

NRAO User's Committee Report 2003

August 18 2003

1. Executive Summary

The User's Committee recognizes that NRAO has undergone extensive changes in the recent past, and faces additional change in the future. In many ways, this is a difficult time for the Observatory, and the Committee is encouraged by the creativity, commitment, enthusiasm and resilience of the management and staff of NRAO in the face of these challenges. We note with approval evidence of widespread determination within the Observatory to exploit the changing landscape for the benefit not only of NRAO, but of the radio astronomy community as a whole. We are confident that the excellence which has characterized NRAO for so many years will continue, and that the complementary and interdependent roles of NRAO and the University community will be maintained and enhanced.

The restructuring effort is major, with relocation of numerous personnel, the formation of new divisions, the dissolution of the AIPS++ consortium, reassignment of priorities, and major shifts in responsibilities. It is inevitable that under such circumstances there will be dislocations and disruptions, occasional morale issues, and considerable controversy. The User's Committee nevertheless generally endorses the changes, perceiving them to be both necessary and potentially highly productive in the long term. The success of these efforts depends to a large extent on the goodwill and support of the staff, and we hope that NRAO as a whole will work to make the transitions as smooth and effective as possible.

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

- We welcome the formation of the DSAA, and make several recommendations with regard to Jansky fellowships, student programs, and visitor programs.
- Software and data management is a critical area for NRAO, and we hope for a swift resolution of current problems. We perceive promising signs in the wake of the dissolution of the AIPS++ consortium, but major challenges exist.
- Scheduling issues are considered, and we are generally happy with the manner in which telescope time is allocated. Among our recommendations are that dynamic scheduling should be extended, and better supported.
- We strongly encourage NRAO to streamline and modernize data archiving and retrieval, for all NRAO telescopes.
- The GBT continues to mature as a user instrument, though some rough edges remain, which need to be addressed. We are concerned about the track problems.
- The VLBA should be upgraded to disk-based recording as soon as possible. Several actions should be taken to expand the VLBA user community, not all of which require additional resources.

- The EVLA project is moving forward well, and we endorse the manner in which NRAO is balancing the needs of the project and of the users.
- We endorse the creation of an ALMA division within NRAO, and hope that the reorganization serves the project well.
- We also like the creation of a technical coordinator position for the Observatory, which we hope will better optimize the activities of the observatory as a whole.
- The Committee is pleased with the state of EPO activities at the Observatory, and makes several suggestions for additional improvements.

2. Division of Science and Academic Affairs (DSAA)

The Users Committee finds the development of DSAA a very positive move for the NRAO. In particular, this division provides a more direct (and clearer) route for non-NRAO astronomers to interact scientifically with the Observatory and for NRAO staff astronomers to interact with the larger community. We look forward to seeing this division progress toward its general goals of more effective communication and collaboration with the astronomical community at large, particularly with astronomers and students at universities. The User's Committee is keenly interested in the work of the DSAA, and we request that NRAO provide a report on progress, and the reorganization this initiative represents, sometime in the Fall. Below, we comment on specific management areas which are now organized under DSAA.

2.1 Jansky Fellowships

The Users Committee understands the NRAO concern that Jansky Fellowships are not viewed externally to be as prestigious as Hubble or Chandra fellowships. Indeed, the proposed enhancements in the Jansky Fellowship program (commensurate salaries and travel benefits with Hubble/Chandra, increased flexibility in choice of host institution) are consistent with the broader goal of enhancing the profile of radio astronomy in the wider astronomical community. However, the committee feels that the best way to achieve this goal is to focus the scientific support of the Observatory on an earlier career stage, in particular on predoctoral students (see our comments on the predoctoral program below).

Given the promise of a significant potential increase in the NSF budget in the next 5 years, in which it is to be hoped that Astronomy in general and NRAO in particular will share, it may be possible to enhance both the predoctoral and the Jansky postdoctoral programs. Therefore, we make these specific recommendations for the Jansky Fellowship program:

- The Jansky Fellowship residency should be more flexible between NRAO sites. Our general impression is that Jansky fellows are allowed to move between sites currently, but significant anecdotal evidence exists among committee members to suggest that such moves are not encouraged, and have in some cases been openly discouraged in the past.
- Every Jansky Fellow should have identical opportunities. Salary, travel support, and flexibility of site choice should be the same for all Fellows. That is, there should not be a two-tiered system for Jansky Fellowships.

- The Jansky Fellowship selection committee should consist of members held in high regard by the general astronomical community. A selection committee composed of senior and prominent members of the field will add public recognition of the Fellows' perceived scientific promise. Selection by such a committee is likely to have an equal, if not greater, impact on the perceived prestige of the fellowship than increased salary, benefits, and flexibility.

There are varying opinions among committee members about the value of Jansky Fellows taking residence at host institutions outside of the NRAO. Some expressed concern about the NRAO funding students who would go elsewhere and use NRAO money to support postdoctoral work with only a small radio component. Other members expressed enthusiasm for Jansky fellowships that required one year at an NRAO site, but noted that the prospects of relocating multiple times in such a short period is not likely to enhance the desirability of the fellowship. In any case, it is not clear that the Jansky program is waning in value, given that the declining number of applicants is also seen in the pools for other prestigious fellowships.

2.2 Predoctoral programs

The GBT Student Support Program is an important step in increasing opportunities for students to gain experience in radio astronomy. It would be valuable to have information about the results of this program on the Student Support Program website, including number of projects funded, oversubscription, and average award value.

The committee suggests that the NRAO consider further expansion of its predoctoral program to include a more long-term funding program, like the NASA Graduate Student Research Program (GSRP), that would fund students seeking to work with any NRAO facility. Supporting students at their home institutions would be a valuable form of indirect support for faculty members who use NRAO facilities in their research programs, providing additional encouragement for incorporating students in radio astronomical research projects. To meet the stated goal of establishing stronger connections with universities, the NRAO might encourage students wanting to complete a thesis with a significant radio component by supporting them for a period of two to three years, which should be sufficient for them to gather most if not all of their data (a two-year period would, for instance, cover one full VLA configuration cycle and include further time for analysis). The structure of the program could also encourage students with a non-radio thesis to add a significant radio component. For reference, information about the NASA GSRP is available at <http://fellowships.hq.nasa.gov/gsrp/>.

2.3 Visitors program

The committee enthusiastically endorses the resuscitation of a formal (or at least semi-formal) visitors program. The creation of the DSAA provides a clearer entry point for external requests for short- or long-term visits to Observatory sites and the collaborations that would accompany them. However, those requests could be better handled if relevant information were available on the NRAO website, describing:

- Contact information for the administrator of the program
- Deadlines and appropriate submission materials

- Typical funding levels available

In this same spirit, adding opportunities for NRAO staff to make short-term or long-term visits to Universities or other research institutes could significantly broaden the interaction between the Observatory and other research groups. This type of program will be most effective if its emphasis is on breadth rather than deepening existing collaborations. We note that NRAO funds are available for staff members to give colloquia at universities. This could be better publicized, including use of the NRAO website. Lastly, in the interests of increasing the user base for NRAO facilities, the Observatory should maintain and advertise helpful and friendly assistance for new observers, whether they are students or professional scientists.

3. Software/DM

Many changes in the Data Management and Science Software group at NRAO have taken place during the months preceding the User's Committee meeting: the AIPS++ consortium was terminated, and a complete re-organization of the structure of scientific software development at NRAO has been started, and is still evolving. The formation of an observatory-wide computing council, the Interferometry Software Division, the new role of scientists in the definition of clear software requirements, and their subsequent role in the development/ testing cycle, all represent a promising framework for the development of functional and user-friendly software for the observatory.

It is hoped that the reorganization process will soon be complete so that the task of addressing rapidly approaching milestones, especially for the AIPS++ project and its contractual obligations to ALMA and the EVLA, can be given the due care and attention that is required. The User's Committee is cautiously optimistic that these changes will bring about the advances in software development that were presented at the meeting. Our caution stems largely from the checkered history of the AIPS++ project and the vainglorious project goals that have been announced in the past. However, some benefits of the new approach are already apparent: for example, the science software requirements have been defined by scientists for the ALMA offline reduction system and the EVLA project, as well as some of the e2e toolkits, so it is clear that some progress has been made.

3.1 AIPS++

The demise of the international AIPS++ consortium allows more emphasis/resources to be placed on specific code development required by NRAO, building on the existing AIPS++ core infrastructure, particularly in the short term for ALMA. However, significant parts of AIPS++ have been developed at institutes other than NRAO, for example the modules Tables, Quanta and Measures. The committee is concerned that NRAO ensure availability of expertise in all areas of the AIPS++ code base, either for maintenance or further development, especially for those components of the code developed outside NRAO.

As part of the reorganization of software development at NRAO, a group comprising all interferometry expertise at NRAO has been formed (the Interferometric Software Division). It has been evident that there has been little communication between the AIPS and AIPS++

software groups, raising the concern that the experience of the AIPS programmers were not being best used. The User's Committee welcomes the formation of this new group and hopes it will provide a framework that permits better use of the available interferometry software expertise at NRAO.

The coming year is crucial to the AIPS++ project, and could decide whether the package has a long-term future. In 2004, AIPS++ has to meet performance goals set by the ALMA project. This is a major goal for the project and will not be easy to attain, given the pressing timescale and the well-known throughput problems of the package. The User's committee endorses all efforts to realize this goal.

The User's Committee sees the AIPS++ contractual obligations to ALMA as beneficial to the project in the long term: for AIPS++ to be ever accepted as the reduction package of choice, it has to demonstrate superior capabilities to the user community. This could be achieved in large part by the work to be done over the next year addressing the performance specifications set by ALMA. It is imperative that benchmarking represent an honest assessment of the capabilities of the software for a typical user, and that the testing process be transparent to the user community. Much of the code development aimed at ALMA can lead to wider application for other radio astronomy instruments.

One initiative that was welcomed by the User's Committee in 2002 was the long-overdue formation of the NRAO AIPS++ User Group (NAUG). The use of AIPS++ by astronomers to reduce real observations was seen as an essential part of the development cycle of the code. It was evident that the NAUG was providing the feedback to the AIPS++ group necessary to advance the code development. While the NAUG was not mentioned this year, we trust that scientists remain heavily involved in the development, and we appreciated the fact that a scientist reported to us on Data Management during the meeting.

3.2 AIPS

In spite of AIPS++, classic AIPS remains the workhorse software package for data reduction at the VLA and VLBA, as well as for many global VLBI experiments. Therefore, it is imperative that AIPS continues to be supported, not just at the level of ensuring that it continues to perform using the latest compilers and operating systems. The committee feels that AIPS offers the only realistic prospect for significant VLA and VLBA functionality enhancement in the near term, areas which have been relatively stagnant for a long time. Consequently, we recommend that the AIPS group be significantly strengthened, so that new capabilities can be contemplated.

This recommendation is, however, tempered by our recognition that programmer availability is limited within NRAO for all projects, and we suggest that NRAO consider specifically strengthening personnel resources in this area.

3.3 GBT

Most of the restructuring of the software effort has been targeted at interferometry. In order that some immediate problems with data reduction at the GBT could be addressed, single-dish data reduction software development has been provisionally handed off to the GBT for one year. The

User's Committee is a little concerned with this situation since it seems to be counter to the "one observatory" approach adopted for other projects at NRAO. However, since ALMA has a requirement for single-dish data reduction, it is hoped that the code developments directed at GBT-specific problems will be of use in a broader context.

3.4 E2E

Last year, the e2e was presented to the UC as the model to be adopted by NRAO for an integrated approach to handling data, from the proposal stage of a project through to archiving of the observed data. At that stage the project was little more than a series of ideas on how such an approach could (would?) be implemented. Given the well-known history of AIPS++, the UC was very concerned that the project could become another behemoth software project that would place further strain on the programming staff at NRAO, and further divide effort that was deemed necessary for AIPS++.

It is refreshing to see that the scientific staff (and other users) have led the definition of the science software requirements (SSR) and set the science priorities for e2e. It appears that there is a successful feedback mechanism between programmers and the SSR group at the software design stage, frequent interaction between scientist and programmer during the development stage, and important on-going testing, and eventually acceptance, by the scientists.

The success of this approach can in part be measured by the rapid development and completion of the calibrator source tool, and the on-going work on the archive tool. This is very encouraging to the UC and it is hoped that this structure is maintained during the development of the remaining, and perhaps more challenging, aspects of e2e. Furthermore, it is hoped that this development mechanism can be successfully applied to AIPS++, and future software developments.

3.5 The Archive

The current approach to data extraction from the VLA/VLBA archive appears dated compared to other institutes (e.g. STSci). The Committee notes the burden placed currently on the data analysts to retrieve archival data from the tape library. Furthermore, there is an onerous approval process required before nominally public data can be exported. Having all archive data on disk (already completed), and the completion and full release of archive tool in the near future (planned for October 2003) will relieve the data analysts of handling the archive data. We strongly recommend that the anticipated success of the archive tool is accompanied by a re-assessment of the current archive policy, specifically regarding fully open, unrestricted and convenient access to public data without the impediment of an approval process.

3.6 The Virtual Observatory

Given the potential impact of online archival access to VLA, VLBA and GBT data to the accessibility of data, the UC was concerned that little detail was made about specification and development of the archival system. Clearly some issues have not yet been considered, such as how to automatically transfer multi-gigabyte data sets to users. Given the on-going efforts

outside NRAO with the Virtual Observatory, interoperability between the NRAO archive and the virtual observatory needs to be considered. We feel that VO access to NRAO data will significantly enhance the impact of radio astronomy on astrophysics in general. We encourage NRAO to play an active role in the development of VO standards for the interchange of radio astronomical data.

4. Scheduling

4.1 The Time-Allocation Process

The Observatory has recently reviewed the current procedures for reviewing and allocating telescope time. The document “A Review of Current NRAO Procedures for the Allocation of Telescope Time” contains an excellent description of the current review process and guiding principles and a thoughtful analysis of how it might be made better. The Users’ Committee carefully considered the current process and the recommendations of this Review. We feel that the NRAO evaluation process works well, and we do not see the need for substantial change. However, there are things that can be done to ensure that it remains a fair and equitable process and that a broad range of science is scheduled on the telescopes. We make the following recommendations, some of which have also been suggested by NRAO’s internal review.

- In the spirit of ensuring transparency of the process, we recommend that the guiding principles in the abovementioned NRAO review document be placed on the NRAO web site. That should be accompanied by a distillation of the process and policies that guide the decision process. In this way it is clear to all proposers and reviewers exactly how proposals are judged. A simple first step could be to put a copy of the review document on the web.
- We recommend retaining one outside person on the TAC. The Committee felt that having non-NRAO members of the TAC is important to ensuring variety and a broad perspective, which is essential to avoiding biases in the evaluation process. There was some concern that one outside reviewer was not enough, and last year the Committee did recommend that an effort be made to recruit more than one. However, we recognize that it is difficult to find people to fill this time-consuming role, and that to have a substantial impact one would really want many more than one outside member. We do recommend that the outside TAC member be paid as other reviewers are now. Next year the Committee would like to hear from the current outside member of the TAC so that we can judge how effective they feel they have been.
- We feel that reviewers need to be given clearer guidelines about how to review proposals.
- After the TAC deliberations, it would be useful to have all of the accepted proposals and their allocation of time put on the NRAO web site. This will be particularly useful as feedback to reviewers who can see how proposals that they rated fared.
- Retaining proposal deadlines that are tied to configuration changes at the VLA makes the most sense. Therefore, we do not recommend adopting 6-month or 12-month proposal cycles.

- At this time we do not recommend changing the isolated reviewer process. The committee was not unanimous on this issue, but we do recognize the trade-off between misunderstandings that could be cleared up in panel discussions and complete independence of the reviews that is lost in face-to-face interactions. The former problem is addressed to some extent by considering the rms deviation of grades from the reviewers.
- So long as each TAC is convinced of the technical feasibility of each proposal which may be scheduled on a telescope, we do not recommend formal technical reviews. However there should be a process by which the technical feasibility of particularly novel or challenging projects can be demonstrated before being scheduled, such as the allocation of time subject to the technical feasibility being demonstrated in telescope test time. This feasibility test should be carried out with the involvement of the PI of the proposal.
- We see no need to implement a formal appeal process of the decision of the TAC.

4.2 Rapid Response Science

The Committee endorses the plan for dealing with science that requires a rapid response to unexpected circumstances, including transients, exploratory science, and targets of opportunity. We consider the choice of 2% of GBT time, 5% of VLA time, and 10% of VLBA time for this category of proposal to be reasonable.

However, we feel that it is better for normal programs that might be displaced to be scheduled with the understanding that they could be bumped than for PIs to find out moments beforehand that they are observing. This gives people, who could be traveling or have other commitments, the opportunity to prepare observe files or otherwise prepare for observing in a timely fashion and under calm conditions. This is the process currently in use at the VLA, and those of us who have experienced it feel that it has worked well. Projects which are affected by TOO observations should be compensated for their lost observing time on a best effort basis.

4.3 Proprietary Periods

We recommend that Target of Opportunity observations have no proprietary period. If in unusual circumstances science is best served by having some proprietary period for the data, the proposer must justify that to the Observatory when they request the telescope time.

We endorse the suggestion of reducing the proprietary period of normal observations at NRAO telescopes from 18 months to 12 months. We recommend that the clock begin ticking when the last observation of a particular proposal number is taken. However, we do feel that some flexibility should be allowed if there are sound reasons for increasing the proprietary period in limited cases (for example, PhD theses). The responsibility for requesting this extension, however, should rest with the proposer and should be stated in the proposal.

4.4 Time-scale for the VLA configuration cycle

NRAO asked us to consider the desirability of shortening the VLA configuration cycle from its current 16 months to perhaps 8 months. An 8-month cycle would still allow a specific configuration to drift through LST, but would shorten the time needed to complete multi-array projects. While the long time-scale to shuffle through all of the configurations can be frustrating, the Committee felt that the inefficiency and increased overhead of moving the antennas this frequently outweighed the advantages, and we recommend against adopting a shortened time-scale for the VLA.

4.5 Other policy changes we were asked to consider:

- **Track PhD proposals better?**
Yes. The Committee feels that PhD theses, once accepted, should be carefully supported to conclusion and protected against non-PhD proposals encroaching on the same science.
- **Increase or decrease the Large Proposal time?**
No. The limits on how much array time and LST time is available to Large Proposals seem reasonable. However, the impact of Large Proposals on the science done with NRAO telescopes should be evaluated regularly.
- **Spend telescope time obtaining "great images" for PR purposes?**
Not at this time. We do feel that beautiful images obtained with NRAO facilities can have great public appeal and are an important component of public outreach (for use as posters, post-cards, calendars, mouse pads, screen savers, etc). However, the Committee feels that there is a considerable body of data in the archives already that could be mined for suitable pictures. We recommend that a concerted effort be made to create an inventory of what the community already has, and then to carefully consider what one would want to do to augment these images or produce additional products.
- **Joint programs with other telescopes?**
Yes. The Committee feels that joint programs with other major Observatories can be important to maximizing the science from both facilities. However, we consider the joint program with Chandra to be a test of this process, and this should be evaluated after sufficient experience has been obtained before considering additional programs.
- **Dynamically schedule the VLA.**
The committee very strongly encourages NRAO to implement dynamical scheduling for high frequency projects on the VLA. The committee would also like to see similar flexible scheduling of high frequency observations on the GBT. We suggest that, in addition to drawing on the experience in dynamic scheduling with the VLBA, NRAO consult with other observatories such as JCMT and UKIRT which have already implemented fully flexible scheduling to learn from their experiences. We note that genuinely efficient dynamic scheduling at high frequencies requires a reliable phase monitoring capability, for which resource allocation should be considered.

5. GBT

The Committee has confidence in the management of the GBT. Instrumentation and software are coming on line in appropriate order and at a good pace overall, although pulsar observing modes continue to lag. The panel charged with understanding the most worrisome problem, track damage and failure, includes appropriate external and internal experts. The Committee appreciates the efforts to keep the telescope in operation as much as possible through the track test and reconstruction periods.

The Committee is concerned about the long observing schedule queue that accumulated through the telescope's commissioning phase. Proposals accepted for much of this phase were made and accepted with an understanding of shared risk; the intention was not to allow PIs to lock up a set of observations. The shared risk aspect has disappeared, however, and the projects are still in the general observing queue and blocking recent proposals. On the other hand, some projects in the queue have a scientific justification that is unchanged, and re-proposing would be inefficient. Opinion is divided on whether it would be reasonable to purge the queue of older projects at this time. In principle, this would allow the TAC to schedule the telescope to optimize the science based on advances in the field and current capabilities. PIs who have projects in the shared-risk queue would be encouraged to resubmit their proposals in their original or updated forms. We suggest that NRAO examine the contents of the queue, and the competitiveness of the projects therein, to guide an appropriate policy on this question.

It is apparent that a positive observing experience at the GBT is still excessively dependent on the physical and timely presence of local experts, in order to provide or operate software which is not in a mature state. The committee recommends that NRAO place a high priority on creating a more observer-friendly online software environment with adequate facilities for monitoring the progress of experiments, thus supporting decision-making by observers. Improvements are also needed in the area of data export, and the speed of certain AIPS++ operations.

6. VLA/VLBA

The VLA and VLBA continue to be the premier imaging radio interferometry instruments in the world, with excellent scientific productivity per dollar on a long-term basis, as measured by publication and citation rates. The User's Committee applauds this continued leadership by NRAO, which reflects the extraordinary competence and commitment of the staff. It is noteworthy, however, that capabilities in other countries are advancing relative to, and in some areas surpassing, those of NRAO's instruments. The EVLA project is vital in this regard, while modernization of key elements of the VLBA is also urgently needed. Steps are also needed to strengthen and revitalize the university radio astronomy community. This requires not only appropriately targeted funding with the cooperation of NRAO, but also proactive efforts to engage university students and faculty, and to improve the accessibility of radio interferometry techniques through software development.

6.1 Responses to specific questions

The Committee was given a list of specific questions by the NRAO Director, to which we selectively respond here.

- **How would users prefer to retrieve data from the VLA on-line archive? What level of security are they comfortable with?**

The committee feels that users would like direct online access to their VLA data in the form of FITS data files. The most desirable interface for data retrieval from a user's standpoint would be via a password-protected web-based form. We further recommend that the password system be put in place for data still within the proprietary period. The username/password combination should be tied to a given project and made available to the PI, with the understanding that they could provide the username/password combination to their co-investigators on an as-needed basis. When the proprietary period is over, the password protection should be removed, and the comments in section 3.5 above would apply. We encourage NRAO to rapidly make this service available to the community and widely publicize its availability.

- **What data products (if any) should be archived from the VLBA calibration service? Should we continue to provide this service for all observers or only upon request?**

The committee valued the presentation by Lorant Sjouwerman on the status of the VLBA calibration pipeline and the time and effort made by NRAO staff to establish this service.

We feel that the service should be provided only upon request and that the data products should include a multi-source FITS file with complete calibration tables and a detailed history outlining the calibration steps taken by the automated pipeline. Pipeline images and calibrated single-source files should not be archived, but should be made available to users upon request (e.g. run SPLIT or IMAGR only when requested by the user).

The archived pipeline product should be made available to users in some form once the proprietary period has been completed.

The committee feels that it would be valuable to improve the calibration pipeline by expanding the range of datasets it can effectively calibrate, such as spectral line data. Also, the development of better scheduling tools would be worthwhile as well. The expansion of the pipeline capability should be given priority.

- **Is the RFI monitoring/notification to observers adequate? Are many observers suffering from RFI?**

As before, we request that interference notices be archived to a web page and that users be sent a brief email with a link to the interference archive instead of emailing the entire interference report. The reason is that for most users the interference report simply does not apply, and is wasteful. It is the sense of the committee that users who are likely to suffer from RFI are aware of the issue and treat their data accordingly. However, some expert advice to novice users should be made available if observations are likely to suffer from RFI. NRAO experts should communicate with users if RFI is likely to corrupt a given experiment.

- **The next Synthesis Imaging School is planned for June 2004. What would users like to see in the 2004 Synthesis Imaging School?**

The committee feels that NRAO should begin now to expand the knowledge of the user community (both current and future users) of the special problems associated with high-frequency interferometry. NRAO should draw on the existing pool of experts in this area, e.g. from the ALMA partners and the US university observatories. At least one day of the 2004 school should be devoted to mm interferometry.

6.2 VLBA and VLA priorities

- We are encouraged by indications that an upgrade for VLBA recording to the Mark 5B disk-based system is in sight. We hope that this transition, made doubly important by uncertainties surrounding headstack maintenance and replacement for the existing recording systems, can be completed on the shortest possible timescale. The VLBA will benefit profoundly from increased recording bandwidth capability combined with lower operating costs, and for these reasons, the upgrade should be a priority. The timing of purchase of the new systems involves a compromise between minimizing costs, and exploiting technology that is already available and is being deployed at numerous non-VLBA antennas. The committee encourages NRAO's efforts to seek outside funding for this upgrade, and hopes that delays caused by financial resource limitations can be minimized.
- Significant and continued effort to expand the VLBA user community is very important to maintaining a viable instrument. There are several ways in which NRAO could be more proactive in its efforts to expand this base.

NRAO scientists should be strongly encouraged to give colloquia on VLBI science at universities and observatories nationwide, and invitations should be requested by NRAO. This will steadily raise community awareness of VLBI science and increase the user pool. Further, NRAO staff should be encouraged to take mini-sabbaticals at universities as visiting faculty and should teach courses in radio astronomy. Special attention might be given to visiting departments without faculty experienced in radio astronomy. As part of the overall effort, more students should be encouraged to undertake dissertation research using the VLBA. This should be discussed by NRAO scientists when they are visiting outside institutions.

Efforts (such as the VLBA calibration pipeline) to make the VLBA more user-friendly should be continued and made widely known. The VLBA is still perceived as an "experts-only" instrument, and continued efforts by NRAO can help to break down this misconception.

The unique capabilities of the VLBA should be recognized as complementary to those of the global VLBI community, and not in competition with it in any sense. Along these lines, we encourage NRAO to facilitate not only the use of the VLBA itself, but of the VLBI technique in general. This can take the form of time allocation at the VLA and GBT, software support for global VLBI experiments, continuing efforts to improve compatibility between VLBA and non-VLBA systems, and taking steps to keep VLBA equipment at the forefront of VLBI technology (initially and most obviously with disk-based recording). The VLBA should both contribute to and benefit from the health of global VLBI.

- The VLA should be a dynamically scheduled instrument, as already noted in section 4.5. This would enable optimal use of fine weather for weather-critical experiments and allow RFI-sensitive experiments to be scheduled during anticipated quiet times. As the move to dynamically scheduled time is made, the user community should be kept aware of the developments and told how and under what conditions their project is likely to be scheduled.
- A long-standing complaint in the radio astronomy community is a lack of funding for research using national (specifically NRAO) instruments. Although NRAO has established a number of programs to aid the user community in this regard (page charge support, student travel for observing and data reduction, etc.) there is still a need for more significant support for research costs, students, post-docs, etc. We therefore encourage NRAO in its proposed efforts to explore alternative funding possibilities with the NSF.

6.3 Other issues identified in 2002 report

There were a number of topics addressed by the 2002 User's Committee report but not yet covered in this report, which we briefly revisit here.

- A web page has been established for large projects, and PIs are informed that data products must be made available to the user community. We reiterate that no proprietary period should be allowed for large proposals, and recommend that this be closely monitored.
- The web pages describing the dynamic queue could still be significantly improved, with little additional effort. It would be helpful if the current page with priority ordering could have a projected window in which the observations are likely to occur. It would also be helpful if the page listing all proposals in the queue had quantitative rankings and observer imposed limitations (e.g. good 3mm weather) so that users might get a better feel on the likelihood of their project being observed.
- We strongly endorse the prompt development of web-based proposal submission, not least because making the process of applying for time as easy as possible will tend to broaden the user base of NRAO instruments.

7. EVLA

The EVLA is an important project for both the Observatory and the radio astronomy community at large, and the committee is pleased to see that it is progressing well. The EVLA project was highly rated in the most recent decadal review, and the committee is enthusiastic about the project and the new science capability it will deliver. The committee commends the Observatory both on the management of this project and its communication with the users on the impact of EVLA on routine VLA operations. The impact of the EVLA on VLA operations must be kept to a minimum, and the committee notes that the Observatory is doing a good job of this.

The committee is particularly pleased with the news that funding for the new correlator has been approved by the Canadian government. The future inclusion of the VLBA with the New Mexico Array will make this an extremely valuable facility.

The committee also commends the Observatory on the effort put into generating the proposal for phase II of the EVLA project. The science case is compelling, and the proposal should be submitted as soon as is practical.

As users, we strongly endorse the strategy of pursuing the EVLA II component in its entirety and on an accelerated timescale. This is made possible by the fact that the EVLA II is based upon proven technology with which the Observatory is quite familiar. Every effort should be made to front-load the funding for EVLA II in order to take advantage of the current technology and expertise.

The flip side of this is that the EVLA II project does not emphasize the development of technologies leading to next generation radio telescopes. The committee feels that NRAO should be involved in the development of the Square Kilometer Array project, and that opportunities to leverage EVLA II developments for SKA should be judiciously exploited.

8. ALMA

We are pleased to hear about the continuing progress with the ALMA construction project. The formation of the new ALMA division within NRAO is a clear positive step toward defining and managing the project within the NRAO organizational frame, and we are glad to hear that Darrel Emerson has rejoined the ALMA project as head the ALMA division. A concern has been expressed regarding the apparent impression that the ALMA project as a whole is managed by people with backgrounds in large optical telescope projects. Thus the committee strongly urges NRAO and the ALMA project to consider candidates familiar with radio astronomy issues for the currently open positions in the Joint Astronomy Office (JAO).

We are told that the North America ALMA Regional Support Center (or Science Support Center) will be located in CV. The nature and role of this center will have a profound impact on the US community and its interaction with ALMA. The committee urges NRAO to move ahead to define the role of the center, allocate and secure enough resources to fulfill its user support functions effectively, and bring it into operation as soon as possible. The committee feels that the early operation of the center should be used to develop and maintain an active millimeter/submillimeter community before ALMA operations and to enhance the interaction between the wider potential ALMA user community and the ALMA project.

Two ALMA issues of the more immediate concern/impact are the priorities of the Data Management division (discussed in the section on the DM division) and the closure of the Tucson office and staff relocation to the CV office, to be completed by 2006. The committee hopes that this change will be made with in the least disruptive manner to all those who are affected directly and indirectly.

9. CDL/Instrumentation

We are glad to hear the recent announcement of an observatory wide technical coordinator. It would be our hope that this position would foster greater communication between the NRAO sites and enable the maximum benefit to be derived from technical resources within the observatory. We see sufficient resources to enable exploration of forward looking and innovative concepts as a key component in creating a vibrant research and development environment.

In this context, we are also encouraged by the observatory's collaboration with external groups in meeting specialized needs through the University-Built Instrumentation Program. Such concepts such as the Penn Array Receiver (PAR) and the Caltech Radiometer for the GBT have exciting scientific potential for millimeter wave continuum observations while complementing existing imaging capabilities. This interaction with the university research and student communities is seen as a potential means of realizing state-of-the-art technologies for use by the radio astronomy community while paving the way for the next generation of user instruments. We hope that this level of involvement and commitment is continued. It is hoped that greater interaction between instrumentation professionals within the observatory and postdoctoral researchers can be fostered within this context.

The Central Development Laboratory's efforts in low noise instrumentation for radio astronomy are to be commended. We would hope as designs for ALMA mature that this expertise is utilized in making a smooth transition from development to production engineering of these world-class designs. Ultimately, achieving the optimal array performance will be dependent on the efficient production of high quality components in quantity. The committee recognizes the importance of the SIS mixer group's ongoing considerations of receiver architecture, automated testing, and yield in achieving these goals.

Evaluation of the TRW Cryo-3 wafer HEMT (High Electron Mobility Transistor) devices is an extremely encouraging development. These significant performance improvements demonstrate the potential benefits of MIC design approach in improving the performance of existing instrumentation assets in a cost effective way. We see securing access to such devices in sufficient numbers and maintaining this expertise as a key element of achieving the observatory's scientific goals. The importance of the on going efforts by the CDL in electromagnetic support, integration/test support for the GBT spectrometer, ALMA correlator, and LO chain designs are also acknowledged.

The consolidation of the ALMA project in Charlottesville in the 2006 time frame can potentially allow greater interaction between design and production elements within the observatory. In the end, this movement of resources should strengthen the overall organization, however, minimizing the impact of these changes upon ongoing efforts and scheduled deliveries is perceived as a potential challenge.

10. RFI

Given the continued importance of spectrum management to both NRAO and the larger radio astronomy community, we suggest the NRAO include a report on these issues in the material provided to the User's committee, as has been done in previous years.

We are very pleased that Green Bank has a group devoted to interference issues and we are encouraged by the research into new techniques for eliminating radio interference in the data stream.

We encourage NRAO to expand the information available to astronomers on the RFI issue. The web pages contain very good information for each site, but the links to broader information, such as the URSI commission, are only under the Green Bank link. It is also not clear from the web site who is leading the wider RFI effort and could act as a resource for astronomers interested in participating in this effort.

The AAS is currently re-formulating their policy statement on radio interference, and we encourage NRAO to contribute to this effort.

EPO

We are very pleased to see significant strengthening of EPO activities during the last year:

- the Green Bank Visitor Center is now ready for visitors
- the VLA Visitor Center has a new gift shop and someone available to answer questions
- the NRAO web site now has a consistent look to all top pages, with good navigational tools and links between pages (a dramatic improvement!)
- the web Image Gallery is on-line and filling up with good images and appropriate supporting information (a great resource for astronomy teachers)
- several EPO powerpoint presentations developed by NRAO staff are now available on the web page (a great resource for astronomers doing public outreach talks)
- a good series of press releases were produced, nicely balanced among various NRAO instruments (and some non-NRAO telescopes) and a range of astronomical topics
- there is increased idea-sharing between EPO staff at different NRAO sites
- some activities (REU, pre-docs, etc.) will be moving to the new Division of Science and Academic Affairs, freeing the EPO staff to focus on children and the general public

We have no major concerns regarding EPO at this time, but do have some suggestions for the EPO staff to consider:

- In order to encourage more observers to submit gallery images and do press releases, include an information sheet about this in the packet sent to successful proposers.
- Now that the Image Gallery is filling up, the categories can be reorganized a bit (remove categories with zero images, split large categories, etc.). Make sure that images from press releases and the NRAO Newsletter are routinely added to the Gallery.
- We look forward to continued improvements and ongoing maintenance of the web site. As the pages are improved, be mindful of making the appropriate balance between lots of convenient links on top pages (so all information is only one or two clicks away), and a clean stream-lined appearance (so that the most relevant information isn't lost in the clutter - a few committee members would like to see more stream-lining).

- To aid proposers, consider adding a web page which summarizes in one place the capabilities of all NRAO instruments (upcoming proposal deadlines and submission process, frequencies, sensitivities, and resolutions available at each telescope, array schedule for VLA, EVLA impact forecast, observing queues for VLBA and GBT, etc.).
- Consider increasing connections with amateur radio astronomy groups. This could be as little as adding links to some of their web sites, or more (designing systems to complement the SRTs, etc.) as you deem appropriate.
- Consider naming new instruments (ALMA, the EVLA+NMA+VLBA) after great radio astronomers (similar to the way NASA's observatories are named after Hubble and Chandra).
- Consider producing "heritage" images to demonstrate the beauty of radio objects (note our recommendation regarding new observations for this purpose, in section 4.5). In production, please avoid using a garish rainbow color palette to indicate radio brightness, which can cause student mis-conceptions.
- A better system should be established to extract from researchers using NRAO instruments their latest results for dissemination to the press if called for.
- The press book that summarizes NRAO's impact in the press should be distributed to key policy makers in Washington by the Director.
- Users should be made aware of the observatory resources that can expand the impact of their research. For example, the E/PO officer made the committee aware of a graphics artist employed by the observatory who could be made available to enhance the quality of user-generated research results.

NRAO User's Committee 2003

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