

2020 July 09

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

Dear Paul,

The NASA Astrophysics Advisory Committee (APAC) had its Summer meeting on 2020 June 23-24. Due to the COVID-19 pandemic and related NASA operational and travel restriction (Stage 4), the entire two-days of the meeting were conducted virtually using WebEx™ videoconferencing technology accompanied by dial-in phone lines. The following members of the APAC attended the meeting: Kelly Holley-Bockelman, Laura Brenneman, John Conklin (Vice Chair), Asantha Cooray, Massimiliano Galeazzi, Jessica Gaskin, Hashima Hasan (APAC Executive Secretary), William Jones, Suvrath Mahadevan, Margaret Meixner, Michael Meyer, Leonidas Moustakas, Lucianne Walkowitz, and Chick Woodward (APAC Chair).

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
- State of the Profession – Chick Woodward and the APAC Committee
- ExoPAG, COPAG, and PhysPAG reports – Michael Meyer, Margaret Meixner, Graca Rocha
- SOFIA update – Margaret Meixner, Naseem Rangwala
- James Webb update – Eric Smith
- ESCAPE update – Kevin France
- Athena update – Rob Petre
- GUSTO update – Chris Walker
- COSI update – John Tomsick
- CASE/ARIEL update – Mark Swain
- Science Activation update – Kristen Erickson

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.

STATE OF THE PROFESSION

Equity in science is essential to the advancement of science. The advancement of science requires participation of the Black, Indigenous, and People of Color (BIPOC) communities. But, the BIPOC communities in particular cannot fully participate while systemic racism threatens their existence (through violence, disproportionate incarceration, lack of educational opportunities, lack of economic advancement, and vital resources for health and safety, etc.). Therefore, science leadership must recognize systemic racism, investigate its own policies and structures and create opportunities and environments for BIPOC participation.

While diversity, equity and inclusion are not among NASA’s stated core values¹, these qualities are integral elements for the opportunities and environment that the Astrophysics Division must commit to. The APAC recognizes its own failure to address and act with urgency concerning this issue. The challenge now for both the APAC and the Astrophysics Division leadership is stand by this commitment for systemic change and steward efforts to create equity. For too long, the equitable access and treatment of our BIPOC colleagues in the astrophysics community, which APAC represents, has not received appropriate attention and consideration either by the APAC or by NASA and Astrophysics Division leadership. The APAC looks forward to working with the Astrophysics Division Director to immediately address these issues and make improvements on this essential matter.

The APAC Chair led a presentation to give context and information related to the “Status of the Profession: Action into Equity - Black, Indigenous, People of Color (BIPOC) Workforce,” to facilitate an open community discussion about systemic racism, and to identify concrete actions and recommendations for Astrophysics Division leadership to implement. The APAC discussion with Astrophysics Division leadership was frank.

The APAC discussed the critical role of BIPOC scientists in leadership positions with authority in routine, planning, and implementation roles at the Astrophysics Division, Division supported centers, missions, and institutes, as well as within the Science Mission Directorate as a whole. Ensuring this leadership is necessary to initiate systemic change. This representation should be reflected in future APAC membership, as well.

The APAC understands that Astrophysics Division leadership are not experts in all issues related to enhancing diversity, equity, and inclusion, and that the current leadership cannot understand all the issues that face the BIPOC community. Nonetheless, the Astrophysics Division has a duty to take these issues seriously and seize this moment to act. Astrophysics Division leadership and the APAC must commit to improved familiarity and education around these state-of-the-

¹ <https://www.nasa.gov/careers/our-mission-and-values>

profession issues and how they connect to the technical and scientific discussions in which we routinely engage. The APAC suggests consideration of a professional equity-audit within the Astrophysics Division and Science Mission Directorate. Such an assessment will reveal specific actions the Astrophysics Division could take to make the Division more diverse and demonstrate leadership by example to its community of practice and other stakeholders.

The APAC notes that the Astrophysics Division leadership should be familiar with and consider using available resources to improve diversity, equity, and inclusion throughout its programs, missions, and centers of operations. These include but are far from limited to the American Institute for Physics (AIP) TEAM-UP Task Force report (TEAM-UP Task Force²), the Inclusive Astronomy Nashville Recommendations endorsed by the American Astronomical Society (Inclusive Astronomy: The Nashville Recommendations, AAS Groups Wiki³) and the American Astronomical Society report on graduate education.⁴ The APAC looks forward to discussing recommendations and findings from these data-driven analyses with Astrophysics Division leadership to effect structural change in the Division's portfolio of activity.

Discussions also highlighted how the Astrophysics Division responded to recommendations within the 1993 Baltimore Charter⁵ and equipped leadership with action to correct systemic gender bias. Actions taken to enhance diversity, equity, and inclusion have included modifications to the Future Investigators in NASA Earth and Space Science and Technology (FINESST) program requirements and selections, application of dual anonymous peer review (DAPR) processes to proposal evaluations, and deliberate advancement of women to leadership in Division-supported centers and mission enterprises. Each Astrophysics Division action has been commendable and welcomed by the community. Integrated over the last decade, these programmatic changes have enhanced the overall quality of and impact on NASA science by increasing participation of predominately white women, a key and previously under-represented component of the US workforce. The APAC expects similar transformation through increased participation of BIPOC scientists.

The APAC apprised Astrophysics Division management that an intersectional approach⁶ is now necessary to reduce bias in and increase creativity within NASA science. To continue expanding diversity, equity and inclusion, the Astrophysics Division must recognize how structures and policies advantage and disadvantage the same individuals in different contexts. The APAC challenged Division management to enact bold changes. Positive change will transform structures and policies to recognize an individual's full identity (race, class, gender-identity, ability, etc.) and experiences.

The APAC discussed actions that the NASA Astrophysics Division could consider immediately, including an evaluation criterion on "promoting diversity, equity, and inclusion in the field" in the review for all Astrophysics Division proposals and directed work. Strengths may be

² <https://www.aip.org/diversity-initiatives/team-up-task-force>

³ https://tiki.aas.org/tiki-index.php?page=Inclusive_Astronomy_The_Nashville_Recommendations

⁴ <https://baas.aas.org/pub/2019i0101/release/1>

⁵ Astrophysics Data System [ADS] abstract server Bibcode: 1993AAS...182.6501U

⁶ See Patricia Hill Collins and Sirma Bilge 2016, in *Intersectionality*, Polity Press, Malden MA, USA, ISBN-13:97-0-6456-8448-2.

reflected in team diversity, equity, and inclusion in Principal Investigator (PI)-led investigations and in personal statements in Fellowship proposals. Ultimately all proposals should state measurable efforts to enhance diversity, equity, and inclusion. The APAC encouraged the Astrophysics Division leadership to engage expert assistance to establish the language and evaluation parameters for diversity (i.e., de-biasing the evaluation process of in-person review panels for a postdoctoral fellowship), and to incorporate language in research and opportunity announcements that states explicitly that PIs are accountable for the climate and team health of their investigation or project. The APAC agreed that the latter examples were minimal actions, to be followed by more expansive and substantive initiatives. The APAC further encouraged NASA and the Astrophysics Division leadership to discuss how such a change might be implemented with leadership at other agencies, particularly in light of the National Science Foundation (NSF) Visitors' Committee Report finding that evaluation of Broader Impacts was often not appropriately rigorous. NASA should strive to include this as an evaluation criterion in a way that gives appropriate weight and consideration to the urgency of these issues.

Participation during the discussion periods on both meeting days was extensive. Questions and comments came through audio, public chat messages, and emails and were read into the record, recognizing technology connectivity issues. The APAC is profoundly grateful for the candid voices that spoke and recognizes that stepping up to publicly share narratives on deeply challenging topics such as this is as important as it has ever been. The Astrophysics Division leadership is listening and learning, and the APAC is committed to urging specific and concrete action.

Although the level of public discussion on the topic of BIPOC in astrophysics science was unprecedented, the communities that the APAC is most keen to hear from and engage with had limited awareness (of the 2020 June APAC meeting) and encouragement to contribute. Transformation of communications and the Astrophysics Division messaging is required to address this shortfall, in part through adopting new media platform technologies. The APAC and Division management agreed to identify new modes of communication consistent with structures governing FACA committee requirements and NASA information technology and cyber security policies.

The APAC signaled its intent to keep the Status of the Profession item in each upcoming meeting, noting the commitment of agenda time may be limited at its 2020 October meeting. The APAC therefore discussed with Astrophysics Division leadership the merits of conducting an additional out-of-cycle regular meeting prior to 2020 October. This public FACA meeting would focus entirely on one Status of the Profession topic: action into equity for Black, Indigenous, People of Color. A specific, focused meeting that is advertised actively and deliberately to a much greater extent than has been done to date will directly address problems of exclusion of BIPOC astronomers and give opportunity for these voices to speak. The transformation of science discussed earlier is not possible until the APAC and the Astrophysics Division create a public space to invite, listen, and respond to these historically excluded voices.

The APAC relayed that it would like to invite members of the American Astronomical Society (AAS) Committee on the Status of Minorities in Astronomy to share concerns and ideas for making the professional more diverse, equitable, and inclusive, as well as dismantling

institutional racism in the field, and particularly within the NASA Astrophysics Division. The APAC also discussed the role of the Program Analysis Groups (PAGs) on this issue and commented on how they continue to engage and act in polling and leadership within their communities.

The APAC agreed that it is appropriate and relevant for the committee itself to have a full meeting and discussion on this topic to fully execute our Charter to serve the Astrophysics Division Director. Clearly, the national scientific enterprise and NASA Astrophysics Division science framework thrives when all US workforce talents are working within a community of inclusive practice.

Findings

While there has been progress in gender parity within the NASA Astrophysics Division, similar progress has not extended into the Black, Indigenous, People of Color community and additional work is needed.

The community clearly expressed frustration and disappointment over the lack of actionable plans and policies that directly address systemic racism within the Astrophysics Division.

Black, Indigenous, and People of Color representation must be explicitly and deliberately brought into positions of leadership and authority at the Astrophysics Division and the Science Mission Directorate (SMD).

The APAC in the past has failed to address and act on issues of the Black, Indigenous, People of Color scientific workforce with urgency.

Recommendations

The APAC fully endorses, and the community welcomes, a clear statement that the NASA Astrophysics Division values the well-being and lives of Black, Indigenous, People of Color and recognizes their contributions to advancing the Astrophysics Division's strategic scientific, education, and technical enterprise.

The APAC advises the Astrophysics Division to conduct a professionally led equity-audit of institutional racism within the Division.

The APAC strongly recommends ensuring BIPOC representation in future APAC membership.

The APAC recommends that NASA immediately consider including an evaluation criterion on "promoting diversity, equity, and inclusion in the field" in the review for all Astrophysics Division proposals and directed work.

The APAC recommends that the Astrophysics Division critically assess current programs and initiatives within the Division portfolio directed toward diversity, equity, and inclusion. The Division should examine why these mechanisms and means have not fully worked and assess what fundamental changes are required to break exclusive and, specifically, racist structures within these.

The APAC recommends that Astrophysics Division Projects and Programs explicitly authorize use of funds for Investigation, Project, and Program leads or their designees to participate in and engage at conferences organized to support BIPOC and other minority scientists, with a reporting requirement.

The APAC recommends establishing additional channels for more extensive community input in APAC discussions.

ASTROPHYSICS DIVISION UPDATE

The APAC appreciates the NASA Astrophysics Division update report as delivered by Dr. Paul Hertz. The science results are inspiring. The Transiting Exoplanet Survey Satellite (TESS) result on variable stars using asteroseismology demonstrates a wider impact of this important exoplanet mission. The Hubble analysis of the Magellanic Stream and leading arm reveals the role of the Milky Way's black hole in energizing this distant gas. Swift's discovery of the young neutron stars shows the importance of time domain astronomy. Hubble celebrated 30 years of science.

The committee is pleased with the new name for WFIRST, The Nancy Grace Roman Telescope, which honors pioneering work at NASA Headquarters for space astrophysics, including establishing the Hubble Space Telescope project. The APAC welcomes the news that observing time allocation on Roman Space Telescope will be open for the community at large through a competitive review process.

The COVID-19 impacts on NASA programs are sobering. The APAC is grateful that NASA has continued operating all mission (except SOFIA, as discussed below), and the proposal solicitation and review process for funding ROSES and guest-observer (GO) proposals. The implementation of the dual anonymous peer review (DAPR) process is laudable. The APAC appreciates that so much mission work was done during the pandemic shutdown. It is a testament to the dedication and commitment of the NASA workforce.

The committee is particularly pleased that the Astrophysics Division is open to hearing advice from them regarding the Astrophysics Data and Analysis (ADAP)-21 cancellation, as detailed below in the summary of PAG reports. The APAC appreciates NASA's strategy to assist the most vulnerable members of the community: graduate students, post-docs and early career researchers on soft money. The committee is pleased with the increase in graduate student fellowships in the FINESST program.

The APAC welcomes the support for new laboratory astrophysics equipment and found the report on the Archive senior review informative. Highlights of the new NASA Strategic Plan 2020-2025 also were presented. The NASA LISA study team, science support taskforce report (2020 February 28) was provided to the committee.

The APAC expressed concerns that recent Administration policy directives may adversely impact segments of the NASA workforce. The importance of foreign students and scientists

associated with US academic institutions, research institutes, and NASA centers to advance NASA's missions, science leadership, and technology innovation interests cannot be understated. The degradation of leadership and innovation in many strategic areas of US national interest that NASA Science Mission Directorate (SMD) and the Astrophysics Division steward in their portfolios is an undesirable outcome if workforce constraints hobble the ability to seek out the best global talents and minds.

NASA values diversity and has programs for improving recruitment of a diverse staff. However, as discussed in the State of the Profession highlight, the APAC reflects that the NASA programs appear to be failing to achieve its goal of diversity particularly for the Black, Indigenous, People of Color (BIPOC) community. For example, the participants in Launchpad for Mission PI development as well as this year's Hubble fellows are not as diverse as the astrophysics community overall. The APAC will continue discussion of this topic for future meetings. A more detailed discussion of findings is within the State of the Profession section.

Findings

NASA's future planning is strong but awaits the Astro2020 Decadal results for clear direction.

Diversity, equity, and inclusion is absent as a fundamental tenant within four core cross-cutting priorities of Vision, Mission, Values, and Focus captured in the NASA Science Mission Directorate's (SMD) Explore Science 2020-2024: Vision for Scientific Excellence strategic plan.

Recommendations

The APAC requests brief update at next meeting on Artemis-inspired Commercial Lunar Payload Services (CLPS) astrophysics payloads selections.

The APAC notes the dynamic nature of the exoplanet planet research program (XRP) driven by changes in the scope of proposals reviewed, as well as the sources of potential funding, and requests to be briefed on the current status of the process at the next meeting.

The APAC requests additional briefings on potential implementation of actions contained within the Archive senior review.

The APAC requests the Astrophysics Division assess and to report out potential impacts on its mission if workforce constraints are mandated and maintained over an extended period into the future.

US (NASA) CONTRIBUTIONS TO FOREIGN-LED ASTRONOMY MISSIONS

The APAC expressed concerns related to the recent Astrophysics Division decision to remove Mission of Opportunity (MoOs) competitions as part of the highly successful explorer program to select instrumental contributions to foreign led missions. APAC heard from the ARIEL/CASE contribution that was selected as a MoO competition where it was clear the team had always intended the contribution to be selected competitively and the CASE PI indicated there was initial discussion with the Astrophysics Division if the contribution should be strategic in nature.

APAC expresses concern that the Astrophysics Division does not have a clear plan to select future contributions, apart from the vague statement that contributions will be limited to missions that are considered strategic within the Astrophysics Division.

Recommendations

The APAC requests a detailed plan from the Astrophysics Division on the mechanisms that will be implemented to decide the missions that NASA will partner with and the instrumental contribution and the team that will lead the contribution.

The APAC also requests the Astrophysics Division clarify how the US science investigators can join the instrument teams, especially potential science team members from universities and institutions who are not part of NASA centers and facilities.

ExoPAG, PhysPAG, COPAG REPORTS

Two new terms of reference (TORS) describing ExoPAG science analysis group (SAGS) initiatives were brought forth for action to the APAC. The APAC reviewed the science focus and scope of the ExoPag SAG entitled “The Effect of Stellar Contamination on Space-based Transmission Spectroscopy,” and the SAG entitled “[The] Exoplanet Target Star Archive.” The APAC was satisfied that the goals and outcomes in the proposed TORS were aligned with supporting current and future NASA missions and were consonant with the Division strategic themes. Reports on outcomes would be delivered in white papers to SMD mid-2021. The APAC looks forward to reviewing highlights from both studies at a future meeting.

Highlights of the PhysPAG presentation included discussion of the gravity wave science interest group (SIG) with the LISA consortium and the Gravitation Wave International Committee (GWIC) to organize the 13th International LISA symposium (virtual meeting, 2020 September) as well as a review of the highlights of the Inflation Probe SIG symposium. The APAC was informed that XRISM development in the COVID-19 pandemic era was progressing using remote collaboration means, and the launch date is still anticipated for 2022. The PhysPAG chair responded to the 2020 March APAC recommendation regarding organization of cross-PAG activities and technology development prior to the first day of the winter 2021 American Astronomical Society (AAS), informing the APAC that conversation have begun to coordinate sessions.

The COPAG update alerted the APAC that activities of the Cosmic Dawn SAG are delayed as a result of COVID-19 impacts and institutional lockdowns. The APAC also was informed that a new Cosmic Origins Chief scientist was arriving at NASA Goddard Space Flight Center (GFSC).

The COPAG chair also described to the APAC the outcomes (including statistics and lateral drill downs) of a joint PAG survey of the community, which solicited input on the impacts of COVID-19 on NASA astrophysics research, with a special focus on the preparation and submission of proposal for the Astrophysics Data Analysis Program (ADAP). The plurality of respondents (60%) indicated the announced change in the ADAP solicitation cadence on research efforts would have a net negative effect. Over two-thirds (76%) of women (self-

identified) and 66% of early career or non-tenured individual (comprising part of the overall pool of respondents cited above) indicated net negative impact. Interpretation of the survey results clearly demonstrated that the change in solicitation cadence will negatively affect research, but women, early-career researchers, and those without job security (e.g., non-tenured, soft money supported) expect to be more significantly and negatively impacted than the general population of ADAP proposers. The APAC expressed serious concern with this survey result and concluded that a change of action was necessary after detailed conversation with members of the Astrophysics Division management.

Findings

The PAGS continue to provide important community feedback to the APAC arising from their activities. These efforts enable the APAC to recommend informed actions to the Astrophysics Division.

Walk-back is required of the decision to cancel the 2021 Astrophysics Data Analysis Program (ADAP) solicitation, wrought in part to COVID-19 pandemic disruptions and internal Agency pressures, as the impact on segments of the science community, especially women and early-career scientists, would be extremely deleterious.

The PAGs could support investigation into Black, Indigenous, People of Color (BIPOC) issues through surveys.

Recommendations

The APAC recommends the TORS for the proposed new ExoPAG SAG to the Astrophysics Division director for consideration and potential approval.

The APAC strongly recommends NASA reverse the decision to cancel the ADAP 2021 solicitation.

The APAC advises the PAGS to provide a mechanism to collect public comments about Black, Indigenous, People of Color (BIPOC) issues, as the current public comment period during APAC meetings provides insufficient input from the community.

SOFIA UPDATE

The APAC thanks the SOFIA management team for an update related to the current operational status of the observatory and project plans for the coming year. SOFIA is now in the extended mission phase of activity. The APAC notes that the COVID-19 pandemic leading to Stage 4 NASA operational shutdown and international quarantine requirements has severely impacted SOFIA 2020 flight activities.

The APAC continues to be concerned with the poor productivity of one of the most expensive programs in the Astrophysics Division portfolio and the seeming lack of commitment from the SOFIA project to understand the urgency for improving the science output. The lack of clarity of the FMR and SOMER recommendations and the apparent inability or pushback on these

recommendations from the project without convincing explanations or a path to great science productivity with bold changes continues to be an area of grave concern for the APAC.

The 2020 March APAC letter had several recommendations yet to be addressed by the NASA Astrophysics Division and/or SOFIA Project Office.

A recommendation within the 2020 March APAC letter-report stated: *"The (APAC) 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 SOFIA presentations did not provide the recommendations from the FMR and SOMER - instead simply stating their goals. These goals cannot be judged out of context without the appropriate discussion with the FMR and SOMER Panel Chairs. The APAC requests that the FMR and SOMER Chairs or their designees be present at the 2020 October APAC meeting and that significant time be devoted to the discussion of the SOFIA plans with these individuals present.

Another recommendation in the APAC 2020 March letter was: *"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 SOFIA management team provided some guidance, including steps taken for proposal selection, "increased lifetime" of proposals, and a plan for longer deployment in 2021. However, it is unclear how these steps will lead to the proposed metrics. A plot of the h-index presented at this APAC meeting seems to suggest the project is unlikely to exceed a h-index greater than 25 by 2022. The SOFIA project set a productivity goal of 45 publications for FY20 year-end, with an out-year objective of 75 (or 100 as stated during the 2020 March APAC meeting, or greater than 150 as recommended by the FMR) annual publications in 2020. How this increase in productivity will be demonstrably be achieved with changes to operations was not clear. The latter modest scientific productivity metric seems to be a very low return on investment for the Astrophysics Division given upwards of \$1 billion-dollar observatory development costs and on-going operations cost of approximately \$85 million per annum.

SOFIA continues to make the argument that the airborne observatory is unique, but the APAC suggests this argument is both inappropriate and incorrect. The APAC notes that the European Space Agency (ESA) cryogenic space-mission Herschel has already accomplished a significant fraction of the science that SOFIA now pursues. SOFIA, with a warm telescope flying at ~12 km altitude is destined to struggle to produce scientifically compelling results especially given the project's seeming lack of desire to fly more hours as recommended by the SOMER and FMR reports and to transform and optimize the aircraft and science operations aspects of the observatory.

The APAC notes the recent cancellation of the HIRMES instrument (designed to reach the spectroscopic sensitivity of the Herschel/SPIRE instrument) may negatively affect the near-term scientific productivity and observatory impact. Existing SOFIA instruments have sensitivities that are three (3) to ten (10) times lower than those provided by Herschel, thereby limiting most observations to Galactic targets. Recently, SOFIA has provided the community with infrared polarization capability via the HAWC+. The APAC advises that the h-indices be carefully tracked as one impact measure arising from instrument capabilities.

The APAC was pleased that the SOFIA project presented statistics related to the number of unique PIs in all guest observers (GOs) proposal calls, 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 APAC requests that these statistics be presented per cycle to gauge the growth of the user base and determine how effectively the wider US community uses SOFIA science opportunities.

The APAC agrees that SOFIA project must consider deploying to and operating from the Southern hemisphere for the maximum extent possible to meet scientific demand for the more target rich environment and the operational advantage of increased flight dwell-time above the troposphere. However, the APAC was concerned that the project did not provide a cost ROM to enable a second crew to support more New Zealand flights as requested. However, the APAC was encouraged that the SOFIA project is exploring alternative southern hemisphere sites (in addition to New Zealand) for deployment.

Findings

Challenges continue to exist that inhibit the scientific return and science impact of SOFIA given the investment.

Alternative southern operational bases may benefit SOFIA science production.

Recommendations

The APAC requests that the FMR and SOMER chairs and the SOFIA Science Mission (SMO) Director be present for an extensive question and answer session at its 2020 October meeting.

The APAC suggests that the SOFIA project develop strategies to achieve success during the next highly competitive NASA Astrophysics Division Senior Review (or similar process), given the current low number of papers and citations coupled with the significant operational costs.

JWST UPDATE

The APAC thanks Dr. Eric Smith for the succinct and transparent James Webb Space (JWST) presentation. The committee was informed that despite COVID-19 disruptions and lockdowns, slow progress occurred on the Webb telescope final integration and test (I&T) schedule. The APAC was apprised that the root causes of prior failures of the traveling wave tunable amplifier (TWTA) and command and telemetry process (CTP) units have finally been traced to manufacturing defects in power transformers. New contingency analysis of post-launch solar

array deployment events ($t + 30$ min) indicated that the current 53 amp-hour flight battery (HCM Li ion) ability to work anomalies had fallen under 3 hours. However, a previously procured spare Moli-M Li ion battery with larger capacity, of order 106 amp-hours, was available and after consultation of the GSFC Engineering Directorate and Standing Review Board briefing and approval battery swap out has occurred.

However, the schedule re-plan of remaining I&T items leading ultimately to ship of Webb to the launch site has not been completed as NASA is “sunrising” out of stage 4 lockdown. In addition, the schedule for the required Ariane 5 launches with the new vents and pressure transducer configuration designed to meet the Webb requirements was not firmly known. Hence, a new launch date for Webb at this point cannot be announced with confidence. The APAC discussed the whether the cost reserves were sufficient to carry the project forward given the COVID-19 hiatus. The APAC notes that the current funded schedule reserve as of 2020 June is running below the both the GSFC recommended reserve profile, and that of the Project reserve usage plan. The APAC expressed concern that continued COVID-19 erosion of Webb schedule may necessitate renewed conversations with Congress to manage the program successfully to launch.

The APAC was apprised that no further changes to observatory capabilities offered in GO Cycle 1 would be forthcoming from those announced in the current call for proposals. Furthermore, once a new launch date has been determined the science community would be given a minimum of twelve (12) weeks to generate and submit final proposals.

Findings

Lengthy Webb schedule erosion may deplete currently funded reserve prior to launch.

Recommendations

The APAC requests a status updated on the COVID-19 induced Webb schedule re-plan and further clarification on the impacts of schedule erosion on the currently funded reserve resources.

ESCAPE UPDATE

The APAC enjoyed the overview of the ESCAPE mission concept, under study in a competition for a future Small Explorer slot, presented by PI, Dr. Kevin France. The committee noted that there were opportunities for other science besides the main mission described given the capabilities under study. The APAC also wondered what opportunities will exist for community input on the source list given the tension between covering a range of ages and range of stellar masses, especially if the goal is to buy down risk on using other activity indicators to predict EUV flux as a function of stellar mass and age. The APAC noted that fabrication, assembly, alignment, and test of the grazing incident mirrors of the telescope is a technical risk item, that although low, warrants attention.

ATHENA UPDATE

The APAC was pleased to hear the report from the NASA Athena Project Scientist, Dr. Rob Petre. Athena is a European Space Agency (ESA)-led flagship X-ray observatory currently slated for launch in the early 2030s. This mission is presently in Phase B1 in ESA parlance. NASA expects to contribute approximately \$100 to \$150 million (USD) to the mission in the form of hardware for its two detectors (X-ray Integral Field Unit [IFU] Focal Plane Array, Wide-Field Imager [WFI]) and the spacecraft (Vibration Isolation System), facility use for mirror calibration (MSFC-XRCF), software (WFI background analysis), science ground segment support, a US guest observe facility (GOF), and preparatory science and guest observer (GO) programs.

Athena will be the great X-ray observatory of the next decade, filling a critical need at high energies in the pan-chromatic astrophysics landscape. Orbiting around L1 with a 4-year baseline mission (10 years planned), Athena will have sensitivity from 0.2-12 keV and an unparalleled combination of energy resolution (2.5 eV, X-IFU), field-of-view (40 x 40 square arc-minute with WFI) and effective area (approximately 1.4 square meters) over this bandpass. The observatory will explore the hot and energetic universe, addressing questions of how ordinary matter assembles into the large-scale structures that we see today, and how black holes grow and influence their surroundings. The X-IFU will revolutionize the study of hot plasmas, while the WFI will produce X-ray surveys that are orders of magnitude more sensitive than the current state-of-the-art in the field. Beyond exploring the most extreme environments in the universe, Athena also will contribute to every area of astrophysics, providing discovery science on exoplanet atmospheres, star formation, stellar endpoints, dark matter candidates, and many other topics. Two-thirds of the operational life of this observatory will be allocated to the international community through a competitive and peer-reviewed proposal process.

The APAC considers Athena mission investment to be critical to advance opportunities for the US X-ray and high-energy communities in the next decade. The APAC questioned the Athena project scientist on several issues and welcomed the clarifications regarding flight heritage mission architecture (including the mirrors), observatory transient event response mechanisms, the fraction of competitive time available to US proposers, and planned announcement of opportunities (AOs) for funding of successful US proposers.

Recommendations

The APAC requests further information regarding plans for the US Athena data center when they become known.

The APAC advises the Athena Project Scientist to discuss with the PhysPAG community the movement for "one-stop-shop" for X-ray data reduction for various missions.

GUSTO UPDATE

The APAC is grateful to the Galactic/Extragalactic Ultra-Long Duration Spectroscopic-Stratospheric Terahertz Observatory (GUSTO) PI, Dr. Christopher Walker, for presenting an

overview and status on the GUSTO Project. The GUSTO team should be commended for their efforts to maintain schedule during this challenging time related to COVID-19. This (Ultra-) Long-Duration balloon-based (ULDB) observatory will probe the lifecycle of the Interstellar Medium, by surveying more than 124 square degrees of the Milky Way and the LMC ([CII], [OI], and [NII] at far-infrared wavelengths [i.e., terahertz frequencies]). Hardware assembly is progressing satisfactorily with most of the hot electron bolometer (HEB) arrays assembled and delivered by the Netherlands Institute for Space Research (SRON), and most of the local oscillator (LO) arrays from the contracted commercial supplier are in-house and being integrated into flight packages. The current readiness of the super-pressure balloon tethering GUSTO has an elevated Project risk. Lack of a super-pressure balloon to loft the payload would result in a shorter mission duration at altitude by several tens of days. However, a mitigation path (worst case) is to fly on a zero-pressure balloon on which the mission threshold science requirements can still be met. Future testing of a super-pressure balloon is still being planned prior to GUSTO launch. At this juncture, overall the APAC has few concerns regarding eventual mission success.

Recommendations

The APAC requests to be informed of the flight-testing progress of super-pressure balloon designs identified for use with GUSTO.

COSI UPDATE

The APAC was interested to hear the progress report on the Compton Spectrometer and Imager (COSI) SMEX mission from its PI, Dr. John Tomsick. Currently in Phase A, this mission is developing its Concept Study Report.

COSI will be a soft gamma-ray observatory with polarimetry capability, flying in low-earth orbit, with sensitivity from 0.1-20 MeV and energy resolution 0.2-1% over this bandpass. This energy range will open up significant discovery space for COSI to investigate nuclear line emission (e.g., from SNe), where and how positrons form and annihilate, and to observe transient phenomena (e.g., GRBs, GW sources, etc.) with greater sensitivity than has previously been achieved over this bandpass. COSI is poised to utilize its Germanium detectors and an all-sky survey approach with a Compton telescope to observe the entire gamma-ray sky each day having leveraged a successful NASA Astrophysics Research and Analysis (APRA) program to advance its hardware and software development and capabilities. The mission will provide rapid transient alerts to the community with localizations of less than 1 degree in an hour or less. Every day, COSI will observe and cover the entire sky.

COSI science will also include pointed observations of black hole binaries and active galactic nuclei (AGN), revolutionizing high-energy polarization measurements of these sources and shedding new light on the physical properties of coronae and jets in actively accreting black hole systems. A guest investigator program is envisioned as part of the science enhancement options, allowing the community access to COSI science beyond the archived results from the baseline mission. The APAC was pleased with the COSI presentation, acknowledging that this mission will fill an important void in the future mission landscape of the 2020s.

The APAC sought further clarifying information from the COSI PI on two points during the question and answer period. These were: (1) Will coordinated observations be planned with other existing observatories, given that COSI science is multi-messenger astrophysics (MMA) science? and (2) What is the response time of COSI to Target of Opportunity (ToO) triggers from other observatories? In response to these APAC queries, the PI replied that the mission has every intention of performing coordinated observations and will be considering these formally (via official memoranda of understanding [MOUs]) after Phase A is completed. Secondly the COSI PI articulated that the nominal mission requirement is a one- to two-day response subsequent to an accepted ToO trigger request from the community. However, they indicated that planning and uploading a command sequence for a pointed ToO observation demands some time to carefully consider the impact of this maneuver on the solar panels (with respect to the sun angle), radiators and star trackers. Eventually this procedure could potentially be optimized by the COSI team if there were a community demand for faster response.

CASE/ARIEL UPDATE

The APAC appreciated the update on the CASE Mission of Opportunity presented by Dr. Mark Swain. ARIEL/CASE represents an exciting new capability that will be extremely complementary to the James Webb Space Telescope (JWST) and build on the heritage of the NASA Kepler and TESS missions. CASE/ARIEL will also benefit from future work done from ground-based facilities with extreme precision radial velocity instrumentation. The APAC looks forward to future discussions on the goals (and requirements) of the mission, an overview of the software plan for the exploitation of the data obtained during the mission, and the range of opportunities for community involvement.

Recommendations

The APAC requests future briefing on aspects of US community distribution and exploitation of CASE/ARIEL data products.

SCIENCE ACTIVATION UPDATE

The APAC appreciates the overview and status by NASA's Director for Science Engagement and Partnerships, Ms. Kristen Erickson on the Science Activation effort. The portfolio of opportunities is comprehensive and the use of science experts to develop content and engage the community should be applauded. Major accomplishments included a large number of registrants for the Universe of Stories summer programming to developing toolkits for science centers and museums and improving citizen science.

While this effort is comprehensive, the APAC had questions regarding the effectiveness and metrics for determining effectiveness for these programs. There were concerns that these programs do not reach the broader community, some of which are without computer and internet resources. A comment from the public requested that a better job be done informing the broader community of the existence of many of these programs. In order to address some of these

concerns, a question of funding sufficiency was asked. There was also concern about how the Scientific Activation efforts coordinated with other NASA and Astrophysics Division activities.

Findings

The objectives of the Science Activation portfolio are important to spearhead NASA science literacy enhancement.

Recommendations

The APAC requests a status on the identification of metrics associated with these programs at the next APAC meeting, and for the Science Activation Team to consider how to reach the broader community, including those without internet access, and to identify how to better coordinate with other existing NASA and Astrophysics Division activities.

Respectively,

A handwritten signature in blue ink, appearing to be 'C. Woodward', written in a cursive style.

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