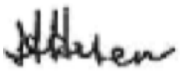
NASA ASTROPHYSICS
Astrophysics Advisory Committee

October 28-29, 2019
Washington, DC: Telecon/Webex

MEETING MINUTES

November 25, 2019

Feryal Ozel, Chair



November 18, 2019

Hashima Hasan, Executive Secretary

Table of Contents

Prepared by Jeanette Edelstein
Electrosoft

Monday, October 28

Introduction and Announcements

Dr. Hashima Hasan, Executive Secretary of NASA's Astrophysics Advisory Committee (APAC), opened the meeting with administrative announcements. She reminded the participants that this is a federal advisory committee established under the Federal Advisory Committee Act (FACA), so all FACA rules applied. The meeting was open to the public and any member of public who wished to speak during public comment period must be recognized. Also, in compliance with FACA, formal minutes were being taken and all presentations should be considered to be on the record.

Dr. Hasan added that each member of the Committee had been appointed to the position because of their subject matter expertise. Each member is subject to Federal ethics laws and those with potential conflicts of interest should recuse/disqualify themselves, when applicable. She identified the following conflicts: Dr. Jessica Gaskin on Imaging X-ray Polarimetry Explorer (IXPE), and Dr. Margaret Meixner on James Webb Space Telescope (JWST, or Webb). In addition, on the Wide Field Infrared Survey Telescope (WFIRST), all members of the Committee were conflicted except Drs. Kelly Holley-Bockelmann, John Conklin, Charles Woodward, Jessica Gaskin, Massimiliano Galeazzi, Lucianne Walkowicz, and Suvrath Mahadevan. If there were conflicts other than those identified, Dr. Hasan asked the members to identify them.

Dr. Hasan then welcomed everyone to the meeting. She thanked Dr. Feryal Ozel for her service to APAC, as this was her last meeting. Dr. Hasan took roll and then invited Dr. Ozel to Chair the meeting.

Dr. Ozel introduced herself and welcomed everyone to the Fall meeting. She stated this telecon-only meeting had a very full agenda with time for discussion at the end of each presentation. She began by introducing Dr. Eric Smith to give the Astrophysics Division (APD) update.

Astrophysics Division Update

Dr. Smith, the APD Chief Scientist, noted that the APD Director, Dr. Paul Hertz, usually covers the recent science highlights, budget, and policy matters. Since Dr. Hertz was at the WFIRST Preliminary Design Review (PDR), he had asked Dr. Smith to make the presentation. Dr. Hertz joined by telecon later and answered questions.

Science highlights

Dr. Smith reviewed a number of NASA science updates. Data from the Spitzer Space Telescope were used to get a glimpse of conditions on a planet orbiting a star beyond the Sun. The planet was discovered by NASA's Transiting Exoplanet Satellite Survey (TESS), which looks at the signature of the combined planet and stellar system to get an assessment of planetary temperatures to determine whether a planet has atmosphere. The first observations of a massive black hole dining regularly on something that had fallen in were seen in results from ESA's XMM-Newton and NASA's Chandra X-ray Observatory in early September. The Hubble Space Telescope (HST) gathered data that showed water vapor in a habitable exoplanet with temperatures that could sustain liquid water. The team is looking forward to more findings in the coming years with Webb when it is operation.

Dr. Smith gave an update on NASA's Artemis program and plans to return to the Moon. He reviewed the suborbital programs at the South Pole. Mr. James Bridenstine, NASA Administrator, has said he will not be using science to fund the Artemis program, but having been tasked with returning to the Moon, he recognized that he would need science to get there. Partnerships in the commercial sector are being

sought. One investor, Astrobiotic, will be visiting Lacus Mortis (Lake of Death), for example. He reviewed the areas of science slated for pre-2024 and post-2024.

There was a review of the efforts the NASA Science Mission Directorate (SMD) has taken towards building the workforce, as it is of importance to the SMD Associate Administrator, Thomas Zurbuchen. These steps included relying on diverse teams, adding and implementing training workshops and career development opportunities, and adopting dual-anonymous reviews for proposals.

Dr. Smith then gave a detailed budget update. He reviewed the FY20 President's Budget Request (PBR), which accommodates the Webb replan to a March 2021 launch readiness date, terminates WFIRST, supports the formulation of a probe mission as early as 2022 conditional on Decadal Survey (DS) recommendations, maintains DS cadence of four AOs per decade for Astrophysics Explorers and Missions of Opportunity (MO), funds the Stratospheric Observatory for Infrared Astronomy (SOFIA) for 3 years, extends operating missions at a reduced budget beyond FY20, and supports mission concept studies and technology investments starting in 2022.

The House markup of the FY20 budget includes funding for WFIRST, SOFIA, Webb, and other astrophysics. The Senate markup includes funding for WFIRST, HST, Webb, and the Research and Analysis (R&A) program. Both budgets include Webb under APD. Dr. Ozel asked to review the impact of the House markup on Astrophysics, specifically, whether it represented a cut. There was discussion about the need for NASA to explain to Congress any reasons why the goals were not met within funding. Dr. Smith then reviewed the Congressional markup of the Astrophysics budget for FY20 and the total money invested in NASA Astrophysics.

Dr. Jones asked whether there was language in the SOFIA line that described the intent, and Dr. Hertz replied that there was no language describing the intent of the extra $12 million.

General Program Update
Dr. Smith gave an overview of the growth in R&A funding, which showed a 26 percent increase in R&A support since the last DS and a projected 33 percent increase over the next 6 years.

He then reviewed the status of current programs:

- *Balloon Program* – Fort Sumner Campaign. This campaign is just finishing up and was completely successful. Ms. Debora Fairbrother was scheduled to give a complete review later in the meeting.
- *Webb* – The spacecraft element has successfully completed environmental testing. Sunshield deployment and tensioning has been completed. FY20 observatory testing is scheduled in preparation for the expected 2021 launch.
- *WFIRST* – Work continues with FY19 funding. The telescope is in the midst of PDR by the standing review board for technical status, feasibility assessment, and budget.
- *IXPE* – The project successfully completed the Critical Design Review (CDR) and selected the SpaceX Falcon 9 as the launch vehicle. Delivery of the first flight detector unit is planned for December 2019.
- *Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory (GUSTO)* – This long duration balloon (LDB) will be able to do science equivalent to 300 dedicated SOFIA flights. The Critical Design Review (CDR) was completed in October 2019 and launch is scheduled for December 2021.
- *XRISM* – The launch for this mission, by the Japanese Space Agency (JAXA), is planned for early 2022. The call for U.S. participating scientists is anticipated in ROSES 2020.

- *Euclid* – NASA completed all flight hardware sensor chip systems deliveries in June 2019 for the NISP instrument focal plane. The assembly integration and test phases are now underway for a planned June 2022 launch.
- *Spectro-Photometer for the History of the Universe, Epoch of Reionization and Ices Explorer (SPHEREx)* – This mission surveys the sky every 6 months in optical infra-red bands.
- *Explorers* – This program has achieved four AOs in a decade.

Dr. Smith noted that Spitzer, which will end in early 2020, and the completed Kepler mission have given the public a new way to think about astronomy – it is the exoplanet bonanza for the public and astrophysics community for planet finding. Following the 2019 Senior Review, APD will keep most of the missions going with few changes.

The 5-year prime mission for SOFIA was completed at the end of FY19. Two assessments of the program and reviews were done to improve science and science productivity going forward. More details to be presented by Drs. Kartik Sheth, Naseem Rangwala, and Harold Yorke as part of this meeting.
Dr. Smith listed the panels and chairs for the DS, including Science, Program, and State of the Profession.

Dr. Ozel thanked Dr. Smith and commented that, as the scientific community and public at large, we tend to focus on negative news; she commended APD for such a successful program. She asked about the Senate budget markup having a SOFIA line up that is grouped with the rest of Astrophysics. Dr. Smith's understanding was that the House called out SOFIA distinctly, but the Senate included SOFIA with the rest of Astrophysics and accepted it with the overall request. Dr. Ozel said she hopes the $134 million dollar deficit from the Senate gets negotiated further. Dr. Hertz replied that it depends on how the conferencing goes and the language in the final appropriation. If the House language is in the approved appropriation, then that difference would have to go to SOFIA.

Discussion
Dr. Jones requested clarification about how the science in the Lunar Discovery and Exploration Program (LDEP) was being funded. Dr. Smith said that APD funding is not being used, rather it's a new budget line in SMD science specifically addressing lunar science and lunar payloads. Dr. Jones asked whether, if there are applications where astrophysics would benefit, and if there will be an avenue for proposals through the lunar program. Dr. Hertz said that all payload calls for lunar surface payloads would be open to all areas of NASA science, including astrophysics. It was noted that last year SMD put out a proposal call in ROSES (ROSES-2018, Element C.28, "Lunar Surface Instrument and Technology Payloads") that included astrophysics, and one astrophysics-relevant payload was selected. All payloads selected within LDEP are budgeted through the lunar exploration program. Astrophysics payloads that could take advantage of the Gateway or NASA's return to cis-lunar space were also solicited this year as Astrophysics Explorers Missions of Opportunity, and any missions selected through that call would be Astrophysics Explorers Missions of Opportunity and would be paid for out of the Explorers Program budget. Mr. Steve Clark's LDEP program is planning to put out future calls for lunar surface science experiments and astrophysics will always be included in those solicitations. Dr. Galeazzi added that there were two more science-oriented payloads from last year's proposal from APD and the Heliophysics Division (HPD). There are limitations because there are only about 15 days before you go into lunar night, but they are interested in Astrophysics proposals.

Dr. Leonidas Moustakas was interested in learning more about the new Principal Investigator (PI) Resources web page. He asked Dr. Smith to comment on the balance between Astrophysics versus SMD. Dr. Hertz clarified that it's all SMD. Drs. Moustakas and Hertz discussed what APD could do to engage the broader community. Dr. Hertz said they want to make sure all early and mid-career scientists are aware of the opportunities, including learning how to do PI submissions and getting access to resources that could help them. Outreach is really important. There are astrophysics scientists participating in the

program now. Dr. Woodward asked whether there are efforts to increase engagement and diversity, and Dr. Hertz requested this question be included in the notes/report, as he would look into it.

There was clarification that a Preliminary Design Review (PDR) is one of the standard NASA lifecycle reviews; it is the gateway review that leads to confirmation. The main criterion is to establish that all requirements for the mission have been laid out and flowed down to constrain design and build. Design review is at a higher level; the team demonstrates that they have an overall architecture and it meets all requirements for planning personnel, funding, and time.

There was a discussion to clarify the specifics of the structure of the LDEP within SMD. It is a small staff (3-4 people) and was set up in response for the Agency's return to the moon. It is headed by Mr. Clark, who has a lot of experience across the Agency. It is not a Division, it is an Office of the SMD Associate Administartor, and they do not have an advisory committee yet, though they do take input from the Lunar Exploration Analysis Group (LEAG), which operates out of the Planetary Science Division (PSD).

Dr. Hertz discussed the evolving nature of the Gateway. It is not a structure with well-defined interfaces, yet. It is being treated by the Astrophysics Division like the International Space Station (ISS), in that there are opportunities to mount external experiments off the Gateway. Calls are included in all on appropriate solicitations. As a policy, when there are opportunities for Astrophysicists to propose for access to the Moon or cis-lunar space, then calls will be open to Astrophysics Science.

In response to a question about the length of SOFIA's prime mission, Dr. Hertz explained SOFIA must have a 20-year capability; however, the governing documents specified a primary mission of 5 years with review for extended mission. After the prime mission is finished, it is up for an extension review every 3 years, as are all missions.

Dr. Ozel thanked Drs. Smith and Hertz for the update and discussion.

Dr. Meixner asked about the JAXA and European Space Agency (ESA) missions. Dr. Conklin, who works on the Laser Interferometer Space Antenna (LISA), gave an update on Phase A, which should go through the end of 2020, at which point they hope to transition to Phase B. Dr. Laura Brenneman said XRISM is a bit farther along that LISA. They have accelerated the rebuild and are on schedule for early 2022. She discussed the NASA contributions, which have been largely the Resolve instruments, the microcalorimeter that is going to achieve revolutionary spectral resolution. Everything on the JAXA side seems to have proceeded as expected. Dr. Ozel said if there is something the Committee thinks APD could be doing regarding the Moon, she can take it to the NAC Science Council.

PhysPAG Update
Dr. Conklin began his update by reviewing the purpose of the PhysPAG. He also reviewed the Executive Committee (EC) and upcoming membership changes. The Great Observatories Study Analysis Group (SAG) strategic goal is to maintain broad multi-wavelength coverage to maximize science return. He then reviewed the highlights of the last several months. Updates on Science Interest Groups (SIGs) included the

- Cosmic Ray SIG hosted a mini-symposium, produced approximately 16 white papers, and initiated community outreach
- Gamma-ray SIG coordinated sessions for various conferences, produced a webpage to coordinate science white papers for Astro2020, and contributed a paragraph to the May 2019 newsletter on the status of Gamma-ray missions
- Gravitational Wave SIG organized a community response to white papers for Astro2020, organized a session at the January American Astronomical Society (AAS) meeting, and continued interactions with the LISA consortium

- Inflation Probe SIG produced eight APC whitepapers for the Astro2020 DS related to space-based projects, technological development, or ground-based projects
- X-Ray SIG coordinated sessions at AAS and High Energy Astrophysics Division (HEAD) meetings, produced a webpage coordinating community Astro2020 science white papers, planning to provide an overview of Astro2020 papers for AAS, provided updates to community on Athena and the NASA concept study for Lynx Observatory, had a major recent milestone in x-ray astronomy: launch of two new telescopes X-Gamma S/C with extended ROentgen Survey with an Imaging Telescope Array (eROSITA) and Astronomical Roentgen Telescope X-ray Concentrator (ART-XC).

Dr. Conklin then reviewed the goals of the Multi-Messenger Astronomy (MMA) SAG. These include determining what science goals can be achieved by combining different astrophysical messengers measured by current and future ground- and space-based observatories, with a focus on currently improved and future planned space observatories in the 2020s and early 2030s; determining how enhanced or new science goals align with NASA astrophysics; and identifying key qualitative technical drivers.

The MMA SAG source teams are organized around astrophysical sources, with the goal of observing the same sources via different messengers. The group has produced 10 community science white papers, including one overarching paper submitted to the 2020 DS. They have also drafted a final report circulating via overleaf and have a plan to complete a near-final report before end of CY2019.

PhysPAG's input to the Technology Gap Assessment was sent to the PhysPAG EC in early June, and the PhysPAG EC report was submitted to Dr. Thai Pham of APD in July. Dr. Conklin discussed a few gaps in the process, noting that there were sometimes issues of clarity, missing information, lack of specific knowledge, or concern about misrepresenting intent.

PhysPAG is planning for several meetings and activities in the near future: the January AAS, the April American Physical Society (APS), and the AAS HEAD in September. Regarding the Detector Characterization Laboratory (DCL) for new PhysPAG members, the PAG advertised and reached out to encourage the community to apply. The group is expecting new members, including a new vice-chair announcement in November.

Dr. Gaskin asked whether the process for identifying gaps was good, and Dr. Conklin said that he thought the process was good, but the EC's role was just one step among many. The goal is to help NASA prioritize the gap and allow the community to provide input.

<u>COPAG/ExoPAG Updates</u>

COPAG

Dr. Meixner listed the COPAG EC members, some of whom will be rotating off. COPAG is recruiting up to four new members, with a deadline for nominations of November 1, 2019.

Dr. Meixner reviewed COPAG activities since August 2019. Many EC members continued to be active contributors to the Science and Technology Definition Team (STDT) exercises, and the COPAG EC continues to track STDT activities through the Origins, HabEx, Large UV/Optical/IR Surveyor (LUVOIR), and Lynx team contacts. CoPAG has two SIGS, on IR and UVis, one Technical Interest Group (TIG), and a recently completed SAG (SAG10 – Great Observatories). They were proposing a new SAG (SAG11 – Cosmic Dawn).

Activity highlights and near-term plans for the IR SIG included:

- AAS Winter 2020 Splinter Session: The role of infrared astronomy in NASAs Strategic Vision to 2030; plans for talks from Origins, Space Infrared Telescope for Cosmology and Astrophysics (SPICA), SPHEREx, SOFIA, JWST, and an early career scientist program.
- Ongoing monthly webinars.
- SIG Leadership Council membership changes
- Continuing outreach to early career IR scientists
- A plan to solicit feedback from the entire IR SIG community to set 2019/2020 activities

Dr. Meixner gave an update on the Great Observatories report. She noted the huge effort by many people and said they are currently at the typo-level polishing stage. They plan to post it on the SAG10 website soon. The contributor list includes 33 authors, 2 co-chairs, 10 subject co-chairs, and 26 institutions. It covered four areas of past and future multi-wavelength science: Evolution of Galaxies; Fundamental Physics; Formation of Planets, Exoplanets, and Origin of Life; and Galactic Processes and Stellar Evolution, Fundamental Physics. All of these have benefited by having multiple missions that come to bear on problems.

Dr. Meixner reviewed a graph that indicated impending gaps in panchromatic coverage will inhibit progress and erode expertise, and she noted that there is opportunity for progress and a need to maintain expertise in this area.

Lessons from the Great Observatories were summarized and reviewed:

- Commensurability of capabilities are essential for multi-wavelength science.
- Mission concurrency enables time domain science and fuels rapid progress in all areas.
- General observer (GO) programs provide a rapid response to a changing scientific landscape.
- Archives provide new science and set the foundations for future observations (but don't necessarily provide commensurability and concurrency).
- A range of mission sizes can result in commensurate and concurrent capabilities.

The key finding was that a program with a strategic goal of maintaining broad wavelength coverage will provide maximum science return in the coming decades by reestablishing a panchromatic, community-driven, interconnected suite of space observatories. More specifically, Dr. Meixner spoke about three key components for success: panchromatic capabilities, mission longevity, and planning. Finally, a program of "Giant Leap Observatories" that builds on the model set by the Great Observatories can advance our understanding of the Universe far into the future.

Regarding an integrated approach to a portfolio of activities, Dr. Michael Meyer said that would have been considered beyond the charge. They weren't supposed to create a strategic plan but were charged with collecting findings. There was discussion about whether an integrated approach may be more forward-looking. Dr. Meyer said this was really designed to remain agnostic as to recommendations.

Dr. Moustakas noted that it could be interesting with broad Observatory capabilities, in looking at the panchromatic capabilities figure, to know what combination of those would have the greatest impact for gravitational wave multi-messenger astrophysics. There was discussion about the possibility of whether the PhysPAG and COPAG might work together to show the complementary nature of space-based and ground-based observations.

Dr. Meixner then reviewed the Cosmic Dawn SAG proposed charter, starting with the goals: identify questions that will remain after the conclusion of the JWST mission; assess the potential for the proposed NASA flagship missions and NASA probe missions to answer these questions; examine the potential for panchromatic observations that can be done now; and identify the need for coordinated programs between

multiple observatories, archives and/or numerical simulations. She noted that the ultimate goal is to publish a report delivered to NASA HQ by the end of 2020.

Dr. Moustakas noted that the range of eras that Cosmic Dawn generally covers will probably require some low-frequency observations that might be relevant to NASA science missions and that science capabilities related to Artemis or the Gateway might be in play for the consideration of low radio background locations. He wondered whether the Artemis framework might be relevant to this SAG. Dr. Holley-Bockelmann said that there will be significant overlap with the LISA gravitational wave mission and encouraged everyone to think broadly to catalogs, for example, from LISA and Lynx.

Dr. Meixner reviewed the timeline. She said the Cosmic Dawn SAG charter would be confirmed by the end of the calendar year and they were hoping to start recruitment and gather people at the AAS in January. The suggested timeline for comments is mid-November. She hoped for feedback from APAC. She would also like to see people from PhysPAG involved. Dr. Ozel recommended going offline to talk about ideas for engaging the broader community. Dr. Ozel said that APAC approval of the new SAG may be required. She would check the process and get back with Dr. Meixner.

Finally, Dr. Meixner reviewed COPAG's future activities. The bi-weekly EC telecons will continue; recruitment of members for the Cosmic Dawn SAG will begin, pending approval; and AAS splinters will take place in January.

ExoPAG Update
Dr. Meyer reviewed the EC, including new members and those rotating off. There is a call out for new members and he is expecting them to join this year. They are seeking diversity to afford NASA the best advice possible.

Dr. Meyer reviewed the 2019 status of SAGs and SIGs. He asked for clarification about whether SAGs and SIGs require approval and formal recognition. Dr. Ozel said she would find out and report back.

The recent ExoPAG activities included:

- The meeting in Seattle in 2019, which had a mini-science symposium, included discussion of interdisciplinary and cross-divisional activities, and included a 3-hour EC session.
- Facilitated coordination of submitted white papers for Astro2020.
- Organized a community data challenge to compare algorithms in finding planets in ground-based direct imagine datasets as part of close-out of SIG19.
- Completed the JWST community impact survey of SAG20.
- Participated in the Great Observatories SAG with COPAG.
- Made plans to participate in a joint Venus Exploration Analysis Group (VExAG)/ExoPAG/Outer Planets Analysis Group (OPAG) conference, "Exoplanets in Our Backyard," in Feb. 2020

Dr. Meyer reviewed the motivation behind SIG2: exoplanet demographics reveal planet formation, migration and evolution processes, and are key in predicting the yields of future missions. He noted that no one technique can tell the whole story. The goal of SIG2 is to extend the Kepler-centric demographics of SAG13. Progress to date included monthly telecons, coordinating white papers for Astro2020, work on a draft report regarding the value of a public database, a list of questions and projects for the community, and a proposal for a mini-symposium for the next ExoPAG meeting. Dr. Meyer also reviewed the survey results for the SAG20 strategies for migrating the impact of the JWST delay on exoplanet science. ExoPAGwill forward the final report to NASA and ask to close out this SAG in March, 2020.

Dr. Meyer then presented future activities for ExoPAG 2019/2020, which include work with the Exoplanet Exploration Program (ExEP) to map the Science Gap List to key areas for ExoPAG inputs. Dr. Gaskin asked how the group determines what is a near-term versus a long-term science gap. Dr. Meyer said it's blue sky, meant to go to the whiteboard and write down what you really want in a broad sense. There were questions about how that maps to addressing astrophysics mission goals and how one would decide when one had closed the gaps. It will be difficult. At the next meeting, the group wants to come up with a list of topics for ExoPAG21 discussion and maybe to identify ashort list of findings to work towards at end of the meeting. Additionally, monthly telecons continue. They are hoping for final reports and request closeout of SAG19, SAG20, and Great Observatories Cross-PAG SAG. They hope to have complete charters and a proposal for SIG 3 (Exoplanets and Solar System) by March 2020.

No actions were requested by ExoPAG at this time. Dr. Meyer added that they are tracking international co-operation when possible, and that the review of technology gaps in ExoPAG seems to be different than in other PAGs.

SOFIA Update

Dr. Kartik Sheth gave an overview of the recommendations from the SOFIA reviews. SOFIA became fully operational in 2014 and completed its 5-year prime mission in 2019. It was banned from being included in the Senior Review by Congressional appropriations language.

Dr. Sheth reviewed the SOFIA Operations and Maintenance Efficiency Review (SOMER) Executive Summary. The SOMER executive summary had four main points: fundamental changes in the management model, operational paradigm, and the workforce construct are necessary; the program conducts safe flight operations; the program suffers from sub-optimal flight-hour production, historically low dispatch rates, and an unnecessary and/or underutilized workforce; and, these inefficiencies encumber the program and originate from SOFIA senior management's failure to effectively transition its workforce and processes from a development model to an operational model.

Next, Dr. Sheth reviewed the recommendations from the Flagship Mission Review (FMR) Executive Summary. The 10 FMR recommendations were to 1) nurture a science-driven culture within the mission, 2) embrace change in operational approaches, 3) emphasize completion of high priority science programs, 4) emphasize the collection of high quality data, 5) maximize observing time at stratospheric altitudes, 6) fly more southern hemisphere flights, 7) transfer data products into the archive quickly, 8) split aircraft operations from telescope/science operations, 9) invoke the High-Resolution Mid-Infrared Spectrometer (HIRMES) cost and schedule control, and 10) focus on current science operations rather than future instrument development.

There was a discussion about the recommendation for more southern hemisphere flights and Dr. Sheth talked about possible departure locations.

NASA has the following responses:

1. NASA Ames Research Center (ARC) will manage SOFIA with the focus on science and mission operations, as recommended by FMR. NASA is converting SOFIA from a single-project-program to a project within the Astrophysics Strategic Missions Program. There is a new project manager who will develop a new project plan that includes metrics based on the FMR report.
2. ARC is engaging with partners AFRC in identifying new operational procedures.
3. HQ expectation that SOFIA will be operating at a higher cadence and higher science productivity by the end of CY19.

Dr. Naseem Rangwala talked about what ARC has been doing. The vision for SOFIA is aligned with the recommendations of the two reviews. She envisions SOFIA to be significantly more productive, produce

an archive with a long-lasting legacy, and be beneficial to other APD missions. SOFIA is currently being led by a new interim manager. The team is in the process of assessing and addressing the recommendations of the reviews. They are looking at the effectiveness of shorter duration flights, how they solicit and evaluate proposals, and the collection of high quality data. They are also focusing on a higher completion rate of programs and operational efficiencies to maximize time in sky. The last observing cycle was the most successful yet. They are at a good launching point for taking a bold step forward.

The new project manager started on September 1, 2019. The Project Level Requirements Appendix (PLRA) has been signed by the Project; the Project Plan is under development. SOFIA will be a single project managed by ARC. The project is working to identify and implement additional operational efficiencies. There are regular communications between NASA HQ, ARC, and the SOFIA project as changes are made during transition.

There was a request for regular updates regarding the detailed backup slides at APAC meetings. Dr. Rangwala clarified that they have weekly meetings with program scientists and program executives for reporting during the process. The SOFIA operations manager is leading the response to all the SOMER recommendations. The goal is to have that done by the end of this year. There will be one way to report back to APAC and APD. Some of the recommendations can be implemented very quickly and some will take longer. Timelines should be ready, with milestones, at the end of the year.

Dr. Moustakas asked for clarifications about references to high priority science programs and high quality data. Dr. Yorke responded that they have to do with an earlier philosophy of SOFIA, that it was treated as a ground-based observatory; if there was a lost flight, it was tough luck for observers, who would have to apply for another time. Now the mission is prioritizing programs and guaranteeing Priority 1 programs. Priority 2 programs, if started, will be completed; if they are not started, NASA encourages PIs to resubmit; Priority 3 programs are open to “dead legs” or “flash call” proposals.

Dr. Rangwala said that FMR asked for a lot of RFIs and would like to see a higher fraction of proposals converted into papers. The project will be assessing all factors that go into that conversion. Dr. Ozel remarked on the management changes discussed in the presentation. She wondered about the point about “maintaining a science-driven culture” and asked what else is seen as an impediment to publication rate. Dr. Rangwala responded that FMR felt that the culture at the science center should be more science-driven and less operations-driven.

Dr. Ozel asked for more examples of how they’re increasing productivity, moving maintenance out of the observing season, for example. Dr. Rangwala said they’re looking at things like contractual language, which could constrain activity for something like software updates, for example. Another example would be exchanging northern hemisphere flights for southern hemisphere flights, if there are budgetary constraints.

Dr. Yorke began his presentation by showing an example of the types of images they are getting. He stressed the fact that Science Mission Operations (SMO) is carefully considering and embracing the recommendations of the FMR report. He then reviewed their responsibilities, which are to run the science center, have personnel on the airplanes, take care of the data acquisition and distribution, and help publish data if there are needs around data analysis. They take care of all the instruments, which are basically everything that is removable from the airplane.

Dr. Yorke gave an update on the program activities underway. There are ongoing, regular strategic meetings with SOFIA Project personnel at NASA Ames; they are identifying/eliminating/reducing “impediments to change” both within and external to SMO. SMO is reorganizing by adding, reducing and

consolidating roles and new responsibilities for staff to enhance efficiencies. They are also creating a way to follow a particular PI from proposal submission to necessary Astronomical Observation Requests (AORs) and publication. There is cross-training of instrument and telescope operators underway. Dr. Yorke talked about a 5-flight week test that was recently conducted and the specifics of those flights. He continued his update with information about calls for proposals and new positions for postdoc and staff scientists. There has been recognition that staff was fairly stressed. The SMO is developing automation software to reduce mundane/repetitive staff activities, and is making the SOFIA pipeline publicly available.

Regarding the quality of SOFIA proposals, there has been a vast improvement over the last year. Cycle 8 selections, which are just starting, will reflect an emphasis on "enhancing science productivity." Selections to be announced in December depend on negotiations with NASA. Goals include fewer but longer instrument campaigns, optimization of flight length and frequency, and adjustment of observing time to accommodate conditions.

Dr. Yorke wrapped up his presentation by giving an update on the First SOFIA Legacy Science Program data. It is Level 3 data, publicly available. The Legacy Science Program team will provide enhanced Level 4 products.

Dr. Ozel thanked Dr. Yorke and opened the meeting for questions.

Dr. Holley-Bockelmann asked what the typical time scale was for getting the data from the instrument into an archive prior to this review. Dr. Yorke responded that there is a need to distinguish between facilities science instruments and PI-led instruments, because each has a different requirement. He discussed data reporting requirements and challenges for various teams and stated that this team is trying to tighten those timelines into optimal windows. They are making every effort to fulfill requirements for facilities scientists but also help the PIs fulfill their instrument needs.

There was a discussion about Level 1 versus Level 3 data requirements. Dr. Yorke said the requirements he's been discussing are Level 3, which are usually reported within 15 days. It was noted that they're doing just as well in Cycle 7 as they did in Cycle 6, in terms of data reporting.

Dr. Meixner asked about the demographic that has moved into the scene via more proposals. Dr. James Yorke said they had 41 new PIs out of 210 proposals; he's not sure about the exact demographics, but they are attracting a new community. People are asking for more ambitious projects and more hours. Dr. Yorke added that the proposals came from 22 different countries. They have considered, and would like to see, a move to double-blind proposals and they are looking to the Cycle 9 selection for that. They would be looking for concurrence from the NASA side of the project.

Dr. Ozel asked whether the primary reason for 8-hour versus 10-hour flights was the effect on pilots. Dr. Yorke said the idea was that having shorter flights would reduce stress on all flying personnel and you get up to altitude quicker where there is generally less water vapor. He discussed the effect of flight length on water vapor value and the southern versus northern hemisphere winter related to that. Dr. Sheth referred Dr. Ozel to his SOMER-specific recommendations for improvement. Dr. Yorke also addressed the stress to flying personnel, including whether it was the late landing times that increased stress levels. He said it has been posited that there is not enough time for staff and ground personnel.

Balloon Update

Ms. Debora Fairbrother started her update with a reminder that the Balloon Program offers a platform for science to do cutting edge research, develop technologies for future spacecraft science missions, advance lighter-than-air platform technologies, provide calibration and validation of on-orbit instrumentation, and

enable hands-on training of the next generation of scientists and engineers. She also reviewed the flight manifest for this year and next year.

Ms. Fairbrother reviewed a series of balloon leaks and their inflation tests. The purpose of the testing was two-fold: Crew Chief training, and leak investigation. Six moored-balloon inflation tests were conducted between March and June 2019. No root cause was found for all the leaks, but the team learned the following: the launch collar can induce damage, the level of damage is reduced with a higher collar release angle, collar electronics functioned 100% during all CCT (new ACER system), post-test inspections of balloon carcass were extremely valuable, and the balloon bubble angle was reduced when the collar location was lowered.

Ms. Fairbrother gave an update of the FY19 Palestine Campaign. This campaign was canceled due to recent balloon leaks and higher populations around the Palestine, TX launch location. Decisions were made based on NASA flight safety requirements.

The FY19 Fort Sumner Campaign required an assumption of a high probability of failure. Ms. Fairbrother discussed the required probability of failure rate and the impact on flight planning. Ultimately, they got the probability of failure down to .28 and were able to fly all large balloons and two small launch balloons and return to the standard way of operating. There was consideration about what could be done to reduce the launch stress index, but in some science missions it just wasn't possible because it would lower the altitude, which was not acceptable for science purposes.

Ms. Fairbrother then discussed all the missions for FY19 Fort Sumner Campaign, which was very successful. As part of the FY20 Antarctica Campaign Super-TIGER will be re-flown, having been recovered and refurbished in FY19, BLAST-TING was winter-overed from FY19-FY20 due to breakdown in circulation, and two more Super Pressure Balloon (SPB) trajectory pathfinder balloons, with Balloon Array for Radiation-belt Relativistic Electron Losses (BARREL) as mission of opportunity will be flown. There is hope that this campaign will get more data to be used in GUSTO. BARREL instruments had additional payloads recovered from their campaigns in Sweden that are now being utilized for trajectory data.

The FY20 New Zealand Campaign begins in mid-February with a first flight ready date of March 26, 2020. The SPB test flight is scheduled to fly out of Wanaka in 2020. The Compton Spectrometer and Imager (COSI) will be the science mission of opportunity.

Overall, the new processes and procedures the Balloon Program has implemented address quality issues, balloon leaks, operational modifications, launch opportunities, a small hand launch balloon system, and the SPB development path to qualify for December 2021 GUSTO mission.

Ms. Fairbrother clarified that the BARREL flight trajectories are not in the critical path for GUSTO. The balloons will either circle Antarctica or start spiraling out. GUSTO has planned for both possibilities.

Ms. Fairbrother discussed plans for Palestine, TX. In the short term, they will be limited to smaller balloons on the order of 4 or 11. They need to follow up with safety to see if they'll be in a position to do smaller balloons or whether they'll have to have more successful flights in order to bring the probability into the safety range. They are attempting to identify locations across the United States that would be suitable for flights in terms of environmental and safety implications. One example is Burns, OR. They also might consider launching in a U.S. site prior to launching in Antarctica. She added that, in order to make that possible, they would need a third launch crew.

In terms of phasing and crew scheduling for a second remote campaign outside of the U.S., they are currently funded for one per year. There is a lot of interest in Sweden for the 2021-22 time frame. There is a balance between overburdening the crews but still getting the science done. Ms. Fairbrother said that this depends on what the total mission model looks like and what kind of personnel are required and when. There was discussion about the difference for crew members between a Palestine operation and a field operation. In order to do Burns, OR, additional funds are necessary and possibly additional personnel, but there is a need to check feasibility first.

Regarding the facilities in Wanaka, NZ, Ms. Fairbrother said the airport is going into a master planning process and has put the NASA building aside while that is in process. Ms. Fairbrother intends to consult with them in person in early 2020 to determine possibilities and potential for something like a temporary structure. Also, from a safety standpoint, what kind of probability of failure is being assigned and whether there are other locations that may be more remote.

Dr. Ozel thanked all the speakers for their time and expertise and the committee members for being present. She also thanked the public for participating. She reminded everyone of the start time for Day 2.

Wrap Up for Day 1
The meeting was adjourned for the day at 5:00 p.m.

Tuesday, October 29

Opening Remarks
Dr. Hasan welcomed everyone to Day 2 of the APAC and took the roll call of members.

Dr. Ozel welcomed all members of the committee, all speakers, and all members of the public. She reminded everyone that there is time reserved for Q&A at the end of each presentation and that the FACA rules that were reviewed on Day 1 regarding ethics and conflicts of interest still apply. She introduced Drs. Fiona Harrison and Robert Kennicutt for the Astro2020 Update.

Astro2020 Update
Dr. Harrison began the presentation by reviewing the members of the steering committee. They aimed for a broad expertise when appointing the members. She reviewed highlights from their first steering committee meeting, attended by NASA, NSF, and DOE. The agencies want to have an ambitious program. They are also tasked with providing decision rules, which can be budgetary, scientific, etc.

White papers are the primary mechanism for the community to provide input. There were 590 science white paper submissions. There were 300+ submissions of activity, project, and state of the profession consideration white papers.

An overview of the Astro2020 Panels was given: six science panels, five program panels considering projects, a panel on enabling foundations, and a panel on the state of the profession and societal impacts. They are being careful as they look at all white papers to ensure that scientific areas don't get lost. All the science whitepapers that were assigned to a panel were looked at and moved, if the chairs agreed.

There are two new panels for Astro2020: an Enabling Foundation for Research and a State of the Profession and Societal Impacts panel. Regarding the first panel, it was particularly important in the current era when so much science is driven by big data, simulations, and computations; the committee needed a separate panel to look specifically at these cross-cutting areas. Regarding the second panel, it

was designed because the community should review the state of the field for things like health, diversity and inclusion, workforce development, education, and public outreach.

Dr. Harrison discussed the Notional Decadal Survey Timeline. They are on schedule; the program is established and they have begun their work. The science panel will hand off key questions and discovery areas to the program panels in December. The program panels have begun work getting more information and issuing RFIs, as needed. The publication and release of the report is scheduled for late 2021.

The science panels are to provide scientific priorities and a strong scientific case to justify the ambitious strategic plan. Dr. Harrison reviewed the process and status and deliverables. Similar to Astro2010, they are identifying key science questions and discovery areas. Program panels will take those science areas and assess proposed projects, including consideration of technical readiness. Specific to the NASA flagships, the panels are reading all the reports from the projects and then NASA is doing its own independent assessment. The panels will present results to the steering committee. They will not rank the projects, rather they will provide assessments on readiness.

Dr. Harrison reviewed Program Panel key goals, activities, and deliverables; process and status; and the Technical, Risk, & Cost Evaluation (TRACE).

Dr. Gaskin asked about TRACE; specifically, whether interactive communication between aerospace and some of the teams was still planned or was this to be a truly independent evaluation. Dr. Harrison confirmed that it would be a truly independent evaluation, but they do plan to have back and forth between projects and program panels, in case more information is needed for full understanding.

Dr. Galeazzi requested more discussion of the deliverables for this panel and Dr. Harrison replied that all panels are confidential at this point. She added that, if NASA wants to have the strongest workforce, scientifically and technically, it needs a diverse workforce that draws from all elements of society, which hasn't been the case. We can't go out and collect large amounts of data – time consuming, expensive, requires a lot of expertise. But there is existing data from the Advanced Multi-Mission Operations System Instrument Toolkit (AIT), for example, and they've involved social scientists to analyze the data. The agencies are receptive. Potential recommendations for the agencies might be, for example, investments in certain areas to improve demographics, or there may be recommendations for government or educational institutions.

Dr. Woodward asked whether the outcomes of the survey will actually inform the main committee in their deliberations about developing the decadal program. Dr. Harrison said that would absolutely be the case: The committee will get briefings before they have to complete the overall integrated report. The committee might, for instance make recommendations about scales of projects where they could influence the diversity of the range of scientists. The intention is to use the findings from the state of the profession panel to influence balance among programs.

Dr. Woodward asked how opportunities presented by, for example, Artemis and the return to the moon might be folded into this discussion. Dr. Harrison replied that those would be driven by white papers and things in the public record, there are some Advanced Composite Consortium (ACC) white papers that propose lunar access; they're following NASA's advertised plans there and those things will be considered in the survey.

Holly-Bockelmann asked whether white papers are assigned to more than one panel, especially in cases with a lot of cross-over. Dr. Harrison said they would be and this commonly happened in science, as did back and forth among the panel chairs. Super massive black holes, for example, are relevant to so many panels and questions. This would also be the case on the program side.

Dr. Kennicutt added that the chairs and panels talk to each other a lot. When dividing program white papers, there was a lot of interaction to make sure that papers went to multiple panels, in particular the science activity. In some cases, cross-panel, small working groups were set up. The state of the profession is not a side activity, it is integral to the entire survey. The state of the profession findings will be included in the overall report.

Dr. Brenneman followed up on points from the town hall about WFIRST, LISA, and Athena and asked whether the additional information includes cost and risk information. Dr. Harrison affirmed that the process is designed to take that into account; although, when plans are in place, it is not always appropriate to perform a TRACE process. In those cases, for instance, the panels may request more information and may have recommendations as to what the U.S. role should be on something that is already planned. NASA is looking for "how is the science program dependent on these missions and is there something we should be doing differently?"

There was a question about any charge to look at whether recommendations have been implemented. Dr. Kennicutt said they try not to micromanage panels and the chairs want to make use of the enormous body of work that's already been done.

JWST Update

Mr. Gregory Robinson began the talk by discussing the simplified schedule, including the observatory and the ground system. He identified the remaining I&T activities, adding that there are a couple thousand activities involved with these. He then broke out the remaining I&T activities into their major phases. They have completed the deployment of the telescope and the sunshield. They are now doing the sunshield updates.

He gave recent updates: programmatic, observatory, and science and operations. The Systems Integration Review (SIR) was conducted and is a prelude to Key Decision Point D (KDP-D). The annual GAO audit was occurring soon. The ground system testing was a full system test.

Regarding current technical issues, maintaining schedule performance has been difficult, but the team is doing all the right work. Small new discoveries can cost days or a week. A few minor design changes have been made along the way, all necessary for confidence regarding mission success. There is an issue with depressurization at fairing jettison, which Dr. Robinson described. The delta pressure is higher than the requirement for the sunshield membrane and the sensors are not sensitive enough. There has been a design change on the fairing vents, which will be incorporated in the next couple months, and in early 2020 there will be two flights with the vents on the fairing to test the design. Another issues is the Spacecraft Element. He discussed failures going into thermal vacuum of the Command and Telemetry Processor (CTP); and Traveling Wave Tube Amplifier (TWTA), but stated that the CTP is no longer failing . Both the CTP and TWTA will be replaced in the same panel. There was no need to procure and test multiple parts, although they will send the part that failed back. There are several hundred in use right now, in systems in development and in orbit. He also clarified the testing process for the failed and replacement CTP. General theory is that a capacitor failed and healed itself, which is possible.

Mr. Robinson ended his presentation with a picture of the fully tensioned sunshield. After repairs, the hope is to get the sunshield folded up prior to Christmas, continue testing, and move into environments in the Spring.

Dr. Gaskin sought to clarify that full deployment cannot be done on the crane. She asked whether there are concerns that there won't be a 100% fully deployed sunshield test? Mr. Robinson said there were not

concerns; this has been modeled thoroughly. And, further, without gravity, in space, it's easier to deploy. There was a brief discussion about how the crane holds weight for full tensioning.

Regarding the correspondence between pressure measured and pressure within the sunshield, Mr. Robinson explained that the pressure was measured inside the fairing at multiple locations and that's how we knew that the pressure exceeded the sunshield membrane specification .

Dr. Conklin asked a question about fairing tests: If, after the first test, the depressure specification is not met, is there an opportunity to make other adjustments? Mr. Robinson said yes, if the passive version works, great; if not, there is an active version of venting, if necessary. He then discussed testing at Goddard Space Flight Center (GSFC). Dr. Conklin also asked for a clarification about the schedule margin and how it is changed. Mr. Robinson said that a formal re-plan was done in June 2018 and had about 9 months of schedule margin; they've eaten more than 6 months of that (in about 15 months).

Dr. Holley-Bockelmann had a question regarding the level of repairs. Mr. Robinson said that many of the repairs are based on the first deployment; the second deployment was almost error-free. They ran into a couple snags but no new issues with the sunshield.

Mr. Robinson confirmed that CTP 1 did not exhibit any failure mode. Dr. Woodward asked whether Dr. Robinson had high confidence even though CTP2 has indicated some flakiness. Dr. Robinson affirmed that and added that it was a good design but maybe there were some workmanship issues. It's possible they just got an unlucky part; most likely a bad part in Unit 2. Dr. Woodward then asked whether CTP2 will be the ground test unit when on orbit. Mr. Robinson replied that, if failures begin to happen, there are multiple ground units. Also, these units are fully redundant and not all functioning at the same time.

Mr. Robinson added that they've had a lot of really good progress in last few months and he is looking forward to environments soon.

There was a discussion about the remaining activities and whether any activity would begin to erode against that remaining contingency time. Mr. Robinson does expect some small issues but, if there is a large unexpected issue, it could be bad for the schedule (right now, he doesn't expect anything major.) The process for meeting the space vehicle for the launch is well understood and the Ground Operations Working Group (GOWG) has had multiple meetings and trips to French Guyana to plan the launch. All launch processing will occur in one building. The observatory will be hoisted up through a halo onto a rocket. The payload adapter has already been fitted; they know it works.

Dual Anonymous Review

Dr. Neill Reid began by giving some background on the HST proposal review process that served as a pilot. Smaller proposals are divided by topic amongst panels, with Space Telescope Science Institute (STScI) staff providing support. It's a two-stage process with preliminary reviews with individual grades. Remaining proposals are discussed and re-graded at face-to-face meetings. Panels can choose to adjust the ranked list to account for science balance.

Dr. Reid discussed the success rate of proposals from Cycle 25, delineating male versus female PI proposals. Any individual cycle is not statistically significant, with the exception of a couple. While they are worried that there may be gender bias, bias is complex. Gender may be the canary in the coal mine because gender statistics are measurable.

There had been an attempt to de-emphasize Principal Investigator (PI) information to address the bias, by, for example, removing names and other potentially revealing information. When that didn't seem to help, external, professional help was sought to look at mitigations for unconscious bias.

When Cycles 21 and 24 were analyzed, there was clear evidence that male reviewers had a preference for proposals led by male PIs. Johnson and Kirk (the external advisors) sat in on Cycle 25 and noted that 60% of the discussion focused on the scientists rather than the science. A recommendation for full anonymizing for proposal reviews was made.

The working group was charged with developing an implementation plan for anonymous proposal reviews. Dr. Reid reviewed the specific tasks for the working group and the actions and recommendations. The Working Group on Anonymizing Proposal Reviews (WGAPR) polled the community and considered implementation mechanisms, documents, and appropriate safeguards. Then they recommended a dual anonymous review.

There have been changes to the process to the proposal submission process. One, proposers craft their PDFs (scientific justification and description of observations) to be anonymous. For instance, proposers must exclude names and affiliations and ownership of past work. In addition to the proposal format, proposers must submit a team expertise and background exposition with Phase 1 submission that is separated from the main body of the proposal. Proposers are no longer required to submit detailed management plans at Phase 1; those are required and reviewed in the budget proposal process. Instructions, including examples, are provided to proposers and reviewers.

Dr. Woodward asked a question about passive voice and whether there had been thought about anonymizing references. Dr. Reid said that there hadn't been, as that could be detrimental to the proposal and could detract from the scientific case that the proposer is trying to make.

Dr. Reid explained the instructions to Telescope Allocation Committee (TAC) members: Consider proposals only on scientific merit, don't spend time identifying the PI or team, don't make guesses on identities, and keep language biases in mind. There are also recommendations to monitor the panel discussion and have levelers in every panel discussion to keep the focus on the science. The levelers have the authority to stop discussion on a proposal or flag the proposal based on the discussion. If the discussion is stopped, the proposals will typically be set aside and returned to later. If the discussion was going off track, the leveler might pause the discussion and then resume. There is flexibility built in to the process.

Dr. Gaskin asked if they tried to correlate the gender and diversity of the review team with the selection over time. Dr. Reid said they did and that the TAC has become more diverse over time, but they haven't seen an effect here.

Regarding compliance with guidelines, TAC members are asked to flag proposals that may have violated the rules. Those proposals are brought to the attention of STScI Science Policy Group members. Proposals may be disqualified if there are egregious violations; less serious cases may get feedback.

Regarding panelist/proposal conflicts, conflicts are only based on persons, now. Panelists submit lists of collaborators and competitors and then proposals are labeled. So, more panelists are generally available to review proposals.

The Dual Anonymous Proposal Review has been implemented for Cycles 26 and 27. There is a high rate of compliance with guidelines. Team expertise was satisfied in all cases. Documentation and communication is in place.

Dr. Reid then reviewed feedback from TAC members. They heard that discussions were much more collegial and efficient and the focus was squarely on the science. Dr. Reid also reviewed the updated

gender statistics for proposals. He explained the perceived change in number of proposals in the last two cycles because it is both successful proposals and only medium and large proposals. Dr. Reid said he'd hope that you'd see the ratios slipping back and forth once gender bias has been accounted for. The differences in the last two cycles are not statistically significant. Dr. Ozel clarified that the number reflects proposals submitted divided by those accepted, but it can show an overall trend in number of submissions accepted.

Dr. Reid reviewed a comparison between Cycle 25 and Cycle 27. Then he reviewed success by seniority: older male PIs do best; older female PIs do worst. Looking at seniority only, they considered how many years before the TAC met did the PI get their PhD. The submitted proposals lines are nearly identical; the accepted proposals line is not, with a slight increase in new PIs. That was born out in Cycle 27 and may suggest that doors are being opened through this process.

Dr. Reid reviewed the summary slide. Statistics show a systematic trend with PI gender over many cycles. The process implemented through Cycles 26 and 27. Dr. Reid noted that introducing dual anonymous is not a magic bullet.

Dr. Walkowicz expressed appreciation for the work on this very complex issue. Dr. Reid said the director is fully behind the project, which helps.

Dr. Evans began the review of the APD plans to implement dual anonymous reviews. It is part of a major initiative within SMD to build an excellent workforce. APD is strongly committed to equitable and fair review of proposals and hopes to reduce or even eliminate unconscious bias. The Astrophysics Division has directed that all Astrophysics General Observer / General Investigator (GOGI) proposals be evaluated using dual anonymous review. APD will be switching to dual anonymous review in 2020, adopting a step-wide process based on learning from HST and respecting the fact that each mission performs its reviews in a slightly different manner. Dr. Evans reviewed the rollout plans for dual anonymous reviews. A pilot study will be conducted with the Nuclear Spectroscopic Telescope Array (NuSTAR) Cycle 6, for which proposals are due in January 2020. Starting with the release of ROSES-2020, all Astrophysics GO/GI programs will be switched to dual anonymous format. Dr. Galeazzi asked why Chandra is still under the traditional format. Dr. Evans said Chandra needed more time to adjust software to accommodate updated proposal requirements. SOFIA is not on the list because they are focused on implementing programmatic recommendations first before switching to dual anonymous.

Dr. Evans reviewed the implementation of dual anonymous peer review. There will be written guidance about writing an anonymized proposal, town halls in spring 2020, training sessions for panel levelers, and mission program staff available to answer questions. Areas of focus include: guidance to proposers, team expertise, institutional access to unique facilities, and return without review for non-anonymized proposals. This initiative merely represents the start of what is expected to be a broader SMD initiative to rollout dual anonymous reviews. There is still a need to identify the correct paths to identify financial conflicts of interest.

Dr. Ozel asked about extendibility, and Dr. Evans said it's clear that some programs within SMD lend themselves more readily to dual anonymous than others. Decisions haven't been made about granting waivers, although that's under discussion.

It was noted that, although there is research that demonstrates that a more diverse workforce is better for problem solving, NASA's infrastructures are something that belongs to the American populace. All people should have fair access to NASA's activities. There was strong agreement from the Committee on this point.

R&A Update

Dr. Smith presented for Dr. Stefan Immler. He reviewed Astrophysics Research Elements, specifically the ROSES elements in SRT, Data Analysis, Mission Science and Instrumentation. This will be an off year for ATP in ROSES 20.

There was a review of growth in R&A funding over time, which was requested by the community through the last DS. The cubesat initiative has come into play in APD and may grow with time.

Dr. Smith reviewed a chart that showed FY19 R&A elements, specifically how the funds are broken out for various payloads and which programs they come from. The Astrophysics Research and Analysis (APRA) program is largest with the Astrophysics Data Analysis Program (ADAP) and the Astrophysics Theory Program (ATP) following shortly thereafter. He then reviewed growth in Future Investigators in NASA Earth and Space Science and Technology (FINESST) funding and selection. FINESST will be targeting many more young investigators.

In response to a question about how theory is funded, Dr. Smith said there are R&A calls and some are funded by the missions themselves (e.g., Chandra theory, Fermi theory, Hubble theory calls).

Low-Technology Readiness Level (TRL) Technology Development is seed funding that will allow missions in the future. The largest R&A element is APRA, followed by Strategic Astrophysics Technology (SAT) (created to bridge the gap that often happens between APRA funding, like for a flight mission, and lower funding requests), and some more specific items like the starshade, mirrors, the Jet Propulsion Lab (JPL) imaging testbed.

Dr. Smith then gave updates on the Suborbital Programs. NASA's Balloon Program provides low-cost, quick response, near space access for cutting edge research, developing technologies, etc. They are useful for students and the next generation of scientists and engineers and for forefront research. NASA's Cubesat Initiative is another avenue for investigating things for a relatively small amount of money. APD is investing approximately $5 million annually in the cubesat initiative: HaloSat, the first APD cubesat, is in orbit and producing excellent data. The Sounding Rocket Program enables discovery through frequent sub-orbital flight opportunities. Dr. Smith discussed the breakdown in various wavelength disciplines by suborbital funding. He noted that distribution is roughly even among wavelengths.

Dr. Smith gave an R&A Proposal status update. Each year, the team tracks proposal numbers, time taken to review, and selection rate. This year, Dr. Immler brought out the number of new PIs accepted. In many cases new PIs are being selected. Selection rates are similar to years past.

A chart showed the amount of funding, the number of proposals, and the success rate for proposals for APRA, ADAP, ATP, and Exoplanet Research Program (XRP) Proposals. Dr. Martin Still explained that there are two factors influencing the increased number of proposals: ATP shifting to every other year and sharing ATP with other division partners. So statistics for XRP will be across all divisions.

Dr. Smith then spoke about the consolidation of exoplanet research; all divisions at NASA have some interest in this science, even HPD and the Earth Science Division (ESD) can contribute to this. Solicitation and review will be consolidated across all divisions, an idea that has been percolating for several years. XRP has been shared between APD and PSD, but it hasn't been making joint selections. There is clear feedback from community that exoplanet will go further through partnerships. The last XRP selections were all done jointly. The two divisions are also budget partners, and selections are done jointly. The investigations will start in FY20. It hasn't been making sense for theory, laboratory, and models to only come in through PSD. In order to make joint selections, they need to come through XRP. There will be no change in quantity of selected proposals. The APD investment will go up by 2/3 from $4

million/year to $7 million/year; mostly matched by PSD. This does not represent a dramatic expansion of scope. People can mix and match archive and theory and archive and lab work in a way that they weren't able to do. Composition of the panels will change and careful attention will be given to themes and the right people to consider cross-divisional proposals.

Dr. Moustakas requested more information about how under ROSES-2020 the WFIRST science working groups are going to be recompeted. Dr. Hertz discussed the solicitation and selection process for WFIRST regarding formulation and implementation and recompete intentions. He explained that the job of the new science working group will be to set parameters for key projects and develop the necessary pipelines required to analyze the data.

Dr. Ozel asked a question about the "Dear Colleague" letter to the community for the Hubble fellowship program that explains the requirements to ensure that Hubble Fellows are offered employee benefits in their host institutions . Dr. Hertz said that letter has not been sent. He expects, this year or next, to require all hosting institutions to offer their employees an option of employee fellowship (employee versus stipendiary status). He will give an update at next meeting; the letter will have been sent by then.

Dr. Ozel asked about the rise of selection rates for FINESST and whether to target selection rate or increase in funding. Dr. Hertz said they've doubled the amount of funding available and made twice as many selections (going from around 10 to 21). They plan to continue that to hit a new target of 45 FINESST awardees at any given time.

Dr. Galeazzi asked a question regarding the APRA shift from March to December and potential new applicants who were left in limbo. Dr. Hertz replied that, other than making sure the change was communicated clearly, there wasn't anything they could do.

Public Comment Period
Dr. Ozel opened the lines for public comments or questions. There were no public comments or questions.

Preliminary Discussion Period
Dr. Ozel invited the members to bring up topics for discussion.

It was noted that the Balloon Program showed significant progress and should be highlighted. It's probably prudent to look for alternate sites, given the population growth in Palestine and staffing issues if Oregon, NZ, and Sweden are used. Palestine is the only site in North America that can launch in the evening. Dr. Ozel noted the recommendations to look for an alternate site to Palestine, specifically one where evening launches would be possible, and to acknowledge and address the stress on current operations teams. There was discussion about a third crew and the strain they might experience if they are based in Palestine but working at a remote site. It was noted that there have been night flights from Fort Sumner but they're rare; there was pushback regarding a night flight this past summer. Also, the BARREL flights are not on the critical path for GUSTO. Dr. Gaskin said that GUSTO is supposed to fly on a SPB balloon but can also fly on a zero pressure balloon. She discussed the importance of a longer mission for GUSTO.

It was noted that it would be useful to get a pulse check on SOFIA in response to SOMER and FMR in the Spring meeting. Dr. Jones said that he would write up his thoughts on this. It's important that they include language that underscores support for the work that's been done in the SOMER and FMR committees and that APAC would expect to hear a report about how specific recommendations outlined in the report documents have been acted upon. If those recommendations have not been acted upon, there should some justification as to why not. Dr. Ozel said that SOFIA should update operational stages and

implement cultural changes in accordance with the specific recommendations. The initial response, it seems, is that they are implementing some changes in response to SOMER and FMR reports, but she thinks a point-by-point accounting of the recommendations, how they were acted upon, and what the results were is necessary. Also, how their changes lead to hopefully better outcomes and that the metrics need to be met. It was noted that one thing that hadn't been done was a schedule regarding milestones that they plan to address. Dr. Gaskin agreed that that was missing and added that the independent review panel asked them to address how they publish their results. They established an example criteria for SOFIA to meet this slightly vague metric. She's heard statistics that it's not unusual to take a decade to finally get some meaningful scientific results in the balloon arena. SOFIA is kind of like one of these programs, it's just that it was expensive up front and expensive to maintain. She asked what everyone thought of comparing SOFIA to the suborbital program: What does enough publishing mean and what does significant science mean? The conclusion was that this was not an appropriate comparison given the vast difference in the resources available to SOFIA and to suborbital programs. Members also noted that the SOMER and FMR reports define thoughtful metrics for success, which should be the guideline for reviewing SOFIA.

IXPE Update

Dr. Martin Weisskopf began by introducing the IXPE team. In addition to this team, the Science Advisory Team (SAT) currently comprises more than 80 scientists from 12 countries.

He reviewed the mission description: launch in Spring 2021 on a Falcon 9 from KSC. It's a 2-year baseline mission, with an optional extension with GO program. Data archiving will be at NASA's High Energy Astrophysics Science Archive Research Center (HEASARC). Dr. Weisskopf reviewed the critical milestones, including mission CDR and plans for delivery of units, Systems Integration Review (SIR), and integrations.

Dr. Weisskopf showed an image of IXPE deployed. He noted that the unit is much shorter than NuSTAR. The boom was just extended a couple weeks ago and performed just fine. He then showed illustrations of the polarization-sensitive detectors and discussed how they worked. He noted that the people in Italy who developed these detectors, some of which, who also worked on Fermi, have developed algorithms to allow us to do this with high precision.

He discussed the detector properties and showed images of the mirror module assembly – engineering unit and discussed the inner and outer shells and thermal shields at the top and bottom. Then, he showed the assembly stations for flight mirror builds. They are building a total of four mirrors, with one being a spare. He walked the Committee through mirror module assembly and showed a chart of the polarization sensitivity figure of merit.

Dr. Weisskopf showed a Chandra image to talk about polarimetry and the angular resolution. He compared the IXPE light curve of the Crab nebula's pulsar and the optical light curve, along with the degree of polarization in the optical. IXPE can measure and track all those variations. He added that you can perform x-ray polarimetry on micro-quasars and that variation of position angle and degree of polarization with energy depends significantly on the spin of the black hole.

Dr. Weisskopf said they would like to do a jet core CEN A experiment, which is very difficult. He said active galaxies are powered by supermassive black holes with jets and radio polarization implies the magnetic field is aligned with jet. He emphasized that the IXPE imaging capability will be very useful for the study of supernova remnants. Both energy and spatial resolution and polarization sensitivity make these measurements feasible.

Another challenging experiment they're taking on is asking whether Sagittarius A (SGR A) was a million times more active a few hundred years ago. Galactic Center molecular clouds (MC) are known X-ray sources which may arise from the scattered X-ray flus from a previously active phase of SGR A. This has the potential to show whether this has become so much more active in just a few hundred years. They also plan to study magnetars with their huge magnetic fields. Having a dedicated mission for these polarization detectors and some imaging capability will be very scientifically useful.

Dr. Moustakas asked whether there are plans for coordinating observations with NuSTAR? Dr. Weisskopf said yes, that's the kind of thing that the science advisory team is working on. We get to choose the targets in the first 2 years. The data will all be public, except during the early phase, within a week of the observation.

Dr. Weisskopf affirmed that a target list would be available, in the spring of 2020 they will be bringing suggested observations for the first and second 6 months. That decision will be made in the summer of 2020 and will be publicly available.

Dr. Woodward asked whether there is any capability in mission design for rapid motion towards target error boxes. Dr. Weisskopf said absolutely not. They will accept targets of opportunity but will not be able to do rapidly. Something on the order of 24-48 hours would be rapid. Dr. Weisskopf said there are several science drivers behind the mission, with the two experiments needing observing time on the order of mega-seconds. They have the ability with boom to correct alignment on board but don't expect to use it at all. The main drivers are things like making sure the detectors have been well calibrated that we can remove systematic effects, etc.

Dr. Ozel asked whether there is anything that is keeping Dr. Weisskopf up at night. Dr. Weisskopf said that, having been through a handful of successful satellite missions and rockets and balloons, he recognized that it's a roller coaster and there is always something to worry about. He emphasized that they have a great team between U.S. and Italy. All four detectors are built; two completed calibration. The furlough affected the team and there was a thermal shield problem but, overall, he is confident.

WFIRST Update

Dr. Ozel recused herself on WFIRST and reminded others to do the same, if necessary. Dr. Jeff Kruk began with a summary of the science program for WFIRST. There have been no changes to this since 2010. It is the program laid out by the DS.

Dr. Kruk noted that the last presentation to the APAC panel was a year ago. There have been only two substantive changes to the technical baseline of the mission: the addition of low-dispersion slitless prism optimized for supernova spectroscopy and a descope of coronagraph integral field spectrograph. Spectroscopy is still being done but with a more standard spectrometer.

Dr. Kruk then discussed technical progress. The PDRs are drawing to a close: instrument carrier, wide field instrument, telescope, CGI, ground system part 1, and mission/spacecraft. Roughly 130 internal reviews have taken place in 2019 in preparation for element PDRs.

He then reviewed the major elements:

- Spacecraft: They have been working with the Launch Services Program on an updated coupled loads analysis from SpaceX. The design is complete for PDR; most subsystems are ready for prototyping. They have completed various procurement activities.
- Telescope: now more than halfway through refiguring the primary mirror. Work is progressing on plan. Primary mirror figuring is on track; full tool polishing complete, now in ion figuring run #4. All inherited hardware has been disassembled. Refiguring of secondary mirror is underway.

Definition of thermal control zones is underway. Engineering models of new and modified components are being built.

- Instrument Carrier: very far along. Interface details for instrument latches are being negotiated. The thermal control algorithm trade closed last month and structure procurement activities are on track.
- Coronagraph Instrument: reevaluated all plans in advance of PDR. There is a new proposed plan to rescope Integral Field Spectrograph (IFS) to address cost, schedule, mass, and power issues. The team discussed spectroscopy and mask design optimization. There has also been a lot of work in optimizing algorithms for wavefront sensing and control.
- Wide-Field Instrument: PDR was this past summer. Main tweak to that design was development of special thermal enclosure for filter wheel that minimizes changes to the wavefront. The prism design was finalized and optimized. There were numerous incremental mechanical and thermal design updates. Updates were added regarding ASIC second-generation design, which is complete; flight detector deliveries; and grism assembly engineering unit testing and characterization.
- Ground System: Mission Operations Center (MOC) and ground station design is on track. Technical interchanges on ground stations with international partners is continuing, planning and scheduling system architecture work has begun, data processing system architecture work is beginning, and the calibration plan is close to being baselined. The MOC PDR has been held; the Science Operations PDR is to be held early next summer.

Dr. Kruk then reviewed programmatics. The furlough was disruptive and the budget that was finally passed didn't quite match budget guidelines. After some re-planning, everything has settled just fine. They re-planned the FY19 budget; operating in FY20 and planning future years based on optimal funding profile. They were able to pre-fund all the big contracts, since they could see the furlough coming. The biggest hits were some of the work at GSFC. They have successfully ramped up the work force for the peak budget year, FY20. They have finalized the contract with STScI, the proposal is in from the Infrared Processing and Analysis Center (IPAC) and expected to be signed soon; and, international partnership agreements have been drafted by agencies and the formal approval process is beginning. The confirmation review (KDP-C) is now expected in early February. He discussed the path to KDP-C, reviewing what needs to be completed, including mission PDR, budget and schedule Joint Confidence Level (JCL) acceptance, other independent costs and schedule estimates, etc.

Dr. Kruk reviewed the WFIRST Project Schedule as of September 30, 2019, including schedule details and milestones completed. Schedule depends on future Congressional appropriations, but internal scheduling is on track.

The observatory concept was reviewed and inherited hardware progress was discussed piece-by-piece, first for primary mirror and then for secondary mirror assembly. The primary mirror received a full tool polish in May 2019.

There were additional reviews of the Instrument Carrier (IC) architecture and the Wide-Field Instrument cold sensing module. Illustrations showed the mechanisms and assembly. The new implementation of supernova spectroscopy was reviewed. Design meets all wavefront specs with all spherical surfaces. Operations are similar to that of the grism, so that simplifies planning. It provides all the spectroscopic capability needed for the supernova program.

Dr. Kruk then reviewed the coronagraph technology demonstration instrument, which has not changed over the last year, even though they had to descope the IFS. He talked about the coronagraph modes to be

commissioned formally and showed diagrams to discuss changes that have been made over the last couple years. It turns out the sensitivity has been slightly improved with these changes.

Science investigations have not changed in the last year. All observing time will be selected competitively. Data will be made public immediately. Scientific priorities will be updated throughout mission. Coronagraph data will be made available through a participating scientist program. Present science investigation teams are in place through CDR.

Dr. Kruk wanted to emphasize that, although we tend to talk about the size of the field of view, the power of WFIRST is not limited to that benefit. Much effort has been given to making sure that it can slew and settle rapidly. It has great survey efficiency. He gave comparisons to other surveys and reported speed times of hundreds to over a thousand times faster than previous large HST survey programs.

The FY2020 budget in the House fully funds WFIRST and the FY2020 budget in Senate would stretch out to launch. The direction from NASA is to proceed with the baseline plan while Congress deliberates.

Dr. Conklin asked about the science impact of the change to the coronagraph. Dr. Kruk said that it does affect observing time; if there are two planets, you'd need twice as long. Dr. Kruk also explained what planning to an optimistic budget schedule means: optimal budget profile is how you would plan the program if you just got the money whenever it was most efficient. Budgets do have mandatory reserves on them. If the deviation from profile is modest, an attempt is made to manage from reserves. If the deviation is big, the launch date will stretch out and the total program will cost more. Dr. Hertz reiterated that both the House and Senate are supporting WFIRST in 2020.

Discussion, Recommendations, Actions

Dr. Ozel introduced general discussion time for the Committee.

COPAG/PAG Cosmic Dawn

It was affirmed that the SAG would need to be recognized by APAC. Dr. Meixner would need to bring it to the Committee and Dr. Hertz would make a decision on action. Dr. Hertz said that PAGs begin by the community working together and then they can be recognized by the community.

SOFIA

There was discussion about the metrics the Committee used to decide that SOFIA returns weren't high enough. It was noted that SOFIA is treated as a "Great Observatory," so that a higher bar is more appropriate. Dr. Ozel agreed and can see many reasons why that would be the case. Comparison may be appropriate if it's $80 million/year for SOFIA compared to $40 million for the Balloon Program, factoring in the science that comes out of it. Dr. Hertz said $40 million is payloads only. Dr. Gaskin says an observatory in a flagship class is much more expensive, and probes and Explorers are also much higher cost. If the bar is based on cost, how do you come to the conclusion of what the metrics should be? She did not think it was clear. Dr. Ozel suggested taking this offline; requesting and reading the full reports in advance of the next APAC meeting. There must be many variables: resources available, stated goals of the mission. Dr. Ozel asked Dr. Sheth about the metrics for SOFIA. Dr. Sheth said there were no comparisons made to the Suborbital Program by the SOFIA review committees. He looked at cost as the first evaluation point. The operating budget is quite large; he appreciated that SOFIA is different from other Great Observatories. A lot of the cost goes into the platform. The report suggests a metric that is several times the current rate of 35 papers a year; the panel suggested a goal of 100/150 papers. But, the panel also recognized that the 2 or 3 months they had to review might not have been enough time. There wasn't anything specifically data driven. Dr. Gaskin noted that the program was tasked with coming up with a project plan. They're just at the precipice of providing a budget and project plan that would reflect what they'd be able to accomplish. Dr. Sheth said there is no magic solution; it's the community that

judges whether this observatory is producing papers at the rate we'd expect it to. APAC has not given any input as to how many papers they should produce. APAC could also ask for a project plan and give feedback, or could ask the FMR panel to describe their thinking. Dr. Ozel said that the community/APAC judges and needs to work with scientific metrics. Dr. Sheth noted that the science metrics are on his slides and listed them. FMR says these metrics form a basis that should include other metrics. Dr. Ozel recommends hearing in the Spring meeting what metrics they are proposing to use and what goals they have. Dr. Woodward notes that there is urgency because they have a 36-month period and there won't be much look-back time. They need to get the metrics settled and protocol implemented to deliver quantitative data. The committee can ask for a written response. Dr. Sheth said he would be happy to present before next meeting.

Dr. Ozel requested further comments on the Dual Anonymous Review. Dr. Moustakas said he's interested in having APAC help HQ get the right level of engagement and education. Dr. Ozel asked whether the Committee should recommend some webinars and town halls and other ways to achieve this. Dr. Woodward thought that would be wise. He also asked how this might apply to steering programs and/or lab astrophysics where it's difficult to remove the investigators from their proposals. Dr. Hertz said they don't know, which is why they're running pilot programs for non-GO ROSES elements. Dr. Ozel said that, while this is in no shape or form a reason not to proceed, she has similar concerns about theory programs where typically a proposal spends one-third to one-half of the proposal on the team and the contributions they're expected to make, along with facilities available. Dr. Moustakas agreed that potential limitations should not stop the committee from trying. There was a request to support Dr. Hertz's efforts to get the "Dear Colleague" letter out to the community.

COPAG/ExoPAG
There were updates on activity and membership changes, but none required an action other than the COPAG SAG; it was affirmed that they should engage the community and, in the next APAC meeting, ask for a formal approval.

Balloon Updates
The striking progress in program is to be commended. The committee talked about encouraging the Balloon Program to start looking for alternate sites to Palestine and maybe sites where evening launches are possible for science cases that require it; they talked about the Oregon site and the stress on available launch crews and how alternate sites might exacerbate that stress; and noted that there is already a third operations team and crew, so the additional demands on them will depend a little on how many of the additional operations they do will be remote. The Committee is looking forward to an update on the status of the Wanaka, NZ facilities. It was suggested to make a note of the fact that progress in the SPB would be advantageous to GUSTO's mission.

Astro2020 Update
The Committee can make recommendations if it feels there was something learned from the conversation that requires action. They did not have a chance to discuss overlap or coordination with other division or disciplines. It's a general topic APAC has discussed in the past and is an area where it could be useful to have a follow on discussion. It was noted that some of the findings from Astro2020 may have impacts beyond APD, which could encourage the committees to consider the impact of return to the moon on astrophysics. Dr. Hertz said the Statement of Task for the DS directs them to consider this.

JWST
Things are going well. Two months of contingency for final challenges might be slim; the schedule margin seems tight. They're 50% of the way through with 70% of the margin used up. It might be interesting to hear about integration of launch goals and spacecraft. The fairing depressurization remedy would be good to hear about after they have a couple of flights.

R&A Update
Given the cross-division restructuring and reallocation between Theory and XRP, can people pay attention to low selection rate going forward? As a community, they'd like them to be higher, but 12-13% seems to be dipping dangerously low. APAC noted that the selection rate is lower than other programs and would like to keep an eye on how the restructuring has impacted it. Dr. Meyer requested a breakdown by area of the ones selected in FINESST.

IXPE
It's proceeding according to schedule; the Committee heard about science cases driving it and what they can hope to address once in orbit. There are no showstoppers although there are challenges, as expected. The Committee commended them on progress and requested a status update around the time of integration.

WFIRST
The Committee thanked Dr. Kruk for the candid update on progress, including minor rescopes, no showstoppers. That they have demonstrated that they can have internal temperatures so low and mitigate changes by moving filters in filter wheels is quite positive. The mission is moving into peak spending year in FY20, so another status report on this mission further on in the year was requested. It was noted that there has been a lot of agile thinking and problem solving to get over some of those major hurdles APAC was worried about.

The next meeting is a face-to-face meeting in Washington, D.C. on March 5 and 6, 2020.

Brief to Division Director
Dr. Ozel asked whether Dr. Hertz required a summary at this time. Dr. Hertz felt that the letter from Dr. Ozel would be sufficient and stated that he is looking forward to receiving it.

Adjourn
The meeting was adjourned at 5:00 pm.

Appendix A
Participants

Committee Members
Feryal Ozel, University of Arizona, *Chair*
Charles Woodward, University of Minnesota, *Acting Chair*
Hashima Hasan, *Executive Secretary*
Asantha Cooray, University of California, Irvine
Jessica Gaskin, Marshall Space Flight Center
John Conklin, University of Florida
Kelly Holley-Bockelmann, Vanderbilt University
Kerri Cahoy, Massachusetts Institute of Technology
Laura Brenneman, Harvard University
Leonidas Moustakas, NASA Jet Propulsion Lab
Lucianne Walkowicz, Adler Planetarium
Margaret Meixner, Space Telescope Science Institute and Johns Hopkins University
Massimiliano Galeazzi, University of Miami
Michael Meyer, University of Michigan
Suvrath Mahadevan, Pennsylvania State University
William C. Jones, Princeton University

NASA Attendees
Azita Valinia, NASA GSFC
Carrie Brandt, NASA GSFC
Daniel Evans, NASA HQ
Debora Fairbrother, NASA GSFC
Eric Smith, NASA HQ
Eric Tollestrup, NASA HQ
Erika Vick, NASA
Ingrid Farrell, NASA HQ
James Thorpe, NASA GSFC
Jeffrey Kruk, NASA GSFC
John Calis, NASA JPL
Kartik Sheth, NASA HQ
Kerry Brandt, NASA GSFC
Mario Perez, NASA HQ
Martin Weisskopf, NASA MSFC
Michael Garcia, NASA HQ
Nancy Kiang, NASA
Naseem Rangwala, NASA ARC
Norman Rioux, NASA GSFC
Paul Hertz, *Astrophysics Division Director*
Patricia Daws, NASA AFRC
Pin Chen, NASA JPL
Thomas Hams, NASA HQ
William Latter, NASA HQ

Non-NASA Attendees
Alexandra Witze, Nature Magazine
Angela Clark-Williams, Electro-Soft
Ashley Wilkins, House Science, Space, and Technology Committee
Charles Burke
Charles Lillie, Lillie Consulting
Dylan Cohen, House Science, Space and Technology Committee
Emily Neeson, Lewis Berch Associates
Fiona Harrison, California Institute for Technology
Harold Yorke, USRA
James Lochner, USRA
Jeanette Edelstein, ElectroSoft
Jeff Foust, Space News
John Bergstresser, House Science, Space and Technology Committee
John Kahn
Kelsie Krafton, AAS
Lilly Larson, Ball Aerospace
Neill Reid, Space Telescope Science Institute
Rick Matthews
Robert Kennicutt, University of Arizona
Shiree Wilkens, House Science, Space, and Technology Committee
Tom Megeath, University of Toledo

Appendix B
Astrophysics Advisory Committee Members

Feryal Ozel, APAC Chair
University of Arizona

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

Kerry Cahoy
Massachusetts Institute of Technology

John Conklin
University of Florida

Asantha Cooray
University of California, Irvine

Massimiliano Galeazzi
University of Miami

Jessica Gaskin
Marshall Space Flight Center

Kelly Holley-Bockelmann
Vanderbilt University

William Jones
Princeton University

Suvrath Mahadevan
Pennsylvania State University

Margaret Meixner
Space Telescope Science Institute and Johns Hopkins University

Michael Meyer
University of Michigan

Leonidas Moustakas
Jet Propulsion Lab

Lucianne Walcowicz
Adler Planetarium

Charles Woodward
University of Minnesota

Appendix C
Presentations

1. *Astrophysics Division Update*, Eric Smith
2. *PhysPag Update*, John Conklin
3. *COPAG/ExoPAG Updates*, Margaret Meixner/Michael Meyer
4. *SOFIA Update,* Kartik Sheth/Naseem Rangwala/Harold Yorke
5. *Balloon Update*, Debora Fairbrother
6. *Astro 2020 Update*, Fiona Harrison/Robert Kennicutt
7. *JWST Update*, Eric Smith/Greg Robinson
8. *Dual Anonymous Review*, Neill Reid/Dan Evans
9. *R&A Update*, Eric Smith
10. *IXPE Update,* Martin Weisskopf
11. *WFIRST Update*, Jeff Kruk

Appendix D
Agenda

Astrophysics Advisory Committee
October 28-29, 2019
NASA Headquarters
Washington, DC

Monday, October 28

12:00 p.m.	Introduction and Announcements	Dr. Hasan Hasan/Feryal Ozel
12:10 p.m.	Astrophysics Division Update	Eric Smith
1:10 p.m.	PhysPAG Update	John Conklin
1:30 p.m.	Break	
2:40 p.m.	COPAG/ExoPAG Updates	Margaret Meixner/Michael Meyer
3:20 p.m.	SOFIA Update	Kartik Sheth/Naseem Rangwala/Harold Yorke
4:20 p.m.	Balloon Update	Debora Fairbrother
5:00 p.m.	Wrap Up for Day 1	Feryal Ozel

Tuesday, October 29

11:00 a.m.	Opening Remarks	Feryal Ozel
11:10 a.m.	Astro 2020 Update	Fiona Harrison/Robert Kennicutt
11:40 a.m.	JWST Update	Eric Smith/Greg Robinson
12:30 p.m.	Dual Anonymous Review	Neill Reid/Dan Evans
1:15 p.m.	R&A Update	Eric Smith
2:15 p.m.	Public Comment Period	
2:20 p.m.	Break	
2:35 p.m.	IXPE Update	Martin Weisskopf
3:15 p.m.	WFIRST Update	Jeff Kruk
4:00 p.m.	Discussion, Recommendations, Actions	APAC members
4:45 p.m.	Brief to Division Director	Feryal Ozel
5:00 p.m.	Adjourn	