NRAO Users Committee Report 2005
16 July 2005

Executive Summary

The Users Committee of the National Radio Astronomy Observatory met on May 12-13, 2005, in Green Bank, WV. The committee considered presentations on all aspects of NRAO facilities and programs. The committee had significant time for discussion of key issues including telescope time allocation policies and the upcoming NSF Senior Review of all major national facilities.

The NRAO provides unique and innovative facilities for US astronomers. The committee commends the NRAO staff for their continued efforts both to design and construct world-class radio telescopes and to develop the associated instrumentation and software needed to maximize the scientific productivity of these facilities. The NRAO facilities serve a broad scientific community and enable new and exciting scientific discoveries in diverse areas of astrophysics. The committee strongly supports the NRAO's open skies policy which prioritizes time allocation based on scientific merit rather than institutional affiliation. The committee is pleased to see NRAO building on international collaborations to construct both the EVLA and ALMA; we look forward to being able to use these new facilities in the near future.

The major points in this report can be summarized as follows:

• The committee is appreciative of the efforts put forth to keep the VLA operating with the maximum number of antennas possible during the transition to the EVLA. However, we recommend maximum possible progress on the EVLA, even at the short term expense of VLA antenna availability. At the same time, the committee is concerned about the potential lag in software development for the EVLA.

• Improvements in the operational efficiency and ease of use of the Green Bank telescope are much appreciated. Similarly, the conversion to Mark V disk-based data transmission on the VLBA is a positive step toward keeping this unique world-class facility operating efficiently and productively.

• The VLA/VLBA and GBT online archives are a much appreciated resource both for retrieval of new observations and for classic archive projects. The committee recommends the addition of search/cross links with other archives to improve user access to the data.

• The progress in ALMA construction is satisfying, and we remain hopeful that the ALMA facility will be realized fully in a timely fashion. At next year's meeting, we hope to have an update of the progress in developing the NAASC to be ready to support the scientific endeavors of ALMA as soon as the array is capable of scientific observations.

• The NRAO has made substantial improvements during the last year in the general area of education and public outreach. The expanded newsletter distribution and well-publicized press releases will increase the awareness of scientific discoveries from NRAO facilities and broaden the impact of radio astronomy in both the astronomical and global communities. In addition, the committee believes that the NRAO image contest is an excellent idea to encourage PIs to create new renditions of their data, and thus expand the image gallery. The committee also encourages the NRAO to continue to explore ways to involve the university community, especially students, in development of instrumentation and observatory operations.

• After extensive review of the current time allocation process on the NRAO's facilities, the committee recommends increased efforts to include the broader astronomical community in the refereeing process. The committee enthusiastically supports the idea of a special (one-time) call for proposals for deep surveys with the VLA. We recommend wide advertisement of this opportunity to the astronomical community.

1 Open Skies

NRAO has a major impact on astronomy and beyond, both in the US and around the world. This impact is fostered by NRAO's policies of openness. First, NRAO has a policy of freely sharing technology. Technical developments pioneered at the NRAO have benefited instrumentation programs at universities, as well as industry and scientific endeavors outside radio astronomy. In addition, NRAO has had an active program of collaboration that has benefited the entire astronomical community.

Most importantly, the policies and attitude of NRAO have fostered an international sense of community among radio astronomers that is unique within the sub-fields of astronomy. This sense of openness has resulted in more productive facilities and a rich scientific environment that benefits everyone. This attitude of openness has resulted most recently in international collaboration on ALMA; combining scientific, technical and funding resources from North America and Europe to build a world-class facility. The collaboration with Canada and Mexico to build the correlator and the infrastructure for EVLA, is another consequence. Without international collaboration, these instruments might not have been built or would have been less than the premier instruments that they will be. In addition, this attitude of openness results in more opportunities for US students abroad. Since science works best when it extends beyond borders, this fragile atmosphere of openness is very important to nurture. The Users Committee, therefore, strongly endorses a continuation of NRAO's policy of "Open Skies," knowing that this policy potentially means less telescope time for US astronomers. Although not all the world is as open as NRAO, NRAO must be a leader and show by example how science should be conducted.

2 Green Bank

In the 2004-2005 timeframe, the GBT has been firmly established as a world-class observatory with reports of new discoveries and characterizations of pulsars, spectral line detections of new interstellar molecules, new detections of molecular lines in high redshift quasars, detections of high latitude clouds in our Galaxy, and left-over building-block clouds of galaxy formation surrounding M31.

The GBT is making positive progress and improvements in all aspects of performance, capability, and operations since the last Users Committee (UC) meeting. The UC is particularly pleased that the number of backlogged proposals has been reduced by 80% since the last report. The committee encourages NRAO to take steps to ensure that the scheduling queue, once discharged, is not allowed to grow again, particularly during upcoming periods with significant down time, as during the anticipated repairs to the GBT track. It is the opinion of the committee that the Green Bank staff is doing excellent support and development work with decreasing staff resources. The committee foresees that expanding the GBT user base to non-radio astronomers will probably not occur as rapidly as previously envisioned due to such staff decreases.

Many user-oriented systems have been improved in the last year. For example, a new GBT spectral line data reduction program has been implemented in IDL that mimics the familiar UNIPOPS single-dish program used for years at NRAO. Even so, the GBT observing mode software and data reduction software is still best utilized by an expert. Therefore, the UC strongly recommends that the local staff continue, and if possible increase, their close involvement with the users to improve and facilitate observational mode development, data reduction additions, and instrument development.

Cooperative development programs with universities for instrumentation, data analysis, pulsar hardware and observing modes, polarimetry techniques, etc., have been very successful and we encourage that this be continued and expanded, if possible.

Scheduling block software has been developed which should change the character of dynamic scheduling which is now burdensome to the user; this situation should improve when a fully implemented block scheduling program permits facilitated remote observing. The UC encourages development of this improvement in dynamic scheduling as rapidly as possible. Moreover, documentation on system calibration methodology has been generated for NRAO internal review but needs to be added to web pages for the benefit of the users.

The UC is concerned to hear that the NRAO staff has had to divert resources to assist observers who arrive at the last minute without adequate preparation. The UC recommends that individual users be notified (with required acknowledgement of the notification) to consult with local staff several days in advance of a scheduled observing run to ensure that telescope time is not wasted in the present developmental environment. Further, the UC recommends that NRAO consider implementing a deadline for notification of travel arrangements for on-site observations to improve communication between observers and local staff. Such deadlines are common in the optical community (often 6 weeks in advance of the scheduled observations). Adopting a deadline consistent with that required for remote observing (2 weeks in advance of observations) would enable the Observatory to allocate limited staff resources in the most efficient manner.

3 Very Large Array

The Users Committee recognizes the strong commitment by NRAO staff to maintain the premier imaging capabilities of the VLA during the transition to the EVLA. This critical effort has allowed the VLA to remain a vital scientific instrument during this time. We urge the maximum possible progress toward the EVLA and feel that the number of antennas required to be maintained in the working VLA could be relaxed somewhat if this would lead to a significant decrease in the maintenance efforts and time required for the transition to the EVLA. We stress, however, the need to maintain a working instrument to retain and grow the user community. One point of concern is the potential impact of the EVLA integration on science operations, and thus we only support the short term loss of VLA antenna availability if the EVLA software will be fully operational on the shorter transition timeline.

The members of the UC have expressed concern about the lack of funding to maintain the railroad tie replacement at the level required for safe operation of all configurations. We encourage NRAO to continue to actively assess the replacements and ensure that sufficient funding is available to maintain the track for the extended A configuration.

4 EVLA

The EVLA project appears to be progressing well. The attainment of the first EVLA fringes is exciting news and represents a clear sign of the progress of the EVLA project. The recovery plan implemented last year to bring the project schedule back on track appears to be working.

The Users Committee appreciates the logistical difficulties and extra effort required to keep a large fraction of the VLA operating during the commissioning of the EVLA antennas. The delay in integrating the first three EVLA antennas into the VLA is unfortunate; "only"

22-24 antennas are available for VLA in 2005. However, we fully support keeping the EVLA project on schedule and making the transition from the VLA as efficient as possible, even at the short term expense of the number of elements available for the VLA.

The UC is concerned about the potential impact of a lagging software effort on the science capability of the EVLA. It is clear from the material presented at this year's meeting that there is a major effort underway to increase the resources available for EVLA software, particularly in the areas of high-level system design and e2e software development. It is encouraging that support for some of the additional resources has been identified. However, we note that a large fraction (20 FTE-years) of the estimated software resources remain to be identified. Though difficult, we strongly encourage NRAO to find these resources.

It is unfortunate that the increased support for software effort has had an impact on the project contingency. This has raised the need to explore options for descoping the project, for which the S, X and U band receiver systems have been identified. We support all efforts to avoid implementing such reductions in scope. However, in the event that such considerations need to be made, the Users Committee concur with the EVLA advisory committee that the first step is to establish with the wider community the relative scientific merits of each of these observing bands.

5 VLBA

The VLBA continues to provide a high-quality science capability that cannot be matched by any other current long-baseline radio antenna array. The quality of the data and user service is the best available in VLBI, and the Users Committee continues to encourage NRAO to devote resources to the VLBA in order to maintain this high level of service to users.

The on-going conversion from tape record/playback to the Mark V disk-based data transmission system is encouraging. The completion of the upgrade to the Mark V system is of primary importance; it provides cost-savings in tape record/playback maintenance and is relatively inexpensive. Though completion of the project is dependent on the availability of funds, the committee reaffirms its position that conversion to Mark V have priority over other upgrades.

The relatively high proposal rate for the High Sensitivity Array (HSA) shows the keen interest of the user community in making high-sensitivity VLBI observations combined with the high standard of data quality typical of the VLBA. We encourage NRAO to continue providing the HSA. However, we recognize that there may be funding concerns with providing Mark V recording/playback for the 14 station HSA.

The now common-place use of the phase-referencing technique to detect weak targets points to the need to keep improving the VLBA capabilities in this area. The recent improvements of the correlator models for geodetic use and the development of the ATMCA routine within the AIPS package are highly appreciated. The continued development of reduction tasks within AIPS highlights the continued reliance of the VLBA community on AIPS, and the critical need to continue AIPS support.

The move to allocate time only for the highest priority high frequency observations has reduced the backlog in the schedule queue. Furthermore, it is reassuring to observers who are given time that there is a high expectation of having the observations completed. However, the status of dynamically scheduled observations remains difficult for project PIs to determine.

We encourage NRAO to keep improving the ease-of-use of the VLBA and to explore

means of attracting new users. While VLBI is widely viewed as an "experts-only" observing technique, the current delivery of *a priori* calibrated data of selected projects and the associated VLBA data pipeline development is a highly commendable service, certainly for non-experts, and its availability should be advertised more aggressively. User support throughout the observing process is an essential element of VLBA observations, most especially for non-experts. It is noted that there are few staff that are available to fulfill this role, but we strongly encourage NRAO to at least maintain high quality user support at current levels. The recent loss of a staff member with considerable experience in this area is lamentable.

The UC encourages NRAO to support more exploratory science with the VLBA. The uniqueness of the VLBA means that it is often the only instrument which can attempt certain science. Taking some risks in scheduling at the expense of conventional VLBI projects opens the door to discovery and may effectively demonstrate to the larger astronomical community the capabilities of the VLBA.

6 ALMA

The Users Committee is glad to see that both ALMA antenna designs meet science requirements for production antennas. Given the higher than expected production cost for antennas of either design, we are also pleased that ALMA has committed to purchasing at least 50 antennas, though we hope all parties will continue to push for the realization of a full 64-antenna array as originally envisioned. Furthermore, we hope that the NRAO will continue to consider the accurate and practical gathering of short-spacing information to be important. The UC encourages the NRAO to take steps to ensure the success of the Compact Array, and to encourage the support for a large, southern hemisphere single-dish telescope as an important adjunct to ALMA.

The development of a radio-quiet zone around the ALMA site, so far in advance of regular array operations, is a good mark of NRAO's stewardship of this project. However, members of the UC raised concern about the continued ALMA Project Scientist vacancy, and the impact that this vacancy is having on the scientific focus of the Joint Project office. The UC concurs with NRAO that a well qualified ALMA Project Scientist is essential to the success of ALMA, and we encourage NRAO to vigorously renew their efforts to recruit such an individual.

The UC is pleased at the continuing efforts to ensure the accessibility of ALMA to a more general base of astronomers. Overshadowing these efforts is a growing concern for how the NRAO is going to maintain and stimulate the growth of an active US millimeter-wave user community over the next few years before ALMA comes online. The Committee requests more specific information on plans in this direction for next year's Users Committee meeting.

There was some question among committee members about the development, role, and relative cost of the North American ALMA Science Center in Charlottesville, which received little coverage at this year's meeting. In particular, what are the relative costs of the ALMA Regional Center and the ALMA Science Center, and how much of the cost of the fully-implemented NAASC is already covered by the funds the NSF has committed?

The UC recognizes that the user support funded directly within the ALMA project is inadequate to maximize the science return on the US investment in ALMA. We support the goals of the NRAO in enhancing the return of ALMA by establishing an appropriately-staffed NAASC. How will the NRAO maintain a balance between archive support and user

support at the NAASC with the increasingly limited resources available? The UC requests a more extensive discussion of the NAASC at next year's Users Committee meeting, and in particular requests that a clearer picture be drawn of the proposed science and support roles at the NAASC, in order to be able to comment in a more informed way about the balance of priorities for the Observatory, both for cost and human resources.

7 Telescope Scheduling & Proposal Review

The Users Committee thanks the NRAO for the effort made in providing detailed statistics and information on proposal scheduling and in allowing us to speak to an external member of the scheduling committee during the meeting.

There are a number of issues regarding the proposal and scheduling process on which the UC has suggestions and recommendations.

1) The NRAO's Rapid Response policy has led to many exciting science results. The UC recognizes that rapid response science is likely to increase in demand. Recent improvements have facilitated the scheduling of rapid response science; in particular, we appreciate the distinction now made in the VLA schedule between projects that can be "bumped" and those that cannot be displaced. However, the UC feels that further improvements to Rapid Response policy are still needed, especially in the cases of the "Target of Opportunity" (TOO) and "Exploratory Time" (ET) categories. Some specific recommendations are as follows:

- We strongly recommend that the Director or his representative should be involved in all decisions to award TOO or ET observations. This provides consistency across NRAO facilities, and is in line with the policy at other major observatories.
- There needs to be a policy or plan of action in place to address major transient events (e.g., a Galactic supernova). For example, how should competing proposals be ranked and time be assigned? Who writes the schedule files for the observations? What is the proprietary period of the data? We feel it is important to have the outlines of such a policy in place in advance of the next such event occurring.
- While the UC can see the value of Exploratory Time, some members are still concerned that this can be used as a loophole for circumventing the normal peer review process. For example, VLA time on GRB afterglows detected by Swift is awarded subject to regular peer review of proposals for 'Known Transient phenomena.' But GBT time to determine period derivatives of pulsars discovered by Parkes has been awarded through Exploratory Time. Since both types of proposal are in response to events that can be anticipated, the NRAO should consider whether there needs to be more consistency in how such proposals are handled.
- The definition of "Exploratory Time" on the NRAO WWW page is still somewhat vague - e.g. the initial definition "These proposals are close in nature to those formerly called Ad-Hoc proposals" is not very helpful. We recommend that NRAO work to define this category better, and/or to give better examples, aimed at making it clear that this is not a 'back door' to circumvent the normal peer review process.
- The UC requested last year that the GBT lists the details of all rapid response proposals on the WWW (as do the VLA and VLBA). We note that the GBT still has no page listing rapid response proposals linked from http://www.vla.nrao.edu/astro/prop/rapid/ , and again ask that this be added.

2) While there was no clear consensus or recommendation from the UC, we note that some committee members were in favor of moving toward a system in which time was

assigned through face-to-face panels and the time allocation terms correspondingly lengthened to six months per year. Others, however, prefer the independent feedback provided by anonymous referees in the current system. Because of the lack of consensus, the UC makes no specific recommendation on the proposal review mechanism at this time.

3) The UC does, however, have some general comments about the membership of the time assignment and scheduling committees. The UC commends the NRAO for its attempts to include the broader community in the refereeing process. The UC urges NRAO to continue these efforts to broaden the expertise of the pool of TAC members. The UC also recommends that the scheduling committee contain more external members. In addition, the UC recommends that NRAO consider faster rotation of the members on the scheduling committee to ensure a broader and fresh perspective.

4) From the discussions between UC members and AOC and GBT staff, it appears that each facility has a different approach to scheduling time. For example, the GBT fills in the schedule using a rank-ordered list of proposals, while the VLA maintains a rank-ordered list but also makes an effort to spread time between different scientific categories. We recommend that NRAO consider the merit of moving to a consistent approach between facilities in how time is scheduled.

5) While the UC acknowledges that NRAO staff time is not an infinite resource, we believe that a simple system to track the success of proposals in terms of papers and citations would be useful for a variety of purposes and should be implemented before EVLA and ALMA come on-line. This can begin by simply asking authors to make use of the "facility" and "dataset" keywords now available in AASTeX 5.2, which allow seamless tracking of specific telescopes and projects through ADS and other search engines. Effort currently used to track paper pre-prints (the NRAO RAP/UNRAP list) could be allocated to set this up.

6) The UC applauds the VLA director's special call for deep surveys. However, we recommend that no time allocation cap be implemented; proposals should be considered only by their scientific merit and feasibility. The UC recommends wide advertisement of this opportunity via the AAS newsletter, AAS email newsletter, and direct contact of previous PIs and PIs of groups at other wavelengths.

7) The Users Committee discussed the length of proprietary period expected for large and survey-style proposals. The UC has no specific recommendations for changes in the current policy. However, it was suggested that the length of proprietary period should be considered when a large proposal is reviewed and that proposers should motivate explicitly their request for (and length of) a proprietary period.

8 Spectrum Management

The members of the Users Committee appreciate the NRAO's continued efforts and vigilance regarding RFI issues. The negative impact of RFI on passive users of spectrum, especially radio astronomers, can be overwhelming and can seriously impact science goals. NRAO should continue to dedicate resources to the monitoring and elimination of RFI at all telescope sites and invest some time and resources in establishing relationships with appropriate government contacts in Chile in order to maintain a good RFI environment for ALMA. The value of the Green Bank Radio Quiet Zone cannot be understated as a necessary resource to conduct the leading edge scientific investigation. We express concern regarding the departure of a leading RFI mitigation researcher (Fisher) from Green Bank site and the impact that it may have on monitoring and mitigation efforts there. In this

transition period, NRAO is encouraged to place emphasis on continuing and expanding these techniques as necessary to provide leadership and technical expertise.

Signal processing for RFI mitigation is seen as an area which the observatory could provide leadership. The spectrum management web site, http://www.cv.nrao.edu/ hliszt/RFI/RFI.htm, overseen by Harvey Liszt, is a useful resource. The UC encourages NRAO to make the web site widely accessible by prominently placing links to the page on each site-specific web page, featuring it regularly in the Observatory Newsletter, and informing the broader astronomical community of its existence through communication channels such as the AAS Newsletter and handouts at AAS meetings.

Links from telescope-based resources should also provide links to a central RFI web page and vice versa in a uniform manner. Although probably not the actual case, the present organization of these resources would suggest the existence of a significant degree of compartmentalizing between the various efforts. From a user perspective, a more coordinated effort to present these resources would be of high value. It would also be helpful to suggest techniques for mitigation of specific interfering signals either during the observations or afterward. As a minimum standard, NRAO should provide sufficient information prior to observations so that users can adequately design their experiments to avoid the negative impacts of RFI where possible. Although an ideal situation would allow one or more staff (as appropriate) at each telescope site to monitor RFI conditions and at least one observatory-wide coordinator for RFI issues to represent the Observatory at the national and international levels, the UC recognizes that this goal is likely unattainable given current resources.

9 Software and Data Analysis

GBT

We are encouraged to see web proposal submission making its debut soon for GBT proposals. The Users Committee recommends that NRAO still allow paper proposals for people who have limited internet capabilities, but suggests a revised deadline such that hardcopies must arrive earlier (e.g., 2 weeks before the electronic deadline) to allow time for processing and to encourage electronic submission. Once proposals are electronic, we hope it will be possible to provide an electronic link from the archive to proposal cover pages and abstracts to allow users to peruse successful programs at the GBT and other NRAO facilities.

Archive

The online VLA archive is easily the most important NRAO software & data tool in recent years. This is a great resource and greatly improved in functionality; the UC strongly supports the continued maintenance of the interferometer archives and NRAO's new archive imaging project. However, the UC notes that there are some existing problems that make it difficult to access the full utility of the archive: the most glaring are the lack of information about when data will become public (even if this is only a "best guess") and the difficulty in searching for programs with observations that span multiple array configurations. Members of the UC found that recording information about program codes by hand is sometimes still necessary to retrieve all the data of interest for a particular project. If resources permit, it would be desirable to have a pipeline calibration tool and imager for standard kinds of datasets, so that a casual user could see whether a source existed or not.

The UC encourages NRAO to explore partnerships with groups which already archive large datasets, such as CADC. Building collaborations with outside groups who have already developed significant archive expertise will maximize the return on limited resources. The

UC notes that a partnership with CADC for the EVLA and ALMA archives would further build on the current collaboration with HIA for the design and construction of the EVLA correlator.

AIPS

Most NRAO users still rely on the traditional AIPS software for processing of VLA and VLBA data sets. We reiterate our support and need for functionality of this package. As mentioned in previous UC reports, the concern remains that only one person really understands AIPS.

EVLA

We hear that the software effort continues to be short-staffed. The UC is concerned that the software to run EVLA will not be ready when the hardware is ready. If a choice must be made, supporting the EVLA effort is more important than the archive software effort.

Operating Systems

There is a growing trend for astronomers to use Apple/MacOSX operating systems in lieu of Unix, Linux, or Windows. It is great that AIPS now runs under MacOSX, but aips++ does not. We want to make NRAO aware of this trend so that future software compatibility efforts for all packages include consideration for Apple/MacOSX.

10 NRAO in the Community/EPO

The NRAO is to be commended for the heightened Observatory profile due to the success of the introduction of traveling Jansky fellowships, the increase in the population of predoctoral students, and the revitalization of a more formal visitors program. Furthermore, there has been significant progress in public outreach in the last year, with the development of resources that make the science pursued by NRAO telescopes (and ways to present it) more accessible to both the general public as well as the wider community of professional astronomers. The expanded newsletter distribution is a great addition and could be expanded even farther (for instance, some Committee members are still not receiving it). The NRAO image contest and the increased distribution of the press releases greatly enhance NRAO's visibility and continued contact with the AAS will ensure these types of events are further publicized. Lastly, the appointment of Juan Uson as an EPO Scientist shows NRAO's commitment to sharing science accurately with the wider community. The increased attendance at the visitor centers is yet another way the NRAO has shown dedication to increasing awareness with the public and the NSF should be pleased with this progress.

The Users Committee continues to be concerned with the effects of ever decreasing resources on user support. We encourage the NRAO to continue to explore ways in which the university community, including students, may be able to assist with user support and carry the developing knowledge base of NRAO instruments out into the wider community. For example, students who gain expertise through the GBT predoc program could be asked to be a resource for others at nearby institutions who want to learn to use the GBT. Possibly a small monetary reimbursement for providing user support could be provided, or the student or user could be flown out to the telescope and accommodation and meals covered for the time the student provides user support. An emphasis on the available user support should also be noted in the call for proposals to encourage "non-radio" astronomers to become users.

The UC is pleased to see that the online VLA/VLBA archives are being used by an ever-increasing number of users, and not just by recent observers looking for their

own proprietary data. The NRAO website continues to see significant improvement, but multiple Committee members noted that the search engine for the site is not effective. One option is to simply replace it with Google, which is both effective and free (see http://services.google.com/publicservice/login). Indeed, one UC member noted that it was generally easier to find things on the NRAO site by querying Google than by using the Observatory search engine.

11 CDL

The importance of continued and sustained support for the CDL's development efforts in detectors, electromagnetics, spectrometer/correlators, and LO systems should not be understated by the user community. For example, the broadband tunerless SIS mixers developed for ALMA Bands 3 and 6 by the CDL and the University of Virginia Microfabrication Laboratory are truly impressive. To enable future advances of mm and sub-mm wave receivers, funding mechanisms should be identified to continue this historically productive collaboration. Preserving these technical and design capabilities is seen as a crucial investment to maintain leadership in detector systems for the Observatory's instrumentation assets. Efforts to explore diffusion cooled Nb HEB mixers under the NSF ACT (Approaches to Combat Terrorism) provide a venue to investigate the noise properties of these promising devices. Characterization of these devices under low-background conditions appropriate for high-sensitivity astrophysical applications should prove to be of interest to the larger detector community as well. In pursuing such cross cutting technologies, however, it is important to convey clearly the linkage to NRAO's end goals.

The continuing and sustained HFET amplifier design, fabrication, and test effort carried out by the CDL are seen as a key not only to maintaining existing instrumentation assets but also to realizing the promise of the EVLA and ALMA projects. It is hoped that in transferring low-noise amplifier production technology to the private sector in support of the observatory's build efforts, an eye is maintained on retaining design and prototyping competencies. Given the life cycle of modern radio telescope systems, a compromise in performance, quality, or reliability in this area is not viewed as a cost effective or acceptable trade in providing the highest-performance instrumentation to the astronomical community.

12 Future Directions

The GBT, VLBA, EVLA, and ALMA form a unique suite of imaging tools which continue to enable leading edge scientific inquiry. The commitment and contributions of the NRAO scientific and engineering staff to these scientific assets, from concept through implementation, are widely recognized. In the interest of maintaining this technical expertise, the concerns presented by the staff regarding how the observatory technical priorities are determined are repeated from last year's report. The UC observes that finite internal resources and external funding opportunities will undoubtedly constrain potential avenues of exploration.

Through an open discussion between senior scientists, the engineering staff, and management, it is hoped that the best match between avenues of greatest scientific impact and available resources can be found. Such a plan will form the foundation for the Observatory's future science and technical assets. Exploration of new concepts, as well as interaction and collaboration with the greater research community, are important elements of realizing a

vibrant research and development environment for the entire Observatory. The UC encourages the NRAO to take steps to ensure that open input and consensus are prized as the Observatory sets priorities for future research and development efforts.

NRAO's involvement with the university community is commended and should continue to be fostered. These efforts are seen as a vehicle to provide users support and retain expertise in the radio community as well as address the underlying need to continue to develop new and innovative technical assets. The NRAO's university-built instrumentation program (e.g., Zpectrometer, Penn Array, FASR) is seen as a key instrumentation and personnel investment for enabling high impact science at the forefront of astronomy. The Users Committee recognizes the importance of the NRAO's broader impact in this area through its commitment to training the next generation of students, scientists, technologists, and engineers in radio astronomy.

Members of the UC were concerned by statements made by NRAO staff such as "The EVLA is the backbone of the future US Square Kilometer Array" and "EVLA + VLA + GBT leads to SKA." These remarks appear to have been based on an SKA discussion document which has been circulating among the US community. However, we do not feel that it is wise or strategic to push current NRAO facilities as SKA technology prototypes, given that the technology needed for SKA is very different from that of the VLA, ELVA or GBT. We encourage NRAO to think broadly about future instrumentation for the next generation of radio telescopes.

13 NSF Senior Review

The Users Committee discussed the upcoming NSF Senior Review at great length. While we recognize that such an activity is a good idea in principle, we are concerned that this process has the potential to impact US astronomy more significantly than the decadal survey. As users of the NRAO facilities, we are particularly concerned that premature descoping of current projects or closure of current facilities will significantly curtail scientific discoveries in the radio astronomy regime. In this context, we are pleased that NRAO has already made significant adjustments to its complement of facilities over the last decade. At this time, the UC believes that every operating facility (including VLA, VLBA, and GBT), the CDL, and the facilities currently under construction (EVLA and ALMA) enable exciting scientific discoveries that cannot be obtained anywhere else in the world. NRAO is to be commended for continuing to develop and build world-class radio telescopes that serve a broad scientific community.

Thus, while we recognize that finite resources may require hard choices, we challenge the NSF to maintain its responsibilities to capital investments and make every effort to preserve the existing capability of the VLA, VLBA, and GBT in light of increasing resources devoted to ALMA. In particular, we strongly urge the NSF to recognize that the loss of facilities is a loss of science. The current complement of radio telescopes are uniquely designed to enable new and fundamental scientific discoveries in diverse areas including studies of nearby objects (i.e., in our solar system and the Galaxy) and those of the very early universe. Reducing the scope or capabilities of these facilities would significantly limit our ability to probe and understand the evolution of the universe from the Big Bang to today.

14 Personnel Issues

As stated in other sections of this report, the Users Committee continues to be concerned about the strength of the connection between NRAO staff members and astronomers elsewhere, as each staff member's FTEs are getting spread over a wider number of tasks. This leaves little time for user support or collaborations with the wider community, which are vital to the scientific health of the NRAO, as well as to maintaining its standing in the wider astronomical community.

The UC also continues to be concerned about the lack of staff diversity. For the second year in a row, there were no presentations by female NRAO staff members at the Users Committee meeting. The face NRAO presents to the world is an important factor in making the Observatory more accessible to the wider astronomical community; the UC feels that this lack of diversity may alienate some parts of the user community.

15 Next Users Committee Meeting

The Users Committee was grateful for both the shortened presentations as well as the extended time they permitted for more extensive discussions, both with NRAO staff and with each other. We were also happy to receive copies of presentation slides at the beginning of the meeting, as this helped provide continuity with the material sent for our perusal before the meeting.

To enable the majority of the committee to attend the next meeting, we request that the date for the next meeting be set as early as possible (preferably by January 1, 2006). In this regard, we request that NRAO identify new members of the UC in a timely manner.

As we desire our recommendations to be well informed and well considered, the UC requests that material sent prior to the meeting be sent a month in advance, even if this requires updates to some documents at the time of the meeting. We consider our recommendations to cover a breadth of topics similar in scope to those considered by a round of telescope refereeing, and would appreciate a commensurate amount of time to deliberate over the materials. We also request that responses to previous UC reports be clearly denoted in the documentation sent to the committee. Furthermore, the members of the UC would like to request that NRAO provide the option to receive review materials in electronic form (e.g., PDF files on a CD) rather than paper hardcopies, as this would be more convenient for some members traveling long distances and bringing their own laptops (and less costly for the NRAO).

Finally, we request that the UC be kept informed of the progress of the NSF Senior Review. In particular, we encourage a considerable period of community comment immediately after the recommendations are made public.

Members of the 2005 User Committee

Robert Becker
Geoffrey Bower
Tracy Clarke
Jeremiah Darling
Sean M. Dougherty
Gary Fuller
Bryan Gaensler
Andrew I. Harris
Jan Michael Hollis
Deidre A. Hunter
Rob Ivison
Henry Kobulnicky
Stanly Kurtz
Cornelia Lang
Mary Putman
Daniel Stinebring
Michele D. Thornley
Stephen E. Thorsett
Edward Wollack
Lisa Young
Liese van Zee (Chair)