Minutes of the Meeting of the
Astronomy and Astrophysics Advisory Committee
26-27 September 2019

Members Attending	Agency Personnel	Others
John O'Meara (Chair)	Ralph Gaume, NSF-AST	Robert Kennicutt, Univ. of Arizona
Ian Dell'Antonio	Jim Neff, NSF-AST	Dieter Hartmann, Clemson Univ.
Nancy Chanover	Edward Ajhar, NSF-AST	Grace Hu, OMB
Kyle Dawson	Richard Barvainis, NSF-AST	Yi Pei, OMB
Andrew Connelly	Elizabeth Pentecost, NSF-AST	Kelsie Krafton, AAS
Eliza Kempton	Renee Adonteng, NSF-AST	Adriana Bankston, UC FGR
Mansi Kasliwal	Allison Farrow, NSF-AST	James Lochner, USRA
Petrus Martens	Hans Krimm, NSF-AST	Stephen Unwin, JPL
Priya Natarajan	Joseph Pesce, NSF-AST	Grant Tremblay, CFA-SAO
Constance Rockosi	David Boboltz, NSF-AST	Kendra Short, JPL
Deirdre Shoemaker	Ed Ajhar, NSF--AST	Jeff Foust, *Space News*
	Jim Whitmore, NSF-PHY	Adria Schwarber, APS
	Jean Cottam Allen, NSF-PHY	Naomi Webber, Lewis-Burke
	Jim Thomas, NSF-PHY	Jerry Kriss, STScI
	Randy Phelps, NSF-OD/OIA	Nick Siegler, JPL
	Reba Bandyopadhyay, NSF-NSB	Stephen Clark, *Astronomy Now*
	Swati Sureka, NSF-MPS	Abigail Sheffer, NAS
	Jim Ulvestad, NSF-OD	Bethany Johns, APS
	Paul Hertz, NASA	Karl Stapelfeldt, JPL
	Hashima Hasan, NASA	Ashlee Wilkins, AAS
	Rita Sambruna, NASA	
	Michael Garcia, NASA	
	Martin Still, NASA	
	Kartik Sheth, NASA	
	Dominic Benford, NASA	
	Terri Brandt, NASA	
	Kathy Turner, DOE	
	Drew Baden, DOE	
	Eric Linder, DOE	
	Tricia Crumley, DOE	
	Helmut Marsiske, DOE	
	Glen Crawford, DOE	

MEETING CONVENED 9:00 PM, 26 SEPTEMBER 2019

The Chair and Jim Neff called the meeting to order.

The minutes from the June 3, 2019 meeting were approved by the Committee.

Jim Neff reviewed the rules, membership, and duties of the AAAC. The AAAC has some new members this term.

Agency Program Updates

NASA

Paul Hertz provided an update on NASA's Astrophysics Division activities.

A few highlights:

- A new study using data from NASA's Spitzer Space Telescope provides a rare glimpse of conditions on the surface of a rocky planet orbiting a star beyond the Sun. Discovered in 2018 by TESS, it orbits a small, cool type star called and M dwarf; it makes one full revolution around its parent start in just 11 hours. The star-facing side is about 1410°F and by measuring the temperature difference between the planet's hot and cold sides, the TESS team found that there is a negligible amount of hear being transferred between the two. The study shows that the planet's surface may resemble those of Earth's Moon or Mercury.
- A team of astronomers using NASA's Chandra X-ray Observatory and ESA's XMM-Newton found x-ray bursts repeating about every nine hours indicating the supermassive black hole located at the center of galaxy GSN 069 is consuming large amounts of material on a regular schedule. The combination of data from Chandra and XMM-Newton implies that the size and duration of the black hole's "meals" have decreased slightly, and the gap between the "meals" has increased. Future observations will be crucial to see if the trend continues.
- Astronomers used data from NASA's Hubble Space Telescope to find water vapor in the atmosphere of K2-18B, an exoplanet orbiting a small red dwarf about 110 light-years away in the constellation Leo. If confirmed, this will be the only exoplanet known to have both water in its atmosphere and temperatures that could sustain liquid water on a rocky surface. The planet, discovered by NASA's Kepler Space Telescope in 2015, also has a mass eight times greater than Earth. Using developed open source algorithms, the team analyzed the host star's light filtered through K2-18b's atmosphere which revealed the molecular signature of water vapor, and also suggested the presence of hydrogen and helium in the planet's atmosphere.
- The TESS project released its first observations of the original Kepler field on September 19, 2019. With hours, 29 members of the TESS/Kepler community created an open collaboration space to coordinate the analysis of the new data set. Early investigations have focused on recovering long-period Kepler planets, identifying long-term changes in planet orbits, and timing eclipsing binaries on the ~10-year baseline. One of the preliminary results is that Tabby's star does not appear to show significant dips in the 27-day TESS observations.

There have been staff changes in the Science Mission Directorate. Several key positions are vacant and in some of the divisions, senior management are in acting positions. In the Astrophysics Division, there are advertisements for a Deputy Division Director, an Associate Division Director for Flight Projects (will be managing WFIRST), and several program scientists and program executives. The Division will be calling for IPA applications in the Fall. NASA achieves excellence by relying on diverse teams, both internal and external to NASA, to most effectively perform NASA's work.

NASA's mission to return to the Moon involves the launch of several robotic and human spaceflight missions. Artemis 1 and 2 will be the first human spacecraft to the Moon (South Pole) in the 21st century. There will be commercial deliveries of science and technology payloads to the Moon with eventual large-scale cargo landers. Artemis 3 will be a crew mission to Gateway and the lunar surface. Under the Commercial Lunar Payload Services (CLPS), nine U.S. companies have been selected to bid on specific task orders to develop landers delivering NASA payloads to the Moon's surface; 12 science instrument payloads have been announced to be developed at NASA Centers with 12 additional instruments

announced to be developed by industry and academia. Two of the nine U.S. commercial space transportation services providers are currently under contract with NASA to deliver NASA payloads for the Artemis Program with 13 U.S. companies being selected for 19 partnerships to mature industry-developed space technologies.

Through its Strategic Plan, NASA Astrophysics is setting the stage for the Decadal Survey; NASA's highest aspiration for the Decadal is that it be ambitious. NASA is a mission-oriented agency, and science is the purpose and consequence of its space missions. NASA Astrophysics supports research and technology through its balloon projects, fellowship programs, technology development programs, astrophysics archives, etc.; through its operating missions such as TESS, XMM-Newton, Hubble, Chandra, Spitzer and SOFIA; and through missions in development and under study such as SPHEREx, Euclid, LISA, and WFIRST. There has been a 26% increase in R&A funding support since the last decadal survey with a projected 33% increase in R&A support over the next 6 years; a R&A selection rate of 21% and a GO selection rate of 26%. An additional $5.0 million was added to the budget to be used for CubeSats. The sounding rocket program has been successful with four launches this year.
There were updates from the astrophysics missions:

- Science payload and spacecraft integration for the James Webb Space Telescope (JWST) began in August, to be followed by test deployment of the sunshield. Testing of the full observatory began in 2019 and continues in 2020. The Webb cost overrun has been covered using offsets from the Astrophysics probes. The launch of JWST is still scheduled for 2021.
- The first of five Wide-Field Infrared Survey Telescope (WFIRST) preliminary design reviews (PDR) took place earlier this year for the instrument module. Throughout the rest of 2019, there will be a PDR for the telescope, the wide-field instruments, the coronagraph instrument, and then the mission itself. Following the mission PDR, there will be the confirmation review and the beginning of Phase C in early 2020.
- IXPE passed KDP-C. The Critical Design Review (CDR) was in June 2019.
- GUSTO passed KDP-C. CDR will was in July 2019.
- The XRISM mission passed PDR in Japan. The Resolve instrument is currently in integration and testing at Goddard Space Flight Center.
- For Euclid, 20 SCEs were delivered, which is about a year early. This will complete NASA's delivery of hardware for this mission.
- SPHEREx was down selected in February 2019. Launch is expected in 2023.

TESS completed its year survey of the southern sky on July 18. The spacecraft has now transitioned to scanning the northern sky for the next year. In its first year, TESS has found 21 confirmed planets, ~1,000 planet candidates for the project, 6 supernovae, 3 exocomets, and ~300 planet candidates for the science community.

SOFIA's 5-year prime mission will be completed at the end of 2019. Given that the program has finished 5 years of operations, NASA has conducted two reviews of the SOFIA project to make changes directed at increasing the science productivity of SOFIA in FY20 and beyond. HIRMES, the next SOFIA science instrument, continues development. The Senior Review reviewed eight operating missions—Hubble, Chandra, XMM-Newton, Gehrels Swift, Fermi, NuSTAR, ISS-NICER, and TESS. Spitzer, SOFIA, and Kepler were not in the Senior Review.

The FY2020 Presidential budget request for NASA Astrophysics accommodates the JWST replan to March 2021, terminates WFIRST and redirects remaining funding to complete JWST, supports formulation of a probe mission as early as 2022 conditional on Decadal Survey recommendations, maintains decadal cadence of four AOs per decade for Explorers and Missions of Opportunity, funds SOFIA for here years beyond prime mission, extend operating missions, and support mission concept

studies and technology investments. The House CJS Appropriations Subcommittee marked up the FY2020 budget request with an augmentation for WFIRST of $510.7 million. This is the amount of funding that is needed in FY2020 to keep WFIRST on track for a launch in 2025 or 2026. The Subcommittee also augmented the funding request for SOFIA to $85.2 million, $12.2 million above what was requested. If the House budget markup were to be adopted, there would be no impact of these augmentations on the rest of the Astrophysics Division in FY2020.

In preparation for the Decadal Survey, NASA Astrophysics commissioned several studies of Medium Mission concepts, i.e. Probes. The Probes are strategic missions that have had a strong impact on astrophysics, either through a focused investigation or as a broadly-capable observatory. Submission of final reports with NASA findings and options are expected to be sent the Astro2020 committee in September. The Large Mission Concepts are the flagship missions that drive the science and contribute to US leadership. The final reports for the Large Mission Concepts were completed in August and an independent assessment of the reports was completed in September; NASA plans to submit a letter to Astro2020 in October.

John O'Meara asked is there is an opportunity for NASA to play a more significant role in the European-led LISA mission. Paul Hertz replied that Astrophysics has laid out a plan in the out year budgets for how much NASA will be spending, and if the Decadal Survey were to suggest that Astrophysics spend part of the Decadal Survey wedge on a larger investment in LISA than doing more US-led missions of any kind, then NASA will discuss with ESA whether they would like for NASA to have a larger share in the mission. At this point in time the major reason why the ESA discussions have not taken place is because NASA has set itself a planning budget of about $400 million for its investment in LISA.

As a follow-up, Priya Natarajan noted that the Europeans have suggested a more enthusiastic response from the US would be good for the Athena mission. Paul Hertz replied that in this case also, NASA has a plan for the future which it can afford, and NASA is waiting the Decadal Survey report on whether NASA will consider changing that plan.

Andrew Connolly asked Paul Hertz to speak to the House and Senate markups for WFIRST and how that translate into a launch date for WFIRST. Paul Hertz replied that the House numbers ($510 million) had only come out yesterday, and NASA has not executed "a what-if" budget against the House number; the Senate number is $445 million. If NASA were to get the House markup number, the nominal launch date would be end of 2025 or early 2026 (planning launch date; commitment launch date would be a year later). If NASA were to get the lower number and taking into account that FY20 is a critical funding year for WFIRST, the launch date would be much later and would cost more.

Paul Hertz indicated that NASA is adopting dual anonymous reviews for all its GO programs, and piloting them for other R&A programs, following successful demonstration by STScI for Hubble GO program. Priya Natarajan congratulated NASA on doing this which will hopefully improve the quality of the proposals.

DOE

Kathy Turner provided an update on DOE's activities.

A few highlights:

- The Dark Energy Survey (DES) completed its observations on January 9, 2019. Many cosmology results have been released because of DES, including the combined analysis of DES-Y3 supernovae (SNe), DES-Y1 photometric baryonic acoustic oscillation (BAO), and DES-Y1 weak lensing + galaxy clustering (3x2pt) detected Dark Energy at 4σ from the DES alone. Also,

discovery of 316 Trans-Neptunian objects and 1st measurement of H0 from a binary black hole collision

- The High-Altitude Water Cherenkov (HAWC) Experiment started in early 2015. Testing the Lorenz Invariance with the Highest Energy gamma rays at HAWC have led to many results.
- The Axion Dark-Matter eXperiment Generation 2 (ADMX-G2) experiment uses strong magnetic field and resonant cavity to convert dark matter axions into detectable microwave photos. Operations were approved to cover the 0.5-2 GHz range. Run 1A (2017) and Run 1B (2019) both reached "invisible" axion (DFSZ model) sensitivity. Run 1C is in the commissioning stage and the Run2 cavities are under development.
- For LSST, the LSSTcam project is in the fabrication phase. Deliverables will be completed in February 2021. The sensors have been delivered and assembled. The science rafts and have been integrated into the cryostat. The refrigeration system and vacuum system have been tested successfully.
- For DESI, the deliverables will be finished in February 2020. Installation is in progress and commissioning starts in October with the full dark energy survey operations starting in FY2020. Recently, all 10 petals with 5000 fiber-fed robotic positioners have been installed in the barrel and 6 of the 10 spectrographs have been installed. DESI will measure the distance scale from BAO and measure the Hubble Parameter to 1.05% at $1.9 < z < 3.7$ from BAO.
- Other projects in the fabrication phase include LZ and SuperCDMS-SNOLab. Commissioning for LZ starts in October 2019 with full science operations in August 2020. Installation for SuperCDMS-SNOLab starts in 2019-2020 with planning and pre-ops activities ongoing now and full science operations in FY2021.

The DOE Office of High Energy Physics (HEP) fulfills its mission by building projects that enable discovery science, operate facilities that provide the capability for discoveries, and support a research program that produces discovery science. HEP receives advice from several advisory committees including the High Energy Physics Advisory Panel (HEPAP), which is jointly chartered by DOE and NSF to advise both agencies and subpanels such as Particle Physics Project Prioritization Panel (P5). For example, the P5 produces a strategy report that HEP plans to implement. The P5 strategy report continues to define investments in the future of the fields of dark matter direct detection, dark energy, and CMB. HEP community support of this process is a critical element of its success.

NASA, NSF, and DOE worked together to deliver a statement of task to the National Academy of Sciences for Astro2020. Guidance from Astro2020 will inform HEP on high impact science directions and research strategies for the Cosmic Frontier and help DOE HEP researchers play a significant role in and make unique and significant contributions to HEP directed science.

The FY2019 enacted HEP budget was $980 million. For FY2020, the Presidential budget request is $768 million to support a balanced program of world-leading research, facilities, and projects like Quantum Information Science (QIS), Artificial Intelligence-Machine Learning research, etc., and continuation of CMB-S4 research and development. The House committee marked up $6.87 billion for DOE's Office of Science—$1.32 billion above the FY2020 Presidential budget request—and HEP's portion of the House Committee budget is $1.045 billion with $814 million for HEP's core programs and $231 million will go towards HEP's construction line items. There is also specific language by the House committee that strongly urges HEP to maintain a balanced portfolio of small, medium, and large-scale experiments, and to ensure adequate funding for research performed at universities and national laboratories.

The Cosmic Frontier Experimental Research Program studies the nature of dark energy, searches for particles that make up dark matter, support CMB experiments, and explore the unknown including through cosmic rays and gamma rays. Within the Office of Science, this program has strong interactions

with offices such as Theory, Detector R&D, Computational HEP, and QIS. DOE also continues to have strong interagency coordination with the NSF by holding two full-day meetings a year to discuss topics related to the Cosmic Frontier. DOE has regular oversight group meetings for LSST and other projects with NSF. DOE currently does not have ongoing programs with NASA, but DOE will meet and coordinate with NASA as needed. There are interagency coordination efforts between DOE, NSF, and NASA for LSST, Euclid, and WFIRST.

DOE, NSF, and NASA partner with DOE on several projects including the Dark Energy Survey (DES), the fabrication of the LSST camera, DESI, and eBOSS. The search for dark matter is done through direct detection experiments over a wide mass range that include LZ, SuperCDMS-SNOLab, and ADMX-G2. The study of cosmic acceleration at energies near the Planck scale and neutrino properties through the Cosmic Microwave Background (CMB) will be done with new generations of the South Pole experiment and next generation CMB.

DOE is participating in the SPT-3G experiment for the Cosmic Microwave Background. DOE is also participating in the CMB Stage 4 (CMB-S4) experiment. This is the last remaining P5 implementation project to start. Coordination planning will be with HEP and NSF-AST/OPP/PHY. The CMB-S4 collaboration is progressing. There is continuing work on science, design, and project development and the collaboration is focusing on submission(s) to the Decadal Survey. Preparations for the project are also in progress. The interagency (NSF-DOE) coordination group meets bi-weekly to share information, monitor, and review the progress.

HEP's research budget supports scientists in all phases of an experiment. The research supports efforts directly in line with program and project priorities such as dark matter, dark energy, and CMB. There are various funding opportunities for workforce development including graduate student programs, visiting faculty programs, undergraduate internships, student exchange programs, traineeship in accelerator science and engineering, and early career research.

Kyle Dawson asked what is available in the Theory area that could justify funding beyond CMB-S4 and what can the high-energy groups do to plan beyond Stage 4. Kathy Turner replied that if there are theoretical ideas they can always be proposed to the theory panel which is competed; she was unaware of the number of PIs doing theory work on CMB-S4.

John O'Meara noted that the Committee could discuss in more detail in tomorrow's session the possible of follow-on to the Dark Energy Task Force to look at new developments.

NSF

Ralph Gaume provided an update on NSF's Division of Astronomical Science (AST) activities.

There have been a few personnel changes. Ralph Gaume has been recently named the AST Division Director. Jim Neff is the Acting Deputy Division Director (Acting DDD) and a job search for a new DDD is moving forward. There are now 3 IPAs in the Individual Investigator Program (IIP) and there will be two new IPAs arriving in December. The Division has concluded the search for a new program officer for facilities, but no name has been announced yet.

A few highlights:

- EHT was awarded the 2020 Breakthrough Prize for Fundamental Physics
- An international team of astronomers co-led by UCLA professor Andrea Ghez used observations of the Galactic Center star S0-2 to test the general theory of relativity that predicts that a star passing close to a supermassive black hole should exhibit a relativistic redshift. They combined

existing spectroscopic and astrometric measurements from 1995-2007, which covers S0-2's 16-year orbit, with measurements from March to September 2018, which cover three events during S0-2's closest approach to the black hole (SagA). They detected a combination of special relativistic and gravitational redshift, quantified using the redshift parameter Y. Their prediction is consistent with general relativity and excludes a Newtonian model with a statistical significance of 5σ. The two-decade study confirmed Einstein's predictions.

- The Gemini-N telescope captured the multi-color image of the first-ever interstellar comet. The object, denoted C/2019 Q4 was obtained on the night of 9-10 September using GMOS on the Gemini North telescope on Maunakea. The image was possible because of Gemini's ability to rapidly adjust observations and observe objects like the comet, which have very short windows of visibility. The image showed a very pronounced tall, indicative of outgassing which is what defines a cometary object; this is the first time an interstellar visitor to our Solar System has clearly shown a tail due to outgassing. C/2019 Q4 was discovered by Russian amateur astronomer Gennady Borisov on 30 August 2019.

An overview of NSF's response to the AAAC Annual Report.

- AAAC recommended that all current and planned surveys supported by NSF, NASA, and DOE should publicly release their data with suitable access tools and documentation. The DKIST and LSST projects are expending considerable effort to produce user-accessable databases. With FY2018 funds, AST provided a supplement to NSO for community- developed data access tools for DKIST spectropolarimetry. The recently revised data model for LSST will allow more partner resources to be devoted to data access tools. AST has provided continuing support to assure that the Dark Energy Survey data are accessible. NRAO will be supporting access to the Very Large Array All-Sky Survey and the NOAO Datalab is hosting a considerable collection of ground-based surveys, including the SDSS.
- AAAC recommended that the three agencies coordinate on the guidelines and expectations for the public releases of data sets, data products, data access tools, and related software used to produce future surveys, astrophysical simulations, and missions. The protocols for data structures and middleware developed and employed by the Virtual Astronomical Observatory are in broad use by the Agencies for astronomical data; LSST is a prime example.
- AAAC recommended that NSF develop a policy to support the archiving and distribution of data sets generated by large and mid-scale observatories beyond the lifetime of the individual experiments. NSF will need to provide a careful examination of long-term curation/migration costs for a data holding like the LSST archive and to give creative thought to any long-term charge in the context of Federal regulation defining a FFRDC as a having a 5-year lifetime, renewable on successful review of mission.
- AAAC urged NSF and DOE to put in place a long-term operations plan that will, while maintaining a balanced overall portfolio, ensure that the US science community can capitalize on the substantial investment in LSST. While NSF cannot discuss the specifics of any proposal under review, it can make some general comments regarding the agency's goals regarding LSST operations. Recent actions taken by the agencies in planning for LSST operations are intended to stabilize operations funding throughout the project, to leverage federal investment in LSST, and to expand resources available to the US astronomical community that will increase the scientific productivity of LSST.
- AAAC recommended that the three agencies either broaden the current discussions or create parallel discussions to consider broadly the costs and benefits of coordination on the science areas of interest to both the Euclid and LSST communities. The Tri-Agency Working Group is prepared to receive the results of the NASA-funded study on the scientific gains from joint pixel-level processing of LSST, Euclid, and WFIRST data.

- AAAC recommended that given the interest in access to the spectrum, NASA and NSF should enhance their collaboration with each other and with other groups, including international agencies and commercial interests, to protect the accessibility of essential astronomical wavelengths to researchers. NSF fully agrees with the assessment that enhanced collaboration between science agencies, as well as collaboration with other public, private, and international entities, is vital to maintaining crucial access to the radio spectrum for scientific purposes, and is actively pursuing such collaboration. Increasing awareness of spectrum management issues is a very critical recommendation. NSF has begun this effort, speaking, for example at the "Radio/Millimeter Astrophysical Frontiers in the Next Decade" conference in June of 2019. NSF has also advocated that spectrum needs be considered as part of the Decadal survey, a technical requirement which will raise awareness among the community. NSF will work to continue and enhance the effort to increase awareness of spectrum management issues among astronomers. To raise awareness among government agencies, NSF has been accepting every speaking opportunity, for example presenting at the annual DOE Spectrum Interagency Collaboration Meeting and regularly attending meetings of NTIA, where issues of concern to the scientific community are raised.
- AAAC recommended that NSF/AST continue to grow and develop the MSIP program in the context of a balanced portfolio. NSF/AST agrees that the value of and demand for the kinds of projects funded through MSIP justify continued growth of that funding opportunity. Rich Barvainis, the MSIP Program Officer, provides active oversight of awarded projects, with detailed annual progress reporting and site visits. Not all MSIP projects offer public access to facilities and data, but review panels do value that offer in their considerations, and AST oversight is exerted to assure that such promises are kept.
- AAAC recommended that NSF/AST ensure that the astronomical community is aware of the MSRI opportunities and in particular the range of infrastructure projects that can be supported by this program. NSF/AST will highlight those MSRI opportunities in expanded communications to the community, particularly when the deadlines for those solicitations are approaching.
- AAAC recommended that the NSF facility divestment process be completed and that the agencies work to ensure that individual investigators are funded, in order to capitalize on and leverage the full capabilities of the new facilities and large projects that represent such important and substantial investments by the agencies. With the signing of the Record of Decision for the Environmental Impact Study and the granting of the 5-year renewal of the operations award to AUI for the Green Bank Observatory, the process of divestment/transition of facilities has been completed. The total annual savings is estimated to be ~$35.5M, including non-facilities programs. The FY 2019 execution plan has ~61% for facilities operations and maintenance (O&M), with the rest toward various investigator-led programs, including MSIP. The balance in future years will depend in part on how NSF responds to the NSB report on facilities O&M costs for next-generation facilities.
- AAAC recommended that efforts by AURA, and NCOA to implement the recommendations of the OIR System Report should be supported by NSF as long as they can be accommodated while maintaining a balanced investment across the portfolio of NSF/AST. The OIR System (Elmegreen) Report presented a number of worthwhile system development recommendations. Many of them were oriented toward efficient integration of observing assets into a system for time-domain observation, discussed below in the context of the GBS subcommittee recommendation. NOAO-NCOA has traditionally catalyzed community planning, most recently for white paper submission to the Decadal Survey. Response to their recommendations for new observing capabilities, such as Southern Hemisphere multi-object spectroscopy or investment in US-supported ELTs will await the findings of the Decadal Survey. NSF/AST accepts the recommendation for continuing healthy investment in technology development, particularly appropriate to ATI.

- AAAC recommended that NSF should work towards implementing the recommendations of the GBS subcommittee, particularly those that affect the impact of the GBS system over the next ~5 years, before the Decadal Survey recommendations take precedence. A major thrust of the Gemini-Blanco-SOAR subcommittee recommendations was efficient coordination for time domain observations aiming toward LSST follow-up. That was the primary scientific rationale for consolidating nighttime OIR operations of the NSF-supported observatories into NCOA. Examples include the current NOAO Datalab development of event brokers and LSST data analysis tools. The major supplement to Gemini in 2018/2019 included development of observatory control protocols to accommodate automated target of opportunity scheduling and event- driven observations.

The FY2019 execution plan for NSF/AST is $389.13 million (including $64.95 million for MREFC). In the FY2020 President's budget there is a 13% budget decrease for research and related activities (R&RA) from the FY2019 budget, while the House budget markup is a 9% increase from last year. The House budget bill included specific language about producing a "comprehensive and prioritized list of large-scale facilities requested by NSF-supported science disciplines," and included a mandate to fund all NSF facilities operations at FY2019 levels.

In FY2019, the Individual Investigator Programs (IIP) had a budget of $55.8 million with a success rate of about 23.7%; AST is headed in the right direction from previous year; AST benefited from the forward funding of the IIP in FY2018. The Division does not limit the number of proposal a PI can submit; AST has not had a huge number of multiple PI proposals in the past.

The major 35-day FY2019 shutdown presented a challenge for NSF in maintaining the flow of funds to facilities awardees; ultimately none of the AST facilities had to curtail operations. As a lesson learned, NSF will maintain 3 months of funding in each facility account to mitigate against an extended interruption in funding. Some of the facilities had carry-over funds that were available for the awardees to draw down on; there was an additional $16 million of FY 2019 forward funding from the Foundation for the facilities so that they would have 3 months of funding in their accounts.

AST has completed the transition activities espoused in the 2012 Portfolio Review. A university-led consortium is operating the KPNO 2.1-meter telescope. DOE is providing operations funding for the Mayall 4-meter telescope on Kitt Peak and NASA is providing funding for the NN EXPLORE program on the WIYN 3.5-meter also on Kitt Peak. Green Bank Observatory was separated from NRAO in 2017 and a new cooperative agreement was signed with new partners in place. USNO provides half of the funding for the VLBA; VLBA has been reintegrated into NRAO. McMath-Pierce on Kitt Peak is being repurposed as a science outreach center. NOAA provides operations funding for GONG and SOLIS is being moved to Big Bear Observatory. A consortium led by New Mexico State University is operating Sacramento Peak Observatory with NSO providing site support. Arecibo Observatory has a new awardee, University of Central Florida, as of April 2018 and has received hurricane repair funding from Congress which has been awarded to UCF. An AAAC subcommittee recommended continuing support for SOAR and AST plans to continue that support. All of the NEPA and NHPA requirements have been completed with the final Record of Decision for Green Bank Observatory issued in July 2019.

NSF's National Center for Optical-Infrared Astronomy (now renamed NSF's National Optical-infrared Astronomy Research Laboratory) integrates the NSF-funded OIR ground based centers, National Optical Astronomy Observatory, Gemini Observatory, and Large Synoptic Survey Telescope (LSST) operations, under a single organizational framework, managed by one management organization as an FFRDC; they will be merged both administratively and scientifically. The NCOA (now NOARL) launch is scheduled

for October 1, 2019; there will be joint NSF/AURA press release to mark the event. LSST construction is not part of NCOA.

AST's two construction projects are moving forward. For DKIST, the telescope optics are in place and both the M1 and M2 mirrors have been aligned on the telescope. Current challenges largely are with the instrument completion and delivery as well as the data policy; the commissioning of the expansive and challenging thermal control loops are also a significant task. But, DKIST is still on schedule for full operations in June 2020 and within budget. For LSST, progress is moving forward with enclosing the Dome, despite delays, and starting assembly of the telescope mount in October; the TMA was delivered to the summit in early September.

Planning is well underway for input to the next Decadal Survey. NSF and NASA are the primary sponsors of the survey, and DOE is also a sponsor. NSF is including all ground-based astrophysics (i.e., gravitational wave detection and Astro-particle detection) for scientific consideration and is not limited to only to AST's programs. AST is supporting development of three major projects, two through activities in national centers, and one through a continuing series of grants; OPP/PHY support a fourth. AST is not planning to explicitly support preparation of mid-scale proposals for Decadal submission via the normal solicitation route but may support this through the AST MSIP solicitation.

Ralph presented a chart showing past, present, and future MREFC projects. FY19 includes those projects that have already been appropriate such as DKIST, LSST, and RCRV (Regional Class Research Vessels). AIMS (Antarctic Infrastructure Modernization for Science), LHC, LCC (Leadership Class Computing) and LSST are included in the FY2020 PBR. Future mid-scale projects would increase through the 2030s along with what is being called Horizon projects (~$2.275 billion integrated over the period of 2023-2030); this would be the ambitious account profile which he asked the Decadal committee to look at.

John O'Meara noted that at one of the previous AAAC meetings, the Committee heard presentations on ngVLA, US ELT, CMB S-4, and IceCube. Do they fit into within the Horizon wedge? Ralph Gaume replied that not all of them fit within the Horizon wedge and profile. Depending on how they rank with the Decadal Survey and if they were to be funded, additional funding would need to be appropriated; all of the Horizon wedge may not be all Astronomy-related projects. Astronomy does share a large part of that Horizon wedge.

Over the years there has been a tension between building major facilities and then trying to operate them later. At present, the divisions are totally responsible for operating the facilities after they have been built, and for a facility-heavy division like Astronomy, the only place to get those funds is to use funds from the grants program; the decrease in the grants programs is partially due to the increase in operating the facilities. It is no longer Astronomy who is experiencing this problem, other divisions who have major facilities are experiencing the same problem of operating these facilities. In May 2018, NSB issued a study on the O&M costs for NSF facilities. The report recommended that both the NSB and the NSF Director should continue to enhance agency-level ownership of the facility portfolio through processes that elevate strategic and budgetary decision-making, it should create a scientifically robust Foundation-wide strategy that is both transparent and fiscally responsible, planning horizons should be longer than the current 5-year projections; the Department of Energy's Office of Science has found success using a 10-year planning model. Even though the NSB did not believe that it was necessary to establish a central O&M account at this time, they thought greater flexibility in use of the MREFC account would enhance visibility and agency-level ownership. NSF is currently working on a solution on how divisions will pay for operations of new facilities.

John O'Meara asked whether the monies saved by the divestment activities was enough to help with the increased costs for operating the facilities. Ralph Gaume replied that it was not enough. The total

savings from the Transition was ~$35.5 million (partly realignment of several programs and actual divestment) and that is not enough to fund DKIST operations and LSST operations; DKIST operations is ~$20 million/year and LSST is estimated to be $30 million/year (NSF share) in full operations.

LSST Update

Edward Ajhar provided an update on LSST activities.

The LSST facility is scheduled to begin its full 10-year survey operations in October 2022. Ramp-up to pre-operations activity began in FY2019. The survey will encompass tens of billions of objects in space and time. The agile 8.4-meter telescope has a wide 3.5 degree field-of-view and a 3.2 gigapixel camera. Every few nights, LSST will image the entire available night sky, over 10 years, opening a unique window to the systematic study of variable objects, transients, and any explosive events throughout the Universe. By tracking moving objects, LSST will discover 10 to 100 times more small bodies throughout our Solar System than are currently known and derive their orbits. More than 15 terabytes of data will be processed every night. LSST's science program covers broad science themes such as structure and stellar content of the Milky way, evolution of galaxies, the nature of dark energy and dark matter, and the variable universe.

The DOE-sponsored Camera has made tremendous progress and is moving forward to a delivery date in 2021. The refrigeration system is undergoing commissioning and the L1-L2 lens (largest in the world) assembly has been delivered to SLAC. The commissioning camera is in Tucson being tested. Nine science rafts and 4 corner rafts have been installed in the camera and are being tested.

Progress on the LSST site has progressed. The coating facility on the LSST site has been completed and the M2 was silver-coated in July; the M1M3 testing was completed at the University of Arizona and the mirror was shipped to Chile and is now on the LSST site. The M2 cart with the mirror cell and surrogate mirror are undergoing commissioning on site. The Auxiliary Telescope is under computer control and is being commissioned. The La Serena base facility is complete and staff are moving into the facility. There is a large EPO component to LSST; work is progressing well and the project are working with students and teachers to introduce them to LSST; LSST had its first Spanish-language user testing at a summer school in Chile and interactive web sites are being tested. Progress is being made on the Dome despite technical delays. The Telescope Mount Assembly was shipped from Spain and arrived in Chile in early September; it has been delivered to the summit and installation will begin in October/November.

In 2012, NSF and DOE signed an MOU for the LSST project, including operations, with NSF as the lead agency but it is defined as a joint project by both agencies; the MOU formally established the Joint Oversight Group (JOG). All LSST issues and problems are managed by the JOG, not by either agency independently; the JOG is the starting point for changes and questions. The JOG meets weekly and asks project leaders to join when appropriate. The JOG has started meeting twice weekly, separately for construction and operations planning.

A new operations funding model has been developed for LSST. Originally, the funding model was split, 50% NSF, 25% DOE, and 25% other funding from international partners (LSSTC would handle these contributions). The new operations funding model has NSF and DOE funding operations (without descopes) and only in-kind (rather than monetary) contributions from international participants for access to LSST proprietary data. NSF and DOE will consider and approve in-kind contributions of appropriate value to the community which could offset operations funding. NSF and DOE will form an International Resource Board to review yearly budgets and monitor international contributions.

Kyle Dawson asked whether these changes in the operations funding model were driven by the international community or something else. Ed Ajhar replied that in trying to see what the plan was for operations, there were not enough contributors; had about half of the people preliminarily signed up to do this and the agencies had to find a way to account for the operations funding shortage. The agencies were also looking at ways for LSST operations and by providing in-kind contributions, the project gets people around the world sharing resources which is a powerful way for the community to work together. Both were a big part of the driving force for the change. Now the agencies can concentrate in having funding available on day one and not have to worry about descoping options. Ralph Gaume commented that any large award has to be approved by the National Science Board and this funding stability would be crucial in getting NSB approval.

A Data Rights Policy has been written and is being reviewed by both Agencies. The LSST data types and access are not new; transient event alerts are streamed publicly with alerts going out within one minute, prompt data products are provided daily and calibrated catalogues are released annually. Open public access is provided for transient alerts, proprietary access (2-years) for data products and catalogues for US and Chilean scientists as well as approved international participants, and open public access for the catalogues after the 2-year proprietary period. The Data Rights Policy should be finalized within the next few months; the AAAC could possibly see it at their January meeting.

As much as possible will be made available once the proprietary period has expired. Nigel Sharp indicated that the pixels will be made available upon request; the plan is to not just go to the web site and download the pixels but would require a request for them. The project is being cautious because they are required to deliver a certain amount of scope over a period of time.

Operations planning is ongoing. NSF and DOE are working with AURA and SLAC to work out details of a revised distribution of NSF and DOE scope and budgets. Operations plans and budgets are being revised for resubmission and review in 2020. The awardee is working with the agencies to develop details of processes to obtain, evaluate, consider and approve in-kind contribution proposals from international participants.

Decadal Survey Progress Update

Robert Kennicutt (Astro2020 co-chair along with Fiona Harrison) provided an update on Decadal Survey activities. A notional timeline for Astro2020 has the Survey being released in 2021 with numerous science and program panels in between; there will also be an external cost review starting in late 2019. The scope for the Survey will include ground and space-based observations, theory, computation, lab astrophysics, ground-based solar astronomy, gravitational-wave observations, multi-messenger astronomy and astrophysics, exoplanets, and the implementation and scope of WFIRST, Athena, and LISA. The plan is to review the current state of astronomy and astrophysics, identify compelling science challenges for the future, develop a research strategy to advance scientific frontiers in the next decade, develop a set of decision rules for robust programs, and assess the state of the profession.

The Survey committee has been appointed, with members from academia, science organizations such as SPIE and STScI, and industry. Panels have been formed and will deliberate in late 2019. Approximately 150 individuals are serving on Astro2020 panels including the main committee. The report writing will begin in Spring 2020 with the report released in late 2020. The deadline for science white papers is March 11 to accommodate those affected by the government shutdown. There is very strong community interest and the Survey expects hundreds of papers to be submitted. It is important that the plan for the science be laid out in the white papers.

White papers are the primary method of community input and drive what the survey considers. There were ~590 science whitepapers submitted which have all been read and discussed by the science panels. Over 300 papers on the both activities and projects and the State of the Profession were received in July; over 250 are relevant for the program panels and over 70 address State of the Profession. All of the papers can be reviewed at https://sites.nationalacademies.org/DEPS/Astro2020/DEPS_192906.

New for Astro2020 are panels, Panel on Enabling Foundation for Research, which includes topics such as laboratory astrophysics, theory, computation, simulation, data collection, archiving, and analysis, and general technology development. The other panel, State of the Profession and Its Societal Impacts, will gather information on the health and demographics of the astronomy and astrophysics community and make actional recommendations to the Astro2020 committee on the topics of demographics, diversity and inclusion, workplace climate, workforce development, education, public outreach, benefits to the nation, and relevant areas of astronomy and public policy.

Many of the Science panels have already met face-to-face and the Program panels are slated to start meetings in October. The Science panels will provide scientific priorities that will be used to assess proposed missions, facilities, and projects, and develop an overall research strategy. The Program panels will assess proposed projects and activities against science priorities and technical readiness, risk, cost and forward priority activities for ranking by the steering committee; will recommend projects for TRACE (formerly known as CATE) analysis and use those results in their assessment.

John O'Meara noted that according to the timeline the TRACE activities would be completed after the program writeups were done. Rob Kennicutt indicated that there has been a change in that part of the timeline; there is an effort to tie the TRACE results to the third meeting of the Program panels so they will have the information before their last meeting. He asked a further question about budgets for these potential projects that might be evaluated in Survey report. Will the Steering Committee look a specific budgets or will they take a certain range of budget numbers for the various projects? Will there be flexibility in growing the budgets? Rob Kennicutt replied for example that Paul Hertz in his presentation to the Steering Committee, provided some up-ramps with various rates of growth; the usual pessimistic scenario is flat funding. Ralph Gaume plans to show some slides on the NSF budget profile that he presented to the Steering Committee in tomorrow's session; this might answer O'Meara's question about budgets at least for NSF.

NSF Big Ideas: MSRI

Richard Barvainis provided an update on the Mid-Scale activities that include MSIP and MSRI 1&2. The mid-scale projects are defined as projects with costs between MRI (Major Research Instrumentation) and MREFC, ~$6-70 million; these projects tackle major scientific questions but are nimble enough to be built and operated on a few years' timescale rather than decades like the MREFC projects. These projects offer student and postdoctoral training in instrumentation and facility development largely unavailable in other programs. There has been considerable demand for these types of programs within the scientific community and up until this year, there was no NSF-wide process for handling this category of project; AST, however, has funded mid-scale projects for decades. In 2018, the National Science Board recommended an agency-level commitment to mid-scale.

AST has had a long tradition of supporting grants, facilities, and mid-scale programs. Over the past decades, these have included both solicited and unsolicited projects like the University Radio Observatories (URO), the Telescope Systems Instrumentation Program (TSIP), the Renewing Small Telescopes (ReSTAR) program, Veritas, Dark Energy Survey (DES), Hobby-Eberly Telescope Dark energy experiment (HETDEX), PAPER, Virtual Astronomical Observatory (VSO), Atacama Cosmology Telescope (ACT), and PolarBear. In 2010, these mid-scale programs peaked with a total of about $34

million; other years were more typically $20-25 million. Astro2010 recommended a competed mid-scale program as did the 2012 AST Portfolio Review.

Currently, there are two competed mid-scale programs relevant to astronomy, the Mid-Scale Innovations Program (MSIP) and Mid-Scale Research Infrastructure (MSRI) 1&2. MSIP is AST only and is offered in alternate years (solicitation is out for FY 2020 funding), proposals range from $4-30 million, total budgets are typically $35 million for each 2-year cycle, and 4-5 proposals are awarded. To date, 22 awards have been made to the MSIP program and 21 are currently active. The AST Program Officer takes an active role in oversight (site visits, project reports) of each of these programs. For MSRI 1&2, these are NSF-wide, have award funding in two ranges ($6-20 million for MSRI-1 and $20-70 million for MSRI-2), and first proposals funded in FY 19-20. Ten proposals were funded under MSRI-1 NSF-wide with funding from divisions in some; the MSRI-2 proposals are under review.

John O'Meara asked about the distribution of funded proposals; is the breakdown available and can the Committee see the frequency of the larger dollar proposals and the smaller dollar proposals? Rich Barvainis showed a slide with the distribution. Andrew Connolly asked how different was the request from the funded amount? Barvainis indicated that there was not much difference between the two. NSF made extensive use of ad hoc reviewers for the MSRI full proposals; pre-proposals were reviewed internally. The proposals need to show a plan for operations but actual operations funding is not financed by NSF.

Mansi Kasliwal asked about the cadence for the next set of proposals. Rich Barvainis replied it is NSF's intention to have a solicitation for MSRI every other year.

John O'Meara asked if there was interest at the Foundation level to expand public/private partnerships to fund these projects. Rich Barvainis replied that one could partner with private foundations, universities, and other organizations to fund a part of the project while NSF funds the other.

NSF Big Ideas: Windows on the Universe

Jim Thomas provided gave a presentation on the Windows on the Universe, one of NSF's Big Ideas. The goal of this program is to build the capabilities and accelerate the synergy and interoperability of three messengers (electromagnetic waves, high-energy particles, gravitational waves) to realize integrated multi-messenger astrophysical explorations of the universe. Multi-messenger astrophysics is a global enterprise. Observatories and facilities around the world from NSF-funded facilities, to space-based observatories, to international partnerships, all work together to produce the best science.

2017 was a good year for WoU-MMA observations. IceCube observed neutrinos from a Blazar (special kind of quasar with a relativistic jet pointing along the line of sight and emitting neutrinos which are undeflected on their path to the earth); Fermi and other telescopes saw light from the same source. The LIGO/VIRGO facilities observed a binary neutron star merger; space-based telescopes saw gamma radiation 1.7 second after the merger signal, ad ground-based observatories saw visible light 11 hours later.

In 2018, the WoU-MMA Program Description was posted to the NSF web site. The program welcomed proposals in any of the areas that were supported through the participating divisions (AST, PHY, OPP) including support of the scientific community to build the observational and analysis capabilities in each of the three window areas, construction of experiments and instrumentation or creation of cyberinfrastructure that would make critical contributions to the multi-messenger research infrastructure, and support enhanced infrastructure and modest upgrades that would enable the full utilization of current multi-messenger facilities and planning and development for the next generation of observatories and

facilities. In FY 2019, $30 million was set aside to make awards; 66 awards, ~ 2/3 for individual investigators and 1/3 split between facilities and instrumentation. Examples include support for 19 institutions to do the scientific analysis of data taken with IceCube; analysis of neutrino detector data to provide a prompt alert for an impending supernovas, hours before it will be visible in the sky; community planning for scalable cyberinfrastructure to support MMA; and hardware upgrades to enhance an existing telescope to improve the capability for detection of prompt electromagnetic counterparts to gravitational wave events out to 200Mpc.

John O'Meara asked about the process by which a proposal is recognized as a Windows proposal, since it is probably of interest to the community. Jim Thomas replied that the principal investigator and the program officer specify if it is a Windows proposal; there is no Windows-specific call for proposals.

Constance Rockosi asked if the criteria and implementation for this effort are posted so that future proposers will know what exactly NSF is looking for in the proposals. Jim Thomas replied that all of the information he presented is on a public web site.

OMB Budget Process

Grace Hu, OMB Examiner for NASA Science and Yi Pei, OMB Examiner for NSF, provided some insight into the budget process and how both agencies respond to OMB requests. OMB is part of the Executive Office of the President and oversees the President's priorities across the Executive Branch. OMB has two roles, to lead the development of the President's budget request to Congress every year. This is a many months' process that starts in late Spring and Summer when OMB will issue budget guidance to the agencies on how to formulate the next fiscal year's budget. In early summer OMB and OSTP will issue an R&D priorities memo to the agencies outlining the science and technology priorities of the Administration. Agencies submit their budget requests to OMB in September and then OMB will evaluate through the budget submissions how agencies have addressed those priorities; this is done through talking with the agencies directly, engaging with external stakeholders and through external reports from the agencies, i.e., Decadals, Academies reports, etc. Sometimes OMB will target specific programs, add funding to specific programs because they support Administration priorities. The role as Examiners is to provide recommendations to OMB leadership. All of the Executive Branch agencies are informed in the November timeframe on their budget requests (called Passback); sometimes OMB will reverse or revise their decisions; the budget request that is submitted to Congress in February is usually a result of the conversations between OMB and the agencies. After the President's budget is passed, then OMB is involved in approving the agencies' operating plans.

OMB works with the agencies to track their performance and provide oversight to agency programs. Grace Hu, for example, has regular tag ups with NASA on JWST and Mars2020 to monitor the progress of these large dollar missions to make sure they are on schedule and on budget.

The OMB examiners see the Decadal Surveys as providing a single well-respected source for the science community's priorities; these are put into the budget process but are not the only input. OMB looks at the Administration's priorities as well as cross-cutting goals, and problems that need to be addressed, how missions and programs are phased in the out years.

Nancy Chanover asked how decisions are made to add or delete funding for programs, how are the decisions made and who is consulted in that process. Grace Hu replied that for example, she will get a briefing from NASA division directors in the Science Mission Directorate in September on how their programs stack up against the Decadal Survey recommendations but there are no huge large- scale changes being made. OMB makes sure that NASA has a budget that supports, for example, the priority of going to the Moon so there is a process in place to make sure that happens; also making sure that

performing programs are funded; the Management side of OMB does inform the Budget side of OMB. There are also discussions with other parts of the White House to let them weigh in on the budget process; the OMB process is a way to bring all of these things together.

John O'Meara asked how, for example, the decision to zero out WFIRST from the PBR happened since it was the number one recommendation of the last Decadal Survey. He appreciated the discussion on the back and forth of programs on the "margin," but this is a zeroing out of a program.; how is a decision like this made. Grace indicated that OMB is operating under different assumptions than the Decadal Survey Committee that wrote the report. For example, OMB didn't know that the time that there would be a cost overrun for JWST and the cost had to be accounted for some way; also, the fact the mission was now larger than originally envisioned and costed. The assumptions are different now and how do you make the best with the monies that are available is the way forward; how do you get a balanced portfolio with the dollars you have. Grace noted that it is not an easy call to make.

Both Grace and Yi spoke with the current Decadal Survey committee and encouraged them to look at various budget scenarios as opposed to looking at only the most optimistic scenarios. OMB is not just looking at the lowest cost option but is looking at the best value to the taxpayer. Yi commented that she told the Committee to look at both the astronomy facilities and the grants to make sure there is a portfolio balance between the two; the community, Congress, and the White House are concerned about this issue. How to achieve that balance is by utilizing the expertise that is in the community and doing the analysis between costing grants and costing facilities.

Other Discussions

John O'Meara led a discussion on several topics:

- AAAC preparations for the Decadal Survey
  - Andrew Connolly – are there computation resources that need to be put in place to support projects that are being or will be considered in the Decadal? O'Meara noted that there were at least 2 white papers written on this topic. He indicated that he would not be surprised that this was not considered in light of LSST and future facilities. If it is not addressed right now by the Committee, the AAAC can wait until the report comes out; if it is addressed, then the AAAC can respond because they are now making recommendations on how data is accessed and now extending it to how it is processed. Doing processing in "the Cloud" is probably going to be addressed. Connolly noted that how individual investigators analyze data in the Cloud is different from what they do today and how scientists transition into that era will need some more discussion. Kathy Turner commented that DOE projects all have a computing plan for their projects. Ralph Gaume noted that one of NSF's Big Ideas is *Harnessing the Data Revolution* and it is looking at this along with AST programs that have an element of this in the grants program; *Windows on the Universe* utilize the existing programs that are already in place. Jim Neff commented that there are several working groups that are discussing this topic; there is also flexibility in the current funding model in the AAG program and an expanding AAG program could handle more activity but it may not be able to handle a fast change in scale which is discussed above the division level. AST is increasing the funding in this area. Nancy Chanover commented that there should be cross-agency discussions on this topic of data access, data transferability, etc.

- *Principles and Best Practices for Large Projects*

  - John O'Meara noted that the AAAC has the document with a set of suggestions but is it current and is it enough? Having projects provide the code for the data is an additional

task that the agencies and individual investigators have to do and fund. Mansi Kasliwal commented that making a distinction between large and small projects would be a good idea because some investigators may not be able to provide the data products that are requested because of the time and money involved. Connie Rockosi commented that another way to think about this is whether the goal of the project is to produce a data set and if it is, whether that data set needs to include the software that created the data set. Martin Still indicated that at least with NASA, the agency is interested in the long-term maintenance of archives; there should be some coordination among the agencies on this.

The next meeting of the AAAC is scheduled for January 23-24, 2020; this will be an in-person meeting. Some of the topics for discussion include the annual report (due March 15), an update on Spectrum Management (extend discussion to questions around optical/IR), budget updates, NCOA update, vice-chair chose, etc. The meeting to get an update on the FY21 President's Budget Request and work on the annual report is scheduled for February 26.

MEETING ADJOURNED AT 12:00 PM, 27 SEPTEMBER 2019