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Dr. Bradley Peterson
Chair, NASA Advisory Council Science Committee
The Ohio State University

Dear Brad,

The NASA Advisory Council's Astrophysics Subcommittee (APS) met via telecon on October 3 and 4, 2016. The following members of the APS were on the telecon: Natalie Batalha, Marshall (Mark) Bautz, James (Jamie) J. Bock, Alan Boss, Patricia Boyd, Asantha Cooray, Neil Cornish, Brenda Dingus, Scott Gaudi (APS Chair), Jason Kalirai, Feryal Ozel, Paul Scowen, Rachel Somerville (APS Vice-Chair), Yun Wang, and Beth Willman attended both days. Paul Hertz (Director, NASA Astrophysics Division) and Hashima Hasan (APS Executive Secretary) were also in attendance. APS member Debra Fischer was only able to attend the second day.

Dr. Hasan 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. Gaudi 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.

APD Update

Dr. Paul Hertz presented an update on the Astrophysics Division (APD) activities. He first shared a few recent science highlights. He noted that the National Academies' mid-term assessment of NASA's response to the 2010 Decadal Survey (DS) had just been released, and APD was still reviewing the recommendations and findings. APD also planned to update their Astrophysics Implementation Plan soon. He then summarized the APD budget situation. Dr. Hertz noted that, 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 full funding for the APD research, projects, and programs. 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. Dr. Hertz updated the APS on the progress of the Stratospheric Observatory for Infrared Astronomy (SOFIA), collaboration with the Japan Aerospace and Exploration Agency (JAXA) on the X-ray Recovery Mission (to address the planned Hitomi science), and NASA's partnership with the European Space Agency (ESA) on the L3 gravitational wave mission. In the latter case, Dr. Hertz noted that the mid-term assessment (discussed in more detail below) was very clear that APD needs to be a strong partner in ESA's L3 mission. The Division had been planning an L3 participation level of less than 10 percent, but is now revising that to 20 percent. Dr. Hertz noted that the Explorer Announcements of Opportunity (AOs) are maintaining the planned cadence. Dr. Hertz also mentioned that the 2-year cadence for Senior Reviews (SRs) is set by law, but Congress may look at moving to a 3-year cadence following the recommendation by a National Academies' study on extended missions. Finally, the only substantive change in preparation for the 2020 Decadal Survey (DS) from the last APS report is the call for probe concept studies, which are due in November. The APD received 36 notices of intent to propose and will select as many as 8 in the spring, with reports due in the fall of 2018.

With regards to the APS itself, NASA has decided to proceed with changing the NASA Advisory Council science subcommittees to full FACA chartered committees. Once chartered, the APS will be the Astrophysics Advisory Council (APAC). At the time of the teleconference, the charters were with the General Services Administration (GSA) for approval. The next step will be for NASA to charter the APAC and appoint all APS members with the same terms and end dates. APAC will report directly to the APD Division Director. This will result in efficiency over the current requirement that recommendations go up through the NAC Science Committee and further up to the NAC before they are delivered to NASA. 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.

Keck Continuation Review

Dr. Doris Daou of NASA's Planetary Science Division (PSD) presented the results of a Keck Continuation Review of the NASA cooperative agreement with the California Association for Research and Astronomy (CARA) to cooperate on the operation of the W. M. Keck Observatory for the last five years, as well as the Keck Science Strategic Plan as it pertains to future NASA science missions. The Keck agreement ends in 2018; the review team evaluated Keck's past contribution to NASA mission support, estimated its likely promise over the next 5 years, and presented its findings to the APS.

The APS thanks the NASA Keck Review committee for its work to assess the value of the cooperative agreement between NASA and the Keck Observatory and its contribution to the science yield of NASA missions. The committee agrees with the finding that access to Keck time is cost effective and has maximized the scientific return from NASA missions. The agreement also opens up access to one of the world's premier observing facilities to the broader research community in the US. The value is evident in the heavy oversubscription rate (5:1 to 7:1, depending on the instrument) and the fact that NASA-use authors are publishing at the same rate as other partners.

The APS commends NASA for investing in the public archive of all Keck data (i.e. NASA as well as other partners). While the usage statistics aren't as high as one might hope, the APS sees potential for growth. For example, the recent expansion of the archive to cover additional instruments should lead to an increase in the number of users.

The NASA-Keck agreement has impacted all astrophysics programs (exoplanet exploration, cosmic origins, and physics of the cosmos) as well as solar system exploration. The current practice of requiring proposals to be aligned with these program elements is resulting in a healthy breadth and balance of science. The APS notes that the funds that support research and analysis are essential to producing science results.

The APS notes that while a significant fraction of the awards support mission science goals, the implementation of key projects that offer larger blocks of observing time to complete primary mission science has been particularly valuable. For example, a Kepler key project enabled a systematic stellar characterization survey that required more nights than are typically allotted to individual observers. The APS recommends that NASA continue to assess the need for key projects of strategic importance to NASA missions. While it is difficult to anticipate which needs might emerge, support at the 30% level seems reasonable.

Looking towards the future, the APS is pleased to hear that the Keck strategic plan includes instrumentation development that takes into consideration future NASA missions. This ensures that continued investment over the next five years will benefit NASA and the scientific community. The APS expects continued synergies with Kepler/K2 and future synergies with TESS, JWST, Euclid and WFIRST.

The APS endorses extending the NASA-Keck cooperative agreement for another 5 years and notes that any funding reduction would significantly lower the science return given the already high oversubscription rate. We commend NASA for recognizing the synergy between ground and space-based astrophysics.

Mid-Decadal Review and APS Response

Dr. Jacqueline Hewitt (MIT) presented the report from the mid-term assessment. Using community input, an ad hoc committee was appointed by the National Academy of Sciences to examine how well NASA, the National Science Foundation (NSF), and the Department of Energy (DOE), were addressing the recommendations of the 2010 DS.

Dr. Hewitt noted several findings relevant to APD. The most notable were that WFIRST has the potential to significantly advance the science envisioned in the 2010 DS, however, the committee viewed the rising cost of the mission, largely associated with the addition of the coronagraph, GO funding and inflation, as a concern. The committee recommended that NASA commission an independent technical, management, and cost assessment of WFIRST, including the coronagraph, and if the mission cost estimate was such that mission execution would compromise the balance of the APD portfolio, NASA should descope the mission in order to restore the scientific priorities.

The committee recommended that NASA should be "a strong technical and scientific partner" in ESA's L3 mission, with the goal of restoring the full scientific capability envisioned in the 2010 DS. The committee also concluded that there is an excessive level of investment in the technology development and precursor science for exoplanet technology research, and the committee viewed further investment in exoplanet technology development as a lower priority than the L3 technology development.

The APS would like to thank Dr. Hewitt and the committee for a clear and thoughtful report. The APS concurs with the committee that the cost of WFIRST should monitored closely to avoid unbalancing the APD portfolio, and endorses the specific suggestions of the committee on how to achieve that.

High End Computing

Dr. Tsengdar Lee, manager of the High-End Computing Program at NASA HQ, discussed High End Computing (HEC) at NASA and HEC support for astrophysics. Dr. Lee noted that the SMD manages the HEC Capability (HECC) project for the Agency, as science users require most of the high-end computing 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. However, 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 computational needs grow in all disciplines.

Dr. Lee outlined a mitigation strategy to ameliorate the expected gap in computing capabilities with respect to requirements, which 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.

APS would like to thank Dr. Lee for his presentation. The APS finds that maintaining and expanding the high-end computing capability is incredibly important, and commends NASA for taking this issue seriously and including it in its long term planning. The APS encourages NASA to maintain vigilance to ensure that computing resources keep up with scientific requirements.

R&A Update

Dr. Linda Sparke, APD Research Program Manager, presented the R&A update. Three primary issues were discussed at length by the APS as a result of her presentation.

Pacing of Solicitations to the Astrophysics Theory Program (ATP)

First, Dr. Sparke noted that in November of 2014, APD advised APS that it would not solicit new ATP investigations in 2015, in order to rephase funding to start closer to the proposal selection date. After the one-year hiatus, in 2016, the APD received 197 proposals – similar to the 214 proposals received for 2014. The funding allocation for the first year of these proposals would be $9 million in total. Because of the larger funding but similar number of proposals, a larger fraction of proposals, and a larger number of meritorious proposals, could be selected in 2016 relative to 2013 and 2014. In particular, Dr. Sparke noted that in 2013 and 2014, all proposals rated Excellent (E) received funding, as did about 60 percent of those rated Excellent/Very Good (E/VG), while almost no VG proposals were selected. For these years, selection rates were below 20 percent, and as a result highly meritorious proposals had to be declined. As a result, the APD proposed to compete ATP in alternate years with the aim of increasing the overall selection rate (while maintaining the overall level of funding), under the assumption that a similar number of proposals will be submitted for a two-year cadence as for a one-year cadence, given the anecdotal example of the number of proposals submitted in 2016 after a one-year hiatus being similar to the number submitted in 2014. The APD proposed to put this new system into effect immediately, so that two years of funding would be dispersed to the set of ATP proposals that have already been submitted for 2016, and there would be no call for proposals in 2017.

This proposal generated substantial discussion amongst the APS. The committee shared NASA's concern about the very low acceptance rates for proposals submitted to the Astrophysics Theory Program for the past many years. The APS agreed that the current situation is clearly inefficient, with an enormous amount of effort being expended to write and review proposals, the majority of which are not funded. However, the committee noted both pros and cons of the proposed new solicitation cadence:

Potential Advantages:

- This would reduce the workload on NASA, as proposal review panels would need to be organized only every two years.
- If NASA receives approximately the same number of proposals in each two year call as it does presently in the yearly call, this will result in a higher fraction of submitted proposals being funded, and it would reduce the amount of effort expended by the community to write and review the proposals.
- Selecting twice as many proposals per cycle removes some of the randomness from peer review ratings.
- If NASA receives approximately the same number of proposals in each two-year call as it does presently in the yearly call, this will result in a higher fraction of submitted proposals being funded.

Potential Disadvantages:

- A two-year cycle for a program that typically awards three years of funding is highly sub-optimal. For example, a proposer who successfully gets ATP funding would have to decide if they will apply for further funding in their year 2, when they still have funding, or will necessarily have to miss a year of funding if they apply in year 4. This would apply to all funded proposals, independent of the success of the project or the outcome of the previous award.
- Program officers put considerable effort into securing a panel that is diverse and broad in its expertise. Nevertheless, committee members who have experience serving on these panels noted that there is inevitably a significant element of stochasticity in the review process. One panel maybe enthusiastic about the science in a particular proposal while another panel may find it solid but not top-ranked. Reducing the number of opportunities for the proposals to be reviewed by going to a two-year cycle will further reduce the chances of obtaining a representative review of a proposal. Of course, this stochasticity may be offset to some degree by the fact that twice as many proposals will be funded each cycle.
- Theoretical proposals are often motivated by new observational discoveries. Going to a two-year cycle will necessarily delay the proposers' ability to respond to new discoveries, ideas, and activities in the community. This is especially important in view of the upcoming launch of numerous new NASA missions in the next few years, where there may be significant discovery potential.

Although NASA received approximately the same number of proposals in the 2016 call as in the usual yearly call (about 200) even after a one year gap, some committee members were not convinced that this would be the

case if the community were informed that a two year proposal cycle was to become the standard cycle of proposal calls. It is likely that many proposers would simply submit multiple proposals, and thereby the main advantages of the proposed two-year system would not come to fruition.

Overall the APS was strongly divided on this issue. Nine panel members voted to adopt the two-year cycle, while seven voted to remain on a yearly cycle and seek other remedies for the problems highlighted above. Several committee members advocated that NASA look for ways to significantly increase the budget for ATP by rebalancing other programs (ATP currently represents less than 1% of the entire Astrophysics budget). It was also suggested that NASA could look for ways to make the workload involved in writing and reviewing proposals less onerous, such as by not requiring full budgets until the proposal is selected.

A clear majority (twelve versus four) of APS members felt that it was critical for NASA to inform the community before changing the proposal cadence to two years, i.e. that this should not be implemented for the 2016 proposals. **The majority of the panel felt that not only would it be unfair to change the rules without informing the community, but that only in this way will the "experiment" of finding out whether the number of proposals submitted to a two year cycle will be the same as is typical for a yearly cycle be at all valid.**

Restructuring of the Roman Technology Fellowship (RTF) Program

The second recommendation from Dr. Sparke regarded the RTF Program. Dr. Sparke reminded the committee that in 2010, APS recommended that APD establish the RTF program. Since its establishment, the number of RTF proposals has declined over the years. Currently 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. APD proposed a new system, in which proposers to the Astrophysics Research and Analysis (APRA) or Strategic Astrophysics Technology (SAT) programs indicate their status as an early career scientist (and thus eligible for an RTF) and desire to be considered for an RTF. RTFs would then be selected from eligible awardees in APRA and SAT, and those who hold or win qualifying positions 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 asked members to consider this action and to provide a response at this meeting.

The APS noted that RTF program goals as stated on the web page are:

- To give early career researchers the opportunity to develop the skills necessary to lead astrophysics flight instrumentation development projects and become principal investigators (PIs) of future astrophysics missions
- To develop innovative technologies that have the potential to enable major scientific breakthroughs
- To foster new talent by putting early-career instrument builders on a trajectory towards long-term positions

The astrophysics subcommittee discussed possible unintended impacts of this new application procedure. Namely, requiring the applicant to both be a successful APRA PI and to be at an early stage of their career (i.e., less than 7 years out from their PhD) might further reduce the number of eligible RTF candidates. Among the eleven past Roman Technology Fellows, only two Fellows had successful APRA proposals at the time they submitted the step one RTF application. Thus, 75% of the people who have already been selected for an RTF would have been ineligible under the new proposed application procedure.

Therefore, the APS committee members concluded that the new application process should be modified to serve the best interests of the NASA RTF program. It was deemed important to streamline the application process and the committee considered reducing the proposal opportunities to every other year or restructuring the RTF in some way so that it would be part of the named NASA Fellowships. While reducing the application to every other year would give the community more time to develop talent, it was generally felt that this presented too stringent a time requirement given that eligibility requires the applicant to be less than 7 years out of their PhD program. It was also felt that restructuring the RTF to be aligned with the named NASA Fellowships would not provide the desired career enrichment that the current RTF offers. It was suggested that the RTF proposal should be kept as a two-step process that is offered for PIs of APRA proposals. Instead of convening a separate

panel, have these proposals evaluated by the APRA selection panel, but soften the requirement that the APRA proposal must be selected in order for the PI to be eligible for the RTF.

The APS recommends that NASA APD run the RTF panel in parallel with the APRA proposal but set a different standard for selecting proposals as RTF-eligible for early career PIs.

Restructuring and Reduction of the NASA Named Fellowship Program

At the previous APS meeting in March 2016, the committee heard a proposal to reduce the number of named fellows by about 30 percent, and to allocate the resulting funds to the APRA program. NASA's proposal was to implement the 30 percent reduction in the number of fellows awarded in 2017 (for the 2016 applications), and going forward. Given the very large overlap in applications that are submitted to multiple fellowship programs, NASA also proposed to consolidate the review process into a single selection process, without changing the overall balance of science topics and ensuring that the composition of the selection panels continue to reflect the diversity of science topics in these fellowships. This would reduce the workload for selecting these fellows. Following our last meeting, the committee requested further information about the NNF program. We thank Dr. Kartik Sheth and the rest of the Astrophysics Division for providing a highly informative report in response to our questions at this meeting.

A majority of the committee (eleven out of twelve non-conflicted members) voted in favor of consolidating the selection process for Hubble, Einstein, and Sagan fellowships.

With regard to reducing the number of fellowships awarded, again the committee was highly divided: six voted in favor of this reduction, while six opposed it (again out of twelve members who were not conflicted). The committee noted arguments in favor of the reduction:

- The fraction of the R&A budget going to the NASA Named Fellows program (Hubble, Einstein, Sagan) has increased over the past decade, while the number of US PhD's per named fellow has declined.
- Anecdotal evidence suggests that the number of other prize fellowships has increased, although figures were not available.
- R&A grants to institutions could be argued to be more "widely distributed" (benefit a broader spectrum of institutions) than the named fellows program.
- Other programs within the R&A portfolio suffer from high oversubscription rates, and the savings achieved by reducing the fellows program could be used to improve the health of these programs.

The committee also noted the following arguments against reducing the NNF program:

- The NNF program has a very strong track record of producing excellent science and of training young, independent scientists. Most former fellows (>90%) go on to successful careers in astrophysics.
- The NNF programs are highly oversubscribed – typically about 5% of all applications are selected. Reviewers state that typically there are about twice as many "deserving" applications as can be selected.
- The total cost to NASA of supporting a named fellow is comparable to that of supporting a postdoc on a grant, so moving funding from one pot to another will not clearly accomplish an increase in the amount of or quality of science per dollar expended.
- The NNF programs have strong track records of appointing a diverse body of fellows. It is unknown whether distributing funds to the R&A program would be as effective a means of encouraging a diverse pool of young scientists to remain in careers in astronomy.

The committee also had a diversity of opinions on how funds should be distributed if the NNF program were to be reduced, although a majority of members felt that funds should not be added solely to the APRA program. The committee noted the very low acceptance rates of proposals in the ATP and ADAP programs (~15% and 20%, respectively), compared with the relatively healthier acceptance rates of 30-36% in the past two cycles of APRA. However, some committee members noted that the APRA program plays a

critical role in developing expertise needed to develop new mission concepts and technology for NASA. Four committee members voted to distribute the funds from any reduction of the NNF program solely to the APRA program, while eight members voted to distribute the funds to some combination of ATP, ADAP, and APRA.

The APS commends NASA for seeking input from community representatives via this committee before implementing these proposed changes to the ATP, RTF, and NNF programs, which could have a profound impact on the community.

PAG Updates

Drs. James Bock (Caltech, chair of the Physics of the Cosmos PAG, or PhysPAG), Alan Boss (Carnegie DTM, chair of the Exoplanet Exploration PAG, or ExoPAG), and Paul Scowen (ASU, chair of the Cosmic Origins PAG, or COPAG) presented updates from all three PAGs.

COPAG

Dr. Scowen reported that nominations were being received for the 4 Executive Committee (EC) member spots being vacated in November. Deadline for nominations is October 7th.

The COPAG EC has spent some time discussing the Mid-Term Assessment Report. Overall the EC regarded the report as an excellent summary of the status of ongoing missions and plans for future endeavors. There were some minor concerns expressed about the security of the coronagraph instrument on WFIRST because of language in Findings 3-3, 4-2 and 4-4, and in particular Recommendation 4-1. Through the efforts of SAG 6 the COPAG has established that there is real COR science value in the inclusion of the coronagraph, even if it is intended as a technology demonstration. There was also some minor concern about language in Recommendation 4-2 that could roll back investment in Euclid to NWNH levels from the elevated levels currently being implemented – and that this could adversely affect the efforts of the three science teams currently planning COR science. A letter summarizing these points was sent to Paul Hertz for his information.

As a result of dialogue at a meeting held by the SIG2 at the recent SPIE meeting on June 28 in Edinburgh, the COPAG has been discussing the need for a new interest group. The meeting attendees had discussed the need for some informed assessment of the Technology Gaps list – and that a new Interest Group – a Technology Interest Group – could serve this role. The charter for such a new group has been drafted and edited by both the EC and the COR staff, and has been distributed to the APS Committee for approval.

The intent is to form an open group of community members both from within the Astrophysics community and from within Industry to inform the COPAG as a whole on the Technology Gaps List. Each year the COR Technology Office sends the draft list to the COPAG EC for review before it goes under review by a Technology Management Board. This past year, the EC felt it did not have the expertise to address the list properly. The new TIG will serve both as a more informed review body and will provide input on technology developments throughout the year. All input will be treated equally but will be reviewed to ensure that the needs forwarded to the COR Technology Office are complete.

When the Charter was presented to the APS, Paul Hertz made the request deferring consideration to the March 2017 meeting to allow him and his staff time to review the Technology Assessment mechanisms and best practices used by all three Program Offices. The APS agreed.

COPAG involvement in the ongoing STDT work: as has been previously reported, the COPAG EC has membership on the FIR (Lee Armus), HabEx (Paul Scowen) and LUVOIR (Daniela Calzetti) STDTs. We had tasked two EC members to tag team to cover the activities of the X-ray Surveyor STDT – Joe Lazio and Suvi Gezari – Dr. Gezari has now formally joined the SWG on "X-ray Surveyor in the Multi-Wavelength, Multi-Messenger Era"; Dr. Lazio has also formally joined the SWG on "First Accretion Light". Similarly Dr. Scowen has now formally joined the LUVOIR SWG on "Cosmic Origins Science" to better interface the COR efforts within HabEx with those being developed for LUVOIR.

Reports were given by the three active COPAG SIGs - the FIR SIG, the UV-visible SIG, and the Cosmic Dawn SIG - all three reported slow activity since July 2016 partly because of the vacation season, but also because many members are actively engaged in support of the STDT activities. All three SIGs reported plans to engage

their communities at the January 2017 AAS meeting in Texas. SIG1 reported the start of a new webinar series for members. SIG2 reported the final assembly of their report on the Summer 2015 workshop held at GSFC.

ExoPAG

Dr. Boss reported that the Executive Committee for the Exoplanet PAG (ExoPAG) is at full strength and is unchanged since the July APS meeting, though Eric Mamajek has been added to the JPL Exoplanet Exploration Program (ExEP) office as the Deputy to Chief Scientist Karl Stapelfeldt.

Dr. Boss summarized the status of the Study Analysis Groups (SAGs) as seven being complete, seven being active, and a new SAG proposal being presented here. Two active SAGs are expected to close down in January 2017, namely SAG 12 on astrometry and SAG 13 on exoplanet demographics. SAG 16 on biosignatures held a workshop this summer and expects to finish its work in March 2017. Other SAGs are also nearing completion. Boss presented the proposed charter a new SAG 19 on "Exoplanet Imaging Signal Detection Theory and Rigorous Contrast Metrics", to be co-chaired by Dimitri Mawet and Rebecca Jensen-Clem. The PAG decided not to create a mid-infrared exoplanet SAG, but rather provided one of the Origins Space Telescope STDT co-chairs (Asantha Cooray) with the advice and cooperation of several scientists with expertise in the mid-IR aspects of exoplanets.

The ExoPAG is now part of the annual technology gap process and will review the technology gap list (TGL) plan during the next ExoPAG meeting, to be held prior to the 229th American Astronomical Society (AAS) meeting in Grapevine, Texas, in January 2017. The TGL process has been expanded to include oversight by an Independent Review Board (the ExEP Technical Assessment Committee), which is also chaired by Dr. Boss.

The APS voted unanimously to approve the new ExoPAG SAG 19 on "Exoplanet Imaging Signal Detection Theory and Rigorous Contrast Metrics."

PhysPAG

Dr. James Bock presented the update on the activities of the PhysPAG. Dr. Bock noted that the PhysPAG membership represents a diverse group segmented into various studies on dark energy, inflation, black holes and general relativity, and behavior of matter in extreme environments. He further noted that, in contrast to, e.g., the ExoPAG, the PhysPAG tends to have Science Investigation Groups (SIGs) rather than SAGs. SIGs are long-term groups addressing many of the PAG's activities.

Dr. Bock reported that there will be several upcoming PhysPAG-related meetings. There will be a general PhysPAG meeting at AAS, along with the joint PAG meeting, a mini-symposium at the American Physical Society meeting in January, and significant meetings at the AAS High Energy Astrophysics Division meeting in Idaho in August.

Dr. Bock next updated the APG on the activities of the various SIGs. The Gravitational Waves (GW) SIG is developing an L3 GW technology roadmap and a white paper related to the ESA L3 observatory. 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. Finally, the Gamma-Ray SIG is working on a roadmap for the next Decadal Survey, is following probe and Explorer concepts, and has meeting plans. The Inflation Probe SIG is following several active mission concepts and recently held the CMB S4 workshop. 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.

<u>Webb Telescope Update</u>

Dr. Eric Smith, the JWST Program Director/Program Scientist, presented an updated schedule for the mission. He reported that the Optical Telescope element/Integrated Science (OTIS) module integration was fully completed just a few days before the meeting, and the pathfinder telescope was in the midst of a 52-day test at Johnson Space Center. 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. Overall, the spacecraft development is progressing well and on schedule. Currently, the solar array is on the critical path, but progress is still within margin.

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. Dr. Smith showed the FY16 milestones and milestone performance. Dr. Smith noted that there was some slippage into the new fiscal year, but two of the six deferred items were off by only a week or so.

In summary, JWST has held to the schedule for 6 years now and has benefitted from having the planned margin.

JWST SOC

Dr. Nikole Lewis (STScI), the 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.

Dr. Lewis summarized the Director's Discretionary Early Release Science (DD-ERS) program, which will allocate about 500 hours of time for early release science. In anticipation of these programs, STScI will design and deliver science-enabling products to help the community learn how to observe effectively with JWST. Raw and processed data will enter the public domain immediately after processing and validation. These programs will provide science pathfinders that will help the community to maximize the capabilities of JWST in future proposals. The full details will be provided in the DD-ERS call for proposals in January 2017.

The APS would like to thanks Dr. Smith and Dr. Lewis for their presentations.

SMD Education Update

The Director of Science Engagement & Partnerships for SMD, Kristen Erickson, gave a briefing on the SMD Science STEM Activation Perspectives and Status. The restructuring of NASA's science STEM programs is designed to increase the efficiency and effectiveness of flowing NASA science content into the learning environment. This new program is now in the activation phase and all 27 awardees have received funding to develop their respective programs. Each of the awardees also has an external evaluator to review the description and plans for audience needs, the logic models, and to ensure reporting of metrics. As the programs execute new goals, it was stressed that the programs will have to remain nimble, will have to ensure robust feedback mechanisms are in place, and ensure close interaction with the science.

The APS would like to thank Kristen Erickson for her presentation, and looks forward to seeing the results from new Astrophysics STEM programs at future meetings.

L3ST Update

David Shoemaker, chair of the L3 Study Team, provided a status report on the study of options for US participation in the European L3 gravitational wave project. Phase 1 of the study is to analyze the options for NASA participation in the L3 mission and to work with the European L3 consortium on proposals to ESA. Phase 2 of the study is to prepare a report for the 2020 decadal survey on priorities for US participation in the L3 mission. David reported that the study team has delivered an interim report on the technologies that could be provided by the US (http://pcos.gsfc.nasa.gov/studies/L3/L3ST_Interim_Report-Final.pdf), and that this report was already being used to inform discussions with ESA. At the recent LISA Symposium in Zurich it was announced by Alvaro Giménez, ESA director of Science, that a call for L3 mission concepts would be issued in October this year. While in Zurich, members of the US study team met with their European counterparts, and it was agreed that they would produce a joint response to the call. Consequently, the main activity of the L3ST in the coming months will be working to produce a joint LISA mission proposal for submission in April 2017. Following the submission, the L3ST will move into Phase 2 of the study, which David pointed out would likely require more resources than the travel support provided to-date.

The APS would like to thank David Shoemaker for his presentation.

Major conclusion and recommendations:

1. **The APS endorses extending the NASA-Keck cooperative agreement for another 5 years and notes that any funding reduction would significantly lower the science return given the already high oversubscription rate.**

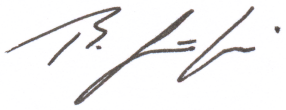
2. **The APS was strongly divided on the issue of whether or not to move to a two-year proposal cycle for the Astrophysics Theory Program, and thus did not make any formal recommendation. However, a clear majority (twelve versus four) of APS members felt that it was critical for NASA to inform the community before changing the proposal cadence to two years, i.e. that this should not be implemented for the 2016 proposals. The majority of the APS felt that not only would it be unfair to change the rules without informing the community, but that only in this way will the "experiment" of finding out whether the number of proposals submitted to a two year cycle will be the same as is typical for a yearly cycle be at all valid.**

3. **The APS recommends that NASA APD run the Roman Technology Fellows Program panel in parallel with the APRA proposal but set a different standard for selecting proposals as RTF-eligible for early career PIs.**

4. **With regard to reducing the number of NNF, the APS was highly divided, and thus will make no formal recommendation. However, the majority of the APS members (eleven out of twelve non-conflicted members) voted in favor of consolidating the selection process for Hubble, Einstein, and Sagan fellowships. The APS had a diversity of opinions on how funds should be distributed if the NNF program were to be reduced, although a majority felt that funds should not be added solely to the APRA program.**

5. **The APS voted unanimously to approve the new ExoPAG SAG 19 on "Exoplanet Imaging Signal Detection Theory and Rigorous Contrast Metrics."**

Sincerely,



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