To: Fred Lo, Director, National Radio Astronomy Observatory

From: NRAO Users Committee 2004,
John Dickey (chair), Robert Becker, Jeremy Darling,
Bryan Gaensler, Andrew Harris, Deidre Hunter, Chip Kobulnicky,
Stanly Kurtz, Cornelia Lang, Kevin Marvel, Mary Putman,
Michele Thornley, Ed Wollack, Min Yun, Liese van Zee

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Subject: **The 2004 NRAO Users Committee Report**

Executive Summary

The Users Committee of the National Radio Astronomy Observatory met on May 24-25, 2004, in Charlottesville at the new Ivy Road home of the Central Development Laboratory. The committee considered presentations on all aspects of NRAO facilities and programs, as presented by the Observatory director and staff. Fifteen out of the twenty-one committee members were present. Thanks to the NRAO staff following an abbreviated presentation schedule, the committee had ample time for questions and discussion. We recommend that at future meetings the schedule should set aside large blocks of time for committee questions and discussion after each block of staff presentations.

The NRAO is an extremely productive and innovative organization that provides facilities and support of the highest quality to the US radio astronomy community. The committee commends the administration and the entire Observatory staff for their impressive accomplishments over the last year on a broad range of hardware and software projects. We particularly appreciate the actions taken to implement the recommendations of the 2003 Users Committee report; many of these have led to improvements in the scientific output of the telescopes.

The Observatory is in the midst of a growth period, with the ALMA and EVLA projects both well underway. This is overall a healthy thing for the NRAO and for the US community. Unfortunately, the level of funding has not fully kept pace with the needs of the Observatory to operate and maintain existing facilities as well as to construct the next generation of telescopes. The Users Committee urges the NSF to increase the funding level of the Observatory in order to provide an adequate budget for operations and maintenance of workhorse telescopes like the VLA, GBT, and VLBA during the critical years of construction of ALMA and the EVLA. These telescopes provide access to radio wavelength observations for a large number of US astronomers. Adequate support ensures that the users of the facilities will have cutting edge instrumentation and enough user support to reap the benefit

of NSF's substantial investment in radio astronomy infrastructure as embodied in the NRAO telescopes.

This report reviews the operation of NRAO's existing telescopes and the other programs that the Observatory provides for its users and the wider community, with separate sections for many different topics. A general theme that the Committee discusses in several places below is the need to find ways for the Observatory to incorporate input and expertise from the broader community. There is currently not wide participation by NRAO users in the setting of Observatory priorities, except in a broad sense. Widening the discussion on Observatory priorities is particularly critical at a time when support is stretched thinly over many facilities and services. This comes up in the sections below on the Central Development Laboratory, on plans for the ALMA Science Center, on user support for various instruments, on outreach and information about new capabilities and how this is promulgated to the community, and on the structure and organization of the Users Committee meeting itself.

An area that gets extended discussion in this report is the Observatory's connections with the academic community, including education, outreach, student support, fellowships, visitors, and joint projects with universities. The NRAO has made great progress in these areas, and the report is mostly very positive in its assessment. On a related topic, there are differences of opinion about the best way to process proposals and schedule the telescopes. The main recommendation here is that next year's committee meeting should include an extended discussion of how to improve the present system. Specific requests that pertain to the 2005 Users Committee meeting are set off from the text in bullets for emphasis.

1. Open Telescope Access

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.

But 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 richer 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 a new correlator and the infrastructure for the 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. Since science works best when it extends beyond borders, this fragile atmosphere of openness requires nurturing. The Users' Committee was, therefore, alarmed by the Director's statement that this policy of "Open Skies" might end. Although not all the world is as open as NRAO, NRAO should be a leader and show by example how the best science is done by unbiased peer review on a level playing field.

2. Green Bank

The GBT is continuing to mature as a world-class observatory, showing improvement in nearly all aspects of telescope performance, capabilities and operations. The PTCS work is particularly impressive and the committee encourages NRAO to continue this effort. The GBT web pages are better organized and more informative than other NRAO pages, and the online documentation of the progress of accepted proposals through the observing queue is much improved. The committee is encouraged by the increased fraction of telescope time available for observations, and we hope that this trend continues.

The investigation of the GBT pointing shows encouraging results. Further study of the effect of environmental parameters and servo performance is needed to effectively allocate and utilize the telescope at high frequencies. Given the potential impacts of the observed azimuth track fatigue on telescope use and service life, we hope that an improved understanding of underlying mechanisms and a clear definition of the required rework are close at hand.

The long observing schedule queue and the weak direction in overall GBT software development remain primary concerns for the committee. The long backlog of observing proposals will have long-term repercussions on the science impact of the GBT. Those organizing the GBT proposal assessment process should take steps to ensure that a long-standing backlog of observations does not arise again in the future and they should take into account extended down time for dealing with solutions for azimuth track wear (e.g. shutdown scheduled for 2006). There has been a sentiment among some proposers that it is difficult to access the GBT, as there have now been several proposal cycles where the reduced number of hours being offered may be limiting the breadth of science that can be attempted with this exciting new facility.

The committee suggests that if the observatory intends to continue with high frequency primary, low frequency backup observing in the winter months, then the observatory must support either remote

observing or queue observing. The ratio of travel time investment to actual telescope time for users is very large under the current primary/backup plan and is especially onerous for investigators with teaching responsibilities.

GBT observing and data reduction software remains in "expert mode" at the GBT, which places severe demands on the local scientific staff who support new users. Experienced users also often require guidance because the observing software is in flux. The decision to make GBT data accessible with IDL routines is a positive step in opening up the GBT to a broader user base, but we are concerned about the time and resources already invested in other data reduction pathways and the late development of this essential aspect of telescope operations. Among the GBT scientific and computing staff, there seems to be duplication of effort; many have their own data reduction tools, which will not necessarily be incorporated into the supported GBT software. Regarding the concern about the cost of IDL to GBT users, we encourage NRAO to develop routines that can be read and used by IDL's new Virtual Machine, which allows users to have a free IDL interface on local machines for IDL tasks written by others.

Several GBT staff members have been engaged in impressive RFI mitigation work of great value to the user community. Due to its special susceptibility to RFI as a single dish facility, understanding and dealing with RFI is frequently an important aspect of conducting a successful GBT project. We recommend that Green Bank consider making an RFI “friend” available to users for planning, observing, and data reduction consultation on mitigation strategies. There is RFI documentation on the GBT web site, but consultation with a local RFI expert would greatly benefit users and enhance the scientific output of the GBT.

The committee strongly supports the GBT student program, and we recommend consideration of a trade-off with postdoc support to allow this program to continue. GBT student support is a high value program in light of NRAO's goal of fostering the next generation of radio astronomers, and it is especially important to provide students with hands-on experience at a world-class facility like the GBT.

3. The VLA

The VLA continues to be a premier imaging radio interferometry instrument with excellent scientific productivity. The EVLA project will keep the VLA functioning as a vital instrument for the next quarter century. We appreciate the concerted effort by NRAO and the VLA staff to keep the VLA as functional as possible during the transition to the EVLA. We continue to value the effort to maintain the instrument infrastructure year after year. Specific improvements over the last year of particular impact to

users include (1) the routine operation and dynamic scheduling of 22 and 43 GHz projects and (2) the great improvements to accessing the VLA data archives.

A major issue raised by the VLA site director is the balance between user support and the competing interests of the new observatory initiatives (EVLA, E2e, ALMA). We understand the additional pressures placed by these initiatives on the staff. However, these new projects are taking place over an extended period of time (> 5 years) and the observatory cannot afford to skimp on user support over this timescale.User support is vital to keeping the current user base productive as well as bringing in new users. Current radio astronomers need user support to do new and/or more complicated projects, and novice and student users are important to increasing the user community. Both of these user groups are essential to the health and future of radio astronomy.

4. The EVLA

The Committee received reports on both Phase I and Phase II of the EVLA project. We are satisfied by the progress that has been made in both phases. Although Phase I schedules have slipped in some areas, we are satisfied that the proposed recovery plan is adequate to bring the project back on schedule by the end of 2005.

In the case of EVLA Phase II, we are pleased that the proposal has been submitted to NSF. This phase of the EVLA project will bring very substantial performance enhancements to the NRAO users. We share the disappointment that it was not feasible to include a low-frequency component in the proposal, but we agree completely that the additional delay that would have resulted was unacceptable.

The staff requested Committee input on user priorities during the VLA to EVLA transition. In particular, should the transition to the EVLA be made before all outfitted antennas are available? And are new frequency capabilities a sufficiently high priority that they should be made available on the old correlator ? In the former case, the committee feels that probably the transition to EVLA should be made before all outfitted antennas are available, but the decision will likely depend on the specific status of the EVLA at the time. In the latter case, our feeling is that early access to additional frequencies is not a sufficiently high priority to warrant the additional effort to install them on the old correlator. In any case, the committee view is that new capabilities of the EVLA should be made available as early as practical, but only if doing so will not significantly compromise the efficiency of the transition process.

5. The VLBA

The VLBA provides unique science capability that cannot be supplied by any other instrument currently in existence, and has an active user community of both expert and non-expert users. The User's committee encourages NRAO to continue to devote resources to the VLBA, especially to expand its capabilities and improve its ease-of-use. With the growing number of new observatory projects such as ALMA and the EVLA it is essential that user support for the VLBA be maintained at least at the current levels.

We encourage the completion of the upgrade to Mark V recording as soon as possible. This improvement is of primary importance as it enhances the instrument's capabilities, will provide cost-savings in tape-drive maintenance over the longer-term and is relatively inexpensive. We appreciate that the rate of the upgrade is dependent on funding resources and encourage utilizing the VLBA for spacecraft navigation purposes for a fraction of its observing time in order to implement the upgrade more quickly. The Mark V recording upgrade definitely has priority over any improvements to surface accuracy at the higher frequencies, as it will have a positive impact on the widest number of users.

We reiterate our request that attention be given to experiment status information for users with dynamically scheduled observations. We appreciate that difficulties exist in how priority is assigned to projects and that a fully automated system could require considerable effort. However, various other telescopes are currently scheduled dynamically and it may not be necessary to invent a new system. We request that NRAO investigate whether implementation of another system is feasible for the VLBA. Dynamic scheduling will have to be solved prior to the completion of ALMA and the VLBA is a good test.

- We request a presentation at the 2005 Users Committee meeting on the distribution of the time different projects spend in the dynamic schedule queue.

We heartily endorse the improvements to the archive data system and the use of FTP data retrieval for some VLBA projects. Although the long-term goal of having all VLBA data accessible from an online archive is of primary importance, posting older VLBA datasets online when requested is an adequate, temporary solution and does not hinder usage of the data significantly. Care should be taken to provide access to the data using various fixed media for those not connected to the Internet via broadband connections.

Upgrades to the VLBA receiver systems are important, especially at the higher frequencies and should remain a priority item. We urge that the relocation of the Los Alamos antenna (if necessary) be

done as quickly as possible to reduce the negative impact of the loss of short baselines in the array.

We thank NRAO for the current level of data reduction pipeline functionality and for providing multi-source FITS files as the final data product. We do not request additional improvements at this time. We applaud the formation of the High Sensitivity Array. Although scheduling and coordinating observations obviously are a burden on the system, the User's Committee feels that the science benefit makes the efforts worthwhile.

Finally, the User's Committee wishes to thank the scientific and technical staff supporting the VLBA. The instrument works well and provides exciting scientific results mainly due to the efforts of the various people working behind the scenes in Socorro and at the remote sites.

6. ALMA

We are pleased to hear that the ALMA construction project is proceeding smoothly, and that other aspects of the project are also making good progress. The appointment of Paul vanden Bout as the first head of the North American ALMA Science Center is particularly good news, and is strongly endorsed by the Users Committee. We are looking forward to seeing how the ASC comes together as a vibrant center for ALMA science for North American users under Paul's leadership. We also welcome the efforts of Harvey Liszt toward Observatory-wide spectrum management, and endorse his recommendation that the protection of the ALMA environment against RFI be established now by appropriate means and maintained to protect the promise of this and future instruments (such as the SKA).

As a group representing the present and future users of the NRAO facilities, the greatest point of concern for us regarding the ALMA project is user support. We understand that the scope and the role of the ASC is still undergoing definition and development, but also encourage the development of plans that ensure the ASC user support structure is in place well before early science observations begin. We are concerned by the extremely limited scope of the "core" functions currently defined by the ALMA project, and in particular that the more traditional user support functions, such as direct consultations with staff scientists or science and technical workshops are now part of the "enhanced" functions to be provided by the existing and already stretched internal NRAO resources. ALMA promises to be a powerful research tool for ALL astronomers, and NRAO should be prepared for high demand for extensive user support from users with relatively little or no radio or interferometry expertise. Along these lines, we appreciate the NRAO's acknowledgement of the expertise and potential available at external millimeter & submillimeter

observatories, and encourage stronger interactions with this community to ensure that the ARC will have access to the best and broadest resources for new ALMA users.

We encourage those planning the North American ALMA science center to communicate clearly to the general community of potential users how the science center will support them, especially during the early science period. A good way to get more of the astronomical community involved with ALMA is to advertise widely the development of a vibrant, well-staffed science center, what kinds of services will be offered there, and what the typical ALMA observing experience is likely to be.

Two additional areas of importance are the financial support for ALMA users (which the user committee endorses enthusiastically) and the software development (which was not discussed much in the ALMA presentation but was covered more broadly in other presentations). Although these points are amplified in the more directly relevant sections elsewhere in this report, we emphasize the importance of these two areas for the future ALMA users.

- We request a further update on financial support for users and software development to be included in the ALMA presentation during the next meeting.

7. Telescope Scheduling and Proposal Review

The Users Committee noted the significant improvement in the way NRAO proposals are now handled. In particular, the level of detail in the comments made by the Scheduling Committee has greatly improved. However, there are still a number of concerns regarding the proposal and scheduling process that the Users Committee would like to see addressed.

1) The Users Committee is pleased to see that NRAO has significantly revised its approach to Rapid Response Science. The new policy is much clearer and fairer. The categories of "Known Transient Phenomena" and "Targets of Opportunity" are consistent with what other major observatories offer.

However, the Committee still feels that the Rapid Response Science program needs improvement. A large part of the motivation for previous recommendations made by the Users Committee was to eliminate "Ad Hoc" time, which we felt had been used as a short cut to getting observations that would otherwise be peer-reviewed in the normal manner. While "Ad Hoc" time has been eliminated, it has been replaced by "Exploratory Time", i. e. proposals which (according to the NRAO WWW page) 'are close in nature to those formerly called "Ad-Hoc" proposals'. Since this is the only definition given, and only two examples follow, we are concerned

that the concept of Exploratory Time is still vague, and thus open to misuse.

There was consensus on the Users Committee that Exploratory Time should be eliminated from NRAO policy. The vast majority of projects currently accepted as Exploratory Time projects could be submitted as normal proposals. We did not feel that the desire to avoid waiting for the appropriate configuration or observing deadline, or the prospect of exciting science, which can't wait for the next proposal deadline, is a compelling argument to warrant circumvention of the normal peer review process. This is especially so for the VLBA and GBT, which do not move through a long array configuration cycle as does the VLA.

We do recognize the worth of having extremely limited amounts of "test time" or "Director's Discretionary Time" available for small pilot projects which are compelling but not time critical, particularly in cases where students are involved. If NRAO feels that some such time needs to be retained, we recommend that the following criteria be considered:

* The proposal does not need to meet any specific criteria for merit or need. Any proposal can be submitted to request such time.

* On a short time scale of a few days, the Scheduling Committee should categorize the proposal submitted, email it to the corresponding external referees who normally review such proposals, and ask them for a quick response. The Scheduling Committee or Officer in Charge should make a discretionary decision based on whatever comments the external referees are able to provide on this short timescale.

* Such proposals should have no proprietary period and go straight to the archive once observations are completed. (Data rights should only be available for proposalsthat undergo a full peer review through the normal proposal process.)

* If possible these observations should be carried out by NRAO staff to avoid any "claim-staking" by those who triggered the observations.

On a lesser note, we note that no information is provided on the GBT WWW pages listing Exploratory Science projects, despite significant science results having come from such observing time. This information needs to be added, in line with the VLA and VLBA WWW pages that clearly list such projects.

2) We applaud NRAO's efforts at dynamic scheduling on NRAO facilities. However, we recommend that the schedulers avoid situations in which swaps take place for which the requirements of low-frequency projects (e.g. LST coverage, array configuration,

length of tracks) are compromised at the expense of high frequency projects. Only when the swap is close to equitable should such scheduling be undertaken.

3) The Users Committee is concerned that proposals are not always being sent to those best equipped to review them. For example, a VLA proposal to study the magnetic fields of spiral galaxies might currently be sent to an "extragalactic" panel, while Galactic astronomers familiar with polarimetry and magnetic fields might be more qualified to judge such a proposal. We thus recommend that proposals be grouped not only according to broad science categories, but also by the techniques they employ.

4) The general process of time allocation at NRAO was a subject of extensive discussion by the Users Committee. Some members of the committee felt that the procedures at NRAO for allocating telescope time are anachronistic, in that most other national facilities, whether ground- or space-based, convene face-to-face external panels to evaluate proposals. These panels change in composition year to year so that the responsibility of allocating telescope time is distributed across many scientists over time. On the other hand, the logistics involved in convening such panels would necessitate switching to two observing terms per year. . Some Users Committee members were concerned that face-to-face panels would allow the person with the loudest voice to "steamroll" the rest of the panel into accepting or rejecting a proposal, which might receive more mixed reviews under the current system. Also, it was pointed out that NRAO reviews generally provide the most useful feedback of all telescopes, since proposers usually receive multiple independentand thoughtful comments on their proposals, as opposed to a short panel summary.

- In the absence of any consensus from the Users Committee, we do not make any recommendations on the time allocation process this year. However, we would like to conduct a full review of this next year and hope to then make an extensive set of recommendations. It would thus be helpful if NRAO could provide a comprehensive set of statistics on proposal grades and time awarded in advance of the next meeting, which will allow us to assess the validity and performance of the current system.

- The Users Committee had requested to meet with the non-NRAO member of the scheduling committee at their 2004 meeting. This proved not to be possible; we repeat this request for 2005.

5) The Users Committee was asked to comment on the possibility that ALMA might have different proposal cycles to the current NRAO system. The Committee suggests that NRAO should not feel

constrained to keep a three-term cycle for telescopes that are not bound by configuration cycles, as is the VLA.

6) The Users Committee encourages NRAO to continue to improve the tracking of the progress of student thesis projects. Proposals designated as thesis projects should include an estimate of how much additional time will be needed on NRAO telescopes for the completion of the project; such projects should be flagged in the database and given special consideration during future proposal cycles if additional time has been clearly justified.

8. Software & Data Management

8.1 The Interferometry Software Division (ISD)

The ISD was formed shortly before the 2003 User's Committee meeting and appears already to have become an integrated division within NRAO's structure. The overall goals of the ISD are to meet the requirements of ALMA and the EVLA, while maintaining and improving the necessary software for users of the VLA and VLBA. We are impressed by developments in all of the sub-divisions of the ISD (AIPS, AIPS++ and E2E). We are also happy to see that overall the ISD is trying to strike a good balance between laying the groundwork for both ALMA and EVLA, while also maintaining a working software system for users of current NRAO instruments.

8.2 AIPS

AIPS continues to be the primary tool for data reduction, image creation, and analysis by most radio astronomers using NRAO facilities. As AIPS++ becomes more focused on meeting ALMA design requirements rather than being available for the general user community, it is crucial that AIPS continue to be supported, at a minimum with versions running on the latest compilers and operating systems.

8.3 AIPS++ and the Science Software Group

The AIPS++ package as it stands supports a broad base of general-purpose tools for interferometry and single dish data reduction and analysis. 2003-2004 have been and continue to be crucial years for the Science Software Group. During the past year, AIPS++ has met new benchmarking requirements in terms of speed, which was previously a major concern of users. The new AIPS++ rpm packages are essential for distributing AIPS++ to the user community. Although the development focus is on supporting new facilities, we strongly urge the AIPS++ group to retain existing functionality. We also strongly support the involvement of scientific staff in the AIPS++ group to help direct and drive the scientific goals and the development of a user-friendly interface.

8.4 The E2E project - Pipeline, Archive & Proposals

Last year's presentation outlining the E2E project showed a clear path of interaction between scientific staff and programmers to develop the tools for the E2E mission. During the past year, the E2E project has taken a new direction by developing an oversight committee, comprising several members of the scientific and computer programming staff. This year's presentation seemed less clear as to how these interactions were progressing, even with the presence of the E2E oversight committee in place. There was some concern among the committee about how effective this restructuring has been in terms of staff members' time and the availability of these staff for general user support. The components of the E2E project (pipeline, archive & proposal tool) are of great interest to users and we outline our comments on each of these below.

8.4.1 Pipeline – The committee recognizes the inherent difficulty with implementing an all-purpose data reduction pipeline, but we suggest that a pipeline for the most commonly used modes (especially those used by the general astronomy community, e.g. X and C band continuum mode) would vastly enhance user friendliness. The same principles should be applied when using E2E to generate observe files from proposal forms for the most common observing modes.

8.4.2 Archive - The committee is very enthusiastic about the progress made with the VLA/VLBA archive since last years' meeting. The new NRAO-wide data archive policy went into effect on 1 Feb 2004, with appropriate similarity to those at most other major observatories. We hope that NRAO continues its efforts to create a complete NRAO archive, as this also puts NRAO in line with other major observatories. However, our view was that the archive still remains primarily of use for radio astronomers and there are several ways in which it could be improved to be of wider use in the broad astronomical community.

- Data Format: A number of users, who do not use AIPS for data reduction, requested that the UV data be made available in basic FITS format, rather than only in AIPS-readable format.

- The link for the NRAO archive and NRAO-wide data archive policy should be featured more prominently on VLA/NRAO web page, as prominently as the call for proposals (which itself could be featured more prominently), and should definitely be featured on the "Resources for Astronomers" section of the web page.

- The Archive search results should provide links to the proposal title, authors, and abstract for information on scientific motivation, description of configuration, and observing details. The current configuration requires users to 'translate' the

details of an observation from the Advanced Query Search. How to do so may not be obvious to a non-radio astronomer.

- NRAO should encourage links to the VLA Archive from the usual archive servers, e.g. NED, MAST, SIMBAD. NRAO should enable scripted querying of the VLA Archive in accordance with accepted standards used by the large archive systems. This will enhance the user base for NRAO data and will likely lead to an increased number of users.

8.4.3 Proposals - The VLA and VLBA proposal system, although functional, is somewhat outdated and at some point needs to be migrated to a web-based system (examples of on-line proposal tools include Chandra, Spitzer, and Gemini observatories). Improvements in the proposal tool, as proposed by the E2E project, will help to streamline the current E2E process for NRAO instruments and will make NRAO facilities more attractive and "user friendly" to the general astronomical user base.

We are encouraged that efforts in this direction are already underway with the GBT proposal tool prototype and plans for the next phase of an NRAO-wide proposal tool scheduled for 2005. We note that the GBT proposal tool prototype currently used has been a boon to telescope scheduling. We await the formal arrival/release of the GBT proposal tool and are anxious for future developments in this area. Again we are especially enthusiastic that a member of the scientific staff is on the proposal tool working-group to give valuable insight from the scientific users' perspective. These developments also appear to be in line with and to meet the needs of the ALMA and EVLA projects, for which a system-wide proposal tool will greatly improve the efficiency and ease of NRAO observing.

9. NRAO in the larger community: training, visitors, and E/PO

The Users' Committee strongly supports NRAO management's efforts to more aggressively promote both radio astronomy and the NRAO's position as a national resource. Parts of the Committee's report focus on the importance of providing modest salary support for students, postdocs, and occasionally more senior researchers outside of NRAO. As a practical matter, NRAO is competing with the better-funded NASA observatory programs, so retaining community is an unfortunate but appropriate concern. Although NRAO is not a surrogate for NSF funding, some direct funding will help.

The following paragraphs are the Committee's detailed comments on the elements of NRAO's outreach and training activities.

9.1 Predoc support

The Committee heard presentations on two programs in this area. Both are important to attract and retain budding astronomers. The Predoc Program primarily supports students who are involved in collaborations with NRAO staff at NRAO sites, while the GBT Student Support Program assists students involved in GBT observations at their home institutions. NRAO also has valuable and active REU and engineering co-op programs that were not part of this year's presentation.

Both the Predoc and the GBT Student Support Programs are very important. In budget tradeoffs, the Committee strongly believes that both should be protected. If possible, creating programs modelled on the GBT's Program would be valuable for other NRAO program areas.

With an emphasis on promoting and retaining young astronomers, the Committee felt that it might be worth trading a Jansky fellow for predoc support if the applicant pools warrant the trade.

The Committee finds that knowledge of the Predoc Program is not as widespread as it could be. It would be worthwhile to send flyers to the Directors of Graduate Studies at universities that have research astronomy and physics departments as well as advertising the programs more broadly and efficiently. Broadening a mailing that includes information on REU and other undergraduate summer research opportunities would be appropriate.

9.2 Jansky Fellowships

The Jansky Fellowships are the most visible postdoc positions NRAO offers, and last year's shift to "portable" Janskys selected by a high-profile committee has been an unqualified success.

The committee is pleased to see a marked increase in both the number of applicants for Jansky Fellowships and the number of proposals considered to be high enough quality to be placed on the short list. There was some concern among committee members that the NRAO and the selection committee continue to look for ways to support not only young radio astronomers that are already "known well" at NRAO but also to look for multi-wavelength astronomers with a significant radio component to their project, in order to enhance NRAO's exposure to the wider astronomical community. The Committee also recommends that NRAO deal explicitly with the issue of overhead when awarding Jansky Fellowships to non-NRAO institutions: either clearly state that no overhead will be allowed, or follow the example of other fellowships that send a fixed amount of funding to the host institution (~$5000/yr) to cover basic administrative costs associated with the grant.

The committee strongly suggests that the NRAO poll the external Jansky Fellows at least twice a year to find the problems they and

their host department encounters. For instance, the current scheme of making the Fellows NRAO employees has the side effect of keeping them from being university employees, which has an impact on local benefits and the ability to submit grant proposals.

9.3 Visitor's Program information

The Visitor's Program is NRAO's one area of direct support for established researchers.

The NRAO Visitors Program web page does a good job of emphasizing the flexibility of the program. The committee suggests that adding the following information may help attract potential visitors:
1) Typical number of visitors NRAO can support per year
2) Kinds of available support (computers, partial salary,etc.)
3) Typical timeline for processing a request
4) Expected submission materials
5) List of recent visitors to NRAO, as a resource for logistical information for new visitors
Making sure this information is always up to date could help bolster the impression that the visitors program is an active NRAO program.

9.4 Expert involvement with ALMA and other projects

It would be appropriate for the NRAO to work with the users' community to find ways to support short- to mid-term visits for work on ALMA and other project activities. It would be good to encourage community interest in participating in these projects in the early stages, to take advantage of the considerable expertise that can be folded into research and development work. To facilitate this, the Committee encourages the NRAO to define and advertise the specific kinds of involvement that would be of interest to the NRAO, including timelines and support.

9.5 University instrumentation

The Committee was pleased that there is continuing interest in supporting university instrumentation on NRAO facilities, when appropriate. The committee was sorry to hear that the GBT program does not expect new starts on NRAO funding, but was encouraged to see that the Observatory is open to alternative ways of funding projects.

This kind of work supports NRAO's desire to promote technical development in the academic community as well as astronomical research. As telescopes become concentrated at major observatories, supporting innovative ideas for specialized instruments built by university groups becomes very important. Some of these instruments could be converted to common-user instruments by NRAO staff. The resource allocation principles

outlined in the user supplied instrumentation policy, e.g. documentation describing instrument interface, commissioning requirements, and observing proposal requirements, are clearly consistent with NRAO's research responsibilities and goals. Finalization and web posting of these policies is encouraged. This is a vehicle for improving interaction and communication between NRAO and its counterparts in the wider instrumentation community.

9.6 Communication with the community at large

The Committee recognizes and appreciates NRAO's improved informational web pages. Advertising new opportunities is still an area that benefits from active notification by email, newsletter, or fliers. A small amount of information distributed actively will spur interest in deeper investigations on the web.

Those members of the Committee who receive the NRAO newsletter find it very informative and useful. Many members do not receive it, however, which makes it an uncertain method at best for communicating even within the broader radio astronomical community. It has little visibility outside the radio community. Cost permitting, the Committee suggests that expanding the subscription list to automatically include active proposers and observer PIs would be a useful step.

As NRAO seeks to broaden its user community, it is important to publish announcements of opportunities of wider interest, for instance summer schools, in the AAS electronic newsletter.

9.7 Education and Public Outreach (E/PO)

The NRAO recognizes the very long term benefits of E/PO and has developed a vigorous and multi-faceted outreach program over the past several years. The Users Committee applauds the energy and breadth of this effort, including facilities, programs, and web-development.

The Committee agrees with the areas for improvement outlined in the presentations. Specifically these included the following:

1) Establish a good mechanism for encouraging press releases by the scientific community. NRAO cannot wait for scientists to wander in the door looking for help developing a press release; NRAO must be proactive in encouraging and facilitating press releases. The Committee suggests that NRAO send an email to successful PIs approximately six months after their observations to encourage them to come up with material that could be captured in press releases.
2) Involve the NRAO staff to a greater degree in E/PO activities. This is a desirable goal, but the current climate of an overburdened staff makes this unlikely to happen.

3) Develop assessment tools to measure and shape programs.
4) Produce eye-catching imagery for the public from the data archives, as in the Hubble Heritage project.

In addition, the Committee encourages the continued improvement and organization of the web site, which has improved in content, but is now rather busy. The Committee also emphasizes again the importance of sending copies of the NRAO press clippings book to relevant people in Congress, especially the members of appropriate committees and members whose constituents have a press release.

9.8 Diversity

A long-term goal of academic and public outreach should be to increase the gender and racial diversity among radio astronomers. The Committee noted the lack of diversity among NRAO senior staff and management and comments that this impacts NRAO's overall reputation. The Committee recognizes that NRAO has done an excellent job in recent years in broadening the base of students that are brought to NRAO in, for example, the REU program. The committee hopes that these efforts will continue and will steadily contribute to changes in the distribution of professional astronomers, which will subsequently be reflected in the increased diversity of NRAO staff.

10. Central Development Laboratory

The Committee was impressed by the new Central Development Laboratory facilities and by the smooth transition to the new building. A number of smaller projects are moving to the telescopes as planned. The CDL's major projects over the past decade have been technical preparation for ALMA and the EVLA. Now that these projects are moving from design to fabrication the CDL staff has the opportunity to investigate broader questions of technical developments in radio astronomy.

The CDL reorganization to accommodate ALMA construction and the unification of the Tucson group at the NRAO technology center is well underway. Technical activities previously carried out in the old Ivy Road facility have been successfully moved to the new facility and are up and running. Consolidation of the ALMA project at one site is a positive means of enabling greater interaction between the personnel concentrating on design and production of the system. An emphasis on manufacturability, reliability, and testability will take on greater importance as ALMA moves from the design to construction phases. It was encouraging to see active and careful consideration of these details that will ultimately influence the schedule of the project.

The efforts of the CDL in the development of electronics and systems that enable new astronomical science are a clear asset to the radio astronomy community. Recent results demonstrate state of the art performance in SIS mixers, balanced amplifiers, hot electron bolometers, and spectrometers. Exploration of new concepts and interaction with the greater research community is an important element of realizing a vibrant research and development environment for the entire Observatory.

The Committee encourages NRAO management to insure that there is strong input from the user community as well as from senior NRAO staff in setting priorities for this development. Neither the presentations nor private discussions with CDL staff members illuminated the process for selecting new projects, much less for prioritizing those with high scientific impact. NRAO could do well here by soliciting advisory participation from the broader community in addition to its internal technical and scientific staff.

11. Spectrum Management

The User's Committee was very pleased to see the excellent and comprehensive web site, http://www.cv.nrao.edu/~hliszt/RFI/RFI.htm built by Harvey Liszt on the issue of spectrum management. Such a central resource is vital for a distributed-site radio observatory such as the NRAO. The User's committee 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.

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 to guarantee a good RFI environment for ALMA.

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 User's Committee recognizes that this goal is likely unattainable given current resources. At a minimum, users of NRAO facilities need to be informed of potential interference and its impact on their data, strong and damaging RFI should be reduced to acceptable levels, and efforts must be made at the national level to prevent establishment of damaging FCC regulations.

We thank NRAO for making RFI reports available on a central web page for the VLA (http://www.vla.nrao.edu/astro/rfi/) and request that the corresponding web page for the GBT (www.gb.nrao.edu/IPG/) should be linked to this central list. Users should be informed of the existence of these pages and of bands where RFI is likely to negatively impact the observations. Links to these telescope-based resources should be made available on the central RFI web page. 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.

The present trend toward greater deregulation, increases in interference source mobility and number, and the proliferation of wide bandwidth systems will require new arguments and approaches for spectrum protection. The methods developed for interference mitigation in radio astronomy have had considerable influence on the signal processing techniques presently found in general instrumentation applications. Other interests are and will continue to compete for spectrum due to their increasing technological value and accessibility. Arguably, such ventures are presently considered economic drivers and frugal use of this resource may not be their primary goal. In such an environment, the answer to “why radio astronomers worry about interference” is perhaps of lesser importance than “why and to what degree society at large should ultimately be concerned about the end consequences” of such unintended effects. Down to earth examples of the technological and economic impacts of EMI/EMC could be considered as a means of conveying these basic points on the “Radioastronomy and Interference” webpage and other outreach forums. The impact of good spectrum management goes beyond mere preservation of humanity’s ability to perform scientific inquiry; in the end the necessary compromises will enable or limit the smooth and reliable operation of the very systems on which our society depends. An emphasis on the implicit value and the benefits of resource stewardship and planning in an era of rapid development could provide a forum for conveying these concerns to individuals outside the astronomy community.

12. Users Committee Meeting Issues

The User's Committee is pleased with the extensive documentation provided by the NRAO in advance of the committee meeting. However, in recent years, much of this material has been needlessly duplicated during presentations to Committee. Thus, the Committee strongly requests that presentations to the Committee be streamlined to emphasize issues for which the Committee can provide input to the NRAO's decision-making process.

Further, during next year's meeting, the Committee plans an extensive discussion of the time allocation process and requests that the NRAO provide sufficient documentation and data to facilitate this discussion (see Section 7).

- In particular, the Committee requests a comprehensive set of statistics on proposal grades and time awarded in advance of the next meeting, and requests to meet with a non-NRAO member of the scheduling committee at the meeting.