Jessica Gaskin, Kelly Holley-Bockelmann (APAC Acting Chair), Jessica Gaskin, Ryan Hickox, Shirley Ho, Mark Mozena, Rita Sambruna, Grant Tremblay, Lou Strolger. The following attended virtually: Hashima Hasan (APAC Executive Secretary), and APAC members, Erika Hamden, Emily Levesque, Margaret Meixner, Michael Meyer, and Ilaria 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 and reminded participants that the public nature of the meeting Dr. Holley-Bockelmann then welcomed the members to the meeting, stated that she would be the acting APAC chair for the meeting and deputized Dr. Strolger to assist in monitoring the virtual participation venues. APAC members proceeded to introduce themselves.

Given the meeting's hybrid nature, there were both in-person demands and technical troubleshooting, and the APAC appreciates the staff efforts that resulted in the logistically-challenging meeting run very smoothly.

The APAC specifically would like to thank and acknowledge Dr. Paul Hertz's candor, insight and Astrophysics Division (APD) leadership over the last decade. The APAC particularly appreciates his bravery in transforming the Astrophysics Division to be an exemplar in inclusion, diversity, equity, and accessibility (IDEA), NASA's new 5th pillar. We look forward to seeing him in action in his new advisory role.

The APAC thanks all the presenters for their time and efforts to provide excellent presentations and for responding to detailed questions. In addition to the agenda, the presentations for the meeting are posted at https://science.nasa.gov/researchers/nac/science-advisory-committees/apac

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

ASTROPHYSICS DIVISION UPDATE

APD Director Paul Hertz gave an extensive and wide-ranging summary of the State of the APD. Among the major events, APD released the first science images from the James Webb Space Telescope and developed a close-out plan for the Stratospheric Observatory for Infrared Astronomy (SOFIA) in FY 2023. There were also major changes in two missions within the NASA portfolio, GUSTO and ESA-led Athena. The APD Director remarked to the committee that the FY2023 budget shortfall of roughly $50M impacted the timeline of the MIDEX missions, with more time being spent in Phase B and a delayed launch. A draft AO for probes is still set for summer 2022.

The APD Director's report to the committee also included an extensive debrief of its attention to developing initiatives to respond to principles associated with NASA's new 5th pillar of Inclusion, Diversity, Equity, and Accessibility (IDEA). APD continues leadership in this area, with the recent pilot of adding Inclusion Plans to Astrophysics Theory Program (ATP) proposals being adopted SMD-wide. The APD Director noted that FY 2024 will be the first NASA budget informed by the Decadal recommendations on the State of the Profession, and anticipated a programmatic rebalancing to further develop and implement IDEA initiatives.

An overview of GOMAP principles and goals was presented, which would "focus first on the Future Great Observatories and make progress on maturation activities for X-ray and Far-IR Flagships". The GOMAP 4 stages included setting up a program, focused technology investment, and notional Phase A entry for the first Flagship mission.

The APD is still receiving expressions of community concern over the lack of transparency and rationale for the decision not to re-name JWST. The APD Director informed the committee that the NASA Historian is delivering a report on the known actions of James Webb during the Lavender Scare to the NASA Administrator. After the NASA Administrator is informed, the APD Director stated that the report will be ready by

the October APAC meeting or that there will be a special APAC meeting to present and discuss the report.

Findings

APD has successfully released the first science images from the flagship great observatory JWST; reporting groundbreaking discoveries from exoplanets atmospheres to the first galaxies.

The mission lifecycle costs of the Roman Observatory have increased over original mission commitments and careful management strategies regarding schedule margin are ensuring success.

GUSTO is being closely monitored to determine if it will be ready for a 2023 launch in Antarctica. A continuation/termination review was conducted and a TVAC Pre-Ship review is underway.

The ESA-led X-ray mission Athena has significant cost overruns, leading ESA to delay its adoption until the mission reformulates to achieve a compelling science case with a cost-cap of 1.3B Euro. APD launched a trade study to analyze possible changes in NASA contributions in the mission.

The terms of reference for the Balloon Program Internal Review now include Data Archiving, in line with the transformation to open science.

APD has thus far responded effectively to implement some of the recommendations contained within the Astro2020 Decadal Survey. The on-set of GOMAP formulation, and placement of Julie Crooke as lead is defining the process and implementation, consistent with the 2020Astro Decadal prioritizations.

APD is formulating ways to enhance the Astrophysics Theory Program (ATP), as recommended in the Astro2020 Decadal Survey.

APD is taking steps to address time domain and multi-messenger science. TDAMM will include interagency and international cooperation. The TDAMM workshop in August 2022 will help to inform the direction that APD takes on this.

The APAC applauds the SOFIA close out priority to fund the SOFIA personnel and scientists as they transition out of the mission.

The APAC expressed extreme concern with the level of support for technology development in general, and in the X-ray and far-IR in particular. APD risks losing key personnel and technological heritage due to focused budget cuts in these areas and due to retirements and other. Maintaining these communities as they support Probe-class and smaller missions, and prepare for the next Flagship missions is critical and is

also a noted Risk within APD. This is especially problematic as APD prioritizes the 2020Astro first Flagship mission with limited budget.

Recommendations

The APAC requests regular updates on the cost and schedule of the Roman Observatory. At the next meeting, the APAC requests a focus on the lessons learned from JWST to apply to Roman if available.

The APAC requests a presentation on the status of GUSTO at its next meeting.

The APAC requests a presentation of the status of the Athena trade study and the Athena mission.

The APAC requests presentations on the Probe and MIDEX programs at the next meeting.

The APAC requests frequent updates on the evolution of the NASA Science Mission Directorate (SMD) Bridge program.

In preparation for the FY2024 budget, the APAC requests a presentation at the October 2022 APAC meeting concerning the slate of APD IDEA initiatives to aid APAC in making recommendations for those to prioritize.

Related, the APAC would like a synopsis of actions taken in response to the recommendations of the first independent review of the Hubble fellowship program, with particular focus on those involving IDEA.

The APAC requests APD to provide frequent updates on action related to time-domain and multi-messenger initiatives, with emphasis on planned infrastructures and related funding timelines, and coordination with NSF.

The APAC advises APD to continue close evaluation of the ROSES Inclusion Plans Initiative as it extends to different programs and begins to have a role in proposal funding.

The APAC requests the APD strongly encourage the NASA historian and their team to document fully and completely in a written report the current status of the ongoing investigation of archival materials, conversations, and other sources. The APAC requests the NASA historian be invited to provide a thorough debrief to the committee for the record as soon as possible, and that a public Town Hall be held to disseminate the findings.

The APAC advises APD to consider development of written policies and guidelines-of-practice of naming flagship missions that could build community trust and endorsement.

The APAC suggests that the findings of the NASA historian, the issue of James Webb memorialization, and the naming of future observatories be discussed by the NASA Advisory Council (NAC).

The APAC advises APD to reconsider its position on tracking the impact of the Balloon and Sounding Rockets programs, and develop policies to track metrics of science, technology and IDEA impacts as well as workforce development.

The APAC requests a presentation from Julie Crooke on the Great Observatories Mission and Technology Maturation Program (GOMAP) process focusing on mechanisms to develop, maintain, and support a pool of technological talent and infrastructure.

The current threat of losing US technical expertise and leadership requires immediate attention and the APAC recommends a taskforce to examine ways APD can maintain the X-ray and Far-IR communities in preparation for the Probe-class and the second and third Flagship missions to maximize technical readiness within APD. In the shorter term, the APAC recommends that APD consider how to incorporate tech development into existing programs, such as SAT, APRA, and ISFM, to better maintain and enhance current capabilities. One example that was discussed during APAC was to modify the APD AOs to weigh technical development suborbital mission proposals that may have less science return more equally with higher-science-based missions that may require less technology development. Another example that could be rapidly implemented is to conduct yearly human capital technological expertise gap assessments similar to the Technology Gap Assessments conducted through the PAGs to better prioritize areas of investment.

ExoPAG UPDATE

The APAC thanks Michael Meyer for the Exoplanet Program Analysis Group update. Among the business, ExoPAG requests that the APAC discuss a proposal for a cross-PAG SIG on GOMAP activities on the IROUV during the October meeting. SAG 23, on exoplanet debris disk properties of Exoplanet hosts, SIG 2, on exoplanet demographics, and SIG 3, on synergies between the solar and exoplanetary systems, all continue their work.
At the first in-person ExoPAG meeting since COVID, the group adopted a Code of Conduct and discussed creative modes of optimizing in-person meetings.

Findings

The ExoPAG continues its active and robust work within the broad Exoplanet community and leads the charge for innovative meeting formats.

The APAC commends ExoPAG for its forward-thinking in optimizing meeting time for more efficient in-person discussion time and better work-life-balance.

The APAC also commends the on-going ExoExplorer activity that embraces IDEA and provides continued opportunity within a more diverse community.

Recommendations

The APAC requests a presentation of the GOMAP cross-PAG SIG proposal at the next meeting.

COPAG UPDATE

The APAC thanks Dr. Janice Lee for her Cosmic Origin Program Analysis Group status update. This group has been involved with the JWST Early Release Data, and reflects that there is a significant opportunity to communicate the importance of a suite of complementary Great Observatories. Four of the eleven COPAG leaders will be rolling off soon, and there is an ongoing effort to fill these positions. COPAG is initiating a draft terms of reference (TOR) for a study on the retention and recruitment of technical expertise, particularly of software engineers. This TOR document will be presented at the October 2022 APAC meeting.

Findings

COPAG continues its significant engagement with the community, and has been particularly responsive to the priorities identified in the Decadal Survey.

The APAC commends COPAG for its proactive focus on maintaining the technical workforce to be responsive to the new astrophysical landscape.

Recommendation

The APAC requests that the COPAG provide further details of the COPAG technical workforce study at the October 2022 APAC meeting.

PRECURSOR SCIENCE WORKSHOP UPDATE

The APAC appreciated the presentation by Dr. Terri Brandt on APD efforts to conduct community education and to gain community feedback on the science that could enable future NASA missions. She emphasized the common misconception on the scope of precursor science, which are scientific studies that inform future mission architectures. It differs from GOMAP, which focuses more on technology and mission architecture trades. The Precursor Science workshop series seeks to inform a future, approximately $2.5M, ROSES precursor science proposal call, with the timeline to be decided. A second precursor science workshop is being planned.

Findings

The APAC lauds the efforts to gather community input on the work needed to inform APD's future mission portfolio. This deliberative approach aligns well with the Decadal Survey recommendations to solidify the foundations of the field.

Recommendation

Recognizing that the workshop is the week just prior to the October APAC meeting, the APAC requests a very cursory update (~2 slides) on first impressions on the second Precursor Science workshop and plans for future ones.

TRANSFORM TO OPEN SCIENCE UPDATE

The APAC thanks Ms. Cynthia Hall for her presentation on the new SMD-wide initiative, Transform to Open Science (TOPS). TOPS will begin in 2023 with a NASA declaration of 2023 as the "Year of Open Science", and will allocate $40M over 5 years to educate the community, accelerate the adoption of open science practices, and to advance the ethos of equity through open science. Several APAC members had questions about the implications of TOPS on issues such as American national security and competitiveness, reward structures for early career scientists, the need for individual investigators to conduct their best work, and the need for open science.

Findings

The APAC recognizes the value of open science and finds the TOPS initiative a promising mechanism to raise awareness in the community.

The APAC recognizes that the TOPS plan is still in formulation and that several questions still remain open regarding implementation.

The TOPS team is cognizant of the need for providing tangible resources and support to underrepresented institutions and groups, which bodes well for their goal of increasing equity.

Recommendations

The APAC requests a presentation from the data science and technology community about the current best practices in open science to mitigate negative impacts on national security or human rights.

The APAC requests more information on the TOPS plan regarding success metrics, providing core services to enable open science, particularly for historically marginalized

groups, partnering with ground-based observatories, and engaging with the commercial sector.

The APAC also requests information from other divisions about the effect of zero proprietary time on early career scientists.

ASTROPHYSICS THEORY PROGRAM UPDATE

The APAC thanks Dr. Stefan Immler for a focused discussion on potential responses to the Decadal Survey request to augment the ATP program and to increase proposal calls to a yearly cadence. Fully responding to the Decadal Survey R+A recommendations would require a 10% increase in the R+A budget. APD is considering three options for the ATP program: 1. Change solicitation to yearly with a lower acceptance rate; 2. Continue ATP on its biannual cadence and add a theory call restricted to early career scientists on the years the ATP is not offered; 3. Continue ATP biannual cadence and partner with NSF to co-fund the Theoretical and Computational Astrophysics Networks program, with the aim to increase the number of funded TCANs and decrease ATP proposal pressure. APD plans to inform APAC of its decision at the October 2022 APAC meeting.

Findings

The APAC finds that none of the proposed solutions by themselves reflect the spirit of the Decadal Survey recommendation to bolster support for foundational theoretical work.

Cooperation with the NSF and prioritization of early career scientists is a promising approach to support the theoretical community as a whole.

Recommendation

The APAC recommends the APD commit to augmenting the ATP program, and to analyze an approach that extends the co-funding concept of the third option to also collaborate with the NSF so that an early career theory program is offered every year (i.e. by coordinating offset biannual calls or by sharing annual calls).

JAMES WEBB SPACE TELESCOPE UPDATE

The APAC congratulates the JWST team for its performance during the validation phase as well as the outstanding outreach campaign to showcase the transformational science of the flagship observatory. In the overview and status update presentation, Dr. Eric Smith touched on the slight degradation in performance from the recent

micrometeorite impact, stating that prior information from the Gaia mission indicates that impacts of this magnitude are rare. There was much-larger-than-expected traffic on the “Where is Webb?” site, with a surprising level of engagement from the public on the technical aspects of deployment and commissioning. Further, the request of the US President and NASA Administrator to reveal the first science images underlined the world-wide appeal of the NASA Great Observatories.

Findings

The depth and breadth of interest in the JWST mission and its first images are a reminder that NASA missions are a global inspiration. The NASA public engagement team has successfully capitalized on the public’s fascination with astronomy, conducting an exemplary outreach campaign. Further, scientific, technical, and managerial team members have been excellent ambassadors for NASA.

Recommendations

The APAC strongly advises the APD to prioritize funding for the scientific, technical, and theoretical investigations conducted by the JWST user community and to use the success of JWST as a jumping off point for the New Great Observatories Program and to leverage the success for increased funding for NASA Astrophysics and the Science Mission Directorate as a whole.

The APAC appreciates continued updates on the mission in the October 2022 meeting.

PHYSPAG UPDATE

The APAC would like to thank Dr. Grant Tremblay for his status on PhysPAG activities. The PhysPAG report described community engagement activities at the recent American Astronomical Society, High Energy Astrophysics Division (HEAD) meeting and review of technology gap assessment. PhysPAG proposed two new SAG ideas on the New Great Observatories and the Gamma Ray Transient Network (which may include not only science, but archival research and computational methods), and a third SAG entitled Astrophysics with Equity. There was discussion on sunsetting the Inflation Probe SIG, and perhaps adopting a CMB SIG, though further thought and discussion are needed. A proposal was also made to change the PCOS acronym to PhysCos to appropriately avoid confusion with the PCOS acronym for “Polycystic Ovary Syndrome".

Findings

The PhysPAG is adapting well with the changing landscape of the community, in response to the 2020Astro Decadal prioritizations and with regard to on-going NASA astrophysics missions.

The APAC approved the three new SAGs, agreed to changing the PCOS acronym to PhysCos. The PhysPAG is exploring ways to keep the CMB community engaged, echoing the concern of the APAC in maintaining a technological workforce.

Recommendations

The APAC recommends reaching out to members of the CMB community, and hosting CMB sessions at the PhysPAG to renew engagement and increase participation.

The APAC recommends PhysPAG reach out to the community for input on maintaining technical readiness within the PhysPAG purview.

PhysPAG should coordinate with the NASA Bridge Program to avoid duplicating effort in the Astrophysics with Equity SAG.

The APAC recommends that APD form the three proposed New Great Observatories, Gamma-ray Transient Network, and AWESOM Science Analysis Groups

The APAC recommends that APD change the Physics of the Cosmos program acronym from PCOS to PhysCos moving forward.

The CMB community should be asked whether they would like to retain a SAG and in which capacity, before the IPSIG is retired.

ROMAN UPDATE

The APAC appreciates the overview and status presentation on Roman by Dr. Julie McEnery. The Roman telescope promises to deliver transformational science with mission objectives that include a wide-field infrared (IR) survey, expansion history of the universe, growth and structure of the universe, exoplanet census, general astrophysics surveys, and a coronographic technology demonstration. Dr. McEnery relayed that the launch vehicle selection process was complete and that SpaceX was awarded the contract. The telescope optics are being integrated, the procurement of the spacecraft is underway, and construction has started on the ground system.The Wide Field Instrument and Coronagraph are also progressing as planned. Dr. McEnery stated that the Program was under significant schedule pressure, and that Covid supply issues (and people out sick) have impacted the schedule as well. Through flexible rearrangement of schedule margin applied to I&T, review deadlines will still be met. The project is looking into how they might improve their schedule margin moving forward. In regard to science operations, Astro2020 recommended that a non-advocate review be

held to assess the balance between core community surveys and general astrophysics surveys, which will be conducted by the Committee for Astronomy and Astrophysics. Roman data management and analysis efforts require handling large amounts of data that is inclusive and easily accessible to scientists.

Findings

The APAC lauds the flexible management of the Roman I&T schedule to compensate for delays due to supply chain issues and Covid, which keeps the Program schedule on time.

Optimizing data management and archiving is an ongoing process that will evolve based on use and experience.

Recommendations

The APAC requests an update on the mission progress at the committee's next meeting.

The APAC requests an update on the status of the Committee on Astrophysics and Astronomy (CAA) non-advocate review of Roman's capacity for large ambitious community driven surveys at a future meeting.

TIME DOMAIN AND MULTI-MESSENGER INITIATIVE

The APAC received a thorough update from Dr. Valerie Connaughton regarding existing Time Domain and Multi-Messenger (TDAMM) missions and initial thoughts on NASA considerations on prioritizing TDAMM in response to the 2020 Astro Decadal recommendation. Dr. Connaughton discussed the value of coordination, sustainability, prioritization, and developing and maintaining a foundational infrastructure. An Advisory Committee will be formed following the TDAMM workshop (which occurred August 22-24, 2022).

Findings

NASA's extensive mission portfolio includes multiple missions (operating and planned) geared towards meeting TDAMM science. More TDAMM missions are being proposed within the existing NASA Program opportunities.

The formulation of an Advisory Committee is a good first step towards defining processes for coordination, sustainability, prioritization, and developing and maintaining a foundational infrastructure for TDAMM.

Recommendations

The APAC would like to hear a summary of the findings (white paper) resulting from the first TDAMM workshop and status of the Advisory Committee formulation and Terms of Reference (TOR).

The Senior Reviews in 2018 and 2022 recommended coordination of the NASA mission portfolio to optimize the fleet for TDAMM. The APAC would like to hear which plans NASA has to address this recommendation.

CONVERSATION WITH DR. MARK CLAMPIN

The APAC welcomes Dr. Clampin and would like to thank him for his thoughts regarding NASA's Astrophysics Division, synergies with other NASA Divisions, GOMAP, Probe-class missions, Roman, and other Decadal priorities. Dr. Clampin also shared his professional background with the APAC and support of this Committee. He mentioned the value of science missions, need for technology development, and importance of systems engineering in science missions. Dr. Clampin also mentioned looking forward towards new technologies, such as Quantum sensors.

Findings

N/A

Recommendations

N/A

STATUS ON ATHENA

The APAC would like to thank Dr. Paul McNamara for presenting the current status on Athena. Recent Program review has highlighted the fact that Athena and LISA are boths over budget and not sustainable as is. Multiple options were recommended, including: stopping the Athena adoption process, re-scoping Athena at reduced cost (reduce costs by ~$600M), maintaining cost constraints on LISA (reduce costs by ~$200M), and advancing the LISA adoption target date to before Athena (11/23). The Science Program Committee (SPC) decided to modify Athena science goals and to descope the mission (aka NewAthena), LISA costs will be reduced, and whichever mission is ready by 2023 will be adopted first. An independent science review team will be formulated to assess the science of the descoped missions. While Athena will be a reduced configuration, Dr. McNamara stated that the microcalorimeter (X-IFU) will remain as part of the essential payload. The mirror performance is currently at ~8 arcseconds PSF,

and it is unclear if the Athena team will be able to achieve the required 5 arcsecond requirement.

Findings

NewAthena is a good compromise, especially in light of the potential for cancellation. Reviewing the descoped science is critical, as is involvement of early career scientists who will be part of the Science Re-definition Team.

LISA remains a critical mission that is also supported by NASA. It is in NASA's best interest to continue to support both Athena and LISA despite the re-scoping.

Recommendations

The APAC would like to get a review of NASA contributions to these L-class missions and evaluation of on-going support during the October meeting. In particular, the APAC requests a briefing on the LISA Science Ground Segment report delivered to HQ.

Since both L-class missions are over the current ESA cost cap and are also tightly coupled in ESA's budget, the APAC recommends APD undergo a feasibility study of possible US contributions to LISA.

Sincerely,

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Chair, NASA LISA Study Team

NASA APAC Vice-Chair