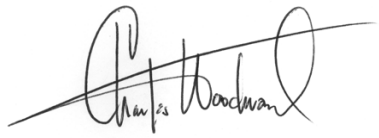
NASA Astrophysics

ASTROPHYSICS ADVISORY COMMITTEE

October 13 and 15, 2021
Virtual Meeting

MEETING MINUTES



Charles Woodward, Chair

HASHIMA HASAN

Digitally signed by HASHIMA HASAN
Date: 2022.02.13 12:06:32 -05'00'

Hashima Hasan, Executive Secretary

Table of Contents

Introductions and Announcements	3
Astrophysics Division Update	3
Webb Telescope Update	8
Senior Review Update	9
Public Comment Period	10
GPRAMA Process Overview	11
GPRAMA Discussion	12
NASA Hubble Fellows Program Review	14
Discussion	16
Opening Remarks Day 2	17
Athena Update	17
Aspera Update	18
Pandora Update	19
Euclid Update	20
PhysPAG Report	21
ExoPAG Report	22
COPAG Report	22
Public Comment Period	23
ISFM Update	23
Keck Review Update	24
R&A Update	26
Discussion	28
Recommendations, Actions/Outbrief to Division Director	29
Adjourn	32

Appendix A-Participants
Appendix B-Membership
Appendix C-Presentations
Appendix D-Agenda

Prepared by Elizabeth Sheley
Tom & Jerry, Inc.

Wednesday, October 13

Introduction and Announcements

Dr. Paul Hertz, Director of NASA's Astrophysics Division (APD), opened the virtual meeting of the Astrophysics Advisory Committee (APAC). As this was a Federal Advisory Committee Act (FACA) meeting, it was open to the public; while APAC members could participate in discussion, there would also be opportunities for members of public to ask questions via the WebEx chat feature and a web portal linked in the Federal Register Notice (FRN). Committee members were required to recuse themselves from discussion of any topics for which they had personal or institutional financial conflicts of interest (COIs).

Dr. Charles Woodward, APAC Chair, then welcomed the participants and noted that minutes were being taken and that all statements and discussion were on the record. The NASA Science Mission Directorate (SMD) Associate Administrator (AA) had appointed the Committee members on the basis of their subject matter expertise; they must comply with Federal ethics laws applying to Special Government Employees (SGEs). The following members were known to have COIs: Dr. Jessica Gaskin – Imaging X-ray Polarimetry Explorer (IXPE); Dr. Margaret Meixner –Stratospheric Observatory for Infrared Astronomy (SOFIA); Dr. Louis-Gregory Strolger – James Webb Space Telescope (JWST or Webb), Nancy Grace Roman Space Telescope (Roman); Dr. Michael Meyer – JWST, Roman; Dr. Erika Hamden – Roman, Aspera; Dr. Shirley Ho – Roman. Any members finding additional COIs were obliged to tell Dr. Hashima Hasan, the APAC Executive Secretary, and recuse themselves during the applicable discussion. Members should address any ethics questions to Dr. Hasan as well. APAC's role is to advise APD and provide a regular forum for discussion of federal astrophysics. The meeting had a full agenda and included several topics on which APAC feedback was required.

Dr. Hasan welcomed the participants and took roll. After determining that there was a quorum, she turned the meeting back over to Woodward, who invited Dr. Hertz to make the first presentation.

Astrophysics Division Update

Dr. Hertz began the APD update with a couple of science highlights. In the first, use of data from the Hubble Space Telescope (HST) and the Neil Gehrels Swift Explorer (Gehrels/Swift) allowed scientists to identify a new, third type of supernova. In the second highlight, archival Spitzer and Gaia data helped astronomers find a previously unrecognized feature – a spur – in one of the Milky Way's spiral arms.

Astrophysics is part of a broader science program at NASA, described in "Science 2020-2024: A Vision for Science Excellence," or "the SMD science plan." A graphic showed SMD's current and future science fleet, including missions in launch and delivery phases. There were over 150 missions on the chart, and the next 12 months will include many launches. IXPE and JWST will launch in December.

The Colorado Ultraviolet Transit Experiment (CUTE) launched in September and was going through in-orbit checkout at the time of the meeting. This mission will do ultra-violet (UV) measurements of exoplanet transits. After cancelling six campaigns due to Covid-19, the Balloon Program has returned to flight using new procedures in the Fall 2021 (Ft. Sumner, NM) campaign. There will not be an Antarctica campaign in 2021, but a full set of campaigns is planned for 2022.

The IXPE Operational Readiness Review (ORR) was happening concurrent with the APAC meeting. Plans were to ship the explorer spacecraft to Kennedy Space Center (KSC) in mid-November for a presumed launch date of December 9, 2021. Dr. Hertz reviewed the IXPE science objectives, which involve use of x-ray polarimetry to study a range of phenomena. A Webb update was to follow the

Division update. Dr. Hertz noted that the telescope (Webb) has been shipped to French Guinea and moved into the pre-launch building.

Regarding the controversy over the mission's name, NASA Administrator Bill Nelson recently stated "We have found no evidence at this time that warrants changing the name of the James Webb Space Telescope." Dr. Hertz explained that Covid-19 restrictions have prevented full access to archives, and NASA intends to complete the historical research once greater access is allowed. The current decision was made based on the publicly available historical information. He then asked Dr. Brian Odom, NASA's Acting Chief Historian, to address the meeting.

Dr. Odom said that the issue of Mr. Webb's role during a period of homophobia is being taken seriously at NASA. Prior to Covid restrictions going into effect, Dr. Odom and a contract historian examined Mr. Webb's record at NASA. Dr. Odom had previously reviewed Mr. Webb's record in context of the civil rights movement of the 1960s. Concerns remain about his record as Undersecretary of State during the "Lavender Scare," which generated fear that homosexuality was a security threat. The current investigation looked at what was already known about Mr. Webb in that context. The available information and discussions with other historians turned up no evidence to back the charges. Once Covid restrictions are pulled back, the contractor will resume work and visit archives related to Mr. Webb's history. The past is never closed, and if new evidence comes to light, it will be presented to the NASA administrator. At this point, however, there is no evidence of a personal role by Mr. Webb.

Dr. Odom clarified that there was no committee involved in the investigation, and there is no intent to write a formal report. Dr. Strolger said that, given the sensitivity of the issue and the need for transparency, it feels insufficient to present findings without a report. Dr. Gaskin asked if Dr. Odom expected additional information with greater access to archives. Dr. Odom said that the effort will keep moving forward. There are historians who have looked at this before. Any evidence is likely to be at the Truman Library archives, which the contract historian intends to visit once they reopen. It is possible that previous historians were looking for something else and did not take note of anti-homosexual statements or actions.

Dr. Meyer asked for an example of what the historians would have consider sufficient compared to what they found. Dr. Odom explained that there is a document that is circumstantial, but they want to see if anything builds on it. It is not enough to say someone might have discussed something. They are not seeing anything direct. Dr. Ho said that transparency matters. She asked how a telescope's name might change, noting that such changes have occurred in the recent past. Dr. Hertz said that there is a NASA procedure for that, with the mission directorate making a recommendation to the Administrator. That happened when the Wide Field Infra Red Space Telescope (WFIRST) became the Nancy Grace Roman telescope. The naming of Webb in 2002 was the decision of the Administrator at that time.

Dr. Odom added that he was impressed with the objective nature that Administrator Nelson took with the decision not to change the name of Webb. He believes that if new evidence were presented, Sen. Nelson would react to it. Dr. Hertz pointed out that Sen. Nelson's statement includes "at this time" as a qualifier. Dr. Woodward said it would be an advantage to have a report about criteria and current findings to go into the file and summarize the work. One of the issues is that the historians need documents in order to move beyond hearsay. APAC would discuss whether to request a tangible report. He thanked Dr. Odom and said that APAC is pleased that the contractor is available to resume work when the Covid situation allows.

Dr. Mark Mozena asked about the time period of the investigation. Dr. Odom replied that it covers Mr. Webb's stint at the State Department. The project itself began earlier in 2021. Dr. Woodward said that

APAC sought this investigation, and if other facts come to light, they would like a further conversation. APAC might also advise APD to consider a different approach to how missions are named.

Dr. Hertz resumed his presentation with an update on Roman, the next flagship mission in development. The mission passed Critical Design Reviews (CDRs) for various key components during the past year. Mission CDR is a major milestone. The project continues to progress in spite of Covid inefficiencies and supply chain impacts. Cost and schedule commitments have been adjusted to accommodate these issues, with the schedule moved out by 7 months. Research Opportunities for Space and Earth Science (ROSES) 2021 will offer Roman research and support options.

Roman science covers a wide field infrared survey, expansion history of the Universe, growth of structure in the Universe, an exoplanet census, general astrophysics surveys, and a coronagraph technology demonstration. Dr. Hertz provided the status of some of the hardware, including the telescope, wide field instrument, coronagraph, instrument carrier, and spacecraft. The science community has asked for coordination between Roman and the ground-based Rubin Observatory, which receives funding from the National Science Foundation (NSF) and the Department of Energy (DOE). These organizations, along with NASA, have asked the Roman and Rubin project leads to identify possible joint activities and produce a report.

Roman's Core Community Surveys will enable the work the last Decadal Survey (DS 2010, *New Worlds, New Horizons*) set as priorities. NASA is asking the community if additional surveys and precursor work might be needed. The Agency is announcing an open Request for Information (RFI) to help define additional surveys, and any such surveys will be developed via an open community process. The February ROSES call included Roman opportunities, with a proposal deadline targeted for early 2022. Dr. Hertz reviewed some of the options in the call, including coronagraph community participation, wide field instrument preparatory science, and key project infrastructure teams.

Budget
NASA is currently operating under a Continuing Resolution (CR), which funds the government at Fiscal Year 2021 (FY21) levels. The CR also funds recovery from hurricane damage at the John C. Stennis Space Center (Stennis) and the Michoud Assembly Facility (Michoud). The FY22 President's Budget Request (PBR) for APD, including Webb, comes to $1,575.5 million. Dr. Hertz reviewed what had changed since the FY21 PBR and what had remained the same. He also presented a sand chart on which the top line reflects the developmental versus operational budgets of flagship missions. Webb will move forward regardless of the CR, as there is adequate funding to support the 2021 December 18 launch. Some of the fluctuations in previous years reflect flagship mission development. R&A and Explorers costs have gone up a lot over the last 10 years. The Division works with what Congress provides and tried to follow the DS priorities. The next Pioneers call will be in spring of 2022. APD is still reviewing how many of the four previously selected Pioneers will go forward. If this program is a great success, there will be decisions on how many to select in the future. Right now, the program is an experiment less than 1 year old.

The Senate has not yet released to the public any mark-up it has made to the PBR. The House made several changes, adding $46.1 million overall, stating that Roman shall proceed, and keeping SOFIA despite a termination request. Since the House funds SOFIA at $85 million, cuts must be made elsewhere. These are designated as $22.7 million less for Explorers, a reduction of $6.4 million for Research, and $10 million less for the Rest of Astrophysics (ROA). This may change when the Senate priorities come to light.

Personnel
Mr. Jeff Volosin, APD Deputy Director, is moving to Goddard Space Flight Center (GSFC) to be the Director of Earth Science Projects. Therefore, Dr. Hertz will delay his transition out of the Division Director position in order to ensure continuity of leadership. Dr. Daniel Evans is now the SMD Assistant Deputy Associate Administrator for Research, while Dr. Kartik Sheth is on detail as the Assistant Director for Research Infrastructures and Science Equity at the White House Office of Science and Technology Policy (OSTP). New staff have joined during 2021, including Program Scientists Drs. Roopesh Ojha, Sanaz Vahidinia, and Heather Watson, and Program Executive Dr. Rachele Cocks. There will be more program scientists brought on via hiring and details.

Inclusion efforts
NASA is committed to inclusion and has added it as a core principle. SMD has added it as a strategy. There are a number of new initiatives in this area. The Directorate is modifying Announcement of Opportunity (AO) requirements to address inclusion; a draft of the modification has been released for community comment. SMD has begun establishing a stronger presence at affinity group conferences and is seeking FY22 funding to establish bridge programs supporting minority-serving institutions (MSIs) and historically Black colleges and universities (HBCUs). SMD is also seeking funds to augment the Science Activation program in a way that supports more diversity and inclusion initiatives. Some of this would be discussed further in the presentation. Dr. Strolger asked how NASA planned to do the bridge programs. Dr. Hertz replied that he believed the bridge program was to fund universities to partner with Minority Serving Institutions (MSIs). These plans are not yet in place, pending approval of funds.

SMD's proposed new AO requirements would require Diversity, Equity, and Inclusion (DEI) to be reflected in all proposals submitted in response to NASA AOs. There would also be the expectation that each project will describe how team members can be assured of an inclusive and equitable environment. NASA would require proposal language to be explicit about these requirements. The requirements will become part of the evaluation, to be assessed by subject matter experts. Dr. Woodward asked if there is a structure to understand how such DEI requirements will work in practices. Dr. Hertz said that SMD sees that as something to address as a next step, which is not yet in place. Dr. Woodward asked for confirmation that the requirements would apply to all AOs. Dr. Hertz said that that is the plan. SMD is awaiting responses to the RFI, which may result in adjusted language. The final language will be added to the standards AO template. Proposal page counts will change to accommodate the requirement for new information. Dr. Manuel Bautista noted that these new requirements could run up against state and federal law. Dr. Hertz explained that every organization large enough to propose already has internal requirements that their staff and teams do what SMD is asking, as he understands it. There are staff who can work with proposers on this.

As part of a pilot program, all Astrophysics Theory Program (ATP) proposals should have included an inclusion plan that addresses means of creating and sustaining a positive and inclusive working environment, and contributions the proposed investigation will make to the training and development of a diverse and inclusive scientific workforce. In addition to the 20 science panels, 4 inclusion panels have evaluated the proposals. The inclusion panels are made up of astronomers active in DEI, and DEI experts. Proposers are receiving feedback, though DEI is not yet an element of ratings or selection. The inclusion panels are helping APD to produce a lessons learned document that will record their findings on how to refine the solicitation and evaluation. Findings therein will suggest strategies on how best to incorporate inclusion goals as a selection criterion in future reviews. NASA will seek proposer reactions to the review comments. SMD is trying to determine whether science panels can do quality reviews of these criteria. There will be a debriefing on this at the next APAC meeting.

Covid impacts
Nothing in this area has changed in recent months for SMD, which adjusted project plans and commitments as needed. Supply chain problems have caused many issues, delays, and anomalies. Projects have sought alternative suppliers, many of whom also have backlogs. Aside from those close to launch, just about every project is "yellow." Roman and the Spectro-Photometer for the History of the Universe, Epoch of Re-ionization,and Ices Explorer (SPHEREx) stand out in this regard, and NASA may need to make some decisions down the road. While most missions have stayed within their cost and schedule profiles, Webb, IXPE, and Roman have exceeded their schedules, and the latter two exceed their cost profiles. Regarding SMD support for better work-life balance, a web page is up to inform SMD-funded researchers about NASA-provided wellness resources and leave options that may be available. Dr. Gaskin said that DEI discussions should address how to create a balance to help prevent people from becoming so stressed that they leave the field. Some intense missions require long hours of effort from the workforce.

Dr. Hertz noted that the R&A budget is only part of NASA's community funding. He reviewed funding growth and selection rates.

Open data/open science
SMD has released SPD-41, the Scientific Information Policy, which consolidates existing guidance on open data. The next step will extend the open data requirement beyond missions. The work here is ongoing, as are discussions on software repositories and cybersecurity. APAC could get a presentation after SMD issues a pending RFI in this area. This is strictly related to curation of NASA-funded projects. Additional information on AI and security, for example, could come from someone else at a future meeting. Dr. Woodward asked about the pivot to open access and PubSpace. Dr. Hertz said that in practice, astrophysics uses the Astrophysics Data System (ADS), which is being extended and is a better tool at this point. This will likely evolve along with the requirements.

Missions
Currently, NASA Astrophysics has no strategic missions or strategic activities planned for the lunar surface, Gateway, or cis-lunar space. Among missions in operation, SOFIA deployed to French Polynesia in a 4-week campaign that ended early due to Covid precautions. There were 13 successful flights. An anomaly affected HST science operations starting in mid-June, but science operations were fully returned by July 20.

This APAC meeting included a presentation on the Astrophysics Senior Review (SR). The SR is a subcommittee of APAC, which will receive the report next spring and advise APD.

The various classes of astrophysics missions fall into four major categories: Strategic Missions recommended by the DS, competed missions solicited through the Explorer AO, Stand Alone Missions of Opportunity Notice (SALMON) AO, ROSES. Astrophysics Pioneers is a new class of small missions solicited annually in ROSES. In the Explorer program, the next Small Explorer (SMEX) downselect is pending and a Medium-class Explorer (MIDEX) AO was recently released.

There was to be a separate presentation on Euclid. NASA has delivered a Sensor Chips System with spares for the Near Infrared Spectrometer Photometer (NISP) instrument. NASA has established the Euclid NASA Science Center at the Infrared Processing and Analysis Center (IPAC), and there are over 70 members of the U.S. Euclid science team. The NISP data communication issue has been resolved, and the payload is about to be shipped to Italy for spacecraft integration. IPAC science ground segment software deliveries are on track. The launch is planned for late 2022.

For the X-Ray Imaging and Spectroscopy Mission (XRISM), NASA and Japanese Space Agency (JAXA) teams have determined that a helium leak in the JAXA dewar has been fixed. Integration and Testing (I&T) continues with in-person and remote NASA support for a launch early 2023. This has been a difficult travel situation due to the pandemic, but NASA personnel rose to the occasion. The XRISM Guest Scientist program will be in ROSES in early 2022.

NASA is partnering with the Israel Space Agency and the Weizmann Institute of Science on the Ultraviolet Transient Astronomy Satellite (ULTRASAT), for which NASA is providing a commercial launch in late 2024/early 2025. This will be a 3-year prime mission in geosynchronous orbit, and the data will become public at IPAC following a 12-month exclusive use period. Dr. Hertz described the science. Dr. Woodward asked how these partnering arrangements are coordinated, given that they come up periodically. Dr. Hertz said that this was done strategically. ULTRASAT will become part of the alert system. He noted that NASA personnel will be able to attend the American Astronomical Society (AAS) meeting if they are fully vaccinated and participate in discussions of alert-system brokerage.

The SPHEREx CDR is planned for 2022 January. This mission is dealing with Covid impacts and staffing issues. The Atmospheric Remote-sensing Infrared Exoplanet Large-survey (ARIEL) mission is a recent selection by the European Space Agency (ESA) and still in Phase B. The Advanced Telescope for High ENergy Astrophysics (ATHENA) mission is another ESA/NASA partnership. NASA is contributing the X-IFU focal plane array and is using the testing facilities at Marshall Space Flight Center (MSFC) for mirror calibration. NASA moved ATHENA from the study phase to the project phase at the end of September.

The DS is not out yet and Dr. Hertz was not sure when it would be issued. Once it is available, NASA will give an implementation response to the community, outlining what will be studied and how scientists can get involved. Any formal plan will have to be vetted through the Agency, but there is no requirement of a formal response other than what SMD has imposed internally. APD will reply within 90 days in order to identify what can and cannot be done quickly.

Dr. Kelly Holley-Bockelmann asked if any ULTRASAT data will become public immediately. Dr. Hertz replied that the alerts will be immediate, but the full data set is limited for 12 months. Dr. Meixner asked what NASA will do at the AAS townhall regarding the DS. Dr. Hertz said that it will be a normal townhall but NASA will not discuss the full DS response. AAS will adjust townhalls so that the DS chairs can host townhalls early in the meeting and NASA responses can take place later in the week. Dr. Ryan Hickox asked if the decreasing R&A funding and the increasing Guest Observer (GO) funding reflects a choice or something else. Dr. Hertz said that these are separate issues. R&A has new initiatives that may or may not be continued in the future. The GO programs reflect the JWST launch.

Dr. Strolger asked if Dr. Hertz will still be with APD when the senior review (SR) comes out. Dr. Hertz said that he does not have a departure date because there is no date for a successor to begin. The goal is to provide continuity and ensure an appropriate transition. He is not retiring, just moving from this job to another within NASA science; he will continue working for NASA and should be available to help out if needed.

Dr. Woodward asked for a sounding rocket presentation at the next meeting. Dr. Hertz said that would happen. The sounding rocket program will be in Australia next year with several astrophysics payloads. Dr. Hamden noted that the Strategic Astrophysics Technology (SAT) due date was contingent on the DS release. Dr. Hertz responded that APD wants the SAT call to address the DS, so when the DS comes out, the Division will see if there is enough time to propose. They need 30 days or more for the due date; if that is not possible, they will cancel the call.

Webb Telescope Update

Dr. Eric Smith, JWST Program Scientist and APD Chief Scientist, provided a JWST update. There are only a few things to highlight at this stage. At the Space Telescope Science Institute (STScI), the software is ready to go. In the Science and Operations Center (S&OC), all systems are complete. Dr. Smith showed a film of Webb loading onto a ship to French Guinea. (www.youtube.com/watch?v=xU3s1Uh8FhI&feature=youtu.be) Launch is now scheduled for Dec. 18, 2021. On the flow chart of activities to launch, the first two rows are specific to Webb, and the last two rows apply to any payload. There will be no more deployments until the mission is in space.

A map showed the location of 470 community events across the United States. These are locally run, with NASA assistance as requested, and are modeled after the very successful community engagement activities from the 2017 solar eclipse. There is also a plan and timeline for media events and coverage. On the commissioning timeline, there will be many activities prior to obtaining science from Webb. A goal is to bring people along as the various stages occur.

Dr. Smith broke out the commissioning timelines for the spacecraft, cooling curves, telescope, and Near-InfraRed Camera (NIRCAM). For spacecraft commissioning, Dr. Smith explained the criticality and the interplay of fuel and L2 orbital insertion point. There is a 5-year prime mission with 10 years of fuel. When the sunshield begins to deploy, cooling will begin which drives commissioning; not all pieces cool at the same level or rate. While this happens, the team will tune up the telescope, aligning the 18 mirror segments. After a few months, they should be able to begin the science instrument commissioning.

Dr. Woodward asked how much contingency is available on the schedule. Dr. Smith explained that the cooling chart shows what will really govern the pace of activities. If items cool safely faster, they might be able to accelerate some activities. Nothing is time critical after the first three items, and many things happen in parallel. There are 11 days of schedule margin they can use prior to the official launch date. In terms of major hurdles, few activities involve touching hardware and there is some schedule available in the event they need to do diagnostics. The last hardware activity is putting ¾" actuators into the observatory. The instrument had bolts in place for shipping. This is a normal amount of margin as a fraction of time to launch date. Dr. Gaskin asked if some of the finer commissioning timeline elements were really broken-out down to the hour. Dr. Smith explained that the timelines show a delineated sequence, and an action might take as little as 4 seconds. Each activity has a known duration, and that may tell down to the minute what they will see.

Dr. Meixner asked about plans to communicate to the public about the commissioning phases, as this is a complex process to communicate and there is a long time after launch to the first images. Dr. Smith said that the project science team will have a public blog on the NASA home page, with weekly updates. The first image will not be beautiful, so they will need to convey the engineering aspect of it. They should not go for 180 days of saying things are great with no further information, so the team will tell how they know the sunshield booms have deployed, etc. Part of the plan is to have various team members discuss what they are doing, not just the PIs.

Senior Review Update

Dr. Smith then presented the SR update. He began by acknowledging Dr. Sheth's work in starting this process and assembling the review panels. The SR is mandated by Congress to evaluate the cost effectiveness and science value of missions that have been extended beyond their prime phases. The process generates advice to NASA, which uses it to help plan budgets and talk to Congress. Options are to continue, terminate, and change mission scope. Missions in the 2022 SR include:

- Chandra X-ray Observatory (Chandra)
- Fermi Gamma-ray Space Telescope (Fermi)
- HST

- Neutron star Interior Composition ExploreR (NICER)
- New Horizons [Astrophysics only]* (part of Planetary)
- Nuclear Spectroscopic Telescope Array (NuSTAR)
- SOFIA
- Gehrels/Swift
- Transiting Exoplanet Survey Satellite (TESS)
- X-ray Multi-mirror Mission-Newton (XMM-Newton)

HST, SOFIA, and Chandra will each have their own panels, and the rest will be bundled together in a Rest of Astrophysics (ROA) panel. An SR subcommittee will be over all of these. There will be seven to nine people on each panel. The subcommittee will include the ROA members and a couple of members from each of the other panels. That subcommittee will operate as a FACA committee and report to APAC, which will deliver it to NASA along with recommendations.

The SR subcommittee will merge the findings from each of the four subpanels and rank the evaluated missions by their scientific merit, relevance and responsiveness to APD's strategic goals, and technical capability and cost reasonableness. The findings will assist APD with its FY23-27 implementation strategy and will provide guidance on whether or not to continue missions. For those missions that do continue, there will be further guidance on whether to enhance, maintain, or reduce their operating budgets.

This will be SOFIA's first entry into the SR. The SR process began in September and APAC should receive the report in 2022 May. The site visits will be longer than last time, panel member commitments permitting. When the SR presents the report to APAC, there will be opportunities for discussion. APAC can then endorse, amend, or otherwise address the report, also passing along the original report. Dr. Hertz noted that this will call for a special meeting of APAC.

Dr. Mozena asked if SOFIA's previous special reviews will be considered. Dr. Smith replied that the panels will receive the 2019 findings for each mission and the SOFIA panel will receive the reports that were the SR analogue. Dr. Hertz added that the previous reviews will guide in determining if the missions lived up to the recommendations. Dr. Hickox asked if the previous SR found a single panel to be sufficient for the Rest-of-Missions ROM. Dr. Hertz said that this has been the structure for a long time, possibly 20 years. He could not recall a panel saying they needed to be split. Dr. Holley-Bockelmann noted the amount of travel involved in site visits. Dr. Smith said that the ROM panel has presentations in a room and does not do site visits. Dr. Hertz explained that the timeline is tight, but he needs the report to set the budget, a process that begins in early May. Other Divisions take more time to do this.

Public Comment Period

The first comment from the public came via the portal: "1,200 NASA community members signed a letter expressing concern about the name of JWST. How will their concerns be addressed?" Dr. Hertz replied that Dr. Odom gave a full report on what has been done to date. Dr. Woodward said that APAC might make some recommendations on the summation of the exercise. Dr. Holley-Bockelmann noted that the top four questions in the portal called for more evidence and/or justification. Dr. Hertz said that NASA was hearing the concerns of the community. Dr. Hickox said that he was hearing that the communication that came out was brief and did not have context. He asked why that was the case, given the level of interest. Dr. Hertz repeated that NASA was aware of the concern. Dr. Strolger said that it is important to try to address the issue and be transparent. The concerns were about the lack of a discussion of how NASA reached the outcome. A report is necessary.

Dr. Holley-Bockelmann read another comment: "There has been a great deal of concern in the astronomy community about the funds that are likely to be available for the GOs for JWST Cycle 1 science. In 2015 the JSTAC did a bottoms-up analysis and recommended that the GO funding level be about $60M to $64M in 2015$. A recent careful assessment by the JSTUC came up with a number that was quite consistent (inflated to nearer $70M in current $). While I understand that NASA has recognized that the original funding was inadequate and would like to make the amount available for Cycle 1 consistent with the JSTUC/JSTAC recommendations, I do think it would be good for the APAC to ask about this and have a discussion with NASA folks on this topic, especially given the wide and deep community concern about having the necessary resources to process the remarkable data that will come from the ~$10B JWST (NASA+ESA+CSA total) in Cycle 1 (and beyond)."

Dr. Smith said that the Cycle 1 budget request was just under $100 million, and STScI put together a task force to review this. When they looked at a subset of Cycle 1 budgets, they estimated that there was a nearly 30 percent overestimate for the budgets. In out years, that is easy to correct. The more immediate problem is near term. The team believes that it will be more of a cash flow problem rather than an actual amount issue. The Institute is getting ready to send out letters now that there is more GO budget certainty. Dr. Woodward asked if there was a disconnect between the expectation of science that ought to be delivered and the likely science return, given the funding. Dr. Smith replied that the community and STScI/NASA had projections from a long time ago. The answer probably lies in the middle. This is what they have to support the first year or so from Webb. Dr. Woodward suggested that there be a hard look at real-people costs for future large missions. Many of the workers are students, postdocs, etc. The balance between GO and R&A should be considered. Dr. Hertz noted that Dr. Smith stated that NASA will be funding the human capital. The mistake they made was being late, but they are correcting that. Dr. Holley-Bockelmann observed that five of the portal questions were about the JWST GO program and possible underfunding.

Another question was: "With the SAT call potentially canceled this year, will there be funding to carry over the SAT programs whose period of performance completes this year until they can propose again for renewal?" Dr. Hertz explained that SAT is for strategic technology investments, which are laid out in the DS, and therefore SAT funding reflects DS recommendations. That is why this year's call will be limited. Many current SAT proposers are not doing work that will be eligible this year; they should propose to the Astrophysics Research and Analysis (APRA) program instead.

GPRAMA Process Overview

Ms. Jennifer Kearns of SMD provided background on the Government Performance and Results Act 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. In SMD, the performance measures address milestones for missions and development. There are also measures of science progress, the nine performance goals, which are reviewed by external experts. For each of the science goals, one division will lead the review and designated divisions will provide input. Dr. James Klimchuk of the Heliophysics Advisory Committee (HPAC) and Dr. Serina Diniega of the Planetary Science Advisory Committee (PAC) were participating on behalf of their respective committees. The SMD science performance goals with primary and secondary review responsibilities are in Table 1.

Table 1

PERFORMANCE GOALS	APAC	ESAC	HPAC	PAC

1.1.1	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.		Yellow	Green	Yellow
1.1.2	NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe.	Green		Yellow	Yellow
1.1.3	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.			Yellow	Green
1.1.4	NASA shall demonstrate progress in discovering and studying planets around other stars.	Green		Yellow	Yellow
1.1.5	NASA shall demonstrate progress in improving understanding of the origin and evolution of life on Earth to guide the search for life elsewhere, exploring and finding locations where life could have existed or could exist today, and exploring whether planets around other stars could harbor life.	Yellow		Yellow	Green
1.1.6	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.			Green	
1.1.7	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.				Green
1.1.8	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.		Green		
1.1.9	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.		Green		

Green = lead. Yellow = secondary.

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 APAC's meeting of October, 2020. The accomplishments considered must result in whole or in part from a NASA-funded activity, but that funding did not need to come from APD specifically. 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 for the final report. SMD prefers published results and the write-ups should be high level, not comprehensive.

Key to the GPRAMA evaluations are the color ratings, which have not changed since 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.

Another requirement is that there be a recorded vote. Ratings other than Green should have a clear rationale in the text so that the result can be properly reflected in the performance report. NASA has streamlined the report so that each performance goal now gets about three paragraphs of text. The Agency is generally able to include one graphic per performance goal. Links are helpful.

GPRAMA Discussion

Dr. Woodward suggested going through the document that Dr. Hasan provided in order to get a sense of what APAC members found useful. He began by reading Performance Goal 1.1.2: "NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe."

Dr. Gaskin noted an absence of Chandra results despite an important result from a massive survey of the galactic center that showed superheated gas and magnetic threads through the Milky Way. This had a lot of press. She provided a link: https://chandra.harvard.edu/photo/2021/gcenter/ . Dr. Meyer thought some of the examples were more appropriate under another performance goal. He and Dr. Bautista were not enamored of the first example, " SOFIA Witnesses Rare Accretion Flare on Massive Protostar." Dr. Meixner said that the point of this result was that time variable observations could be done at far-infrared wavelengths and it opens a new area of research for astronomers.

The second example, "NuSTAR and XMM-Newton See Light Echo from Behind a Black Hole," struck Dr. Woodward as significant due to the 3D map. Dr. Hickox added that it made good use of multiple NASA resources. Others agreed. Going down the list, Drs. Hickox and Strolger thought that "NASA's Fermi Spots a Supernova's 'Fizzled' Gamma-ray Burst" was important science but would be too obscure for a general audience. Ms. Kearns said that on occasion, NASA will include in the performance report results of extreme importance even if the intelligent layperson is unlikely to grasp them. Dr. Meyer offered a link – https://www.nature.com/articles/s41550-021-01384-2 – to an article about electron capture of a new kind of supernovae. Dr. Woodward thought it might warrant inclusion. Dr. Klimchuk pointed out that examples could cover more than one result, and Dr. Gaskin thought there was value in showing breadth, as well as giving examples of how assets work together. Dr. Meyer offered another link, this one to an article about old brown dwarfs (https://exoplanets.nasa.gov/news/1687/accidental-discovery-hints-at-a-hidden-population-of-cosmic-objects/). While he did not like the result, it breaks a long-held paradigm.

The following examples came from PAC:

- Study Reveals MESSENGER Watched a Meteoroid Strike Mercury
- Ten Months of Perseverance on Mars
- Juno Spacecraft Doubles as An Interplanetary Dust Detector
- Detection of a Satellite of the Trojan Asteroid (3548) Eurybates—A Lucy Mission Target

Dr. Woodward found the first and fourth to be most compelling. Dr. Diniega thought that the Perseverance one shows direction but might be premature. The Lucy mission is important, and while the MESSENGER mission would work, she would go with Lucy. Dr. Meyer thought the Juno result was interesting, as it is about zodiacal dust, and Dr. Diniega agreed.

HPAC offered the following examples:

- Coordinated Hinode and Sounding Rocket Observations Challenge Coronal Heating Theories
- Rapidly Growing Field of Solar Toroidal Modes Gives New Looks Inside the Sun

- VOYAGER Observes First Persistent Plasma Waves in Interstellar Space
- Konus-Wind and IPN Observations Reveal Twin Giant Magnetar Flares in Nearby Galaxies
- Konus-Wind Observes a Peculiar Hard X-ray Counterpart of a Galactic Fast Radio Burst

Dr. Woodward liked the Voyager and Hinode sounding rocket results. Dr. Klimchuk said that the latter was important, as it addresses the mechanisms of reconnection. He explained how the solar toroidal modes example might apply to stars. Voyager is in the interstellar medium now; it measures plasma waves and density, showing evidence of continuous waves. The others were more astrophysics results from heliophysics missions and not in his area.

In determining which of these would be useful and relevant, Dr. Meyer preferred the Hinode and Voyager examples. Drs. Meixner and Hamden liked the Voyager example, as did Dr. Strolger, who also thought there was value in the second Konus-Wind example. Dr. Gaskin thought both Konus-Wind examples were important. Dr. Klimchuk pointed out there seems to be an emphasis on new observation, but there is little on access and modeling, which warrant funding and are important. NASA does not sufficiently emphasize the role of interpretation. Dr. Strolger agreed, as did Dr. Bautista, who added that that was why he thought the Voyager mission was important. Dr. Woodward said that if they were to consider the supernova activity, they could highlight the importance of theoretical studies.

Dr. Meixner posted two SOFIA results in the chat box: https://www.sofia.usra.edu/multimedia/science-results-archive/stellar-feedback-and-triggered-star-formation-rcw-120 tackles formation of stars, and https://www.sofia.usra.edu/multimedia/science-results-archive/warped-magnetic-field-centaurus is on a magnetic field survey.

Dr. Woodward read the next Performance Goal, 1.1.4: "NASA shall demonstrate progress in discovering and studying planets around other stars." Of the two TESS examples, Dr. Meyer considered "TESS Discovers New Worlds in a River of Young Stars" to be more compelling. He also liked "Hubble Watches How a Giant Planet Grows. The example "Chains of Planets in Mean Motion Resonances Arising from Oligarchic Growth" was a theory supported by the Exoplanet Research Program (XRP). He suggested an additional result, a catalogue paper from TESS (https://exoplanets.nasa.gov/news/1677/space-telescope-delivers-the-goods-2200-possible-planets/ and https://ui.adsabs.harvard.edu/abs/2021ApJS..254...39G/abstract). Dr. Ho agreed that the TESS catalogue and oligarchic growth examples were important. Dr. Woodward reviewed the list with the Committee, which chose the TESS catalogue, oligarchic growth, TESS river of young stars, and Hubble examples.

Dr. Hasan called roll for the recorded vote on the color rating for Performance Goal 1.1.4. It was unanimous for green.

Dr. Woodward noted that Performance Goal 1.1.2 had more examples than desired in the first pass. His goal was to cut the number in half when APAC returned to the topic later in the meeting.

NASA Hubble Fellows Program Review

Drs. Rita Sambruna and Nicolle Zellner gave a presentation on the NASA Hubble Fellows Program (NHFP) review. Dr. Hertz explained that he chartered this review. NHFP has been going on for more than 30 years and now includes other fellowship programs. He asked the panel to look at how the program serves the fellows and the goal of achieving excellence, and how NHFP can improve diversity and inclusion. The panel did a lot of good work and produced an interesting report, for which he wanted APAC feedback. If enacted, the recommendations would have a strong impact on the program; they are not just tweaks.

Dr. Zellner explained that the charter asked the panel to look at the program's success and DEI elements. She listed the team members, noting that Dr. Stefanie Johnson is a social scientist and Dr. Sherard Robbins is a DEI expert. Dr. Zellner gave credit to other contributors, then reviewed the process. It began with a fact-gathering phase that examined program implementation, application and selection processes, health and well-being of the fellows, and DEI topics. The process then moved to a Q&A session with former and current fellows, a survey of administrators and chairs of host institutions that have not been frequently selected, and a survey of previous and current fellows.

The results were 27 findings in 5 broad topics:

- Mission of the NHFP
- Management of the Program
- Application and Review Processes
- Diversity and Accessibility of the Program
- Support of the Fellows

These generated 32 recommendations.

Dr. Sambruna then gave a high-level view of the findings. The panel appreciated the dedication of the NHFP leads and supporting personnel, who strive to maintain the prestige of the fellowship and integrity of the review process; the panel does not want that to change. The fellowships are important in shaping careers and defining the field and culture of astrophysics, and there is a need for the NHFP to formulate a shared mission statement, in alignment with NASA and SMD core values. The panel wants to see a holistic evaluation of applicants, including an assessment of inclusive leadership, which will require a restructuring of the application and review processes. Related to this is a need to provide additional information and discussion sessions for applicants, reviewers, and other stakeholders, possibly in the form of an orientation session for fellows and even applicants. Finally, NASA needs to collect data about applicants and the experiences of fellows so that NHFP can be effectively evaluated over time. NASA cannot legally do this, but the data are necessary and so the panel urges creativity.

The findings offer NASA the opportunity to change the culture of astrophysics. The panel found that there "is a missed opportunity for NASA to use the Fellowship as a vehicle to improve equity of our field, and to set the standards for the inclusive leadership attributes that will define the Astrophysicists of tomorrow." The landscape has changed since NHFP began. A summary of the report made the following key observations:

- The NHFP aims at excellence, and the 21st-century Astrophysics landscape calls for more than just scientific excellence (…) if the great challenges of the future are to be met. Teamwork, mentoring, and community building skills should be paramount for the leaders of tomorrow.
- A new definition of excellence is crucial for the NHFP and it must embrace the NASA/SMD core values. It must place a focus on inclusive, collaborative leadership as one of the defining criteria for the selection of Fellows.
- Changing the demographics of the Fellows is imperative for the field, as the NHFP embodies the aspirations, values, and standards of the Astrophysics community. Only in the last call was diversity mentioned. Want this to be sustained and amplified in future calls.
- While "first order" changes have been presented and suggested in the review report as the first essential step, a much more challenging endeavor is to change the culture of the community - a "second order" change - to fully reflect the values of diversity and inclusion, without which significant innovation is not possible.

The message to the astronomy community is that there must be a changed design and changed behavior in order to have a changed outcome. The report quotes Dr. Karen Bjorkman of the University of Toledo as

saying: "The NHFP is without a doubt one of our most prestigious fellowships in Astronomy. As such, it really is well-suited to help change the culture ..., and to help open up opportunities in Astronomy (and other sciences) to a broader and more diverse pool of participants."

Dr. Strolger found the presentation enlightening and liked the direction of the recommendations. He asked what other criteria the selection committee might apply, or what other process changes could advance diversity. Dr. Zellner said that the long report contains multiple recommendations. There are new evaluation options, like dual anonymous (dual anon) review, removing letters of recommendation, training reviewers and letter writers, and more. One option is to allow applicants to leave choosing their host institution until after the fellows are selected, as the choice of an institution often requires applicants to have access to the "right network" or well-connected advisors. Waiting until after fellows are selected could reduce some of these barriers. Dr. Sambruna added that the panel recommended calibrating reviewers before they do triage, which apparently occurs before the review. However, it is during the review that the evaluators have an opportunity to get to know each other and establish common values. In addition, the application could change to allow fellows to talk about leadership and experience in addition to science and could ask for a plan on how to make institutions inclusive.

Dr. Meixner asked if there had been discussion of recruitment of applicants. Dr. Sambruna replied that there has been a lot of work in this area, which the panel discussed. They may do a special workshop at AAS and other conferences. Dr. Hickox commended the recognition that fellows are concentrated at certain institutions. He asked about the success of the program, noting that while the fellows seem to do impactful research and get good positions, it is possible that some of that is self-reinforcing. What leads fellows to be successful and how is that measured? Dr. Zellner replied that Dr. Johnson surveyed the program and found that networks were helpful in fellows' success, and their cohorts helped as well. The panel recommended doing a broader survey more frequently. The reputation of the institutions, the advisors, the networks, and cohorts seem to be factors.

Dr. Bautista wanted to compare the program with the rest of the community. Most of the recommendations are difficult within the nature of the application itself. He did not think they could detach the host institution from the application and proposal. It is difficult to build diversity and inclusion because the fellow is only supported as an individual. He sees the key as networking, which allows them to fold in and emphasize diverse groups. Dr. Sambruna replied that the fellows themselves say they want resources to hire and work with students and cultivate this aspect of the fellowship. She can only guess how difficult it is for an inclusion plan. Dr. Zellner added that they heard from fellows that some had changed their research from what they had proposed, so it is not clear that selecting the host institution is important. The panel recommended a way to diversify the institutions by discussing with the fellows how they want to see their careers progress. Dr. Woodward said that APAC would return to this topic. There ought to be a regular review of the program, maybe every 5 years or so.

Discussion

The APAC members resumed discussing Performance Goal 1.1.2. Dr. Woodward led discussion of the candidate examples, which needed to be narrowed down from a list of 13. He had the sense that APAC wanted something about Voyager to be included, as well as the electron capture example. The Juno example seemed to resonate, as did the Chandra observation involving MeerKAT, the brown dwarfs discovery, and the Newton-XMM 3D black hole data. After that, Dr. Woodward saw less agreement on priorities. He noted the HST small black hole detection, Lucy mission, sounding rockets with Konus winds, and SOFIA stellar feedback examples.

Dr. Hickox thought it was important to use these to illustrate the breadth and depth of NASA science, and therefore lobbied for variety. Dr. Strolger said that they should select a range of missions and topics. He and Dr. Meixner noted the importance of gravitational lensing work. It was agreed to combine the galactic

magnetic field examples into one. The Juno and Voyager examples were also to be combined. Similarly, the HST and Chandra examples were merged.

Dr. Hasan took a roll call vote on Performance Goal 1.1.2. All APAC members voted for green except for Dr. Meyer, who was unable to participate in the meeting at this time. There were 10 votes green, which was unanimous.

For Performance Goal 1.1.5, Dr. Meyer would participate in the upcoming PAC meeting as the APAC representative. Dr. Woodward then made writing assignments, promising to follow up in writing. He asked that the sections be sent to him within 2 days so that he could then coordinate with the entire Committee. The goal was to complete the writing and reviews by October 22.

Moving on to the next topic, Dr. Woodward said that APAC was disappointed with the Webb renaming decision and wants a written report so that the community has something to review. Dr. Bautista asked for more on the NHFP report. He would like to see the achievements of the fellows. Dr. Woodward asked APAC members if they had additional thoughts, to send them in writing to himself and Dr. Holley-Bockelmann.

Wrap up for Day 1
Dr. Hasan thanked the participants and said she looked forward to Day 2.

Adjourn
The meeting adjourned for the day at 5:03 p.m.

Friday, October 15

Opening Remarks
Dr. Hertz opened Day 2 of the meeting and reviewed the FACA rules. Dr. Woodward also reviewed the FACA rules and repeated the identified COIs among the APAC members. The first day's conversation was robust and respectful. He asked the members to pay attention to the Keck review and determine whether APAC might have an opinion on it. Dr. Hasan then joined the meeting and took roll; she determined that there was a quorum.

Athena Update
Dr. Robert Petre, Athena Project Scientist, presented a progress report on the mission. He had previously discussed Athena science, so this time he took a programmatic perspective.

As the second large mission in the ESA Cosmic Visions program, Athena is a very large x-ray telescope with a wide field imager (WFI), and x-ray integral field unit (XIFU). The mirror tilts back and forth to allow switching between the two instruments. Launch to an L1 orbit is planned for the early 2030s. The baseline mission is 4 years, and the mission is designed for 10 years

The two main science questions address the hot Universe (ordinary matter assembling into large-scale structures) and the energetic Universe (the growth and influence of black holes). Graphs showed how Athena will be transformational. A comparison to other missions illustrated how the mission will be highly complementary to the fleet projected to be in operations at the time of launch. A modular mirror is the key technology that will allow this, and ESA has been working on it for a number of years. The x-ray mirror will have a large field of view and a very large effective area.

Dr. Petre then provided a study status from ESA, detailing where the mission is at the moment. The mission adoption review is now planned for early 2023, a slight slip that affects the remaining schedule. It is likely that the spacecraft will be solicited in late 2023. Both candidate spacecraft designs are stable, and the focus is now on the mirror assembly module (MAM) and the MAM Demonstrator (MAMD). The latter will come to MSFC for testing. The custom adaptor design concept has been completed and is slightly better than estimated.

There are issues on the Science Instrument Module (SIM) and payloads cooling system. The main problem has been a mass reduction issue. The XIFU Detector Cooling System (DCS) will have its first cool-down in mid-2022, but a significant number of subsystem and component-level demonstration activities are already occurring. These items are driving the mission adoption date, closely followed by the optics developments. Regarding the optics, technology development continues, and next year will be pivotal in understanding actual performance capabilities. Mirror demonstrator activities with each candidate spacecraft are at the CDR stage, with pre-demonstrations planned to precede manufacturing of the full-size demonstrator for mechanical testing at MSFC in 2024. Small mirror adjustments are not affecting the interface with the spacecraft.

NASA's existing contributions are stable and there is now a well-defined division of responsibilities. The Agency hardware contributions are in the $100-$150 million range and include components for the XIFU focal plane array, use of testing facilities, mirror calibration, WFI design and analysis assistance, and the vibration isolation system. Outside of the amount cited, NASA will provide science ground segment support, a U.S. GO facility, and a GO program.

Dr. Petre showed a graphic and photos of the X-Ray and Cryogenic Facility for ATHENA Mirror Calibration, which is very challenging.

APD has transitioned Athena from a study to a project, and it is now based in the GSFC Explorers office. GSFC is continuing to study some elements of the mass issue and has provided a draft facility contamination control plan. NASA has taken delivery of the vibration isolation model. New information available from L2 is relevant here. This is not a typical project from the NASA perspective, so the project plan is a departure and takes some additional work, but it will pay off.

There are currently some major concerns around the goal of a 5-arcsec angular resolution. This is unlikely to be demonstrated by adoption, and it may be that it is unachievable. The mirror design also does not meet the effective area requirement. The Athena Science Study Team (ASST) is assessing a revised science case in case only 10 arcsec point-spread-function (PSF) is achieved. Dr. Petre said that he is concerned about this.

(Dr. Gaskin removed herself from discussion at this point because she realized she had a COI.)

Dr. Strolger asked about the driver of the 5 arcsecond requirement. Dr. Petre explained that the science question is predicated on a very low flux. There is confusion with the x-rays above that. Most spectroscopy requirements are not compromised by the arcsecs, however. The effective area issue may result in needing longer exposure times, thus missing mission requirements. Dr. Bautista asked if there might be major obstacles on the spectroscopic side. Dr. Petre replied that the cryo system could be problematic. The cooler stages are well-developed, but providing sufficient redundancy is an issue. Dr. Hickox asked if ASST was confident that Athena could achieve even a 10 arcsecond PSF resolution. Dr. Petre said that the work done so far indicates it will, but he is not confident they can get beyond that. The team is making changes and tweaks, and he thinks 10 arcsecs is a safe assumption. However, he wonders if that is enough.

Aspera Update

Dr. Carlos Vargas described Aspera, one of the four Pioneers selections, which will map the warm-hot circumgalactic medium (CGM) in a study of galactic in-flow and out-flow of gas. Graphics illustrated how this fuels star formation and is key to understanding galactic evolution. Key elements at play here include cold extraplanar gas, warm ionized gas, and hot gas. The question is whether there is an intermediate boundary between warm and hot gas. Models of the CGM indicate that there is. This "absorption line" accounts for more than 10 percent of galactic feedback energy, which is more mass than is found in stars. Astronomers have typically pointed telescopes to quasars with known spectra and analyzed absorption features. The need to map warm-hot gas is significant.

There are reasons this has not yet been addressed. Dr. Vargas presented several of these, which include the need for measurements to be taken in space above the ozone layer; low surface brightness; and luck. However, technology development has taken us to where this research is now feasible. The team that will study this is diverse, and almost half are Early Career (EC) researchers. They will observe surface brightness, using the work of project scientist Dr. Haeun Chung in refining measurements of galaxy halos and enabling study of dusty galaxies that were previously difficult to assess. Aspera is designed to detect and map O VI with little background interference.

The instrument is small, about the size of a mini-fridge, which helps focus the detection on a very small UV background. The point is that big science can be done on small platforms. Dr. Vargas showed the target selection criteria. Aspera will observe 10 of 18 targets and map three star-forming galaxies that meet certain criteria. Dr. Vargas presented a graphic of the payload. Aspera will use micro-channel plate detectors that have flown successfully in the past. The spacecraft bus will allow the payload to reside within the bus in a hospitable temperature environment. The plan is for a 9-month prime mission, and all 52 weeks of the year are available for the baseline mission. Aspera will launch in 2025.

Dr. Ho asked if there will be more simulations based on the targets and wanted to know about the spatial scales and galaxy characteristics required to achieve desired project science goals. Dr. Vargas said that the team has a strong handle on typical star-forming behaviors and is restricting the samples to those types of galaxies. It is possible that Aspera could lead to study of more massive galaxies and other phenomena for which there are simulations. He referred to Japanese studies on redshift in dwarf galaxies. Dr. Gaskin asked how the orbit was determined. Dr. Vargas replied that the team sought a rideshare, but the stable thermal environment was a high priority as well in order to help keep the optics aligned. The use of a rideshare will keep the use of titanium to a minimum. The biggest observational constraint is the geocorona.

Pandora Update

Dr. Elisa Quintana, the PI for Pandora, described this smallsat mission, which will do multiwavelength characterization of exoplanets and their host stars, building on work by TESS and HST, as well as Webb.

Most stars are active, with brightness variations that evolve spatially and with time. These variations can mask or mimic planetary features, causing inaccuracies and unreliable results. Correcting for star spots is most important for smaller planets and stars, like those that Webb will observe. Pandora's observing strategy will help to correct these issues. Its capabilities include long duration baseline observations of 24 hours per transit, and 10 transits per planet. One of the benefits here is that the larger missions are oversubscribed and therefore it is hard to enable these longer observations, creating a gap that Pandora will fill. The smallsat will offer simultaneous visible photometry and Near InfraRed (NIR) spectroscopy.

Objectives include determining the covered percentages of low-mass exoplanet host stars and the impact of these active regions on exoplanetary transmission spectra; and identifying exoplanets that are covered by clouds and hazes. Dr. Quintana described a baseline of a sample mission. Pandora will cover a range

of Earth- to Jupiter-sized planets. The current plan includes 135 unscheduled days to allow for flexibility and other science cases. The observing strategy combines simultaneous visible photometry and spectroscopy to distinguish among star and planetary spectra and enable robust measurements of a planet's true atmospheric make-up. There is a single instrument, an all aluminum 0.45m relayed Cassegrain telescope "CODA."

The Pandora team includes both government and private entities, among them Lawrence Livermore National Lab (LLNL). It will fly on a commercial bus. EC members fill over half the science team roles, and the engineering team includes both EC members and summer interns. Mentoring matches experienced and EC team members. A shadow program allows grad students to pair with team members. There is broad community support, and the team is awaiting feedback from NASA in order to proceed.

Dr. Woodward found the discussion of workforce development and the EC researchers to be especially interesting. He asked about target selection criteria and x-ray variability as a factor. Dr. Quintana replied that there will be an active outreach program to encourage concurrent observation. Many of these stars are already in programs with simultaneous measurements. The stellar activity is an issue for RV measurements as well, and the team is interested in this.

Dr. Meyer asked about wavelength range and trades, and photometric precision. Dr. Quintana called up a slide showing eight proposed trades. One trade was to see if the team could obtain a government spare, which they acquired from Webb. There was a lot of modeling, which helped them design the detector and concept of operations (conops). The team has the capacity to swap in dozens of other viable planets, and the list will be flexible with frequent uploads to enable complementarity.

There was Committee interest in how the Pandora team acquired the spare hardware. Dr. Quintana explained that part of the original proposal involved procurement of two detectors, which the team knew existed, though there was no documentation as such. So, they proposed a trade study to examine the options. That was very opaque to the team and they might be able to write up how to investigate this for future proposers. Essentially, though, it was grassroots. Dr. Woodward noted that flight spares can be requested from any NASA project. Dr. Hertz added that there is no cost-effective way to maintain a database of spares. Dr. Woodward stated that this is a networking issue that needs to be publicized.

<u>Euclid Update</u>
Dr. Jason Rhodes explained that Euclid is an ESA mission with enabling technology from NASA, which will also participate in ground data processing, analysis, and science. Euclid seeks to quantify dark energy, modified gravity, dark matter, and the conditions at the birth of the Universe. The mission will rely on two primary probes to measure expansion of the Universe, growth of structures, and the expansion history of the universe. Euclid will look at the transition from the decelerating to accelerating Universe in order to better understand it. There will be legacy science from the imaging and spectroscopic data. Dr. Rhodes gave some examples of what will be imaged. There will be synergy with JWST and the combination of Euclid, Rubin, and Roman will be quite powerful. The Near Infrared Spectrometer and Photometer (NISP) and Visual Imager (VIS) will be able to operate simultaneously. Euclid will have 2K by 2K NIR detectors supplied by NASA.

Launch is planned for no earlier than October, 2022. The mission lifetime will be a minimum of 6 years. Euclid will have one blue and three red grisms. The filters will be unique until Roman is operating. NASA has been formally involved since 2012 and has three science teams. Dr. Rhodes leads the "Constraining Dark Energy and Gravity with Euclid" team, which has about 70 people. The second team, "Looking at Infrared Background Radiation Anisotropies" is smaller, with seven members. The third team has three researchers looking at nebular emission. NASA also selected Dr. Rhodes to be on the Euclid Consortium Board and the ESA Euclid Science team. Dr. Michael Seiffert is the NASA project

scientist. All of the NASA hardware has been integrated into the NISP instrument. The payload has completed thermal vacuum testing and spacecraft I&T is underway.

Dr. Rhodes next described the Euclid surveys, along with possible extensions and complementary missions. The three deep fields will be imaged repeatedly throughout the mission, while the wide field will have a single pass. A chart showed nominal exposure times. There is the possibility of occasional jitter that could disrupt simultaneous VIS and NISP measurements. Another activity is a joint Euclid/Rubin effort on derived data products. Some pixel-level work will need joint processing, which would require additional funding and a justification.

The Euclid NASA Science Center (ENSCI) at the Infrared Processing and Analysis Center (IPAC) will support the U.S. science community in using Euclid data. There will be a help desk, specific support, and archiving. A timeline showed how the data release will flow. ENSCI expects a flood of proposals after the first data release. To join Euclid at this point, investigators need both a compelling idea and funding for engagement, as NASA has already designated its Euclid funds. The ESA Euclid Science team is separate from the consortium. About 10 percent of the time remains unallocated. There will be additional surveys defined for the prime mission and any extended mission. The team is addressing how to implement this now.

Dr. Strolger asked about the timeline for working out the observing strategy. He also wanted to know about smaller data releases in shorter timeframes. Dr. Rhodes replied that the survey strategy is well-defined right now. The unallocated time will be late in the 6 years and will be assigned after launch. Regarding smaller data releases, the idea is to release full imaging and spectroscopic data and ground-based data. There has not been discussion of smaller releases due to the consortium wanting to protect its proprietary time (i.e., exclusive use period).

Dr. Hickox referenced the large volume of data that is likely and asked if there is a plan for cloud computing or other resources to enable access. Dr. Rhodes said that the team is probably behind on this and he will take it under advisement. The short answer is that there is no current plan, but they should consider it. Dr. Holley-Bockelmann pointed out that to buy in, a researcher must have resources already. She wanted to know how that meshed with inclusion. Dr. Rhodes said that he was not sure how to address this question and thought it was a NASA Headquarters issue. He does not have additional resources, and the U.S. researchers have come from institutions that do have considerable resources. Dr. Woodward asked how they might handle an uptick in proposal pressure. Dr. Rhodes agreed that it could be a concern. He has discussed this with Dr. Hertz and others. Dr. Woodward asked if the synergy with ground-based observatories is essential. Dr. Rhodes answered that it is. The team will require a number of ground-based filters and the observing time has been secured already.

<u>COPAG/PhysPAG/ExoPAG Updates</u>

PhysPAG

Dr. Hickox began the update for the Physics of the Cosmos Program Analysis Group (PhysPAG) by listing the objectives. Within PhysPAG, the Multi-Messenger Astrophysics (MMA) Science Analysis Group (SAG) disbanded a while ago. There are six remaining Science Interest Groups (SIGs):

- Inflation Probe (IP SIG)
- Gravitational Wave (GW SIG)
- X-ray (XR SIG)
- Gamma Ray (GR SIG or GammaSIG)
- Cosmic Ray (CR SIG)
- Cosmic Structure (CoS SIG)

Dr. Hickox listed the Executive Committee membership, which is taking nominations for new members as some participants are cycling off.

PhysPAG is anticipating the release of the Astro2020 DS and, in the meantime, it continues discussions with the other PAGs on cross-cutting technologies and data analysis frameworks that will proceed once the DS is released. The PAGs hope to host a joint discussion with the community within a few weeks of the DS release in order to determine how the Groups can best support the recommendations.

There has not been a lot of SIG activity recently. The Executive Committee has discussed having Physics of the Cosmos (PCOS) Discovery Seminars, which they hope will replicate the success of similar efforts. The goals are to bring together the diverse PCOS community more frequently and to highlight outstanding research by PCOS members, especially EC scientists and those from institutions serving historically marginalized populations. The seminars would include Executive Committee updates, one or two talks solicited from members of the PhysPAG community, and opportunities for discussion of relevant news and topics.

To expand participation in the NASA astrophysics community, the three PAGs are looking at having a cross-PAG SAG with the proposed name Astrophysics With Equity: Surmounting Obstacles to Membership (AWESOM). Draft Terms of Reference (TOR) were presented to the Meeting of Experts (MOE) in June 2021. The MOE advised having a program that is proactive beyond gathering information. There has been little discussion since then. The focus is shifting to collaboration with ongoing efforts within NASA on how to maximize participation in NASA astrophysics research. It will be important to have the program align with recommendations from the Astro2020 DS regarding the state of the profession.

Dr. Hickox listed conference sessions on engagement with NASA astrophysics, emphasizing DEI and outreach to organizations focused on underrepresented groups. Upcoming meetings and activities begin with five SIG sessions and a town hall at the January AAS meeting, the spring American Physical Society (APS) conference, regular meetings of PhysPAG and the SIGs, and organization of potential SAGs.

ExoPAG

Dr. Meyer gave the update for the Exoplanet Program Analysis Group (ExoPAG). He began by listing the members of the Executive Committee, with observers and liaisons from other SMD divisions. He then listed activities since the June astrophysics MOE meeting. The cross-PAG activities are becoming more institutionalized, which is good. There is a 2021 review of the Exoplanet Exploration Program (ExEP) science gap list, possibly leading to a map of future needs in ROSES calls. The community is invited to participate; Dr. Meyer included the URL in his presentation materials. A planned community forum on the DS has been postponed until the AAS meeting. New SAG TORs are under development. An ongoing concern is the XRP selection rate, currently around 11 percent, and the JWST Cycle 1 funding. Planning has begun for ExoPAG 25, to be held at the AAS meeting with support for remote participation.

Two SAGs will be closing soon. The two SIGs are ongoing and open to additional community participation. SIG 2, Exoplanet Demographics, will submit at AAS a draft white paper on the value of providing certain kinds of information along with exoplanet demographic products, covering all techniques. SIG 3, on Exoplanet Solar System Synergies, is active and open to all. This SIG provides a forum for interaction between the solar system and exoplanet communities on topics of mutual interest, resulting in things like cross-disciplinary meetings and possible application of investigation techniques across the two communities. SAG 21, “The Effect of Stellar Contamination on Space-based Transmission Spectroscopy,” will issue its final report by the end of the year. The draft report from SAG 22, “Exoplanet

Host Properties," has been submitted to the ExoPAG Executive Committee and will report out at ExoPAG 25.

There are SAGs under consideration, though these are just in the preliminary discussion phase. There are draft TORs for a new exozodi SAG based on results from various sources. The question is whether there is a need for a new effort to assess risk to exoplanet imaging missions presented by zodiacal light. This is on hold pending the release of the DS. ExoPAG hopes to present more at APAC's March 2022 meeting.

At the face-to-face meeting at the winter AAS, ExoPAG expects to be able to discuss the new DS and how the PAG can support APD. Dr. Meyer listed more items from the draft agenda for ExoPAG 25. The ExoPAG meetings always have talks by junior scientists, who receive travel funding from the PAG in order to present their work. There will also be an update on the Exoplanet Explorers program, which seeks to create networks among junior scientists and support DEI. The EC scientists are paired with senior scientists and have other opportunities for connections within the discipline.

COPAG
Dr. Meixner listed the Executive Committee for the Cosmic Origins PAG (COPAG). She is about to rotate off as chair, and the PAG is actively recruiting Executive Committee members. She described how COPAG fits into the larger astrophysics community and relates to APAC and APD. Three SIGs mirror the DS panels, and two Science/Technology Interest Groups (STIGs) reflect the organization of NASA.

The Infrared STIG (IR STIG) has an ongoing webinar series that has resumed its monthly cadence after a summer hiatus. Attendance has been high, with 30 to 60 scientists from around the globe. All recordings are posted to a YouTube channel and website. In addition, a newsletter comes out periodically.

The UV STIG Quorum for Ultraviolet Exploration of Science and Technology (QUEST) activity focuses on a community forum for science updates and sharing of information about practices. This STIG is developing prioritization metrics for the UV/Vis components of cosmic origins science from the upcoming DS. There are monthly presentations with videos linked to the website, and the intent is to have both science and technology talks. The Stars SIG has formed a transitional leadership council of nine top scientists in various areas; more than 70 scientists are subscribed to the SIG, and the group is open to new members. There are webinars every 2 weeks, which are posted to the Stars SIG home page. This SIG covers a number of major facilities and research areas, which Dr. Meixner listed. Eventually, the SIG will host monthly town halls to discuss the DS, and there will be a virtual workshop in early 2022.

COPAG is creating three new SIGs that parallel DS panels: galaxies; ISM and planet formation; and stars, sun, and stellar populations. COPAG's DEI commitment manifests through active participation at meetings for members of underrepresented groups.

Discussion
Dr. Gaskin noted that Dr. Meyer mentioned the Exoplanet Explorer program. This might benefit other PAGs and APAC, as it facilitates networking and supports young researchers. Dr. Meyer said that the lessons learned are modest, but they are recruiting more mentors and have good energy. Dr. Gaskin then asked if the science gaps are mapped to technology gaps, and how that relates to future technology development needs. Dr. Meyer explained that the program office does the mapping, while ExoPAG gives input during the review. Dr. Hickox added that for gaps not in the DS, the next phase is a question. The SAT call will focus on technologies prioritized in the DS, but there is a need to think about the next generation of telescopes and new ideas. Everyone seems to be waiting for the DS before moving ahead. Dr. Meyer noted that many technology gaps take the long view.

Dr. Strolger said he enjoyed hearing of AWESOM and wondered when it could become a reality. Dr. Hickox said that it was challenging to gather people over the summer, but the PAGs would like to move forward quickly now. At the same time, they are awaiting release of the DS in order to focus on concrete outcomes. The hope is to have something ready to go by the spring APAC meeting, and perhaps take intermediate steps before then. Dr. Woodward said that APAC would like that effort to move quickly when the DS is out and to have something concrete at the March 2022 APAC meeting.

Public Comment Period

There were no new submissions to the portal and no members of the public came forward to comment.

ISFM Update

Dr. Mario Perez, APD lead for the Internal Scientist Funding Model (ISFM) Program, provided an update. For clarity, he noted that ISFM is often referred to as "work packages." Dr. Perez took over recently from Dr. Dan Evans, who now has a position in SMD. ISFM was supposed to be a 3-year pilot that NASA was to review in 2021. Then the pandemic hit, changing the timeline.

Dr. Perez reviewed the five key principles of ISFM and the qualities of work packages. ISFM has not reduced community funding. It accounts for 25 percent of outgoing research dollars, which is the same as before the program began. Of the 10 current astrophysics ISFM packages, six are at GSFC, two are at MSFC, and two are at Ames Research Center (ARC). All external reviews have taken place. APD is waiting for the DS before soliciting another round of ISFM funding and has issued no guidelines for continuing. The three Centers have the option to extend the programs unchanged, make minor adjustments, or terminate them. Nine kept the projects unchanged and one had tweaks; none ended their work packages. The scope of work is extending what the investigators have been doing in the last 3 years. It is unlikely that the DS will show them to be irrelevant.

The Office of the Chief Scientist (OCS) evaluated ISFM by eight criteria, detailed in Dr. Perez's slides. All points were deemed neutral, positive, or ongoing. OCS recommendations include the following:

- NASA should continue with the highly successful ISFM program.
- SMD should rigorously monitor and adhere to the funding distribution between internal and external research.
- SMD should ensure a uniform process for ISFM across all five SMD divisions.
- Program scientists should invite more civil service scientists to serve on SMD review panels.

A February SMD assessment found the following:

- For the most part, the ISFM research and technology development has been strategic, scientifically sound (external review), science enabling, forward-leaning, and distinctive.
- SMD wants the ISFM pilot project converted to a permanent program.
- SMD intends to fully integrate ISFM into relationships with the NASA Centers.
- SMD will continue to monitor and maintain the balance between funding awarded to Centers and funding awarded to the outside community.
- SMD will continue to monitor the scientific productivity of directed work and the degree to which directed work packages enable new science by the non-NASA community. This should be a resource the community can use coming from the Centers.

In March, NASA's Mission Support Council (MSC) decided to take the OCS recommendations and convert ISFM to a permanent program, with SMD monitoring for balance and scientific productivity. The cross-SMD call for FY23-25 ISFM white papers was sent to Centers in early October, with a November 19 deadline.

Dr. Woodward asked if this situation provides sufficient resources to cover the civil service scientists. Dr. Perez pointed out that the ISFM money was going to the Centers anyway. He expects it to remain the same. Dr. Hertz added that this funding accounts for one third to 40 percent of center funding, and NASA wants to have about two thirds of the Centers' scientists continuing to compete in ROSES.

Dr. Hickox asked about the extension of the pilot done in APD to the rest of SMD. Dr. Perez said that he did not have data from the other divisions, but SMD is normalizing this. (A later comment in the chat indicated that there was no such pilot; all SMD science divisions had ISFM work packages.) Dr. Bautista asked how ISFM proposals are reviewed. Dr. Perez explained that the first step is that white papers are submitted for an internal NASA review. Some of those submitters are then asked for proposals that are evaluated externally. Teams are more likely to succeed in ISFM; individuals are steered to ROSES.

Keck Review Update

Dr. Jeffrey Hayes chaired the Keck Planning Committee, which was charged with seeing if NASA's Keck participation should continue. NASA has had a partnership with the W.M. Keck Observatory (WMKO) in Maunakea, Hawaii, for over 20 years. The arrangement has been fruitful, and the question is whether to continue. The FY22 budget supports WMKO at about $4.9 million for operations, with another $2.6 million going to the NASA Exoplanet Science Institute (NExScI) for archive support, GO funding, etc. APD manages this for the whole of NASA. The current agreement expires in early 2023.

The Planning Committee divided findings into advantages and disadvantages. Among the former, there have been many proposals and the proposal oversubscription rate is 5.6, comparable to Chandra, while the GO oversubscription rate is 4.4. Clearly the community sees WMKO as a significant and important resource. Due to NASA's status as a formal partner, the Agency receives special consideration from WMKO. The working arrangement is characterized as respectful and there is good collaboration. NASA participation in observatory planning ensures attention to NASA's requirements and objectives. Finally, NASA benefits tremendously from the continuous major upgrades of the facility without having to sink funds into those efforts.

On the other hand, NASA is not a voting member of the facility's managing board, and therefore must negotiate new priorities. In addition, Keck and NExScI have an 18-month exclusive use period for all data obtained on the telescopes. This is the main thing the panel wants changed, as it does not match practices at other NASA-supported facilities.

Therefore, for purposes of this presentation to APAC, the Keck Planning Committee had the following findings:

- WMKO and NExScI activities provide tremendous benefit to NASA's research goals in astrophysics and planetary sciences.
- The cost to NASA (~$7.5 million in FY22) is an excellent value and allows researchers use of a premier ground-based facility. NASA should consider whether additional investments in the Keck facilities would further the community's needs.
- NASA should try to modify the 18-month proprietary period to better match the shorter periods of other NASA missions.
- NASA should continue the Data Services Initiative (DSI), which would allow for higher-level data products to be created as well as the development of instrument calibration pipelines. This would enhance the ability of the Keck Observatory Archive (KOA) to serve NASA and the broader user community.

All findings were unanimous with no dissent.

Dr. Perez said that the Keck board discussions in which NASA does not participate address administrative issues, not science questions or things that relate to NASA concerns. Dr. Hayes noted that the data initiative has been percolating at SMD for a couple of years, and it is evolving. It is very complicated, and he has been involved for APD and the Heliophysics Division (HPD) to address Agency and PI rights in research. The Keck proprietary period needs to be worked through. The software is less relevant to Keck, but other disciplines are using commercial packages and it is not clear how to handle those. It will have to happen quickly. Dr. Hertz added that the SMD requirements have not been finalized to flow down to Keck.

Dr. Hayes explained that the extension will be in the form of a 5-year cooperative agreement. He would be comfortable moving forward without the DS. There are synergies between ground-based work and what is going on in APD and the Planetary Science Division (PSD). Programmatically, this would be something to consider carefully. Dr. Hertz added that this can wait for the DS. The budget is done every spring. In a sole-source agreement of this type, SMD will have to provide a justification.

Dr. Strolger asked about measures of science impact beyond oversubscription. Dr. Hertz cited publication rates compared to other observatories. NASA gets about one-sixth of all the nights. Dr. Perez explained that this comes to about 100 nights per year, as some observations could be half of a night and others will cover multiple nights. Dr. Hasan added that some run across semesters. Dr. Hertz said that the NASA missions most involved with these proposals are the flagships, as well as planetary. Dr. Perez said that investigators wanting to study the archives submit to the Astrophysics Data Analysis Program (ADAP). This program funds people to go to Hawaii for the research. Dr. Hasan said that the Keck archive is funded by NASA, including the non-NASA data.

R&A Update

Dr. Stefan Immler presented the latest information on the R&A program. With Covid-19 still a factor, NASA staff continue to work remotely. No ROSES-2020 and ROSES-2021 solicitations were canceled, but two had delayed due dates. Since the start of the pandemic, 31 R&A peer reviews have been conducted as virtual reviews. ADAP and the Nuclear Spectroscopic Telescope Array (NuSTAR) Cycle 6 were APD's pilot programs for dual anon peer reviews last year. The Division continues to notify and funds PIs as quickly as during the pre-pandemic years.

The economic disruptions from Covid-19 have been especially acute for EC researchers, and therefore SMD released an augmentation solicitation to mitigate damage to their careers. APD received 33 augmentation requests ranging from $21,000 to $1 million, with a median amount of $125,000. The Division approved 88 percent of the requested amount, for a total of $3.4 million.

Peer reviews will remain virtual at least through the end of the calendar year. The R&A program has arranged for more panels with fewer proposals, and five to seven proposals per panel. The technological tools employed include Google Meet, Google Drive, and Slack. To accommodate different times zones, childcare, teaching obligations, fatigue, etc., the panels have added homework days for writing assignments. A chart showed how panels might be scheduled over the course of 3 weeks.

Another chart provided data on the numbers of proposals by program. A graphic displayed university partners by the amount of NASA R&A funding they receive. All exoplanet investigations are now under XRP, which has grown from $4 million in FY19 to $7.3 million in FY22. For Laboratory Astrophysics (Lab Astro), capital equipment purchases are eligible under APRA, as of ROSES-2020. Both funding and the selection rate for the Future Investigators in NASA Earth and Space Science and Technology (FINESST) have doubled and the student stipend will increase in ROSES-2022. Proposals must now include a Data Management Plan (DMP), which is part of the intrinsic merit evaluation.

APD's Code of Conduct for peer reviews has been adopted for all SMD reviews, and all peer reviewers receive bias training at the start. The Inclusion, Diversity, Equity, and Accessibility (IDEA) task force for R&A is implementing recommendations of SMD's Anti-Racism Action Group (ARAG). An Inclusion Plan was implemented as a pilot program for this year's ATP to increase diversity in proposing teams. Dr. Immler reviewed the specific requirements of the pilot program. Inclusion plans were evaluated for adequacy and completeness before the 20 science panels evaluated all 184 inclusion plans and captured their findings as strength and weaknesses in a separate inclusion plan evaluation form. In addition, four inclusion panels performed more in-depth evaluations of 40 inclusion plans. These four panels included experts in DEI. The evaluations will be provided to the proposers as part of the panel review summaries but will not become part of the ratings or selection recommendations in the current ROSES cycle. However, this may change for future cycles. NASA will invite proposer feedback.

Dr. Immler described the goals of the pilot program, which include emphasizing to proposers the importance of DEI at NASA, learning about PI understanding of DEI, determining whether panels of scientists can competently evaluate inclusion plans, and soliciting feedback for improvement. NASA has not yet analyzed the outcome of the pilot program and no decision has been made whether to expand it in ROSES-2022.

Proposals that do not include a DMP should explain why it is not necessary for the work. DMPs should describe whether and how data generated by the proposed research will be shared and preserved, or why data sharing and/or preservation are not possible or scientifically appropriate. DMPs must provide a plan for making research data that underlie the results in peer-reviewed publications digitally accessible at the time of publication or within a reasonable time period after publication. Where practical and feasible, software should be made publicly available when there is scientific utility in doing so.

A bar graph showed R&A research funding for FY09-26, with 38 percent growth since the last DS and 60 percent over 17 years. Aside from Hubble, Chandra, and SOFIA, the FY21 selection rates were 20 percent for R&A programs and 46 percent for mission GO and General Investigator (GO/GI) programs, with a total average selection rate of 30 percent across all ROSES programs. Dr. Immler showed the balance of R&A research elements by program, breaking out APRA more finely. About half of APRA funding goes to suborbital programs.

Dr. Immler then reviewed HaloSat, APD's first cubesat; CUTE, which launched as ride share with Landsat-9 in September and has communicated with the ground; and the Suborbital Program, which has a process to resume launches for both sounding rockets and the Balloon Program with Covid protocols. In FY21, there were 12 successful sounding rocket launches and APD has 4 more planned for the next 7 months. Three astrophysics sounding rocket payloads will launch from Australia in mid-2022. The Balloon Program conducted successful spring and fall campaigns in Ft. Sumner, NM, with 10 balloon launches in FY21 and an exercise in training crew chiefs for the upcoming super-pressure balloon campaign in New Zealand. There will also be four science payloads launched on balloons in Sweden.

Dr. Immler displayed a chart of Research Program elements, noting those that are not solicited this year or in ROSES-2021, and highlighting the reviews being done under the dual anon protocol. In preparing for the DS, APD amended the ROSES-2021 solicitation to include SAT. The due dates have been extended to allow PIs to respond to DS priorities, and currently funded SAT PIs received bridge funding to protect their workforce. A new solicitation will be included in ROSES-2022, to be released in February, for Preparatory R&A Science Investigations to meet the DS goals. APD will meet internally to address DS priorities once the document is released.

Dr. Meyer said that he expected the selection rate of some programs to go up once they moved to XRP. He asked about when and how to evaluate this. Dr. Immler said that the percentage is the same as ATP

before the move. He would wait for the DS before doing any planning. If the DS is delayed past the end of November, APD will reprogram SAT funds to APRA. At this point, it is too early to compare institutional types on the selected dual anon versus non-dual anon proposals. What he can see is that the panel discussions are steering away from PIs and institutions, to just consider the merits of investigations. The Program does intend to do an analysis. Dr. Woodward said that APAC would like to hear about the pilot program next spring. In terms of PIs decisions being faster in the pandemic era, he wondered if there would be any changes post-Covid. Dr. Immler said that APD has an internal metric to notify PIs within 150 days. He was not sure why it was faster during the pandemic, but notification does not translate into faster funding.

Dr. Strolger asked if R&A had received any feedback from proposers and reviewers on the quality of inclusion plans and if there were any recommendations to be made. Dr. Immler replied that there has been a lot of feedback and it is the nature of a pilot program to provide direction for improvement. There were a large range ideas from the feedback provided. Inclusion plans have to be specific to this project, not just refer to the PI's institution. NASA will need to demonstrate what is wanted and have a repository of tools PIs can rely on to create inclusion plans and educate themselves. ROSES 2022 will likely amend some elements in the requirement.

Dr. Holley-Bockelmann asked if there had been different reactions from the science panels versus the DEI panels. Dr. Immler said that that is still being reviewed. The science panels did not have as much time as the inclusion panels, and some felt uncomfortable with this, but others provided enormous feedback and could have offered more had time permitted. NASA will probably rely on DEI panels going forward. Dr. Bautista pointed out that if a second panel reviews proposals, that changes the nature of the peer reviews to something else. Dr. Immler said that there may need to be some movement of the various experts. Regarding the DMP, this is not a new requirement, it is just now becoming a focus. He is not on the SMD task force addressing this. Dr. Woodward suggested having a deeper conversation at the next APAC meeting. Dr. Meixner praised the proactive approach of reaching out to PIs during the pandemic in order to fund them.

Discussion

Dr. Woodward led the review of the day's discussion. Dr. Gaskin asked what APAC should do about Keck. She had the impression of enough justification to move forward but wondered if they should wait for the DS. Dr. Bautista said that the change to the peer review process is quite fundamental with this new entity participating in the evaluation. The interaction between those experts and the scientists constitute quite an important change. Dr. Strolger agreed with what Dr. Gaskin said about Keck, especially if SMD might want to change the contract in some way. He also agreed with Dr. Bautista in part but noted that these are not unnavigated waters. NSF has done this, and it is not a big burden to the proposing community. The field's priorities now include the scientists they include, not just the science alone. Dr. Hertz said that on Keck, NASA wants time to make alterations. They always offer an option to buy more nights, which the Agency has done.

Dr. Meyer said that Keck can be used for a diverse range of topics and he cannot imagine the DS altering this in a fundamental way. He did not see a compelling reason to wait. He agreed with Dr. Strolger on the DEI reviews, but they can always make improvements. The Agency should take care not to disadvantage certain states where these criteria are viewed as anathema. Dr. Holley-Bockelmann said that while it is unlikely the DS will not drill down deep on Keck, there could be a statement about open data, which would be reason to wait. She was of two minds about whether the DEI experts alone or experts and science panels should review inclusion plans. Dr. Meixner asked if there was an expectation that NASA will request an inclusion element from Keck. Dr. Hertz said that that had not come up.

Dr. Hickox agreed with Dr. Holley-Bockelmann about having the science panels review the work of the inclusion panels. A successful plan should interface with the science. He liked having the outside experts but there is something to be said for having synergy. Dr. Ho pointed out that while a goal is to enable research and data management, data and software access can be affected by institution. Dr. Woodward noted that the cloud pops up as a topic on occasion, so a coherent understanding of this would be useful for APAC's conversation.

On Keck, Dr .Woodward wanted to see what the DS may or may not say. He observed that the Euclid discussion showed an interweaving of missions, which made him wonder if the DS might put forth a deeper meshing of space and ground assets. If so, that is an argument for deferral. Dr. Hertz explained that SMD will have to seek a Keck proposal before the next APAC meeting. The joint analysis of Rubin, Euclid, and Roman has been discussed for years but it will be costly. Dr. Strolger said that what seemed unspoken was that there is less availability of ground support for these crucial missions. This discussion is evolving. He was not sure what the community would do without these assets. Dr. Hertz agreed, saying that that has been a rationale for Keck over the years. Congress generally funds ground-based assets through NSF, which makes the Keck situation different.

Dr. Woodward was concerned that not all of the Athena mission requirements could be met, noting the 5 versus 10 arcsecs revelation. Dr. Hickox said this technical design challenge calls for updates, as it could be problematic. The immediate impact jumps out right away. He was not sure the extent they could comment without more rigorous analysis, but this is not a subtle effect. Dr. Bautista added that the cooling system on the microcalorimeter is critical. There are a lot of unknowns, with potentially dangerous terrain. Dr. Holley-Bockelmann pointed out that there are potential synergies between Athena and the Laser Interferometer Space Antenna (LISA), which they will want to watch. As both are ESA missions, it was unclear what APAC might be able to recommend. Dr. Woodward said that since NASA is making a substantial investment in Athena, a cautionary note to the Division about the technology development of the mission is warranted. APAC should let APD know that they are watching the situation.

He thought the Pioneers presentations were illuminating in regard to their positive reaction to the diversity efforts. There were good points about networking and privilege. It would be useful to note the "spare parts" as well, and how to access them. He wondered about the rideshare orbits. Dr. Hertz said that if there was a need for one, APD would discuss the capability with NASA colleagues. It can be complicated, but if a rocket is going in the right direction, it is possible to negotiate a rideshare. Dr. Hamden wondered if there might be a note in the AOs or other information on how to locate spares. Dr. Meixner suggested having points of contact instead, which Dr. Meyer thought was a great idea.

Dr. Woodward then observed that the PAGs all seem to be waiting for the DS. Dr. Strolger said he would like to see the cross-PAG SAG flourish, and it is not DS-dependent. Dr. Bautista cited the ExoPAG presentation and the networking with students, postdocs, and young faculty. This could mesh with what they heard about the NHFP. Dr. Woodward suggested having ExoPAG present on that. Dr. Hickox said he would like to see PhysPAG offer a similar opportunity for EC researchers to make presentations to the greater community. Dr. Gaskin suggested recording these presentations to take to various universities and centers, having the speakers on hand to answer questions. Dr. Hickox found that to be an interesting idea and speculated about making a video repository available with corresponding opportunities to query the presenters. The cross-PAG SAG could do this.

Dr. Woodward wanted a sense of the Committee on Keck and whether they would feel comfortable recommending that Dr. Hertz proceed in soliciting a proposal. Dr. Bautista thought they should wait. Dr. Hertz said that if they were to assume the DS says nothing about Keck, he needed to know if that is sufficient. NASA could outline any requirements in the request and ask the costs for a range of nights. Dr.

Woodward wanted to recommend inclusion of a DEI narrative, and Dr. Holley-Bockelmann advised that they renegotiate proprietary periods. Dr. Woodward said that that would go into the recommendation. Dr. Meixner favored telling NASA to solicit a proposal; they could address details later.

Recommendations, Actions/Outbrief to Division Director

Regarding the NHFP, Dr. Strolger said that while there was a list of suggestions on how to improve the program, he would like to see something that is implementable. Dr. Hertz asked if this was a request for APD to develop an implementation plan and show it to APAC before executing it. Drs. Woodward and Strolger confirmed that, with Dr. Strolger pointing out that there were many recommendations, so APD might want to consolidate or otherwise categorize them. Dr. Hertz replied that APD plans to discuss the report at the AAS. Dr. Woodward said that that discussion would help inform APD on how to implement the recommendations, and APAC will then be able to see the plan in March. The review is impactful, and the Division can be strategic about it. He would like to do this robustly. Dr. Meyer agreed, suggesting that APD might want to implement in stages.

Dr. Woodward said that regarding the Webb name conversation, APAC had the sense that the Agency decision was not sufficiently transparent. Therefore, the letter to Dr. Hertz would ask that there be a fully-documented written report. APAC would like this in March in order to have a record of the decision in the archives. Dr. Hertz pointed out that APAC would be advising him to make requests to people he cannot command. Dr. Woodward rephrased it that APAC would like these things to occur.

Dr. Woodward raised another issue, the funding wedge for Webb R&A, which may be insufficient. APAC was advising APD to be more aggressive on this. It may be a cash flow problem, but APAC wants great science out of this mission. In addition, APD should probably review and reconsider the process by which it names flagship missions. The Committee endorsed the plan for the upcoming SR and requested a target window for the SR report to APAC.

APAC heard that it has been 30 years since NHFP has been assessed. There would be a recommendation that reviews occur more frequently, such as every 5 years, and on a regular cadence. The Committee discussed issues with Athena and the topic of flight spares. The Committee may ask for a science update on sounding rockets at the next meeting. Dr. Meyer noted that Euclid could stress resource programs and the archives. Dr. Hertz said that APD has planned for a potential surge in the out-year budgets.

Dr. Gaskin emphasized the importance of addressing work-life balance and asked for an in-depth look at how that fits into the DEI infrastructure. Dr. Hertz asked how NASA might play a role in this, being that it calls for affecting others outside the Agency. Dr. Gaskin replied that that is one of the questions, but they have opportunities to facilitate more inclusion, and she was seeing contradictions in what NASA said it wants and how it implements. Dr. Hertz observed that the field has been wedded to competition for so long that it is hard to think differently. Dr. Woodward said that Dr. Gaskin had sent him some ideas that could be the basis for a future conversation. Dr. Holley-Bockelmann asked that APAC would like to see the Euclid consortium cover inclusion. Dr. Hertz explained that there was an open competition, and the European funding model for ESA is very different from the U.S. funding model for NASA. Dr. Meixner asked if the NHFP information would be made public. Dr. Hertz replied that it was made public by virtue of being presented to APAC. Dr. Hickox said that data analysis tools can help make Euclid more equitable. Dr. Hertz said that the team is moving forward with that.

Dr. Woodward again reviewed the GPRAMA writing assignments and said that Committee members would hear from him and Dr. Holley-Bockelmann.

He thanked the speakers, the Committee, and those members rotating off.

Adjourn

Dr. Hasan thanked Dr. Woodward, Dr. Holley-Bockelmann, the Committee members, and the speakers.

The meeting was adjourned at 5:07 p.m.

Appendix A
Participants

Committee members
Charles Woodward, University of Minnesota, *Chair, Astrophysics Advisory Committee*
Manuel Bautista, University of West Michigan
Jessica Gaskin, NASA Marshall Space Flight Center
Erika Hamden, University of Arizona
Ryan Hickox, Dartmouth College
Shirley Ho, Flatiron Institute
Kelly Holley-Bockelmann, Vanderbilt University
Margaret Meixner, USRA
Michael R. Meyer, University of Michigan
Mark Mozena, Planet Labs Inc.
Louis Strolger, Space Telescope Science Institute

NASA
Paul Hertz, NASA HQ, *Director, Astrophysics Division*
Hashima Hasan, NASA HQ, *Executive Secretary, APAC*

Marin Anderson
Elizabeth Apala
Kathleen Armstrong
Manan Arya
Vanessa Bailey
Louis Barbier
Catherine Barclay
James Bartlett
Natasha Batalha
Dominic Benford
Jeff Booth
Patricia Boyd
Terri Brandt
Jennifer Burt
John Callas
David Chelmins
Brendan Crill
Thomas P. Connor
Steven Crawford
Doris Daou
Raissa De Lourdes
Tamara Dickinson
Serina Diniega
Terence Doiron
Jessie Dotson
Kristen Erickson
Freitas Estrela
Daniel Evans
Ingrid Farrell
Alise Fisher
Todd Gaier
Ronald Gamble
Michael Garcia
Jonathan Gardner
Henry Grasshorn Gebhardt
Paul Goldsmith
Thomas Greene
Barbara Grofic
Keith Grogan
Michael Guarraia
Shahid Habib
Samuel Halverson
Thomas Hams
Jeffrey Hayes
Elizabeth Hays
Douglas Hudgins
Joseph Hunt
Stefan Immler
Keith Jahoda
Hannah Jang-Condell
Jennifer Kearns
Bernard Kelly
James Klimchuk
Patricia Knezek
Elizabeth Landau
William Latter

David Leisawitz
Vern Long
Patrick Lynch
Sangeeta Malhotra
Eric Mamajek
Dida Markovic
Mark Matsumura
Barbara Mattson
Peter Meister
Farisa Morales
Christine Moran
Leonidas Moustakas
Mamta Nagaraja
Zachary Nasipak
Brian Odom
Deborah Padgett
Keyur Patel
Kyle Pearson
Mario Perez
Robert Petre
Thai Pham
Natasha Pinol
Andy Ptak
Jason Rhodes
Jane Rigby
Graca Rocha
Thomas Roellig
Rita Sambruna
Jolyne San
Evan Scannapieco
Analyn Schneider
Paul Scowen
Michael Seiffert
Eduardo Bendek Selman
Gene Serabyn
Nicholas Siegler
Jacob Slutsky
Alan Smale
Eric Smith
Kaitlyn Soares
Karl Stapelfeldt
Amber Straughn
Rich Terrile
Neal Turner
Sanaz Vahidinia
Azita Valinia
Jeffrey Volosin
Keith Warfield
Brian Williams
Selene Willis
Jennifer Wiseman
Rob Zellem
Nicolle Zellner
Feng Zhao

Non-NASA/Unknown
Katherine Alatalo
Lili Alderson
Deep Anand
Ghassem Asrar
Tom Barclay
Ruslan Belikov
Jan Joris Brügmann
Paul Byrne
Teddy Cheung
Yilen Gomez Maqueo Chew
Haeun Chung
David Ciardi
Stephen Clark
Knicole Colon
Jonathan Crass
Miguel Angel Vargas Cruz
Thayne Currie
Etienne Dauvergne
Julie Davis
Jeanette Domber
Nestor Espinoza
Mike Fanelli
Jeff Filippini
Trevor Foote
Jeff Foust
Andy Fruchter
David Gaba
Emily Gilbert
Ajay Gill
Julien Girard
P. Green
Bruce Grossan
Lewis Groswald
Sally Heap
George Helou
Garth Illingworth
Seyda Ipek
Teresa Jensen
William Jones
Max Joshua
Jordan Karburn
Steve Kendrick

Matthew Kenworthy
James Lochner
Suvrath Mahadevan
Yao-Yuan Mao
Stephan McCandliss
Brett McGuire
Bonnie Meinke
Brandon Migdal
Gene Mikulka
David Millman
Rodolfo Montez
Mayra Montrose
Susan Mullally
Asal Naseri
Alison Nordt
Roopesh Ojha
Angela Olinto
John O'Meara
Chris Packham
Flora Paganelli
Joel Parriott
Joe Pesce
Larry Petro
Vinicius Placco
Peter Plavchan
Klaus Pontoppidan
Marc Postman
Elisa Quintana
Maryam Rahmani
Paul Ray
Griffin Reinecke
Scott Richardson
George Ricker
Richard Rogers
Wilton Sanders
Marcos Santander
Eric Schatt
Phil Scott
Elizabeth Sheley
Marcia Smith
Randall Smith
Harvey Tananbaum
Johanna Teske
Alan Thurgood
David Traore
Grant Tremblay
Stephen Unwin
Rolando Valdesaguilar
Carlos Vargas
Fred Walter
Nicholas White
Ashlee Wilkins
Dan Wilkins
Christina Williams
Alexandra Witze

Appendix B
Astrophysics Advisory Committee Members

Charles Woodward, APAC Chair
University of Minnesota

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

Manuel Bautista
University of West Michigan

Jessica Gaskin
Marshall Space Flight Center

Erika Hamden
University of Arizona

Ryan Hickox
Dartmouth College

Shirley Ho
Flatiron Institute

Dr. Holley-Bockelmann Holley-Bockelmann
Vanderbilt University

Margaret Meixner
USRA/SOFIA

Michael R. Meyer
University of Michigan

Mark Mozena
Planet Labs Inc.

Louis Strolger
Space Telescope Science Institute

Appendix C
Presentations

1. *Astrophysics Division Update*, Paul Hertz
2. *Webb Telescope Update,* Eric Smith
3. *Senior Review Updated,* Eric Smith
4. *GPRAMA Overview,* Jennifer Kearns
5. *NASA Hubble Fellows Program Review*, Rita Sambruna/Nicolle Zellner
6. *Athena Update,* Robert Petre
7. *Aspera Update*, Carlos Vargas
8. *Pandora Update*, Elisa Quintana
9. *Euclid Update*, Jason Rhodes
10. *COPAG/PhysPAG/ExoPAG Updates*, Margaret Meixner/Ryan Hickox/Michael Meyer
11. *ISFM Update*, Mario Perez
12. *Keck Update,* Jeffrey Hayes
13. *R&A Update*, Stefan Immler

Appendix D
Agenda

Astrophysics Advisory Committee
Virtual
October 13 and 15, 2021

Wednesday 13 October

11:00 a.m.	Introduction and Announcements	Hashima Hasan/Chick Woodward
11:10 a.m.	Astrophysics Division Update	Paul Hertz
1:10 p.m.	Webb Telescope Update	Eric Smith
1:30 p.m.	Senior Review Update	Eric Smith
1:50 p.m.	Public Comment Period	
1:55 p.m.	Break	
2:25 p.m.	GPRAMA Process Overview	Jennifer Kearns
2:35 p.m.	GPRAMA Discussion	APAC members
3:35 p.m.	Break	
3:45 p.m.	NASA Hubble Fellows Program Review	Rita Sambruna/Nicolle Zellner
4:15 p.m.	Discussion	APAC members
4:55 p.m.	Wrap up for Day 1	Chick Woodward
5:00 p.m.	Adjourn	

Friday 15 October

11:00 a.m.	Opening Remarks	Hashima Hasan/Chick Woodward
11:05 a.m.	Athena Update	Robert Petre
11:35 a.m.	Aspera Update	Carlos Vargas
12:05 p.m.	Pandora Update	Elisa Quintana
12:35 p.m.	Euclid Update	Jason Rhodes
1:05 p.m.	COPAG/ExoPAG/PhysPAG Updates	Margaret Meixner/Michael Meyer/ Ryan Hickox
2:05 p.m.	Public Comment Period	
2:10 p.m.	Break	
2:25 p.m.	ISFM Update	Mario Perez
2:50 p.m.	Keck Review Update	Jeffrey Hayes
3:10 p.m.	R&A Update	Stefan Immler
3:40 p.m.	Discussion	APAC members
4:40 p.m.	Recommendations, Actions	Chick Woodward
4:45 p.m.	Brief to Division Director	
5:00 p.m.	Adjourn	