Minutes of the Meeting of the
Astronomy and Astrophysics Advisory Committee
17-18 November 2014
National Science Foundation, Arlington, VA

Members attending:	James Buckley	John Johnson (Telecon)
	William Cochran	Angela Olinto
	Priscilla Cushman (Chair)	Angela Speck
	Craig Hogan	Suzanne Staggs
	David Hogg	Paula Szkody
	Klaus Honscheid	
	Scott Hughes	Jean Turner
Agency personnel:	Fleming Crim, NSF-MPS	Randy Phelps, NSF-OIIA
	James Ulvestad, NSF-AST	Glen Langston, NSF-AST
	Maria Womack, NSF-AST	Jean Cottam, NSF-PHY
	Elizabeth Pentecost, NSF-AST	James Whitmore, NSF-PHY
	Nigel Sharp, NSF-AST	Pedro Maronetti, NSF-PHY
	Joan Schmelz, NSF-AST	Paul Hertz, NASA
	Diana Phan, NSF-AST	Rita Sambruna, NASA (Telecon)
	David Boboltz NSF-AST	Glen Wahlgren, NASA
	Richard Barvainis, NSF-AST	Kathleen Turner, DOE
	Daniel Evans, NSF-AST	James Siegrist, DOE (Telecon)
	Craig Foltz, NSF-AST	Helmut Marsiske, DOE
	Ralph Gaume, NSF-AST	Anwar Bhatti, DOE
	Patricia Knezek, NSF-AST	Saul Gonzalez, OSTP
	Jim Neff, NSF-AST	Meredith Proshan, OSTP
	Ivy Kupec, NSF-OLPA	
Others:	Joel Parriott, AAS	Thomas Statler, UMD
	Josh Shiode, AAS	Tricia Crumley, UTexas
	James Lochner, USRA	Jackie Hewitt, MIT
	Miriam Quintal, Lewis-Burke	Alison Rose Sonnesyn, US House, CSST
	Keivan Stassun, Vanderbilt	David Lang, NRC
	Kathryn Flanagan, STScI	William Smith, AURA
	Dan Clery, Science	Reba Bandyopadhyay, UFL
	Steve Unwin	Tali Bar Shalom, OMB
	Amaya Moro Morton, STScI	Ben Kallen
	Brad Reever, British Embassy	Marc Sher
	Katie David, NRC	

MEETING CONVENED 9:00 AM EST, 17 November 2014

The Chair called the meeting to order. Introductions were done.

The minutes from the 10 June 2014 meeting were approved by the Committee.

Elizabeth Pentecost, the AAAC Recording Secretary, reviewed the list of identified Conflicts of Interest (COIs) for the AAAC. There were no additional changes to the list. The list will be distributed again before the January meeting.

James Ulvestad presented an update on AST activities. He spent a few minutes reminding the AAAC of its role in advising the three agencies.

Ulvestad provided some programmatic and science highlights. ALMA construction is nearly complete except for some punchlist items. ALMA has been providing some high-impact science results, one of which was featured in world-wide publications. HL Tau. In astonishing detail, the planet-forming disk measured ~235 AU in diameter around a young Sun-like star 450 ly away; the rings may have been created by planet-like bodies and/or resonances. With observations with the Gemini-N AO system and imaged with HST, a massive black hole was discovered in M60-UCD1 of 20 x 10^6 M_{Sun} in a galaxy of total mass only 140 x 10^6 M_{Sun}. In a paper in *Science*, VLBI parallax measurements of the 5 stars in the Pleiades gave a distance of 136.2 +/- 1.2 pc, which were consistent with pre-Hipparcos results; Hipparcos "reported the distance to the Pleiades as 120.2 +/- 1.5 pc closer than previously accepted distances that were >10% larger. This has implications for astrophysical models of Pleiades-age stars. Researchers operating the South Pole 10m Telescope (SPT) in Antarctica used recent data from a 100 degree-squared patch of the sky to detect for the first time tiny fluctuations in the Cosmic Microwave Background (CMB) - known as the B-mode polarization - that were caused by "gravitational lensing;" these also were reported by POLARBEAR. The NSF-funded IceCube Neutrino Observatory at the South Pole reported the highest energy neutrinos from outside the Solar System. Up to date, over 40 neutrinos with energies above 30 trillion electron volts (TeV) have been spotted.

Construction of the Daniel K. Inouye Solar Telescope (DKIST) is well underway. The Mid-scale Innovations Programs (MSIP) concluded its first round of submissions, with several new awards. AST has completed a reorganization of the grant discipline areas to group Planetary and Exoplanetary Astronomy.

The AST Division budget remains stagnant. The AST FY2015 President's Budget Request was $236M compared to the $246M appropriated in FY2010; a decrease of ~4% and a decrease of 5 years of inflation (an order of ~10-15%). The Astronomy and Astrophysics Research Grants (AAG) budget went from $49.4M in FY2010 to $43.7M in FY2014, with a funding rate falling from 22% to 16%. AST ended the University Radio Observatories (URO) program and Telescope Systems Instrumentation Program (TSIP) as standalone activities; they were folded into MSIP. "Open access" time is headed for reductions in both the optical and radio regimes.

In the AAG programs, there were 732 proposals received in 2014 (with a 16% success rate). The overall NSF funding rate for research proposals is ~19% and some other divisions have funding rates of around 10%. The number of AAG proposals received in AST in FY 2015 was 770, about a 5% increase from 2014. The Division strongly encouraged investigators to restrict themselves to 1 AAG proposal in FY 2015, with mixed results. Under consideration is an effort to reduce the frequency of AAG calls. The Division will need to develop a strategy for what to do when the funding rates hit 12% and below.

David Hogg asked if the success rate was the same across the AAG disciplines in AST. Ulvestad replied that AST has made an effort to make sure the success rate was distributed evenly across the disciplines.

James Buckley commented that there needs to be a look at trends in how multiple proposals are growing over time. Dan Evans indicated that there has been a gradual increase over the past 8 years in which people are proposing more often. For example, PIs more commonly propose the immediate year after getting an award and rather than taking two-year break.

AST is making progress on the recommendations from the AAAC's 2014 report. The *Principles for Access to Large Astrophysics Projects and Facilities* document is being used in negotiating future agreements, specifically the DESI and exoplanet programs. AST has started the engineering feasibility

and baseline environmental reviews needed in the divestment process. Many ongoing discussions are in process to leverage the divested facilities for community access. AST has commissioned a NRC study of the US OIR System in the Era of LSST and the report is expected in Spring 2015.

Paul Hertz presented the NASA update, including some programmatic and science highlights. A suspected black hole in M82X-2 was unmasked as a ultra-luminous pulsar by NuSTAR. Hubble, Spitzer, and Kepler telescopes found clear skies and water vapor on an exo-Neptune. The Spitzer telescope witnessed an asteroid smashup around a nearby star. Comet C/2013 A1 Siding Spring made a close approach to Mars on October 19. The NASA Mars spacecraft took advantage of a unique and unexpected science opportunity for a close study of a visitor from the edge of the solar system, along with possible effects on Mars' atmosphere. Early results probed the size and properties of the comet's nucleus and the properties of dust and gas in the comet's coma. NASA space observatories that orbit the Earth also observed the comet and Mars during the close encounter.

The Astrophysics Division is addressing the decadal priorities within budget constraints. The budget for NASA Astrophysics, which includes JWST, continues at $1.33B in FY2014. The President has requested $1.25B in FY2015 (the difference is mostly due to deletion of SOFIA's operating budget from FY2015 budget request). Primarily because of the reduction in SOFIA's budget, the FY 2015 budget request represents a ~10% decrease for the Astrophysics Division. However, JWST, the highest priority of the community, is making progress, remains on schedule, and is fully funded in the FY15 budget request for an October 2018 launch. NASA is preparing for a strategic Astrophysics mission to follow JWST as soon as funding becomes available. Pre-formulation of WFIRST/AFTA was funded in the FY14 appropriation and is included in the FY15 budget request. The Stratospheric Observatory for Infrared Astronomy (SOFIA) has completed development and has entered its operations phase. NASA is developing new Explorer missions (NICER, TESS) and contributions to its international partners (LPF, ASTRO-H, Euclid). NASA is discussing contributions to ESA's Athena and L3 GW observatory. NASA is planning a robust Astrophysics Explorers Program with a SMEX AO in late CY2014 and a MIDEX AO in ~FY2017. Following the 2014 Senior Review, NASA plans to continue operating all currently operating missions, including Spitzer. NASA continues to support individual investigators for data analysis, theory, and technology investigations through open, competitive, peer reviews. However, the budgetary future remains uncertain.

The FY2015 PBR requested $607M for Astrophysics and $645M for JWST. There have been positive endorsements from the Administration and Congress on WFIRST/AFTA. The House and Senate appropriations bills have different allocation recommendations and will need to be discussed and a compromise agreed upon. A continuing resolution through December 11, 2014 funds the first 10 weeks of FY2015 at the same levels as FY 2014.

Hertz gave an update on JWST. The Integrated Science Instrument Module (ISIM) completed a very successful cryo-vacuum test. The first of 5 flight sunshields were completed with two others being manufactured. The engineering sunshields successfully completed deployment testing. The spacecraft bus is under construction. The Pathfinder backplane had its optics installed and is undergoing final assembly before the 2015 testing at Johnson Space Center (JSC). The program remains on track and within budget for an October 2018 launch.

In May 2013, the NASA Administrator approved the Astrophysics Division's study of WFIRST-AFTA (Widefield Infrared Survey Telescope-Astrophysics Focused Telescope Assets) and preserved an option for a FY2017 new start if the budget is available. No decision is expected before early 2016. The Division is currently in the pre-formulation phase. The FY14 appropriation ($56M) supports pre-formulation including technology development for detectors and the coronagraph. The FY15 request ($14M) supports the Agency/Administration decision for formulation to begin in FY2017 should funding

be available. AFTA was endorsed by an NRC study released in March 2014. The Science Definition Team (SDT) final report is due in January 2015.

NASA is seeking to work with its current partner Germany and potential partners to identify a path forward for SOFIA with greatly reduced NASA funding. Unless partners are able to support the U.S. portion of SOFIA costs, the Administration proposes that NASA will place the aircraft into storage FY2015.

The NASA/NSF partnership for exoplanet research proposes to capitalize on the NOAO share of the WIYN consortium to implement a joint exoplanet research program that will focus on high precision radial velocities. This will enable follow-up observations in support of current NASA missions such as Kepler/K2 and TESS and pathfinder observations to inform the design and operation of future missions such as JWST and WFIRST-AFTA. The program, as currently envisioned, would be carried out in two stages, first using the existing instrumentation on WIYN and a release of a solicitation in FY2015 (January) for a new instrument, a facility-class Extreme Precision Doppler Spectrograph (EPDS), and second, an exoplanet-targeted Guest Observer and guaranteed time program at WIYN using the EPDS instrument with open community access to the instrument for observations that support NASA missions in FY2018.

Funding amounts have not kept pace with the number of proposals submitted to the NASA Astrophysics ROSES (research grants) solicitation over the past few years. As a consequence, the selection rate has decreased. The Division will not solicit proposals for the Astrophysics Theory Program (ATP) in FY 2015 but there will be an opportunity in 2016 to realign the submission of proposals with the release of funding to PIs.

The Science Mission Directorate intends to release a Cooperative Agreement Notice (CAN) soliciting team-based proposals for science education. The Astrophysics Division has consolidated its education programs during the FY14-FY15 transition period (until CAN awardees begin work) into four science areas: Cosmic Origins, Physics of the Cosmos, Exoplanet Exploration, and SOFIA Airborne Astronomy Ambassadors. During the continuing resolution, funding levels for Astrophysics E/PO are being maintained at the same annualized level as FY2014.

NASA is preparing for the 2020 Decadal Survey by identifying notional mission concepts to study, initiating studies, conducting those studies and building a science case, and identifying technology requirements for early technology development. These results will be reported to the 2020 Decadal Survey committee.

Kathy Turner gave an update on DOE activities. The U.S. High Energy Physics (HEP) program is following the strategic plan laid out by the previous High Energy Physics Advisory Panel (HEPAP)/P5 (Particle Physics Project Prioritization Panel) studies, but HEP needed a compelling and executable strategic plan with the community behind it. The community-led planning process (Snowmass) to develop a strategic plan for the field was started in 2013. The plan was to be executed over a ten year timescale in the context of a 20-year global vision for the field. HEPAP unanimously approved a new long term strategic planning report from P5 in May 2014. The report identified five intertwined science drivers that would show great promise of discovery: (1) use the Higgs boson as a new tool for discovery; (2) pursue the physics associated with neutrino mass; (3) identify the new physics of dark matter; (4) understand cosmic acceleration: dark energy and inflation; and, (5) explore the unknown: new particles, interactions, and physical principles. The Science Drivers were studied using techniques in one or more of the HEP program experimental research frontiers, Energy, Intensity, and Cosmic. HEP will use the P5 criteria in developing their program.

The final FY2014 HEP budget was $774.92M. Projects approved in the FY2014 budget were the LSST camera (at $22M), Belle-II, Muon g-2 and Muon to electron conversion (m2e) experiment. Specific guidance in the approved budget for the additional $21M was provided for LBNE and the Homestake Mine operations.

The FY2015 PBR for High Energy Astrophysics (HEP) was $744M. The P5 report recommendations suggested increasing the project budget fraction to 20%-25%. The report strategy guided the FY2015 budget. Impacts should begin to become evident in the FY 2016 PBR.

Through ground-based telescopes, space missions, and deep underground detectors, research at the cosmic frontier aims to explore dark energy and dark matter. The FY2015 PBR is $101.24M for the Cosmic Frontier.

Currently the Dark Energy program consists of the Baryon Oscillation Spectroscopic Survey (BOSS), Dark Energy Survey (DES), and the supernova surveys. LSST is the priority for the next HEP dark energy project to be developed. NSF is the lead agency responsible for the telescope and data management; DOE is responsible for the camera. The LSST camera was approved for fabrication in the FY2014 budget. Future planning includes the Dark Energy Spectroscopic Instrument (DESI). HEP is moving forward in planning DESI in coordination with NSF, including upcoming discussions regarding the model for the DESI program, assuming an FY2016 fabrication start. DOE also funds experiments measuring properties of high energy cosmic rays and gamma rays. There is also an extensive program in direct-detection dark matter experiments and support for CMB experiments.

HEP is not continuing to fund research, R&D, or planning efforts on the Cherenkov Telescope Array (CTA) going forward. Currently ongoing efforts funded by HEP will be ramped down.

Considerations for research support include priorities to support efforts in the programs that HEP has responsibility for experiments, working in collaborative arrangements, and increasing university involvement in dark energy and dark matter. The amount requested in FY2014 for grant money was $7.5M (for 29 proposals) and the amount funded was $3.2M (for 19 proposals), with a success rate of around 65%. The number of proposals, the funding request, and funding availability in FY2015 is similar to FY2014. DOE does not have a separate funding line for small research projects.

James Whitmore of the NSF Physics Division presented an overview of AAAC-related programs in Physics Division. The Physics Division works with both the DOE/HEP and the DOE Office of Nuclear Physics and within NSF work with AST and the Division of Polar Programs.

The Physics Division budget for FY2014 was $266.3M. This budget included funding for individual investigator grants, education and infrastructure, and facilities. Major undertakings in FY2014 included the launch of a new academic-based program in accelerator science, a formal midscale funding program, upgrades for the Large Hadron Collider detectors, a selection of dark matter G2 experiments in coordination with DOE, and the first steps in NSF's response to the P5 report. The FY2015 PBR is $263.7M.

One of the most critical needs of research projects funded through the Physics Division is that of having cutting-edge instrumentation that enables investigators to remain competitive in a rapidly-changing scientific environment. The Physics Division established a Mid-Scale Instrumentation Fund and released a Dear Colleague letter in 2013 for 2014 awards. This is not a separate program to which investigators can apply directly. PIs request funding for specialized equipment as part of a regular proposal to a disciplinary program in the Division. The Program Officer then requests funds be provided through the

Mid-Scale Instrumentation Fund Funding levels begin at ~$4M and can go up to ~$20M. FY14 awards included upgrades to ATLAS and CMS and the LHCb upgrade.

In response to the recommendations of the P5 report, the Physics Division is considering several scenarios for major investments in the next 10 years including investments in LHC Phase 2 upgrades which could range from the midscale to the MREFC level, and midscale investments in other scientific priority areas identified by P5. A subcommittee of the MPS Advisory Committee (MPSAC) will look at these priorities and relevant budgets and will provide a report to the MPSAC in January.

Priscilla Cushman gave a presentation to set the stage for the discussion on demographics. Over the last decade, budget pressures and a steep rise in the number of proposals have had an impact on researchers and funding agencies in the fields of Astronomy and Astrophysics. The decreasing success rate of individual proposals, a general decrease in funding levels in many agencies, and increased reviewer load has been a topic of concern within the community. Consequently, a working group was formed under the auspices of the AAAC in consultation with representatives from the relevant divisions of NSF, DOE and NASA. The working group is evaluating the effect of this changing environment on the health of the field, specifically addressing whether this will result in unacceptable restrictions in the range of new scientific initiatives and negatively impact career choices of the most promising researchers. The working group will gather relevant demographic data in order to understand how the funding environment over the last 10 years has affected researchers and projects, and then will compare funding models across agencies and determine appropriate metrics for evaluating success. This will allow the Committee to provide data-driven projections of the impact of such trends in the future, as well as that of any proposed solutions. A wiki page is being set up for each agency's response to the questions being asked by the working group along with the available data. There are also some community questions being asked of the AAS; they have quite a lot of data available. A preliminary set of data are to be collected by January with a dissemination of results by Summer 2015. Some of the solutions that have been discussed include no change, one proposal per year per PI, requests for proposals every other year, having a pre-proposal stage.

Jim Ulvestad indicated that having a set of well thought-out questions that the Agencies can answer provided in the annual report is quite important to NSF.

David Hogg asked whether the Committee had a budget because the analysis of the gathered data can be expensive. It would be expensive to fully understand the issues, but he agrees that it would be good to come up with a small number of very well-defined set of questions (that would probably be causal in nature; What observational data is available? and What does the data suggest?). Ulvestad commented that some resources might be available either through NSF (AAAS Fellow) or through AAS.

Joel Parriott of the AAS indicated their demographic data and numbers is voluntary. He noted that the AAS might want to support a statistically valid survey with the AIP Statistical Resources Center. AAS is currently doing a longitudinal survey with support from NSF (data surveys).

Paula Szkody commented that the Agencies should promote the small projects. Good science can come out of these projects.

Keivan Stassun (Vanderbilt Univ.) commented that it is very tempting to advance the recommendations of the Decadal Survey with regards to new facilities but the individual grants programs are extremely important and it would be detrimental to the health of the science if the balance was leaning toward facilities. Looking at demographics is important, but only thinking about solutions that reduce reviewer workload or reduce the number of proposals submitted really avoids the issue of achieving a balance between funding facilities and funding investigators. Ulvestad noted that the reason AST did the

Portfolio Review was to keep a balance between the facilities and the individual investigator programs, but it is very difficult to take long term facilities and find ways to take them off the budget. The timescale for making those decisions is 5-10 years; it takes some time to turn things around.

There has been a doubling of the number of proposals being submitted over the past 10 years to NASA and NSF. Reba Bandyopadhyay asked whether there is a workforce driver or something in the community driving that increase; is there a cause for this? Cushman commented that this may be something that AAS could provide, but it is important that the right questions be asked.

Ulvestad commented that the whole model of how astronomy runs has changed. Thirty years ago, the funding rate was around 50%. That meant that persons proposing federal support for astronomy research were likely to get funded over a 2-3 year period.. Now, the funding rate is less than 20% and it is probably never going to go above 20% again in AST without some dramatic changes. So the model where most people who request federal funding for astronomy research eventually receive such funding is no longer valid and it is not coming back; that is a fundamental shift in the field that the community needs to understand.

Paul Hertz gave a presentation on the planning for the mid-decadal survey. NASA is required by statute to conduct a mid-decade review of their science programs while NSF and DOE voluntarily do it in astronomy and astrophysics. The NRC conducts such mid-decade reviews for each of NASA's four space science divisions.. There have been many lessons learned since the first astrophysics mid-decade review began in 2006 and the Space Studies Board discussed this at their November meeting. The review will be conducted during 2015-2016. Discussions of the Statement of Task are underway with the National Research Council (NRC). Given the funding circumstances that are substantially below those assumed in *New Worlds New Horizons* (NWNH), the committee's review will describe the most significant scientific discoveries, technical advances, and relevant programmatic changes in astronomy and astrophysics over the 5 years since the publication of the decadal survey; how well the Agencies' programs address the strategies, goals, and priorities outline in the 2010 survey and other relevant NRC reports; and, progress toward realizing these strategies, goals, and priorities. The Agencies will be sharing the costs of the study and anticipate a proposal from the NRC in early 2015. The review will start after the OIR Study finishes and will take 14 months with a report in 2016.

MEETING ADJOURNED AT 5:00 PM EST, 17 NOVEMBER 2014
MEETING RECONVENED AT 9:00 AM EST, 18 NOVEMBER 2014

There was discussion of the 2014 Annual Report and the Principles document. Jim Ulvestad mentioned to the group that the Principles document has caused AST to focus its thinking a little differently. When AST has been looking at partnerships for facilities that are being planned for divestment, these principles are being kept in the forefront of its thinking. With partnerships with other federal agencies, these Principles have been considered in discussions on such projects as the DES and DESI. Having the idea of these principles upfront has helped in crafting programs for the entire community.

Paula Szkody commented that the wider the community the more access to all kinds of fields that can use a particular instrument, the better science that can come out and the more acceptance by the community rather than one particular project. Jim Ulvestad commented in turn, that it comes down to the idea of highly focused research and broad availability; AST has the same issue in its mid-scale programs. There is some balance one strives for between focused investigations versus very broad investigations, focused facilities versus very broad facilities.

The Committee spent some time discussing an outline of the annual report that is due on March 15, 2015. Topics such as science highlights, status of Decadal Survey programs and recommendations, interagency

cooperation, budgets and budget impacts, demographics, and challenges and opportunities, will be incorporated into the report. Writing assignments were made to the Committee.

Suzanne Staggs received a note from several scientists including Lyman Page and David Spergel, recommending that the AAAC consider another CMB Task Force study; the first study by the Committee was done in 2004. The reason for this being that the CMB projects are in such a state that it might be time for a Generation-4 CMB experiment that could be supported by the three agencies. Figuring out the purpose of such a task force is important before the Committee commits any time to this activity. How the agencies could be involved needs to be addressed. Jim Ulvestad noted that he was not sure that he would want to see a Task Force operating at the same time as the mid-decade review. He suggested that this topic be put on the agenda for the January meeting and one of the authors of the letter be invited to talk with the Committee.

Angela Speck mentioned that the next total solar eclipse will occur in 2017. The path of the eclipse covers an area from Oregon to South Carolina. This is a very big event and an opportunity to exploit. It is an opportunity to engage people on all levels. She suggested that some mention of the preparations be included in the annual report.

The next face-to-face meeting of the AAAC is scheduled for January 28-29, 2015 at NSF. The Committee selected June 1, 2015 for the third meeting (teleconference) of 2015.

MEETING ADJOURNED AT 12:00 AM EST, 18 NOVEMBER 2014