



National Science Foundation
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Dear Colleagues,

The success and momentum of research in astronomy has presented us with an exciting, but challenging and expensive, future. In order to make progress towards that future in a time of constrained budget growth, we convened the Senior Review and charged them with examining the balance within our program and recommending places where we could free up funds to invest in new activities.

Since the report of the Senior Review committee was released in November 2006, the Astronomy Division (AST), the observatories and their management, and the community have been active in considering the impact of the recommendations, looking at implementation plans, and exploring partnerships that would build on the strengths of our observing system to expand its capabilities beyond the period considered by the Senior Review. In this letter we would like to update you on this progress and tell you about our future plans.

As promised, we held a series of town meetings across the country after the release of the report. Starting with the American Astronomical Society (AAS) meeting in Seattle in January 2007 and ending with a meeting in Tucson in April, we held a total of 7 town halls, and together heard from many hundreds of community members both at these meetings and through email and letters. We found widespread support for the process of the Senior Review, appreciation of the quality and thoughtfulness of the committee's report, and understanding and acceptance of its basic recommendations and findings, as difficult as those might be and with recognition of the serious impact they would have on some members of our community. Of course, not everyone was happy with specific recommendations, but there was general acceptance that such prioritization was necessary and the overall conclusions of the report were valid.

Our FY 2007 appropriation and FY 2008 Budget Request are very good news, providing healthy increases to the Division's budget. Your research accomplishments speak eloquently to the enduring opportunities in astronomy on an almost daily basis and continue to fascinate the general public. Certainly the community is highly regarded within NSF, at the Office of Science and Technology Policy and the Office of Management and Budget and in Congress for its willingness to undertake the Senior Review. However, the bottom line remains that even under the most optimistic budget projection, and all historical experience tells us that we should be more cautious, the premise of the Senior Review remains valid and we will need to find savings from existing programs to build for the future. As a result, we have proceeded to act on each of the recommendations, while gathering the necessary additional information that will inform our later decisions.

Let me describe for each facility, the actions that we and the managing organizations have taken, the budget implications and the immediate plans for the future.

- **National Astronomy and Ionosphere Center (NAIC)/Arecibo** – Cornell acted quickly to implement the first of the Senior Review's recommendations to reduce the base operating budget to \$8M over the next three years, by modifying the operating mode for astronomy observations, increasing the fraction of time for survey work, and limiting the number of receivers supported and the number of hours for astronomy observations. They also eliminated 30 FTEs, or 25% of their staff. Not all of these savings are realizable immediately, since personnel termination costs must be covered and the observatory requires basic maintenance to ensure safety of operations. By FY 2010, the full \$2.5 million savings identified by the Senior Review will be recovered into the AST base budget and available for other uses.

Cornell has said that it will cease operations of the planetary radar in October 2007 to meet these budget reductions. We have recently learned that, in fact, they are maintaining the capability to operate the planetary radar, although on a less frequent schedule. In conversations with NASA management, it has

been made clear that NASA has no intention of resuming support of the planetary radar, which they terminated in FY 2006.

With NSF's encouragement and support, Cornell and Arecibo staff are actively pursuing partnerships with the Puerto Rican government, local businesses, and academic institutions to provide additional operations support by 2011. We recently visited Puerto Rico, held a town hall for the Arecibo community, and met with commonwealth officials, business leaders, representatives from the universities and concerned citizens. We clarified the Senior Review recommendations and NSF's role in supporting the observatory and helped foster discussions among the many parties interested in maintaining the observatory as a viable operating facility for scientific research, education, and public outreach. The meetings were very positive with many expressions of a desire to work together to identify creative solutions to obtaining additional support. Many challenges face Cornell in preparing a plan for sustained long-term support from non-AST sources. I am optimistic that such a plan can be put together. NSF has informed Cornell that a concrete plan for operations in 2011 and beyond must be in place by spring of 2009. It is at that point that NSF must set the FY 2011 budget and so make a decision about the long-term future of Arecibo.

Nonetheless, in order to plan responsibly, and weigh the various options, we have to understand the cost of closure to be weighed against other options. As recommended by the Senior Review, NSF is also engaging an engineering firm to carry out a study of the cost of decommissioning the observatory facility. The study will explore a variety of possible endpoints, ranging from complete deconstruction and restoration of the site to its natural state to securely 'mothballing' the facility. The results of this study will be available in December 2007 and will serve as critical input to our planning for the long-term future of the observatory. This is part of responsible lifecycle costing, and should not be regarded as indicating that any final decisions have been made.

- **National Radio Astronomy Observatory (NRAO)** – The primary recommendation of the Senior Review concerning NRAO was the reduction in support for Very Long Baseline Array (VLBA) beginning in FY 2011, with the option of closure should additional sources of support not be forthcoming. NRAO has been very active in pursuing possible partnerships to contribute to the operations support of the VLBA and although no formal agreements have yet been made, signs are very positive that funding sufficient to keep the VLBA operating will be found. Again, no decisions will be made until the spring of 2009 when FY 2011 budgets are established. I am optimistic that a way will be found to keep VLBA running with reduced cost to NSF.

NRAO and the Atacama Large Millimeter Array (ALMA) project have developed an operating budget profile for ALMA, which is under review by NSF and the ALMA partnership. AST recognizes ALMA as the highest priority among the NRAO facility portfolio, and is working with Associated Universities, Inc (AUI)/NRAO to accommodate a steeply rising ALMA operations ramp within a balanced overall AST budget. This budget must provide support to the other parts of the base program for NRAO as defined by the Senior Review, the Green Bank Telescope (now hitting its scientific stride) and Expanded Very Large Array (just three years from completion), as well as all of the other AST-supported activities. The challenge for all of us is to obtain the right balance.

- **National Optical Astronomy Observatory (NOAO)** - The report's recommendations for NOAO addressed complex questions of balance and priorities among the Observatory's programs. The Senior Review called for an integrated program of increased access to telescopes of a wide range of apertures, justified on the basis of scientific merit, and a more moderately paced and coherent long term plan involving private and international partners towards a Giant Segmented Mirror Telescope (GSMT). NOAO and Associated Universities for Research in Astronomy (AURA) have responded with significant changes in internal programming and level of effort.

The first priority is to assure the healthy observing system recommended by the Senior Review, beginning now and leading into the GSMT era. This system will incorporate an appropriate balance of aperture and instrumentation supported by public and private resources.

As part of the charge to assure a healthy observing system, and to address the recommendation for access to 'an optimized suite of high performance telescopes of all apertures,' NOAO has sponsored a community group, led by Katy Pilachowski, known as ReSTAR (Renewing Small Telescopes for Astronomical Research) to assess and quantify the science-driven need for capabilities met by telescopes with apertures less than 6 meters. The committee has solicited input widely from the community; their report is expected in late 2007. The report will serve as the basis for evaluating the need for new investment or for developing partnerships with private observatories for general access to desired capabilities.

In the meantime, NOAO has developed a plan for refurbishment and modernization of the facilities at Kitt Peak and Cerro Tololo, and work at the national observatories is already underway. AST's FY 2008 budget request includes a modest (\$2.3M) increase for this purpose. Users of NOAO facilities should be seeing the changes soon.

As a result of the Senior Review recommendations, NSF asked that NOAO assume a leadership role in a phased and multi-faceted national GSMT program. In this role, NOAO assumes a position somewhat like a NASA center in a large space mission, organizing and representing community input and participation, effectively acting as our agent in managing the overall program and serving as the national presence in any eventual partnership operating the GSMT. NOAO has expanded the GSMT Science Working Group (SWG) and is charging the SWG with the assembly of a community-based Design Reference Mission in order to characterize the community-wide science requirements, including telescope performance, instrumentation, observing modes, data handling and pipelines, etc. This will assure that all aspects of the GSMT are well understood going into the next Decade Survey.

In order to lead the effort to realize a public-private partnership for the GSMT without any perceived or real conflict of interest, AURA/NOAO has withdrawn as a partner from both the Thirty Meter Telescope and Giant Magellan Telescope design efforts. NSF continues to fund the technology development program for GSMT through AURA/NOAO; funds are distributed to the two projects equally. (I note, as did the Senior Review report, that more than \$50M of federal money has already been spent in support of GSMT technology development, through work carried out at NOAO, adaptive optics and laser development, and individual university grants, a sum comparable to that invested by the private sector.)

The description of this new role for NOAO can be found at:

http://www.aura-astronomy.org/nv/Steps_Towards_a_National_GSMT_Program_Final.pdf

- **National Solar Observatory (NSO)** – The Senior Review called for the divestiture of the Global Oscillations Network Group (GONG++) operations one year after the launch of NASA's Solar Dynamics Observatory, which is currently scheduled for early 2009. NSO is in active discussion with other possible partners for support of GONG++ after this period.

The Senior Review also predicated its recommendations on the assumption that ATST would be realized. The Advanced Technology Solar Telescope (ATST) project is well positioned to move into construction and has passed NSF requirements for preliminary design and cost reviews. The process for gaining approval to move ATST into a future NSF budget request is proceeding well through internal NSF channels. In the meantime, AST is continuing to support the ATST team through increments to the base NSO budget in FY 2008.

The Senior Review also recommended moving rapidly, once approval of ATST construction was obtained, on the consolidation of NSO sites and closure of existing facilities. We recognize that the timing of these activities with progress on ATST is critical, and are working with NSO to ensure that the current research and training opportunities continue to be available to the solar physics community through this transition period.

Cost Reviews – The Senior Review recommended that NSF carry out cost and management reviews of all the facilities in an effort to identify possible cost savings in the administration and operations of the observatories.

Working with the observatory management jointly across all our facilities, we have defined an extensive set of common cost centers and as of late June, all the observatories had provided a complete set of budgetary data for review. At the suggestion of the observatory management themselves, we are seeking an external firm to provide us with an independent review of the observatories using these cost data as a basis. Although doing so will take longer than were we to carry out the review ourselves, we consider the delay to be worthwhile to ensure that we have the most thorough review possible by those with a broad range of expertise in administration and management.

Future Prospects

Even though we are immersed in the details of implementation of the recommendations, or, rather, because we are immersed in those details, it is important to remember that the object of the Senior Review was to help realize the exciting future that the Decadal Survey and other studies have put in front of us. I wanted to give you a look into this future. It will not be as specific as I would like because we are in the middle of preparation of the FY 2009 budget, so many details are embargoed and will remain so until early February.

I hope you have seen the complimentary language in the House Appropriations language that reads, in part: "The Committee commends the NSF for including funds in the fiscal year 2008 request to begin implementing the recommendations of the 'Senior Review' of NSF astronomy facilities." The overall approval of the effort that the community put into the Senior Review is reflected in our FY 2008 Request and, I hope, will result in an appropriation of this amount. Provided that this occurs, we look forward to a considerably enhanced program in 2008:

- A healthy increase in our Astronomy and Astrophysics grants program of about 10%, responding to the Senior Review's first recommendation;
- The initiation of a new program, Partnerships in Astronomy and Astrophysics Research and Education (PAARE, NSF 07-561);
- A program to assist the entry of young investigators at several levels into instrumentation careers (stay tuned for the announcement in FY 2008);
- Increases in the Advanced Technologies and Instrumentation program (by 30%), the Telescope System Instrumentation Program (TSIP) (by 25%), and support for the University Radio Observatories, all aspects of the Senior Review's base program;
- An increase of \$2.3M to NOAO to start revitalization of the optical/IR telescope system (see above);
- An increase of \$2M for NRAO sufficient to meet the ALMA early operations ramp;
- Funding for technology development programs for GSMT (continued at \$5M/year), the Square Kilometer Array (at \$3M/year) and adaptive optics.

Once again, whether we can continue or expand these development programs for future facilities and the balance we must strike between ensuring healthy grants programs and existing facilities depends on the details of budgets for FY 2009 and future years and the recommendations of the upcoming Decadal Survey. In making these trades we will continue to consider the priorities and findings of the Senior Review report and work with the community to determine how best to utilize what budget growth we have.

Summary

We are well along the road to implementing many of the recommendations of the Senior Review. As a result of the responsible action and hard work of our facilities managers we are now able to start planning for the wedge of funding that begins to open in FY 2010. At this time also, the next Decadal Survey will provide us with projects and priorities that reflect another decade of progress in our field. We note that both AUI (under Dick McCray) and AURA (under Juri Toomre) have convened groups to begin to organize input into the Decade Survey.

The Senior Review has been a long and trying path from realizing the need, through formulating and then carrying out the process, and now dealing with the implementation. It has been recognized as a responsible and necessary community-based exercise in facilities stewardship. Most importantly, we have identified and can now strengthen our base program and be well poised to move into an exciting future.

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