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NSF 15-044

Dear Colleague Letter: Status of MPS/AST Response to Recommendations of *New Worlds, New Horizons* Decadal Survey

March 4, 2015

Dear Colleague:

In August 2010, the National Research Council (NRC) released the most recent in its series of decadal surveys in Astronomy and Astrophysics, entitled “*New Worlds, New Horizons in Astronomy and Astrophysics* (hereafter referred to as *NWNH*). The National Science Foundation (NSF) Division of Astronomical Sciences (AST), part of the Directorate for Mathematical and Physical Sciences (MPS), congratulates the U.S. astronomy community on its accomplishments in the 4.5 years since release of *NWNH*. These accomplishments were supported strongly by federal, state, and private agencies, in spite of funding challenges that were more significant than those envisioned in *NWNH*.

The budget for AST has remained stagnant, rather than increasing at the rate of 4 percent per year in purchasing power (plus inflation) assumed in *NWNH*. The Fiscal Year (FY) 2015 budget estimate for AST is \$244.16 million, compared to an actual value of \$246.53 million in FY 2010. Thus it has not been feasible to implement positive responses to all *NWNH* recommendations. In this context, as recommended in *NWNH*, AST undertook a comprehensive community-based review of its research portfolio in 2011-2012, under the auspices of the Advisory Committee for MPS. The progress of the response to the report of the Portfolio Review Committee is a critical element of the AST response to *NWNH*.

In the coming year, NSF and its partner federal agencies, the National Aeronautics and Space Administration (NASA) and the Department of Energy (DOE), are asking the NRC to produce a mid-decadal report on the agencies’ progress in responding to the *NWNH* recommendations. In anticipation of the start of the NRC study, this letter is an update to the science community on the status of the AST response to *NWNH*.

1. GROUND PROJECTS IN RANK ORDER

Large Synoptic Survey Telescope (LSST). A construction award for the NSF-funded portion of LSST was made to the Association of Universities for Research in Astronomy, Inc., in August 2014. This award followed successful executions of a Preliminary Design Review in 2011 and a Final Design Review in 2013. Concurrently, DOE has been conducting its Critical Decision process for the LSST camera, and the two agencies coordinate schedules and funding through a Joint Oversight Group that has met regularly since the end of 2010. On the current schedule, the 10-year LSST survey will begin in 2022.

Mid-Scale Innovations Program (MSIP). The first MSIP solicitation was issued in FY 2013, for funds to be awarded in FY 2014 and FY 2015. Through those two years, a total of \$27 million in AST funding was made available, together with several million dollars of non-AST NSF funding. Because of limited funds,

MSIP was modified somewhat from the *NWNH* recommendation, and incorporated “open-access” capabilities such as those previously supported within the University Radio Observatories (URO) program and the Telescope Systems Instrumentation Program (TSIP). AST received 38 MSIP pre- proposals requesting \$398 million. The initial value (FY 2014 and FY 2015) of ~\$14 million in annual funding for MSIP is considerably lower than the annual funding level of \$40 million suggested by *NWNH*.

Giant Segmented Mirror Telescope (GSMT). *NWNH* recommended “that a choice between the [Thirty Meter Telescope and Giant Magellan Telescope] be made as soon as possible for a federal partnership at a level of about a 25 percent investment in one of them.” Given the financial outlook, AST instead issued a solicitation for partnership planning for a GSMT to enable community involvement in the event that NSF were able to invest at a later date. Following proposal review, an award of \$250,000 per year for five years was made to the Thirty Meter Telescope (TMT) Observatory Corporation for planning activities, resulting in both NSF and community participation in the TMT Collaborative Board and the TMT Science Advisory Committee. At this point, NSF has made no commitment to any construction contribution for a GSMT.

Atmospheric Cherenkov Telescope Array (ACTA). *NWNH* recommended a U.S. investment of \$100 million, roughly one-quarter of the total cost of the European-led Cherenkov Telescope Array (CTA). This was envisioned as a joint investment of DOE, the NSF Division of Physics (PHY), and AST, and thus would require ~\$33 million from AST, not including operating costs. In May 2014, the Particle Physics Project Prioritization Panel of the High Energy Physics Advisory Panel recommended that DOE and PHY “[i]nvest in CTA as part of the small projects portfolio if the critical NSF Astronomy funding can be obtained.” The AST budget is not sufficient to support a strategic investment in CTA, so CTA would have to compete under the MSIP solicitation; a successful proposal would need to explain the status and availability of the other federal resources needed to complete the U.S. portion of the project and to operate the facility. AST anticipates issuing its next MSIP solicitation in FY 2015 for funding that could begin in FY 2016, although the exact content of that solicitation has not yet been determined.

2. GROUND PROJECTS – MEDIUM

NWNH recommended an AST investment in the construction and operations of CCAT, previously known as the Cornell-Caltech Atacama Telescope and the Cerro Chajnantor Atacama Telescope. The recommended investment was approximately \$37 million of a projected \$140 million construction cost, plus a \$7.5 million annual share of the CCAT operations costs. Subsequently, NSF invested \$4.75 million in the final design and development of CCAT, an effort which is concluding in 2015. In view of the inability to make the recommended large commitment out of a heavily constrained budget, AST is unable to support CCAT as a strategic investment, and would be able to fund CCAT only through the competitive MSIP proposal process.

3. GROUND PROJECTS – SMALL

Small projects were not prioritized relative to one another by *NWNH*, and are listed in the order they were given in Table ES.1 of *NWNH*. In general, each of these recommendations was for a specific budget augmentation, and it has not been possible to initiate or sustain most such augmentations in the present funding environment.

Augmentation (\$5M/yr additional) to Advanced Technologies and Instrumentation (ATI) Program. The recommendation could not be supported because the flat/declining budget for AST and ongoing commitments to facility operations limited the availability of funding. AST maintained ATI at \$10.5 million/yr through 2012, then reduced the ATI funding in order to gather sufficient funds for MSIP. The FY 2014 AST expenditure on ATI was \$7.5 million.

Augmentation (\$8M/yr additional) to Astronomy and Astrophysics Research Grants (AAG)

Program. This augmentation also could not be supported because of the flat/declining AST budget and the commitments to facility operations. *NWNH* cited a baseline of \$46 million/yr for AAG when recommending the \$8 million increase. AST successfully increased the AAG budget to \$49.4 million in FY 2011, but this budget has since decreased gradually to \$43.7 million in FY 2014.

Augmentation (\$2M/yr additional) to the Gemini international partnership. Exact language from *NWNH* (p. 236) was “An augmentation of \$2 million to the annual budget is recommended subject to the results of NSF’s exploring a restructuring of the management and operations of Gemini and acquiring an increased share of the observing time.” After the departure of the United Kingdom from the Gemini partnership, the remaining partners agreed that the Gemini Observatory could be restructured to conduct operations more efficiently with a relatively small scientific impact. Thus, without an extra infusion of funds, the U.S. share of Gemini observing time has been increased from 50% to approximately 65%, compared to the increase from 50% to about 55% that would have been achieved simply by a \$2 million augmentation.

Augmentation (\$2.5M/yr additional) to the Telescope System Instrumentation Program (TSIP). This augmentation was not possible. Open-access programs such as TSIP and the University Radio Observatories were incorporated into the MSIP solicitation, as recommended by the AST Portfolio Review (itself a recommendation of *NWNH*). This provides a competitive opportunity for more funds over a longer period if a highly meritorious proposal is received.

Theory and Computation Networks, \$2.5M/yr from NSF. The Theoretical and Computational Astrophysics Networks (TCAN) program initiated by NSF and NASA was a direct response to this recommendation; NSF allocated \$1.5 million annually for the first round of three-year proposals, which were awarded late in FY 2013. NSF and NASA intend to evaluate the success of TCAN in FY 2016 in order to determine whether the program is meeting *NWNH* goals and should be continued.

4. OTHER NSF RECOMMENDATIONS

A number of additional recommendations were made to the NSF in Chapter 2 of *NWNH*. This Section summarizes the NSF responses to these items, with page references given for the complete *NWNH* recommendations.

Decadal Survey Implementation Advisory Committee=DSIAC (p. 15). Many of the functions of the DSIAC have been assigned to the NRC Committee on Astronomy and Astrophysics (CAA) (http://sites.nationalacademies.org/BPA/BPA_048755), a standing committee funded by the federal agencies, but with membership determined independent of the agencies. There is no mechanism to charge such a committee to report annually to branches of government, as suggested in *NWNH*. We note that independent committees outside of the federal advisory structure typically advise federal agencies on science strategy and priorities rather than on implementation. The agencies are in the process of commissioning a mid-decadal review via the CAA.

International Collaboration and Open Access (pp. 27-28). This recommendation related to maximizing scientific input via open access and various means of participation in international projects. The Astronomy and Astrophysics Advisory Committee has recommended new “Principles for Access to Large Federally Funded Astrophysics Projects and Facilities,” which may be found at <http://www.nsf.gov/mps/ast/aaac.jsp>. AST is using those principles as guidelines in all discussions of ongoing and future collaborative efforts.

International Science Community Forum (p. 28). This recommended forum for future large projects has not been organized by AST. Given the current funding levels, and the pressure on individual investigator programs, it is not an appropriate strategy for AST to commit to additional large international astronomical projects at this time.

Data Handling and Data Curation (p. 31). *NWNH* made two recommendations on this topic. The LSST project includes significant and substantial planning for all aspects of data management, including data access. NSF-funded national astronomy facilities host long-term data archives that are expected to be available for as long as those facilities are in operation. NSF also takes very seriously the recommendations on data availability in the “Principles for Access” document mentioned above, and is using them for new projects.

Lab Astrophysics (p. 32). *NWNH* recommended continuation of support at or above previous levels. AST has established a practice of consolidating laboratory astrophysics proposals into a small number of individual panels within AAG, facilitating merit review that will identify the best lab astrophysics proposals.

Senior Review (p. 32). As recommended, AST conducted a Senior Review (called a “Portfolio Review”) before mid-decade, in the 2011-2012 time period. That Portfolio Review is discussed in more detail in Section 5 of this Letter.

Restructure Gemini, consider consolidation of NOAO and Gemini (p. 33). Restructuring Gemini and acquiring an increased observing share were discussed as part of the recommendations for Small Ground Projects. The managing organization for the National Optical Astronomy Observatory (NOAO) and Gemini has consolidated administrative services to increase efficiency. AST has appointed the NOAO Director as a member of the Gemini Board and recruited NOAO staff scientists to serve on the Gemini Science and Technical Advisory Committee; in addition, proposals in the new Gemini Large/Long-term programs opportunity are being handled through the NOAO Time Allocation Committee process. Scientific synergies among NOAO, Gemini, and LSST are being discussed by the NRC Committee on “A Strategy to Optimize the U.S. Optical and Infrared System in the Era of the Large Synoptic Survey Telescope (LSST).” A report from that committee is expected by May 2015.

Ground-based solar astronomy program (p. 34). The *NWNH* recommendation related to determining the best route to a balanced program with multidisciplinary ties and developing long-term funding models. AST is actively involved in federal planning of space weather capabilities, including the impact of the fundamental research from the Daniel K. Inouye Solar Telescope (DKIST) on the understanding of the source of space weather. The NSF budget request for FY 2016 includes a one-time augmentation for the Global Oscillations Network Group (GONG) in order to make its infrastructure more sustainable for space weather predictions. The NSF budget requests for FY 2015 and FY 2016 also included the first two increments of operations funding for DKIST, so that it can transition to a robust plan for long-term operations. Further, the headquarters of the National Solar Observatory is being moved to Boulder, Colorado. The resulting co-location with the solar and heliophysics programs of the University of Colorado and the National Center for Atmospheric Research is expected to lead to increased multidisciplinary ties.

New Worlds Technology Development Program (p. 20). *NWNH* recommended that “NASA and NSF should support an aggressive program of ground-based high-precision radial velocity surveys of nearby stars to identify potential candidates” for “a future space imaging and spectroscopy mission.” The recommended program will be carried out using the recently initiated NN-EXPLORE Exoplanet Research Program utilizing the WIYN (formerly Wisconsin-Indiana-Yale-NOAO) 3.5-meter telescope. A NASA call for an Extreme Precision Doppler Spectrometer to be built for WIYN was released in January 2015.

5. AST PORTFOLIO REVIEW

NWNH (p. 32) recommended that “NSF-Astronomy should complete its next senior review before the mid-decade independent review that is recommended elsewhere in this report, so as to determine which,

if any, facilities NSF-AST should cease to support in order to release funds for (1) the construction and ongoing operation of new telescopes and instruments and (2) the science analysis needed to capitalize on the results from existing and future facilities.”

In order to satisfy this recommendation, AST needed a community-based assessment of the relative importance of all its facilities and grants programs. Thus the review commissioned in 2011-2012 looked at the entire AST portfolio, and not just the facilities. The report of the Portfolio Review Committee may be found on the AST web site (http://www.nsf.gov/mps/ast/ast_portfolio_review.jsp).

In late 2013, AST published a Dear Colleague Letter (14-022) regarding the portfolio divestment options that were then under consideration, and the notional timeline for those considerations. For a variety of reasons, activities have not moved at the pace predicted in 14-022. In order to support a methodical approach to divestment decision-making, NSF has contracted to produce divestment feasibility reports that will provide the results of baseline structural and environmental surveys of a number of individual telescopes and observatories, as well as cost estimates for implementation of a range of potential scenarios. These studies will constitute part of NSF’s internal deliberative process, and will not be made public. Once NSF has identified truly viable options for divestment, it will embark on environmental reviews (2015-2016) for decommissioning options for telescopes that do not yet have firm partnership options, or to evaluate partnership options that could have impacts to the environment. With this approach, the schedule is 9-12 months behind what was originally anticipated. Below, we provide a capsule summary of current divestment activities and notional timescales for the telescopes that the Portfolio Review Committee recommended for divestment consideration. (To avoid any unintended implication of priority, the observatories are listed in alphabetical order.)

ARECIBO OBSERVATORY

- The Portfolio Review report recommended assessing the status of Arecibo following the completion of its current cooperative agreement in September 2016. However, in view of the long timescale required to execute a renewal or competition process, that assessment process must begin much sooner than the end of the cooperative agreement. Thus, the engineering study and environmental baseline survey for Arecibo has begun, with a report to the NSF expected in the first half of 2015.

NATIONAL OPTICAL ASTRONOMY OBSERVATORY (NOAO)

- The 2.1-meter telescope on Kitt Peak is no longer being operated by NOAO; community proposals for taking over its operations currently are under evaluation.
- The Mayall 4-meter telescope on Kitt Peak has been identified as the preferred platform for the Dark Energy Spectroscopic Instrument (DESI), to be funded primarily by DOE. The Mayall has been removed from the NOAO base budget after FY 2015, but AST has committed to two succeeding years of bridge funding to enable the telescope to remain operational for DESI. Details are under discussion between NSF and DOE.
- The NOAO share of the WIYN 3.5-meter telescope on Kitt Peak has been selected as the future avenue for a joint NSF-NASA exoplanet research program, NN-EXPLORE, discussed above in the context of the *NWNH* recommendations. As for the Mayall telescope, the AST contribution to WIYN has been removed from the NOAO base budget after FY 2015 and will be funded as a special project.
- The Portfolio Review report recommended assessing the future of the Southern Astrophysical Research (SOAR) Telescope following the end of the current consortium agreement in 2018. AST is awaiting the recommendations of the NRC committee on the U.S. Optical and Infrared System before making any further plans.

NATIONAL RADIO ASTRONOMY OBSERVATORY (NRAO)

- The Robert C. Byrd Green Bank Telescope (GBT) was partitioned from the competition for the management of NRAO. Partnership discussions with university groups and other entities are ongoing. An engineering feasibility study and environmental baseline survey of various divestment options for the Green Bank Observatory is under way, and NSF expects a report in the first half of 2015. Once viable options are identified, NSF will initiate any necessary environmental reviews to follow.
- The Very Long Baseline Array (VLBA) was also partitioned from the competition for the management of NRAO. Partnership discussions are ongoing. An engineering feasibility study and environmental baseline survey for the VLBA began in early 2015 and will be completed by approximately mid-year, with any necessary environmental reviews to follow.

NATIONAL SOLAR OBSERVATORY (NSO)

- The Dunn Solar Telescope, the key instrument at the Sacramento Peak Observatory, was recommended for divestment approximately two years before DKIST becomes operational. Discussions with potential university partners are ongoing. Baseline engineering and environmental review studies for the Sacramento Peak Observatory are being carried out during 2015. Once viable divestment options are identified, NSF will work with the land owner (U.S. Forest Service) on any permitting and environmental review requirements.
- The McMath-Pierce Solar Telescope is being transitioned to near-term operations by a university-based consortium, with some initial assistance from AST. An engineering study and environmental baseline survey of the McMath-Pierce is taking place during 2015.
- The Portfolio Review Committee recommended that the NSO Integrated Synoptic Program be reduced to half of the current AST costs, or to roughly \$2 million annually. The Synoptic Optical Long-term Investigations of the Sun (SOLIS) telescope has been removed from Kitt Peak for refurbishing, and most likely will be housed at a different site in the future. The President's FY 2016 budget request includes funding within NSF for refurbishment of GONG for robust space weather operations, as well as funding within the National Oceanic and Atmospheric Administration to support GONG operations.

6. CONCLUSION

The funding for the National Science Foundation since 2010, including that for the Division of Astronomical Sciences, has not been sufficient to satisfy all community aspirations. Although the *NWNH* report included the results of very difficult choices, still more challenging decisions have been required. We are very pleased to report that those decisions have enabled a construction start for LSST, initiation of the MSIP line, and increased input from NOAO to Gemini on behalf of the U.S. community. Considering recommendations from past decadal surveys, we have seen the Atacama Large Millimeter/submillimeter Array (ALMA) come into operation, while construction on the Daniel K. Inoué Solar Telescope (DKIST) continues apace. The necessity to transition some NSF telescopes away from full open access has been cushioned by strong collaborations developed with other federal agencies, specifically NASA and DOE, which will enable those telescopes to remain scientifically productive with new missions. Together with our agency partners, we are in the process of commissioning a mid-decadal review of progress on *NWNH*, which we expect to be concluded during 2016. In cooperation with the U.S. scientific community, we look forward to new opportunities in the remainder of this decade and beyond.

Sincerely,

James S. Ulvestad
Division Director, MPS/AST