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TO: Wes Huntress, Chair, NASA Advisory Council Science Committee
RE: Report from the Astrophysics Subcommittee (APS)
FROM: Alan Boss, Chair, APS

This letter report summarizes the APS meeting held on February 16-17, 2011 at NASA HQ in Washington, D.C. With one exception, all of the members of the APS participated in this meeting, either in person or through Webex and telephones.

The Subcommittee is grateful for presentations from Jon Morse, Paul Hertz, Linda Sparke, Jay Gallagher, Rick Howard, Hashima Hasan, Michael Moore, Nick Gautier, and by NASA's new Chief Scientist, Waleed Abdalati. We are also thankful for the ongoing NASA staff support, in particular the work by Rita Sambruna and Marian Norris.

Division Update: Jon Morse presented the status of the Astrophysics Division (APD), beginning with several examples of the latest science results being returned by operating APD missions, as exemplified by numerous press releases at the January meeting of the American Astronomical Society (AAS) in Seattle and others released since then. APD will have 13 operating space missions after the decommissioning of the Wilkinson Microwave Anisotropy Probe (WMAP) and the Wide-Field Infrared Survey Explorer (WISE), with 5 missions in development and another in formulation, as well as active Sub-Orbital Rocket and Balloon Programs. The Balloon Program returned to flight in Antarctica after a launch mishap in Australia in 2010 led to a thorough review of launch safety procedures. APS members reported that much stricter safety regulations are now in force in the Balloon Program as a result of this mishap. The improved level of safety is a welcome change. However, concern was raised about the impact of some of the safety regulations on balloon team operations and project costs. **The APS suggests that these new safety regulations are a topic that the Balloon Working Group may want to discuss in one of its upcoming meetings.**

The timing of this meeting was chosen to follow the release of the President's FY2012 proposed budget on February 14, 2011. The FY2012 budget for APD is slightly reduced compared to FY2010, after taking into account the removal of the James Webb Space Telescope (JWST) budget from APD, but projects modest increases in FY2013 through FY2016, though these increases are notional only. The budget situation is still unclear for

FY2011, as the federal government continues to operate on a Continuing Resolution that expires on March 4, 2011. In spite of this uncertain fiscal picture, APD is planning on funding all of the highest priorities outlined in the New Worlds, New Horizons (NWNH) Decadal Survey Report (released August 13, 2010), with the major exception of the top large mission priority of NWNH, the Wide-Field Infrared Survey Telescope (WFIRST). While a Science Definition Team (SDT) for WFIRST has been chosen and charged with developing a science case and rationale for an eventual WFIRST mission, the fact is that a large mission like WFIRST cannot begin Phase A development with the FY2012 budget plan until the current large mission in development, JWST, is launched. APD has informed the European Space Agency (ESA) that ESA's offer for NASA to participate in ESA's Euclid dark energy mission with a 20% share will not be accepted. Instead, NASA is considering a joint mission with ESA, which would serve the science goals of both Euclid and WFIRST. **The APS concurs with APD's intention to move forward with all of the top priorities of NWNH, while beginning the science definition and technology development efforts for the WFIRST mission and exploring the possibilities of a joint WFIRST/Euclid-type mission with ESA. In particular, the creation of a separate budget line specifically within APD for Explorer Missions, with an increased flight rate, is highly responsive to the NWNH Decadal Survey's prioritizations. APS also supports the plan to create a new APD Technology Fellowship Program, for both postdoctoral fellows and early career faculty.**

NWNH also called for the creation of a Decadal Survey Implementation Advisory Committee (DSIAC), which would produce annual reports as well as a mid-decade review of the progress made. The APS notes the progress NASA is making in working with the National Research Council (NRC) and other federal agencies to establish the DSIAC, as well as the complexity of the task, given the myriad of often overlapping Congressional and federal agency advisory committees and NRC panels and committees. **The APS therefore requests a more detailed discussion at its next face-to-face meeting of the roles of the various committees that provide strategic advice to NASA, so that the roles of the APS and the other current standing committees with relation to a potential DSIAC become clearer. To support an effective discussion, the APS suggests inviting the chairs or representatives of these other committees to attend the next face-to-face APS meeting.**

Following the most recent Senior Review of APD's operating missions, APD made funding decisions for a number of proposed extended-mission phases, and those missions planned accordingly. Unfortunately, because of the severe current budget problems, APD has had to terminate support at the end of FY2011 for the extended-mission phase of several more missions on the Senior Review prioritization list. As this is a very recent development, it is difficult to understand all the consequences. These include further reductions in the operations and guest observer programs for the Hubble Space Telescope (HST), Chandra, and Swift, and termination of GALEX before a legacy survey and data products can be completed. Extended support for the RXTE and INTEGRAL missions and the Suzaku Guest Observer Programs has also been terminated. **The APS requests a more detailed description of the consequent science losses at our next face-to-face**

meeting. This painful event reinforces the critical importance of the Senior Review as a primary tool for APD as it makes difficult decisions. **The APS also suggests that future Senior Review panels should be charged to consider a range of optimistic and pessimistic future funding scenarios, to help ensure that their advice is appropriate in the face of changing budgetary circumstances.** The 2012 Senior Review for several operational APD missions, e.g., HST, Fermi, and Kepler, is likely to face an equally constrained budget environment.

SOFIA Update: Paul Hertz presented the status of the Stratospheric Observatory for Infrared Astronomy (SOFIA) airborne observatory, which started its “short science” observations in late 2010. Basic science is scheduled to start in September 2011, with full operational science slated to begin by February 2014. With a planned 20-year mission, SOFIA will face its first Senior Review 4 to 5 years after science begins. **The APS congratulates the SOFIA Mission on its first science flights, and looks forward to seeing the future science results.**

Research & Analysis Update: Linda Sparke presented the status of the Research & Analysis (R&A) Programs. Following the recommendations of NWNH, APD is planning on augmenting the funding for the Astrophysical Theory Program (ATP) by 25% in coming years, in an attempt to improve the current dismal proposal success rate of 17%. The ATP does not specifically support theoretical models on exoplanet formation and evolution. Such modeling is supported by the Origins of Solar Systems Program (OSSP), which is funded jointly with the Planetary Sciences Division (PSD). ATP’s OSSP contributions are used to support only exoplanet detection efforts, not theoretical modeling. PSD has cut its support for OSSP in the current fiscal year by 10%, so that exoplanet theory grants have been reduced accordingly. **The APS requests that APD find a way to meet the recommendations of NWNH for augmented support of all astrophysical theory elements, including exoplanet theory, within the existing ATP or OSSP programs.**

Senior Review of RA&ET Update: Jay Gallagher presented the status of the Senior Review (SR) of the APD’s Research, Analysis, & Enabling Technology (RA&ET) Programs. The SR panel has been created and tasked with delivering a report by May 15, 2011, prior to the Boston AAS meeting. **The APS supports this timely effort to reassess how APD’s RA&ET programs can best support NASA’s mission goals.**

JWST Office Update: Rick Howard presented the status of the James Webb Space Telescope (JWST) Office, which is now effectively a separate Division within the Science Mission Directorate (SMD), though the JWST Science Program remains within APD. A major re-plan of the JWST Program is now underway, with the only constraints on this effort being the FY2011 Continuing Resolution and the proposed FY2012 budget, which specifies \$375M for JWST as well as notionally in the out years. This amount is considerably less than was estimated by the Casani Report to be necessary to achieve launch in 2015. **The APS fully supports this re-plan effort, and requests a presentation about the status and details of the re-plan under different funding profiles, along with their consequences, at the next meeting.**

JWST Science Update: Hashima Hasan presented the status of the JWST Science Program, which remains in APD. JWST's science remains as compelling as it was when it was listed as the top large space mission priority in the 2001 Decadal Survey. APD has responded fully to the requests made by the Casani Report for changes in the JWST Science Program. **The APS commends this effort to strengthen JWST's Science Program.**

NASA Technology Roadmap Update: Michael Moore presented the status of the Roadmap effort currently underway for NASA's technology programs, driven by the recent creation of a NASA-wide Office of the Chief Technologist (OCT). Technology has been and will continue to be a major enabler of SMD missions. **The APS supports and endorses this technology partnership between SMD and OCT and looks forward to hearing more details as the plans evolve.**

ExoPAG Status Update: Jim Kasting presented the status of the Exoplanet Exploration Program Analysis Group (ExoPAG), which held a well-attended two-day meeting before the Seattle AAS meeting. The ExoPAG asked permission to create a Study Analysis Group (SAG) to define the science requirements and scope of a future flagship mission to identify and characterize Earth-sized planets in the habitable zones of nearby stars. This unfunded activity is planned to set the stage for a funded study of two different mission designs sometime in the 2013 time frame. Both mission designs will involve some sort of optical telescope, at least 4 m in diameter, perhaps with additional capabilities at UV or near-IR wavelengths. The key difference in the designs is how the starlight suppression system would work. One design would employ an internal coronagraph, the other an external occulter. Even larger telescopes may also be considered. The SAG will define the "ground rules" for these two studies in such a way that their results can be easily compared. Providing the findings of trade studies for this mission will be done jointly with the COPAG, which is also interested in studying a future large, UV/optical space telescope. A report on this activity is planned for presentation and discussion at the fifth ExoPAG meeting in January 2012 and for finalization by Spring 2012. **The APS approves the creation of this new SAG, and congratulates the ExoPAG on its efforts to achieve a plan for moving forward in defining the science goals for a future flagship mission for Exoplanet Exploration.**

COPAG Status Update: Chris Martin presented the status of the Cosmic Origins Program Analysis Group (COPAG). As noted above, the COPAG is working with the ExoPAG to consider plans for a future large UV/optical space telescope. The COPAG wishes to create three new SAGs, in the following areas: 1) technology development and straw man mission plans for a large UV/optical space telescope, 2) the same for a telescope that could also perform the Exoplanet Exploration science goals to be defined by the ExoPAG's SAG, and 3) the same for a large telescope that would extend into the

infrared. **The APS concurs with the request that these three new SAGs be created for the COPAG.**

PhysPAG Status Update: Steve Ritz presented the status of the Physics of the Cosmos Program Analysis Group (PhysPAG), which is planning not just for the next Decadal Survey, but also for Explorer Missions in the current decade. The PhysPAG requests permission to create three SAGs, as follows: 1) one for technology development, with their ideas to be reviewed by the APS and then submitted to the ongoing NRC technology development study, as well as anticipated to be relevant to technology development for future Explorer Missions, 2) another for technology development and definition for a future inflation probe mission, and 3) the last for considering how to optimize community interactions with the SAGs of all three PAGs. **The APS again concurs with the request that these three new SAGs be created for the PhysPAG, and commends the efforts of all three PAGs to work together toward the common APD goals.** There is an open action item for APD to ascertain if and how international participation is possible in the SAGs.

EPO Overview Update: Hashima Hasan presented the status of APD's Education and Public Outreach (EPO) efforts, which cover the spectrum of APD missions at the level of 1% of total mission cost. The APS is pleased to see the broad range of EPO activities pursued and supported by APD and how well they complement one another across the K-12 grades through the informal education of school students and teachers. The APS is particularly interested in encouraging a larger number of the Principal Investigators (PIs) of RA&ET grants to submit proposals for EPO supplements. However, given the small amount of funds available for such supplements, **the APS recommends that the expectation for a systematic, professional-level, external evaluation component to the proposed EPO project be relaxed to an appropriate level.** Having the EPO supplement funds be available predominantly for the actual development and implementation of the proposed EPO activity, rather than for evaluating those efforts, will surely help with encouraging PIs to pursue supplemental EPO funds.

Kepler Update: Nick Gautier presented the status of the Kepler Mission, which recently released the second major data set on over 150,000 stars ahead of schedule. Kepler has more than tripled the number of exoplanet candidates in its first full year of operations, and has detected a system with six transiting planets, five in the super-Earth size range, whose masses have been estimated by transit timing variations. **The APS congratulates Kepler on its successes to date, and looks forward to learning the frequency of habitable worlds.**

NASA Chief Scientist: The APS met with Waleed Abdalati, NASA's new Chief Scientist, who briefed the APS about his background and expectations for providing an independent science voice to NASA Administrator Charles Bolden and Associate Administrator Lori Garvin. Abdalati intends to interact with Bobby Braun, the new NASA Chief Technologist, **and the APS strongly supports such interactions.**

Abdalati informed the APS that Administrator Bolden had just sent a letter to ESA inquiring about the possibility of exploring partnerships on high-priority science missions. Such cooperation may be essential for accomplishing all of the science goals of WFIRST, the top-priority large space mission in the NWNH Decadal Survey. **The APS is encouraged by this development, and looks forward to hearing more information about possible future NASA/ESA joint missions at the next meeting.**

Finally, **the APS concurs with the selection of the new members of the APS**, replacing those who will rotate off in March 2011: James Rhoads, Jim Manning, Ron Polidan, and Leisa Townsley. We sincerely thank all four for their efforts on behalf of NASA and the APD over the last several years. We also look forward to beginning work with the five new APS members (the fifth replacing John Huchra, who passed away in 2010), namely Edna DeVore, Gabriela Gonzalez, Paul Ray, Gary Bernstein, and Terry Oswalt, pending confirmation of their appointments by the NASA Administrator. The APS also supports the confirmation of Guido Mueller as a new member of the PhysPAG Executive Committee. The importance of APS's efforts at advising APD can only grow in the current budget climate, and we anticipate lively APS meetings in 2011-12 as we continue to grapple with the changing astrophysical, technological, and fiscal worlds.

Best wishes,



Alan Boss, Chair, APS