NASA Astrophysics

ASTROPHYSICS ADVISORY COMMITTEE

October 17-18, 2022
Hybrid Meeting

MEETING MINUTES

Charles E. Woodward 11/26/2022

Charles Woodward, Chair

Hashima Hasan 11/25/2022

Hashima Hasan, Executive Secretary

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Introduction and Announcements
Dr. Hashima Hasan, Executive Secretary of the Astrophysics Advisory Committee (APAC), called the meeting to order. As this was a Federal Advisory Committee Act (FACA) meeting, it was open to the public and all statements were to become part of the public record. This meeting was being recorded on WebEx. By attending the meeting, participants consented to their voice and likeness being recorded and shared on the APAC website and in any media in existence now or in the future. Participants released NASA from any claims and demands that may arise from such use, including claims for compensation. While discussions during the meeting were for APAC members only, the public would have opportunities to ask questions via the WebEx chat feature and a web portal. All APAC member conversations were to be on the record, and formal minutes were being taken.

The NASA Science Mission Directorate (SMD) Associate Administrator (AA) had appointed the Committee members on the basis their subject matter expertise; as such, they must comply with Federal ethics laws applying to Special Government Employees (SGEs). Committee members were required to recuse themselves from discussion of any topics for which they had personal or institutional financial conflicts of interest (COIs). For this meeting, no APAC members had known COIs. Any members finding COIs were obliged to tell Dr. Hasan and recuse themselves during the discussion. Members should address any ethics questions to Dr. Hasan. She then introduced Dr. Charles Woodward, APAC Chair.

Dr. Woodward welcomed the participants. A primary activity for this meeting was the annual Government Performance and Results Act Modernization Act (GPRAMA) review.

Astrophysics Division Update
Dr. Mark Clampin, Director of NASA's Astrophysics Division (APD), began his update by saying that he had been in the position for 2 months and had made some changes in the Division's organization. The Program Scientists now report to Dr. Eric Smith, Associate Director of Research and Analysis (R&A), while the Program Executives report to Dr. Joseph Smith, Associate Director of Flight Programs. Dr. Sandra Cauffman leads Strategic Missions. The Cross-Cutting Technologies area and the Inclusion, Diversity, Equity, and Access (IDEA) offices remain unchanged, while Dr. Hasan is the lead for communications.

The first science highlight was from the James Webb Space Telescope (JWST) and illustrated the differences between the Near Infrared Camera (NIRCam) and Mid-Infrared Instrument (MIRI). JWST is a cornerstone of APD work now, producing science in all major areas and resulting in a multitude of submissions for publication. The mission is doing well largely due to the optical performance of the telescope and the pointing performance. Its imaging and sensitivity far exceed the requirements. In another science highlight, the Transiting Exoplanet Survey Satellite (TESS), which is in extended mission, identifies small rocky planets around bright stars. TESS has officially surpassed 1,000 peer-reviewed publications and is a great example of the Medium-class Explorer (MIDEX) program.

Dr. Clampin then addressed the recommendations APAC made at its July meeting. There will be an update on the Bridge program at the March, 2023, meeting. He was not yet at liberty to discuss the Fiscal Year 2024 (FY24) budget. He did plan on addressing the independent review of the Hubble Fellowship Program. APD will continue to evaluate the Research Opportunities for Space and Earth Science (ROSES) Inclusion Plan Initiative. Regarding augmentation of the Astrophysics Theory Program (ATP) and collaboration with the National Science Foundation (NSF) on a possible Early Career (EC) theory program, those discussions are ongoing and there will be an update in March. It was noted that the Department of Energy (DOE) should be included in these discussions, and there had been talk of organizing through NSF's Astronomy and Astrophysics Advisory Committee (AAAC).

APAC also asked that APD urge the NASA historian and team to complete, document, and release their research on Mr. James Webb. Dr. Clampin reported that while the historian plans to release additional information, there was no expected date. Dr. Paul Hertz, the previous APD Director, added that the NASA and contract historians have visited the Truman and National archives, and are currently writing their reports. Regarding a recommendation to develop written policies and guidelines for naming flagship missions, Dr. Clampin reported that this is being done by SMD, and the policy is not yet ready for release.

There was to be an update on the Nancy Grace Roman Observatory (Roman) at this meeting, and it would include lessons learned from JWST. The Committee on Astrophysics and Astronomy (CAA) report on Roman's capacity for large, community-driven surveys was released on October 7. A full report, with APD's response, will be presented at the March APAC meeting. That meeting will also include a full discussion of the Great Observatories Mission and Technology Maturation Program (GOMAP) and the Decadal Survey (DS) recommendation for a Near Infrared/Optical/Ultraviolet telescope. At this meeting, Dr. Eric Smith planned a presentation on JWST. There would also be updates on both the Athena mission and NASA's contributions to the European Space Agency (ESA) L-class missions. APD does not plan to increase its contributions to ESA's Large Interferometer Space Antenna (LISA).

APAC advised APD to reconsider its position on tracking the impact of the Balloon and Sounding Rockets programs, and to develop policies to track metrics covering science, technology, IDEA impacts, and workforce development. Dr. Clampin explained that for all but the IDEA impacts, APD has done "quad charts" at its annual review of PI programs. After a pause due to Covid, these have now resumed. The NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) is tracking beginning and end Technology Readiness Levels (TRLs).

APAC also recommended having a task force that will study ways to maintain the x-ray and Far InfraRed (FIR) communities. To that end, additional funds went to the most recent Astrophysics Research and Analysis Program (APRA) selections in order to select proposals directly relevant to UltraViolet-Optical InfraRed (UVOIR) technologies. The APRA suborbital program was extended to include commercial launches in support of further technology development. APD is looking at the Strategic Astrophysics Technology (SAT) program for possible changes as well. The additional funds cover x-ray astronomy, among other areas. Dr. Woodward said that there was concern that the technologies necessary for Cosmic Microwave Background (CMB) were excluded in the recent call for proposals. He asked about the breadth of the technology development plan. Dr. Clampin replied that the plan to balance FIR will include CMB activities. Dr. Jessica Gaskin asked if the SAT call includes CMB, and Dr. Woodward added that there is community concern that it does not seem to do so. Dr. Clampin said that APD will make sure to balance technology development in a way that will not leave out portions of the science community. NASA understands the need to maintain capabilities. He further noted that APD does not intend to allocate all of SAT to a 6-meter mission.

Dr. Rita Sambruna cited the need to support the rest of the community through SAT. Dr. Clampin agreed, noting that another major recommendation addresses Time Domain Astrophysics and Multi Messenger (TDAMM) astronomy, which may use science not relevant to upcoming great observatories. The Internal Scientist Funding Model (ISFM) may be an avenue to enable focus on technologies needed for probes, TDAMM, and GOMAP. Dr. Ryan Hickox pointed out that the probe call has a shorter timeline, so timeliness and balance are key. He thought 20 percent of SAT should go into that. Dr. Gaskin said that it was not clear that strategic missions in the DS cover a broad range, blurring the line between SAT and APRA. Her colleagues are unclear on where to propose, whether for TDAMM, large missions, etc., so clear guidance going forward would help. Dr. Clampin said that SAT and APRA were set when he joined APD. Another issue to address is an integrated view of how APD addresses the DS along with the technology demands for probes and future TDAMM missions. He expected to have more clarity at the

next meeting. Dr. Gaskin observed that funding is a factor, and Dr. Sambruna noted the importance of infrastructure. Dr. Clampin agreed with both statements. A question is how to integrate the elements for balance. NASA is engaging with NSF to integrate infrastructure work.

A number of additional requests will be deferred to the March APAC meeting, though some topics will be discussed at the January meeting of the American Astronomical Society (AAS). That meeting will also have splinter sessions. The recent Precursor Science workshop covered some GOMAP topics, as well as inclusion. When told that not everyone in the science community received notice of the workshop, leading to a loss in participation, Dr. Clampin said that he will ensure this does not happen again. The program scientists were preparing a report. Several APAC recommendations were to be addressed at the current meeting, during the Program Analysis Group (PAG) reports. As advised, APD formed three new Science Analysis Groups (SAGs) and changed the acronym of the Physics of the Cosmos program from PCOS to PhysCos. Several more recommendations would be addressed during this meeting. Held to March was a discussion about the impact that zero proprietary time might have on EC scientists. While other SMD divisions do not typically have proprietary time, they also do not have the proportion of pointed observations that is the norm in astrophysics.

Dr. Clampin turned his attention to TDAMM efforts. The Gamma-ray Coordination Network (GCN) has been upgraded, and additional funding will be available. Discussions with NSF are ongoing and the teams have identified a number of areas for coordination. The Division has reached out to the Department of Energy (DOE) as well. APD is involved in SMD development of a global cloud program. TDAMM touches on a number of R&A programs but can be difficult to pin down as it crosses existing areas. ROSES 23 will explore ways to fund and enable TDAMM. Dr. Sambruna said that one of the community's concerns is the lack of a single program that brings this together for proposals. That is compounded by the review panels, which typically have a mix of expertise, meaning that the right people might not be available where needed to evaluate these proposals. This discussion was held until Dr. Stefan Immler could join the meeting and provide clarification.

Dr. Clampin addressed an APAC request for the findings of the first TDAMM workshop, held in August. A white paper was in progress, and NASA intends to form an advisory committee on the topic. This committee will be separate from an international group being established to ensure coordination. The workshop revealed a lot of cross-agency interest as well, so APD will take steps to ensure interoperability. This reflects recommendations from recent APD Senior Reviews (SRs) to optimize the NASA mission portfolio for TDAMM. The PhysCos Program is funding study of a proposal-driven, multi-mission TDAMM Guest Observer (GO) facility that would remove or alleviate the burden on individual missions to evaluate rare Target of Opportunity (ToO) observing campaigns, while allowing better coordination and deployment of NASA assets.

NASA has issued a draft Announcement of Opportunity (AO) for an astrophysics probe. Affecting this is the uncertainty caused by ESA's reassessment of the Athena and LISA mission plans. Therefore, NASA determined that it is no longer practical to require proposed x-ray probes to complement Athena, and removed that requirement. APD will now accept proposals for a FIR imaging and/or spectroscopy mission, as well as an x-ray probe.

Dr. Clampin listed recent Explorer Step 1 selections, two of which are MIDEXes and two of which are Missions of Opportunity (MoOs). All four are strongly linked to TDAMM science goals. Dr. Woodward asked about International Space Station (ISS) plans. Dr. Hertz explained that NASA plans to retire ISS as of 2030, so new work needs to take that into account. He believed that ADP will no longer solicit for ISS beyond selection of the Large Area burst Polarimeter (LEAP) MoO, which will be the last. NASA is working with the commercial space industry on future Low Earth Orbit (LEO) destinations and opportunities for astrophysics payloads. The lunar Gateway will be small, with limited opportunities.

TDAMM was not a criterion in these Explorer selections. Dr. Clampin added that if there is no requirement to address TDAMM, the science can still be included. Dr. Patricia Knezek said that nothing in the probe AO explicitly calls out TDAMM.

Dr. Clampin updated the Pioneers program mission status, for which the most recent selection was the Trans-Iron Galactic Element Recorder on the International Space Station (TIGERISS). The Pioneers program helps EC scientists advance their careers. The DS recommended that NASA end the Stratospheric Observatory for Infrared Astronomy (SOFIA) mission, which completed operations at the end of FY22. The closeout plan for FY23 includes data processing and archiving. At the same time, the process of disposing of the associated government property is underway. Dr. Clampin thanked the SOFIA science and operations teams for their work. Dr. Knezek added that the closeout plan provides a full year of funding for SOFIA's EC scientists who need to find new jobs.

The Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory (GUSTO) mission had been in some trouble, to the point that APD conducted a review to determine extension or termination options. The Division gave the project three launch readiness milestones and, as the team has met the first two, GUSTO is moving forward. However, if there is a problem with the 2023 Antarctica balloon campaign, NASA does not have additional reserves to contribute to a further extension. The Spectro-Photometer for the History of the Universe, Epoch of Re-ionization, and Ices Explorer (SPHEREx) mission is on track, with a current launch readiness date of spring 2025.

NASA is partnering with ESA on the latter's Euclid mission. Dr. Clampin listed NASA contributions, noting that everything is on track. Due to the suspension of cooperation with Russia, ESA is now investigating the SpaceX Falcon 9 as a launch vehicle. The Ultraviolet Transient Astronomy Satellite (ULTRASAT) mission is funded by the Israel Space Agency; NASA is providing the commercial launch and plans a participating scientist program. The Atmospheric Remote-sensing Infrared Exoplanet Large-survey (ARIEL) is another ESA mission on which NASA is partnering. Dr. Clampin listed the Agency's contributions. NASA's Preliminary Design Review (PDR) occurred in September and went well; confirmation review will be in December.

Due to cost issues on Athena and LISA, ESA initiated a reformulation study to reconfigure Athena and adjust costs. Dr. Clampin described NASA's planned contributions. The Agency is engaged in the reformulation and envisions a need to review its commitment. Current plans at ESA are to delay Athena mission adoption to at least 2027, with launch occurring no sooner than 2035. Dr. Shahid Habib provided more detail, explaining that the ESA plan is to bring Athena's total cost down to 1.2 billion Euros. ESA will meet soon to discuss the budgets for both Athena and LISA. In answer to a question about Euclid, Dr. Habib said that other missions are seeking launch vehicles, and ESA is doing a feasibility study with SpaceX. Returning to Athena, he said that the usual time from mission adoption to launch is about 10 years for this type of effort, but if ESA can do it sooner, they will. One of the questions under study is whether the available instruments will actually be able to achieve Athena science goals. The focus is on the mirror resolution. Dr. Tremblay asked about the NASA contribution to Athena. Dr. Clampin said that the Agency does not intend to increase the contribution, but the reconfiguration may lead NASA to review its contributions. It was premature to say more. If community input is warranted, NASA will solicit it. Dr. Knezek explained that APD dropped its requirement that probes relate to Athena. There has never been a requirement that probes relate to TDAMM.

Dr. Clampin continued, noting that NASA has already made substantial contributions to LISA and does not currently plan to go beyond that. Ground-based science support is something to discuss in the future. The ESA review does not affect NASA funding priorities in the near term, through FY24. It will be up to ESA to tell NASA when they expect to launch. A good fraction of the portfolio is awaiting these decisions. Dr. Tremblay observed that while ESA currently has no formal priorities between LISA and

Athena, every year of slippage on one will affect costs for the other. He asked if NASA plans to maintain its existing cost caps. Dr. Clampin said that the Agency does. Unlike ESA, the NASA perspective is that these are separate missions, not part of a pool. The dates are nominal. Dr. Habib noted that NASA understands that ESA is prioritizing LISA. The two missions together are not to exceed 2.6 billion Euros

The R&A selection rates from ROSES have gone up, a factor of APD receiving fewer proposals. This has been the case across SMD and appears to be a Covid effect. Overall, APD notification times easily meet both SMD goals and goals the Division set internally, though the Future Investigators in NASA Earth and Space Science and Technology (FINESST) program was off by 2 days.

IDEA is a key part of NASA's action plan, and APD tries to infuse it into everything the Division does. As part of the FY24 budget process, APD was considering some initiatives that Dr. Clampin would discuss at a later date. He is committed to IDEA.

A review of the NASA Hubble Fellows Program (NHFP) has led to a number of actions, including:

- Establishment of an NHFP Working Group (WG) to develop an implementation plan;
- Implementation of recommendations that have minimal workload impact while also being high priority and funding neutral; and,
- Self-organization of current and past NHFP Fellows.

NHFP leads are interacting with these efforts to ensure coordination and minimize duplication. The WG has biweekly meetings with community input and has offered webinars and splinter sessions in conjunction with AAS meetings. An intern at NASA is analyzing responses from a community survey, which will be used in the response to the recommendations.

The self-organized Fellows have identified three high-priority pilot programs for FY23. These include:

- Funding to support broader participation in meetings of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS), the National Society of Black Physicists (NSBP), and other non-research groups;
- Providing career development training to Fellows; and,
- Providing funds for Fellows to support student mentees.

Dr. Clampin listed a number of actions the NHFP Program has already taken. The self-organized Fellows have established the NHFP Fellows' Anti-Racism Initiative (FARI), which has already held a workshop and an orientation program, in addition to setting up online paths to crucial resources. The various parallel efforts are expanding beyond what a single approach could accomplish.

Dr. Sambruna noted the importance of a rubric in a holistic evaluation. However, she had not been able to find a rubric, and it was not clear how to establish teams. Dr. Knezek said that there is a link to the rubric at the start of the 2023 AO application. This was developed by the IDEA expert at the Space Telescope Science Institute (STScI). It allows applicants to discuss their IDEA activities. Dr. Woodward asked about the long-term plan for stewardship of the FARI. Dr. Knezek replied that APD is discussing that with the current NHFP cohort. The Division prefers a collaboration in which the Fellows drive what they need, with NASA providing infrastructure and resources. Dr. Hickox asked about efforts to expand the range of institutions. Dr. Knezek said that this is being discussed in the WG, and APD is trying to tie into SMD efforts in this area.

Dr. Clampin then discussed NASA's astrophysics science data archives structure, listing the various archives. There is already good coordination and support for multi-mission efforts. The long-term goal is

to move to SMD's cloud-based Joint Science Platform, which will support interoperability and commonality.

Dr. Ilaria Pascucci asked about the timeline for GOMAP. Dr. Clampin replied that the DS has laid out a timeline of about 5 years for technology development, and a projected cost of $1.25 billion. The subsequent flagship missions, to launch in the 2030s, will likely have technology development investments later in this decade and should include an integrated plan for TDAMM. Dr. Pascucci asked about probe complementarity and coordination with Athena. Dr. Knezek said that that requirement has been removed from the x-ray probe. Phase B should be no earlier than 2025, however, at which point there will be clarity on Athena. NASA is very aware of the situation and is watching ESA carefully.

Having examined the rubric that Dr. Knezek discussed, Dr. Sambruna said that it did not show compliance with the main message of the NHFP Independent Review report. It was all about being a science leader and had nothing about inclusive excellence and building a diverse community. Dr. Knezek agreed, stating that it is a first step. Implementing the report recommendations is a multi-year task and APD hoped to hear APAC's comments on priorities for the next steps. The rubric was a single step that will evolve. Dr. Woodward said that APAC would write something on paths forward.

ExoPAG/PhysPAG/COPAG Updates
Representatives of the three PAGs presented updates.

ExoPAG
Dr. Pascucci, Chair of the Exoplanet PAG (ExoPAG), listed the PAG's Terms of Reference (TOR) and the members of the Executive Committee (ExCom). The PAG has assigned ExCom members to lead ongoing and upcoming activities. Since the July APAC meeting, the ExCom has had two monthly meeting and a cross-PAG meeting. Dr. Pascucci presented a list of ongoing and recent ExoPAG activities, which include growing interaction with planetary scientists and NASA's Planetary Science Division (PSD). At the September ExCom meeting, members expressed support the Space Telescope User Committee (STUC) recommendation on open science. This recommendation had two elements: no endorsement of the zero exclusive use period, and a call for broader community feedback.

Dr. Pascucci listed ExoPAG's Science Interest Groups (SIGs) and its SAG. The three PAG ExCom chairs met in September to discuss a number of items. Out of this meeting came endorsement of a cross-PAG SIG to support InfraRed/Optical/UltraViolet (IROUV) GOMAP-related activities. The expectation is that such a SIG would be useful to APD for a number of years. As envisioned, the SIG will be coordinated by a team of five drawn from the three PAGs.

Meanwhile, ExoPAG is starting to organize a meeting to be held at the January AAS conference. Accessibility is a goal of this meeting, which will be achieved by having fewer acronyms and more background in presentations, along with a topic orientation. The ExCom hopes to assist participants in meeting these objectives. The ExoExplorers Program has expanded to include international participants in its third cohort. The inaugural cohort will present a special session at AAS. Finally, SAG 23, on the impact of debris dust on exoplanet direct imaging, has kicked off with 38 members working across 8 topics. The Group is seeking additional community participation.

Dr. Hickox asked what sort of guidance ExoPAG is using to make the AAS sessions more accessible, noting that this seems like a good idea. Dr. Pascucci said that the ExCom has discussed coaching speakers to reduce acronyms in talks and in slides, while also providing acronym lists. This idea has had a lot of support. Dr. Hickox thought this was a great idea, as did Dr. Woodward, who suggested that feedback from participants could be helpful for the future.

PhysPAG
Dr. Tremblay, outgoing Chair of the Physics of the Cosmos PAG (PhysPAG), listed the ExCom members and provided an update on PAG activities. Dr. Clampin recently approved three new SAGs for PhysPAG. The PAG is making plans for a number of meetings and is increasingly engaged with the other two PAGs. PhysPAG also hopes to work with the Inflation Probe (IP) SIG to pull in the CMB community.

Dr. Tremblay then reviewed the plans for the three newly approved SAGs, which had been discussed at the July APAC meeting. As its name indicates, the Great Observatories SAG will emphasize scientific advances enabled by future great observatories. This is a cross-PAG SAG and could be structured around the key science questions and discovery areas from the 2020 DS. Dr. Tremblay proposed three pillars of discovery, with multiwavelength figures of merit for each pillar. While PhysPAG is ready to recruit community members, it is important to remember that the SAG reports are written by people who are already busy. Therefore, to pull in more EC participants, the PAGs want to find ways to benefit them via these reports. That discussion continues among the PAG chairs.

The second new SAG is on Inter-Planetary Networks (IPNs) and gamma-ray transients, and is within PhysPAG rather than operating as a cross-PAG SAG. The third new SAG, Astrophysics With Equity: Surmounting Obstacles to Membership (AWESOM), will involve all three PAGs. The next step here will be a cross-PAG meeting to identify initial co-chairs and recruit participants. PAGs do not advise, but there has been a discussion of a notional schematic for GOMAP, which Dr. Tremblay presented. The community is concerned about moving too slowly or being excluded, and cost-neutral ways of addressing this might come via the PAGs and SIGs.

Dr. Woodward asked if there were any thoughts on how to elevate the visibility of people contributing to these uncompensated efforts, which often go unrecognized. Dr. Tremblay said there is an overall need to give greater value to service work. It might be possible to include names on SAG reports in order to prove authorship. Especially for EC scientists, some of the work on these activities could go into more career-enhancing projects. The conversation on how to value the efforts needs to take place. Dr. Woodward said that this would address changing community norms. Much GOMAP activity is multi-dimensional, and this will be an ongoing challenge, especially regarding stewardship.

COPAG
Dr. Rachael Beaton gave the update on the Cosmic Origins PAG (COPAG), which is seeking new ExCom members. COPAG has three SIGs and two Science/Technology Interest Groups (STIGs), roughly mirroring the DS panels. The InfraRed STIG (IRSTIG) has restarted its webinar series, while the UVSTIG is preparing for a splinter session at the upcoming AAS. The Stars SIG is having presentations for participants who do not often get topically-related colloquium-style talks. The Galaxies SIG, which launched at the end of 2021, also has regular presentations. The Active Galactic Nucleus (AGN) SIG became active in August, with a great deal of enthusiasm from the community. It has already begun biweekly seminars, and there are plans for monthly informal Zoom lunches and AAS colloquia. COPAG has reduced the number of its planned AAS splinter sessions from seven to three.

Dr. Beaton then reported on the COPAG technical workforce study. The study was motivated by concerns about hiring and attrition. The field is establishing huge systems, so any workforce problems create a knowledge gap, especially with small teams. One of the underlying issues is the difference between industry and academic hiring practices. Industry is much faster and more nimble, which gives it an advantage. There is also a supply and demand imbalance. Industry is more employee-centric, offering appealing work structures that academia does not and often cannot provide. At the same time, only about 1 in 10 astronomy PhDs will become tenured professors. A chart showed the flow of research staff out of the university environment and into industry.

As a result of the pandemic and its impacts, scientists at all career stages are reevaluating where they are and what they are doing, highlighting structural weaknesses in the workplace. Meanwhile, there has been increased scrutiny of the layers of inequity in the field, and industry continues to ramp up recruitment. Independence has become a factor in many worker decisions. The issues go beyond COPAG, which is constrained from collecting data by both the TOR and the Paperwork Reduction Act.

Some potential solutions have come via affinity groups. These do not include people who write software, and while such individuals are needed, there is possibly a corresponding need for retraining. That is costly, however, and so a lot of this work goes to industry. Dr. Sambruna said that there should be recognition of the scientists who do this work. She heard from the TDAMM workshop that they feel unacknowledged. The DS also made this point. She wondered about developing a curriculum to guide career scientists into data science. Dr. Beaton said that while she agreed personally, there are no data on that and the report does not cover it.

According to the perceptions of astronomers – not data scientists – the issues are location, salary, long-term stability, work/life balance, and lack of support/room for growth. Data from the AAS Committee on the Status of Women in Astronomy (CSWA) provide some information on why 27 scientists left between 2013 and 2021. Location and stability each accounted for about half of the answers. Dr. Beaton pointed out that these data are anecdotal by definition. A more reliable, systematic survey of those who stay in academia versus those who leave has yet to be conducted. Salary was a factor in 30 to 40 percent of the departures. A pair of graphs depicted starting salaries by sector for individuals with Bachelor's degrees in physics and PhDs in physics, the latter being further delineated by likely permanence of the positions. Starting salaries were clearly higher for PhDs in the private sector, which offers the greatest rewards or differentials for advanced training and education. At the same time, some academic salaries are lower because of tuition benefits that are allocated separately. Yet a computer science major with a Bachelor's degree and no experience will receive a higher private sector salary than nearly all individuals with PhDs in physics. These computer science graduates are also less likely to have to relocate.

A 2021 salary and satisfaction survey by the journal Nature cited the anxiety some new postdocs have regarding their financial status. Those who cannot rely on family members for financial support are more likely to need the higher pay offered by industry. This situation reflects sharp racial divides in the United States and often dictates whether a scientist can consider pursuing a research-oriented career in academia. Dr. Beaton showed some of the analysis EC researchers do among themselves and distribute within their networks. Salaries have not kept up with the increasing cost of living. While prize fellows earn a premium over other postdocs, they often have to grapple with the fact that the leading institutions are usually based in costly communities. A 2022 Nature article further illustrates inequities in academia, including the strong likelihood that faculty have a parent with a PhD. Data indicate that 15 years in, astronomers remain in the sectors in which they have their first job upon completion of their graduate education.

In discussion, Dr. Beaton explained that funding had been a factor in her own career decisions, and that NASA support had made a difference. NASA has some capacity to lead, but these are existential issues. Dr. Tremblay praised the work and wondered what other data on outlays and decreased buying power are available. Universities take a significant amount from awards. Dr. Beaton replied that a common rationale is that institutions are not allowed to pay more. Dr. Gaskin added that this is a systemic problem that puts the onus on people in transition from their postdoc work. Dr. Woodward noted that APAC has sought the executable costs of doing science. It would behoove APD to identify strategies on how to make this sustainable. Dr. Beaton asked why there cannot be more support for remote or hybrid work, which would allow people to live in less expensive places. However, the ultimate need is to change salaries, which cannot be done on the basis of a single presentation. She was also wary of reliance on old data. Dr. Sambruna added that this is a particular issue for those from under-represented communities, because they often have to help their families to a greater extent.

LISA Independent Data Study

Dr. James Ira Thorpe, NASA Study Scientist for the LISA mission, gave an update and an overview of the LISA Science Implementation Data Center (SIDC) Study. He began by describing the mission, which he called "the JWST for gravitational waves." Over time, the technologies have been proven to a greater extent. The last three astrophysics DSes have supported LISA science. LISA is both a survey and a time domain mission. It will accumulate knowledge about sources over time. While the data set is rich and the software is complex, the instrument is a relatively simple seismometer pointed in a single direction. A graphic illustrated the data complexity.

ESA currently has LISA in Phase B1, which should lead to mission adoption in November 2023. Launch would then be about 10 years later. As an element of its participation, NASA established a study office. The Agency will also provide payload elements, a science ground segment, some systems engineering and mission support, and science participation support. It is important to be engaged in the totality of how LISA works. The SIDC study grew out of a recommendation from a prior study of hardware and technology, with the goal of identifying potential NASA contributions to the science ground segment and science activities. Among the considerations are the functional role, how LISA participation fits in with NASA as a whole, the development approach, and alternatives. Dr. Thorpe then listed the study panel members, including NASA center observers. The study process involved information gathering through live briefings and background reports. There were also work sessions, panel discussions, and draft findings prior to writing the final report.

The first finding, on data analysis, recommended end-to-end analysis as part of several independent pipelines contributing to the final delivery of L2 and L3 products. It also advised early investment in R&A resources. The next recommendation was for NASA to provide opportunities and funding to the science community in order to facilitate engagement with LISA software development, theoretical studies, and mock data analysis. The study also found that multiple agencies could benefit from overlaps in gravitational wave science and research, and recommended coordination with NSF.

A recommended research approach was the hub and distributed node model, in which nodes would be tailored more specifically by community or types of investigations. The study advised NASA to be active in the LISA Consortium and fund participation by members of the community. A Memorandum of Understanding (MOU) will define NASA's role in the LISA mission, and this should define both NASA's relationship with the ESA Science Center and the role of the U.S. LISA community within the LISA Consortium. Dr. Thorpe explained that the ESA model leaves open to its member states some grey areas, and NASA prefers to work with ESA rather than the individual member states. That makes it imperative that interactions be spelled out in the overall structure.

The NASA response to the findings and recommendations includes continued support for LISA science through ROSES, as well as ongoing engagement with the LISA study team and with ESA. The Agency has begun asking ESA key questions about structures, data policy, and NASA involvement. Nonetheless, open questions remain in the areas of interface with the European ground segment and differing philosophies on science investigation. It would be helpful to have some answers, as expert users need access on a deeper level, and a single, uniform data policy would be preferable. Finally, the time scale for developing detailed plans for NASA science contributions is short – driven by ESA's push to solidify plans in advance of Mission Adoption in 2023.

Among the biggest issues are that the Laser Interferometer Gravitational-Wave Observatory (LIGO) and LISA operate in very different regimes. LIGO mostly distinguishes among signals, while LISA is signal-dominated. Dr. Shirley Ho asked about the timescale for open data. Dr. Thorpe said that one rationale for the collaboration model is exclusive access to data down the road. That applied to LIGO. LISA has

different expectations, partly because the U.S. partner is NASA and not NSF and also because the LIGO structure was in part designed to meet the high bar needed to claim the first detection of gravitational waves.. There is no easy answer.

Dr. Sambruna asked if there had been an analysis of pros and cons for the hub/node model. Dr. Thorpe replied that a number of models were discussed, and which may be mentioned in a limited executive summary that was being written. This was not a model with which he has personal experience, but he thought it fit. Dr. Woodward asked how the team will adjudicate strategies for data. Dr. Thorpe applied a weather forecast analogy, in which most consumers want an easy-to-understand product that they can act on but some experts want deeper insight into the underlying models. There will be layered access to information.

Webb Update

Dr. Eric Smith gave an update on JWST. Cycle 1 performance has exceeded requirements on many measures. The thousands of engineers who worked on this for decades developed a fantastic tool. Almost all elements of optical performance are below the budgets. Dr. Smith presented charts depicting Near InfraRed (NIR) sensitivity and the commissioning of moving targets. JWST went well beyond expectations in these areas. Investigators began doing science almost immediately from the Early Release Science (ERS) program. Anyone can have access to ERS, and more than 2,000 hours of data from Cycle 1, which covers the first year, have a zero exclusive use period. Dr. Erika Hamden asked if people are getting scooped. Dr. Smith said he did not have information on that, but he was not concerned.

Regarding the micrometeoroid strikes, the mission knew this would happen and was designed around it using models from PSD and other sources. Impacts are at the expected rate, though one in May was a bit larger than anticipated. To help future missions, JWST is collecting data on this, including the amount of wavefront error the strikes induce. The May strike was near one of the supports. Evidence of the deformation comes largely from the wavefront error. These strikes could eventually lead to changes in the way scientists look when observing. Dr. Smith presented a graphic of how this might occur. When the team sees something like a meteor shower coming, they will shift the pointing. The mission wants to enable rather than constrain scheduling. A strike of the support structure is unlikely.

There was a report of a friction issue with the Medium Resolution Spectrometer (MRS) grating wheel affecting one of the MIRI's four observing modes. The mission team has paused scheduled observations through this observing mode while it analyzes the issue, though the team is also developing strategies to resume observations as soon as possible. The other three modes are continuing as normal. Dr. Smith showed illustrations of the instrument and the problematic mechanism. The goal is to know more before putting out the call for Cycle 2. Dr. Smith summarized his presentation by noting that open science enables rapid publication.

Dr. Kelly Holley-Bockelmann said that there has been a flurry of high redshift galaxy publications, but there was also a need for recalibration, calling those papers into question. She asked about lessons learned here in regard to the open data policy. Dr. Smith replied that JWST's default exclusive use period is 12 months. He believes that science is self-correcting. Scientists need to be careful not to publish too quickly, but this has not bothered him. Dr. Woodward asked how the mission is supporting a wide range of investigators, and if things are moving smoothly in customer service. Dr. Smith said that STScI is learning, too, and that Cycle 2 should run more smoothly than Cycle 1. Knowledge about budgets will be helpful. Dr. Tremblay asked if investigators should expect efficiency to equal hours. Dr. Smith said that he expects more demanding science. Dr. Woodward asked if there have been lessons learned that might help challenging missions. Dr. Smith answered that each mission will have unique challenges. JWST had unique deployment challenges. Other IR missions will not have the thermal complexity, but they will

have to account for serviceability, which JWST did not. The key is to have a fabulous systems engineering team.

Dr. Tremblay expressed concern about lost institutional memory. Dr. Clampin said that NASA has assembled a lessons learned team to address this very thing. There will be a similar effort with industry partners. Dr. Woodward asked if there is concern about upcoming missions' demands for telecommunications, especially in regard to data rates and what the downlinks will actually handle. Dr. Smith said that SMD does know that this is an issue that will need resolution. As for missed observations on MIRI, almost everything will be rescheduled, but those observations will not receive higher priority. Dr. Gaskin said that while documenting expertise is helpful, experience is different from documentation. She asked how NASA might take advantage of the expertise and if there might be a way to engage that knowledge to facilitate its use. Dr. Smith replied that JWST had succession planning in mind. Regarding possible lapse in a capability, the government does have an emeritus program. This is more of an issue in industry, where the transitions are faster.

Public Comment Period

The meeting provided an opportunity for public comment. Dr. Holley-Bockelmann read a question from the public portal that began by noting the need to mature technologies for a future IP mission. However, recent SAT calls have excluded IP submissions, while encouraging proposals for future flagship missions. This was puzzling, given that the flagships in question are unlikely to launch before the 2040s, while the IP will go up sooner. The questioner asked for clarification and wanted to know when such proposals will be permitted. Dr. Dominic Benford, the APRA program scientist, said that it is necessary to respect the boundaries between APRA and SAT. These boundaries should be distinct, and there should not be a need for proposers to submit the same concept to both programs. The SAT language should make it clear that technologies that are at least TRL 3 but not higher than TRL 5 should be submitted to SAT if they directly support the future UVOIR flagship mission or the FIR probe (which is distinct from the CMB or IP probe) or the x-ray probe. Proposals addressing missions beyond UVOIR should go to APRA, and that would include those advancing technologies for the IP mission. There should not be gaps or overlap. Dr. Hickox asked if the current SAT call is only relevant to probes rather than flagships. Some of the technology development is presumably for technologies that could be used for flagship missions. Dr. Benford said that there is indeed significant overlap in probe and flagship technology needs. Things that are relevant in this decade are particularly important and urgent for SAT. For those technologies that will be needed on flagships further into the future, if at all, the need by a probe is sufficient justification in and of itself.

In the chat, Dr. Mario Perez added that proposers should focus proposals on the technology needs of the highest-priority mission recommendations of Astro2020, the most recent DS. These include IROUV, probe-class missions at FIR and x-ray wavelengths, and subsequent FIR and x-ray great observatories. Maturation of technology components that will be needed within the current decade will have a higher priority for selection under the program.

Dr. Holley-Bockelmann read the second question, which asked when the astronomy community can expect to receive the report regarding the JWST naming issues and the accompanying research. Dr. Clampin said that the NASA historian plans to release this information but there was as yet no timeline. Dr. Holley-Bockelmann pointed out that APAC has asked for this information repeatedly, so it would be good to get an answer.

GPRAMA Overview

Ms. Jennifer Kearns of SMD provided background on the Government Performance and Results Act (GPRA) Modernization Act (GPRAMA), which requires each Federal entity to provide a strategic plan, an annual performance plan, and an annual performance report to evaluate progress made in key areas.

For SMD, one of the two main types of performance measures addresses milestones for missions in formulation and development. The other key type of measure addresses science progress., These performance goals call for external experts to review NASA's annual science progress in ten areas, a role that is performed by the division advisory committees. For each of these performance goals, one division's committee rleads the review, with additional input as appropriate from other divisions and their committees for those goals that are interdisciplinary in nature. For the astrophysics review, Dr. Kristin Simunac of the Heliophysics Advisory Committee (HPAC) and Dr. Tyler Robinson of the Planetary Science Advisory Committee (PAC) were serving as representatives to address the contributions that heliophysics and planetary science results had made toward the advancement of performance goals 1.2.2 and 1.2.4. Table 1 lists the science performance goals, with lead and supporting review responsibilities indicated by the green and yellow dots, respectively. Ms. Kearns noted that the table had changed from the previous year; the performance goals had been renumbered to correspond to the new 2022 NASA Strategic Plan, and a new performance goal had been added for the Biological and Physical Science Division (BPSD).

Table 1

PERFORMANCE GOALS	APAC	ESAC	HPAC	PAC	BPSAC
1.1.1 NASA shall demonstrate progress in characterizing the behavior of the Earth system, including its various components and the naturally-occurring and human-induced forcings that act upon it.		●			
1.1.2 NASA shall demonstrate progress in enhancing understanding of the interacting processes that control the behavior of the Earth system, and in utilizing the enhanced knowledge to improve predictive capability.		●			
1.2.1 NASA shall demonstrate progress in exploring and advancing understanding of the physical processes and connections of the Sun, space, and planetary environments throughout the Solar System.		○	●	○	
1.2.2 NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe.	●		○	○	
1.2.3 NASA shall demonstrate progress in exploring, observing, and understanding objects in the Solar System in order to understand how they formed, operate, interact, and evolve.			○	●	
1.2.4 NASA shall demonstrate progress in discovering and studying planets around other stars.	●		○	○	
1.2.5 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.	○		○	●	
1.2.6 NASA shall demonstrate progress in developing the capability to detect and knowledge to predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.			●		

1.2.7	NASA shall demonstrate progress in identifying, characterizing, and predicting objects in the Solar System that pose threats to Earth or offer resources for human exploration.				●	
1.2.8	NASA shall demonstrate progress in understanding the properties of physical and biological systems in spaceflight environments to advance scientific knowledge, enable space exploration, and benefit life on Earth.					●

In performing the evaluation the committee members and visiting representatives were to consider results that clearly advanced the existing body of knowledge. The time period under consideration does not follow the fiscal year precisely, but rather covers the time since the previous review, which in this case would go back to the APAC's meeting of fall 2021. The accomplishments considered must have resulted in whole or in part from a NASA-funded activity/data, but that funding did not need to come from APD or SMD specifically. Results published in peer-reviewed literature are strongly preferred. Dr. Hasan had sent the members a document with items that they could consider, though they were not restricted to using those examples. A NASA team will synthesize APAC's examples to develop text for the final Annual Performance Report, which, like the evaluation itself, should be high level, not comprehensive.

Key to the GPRAMA evaluations are the color ratings, which have not changed since the last year:

- GREEN: Expectations for the research program fully met or exceeded in the context of resources invested.
- YELLOW: Some notable or significant shortfalls in context of resources invested, but some worthy scientific advancements achieved.
- RED: Major disappointments or shortfalls in the context of resources invested, uncompensated by other unusually positive results.

A recorded vote is required.

Deleted: Should a rating other than Green be assigned, the committee is asked to provide a clear rationale in their text so that this can be properly reflected in the Agency's Annual Performance Report.

GPRAMA Discussion

Dr. Woodward confirmed that SMD wanted refereed publications. Ms. Kearns emphasized that the color ratings are most important. Dr. Woodward then led discussion of Performance Goal 1.2.2: "NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe."

The Heliophysics Division suggestions for examples in this area included:

1. A New Rayleigh-Taylor-like Instability Discovered in Global Heliosheath Simulations
2. Connecting Solar Wind Flux to the Solar Surface

Dr. Simunac explained that the first example had to do with the shape of the heliotail with and without neutrals. This could apply to what might be seen elsewhere in the Universe. The second example addressed in situ measurement of solar wind and correlates with temperature.

The Planetary Science Division examples were:

1. X-Ray and UV-Driven Atmospheric Escape
2. Using Stars to Spot Planetary Surfaces and Atmospheres
3. Habitable Zones of Rapidly Rotating Main Sequence A/F Stars
4. The Atmospheres of Tidally Locked Planets
5. Modeling TRAPPIST-1 Planetary Atmospheres

Dr. Robinson explained that the first example, on atmospheric escape, was driven by models. The second example, on use of stars to determine planetary surfaces and atmospheres, reflected a fairly new concept of using our sun to identify noise sources. The habitable zones example explored the planetary impact of known astrophysical phenomena, while the tidally locked planets example addressed the expectation that the climates of rotationally locked and non-locked planets will differ. Finally, the TRAPPIST example involved a 3D climate model.

Dr. Sambruna asked for clarity on examples 2 and 4. Dr. Robinson said that the second example was about the feasibility of the approach, which was a new idea. The fourth example had more to do with comparative planetology, showing that Venus can be used as an example. Dr. Woodward advised selecting more concrete examples, and wanted to set those two aside. He liked the TRAPPIST example. There was some concern about the lack of a JWST example, but APAC had not yet reviewed the APD examples. Dr. Holley-Bockelmann reminded the Committee of the need to have things that were easy to convey and that had good images. Dr. Woodward thought the first PAC example dovetailed with JWST. Dr. Hickox thought some of these might be more appropriate for APAC's second goal. Dr. Woodward asked the Committee to take another look at the HPAC suggestions. Dr. Tremblay said that the graph in the second one was not obvious even to the astrophysicists in the room. He and others did not want to include it. Dr. Woodward said they would use the first HPAC example, which did have a compelling, colorful illustration.

APD had made the following five suggestions:

1. Webb Sheds Light on Galaxy Evolution, Black Holes
2. NASA's Swift Tracks Potential Magnetic Flip of Monster Black Hole
3. SOFIA Maps the First Magnetic Fields of a Galactic Bone in Their Entirety
4. Tiny Star Unleashes Gargantuan Beam of Matter and Antimatter
5. Hubble Discovers Hydrogen-Burning White Dwarfs Enjoying Slow Ageing

Dr. Woodward said that the second example offered companion observations with Newton XMM and Swift, and included black holes, which always make good examples. These observations were important in understanding magnetic fields around black holes. Dr. Hickox liked that the example covered both ground and space observations, as well as Swift and XMM. APAC could highlight that NASA contributes to XMM as a partner. Dr. Holley-Bockelmann added that it used instruments in a novel way. Dr. Woodward wondered if there might be a way to relate it to TDAMM.

Regarding the third example, Dr. Gaskin asked if they should be careful about mentioning SOFIA, which had been shut down. While others agreed, Dr. Hickox said that the example had an amazing graphic and presented an excellent view of NASA science going forward. He added that cool science is cool science. Ms. Kearns said that for GPRAMA, NASA wants to look at the strongest science results regardless of political considerations. Dr. Woodward said they would keep the example for the time being. He thought the fourth example was good because it mentioned Chandra, would be interesting to the public, and had great graphics. The final example was a good study of white dwarfs. Some others were more exciting, but this underpinned a wide range of disciplines.

Dr. Gaskin wanted to share a press release on an unusual result from Fermi; Dr. Tremblay knew of this example and agreed it would be a good one. Via WebEx chat, Dr. Ho sent an example in which the Hubble Space Telescope (HST) found a jet from a star crash. Dr. Sambruna liked it and thought it would apply to TDAMM. Dr. Woodward suggested including the HST example, plus numbers 1 and 4 from the APD document.

Dr. Woodward then took the vote on the color rating for Performance Goal 1.2.2. The vote was for 10 green, none for yellow, and none for red.

Dr. Woodward reminded APAC that it was important to consider the balance and breadth of the NASA astrophysics portfolio. He then turned discussion to Performance Goal 1.2.4: "NASA shall demonstrate progress in discovering and studying planets around other stars."

HPAC had suggested the example of "Relating Coronal Dimmings to Coronal Mass Ejections on the Sun and Other Stars." Dr. Simunac explained that this provided evidence of the magnetic activity cycle. Dr. Hickox found it interesting but thought it said more about the star than the planet. He suggested that it might fit better in the previous Performance Goal. Others agreed. Dr. Woodward said they would come back to it.

The planetary examples were:
1. Heat-Producing Elements in Planetary Formation and the Habitability of the TRAPPIST System
2. Tidal Evolution of the TRAPPIST-1 System
3. The Exoplanet Radius Gap
4. A Close-in Puffy Neptune with Hidden Friends: The Enigma of TOI 620

Dr. Robinson thought that the TRAPPIST examples could be combined. Dr. Ho thought the second TRAPPIST example lacked a conclusion, and it struck her as theoretical. Dr. Woodward noted that NASA does fund theoretical work, and it could be useful to cite how simulations advance knowledge. Dr. Ho agreed that that might be important to include, in order to reinforce the fact that NASA funds work other than observations. Dr. Pascucci compared the exoplanet gap article with another paper with the finding that the gap is due to composition. She thought the second paper might make the case better. Dr. Robinson agreed, stating that the other study provides an even stronger argument on using structure in the radius gap. Dr. Woodward suggested going with the second example and the alternative exoplanet gap article, which he called the "new 3" example.

APD had made the following suggestions:
1. Intriguing New "Super-Earth" TOI-1452 b
2. NASA Helps Decipher How Some Distant Planets Have Clouds of Sand
3. Two New, Rocky Planets in the Solar Neighborhood
4. Chandra Sees Evidence for Possible Planet in Another Galaxy
5. Cosmic Milestone: NASA Confirms 5,000 Exoplanets

The first was an observation backed up by modeling. Dr. Woodward noted that HST papers often rely on archival data, which was something APAC needed to consider. Dr. Sambruna was wary of the fourth example, due to a sentence about the case not being ironclad. Dr. Woodward agreed, and added that he was unsure of the timeline on the fifth example. Dr. Hamden liked it and thought it could be edited to emphasize the ever-increasing numbers, addressing the stewardship and value of missions that have gone beyond the prime mission. Dr. Woodward thought that that approach made it a good candidate. Dr. Hickox liked the second example, but the first did not get much backing in the Committee. Dr. Woodward said they would go with numbers 2, 3, and 5. He wanted to take a closer look at the investigators and authors in order to support diversity of teams and institutions.

He then took the vote on the color rating for Performance Goal 1.2.4. The vote was 10 for green, none for yellow, and none for red.

There was a multi-year Performance Goal that APAC was to discuss, then pass thoughts along to PAC: "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."

Dr. Woodward asked the APAC members to think about this overnight in order to discuss further the next day. He then made writing assignments. After the next day's discussion, Drs. Woodward and Holley-Bockelmann would revise the resulting document and send it to APAC members for feedback.

Wrap up for Day 1
The meeting was adjourned for the day at 5:01 p.m.

Tuesday, October 18

Opening Remarks
Dr. Hasan opened the second day of the meeting by taking roll and reminding the public that the meeting was being recorded. Dr. Woodward then introduced the first speakers.

Roman Update
Mr. Jamie Dunn gave an update on the Roman Space Telescope (Roman, or RST). The SpaceX Falcon Heavy has been selected as the launch vehicle. The Wide Field Instrument (WFI) is now in integration at Ball Aerospace (Ball) after working through some subsystems. On the flight mosaic plate, detector development has been successful and there are more spares than planned. This element is now in final integration and testing (I&T). The Instrument and Command Data Handling (ICDH) boxes, developed at Goddard Space Flight Center (GSFC), is also now at Ball. The simplified Relative Calibration System (sRCS) is going well and the flight sRCS sphere is enroute to GSFC for I&T. Sensor Control Electronics (SCEs) are installed and undergoing functional testing. The team has installed the flight Alignment Compensation Mechanism (ACM) and conducted a fit check of the focal plane system. Optical Telescope Assembly (OTA) integration is also underway and will begin stacking soon. The Instrument Carrier Structure assembly is underway, and a snag with a couple of the nodes has been remedied. This has been a pacing item, but the team is down to the last few nodes and remains within the contingency schedule. The Spacecraft Bus is another pacing item. The central cylinder and deck assemblies have been delivered to GSFC for alignment and assembly. The team is on track for spring delivery of avionics integration and now has all six solar array panels. Other systems are coming along well.

Mr. Dunn then discussed the cost and schedule status. Roman exited FY22 with reserves and is in good shape for FY23. There has been some schedule erosion, and the team expects to finalize resolution of ongoing supply chain delays. The I&T flow has been optimized, giving back 5 months of schedule to provide a healthy margin. The critical systems tests are still in the optimization plan. As the team learned more, they found positives to take advantage of and mitigations they did not need. The technical team likes the new flow better. The peak of the supply chain issues is past, but there are still items coming in. The schedule accommodates the later deliveries and the team is working hard to get the remaining items. Mr. Dunn presented a graphic of the master schedule, noting the changes.

Key lessons learned from JWST have been applied to Roman, which is cost capped. Investment in key enabling technologies, such as detectors, to ensure they are truly at TRL 6 by PDR has been important. The team is intent on avoiding requirements creep, another lesson from JWST. It is also important to have NASA serve as systems engineering lead and integrator. Forward funding provides flexibility for longer term risk avoidance. The final lesson is to continuously reassess plans instead of being wedded to the baseline. Dr. Woodward noted that APAC had discussed enabling technologies at TRL 6. He asked about NASA as the systems engineering lead and how that applies to industry partners. Mr. Dunn replied that being able to make system-level trades is key to the greater good and can be harder to do when a contractor has that position.

Dr. Gaskin asked about systems versus components in achieving TRL 6. Mr. Dunn agreed that they need to be considered as an entire system, as components can drive other things without being obvious. Dr. Gaskin asked about his concerns going forward. Mr. Dunn replied that until the team has everything in hand, he will be concerned about procurements. He also wants to be diligent with contractors to ensure all are on track, and he thinks about how to facilitate deliveries. It is a continued risk that decreases with the number of items in hand, but surprises happen. Otherwise, he is mostly into the phase of normal worries that come with any spacecraft. He feels good about the schedule margin, and performance has been beating requirements in many areas. Dr. Tremblay asked about the top items with the largest risk for a surprise delay. Mr. Dunn said that the items to track due to schedule impact are a vibration isolation system that is being developed by a contractor, and the outer barrel assembly – a tube around the telescope – that is being built. Those are the big ones. Spacecraft components look good, and assembly is going well.

Dr. Hickox asked about whether the detector technology was chosen early or if there were multiple technologies in development. Dr. Benford explained that more than 10 years ago, NASA was considering multiple technologies and invested in technology development for all of them. However, the H4RG became the obvious choice. It still requires millions of dollars to develop; reaching TRL 6 calls for significant investment across the entire chain. There have been modifications to some of the technologies. The Application Specific Integrated Circuits (ASIC) have had significant investment, but these are not the same ones used on JWST. Dr. Tremblay asked if the low-level investment was directed to a trade. Dr. Benford explained that after the 2010 DS, when the mission was called the Wide Field InfraRed Space Telescope (WFIRST), a study office began thinking about the technology gaps. That narrowed down what received funding. He cautioned against drawing parallels between Roman and upcoming flagships.

Dr. Julie McEnery took over the presentation, providing an update on Roman's science status. The flight hardware for the coronagraph is all at the Jet Propulsion Lab (JPL) and the optical bench is almost fully populated. The deformable mirrors are assembled and being tested. Plans for the winter AAS meeting include a town hall and special sessions, one of which will provide information on the Core Community Survey (CCS) definitions. Recordings of the sessions will be available after the meetings.

In June of 2023, STScI will host a science conference on Roman science inspired by emerging JWST results. The conference is in the early planning stages. The team is being proactive in considering data releases to the community, and to that end is enabling test data and a mock catalog. This is more a preview of what investigators will see rather than a release of operating information. The software environment is not yet released. The team wants the community to have what it needs. The notebook will be a learning tool, to be replaced by a significantly more robust system. It is in the community's interest to engage in learning opportunities.

The Roman team began a series of monthly community forums in September. These will always have a brief mission status, a dive into a subsystem, and discussion of proposals. There were more than 100 participants at first forum and the team hopes to see that number grow. There will be frequent touch points for the community. Regarding ROSES solicitations, there are currently no funded science teams. This was a lesson learned from JWST, that there should be turnover to avoid concentration within the same group of people. The next call is somewhat delayed, however. In order to have a funded community providing input for calibration planning, the team is enabling community participation in the internal software and calibration group for now. The draft ROSES solicitation was put together by the project and program scientists, and the comment period indicated no significant issues from the community, which was helpful because it helps with clarification. The CAA report does not suggest much change, so the solicitation should be released soon.

The CCSes are important and require significant community engagement. The plan is to start with a white paper call for people to detail what they can do. The team wants all science ideas on the table as the beginning of an extensive community discussion. A chart showed how this fits into the baseline plan. This is a difficult and complex process that is new and being continuously redefined. Dr. Gaskin asked for more clarity on the purpose and goal of the CCSes. Dr. McEnery said that the plan has always been to do three large surveys to meet the top mission objective of wide field surveys for astrophysics. There are also mission objectives in cosmology and exoplanet demographics, and the cosmology objective dovetails with the wide field surveys for astrophysics objective. The cosmology objectives are more quantitative, however, allowing investigators to define a figure of merit for weak lensing. The Roman team can be quite precise in what the survey needs to address the cosmology goals. However, the team wants to make sure it is using the surveys for astrophysics goals as well. The astrophysics element of the CCSes is an integral part of meeting the purpose of the surveys. Now that the mission is closer to launch and ideas have matured, the team wants more concrete ideas on the table in order to optimize against both astrophysics and cosmology figures of merit. In determining what to design around, the team employs a notional plan informed by what other groups have done in the past. It is not rigid and is constantly evolving based on feedback.

The team is still digesting the CAA report recommendations, so there is no response yet. Preliminary takeaways include endorsement of having the community lead in setting the Roman observation program; the importance of competitively balancing and awarding time among the three CCS and general astrophysics surveys; and a suggestion to combine evaluation of the surveys. The team hopes to discuss this further with the Roman SIG. While the report supports the baseline overall, there are other ideas to consider and possibly incorporate. The mission is ramping up ways to engage with Roman and intends for the CCSes to go beyond selected NASA science teams.

Dr. Sambruna asked what they are doing to prepare Roman for TDAMM. Dr. McEnery said that while the mission is cost capped and the team does not want requirement creep, TDAMM fits naturally with the mandate to support astrophysics generally, and two of the CCSes are time domain surveys. There is a requirement to do TOO surveys, so that could apply. Regarding the ground system, the baseline includes calculation of light curves. She expects the ROSES call to support teams that want to develop additional infrastructure in partnerships. There is not any on-board science detection, however; changes will take 48 hours or so. The TOOs will be a proposal opportunity, and there will be a balance between flexibility and focus. Dr. Holley-Bockelmann wanted to see Roman enabled as a TDAMM resource and thought APD should provide resources to support that, either through the mission proper or through dedicated TDAMM infrastructure to tie together several elements. Dr. Sambruna agreed. Dr. McEnery said that it is likely that a mission with these capabilities will have proposals to provide these things. Dr. Woodward observed that this might be how new relationships are formed for future missions. Dr. Holley-Bockelmann said that she thinks of ROSES as being science or data analysis, and this sounded like infrastructure. Dr. McEnery said that there will be project infrastructure teams in the ROSES call, to enable and enhance science return for the entire community. Dr. Woodward said that there has to be an environment that compensates people for benefitting the community. Dr. Pascucci asked how the community will engage with the coronagraph. Dr. McEnery replied that there is a group for the instrument team to work through the demonstration, and she noted the coronagraph participation program.

GPRAMA Discussion

APAC discussed items for the GPRAMA narrative. Dr. Hamden said that the piece about heat-producing planet habitability was interesting but not at the level they would want, and there were no good graphics. Dr. Hickox agreed that it was subtle, saying the tidal evolution one was clearer. After Dr. Holley-Bockelmann also expressed concerns, they decided to drop it. Dr. Pascucci found a different example showing a density gap and indicating that this is not the result of atmospheric loss in M dwarfs. It was particularly applicable to small planets. She would look for graphics. Dr. Woodward suggested including

an accompanying figure to communicate the idea of water worlds. Meanwhile, Dr. Sambruna found a good illustration for rocky rain.

Dr. Woodward said that he would integrate the contributions and post them on the Google Drive in order to have a quick edit and review. He thanked everyone for their contributions.

APAC Discussion

Dr. Woodward asked for Committee input on findings or highlights. Dr. Hickox said that an emerging theme is how planning for large new missions should consider development of both technology and the workforce. It was interesting to hear about detector development for Roman. As they look at probes and UVOIR flagship, it illustrates importance of the GOMAP program and the technology development needed for probes. The probes have shorter timeframes than flagships, so the ability to invest right away is important. Dr. Gaskin agreed. Part of this is how to ramp up the flagships and when that comes into play. How to down-select parallel technologies, and when, has not yet been well-defined. Dr. Clampin said that the DS does offer guidelines on the subsequent flagships. Dr. Gaskin pointed out that that does not include budgeting for an early ramp-up. There is also decision-making. If NASA tries to bring multiple technologies to higher TRLs, that splits funding. Dr. Woodward observed that APAC was hesitant about the GOMAP rollout. There is concern about causing delays and falling behind in the thinking. There will be technology challenges that NASA should start addressing now.

Dr. Tremblay asked about naming all three GOMAP entrants as a way to encourage the community. Dr. Clampin said that he understood that idea, but the DS was released not that long ago and he had only been APD Director for 2 months. He was taking time to follow the process in order to ensure that NASA is ready with a cogent, integrated DS response. Some of the technologies are synergistic across all three flagships, like the sensor technologies. His first budget from scratch will be for FY25. He agreed on names, however, and even "TDAMM" did not resonate. There is a need for better ways of discussing and promoting the missions. He offered to have Dr. Perez discuss progress and integrations of the various technologies. Regarding ISFM, he will make it responsive but will not restructure the program.

Dr. Gaskin said that there is a need for more young community members as part of the next great observatory program. There had been a program that had postdocs at the center program offices. Something like this would invest in the next generation. Dr. Clampin said he would look into it. Dr. Gaskin added that she envisioned something similar to the ExoExplorer program, on which ExoPAG led. It was noted that ExoPAG involved a cohort of EC researchers who met at JPL in order to determine steps; there were stipends for presenters. This has brought new voices to the table.

Public Comment Period

Dr. Holley-Bockelmann read a portal question about the timeline for Explorer AOs, and whether there might be significant changes in scope related to TDAMM. Because APD staff could not answer this, it was put on hold for another time.

In answer to a question about a paper Dr. Pascucci had mentioned, a citation of the paper was placed in the chat box: (Luque, R. & Palle, E. 2022, Science, 377, 6611. Published on 8 Sep 2022 (DOI: 10.1126/science.abl7164)).

Held over from the previous day was a comment about the need for clarification on SAT, APRA, and why the IP is excluded from SAT. The questioner said they were told to submit to SAT, which is not open to the IP. Dr. Benford said that technologies needed in the current decade have a higher priority in selection, and that does not include the IP, so it is not urgent. APRA is always available. Anything that could go to SAT can also go to APRA, though SAT brings additional management assistance. As of 2021, the

oversubscription rate was 4.6 to 1 for both. There is no funding reason to prefer APRA or SAT, but SAT works more fruitfully with PIs to advance TRLs.

Discussion

As APAC discussion continued, Dr. Sambruna reported that SMD has started a study of the NASA Postdoctoral Program (NPP) to address the question of how this Program is of value to NASA, and whether postdocs should be funded exclusively thru ROSES grants. She would hate to see the NASA Postdoctoral Program (NPP) cut or eliminated, as it has been successful. The value to NASA is huge, the postdocs bring in great ideas and innovation, and it is a pipeline for civil servants at NASA Centers. The program is managed by a contractor, and the increase of costs for the recent contractor was cited by the SMD Administrator as a reason for scrutiny. She speculated personally that there could be a desire to shift the funds elsewhere. Dr. Woodward said that NPP has weight beyond its budget. Dr. Sambruna replied that SMD understands the value to the community but was looking at the value to NASA. That is why the Agency asked the Centers to provide input about it. The responses had been that it is a pipeline for many who work for NASA both directly and indirectly.

Dr. Gaskin noted that both she and Dr. Sambruna had been in the program, which also has the ability to hire foreign nationals. That might be affected if it goes to ROSES. Dr. Woodward said this should be on the agenda at APAC's next meeting. Dr. Clampin said that while he was not sure of the goal, program review helps ensure that programs work as planned and desired. Dr. Hickox wondered if they could think of the more forward-looking ideas from Dr. Beaton's presentation. It would be good to point people to the training they need. The NPPs seem like a potentially good cohort to bring into the technology workforce. Dr. Sambruna wondered if it might be possible for industry to co-sponsor NPPs. Dr. Hamden thought it was an interesting idea but one that might lead to a loss of some of the freedom to innovate. Dr. Sambruna agreed that that would have to be among the considerations. Dr. Gaskin said it could infuse the next generation beyond the traditional science path. Also, many students want internships with NASA, which can only select a few. However, industry could easily take them on and grow the community. Dr. Hickox observed that students often say they want to work for NASA when they really want to launch spacecraft or build missions. Industry has more of those opportunities, which should perhaps be made more explicit. Dr. Woodward suggested further thought about the intersection between NASA and industry. It might warrant APAC having a small group examine the situation further.

He also wanted to encourage the APD work in the IDEA area. Dr. Sambruna noted that SMD did a lot of good work early on. Going back to the NHFP,while it is great to have the science leadership in the rubric of the NHFP review process, she would like to see an emphasis for the candidates' evaluation on the abilities and/or potential to build a community that is diverse and does things differently. The rubric should start reflecting that. Dr. Woodward mentioned concerns about the Athena/probe linkage and possible hobbling of APD's ability to entertain missions that are scientifically parallel. Dr. Tremblay said that when he first read the DS, he was not impressed with the phrase "complementary to Athena." He thought it was weak. "New Athena" will inform selection of a probe, but he was concerned about the community and proposers. Dr. Hickox raised the issue that once the down-select happens, many probe concepts could have distinct capabilities that Athena lacks. He wondered how that might play into the decision-making. Dr. Clampin replied that the science is typically selected first, and that is not expected to change. NASA has to behave as honest brokers and allow what it selects in Step 1 be the science mission it takes to Step 2. It is not fair to change the science. Dr. Hickox speculated that there may be more clarity about Athena by time Step 1 is selected and wondered if it would matter. Dr. Clampin said that NASA does not want to change the ground rules after putting out the AO. The draft AO is out and people are already developing proposals.

Dr. Hamden noted that a lot of the missions are probably locked into science and implementation already. In addition, this call is for x-ray and IR, but it is making the x-ray astronomers tap dance around and

guess, which is extremely unfair to those proposers. It is important to avoid making things worse. The reviewers do not generally apply standards set after the fact, and the role of the mid-sized missions is to have some creativity. NASA should let the PIs do that. Dr. Gaskin said that Athena is uncertain until adopted. To ask people to consider it is unfair. But having some overlapping science goals is not bad; there are advantages and disadvantages. Dr. Hickox cited x-ray astronomy proposals that complement Athena. Two missions flying at the same time would offer double the observing time, so he agreed with Dr. Gaskin. NASA should evaluate these on their own merits. Dr. Tremblay asked if NASA or APD had a stated position on Athena versus LISA. Dr. Clampin replied that NASA does not weigh them against each other. Dr. Hamden said that if Athena were a NASA program, the synergy would make sense, but as NASA does not control it, the plan as is makes sense.

Dr. Alina Kiessling asked if it might be possible to get a briefing on the reality of servicing future missions. Dr. Woodward agreed. He was not sure what levels that covers. APAC also needs to think of where to go after the ISS platform is lost.

When discussion resumed following a lunch break, Dr. Woodward listed a few items to revisit:

1. State of the GUSTO mission. The mission team went through the gateways of the termination review and yet there is no more flexibility if the launch were to be held up. Should APAC advise on this?
2. ULTRASAT offers opportunities for U.S. participation, but APAC is curious about community access, especially in terms of IDEA.
3. APAC also heard of the SOFIA closeout and is generally supportive of the soft off-ramp, especially for EC workers. The Committee also wants timely delivery of products to archives.
4. APAC would like to learn more about ISFM funding for TDAMM and what the plan is to sustain the priorities consistent with DS recommendations.

Dr. Sambruna wanted to commend APD for taking the initiative on TDAMM. She would like a more accelerated schedule so that NASA does not lose the edge to Europe. She appreciated the balance of implementation of DS recommendations, which covered the state of the profession as well. Dr. Tremblay asked if TDAMM will have its own AO or be incorporated into other things. Dr. Clampin said that it will be part of other AOs, but NASA is also looking at infrastructure and talking to NSF about a tie-in to the LIGO network. NASA and Rubin seem to be going in one direction while NSF goes in another. NASA is also looking at workforce considerations. Dr. Gaskin noted that the centers require people to prove themselves on recent missions of a certain size before moving up to a larger mission. Dr. Sambruna said that the DS recommended a standing advisory structure on TDAMM to provide advice to NASA. APAC had discussed the possibility of this being a subcommittee. Dr. Clampin said that the structure was still being discussed. At an international meeting of space agency heads, it was agreed to have an international working group in order to leverage resources. This would be a separate group, and he agreed to discuss the two groups with APAC in the spring. Dr. Woodward said that another topic for the spring meeting would be theory calls and EC scientists. Theory will help guide Roman and other missions.

Dr. Pascucci asked if APAC could learn how other science divisions handle proprietary time. She would like to learn if APD can provide protections for EC scientists, give credit to PIs, and more. Dr. Woodward thought this would be a good discussion. The goals of open science are laudatory but the practical application could be deleterious. It is important that teams not be undercut. Use of archived data has to be done judiciously or it will discourage innovation. Dr. Hickox thought the PSD perspective was useful. Dr. Pascucci wanted to consider that the astrophysics community and APD might be different from the other disciplines, warranting a discussion of protections. Dr. Woodward suggested the need for a cultural change. Dr. Sambruna reminded APAC that NASA is legally bound to SMD Policy Document (SPD) 41a. Dr. Pascucci thought the discussion remained necessary in light of such things as the rush to publish

and protection of EC scientists. It could be that the community needs to think differently but also needs help to get there.

Dr. Clampin said that he managed all four science divisions at GSFC. Astrophysics is unique in having pointed observations, which is why APD has been struggling to make a useful comparison with the other three disciplines, where scientists primarily work from an archival data." He had talked widely, including with the JWST user community. The concern that kept coming up was to somehow help EC scientists. Dr. Hertz added that APD removed proprietary time on most missions and decreased it on others. He received only one complaint of a grad student being scooped. Mission directors can waive the zero proprietary time if justified to protect EC scientists. If an EC scientist needs protection, then it makes sense to grant the waiver. But not everyone needs proprietary time, and the communities where it went away are not complaining.

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Dr. Ho raised the issue of salaries for EC scientists. Dr. Woodward said that APAC wants APD to consider this in its cost models to design missions and set cost caps. There are challenges. Dr. Sambruna said that the APAC should look into the EC complaints about the non-proprietary data rights enforcement. She suggested that APD look into how many have complained and why. Dr. Hamden suggested that it might help to examine who publishes these papers, who is getting scooped, and on what timeline. Dr. Pascucci said that she knows of more than one scientist who has been scooped and so would like to look at inputs and the community. Dr. Woodward asked if the PAGs could delve into this anxiety and determine if it is a problem with the waivers, a cultural problem, or something else. They might mingle at AAS and come back to APAC in March. Dr. Tremblay said that this is what the PAGs are meant to do. He did not know about the waiver option. Dr. Hertz explained that SPD-41a applies to future missions only.

Dr. Hickox thought the concept of granting waivers made a lot of sense, especially for EC researchers. It would be helpful to make the option and the process better known. If APAC was previously unaware of it as a possibility, the information needs to be widely disseminated and made clear in proposal calls. Dr. Woodward said that the PAGs now have a charge, especially if they can develop hard evidence rather than just anecdotes. Dr. Tremblay noted the procedural difficulties in sending out surveys and asked Dr. Hertz to help distinguish between the subtle differences between surveys and solicitation of feedback. Dr. Hertz raised the issue of how to normalize those who have had problems against those who have not. Social scientists worry about this when they do surveys. Dr. Tremblay agreed, citing the tendency of people to only leave reviews when they have problems. Dr. Hickox said it would be good to ask this question out in the open at AAS, which would provide the best opportunity for something close to random sampling. Dr. Tremblay added that AAS was considering having an instant poll option available. Dr. Hertz said that it was important to ask the right question. He thought that question would be "have you ever been negatively impacted by zero proprietary time?" Most missions have zero proprietary time; only HST, Chandra, and JWST are not currently zero proprietary time. Dr. Woodward said that is was becoming clear what should be probed, but the question would be how to do it properly. He liked the direction suggested by Dr. Hertz.

Dr. Tremblay asked about the efficiency of NASA expenditures on postdocs and exposure of NASA funds to universities. Dr. Sambruna said that there is always going to be overhead and each university has its own system. Dr. Hertz added that NPP is run by a contractor and is not zero overhead. Dr. Woodward said that it would also be helpful to have further updates on LISA science participation. Dr. Pascucci added that she would like an analysis of the pros and cons of the model, along with any alternatives. Dr. Woodward thanked Dr. Clampin for reiterating his commitment to ensuring a diverse and balanced workforce, which invigorates stakeholders, students, and the public.

Formulate Recommendations

Dr. Woodward cited the urgent need to bring to conclusion the NASA historian's report. It has been a high priority for several meetings, and a crisp conclusion will allow the community to move on. APAC also wanted to learn of naming policy changes at the next meeting. He and Dr. Holley-Bockelmann would create a draft of the findings and GPRAMA to circulate among APAC members for input.

Debrief Division Director
Dr. Clampin thanked APAC for the input and commentary. He also thanked Dr. Woodward for being chair. This was his final meeting in that position, and Dr. Holley-Bockelmann was his successor.

Adjourn
The meeting was adjourned at 1:41 p.m.

Appendix A
Participants

Committee members
Charles Woodward, University of Minnesota, *Chair, Astrophysics Advisory Committee*
Kelly Holley-Bockelmann, Vanderbilt University, *Co-Chair*
Jessica Gaskin, NASA Marshall Space Flight Center
Erika Hamden, University of Arizona
Ryan Hickox, Dartmouth College
Shirley Ho, Flatiron Institute
Alina Kiessling, Jet Propulsion Laboratory
Mark Mozena, Planet Labs Inc.
Ilaria Pascucci, University of Arizona
Rita Sambruna, NASA Goddard Space Flight Center
Grant Tremblay, Harvard-Smithsonian Center for Astrophysics

NASA
Mark Clampin,
Director, APD
Louis Barbier
Manuel Bautista-Plaza
Dominic Benford
Gary Blackwood
Terri Brandt
Jennifer Burt
Francesca Civano
Julie Crooke
Nino Cucchiara
Doris Daou
Jessie Dotson
Daniel Evans
Debbie Fairbrother
Ingrid Farrell
Alise Fisher
Julie Fletcher
Alistair Funge
Michael Garcia
Jonathan Gardner
Barbara Grofic
Shahid Habib
Thomas Hams
Hashima Hasan
Executive Secretary, APAC
Elizabeth Hays
Paul Hertz
Chiumun Hui
Brian Humensky
Stefan Immler
Tess Jaffe
Hannah Jang-Condell
Jennifer Kearns
Beth Keer
Bernard Kelly
Patricia Knezek
Jeffrey Kruk
David Leisawitz
Odilyn Luck
Sangeeta Malhotra
Mark Matsumura
Julie McEnery
Elisabeth Morse
Arielle Moullet
Leonidas Moustakas
Michael New
Omid Noroozian
Lucas Paganini
Sarah Peacock
Joshua Pepper
Mario Perez
Robert Petre
Natasha Pinol
Rachael Rivera
Michael Robinson
Graca Rocha
Andrew Rowe
Kartik Sheth
Nicholas Siegler
Jacob Slutsky
Eric Smith
Linda Sparke
H. Stahl

Karl Stapelfeldt
James Thorpe
Steve Unwin
Sanaz Vahidinia
Azita Valinia
Debra Wallace
Tonjua Hines Watts
Lin Yi

Non-NASA/Unknown

Rachel Akeson
Megan Ansdell
Benjamin Bacon
Cathy Barclay
Meghan Bartels
Rachael Beaton
Marufa Bhuiyan
Breana Branham
Teddy Cheung
Carol Christian
Haeun Chung
Lori D. Coombs
Etienne Dauvergne
Vandana Desai
Monty Di Biasi
Terence Doiron
Jeanette Domber
Charles Lawrence
John Dyster
Mike Famiano
Jeff Filippini
Jeff Foust
Steve Groom
Shaul Hanany
Sara Heap
George Helou
Christopher Hirata
Evans Kampate
Kelsie Krafton
Elizabeth Landau
Charles Lawrence
Julie Leetch
Tsulon Li
James Lochner
Joe Mazzarella
Dan McCammon
Stephan McCandliss
Craig McMurty
Margaret Meixner
Gene Mikulka
Richard Miller
David Millman
Mayra Montrose
Jon Morse
Mason Ng
Rachel O'Connor
Roopesh Ojha
April Olson
Peter Plavchan
Cristian Randieri
William Reach
Neill Reid
Amy Reis
Tyler Robinson
Richard Rogers
Isabel Ramirez Ruiz
Nick Saab
Marcos Santander
Phil Scott
Paul Scowen
Elizabeth Sheley
Diksha Shinde
David Shoemaker
Kristin Simunac
Kevin Stevenson
Harvey Tananbaum
Harry Teplitz
Sean Terry
David Traore
Terry Trevino
Miguel Angel Vargas Cruz
Alexey Vikhlinin
Stu Wiens
Nicholas White
Alexandra Witze
Deborah Woods
Xiuqin Wu
Santosh Yadav
Matthew Zajac
Jun-Hui Zhao
John Ziemer

Appendix B
Astrophysics Advisory Committee Members

Charles Woodward, APAC Chair
University of Minnesota

Hashima Hasan, Executive Secretary
Astrophysics Division
Science Mission Directorate
NASA Headquarters

Jessica Gaskin
Marshall Space Flight Center

Erika Hamden
University of Arizona

Ryan Hickox
Dartmouth College

Shirley Ho
Flatiron Institute

Kelly Holley-Bockelmann
Vanderbilt University

Alina Kiessling
Jet Propulsion Lab

Emily Levesque
University of Washington

Mark Mozena
Planet Labs Inc.

Ilaria Pascucci
University of Arizona

Rita Sambruna
Goddard Space Flight Center

Grant Tremblay
Harvard-Smithsonian Center for Astrophysics

Appendix C
Presentations

1. *Astrophysics Division Update*, Mark Clampin
2. *ExoPAG Update,* Ilaria Pascucci
3. *PhysPAG Update,* Grant Tremblay
4. *COPAG Update,* Rachael Beaton
5. *LISA Independent Data Study,* Ira Thorpe
6. *Webb Update,* Eric Smith
7. *GPRAMA Overview,* Jennifer Kearns
8. *Roman Update,* Jamie Dunn/Julie McEnery

Appendix D
Agenda

Astrophysics Advisory Committee
Virtual
October 17-18, 2022

Monday, October 17

9:00 a.m.	Introduction and Announcements	Hashima Hasan/Chick Woodward
9:10 a.m.	Astrophysics Division Update	Mark Clampin
11:15 a.m.	Break	
11:30 a.m.	ExoPAG/PhysPAG/COPAG Updates	Ilaria Pascucci/Grant Tremblay/ Rachel Beaton
12:30 p.m.	Lunch	
1:30 p.m.	LISA Independent Data Study	Ira Thorpe
2:00 p.m.	Webb Update	Eric Smith
2:30 p.m.	Public Comment Period	
2:40 p.m.	Break	
3:00 p.m.	GPRAMA Overview	Jennifer Kearns
3:15 p.m.	GPRAMA Discussion	APAC members
5:00 p.m.	Wrap up for Day 1	Chick Woodward

Tuesday, October 18

9:00 a.m.	Opening Remarks	Hashima Hasan/Chick Woodward
9:10 a.m.	Roman Update	Jamie Dunn/Julie McEnery
9:45 a.m.	GPRAMA Discussion	APAC members
11:15 a.m.	Public Comment Period	
11:25 a.m.	Discussion	APAC members
12:00 p.m.	Lunch	
1:00 p.m.	Discussion	APAC members
1:30 p.m.	Formulate Recommendations	APAC members
1:45 p.m.	Debrief Division Director	APAC members
2:00 p.m.	Adjourn	

Appendix E
WebEx Chat Transcripts

Chat Day One

from Hashima Hasan (Ext) to everyone: 8:36 AM
https://nasa.cnf.io/sessions/tjk2/#!/dashboard
from Hashima Hasan (Ext) to everyone: 8:37 AM
Portal for questions/comments from public. https://nasa.cnf.io/sessions/tjk2/#!/dashboard

from Doris Daou (Int) to everyone: 8:46 AM
Good Morning Ingrind and Hashima. Camera is working. I see you are working on sound.
from Shirley Ho (Ext) to everyone: 9:01 AM
I am remote, and can't unmute myself to say "yes I am here" :)

from Cristian Randieri Ext (Ext) to everyone: 9:09 AM
Hello to all, from Siracusa, Italy
from Marufa Bhuiyan Ext (Ext) to everyone: 9:09 AM
Aloha from Hawaii
from kelly hb (Ext) to everyone: 9:10 AM
Good morning! Kelly Holley-Bockelmann here…can y'all promote me so I can speak?

from PAUL HERTZ (Int) to everyone: 9:23 AM
The visits to the archives have been completed
from Patricia Knezek (Int) to everyone: 9:24 AM
We can't hear what's being said in the room.
from Patricia Knezek (Int) to everyone: 9:24 AM
Only Mark, Chick, and Grant.
from kelly hb (Ext) to everyone: 9:24 AM
As I recall, we learned that the visit to the archive is complete. Oh! Jinx, Paul!

from kelly hb (Ext) to everyone: 9:30 AM
Also, the recommendation for ATP from APAC is to consider collaborating with NSF so that an early-career-focused call and a traditional call can be held each year.

from MICHAEL NEW (Ext) to everyone: 9:37 AM
Everyone in the room needs to mute their speakers.

from kelly hb (Ext) to everyone: 9:43 AM
+1 Rita — tdamm infrastructure is sorely needed

from Cristian Randieri Ext (Ext) to everyone: 9:55 AM
Did you ever think to make the data ready to be investigated by Artificial Intelligence algorithms ?

from Patricia Knezek (Int) to everyone: 10:00 AM
I tlloks like Stefan is talking, but we can't hear him.
from Patricia Knezek (Int) to everyone: 10:02 AM

Is Mark talking? I don't hear anything.
from Shirley Ho (Ext) to everyone: 10:02 AM
We can't hear anything ...
from Patricia Knezek (Int) to everyone: 10:02 AM
I can hear Chick.

from Shirley Ho (Ext) to everyone: 10:03 AM
@Christian Randieri, I think it is a good idea to serve the data in a way that allows most algorithms to run on.
from Cristian Randieri Ext (Ext) to everyone: 10:04 AM
On the AI/ML group of Genelab we are working on this topic...
from PAUL HERTZ (Int) to everyone: 10:04 AM
Need to share the charts
from PAUL HERTZ (Int) to everyone: 10:05 AM
Thanks
from Alina Kiessling (Ext) to everyone: 10:05 AM
@Paul - technical difficulties in the room. Apologies to all
from Rita Sambruna (Int) to everyone: 10:06 AM
someone needs to mute

from Shirley Ho (Ext) to everyone: 10:10 AM
@Christian, feel free to look me up :)
from Shirley Ho (Ext) to everyone: 10:10 AM
and stay in touch

from Eric Smith (Int) to everyone: 10:24 AM
Unallocated Future Expenses
from PAUL HERTZ (Int) to everyone: 10:25 AM
UFE = Unallocated Future Expenses (NASA-ese for Hq-held funding reserves)

from Marufa Bhuiyan Ext (Ext) to everyone: 10:30 AM
https://www.everestinnovationlab.com/admissions-open-join-our-school/
from Marufa Bhuiyan Ext (Ext) to everyone: 10:33 AM
If anyone is interested in joining, please email me at admin@everestinnovationlab.com

from chick woodward (Ext) to everyone: 10:42 AM
Pat ... Question was about statement in chart 25 of Mark's presentation ... C

from chick woodward (Ext) to everyone: 10:43 AM
Due to European Space Agency (ESA) consideration of whether the Athena mission will be substantially replanned, it was no longer practical to require proposed X-ray probes to “complement ESA’s Athena Observatory.” This requirement was therefore removed.
from Patricia Knezek (Int) to everyone: 10:46 AM
@Chick, that statement you just quote is correct. I meant that there was nothing in the AO that defined what "complementary to Athena" meant, so there was never any explicit TDAMM requirement. We had intended to leave it up to the proposers to define "complementary." And that requirement has now been completely dropped.

from Rachael Beaton (Ext) to everyone: 11:06 AM
==> Important that this is not seen as replacing science discussion.
from Nino Cucchiara he/him, NASA HQ (Ext) to everyone: 11:06 AM
https://www.stsci.edu/stsci-research/fellowships/nasa-hubble-fellowship-program/announcement-of-opportunity/nhfp-selection-rubric
from Kelly Holley-Bockelmann (Ext) to everyone: 11:09 AM
Agree with Rachael -- there's a world of difference between DEI leadership discussion as a tack-on versus a reframing of the fellowship
from Rachael Beaton (Ext) to everyone: 11:10 AM
I actually had the PRO/CON discussion with a student on Friday. :-)

from Shirley Ho (Ext) to everyone: 11:10 AM
We can't hear mark
from PAUL HERTZ (Int) to everyone: 11:10 AM
Cant hear Mark

from Kelly Holley-Bockelmann (Ext) to everyone: 11:13 AM
Folks, there is a Q+A function for your questions. I will do my best to monitor this!

from Marufa Bhuiyan Ext (Ext) to everyone: 11:23 AM
What is any ideal teamsize or any min-max team member required for any project?

from Marufa Bhuiyan (Ext) to everyone: 11:29 AM
Where can we access to these PowerPoint slides? Thank you.
from Hashima Hasan (Ext) to everyone: 11:35 AM
All presentations will be posted on the APAC website within a week of the meeting
from Hashima Hasan (Ext) to everyone: 11:36 AM
Portal for questions/comments from public. https://nasa.cnf.io/sessions/tjk2/#!/dashboard

from Terry Trevino (Ext) to everyone: 11:37 AM
My favorite PAG!

from Marufa Bhuiyan (Ext) to everyone: 11:46 AM
Thank you for answering my question.

from Patricia Knezek (Int) to everyone: 11:54 AM
Very cool image, @Grant
from Francesca Civano (Ext) to everyone: 11:54 AM
Thank you Grant!
from Alina Kiessling (Ext) to everyone: 11:56 AM
SACNAS: Society for the Advancement of Chicanos/Hispanics and Native Americans in Science
from Alina Kiessling (Ext) to everyone: 11:57 AM
NSBP: National Society of Black Physicists

from Bernard Kelly (Ext) to everyone: 12:42 PM
... or ROSES-supported postdocs at universities?

from Stephan McCandliss (Ext) to everyone: 12:43 PM

Good point Grant! Can we renegoinate PD/GS F&A at national level???

from Craig McMurtry (Ext) to everyone: 12:47 PM
@Stephan The universities will fight that because they have dramatically increased their number of (useless) deans and administration staff to match the current F&A rate.

from Kelly Holley-Bockelmann (Ext) to everyone: 2:40 PM
Chick is dropping out for me

from Hashima Hasan (Ext) to everyone: 2:43 PM
APRA _ Astrophysics Research and Analysis
from Hashima Hasan (Ext) to everyone: 2:43 PM
SAT - Strategic Astrophysics Technology

from Mario Perez (Ext) to everyone: 2:45 PM
SAT proposers for ROSES-2023 must:
from Mario Perez (Ext) to everyone: 2:45 PM
- Focus their proposals on the technology needs of the highest-priority mission recommendations of Astro2020. These include the top-priority large mission, a flagship-class infrared/optical/ultraviolet (IR/O/UV) Great Observatory, as well as probe-class missions at Far-IR and X-ray wavelengths, and subsequent Far-IR and X-ray Great Observatories. Maturation of technology components that will be needed within the current decade will have a higher priority for selection under the program.

from Shaul Hanany (Ext) to everyone: 2:46 PM
Sorry, I can't unmute. I'd like to clarify Dominic's question.
from Shaul Hanany (Ext) to everyone: 2:46 PM
No, sorry, trying to clarify the answer. I will try to type quickly, but this may need to wait for tomorrow.
from Shaul Hanany (Ext) to everyone: 2:47 PM
I'll send a follow up tomorrow
from Kelly Holley-Bockelmann (Ext) to everyone: 2:48 PM
Sorry Shaul -- Happy to read out your comments and/or get permission to unmute you tomorrow

from Jennifer Kearns (Int) to everyone: 3:03 PM
Yes, ready

from Marufa Bhuiyan (Ext) to everyone: 3:32 PM
Carrington Event

from Kelly Holley-Bockelmann (Ext) to everyone: 3:43 PM
As Chick says, part of our task is to pick the most salient examples to justify our ratings (and/or provide our own if the ones provided aren't appropriate). We should pick ones with a big impact, are easy to explain in 300 words, and have a nice image.
from PAG Reps (Ext) to everyone: 3:45 PM
The Early Release Observations from JWST are published, themselves, in a Letter to ApJ:
https://ui.adsabs.harvard.edu/abs/2022ApJ...936L..14P/abstract

from Kelly Holley-Bockelmann (Ext) to everyone: 3:59 PM
The pulsar story has a grea timage

from Jessica Gaskin (Int) to everyone: 4:07 PM
Press release for GRB 221009A: https://www.nasa.gov/feature/goddard/2022/nasa-s-swift-fermi-missions-detect-exceptional-cosmic-blast

from Kelly Holley-Bockelmann (Ext) to everyone: 4:10 PM
Green!
from Shirley Ho (Ext) to everyone: 4:10 PM
Green !

from Alina Kiessling (Ext) to everyone: 4:26 PM
+1 to Chick and Shirley for including a theory/simulation result

from Tyler Robinson he/him (Ext) to everyone: 4:41 PM
Throwback follow-up to the mystery in Brasser+ (2022) under 1.2.4 -- the study states that aspects of the TRAPPIST-1 system's orbital configuration cannot be reproduced by planetary tidal evolution alone. They propose that dissipation in the star could help with the explanation, but their current tidal dissipation model still doesn't fully explain the system even with stellar dissipation.

from Shirley Ho (Ext) to everyone: 4:43 PM
Yes

from Terry Trevino (Ext) to everyone: 4:46 PM
Any link to that paper?

from Shirley Ho (Ext) to everyone: 4:50 PM
I can do 5
from Marufa Bhuiyan (Ext) to everyone: 4:51 PM
I'm interested :)

Chat Day Two

from Jamie Dunn (Ext) to everyone: 8:54 AM
Hi Ingrid, I had not planned on it...
from Jamie Dunn (Ext) to everyone: 8:54 AM
I can if needed though

from shirley ho (Ext) to everyone: 8:59 AM
Shirley is here
from Alina Kiessling (Ext) to everyone: 9:00 AM
I'm here - not covid, cold. Didn't want to pass it along though!
from Kelly Holley-Bockelmann (Ext) to everyone: 9:00 AM
Good Morning!
from shirley ho (Ext) to everyone: 9:01 AM
Good morning!!
from chick woodward (Ext) to everyone: 9:02 AM

everyone standby .. we are experiencing tecthical connectivity issues
from chick woodward (Ext) to everyone: 9:04 AM
Dashboard for public input: https://nasa.cnf.io/sessions/tjk2/#!/dashboard

from Kelly Holley-Bockelmann (Ext) to everyone: 9:08 AM
HERE!
from shirley ho (Ext) to everyone: 9:08 AM
Yes
from shirley ho (Ext) to everyone: 9:08 AM
Here
from Kelly Holley-Bockelmann (Ext) to everyone: 9:08 AM
Sorry, can't unmute myself!
from shirley ho (Ext) to everyone: 9:09 AM
Sorry can’t unmute myself

from Kelly Holley-Bockelmann (Ext) to everyone: 10:14 AM
Nice question, RIta -- Roman is a huge TDAMM resource, and it would be remiss of APD to not provide resources to support that, either through the mission proper or through dedicated TDAMM infrastructure to tie together several missions/surveys/things

from Santosh Yadav (Ext) to everyone: 10:28 AM
congratulations to NASA scientists and space agency

from shirley ho (Ext) to everyone: 10:49 AM
I am all good
from shirley ho (Ext) to everyone: 10:49 AM
I am here
from shirley ho (Ext) to everyone: 10:50 AM
I am all good

from Ilaria (Ext) to everyone: 11:19 AM
Luque, R. & Palle, E. 2022, Science, 377, 6611. Published on 8 Sep 2022 (DOI: 10.1126/science.abl7164)
from Terry Trevino (Ext) to everyone: 11:20 AM
Thank you Ilaria

from Kelly Holley-Bockelmann (Ext) to everyone: 11:25 AM
Thank you for your explanation, Dominic! That was exceptionally clear!

from Alina Kiessling (Ext) to everyone: 11:57 AM
I have a change of topic question when we are ready to move on

from Shirley Ho (Ext) to everyone: 12:01 PM
see you all soon!!

from PAUL HERTZ (Int) to everyone: 1:15 PM
Astrophysics is the only SMD division that has a period of limited data access

from Eric Smith (Int) to everyone: 1:19 PM

For what it's worth, I spoke with Neill Reid at STScI about the early science coming out from JWST and whether they've heard any concerns about data being "poached". He has not heard any such complaints.

from Hashima Hasan (Ext) to everyone: 1:30 PM
Check the NASA Keck Call for Proposals for change in proprietray time.
https://nexsci.caltech.edu/missions/KeckSolicitation/
from Hashima Hasan (Ext) to everyone: 1:30 PM
Proposers are given instructions on how to get waivers
from george helou (Ext) to everyone: 1:31 PM
Paul: Actually Spitzer went to zero prop time at some point during the extended mission
from Hashima Hasan (Ext) to everyone: 1:32 PM
NuSTAR has 6 months proprietary time

from Shirley Ho (Ext) to everyone: 1:35 PM
All good :)