



29 August 2015

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

Dear Brad,

The NASA Advisory Council's Astrophysics Subcommittee (APS) met remotely on July 21 and 22, 2015. The following members of the APS joined the teleconference: Natalie Batalha, Marshall (Mark) Bautz, James J. Bock, Alan Boss, Patricia Boyd, Joel Bregman (APS Vice-Chair), Giovanni Fazio, Scott Gaudi (APS Chair), Fiona Harrison, Jason Kalirai, Chryssa Kouveliotou, Paul Scowen, Kenneth Sembach, Rachel Somerville, and Yun Wang. Neil Cornish and Hashima Hasan (APS Executive Secretary) were unable to attend. Paul Hertz (Director, NASA Astrophysics Division) was also in attendance.

Dr. Hertz presented an update on the Astrophysics Division (ApD) activities. He first shared a few recent science highlights. He then summarized the ApD budget situation. The Fiscal Year (FY)15 budget appropriation and FY16 request continue to fund the James Webb Space Telescope (JWST), pre-formulation activities for the Wide-Field InfraRed Survey Telescope (WFIRST), and restore funding for the Stratospheric Observatory for Infrared Astronomy (SOFIA) mission. The FY16 request includes funding for the Science Mission Directorate (SMD) Education Program, though at less than the FY15 level.

Dr. Hertz reported that all of ApD's currently operating missions are going well. He summarized the development of future missions either led by NASA, or with NASA contributions, including European Space Agency's Laser Interferometer Space Antenna (LISA) Pathfinder mission, the Japanese Space Agency (JAXA) Astro-H mission, the Neutron-star Interior Composition Explorer (NICER), the Transiting Exoplanet Survey Satellite (TESS), ESA's Euclid mission, and the James Webb Space Telescope. Progress on all of these missions continues as planned.

Dr. Hertz also summarized the status of potential future missions. The ApD plans to announce selections from the Small-to-Mid Explorer (SMEX) Announcement of Opportunity (AO) before the end of summer, with a downselect in 2017. NASA and ESA are discussing potential NASA contributions for ESA's L2 mission Athena. The Agency put out a Request for Information (RFI) earlier this year, and is using the input from this RFI in these discussions. Dr. Hertz reviewed progress on preformulation activities for WFIRST. These include issuing a Request for Information (RFI) for industry input, a solicitation for teams to constitute the science working group for the early phases of the development of the mission, and progress on the technology development plan to be at technology readiness level 5 (TRL5) by the end of FY16.

Dr. Hertz noted that the ApD recently conducted a Senior Review of the Division archives in order to have an independent assessment of their performance and how well they serve the community. The archives have not suffered from budget cuts, but the investments needed for growth and improvement have not been made, either. The review panel advised considering this as an area of future investment.

Dr. Hertz noted that the organization of the National Research Council's (NRC) mid-decade review of the ApD and its implementation of the 2010 Decadal Survey has begun. The first meeting is scheduled to take place in August, and subsequent meetings are planned for October and December. The final report is due in May 2016.



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Finally, Dr. Hertz reminded the APS of the charge he gave to the program analysis groups (PAGs) to suggest several large mission concepts as candidates for detailed study in preparation for the next decadal survey. The activities of the PAGs in response to this charge to date are summarized below.

The primary activity of the meeting was the evaluation by the APS of the degree to which the ApD has met its performance goals over the past year, in accord with the Government Performance and Results Act Modernization Act (GPRAMA). In particular, the APS was asked to evaluate the degree to which the ApD has advanced its primary strategic objective, namely to *Discover how the universe works, explore how it began and evolved, and search for life on planets around other stars*. The APS was specifically asked to rate the ApD progress in achieving the following three specific performance goals: *Demonstrate progress in probing the origin and destiny of the universe, including the nature of black holes, dark energy, dark matter, and gravity*; *Demonstrate progress in exploring the origin and evolution of the galaxies, stars, and planets that make up the universe*; and *Demonstrate progress in discovering and studying planets around other stars and exploring whether they could harbor life*. The APS was to evaluate these three goals based on a three-color rating of green (expectations were fully met), yellow (some notable or significant shortfalls), or red (major disappointments or shortfalls). After reviewing some of the major science achievements of the ApD over the past year, the APS unanimously voted to assign a rating of green to all three performance goals.

Dr. George Ricker (MIT) presented an update on the Transiting Exoplanet Survey Satellite (TESS) mission. TESS has the goal of discovering potentially habitable transiting earths and super earths orbiting bright, nearby stars. Dr. Ricker reviewed the TESS instruments, noted that the critical design review (CDR) is scheduled for August, and that the mission remains on target for a late 2017 launch. The nominal mission lifetime is three years, with the first science results expected in 2018. Regarding the recent Falcon 9 launch issue, Dr. Ricker noted there will be 20-30 Falcon 9 launches before TESS is to launch, and he therefore expects any issues with the launch vehicle to be worked out well before then. Finally, he noted that the mission still has the specified reserves for funds and schedule. The APS would like to thank Dr. Ricker for his presentation.

Dr. Robin (Tuck) Stebbins (NASA GSFC) summarized the status of the Gravitational Observatory Advisory Team (GOAT). The goal of the GOAT is to look at possible scientific and technical approaches for a gravitational wave observatory, with the current efforts focused on promising technologies. The technology recommendations will allow ESA and its partners (including NASA) to begin targeted investments. There will be an AO for mission concepts and a competitive selection. Dr. Stebbins noted that the NASA contribution is likely to come from among four technology areas: laser subsystems, telescopes, phase meters, and/or micro-neutron thrusters. The APS would like to thank Dr. Stebbins for his presentation.

Dr. Keivan Stassun (Vanderbilt U) gave a presentation summarizing “Inclusive Astronomy 2015,” a recent meeting on diversity in the astrophysics workforce. This meeting was held at Vanderbilt University, and included about 170 attendees, including Dr. Hertz, Dr. Gaudi, and representatives from the National Science Foundation (NSF), the American Astronomical Society (AAS), and the Department of Energy (DOE). Dr. Stassun noted that one of the key issues discussed at the meeting was the fact that, as one goes further along the educational pipeline, from K-12 through faculty positions, the percentages of under-represented minorities (URMs) in the science, technology, engineering, and math (STEM) fields steadily decrease. In particular, URMs account for about one third of the U.S. population but have only 6.6 percent of the permanent jobs in STEM fields. Physics and astronomy, in particular, have the lowest permanent representation of URMs in STEM fields at only 2 percent. Dr. Stassun noted that the NSF has a program that supports efforts to ease the transition of individuals across critical academic junctures (the Partnerships in Astronomy & Astrophysics Research and Education [PAARE] program), and that this program was inspired by a former NASA program, the Minority University College Education and Research Partnership Initiative (MUCERPI). However, MUCERPI was renamed the Minority University Research and Education Program (MUREP) over a decade ago, and its awards now cover a much broader demographic than the original MUCERPI program. In particular, much of the MUREP funding is for focused educational development of URM in grades K-12. Dr. Stassun noted that few of the funded MUREP programs are invested at the higher (post baccalaureate) levels, and only a very small fraction of



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these funded programs are likely to be in Astrophysics. For example, of the ten MUREP Institutional Research Opportunity (MIRO) center awards in FY14, none included graduate level astrophysics programs, and of the 122 projects in the MUREP Advanced STEM Training and Research (ASTAR) graduate fellowships program, only about 10% are in astrophysics, likely resulting in only 1 or 2 graduate astrophysics fellowships awarded. The APS concluded that before making any recommendations on this issue, they needed more historical data about the MUREP program and the scope of its awards over the past decade.

The APS also heard updates from all three Program Analysis Groups (PAGs).

- Dr. Scott Gaudi (Ohio State U) summarized the joint activities of the three PAGs with regard to the charge from Dr. Hertz to recommend large mission concepts to study in advance of the next decadal survey. To this end, the PAGs have held many meetings in which this charge was discussed. Reference material from the Cosmic Origins PAG (COPAG), Exoplanet Program Analysis Group (ExoPAG), and the Physics of the Cosmos PAG (PhysPAG) can be found at the following websites:
  - <http://cor.gsfc.nasa.gov/copag/rfi/>
  - <https://exep.jpl.nasa.gov/exopag/decadal/>
  - <http://pcos.gsfc.nasa.gov/physpag/>

The three PAG ECs have decided to write a joint executive summary. It is likely that they will endorse the four mission concepts suggested by Dr. Hertz.

- Dr. Alan Boss (Carnegie Institution) updated the status of the ExoPAG. The ExoPAG Executive Committee (EC) is at full strength, having added three new members and having retained former chair Dr. Gaudi, who continues to lead the ExoPAG EC response to the Large Missions Concept Studies charge. ExoPAG#12 was held prior to the 2015 Astrobiology Science Conference meeting in Chicago in June, where one day was spent hearing the final reports for the Exo-S and Exo-C probe-scale studies and the AFTA coronagraph study, as well as a comparison analysis of the various mission concepts using a consistent set of assumptions. The second day was devoted to the large missions charge described above, when Dr. Gaudi led a spirited discussion of the many issues involved.

The ExoPAG EC approved the final report for Study Analysis Group 9 (chair, Remi Soummer) dealing with direct-imaging mission requirements, as well as the charter for a proposed new SAG 13 (chair, Rus Belikov) dealing with estimating exoplanet occurrence rates. Dr. Boss requested that the APS approve both of these recommendations, and the **APS voted to accept the SAG 9 final report and approve the new SAG 13.**

- Dr. James Bock (Caltech) reported on the activities of the PhysPAG. The PhysPAG has been active in responding to the recent charge regarding planning for new flagship missions. To collect input from the scientific community, the PhysPAG set up dedicated splinter sessions at the AAS in January (X-Ray, gamma-ray and cosmic-ray SIGs), a discussion session at the CMB Polarization Workshop in Minneapolis in January, a meeting of the gamma-SIG at 'Future Space-Based Gamma-Ray Observatories' in February, meetings of the cosmic-ray, gamma-ray and gravitational-wave SIGs and a dedicated PhysPAG session at the APS in April, and meetings of the gamma-ray and X-ray SIGs with panel discussions at the Chicago HEAD meeting in June.

The development of the report has been furthered by a regular cadence of EC telecons with presentations from teams engaged in the four large mission concepts. The PhysPAG is actively communicating with the COPAG and ExoPAG to coordinate the reports and to develop a common joint PAG statement. Writing of the joint statement and the PhysPAG report have both commenced.

The Cosmic Structure SIG, approved by the APS in March 2015, has been formed and is being co-led by Olivier Dore and Rachel Bean. The PhysPAG recently engaged in the annual PCOS gap technologies process, first by encouraging the community to provide input. After the 22 new gap technologies were collected from the community, area experts from the PhysPAG EC examined these submissions for potential overlap with the existing list of 15 gap technologies from 2014. The result was a revised list of 14 existing gaps plus 9 new items. These were passed along to the PCOS technology lead for next stage in the technology cycle.



The membership of the PhysPAG EC has 3 members that are concluding their terms of service in December 2015. An open 'Dear Colleague' letter for nominating new members was distributed on July 13 with a deadline for responses of 1 September with an announcement of selections anticipated in early October.

The PhysPAG did not present any motions for approval by the APS in this July meeting.

- Dr. Ken Sembach (STScI) presented a status of the COPAG activities.

Since the last Astrophysics Subcommittee meeting, the COPAG has been actively engaged in addressing the flagship mission charter given to the PAGs by Dr. Hertz. This has included soliciting community input, working with and sharing information with the other PAGs, and drafting findings. There have been numerous PAG meetings at which this topic has been discussed, and there has been good cross-PAG representation at many of these meetings. The COPAG Science Interest Groups #1 (Far-IR) and #2 (UV/Optical) have been actively engaging the community in discussions of the flagship mission charge. SIG #1 held a Far-IR Surveyor workshop in Pasadena on June 3-5, and SIG #2 held a UV/Visible Science and Technology Development workshop at GSFC on June 25-26. Both workshops were well attended, with broad representation from the community. SIG #3, Cosmic Dawn Science, is still organizing their response. All three SIGs are expected to hold splinter sessions at the January 2016 AAS meeting to discuss ongoing business.

The COPAG provided input into the Cosmic Origins Program Annual Technology Report in June, and reviewed the office's descriptions of existing and new technology gaps.

The COPAG also recently completed activities associated with Science Analysis Group #9: Cosmic Origins Science Enabled by Spitzer Observations Prior to JWST. **The APS voted to accept the SAG #9 final report issued by Calzetti et al., and formally closed this SAG activity.** The COPAG has also produced a report for SAG #8: Cosmic Origins Science Enabled by the WFIRST-AFTA archive, which was led by Dr. Sally Heap. The Subcommittee will be reviewing that report in the coming months and will provide individual comments to the COPAG prior to considering closure of the SAG at the autumn 2015 meeting. **The APS voted to approve the COPAG's request to close SAG #5: Science Objectives and Technology Requirements for a Series of Cosmic Origins Probes,** which has been inactive for several years. Activities related to this SAG may still be discussed within the COPAG Science Interest Groups as applicable.

The COPAG is soliciting nominations for at least two new members for its Executive Committee to replace members who will be rotating off in the coming year. Self-nominations are welcome. A "Dear Colleague" letter has been sent to the community, with a nomination deadline of September 4, 2015. Selections are expected in late September or early October.

Finally, the APS revisited the issue of the travel approval process for NASA civil servants and contractors. In its August 2014 meeting, the APS offered several suggestions to NASA for streamlining the travel approval process for civil servants and contractors. The APS commends the SMD/ApD leadership for successfully implementing new travel policies that ameliorate most of these issues (e.g., timely announcements of approved travelers and conferences). Specifically, notifications of successful travel requests for the summer International Astronomical Union meeting in Hawaii were sent out several months before the conference start date, instead of 30 days (or less) before the start date, as for previous meetings. The subcommittee requested clarification on whether NASA decouples civil servants and contractors when applying the 50-person rule for foreign conferences. A response from Dr. Hertz immediately after the APS meeting indicated that this rule does indeed apply to both civil servants and contractors.

The APS indicated that, at a future meeting, they would like to have a discussion of the potential future role of probe-scale missions in the ApD. The APS also requests that NASA provide



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information on the awards made within the MUREP program, as well as a briefing on the Cooperative Agreement Notice (CAN) proposal selections for team-based education activities within the SMD. Finally, the APS looks forward to hearing a presentation on the final report of the AAAC study on proposal pressures and success rates.

Finally, Dr. Hertz welcomed Dr. Scowen to the APS, and thanked outgoing members Dr. Kouveliotou and Dr. Harrison for their work on the Subcommittee. The APS would like to echo Dr. Hertz's welcome to Dr. Scowen, and thanks to Drs. Kouveliotou and Harrison for their service to the APS.

**Major conclusions:** In response to the Government Performance and Results Act Modernization Act (GPRAMA), the APS evaluated the Astrophysics Division's progress towards its primary strategic objective and performance goals, and unanimously assigned a rating of green to these goals, meaning that we concluded that the expectations of the research program were fully met in context of the resources invested.

Sincerely,

Scott Gaudi  
APS Chair  
The Ohio State University

Joel Bregman  
APS Vice-Chair  
University of Michigan