NASA Astrophysics

ASTROPHYSICS ADVISORY COMMITTEE

March 15-17, 2021
Virtual Meeting

MEETING MINUTES

2021.May.11 _____

Charles Woodward, Chair

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Hashima Hasan, Executive Secretary

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Electrosoft

Monday, March 15

Introduction and Announcements

Dr. Hashima Hasan, Executive Secretary of the Astrophysics Advisory Committee (APAC), opened the virtual meeting by welcoming the Committee members. After taking roll, Dr. Hasan reviewed the Federal Advisory Committee Act (FACA) rules. As APAC is a FACA committee, this meeting was open to the public, and there would be opportunities for public comment; members of the public were asked to submit questions via the WebEx chat feature, or the web portal linked in the Federal Register Notice (FRN). Minutes were being taken for the public record, and all statements and discussion were on the record, including those in the WebEx chat dialogue box. APAC members had been appointed on the basis their subject matter expertise and must comply with Federal ethics laws applying to Special Government Employees (SGEs).

Dr. Hasan noted that a number of APAC members had conflicts of interest (COIs) with specific topics on the agenda: Dr. Jessica Gaskin - Imaging X-ray Polarimetry Explorer (IXPE); Dr. Margaret Meixner – James Webb Space Telescope (JWST, or Webb), Nancy Grace Roman Space Telescope (Roman), Stratospheric Observatory for Infrared Astronomy (SOFIA); Dr. Louis-Gregory Strolger - JWST, Roman; Dr. Michael Meyer - JWST, Roman. These members were required to recuse themselves from discussion during the presentations for which they were conflicted. Any member with questions related to ethics should contact Dr. Hasan. She then turned the meeting over to Dr. Charles Woodward, APAC Chair.

Dr. Woodward welcomed the participants and asked that APAC members identify highlights leading to potential findings and recommendations for the written report. He then introduced Dr. Paul Hertz, Director of NASA's Astrophysics Division (APD).

Astrophysics Division Update

Dr. Hertz thanked Dr. Woodward and the APAC members. He looks forward to resuming in-person meetings eventually. Despite the COVID-19 pandemic, it was a great year for astrophysics, as illustrated by some science highlights. First, the Hubble Space Telescope (HST) turned 30, and while its age is beginning to show, it is still producing good science. Another one of NASA's Great Observatories, Spitzer, ended its mission in early 2020 after more than 16 years of exploration. In the planetary area, Mars Perseverance successfully landed on Mars and is now in commissioning.

SpaceX carried NASA astronauts to the International Space Station (ISS), and additional missions are planned. The commercial crew program is working to bring on Boeing soon. The 2020 Nobel Physics prize went to three scientists who studied black hole formation and the supermassive compact object at the center of our galaxy. While this work was not funded by NASA, it relates to the astrophysics community and illustrates its importance. The Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-Rex) mission did a touch-and-go maneuver and stowed a sample for return to Earth in 2023. The APAC agenda included updates on Roman and JWST; the latter completed environmental testing and is ready to ship. Roman, formerly the Wide-Field InfraRed Survey Telescope (WFIRST), was confirmed.

NASA added Inclusion to its core values for success. The recent Science Mission Directorate (SMD) science plan includes a strategy "to increase the diversity of thought and backgrounds represented across the entire SMD portfolio through a more inclusive and accessible environment." In addition, Research Opportunities in Earth and Space Science (ROSES) is incorporating development of diverse communities and inclusion into its calls and announcements. The NASA Headquarters building has been named after Mary W. Jackson, the first Black female engineer at NASA, whose story was told in the book and movie

"Hidden Figures." The street on which the building is located was also renamed Hidden Figures Way, which shows in the Agency's address. The third day of this APAC meeting was to focus on diversity, equity and inclusion (DEI).

Dr. Hertz alerted the Committee that there will be an opening for at least one Program Scientist in APD and encouraged interested individuals to promptly apply. Dr. Hertz then showed a science highlight from the Nuclear Spectroscopic Telescope Array (NuSTAR).

APD Responses to APAC Recommendations

Dr. Hertz provided the APD responses to recommendations from APAC's October 2020 meeting:

- Black, Indigenous, and People of Color (BIPOC) representation must be explicitly and deliberately brought into positions of leadership and authority at APD, SMD, and NASA centers.
    - All NASA personnel actions are taken with inclusion and diversity in mind.
- APD should consider incentives to investigators to diversify their teams and provide meaningful diversity plans as part of major proposals to programs.
    - APD has a pilot initiative requiring Astrophysics Theory Program (ATP) proposals to have an inclusion plan. The plans will not be factored into selections during the first year of the requirement. The pilot is for all of SMD, which will bring in inclusion experts for evaluation and recommendations for further steps.
- APAC wants a more detailed report on the impact of the Dual Anonymous Peer Review (DAPR) process in ROSES on Early Career (EC) scientists, first-time proposers, first-time institutions, and any other community or demographic type information that can be legally gathered.
    - There will be a presentation on this at a future meeting, as it is still early in the process, and APD wants more data and lessons learned.
- APAC advises APD to publicize broadly the DAPR process and the impact of DAPR results. These items should be included in community briefings and town halls.
    - This has been done. Only one proposal has been noncompliant, so it appears that word has gotten out.
- APAC urges all PAGs to make their Executive Committees as diverse and inclusive as possible.
    - Concur
- APAC asks that APD and SMD undertake internal discussion to explore and understand what creation of a Cultural Ethics/Protocol Office that includes BIPOC from inception might entail and report out at the next APAC status of the profession session.
    - This would have to happen at the Agency level and is above what APD and SMD can do.
- APAC asks APD to assess and to report the potential impacts on its mission of workforce constraints from [previous] Administration policy directives that adversely impact segments of the NASA workforce.
    - APD does not have this expertise or capability.
- APAC strongly endorses the use of DAPR, as its effectiveness at mitigating bias without muddying the evaluation process has now been demonstrated for various types of proposal reviews. APAC advises that the ATP reviews incorporate DAPR without delay.
    - The 2021 ATP will use DAPR.
- APAC recommends analyzing whether Cubesat calls could be made every 2 years instead of on the current yearly cycle.
    - CubeSats are part of the annual APRA call and APD wants to keep it that way.
- APAC recommends an assessment and report on whether investigators might benefit from NASA management of the spacecraft bus.
    - The chair of the SMD Small Spacecraft Working Group reports that the astrophysics and heliophysics communities raise this issue periodically. NASA seeks to have teams beyond NASA centers be capable of developing spaceflight hardware and leading

spaceflight missions. This means growing the capability in the community, and some teams are capable of providing this service themselves. There is also the danger of locking in obsolete technology. Finally, there are substantial resources available to the community in this area.

- APAC recommends that APD have discussions within SMD and the Agency to ensure best-practice planetary protection protocols, particularly regarding the lunar environment.
    - APD has no role in planetary protection. SMD's Exploration Science Strategy and Integration Office (ESSIO) has led this effort. The National Academy of Sciences (NAS) has a committee to help modernize standards and practices. APAC may request a briefing at its next meeting should this be a prioritized topic.
- APAC recommends clearer communications with the community regarding laboratory astrophysics (Lab astro) opportunities that have been shifted to the Exoplanet Research Program (XRP), while general exoplanet-related hardware development remains within APRA.
    - Lab astro has not been shifted to XRP. The topic has been addressed at the American Astronomical Society (AAS) NASA Town Hall, AAS NASA R&A Town Hall, Exoplanet Program Analysis Group (ExoPAG) meeting, and in ROSES-21. Further clarifications are planned.
- APAC wishes to continue discussion with APD about the programmatic balance across XRP in light of the forthcoming Decadal Survey (DS) priorities.
    - This will occur after receipt of the 2020 DS.
- APAC recommends that APD leverage cloud-computing services approved for NASA use by other Directorates to advance scientific computing needs of investigators and centers.
    - APD is working with its data archives to develop a plan for a cloud-based platform as a single, interoperable science platform. There was to be a separate presentation on SMD science information policy at this meeting.
- APAC also sought updates on: proposer demographic information provided to APD Announcements of Opportunity (AOs) and collected by the NASA Office of the Chief Scientist (OCS); status of the profession; institutional demographics resulting from the latest smallsat and Pioneers selections; impacts of COVID-19; information to help determine whether mid-cycle proposals would increase the science return from Webb; advances in aerostat technologies and other long-duration balloon (LDB) projects that might enable Guest Observer (GO) science; whether APD might add a formal process for proposing piggyback balloon payloads; the Balloon Roadmap; and the ongoing interactions and meetings across Program Analysis Groups (PAGS).
    - Responsive updates and reports were to be provided at this meeting.

Non-Mission Program Update

Another science highlight explained how citizen scientists helped create a map of brown dwarfs. Among other things, this shows that our Sun is in a brown dwarf desert. There is new seed funding for citizen science projects.

Dr. Hertz listed the 2021 APD R&A program elements, indicating which reviews will be under the DAPR format, highlighting some new solicitations, and noting elements not included in this call. NASA is moving from open data to open science. While mission science is already public, the Agency has launched an open science data initiative with investments in cloud computing. To that end, there will be two ROSES calls for support of open-source tool development and the opening of legacy software. NASA is still writing policy toward the sharing of scientific research and technology development, including software. This will be presented to the community for comment before being finalized.

There were three new selections for the Science Activation program, and the next complete review will include these. The new selections emphasized underserved communities and included both a community college network and a neurodiversity network.

There have been changes in the Hubble Fellowship program. Starting with the 2022-2023 academic year, host institutions must offer Hubble Fellows the opportunity to be employees. APD is reviewing the program to identify areas for improvement. A number of current and former Hubble Fellows created a working group to study diversity and inclusion. All 24 new Hubble Fellows have accepted. There will be another PI Launchpad event in 2021 June, to occur virtually. This APAC meeting was to have a presentation on the 2019 inaugural Launchpad. The content from that event is now online.

COVID-19 has had many impacts on APD R&A, which Dr. Hertz discussed. The review panels are now all virtual, and this is going well, with the quality maintained. The major negative is the lack of networking opportunities, especially for EC reviewers. Virtual panels will continue through December at least. The APD R&A team has continued on via telework. No ROSES-20 solicitations were canceled, though two due dates were pushed back. Notification and funding of PIs has continued normally. NASA is funding some augmentations and extension requests for existing awards, especially where EC scientists and engineers are involved. This is being done through a ROSES call and only applies to current awards. NASA has received no additional budget for this effort, so the funding, equal to about 15 percent of new awards, is coming from what would have been available in FY21. Around 170 requests came in, for a total of approximately $20 million from across all of SMD. These proposals are being reviewed. The March 2021 NPP call is limited to applicants who already have permission to work in the United States. Dr. Stefan Immler could provide further information in his presentation. Investigators who do not need an augmentation should use existing funds, as grant dollars do not expire once they go out to the universities. Dr. Hertz said that he will stay on top of the J-1 visa situation, but that is outside of NASA.

Dr. Manuel Bautista observed that making all results public sounds like a major task, and it could conflict with publications and software that have copyright or proprietary elements. Dr. Hertz said that that is one reason NASA is moving slowly and taking community input. However, regarding publications, that is not a new rule or change. NASA has a server called PubSpace where grantees are supposed to upload pre-published versions of their papers. The requirement is government-wide. However, the inclusion of software is a change, and the details will require some study and work. The draft policy document will go out for comment. Dr. Woodward asked about possible consolidation of the Astrophysics Data System (ADS) and other systems. Dr. Hertz replied that APD is advocating expanding ADS to the other SMD divisions, though it might be complicated to include the Earth Science Division (ESD), which is quite large and has little overlap with APD. Suborbital will go into the current archives.

Mission Program Update
Another science highlight showed how a gamma-ray burst detected by multiple SMD missions was located in a neighboring galaxy, the first isolated to an extragalactic source.

Astrophysics payloads can be part of the Artemis campaign, leveraging from the infrastructure. The upcoming astrophysics DS will identify appropriate opportunities.

NASA and the National Science Foundation (NSF) signed a Memorandum of Understanding (MOU) to continue collaborating in a number of science areas, including astrophysics. NASA also signed an MOU with the Department of Energy (DOE) to identify collaboration areas. The two agencies are setting up working groups on lunar surface infrastructure, space nuclear power and propulsion, and science and innovation. They released a Request for Information (RFI) related to high-energy physics and space-based astrophysics, with three focus areas: sensitive radio telescopes or sensors on the Moon's far side to explore the early universe and to test the standard cosmological model; space-based probes of

fundamental physics on the International Space Station (ISS); and expanding the science reach of the NSF's ground-based Rubin Observatory and NASA's Roman.

NASA has not flown any balloons since the pandemic began, and while a restart could occur in the next few months, that is not yet certain. HST had to go into safe mode following a bug in some new software that is now being retested. There was also a door motor issue, but the backup motor took over successfully. A slight instrument low-voltage reading reflected the mission's age. The team lowered the voltage limit and HST is back at full operations. The mission lost about 5 days of science.

Funding for the various mission classes goes from $5 million to billions of dollars. This structure allows the community to propose any size mission that does compelling astrophysics. Dr. Hertz reviewed the classes from smallest to largest.

CubeSats are solicited annually in ROSES APRA. There is an approximate cadence of one new start per year, each costing about $5 million in total. Dr. Hertz reviewed the five selections made thus far. There were four 2020 selections in the Pioneers class, from among 25 proposals. Dr. Hertz went over the demographics of the proposers. Selections were 50/50 male/female even though proposers were at a 83/17 male/female ratio. One quarter of the selections were for balloons, the proposals being 29 percent balloons, and three quarters were smallsats, with proposals at 71 percent. Half of the selections were for NASA centers and half for universities, though about two thirds of the proposals came from universities.

Dr. Suvrath Mahadevan said he thought the challenge for Pioneers was the cost cap. Dr. Hertz said that if the four selections all fit and pass review, that would be a great budget problem. Reviews will be early next year, and there will be contingency plans for more than one making it past the gate. APD plans to have a second call this year. Twenty of the 25 proposals were selectable, with lots of good science to choose from. This could be a fun class of mission. Dr. Jessica Gaskin noted the discrepancy between the proposal rate from universities and the selection rate, but Dr. Hertz explained that the small numbers can cause seemingly big shifts in the percentages. Regardless, these four offer the most compelling science. While this may reflect center resources, one mission has a broad science team with many members not actually at the centers. Some universities have connections with centers or industry, and some do not; there is no requirement. All of the centers understand that it is their responsibility to enable external communities.

The Explorer program is still on track for selections. The Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory (GUSTO) is a suborbital Explorer that has been affected by NSF's delays in its Antarctic program. NSF is taking the year to do maintenance rather than science campaigns, so NASA is replanning GUSTO with the PI. The Spectro-Photometer for the History of the Universe, Epoch of Re-ionization, and Ices Explorer (SPHEREx) went through confirmation review at the end of 2020 and will have its Critical Design Review (CDR) in September 2021, to launch in 2024 or 2025. ROSES-21 will include opportunities for participation in Roman. All Roman observing time is available through open processes.

Despite the disruptions of COVID-19, many of the missions in development are likely to stay within their cost commitments, the Agency Baseline Commitment (ABC), which includes headquarters reserves. ABC is set at confirmation review. Some missions have had COVID-19 impacts affecting cost and schedule commitments. These include Webb, Roman, and IXPE. The assumption is that missions that have gone or will go through confirmation since the pandemic began have those impacts included in their cost and schedule plans. It could be that this will be felt in future Explorers.

Budget
The enacted Fiscal Year 2020 (FY20) APD budget came to $1.73 billion. For FY21, Astrophysics is slated to receive $1.77 billion. SMD has been appropriated $7.3 billion for FY21, almost $1 billion above the President's Budget Request (PBR) and $162 million above the enacted FY20 budget.

The FY21 PBR for APD had zeroed out Roman and slashed SOFIA. That did not happen in the enacted appropriation, which Dr. Hertz reviewed:

- $414.7 million directed for Webb, as requested;
- $505.2 million for Roman, equal to what APD had planned for Key Decision Point C (KDP-C);
- $93.3 million for HST, $5 million more than the request; and
- $85.2 million for SOFIA, $73.2 million more than the request and equal to the FY20 amount.

The appropriated budget is $525 million above the PBR.

Dr. Hertz listed technology development and risk reduction activities, which will continue as planned pending the issuance of the 2020 DS. If the DS results in any changes of priorities, it is unlikely that APD will zero out the non-priorities. Balancing Pioneers and Cubesats is an ongoing process, but the bottom line is that investigators can propose compelling science at all cost levels.

SOFIA Update
Dr. Margaret Meixner, the SOFIA Director of Science Mission Operations (SMO), and Project Scientist Dr. Naseem Rangwala gave the SOFIA update. Dr. Meixner began by reviewing some important science highlights, then presented an overview of Observing Cycle 9. This cycle starts in 2021 June, and observing time remains highly competitive, with an oversubscription rate of more than four. The program increased research hours by 25 percent over previous cycles, while also increasing observing time in the Southern Hemisphere. There are also more observatory partnerships, which include two joint SOFIA-HST programs. The team has a plan to prioritize one third of Cycle 9 time.

In order to expand the amount of archival research, SOFIA is improving accessibility of data and increasing funding for this work. A recent archival call was significantly oversubscribed compared to the pilot, by a factor of 10. The project hopes to make the archival call annual. Publication metrics reflect the greater use of the archives, and science metrics show that both the publication rate and the citation rate are growing. As part of the effort to expand use of SOFIA data, the project is hosting virtual workshops, and a summer program will support graduate student use of SOFIA data.

The project team is developing an instrument roadmap to guide the development of SOFIA instrumentation through 2034. Current technology development includes an upgrade of the High-resolution Airborne Wideband Camera (HAWC+) with existing technology. Two new instruments – a direct-detection 30-120 μm spectrometer and a terahertz mapper – are possible next steps. The team will consult with the community in order to determine future instruments.

Dr. Rangwala then explained how SOFIA has an interdisciplinary impact that also draws in Earth science, Planetary science, and Heliophysics. The SOFIA team had previously presented five "bold initiatives" to APAC, and she wanted to focus on two that will increase observing time and grow scientific impact:

- Increase the number of Southern Hemisphere flights to 50 annually; and
- Build the operational capacity to plan for a 5th weekly contingency flight.

SOFIA will offer the community more observing time in Cycles 9 and 10, within a lower operating budget ($80 million.) There is also an initiative in progress to add more contingency flights, which will improve the program completion rate and thereby grow the number of publications. Dr. Rangwala presented graphic representations of the impact of increased observing time, noting science flight time

and research hours. One step that will enhance efficiency while providing more science observation time is consolidating maintenance. The proposed weekly contingency flights will help make up for lost flights and possibly expand the total number of flights. The planned 50 annual flights in the Southern Hemisphere will double that observing time. Cycle 9 has 40 such flights and the schedule for Cycle 10 flights is being planned. The team has sought to survey possible alternative deployment sites in Tahiti, Argentina, and Chile. The Tahiti site survey is complete, and SOFIA can plan to deploy from this site. The Argentina survey is on hold due to COVID-19, while the site survey planning for Chile is under way. SOFIA recently completed its first multi-flight science campaign from Germany, as well.

Dr. Gaskin praised their work to increase science productivity. She asked about science per dollar, as it seems likely the flight time increases carry costs. Dr. Rangwala explained that flight costs are lower due to the workforce reductions following SOFIA moving into more science in its extended mission. Those residual funds resulting from workforce reductions are going into science. However, she does not have a science per dollar figure of merit. Dr. Gaskin urged Dr. Rangwala to develop one, as it would be to their advantage to know how the costs trade with workforce reduction, more work in the Southern Hemisphere, etc. SOFIA will need to be able to track trends and indicate that they will meet their goals with the funds they have.

Dr. Ryan Hickox expressed interest in the contingency flights and how this would affect the rate of program completeness. Dr. Rangwala said that thus far, the highest program completion rate was 67 percent of high-priority observations in Cycle 7. The goal is 80 percent, and the stretch goal is 90 percent.

IXPE Update

Dr. Martin Weisskopf, PI for IXPE, began his update by showing what the Explorer will look like when deployed. The key science elements are three mirror telescopes, three x-ray detectors, a forward star tracker, and an aft tracker. He identified the teams and working groups involved, then showed a graphic of how the shield and collimator suppress background, reviewed the mirror-shell production process, and showed the optics. X-ray calibration of the optics occurred at Marshall Space Flight Center (MSFC), which Dr. Weisskopf described. He also provided other science element information and compared the polarimetry to a comparable Chandra measurement. The detection principle is based on the photoelectric effect. A graphic showed how the detector will work. The idea is to image the entire track and deduce the initial direction. The Filter and Calibration Wheel (FCW) assembly has five sources, which Dr. Weisskopf discussed. He also explained the Minimum Detectable Polarization (MDP) and Neural-Network Analysis.

The next version of the first year's mission observing plan will be released 6 months prior to launch. The observing plan derives from input from the IXPE Science Advisory Team and seven Topical Working Groups (TWGs). The exposure times assume moments-method event reconstruction, and results from recent calibration indicate that this will increase scientific efficacy. Neural-network event reconstruction will enhance the sensitivity. To illustrate what IXPE can do, Dr. Weisskopf told how the mission's x-ray phase-resolved polarimetry will test models for radio pulsars, as on the Crab Nebula. Microquasars also are an interesting area, in which IXPE can get the degree of polarization. With active galaxies, such as Cen A, IXPE will be able to eliminate contamination and measure polarization. Launch is scheduled for mid-November of this year. In answer to a question from Dr. Woodward, Dr. Weisskopf said that background rejection of x-ray sources is very good; IXPE will discriminate the background by looking at the shape of the track.

CUTE Update

Dr. Kevin France discussed the Colorado Ultraviolet Transit Experiment (CUTE), which will study the UV spectra of hot Jupiters and super-Earths, looking at extreme environments unlike those in our own solar system. The selections will tend to candidates with short orbits. Planet spectroscopy will measure

atmospheric escape. There has been a lot of controversy about escape rates, as sometimes results conflict. Among the reasons for this is the small sample size; the six measured thus far differ and present no uniform picture. The models also differ. CUTE will address these issues with its transit schedule, increased data and coverage, and state-of-the-art models. Most atmospheric loss has been measured via Far UV (FUV), but CUTE will use the Near UV (NUV), which has a more uniform and mostly photospheric intensity distribution, with a brighter background for transit observations. Dr. France discussed how spectroscopy is required to investigate escaping gas information.

CUTE is the first NASA-funded UV Optical Infrared (UV/O/IR) astronomy CubeSat, and is the same size as a "family size" box of cereal. Its rectangular telescope will allow for a much larger distribution of stars. The spectrograph grew out of the suborbital program. There will be student and EC PI training opportunities. CUTE is now in environmental testing. Dr. France reviewed the predicted science data and showed simulated light curves. CUTE will be able to get close to HST on transit sensitivity and will detect geometric transit and atmospheric transits over multiple observations. CUTE has been designated to fly with the next LandSat mission, which has had some delays but is now scheduled to launch in September. There will be an 8-month baseline mission of 12 exoplanetary systems, with 6 to 10 transits each, and 12 to 20 additional systems in the 12-month extended mission.

In answer to a question from Dr. Micheal Meyer, Dr. France explained that NUV requires bright backgrounds, which eliminates M-dwarfs as targets. CUTE will instead focus on A stars through K-dwarfs. The expected early release science will be issued in the first part of 2022, with the remaining science released that summer.

Balloon Roadmap Update

Dr. Carolyn Kierans, of Goddard Space Flight Center (GSFC), discussed the status of the Balloon Roadmap on behalf of the Balloon Roadmap PAG. She began by noting the team members and the terms of reference (TOR). The Roadmap will articulate and prioritize the key scientific drivers and capabilities needed for NASA's Balloon Program. The Roadmap process began with a 2018 call for white papers.

There are three main advantages to scientific ballooning: groundbreaking science; technology development; and opportunities for students and EC scientists. Dr. Kierans listed the many science drivers by SMD discipline, then gave two in-depth examples: the Compton Spectrometer and Imager (COSI), which seeks to understand the source of Galactic positrons; and the Balloon Array for Radiation belt Relativistic Electron Losses (BARREL), which has the goal of understanding electron precipitation in Earth's atmosphere.

The Roadmap distilled the science drivers across SMD: Balloon Capabilities; Launch Sites and Facilities; Funding Opportunities; and Workforce Development, Education, and Outreach. Dr. Kierans addressed each of these. The Balloon Capabilities Science Traceability Matrix includes as its first recommendation to continue the Super-Pressure Balloon (SPB), which is still being developed. The second recommendation is for increased payload telemetry. The Roadmap had six recommendation under Launch Sites and Facilities. The first is to continue the New Zealand launch site, which is the SPB site, and the second recommendation addresses availability of launch crews and facilities. The Funding Opportunities science driver largely reflects APRA and addresses Earth and Planetary Science; Pioneers, and Explorers Missions of Opportunity (MoOs); and Guest Investigators programs. Finally, in the area of Workforce Development, Education, and Outreach, the Roadmap includes a number of recommendations, emphasizing the Program as a pipeline, and urging additional effort to engage more female and minority scientists and engineers in the program at all levels.

Dr. Kierans reviewed the findings and recommendations from the last APAC meeting. She noted that, due to timing, the current draft of the Roadmap does not include the Biological and Physical Sciences (BPS)

Division, which is now part of SMD. However, the team did get some community input on the effects of radiation exposure on biological systems.

- APAC asked for an update on advances in aerostat technologies and other LDB projects that might enable GO science using large aperture telescopes with arcsecond pointing precisions across the electromagnetic spectrum.
    - The response said that "balloon instruments are traditionally purpose-built for a dedicated cost-effective science investigation, usually with small teams." Common technology designs are shared, and "many science questions can be answered with similar telescope designs," especially in UV, IR, and submillimeter levels.
- APAC recommended that APD consider adding a formal process for proposing piggyback payloads, potentially across disciplines.
    - Sixteen of these were flown in the 2019 Ft. Sumner campaign alone, so it is an option that is used, and it is accessible for new investigators. This is not well-known outside of the balloon community, however, and more can be done to increase diversity.
- APAC asked how this initiative would incorporate opportunities for under-represented communities and broaden the workforce capabilities and PI/Co-I opportunities beyond the core groups that have historically participated in the balloon program.
    - The available information, from one third of the astrophysics payloads, shows that female graduate student involvement is 40 to 50 percent. This is encouraging and higher than the national average in STEM, but there is not much involvement with under-represented minorities. More specific data showed that out of 51 launches for 32 projects, 22 distinct institutions were involved, of which 4 were Minority Serving Institutions (MSIs).

Dr. Kierans showed the High-Altitude Student Payload (HASP) initiative, which operates as a partnership between the NASA Balloon Program Office (BPO) and the Louisiana Space Consortium (LaSPACE) to offer annual flight opportunities to student groups.

Dr. Meyer asked about the involvement from Earth and Planetary science. Dr. Kierans replied that they participate at all scales. Dr. Hickox asked whether, since BPO cannot count on recovering payloads from over the ocean, is there some kind of observing plan or technology development that could make recovery possible. Dr. Kierans confirmed that the technology is in development, and she expects it to become more important over the next decade. Dr. Lou Strolger asked about the Roadmap plan for greater involvement of under-represented students. Dr. Kierans said that one avenue is to have such individuals become guest investigators when they cannot provide the hardware. There is a lot of informal mentorship in the balloon community. The shared technology and designs at the workshops help.

Dr. Kierans explained that science data stays with the teams rather than going to archives. APAC has recommended that the data become archived, and the user community would agree. Dr. Paul Goldsmith introduced himself as the project scientist on GUSTO. It would be interesting to see NASA's plan for the SPBs. He noted that he is also the PI on an APRA project that was funded to go into the archives, and that is really important, as people want the data.

<u>Astrophysics Balloon Program Update</u>

Dr. Thomas Hams, APD Program Scientist for BPO, presented a program overview, starting with some examples of flights. He explained that the Zero-Pressure Balloon (ZPP) changes volume from day to night and cannot sustain a given altitude. It is used for conventional flights and polar LDB flights. The SPB, which is under development, will maintain a near-constant volume and enable Ultra LDB (ULDB) flights, and a stable altitude for LDB flights at mid-latitudes. Dr. Hams reviewed the launch locations, noting that because Southern Hemisphere balloons do not go over as many high-density population areas, those launches are safer.

All of the 2020 campaigns were cancelled due to COVID-19. As previously noted, this resulted in GUSTO being held back because the SPB qualification flights had to be cancelled. NASA will probably fly GUSTO in 2021 or 2022. There is a ZPB as a backup. If GUSTO were to be launched on a ZPB in the early part of the season, there is a 90 percent chance it will reach its altitude and consistency criteria. However, the program took advantage of the downtime with no payloads by simulating launch opportunities for crew chief training exercises. It is possible that flights could resume in April. Social distancing of the payload teams will be a challenge, but the team expects it to be overcome. A chart showed the rescheduled flight opportunities. The hope is that all of the science teams will be able to travel by fall.

APAC had asked for an update on GO science in the balloon program. LDB and ULDB payloads that spend sufficient time aloft can support GO science, and this has been done. However, GO opportunities on balloons are provided at the discretion of the PIs, who will make the selections. Funding for such investigations could be part of the original proposal or a separate APRA proposal.

APAC had also recommended that there be a formal process for proposing piggyback payloads, which are typically small, innovative instruments that are easy to add to existing flights and do not require as much support as a full scientific instrument payload. The balloon program has about 15 of these per year. They cannot drive the science but are add-ons, and APD already allows them to be proposed through APRA. Other SMD divisions also allow piggyback investigations. They are an important part of the BPO's launch opportunities and provide a low-threshold access to the program, particularly for university-funded investigations. However, ROSES could be more explicit about piggyback opportunities.

Dr. Bautista asked about energy to keep the instruments going. Dr. Hams explained that in Sweden and Antarctica, sunlight is available during the campaigns around the clock; other locations rely on storing energy during the day. There has to be a balance of average power consumption and daytime power generation. Dr. Hickox asked about possible SPB test flights this year. Dr. Hams said that the problem is overflight, which is an issue in the Northern Hemisphere. Antarctica and New Zealand are the only options for SPBs. Dr. Gaskin asked about multiple flights for GUSTO. Dr. Hams said that that assessment has yet to be made. SPBs offer a slight advantage of recoverability.

SMD Information Policy

Dr. Steven Crawford, SMD Science Data Officer, provided an update on data policy in SMD. The Strategy for Data and Computing for Groundbreaking Science 2019-2024 came out in 2019, based on several years of work. The strategy's purpose is to enable transformational open science through continuous evolution of science data and computing systems for SMD. This update was to focus on Strategy 1.1: "Develop and implement a consistent open data and software policy tailored for SMD."

NASA produces and maintains information generated from scientific research activities in order to increase knowledge and serve the public good. This information can take the form of publications, data, software, and more. The policy will help ensure that this information is shared openly and in support of science, while providing guidance and structure that eases the burden of compliance. Therefore, the policy tries to consolidate the existing policies, directives, etc., as they relate to SMD. The policy is now in internal review, with approval to come no earlier than June. The goal is to issue it in early 2022, possibly applying to that year's ROSES calls and AOs. Funded projects will likely start in 2023. Certain requirements already apply, and some solicitations may adopt parts of the policy earlier. Existing missions and investigators should adopt the policy as their resources allow.

Currently, PubSpace serves as the submission's portal, but NASA is developing a new portal for external users. Dr. Crawford described various login options. The target for completion is June. The new policy will be made available for public comment, and SMD would like APAC's input. Developing the policy is

the first of a series of steps to be taken over the next 3 to 5 years. Each SMD division will take into consideration its unique elements.

Dr. Strolger thanked Dr. Crawford, then said that it is hard to give feedback without seeing a preliminary document. Dr. Crawford said that he had wanted to give APAC such a document but could not because it is still in internal review. It will be important to ensure that all manuscripts are made publicly available through the portal. Most NASA mission and astronomy data are publicly accessible already, and the journals do a good job of this as well. Dr. Strolger then asked about the challenges. Dr. Crawford said that the SMD divisions are in different places with this. ESD is very open and well ahead in many areas, so the policy team has followed them to a degree. The astronomy community is also well-engaged. It might be a case of ensuring that the tools are better integrated with each other. One of the challenges for all divisions will be software. Some communities are more open than others in this area.

Dr. Meixner applauded the effort. She asked if they [NASA] were starting with what has worked well and building out or taking another approach. Most people likely want to comply, but how will they make it easy? Dr. Crawford agreed, observing that it can be a lot of work to be open, so making it easy will help. Part of that is leveraging what exists. ADS is a phenomenal resource, for example.

Dr. Woodward said that the next APAC meeting will be in June, and he was not sure how the members can review the policy with that timeline. He was also concerned about the International Traffic in Arms Regulations (ITAR). Further, this would be something new for PIs to understand, as institutions often want to keep their innovations to themselves. Dr. Crawford explained that some things, like ITAR and security, are not covered by the policy. There are aspects of intellectual property and sponsored research for which there are laws, and the team is trying to work through that in order to have a clear direction. They will make sure to engage with the sponsored research groups.

Dr. Lucianne Walkowicz observed that NASA archives mission data well but expressed concern about the long-term reproducibility of software becoming an issue. They asked if there were any thoughts about sustainable solutions in order to avoid reliance on certain tools. Dr. Crawford agreed that this is a problem the team has to solve. He noted that each NASA center has a software release process, which is an element that SMD might want to streamline. Dr. Bautista pointed out that software and data are intrinsically different. Software continues to evolve and runs on changing platforms; there will be an issue of keeping up. Dr. Crawford agreed, though he noted that grants and cooperative agreements policy treat software as data. They will need to ensure the software is reusable to the extent possible. Dr. Walkowicz cited an issue with Kepler data and version control. It should be possible to address the software issue.

Public Comment Period

The meeting was opened for public comment. As Dr. Hasan had had to leave the meeting, Dr. Patricia Knezek filled in for her. In addition, Dr. Hertz was unable to be present, so Dr. Woodward said they would hold some comments for him to address on Days 2 and 3.

Dr. Leo Singer asked about export control in the information policy. Dr. Crawford said that the document will be recommending that projects be as open as possible as early as possible. He noted export control as an issue requiring consideration at the same time.

Discussion

Dr. Woodward said it was notable that APD is still dealing with COVID-19 and attempting to pivot in support of EC investigators. He thought the Division had done well in maintaining the status and operability of missions in the portfolio during the pandemic. Dr. Kelly Holley-Bockelmann said she was a bit dissatisfied with the response to the APAC recommendation to consider platforms provided to CubeSat proposers. She thought a “Track A” or pilot program providing the spacecraft bus might help.

Dr. Gaskin suggested a broader range of options than NASA solely providing the bus, to facilitate and reduce the barrier to entry while leaving the option open for those who want to do their own work in this area. It is difficult for those without the capability or experience to break in. It seems like there should be a compromise.

Dr. Suvrath Mahadevan said that APAC needs to see the science information policy. Dr. Woodward agreed and said that the letter report would state this. Dr. Strolger pointed out that people are talking about diversity but not yet making it a priority, and APAC needs to push so that it is included in roadmaps. Dr. Hickox suggested that the way to make CubeSats more accessible could be through a hybrid model, providing the expertise to deal with the vendors and the integration, and maybe providing an instruction manual. A lot of the details could be handled by a NASA center. It is important to expand this access. Also, it struck him that it is not obvious how programs will be held to the standards. Accountability can be hard, but APAC might recommend how that could look. Dr. Woodward noted that Dr. Hertz mentioned some sort of entity in NASA that is a repository of information on CubeSats.

Dr. Bautista wanted more on how inclusion will work. NASA does not have something like NSF's requirement. There are state laws to consider, as well. Dr. Woodward said it was an interesting issue, and the topic was to be discussed on the third day of the meeting. Dr. Meixner supported Dr. Hickox's comment about holding people accountable. NASA needs to provide guidance on how to be more inclusive. People have good intentions but do not always know how to follow through. Dr. Strolger was concerned that the policy will not have teeth. Dr. Holley-Bockelmann pointed out that when asked about methods to broaden participation, mentoring is suggested, but it is not clear how those outside the mentoring circle are to break in. There needs to be a sea change in how things are done. Dr. Walkowicz shared the concerned about accountability and enforcement. For the pilot program, NASA should provide a rubric for what a good program looks like. There is a lot of material. They were concerned about the level of engagement on this and would like to see more efforts. Dr. Gaskin wondered if there could be a call for new PIs. APRA does not distinguish between seasoned and new PIs. She was also concerned about the Pioneers selections being half NASA. There should be more direct facilitating.

Regarding SOFIA, Dr. Woodward thought it was unclear how the roadmap might be funded. Dr. Meixner said she would check with Dr. Rangwala. She was not sure how the future instrument technology development will be funded. It might not be direct. Dr. Knezek explained that in technology development, NASA asked the project to provide a prioritized list of the technologies that need to be developed. Once the Agency has that, NASA can determine the path for funding. Dr. Meixner added that funding for SOFIA's HIRMES instrument has expired, and Dr. Knezek said that the HAWC+ upgrade is taking advantage of unused funds.

Dr. Bautista saw the mentoring plan as well-intentioned, but it becomes an impediment if there are no teeth. Dr. Woodward said the letter would capture that. He asked APAC to consider the balloon roadmap and advancing it to NASA. IXPE had a good presentation, as did CUTE. In low-Earth orbit (LEO), the NUV can be challenging, but he did not have a chance to ask about it. He would like further updates. He wanted to expand the DEI conversation to include engineers and other people who need to be in the pipeline. He noted that Dr. Hertz mentioned technology development investment. Perhaps the next APAC meeting can present what the DS recommends in that area. The Committee often hears about deficits in coverage, but the CubeSats, Pioneers, and other programs are creating balance.

Wrap Up for Day 1

The meeting adjourned for the day at 4:57 p.m.

Tuesday, March 16, 2021

Opening Remarks

Dr. Hasan opened the meeting and took roll of APAC members. Dr. Strolger was unable to participate that day. Dr. Woodward asked the members to keep track of their thoughts during the meeting. He reminded them that this was a public meeting, and they should keep the WebEx chats to a minimum in order to ensure full and open participation. Dr. Hasan said that members of the public could write comments in the Q&A portal.

PI Launchpad Update

Dr. Erika Hamden, of the University of Arizona, provided the update on the PI Launchpad. The context for creation of the Launchpad was her own experience of submitting a proposal. She found the process incredibly frustrating and impenetrable despite the rewards. The range of support she encountered was broad, from none to a lot, and this went beyond the science question. She joined forces with Dr. Michael New and Ms. Ellen Gertsen of SMD to create the workshop, which received funding from the Heising-Simons Foundation and NASA. A STEM-equity consultant, Dr. Nicole Cabrera Salazar, provided assistance in creating and targeting the workshop to scientists who do not know how to start the proposal process. Applicants filled out a short questionnaire, resulting in 40 attendees selected from about 200 candidates. The workshop took place in November of 2019 for 2.5 days and was a huge success.

Dr. Hamden reviewed the key takeaways. Almost all (93 percent) participants said that the Launchpad was a good use of their time. Prior to the workshop, only six participants reported knowing someone in the industry who they felt comfortable asking to be on their team. After the workshop, this number increased to 26 participants. More than half felt more comfortable getting institutional support, compared to only three participants prior to the Launchpad. In addition, 93 percent said they knew what steps to take to develop a mission, up from 13 percent before the workshop. The pre- and post-workshop assessments indicated that the Launchpad provided participants with information on next steps in the proposal process, which was the goal. Developing a timeline proved to be really important, and everyone generally felt more comfortable with the concepts. The organizers recorded as much discussion as possible, though not the personal information on ideas, etc., and put this on the NASA website. Dr. Hamden has some changes she wants to make going forward.

In early 2020, Heising-Simons offered funds for an August workshop at the University of Michigan, but then the pandemic happened. The team decided to go virtual after it became apparent that the pandemic was going to last for a while. Therefore, the 2021 Launchpad will be via WebEx, from June 14-25, with 3 hours of content per day presented in a mix of live and asynchronous sessions. The plan is to select another 40 participants, the limit coming from the number of mentors available for a good, small group experience. Applications were due via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) on March 22nd. This year will have more focus on applicant pool diversity, especially recruitment from smaller universities and under-represented populations. The team is using feedback from the 2019 event to adjust the agenda and scope. That workshop was planned by a small group of people, and there is now broader input.

The 2021 application questions will be similar to 2019 but shorter, with a focus on science, leadership, teams, decision-making, and diversity, equity, inclusion, and accessibility (DEIA). The team is now assembling panels to review applications. In 2019, two thirds of the selections were women. A goal for the 2021 workshop is to have stronger representation of marginalized groups. The agenda will include virtual networking as a key component and will emphasize the elements of science case development. The workbook will go out in advance, and information will be made available for those not selected. Dr. Hamden noted that she is not paid for this and it is not her area of expertise. The team hopes to have inclusion experts offer additional steps to address the lack of PI diversity across SMD. Another goal is to

develop a sustainability strategy so that the Launchpad is less dependent on one person. They are considering having a PI incubator, which would be a longer-term process similar to the Planetary Science Summer School; this requires more than she can do.

Dr. Meyer noted how it could be helpful to track cohorts and keep a sense of community among them. Dr. Hamden agreed this could be helpful. The team has asked 2019 participants to be on the review panel, but otherwise has not been able to do much to support networking. Her capacity is limited. Dr. Gaskin cited a NASA proposal writing course she worked on, for students that is 4 hours per week for 12 weeks. For this, Dr. Gaskin borrowed from the NASA website's PI Launchpad workshop information. Sharing these resources might be helpful and could reach more students. Also, one key is to make sure universities know about this in the first place. NASA Ambassadors can help bring in some of the more remote universities. Dr. Hamden said that the Launchpad aimed more at EC scientists rather than students.

Dr. Bautista said that this program could be transformative. He asked about the longer-term evaluation plan. Dr. Hamden said that a 2019 white paper on PI diversity on Explorer missions is the baseline. It is hard to evaluate but tracking the demographics of those doing missions over time would be helpful. Some participants have put in or started proposals. A longer-term organizing committee could address this. Dr. Hickox asked about the selection criteria. Dr. Hamden explained that they are not choosing for good science. The science questions are very basic in order to ensure that they relate to SMD. The other questions try to gauge leadership and awareness. A candidate does not have to have been a leader to have the desired traits of being able to evaluate awareness of other people on the team, and to identify power dynamics. The goal was to bring in people who were thoughtful, interested, and curious. The workshop does not teach leadership per se.

Dr. Walkowicz wondered about those who remain unsure after the Launchpad. They asked if there were plans for exit interviews and if any of those uncertain people were the ones the team really wanted to reach. Dr. Hamden said the survey questions were anonymous, but she liked this idea and would take it to the team to see if it is something they can address. Dr. Walkowicz pointed out that midpoint interviews can be illuminating and helpful. People are often willing to share their experience.

There was discussion comparing this and an SMD 2018 event in Colorado. SMD held a 2018 colloquium in DC as well. Dr. Hamden said she was at the DC event, which was not a how-to, but rather more exploratory and not as effective as it could have been. The Colorado event was 2 hours and had useful how-to information, but she believes it almost starts too late in the process. There is the iterative nature of developing the science case, and the early stages were not covered. For example, how do you contact a NASA center? Dr. Woodward asked whether, as they look at different institutions and demographics, along with networking and contact, how are the cohorts are doing that staying in touch. Is this done organically? Dr. Hamden said that within the different branches of SMD, attendees were able to network, but the team did not have the capacity to poll them. Participants did get a list of everyone who attended.

Dr. Holley-Bockelmann observed that there was no tracking of who downloaded the information from the website. It would be helpful for NASA to track that, and she wanted it in the record that NASA should have this information.

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

COPAG Report

Dr. Meixner provided the update for the Cosmic Origins PAG (COPAG), of which she is the chair. She began by listing the Executive Committee, noting the new members, and providing application information for anyone who wanted to join the Committee or Science Interest Groups (SIGs). She then discussed a number of recent activities. Among these was an Ultraviolet-Visible (UV/VIS)

SIG/Technology Interest Group (TIG) splinter session at the AAS conference. The group decided to have monthly UV/VIS SIG/TIG talks.

The Infrared SIG (IRSIG) continues website development and has published a newsletter. The mailing list exceeds 450 addresses. There is also an ongoing webinar series. The SIG had a splinter session at the virtual AAS and is organizing a virtual workshop to discuss the upcoming DS. A Long Wavelength Radio Astronomy event also took place. SAG11: Cosmic Dawn, was a victim of the pandemic and never quite got off the ground. The plan is to dissolve this SAG and roll the topic and participants into the new Galaxies SIG that will start up upon release of the DS.

Dr. Meixner showed how COPAG relates to NASA organizationally and reflects the DS panels. The five SIGs that mirror DS panels will analyze the DS to identify gaps in achieving recommendations. They will work with Science/Technology Interest Groups (S/TIGs). The five new SIGs are: cosmology; galaxies; interstellar medium and planet formation; stars, sun, and stellar populations; and state of the profession and societal impacts (a cross-cutting SIG). These are still in the conceptual stage and will serve as discussion platforms.

PhysPAG Report
Dr. Hickox reviewed the status of the Physics of the Cosmos PAG (PhysPAG). This PAG has one science analysis group (SAG) and six SIGs. The SIGs are organized primarily around wavelength, and while there had been talk of reorganizing them by science themes, it was concluded that wavelength organization is the best option for now. Dr. Hickox listed the Executive Committee members, thanked those rotating off, and noted NASA program help. PhysPAG's main activity over the past months was to organize or contribute to eight sessions at the January virtual AAS.

The Cosmic Ray SIG (CRSIG) has broadened its science focus to include high-energy neutrinos, reflecting the interest of the community. This SIG held a joint multi-messenger astronomy (MMA) session with the Gamma Ray SIG (GRSIG) and Gravitational Wave SIG (GWSIG) at the virtual AAS. There are plans for a mini-symposium at the upcoming American Physical Society (APS) meeting, and there will be regular webinars on topics of interest to the SIG.

In addition to the joint session noted above, the GRSIG is organizing sessions at upcoming meetings. The NASA Pioneers program selected the StarBurst gamma-ray burst mission, reflecting the importance of this area. The GWSIG, Inflation Probe SIG (IPSIG), and Cosmic Structure SIG (CoSSIG) also had AAS sessions. IPSIG and CoSSIG have called attention to a joint NASA/DOE RFI on high energy physics and space-based astrophysics, which generated broad community interest. Finally, the X-Ray SIG had a session at the AAS and is planning another for the APS meeting. Dr. Hickox showed several science highlights for this SIG.

PhysPAG has continued discussions on potential cross-PAG initiatives addressing cross-cutting technologies and data analysis frameworks. All three PAGs are interested in promoting these areas, though the consensus is that the efforts will be most effective after publication of the 2020 DS. The three PAGs also have a joint effort on diversity and participation in NASA astrophysics. There was a session on this at AAS that drew a lot of community interest. A group has convened to continue this, and so the three PAGs have proposed a new SAG. Dr. Hickox listed its goals, noting that the details are in the TOR. He closed by listing PhysPAG's upcoming virtual meetings.

In answer to a question, Dr. Hickox said that the TOR for the new DEI SAG will be further developed before the next APAC meeting, but the PAGs would like APAC and expert input. Dr. Woodward encouraged the APAC members to review the TOR so there can be formal input at APAC's June meeting. Dr. Hickox confirmed that there is funding for this to move forward. Dr. Meixner pointed out that a SAG

will need to produce a report. She thought the proposed topics were broad, which led her to wonder about the scope. Dr. Hickox said that this has been discussed a lot, and there are a lot of "unknown unknowns." The aim would be to analyze interventions to expand participation in NASA astrophysics, but at this point it is not clear which interventions would be most effective. He envisions a broad fact-finding phase and more targeted analysis to follow. It is a big question.

Dr. Bautista said that there are some activities outside of specific wavelengths, and in the data analysis framework they need to include the resources to analyze the data. Dr. Hickox said that it is often challenging for people to work across wavelengths. The aim would be to bring together the pieces into an accessible framework.

ExoPAG Report
Dr. Meyer listed the Executive Committee members for ExoPAG, noting those about to depart. The PAG is seeking new Committee members and trying to become more diverse. ExoPAG includes representatives from other SMD divisions in addition to APD.

Since the last APAC meeting, ExoPAG held a community forum, participated in cross-PAG activities, and held splinter sessions at AAS. The PAG held the first Exoplanet Explorers events, with more than 100 participants, junior scientist talks, and mentoring. The community forum, which occurred in December with 23 participants, discussed a proposed finding on the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance. The full text of this finding was available in Dr. Meyer's backup slides. The ExoPAG 23 meeting was held virtually in early January, with a mini-symposium, science updates, EC scientist presentations, and more. However, after polling the participants, the PAG cancelled the January 6 business meeting due to the insurrection on Capitol Hill. A subsequent online poll on the proposed finding did not have the desired response level, with 41 yes votes, 7 no, and 2 abstentions. Since more than two thirds voted in favor, the finding will be shared with APD.

SAG19, on exoplanet imaging signal detection theory and rigorous contrast metrics, was to close in 2020, but the other SAGs and SIGs are still quite active. Dr. Meyer described the work of each. He summarized the findings of SAG19, noting that this SAG led to publications. It provides definitions for the community to use going forward. Upcoming activities include several potential initiatives, planning to react to the upcoming DS, and organizing a virtual ExoPAG 24 in June.

Dr. Meyer asked APAC to advise APD to accept SAG 19's final report and formally close the SAG.

Dr. Woodward asked about the various disciplines coming together in habitable worlds work, and the goals and objectives. Dr. Meyer said that this effort will use what we know from within our own solar system to inform how we characterize exoplanets. Other divisions have a lot to tell us about solar activity impacts, and vice versa.

Discussion
Dr. Woodward said that APAC would respond to the request to close out SAG 19. He asked about the cross-PAG diversity effort. Dr. Meyer said that the PAGs are trying to articulate more clearly the main barriers and identify solutions. To get there, they need a broader, more diverse leadership team. Dr. Meixner suggested discussing this on Day 3 of the APAC meeting, in context of the state of the profession focus. The PAGs want to call attention to DEI, but it is not yet clear how to sustain this effort. For that, they will need to rely on some of the NASA infrastructure. Dr. Meyer noted that the PAG analysis is short-term, after which NASA should take steps.

Dr. Gaskin wondered if a roadmap that shows the beginning, end, and ultimate goal might be more precise. This struck her as a lot of information gathering, which can create frustration when there is no

end to be seen coming out of it. A roadmap would offer concrete goals. Dr. Walkowicz said they took it to mean a concrete analysis of existing efforts, and identification of barriers and how they are or are not being addressed by NASA programs. Dr. Meyer said that that is his take, and Dr. Hickox said that the aim is to understand the barriers from the perspectives of institutions and to learn how well existing NASA programs address them. This would help identify which programs can be extended or supported, and what new activities could address what NASA is not yet doing. More specifically, it would be a systematic study of existing NASA programs, coupled with rigorous information, pictures of the lived experience of the barriers, and engagement with the people running up against those barriers. The PAGs are reaching out right now, and they want to pull in many different perspectives. They also want to do a rigorous survey of the field via outside experts, and to present information on the experience of the barriers. Dr. Gaskin said that this sounded like a well-thought-out plan, but she would like to see a timeline to inform the community, with more concrete milestones and less ambiguity. Dr. Meyer said that the SAG will be time constrained, with an end date. Dr. Woodward said they would continue this conversation the following day. In the meantime, he heard that APAC was recommending articulation of these elements before the winter AAS meeting.

Meeting with SMD AA

Dr. Thomas Zurbuchen, SMD Associate Administrator (AA), joined the meeting to talk with the APAC members. He said that a functioning program needs the voices of the community to help move the organization forward. Excellence in leadership has more to do with change than with being the same, so groups like this are important. NASA advances compelling science with the highest priority and has a good process. Soon, the next astrophysics DS will come out, and the most important measure of DS success is whether the community can align behind it. Communities that split and fracture are not as successful as those that align. He hopes the 2020 DS will be a rallying cry.

NASA recently landed the Perseverance Rover on Mars; the name of this rover was quite controversial. Many people see it as meaning a hard struggle, but that is how life has been in his experience. Doing a mission of any size, the team needs diversity and inclusion to create excellence. A discussion the APAC had focused on. He did not go to the best school in his home country of Switzerland, and from that experience developed a sense of the need to pull in all institutions. He is also excited about innovation, including smaller missions like IXPE. The astronomy community needs to be able to train up the scientists and engineers and have the ability to work in teams. That is something that has to be practiced and learned. He is proud of astrophysics for creating these opportunities. A lot of energy comes from the balloon flights and sounding rockets. Technology innovation and first-time flights of technologies are also exciting. It is essential to do these missions. Dr. Hertz has been an amazing leader of APD, and Dr. Zurbuchen had nominated him for an award to acknowledge his DEI efforts.

Dr. Zurbuchen then asked if there were any questions from APAC members. Dr. Meixner thanked him. She said that the DS will be important and wanted to know how he sees NASA receiving the report. She also wanted to know what he would like to hear from the community. Dr. Zurbuchen replied that the most important thing in first phase is for NASA to learn the intent and to understand what is there. The team is getting ready now. He wants the community to dig into it, identify what they want to do, and get the ambiguity out. It is also important to take time to think and discuss, as it is better to do the right thing later than to do the wrong thing quickly. There are easy things NASA should identify and do, and APD is preparing that way. Dr. Hertz agreed with that characterization. Dr. Meixner asked if this meant they want APAC to connect what SMD is doing to the community. Dr. Zurbuchen said that one of the benefits of advisory committees is that they understand not just “what” but also “why.” He counts on their leadership. The DS is a huge opportunity; it is a lift that creates momentum, and it requires many voices and repetition.

Dr. Woodward said that the community expects NASA investment in technologies to come out of the DS and asked if that is still a critical part of the NASA portfolio. Dr. Zurbuchen replied that the tools NASA uses in the missions of today grow from that investment. All programs need to be re-examined from the perspective of the DS, which will advise more of some things, less of others, and some things that are new. The hardest recommendation is for less, but that gives NASA credibility. SMD needs to learn to say no even though no one wants to hear it.

Dr. Woodward then asked how he sees Artemis enabling astrophysics. Dr. Zurbuchen said that there are already several astrophysics payloads proposed for the Gateway, and he expects more to be proposed for the Moon once we are there. NASA wants amazing science and will open the door for those opportunities. He cited the Neutron star Interior Composition Explorer (NICER) on ISS as an example of using platforms in collaboration. SMD has a deputy for exploration who interacts with the Human Exploration and Operations Mission Directorate (HEOMD) and other domains.

Dr. Gaskin asked about NASA's role in providing the community with mentorship resources, and how the DS might affect that. Dr. Zurbuchen said that he is interested in what the DS will say. He cannot imagine his career opportunities without mentorship, especially those who told him when he was wrong. He spends a lot of time mentoring others. That is what good communities do. He wants to help people and learn from them at the same time. SMD is moving in a good direction but is not there yet.

Dr. Walkowicz expressed concern about the increased focus on private entities' involvement in Artemis and the possibility that industry might squeeze science goals out of policy. They asked what role SMD is playing in that. Dr. Zurbuchen said that SMD has been at the table for some of the discussions. Overall, science has a critical voice in these conversations. He believes that the Artemis Accords are aligned with SMD's core values. But it is important to keep looking at that from all directions. The struggle is that SMD has benefited from some of these companies. The cost of launch per kilogram has dropped due to new entrants to the market. It is also true that there are areas where SMD needs to figure out the right way to proceed, like with planetary protection, and the commercial side should be at the table for that. He will bring the voice of science to the forefront to the extent possible. Dr. Walkowicz observed that industry benefits from science like science benefits from industry. Dr. Zurbuchen noted that there are some important areas where NASA does not have much of a voice, like orbital debris.

Dr. Hickox said that in the flagship concept development efforts, conversations occurred that led to the building of community and networks and understanding each other's science goals. Dr. Hertz has been forthright about not doing all of these flagship missions at once, but the effort in pulling these communities together to do this might be valuable to continue in some form. He asked how Dr. Zurbuchen would envision that. Dr. Zurbuchen said that this is why NASA has the DS. What is most important is to recognize that the best DS have a lot of struggle among great ideas. Smaller missions have often grown from focus on a more targeted element of a flagship concept. The path to success is not a straight line to one goal. He looks forward to the DS. The studies have coalesced ideas and brought excellence to the table.

Dr. Woodward said that in science and technology, many other countries are catching up to the United States. He asked how to take the DS ideas to continue to lead, given that environment. Dr. Zurbuchen said that it is in our interest for other countries to develop some of these missions. We try our best to work with stakeholders and use the DS to enhance and create speed toward implementation. We do not want to spend too much time on pondering the next step.

Dr. Mahadevan raised the issue of risk aversion and balance, and where NASA and SMD are in that equation. Dr. Zurbuchen said that JWST meetings will make one feel that NASA is anything but risk averse. There is a lot of risk the Agency does not talk about, and maybe they should, as it would help with

the focus. He wants to know the risk so they can deal with it. SMD has tried very hard. There is now a helicopter on Mars that was done that way, and he initially opposed it because he was told it was low risk. It is high risk, however, and that is how it should be seen. He is glad NASA is doing it; it is what they should be doing. He used to think NASA was too risk-averse when he was outside and worked as an instrument PI. He got a lot of feedback that pushed him to reduce risk. He believes in risk portfolios that have varying levels of risk across the portfolio. Webb is taking risks and the team is continually focused on them. In 5 years, he wants a better understanding of what risk is so that SMD has part of the portfolio that is audacious, with other parts handled more conservatively. He described the reviews for Perseverance landing on Mars to get the appropriate level of risk. The key is to manage risk and back off if necessary. He was not talking about team and leadership risk here. Horrible leadership creates a lot more risk than does a more complex mission with strong leadership. There is a lot to learn and this is a journey. The Pioneers are risky, and he loves it. Dr. Mahadevan asked if there is a way to improve the community perception of NASA risk-taking. Dr. Zurbuchen said that it is important to talk about struggles rather than pretend to be heroes. These risks make NASA worthy of support and inspiration. It is risk that is necessary to get to the new level of knowledge. The Webb team is so united, and he is so proud of them, including the partners. That is because it is hard.

Dr. Gaskin said that leadership and team are everything. The science and technology definition teams (STDTs) formed during the DS created good teams across the community, and these are very powerful. Their role in creating leaders in the community is unclear, however. Dr. Hamden had told them that the PI Launchpad is meant to train people to propose, not to create leaders. It is hard to know who should train and what should be done. NASA has a good portfolio vis-a-vis risk, but often does not scale the work required to propose. SMD and the Space Technology Mission Directorate (STMD) have extremely different proposal requirements, for example. They might want to think about how to provide the community with greater accessibility on these higher risk efforts. Dr. Zurbuchen said that one risk to accept is that of having first-time PIs. That discussion happens in selection meetings, especially in smaller missions. He would never claim that SMD is there, and excellence requires constant improvement. The barrier to entry for PIs is too high, and SMD is trying to figure out how to reduce that. The Pioneers program is a step in that direction. There is history behind the requirements. He is a huge fan of having a traceability matrix, for example. They are considering the barriers, however, and whether they are set at the right place. NASA needs more PIs.

Dr. Woodward thanked Dr. Zurbuchen for his time. The APAC looks forward to the release of the DS, and hope to have a similar session with the SMD director in the future.

Public Comment

The meeting was opened to the public. First to speak was Ms. Marufa Bhuiyan, who asked how one gets to work on a project paid by NASA. Dr. Woodward replied that there are multiple gateways, and NASA maintains websites that allow individuals to get involved in opportunities.

Dr. Holley-Bockelmann read a question from the portal: “What progress has been made in putting more members of the BIPOC community into positions of leadership?” Dr. Hertz explained that by leadership, NASA means hiring and promotion. All personnel actions have inclusion in mind, and the Agency wants teams that work well together. NASA staff and leadership over the last few years are putting this in practice.

Another portal question was: “I ask that NASA consider the carbon footprint of its astrophysics missions and look for ways to reduce it.” Dr. Hertz replied APD learned that the Division has an impact via virtual peer reviews instead of flying thousands of people into DC for that purpose. APD will continue that once the pandemic becomes an endemic. If there are other areas where the Division can reduce the carbon footprint without affecting the science, they will do that. The advice they get is to grow the portfolio,

though, and he is not going to start tracking the carbon footprint. NASA is working 25 percent on-site overall and can telework more while still meeting at times.

Roman Update

Dr. Julie McEnery, Senior Project Scientist for Roman, provided a mission update, with a focus on coronagraph development and data processing. Nancy Grace Roman, after whom the mission is now named, was NASA's first chief astronomer and is called "the mother of Hubble." Since the last APAC meeting, Roman added a new science filter and now has imaging filters covering the entire spectral range supported by mirrors/detectors, with eight imaging filters all together. A change in Integration and Testing (I&T) plans enabled this at minimal cost.

Dr. McEnery recapped the Roman objectives, which include a Wide Field Infrared (WFI) survey; study of the expansion history of the Universe and the growth of structure in the Universe; an exoplanet census; a GO program; and a coronagraph technology demonstration. The instruments that will meet these objectives include a 2.4-meter telescope, wide-field imager, and a coronagraph. In addition to having a wider field of view than HST, Roman will offer very exquisite precision and a strong survey capability.

The telescope assembly passed CDR in December 2020, and the mirrors and coronagraph relay optics have been polished and coated. Work continues on the WFI relay optics. Procurement of flight subsystems is underway and mechanical hardware engineering development units (EDUs) are nearly complete. Sensor chip assemblies are in flight production. Dr. McEnery described the testing, which is going quite well. Flight fabrication is underway for the grism, prism, and filters. The coronagraph will demonstrate a number of key technologies: deformable mirrors; camera; wavefront sensing and control; masks; and data post-processing. All are progressing well and have reached Technology Readiness Level (TRL) 6 or greater.

A graphic illustrated how the ground system will work, including STScI support for science operations and the science community, and the IPAC science support center. Dr. McEnery described the data system and explained how STScI and IPAC will augment high-level science processing to implement expanded catalog functions. The user community will need to have interoperability, so the team demonstrated a prototype data platform to explore the system for usability. While the idea is to have a multi-tiered system, there need to be checks and balances to prevent runaway code from inadvertently exploding costs.

Roman observations will involve a number of core community surveys designed to address 2010 DS science goals. This will involve defining the surveys to maximize the science return. There will be three months of coronagraph observations during the first 18 months. GO calls will begin closer to launch. Roman data will not be subject to any proprietary period, and no specific team or PI will "own" the observations. The Design Reference Mission (DRM) shows observations programs that will meet requirements.

There is an active SIG and community involvement already, and science investigation teams include about 300 researchers at this point. Roman opportunities were announced in the recent ROSES call. A virtual lecture series began in 2020. STScI and IPAC are taking turns hosting annual conferences. The team has established ongoing communications with partners. CDRs for various elements are planned for 2021. While COVID impacts necessitate some replanning, the delay is by months and not horribly long. Overall, Roman is on track, and everything is where it needs to be approaching CDR.

Dr. Woodward asked if any aspects of the program were being evaluated for risk posture. Dr. McEnery said no, not formally. On a day-to-day basis, little things happen that are within scope. The team is trying to understand calibrations of the WFI, and the details there matter. Dr. Holley-Bockelmann asked about

how the addition of the new science filter came about. Dr. McEnery replied that this was a happy story. The project was moving to a facility that could support the mirror and freed up a filter slot. As the team was about to start coating for flight filters, they saw they could use the slot for a science filter. The science working group had recommended the first seven filters and considered what to do if an additional slot became available. There were only 2 weeks in which to make a decision, but they already had a well-studied candidate. A meeting open to all of the science investigation teams invited suggestions for the science case for the K-short filter and other options. Another filter was proposed as an alternative, but ultimately, the K-short filter seemed best.

JWST Update

Drs. Eric Smith and Ian Neill Reid provided the Webb update. Dr. Smith explained that, as with other NASA programs, COVID-19 has affected JWST, specifically the schedule. However, the General Accounting Office (GAO) will not likely have any recommendations from their study, and work continues. The observatory completed post-environmental sunshield deployment and observatory functional testing. The ground segment testing and operations rehearsals restarted. There have been many commissioning rehearsals, which have become more complex due to COVID protocols, but the second launch readiness exercise was completed. The Cycle 1 announcement of selections are on track. Time between launch and receipt of the first data will be 6 months.

Dr. Smith then showed a simplified schedule and a detailed I&T schedule with the remaining steps. Out of 13 Headquarters milestones for FY21, they have completed 7. A graphic denoted the activities to take place at the Kourou, French Guiana, launch site. Another chart detailed software activities.

Many of the remaining technical issues are closing out. S-band transponder anomalies came up in January. The boxes were removed, sent back to the provider, and repaired; the boxes will be returned in time for shipping. Dr. Smith had previously told APAC about a fairing depressurization issue, which has been resolved. Membrane release device and nonexplosive actuator issues have also been resolved. Fastener retorquing is ongoing. The four deployable radiator shade assembly-horizontal (DRSA-H) units are being remanufactured and will be complete in time for final I&T.

Dr. Woodward asked about COVID-19 protocols in Kourou and how they might affect the launch. Dr. Smith replied that they still have restrictions, including quarantining. This is a European Space Agency (ESA) facility. There have been some launches during the pandemic, though not an Ariane 5. Dr. Mahadevan asked if he was comfortable with the schedule margin. Dr. Smith answered that the margin fluctuates a day or two here or there, sometimes affected by COVID. The main thing they are watching is the transponder box, which will have to use some of the schedule reserve. Dr. Walkowicz said that APAC wanted to know more about the naming issue. Dr. Smith replied that the team is working with NASA historians to examine this. The Agency will make a decision once the information has been provided. Dr. Walkowicz pointed out that the points of disagreement are about what the facts mean. Dr. Woodward said that there will be an update on this at the next meeting.

Dr. Reid then presented lessons learned from Webb's Cycle 1 Telescope Allocation Committee (TAC) process. The data are still under analysis, but some initial results are available. The JWST Cycle 1 GO deadline was in late 2020, resulting in almost 1,200 submissions. These included 1,084 GO proposals. About two thirds of the proposals came from U.S.-based PIs, with many of the rest from ESA, a small percentage from Canada, and 44 countries represented overall. STScI determined that of the 4,332 unique investigators, just under 2,000 have not been on a past HST proposal. The JWST Cycle 1 PIs are more junior than HST Cycle 28 PIs by a couple of years, based on year of PhD as a gauge of seniority. There are also slightly more student PIs (10.4 percent versus 9 percent for HST). The TAC review process was done via DAPR, with a reranking and second review of lower ranked proposals.

Dr. Klaus Pontoppidan discussed the Cycle 1 GO proposal survey, which generated 376 responses. STScI is reviewing the results. Of the respondents, 37 percent had attended a master class workshop. The survey revealed clear differences in preferences and ratings as a function of career stage, and junior career researchers demonstrated a higher rate of social media use and a more positive experience with the online documentation system. The great majority of users had success with the proposal planning system, which includes help desk support, workshops, and collaborative features. However, there were issues with speed and interoperability, discoverability of tools, and navigation.

Dr. Reid then showed the science timeline. There were deadline issues, as the proposals were due right before Thanksgiving, which had to be done in order to make assignments to the TACs and reviewers. In the science categories, the team underestimated the proportion/number of "exoplanet and disks" and "galaxies" proposals that came in. They expected a greater proportion of stellar physics and super-massive black hole (SBMH) proposals. This affected the assembly of panels.

The virtual nature of the panels contributed to lessons learned, as it is easier to recruit when people do not have to travel, but it is also easier for people to overcommit when they do not have to travel. This resulted in distractions and competing priorities. The range of time zones also caused scheduling issues. The panels were able to do more in advance, but they also had more to read. STScI is addressing part of this situation by putting all of the materials online all the time. Weather issues (e.g., Texas) also created problems, with some reviewers sitting in their cars because they had no electricity in their homes. The Slack channel proved invaluable. Another issue was addressing cross-panel concerns. The proposal quality is still being evaluated, though at the time of this presentation very few proposals had been identified as having substantive technical/scheduling issues. The preparation efforts seemed to help, and the general consensus is that the quality is very high. The TAC members were all highly conscientious and their efforts are much appreciated. Dr. Reid showed the future science timeline, with the Cycle 2 call for Guaranteed Time Observations (GTO) to occur about months after launch and Cycle 2 call to occur about 3 months after that. He wanted to know what APAC thought of having mid-cycle calls.

Dr. Woodward observed that a lot of effort went into the panels. He asked if the panelists would do it again if asked. Dr. Reid said that STScI just sent out a survey to find out. Dr. Mahadevan said that a mid-cycle call is for urgent things that were not anticipated. While a mid-cycle call might have restrictions, it is important to have something. Dr. Reid explained that Director Discretionary Time (DDT) is always available for outstanding events at any time. These proposals are typically time-critical, but DDT can be used to find things that are high profile. There is a fully subscribed set of observations for Cycle 1, and balance is a consideration, including the possibility of creating a backlog for Cycle 2. The team will not know how JWST performs until 6 months after launch.

Dr. Woodward asked about the high uptake of the master classes and what sounded like the technical issues having been somewhat minimized as a result. He asked if other missions of this size and scope had shown that this type of advance education presented a useful model to consider. Dr. Reid said that the goal is to prepare communities to make the most of a mission. Dr. Pontoppidan added that offering this many hours is unprecedented. The team was happy to see how well-written the proposals were. Dr. Woodward said he looks forward to APD taking the Webb experience to prepare the community to do exciting science in the future.

R&A Update

Dr. Immler began the R&A update by reviewing the data. Without ATP or Strategic Astrophysics Technology (SAT), there were 890 proposals from March 2020 to March 2021. The average selection rate was 18 percent, and more than half of the PIs are new PIs. The selection rate for female-led proposals is not at the level of women in STEM. NSF data show that 43 percent of U.S. scientists and engineers are women, but for APD R&A, only 22 percent of the proposals came from women, accounting for 24

percent of funded proposals. Further analysis shows that female-led proposals have a lower average funding level, and a graph showed a decreasing female-led proposal submission rate as a function of requested funding amount. However, submission and selection rates for female PIs have risen over the last 8 years of data.

For FY21, APD R&A funding comes to $110 million. Of this, 72 percent is going outside of NASA, and 67 percent is going outside of government. Dr. Immler listed investigation areas and showed the Nancy Grace Roman Fellowship winners. He then broke out allocation information for suborbital programs, which receive half of the APRA funds, and the GO/GI programs. In total, R&A reviewed 3,143 proposals in one year for a 22 percent overall selection rate. Dr. Immler then discussed recent R&A initiatives, noting the consolidated XRP area, with funding to almost double between FY19 and FY24. There are also significant budget increases for lab astro and Future Investigators in NASA Earth and Space Science and Technology (FINESST). SMD now has a special review process for unfunded high-risk proposals. Peer reviewers receive training on unconscious bias and a code of conduct is being developed. ATP is running a pilot program this year to evaluate proposal plans for creating and sustaining inclusive work environments. Since the last DS, R&A funding has grown by more than 38 percent, though costs are going up and more people are proposing. Almost half of astrophysics R&A is within APRA. A chart showed how flight programs are spread across the electromagnetic spectrum.

HaloSat, APD's first CubeSat, was a productive mission with some good science highlights. Dr. Immler noted the student and EC training opportunities, including PhDs, postdocs, and a number of undergraduates in physics and engineering.

The R&A program was particularly affected by COVID-19 and associated measures to keep people safe. However, R&A management continues via telework. R&A program officers have reached out to currently funded PIs and are working with them to protect the most vulnerable team members, typically students, postdocs, and non-tenured faculty. During the virtual AAS meeting in January, R&A held a town hall in order to address PI questions directly. No ROSES 20 solicitations were canceled, though Theoretical and Computational Astrophysics Networks (TCAN) and Astrophysics Data Analysis Program (ADAP) proposal due dates were delayed. Virtual reviews will continue at least through the end of the year. NuSTAR Cycle 6 and ADAP were the APD pilot programs for DAPR. Going forward, more R&A peer reviews will be DAPR. All peer reviews are being conducted virtually, and these have required accommodation of such things as childcare, teaching obligations, screen fatigue, etc. The result is panels that last longer than pre-COVID face-to-face peer reviews, meeting three times for in-person virtual panel discussions and using two homework days to work on evaluation writing assignments. This virtual review format allows for more flexibility to accommodate reviewer schedules while maintaining the quality of the proposal evaluation. SMD is augmenting some currently funded R&A grants in order to mitigate the impact of COVID-19 on EC researchers. Proposals had been due in early January and March. Most of the January augmentations requests were funded. While in the range of normal, R&A received slightly more proposals in 2020 than in 2019. The notification rates held, although notifications for the cross-divisional XRP took more than 150 days. Overall, it is taking a week longer to notify PIs. ROSES 21 was released in mid-February. Dr. Immler showed the DAPR elements, the peer review schedule, and the cadence. Peer review activities happen every day of the year.

Dr. Gaskin noted that the multi-wavelength slide showed a slight gap on gamma-ray and asked why this might be. Dr. Immler replied that some areas have gaps because they are hard to observe, and while some of the balloon programs are closing those gaps, that is ongoing, so NASA is not receiving proposals in those areas. Dr. Hertz added that ground observations are a factor as well. Dr. Gaskin asked about funding allocation on the selection rate slide, and the reason for out-year increases. Dr. Immler explained that R&A is the bread and butter of development for future missions. NASA recognizes that, so R&A is protected to a degree, but just adding dollars to a program to keep selection rates high is not a real

solution. Other ideas could be biannual solicitations, and there are many angles to investigate, so the funding level is only part of the answer. Dr. Gaskin noted that the proposals are getting more costly and asked what Dr. Immler foresees on selection rates. He answered that some R&A elements have healthier selection rates than others. It is always a question of whether to evaluate the elements with low rates; it is something they think of continually and try to balance as well as they can.

Dr. Mahadevan said that funding rates for FINESST are perhaps lower than APAC would want, and this is an area where NASA can influence diversity most directly. Dr. Immler agreed. When considering whether to switch programs to a different cadence, FINESST is not one APD would move to alternate years. Dr. Hickox said that the PAGs have talked about cross-cutting technologies for future missions, which will be made clearer with the DS. He asked what R&A has in the way of a plan to respond to technologies that may cut across different wavelengths. Dr. Immler said that they will wait for the DS. R&A is very nimble, and APD can reprogram it quickly if recommended. The Division is ready to address emerging needs.

Dr. Bautista noted that the program has made a good effort to balance funding to universities and other institutions. At the university level, the demographics are changing, with decreasing enrollments that may lead some institutions to change or even close. He asked if this is something the R&A team discusses. Dr. Immler said that that conversation has not yet occurred, but there might be a greater need for universities to bring in funding for their programs.

Wrap Up for Day 2

Dr. Woodward said that the last few presentations indicated that the virtual review environment could be more efficient, cost-effective, and more, and possibly present a pivot point on how APD manages proposals. He wanted to talk about this further. He also asked that there be APD program scientists at the Day 3 discussion. He said that he would send out ideas that evening for APAC members to write pieces for the letter to Dr. Hertz and asked the PAG chairs to invite the program scientists to the next day's meeting. Dr. Hertz said that he would contact them as well.

Adjourn

The meeting adjourned for the day at 5 p.m.

Wednesday, March 17, 2021

Opening Remarks

Dr. Hasan opened the meeting and took roll. Dr. Woodward explained that the Day 3 agenda would continue discussions about the state of the profession. An objective of these conversations is to ensure that NASA has a diverse workforce.

Dr. Kartik Sheth of APD began with a personal statement. He is tired but optimistic about equity and justice, but 25 years ago he almost dropped out of graduate school due to racism and sexism in a toxic academic environment. He stayed and has since worked in this area to bring students outside the traditional pipeline into STEM. He nearly burned out a couple of times. Many of those present for this meeting have done this work, and it is difficult. It is the success of programs and these communities that keep him going. The past few months have been a whirlwind, with much dedication, and so he thanked APAC, Dr. Hertz, and others for giving him the space for this work, and he appreciated APAC's pressure to keep the effort going. He cited the work he has done recently, with much momentum and dedication, and it would not be possible without APAC, APD, and SMD support. One of his goals was to create a cohort of those who could engage and take some of the burden off people like him. He appreciates that

people are listening and that the focus is less on the pipeline and more on creating a welcoming environment with meaningful leadership positions for BIPOC individuals. NASA has made significant changes, and he thanked everyone involved.

State of Profession – SMD Initiatives

In his formal presentation, Dr. Sheth noted that in July 2020, NASA published Inclusion as a core value. He read it out loud, as it is a key tool in making these changes.

> "Inclusion – NASA is committed to a culture of diversity, inclusion, and equity, where all employees feel welcome, respected, and engaged. To achieve the greatest mission success, NASA embraces hiring, developing, and growing a diverse and inclusive workforce in a positive and safe work environment where individuals can be authentic. This value will enable NASA to attract the best talent, grow the capabilities of the entire workforce, and empower everyone to fully contribute."

This has to be part of everything they do.

Dr. Sheth then cited Strategy 4.1 from SMD's Science Strategy:

> "Increase the diversity of thought and backgrounds represented across the entire SMD portfolio through a more inclusive and accessible environment.
> In alignment with the NASA core value of Inclusion and SMD Science Plan, we seek to foster a community where everyone feels welcome, included and valued.
> SMD's goals are to develop a workforce and scientific community that reflects the diversity of the country and to instill a culture of inclusion across its entire portfolio."

To further this vision, SMD established the Anti-Racism Action Group (ARAG) as a short-term group to develop actionable ideas for a 1-to-3-month period, distinct from the longer-term Inclusion, Diversity, Equity, and Access (IDEA) working group (WG). ARAG decided to use design theory because it is nonlinear. ARAG developed the following parameters for solutions:

- Solutions cannot repeat doing the same things we have been doing for the past 3 to 5 decades and expect different results. Dr. Sheth highlighted this as very important.
- Solutions must begin by questioning the underlying assumptions that lead to that solution and explore the assumptions and possible solutions by engaging with the BIPOC community.
- Solutions should urgently focus on putting BIPOC members in positions of leadership in organizations so that they can be fully involved in day-to-day decisions of the organization. This has been shown to work through dedicated efforts.

ARAG has taken a number of steps to solicit input, with good responses and many ideas. Dr. Sheth gave a few examples of longer-term ideas that ARAG is leaving for the IDEA WG. ARAG identified the following eight ideas to move forward:

> 1. Supervisor performance plans will include examples of how to make meaningful progress in IDEA-relevant performance goals. Dr. Zurbuchen is leading this effort.
> 2. Expand short-term virtual rotations and assign leadership tasks to staff on a regular basis. ARAG has drafted a strategy for this and moved it to a subgroup. It will encompass measurements and sustainability.
> 3. Establish an engagement committee to build relationships with under-represented groups leading to partnerships.
> 4. Initiate a series of internal culture surveys to establish a baseline and measure progress in diversity and inclusion across SMD. ARAG is working on the clearances needed for this.
> 5. Collect and publicize current and historic aggregate demographic data of ROSES awardees. OCS is working on this. It is important to have the baseline in order to measure progress.

6. Require that all panel reviews adopt a code of conduct that reflects commitment to a diverse and inclusive working environment. This is a "quick win" that is now going across all of SMD. ARAG would like to expand it beyond review panels.
7. Set a goal for each SMD division to increase the aggregate demographic diversity of its reviewers in ROSES panels by the end of 2022. This is another quick win, and it should lead to diversity among proposers. APD has already done some of this.
8. Create a monthly continuing conversation series to foster improved communication across SMD. This is a quick win as well. Talking about race is difficult, and ARAG hopes this will help.

There have been many lessons learned from ARAG, some of which Dr. Sheth reviewed. It was important to have Dr. Zurbuchen involved because he facilitates progress. Other SMD activities include:

- Public statements by NASA and SMD leaders on identification of existing exclusion and lack of participation by all communities at NASA and a commitment to better inclusion going forward.
- Working group modifying requirements for AOs to align with NASA's core value of Inclusion.
- APD has a R&A task force looking at ways to make the R&A process more inclusive and diverse.
- ESD has multiple groups examining all aspects of its portfolio and work from the ROSES solicitations to data initiatives to a "Speak Up" email/discussion series.
- Advisory committees are discussing inclusion.

Some takeaways from the work include:

- It is critical to have leadership acknowledge the problem, take responsibility, pledge actions and ask to be held accountable. Dr. Sheth noted Dr. Hertz's leadership and mentorship in this area.
- Put people in positions of real leadership and do not focus solely on the pipeline.
- Work hard to create an inclusive and welcoming environment for all.
- Ensure one has the attributes for solutions before jumping to solutions.
- Avoid making assumptions.
- Ensure actions are impactful, measurable, and sustainable.
- Evaluate and be ready to change tactics when necessary.

The IDEA WG has over 40 civil servant and contractor volunteers already and will explore actions in a number of categories in order to align the outcomes and activities with NASA's core value of inclusion. IDEA aims to identify two or three actions that SMD can implement and report on within 6 months, building on ARAG's work. They will meet with Dr. Zurbuchen regularly, and subject matter experts will be brought in to ensure sustainability. Eventually, IDEA will expand to cover SMD stakeholders and the general public.

Dr. Meyer noted that this creates extra work for those involved, which is an issue. It is important that leadership recognize this. Dr. Sheth agreed, and it is an ongoing concern. Working virtually, ARAG members have taken on even more. Dr. Walkowicz said that the Adler Planetarium is engaged in a similar process. Not everyone in majority white institutions has a similar understanding of the problem, so bringing people on board and implementing processes are issues. They asked what approaches ARAG has to a community understanding, and the challenges. Dr. Sheth explained that he asked a white male leader what moved him, and it was the George Floyd murder. Keys to progress include leadership buy-in, and the willingness of leaders to educate themselves beyond just reading; people need to have difficult discussions and role play. Positive reinforcement of leaders taking valuable actions is also important so that their understanding grows. Finally, it is necessary to figure out which people in power one can talk to. This does not happen overnight, and leaders have to commit to educating themselves. Diversity and equity work is not something the "other person" should do; we should ask the leaders to do it. Our national consciousness has changed so that people are more receptive. He challenged those in APAC to have their own statements ready and to hold themselves accountable.

Dr. Hickox recounted being at a workshop where he was struck by the scholarly work that showed how effective it is to have clear expectations and a culture that holds people to them. He wondered how a code of conduct might be disseminated. Dr. Sheth said that there is not a good sense of that yet, and the code needs to have teeth. They are talking about creating one for APD as generic mission and team guidance. Black students do not see themselves welcomed, so leaders need to model enforcement of the code. EC people in review panels love this. Dr. Hertz added that SMD has noticed that many missions have codes of conduct that serve the same purpose. It is a best practice, so they are looking at how to extend that to all missions in the future.

State of Profession – APD Initiatives

Dr. Evan Scannapieco described APD activities to promote DEI, starting with a task force established in September. He listed the members; Dr. Hertz participates. He then presented the charter, which emphasizes empowerment, modification of the proposal environment to make it more inclusive and equitable, and working with a diverse outside community to remove barriers to the participation of underrepresented groups. The Task Force wants to bring in the voices needed to make the right decisions. In trying to define the desired outcomes and actions, they have found that some require more conversation and engagement.

Dr. Scannapieco then described a series of outcomes and actions.

Outcome:

- Receiving more proposals from scientists underrepresented in our current/traditional proposer pool, including BIPOC scientists, achieving a commensurate selection rate.

Actions:

- Monitor and increase diversity on reviewer panels and advisory boards. APD was already doing this.
- Reduce cognitive biases in reviews. This is one of the goals of DAPR, which focuses on the science rather than the team.
- Open up better communication and coordination with the NASA Office of STEM Engagement.

Outcome:

- Assist grant recipients to maintain a professional environment, taking appropriate actions to root out toxic behaviors in grantees when they arise.

Actions we are taking and/or *considering:

- *A general code of conduct for grantees. This is in development.
- *Input from more than the PIs. This would include team members who might have a different perspective from the PIs. It is typically the PIs who do the reporting at present.
- An Inclusion criteria pilot program. APD will ask ATP proposers to include an inclusion plan that encompasses training. This will not go into selection decisions in the pilot, and there is concern about providing overly prescriptive examples that can be repeated back. Instead, APD is giving teams resources and would like APAC input. Proposals will be looked at by a panel of experts in addition to internal staff, and APD will solicit feedback from the proposers once it is all done. This should inform how APD will move on from the pilot.

Outcome:

- Provide access to training to researchers who have less opportunity to learn to write successful proposals from their colleagues.

Actions we are *considering:

- *Research Initiation Awards model. These are 1-year awards for people getting started or coming back to funded research after a long break, partnering with a mentor.

- *Regular workshops on proposal writing and processes at minority-serving institutions (MSIs) and Historically Black Colleges and Universities (HBCUs).

Outcome:

- Develop a better understanding of the experience of the BIPOC STEM community, and more sustained communication and engagement, forging better permanent relationships.

Actions we are taking and/or *considering:

- BIPOC engagement workshop to help articulate barriers to entering NASA astrophysics programs.
- Regular presentations for input.
- *Externships from APD to MSIs, incoming temporary assignment with a leadership role from a MSI to APD.

Dr. Scannapieco said that APD is open to other actionable and executable suggestions.

Dr. Bautista said that while he favored the intent of the inclusion plan in proposals, he would have a hard time figuring out what to write. The numbers of postdocs and students is limited at some institutions, and he has to take who he can get. If it relates to management of the budget, that can be tricky, and it varies from one state to another. He would need to see more on this. Dr. Scannapieco said that the issue is more about how a PI draws people to a group, including what they look at and how they advertise and evaluate. Within the group, actions could be taken to mentor or otherwise change the environment. A variety of things could adapt to circumstances. This will not be released in a vacuum, and resources will be available. In a pilot, they want to err on the side of being too broad.

Dr. Holley-Bockelmann agreed that examples of best practices would be helpful. Workshops are a good idea, but staff are not always available to help with proposals. Regarding toxic work environments, a proposal she reviewed was from a toxic work environment, and she was concerned that DAPR could make it hard to identify these situations. Dr. Scannapieco agreed that the workshops on proposals call for more engagement. The DAPR process includes a step at the end where the proposer is revealed, and that is where a toxic work environment can be identified. Dr. Meixner asked whether there might be funding provided to proposers in order to support their proactive outreach efforts. NSF does this. Dr. Scannapieco said that that might warrant further discussion.

NASA's Demographic Data Collection Program

Dr. Louis Barbier, NASA Associate Chief Scientist, discussed the OCS demographic data collection program, which began in 2016 with five question and expanded to nine questions in 2019. OCS collects the data of proposers, reviewers, and students via NSPIRES. Answers are voluntary and personally identifiable information is protected.

The inferred gender success rate data for SMD for 2013-18 show a stable rate for males and growth for females. For astrophysics, about two thirds of the proposals come from men, roughly 20 percent from women, and the rest are unknown. Ethnicity data are by Hispanic, non-Hispanic, or N/A. The rate of Hispanic submissions is consistently low, around 3 percent, although Hispanics account for almost 20 percent of the U.S. population. Of note is that in 2020, there were fewer responses to ethnicity and race questions. Data for race are also disproportionate when compared to the overall population. PI career stage is inferred from years since completion of last degree, usually a PhD. For the youngest cohort, the female proposers are holding their own or are ahead. But beyond that, males dominate across the board. NASA recent hires for science by gender show more progress. Some of the ROSES elements are not on an annual cadence, and some selections are delayed, affecting data. There were some issues with data gaps and student versus advisor numbers. However, response rates have been good overall. The 2020 drop-off in voluntary identification of race and ethnicity is a concern that OCS wants to explore.

Dr. Woodward wondered if EC proposers in the system might not identify themselves by the available categories. Dr. Barbier said that OCS was in the early stages of analyzing this. The Office would like to expand what it asks, going beyond binary gender for example. In this area, NASA is subject to oversight from OMB and Congress. OCS would also like to expand ADA categories. For APD especially, the GO data are not captured, as much of that comes from STScI. There are other data that go through GSFC. Dr. Meixner said it would be helpful to get guidance on what they [NASA] can and cannot ask. Dr. Barbier said that this is sometimes a factor of political leadership. These discussions take time, and currently NASA can ask about binary gender, Hispanic/non-Hispanic, race, and specific disabilities. Contracting officers might want to talk to NASA's Office of General Counsel (OGC). Dr. Walkowicz pointed out that there are numerous papers by nonbinary scientists providing guidance on analyzing gender, which could help address the frustrations presented by the legal limitations. In answer to a question, Dr. Barbier said that there will be error bars in the final report. OCS also wants to revise race and ethnicity questions and is happy to take input on that, though the Office will have to go along with OMB guidance.

Dr. Hickox said that regarding the data collection and analysis, it is critically important to engage established experts on how to do this. Any expansion should be motivated by best practices. He asked about plans to make the results public. Dr. Barbier said that he has suggested to the Chief Scientist that they bring in a sociologist at least part time. The goal is to have the first of these annual reports out this May. From there, they can add refinements, as new questions will keep coming up. His plan is to make this an annual report, ideally issued in the spring in order to coordinate with ROSES. He would like to share it as widely as possible within NASA and the community. The analysis is for the entire Agency, and OCS will give it to anyone who will read and use it. Dr. Woodward said that in regard to OMB and other stakeholders, it would be advantageous to take any opportunities to get these points under discussion. APAC wants to understand if they are capturing the diversity of the profession in the environment they have. Dr. Barbier said that the Chief Scientist participates in a number of governmentwide committees, as does he and another deputy, and they are bringing this forward.

Dr. Meixner told of how, when she arrived at STScI in 2002/3, there was a lot of tension about the role of women in astronomy. The women supported each other and discussed the business argument among themselves about capturing as much talent as possible while also staying relevant. That idea fell flat, but she wondered if it is viable as a business case. Can they change the head if they cannot change the heart? Dr. Barbier said that by 2045, white people will no longer be the majority in the United States. If an economic argument can come to the table, it would not hurt. NASA has a chief economist who might be able to speak at a future APAC meeting. Dr. Sheth said that there are numerous studies supporting the economic argument for diversity resulting in better outcomes. ARAG found that changing actions and behavior precede changing the heart.

Discussion

Dr. Woodward pivoted back to something Dr. Hertz said about having best practices and instilling expectations in the community as they respond to potential NASA opportunities. This idea could have some traction. Dr. Hickox said that having a clear set of expectations and values can be helpful in how teams are managed, in mentoring, and in how departments and groups function. It is important that people are made aware of and held to the rules of the road, which does not have to be complicated. There should just be something to point back to expectations. However, there also needs to be a reporting process beyond the PI. If best practices are provided, they might be just copied and pasted, but if the reporting process includes them, that has more meaning. Clear messaging from leadership can make an impact.

Public Comment Period

Dr. Woodward read a comment from the portal: "Showing SMD/APD demographics data in comparison with population data suggests that the goal is to reach the distribution in the population. Is that the goal?

People in underrepresented groups are often held to a higher standard. If selecting on excellence, wouldn't that indicate that underrepresented groups should be selected for funding at higher rates? How will APD define the goal by which they evaluate success?"

Dr. Sheth replied that it is clear that ultimately, they want APD to reflect what the nation looks like, but that is not the pool of applicants today. APD wants to move in that direction. The example of white women shows how quickly change can happen. Women and minorities tend to select themselves out of the pool. What are the metrics? The main one is to continually improve the pool of people proposing. APD should see annual progress in the diversity of proposers. Dr. Hertz said it is not just proposers, but also people who want to work at NASA. The data show whether NASA is making progress and helps identify problems and point to initiatives to increase the size of the pools.

Dr. William Waller asked how the Science Activation program could help to advance IDEA at NASA/SMD and beyond. Dr. Hertz said that this program uses NASA science to improve nationwide science literacy. The second round specifically addressed activities that extended the Science Activation program to communities that had been under-reached in the first round. Across the science portfolio, the new selections reach out to these communities and broaden NASA's reach. Another question from the portal raised the issue of the response to COVID-19 and the funds going to those who are negatively impacted. There was concern about the rollover effect this might have on EC individuals in FY21 and asked about the funding. Dr. Hertz replied that APD received no additional funds to address problems created by the pandemic. The Division is prioritizing EC scientists it was already supporting.

Dr. Woodward read another comment from the portal: "How will you help ensure that people of different identities are not forced to assimilate or leave? Demographics data frequently help us understand the existence of different identities, but not the extent to which people are allowed or empowered to fully show up with those identities, without assimilating. Historically, training and mentoring is often about teaching people how to assimilate." Dr. Hertz said that the attention to inclusion is intended to address this concern. Dr. Sheth added that there are many forms of leadership, so NASA will be recognizing that not everyone has to conform to the alpha caricature. They will think about how they train to encompass different leadership styles.

Dr. Woodward combined two related portal questions: "What progress has been made in putting more members of the BIPOC community into positions of leadership?" And what are the metrics? Dr. Hertz said that while NASA does not want to count noses, when he compares the Agency now to what it was years ago, he sees more leaders who look like America. If NASA is true to the principle of inclusion, that trend will continue. Dr. Sheth agreed but noted that the numbers are poor, nonetheless. NASA's Asian Americans and Pacific Islanders (AAPI) group made the point that they do not have representation in leadership even as the "model minorities." NASA claims to hire the best, but the pictures do not convey that the Agency wants to hire the diverse community. APD probably has the most diverse SMD team, but he would still love to see this at a higher level. Dr. Woodward said that with the reassessment of current programs designed to diversify NASA activities, he would like to see APD study the effectiveness of those activities. He asked if such introspection would be useful. Dr. Hertz thought it would be reasonable. There is an assessment like this in the Hubble Fellows. Dr. Hickox said that the proposed SAG from the PAGs could potentially contribute to this, within the context of keeping the scope manageable.

Dr. Holley-Bockelmann summarized another portal question, asking that mission proposal deadlines be delayed so that the full workforce can participate, as the pandemic has made it particularly difficult for some people to submit proposals or take leading roles. This has dampened female/minority participation and the questioner was doubtful that anyone at NASA truly cared. Dr. Hertz said that most of the due dates are recurring and annual, so to keep funding people, APD does not want to move those dates. The Division tries to give advance notice of deadlines. No matter what date they pick, it will be bad for some

people. So given that there are annual due dates, APD has not seen delaying the dates as a solution to this very real problem. He did not want to say this would not happen, but to do so would create problems next year and delay funding to those who need it.

Ms. Bhuiyan from the previous day said that she never felt Black or white, but something in between. She has not lived in the United States her whole life. She also admires all the work and has learned a lot the last few days. Culture and language make a difference, and science is science.

Dr. Holley-Bockelmann read a portal question: "What efforts are being made to make LGBTQ+ scientists feel safe in their field? Naming the JWST after a man who fired govt. employees - including astronomers - for their sexuality does not send a positive message. What is being done to combat homophobia in astrophysics?" Dr. Hertz replied that NASA is trying to be inclusive of everyone and is having historians look at the Webb situation so they can make a call on that. Dr. Woodward asked that APAC receive an update at the June meeting.

Another portal question was: "Many efforts are made to help marginalized people learn to navigate racist and marginalized spaces. But not so much is done to change these spaces --- e.g., by holding people accountable for bigoted and exclusionary behavior. When will NASA start holding PIs, for example, accountable when they contribute to exclusionary research environments?" Dr. Sheth said that this has come up and the DS will address it. NASA awards go to the universities, not the PIs, so there is a gap that NASA cannot bridge directly. He would like ideas beyond progress reports, if there are any. Dr. Hertz pointed out that the legal requirements of Title IX flow down with all federal funding, and this funding is accompanied by audits and enforcement. However, only some of the things contributing to toxic environments are in the law. Therefore, SMD is looking for other ways of determining if the environment meets community norms. Dr. Sheth cited the change in the benefits package for Hubble Fellows. SMD has thought about having an expectations document. He would love to hear more innovative ideas. Dr. Hertz observed that this is not an APD question, it is an academic question. He asked if there are written norms that the academic communities expect of PIs running research groups with EC and diverse members that APD could write down for its grantees.

Discussion

Dr. Meixner said that her academic experience is that the professor is queen of her empire, and the university has little oversight or training, though that may have changed. Title IX can seem heavy handed but that is a possible lever. It would be better if the academic institutions had an HR department or similar element. NASA must have the ability to withdraw funding from an entire university if the environment is toxic. Dr. Woodward suggested that the PAGs discuss this. APD conveys expectations to centers and other stakeholders, so it would help to understand the implicit and explicit expectations. If NASA and community leaders set an expectation, the community will eventually flow in that direction. The DS will possibly help with discussions of the path forward. He asked the PAG chairs to take an action to make this a conversation in their communities.

Dr. Holley-Bockelmann said that in regard to Title IX, which is very powerful, she knows of an issue that was not pursued because of a requirement that the students reveal their names. While she likes the idea of some sort of reporting mechanism for students, there needs to be a way to ensure there is not any pushback. Dr. Walkowicz agreed, stating that money is NASA's primary lever. Universities deal with harassment in a wide variety of ways. They would like something outside of that, like allowing students to give evaluations of their workplaces, because a lot of these environments do not protect their people. NASA can do a lot in setting standards, and that requires identifying the levers it has. Dr. Sheth said that in its sexual harassment unit, the University of Maryland (UMD) has a model that works to improve the environment and encourages people to report. As for funding being the lever, he wondered if there were any soft diplomacy ideas, like talking with department chairs and modeling what NASA wants the

universities to emulate. Dr. Scannapieco said that at universities, the system is kind of broken. Losing money and prestige could be levers, as could finding ways of making the system more open. The community could change things to disincentivize supporting a problematic person.

Dr. Bautista wanted to make two points. First, there is a huge diversity in those institutions, and it seemed they were talking about large universities with lots of students. Small universities may have a single professor in physics, and some of the actions discussed may be detrimental to them. Universities also are talking diversity and inclusion, and most are deeply engaged in having better practices. He worries about the impact of punitive actions rather than engaging in dialogue to cooperate.

Dr. Hickox mentioned the best process for proceeding with the SAG that had been proposed by the three PAGs, on improving participation in NASA science. Dr. Woodward said that he thought they had discussed maturing the TOR in order to have an actionable outcome at the June APAC meeting. While it is not a requirement that APAC approve the TOR, he wanted to make sure it reflects APAC thinking.

Recommendations, Actions/Outbrief to Division Director

Dr. Woodward felt the sense of the Committee was that the balloon roadmap was mature and that APAC should take the findings and recommendations for review and possible action. Regarding a TCAN pilot program on DEI, he wanted to recommend that APAC get a brief out when those activities are known. Another topic was the SMD information policy document and what that policy might look like as it matures and the feedback mechanism. The draft is not yet available, and APAC members will have to see it in order to provide feedback. The Committee will want an update in June. Dr. Hertz said APAC members and the community can comment as individuals when the draft is released.

Dr. Scannapieco provided clarification on the TCAN effort, which has a specific criterion: "The effectiveness of network activities in contributing to the training and development of the future scientific workforce." Some people included DEI activities in support of this, and that was viewed as appropriate, but this is not an inclusion criterion per se. There is no pilot activity involved with TCAN; the only pilot is the ATP one.

Dr. Meixner said she thought the TOR had a good introduction. However, the goals, as given in the presentation, struck her as diffuse. She liked the last goal the most as it is tractable and would serve the purpose well. If all they did was that it would be remarkable. She also thought that trying to analyze effectiveness of NASA programs is a project in and of itself. Dr. Meyer agreed, noting that the effort would not analyze efficacy, but would define the matrix of existing programs and the problems, and identify where things need to be done. Dr. Sheth said that there are similar efforts in SMD, warranting coordination. He also wondered about the timing of this SAG with the DS about to be issued. Dr. Hickox said that a full workup of NASA programs was beyond the intent, and actions that could be done in concert would be great. He recommended casting a wide net. He asked if it would make sense to get a SAG in place to respond to the DS right away, or if the DS might have something unexpected that would justify waiting. He leaned toward the former. Dr. Meyer said he did not expect the DS to go deep enough to change what they might do, but he would not mind slowing down and having the revised TORs in June. He also wanted to broaden the leadership team to better reflect the community. Dr. Meixner agreed.

Dr. Sheth pointed out that the Paperwork Reduction Act could inhibit NASA involvement in surveys, though Dr. Hertz noted that there may be exceptions for those receiving NASA funds. Dr. Hickox said he was getting the sense that people wanted to take more time on the TORs and come back in June. They are already reaching out to experts in DEI, as well as underrepresented institutions. Dr. Woodward saw a consensus that honing the TOR is reasonable and the DS might affect context. He would engage with individuals to convey that this is likely to move forward. It minimizes risk and allows a good on-ramp and will help get the desired communities poised to become involved.

Dr. Woodward read a question from Dr. Mahadevan, who was having technical difficulties: SOFIA looks like it is making great progress, but will they have the number of flight hours recommended, and what is the metric on publications? Dr. Meixner answered that increasing publications is challenging. The goal is 66 publications per year, with 100 as the stretch goal. The team is still trying to figure out why the publications are not coming out, so a user survey will be conducted to help identify barriers to publishing. To engage the community, they want to increase the number of science workshops. It had been one a year, so the team is having more of its own meetings in addition to building a greater presence at other meetings. There will be three workshops this fiscal year. SOFIA is also executing to a higher completion rate. The delays between data and papers is 2.5 years, which seems long but is comparable to great observatories. The archival call will take time in building participation, but it is working. They just hired a data analyst to look at trends. Dr. Hertz added that APD plans to put SOFIA in the next Senior Review (SR). While APD has not yet designed the SR, the standards always come down to whether the mission provides value and is worth continuing. Dr. Mahadevan wanted to know the number of SOFIA papers from 2020 and the number of flight hours above the stratosphere in 2020 or planned for 2021. Dr. Meixner took an action to get those data. Dr. Gaskin asked how SOFIA quantifies the science per dollar, and Dr. Meixner promised to bring that back to APAC as well.

Dr. Mahadevan raised another issue, that of mid-cycle calls for JWST. He felt there should be a mechanism by which people can propose for high-priority science in the middle of a cycle. Dr. Woodward wondered if this was a phasing problem. Dr. Walkowicz spoke in support of Dr. Mahadevan's comment. There should be a mechanism for mid-cycle proposals and a way to set a bar. Dr. Holley-Bockelmann noted that this might be increasingly important as MMA becomes more prominent. Dr. Woodward said that one of the PAGs is looking at MMA, and there is transformational science coming out of that approach. APAC might want to ask APD to think about this. Dr. Hickox added that MMA has brought a lot of people to astrophysics who have not been engaged previously. It is an argument for something more structured than a DDT call. It is important to avoid missing something unexpected. Dr. Hertz pointed out that NASA does not direct how to run the GO programs, but he could pass along any of these suggestions for consideration. Dr. Holley-Bockelmann thought a call that would be a target of opportunity released every so often between cycles might be a good idea. Dr. Woodward believed APAC was thinking more of strategic use of portfolio assets to pursue transformational science. It is interesting to consider portfolio-wide how to take assets to an integrated science question. Dr. Hertz said that APD is doing that to a degree. Each mission looks to optimize science, and they work together. The user groups are also interested. He would like any additional APAC recommendations in this area.

Dr. Woodward asked about the intent, scope, and engagement of the NASA/DOE RFI. Dr. Hertz said that there is no money in it, but it offers the two agencies an opportunity to collaborate better and go into new areas together. New initiatives depend on the DS. Dr. Woodward then asked if APAC had anything on IXPE or CUTE. Dr. Hickox said that with IXPE, machine learning for event detection was a welcome development to highlight. Dr. Woodward agreed, as this could have an impact on future missions. Dr. Gaskin said it was interesting to hear about smallsats and CubeSats. It shows that these collaborations and groups come together to fit all this science into a cereal-box-sized instrument. She would be happy to hear from another CubeSat mission in the future. Dr. Woodward agreed. Dr. Meyer was interested in what was said about NASA not wanting to prescribe technical solutions to working with different firms or using different buses. But yet the Agency tries to collect enough information so that if someone needs assistance, they have that. It is a non-obvious demarcation between overprescribing and correcting versus trying to facilitate connections where possible. He wanted to highlight this. Dr. Hertz replied that the Small Spacecraft Virtual Institute (SSVI) at Ames Research Center (ARC) has a lot of activities going on in this area. That is how much of NASA, including human exploration and space technology, interfaces with the smallsat community. The role of the centers is to do big things that cannot be done elsewhere while transferring expertise and knowledge out to the community.

Dr. Holley-Bockelmann thought the CUTE presentation was well done, but the leadership team seemed senior and she would be interested in hearing from teams that are relatively new. Dr. Hertz said that almost all CubeSat PIs have sounding rocket or balloon experience. However, the four Pioneers PIs are all new. Dr. Gaskin expressed interest in learning how people progress if they do not have experience. There are user groups for new people, but it is not clear how people become aware of them. Dr. Hertz said that most suborbital PIs come out of other people's suborbital groups, so they take their experience of working on someone else's project to run their own.

Dr. Woodward expressed concern about the SPB situation. Dr. Hertz replied that the pandemic affected it. In addition, it does not have a fast improvement cycle and the flight opportunities are infrequent. However, it also takes years to build a payload, so these activities are going in parallel. Dr. Gaskin asked about the likelihood that all the scheduled flights will take off from Ft. Sumner this fall. Dr. Hertz explained that not all of the PIs will be ready to fly, and weather is a factor. The program is planning on spring flights as well. It is a matter of working down the backlog while investigating additional launch sites. New site investigations had been planned for 2020 but could not occur due to COVID-19.

Dr. Woodward mentioned the addition of the filter on Roman, as well as the new logo. Dr. Hertz confirmed that it represents the focal plane, and the dots around the "o" in "Roman" are for the coronagraph. Dr. Woodward thought WFI focal plane array characterization could be an issue, but it seems to be moving ahead. Webb seems to be advancing with few additional technology gremlins, and it seems to have reserves and readiness. This mission will affect the next decade of moving forward, and APD has had good stewardship. It has also become clear that listening at the townhalls and the virtual townhalls is fruitful, and he encouraged APD to continue this.

From the R&A presentation, Dr. Bautista noticed the increment in lab astro, which was good, and he wanted the rationale behind that. Dr. Hertz did not have the numbers at hand but explained that R&A augmented lab astro with funds for capital improvement; that number is folded in with lab astro overall. Dr. Woodward asked about APD budget growth over the last 20 years. Dr. Hertz said that the core program is flat without the flagships, and APD is preserving the buying power of the rest of the program. Dr. Woodward thought the community needs to be reminded of that. He asked if APAC could get a status update on the NAS study on PI diversity. Dr. Hertz said that might be possible, but the effort had just begun and is being done out of SMD, not APD. Dr. Woodward said that APAC is largely pleased with the proposal evaluation cycles and DAPR. They did hear about some of the unintended consequences, so they want to track the back-end results vis-a-vis PIs adhering to APD expectations. Dr. Hertz said the reveal is done to the peer review panel, at which point the panelists are asked if they have concerns about the ability of the PI to carry out the work. There have not yet been any rejections on that basis, but he acknowledged Dr. Holley-Bockelmann's suggestion that it would help to have more specific language.

Regarding DAPR, it is too early to see publication data, and it is possible to envision a team that never publishes. The longer-term information could be useful eventually. Dr. Woodward said the APAC letter will have something about that. APD leadership in addressing the state of the profession is laudable. Further, APAC would like a presentation about the StarBurst and Payload for Ultrahigh Energy Observations (PUEO) missions in June, if possible. The Committee would also like to hear APD's initial reaction and responses to the DS priorities. APAC was intrigued with the ability of APD to carry on through the pandemic and get solicitations on the street without large-scale disruptions, and with very timely reviews and funding.

Dr. Woodward said that APAC wanted APD to look critically at the virtual environment for panel reviews, including elements of carbon footprint, participation, and cost. Possibly there are hybrid models that could work to benefit EC panelists. Regarding the SMD information policy, APAC will recommend

that the policy development makes sure that university-sponsored projects and institutional research offices are engaged early in the formulation of the policy so they can provide feedback and be prepared for the new requirements. Other stakeholders should be similarly informed of evolving obligations. Given that policy implementation may be a major pivot, this could affect how PIs curate their activities, possibly creating budgetary issues for them. Roman and other missions will rely heavily on the cloud computing environment. It is important to follow best practices and not reinvent the wheel.

Drs. Holley-Bockelmann and Walkowicz asked for a debrief about the process in thinking about the new name for JWST. Dr. Walkowicz appreciated the focus of the third day on making APD more inclusive and sustainable. Dr. Holley-Bockelmann was happy to see them move quickly and intentionally. Dr. Hertz said that the people who work in APD and SMD are humans, and so they are also moved and upset by the lack of progress. There are things they can do to move the needle. He thanked APAC for the honest, frank conversations.

Dr. Meyer said he would like more on Science Activation 2.0 and the response to the review. In addition, he would like an update on the Minority University Research and Education Project (MUREP) and any comparable instruments that NASA is using. Dr. Woodward said they will consider that for the next agenda. Dr. Sheth said that there is a great presentation on MUREP that would be good for APAC. He is involved in a nonprofit that works to help people create their own solutions. That might be something to think about in context of the state of the profession.

Because NASA and DC are still mostly locked down, the next APAC meeting will be virtual, occurring at the end of June. The October meeting will be 2.5-3 days. Dr. Hertz said that if there were any recommendations above the level of APD, they should go to the Science Committee.

Adjourn

The meeting was adjourned at 3:56 p.m.

Appendix A
Participants

Committee members
Charles W. Woodward, University of Minnesota, *Chair, Astrophysics Advisory Committee*
Manuel Bautista, University of West Michigan
Jessica Gaskin, NASA Marshall Space Flight Center
Ryan Hickox, Dartmouth College
Kelly Holley-Bockelmann, Vanderbilt University
Suvrath Mahadevan, Penn State
Margaret Meixner, Universities Space Research Association/Stratospheric Observatory For Infrared Astronomy
Michael R. Meyer, University of Michigan
Louis Strolger, Space Telescope Science Institute
Lucianne Walkowicz, Adler Planetarium

NASA
Paul Hertz, NASA HQ, *Director, Astrophysics Division*
E. Lucien Cox
Steven Crawford
Dan Evans
Ingrid Farrell
Barbara Grofic
Thomas Hams
Hashima Hasan, NASA HQ, *Executive Secretary, APAC*
Stefan Immler
Bernard Kelly
Carolyn Kierans
Patricia Knezek
Mark Matsumura
Julie McEnery
Neill Reid
Evan Scannapieco
Kartik Sheth
Eric Smith
Azita Valinia
Aurelia Waller
Brian Williams
Thomas Zurbuchen

Non-NASA/Unknown
Rod Adkins
Louis Barbier
Marufa Bhuiyan
Peter Bloser
Terri Brandt
Teddy Cheung
Valerie Connaughton
John Dyster
Kevin France

Jeff Foust
Paul Goldsmith
Yilen Gomez Maqueo Chew
Erika Hamden
Grace Hu
Martin Israel
Teresa Jensen
Bernard Kelly
Justin Lazear
Eric Mamajek
Emma Marcucci
Stephan McCandliss
Susan Mullally
Elizabeth Sheley, Electrosoft
Leo Singer
Josh Spradlin
Janice Starzyk
Karin Sturm
Steve Thompson
William H. Waller
Mitch Watkins
Martin Weisskopf

Appendix B
Astrophysics Advisory Committee Members

Charles E. 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

Ryan Hickox
Dartmouth College

Kelly Holley-Bockelmann
Vanderbilt University

Suvrath Mahadevan
Pennsylvania State

Margaret Meixner
Space Telescope Science Institute

Michael R. Meyer
University of Michigan

Louis Strolger
Space Telescope Science Institute

Lucianne Walkowicz
Adler Planetarium

Appendix C
Presentations

1. *Astrophysics Division Update*, Paul Hertz
2. *SOFIA Update,* Margaret Meixner/Naseem Rangwala
3. *IXPE Update,* Martin Weisskopf
4. *CUTE Update,* Kevin France
5. *Balloon Roadmap Update*, Carolyn Kierans
6. *Astrophysics Balloon Program Update*, Thomas Hams
7. *SMD Information Policy*, Steve Crawford
8. *PI Launchpad Update*, Erika Hamden
9. *COPAG/PhysPAG/ExoPAG Updates*, Margaret Meixner/Ryan Hickox/Michael Meyer
10. *Roman Update*, Julie McEnery
11. *Webb Telescope Update,* Eric Smith
12. *R&A Update*, Stefan Immler
13. *State of Profession – SMD Initiatives,* Kartik Sheth
14. *State of Profession – APD Initiatives,* Evan Scannapieco
15. *NASA's Demographic Data Collection Program*, Louis Barbier

Appendix D
Agenda

Astrophysics Advisory Committee
Virtual
March 15-17, 2021

Monday 15 March

11:00 a.m.	Introduction and Announcements	Hashima Hasan/Charles Woodward
11:10 a.m.	Astrophysics Division Update	Paul Hertz
12:40 p.m.	SOFIA Update	Margaret Meixner/Naseem Rangwala
1:10 p.m.	IXPE Update	Martin Weisskopf
1:40 p.m.	CUTE Update	Kevin France
2:10 p.m.	Break	
2:25 p.m.	Balloon Roadmap Update	Carolyn Kierans
2:55 p.m.	Astrophysics Balloon Program Update	Thomas Hams
3:25 p.m.	SMD Information Policy	Steve Crawford
3:55 p.m.	Public Comment Period	
4:05 p.m.	Discussion	APAC members
5:00 p.m.	Wrap Up for Day 1	Charles Woodward

Tuesday 16 March

11:00 a.m.	Opening Remarks	Hashima Hasan/Charles Woodward
11:10 a.m.	PI Launchpad Update	Erika Hamden
11:40 a.m.	COPAG/PhysPAG/ExoPAG Updates	Margaret Meixner/Ryan Hickox/ Michael Meyer
12:40 p.m.	Discussion	APAC members
1:00 p.m.	Meet with SMD AA	Thomas Zurbuchen
2:00 p.m.	Public Comment Period	
2:15 p.m.	Break	
2:30 p.m.	Roman Update	Julie McEnery
3:00 p.m.	JWST Update	Eric Smith/Neill Reid
4:00 p.m.	R&A Update	Stefan Immler
4:55 p.m.	Wrap Up for Day 2	Charles Woodward
5:00 p.m.	Adjourn	

Wednesday 17 March

11:00 a.m.	Opening Remarks	Hashima Hasan/Charles Woodward
11:10 a.m.	State of Profession – SMD Initiatives	Kartik Sheth
11:40 a.m.	State of Profession – APD Initiatives	Evan Scannapieco
12:00 p.m.	NASA's Demographic Data Collection Program	Louis Barbier
12:30 p.m.	Discussion	APAC members
1:00 p.m.	Public Comment Period	
2:00 p.m.	Break	
2:15 p.m.	Discussion	APAC members
3:30 p.m.	Recommendations, Actions	Charles Woodward
3:45 p.m.	Brief to Division Director	
4:00 p.m.	Adjourn	