Input to the NSF/AST Portfolio Review from an NOAO Community Forum

As the anticipated NSF/AST budget for the coming years is much less than forecast for the 2010 Decadal Survey, the US astronomy community must make difficult choices in planning for its future. In order to enable community discussion on this topic, NOAO created a website for open discussion. Diverse members of the astronomical community, at all career stages, wrote in to express their views. This submission gives an overview of the major themes that emerged.

What We Heard

Many people stressed the importance of NOAO facilities and programs to their research and education programs and the science that is at stake if NOAO facilities are closed. Others addressed funding priorities more generally, describing the need for a balanced, cost-efficient set of facilities that are the engines of discovery and enable a robust individual investigator program. NOAO facilities are described as highly relevant to the science of the coming decade, with their excellent cost-efficiency making them an attractive way to deliver needed capabilities within the budgetary constraints.

The community strongly endorsed the NSF goal of enabling broad participation, a goal that finds strong synergy with the open access policy of NOAO. Broad participation is described as critical in driving scientific discovery and in maintaining the health of the astronomical profession. Changes to the NSF portfolio that reduce broad participation are seen as highly detrimental to the status of the profession.

These themes are described in greater detail below with excerpts from the comments we received. A complete record of the discussion is available at http://ast.noao.edu/node/168

Discovery in astronomy: "There are many more astronomy puzzles than astronomers" and therefore astronomy is "rapidly expanded by small teams or individuals working on many interdependent problems simultaneously." The NOAO 4-m telescopes are "powerful engines of discovery." They "provide an excellent test-bed for riskier ideas that need more proof of concept before [being tested] with larger ground-based or space-based telescopes, and in this way provide an excellent avenue for pure discovery and scientific exploration."

Broad participation and the health of the profession: NOAO serves a broad community. In 2011 NOAO allocated 1000 nights to more than a thousand scientists (PIs and CoIs) on the NSF-funded 2-m to 4-m telescopes at CTIO and KPNO. NOAO open access resources are the "lifeblood for astronomical research at a wide array of US universities," enabling the "robust individual investigator program" and "diverse scientific workforce" that is a priority for the NSF. The "existence of open access facilities like KPNO is critical to that mandate, by allowing students and scientists in small Colleges and Universities to carry out even modest observing programs which still rank as top scientific research."

An open access system keeps us on our toes: “Because each run, each visit has to be earned by competition and review, we’ve kept our science sharp. Equally important, the diversity of scientists using and being trained at these facilities has been preserved.” Diversity is further tied to discovery: “We need to continue to provide national facilities and equal access for anyone with a great idea to execute that idea.”

Need for a system of ground-based OIR facilities: “Our nation needs a balanced distribution of large, medium, and small [aperture facilities] for the same programmatic advantages provided by flagship class, medium class, and small class Explorer missions in NASA's Astrophysics program.” Currently, KPNO and CTIO play important roles as “pillars of the US astronomy system.”

NOAO facilities provide critical, world-class capabilities. The 4-m telescopes are being equipped with very wide-field optical imaging (e.g., DECam/Blanco) that is “immensely more efficient as a mapping and survey instrument than anything on Gemini (or even VLT)” as well as very wide-field, highly multiplexed multi-object spectroscopy (BigBOSS/Mayall), capabilities that “leverage the unrivalled fields-of-view of the Blano and Mayall telescopes”.

The NOAO facilities also impact the science carried out on other facilities. “One of the roles of the 4m telescopes is as discovery engines, providing questions that can be followed up with larger telescopes like Gemini.” The unique wide fields-of-view of the NOAO 4-m telescopes “enable us to probe the whole sky for rare objects (supernovae, brown dwarfs, distant galaxy clusters) that can spur new science.”

Leveling the playing fields for science on other federal facilities: Open access to NOAO facilities levels the playing field for proposals to use other federal facilities (NASA, NRAO), both current and future (e.g., LSST). An investigator’s ability to propose successfully for data (and any associated funding) from these facilities is contingent only on the strength of their ideas and not on whether they have institutional access to the complementary ground-based OIR observing data that are needed to plan, initiate, or complete the project (i.e., target selection or follow up).

As one person wrote, “In the past 30+ years, my research involved multi-wavelength observations from IR to gamma-ray. These research projects would be impossible if I did not have complementary ground-based optical observations, and I completely rely on NOAO facilities to obtain these observations. NOAO is so essential to the main street astronomers who do not have access to private telescopes.”

Open access to NOAO facilities is important to prepare the broad community for science in the LSST era: “open access to intermediate-size telescopes at KPNO and CTIO provide badly needed spectroscopy and multi-filter photometry. To close these facilities now would severely damage our ability to learn how to do transient science, leaving us unprepared for the era of LSST. We have a lot to learn before we are ready to drink from the LSST fire hose.”

Without a strong open-access ground-based OIR system, the best ideas may not make it onto NSF and NASA facilities, and broad participation in those facilities will be hampered.

Training the next generation of astronomers: As one student wrote, 4-m class telescopes "play a critical role in the training of next-generation astronomers. Many university programs…do not have instrumentation and observation coursework, and larger observatories typically have professional observing staff: reading technical overviews and even sitting in during observations at larger observatories cannot match the experience and insight gained through applying for time, planning and conducting the observations personally, and reducing the data. Closing these facilities will negatively impact many graduate programs that have no other such (i.e., institutional) resources." Such hands-on observing experiences are not available through queue-scheduled facilities such as Gemini. In contrast to the scarcity of observing time on large aperture telescopes, open "access to telescopes at CTIO and KPNO provides many nights of valuable observing experience for undergraduate and graduate students who might otherwise never see a telescope."

Scientific Productivity: As one time allocation committee member commented, "After serving two and a half years on the NOAO TAC, I have a very good first hand view of the great science being done with the KPNO and CTIO telescopes. Especially with some of the newer instruments, the 4-meters are as productive as ever or even more so. I am extremely enthusiastic about the scientific impact of just about every proposal we recommend to be scheduled on [these facilities]."

Regarding the future productivity of NOAO facilities, one person quoted Nobel Prize recipient Brian Schmidt, who chaired the committee that reviewed the BigBOSS proposal to NOAO, as saying, "If BigBOSS achieves its stated science goals, it will be a highly effective use of the Mayall Telescope in the period of 2016-2020, and the resulting survey would be one of the telescope's major scientific contributions during its lifetime." The contributor went on to add, "For a telescope that was used to discover dark matter in galaxies, helped demonstrate the existence of dark energy, and was used to find the first gravitational lens, this is high praise indeed…NOAO facilities [can] be the best in the world at tackling some of the most important scientific questions of our time."

Cost efficiency in our age of austerity: Many were concerned that the closure of NOAO facilities would deprive the community of some of its most productive, popular ("the high oversubscription factors show that [the facilities] are much in demand"), and cost efficient facilities. Pointing to the very high science-per-dollar ratio of the 4-m telescopes, people found "the cost effectiveness and productivity of the 4-m systems…well suited to our current age of austerity."

Citing estimates of scientific impact based on citation count alone, it was noted, "Crabtree finds that the CTIO and KPNO 4-meter class telescopes have actually maintained a higher mean impact factor than Gemini, Subaru, the VLT, and most other ground-based telescopes within that period (2005-2009)." When operating costs are

factored into the performance metric, the 4-m telescopes are even more outstanding. Because of their excellent cost efficiency, closing NOAO facilities would mean a "huge loss in science, [and] only meager savings to the overall budget." "If we base our decisions on the basis of science per dollar, then KPNO and CTIO would be the last place to cut."

More generally, being able to "work on myriad unanswered questions with 4-m telescopes on the front lines without spending billions of dollars...is an appealing...back-to-basics approach that would enable the community to weather the budget crisis" while producing strong, potentially ground-breaking science.

The cost efficiency of NSF investment in KPNO and CTIO is greater than the above metrics imply, because these sites host facilities operated by other consortia (e.g., SMARTS, WIYN, SOAR, the Bok telescope, Spacewatch, MDM, SARA, PROMPT, WHAM, ALO, and soon LCOGTN). As a result, NSF support for CTIO and KPNO is leveraged to serve a broader community and address a diverse range of science questions. "[Many] private observatories rely on the infrastructure created by the national observatories." "If NOAO did not provide the infrastructure at Kitt Peak (and CTIO), universities like RIT would find it economically infeasible to band together to run small telescopes at good sites. This small investment by the federal government leads to additional investment by private and public universities."

Astro2010 and the NSF/AST Portfolio Review: Calling for careful planning, people noted that although the Astro2010 priorities were based on optimistic budget scenarios, the declining budget situation we face requires "a careful look at all options." Many encouraged the NSF and the Portfolio Review committee to compare the scientific productivity of all facilities and programs under review because "the dire budget scenario requires an honest look at all programs."

In its deliberations on how to prioritize key capabilities, the community stressed that "Science per dollar must be one of the arguments made for continued support or for modest investment in instrument improvements and augmentations (e.g. ReSTAR)."

Expressing a view of the future held by others, one person commented, "This is an era of lean budgets that extends into the foreseeable future," and as a result "we may not realize most of the Astro2010 recommendations in our careers…We need to maintain the necessary core capabilities and the broad health of the astronomy community. Perhaps progress on key questions will be slower than we wish, but the field needs to be positioned to capitalize when times are better."

Another commented, "I think we need to be careful about the mandate for future capability over present productivity. Yes of course we need to ensure future productivity, but current oversubscription rates should also be considered. It would be [unfortunate] if we eliminated current productivity and then fumbled on a future project for which it was sacrificed."

Alternatives to the closure or defunding of facilities: Rather than closing facilities, contributors urged NSF to consider asking for "shared sacrifice" and economizing measures from all ground-based resources (including NOAO) to preserve open access to NOAO facilities. Closing NOAO facilities would disproportionately disenfranchise a large, productive sector of the US astronomical community from the enterprise of astronomical research and greatly limit their ability to carry out Astro2010 science in this decade.

Others asked NSF to reevaluate the need to preserve international agreements and to investigate amendments to the agreements in order to preserve access to NOAO facilities and to better optimize and balance the science output of the NSF portfolio.

Another suggestion was to investigate the possibility of additional international partners for the high-profile projects ALMA and LSST.

Invoking a strategy previously employed by NOAO, contributors also urged NSF to consider "bringing universities, private entities, and any other interested parties to the table to purchase telescope time" to preserve these critical capabilities.