NASA ADVISORY COUNCIL

ASTROPHYSICS SUBCOMMITTEE

October 3-4, 2016

Teleconference

MEETING MINUTES

November 13, 2016

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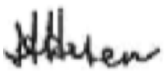
B. Scott Gaudi, Chair



November 11, 2016

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Hashima Hasan, Executive Secretary

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Ingenicomm

Monday, October 3, 2016

Introduction and Announcements

Dr. Hashima Hasan, Executive Secretary of the Astrophysics Subcommittee (APS) of the NASA Advisory Council (NAC), opened the meeting by welcoming the Subcommittee members. She noted that a few APS members had conflicts of interest with specific topics on the agenda. During those presentations, the conflicted members would be allowed to listen to the presentation, but they could not participate in discussion. Dr. Hasan then reviewed the Federal Advisory Committee Act (FACA) rules.

Dr. Scott Gaudi, APS Chair, added that offline conversations cannot form the basis for APS recommendations. Dr. Mark Devlin recently resigned from APS; Dr. Gaudi thanked him for his time and service. As Dr. Gaudi had a couple of conflicts of interest, Dr. Rachel Somerville, APS Vice Chair, would take over the meeting during those discussions.

Astrophysics Division Update

Dr. Paul Hertz, Director of NASA's Astrophysics Division (APD), welcomed the APS members, then presented a brief outline of his presentation. The National Academies Midterm Assessment of APD's response to the 2010 Decadal Survey (DS) had just been released, and APD was still reviewing the recommendations and findings. In response to the Midterm Assessment report, APD planned to update its DS implementation plan soon.

The Hubble Space Telescope (HST) recently observed Europa transiting in front of Jupiter. The plume silhouettes were where investigators expected them. Plume signals are intermittent, and no model can successfully predict when they will be visible, unlike with Enceladus. HST also observed the Trappist-1 system, spotting two small planets in the "super-Earth" category. Investigators sought extended atmospheres, like that of Neptune, but did not see them, and therefore believe the two bodies could be rocky planets with thin atmospheres like that on Earth.

Kepler 2 (K2) observed the Pleiades cluster in a study of star rotation periods. There were low-mass stars that have faster rotations; higher mass stars are slower. The Chandra mission observed supernova G11.2-0.3, a historical supernova seen by the Chinese 1,700 years ago. Chandra indicates that this should not have been visible to the naked eye. It could be that these were not the same event, or that the event time is right and there was a coincidence. It is also possible that the conclusion that G11.2-0.3 was not visible is in error.

As Congress has not yet passed a budget, NASA is currently funded under a Continuing Resolution (CR). The Fiscal Year 2016 (FY16) budget and the FY17 President's Budget Request (PBR) both provide the funding APD needs, however. For all budgets, the James Webb Space Telescope (JWST) has full funding. Wide Field InfraRed Survey Telescope (WFIRST) funding is adequate for formulation, and research and analysis (R&A) and suborbital program increases remain in place.

APD is continuing to upgrade the Stratospheric Observatory for Infrared Astronomy (SOFIA) instrument suite and will solicit fourth-generation instrumentation in 2017. Missions in development are making progress. The Japanese Space Agency (JAXA) is working to decide on an X-ray Recovery Mission (XRRM) to address lost Hitomi science, and NASA continues to partner with the European Space Agency (ESA) on the latter's L3 mission. Explorer Announcements of Opportunity (AOs) are still in cadence. At the

moment, the 2-year cadence for Senior Reviews (SRs) is set by law, but Congress may look at moving to a 3-year cadence in response to a recommendation from a National Academies study.

NASA has decided to proceed with changing the science subcommittees to full FACA committees. Once chartered, APS will be the Astrophysics Advisory Council (APAC). At the time of this teleconference, the charters were with the General Services Administration (GSA) for approval. Next, NASA will charter APAC and appoint all APS members with the same terms and end dates. APAC will report to the APD Division Director (DD), which will allow the Committee to make recommendations to the APD DD directly instead of going through the NAC Science Committee and up to the NAC. In addition, APAC and APD can establish subordinate groups that report to the Committee. The reporting structure of the Program Analysis Groups (PAGs) is an open question, but they will continue to exist and do their work.

The cooperative agreement with the California Association for Research and Astronomy (CARA) to operate the Keck Observatory expires in 2018. The current agreement has NASA providing one-sixth of the observing cost and receiving an equivalent amount of observing time. The Agency also funds Guest Observers (GOs) and archives Keck data. NASA can direct time to key projects for strategic support for NASA missions. Examples include the K2 small exoplanets observations, monitoring of Europa plumes, and starting Euclid/WFIRST galaxy color/redshift calibrations. Dr. Hertz wanted community input on whether to move forward on renewal of the agreement. He had already pulled together a mixed NASA/community panel to identify the pros and cons, and would present that to APS later in the meeting.

XRRM is the next version of the Hitomi/Astro-H mission that was lost in March. JAXA wants to recover the science and therefore has submitted a proposal to the Japanese government. JAXA has also talked to NASA about participating again. The NAC recommended that NASA do so, and the Agency has agreed. Dr. Hertz thanked APS for making the case for this project. The NASA hardware will be the same as it was for Hitomi, and the project will be run through the Goddard Space Flight Center (GSFC). In addition, there will be a new call for US community participants.

The mid-sized Explorer (MIDEX) AO was released in September, 2016, with proposals due in December, 2016. There was also an announcement for a Mission of Opportunity (MoO), which includes Partner Mission of Opportunity, Small Complete Mission (SCM) including ISS & suborbital-class (ULDB, sRLV, CubeSats), & New Missions using Existing Spacecraft. Dr. Hertz next reviewed activities of the Suborbital Program, including balloon launches. Three balloons will launch from Antarctica in December 2016 and January 2017, and there will be four sounding rockets in the next year.

SOFIA received over 200 proposals in response to the Cycle 5 Call for Proposals with selections to be announced in early October 2016. Commissioning of second-generation instrument upGREAT, and Phase II commissioning of HAWC+ is planned for November and December 2016, respectively. A third-generation instrument, the High Resolution Mid-InfrarEd Spectrometer (HIRMES), was selected and is planned to be available in the Spring of 2019. NASA continues its collaboration on ESA's L3 gravitational wave (GW) observatory. In June, the NASA L3 study team released an interim report summarizing technology candidates for the NASA payload, and in August the National Academies Midterm Assessment report strongly urged NASA involvement. In September, ESA announced that it was accelerating the call for L3 mission concepts to this year, and NASA simultaneously announced that it will be a strong partner in the mission.

In producing an interim report, the NASA L3 study team (L3ST) considered technologies the United States could contribute. L3ST used three metrics: impact and insight; U.S. capabilities and heritage; and implementation simplicity. The team also generated rough cost estimates. NASA will use this input to move forward. After ESA makes a selection, it will begin Phase A and mission definition, which are expected to take 3 years. ESA will then define the payload and begin the technology maturation phase. In 2024, ESA will adopt a mission, analogous to NASA's confirmation process. The projected launch date is late 2033 or early 2034. NASA's GW activities include partnering on the Laser Interferometer Space Antenna (LISA) Pathfinder; investing in GW technologies; funding theory, computation, and modeling, along with other programs; and establishing the L3ST and L3 study office at GSFC. The Agency has also stepped up discussions with ESA. The Midterm Assessment recommends that NASA be a strong partner in the effort, enabling the L3 mission to cover the science capabilities of the original LISA concept. The ESA limit for international participation is about 20 percent, which would be about $300-350 million for hardware from NASA.

This was the third large mission recommendation of the 2010 DS, and the Midterm Assessment was very clear that APD needs to be a strong partner in this mission. The Division had been planning an L3 participation level of less than 10 percent, but that is now 20 percent. This means APD will have to do less of something else.

For missions in development, there may be some impacts from the recent SpaceX anomaly, which has taken the Falcon 9 launch vehicle offline for some time. The Neutron-star Interior Composition Explorer (NICER) launch has moved by 1 month, and the Cosmic-Ray Energetics and Mass investigation (CREAM) is still scheduled for June 2017. The new dates assume a quick resolution to the SpaceX issues, which are still under investigation. SpaceX will take the time it needs.

The only substantive change in preparation for the 2020 DS is the call for probe concept studies. The four large mission concept studies are ongoing. The four large mission concept study teams will make presentations at a community session to be held during the next American Astronomical Society (AAS) meeting. The probe concept study proposals are due in November 2016. APD received 36 notices of intent to propose and will select 5-8 in the Spring of 2017, with reports due in the Fall of 2018. There will also be workshop reports that year.

Dr. Jason Kalirai reported hearing that some study teams for the large mission concepts are facing roadblocks on engagement with industry. Dr. Hertz said that the charters for the science and technology definition teams (STDTs) indicate a desire for industry involvement, but that is up to the centers. He has met with industry to discuss their participation. He expects more engagement in the near term. Study leadership will be meeting soon, and they will talk about enabling industry engagement. He would not repeat the false rumor going around. Federal procurement laws do apply here.

Keck Continuation Report

Ms. Doris Daou of NASA's Planetary Science Division (PSD) led a team that was asked to review NASA programs with Keck from the last 5 years, as well as the Keck Science Strategic Plan as pertains to future NASA science missions. The team evaluated Keck's contribution to NASA mission support, estimated its likely promise over the next 5 years, and prepared findings. The main issues are time allocation and cost. NASA's total outlay for this endeavor comes to about $6 million per year.

The benefits of continuing include cost-effectiveness; Keck's state-of-the-art instrumentation, with significant technical improvements planned through 2023; Keck's role as a resource to maximize the scientific productivity of existing and upcoming flight missions; the reasonable price to NASA; the good working relationship between NASA and CARA; the value to the community; and the Keck Observatory Archive. Concerns include the lack of Keck time assigned to key science projects, which is below 30 percent. In addition, there is a weak definition of "mission support," which makes it difficult to evaluate effectiveness. The level of publications is low compared to the investments, and there may be better coverage from other large telescopes.

Dr. John Gagosian of APD added that the primary justification for NASA's investment would be the unique capabilities and values to the Agency, specifically the mission support and projects complementing space-based observatories. If that comes to only 30 percent, there is an issue of alignment. However, he was not sure the team had sufficiently accounted for GO time. Dr. Kalirai said that he has used Keck and feels it offers the community access to powerful ground-based observations. It will become even more useful with JWST. It is also important, however, to consider programs with observatories in the Southern Hemisphere. Dr. Hertz explained that NASA considers Keck to be a pathfinder in data archiving because it has enabled the Agency to determine how to archive ground-based data as if it were space-based data.

Mid Decadal Report

Dr. Jacqueline Hewitt of MIT presented the report from the National Academies Midterm Assessment Committee. An ad hoc committee was appointed to examine how well APD, the National Science Foundation (NSF), and the Department of Energy (DOE) were addressing the recommendations of the 2010 DS. In compiling the report, the committee sought community input.

The committee first looked at the science discoveries and technology advances, including the detection of gravitational waves by the Laser Interferometry Gravitational-wave Observatory (LIGO), the exoplanet discoveries made by Kepler and K2, and the discoveries of galaxies enabling study of the cosmic dawn. There were numerous other discoveries, as well as technology advances.

The second chapter of the report included a number of findings, some of which reflected the fact that the budgets enacted for NASA and NSF astrophysics have been substantially below what the 2010 DS assumed they would be. Advances in the field have occurred despite these budget issues. The committee determined that program balance should include a viable mix of small, medium, and large initiatives on the ground and in space that collectively optimize science return. It does necessarily not mean a balance among astronomy subtopics, however; this should reflect scientific priorities. The third section of the report addressed ground-based observations and included findings and recommendations pertaining to NSF's various telescopes and programs.

The fourth chapter dealt with space-based science, which was more relevant to APD. Finding 4-1 stated that WFIRST has potential to significantly advance the science envisioned in the 2010 DS. The committee found that cost increases through 2015 were due to increase in scope, of the coronagraph along with GO funding and inflation. Dr. Hewitt said that the recommendation was to revisit the mission management, as future cost increases might call for a descope. Finding 4-4 also expressed concern about the coronagraph as a possible driver of increased costs.

Recommendation 4-1 directed NASA to commission an independent technical, management, and cost assessment of WFIRST, including the coronagraph. If the mission cost estimate is such that mission execution would compromise the science priorities and program balance, NASA should descope the mission in order to restore the scientific priorities and program balance.

The committee determined that the 2010 DS recommendation for the Explorer program was ambiguous, and it is not executable due to budget realities. The committee recommended that APD continue with its plan of having at least four Explorer AOs from 2012 to 2021, each with an MoO call.

The committee noted ESA's plans to have GW as the L3 mission theme. Recommendation 4-4 stated that NASA should be "a strong technical and scientific partner" in this mission, with the goal of restoring the full scientific capability envisioned in the 2010 DS. Recommendation 4-5 stated that NASA should proceed with its plans to participate in ESA's Athena mission.

Finding 4-11 stated that the current level of investment in the technology development and precursor science for exoplanet research exceeds DS recommended levels. As discussed earlier in the report, this was justified when considering the growth in the field and the broader societal interest in the possibility of life beyond Earth. The committee views further growth in the exoplanet technology development program as a lower priority than GW technology development. Finding 4-12 stated that the Inflation Probe Technology Development program is well-aligned with the 2010 DS recommendations, noting that the ground-based and suborbital programs target Cosmic Microwave Background (CMB) B-mode polarization. The committee urged continuation of these efforts, which could be important for the 2020 DS. Finally, the committee pointed out a drop in the GO program at the end of the previous decade, observing that the funding has yet to be restored.

Discussion
Dr. Natalie Batalha pointed out that some of the technology development for the WFIRST coronagraph will enable future missions. She wondered if Finding 4-11, which stated that exoplanet research has exceeded the DS recommendation, took that into account. Dr. Hewitt replied that the committee tried to include all technology development. Dr. Batalha explained that the Astrophysics-Focused Telescope Assets (AFTA) design elements sometimes do not apply to future missions. Dr. Hewitt said that the committee was told that it was future-oriented. Regardless, other important areas, like GW, need to be addressed in technology development.

Dr. Gaudi agreed with Dr. Batalha that more work is needed in exoplanets, and there could be significant mission delays were APD to follow the Midterm Assessment Committee's recommendations. He thought the committee was pitting exoplanets against GW instead of stating the need for greater GW investments. It was not obvious to him that this was the right decision. Dr. Hewitt said that the logic was that GW science is very high priority science that has moved forward at ESA, and exoplanets are not the only priority.

Dr. Feryal Ozel said that the recommendation to descope WFIRST is of concern to the entire science community. She asked if the committee recommended a particular descoping or another committee to address the issue. Dr. Hewitt replied that they envisioned another committee. Much of the cost increase involves the launch vehicle, an element that is uncertain and volatile, and which may solve the problem. Dr. Ozel next stated that she disagreed that Athena fulfills most of the IXO science goals. She was concerned that nothing has been done to change the situation for IXO or any other x-ray mission, and

she did not think Athena was the answer. Dr. Hewitt agreed that Athena is much less capable than IXO might have been. However, there is a shortage of funding in many areas.

Dr. Gaudi said it was not clear why the committee singled out one area, exoplanets, to pit against GW. Dr. Hewitt said that GW was second as a large mission to WFIRST, and the exoplanet funding goals have been met. An interesting question is how effective the exoplanet program has been with respect to the technology development and science goals.

First Response to Midterm Assessment Report

Dr. Hertz explained that APD would be conducting a more thorough review of the Midterm Assessment report, and his presentation was a first pass at a response. He thanked the Midterm Assessment Committee for their impressive work, which was clear and unambiguous. It will take a while to formulate a full response, and the budget cycle is such that nothing can change until FY19.

He agreed with Finding 4-14, which says the program is balanced. On WFIRST, NASA plans to conduct an independent Technical, Management, Cost (TMC) assessment of WFIRST prior to KDP-B. This is standard practice. There will be multiple independent cost assessments. At this point of formulation, the work is not completely laid out for the mission. The multiple assessments will help identify the uncertainties. Cost estimates are an art, not a science. NASA will manage WFIRST and the overall astrophysics portfolio to maintain program balance. There are many ways to achieve program balance, and descoping WFIRST, APD's highest priority, is only one of them.

NASA will treat growth in Euclid elements beyond commitments to ESA as lower priority. NASA will discuss with the Committee on Astronomy and Astrophysics (CAA) whether this means that no funded Euclid GO program can be initiated for the community. APD agrees with the findings on Explorers and Athena. NASA has begun discussions with ESA about having a larger role for the L3 mission, but ESA has its limits on international collaboration. NASA has also begun discussing budgets for the effort within the Administration, but due to the nature of the government, nothing can be assured at this time. Any current increase in technology development for the L3 mission will require funding shifts within APD, and it is not yet clear how to accomplish that. In addition, extra funds from the out-years would come from areas that the next DS might consider priorities. No decisions have been made.

Regarding DS-recommended technology development in general, NASA has done some work and is reviewing options. APD agreed with the committee about inflation probe technology. There were some small activities that Dr. Hewitt did not mention in her presentation, in which the committee said that implementation has been mixed. Dr. Hertz did not disagree with the math, but noted that R&A support has increased overall. The reduction in GO programs was due to the ending of missions that had substantial GO programs. GO funding will increase with the launch of some missions in development. Finally, a reduced launch rate has affected the number of GO opportunities. APD will incorporate any decisions based on the report into budget formulation next spring.

Dr. Gaudi pointed out that LIGO detected the first GW only 8 months before, and while it was exciting, he thought the report might have been biased by a reaction to a new discovery. Dr. Hewitt disagreed. Dr. Batalha noted that some of APD's spending is the result of Congressional direction. Dr. Hertz said that he thinks the DS and supporting reports provide the right priorities, and it is not his job to impose his preferences. He hears the community through studies and APS. He will respond to the report thoroughly and thoughtfully, explaining any disagreements.

High End Computing

Dr. Tsengdar Lee discussed High End Computing (HEC) at NASA and HEC support of astrophysics. SMD manages the HEC Capability (HECC) project for the Agency, as science users require the most capacity. HECC maintains a stable core capability to provide baseline computational resources. About one third of the HECC budget refreshes technologies each year, leading to a continuously increasing capability. The budget has been steady since 2006, with little fluctuation. As of 2016, HECC has maxed out the current facility and has no capacity to address expanding programmatic requirements even if additional programmatic funding is provided. This means there is a limited ability to add computers to the facility. Meanwhile, the needs grow in all disciplines.

Computing allocations are based on 2006 data. In that construct, APD receives 21.7 percent of the capacity, the Earth Science Division (ESD) has 53.8 percent, the Heliophysics Division (HPD) is allotted 13.9 percent, and PSD gets 10.6 percent. SMD is flexible with the allocations, moving unused capacity to those who need it. However, needs are growing in the face of quite constrained capacity. Dr. Lee showed a graphic of the HECC allocation cycle, which indicated that the program is already falling behind as demand exceeds capacity. Time-critical projects are causing further delays.

The mitigation strategy includes the following steps:

- Build a facility to allow future expansion. The Agency has already approved a proposal to expand the HECC facility, which is very significant. Construction will start in 2018, and there are some early expansion efforts.
- Tie HEC resource needs to the budget planning process;
- Give SMD's science divisions the flexibility to buy more resources as needed, though only when the facility is available;
- Work with the science community through the normal strategic planning process to understand the relative priority of HEC.

Dr. Lee showed a prototype of the facility expansion, which will take place at the Ames Research Center (ARC). The new facility will have 16 modules that will be added over a 5-year period. This means that 2022, the new facility will be complete, doubling current capacity. Governing principles for the HECC budget planning process include treating HEC resources as limited resource and in need of planning. SMD will plan for HEC resources similar to and in coordination with the Planning, Programming, Budgeting, and Execution (PPBE) process. Once HEC resource demands have been approved through the PPBE process, they will become an implementation requirement. Planned HEC resources will be allocated during the proposal evaluation and award process. SMD divisions will have the flexibility to buy additional needed resources if those resources are available, which means not before 2018.

Discussion

Dr. Batalha asked how priorities are set, and sought clarification for when the facility improvements will begin. Dr. Lee said that the computing modules will start coming in after HECC begins construction in 2018, with a phase-in plan. Dr. Hertz said that before APD selected the Transiting Exoplanet Survey Satellite (TESS), the Division asked for an estimate of its computing needs relative to Kepler. That estimate was small, so the assumption is that it will not be an issue. Dr. Batalha hoped that that remained the case, noting that Kepler itself needed more time than anticipated. She expressed wariness about TESS's computational needs, as TESS will perform new searches more often than Kepler. Dr. Hertz explained that APD made it clear to the TESS team that HEC is a limited resource, just like the budget.

Dr. Lee explained that all research projects are treated as equal unless there is a critical time constraint, in which case there is a process involved. Once such projects have passed the critical point, they move out of the priority queue. Dr. Ozel said she was very pleased to see the expansion effort, and asked Dr. Lee if he envisioned coordinating with the Theoretical and Computational Astrophysics Networks (TCAN) program. Dr. Lee replied that he has discussed that, WFIRST, and other projects with APD. Dr. Paul Scowen noted that the artist's rendering has the new facility on a concrete platform in a flat area. Dr. Lee explained that sea level rise and earthquake are concerns at ARC. The platform is elevated by 1 foot on a concrete pad, and the facility engineering people are planning for future expansion. The module has all the lightning, fire, flood, etc., possibilities taken into consideration.

APD returned to discussing the Keck allocation. Dr. Batalha sought clarification about key projects and community GOs. Dr. Hertz said that the call for key projects was separate from the twice yearly GO call. The amount of telescope time is very different from those for GOs normally. There have been key projects for Kepler, K2, Europa, and WFIRST. The distribution between key projects and GOs is completely within NASA's control. Every proposal must be NASA-relevant, and mission relevance must be endorsed by the mission team. Dr. Marshall Bautz said that the Keck archive of ground-based data is a brilliant accomplishment, and wondered if it could be developed further.

R&A Update

Dr. Linda Sparke, APD Research Program Manager, presented the R&A update. Because of pressure on HEC, everyone who applies to ROSES 2016 must estimate and justify their computing requirements. She reviewed the Astrophysics Division requests for FY2017 and past allocations, noting that Kepler and the Astrophysics Theory Program (ATP) have significant demands. TCAN was first solicited in 2013 as a joint program with NSF, and funded six networks at $1.5 million for 3 years ($0.5 million/year/network). In September, NSF said that it would not issue a second TCAN solicitation. Because of a favorable external review of the program, APD plans to proceed with a TCAN solicitation possibly in 2017 to fund two or three research networks.

In November of 2014, APD advised APS that it would not solicit new ATP investigations in 2015, to allow funding to start closer to the proposal due date. For ATP-16, the Division received 197 proposals requesting a total of $30 million in Year 1 funding and $91 million in total – similar to the 214 proposals received for ATP-14. Selected proposers should receive their funds early in 2017. In ATP-13 and ATP-14, all proposals rated Excellent (E) received funding, as did about 60 percent of those rated Excellent/Very Good (E/VG); almost no VG proposals were selected. With selection rates below 20 percent, highly meritorious proposals must be declined and review panels are reluctant to "take a chance" on riskier proposals or new investigators. To address the problem of low selection rates, APD plans to compete ATP in alternate years. If the number of new proposals follows past trends, this will enable funding of the E and E/VG proposals, as well as some VG proposals.

In 2010, APS recommended that APD establish the Roman Technology Fellowship (RTF) program. Early career researchers propose to RTF in two phases: those selected for a 1-year concept study (Phase 1) may propose to continue into a 4-year development (Phase 2). Phase 2 proposals must include an institutional commitment for required lab space and other needed resources. The number of RTF proposals has declined over the years. APD plans to make a change to allow scientists proposing technology projects or suborbital payloads to other APD ROSES elements (specifically the Astrophysics Research and Analysis (APRA) or Strategic Astrophysics Technology (SAT) programs) to indicate their

status as an early career scientist, and to select the Fellows from among the eligible winning proposers. This is similar to Planetary Science Division's Early Career Fellowship program, which has been successful in helping the award winners move into tenure-track positions. Those selected as Roman Technology Fellows who hold or win qualifying position within 10 years of receiving a PhD may then seek additional funds for a lab or research group, or they may continue their APRA/SAT project. At the previous APS meeting, APD had asked members to consider this action and to provide a response at this meeting.

Discussion
Dr. Ozel asked for clarification on the ATP proposal. Dr. Sparke replied that APD wanted to shift the cadence to every other year. Drs. Ozel and Batalha said that they would oppose such a move, as it would not solve the problem of underfunding and it would leave some awardees with unexpected funding gaps. Dr. Neil Cornish said that it would be devastating for an applicant to not have a chance to apply for 2 years. Dr. Ozel added that it would diminish candidates' opportunities to make long-term plans.

Dr. Hertz pointed out that the APD proposal would result in selecting twice as many meritorious proposals, just every other year. The funding amount would double so that the investment over time would remain the same. The amount of proposing work would go down by a factor of two, with the same number selected over 2 years. Dr. Ozel said that those who were not selected would change their focus.

Dr. Bautz was in favor of the shifting ATP to every 2 years. Dr. Sparke explained that R&A had skipped a year with the program due to a funding cycle issue, and it seemed to be a successful, albeit unplanned, experiment. APD would like to skip it in FY17 and start the alternate year cadence in FY18. Dr. Somerville was not convinced that this saves effort for the proposers. She recommended having a two-step review process. Dr. Hertz said that if a proposal is declined during triage, there has to be a peer review for the first step. Dr. Ozel added that she did not believe triage would save time, nor would it be fair. She cited a trial NSF program that asked for budget justification but not budget numbers, and wondered if APD might consider something like that.

Dr. Gaudi identified three issues this proposal attempted to address: the burden to reviewers, the burden to proposers, and the selection rate. Dr. Ozel noted that she does not always resubmit after a proposal goes unfunded, but instead takes a different direction. She suggested that the detailed budget requirement be postponed until a proposal is accepted based on its scientific merit. She also thought APS did not have sufficient data to make a decision. Dr. Beth Willman said she supported the plan to have ATP every other year. As a proposer, she would rather propose to a call for which she feels that the proposal has a chance to be accepted. She did sense a tension between the 2-year cycle for 3-year awards, but thought it could be worked through. Dr. Sparke explained that proposers can seek 1, 2, or 4 year awards under ATP as well as the usual 3 year awards. Dr. Ozel was concerned that review panels do not always fully represent the community, a problem that could be exacerbated by a 2-year cycle. Dr. Asantha Cooray said that that stochastic element is a factor of the low selection rate.

<u>NASA Named Fellows Update</u>
Dr. Kartik Sheth explained that APD was proposing to shift a fraction of the funds for the NASA Named Fellowships (NNFs) to R&A, as the ratio of funding for the NNFs versus R&A has changed as was presented at the last meeting by Dr. Sparke. NASA supported about 106 NNFs in 2014-16. Each fellowship costs NASA from $110,000 to $130,000 -- the range primarily depends on institutional overheads.

At a previous meeting, APS asked seven questions about the NNFs and the APD proposal. The first question sought information on how the salary and other figures are determined, and how they compare to other fellowships. Dr. Sheth's research determined that the current salary is based on a market study conducted by the Space Telescope Science Institute (STScI) and is consistent with what physics PhDs in government labs receive. This is higher than what astrophysics postdocs typically receive at universities.

The next two questions asked about NNF career paths and a comparison to the U.S. rate of astrophysics PhDs. Dr. Sheth said that more than 90 percent of NNFs stay in the profession. The number is slightly higher than the numbers quoted by a couple of programs (Maryland and Caltech) however the comparison is not exact since the university numbers are over a longer time scale (so their fraction is lowered by such things as deceased alumni). Thus, the NNF program does slightly better, but this is expected since these are the leaders in the field.

The number of NNFs has increased significantly relative to U.S. astrophysics PhD production. The ratio has changed from 6:1 at the beginning of the NNF program to 4:1 today.

The answer to Question 4, about the oversubscription rate, is also hard to determine since the applications are not evaluated in the same way as NASA R&A proposals. The NNF program leads say their panels feel they have twice as many deserving candidates as fellowships.

The fifth question asked for the fraction of applicants applying for multiple fellowships. The overlap between Hubble and Sagan applicants and Hubble and Einstein applicants exceeds 70 percent. On the other hand, regarding the question of individuals holding multiple NNFs, Dr. Sheth identified only 8 of 558 with both Hubble and Einstein awards, and 1 with a Hubble and a Sagan. Finally, the distribution of all NNFs over the history of the program has been such that over half of the NNFs have gone to six institutions.

In light of these data, APD modified its proposal, which would be phased in over three years as follows:

- Given the large overlap in applicants, combine the fellowships to a single review;
- Maintain program balance with selection of multiple fellows for each theme;
- Ensure that fellows maintain their connection to the program office themes; and
- Ensure that the NASA Exoplanet Science Institute (NExScI), Chandra X-ray Center (CXC), and STScI all play an integral role in organizing the review and the selection of fellows.

This assumes the fellows keep the fellowships for 3 years, which does not actually happen. If a fellow leaves the program early, those funds go back into the pool and more fellows can be selected. The details for implementing this will need to be worked out. If APD does this, it will be essential to maintain the connection to the themes. There will be no reduction in salaries. APD would prefer to give all of the shifted funds to APRA, but APS could advise otherwise.

Dr. Brenda Dingus sought clarification on the funding increases to NNFs over time. Dr. Sheth said that the proposed reduction will restore the balance from 10 years ago. If APD were to cut the NNF salaries by 10 percent instead and reduce the research budget by half, as had been discussed, the total funds freed would not amount to a large fraction and there would be administrative complications such as how / when do we reduce the salaries etc.

Dr. Ozel came up with different numbers when she did her own research. She and Drs. Sheth and Sparke reviewed some of the details. Dr. Sheth pointed out travel to symposia as an expense, and Dr. Sparke said that there were overhead expenses. Dr. Ozel questioned whether some of the information was current, and Dr. Sheth agreed to do some additional investigation.

Dr. Ozel added that the Chandra users committee sent Dr. Gaudi a comment that combining the three NNFs would reduce the number of applications graduates would send, as long as the panels have good expertise and diversity to identify the best among them. Dr. Sheth said that there is a great deal of expertise amongst the current NNF leads, and they have discussed the number of panels that would be needed. They also talked about having the panels all at once, with the NNF leads fostering communication across the themes.

Dr. Alan Boss asked about the mechanics of assigning the winners to the fellowships. There are limits on the number of fellows of different types a single institution can host. Dr. Sheth replied that an increase in the limit has been discussed but no decisions have been made. APD will seek APS advice as this change is implemented.

Community Comment Period

No one from the public came forward during the public comment period. A second public comment period was scheduled for the following day.

Discussion

Dr. Gaudi listed several discussion points. The first was a response to the Keck continuation question. Dr. Somerville chaired this discussion, and asked if the members wanted to make a recommendation. Dr. Boss thought they should continue the Keck contract, as it has been a wonderful resource for NASA science. Others agreed. Dr. Somerville said the recommendation would include a statement like that, as well as a commendation on the archiving of ground-based data.

Regarding Southern Hemisphere access, Dr. Kalirai said that it already exists, and Dr. Boss added that specific observations from the south can be coordinated in most cases. Dr. Somerville noted that there are apparently informal swaps of time. The recommendation would advocate continuing with Keck, thank NASA for the archiving, seek an assessment of whether the balance is appropriate regarding key projects, and say nothing about the Southern Hemisphere. Dr. Hertz said that APD would move forward with soliciting a proposal from CARA to extend NASA's time with Keck.

The next topic was the Midterm Assessment. Dr. Gaudi thanked Dr. Hewitt and the ad hoc committee for producing a clear report. He thought the only potentially contentious issue was that of exoplanet technology funding. Dr. Boss noted that the Exoplanet PAG (ExoPAG) was drafting a letter to Dr. Hertz about this concern.

Dr. Cornish thought the coronagraph loss on WFIRST might be a problem. The report contained both a specific recommendation to revisit the costing of WFIRST in the next year and a suggestion that the coronagraph could be descoped if costs ran too high. Dr. Ozel reminded APS that Dr. Hewitt had said that this would call for another committee. Dr. Bautz added that Dr. Hertz's response was reasonable. Dr. Gaudi agreed that NASA seemed likely to take budget growth seriously. Dr. Hertz noted that APD will

do multiple independent cost evaluations as part of KDP-B. Dr. Gaudi said that the APS statement would be a concurrence with NASA's response here.

Dr. Cornish pointed out that the Midterm Assessment language calls out the coronagraph. Dr. Hertz agreed that the Midterm Committee was very concerned about the coronagraph. However, the coronagraph is not a top risk in formulation. It is off the critical path, about to meet Technology Readiness Level (TRL) 5, and in great shape for Phase A. It is not what he loses sleep over, and it is not obvious that the coronagraph would be the cause of cost growth. Dr. Gaudi said that APS would accept that.

On the topic of HEC, APS planned to thank Dr. Lee, praise the long-term planning, and encourage NASA to continue watching computational capacity.

Regarding the proposed move of ATP to a 2-year cadence, Drs. Somerville and Ozel were both strongly opposed. Others stated that they supported the move, and it became apparent that there was a range of opinions on the topic. Dr. Gaudi noted that there was no requirement that they reach consensus. He was hearing that APS members were unsure whether the proposed change would work. Dr. Ozel suggested waiting until after the ATP reviews that would occur in a few weeks. Dr. Hertz reminded APS that there would be no change in the budget, just a rephasing. Dr. Gaudi restated the issue, saying that by skipping a year and doubling the funds, APD would receive the same number of proposals and select twice as many. Dr. Hertz confirmed that APD would select twice as many half as often, for the same total funding. Those funded in the current round would receive their funds right away.

Dr. Somerville held that the selection rate is a false metric. This would not be fair to the community, since they would not be able to plan for it. If people know it will be every 2 years, they will propose twice as often. Others agreed, but Dr. Hertz said that no one knows until they try it. Dr. Gaudi noted that the issue in the Astronomy and Astrophysics Advisory Committee (AAAC) report was resubmission of proposals. Dr. Cooray thought there would be less recycling if the call were every other year.

It was suggested that an announcement go out before initiating this change. Dr. Boss asked if there had been an outcry when APD skipped a year for in order to align the funding. Dr. Hertz replied that APD had expected a negative response, but it did not occur. Dr. Sparke added that she had a couple of people remark upon it, but they did not follow up. Dr. Hertz said that APD was trying to be responsive to the community and APS regarding concerns about the very low selection rates. The Division is looking for solutions. APD expected the number of proposals to go up after missing a year, but that did not happen.

Dr. Ozel suggested starting with the announcement. Dr. Gaudi said that he would support having it for 1 year, with the next call announcing that it is for 2 years. When Dr. Sparke showed the number of proposals per year, Dr. Boss observed that it appeared fairly stable in a range. There seems to be a saturation point, but there are no data on that. Dr. Gaudi thought APS should vote on whether to maintain the annual funding for this cycle, then explicitly try the experiment after that. Dr. Boss said that he wanted the option of accepting the APD proposal as presented. Dr. Gaudi then suggested revisiting it the next day. However, Dr. Yun Wang said that she would be traveling and therefore wanted to state that she favored the APD proposal as presented. Dr. Bautz advised saying that APS would monitor it and go back to an annual call if warranted. He would have them track the change over a number of years.

Dr. Somerville questioned the fairness of doing this without an announcement first. Dr. Gaudi mentioned the need for proposers to plan several years in the future. APS represents the community and should consider that in making decisions. When he suggested delaying the decision, Dr. Sparke pointed out that ROSES 17 will be issued in February, before the next APS meeting. Dr. Gaudi was concerned about those whose awards were expiring and expected to apply next year. Dr. Cooray observed that ROSES calls do not state that they will be annual. Dr. Gaudi said that APS did not know how many people planned on applying next year and therefore did not apply this year. He had significant issues with implementing the change with no announcement.

It was not obvious that APS was converging, so the discussion shifted to options for voting. It was agreed that the options would be presented to the APS members the next day, with the votes to be read out loud during the meeting.

Wrap Up for Day 1
The meeting was adjourned for the day at 5:06 p.m.

Tuesday, October 4, 2016

Opening Remarks
Dr. Hasan opened the meeting with a quick review of FACA rules. Dr. Gaudi then took roll.

ExoPAG/PhysPAG/COPAG Updates

ExoPAG
Dr. Boss presented an update on ExoPAG activities. Seven of the PAG's 14 Study Analysis Groups (SAGs) have completed their work. Of the remaining seven, two are shutting down: SAG 12 on exoplanet astrometry, and SAG 13 on exoplanet demographics. Both will present their final reports at ExoPAG's January 2017 meeting. ExoPAG was proposing a new SAG, SAG 19, on direct imaging/coronagraph metrics.

SAG 16, which addresses biosignatures, had a 3-day workshop in late July along with the NASA Astrobiology Institute (NAI) and the Nexus for Exoplanet System Science (NExSS). The SAG hopes to have a draft report and a peer-reviewable paper in October 2016, with the final report by March 2017. The proposed SAG 19 relates to measurements that a star shade could collect, and the best ways to gather those measurements. It would go back to Bayesian Signal Detection Theory to rebuild a solid set of definitions of contrast in different contexts. The SAG would also identify what can be learned from other fields and define precise contrast computation to set a new industry standard. ExoPAG sought APS approval of this SAG.

ExoPAG began conducting the technology list process, adding a new step of independent review by the exoplanet technology assessment committee. This will serve as a check on the ExoPAG process. Future activities include monthly telecons, support for the far-infrared/origins STDT, and review of the technology gap list planning. Upcoming meetings include ExoPAG 15 prior to the AAS winter meetings, and a joint PAG session.

Dr. Gaudi asked if anyone was opposed to SAG 19. As no one was, he declared the SAG approved.

PhysPAG

Dr. James Bock presented the update on the Physics of the Cosmos PAG (PhysPAG). The membership represents a scientifically diverse group segmented into various studies on dark energy, inflation, black holes and general relativity, and behavior of matter in extreme environments. These are separate communities that attend their own conferences. Instead of SAGs, PhysPAG tends to have Science Investigation Groups (SIGs), which are long-term groups addressing many of the PAG's activities. There will be a general PhysPAG meeting at AAS, along with the joint PAG meeting. There will also be a mini-symposium at the American Physical Society meeting in January, and significant meetings at the AAS meeting in Idaho in August.

Dr. Bock next updated SIG activities. The GW SIG is developing an L3 GW technology roadmap and a white paper related to the L3 observatory, and is engaged in discussions about the U.S. contributions to ESA AO mission concepts. As Dr. Hertz previously reported, the L3 interim report examines five different approaches. The GW SIG is encouraged that the U.S. contribution will increase.

The X-Ray SIG is following a number of developments, including the NASA role in Athena, the upcoming NICER launch, potential U.S. participation in XRRM, and the two x-ray polarimetry SMEX concepts that are up for a MoO. The SIG continues reviewing the x-ray surveyor large mission concept, and has a number of meetings scheduled. Similarly, the Gamma-Ray SIG is working on a roadmap for the next DS, is following probe and Explorer concepts, and has meeting plans.

The Inflation Probe SIG is following a couple of active mission concepts and just had the CMB S4 workshop. There will be an opportunity to propose for ESA's M5. The Cosmic Ray SIG is awaiting the CREAM launch, and the Cosmic Structure SIG is supporting the large mission studies and a SMEX mission concept.

COPAG

Dr. Scowen gave the Cosmic Origins PAG (COPAG) presentation. The PAG did not have a lot of issues with the Midterm Assessment, which seemed to be a good snapshot. Although COPAG had some minor concerns about the security of the coronagraph on WFIRST due to the language in the report, members understand that APD has this in hand. COPAG is nonetheless voicing support for the coronagraph and its applications to cosmic origins science. Even as a technology demonstration, the coronagraph can contribute valuable science.

SIG2 met in June, where members discussed the review of technology gaps. COPAG is hoping to open a new Technology Interest Group (TIG), which would include members of the science community and industry, and focus on the technology gaps list. One reason for the TIG is that the COPAG Executive Committee felt it lacked the expertise needed to review the list this year. The TIG would serve as a more informed review body and provide input on technology developments throughout the year. Industry participation would help include innovative technologies that might not be familiar to the science community. After discussions with APD program officers, COPAG has redefined the TIG proposal to ensure that it will be advisory. COPAG also want to open a forum for distributing and discussing new technology developments with members, and seeks APS permission to move forward.

In other COPAG activities, members are active on the STDTs for the four large study concepts. The Far Infrared SIG (FIRSIG) began a webinar series and has plans for sessions at the January AAS meeting.

SIG2, on UV-visible science and technology, has been quiet, but many of its members are active on the large mission studies. SIG2 pulled together a 55-page report on the workshop from mid-2015. SIG3, on the Cosmic Dawn, also has members on the large mission concept STDTs, is working on mission concept studies, and will have a splinter meeting at the January AAS meeting.

COPAG sought APS permission to establish the TIG. Dr. Hertz asked that APS defer this action until the next meeting so that APD can first evaluate how the Division is handling the PAGs' input on technology gaps. He took an action to report back on the findings and what he sees as the best path forward. Dr. Scowen agreed to defer, and the likely date of the spring APS meeting will ensure that any positive decision will be in time for COPAG to establish the TIG on its own timeline.

Webb Telescope Update

Dr. Eric Smith, JWST Program Director/Program Scientist, presented a simplified schedule for the mission. The Optical Telescope element/Integrated Science (OTIS) module integration was fully completed just a few days before the meeting. The pathfinder telescope was in the midst of a 52-day pathfinder test at JSC. Dr. Smith reviewed the OTIS schedule flow, flight hardware progress, and sunshield progress. The final layer of the sunshield was delivered in late September, and major manufacturing work is done. The spacecraft is progressing well and on schedule. The solar array is the pacing item. The membrane tensioning system component remanufacturing is also proceeding well, following a redesign. One of the forward units is being tested, and the other is nearly complete.

The Science and Operations Center (SOC) is well along toward completion of software work and that software will be available to drive tests of the flight hardware. All of the technology performance parameters are being watched, and almost all are on the stoplight chart as green. The observatory wet mass allocation was reduced to open up more launch windows, thereby creating program flexibility. Dr. Smith showed the FY16 milestones and milestone performance. There was some slippage into the new fiscal year, but two of the six deferred items were off by only a week or so. Among the milestones for the coming year is initiation of early science release programs, which will bring in the science community more fully. In terms of funded schedule reserve, the mission is on plan and above the GSFC recommendations. The pieces are in, and they work. JWST has held to the schedule for 6 years now and has been fortunate to have the margin. Mission development is now at a stage change.

SOC

Dr. Nikole Lewis, STScI JWST Project Scientist, provided more detail on the SOC activities. Major segments of the operations flow include the proposal planning system, flight operations, and data management system. The SOC is on track to provide robust support for all of these.

JWST is scheduled to launch in October, 2018. The first 6 months will be devoted to commissioning and deployment. Cycle 1 observations will begin at that time, from the Guaranteed Time Observer (GTO) program. The GTO observations will account for 4,020 hours in the first 30 months. The GO program will last the entire lifetime of JWST. The call for proposals will be in September, 2019. The issue is that most Cycle 1 data will still be proprietary at that time, limiting the use of those data in Cycle 2 proposals. The JWST Advisory Committee (JSTAC) has recommended an early release science program to enable the Cycle 2 proposals to be informed. In response to that recommendation, Dr. Ken Sembach, STScI Director, will allocate about 500 hours of time for early release science to accelerate the diffusion of JWST information.

This effort, the Director's Discretionary Early Release Science (DD-ERS) will support no more than 15 teams. Dr. Lewis showed how this differs from the standard GO program. STScI will design and deliver science-enabling products to help the community learn how to observe JWST effectively. The DD-ERS targets must have some flexibility. Raw and processed data will enter the public domain immediately after processing and validation. These programs are the science pathfinders for the community. The full details will be provided in the DD-ERS call for proposals in January, 2017. Current details are available to the community at www.jwst.stsci.edu/science-planning/early-release-science-program . DD-ERS proposal requirements include justification for ERS time; project management plan and budget; science justification; description of the observations; and team diversity.

Dr. Lewis gave some examples of suggested DD-ERS data products. This will be a great opportunity to learn about best practices for JWST. The SOC has already begun interacting with the community on this. The DD-ERS will complement, not compete with, the Cycle 1 GO program. Cycle 1 GO proposers will have the details of the GTO and DD-ERS programs at the time of the release of the call for proposals, well in advance of the March, 2018, deadline. DD-ERS activities will provide a focal point for the organization of all user support activities. JWST community engagement has begun with workshops on proposal planning, topical science, and other topics, as well as webinars and video libraries. Despite the webinars and other efforts, however, there is a need to reach a wider community, which SOC is addressing primarily through a web-based presence.

Dr. Gaudi pointed out that ERS has a focus on targets in the continuing viewing zone, but he wonders if, in order to test mission capabilities, target should also be considered elsewhere. Dr. Lewis replied that SOC wants to start with simple targets in addition to pushing the limits. Dr. Batalha said that she finds a challenge in community proposals that are broad, and was unsure about the means of spreading out the funds and deliverables. Dr. Lewis replied that requirements will vary by science area, and documentation will be useful for everything. In terms of mobilizing communities, there will be a core team delivering these products. It is useful to have input from collaborators, but the team needs to be manageable.

SMD STEM Activation Update

Ms. Kristen Erickson, SMD Director of Science Engagement and Partnerships, presented that SMD's Science, Technology, Engineering, and Math (STEM) activation program at NASA was restructured a few years ago and is now working to integrate NASA science experts and content into the learning environment across all ages of learners more effectively and efficiently. In FY16, the program signed 27 cooperative agreements with institutions that are bringing expertise and capabilities into the effort. A January kick-off meeting with PIs and team members resulted in over 120 cross-collaboration memoranda. All 27 awardees have submitted evaluation plans. Each plan must have an external evaluator to include descriptions and/or plans for audience needs assessments, logic models, reporting, and top-level metrics. All of the plans have now been put in place and approved. During the competitive process, the program identified some gaps and so has reached out to National Academies of Sciences for advice on connecting scientists with the learning environment and getting information into the formal education arena.

Within NASA, the program looked at leveraging existing efforts. There is now a Weekly on Wednesday (WOW) listserv incorporating science information from other NASA sources that the Marshall Space Flight Center, Office of Education organization manages. In November, SMD will hold a meeting with the institutions with cooperative agreements, at which they will establish baselines and priorities for the

upcoming year, and leverage efforts. There is also a plan to leverage toolkits. Three of the institutions are working on 2017 eclipse events with various partners. The program recently updated the science.nasa.gov website to be mobile-device-friendly. There will also be a community meeting at the next AGU meeting. Ms. Erickson presented a summary chart of opportunities, achievements, risks/areas of concern, and external evaluators. Evaluation of the total effort will occur each summer, starting in 2017. Ms. Erickson thanked those groups that have been supportive of this effort. The early restructuring was difficult, but this effort is getting Earth and space science into the learning communities.

When asked about concerns, Ms. Erikson said that there are a couple of risk areas. She hopes to keep the program nimble, so that it can adapt to what is outside of its control. In addition, the program refers to "activation" because of the misperception that they are education experts. Rather, they are connected to the science, and the scientists and engineers. It is important to maintain that connection. Feedback from NAS will help strengthen it further.

Dr. Kalirai said that science education often has a focus on communication to external stakeholders, but there is also a need to ensure internal visibility. Ms. Erickson said that NASA has an internal set of reviews of various agency functions, like IT and facilities, and one of the reviews has addressed education. That led to some internal sharing. One of the review co-chairs is from GSFC, which has all of the SMD science disciplines. The results of the review are pending, however. Dr. Cooray asked about the Minority Education Office, which awards grants. Ms. Erickson said that it is run by the Office of Education. Their annual report on the awardees is available online.

Discussion

APS discussion began with the NNFs. Dr. Gaudi recused himself, and Dr. Somerville asked for comments. Dr. Bautz said that during the presentation, there was an implication that the overhead of the administering centers might be a factor. He asked for clarification. Dr. Hertz said that he understands that it is not a significant factor, and that most variability comes from the overhead of the host institutions.

Dr. Patricia Boyd asked about the dollar savings over time, the reallocation of funds into R&A, and the process of combining the fellowships. Dr. Hertz said that the proposal is to reduce the total number of fellows from 105 to 75, which would free up about $4 million annually. The funds would go to R&A, increasing over the 3 years during which the total number of active fellowships drops. He would like to see the funds go to the Astrophysics Research and Analysis (APRA) program, which supports technology and suborbital programs. There would also be an integrated application and an integrated review. This would eliminate the reviews of duplicate applications. The reviews would be organized by the three programs, and the selections would be comparable by topic. However, he would like to see it driven by the quality of proposals, which will change over time. APD will not set a quota.

Being that APRA has a 30-36 percent selection rate, Dr. Batalha would like to shift the funds to ATP and ADAP instead. Dr. Dingus disagreed, stating that the APRA program needs to be strengthened. APRA is important in building new missions, and there are not many R&A avenues for that. Dr. Boss said that when this was first suggested, Dr. Hertz said he would use the funds to fly another balloon mission. Dr. Hertz said that he would not do an earmark. Because suborbital is more expensive per proposal per year, it always seems like the highest ranked unselected proposals tend to be suborbital. There is space for more suborbital payloads.

Dr. Boyd said that there are some amazing proposals from the fellowship applicants. She was unsure about this as an option, and noted that several APS members were conflicted on this issue. Dr. Dingus agreed. She did like the suggestion to pool the NNFs, which could enhance institutional diversity. The fellows carry out their own visions and that enables leadership. However, she did not want to reduce the number of named fellows.

Dr. Boss asked whether NASA being mission-driven factored into Dr. Hertz's preference for APRA. Dr. Hertz thought that was a good summation. He is charged with enabling science while also ensuring that NASA has the capabilities to continue doing astrophysics in space in the future. That means going beyond the analysis capabilities of the community, to develop technologies and missions that enable the next mission to address the big questions. He pays a lot of attention to the various pipelines, which includes strategic technology and mission concepts for the next large missions. That is a big part of his job in addition to supporting the science being done. He has to look toward the future.

Dr. Dingus cited a DS recommendation to increase funding for APRA. Dr. Hertz added that the DS specifically mentioned suborbital and the technology pipeline, as well as theory. The first two fall under APRA. He cannot do all of these with the funds shifted from the NNFs to R&A. At this point, everything in the program is a DS priority. Dr. Boyd said that she thought ATP needs the most help and could make the smallest amount of funding go further.

In answer to a question, Dr. Hertz said that HST funding is set in appropriations law. There is a need to ensure the ensemble of selected fellows spans astrophysics. Making the budget work is complicated. Dr. Bautz felt that postdocs are productive, especially these. On the other hand, the technology development program for astrophysics is not adequate. He saw this as an attempt to address that DS recommendation, and therefore he would support the proposed reduction of postdocs to enable a more vigorous technology development program. Dr. Cornish added that there is also a workforce shortage of technologists. There are not enough programs to support them.

L3ST Update

Dr. David Shoemaker of MIT, Chair of the L3ST, explained that LISA is an ESA mission to observe GWs from space. To this end, NASA initiated the L3 Study to assess participation options and to prepare for the 2020 DS. The study has two phases. Phase 1 is to analyze NASA participation options and work with the "eLISA" consortium on proposals to ESA. Phase 2 will prepare a report for the upcoming DS on NASA's L3 participation.

Dr. Shoemaker presented a list of study members, including a Technology Analysis Group (TAG) of experts from within and outside of NASA. ESA is moving faster than NASA had anticipated and will be compressing the schedule further, especially in the technology development area. The LISA Pathfinder is performing superbly, better than required, and close coordination between NASA and ESA will help understand the noise sources in the joint activities. Dr. Shoemaker reviewed some of the LISA Pathfinder results and data thus far.

Another significant event was ESA's Gravitational Observatory Advisory Team (GOAT) report, which invited strong U.S. participation. The report recommends a full three-satellite, six-link system like that envisioned for the original LISA, and NASA partnership in the ESA mission. The LISA symposium brought

together European and U.S. teams, as well as L3ST members. The Midterm Assessment report is encouraging for this program.

L3ST activities include an interim report that covers a range of technologies and summarizes the Team's perspective on priorities. The main deliverable is a set of matrices outlining options and their costs to NASA. L3ST also evaluated the various potential contributions. Near-term activities are to support NASA/ESA negotiations regarding which technologies NASA can supply, and to understand ESA concepts for design and where the United States can complement them. L3ST will also develop a technology roadmap for U.S. efforts. The roadmap should be both realistic and broad, and identify the resources needed.

Another task is to identify the prime targets for LISA astrophysics. This will involve updating 2010 DS materials, and identifying the challenges and opportunities. Dr. Shoemaker said that this re-evaluation will be from the ground up. In addition, L3ST will help support the ESA call for mission concepts, ensuring a robust response to the call, which is expected in October, 2016. Finally, L3ST will explore U.S. participation in the mission. This should complete the Phase 1 deliverable.

The Phase 2 deliverable would be a submission to the 2020 DS, in which the study team will describe the full endeavor regarding both the science and the mission to deliver it. In the mission description, who does what is secondary to the science perspective. L3ST will need NASA resources appropriate for the study team phase. Finally, L3ST will do advocacy with the larger science community. The next in-person meeting will be early in 2017 and will focus on DS activities, technology development activities, and engagement of the U.S. science community.

Dr. Gaudi asked for clarification on the statement about NASA versus ESA roles being secondary. Dr. Shoemaker explained that this is not about the possibility of NASA leading a mission, but instead reflects a preference to describe the mission and note that ESA and NASA will both participate, without saying what each agency will do. Dr. Gaudi was concerned that the DS panel will be unsure how to make this into a recommendation or priority without the roles being designated. Dr. Shoemaker agreed that L3ST will need to be clear on that. However, the study team does not want a review of the U.S. section, preferring a review of the entire GW mission. Dr. Cornish pointed out that the Cost And Technical Evaluation (CATE) process examines missions, not parts of missions, and so the DS would cost the full mission. Dr. Gaudi added that the United States has a cap of 20 percent involvement.

Dr. Bock asked about funding for the L3 DS study compared to the large mission concept studies. Dr. Hertz said it was about the same. NASA is not doing a NASA mission concept study for LISA, however. There is a budget for the NASA work on the LISA/L3 study, to cover technology development. The costing of technology development remains to be done because there is not yet a technology development plan.

Public Comment Period

No one from the public came forward during the public comment period.

Discussion, Recommendations, Actions

A number of the issues on which APS held votes had multiple options. In order to clarify the voting process, Dr. Gaudi set up an electronic spreadsheet on which APS members voted in real time. The votes were also read out loud for the record.

Dr. Somerville began the discussion session with the NNF proposal. She noted that she had heard diverse views, and APS had no consensus. A decrease in the total number of fellows and consolidation of the selection process was the first proposal. The remaining issue concerned whether the funds from the decrease should shift to APRA or elsewhere in R&A. Dr. Ozel suggested that APS recommend capping overhead costs. Dr. Cornish was concerned that funds for a valuable and successful program might be shifted into a more fungible environment in which the budget can vary. In that scenario, the shifted funds could be lost in a future budget.

The next issue for discussion was having the ATP call go to every other year. Dr. Gaudi said that the first vote would address whether the program should go to an alternate year schedule. APS would then vote on how to implement an alternate year schedule. He explained that there had been some emails sent to APS members the previous evening that should go on the record in order to keep within the FACA rules. First, Dr. Ozel wrote that the potential advantage of 2-year cycle is reduced review effort and higher success rate during reviews. Disadvantages include the logistics of implementation, which would cause a serious dilemma for those in their second year of ATP funding. She was also concerned about differences among the review panels. ATP must be in line with NASA activities, and the alternate-year schedule could reduce the ability to address certain missions.

Dr. Somerville explained that her criticisms from the previous day were limited to the proposal itself, and she wanted to make it clear that she believed Dr. Hertz and the APD staff were simply trying to find a way to make the program better. She agreed that the low acceptance rate in ATP is a dysfunction, but she wanted to look for other solutions. It is critical to have an appropriate and balanced level of support for theory and data analysis; theory is necessary for interpretation of observations. She thought APS should review whether APD provides sufficient support for theory. The 30 ATP proposals funded each year represent about 1 percent of the APD budget. That is inadequate and calls for a substantial increase. ATP provides unique opportunities. The small ATP budget makes it unlikely that a funding shift would have more than a minor impact on other programs, yet it would have a significant impact on ATP. Therefore, she wanted APS to consider that the 2-year cycle is not needed if APD otherwise rebalances the R&A budget. She also recommended that NASA consider ways to make reviews less onerous for all involved.

Dr. Gaudi said that, like Dr. Somerville, he did not want his disapproval of the proposal to be misconstrued as disapproval of the individuals behind it. He believed that APS was conflating two different issues, as his understanding was that the proposal would not change the overall amount of ATP funding. He recommended that APS first decide whether to go to 2-year system and, if that were advised, when to start.

Dr. Kalirai spoke in support of Dr. Ozel's email, especially regarding nimbleness in following up new discoveries. Dr. Boyd said that the core issue was the oversubscription rate. On many proposals for Kepler GO time, there are co-Is who do the theory component. When science is closely linked to missions that way, the theory component is embedded. Dr. Dingus said that she preferred an annual call, as theory is quite general and there are many ways to see new results. She was also concerned about the individuals who might go unfunded. Dr. Batalha wondered if the change in cadence might tap into new populations of awardees. There are scientists who have not yet won the annual awards who might win under the proposed alternative. Dr. Bock agreed. When a review panel can only take few

proposals, they often take safe ones from well-known people. If they could choose more proposals, they could go broader.

Dr. Cooray said that there are other programs in addition to ATP that have issues with selection rates. This should be a broader discussion. Dr. Debra Fischer said that instead of focusing on success rates, APS should emphasize the NASA overall mission and needs. Dr. Ozel repeated her belief that NASA would be damaged by a loss in theory.

Dr. Gaudi said that he was not hearing a convergence, no one was changing anyone else's mind, and the members seemed evenly split. They were all aware that there is insufficient R&A funding, and that problem cannot be solved by changing one program, regardless of which one it is. He asked that the members focus on what would be good for theory in and of itself, rather than how to rebalance the R&A program. They needed to either make a decision about ATP, or leave the decision to APD. The vote on the spreadsheet was 9 in favor of the 2-year cadence and 7 against. Dr. Somerville suggested reporting that there was no consensus.

It was agreed that APS should not make a recommendation based on such a close division. The discussion then moved on to whether there should be an announcement preceding any move to a 2-year cycle. Dr. Gaudi took the votes, which came to 4 preferring to start immediately, and 8 wanting an announcement first. Dr. Gaudi said the letter to Dr. Hertz would state that APS had no recommendation on the 2-year cadence, but if APD were to go in that direction, the move should have an announcement in 2017 stating that the program would go to alternate years starting in 2018.

Moving on to NNF, the votes on the various options were as follows:

1. Keep the NNF as is (Option 1): 4 yes, 8 no.
2. If no on Option 1, consolidate selection process into one committee: 11 yes, 1 no.
3. If no on Option 1, reduce the number of fellows by about 30%: 7 yes, 5 no. (The initial vote was 6 to 6. The 7 to 5 tally reflects Dr. Fischer's later decision to change her vote.)
4. If yes on Option 3 (i.e. reduce the number of fellows by about 30%), money goes to APRA only: 4 yes, 8 no.
5. If yes on Option 3, money goes to APRA, ADAP, or ATP: 8 yes, 4 no.

Dr. Somerville reported that a significant majority voted to modify the NNF program, and a strong majority recommended consolidating the selection process. The votes were even on the 30 percent reduction. Dr. Fischer said that she would have preferred a more modest cut. There was no consensus on whether to reduce the program and how to redistribute funds from any reduction. Drs. Fischer and Boyd said that they would have preferred a reduction of less than 30 percent, and would like to see other options. Dr. Fischer said that she would like to see it roll out more slowly, starting at 15 percent, for example. After that, APD and APS could determine if a deeper cut was warranted. Dr. Somerville suggested the recommendation be that NASA explore ways to reduce the NNF costs, and propose a more modest reduction in the number of fellows.

There was discussion about reducing overhead, or having the applicants take less salary. Dr. Boss observed that APS had been told that the 30 percent was based on growth of the NNF budget relative to other programs that have remained flat. Dr. Hertz explained that the increase in the number of fellows was a strategic decision made 10 years ago. Dr. Boyd said that there has been a significant rise in the fellowships given out by private foundations, which would soften the impact of APD's reduction. Dr.

Fischer changed her vote. The total voting in favor of reduction by 30 percent (Option 3, above) changed from 6 in favor and 6 against to 7 in favor and 5 against.

After further discussion of other percentages for the reduction, Dr. Gaudi pointed out that the meeting was on the cusp of running late and they had other business to address. Dr. Somerville said that she would summarize the recommendations later.

Dr. Gaudi asked Dr. Fischer to present her thoughts on the RTFs. Dr. Fischer said that one option was to have a check box on eligible proposals, then select among those. She was not certain that this would help APD meet its proposal goals, however. Early in the history of these awards, the three main goals were to: 1. help boost the PI's of future missions; 2. develop innovative technologies; and, 3. foster new talent by supporting early career technologists. That is not resulting in the pre-tenure-track applicants envisioned, however. An APRA check box would cover the first two goals but move away from the third. Therefore, she did not think it was in NASA's best interest to do this.

She recommended having the RTFs in alternate years, which would give the community more time to develop talent. She wondered if the RTFs could be selected along with the NNFs, as the best instrumentalists have to be doing great science anyway. That would be a significant change to the program. The minimum is to make it alternate years. She suggested thinking about whether to focus on early career applicants, tenured faculty, or emerging talent.

Dr. Bock said that the main challenge was reportedly in implementing the two-step process. The mechanics of the proposal process are difficult. He knows someone with excellent qualifications who did not apply because it was too difficult. The current program is not working well, and Dr. Bock felt that APS should do something about that. He was less sure about the checkbox, though it might have some advantages. He hoped this could provide be additional motivation for senior postdocs to write technology proposals. Dr. Fischer noted that only 2 of the 11 RTFs in the last 5 years were PIs.

Dr. Somerville thought the NNF pool might be too junior. Dr. Bock said that the first phase is small and awkward and turns people off. Dr. Fischer said that she likes having an instrumentation postdoc to foster instrument builders who can be in the pool to draw from for a later phase. Dr. Hertz said that the RTF is not a postdoc fellowship like the NNFs, though he was open to creative options. The NNFs are for 3 years or less, whereas the RTFs are longer term, with more institutional commitment. The dilemma is how to keep the objectives of the RTFs and make it less onerous to propose.

Dr. Bock said that while he liked having APRA function as a gate, he would not want it to be the only program for that. Dr. Gaudi noted that the Sagan fellowship used to choose an instrumentation person. Dr. Hertz said that the questions are whether the RTFs get fewer applicants because of the process, and how to get more applicants. Dr. Fischer suggested remarketing the program, having it every other year, and changing the 7-year limit to 10 years. The community perceives this as a postdoc, and it is not. Dr. Hertz said that the question remains as to whether this should be a one- or two-step process. As currently constructed, there is a 1-year study phase proposal, then a 4-year proposal. APD was suggesting that APRA serve as the 1-year proposal. Dr. Bock wondered why the first phase was even needed.

Dr. Hertz said that another way would be to have one step in parallel with APRA and reviewed by the same panel. APD already has experience with this kind of thing. Dr. Gaudi clarified that that would mean

running RTF with APRA on the same panel, which would understand that it is a different standard, and it is every year. He held this to a yes/no vote. There were 15 votes in favor of the change, and none opposed. Dr. Wang was not available for this vote due to other obligations.

Brief to Division Director

Dr. Gaudi summarized the meeting. APS approved the new ExoPAG SAG. Dr. Hertz was to report back on shared best practices in technology gap assessment. The Keck contract extension was approved, APS wants information about archiving, there was no recommendation about the southern hemisphere, and APS recommended that NASA continue assessing the balance between key projects and the GO program. Regarding the Midterm Assessment, APS thanked Dr. Hewitt and the ad hoc committee, and agreed with the NASA response, especially in regard to WFIRST cost monitoring. The HECC expansion is important, and APS commends NASA for moving ahead, while also encouraging vigilance to ensure the program keeps up. APS agreed on L3 path forward.

There was no formal recommendation about switching ATP to a 2-year cadence, but the majority of APS members felt that a move in that direction should be preceded by an announcement and not occur immediately. Dr. Somerville reported that on the NNFs, there was consensus to change to a single selection committee. However, APS was closely divided on the 30 percent reduction, with some members preferring a more modest reduction. The majority believed that a reduction should be accompanied by flexibility in redistributing the funds. In addition, some members would like to see any reduction phased in. Dr. Gaudi said that for RTF, APS agreed to restructure it to run in parallel with APRA, using a different standard and offering it every year.

Dr. Gaudi ran through the list of which APS members would write what portions of the official letter to Dr. Hertz.

Adjourn

Dr. Hertz thanked the APS members, saying that they did a great job of working through the issues. Several members were scheduled to rotate off, but he was asking them to extend their term to May 30 in order to make the first meeting after APS becomes APAC.

The meeting was adjourned at 4:33 p.m.

Appendix A
Attendees/Participants

Subcommittee members
B. Scott Gaudi, Ohio State University, *Chair, Astrophysics Subcommittee*
Nathalie Batalha, NASA Ames
Marshall (Mark) Bautz, Massachusetts Institute of Technology
James J. Bock, NASA JPL
Alan Boss, Carnegie Institution of Science
Patricia Boyd, Goddard Space Flight Center
Asantha Cooray, University of California, Irvine
Neil John Cornish, Montana State University
Brenda Dingus, Los Alamos National Laboratory
Debra Fischer, Yale University
Jason Kalirai, Space Telescope Science Institute
Feryal Ozel, University of Arizona
Paul Scowen, Arizona State University (via teleconference)
Rachel Somerville, Rutgers University
Yun Wang, California Institute of Technology
Beth Willman, University of Arizona

NASA attendees
Paul Hertz, NASA HQ, *Director, Astrophysics Division*
Mansoor Ahmed, NASA GSFC
Dominic Benford, NASA HQ
Max Bernstein, NASA HQ
Joan Centrella, NASA GSFC
Mark Clampin, NASA GSFC
Doris Daou, NASA HQ
Jeanne Davis, NASA HQ
Kristen Erickson, NASA HQ
John Gagosian, NASA HQ
Michael Garcia, NASA HQ
Neil Gehrels, NASA GSFC
Hashima Hasan, NASA HQ, *Executive Secretary, APS*
Tsengdar Lee, NASA HQ
Stefan Muller, NASA HQ
Andrea Razzaghi, NASA HQ
Kartik Sheth, NASA HQ
Eric Smith, NASA HQ
Linda Sparke, NASA HQ

Non-NASA Attendees
Elizabeth Sheley, Ingenicomm

Webex/Telecon
Rick Crisman

Mona Dickson
Nikole Lewis, STScI
David Shoemaker, MIT
Shamina Sing
Wendy Spencer
Pamela Terrell, NASA HQ

Appendix B
NAC Astrophysics Subcommittee Members

B. Scott Gaudi, APS Chair
Department of Astronomy
Ohio State University

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

Natalie Batalha
NASA-AMES

Marshall (Mark) Bautz
Massachusetts Institute of Technology

James J. Bock
Jet Propulsion Laboratory

Alan Boss
Carnegie Institution of Science

Patricia Boyd
Goddard Space Flight Center

Asantha Cooray
Department of Physics and Astrophysics
University of California, Irvine

Neil John Cornish
Department of Physics
Montana State University

Brenda Dingus
Los Alamos National Laboratory

Debra Fischer
Department of Astronomy
Yale University

Jasonjot (Jason) Singh Kalirai

Space Telescope Science Institute

Feryal Ozel
University of Arizona

Paul Scowen
Arizona State University

Rachel Somerville
Department of Physics and Astronomy
Rutgers University

Yun Wang
California Institute of Technology

Beth Willman
LSST/Steward Observatory
University of Arizona

Appendix C
Presentations

1. *Astrophysics Division Update*, Paul Hertz
2. *Keck Review*, Doris Daou
3. *New Worlds New Horizons: Midterm Assessment*, Jacqueline Hewitt
4. *First Response to Midterm Assessment*, Paul Hertz
5. *State of NASA High End Computing Capability Project and Its Support of Astrophysics*, Tsengdar Lee
6. *Astrophysics Research Program,* Linda Sparke
7. *Named Fellowships Discussion*, Kartik Sheth
8. *ExoPAG Report*, Alan Boss
9. *PhysPAG Report*, James Bock
10. *COPAG Report,* Paul Scowen
11. *James Webb Space Telescope,* Eric Smith, Nikole Lewis
12. *SMD Science STEM Activation Perspectives and Status,* Kristen Erickson
13. *L3 Study Update,* David Shoemaker

Appendix D
Agenda

Astrophysics Subcommittee (telecom/webex)
October 3-4, 2016

Monday 3 October

11:00 a.m.	Introduction and Announcements	Hashima Hasan/Scott Gaudi
11:10 a.m.	Astrophysics Division Update	Paul Hertz
12:00 p.m.	Keck Continuation Report	Doris Daou
12:15 p.m.	Discussion	APS members
12:30 p.m.	Mid Decadal Report	Jacqueline Hewitt
1:00 p.m.	First Response to Mid Term Review	Paul Hertz
1:30 p.m.	Discussion	APS members
2:00 p.m.	High End Computing	Tsengdar Lee
2:30 p.m.	Break	
2:45 p.m.	R&A Update	Linda Sparke/William Lightsey
3:15 p.m.	NASA Named Fellows update	Kartik Sheth
3:30 p.m.	Discussion	APS members
4:00 p.m.	Community Comment Period	
4:05 p.m.	Discussion	APS members
5:00 p.m.	Wrap up for Day 1	Scott Gaudi

Tuesday 4 October

11:00 a.m.	Opening Remarks	Scott Gaudi
11:10 a.m.	ExoPAG/PhysPAG/COPAG Updates	Alan Boss/Jamie Bock/Paul Scowen
12:00 p.m.	Webb Telescope Update	Eric Smith/Nikole Lewis
1:00 p.m.	SMD STEM Activation Update	Kristen Erickson
1:45 p.m.	Break	
2:00 p.m.	L3ST Update	David Shoemaker
2:30 p.m.	Public Comment Period	
2:35 p.m.	Discussion, Recommendations, Actions	APS members/Scott Gaudi
4:00 p.m.	Brief to Division Director	Scott Gaudi
4:30 p.m.	Adjourn	